Single Supply, Rail-to-Rail Output Quad Operational Amplifier

**GENERAL DESCRIPTION**
NJM2747 is a low noise Rail-to-Rail Output quad operational amplifier.
Rail-to-Rail Output function provides wide dynamic range, is from ground to power supply level. And Input range rails from ground level.
It is suitable for audio section of portable sets, PCs and any General-purpose applications.
NJM2747SCC is available in the small PCSP package, which saves space on printed circuit boards and suitable for small portable devices.

**FEATURES**
- Operating Voltage 2.5V to 14V
- Rail-to-Rail Output $V_{OH} \geq 4.9V$ Typ. (at $V^+=5V$, $R_L=5k\Omega$) $V_{OL} \leq 0.1V$ Typ. (at $V^+=5V$, $R_L=5k\Omega$)
- Offset Voltage 1mV Typ.
- Slew Rate 3.5V/µs Typ.
- Low Distortion 0.001% Typ. (at $V^+=5V$, $f=1kHz$)
- Low Input Voltage Noise 10nV/√Hz Typ. (at $f=1kHz$)
- Bipolar Technology
- Package Outline
  - NJM2747D DIP14 (Lead insertion type)
  - NJM2747M DMP14 (Surface mount type)
  - NJM2747V SSOP14 (Surface mount type)
  - NJM2747SCC PCSP20-CC (Surface mount type very small size package)
### PIN CONFIGURATION

#### NJM2747D, NJM2747M, NJM2747V

**PIN FUNCTION**

1. OUTPUT A
2. –INPUT A
3. +INPUT A
4. V+
5. +INPUT B
6. –INPUT B
7. OUTPUT B
8. OUTPUT C
9. –INPUT C
10. +INPUT C
11. GND
12. +INPUT D
13. –INPUT D
14. OUTPUT D

#### NJM2747SCC

**PIN FUNCTION**

1. NC
2. OUTPUT B
3. NC
4. OUTPUT C
5. NC
6. –INPUT C
7. +INPUT C
8. GND
9. +INPUT D
10. –INPUT D
11. NC
12. OUTPUT D
13. NC
14. OUTPUT A
15. NC
16. –INPUT A
17. +INPUT A
18. V+
19. +INPUT B
20. –INPUT B

(Note1) The NC pin and the PAD should connect with a GND terminal.
(Note2) The NC pin is electrically not connected to the die in a package.
(Note3) The PAD is electrically not connected to the backside of the die. The PAD cannot be used as GND pin.
(Note4) NJM2747SCC package size is [W: 2.7mm, D: 2.7mm, H: 0.8mm]. Please confirm the size information by a package specification.
ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>RATINGS</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>V</td>
<td>15</td>
<td>V</td>
</tr>
<tr>
<td>Differential Input Voltage Range</td>
<td>V&lt;sub&gt;DI&lt;/sub&gt;</td>
<td>±15 (Note5)</td>
<td>V</td>
</tr>
<tr>
<td>Common Mode Input Voltage Range</td>
<td>V&lt;sub&gt;ICM&lt;/sub&gt;</td>
<td>0 to 15 (Note5)</td>
<td>V</td>
</tr>
</tbody>
</table>

Power Dissipation

- P<sub>D</sub> 870 [DIP14]
- 450 [DMP14] (Note6), 420 [SSOP14] (Note6), 380 [PCSP20-CC] (Note6),
- 560 [DMP14] (Note7), 520 [SSOP14] (Note7), 550 [PCSP20-CC] (Note7),

Operating Temperature Range

- T<sub>opr</sub> -40 to +85 °C

Storage Temperature Range

- T<sub>stg</sub> -50 to +125 °C

For supply voltage less than 15V, the absolute maximum input voltage is equal to the supply voltage.

On the PCB “EIA/JEDEC (76.2×114.3×1.6mm, two layers, FR-4)”

On the PCB “EIA/JEDEC (76.2×114.3×1.6mm, four layers, FR-4)”

Do not exceed “Power dissipation: PD” in which power dissipation in IC is shown by the absolute maximum rating.

Refer to following Figure 1A and Figure 1B for a permissible loss when ambient temperature (Ta) is Ta≥25°C.

Operating Voltage (Ta=25°C)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>RATINGS</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>V</td>
<td>2.5 to 14 (Note8)</td>
<td>V</td>
</tr>
</tbody>
</table>
### ELECTRICAL CHARACTERISTICS

#### DC CHARACTERISTICS (V+=5V, Ta=25°C)

<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>( I_C )</td>
<td>( R_L = \infty, V_{IN} = 2.5V, ) No Signal Apply</td>
<td>-</td>
<td>8</td>
<td>11</td>
<td>mA</td>
</tr>
<tr>
<td>Input Offset Voltage</td>
<td>( V_{IO} )</td>
<td>( R_S \leq 10k\Omega )</td>
<td>-</td>
<td>1</td>
<td>6</td>
<td>mV</td>
</tr>
<tr>
<td>Input Bias Current</td>
<td>( I_B )</td>
<td>-</td>
<td>100</td>
<td>350</td>
<td>nA</td>
<td></td>
</tr>
<tr>
<td>Input Offset Current</td>
<td>( I_{IO} )</td>
<td>-</td>
<td>5</td>
<td>100</td>
<td>nA</td>
<td></td>
</tr>
<tr>
<td>Large Signal Voltage Gain</td>
<td>( A_{V} )</td>
<td>( R_L \geq 10k\Omega ) to 2.5V, ( V_o = 0.5V ) to 4.5V</td>
<td>65</td>
<td>85</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Common Mode Rejection Ratio</td>
<td>CMR</td>
<td>0V ( \leq V_{CM} \leq 4V )</td>
<td>60</td>
<td>75</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Supply Voltage Rejection Ratio</td>
<td>SVR</td>
<td>( V^+ = 2.5V ) to 14V</td>
<td>60</td>
<td>80</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>( V_{OH} )</td>
<td>( R_L = 5k\Omega ) to 2.5V</td>
<td>4.75</td>
<td>4.9</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>( V_{OL} )</td>
<td>( R_L = 5k\Omega ) to 2.5V</td>
<td>-</td>
<td>0.1</td>
<td>0.25</td>
<td>V</td>
</tr>
<tr>
<td>Input Common Mode Voltage Range</td>
<td>( V_{ICM} )</td>
<td>CMR ( \geq 60dB )</td>
<td>0</td>
<td>-</td>
<td>4</td>
<td>V</td>
</tr>
</tbody>
</table>

#### AC CHARACTERISTICS (V+=5V, Ta=25°C)

<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>Unity Gain Bandwidth</td>
<td>( GB )</td>
<td>( f = 10kHz )</td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>MHz</td>
</tr>
<tr>
<td>Phase Margin</td>
<td>( \Phi_M )</td>
<td>( R_L = 10k\Omega, C_L = 10pF )</td>
<td>-</td>
<td>75</td>
<td>-</td>
<td>Deg</td>
</tr>
<tr>
<td>Equivalent Input Noise Voltage</td>
<td>( V_{NI} )</td>
<td>( f = 1kHz, V_{CM} = 2.5V )</td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>nV/√Hz</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>THD</td>
<td>( f = 1kHz, A_{V} = \pm 2 ) ( R_L = 10k\Omega ) to 2.5V, ( V_o = 1.5V_{rms} )</td>
<td>-</td>
<td>0.001</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>Amp to Amp Separation</td>
<td>( CS )</td>
<td>( f = 1kHz ) ( R_L = 10k\Omega ) to 2.5V, ( V_o = 1.5V_{rms} )</td>
<td>-</td>
<td>120</td>
<td>-</td>
<td>dB</td>
</tr>
</tbody>
</table>

#### AC CHARACTERISTICS (V+=5V, Ta=25°C) (Note 9)

<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>Slew Rate</td>
<td>( SR )</td>
<td>( \text{(Note 9), } A_{V} = 1, V_{IN} = 2V_{pp} ) ( R_L = 10k\Omega ) to 2.5V, ( C_L = 10pF ) to 2.5V</td>
<td>-</td>
<td>3.5</td>
<td>-</td>
<td>V/μs</td>
</tr>
</tbody>
</table>

(Note 9) Number specified is the slower of the positive and negative slew rates.
TYPICAL CHARACTERISTICS

Supply Current vs. Supply Voltage
(Temperature)

Supply Current vs. Ambient Temperature
(Supply Voltage)

Input Offset Voltage vs. Supply Voltage
(Temperature)

Input Offset Voltage vs. Supply Voltage
(Temperature, $V^+ = 5V$)

Input Offset Voltage vs. Input Common Mode Voltage
(Temperature, $V^+ = 5V$)
TYPICAL CHARACTERISTICS

Input Bias Current vs. Ambient Temperature (Supply Voltage)

Input Offset Current vs. Ambient Temperature (Supply Voltage)

Maximum Output Voltage vs. Supply Voltage (Temperature, $R_L=10\,\text{k}\Omega$
$G_V=\text{OPEN}, R_L=10\,\text{k}\Omega$

Maximum Output Voltage vs. Load Resistance (Temperature, $V^+=5\,\text{V}$)
$V^+=5\,\text{V}, G_V=\text{OPEN}$

Maximum Output Voltage vs. Output Current (Temperature, $V^+=5\,\text{V}$)
$V^+=5\,\text{V}, G_V=\text{OPEN}$
TYPICAL CHARACTERISTICS

Maximum Output Voltage vs. Ambient Temperature
(Temperature, $R_L=10k\Omega$)

$G_{V}=\text{OPEN}, R_L=10k\Omega$

-8 -6 -4 -2 0 2 4 6 8

Ambient Temperature [°C]

$V+/V-=\pm 14V$

$V+/V-=\pm 2.5V$

$V+/V-=\pm 1.25V$

Maximum Output Voltage vs. Ambient Temperature
(Temperature, $R_L=5k\Omega$)

$G_{V}=\text{OPEN}, R_L=5k\Omega$

-8 -6 -4 -2 0 2 4 6 8

Ambient Temperature [°C]

$V+/V-=\pm 2.5V$

$V+/V-=\pm 14V$

Common Mode Rejection Ratio vs. Ambient Temperature (Supply Voltage)

$R_L=10k\Omega, 0V \leq V_{CM} \leq V^+-1V$

-50 -25 0 25 50 75 100 125

Ambient Temperature [°C]

$V^+=14V$

$V^+=5V$

$V^+=2.5V$

Power Supply Rejection Ratio vs. Ambient Temperature

$R_L=10k\Omega, 2.5V \leq V^+ \leq 14V$

-50 -25 0 25 50 75 100 125

Ambient Temperature [°C]

$V^+=14V$
TYPICAL CHARACTERISTICS

Gain/Phase vs. Frequency (Load Capacitance)

Gain/Phase vs. Frequency (Temperature)

Phase Margin vs. Load Capacitance

Pulse Response (Load Capacitance, $V^+V^- = \pm 2.5V$)

Pulse Response (Temperature, $V^+V^- = \pm 2.5V$)

- $V^+=5V$, $V_n=30dBm$, $G_n=40dB$, $R_1=50\Omega$, $R_2=10k\Omega$, $R_n=100\Omega$, $T_a=\pm 25^\circ C$
- $V^+=5V$, $V_n=30dBm$, $G_n=40dB$, $R_1=50\Omega$, $R_2=10k\Omega$, $R_n=100\Omega$, $C_1=10pF$
- $V+=2.5V$, $V_n=1Vp-p$, $R_2=10k\Omega$, $T_a=25^\circ C$
- $V^+=2.5V$, $V_n=1Vp-p$, $A_n=1$, $R_2=10k\Omega$, $C_1=10pF$
**TYPICAL CHARACTERISTICS**

**THD+N vs. Output Voltage (Frequency)**
- $V^+ = 5V$, $A_v = 2$, $R_s = 600\Omega$, $R_f = 5k\Omega$, $R_g = 5k\Omega$
- $BW = 10Hz - 80kHz$, $Ta = 25^\circ C$
- $f = 1kHz$, $f = 10kHz$, $f = 100kHz$

**THD+N vs. Output Voltage (Supply Voltage)**
- $f = 1kHz$, $V^+ = 2.5V$, $V^+ = 5V$, $V^+ = 14V$
- $BW = 10Hz - 80kHz$, $Ta = 25^\circ C$

**Equivalent Input Noise Voltage vs. Frequency (Supply Voltage)**
- $V^+ = 14V$, $V^+ = 5V$, $V^+ = 2.5V$
- $G_v = 60dB$, $R_f = 600\Omega$, $R_g = 100k\Omega$, $R_s = 10\Omega$
- $Ta = 25^\circ C$

**Channel Separation vs. Frequency**
- $V^+ = 5V$, $Cch$ Input, $V_o = 1.5Vrms$, $G_v = 40dB$, $R_f = 100k\Omega$, $R_s = 10k\Omega$, $R_g = 1k\Omega$
- $Ta = 25^\circ C$
MEMO

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