

## 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

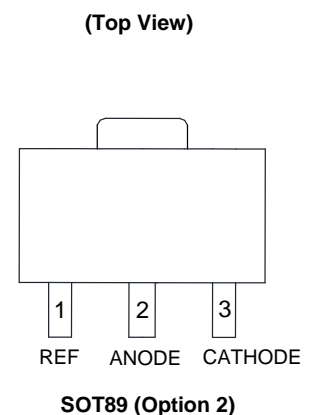
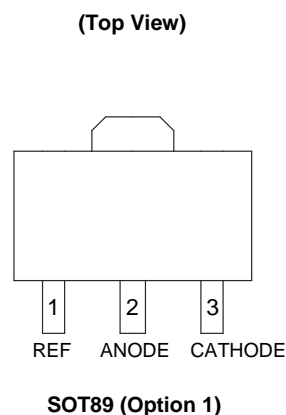
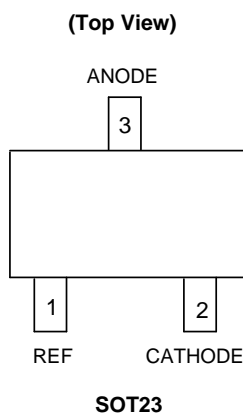
- Programmable Precise Output Voltage from 2.5V to 36V
- High Stability under Capacitive Load
- Low Temperature Deviation: 4.5mV Typical
- Low Equivalent Full-range Temperature Coefficient with 20PPM/°C Typical
- Sink Current Capacity from 1mA to 100mA
- Low Output Noise
- Wide Operating Range of -40 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

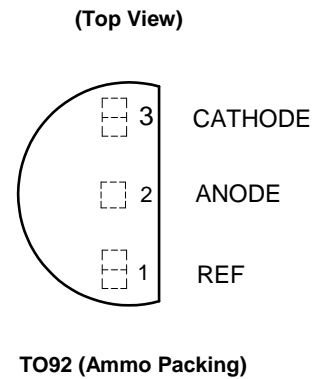
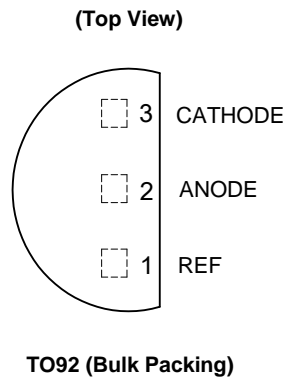
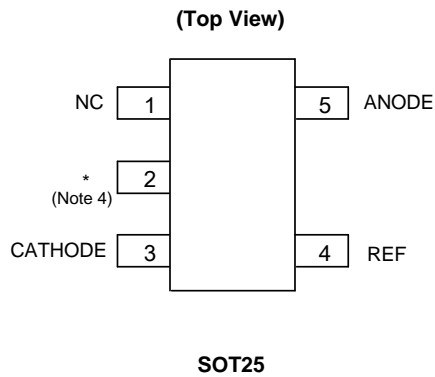
- Charger
- Voltage Adapter
- Switching Power Supply
- Graphic Card
- Precision Voltage Reference

- 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](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

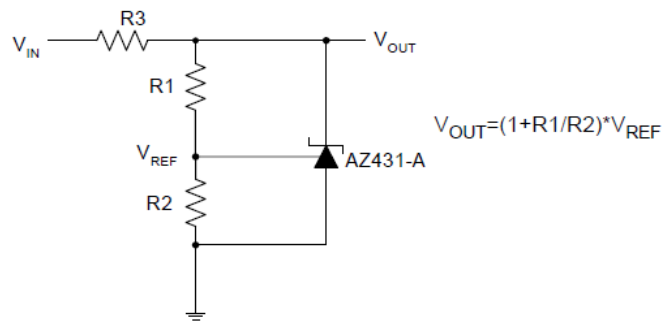


**Pin Assignments (Cont.)**

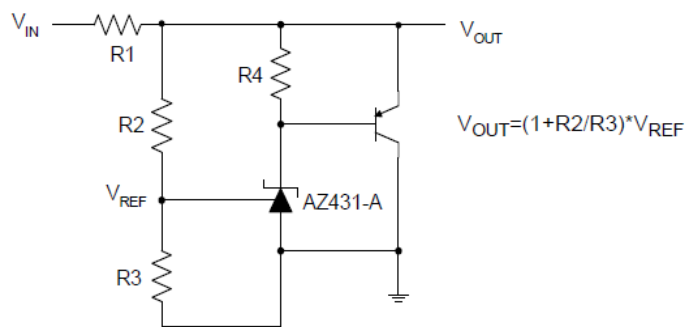


Note 4: \* Pin 2 is attached to substrate and must be connected to ANODE or open.

**Typical Applications Circuit**

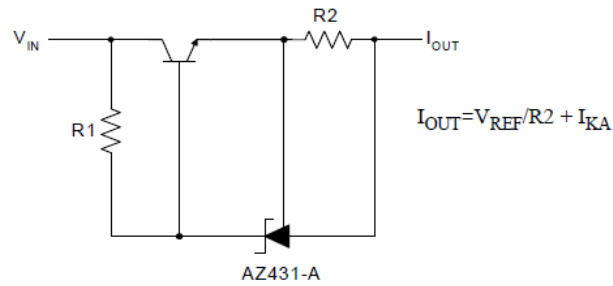


**Shunt Regulator**

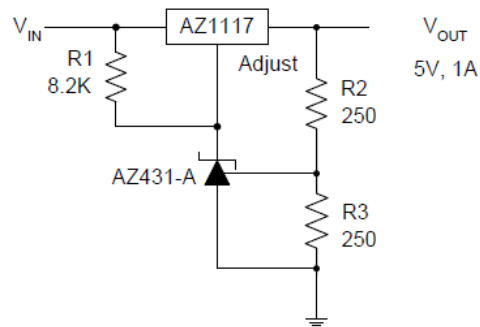


**High Current Shunt Regulator**

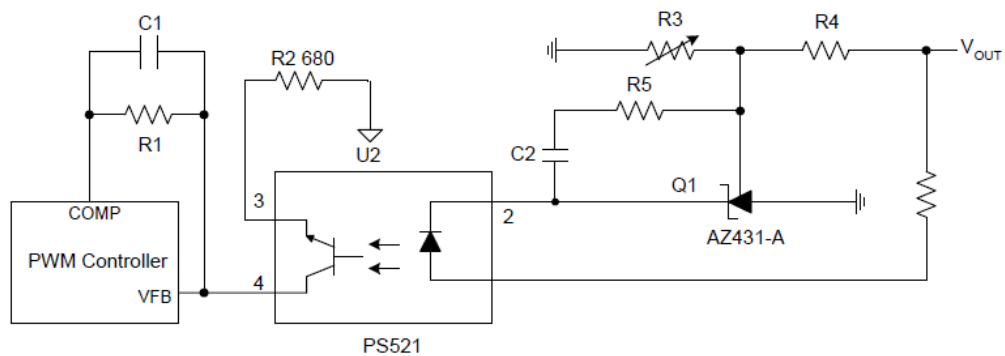
**Typical Applications Circuit (Cont.)**



**Current Source or Current Limit**

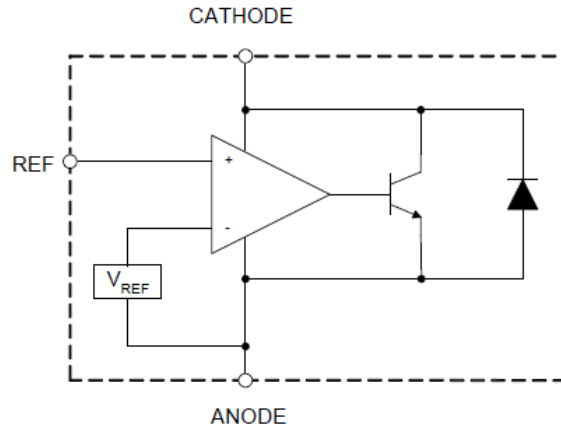


**Precision 5V 1A Regulator**



**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	
$\theta_{JA}$	Thermal Resistance (Junction to Ambient)	SOT23	380	°C/W
		SOT25	380	
		TO92	165	
		SOT89	165	
$T_J$	Junction Temperature		+150	°C
$T_{STG}$	Storage Temperature Range		-65 to +150	°C
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.

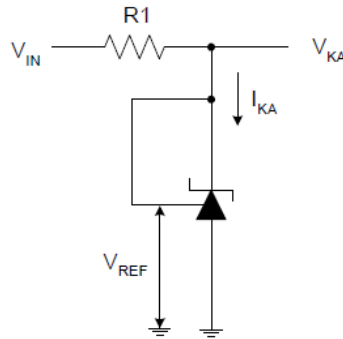
## Recommended Operating Conditions

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	°C

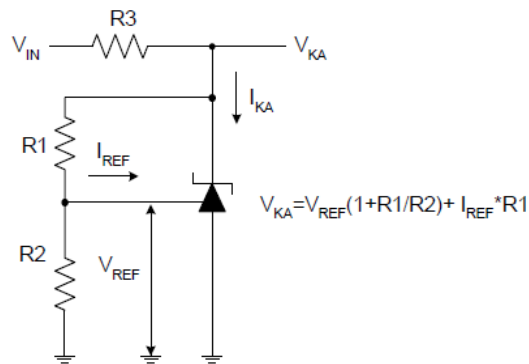
**Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Symbol	Test Circuit	Parameter	Conditions	Min	Typ	Max	Unit	
V <sub>REF</sub>	4	Reference Voltage	V <sub>KA</sub> = V <sub>REF</sub> , I <sub>KA</sub> = 10mA	0.4%	2.490	2.500	2.510	V
				0.8%	2.480	2.500	2.520	
ΔV <sub>REF</sub>	4	Deviation of Reference Voltage Over Full Temperature Range	V <sub>KA</sub> = V <sub>REF</sub> I <sub>KA</sub> = 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 <sub>KA</sub> = 10mA	ΔV <sub>KA</sub> = 10V to V <sub>REF</sub>	–	-1.0	-2.7	mV/V
				ΔV <sub>KA</sub> = 36V to 10V	–	-0.5	-2.0	
I <sub>REF</sub>	5	Reference Current	I <sub>KA</sub> = 10mA, R1 = 10KΩ, R2 = ∞	–	0.7	4	μA	
ΔI <sub>REF</sub>	5	Deviation of Reference Current Over Full Temperature Range	I <sub>KA</sub> = 10mA, R1 = 10KΩ, R2 = ∞, T <sub>A</sub> = -40 to +125°C	–	0.4	1.2	μA	
I <sub>KA</sub> (Min)	4	Minimum Cathode Current for Regulation	V <sub>KA</sub> = V <sub>REF</sub>	–	0.4	1.0	mA	
I <sub>KA</sub> (Off)	6	Off-state Cathode Current	V <sub>KA</sub> = 36V, V <sub>REF</sub> = 0	–	0.05	1.0	μA	
Z <sub>KA</sub>	4	Dynamic Impedance	V <sub>KA</sub> = V <sub>REF</sub> , I <sub>KA</sub> = 1 to 100mA, f ≤ 1.0KHz	–	0.15	0.5	Ω	
θ <sub>JC</sub>	–	Thermal Resistance	SOT23	–	135.48	–	°C/W	
	–		SOT25	–	135.48	–		
	–		TO92	–	81.63	–		
	–		SOT89	–	29.80	–		

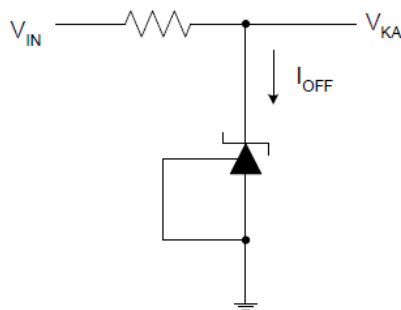
**Electrical Characteristics** (Cont.)



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



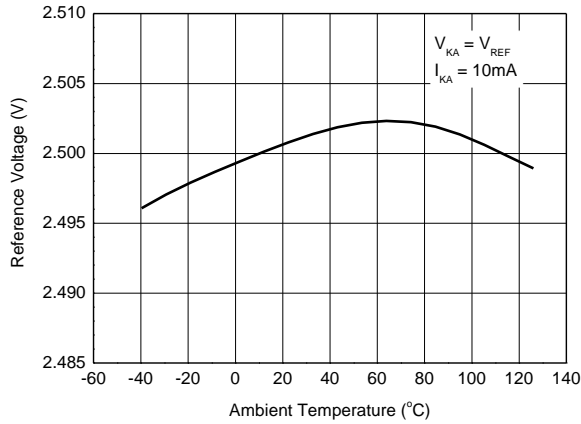
**Test Circuit 5 for  $V_{KA} > V_{REF}$**



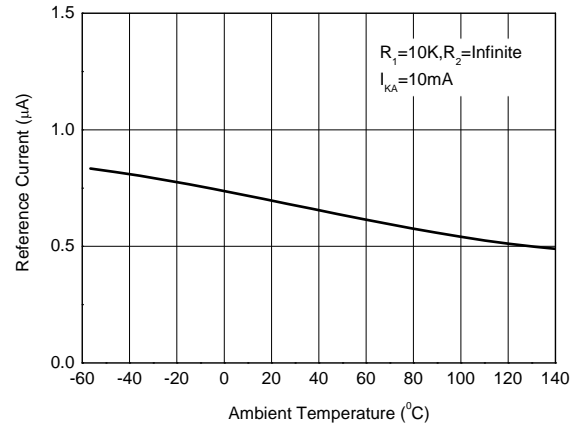
**Test Circuit 6 for  $I_{OFF}$**

**Performance Characteristics**

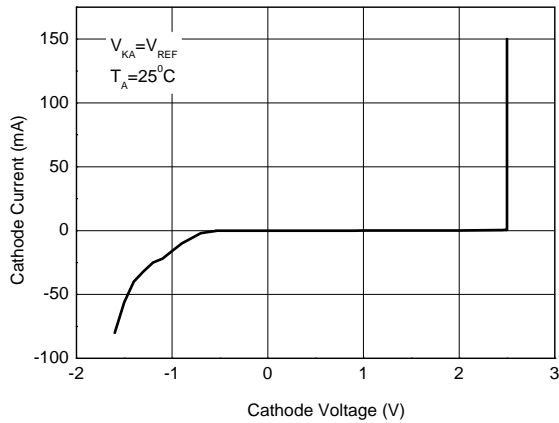
**Reference Voltage vs. Ambient Temperature**



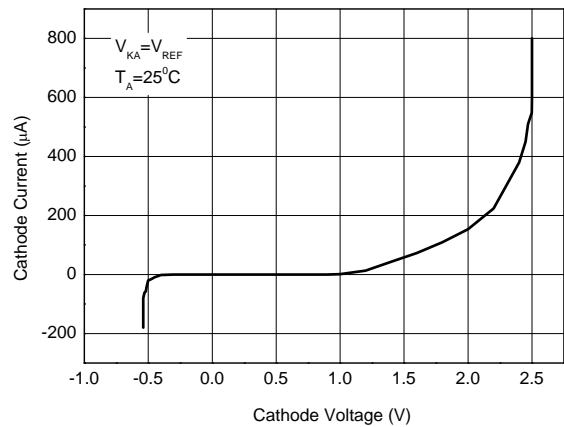
**Reference Current vs. Ambient Temperature**



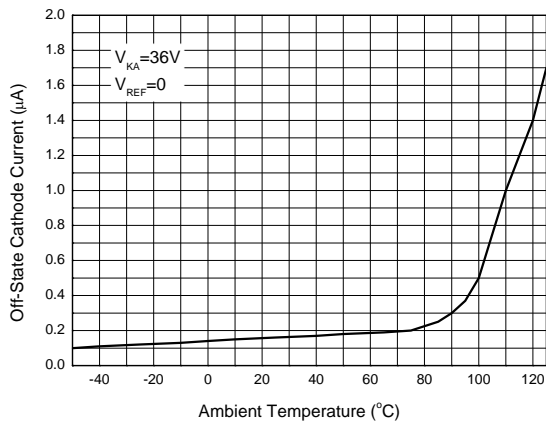
**Cathode Current vs. Cathode Voltage**



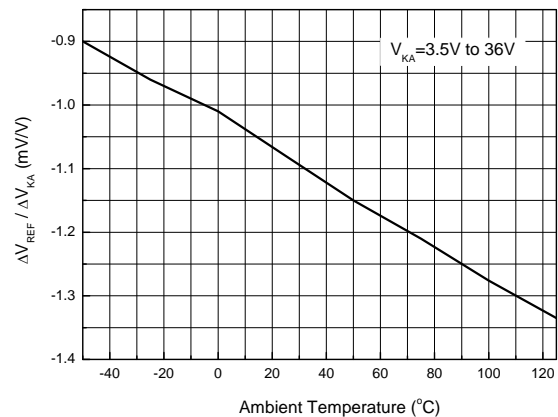
**Cathode Current vs. Cathode Voltage**



**Off-State Cathode Current vs. Ambient Temperature**

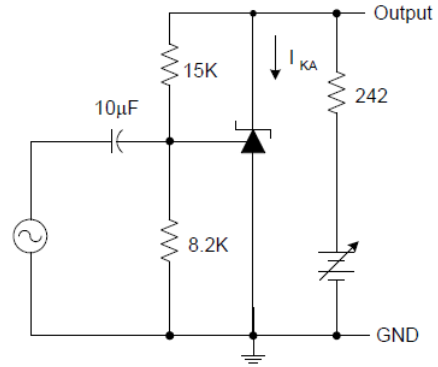
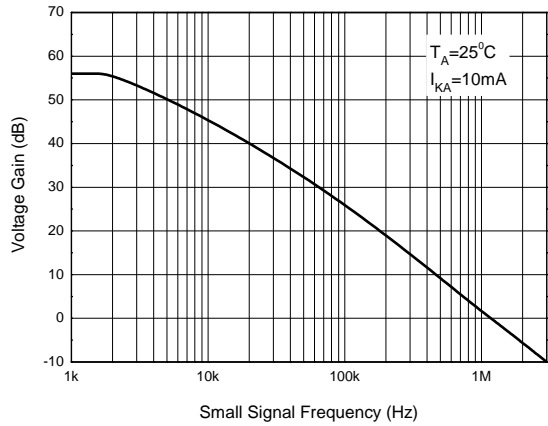


**Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage**

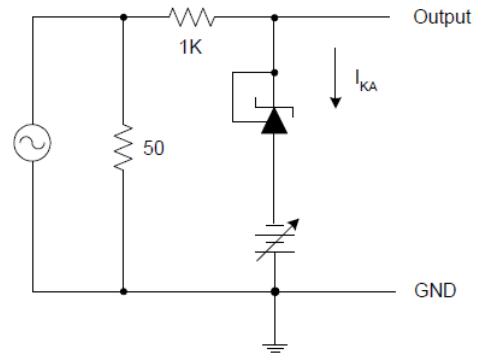
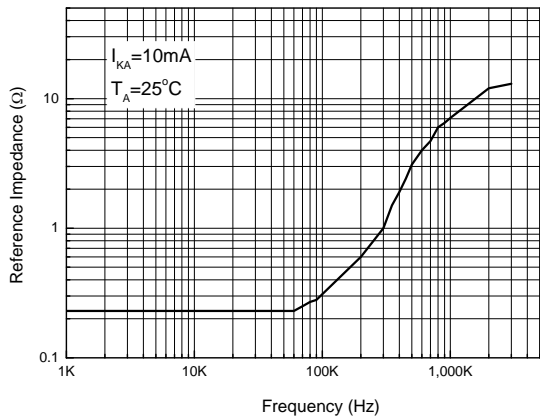


**Performance Characteristics (Cont.)**

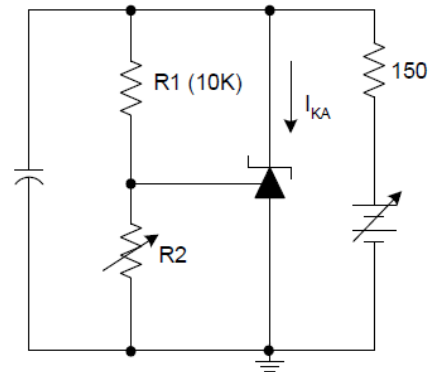
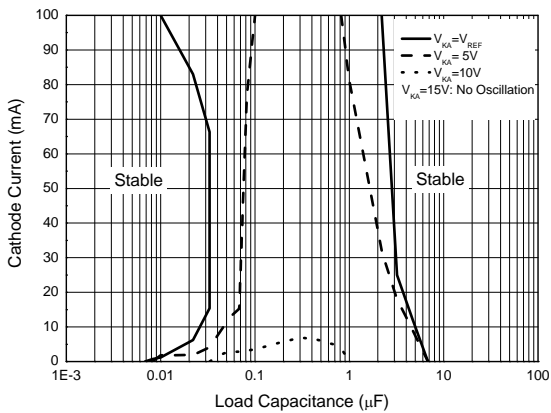
**Small Signal Voltage Gain vs. Frequency**



**Reference Impedance vs. Frequency**



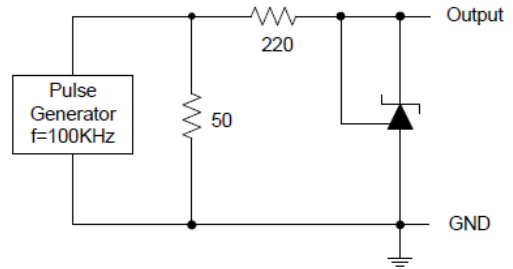
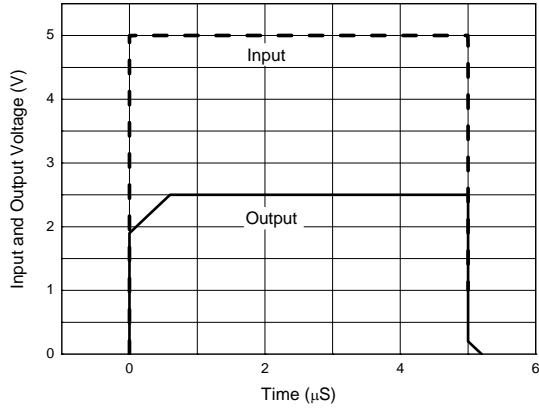
**Stability Boundary Conditions vs. Load Capacitance**



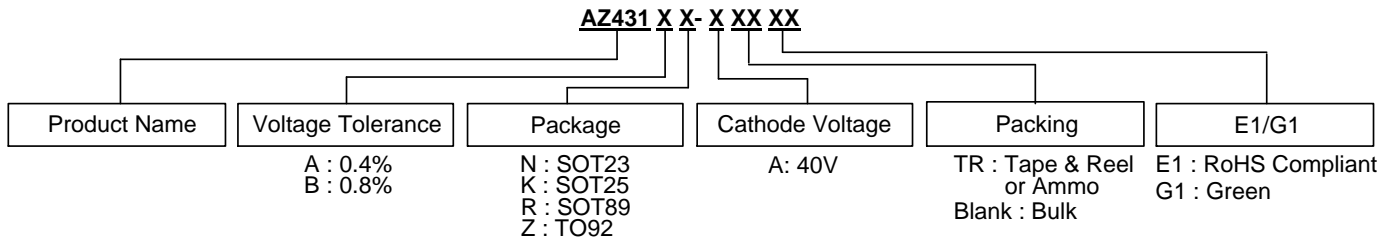


**Performance Characteristics (Cont.)**

**Pulse Response of Input and Output Voltage**



## Ordering Information

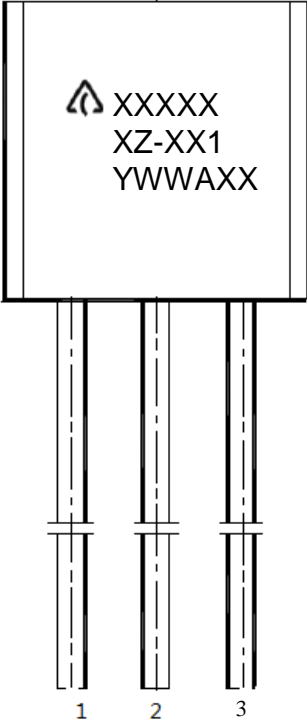


Package	Temperature Range	Voltage Tolerance	Part Number		Marking ID		Packing
			RoHS Compliant	Green	RoHS Compliant	Green	
SOT23	-40 to +125°C	0.4%	AZ431AN-ATRE1	AZ431AN-ATRG1	EA1	GA1	3000/ Tape & Reel
		0.8%	AZ431BN-ATRE1	AZ431BN-ATRG1	EA2	GA2	3000/ Tape & Reel
SOT25	-40 to +125°C	0.4%	AZ431AK-ATRE1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

**Marking Information**

(1) TO92

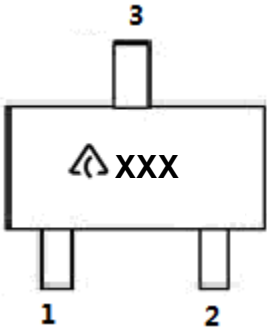
(Top View)



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

(2) SOT23

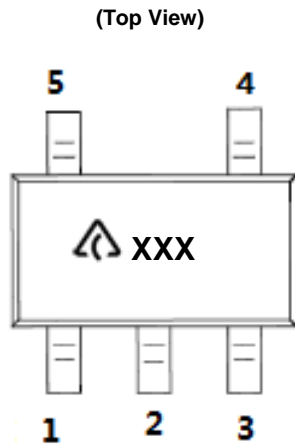
(Top View)




Logo : Logo  
XXX: Marking ID  
(See Ordering Information)

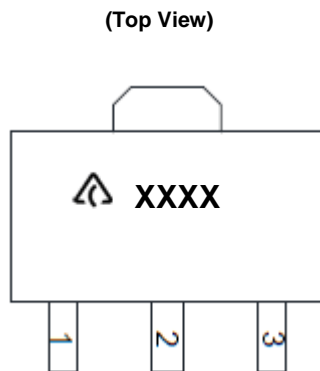
**Marking Information** (Cont.)


(3) SOT25



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(See Ordering Information)

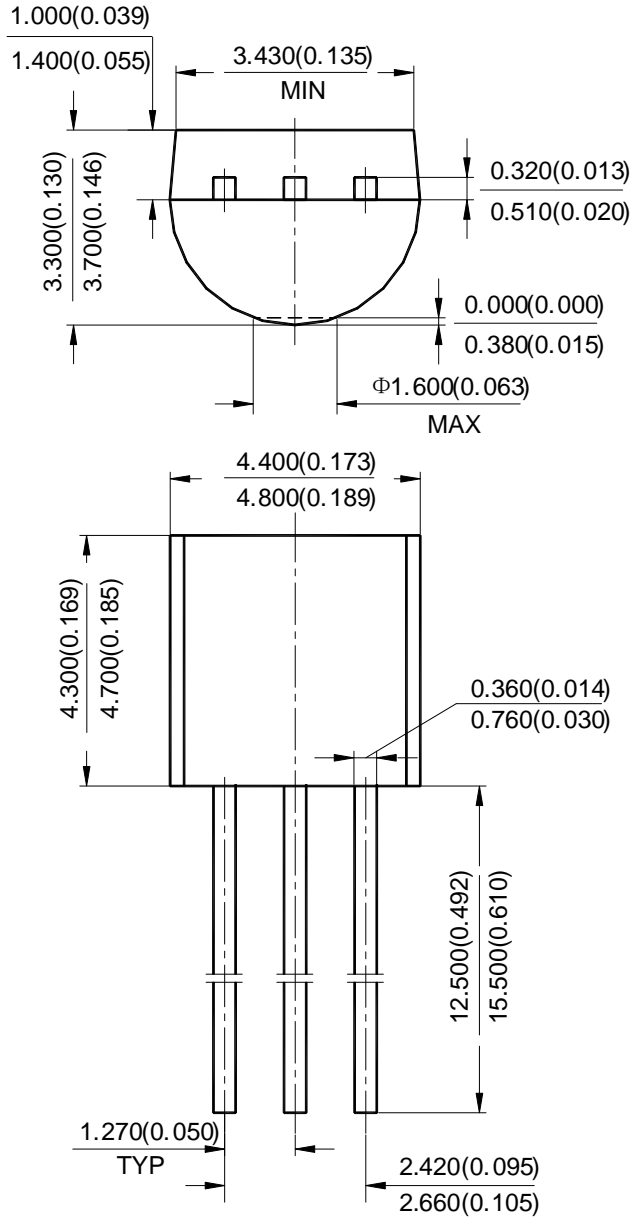
(4) SOT89



 : Logo  
XXXX: Marking ID  
(See Ordering Information)

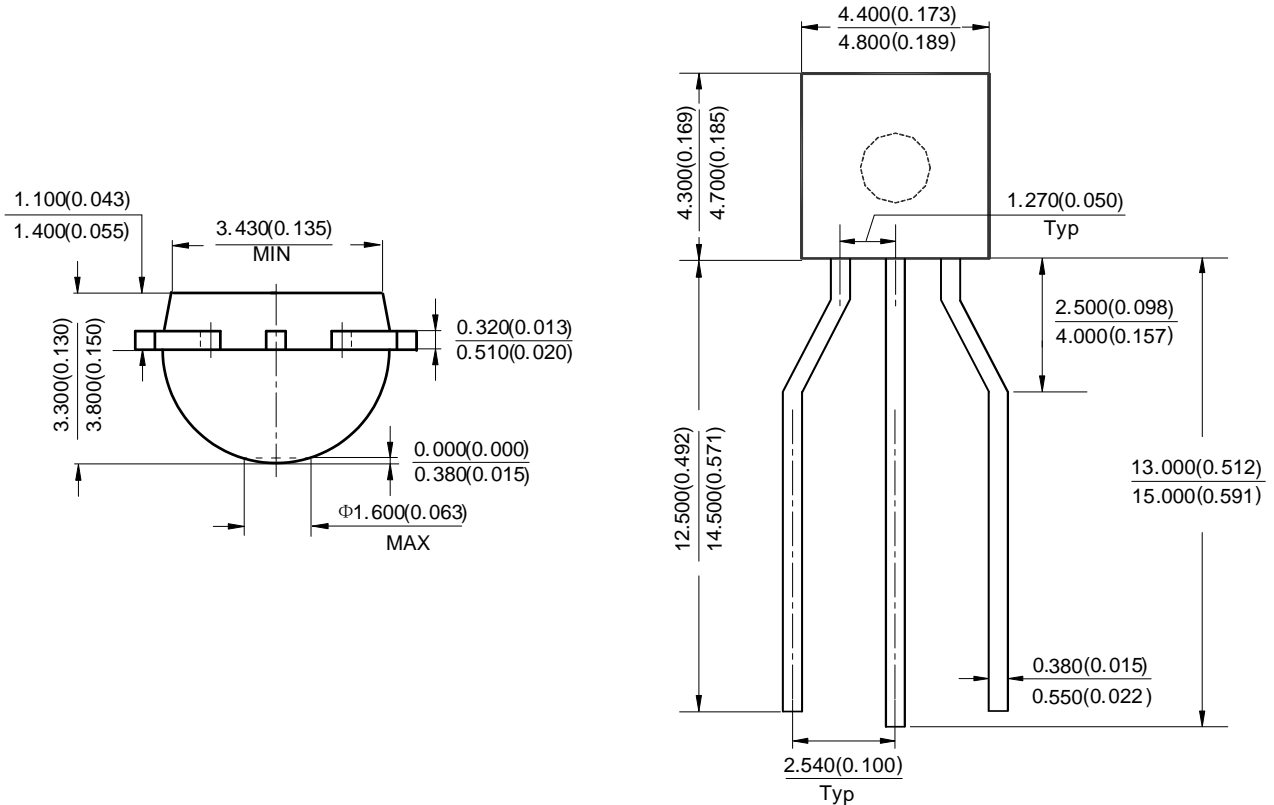
**Package Outline Dimensions** (All dimensions in mm.)

(1) Package Type: TO92 (Bulk Packing)



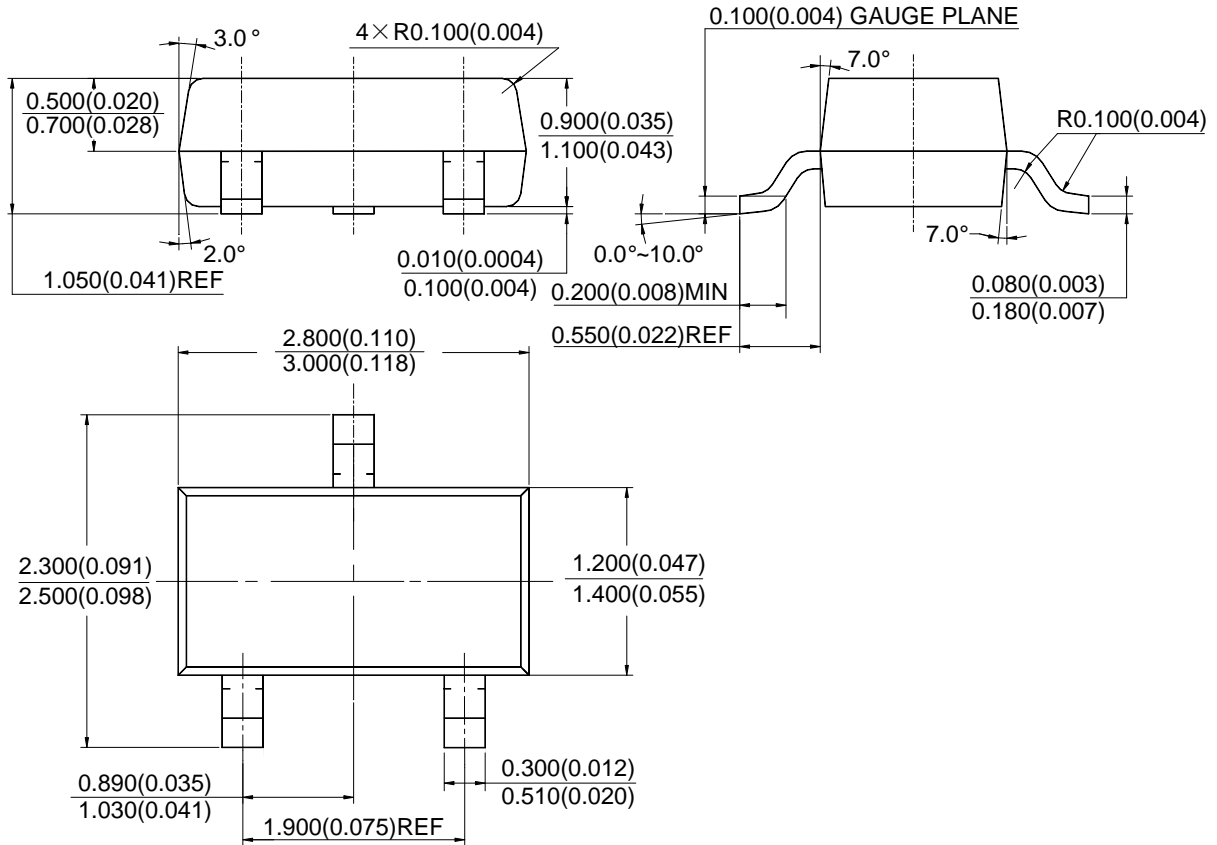
**Package Outline Dimensions** (Cont. All dimensions in mm.)

(2) Package Type: TO92 ( Ammo Packing)



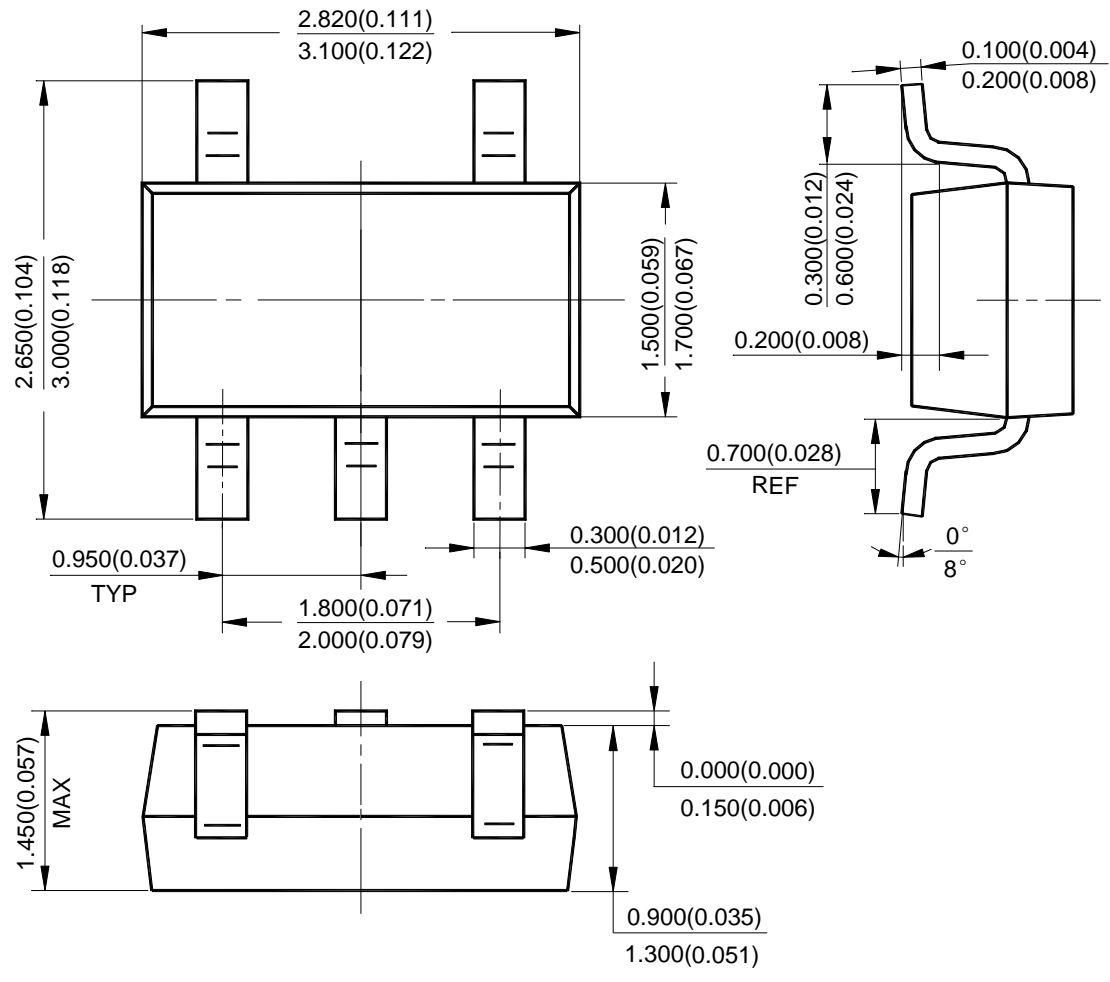
**Package Outline Dimensions** (Cont. All dimensions in mm.)

(3) Package Type: SOT23



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

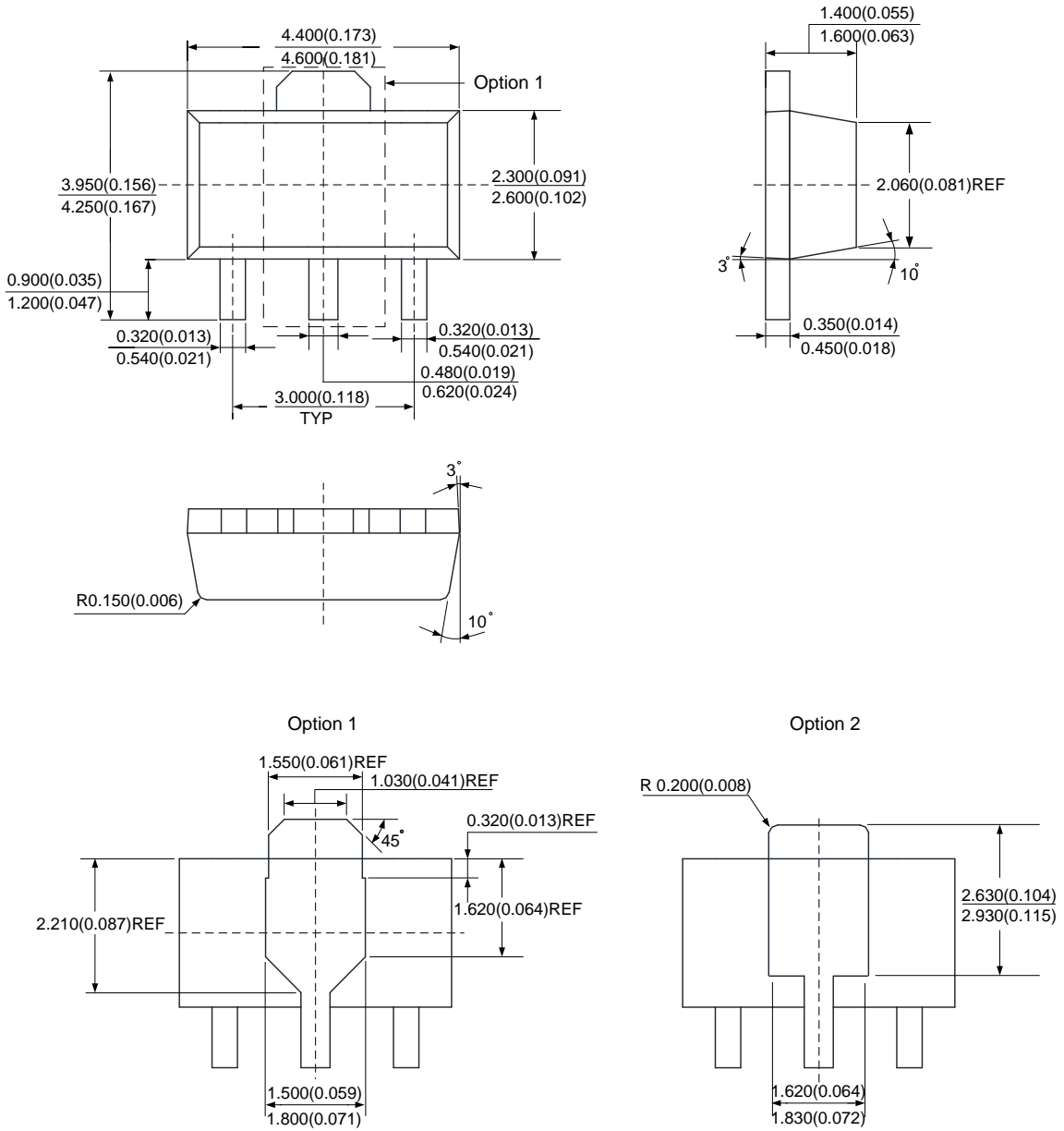
(4) Package Type: SOT25





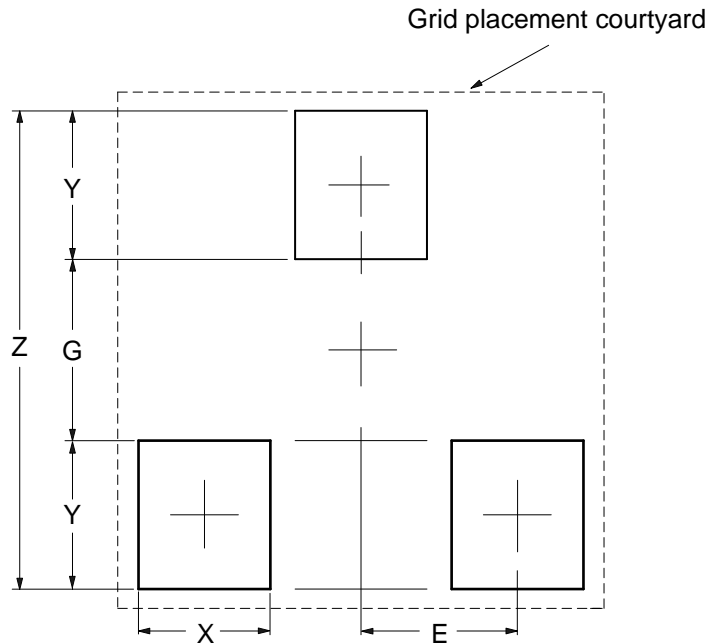
**Package Outline Dimensions** (Cont. All dimensions in mm.)

(5) Package Type: SOT89



**Suggested Pad Layout**

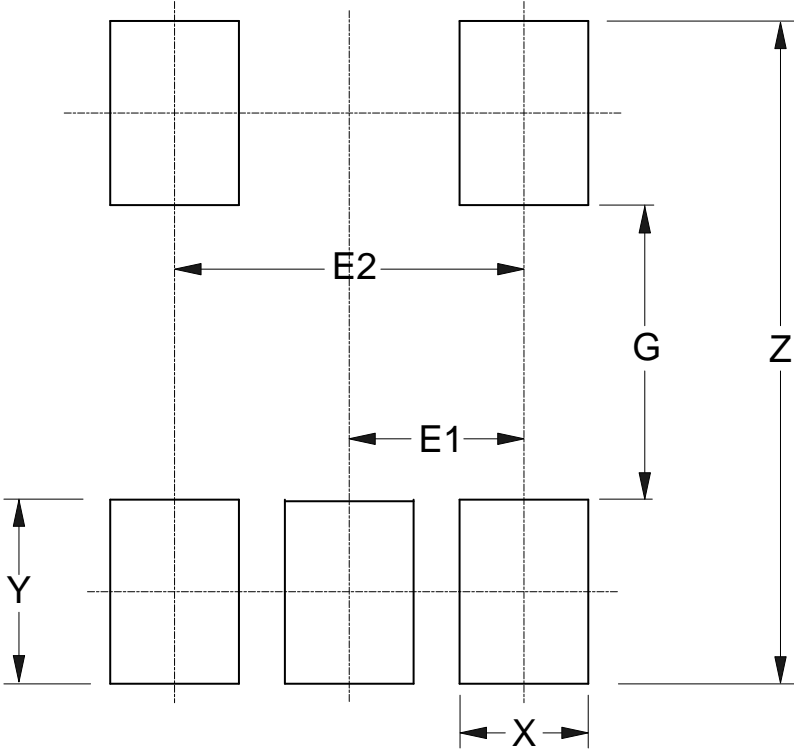
(1) Package Type: SOT23



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.)**

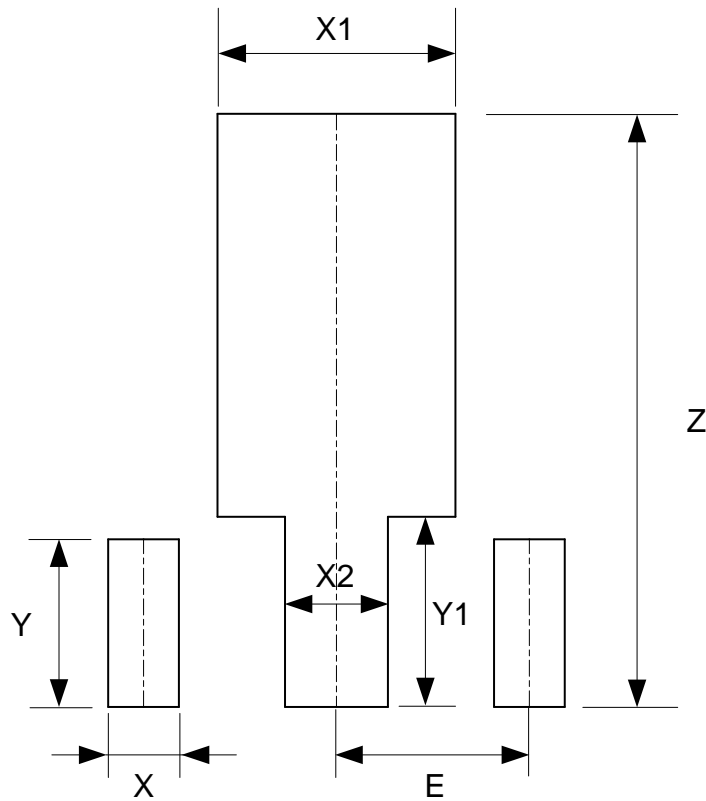
(2) Package Type: SOT25



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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