

## Headphone Amplifier for Portable Audio

### ■ GENERAL DESCRIPTION

The **NJM2776** is a low voltage headphone amplifier for portable audio applications.

The **NJM2776** operates directly for one battery supply with independent power supply terminals ( $V^{+1}$  and  $V^{+2}$ ).

Also it provides shock-noise less standby mode.

The **NJM2776** is suitable for portable MD, portable CD and others.

### ■ PACKAGE OUTLINE



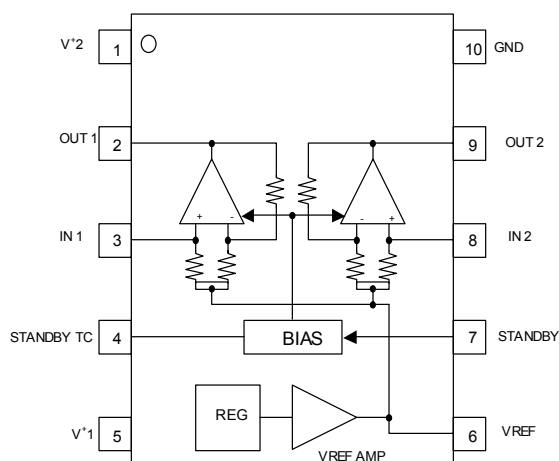
**NJM2776RB2**  
**MSOP10 (TVSP10)**

### ■ FEATURES

- Operating Voltage  $V^{+1}$ (from step-up converter) = 1.8 to 4.5V (however,  $V^{+1} > V^{+2}$ )  
 $V^{+2}$ (from battery) = 0.9 to 4.5V (however,  $V^{+1} > V^{+2}$ )
- Low Operating Current  $I_{CC4}(V^{+1} \text{ side}) = 200\mu\text{A typ.}$  ( $V^{+1} = 2.3\text{V}$ ,  $V^{+2} = 1.2\text{V}$ , No signal)  
 $I_{CC3}(V^{+2} \text{ side}) = 350\mu\text{A typ.}$  ( $V^{+1} = 2.3\text{V}$ ,  $V^{+2} = 1.2\text{V}$ , No signal)
- Supply Current in Standby mode  $I_{CC2}(V^{+1} \text{ side}) = 25\mu\text{A typ.}$  ( $V^{+1} = 2.3\text{V}$ ,  $V^{+2} = 1.2\text{V}$ )  
 $I_{CC1}(V^{+2} \text{ side}) = 6\mu\text{A typ.}$  ( $V^{+1} = 2.3\text{V}$ ,  $V^{+2} = 1.2\text{V}$ )  
 $P_O = 8.5\text{mW typ.}$  ( $R_L = 16\Omega$ , THD = 10%)
- Output Power Exceeds
- Shock-noise less Standby mode
- Bipolar Technology
- Package Outline MSOP10 (TVSP10)\*

\*MEET JEDEC MO-187-DA / THIN TYPE

### ■ PIN CONFIGURATION AND BLOCK DIAGRAM



1.  $V^{+2}$
2. OUT1
3. IN1
4. STADBY\_TC
5.  $V^{+1}$
6. VREF
7. STANDBY
8. IN2
9. OUT2
10. GND

# NJM2776

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

| PARAMETER                   | SYMBOL           | RATINGS               | UNIT |
|-----------------------------|------------------|-----------------------|------|
| Supply Voltage              | V <sup>+</sup>   | 5                     | V    |
| Power Dissipation           | P <sub>D</sub>   | 320 <sup>(note)</sup> | mW   |
| Operating Temperature range | T <sub>opr</sub> | -20 to +75            | °C   |
| Storage Temperature Range   | T <sub>stg</sub> | -40 to +125           | °C   |

## ■ RECOMMENDED OPERATING CONDITIONS

| PARAMETER               | SYMBOL           | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|-------------------------|------------------|----------------|------|------|------|------|
| Operating Voltage Range | V <sup>+</sup> 1 | -              | 1.8  | 2.3  | 4.5  | V    |
|                         | V <sup>+</sup> 2 | -              | 0.9  | 1.2  | 4.5  |      |

## ■ ELECTRICAL CHARACTERISTICS (Ta=25°C, V<sup>+</sup>1=2.3V, V<sup>+</sup>2=1.2V, V<sub>IN</sub>=-30dBV (31.6mVrms), f=1kHz, R<sub>L</sub>=16Ω, Active mode, unless otherwise specified)

### ● Power Supply

| PARAMETER         | SYMBOL           | TEST CONDITION              | pin              | MIN. | TYP. | MAX. | UNIT |
|-------------------|------------------|-----------------------------|------------------|------|------|------|------|
| Operating Current | I <sub>CC0</sub> | V <sup>+</sup> 1=0V         | V <sup>+</sup> 2 | -    | -    | 1.0  | μA   |
|                   | I <sub>CC1</sub> | Standby mode                | V <sup>+</sup> 2 | -    | 6.0  | 10.0 |      |
|                   | I <sub>CC2</sub> |                             | V <sup>+</sup> 1 | -    | 25   | 35   |      |
|                   | I <sub>CC3</sub> | No signal                   | V <sup>+</sup> 2 | -    | 350  | 750  |      |
|                   | I <sub>CC4</sub> |                             | V <sup>+</sup> 1 | -    | 200  | 400  | mA   |
|                   | I <sub>CC5</sub> | P <sub>O</sub> =0.1mW+0.1mW | V <sup>+</sup> 2 | -    | 2.5  | -    |      |
|                   | I <sub>CC6</sub> |                             | V <sup>+</sup> 1 | -    | 200  | -    |      |
| Reference Voltage | V <sub>REF</sub> | No signal                   |                  | 0.50 | 0.60 | 0.65 | V    |

### ● Amplifier

| PARAMETER                         | SYMBOL          | TEST CONDITION                                           | MIN. | TYP.           | MAX.          | UNIT        |
|-----------------------------------|-----------------|----------------------------------------------------------|------|----------------|---------------|-------------|
| Closed loop Gain                  | G <sub>V</sub>  |                                                          | 10.0 | 11.5           | 12.5          | dB          |
| Output Power                      | P <sub>O</sub>  | THD=10%                                                  | 5.0  | 8.5            | -             | mW          |
| Total Harmonic Distortion         | THD             | P <sub>O</sub> =1mW                                      | -    | 0.20           | 0.50          | %           |
| Output Noise Voltage              | V <sub>NO</sub> | A-Weighted                                               | -    | -100<br>(10.0) | -96<br>(15.8) | dBV<br>(μV) |
| Channel Separation                | CS              |                                                          | 44   | 55             | -             | dB          |
| Mute Level                        | MUTE            | Standby mode<br>1kHz Band Pass                           | -    | -100           | -80           | dB          |
| Supply Voltage<br>Rejection Ratio | PSRR1           | V <sup>+</sup> 1=1.8V + 0.1Vrms<br>V <sup>+</sup> 2=0.9V | 46   | 52             | -             | dB          |
|                                   | PSRR2           | V <sup>+</sup> 1=1.8V<br>V <sup>+</sup> 2=0.9V + 0.1Vrms | 70   | 77             | -             |             |

### ● Mode Control

| PARAMETER                | SYMBOL          | TEST CONDITION              | MIN. | TYP. | MAX.             | UNIT |
|--------------------------|-----------------|-----------------------------|------|------|------------------|------|
| High Level Input Voltage | V <sub>IH</sub> | V <sub>IN</sub> =High Level | 1.2  | -    | V <sup>+</sup> 1 | V    |
| Low Level Input Voltage  | V <sub>IL</sub> | V <sub>IN</sub> =Low Level  | 0.0  | -    | 0.3              |      |

## ■ MODE SWITCHCH FUNCTION

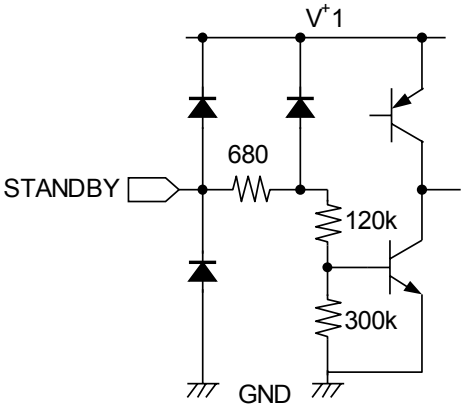
### ● STANDBY (7PIN)

| PARAMETER | CONTROL SIGNAL | STATUS            |
|-----------|----------------|-------------------|
| Standby   | L, open        | IC is non-active. |
| Active    | H              | IC is active.     |

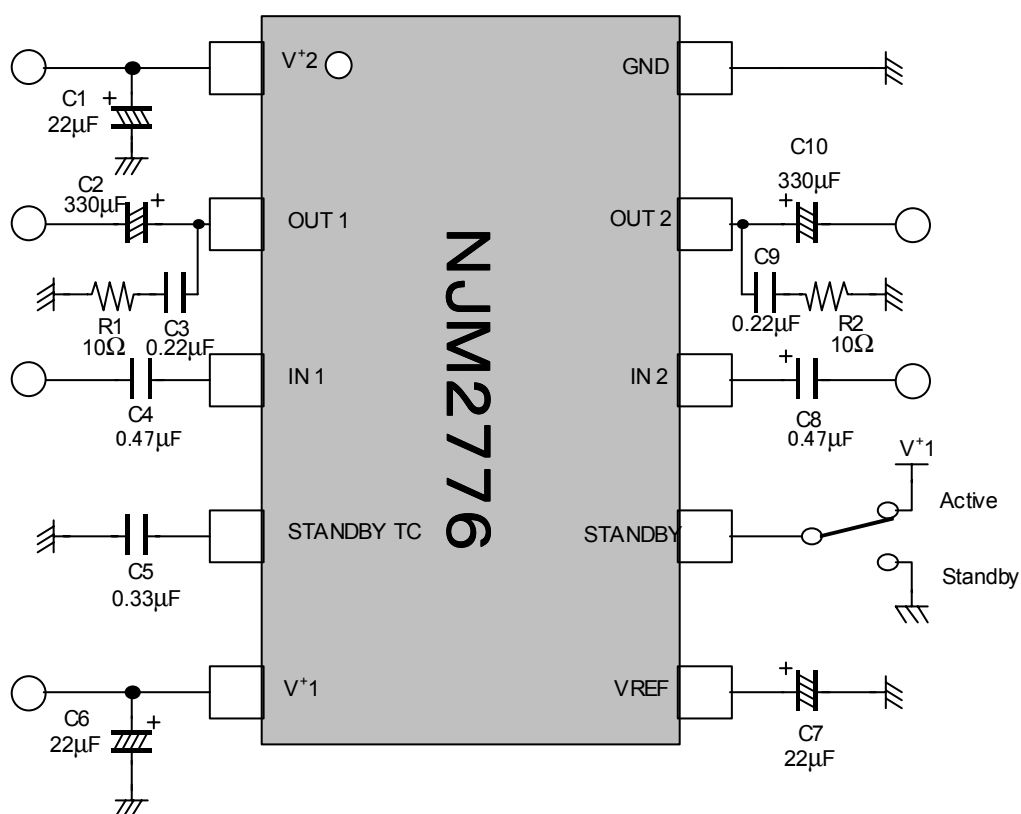
## ■ TERMINAL DESCRIPTION

| PIN No. | SYMBOL     | EQUIVALENT CIRCUIT | VOLTAGE | NOTE |
|---------|------------|--------------------|---------|------|
| 2,9     | OUT1, OUT2 |                    | 0.6V    |      |
| 3,8     | IN1, IN2   |                    | 0.6V    |      |
| 4       | STANDBY_TC |                    | 1.2V    |      |
| 6       | VREF       |                    | 0.6V    |      |

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| PIN No. | SYMBOL  | EQUIVALENT CIRCUIT                                                                | VOLTAGE | NOTE |
|---------|---------|-----------------------------------------------------------------------------------|---------|------|
| 7       | STANDBY |  | -       |      |

## ■ APPLICATION CIRCUIT



Note) Recommended the capacitors — C1, C3, C6 and C9 — are featuring higher frequency efficiency to prevent the oscillation.

## ■ APPLICATION NOTE

### 1. Procedure for Supplying Power

Supply the power to first  $V^{+}2$ (Battery side) and then  $V^{+}1$ (Step-up Converter side).

### 2. Input Dynamic Voltage Range

The reference voltage is fixed at 0.6V. Therefore input dynamic voltage range is not proportion to the power supply voltage.

The input signal over dynamic range makes distortion. For prevent the distortion, adjust the maximum input signal level.

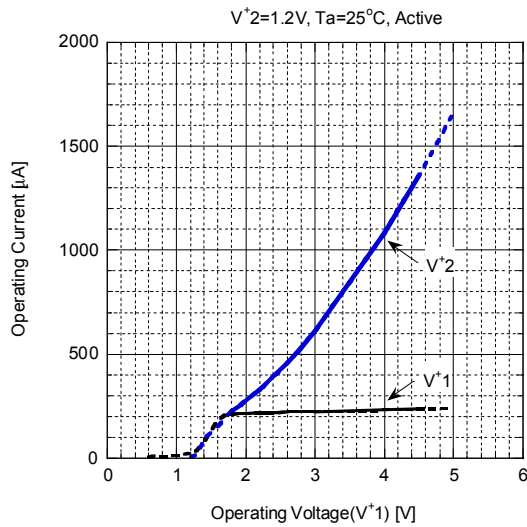
### 3. Charge Sequence

Pop noise may not be happened with mode switch operation once output voltage becomes reference voltage. The "Charge Sequence" may shorter the time for power up initialization.

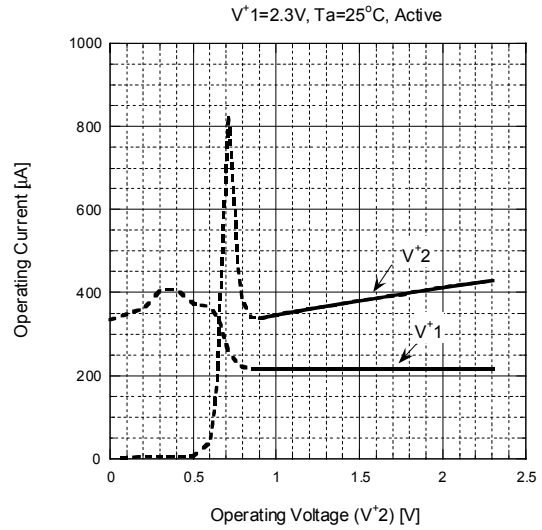
Charge Sequence: To set mode switch from standby to active during power up initialization, activate rapid charge circuit for stabilizing the output voltage.

## ■ TYPICAL CHARACTERISTICS

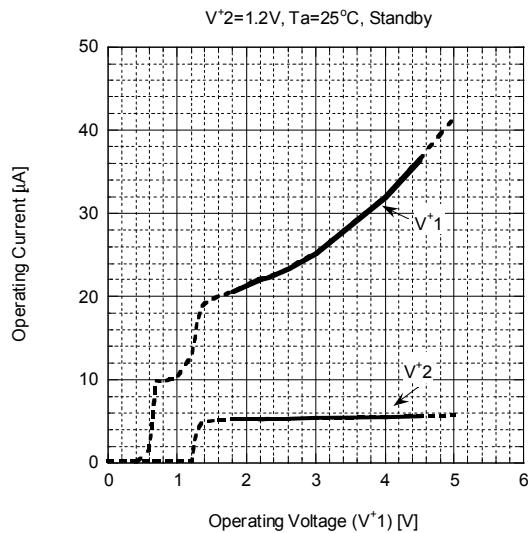
### Operating Current vs. Operating Voltage



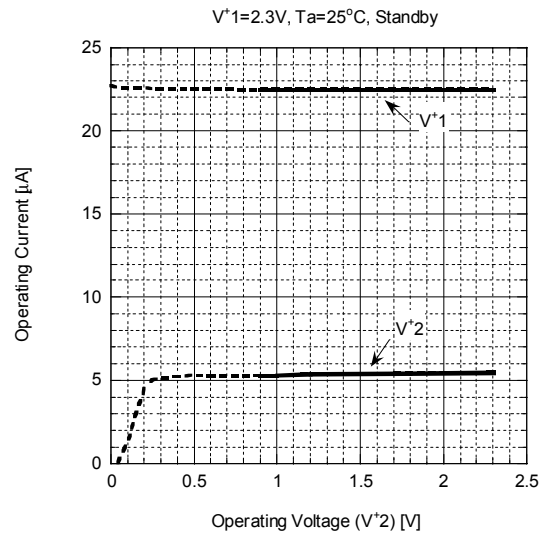
### Operating Current vs. Operating Voltage



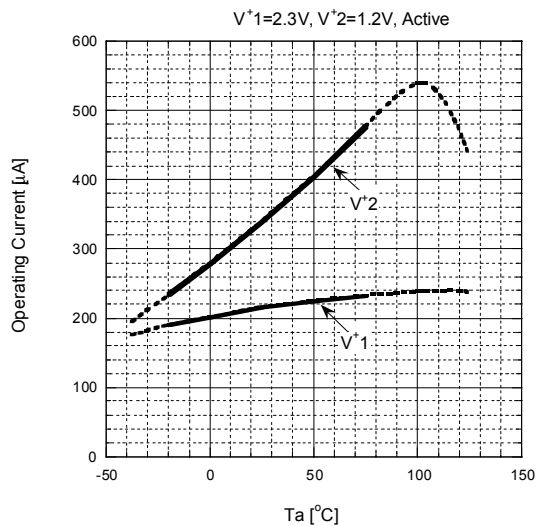
### Operating Current vs. Operating Voltage



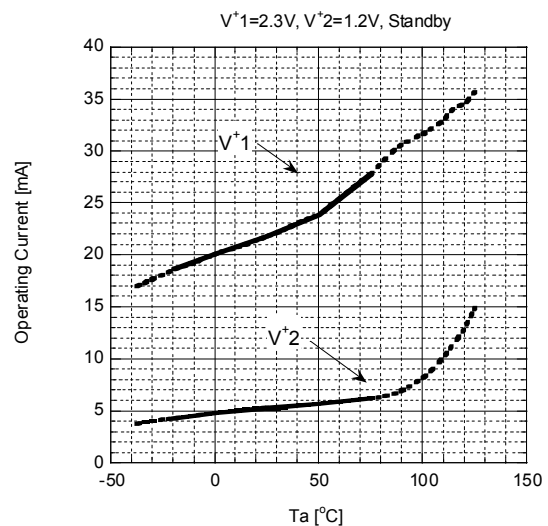
### Operating Current vs. Operating Voltage



### Operating Current vs. Temperature

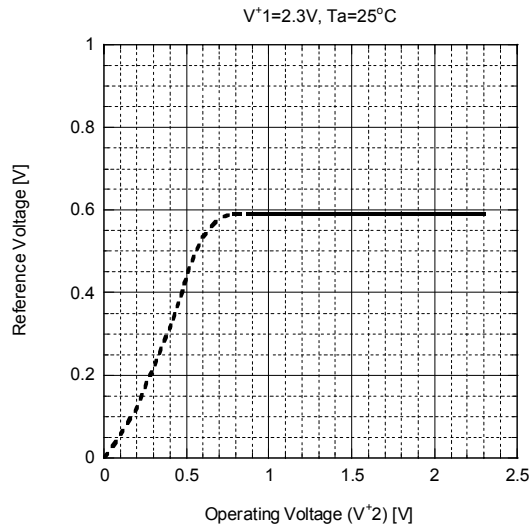


### Operating Current vs. Temperature

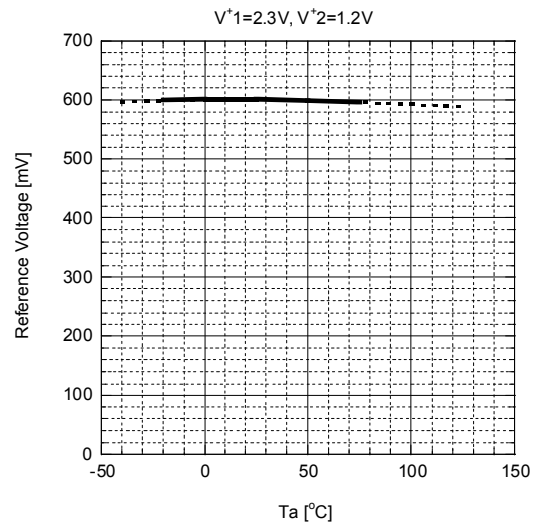


## ■ TYPICAL CHARACTERISTICS

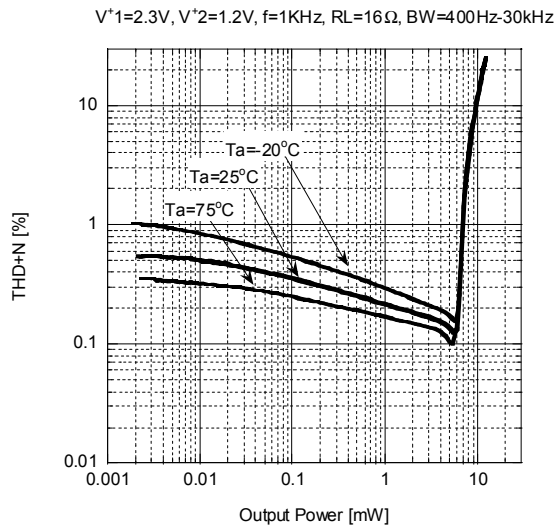
Reference Voltage vs. Operating Voltage



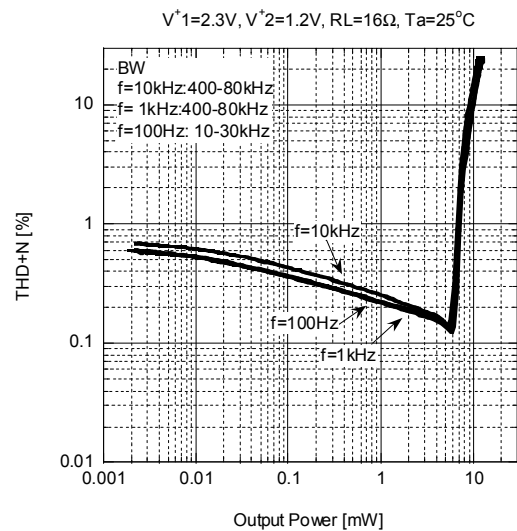
Reference Voltage vs. Temperature



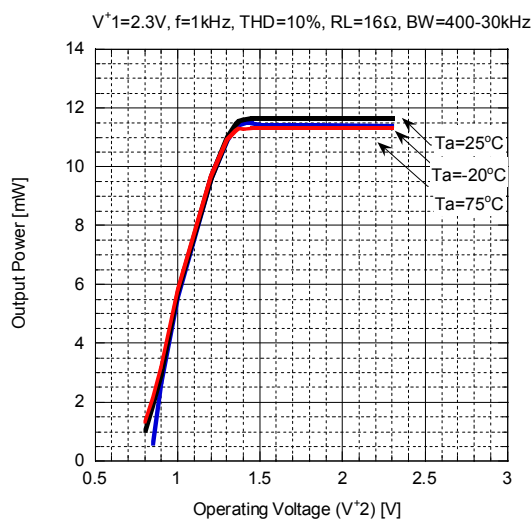
Total Harmonic Distortion vs. Output Power



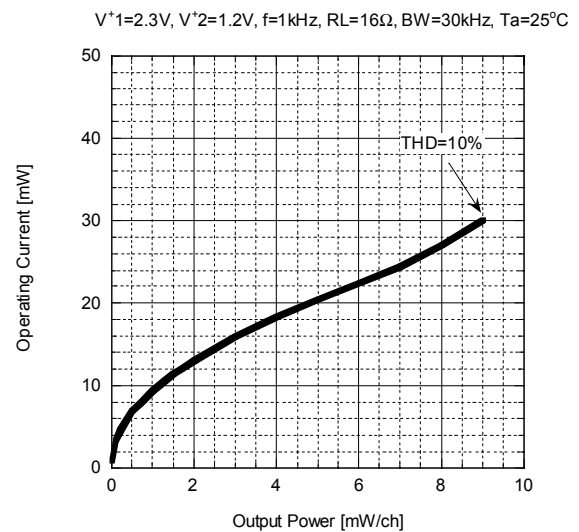
Total Harmonic Distortion vs. Output Power



Output Power vs. Operating Voltage

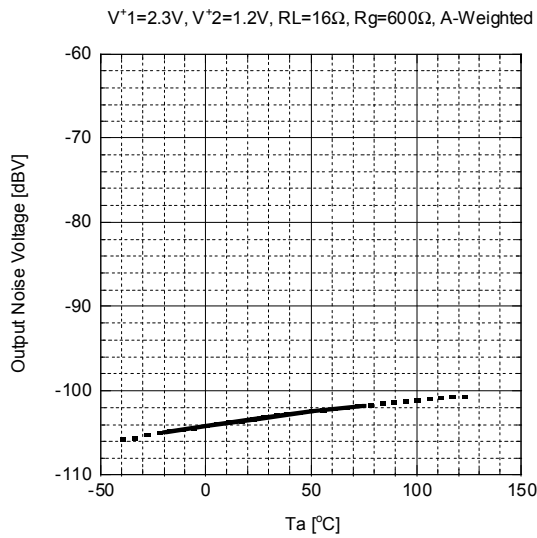


Power Dissipation vs. Output Power

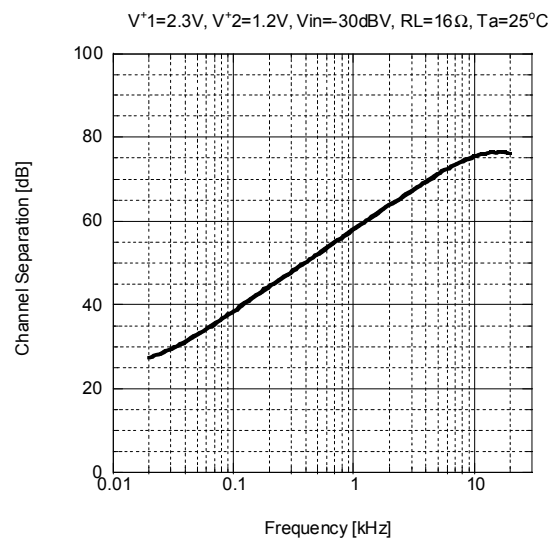


## ■ TYPICAL CHARACTERISTICS

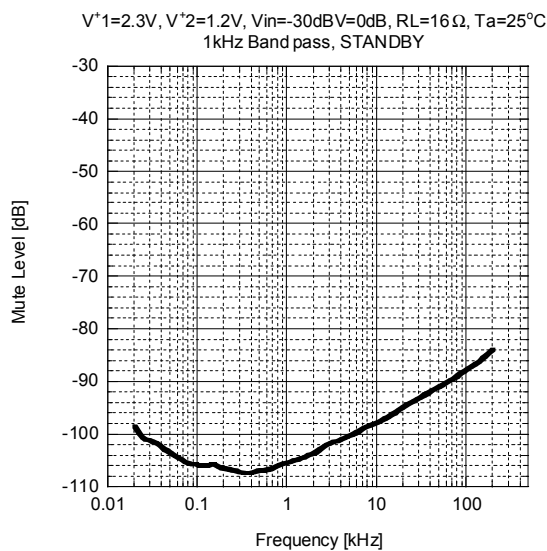
### Output Noise Voltage vs. Temperature



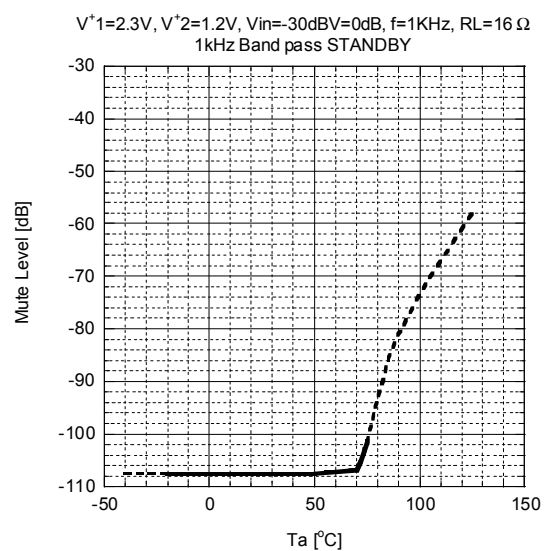
### Channel Separation vs. Frequency



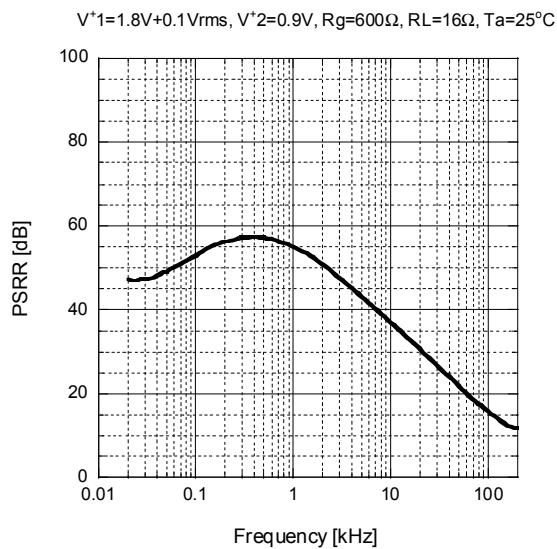
### Mute Level vs. Frequency



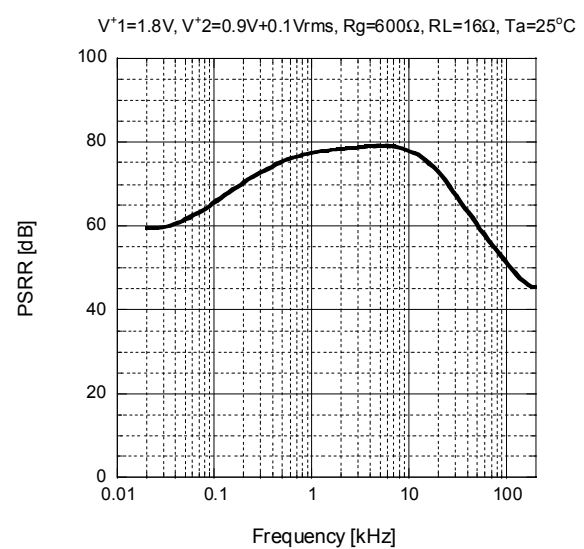
### Mute Level vs. Temperature



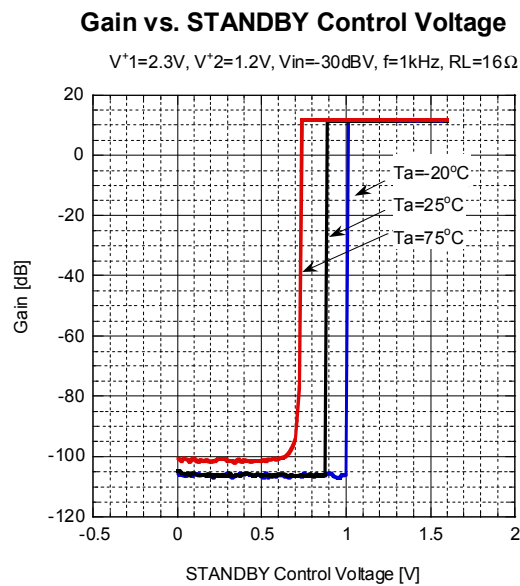
### PSRR vs. frequency ( $V^+1$ )



### PSRR vs. frequency ( $V^+2$ )



■ TYPICAL CHARACTERISTICS



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