LOW NOISE 150mA LDO REGULATOR

OUTLINE

The R1126N Series are CMOS-based voltage regulator ICs with high output voltage accuracy, low supply current, low on Resistance, and low ripple rejection. Each of these ICs consists of a voltage reference unit, an error amplifier, resistor-net for voltage setting, a short current limit circuit, a chip enable circuit, and so on.

These ICs perform with low dropout voltage and the chip-enable function. The supply current at no load of this IC is only 10μA, and the line transient response and the load transient response of the R1126N Series are excellent, thus these ICs are very suitable for the power supply for hand-held communication equipment.

The supply current at no load of R1126x Series is remarkably reduced compared with R1114x Series. The mode change signal to reduce the supply current is not necessary. The output voltage accuracy is also improved. (±1.5)"

The output voltage of these ICs is fixed with high accuracy. Since the package for these ICs is SOT-23-5 therefore high density mounting of the ICs on boards is possible.

R1116N Series that a pin configuration differs from R1126N Series are available.

FEATURES

- Low Supply Current ......................................................... Typ. 10μA
- Standby Current ............................................................. Typ. 0.1μA
- Input Voltage Range ....................................................... 1.8V to 6.0V
- Output Voltage Range ..................................................... 1.5V to 4.0V
- Low Dropout Voltage ..................................................... Typ. 0.29V (IOUT=150mA, VOUT=2.8V)
- High Ripple Rejection ..................................................... Typ. 70dB (f=1kHz, VOUT=3.0V)
- High Output Voltage Accuracy ......................................... ±1.5% (1.5V ≤ VOUT ≤ 3.0V), ±2.0% (VOUT>3.0V)
- Low Temperature-Drift Coefficient of Output Voltage........ Typ. ±100ppm/°C
- Excellent Line Regulation ................................................. Typ. 0.02%/V
- Small Packages ............................................................. SOT-23-5
- Built-in Fold Back Protection Circuit ................................. Typ. 40mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC ... CIN=COUT=1.0μF (Ceramic)

APPLICATIONS

- Power source for portable communication equipment.
- Power source for portable music player.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.
R1126N

BLOCK DIAGRAMS

R1126Nxx1B

R1126Nxx1D

VDD

GND

VOUT

CE

Vref

Current Limit

VDD

GND

VOUT

CE

Vref

Current Limit

SELECTION GUIDE

The output voltage, version, and the taping type for the ICs can be selected at the user’s request.
The selection can be made with designating the part number as shown below:

R1126Nxx1x-xx ← Part Number

a b c d

Code | Contents
---|---
a | Designation of Package Type:

N: SOT-23-5

b | Setting Output Voltage (V_{out}): Stepwise setting with a step of 0.1V in the range of 1.5V to 4.0V is possible.

Exceptions: 2.85V = R1126N281x5, 1.85V = R1126N181x5
c | Designation of Active Type:

B: active high type

D: active high, with auto discharge
d | Designation of Taping Type:

Ex. TR (refer to Taping Specifications; TR type is the standard direction.)
PIN CONFIGURATION

SOT-23-5

(mark side)

PIN DESCRIPTION

• R1126N

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CE</td>
<td>Chip Enable Pin</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground Pin</td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td>No Connection</td>
</tr>
<tr>
<td>4</td>
<td>VOUT</td>
<td>Output pin</td>
</tr>
<tr>
<td>5</td>
<td>VDD</td>
<td>Input Pin</td>
</tr>
</tbody>
</table>

ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIN</td>
<td>Input Voltage</td>
<td>6.5</td>
<td>V</td>
</tr>
<tr>
<td>VCE</td>
<td>Input Voltage (CE Pin)</td>
<td>6.5</td>
<td>V</td>
</tr>
<tr>
<td>VOUT</td>
<td>Output Voltage</td>
<td>–0.3–Vin+0.3</td>
<td>V</td>
</tr>
<tr>
<td>IOUT</td>
<td>Output Current</td>
<td>160</td>
<td>mA</td>
</tr>
<tr>
<td>Po</td>
<td>Power Dissipation (SOT-23-5)</td>
<td>420</td>
<td>mW</td>
</tr>
<tr>
<td>Topt</td>
<td>Operating Temperature Range</td>
<td>–40–85</td>
<td>°C</td>
</tr>
<tr>
<td>Tstg</td>
<td>Storage Temperature Range</td>
<td>–55–125</td>
<td>°C</td>
</tr>
</tbody>
</table>

*) For Power Dissipation, please refer to PACKAGE INFORMATION to be described.
### ELECTRICAL CHARACTERISTICS

- **R1126Nxx1B/D**

#### Symbol | Item | Conditions | \( V_{\text{OUT}} = \text{Set } V_{\text{OUT}} + 1 \text{V} \) | Min. | Typ. | Max. | Unit
---|---|---|---|---|---|---|---
\( V_{\text{OUT}} \) | Output Voltage | \( 1 \text{mA} \leq I_{\text{OUT}} \leq 30 \text{mA} \) | \( 0.985 \) &times; | 1.015 &times; | V
\( I_{\text{OUT}} \) | Output Current | \( V_{\text{IN}} - V_{\text{OUT}} = 1.0 \text{V} \) | 150 | mA

#### \( \Delta V_{\text{OUT}} / \Delta I_{\text{OUT}} \) | Load Regulation | \( V_{\text{IN}} = \text{Set } V_{\text{OUT}} + 1 \text{V} \) | 28 | 55 | mV
---|---|---|---|---|---|---|---
1mA &leq; | I_{\text{OUT}} &leq; 150mA | 33 | 66 |
1.5V &leq; | V_{\text{OUT}} &leq; 2.0V | 35 | 80 |
2.0V &leq; | V_{\text{OUT}} &leq; 3.0V | 3.0V &leq; | V_{\text{OUT}} |

#### \( V_{\text{DIFF}} \) | Dropout Voltage | Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

#### \( I_{SS} \) | Supply Current | \( V_{\text{IN}} = \text{Set } V_{\text{OUT}} + 1 \text{V}, I_{\text{OUT}} = 0 \text{mA} \) | 10 | 18 | \( \mu \text{A} \)

#### \( I_{\text{STANDBY}} \) | Supply Current (Standby) | \( V_{\text{IN}} = \text{Set } V_{\text{OUT}} + 1 \text{V}, V_{\text{CE}} = V_{\text{DD}} \) | 0.1 | 1.0 | \( \mu \text{A} \)

#### \( \Delta V_{\text{OUT}} / \Delta V_{\text{IN}} \) | Line Regulation | \( I_{\text{OUT}} = 30 \text{mA} \) | 0.02 | 0.10 | %/V
---|---|---|---|---|---|---|---
Set \( V_{\text{OUT}} + 0.5 \text{V} \leq V_{\text{IN}} \leq 6.0 \text{V} \)

#### RR | Ripple Rejection | \( f=1 \text{kHz} \) | 70 | 53 | dB
---|---|---|---|---|---|---|---
\( f=10 \text{kHz} \) | Ripple 0.2Vp-p | \( V_{\text{IN}} = V_{\text{OUT}} = 1.0 \text{V}, I_{\text{OUT}} = 30 \text{mA} \)

#### \( V_{\text{IN}} \) | Input Voltage | 1.8 | 6.0 | V

#### \( \Delta V_{\text{OUT}} / \Delta T_{\text{OPT}} \) | Temperature Coefficient | \( I_{\text{OUT}} = 30 \text{mA} \) | ±100 | ppm | /°C
---|---|---|---|---|---|---|---
\( -40 \text{°C} \leq T_{\text{OPT}} \leq 85 \text{°C} \)

#### \( I_{\text{EM}} \) | Short Current Limit | \( V_{\text{OUT}} = 0 \text{V} \) | 40 | mA

#### \( I_{\text{PD}} \) | CE Pull-down Current | | 0.5 | \( \mu \text{A} \)

#### \( V_{\text{CEH}} \) | CE Input Voltage “H” | | 1.0 | 6.0 | V

#### \( V_{\text{CEL}} \) | CE Input Voltage “L” | | 0.0 | 0.3 | V

#### \( R_{\text{LOW}} \) | On Resistance of Nch Tr. for auto-discharge (Only for D version) | \( V_{\text{CE}} = 0 \text{V} \) | 70 | \( \Omega \)

#### Notes
- \( T_{\text{OPT}} = 25 \text{°C} \)
**ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE**

<table>
<thead>
<tr>
<th>Output Voltage $V_{OUT}$ (V)</th>
<th>Dropout Voltage $V_{DF}$ (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition</td>
<td>Typ.</td>
</tr>
<tr>
<td>$V_{OUT} = 1.5V$</td>
<td>0.54</td>
</tr>
<tr>
<td>$1.5V &lt; V_{OUT} \leq 1.6V$</td>
<td>0.50</td>
</tr>
<tr>
<td>$1.6V &lt; V_{OUT} \leq 1.7V$</td>
<td>0.46</td>
</tr>
<tr>
<td>$1.7V &lt; V_{OUT} \leq 2.0V$</td>
<td>0.44</td>
</tr>
<tr>
<td>$2.0V &lt; V_{OUT} \leq 2.7V$</td>
<td>0.37</td>
</tr>
<tr>
<td>$2.7V &lt; V_{OUT} \leq 4.0V$</td>
<td>0.29</td>
</tr>
</tbody>
</table>

$\text{Topt} = 25^\circ\text{C}$

**TYPICAL APPLICATIONS**

(External Components)

- $C_2$ Ceramic 1.0μF  Ex. Murata GRM155B30J105KE18B
  Kyocera CM05X5R105K06AB
- $C_1$ Ceramic 1.0μF
**TEST CIRCUITS**

![Standard Test Circuit](image1)

C1=Ceramic 1.0μF  
C2=Ceramic 1.0μF

**Fig.1 Standard test Circuit**

![Supply Current Test Circuit](image2)

C1=Ceramic 1.0μF  
C2=Ceramic 1.0μF

**Fig.2 Supply Current Test Circuit**

![Ripple Rejection, Line Transient Response Test Circuit](image3)

C2=Ceramic 1.0μF

**Fig.3 Ripple Rejection, Line Transient Response Test Circuit**
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (Topt=25°C)

R1126N151x

R1126N281x

R1126N401x

2) Output Voltage vs. Input Voltage (Topt=25°C)

R1126N151x

R1126N281x
3) Supply Current vs. Input Voltage (Topt=25°C)
4) Output Voltage vs. Temperature

- R1126N151x
- R1126N281x
- R1126N401x

5) Supply Current vs. Temperature

- R1126N151x
- R1126N281x
6) Dropout Voltage vs. Temperature

**R1126N151x**

- Dropout Voltage VDIF (mV)
- Output Current IOUT (mA)

**R1126N161x**

- Dropout Voltage VDIF (mV)
- Output Current IOUT (mA)

**R1126N171x**

- Dropout Voltage VDIF (mV)
- Output Current IOUT (mA)

**R1126N181x**

- Dropout Voltage VDIF (mV)
- Output Current IOUT (mA)
7) Dropout Voltage vs. Set Output Voltage (Topt=25°C)
8) Ripple Rejection vs. Input Bias Voltage (Topt=25°C, CIN = none, Cout = 1μF)

R1126N281x

Ripple Vp-p=0.2V, Iout=1mA

Ripple Vp-p=0.5V, Iout=1mA

R1126N281x

Ripple Vp-p=0.2V, Iout=30mA

Ripple Vp-p=0.5V, Iout=30mA

R1126N281x

Ripple Vp-p=0.2V, Iout=50mA

Ripple Vp-p=0.5V, Iout=50mA
9) Ripple Rejection vs. Frequency (C_{in}=none)

**R1126N151x**

- $V_{IN}=2.7\,V_{DC}+0.5\,V_{p-p}, C_{OUT}=1\,\mu F$

**R1126N281x**

- $V_{IN}=3.8\,V_{DC}+0.5\,V_{p-p}, C_{OUT}=1\,\mu F$

**R1126N401x**

- $V_{IN}=5\,V_{DC}+0.5\,V_{p-p}, C_{OUT}=1\,\mu F$

- $I_{OUT}=1\,mA$
- $I_{OUT}=30\,mA$
- $I_{OUT}=50\,mA$
- $I_{OUT}=150\,mA$

**R1126N151x**

- $V_{IN}=2.7\,V_{DC}+0.5\,V_{p-p}, C_{OUT}=2.2\,\mu F$

**R1126N281x**

- $V_{IN}=3.8\,V_{DC}+0.5\,V_{p-p}, C_{OUT}=2.2\,\mu F$

**R1126N401x**

- $V_{IN}=5\,V_{DC}+0.5\,V_{p-p}, C_{OUT}=2.2\,\mu F$

- $I_{OUT}=1\,mA$
- $I_{OUT}=30\,mA$
- $I_{OUT}=50\,mA$
- $I_{OUT}=150\,mA$
10) Input Transient Response (I_{OUT}=30mA, C_{IN}= none, t_{r}=t_{f}=5\mu s, C_{OUT}= Ceramic 1\mu F)

R1126N151x

R1126N281x

R1126N401x

11) Load Transient Response (t_{r}=t_{f}=0.5\mu s, C_{IN}=Ceramic 1\mu F)

R1126N151x

\(V_{IN}=2.5V, C_{OUT}=Ceramic 1.0\mu F\)

R1126N151x

\(V_{IN}=2.5V, C_{OUT}=Ceramic 2.2\mu F\)
R1126N

12) Turn-on/off speed with CE pin (D version) (C\textsubscript{IN}=Ceramic 1.0\,\mu\text{F}, C\text{OUT}=Ceramic 1.0\,\mu\text{F})

\begin{align*}
\text{R1126N401x} & \\
V_{IN}=5.0\,V, C\text{OUT}=\text{Ceramic 1.0}\,\mu\text{F} & \\
\text{Output Voltage V\textsubscript{OUT}(V)} & \\
\text{Output Current I\textsubscript{OUT}(mA)} & \\
\text{Time t(\mu s)} & \\
\end{align*}

\begin{align*}
\text{R1126N401x} & \\
V_{IN}=5.0\,V, C\text{OUT}=\text{Ceramic 2.2}\,\mu\text{F} & \\
\text{Output Voltage V\textsubscript{OUT}(V)} & \\
\text{Output Current I\textsubscript{OUT}(mA)} & \\
\text{Time t(\mu s)} & \\
\end{align*}

\begin{align*}
\text{R1126N401x} & \\
V_{IN}=5.0\,V, C\text{OUT}=\text{Ceramic 1.0}\,\mu\text{F} & \\
\text{Output Voltage V\textsubscript{OUT}(V)} & \\
\text{Output Current I\textsubscript{OUT}(mA)} & \\
\text{Time t(\mu s)} & \\
\end{align*}

\begin{align*}
\text{R1126N401x} & \\
V_{IN}=5.0\,V, C\text{OUT}=\text{Ceramic 2.2}\,\mu\text{F} & \\
\text{Output Voltage V\textsubscript{OUT}(V)} & \\
\text{Output Current I\textsubscript{OUT}(mA)} & \\
\text{Time t(\mu s)} & \\
\end{align*}

\begin{align*}
\text{R1126N151D} & \\
V_{IN}=2.5\,V & \\
\text{CE Input Voltage V\textsubscript{CE}(V)} & \\
\text{Output Voltage V\textsubscript{OUT}(V)} & \\
\text{Time t(\mu s)} & \\
\end{align*}

\begin{align*}
\text{R1126N151D} & \\
V_{IN}=2.5\,V & \\
\text{CE Input Voltage V\textsubscript{CE}(V)} & \\
\text{Output Voltage V\textsubscript{OUT}(V)} & \\
\text{Time t(\mu s)} & \\
\end{align*}
TECHNICAL NOTES

(External Components)
C2 Ceramic 1.0μF   Ex. Murata GRM155B30J105KE18B
                   Kyocera CM05X5R105K06AB
C1 Ceramic 1.0μF

When using these ICs, consider the following points:

1. Mounting on PCB
   Make VDD and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result.
   Connect a capacitor with a capacitance value as much as 1.0μF or more as C1 between VDD and GND pin, and
   as close as possible to the pins.
   Set external components, especially the output capacitor, as close as possible to the ICs, and make wiring as
   short as possible.

2. Phase Compensation
   In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For
   this purpose, use a capacitor C2 with good frequency characteristics and ESR (Equivalent Series Resistance).
   (Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for
   phase compensation, the operation might be unstable. Because of this, test these ICs with as same external
   components as ones to be used on the PCB.)

   If you use a tantalum type capacitor and ESR value of the capacitor is large, output might be unstable.
   Evaluate your circuit with considering frequency characteristics.
   Depending on the capacitor size, manufacturer, and part number, the bias characteristics and temperature
   characteristics are different. Evaluate the circuit with actual using capacitors.
ESR vs. Output Current

When using these ICs, consider the following points:

The relations between $I_{\text{OUT}}$ (Output Current) and ESR of an output capacitor are shown below. The conditions when the white noise level is under $40\mu\text{V}$ (Avg.) are marked as the hatched area in the graph.

**Measurement conditions**

$V_{\text{IN}} = V_{\text{OUT}} + 1\text{V}$

$C_{\text{OUT}}$: GRM155B30J105KE18B

Frequency Band: 10Hz to 2MHz

Temperature: $-40\degree\text{C}$ to $25\degree\text{C}$
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Ricoh awarded ISO 14001 certification.
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