

LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR AS431I

General Description

The AS431I 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 AS431I can be set to any value between V_{REF} (2.5V) and the corresponding maximum cathode voltage (36V).

The AS431I is offered in two grade initial voltage tolerance at 25°C, 0.5%, and 1%.

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

Features

- Programmable Precise Output Voltage from 2.5V to 36V
- High Stability Under Capacitive Load
- Low Minimum Cathode Current for Regulation: 10 μ A (Typ.), 50 μ A (Max.)
- Low Temperature Deviation: 4.5mV Typical
- Sink Current Capacity from 50 μ A to 100mA
- Low Output Noise
- Wide Operating Range: -40°C to 125°C

Applications

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

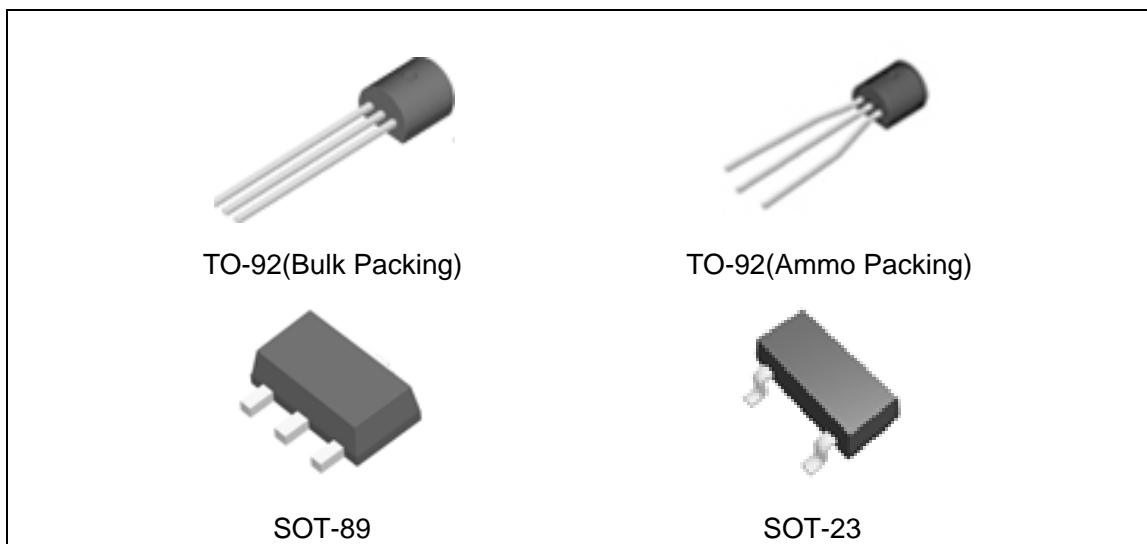


Figure 1. Package Type of AS431I

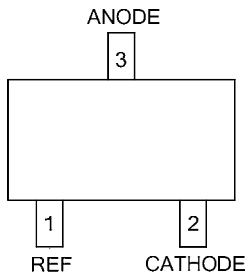
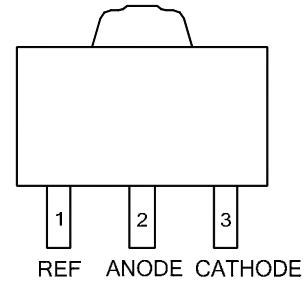
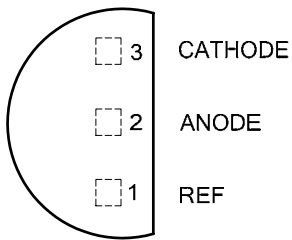
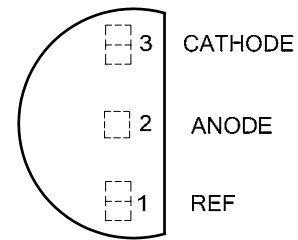
LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR AS431I**Pin Configuration**N Package
(SOT-23)P Package
(SOT-89)Z Package
(TO-92 (Bulk Package))Z Package
(TO-92 (Ammo Package))

Figure 2. Pin Configuration of AS431I (Top View)

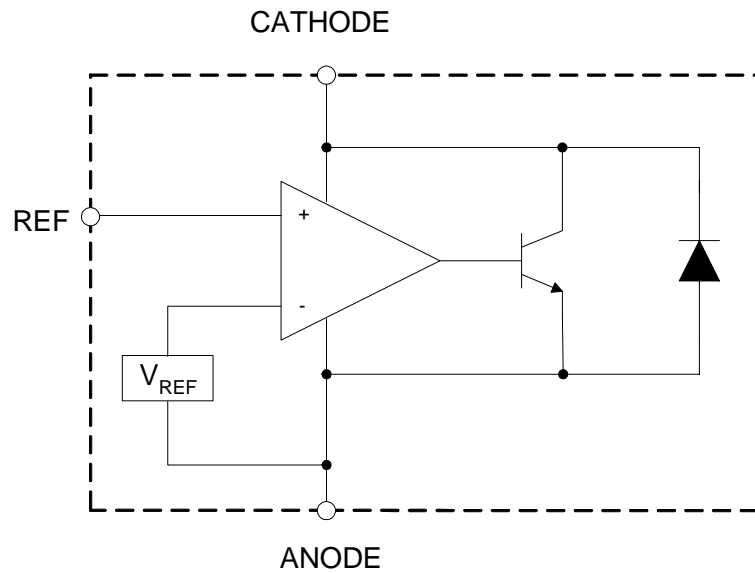
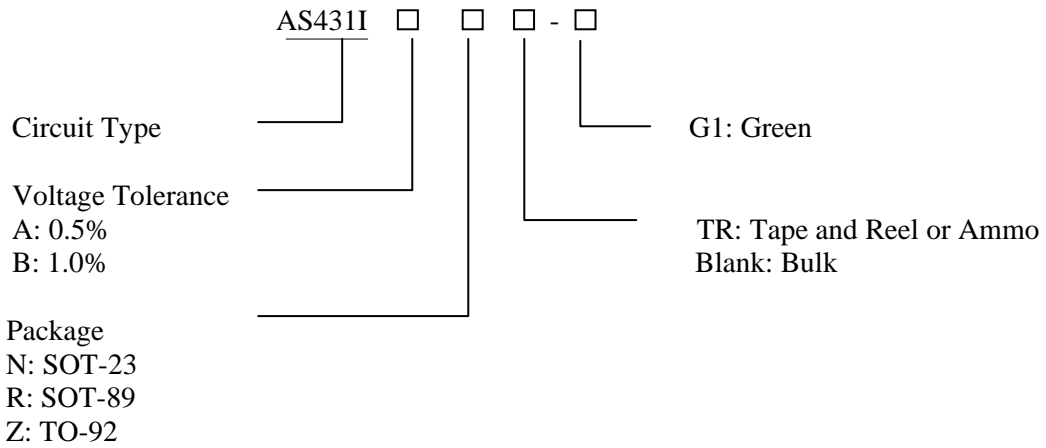
Functional Block Diagram

Figure 3. Functional Block Diagram of AS431I



LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR AS431I

Ordering Information



| Package | Temperature Range | Voltage Tolerance | Part Number | Marking ID | Packing Type |
|---------|-------------------|-------------------|---------------|-------------|--------------|
| SOT-23 | -40 to 125°C | 0.5% | AS431IANTR-G1 | GB9 | Tape & Reel |
| | | 1.0% | AS431IBNTR-G1 | GC9 | Tape & Reel |
| TO-92 | -40 to 125°C | 0.5% | AS431IAZ-G1 | AS431IAZ-G1 | Bulk |
| | | 0.5% | AS431IAZTR-G1 | AS431IAZ-G1 | Ammo |
| | | 1.0% | AS431IBZ-G1 | AS431IBZ-G1 | Bulk |
| | | 1.0% | AS431IBZTR-G1 | AS431IBZ-G1 | Ammo |
| SOT-89 | -40 to 125°C | 0.5% | AS431IARTR-G1 | G43J | Tape & Reel |
| | | 1.0% | AS431IBRTR-G1 | G43K | Tape & Reel |

BCD Semiconductor's products, as designated with "G1" suffix in the part number, are RoHS compliant and Green.

**LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR AS431I****Absolute Maximum Ratings (Note 1)**

| Parameter | Symbol | Value | | Unit |
|------------------------------------|-----------|-------------|-----|------|
| Cathode Voltage | V_{KA} | 40 | | V |
| Cathode Current Range (Continuous) | I_{KA} | -100 to 150 | | mA |
| Reference Input Current Range | I_{REF} | 10 | | mA |
| Power Dissipation | P_D | TO-92 | 770 | mW |
| | | SOT-89 | 770 | |
| | | SOT-23 | 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} | 36 | V |
| Cathode Current | I_{KA} | 0.05 | 100 | mA |
| Operating Ambient Temperature Range | T_A | -40 | 125 | °C |



LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR AS431I

Electrical Characteristics

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

| Parameter | Test Circuit | Symbol | Conditions | Min | Typ | Max | Unit |
|---|--------------|--|--|---|-------|-------|----------------------|
| Reference Voltage | 0.5% | 4 | $V_{KA}=V_{REF}, I_{KA}=10\text{mA}$ | 2.487 | 2.500 | 2.512 | V |
| | 1.0% | | | 2.475 | 2.500 | 2.525 | |
| Deviation of Reference Voltage Over Full Temperature Range | 4 | ΔV_{REF} | $V_{KA}=V_{REF}, I_{KA}=10\text{mA}$ | 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 | $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ | $I_{KA}=10\text{mA}$ | $\Delta V_{KA}=10\text{V to } V_{REF}$ | -1.0 | -2.7 | mV/V |
| | | | | $\Delta V_{KA}=36\text{V to } 10\text{V}$ | -0.5 | -2.0 | |
| Reference Current | 5 | I_{REF} | $I_{KA}=10\text{mA}, R1=10\text{k}\Omega, R2=\infty$ | | 0.035 | 0.5 | μA |
| Deviation of Reference Current Over Full Temperature Range | 5 | ΔI_{REF} | $I_{KA}=10\text{mA}, R1=10\text{k}\Omega, R2=\infty, T_A=-40$ to 125°C | | 0.03 | 0.3 | μA |
| Minimum Cathode Current for Regulation | 4 | $I_{KA}(\text{Min})$ | $V_{KA}=V_{REF}$ | | 10 | 50 | μA |
| Off-state Cathode Current | 6 | $I_{KA}(\text{Off})$ | $V_{KA}=36\text{V}, V_{REF}=0$ | | 0.05 | 1.0 | μA |
| Dynamic Impedance | 4 | Z_{KA} | $V_{KA}=V_{REF}, I_{KA}=1$ to $100\text{mA}, f\leq 1.0\text{kHz}$ | | 0.15 | 0.5 | Ω |
| Thermal Resistance | | θ_{JC} | TO-92 | | 68 | | $^{\circ}\text{C/W}$ |
| | | | SOT-89 | | 70 | | |
| | | | SOT-23 | | 113 | | |

Electrical Characteristics (Continued)

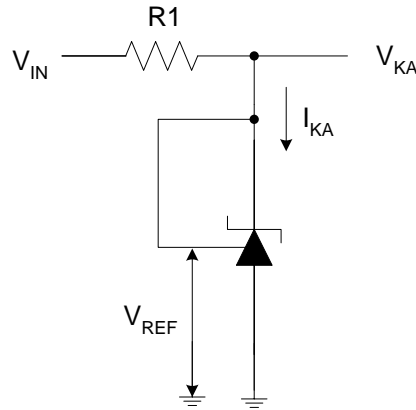


Figure 4. Test Circuit 4 for $V_{KA} = V_{REF}$

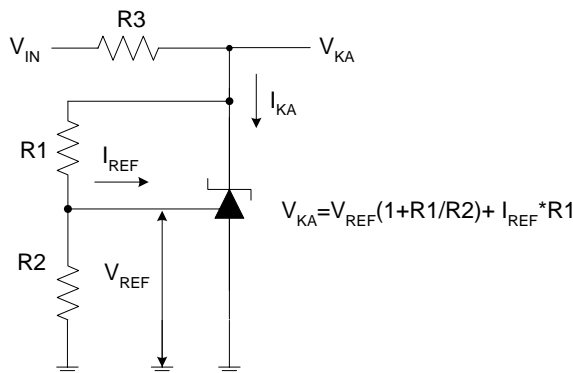


Figure 5. Test Circuit 5 for $V_{KA} > V_{REF}$

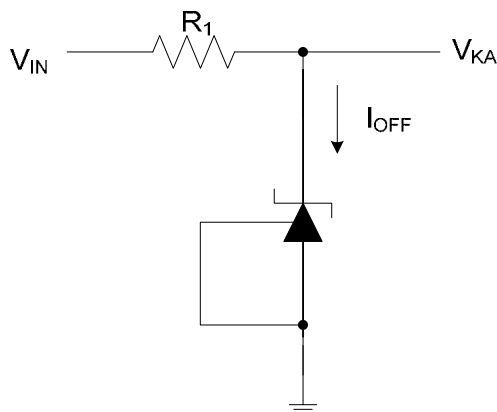


Figure 6. Test Circuit 6 for I_{OFF}

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Typical Performance Characteristics

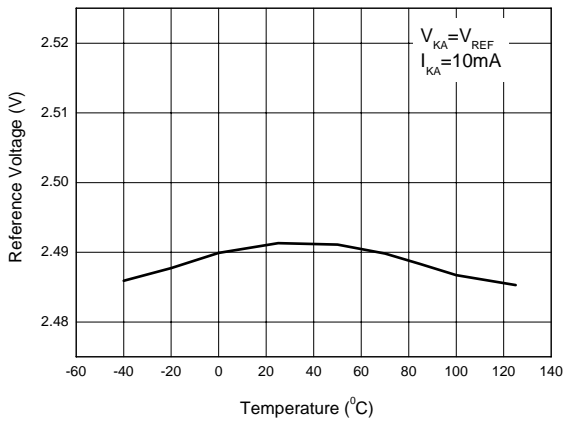


Figure 7. Reference Voltage vs. Ambient Temperature

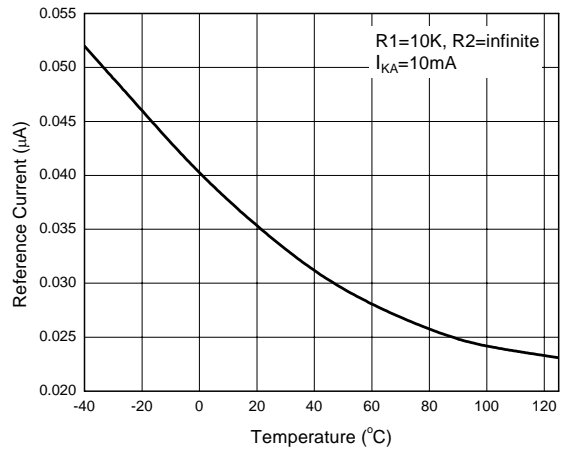


Figure 8. Reference Current vs. Ambient Temperature

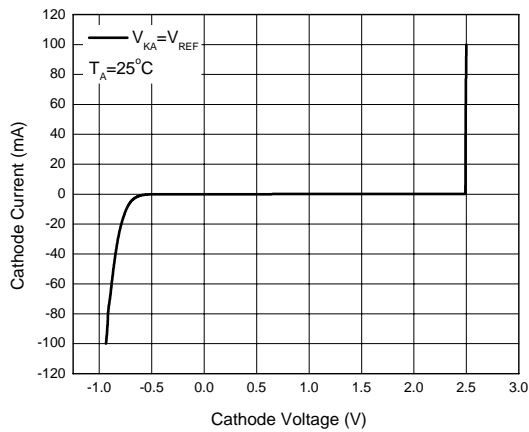


Figure 9. Cathode Current vs. Cathode Voltage

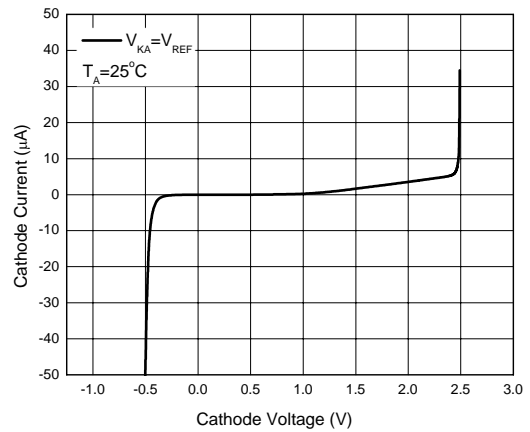


Figure 10. Cathode Current vs. Cathode Voltage

LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR AS431I

Typical Performance Characteristics (Continued)

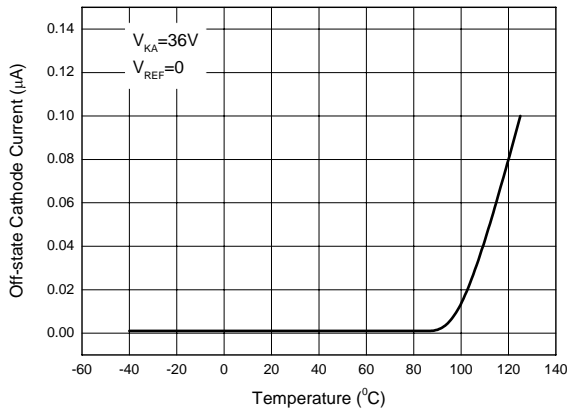


Figure 11. Off-state Cathode Current vs. Ambient Temperature

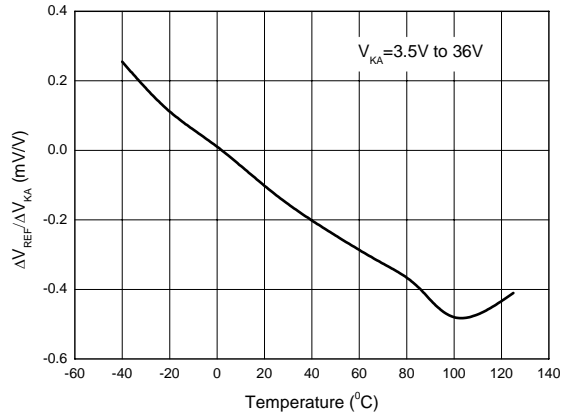


Figure 12. Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage

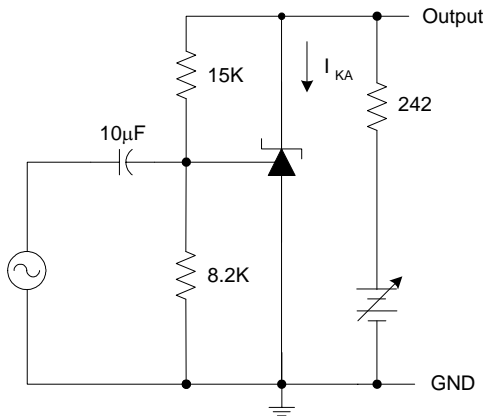
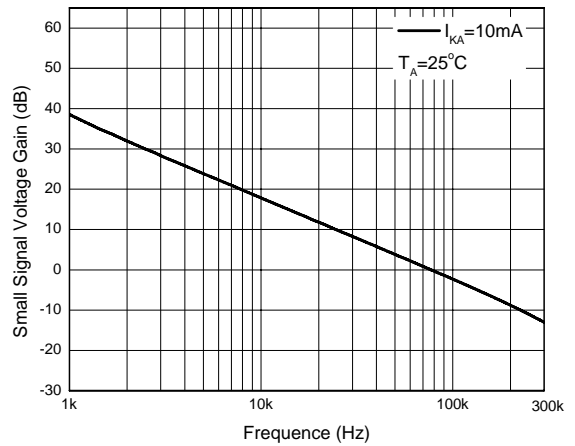


Figure 13. Small Signal Voltage Gain vs. Frequency



LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR AS431I

Typical Performance Characteristics (Continued)

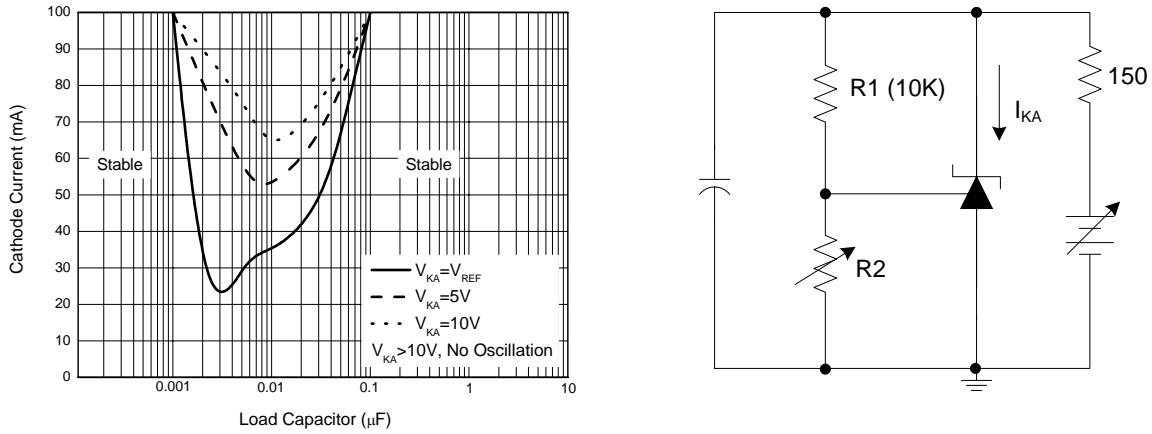


Figure 14. Stability Boundary Conditions vs. Load Capacitance

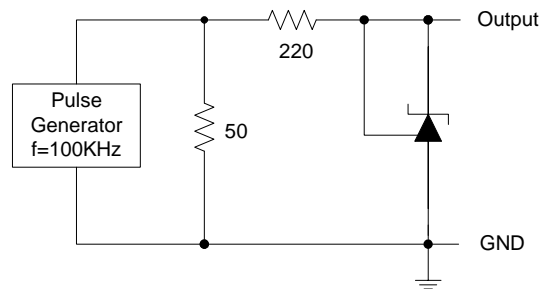
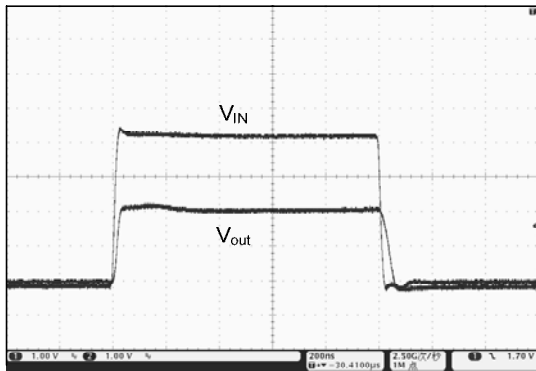


Figure 15. Pulse Response of Input and Output Voltage

Typical Application

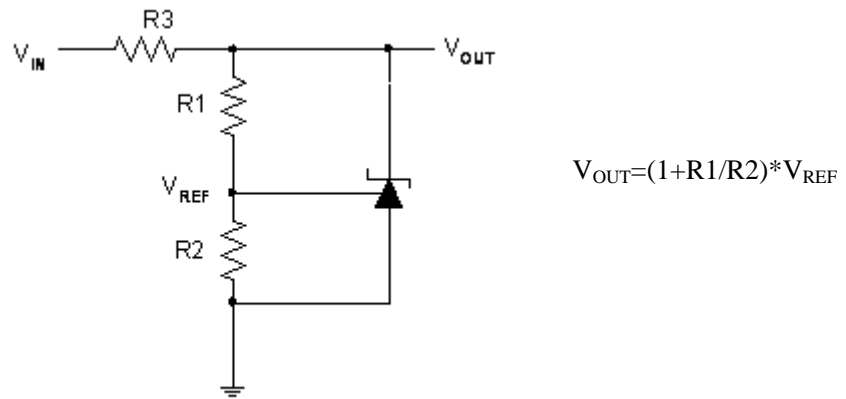


Figure 16. Shunt Regulator

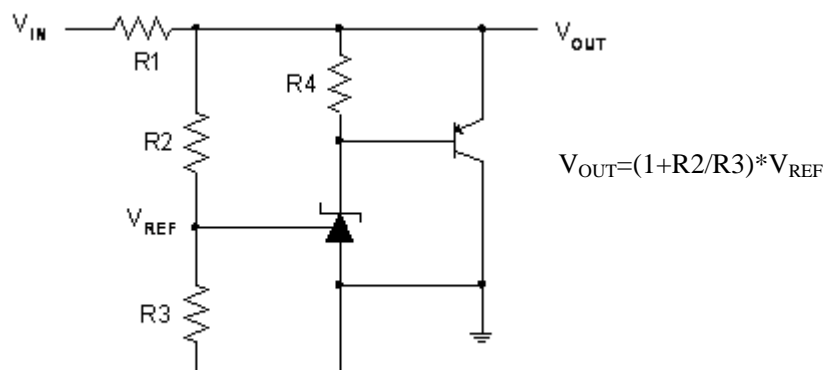


Figure 17. High Current Shunt Regulator

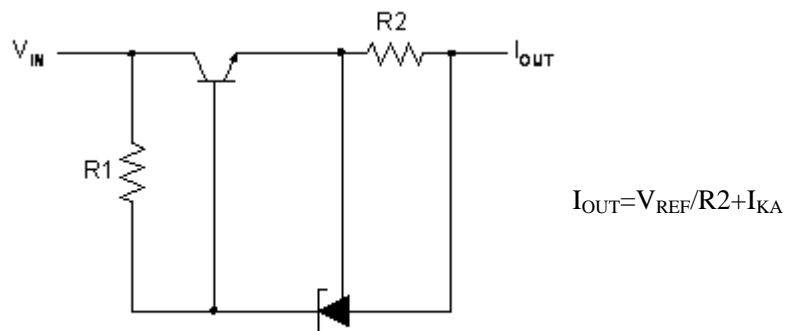


Figure 18. Current Source or Current Limit

Typical Application (Continued)

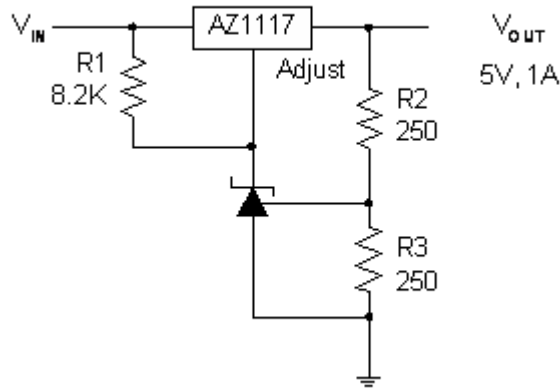


Figure 19. Precision 5V 1A Regulator

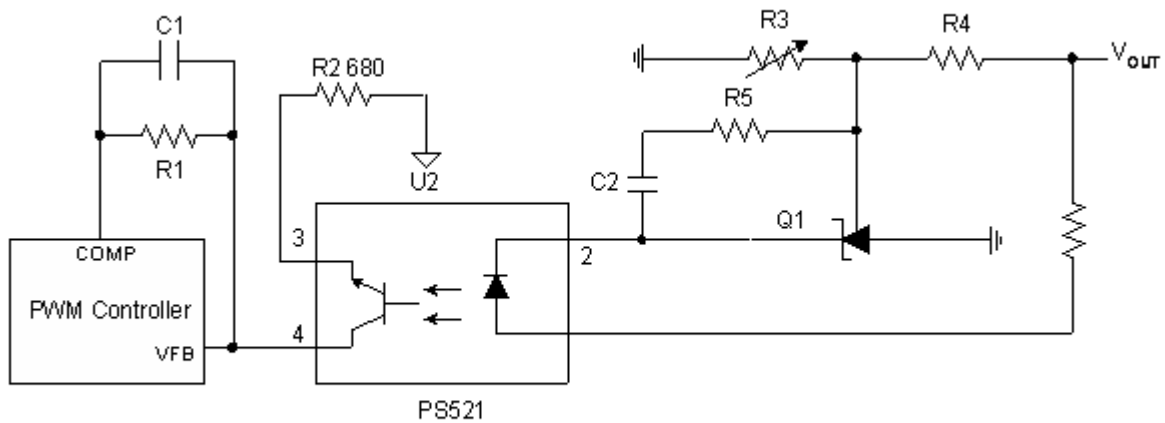


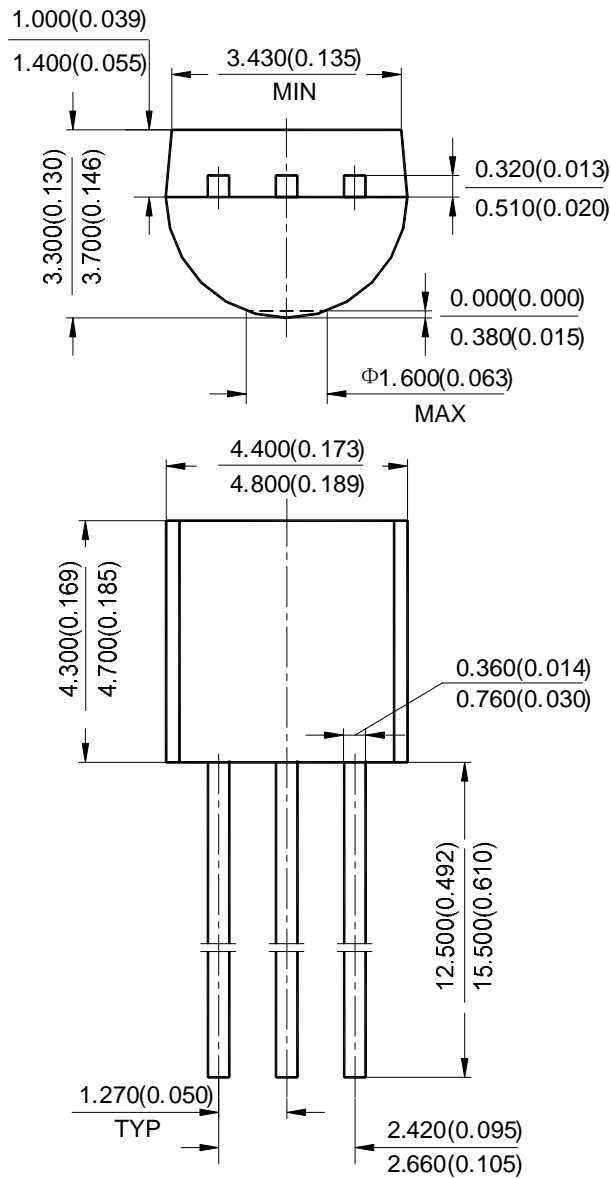
Figure 20. PWM Converter with Reference

LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR AS431I

Mechanical Dimensions

TO-92(Bulk Packing)

Unit: mm(inch)

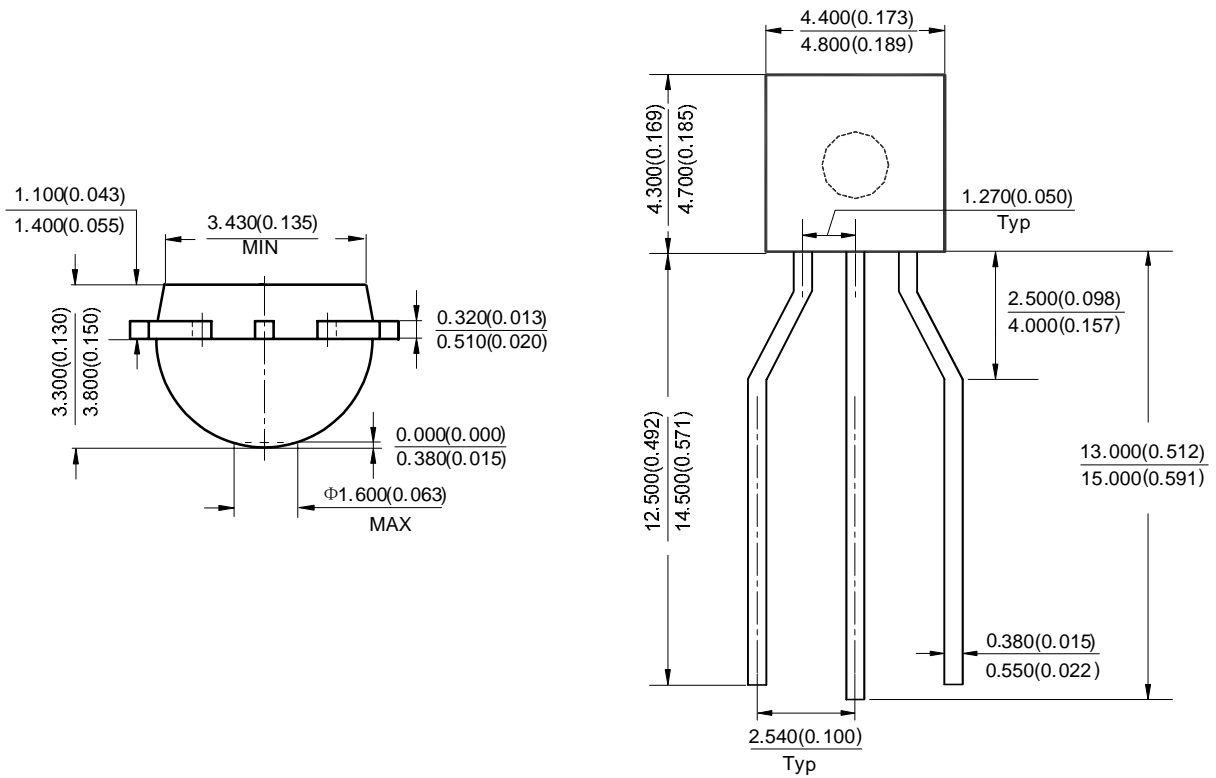


LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR AS431I

Mechanical Dimensions (Continued)

TO-92(Ammo Packing)

Unit: mm(inch)

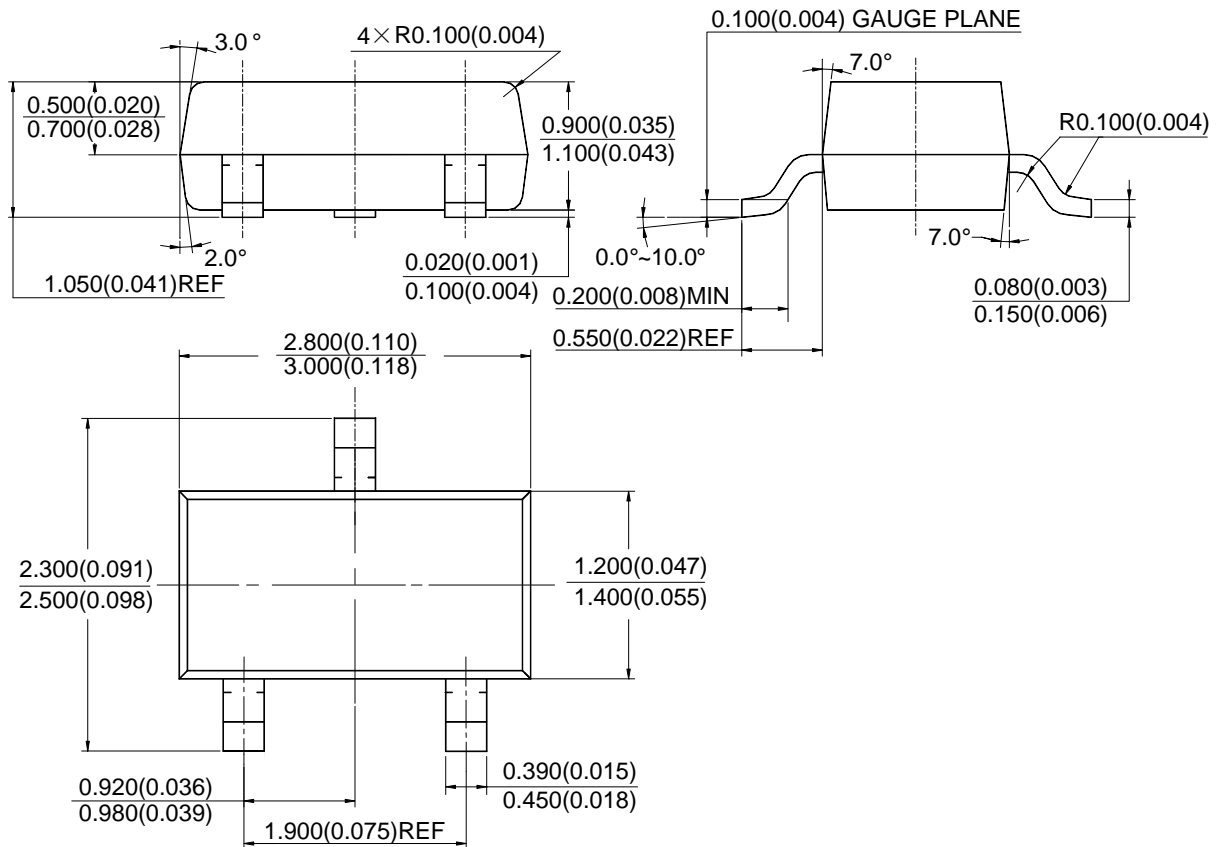


LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR AS431I

Mechanical Dimensions (Continued)

SOT-23

Unit: mm(inch)

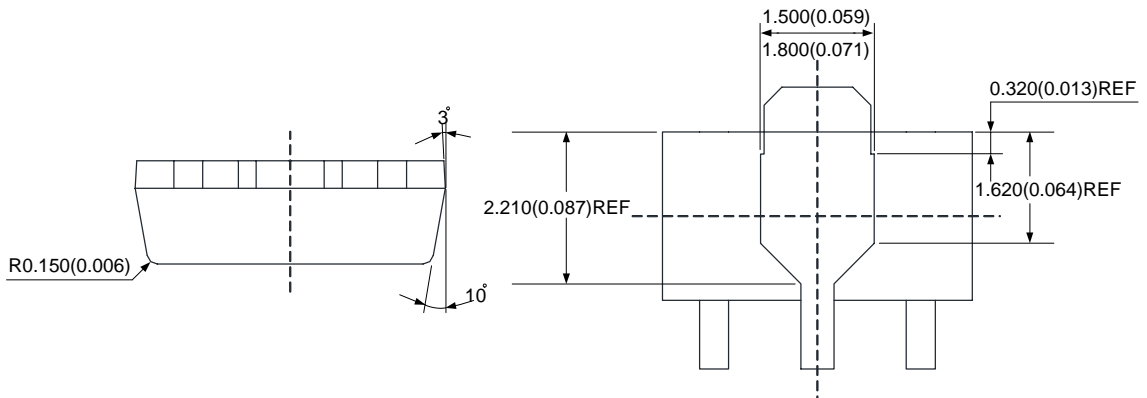
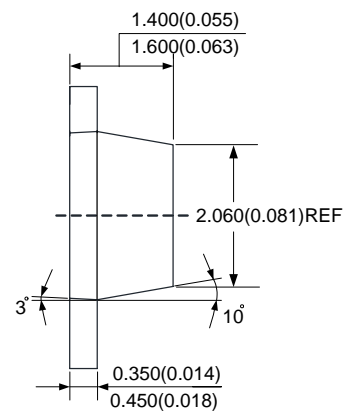
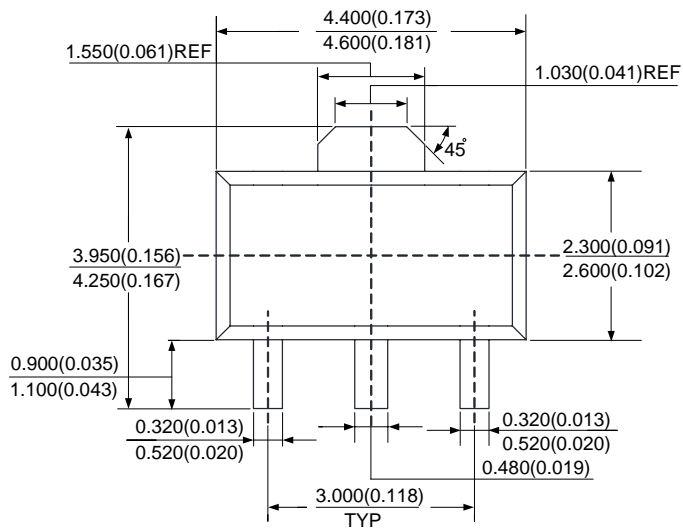


LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR AS431I

Mechanical Dimensions (Continued)

SOT-89

Unit: mm(inch)





BCD Semiconductor Manufacturing Limited

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