Negative Output Low Drop Out voltage regulator

**GENERAL DESCRIPTION**

The NJM2827 is a negative output low dropout regulator. Advanced bipolar technology achieves low noise, high precision voltage and high ripple rejection. It has soft-start and shunt SW function. 1.0\(\mu\)F Output capacitor and small package can make NJM2827 suitable for portable items.

**FEATURES**

- **Low Dropout Voltage**: \(0.13\text{V} \text{ (typ.)} @ I_o = 60\text{mA}\)
- **High Precision Output**: \(\pm 1.5\%\)
- **High Ripple Rejection**: \(65\text{dB (typ.)} @ f = 1\text{kHz}, V_o = -7\text{V Version}\)
- **Output capacitor with 1.0\(\mu\)F ceramic capacitor.**
- **Output Current**: \(I_o (\text{max.}) = 100\text{mA}\)
- **Soft-start Function**
- **Shunt SW Function**
- **Internal Thermal Overload Protection**
- **Internal Short Circuit Current Limit**
- **Bipolar Technology**
- **Package Outline**: SC88A

**PIN CONFIGURATION**

```
1. GND
2. V_IN
3. V_OUT
4. NC
5. CS
```

**BLOCK DIAGRAM**
NJM2827

■ OUTPUT VOLTAGE RANK LIST

<table>
<thead>
<tr>
<th>Device Name</th>
<th>V_{out}</th>
</tr>
</thead>
<tbody>
<tr>
<td>NJM2827F3-14</td>
<td>-1.4V</td>
</tr>
<tr>
<td>NJM2827F3-15</td>
<td>-1.5V</td>
</tr>
<tr>
<td>NJM2827F3-05</td>
<td>-5.0V</td>
</tr>
<tr>
<td>NJM2827F3-06</td>
<td>-6.0V</td>
</tr>
<tr>
<td>NJM2827F3-07</td>
<td>-7.0V</td>
</tr>
<tr>
<td>NJM2827F3-75</td>
<td>-7.5V</td>
</tr>
<tr>
<td>NJM2827F3-08</td>
<td>-8.0V</td>
</tr>
<tr>
<td>NJM2827F3-10</td>
<td>-10.0V</td>
</tr>
</tbody>
</table>

Output voltage options available: -1.4 ~ -10.0V

■ 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>Input Voltage</td>
<td>V_{IN}</td>
<td>-14</td>
<td>V</td>
</tr>
<tr>
<td>Power Dissipation</td>
<td>P_{D}</td>
<td>250(*1)</td>
<td>mW</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>Topr</td>
<td>-40 ~ +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>T_{stg}</td>
<td>-40 ~ +125</td>
<td>°C</td>
</tr>
</tbody>
</table>

(*1): Mount on EIA/JEDEC STANDARD Test board (76.2*114.3*1.6mm, 2layers, FR-4)

■ Operating voltage

V_{IN}=-3.2 ~ -12V (In case of V_{o}>-3.0V version)

■ ELECTRICAL CHARACTERISTICS

(Vo<2.2V Version: V_{IN}=Vo-1V, C_{IN}=0.1μF, C_{O}=1.0μF, Ta=25°C)
(Vo≥2.2V Version: V_{IN}=-3.2V, C_{IN}=0.1μF, C_{O}=2.2μF(Vo≥2.0V: C_{O}=4.7μF), Ta=25°C)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Voltage</td>
<td>Vo</td>
<td>+1.5%</td>
<td>-</td>
<td>-1.5%</td>
<td>V</td>
</tr>
<tr>
<td>Quiescent Current</td>
<td>I_{Q}</td>
<td>Io=0mA</td>
<td>-</td>
<td>130</td>
<td>200</td>
</tr>
<tr>
<td>Output Current</td>
<td>Io</td>
<td>V={O+0.3V</td>
<td>100</td>
<td>130</td>
<td>-</td>
</tr>
<tr>
<td>Line Regulation</td>
<td>ΔVo/ΔV_{IN}</td>
<td>V_{IN}=Vo-1V ~ -12V(V_{O}&lt; -2.2V)</td>
<td>-</td>
<td>-</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{IN}=3.2V ~ -12V(V_{O} ≥ -2.2V)</td>
<td>Io=30mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load Regulation</td>
<td>ΔVo/ΔIo</td>
<td>Io=0 ~ 60mA</td>
<td>-</td>
<td>-</td>
<td>0.03</td>
</tr>
<tr>
<td>Dropout Voltage(*2)</td>
<td>ΔV_{O}</td>
<td>Io=60mA</td>
<td>-</td>
<td>0.13</td>
<td>0.23</td>
</tr>
<tr>
<td>Ripple Rejection</td>
<td>RR</td>
<td>V_{IN}=Vo-1V ~ -12V(V_{O} ≤ -3.0V)</td>
<td>-</td>
<td>65</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{IN}=4.0V ~ -12V(V_{O} &gt; -3.0V)</td>
<td>ein=200mVrms, f=1kHz, Io=10mA, V_{O}=7V Version</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Temperature Coefficient of Output Voltage</td>
<td>ΔVo/ΔTa</td>
<td>Ta=0 ~ 85°C, Io=10mA</td>
<td>-</td>
<td>±50</td>
<td>-</td>
</tr>
<tr>
<td>Output Noise Voltage</td>
<td>V_{NO}</td>
<td>f=10Hz ~ 80kHz, Io=10mA, V_{O}=7V Version</td>
<td>-</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>CS Terminal Charge Current</td>
<td>Ics</td>
<td>V_{CS}=0V</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>V_{IN}</td>
<td>-12</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
</tbody>
</table>

(*2): Excludes V_{o}>-3.0V version.

The above specification is a common specification for all output voltages. Therefore, it may be different from the individual specification for a specific output voltage.
**TEST CIRCUIT**

```
*3 \(-2.2\text{V} \leq V_o \leq -2.0\text{V} \) version: \( C_o = 2.2\mu\text{F} \) (Ceramic)
\( V_o > -2.0\text{V} \) version: \( C_o = 4.7\mu\text{F} \) (Ceramic)
```
**TYPICAL APPLICATIONS**

![Circuit Diagram](image)

*• Input Capacitance \( C_{IN} \)

Input capacitance \( C_{IN} \) is required to prevent oscillation and reduce power supply ripple for applications with high power supply impedance or a long power supply line.

Use the \( C_{IN} \) value of 0.1\( \mu \)F greater to avoid the problem.

\( C_{IN} \) should connect between GND and \( V_{IN} \) as short as possible.

*• Output Capacitance \( C_{O} \)

Output capacitor (\( C_{O} \)) is required for a phase compensation of the internal error amplifier. The capacitance and the equivalent series resistance (ESR) influences stability of the regulator.

This product is designed to work with a low ESR capacitor for the \( C_{O} \); however, use of recommended capacitance or greater value is essential for stable operation.

Use of a smaller \( C_{O} \) may cause excess output noise or oscillation of the regulator due to lack of the phase compensation.

Therefore, use \( C_{O} \) with the recommended capacitance or greater value and connect between \( V_{O} \) terminal and GND terminal with minimal wiring. The recommended capacitance depends on the output voltage. Low voltage regulator requires greater value of the \( C_{O} \). Thus, check the recommended capacitance for each output voltage.

Use of a greater \( C_{O} \) reduces output noise and ripple output, and also improves transient response of the output voltage against rapid load change.
**Soft-start function**

Capacitance Cs connect between CS pin and GND for the following.
- Control at risetime of output voltage.
- Reduces inrush current at output ON.

When the soft start function is not used, CS pin should be open.

1. Cs capacitance vs risetime of output voltage
   Calculation: risetime of output voltage $\Delta t \approx 213 \times Cs(\mu F)$

2. Inrush current at control ON

   The peak value of the inrush current can be limited according to the capacitance of the Cs.

   ![Inrush current wave](image)

   * This characteristic is one example. It is necessary to examine the characteristic with an actual circuit because there is an influence by the characteristic such as output voltage/output capacitor.*
POWER DISSIPATION vs. AMBIENT TEMPERATURE

NJM2827F3 Power Dissipation
(Topr = -40 ~ +85°C, Tj = 125°C)

Ambient Temperature Ta(°C) vs. Power Dissipation

- Layers board (76.2×114.3×1.6mm, FR-4)
TYPICAL CHARACTERISTICS

NJM2827/7.0V
Output Voltage vs. Input Voltage

Input Voltage : V_in (V)

Output Voltage : V_out (V)

@ Ta=25°C
C=1.0μF (Ceramic)

Io=0A
Io=30mA
Io=100mA

NJM2827/7.0V
Output Voltage vs. Output Current

Output Voltage : V_out (V)

Input Current : I (mA)

@ Ta=25°C
V_in=8.0V
C=1.0μF (Ceramic)

NJM2827/7.0V
Ground Pin Current vs. Output Current

Ground Pin Current : I_{G}(mA)

Output Current : I_o (mA)

@ Ta=25°C
V_in=8.0V
C=1.0μF (Ceramic)

NJM2827/7.0V
Dropout Voltage vs. Output Current

Dropout Voltage : V_{drop} (V)

Output Current : I_o (mA)

@ Ta=25°C
V_in=8.0V
C=1.0μF (Ceramic)

NJM2827/7.0V
Load Regulation vs. Output Current

Load Regulation : V_{load} (mV)

Output Current : I_o (mA)

@ Ta=25°C
V_in=8.0V
C=1.0μF (Ceramic)

NJM2827/7.0V
Peak Output Current vs. Input Voltage

Peak Output Current : I_{peak} (mA)

Input Voltage : V_in (V)

@ Ta=25°C
V_in=8.0V
C=1.0μF (Ceramic)
NJM2827

**Quiescent Current vs. Input Voltage**

@: $T_a = 25^\circ C$

Output is open.

$C_o = 1.0 \mu F$ (Ceramic)

**Output Noise Voltage vs. Output Current**

@: $T_a = 25^\circ C$

$V_{IN} = -8.0V$

$C_o = 1.0 \mu F$

**Ripple Rejection Ratio vs. Frequency**

@: $T_a = 25^\circ C$

$V_{IN} = -8.0V$

$e_{in} = 200mV_{rms}$

$C_o = 1.0 \mu F$ (Ceramic)

**Ripple Rejection vs. Output Current**

@: $T_a = 25^\circ C$

$V_{IN} = -8.0V$

$e_{in} = 200mV_{rms}$

$C_o = 1.0 \mu F$ (Ceramic)

**Dropout Voltage vs. Temperature**

@: $I_o = 60mA$

$C_o = 1.0 \mu F$ (Ceramic)

**Equivalent Series Resistance vs. Output Current**

@: $T_a = 25^\circ C$

$C_o = 1.0 \mu F$ (Ceramic)

STABLE REGION
Output Voltage vs. Temperature
@V_IN = -8.0V
Io = 30mA
Co = 1.0uF (Ceramic)

Quiescent Current vs. Temperature
@V_IN = -8.0V
Output is open.
Co = 1.0uF (Ceramic)

Line Regulation vs. Temperature
@V_IN = -8.0V
Io = 30mA
Co = 1.0uF (Ceramic)

Load Regulation vs. Temperature
@V_IN = -8.0V
Io = 0-60mA
Co = 1.0uF (Ceramic)

CS Charge Current vs. Temperature
@V_IN = -8.0V
CS is short to ground.
Co = 1.0uF (Ceramic)
[CAUTION]

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