Technical Note

Sound Processor Series for Car Audio

# Sound Processor with Built-in 3-band Equalizer

**BD37524FS**

No.10085EAT05

## ●Description

BD37524FS is sound processors built-in 3-band equalizer for car audio. The functions are stereo 5ch input selector, input-gain control, main volume, loudness, 5ch fader volume, LPF for subwoofer, level meter. Moreover, "Advanced switch circuit", that is ROHM original technology, can reduce various switching noise (ex. No-signal, low frequency likes 20Hz & large signal inputs). "Advanced switch" makes control of microcomputer easier, and can construct high quality car audio system.

## ●Features

1) Reduce switching noise of input gain control, mute, main volume, fader volume, bass, treble, loudness by using advanced switch circuit [Possible to control all steps]
2) Built-in 1 differential input selector and 4 single-ended input selectors
3) Built-in ground isolation amplifier inputs, ideal for external stereo input.
4) Built-in input gain controller reduces switching noise for volume of a portable audio input.
5) Decrease the number of external components by built-in 3-band equalizer filter, LPF for subwoofer, loudness filter. And, possible to control Q, Gv, fo of 3-band equalizer and fc of LPF, fo, Gv of loudness by $I^2C$ BUS control freely
6) It is possible for the bass, middle, and treble to the gain adjustment quantity of ±20dB and 1 dB step gain adjustment.
7) Terminals for the subwoofer outputs are equipped.
8) Bi-CMOS process is suitable for the design of low current and low energy. And it provides more quality for small scale regulator and heat in a set.
9) Package is SSOP-A24. Putting input-terminals together and output-terminals together can make PCB layout easier and can makes area of PCB smaller.
10) It is possible to control by 3.3V / 5V for $I^2C$ BUS.

## ●Applications

It is the optimal for the car audio. Besides, it is possible to use for the audio equipment of mini Compo, micro Compo, TV etc with all kinds.

## ●Line up matrix

| Function | Specifications |
|---|---|
| Input selector | ・Stereo 4 input<br>・Differential 1 input |
| Input gain | ・0～20dB（1dB step）<br>・Possible to use “Advanced switch” for prevention of switching noise. |
| Mute | ・Possible to use “Advanced switch” for prevention of switching noise. |
| Volume | ・+15dB～-79dB（1dB step）, -∞<br>・Possible to use “Advanced switch” for prevention of switching noise. |
| Bass | ・-20～+20dB（1dB step）<br>・Q=0.5, 1, 1.5, 2 variable<br>・fo=60, 80, 100, 120Hz<br>・Possible to use “Advanced switch” at changing gain |
| Middle | ・-20～+20dB（1dB step）<br>・Q=0.75, 1, 1.25, 1.5 variable<br>・fo=500, 1k, 1.5k, 2.5kHz variable<br>・Possible to use “Advanced switch” at changing gain |
| Treble | ・-20～+20dB（1dB step）<br>・Q=0.75, 1.25 variable<br>・fo=7.5k, 10k, 12.5k, 15kHz variable<br>・Possible to use “Advanced switch” at changing gain |
| Fader | ・+15dB～-79dB(1dB step), -∞dB<br>・Possible to use “Advanced switch” for prevention of switching noise. |
| Loudness | ・0dB～20dB(1dB step)<br>・fo=250/400/800Hz<br>・Possible to use “Advanced switch” for prevention of switching noise. |
| LPF | ・fc=55/85/120/160Hz, pass<br>・Phase shift (0°/180°) |
| Level meter | ・I2C BUS control<br>・DC Output |

## ●Absolute maximum ratings (Ta=25℃)

| Item | Symbol | Rating | Unit |
|---|---|---|---|
| Power supply Voltage | VCC | 10.0 | V |
| Input voltage | Vin | VCC+0.3～GND-0.3 | V |
| Power Dissipation | Pd | 1000 ※1 | mW |
| Storage Temperature | Tastg | -55～+150 | ℃ |

※This value decreases 8mW/℃ for Ta=25℃ or more.
ROHM standard board shall be mounted.
Thermal resistance θja = 125(℃/W)
ROHM Standard board
Size：70×70×1.6(㎣)
Material：A FR4 grass epoxy board(3% or less of copper foil area)

## ●Operating conditions

| Item | Symbol | MIN | TYP | MAX | Unit |
|---|---|---|---|---|---|
| Power supply Voltage | VCC | 7.0 | ─ | 9.5 | V |
| Temperature | Topr | -40 | ─ | +85 | ℃ |

## ●Electrical characteristics

(Unless specified particularly, Ta=25℃, VCC=8.5V, f=1kHz, Vin=1Vrms, Rg=600Ω, $R_L$=10kΩ, A1 input, Input gain 0dB, Mute off, Volume 0dB, Tone control 0dB, Loudness 0dB, LPF OFF, Fader 0dB)

| BLOCK | Item | Symbol | Limit Min. | Limit Typ. | Limit Max. | Unit | Condition |
|---|---|---|---|---|---|---|---|
| GENERAL | Current upon no signal | $I_Q$ | — | 38 | 48 | mA | No signal |
| | Voltage gain | $G_V$ | -1.5 | 0 | 1.5 | dB | Gv=20log(VOUT/VIN) |
| | Channel balance | CB | -1.5 | 0 | 1.5 | dB | CB = GV1-GV2 |
| | Total harmonic distortion 1 (FRONT,REAR) | THD+N1 | — | 0.001 | 0.05 | % | VOUT=1Vrms BW=400-30KHz |
| | Total harmonic distortion 2 (SUBWOOFER) | THD+N2 | — | 0.002 | 0.05 | % | VOUT=1Vrms BW=400-30KHz |
| | Output noise voltage 1 (FRONT,REAR) ∗ | $V_{NO1}$ | — | 3.8 | 15 | μVrms | Rg = 0Ω BW = IHF-A |
| | Output noise voltage 2 (SUBWOOFER) ∗ | $V_{NO2}$ | — | 4.8 | 15 | μVrms | Rg = 0Ω BW = IHF-A |
| | Residual output noise voltage ∗ | $V_{NOR}$ | — | 1.8 | 10 | μVrms | Fader = -∞dB Rg = 0Ω BW = IHF-A |
| | Cross-talk between channels ∗ | CTC | — | -100 | -90 | dB | Rg = 0Ω CTC=20log(VOUT/VIN) BW = IHF-A |
| | Ripple rejection | RR | — | -70 | -40 | dB | f=1kHz VRR=100mVrms RR=20log(VCC IN/VOUT) |
| INPUT SELECTOR | Input impedance(A, B) | $R_{IN\_S}$ | 70 | 100 | 130 | kΩ | |
| | Input impedance (C,D,E) | $R_{IN\_D}$ | 175 | 250 | 325 | kΩ | |
| | Maximum input voltage | $V_{IM}$ | 2.1 | 2.3 | — | Vrms | VIM at THD+N(VOUT)=1% BW=400-30KHz |
| | Cross-talk between selectors ∗ | CTS | — | -100 | -90 | dB | Rg = 0Ω CTS=20log(VOUT/VIN) BW = IHF-A |
| | Common mode rejection ratio ∗ | CMRR | 50 | 65 | — | dB | CP1 and CN input CP2 and CN input CMRR=20log(VIN/VOUT) BW = IHF-A |
| INPUT GAIN | Minimum input gain | $G_{IN\ MIN}$ | -2 | 0 | +2 | dB | Input gain 0dB VIN=100mVrms Gin=20log(VOUT/VIN) |
| | Maximum input gain | $G_{IN\ MAX}$ | 18 | 20 | 22 | dB | Input gain 20dB VIN=100mVrms Gin=20log(VOUT/VIN) |
| | Gain set error | $G_{IN\ ERR}$ | -2 | 0 | +2 | dB | GAIN=+20～+1dB |
| MUTE | Mute attenuation ∗ | $G_{MUTE}$ | — | -105 | -85 | dB | Mute ON Gmute=20log(VOUT/VIN) BW = IHF-A |
| VOLUME | Maximum gain | $G_{V\ MAX}$ | 13 | 15 | 17 | dB | Volume = 15dB VIN=100mVrms Gv=20log(VOUT/VIN) |
| | Maximum attenuation ∗ | $G_{V\ MIN}$ | — | -100 | -85 | dB | Volume = -∞dB Gv=20log(VOUT/VIN) BW = IHF-A |
| | Attenuation set error 1 | $G_{V\ ERR1}$ | -2 | 0 | 2 | dB | GAIN & ATT=+15dB～-15dB |
| | Attenuation set error 2 | $G_{V\ ERR2}$ | -3 | 0 | 3 | dB | ATT=-16dB～-47dB |
| | Attenuation set error 3 | $G_{V\ ERR3}$ | -4 | 0 | 4 | dB | ATT=-48dB～-79dB |

| BLOCK | Item | Symbol | Limit Min. | Limit Typ. | Limit Max. | Unit | Condition |
|---|---|---|---|---|---|---|---|
| BASS | Maximum boost gain | $G_{B\ BST}$ | 18 | 20 | 22 | dB | Gain=+20dB f=100Hz<br>VIN=100mVrms<br>$G_B$=20log (VOUT/VIN) |
| BASS | Maximum cut gain | $G_{B\ CUT}$ | -22 | -20 | -18 | dB | Gain=-20dB f=100Hz<br>VIN=2Vrms<br>$G_B$=20log (VOUT/VIN) |
| BASS | Gain set error | $G_{B\ ERR}$ | -2 | 0 | 2 | dB | Gain=-20～+20dB f=100Hz |
| MIDDLE | Maximum boost gain | $G_{M\ BST}$ | 18 | 20 | 22 | dB | Gain=+20dB f=1kHz<br>VIN=100mVrms<br>$G_M$=20log (VOUT/VIN) |
| MIDDLE | Maximum cut gain | $G_{M\ CUT}$ | -22 | -20 | -18 | dB | Gain=-20dB f=1kHz<br>VIN=2Vrms<br>$G_M$=20log (VOUT/VIN) |
| MIDDLE | Gain set error | $G_{M\ ERR}$ | -2 | 0 | 2 | dB | Gain=-20～+20dB f=1kHz |
| TREBLE | Maximum boost gain | $G_{T\ BST}$ | 17 | 20 | 23 | dB | Gain=+20dB f=10kHz<br>VIN=100mVrms<br>$G_T$=20log (VOUT/VIN) |
| TREBLE | Maximum cut gain | $G_{T\ CUT}$ | -23 | -20 | -17 | dB | Gain=-20dB f=10kHz<br>VIN=2Vrms<br>$G_T$=20log (VOUT/VIN) |
| TREBLE | Gain set error | $G_{T\ ERR}$ | -2 | 0 | 2 | dB | Gain=-20～+20dB f=10kHz |
| FADER / SUBWOOFER | Maximum boost gain | $G_{F\ BST}$ | 13 | 15 | 17 | dB | Fader=15dB<br>$V_{IN}$=100mVrms<br>$G_F$=20log(VOUT/VIN) |
| FADER / SUBWOOFER | Maximum attenuation＊ | $G_{F\ MIN}$ | ― | -100 | -90 | dB | Fader = -∞dB<br>$G_F$=20log(VOUT/VIN)<br>BW = IHF-A |
| FADER / SUBWOOFER | Gain set error | $G_{F\ ERR}$ | -2 | 0 | 2 | dB | Gain=+1～+15dB |
| FADER / SUBWOOFER | Attenuation set error 1 | $G_{F\ ERR1}$ | -2 | 0 | 2 | dB | ATT=-1～-15dB |
| FADER / SUBWOOFER | Attenuation set error 2 | $G_{F\ ERR2}$ | -3 | 0 | 3 | dB | ATT=-16～-47dB |
| FADER / SUBWOOFER | Attenuation set error 3 | $G_{F\ ERR3}$ | -4 | 0 | 4 | dB | ATT=-48～-79dB |
| FADER / SUBWOOFER | Output impedance | $R_{OUT}$ | - | ― | 50 | Ω | VIN=100mVrms |
| FADER / SUBWOOFER | Maximum output voltage | $V_{OM}$ | 2 | 2.2 | ― | Vrms | THD+N=1%<br>BW=400-30KHz |
| LOUDNESS | Maximum gain | $G_{L\ MAX}$ | 17 | 20 | 23 | dB | Gain 20dB<br>VIN=100mVrms<br>$G_L$=20log(VOUT/VIN) |
| LOUDNESS | Gain set error | $G_{L\ ERR}$ | -2 | 0 | 2 | dB | GAIN=+20～+1dB |
| Level meter | Maximum output voltage | $V_{L\ MAX}$ | 2.8 | 3.1 | 3.5 | V | |
| Level meter | Output offset voltage | $V_{L\ OFF}$ | ― | 0 | 100 | mV | |

VP-9690A(Average value detection, effective value display) filter by Matsushita Communication is used for ＊ measurement.
Phase between input / output is same.

## ●Electrical characteristic curves (Reference data)

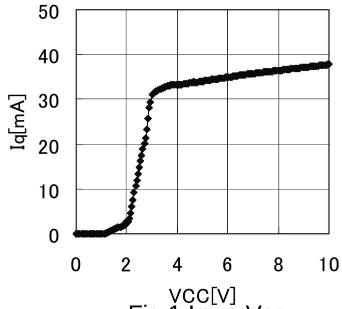


Fig.1 Iq vs Vcc

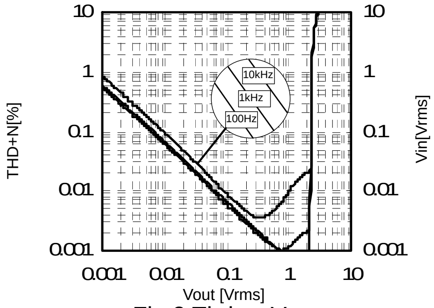


Fig.2 Thd vs Vo

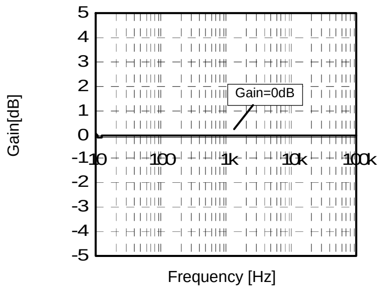


Fig.3 Gain vs Freq

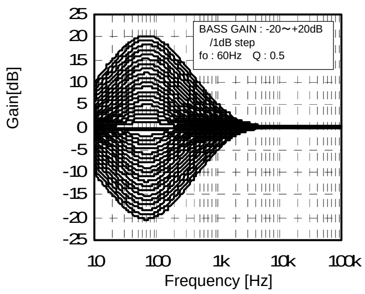


Fig.4 Bass Gain vs Freq

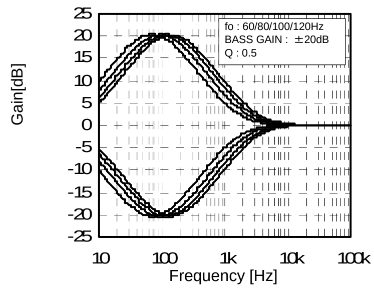


Fig.5 Bass fo vs Freq

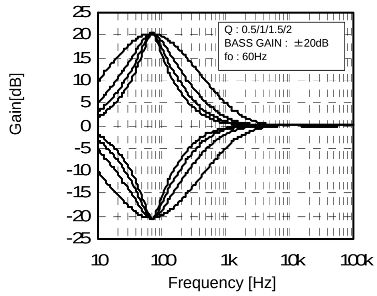


Fig.6 Bass Q vs Freq

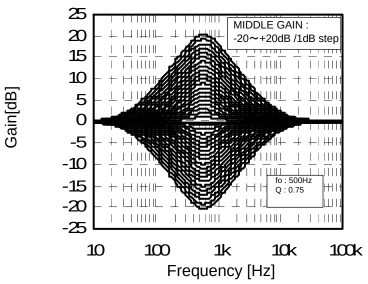


Fig.7 Middle Gain vs Freq

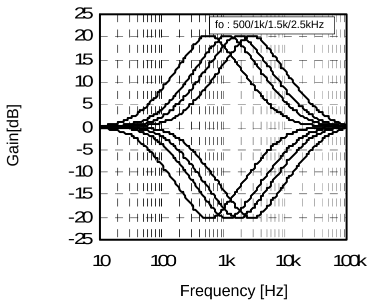


Fig.8 Middle fo vs Freq

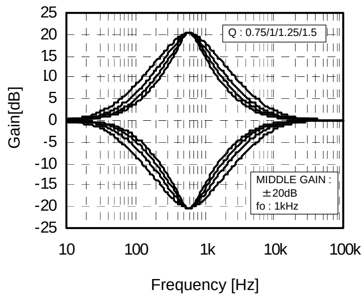


Fig.9 Middle Q vs Freq

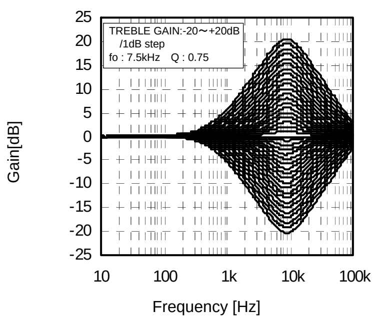


Fig.10 Treble Gain vs Freq

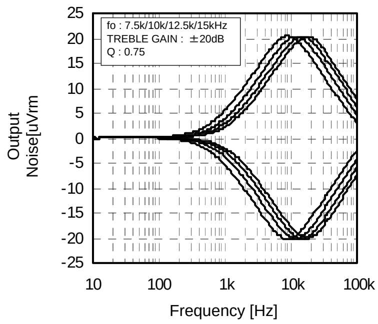


Fig.11 Treble fo vs Freq

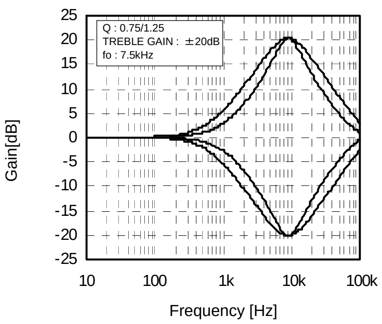


Fig.12 Treble Q vs Freq

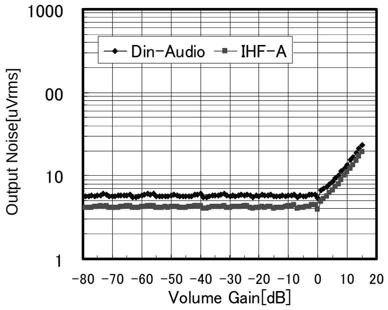



Fig.13 Volume Gain vs Noise

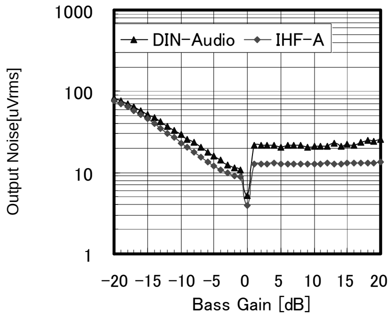



Fig.14 Bass Gain vs Noise

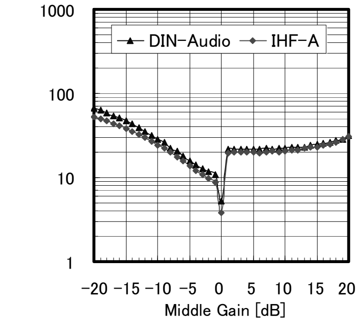



Fig.15 Middle Gain vs Noise

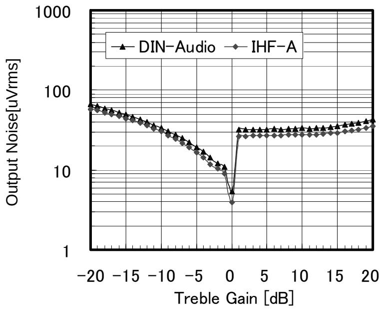



Fig.16 Treble Gain vs Noise

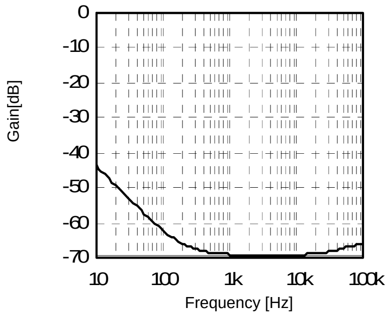



Fig.17 CMRR vs Freq

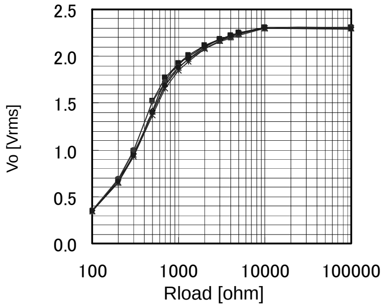



Fig.18 Rload vs Vo

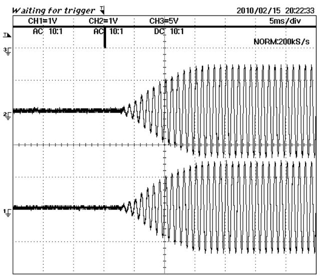



Fig.19 Advanced Switch 1

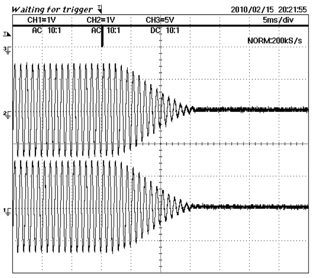



Fig.20 Advanced Switch 2

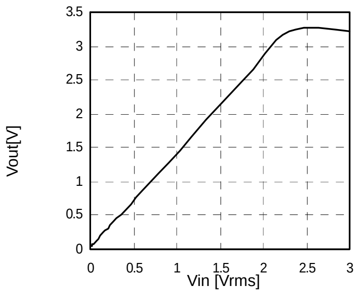



Fig.21 Level Meter Vin vs Vo

## ●Block diagram and pin configuration

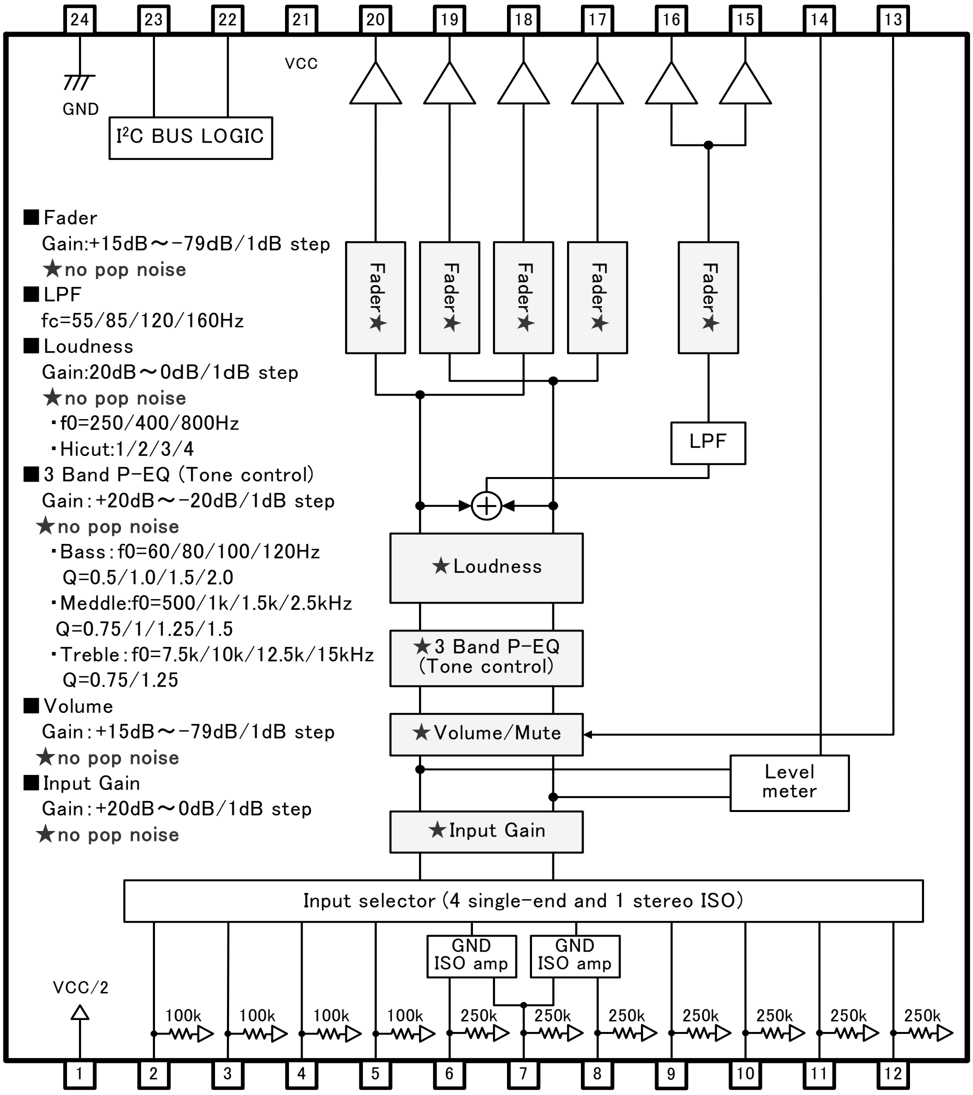



Fig.22 BD37524FS

**Descriptions of terminal**

| Terminal No. | Terminal Name | Description | Terminal No. | Terminal Name | Description |
|---|---|---|---|---|---|
| 1 | FIL | VCC/2 terminal | 13 | MUTE | External compulsory mute terminal |
| 2 | A1 | A input terminal of 1ch | 14 | LOUT | Output terminal for Level meter |
| 3 | A2 | A input terminal of 2ch | 15 | OUTS2 | Subwoofer output terminal of 2ch |
| 4 | B1 | B input terminal of 1ch | 16 | OUTS1 | Subwoofer output terminal of 1ch |
| 5 | B2 | B input terminal of 2ch | 17 | OUTR2 | Rear output terminal of 2ch |
| 6 | CP1 | C positive input terminal of 1ch | 18 | OUTR1 | Rear output terminal of 1ch |
| 7 | CN | C negative input terminal | 19 | OUTF2 | Front output terminal of 2ch |
| 8 | CP2 | C positive input terminal of 2ch | 20 | OUTF1 | Front output terminal of 1ch |
| 9 | D1 | D input terminal of 1ch | 21 | VCC | Power supply terminal |
| 10 | D2 | D input terminal of 2ch | 22 | SCL | I²C Communication clock terminal |
| 11 | E1 | E input terminal of 1ch | 23 | SDA | I²C Communication data terminal |
| 12 | E2 | E input terminal of 2ch | 24 | GND | GND terminal |

●**Timming Chart**

CONTROL SIGNAL SPECIFICATION

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

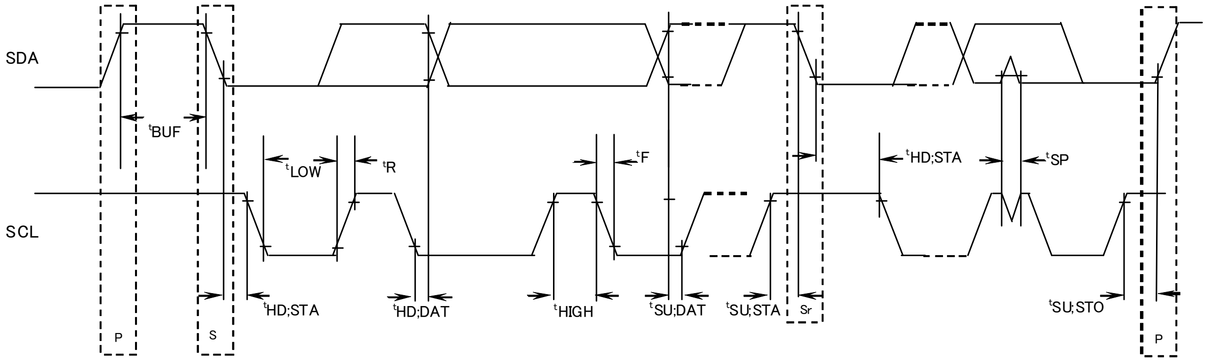



Fig.23 Definition of timing on the $I^2C$-bus

Table 1 Characteristics of the SDA and SCL bus lines for $I^2C$-bus devices
(Unless specified particularly, Ta=25℃, VCC=8.5V)

| Parameter | | Symbol | Fast-mode $I^2C$-bus | | 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 | 0.06* | – | μS |
| 8 | Data set-up time | tSU;DAT | 120 | – | 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).

* A device must internally provide a hold time of at least 300 ns for the SDA signal (referred to the VIH min. of the SCL signal) in order to bridge the undefined region of the falling edge of SCL.

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 $I^2C$-bus devices

| | Parameter | Symbol | Fast-mode devices | | 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: at 3mA sink current | VOL1 | 0 | 0.4 | V |
| 14 | Input current each I/O pin with an input voltage between 0.4V and 4.5V. | Ii | -10 | 10 | μA |

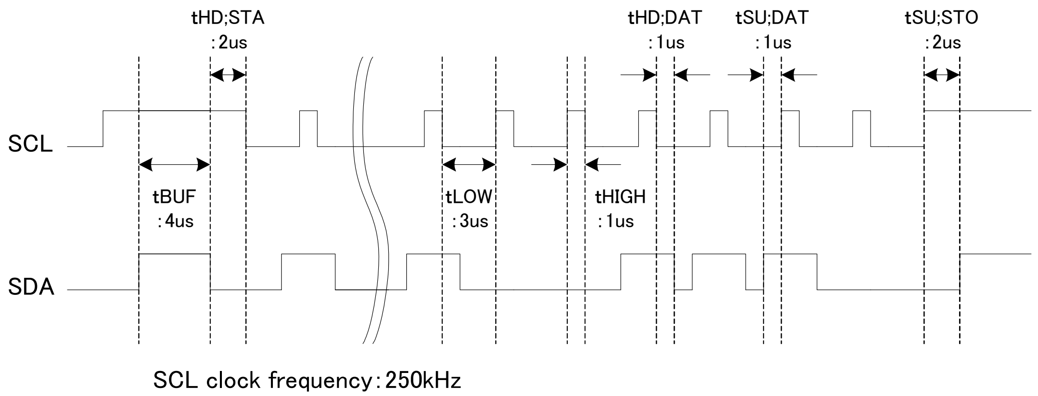



Fig.24 A command timing example in the I2C data transmission

## (2) I²C 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. 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) I²C 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 (Select Address increases (+1) 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 | | |

(Example) ①Data1 shall be set as data of address specified by Select Address.
②Data2 shall be set as data of address specified by Select Address +1.
③DataN shall be set as data of address specified by Select Address +N-1.

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

| 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 | | |

(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 | 0 | 0 |

80H

## （5）Select Address & Data

| Items | Select Address (hex) | MSB D7 | D6 | D5 | D4 | D3 | D2 | D1 | LSB D0 |
|---|---|---|---|---|---|---|---|---|---|
| Initial setup 1 | 01 | Advanced switch ON/OFF | 0 | Advanced switch time of Input Gain/Volume Tone/Fader/Loudness | | 0 | 0 | Advanced switch time of Mute | |
| Initial setup 2 | 02 | LPF Phase | Level Meter RESET | 0 | 0 | 0 | Subwoofer LPF fc | LPF Phase | Level Meter RESET |
| Initial setup 3 | 03 | 0 | 0 | 0 | Loudness fo | | 0 | 0 | 1 |
| Input Selector | 05 | 0 | 0 | 0 | Input selector | | | | |
| Input gain | 06 | Mute ON/OFF | 0 | 0 | Input Gain | | | | |
| Volume gain | 20 | Volume Gain / Attenuation | | | | | | | |
| Fader 1ch Front | 28 | Fader Gain / Attenuation | | | | | | | |
| Fader 2ch Front | 29 | Fader Gain / Attenuation | | | | | | | |
| Fader 1ch Rear | 2A | Fader Gain / Attenuation | | | | | | | |
| Fader 2ch Rear | 2B | Fader Gain / Attenuation | | | | | | | |
| Fader Subwoofer | 2C | Fader Gain / Attenuation | | | | | | | |
| Bass setup | 41 | 0 | 0 | Bass fo | | 0 | 0 | Bass Q | |
| Middle setup | 44 | 0 | 0 | Middle fo | | 0 | 0 | Middle Q | |
| Treble setup | 47 | 0 | 0 | Treble fo | | 0 | 0 | 0 | Treble Q |
| Bass gain | 51 | Bass Boost/ Cut | 0 | 0 | Bass Gain | | | | |
| Middle gain | 54 | Middle Boost/ Cut | 0 | 0 | Middle Gain | | | | |
| Treble gain | 57 | Treble Boost/ Cut | 0 | 0 | Treble Gain | | | | |
| Loudness Gain | 75 | 0 | Loudness Hicut | | Loudness Gain | | | | |
| System Reset | FE | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

(shaded) Advanced switch

Note

1． In function changing of the hatching part, it works Advanced switch.

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

→01→02→03→05→06→20→28→29→2A→2B→2C

→41→44→47→51→54→57→75

3． For the function of input selector etc, it is not corresponded for advanced switch. Therefore, please apply mute on the side of a set when changes these setting.

4． When using mute function of this IC at the time of changing input selector, please switch mute ON/OFF for waiting advanced-mute time.

Select address 01 (hex)

| Time | MSB | Advanced switch time of Mute | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0.6msec | Advanced Switch ON/OFF | 0 | Advanced switch time of Input gain/Volume Tone/Fader/Loudness | | 0 | 0 | 0 | 0 |
| 1.0msec | | | | | | | 0 | 1 |
| 1.4msec | | | | | | | 1 | 0 |
| 3.2msec | | | | | | | 1 | 1 |

| Time | MSB | Advanced switch time of Input gain/Volume/Tone/Fader/Loudness | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 4.7 msec | Advanced Switch ON/OFF | 0 | 0 | 0 | 0 | 0 | Advanced switch Time of Mute | |
| 7.1 msec | | | 0 | 1 | | | | |
| 11.2 msec | | | 1 | 0 | | | | |
| 14.4 msec | | | 1 | 1 | | | | |

| Mode | MSB | Advanced switch ON/OFF | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| OFF | 0 | 0 | Advanced switch time of Input gain/Volume Tone/Fader/Loudness | | 0 | 0 | Advanced switch Time of Mute | |
| ON | 1 | | | | | | | |

Select address 02(hex)

| fc | MSB | Subwoofer LPF fc | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| OFF | LPF Phase | Level Meter RESET | 0 | 0 | 0 | 0 | 0 | 0 |
| 55Hz | | | | | | 0 | 0 | 1 |
| 85Hz | | | | | | 0 | 1 | 0 |
| 120Hz | | | | | | 0 | 1 | 1 |
| 160Hz | | | | | | 1 | 0 | 0 |
| Prohibition | | | | | | Other setting | | |

| Mode | MSB | Level Meter RESET | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| HOLD | LPF Phase | 0 | 0 | 0 | 0 | Subwoofer LPF fc | | |
| RESET | | 1 | | | | | | |

| Phase | MSB | LPF Phase | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0° | 0 | Level Meter RESET | 0 | 0 | 0 | Subwoofer LPF fc | | |
| 180° | 1 | | | | | | | |

Select address 03(hex)

| f0 | MSB | Loudness fo | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 250Hz | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 400Hz | | | | 0 | 1 | | | |
| 800Hz | | | | 1 | 0 | | | |
| Prohibition | | | | 1 | 1 | | | |

(shaded) : Initial condition

Select address 05(hex)

| Mode | OUT F1/R1 | OUT F2/R2 | MSB | | Input Selector | | | | | LSB |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| A | A1 | A2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| B | B1 | B2 | | | | | 0 | 0 | 1 | 0 |
| C diff | CP1 | CP2 | | | | | 0 | 1 | 1 | 0 |
| D | D1 | D2 | | | | | 1 | 0 | 1 | 0 |
| E | E1 | E2 | | | | | 1 | 0 | 1 | 1 |
| Input SHORT | | | | | | | 1 | 0 | 0 | 1 |
| Prohibition | | | | | | | Other setting | | | |

**Input SHORT**：The input impedance of each input terminal is lowered from 100kΩ(TYP) to 6 kΩ(TYP).
(For quick charge of coupling capacitor)

Select address 06 (hex)

| Gain | MSB | | | Input Gain | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0dB | Mute ON/OFF | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1dB | | | | 0 | 0 | 0 | 0 | 1 |
| 2dB | | | | 0 | 0 | 0 | 1 | 0 |
| 3dB | | | | 0 | 0 | 0 | 1 | 1 |
| 4dB | | | | 0 | 0 | 1 | 0 | 0 |
| 5dB | | | | 0 | 0 | 1 | 0 | 1 |
| 6dB | | | | 0 | 0 | 1 | 1 | 0 |
| 7dB | | | | 0 | 0 | 1 | 1 | 1 |
| 8dB | | | | 0 | 1 | 0 | 0 | 0 |
| 9dB | | | | 0 | 1 | 0 | 0 | 1 |
| 10dB | | | | 0 | 1 | 0 | 1 | 0 |
| 11dB | | | | 0 | 1 | 0 | 1 | 1 |
| 12dB | | | | 0 | 1 | 1 | 0 | 0 |
| 13dB | | | | 0 | 1 | 1 | 0 | 1 |
| 14dB | | | | 0 | 1 | 1 | 1 | 0 |
| 15dB | | | | 0 | 1 | 1 | 1 | 1 |
| 16dB | | | | 1 | 0 | 0 | 0 | 0 |
| 17dB | | | | 1 | 0 | 0 | 0 | 1 |
| 18dB | | | | 1 | 0 | 0 | 1 | 0 |
| 19dB | | | | 1 | 0 | 0 | 1 | 1 |
| 20dB | | | | 1 | 0 | 1 | 0 | 0 |
| Prohibition | | | | 1 | 1 | 0 | 1 | 1 |
| | | | | : | : | : | : | : |
| | | | | 1 | 1 | 1 | 1 | 1 |

| Mode | MSB | | | Mute ON/OFF | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| OFF | 0 | 0 | 0 | Input Gain | | | | |
| ON | 1 | | | | | | | |

(shaded) : Initial condition

Select address 20, 28, 29, 2A, 2B, 2C (hex)

| Gain & ATT | MSB | Vol, Fader Gain / Attenuation | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| Prohibition | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | : | : | : | : | : | : | : | : |
| | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 15dB | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| 14dB | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| 13dB | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| : | : | : | : | : | : | : | : | : |
| -77dB | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| -78dB | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| -79dB | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| Prohibition | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| -∞dB | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

(shaded) : Initial condition

Select address 41(hex)

| Q factor | MSB | | Bass Q factor | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0.5 | 0 | 0 | Bass fo | | 0 | 0 | 0 | 0 |
| 1.0 | | | | | | | 0 | 1 |
| 1.5 | | | | | | | 1 | 0 |
| 2.0 | | | | | | | 1 | 1 |

| fo | MSB | | Bass fo | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 60Hz | 0 | 0 | 0 | 0 | 0 | 0 | Bass Q factor | |
| 80Hz | | | 0 | 1 | | | | |
| 100Hz | | | 1 | 0 | | | | |
| 120Hz | | | 1 | 1 | | | | |

Select address 44(hex)

| Q factor | MSB | | Middle Q factor | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0.75 | 0 | 0 | Middle fo | | 0 | 0 | 0 | 0 |
| 1.0 | | | | | | | 0 | 1 |
| 1.25 | | | | | | | 1 | 0 |
| 1.5 | | | | | | | 1 | 1 |

| fo | MSB | | Middle fo | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 500Hz | 0 | 0 | 0 | 0 | 0 | 0 | Middle Q factor | |
| 1kHz | | | 0 | 1 | | | | |
| 1.5kHz | | | 1 | 0 | | | | |
| 2.5kHz | | | 1 | 1 | | | | |

Select address 47 (hex)

| Q factor | MSB | | Treble Q factor | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0.75 | 0 | 0 | Treble fo | | 0 | 0 | 0 | 0 |
| 1.25 | | | | | | | | 1 |

| fo | MSB | | Treble fo | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 7.5kHz | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Treble Q factor |
| 10kHz | | | 0 | 1 | | | | |
| 12.5kHz | | | 1 | 0 | | | | |
| 15kHz | | | 1 | 1 | | | | |

(shaded): Initial condition

Select address 51, 54, 57 (hex)

| Gain | MSB | Bass/ Middle/ Treble Gain | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0dB | Bass/ Middle/ Treble Boost /cut | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1dB | | | | 0 | 0 | 0 | 0 | 1 |
| 2dB | | | | 0 | 0 | 0 | 1 | 0 |
| 3dB | | | | 0 | 0 | 0 | 1 | 1 |
| 4dB | | | | 0 | 0 | 1 | 0 | 0 |
| 5dB | | | | 0 | 0 | 1 | 0 | 1 |
| 6dB | | | | 0 | 0 | 1 | 1 | 0 |
| 7dB | | | | 0 | 0 | 1 | 1 | 1 |
| 8dB | | | | 0 | 1 | 0 | 0 | 0 |
| 9dB | | | | 0 | 1 | 0 | 0 | 1 |
| 10dB | | | | 0 | 1 | 0 | 1 | 0 |
| 11dB | | | | 0 | 1 | 0 | 1 | 1 |
| 12dB | | | | 0 | 1 | 1 | 0 | 0 |
| 13dB | | | | 0 | 1 | 1 | 0 | 1 |
| 14dB | | | | 0 | 1 | 1 | 1 | 0 |
| 15dB | | | | 0 | 1 | 1 | 1 | 1 |
| 16dB | | | | 1 | 0 | 0 | 0 | 0 |
| 17dB | | | | 1 | 0 | 0 | 0 | 1 |
| 18dB | | | | 1 | 0 | 0 | 1 | 0 |
| 19dB | | | | 1 | 0 | 0 | 1 | 1 |
| 20dB | | | | 1 | 0 | 1 | 0 | 0 |
| Prohibition | | | | 1 | 0 | 1 | 0 | 1 |
| | | | | : | : | : | : | : |
| | | | | 1 | 1 | 1 | 1 | 0 |
| | | | | 1 | 1 | 1 | 1 | 1 |

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

: Initial condition

Select address 75 (hex)

| Mode | MSB | Loudness Hicut | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| Hicut1 | 0 | 0 | 0 | Loudness Gain | | | | |
| Hicut2 | | 0 | 1 | | | | | |
| Hicut3 | | 1 | 0 | | | | | |
| Hicut4 | | 1 | 1 | | | | | |

| Gain | MSB | Loudness Gain | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0dB | 0 | Loudness Hicut | | 0 | 0 | 0 | 0 | 0 |
| 1dB | | | | 0 | 0 | 0 | 0 | 1 |
| 2dB | | | | 0 | 0 | 0 | 1 | 0 |
| 3dB | | | | 0 | 0 | 0 | 1 | 1 |
| 4dB | | | | 0 | 0 | 1 | 0 | 0 |
| 5dB | | | | 0 | 0 | 1 | 0 | 1 |
| 6dB | | | | 0 | 0 | 1 | 1 | 0 |
| 7dB | | | | 0 | 0 | 1 | 1 | 1 |
| 8dB | | | | 0 | 1 | 0 | 0 | 0 |
| 9dB | | | | 0 | 1 | 0 | 0 | 1 |
| 10dB | | | | 0 | 1 | 0 | 1 | 0 |
| 11dB | | | | 0 | 1 | 0 | 1 | 1 |
| 12dB | | | | 0 | 1 | 1 | 0 | 0 |
| 13dB | | | | 0 | 1 | 1 | 0 | 1 |
| 14dB | | | | 0 | 1 | 1 | 1 | 0 |
| 15dB | | | | 0 | 1 | 1 | 1 | 1 |
| 16dB | | | | 1 | 0 | 0 | 0 | 0 |
| 17dB | | | | 1 | 0 | 0 | 0 | 1 |
| 18dB | | | | 1 | 0 | 0 | 1 | 0 |
| 19dB | | | | 1 | 0 | 0 | 1 | 1 |
| 20dB | | | | 1 | 0 | 1 | 0 | 0 |
| Prohibition | | | | 1 | 0 | 1 | 0 | 1 |
| | | | | : | : | : | : | : |
| | | | | 1 | 1 | 1 | 1 | 1 |

: Initial condition

(6) About power on reset

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 | 33 | — | — | usec | VCC rise time from 0V to 5V |
| VCC voltage of release power on reset | Vpor | — | 4.1 | — | V | |

(7) About external compulsory mute terminal

Mute is possible forcibly than the outside after input again department, by the setting of the MUTE terminal.

| Mute Voltage Condition | Mode |
|---|---|
| GND～1.0V | MUTE ON |
| 2.3V～VCC | MUTE OFF |

Establish the voltage of MUTE in the condition to have been defined.

Volume / Fader volume attenuation of the details

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

▭ : Initial condition

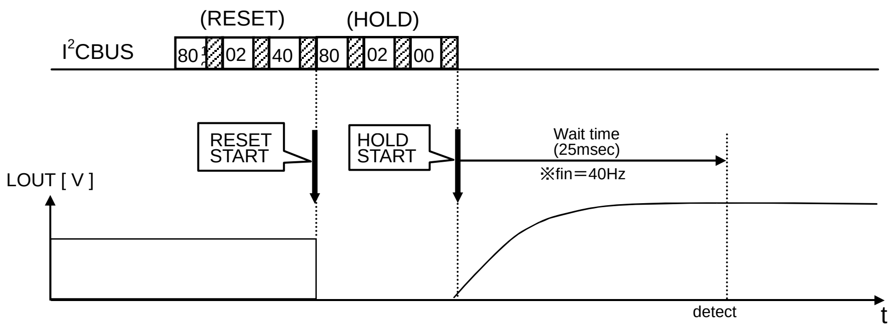
About Level meter

（１） The operation of circuit
Level meter is a function which gives DC voltage proportional to the size of signal of sound. It detects the peak level of signal and keeps the peak level, so that it is possible to monitor the size of signal by resetting DC voltage kept with suitable interval.

（２） The way to reset level meter output
Please send reset data through I²C BUS
When reset output of level meter：Send D6 = “ 1 “ of select address 02(hex).
When cancel of output reset of level meter (HOLD)… → Send D6 = “ 0 “ of select address 02(hex).

（３） The settings about period of reset
Peak hold operation will start after HOLD data is transmitted. Set the WAIT time after HOLD data transmission according to the frequency bandwidth detected.
WAIT time must be set to a minimum of one cycle over the detected frequency bandwidth.
Ex) Detected frequency bandwidth is above 40Hz, 『40Hz = 25ms = WAIT time』

Transmission Example by I²C BUS



## ●Application circuit

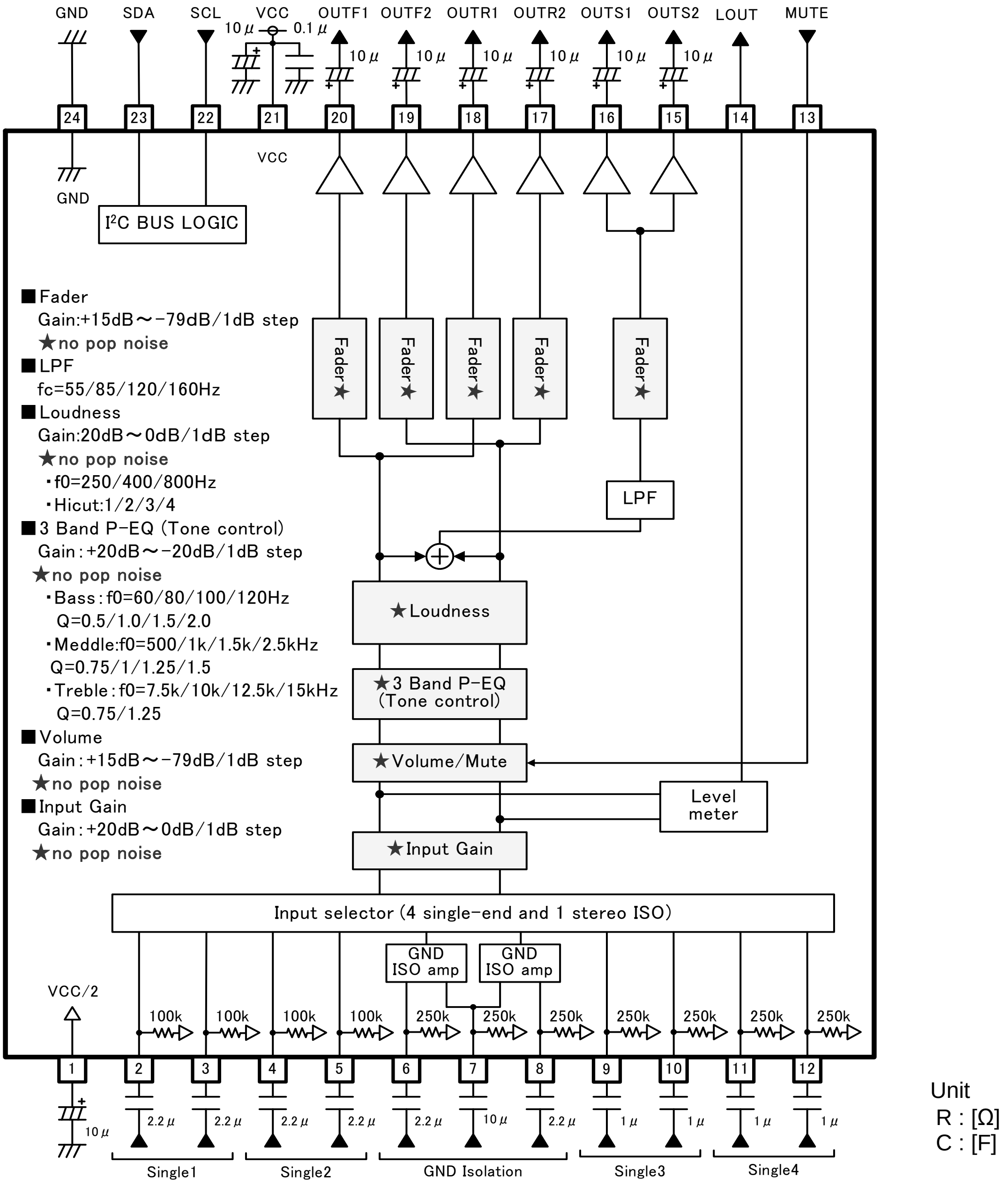
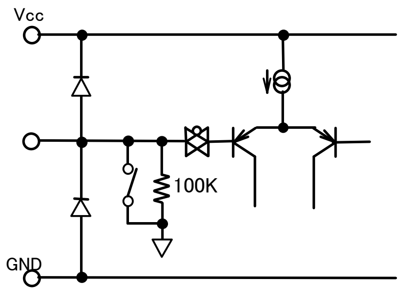
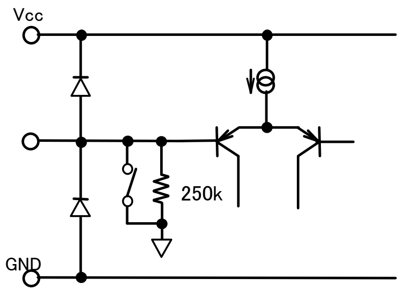
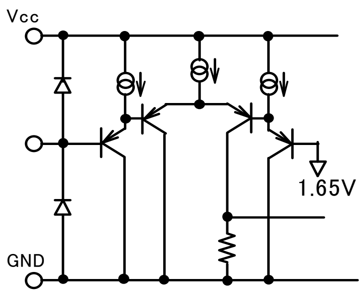
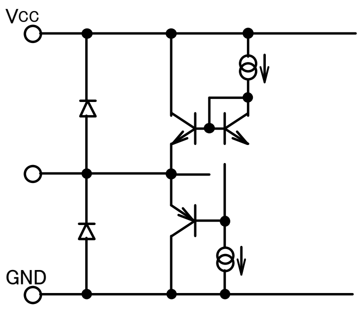



Fig.25 Application Circuit Diagram

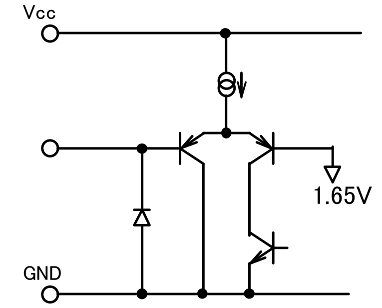
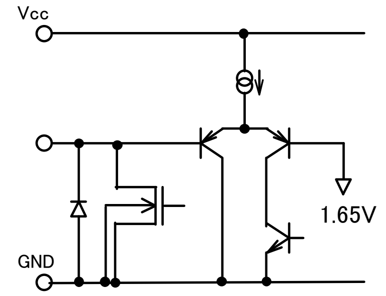
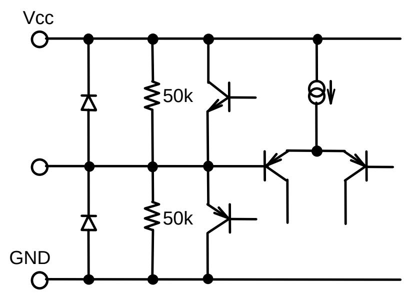
**Notes on wiring**

① Please connect the decoupling capacitor of a power supply in the shortest distance as much as possible to GND.
② Lines of GND shall be one-point connected.
③ Wiring pattern of Digital shall be away from that of analog unit and cross-talk shall not be acceptable.
④ Lines of SCL and SDA of I²C BUS shall not be parallel if possible.
The lines shall be shielded, if they are adjacent to each other.
⑤ Lines of analog input shall not be parallel if possible. The lines shall be shielded, if they are adjacent to each other.

● **Interfaces**

| Terminal No. | Terminal Name | Terminal Voltage | Equivalent Circuit | Terminal Description |
|---|---|---|---|---|
| 2<br>3<br>4<br>5 | A1<br>A2<br>B1<br>B2 | 4.25 |  | A terminal for signal input.<br>The input impedance is 100kΩ(typ). |
| 6<br>7<br>8<br>9<br>10<br>11<br>12 | CP1<br>CN<br>CP2<br>D1<br>D2<br>E1<br>E2 | 4.25 |  | A terminal for signal input.<br>The input impedance is 250kΩ(typ). |
| 13 | MUTE | — |  | A terminal for external compulsory mute. If terminal voltage is High level, the mute is off. And if the terminal voltage is Low level, the mute is on. |
| 16<br>17<br>18<br>19<br>20 | OUTS1<br>OUTR2<br>OUTR1<br>OUTF2<br>OUTF1 | 4.25 |  | A terminal for fader and Subwoofer output. |

The figure in the pin explanation and input/output equivalent circuit is reference value, it doesn't guarantee the value.

| Terminal No. | Terminal Name | Terminal Voltage | Equivalent Circuit | Terminal Description |
|---|---|---|---|---|
| 21 | VCC | 8.5 | | Power supply terminal. |
| 22 | SCL | — |  | A terminal for clock input of $I^2C$ BUS communication. |
| 23 | SDA | — |  | A terminal for data input of $I^2C$ BUS communication. |
| 24 | GND | 0 | | Ground terminal. |
| 1 | FIL | 4.25 |  | Voltage for reference bias of analog signal system. The simple precharge circuit and simple discharge circuit for an external capacitor are built in. |

The figure in the pin explanation and input/output equivalent circuit is reference value, it doesn't guarantee the value.

●**Notes for use**

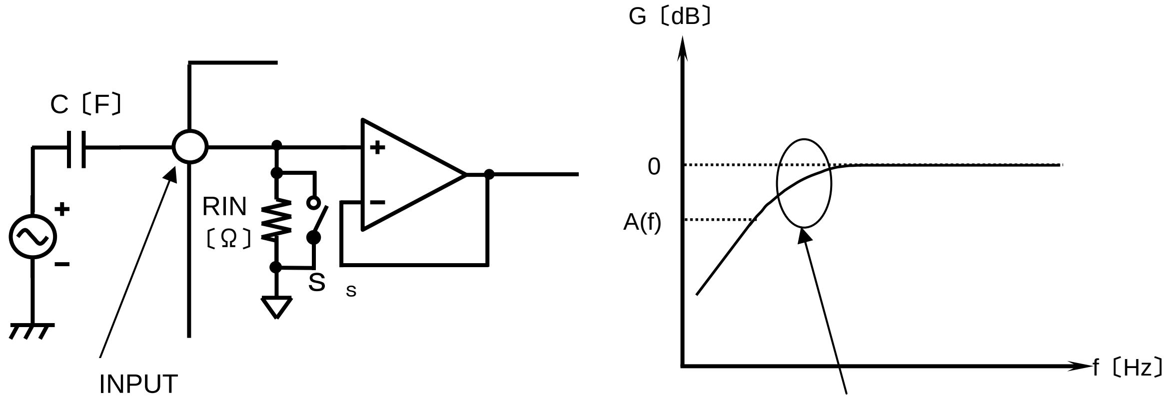
1. Absolute maximum rating voltage

When it impressed the voltage on VCC more than the absolute maximum rating voltage, circuit currents increase rapidly, and there is absolutely a case to reach characteristic deterioration and destruction of a device. In particular in a serge examination of a set, when it is expected the impressing serge at VCC terminal (21pin), please do not impress the large and over the absolute maximum rating voltage (including a operating voltage + serge ingredient (around 14V)).

2. About a signal input part

1) 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 $R_{IN}$(Ω) inside IC and please decide. The first HPF characteristic of RC is composed.




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

2) About the input selector SHORT

SHORT mode is the command which makes switch $S_{SH}$ =ON an input selector part and input impedance RIN of all terminals, and makes resistance small. Switch $S_{SH}$ is OFF when not choosing a SHORT command.
A constant time becomes small at the time of this command twisting to the resistance inside the capacitor connected outside and LSI. The charge time of a capacitor becomes short. Since SHORT mode turns ON the switch of $S_{SH}$ and makes it low impedance, please use it at the time of a non-signal.

3. About Mute terminal(13pin) when power supply is off

Any voltage shall not be supplied to Mute terminal (13pin) when power-supply is off.
Please insert a resistor (about 2.2kΩ) to Mute terminal in series, if voltage is supplied to mute terminal in case. (Please refer Application Circuit Diagram.)

**●Thermal Derating Curve**

About the thermal design by the IC

Characteristics of an IC have a great deal to do with the temperature at which it is used, and 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.

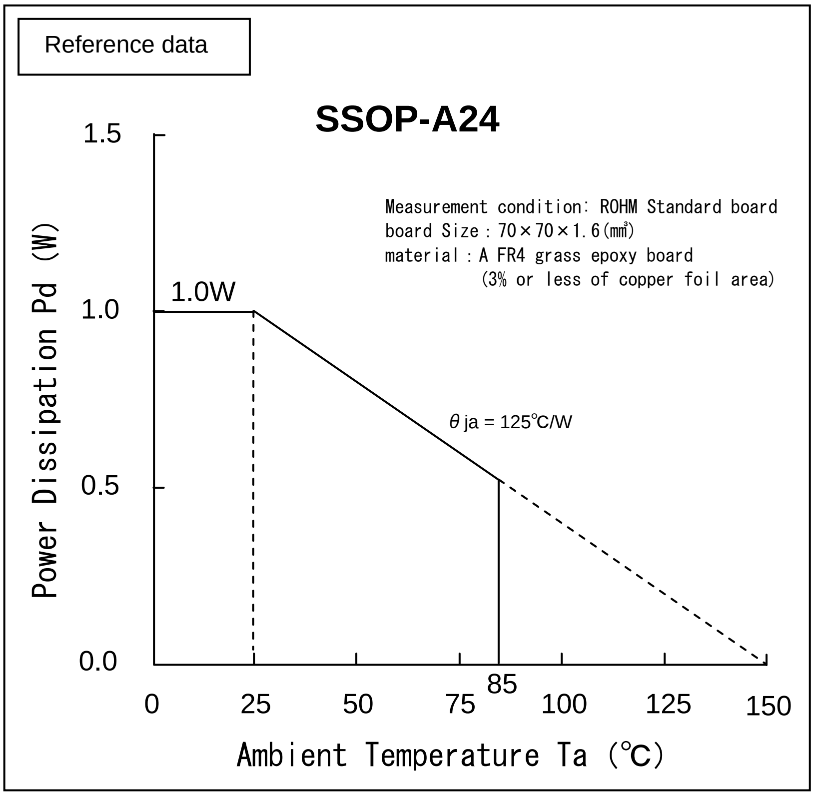



Fig.26 Temperature Derating Curve

Note) Values are actual measurements and are not guaranteed.

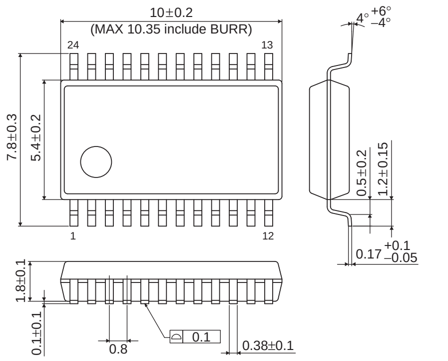
Power dissipation values vary according to the board on which the IC is mounted.

## ●Ordering part number

| B | D | | 3 | 7 | 5 | 2 | 4 | | F | S | - | E | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

- Part No.
- Part No.
  37524
- Package
  FS : SSOP-A24
- Packaging and forming specification
  E2: Embossed tape and reel

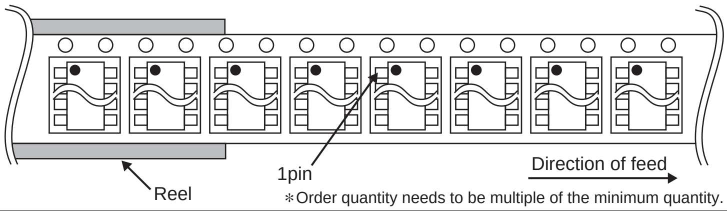
### SSOP-A24




(Unit : mm)

<Tape and Reel information>

| | |
|---|---|
| Tape | Embossed carrier tape |
| Quantity | 2000pcs |
| Direction of feed | E2<br>( The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand ) |




∗Order quantity needs to be multiple of the minimum quantity.

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