

Sound Processors for BOOM BOX / Mini-component Stereo

# Sound Processors with Built-in 2-band Equalizers



BD3870FS, BD3871FS, BD3872FS, BD3873FS

No.10086EAT02

## ●Description

The Sound Processor with built-in 2 Band Equalizer, incorporates functions required for BOOM BOX and mini-component systems, such as input selector, input gain amp, volume, surround, tone (bass, treble), and loud speaker equalizer (BD3872FS only). These functions can be controlled through the two-wire serial control.

## ●Features

- 1) Using external components, center frequencies and Q factors of the bass characteristics are flexible.
- 2) Providing a mute switch onto one of the input pins allows cross-talk suppression.
- 3) A surround function can be constructed without external components.
- 4) Energy-saving design resulting in low current consumption, by utilizing the BiCMOS process

## ●Applications

BOOM BOX, mini-audio systems, and micro-audio systems.

## ●Line up matrix

| Parameter                    | BD3870FS                      | BD3871FS                      | BD3873FS                      | BD3872FS                       |
|------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|
| Input Gain                   | 0, 6, 12, 18dB                | 24, 26, 28dB                  | 18, 21, 24, 27dB              | 0, 5, 10, 19, 21, 23, 26, 28dB |
| Loud Speaker Equalizer (SEQ) | No                            | No                            | No                            | Yes                            |
| Input Selector               | Three inputs                  | Three inputs                  | Three inputs                  | Five inputs                    |
| Volume                       | 0 to -87dB/<br>1dB step, -∞dB | 0 to -87dB/<br>1dB step, -∞dB | 0 to -87dB/<br>1dB step, -∞dB | 0 to -87dB/<br>1dB step, -∞dB  |
| Equalizer                    | 2 band<br>(Bass, Treble)      | 2 band<br>(Bass, Treble)      | 2 band<br>(Bass, Treble)      | 2 band<br>(Bass, Treble)       |
| Surround                     | Yes                           | Yes                           | Yes                           | Yes                            |
| Serial Control               | Two-wire serial               | Two-wire serial               | Two-wire serial               | Two-wire serial                |
| Package                      | SSOP-A24                      | SSOP-A24                      | SSOP-A24                      | SSOP-A32                       |

## ●Absolute maximum ratings (Ta=25°C)

| Parameter                   | Symbol | Ratings            |                    |                    |                    | Unit |
|-----------------------------|--------|--------------------|--------------------|--------------------|--------------------|------|
|                             |        | BD3870FS           | BD3871FS           | BD3873FS           | BD3872FS           |      |
| Power Supply Voltage        | Vcc    | 10                 | 10                 | 10                 | 10                 | V    |
| Power Dissipation           | Pd     | 800 * <sup>1</sup> | 800 * <sup>1</sup> | 800 * <sup>1</sup> | 950 * <sup>2</sup> | mW   |
| Operating Temperature Range | Topr   | -25 to +75         | -25 to +75         | -25 to +75         | -25 to +75         | °C   |
| Storage Temperature Range   | Tstg   | -55 to +125        | -55 to +125        | -55 to +125        | -55 to +125        | °C   |

\*<sup>1</sup> Reduced by 8.0 mW/°C at 25°C or higher, when installed on the standard board (Size: 70 × 70 × 1.6mm).

\*<sup>2</sup> Reduced by 9.5 mW/°C at 25°C or higher, when installed on the standard board (Size: 70 × 70 × 1.6mm).

## ●Operating voltage range

| Parameter               | Symbol | Ratings    |            |            |            | Unit |
|-------------------------|--------|------------|------------|------------|------------|------|
|                         |        | BD3870FS   | BD3871FS   | BD3873FS   | BD3872FS   |      |
| Operating Voltage Range | Vcc    | 4.5 to 9.5 | 4.5 to 9.5 | 4.5 to 9.5 | 4.5 to 9.5 | V    |

\*It must function normally at Ta=25°C.

## ●Electrical characteristics

(Ta=25°C, VCC=8V, f=1kHz, Vi=200mVrms, RL=10kΩ, Rg=600Ω, Input Gain=0dB (BD3870FS, BD3872FS only), Input Gain=24dB (BD3871FS only), Input Gain=18dB (BD3873FS only), Volume=0dB, Bass=0dB, Treble=0dB, Surround=OFF, Loud Speaker Equalizer=OFF (BD3872FS only), unless otherwise noted)

| Block                  | Parameter                                   | Symbol | Limits |      |          | Unit  | Condition                                |
|------------------------|---|--------|--------|------|----------|-------|--|
|                        |   |        | Min.   | Typ. | Max.     |       |  |
| Total                  | Circuit Current                             | IQ     | -      | 8    | 21       | mA    | At no signal                             |
|                        | Total Output Voltage Gain                   | Gv     | -2     | 0    | 2        | dB    | BD3870FS, BD3872FS<br>Gv=20log(VOUT/VIN) |
|                        |   |        | 22     | 24   | 26       |       | BD3871FS<br>Gv=20log(VOUT/VIN)           |
|                        |   |        | 16     | 18   | 20       |       | BD3873FS<br>Gv=20log(VOUT/VIN)           |
|                        | Total Harmonic Distortion ratio             | THD    | -      | 0.01 | 0.1      | %     | BW=400 to 30kHz                          |
|                        | Maximum Output Voltage                      | Vom    | 1.6    | 2.1  | -        | Vrms  | THD=1%<br>BW=400 to 30kHz                |
|                        | Total Output Noise Voltage                  | Vno    | -      | 4.5  | 15       | μVrms | BD3870FS, BD3872FS<br>Rg=0Ω, BW=IHF-A    |
|                        |   |        | -      | 40   | 80       |       | BD3871FS, BD3873FS<br>Rg=0Ω, BW=IHF-A    |
|                        | Total Residual Noise Voltage                | Vmno   | -      | 4.5  | 15       | μVrms | Rg=0Ω, BW=IHF-A<br>Volume=-∞dB           |
|                        | Cross-talk between Channels                 | CTC    | -      | -80  | -70      | dB    | Rg=0Ω, BW=IHF-A<br>VOUT=1Vrms            |
|                        | Cross-talk between Selectors                | CTS    | -      | -80  | -70      | dB    | Rg=0Ω, BW=IHF-A                          |
|                        | Input Impedance                             | Rin    | 35     | 50   | 65       | kΩ    | BD3870FS, BD3871FS, BD3873FS             |
| 70                     |   |        | 100    | 130  | BD3872FS |       |  |
| Output Impedance       | Rout  | -      | -      | 50   | Ω        |       |  |
| Volume                 | Volume Control Range                        | VRI    | -90    | -87  | -84      | dB    | VR=20log(VOUT/VIN)                       |
|                        | Maximum Volume Attenuation                  | Vmin   | -      | -    | -90      | dB    | BW=IHF-A                                 |
|                        | Volume Input Impedance                      | Rvin   | 39     | 56   | 73       | kΩ    |  |
| Bass                   | Bass Boost Gain                             | GBB    | 12     | 14   | 16       | dB    | GB=20log(VOUT/VIN)                       |
|                        | Bass Cut Gain                               | GBC    | -16    | -14  | -12      | dB    | GB=20log(VOUT/VIN)                       |
|                        | Bass Step Resolution                        | BR     | -      | 2    | -        | dB    |  |
| Treble                 | Treble Boost Gain                           | GTB    | 10     | 12   | 14       | dB    | BD3870FS, BD3871FS, BD3873FS             |
|                        |   |        | 12     | 14   | 16       |       | BD3872FS                                 |
|                        | Treble Cut Gain                             | GTC    | -14    | -12  | -10      | dB    | BD3870FS, BD3871FS, BD3873FS             |
|                        |   |        | -16    | -14  | -12      |       | BD3872FS                                 |
| Treble Step Resolution | TR  | -      | 2      | -    | dB       |       |  |
| Surround               | Surround In-phase Gain                      | Vsur1  | -2     | 0    | 2        | dB    | 2ch in-phase inputs                      |
|                        | Surround Single-phase Gain                  | Vsur2  | 4.3    | 6.3  | 8.3      | dB    | 1ch input, 1ch grounded                  |
|                        | Surround Opposite-phase Gain                | Vsur3  | 8      | 10   | 12       | dB    | 2ch opposite-phase inputs                |
| SEQ                    | Loud Speaker Equalizer Gain (BD3872FS only) | Seq    | 3      | 5    | 7        | dB    | f=10kHz                                  |

\* For measurement, VP-9690A (Average value wave detection, Effective value display) IHF-A filter by Matsushita Communication Industrial is used.

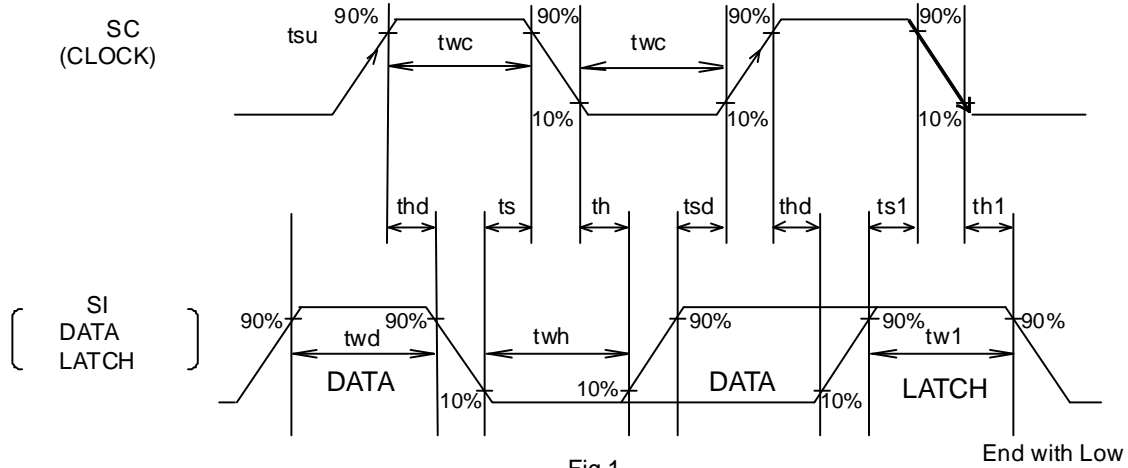
\* Phase relation between Input/Output signal terminals is the same.

\* Note: This IC is not designed to be radiation-resistant.

●Timing chart

1) Signal Timing Conditions

- Data is read on the rising edge of the clock.
  - Latch is read out on the falling edge of the clock.
  - Latch signal must end with the LOW state.
  - To avoid malfunctions, clock and data signals must terminate with the LOW state.
- 1byte=10bit



| Parameter                     | Symbol | Limits |      |      | Unit |
|-------------------------------|--------|--------|------|------|------|
|                               |        | Min.   | Typ. | Max. |      |
| Minimum Clock Width           | Twc    | 2.0    | -    | -    | μs   |
| Minimum Data Width            | twd    | 2.0    | -    | -    | μs   |
| Minimum Latch Width           | Tw1    | 2.0    | -    | -    | μs   |
| Data Set-up Time (DATA→CLK)   | Tsd    | 1.0    | -    | -    | μs   |
| Data Hold Time (CLK→DATA)     | Thd    | 1.0    | -    | -    | μs   |
| Latch Set-up Time (CLK→LATCH) | Ts1    | 1.0    | -    | -    | μs   |
| Latch Hold Time (DATA→LATCH)  | Th1    | 1.0    | -    | -    | μs   |
| Latch Low Set-up Time         | Ts     | 1.0    | -    | -    | μs   |
| Latch Low Hold Width          | Twh    | 2.0    | -    | -    | μs   |

2) Voltage Conditions for Control Signals

| Parameter         | Limits |      |                | Unit | Condition       |
|-------------------|--------|------|----------------|------|-----------------|
|                   | Min.   | Typ. | Max.<br>(≤Vcc) |      |                 |
| “H” Input Voltage | 2.2    | -    | 5.5            | V    | Vcc=4.5 to 9.5V |
| “L” Input Voltage | 0      | -    | 1.0            | V    | Vcc=4.5 to 9.5V |

3) Control Data Format List  
 Basic Configuration of Control Data Format  
 ← Data input direction

|      |    |    |    |    |    |    |    |                |    |
|------|----|----|----|----|----|----|----|----------------|----|
| MSB  |    |    |    |    |    |    |    | LSB            |    |
| D9   | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1             | D0 |
| Data |    |    |    |    |    |    |    | Select Address |    |

Control Data Format (BD3870FS, BD3871FS, BD3873FS)

← Data input direction

|     |                |    |            |    |             |    |    |    |    |    |
|-----|----------------|----|------------|----|-------------|----|----|----|----|----|
|     | D9             | D8 | D7         | D6 | D5          | D4 | D3 | D2 | D1 | D0 |
| (1) | Input Selector |    | Input Gain |    | Surround    | *  | *  | *  | 0  | 0  |
| (2) | Volume A       |    |            |    | Volume B    |    | *  | 0  | 1  |    |
| (3) | Bass Gain      |    |            |    | Treble Gain |    |    |    | 1  | 0  |
| (4) | *              | *  | *          | *  | *           | *  | *  | *  | 1  | 1  |

Control Data Format (BD3872FS)

← Data input direction

|     |            |    |    |                |             |    |          |     |    |    |
|-----|------------|----|----|----------------|-------------|----|----------|-----|----|----|
|     | D9         | D8 | D7 | D6             | D5          | D4 | D3       | D2  | D1 | D0 |
| (1) | Input Gain |    |    | Input Selector |             |    | *        | *   | 0  | 0  |
| (2) | Volume A   |    |    |                | Volume B    |    | *        | 0   | 1  |    |
| (3) | Bass Gain  |    |    |                | Treble Gain |    |          |     | 1  | 0  |
| (4) | *          | *  | *  | *              | *           | *  | Surround | SEQ | 1  | 1  |

- "\*" indicates 0 or 1.
- By changing the setting of Select Address, three or four different control formats (BD3871FS, BD3872FS, BD3873FS, plus BD3872FS) are selectable.
- In every power-on sequence, all of the address data must be initialized.

Example:

←Input direction

|         |     |         |     |         |     |         |     |
|---------|-----|---------|-----|---------|-----|---------|-----|
| MSB     | LSB | MSB     | LSB | MSB     | LSB | MSB     | LSB |
| Data(1) | L   | Data(2) | L   | Data(3) | L   | Data(4) | L   |

"L" indicates a latch.

- After power-on, for the second and subsequent times, only the necessary data can be selected for setting.

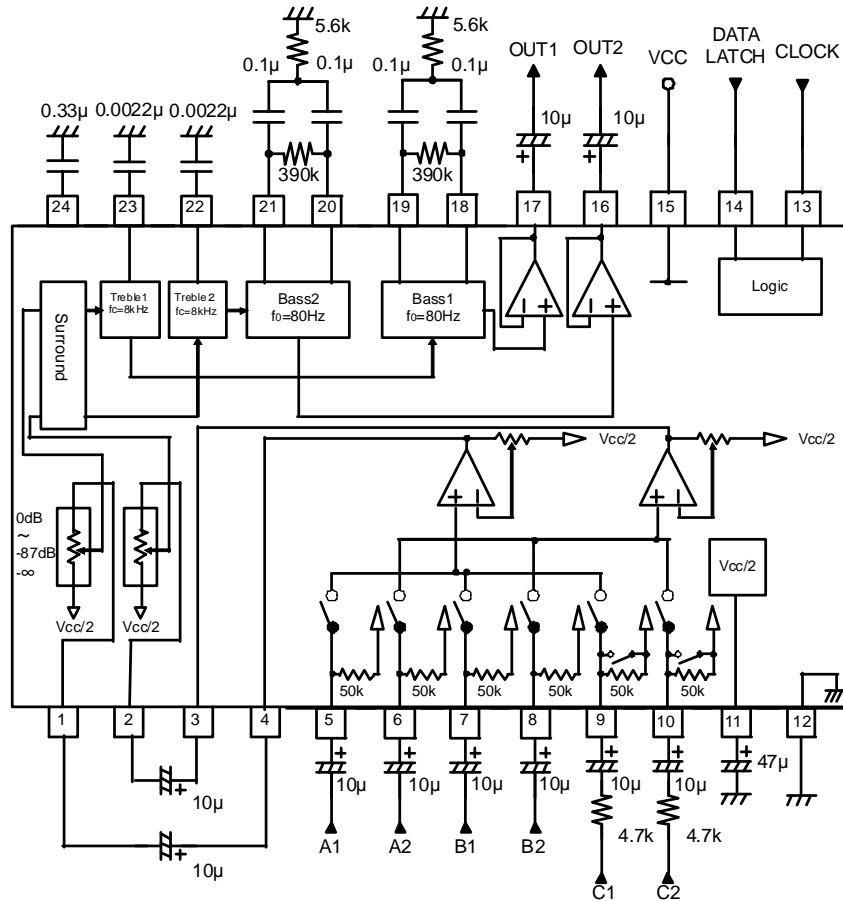
Example: When changing the volume,

←Input direction

|         |     |
|---------|-----|
| MSB     | LSB |
| Data(2) | L   |

"L" indicates a latch.

●Block diagram, application circuit, pin assignment (BD3870FS, BD3871FS, BD3873FS)



Unit: Resistance =Ω, Capacitor = F

Fig.2

●Pin description (BD3870FS, BD3871FS, BD3873FS)

| Pin No. | Pin Name | Description                   | Pin No. | Pin Name | Description  |
|---------|----------|-------------------------------|---------|----------|--|
| 1       | VIN1     | 1ch volume input pin          | 13      | SC       | Serial clock input pin   |
| 2       | VIN2     | 2ch volume input pin          | 14      | SI       | Serial data input pin  |
| 3       | SEL2     | 2ch input selector output pin | 15      | VCC      | Power supply pin   |
| 4       | SEL1     | 1ch input selector output pin | 16      | OUT2     | 2ch output pin   |
| 5       | A1       | 1ch input pin A               | 17      | OUT1     | 1ch output pin   |
| 6       | A2       | 2ch input pin A               | 18      | BOUT1    | 1ch bass filter setting pin  |
| 7       | B1       | 1ch input pin B               | 19      | BNF1     | 1ch bass filter setting pin  |
| 8       | B2       | 2ch input pin B               | 20      | BOUT2    | 2ch bass filter setting pin  |
| 9       | C1       | 1ch input pin C               | 21      | BNF2     | 2ch bass filter setting pin  |
| 10      | C2       | 2ch input pin C               | 22      | TNF2     | 2ch treble filter setting pin  |
| 11      | FILTER   | 1/2 VCC pin                   | 23      | TNF1     | 1ch treble filter setting pin  |
| 12      | GND      | Ground pin                    | 24      | CAP      | Time constant setting pin for absorbing surround switching shock sound |

●Block diagram, application circuit, pin assignment (BD3872FS)

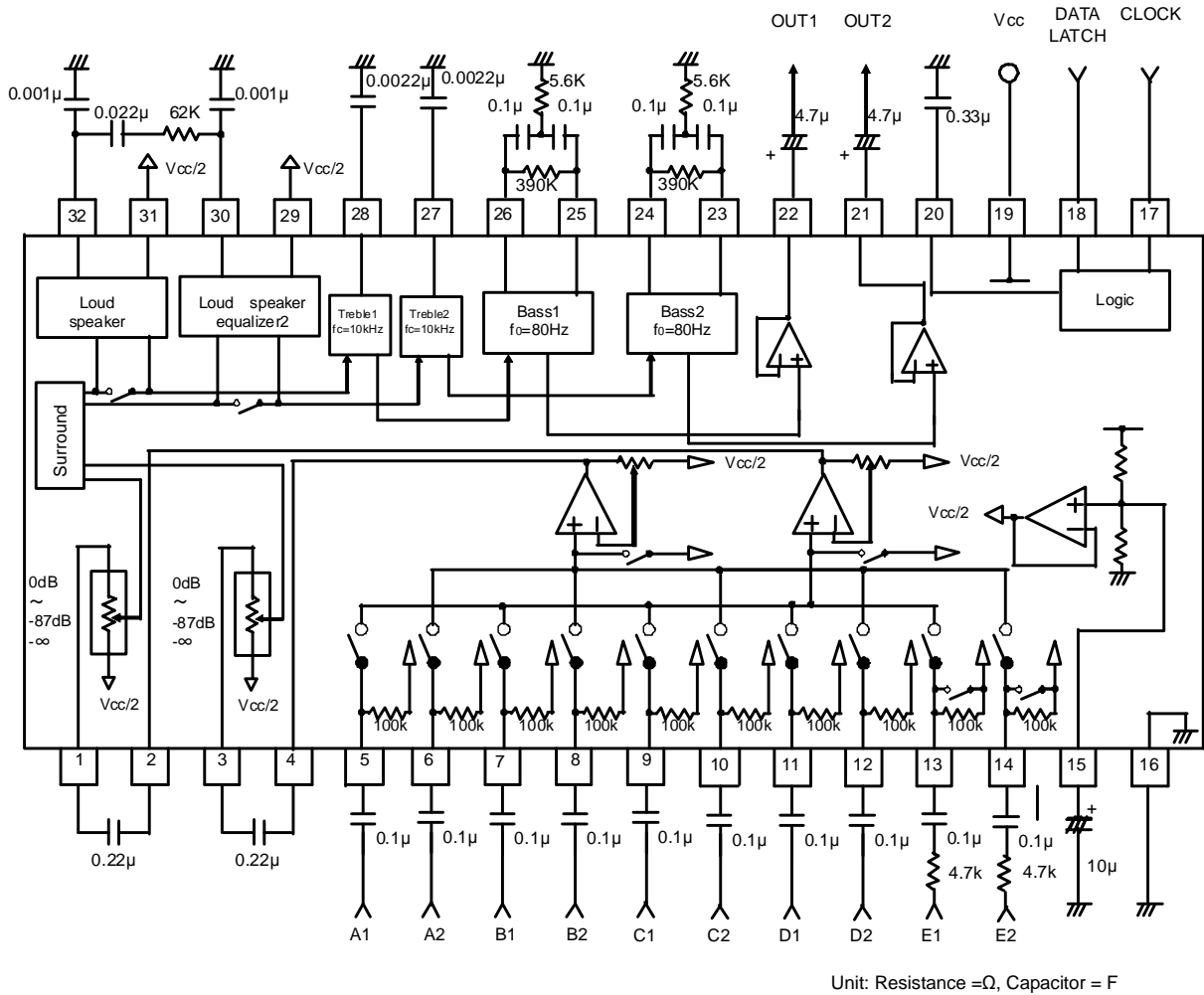


Fig.3 Application to Cinema Surround



## ●Pin description (BD3872FS)

| Pin No. | Pin Name | Description                   | Pin No. | Pin Name | Description   |
|---------|----------|-------------------------------|---------|----------|---|
| 1       | VIN1     | 1ch volume input pin          | 17      | SC       | Serial clock input pin  |
| 2       | SEL1     | 1ch input selector output pin | 18      | SI       | Serial data input pin   |
| 3       | VIN2     | 2ch volume input pin          | 19      | VCC      | Power supply pin  |
| 4       | SEL2     | 2ch input selector output pin | 20      | CAP      | Time constant setting pin for absorbing switching shock sound |
| 5       | A1       | 1ch input pin A               | 21      | OUT2     | 2ch output pin  |
| 6       | A2       | 2ch input pin A               | 22      | OUT1     | 1ch output pin  |
| 7       | B1       | 1ch input pin B               | 23      | BOUT2    | 2ch bass filter setting pin                                   |
| 8       | B2       | 2ch input pin B               | 24      | BNF2     | 2ch bass filter setting pin                                   |
| 9       | C1       | 1ch input pin C               | 25      | BOUT1    | 1ch bass filter setting pin                                   |
| 10      | C2       | 2ch input pin C               | 26      | BNF1     | 1ch bass filter setting pin                                   |
| 11      | D1       | 1ch input pin D               | 27      | TNF2     | 2ch treble filter setting pin                                 |
| 12      | D2       | 2ch input pin D               | 28      | TNF1     | 1ch treble filter setting pin                                 |
| 13      | E1       | 1ch input pin E               | 29      | SOUT2    | 2ch cinema surround or SEQ setting pin                        |
| 14      | E2       | 2ch input pin E               | 30      | SQI2     | 2ch cinema surround or SEQ setting pin                        |
| 15      | FILTER   | 1/2 VCC pin                   | 31      | SOUT1    | 1ch cinema surround or SEQ setting pin                        |
| 16      | GND      | Ground pin                    | 32      | SQI1     | 1ch cinema surround or SEQ setting pin                        |



●Description of operations

1) Bass filter

Using external components, center frequencies and Q factors of the bass characteristics are flexible

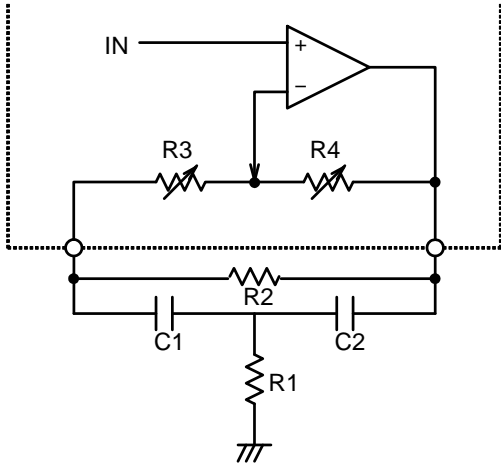


Fig.5

$$f_0 = \frac{1}{2\pi \sqrt{\frac{R1R2(R3 + R4)C1C2}{R2 + R3 + R4}}} \text{ (Hz)}$$

$$Q = \frac{\sqrt{\frac{R1R2R4C1C2}{R2 + R3 + R4}}}{R1(C1 + C2)}$$

$$G(\text{boost}) = 20 \log \frac{\frac{R2(R3 + R4)}{R1(R2 + R3 + R4)} + \frac{C2}{C1} + 1}{\frac{R2R3}{R1(R2 + R3 + R4)} + \frac{C2}{C1} + 1} \text{ (dB)}$$

$$G(\text{cut}) = 20 \log \frac{\frac{R2R3}{R1(R2 + R3 + R4)} + \frac{C2}{C1} + 1}{\frac{R1(R2 + R3 + R4)}{R2(R3 + R4)} + \frac{C2}{C1} + 1} \text{ (dB)}$$

Standard values of R3, R4 (reference)  
(R1=5.6kΩ, R2=390kΩ, C1=C2=0.1μF)

| Bass Boost Cut Amount | Resistance (kΩ) * Typ. |       |
|-----------------------|------------------------|-------|
|                       | R3                     | R4    |
| 0dB                   | 77.64                  | 0     |
| 2dB                   | 58.90                  | 18.73 |
| 4dB                   | 44.02                  | 33.60 |
| 6dB                   | 32.20                  | 45.42 |
| 8dB                   | 22.82                  | 54.80 |
| 10dB                  | 15.36                  | 62.26 |
| 12dB                  | 9.44                   | 68.18 |
| 14dB                  | 4.78                   | 72.84 |

\* The actual boost cut amount may deviate from the standard values in some degree.

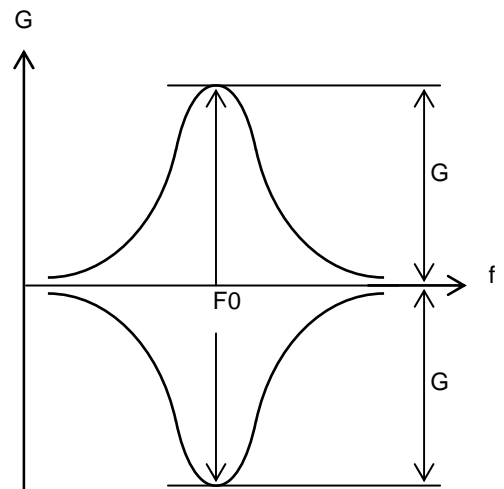


Fig.6

2) Treble filter

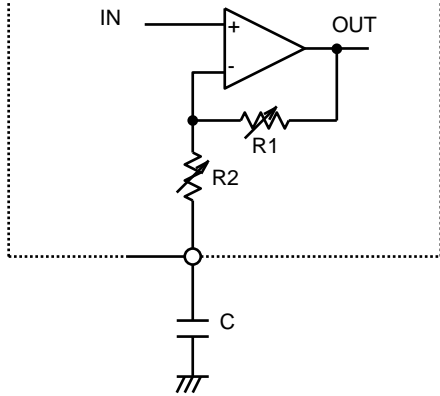


Fig.7

$$f_c = \frac{1}{2\pi R_2 C} \text{ (Hz)}$$

$$G \text{ (boost)} = 20 \log \frac{R_1 + R_2 + Z_c}{R_2 + Z_c} \text{ (dB)}$$

$$G \text{ (cut)} = 20 \log \frac{R_2 + Z_c}{R_1 + R_2 + Z_c} \text{ (dB)}$$

$$Z_c = \frac{1}{j\omega c} \text{ (\Omega)}$$

Standard values of R1, R2 (reference)

| Treble Boost Cut Amount | Resistance (kΩ) * Typ. |       |
|-------------------------|------------------------|-------|
|                         | R1                     | R2    |
| 0dB                     | 0                      | 36.28 |
| 2dB                     | 7.46                   | 28.82 |
| 4dB                     | 13.39                  | 22.89 |
| 6dB                     | 18.10                  | 18.18 |
| 8dB                     | 21.84                  | 14.44 |
| 10dB                    | 24.81                  | 11.47 |
| 12dB                    | 27.20                  | 9.08  |
| 14dB (BD3872FS only)    | 29.04                  | 7.24  |

\* The actual boost cut amount may deviate from the standard values in some degree.

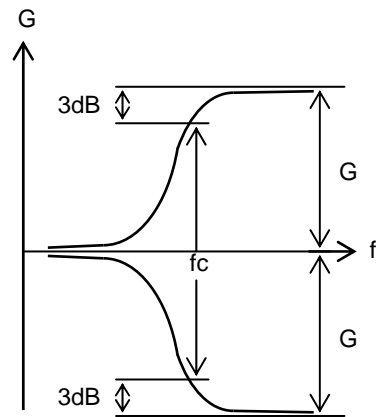


Fig.8

3) Matrix surround

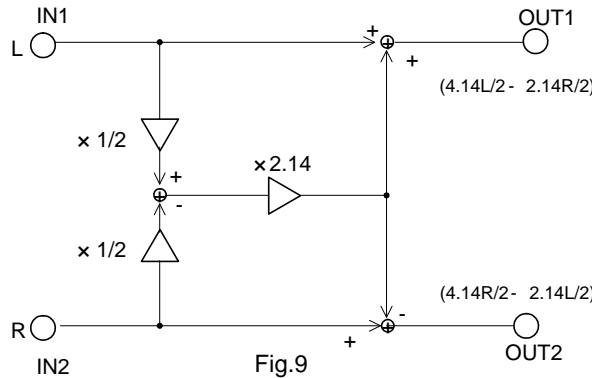


Fig.9

Matrix surround is constructed as shown above. Gains are defined as follows:

In-phase Gain: Gains obtained on OUT1 and OUT2 against IN1 when inputting a signal of the equivalent level and in-phase (L=R) to IN1 and IN2.

$$\frac{OUT1}{IN1} = \frac{OUT2}{IN2} = \left( \frac{4.14}{2} L - \frac{2.14}{2} L \right) / L = 1 \quad 20 \log 1 = 0 \text{ (dB)}$$

Single-phase Gain: Gains obtained on OUT1 and OUT2 against IN1 when inputting a signal to IN1 and AC-grounding IN2 (R=0).

$$\frac{OUT1}{IN1} = \frac{4.14}{2} L / L = 2.07 \quad 20 \log 2.07 = 6.3 \text{ (dB)}$$

$$\frac{OUT2}{IN1} = -\frac{2.14}{2} L / L = -1.07 \quad 20 \log |-1.07| = 0.59 \text{ (dB)}$$

Opposite-phase Gain: Gains obtained on OUT1 and OUT2 against IN1 when inputting signals of the equivalent level and opposite-phase (L-R) to IN1 and IN2.

$$\frac{OUT1}{IN1} = \frac{OUT2}{IN2} = \left( \frac{4.14}{2} L + \frac{2.14}{2} L \right) / L = 3.14 \quad 20 \log 3.14 = 10 \text{ (dB)}$$

1) Sound generation using Loud Speaker Equalizer (BD3872FS)

Using external components, one of the following two functions can be established; one having an effect to localize the vocal forward and enhance it (Loud Speaker Equalizer) and the other having an effect to clarify the vocal quality and improve the Articulation Index (Cinema Surround). Those characteristic values can be adjusted by choosing the external components with desirable constants. Details of above two functions are described below:

◎Cinema Surround

Constructing the external components as shown below allows the vocals to be moved forward and enhanced. Surround effect with enhanced vocal is achieved by turning on the built-in surround simultaneously. Merging this effect, while playing movies on a DVD player, will make vocal listening clearer and surround effect more impactful.

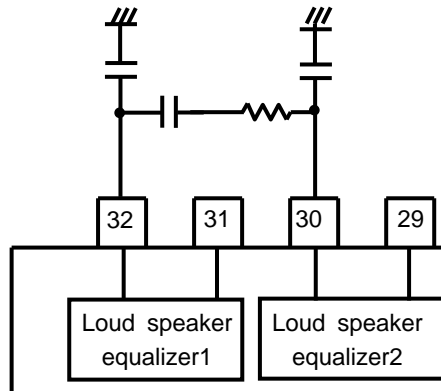


Fig.10

◎Loud Speaker Equalizer (SEQ)

BOOM BOX and Micro-sound systems are often restricted to using small-diameter speakers because of location space. These speakers, where the vocal range are attenuated, may give an impression of having a muffled vocal sound with respect to its audibility. Using the Loud Speaker Equalizer, the vocal quality which degrades in small-diameter speakers, can be improved and the Articulation Index is also increased.

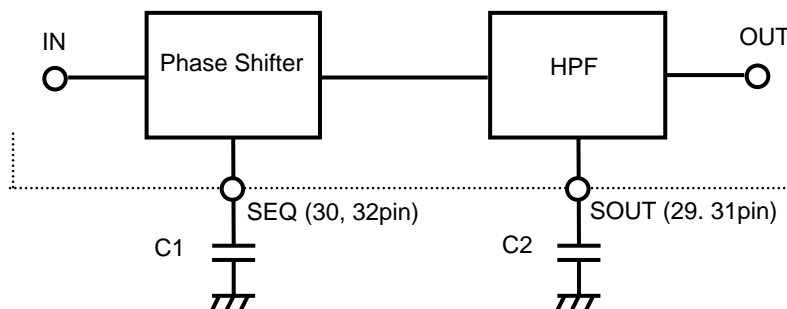


Fig.11

- C1 can be selected to determine the frequency where the phase should be inverted.

| C1            | Frequency where the phase is inverted |
|---------------|---------------------------------------|
| Larger value  | Set to the lower frequency side       |
| Smaller value | Set to the higher frequency side      |

- C2 can be selected to determine the HPF cut-off frequency  $f_c$ . The SEQ gain remains constant.

$$f_c = \frac{1}{2\pi RC} \quad (\text{Hz})$$

(Where R is a built-in resistance of 10kΩ)

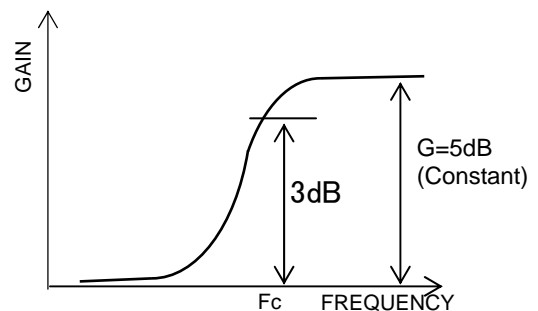


Fig.12

●Reference data

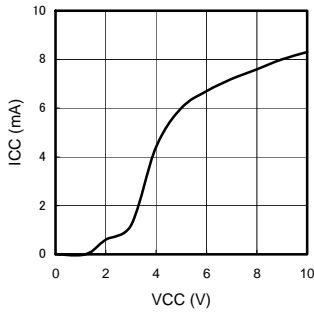


Fig.13 Circuit Current - Power Supply Voltage

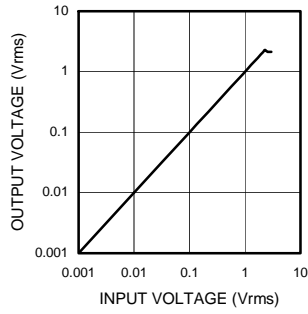


Fig.14 Output Voltage - Input Voltage (BD3870FS)

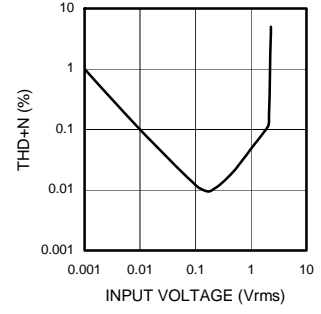


Fig.15 Total Harmonic Distortion ratio - Input Voltage (BD3870FS)

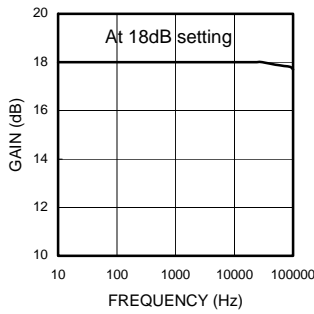


Fig.16 Current Gain - Frequency (BD3870FS, BD3873FS)

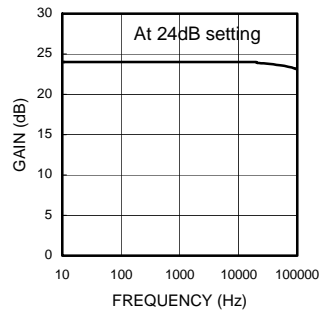


Fig.17 Voltage Gain - Frequency (BD3871FS)

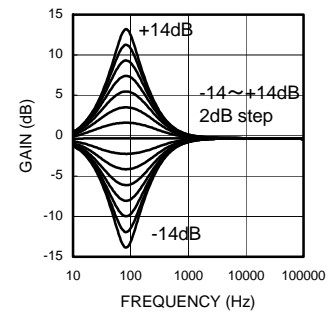


Fig.18 Bass Gain - Frequency

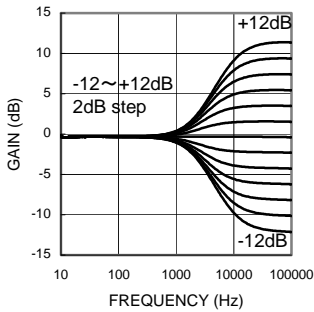


Fig.19 Treble Gain - Frequency (BD3870FS, BD3871FS, BD3873FS)

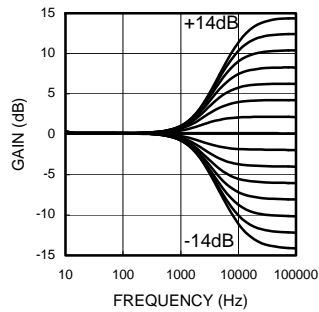


Fig.20 Treble Gain - Frequency (BD3872FS)

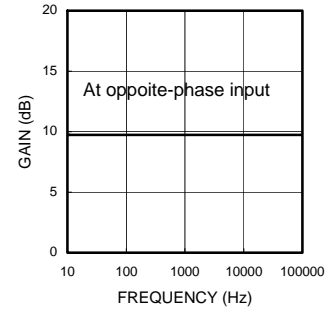


Fig.21 Surround Gain - Frequency

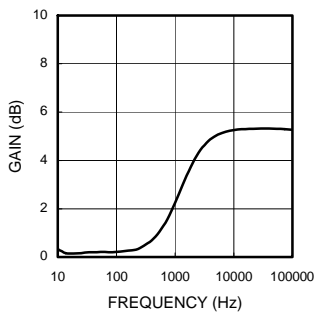


Fig.22 Treble Gain - Frequency (BD3872FS)

●Notes for use

- 1) Numbers and data in entries are representative design values and are not guaranteed values of the items.
- 2) Although ROHM is confident that the example application circuit reflects the best possible recommendations, be sure to verify circuit characteristics for your particular application. Modification of constants for other externally connected circuits may cause variations in both static and transient characteristics for external components as well as this Rohm IC. Allow for sufficient margins when determining circuit constants.
- 3) Absolute maximum ratings  
Use of the IC in excess of absolute maximum ratings, such as the applied voltage or operating temperature range (Topr), may result in IC damage. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. A physical safety measure, such as a fuse, should be implemented when using the IC at times where the absolute maximum ratings may be exceeded.
- 4) GND potential  
Ensure a minimum GND pin potential in all operating conditions. Make sure that no pins are at a voltage below the GND at any time, regardless of whether it is a transient signal or not.
- 5) Thermal design  
Perform thermal design, in which there are adequate margins, by taking into account the permissible dissipation (Pd) in actual states of use.
- 6) Short circuit between terminals and erroneous mounting  
Pay attention to the assembly direction of the ICs. Wrong mounting direction or shorts between terminals, GND, or other components on the circuits, can damage the IC.
- 7) Operation in strong electromagnetic field  
Using the ICs in a strong electromagnetic field can cause operation malfunction.
- 8) Power-ON RESET  
A built-in circuit for performing initialization inside the IC at power-ON is provided. In unstable systems it is recommended that the data shall be sent to all the addresses during power-ON, until this operation cycle is completed. Mute should be applied during this cycle.

| Function                               | Initial Condition |
|--|-------------------|
| Input Selector                         | Input A           |
| Input Gain                             | 0dB               |
| Loud Speaker Equalizer (BD3872FS only) | OFF               |
| Volume                                 | -∞dB              |
| Surround                               | OFF               |
| Treble Gain                            | 0dB               |
| Bass Gain                              | 0dB               |

- 9) 2-wire serial control  
For the CL and DA terminals, the patterned and other wirings should be routed as not to cause interference with the analog-signal-related lines.
- 10) Switching between functions  
Shock sound is absorbed when switching between the volume, bass, and treble functions.
- 11) Input coupling capacitor  
As described in the figure below, low frequency characteristics are determined depending on the external capacitor value for input coupling, and the input impedance value inside the IC.

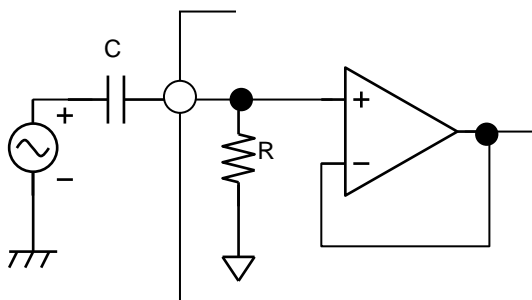
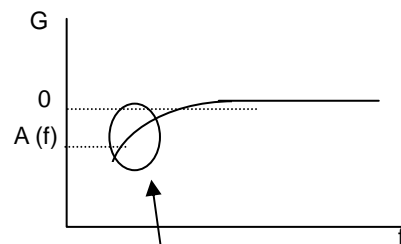


Fig.23



$$A(f) = \sqrt{\frac{(2\pi fCR)^2}{1+(2\pi fCR)^2}}$$

Fig.24

12) Switching noise

For Surround and Loud Speaker Equalizer (BD3872FS only), external capacitor C is attached to the CAP pin as a measure to control the switching noise. In the application circuit, a constant value as an example, is indicated by the CAP pin. The time constant, which is used to charge/discharge the external capacitor C (varying between  $V_{be}$  to  $5V_{be}$  (2.65V)) on the CAP pin, controls the soft switching operation. The switching time constant T is stated as  $T=2.55 \times 10^5 \times C$ .  $V_{be}$  has a temperature characteristic and may affect the time constant T.

13) Input Selector and Input Gain

When setting/changing Input Selector or Input Gain, the soft switching operation does not function and therefore noise is not controlled. For this reason, it is recommended to provide a mute circuit constructed of the external components for the set design.

MUTE setting example

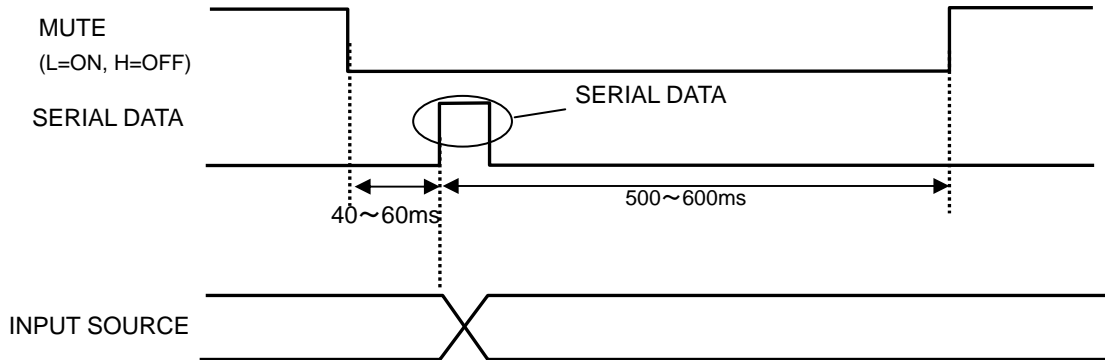
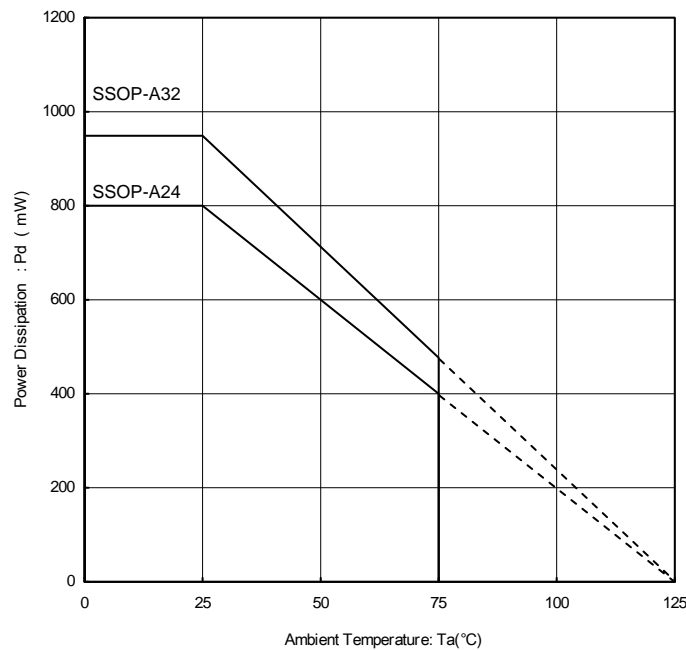


Fig.25

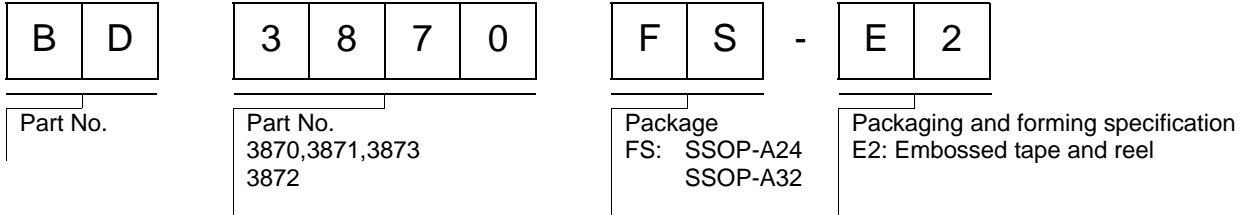
● Thermal Derating Curve



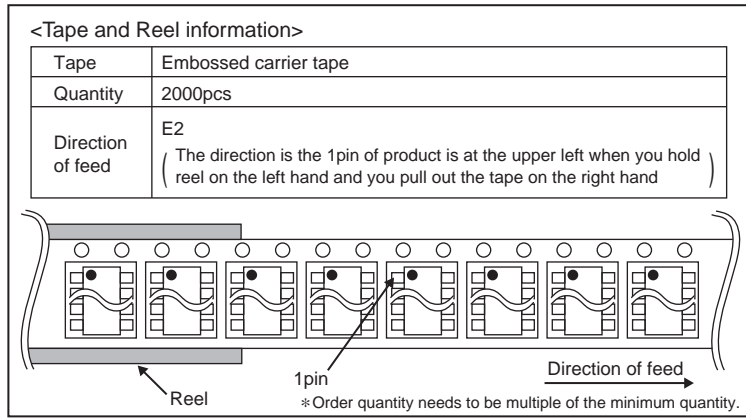
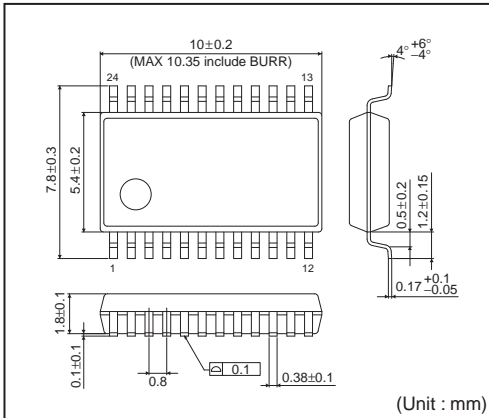
When installed ROHM standard board  
(70 × 70 × 1.6mm Glass epoxy board)

Fig.26

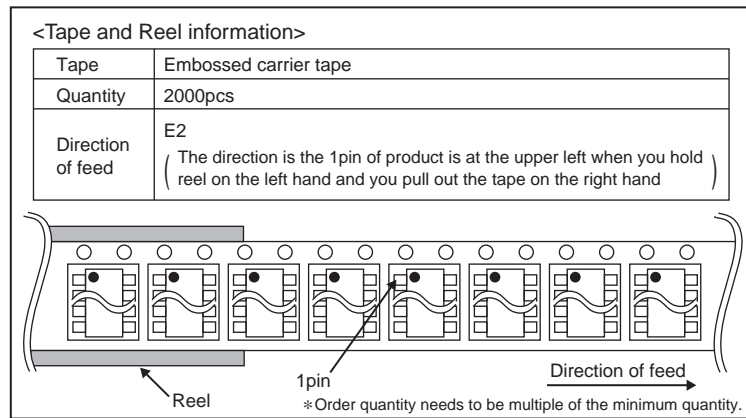
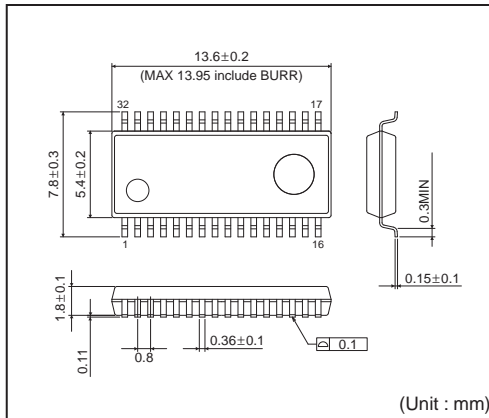
●Ordering part number



SSOP-A24



SSOP-A32



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| JAPAN     | USA       | EU         | CHINA     |
|-----------|-----------|------------|-----------|
| CLASS III | CLASS III | CLASS II b | CLASS III |
| CLASS IV  |           | CLASS III  |           |

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  - Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
  - Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
  - Sealing or coating our Products with resin or other coating materials
  - Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
  - Use of the Products in places subject to dew condensation
- The Products are not subject to radiation-proof design.
- Please verify and confirm characteristics of the final or mounted products in using the Products.
- In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.
- De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

## Precaution for Mounting / Circuit board design

- When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification



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1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.
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This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of ionizer, friction prevention and temperature / humidity control).

**Precaution for Storage / Transportation**

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
  - [a] the Products are exposed to sea winds or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [b] the temperature or humidity exceeds those recommended by ROHM
  - [c] the Products are exposed to direct sunshine or condensation
  - [d] the Products are exposed to high Electrostatic
2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.
3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

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