

## 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°C, 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 50μA to 100mA
- Low Output Noise
- Wide Operating Range: -40°C to 125°C

## Applications

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

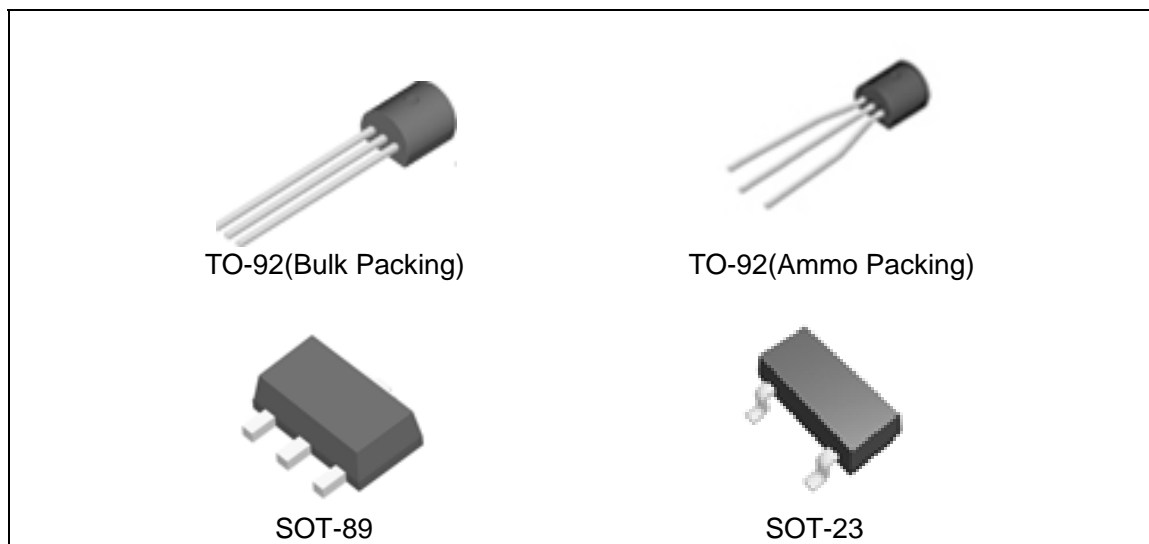
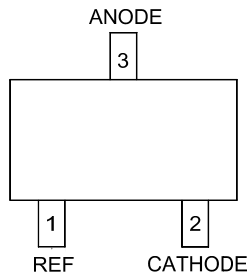


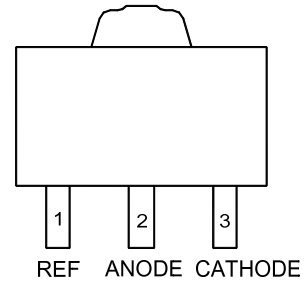
Figure 1. Package Type of AS431I

## Pin Configuration

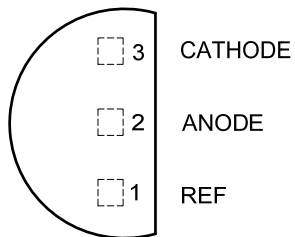
N Package  
(SOT-23)



R Package  
(SOT-89)



Z Package  
(TO-92 (Bulk Packing))



Z Package  
(TO-92 ( Ammo Packing))

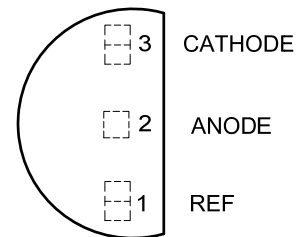


Figure 2. Pin Configuration of AS431I (Top View)

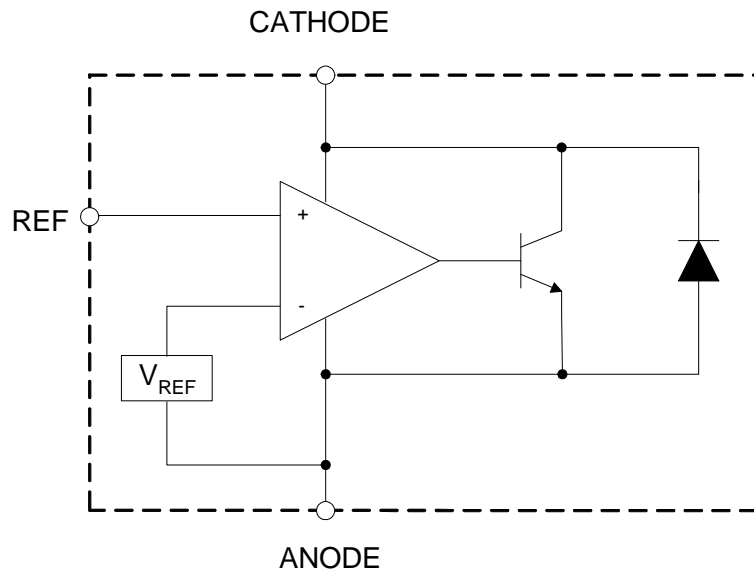
**Functional Block Diagram**

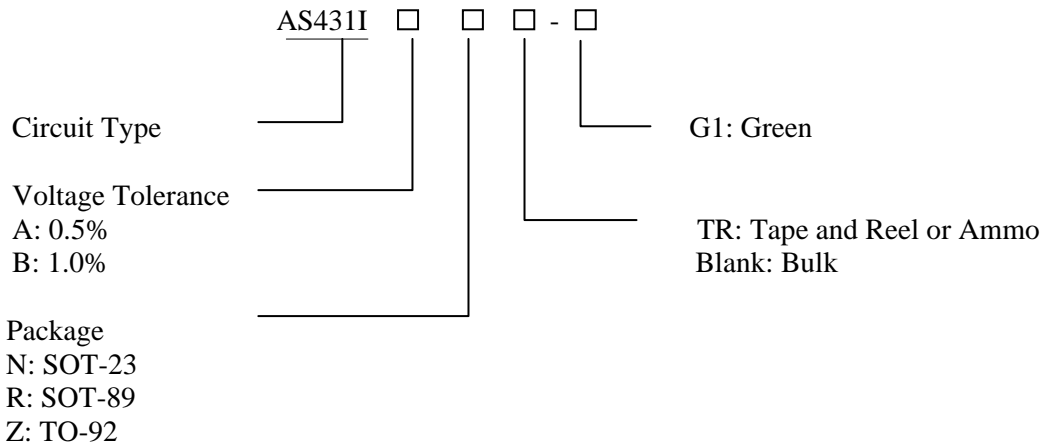
Figure 3. Functional Block Diagram of AS431I



**LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR**

**AS431I**

**Ordering Information**



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

**LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR****AS431I****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



**LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR**

**AS431I**

**Electrical Characteristics**

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

Parameter	Test Circuit	Symbol	Conditions	Min	Typ	Max	Unit
Reference Voltage	0.5%	4	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}$	2.487	2.500	2.512	V
	1.0%			2.475	2.500	2.525	
Deviation of Reference Voltage Over Full Temperature Range	4	$\Delta V_{REF}$	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}$	0 to $70^{\circ}\text{C}$	4.5	8	mV
				$-40$ to $85^{\circ}\text{C}$	4.5	10	
				$-40$ to $125^{\circ}\text{C}$	4.5	16	
Ratio of Change in Reference Voltage to the Change in Cathode Voltage	5	$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	$I_{KA}=10\text{mA}$	$\Delta V_{KA}=10\text{V to } V_{REF}$	-1.0	-2.7	mV/V
				$\Delta V_{KA}=36\text{V to } 10\text{V}$	-0.5	-2.0	
Reference Current	5	$I_{REF}$	$I_{KA}=10\text{mA}, R1=10\text{k}\Omega, R2=\infty$		0.035	0.5	$\mu\text{A}$
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 $125^{\circ}\text{C}$		0.03	0.3	$\mu\text{A}$
Minimum Cathode Current for Regulation	4	$I_{KA}(\text{Min})$	$V_{KA}=V_{REF}$		10	50	$\mu\text{A}$
Off-state Cathode Current	6	$I_{KA}(\text{Off})$	$V_{KA}=36\text{V}, V_{REF}=0$		0.05	1.0	$\mu\text{A}$
Dynamic Impedance	4	$Z_{KA}$	$V_{KA}=V_{REF}, I_{KA}=1$ to $100\text{mA}, f\leq 1.0\text{kHz}$		0.15	0.5	$\Omega$
Thermal Resistance		$\theta_{JC}$	TO-92		68		$^{\circ}\text{C/W}$
			SOT-89		29		
			SOT-23		113		

Electrical Characteristics (Continued)

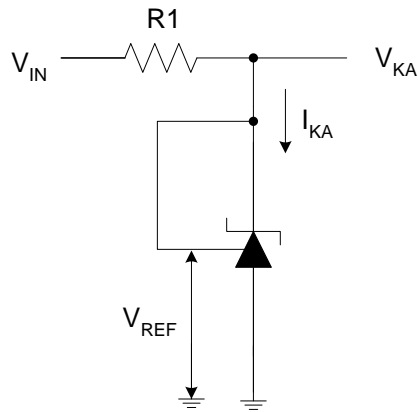


Figure 4. Test Circuit 4 for  $V_{KA} = V_{REF}$

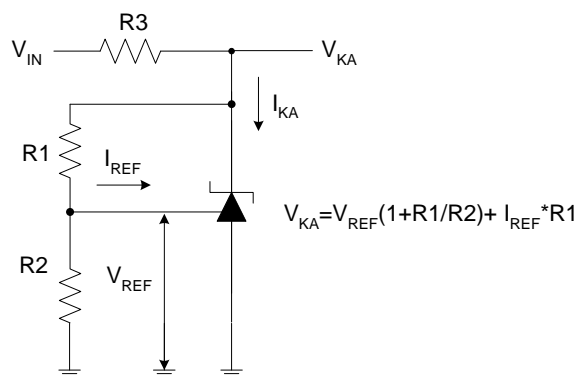


Figure 5. Test Circuit 5 for  $V_{KA} > V_{REF}$

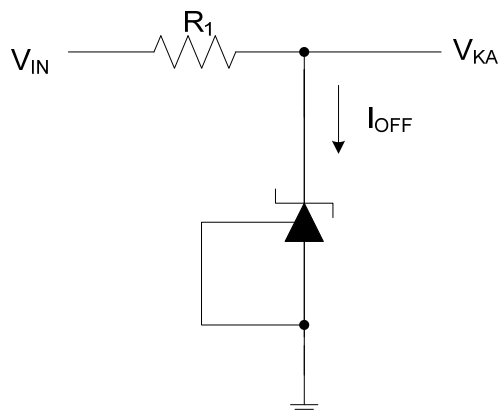


Figure 6. Test Circuit 6 for  $I_{OFF}$

**Typical Performance Characteristics**

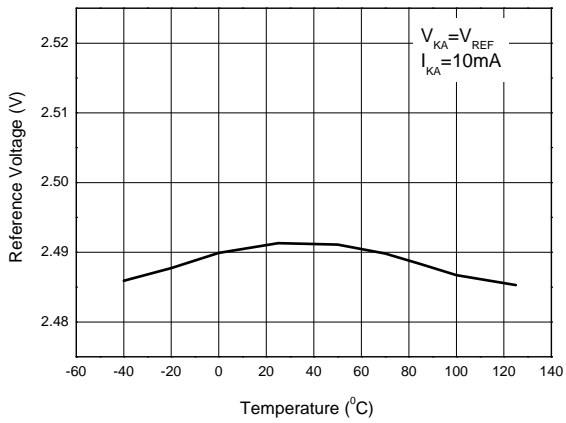


Figure 7. Reference Voltage vs. Ambient Temperature

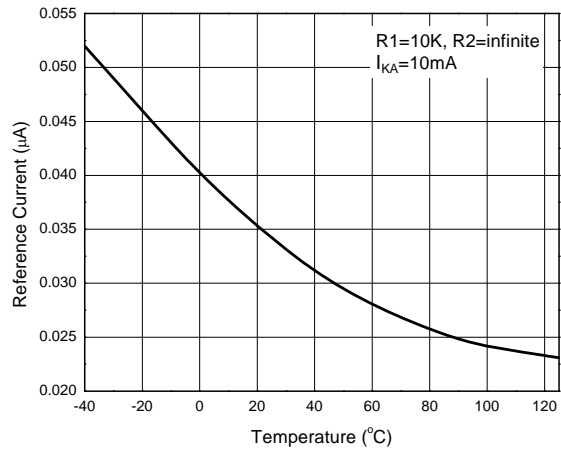


Figure 8. Reference Current vs. Ambient Temperature

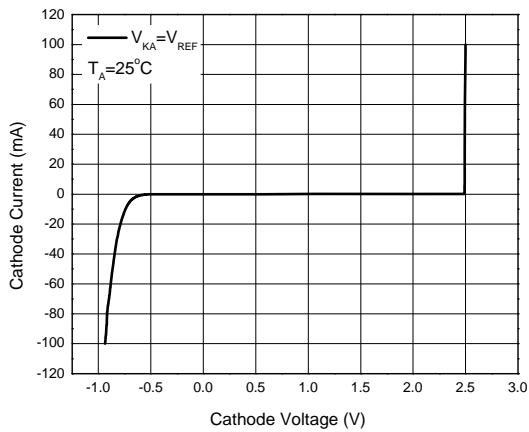


Figure 9. Cathode Current vs. Cathode Voltage

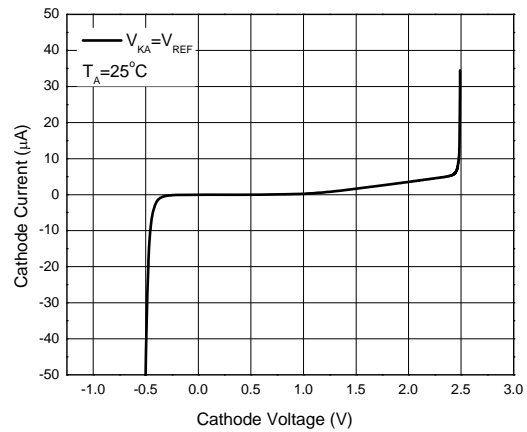


Figure 10. Cathode Current vs. Cathode Voltage



Typical Performance Characteristics (Continued)

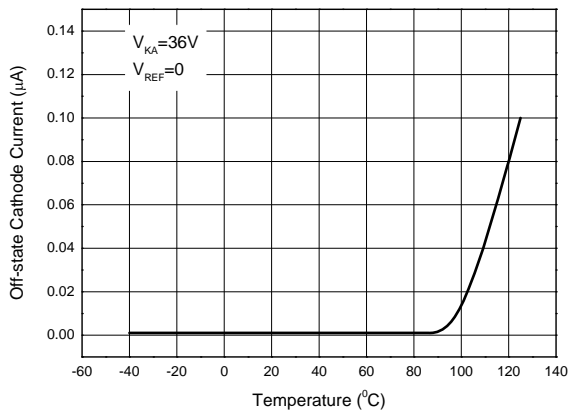


Figure 11. Off-state Cathode Current vs. Ambient Temperature

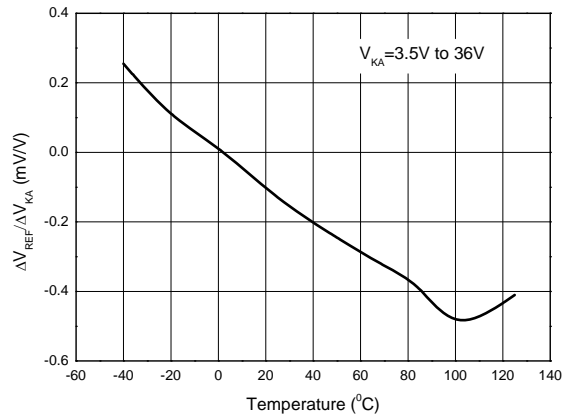


Figure 12. Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage

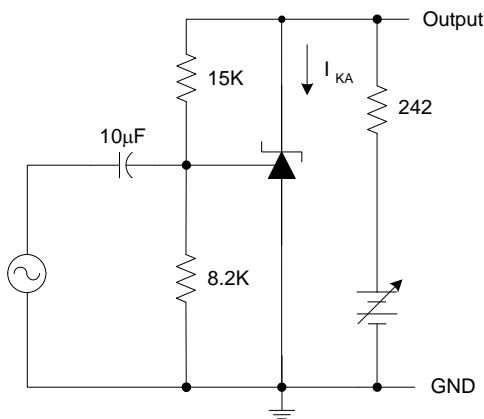
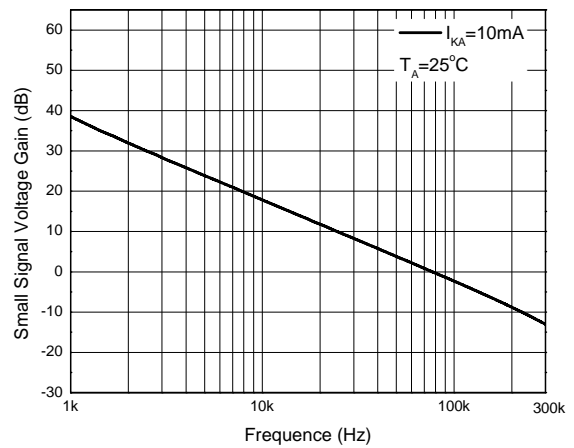


Figure 13. Small Signal Voltage Gain vs. Frequency



**Typical Performance Characteristics (Continued)**

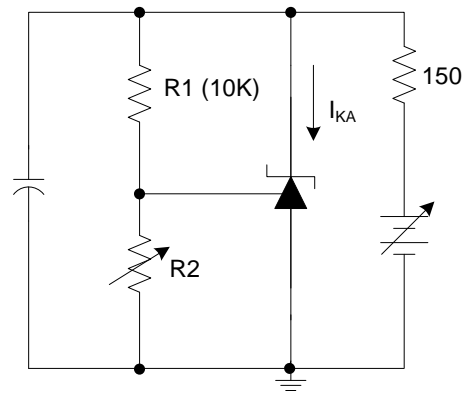
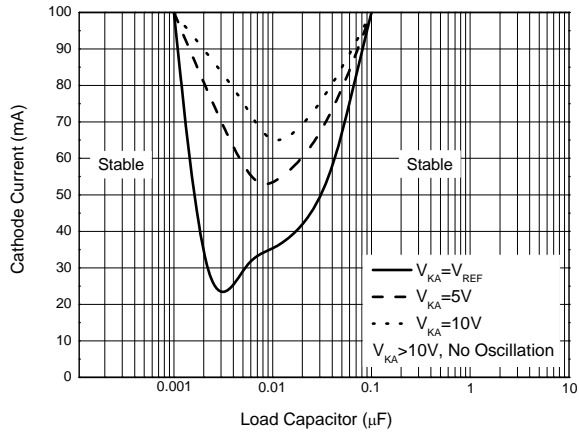


Figure 14. Stability Boundary Conditions vs. Load Capacitance

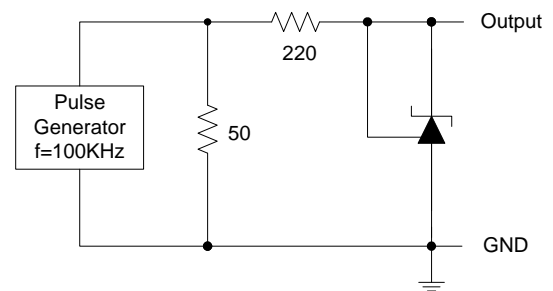
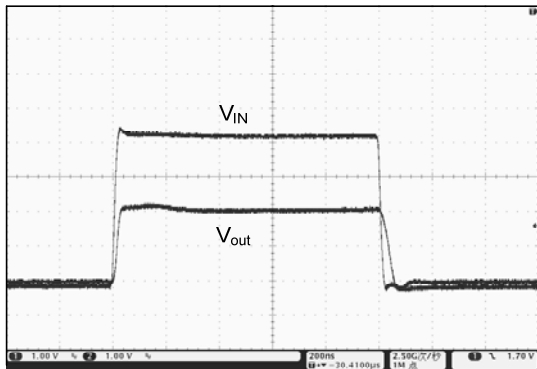
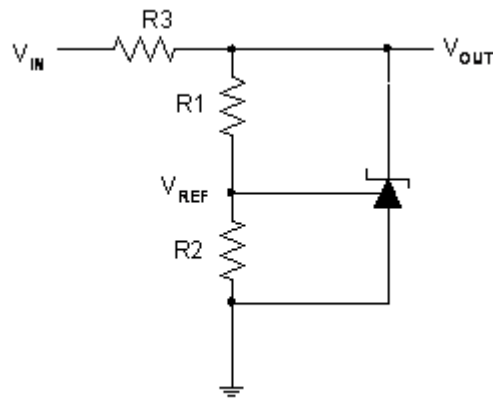


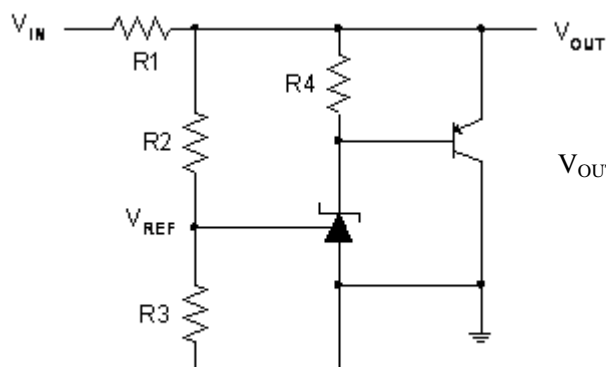
Figure 15. Pulse Response of Input and Output Voltage

### Typical Application



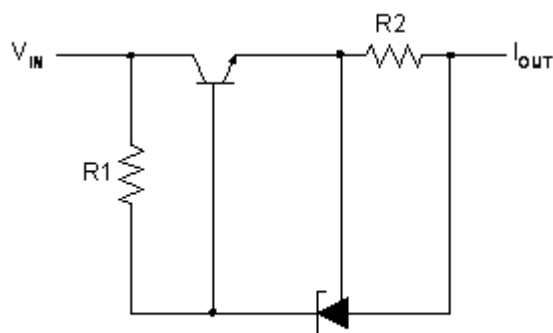
$$V_{OUT} = (1 + R1/R2) * V_{REF}$$

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)

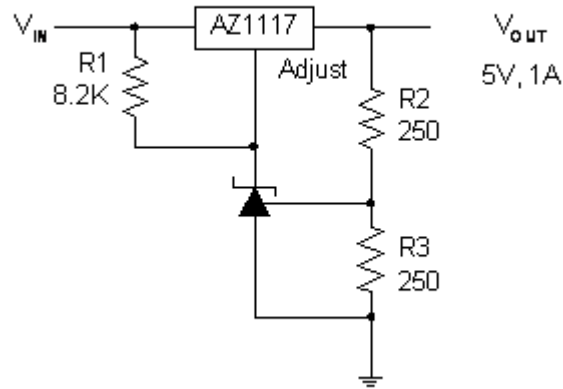


Figure 19. Precision 5V 1A Regulator

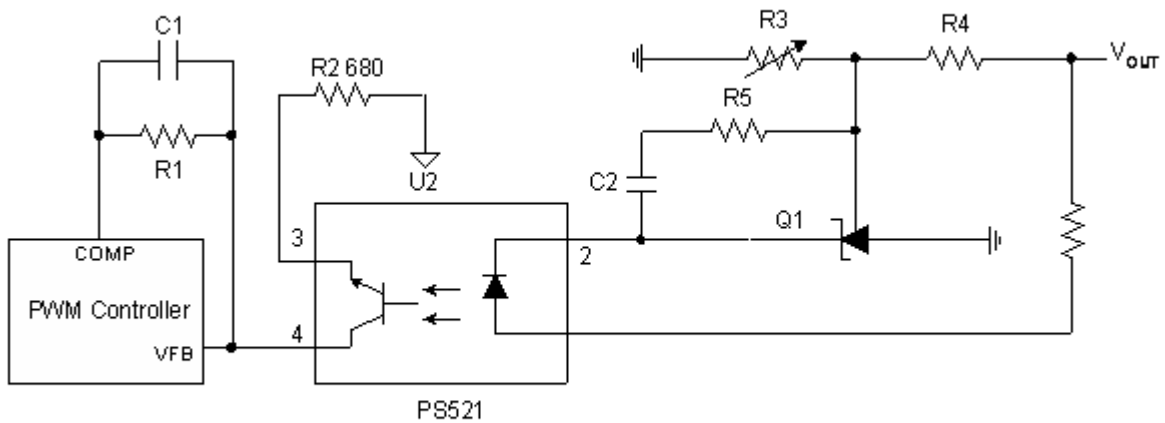
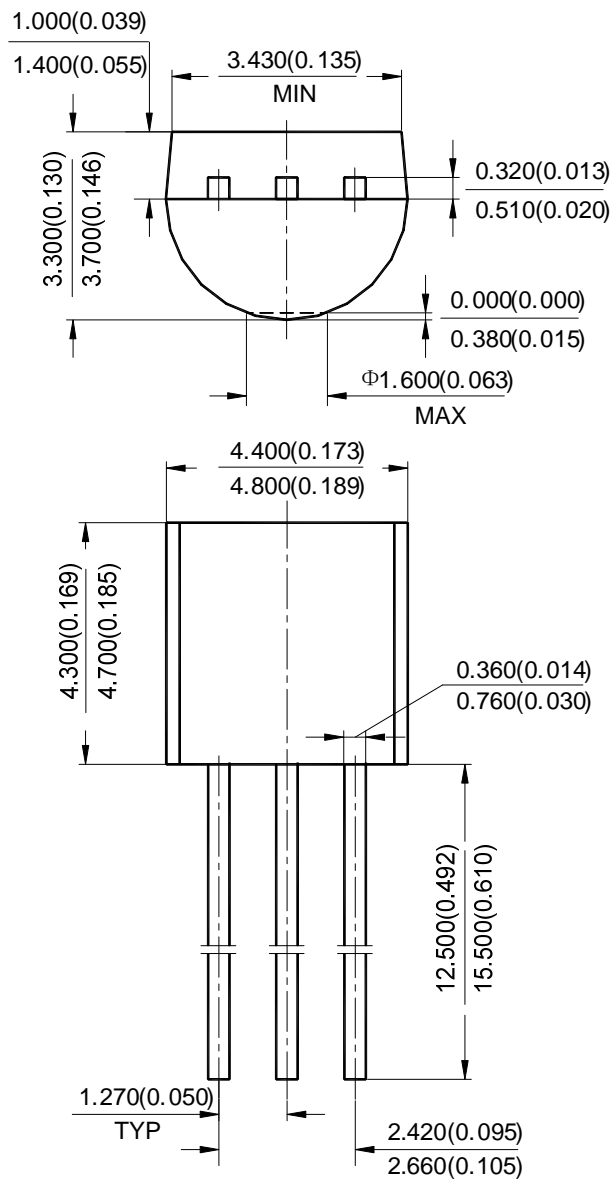


Figure 20. PWM Converter with Reference

## Mechanical Dimensions

TO-92(Bulk Packing)

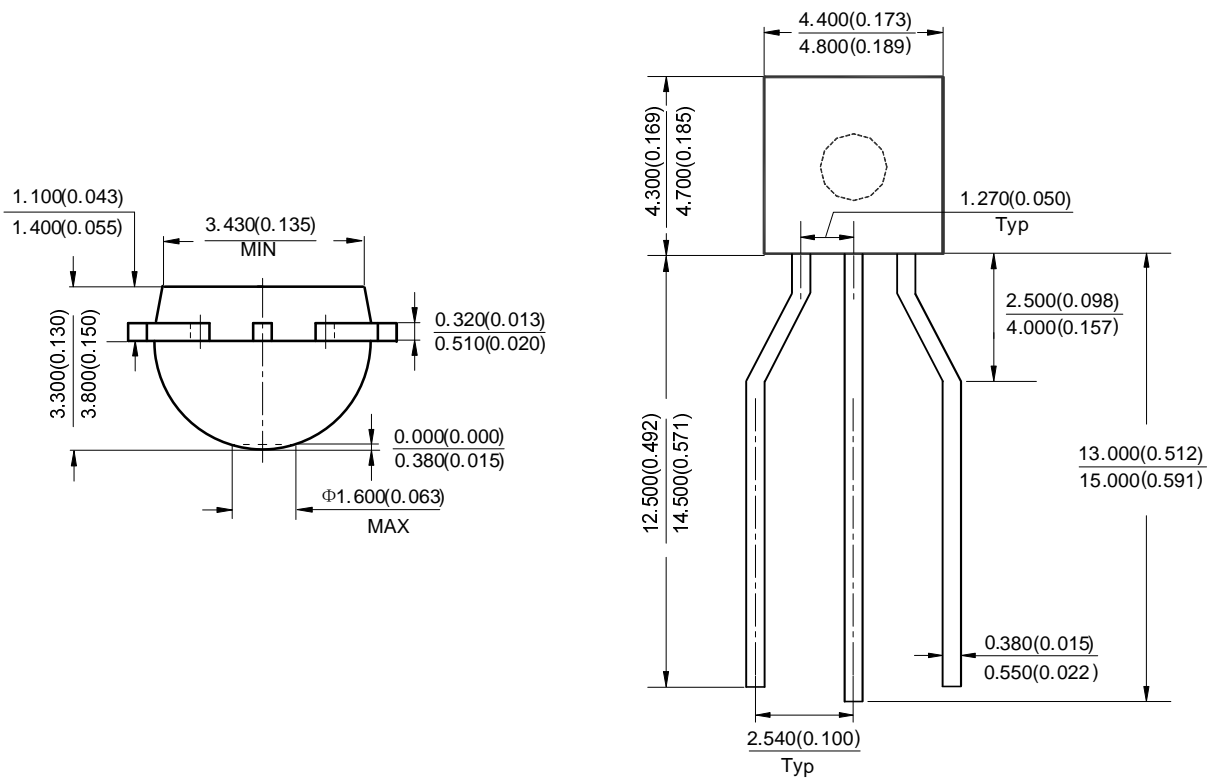
Unit: mm(inch)

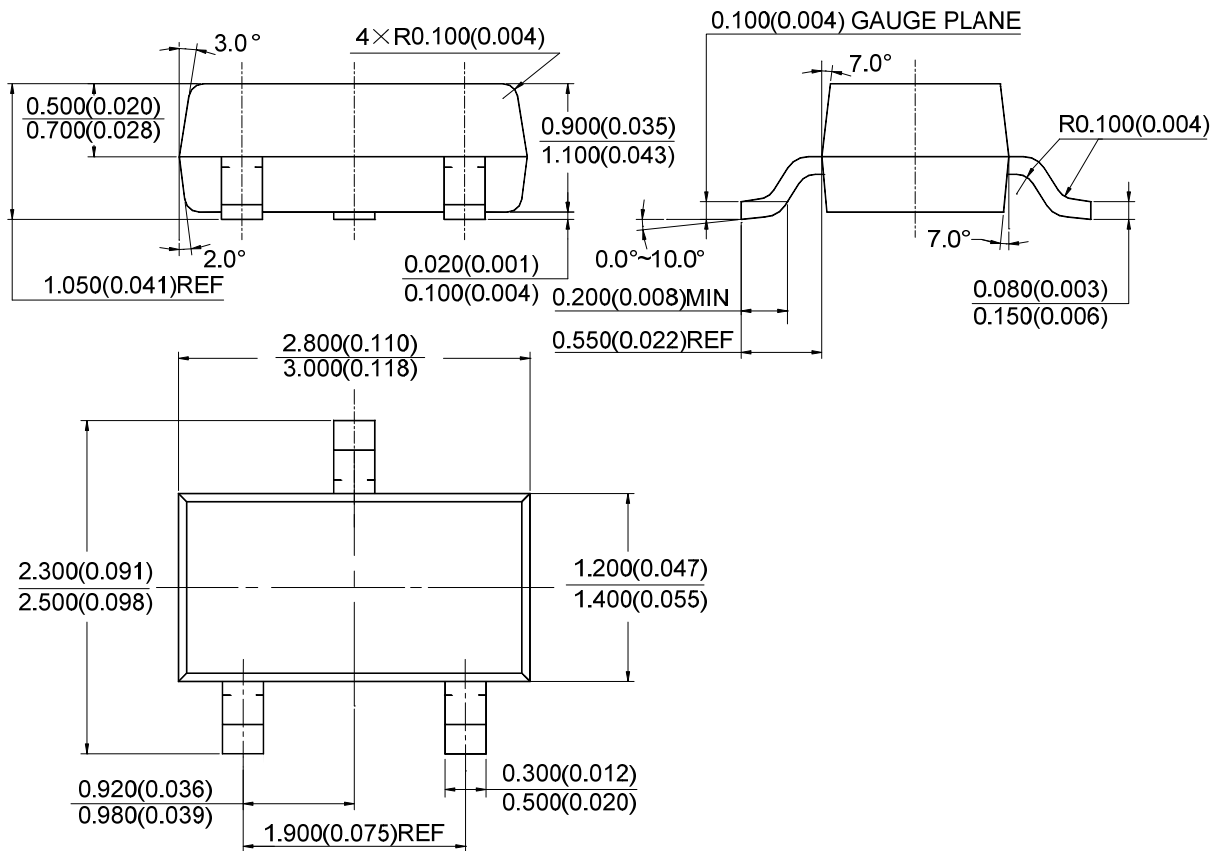


**Mechanical Dimensions (Continued)**

**TO-92(Ammo Packing)**

**Unit: mm(inch)**

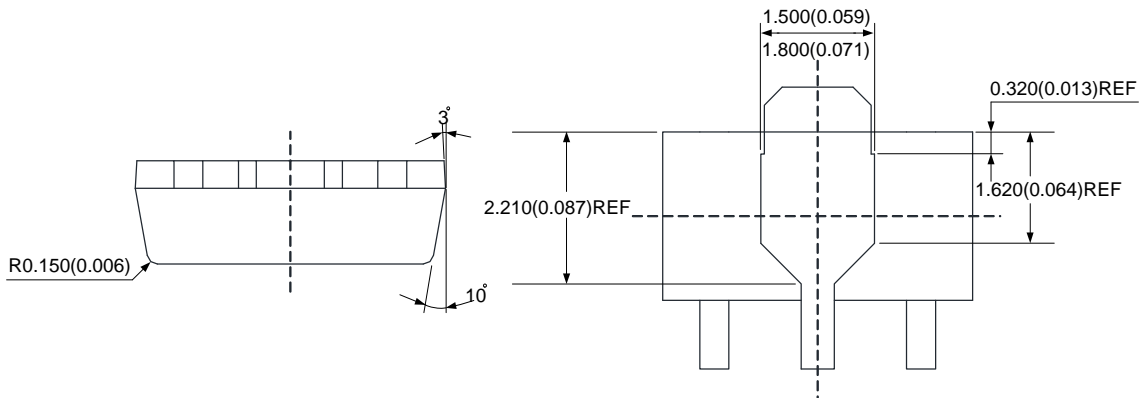
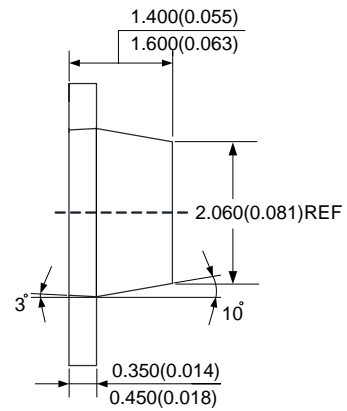
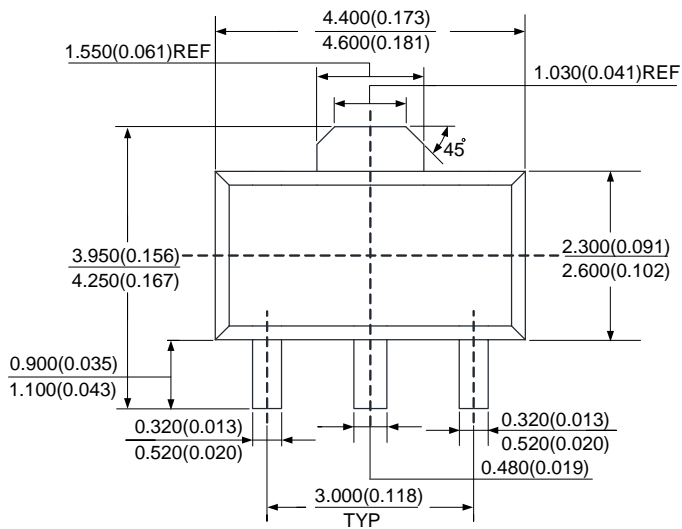


**Mechanical Dimensions (Continued)****SOT-23****Unit: mm(inch)**

**Mechanical Dimensions (Continued)**

**SOT-89**

**Unit: mm(inch)**







## **BCD Semiconductor Manufacturing Limited**

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#### **MAIN SITE**

##### **- Headquarters**

##### **BCD Semiconductor Manufacturing Limited**

No. 1600, Zi Xing Road, Shanghai Zizhu Science-based Industrial Park, 200241, China  
Tel: +86-21-24162266, Fax: +86-21-24162277

##### **- Wafer Fab**

##### **Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd.**

800 Yi Shan Road, Shanghai 200233, China  
Tel: +86-21-6485 1491, Fax: +86-21-5450 0008

#### **REGIONAL SALES OFFICE**

##### **Shenzhen Office**

##### **Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd., Shenzhen Office**

Unit A Room 1203, Skyworth Bldg., Gaoxin Ave. 1.S., Nanshan District, Shenzhen, China  
Tel: +86-755-8826 7951  
Fax: +86-755-8826 7865

##### **Taiwan Office**

##### **BCD Semiconductor (Taiwan) Company Limited**

4F, 298-1, Rui Guang Road, Nei-Hu District, Taipei, Taiwan  
Tel: +886-2-2656 2808  
Fax: +886-2-2656 2806

##### **USA Office**

##### **BCD Semiconductor Corp.**

30920 Huntwood Ave. Hayward, CA 94544, USA  
Tel : +1-510-324-2988  
Fax: +1-510-324-2788

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Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А