OUTLINE

The R1180x is a CMOS-based voltage regulator IC with high output voltage accuracy, extremely low supply current, and low ON-resistance. This IC consists of a voltage reference unit, an error amplifier, resistor-net for voltage setting, a current limit circuit which prevents the destruction by excess current, and so on. The output voltage is fixed with high accuracy. B version has a chip enable pin, therefore ultra-low consumption current standby mode can be realized with the pin.

The R1180x is available in SOT-23-5 package which is possible to mount at high density.

FEATURES

- Input Voltage (Maximum Rating) ......................... 1.7V to 6.0V (6.5V)
- Supply Current .................................................. Typ. 1.0μA
  (Except the current through CE pull-down circuit)
- Standby Mode .................................................. Typ. 0.1μA
- Dropout Voltage ............................................ Typ. 0.25V (I_{out}=150mA 3.0V Output type)
- Temperature-Drift Coefficient of Output Voltage .. Typ. ±100ppm/°C
- Line Regulation ............................................... Typ. 0.05%/V
- Output Voltage Accuracy ................................. ±2.0%
- Packages ...................................................... SOT-23-5
- Output Voltage Range ................................. 1.2V to 3.6V (0.1V steps)
- Built-in Fold Back Protection Circuit .................. Typ. 40mA (Current at short mode)
- Recommended Ceramic Capacitor to IC .......... 0.1μF or more

APPLICATIONS

- Power source for car accessories including car audio equipment, car navigation system, and ETC system.
- Power source for control units including EV inverter and charge control.
**SELECTED GUIDE**

The output voltage, CE pin polarity, package, etc. for the ICs can be selected at the user’s request.

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Package</th>
<th>Quantity per Reel</th>
<th>Pb Free</th>
<th>Halogen Free</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1180Nxx1*-TR-#E</td>
<td>SOT-23-5</td>
<td>3,000 pcs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

xx: The output voltage can be designated in the range from 1.2V(12) to 3.6V(36) in 0.1V steps.

* : CE pin polarity is options as follows.
- (B) "H" Active
- (C) without CE pin

# : Specify the automotive class code.

<table>
<thead>
<tr>
<th>Operating Temperature Range</th>
<th>Guaranteed Specs Temperature Range</th>
<th>Screening</th>
</tr>
</thead>
<tbody>
<tr>
<td>A  -40°C to 85°C</td>
<td>25°C</td>
<td>High Temperature</td>
</tr>
<tr>
<td>H  -40°C to 85°C</td>
<td>25°C</td>
<td>High and Low Temperature</td>
</tr>
</tbody>
</table>

Note: The product with "H" class code supports the device with CE pin ("H" Active) only.
(R1180Nxx1B-TR-HE)
PIN DESCRIPTIONS

**SOT-23-5**

![Pin Diagram]

- **Pin No** | **Symbol** | **Pin Description**
- 1  | $V_{DD}$ | Input Pin
- 2  | GND | Ground Pin
- 3  | CE or NC | Chip Enable Pin or No Connection
- 4  | NC | No Connection
- 5  | $V_{OUT}$ | Output pin
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 to V&lt;sub&gt;IN&lt;/sub&gt;+0.3</td>
<td>V</td>
</tr>
<tr>
<td>I&lt;sub&gt;OUT&lt;/sub&gt;</td>
<td>Output Current</td>
<td>180</td>
<td>mA</td>
</tr>
<tr>
<td>PD</td>
<td>Power Dissipation (SOT-23-5)&lt;sup&gt;*&lt;/sup&gt;</td>
<td>525</td>
<td>mW</td>
</tr>
<tr>
<td>Tj</td>
<td>Junction Temperature</td>
<td>-40 to 150</td>
<td>°C</td>
</tr>
<tr>
<td>Tstg</td>
<td>Storage Temperature Range</td>
<td>-55 to 150</td>
<td>°C</td>
</tr>
</tbody>
</table>

<sup>*</sup> For Power Dissipation, please refer to PACKAGE INFORMATION.

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage and may degrade the life time and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum rating is not assured.

RECOMMENDED OPERATING 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>1.7 to 6.0</td>
<td>V</td>
</tr>
<tr>
<td>Ta</td>
<td>Operating Temperature Range</td>
<td>-40 to 85</td>
<td>°C</td>
</tr>
</tbody>
</table>

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating ratings. The semiconductor devices cannot operate normally over the recommended operating ratings, even if they are used over such ratings by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating ratings.
# ELECTRICAL CHARACTERISTICS

**R1180xxx1B/C**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{\text{OUT}}$</td>
<td>Output Voltage</td>
<td>$V_{\text{IN}}=\text{Set }V_{\text{OUT}}+1V$&lt;br&gt;$1\text{mA} \leq I_{\text{OUT}} \leq 30\text{mA}$</td>
<td>×0.980</td>
<td>×1.020</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$I_{\text{OUT}}$</td>
<td>Output Current</td>
<td>$V_{\text{IN}}-V_{\text{OUT}}=1.0V(V_{\text{OUT}} \geq 1.5V)$&lt;br&gt;$V_{\text{IN}}=2.4V(V_{\text{OUT}}&lt;1.5V)$</td>
<td>150</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>$\Delta V_{\text{OUT}}/\Delta I_{\text{OUT}}$</td>
<td>Load Regulation</td>
<td>$V_{\text{IN}}-V_{\text{OUT}}=1.0V(V_{\text{OUT}} \geq 1.5V)$&lt;br&gt;$V_{\text{IN}}=2.4V(V_{\text{OUT}}&lt;1.5V)$&lt;br&gt;$1\mu\text{A} \leq I_{\text{OUT}} \leq 150\text{mA}$</td>
<td>20</td>
<td>40</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>$V_{\text{DIF}}$</td>
<td>Dropout Voltage</td>
<td>$I_{\text{OUT}}=150\text{mA}$</td>
<td></td>
<td></td>
<td></td>
<td>Refer to the Product-specific Electrical Characteristics.</td>
</tr>
<tr>
<td>$I_{\text{SS}}$</td>
<td>Supply Current</td>
<td>$V_{\text{IN}}-V_{\text{OUT}}=1.0V,I_{\text{OUT}}=0\text{mA}$</td>
<td>1.0</td>
<td>1.5</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>$I_{\text{standby}}$</td>
<td>Supply Current (Standby)</td>
<td>$V_{\text{IN}}-V_{\text{OUT}}=1.0V,V_{\text{CE}}=\text{GND}$</td>
<td>0.1</td>
<td>1.0</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>$\Delta V_{\text{OUT}}/\Delta V_{\text{IN}}$</td>
<td>Line Regulation</td>
<td>$I_{\text{OUT}}=30\text{mA}$&lt;br&gt;$V_{\text{OUT}}+0.5V \leq V_{\text{IN}} \leq 6.0V$&lt;br&gt;($V_{\text{OUT}} \geq 1.5V$)&lt;br&gt;$2.0V \leq V_{\text{IN}} \leq 6.0V$&lt;br&gt;(1.2V $\leq V_{\text{OUT}} \leq 1.4V$)</td>
<td>0.05</td>
<td>0.20</td>
<td></td>
<td>%/V</td>
</tr>
<tr>
<td>$V_{\text{IN}}$</td>
<td>Input Voltage</td>
<td></td>
<td>1.7</td>
<td>6.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$\Delta V_{\text{OUT}}/\Delta T_{\text{a}}$</td>
<td>Output Voltage Temperature Coefficient</td>
<td>$I_{\text{OUT}}=30\text{mA}$&lt;br&gt;$-40^\circ\text{C} \leq T_{\text{a}} \leq 85^\circ\text{C}$</td>
<td>±100</td>
<td></td>
<td></td>
<td>ppm /°C</td>
</tr>
<tr>
<td>$I_{\text{SC}}$</td>
<td>Short Current Limit</td>
<td>$V_{\text{OUT}}=0V$</td>
<td>40</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>$I_{\text{PD}}$</td>
<td>CE Pull-down Constant Current (R1180xxx1B)</td>
<td></td>
<td>0.35</td>
<td></td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>$V_{\text{CEH}}$</td>
<td>CE Input Voltage &quot;H&quot; (R1180xxx1B)</td>
<td></td>
<td>1.2</td>
<td>6.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{\text{CEL}}$</td>
<td>CE Input Voltage &quot;L&quot; (R1180xxx1B)</td>
<td></td>
<td>0.0</td>
<td>0.3</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

*Ta=25°C*
<table>
<thead>
<tr>
<th>Product Name</th>
<th>V\text{OUT} [V]</th>
<th>V\text{DIFF} [V]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MIN.</td>
<td>TYP.</td>
</tr>
<tr>
<td>R1180N121x</td>
<td>1.176</td>
<td>1.200</td>
</tr>
<tr>
<td>R1180N131x</td>
<td>1.274</td>
<td>1.300</td>
</tr>
<tr>
<td>R1180N141x</td>
<td>1.372</td>
<td>1.400</td>
</tr>
<tr>
<td>R1180N151x</td>
<td>1.470</td>
<td>1.500</td>
</tr>
<tr>
<td>R1180N161x</td>
<td>1.568</td>
<td>1.600</td>
</tr>
<tr>
<td>R1180N171x</td>
<td>1.666</td>
<td>1.700</td>
</tr>
<tr>
<td>R1180N181x</td>
<td>1.764</td>
<td>1.800</td>
</tr>
<tr>
<td>R1180N191x</td>
<td>1.862</td>
<td>1.900</td>
</tr>
<tr>
<td>R1180N201x</td>
<td>1.960</td>
<td>2.000</td>
</tr>
<tr>
<td>R1180N211x</td>
<td>2.058</td>
<td>2.100</td>
</tr>
<tr>
<td>R1180N221x</td>
<td>2.156</td>
<td>2.200</td>
</tr>
<tr>
<td>R1180N231x</td>
<td>2.254</td>
<td>2.300</td>
</tr>
<tr>
<td>R1180N241x</td>
<td>2.352</td>
<td>2.400</td>
</tr>
<tr>
<td>R1180N251x</td>
<td>2.450</td>
<td>2.500</td>
</tr>
<tr>
<td>R1180N261x</td>
<td>2.548</td>
<td>2.600</td>
</tr>
<tr>
<td>R1180N271x</td>
<td>2.646</td>
<td>2.700</td>
</tr>
<tr>
<td>R1180N281x</td>
<td>2.744</td>
<td>2.800</td>
</tr>
<tr>
<td>R1180N291x</td>
<td>2.842</td>
<td>2.900</td>
</tr>
<tr>
<td>R1180N301x</td>
<td>2.940</td>
<td>3.000</td>
</tr>
<tr>
<td>R1180N311x</td>
<td>3.038</td>
<td>3.100</td>
</tr>
<tr>
<td>R1180N321x</td>
<td>3.136</td>
<td>3.200</td>
</tr>
<tr>
<td>R1180N331x</td>
<td>3.234</td>
<td>3.300</td>
</tr>
<tr>
<td>R1180N341x</td>
<td>3.332</td>
<td>3.400</td>
</tr>
<tr>
<td>R1180N351x</td>
<td>3.430</td>
<td>3.500</td>
</tr>
<tr>
<td>R1180N361x</td>
<td>3.528</td>
<td>3.600</td>
</tr>
</tbody>
</table>

Product-specific Electrical Characteristics

Topt=25°C
TYPICAL APPLICATION

External Parts Example:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>1.0µF (Ceramic)</td>
</tr>
<tr>
<td>C2</td>
<td>0.1µF (Ceramic)</td>
</tr>
</tbody>
</table>

TECHNICAL NOTES

When using these ICs, consider the following points:

Phase Compensation

In this device, 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 this device with as same external components as ones to be used on the PCB.)

PCB Layout

Ensure the V_{DD} and GND lines are sufficiently robust. If their impedance is too high, noise pickup or unstable operation may result. Connect a 1.0µF input capacitor (C1) between the V_{DD} and GND pins, and as close as possible to the pins. Connect C2 as close as possible to the IC to make the wiring as short as possible. Please refer to the Basic Circuit Diagram as above.
TYPICAL APPLICATION FOR IC CHIP BREAKDOWN PREVENTION

Ex. R1180x Circuit Diagram

When a sudden surge of electrical current travels along the VOUT pin and GND due to a short-circuit, electrical resonance of a circuit involving an output capacitor (COUT) and a short circuit inductor generates a negative voltage and may damage the device or the load devices. Connecting a schottky diode (D1) between the VOUT pin and GND has the effect of preventing damage to them.
PACKAGE INFORMATION

POWER DISSIPATION (SOT-23-5)

Power Dissipation (P_D), which indicates the P_D of SOT-23-6 package as a substitute, depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

**Measurement Conditions**

<table>
<thead>
<tr>
<th></th>
<th>Standard Test Land Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Mounting on Board (Wind velocity=0m/s)</td>
</tr>
<tr>
<td>Board Material</td>
<td>Glass cloth epoxy plastic (Double sided)</td>
</tr>
<tr>
<td>Board Dimensions</td>
<td>40mm x 40mm x 1.6mm</td>
</tr>
<tr>
<td>Copper Ratio</td>
<td>Top side: Approx. 50%, Back side: Approx. 50%</td>
</tr>
<tr>
<td>Through-holes</td>
<td>Ø 0.5mm * 44pcs</td>
</tr>
</tbody>
</table>

**Measurement Result** (Ta=25°C, Tjmax=150°C)

<table>
<thead>
<tr>
<th></th>
<th>Standard Test Land Pattern</th>
<th>Free Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Dissipation</td>
<td>525mW</td>
<td>310mW</td>
</tr>
<tr>
<td>Thermal Resistance</td>
<td>θja = (150-25°C)/0.525W = 238°C/W</td>
<td>400°C/W</td>
</tr>
</tbody>
</table>

![Diagram](image_url)
PACKAGE DIMENSIONS (SOT-23-5)

MARK SPECIFICATION (SOT-23-5)

①②③: Product Code
④⑤: Lot Number  ⋯ Alphanumeric Serial Number
TEST CIRCUITS

**Standard Test Circuit**

**Supply Current Test Circuit**

**Ripple Rejection, Line Transient Response Test Circuit**
TYPICAL CHARACTERISTICS

Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

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

![Output Voltage vs. Output Current for R1180x121x](image1)

![Output Voltage vs. Output Current for R1180x281x](image2)

![Output Voltage vs. Output Current for R1180x361x](image3)

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

![Output Voltage vs. Input Voltage for R1180x121x](image4)

![Output Voltage vs. Input Voltage for R1180x281x](image5)
3) Dropout Voltage vs. Output Current
4) Output Voltage vs. Temperature (I_{OUT}=30mA)

R1180x121x (V_{IN}=2.2V)

\[ \begin{array}{|c|c|}
\hline
\text{Temperature } T_a [^\circ C] & \text{Output Voltage } V_{OUT} [V] \\
\hline
-40 & 1.16 \\
-25 & 1.17 \\
0 & 1.18 \\
25 & 1.19 \\
50 & 1.20 \\
75 & 1.21 \\
85 & 1.22 \\
\hline
\end{array} \]

R1180x281x (V_{IN}=3.8V)

\[ \begin{array}{|c|c|}
\hline
\text{Temperature } T_a [^\circ C] & \text{Output Voltage } V_{OUT} [V] \\
\hline
-40 & 2.74 \\
-25 & 2.76 \\
0 & 2.78 \\
25 & 2.80 \\
50 & 2.82 \\
75 & 2.84 \\
85 & 2.86 \\
\hline
\end{array} \]

R1180x361x (V_{IN}=4.6V)

\[ \begin{array}{|c|c|}
\hline
\text{Temperature } T_a [^\circ C] & \text{Output Voltage } V_{OUT} [V] \\
\hline
-40 & 3.52 \\
-25 & 3.54 \\
0 & 3.56 \\
25 & 3.58 \\
50 & 3.60 \\
75 & 3.62 \\
85 & 3.64 \\
\hline
\end{array} \]

5) Supply Current vs. Input Voltage (T_a=25^\circ C)

R1180x121x

\[ \begin{array}{|c|c|}
\hline
\text{Input Voltage } V_{IN} [V] & \text{Supply Current } I_{SS} [\mu A] \\
\hline
0 & 0.0 \\
1 & 0.2 \\
2 & 0.4 \\
3 & 0.6 \\
4 & 0.8 \\
5 & 1.0 \\
6 & 1.2 \\
\hline
\end{array} \]

R1180x281x

\[ \begin{array}{|c|c|}
\hline
\text{Input Voltage } V_{IN} [V] & \text{Supply Current } I_{SS} [\mu A] \\
\hline
0 & 0.0 \\
1 & 0.2 \\
2 & 0.4 \\
3 & 0.6 \\
4 & 0.8 \\
5 & 1.0 \\
6 & 1.2 \\
\hline
\end{array} \]
6) Supply Current vs. Temperature

**R1180x121x (V_{IN}=2.2V)**

**R1180x281x (V_{IN}=3.8V)**

**R1180x361x (V_{IN}=4.6V)**
7) Dropout Voltage vs. Set Output Voltage (Ta=25°C)

![Dropout Voltage vs. Set Output Voltage Graph]

8) Ripple Rejection vs. Frequency (C1 =none)

**R1180x121x**

![Ripple Rejection vs. Frequency Graph for R1180x121x]

**R1180x281x**

![Ripple Rejection vs. Frequency Graph for R1180x281x]**
9) Ripple Rejection vs. Input Bias Voltage (Ta=25°C, C1=none, C2=Ceramic0.1μF)

R1180x281x (Iout=1mA)

R1180x281x (Iout=30mA)

R1180x281x (Iout=50mA)
10) Input Transient Response (C1=none, tr=tf=5μs)

**R1180x281x**

- Input Voltage: VIN
- Output Voltage: VOUT
- Time: T[μs]
- Input Current: IOUT = 1mA
- Capacitance: COUT = Ceramic1μF

**R1180x281x**

- Input Voltage: VIN
- Output Voltage: VOUT
- Time: T[μs]
- Input Current: IOUT = 30mA
- Capacitance: COUT = Ceramic0.1μF

**R1180x281x**

- Input Voltage: VIN
- Output Voltage: VOUT
- Time: T[μs]
- Input Current: IOUT = 30mA
- Capacitance: COUT = Ceramic0.47μF
11) Load Transient Response (\(\text{tr}_{\text{f}}=0.5\mu\text{s} \ \text{V}_{\text{IN}}=3.8\text{V}\))

R1180x281x

R1180x281x

R1180x281x
R1180x281x

Output Voltage $V_{OUT}$ [V] vs. Time $T$ [$\mu$s]

- Output Current
- Output Voltage

$C_{OUT} = \text{Ceramic} \ 1.0 \mu F$
ESR vs. Output Current

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 $40\mu V \ \text{(Avg.)}$ are marked as the hatched area in the graph.

<Measurement conditions>
(1) $V_{\text{IN}}=V_{\text{OUT}}+1V$
(2) Frequency Band: 10Hz to 2MHz (BW=30Hz)
(3) Temperature: $-40^\circ \text{C}$ to $85^\circ \text{C}$
1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to Ricoh sales representatives for the latest information thereon.

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3. Please be sure to take any necessary formalities under relevant laws or regulations before exporting or otherwise taking out of your country the products or the technical information described herein.

4. The technical information described in this document shows typical characteristics and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under Ricoh’s or any third party’s intellectual property rights or any other rights.

5. The products in this document are designed for automotive applications. However, when using the products for automotive applications, please make sure to contact Ricoh sales representative in advance due to confirming the quality level.

6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.

7. Anti-radiation design is not implemented in the products described in this document.

8. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.

9. WL CSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.

10. There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used.

In the case of recognizing the marking characteristic with AOI, please contact Ricoh sales or our distributor before attempting to use AOI.

11. Please contact Ricoh sales representatives should you have any questions or comments concerning the products or the technical information.

Ricoh is committed to reducing the environmental loading materials in electrical devices with a view to contributing to the protection of human health and the environment. Ricoh has been providing RoHS compliant products since April 1, 2006 and Halogen-free products since April 1, 2012.

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