



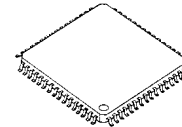
## AUDIO PROCESSOR with BBE Sound Enhancement & Passive Matrix TruSurround Virtualizer & TruBass

### ■ GENERAL DESCRIPTION

The **NJW1169** is an audio processor with Passive Matrix TruSurround Virtualizer, TruBass and BBE sound enhancement. It includes all of functions processing audio signal for TV, such as volume, balance, tone control, "eala" NJRC Surround, simulated stereo, mute function, line out and AGC function.

All of internal status and variables are controlled by I<sup>2</sup>C BUS.  
It is suitable for any TV set.

### ■ PACKAGE OUTLINE

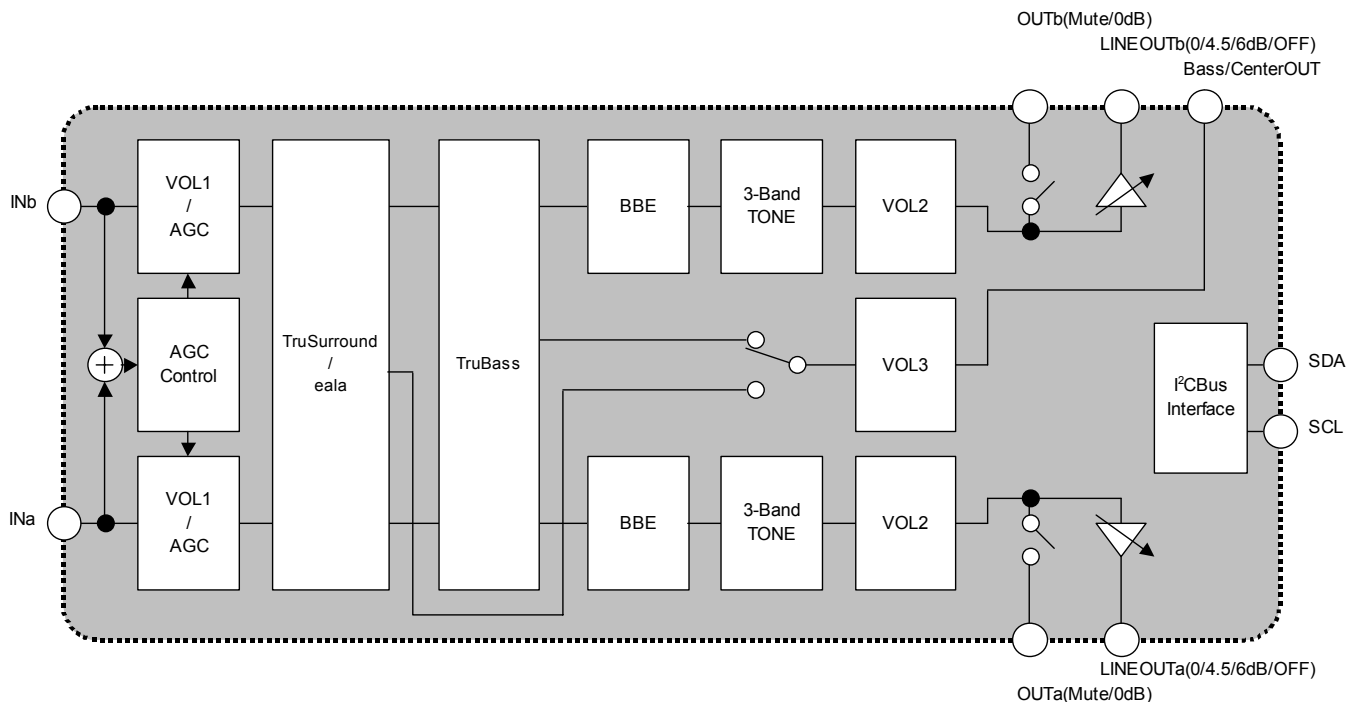


**NJW1169FH1**

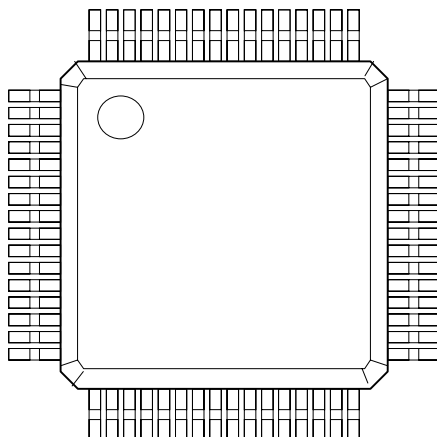
### ■ FEATURES

- Operating Voltage 8 to 13V
- I<sup>2</sup>C BUS Interface Fast mode
- Passive Matrix TruSurround
- TruBass Function
- Subwoofer Output
- "eala" (NJRC Surround) & Simulated Stereo
- Volume 0 to -80dB(0.33dB/step), MUTE
- Balance 0 to -30dB(1dB/step), MUTE
- Tone Control Bass/Middle/Treble, ±15dB(0.5dB/step)
- Bi-CMOS Technology
- Package Outline QFP64-H1

### ■ BLOCK DIAGRAM



## ■ PIN CONFIGURATION (QFP64)



| No. | SYMBOL             | FUNCTION                                      | No. | SYMBOL   | FUNCTION                                     |
|-----|--------------------|-----------------------------------------------|-----|----------|----------------------------------------------|
| 1   | HPF1a              | Ach HPF for TruBass Capacitor 1               | 33  | OUTb     | Bch Output (0dB)                             |
| 2   | HPF2a              | Ach HPF for TruBass Capacitor 2               | 34  | LINEOUTb | Bch Lineout (0/4.5/6.0/Mute)                 |
| 3   | HPF3a              | Ach HPF for TruBass Capacitor 3               | 35  | INb      | Bch Input                                    |
| 4   | TS1                | TruSurround Filter Capacitor 1                | 36  | Tone-Lb  | Bch Tone (Treble) Filter                     |
| 5   | TS2                | TruSurround Filter Capacitor 2                | 37  | Tone-M2b | Bch Tone (Middle) Filter 2                   |
| 6   | TS3                | TruSurround Filter Capacitor 3                | 38  | Tone-M1b | Bch Tone (Middle) Filter 1                   |
| 7   | VREFOUT            | Reference Voltage Output                      | 39  | Tone-Hb  | Bch Tone (Treble) Filter                     |
| 8   | BBE-La             | Ach BBE Filter (Lo Contour)                   | 40  | BBE-Hb   | Bch BBE Filter (Process)                     |
| 9   | BBE-Ha             | Ach BBE Filter (Process)                      | 41  | BBE-Lb   | Bch BBE Filter (Lo Contour)                  |
| 10  | Tone-Ha            | Ach Tone (Treble) Filter                      | 42  | SRS4     | SRS Filter Capacitor 4                       |
| 11  | Tone-M1a           | Ach Tone (Middle) Filter 1                    | 43  | SRS3     | SRS Filter Capacitor 3                       |
| 12  | Tone-M2a           | Ach Tone (Middle) Filter 2                    | 44  | SRS2     | SRS Filter Capacitor 2                       |
| 13  | Tone-La            | Ach Tone (Bass) Filter                        | 45  | SRS1     | SRS Filter Capacitor 1                       |
| 14  | INa                | Ach Input                                     | 46  | HPF3b    | Bch HPF for TruBass Capacitor 3              |
| 15  | LINEOUTa           | Ach Lineout (0/4.5/6.0/Mute)                  | 47  | HPF2b    | Bch HPF for TruBass Capacitor 2              |
| 16  | OUTa               | Ach Output (0dB)                              | 48  | HPF1b    | Bch HPF for TruBass Capacitor 1              |
| 17  | Bass<br>/CenterOUT | Bass/Center Output                            | 49  | ealaFil  | eala Filter Capacitor                        |
| 18  | AGCSENSE           | AGC Boost Level Setting Terminal              | 50  | CENTER   | SRS CENTER Effect Control Terminal           |
| 19  | AGCINT             | AGC Attack & Recovery Time Setting Terminal   | 51  | SPACE1   | SRS SPACE Effect Control Terminal 1          |
| 20  | VOLATC             | Pop Noise Reduction for Ach Volume Control    | 52  | SPACE2   | SRS SPACE Filter                             |
| 21  | VOLBTC             | Pop Noise Reduction for Bch Volume Control    | 53  | BPF3OUT  | BPF Output for TruBass Terminal 3            |
| 22  | SDA                | I <sup>2</sup> C Data Input                   | 54  | BPF3IN   | BPF Input for TruBass Terminal 3             |
| 23  | SCL                | I <sup>2</sup> C Clock Input                  | 55  | BPF2OUT  | BPF Output for TruBass Terminal 2            |
| 24  | GND                | Ground                                        | 56  | BPF2IN   | BPF Input for TruBass Terminal 2             |
| 25  | V+                 | Power Supply                                  | 57  | BPF1OUT  | BPF Output for TruBass Terminal 1            |
| 26  | VREFIN             | Reference Voltage Stabilizing Capacitor       | 58  | BPF1IN   | BPF Input for TruBass Terminal 1             |
| 27  | OUTTC              | Pop Noise Reduction for Lineout Gain Setting  | 59  | LPFOUT   | LPF Output for TruBass                       |
| 28  | TONELTC            | Pop Noise Reduction for Tone (Bass) Control   | 60  | LPF2     | LPF for TruBass Capacitor Terminal 2         |
| 29  | TONEMTC            | Pop Noise Reduction for Tone (Middle) Control | 61  | LPF1     | LPF for TruBass Capacitor Terminal 1         |
| 30  | TOHEHTC            | Pop Noise Reduction for Tone (Treble) Control | 62  | TBCONT   | TruBass Punch Control Terminal               |
| 31  | BBEHTC             | Pop Noise Reduction for BBE (Process) Control | 63  | SURTC    | Pop Noise Reduction for Surround Control     |
| 32  | TBTC               | Pop Noise Reduction for TruBass ON/OFF        | 64  | TBINT    | Capacitor Terminal for TruBass Time Constant |

## ■ ABSOLUTE MAXIMUM RATING (Ta=25°C)

| PARAMETER                   | SYMBOL         | RATING      | UNIT |
|-----------------------------|----------------|-------------|------|
| Supply Voltage              | V <sup>+</sup> | 15          | V    |
| Power Dissipation           | P <sub>D</sub> | 700*        | mW   |
| Operating Temperature Range | Topr           | -20 to +75  | °C   |
| Storage Temperature Range   | Tstg           | -40 to +125 | °C   |

\*(Note) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 2-Layers, FR-4) mounting

## ■ ELECTRICAL CHARACTERISTICS (Ta=25°C, V<sup>+</sup>=9V, R<sub>g</sub>=600Ω, R<sub>L</sub>=47kΩ, Vin=100mVrms/1kHz, MODE: VOL/BAL/TONE=0dB, SUR/BBE/TB/AGC=OFF unless otherwise specified)

| PARAMETER                  | SYMBOL              | TEST CONDITION                                 | MIN. | TYP.          | MAX.          | UNIT           |
|----------------------------|---------------------|------------------------------------------------|------|---------------|---------------|----------------|
| Operating Voltage          | V <sup>+</sup>      | -                                              | 8.0  | 9.0           | 13.0          | V              |
| Supply Current             | I <sub>CC</sub>     | No Signal                                      | -    | 17            | 45            | mA             |
| Reference Voltage          | V <sub>REF</sub>    | No Signal                                      | 4.0  | 4.5           | 5.0           | V              |
| Maximum Input Voltage      | V <sub>IM</sub>     | VOL=-20dB, THD=10%                             | 2.8  | 3.0           | -             | Vrms           |
| Maximum Output Voltage     | V <sub>OM</sub>     | OUTPUT, VOL=0dB, THD=1%                        | -    | 2.5           | -             | Vrms           |
| Channel Balance            | G <sub>CB</sub>     | VOL=0dB                                        | -1.5 | 0.0           | 1.5           | dB             |
| Balance Boost A            | BA <sub>BST</sub>   | CHS="0", BAL=Mute                              | -2.0 | 0.0           | 2.0           | dB             |
| Balance Cut A              | BA <sub>CUT</sub>   | CHS="1", BAL=Mute, Vin=1Vrms                   | -    | -             | -70           | dB             |
| Balance Boost B            | BB <sub>BST</sub>   | CHS="1", BAL=Mute                              | -2.0 | 0.0           | 2.0           | dB             |
| Balance Cut B              | BB <sub>CUT</sub>   | CHS="0", BAL=Mute, Vin=1Vrms                   | -    | -             | -70           | dB             |
| Total Harmonic Distortion  | THD                 | Vo=0.5Vrms<br>BW=400Hz to 30kHz                | -    | -             | 0.5           | %              |
| Maximum Gain               | G <sub>VMAX</sub>   | VOL=0dB                                        | -2.0 | 0.0           | 2.0           | dB             |
| Minimum Gain               | G <sub>VMIN</sub>   | VOL=Mute                                       | -    | -             | -70           | dB             |
| Line Output Voltage Gain 1 | G <sub>VLINE1</sub> | LINEOUT G=0dB, VOL=0dB                         | -2.0 | 0.0           | 2.0           | dB             |
| Line Output Voltage Gain 2 | G <sub>VLINE2</sub> | LINEOUT G=4.5dB, VOL=0dB                       | 2.5  | 4.5           | 6.5           | dB             |
| Line Output Voltage Gain 3 | G <sub>VLINE3</sub> | LINEOUT G=6dB, VOL=0dB                         | 4.0  | 6.0           | 8.0           | dB             |
| Channel Separation         | CS                  | Vin=1Vrms                                      | -    | -             | -70           | dB             |
| Output Noise 1             | V <sub>NO1</sub>    | VOL=0dB<br>BW=400Hz to 30kHz                   | -    | -90<br>(31.6) | -85<br>(56.2) | dBV<br>(μVrms) |
| Output Noise 2             | V <sub>NO2</sub>    | VOL=Mute<br>BW=400Hz to 30kHz                  | -    | -106<br>(5.0) | -96<br>(15.8) | dBV<br>(μVrms) |
| Output Noise 3             | V <sub>NO3</sub>    | LINEOUT G=4.5dB, VOL=0dB<br>BW=400Hz to 30kHz  | -    | -85<br>(56.2) | -80<br>(100)  | dBV<br>(μVrms) |
| Output Noise 4             | V <sub>NO4</sub>    | LINEOUT G=4.5dB, VOL=Mute<br>BW=400Hz to 30kHz | -    | -101<br>(8.9) | -91<br>(28.2) | dBV<br>(μVrms) |

BW: Band Width

■ **ELECTRICAL CHARACTERISTICS** (Ta=25°C, V+=9V, Rg=600Ω, RL=47kΩ, Vin=100mVrms/1kHz,  
MODE: VOL/BAL/TONE=0dB, SUR/BBE/TB/AGC=OFF unless otherwise specified)

◆ **TONE CONTROL**

| PARAMETER              | SYMBOL             | TEST CONDITION      | MIN.  | TYP.  | MAX.  | UNIT |
|------------------------|--------------------|---------------------|-------|-------|-------|------|
| High Frequency Boost   | G <sub>HFBST</sub> | TREB=+15dB, f=10kHz | 12.5  | 15.0  | 17.5  | dB   |
| High Frequency Flat    | G <sub>HFFLT</sub> | TREB=0dB, f=10kHz   | -2.0  | 0.0   | 2.0   | dB   |
| High Frequency Cut     | G <sub>HFCUT</sub> | TREB=-15dB, f=10kHz | -17.5 | -15.0 | -12.5 | dB   |
| Middle Frequency Boost | G <sub>MFBST</sub> | MID=+15dB, f=1kHz   | 12.5  | 15.0  | 17.5  | dB   |
| Middle Frequency Flat  | G <sub>MFFLT</sub> | MID=0dB, f=1kHz     | -2.0  | 0.0   | 2.0   | dB   |
| Middle Frequency Cut   | G <sub>MFCUT</sub> | MID=-15dB, f=1kHz   | -17.5 | -15.0 | -12.5 | dB   |
| Low Frequency Boost    | G <sub>LFBST</sub> | BASS=+15dB, f=100Hz | 12.5  | 15.0  | 17.5  | dB   |
| Low Frequency Flat     | G <sub>LFFLT</sub> | BASS=0dB, f=100Hz   | -2.0  | 0.0   | 2.0   | dB   |
| Low Frequency Cut      | G <sub>LFCUT</sub> | BASS=-15dB, f=100Hz | -17.5 | -15.0 | -12.5 | dB   |

◆ **AGC CHARACTERISTICS (AGC=ON)**

| PARAMETER | SYMBOL              | TEST CONDITION                      | MIN. | TYP. | MAX. | UNIT |
|-----------|---------------------|-------------------------------------|------|------|------|------|
| AGC Boost | G <sub>AGCBST</sub> | Vin=50mVrms, f=1kHz                 | 1.5  | 3.5  | 5.5  | dB   |
| AGC Flat  | G <sub>AGCFLT</sub> | Vin=300mVrms, f=1kHz<br>Rsense=24kΩ | -2.5 | 0.0  | 2.5  | dB   |
| AGC Cut   | G <sub>AGCCUT</sub> | Vin=2Vrms, f=1kHz                   | -14  | -10  | -6.0 | dB   |

◆ **BBE CHARACTERISTICS (BBE=ON)**

| PARAMETER       | SYMBOL               | TEST CONDITION           | MIN. | TYP. | MAX. | UNIT |
|-----------------|----------------------|--------------------------|------|------|------|------|
| Low Boost Gain  | G <sub>BBELOW</sub>  | BBE-LOW =+15dB, f=50Hz   | 12.5 | 15.0 | 17.5 | dB   |
| High Boost Gain | G <sub>BBEHIGH</sub> | BBE-HIGH =+15dB, f=10kHz | 12.5 | 15.0 | 17.5 | dB   |

◆ **eala CHARACTERISTICS (SUR=ON)**

| PARAMETER                 | SYMBOL            | TEST CONDITION                    | MIN. | TYP. | MAX. | UNIT |
|---------------------------|-------------------|-----------------------------------|------|------|------|------|
| Simulated Surround Gain 1 | G <sub>SIMA</sub> | INa+INb→OUTa, f=1kHz<br>SUR=MONO  | 1.0  | 3.0  | 5.0  | dB   |
| Simulated Surround Gain 2 | G <sub>SIMB</sub> | INa+INb→OUTb, f=1kHz<br>SUR=MONO  | 1.0  | 3.0  | 5.0  | dB   |
| Surround Gain 1           | G <sub>3D1</sub>  | INa→OUTa, f=100Hz<br>SUR=ealaLow  | 1.5  | 3.5  | 5.5  | dB   |
| Surround Gain 2           | G <sub>3D2</sub>  | INa→OUTa, f=100Hz<br>SUR=ealaMid  | 3.5  | 5.5  | 7.5  | dB   |
| Surround Gain 3           | G <sub>3D3</sub>  | INa→OUTa, f=100Hz<br>SUR=ealaHigh | 8.0  | 10.0 | 12.0 | dB   |
| Surround Gain 4           | G <sub>3D4</sub>  | INa→OUTb, f=100Hz<br>SUR=ealaHigh | 5.0  | 7.0  | 9.0  | dB   |

■ **ELECTRICAL CHARACTERISTICS** (Ta=25°C, V+=9V, Rg=600Ω, RL=47kΩ, Vin=100mVrms/1kHz,  
MODE: VOL/BAL/TONE=0dB, SUR/BBE/TB/AGC=OFF unless otherwise specified)

◆ **TruSurround CHARACTERISTICS (SUR=ON)**

| PARAMETER          | SYMBOL           | TEST CONDITION             | MIN.  | TYP.  | MAX. | UNIT |
|--------------------|------------------|----------------------------|-------|-------|------|------|
| TruSurround Gain 1 | G <sub>TS1</sub> | INa→OUTa, f=1kHz<br>SUR=TS | 0.3   | 2.3   | 4.3  | dB   |
| TruSurround Gain 2 | G <sub>TS2</sub> | INa→OUTb, f=1kHz<br>SUR=TS | -13.4 | -11.4 | -9.4 | dB   |

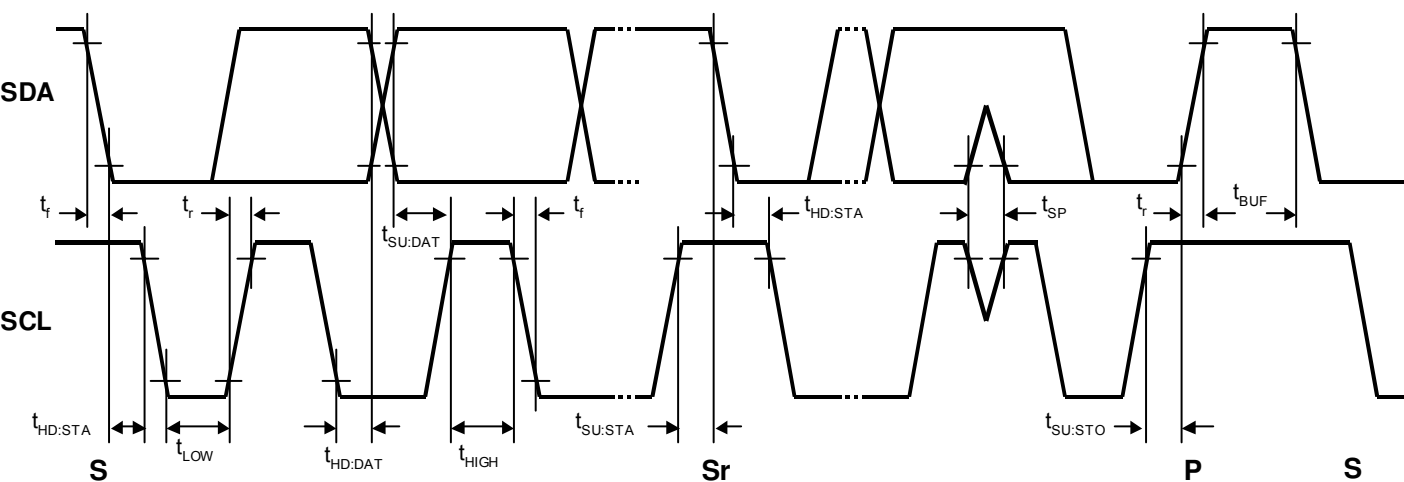
◆ **SRS 3D CHARACTERISTICS (SUR=ON)**

| PARAMETER         | SYMBOL               | TEST CONDITION                                                                        | MIN.  | TYP.  | MAX.  | UNIT |
|-------------------|----------------------|---------------------------------------------------------------------------------------|-------|-------|-------|------|
| Feed Through Gain | G <sub>THROUGH</sub> | INa→OUTa, f=1kHz<br>SPACE1 VR=Min.<br>SPACE2 VR=Max.<br>CENTER VR=Min.<br>SUR=SRS 3D  | -20.2 | -18.2 | -16.2 | dB   |
| L+R Gain          | G <sub>L+R</sub>     | INa→OUTb, f=1kHz<br>SPACE1 VR=Min.<br>SPACE2 VR=Max.<br>CENTER VR=Max.<br>SUR=SRS 3D  | -15.0 | -13.0 | -11.0 | dB   |
| L-R Gain          | G <sub>L-R</sub>     | INa→OUTa, f=125Hz<br>SPACE1 VR=Max.<br>SPACE2 VR=Max.<br>CENTER VR=Min.<br>SUR=SRS 3D | -2.0  | 0.0   | 2.0   | dB   |

◆ **TruBass CHARACTERISTICS (TB=ON, f<sub>0</sub>=60Hz setting)**

| PARAMETER      | SYMBOL           | TEST CONDITION                                            | MIN. | TYP. | MAX. | UNIT |
|----------------|------------------|-----------------------------------------------------------|------|------|------|------|
| TruBass Gain 1 | G <sub>TB1</sub> | INa+INb→OUTa, f=60Hz<br>TB VR=∞                           | 4.0  | 6.0  | 8.0  | dB   |
| TruBass Gain 2 | G <sub>TB2</sub> | INa+INb→OUTb, f=60Hz<br>TB VR=0Ω                          | 16.0 | 18.0 | 20.0 | dB   |
| TruBass Gain 3 | G <sub>TB3</sub> | INa+INb→OUTa, f=60Hz<br>TB VR=∞, V <sub>IN</sub> =1Vrms   | -2.0 | 0.0  | 2.0  | dB   |
| TruBass Gain 4 | G <sub>TB4</sub> | INa-INb→OUTa, f=120Hz<br>TB VR=0Ω, V <sub>IN</sub> =1Vrms | -5.0 | -3.0 | -1.0 | dB   |
| TruBass Gain 5 | G <sub>TB5</sub> | INa-INb→OUTb, f=120Hz<br>TB VR=0Ω, V <sub>IN</sub> =2Vrms | -5.0 | -3.0 | -1.0 | dB   |

■TIMING ON THE I<sup>2</sup>C BUS (SDA,SCL)



■CHARACTERISTICS OF I/O STAGES FOR I<sup>2</sup>C BUS (SDA,SCL)

I<sup>2</sup>C BUS Load Conditions  
STANDARD MODE : Pull up resistance 4k $\Omega$  (Connected to +5V), Load capacitance 200pF (Connected to GND)  
FAST MODE : Pull up resistance 4k $\Omega$  (Connected to +5V), Load capacitance 50pF (Connected to GND)

| PARAMETER                                                                                             | SYMBOL          | Standard mode |      |      | Fast mode |      |      | UNIT    |
|-------------------------------------------------------------------------------------------------------|-----------------|---------------|------|------|-----------|------|------|---------|
|                                                                                                       |                 | MIN.          | TYP. | MAX. | MIN.      | TYP. | MAX. |         |
| Low Level Input Voltage                                                                               | V <sub>IL</sub> | 0.0           | -    | 1.5  | 0.0       | -    | 1.5  | V       |
| High Level Input Voltage                                                                              | V <sub>IH</sub> | 2.7           | -    | 5.0  | 2.7       | -    | 5.0  | V       |
| Low level output voltage (3mA at SDA pin)                                                             | V <sub>OL</sub> | 0             | -    | 0.4  | 0         | -    | 0.4  | V       |
| Input current each I/O pin with an input voltage between 0.1V <sub>DD</sub> and 0.9V <sub>DDmax</sub> | I <sub>i</sub>  | -10           | -    | 10   | -10       | -    | 10   | $\mu$ A |

## ■CHARACTERISTICS OF BUS LINES (SDA,SCL) FOR I<sup>2</sup>C-BUS DEVICES

| PARAMETER                                        | SYMBOL              | Standard mode |      |      | Fast mode |      |      | UNIT |
|--------------------------------------------------|---------------------|---------------|------|------|-----------|------|------|------|
|                                                  |                     | MIN.          | TYP. | MAX. | MIN.      | TYP. | MAX. |      |
| SCL clock frequency                              | f <sub>SCL</sub>    | -             | -    | 100  | -         | -    | 400  | kHz  |
| Hold time (repeated) START condition.            | t <sub>HD:STA</sub> | 4.0           | -    | -    | 0.6       | -    | -    | μs   |
| Low period of the SCL clock                      | t <sub>LOW</sub>    | 4.7           | -    | -    | 1.3       | -    | -    | μs   |
| High period of the SCL clock                     | t <sub>HIGH</sub>   | 4.0           | -    | -    | 0.6       | -    | -    | μs   |
| Set-up time for a repeated START condition       | t <sub>SU:STA</sub> | 4.7           | -    | -    | 0.6       | -    | -    | μs   |
| Data hold time <sup>(NOTE)</sup>                 | t <sub>HD:DAT</sub> | 0             | -    | -    | 0         | -    | -    | μs   |
| Data set-up time                                 | t <sub>SU:DAT</sub> | 250           | -    | -    | 100       | -    | -    | ns   |
| Rise time of both SDA and SCL signals            | t <sub>r</sub>      | -             | -    | 1000 | -         | -    | 300  | ns   |
| Fall time of both SDA and SCL signals            | t <sub>f</sub>      | -             | -    | 300  | -         | -    | 300  | ns   |
| Set-up time for STOP condition                   | t <sub>SU:STO</sub> | 4.0           | -    | -    | 0.6       | -    | -    | μs   |
| Bus free time between a STOP and START condition | t <sub>BUF</sub>    | 4.7           | -    | -    | 1.3       | -    | -    | μs   |
| Capacitive load for each bus line                | C <sub>b</sub>      | -             | -    | 400  | -         | -    | 400  | pF   |
| Noise margin at the Low level                    | V <sub>nL</sub>     | 0.5           | -    | -    | 0.5       | -    | -    | V    |
| Noise margin at the High level                   | V <sub>nH</sub>     | 1             | -    | -    | 1         | -    | -    | V    |

C<sub>b</sub> ; total capacitance of one bus line in pF.

NOTE). Data hold time : t<sub>HD:DAT</sub>

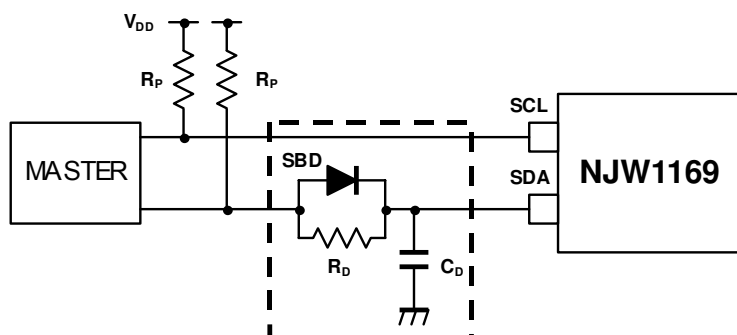
Please hold the Data Hold Time (t<sub>HD:DAT</sub>) to 300ns or more to avoid status of unstable at SCL falling edge.

The SDA block in the NJW1169 does not hold data. Add external data-delay-circuit of the SDA terminal, in case of not providing a hold time of at least 300nsec for the SDA in the master device.

The time-consists of the data-delay-circuit of the SDA terminal are as follows.

- (a) Low level → High level :  $T_{LH} \approx R_P \cdot C_D$   
 (b) High level → Low level :  $T_{HL} \approx R_D \cdot C_D$

In addition, Schottky barrier diode (SBD) influences a Low level at the Acknowledge. Therefore choose the low forward voltage (V<sub>f</sub>) as much as possible.



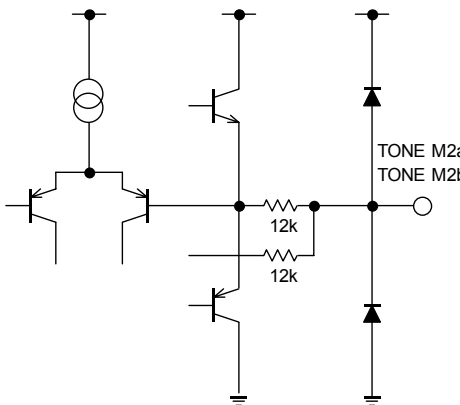
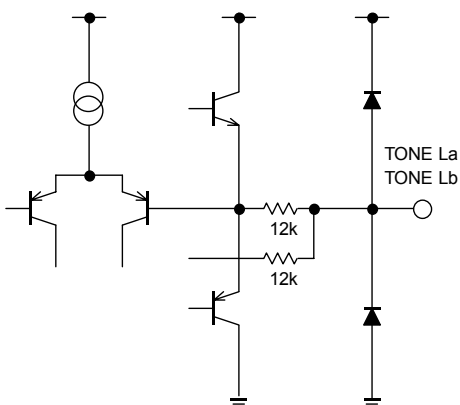
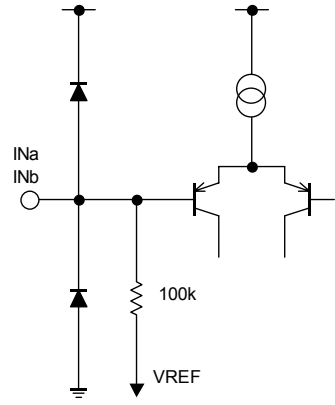
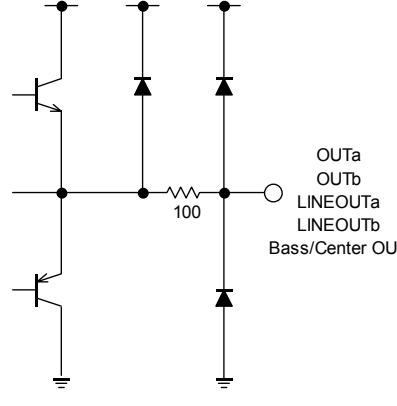
■ TERMINAL DESCRIPTION

| No.         | SYMBOL            | FUNCTION                                                                                           | EQUIVALENT CIRCUIT | VOLTAGE |
|-------------|-------------------|----------------------------------------------------------------------------------------------------|--------------------|---------|
| 1<br>48     | HPF1a<br>HPF1b    | Ach HPF for TruBass Capacitor 1<br>Bch HPF for TruBass Capacitor 1                                 |                    | V+/2    |
| 2<br>47     | HPF2a<br>HPF2b    | Ach HPF for TruBass Capacitor 2<br>Bch HPF for TruBass Capacitor 2                                 |                    | V+/2    |
| 3<br>46     | HPF3a<br>HPF3b    | Ach HPF for TruBass Capacitor 3<br>Bch HPF for TruBass Capacitor 3                                 |                    | V+/2    |
| 4<br>5<br>6 | TS1<br>TS2<br>TS3 | TruSurround Filter Capacitor 1<br>TruSurround Filter Capacitor 2<br>TruSurround Filter Capacitor 3 |                    | V+/2    |

■ TERMINAL DESCRIPTION

| No.                | SYMBOL                               | FUNCTION                                                                                                           | EQUIVALENT CIRCUIT | VOLTAGE |
|--------------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------|---------|
| 7                  | VREFOUT                              | Reference Voltage Output                                                                                           |                    | $V+/2$  |
| 8<br>41<br>9<br>40 | BBE-La<br>BBE-Lb<br>BBE-Ha<br>BBE-Hb | Ach BBE Filter (Lo Contour)<br>Bch BBE Filter (Lo Contour)<br>Ach BBE Filter (Process)<br>Bch BBE Filter (Process) |                    | $V+/2$  |
| 10<br>39           | TONE-Ha<br>TONE-Hb                   | Ach Tone (Treble) Filter<br>Bch Tone (Treble) Filter                                                               |                    | $V+/2$  |
| 11<br>38           | TONE-M1a<br>TONE-M1b                 | Ach Tone (Middle) Filter 1<br>Bch Tone (Middle) Filter 1                                                           |                    | $V+/2$  |

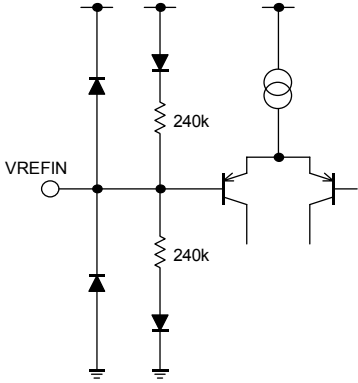
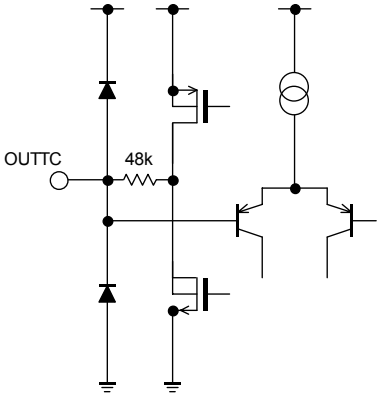
■ TERMINAL DESCRIPTION

| No.                        | SYMBOL                                                  | FUNCTION                                                                                                                   | EQUIVALENT CIRCUIT                                                                   | VOLTAGE |
|----------------------------|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------|
| 12<br>37                   | TONE-M2a<br>TONE-M2b                                    | Ach Tone (Middle) Filter 2<br>Ach Tone (Middle) Filter 2                                                                   |    | V+/2    |
| 13<br>36                   | TONE-La<br>TONE-Lb                                      | Ach Tone (Bass) Filter<br>Ach Tone (Bass) Filter                                                                           |   | V+/2    |
| 14<br>35                   | INa<br>INb                                              | Ach Input<br>Bch Input                                                                                                     |  | V+/2    |
| 15<br>34<br>16<br>33<br>17 | LINEOUTa<br>LINEOUTb<br>OUTa<br>OUTb<br>Bass/Center OUT | Ach Lineout (0/4.5/6.0/Mute)<br>Bch Lineout (0/4.5/6.0/Mute)<br>Ach Output (0dB)<br>Bch Output (0dB)<br>Bass/Center Output |  | V+/2    |

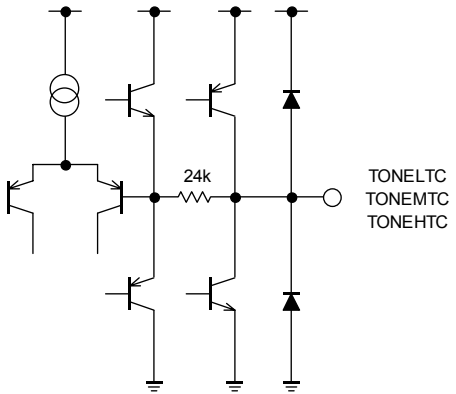
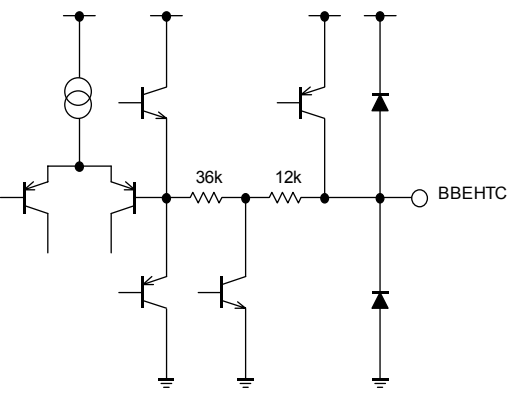
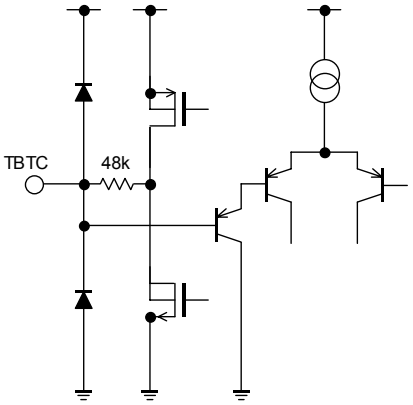
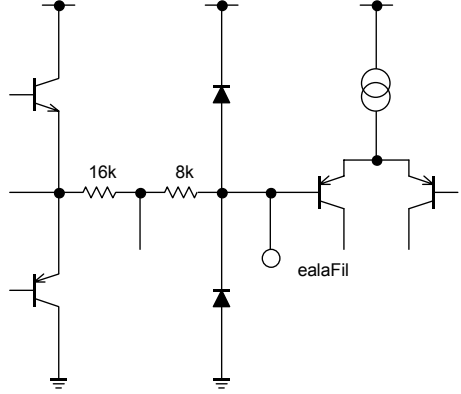
## ■ TERMINAL DESCRIPTION

| No.      | SYMBOL           | FUNCTION                                                                                 | EQUIVALENT CIRCUIT | VOLTAGE                    |
|----------|------------------|------------------------------------------------------------------------------------------|--------------------|----------------------------|
| 18       | AGCSENSE         | AGC Boost Level Setting Terminal                                                         |                    | 0V                         |
| 19       | AGCINT           | AGC Attack & Recovery Time Setting Terminal                                              |                    | 1.4V                       |
| 20<br>21 | VOLATC<br>VOLBTC | Pop Noise Reduction for Ach Volume Control<br>Pop Noise Reduction for Bch Volume Control |                    | Vref=0.7V<br>(VOL=BAL=0dB) |
| 22<br>23 | SDA<br>SCL       | I <sup>2</sup> C Data Input<br>I <sup>2</sup> C Clock Input                              |                    | -                          |

■ TERMINAL DESCRIPTION

| No. | SYMBOL | FUNCTION                                     | EQUIVALENT CIRCUIT                                                                   | VOLTAGE          |
|-----|--------|----------------------------------------------|--------------------------------------------------------------------------------------|------------------|
| 24  | GND    | Ground                                       | -                                                                                    | -                |
| 25  | V+     | Power Supply                                 | -                                                                                    | -                |
| 26  | VREFIN | Reference Voltage Stabilizing Capacitor      |  | V+/2             |
| 27  | OUTTC  | Pop Noise Reduction for Lineout Gain Setting |  | 0V<br>(OUT-Mute) |

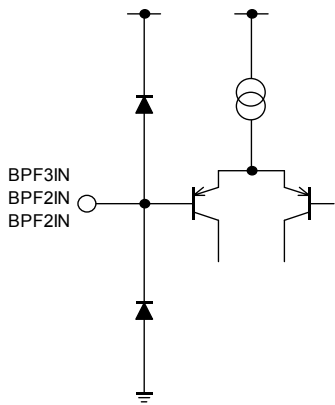
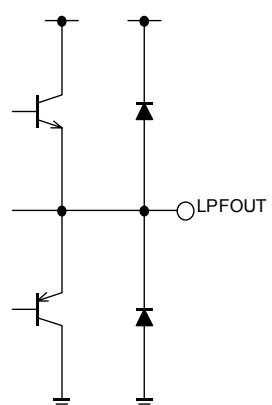
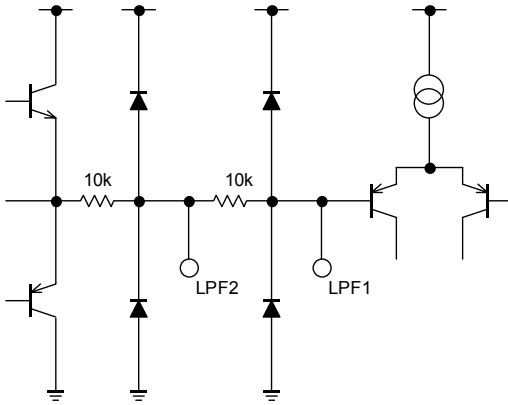
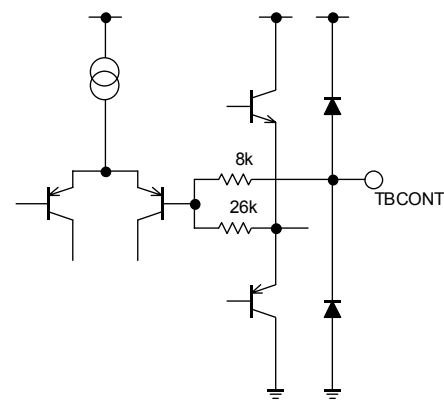
## ■ TERMINAL DESCRIPTION

| No.            | SYMBOL                        | FUNCTION                                                                                                                                               | EQUIVALENT CIRCUIT                                                                   | VOLTAGE                  |
|----------------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------|
| 28<br>29<br>30 | TONELTC<br>TONEMTC<br>TONEHTC | Pop Noise Reduction for Tone<br>(Bass) Control<br>Pop Noise Reduction for Tone<br>(Middle) Control<br>Pop Noise Reduction for Tone<br>(Treble) Control |    | Vref-0.7V<br>(Tone=FLAT) |
| 31             | BBEHTC                        | Pop Noise Reduction for BBE<br>(Process) Control                                                                                                       |   | Vref-0.2V<br>(BBE=OFF)   |
| 32             | TBTC                          | Pop Noise Reduction for TruBass<br>ON/OFF                                                                                                              |  | 0V<br>(TB=OFF)           |
| 49             | ealaFil                       | eala Filter Capacitor                                                                                                                                  |  | V+/2                     |

■ TERMINAL DESCRIPTION

| No.            | SYMBOL                        | FUNCTION                                                                                                    | EQUIVALENT CIRCUIT | VOLTAGE |
|----------------|-------------------------------|-------------------------------------------------------------------------------------------------------------|--------------------|---------|
| 50             | CENTER                        | SRS CENTER Effect Control Terminal                                                                          |                    | V+/2    |
| 51             | SPACE1                        | SRS SPACE Effect Control Terminal 1                                                                         |                    | V+/2    |
| 52             | SPACE2                        | SRS SPACE Filter                                                                                            |                    | V+/2    |
| 53<br>55<br>57 | BPF3OUT<br>BPF2OUT<br>BPF1OUT | BPF Output for TruBass Terminal 3<br>BPF Output for TruBass Terminal 2<br>BPF Output for TruBass Terminal 1 |                    | V+/2    |

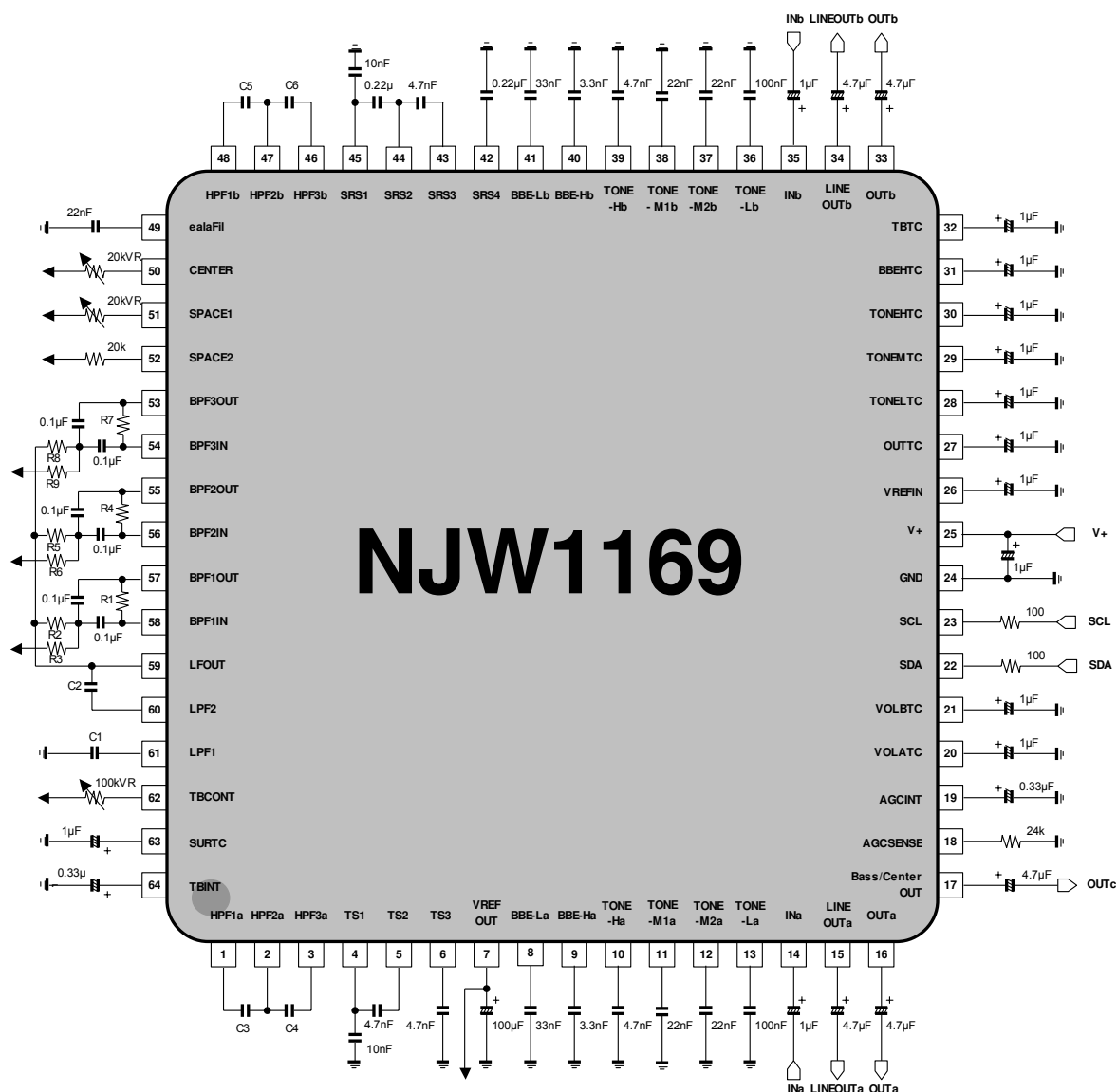
## ■ TERMINAL DESCRIPTION

| No.            | SYMBOL                     | FUNCTION                                                                                                          | EQUIVALENT CIRCUIT                                                                   | VOLTAGE |
|----------------|----------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------|
| 54<br>56<br>58 | BPF3IN<br>BPF2IN<br>BPF1IN | BPF Input for TruBass<br>Terminal 3<br>BPF Input for TruBass<br>Terminal 2<br>BPF Input for TruBass<br>Terminal 1 |    | V+/2    |
| 59             | LPFOUT                     | LPF Output for TruBass                                                                                            |   | V+/2    |
| 60<br>61       | LPF2<br>LPF1               | LPF for TruBass Capacitor<br>Terminal 2<br>LPF for TruBass Capacitor<br>Terminal 1                                |  | V+/2    |
| 62             | TBCONT                     | TruBass Punch Control<br>Terminal                                                                                 |  | V+/2    |

■ TERMINAL DESCRIPTION

| No. | SYMBOL | FUNCTION                                     | EQUIVALENT CIRCUIT | VOLTAGE           |
|-----|--------|----------------------------------------------|--------------------|-------------------|
| 63  | SURTC  | Pop Noise Reduction for Surround Control     |                    | 1.4V<br>(SUR=OFF) |
| 64  | TBINT  | Capacitor Terminal for TruBass Time Constant |                    | 0V<br>(TB=OFF)    |

## APPLICATION CIRCUIT



| TruBass<br>Speaker Size<br>f <sub>0</sub> Setting | Resistance Value [kΩ] |      |       |      |      |      |      |      |      | Capacitance Value [nF] |     |     |     |     |     |
|---------------------------------------------------|-----------------------|------|-------|------|------|------|------|------|------|------------------------|-----|-----|-----|-----|-----|
|                                                   | R1                    | R2   | R3    | R4   | R5   | R6   | R7   | R8   | R9   | C1                     | C2  | C3  | C4  | C5  | C6  |
| 40Hz                                              | 78.7                  | 20   | 6.65  | 107  | 26.7 | 8.87 | 158  | 40.2 | 13.3 | 270                    | 270 | 33  | 33  | 33  | 33  |
| 60Hz                                              | 53.6                  | 13.3 | 4.42  | 71.5 | 17.8 | 5.9  | 107  | 26.7 | 8.87 | 180                    | 180 | 22  | 22  | 22  | 22  |
| 100Hz                                             | 31.6                  | 7.87 | 2.67  | 42.2 | 10.7 | 3.57 | 63.4 | 15.8 | 5.36 | 100                    | 100 | 12  | 12  | 12  | 12  |
| 150Hz                                             | 21                    | 5.36 | 1.78  | 28   | 7.15 | 2.37 | 42.2 | 10.7 | 3.57 | 68                     | 68  | 8.2 | 8.2 | 8.2 | 8.2 |
| 200Hz                                             | 15.8                  | 4.02 | 1.33  | 21   | 5.36 | 1.78 | 31.6 | 7.87 | 2.67 | 56                     | 56  | 6.8 | 6.8 | 6.8 | 6.8 |
| 250Hz                                             | 12.7                  | 3.16 | 1.07  | 16.9 | 4.22 | 1.4  | 25.5 | 6.34 | 2.1  | 39                     | 39  | 5.6 | 5.6 | 5.6 | 5.6 |
| 300Hz                                             | 12.7                  | 3.16 | 1.07  | 15.8 | 4.02 | 1.33 | 21   | 5.36 | 1.78 | 39                     | 39  | 4.7 | 4.7 | 4.7 | 4.7 |
| 400Hz                                             | 10.7                  | 2.67 | 0.887 | 12.7 | 3.16 | 1.07 | 15.8 | 4.02 | 1.33 | 33                     | 33  | 3.9 | 3.9 | 3.9 | 3.9 |

\*) The standard TruBass speaker size setting is as aforementioned.  
Set the speaker size setting by TruBass effect of your application.

NOTE1) Separate the I<sup>2</sup>C bus line from the following terminals for avoiding digital noise problem.

Especially, the terminals for BBE filter (No.8, 9, 40 and 41) and Tone filter (No.10 to 13 and 36 to 39) are easily influenced.

| Pin No. | Symbol | Pin No. | Symbol   | Pin No. | Symbol | Pin No. | Symbol  | Pin No. | Symbol  |
|---------|--------|---------|----------|---------|--------|---------|---------|---------|---------|
| 1       | HPF1a  | 10      | Tone-Ha  | 40      | BBE-Hb | 48      | HPF1b   | 56      | BPF2IN  |
| 2       | HPF2a  | 11      | Tone-M1a | 41      | BBE-Lb | 49      | ealaFIL | 57      | BPF1OUT |
| 3       | HPF3a  | 12      | Tone-M2a | 42      | SRS4   | 50      | CENTER  | 58      | BPF1IN  |
| 4       | TS1    | 13      | Tone-La  | 43      | SRS3   | 51      | SPACE1  | 59      | LPFOUT  |
| 5       | TS2    | 36      | Tone-Lb  | 44      | SRS2   | 52      | SPACE2  | 60      | LPF2    |
| 6       | TS3    | 37      | Tone-M2b | 45      | SRS1   | 53      | BPF3OUT | 61      | LPF1    |
| 8       | BBE-La | 38      | Tone-M1b | 46      | HPF3b  | 54      | BPF3IN  | 62      | TBCONT  |
| 9       | BBE-Ha | 39      | Tone-Hb  | 47      | HPF2b  | 55      | BPF2OUT | -       | -       |

NOTE 2) The constant of capacitors connected to the terminals No.8, 9, 40 and 41 are designated by BBE Sound Inc.  
Do not change the constant of these capacitors without the approval of BBE Sound Inc.

NOTE 3) The constant of capacitors and resistors connected to the terminals No.1 to 6, 42 to 48, 53 to 62 and 64 are designated by SRS Labs Inc. Do not change the constant of these parts without the approval of SRS Labs Inc.

## ■ DEFINITION OF I<sup>2</sup>C REGISTER

### ● I<sup>2</sup>C BUS FORMAT



S: Starting Term

A: Acknowledge Bit

P: Ending Term

### ● SLAVE ADDRESS

|     |   |   |   |   |   |   |     |
|-----|---|---|---|---|---|---|-----|
| MSB |   |   |   |   |   |   | LSB |
| 1   | 0 | 0 | 0 | 0 | 0 | 1 | R/W |

$\overline{R/W}$ =0: Write mode for register setting

$\overline{R/W}$ =1: Not available

### ● CONTROL REGISTER TABLE

The select address sets each function (Volume, Balance, AGC, Tone Control, Surround etc.).

The auto-increment function cycles the select address as follows.

00H→01H→02H→03H→04H→05H→06H→00H

| Select Address | BIT  |      |    |    |    |     |                 |            |
|----------------|------|------|----|----|----|-----|-----------------|------------|
|                | D7   | D6   | D5 | D4 | D3 | D2  | D1              | D0         |
| 00H            | VOL  |      |    |    |    |     |                 |            |
| 01H            | CHS  | BAL  |    |    |    |     | Don't Care      |            |
| 02H            | BCB  | BASS |    |    |    |     | TB              | Don't Care |
| 03H            | BCM  | MID  |    |    |    |     | AGC             | OUT        |
| 04H            | BCT  | TREB |    |    |    |     | LINEOUT         |            |
| 05H            | BBEL |      |    |    |    | BBE | BASS/CENTER-OUT |            |
| 06H            | BBEH |      |    |    |    | SUR |                 |            |

### ● CONTROL REGISTER DEFAULT VALUE

Control register default value is all "0".

| Select Address | BIT |    |    |    |    |    |    |    |
|----------------|-----|----|----|----|----|----|----|----|
|                | D7  | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 00H            | 0   | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| 01H            | 0   | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| 02H            | 0   | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| 03H            | 0   | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| 04H            | 0   | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| 05H            | 0   | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| 06H            | 0   | 0  | 0  | 0  | 0  | 0  | 0  | 0  |

## ■ I<sup>2</sup>C CONTROL COMMAND DESCRIPTION

### a) MASTER VOLUME CONTROL

| Select Address | BIT |    |    |    |    |    |    |    |
|----------------|-----|----|----|----|----|----|----|----|
|                | D7  | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 00H            | VOL |    |    |    |    |    |    |    |

- VOL: Master Volume Control  
Attenuation Level: 0 to -80dB(0.33dB/step), MUTE  
The volume is consisted of volume1 and volume2. The level is divided into half to each volume1 and volume2.

### b) BALANCE SETTINGS

| Select Address | BIT |     |    |    |    |    |            |    |
|----------------|-----|-----|----|----|----|----|------------|----|
|                | D7  | D6  | D5 | D4 | D3 | D2 | D1         | D0 |
| 01H            | CHS | BAL |    |    |    |    | Don't Care |    |

- CHS: Channel Select for Balance Control  
"0": Ach "Bch is attenuated"  
"1": Bch "Ach is attenuated"
- BAL: Balance Level Setting  
Balance Level: 0 to -30(1dB/step), MUTE

### c) TONE CONTROL (Bass) and TruBass ON/OFF SETTINGS

| Select Address | BIT |      |    |    |    |    |    |            |
|----------------|-----|------|----|----|----|----|----|------------|
|                | D7  | D6   | D5 | D4 | D3 | D2 | D1 | D0         |
| 02H            | BCB | BASS |    |    |    |    | TB | Don't Care |

- BCB: Boost or Cut Select for Tone Control (Bass)  
"0": Cut  
"1": Boost
- BASS: Bass Boost or Cut Level  
Cut Level : -15 to 0dB(1dB/step)  
Boost Level : 0 to +15dB(1dB/step)
- TB: TruBass ON/OFF Setting  
"0": OFF  
"1": ON

### c) TONE CONTROL (Middle), AGC ON/OFF and OUT Switch ON/OFF SETTINGS

| Select Address | BIT |     |    |    |    |    |     |     |
|----------------|-----|-----|----|----|----|----|-----|-----|
|                | D7  | D6  | D5 | D4 | D3 | D2 | D1  | D0  |
| 03H            | BCM | MID |    |    |    |    | AGC | OUT |

- BCM: Boost or Cut Select for Tone Control (Middle)  
"0": Cut  
"1": Boost
- MID: Middle Boost or Cut Level  
Cut Level : -15 to 0dB(1dB/step)  
Boost Level : 0 to +15dB(1dB/step)
- AGC: AGC ON/OFF Setting  
"0": OFF  
"1": ON
- OUT: No.16 and 33 Pin Out Switch Setting  
"0": OFF  
"1": ON

**e) TONE CONTROL (Treble) and LINEOUT GAIN SETTINGS**

| Select Address | BIT |      |    |    |    |    |         |    |
|----------------|-----|------|----|----|----|----|---------|----|
|                | D7  | D6   | D5 | D4 | D3 | D2 | D1      | D0 |
| <b>04H</b>     | BCT | TREB |    |    |    |    | LINEOUT |    |

- BCT: Boost or Cut Select for Tone Control (Treble)  
 "0": Cut  
 "1": Boost
- TREB: Treble Boost or Cut Level  
 Cut Level : -15 to 0dB(1dB/step)  
 Boost Level : 0 to +15dB(1dB/step)
- LINEOUT: Lineout(No.15 and 34 pin out) Gain Setting  
 Gain Setting: 0dB, 4.5dB, 6dB, OFF

(NOTE) The click noise may be generated by changing the LINEOUT Gain setting.  
 Provide the external circuit for preventing the click noise on above condition.

**f) BBE-Low, BASS/CENTER OUT SETTINGS**

| Select Address | BIT  |    |    |    |    |     |                 |    |
|----------------|------|----|----|----|----|-----|-----------------|----|
|                | D7   | D6 | D5 | D4 | D3 | D2  | D1              | D0 |
| <b>05H</b>     | BBEL |    |    |    |    | BBE | BASS/CENTER-OUT |    |

- BBEL: BBE-LOW Level Setting  
 BBE Low Level (Lo Contour): 0dB to 15dB(0.5dB/step)  
 (NOTE) The click noise may be generated by changing the BBE Low Level setting.  
 The click noise problem may be prevented the following process.  
 BBE OFF → BBE-Low Level Setting → BBE ON
- BBE: BBE ON/OFF Setting  
 "0": OFF  
 "1": ON
- BASS/CENTER-OUT: No.17 Pin Out Setting  
 Output Mode: OFF, Center Out (at TS mode), TB Effect Out (at TruBass mode)

**g) BBE-High, SURROUND SETTINGS**

| Select Address | BIT  |    |    |    |    |     |    |    |
|----------------|------|----|----|----|----|-----|----|----|
|                | D7   | D6 | D5 | D4 | D3 | D2  | D1 | D0 |
| <b>06H</b>     | BBEH |    |    |    |    | SUR |    |    |

- BBEH: BBE-HIGH Level Setting  
 BBE High Level (Process): 0dB to 15dB(0.5dB/step)
- SUR: Surround Mode Setting  
 Mode: Bypass, MONO, SRS 3D, TS, eala-Low/Mid/High

## ■ MASTER VOLUME SETTING (Select Address: 00H)

| Gain (dB) | HEX | VOL |    |    |    |    |    |    |    |
|-----------|-----|-----|----|----|----|----|----|----|----|
|           |     | D7  | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0         | FF  | 1   | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
| -1        | FC  | 1   | 1  | 1  | 1  | 1  | 1  | 0  | 0  |
| -2        | F9  | 1   | 1  | 1  | 1  | 1  | 0  | 0  | 1  |
| -3        | F6  | 1   | 1  | 1  | 1  | 0  | 1  | 1  | 0  |
| -4        | F3  | 1   | 1  | 1  | 1  | 0  | 0  | 1  | 1  |
| -5        | F0  | 1   | 1  | 1  | 1  | 0  | 0  | 0  | 0  |
| -6        | ED  | 1   | 1  | 1  | 0  | 1  | 1  | 0  | 1  |
| -7        | EA  | 1   | 1  | 1  | 0  | 1  | 0  | 1  | 0  |
| -8        | E7  | 1   | 1  | 1  | 0  | 0  | 1  | 1  | 1  |
| -9        | E4  | 1   | 1  | 1  | 0  | 0  | 1  | 0  | 0  |
| -10       | E1  | 1   | 1  | 1  | 0  | 0  | 0  | 0  | 1  |
| -11       | DE  | 1   | 1  | 0  | 1  | 1  | 1  | 1  | 0  |
| -12       | DB  | 1   | 1  | 0  | 1  | 1  | 0  | 1  | 1  |
| -13       | D8  | 1   | 1  | 0  | 1  | 1  | 0  | 0  | 0  |
| -14       | D5  | 1   | 1  | 0  | 1  | 0  | 1  | 0  | 1  |
| -15       | D2  | 1   | 1  | 0  | 1  | 0  | 0  | 1  | 0  |
| -16       | CF  | 1   | 1  | 0  | 0  | 1  | 1  | 1  | 1  |
| -17       | CC  | 1   | 1  | 0  | 0  | 1  | 1  | 0  | 0  |
| -18       | C9  | 1   | 1  | 0  | 0  | 1  | 0  | 0  | 1  |
| -19       | C6  | 1   | 1  | 0  | 0  | 0  | 1  | 1  | 0  |
| -20       | C3  | 1   | 1  | 0  | 0  | 0  | 0  | 1  | 1  |
| -21       | C0  | 1   | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
| -22       | BD  | 1   | 0  | 1  | 1  | 1  | 1  | 0  | 1  |
| -23       | BA  | 1   | 0  | 1  | 1  | 1  | 0  | 1  | 0  |
| -24       | B7  | 1   | 0  | 1  | 1  | 0  | 1  | 1  | 1  |
| -25       | B4  | 1   | 0  | 1  | 1  | 0  | 1  | 0  | 0  |
| -26       | B1  | 1   | 0  | 1  | 1  | 0  | 0  | 0  | 1  |
| -27       | AE  | 1   | 0  | 1  | 0  | 1  | 1  | 1  | 0  |
| -28       | AB  | 1   | 0  | 1  | 0  | 1  | 0  | 1  | 1  |
| -29       | A8  | 1   | 0  | 1  | 0  | 1  | 0  | 0  | 0  |
| -30       | A5  | 1   | 0  | 1  | 0  | 0  | 1  | 0  | 1  |
| -31       | A2  | 1   | 0  | 1  | 0  | 0  | 0  | 1  | 0  |
| -32       | 9F  | 1   | 0  | 0  | 1  | 1  | 1  | 1  | 1  |
| -33       | 9C  | 1   | 0  | 0  | 1  | 1  | 1  | 0  | 0  |
| -34       | 99  | 1   | 0  | 0  | 1  | 1  | 0  | 0  | 1  |
| -35       | 96  | 1   | 0  | 0  | 1  | 0  | 1  | 1  | 0  |
| -36       | 93  | 1   | 0  | 0  | 1  | 0  | 0  | 1  | 1  |
| -37       | 90  | 1   | 0  | 0  | 1  | 0  | 0  | 0  | 0  |
| -38       | 8D  | 1   | 0  | 0  | 0  | 1  | 1  | 0  | 1  |
| -39       | 8A  | 1   | 0  | 0  | 0  | 1  | 0  | 1  | 0  |
| -40       | 87  | 1   | 0  | 0  | 0  | 0  | 1  | 1  | 1  |
| -41       | 84  | 1   | 0  | 0  | 0  | 0  | 1  | 0  | 0  |
| -42       | 81  | 1   | 0  | 0  | 0  | 0  | 0  | 0  | 1  |

## ■MASTER VOLUME SETTING (Cont'd)

| Gain (dB) | HEX | VOL |    |    |    |    |    |    |    |
|-----------|-----|-----|----|----|----|----|----|----|----|
|           |     | D7  | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| -43       | 7E  | 0   | 1  | 1  | 1  | 1  | 1  | 1  | 0  |
| -44       | 7B  | 0   | 1  | 1  | 1  | 1  | 0  | 1  | 1  |
| -45       | 78  | 0   | 1  | 1  | 1  | 1  | 0  | 0  | 0  |
| -46       | 75  | 0   | 1  | 1  | 1  | 0  | 1  | 0  | 1  |
| -47       | 72  | 0   | 1  | 1  | 1  | 0  | 0  | 1  | 0  |
| -48       | 6F  | 0   | 1  | 1  | 0  | 1  | 1  | 1  | 1  |
| -49       | 6C  | 0   | 1  | 1  | 0  | 1  | 1  | 0  | 0  |
| -50       | 69  | 0   | 1  | 1  | 0  | 1  | 0  | 0  | 1  |
| -51       | 66  | 0   | 1  | 1  | 0  | 0  | 1  | 1  | 0  |
| -52       | 63  | 0   | 1  | 1  | 0  | 0  | 0  | 1  | 1  |
| -53       | 60  | 0   | 1  | 1  | 0  | 0  | 0  | 0  | 0  |
| -54       | 5D  | 0   | 1  | 0  | 1  | 1  | 1  | 0  | 1  |
| -55       | 5A  | 0   | 1  | 0  | 1  | 1  | 0  | 1  | 0  |
| -56       | 57  | 0   | 1  | 0  | 1  | 0  | 1  | 1  | 1  |
| -57       | 54  | 0   | 1  | 0  | 1  | 0  | 1  | 0  | 0  |
| -58       | 51  | 0   | 1  | 0  | 1  | 0  | 0  | 0  | 1  |
| -59       | 4E  | 0   | 1  | 0  | 0  | 1  | 1  | 1  | 0  |
| -60       | 4B  | 0   | 1  | 0  | 0  | 1  | 0  | 1  | 1  |
| -61       | 48  | 0   | 1  | 0  | 0  | 1  | 0  | 0  | 0  |
| -62       | 45  | 0   | 1  | 0  | 0  | 0  | 1  | 0  | 1  |
| -63       | 42  | 0   | 1  | 0  | 0  | 0  | 0  | 1  | 0  |
| -64       | 3F  | 0   | 0  | 1  | 1  | 1  | 1  | 1  | 1  |
| -65       | 3C  | 0   | 0  | 1  | 1  | 1  | 1  | 0  | 0  |
| -66       | 39  | 0   | 0  | 1  | 1  | 1  | 0  | 0  | 1  |
| -67       | 36  | 0   | 0  | 1  | 1  | 0  | 1  | 1  | 0  |
| -68       | 33  | 0   | 0  | 1  | 1  | 0  | 0  | 1  | 1  |
| -69       | 30  | 0   | 0  | 1  | 1  | 0  | 0  | 0  | 0  |
| -70       | 2D  | 0   | 0  | 1  | 0  | 1  | 1  | 0  | 1  |
| -71       | 2A  | 0   | 0  | 1  | 0  | 1  | 0  | 1  | 0  |
| -72       | 27  | 0   | 0  | 1  | 0  | 0  | 1  | 1  | 1  |
| -73       | 24  | 0   | 0  | 1  | 0  | 0  | 1  | 0  | 0  |
| -74       | 21  | 0   | 0  | 1  | 0  | 0  | 0  | 0  | 1  |
| -75       | 1E  | 0   | 0  | 0  | 1  | 1  | 1  | 1  | 0  |
| -76       | 1B  | 0   | 0  | 0  | 1  | 1  | 0  | 1  | 1  |
| -77       | 18  | 0   | 0  | 0  | 1  | 1  | 0  | 0  | 0  |
| -78       | 15  | 0   | 0  | 0  | 1  | 0  | 1  | 0  | 1  |
| -79       | 12  | 0   | 0  | 0  | 1  | 0  | 0  | 1  | 0  |
| -80       | 0F  | 0   | 0  | 0  | 0  | 1  | 1  | 1  | 1  |
| Mute      | 00  | 0   | 0  | 0  | 0  | 0  | 0  | 0  | 0  |

## ■ BALANCE SETTING (Select Address: 01H)

| Channel Select          | CHS |
|-------------------------|-----|
|                         | D7  |
| Ach (Bch is attenuated) | 0   |
| Bch (Ach is attenuated) | 1   |

| Gain(dB) | BAL |    |    |    |    |
|----------|-----|----|----|----|----|
|          | D6  | D5 | D4 | D3 | D2 |
| 0        | 0   | 0  | 0  | 0  | 0  |
| -1       | 0   | 0  | 0  | 0  | 1  |
| -2       | 0   | 0  | 0  | 1  | 0  |
| -3       | 0   | 0  | 0  | 1  | 1  |
| -4       | 0   | 0  | 1  | 0  | 0  |
| -5       | 0   | 0  | 1  | 0  | 1  |
| -6       | 0   | 0  | 1  | 1  | 0  |
| -7       | 0   | 0  | 1  | 1  | 1  |
| -8       | 0   | 1  | 0  | 0  | 0  |
| -9       | 0   | 1  | 0  | 0  | 1  |
| -10      | 0   | 1  | 0  | 1  | 0  |
| -11      | 0   | 1  | 0  | 1  | 1  |
| -12      | 0   | 1  | 1  | 0  | 0  |
| -13      | 0   | 1  | 1  | 0  | 1  |
| -14      | 0   | 1  | 1  | 1  | 0  |
| -15      | 0   | 1  | 1  | 1  | 1  |
| -16      | 1   | 0  | 0  | 0  | 0  |
| -17      | 1   | 0  | 0  | 0  | 1  |
| -18      | 1   | 0  | 0  | 1  | 0  |
| -19      | 1   | 0  | 0  | 1  | 1  |
| -20      | 1   | 0  | 1  | 0  | 0  |
| -21      | 1   | 0  | 1  | 0  | 1  |
| -22      | 1   | 0  | 1  | 1  | 0  |
| -23      | 1   | 0  | 1  | 1  | 1  |
| -24      | 1   | 1  | 0  | 0  | 0  |
| -25      | 1   | 1  | 0  | 0  | 1  |
| -26      | 1   | 1  | 0  | 1  | 0  |
| -27      | 1   | 1  | 0  | 1  | 1  |
| -28      | 1   | 1  | 1  | 0  | 0  |
| -29      | 1   | 1  | 1  | 0  | 1  |
| -30      | 1   | 1  | 1  | 1  | 0  |
| MUTE     | 1   | 1  | 1  | 1  | 1  |

■ TONE CONTROL BASS SETTINGS (Select Address: 02H)

| Bass<br>Cut or Boost | BCB<br>D7 |
|----------------------|-----------|
| Cut                  | 0         |
| Boost                | 1         |

|              |                | BASS |    |    |    |    |
|--------------|----------------|------|----|----|----|----|
| Cut Gain(dB) | Boost Gain(dB) | D6   | D5 | D4 | D3 | D2 |
| -15          | 15             | 1    | 1  | 1  | 1  | 0  |
| -14          | 14             | 1    | 1  | 1  | 0  | 0  |
| -13          | 13             | 1    | 1  | 0  | 1  | 0  |
| -12          | 12             | 1    | 1  | 0  | 0  | 0  |
| -11          | 11             | 1    | 0  | 1  | 1  | 0  |
| -10          | 10             | 1    | 0  | 1  | 0  | 0  |
| -9           | 9              | 1    | 0  | 0  | 1  | 0  |
| -8           | 8              | 1    | 0  | 0  | 0  | 0  |
| -7           | 7              | 0    | 1  | 1  | 1  | 0  |
| -6           | 6              | 0    | 1  | 1  | 0  | 0  |
| -5           | 5              | 0    | 1  | 0  | 1  | 0  |
| -4           | 4              | 0    | 1  | 0  | 0  | 0  |
| -3           | 3              | 0    | 0  | 1  | 1  | 0  |
| -2           | 2              | 0    | 0  | 1  | 0  | 0  |
| -1           | 1              | 0    | 0  | 0  | 1  | 0  |
| 0            | 0              | 0    | 0  | 0  | 0  | 0  |

■ TONE CONTROL MIDDLE SETTINGS (Select Address: 03H)

| Middle<br>Cut or Boost | BCM<br>D7 |
|------------------------|-----------|
| Cut                    | 0         |
| Boost                  | 1         |

|              |                | MID |    |    |    |    |
|--------------|----------------|-----|----|----|----|----|
| Cut Gain(dB) | Boost Gain(dB) | D6  | D5 | D4 | D3 | D2 |
| -15          | 15             | 1   | 1  | 1  | 1  | 0  |
| -14          | 14             | 1   | 1  | 1  | 0  | 0  |
| -13          | 13             | 1   | 1  | 0  | 1  | 0  |
| -12          | 12             | 1   | 1  | 0  | 0  | 0  |
| -11          | 11             | 1   | 0  | 1  | 1  | 0  |
| -10          | 10             | 1   | 0  | 1  | 0  | 0  |
| -9           | 9              | 1   | 0  | 0  | 1  | 0  |
| -8           | 8              | 1   | 0  | 0  | 0  | 0  |
| -7           | 7              | 0   | 1  | 1  | 1  | 0  |
| -6           | 6              | 0   | 1  | 1  | 0  | 0  |
| -5           | 5              | 0   | 1  | 0  | 1  | 0  |
| -4           | 4              | 0   | 1  | 0  | 0  | 0  |
| -3           | 3              | 0   | 0  | 1  | 1  | 0  |
| -2           | 2              | 0   | 0  | 1  | 0  | 0  |
| -1           | 1              | 0   | 0  | 0  | 1  | 0  |
| 0            | 0              | 0   | 0  | 0  | 0  | 0  |

## ■ TONE CONTROL TREBLE SETTINGS (Select Address: 04H)

| Treble<br>Cut or Boost | BCT<br>D7 |
|------------------------|-----------|
| Cut                    | 0         |
| Boost                  | 1         |

|              |                | TREB |    |    |    |    |
|--------------|----------------|------|----|----|----|----|
| Cut Gain(dB) | Boost Gain(dB) | D6   | D5 | D4 | D3 | D2 |
| -15          | 15             | 1    | 1  | 1  | 1  | 0  |
| -14          | 14             | 1    | 1  | 1  | 0  | 0  |
| -13          | 13             | 1    | 1  | 0  | 1  | 0  |
| -12          | 12             | 1    | 1  | 0  | 0  | 0  |
| -11          | 11             | 1    | 0  | 1  | 1  | 0  |
| -10          | 10             | 1    | 0  | 1  | 0  | 0  |
| -9           | 9              | 1    | 0  | 0  | 1  | 0  |
| -8           | 8              | 1    | 0  | 0  | 0  | 0  |
| -7           | 7              | 0    | 1  | 1  | 1  | 0  |
| -6           | 6              | 0    | 1  | 1  | 0  | 0  |
| -5           | 5              | 0    | 1  | 0  | 1  | 0  |
| -4           | 4              | 0    | 1  | 0  | 0  | 0  |
| -3           | 3              | 0    | 0  | 1  | 1  | 0  |
| -2           | 2              | 0    | 0  | 1  | 0  | 0  |
| -1           | 1              | 0    | 0  | 0  | 1  | 0  |
| 0            | 0              | 0    | 0  | 0  | 0  | 0  |

## ■BBE ON/OFF SETTING (Select Address: 05H)

| BBE ON/OFF | BBE |
|------------|-----|
|            | D2  |
| OFF        | 0   |
| ON         | 1   |

## ■BBE-LOW (Lo Contour) GAIN SETTING (Select Address: 05H)

| Gain(dB) | BBEL |    |    |    |    |
|----------|------|----|----|----|----|
|          | D7   | D6 | D5 | D4 | D3 |
| 15       | 1    | 1  | 1  | 1  | 0  |
| 14       | 1    | 1  | 1  | 0  | 0  |
| 13       | 1    | 1  | 0  | 1  | 0  |
| 12       | 1    | 1  | 0  | 0  | 0  |
| 11       | 1    | 0  | 1  | 1  | 0  |
| 10       | 1    | 0  | 1  | 0  | 0  |
| 9        | 1    | 0  | 0  | 1  | 0  |
| 8        | 1    | 0  | 0  | 0  | 0  |
| 7        | 0    | 1  | 1  | 1  | 0  |
| 6        | 0    | 1  | 1  | 0  | 0  |
| 5        | 0    | 1  | 0  | 1  | 0  |
| 4        | 0    | 1  | 0  | 0  | 0  |
| 3        | 0    | 0  | 1  | 1  | 0  |
| 2        | 0    | 0  | 1  | 0  | 0  |
| 1        | 0    | 0  | 0  | 1  | 0  |
| 0        | 0    | 0  | 0  | 0  | 0  |

## ■BBE-HIGH (Process) GAIN SETTING (Select Address: 06H)

| Gain(dB) | BBEH |    |    |    |    |
|----------|------|----|----|----|----|
|          | D7   | D6 | D5 | D4 | D3 |
| 15       | 1    | 1  | 1  | 1  | 0  |
| 14       | 1    | 1  | 1  | 0  | 0  |
| 13       | 1    | 1  | 0  | 1  | 0  |
| 12       | 1    | 1  | 0  | 0  | 0  |
| 11       | 1    | 0  | 1  | 1  | 0  |
| 10       | 1    | 0  | 1  | 0  | 0  |
| 9        | 1    | 0  | 0  | 1  | 0  |
| 8        | 1    | 0  | 0  | 0  | 0  |
| 7        | 0    | 1  | 1  | 1  | 0  |
| 6        | 0    | 1  | 1  | 0  | 0  |
| 5        | 0    | 1  | 0  | 1  | 0  |
| 4        | 0    | 1  | 0  | 0  | 0  |
| 3        | 0    | 0  | 1  | 1  | 0  |
| 2        | 0    | 0  | 1  | 0  | 0  |
| 1        | 0    | 0  | 0  | 1  | 0  |
| 0        | 0    | 0  | 0  | 0  | 0  |

## ■ TruBass ON/OFF SETTING (Select Address: 02H)

| TruBass | TB |
|---------|----|
|         | D1 |
| OFF     | 0  |
| ON      | 1  |

## ■ AGC ON/OFF SETTING (Select Address: 03H)

| AGC | AGC |
|-----|-----|
|     | D1  |
| OFF | 0   |
| ON  | 1   |

## ■ OUTPUT SWITCH SETTING (Select Address: 03H)

| Output | OUT |
|--------|-----|
|        | D0  |
| OFF    | 0   |
| ON     | 1   |

## ■ LINEOUT GAIN SETTING (Select Address: 04H)

| Gain  | LINEOUT |    |
|-------|---------|----|
|       | D1      | D0 |
| OFF   | 0       | 0  |
| 0dB   | 0       | 1  |
| 4.5dB | 1       | 0  |
| 6dB   | 1       | 1  |

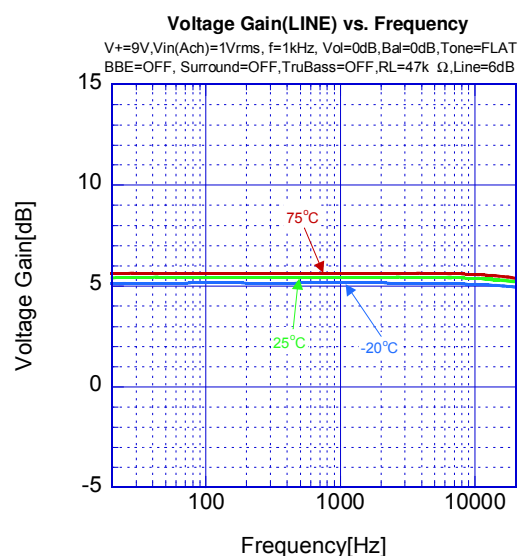
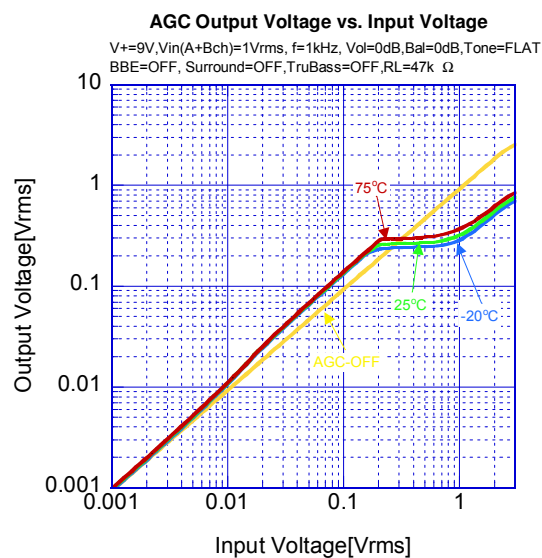
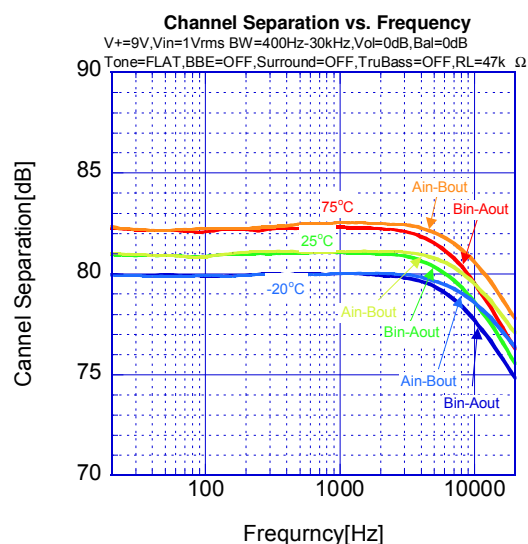
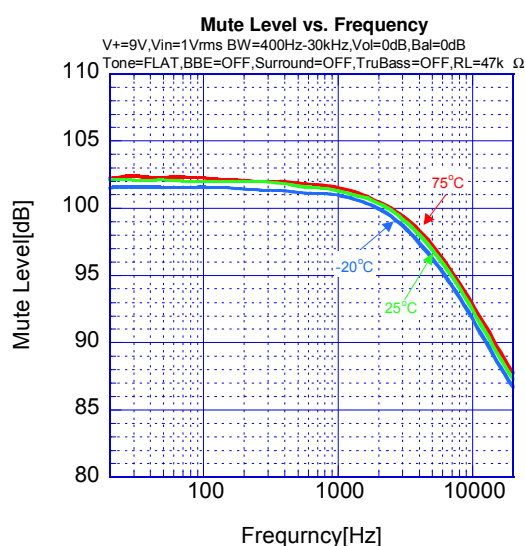
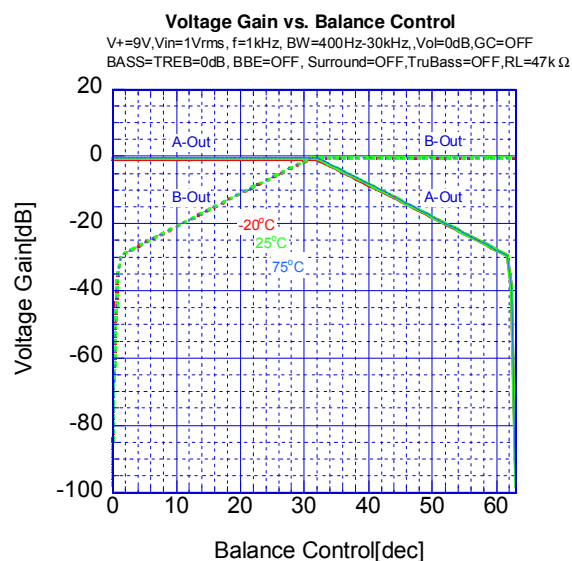
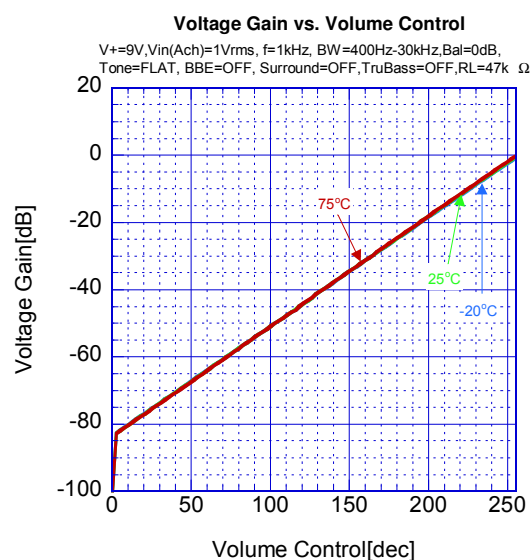
## ■ BASS/CENTER-OUT SETTING (Select Address: 05H)

| Output Mode   | BASS/CENTER-OUT |    |
|---------------|-----------------|----|
|               | D1              | D0 |
| OFF           | 0               | 0  |
|               | 1               | 0  |
| Center Out    | 0               | 1  |
| TB Effect Out | 1               | 1  |

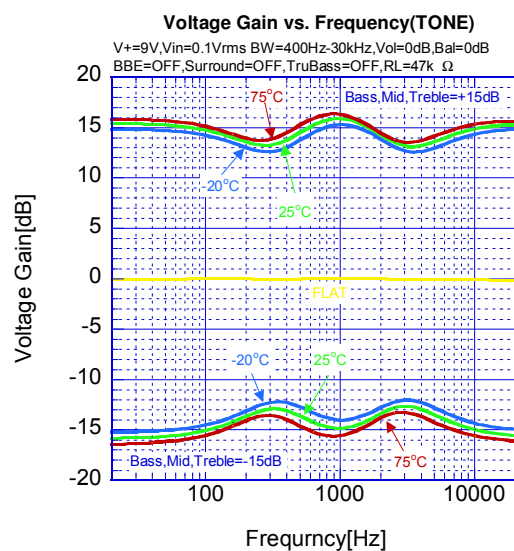
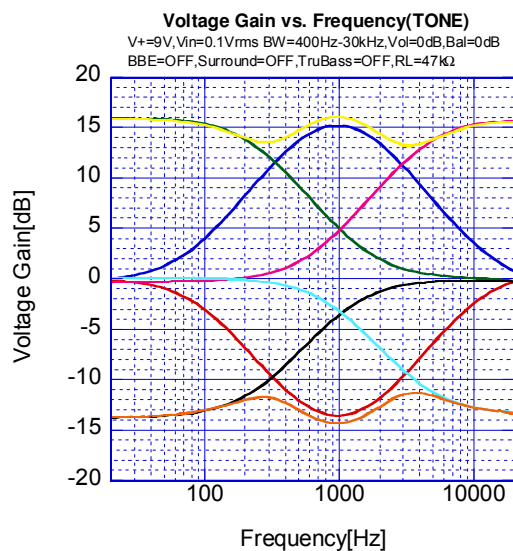
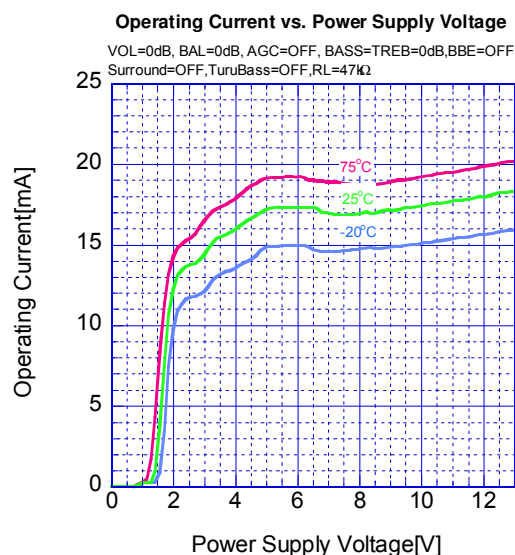
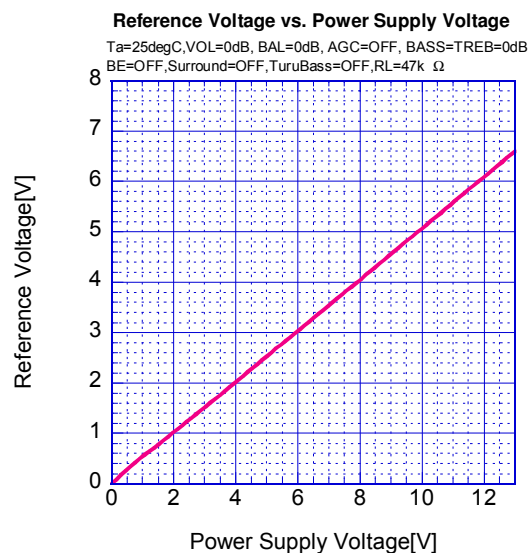
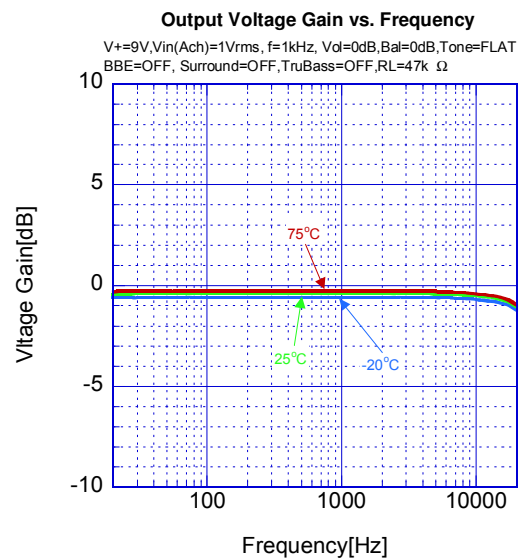
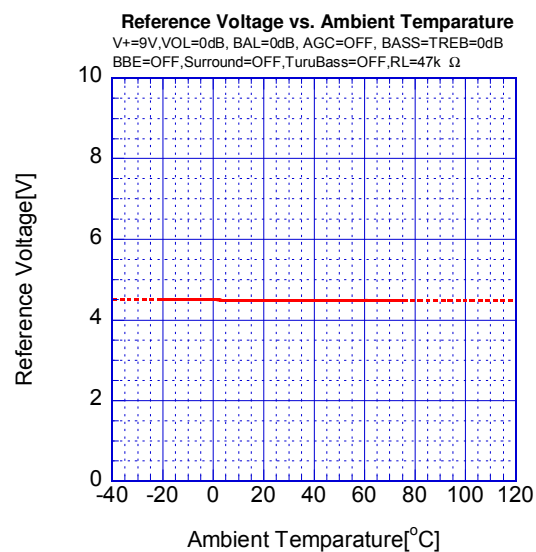
## ■ SURROUND MODE SETTING (Select Address: 06H)

| Mode      | SUR |    |    |
|-----------|-----|----|----|
|           | D2  | D1 | D0 |
| Bypass    | 0   | 0  | 0  |
| eala Low  | 0   | 0  | 1  |
| eala Mid  | 0   | 1  | 0  |
| eala High | 0   | 1  | 1  |
| TS        | 1   | 0  | 1  |
| SRS 3D    | 1   | 1  | 0  |
| MONO      | 1   | 1  | 1  |

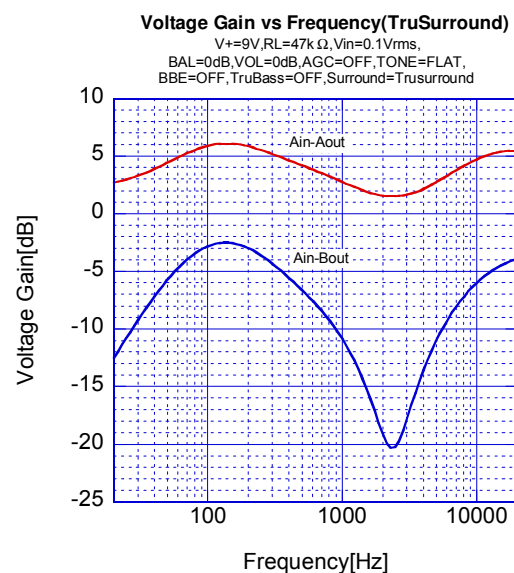
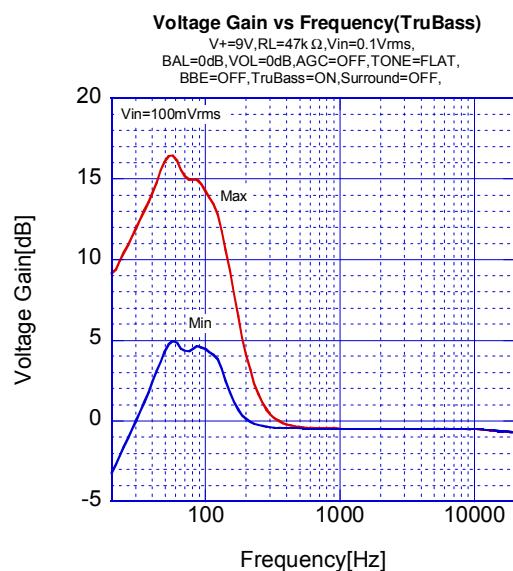
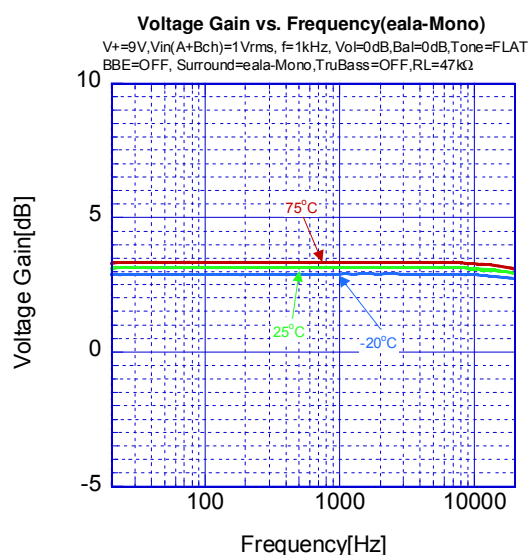
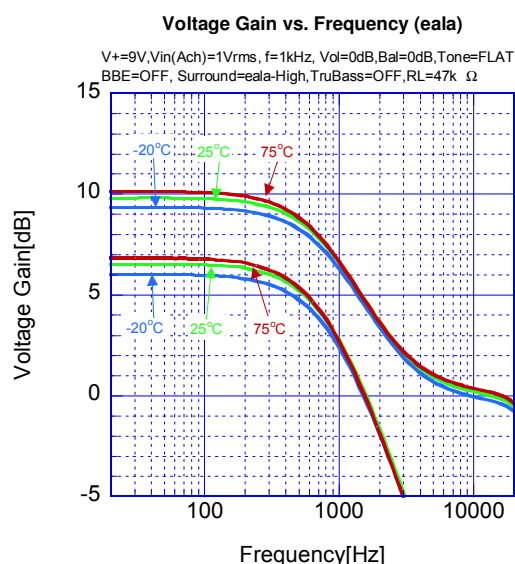
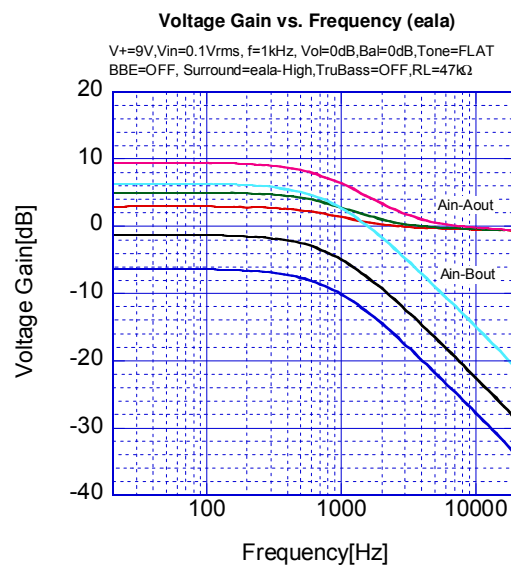
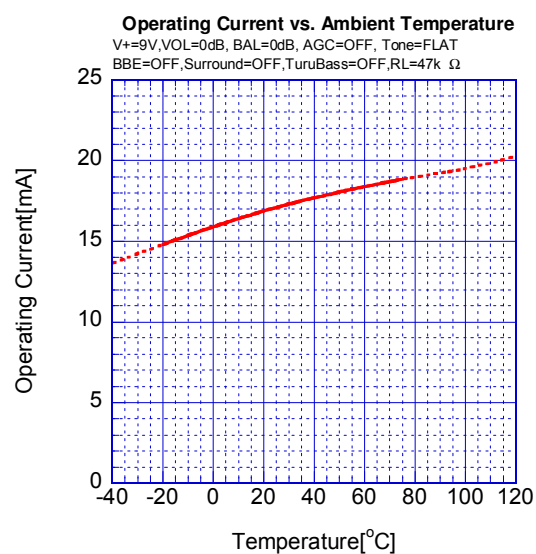
## TYPICAL CHARACTERISTICS



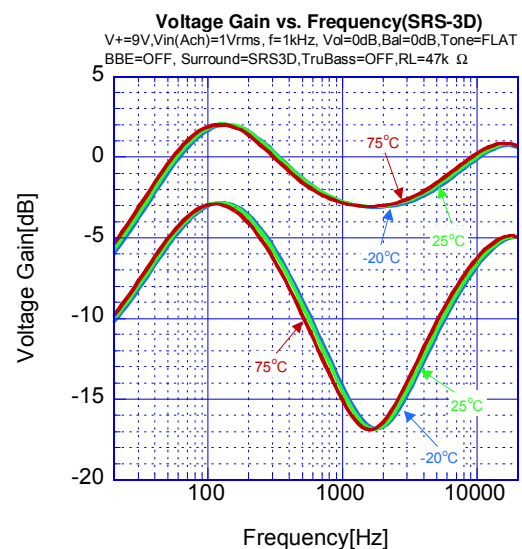
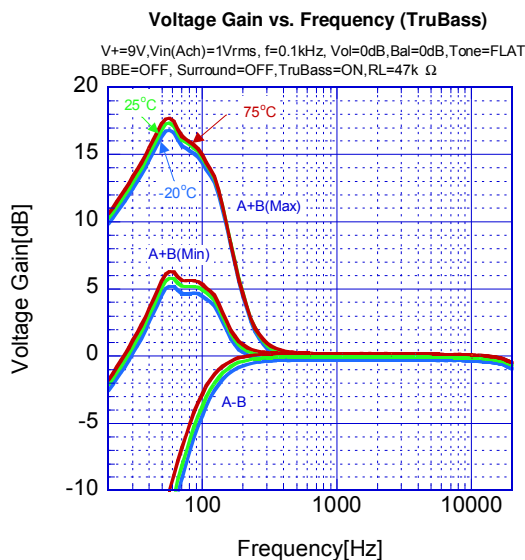
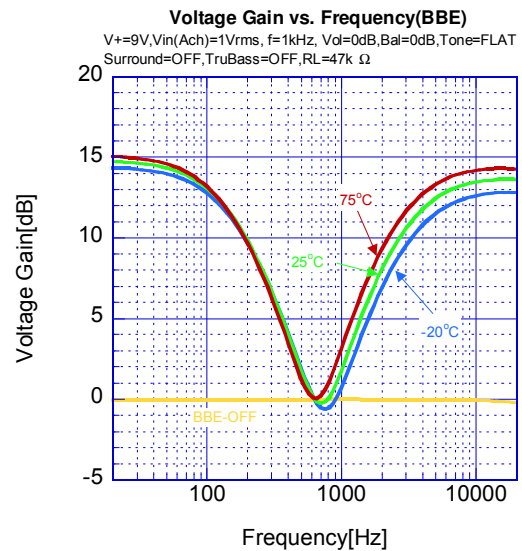
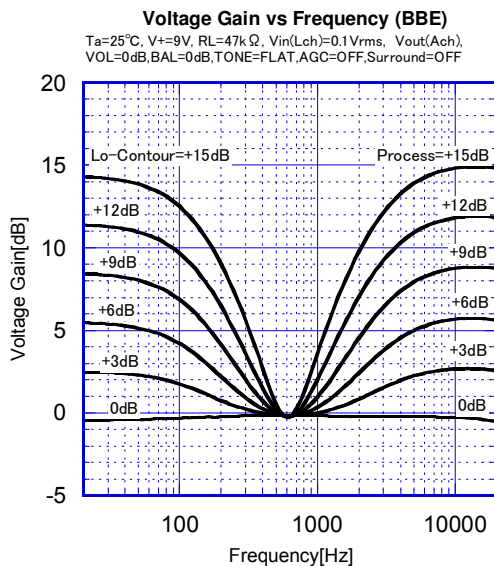
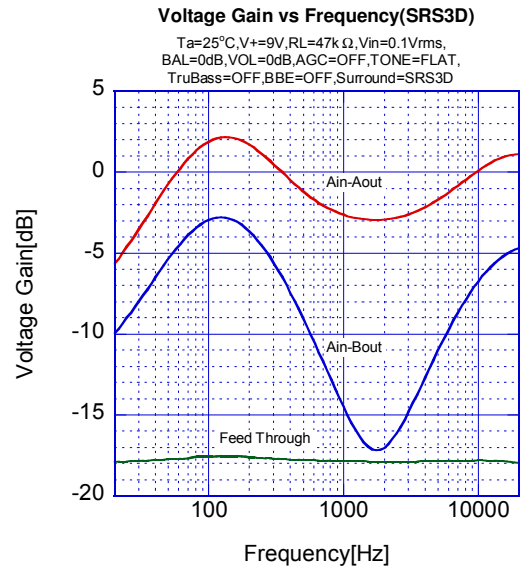
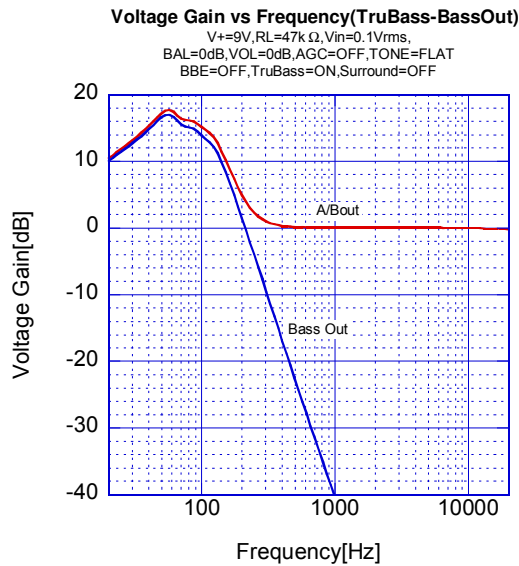
## ■TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS



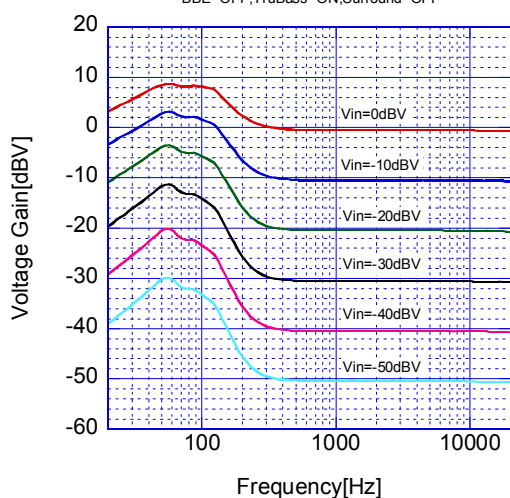
## ■TYPICAL CHARACTERISTICS



# ■TYPICAL CHARACTERISTICS

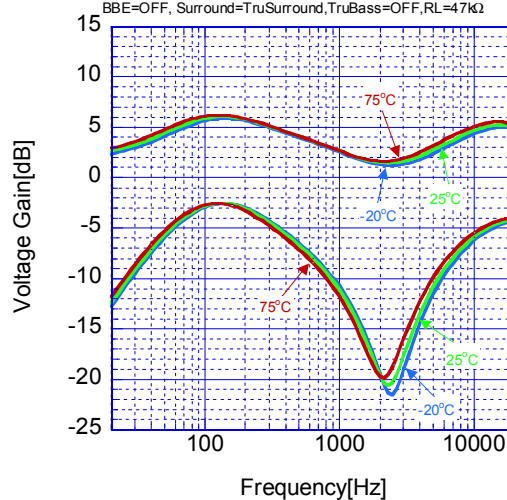
**Voltage Gain vs Frequency(TruBass)**

V+=9V, RL=47k $\Omega$ ,  
BAL=0dB, VOL=0dB, AGC=OFF, TONE=FLAT,  
BBE=OFF, TruBass=ON, Surround=OFF



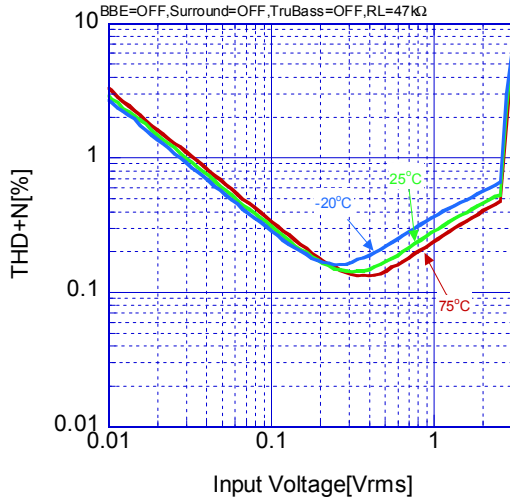
**Voltage Gain vs. Frequency(TruSurround)**

V+=9V, Vin(Ach)=1Vrms, f=1kHz, Vol=0dB, Bal=0dB, Tone=FLAT  
BBE=OFF, Surround=TruSurround, TruBass=OFF, RL=47k $\Omega$



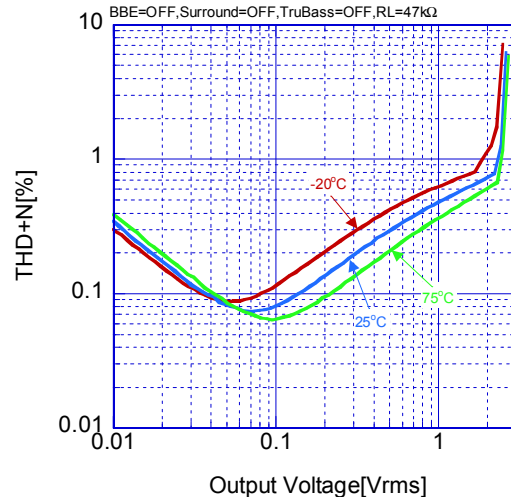
**Total Harmonic Distortion vs. Input Voltage**

V+=9V, f=1kHz, BW=400Hz-30kHz, Vol=-20dB, Bal=0dB, Tone=FLAT  
BBE=OFF, Surround=OFF, TruBass=OFF, RL=47k $\Omega$



**Total Harmonic Distortion vs. Output Voltage**

V+=9V, f=1kHz, BW=400Hz-30kHz, Vol=0dB, Bal=0dB, Tone=FLAT  
BBE=OFF, Surround=OFF, TruBass=OFF, RL=47k $\Omega$



## ■ NOTE

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