DEVICE DESCRIPTION

The ZR431 is a three terminal adjustable shunt regulator offering excellent temperature stability and output current handling capability up to 100mA. The output voltage may be set to any chosen voltage between 2.5 and 20 volts by selection of two external divider resistors.

The devices can be used as a replacement for zener diodes in many applications requiring an improvement in zener performance.

FEATURES

- Surface mount SO8, SOT223 and SOT23 packages
- TO92 package
- 2%, 1% and 0.5% tolerance
- Max. temperature coefficient 55 ppm/°C
- Temperature compensated for operation over the full temperature range
- Programmable output voltage
- 50μA to 100mA current sink capability
- Low output noise

APPLICATIONS

- Shunt regulator
- Series regulator
- Voltage monitor
- Over voltage/under voltage protection
- Switch mode power supplies

SCHEMATIC DIAGRAM
# ZR431

**ABSOLUTE MAXIMUM RATING**
- Cathode Voltage (Vz): 20V
- Cathode Current: 150mA
- Operating Temperature: -40 to 85°C
- Storage Temperature: -55 to 125°C

**Recommended Operating Conditions**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode Voltage</td>
<td>Vref</td>
<td>2.45</td>
<td>2.50</td>
<td>2.55</td>
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<tr>
<td></td>
<td></td>
<td>2.475</td>
<td>2.50</td>
<td>2.525</td>
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<td></td>
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<td>2.489</td>
<td>2.50</td>
<td>2.513</td>
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<tr>
<td>Min Max</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cathode Voltage</td>
<td>Vref</td>
<td>20V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cathode Current</td>
<td>G01</td>
<td>50μA</td>
<td>100mA</td>
<td></td>
</tr>
</tbody>
</table>

**Power Dissipation (Tamb=25°C, Tjmax=150°C)**
- SOT23: 330mW
- TO92: 780mW
- SOT223: 2W
- SO8: 780mW

**ELECTRICAL CHARACTERISTICS TEST CONDITIONS**
(Unless otherwise stated): Tamb=25°C

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference Voltage</td>
<td>Vref</td>
<td></td>
<td>V</td>
<td>I_L=10mA (Fig1), V_Z=V_ref</td>
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<tr>
<td>Deviation of Reference Input Voltage over Temperature</td>
<td>Vdev</td>
<td></td>
<td>mV</td>
<td>I_L=10mA, V_Z=V_ref, T_a=full range (Fig1)</td>
</tr>
<tr>
<td>Ratio of the change in Reference Voltage to the Change in Cathode Voltage</td>
<td>ΔVref/ΔVZ</td>
<td>V_Z from Vref to 10V</td>
<td>mV/V</td>
<td>l_Z=10mA (Fig2)</td>
</tr>
<tr>
<td>Deviation of Reference Input Current over Temperature</td>
<td>ΔI_ref</td>
<td>I_Zmin</td>
<td>μA</td>
<td>R1=10k, R2=O/C, l_L=10mA (Fig2)</td>
</tr>
<tr>
<td>Minimum Cathode Current for Regulation</td>
<td>l_Zmin</td>
<td></td>
<td>μA</td>
<td>V_Z=Vref (Fig1)</td>
</tr>
<tr>
<td>Off-state Current</td>
<td>I_Zoff</td>
<td></td>
<td>μA</td>
<td>V_Z=20V, V_ref =0V (Fig3)</td>
</tr>
<tr>
<td>Dynamic Output Impedance</td>
<td>R_Z</td>
<td></td>
<td>Ω</td>
<td>V_Z=V_ref (Fig1), f=0Hz</td>
</tr>
</tbody>
</table>

(1) 0.5% SOT23 only.

For definitions of reference voltage temperature coefficient and dynamic output impedance see NOTES following DC TEST CIRCUITS
TYPICAL CHARACTERISTICS

Reference Current v Temperature

Cathode Current v Temperature

Dynamic Impedance v Frequency

Change in Reference Output Voltage (mV)

Temperature (°C)

Reference Voltage v Temperature

Power Dissipation (W)

Ambient Temperature (°C)

IZ=10mA

Vref=VZ

IZ=10mA

IZ=10mA

IZ=10mA

SOT223

SOT23

SO8/TO92
TYPICAL CHARACTERISTICS

**Gain v Frequency**

- **Frequency (Hz)**
- **Load Capacitance (F)**
- **Stability Boundary Conditions**

**Test Circuit for Open Loop Voltage Gain**

- **VZ**
- **15k**
- **9pF**
- **8k25**
- **IZ = 10mA, TA = 25°C**

**Pulse Response**

- **Time (µs)**
- **Voltage Swing (V)**

**Test Circuit for Pulse Response**

- **V<sub>ref</sub> < VZ < 20, IZ = 10mA, TA = 25°C**

**Stability Boundary Conditions**

- **Cathode Current (mA)**
- **Load Capacitance (F)**

**Test Circuit for Stability Boundary Conditions**

- **V<sub>ref</sub> < VZ < 20, IZ = 10mA, TA = 25°C**

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**ZETEX**
APPLICATION CIRCUITS

**SHUNT REGULATOR**

\[ V_{\text{out}} = \frac{1 + R_1}{R_2} V_{\text{ref}} \]

**HIGHER CURRENT SHUNT REGULATOR**

\[ V_{\text{out}} = \frac{1 + R_1}{R_2} V_{\text{ref}} \]

**OUTPUT CONTROL OF A THREE TERMINAL FIXED REGULATOR**

\[ V_{\text{out}} = V_{\text{ref}} + V_{\text{regMIN}} \]

**SERIES REGULATOR**

\[ V_{\text{out}} = \frac{1 + R_1}{R_2} V_{\text{ref}} \]

**SINGLE SUPPLY COMPARATOR WITH TEMPERATURE COMPENSATED THRESHOLD**

\[ V_{\text{in}} = 2.5V_{\text{TH}} \]

\[ V_{\text{in}} = V_{+\text{off}} \]

**OVER VOLTAGE / UNDER VOLTAGE PROTECTION CIRCUIT**

\[ \text{Low limit} = \frac{1}{1 + \frac{R_{1A}}{R_{2A}}} V_{\text{ref}} \]

\[ \text{High limit} = \frac{1}{1 + \frac{R_{1B}}{R_{2B}}} V_{\text{ref}} \]
NOTES
Deviation of reference input voltage, $V_{dev}$, is defined as the maximum variation of the reference input voltage over the full temperature range.
The average temperature coefficient of the reference input voltage, $V_{ref}$, is defined as:

$$V_{ref\,(ppm/°C)} = \frac{V_{dev} \times 1000000}{V_{ref}(T1-T2)}$$

The dynamic output impedance, $R_Z$, is defined as:

$$R_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

When the device is programmed with two external resistors, $R_1$ and $R_2$ (fig 2), the dynamic output impedance of the overall circuit, $R'$, is defined as:

$$R' = R_Z \left(1 + \frac{R_1}{R_2}\right)$$
connection diagrams

so8 package suffix – n8

sot23 package suffix – f

sot223 package suffix – g

to92 package suffix – c

ordering information

<table>
<thead>
<tr>
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<th>Tol. %</th>
<th>Part Mark</th>
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<td>ZR431C01</td>
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<td>ZR43101</td>
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<tr>
<td>ZR431C</td>
<td>TO92</td>
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<td>ZR431G</td>
<td>SOT223</td>
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<td>ZR431</td>
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<td>ZR431F005</td>
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