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℃, 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: 10μA (Typ.), 50μA (Max.)
- Low Temperature Deviation: 4.5mV Typical
- Sink Current Capacity from 50μ A to 100mA
- Low Output Noise
- Wide Operating Range: -40℃ to 125℃

Applications

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

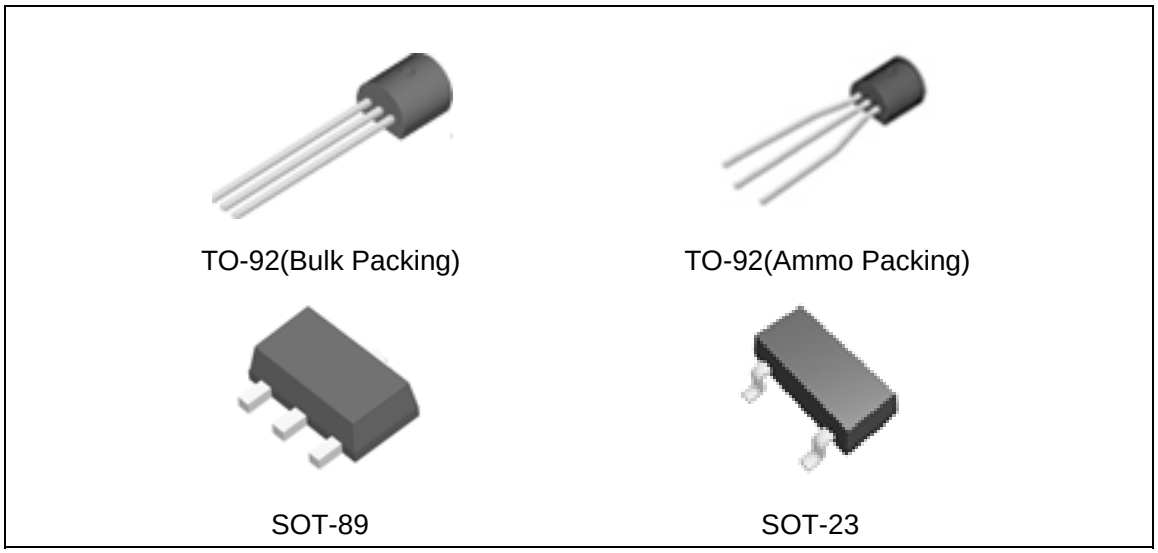
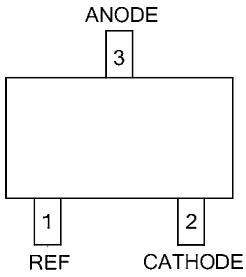


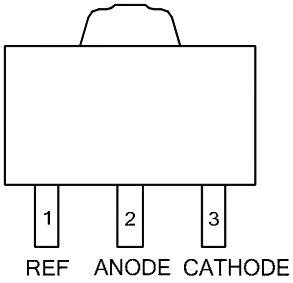
Figure 1. Package Type of AS431I

Pin Configuration

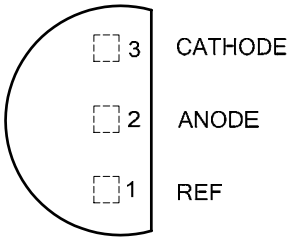
N Package
(SOT-23)



P Package
(SOT-89)



Z Package
(TO-92 (Bulk Package))



Z Package
(TO-92 (Ammo Package))

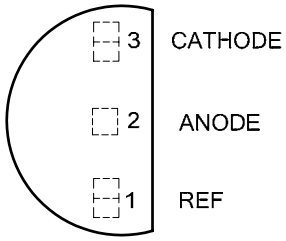


Figure 2. Pin Configuration of AS431I (Top View)

Functional Block Diagram

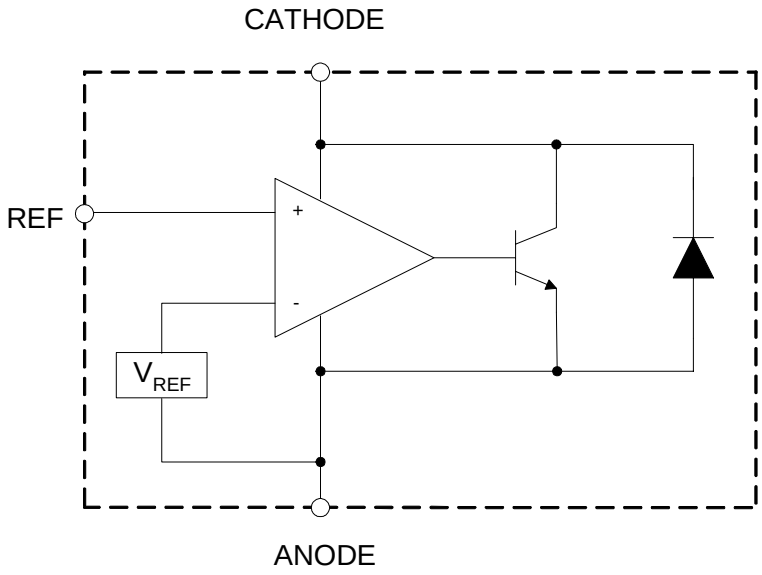
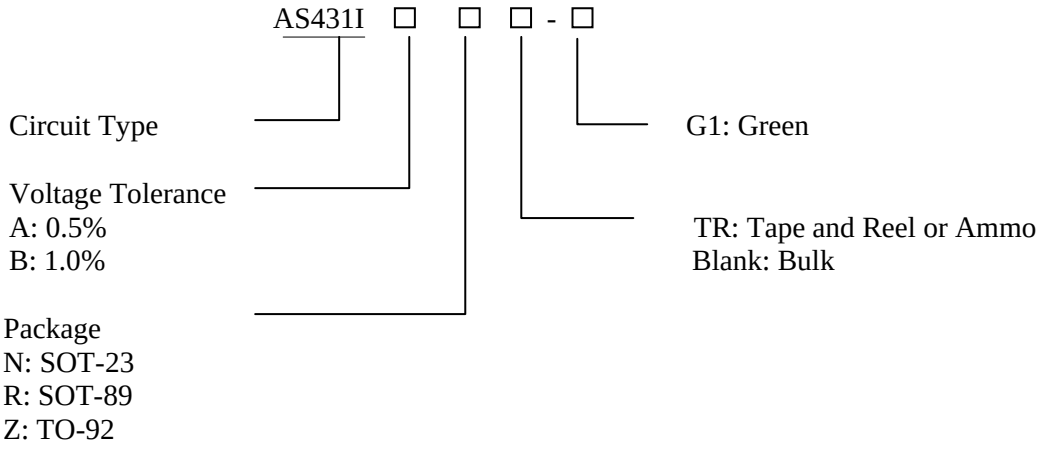


Figure 3. Functional Block Diagram of AS431I

Ordering Information



Package	Temperature Range	Voltage Tolerance	Part Number	Marking ID	Packing Type
SOT-23	-40 to 125℃	0.5%	AS431IANTR-G1	GB9	Tape & Reel
		1.0%	AS431IBNTR-G1	GC9	Tape & Reel
TO-92	-40 to 125℃	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℃	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.

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

Electrical Characteristics

Operating Conditions: T_A=25℃, unless otherwise specified.

Parameter		Test Circuit	Symbol	Conditions		Min	Typ	Max	Unit
Reference Voltage	0.5%	4	V_{REF}	$V_{KA}=V_{REF}$, I_{KA}=10mA		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}= 10mA	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}=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=∞			0.035	0.5	μA
Deviation of Reference Current Over Full Temperature Range		5	ΔI_{REF}	I_{KA}=10mA, R1=10kΩ, R2=∞, T_A=-40 to 125 °C			0.03	0.3	μA
Minimum Cathode Current for Regulation		4	I_{KA} (Min)	$V_{KA}=V_{REF}$			10	50	μA
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
Thermal Resistance			θ_{JC}	TO-92			68		°C/W
				SOT-89			70		
				SOT-23			113		

Electrical Characteristics (Continued)

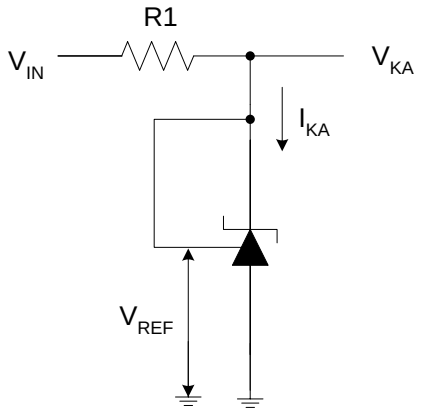


Figure 4. Test Circuit 4 for $V_{KA}=V_{REF}$

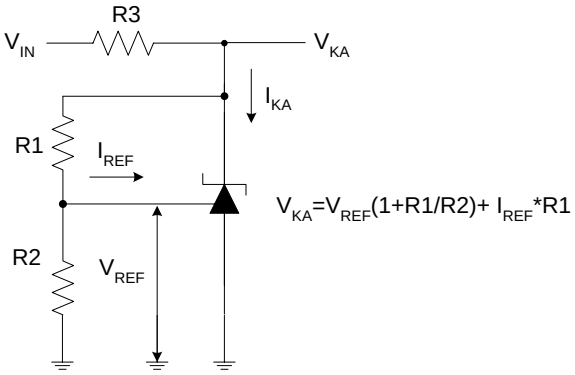


Figure 5. Test Circuit 5 for $V_{KA} > V_{REF}$

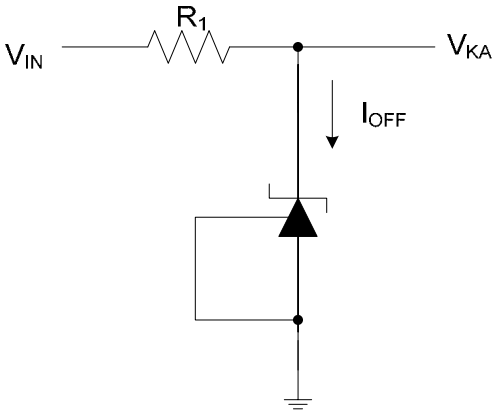


Figure 6. Test Circuit 6 for I_{OFF}

Typical Performance Characteristics

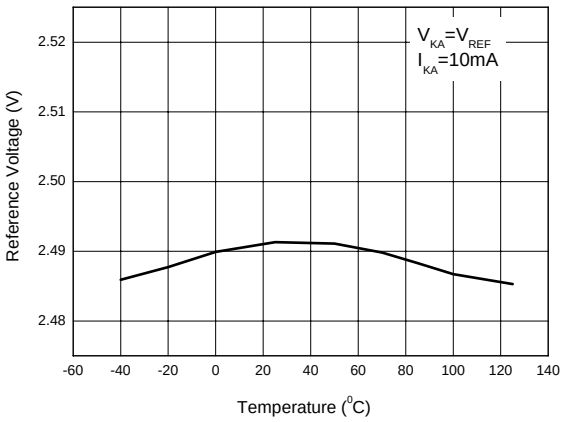


Figure 7. Reference Voltage vs. Ambient Temperature

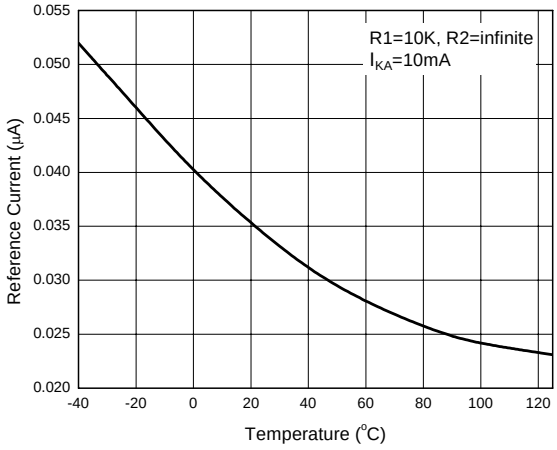


Figure 8. Reference Current vs. Ambient Temperature

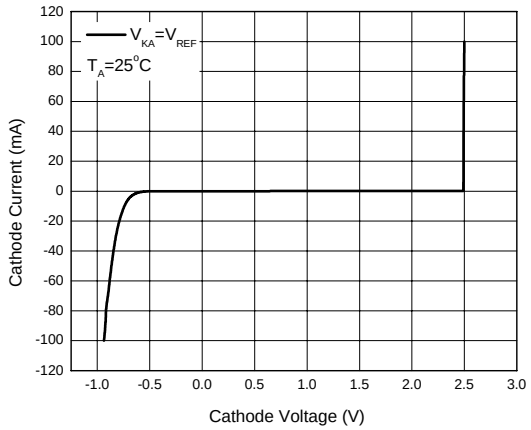


Figure 9. Cathode Current vs. Cathode Voltage

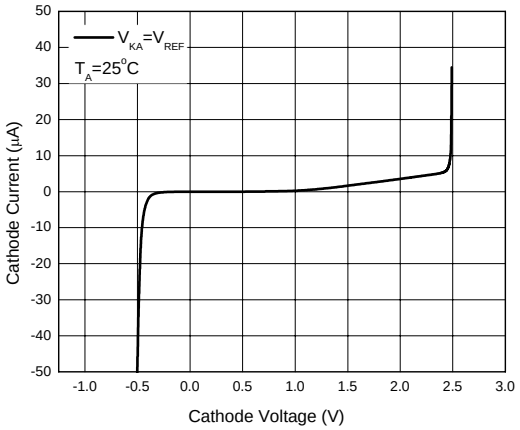


Figure 10. Cathode Current vs. Cathode Voltage

Typical Performance Characteristics (Continued)

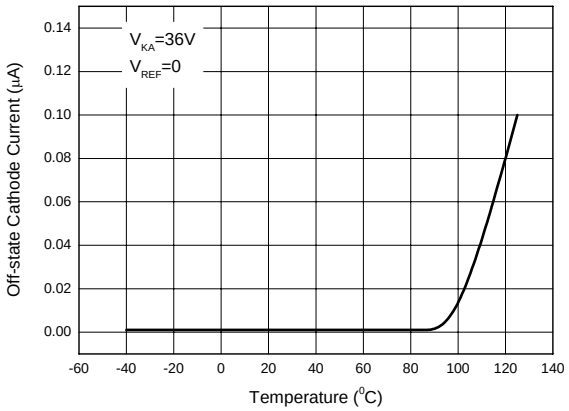


Figure 11. Off-state Cathode Current vs. Ambient Temperature

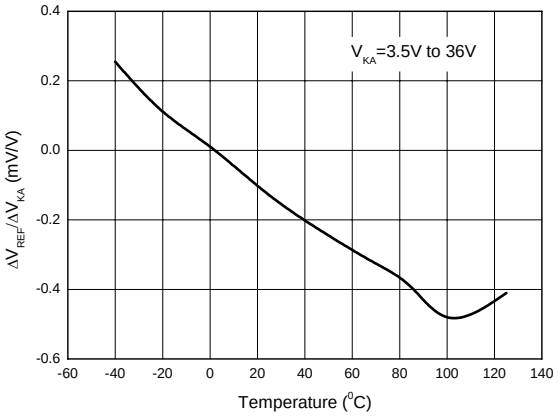
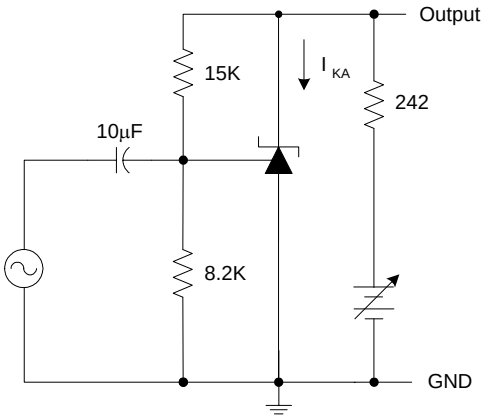


Figure 12. Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage



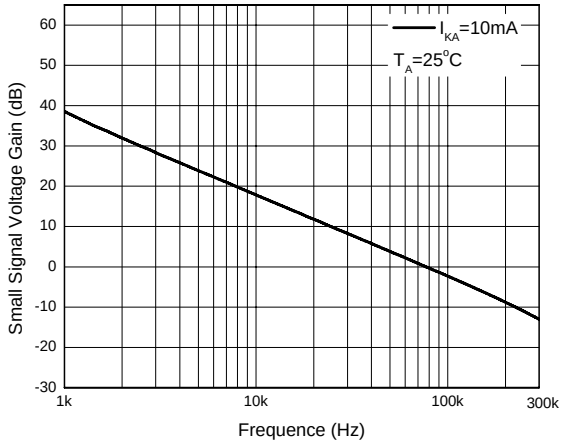


Figure 13. Small Signal Voltage Gain vs. Frequency

Typical Performance Characteristics (Continued)

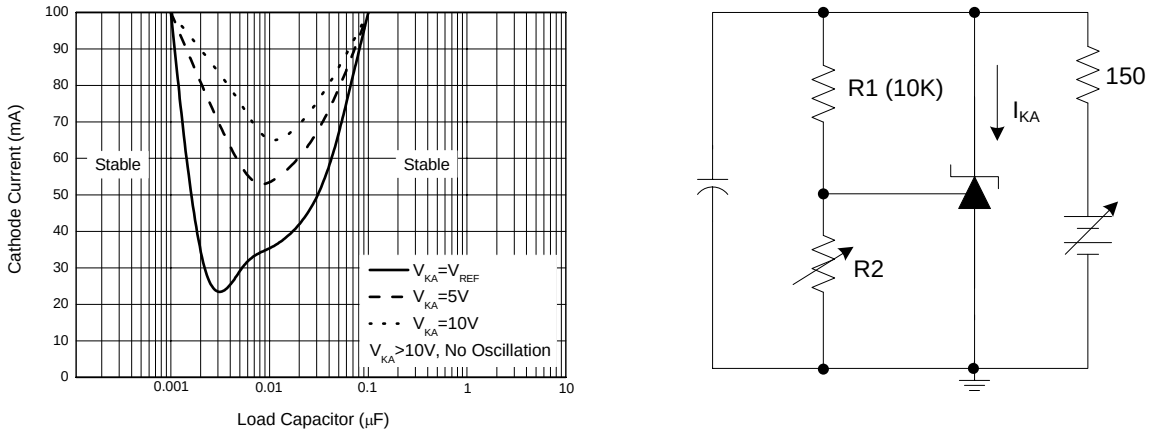


Figure 14. Stability Boundary Conditions vs. Load Capacitance

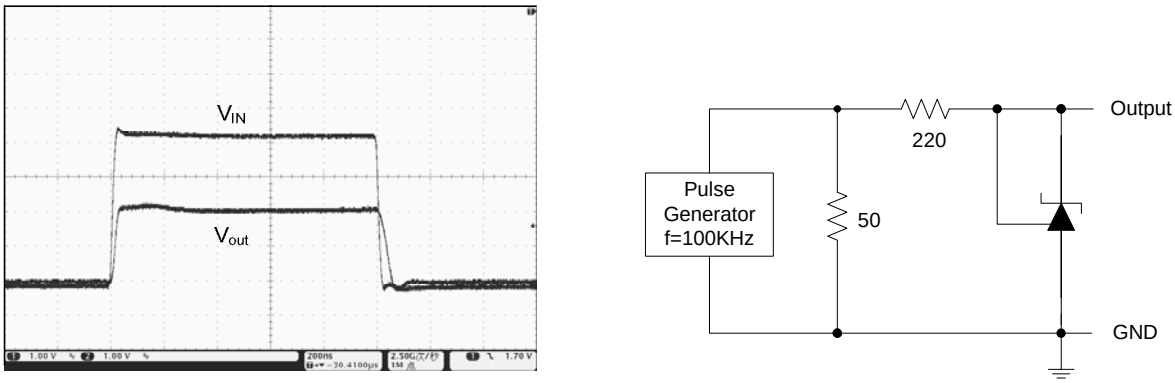
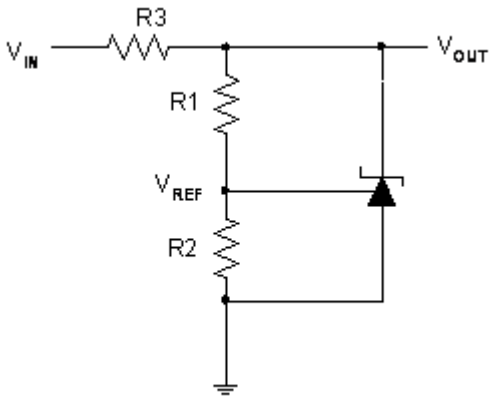


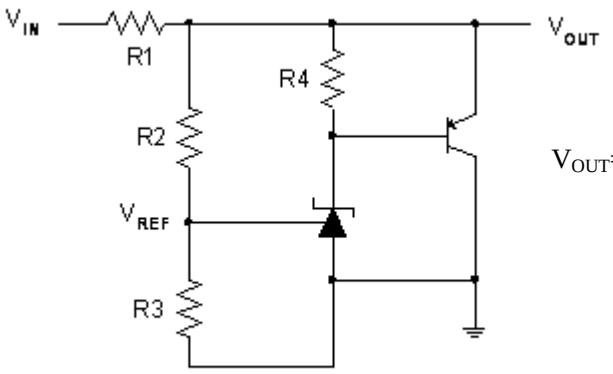
Figure 15. Pulse Response of Input and Output Voltage

Typical Application



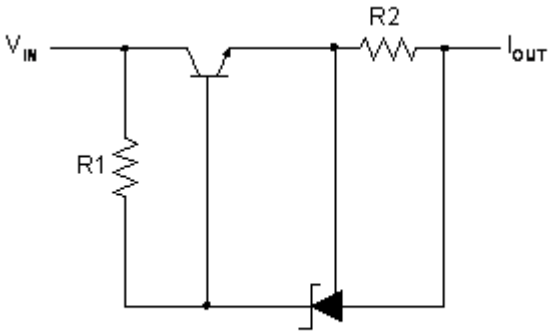
$V_{OUT}=(1+R1/R2)*V_{REF}$

Figure 16. Shunt Regulator



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

Figure 17. High Current Shunt Regulator



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

Figure 18. Current Source or Current Limit

Typical Application (Continued)

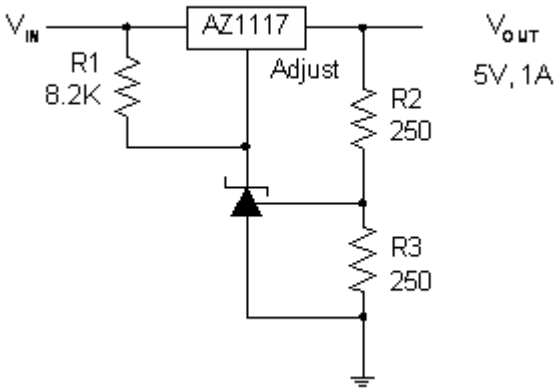


Figure 19. Precision 5V 1A Regulator

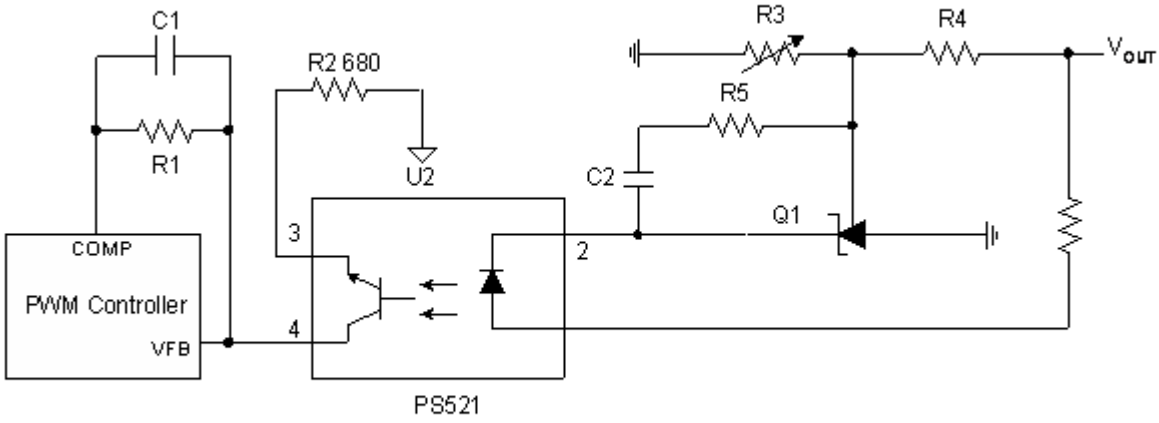
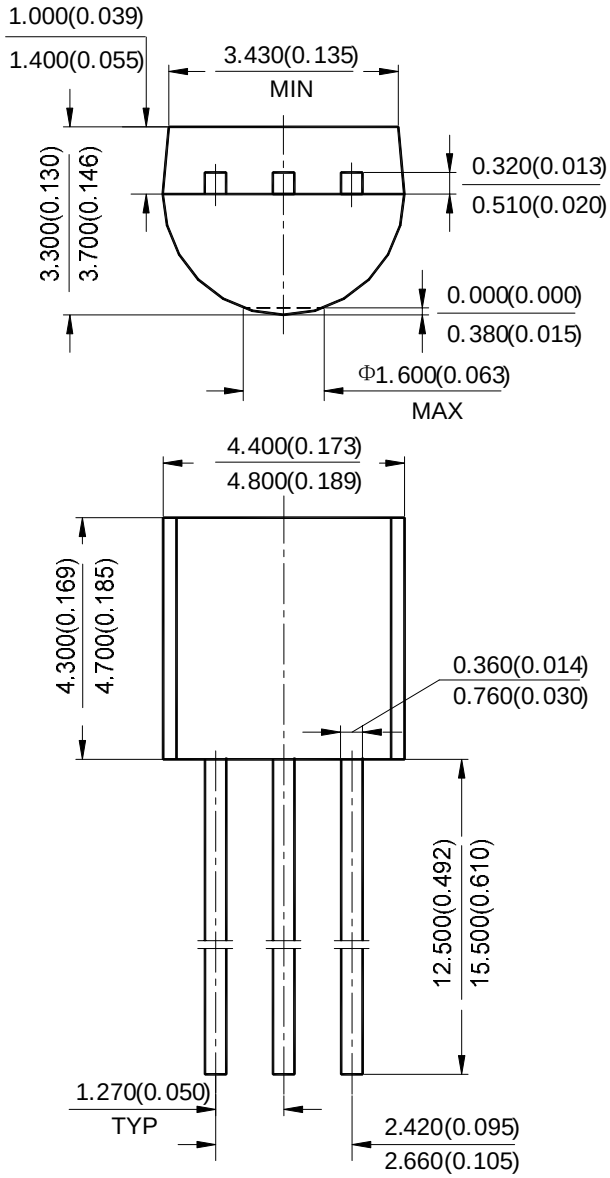


Figure 20. PWM Converter with Reference

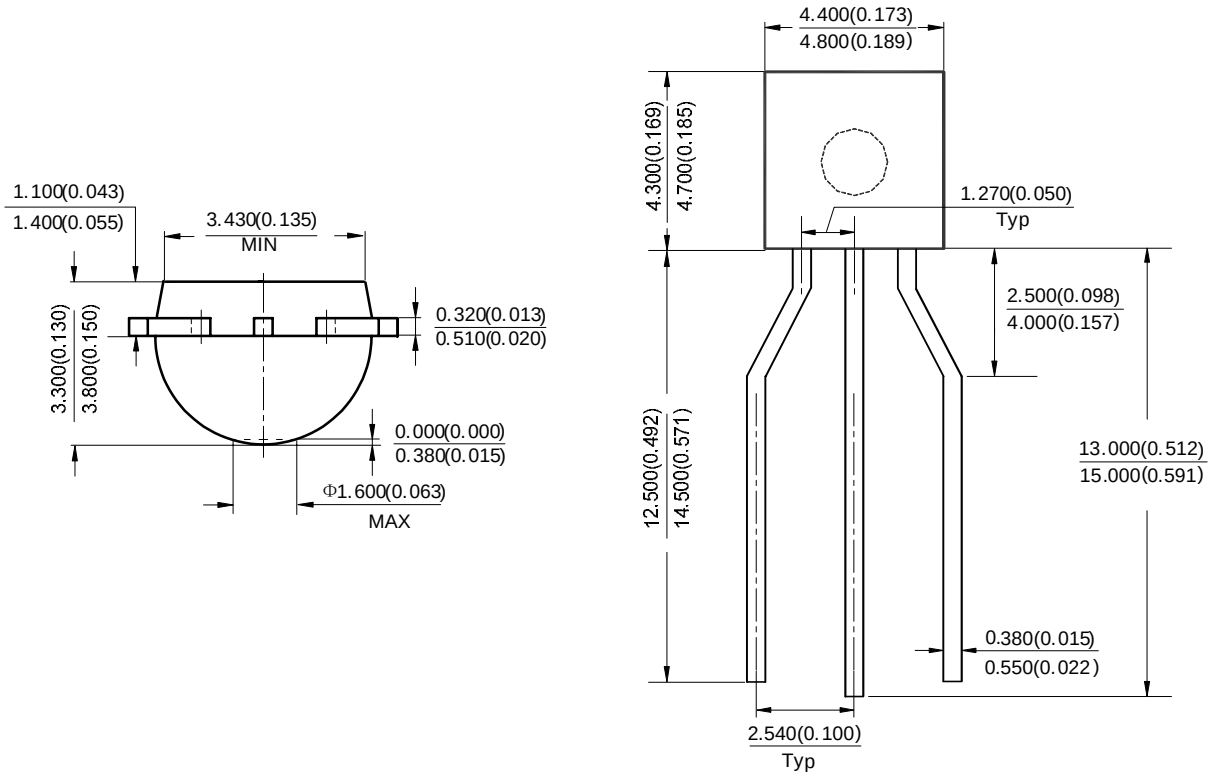
Mechanical Dimensions

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



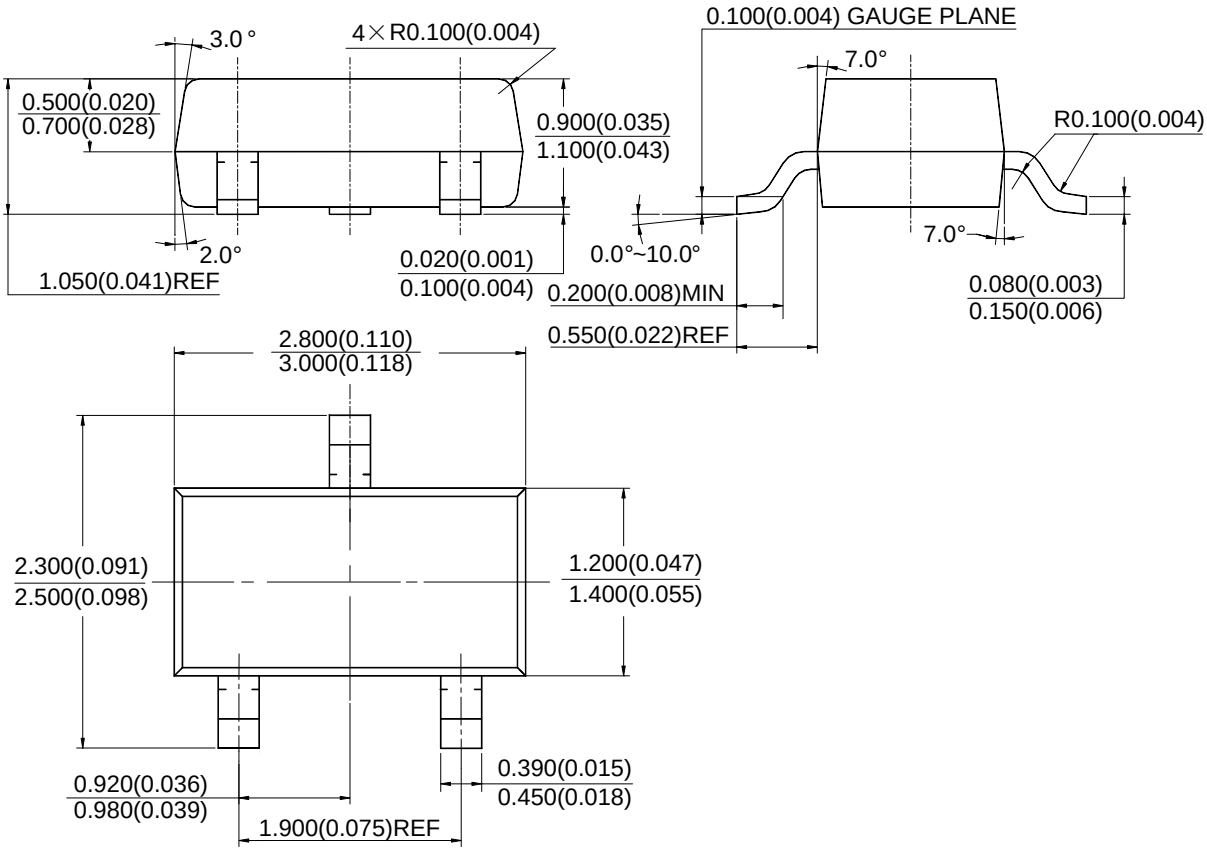
Mechanical Dimensions (Continued)

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



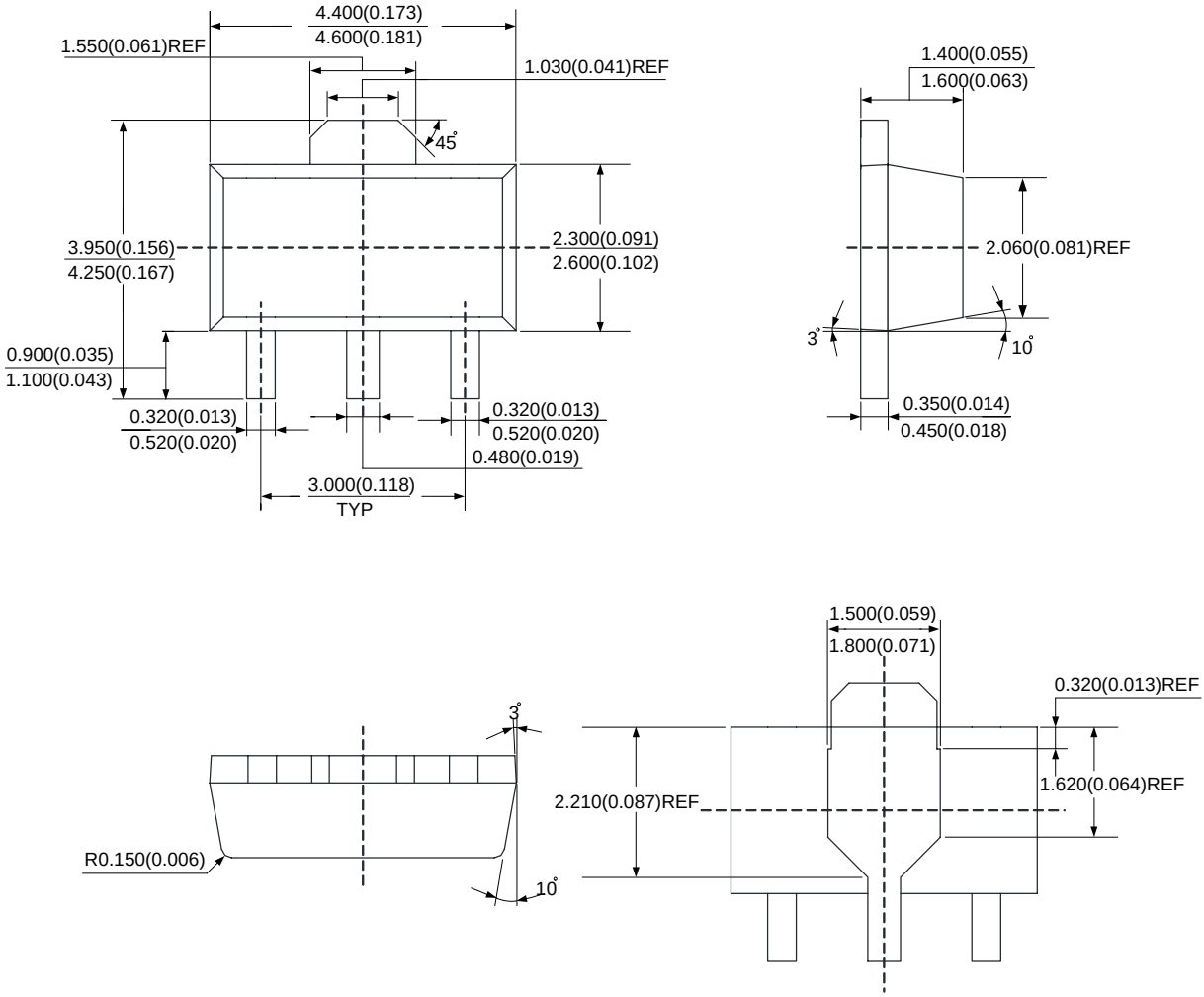
Mechanical Dimensions (Continued)

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



Mechanical Dimensions (Continued)

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



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