ADJUSTABLE PRECISION SHUNT REGULATORS AS431

General Description

The AS431 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 output voltage of these ICs can be set to any value between V_{REF} (2.5V) and the maximum cathode voltage (36V).

The AS431 precision reference is offered in two bandgap tolerance: 0.4% and 0.8%.

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

Features

Programmable Precise Output Voltage from 2.5V to 36V
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/^{o}C Typical
Low Dynamic Output Resistance: 0.15Ω Typical
Sink Current Capacity from 1mA to 100 mA
Low Output Noise
Wide Operating Range of -40 to 125^{o}C

Applications

Charger
Voltage Adapter
Switching Power Supply
Graphic Card
Precision Voltage Reference

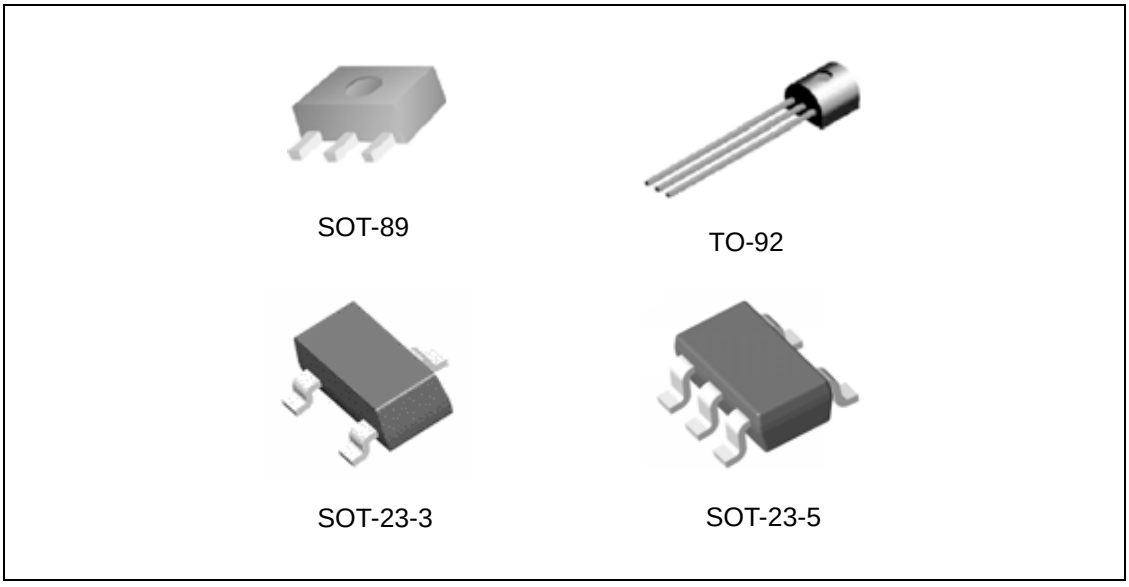
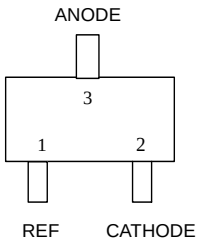


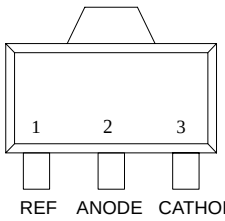
Figure 1. Package Types of AS431

Pin Configuration

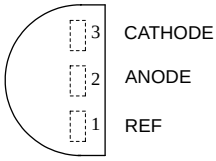
N Package
(SOT-23-3)



R Package
(SOT-89)



Z Package
(TO-92)



K Package
(SOT-23-5)

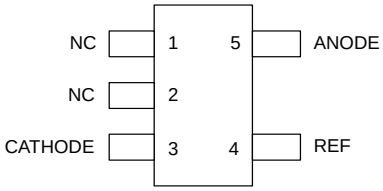


Figure 2. Pin Configuration of AS431 (Top View)

Functional Block Diagram

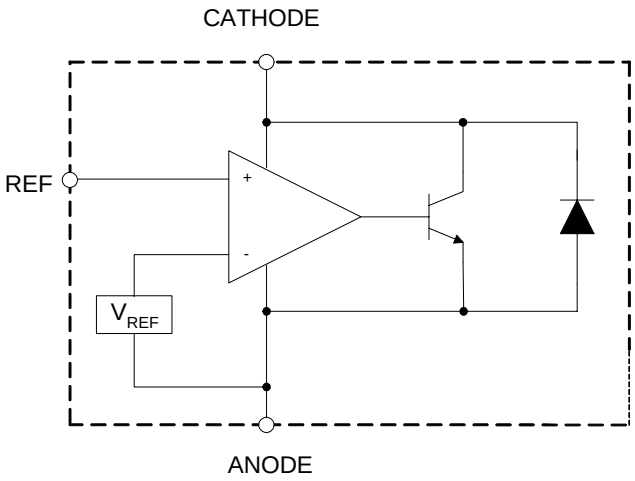
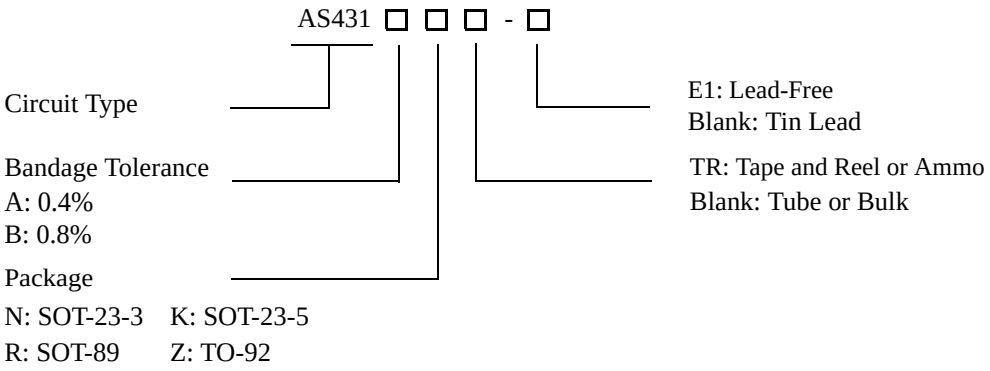


Figure 3. Functional Block Diagram of AS431

Ordering Information



Package	Temperature Range	Voltage Tolerance	Part Number		Marking ID		Packing Type
			Tin Lead	Lead Free	Tin Lead	Lead Free	
SOT-23-3	-40 to 125°C	0.4%		AS431ANTR-E1		EB5	Tape & Reel
		0.8%		AS431BNTR-E1		EB6	Tape & Reel
SOT-23-5	-40 to 125°C	0.4%		AS431AKTR-E1		E6H	Tape & Reel
		0.8%		AS431BKTR-E1		E6I	Tape & Reel
TO-92	-40 to 125°C	0.4%		AS431AZ-E1		AS431AZ-E1	Bulk
		0.4%		AS431AZTR-E1		AS431AZ-E1	Ammo
		0.8%		AS431BZ-E1		AS431BZ-E1	Bulk
		0.8%		AS431BZTR-E1		AS431BZ-E1	Ammo
SOT-89	-40 to 125°C	0.4%		AS431ARTR-E1		E43G	Tape & Reel
		0.8%		AS431BRTR-E1		E43H	Tape & Reel

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

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	Z, R Package: 770	mW
		N, K Package: 370	
Junction Temperature	T_J	160	^oC
Storage Temperature Range	T_{STG}	-65 to 150	^oC
Package Thermal Impedance	θ_{JA}	N Package: 330	$^oC/W$
		Z Package: 150	
		R Package: 50	
		K Package: 250	
ESD (Human Body Model)		4000	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}	1.0	100	mA
Operating Ambient Temperature Range		-40	125	^oC

Electrical Characteristics for AS431

Operating Conditions: T_A=25°C, unless otherwise specified.

Parameter		Test Circuit	Symbol	Conditions		AS431 Min	AS431 Typ	AS431 Max	Unit
Reference Voltage	0.4%	4	V_{REF}	$V_{KA}=V_{REF}$, I_{KA}=10mA		2.490	2.500	2.510	V
	0.8%					2.480	2.500	2.520	
Deviation of Reference Voltage Over-temperature		4	ΔV_{REF}	$V_{KA}=V_{REF}$ I_{KA}=10mA	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}=10mA	ΔV_{KA}= 10V to V_{REF}		-1.0	-2.7	mV/V
					ΔV_{KA}= 36V to 10V		-0.5	-2.0	
Reference Current		5	I_{REF}	I_{KA}=10mA, R1=10KΩ, R2=∞			0.7	4	μA
Deviation of Reference Current Over Full Temperature Range		5	ΔI_{REF}	I_{KA}=10mA, R1=10KΩ R2=∞, T_A=-40 to 85°C			0.4	1.2	μA
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}=36V, V_{REF}=0			0.05	1.0	μA
Dynamic Impedance		4	Z_{KA}	$V_{KA}=V_{REF}$, I_{KA}=1 to 100mA, f ≤ 1.0KHz			0.15	0.5	Ω

Electrical Characteristics (Continued)

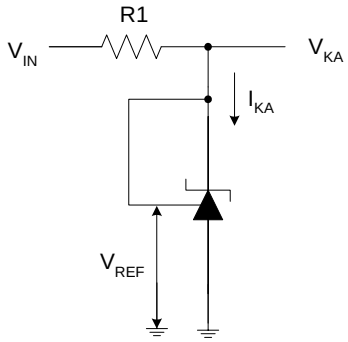


Figure 4. Test Circuit 4 for $V_{KA}=V_{REF}$

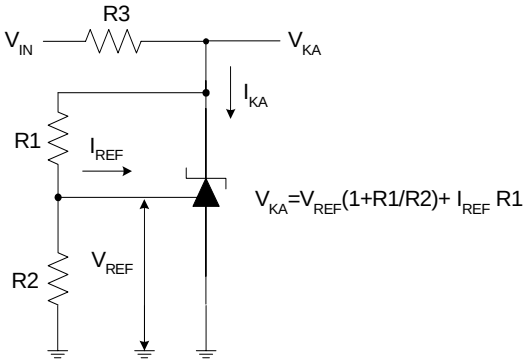


Figure 5. Test Circuit 5 for $V_{KA}>V_{REF}$

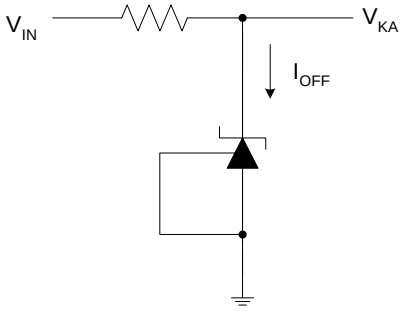


Figure 6. Test Circuit 6 for I_{OFF}

Typical Performance Characteristics

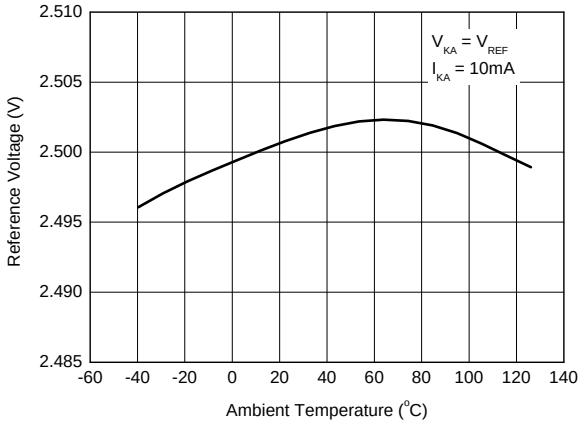


Figure 7. Reference Voltage vs. Ambient Temperature

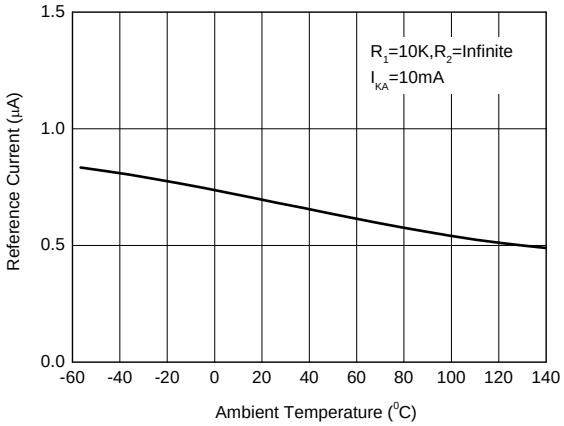


Figure 8. Reference Current vs. Ambient Temperature

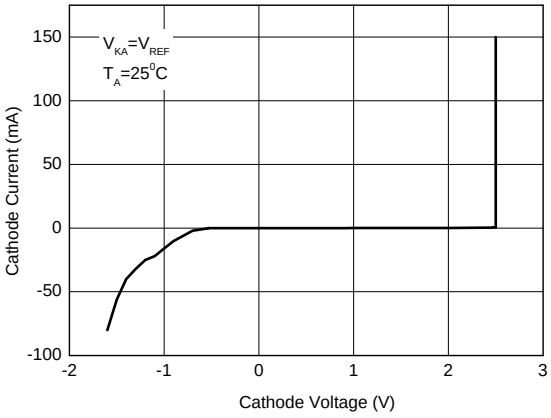


Figure 9. Cathode Current vs. Cathode Voltage

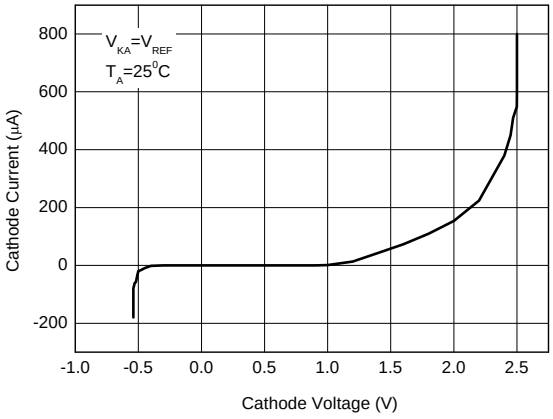


Figure 10. Cathode Current vs. Cathode Voltage

Typical Performance Characteristics (Continued)

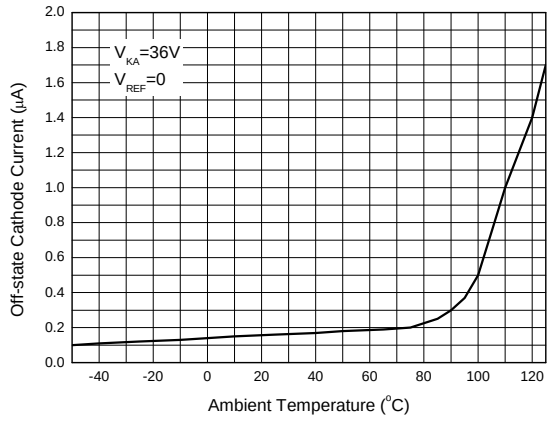


Figure 11. Off-state Cathode Current vs. Ambient Temperature

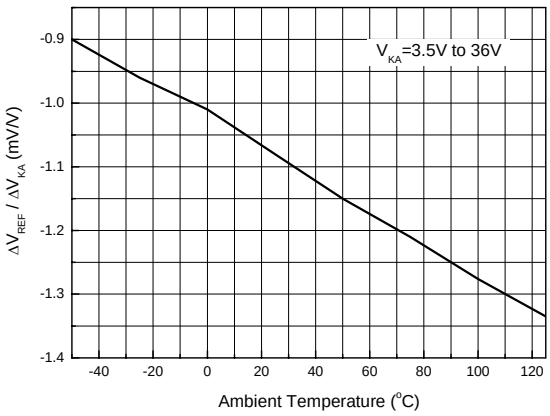
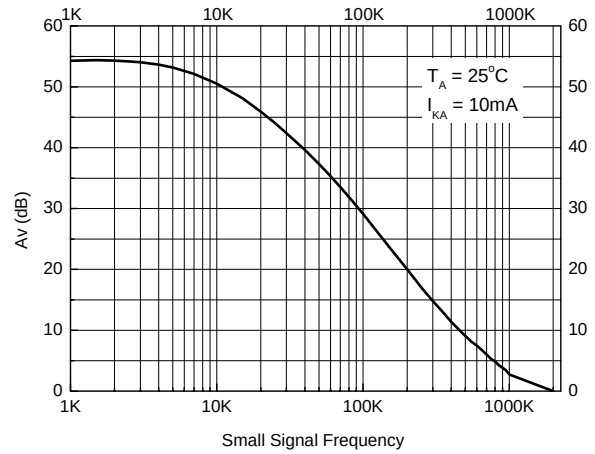


Figure 12. Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage



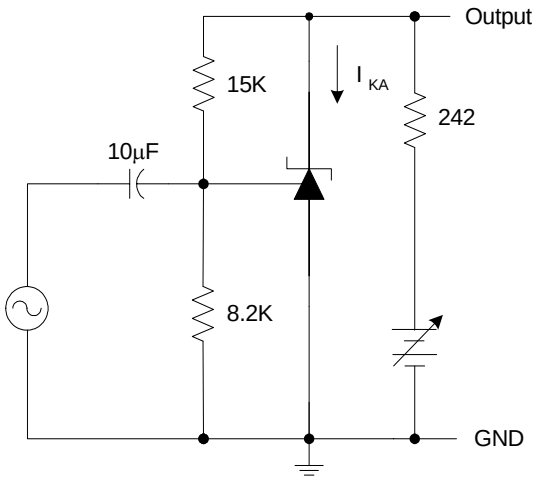


Figure 13. Small Signal Voltage Gain vs. Frequency

Typical Performance Characteristics (Continued)

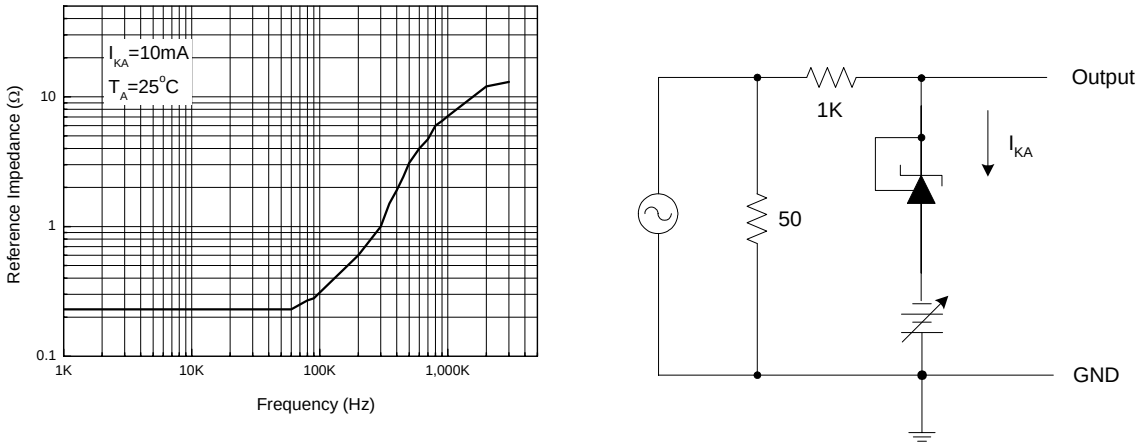


Figure 14. Reference Impedance vs. Frequency

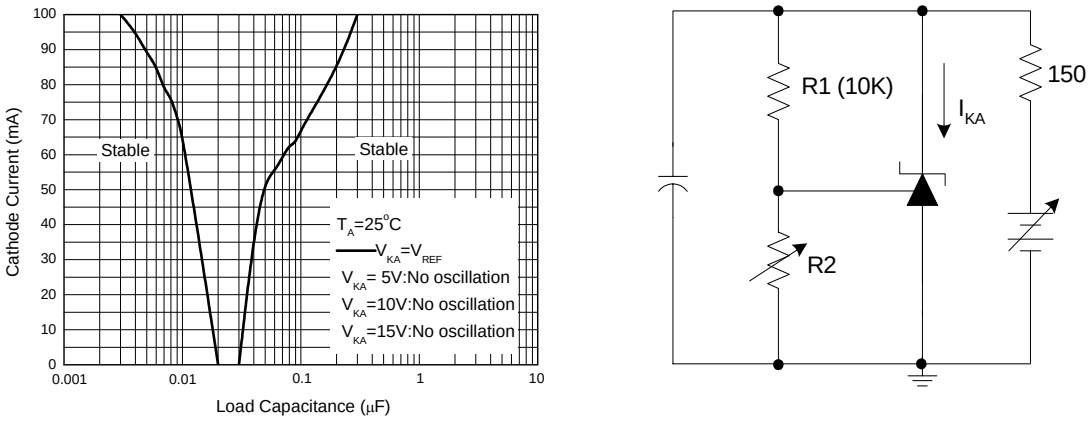


Figure 15. Stability Boundary Conditions vs. Load Capacitance

Typical Performance Characteristics (Continued)

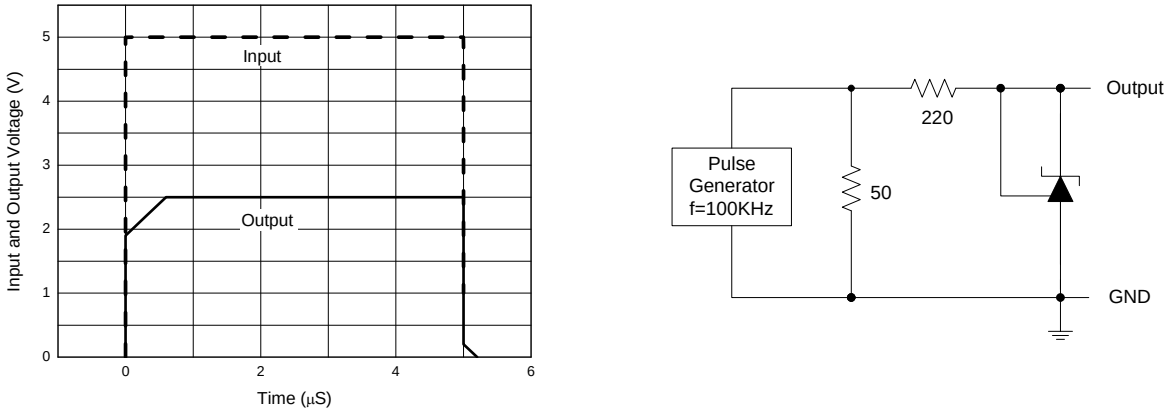


Figure 16. Pulse Response of Input and Output Voltage

Typical Application

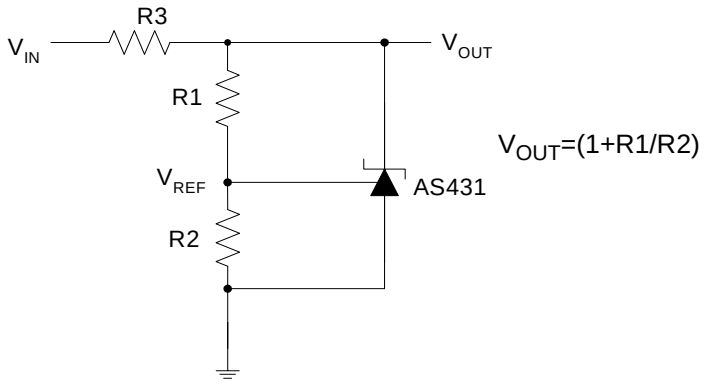


Figure 17. Shunt Regulator

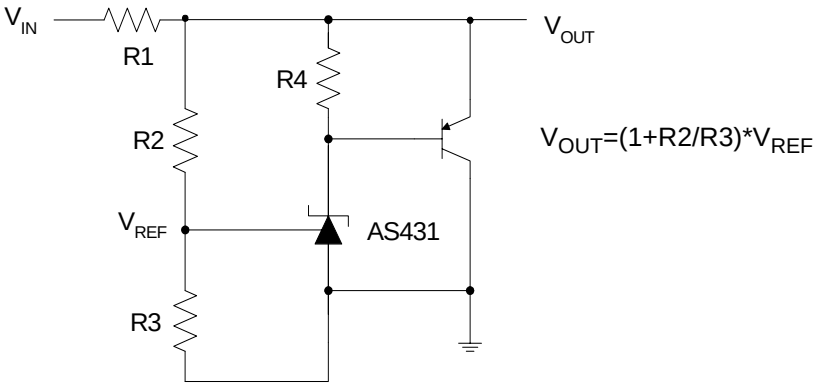


Figure 18. High Current Shunt Regulator

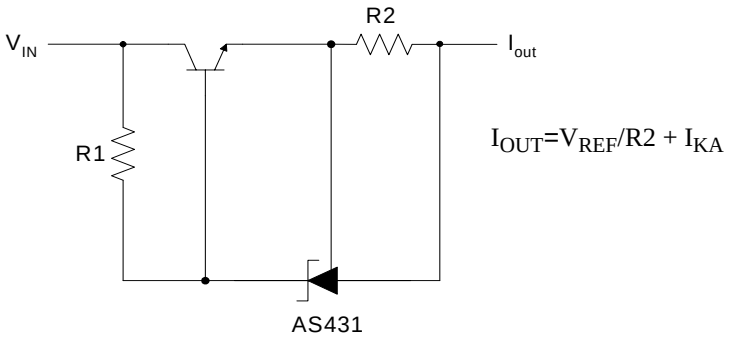


Figure 19. Current Source or Current Limit

Typical Application (Continued)

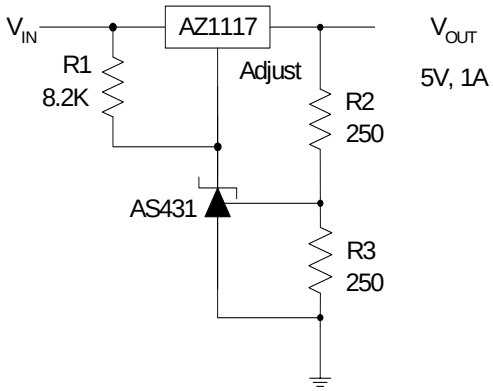


Figure 20. Precision 5V 1A Regulator

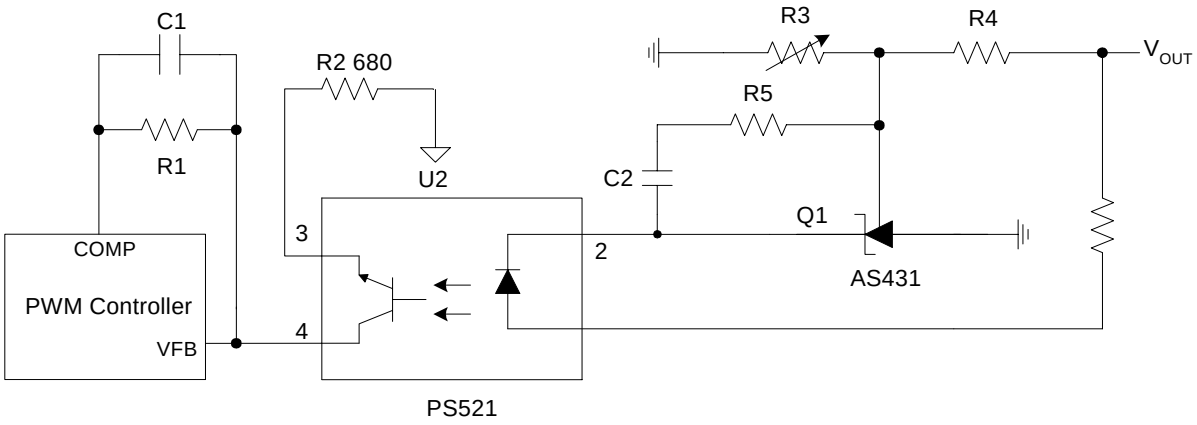
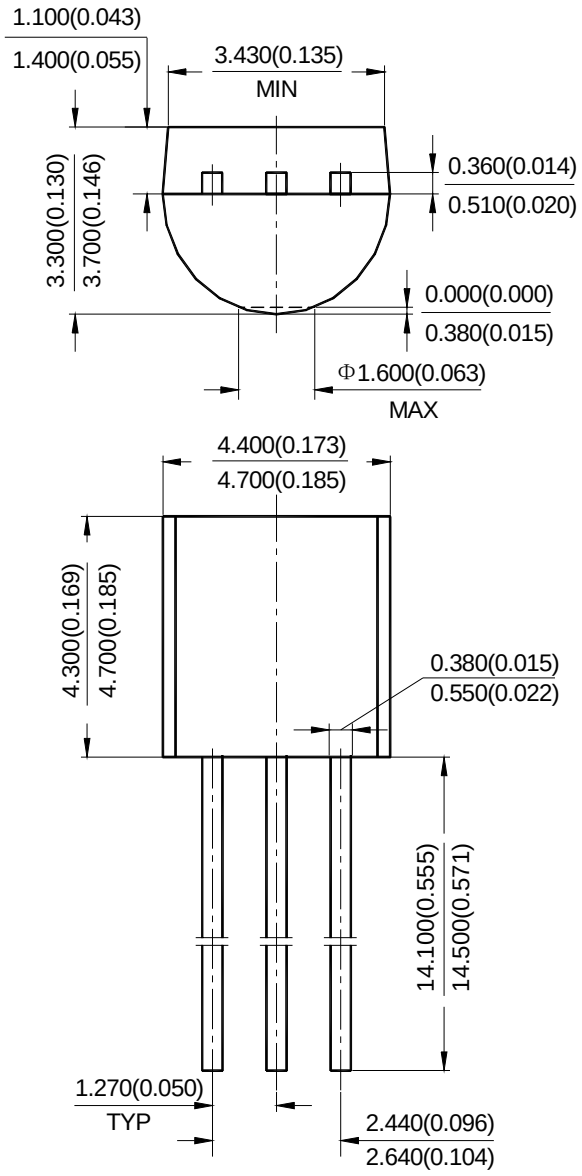


Figure 21. PWM Converter with Reference

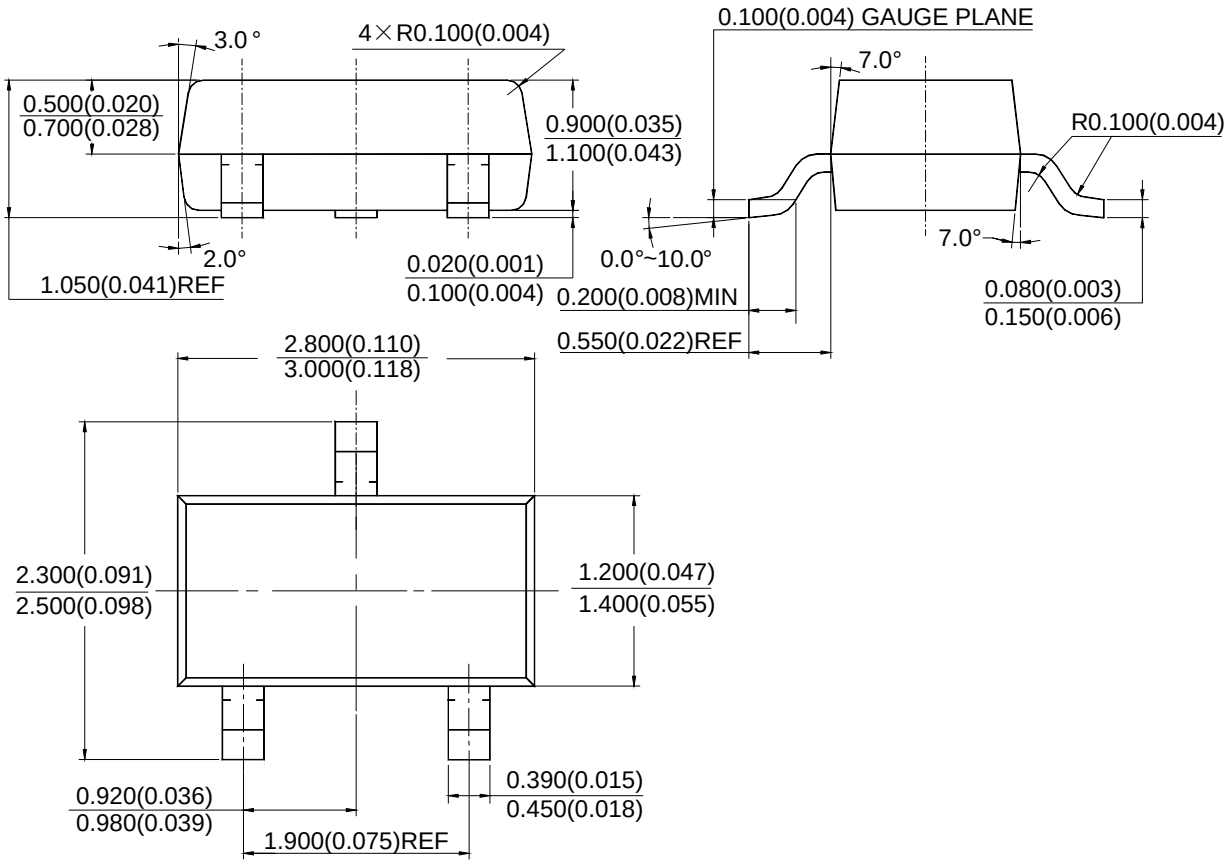
Mechanical Dimensions

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



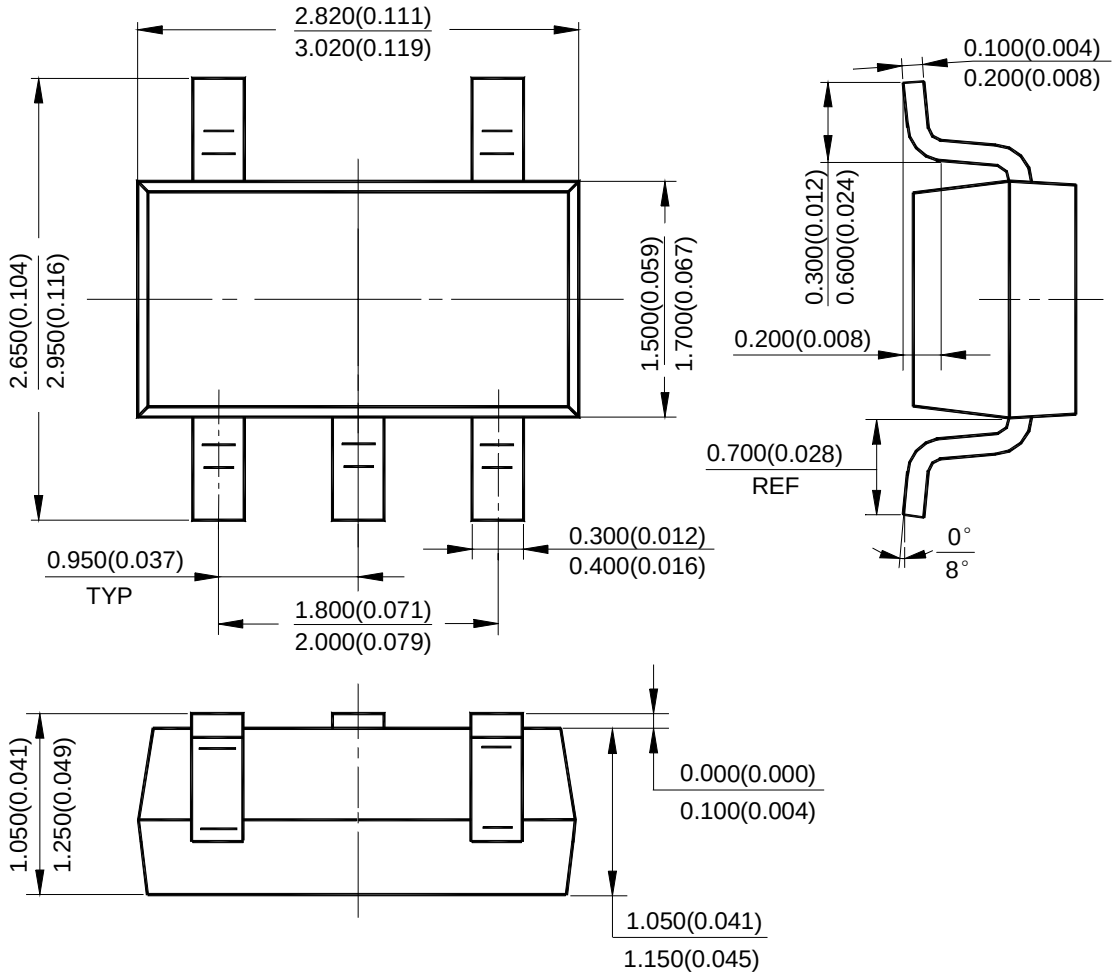
Mechanical Dimensions (Continued)

SOT-23-3 **Unit: mm(inch)**



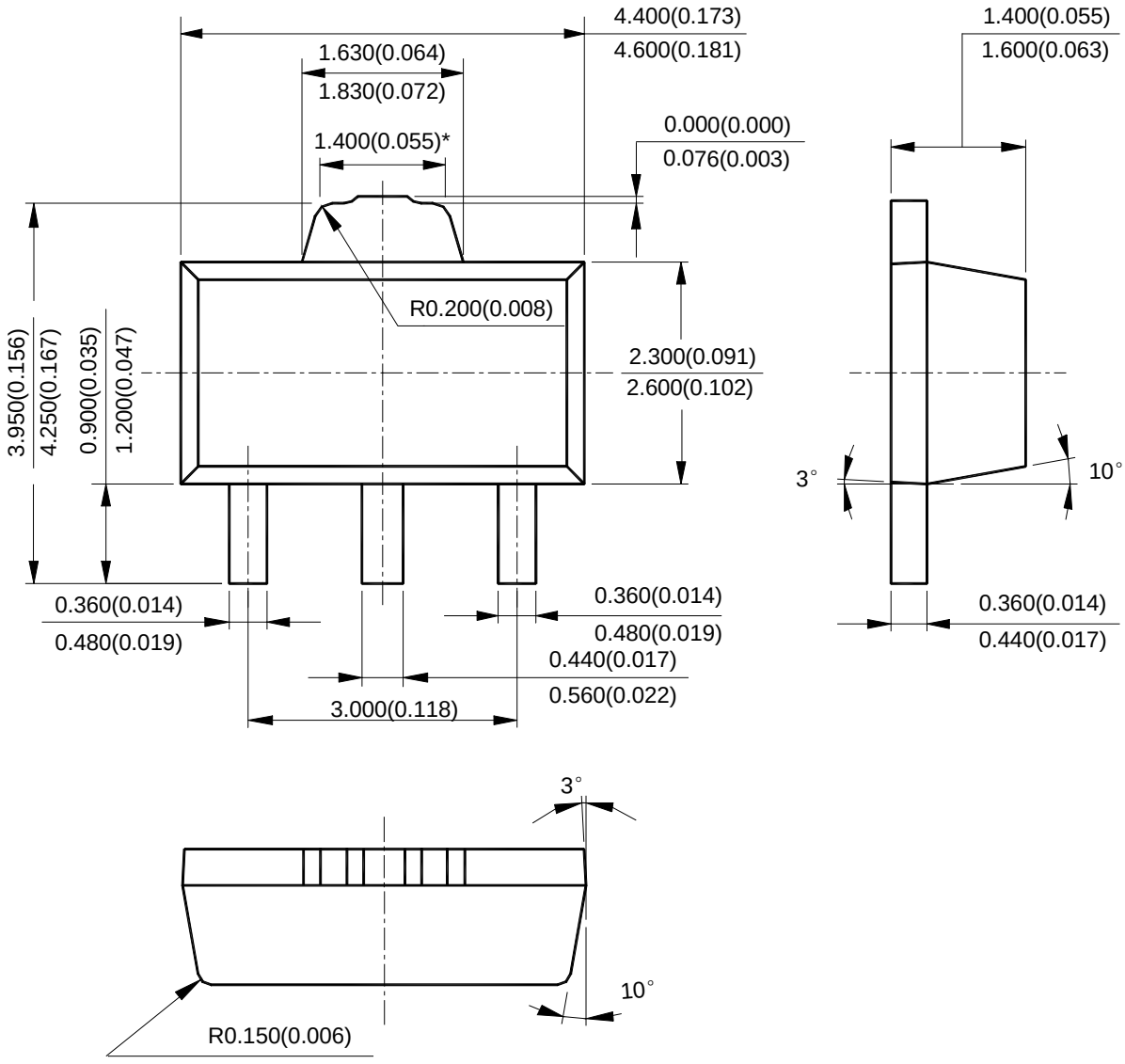
Mechanical Dimensions (Continued)

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



Mechanical Dimensions (Continued)

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



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