

4 Channels Electronic Volume

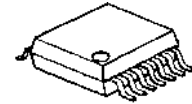
■GENERAL DESCRIPTION

The NJU72342 is a 4 channels I²C electronic volume IC with external mute controls.

The NJU72342 has many characteristics that are useful in audio application, such as low noise, low distortion, and wide operating voltage range.

All functions are controlled by I²C BUS interface.

■PACKAGE OUTLINE

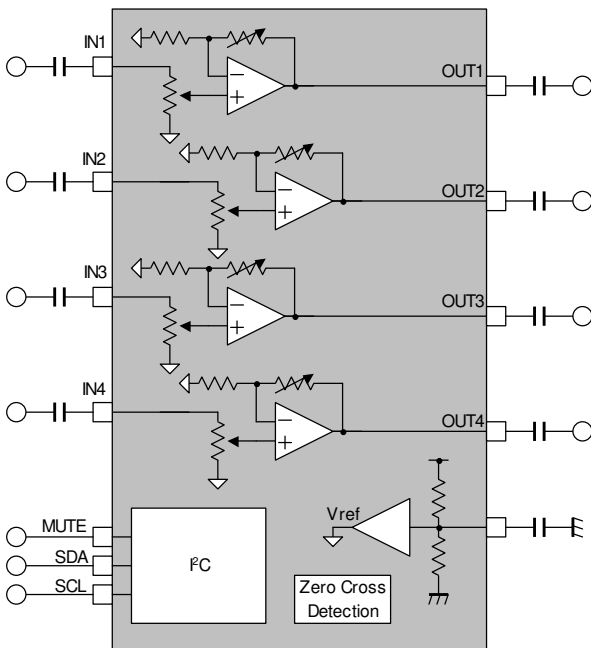


SSOP14

■FEATURES

- Operating Voltage V₊=4.5V ~ 14.5V
- Input Gain 0dB/+3dB/+6dB/+9dB
- Volume 0~-95dB/Mute ,1dBstep
- Low Distortion 0.002% typ.
- Low Noise 2.0μVrms typ.
- External Mute
- Zero Cross Detection
- I²C BUS Control
- CMOS Technology
- Small Package SSOP14

■BLOCK DIAGRAM



■PIN CONFIGURATION

| No. | Symbol | Function |
|-----|--------|--|
| 1 | IN1 | Input Terminal 1 |
| 2 | IN2 | Input Terminal 2 |
| 3 | IN3 | Input Terminal 3 |
| 4 | IN4 | Input Terminal 4 |
| 5 | MUTE | Mute Terminal |
| 6 | SDA | I ² C Data Input Terminal /Acknowledge Output |
| 7 | SCL | I ² C Clock Terminal |
| 8 | V+ | Power Supply Terminal |
| 9 | VREF | Reference Voltage Terminal |
| 10 | GND | Ground Terminal |
| 11 | OUT4 | Output Terminal 4 |
| 12 | OUT3 | Output Terminal 3 |
| 13 | OUT2 | Output Terminal 2 |
| 14 | OUT1 | Output Terminal 1 |

■ABSOLUTE MAXIMUM RATING (Ta=25°C)

| PARAMETER | SYMBOL | RATING | UNIT |
|-----------------------------|-------------------|----------------------------|------|
| Supply Voltage | V ₊ | +15 | V |
| Power Dissipation | P _D | 560 (Note1) | mW |
| Maximum Input Voltage | V _{IMAX} | 0 ~ V ₊ (Note2) | V |
| Operating Temperature Range | Topr | -40 ~ +85 | °C |
| Storage Temperature Range | Tstg | -40 ~ +150 | °C |

(Note1) EIA/JEDEC STANDARD Test board (76.2x114.3x1.6mm, 2layer, FR-4) mounting

(Note2) Don't put Input Voltage more than Power Supply Voltage.

■ELECTRICAL CHARACTERISTICS

(Ta=25°C, V⁺=9V, R_L=47kΩ, V_{IN}=1.5Vrms, f=1kHz, all controls flat unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---------------------------|------------------|--|------|-------|------|-------|
| Operating Voltage | V ₊ | | 4.5 | 9 | 14.5 | V |
| Supply Current | I _{DD} | No signal | - | 10 | 16 | mA |
| Reference Voltage | V _{REF} | No signal | 4.0 | 4.5 | 5.0 | V |
| Maximum Input Voltage | V _{INS} | Main Volume=-6dB, THD=1% | - | 3.6 | - | Vrms |
| Maximum Output Voltage | V _{OM} | THD=1% | 2.2 | 2.6 | - | Vrms |
| Voltage Gain 1 | G _{V1} | Input Gain=+6dB, V _{IN} =100mVrms | 4 | 6 | 8 | dB |
| Voltage Gain 2 | G _{V2} | | -1.5 | 0 | 1.5 | dB |
| Voltage Gain 3 | G _{V3} | Main Volume=Mute, BW=400Hz-30kHz | - | -100 | -95 | dB |
| Channel Balance | G _{CB} | Main Volume=0dB | -1 | 0 | 1 | dB |
| Total Harmonic Distortion | THD | Vo=1.5Vrms, BW=400Hz~30kHz | - | 0.002 | 0.01 | % |
| Output Noise Voltage | V _{NO} | Main Volume=0dB | - | 2.0 | 7.0 | μVrms |
| Channel Separation | CS | R _g =0 | - | -110 | -90 | dB |

MUTE TERMINAL CONTROL CHARACTERISTICS (Ta=25°C, all controls flat unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|--------------------------|-----------------|----------------|------|------|----------------|------|
| Low Level Input Voltage | V _{IL} | | 0 | - | 0.6 | V |
| High Level Input Voltage | V _{IH} | | 2.0 | - | V ⁺ | V |

■CONTROL TERMINAL EXPLANATION -Mute Terminal-

(Ta=25°C, V⁺=9V, R_L=47kΩ, V_{IN}=1.5Vrms, f=1kHz, all controls flat unless otherwise specified)

| MODE | STATUS | TEST CONDITION |
|----------|--------|--------------------|
| Mute ON | H | Mute is Active |
| Mute OFF | L | Mute is NOT Active |

■ TERMINAL DESCRIPTION

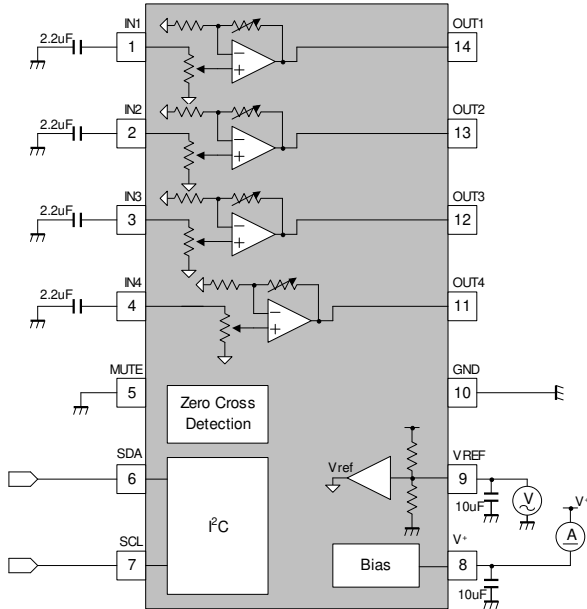
| Terminal | SYMBOL | FUNCTION | EQUIVALENT CIRCUIT | VOLTAGE |
|------------------|--------------------------|--|--------------------|---------|
| 1 2 3 4 | IN1 IN2 IN3 IN4 | AC Input | | $V^+/2$ |
| 5 | MUTE | MUTE Control | | 0V |
| 6 | SDA | I ² C Data Input / Acknowledge Output | | - |
| 7 | SCL | I ² C Clock Input | | - |

■ TERMINAL DESCRIPTION

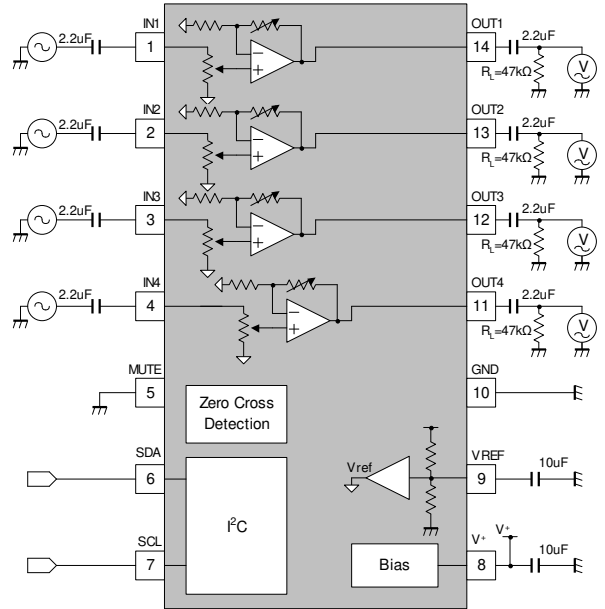
| Terminal | SYMBOL | FUNCTION | EQUIVALENT CIRCUIT | VOLTAGE |
|----------------------|------------------------------|-------------------|--------------------|---------|
| 8 | V+ | Supply Voltage | | V+ |
| 9 | VREF | Reference Voltage | | $V^+/2$ |
| 11 12 13 14 | OUT4 OUT3 OUT2 OUT1 | AC Output | | $V^+/2$ |

TEST CIRCUIT

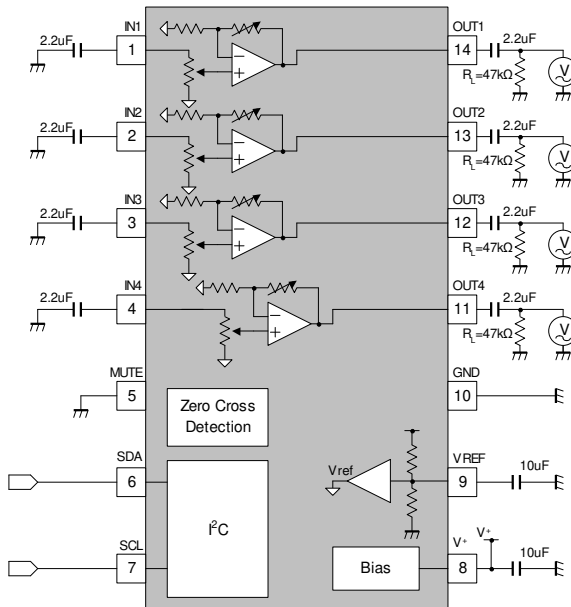
◆ I_{DD} / V_{REF}



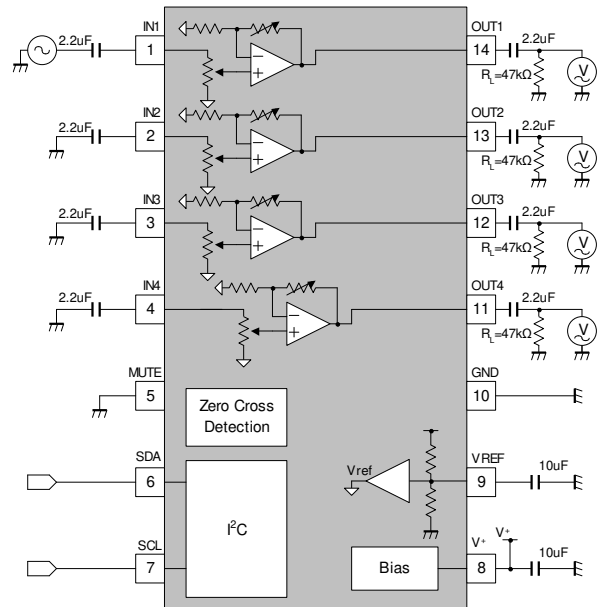
◆ $V_{INS} / V_{OM} / G_{V1} / G_{V2} / G_{V3} / G_{CB} / THD$



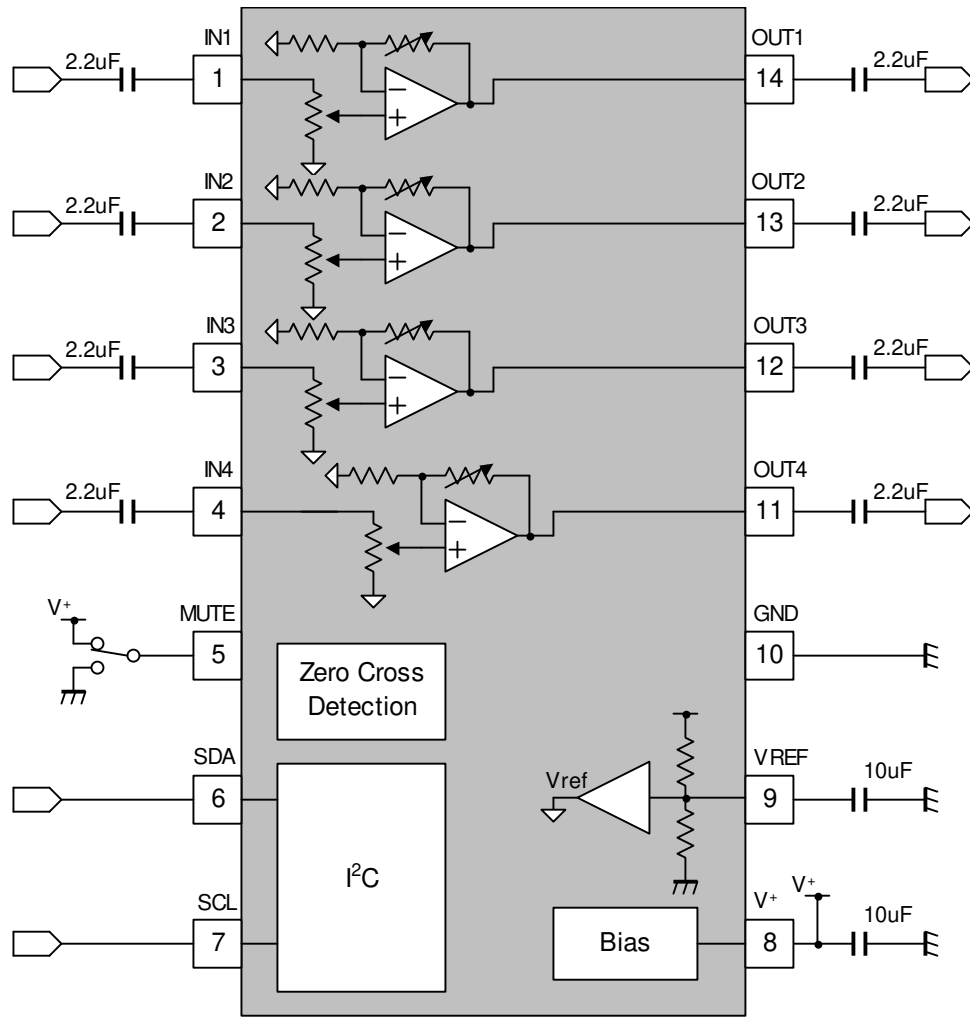
◆ V_{NO}



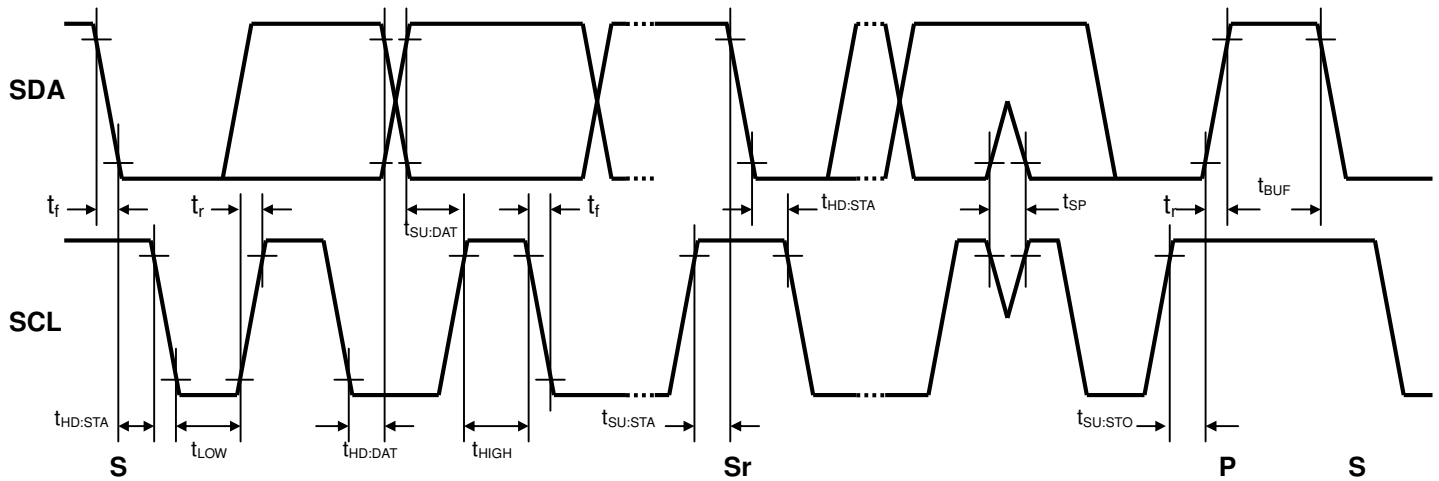
◆ CS



APPLICATION CIRCUIT



■TIMING ON THE I²C BUS (SDA,SCL)



■CHARACTERISTICS OF I/O STAGES FOR I²C BUS (SDA,SCL)

I²C BUS Load Conditions

STANDARD MODE : Pull up resistance 4kΩ (Connected to +5V), Load capacitance 200pF (Connected to GND)

FAST MODE : Pull up resistance 4kΩ (Connected to +5V), Load capacitance 50pF (Connected to GND)

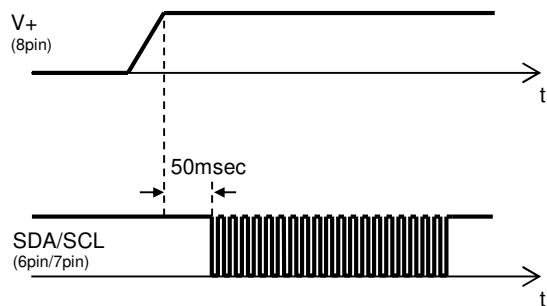
| PARAMETER | SYMBOL | Standard mode | | | Fast mode | | | UNIT |
|---|-----------------|---------------|------|------|-----------|------|------|------|
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| Low Level Input Voltage | V _{IL} | 0.0 | - | 1.5 | 0.0 | - | 1.5 | V |
| High Level Input Voltage | V _{IH} | 2.7 | - | 5.5 | 2.7 | - | 5.5 | V |
| Low level output voltage (3mA at SDA pin) | V _{OL} | 0 | - | 0.4 | 0 | - | 0.4 | V |
| Input current each I/O pin with an input voltage between 0.1V _{DD} and 0.9V _{DDmax} | I _i | -10 | - | 10 | -10 | - | 10 | μA |

■CHARACTERISTICS OF BUS LINES (SDA,SCL) FOR I²C-BUS DEVICES

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

C_b ; total capacitance of one bus line in pF.

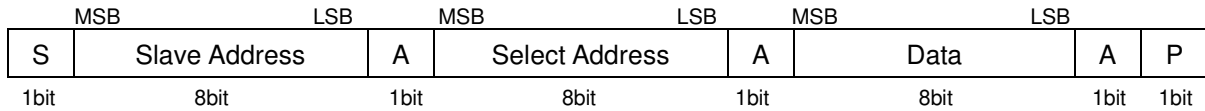
■ RECOMMENDED POWER-UP SEQUENCE



■ DEFINITION OF I²C REGISTER

Note) Please don't send except specified data for avoiding an incorrect operation.

◆ I²C BUS FORMAT



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

◆ SLAVE ADDRESS

| Slave Address | | | | | | | | Hex |
|---------------|---|---|---|---|---|---|-----|-------|
| MSB | | | | | | | LSB | - |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80(h) |

◆ CONTROL REGISTER TABLE

The select address sets each function
(Volume A, Volume 1B, Volume 2B, Volume 3B, Volume 4B).
The auto increment function cycles the select address as follows.
00H→01H→02H→03H→04H→00H

<Write Mode>

| Select Address | BIT | | | | | | | | |
|----------------|-----------|----|-----------|----|-----------|----|-----------|-----------|--|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| 00H | VOLUME 4A | | VOLUME 3A | | VOLUME 2A | | VOLUME 1A | | |
| 01H | ZERO 1 | | | | | | | VOLUME 1B | |
| 02H | ZERO 2 | | | | | | | VOLUME 2B | |
| 03H | ZERO 3 | | | | | | | VOLUME 3B | |
| 04H | ZERO 4 | | | | | | | VOLUME 4B | |

*: Don't Care

◆ 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 |

Note.) This product starts up by MUTE setting in power "ON". Use it after removing MUTE of each setting.
If any audio signal is inputted in input signal terminal before power "ON", it may cause initial condition abnormality.
In conditions of use such as the above, it prevents that abnormality by setting MUTE before power "OFF"

■ INSTRUCTION CODE

a) VOLUME_A SETTING

| Select Address | BIT | | | | | | | |
|----------------|-----------|----|-----------|----|-----------|----|-----------|----|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 00H | VOLUME 4A | | VOLUME 3A | | VOLUME 2A | | VOLUME 1A | |

•VOLUME1A/2A/3A/4A: 0 to +9dB (3dB/Step)

b) VOLUME_B SETTING

| Select Address | BIT | | | | | | | |
|----------------|--------|-----------|----|----|----|----|----|----|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 01H | ZERO 1 | VOLUME 1B | | | | | | |
| 02H | ZERO 2 | VOLUME 2B | | | | | | |
| 03H | ZERO 3 | VOLUME 3B | | | | | | |
| 04H | ZERO 4 | VOLUME 4B | | | | | | |

•ZERO 1/2/3/4: Ch1/Ch2/Ch3/Ch4 Zero Cross Detection ON/OFF setting

“0”: OFF

“1”: ON

•VOLUME1B/2B/3B/4B: Volume 1B/2B/3B/4B setting 0 to -95 dB (1dB/Step) / Mute

■ VOLUME A (Select Address : 00H)

| | | VOLUME A | |
|----------|------|----------|----|
| Gain(dB) | Ch 1 | D1 | D0 |
| | Ch 2 | D3 | D2 |
| | Ch 3 | D5 | D4 |
| | Ch 4 | D7 | D6 |
| 0* | | 0 | 0 |
| +3 | | 0 | 1 |
| +6 | | 1 | 0 |
| +9 | | 1 | 1 |

*: Default Value

■ ZERO CROSS DETECTION (Select Address : 01H/02H/03H/04H)

| | | ZERO |
|----------------------|------|------|
| ZERO CROSS DETECTION | Ch 1 | D7 |
| | Ch 2 | D7 |
| | Ch 3 | D7 |
| | Ch 4 | D7 |
| OFF* | | 0 |
| ON | | 1 |

*: Default Value

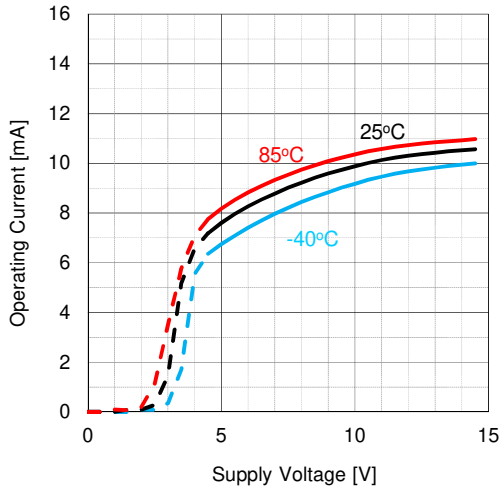
■ VOLUME B (Select Address : 01H/02H/03H/04H)

| | | VOLUME B | | | | | | |
|----------|------|----------|----|----|----|----|----|----|
| | | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| Gain(dB) | Ch 1 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | Ch 2 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | Ch 3 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | Ch 4 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| Mute | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| ... | | ... | | | | | | |
| Mute | | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| -1 | | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
| -2 | | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| -3 | | 1 | 1 | 1 | 0 | 1 | 0 | 0 |
| -4 | | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| -5 | | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| -6 | | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| ... | | ... | | | | | | |
| -90 | | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| -91 | | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| -92 | | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| -93 | | 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| -94 | | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| -95 | | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| Mute | | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| ... | | ... | | | | | | |
| Mute* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

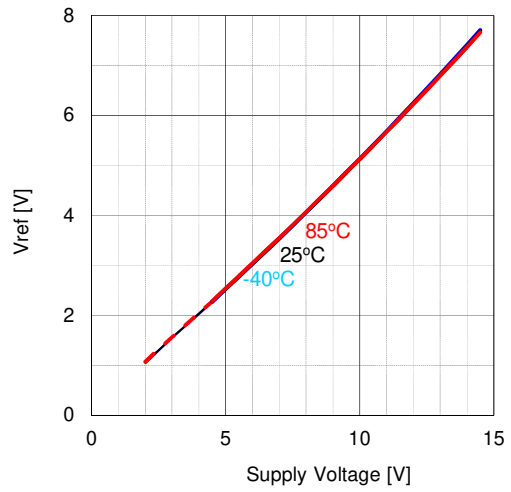
*: Default Value

TYPICAL CHARACTERISTICS

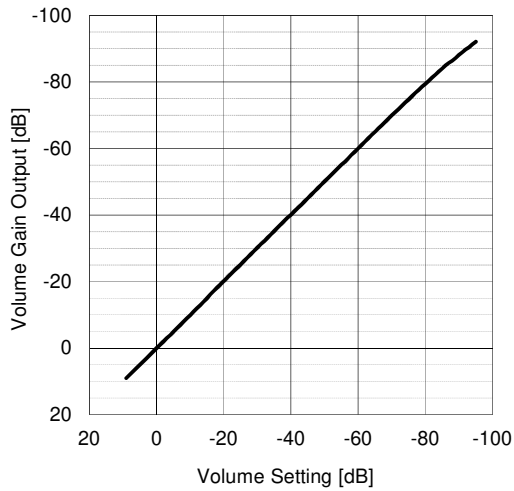
Operating Current vs Supply Voltage
 V_{in} =no signal, R_L =No Load



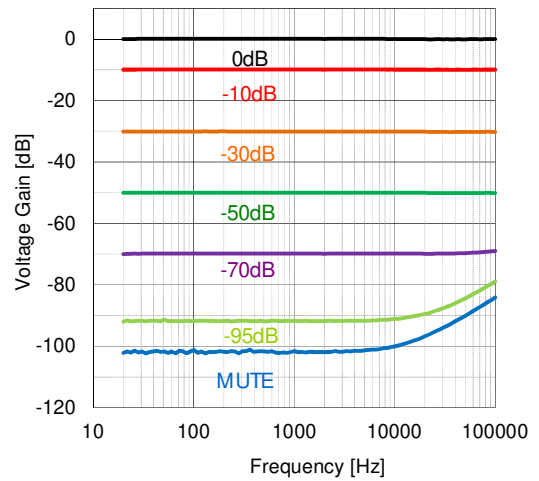
Reference Voltage vs Supply Voltage
 V_{in} =no signal, R_L =No Load



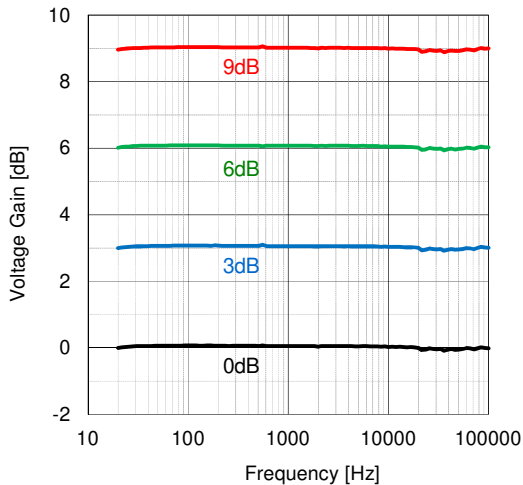
Volume Gain Output vs Volume Setting
 V_s =9V, T_a =25°C, f =1kHz, Bandpass



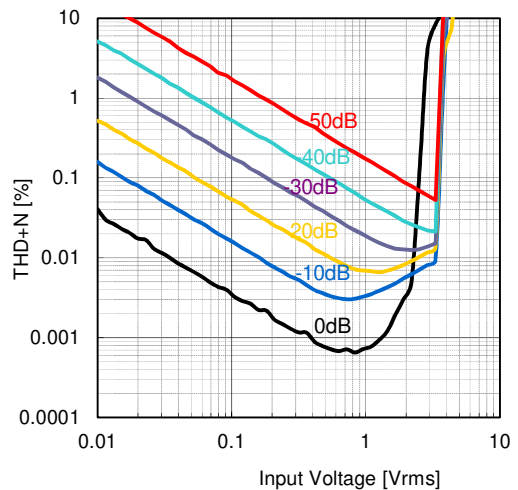
Voltage Gain Output vs Frequency
 V_s =9V, T_a =25°C, V_{in} =1.5Vrms, Bandpass



Voltage Gain Output vs Frequency
 V_s =9V, T_a =25°C, V_{in} =0.1Vrms, Bandpass



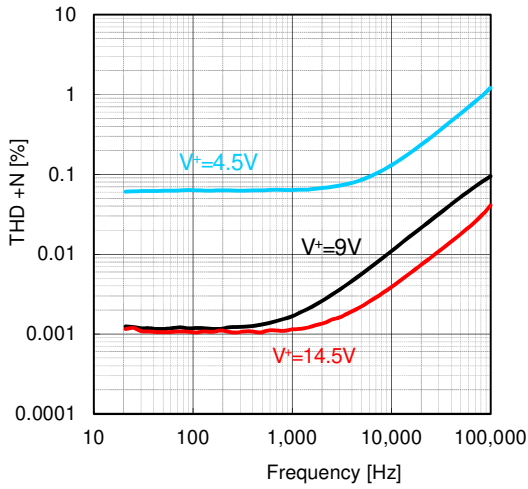
THD+N vs V_{in} -Volume
 V_s =9V, T_a =25°C, f =1kHz, BW=400Hz-30kHz



TYPICAL CHARACTERISTICS

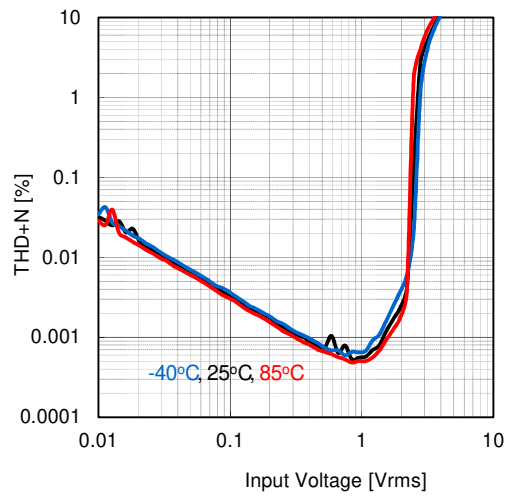
THD+N vs Frequency

Ta=25°C, Vin= 1.5Vrms (0.8Vrms for V+=4.5V), Vol =0dB



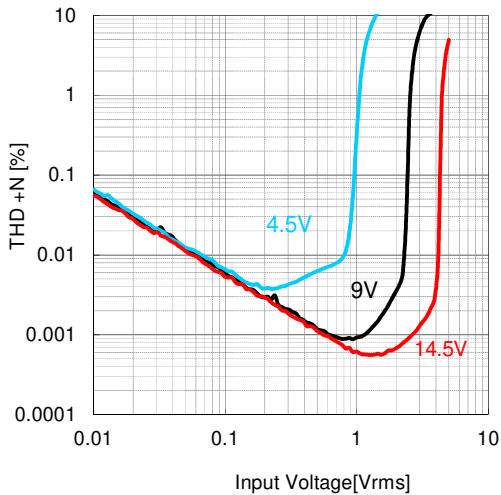
THD+N vs Vin - Temperature

V+=9V, f=1kHz, BW=400Hz-30kHz, Vol =0dB



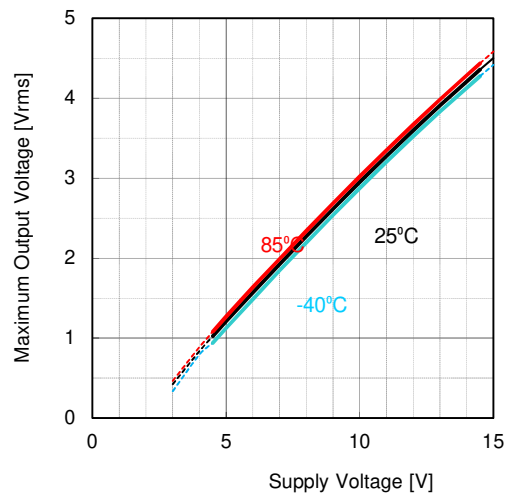
THD+N vs Vin - Supply

Ta=25°C, f=1kHz, BW=400Hz-30kHz, Gain=0dB



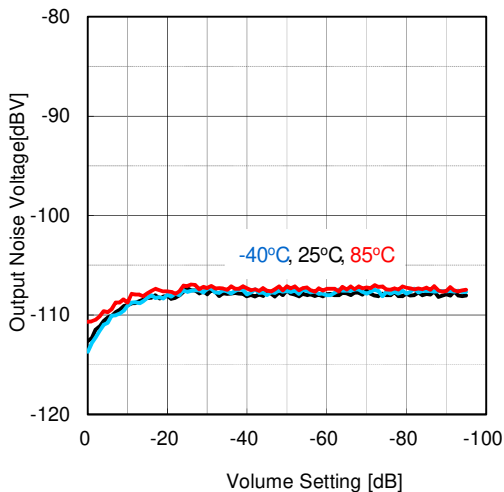
Maximum Output Voltage vs Supply Voltage

f=1kHz THD=1% ,Gain =0dB



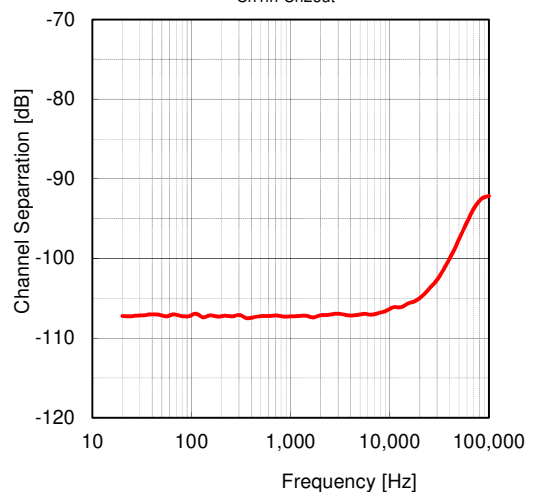
Output Noise Voltage vs Volume Setting

V+=9V, Ta=25°C, Rg=0, A-Weight filter

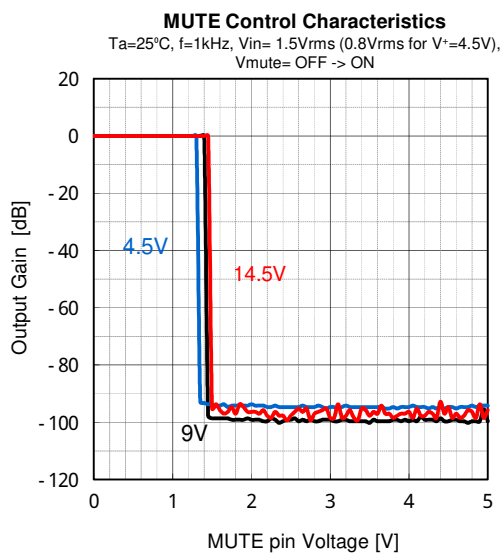


Channel Separation vs Frequency

V+=9V, Vin=1.5Vrms, Vol =0dB, BW:10-80kHz
Ch1in-Ch2out



■ TYPICAL CHARACTERISTICS



[CAUTION]

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