Description

The AS431 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 AS431 can be set to any value between VREF (2.5V) and the corresponding maximum cathode voltage (36V).

The AS431 precision reference is offered in two voltage tolerance: 0.5% and 1.0%.

This IC is available in 4 packages: TO92 (Ammo Packing), SOT23, SOT25 and SOT89.

Features

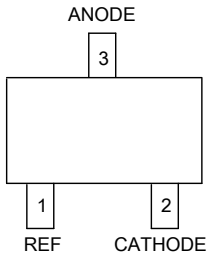
- Programmable Precise Output Voltage from 2.5V to 36V
- High Stability under Capacitive Load
- Low Temperature Deviation: 4.5mV Typical
- Low Equivalent Full-range Temperature Coefficient with 20PPM/°C Typical
- Sink Current Capacity from 1mA to 100mA
- Low Output Noise
- Wide Operating Range of -40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

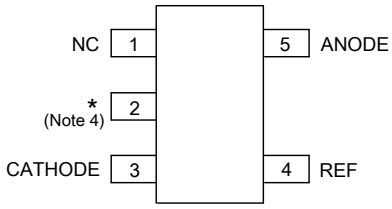
Pin Assignments

(Top View)



SOT23

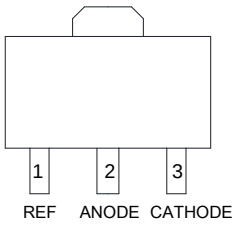
(Top View)



SOT25

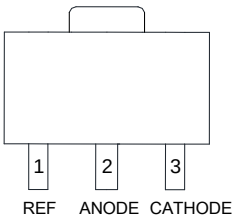
Note 4: * Pin 2 is attached to substrate and must be connected to ANODE or open.

(Top View)



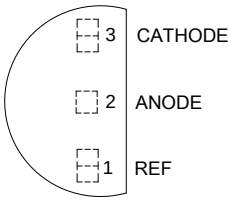
SOT89 (Option 1)

(Top View)



SOT89 (Option 2)

(Top View)



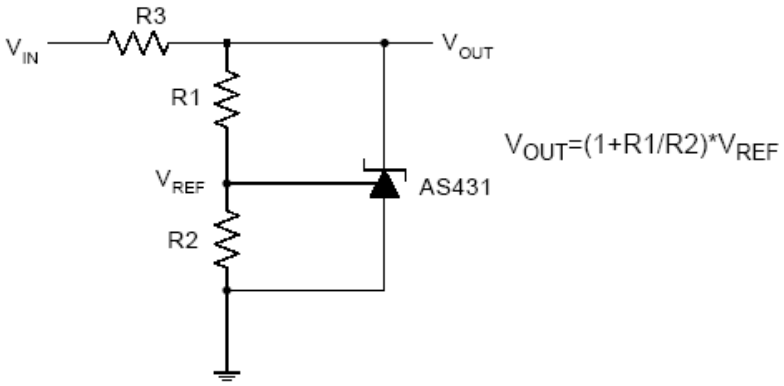
TO92 (Ammo Packing)

Notes: 1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.

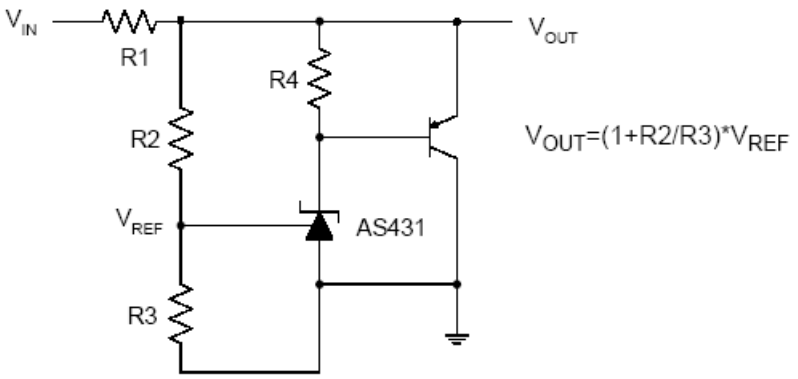
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.

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.

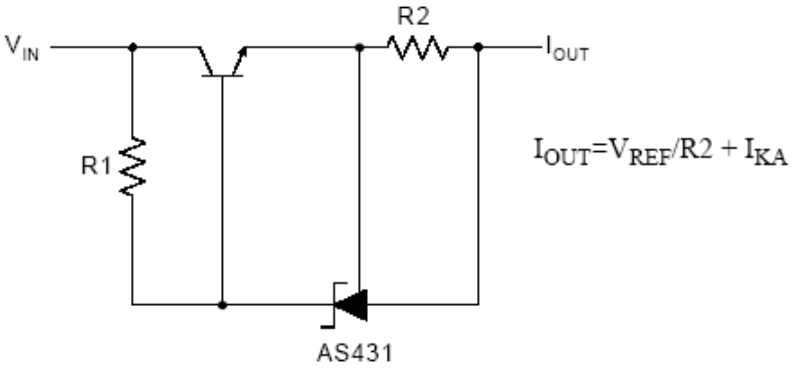
Typical Applications Circuit



Shunt Regulator

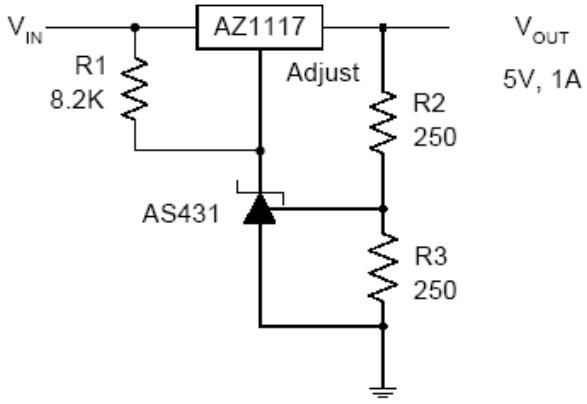


High Current Shunt Regulator

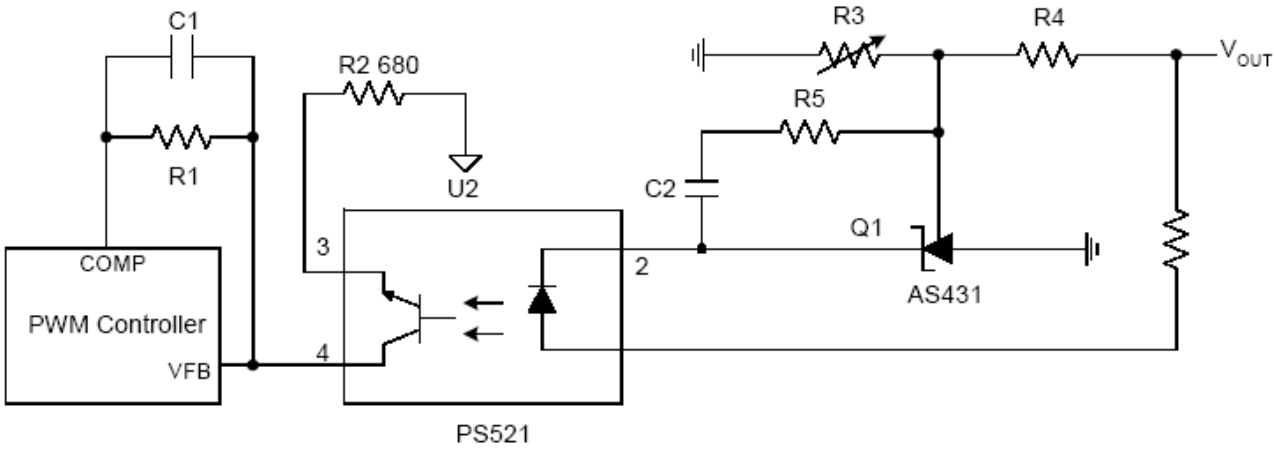


Current Source or Current Limit

Typical Applications Circuit (Cont.)

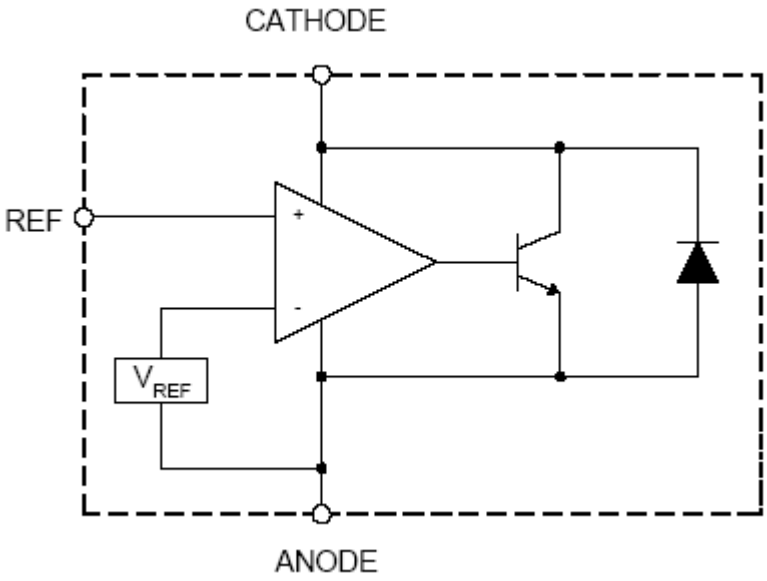


Precision 5V 1A Regulator



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		°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.

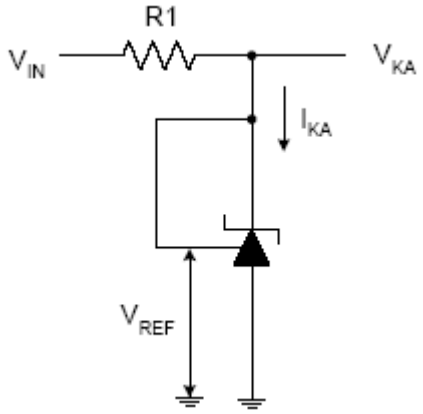
Recommended Operating Conditions

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

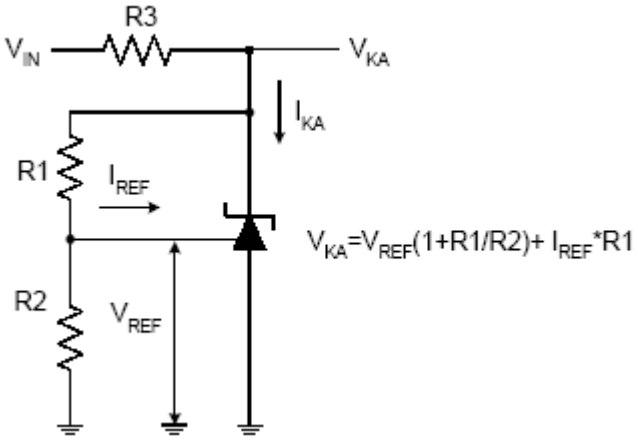
Electrical Characteristics (Operating Conditions: T_A = +25°C, unless otherwise specified.)

Symbol	Parameter		Test Circuit	Conditions		Min	Typ	Max	Unit
V_{REF}	Reference Voltage	0.5%	4	$V_{KA} = V_{REF}$, I_{KA} = 10mA		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} = 10mA	0 to +70°C	—	4.5	8	mV
					-40 to +85°C	—	4.5	10	
					-40 to +125°C	—	4.5	16	
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of Change in Reference Voltage to the Change in Cathode Voltage		5	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}	Reference Current		5	I_{KA} = 10mA, R1 = 10kΩ, R2 = ∞		—	0.7	4	µA
ΔI_{REF}	Deviation of Reference Current Over Full Temperature Range		5	I_{KA} = 10mA, R1 = 10kΩ, R2 = ∞, T_A = -40 to +125°C		—	0.4	1.2	µA
I_{KA} (Min)	Minimum Cathode Current for Regulation		4	$V_{KA} = V_{REF}$		—	0.4	1.0	mA
I_{KA} (Off)	Off-state Cathode Current		6	V_{KA} = 36V, V_{REF} = 0		—	0.05	1.0	µA
Z_{KA}	Dynamic Impedance		4	$V_{KA} = V_{REF}$, I_{KA} = 1 to 100mA, f ≤ 1.0kHz		—	0.15	0.5	Ω
θ_{JC}	Thermal Resistance		—	SOT23		—	135.9	—	°C/W
				SOT25		—	135.9	—	
				TO92 (Ammo Packing)		—	81.9	—	
				SOT89		—	29.8	—	

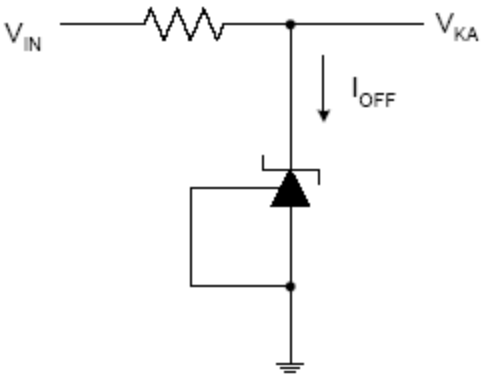
Electrical Characteristics (Cont.)



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



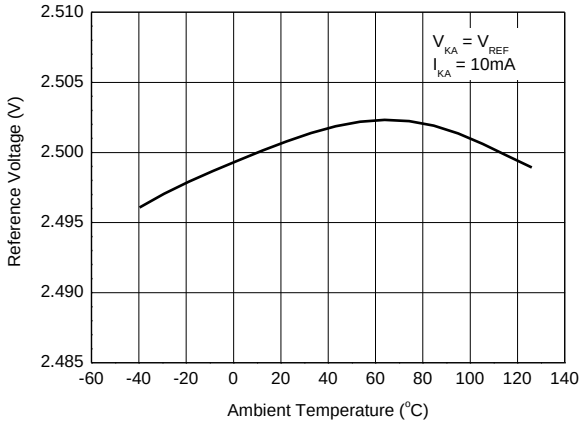
Test Circuit 5 for $V_{KA} > V_{REF}$



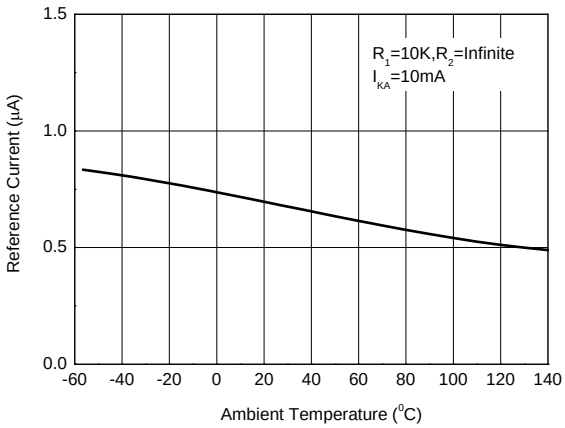
Test Circuit 6 for I_{OFF}

Performance Characteristics

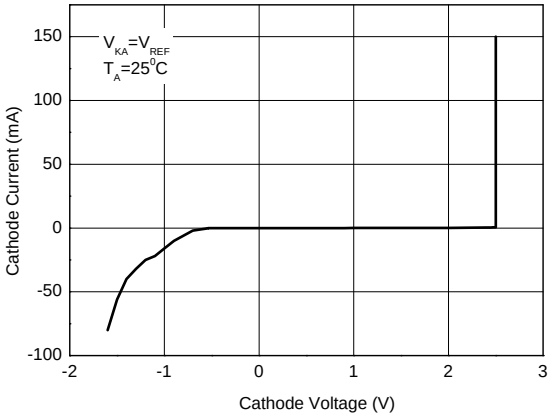
Reference Voltage vs. Ambient Temperature



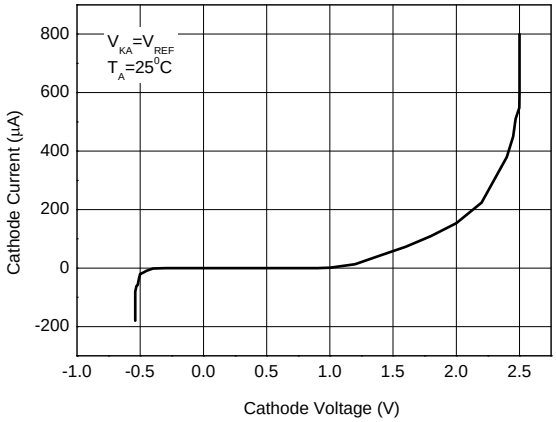
Reference Current vs. Ambient Temperature



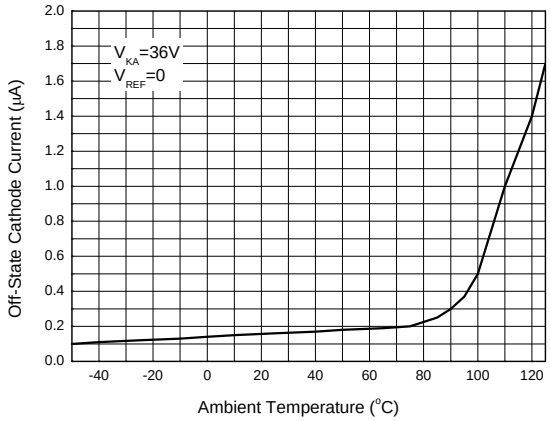
Cathode Current vs. Cathode Voltage



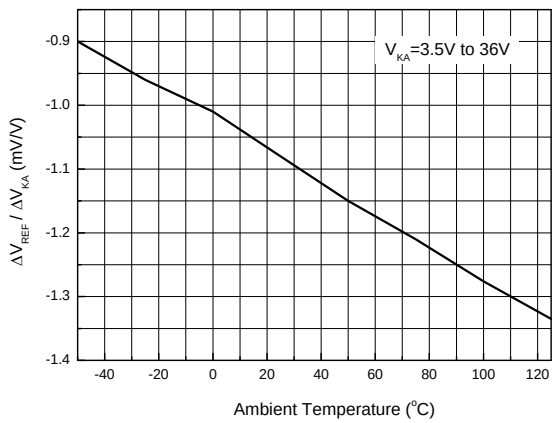
Cathode Current vs. Cathode Voltage



Off-State Cathode Current vs. Ambient Temperature

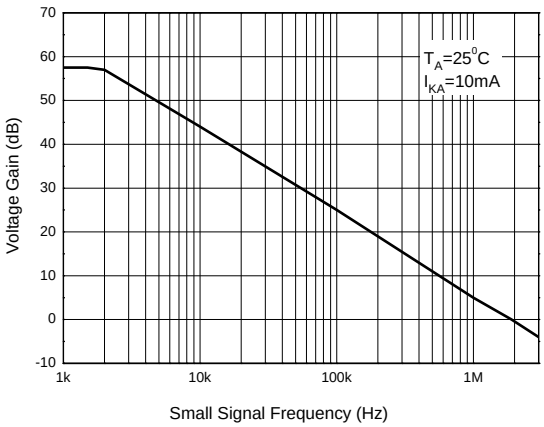


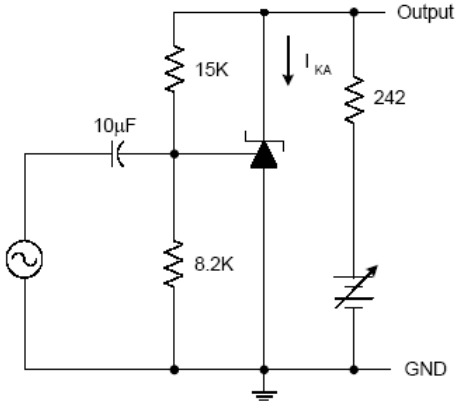
Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage



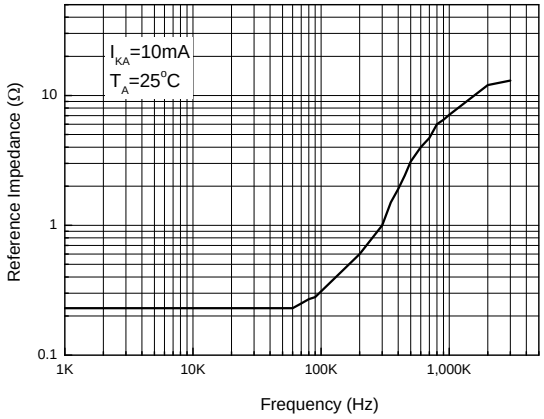
Performance Characteristics (Cont.)

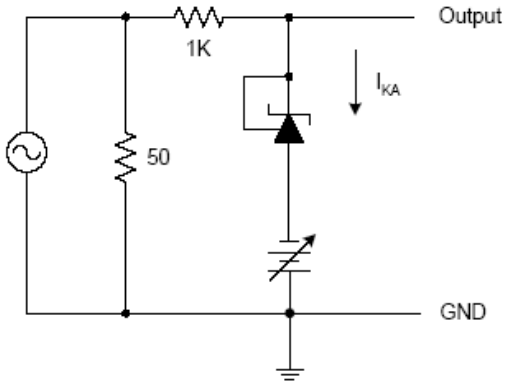
Small Signal Voltage Gain vs. Frequency



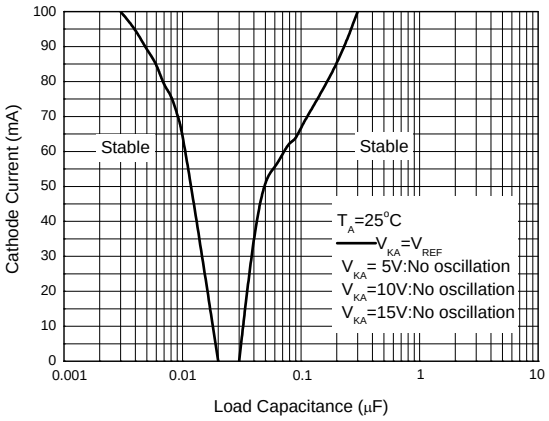


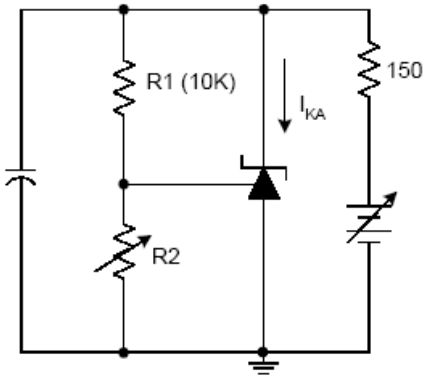
Reference Impedance vs. Frequency





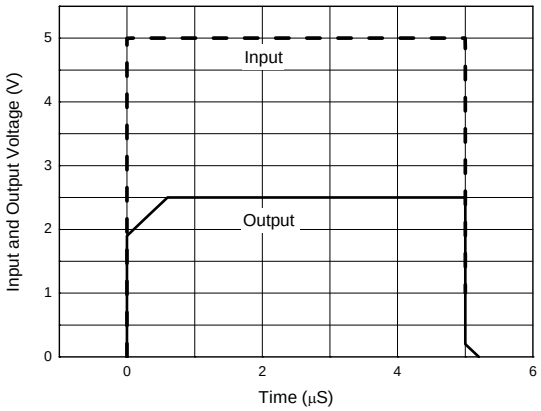
Stability Boundary Conditions vs. Load Capacitance

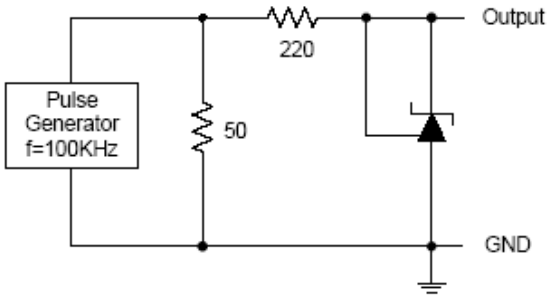




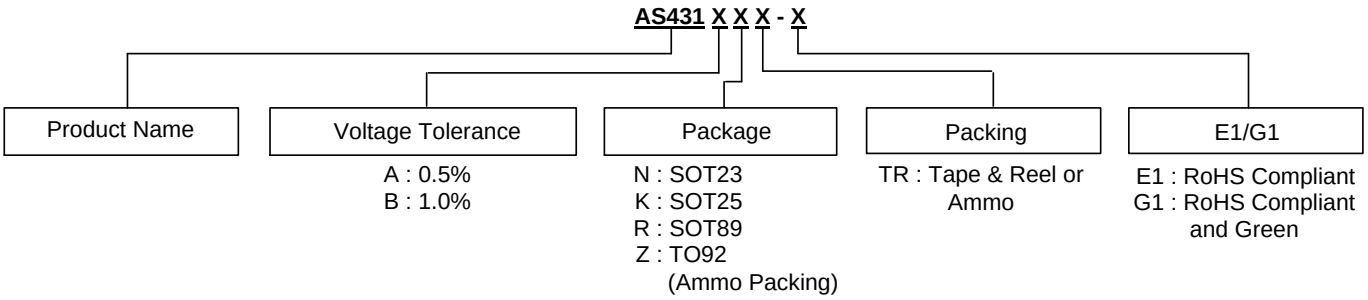
Performance Characteristics (Cont.)

Pulse Response of Input and Output Voltage





Ordering Information



	Part Number	Voltage Tolerance	Package (Note 7)	RoHS Compliant Lead Free / Green	Marking ID	Packing	Quantity	Status (Note 6)	Alternative
Lead-Free	AS431ANTR-E1	0.5%	SOT23	Lead Free	EB5	Tape & Reel	3000	NRND	AS431ANTR-G1
Lead-Free	AS431BNTR-E1	1.0%	SOT23	Lead Free	EB6	Tape & Reel	3000	NRND	AS431BNTR-G1
Lead-Free Green	AS431ANTR-G1	0.5%	SOT23	Green	GB5	Tape & Reel	3000	In Production	—
Lead-Free Green	AS431BNTR-G1	1.0%	SOT23	Green	GB6	Tape & Reel	3000	In Production	—
Lead-Free	AS431AKTR-E1	0.5%	SOT25	Lead Free	E6H	Tape & Reel	3000	NRND	AS431AKTR-G1
Lead-Free	AS431BKTR-E1	1.0%	SOT25	Lead Free	E6I	Tape & Reel	3000	NRND	AS431BKTR-G1
Lead-Free Green	AS431AKTR-G1	0.5%	SOT25	Green	G6H	Tape & Reel	3000	In Production	—
Lead-Free Green	AS431BKTR-G1	1.0%	SOT25	Green	G6I	Tape & Reel	3000	In Production	—
Lead-Free	AS431AZ-E1	0.5%	TO92	Lead Free	AS431AZ-E1	Bulk	1000	End of Life	AS431AZTR-E1
Lead-Free	AS431AZTR-E1	0.5%	TO92	Lead Free	AS431AZ-E1	Ammo	2000	In Production	—
Lead-Free	AS431BZ-E1	1.0%	TO92	Lead Free	AS431BZ-E1	Bulk	1000	End of Life	AS431BZTR-E1
Lead-Free	AS431BZTR-E1	1.0%	TO92	Lead Free	AS431BZ-E1	Ammo	2000	In Production	—
Lead-Free Green	AS431AZ-G1	0.5%	TO92	Green	AS431AZ-G1	Bulk	1000	End of Life	AS431AZTR-G1
Lead-Free Green	AS431AZTR-G1	0.5%	TO92	Green	AS431AZ-G1	Ammo	2000	In Production	—
Lead-Free Green	AS431BZ-G1	1.0%	TO92	Green	AS431BZ-G1	Bulk	1000	End of Life	AS431BZTR-G1
Lead-Free Green	AS431BZTR-G1	1.0%	TO92	Green	AS431BZ-G1	Ammo	2000	In Production	—

Ordering Information (Cont.)

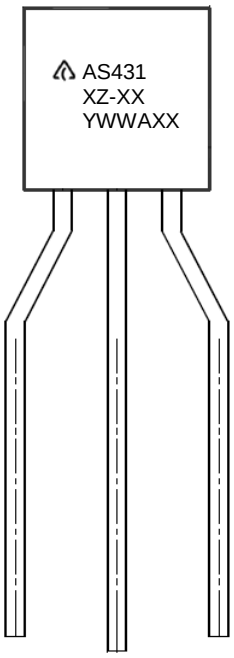
	Part Number	Voltage Tolerance	Package (Note 7)	RoHS Compliant Lead Free / Green	Marking ID	Packing	Quantity	Status (Note 6)	Alternative
Lead-Free	AS431ARTR-E1	0.5%	SOT89	Lead Free	E43G	Tape & Reel	1000	NRND	AS431ARTR-G1
Lead-Free	AS431BRTR-E1	1.0%	SOT89	Lead Free	E43H	Tape & Reel	1000	NRND	AS431BRTR-G1
Lead-Free Green	AS431ARTR-G1	0.5%	SOT89	Green	G43G	Tape & Reel	1000	In Production	—
Lead-Free Green	AS431BRTR-G1	1.0%	SOT89	Green	G43H	Tape & Reel	1000	In Production	—

Notes: 6. All variants with TO92 package in Bulk packing (AS431AZ-E1, AS431BZ-E1, AS431AZ-G1 and AS431BZ-G1) are End of Life, recommended alternatives are the variants with the same package in Ammo packing.
NRND: Not Recommended for New Design.
7. For packaging details, go to our website at: https://www.diodes.com/design/support/packaging/diodes-packaging/.

Marking Information

(1) TO92 (Ammo Packing)

(Front View)

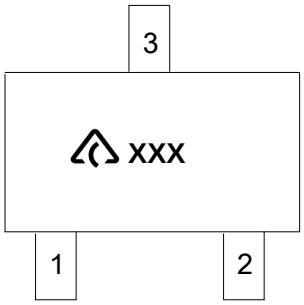


First and Second Lines: Logo and Marking ID
(See Ordering Information)
Third Line: Date Code
Y: Year
WW: Work Week of Molding
A: Assembly House Code
XX: Internal Code

Marking Information (Cont.)

(2) SOT23

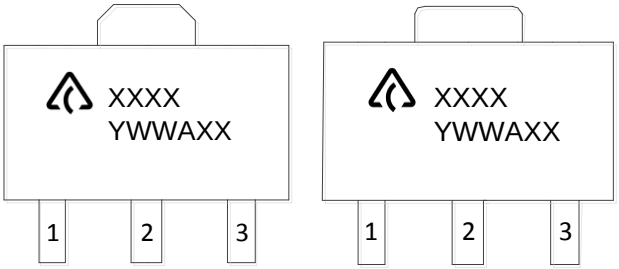
(Top View)



: Logo
XXX: Marking ID (See Ordering Information)

(3) SOT89

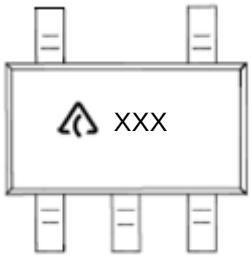
(Top View)



First Line: Logo and Marking ID
(See Ordering Information)
Second Line: Date Code
Y: Year
WW: Work Week of Molding
A: Assembly House Code
XX: Internal Code

(4) SOT25

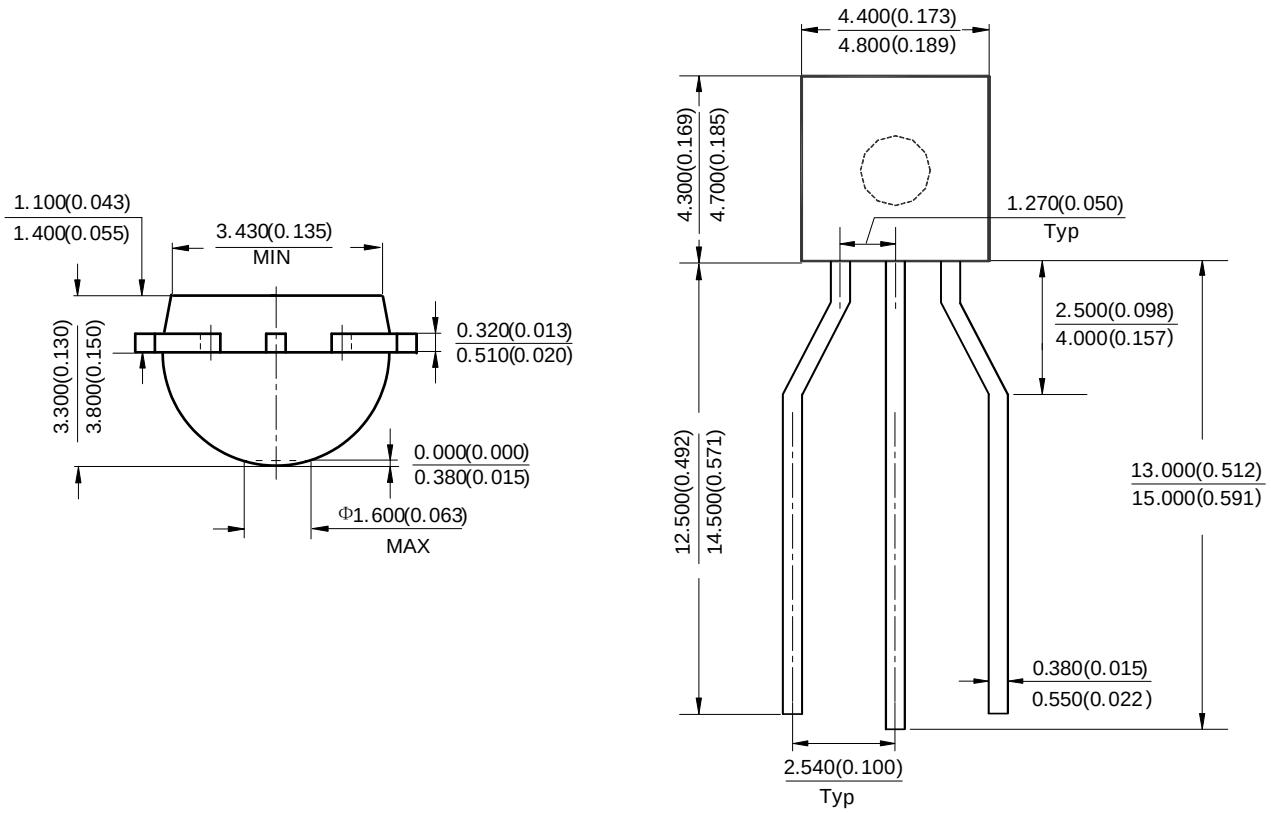
(Top View)



: Logo
XXX: Marking ID (See Ordering Information)

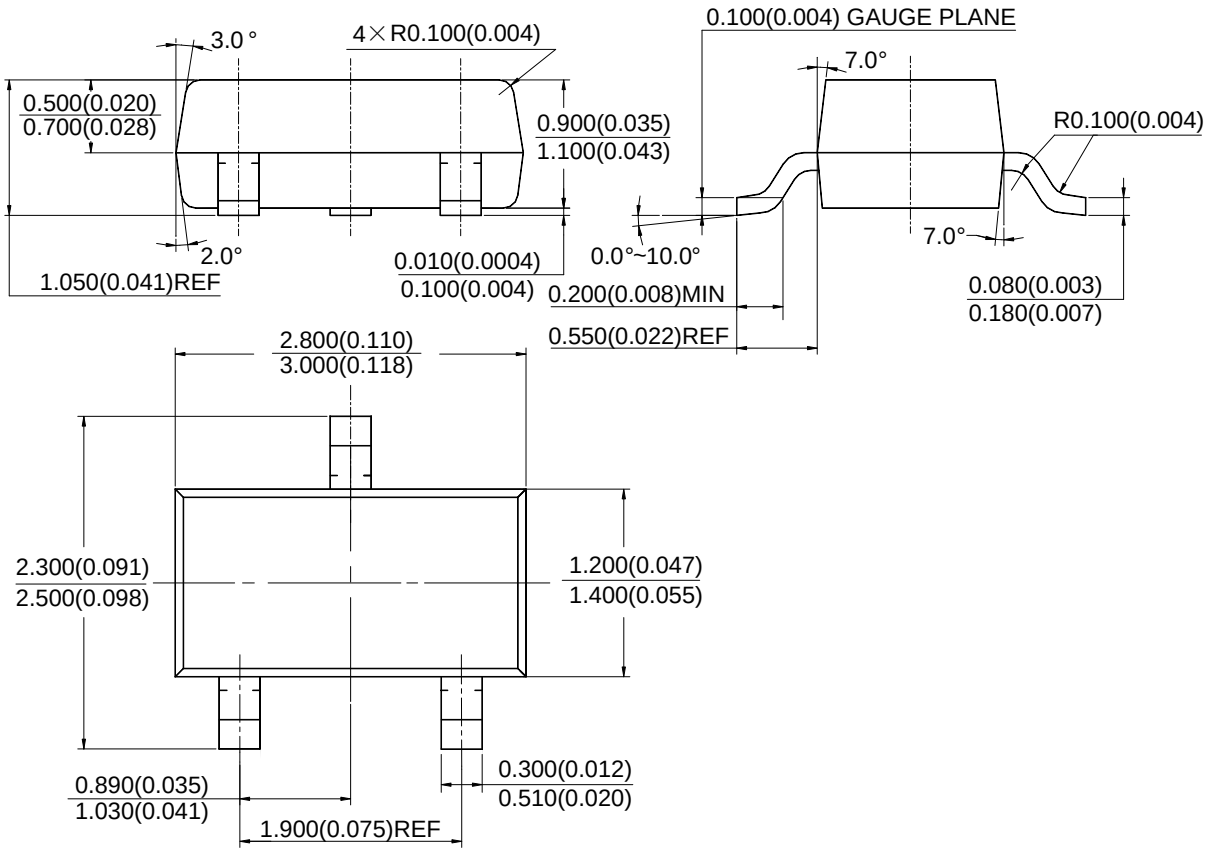
Package Outline Dimensions (All dimensions in mm(inch).)

(1) Package Type: TO92 (Ammo Packing)



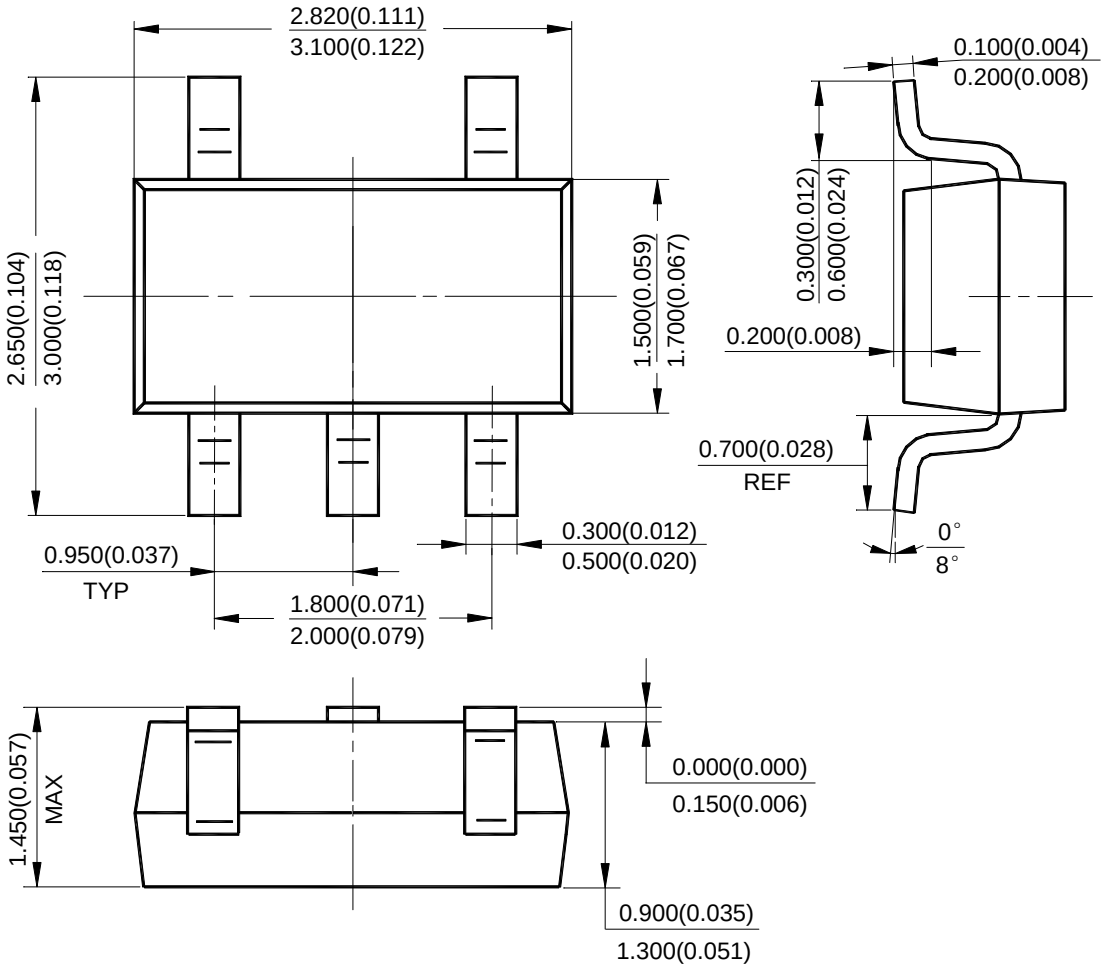
Package Outline Dimensions (Cont. All dimensions in mm(inch).)

(2) Package Type: SOT23



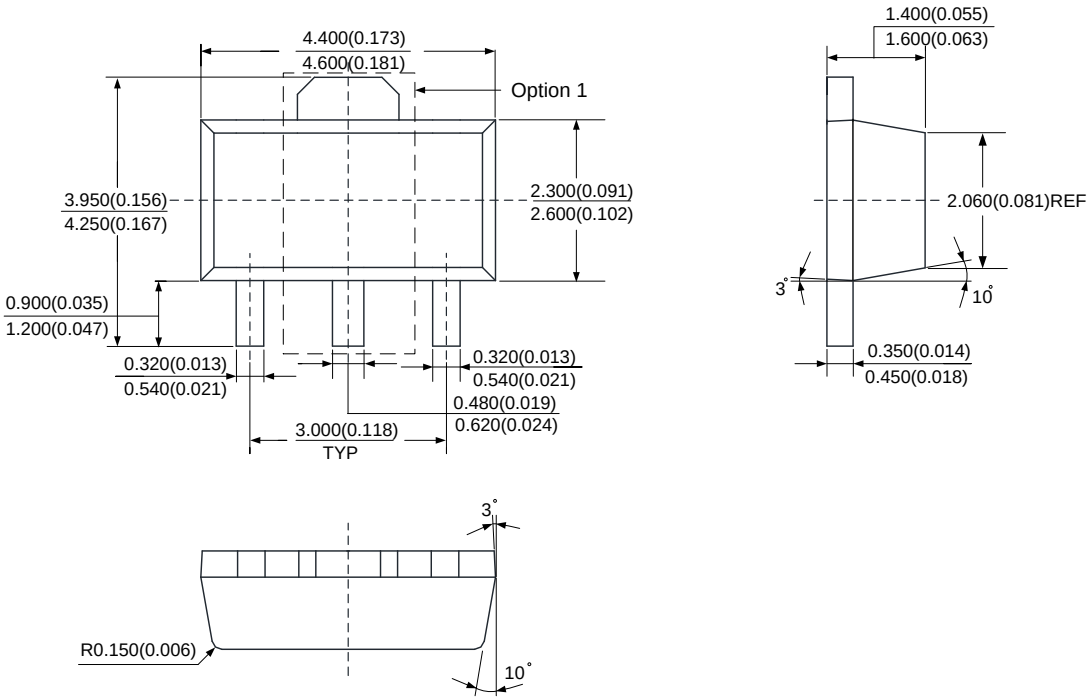
Package Outline Dimensions (Cont. All dimensions in mm(inch).)

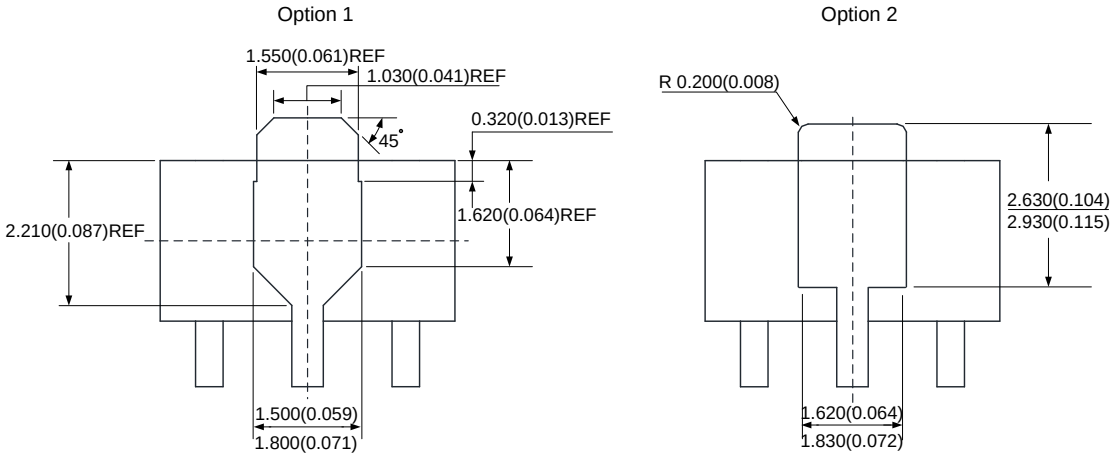
(3) Package Type: SOT25



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

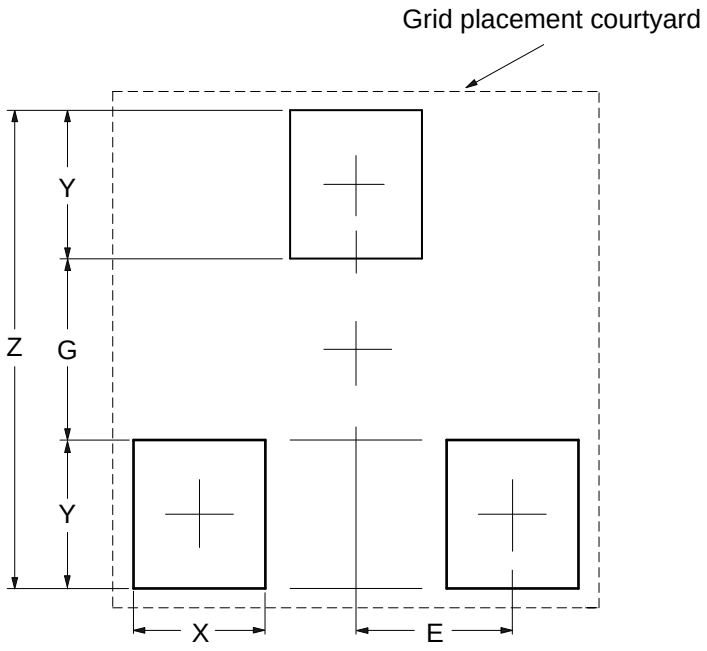
(4) Package Type: SOT89





Suggested Pad Layout

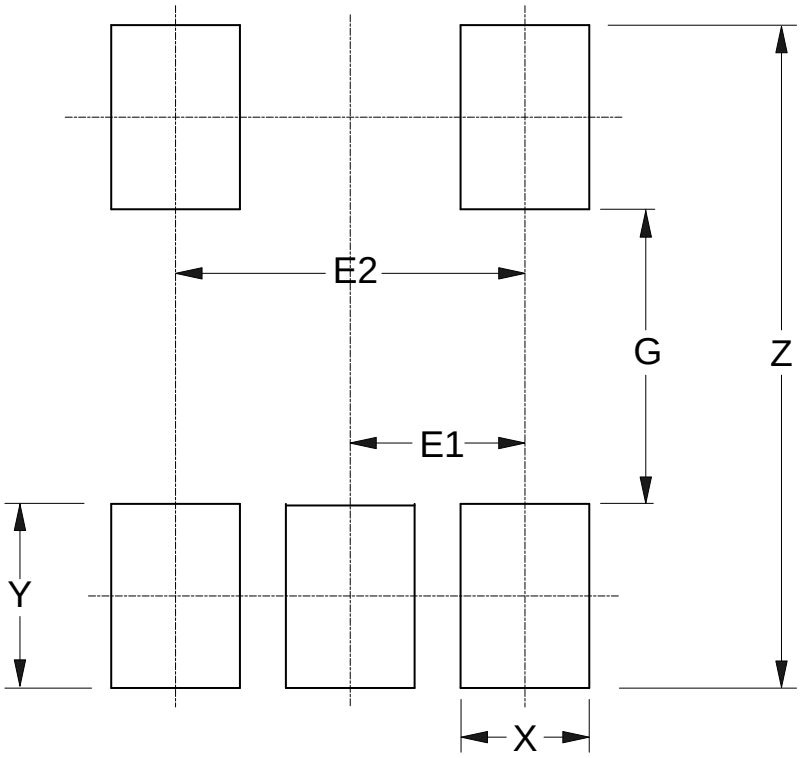
(1) Package Type: SOT23



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.)

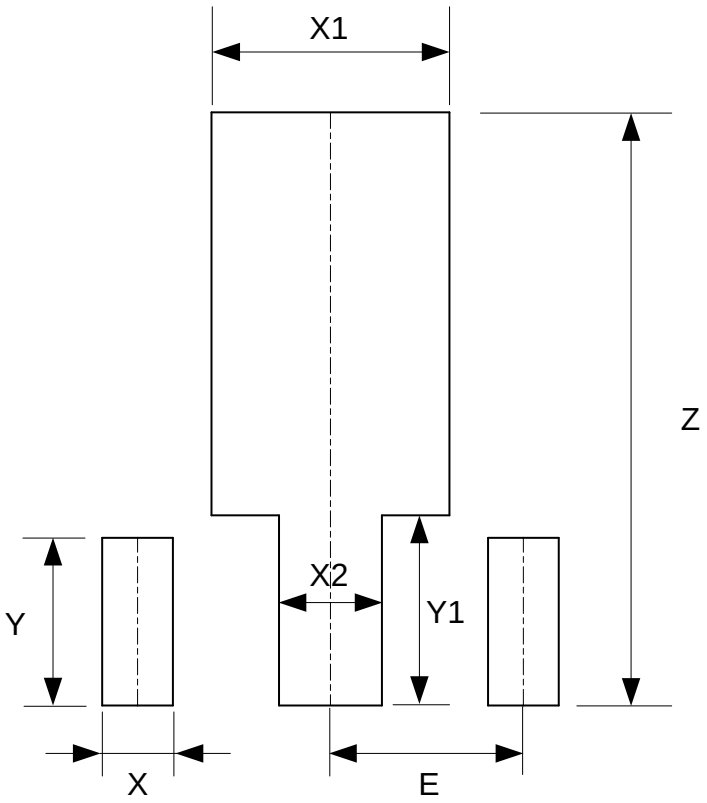
(2) Package Type: SOT25



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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