**Description**

The ZXTR2005Z monolithically integrates a transistor, Zener diode and resistor to function as a high voltage linear regulator. The device regulates with a 5V nominal output at 15mA. It is designed for use in high voltage applications where standard linear regulators cannot be used. This function is fully integrated into a SOT89 package, minimizing PCB area and reducing number of components when compared with a multi-chip discrete solution.

**Features**

- Series Linear Regulator Using Emitter-Follower Stage
- Input Voltage = 10 to 100V (For Regulated Output Voltage)
- Output Voltage = 5V ± 10%
- 150kΩ Resistor to Limit Quiescent Current
- Fully Integrated Into a SOT89 Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- Halogen and Antimony Free. “Green” Device (Note 3)
- Qualified to AEC-Q101 for High Reliability

**Applications**

Supply Voltage Regulation in:
- Startup Switch in DC-DC Converters
- Networking
- Telecommunications
- Power-over-Ethernet (PoE)

**Mechanical Data**

- Case: SOT89
- Case Material: Molded Plastic. “Green” Molding Compound. UL Flammability Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Weight: 0.052 grams (Approximate)

**Ordering Information** (Note 4)

<table>
<thead>
<tr>
<th>Product</th>
<th>Package</th>
<th>Marking</th>
<th>Reel Size (inches)</th>
<th>Tape Width (mm)</th>
<th>Quantity per Reel</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZXTR2005Z-7</td>
<td>SOT89</td>
<td>T3</td>
<td>7</td>
<td>12</td>
<td>1,000</td>
</tr>
<tr>
<td>ZXTR2005Z-13</td>
<td>SOT89</td>
<td>T3</td>
<td>13</td>
<td>12</td>
<td>2,500</td>
</tr>
</tbody>
</table>

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated’s definitions of Halogen and Antimony free, “Green” and Lead-Free.
3. Halogen- and Antimony-free “Green” products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

**Marking Information**

1T3 = Product Type Marking Code
### Absolute Maximum Ratings  
(Voltage relative to GND, \( @T_A = +25^\circ\text{C} \), unless otherwise specified.)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>( V_{IN} )</td>
<td>-0.3 to 100</td>
<td>V</td>
</tr>
<tr>
<td>Continuous Input &amp; Output Current</td>
<td>( I_{IN, I_{OUT}} )</td>
<td>350</td>
<td>mA</td>
</tr>
<tr>
<td>Peak Pulsed Input &amp; Output Current</td>
<td>( I_{IM, I_{OM}} )</td>
<td>2</td>
<td>A</td>
</tr>
<tr>
<td>Maximum Voltage applied to ( V_{OUT} )</td>
<td>( V_{OUT(MAX)} )</td>
<td>Smaller of ( V_{IN}+5\text{V} ) or 11V</td>
<td>V</td>
</tr>
</tbody>
</table>

### Maximum Current at \( V_{IN} = 48\text{V} \)  
(\( @T_A = +25^\circ\text{C} \), unless otherwise specified.)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Output Current</td>
<td>( I_{OUT} )</td>
<td>38</td>
<td>mA</td>
</tr>
<tr>
<td>Pulsed Output Current</td>
<td>( I_{OM} )</td>
<td>740</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>150</td>
<td></td>
</tr>
</tbody>
</table>

### Thermal Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Dissipation</td>
<td>( P_D )</td>
<td>1.7</td>
<td>W</td>
</tr>
<tr>
<td>Thermal Resistance, Junction to Ambient</td>
<td>( R_{\theta JA} )</td>
<td>59</td>
<td>(^\circ\text{C/W} )</td>
</tr>
<tr>
<td>Thermal Resistance, Junction to Lead</td>
<td>( R_{\theta JL} )</td>
<td>112</td>
<td></td>
</tr>
<tr>
<td>Thermal Resistance, Junction to Case</td>
<td>( R_{\theta JC} )</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Recommended Operating Junction Temperature Range</td>
<td>( T_J )</td>
<td>-40 to +125</td>
<td>(^\circ\text{C} )</td>
</tr>
<tr>
<td>Maximum Operating Junction and Storage Temperature Range</td>
<td>( T_J, T_{STG} )</td>
<td>-65 to +150</td>
<td>(^\circ\text{C} )</td>
</tr>
</tbody>
</table>

### ESD Ratings  
(Note 11)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Symbols</th>
<th>Value</th>
<th>Unit</th>
<th>JEDEC Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic Discharge – Human Body Model</td>
<td>ESD HBM</td>
<td>4,000</td>
<td>V</td>
<td>3A</td>
</tr>
<tr>
<td>Electrostatic Discharge – Machine Model</td>
<td>ESD MM</td>
<td>400</td>
<td>V</td>
<td>C</td>
</tr>
</tbody>
</table>

Notes:
- 5. For a device mounted with the exposed \( V_{IN} \) pad on 50mm x 50mm 1oz copper that is on a single-sided 1.6mm FR4 PCB; device is measured under still air conditions whilst operating in steady-state.
- 6. Same as note 5, except mounted on 15mm x 15mm 1oz copper.
- 7. Same as note 5, whilst operating at \( V_{IN} = 48\text{V} \). Refer to Safe Operating Area for other Input Voltages.
- 8. Same as note 5, except measured with a single pulse width = 100\mu s and \( V_{IN} = 48\text{V} \).
- 9. Same as note 5, except measured with a single pulse width = 10ms and \( V_{IN} = 48\text{V} \).
- 10. \( R_{\theta JL} \) = Thermal resistance from junction to solder-point (on the exposed \( V_{IN} \) pad). \( R_{\theta JC} \) = Thermal resistance from junction to the top of case.
- 11. Refer to JEDEC specification JESD22-A114 and JESD22-A115.
Thermal Characteristics and Derating Information

- **Max Power Dissipation (W)**
  - Graph showing Max Power Dissipation (W) vs. Ambient temperature (°C) for 15mm x 15mm 1oz Cu and 50mm x 50mm 1oz Cu.

- **Continuous Output Current (mA)**
  - Graph showing Continuous Output Current (mA) vs. Input Voltage (V) for Steady state D.C. with TA = 25°C and TJ ≤ 125°C.

- **Derating Curve**
  - Graph showing Derating Curve for Pulse Power Dissipation with Max Power Dissipation (W) vs. Pulse Width (s) for 100µ, 1m, 10m, 100m, 1, 10, 100, 1k.

- **Thermal Resistance (°C/W)**
  - Graph showing Thermal Resistance (°C/W) vs. Pulse Width (s) for Single Pulse with D=0.5, 0.2, 0.1, 0.05.

- **Pulse Power Dissipation**
  - Graph showing Max Power Dissipation (W) vs. Pulse Width (s) for Single Pulse with 50mm x 50mm 1oz Cu and 15mm x 15mm 1oz Cu.
**Electrical Characteristics (@TA = +25°C, unless otherwise specified.)**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Test Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Voltage (Note 12)</td>
<td>VOUT</td>
<td>4.5</td>
<td>5.0</td>
<td>5.5</td>
<td>V</td>
<td>V IN = 48V, I OUT = 15mA</td>
</tr>
<tr>
<td>Line Regulation (Notes 12 &amp; 13)</td>
<td>ΔVOUT</td>
<td>—</td>
<td>195</td>
<td>300</td>
<td>mV</td>
<td>V IN = 10 to 72V, I OUT = 15mA</td>
</tr>
<tr>
<td>Temperature Coefficient</td>
<td>ΔVOUT/ΔT</td>
<td>—</td>
<td>7.0</td>
<td>—</td>
<td>mV/°C</td>
<td>T J = -40°C to +125°C, V IN = 48V, I OUT = 15mA</td>
</tr>
<tr>
<td>Load Regulation (Notes 12 &amp; 14)</td>
<td>ΔVOUT</td>
<td>—</td>
<td>-185</td>
<td>-205</td>
<td>-350</td>
<td>-400 mV I OUT = 0.1 to 30mA, V IN = 48V, I OUT = 0.1 to 100mA, V IN = 48V</td>
</tr>
<tr>
<td>Minimum Value of Input Voltage Required to Maintain Line Regulation</td>
<td>V IN(MIN)</td>
<td>10</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>V IN = 48V, I OUT = 15mA</td>
</tr>
<tr>
<td>Quiescent Current</td>
<td>I Q</td>
<td>260</td>
<td>550</td>
<td>500</td>
<td>900</td>
<td>µA V IN = 48V, I OUT = 10µA, V IN = 100V, I OUT = 10µA</td>
</tr>
<tr>
<td>Power Supply Rejection Ratio</td>
<td>ΔV IN/ΔV OUT</td>
<td>—</td>
<td>45</td>
<td>—</td>
<td>dB</td>
<td>C OUT = 100nF, I OUT = 15mA, V OUT = 5V, V IN = 10 to 100V, f = 100Hz</td>
</tr>
</tbody>
</table>

Notes:
12. Measured under pulsed conditions. Pulse width ≤ 300µs, duty cycle ≤ 2%.
13. Line regulation: ΔV OUT = V OUT(@ V IN = 72V) − V OUT(@ V IN = 10V)
14. Load regulation: ΔV OUT = V OUT(@ I OUT = 30mA) − V OUT(@ I OUT = 0.1mA)
ΔV OUT = V OUT(@ I OUT = 100mA) − V OUT(@ I OUT = 0.1mA)

**Typical Application Circuit**

Example of a 5V regulated supply from a nominal 48V for powering a Controller IC.

**Pin Functions**

<table>
<thead>
<tr>
<th>Pin Name</th>
<th>Pin Function</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>V IN</td>
<td>Input Supply</td>
<td>Input voltage can vary from -0.3V to 100V with respect to GND; for V OUT regulated then 10V ≤ V IN ≤ 100V. It is recommended to connect a 1µF capacitor to GND.</td>
</tr>
<tr>
<td>GND</td>
<td>Power Ground</td>
<td>This pin should be tied to the system ground.</td>
</tr>
<tr>
<td>V OUT</td>
<td>Voltage Output</td>
<td>Outputs a regulated 5V when 10V ≤ V IN ≤ 100V. When V IN &lt; 10V, then V OUT maximum = V IN − 1.5V. The pin can be pulled high to a maximum of +11V with respect to GND, or +5V with respect to V IN, whichever is lower. It is recommended to connect a 10µF capacitor to GND and a minimum of 10µA to be drawn from V OUT to maintain regulation.</td>
</tr>
</tbody>
</table>
Typical Electrical Characteristics (@T_A = +25°C, unless otherwise specified.)

**Line transient response**

**Load transient response**

**Line Regulation (Note 15)**

**Load Regulation (Note 16)**

**Temperature Coefficient (Note 17)**

**Quiescent Current**

Notes:

15. Line regulation $\Delta V_{OUT} = V_{OUT} - V_{OUT} @ V_{IN} = 10V, I_{OUT} = 15mA, T_J = +25^\circ C$

16. Load regulation $\Delta V_{OUT} = V_{OUT} - V_{OUT} @ V_{IN} = 48V, I_{OUT} = 0.1mA, T_J = +25^\circ C$

17. Temperature Coefficient $\Delta V_{OUT} = V_{OUT} - V_{OUT} @ V_{IN} = 48V, I_{OUT} = 15mA, T_J = +25^\circ C$
Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

<table>
<thead>
<tr>
<th>SOT89</th>
<th>Dim</th>
<th>Min</th>
<th>Max</th>
<th>Typ</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.40</td>
<td>1.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>0.50</td>
<td>0.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>0.42</td>
<td>0.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>0.35</td>
<td>0.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>4.40</td>
<td>4.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>1.62</td>
<td>1.733</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>1.61</td>
<td>1.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>2.40</td>
<td>2.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E2</td>
<td>2.05</td>
<td>2.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>-</td>
<td>-</td>
<td>1.50</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>3.95</td>
<td>4.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1</td>
<td>2.63</td>
<td>2.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>0.90</td>
<td>1.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td>0.327</td>
<td>0.427</td>
<td></td>
<td></td>
</tr>
<tr>
<td>z</td>
<td>0.20</td>
<td>0.30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All Dimensions in mm

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Value (in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>1.500</td>
</tr>
<tr>
<td>G</td>
<td>0.244</td>
</tr>
<tr>
<td>X</td>
<td>0.580</td>
</tr>
<tr>
<td>X1</td>
<td>0.760</td>
</tr>
<tr>
<td>X2</td>
<td>1.933</td>
</tr>
<tr>
<td>Y</td>
<td>1.730</td>
</tr>
<tr>
<td>Y1</td>
<td>3.030</td>
</tr>
<tr>
<td>Y2</td>
<td>1.500</td>
</tr>
<tr>
<td>Y3</td>
<td>0.770</td>
</tr>
<tr>
<td>Y4</td>
<td>4.530</td>
</tr>
</tbody>
</table>