



**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 bandgap tolerance: 0.5% and 1%.

These ICs are available in 4 packages: TO-92, SOT-23-3, SOT-23-5, SOT-89.

**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 55μA to 100 mA
- Low Output Noise
- Wide Operating Range of -40 to 125°C

**Applications**

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

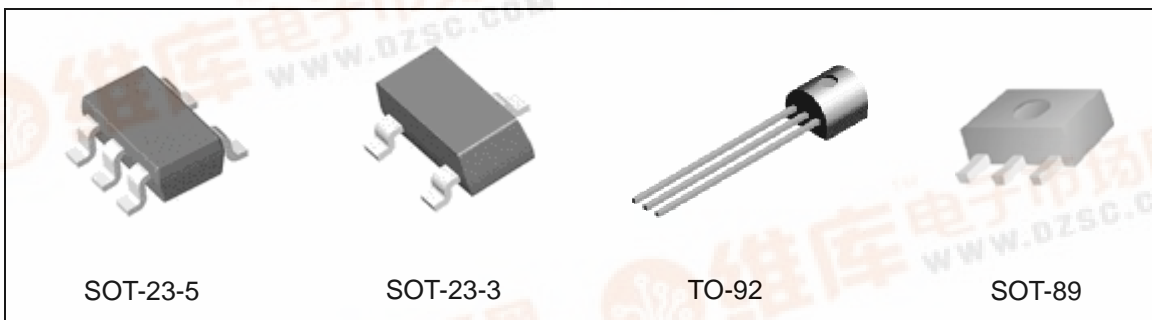


Figure 1. Package Types of AZ431L





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**Pin Configuration**

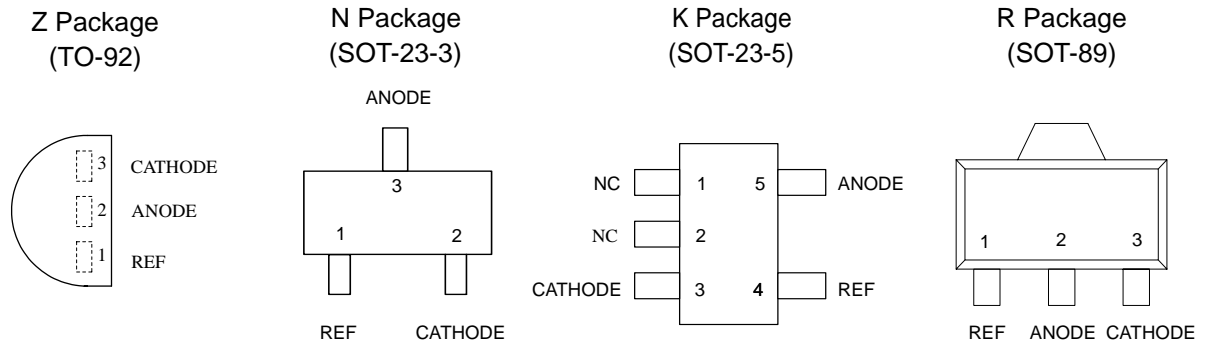


Figure 2. Pin Configuration of AZ431L (Top View)

**Functional Block Diagram**

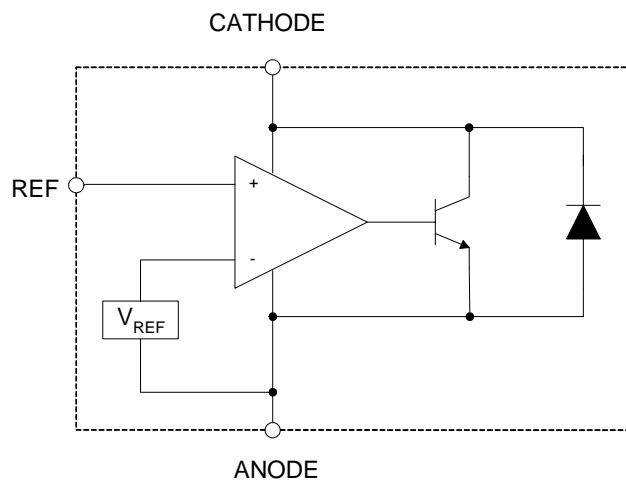


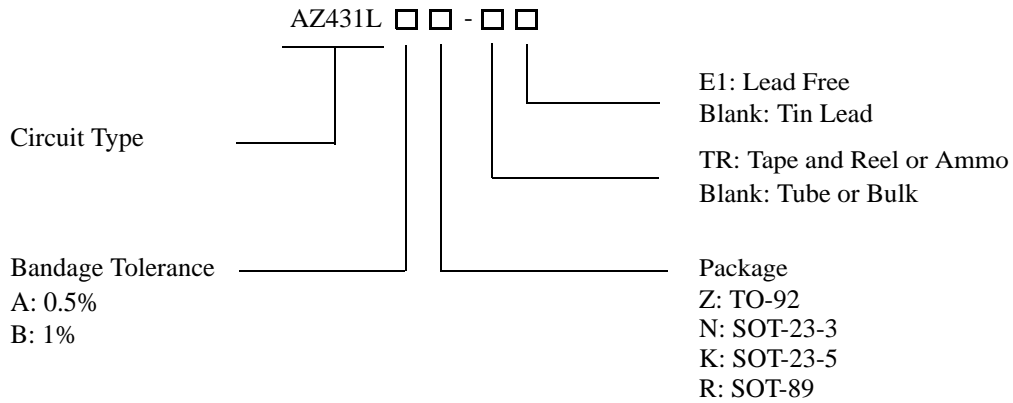
Figure 3. Functional Block Diagram of AZ431L



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**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	0.50%	AZ431LAZ	AZ431LAZ-E1	AZ431LAZ	AZ431LAZ-E1	Bulk
		0.50%	AZ431LAZTR	AZ431LAZTR-E1	AZ431LAZ	AZ431LAZ-E1	Ammo
		1%	AZ431LBZ	AZ431LBZ-E1	AZ431LBZ	AZ431LBZ-E1	Bulk
		1%	AZ431LBZTR	AZ431LBZTR-E1	AZ431LBZ	AZ431LBZ-E1	Ammo
SOT-23-3	-40 to 125°C	0.50%	AZ431LANTR	AZ431LANTR-E1	N46	EA6	Tape & Reel
		1%	AZ431LBNTR	AZ431LBNTR-E1	N47	EA7	Tape & Reel
SOT-23-5	-40 to 125°C	0.50%	AZ431LAKTR	AZ431LAKTR-E1	K41	E5A	Tape & Reel
		1%	AZ431LBKTR	AZ431LBKTR-E1	K42	E6A	Tape & Reel
SOT-89	-40 to 125°C	0.50%	AZ431LARTR	AZ431LARTR-E1	R41A	E41A	Tape & Reel
		1%	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.



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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	
Storage Temperature Range	$T_{STG}$	-65 to 150		°C
Package Thermal Impedance	$Q_{JA}$	TO-92	130	°C/W
		SOT-23-3	330	
		SOT-23-5	250	
		SOT-89	100	

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



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**Electrical Characteristics**

(Typical and limits apply for  $T_j=25^{\circ}\text{C}$  unless otherwise noted.)

Parameter	Test Circuit	Symbol	Conditions	Min	Typ	Max	Unit	
Reference Voltage	0.5%	4	$V_{REF}$	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}$	1.234	1.240	1.246	V
	1%				1.228	1.240	1.252	
Deviation of Reference Voltage Over-Temperature	4	$\Delta V_{REF}$	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}$	0 $^{\circ}\text{C}$ to 70 $^{\circ}\text{C}$	2	10	mV	
				-40 $^{\circ}\text{C}$ to 85 $^{\circ}\text{C}$	3	10		
Ratio of Change in $V_{REF}$ to the Change in Cathode Voltage	5	$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	$I_{KA}=10\text{mA}, \Delta V_{KA}:V_{REF}$ 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	$\Delta I_{REF}$	$I_{KA}=10\text{mA}, R1=10\text{K}\Omega, R2=\infty, T_A=-40$ to 85 $^{\circ}\text{C}$		0.1	0.4	$\mu\text{A}$	
Minimum Cathode Current for Regulation	4	$I_{KA}$ (MIN)	$V_{KA}=V_{REF}$		55	80	$\mu\text{A}$	
Off-State Cathode Current	6	$I_{KA}$ (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 100mA $f \leq 1.0\text{kHz}$		0.05	0.15	$\Omega$	



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**Electrical Characteristics (Continued)**

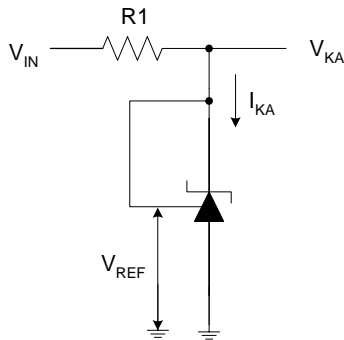


Figure 4. Test Circuit 4 for  $V_{KA} = V_{REF}$

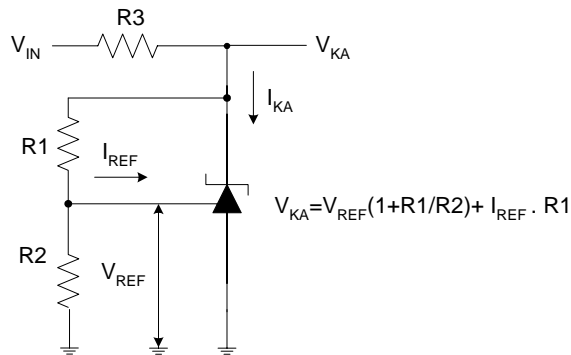


Figure 5. Test Circuit 5 for  $V_{KA} > V_{REF}$

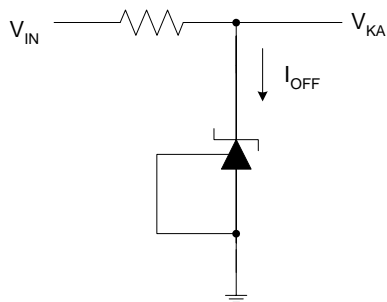


Figure 6. Test Circuit 6 for  $I_{OFF}$



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**Typical Performance Characteristics**

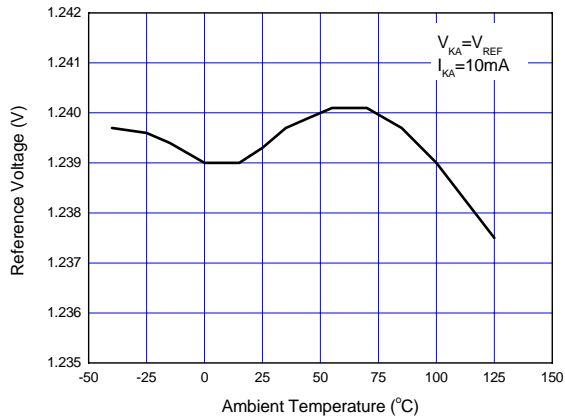


Figure 7. Reference Voltage vs. Ambient Temperature

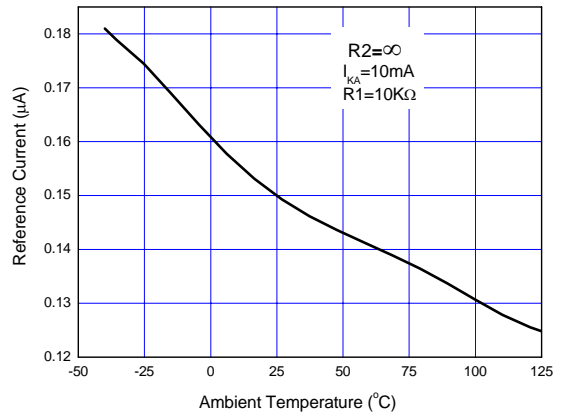


Figure 8. Reference Current vs. Ambient Temperature

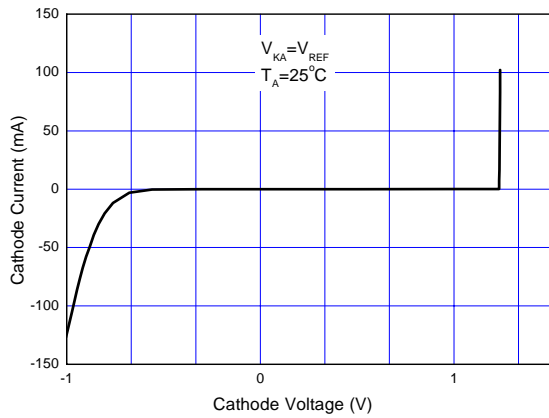


Figure 9. Cathode Current vs. Cathode Voltage

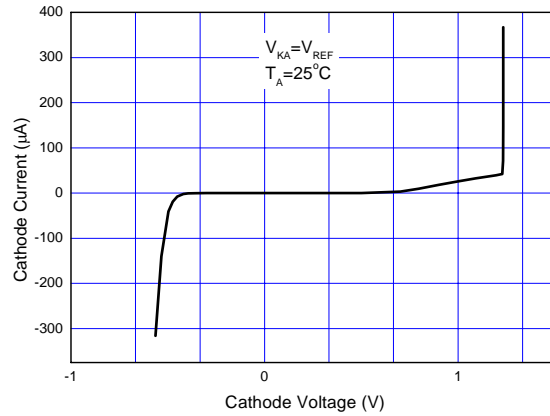


Figure 10. Current vs. Cathode Voltage



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

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**Typical Performance Characteristics (Continued)**

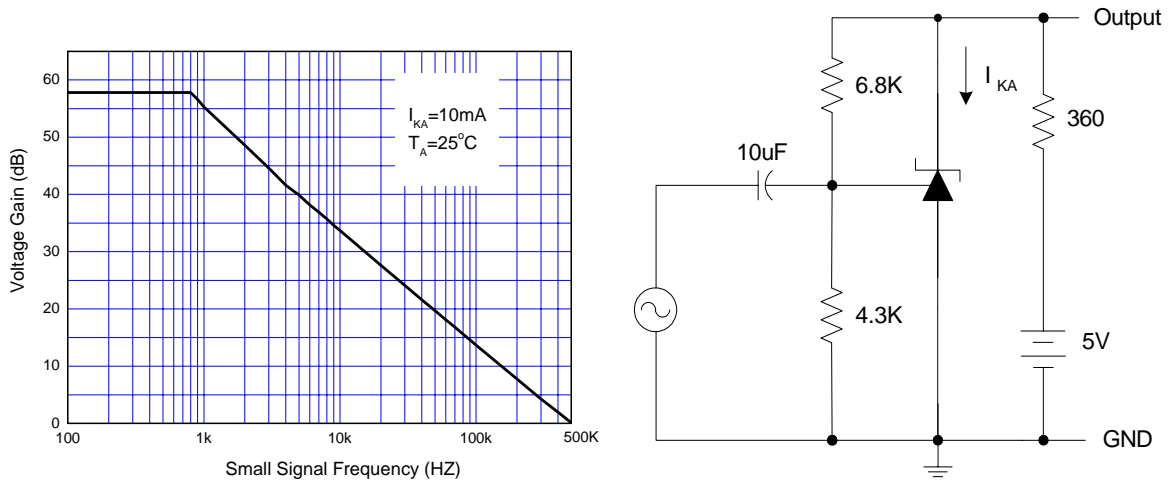


Figure 11. Small Signal Voltage Gain vs. Frequency

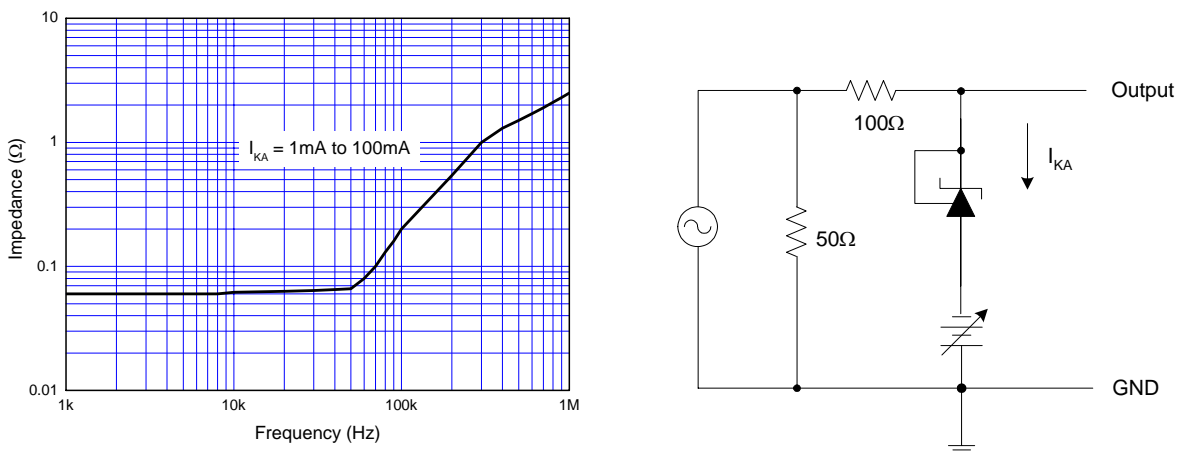


Figure 12. Dynamic Impedance vs. Frequency





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**Typical Performance Characteristics (Continued)**

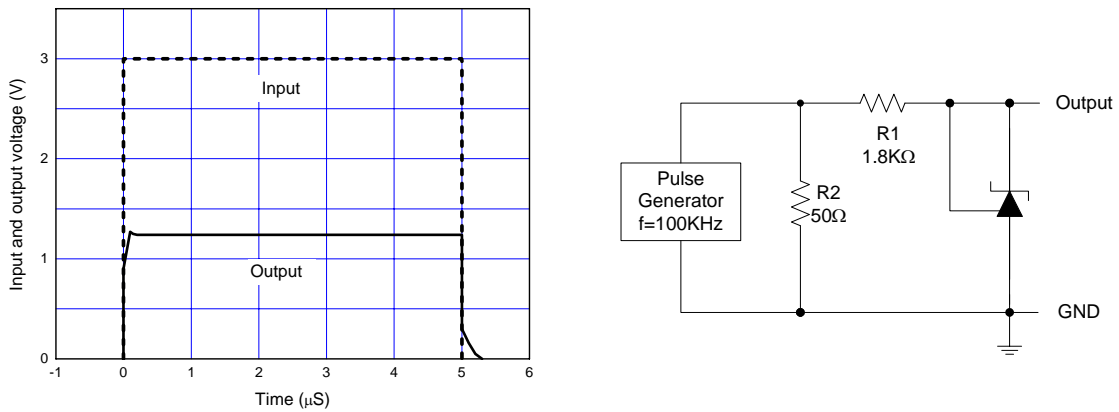


Figure 13. Pulse Response of Input and Output Voltage

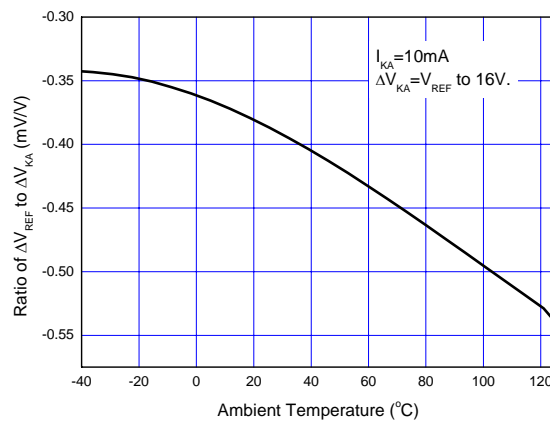
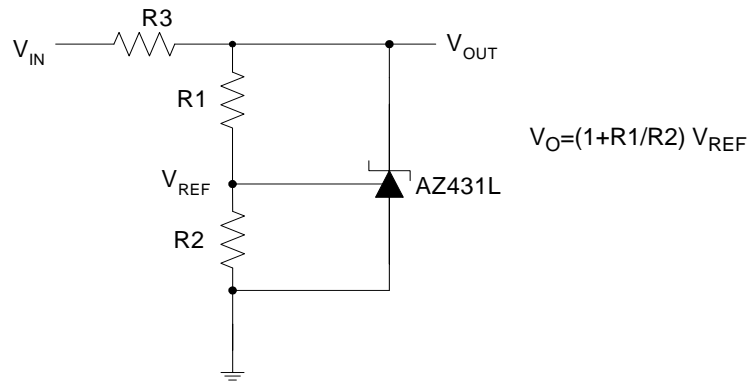


Figure 14. Ratio of Delta Reference Voltage to the Ratio of Cathode Voltage vs. Ambient Temperature

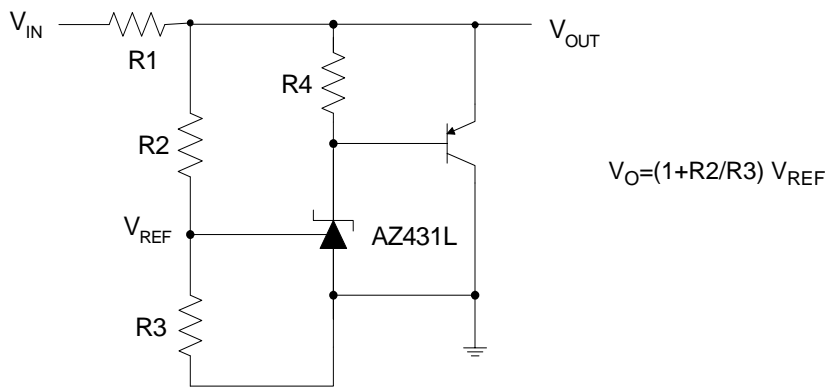


**Typical Applications**



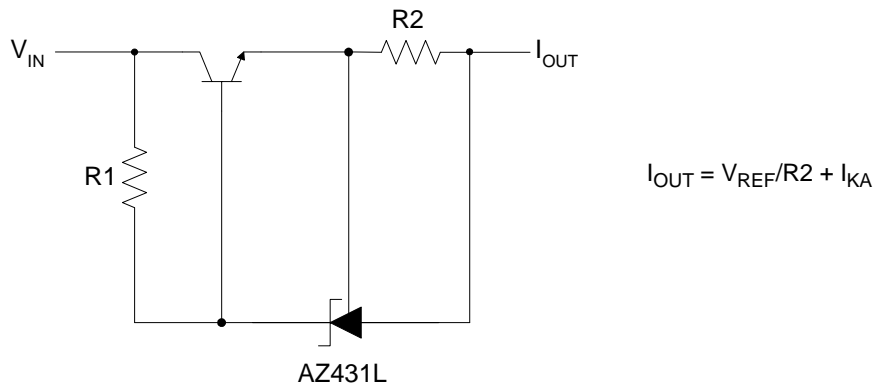
$$V_O = (1 + R1/R2) V_{REF}$$

Figure 15. Shunt Regulator



$$V_O = (1 + R2/R3) V_{REF}$$

Figure 16. High Current Shunt Regulator



$$I_{OUT} = V_{REF}/R2 + I_{KA}$$

Figure 17. Current Source or Current Limit



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**Typical Application (Continued)**

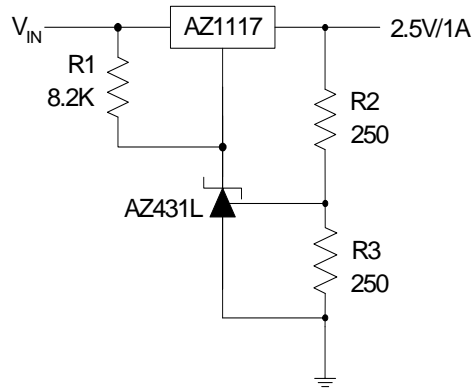


Figure18. Precision 5-V 1.5A Regulator

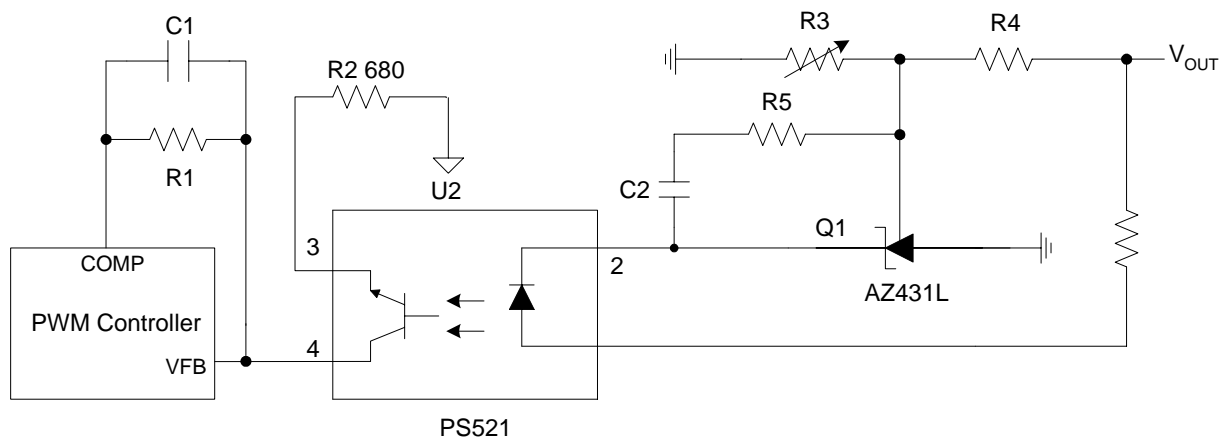


Figure 19. PWM Converter with Reference



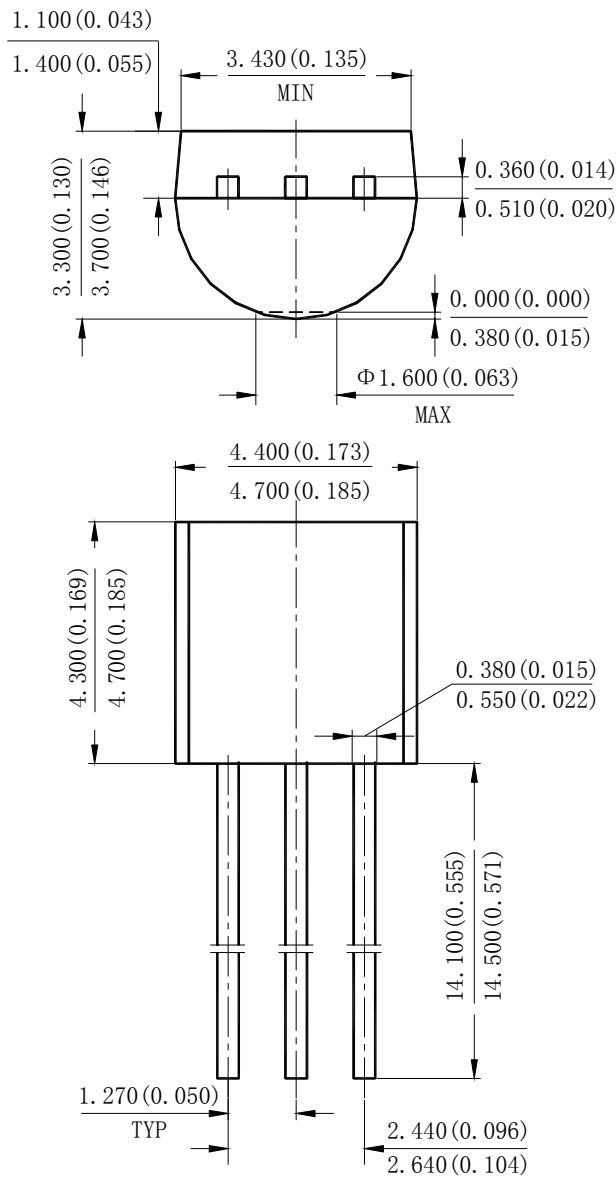
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**Mechanical Dimensions**

**TO-92**

**Unit: mm (inch)**





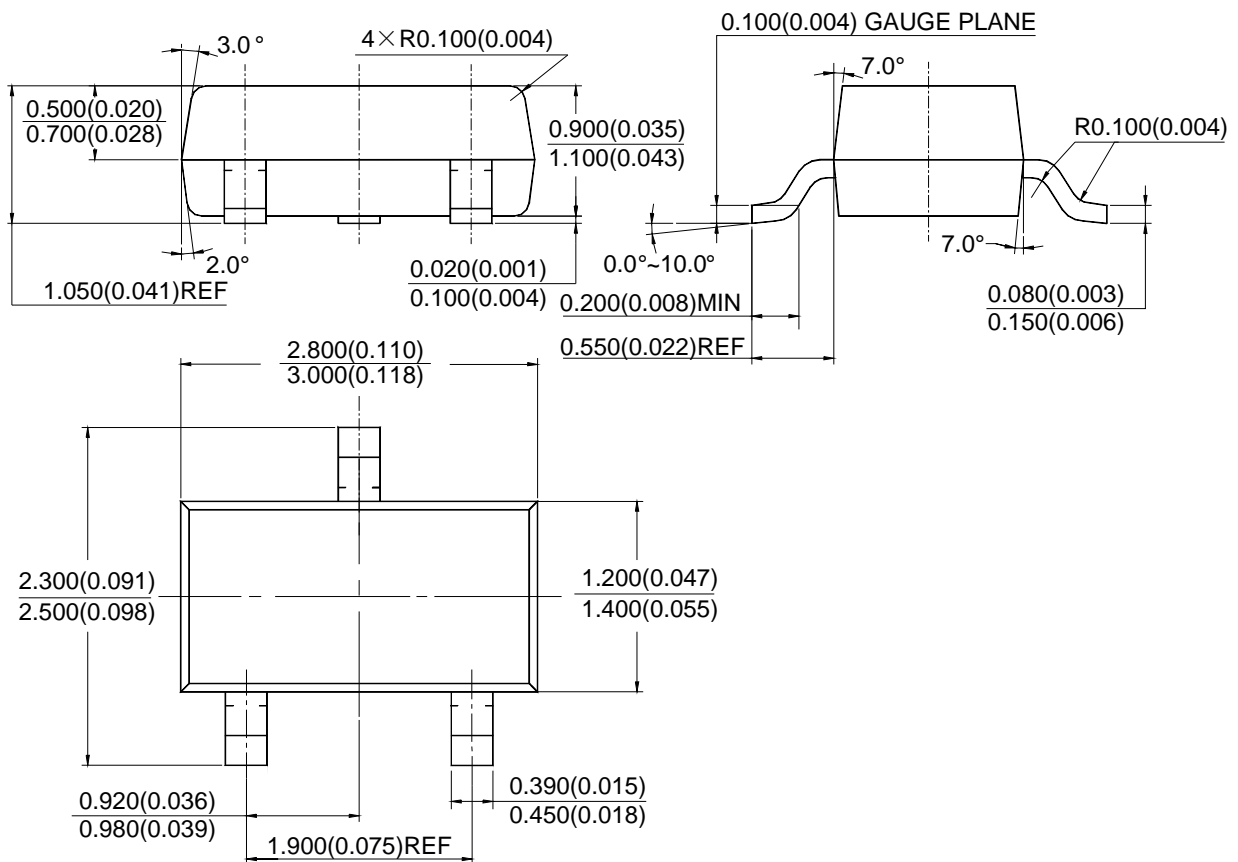
**LOW VOLTAGE (1.24V) ADJUSTABLE PRECISION SHUNT REGULATOR**

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**Mechanical Dimensions (Continued)**

**SOT-23-3**

**Unit: mm(inch)**





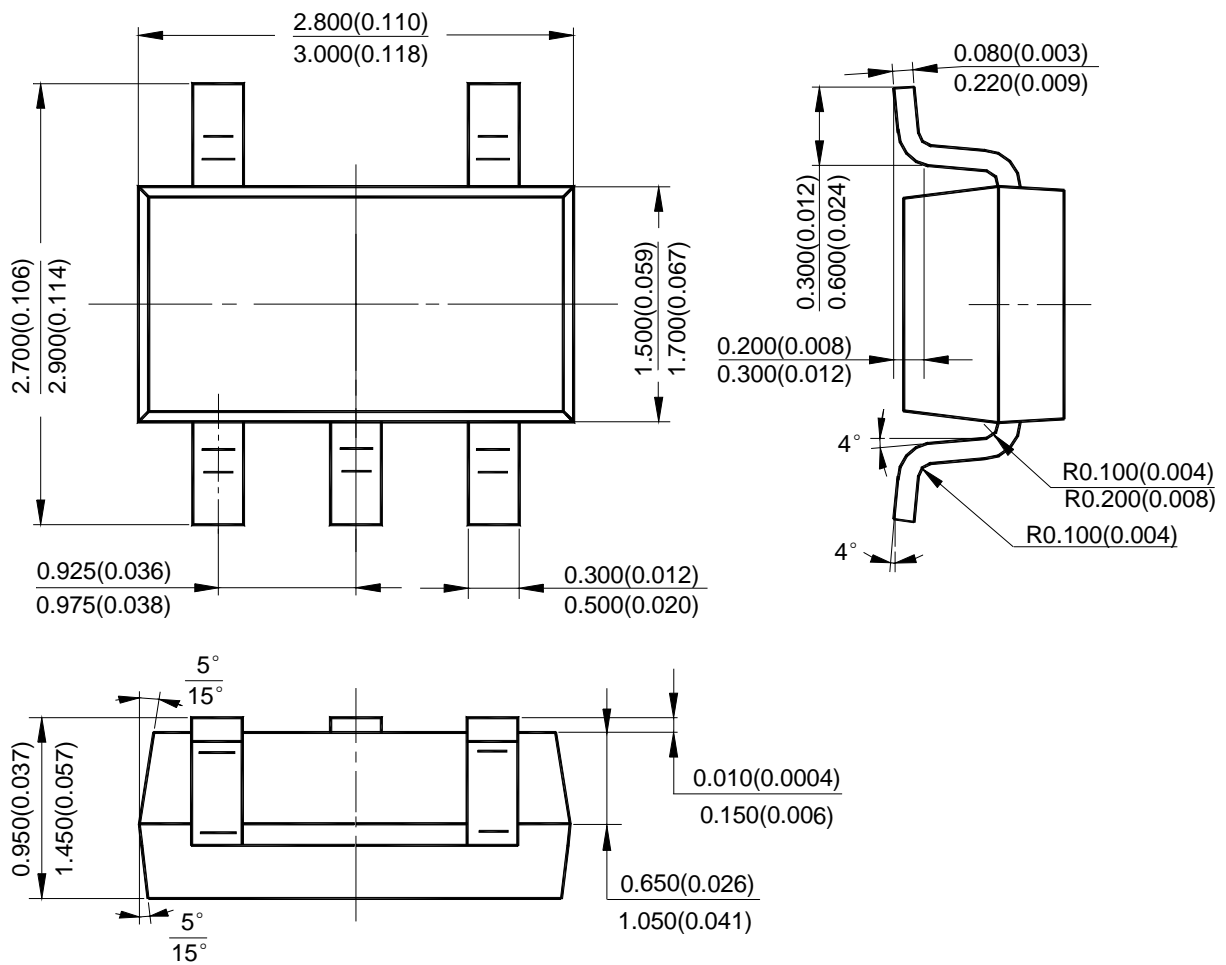
**LOW VOLTAGE (1.24V) ADJUSTABLE PRECISION SHUNT REGULATOR**

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**Mechanical Dimensions (Continued)**

**SOT-23-5**

**Unit: mm(inch)**





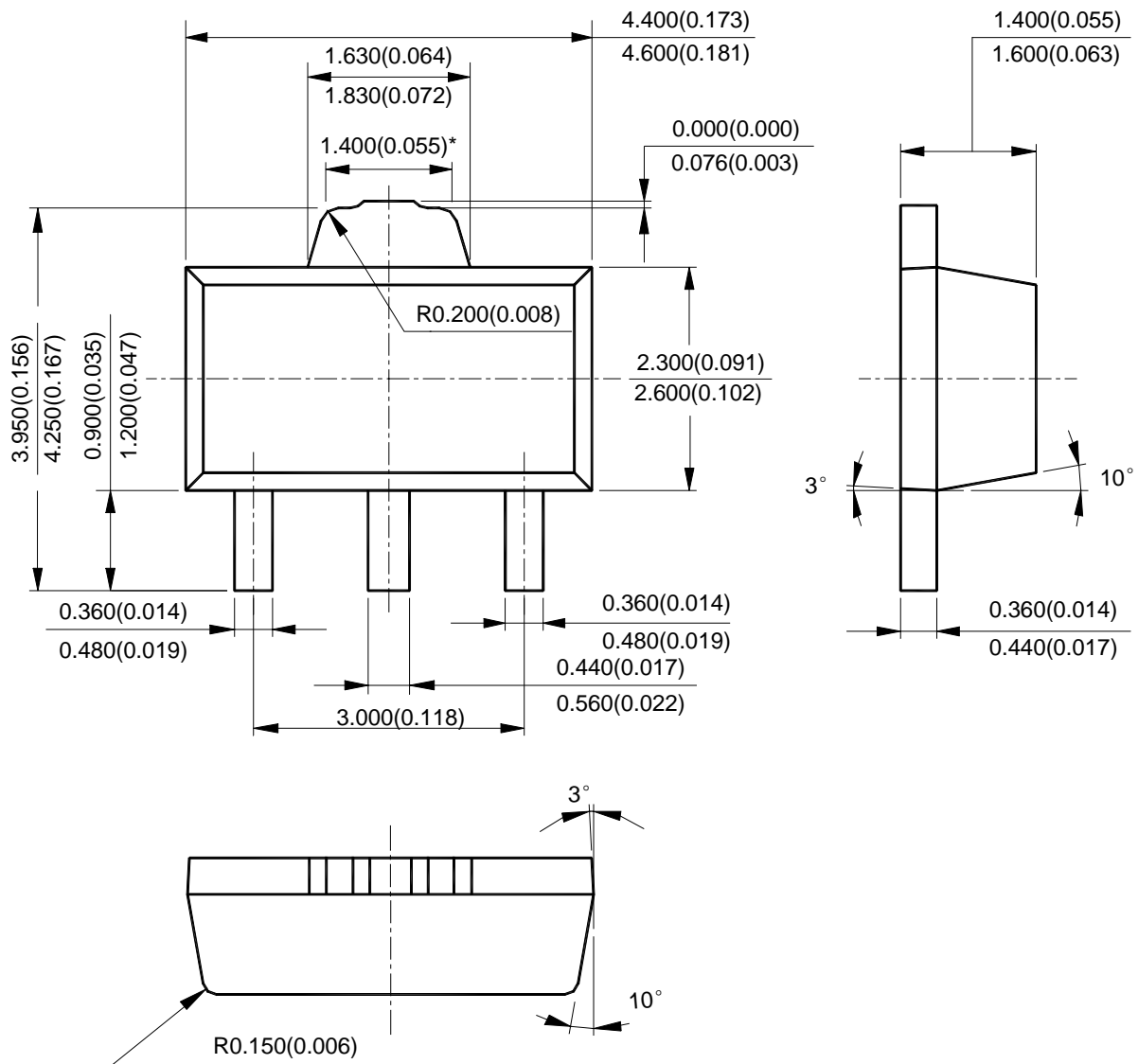
**LOW VOLTAGE (1.24V) ADJUSTABLE PRECISION SHUNT REGULATOR**

**AZ431L**

**Mechanical Dimensions (Continued)**

**SOT-89**

**Unit: mm(inch)**





BCD Semiconductor Manufacturing Limited

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