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Analog Sound Processor series

# Sound Processor with Built-in Surround Sound Function

**BD3491FS**

**General Description**

Built in stereo 6 input selectors and volume that there is not an impedance change of a volume terminal. And this is sound processor can realize 2-band equalizer (Bass/Treble, Gain  $\pm 14\text{dB}$  /  $2\text{dB\_step}$ ) and BassBoost, Output gain, Surround by external components.

**Features**

- Equipped with 6 single ended stereo input selectors
- Built-in input gain controller suitable for mobile audio.
- Volume input terminal can be used as a microphone input terminal since its impedance remains constant even if volume setting is changed.
- Bi-CMOS process is suitable for the design of low current and low energy. It also provides more quality for Bi-CMOS small scale regulator and heat in a set.
- The package of this IC is SSOP-A32. Sound input terminals and output terminals arrangement is optimized for easy and fast layout of PCB pattern. At the same time, it minimizes PCB area.

**Applications**

- Suitable for mini-components or micro components. Used for audio equipment of TV, DVD, etc.

**Key Specification**

- Current upon no signal: 7mA(typ)
- Total Harmonic Distortion: 0.002%(typ)
- Maximum Input Voltage: 2.4Vrms(typ)
- Crosstalk between Selectors: 100dB(typ)
- Volume Control Range: 0dB to -87dB
- Output Noise Voltage: 5 $\mu\text{Vrms}$ (typ)
- Residual Output Noise Voltage: 5 $\mu\text{Vrms}$ (typ)
- Operating Temperature Range: -40°C to +85°C

**Package**  
SSOP-A32

**W(typ) x D(typ) x H(max)**  
13.60mm x 7.80mm x 2.01mm



SSOP-A32

**Typical Application Circuit**

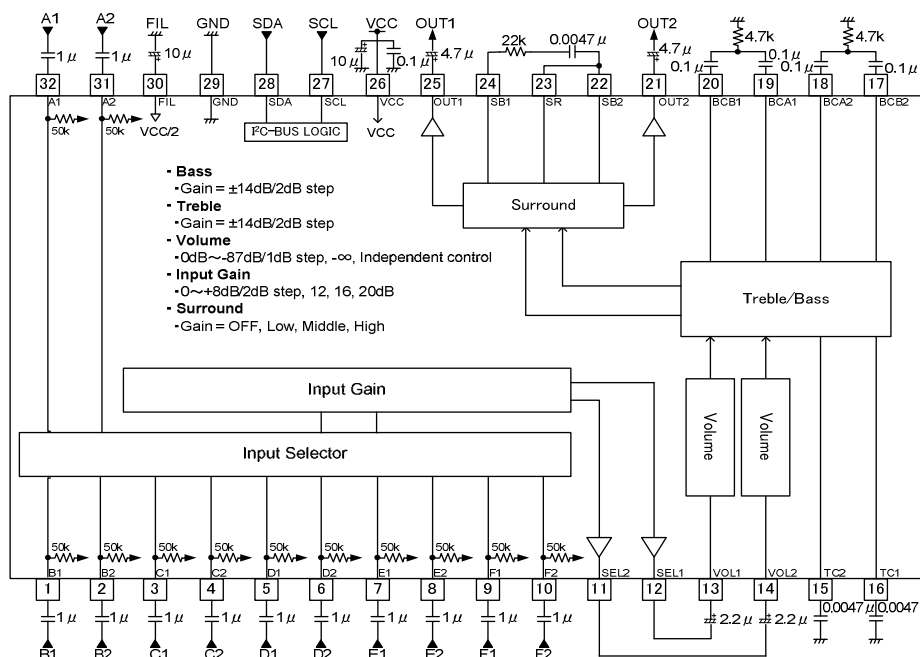


Figure 1. Application Circuit Diagram

○Product structure : Silicon monolithic integrated circuit ○This product is not designed for protection against radioactive rays

## Pin Configuration

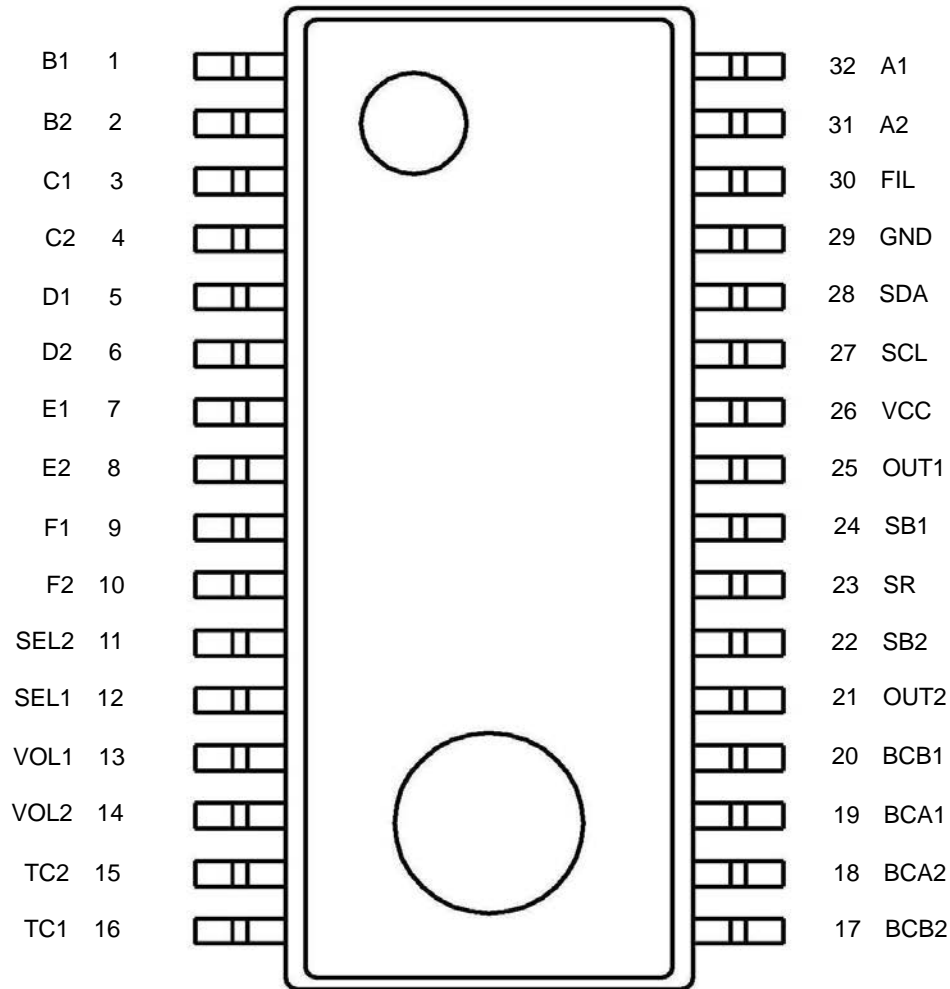


Figure 2. Pin Configuration

## Pin Descriptions

| Terminal Number | Terminal Name | Description                     | Terminal Number | Terminal Name | Description                         |
|-----------------|---------------|---------------------------------|-----------------|---------------|-------------------------------------|
| 1               | B1            | Ch1 of B input terminal         | 17              | BCB2          | Ch2 of Bass filter terminal         |
| 2               | B2            | Ch2 of B input terminal         | 18              | BCA2          | Ch2 of Bass filter terminal         |
| 3               | C1            | Ch1 of C input terminal         | 19              | BCA1          | Ch1 of Bass filter terminal         |
| 4               | C2            | Ch2 of C input terminal         | 20              | BCB1          | Ch1 of Bass filter terminal         |
| 5               | D1            | Ch1 of D input terminal         | 21              | OUT2          | Ch2 of Output terminal              |
| 6               | D2            | Ch2 of D input terminal         | 22              | SB2           | Ch2 of Bass boost terminal          |
| 7               | E1            | Ch1 of E input terminal         | 23              | SR            | Surround terminal                   |
| 8               | E2            | Ch2 of E input terminal         | 24              | SB1           | Ch1 of Bass boost terminal          |
| 9               | F1            | Ch1 of F input terminal         | 25              | OUT1          | Ch1 of Output terminal              |
| 10              | F2            | Ch2 of F input terminal         | 26              | VCC           | Power supply terminal               |
| 11              | SEL2          | Ch2 of selector output terminal | 27              | SCL           | Serial communication clock terminal |
| 12              | SEL1          | Ch1 of selector output terminal | 28              | SDA           | Serial communication data terminal  |
| 13              | VOL1          | Ch1 of Volume input terminal    | 29              | GND           | GND terminal                        |
| 14              | VOL2          | Ch2 of Volume input terminal    | 30              | FIL           | VCC/2 terminal                      |
| 15              | TC2           | Ch2 of Treble filter terminal   | 31              | A2            | Ch2 of A input terminal             |
| 16              | TC1           | Ch1 of Treble filter terminal   | 32              | A1            | Ch1 of A input terminal             |

Block Diagram

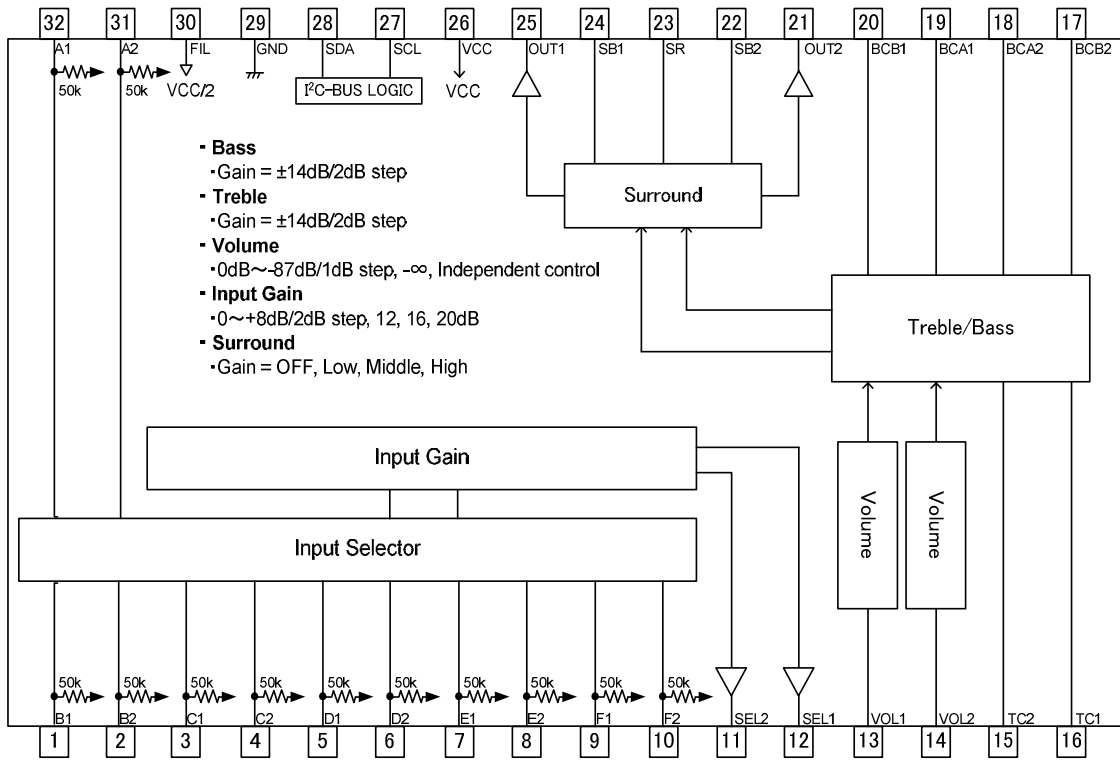


Figure 3. Block Diagram

Absolute Maximum Ratings

| Parameter            | Symbol | Limits                                           | Unit |
|----------------------|--------|--------------------------------------------------|------|
| Power supply Voltage | VCC    | 10.0                                             | V    |
| Input Voltage        | Vin    | VCC+0.3 to GND-0.3<br>SCL, SDA only 7 to GND-0.3 | V    |
| Power Dissipation    | Pd     | 0.95 ※1                                          | W    |
| Storage Temperature  | Tastg  | -55 to +150                                      | °C   |

※1 Derate by 7.6mW/°C for Ta=25°C or more.

ROHM standard board shall be mounted. Thermal resistance  $\theta_{ja} = 131.6(^{\circ}\text{C}/\text{W})$ .

ROHM standard board Size: 70x70x1.6(mm<sup>3</sup>)

Material: A FR4 glass epoxy board (3% or less of copper foil area)

Operating Range

| Parameter            | Symbol | Limits      | Unit |
|----------------------|--------|-------------|------|
| Power supply voltage | VCC    | 4.75 to 9.5 | V    |
| Temperature          | Topr   | -40 to +85  | °C   |

## Electrical Characteristics

(Unless specified particularly,  $T_a=25^{\circ}\text{C}$ ,  $V_{CC}=9.0\text{V}$ ,  $f=1\text{kHz}$ ,  $V_{in}=1\text{Vrms}$ ,  $R_g=600\Omega$ ,  $R_L=10\text{k}\Omega$ , A input, Input gain 0dB, Volume 0dB, Bass 0dB, Treble 0dB, Surround Mode OFF, Surround Gain = OFF)

| BLOCK          | Item                          | Symbol            | Limit |       |       | Unit             | Condition                                                                                   |
|----------------|-------------------------------|-------------------|-------|-------|-------|------------------|---------------------------------------------------------------------------------------------|
|                |                               |                   | Min.  | Typ.  | Max.  |                  |                                                                                             |
| GENERAL        | Current upon no signal        | $I_Q$             | —     | 7     | 15    | mA               | No signal                                                                                   |
|                | Voltage Gain                  | $G_V$             | -1.5  | 0     | +1.5  | dB               | $G_V=20\log(V_{out}/V_{in})$                                                                |
|                | Channel Balance               | CB                | -1.5  | 0     | +1.5  | dB               | $CB = G_{V1}-G_{V2}$                                                                        |
|                | Total Harmonic Distortion     | THD+N             | —     | 0.002 | 0.1   | %                | $V_{out}=1\text{Vrms}$<br>$BW=400\text{-}30\text{kHz}$                                      |
|                | Output Noise Voltage          | $V_{NO}$          | —     | 5     | 20    | $\mu\text{Vrms}$ | $R_g = 0\Omega$<br>$BW = \text{IHF-A}$                                                      |
|                | Residual Output Noise Voltage | $V_{NOR}$         | —     | 5     | 20    | $\mu\text{Vrms}$ | $R_g = 0\Omega$<br>$BW = \text{IHF-A}$<br>Volume = $-\infty$                                |
|                | Crosstalk between Channels    | CTC               | —     | -100  | -80   | dB               | $R_g = 0\Omega$<br>$CTC=20\log(V_{out2}/V_{out1})$<br>$BW = \text{IHF-A}$                   |
| INPUT SELECTOR | Input Impedance               | $R_{IN}$          | 35    | 50    | 65    | k $\Omega$       |                                                                                             |
|                | Maximum Input Voltage         | $V_{IM}$          | 2.1   | 2.4   | -     | Vrms             | $V_{IM}$ at $THD+N(V_{out})=1\%$<br>$BW=400\text{-}30\text{kHz}$                            |
|                | Crosstalk between Selectors   | CTS               | —     | -100  | -84   | dB               | $R_g = 0\Omega$<br>$CTS=20\log(V_{out}/V_{in})$<br>$BW = \text{IHF-A}$                      |
| VOLUME         | Control Range                 | $G_{V\text{MAX}}$ | -90   | -87   | -84   | dB               | $V_{in}=2\text{Vrms}$<br>$G_V=20\log(V_{out}/V_{in})$                                       |
|                | Maximum Attenuation           | $G_{V\text{MIN}}$ | —     | -100  | -80   | dB               | Volume = $-\infty$<br>$G_V=20\log(V_{out}/V_{in})$                                          |
| BASS           | Maximum Boost Gain            | $G_{B\text{BST}}$ | 11.5  | 14    | 16.5  | dB               | Gain = 14dB, $f = 100\text{Hz}$<br>$V_{in}=100\text{mVrms}$<br>$G_V=20\log(V_{out}/V_{in})$ |
|                | Maximum Cut Gain              | $G_{B\text{CUT}}$ | -16.5 | -14   | -11.5 | dB               | Gain = -14dB, $f = 100\text{Hz}$<br>$V_{in}=2\text{Vrms}$<br>$G_V=20\log(V_{out}/V_{in})$   |
| TREBLE         | Maximum Boost Gain            | $G_{T\text{BST}}$ | 11.5  | 14    | 16.5  | dB               | Gain = 14dB, $f = 10\text{kHz}$<br>$V_{in}=100\text{mVrms}$<br>$G_V=20\log(V_{out}/V_{in})$ |
|                | Maximum Cut Gain              | $G_{T\text{CUT}}$ | -16.5 | -14   | -11.5 | dB               | Gain = -14dB, $f = 10\text{kHz}$<br>$V_{in}=2\text{Vrms}$<br>$G_V=20\log(V_{out}/V_{in})$   |

※Phase between input / output is same.

Typical Performance Curves

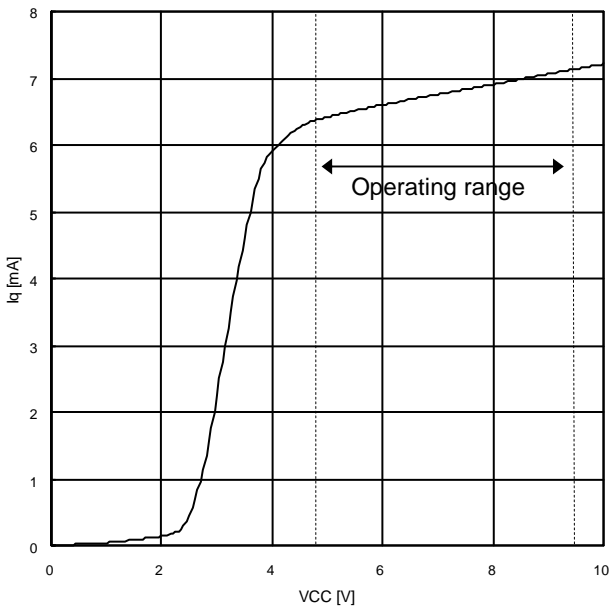


Figure 4. Vcc vs. Iq

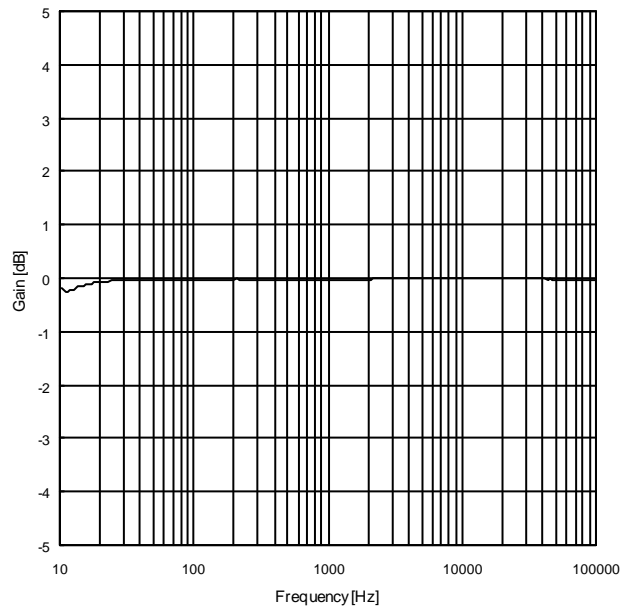


Figure 5. Gain vs. Frequency

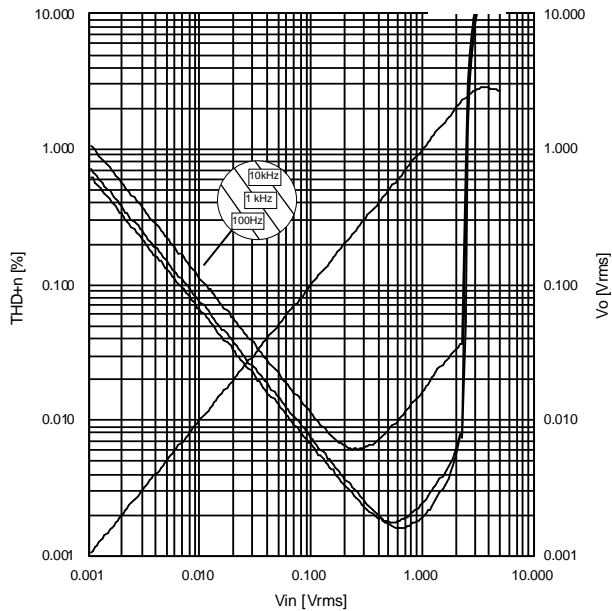


Figure 6. THD+N, Vo vs. Vin

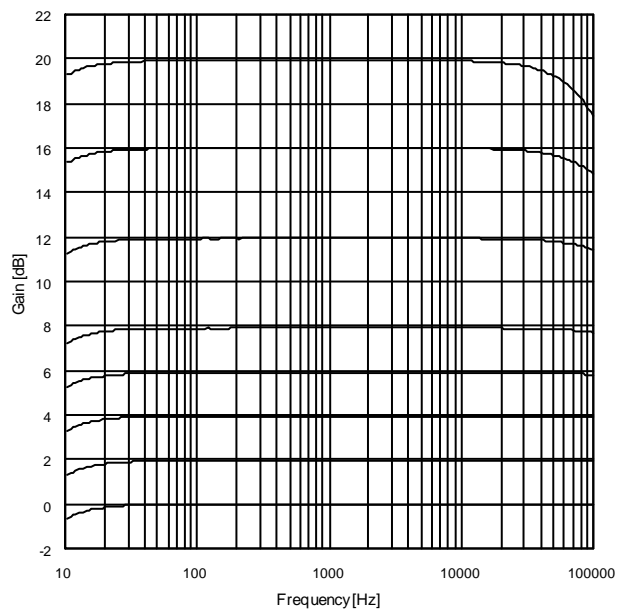


Figure 7. Input Gain vs. Frequency.

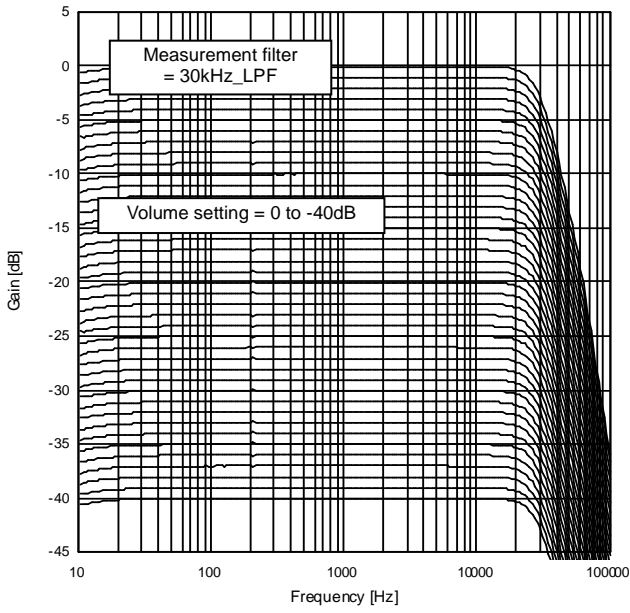


Figure 8. Volume Attenuation 1

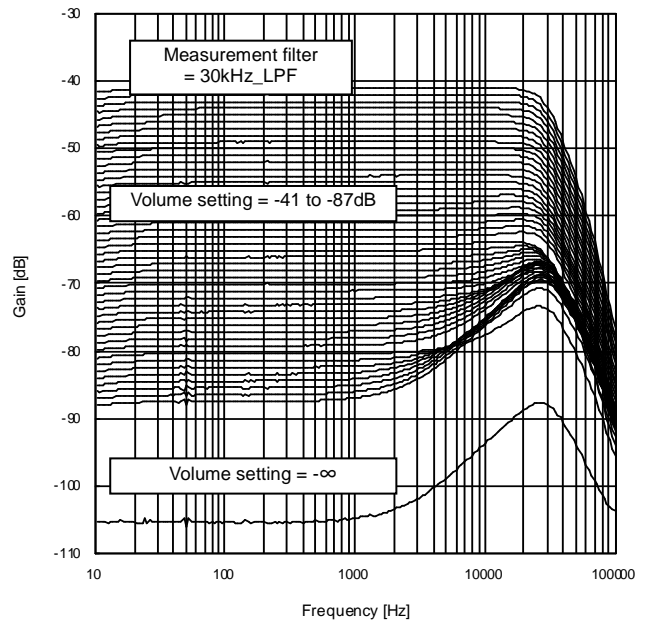


Figure 9. Volume Attenuation 2

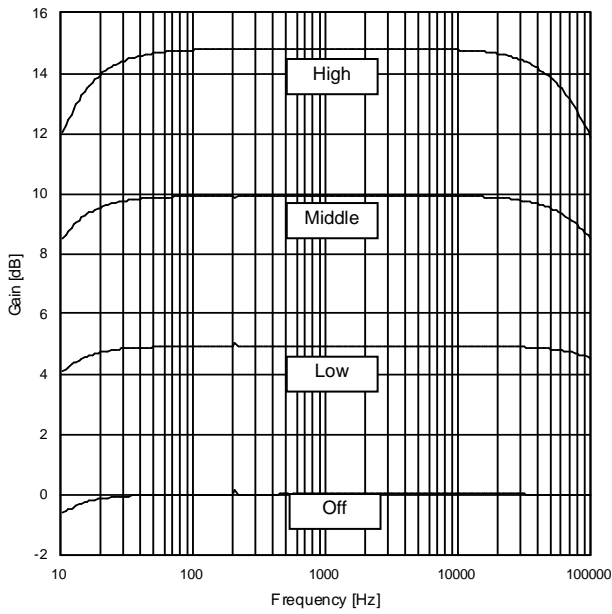


Figure 10. Output Gain vs. Frequency

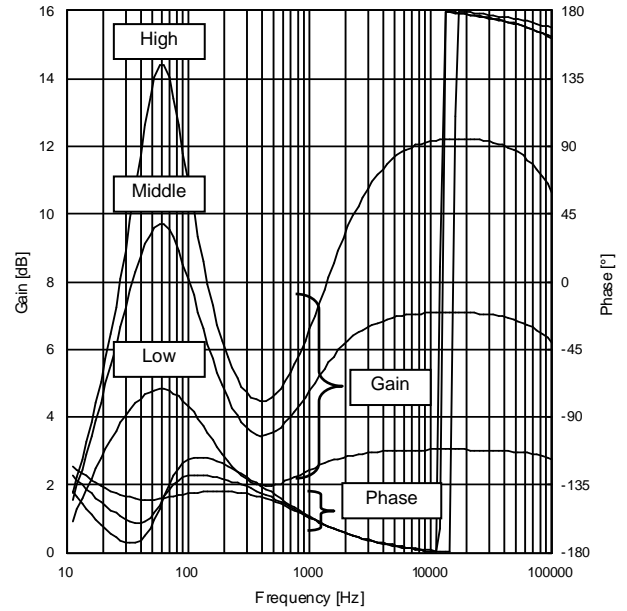


Figure 11. BassBoost & Surround

CONTROL SIGNAL SPECIFICATION

(1) Electrical specifications and timing for bus lines and I/O stages

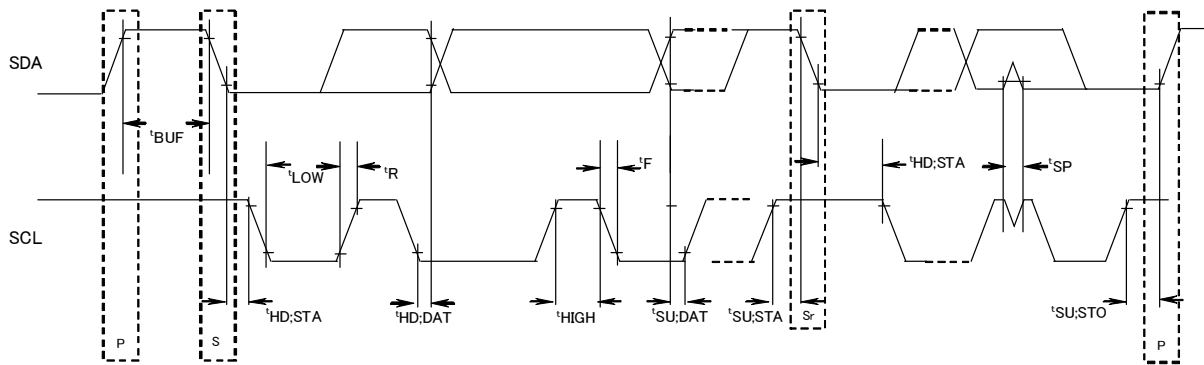


Figure 12. Definition of timing on the I<sup>2</sup>C-BUS

Table 1. Characteristics of the SDA and SCL bus lines for I<sup>2</sup>C-BUS devices

| Parameter                                                                                     | Symbol  | Fast-mode |      | Unit |
|-----------------------------------------------------------------------------------------------|---------|-----------|------|------|
|                                                                                               |         | Min.      | Max. |      |
| 1 SCL clock frequency                                                                         | fSCL    | 0         | 400  | kHz  |
| 2 Bus free time between a STOP and START condition                                            | tBUF    | 1.3       | —    | μs   |
| 3 Hold time (repeated) START condition. After this period, the first clock pulse is generated | tHD;STA | 0.6       | —    | μs   |
| 4 LOW period of the SCL clock                                                                 | tLOW    | 1.3       | —    | μs   |
| 5 HIGH period of the SCL clock                                                                | tHIGH   | 0.6       | —    | μs   |
| 6 Set-up time for a repeated START condition                                                  | tSU;STA | 0.6       | —    | μs   |
| 7 Data hold time                                                                              | tHD;DAT | 300*      | —    | ns   |
| 8 Data set-up time                                                                            | tSU;DAT | 300*      | —    | ns   |
| 9 Set-up time for STOP condition                                                              | tSU;STO | 0.6       | —    | μs   |

All values referred to VIH min and VIL max levels (see Table 2).  
 \*About 7(tHD;DAT), 8(tSU;DAT), make it the setup which a margin is fully in .

Table 2. Characteristics of the SDA and SCL I/O stages for I<sup>2</sup>C-BUS devices

| Parameter                                                                        | Symbol | Fast-mode |      | Unit |
|----------------------------------------------------------------------------------|--------|-----------|------|------|
|                                                                                  |        | Min.      | Max. |      |
| 10 LOW level input voltage:                                                      | VIL    | -0.3      | 1    | V    |
| 11 HIGH level input voltage:                                                     | VIH    | 2.3       | 5    | V    |
| 12 Pulse width of spikes which must be suppressed by the input filter.           | tSP    | 0         | 50   | ns   |
| 13 LOW level output voltage (open drain or open collector): at 3mA sink current. | VOL1   | 0         | 0.4  | V    |
| 14 Input current in each I/O pin with an input voltage between 0.4V and 4.5V.    | Ii     | -10       | 10   | μA   |

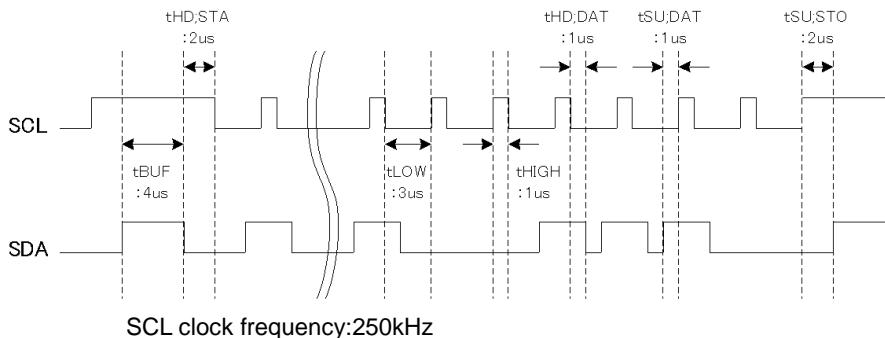


Figure 13. A command timing example in the I<sup>2</sup>C data transmission.



(2) I<sup>2</sup>C-BUS FORMAT

|      |                |                                                                                                                          |                |      |      |      |      |
|------|----------------|--------------------------------------------------------------------------------------------------------------------------|----------------|------|------|------|------|
| MSB  | LSB            | MSB                                                                                                                      | LSB            | MSB  | LSB  |      |      |
| S    | Slave Address  | A                                                                                                                        | Select Address | A    | Data | A    | P    |
| 1bit | 8bit           | 1bit                                                                                                                     | 8bit           | 1bit | 8bit | 1bit | 1bit |
|      | S              | = Start conditions (Recognition of start bit)                                                                            |                |      |      |      |      |
|      | Slave Address  | = Recognition of slave address. 7 bits in upper order are voluntary.<br>The least significant bit is "L" due to writing. |                |      |      |      |      |
|      | A              | = ACKNOWLEDGE bit (Recognition of acknowledgement)                                                                       |                |      |      |      |      |
|      | Select Address | = Select every of volume, bass and treble.                                                                               |                |      |      |      |      |
|      | Data           | = Data on every volume and tone.                                                                                         |                |      |      |      |      |
|      | P              | = Stop condition (Recognition of stop bit)                                                                               |                |      |      |      |      |

(3) I<sup>2</sup>C-BUS Interface Protocol

1) Basic form

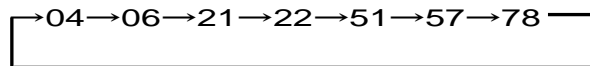
|     |               |     |                |     |      |   |   |
|-----|---------------|-----|----------------|-----|------|---|---|
| S   | Slave Address | A   | Select Address | A   | Data | A | P |
| MSB | LSB           | MSB | LSB            | MSB | LSB  |   |   |

2) Automatic increment (Assigned select Address is increased according to the number of data.)

|     |               |     |                |     |       |     |       |     |     |       |     |   |
|-----|---------------|-----|----------------|-----|-------|-----|-------|-----|-----|-------|-----|---|
| S   | Slave Address | A   | Select Address | A   | Data1 | A   | Data2 | A   | ... | DataN | A   | P |
| MSB | LSB           | MSB | LSB            | MSB | LSB   | MSB | LSB   | MSB | LSB | MSB   | LSB |   |

- No.1. Data1 is set as data of address specified by Select Address.
- No.2. Data2 is set as data of next address from the address specified by No.1.
- No.3. DataN is set as data of address incremented N-1 times from the address specified by No.1.

Circulation of Select Address by the automatic increment function is shown below.



3) Configuration unavailable for transmission (In this case, only Select Address1 is set properly.)

|     |               |     |                 |     |      |     |                  |     |      |     |     |
|-----|---------------|-----|-----------------|-----|------|-----|------------------|-----|------|-----|-----|
| S   | Slave Address | A   | Select Address1 | A   | Data | A   | Select Address 2 | A   | Data | A   | P   |
| MSB | LSB           | MSB | LSB             | MSB | LSB  | MSB | LSB              | MSB | LSB  | MSB | LSB |

(Note) If any data is transmitted as Select Address 2 next to data, it is recognized as data, not as Select Address 2.

(4) Slave Address

|     |    |    |    |    |    |    |     |
|-----|----|----|----|----|----|----|-----|
| MSB |    |    |    |    |    |    | LSB |
| A6  | A5 | A4 | A3 | A2 | A1 | A0 | R/W |
| 1   | 0  | 0  | 0  | 0  | 0  | 1  | 0   |

82H

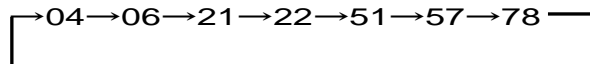
(5) Select Address & Data

| Items           | Select Address (hex) | Data             |                        |    |            |               |                |     |    |
|-----------------|----------------------|------------------|------------------------|----|------------|---------------|----------------|-----|----|
|                 |                      | MSB              | Data                   |    |            |               |                | LSB |    |
|                 |                      | D7               | D6                     | D5 | D4         | D3            | D2             | D1  | D0 |
| Input Selector  | 04                   | 0                | 0                      | 0  | 0          | 0             | Input Selector |     |    |
| Input Gain      | 06                   | 0                | 0                      | 0  | Input Gain |               |                | 0   |    |
| Volume Gain 1ch | 21                   | 1                | Volume Attenuation 1ch |    |            |               |                |     |    |
| Volume Gain 2ch | 22                   | 1                | Volume Attenuation 2ch |    |            |               |                |     |    |
| Bass Gain       | 51                   | Bass Boost/Cut   | 0                      | 0  | 0          | Bass Gain     |                | 0   |    |
| Treble Gain     | 57                   | Treble Boost/Cut | 0                      | 0  | 0          | Treble Gain   |                | 0   |    |
| Surround        | 78                   | Surround Mode    | 0                      | 0  | 0          | Surround Gain |                |     |    |
| Test Mode       | F0                   | 0                | 0                      | 0  | 0          | 0             | 0              | 0   | 0  |
| System Reset    | FE                   | 1                | 0                      | 0  | 0          | 0             | 0              | 0   | 1  |

About the register that a function isn't assigned (above table, D0~D7 is "0" or "1"), set it up as the value of the above table.

Note:

Upon continuous data transfer, the Select Address is circulated by the automatic increment function, as shown below.



Select Address 04 (hex)


| Mode        | Input Selector |    |    |    |    |    |    |     |
|-------------|----------------|----|----|----|----|----|----|-----|
|             | MSB            |    |    |    |    |    |    | LSB |
|             | D7             | D6 | D5 | D4 | D3 | D2 | D1 | D0  |
| A           | 0              | 0  | 0  | 0  | 0  | 0  | 0  | 0   |
| B           |                |    |    |    |    | 0  | 0  | 1   |
| C           |                |    |    |    |    | 0  | 1  | 0   |
| D           |                |    |    |    |    | 0  | 1  | 1   |
| E           |                |    |    |    |    | 1  | 0  | 0   |
| F           |                |    |    |    |    | 1  | 1  | 0   |
| INPUT SHORT |                |    |    |    |    | 1  | 0  | 1   |
| INPUT MUTE  |                |    |    |    |    | 1  | 1  | 1   |

INPUT MUTE : Mute is done at the input signal in the part of Input Selector.

Select Address 06 (hex)

| Gain        | Input Gain |    |    |    |    |    |    |     |
|-------------|------------|----|----|----|----|----|----|-----|
|             | MSB        |    |    |    |    |    |    | LSB |
|             | D7         | D6 | D5 | D4 | D3 | D2 | D1 | D0  |
| 0dB         | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0   |
| 2dB         |            |    |    | 0  | 0  | 0  | 1  |     |
| 4dB         |            |    |    | 0  | 0  | 1  | 0  |     |
| 6dB         |            |    |    | 0  | 0  | 1  | 1  |     |
| 8dB         |            |    |    | 0  | 1  | 0  | 0  |     |
| 12dB        |            |    |    | 0  | 1  | 1  | 0  |     |
| 16dB        |            |    |    | 1  | 0  | 0  | 0  |     |
| 20dB        |            |    |    | 1  | 0  | 1  | 0  |     |
| Prohibition |            |    |    | 0  | 1  | 0  | 1  |     |
|             |            |    |    | 0  | 1  | 1  | 1  |     |
|             | 1          | 0  | 0  | 1  |    |    |    |     |
|             | 1          | 0  | 1  | 1  |    |    |    |     |
|             | 1          | 1  | 0  | 0  |    |    |    |     |
|             |            |    |    | 1  | 1  | 1  | 0  |     |
|             |            |    |    | 1  | 1  | 1  | 1  |     |

About Input Gain, the allotment of D4/D3/D2/D1 is discontinuous, please be careful.

 : Initial condition

Select Address 21, 22 (hex)

| Attenuation | Volume Attenuation |    |    |    |    |    |    |           |
|-------------|--------------------|----|----|----|----|----|----|-----------|
|             | MSB<br>D7          | D6 | D5 | D4 | D3 | D2 | D1 | LSB<br>D0 |
| 0dB         | 1                  | 0  | 0  | 0  | 0  | 0  | 0  | 0         |
| -1dB        |                    | 0  | 0  | 0  | 0  | 0  | 0  | 1         |
| -2dB        |                    | 0  | 0  | 0  | 0  | 0  | 0  | 1         |
| -3dB        |                    | 0  | 0  | 0  | 0  | 0  | 0  | 1         |
| -4dB        |                    | 0  | 0  | 0  | 0  | 0  | 1  | 0         |
| -5dB        |                    | 0  | 0  | 0  | 0  | 0  | 1  | 0         |
| -6dB        |                    | 0  | 0  | 0  | 0  | 0  | 1  | 1         |
| -7dB        |                    | 0  | 0  | 0  | 0  | 0  | 1  | 1         |
| -8dB        |                    | 0  | 0  | 0  | 0  | 1  | 0  | 0         |
| -9dB        |                    | 0  | 0  | 0  | 0  | 1  | 0  | 0         |
| -10dB       |                    | 0  | 0  | 0  | 0  | 1  | 0  | 1         |
| -11dB       |                    | 0  | 0  | 0  | 0  | 1  | 0  | 1         |
| -12dB       |                    | 0  | 0  | 0  | 0  | 1  | 1  | 0         |
| -13dB       |                    | 0  | 0  | 0  | 0  | 1  | 1  | 0         |
| -14dB       |                    | 0  | 0  | 0  | 0  | 1  | 1  | 1         |
| -15dB       |                    | 0  | 0  | 0  | 0  | 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         |
| ⋮           |                    | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮         |
| ⋮           |                    | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮         |
| -83dB       |                    | 1  | 0  | 1  | 0  | 0  | 1  | 1         |
| -84dB       |                    | 1  | 0  | 1  | 0  | 1  | 0  | 0         |
| -85dB       |                    | 1  | 0  | 1  | 0  | 1  | 0  | 1         |
| -86dB       |                    | 1  | 0  | 1  | 0  | 1  | 1  | 0         |
| -87dB       | 1                  | 0  | 1  | 0  | 1  | 1  | 1  |           |
| Prohibition | 1                  | 0  | 1  | 1  | 0  | 0  | 0  |           |
|             | ⋮                  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  |           |
| -∞dB        | 1                  | 1  | 1  | 1  | 1  | 1  | 0  |           |
|             | 1                  | 1  | 1  | 1  | 1  | 1  | 1  |           |

 : Initial condition

Select Address 51(hex)


| Gain | Bass Gain       |    |    |    |    |    |    | LSB |
|------|-----------------|----|----|----|----|----|----|-----|
|      | D7              | D6 | D5 | D4 | D3 | D2 | D1 | D0  |
| 0dB  | Bass Boost /Cut | 0  | 0  | 0  | 0  | 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  |     |

| Mode  | Bass Boost/Cut |    |    |    |           |    |    | LSB |
|-------|----------------|----|----|----|-----------|----|----|-----|
|       | D7             | D6 | D5 | D4 | D3        | D2 | D1 | D0  |
| Boost | 0              | 0  | 0  | 0  | Bass Gain |    |    | 0   |
| Cut   | 1              |    |    |    |           |    |    |     |

Select Address 57(hex)

| Gain | Treble Gain       |    |    |    |    |    |    | LSB |
|------|-------------------|----|----|----|----|----|----|-----|
|      | D7                | D6 | D5 | D4 | D3 | D2 | D1 | D0  |
| 0dB  | Treble Boost /Cut | 0  | 0  | 0  | 0  | 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  |     |

| Mode  | Treble Boost/Cut |    |    |    |             |    |    | LSB |
|-------|------------------|----|----|----|-------------|----|----|-----|
|       | D7               | D6 | D5 | D4 | D3          | D2 | D1 | D0  |
| Boost | 0                | 0  | 0  | 0  | Treble Gain |    |    | 0   |
| Cut   | 1                |    |    |    |             |    |    |     |

 : Initial condition


Select Address 78(hex)

| Gain        | Surround Gain |               |    |    |    |    |    |     |
|-------------|---------------|---------------|----|----|----|----|----|-----|
|             | MSB           | Surround Gain |    |    |    |    |    | LSB |
|             | D7            | D6            | D5 | D4 | D3 | D2 | D1 | D0  |
| OFF         | Surround Mode | 0             | 0  | 0  | 0  | 0  | 0  | 0   |
| Low         |               |               |    |    | 0  | 1  | 0  | 1   |
| Middle      |               |               |    |    | 1  | 0  | 1  | 0   |
| High        |               |               |    |    | 1  | 1  | 1  | 1   |
| Prohibition |               |               |    |    | 0  | 0  | 0  | 1   |
|             |               |               |    |    | 0  | 0  | 1  | 0   |
|             |               |               |    |    | 0  | 0  | 1  | 1   |
|             |               |               |    |    | 0  | 1  | 0  | 0   |
|             |               |               |    |    | 0  | 1  | 1  | 0   |
|             |               |               |    |    | 0  | 1  | 1  | 1   |
|             |               |               |    |    | 1  | 0  | 0  | 0   |
|             |               |               |    |    | 1  | 0  | 0  | 1   |
|             |               |               |    |    | 1  | 0  | 1  | 1   |
|             |               |               |    |    | 1  | 1  | 0  | 0   |
|             |               |               |    |    | 1  | 1  | 0  | 1   |
|             |               |               |    |    | 1  | 1  | 1  | 0   |

About Surround Gain, the allotment of D3/D2/D1/D0 is discontinuous, please be careful.

| Mode               | Surround Mode |               |    |    |               |    |    |     |
|--------------------|---------------|---------------|----|----|---------------|----|----|-----|
|                    | MSB           | Surround Mode |    |    |               |    |    | LSB |
|                    | D7            | D6            | D5 | D4 | D3            | D2 | D1 | D0  |
| Mode OFF           | 0             | 0             | 0  | 0  | Surround Gain |    |    |     |
| Surround SW (A)=ON |               |               |    |    |               |    |    |     |
| Mode ON            | 1             | 0             | 0  | 0  | Surround Gain |    |    |     |
| Surround SW (B)=ON |               |               |    |    |               |    |    |     |

About Surround SW, please refer to Figure 22,25,28,30,32,36 (From P22 to P27).

 : Initial condition

(6) About initial condition at supply voltage on

At on of supply voltage circuit made initialization inside IC is built-in. Please send data to all address as initial data at supply voltage on. And please supply mute at set side until this initial data is sent.

| Item                                  | Symbol | Limit |      |      | Unit | Condition                   |
|---------------------------------------|--------|-------|------|------|------|-----------------------------|
|                                       |        | Min.  | Typ. | Max. |      |                             |
| Rise time of VCC                      | Trise  | 20    | —    | —    | usec | VCC rise time from 0V to 3V |
| VCC voltage of release power on reset | Vpor   | —     | 3.0  | —    | V    |                             |

Volume Attenuation

| ATT(dB) | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | ATT(dB)     | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---------|----|----|----|----|----|----|----|----|-------------|----|----|----|----|----|----|----|----|
| 0       | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | -46         | 1  | 0  | 1  | 0  | 1  | 1  | 1  | 0  |
| -1      | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | -47         | 1  | 0  | 1  | 0  | 1  | 1  | 1  | 1  |
| -2      | 1  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | -48         | 1  | 0  | 1  | 1  | 0  | 0  | 0  | 0  |
| -3      | 1  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | -49         | 1  | 0  | 1  | 1  | 0  | 0  | 0  | 1  |
| -4      | 1  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | -50         | 1  | 0  | 1  | 1  | 0  | 0  | 1  | 0  |
| -5      | 1  | 0  | 0  | 0  | 0  | 1  | 0  | 1  | -51         | 1  | 0  | 1  | 1  | 0  | 0  | 1  | 1  |
| -6      | 1  | 0  | 0  | 0  | 0  | 1  | 1  | 0  | -52         | 1  | 0  | 1  | 1  | 0  | 1  | 0  | 0  |
| -7      | 1  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | -53         | 1  | 0  | 1  | 1  | 0  | 1  | 0  | 1  |
| -8      | 1  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | -54         | 1  | 0  | 1  | 1  | 0  | 1  | 1  | 0  |
| -9      | 1  | 0  | 0  | 0  | 1  | 0  | 0  | 1  | -55         | 1  | 0  | 1  | 1  | 0  | 1  | 1  | 1  |
| -10     | 1  | 0  | 0  | 0  | 1  | 0  | 1  | 0  | -56         | 1  | 0  | 1  | 1  | 1  | 0  | 0  | 0  |
| -11     | 1  | 0  | 0  | 0  | 1  | 0  | 1  | 1  | -57         | 1  | 0  | 1  | 1  | 1  | 0  | 0  | 1  |
| -12     | 1  | 0  | 0  | 0  | 1  | 1  | 0  | 0  | -58         | 1  | 0  | 1  | 1  | 1  | 0  | 1  | 0  |
| -13     | 1  | 0  | 0  | 0  | 1  | 1  | 0  | 1  | -59         | 1  | 0  | 1  | 1  | 1  | 0  | 1  | 1  |
| -14     | 1  | 0  | 0  | 0  | 1  | 1  | 1  | 0  | -60         | 1  | 0  | 1  | 1  | 1  | 1  | 0  | 0  |
| -15     | 1  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | -61         | 1  | 0  | 1  | 1  | 1  | 1  | 0  | 1  |
| -16     | 1  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | -62         | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 0  |
| -17     | 1  | 0  | 0  | 1  | 0  | 0  | 0  | 1  | -63         | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 1  |
| -18     | 1  | 0  | 0  | 1  | 0  | 0  | 1  | 0  | -64         | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
| -19     | 1  | 0  | 0  | 1  | 0  | 0  | 1  | 1  | -65         | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 1  |
| -20     | 1  | 0  | 0  | 1  | 0  | 1  | 0  | 0  | -66         | 1  | 1  | 0  | 0  | 0  | 0  | 1  | 0  |
| -21     | 1  | 0  | 0  | 1  | 0  | 1  | 0  | 1  | -67         | 1  | 1  | 0  | 0  | 0  | 0  | 1  | 1  |
| -22     | 1  | 0  | 0  | 1  | 0  | 1  | 1  | 0  | -68         | 1  | 1  | 0  | 0  | 0  | 1  | 0  | 0  |
| -23     | 1  | 0  | 0  | 1  | 0  | 1  | 1  | 1  | -69         | 1  | 1  | 0  | 0  | 0  | 1  | 0  | 1  |
| -24     | 1  | 0  | 0  | 1  | 1  | 0  | 0  | 0  | -70         | 1  | 1  | 0  | 0  | 0  | 1  | 1  | 0  |
| -25     | 1  | 0  | 0  | 1  | 1  | 0  | 0  | 1  | -71         | 1  | 1  | 0  | 0  | 0  | 1  | 1  | 1  |
| -26     | 1  | 0  | 0  | 1  | 1  | 0  | 1  | 0  | -72         | 1  | 1  | 0  | 0  | 1  | 0  | 0  | 0  |
| -27     | 1  | 0  | 0  | 1  | 1  | 0  | 1  | 1  | -73         | 1  | 1  | 0  | 0  | 1  | 0  | 0  | 1  |
| -28     | 1  | 0  | 0  | 1  | 1  | 1  | 0  | 0  | -74         | 1  | 1  | 0  | 0  | 1  | 0  | 1  | 0  |
| -29     | 1  | 0  | 0  | 1  | 1  | 1  | 0  | 1  | -75         | 1  | 1  | 0  | 0  | 1  | 0  | 1  | 1  |
| -30     | 1  | 0  | 0  | 1  | 1  | 1  | 1  | 0  | -76         | 1  | 1  | 0  | 0  | 1  | 1  | 0  | 0  |
| -31     | 1  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | -77         | 1  | 1  | 0  | 0  | 1  | 1  | 0  | 1  |
| -32     | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | -78         | 1  | 1  | 0  | 0  | 1  | 1  | 1  | 0  |
| -33     | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 1  | -79         | 1  | 1  | 0  | 0  | 1  | 1  | 1  | 1  |
| -34     | 1  | 0  | 1  | 0  | 0  | 0  | 1  | 0  | -80         | 1  | 1  | 0  | 1  | 0  | 0  | 0  | 0  |
| -35     | 1  | 0  | 1  | 0  | 0  | 0  | 1  | 1  | -81         | 1  | 1  | 0  | 1  | 0  | 0  | 0  | 1  |
| -36     | 1  | 0  | 1  | 0  | 0  | 1  | 0  | 0  | -82         | 1  | 1  | 0  | 1  | 0  | 0  | 1  | 0  |
| -37     | 1  | 0  | 1  | 0  | 0  | 1  | 0  | 1  | -83         | 1  | 1  | 0  | 1  | 0  | 0  | 1  | 1  |
| -38     | 1  | 0  | 1  | 0  | 0  | 1  | 1  | 0  | -84         | 1  | 1  | 0  | 1  | 0  | 1  | 0  | 0  |
| -39     | 1  | 0  | 1  | 0  | 0  | 1  | 1  | 1  | -85         | 1  | 1  | 0  | 1  | 0  | 1  | 0  | 1  |
| -40     | 1  | 0  | 1  | 0  | 1  | 0  | 0  | 0  | -86         | 1  | 1  | 0  | 1  | 0  | 1  | 1  | 0  |
| -41     | 1  | 0  | 1  | 0  | 1  | 0  | 0  | 1  | -87         | 1  | 1  | 0  | 1  | 0  | 1  | 1  | 1  |
| -42     | 1  | 0  | 1  | 0  | 1  | 0  | 1  | 0  |             | 1  | 1  | 0  | 1  | 1  | 0  | 0  | 0  |
| -43     | 1  | 0  | 1  | 0  | 1  | 0  | 1  | 1  | Prohibition | ·  | ·  | ·  | ·  | ·  | ·  | ·  | ·  |
| -44     | 1  | 0  | 1  | 0  | 1  | 1  | 0  | 0  |             | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  |
| -45     | 1  | 0  | 1  | 0  | 1  | 1  | 0  | 1  | -∞          | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |

 : Initial condition

Application Circuit Diagram

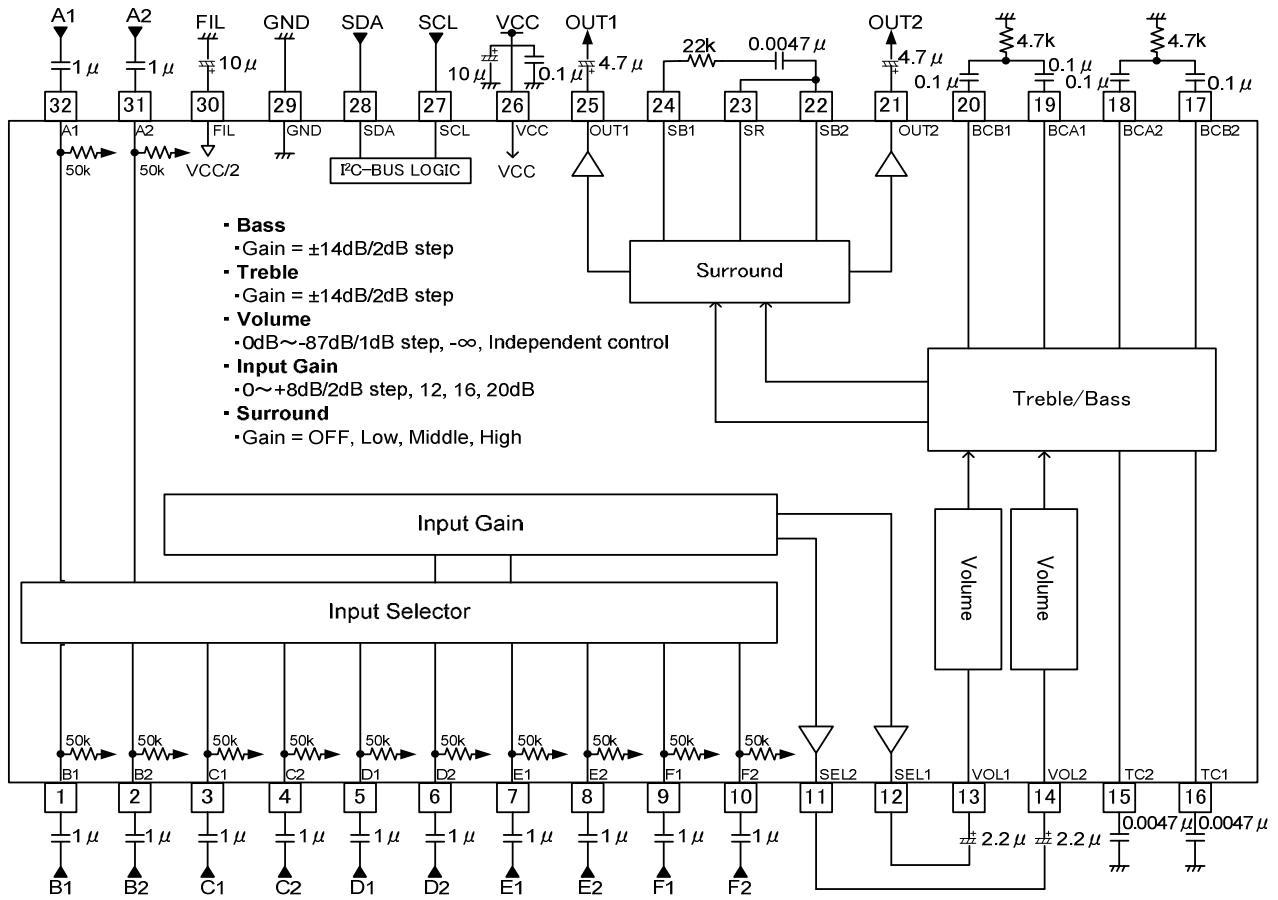


Figure 14. Application Circuit Diagram

UNIT  
RESISTANCE: Ω  
CAPACITANCE: F

**Notes on Wiring**

- ① Decoupling capacitor of the power supply has to be connected in the shortest distance possible.
- ② GND lines has to follow star-point connection.
- ③ Wiring pattern of Digital signal should be away from that of analog unit. At the same time, crosstalk has to be minimized, if not eliminated.
- ④ If possible, SCL and SDA lines of I<sup>2</sup>C-BUS should not be parallel.  
If it cannot be avoided, the lines must, at least, be shielded.
- ⑤ Analog input lines should not be parallel, as well. If it cannot be avoided, the lines must, at least, be shielded.



**Thermal Derating Curve**

The temperature, at which it is used, affects the electrical characteristics of an IC. Exceeding absolute maximum ratings may degrade and destroy elements. Careful consideration must be given to the heat of the IC from the two standpoints of immediate damage and long-term reliability of operation.

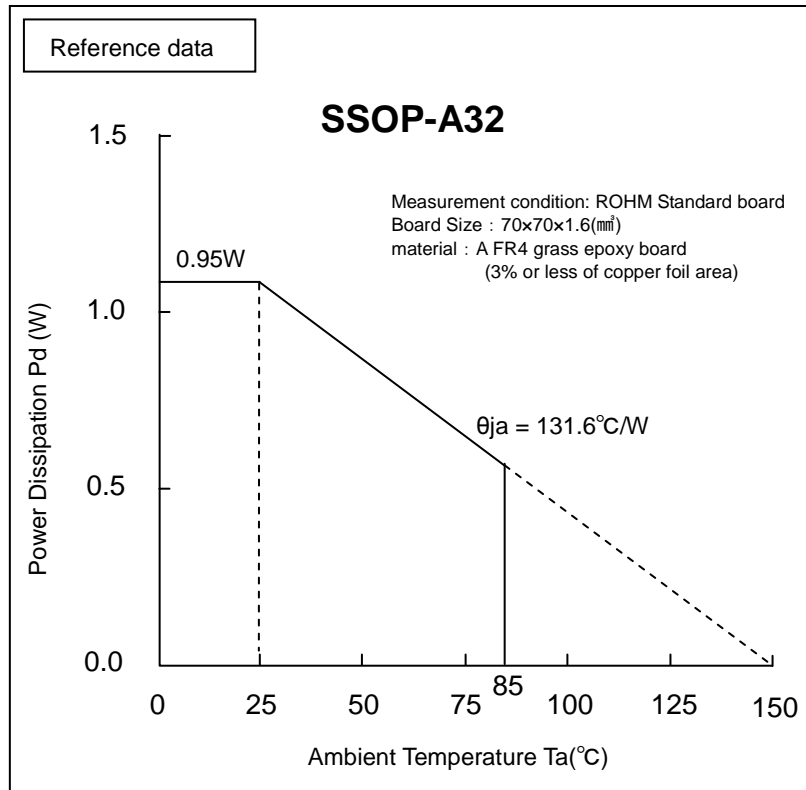


Figure 15. Temperature Derating Curve

Note: Values are actual measurements and are not guaranteed.

Power dissipation values vary according to the board on which the IC is mounted.

Pin Equivalent Circuit and Description

| Pin No.                                                     | Pin Name                                                             | Pin Voltage | Equivalent Circuit | Pin Description                                                                                                                                                                         |
|-------------------------------------------------------------|----------------------------------------------------------------------|-------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 32<br>31<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10 | A1<br>A2<br>B1<br>B2<br>C1<br>C2<br>D1<br>D2<br>E1<br>E2<br>F1<br>F2 | 4.5V        |                    | Stereo signal input pin<br>Input impedance = 50kΩ(typ)                                                                                                                                  |
| 11<br>12<br>21<br>25                                        | SEL2<br>SEL1<br>OUT2<br>OUT1                                         | 4.5V        |                    | Output pin                                                                                                                                                                              |
| 13<br>14                                                    | VOL1<br>VOL2                                                         | 4.5V        |                    | Volume input pin<br>Input impedance = 50kΩ(typ)                                                                                                                                         |
| 15<br>16<br>17<br>20                                        | TC2<br>TC1<br>BCB2<br>BCB1                                           | 4.5V        |                    | TC1,TC2 : Treble filter pin<br>Refer to P21, Figure 20, Table 4 for the input impedance.<br><br>BCB1,BCB2 : Bass filter pin<br>Refer to P20, Figure 18, Table 3 for the input impedance |
| 18<br>19                                                    | BCA2<br>BCA1                                                         | 4.5V        |                    | Bass filter pin                                                                                                                                                                         |
| 26                                                          | VCC                                                                  | 9.0V        |                    | Power supply pin.                                                                                                                                                                       |

The figure in the pin description, pin voltage and input/output equivalent circuit is reference value only. It does not guarantee the value.

| Pin No.  | Pin name   | Pin voltage | Equivalent Circuit | Pin Description                                                                                                                                                  |
|----------|------------|-------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22<br>24 | SB2<br>SB1 | 4.5V        |                    | Bass boost pin.<br>Refer to P22, Figure 22, Table 5 for the input impedance.                                                                                     |
| 23       | SR         | 4.5V        |                    | Surround pin<br>Refer to P22, Figure 22, Table 5 for the input impedance.                                                                                        |
| 27       | SCL        | —           |                    | Clock input pin of I <sup>2</sup> C-BUS communication.                                                                                                           |
| 28       | SDA        | —           |                    | Data input pin of I <sup>2</sup> C-BUS communication.                                                                                                            |
| 29       | GND        | 0V          |                    | Analog ground pin.                                                                                                                                               |
| 30       | FIL        | 4.5V        |                    | 1/2 VCC pin.<br>Reference voltage of analog signal system.<br>The simple pre-charge circuit and simple discharge circuit for an external capacitor are built-in. |

The figure in the pin description, pin voltage and input/output equivalent circuit is reference value only. It does not guarantee the value.

Cautions on use

1. Absolute Maximum Voltage Rating

When the voltage supplied to VCC is more than the absolute maximum voltage rating, circuit current increases rapidly. This will lead to characteristic deterioration and destruction of the device. Especially in a surge test of the set, when surge application is expected at VCC terminal (26pin), absolute maximum voltage rating must not be exceeded (including a operating voltage + surge ingredient (around 14V)).

2. Input Signal

a) About constant set up of input coupling capacitor

In the signal input terminal, the constant setting of input coupling capacitor C(F) be sufficient input impedance  $R_{IN}(\Omega)$  inside IC and please decide. The 1<sup>st</sup> order HPF characteristic of RC is composed.

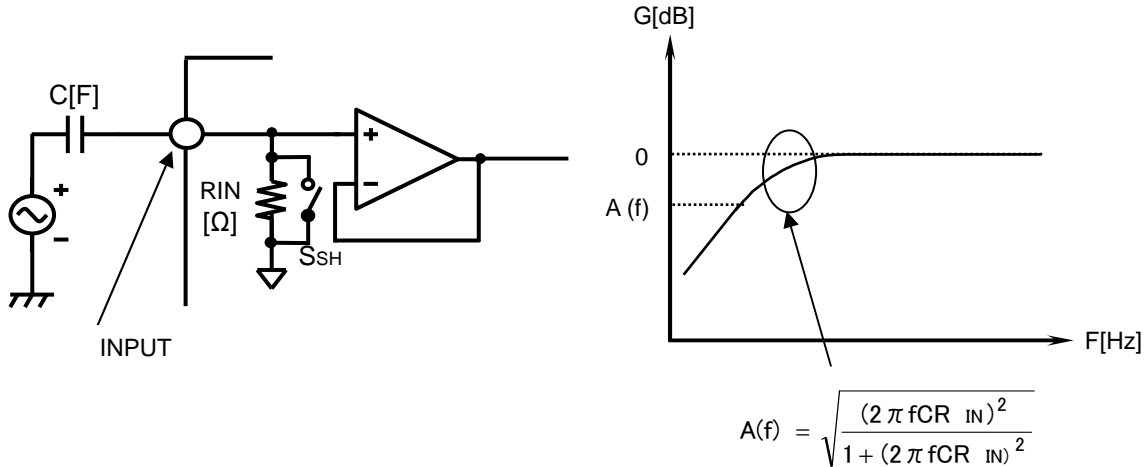


Figure 16. Input Short Circuit

b) Input Selector SHORT

SHORT mode is the command which makes input impedance of all terminals in input selector small by setting switch  $S_{SH}$  is ON. Switch  $S_{SH}$  is OFF, when SHORT command is disabled.

The charge time of an external coupling capacitor becomes short during the command.

It is recommended to use SHORT mode when there is no signal.

3. Output Load Characteristics

The usages of load for output are below (reference). Please use the load more than 10kΩ (TYP)

| Pin No. | Pin Name | Pin No. | Pin Name |
|---------|----------|---------|----------|
| 11      | SEL2     | 21      | OUT2     |
| 12      | SEL1     | 25      | OUT1     |

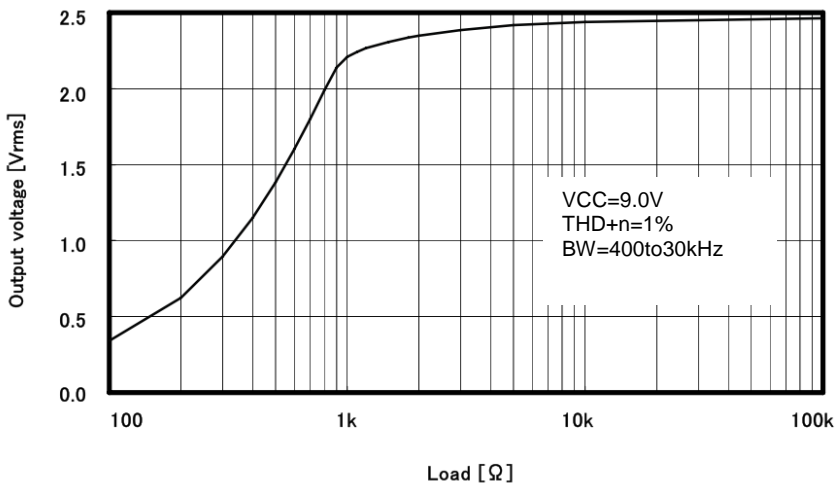


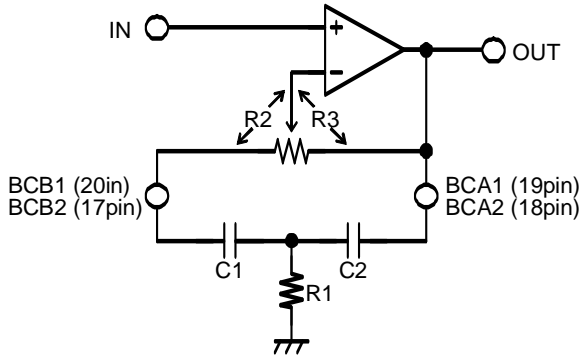
Figure 17. Output Load Characteristic (Reference Vcc=9.0V)

4. Sound Input Terminal

If this terminal is open, the input resistance is 50kΩ which may induce pop noise from the outside. If a sound input terminal is not used, it has to be connected to GND using a capacitor or set up the input selector using a microcomputer so that the unused input terminal will not be selected.

5. Bass Filter Constant Set Up

**Bass Boost**



**Bass Cut**

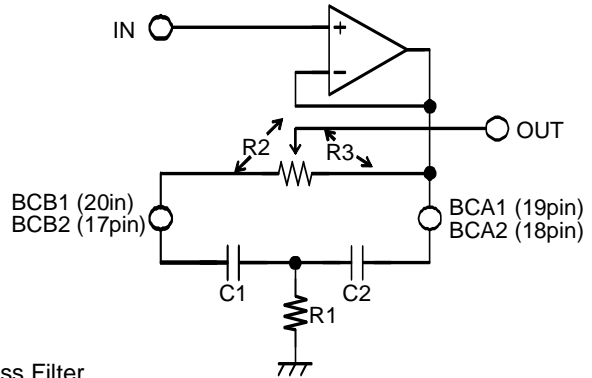


Figure 18. Bass Filter

$$f_0 = \frac{1}{2\pi\sqrt{R1(R2+R3) \cdot C1 \cdot C2}} \text{ [Hz]}$$

$$Q = \frac{\sqrt{R1(R2+R3) \cdot C1 \cdot C2}}{R1(C1+C2) + R2C1}$$

$$\text{BOOST GAIN} = 20 \log \frac{\frac{R2+R3}{R1} + \frac{C2}{C1} + 1}{\frac{R2}{R1} + \frac{C2}{C1} + 1} \text{ [dB]}$$

$$\text{CUT GAIN} = 20 \log \frac{\frac{R2}{R1} + \frac{C2}{C1} + 1}{\frac{R2+R3}{R1} + \frac{C2}{C1} + 1} \text{ [dB]}$$

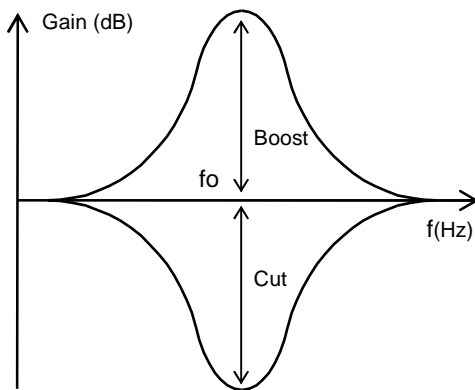


Figure 19. Bass Frequency Characteristics

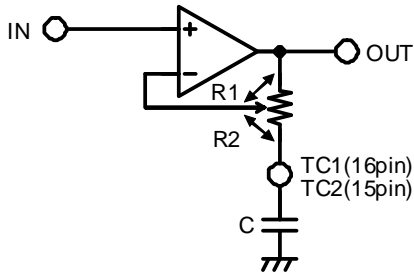
Table 3. Standard value of R2 and R3

| Bass Boost/Cut Gain | Resistance(kΩ)<br>※TYP. |      |
|---------------------|-------------------------|------|
|                     | R2                      | R3   |
| ±0dB                | 53.5                    | 0    |
| ±2dB                | 40.9                    | 12.6 |
| ±4dB                | 30.5                    | 23.0 |
| ±6dB                | 22.3                    | 31.2 |
| ±8dB                | 15.8                    | 37.7 |
| ±10dB               | 10.6                    | 42.9 |
| ±12dB               | 6.5                     | 47.0 |
| ±14dB               | 3.2                     | 50.3 |

Actual boost/cut value may vary slightly .

6. Treble Filter Constant Set Up

**Treble Boost**



**Treble Cut**

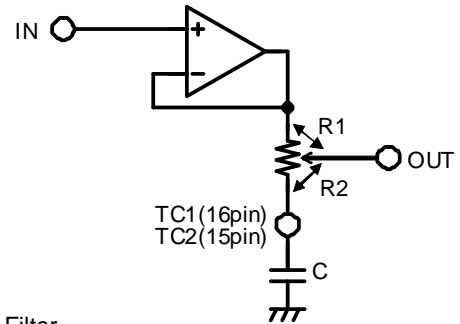


Figure 20. Treble Filter

$$f_c = \frac{1}{2\pi R_2 \cdot C} \text{ [Hz]}$$

$$\text{BOOST GAIN} = 20 \log \frac{R_1 + R_2 + Z_C}{R_2 + Z_C} \text{ [dB]}$$

$$\text{CUT GAIN} = 20 \log \frac{R_2 + Z_C}{R_1 + R_2 + Z_C} \text{ [dB]}$$

$$Z_C = \frac{1}{j\omega C} \text{ [\Omega]}$$

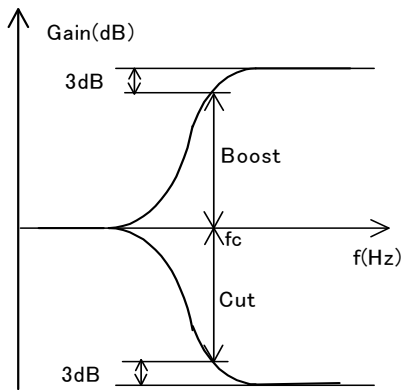


Figure 21. Treble Frequency Characteristics

Table 4. Standard value of R1 and R2(reference)

| Treble Boost/Cut Gain | Resistance(kΩ)<br>※TYP. |      |
|-----------------------|-------------------------|------|
|                       | R1                      | R2   |
| ±0dB                  | 0                       | 29.1 |
| ±2dB                  | 6.1                     | 23.0 |
| ±4dB                  | 10.9                    | 18.2 |
| ±6dB                  | 14.8                    | 14.3 |
| ±8dB                  | 17.9                    | 11.2 |
| ±10dB                 | 20.5                    | 8.6  |
| ±12dB                 | 22.6                    | 6.5  |
| ±14dB                 | 24.4                    | 4.7  |

Actual boost/cut value may vary slightly

7. BassBoost Application

7-1. BassBoost Application Circuit

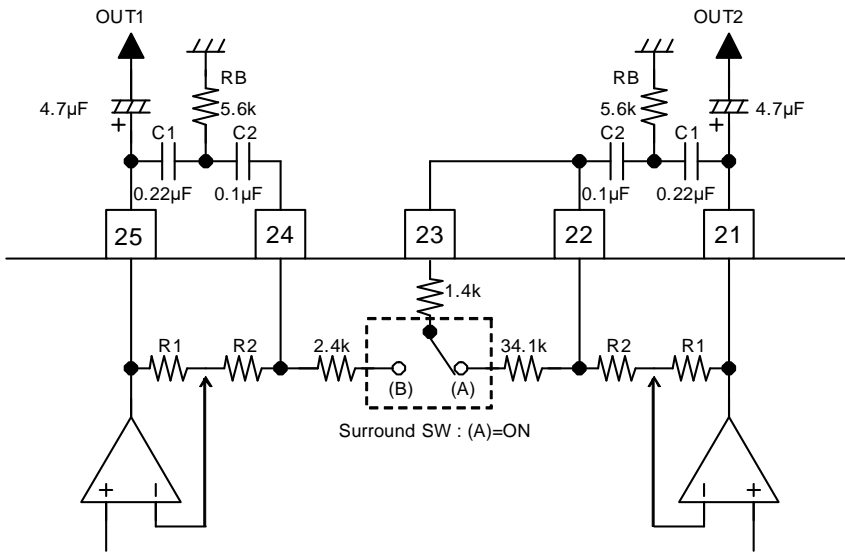


Table 5. Standard value of R1 and R2

| Surround Gain | R1[kΩ] | R2[kΩ] |
|---------------|--------|--------|
| OFF           | 0      | 84.5   |
| Low           | 44.8   | 39.7   |
| Middle        | 70.0   | 14.5   |
| High          | 84.2   | 0.3    |

Figure 22. Example of a BassBoost Application Circuit

7-2. The computation formula and the BassBoost Gain Characteristic Curve (fo=50Hz, Q=1.8(Surround Gain=High))

$$\text{Gain} = 20 \log \frac{\frac{R1 + R2}{RB} + \frac{C1}{C2} + 1}{\frac{R2}{RB} + \frac{C1}{C2} + 1} \text{ [dB]}$$

$$f_o = \frac{1}{2\pi \sqrt{RB(R1 + R2) \cdot C1 \cdot C2}} \text{ [Hz]}$$

$$Q = \frac{\sqrt{RB(R1 + R2) \cdot C1 \cdot C2}}{RB(C1 + C2) + R2 \cdot C2}$$

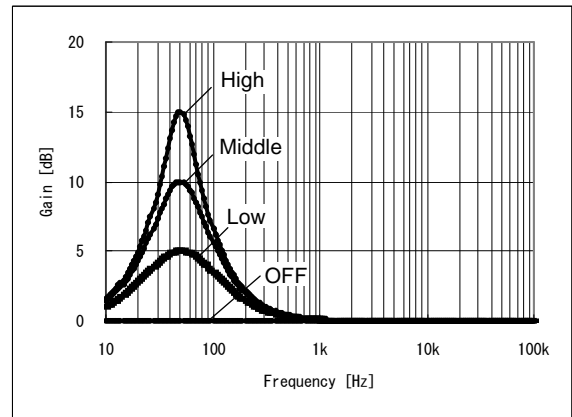


Figure 23. BassBoost Gain Characteristic Curve

7-3. The Characteristic Curve in fixed number change

Table 6. The fixed number example (\*1)

| No. | The specification           | C1 [µF] | C2 [µF] | RB [kΩ] |
|-----|-----------------------------|---------|---------|---------|
| ①   | fo=60Hz, Q=1.8, Gain=16.8dB | 0.15    | 0.1     | 5.6     |
| ②   | fo=72Hz, Q=1.7, Gain=15.0dB | 0.15    | 0.068   | 5.6     |
| ③   | fo=79Hz, Q=1.9, Gain=16.2dB | 0.15    | 0.068   | 4.7     |
| ④   | fo=89Hz, Q=1.8, Gain=16.9dB | 0.1     | 0.068   | 5.6     |

(\*1): Surround Gain=High

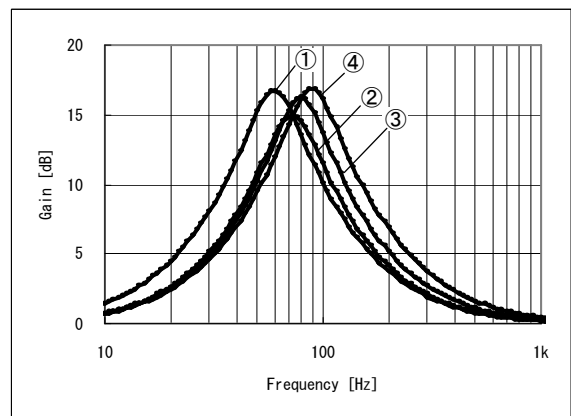
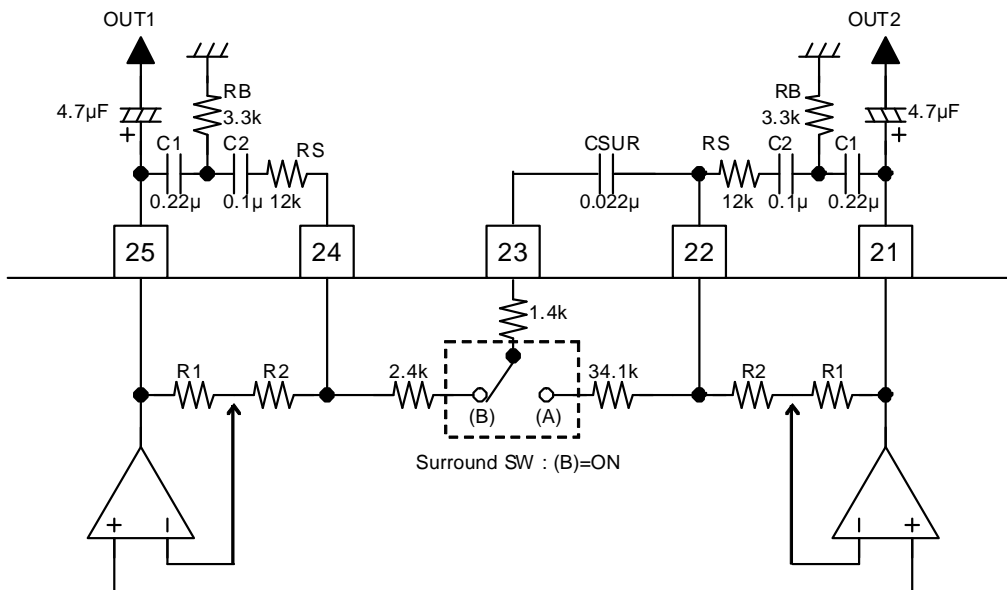


Figure 24. BassBoost Gain Characteristic Curve in fixed number change

8. BassBoost & Surround Application

8-1. BassBoost & Surround Application Circuit

In this application circuit example, it isn't possible to do the use only of Surround. Also, Surround Gain depends on the setting value of BassBoost Gain.



Refer to Table 5 for R1 and R2 standard values.

Figure 25. Example of BassBoost & Surround Application Circuit

8-2. BassBoost & Surround Characteristic Curve and the computation formula of BassBoost Gain(Surround SW : (A)=ON)

$$\text{Gain} = 20 \log \frac{\frac{R1 + R2 + RS}{RB} + \frac{C1}{C2} + 1}{\frac{R2 + RS}{RB} + \frac{C1}{C2} + 1} \text{ [dB]}$$

$$f_o = \frac{1}{2 \pi \sqrt{RB(R1 + R2 + RS) \cdot C1 \cdot C2}} \text{ [Hz]}$$

$$Q = \frac{\sqrt{RB(R1 + R2 + RS) \cdot C1 \cdot C2}}{RB(C1 + C2) + C2(R2 + RS)}$$

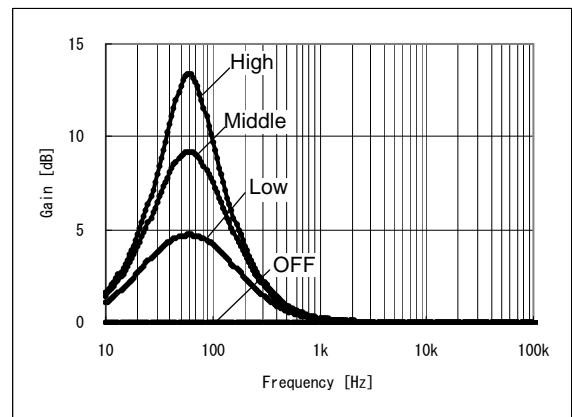


Figure 26. BassBoost & Surround Characteristic Curve(Surround SW : (A)=ON)

8-3. BassBoost & Surround Characteristic Curve(Surround SW : (B)=ON)

In this application circuit example, it isn't possible to do the use only of Surround. Also, Surround Gain depends on the setting value of BassBoost Gain.

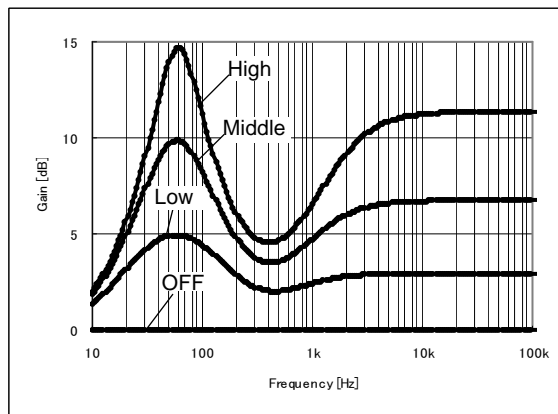


Figure 27. BassBoost & Surround Characteristic Curve(Surround SW : (B)=ON)



9. Easy Surround Application

9. Easy Surround Application Circuit

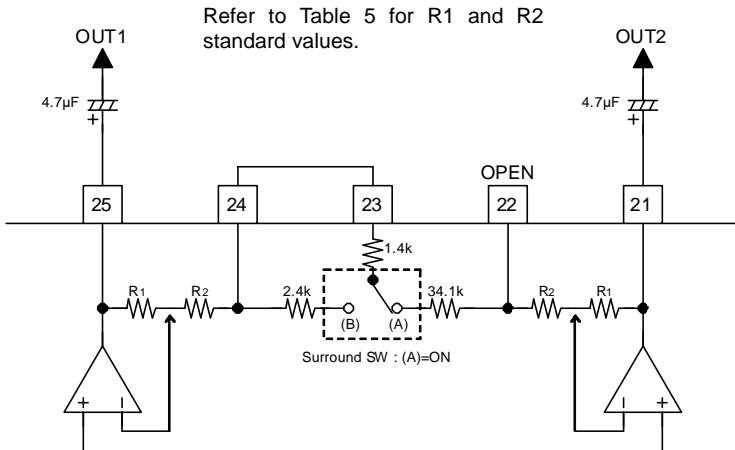


Figure 28. Example of Easy Surround Application Circuit

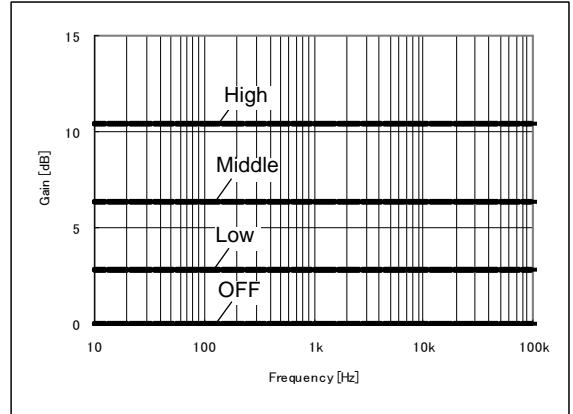
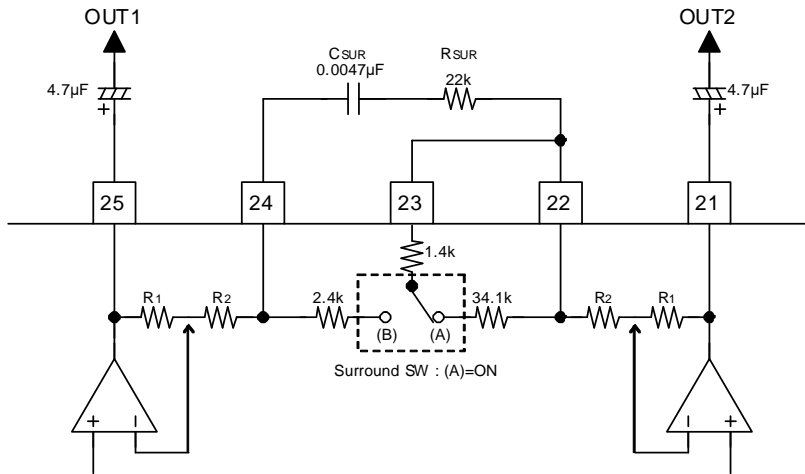


Figure 29. Easy Surround Characteristic Curve

10. Surround Application

10-1. Surround Application Circuit



Refer to Table 5 for R1 and R2 standard values.

Figure 30. Example of Surround Application Circuit

10-2. Surround Characteristic Curve

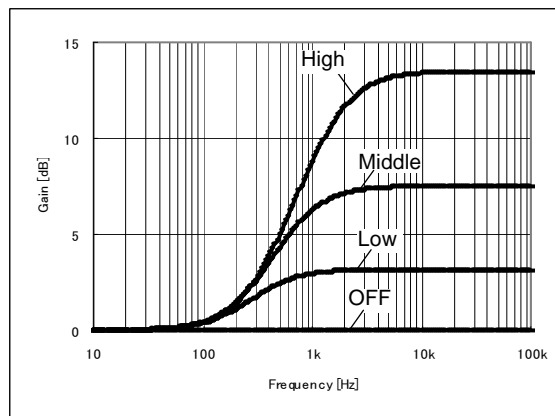
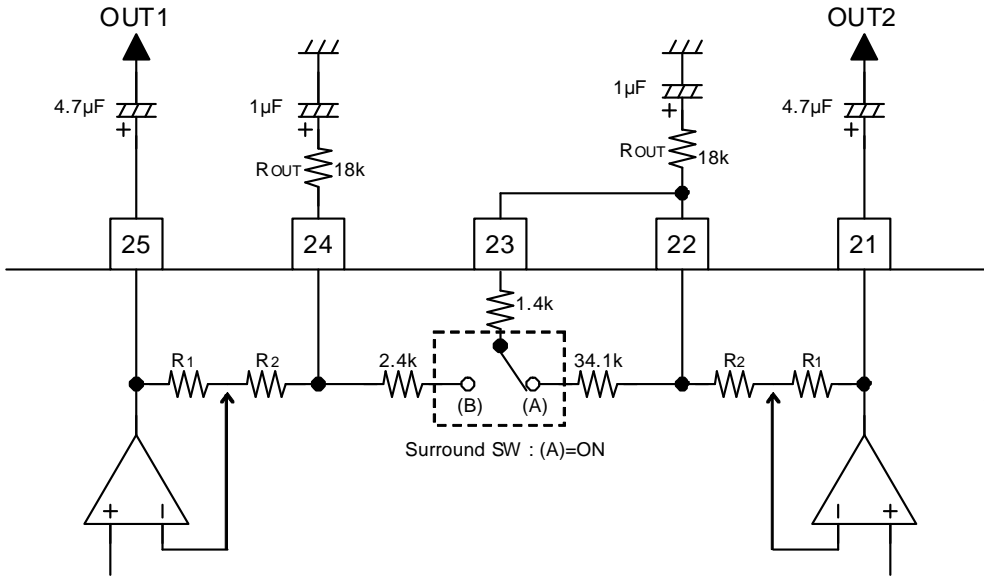


Figure 31. Surround Characteristic Curve

11. Output Gain Application

11-1. Output Gain Application Circuit



Refer to Table 5 for R1 and R2 standard values.

Figure 32. Example of Output Gain Application Circuit

11-2. The computation formula and the Output Gain Characteristic Curve

$$\text{Gain} = 20 \log \frac{R1 + R2 + R_{OUT}}{R2 + R_{OUT}} \text{ [dB]}$$

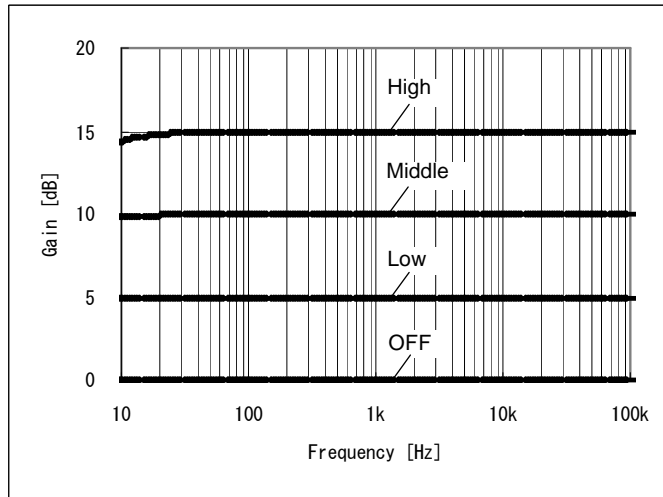


Figure 33. Output Gain Characteristic Curve

12. Easy 3 Band Application

12-1. Easy 3 Band Application Circuit

- Easy 3 band is formed using BassBoost, Bass and Treble.
- Use BassBoost for Bass band, Bass for Middle band and Treble for Treble band.
- The Middle band and Treble band Gain ranges from -14dB to 14dB with 2dB step while Bass band have four Gain settings (OFF/Low/Middle/High).
- At the addition function unused time, it is Surround Gain=OFF, Surround SW : Use in (A)=ON.
- Surround SW : Be careful because it damages output (25pin, 21pin) short-circuiting next, a characteristic when having made (B)=ON.

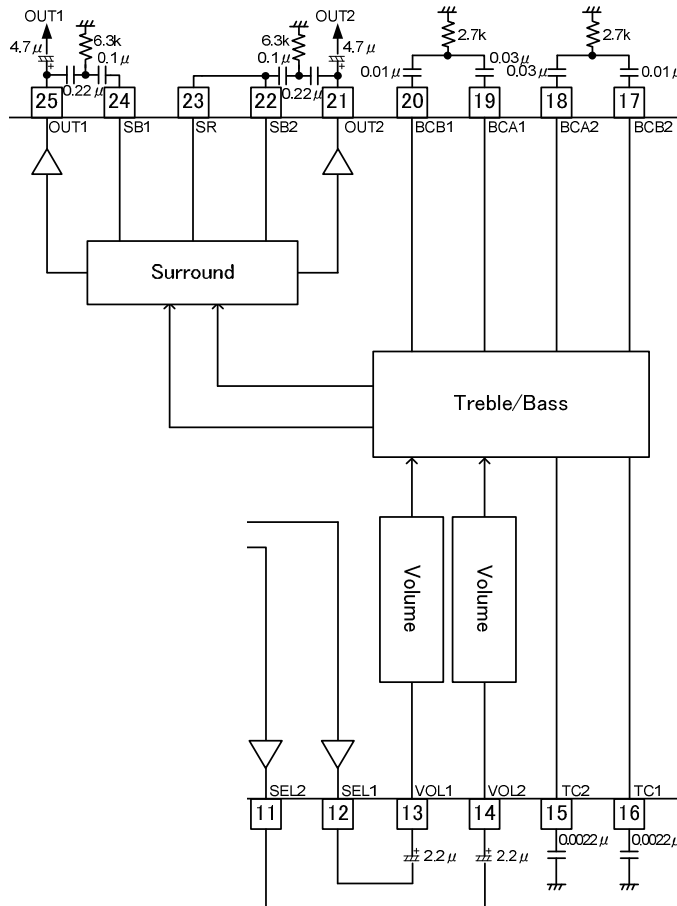


Figure 34. Example of Easy 3 band Application Circuit

6-2. Easy 3 Band Characteristic Curve

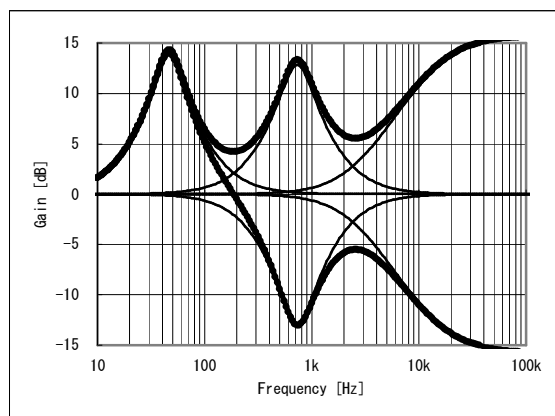


Figure 35. Easy 3 Band Characteristic Curve

13. Application Circuit example when added function is not used

- When the added function is unused, Surround Gain=OFF, Surround SW : (A)=ON.
- Surround SW : Caution must be taken when set to (B)=ON. In this condition, the outputs are shorted(25pin, 21pin) and will degrade the electrical characteristics of the chip.

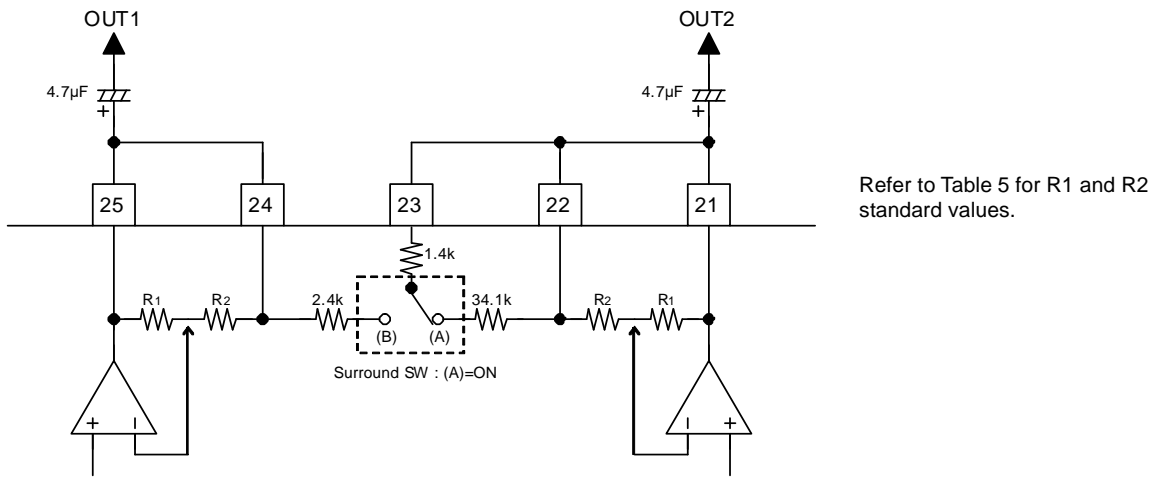


Figure 36. Example of addition function unused time Application Circuit

14. INPUT SHORT Function Application Circuit

- The INPUT SHORT function makes input impedance RIN small in the switch control and causes fast charging in the external coupling capacitance.
- The input terminal DC bias voltage can be changed to its regular condition (1/2VCC) by enabling this function (I<sup>2</sup>C-BUS setting : Select Address=04(hex),Data=05(hex)) immediately after start-up.
- INPUT SHORT function has to be used whenever there is no input at the input terminals.

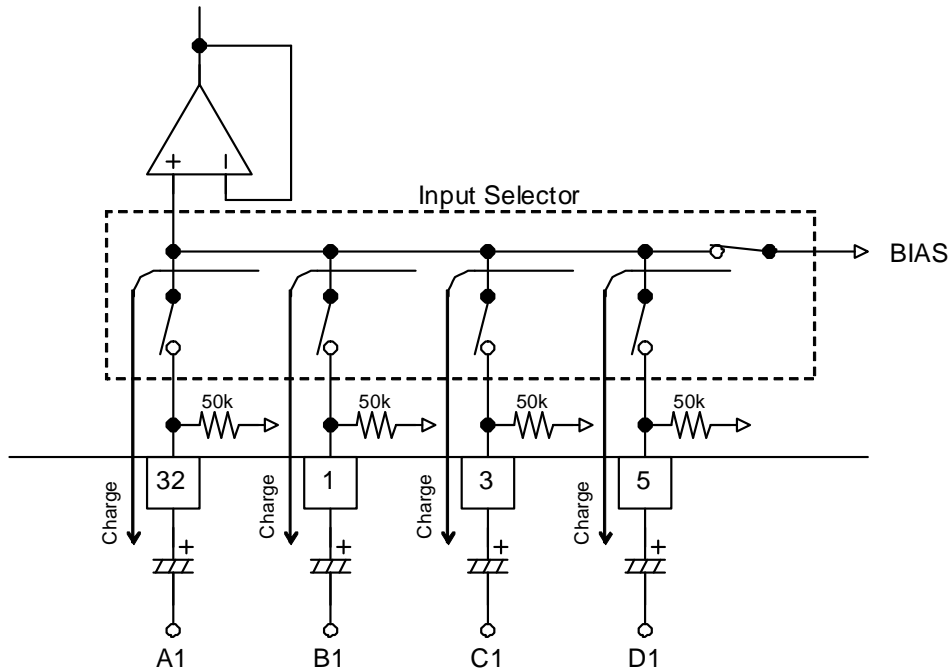


Figure 37. INPUT SHORT mode in Ch1

15. Microphone Input Application

- Outside sound signal can be added to VOL1(13pin) and VOL2(14pin) since its input impedance is constant (50kΩ). Even if the volume attenuation setting changes, it can still be used as the microphone input terminal.
- Due to the added resistor at VOL1 and VOL2 terminal, the signal level of this terminals (VOL1, VOL2) is determined by its resistance value and acts as signal level VOLUME.

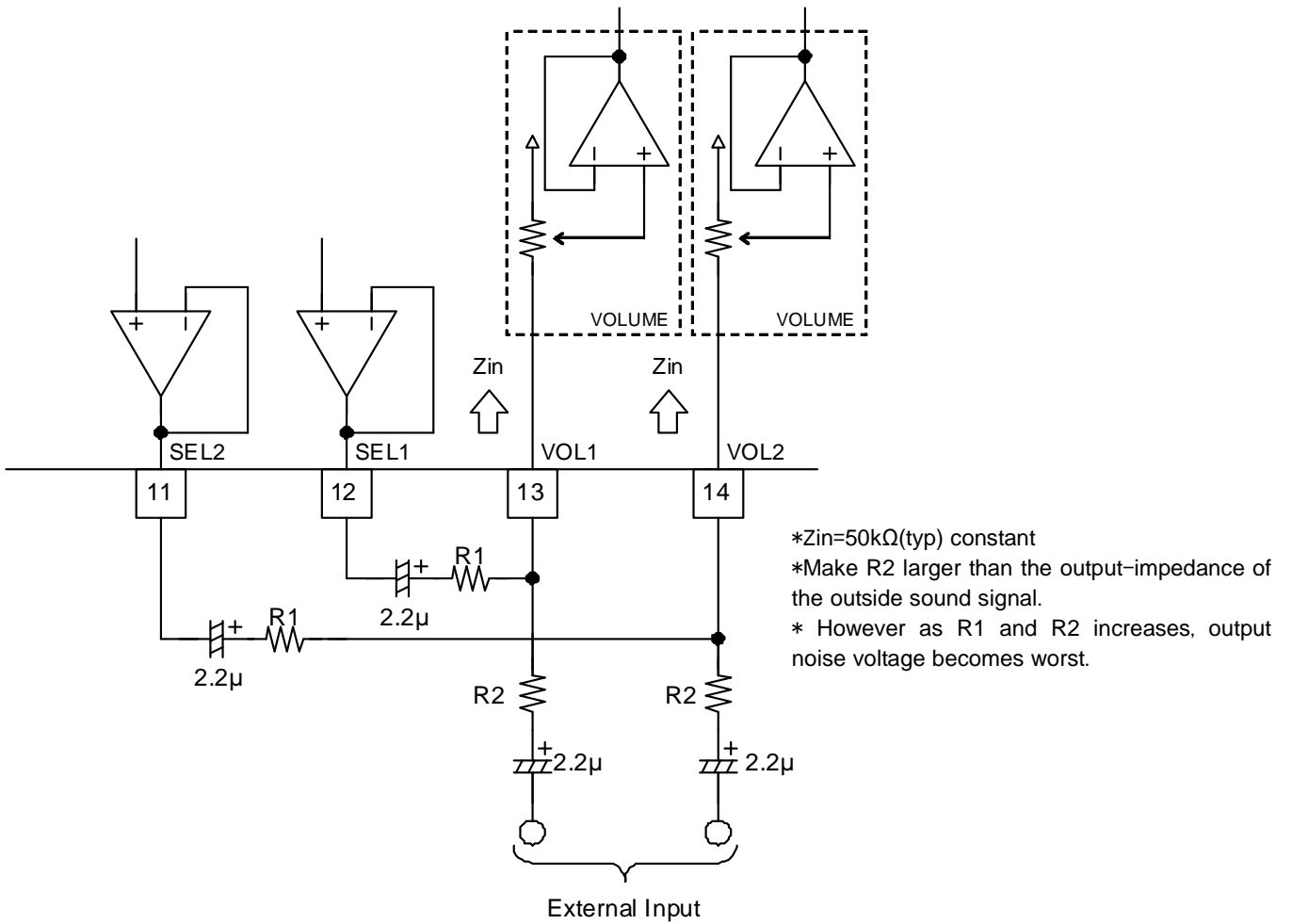
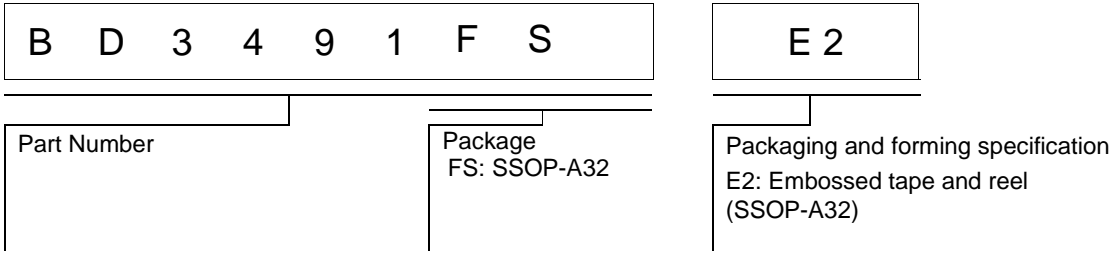


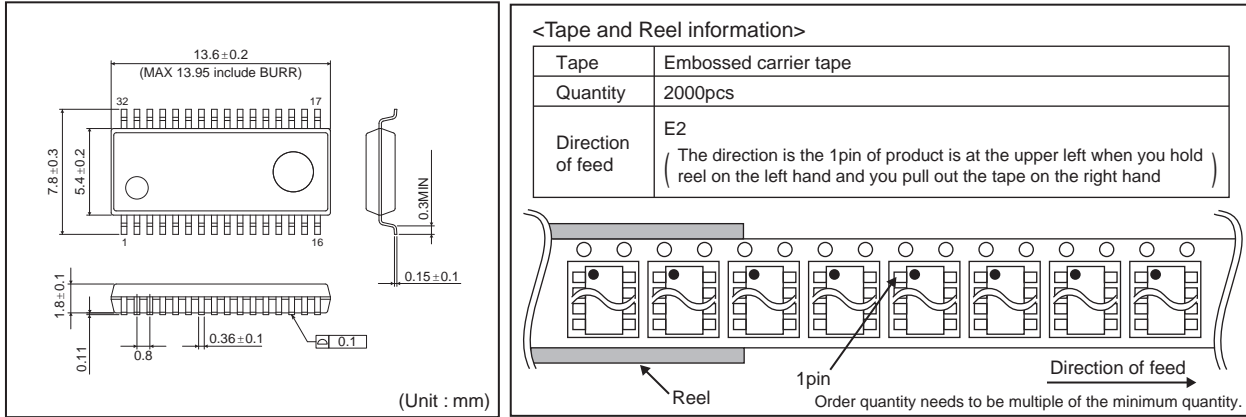
Figure 38. Example of microphone input Application Circuit

Ordering Information

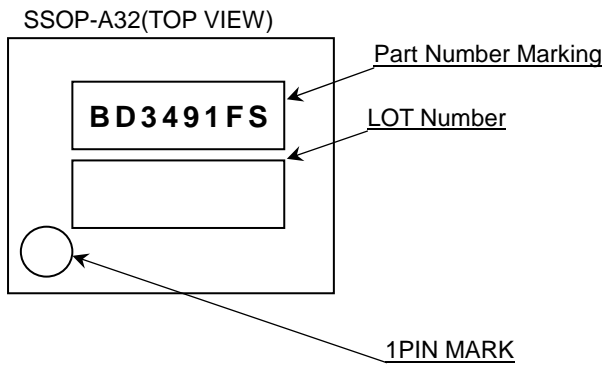


Physical Dimension: Tape and Reel Information

SSOP-A32



Marking Diagram(TOP VIEW)



## Revision history

| Date        | Revision | Changes     |
|-------------|----------|-------------|
| 08.FEB.2013 | 001      | New Release |

| Date       | Revision | Changes                 |
|------------|----------|-------------------------|
| 5.Dec.2013 | 002      | All page, format update |
| 5.Dec.2013 | 002      | Minor correction        |

| Date        | Revision | Changes                                                                        |
|-------------|----------|--------------------------------------------------------------------------------|
| 28.FEB.2014 | 003      | Correct figure, Application Circuit Diagram, Pin Configuration, Block Diagram. |
| 28.FEB.2014 | 003      | Correct CONTROL SIGNAL SPECIFICATION, Slave address, initial condition.        |
| 28.FEB.2014 | 003      | Correct Thermal resistance and Power Dissipation.                              |
| 28.FEB.2014 | 003      | Minor correction                                                               |

| Date       | Revision | Changes                                                 |
|------------|----------|---------------------------------------------------------|
| 1.APR.2014 | 004      | Comment about Prohibition in I <sup>2</sup> C-data add. |
| 1.APR.2014 | 004      | Minor correction                                        |

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|-----------|-----------|------------|-----------|
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