**GENERAL DESCRIPTION**

The NJM2113 is a low voltage audio power amplifier designed for telephone applications, such as in speakerphones.

Coupling capacitors to the speaker are not required, as it has differential speaker outputs. The closed loop gain is set with two external resistors. A CD pin permits powering down with muting the input signal.

**FEATURES**

- Wide Operating Voltage (2~16V)
- Low Operating Current (2.7mA Typ.)
- CD Input to Power Down the IC with Mute
- Low Power-Down Operating Current (72μA Typ.)
- Output Power Exceeds 250mW (Vsupply=6V, Rload=32Ω)
- Gain Adjustable (Gain=0~43dB, Voice Band)
- Package Outline DMP8, DMP8, SIP8, SSOP8, VSP8
- Bipolar Technology

**RECOMMENDED OPERATING CONDITIONS**

- Load Impedance \( R_L \)
- Differential Gain \( G_{VD} \)
- Input Voltage at CD \( V_{CD} \)

**PIN CONFIGURATION**

Pin Function
1. CD
2. \( +V_{IN} \)
3. \( +V_{IN} \)
4. \( -V_{IN} \)
5. \( V_{O1} \)
6. \( V^+ \)
7. GND
8. \( V_{O2} \)

**BLOCK DIAGRAM**
## ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>RATING (Ta=25°C)</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>V**</td>
<td>+18</td>
<td>V</td>
</tr>
<tr>
<td>Output Peak Current</td>
<td>Iop</td>
<td>±250</td>
<td>mA</td>
</tr>
</tbody>
</table>
| Input Voltage Range           | Vin    | (1~4pin)-0.3 to V**+0.3  
(5.8pin) -0.3 to V**+0.3 when Power-Down | V    |
| Power Dissipation             | Po     | (DIP8) 500       | mW   |
|                               |        | (SIP8) 800       |      |
|                               |        | (DMP8) 500 (note 1) |      |
|                               |        | (SSOP8) 360 (note 1) |      |
|                               |        | (VSPB) 320      |      |
| Operating Temperature Range   | Toper  | -20~+75          | °C   |
| Storage Temperature Range     | Tstg   | -40~+125         | °C   |

(note 1) Mounted on PC Board

## ELECTRICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>TEST CONDITION</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Current</td>
<td>Icc1</td>
<td>V**=3V, RL =∞, IPin=0.8mA</td>
<td>2.7</td>
<td>4.0</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>(no signal)</td>
<td>Icc2</td>
<td>V**=16V, RL =∞, IPin=0.8mA</td>
<td>3.4</td>
<td>5.0</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>IcCD</td>
<td>V**=3V, RL =∞, IPin=2mA</td>
<td>72</td>
<td>100</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>Open Loop Gain</td>
<td>Av1</td>
<td>Amplifier A, f&lt;1kHz</td>
<td>77</td>
<td>83</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Closed Loop Gain</td>
<td>Av2</td>
<td>Amplifier B, f=1kHz, RL =32Ω</td>
<td>-0.35</td>
<td>0</td>
<td>0.35</td>
<td>dB</td>
</tr>
<tr>
<td>Output Power</td>
<td>Po1</td>
<td>V**=3V, RL =16Ω, THD≤10%</td>
<td>55</td>
<td></td>
<td></td>
<td>mW</td>
</tr>
<tr>
<td>(note 2)</td>
<td>Po2</td>
<td>V**=6V, RL =32Ω, THD≤10%</td>
<td>250</td>
<td></td>
<td></td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td>Po3</td>
<td>V**=12V, RL =100Ω, THD≤10% (note 3)</td>
<td>400</td>
<td></td>
<td></td>
<td>mW</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>THD1</td>
<td>V**=6V, RL =32Ω, Po=125mW, Gpo=34dB</td>
<td>0.5</td>
<td>1.0</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>(f=1kHz)</td>
<td>THD2</td>
<td>V**=13V, RL =8Ω, Po=20mW, Gpo=12dB</td>
<td>0.5</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>THD3</td>
<td>V**=12V, RL =32Ω, Po=200mW, Gpo=34dB</td>
<td>0.6</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Power Supply Rejection Ratio</td>
<td>PSRR1</td>
<td>C1=∞, C2=0.01μF, DC</td>
<td>50</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>(V**=6V, ΔV**=3V)</td>
<td>PSRR2</td>
<td>C1=0.1μF, C2=0, f=1kHz</td>
<td>12</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>PSRR3</td>
<td>C1=1μF, C2=5μF, f=1kHz</td>
<td>52</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Mute Attenuation</td>
<td>MAT</td>
<td>f=1kHz~20kHz, IPin=2V</td>
<td>70</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>Vo1</td>
<td>V**=3V, RL =16Ω</td>
<td>1.00</td>
<td>1.18</td>
<td>1.25</td>
<td>V</td>
</tr>
<tr>
<td>(Rt =75kΩ, DC)</td>
<td>Vo2</td>
<td>V**=6V</td>
<td>2.68</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Vo3</td>
<td>V**=12V</td>
<td>5.71</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Output High Level</td>
<td>Voh</td>
<td>Iout=±75mA, V**=2~16V</td>
<td>V**-1.1</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Output Low Level</td>
<td>Vol</td>
<td>Iout=75mA, V**=2~16V</td>
<td>0.21</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Output DC Offset</td>
<td>ΔVo</td>
<td>Rs=75kΩ, RL =32Ω, 5pin-8pin</td>
<td>-30</td>
<td>0</td>
<td>+30</td>
<td>mV</td>
</tr>
<tr>
<td>Input Bias Current</td>
<td>Ib1</td>
<td>4pin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>R+IN</td>
<td>3pin</td>
<td>100</td>
<td>150</td>
<td>220</td>
<td>kΩ</td>
</tr>
<tr>
<td>Equivalent Resistance</td>
<td>RREF</td>
<td>2pin</td>
<td>18</td>
<td>25</td>
<td>40</td>
<td>kΩ</td>
</tr>
<tr>
<td>CD Input Voltage H</td>
<td>VCDH</td>
<td>1pin</td>
<td>2.0</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>CD Input Voltage L</td>
<td>VCDL</td>
<td>1pin</td>
<td>0.0</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>CD Input Resistance</td>
<td>RCD</td>
<td>V**=16V, 1pin</td>
<td>50</td>
<td>75</td>
<td>175</td>
<td>kΩ</td>
</tr>
</tbody>
</table>

(note 2) NJM2113, NJM2113V, NJM2113V:1 on PC Board

(note 3) Not specified for NJM2113, NJM2113R

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**APPLICATION CIRCUIT**

![Circuit Diagram]

*(note)*

1. The NJM2113 is active mode during the CD terminal is Low level (<0.8V) and it is stand-by mode during the CD terminal is High level (>2.0V).
2. C1 and C2 improve power supply rejection ratio. In case of C1 is enough large, C2 is unnecessary.
3. Please note that the C1 and C2 make slow power rise up to the NJM2113 regardless the external power supply condition.
4. Input current flow on the internal resistor shown in the equivalent circuit of CD terminal.
5. No snubber resistor and capacitor are required are required normally.
   But the snubber resistor and capacitor are required if the NJM2113 oscillates by condition of PCB layout, stray capacitor and speaker wire length.
## Typical Characteristics

### AmpA Loop Gain, Phase vs. Frequency

[Graph showing voltage gain and phase vs. frequency]

### Power Dissipation vs. Output Power

**Configuration 1:**
- \( R_L = 8\Omega, \ f = 1\text{kHz} \)

- Power Dissipation vs. Output Power
  - \( V^* = 12V \)
  - \( V^* = 6V \)
  - \( V^* = 3V \)

- Output Power \( P_o \) (mW)

**Configuration 2:**
- \( R_L = 16\Omega, \ f = 1\text{kHz} \)

- Power Dissipation vs. Output Power
  - \( V^* = 12V \)
  - \( V^* = 4V \)
  - \( V^* = 3V \)

- Output Power \( P_o \) (mW)

**Configuration 3:**
- \( R_L = 32\Omega, \ f = 1\text{kHz} \)

- Power Dissipation vs. Output Power
  - \( V^* = 16V \)
  - \( V^* = 12V \)
  - \( V^* = 6V \)

- Output Power \( P_o \) (mW)

**Configuration 4:**
- \( R_L = 100\Omega, \ f = 1\text{kHz} \)

- Power Dissipation vs. Output Power
  - \( V^* = 16V \)
  - \( V^* = 12V \)
  - \( V^* = 6V \)

- Output Power \( P_o \) (mW)
TYPICAL CHARACTERISTICS

Operating Current vs. Supply Voltage

CD Terminal Sink Current vs. Supply Voltage

Power Supply Rejection Ratio vs. Frequency

Power Supply Rejection Ratio vs. Frequency

Power Supply Rejection Ratio vs. Frequency

Power Supply Rejection Ratio vs. Frequency

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TYPICAL CHARACTERISTICS

Total Harmonic Distortion vs. Output Power

\( f=1 \text{kHz}, \ A_{\text{op}}=34 \text{dB} \)

- \( V^*=3 \text{V}, R_L=10 \Omega \)
- \( V^*=3 \text{V}, R_L=20 \Omega \)
- \( V^*=5 \text{V}, R_L=10 \Omega \)
- \( V^*=12 \text{V}, R_L=32 \Omega \)

Output Power \( P_0 \) (mW)

Total Harmonic Distortion THD (%)

\( f=3 \text{kHz}, \ A_{\text{op}}=34 \text{dB} \)

- \( V^*=3 \text{V}, R_L=10 \Omega \)
- \( V^*=3 \text{V}, R_L=20 \Omega \)
- \( V^*=6 \text{V}, R_L=10 \Omega \)
- \( V^*=12 \text{V}, R_L=32 \Omega \)

Output Power \( P_0 \) (mW)

Total Harmonic Distortion THD (%)

\( f=1.5 \text{kHz}, \ A_{\text{op}}=12 \text{dB} \)

- \( V^*=2 \text{V}, R_L=10 \Omega \)
- \( V^*=1 \text{V}, R_L=20 \Omega \)
- \( V^*=5 \text{V}, R_L=32 \Omega \)
- \( V^*=12 \text{V}, R_L=32 \Omega \)

Output Power \( P_0 \) (mW)

Total Harmonic Distortion THD (%)

Operating Current vs. Ambient Temperature

- \( V^*=15 \text{V} \)
- \( V^*=3 \text{V} \)

Operating Current \( I_{\text{oc}} \) (mA)

Ambient Temperature \( T_a \) (°C)

Operating Current vs. Ambient Temperature at Power Down Mode

\( V^*=3 \text{V}, \ V_{\text{CE}}=3 \text{V} \)

Operating Current \( I_{\text{oc}} \) (μA)

Ambient Temperature \( T_a \) (°C)