AZ431-A

ADJUSTABLE PRECISION SHUNT REGULATORS

Description

The AZ431-A 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 AZ431-A can be set to any value between V_{REF} (2.5V) and the corresponding maximum cathode voltage (36V).

The AZ431-A precision reference is offered in two voltage tolerance: 0.4% and 0.8%.

This IC is available in 4 packages: TO92 (bulk or ammo packing), SOT23, SOT25 and SOT89.

Features

- Programmable Precise Output Voltage from 2.5V to 36V
- High Stability under Capacitive Load
- Low Temperature Deviation: 4.5mV Typical
- Low Equivalent Full-range Temperature Coefficient with 20PPM/°C Typical
- Sink Current Capacity from 1mA to 100mA
- Low Output Noise
- Wide Operating Range of -40 to +125°C
- Lead-Free Packages: TO92, SOT23, SOT25, SOT89
  - **Totally Lead-Free; RoHS Compliant (Notes 1 & 2)**
- Lead-Free Packages, Available in "Green" Molding Compound: TO92, SOT23, SOT25, SOT89
  - **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
  - **Halogen and Antimony Free. "Green" Device (Note 3)**

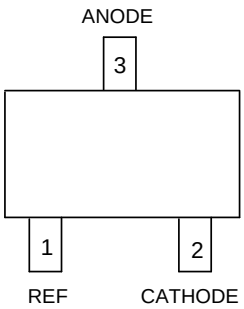
Applications

- 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) compliant.
2. See http://www.diodes.com/quality/lead_free.html 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.

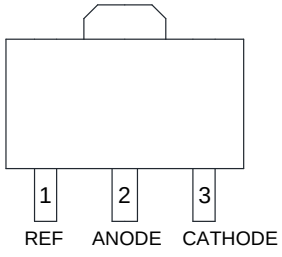
Pin Assignments

(Top View)



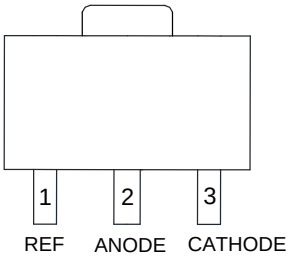
(SOT23/ N Package)

(Top View)



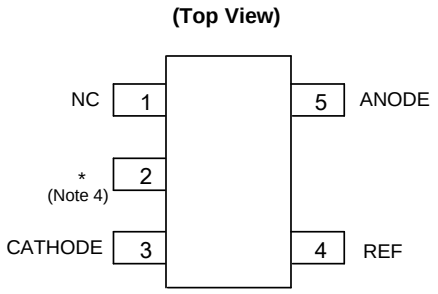
(SOT89 Option 1/ R Package)

(Top View)

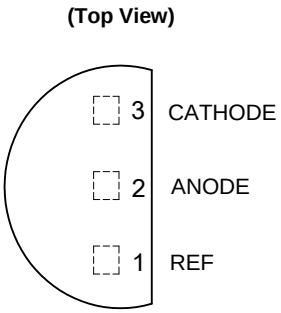


(SOT89 Option 2/ R Package)

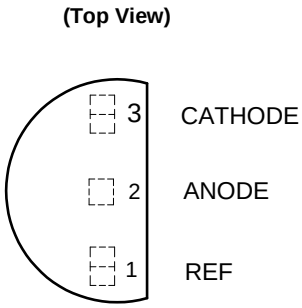
Pin Assignments (Cont.)



(SOT25/ K Package)



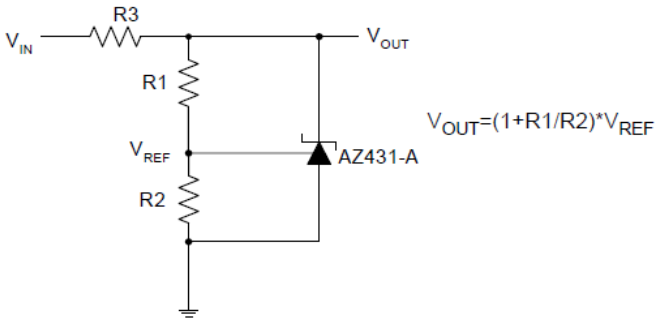
(TO92 (Bulk Packing)/ Z Package)



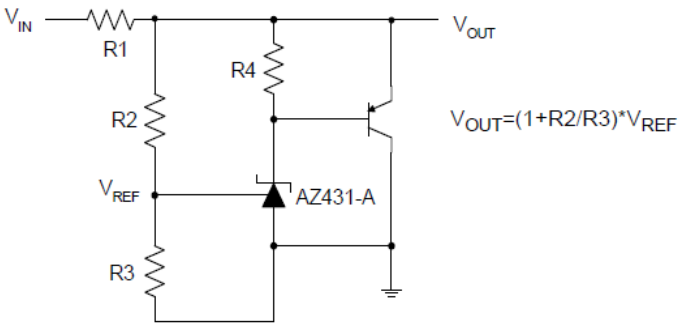
(TO92 (Ammo Packing)/ Z Package)

Note: 4. * Pin 2 is attached to substrate and must be connected to ANODE or open.

Typical Applications Circuit

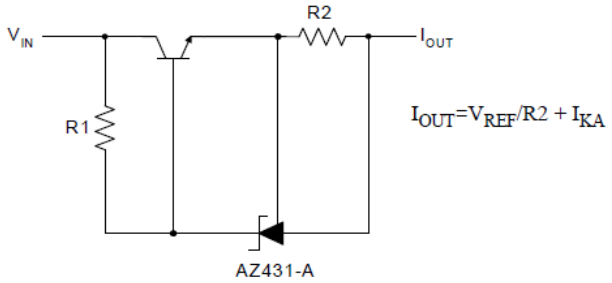


Shunt Regulator

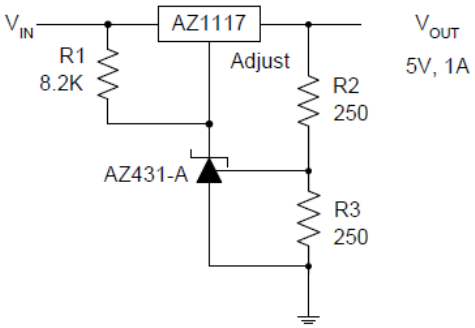


High Current Shunt Regulator

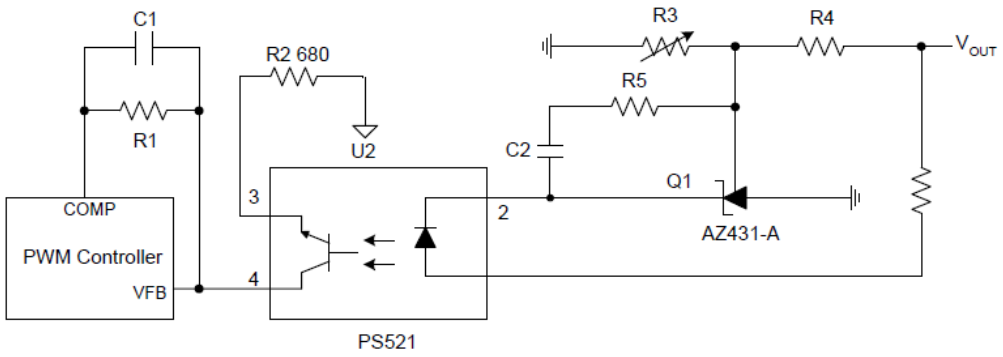
Typical Applications Circuit (Cont.)



Current Source or Current Limit

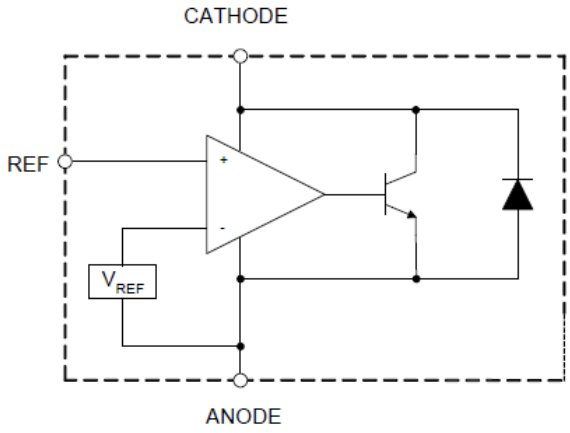


Precision 5V 1A Regulator



PWM Converter with Reference

Functional Block Diagram



Absolute Maximum Ratings (Note 5)

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	Z, R Package: 770	mW
		N, K Package: 370	
T_J	Junction Temperature	+150	ºC
T_{STG}	Storage Temperature Range	-65 to +150	ºC
ESD	ESD (Human Body Model)	2000	V

Note: 5. 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.

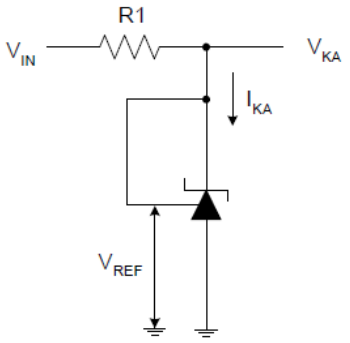
Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{KA}	Cathode Voltage	V_{REF}	36	V
I_{KA}	Cathode Current	1.0	100	mA
T_A	Operating Ambient Temperature Range	-40	+125	ºC

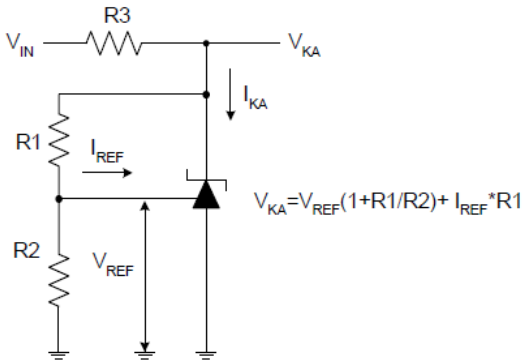
Electrical Characteristics (@T_A = +25°C, unless otherwise specified.)

Symbol	Test Circuit	Parameter		Conditions		Min	Typ	Max	Unit
V_{REF}	4	Reference Voltage	0.4%	$V_{KA} = V_{REF}$, I_{KA} = 10mA		2.490	2.500	2.510	V
			0.8%			2.480	2.500	2.520	
ΔV_{REF}	4	Deviation of Reference Voltage Over Full Temperature Range		$V_{KA} = V_{REF}$ 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	
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	5	Ratio of Change in Reference Voltage to the Change in Cathode Voltage		I_{KA} = 10mA	ΔV_{KA} = 10V to V_{REF}	–	-1.0	-2.7	mV/V
					ΔV_{KA} = 36V to 10V	–	-0.5	-2.0	
I_{REF}	5	Reference Current		I_{KA} = 10mA, R1 = 10KΩ, R2 = ∞		–	0.7	4	µA
ΔI_{REF}	5	Deviation of Reference Current Over Full Temperature Range		I_{KA} = 10mA, R1 = 10KΩ R2 = ∞, T_A = -40 to +125°C		–	0.4	1.2	µA
I_{KA} (Min)	4	Minimum Cathode Current for Regulation		$V_{KA} = V_{REF}$		–	0.4	1.0	mA
I_{KA} (Off)	6	Off-state Cathode Current		V_{KA} = 36V, V_{REF} = 0		–	0.05	1.0	µA
Z_{KA}	4	Dynamic Impedance		$V_{KA} = V_{REF}$, I_{KA} = 1 to 100mA, f ≤ 1.0KHz		–	0.15	0.5	Ω
θ_{JC}	–	Thermal Resistance		SOT23		–	135.48	–	°C/W
	–			SOT25		–	135.48	–	
	–			TO92		–	81.63	–	
	–			SOT89		–	29.80	–	

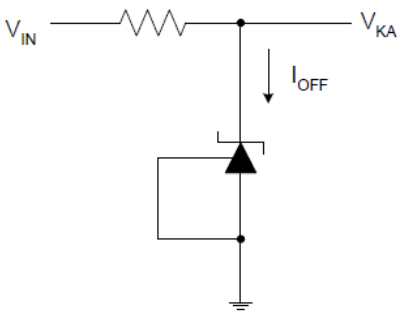
Electrical Characteristics (Cont.)



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



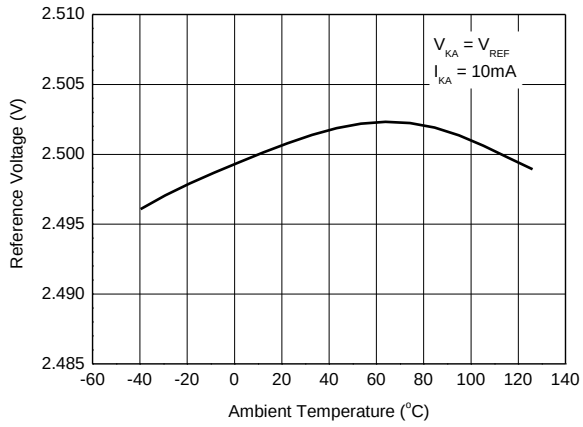
Test Circuit 5 for $V_{KA} > V_{REF}$



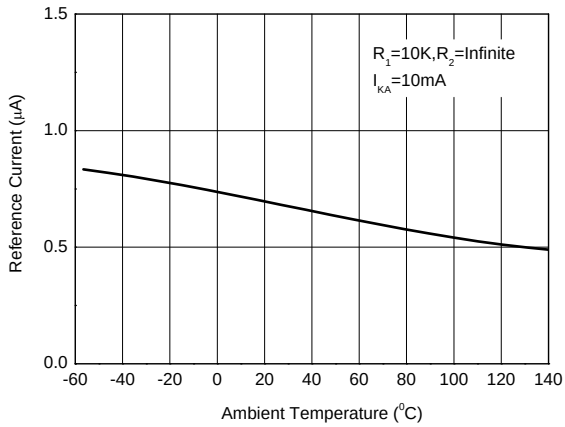
Test Circuit 6 for I_{OFF}

Performance Characteristics

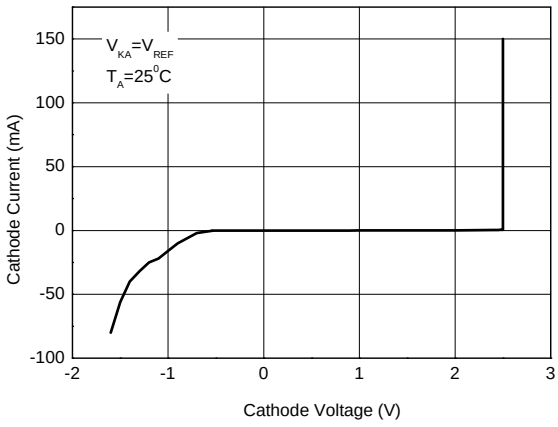
Reference Voltage vs. Ambient Temperature



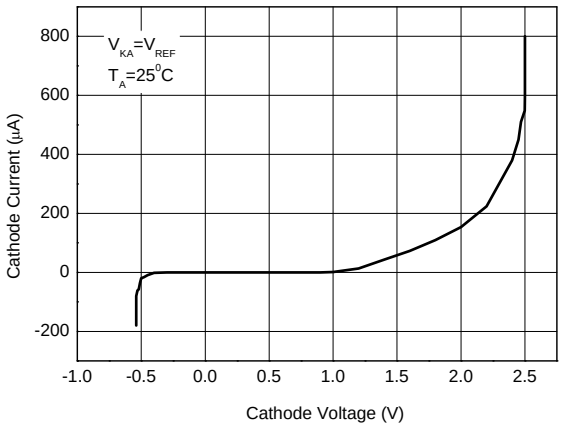
Reference Current vs. Ambient Temperature



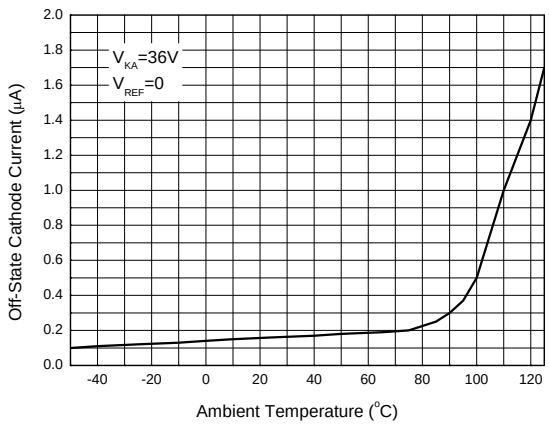
Cathode Current vs. Cathode Voltage



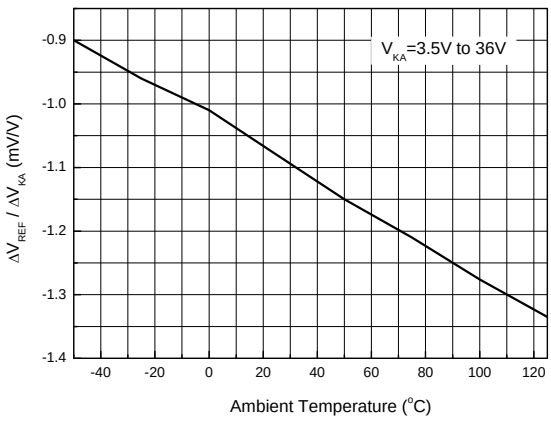
Cathode Current vs. Cathode Voltage



Off-State Cathode Current vs. Ambient Temperature

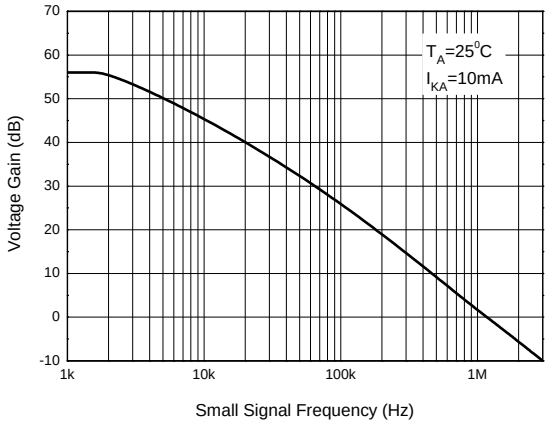


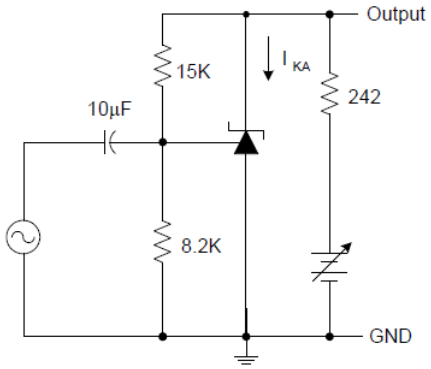
Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage



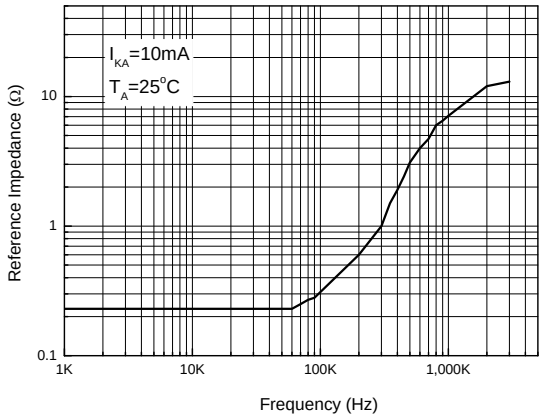
Performance Characteristics (Cont.)

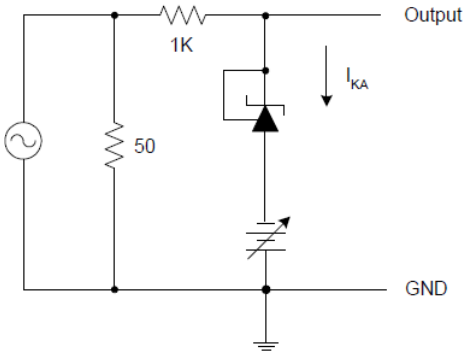
Small Signal Voltage Gain vs. Frequency



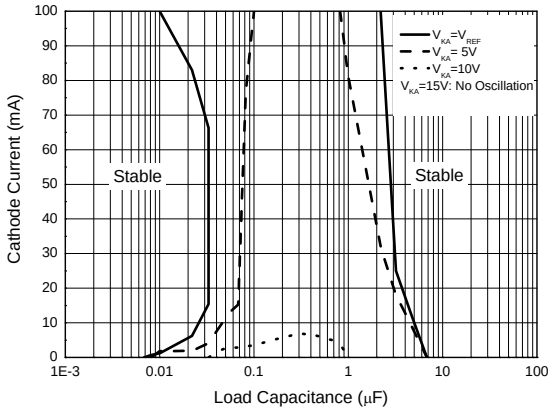


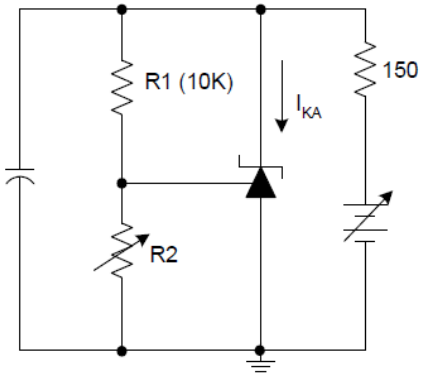
Reference Impedance vs. Frequency





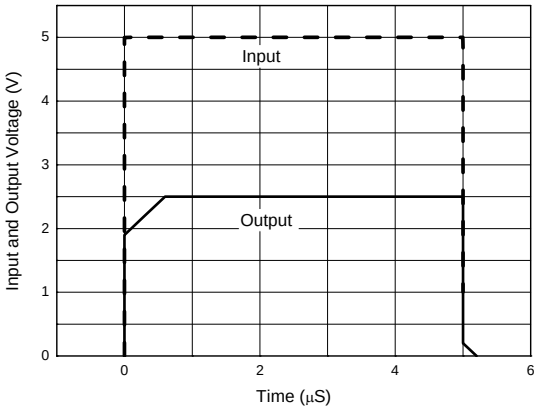
Stability Boundary Conditions vs. Load Capacitance

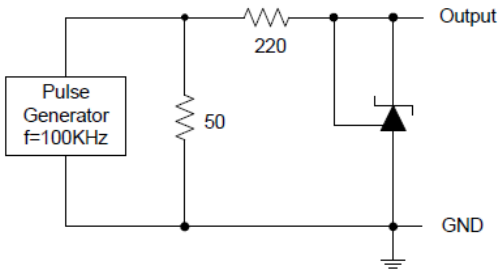




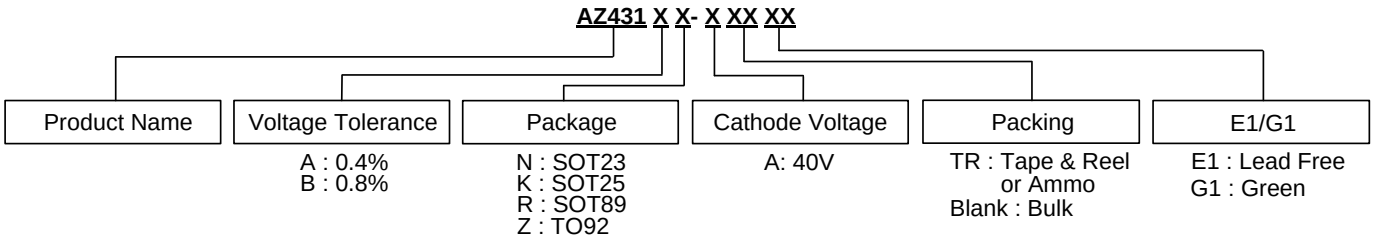
Performance Characteristics (Cont.)

Pulse Response of Input and Output Voltage





Ordering Information



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

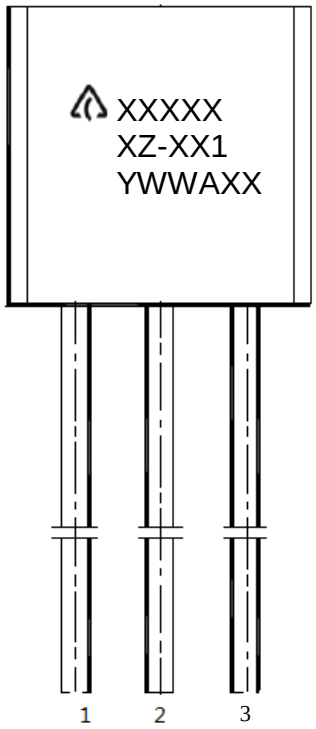
Products with "G1" suffix are available in green packages.

	Package	Temperature Range	Voltage Tolerance	Part Number		Marking ID		Packing
				Lead- Free	Green	Lead-Free	Green	
Lead-Free	SOT23	-40 to +125°C	0.4%	AZ431AN-ATRE1	AZ431AN-ATRG1	EA1	GA1	3000/ Tape & Reel
Lead-free Green			0.8%	AZ431BN-ATRE1	AZ431BN-ATRG1	EA2	GA2	3000/ Tape & Reel
Lead-Free	SOT25	-40 to +125°C	0.4%	AZ431AK-ATRE1	AZ431AK-ATRG1	E3A	G3A	3000/ Tape & Reel
Lead-free Green			0.8%	AZ431BK-ATRE1	AZ431BK-ATRG1	E3B	G3B	3000/ Tape & Reel
	TO92	-40 to +125°C	0.4%	AZ431AZ-AE1	AZ431AZ-AG1	AZ431AZ-AE1	AZ431AZ-AG1	1000/ Bulk
Lead-Free			0.4%	AZ431AZ-ATRE1	AZ431AZ-ATRG1	AZ431AZ-AE1	AZ431AZ-AG1	2000/ Ammo
Lead-free Green			0.8%	AZ431BZ-AE1	AZ431BZ-AG1	AZ431BZ-AE1	AZ431BZ-AG1	1000/ Bulk
			0.8%	AZ431BZ-ATRE1	AZ431BZ-ATRG1	AZ431BZ-AE1	AZ431BZ-AG1	2000/ Ammo
Lead-Free	SOT89	-40 to +125°C	0.4%	AZ431AR-ATRE1	AZ431AR-ATRG1	E43A	G43A	1000/ Tape & Reel
Lead-free Green			0.8%	AZ431BR-ATRE1	AZ431BR-ATRG1	E43B	G43B	1000/ Tape & Reel

Marking Information

(1) TO92

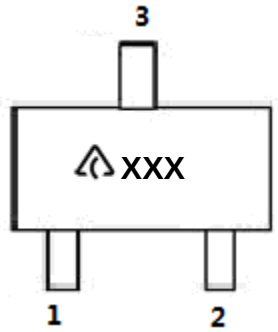
(Top View)



First and Second Line: 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.

(2) SOT23

(Top View)

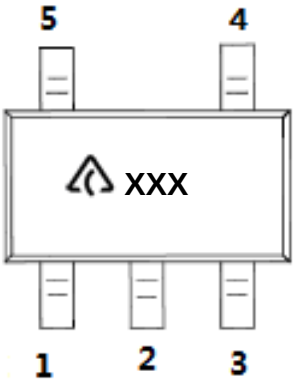


: Logo
XXX: Marking ID
(See Ordering Information)

Marking Information (Cont.)

(3) SOT25

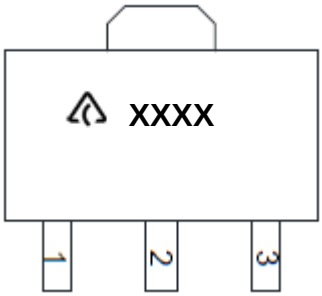
(Top View)



: Logo
XXX: Marking ID
(See Ordering Information)

(4) SOT89

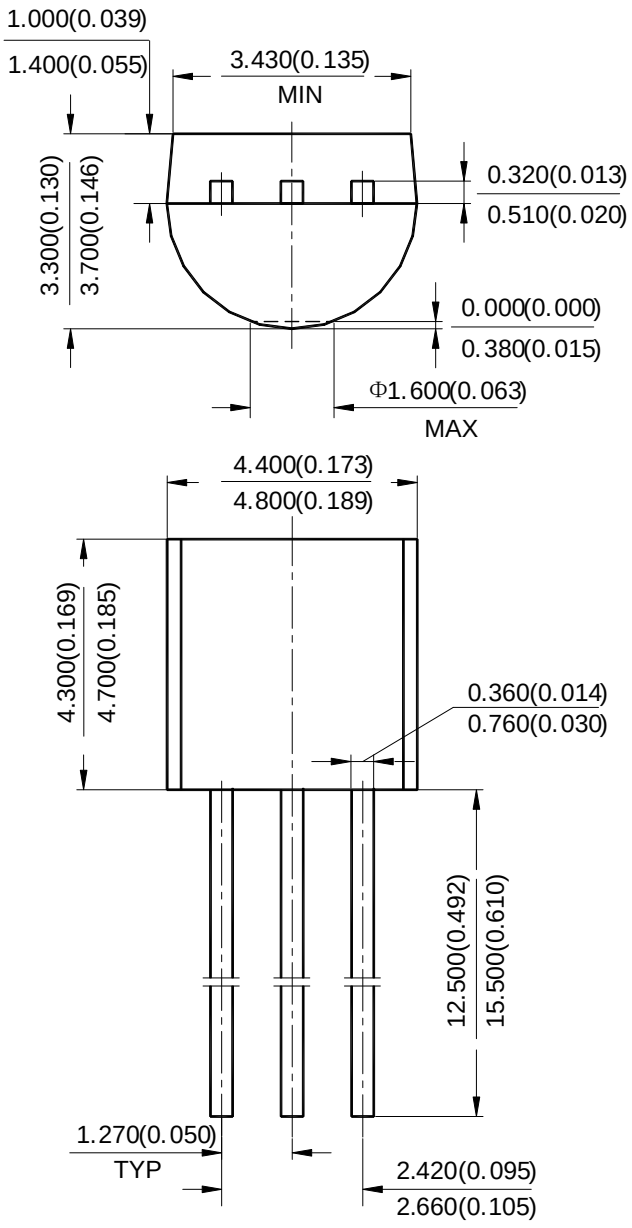
(Top View)



: Logo
XXXX: Marking ID
(See Ordering Information)

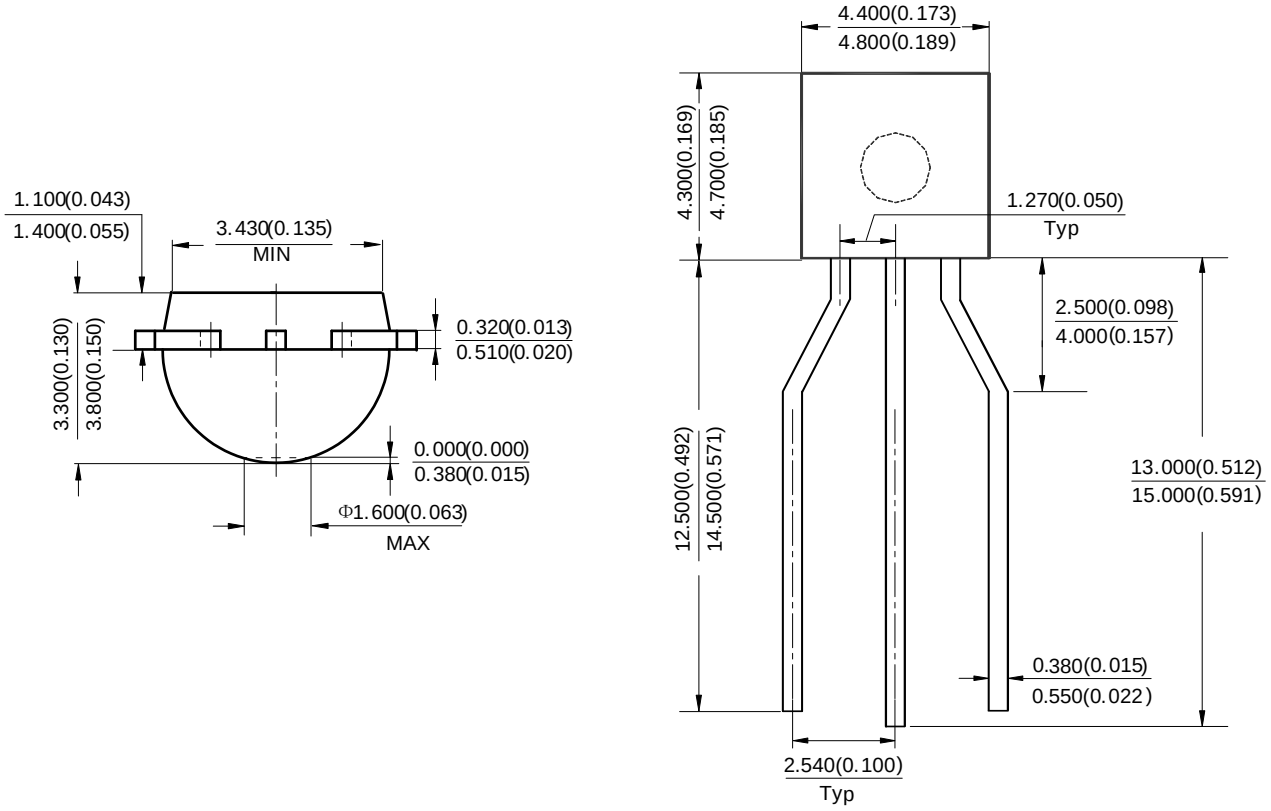
Package Outline Dimensions

(1) Package Type: TO92 (Bulk Packing)



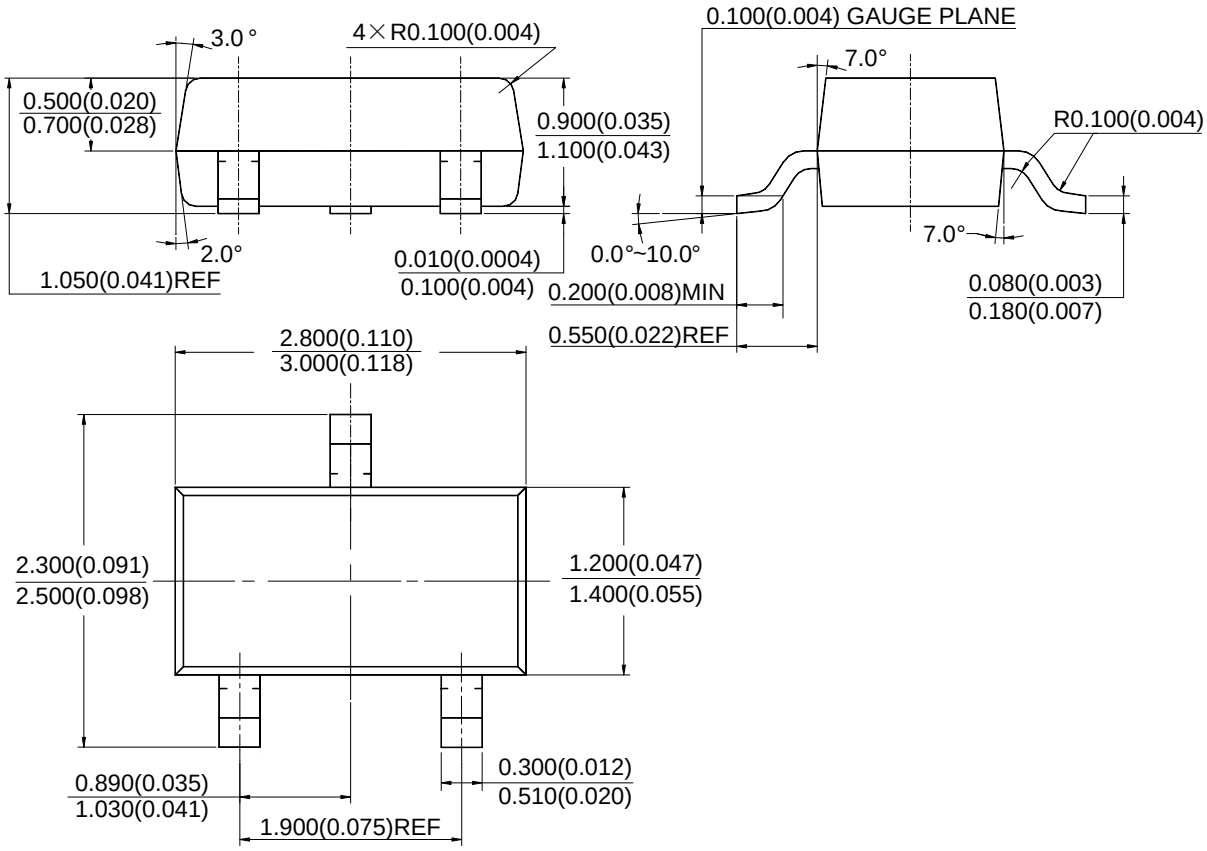
Package Outline Dimensions (Cont.)

(2) Package Type: TO92 (Ammo Packing)



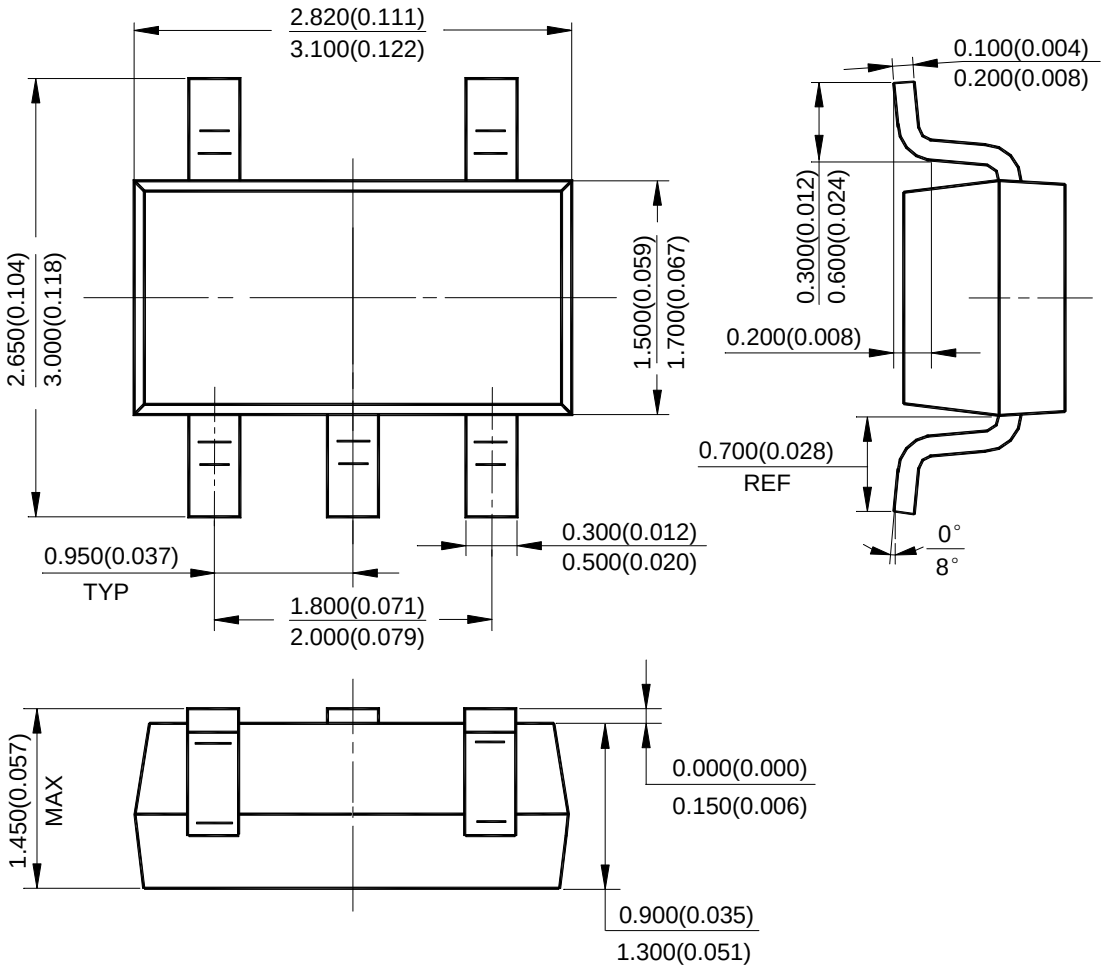
Package Outline Dimensions (Cont.)

(3) Package Type: SOT23



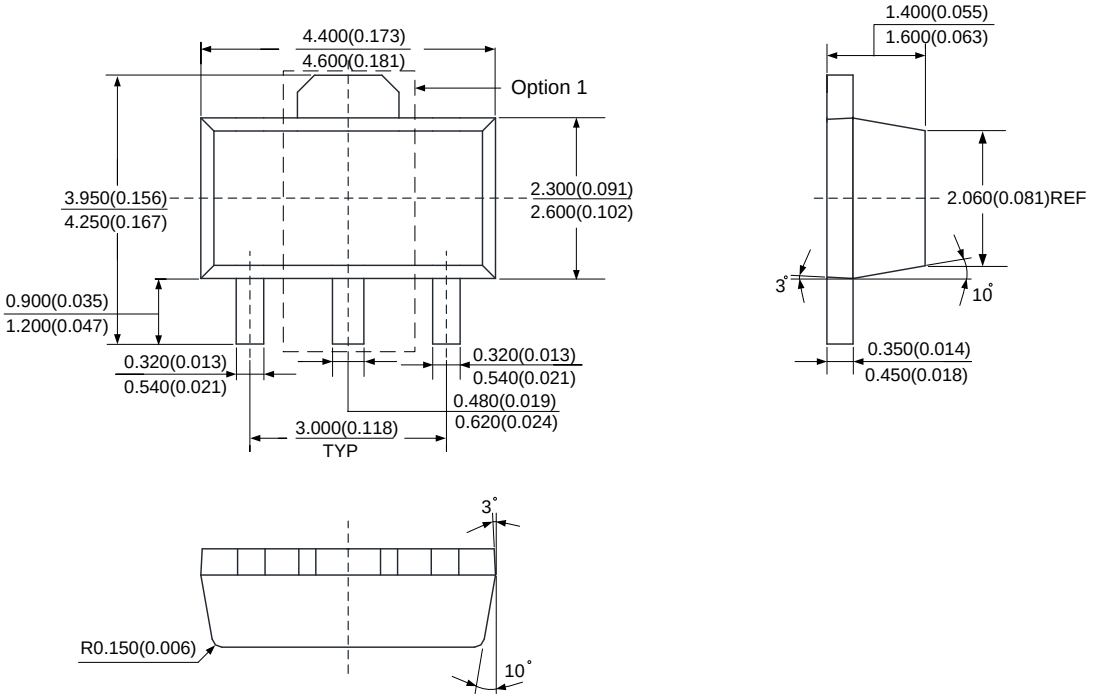
Package Outline Dimensions (Cont.)

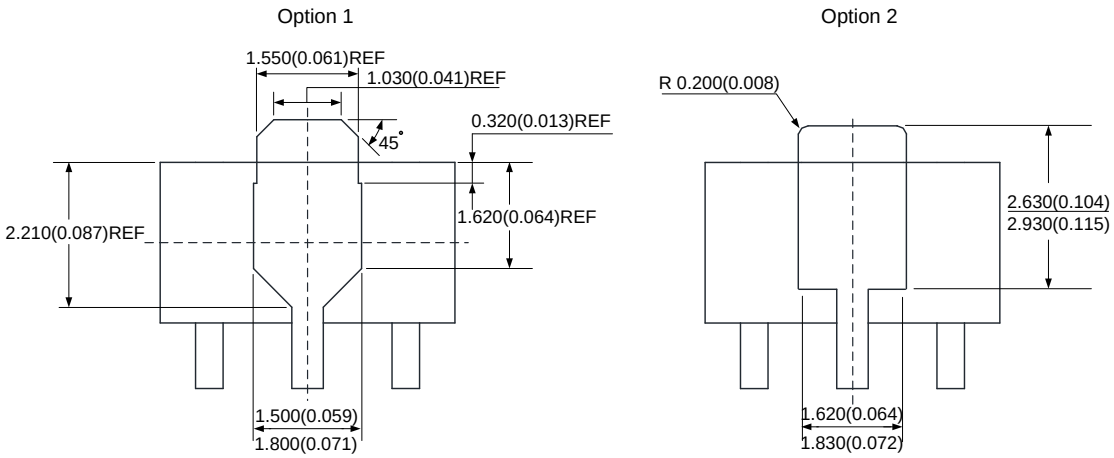
(4) Package Type: SOT25



Package Outline Dimensions (Cont.)

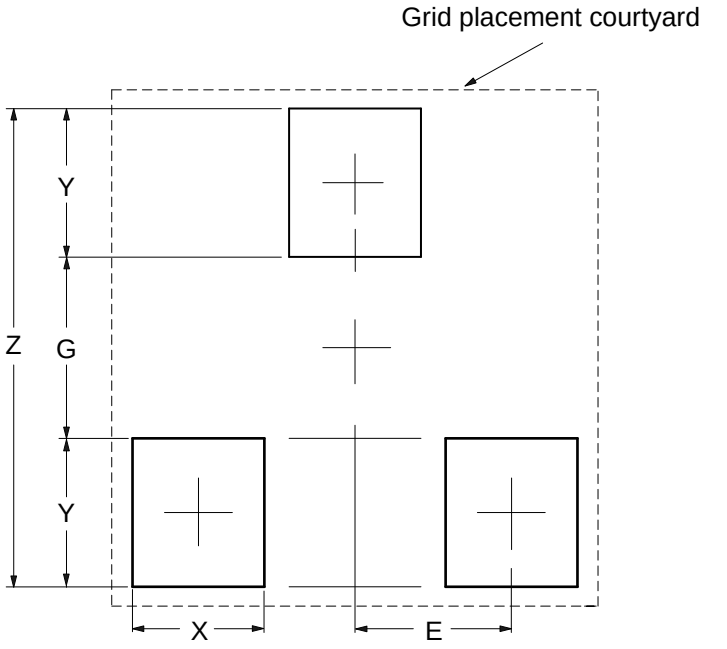
(5) Package Type: SOT89





Suggested Pad Layout

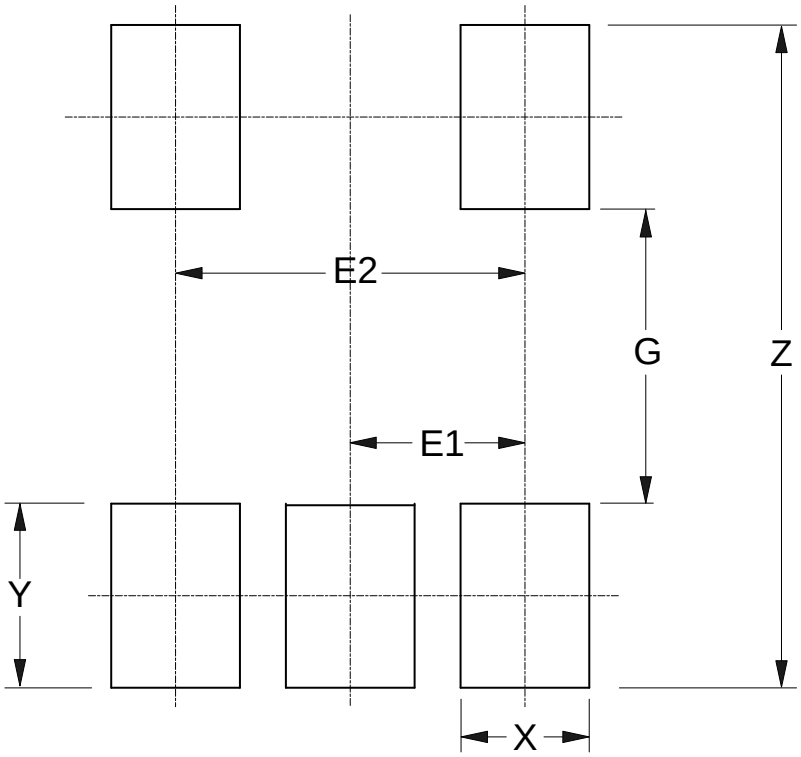
(1) Package Type: SOT23



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

Suggested Pad Layout (Cont.)

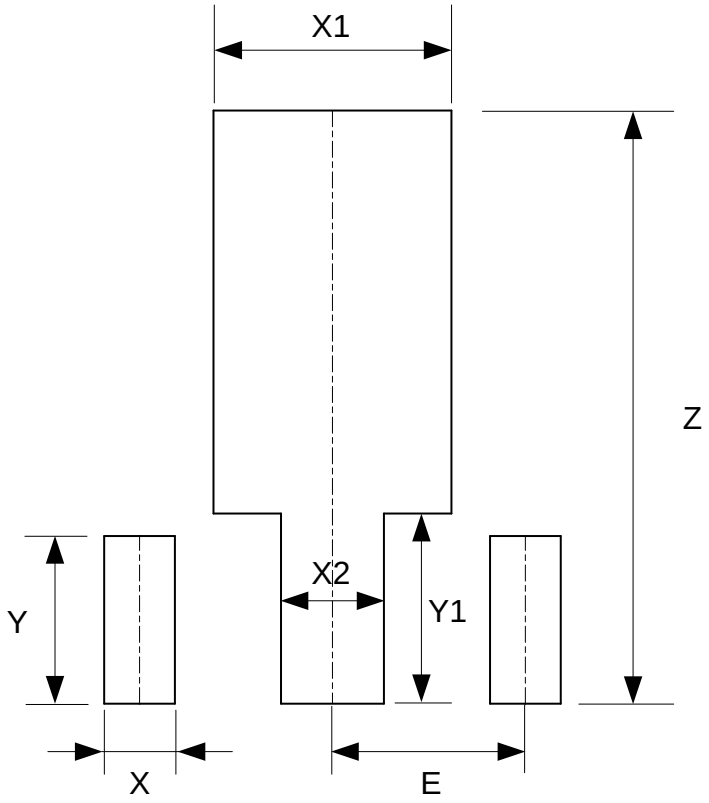
(2) Package Type: SOT25



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E1 (mm)/(inch)	E2 (mm)/(inch)
Value	3.600/0.142	1.600/0.063	0.700/0.028	1.000/0.039	0.950/0.037	1.900/0.075

Suggested Pad Layout (Cont.)

(3) Package Type: SOT89



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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