KA278RXXC-Series
2A Output Low Dropout Voltage Regulators

Features

KA278RXXC-series (33/05/51/09/12)
- 2A/3.3V, 5V, 5.1V, 9V, 12V output low dropout voltage regulator
- TO-220 full-mold package (4pin)
- Overcurrent protection, thermal shutdown
- Overvoltage protection, short circuit protection
- With output disable function

KA278RA05C
- Nominal 5V output without adjusting
- Output adjustable between 1.25V and 32V
- 2A output low dropout voltage regulator
- TO-220 full-mold package (4pin)
- Overcurrent protection, thermal shutdown
- Overvoltage protection, short circuit protection

Description

The KA278RXXC is a low-dropout voltage regulator suitable for various electronic equipments. It provides constant voltage power source with TO-220-4 lead full mold package. The dropout voltage of KA278RXXC is below 0.5V in full rated current (2A). This regulator has various functions such as a peak current protection, a thermal shutdown, an overvoltage protection.

Internal Block Diagram

THERMAL SHUTDOWN
BANDGAP REFERENCE
OVERVOLTAGE PROTECTION
SOA PROTECTION
SHORTCIRCUIT PROTECTION

KA278R33/05/51/09/12C

(THERMAL SHUTDOWN)
(BANDGAP REFERENCE)
(OVERVOLTAGE PROTECTION)
(SOA PROTECTION)
(SHORTCIRCUIT PROTECTION)

KA278RA05C

1. Vin 2. Vo 3. GND 4. Vdis - KA278RXXC(33/05/51/09/12)
## Absolute Maximum Ratings

**KA278RXXC, KA278RA05C**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>Vin</td>
<td>35</td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Disable voltage</td>
<td>KA278RXXC</td>
<td>Vdis</td>
<td>35</td>
<td>-</td>
</tr>
<tr>
<td>Output current</td>
<td>Io</td>
<td>2.0</td>
<td>A</td>
<td>-</td>
</tr>
<tr>
<td>Power dissipation 1</td>
<td>Pd1</td>
<td>1.5</td>
<td>W</td>
<td>No heatsink</td>
</tr>
<tr>
<td>Power dissipation 2</td>
<td>Pd2</td>
<td>15</td>
<td>W</td>
<td>With heatsink</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>Tj</td>
<td>150</td>
<td>°C</td>
<td>-</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>Topr</td>
<td>-20 ~ 80</td>
<td>°C</td>
<td>-</td>
</tr>
<tr>
<td>Thermal resistance, junction-to case (note2)</td>
<td>Rθjc</td>
<td>2.9</td>
<td>°C/W</td>
<td>-</td>
</tr>
<tr>
<td>Thermal resistance, junction-to-air (note2)</td>
<td>Rθja</td>
<td>48.51</td>
<td>°C/W</td>
<td>-</td>
</tr>
</tbody>
</table>
### Electrical Characteristics

(Vin=Note3, Io=1.0A, Ta=25°C, unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Output voltage</td>
<td>KA278R33C</td>
<td>Vo</td>
<td>3.22</td>
<td>3.3</td>
<td>3.38</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>KA278R05C</td>
<td>4.88</td>
<td>5</td>
<td>5.12</td>
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<tr>
<td></td>
<td>KA278R51C</td>
<td>4.98</td>
<td>5.1</td>
<td>5.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>KA278R09C</td>
<td>8.78</td>
<td>9</td>
<td>9.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>KA278R12C</td>
<td>11.7</td>
<td>12</td>
<td>12.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load regulation V&lt;sub&gt;load&lt;/sub&gt;</td>
<td>R&lt;sub&gt;load&lt;/sub&gt;</td>
<td>5mA &lt; Io &lt; 2A</td>
<td>-</td>
<td>0.1</td>
<td>2.0</td>
<td>%</td>
</tr>
<tr>
<td>Line regulation V&lt;sub&gt;line&lt;/sub&gt;</td>
<td>R&lt;sub&gt;line&lt;/sub&gt;</td>
<td>Note4</td>
<td>-</td>
<td>0.5</td>
<td>2.5</td>
<td>%</td>
</tr>
<tr>
<td>Ripple rejection ratio RR</td>
<td>RR</td>
<td>Note1</td>
<td>45</td>
<td>55</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Dropout voltage V&lt;sub&gt;drop&lt;/sub&gt;</td>
<td>V&lt;sub&gt;drop&lt;/sub&gt;</td>
<td>Io = 2A</td>
<td>-</td>
<td>-</td>
<td>0.5</td>
<td>V</td>
</tr>
<tr>
<td>Disable voltage high</td>
<td>KA278RXXC</td>
<td>V&lt;sub&gt;disH&lt;/sub&gt;</td>
<td>2.0</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Disable voltage low</td>
<td>KA278RXXC</td>
<td>V&lt;sub&gt;disL&lt;/sub&gt;</td>
<td>-</td>
<td>-</td>
<td>0.8</td>
<td>V</td>
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<tr>
<td>Disable bias current high</td>
<td>KA278RXXC</td>
<td>I&lt;sub&gt;disH&lt;/sub&gt;</td>
<td>-</td>
<td>-</td>
<td>20</td>
<td>µA</td>
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<td>Disable bias current low</td>
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<td>I&lt;sub&gt;disL&lt;/sub&gt;</td>
<td>-</td>
<td>-</td>
<td>-0.4</td>
<td>mA</td>
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<tr>
<td>Quiescent current</td>
<td>KA278RXXC</td>
<td>I&lt;sub&gt;q&lt;/sub&gt;</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>mA</td>
</tr>
<tr>
<td>Reference voltage</td>
<td>KA278RA05C</td>
<td>V&lt;sub&gt;ref&lt;/sub&gt;</td>
<td>1.24</td>
<td>1.27</td>
<td>1.30</td>
<td>V</td>
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</tbody>
</table>

**Note:**
1. These parameters, although guaranteed, are not 100% tested in production.
   - Pneumatic heat sink fixture.
   - Clamping pressure 60psi through 12mm diameter cylinder.
   - Thermal grease applied between PKG and heat sink fixture.
3. KA278R33C : Vin = 5V
   KA278R05C : Vin = 7V
   KA278R09C : Vin = 11V
   KA278R12C : Vin = 15V
4. KA278R33C : Vin = 4 to 10V
   KA278R05C, KA278R51C : Vin=6 to 12V
   KA278R09C : Vin=10 to 25V
   KA278R12C : Vin = 13V to 29V
Typical Performance Characteristics
KA278R33C

Figure 1. Output Voltage vs. Input Voltage

Figure 2. Quiescent Current vs. Input Voltage

Figure 3. Output Voltage vs. Disable Voltage

Figure 4. Output Voltage vs. Temperature(Tj)

Figure 5. Quiescent Current vs. Temperature(Tj)

Figure 6. Dropout Voltage vs. Junction Temperature
Typical Performance Characteristics (Continued)

Figure 7. Power Dissipation vs. Temperature (Tj)

Figure 8. Overcurrent Protection Characteristics (Typical Value)

Figure 9. Output Peak Current vs. Input-Output Differential Voltage
Typical Performance Characteristics (Continued)

KA278R05C

Figure 1. Output Voltage vs. Input Voltage

Figure 2. Quiescent Current vs. Input Voltage

Figure 3. Output Voltage vs. Disable Voltage

Figure 4. Output Voltage vs. Temperature (Tj)

Figure 5. Quiescent Current vs. Temperature (Tj)

Figure 6. Dropout Voltage vs. Junction Temperature
Typical Performance Characteristics (Continued)

Figure 7. Power Dissipation vs. Temperature\(T_j\)

Figure 8. Overcurrent Protection Characteristics (Typical Value)

Figure 9. Output Peak Current vs. Input-Output Differential Voltage
Typical Performance Characteristics (Continued)

KA278R51C

Figure 1. Output Voltage vs. Input Voltage

Figure 2. Quiescent Current vs. Input Voltage

Figure 3. Output Voltage vs. Disable Voltage

Figure 4. Output Voltage vs. Temperature(Tj)

Figure 5. Quiescent Current vs. Temperature(Tj)

Figure 6. Dropout Voltage vs. Junction Temperature
Typical Performance Characteristics (Continued)

![Power Dissipation vs. Temperature (Tj)](image1)

**Figure 7.** Power Dissipation vs. Temperature (Tj)

![Overcurrent Protection Characteristics](image2)

**Figure 8.** Overcurrent Protection Characteristics (Typical value)

![Ripple Rejection vs. Input Ripple Frequency](image3)

**Figure 9.** Ripple Rejection vs. Input Ripple Frequency

![Line Transient Response](image4)

**Figure 10.** Line Transient Response

![Load Transient Response](image5)

**Figure 11.** Load Transient Response

![Output Peak Current vs. Input-Output Differential Voltage](image6)

**Figure 12.** Output Peak Current vs. Input-Output Differential Voltage
Typical Performance Characteristics (Continued)

KA278R09C

Figure 1. Output Voltage vs. Input Voltage

Figure 2. Quiescent Current vs. Input Voltage

Figure 3. Output Voltage vs. Disable Voltage

Figure 4. Output Voltage vs. Temperature (Tj)

Figure 5. Quiescent Current vs. Temperature (Tj)

Figure 6. Dropout Voltage vs. Junction Temperature
Typical Performance Characteristics (Continued)

Figure 7. Power Dissipation vs. Temperature (Tj)

Figure 8. Overcurrent Protection Characteristics (Typical Value)

Figure 9. Output Peak Current vs. Input-Output Differential Voltage
Typical Performance Characteristics (Continued)

KA278R12C

**Figure 1. Output Voltage vs. Input Voltage**

**Figure 2. Quiescent Current vs. Input Voltage**

**Figure 3. Output Voltage vs. Disable Voltage**

**Figure 4. Output Voltage vs. Temperature(Tj)**

**Figure 5. Quiescent Current vs. Temperature(Tj)**

**Figure 6. Dropout Voltage vs. Junction Temperature**
Typical Performance Characteristics (Continued)

- **Figure 7. Power Dissipation vs. Temperature (Tj)**

- **Figure 8. Overcurrent Protection Characteristics (Typical Value)**

- **Figure 9. Output Peak Current vs. Input-Output Differential Voltage**
Typical Performance Characteristics (Continued)

KA278RA05C

**Figure 1. Output Voltage vs. Input Voltage**

**Figure 2. Quiescent Current vs. Input Voltage**

**Figure 3. Output Voltage vs. Temperature(Tj)**
* Fixed Mode (Vo=5V)

**Figure 4. Quiescent Current vs. Temperature(Tj)**

**Figure 5. Dropout Voltage vs. Junction Temperature**

**Figure 6. Power Dissipation vs. Temperature(Tj)**
Typical Performance Characteristics (Continued)

Figure 7. Overcurrent Protection Characteristics (Typical value)

Figure 8. Output Peak Current vs. Input-Output Differential Voltage
Typical Application

KA278R33/05/10/09/12C

Figure 1. Application Circuit

- Ci is required if regulator is located at an appreciable distance from power supply filter.
- Co improves stability and transient response. (Co > 47 μF)

KA278RA05

Figure 2. Application Circuit (Adjustable Mode)

- Ci is required if regulator is located at an appreciable distance from power supply filter.
- Co improves stability and transient response. (Co > 47 μF)

Figure 3. Internal Resistor (R1, R2) Variation vs. Temperature (Tj)

Figure 4. Application Circuit (Fixed Mode)
Mechanical Dimensions

Package

Dimensions in millimeters

TO-220F-4L
Mechanical Dimensions (Continued)

Package

Dimensions in millimeters

TO-220F-4L (Forming)
Mechanical Dimensions (Continued)

Package

Dimensions in millimeters

TO-220F-4L (Short Lead)

1. THESE DIMENSIONS DO NOT INCLUDE MOLD PROTRUSION.
2. (   ) IS REFERENCE
3. [   ] IS ASS'Y OUT QUALITY

NOTE
PKG OUTLINE
Ordering Information

<table>
<thead>
<tr>
<th>Product Number</th>
<th>Package</th>
<th>Operating Temperature</th>
</tr>
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<tbody>
<tr>
<td>KA278R05CTU</td>
<td>TO-220F-4L</td>
<td>-20°C to +80°C</td>
</tr>
<tr>
<td>KA278R09CTU</td>
<td>TO-220F-4L(Forming)</td>
<td></td>
</tr>
<tr>
<td>KA278R12CTU</td>
<td>TO-220F-4L(Short Lead)</td>
<td></td>
</tr>
</tbody>
</table>

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