

LOW CATHODE CURRENT ADJUSTABLE PRECISION SHUNT REGULATOR

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

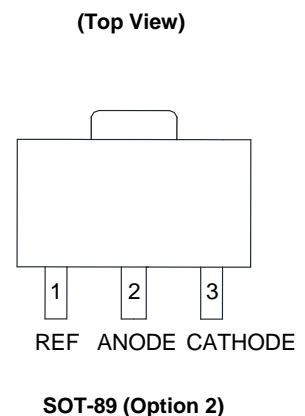
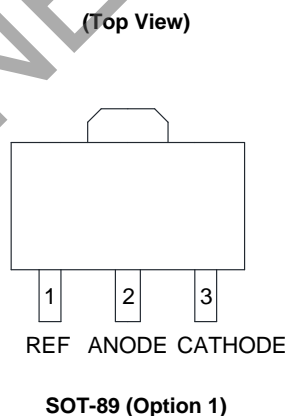
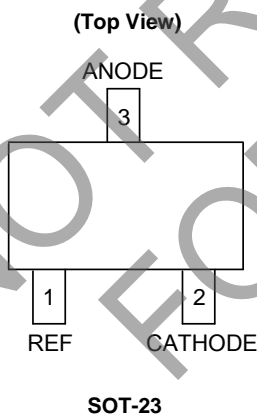
- Programmable Precise Output Voltage from 2.5V to 36V
- High Stability Under Capacitive Load
- Low Minimum Cathode Current for Regulation: 10µA (Typ.), 50µA (Max.)
- Low Temperature Deviation: 4.5mV Typical
- Sink Current Capacity from 50µA to 100mA
- Low Output Noise
- Wide Operating Range: -40 to +125°C
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Applications

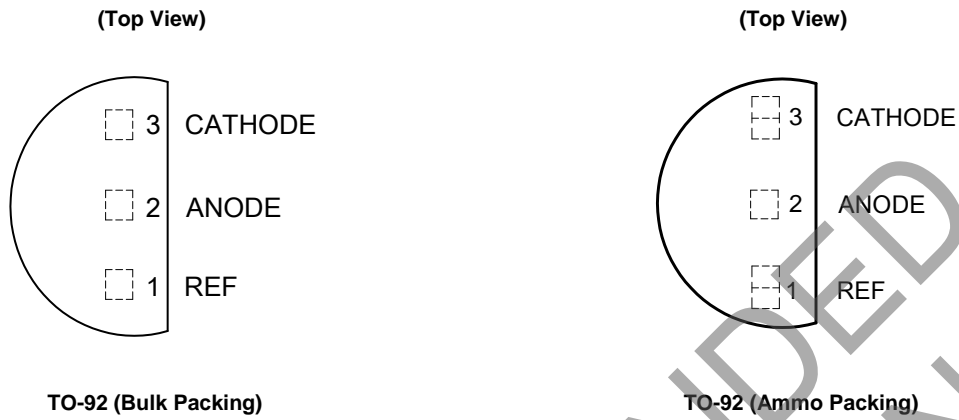
- Charger
- Voltage Adapter
- Switching Power Supply
- Graphic Card
- Precision Voltage Reference

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
 2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
 3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

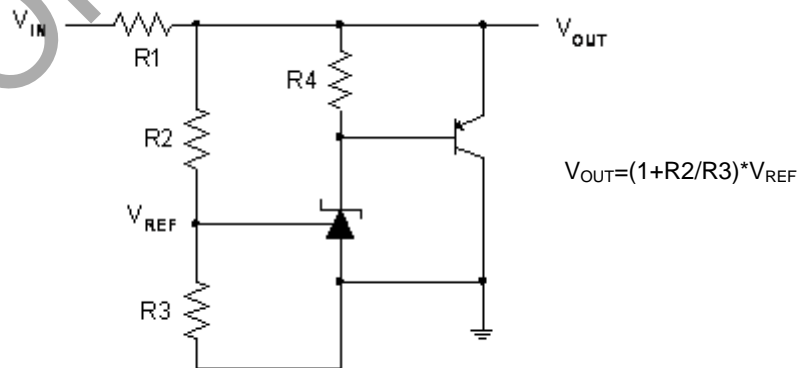
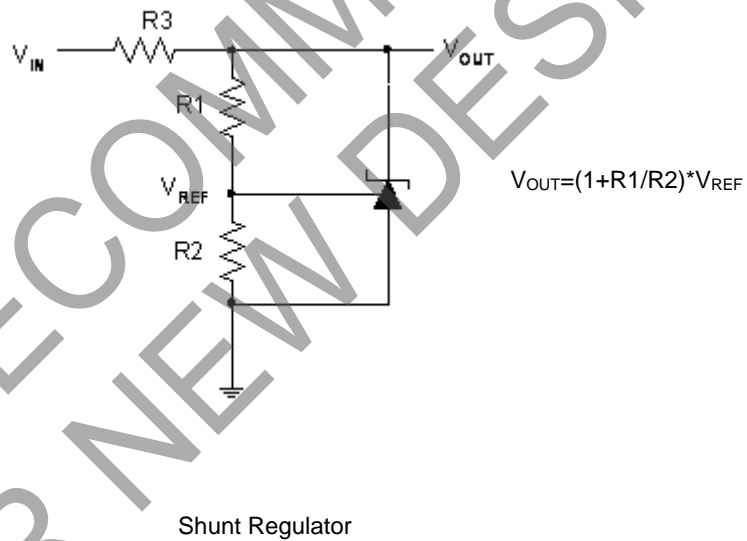
Pin Assignments



Pin Assignments (Cont.)

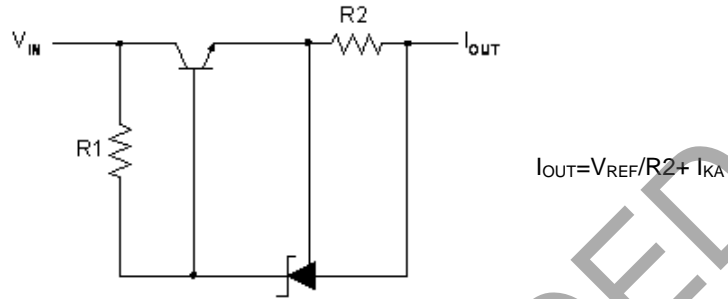


Typical Applications Circuit



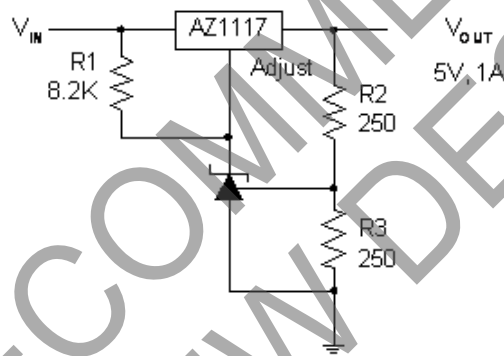
NOT RECOMMENDED FOR NEW DESIGN

Typical Applications Circuit (Cont.)

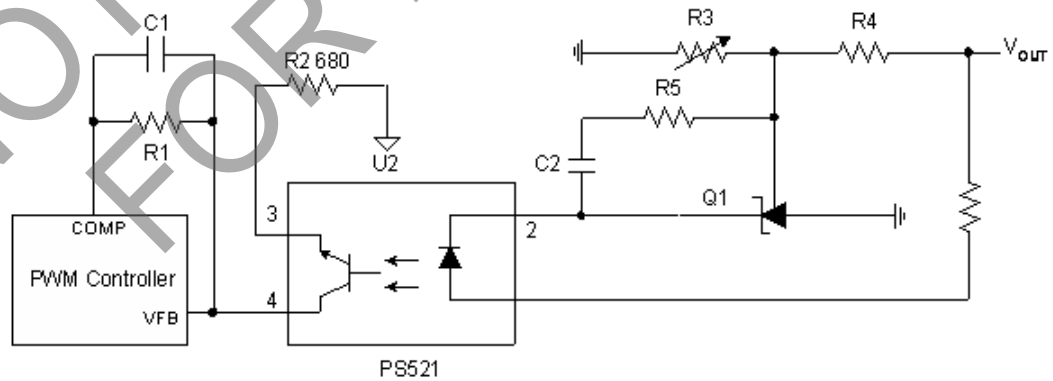


$$I_{OUT} = V_{REF} / R2 + I_{KA}$$

Current Source or Current Limit

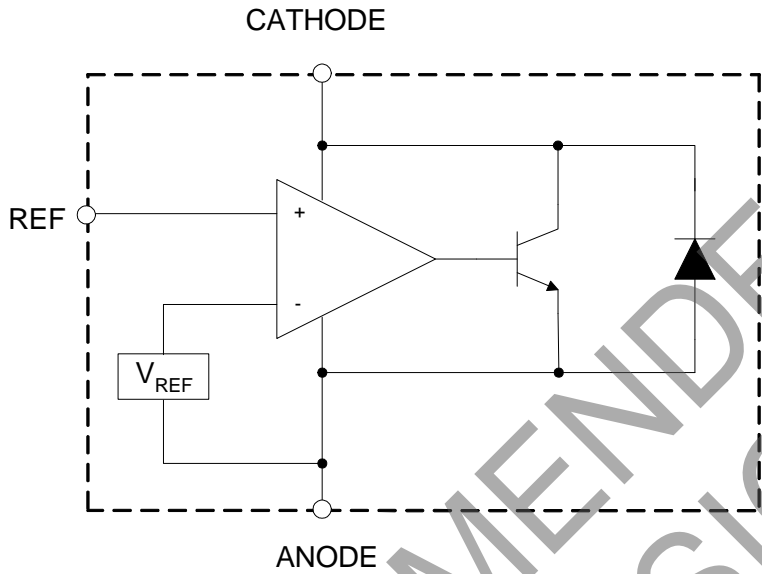


Precision 5V 1A Regulator



PWM Converter with Reference

Functional Block Diagram



Absolute Maximum Ratings (Note 4)

Symbol	Parameter	Rating		Unit
V_{KA}	Cathode Voltage	40		V
I_{KA}	Cathode Current Range (Continuous)	-100 to 150		mA
I_{REF}	Reference Input Current Range	10		mA
P_D	Power Dissipation	TO-92	770	mW
		SOT-89	770	
		SOT-23	370	
T_J	Junction Temperature	+150		°C
T_{STG}	Storage Temperature Range	-65 to +150		°C
ESD	ESD (Human Body Model)	2000		V

Note 4: 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

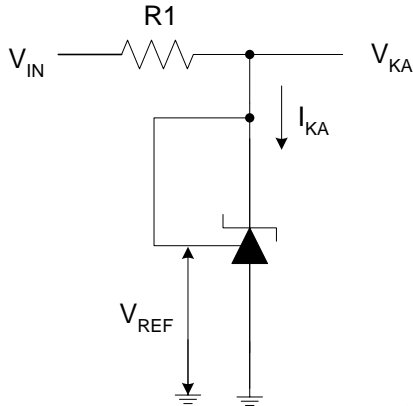
Symbol	Parameter	Min	Max	Unit
V_{KA}	Cathode Voltage	V_{REF}	36	V
I_{KA}	Cathode Current	0.05	100	mA
T_A	Operating Ambient Temperature Range	-40	+125	°C

Electrical Characteristics (Operating Conditions: $T_A = +25^\circ\text{C}$, unless otherwise specified.)

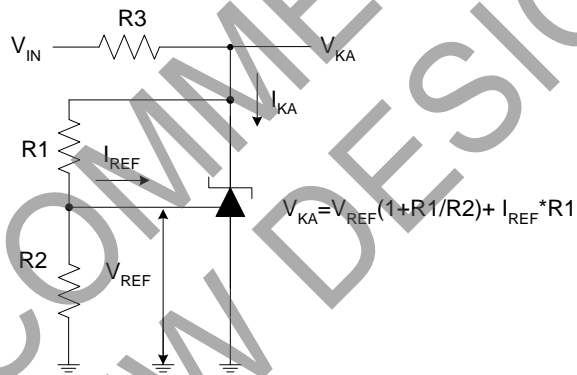
Symbol	Parameter		Test Circuit	Conditions	Min	Typ	Max	Unit	
V_{REF}	Reference Voltage	0.5%	4	$V_{KA} = V_{REF}, I_{KA} = 10\text{mA}$	2.487	2.500	2.512	V	
		1.0%			2.475	2.500	2.525		
ΔV_{REF}	Deviation of Reference Voltage Over Full Temperature Range		4	$V_{KA} = V_{REF}, I_{KA} = 10\text{mA}$	0 to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

NOT RECOMMENDED FOR NEW DESIGN

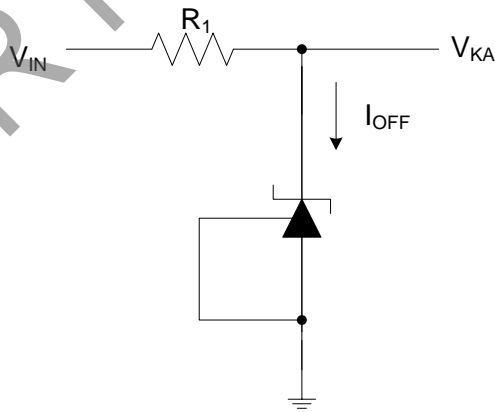
Electrical Characteristics (Cont.)



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



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

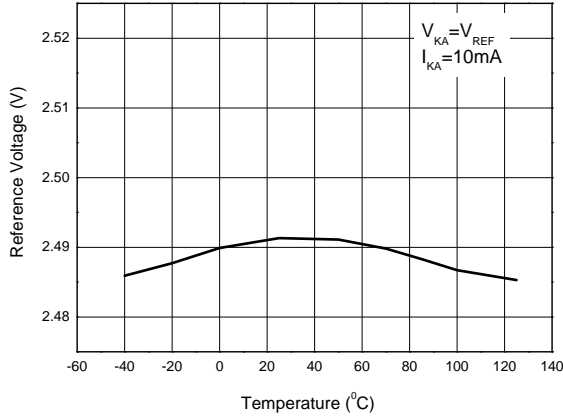


Test Circuit 6 for I_{OFF}

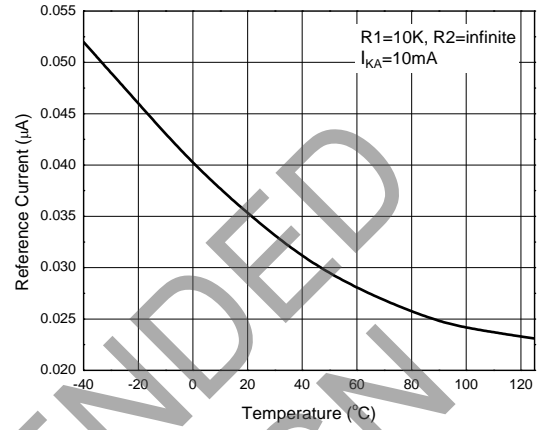
NOT RECOMMENDED FOR NEW DESIGN

Performance Characteristics

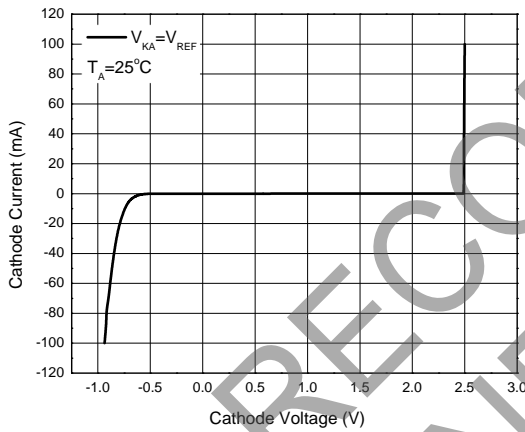
Reference Voltage vs. Ambient Temperature



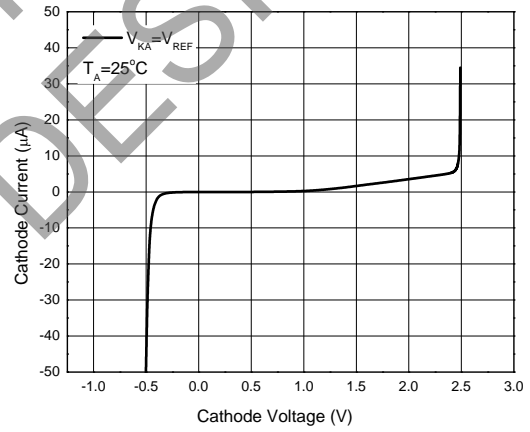
Reference Current vs. Ambient Temperature



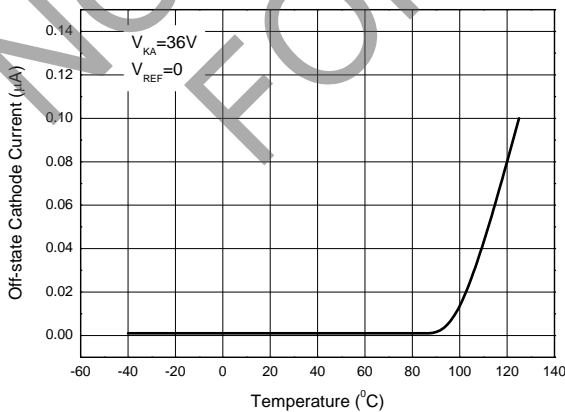
Cathode Current vs. Cathode Voltage



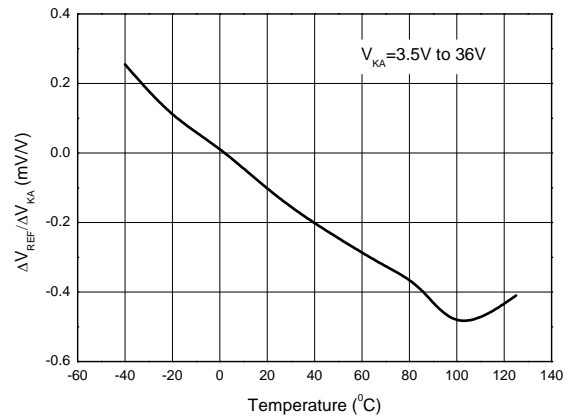
Cathode Current vs. Cathode Voltage



Off-state Cathode Current vs. Ambient Temperature

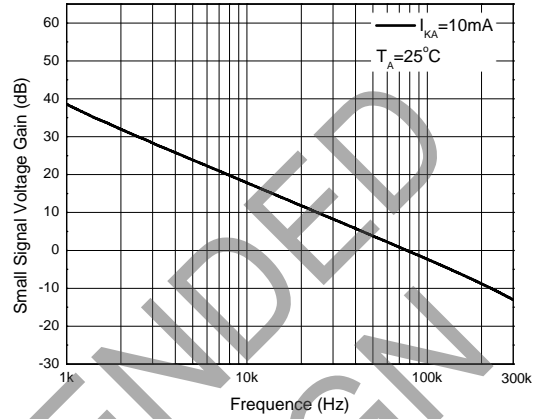
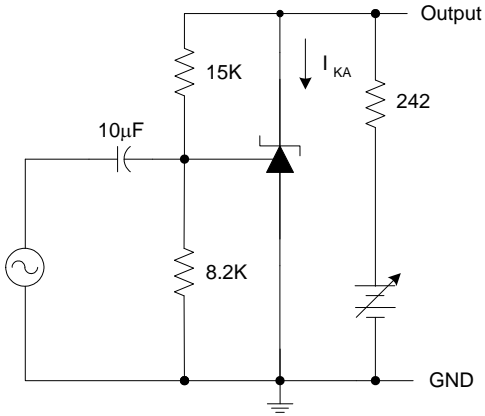


Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage

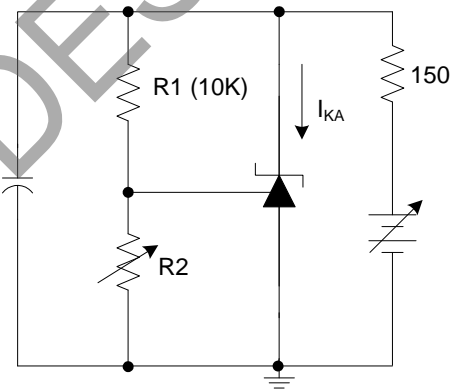
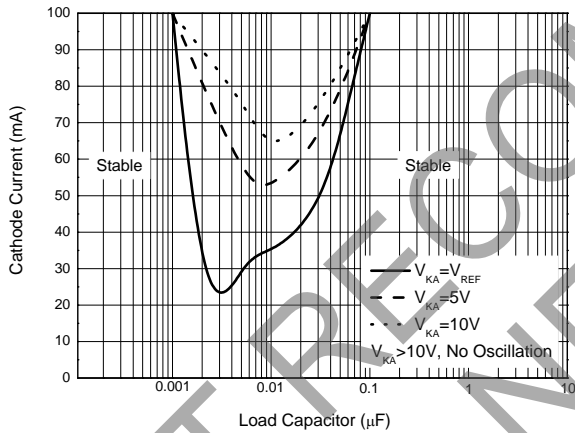


Performance Characteristics (Cont.)

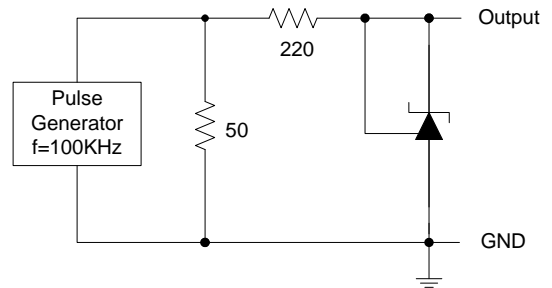
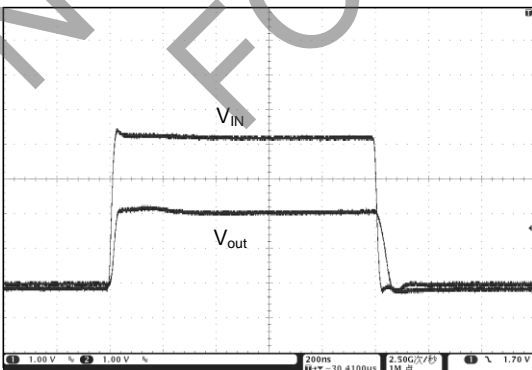
Small Signal Voltage Gain vs. Frequency



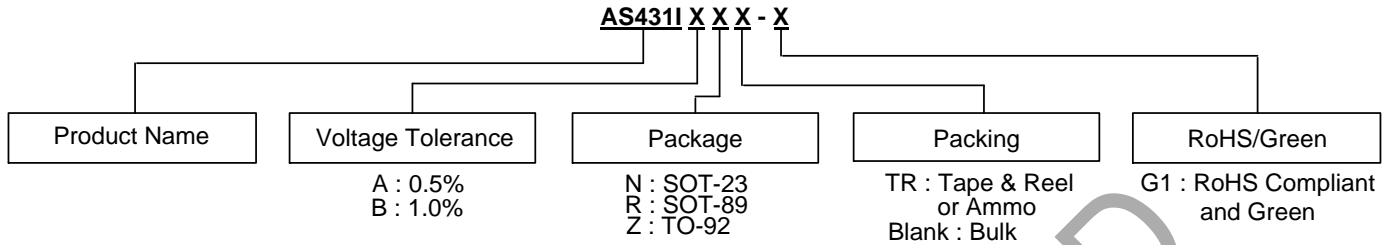
Stability Boundary Conditions vs. Load Capacitance



Pulse Response of Input and Output Voltage



Ordering Information

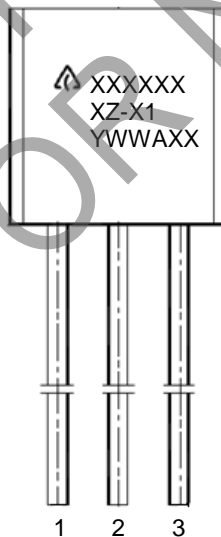


Package	Temperature Range	Voltage Tolerance	Part Number	Marking ID	Packing
SOT-23	-40 to +125°C	0.5%	AS431IANTR-G1	GB9	3000/Tape & Reel
		1.0%	AS431IBNTR-G1	GC9	3000/Tape & Reel
TO-92	-40 to +125°C	0.5%	AS431IAZ-G1	AS431IAZ-G1	1000/Bulk
		0.5%	AS431IAZTR-G1	AS431IAZ-G1	2000/Ammo
		1.0%	AS431IBZ-G1	AS431IBZ-G1	1000/Bulk
		1.0%	AS431IBZTR-G1	AS431IBZ-G1	2000/Ammo
SOT-89	-40 to +125°C	0.5%	AS431IARTR-G1	G43J	1000/Tape & Reel
		1.0%	AS431IBRTR-G1	G43K	1000/Tape & Reel

Marking Information

(1) TO-92

(Front View)

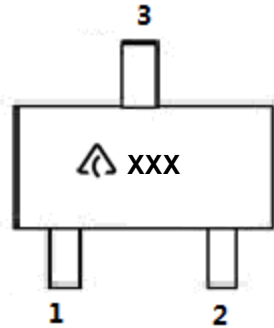



First and Second Lines: Logo and Marking ID
(See Ordering Information)
Third Line: Date Code
Y: Year
WW: Work Week of Molding
A: Assembly House Code
XX: 7th and 8th Digits of Batch Number

Marking Information (Cont.)

(2) SOT-23

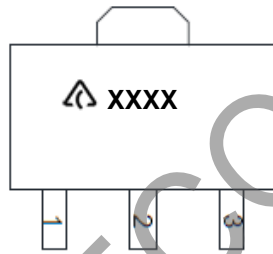
(Top View)



 : Logo
XXX: Marking ID (See Ordering Information)

(3) SOT-89

(Top View)

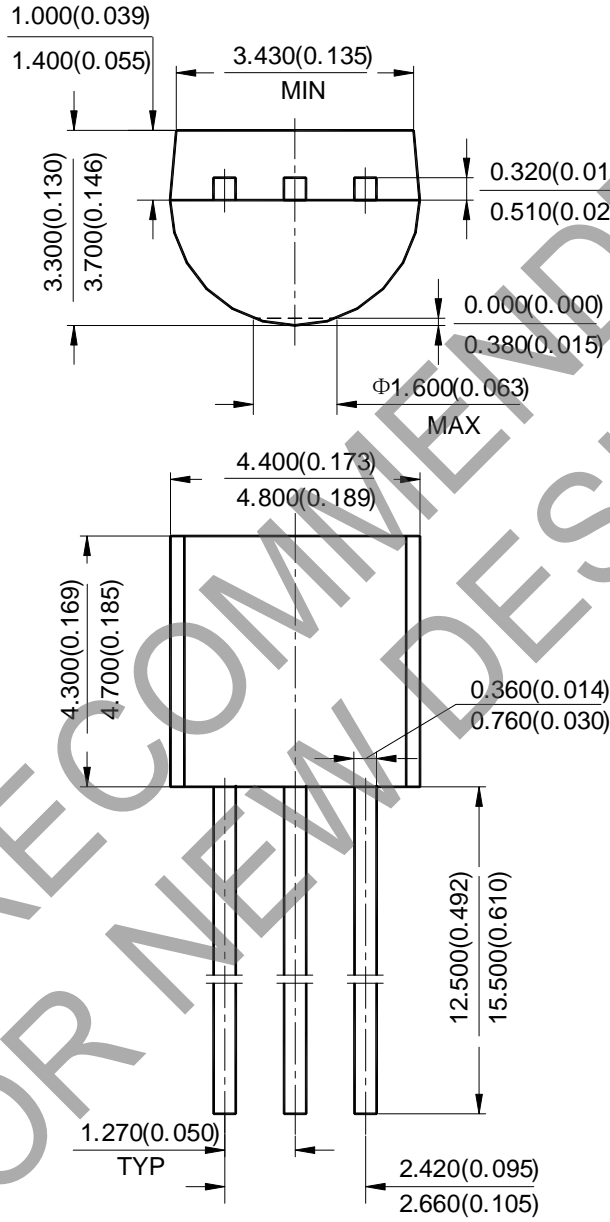


 : Logo
XXXX: Marking ID (See Ordering Information)

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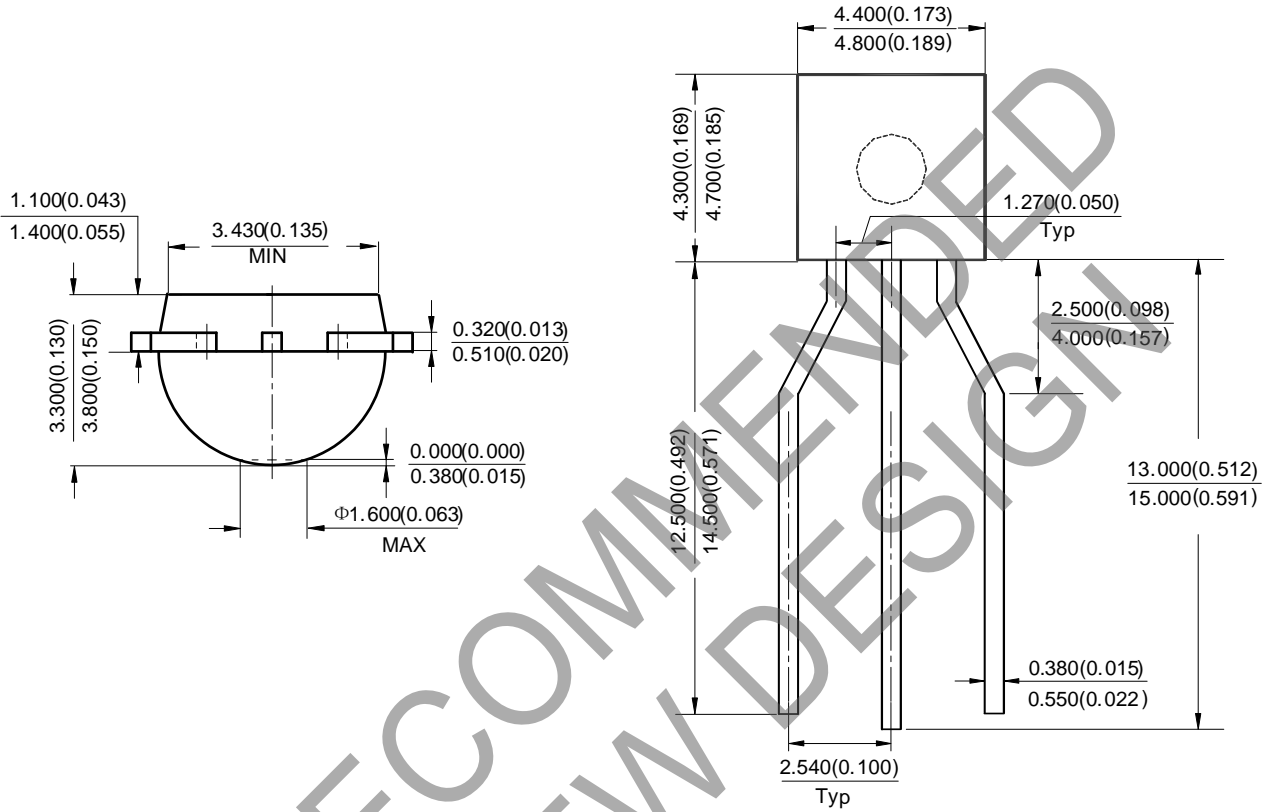
Package Outline Dimensions (All dimensions in mm(inch).)

(1) Package Type: TO-92 (Bulk Packing)



Package Outline Dimensions (Cont. All dimensions in mm(inch).)

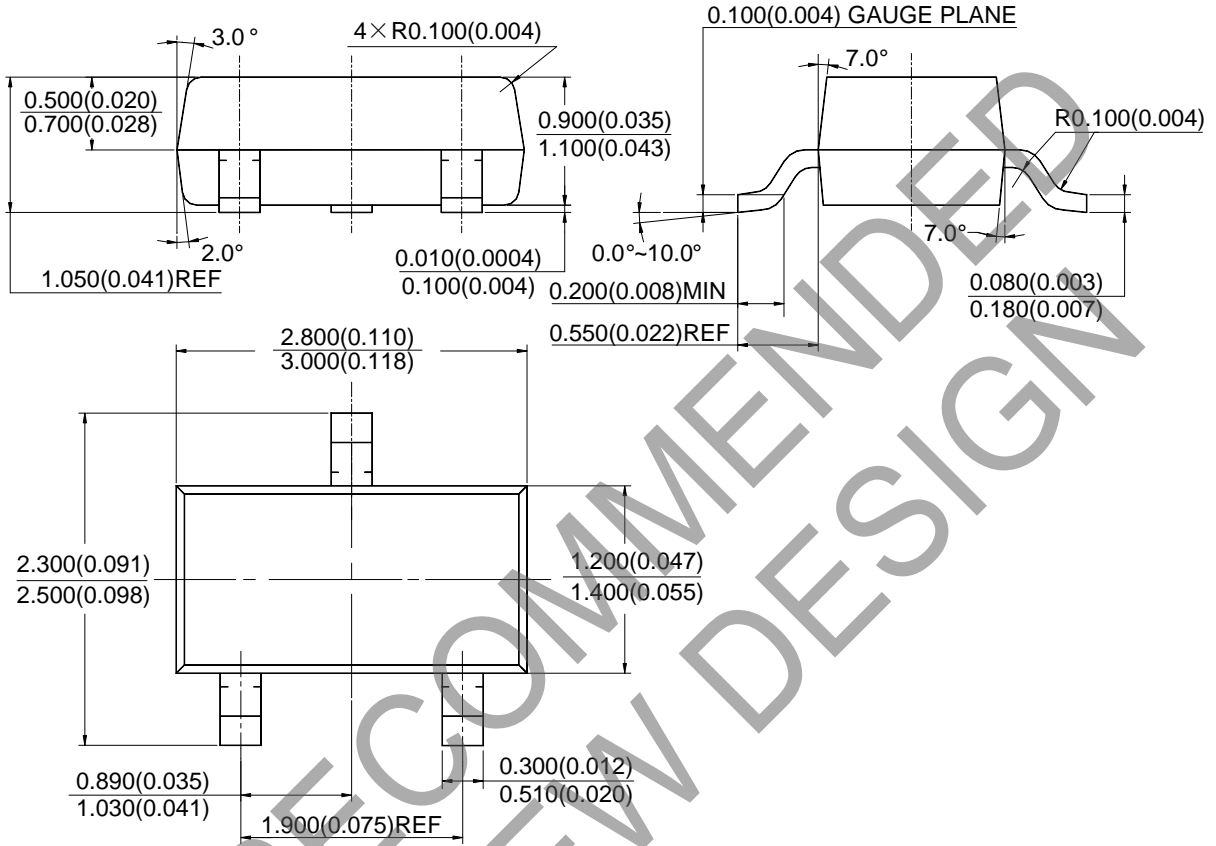
(2) Package Type: TO-92 (Ammo Packing)



NOT RECOMMENDED FOR NEW DESIGN

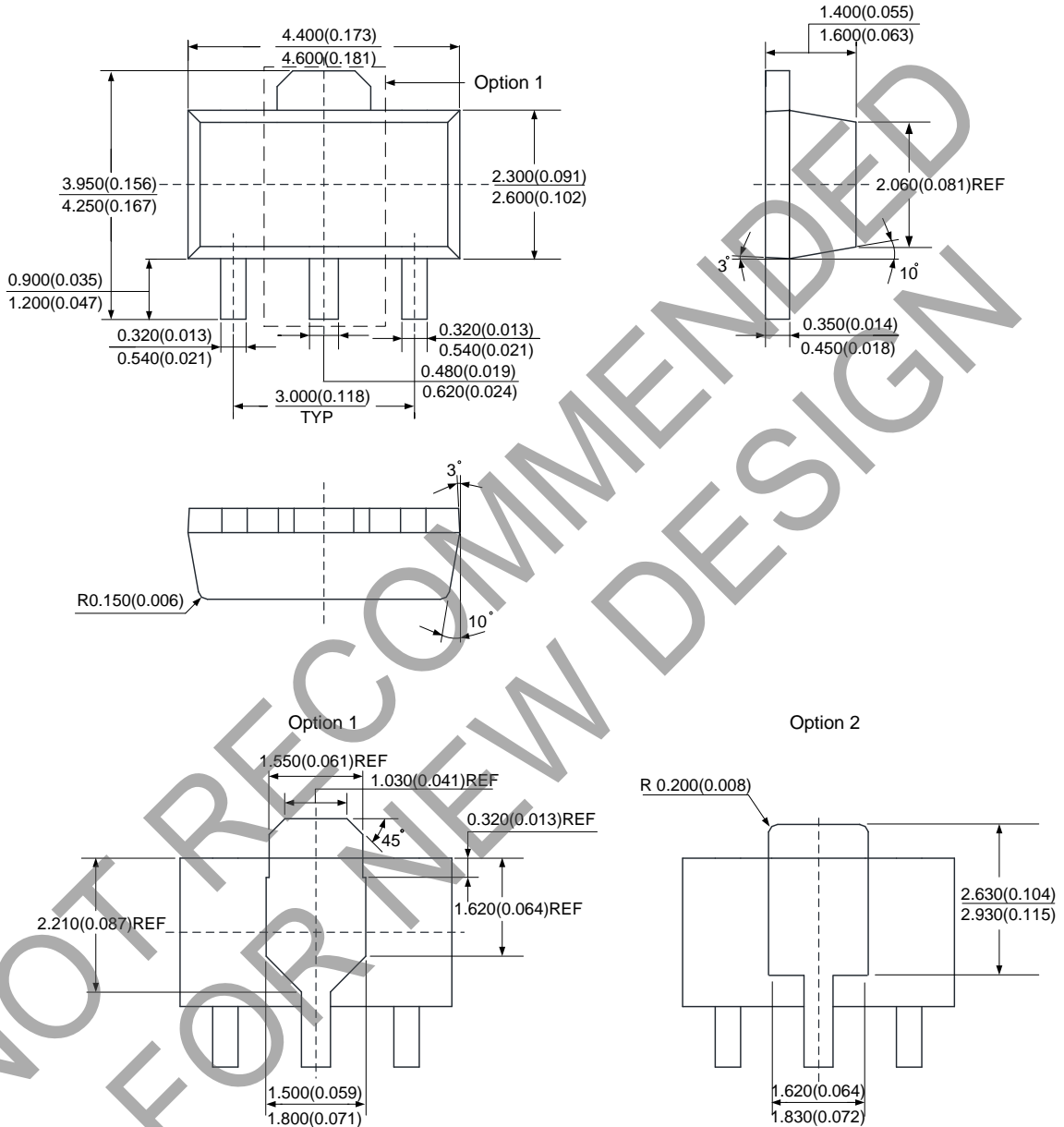
Package Outline Dimensions (Cont. All dimensions in mm(inch).)

(3) Package Type: SOT-23



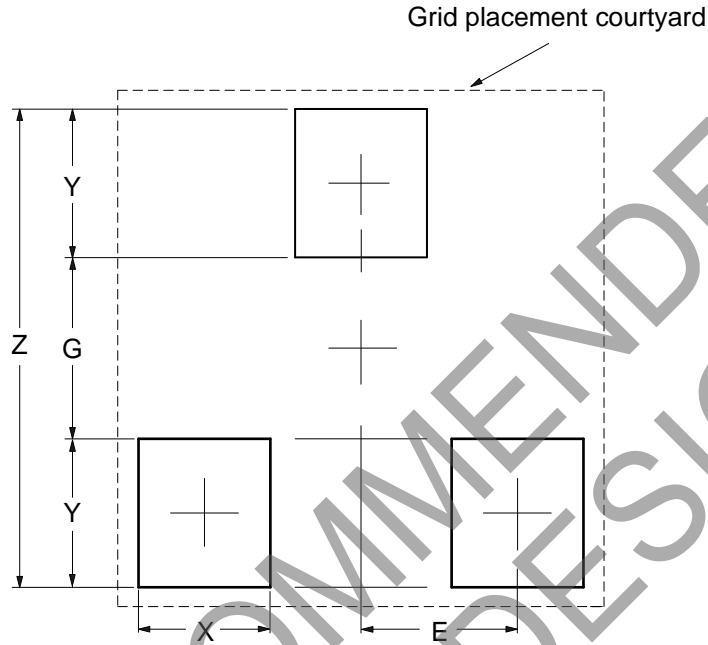
Package Outline Dimensions (Cont. All dimensions in mm(inch).)

(4) Package Type: SOT-89



Suggested Pad Layout

(1) Package Type: SOT-23

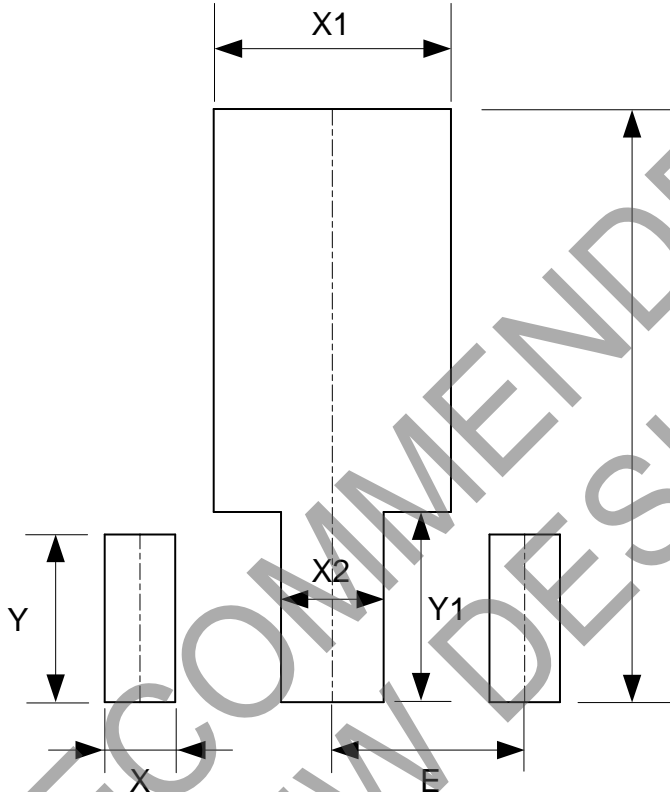


Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)
Value	2.900/0.114	1.100/0.043	0.800/0.031	0.900/0.035	0.950/0.037

NOT RECOMMENDED FOR NEW DESIGN

Suggested Pad Layout (Cont.)

(2) Package Type: SOT-89



Dimensions	Z (mm)/(inch)	X (mm)/(inch)	X1 (mm)/(inch)	X2 (mm)/(inch)	Y (mm)/(inch)	Y1 (mm)/(inch)	E (mm)/(inch)
Value	4.600/0.181	0.550/0.022	1.850/0.073	0.800/0.031	1.300/0.051	1.475/0.058	1.500/0.059

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