

**ADJUSTABLE PRECISION SHUNT REGULATORS****AZ431-B****General Description**

The AZ431-B is a three-terminal adjustable shunt regulator with guaranteed thermal stability over a full operation range. It features sharp turn-on characteristics, low temperature coefficient and low output impedance, which make it ideal substitute for Zener diode in applications such as switching power supply, charger and other adjustable regulators.

The output voltage of AZ431-B can be set to any value between  $V_{REF}$  (2.5V) and the corresponding maximum cathode voltage.

The AZ431-B precision reference is offered in two voltage tolerance: 0.4% and 0.8%.

This IC is available in 5 packages: TO-92 (bulk or ammo packing), SOT-23, SOT-23-5, SOT-89-3 and SOIC-8.

**Features**

- Programmable Precise Output Voltage from 2.5V to 18V
- High Stability under Capacitive Load
- Low Temperature Deviation: 4.5mV Typical
- Low Equivalent Full-range Temperature Coefficient with 20PPM/°C Typical
- Sink Current Capacity from 1mA to 100mA
- Low Output Noise
- Wide Operating Range of -40 to 125°C

**Applications**

- Charger
- Voltage Adapter
- Switching Power Supply
- Graphic Card
- Precision Voltage Reference

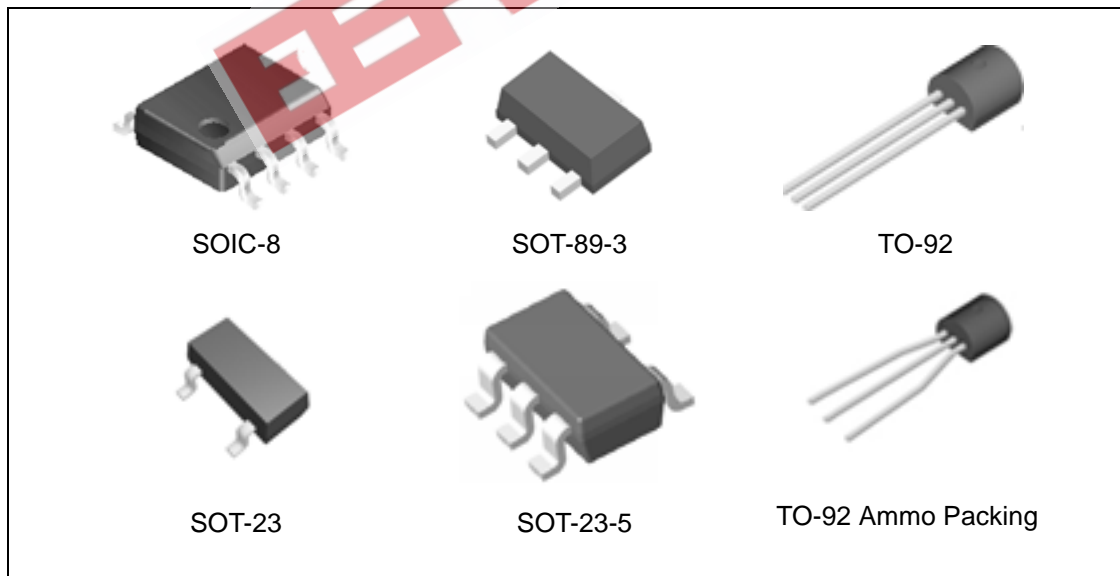


Figure 1. Package Types of AZ431-B



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Pin Configuration**

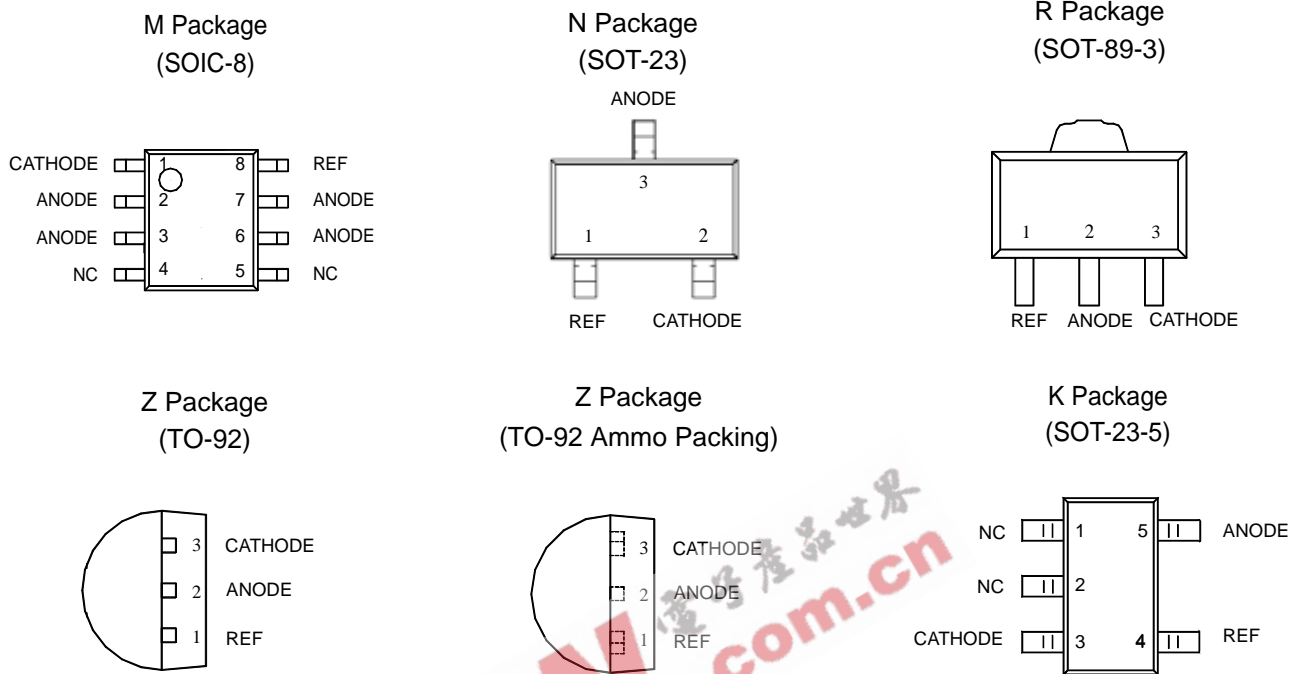


Figure 2. Pin Configuration of AZ431-B (Top View)

**Functional Block Diagram**

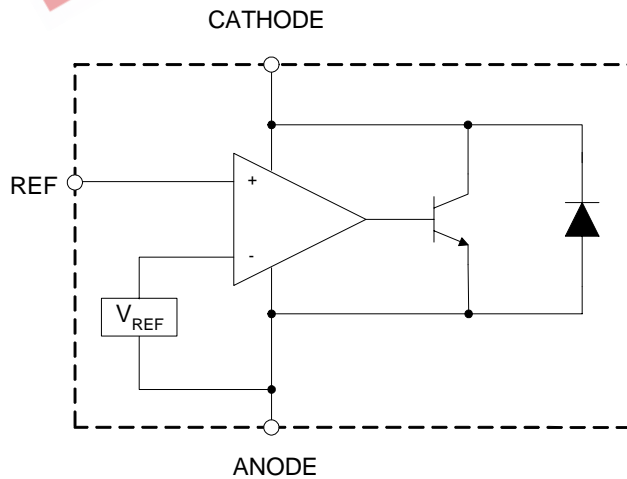


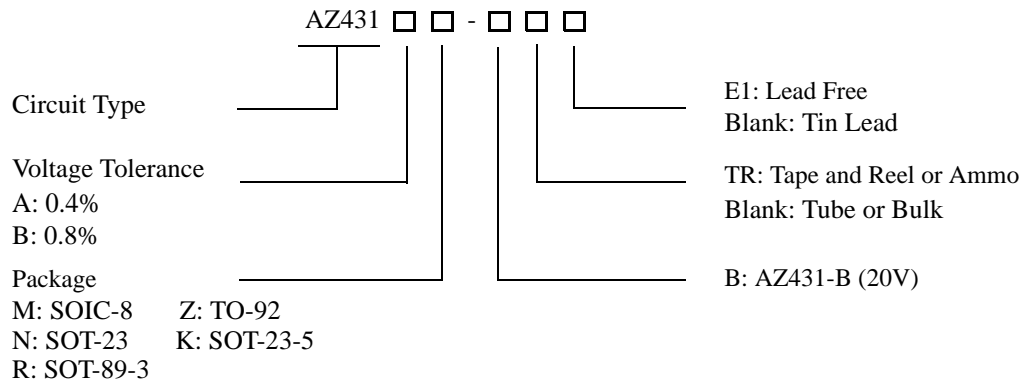
Figure 3. Functional Block Diagram of AZ431-B



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Ordering Information**



| Package  | Temperature Range | Voltage Tolerance | Part Number |               | Marking ID |             | Packing Type |
|----------|-------------------|-------------------|-------------|---------------|------------|-------------|--------------|
|          |                   |                   | Tin Lead    | Lead Free     | Tin Lead   | Lead Free   |              |
| SOT-23   | -40 to 125°C      | 0.4%              |             | AZ431AN-BTRE1 |            | EA4         | Tape & Reel  |
|          |                   | 0.8%              |             | AZ431BN-BTRE1 |            | EA5         | Tape & Reel  |
| SOT-23-5 | -40 to 125°C      | 0.4%              | AZ431AK-BTR | AZ431AK-BTRE1 | K4A        | E4A         | Tape & Reel  |
|          |                   | 0.8%              | AZ431BK-BTR | AZ431BK-BTRE1 | K4B        | E4B         | Tape & Reel  |
| TO-92    | -40 to 125°C      | 0.4%              | AZ431AZ-B   | AZ431AZ-BE1   | AZ431AZ-B  | AZ431AZ-BE1 | Bulk         |
|          |                   | 0.4%              | AZ431AZ-BTR | AZ431AZ-BTRE1 | AZ431AZ-B  | AZ431AZ-BE1 | Ammo         |
|          |                   | 0.8%              | AZ431BZ-B   | AZ431BZ-BE1   | AZ431BZ-B  | AZ431BZ-BE1 | Bulk         |
|          |                   | 0.8%              | AZ431BZ-BTR | AZ431BZ-BTRE1 | AZ431BZ-B  | AZ431BZ-BE1 | Ammo         |
| SOIC-8   | -40 to 125°C      | 0.4%              | AZ431AM-B   | AZ431AM-BE1   | AZ431AM-B  | AZ431AM-BE1 | Tube         |
|          |                   | 0.4%              | AZ431AM-BTR | AZ431AM-BTRE1 | AZ431AM-B  | AZ431AM-BE1 | Tape & Reel  |
|          |                   | 0.8%              | AZ431BM-B   | AZ431BM-BE1   | AZ431BM-B  | AZ431BM-BE1 | Tube         |
|          |                   | 0.8%              | AZ431BM-BTR | AZ431BM-BTRE1 | AZ431BM-B  | AZ431BM-BE1 | Tape & Reel  |
| SOT-89-3 | -40 to 125°C      | 0.4%              | AZ431AR-BTR | AZ431AR-BTRE1 | 431C       | E43C        | Tape & Reel  |
|          |                   | 0.8%              | AZ431BR-BTR | AZ431BR-BTRE1 | 431D       | E43D        | Tape & Reel  |

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant.

**ADJUSTABLE PRECISION SHUNT REGULATORS****AZ431-B****Absolute Maximum Ratings (Note 1)**

| Parameter                          | Symbol    | Value                | Unit |
|------------------------------------|-----------|----------------------|------|
| Cathode Voltage                    | $V_{KA}$  | 20                   | V    |
| Cathode Current Range (Continuous) | $I_{KA}$  | -100 to 150          | mA   |
| Reference Input Current Range      | $I_{REF}$ | 10                   | mA   |
| Power Dissipation                  | $P_D$     | M, Z, R Package: 770 | mW   |
|                                    |           | N, K Package: 370    |      |
| Junction Temperature               | $T_J$     | 150                  | °C   |
| Storage Temperature Range          | $T_{STG}$ | -65 to 150           | °C   |
| ESD (Human Body Model)             | ESD       | 2000                 | V    |

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

**Recommended Operating Conditions**

| Parameter                           | Symbol   | Min       | Max | Unit |
|-------------------------------------|----------|-----------|-----|------|
| Cathode Voltage                     | $V_{KA}$ | $V_{REF}$ | 18  | V    |
| Cathode Current                     | $I_{KA}$ | 1.0       | 100 | mA   |
| Operating Ambient Temperature Range | $T_A$    | -40       | 125 | °C   |



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Electrical Characteristics**

Operating Conditions:  $T_A=25^{\circ}\text{C}$ , unless otherwise specified.

| Parameter   | Test Circuit | Symbol   | Conditions  | Min  | Typ   | Max   | Unit          |
|---|--------------|--|---|--|-------|-------|---------------|
| Reference Voltage   | 0.4%         | 4  | $V_{\text{REF}}$<br>$V_{\text{KA}}=V_{\text{REF}}, I_{\text{KA}}=10\text{mA}$                           | 2.490  | 2.500 | 2.510 | V             |
|   | 0.8%         |  |   | 2.480  | 2.500 | 2.520 |               |
| Deviation of Reference Voltage Over Full Temperature Range            | 4            | $\Delta V_{\text{REF}}$                              | $V_{\text{KA}}=V_{\text{REF}}$<br>$I_{\text{KA}}=10\text{mA}$   | 0 to 70°C  | 4.5   | 8     | mV            |
|   |              |  |   | -40 to 85°C  | 4.5   | 10    |               |
|   |              |  |   | -40 to 125°C   | 4.5   | 16    |               |
| Ratio of Change in Reference Voltage to the Change in Cathode Voltage | 5            | $\frac{\Delta V_{\text{REF}}}{\Delta V_{\text{KA}}}$ | $I_{\text{KA}}=10\text{mA}$   | $\Delta V_{\text{KA}}=10\text{V to } V_{\text{REF}}$ | -1.0  | -2.7  | mV/V          |
|   |              |  |   | $\Delta V_{\text{KA}}=18\text{V to } 10\text{V}$     | -0.5  | -2.0  |               |
| Reference Current   | 5            | $I_{\text{REF}}$                                     | $I_{\text{KA}}=10\text{mA}, R1=10\text{K}\Omega, R2=\infty$   |  | 0.7   | 4     | $\mu\text{A}$ |
| Deviation of Reference Current Over Full Temperature Range            | 5            | $\Delta I_{\text{REF}}$                              | $I_{\text{KA}}=10\text{mA}, R1=10\text{K}\Omega, R2=\infty$<br>$T_A=-40\text{ to } 125^{\circ}\text{C}$ |  | 0.4   | 1.2   | $\mu\text{A}$ |
| Minimum Cathode Current for Regulation                                | 4            | $I_{\text{KA}}(\text{Min})$                          | $V_{\text{KA}}=V_{\text{REF}}$  |  | 0.4   | 1.0   | mA            |
| Off-state Cathode Current   | 6            | $I_{\text{KA}}(\text{Off})$                          | $V_{\text{KA}}=18\text{V}, V_{\text{REF}}=0$  |  | 0.05  | 1.0   | $\mu\text{A}$ |
| Dynamic Impedance   | 4            | $Z_{\text{KA}}$                                      | $V_{\text{KA}}=V_{\text{REF}}, I_{\text{KA}}=1\text{ to } 100\text{mA}$<br>$f \leq 1.0\text{KHz}$       |  | 0.2   | 0.5   | $\Omega$      |



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Electrical Characteristics (Continued)**

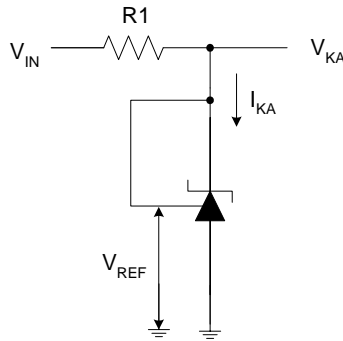


Figure 4. Test Circuit 4 for  $V_{KA} = V_{REF}$

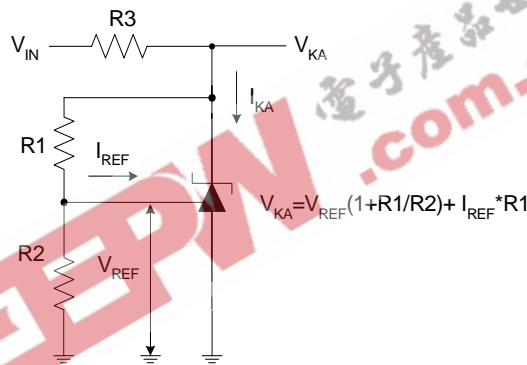


Figure 5. Test Circuit 5 for  $V_{KA} > V_{REF}$

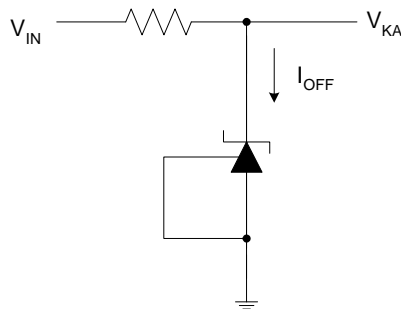


Figure 6. Test Circuit 6 for  $I_{OFF}$



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Typical Performance Characteristics**

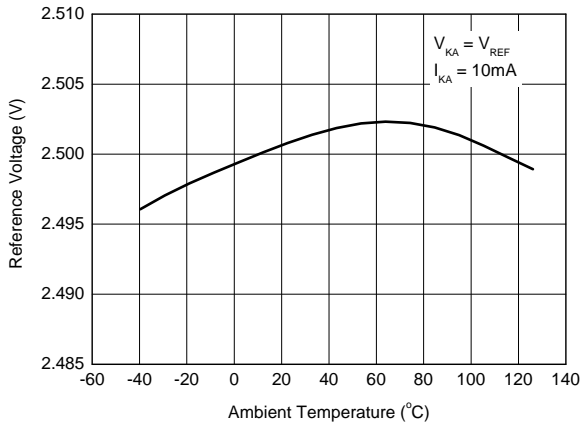


Figure 7. Reference Voltage vs. Ambient Temperature

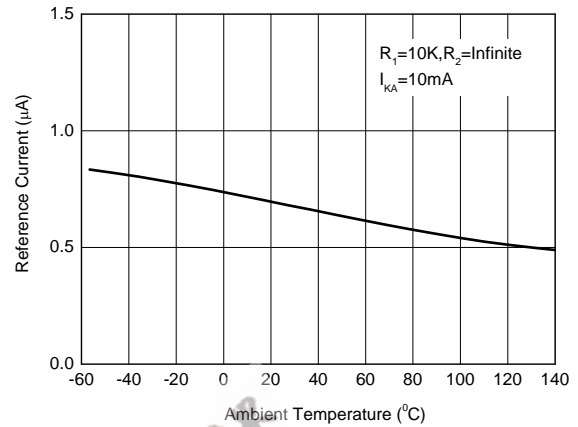


Figure 8. Reference Current vs. Ambient Temperature

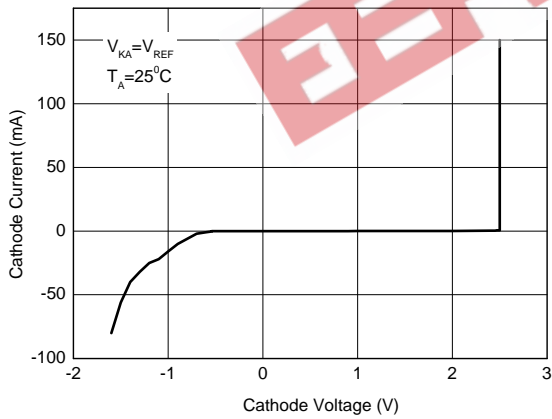


Figure 9. Cathode Current vs. Cathode Voltage

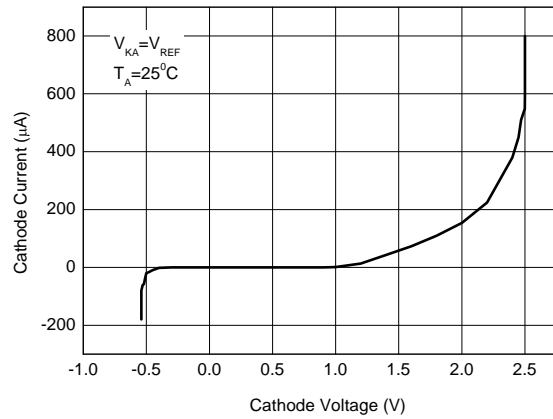


Figure 10. Cathode Current vs. Cathode Voltage



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Typical Performance Characteristics (Continued)**

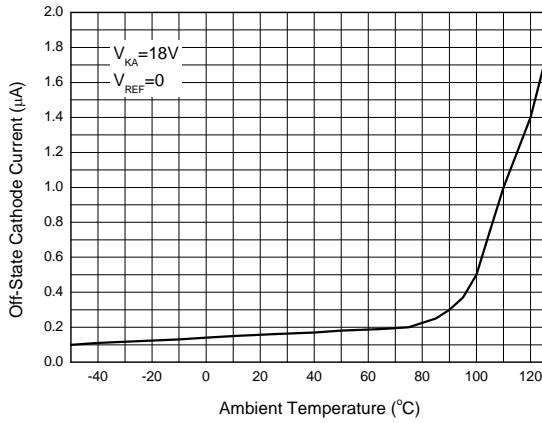


Figure 11. Off-State Cathode Current vs. Ambient Temperature

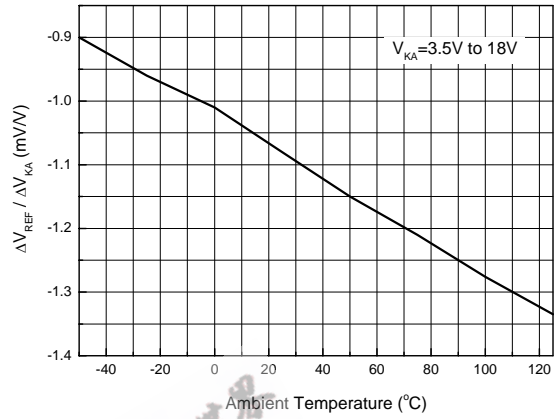


Figure 12. Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage

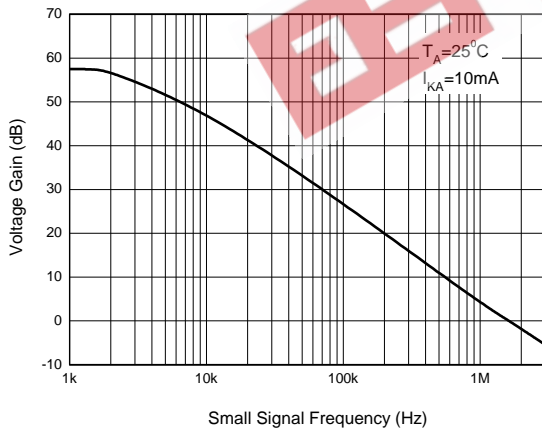
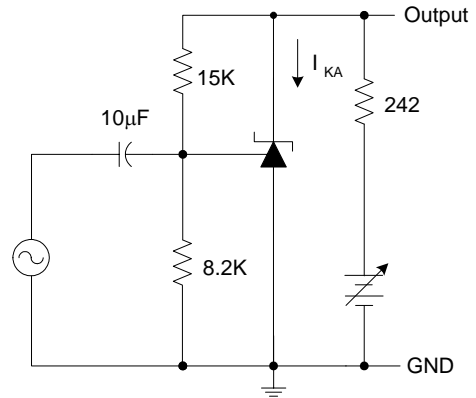


Figure 13. Small Signal Voltage Gain vs. Frequency







**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Typical Performance Characteristics (Continued)**

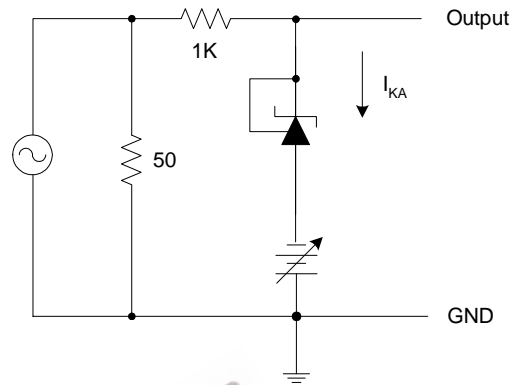
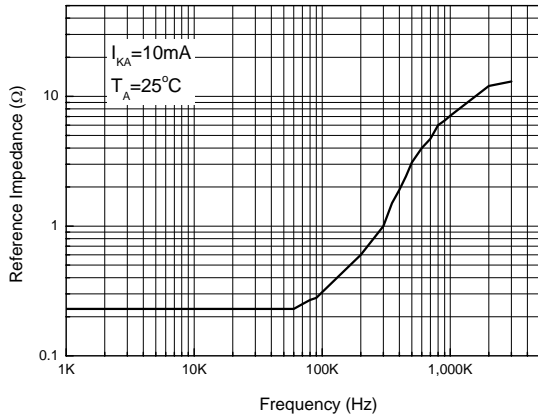


Figure 15. Reference Impedance vs. Frequency

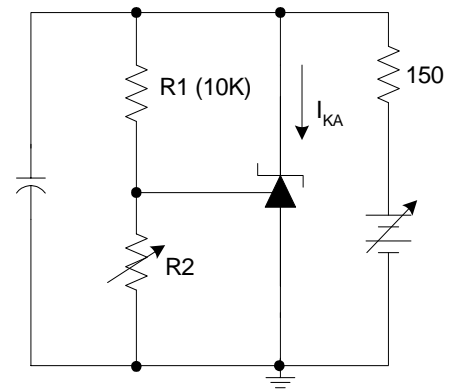
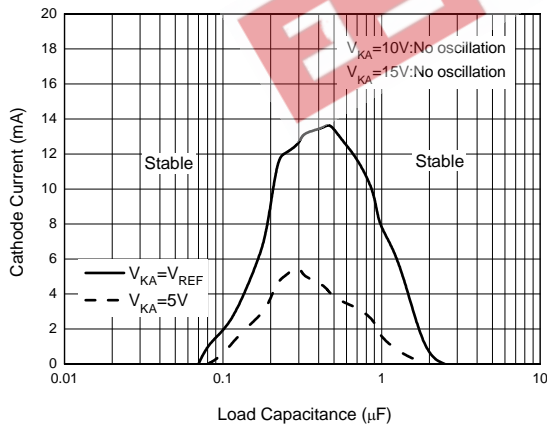


Figure 16. Stability Boundary Conditions vs. Load Capacitance



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Typical Performance Characteristics (Continued)**

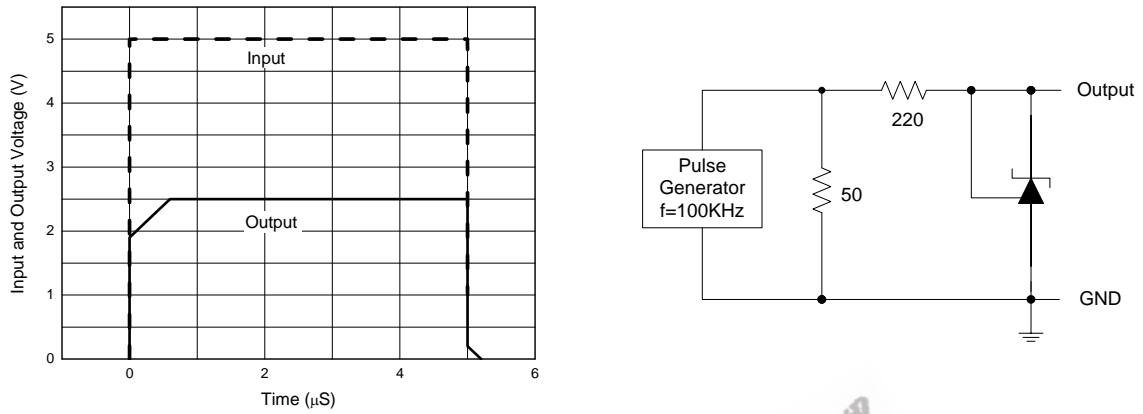


Figure 18. Pulse Response of Input and Output Voltage



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Typical Application**

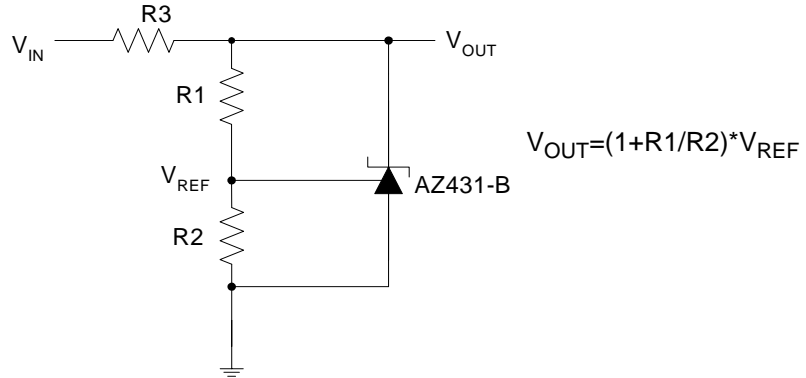


Figure 19. Shunt Regulator

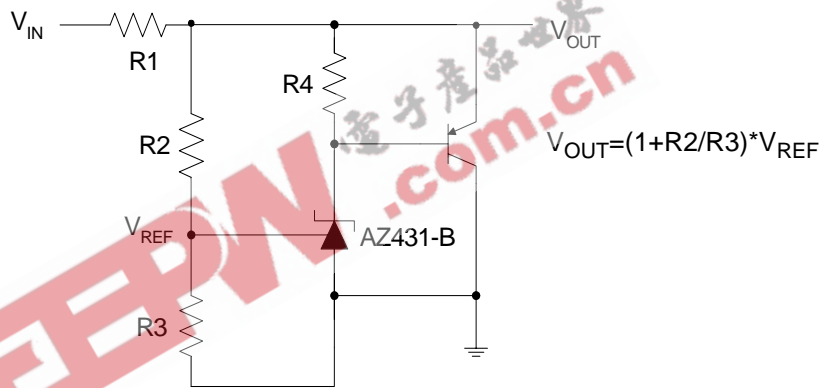


Figure 20. High Current Shunt Regulator

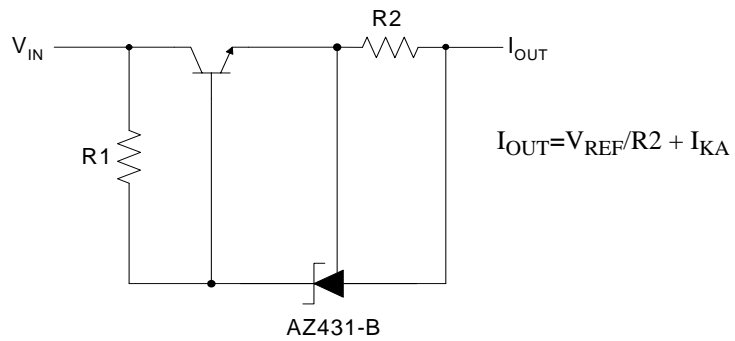


Figure 21. Current Source or Current Limit



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Typical Application (Continued)**

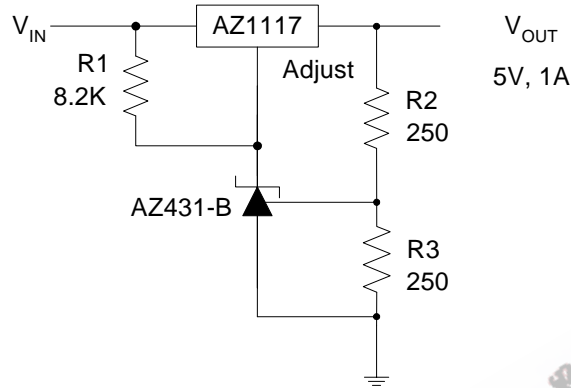


Figure 22. Precision 5V 1A Regulator

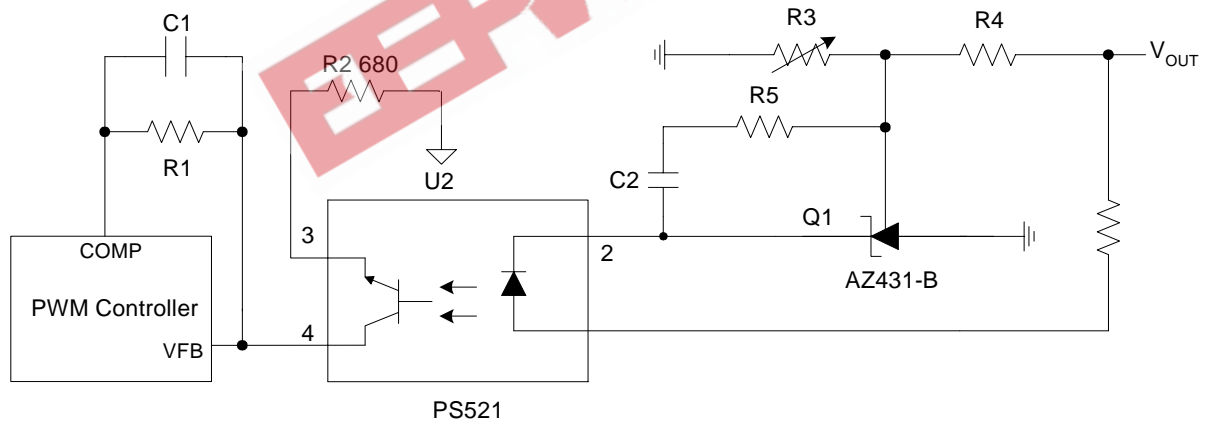


Figure 23. PWM Converter with Reference



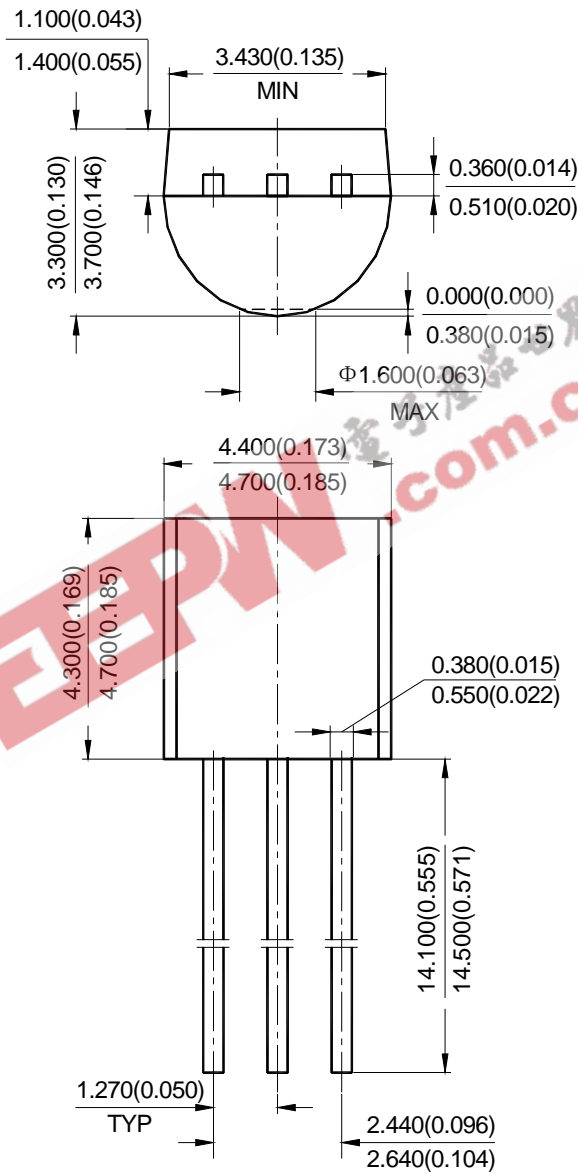
**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Mechanical Dimensions**

**TO-92**

**Unit: mm(inch)**





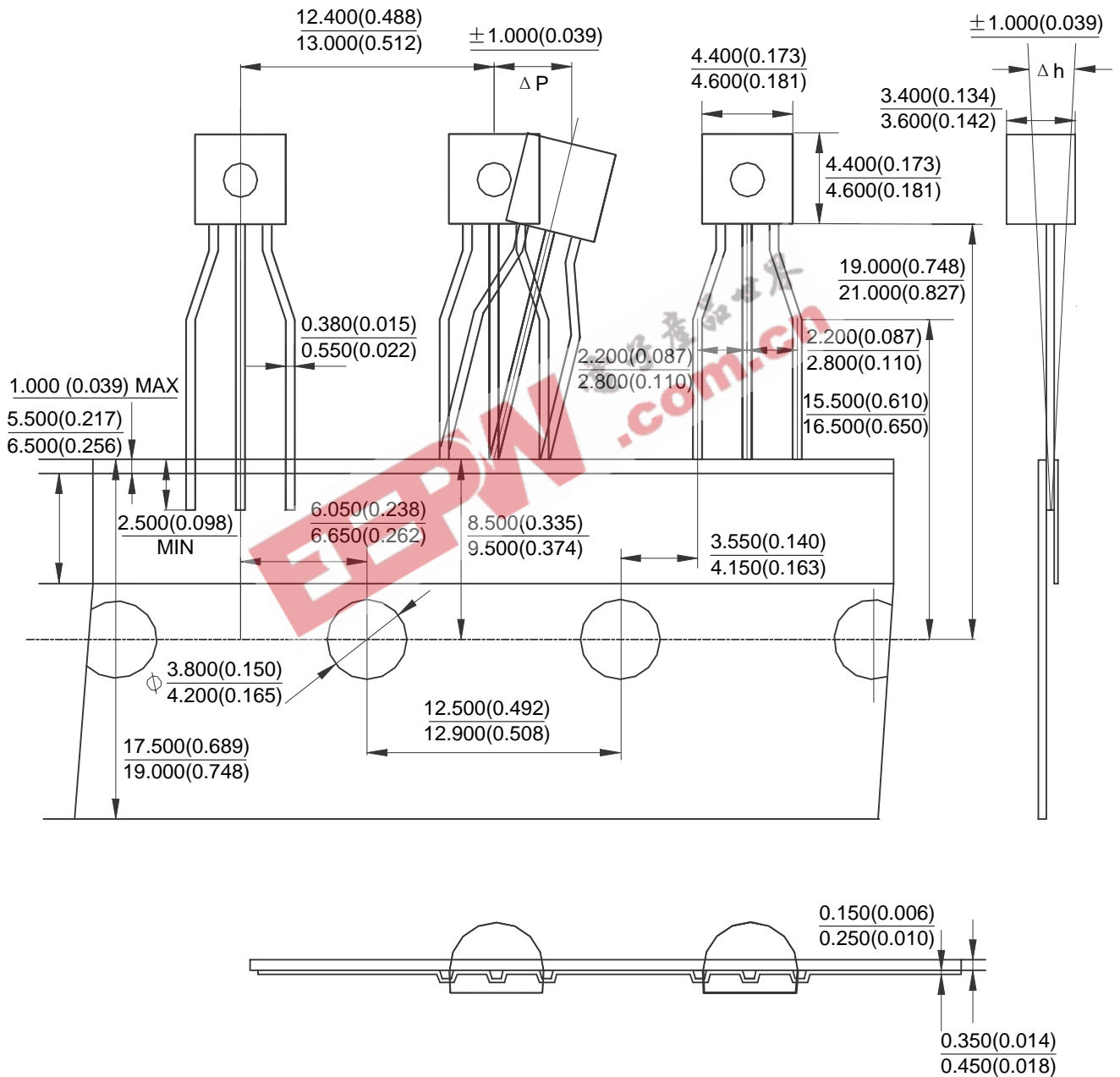
**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Mechanical Dimensions (Continued)**

**TO-92 Ammo Packing**

**Unit: mm(inch)**





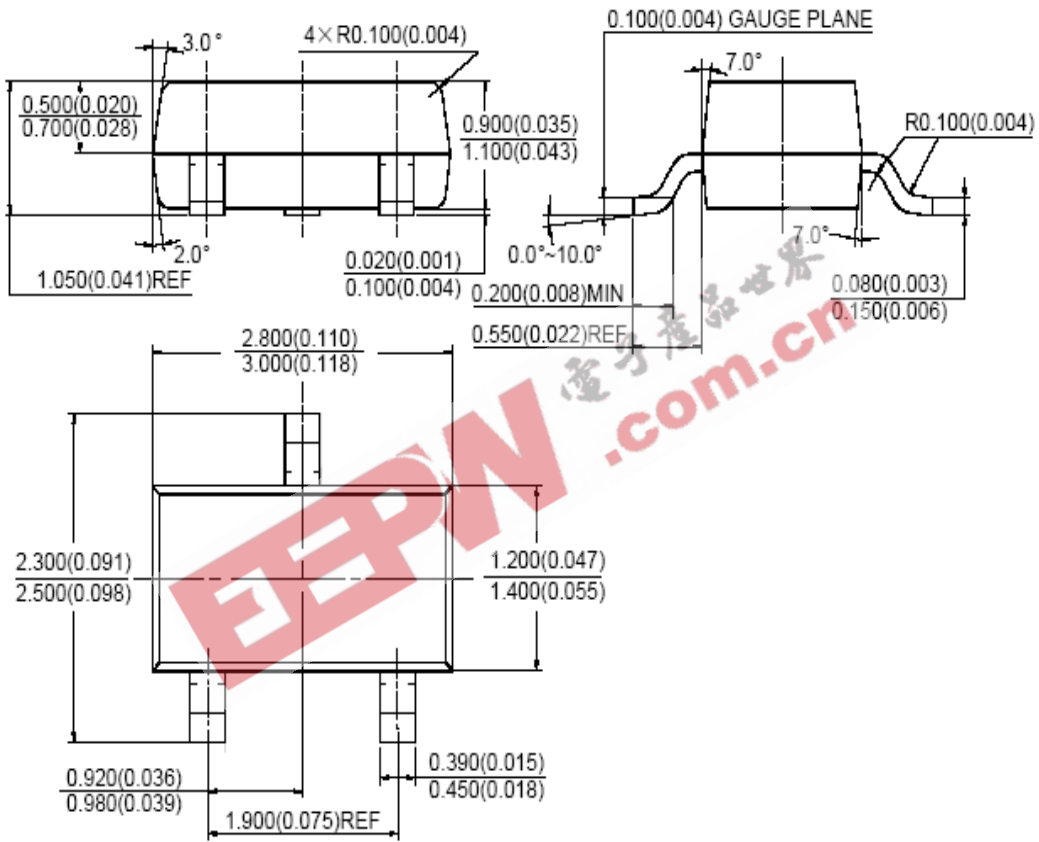
**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Mechanical Dimensions (Continued)**

**SOT-23**

**Unit: mm(inch)**





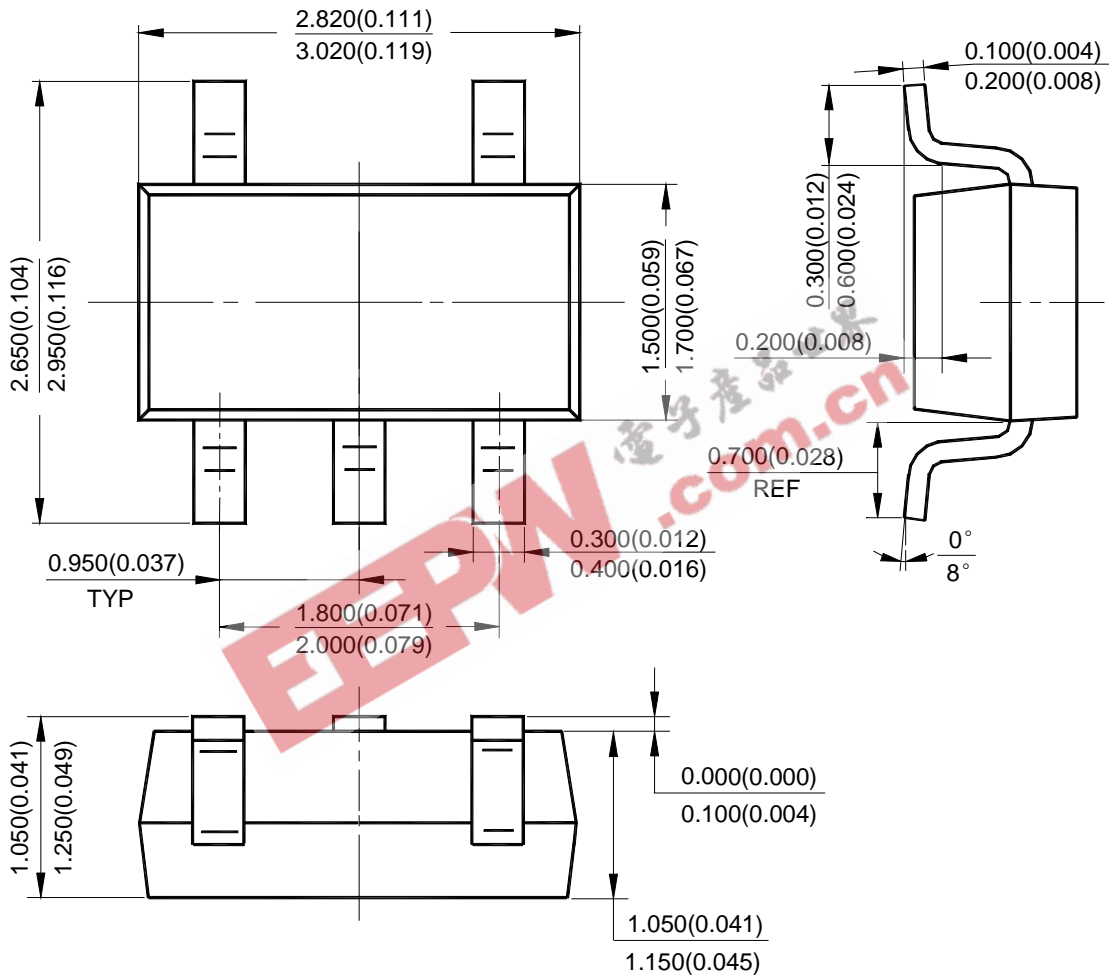
**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Mechanical Dimensions (Continued)**

**SOT-23-5**

**Unit: mm(inch)**







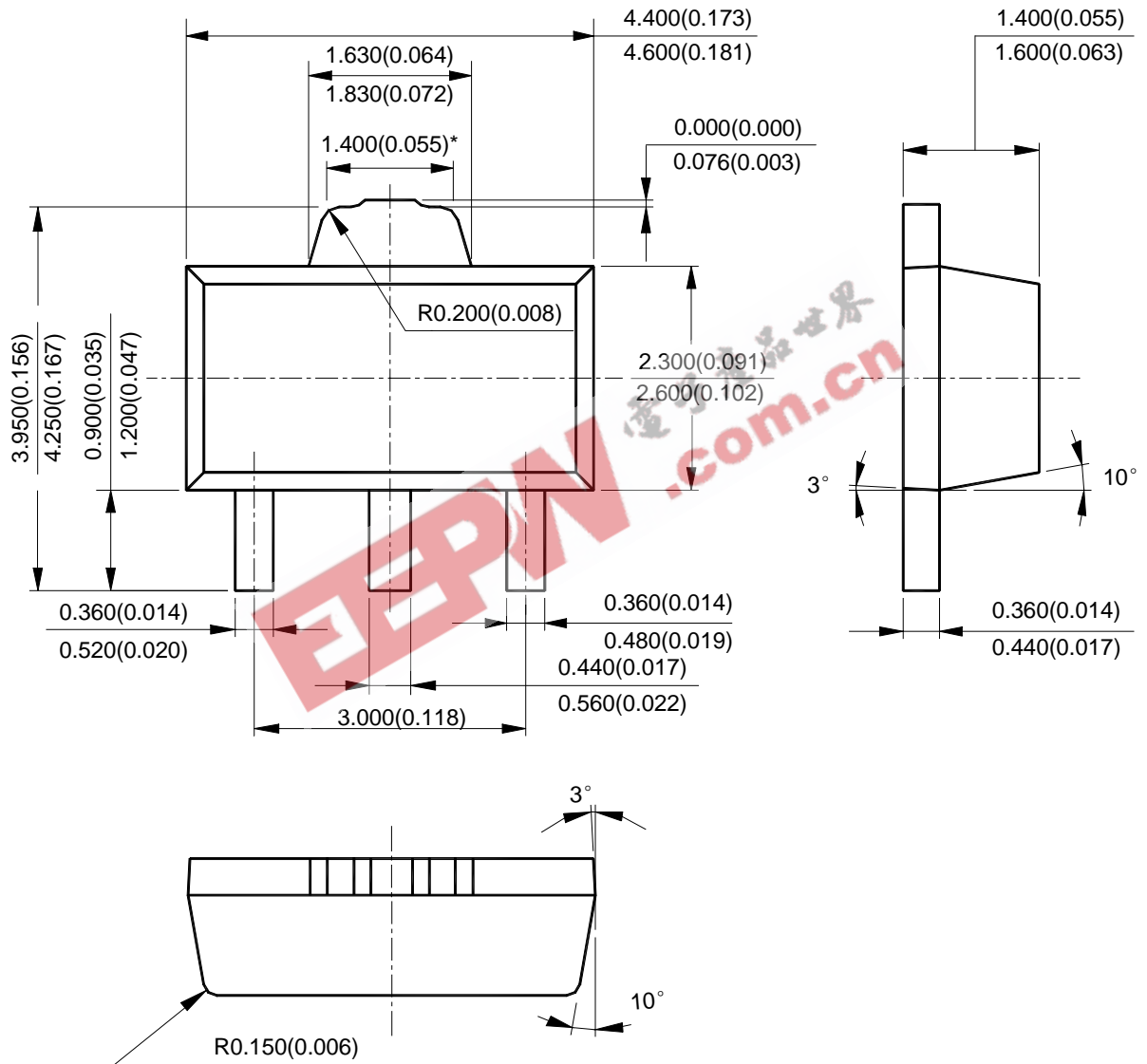
**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Mechanical Dimensions (Continued)**

**SOT-89-3**

**Unit: mm(inch)**





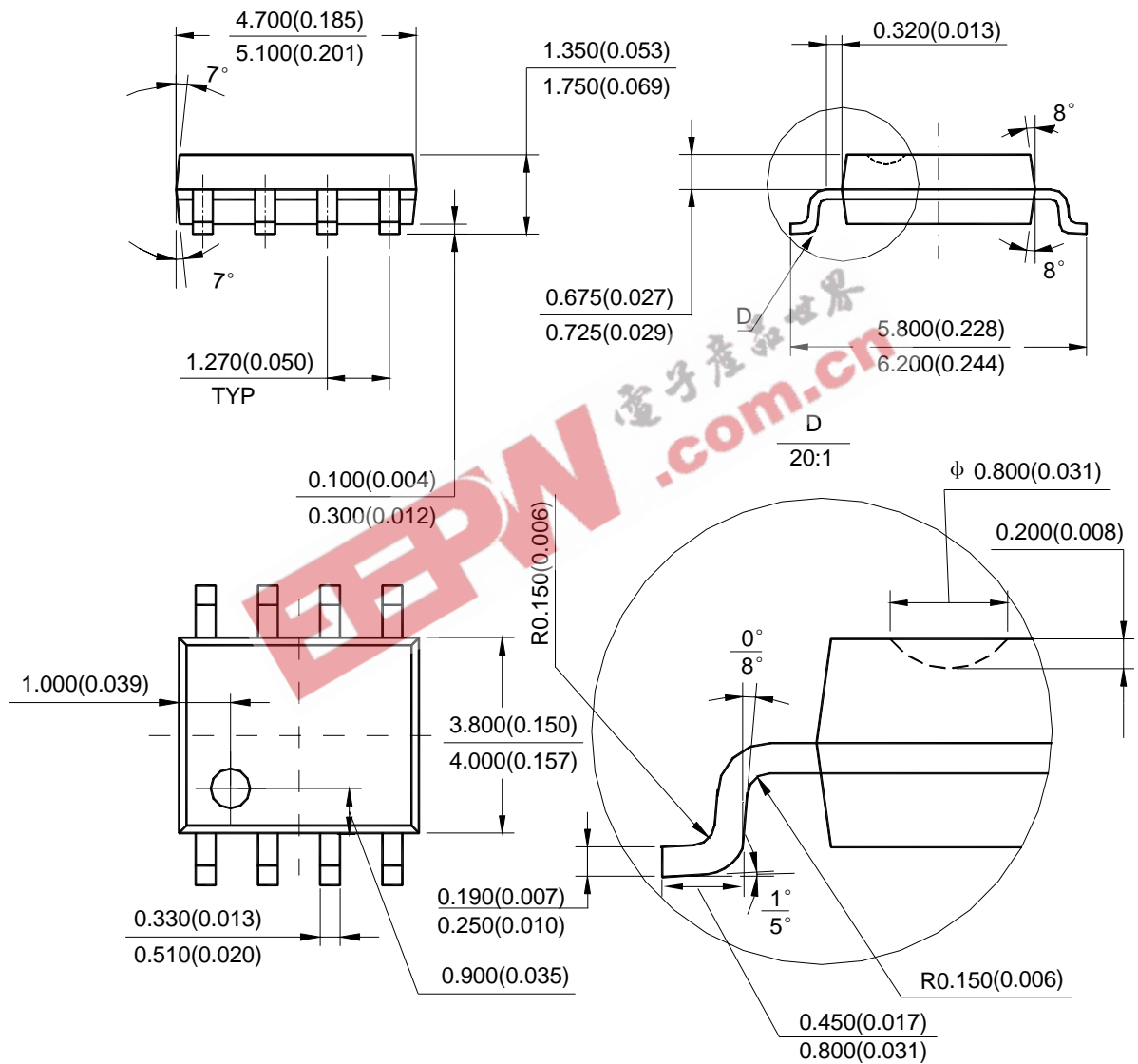
**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431-B**

**Mechanical Dimensions (Continued)**

**SOIC-8**

**Unit: mm(inch)**





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