LOW NOISE, BIPOLAR INPUT
DUAL AUDIO OPERATIONAL AMPLIFIER

FEATURES
- Designed for High-Quality Sound
- Low Noise 3.5 nV/√Hz at 1kHz
- Low Distortion 0.001%
- Slew Rate 6.8V/μs
- Gain Bandwidth Product 19 MHz
- Open-Loop Voltage Gain 120dB
- Unity-Gain Stable
- Bipolar Input
- Supply Voltage ±4V to ±18V
- Operating Temperature -40°C to 125°C
- Supply Current (All Amplifiers) 5 mA typ.
- Package SOP8

DESCRIPTION
NJM8068 is a low noise bipolar input dual audio operational amplifier has 3.5 nV/√Hz at 1kHz.

The NJM8068 features Low distortion, high slew rate, wide bandwidth and high open-loop gain. In addition, unity-gain stable allows voltage-follower operation. These features make NJM8068 ideal for audio pre amplifier, microphone amplifier, line amplifier and other audio applications. NJM8068 operate over a wide temperature range of -40°C to 125°C, making this IC ideal for use in industrial measurement instruments.

The NJM8068 is available in 8-pin SOP and MSOP (TVSP) packages.

APPLICATIONS
- Professional Audio Sets
- Audio Pre / Microphone Amplifiers
- Analog / Digital Mixers
- AV Receivers
- Car Audio
- Industrial Measurement Instruments

RELATED PRODUCT

<table>
<thead>
<tr>
<th>PRODUCT NAME</th>
<th>FEATURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NJM8080</td>
<td>5nV/√Hz, 0.0005%, 5V/¼s, 15MHz (Low noise, low distortion audio Op-Amp)</td>
</tr>
</tbody>
</table>

EQUIVALENT CIRCUIT
## PIN CONFIGURATIONS

<table>
<thead>
<tr>
<th>PRODUCT NAME</th>
<th>NJM8068G</th>
<th>NJM8068B1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>SOP8 (Top View)</td>
<td>MSOP8 (TVSP8)</td>
</tr>
</tbody>
</table>

### Pin Functions

<table>
<thead>
<tr>
<th>Pin Function</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>A OUTPUT</td>
<td>1</td>
</tr>
<tr>
<td>A -INPUT</td>
<td>2</td>
</tr>
<tr>
<td>A +INPUT</td>
<td>3</td>
</tr>
<tr>
<td>V+</td>
<td>4</td>
</tr>
<tr>
<td>B OUTPUT</td>
<td>5</td>
</tr>
<tr>
<td>B -INPUT</td>
<td>6</td>
</tr>
<tr>
<td>B +INPUT</td>
<td>7</td>
</tr>
</tbody>
</table>

## PRODUCT NAME INFORMATION

<table>
<thead>
<tr>
<th>PRODUCT NAME</th>
<th>RB1 (TE1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Number</td>
<td>Package</td>
</tr>
</tbody>
</table>

## ORDER INFORMATION

<table>
<thead>
<tr>
<th>PRODUCT NAME</th>
<th>PACKAGE</th>
<th>RoHS</th>
<th>HALOGEN-FREE</th>
<th>TERMINAL FINISH</th>
<th>MARKING</th>
<th>WEIGHT (mg)</th>
<th>MOQ (pcs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NJM8068G</td>
<td>SOP8</td>
<td>Yes</td>
<td>Yes</td>
<td>Pure Sn</td>
<td>8068</td>
<td>88</td>
<td>2500</td>
</tr>
<tr>
<td>NJM8068RB1</td>
<td>MSOP8 (TVSP8)</td>
<td>Yes</td>
<td>Yes</td>
<td>Sn2Bi</td>
<td>8068</td>
<td>18</td>
<td>2000</td>
</tr>
</tbody>
</table>

## ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>RATING</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>V⁺/V⁻</td>
<td>±18</td>
<td>V</td>
</tr>
<tr>
<td>Differential Input Voltage(1)</td>
<td>VᵢD</td>
<td>±36</td>
<td>V</td>
</tr>
<tr>
<td>Input Voltage(2)</td>
<td>VᵢN</td>
<td>V⁻0.3 to V⁺+36</td>
<td>V</td>
</tr>
<tr>
<td>Output Terminal Input Voltage</td>
<td>Vₒ</td>
<td>V⁻0.3 to V⁺+0.3</td>
<td>V</td>
</tr>
<tr>
<td>Power Dissipation(3)</td>
<td>Pₒ</td>
<td>2-Layer / 4-Layer(4)</td>
<td>mW</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>Tₑ</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>Tᵢₘax</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

## THERMAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>PACKAGE</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junction-to-Ambient Thermal Resistance SOP8</td>
<td>2-Layer / 4-Layer(4)</td>
<td>181 / 125</td>
</tr>
<tr>
<td></td>
<td>MSOP8 (TVSP8)</td>
<td>245 / 184</td>
</tr>
<tr>
<td>Junction-to-Top of Package Characterization Parameter SOP8</td>
<td>2-Layer / 4-Layer(4)</td>
<td>49 / 43</td>
</tr>
<tr>
<td></td>
<td>MSOP8 (TVSP8)</td>
<td>51 / 45</td>
</tr>
</tbody>
</table>

(1) Differential voltage is the voltage difference between +INPUT and -INPUT.
(2) Input voltage is the voltage should be allowed to apply to the input terminal independent of the magnitude of V⁺.
The normal operation will establish when any input is within the “Common-Mode Input Voltage Range” of electrical characteristics.
(3) Power dissipation is the power that can be consumed by the IC at Ta=25°C, and is the typical measured value based on JEDEC condition.
(4) 2-Layer: Mounted on glass epoxy board. (76.2×114.3×1.6 mm: based on EIA/JDEC standard, 2-layer FR-4)
4-Layer: Mounted on glass epoxy board. (76.2×114.3×1.6 mm: based on EIA/JDEC standard, 4-layer FR-4), internal Cu area: 74.2 x 74.2 mm
POWER DISSIPATION vs. AMBIENT TEMPERATURE

![Power Dissipation vs. Temperature](chart1.png)

RECOMMENDED OPERATING CONDITIONS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>V+V</td>
<td>Ta=25°C</td>
<td>±4 to ±18</td>
<td>V</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>T_{op}</td>
<td></td>
<td>-40 to 125</td>
<td>°C</td>
</tr>
</tbody>
</table>

ELECTRICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT/OUTPUT CHARACTERISTICS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Offset Voltage</td>
<td>V_{IO}</td>
<td>R_S=1kΩ</td>
<td>-</td>
<td>0.3</td>
<td>3</td>
<td>mV</td>
</tr>
<tr>
<td>Input Bias Current</td>
<td>I_{B}</td>
<td></td>
<td>-</td>
<td>260</td>
<td>1000</td>
<td>nA</td>
</tr>
<tr>
<td>Input Offset Current</td>
<td>I_{IO}</td>
<td></td>
<td>-</td>
<td>5</td>
<td>200</td>
<td>nA</td>
</tr>
<tr>
<td>Open-Loop Voltage Gain</td>
<td>A_V</td>
<td>R_L=2kΩ, V_O=±10V</td>
<td>90</td>
<td>120</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Common-Mode Rejection Ratio</td>
<td>CMR</td>
<td></td>
<td>80</td>
<td>110</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Input Resistance</td>
<td>R_{IN}</td>
<td></td>
<td>50</td>
<td>300</td>
<td>-</td>
<td>kΩ</td>
</tr>
<tr>
<td>Common-Mode Input Voltage Range</td>
<td>V_{ICM}</td>
<td>R_L=2kΩ</td>
<td>±12</td>
<td>±13.5</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Output Voltage</td>
<td>V_{OM}</td>
<td>R_L=2kΩ</td>
<td>±12</td>
<td>±13.5</td>
<td>-</td>
<td>V</td>
</tr>
</tbody>
</table>

POWER SUPPLY

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Current (All Amplifiers)</td>
<td>I_{SUP}</td>
<td></td>
<td>5</td>
<td>8</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>Supply Voltage Rejection Ratio</td>
<td>SVR</td>
<td></td>
<td>80</td>
<td>120</td>
<td>-</td>
<td>dB</td>
</tr>
</tbody>
</table>

AC CHARACTERISTICS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain Bandwidth Product</td>
<td>GBW</td>
<td>f=100kHz</td>
<td>19</td>
<td>-</td>
<td>-</td>
<td>MHz</td>
</tr>
<tr>
<td>Unity Gain Frequency</td>
<td>f_T</td>
<td>G_U=0dB</td>
<td>7.5</td>
<td>-</td>
<td>-</td>
<td>MHz</td>
</tr>
<tr>
<td>Slew Rate</td>
<td>SR</td>
<td>R_L=2kΩ</td>
<td>6.8</td>
<td>-</td>
<td>-</td>
<td>V/µs</td>
</tr>
</tbody>
</table>

Noise, Distortion

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equivalent Input Noise Voltage</td>
<td>e_n</td>
<td>f=1kHz</td>
<td>3.5</td>
<td>-</td>
<td>-</td>
<td>nV/√Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FLAT, f=20Hz to 20kHz</td>
<td>0.5</td>
<td>0.7</td>
<td>-</td>
<td>µVrms</td>
</tr>
<tr>
<td>Total Harmonic Distortion + Noise</td>
<td>THD+N</td>
<td></td>
<td>0.001</td>
<td>-</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>Channel Separation</td>
<td>CS</td>
<td></td>
<td>120</td>
<td>-</td>
<td>-</td>
<td>dB</td>
</tr>
</tbody>
</table>
**TYPICAL CHARACTERISTICS**

**80dB Gain/Phase vs. Frequency**

- **Gain** vs. Frequency for different temperatures:
  - Ta=25ºC
  - Ta=125ºC
  - Ta=-40ºC

- **Phase** vs. Frequency for different temperatures:
  - Ta=25ºC
  - Ta=125ºC
  - Ta=-40ºC

**Voltage Noise vs. Frequency**

- Equivalent Input Noise Voltage [nV/Hz] vs. Frequency for different temperatures:
  - Ta=25ºC
  - Ta=-40ºC
  - Ta=125ºC

**Maximum Output Voltage vs. Load Resistance**

- Maximum Output Voltage [V] vs. Load Resistance [Ω] for different temperatures:
  - Ta=25ºC
  - Ta=125ºC
  - Ta=-40ºC

**Maximum Output Voltage vs. Output Current**

- Maximum Output Voltage [V] vs. Output Current [mA] for different temperatures:
  - Ta=25ºC
  - Ta=125ºC
  - Ta=-40ºC

**Supply Current vs. Supply Voltage**

- Supply Current [mA] vs. Supply Voltage [V] for different temperatures:
  - Ta=25ºC
  - Ta=125ºC
  - Ta=-40ºC

**Supply Current vs. Temperature**

- Supply Current [mA] vs. Ambient Temperature [ºC] for different voltages:
  - V=±15V
  - V=±4V
TYPICAL CHARACTERISTICS

**Input Offset Voltage vs. Supply Voltage**

- Supply Voltage $V^+/V^-$ vs. Input Offset Voltage $[\text{mV}]$
- Temperatures: $-40^\circ\text{C}$, $25^\circ\text{C}$, $105^\circ\text{C}$, $125^\circ\text{C}$

**Input Offset Voltage vs. Temperature**

- Ambient Temperature vs. Input Offset Voltage $[\text{mV}]$
- Supply Voltage $V^+/V^-$ vs. Input Offset Voltage $[\text{mV}]$
- Temperatures: $-40^\circ\text{C}$, $25^\circ\text{C}$, $105^\circ\text{C}$, $125^\circ\text{C}$

**Input Offset Voltage vs. Common-Mode Input Voltage**

- Common-Mode Input Voltage vs. Input Offset Voltage $[\text{mV}]$
- $V^+/V^-$ $= \pm 4\text{V}$
- Temperatures: $-40^\circ\text{C}$, $25^\circ\text{C}$, $105^\circ\text{C}$, $125^\circ\text{C}$

**Input Bias Current vs. Temperature**

- Ambient Temperature vs. Input Bias Current $[\text{nA}]$
- $V^+/V^-$ $= \pm 15\text{V}$

**Common Mode and Supply Voltage Rejection Ratio vs. Temperature**

- Common Mode and Supply Voltage Rejection Ratio vs. Ambient Temperature $[\text{dB}]$
- $S\text{WR}$, $CMR @ V^+/V^- = \pm 15\text{V}$
TYPICAL CHARACTERISTICS

- Open-Loop Voltage Gain vs. Temperature
  \[ V_{\text{out}} = 15 \text{V}, V_{\text{in}} = 10 \text{V} \]

- Maximum Output Voltage vs. Temperature
  \[ V_{\text{out}} = 15 \text{V}, V_{\text{in}} = 4 \text{V} \]

- Maximum Output Voltage vs. Supply Voltage
  \[ R_L = 2k \Omega, V_{\text{out}} = \pm 10 \text{V} \]

- THD+N vs. Output Voltage
  \[ f = 20 \text{Hz}, f = 1 \text{kHz}, f = 20 \text{kHz} \]
### TEST CIRCUITS

- **I\_SUPPLY**
- **V\_IN, CMR, SVR**
  
  \[ V_{\text{IO}} = \frac{R_G}{(R_G + R_F)} \times V_O \]
  
  CMR = 20\log \left( \frac{1 + \frac{R_F}{R_G}}{\frac{R_F}{R_G}} \right)
  
  SVR = 20\log \left( \frac{1 + \frac{R_F}{R_G}}{\frac{R_F}{R_G}} \right)

- **V\_OH, V\_OL**
  
  \[ V_{\text{OH}}: V_{\text{in+}} = 1\text{V}, V_{\text{in-}} = -1\text{V} \]
  
  \[ V_{\text{OL}}: V_{\text{in+}} = -1\text{V}, V_{\text{in-}} = 1\text{V} \]

- **SR**
  
  \[ R_S = 2k\Omega \]

\[ V_{\text{O}} = V_{\text{in+}} - V_{\text{in-}} \]

\[ R_G = 50\Omega, R_F = 50k\Omega \]
EXAMPLE OF SOLDER PADS DIMENSIONS

Unit: mm
MSOP8 (TVSP8)  JEDEC MO-187-DA/THIN TYPE

■ PACKAGE DIMENSIONS

![Package Diagram]

■ EXAMPLE OF SOLDER PADS DIMENSIONS

![Solder Pads Diagram]
SOP8

PACKING SPEC

REEL DIMENSIONS / TAPING DIMENSIONS

TAPING STATE

PACKING STATE
**MSOP8 (TVSP8) MEET JEDEC MO-187-DA/THIN TYPE**

**PACKING SPEC**

**TAPING DIMENSIONS**

- **Feed direction**
  - B
  - A
  - W1
  - P2
  - P0
  - P1
  - A0
  - E
  - F
  - W
  - T
  - T2

- **Dimension**
  - 4.4
  - 3.2
  - 1.5
  - 1.5
  - 1.75±0.1
  - 5.5±0.05
  - 4.0±0.1
  - 8.0±0.1
  - 2.0±0.05
  - 0.30±0.05
  - 1.75(MAX.)
  - 12.0±0.3
  - 9.5

- **Remarks**
  - Bottom dimension
  - Thickness: 0.1 max
  - +0.1
  - 0
  - +0.1

**REEL DIMENSIONS**

- **Symbol**
  - A
  - B
  - C
  - D
  - E
  - W
  - W1

- **Dimension**
  - ∅254±2
  - ∅100±1
  - ∅13±0.2
  - ∅21±0.8
  - 2±0.5
  - 13.5±0.5
  - 2.0±0.2

**TAPING STATE**

- **Sealing with covering tape**
- **Empty tape Devices Empty tape Covering tape**
- **more than 20 pitch 2000 pcs/reel more than 20 pitch reel more than 1 round**

**PACKING STATE**

- **Put a reel into a box**
- **Label**

**Unit: mm**

---

**New Japan Radio Co., Ltd.**

http://www.njr.com/
**RECOMMENDED MOUNTING METHOD**

**INFRARED REFLOW SOLDERING PROFILE**

<table>
<thead>
<tr>
<th>Step</th>
<th>Temperature Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Temperature ramping rate 1 to 4°C/s</td>
</tr>
<tr>
<td>b</td>
<td>Pre-heating temperature 150 to 180°C, Pre-heating time 60 to 120s</td>
</tr>
<tr>
<td>c</td>
<td>Temperature ramp rate 1 to 4°C/s</td>
</tr>
<tr>
<td>d</td>
<td>220°C or higher time shorter than 60s</td>
</tr>
<tr>
<td>e</td>
<td>230°C or higher time shorter than 40s</td>
</tr>
<tr>
<td>f</td>
<td>Peak temperature lower than 260°C</td>
</tr>
<tr>
<td>g</td>
<td>Temperature ramping rate 1 to 6°C/s</td>
</tr>
</tbody>
</table>

The temperature indicates at the surface of mold package.

The diagram shows the recommended reflow soldering profile with key points labeled a to g.
1. NJR strives to produce reliable and high quality semiconductors. NJR's semiconductors are intended for specific applications and require proper maintenance and handling. To enhance the performance and service of NJR's semiconductors, the devices, machinery or equipment into which they are integrated should undergo preventative maintenance and inspection at regularly scheduled intervals. Failure to properly maintain equipment and machinery incorporating these products can result in catastrophic system failures.

2. The specifications on this datasheet are only given for information without any guarantee as regards either mistakes or omissions. The application circuits in this datasheet are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial property rights. All other trademarks mentioned herein are the property of their respective companies.

3. To ensure the highest levels of reliability, NJR products must always be properly handled. The introduction of external contaminants (e.g. dust, oil or cosmetics) can result in failures of semiconductor products.

4. NJR offers a variety of semiconductor products intended for particular applications. It is important that you select the proper component for your intended application. You may contact NJR's Sales Office if you are uncertain about the products listed in this datasheet.

5. Special care is required in designing devices, machinery or equipment which demand high levels of reliability. This is particularly important when designing critical components or systems whose failure can foreseeably result in situations that could adversely affect health or safety. In designing such critical devices, equipment or machinery, careful consideration should be given to amongst other things, their safety design, fail-safe design, back-up and redundancy systems, and diffusion design.

6. The products listed in this datasheet may not be appropriate for use in certain equipment where reliability is critical or where the products may be subjected to extreme conditions. You should consult our sales office before using the products in any of the following types of equipment:
   - Aerospace Equipment
   - Equipment Used in the Deep Sea
   - Power Generator Control Equipment (Nuclear, steam, hydraulic, etc.)
   - Life Maintenance Medical Equipment
   - Fire Alarms / Intruder Detectors
   - Vehicle Control Equipment (Airplane, railroad, ship, etc.)
   - Various Safety Devices

7. NJR's products have been designed and tested to function within controlled environmental conditions. Do not use products under conditions that deviate from methods or applications specified in this datasheet. Failure to employ the products in the proper applications can lead to deterioration, destruction or failure of the products. NJR shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of the products. The products are sold without warranty of any kind, either express or implied, including but not limited to any implied warranty of merchantability or fitness for a particular purpose.

8. Warning for handling Gallium and Arsenic (GaAs) Products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.

9. The product specifications and descriptions listed in this datasheet are subject to change at any time, without notice.