# LOW VOLTAGE (1.25V) ADJUSTABLE PRECISION SHUNT REGULATOR AZ432

## General Description

The AZ432 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 1.25V and 18V with two external resistors.

The AZ432 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 and SOT-89.

## Features

- Wide Programmable Precise Output Voltage from 1.25V to 18V
- High Stability under Capacitive Load
- Low Temperature Deviation: 3mV Typical
- Low Equivalent Full-Range Temperature Coefficient: 20PPM/$^{o}$C Typical
- Low Dynamic Output Resistance: 0.05Ω Typical
- High Sink Current Capacity from 0.1mA to 100 mA
- Low Output Noise
- Wide Operating Range of -40 to 125$^{o}$C

## Applications

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

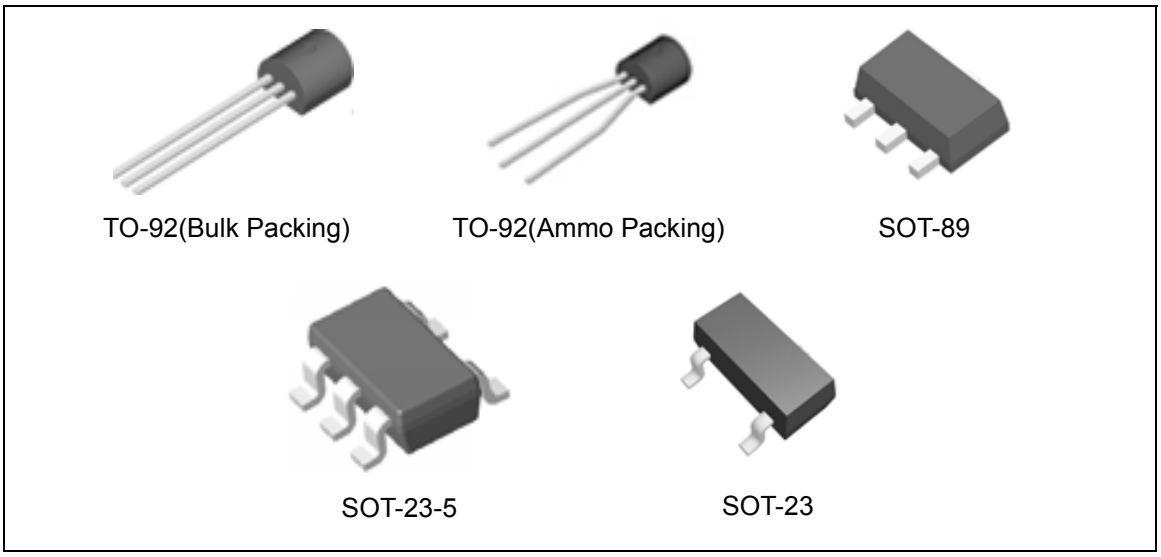



Figure 1. Package Types of AZ432

## Pin Configuration

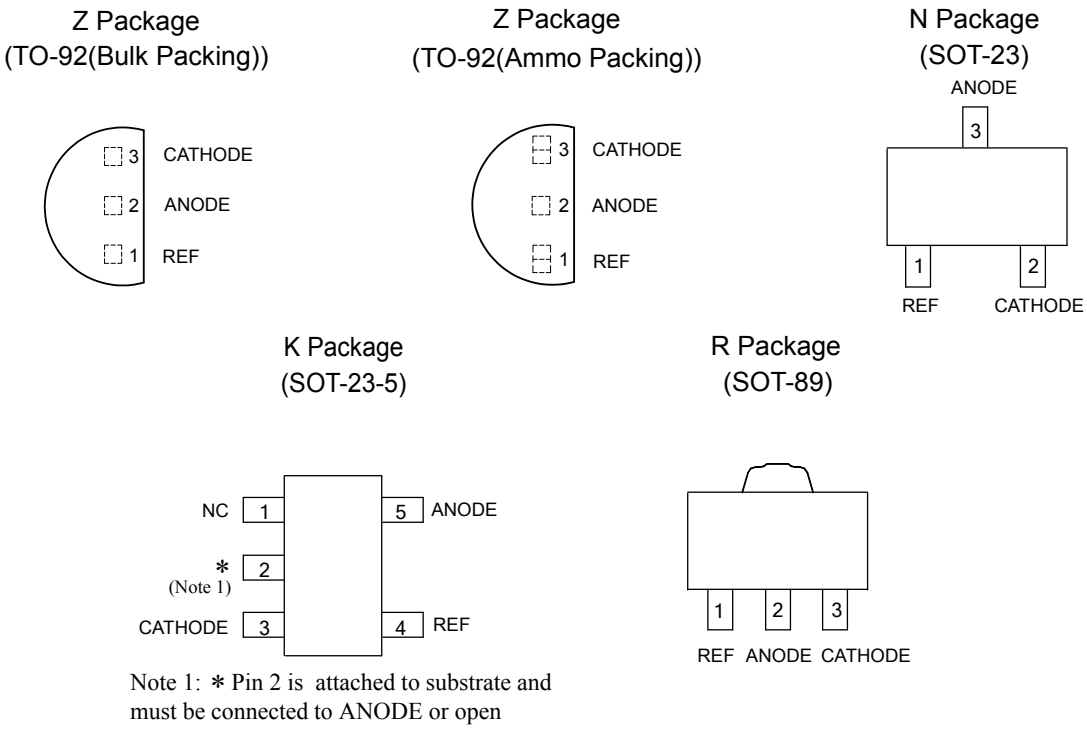



Figure 2. Pin Configuration of AZ432 (Top View)

## Functional Block Diagram

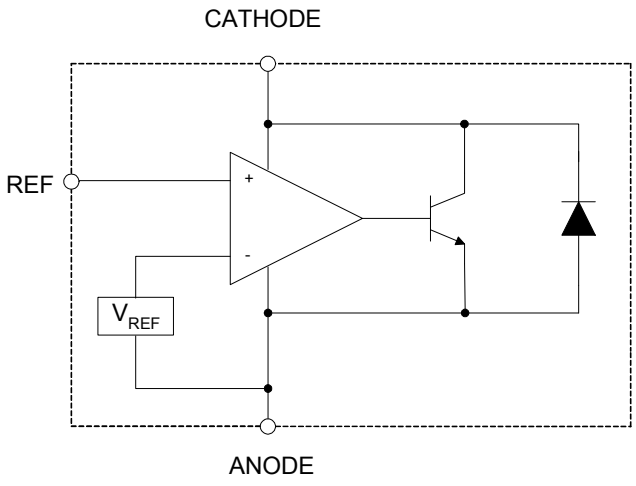
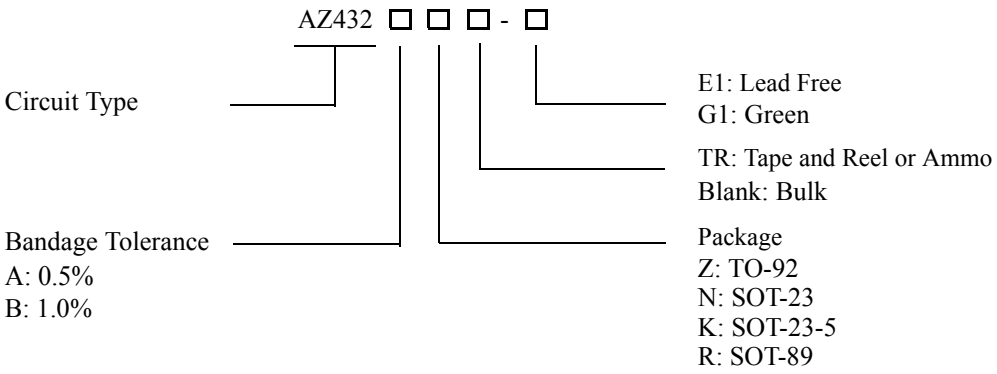



Figure 3. Functional Block Diagram of AZ432

## Ordering Information




| Package | Tempera-ture Range | Voltage Tolerance | Part Number | | Marking ID | | Packing Type |
|---|---|---|---|---|---|---|---|
| | | | Lead Free | Green | Lead Free | Green | |
| TO-92 | -40 to 125°C | 0.5% | AZ432AZ-E1 | AZ432AZ-G1 | AZ432AZ-E1 | AZ432AZ-G1 | Bulk |
| | | 0.5% | AZ432AZTR-E1 | AZ432AZTR-G1 | AZ432AZ-E1 | AZ432AZ-G1 | Ammo |
| | | 1.0% | AZ432BZ-E1 | AZ432BZ-G1 | AZ432BZ-E1 | AZ432BZ-G1 | Bulk |
| | | 1.0% | AZ432BZTR-E1 | AZ432BZTR-G1 | AZ432BZ-E1 | AZ432BZ-G1 | Ammo |
| SOT-23 | -40 to 125°C | 0.5% | AZ432ANTR-E1 | AZ432ANTR-G1 | EA8 | GA8 | Tape & Reel |
| | | 1.0% | AZ432BNTR-E1 | AZ432BNTR-G1 | EA9 | GA9 | Tape & Reel |
| SOT-23-5 | -40 to 125°C | 0.5% | AZ432AKTR-E1 | AZ432AKTR-G1 | E7A | G7A | Tape & Reel |
| | | 1.0% | AZ432BKTR-E1 | AZ432BKTR-G1 | E8A | G8A | Tape & Reel |
| SOT-89 | -40 to 125°C | 0.5% | AZ432ARTR-E1 | AZ432ARTR-G1 | E42A | G42A | Tape & Reel |
| | | 1.0% | AZ432BRTR-E1 | AZ432BRTR-G1 | E42B | G42B | Tape & Reel |

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant. Products with "G1" suffix are available in green packages.

## Absolute Maximum Ratings (Note 2)

| 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 2: 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 Operation Ratings

| 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 |

## Electrical Characteristics

(Typical and limits apply for $T_A$=25°C, unless otherwise noted.)

| Parameter | | Test Circuit | Symbol | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|
| Reference Voltage | 0.5% | 4 | $V_{REF}$ | $V_{KA}=V_{REF}$, $I_{KA}$=10mA | | 1.244 | 1.250 | 1.256 | V |
| | 1.0% | | | | | 1.238 | 1.250 | 1.262 | |
| Deviation of Reference Voltage Over Full Temperature Range | | 4 | $\Delta V_{REF}$ | $V_{KA}=V_{REF}$ $I_{KA}$=10mA | 0 to 70°C | | 2 | 10 | mV |
| | | | | | -40 to 85°C | | 3 | 10 | |
| | | | | | -40 to 125°C | | 4 | 15 | |
| Ratio of Change in $V_{REF}$ to the Change in Cathode Voltage | | 5 | $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ | $I_{KA}$=10mA, $\Delta V_{KA}$: $V_{REF}$ to 16V | | | -0.5 | -1.5 | mV/V |
| Reference Input Current | | 5 | $I_{REF}$ | $I_{KA}$=10mA, R1=10KΩ, R2=∞ | | | 0.15 | 0.4 | μA |
| Deviation of Reference Current Over Full Temperature Range | | 5 | $\Delta I_{REF}$ | $I_{KA}$=10mA, R1=10KΩ, R2=∞ $T_A$=-40 to 125°C | | | 0.1 | 0.4 | μA |
| Minimum Cathode Current for Regulation | | 4 | $I_{KA}$ (MIN) | $V_{KA}=V_{REF}$ | | | 55 | 80 | μA |
| Off-state Cathode Current | | 6 | $I_{KA}$ (OFF) | $V_{REF}$=0, $V_{KA}$=18V | | | 0.04 | 0.10 | μA |
| | | | | $V_{KA}$=6V, $V_{REF}$=0 | | | 0.01 | 0.05 | |
| Dynamic Impedance | | 4 | $Z_{KA}$ | $V_{KA}=V_{REF}$, $I_{KA}$=1 to 100mA f≤1.0kHz | | | 0.05 | 0.15 | Ω |
| Thermal Resistance (Junction to Case) | | | $\theta_{JC}$ | SOT-23 | | | 84.84 | | °C/W |
| | | | | SOT-23-5 | | | 84.84 | | |
| | | | | TO-92 | | | 140.80 | | |
| | | | | SOT-89 | | | 29.80 | | |

## Electrical Characteristics (Continued)

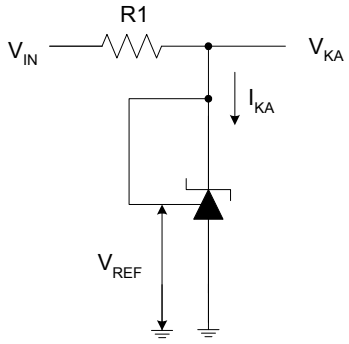



Figure 4. Test Circuit 4 for $V_{KA}=V_{REF}$

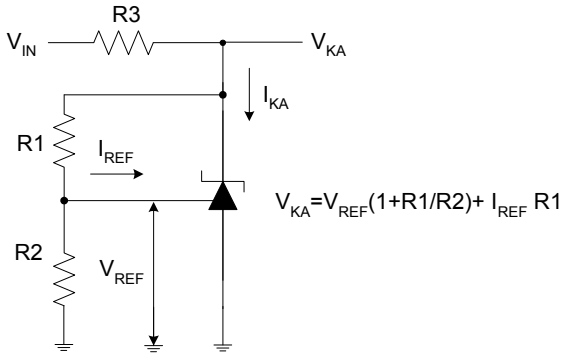



Figure 5. Test Circuit 5 for $V_{KA}>V_{REF}$

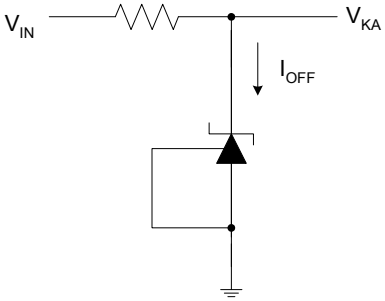



Figure 6. Test Circuit 6 for $I_{OFF}$

## Typical Performance Characteristics

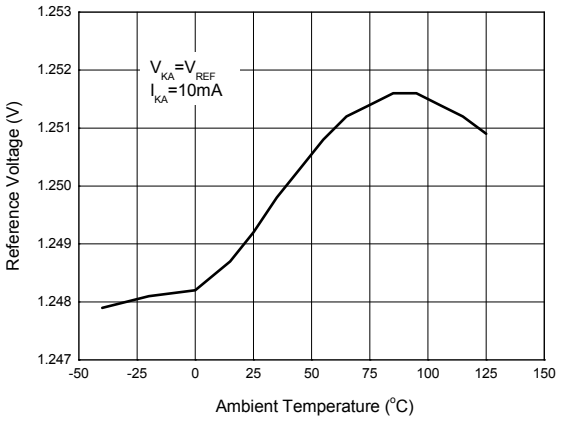



Figure 7. Reference Voltage vs. Ambient Temperature

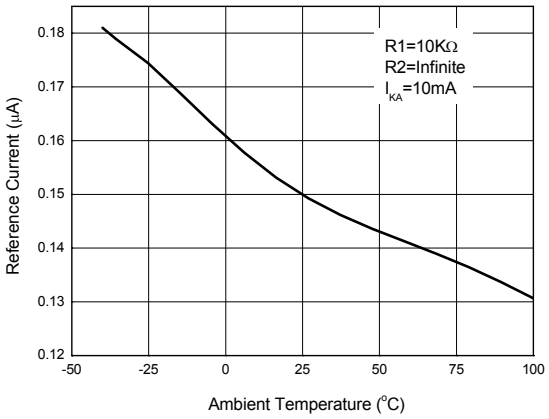



Figure 8. Reference Current vs. Ambient Temperature

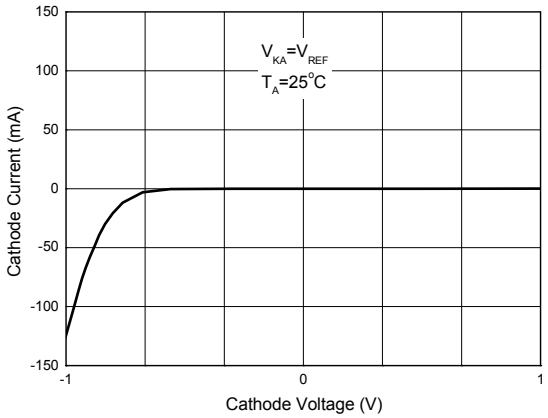



Figure 9. Cathode Current vs. Cathode Voltage

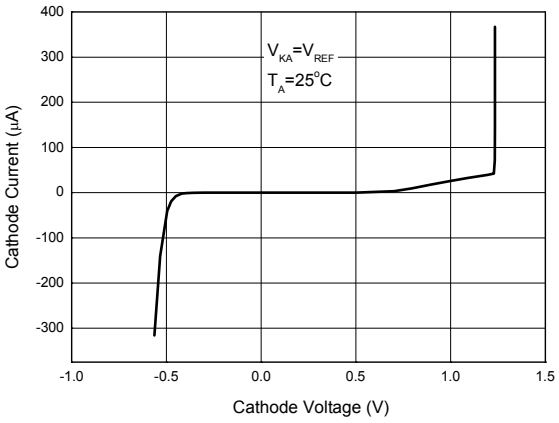



Figure 10. Cathode Current vs. Cathode Voltage

## Typical Performance Characteristics (Continued)

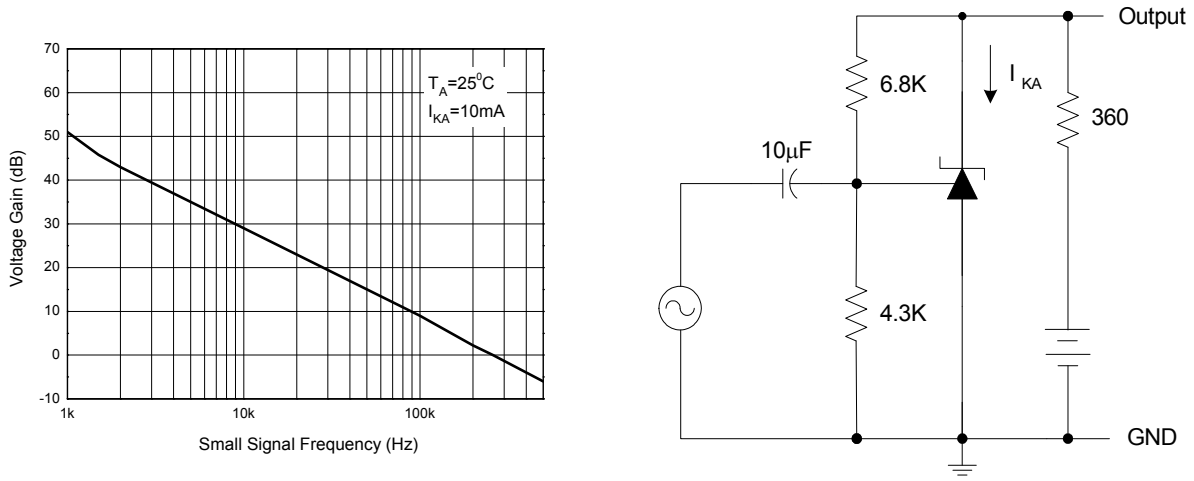



Figure 11. Small Signal Voltage Gain vs. Frequency

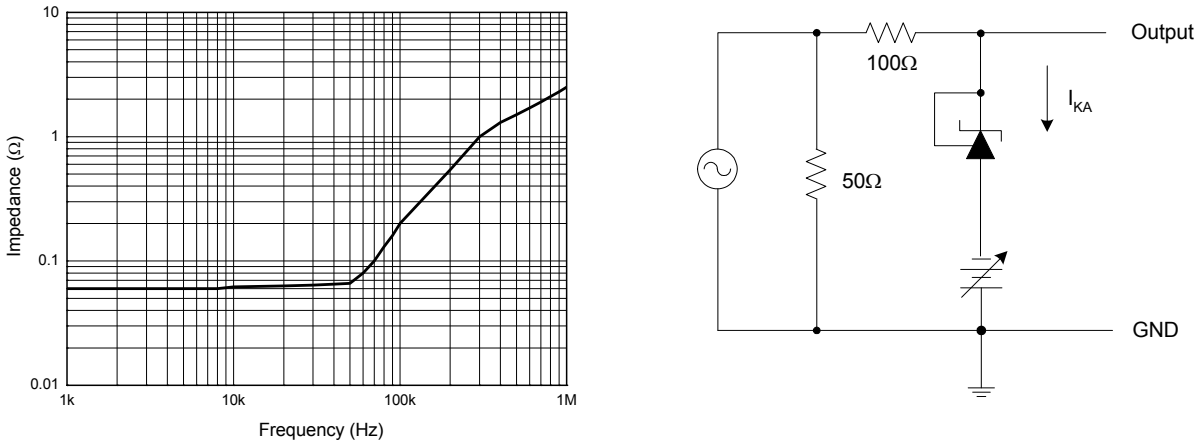



Figure 12. Dynamic Impedance vs. Frequency

## Typical Performance Characteristics (Continued)

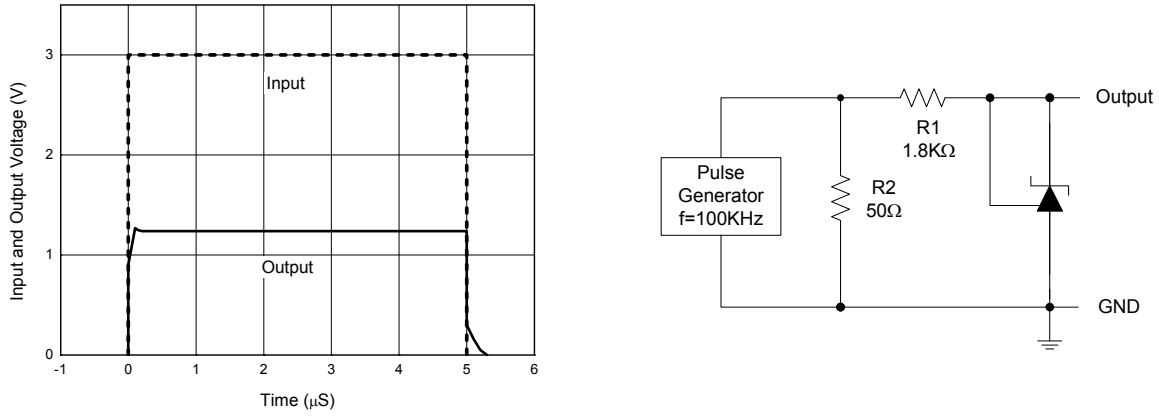



Figure 13. Pulse Response of Input and Output Voltage

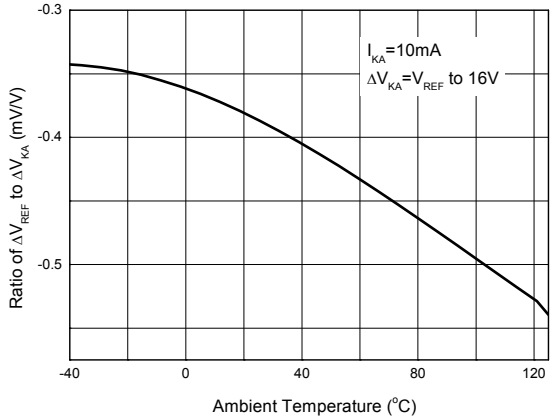



Figure 14. Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage vs. Ambient Temperature

## Typical Applications

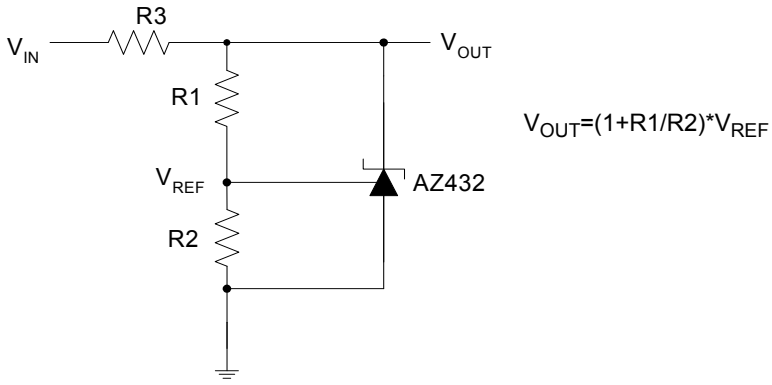



Figure 15. Shunt Regulator

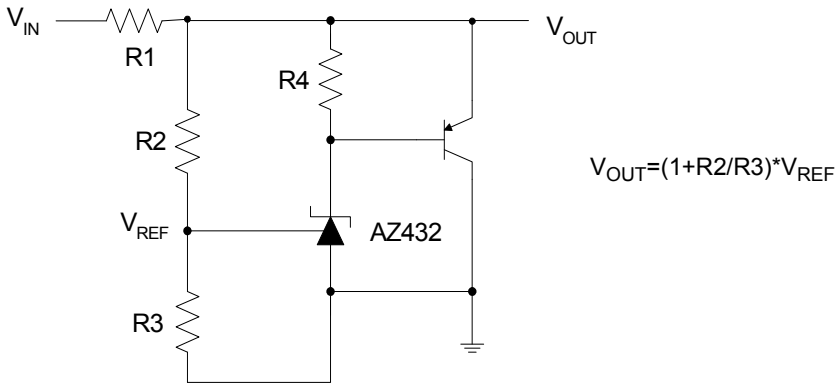



Figure 16. High Current Shunt Regulator

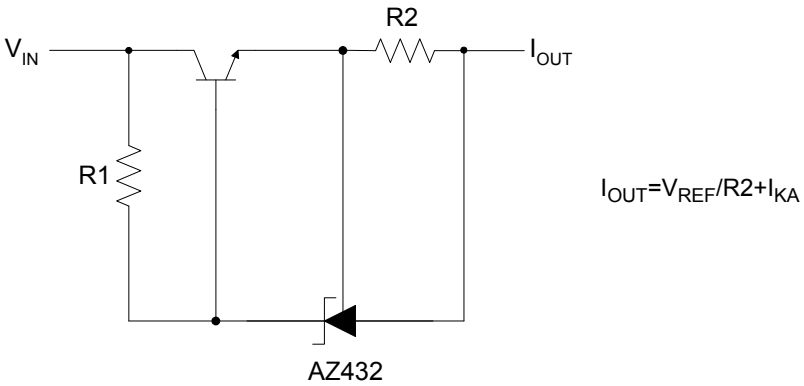



Figure17. Current Source or Current Limit

## Typical Application (Continued)

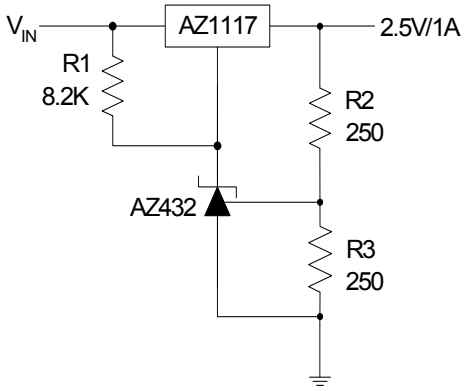



Figure18. Precision 2.5V/1A Regulator

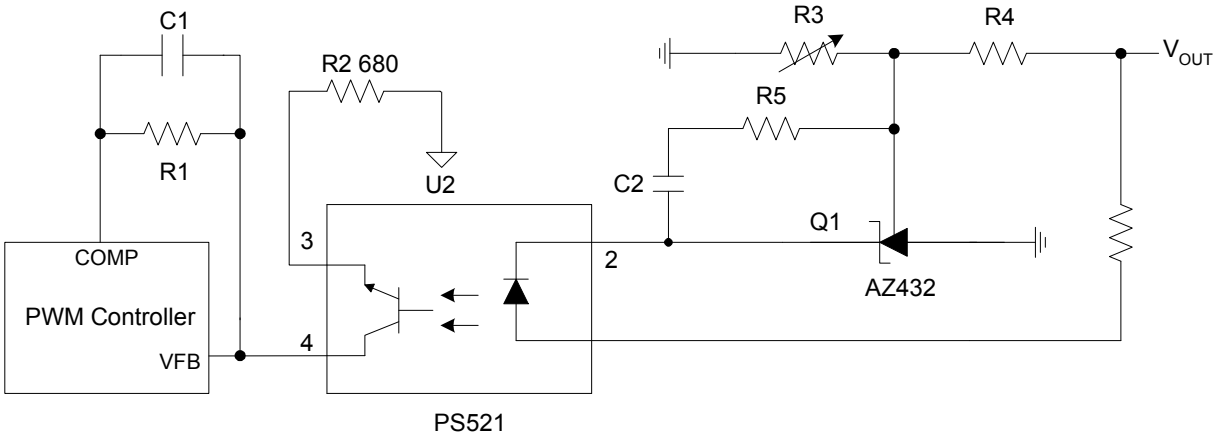
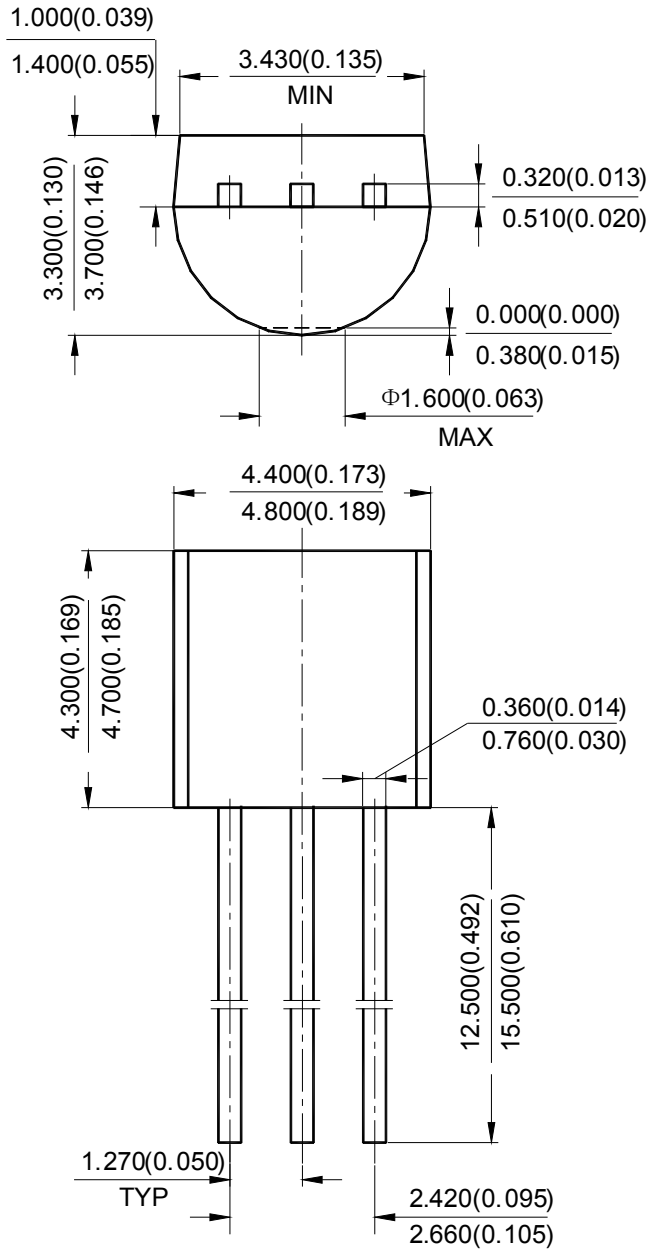



Figure 19. PWM Converter with Reference

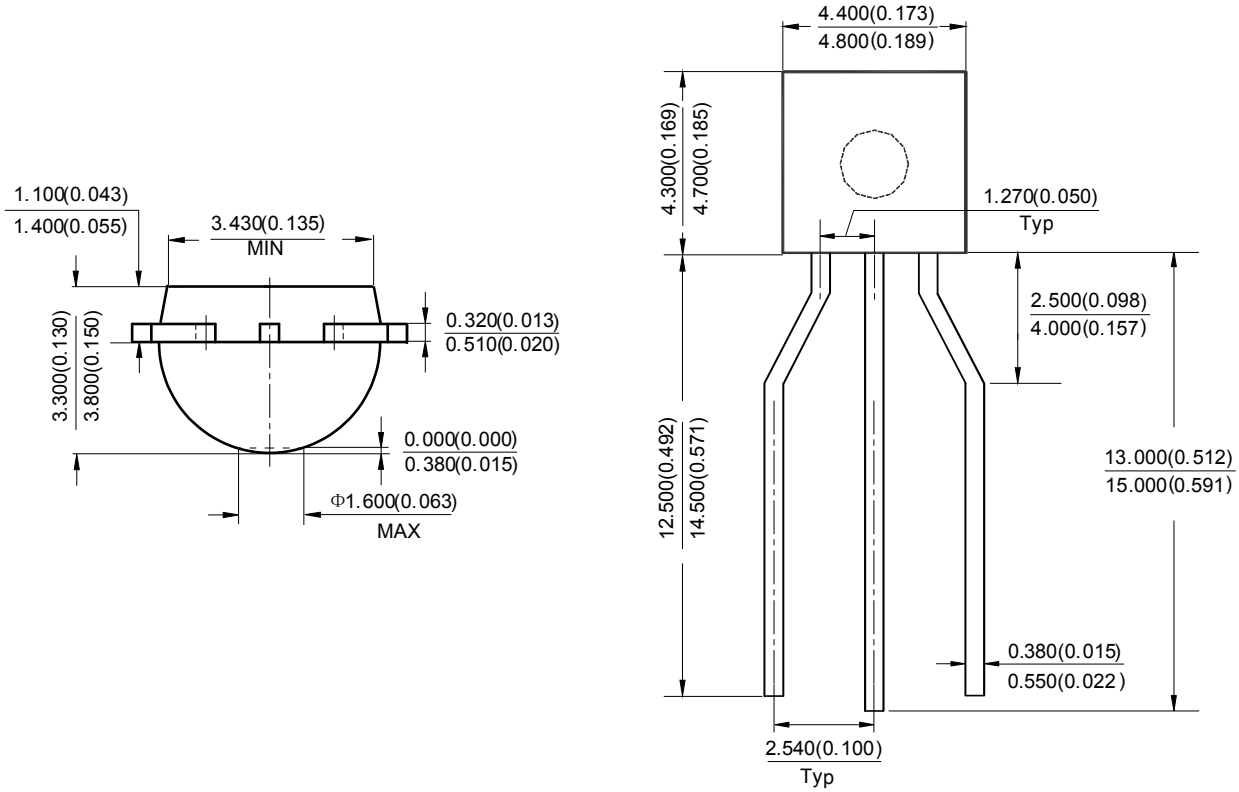
## Mechanical Dimensions

**TO-92(Bulk Packing)** **Unit: mm(inch)**



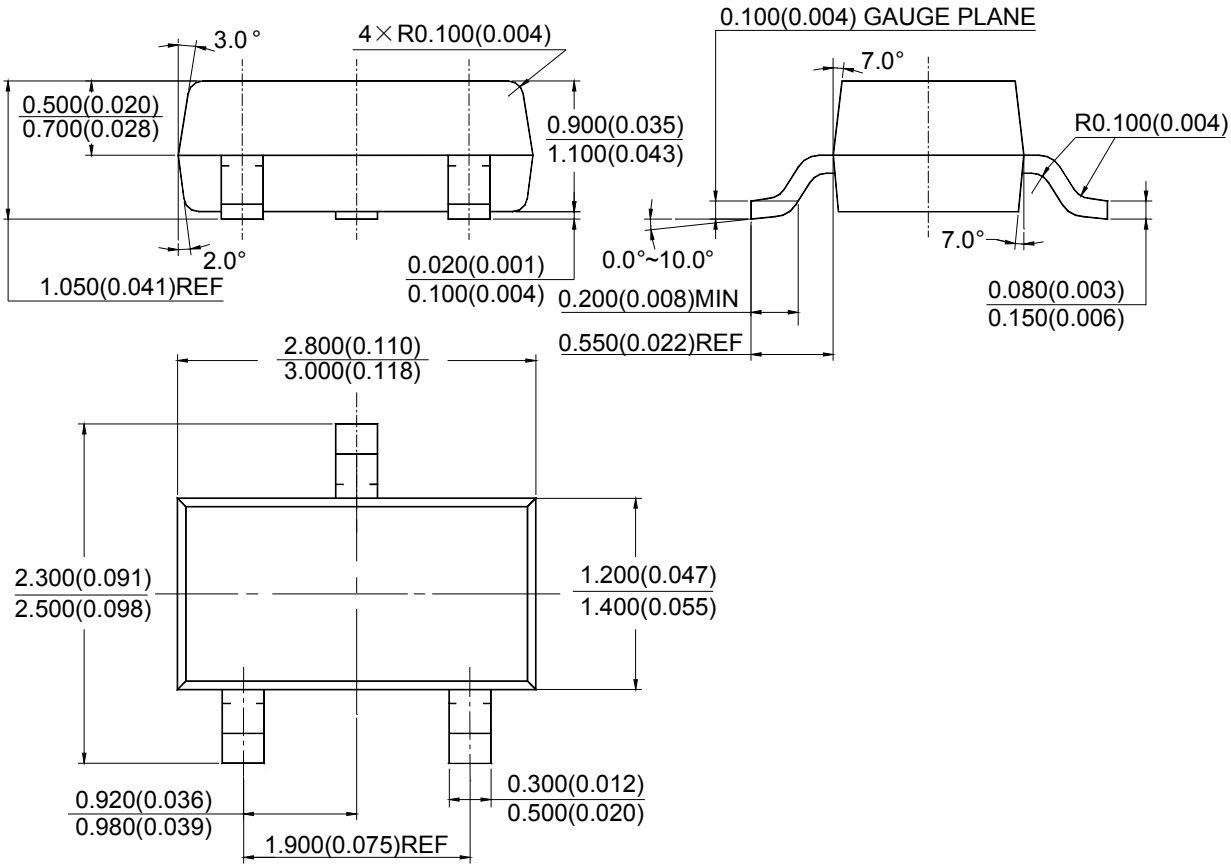
## Mechanical Dimensions (Continued)

**TO-92(Ammo Packing)** **Unit: mm(inch)**



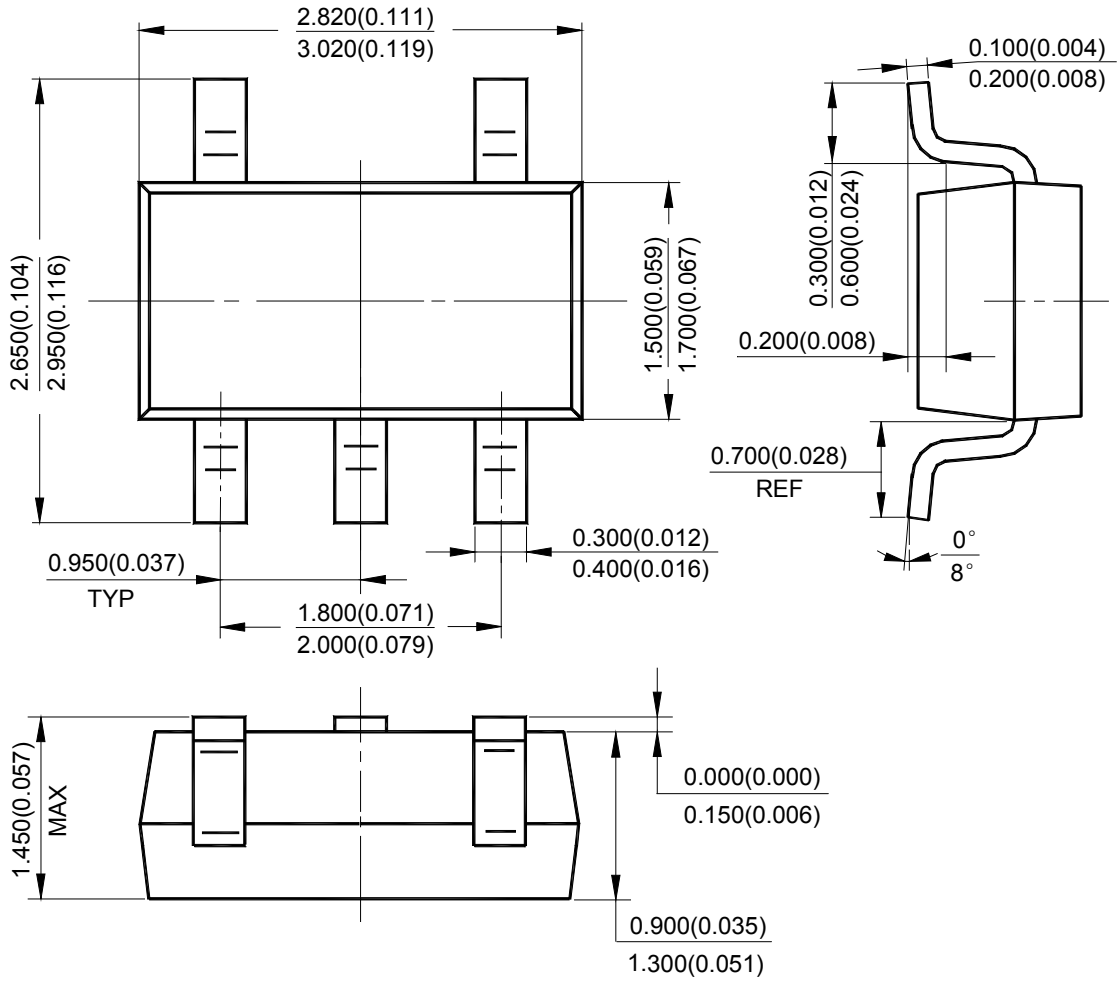
## Mechanical Dimensions (Continued)

**SOT-23** **Unit: mm(inch)**



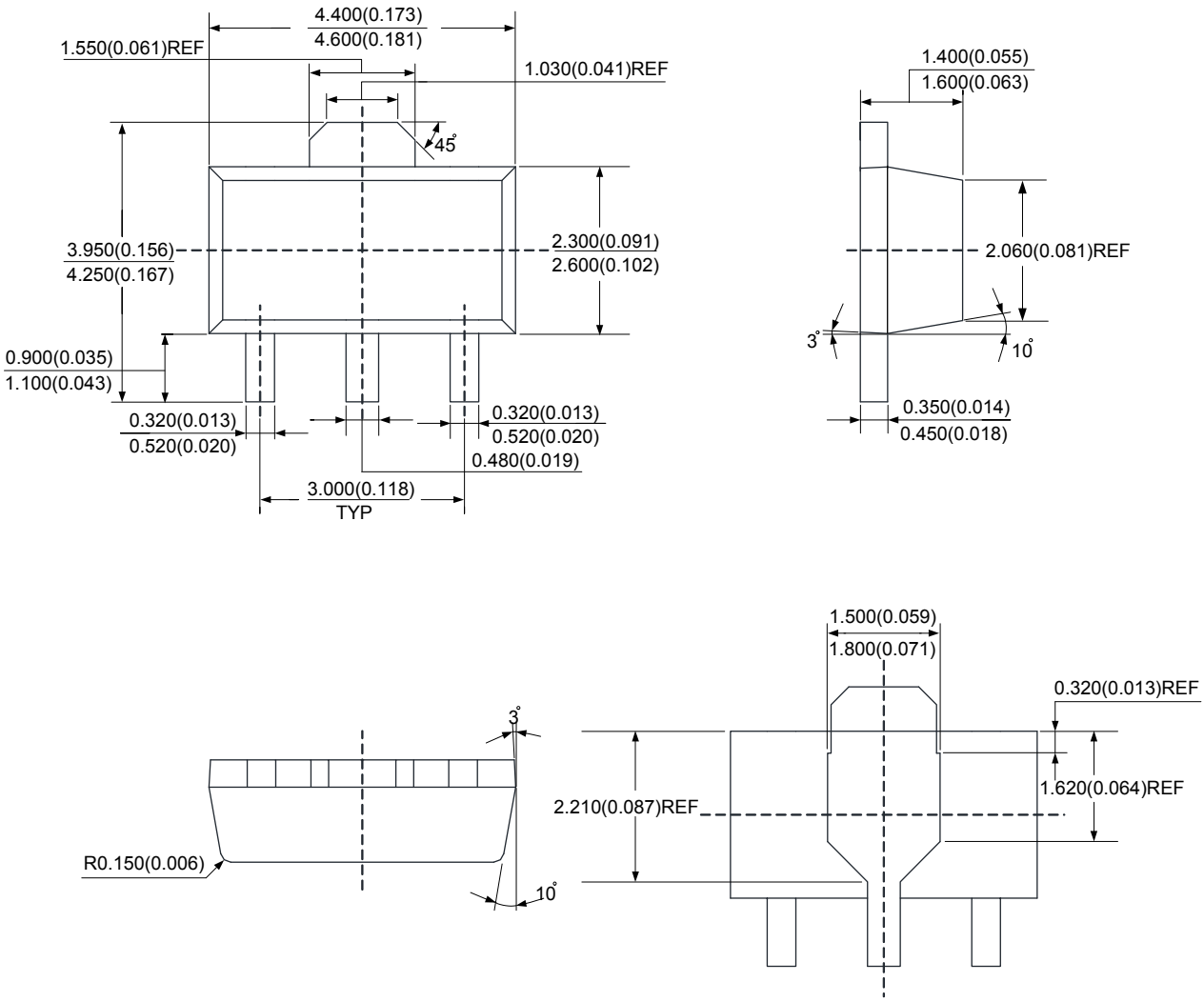
## Mechanical Dimensions (Continued)

**SOT-23-5** **Unit: mm(inch)**



## Mechanical Dimensions (Continued)

**SOT-89** **Unit: mm(inch)**



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