



2-CHANNEL Audio Processor with eala surround

■ GENERAL DESCRIPTION

The NJU7391A is a 2-channel Audio Processor with 5-in 1-out stereo audio selector, 2-band Tone Control and eala surround.

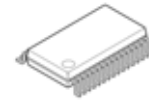
The NJU7391A performs low noise and low distortion characteristics with resistance ladder circuit.

All of functions are controlled via three-wired serial bus.

■ FEATURES

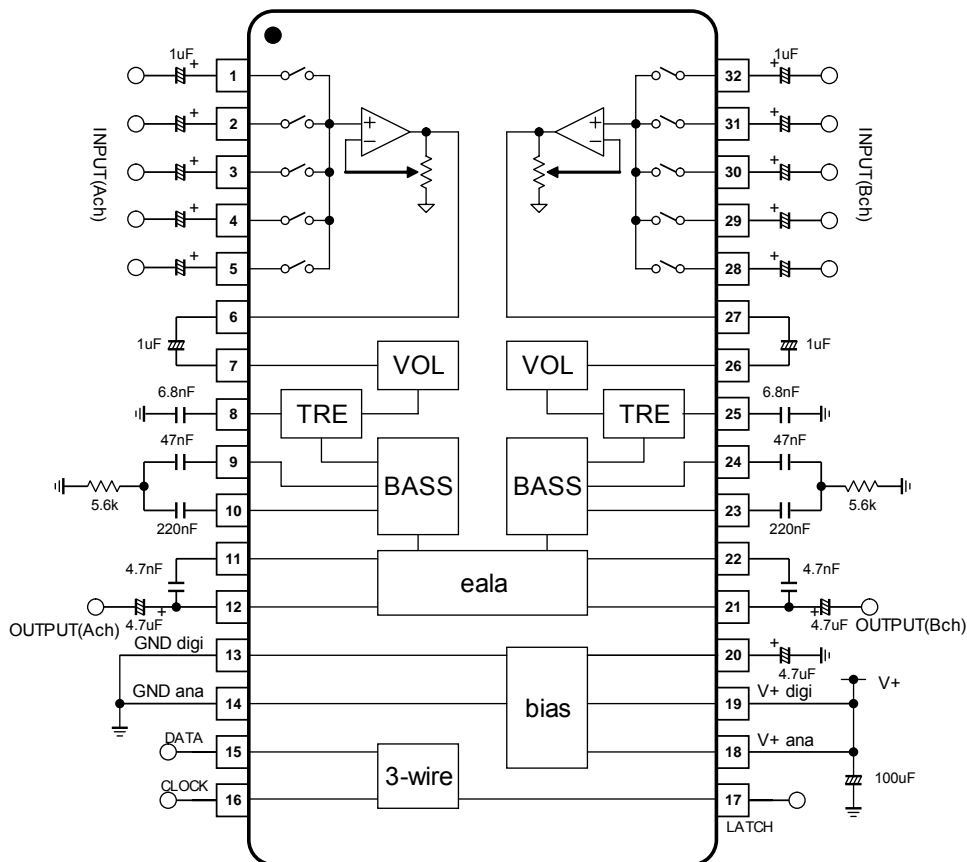
- Operating Voltage +4.7 to +9.7V
- Three-wired serial bus
- Low output noise -110dBVtyp.
0.002%typ. (Vo=1Vrms, Gv=0dB, f=1kHz)
0.01%typ. (Vo=2Vrms, Gv=0dB, f=1kHz)
0.01%typ. (Vo=2Vrms, Gv=+6dB, f=10kHz)
- Low THD
- Input Selector(X5)
- Input Gain 0 to +14dB/2dBstep
- Volume 0 to -95.0dB / 1dBstep, MUTE
- Tone Control 0 to ±14dB/2dBstep
- eala Surround 3-level effects
- CMOS Technology
- Package Outline SSOP32

■ PACKAGE OUTLINE



NJU7391AV

■ BLOCK DIAGRAM



■PIN CONFIGURATION

SSOP32

| | | | |
|----|----------|----------|----|
| 1 | IN1A | IN1B | 32 |
| 2 | IN2A | IN2B | 31 |
| 3 | IN3A | IN3B | 30 |
| 4 | IN4A | IN4B | 29 |
| 5 | IN5A | IN5B | 28 |
| 6 | SELOUTA | SELOUTB | 27 |
| 7 | VOL1A | VOL1B | 26 |
| 8 | TONE-HA | TONE-HB | 25 |
| 9 | TONE-BA | TONE-BB | 24 |
| 10 | TONE-DBA | TONE-DBB | 23 |
| 11 | SRA | SRB | 22 |
| 12 | OUTA | OUTB | 21 |
| 13 | GND D | VREF | 20 |
| 14 | GND A | V+ D | 19 |
| 15 | DATA | V+ A | 18 |
| 16 | CLOCK | LATCH | 17 |

| No. | Symbol | Function | No | Symbol | Function |
|-----|----------|----------------------------------|----|----------|----------------------------------|
| 1 | IN1A | Ach Input1 Terminal | 17 | LATCH | 3-Wired LATCH Input Terminal |
| 2 | IN2A | Ach Input2 Terminal | 18 | V+ A | Analog Supply Terminal |
| 3 | IN3A | Ach Input3 Terminal | 19 | V+ D | Digital Supply Terminal |
| 4 | IN4A | Ach Input4 Terminal | 20 | VREF | Reference Voltage Terminal |
| 5 | IN5A | Ach Input5 Terminal | 21 | OUTB | Bch Output Terminal |
| 6 | SELOUTA | Ach Selector Output Terminal | 22 | SRB | Bch Surround Filter Terminal |
| 7 | VOL1A | Ach Volume Input Terminal | 23 | TONE-DBB | Bch Bass(Tone) Filter Terminal |
| 8 | TONE-HA | Ach Treble(Tone) Filter Terminal | 24 | TONE-BB | Bch Bass(Tone) Filter Terminal |
| 9 | TONE-BA | Ach Bass(Tone) Filter Terminal | 25 | TONE-HB | Bch Treble(Tone) Filter Terminal |
| 10 | TONE-DBA | Ach Bass(Tone) Filter Terminal | 26 | VOL1B | Bch Volume Input Terminal |
| 11 | SRA | Ach Surround Filter Terminal | 27 | SELOUTB | Bch Selector Output Terminal |
| 12 | OUTA | Ach Output Terminal | 28 | IN5B | Bch Input5 Terminal |
| 13 | GND D | Digital Ground Terminal | 29 | IN4B | Bch Input4 Terminal |
| 14 | GND A | Analog Ground Terminal | 30 | IN3B | Bch Input3 Terminal |
| 15 | DATA | 3-Wired DATA Input Terminal | 31 | IN2B | Bch Input2 Terminal |
| 16 | CLOCK | 3-Wired CLOCK Input Terminal | 32 | IN1B | Bch Input1 Terminal |

■ ABSOLUTE MAXIMUM RATING (Ta=25°C)

| PARAMETER | SYMBOL | RATING | UNIT |
|-----------------------------|-------------------|----------------------------|------|
| Power Supply Voltage | V ₊ | 10 (Note1) | V |
| Power Dissipation | P _D | 800 (Note2) | mW |
| Maximum Input Voltage | V _{IMAX} | 0 ~ V ₊ (Note3) | V |
| Operating Temperature Range | Topr | -40 ~ +85 | °C |
| Storage Temperature Range | Tstg | -40 ~ +125 | °C |

(Note1) Pay attention to supply voltage not to exceed the absolute maximum power supply voltage by spike noise etc. Because the difference between the absolute maximum power supply voltage and the operating voltage is small.

(Note2) EIA/JEDEC STANDARD Test board (76.2x114.3x1.6mm, 2layer, FR-4) mounting

(Note3) Don't apply the input voltage that exceeds supply voltage.

■ ELECTRICAL CHARACTERISTICS (Ta=25°C, V⁺=9V, RL=47kΩ, Vin=100mVrms/1kHz, VOL=0dB, TONE=OFF, SUR=OFF)

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|-----------------------------|---------------------|---|------|-------|------|------|
| Operating Voltage | V ₊ | | 4.7 | 9.0 | 9.7 | V |
| Supply Current | I _{DD} | No signal | - | 10 | 18 | mA |
| Reference Voltage | V _{REF} | No signal | 3.5 | 4.0 | 4.5 | V |
| Input impedance | R _{IN} | | - | 60 | - | kΩ |
| Output impedance | R _{OUT} | | - | 200 | - | Ω |
| Maximum Input Voltage | V _{IM} | VOL=0dB, THD=1% | - | 3.0 | - | Vrms |
| Maximum Output Voltage | V _{OM} | OUTPUT VOL=0dB, THD=1% | - | 3.0 | - | Vrms |
| Maximum Gain | G _{VMAX} | VOL=0dB | -1.0 | 0 | 1.0 | dB |
| Minimum Gain | G _{VMIN} | V _{IN} =1Vrms, VOLA/B=MUTE | - | -100 | -90 | dB |
| Maximum Input Gain | G _{VINMAX} | GVIN="111" (+14dB) | - | 14 | - | dB |
| Channel Balance | G _{CB} | VOL=0dB | -1 | 0 | 1 | dB |
| Cross Talk | CT | V _{IN} =1Vrms Selected Input : 0Ω Unselected Input : Signal | - | - | -80 | dB |
| Channel Separation | CS | V _{IN} =1Vrms | - | - | -80 | dB |
| Total Harmonic Distortion 1 | THD+N1 | V _O =1Vrms, BW=400Hz-30kHz | - | 0.002 | 0.01 | % |
| Total Harmonic Distortion 2 | THD+N2 | V _O =2Vrms, BW=400Hz-30kHz | - | 0.01 | - | % |
| Total Harmonic Distortion 3 | THD+N3 | GVIN="011" (G _{VIN} =+6dB) V _O =2Vrms, f=10kHz BW=400Hz ~ 80kHz | - | 0.01 | - | % |
| Output Noise | V _{NO} | Rg=0Ω, A-weight | - | -110 | -97 | dBV |

◆ Tone Control Characteristics

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|----------------------|-------------------|------------------------------|-------|-------|-------|------|
| High Frequency Boost | HF _{BST} | BCT="1", TREB="111", f=10kHz | 11.5 | 14.0 | 16.5 | dB |
| High Frequency Cut | HF _{CUT} | BCT="0", TREB="111", f=10kHz | -16.5 | -14.0 | -11.5 | dB |
| Low Frequency Boost | LF _{BST} | BCB="1", BASS="111", f=100Hz | 11.5 | 14.0 | 16.5 | dB |
| Low Frequency Cut | LF _{CUT} | BCB="0", BASS="111", f=100Hz | -16.5 | -14.0 | -11.5 | dB |

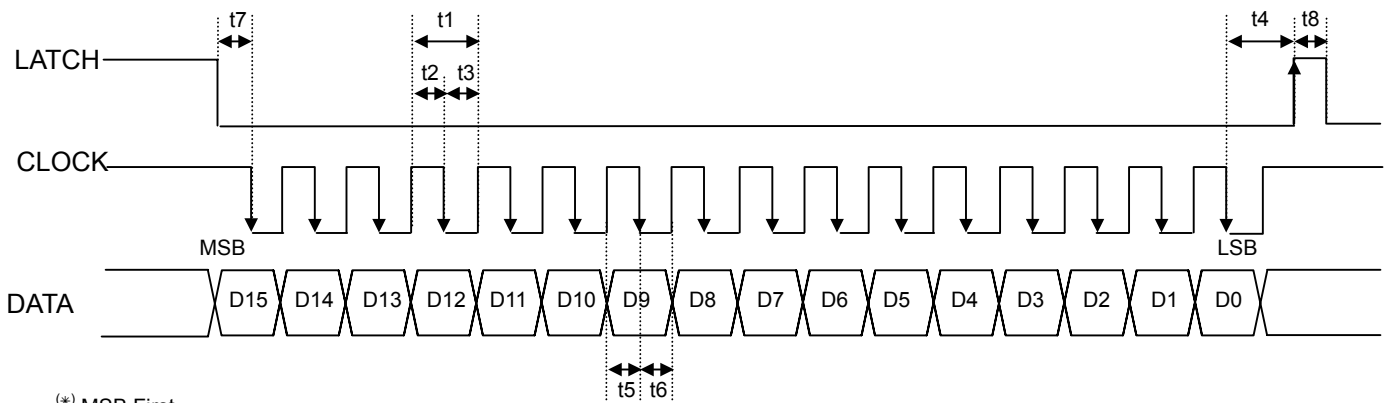
◆Surround (eala) Characteristics

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|------------|------------------|-----------------------------|------|------|------|------|
| Surround 1 | SUR ₁ | SUR="01", f=100Hz, Ain-Aout | 1.6 | 3.6 | 5.6 | dB |
| Surround 2 | SUR ₂ | SUR="10", f=100Hz, Ain-Aout | 4.3 | 6.3 | 8.3 | dB |
| Surround 3 | SUR ₃ | SUR="11", f=100Hz, Ain-Aout | 6.6 | 8.6 | 10.6 | dB |
| Surround 4 | SUR ₄ | SUR="11", f=100Hz, Ain-Bout | 2.8 | 4.8 | 6.8 | dB |

◆Logic Control Characteristics

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|--------------------------|-----------------|------------------|------|------|------|------|
| High Level Input Voltage | V _{IH} | DATA,CLOCK,LATCH | 2.6 | - | 5.5 | V |
| Low Level Input Voltage | V _{IL} | DATA,CLOCK,LATCH | 0 | - | 1.0 | V |

CONTROL DATA FORMAT



(*) MSB First

| SYMBOL | PARAMETER | MIN | TYP | MAX | UNIT |
|--------|--------------------------|-----|-----|-----|------|
| t1 | CLOCK Clock Width | 4 | - | - | μsec |
| t2 | CLOCK Pulse Width (High) | 2 | - | - | μsec |
| t3 | CLOCK Pulse Width (Low) | 2 | - | - | μsec |
| t4 | LATCH Rise Hold Time | 4 | - | - | μsec |
| t5 | DATA Setup Time | 1.6 | - | - | μsec |
| t6 | DATA Hold Time | 1.6 | - | - | μsec |
| t7 | CLOCK Setup Time | 1.6 | - | - | μsec |
| t8 | LATCH High Pulse Width | 1.6 | - | - | μsec |

CONTROL DATA

NJU7391A control data is constructed with 16bits.

| MSB | | | | | | | | | | | | | | | LSB |
|------|-----|-----|-----|-----|-----|----|----|----------------|----|----|----|--------------|----|----|-----|
| D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| Data | | | | | | | | Select Address | | | | Chip Address | | | |

| MSB | | | | | | | | | | | | | | | | LSB |
|------------|------|-----|-----|-----|------|----|----|----|----|----|----|----|----|----|----|-----|
| D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| Don't Care | VOLA | | | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | |
| Don't Care | VOLB | | | | | | | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | |
| BCB | BAS | | | BCT | TRE | | | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | |
| SUR | | SEL | | | GVIN | | | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | |

INITIAL CONDITION

| MSB | | | | | | | | | | | | | | | LSB |
|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|-----|
| D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |

NJU7391A

■ DEFINITION OF RESISTOR

◆Volume A, Volume B 0dB to -95dB in 1dB/step. *Each volume is controlled independently.

| D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------------|------|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
| Don't Care | VOLA | | | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Don't Care | VOLB | | | | | | | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |

< Volume Control Data >

| Data | | | | | | | Setting |
|------|-----|------------|-----|-----|----|----|---------|
| D14 | D13 | D12 | D11 | D10 | D9 | D8 | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0dB (*) |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | -1dB |
| 1 | 1 | 1 | 1 | 1 | 0 | 1 | -2dB |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | -3dB |
| 1 | 1 | 1 | 1 | 0 | 1 | 1 | -4dB |
| 1 | 1 | 1 | 1 | 0 | 1 | 0 | -5dB |
| 1 | 1 | 1 | 1 | 0 | 0 | 1 | -6dB |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | -7dB |
| 1 | 1 | 1 | 0 | 1 | 1 | 1 | -8dB |
| 1 | 1 | 1 | 0 | 1 | 1 | 0 | -9dB |
| 1 | 1 | 1 | 0 | 1 | 0 | 1 | -10dB |
| 1 | 1 | 1 | 0 | 1 | 0 | 0 | -11dB |
| 1 | 1 | 1 | 0 | 0 | 1 | 1 | -12dB |
| 1 | 1 | 1 | 0 | 0 | 1 | 0 | -13dB |
| 1 | 1 | 1 | 0 | 0 | 0 | 1 | -14dB |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | -15dB |
| 1 | 1 | 0 | 1 | 1 | 1 | 1 | -16dB |
| ••• | | | | | | | ••• |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 | -80dB |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 | -88dB |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | -95dB |
| 0 | 0 | Don't Care | | | | | MUTE(*) |

(*)Initial Setting

Tone Control

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
| D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| BCB | BAS | | | BCT | TRE | | | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |

- BCB : Boost Cut select for Bass control
 "0" : Cut
 "1" : Boost
- BAS : BASS Level Setting
 Cut Level : -14 to 0dB (2dB/step)
 Boost Level : 0 to +14dB (2dB/step)
- BCT : Boost Cut select for Treble control
 "0" : Cut
 "1" : Boost
- TRE : BASS Level Setting
 Cut Level : -14 to 0dB (2dB/step)
 Boost Level : 0 to +14dB (2dB/step)

< Tone Control Data >

●BAS: TONE-BASS Level

| Data | | | | Setting |
|------|-----|-----|-----|---------|
| D15 | D14 | D13 | D12 | |
| BCB | BAS | | | |
| 1 | 1 | 1 | 1 | +14dB |
| 1 | 1 | 1 | 0 | +12dB |
| 1 | 1 | 0 | 1 | +10dB |
| 1 | 1 | 0 | 0 | +8dB |
| 1 | 0 | 1 | 1 | +6dB |
| 1 | 0 | 1 | 0 | +4dB |
| 1 | 0 | 0 | 1 | +2dB |
| 1 | 0 | 0 | 0 | 0dB |
| 0 | 0 | 0 | 0 | 0dB (*) |
| 0 | 0 | 0 | 1 | -2dB |
| 0 | 0 | 1 | 0 | -4dB |
| 0 | 0 | 1 | 1 | -6dB |
| 0 | 1 | 0 | 0 | -8dB |
| 0 | 1 | 0 | 1 | -10dB |
| 0 | 1 | 1 | 0 | -12dB |
| 0 | 1 | 1 | 1 | -14dB |

(*)Initial Setting

●TRE: TONE-TREBLE Level

| Data | | | | Setting |
|------|-----|----|----|---------|
| D11 | D10 | D9 | D8 | |
| BCT | TRE | | | |
| 1 | 1 | 1 | 1 | +14dB |
| 1 | 1 | 1 | 0 | +12dB |
| 1 | 1 | 0 | 1 | +10dB |
| 1 | 1 | 0 | 0 | +8dB |
| 1 | 0 | 1 | 1 | +6dB |
| 1 | 0 | 1 | 0 | +4dB |
| 1 | 0 | 0 | 1 | +2dB |
| 1 | 0 | 0 | 0 | 0dB |
| 0 | 0 | 0 | 0 | 0dB (*) |
| 0 | 0 | 0 | 1 | -2dB |
| 0 | 0 | 1 | 0 | -4dB |
| 0 | 0 | 1 | 1 | -6dB |
| 0 | 1 | 0 | 0 | -8dB |
| 0 | 1 | 0 | 1 | -10dB |
| 0 | 1 | 1 | 0 | -12dB |
| 0 | 1 | 1 | 1 | -14dB |

(*)Initial Setting

◆Surround(eala), Input Selector, Input Gain

| D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-----|-----|-----|-----|-----|------|----|----|----|----|----|----|----|----|----|----|
| SUR | | SEL | | | GVIN | | | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |

< Surround(eala) Data >

| Data | | Setting |
|------|-----|----------------|
| D15 | D14 | |
| 0 | 0 | BYPASS (*) |
| 0 | 1 | Surround1(MIN) |
| 1 | 0 | Surround2(MID) |
| 1 | 1 | Surround3(MAX) |

(*)initial setting

< Input Selector Data >

| Data | | | Setting |
|------|-----|-----|-------------|
| D13 | D12 | D11 | |
| 0 | 0 | 0 | Input 1 (*) |
| 0 | 0 | 1 | Input 2 |
| 0 | 1 | 0 | Input 3 |
| 0 | 1 | 1 | Input 4 |
| 1 | 0 | 0 | Input 5 |

(*)initial setting

< Input Gain Data >

| Data | | | Setting |
|------|----|----|------------|
| D10 | D9 | D8 | |
| 0 | 0 | 0 | BYPASS (*) |
| 0 | 0 | 1 | +2dB |
| 0 | 1 | 0 | +4dB |
| 0 | 1 | 1 | +6dB |
| 1 | 0 | 0 | +8dB |
| 1 | 0 | 1 | +10dB |
| 1 | 1 | 0 | +12dB |
| 1 | 1 | 1 | +14dB |

(*)initial setting

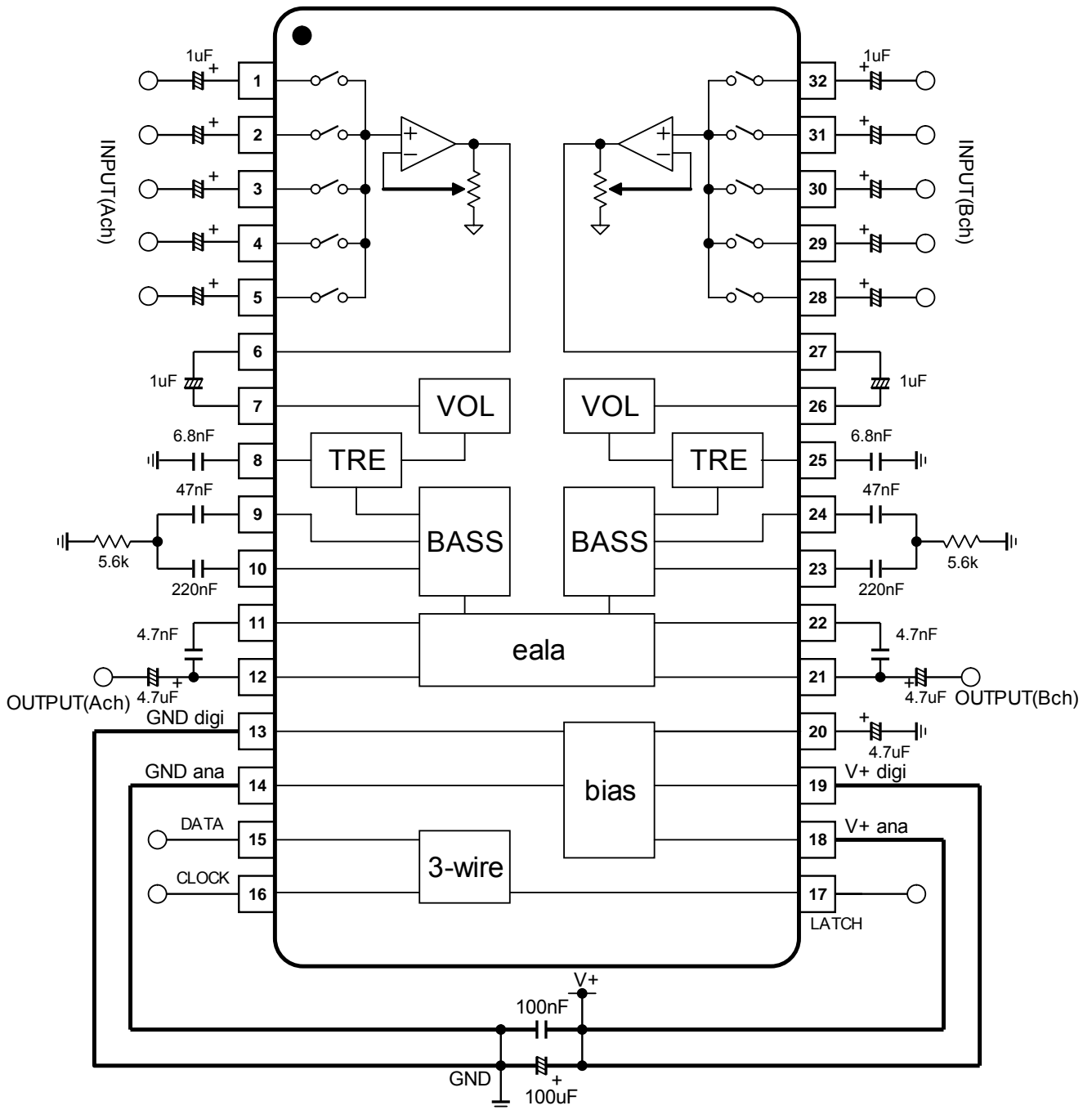
■TERMINAL DESCRIPTION

| No. | SYMBOL | FUNCTION | EQUIVALENT CIRCUIT | VOLTAGE |
|---|--|--|--------------------|------------|
| 1 2 3 4 5 28 29 30 31 32 | IN1A IN2A IN3A IN4A IN5A IN5B IN4B IN3B IN2B IN1B | Ach input1 terminal Ach input2 terminal Ach input3 terminal Ach input4 terminal Ach input5 terminal Bch input5 terminal Bch input4 terminal Bch input3 terminal Bch input2 terminal Bch input1 terminal | | V+ * (4/9) |
| 6 9 12 21 24 27 | SELOUTA TONE-BA OUTA OUTB TONE-BB SELOUTB | Ach selector output terminal Ach Bass(tone) filter terminal Ach output terminal Bch output terminal Bch Bass(tone) filter terminal Bch selector output terminal | | V+ * (4/9) |
| 7 26 | VOL1A VOL1B | Ach Volume input terminal Bch Volume input terminal | | V+ * (4/9) |
| 8 10 23 25 | TONE-HA TONE-DBA TONE-DBB TONE-HB | Ach Treble(tone) filter terminal Ach Bass(tone) filter terminal Bch Bass(tone) filter terminal Bch Treble(tone) filter terminal | | V+ * (4/9) |
| 11 22 | SRA SRB | Ach Surround filter terminal Bch Surround filter terminal | | V+ * (4/9) |

■TERMINAL DESCRIPTION

| No. | SYMBOL | FUNCTION | EQUIVALENT CIRCUIT | VOLTAGE |
|----------------|------------------------|---|--------------------|--------------|
| 15 16 17 | DATA CLOCK LATCH | 3-Wired DATA terminal 3-Wired CLOCK terminal 3-Wired LATCH terminal | | |
| 20 | VREF | Reference voltage terminal | | $V+ * (4/9)$ |

APPLICATION CIRCUIT



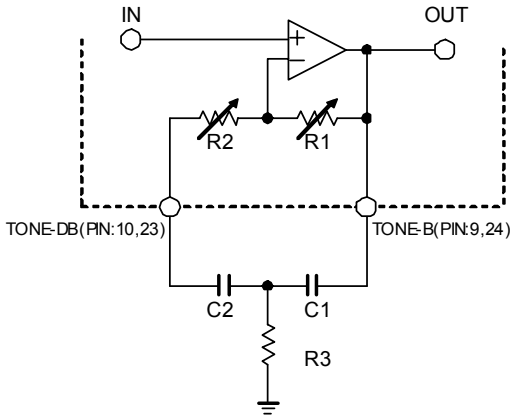
Please connect the wiring for the de-coupling capacitor (especially C13) between V+ and GND as short as possible to reduce the digital bus noise.

■ APPLICATION NOTE

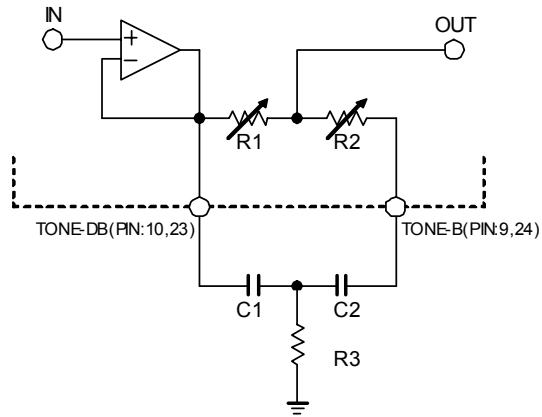
(1) TONE Control Application note

(a) Bass Control

(a-1) Boost



(a-2) Cut



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

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

$$G_0 = \pm 20 \text{Log} \frac{(R1 + R2 + R3) * C2 + R3 * C1}{R2 * C2 + R3 * (C1 + C2)} \quad (\text{dB})$$

Table.a-1 : Internal resistance in each Gain.

| Gain | R1 | R2 |
|-------|--------|--------|
| ±14dB | 36.1kΩ | 2.9kΩ |
| ±12dB | 34.4kΩ | 4.6kΩ |
| ±10dB | 31.7kΩ | 7.3kΩ |
| ±8dB | 28.1kΩ | 10.9kΩ |
| ±6dB | 23.9kΩ | 15.1kΩ |
| ±4dB | 17.3kΩ | 21.7kΩ |
| ±2dB | 10.1kΩ | 28.9kΩ |
| ±0dB | 0Ω | 39kΩ |

Table.a-1 (fc : variable)
f0 =variable, Gain=14dB, Q≈0.7

| f0 | C1 (F) | C2 (F) | R3 (Ω) |
|-----|--------|--------|--------|
| 50 | 100n | 470n | 5.6k |
| 100 | 47n | 220n | 5.6k |
| 200 | 22n | 100n | 5.6k |

Gain vs Frequency (TONE BASS)

V+=9V, Vin=0.1Vrms, TONE Gain=+14dB, Ta=25°C

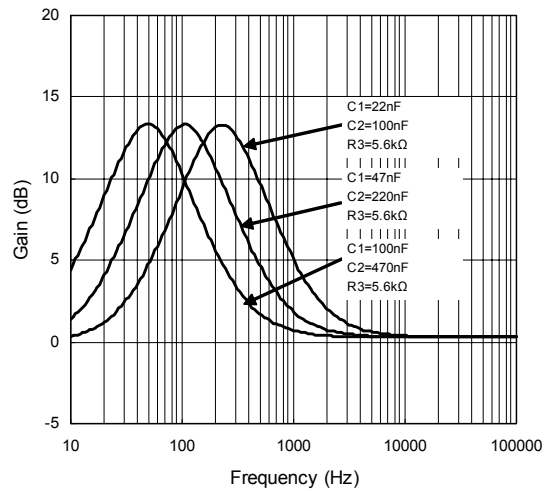


Table.a-2 (Q : variable)
f0≈100Hz, Gain=14dB, Q =variable

| Q | C1 (F) | C2 (F) | R3 (Ω) |
|-----|--------|--------|--------|
| 0.5 | 33n | 330n | 6.2k |
| 0.7 | 47n | 220n | 5.6k |
| 1 | 100n | 150n | 3.9k |

Gain vs Frequency (TONE BASS)

V+=9V, Vin=0.1Vrms, TONE Gain=+14dB, Ta=25°C

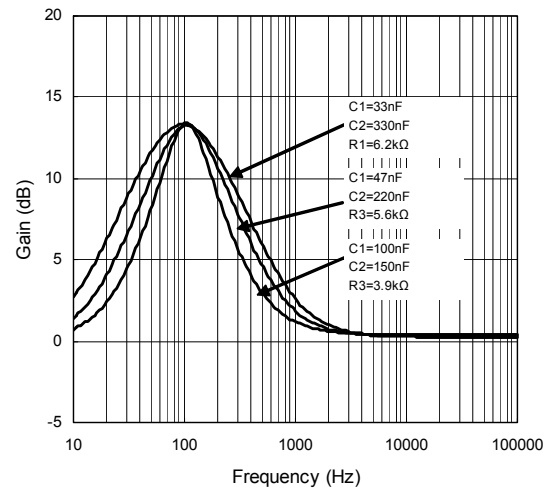
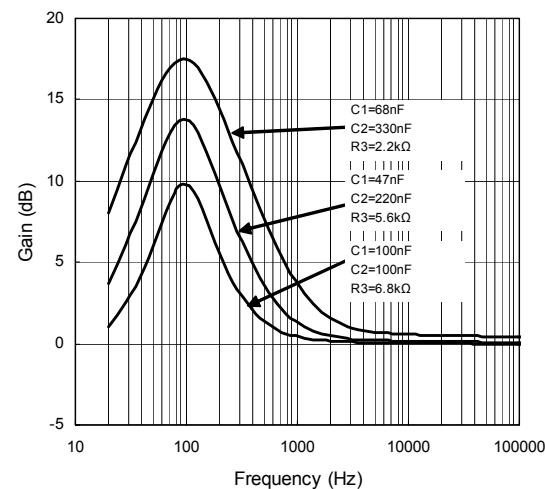


Table.a-3 (Gain : variable)
f0≈100Hz, Gain=14dB setting

| Gain(dB) | C1 (F) | C2 (F) | R3 (Ω) |
|----------|--------|--------|--------|
| 10 | 100n | 100n | 6.8k |
| 14 | 47n | 220n | 5.6k |
| 17.5 | 68n | 330n | 2.2k |

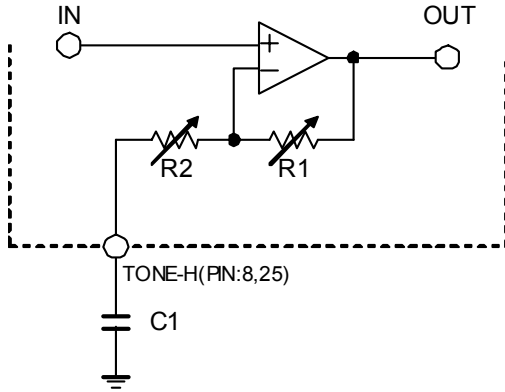
Gain vs Frequency (TONE BASS)

V+=9V, Vin=0.1Vrms, TONE Gain=+14dB, Ta=25°C

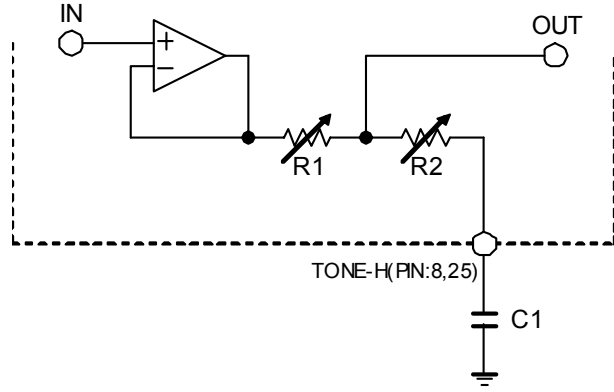


(b) Treble Control

(b-1) Boost



(b-2) Cut



$$G_v = \pm 20 \text{Log} \left[1 + \frac{R1}{R2} \times \frac{1}{\sqrt{1 + (1/(2\pi \times f \times C1 \times R2))^2}} \right] \quad (\text{dB})$$

Table.b-1 : Internal resistance in each Gain.

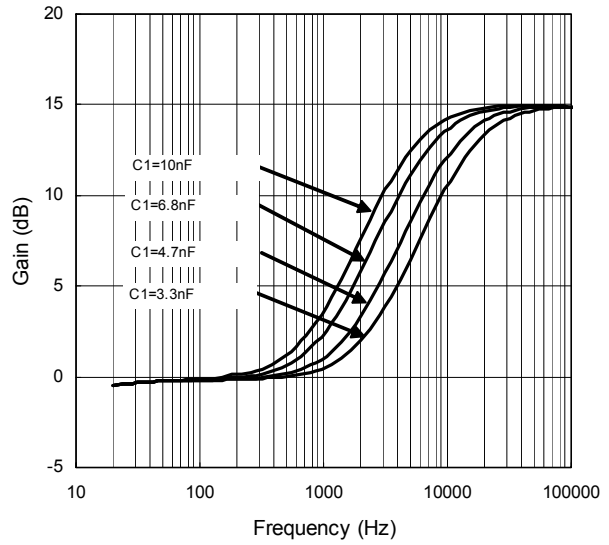
| Gain | R1(Ω) | R2(Ω) |
|-------|--------|--------|
| ±14dB | 16.2kΩ | 3.3kΩ |
| ±12dB | 15.2kΩ | 4.3kΩ |
| ±10dB | 14.2kΩ | 5.3kΩ |
| ±8dB | 12.8kΩ | 6.7kΩ |
| ±6dB | 10.9kΩ | 8.6kΩ |
| ±4dB | 8.2kΩ | 11.3kΩ |
| ±2dB | 4.7kΩ | 14.8kΩ |
| ±0dB | 0Ω | 19.5kΩ |

Table.b-2 (fc : variable)
Gain=14dB, fc =variable

| fc(Hz) | C1 (F) |
|--------|--------|
| 1.8k | 22n |
| 4k | 10n |
| 8.5k | 4.7n |
| 18k | 2.2n |

Gain vs Frequency (TONE TREBLE)

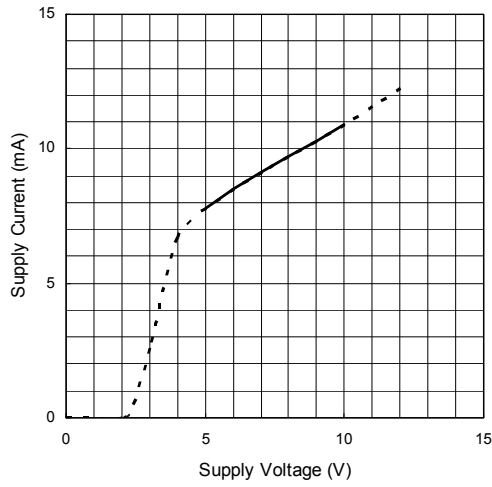
V+=9V, Vin=0.1Vrms, TONE Gain=+14dB, Ta=25°C



■ TYPICAL CHARACTERISTICS

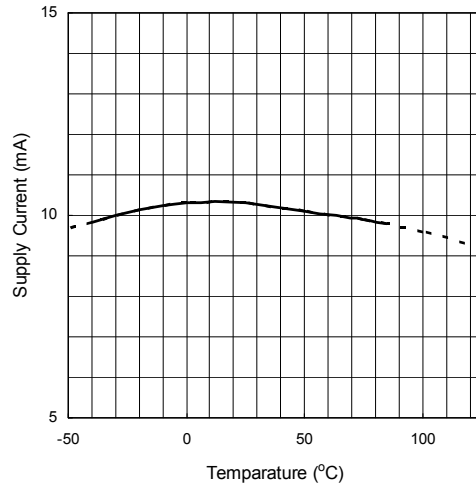
Supply Current vs Supply Voltage

Ta=25°C



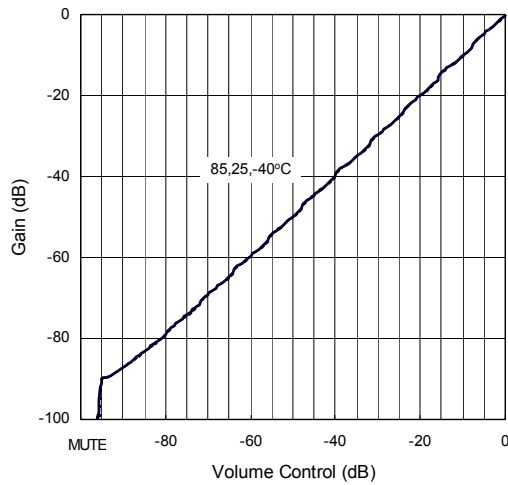
Supply Current vs Temperature

V+=9V



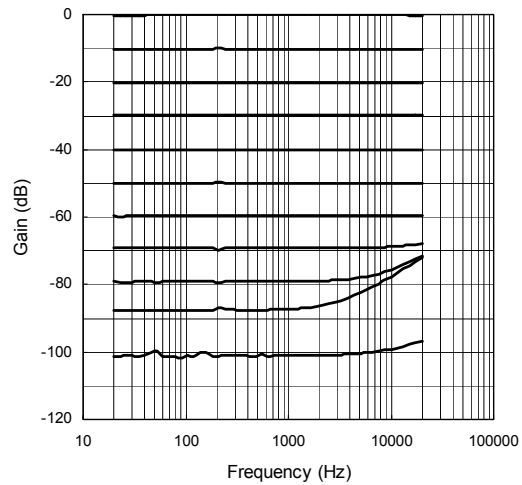
Gain vs Volume Control

V+=9V, Vin(VoIIN)=1Vrms, f=1kHz, Rg=0Ω



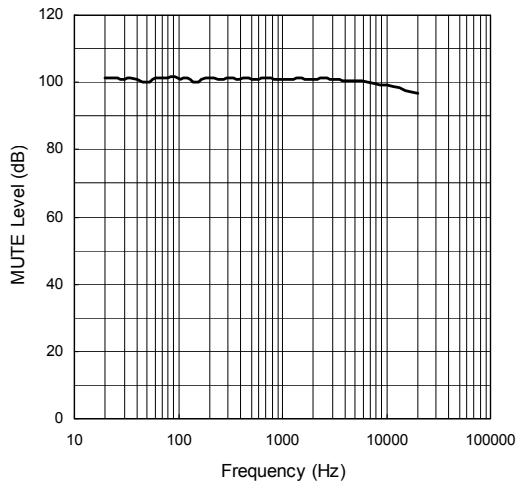
Gain vs Frequency (Volume)

V+=9V, VOL=0dB to MUTE -10dBstep, Vin=1Vrms, Ta=25°C



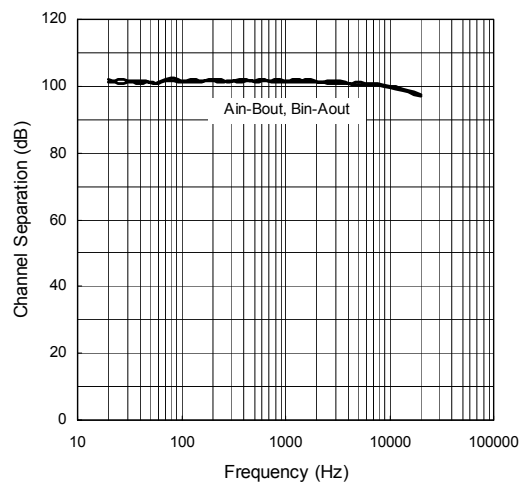
MUTE Level vs Frequency (MUTE)

V+=9V, Vin(VoIIN)=1Vrms, Vol=MUTE, Rg=0Ω, Ta=25°C



Channel Separation vs Frequency

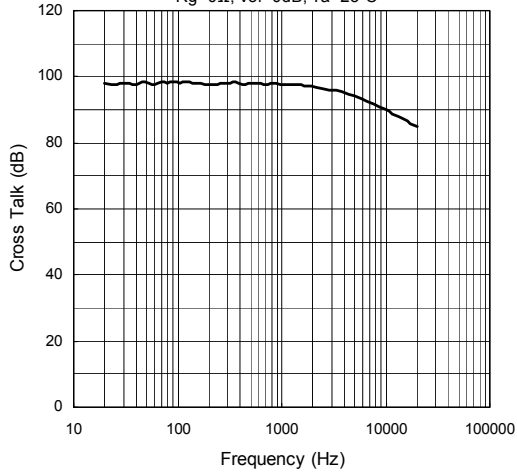
V+=9V, Vin=1Vrms, Vo=OUTPUT, Rg=0Ω, Vol=0dB, Ta=25°C



■ TYPICAL CHARACTERISTICS

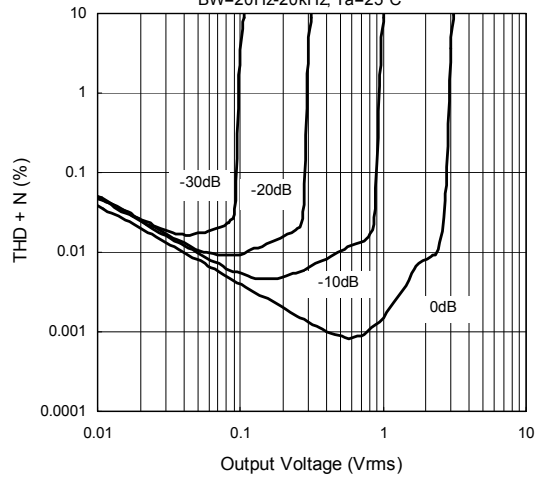
Cross Talk vs Frequency

$V+=9V$, $V_{in}(SEL2-5)=1V_{rms}$, $V_{in}(SEL1)=GND$, $V_o=OUTPUT$,
 $R_g=0\Omega$, $V_{ol}=0dB$, $T_a=25^\circ C$



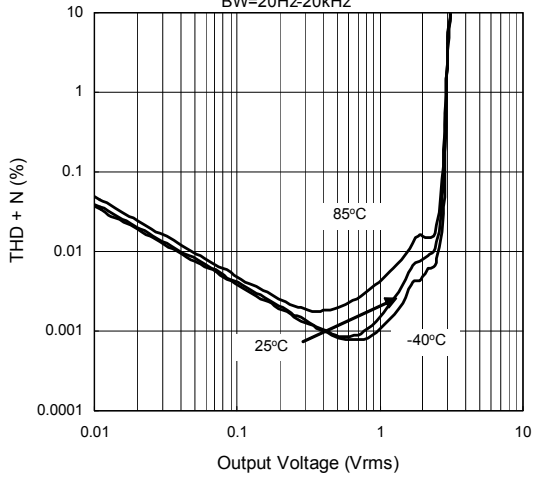
THD+N vs Output Voltage (Volume Sweep)

$V+=9V$, $V_{in}(Ach)$, $f=1kHz$, $V_o(Ach)OUTPUT$, $R_g=0\Omega$,
 $BW=20Hz-20kHz$, $T_a=25^\circ C$



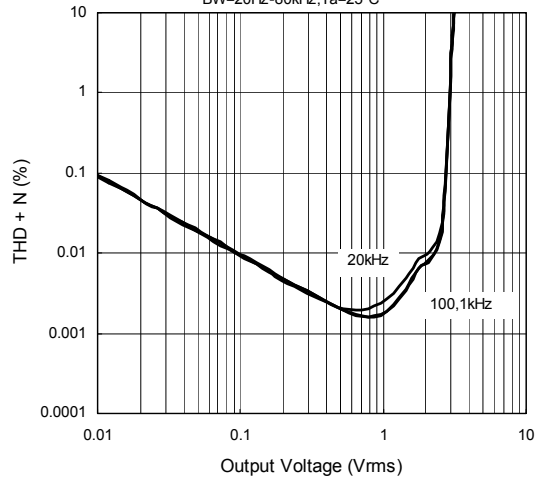
THD+N vs Output Voltage

$V+=9V$, $V_{in}(Ach)$, $f=1kHz$, $V_o(Ach)OUTPUT$, $R_g=0\Omega$,
 $BW=20Hz-20kHz$



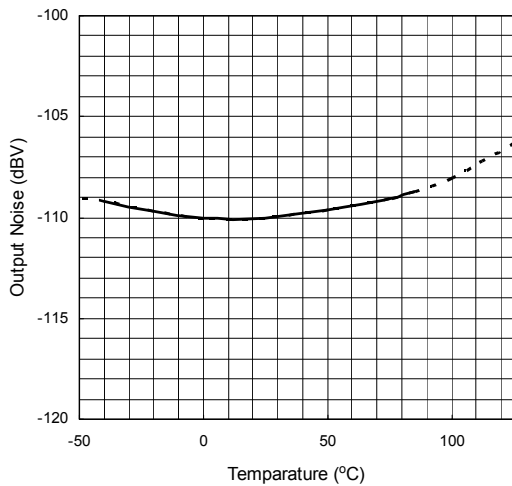
THD+N vs Output Voltage (Frequency Sweep)

$V+=9V$, $V_{in}(Ach)$, $V_o(Ach)OUTPUT$, $R_g=0\Omega$,
 $BW=20Hz-80kHz$, $T_a=25^\circ C$



Output Noise vs Temperature

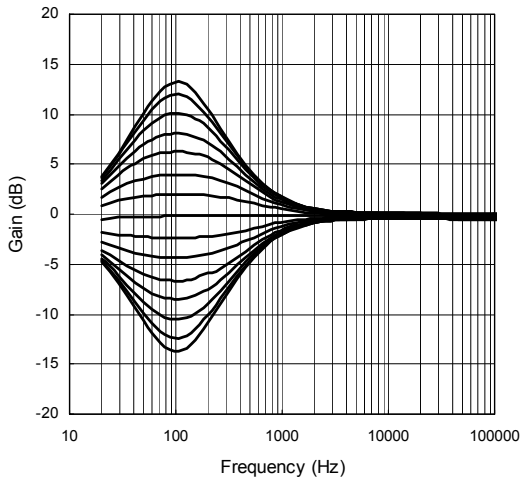
$V+=9V$, $V_{in}=GND$, $R_g=0\Omega$, A-weight



TYPICAL CHARACTERISTICS

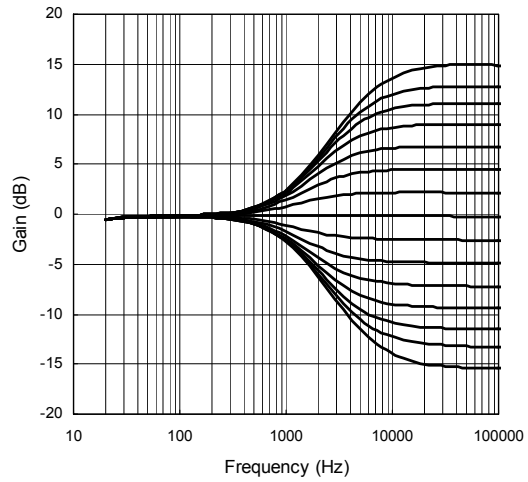
Gain vs Frequency (TONE BASS)

V+=9V, Vin=0.1Vrms, BASS Gain=2dB steps, Ta=25°C



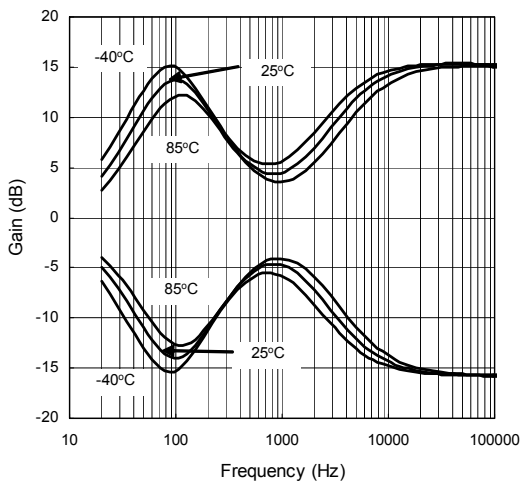
Gain vs Frequency (TONE TREB)

V+=9V, Vin=0.1Vrms, TREB Gain=2dB steps, Ta=25°C



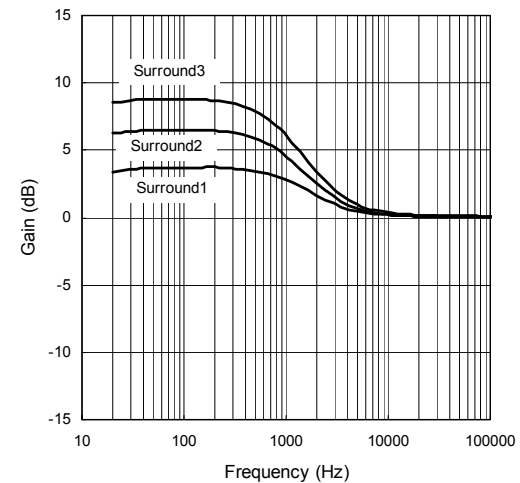
Gain vs Frequency (TONE)

V+=9V, Vin=0.1Vrms, TONE Gain=+14dB, -14dB



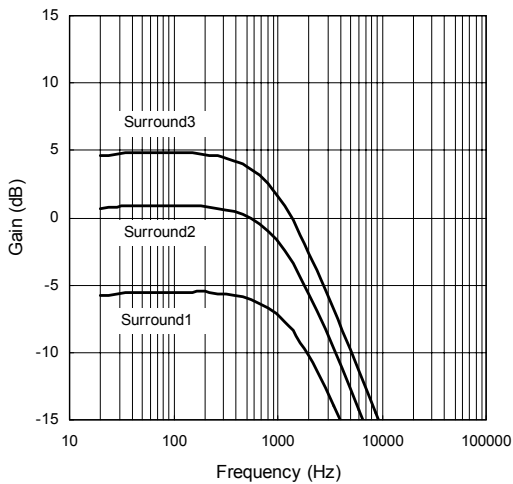
Gain vs Frequency (eala)

V+=9V, Vin(Ach)=0.1Vrms, Vout=Ach, Ta=25°C



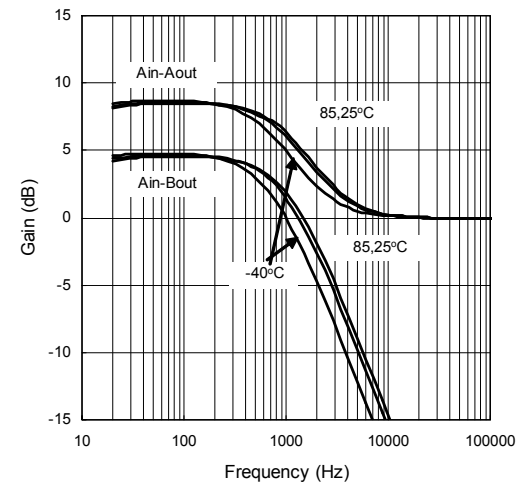
Gain vs Frequency (eala)

V+=9V, Vin(Ach)=0.1Vrms, Vout=Bch, Ta=25°C



Gain vs Frequency (eala)

V+=9V, Vin(Ach)=0.1Vrms, Surround level=Surround3



[CAUTION]

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