

## LOW VOLTAGE (1.24V) ADJUSTABLE PRECISION SHUNT REGULATOR

AZ431L

### General Description

The AZ431L series ICs are low voltage three-terminal adjustable regulators with guaranteed thermal stability over a full operation range. These ICs feature sharp turn-on characteristics, low temperature coefficient and low output impedance, which make them ideal substitutes for Zener diodes in applications such as switching power supply, charger, motherboard and other adjustable regulators.

The output voltage can be set to any value between 1.24V and 18V with two external resistors.

The AZ431L precision reference is offered in two voltage tolerance: 0.5% and 1.0%.

These ICs are available in 4 packages: TO-92 (bulk or ammo packing), SOT-23, SOT-23-5, SOT-89-3.

### Features

- Wide Programmable Precise Output Voltage from 1.24V to 18V
- High Stability under Capacitive Load
- Low Temperature Deviation: 3mV Typical
- Low Equivalent Full-range Temperature Coefficient: 20PPM/°C Typical
- Low Dynamic Output Resistance: 0.05Ω Typical
- High Sink Current Capacity from 0.1mA to 100mA
- Low Output Noise
- Wide Operating Range of -40 to 125°C

### Applications

- Graphic Card
- PC Motherboard
- Voltage Adapter
- Switching Power Supply
- Charger

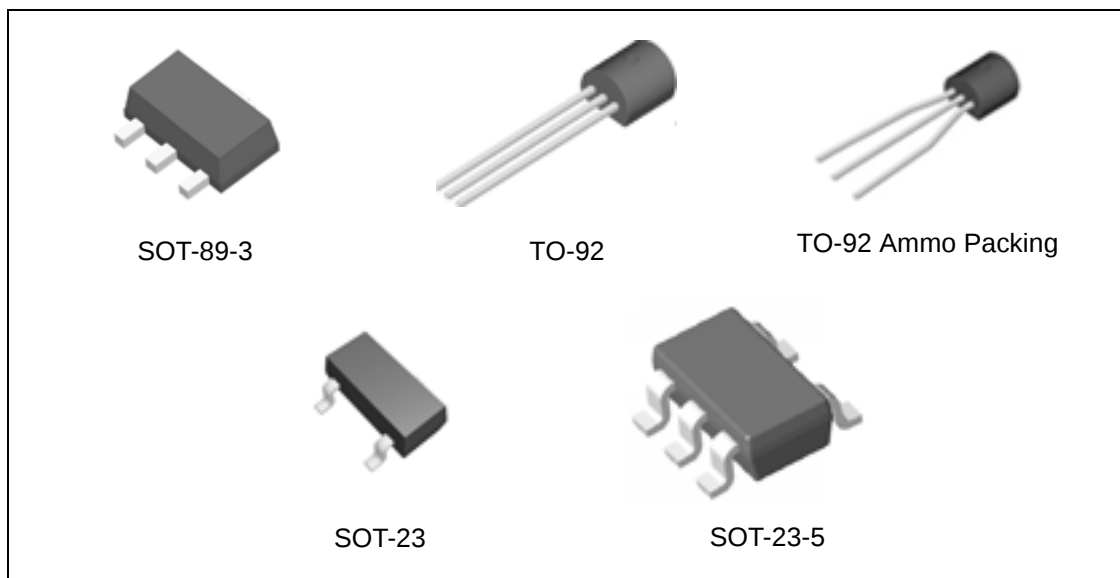


Figure 1. Package Types of AZ431L

**LOW VOLTAGE (1.24V) ADJUSTABLE PRECISION SHUNT REGULATOR**

**AZ431L**

**Pin Configuration**

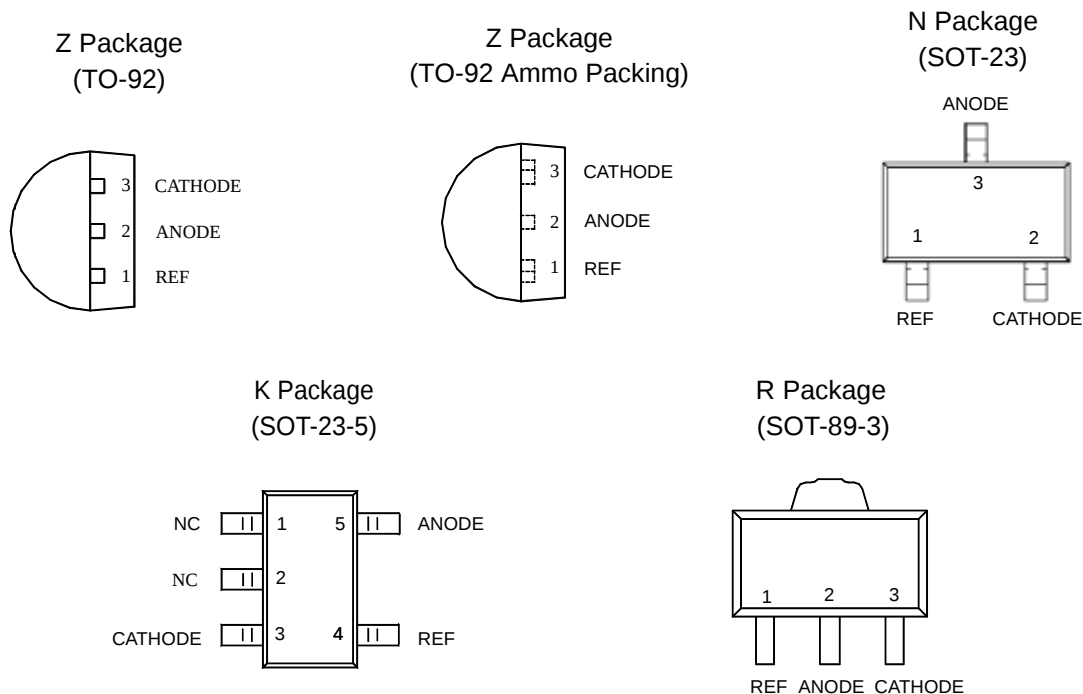


Figure 2. Pin Configuration of AZ431L (Top View)

**Functional Block Diagram**

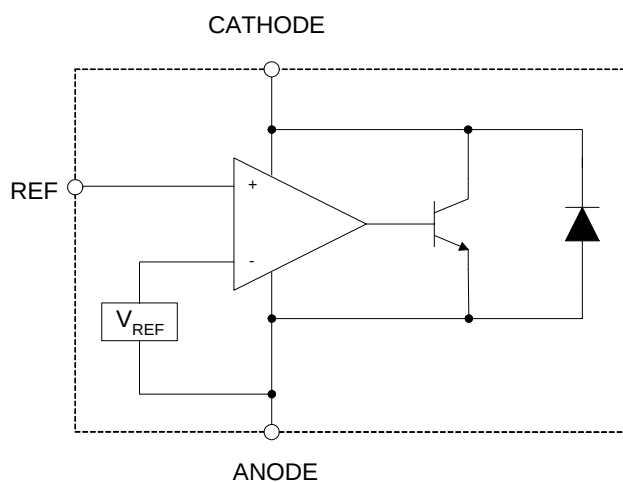
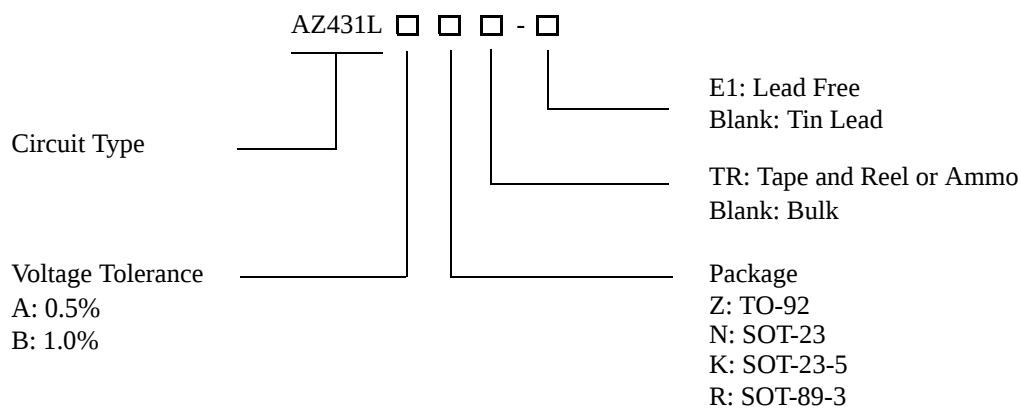


Figure 3. Functional Block Diagram of AZ431L

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**AZ431L**

**Ordering Information**



| Package  | Temperature Range | Voltage Tolerance | Part Number |               | Marking ID |             | Packing Type |
|----------|-------------------|-------------------|-------------|---------------|------------|-------------|--------------|
|          |                   |                   | Tin Lead    | Lead Free     | Tin Lead   | Lead Free   |              |
| TO-92    | -40 to 125°C      | 0.5%              | AZ431LAZ    | AZ431LAZ-E1   | AZ431LAZ   | AZ431LAZ-E1 | Bulk         |
|          |                   | 0.5%              | AZ431LAZTR  | AZ431LAZTR-E1 | AZ431LAZ   | AZ431LAZ-E1 | Ammo         |
|          |                   | 1.0%              | AZ431LBZ    | AZ431LBZ-E1   | AZ431LBZ   | AZ431LBZ-E1 | Bulk         |
|          |                   | 1.0%              | AZ431LBZTR  | AZ431LBZTR-E1 | AZ431LBZ   | AZ431LBZ-E1 | Ammo         |
| SOT-23   | -40 to 125°C      | 0.5%              |             | AZ431LANTR-E1 |            | EA6         | Tape & Reel  |
|          |                   | 1.0%              |             | AZ431LBNTR-E1 |            | EA7         | Tape & Reel  |
| SOT-23-5 | -40 to 125°C      | 0.5%              | AZ431LAKTR  | AZ431LAKTR-E1 | K41        | E5A         | Tape & Reel  |
|          |                   | 1.0%              | AZ431LBKTR  | AZ431LBKTR-E1 | K42        | E6A         | Tape & Reel  |
| SOT-89-3 | -40 to 125°C      | 0.5%              | AZ431LARTR  | AZ431LARTR-E1 | R41A       | E41A        | Tape & Reel  |
|          |                   | 1.0%              | AZ431LBRTR  | AZ431LBRTR-E1 | R41B       | E41B        | Tape & Reel  |

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

**LOW VOLTAGE (1.24V) ADJUSTABLE PRECISION SHUNT REGULATOR**

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**Absolute Maximum Ratings (Note 1)**

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

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                     | $I_{KA}$ | 0.1       | 100 | mA   |
| Operating Ambient Temperature Range |          | -40       | 125 | °C   |

**LOW VOLTAGE (1.24V) ADJUSTABLE PRECISION SHUNT REGULATOR**

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**Electrical Characteristics**

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

| Parameter                                                     | Test Circuit | Symbol                                 | Conditions                                                                                       | Min                                            | Typ   | Max   | Unit          |
|---------------------------------------------------------------|--------------|----------------------------------------|--------------------------------------------------------------------------------------------------|------------------------------------------------|-------|-------|---------------|
| Reference Voltage                                             | 0.5%         | 4                                      | $V_{KA}=V_{REF}$ , $I_{KA}=10\text{mA}$                                                          | 1.234                                          | 1.240 | 1.246 | V             |
|                                                               | 1.0%         |                                        |                                                                                                  | 1.228                                          | 1.240 | 1.252 |               |
| Deviation of Reference Voltage Over Full Temperature Range    | 4            | $\Delta V_{REF}$                       | $V_{KA}=V_{REF}$<br>$I_{KA}=10\text{mA}$                                                         | $0^{\circ}\text{C}$ to $70^{\circ}\text{C}$    | 2     | 10    | mV            |
|                                                               |              |                                        |                                                                                                  | $-40^{\circ}\text{C}$ to $85^{\circ}\text{C}$  | 3     | 10    |               |
|                                                               |              |                                        |                                                                                                  | $-40^{\circ}\text{C}$ to $125^{\circ}\text{C}$ | 4     | 15    |               |
| Ratio of Change in $V_{REF}$ to the Change in Cathode Voltage | 5            | $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ | $I_{KA}=10\text{mA}$ ,<br>$\Delta V_{KA}:V_{REF}$ to 16V                                         |                                                | -0.5  | -1.5  | mV/V          |
| Reference Input Current                                       | 5            | $I_{REF}$                              | $I_{KA}=10\text{mA}$ , $R1=10\text{K}\Omega$ , $R2=\infty$                                       |                                                | 0.15  | 0.4   | $\mu\text{A}$ |
| Deviation of Reference Current Over Full Temperature Range    | 5            | $\Delta I_{REF}$                       | $I_{KA}=10\text{mA}$ , $R1=10\text{K}\Omega$ , $R2=\infty$<br>$T_A=-40$ to $125^{\circ}\text{C}$ |                                                | 0.1   | 0.4   | $\mu\text{A}$ |
| Minimum Cathode Current for Regulation                        | 4            | $I_{KA}$<br>(Min)                      | $V_{KA}=V_{REF}$                                                                                 |                                                | 55    | 80    | $\mu\text{A}$ |
| Off-state Cathode Current                                     | 6            | $I_{KA}$<br>(Off)                      | $V_{REF}=0$ , $V_{KA}=18\text{V}$                                                                |                                                | 0.04  | 0.10  | $\mu\text{A}$ |
|                                                               |              |                                        | $V_{KA}=6$ , $V_{REF}=0$                                                                         |                                                | 0.01  | 0.05  |               |
| Dynamic Impedance                                             | 4            | $Z_{KA}$                               | $V_{KA}=V_{REF}$ , $I_{KA}=1$ to $100\text{mA}$<br>$f \leq 1.0\text{kHz}$                        |                                                | 0.05  | 0.15  | $\Omega$      |

## Electrical Characteristics (Continued)

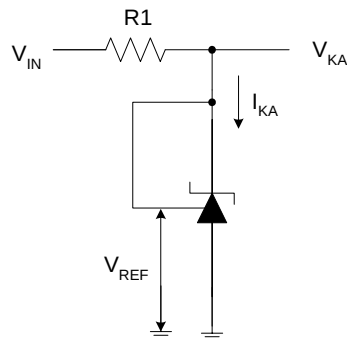


Figure 4. Test Circuit 4 for  $V_{KA}=V_{REF}$

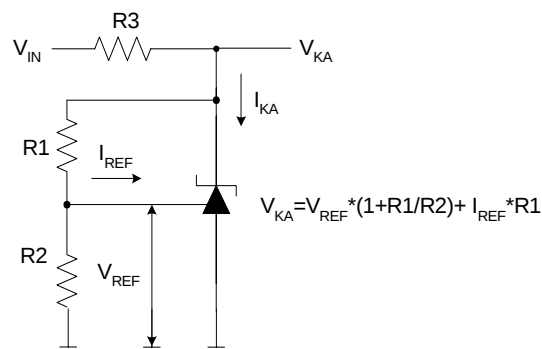


Figure 5. Test Circuit 5 for  $V_{KA}>V_{REF}$

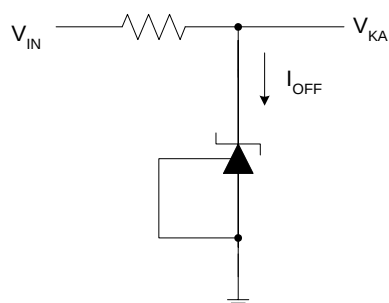


Figure 6. Test Circuit 6 for  $I_{OFF}$

**LOW VOLTAGE (1.24V) ADJUSTABLE PRECISION SHUNT REGULATOR**

**AZ431L**

**Typical Performance Characteristics**

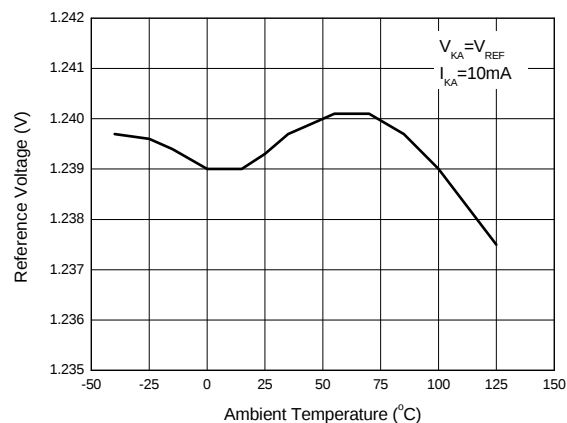


Figure 7. Reference Voltage vs. Ambient Temperature

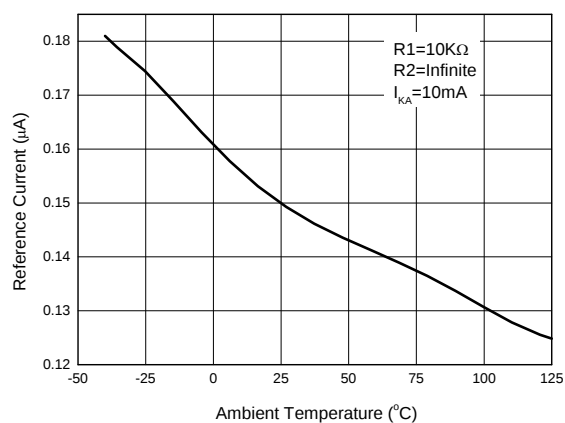


Figure 8. Reference Current vs. Ambient Temperature

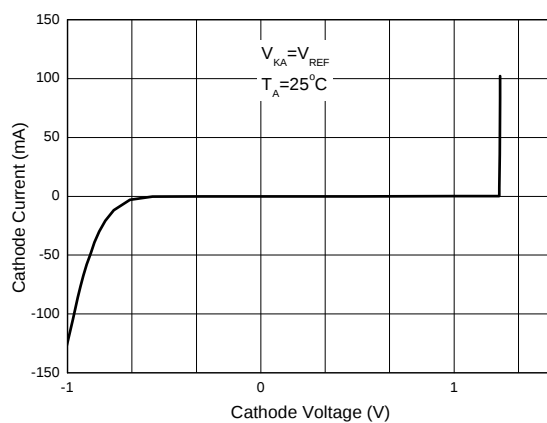


Figure 9. Cathode Current vs. Cathode Voltage

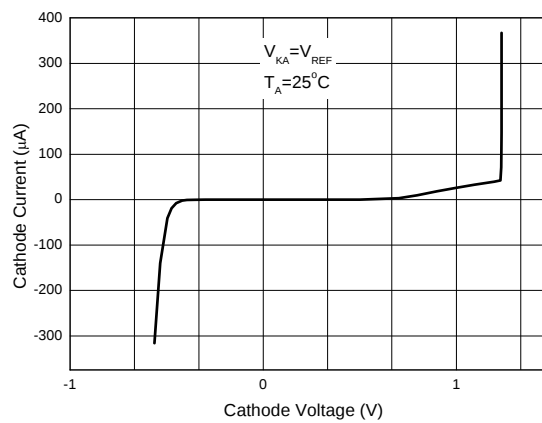


Figure 10. Cathode Current vs. Cathode Voltage

**LOW VOLTAGE (1.24V) ADJUSTABLE PRECISION SHUNT REGULATOR**

**AZ431L**

**Typical Performance Characteristics (Continued)**

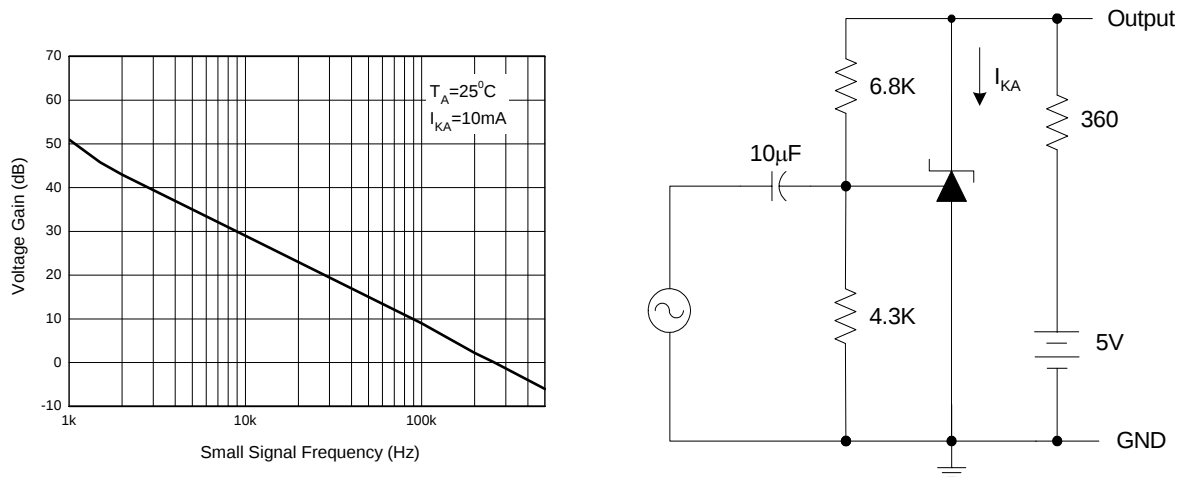


Figure 11. Small Signal Voltage Gain vs. Frequency

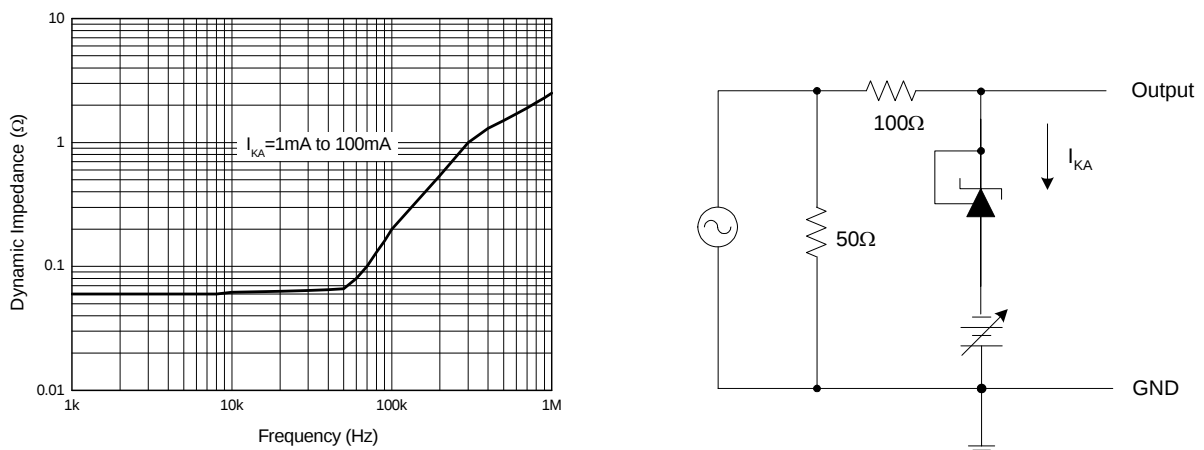


Figure 12. Dynamic Impedance vs. Frequency

**Typical Performance Characteristics (Continued)**

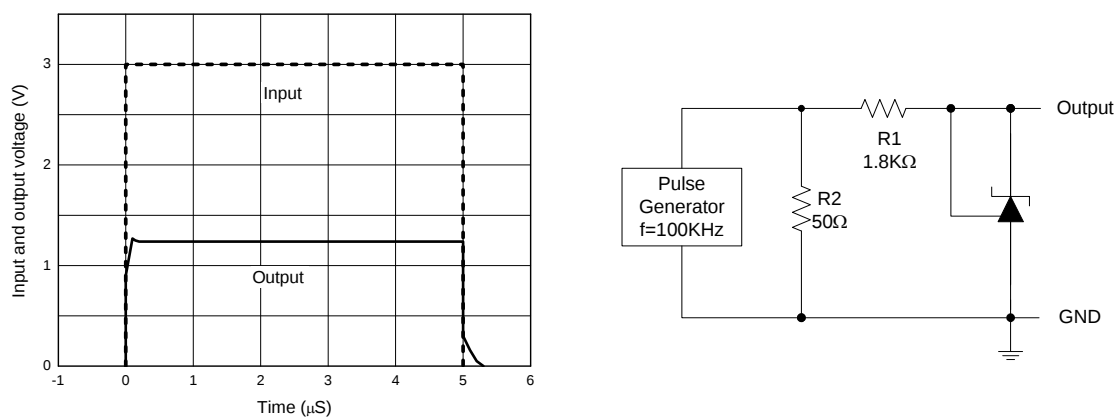


Figure 13. Pulse Response of Input and Output Voltage

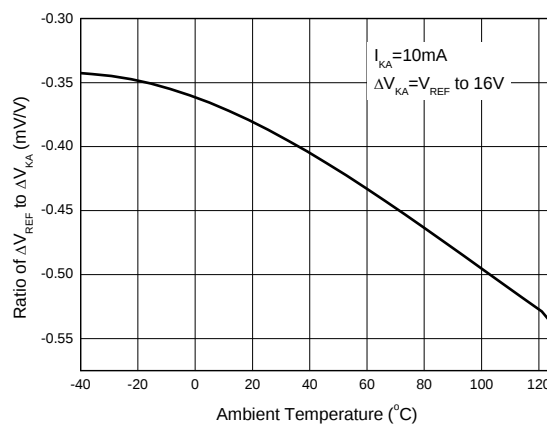


Figure 14. Ratio of Delta Reference Voltage to the Ratio of Cathode Voltage vs. Ambient Temperature



## Typical Applications

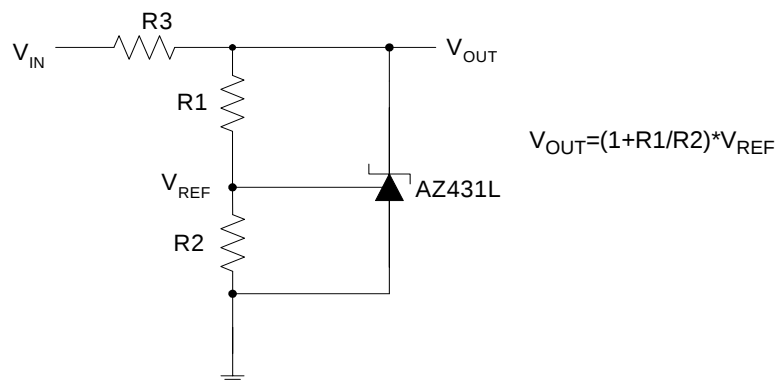


Figure 15. Shunt Regulator

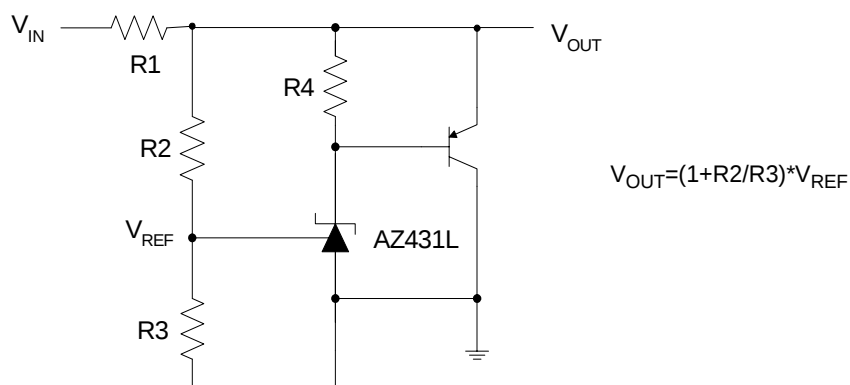


Figure 16. High Current Shunt Regulator

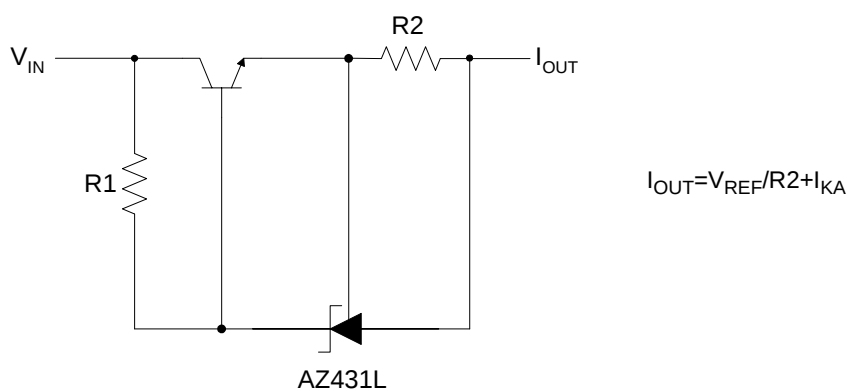


Figure17. Current Source or Current Limit

**Typical Application (Continued)**

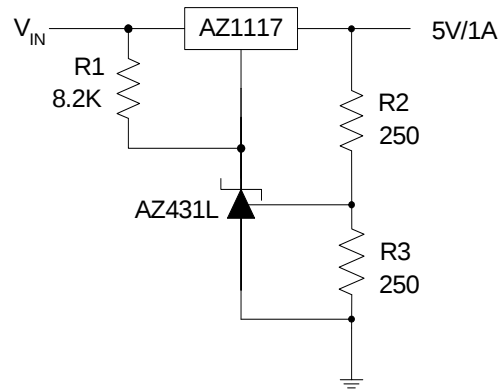


Figure18. Precision 5V 1A Regulator

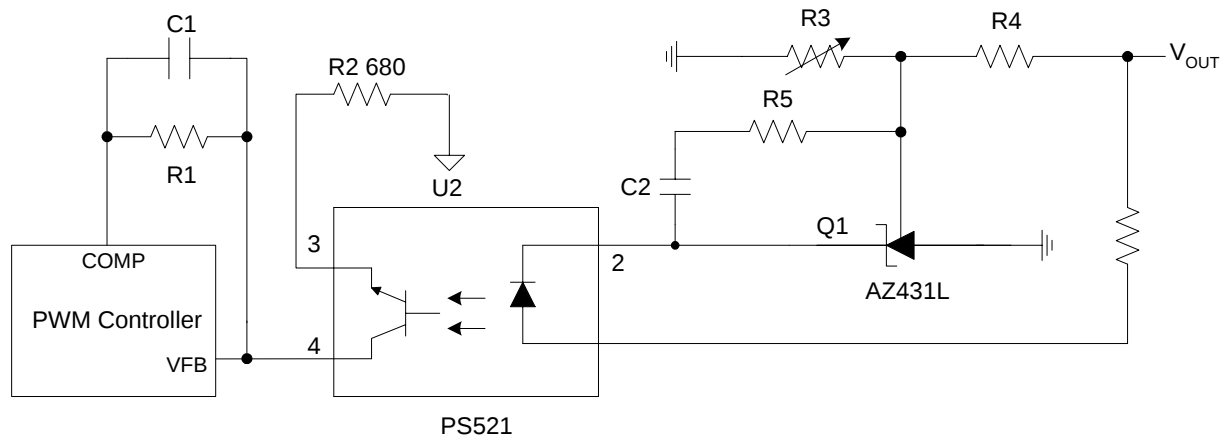
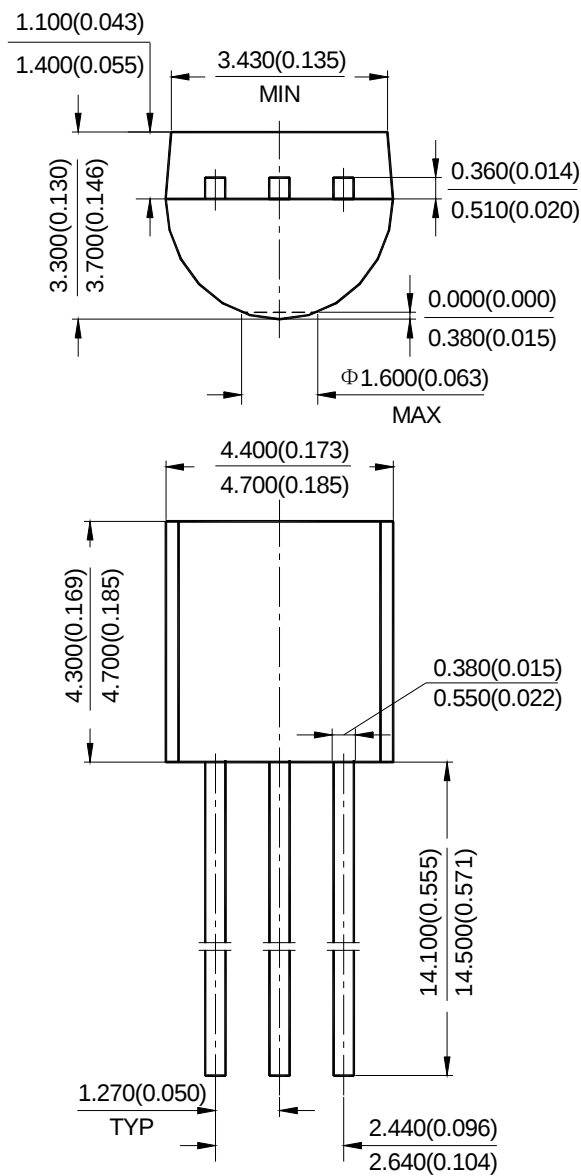


Figure 19. PWM Converter with Reference

## Mechanical Dimensions

TO-92

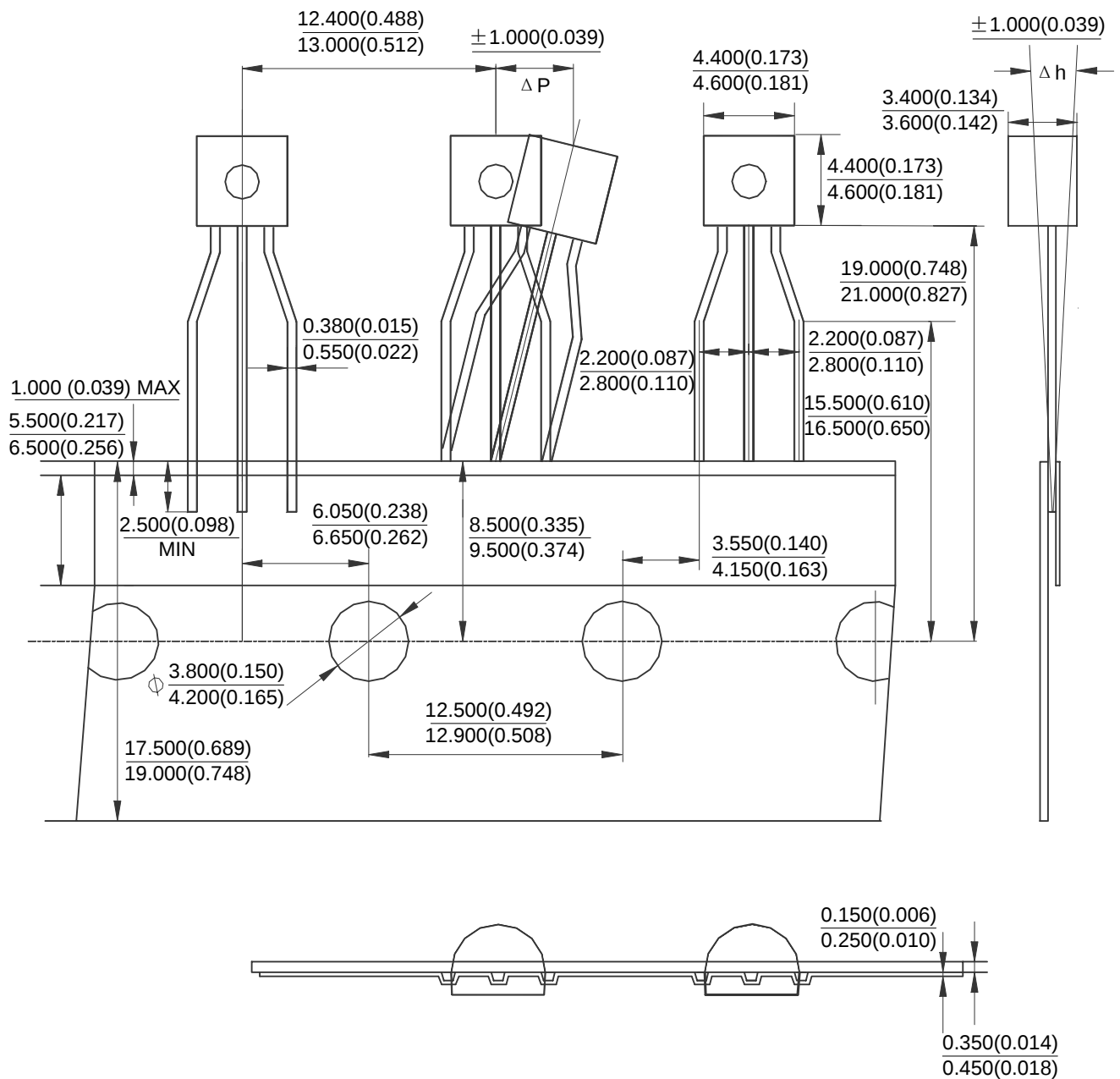
Unit: mm(inch)

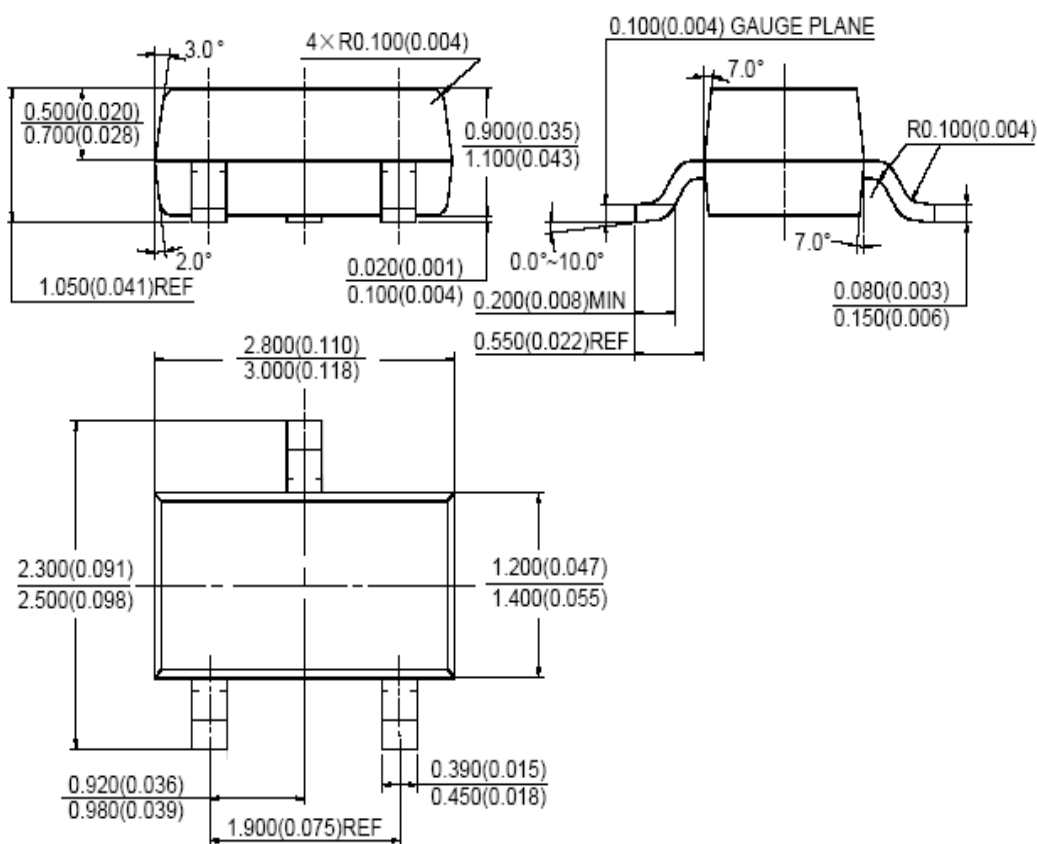


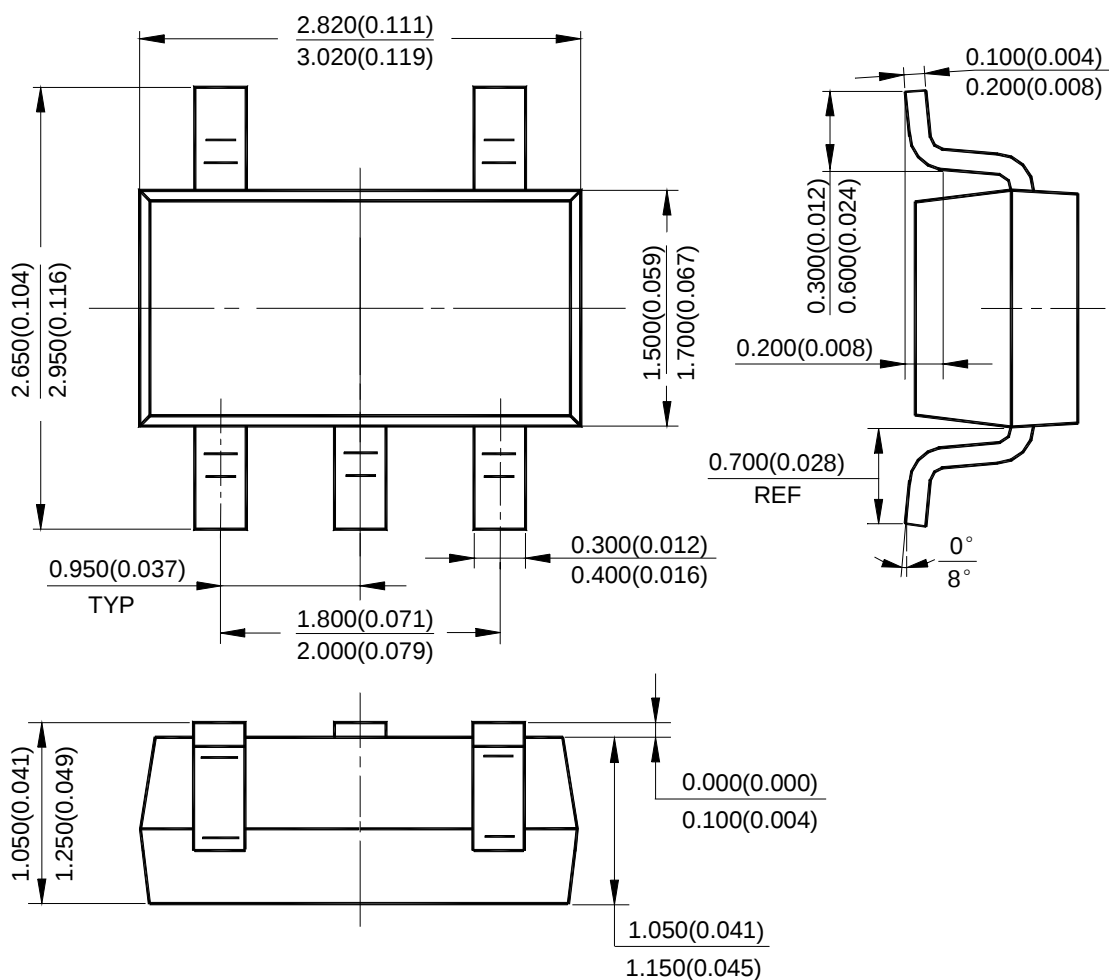
Mechanical Dimensions (Continued)

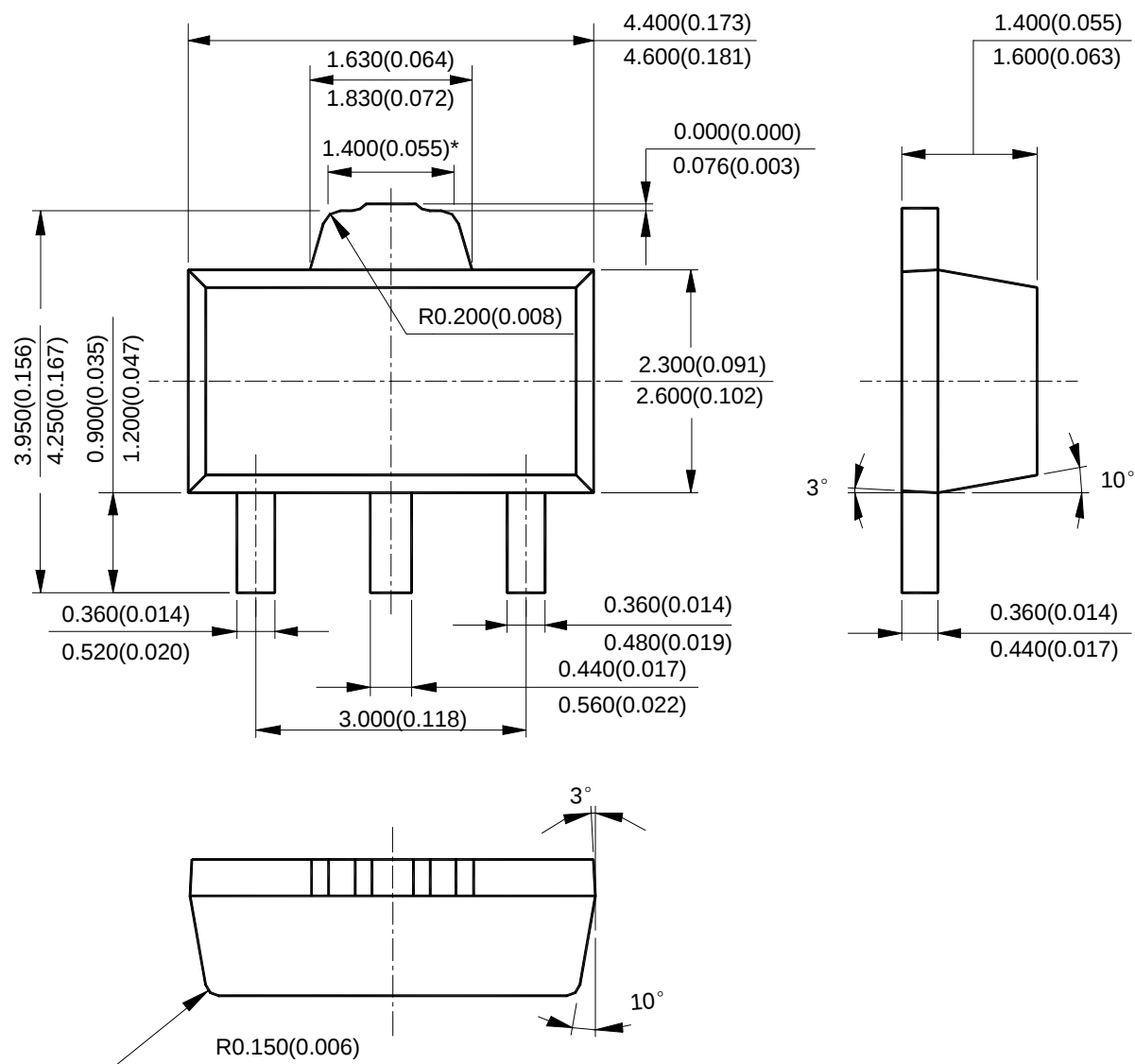
TO-92 Ammo Packing

Unit: mm(inch)



**LOW VOLTAGE (1.24V) ADJUSTABLE PRECISION SHUNT REGULATOR****AZ431L****Mechanical Dimensions (Continued)****SOT-23****Unit: mm(inch)**

**LOW VOLTAGE (1.24V) ADJUSTABLE PRECISION SHUNT REGULATOR****AZ431L****Mechanical Dimensions (Continued)****SOT-23-5****Unit: mm(inch)**

**LOW VOLTAGE (1.24V) ADJUSTABLE PRECISION SHUNT REGULATOR****AZ431L****Mechanical Dimensions (Continued)****SOT-89-3****Unit: mm(inch)**



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