

4-CHANNEL ELECTRONIC VOLUME

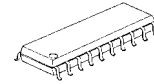
■ GENERAL DESCRIPTION

The **NJW1184** is a four channel electronic volume.

The **NJW1184** performs click-noiseless characteristics with VCA circuit.

These functions are controlled by I²C Bus. And the Slave Address selector is available for using two chips on same serial bus line. It's available for two-channel stereo and or multi-channel audio volume.

■ PACKAGE OUTLINE

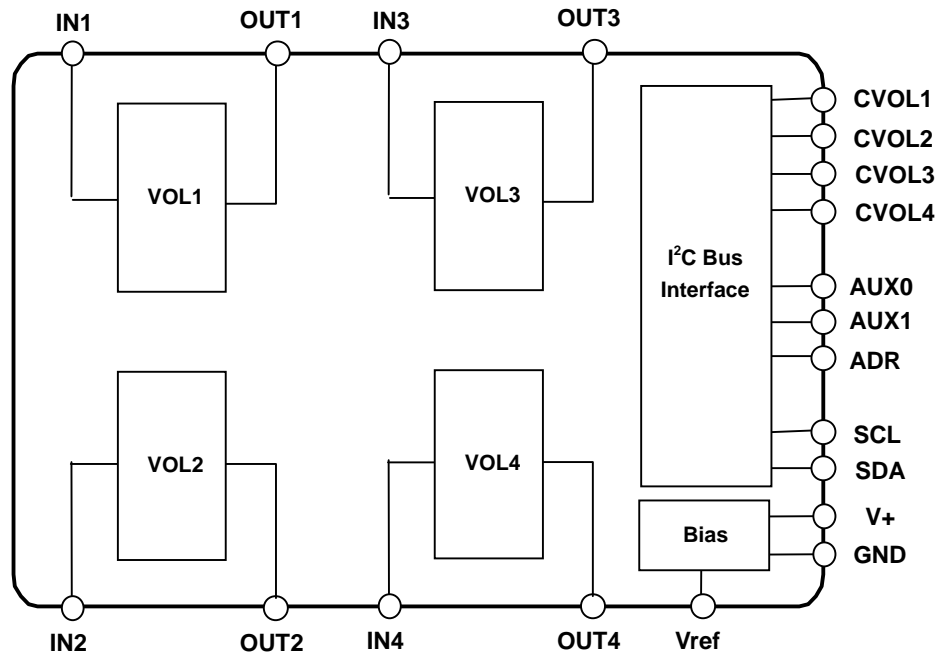


NJW1184M

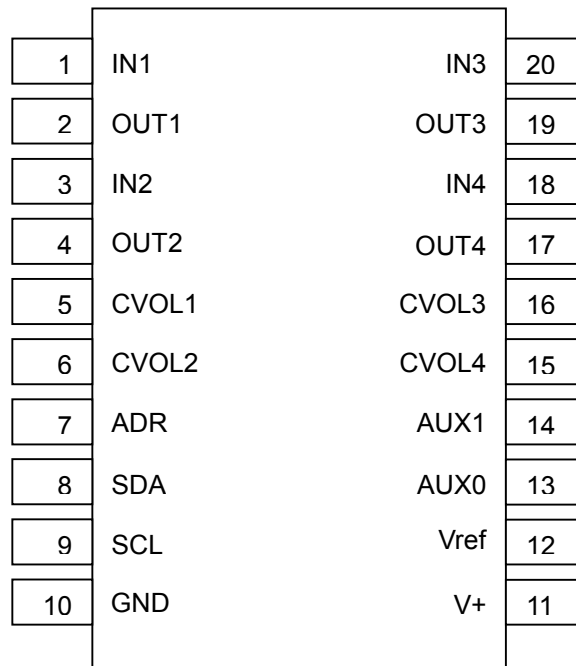
■ FEATURES

- Operating Voltage 7.5 to 13V
- I²C Bus control
- Slave Address Selector available for using two chips on same serial bus line
- Volume (VCA type) 0 to -100dB/0.5dBstep, MUTE
- 2 Auxiliary Port
- Bi-CMOS Technology
- Package Outline DMP20

■ BLOCK DIAGRAM



■PIN CONFIGURATION



| No. | Symbol | Function | No. | Symbol | Function |
|-----|--------|---------------------------------------|-----|--------|-------------------------|
| 1 | IN1 | Input 1 | 11 | V+ | Power Supply Pin |
| 2 | OUT1 | Output 1 | 12 | Vref | Reference Voltage |
| 3 | IN2 | Input 2 | 13 | AUX0 | Auxiliary Output0 |
| 4 | OUT2 | Output 2 | 14 | AUX1 | Auxiliary Output1 |
| 5 | CVOL1 | DAC Output for Volume 1 | 15 | CVOL4 | DAC Output for Volume 4 |
| 6 | CVOL2 | DAC Output for Volume 2 | 16 | CVOL3 | DAC Output for Volume 3 |
| 7 | ADR | Slave Address Setting | 17 | OUT4 | Output 4 |
| 8 | SDA | SDA Data Input (I ² C BUS) | 18 | IN4 | Input 4 |
| 9 | SCL | SCL Data Input (I ² C BUS) | 19 | OUT3 | Output 3 |
| 10 | GND | GND | 20 | IN3 | Input 3 |

■ ABSOLUTE MAXIMUM RATING (Ta=25°C)

| PARAMETER | SYMBOL | RATING | UNIT |
|-----------------------------|-----------------|-------------------------|------|
| Supply Voltage | V ⁺ | 15 | V |
| Maximum Input Voltage | V _{IM} | 0 to V ⁺ (*) | V |
| Power Dissipation | P _D | DMP20 : 350 | mW |
| Operating Temperature Range | Topr | -40 to +85 | °C |
| Storage Temperature Range | Tstg | -40 to +125 | °C |

(*) For the maximum input voltage less than 0 to V⁺

■ ELECTRICAL CHARACTERISTICS

(Ta=25°C, V+=9V, R_L=47kΩ, Vin=100mVrms/1kHz, unless otherwise specified)

● POWER SUPPLY

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|-------------------|------------------|----------------|------|------|------|------|
| Operating Voltage | V ⁺ | | 7.5 | 9.0 | 13.0 | V |
| Supply Current | I _{CC} | No Signal | - | 4 | 10 | mA |
| Reference Voltage | V _{REF} | No Signal | 4.0 | 4.5 | 5.0 | V |

● VOLUME

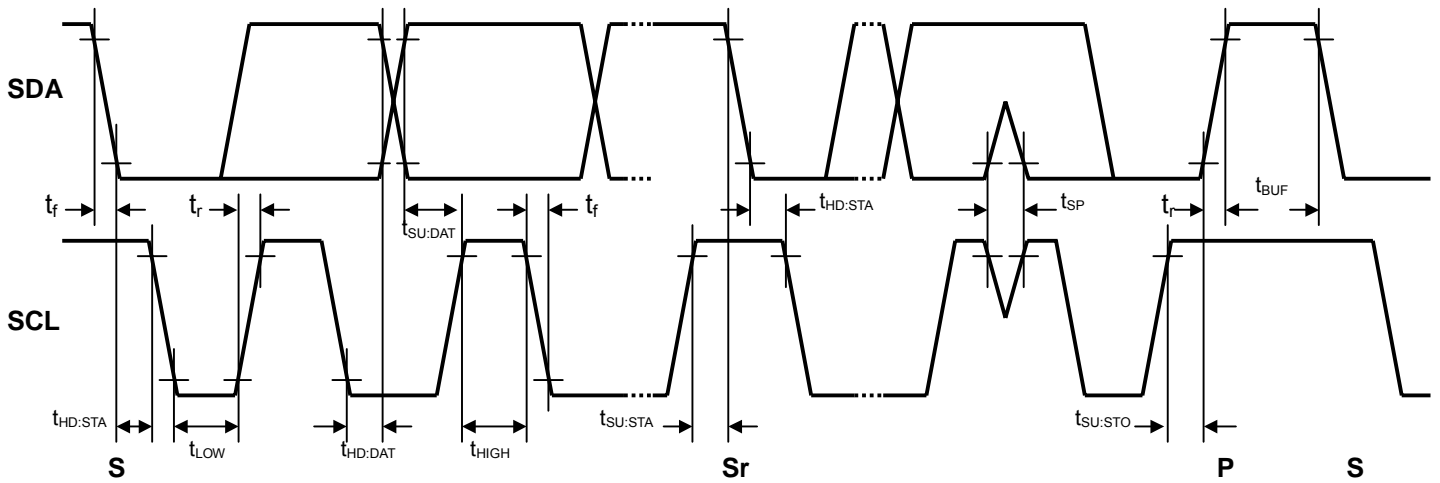
| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---------------------------|-------------------|---------------------------------|------|---------------|---------------|----------------|
| Maximum Input Voltage | V _{IM} | VOL=-20dB, THD=1% | 2.8 | 3.0 | - | Vrms |
| Maximum Output Voltage | V _{OM} | OUTPUT VOL=0dB, THD=1% | - | 2.5 | - | Vrms |
| Channel Balance | G _{CB} | VOL=0dB | -1.0 | 0.0 | 1.0 | dB |
| Total Harmonic Distortion | THD | Vo=0.5Vrms BW=400Hz to 30kHz | - | - | 0.3 | % |
| Maximum Gain | G _{VMAX} | VOL= 0dB | -2.0 | 0.0 | 2.0 | dB |
| Minimum Gain | G _{VMIN} | VOL= MUTE, Vin=2Vrms | - | -100 | -90 | dB |
| Channel Separation | CS | Vin = 1Vrms A-weighting | - | -80 | -70 | dB |
| Output Noise 1 | V _{NO1} | VOL = 0dB A-weighting | - | -90 (31.6) | -85 (56.2) | dBV (μVrms) |
| Output Noise 2 | V _{NO2} | VOL = MUTE A-weighting | - | -106 (5.0) | -96 (15.8) | dBV (μVrms) |
| Input Impedance | R _i | | - | 20 | - | kΩ |
| AUX Output Voltage | V _{AUX} | Logic Output: High | 4.5 | - | 5.5 | V |
| | | Logic Output: Low | 0 | - | 0.5 | |

BW: Band Width

● CONTROL

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|--------------------------|-------------------|--------------------------|-------------------|------|------|------|
| High Level Input Voltage | V _{ADRH} | High : Slave Address 82H | V ⁺ /2 | - | - | V |
| Low Level Input Voltage | V _{ADRL} | Low : Slave Address 80H | - | - | 1.0 | V |

■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 | - | 5.0 | 2.7 | - | 5.0 | 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.

NOTE). Data hold time : t_{HD:DAT}

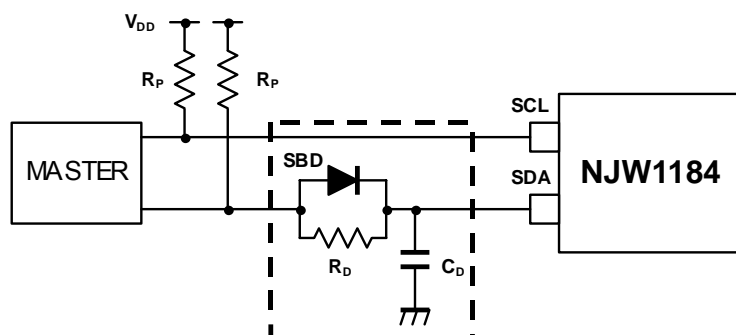
Please hold the Data Hold Time (t_{HD:DAT}) to 300ns or more to avoid status of unstable at SCL falling edge.

The SDA block in the NJW1184 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_f) as much as possible.



■ TERMINAL DESCRIPTION

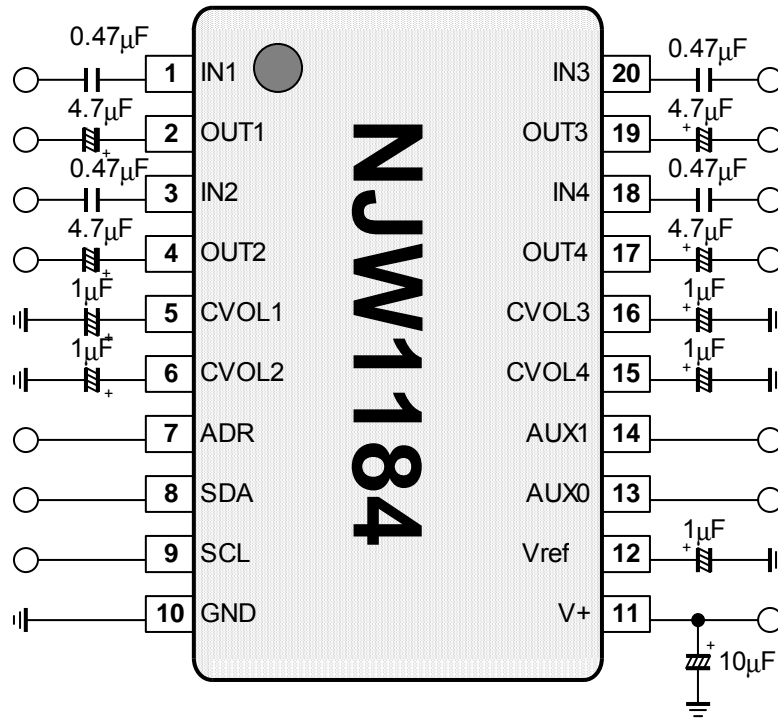
| PIN NO. | SYMBOL | FUNCTION | EQUIVALENT CIRCUIT | TERMINAL DC VOLTAGE |
|--------------------|----------------------------------|--|--------------------|--|
| 1 3 20 18 | IN1 IN2 IN3 IN4 | Input 1 Input 2 Input 3 Input 4 | | $V^+/2$ |
| 2 4 19 17 | OUT1 OUT2 OUT3 OUT4 | Output 1 Output 2 Output 3 Output 4 | | $V^+/2$ |
| 5 6 16 15 | CVOL1 CVOL2 CVOL3 CVOL4 | DAC Output for Volume 1 DAC Output for Volume 2 DAC Output for Volume 3 DAC Output for Volume 4 | | $V^+/2 - 0.7V$ (0dB setting) |
| 7 | ADR | Slave Address Setting | | 82(h) $V_{ADR} > V^+/2$ 80(h) $V_{ADR} \leq 1.0V$ |

■ TERMINAL DESCRIPTION

| PIN NO. | SYMBOL | FUNCTION | EQUIVALENT CIRCUIT | TERMINAL DC VOLTAGE |
|----------|--------------|--|--|---------------------|
| 8 9 | SDA SCL | SDA Data Input (I ² C BUS) SCL Data Input (I ² C BUS) | <p style="text-align: center;">SCL:GND SDA:ACK</p> | - |
| 12 | Vref | Reference Voltage | | $V^+/2$ |
| 13 14 | AUX0 AUX1 | Auxiliary Output 0 Auxiliary Output 1 | | 0V / 5V |

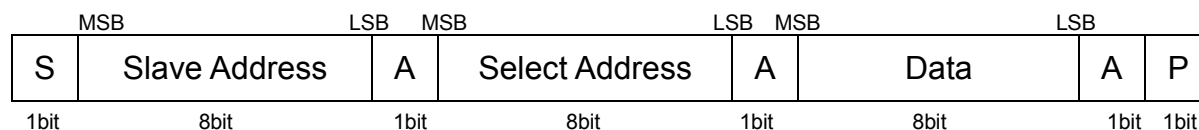
NJW1184

APPLICATION CIRCUIT



■ DEFINITION OF I²C REGISTER

● I²C BUS FORMAT



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

● SLAVE ADDRESS



ADR: Hardware pin programmable address bits
80(h), 82(h)

R/W=0: Write mode for register setting
R/W=1: Not available

● CONTROL REGISTER TABLE

The select address sets each function (Volume, Aux).
The auto-increment function cycles the select address as follows.
00H→01H→02H→03H→04H→00H

| Select Address | BIT | | | | | | | |
|----------------|------------|------------|------------|------------|------------|------------|------|------|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 00H | VOL-1 | | | | | | | |
| 01H | VOL-2 | | | | | | | |
| 02H | VOL-3 | | | | | | | |
| 03H | VOL-4 | | | | | | | |
| 04H | Don't Care | Don't Care | Don't Care | Don't Care | Don't Care | Don't Care | AUX1 | AUX0 |

● 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 |

■ I²C CONTROL COMMAND DESCRIPTION

a) Master Volume (Select Address: 00H, 01H, 02H, 03H) Volume level : 0 to -100dB(0.5dB/step), MUTE

| Gain(dB) | HEX | VOL-1 / VOL-2 / VOL-3 / VOL-4 | | | | | | | |
|----------|-----|-------------------------------|-----|-----|-----|-----|-----|-----|-----|
| | | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0 | FF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| -0.5 | FE | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| -1.0 | FD | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| -1.5 | FC | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| -2.0 | FB | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| -2.5 | FA | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| -3.0 | F9 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| -3.5 | F8 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| -4.0 | F7 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| -4.5 | F6 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
| -5.0 | F5 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| -5.5 | F4 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 |
| -6.0 | F3 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| -6.5 | F2 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| -7.0 | F1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| -7.5 | F0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| -8.0 | EF | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| -8.5 | EE | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| -9.0 | ED | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| -9.5 | EC | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| -10.0 | EB | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| -10.5 | EA | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| -11.0 | E9 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| -11.5 | E8 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 |
| -12.0 | E7 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| -12.5 | E6 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| -13.0 | E5 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 |
| -13.5 | E4 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| -14.0 | E3 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| -14.5 | E2 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| -15.0 | E1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| -15.5 | E0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| -16.0 | DF | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| -16.5 | DE | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| -17.0 | DD | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| -99.5 | 38 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| -100.0 | 37 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Mute | 00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

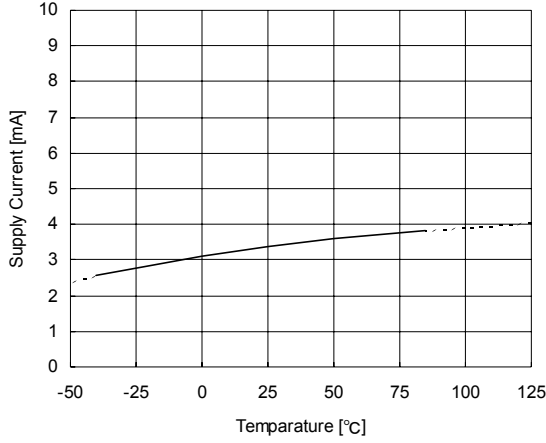
b) AUXILIARY SETTING

| Select Address | BIT | | | | | | | |
|----------------|------------|------------|------------|------------|------------|------------|-------------|-------------|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 04H | Don't Care | Don't Care | Don't Care | Don't Care | Don't Care | Don't Care | AUX1 | AUX0 |

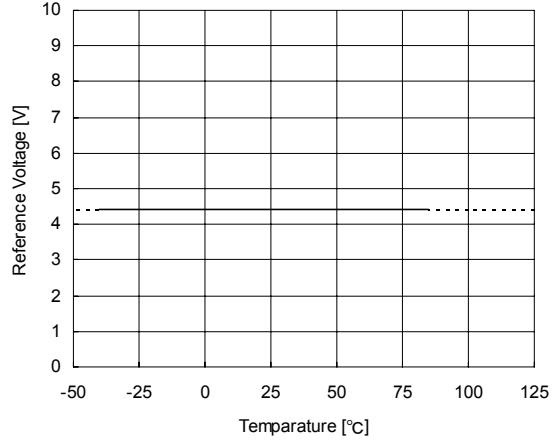
- AUX1/AUX0: Auxiliary port High/Low
 - “0” : Logic output "Low"
 - “1” : Logic output "High"

TYPICAL CHARACTERISTICS

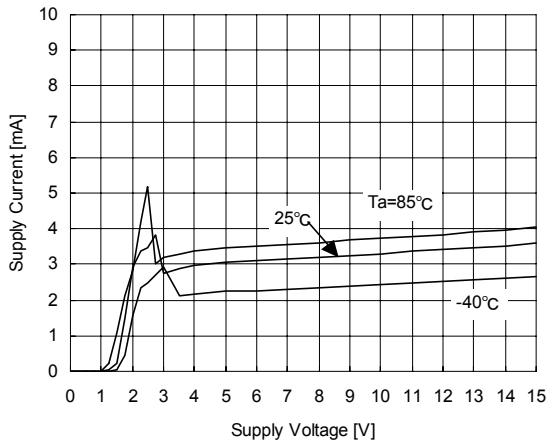
Supply Current vs Temperature
 $V+=9V$, V_{in} =No Signal, Volume=0dB



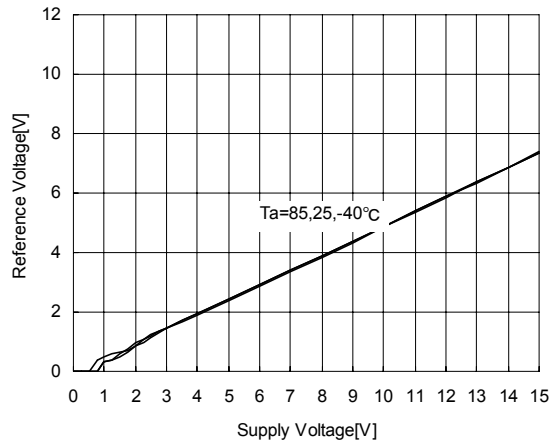
Reference Voltage vs Temperature
 $V+=9V$, V_{in} =No Signal, Volume=0dB



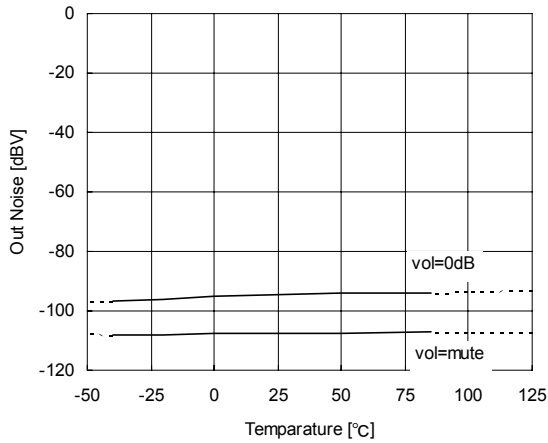
Supply Current vs Supply Voltage
 V_{in} =No Signal, Volume=0dB



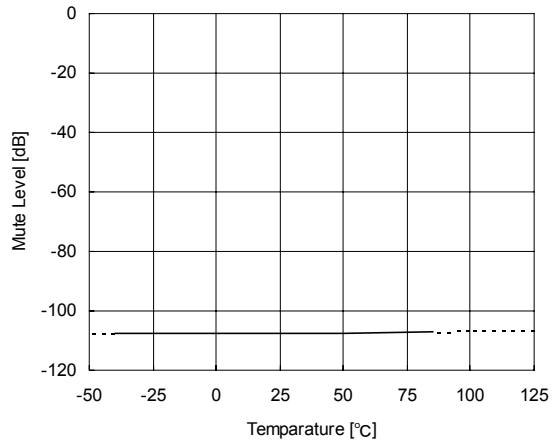
Reference Voltage vs Supply Voltage
 V_{in} =No Signal, Volume=0dB



Out Noise vs Temperature
 $V+=9V$, $R_g=600\Omega$, A-Weighting



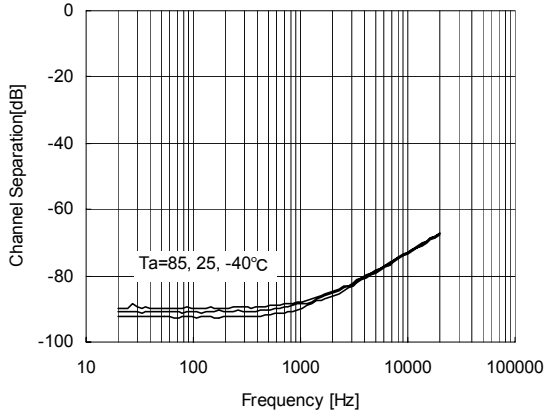
Mute Level vs Temperature
 $V+=9V$, $R_g=600\Omega$, $V_{in}=1V_{rms}$, A-Weighting



TYPICAL CHARACTERISTICS

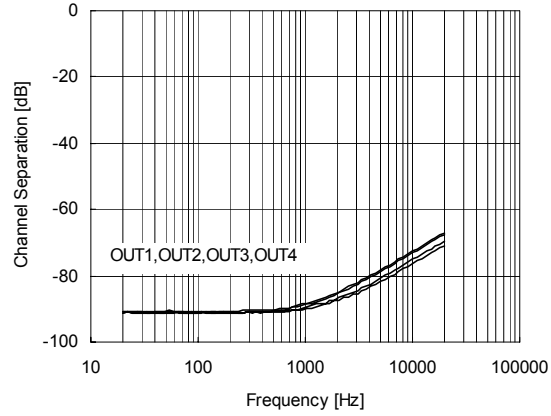
Channel Separation vs Frequency

V+=9V, Vin=1Vrms, A-Weighting, Rg=600Ω
Vin:IN2+IN3+IN4, Vout:OUT1



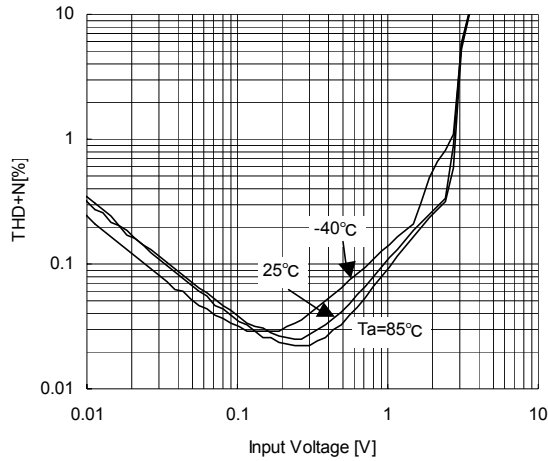
Channel Separation vs Frequency

V+=9V, Vin=1Vrms, A-Weighting, Ta=25°C
Rg=600Ω



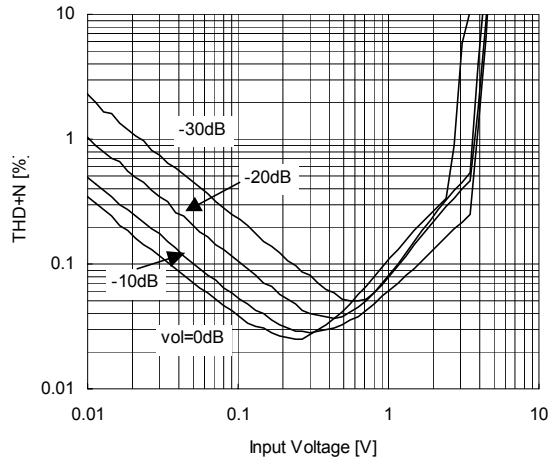
THD+N vs Input Voltage (Temperature)

V+=9V, Vin=CH1, f=1kHz, volume=0dB
Rg=600Ω, BW=400Hz-30kHz, Vout=OUT1



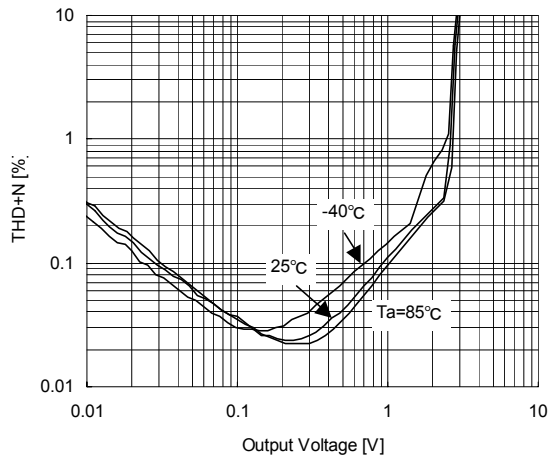
THD+N vs Input Voltage (Volume Control)

V+=9V, Vin=CH1, f=1kHz, Ta=25°C
Rg=600Ω, BW=400Hz-30kHz, Vout=OUT1



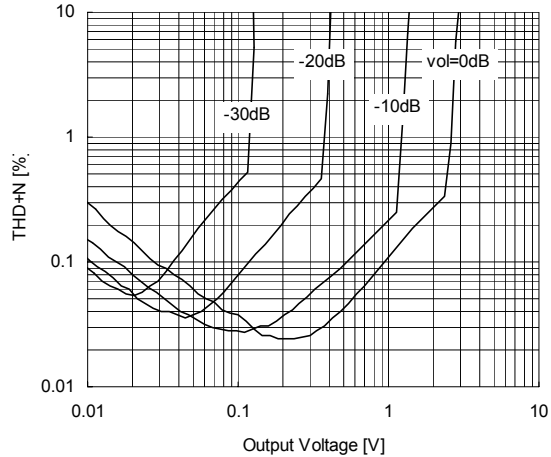
THD+N vs Output Voltage (Temperature)

V+=9V, Vin=CH1, f=1kHz, volume=0dB
Rg=600Ω, BW=400Hz-30kHz, Vout=OUT1



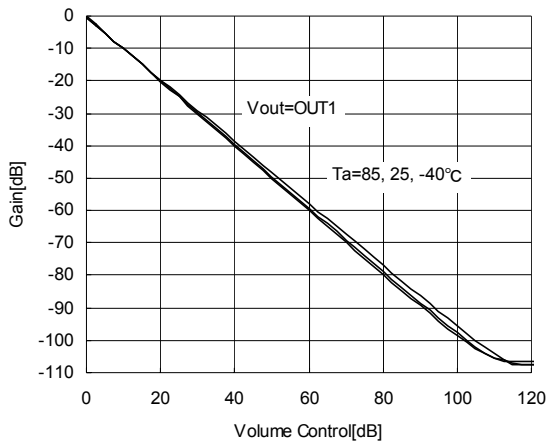
THD+N vs Output Voltage (Volume Control)

V+=9V, Vin=CH1, f=1kHz, Ta=25°C
Rg=600Ω, BW=400Hz-30kHz, Vout=OUT1

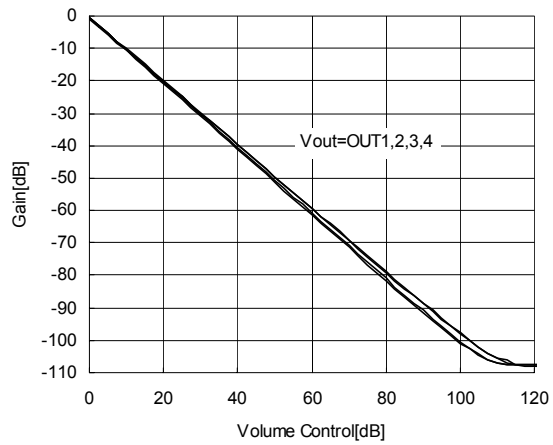


■ TYPICAL CHARACTERISTICS

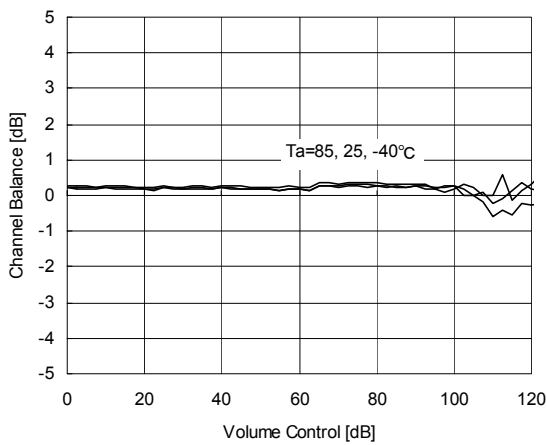
Gain vs Volume Control (Temperature)
 $V+=9V, R_g=600\Omega, V_{in}=1V_{rms}, V_{in}=IN1$



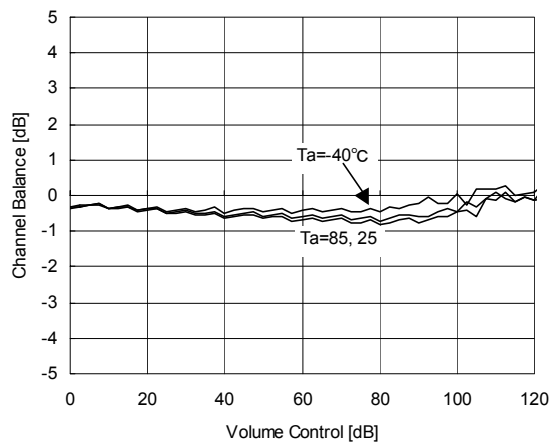
Gain vs Volume Control
 $V+=9V, R_g=600\Omega, V_{in}=1V_{rms}, T_a=25^\circ\text{C}$



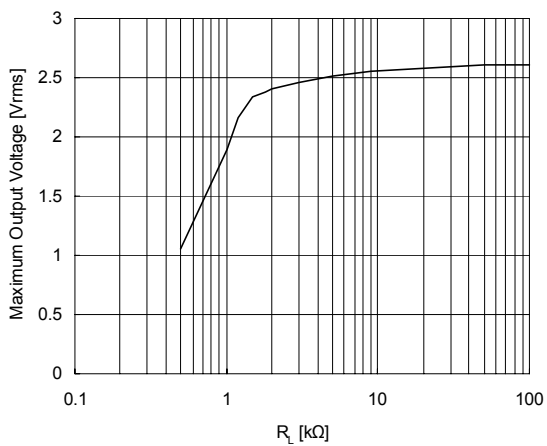
Channel Balance vs Volume Control (CH1-CH2)
 $V_{in}=1V_{rms}, V+=9V$



Channel Balance vs Volume Control (CH3-CH4)
 $V_{in}=1V_{rms}, V+=9V$



Maximum Output Voltage vs R_L
 $V+=9V, THD=1\%$



[CAUTION]

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- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.