PWM DC/DC CONVERTER IC

GENERAL DESCRIPTION

The NJM2374A is a PWM DC/DC converter IC. It features fixed frequency type PWM control for better noise handling and to avoid intermittent oscillation observed in a simplified controller.

It is suitable for Step-Up, Step-Down and Inverting applications for EMI sensitive application.

FEATURES

- Operating Voltage (2.5V* to 40V)
- NJM2374AE Operating Voltage (2.5V* to 48V)
- Wide Oscillator Frequency (100Hz to 100kHz)
- Internal High Power Transistor 1.5A (max.)
- Internal Over Current Limit Circuit
- PWM form Switching Power Supply Control
- Bipolar Technology
- Package Outline DIP8, DMP8, SOP8 JEDEC 150mil SSOP14

*Ta =25°C. At low temperature, the minimum voltage is 3.0V.

PIN CONFIGURATION

NJM2374AD
NJM2374AM
NJM2374AE

NJM2374AV

PIN FUNCTION

1. CS
2. NC
3. NC
4. NC
5. IN
6. V
7. SI
8. CD
9. NC
10. V
11. NC
12. SI
13. NC
14. CD

NJM2374AD
NJM2374AM
NJM2374AE

NJM2374AV

PIN FUNCTION

1. CS
2. NC
3. NC
4. NC
5. CT
6. GND
7. SI
8. CD
9. NC
10. V
11. NC
12. SI
13. NC
14. CD
■ BLOCK DIAGRAM

(DIP8, DMP8, SOP8: PACKAGE)

(SSOP14: PACKAGE)
ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>RATINGS</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Supply Voltage</td>
<td>V+</td>
<td>40</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(NJM2374AE: 48V)</td>
<td></td>
</tr>
<tr>
<td>Output Switch Current</td>
<td>I_{SW}</td>
<td>1.5</td>
<td>A</td>
</tr>
<tr>
<td>Output Switch Voltage</td>
<td>V_{SW}</td>
<td>40</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(NJM2374AE: 48V)</td>
<td></td>
</tr>
<tr>
<td>Comparator Input Voltage</td>
<td>V_{IR}</td>
<td>-0.3 ~ 40</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(NJM2374AE: 48V)</td>
<td></td>
</tr>
<tr>
<td>Power Dissipation</td>
<td>P_D</td>
<td>DIP8: 875</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DMP8: 750</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SOP8: 1,000</td>
<td>(note1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SSOP14: 375</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>Topr</td>
<td>-40 ~ +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>Tstg</td>
<td>-50 ~ +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

(note1) At on PC board.

In the case of Step-Down and Inverting Conversion with the internal power transistor, the Output Voltage must be set lower than 6V(-6V).

POWER DISSIPATION vs. AMBIENT TEMPERATURE

In the case of SSOP packaging, the power dissipation should carefully be considered when designing this parts.
## ELECTRICAL CHARACTERISTICS

### DC Characteristics  \( (V^+=5V, \, Ta=25^\circ C) \)

<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>Operating Current 1</td>
<td>( I_{CC1} )</td>
<td>( C_T=1nF, , S_P=V^+, , IN^+&gt; V_{th}, , E_S=GND )</td>
<td>–</td>
<td>2.8</td>
<td>4.0</td>
<td>mA</td>
</tr>
<tr>
<td>Operating Current 2</td>
<td>( I_{CC2} )</td>
<td>( V^+=48V, C_T=1nF, S_P=V^+, , IN^+&gt; V_{th}, , E_S=GND )</td>
<td>–</td>
<td>3.4</td>
<td>4.5</td>
<td>mA</td>
</tr>
<tr>
<td>(NJM2374AE Only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charge Current</td>
<td>( I_{ch} )</td>
<td></td>
<td>12</td>
<td>20</td>
<td>30</td>
<td>( \mu )A</td>
</tr>
<tr>
<td>Discharge Current</td>
<td>( I_{ds} )</td>
<td></td>
<td>110</td>
<td>180</td>
<td>300</td>
<td>( \mu )A</td>
</tr>
<tr>
<td>Voltage Swing</td>
<td>( V_{OSC} )</td>
<td></td>
<td>–</td>
<td>0.5</td>
<td>–</td>
<td>( V_{P-P} )</td>
</tr>
<tr>
<td>Discharge to Charge Current Ratio</td>
<td>( I_{ratio} )</td>
<td>( S_I=V^+ )</td>
<td>–</td>
<td>9</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Peak Current Sense Voltage</td>
<td>( V_{pk} )</td>
<td>( I_{ch}=I_{ds} )</td>
<td>250</td>
<td>300</td>
<td>350</td>
<td>mV</td>
</tr>
<tr>
<td>Saturation Voltage 1</td>
<td>( V_{sat1} )</td>
<td>Darlington Connection  ( (C_S=C_D), , I_{SW}=0.7A )</td>
<td>–</td>
<td>1.0</td>
<td>1.3</td>
<td>V</td>
</tr>
<tr>
<td>Saturation Voltage 2</td>
<td>( V_{sat2} )</td>
<td>( I_{SW}=0.7A, I_{c(driver)}=50mA ) ( (Forced \beta=14) )</td>
<td>–</td>
<td>0.5</td>
<td>0.7</td>
<td>V</td>
</tr>
<tr>
<td>Output Transistor Bias Resistance</td>
<td>( R_{bias} )</td>
<td></td>
<td>–</td>
<td>160</td>
<td>–</td>
<td>( \Omega )</td>
</tr>
<tr>
<td>DC Voltage Gain</td>
<td>( h_{FE} )</td>
<td>( I_{SW}=0.7A, , V_{CE}=5.0V )</td>
<td>35</td>
<td>120</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Collector Off-State Current</td>
<td>( I_{C(Off)} )</td>
<td>( V_{CE}=40V ) ( (NJM2374AE: , V_{CE}=48V) )</td>
<td>–</td>
<td>10</td>
<td>–</td>
<td>nA</td>
</tr>
<tr>
<td>Threshold Voltage</td>
<td>( V_{th} )</td>
<td></td>
<td>1.225</td>
<td>1.250</td>
<td>1.275</td>
<td>V</td>
</tr>
<tr>
<td>Input Bias Current</td>
<td>( I_{IB} )</td>
<td>( IN^+=0V )</td>
<td>–</td>
<td>40</td>
<td>400</td>
<td>nA</td>
</tr>
</tbody>
</table>

(note) Output switch tests are performed under pulsed conditions to minimize power dissipation.

## TIMING CHART

![Timing Chart](chart.png)

- High Voltage Detect
- Current-Limit Active Point
- Reference Voltage
- Output Voltage
- Oscillator Waveform
- OSC Block to FF Reset
- Collector-Emitter Voltage

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TYPICAL CHARACTERISTICS

Oscillator Frequency vs. Timing Capacitor
\( (V^+=5V, S_i=V^+, \text{Pin5}=\text{GND}, T_a=25^\circ\text{C}) \)

Switch ON/OFF Time vs. Timing Capacitor
\( (V^+=5V, S_i=V^+, \text{Pin5}=\text{GND}, T_a=25^\circ\text{C}) \)

Saturation Voltage 1 vs. Collector Current
\( (V^+=5V, C_s=C_D, T_a=25^\circ\text{C}) \)

Saturation Voltage 2 vs. Collector Current
\( (V^+=5V, I_{\text{c(driver)}}=50mA, \beta \approx 34, T_a=25^\circ\text{C}) \)

Operating Current vs. Operating Voltage
\( (C_t=1nF, S_i=V^+, I_{N+}>V_{th}, E_s=\text{GND}, T_a=25^\circ\text{C}) \)
TYPICAL CHARACTERISTICS

Threshold Voltage vs. Temperature
(V+=5V)

Saturation Voltage 1 vs. Temperature
(V+=5V, C_S=C_D, I_SW=0.7A)

Saturation Voltage 2 vs. Temperature
(V+=5V, I_SW=0.7A, I_c(driver)=50mA, β=14)

Discharge to Charge Current Ratio vs. Temperature
(V+=5V, S_I=V+)

Operating Current vs. Temperature
(V+=5V, C_T=1nF, S_I=V+, I_N> Vth, E_S=GND)
**TYPICAL APPLICATIONS**

**Step-Down Converter**

In the case of Step-Down Conversion with the internal power transistor, the Output Voltage must be set lower than 6V.

**Step-Up Converter**

**Inverting Converter**

In the case of Inverting Conversion with the internal power transistor, the Output Voltage must be set lower than -6V.

D1 use to schottky diode.

In the case of SSOP packaging, the power dissipation should be carefully considered when designing this parts.
NJM2374A

Step-Down Converter (High Current)

D1 use to schottky diode.

Step-Up Converter (High Current)

[CAUTION]
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