

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

The AZ431 series ICs are three-terminal adjustable shunt 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 and other adjustable regulators.

The AZ431 series ICs contain two voltage types, 40V and 20V. The output voltage of both types can be set to any value between  $V_{REF}(2.5V)$  and the corresponding maximum cathode voltage.

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

These ICs are available in 5 Packages: TO-92, SOT-23-3, SOT-23-5, SOT-89 and SOIC-8.

**Features**

- Programmable Precise Output Voltage from 2.5V to 36V or 18V
- Very Accurate Reference Voltage: 0.15% Typical
- High Stability under Capacitive Load
- Low Temperature Deviation: 4.5mV Typical
- Low Equivalent Full-range Temperature Coefficient with 20PPM/°C Typical
- Low Dynamic Output Resistance: 0.2Ω Typical
- Sink Current Capacity from 1mA to 100 mA
- Low Output Noise
- Wide Operating Range of -40 to 125°C

**Applications**

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

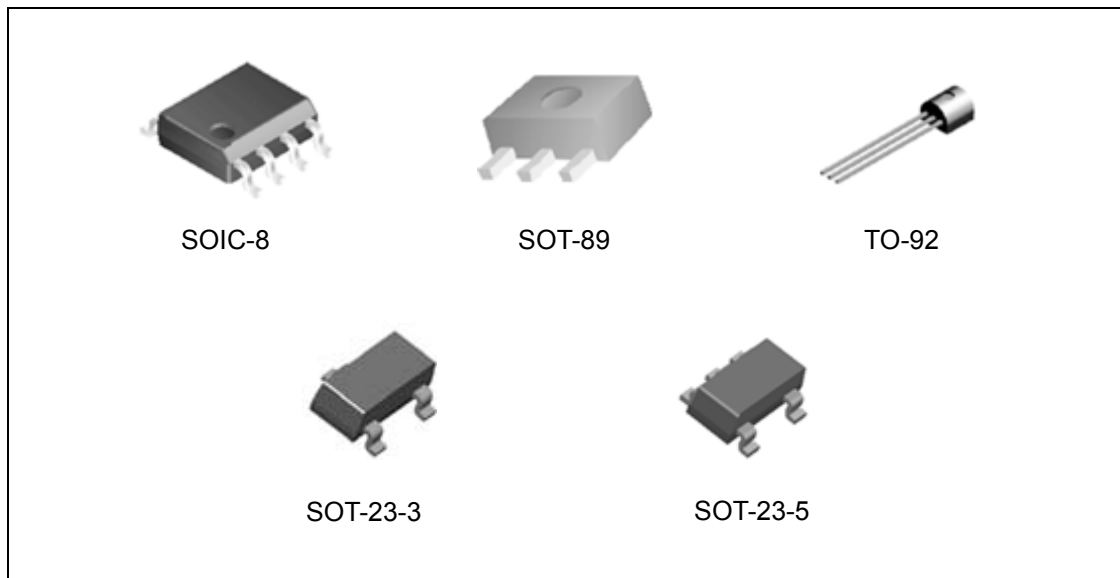


Figure 1. Package Types of AZ431



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Pin Configuration**

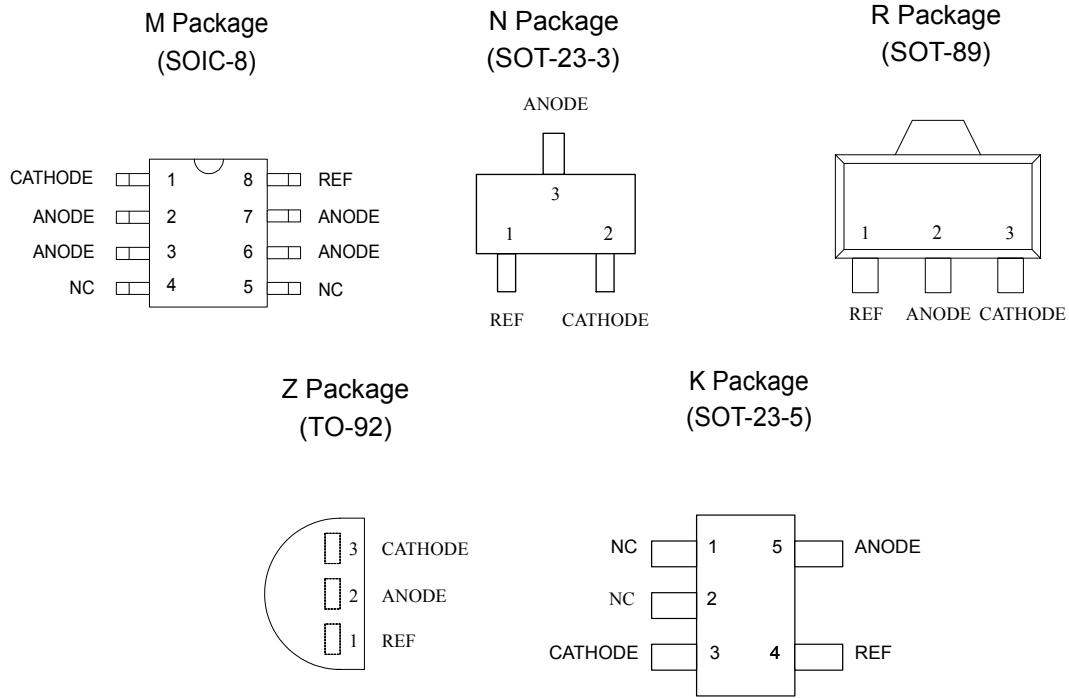


Figure 2. Pin Configuration of AZ431 (Top View)

**Functional Block Diagram**

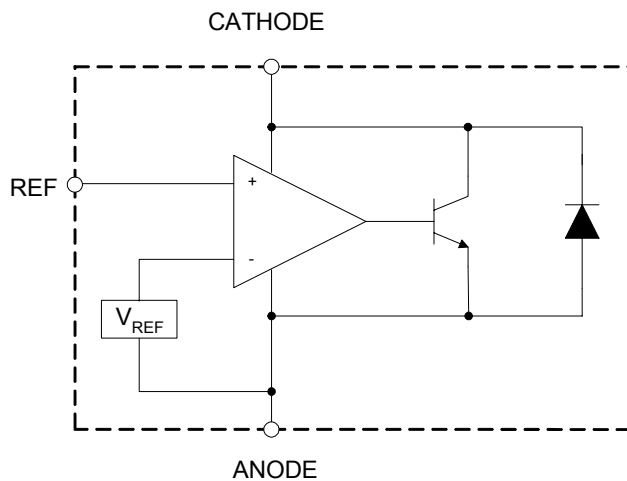


Figure 3. Functional Block Diagram of AZ431



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Ordering Information for 40V Products**

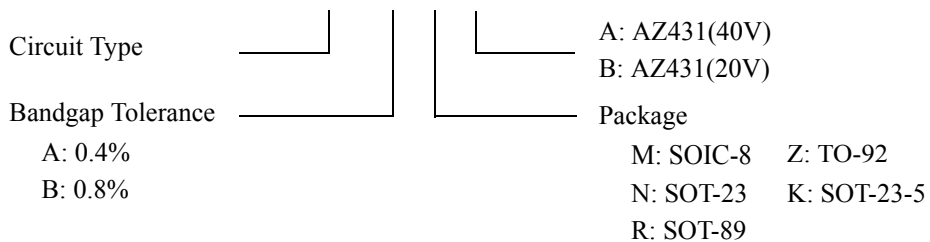
Package	Temperature Range	Voltage Tolerance	Part Number	Marking ID	Packing Type
SOT-23-3	-40 to 125°C	0.4%	AZ431AN-A	N41	Reel
		0.8%	AZ431BN-A	N42	Reel
SOT-23-5		0.4%	AZ431AK-A	K3A	Reel
		0.8%	AZ431BK-A	K3B	Reel
TO-92		0.4%	AZ431AZ-A	AZ431AZ-A	Bulk/Ammo
		0.8%	AZ431BZ-A	AZ431BZ-A	Bulk/Ammo
SOIC-8		0.4%	AZ431AM-A	AZ431AM-A	Tube/Tape/Reel
		0.8%	AZ431BM-A	AZ431BM-A	Tube/Tape/Reel
SOT-89		0.4%	AZ431AR-A	431A	Reel
		0.8%	AZ431BR-A	431B	Reel

**Ordering Information for 20V Products**

Package	Temperature Range	Voltage Tolerance	Part Number	Marking ID	Packing Type
SOT-23-3	-40 to 125°C	0.4%	AZ431AN-B	N44	Reel
		0.8%	AZ431BN-B	N45	Reel
SOT-23-5		0.4%	AZ431AK-B	K4A	Reel
		0.8%	AZ431BK-B	K4B	Reel
TO-92		0.4%	AZ431AZ-B	AZ431AZ-B	Bulk/Ammo
		0.8%	AZ431BZ-B	AZ431BZ-B	Bulk/Ammo
SOIC-8		0.4%	AZ431AM-B	AZ431AM-B	Tube/Tape/Reel
		0.8%	AZ431BM-B	AZ431BM-B	Tube/Tape/Reel
SOT-89		0.4%	AZ431AR-B	431C	Reel
		0.8%	AZ431BR-B	431D	Reel

Some of our products are available in Lead Free packages; If buyers need Lead Free product, please add -E1 after the part number in your order. For example, AZ431AM-A is a standard tin-lead product, AZ431AM-A-E1 means a Lead Free product.

**A Z 431 X Y - Z**



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

Parameter	Symbol	Value	Unit
Cathode Voltage	$V_{KA}$	AZ431 (40V): 40	V
		AZ431 (20V): 20	
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	$T_J$	160	°C
Storage Temperature Range	$T_{STG}$	-65 to +150	°C
Package Thermal Impedance	$Q_{JA}$	M Package: 150	°C/W
		N Package: 330	
		Z Package: 150	
		R Package: 50	
		K Package: 250	

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	$V_{KA}$	$V_{REF}$	AZ431(40V): 36	V
			AZ431(20V): 18	
Cathode Current	$I_{KA}$	1.0	100	mA
Operating Ambient Temperature Range		-40	125	°C



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Electrical Characteristics for AZ431(40V)**

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

Parameter	Test Circuit	Symbol	Conditions	AZ431 (40V)			Unit	
				Min	Typ	Max		
Reference Voltage	0.4%	4	$V_{REF}$	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}$	2.490	2.500	2.510	V
	0.8%				2.480	2.500	2.520	
Deviation of Reference Voltage Over-Temperature	4	$\Delta V_{REF}$	$V_{KA}=V_{REF}$ $I_{KA}=10\text{mA}$	0 to 70°C	4.5	8	mV	
				-40 to 85°C	4.5	10		
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	$I_{REF}$	$I_{KA}=10\text{mA}, R1=10\text{K}\Omega, R2=\infty$		0.7	4	$\mu\text{A}$	
Deviation of Reference Current Over Full Temperature Range	5	$\Delta I_{REF}$	$I_{KA}=10\text{mA}, R1=10\text{K}\Omega$ $R2=\infty, T_A=-40\text{ to }85^{\circ}\text{C}$		0.4	1.2	$\mu\text{A}$	
Minimum Cathode Current for Regulation	4	$I_{KA}$ (MIN)	$V_{KA}=V_{REF}$		0.4	1.0	mA	
Off-State Cathode Current	6	$I_{KA}$ (OFF)	$V_{KA}=36\text{V}, V_{REF}=0$		0.05	1.0	$\mu\text{A}$	
Dynamic Impedance	4	$Z_{KA}$	$V_{KA}=V_{REF}, I_{KA}=1\text{ to }100\text{mA},$ $f \leq 1.0\text{KHz}$		0.15	0.5	$\Omega$	



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Electrical Characteristics for AZ431(20V)**

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

Parameter	Test Circuit	Symbol	Conditions	AZ431 (20V)			Unit	
				Min	Typ	Max		
Reference Voltage	0.4%	4	$V_{\text{REF}}$	$V_{\text{KA}}=V_{\text{REF}}, I_{\text{KA}}=10\text{mA}$	2.490	2.500	2.510	V
	0.8%				2.480	2.500	2.520	
Deviation of Reference Voltage Over-Temperature	4	$\Delta V_{\text{REF}}$	$V_{\text{KA}}=V_{\text{REF}}, I_{\text{KA}}=10\text{mA}$	0 to 70°C	4.5	8	mV	
				-40 to 85°C	4.5	10		
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	$\Delta I_{\text{REF}}$	$I_{\text{KA}}=10\text{mA}, R1=10\text{K}\Omega, R2=\infty, T_A=-40\text{ to } 85^{\circ}\text{C}$		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	$Z_{\text{KA}}$	$V_{\text{KA}}=V_{\text{REF}}, I_{\text{KA}}=1\text{ to } 100\text{mA}, f \leq 1.0\text{KHz}$		0.2	0.5	$\Omega$	



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Electrical Characteristics (Continued)**

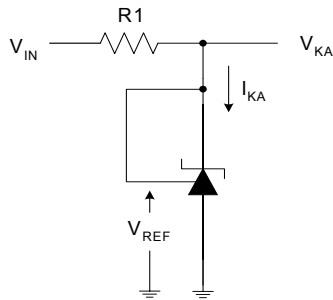


Figure 4. Test Circuit 4 for  $V_{KA} = V_{ref}$

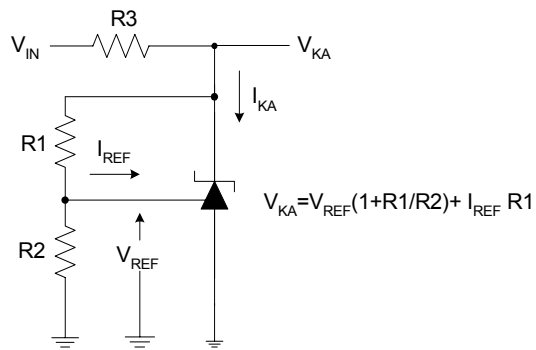


Figure 5. Test Circuit 5 for  $V_{KA} > V_{ref}$

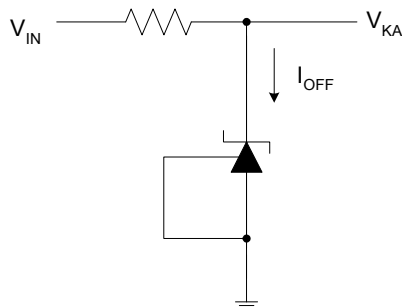


Figure 6. Test Circuit 6 for  $I_{OFF}$



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Typical Performance Characteristics**

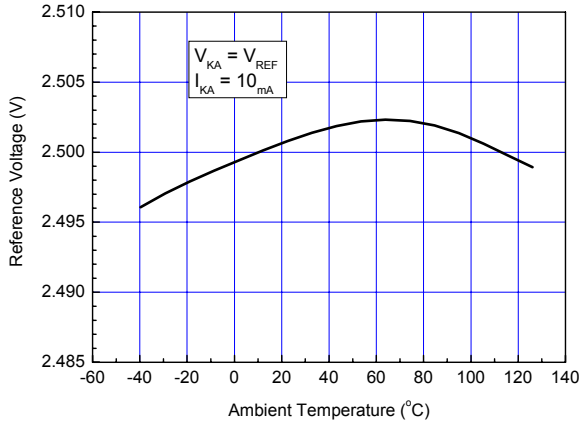


Figure 7. Reference Voltage vs. Ambient Temperature

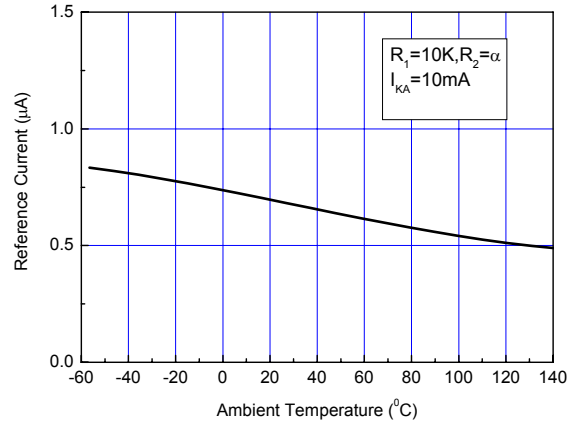


Figure 8. Reference Current vs. Ambient Temperature

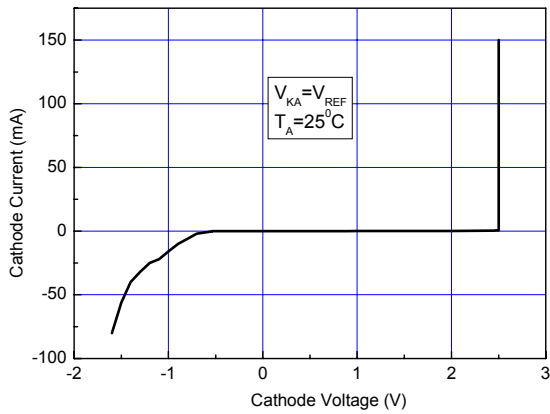


Figure 9. Cathode Current vs. Cathode Voltage

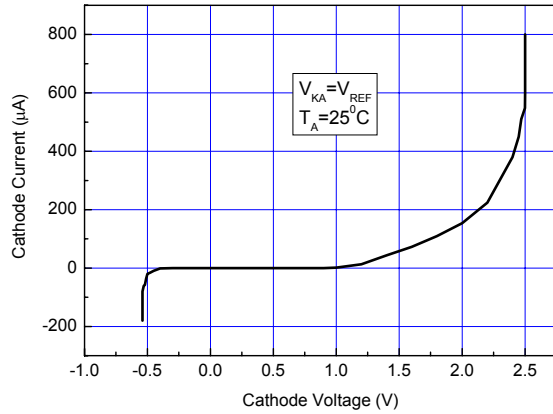


Figure 10. Current vs. Cathode Voltage





**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Typical Performance Characteristics (Continued)**

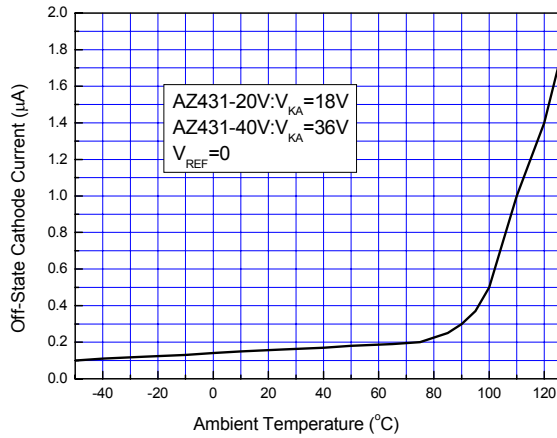


Figure 11. Off-state Cathode Current vs. Ambient Temperature

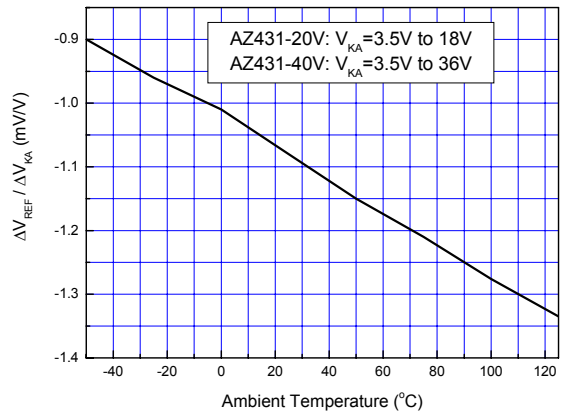


Figure 12. Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage

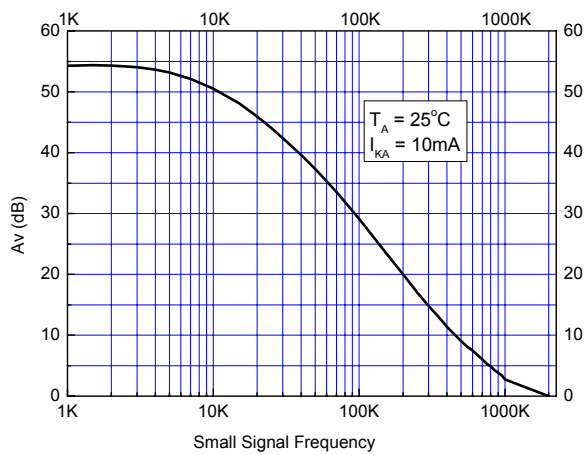
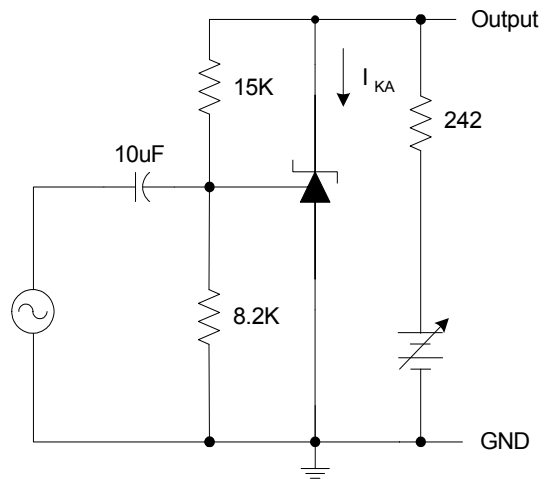


Figure 13. Small Signal Voltage Gain vs. Frequency





**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Typical Performance Characteristics (Continued)**

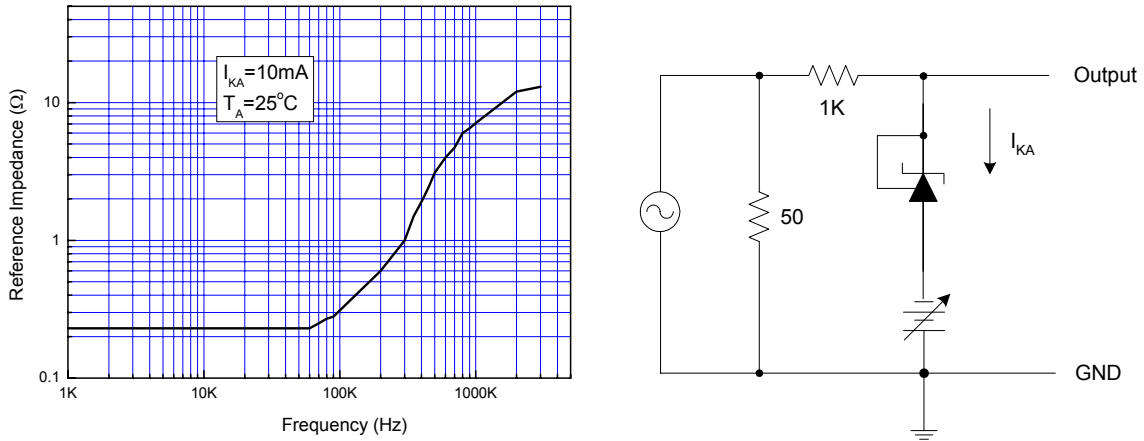


Figure 14. Reference Impedance vs. Frequency

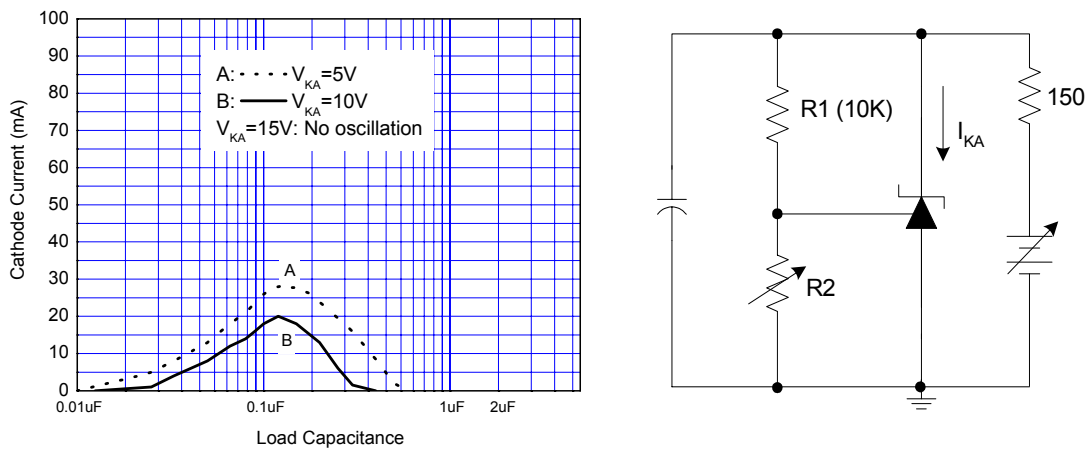


Figure 15. Stability Boundary Conditions vs. Load Capacitance



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Typical Performance Characteristics (Continued)**

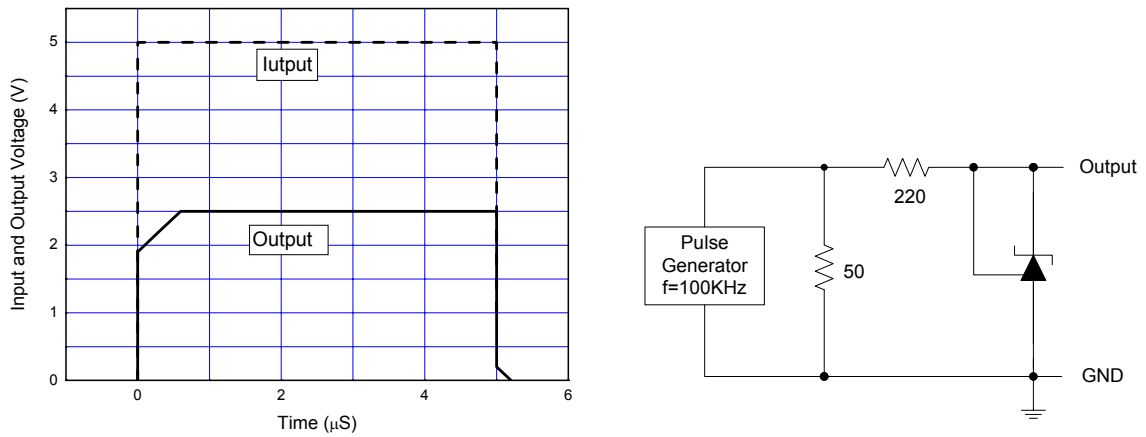


Figure 16. Pulse Response of Input and Output Voltage



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Typical Applications**

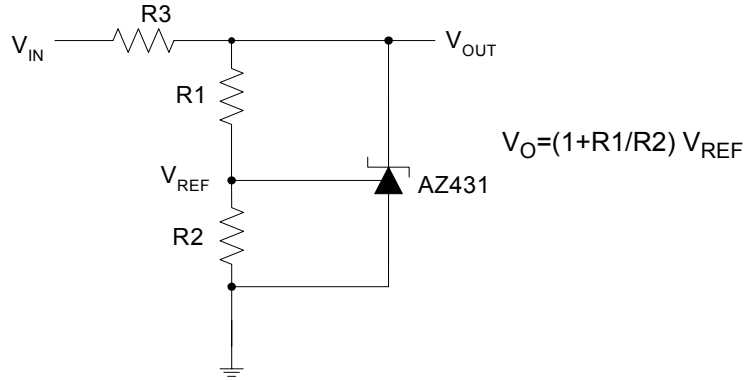


Figure 17. Shunt Regulator

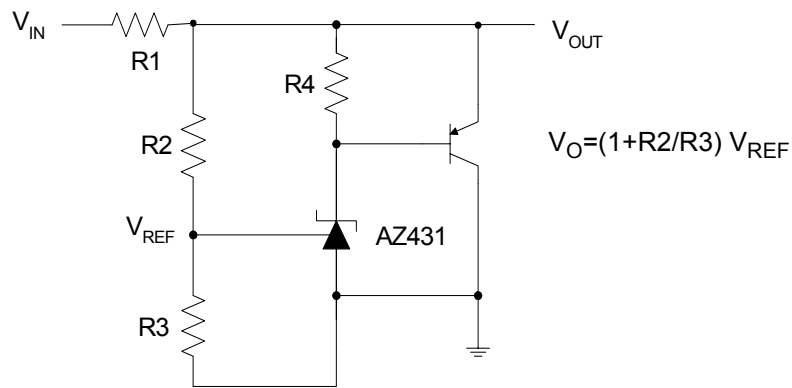


Figure 18. High Current Shunt Regulator

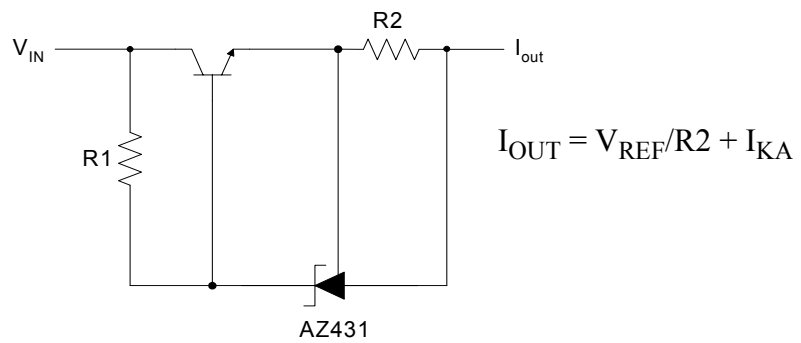


Figure 19. Current Source or Current Limit



**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Typical Applications (Continued)**

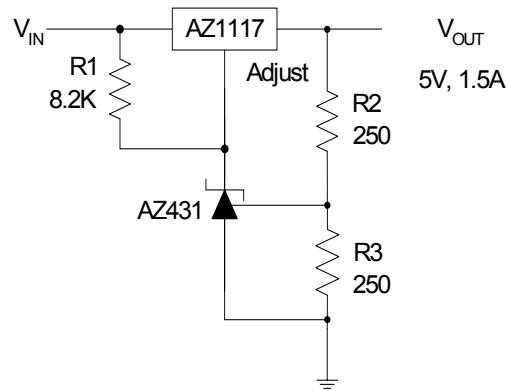


Figure20. Precision 5V 1.5A Regulator

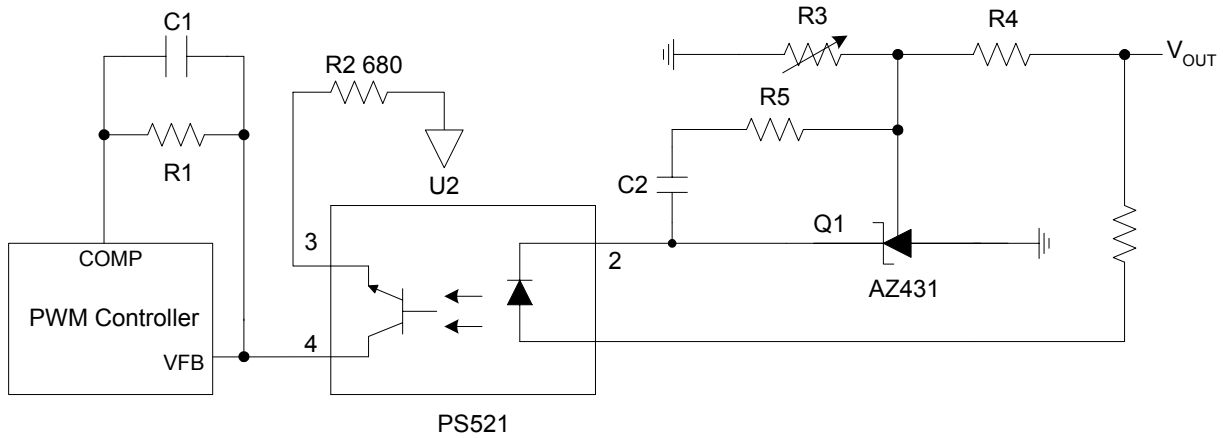


Figure 21. PWM Converter with Reference



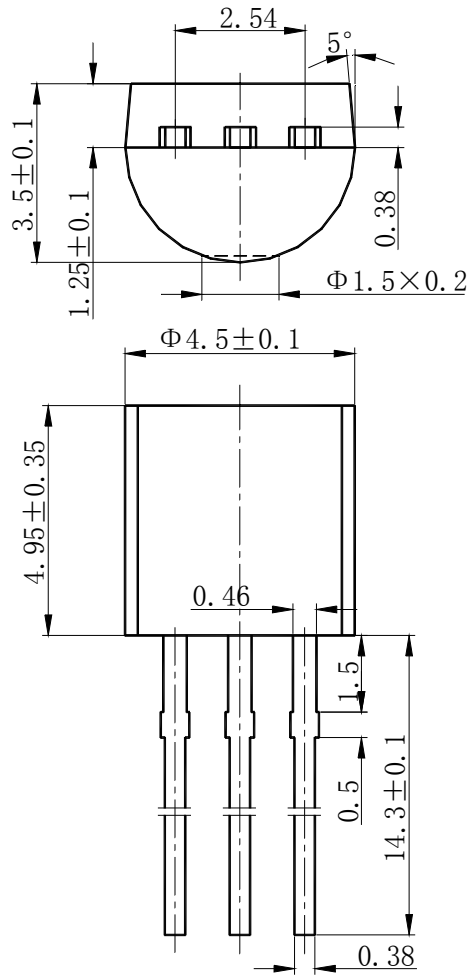
**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Mechanical Dimensions**

**TO-92**

**Unit: mm**





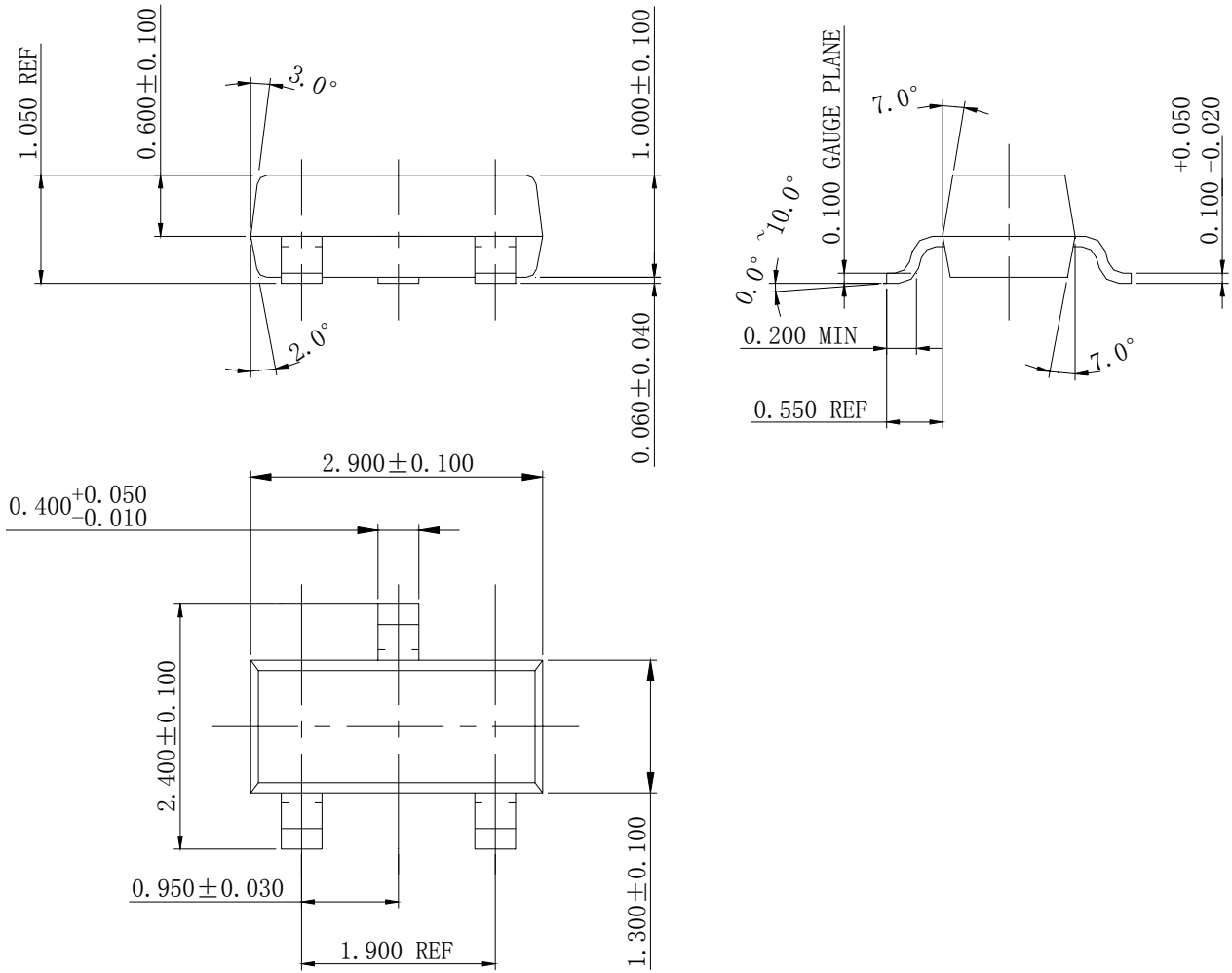
**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Mechanical Dimensions (Continued)**

**SOT-23-3**

**Unit: mm**





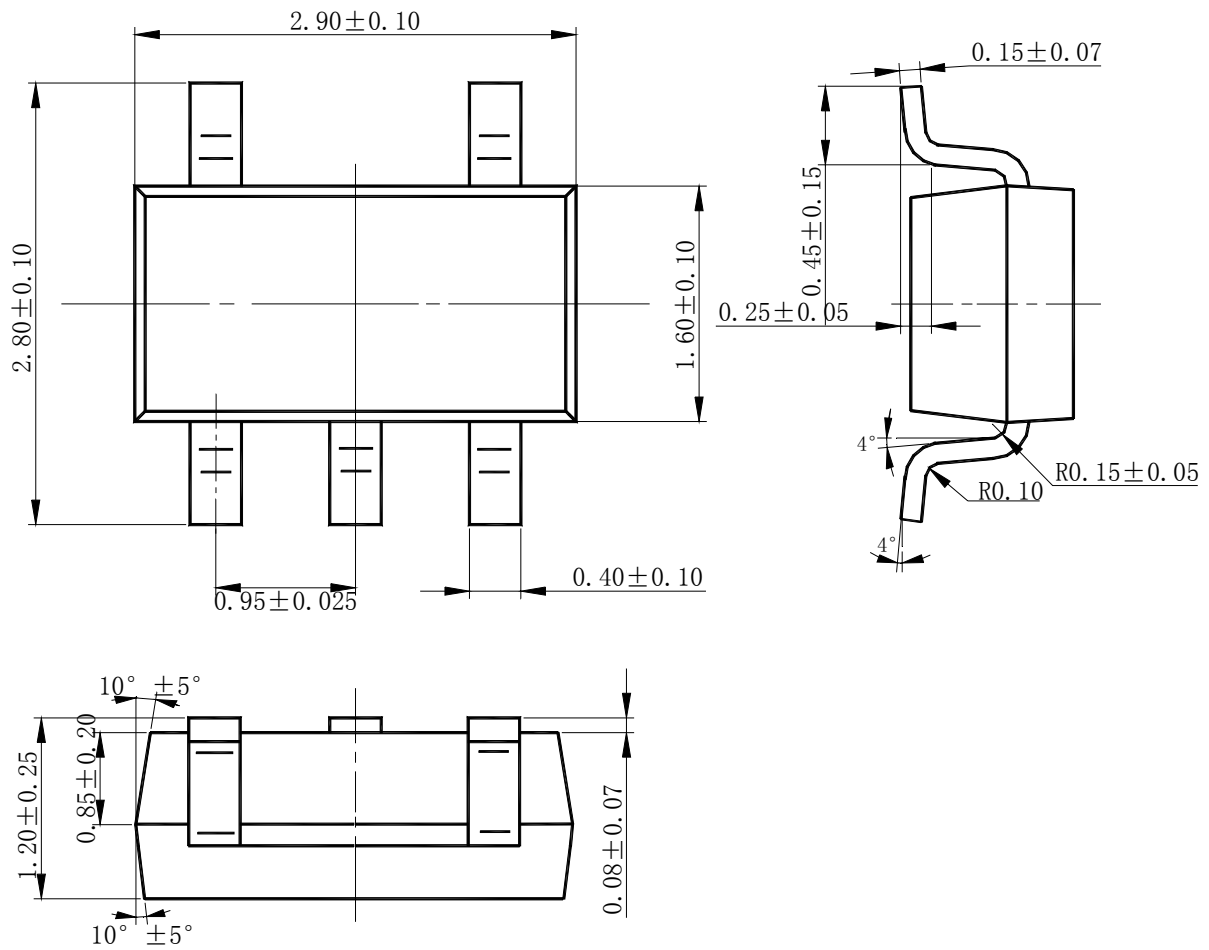
**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Mechanical Dimensions (Continued)**

**SOT - 23 - 5**

**Unit: mm**







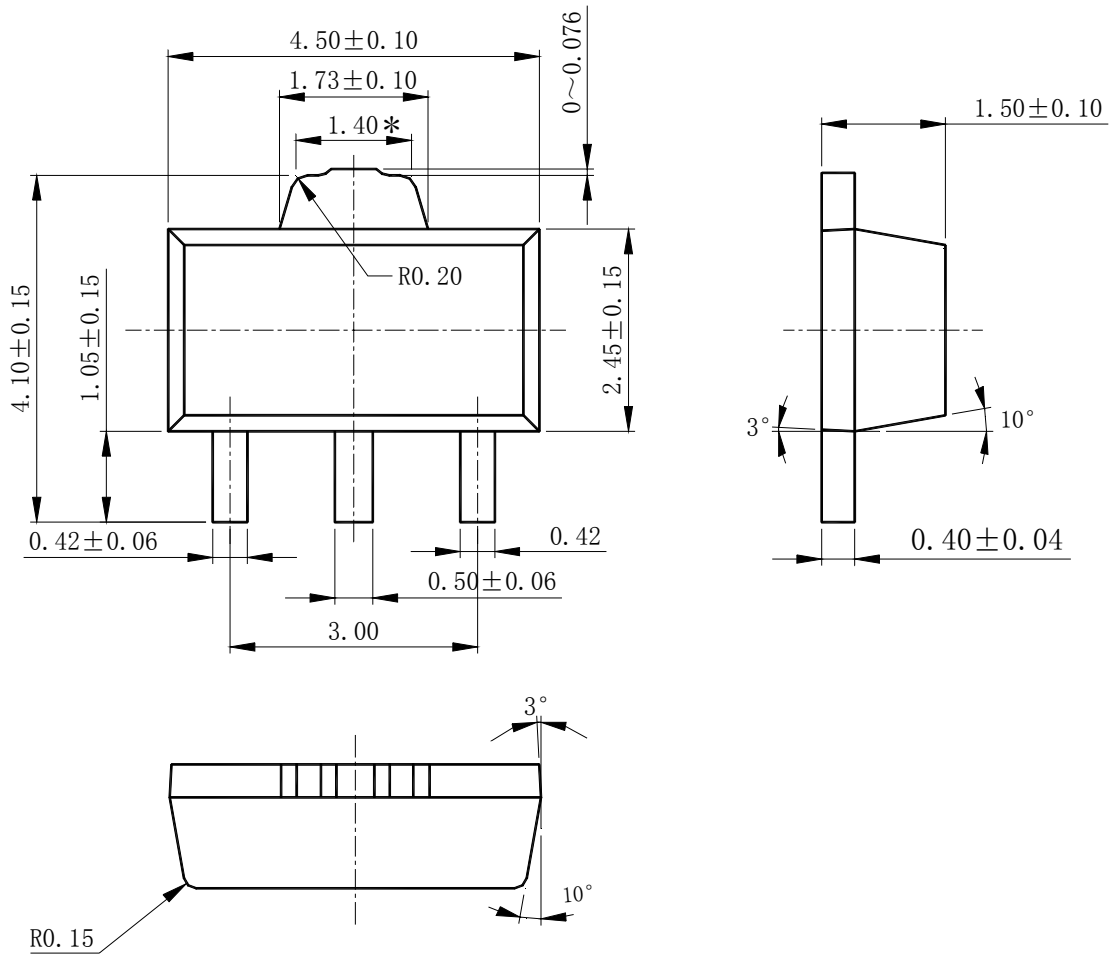
**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Mechanical Dimensions (Continued)**

**SOT- 89**

**Unit: mm**





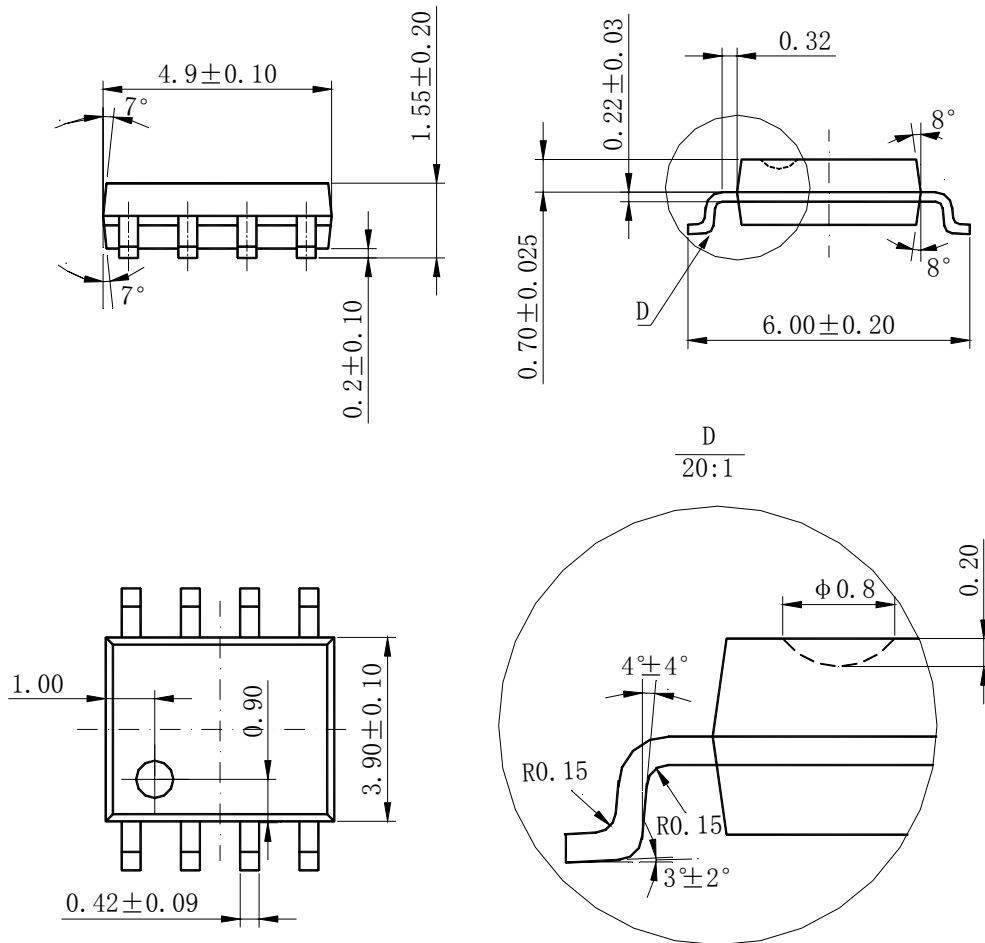
**ADJUSTABLE PRECISION SHUNT REGULATORS**

**AZ431**

**Mechanical Dimensions (Continued)**

**SOIC-8**

**Unit: mm**





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