



SOUND PROCESSOR with SOUND ENHANCEMENT

■ GENERAL DESCRIPTION

The **NJW1132** is a sound processor with sound enhancement (BBE). It includes all of functions processing audio signal for TV, such as tone control, balance, volume, mute, and AGC functions.

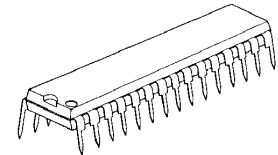
Also the **NJW1132** performs surround and sound enhancement. The sound enhancement regenerates high definitive and nearly real sound.

All of internal status and variables are controlled by I²C BUS interface.

■ PACKAGE OUTLINE



NJW1132M

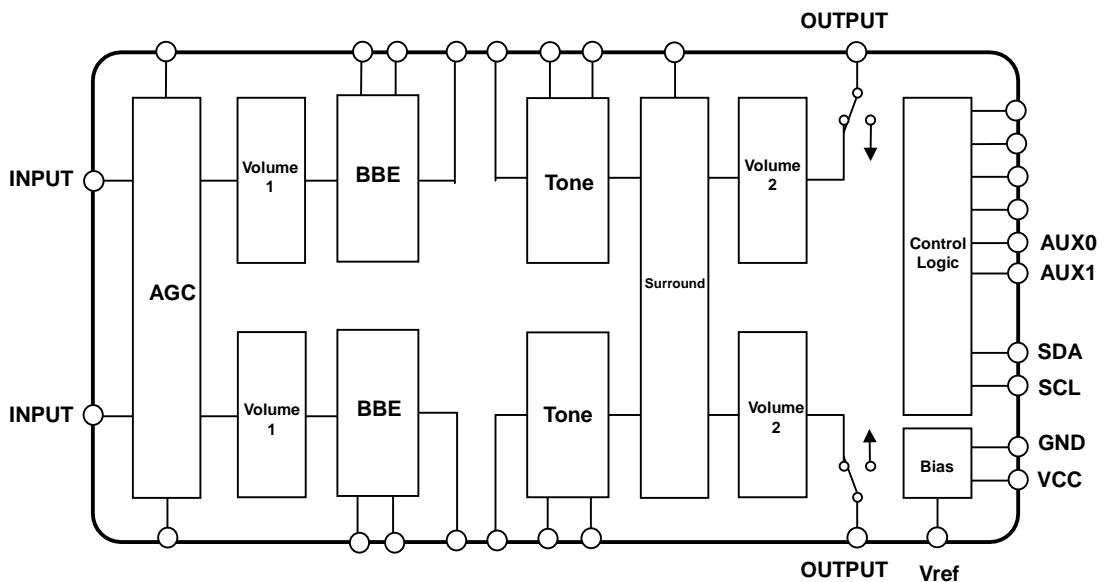


NJW1132L

■ FEATURES

- Operating Voltage (8 to 13V)
- I²C BUS Interface
- BBE Sound Enhancement (Low Boost and High Boost: 15dB max.)
- The AGC circuit reduces volume difference among input sources.
- Matrix Surround
- Bi-CMOS Technology
- Package Outline SDIP30,SDMP30

■ BLOCK DIAGRAM



■ PIN FUNCTION

| | | | | | |
|--|----|----------|----------|----|---------------------------------------|
| Ach Input | 1 | INa | INb | 30 | Bch Input |
| Ach BBE Filter1 | 2 | BBE1a | BBE1b | 29 | Bch BBE Filter1 |
| Ach BBE Filter2 | 3 | BBE2a | BBE2b | 28 | Bch BBE Filter2 |
| Ach BBE Output | 4 | BBEout_a | BBEout_b | 27 | Bch BBE Output |
| Ach Tone Input | 5 | Tone_INa | Tone_INb | 26 | Bch Tone Input |
| Ach High Frequency | 6 | TONE-Ha | TONE-Hb | 25 | Bch High Frequency |
| Ach Low Frequency | 7 | TONE-La | TONE-Lb | 24 | Bch Low Frequency |
| Ach Output (0dB) | 8 | OUTa | OUTb | 23 | Bch Output(0dB) |
| AGC1 | 9 | AGC1 | PS | 22 | Phase Shift |
| AGC2 | 10 | AGC2 | VREF | 21 | Reference Voltage |
| DAC Output for Bch Volume & Balance | 11 | CVB | CTH | 20 | DAC Output for Tone High Frequency |
| DAC Output for Ach Volume & Balance | 12 | CVA | CTL | 19 | DAC Output for Tone Low Frequency |
| I ² C BUS SDA | 13 | SDA | AUX0 | 18 | AUX Output0 |
| I ² C BUS SCL | 14 | SCL | AUX1 | 17 | AUX Output1 |
| GND | 15 | GND | Vcc | 16 | Power Supply |

SDIP30, SDMP30

■ ABSOLUTE MAXIMUM RATING (Ta=25°C)

| PARAMETER | SYMBOL | RATING | UNIT |
|-----------------------------|----------------|-------------|------|
| Supply Voltage | V ⁺ | 14 | V |
| Power Dissipation | P _D | 700 | mW |
| Operating Temperature Range | Topr | -20 to +75 | °C |
| Storage Temperature Range | Tstg | -40 to +125 | °C |

■ ELECTRICAL CHARACTERISTICS (Ta=25°C, V+=9V, Rg=600Ω, RL=47kΩ, Vin=100mVrms/1kHz)

| PARAMETER | SYM BOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---------------------------|-------------------|--|------|---------------|---------------|----------------|
| Operating Voltage | V ⁺ | | 8.0 | 9.0 | 13.0 | V |
| Supply Current | I _{CC} | No Signal | - | 30 | 50 | mA |
| Reference Voltage | V _{REF} | No Signal | 4.0 | 4.5 | 5.0 | V |
| Maximum Input Voltage | V _{IM} | VOL=C3H, THD=1% | 2.6 | 2.8 | - | Vrms |
| Maximum Output Voltage | V _{OM1} | OUTPUT VOL=FFH, THD=1% | - | 2.5 | - | Vrms |
| Channel Balance | G _{CB} | VOL=FFH | -1.5 | 0.0 | 1.5 | dB |
| Balance Boost A | BA _{BST} | BAL="00000" | -2.0 | 0.0 | 2.0 | dB |
| Balance Cut A | BA _{CUT} | BAL="11111" | - | - | -70 | dB |
| Balance Boost B | BB _{BST} | BAL="00000" | -2.0 | 0.0 | 2.0 | dB |
| Balance Cut B | BB _{CUT} | BAL="11111" | - | - | -70 | dB |
| Total Harmonic Distortion | THD | V _o =0.5Vrms BW=400Hz to 30kHz | - | - | 0.5 | % |
| Mute Level | MUTE | VOL=00H | - | - | -70 | dB |
| Channel Separation | CS | Vin=2Vrms | - | - | -70 | dB |
| Output Noise 1 | V _{NO1} | VOL=FFH BW=400Hz to 30kHz | - | - | -60 (1.0) | dBV (mVrms) |
| Output Noise 2 | V _{NO2} | VOL=00H BW=400Hz to 30kHz | - | -90 (31.6) | -82 (79.4) | dBV (uVrms) |

● TONE CONTROL

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|------------------------------------|-------------------|---------------------|-------|-------|-------|------|
| High Frequency Boost | HF _{BST} | TREB="1111",f=10kHz | 12.5 | 15.0 | 17.5 | dB |
| High Frequency Flat | HF _{FLT} | TRBE="0000",f=10kHz | -2.0 | 0.0 | 2.0 | dB |
| High Frequency Cut | HF _{CUT} | TRBE="1111",f=10kHz | -12.5 | -15.0 | -17.5 | dB |
| Low Frequency Boost | LF _{BST} | BASS="1111",f=100Hz | 12.5 | 15.0 | 17.5 | dB |
| Low Frequency Flat | LF _{FLT} | BASS="0000",f=100Hz | -2.0 | 0.0 | 2.0 | dB |
| Low Frequency Cut | LF _{CUT} | BASS="1111",f=100Hz | -12.5 | -15.0 | -17.5 | dB |
| High Frequency Cut DC Offset1 | HF _{DC1} | TREB="1111"→"0000" | -1.0 | 0.0 | 1.0 | V |
| High Frequency Boost DC Offset2 | HF _{DC2} | TREB="1111"→"0000" | -1.0 | 0.0 | 1.0 | V |
| Low Frequency Cut DC Offset1 | LF _{DC1} | BASS="1111"→"0000" | -1.0 | 0.0 | 1.0 | V |
| Low Frequency Boost DC Offset2 | LF _{DC2} | BASS="1111"→"0000" | -1.0 | 0.0 | 1.0 | V |

● SUB-TONE CONTROL

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|----------------------|--------------------|-----------------------|------|------|------|------|
| High Frequency Boost | SHF _{BST} | SUB-TREB="11",f=10kHz | 2.0 | 3.0 | 4.0 | dB |
| High Frequency Flat | SHF _{FLT} | SUB-TREB="00",f=10kHz | -2.0 | 0.0 | 2.0 | dB |
| High Frequency Cut | SHF _{CUT} | SUB-TREB="11",f=10kHz | -4.0 | -3.0 | -2.0 | dB |
| Low Frequency Boost | SLF _{BST} | SUB-BASS="11",f=100Hz | 2.0 | 3.0 | 4.0 | dB |
| Low Frequency Flat | SLF _{FLT} | SUB-BASS="00",f=100Hz | -2.0 | 0.0 | 2.0 | dB |
| Low Frequency Cut | SLF _{CUT} | SUB-BASS="11",f=100Hz | -4.0 | -3.0 | -2.0 | dB |

● AGC CONTROL: AGC=1H (AGC-ON)

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|-------------|---------------------|----------------|------|------|------|------|
| AGC BOOST 1 | AGC _{BST1} | Vin=10mVrms | 0.0 | 2.5 | 5.0 | dB |
| AGC BOOST 2 | AGC _{BST2} | Vin=50mVrms | 5.0 | 7.0 | 10.0 | dB |
| AGC FLAT | AGC _{FLT} | Vin=200mVrms | -2.5 | 0.0 | 2.5 | dB |
| AGC CUT | AGC _{CUT} | Vin=2Vrms | -24 | -20 | -16 | dB |

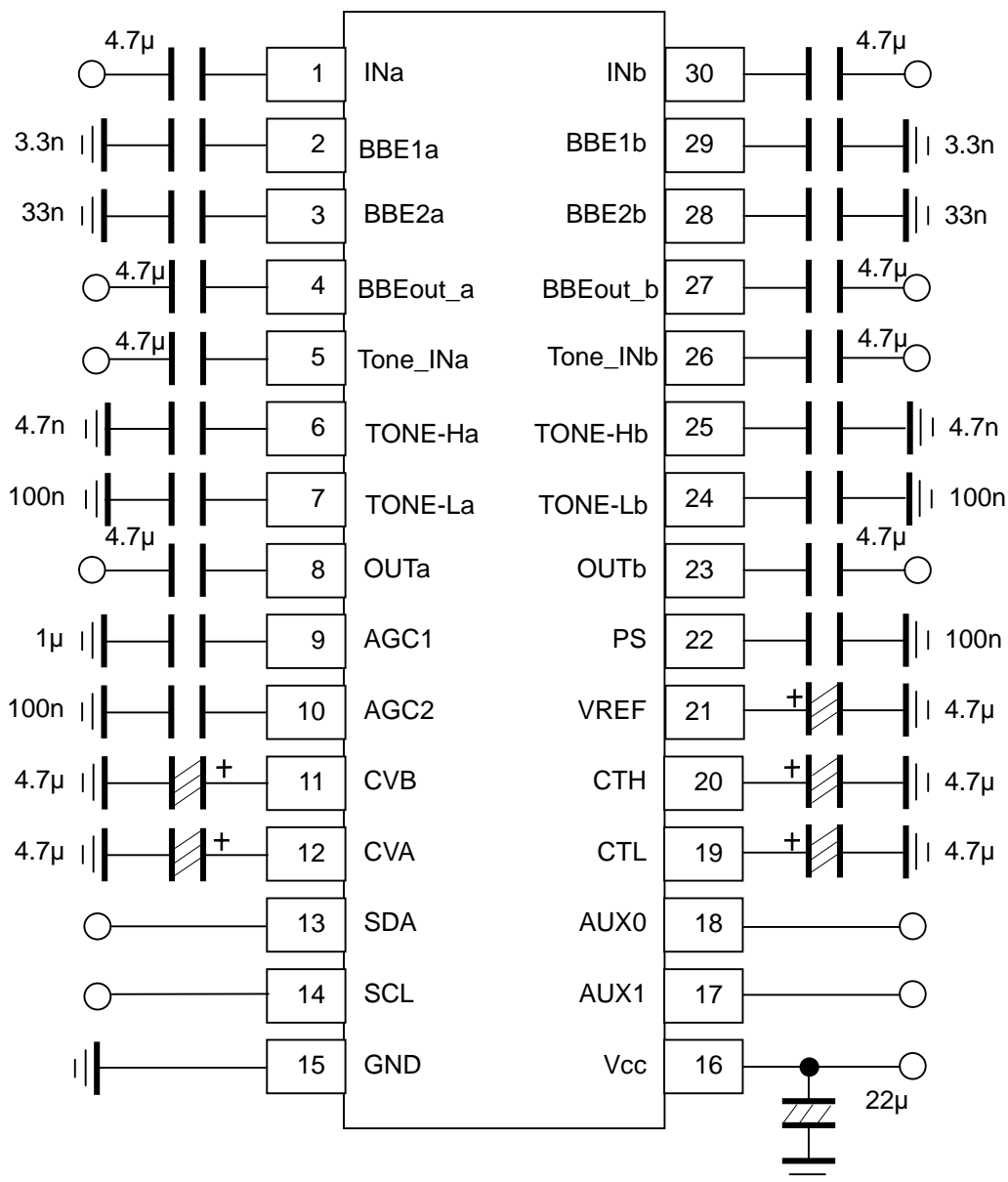
● SURROUND CONTROL: MODE=1H (SURROUND-ON)

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|----------------|--------------------|------------------|------|------|------|------|
| SURROUND MIX 1 | SR _{MIX1} | Ain → Bout | -2.0 | 0.0 | 2.0 | dB |
| SURROUND MIX 2 | SR _{MIX2} | Bin → Aout | -2.0 | 0.0 | 2.0 | dB |
| SURROUND DEF | SR _{DEF} | Ain-Bin(-180deg) | 8.0 | 10.0 | 12.0 | dB |
| DC Offset | SR _{DC} | MODE="0" → "1" | -1.0 | 0.0 | 1.0 | V |

● BBE =1H (BBE-ON)

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|-----------------------------------|---------------------|-----------------|------|------|------|------|
| BBE low Frequency Boost Range | BBE _{LOW} | BBE-Low="1111" | - | 15.0 | - | dB |
| BBE High Frequency Boost Range | BBE _{HIGH} | BBE-High="1111" | - | 15.0 | - | dB |

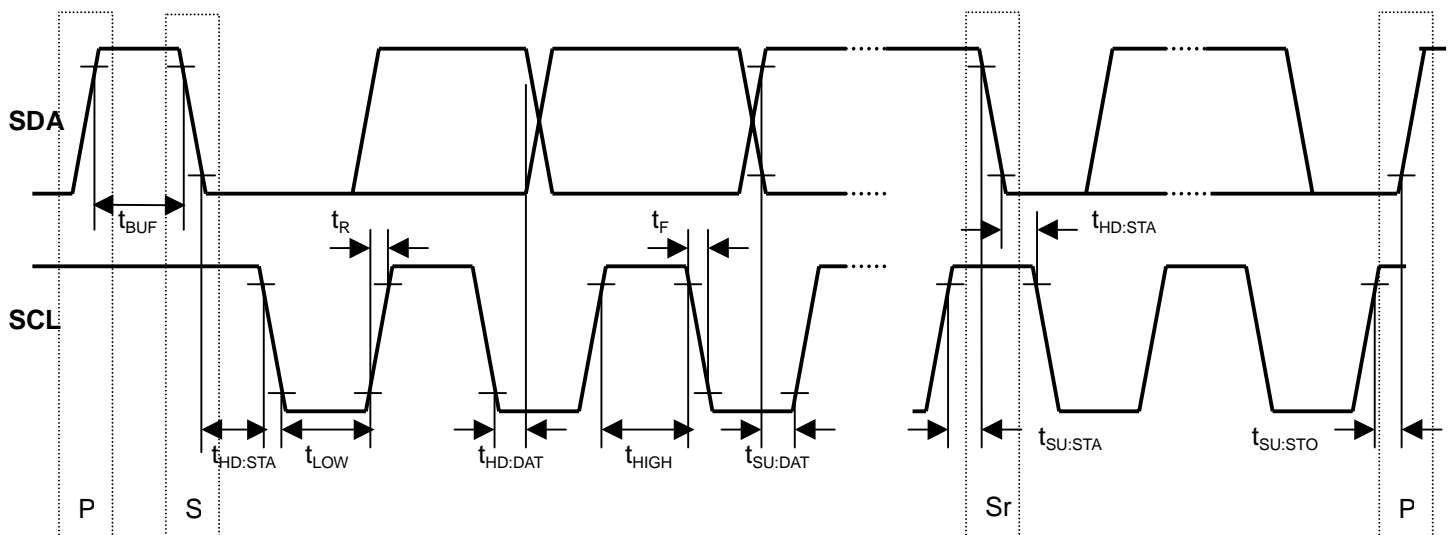
■ APPLICATION CIRCUIT



■ I²C BUS Block CHARACTERISTICS (SDA,SCL)

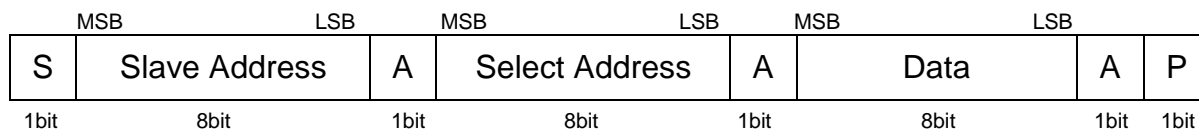
| PARAMETER | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---------------------|------|------|------|------|
| High Level Input Voltage | V _{IH} | 3.0 | - | 5.0 | V |
| Low Level Input Voltage | V _{IL} | 0 | - | 1.5 | V |
| High Level Input Current | I _{IH} | - | - | 10 | μA |
| Low Level Input Current | I _{IL} | - | - | 10 | μA |
| Low Level Output Voltage (3mA at SDA pin) | V _{OL} | 0 | - | 0.4 | dB |
| Maximum Output Current | I _{OL} | -3.0 | - | - | mA |
| Maximum Clock Frequency | f _{SCL} | 0 | - | 100 | kHz |
| Data Change Minimum Waiting Time | t _{BUF} | 4.7 | - | - | μS |
| Data Transfer Start Minimum Waiting Time | t _{HD:STA} | 4.0 | - | - | μS |
| Low Level Clock Pulse Width | t _{LOW} | 4.7 | - | - | μS |
| High Level Clock Pulse Width | T _{HIGH} | 4.0 | - | - | μS |
| Minimum Start Preparation Waiting Time | t _{SU:STA} | 4.7 | - | - | μS |
| Minimum Data Hold Time | t _{HD:DAT} | 5.0 | - | - | μS |
| Minimum Data Preparation Time | t _{SU:DAT} | 250 | - | - | nS |
| Rise Time | t _R | - | - | 1.0 | μS |
| Fall Time | t _F | - | - | 300 | nS |
| Minimum Stop Preparation Waiting Time | t _{SU:STO} | 4.7 | - | - | μS |

I²C BUS Load Condition: Pull up resistance 4kΩ (Connected to +5V)
Load capacitance 200pF (Connected to GND)



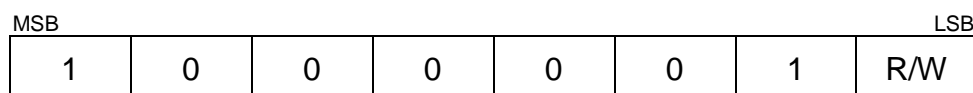
■ DEFINITION OF I²C REGISTER

● I²C BUS FORMAT



S: Starting Term
A: Acknowledge Bit
P: Ending Term

● SLAVE ADDRESS



R/W=0: Receive Only

● CONTROL REGISTER TABLE

| Select Address | BIT | | | | | | | |
|----------------|---------|------|----|----|-----------|----------|------|------|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 00H | VOL | | | | | | | |
| 01H | CHS | BAL | | | | | AGC | SUR |
| 02H | BCB | BASS | | | BCSB | SUB-BASS | | |
| 03H | BCT | TREB | | | BCST | SUB-TREB | | |
| 04H | BBE-Low | | | | BBE-High | | | |
| 05H | OUT | * | | | Reserved* | | AUX1 | AUX0 |

* : Don't care.

● CONTROL REGISTER DEFAULT VALUE

| 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 |

● CONTROL COMMAND TABLE

| Select Address | BIT | | | | | | | | REMARKS |
|----------------|-----|------|----|----|----|------|----------|-----|--|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| 00H | VOL | | | | | | | | VOL : Volume control for both Ach and Bch (0.33dB/step) Ex.) FFH=0dB FEH=-0.33dB FDH=-0.66dB FCH=-1.0dB : : 03H=-84dB 00H=MUTE The Volume is consisted of volume1 and volume 2. The volume level is divided into half to each volum1 and volume2. Ex.) volume level = -30dB (volume 1 =-15dB,volume 2=-15dB) |
| | | F | | | | | F | | |
| | | F | | | | | E | | |
| | | F | | | | | D | | |
| | | F | | | | | C | | |
| | | : | | | | | : | | |
| | | 0 | | | | | 3 | | |
| | | 0 | | | | | 2 | | |
| 01H | CHS | BAL | | | | | AGC | SUR | CHS : Channel select for Balance control "0"=Ach "1"=Bch BAL : Balance control for both Ach and Bch (1dB/step) Ex.) "00000"=0dB "00001"=-1dB : : "11110"=-30dB "11111"=MUTE The Balance is consisted of volume1 and volume 2. The Balance level is divided into half to each volum1 and volume2. AGC : AGC switch "0"=AGC OFF "1"=AGC ON SUR : Surround mode switch "0"=Surround OFF "1"=Surround ON |
| | 0/1 | 0 | 0 | 0 | 0 | 0 | 0/1 | 0/1 | |
| | | 0 | 0 | 0 | 0 | 1 | | | |
| | | 0 | 0 | 0 | 1 | 0 | | | |
| | | 0 | 0 | 0 | 1 | 1 | | | |
| | | : | : | : | : | : | | | |
| | | : | : | : | : | : | | | |
| | | 1 | 1 | 1 | 0 | 0 | | | |
| 1 | 1 | 1 | 0 | 1 | | | | | |
| 1 | 1 | 1 | 1 | 0 | | | | | |
| 1 | 1 | 1 | 1 | 1 | | | | | |
| 02H | BCB | BASS | | | | BCSB | SUB-BASS | | BCB : Boost-cut select for Bass control "0"=Cut "1"=Boost BASS : Bass control (1dB/step) Ex.) "0000"=0dB "0001"=1dB : : "1110"=14dB "1111"=15dB BCSB : Boost-cut select for Sub-Bass control "0"=Cut "1"=Boost SUB-BASS : Sub-Bass control (1dB/step) "00"=0dB "01"=1dB "10"=2dB "11"=3dB |
| | 0/1 | 0 | 0 | 0 | 0 | 0/1 | 0 | 0 | |
| | | 0 | 0 | 0 | 1 | | 0 | 1 | |
| | | 0 | 0 | 1 | 0 | | 1 | 0 | |
| | | 0 | 0 | 1 | 1 | | 1 | 1 | |
| | | : | : | : | : | | : | : | |
| | | : | : | : | : | | : | : | |
| | | 1 | 1 | 0 | 0 | | | | |
| 1 | 1 | 0 | 1 | | | | | | |
| 1 | 1 | 1 | 0 | | | | | | |
| 1 | 1 | 1 | 1 | | | | | | |
| 03H | BCT | TREB | | | | BCST | SUB-TREB | | BCT : Boost-cut select for Treble control "0"=Cut "1"=Boost TREB : Treble control (1dB/step) Ex.) "0000"=0dB "0001"=1dB : : "1110"=14dB "1111"=15dB BCST : Boost-cut select for Sub-Treble control "0"=Cut "1"=Boost SUB-TREB : Sub-Treble control (1dB/step) "00"=0dB "01"=1dB "10"=2dB "11"=3dB |
| | 0/1 | 0 | 0 | 0 | 0 | 0/1 | 0 | 0 | |
| | | 0 | 0 | 0 | 1 | | 0 | 1 | |
| | | 0 | 0 | 1 | 0 | | 1 | 0 | |
| | | 0 | 0 | 1 | 1 | | 1 | 1 | |
| | | : | : | : | : | | : | : | |
| | | : | : | : | : | | : | : | |
| | | 1 | 1 | 0 | 0 | | | | |
| 1 | 1 | 0 | 1 | | | | | | |
| 1 | 1 | 1 | 0 | | | | | | |
| 1 | 1 | 1 | 1 | | | | | | |

● CONTROL COMMAND TABLE

| Select Address | BIT | | | | | | | | REMARKS |
|----------------|---------|------------|----|------------|----------|------|------|----|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| 04H | BBE-Low | | | | BBE-High | | | | BBE-Low : Boost level control for BBE Lo-Contour (1dB/step) Ex.) "0000"=0dB "0001"=1dB : "1110"=14dB "1111"=15dB BBE-High : Boost level control for BBE Process (1dB/step) Ex.) "0000"=0dB "0001"=1dB : "1110"=14dB "1111"=15dB When all bits are "0"(=00H), BBE becomes off. |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | |
| | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | |
| | : | : | : | : | : | : | : | : | |
| | : | : | : | : | : | : | : | : | |
| | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | |
| | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| 05H | OUT | SEL | | Reserved | | AUX1 | AUX2 | | OUT : ON / OFF switch for OUTPUT "0"=OFF "1"=ON AUX1/AUX2 : Auxiliary port ON/OFF "0"=OFF "1"=ON |
| | 0/1 | don't care | | don't care | | 0/1 | 0/1 | | |

■NOTE

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