

**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 .

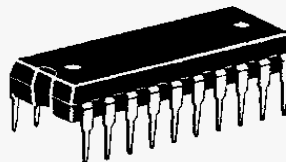
### APPLICATION

- 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

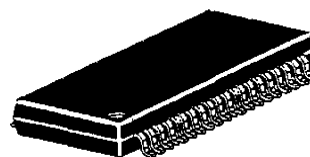


**28 P 4 B ( SP )**

(28pin Shrink DIP)

PITCH : 1.778mm

SIZE : 19.0mmX6.3mmX3.3mm

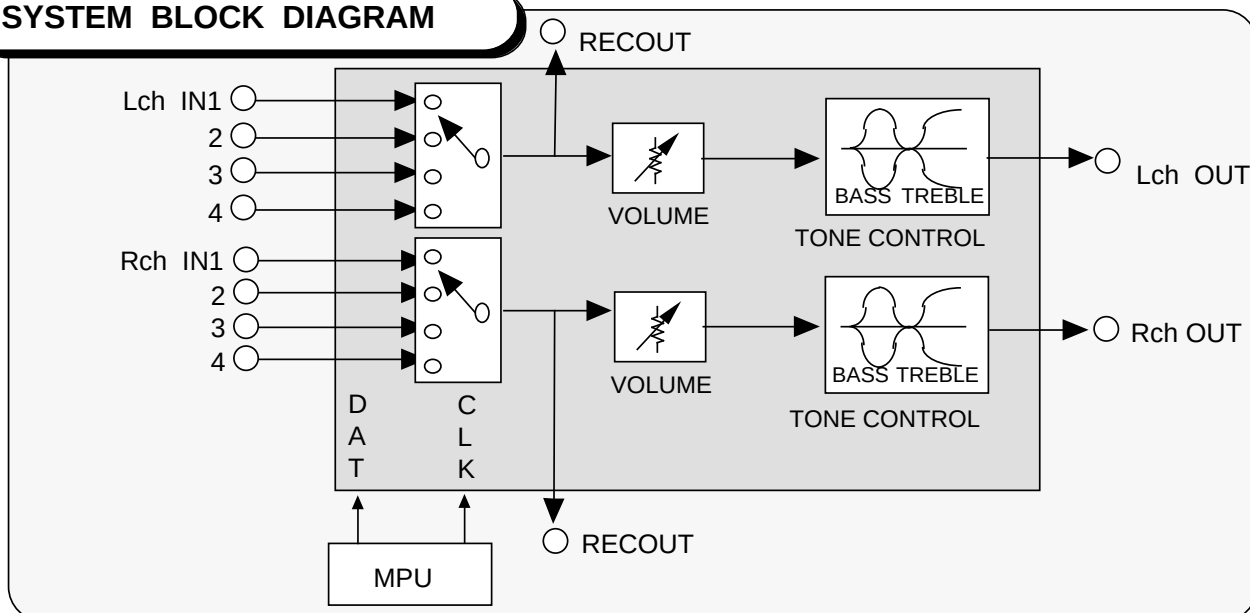


**28 P 2 W-A( FP )**

PITCH : 1.27mm

SIZE : 8.4mmX17.5mmX2.0mm

### SYSTEM BLOCK DIAGRAM



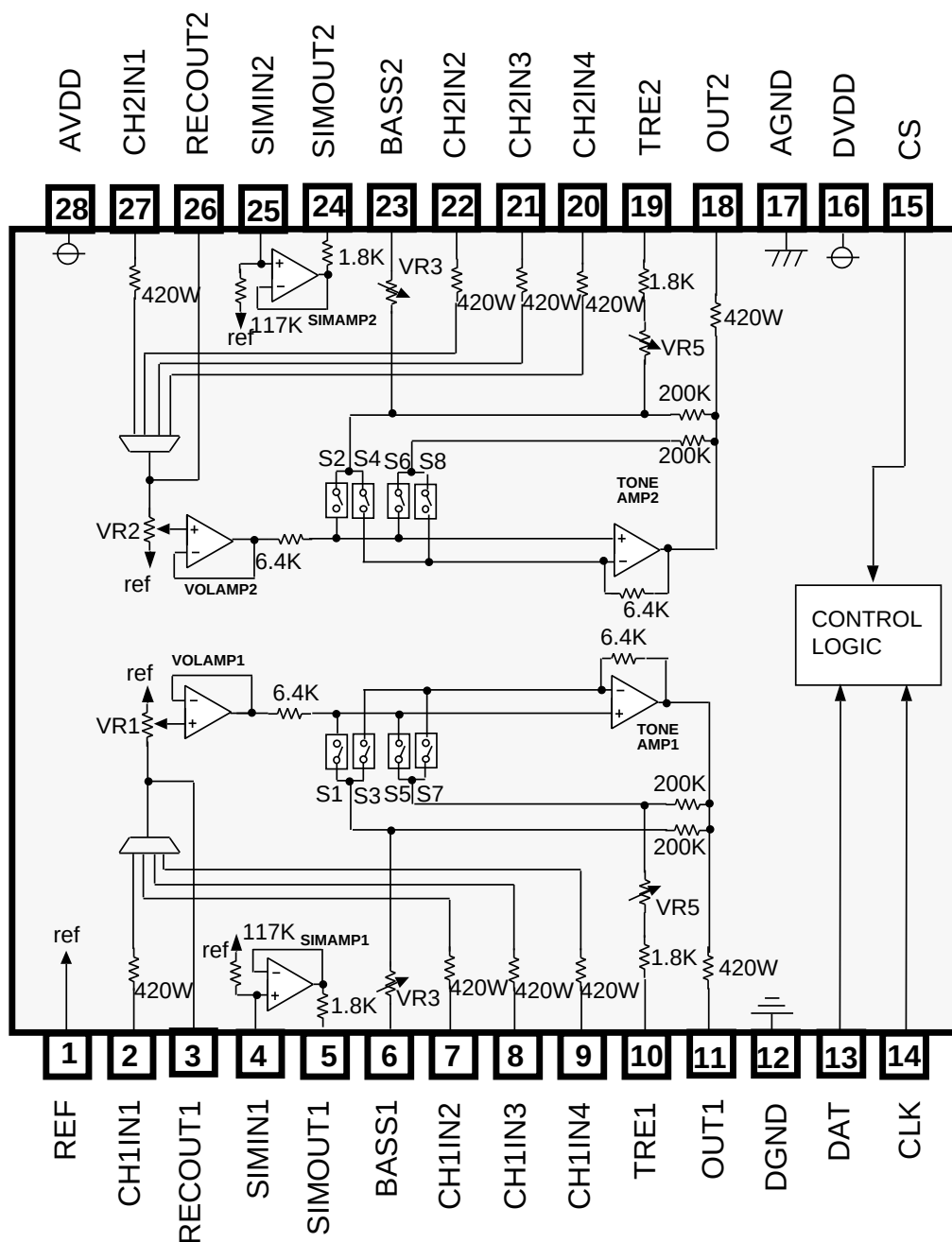
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**BLOCK DIAGRAM**



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**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                       |



MITSUBISHI  
ELECTRIC

( 3 / 16 )

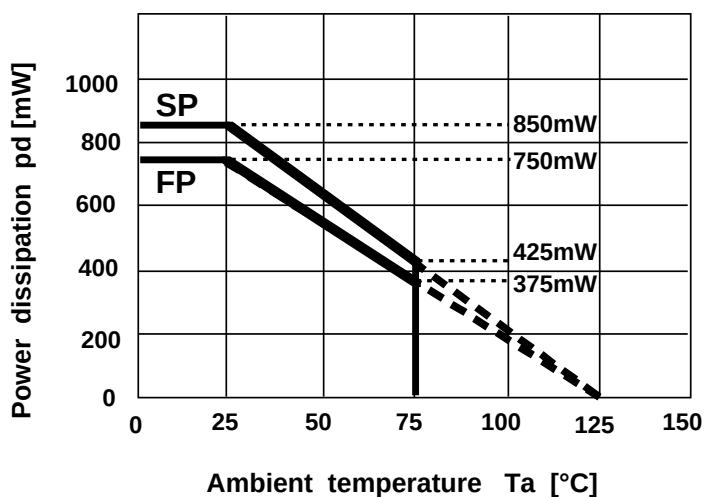
# M62443SP/FP

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      | $T_a \leq 25^{\circ}\text{C}$ | 850(SP)<br>750(FP) | mW                     |
| $K_{\theta}$ | Thermal Derating ratio | $T_a > 25^{\circ}\text{C}$    | 8.5(FP)<br>7.5(FP) | mW/ $^{\circ}\text{C}$ |
| Topr         | Operating temperature  |                               | -20~+75            | $^{\circ}\text{C}$     |
| Tstg         | Storage temperature    |                               | -40~+125           | $^{\circ}\text{C}$     |

## Thermal Derating



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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<br>(logic circuit) | VIH    |           | 0.7 DVDD | —   | VDD      | V    |
| L level input voltage<br>(logic circuit) | VIL    |           | 0        | —   | 0.3 DVDD | V    |

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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<br>•measure terminal=28 pin<br>•no signal input | —     | 10  | 20  | mA   |
| Digital supply current | Idd    | •DVdd= 5V<br>•measure terminal=16 pin<br>•no signal input  | —     | 0   | 2   | μA   |

### ( 2 ) I / O CHARACTERISTICS

| ITEM                      | SYMBOL | CONDITION                                                          | LIMIT |       |      | UNIT   |
|---------------------------|--------|--------------------------------------------------------------------|-------|-------|------|--------|
|                           |        |                                                                    | Min   | typ   | Max  |        |
| Maximum input voltage     | VIM    | 2,27pin input11,18pin output<br>RL=10KW, THD=1%,f=1kHz<br>ATT=-6dB | 2.0   | 3.2   | —    | Vrms   |
| Output voltage            | Vodc   | 11pin,18pin,<br>no signal                                          | 4.35  | 4.5   | 4.65 | V      |
| Gain                      | Gv     | Vin=0dBm,FLAT,f=1kHz<br>2- 11PIN 27-18PIN gain                     | -2    | 0     | 2    | dB     |
| Output noise voltage      | Vono   | IHF-A filter<br>no signal<br>Rg=10KW 11,18pin                      | —     | 4.5   | 10   | μ Vrms |
| Total harmonic distortion | THD    | 11pin,18pin f=1kHz<br>Vo=0.5Vrms , RL=10KW<br>LPF=30kHz            | —     | 0.007 | 0.1  | %      |
| Channel separation        | CT     | RL=10KW<br>S:Vin=1Vrms,f=1kHz<br>M:Rg=10kW,IHF-A filter            | —     | -100  | -70  | dB     |



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## ( 3 ) TONE CHARACTERISTICS

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

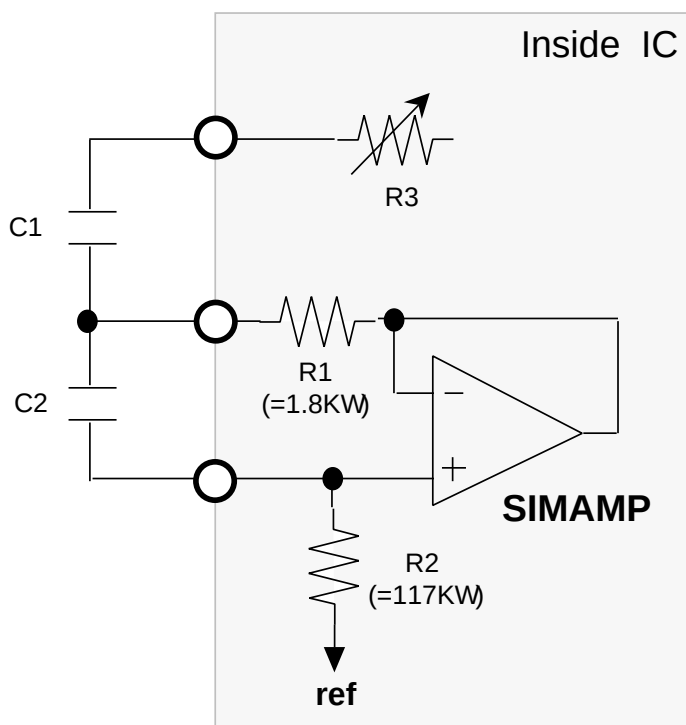
## ( 4 ) VOLUME CHARACTERISTICS

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

## 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

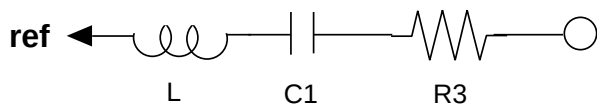
$$f_0 = 1 / 2\pi \sqrt{C1 \cdot C2 \cdot R1 \cdot R2} \text{ [Hz]}$$

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

( EX ) BASS band (  $f_0 \approx 100\text{Hz}$  )  
 $R1=1.8\text{KW}$ ,  $R2=117\text{KW}$   
 $C1=0.47\mu$ ,  $C2=0.022\mu$

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.



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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<br>SELECTOR |    |     | 1   | 0   |     |

0: BOTH  
 1: ONLY 1CHANNEL

These functions  
 are effective only  
 VOLUME data.

0: 1ch  
 1: 2ch

\*(Notice1)

\*(Notice1)

### INPUT SELECTOR

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

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.

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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  |

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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.

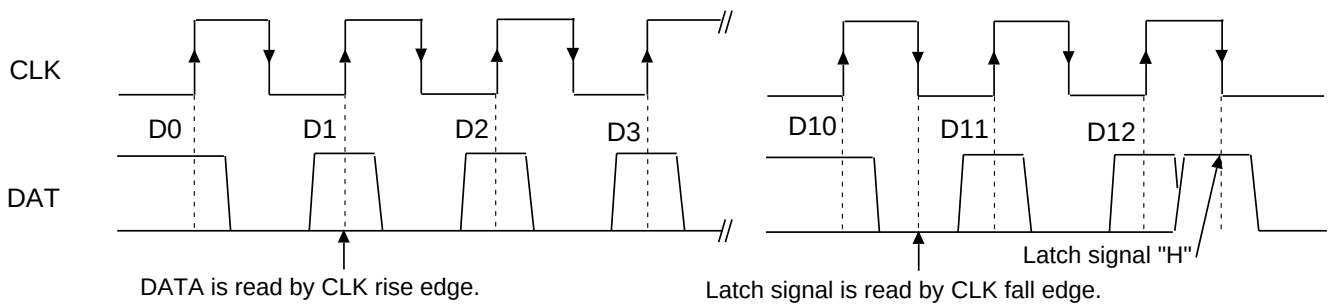
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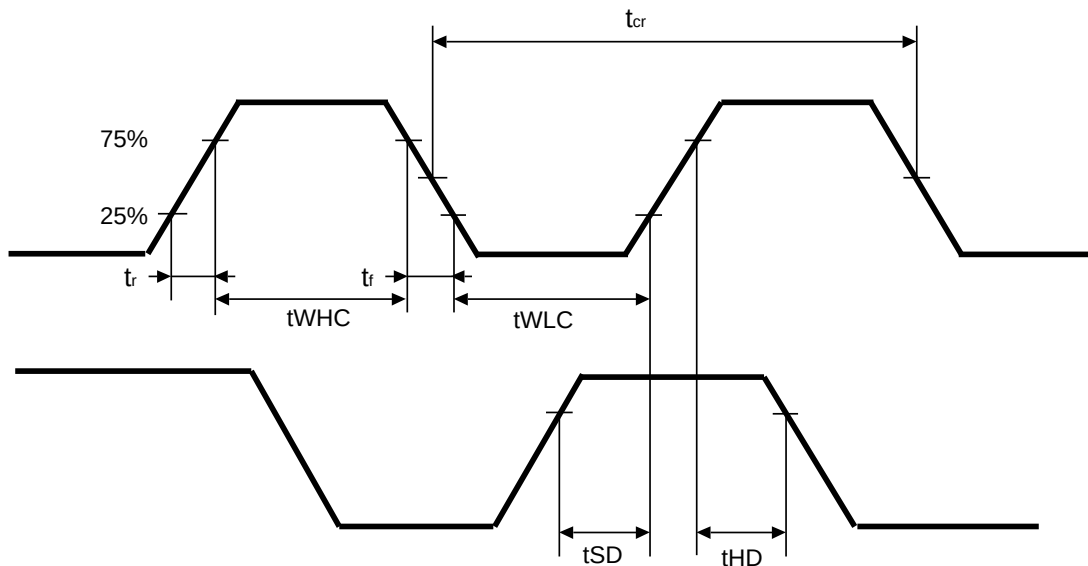
**M62443SP/FP**

SOUND CONTROLLER

## DATA and CLOCK



**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 | -   | $\mu s$ |

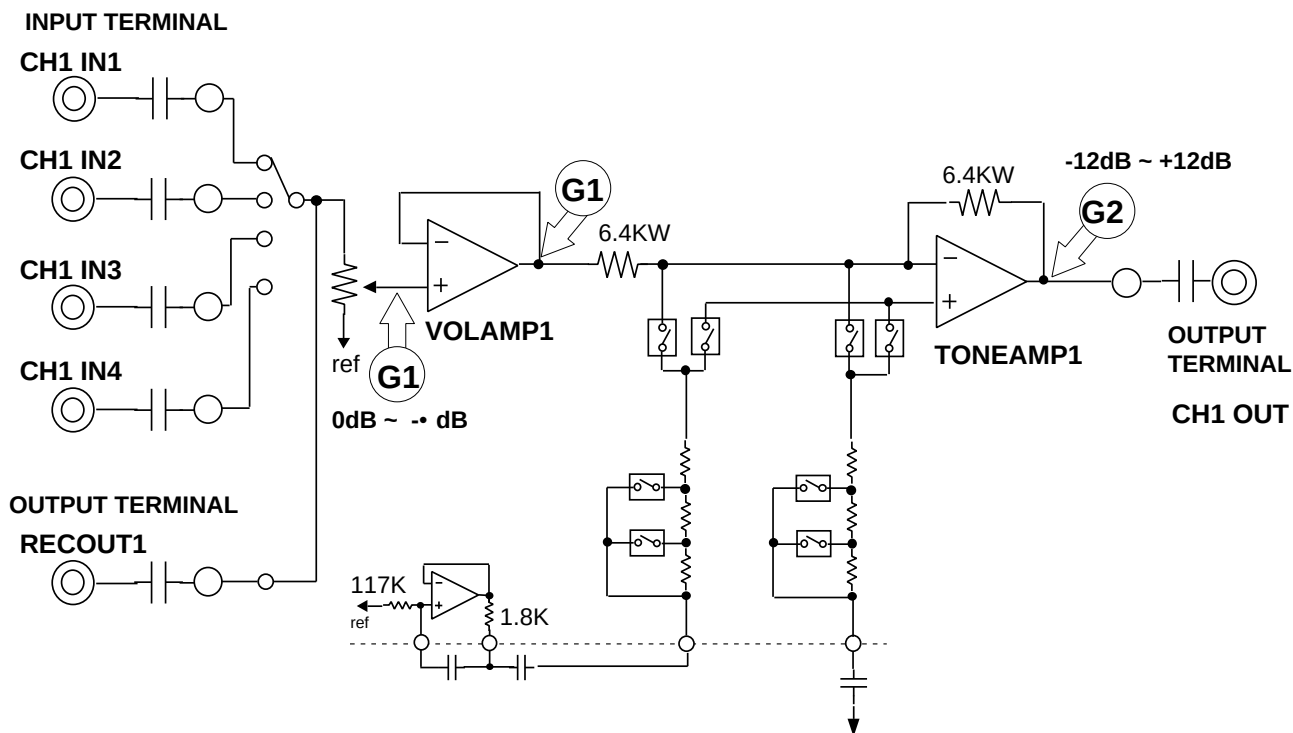
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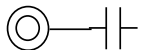
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## LEVEL DIAGRAM

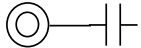


**INPUT TERMINAL**

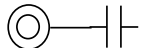
CH2 IN1



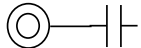
CH2 IN2



CH2 IN3

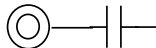


CH2 IN4

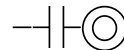


**OUTPUT TERMINAL**

RECOUT2



Same to CH 1



**OUTPUT TERMINAL**

CH2 OUT



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**LOGIC CIRCUIT**

