Low Dropout Voltage Regulator

**GENERAL DESCRIPTION**

The NJM2877 is a 150mA output low dropout voltage regulator with ON/OFF control.

Advanced Bipolar technology achieves low noise, high ripple rejection, High accuracy and low quiescent current.

Package line-up is very small package: SC88A and standard package: SOT23-5.

Small packaging and 0.47µF small decoupling capacitor make the NJM2877 suitable for space conscious applications.

**FEATURES**

- High Ripple Rejection 75dB typ. (f=1kHz Vo=3V version)
- Output Noise Voltage Vno=30µVrms typ. (Cp=0.01µF)
- Output capacitor with 0.47µF ceramic capacitor (Vo≥2.7V Version)
- Output Current Io(max.)=150mA
- High Precision Output Vo ±1.0%
- Low Dropout Voltage 0.10V typ. (Io=60mA)
- ON/OFF Control (Active High)
- Internal Thermal Overload Protection
- Internal Over Current Protection
- Bipolar Technology
- Package Outline SC88A, SOT23-5

**PIN CONFIGURATION**

1. CONTROL 2. GND 3. NOISE BYPASS 4. VOUT 5. VIN

**EQUIVALENT CIRCUIT**
### OUTPUT VOLTAGE RANK LIST

**SC88A Package**

<table>
<thead>
<tr>
<th>Device Name</th>
<th>V(_{\text{out}})</th>
<th>Device Name</th>
<th>V(_{\text{out}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>NJM2877F3 -15</td>
<td>1.5V</td>
<td>NJM2877F3 -33</td>
<td>3.3V</td>
</tr>
<tr>
<td>NJM2877F3 -18</td>
<td>1.8V</td>
<td>NJM2877F3 -34</td>
<td>3.4V</td>
</tr>
<tr>
<td>NJM2877F3 -21</td>
<td>2.1V</td>
<td>NJM2877F3 -345</td>
<td>3.45V</td>
</tr>
<tr>
<td>NJM2877F3 -22</td>
<td>2.2V</td>
<td>NJM2877F3 -35</td>
<td>3.5V</td>
</tr>
<tr>
<td>NJM2877F3 -23</td>
<td>2.3V</td>
<td>NJM2877F3 -355</td>
<td>3.55V</td>
</tr>
<tr>
<td>NJM2877F3 -24</td>
<td>2.4V</td>
<td>NJM2877F3 -36</td>
<td>3.6V</td>
</tr>
<tr>
<td>NJM2877F3 -25</td>
<td>2.5V</td>
<td>NJM2877F3 -38</td>
<td>3.8V</td>
</tr>
<tr>
<td>NJM2877F3 -255</td>
<td>2.55V</td>
<td>NJM2877F3 -04</td>
<td>4.0V</td>
</tr>
<tr>
<td>NJM2877F3 -26</td>
<td>2.6V</td>
<td>NJM2877F3 -42</td>
<td>4.2V</td>
</tr>
<tr>
<td>NJM2877F3 -27</td>
<td>2.7V</td>
<td>NJM2877F3 -45</td>
<td>4.5V</td>
</tr>
<tr>
<td>NJM2877F3 -28</td>
<td>2.8V</td>
<td>NJM2877F3 -46</td>
<td>4.6V</td>
</tr>
<tr>
<td>NJM2877F3 -285</td>
<td>2.85V</td>
<td>NJM2877F3 -47</td>
<td>4.7V</td>
</tr>
<tr>
<td>NJM2877F3 -29</td>
<td>2.9V</td>
<td>NJM2877F3 -48</td>
<td>4.8V</td>
</tr>
<tr>
<td>NJM2877F3 -03</td>
<td>3.0V</td>
<td>NJM2877F3 -05</td>
<td>5.0V</td>
</tr>
<tr>
<td>NJM2877F3 -31</td>
<td>3.1V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NJM2877F3 -32</td>
<td>3.2V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SOT23-5 Package**

<table>
<thead>
<tr>
<th>Device Name</th>
<th>V(_{\text{out}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>NJM2877F15</td>
<td>1.5V</td>
</tr>
<tr>
<td>NJM2877F28</td>
<td>2.8V</td>
</tr>
<tr>
<td>NJM2877F03</td>
<td>3.0V</td>
</tr>
<tr>
<td>NJM2877F33</td>
<td>3.3V</td>
</tr>
<tr>
<td>NJM2877F05</td>
<td>5.0V</td>
</tr>
</tbody>
</table>
### ABSOLUTE MAXIMUM RATINGS

<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>+10</td>
<td>V</td>
</tr>
<tr>
<td>Control Voltage</td>
<td>$V_{CONT}$</td>
<td>+10(*1)</td>
<td>V</td>
</tr>
<tr>
<td>Power Dissipation</td>
<td>$P_{D}$</td>
<td>SC88A</td>
<td>250(*2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SOT23-5</td>
<td>350(*2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>200(*3)</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>$T_{opr}$</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): When input voltage is less than +10V, the absolute maximum control voltage is equal to the input voltage.

(*2): Mounted on glass epoxy board based on EIA/JEDEC. (114.3 × 76.2 × 1.6mm: 2Layers FR-4)

(*3): Device itself.

### ELECTRICAL CHARACTERISTICS

$(V_{IN}=V_{O}+1V, C_{IN}=0.1\mu F, C_{O}=0.47\mu F; V_{O}=+2.7V (C_{O}=1.0\mu F: 1.8V<V_{O}<2.6V, C_{O}=2.2\mu F : V_{O}<1.8V), C_{P}=0.01\mu F, T_{a}=25^°C)$

<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>Output Voltage</td>
<td>$V_{O}$</td>
<td>$I_{O}=30mA$</td>
<td>-1.0%</td>
<td>–</td>
<td>+1.0%</td>
<td>V</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>$V_{IN}$</td>
<td></td>
<td>–</td>
<td>–</td>
<td>9</td>
<td>V</td>
</tr>
<tr>
<td>Quiescent Current</td>
<td>$I_{Q}$</td>
<td>$I_{O}=0mA$, except $I_{CONT}$</td>
<td>–</td>
<td>120</td>
<td>180</td>
<td>µA</td>
</tr>
<tr>
<td>Quiescent Current at Control OFF</td>
<td>$I_{Q(OFF)}$</td>
<td>$V_{CONT}=0V$</td>
<td>–</td>
<td>–</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td>Output Current</td>
<td>$I_{O}$</td>
<td>$V_{O} - 0.3V$</td>
<td>150</td>
<td>200</td>
<td>–</td>
<td>mA</td>
</tr>
<tr>
<td>Line Regulation</td>
<td>$\Delta V_{O}/\Delta V_{IN}$</td>
<td>$V_{O}=V_{O}+1V - V_{O}+6V, I_{O}=30mA$</td>
<td>–</td>
<td>–</td>
<td>0.10</td>
<td>%/V</td>
</tr>
<tr>
<td>Load Regulation</td>
<td>$\Delta V_{O}/\Delta I_{O}$</td>
<td>$I_{O}=0 - 100mA$</td>
<td>–</td>
<td>–</td>
<td>0.03</td>
<td>%/mA</td>
</tr>
<tr>
<td>Dropout Voltage (*4)</td>
<td>$\Delta V_{LO}$</td>
<td>$I_{O}=60mA$</td>
<td>–</td>
<td>0.10</td>
<td>0.18</td>
<td>V</td>
</tr>
<tr>
<td>Ripple Rejection</td>
<td>RR</td>
<td>$e_{in}=200mVrms, f=1kHz, I_{O}=10mA, V_{O}=3V version$</td>
<td>–</td>
<td>75</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td>Average Temperature Coefficient of Output Voltage</td>
<td>$\Delta V_{O}/\Delta T_{a}$</td>
<td>$T_{a}=0 ~ +85^°C, I_{O}=10mA$</td>
<td>–</td>
<td>± 50</td>
<td>–</td>
<td>ppm/°C</td>
</tr>
<tr>
<td>Output Noise Voltage</td>
<td>$V_{NO}$</td>
<td>$f=10Hz$~80kHz, $I_{O}=10mA, V_{O}=3V$ Version</td>
<td>–</td>
<td>30</td>
<td>–</td>
<td>µVrms</td>
</tr>
<tr>
<td>Control Current</td>
<td>$I_{CONT}$</td>
<td>$V_{C_{CONT}}=1.6V$</td>
<td>–</td>
<td>3</td>
<td>12</td>
<td>µA</td>
</tr>
<tr>
<td>Control Voltage for ON-state</td>
<td>$V_{C_{CONT(ON)}}$</td>
<td></td>
<td>1.6</td>
<td>–</td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td>Control Voltage for OFF-state</td>
<td>$V_{C_{CONT(OFF)}}$</td>
<td></td>
<td>–</td>
<td>–</td>
<td>0.6</td>
<td>V</td>
</tr>
</tbody>
</table>

(*4): The output voltage excludes under 2.1V.

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

![Circuit Diagram](NJM2877)

*4: $1.8V < Vo < 2.6V$ version: $Co = 1.0\mu F$(Ceramic)
$Vo < 1.8V$ version: $Co = 2.2\mu F$(Ceramic)

## TYPICAL APPLICATIONS

1. In the case where ON/OFF Control is not required:

![Application Diagram](NJM2877)

*5: $1.8V < Vo < 2.6V$ version: $Co = 1.0\mu F$
$Vo < 1.8V$ version: $Co = 2.2\mu F$

Connect control terminal to $V_{IN}$ terminal
In use of ON/OFF CONTROL:

- State of control terminal:
  - "H" → output is enabled.
  - "L" or "open" → output is disabled.

Noise bypass Capacitance \( C_p \)
Noise bypass capacitance \( C_p \) reduces noise generated by band-gap reference circuit.
Noise level and ripple rejection will be improved when larger \( C_p \) is used.
Use of smaller \( C_p \) value may cause oscillation.
Use the \( C_p \) value of 0.01 \( \mu \)F greater to avoid the problem.

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.

In the case of using a resistance "R" between \( V_{IN} \) and control.
The current flow into the control terminal while the IC is ON state \( (I_{CONT}) \) can be reduced when a pull up resistance
"R" is inserted between \( V_{IN} \) and the control terminal.
The minimum control voltage for ON state \( (V_{CONT(ON)}) \) is increased due to the voltage drop caused by \( I_{CONT} \) and the
resistance "R". The \( I_{CONT} \) is temperature dependence as shown in the "Control Current vs. Temperature"
characteristics. Therefore, the resistance "R" should be carefully selected to ensure the control voltage exceeds
the \( V_{CONT(ON)} \) over the required temperature range.
Output Capacitance Co

Output capacitor (Co) 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 Co; however, use of recommended capacitance or greater value is essential for stable operation. Use of a smaller Co may cause excess output noise or oscillation of the regulator due to lack of the phase compensation. Therefore, use Co with the recommended capacitance or greater value and connect between Vo terminal and GND terminal with minimal wiring. The recommended capacitance depends on the output voltage. Low voltage regulator requires greater value of the Co. Thus, check the recommended capacitance for each output voltage. Use of a greater Co reduces output noise and ripple output, and also improves transient response of the output voltage against rapid load change.
POWER DISSIPATION vs. AMBIENT TEMPERATURE (SC-88A)

**NJM2877F3 Power Dissipation**  
(Topr=-40~+85°C, Tj=125°C)

- Ambient Temperature $T_a$(°C)
- Power Dissipation $P_d$(mW)

On Board(114.3×76.2×1.6mm, FR-4)

**NJM2877F Power Dissipation**  
(Topr=-40~+85°C, Tj=125°C)

- Ambient Temperature $T_a$(°C)
- Power Dissipation $P_d$(mW)
TYPICAL CHARACTERISTICS

**Output Voltage vs. Input Voltage**

Output Voltage: $V_o$ (V)
Input Voltage: $V_{IN}$ (V)

@ $T_a = 25^\circ C$
$C_o = 0.47 \mu F$ (Ceramic)

Io = 10mA
Io = 30mA

**Output Voltage vs. Output Current**

Output Voltage: $V_o$ (V)

@ $T_a = 25^\circ C$
$V_{IN} = 4.0$V

$C_o = 0.47 \mu F$ (Ceramic)

Io = 100mA

**Ground Pin Current vs. Output Current**

Ground Pin Current: $I_{GND}$ (mA)
Output Current: $I_o$ (mA)

@ $T_a = 25^\circ C$
$V_{IN} = 4.0$V

$C_o = 0.47 \mu F$ (Ceramic)

Cp = 0.01 \mu F

Io = 30mA

**Dropout Voltage vs. Output Current**

Dropout Voltage: $dV_{I-O}$ (V)
Output Current: $I_o$ (mA)

@ $T_a = 25^\circ C$
$V_{IN} = 4.0$V

$C_o = 0.47 \mu F$ (Ceramic)

$C_p = 0.01 \mu F$

Io = 30mA

**Control Current vs. Control Voltage**

Control Current: $I_{Cont}$ ($\mu A$)
Control Voltage: $V_{Cont}$ (V)

@ $T_a = 25^\circ C$
$V_{IN} = 4.0$V

$C_o = 0.47 \mu F$ (Ceramic)

$C_p = 0.01 \mu F$

Io = 30mA

**Output Voltage vs. Control Voltage**

Output Voltage: $V_o$ (V)
Control Voltage: $V_{Cont}$ (V)

$R_c = 0$Ω
$R_c = 50k\Omega$
$R_c = 100k\Omega$

@ $T_a = 25^\circ C$
$V_{IN} = 4.0$V

$C_o = 0.47 \mu F$ (Ceramic)

$C_p = 0.01 \mu F$

Io = 30mA
### TYPICAL CHARACTERISTICS

**Load Regulation vs. Output Current**

- @Ta=25°C
- VDC=4.0V
- CP=0.47µF (Ceramic)

**Peak Output Current vs. Input Voltage**

- @Ta=25°C
- VDC=4.0V
- CP=0.47µF (Ceramic)

**Quiescent Current vs. Input Voltage**

- Output is open.
- @Ta=25°C
- CP=0.47µF (Ceramic)

**Output Noise Voltage vs. Noise Bypass Capacitor**

- @Ta=25°C
- VIN=4.0V
- CP=0.01µF

**Output Noise Voltage vs. Output Current**

- @Ta=25°C
- VIN=4.0V
- CP=0.01µF

**Output Noise Voltage vs. Frequency**

- @Ta=25°C
- VIN=4.0V
- CP=0.01µF
- LPF: 80kHz
TYPICAL CHARACTERISTICS

Ripple Rejection Ratio vs. Frequency

Ripple Rejection Ratio vs. Output Current

Equivalent Series Resistance vs. Output Current

Dropout Voltage vs. Temperature

Output Voltage vs. Temperature
TYPICAL CHARACTERISTICS

NJM2877_3.0V
Control Voltage v.s. Temperature

Control Voltage : V_cont-off [V]

-50 0 50 100 150

Temperature : T_a [°C]

@: V_in=4.0V, V_cont=1.6V
Co=0.47µF (Ceramic)
Cp=0.01µF (Ceramic)

Output is open.

NJM2877_3.0V
Control Current vs. Temperature

Control Current : I_CONT [µA]

-50 0 50 100 150

Temperature : T_a [°C]

@: V_in=4.0V
Co=0.47µF (Ceramic)
Cp=0.1µF (Ceramic)

Quiescent Current : I_q [µA]

-50 0 50 100 150

Temperature : T_a [°C]

@: V_in=4.0V, V_cont=1.6V
Co=0.47µF (Ceramic)
Cp=0.01µF (Ceramic)

Short Circuit Current : I_sc [mA]

-50 0 50 100 150

Temperature : T_a [°C]

@: V_in=4.0V, Output is short to ground.
Co=0.47µF (Ceramic)
Cp=0.01µF

Line Regulation : dV_o/dV_in [%/V]

-0.2 0 0.2

Temperature : T_a [°C]

@: V_in=4.0-9.0V, I_o=30mA
Co=0.47µF (Ceramic)
Cp=0.01µF

Load Regulation : dV_o/dI_o [%/mA]

-0.005 0 0.005

Temperature : T_a [°C]

@: V_in=4.0V, I_o=0-100mA
Co=0.47µF (Ceramic)
Cp=0.01µF
NJM2877

TYPICAL CHARACTERISTICS

Output Peak Current: $I_{\text{peak}}$ [mA]

Temperature: $T_a$ [°C]

Output Voltage: $V_o$ [V]

Control Voltage

Output Voltage

Time: $t$ [µS]

Input Voltage: $V_{\text{IN}}$ [V]

Output Current: $I_o$ [mA]

Load Transient Response

ON/OFF Transient Response without Load

ON/OFF Transient Response

Input Transient Response

Output Voltage: $V_o$ [V]

Time: $t$ [µS]

Output Current: $I_o$ [mA]

Input Voltage: $V_{\text{IN}}$ [V]

TYPICAL CHARACTERISTICS

Output Peak Current v.s. Temperature

$@: V_{\text{IN}} = 4.0V$

$C_o = 0.47 \mu F$ (Ceramic)

$C_p = 0.01 \mu F$

Temperature: $T_a$ [°C]

Output Voltage v.s. Temperature

$@: V_{\text{IN}} = 4.0V$

$V_o = 30mA$

$C_o = 0.47 \mu F$ (Ceramic)

$C_p = 0.01 \mu F$

Temperature: $T_a$ [°C]

ON/OFF Transient Response without Load

$@: V_{\text{IN}} = 4.0V$

$C_o = 0.47 \mu F$ (Ceramic)

$C_p = 0.01 \mu F$

$V_o = 30mA$

Temperature: $T_a$ [°C]

Output Voltage: $V_o$ [V]

Control Voltage

Output Voltage

Time: $t$ [µS]

Input Transient Response

$@: V_{\text{IN}} = 4.0V$

$C_o = 0.47 \mu F$ (Ceramic)

$C_p = 0.01 \mu F$

$V_o = 30mA$

Temperature: $T_a$ [°C]

Output Voltage: $V_o$ [V]

Time: $t$ [µS]

Output Current: $I_o$ [mA]

Input Voltage: $V_{\text{IN}}$ [V]
[CAUTION]

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