

ADJUSTABLE PRECISION SHUNT REGULATORS

Description

The TL431AN 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 TL431AN- can be set to any value between V_{REF} (2.5V) and the corresponding maximum cathode voltage (36V).

The TL431AN precision reference is offered in two voltage tolerance: 0.5% and 0.8%.

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

Features

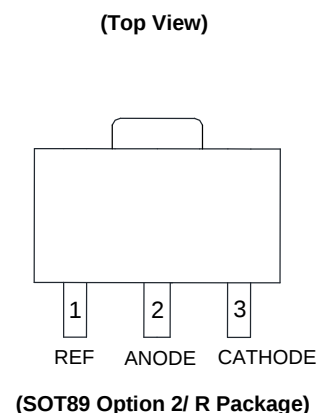
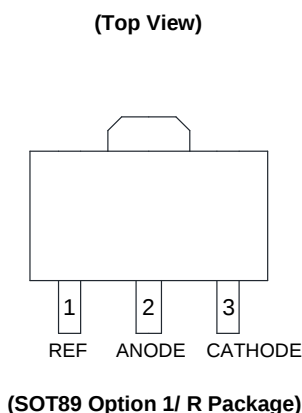
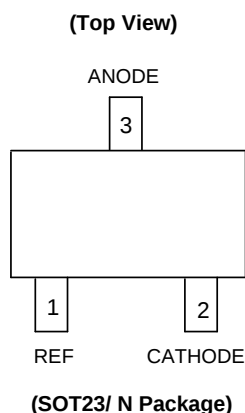
- Programmable Precise Output Voltage from 2.5V to 36V
- High Stability under Capacitive Load
- Low Temperature Deviation: 4.5mV Typical
- Low Equivalent Full-range Temperature Coefficient with 20PPM/°C Typical
- Sink Current Capacity from 1mA to 100mA
- Low Output Noise
- Wide Operating Range of -40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

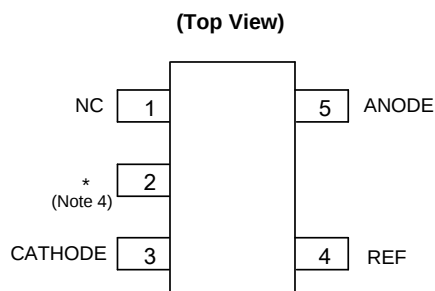
- Charger
- Voltage Adapter
- Switching Power Supply
- Graphic Card
- Precision Voltage Reference

- 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.

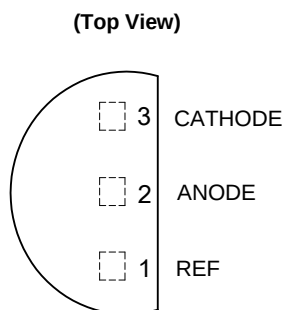
Pin Assignments



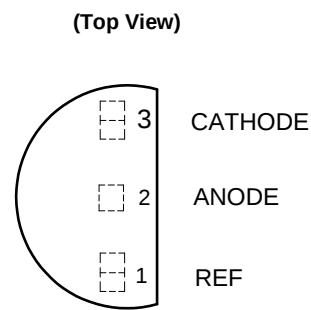
Pin Assignments (Cont.)



(SOT25/ K Package)



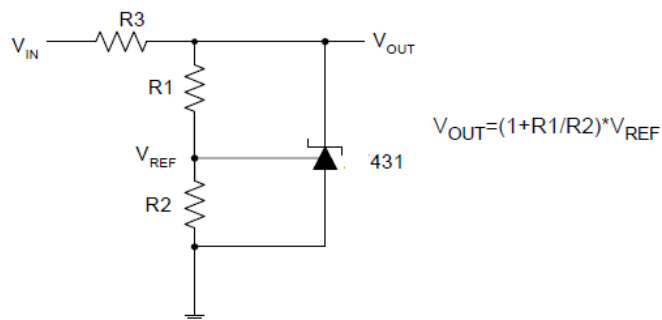
(TO92 (Bulk Packing)/ Z Package)



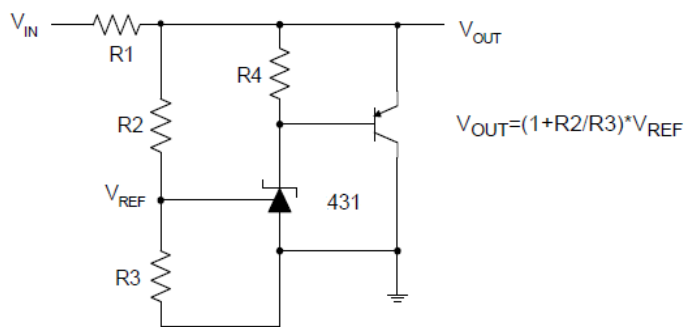
(TO92 (Ammo Packing)/ Z Package)

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

Typical Applications Circuit

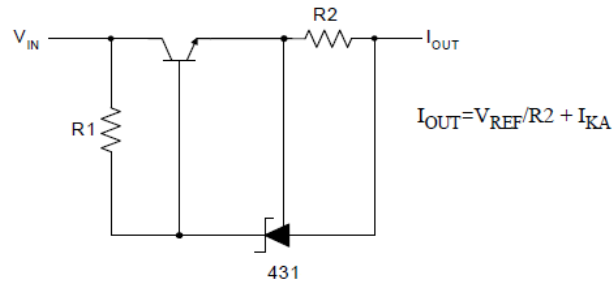


Shunt Regulator

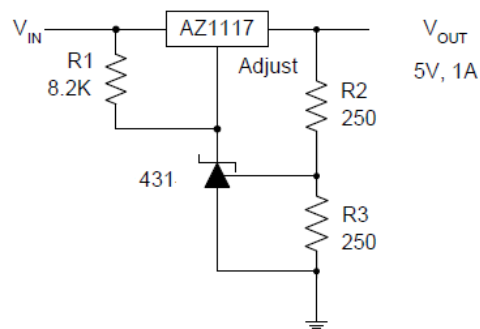


High Current Shunt Regulator

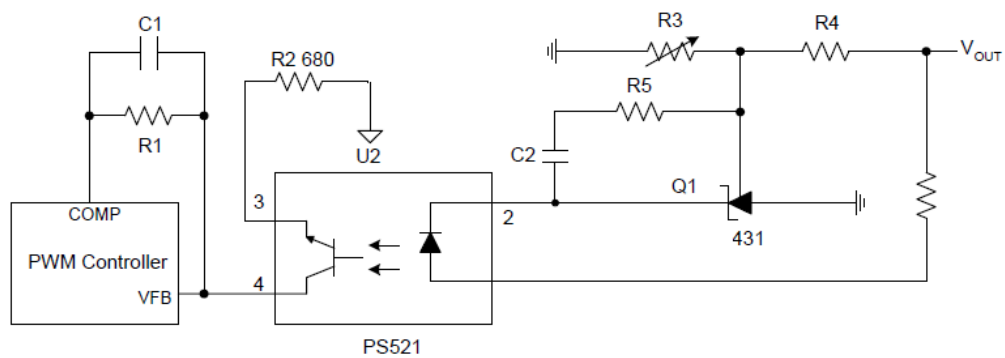
Typical Applications Circuit (Cont.)



Current Source or Current Limit

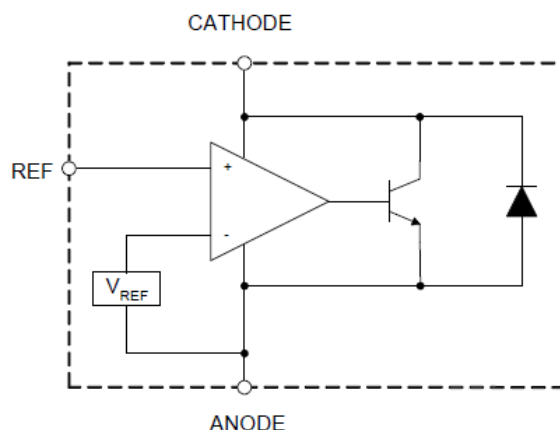


Precision 5V 1A Regulator



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	°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.

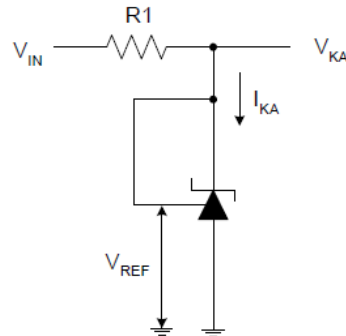
Recommended Operating Conditions

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

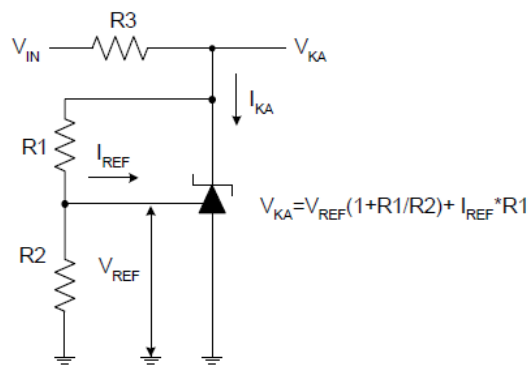
Electrical Characteristics (@T_A = +25°C, unless otherwise specified.)

Symbol	Test Circuit	Parameter		Conditions		Min	Typ	Max	Unit
V _{REF}	4	Reference Voltage		V _{KA} = V _{REF} , I _{KA} = 10mA					V
			0.5%			2.4875	2.500	2.5125	
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	–			

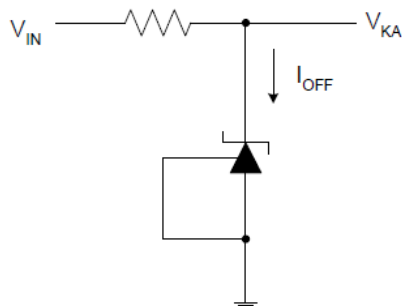
Electrical Characteristics (Cont.)



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



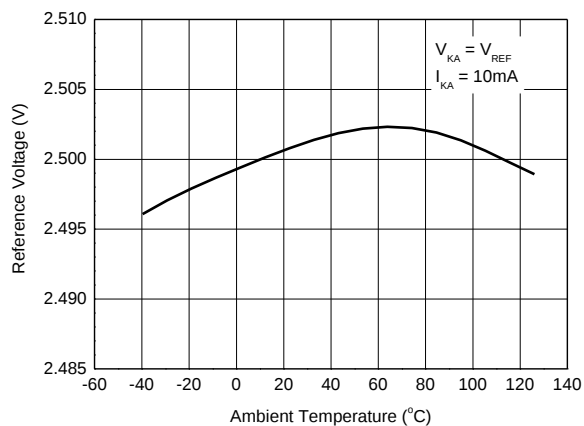
Test Circuit 5 for $V_{KA} > V_{REF}$



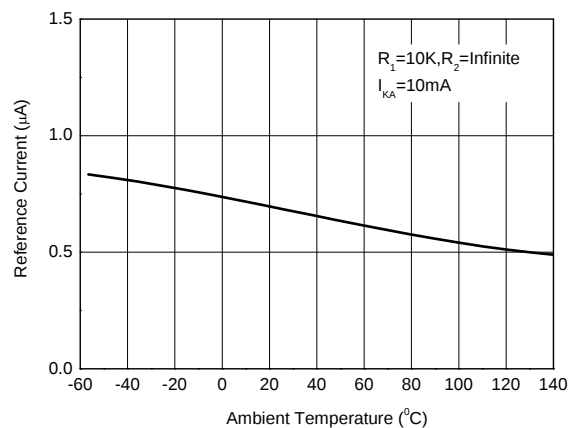
Test Circuit 6 for I_{OFF}

Performance Characteristics

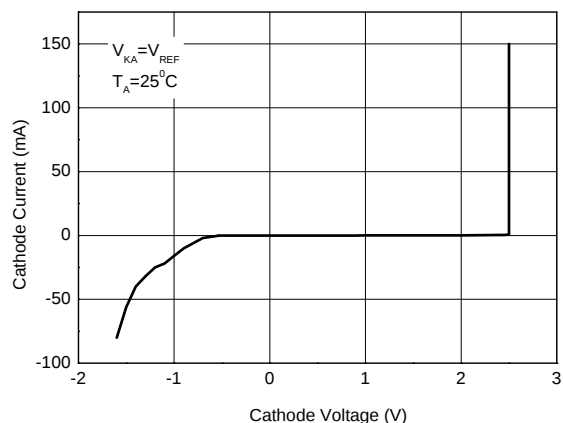
Reference Voltage vs. Ambient Temperature



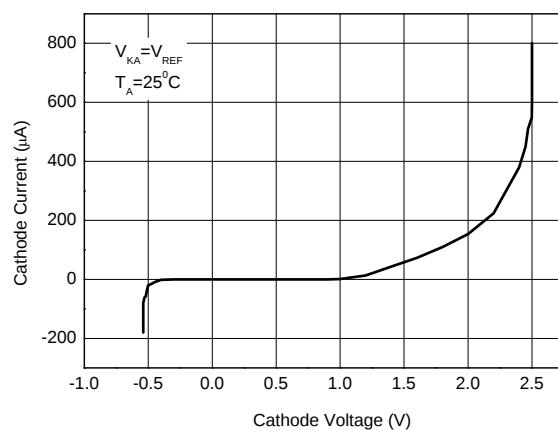
Reference Current vs. Ambient Temperature



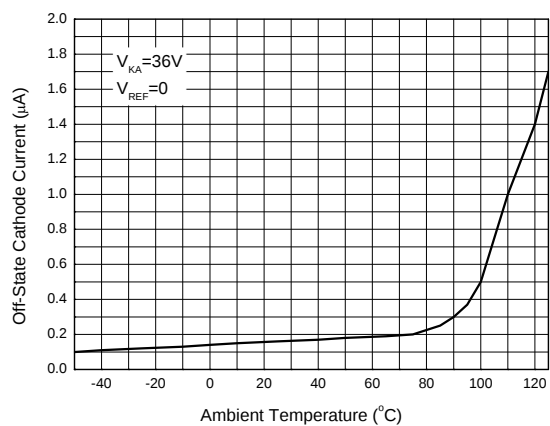
Cathode Current vs. Cathode Voltage



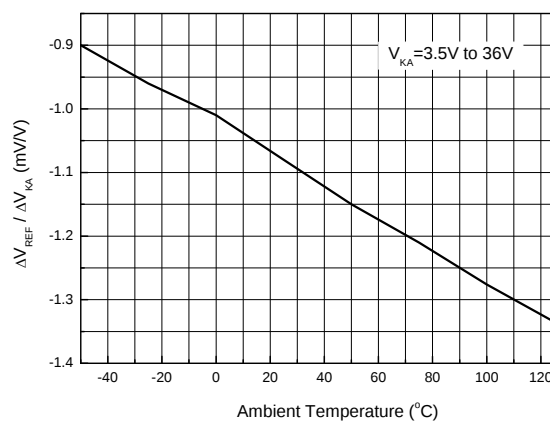
Cathode Current vs. Cathode Voltage



Off-State Cathode Current vs. Ambient Temperature

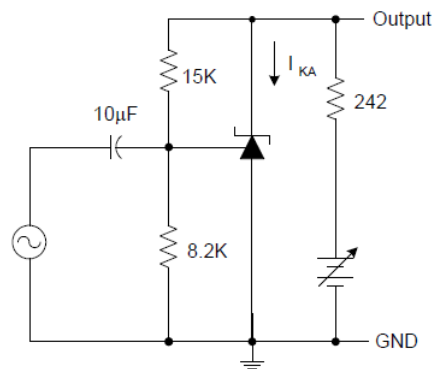
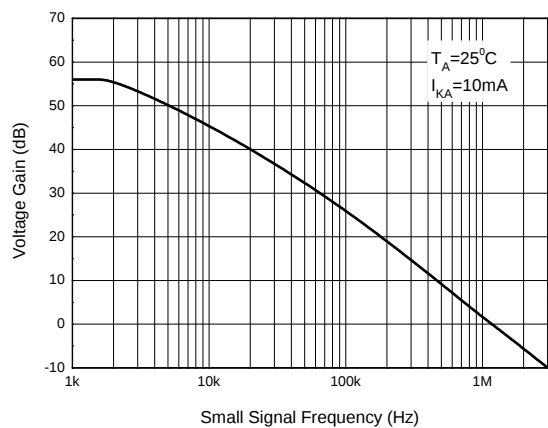


Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage

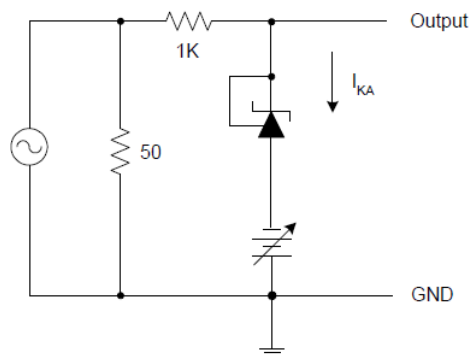
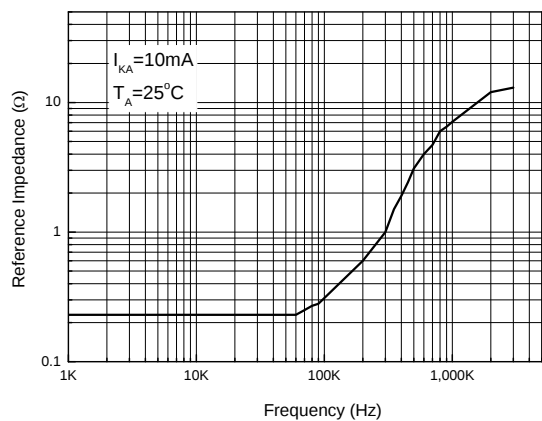


Performance Characteristics (Cont.)

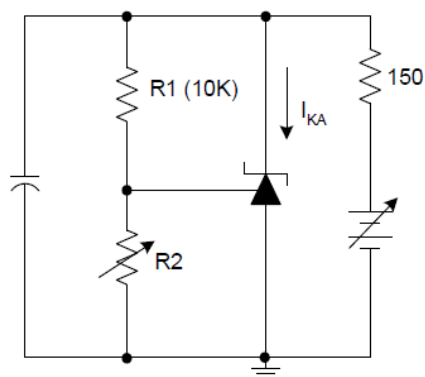
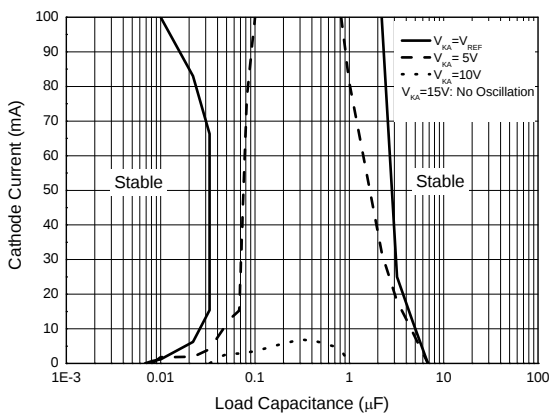
Small Signal Voltage Gain vs. Frequency



Reference Impedance vs. Frequency

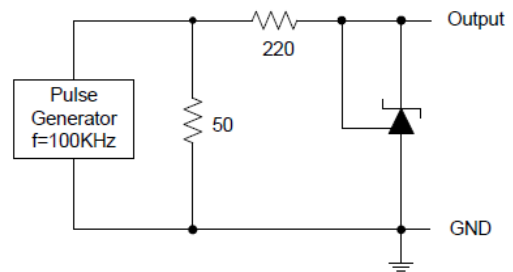
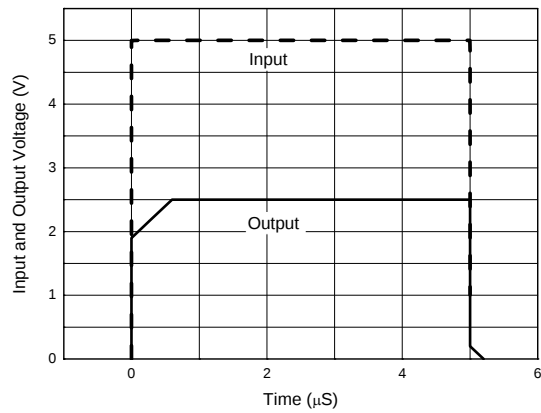


Stability Boundary Conditions vs. Load Capacitance



Performance Characteristics (Cont.)

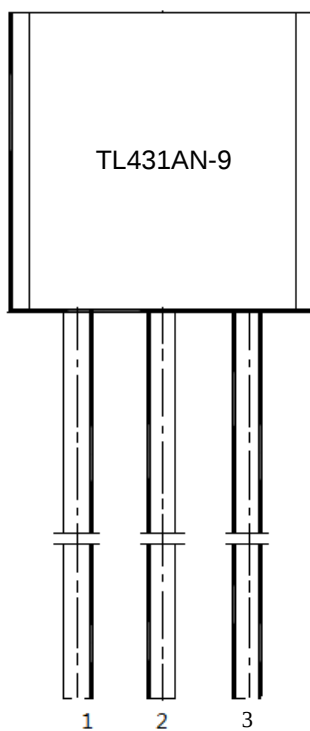
Pulse Response of Input and Output Voltage



Marking Information

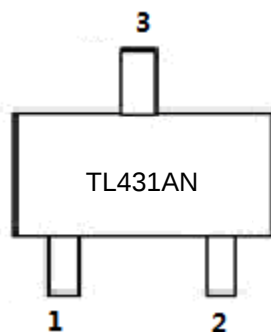
(1) TO92

(Top View)



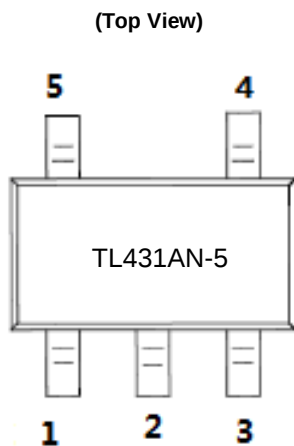
(2) SOT23

(Top View)

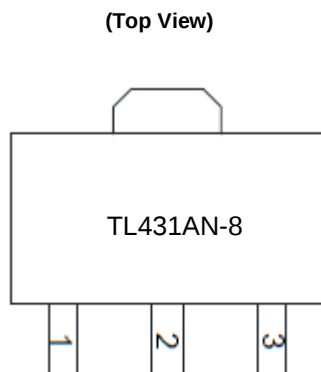


Marking Information (Cont.)

(3) SOT25

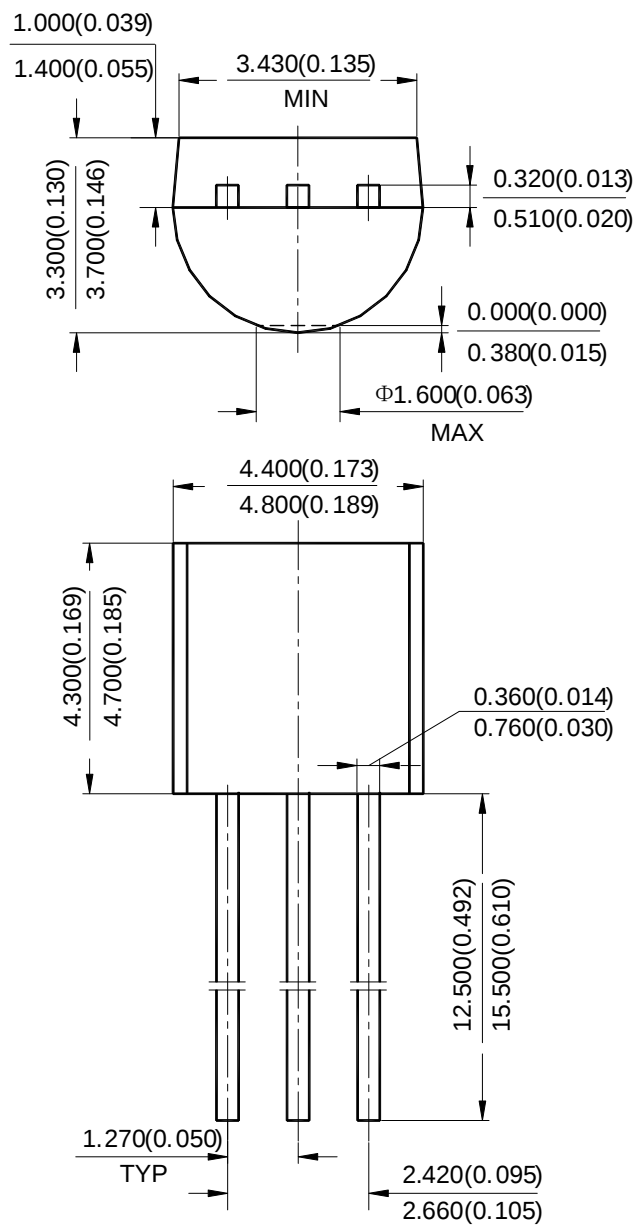


(4) SOT89



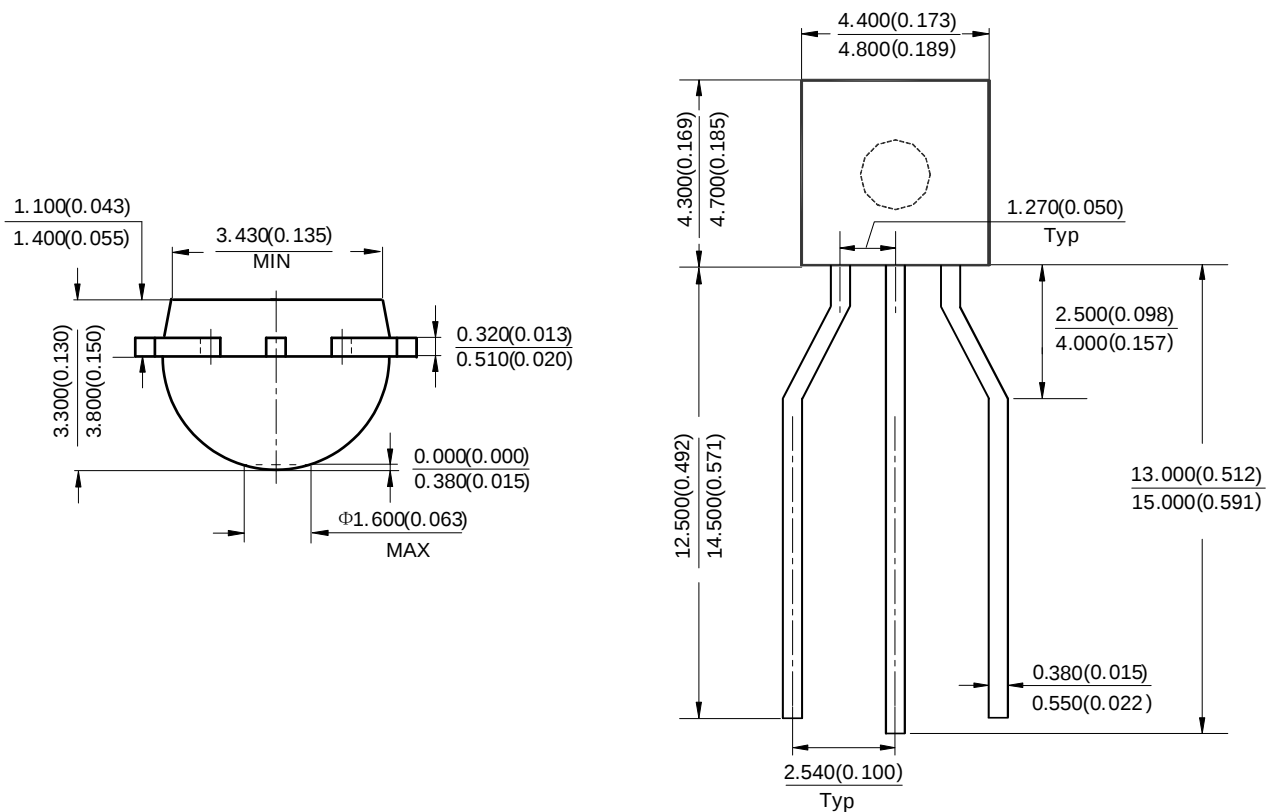
Package Outline Dimensions

(1) Package Type: TO92 (Bulk Packing)

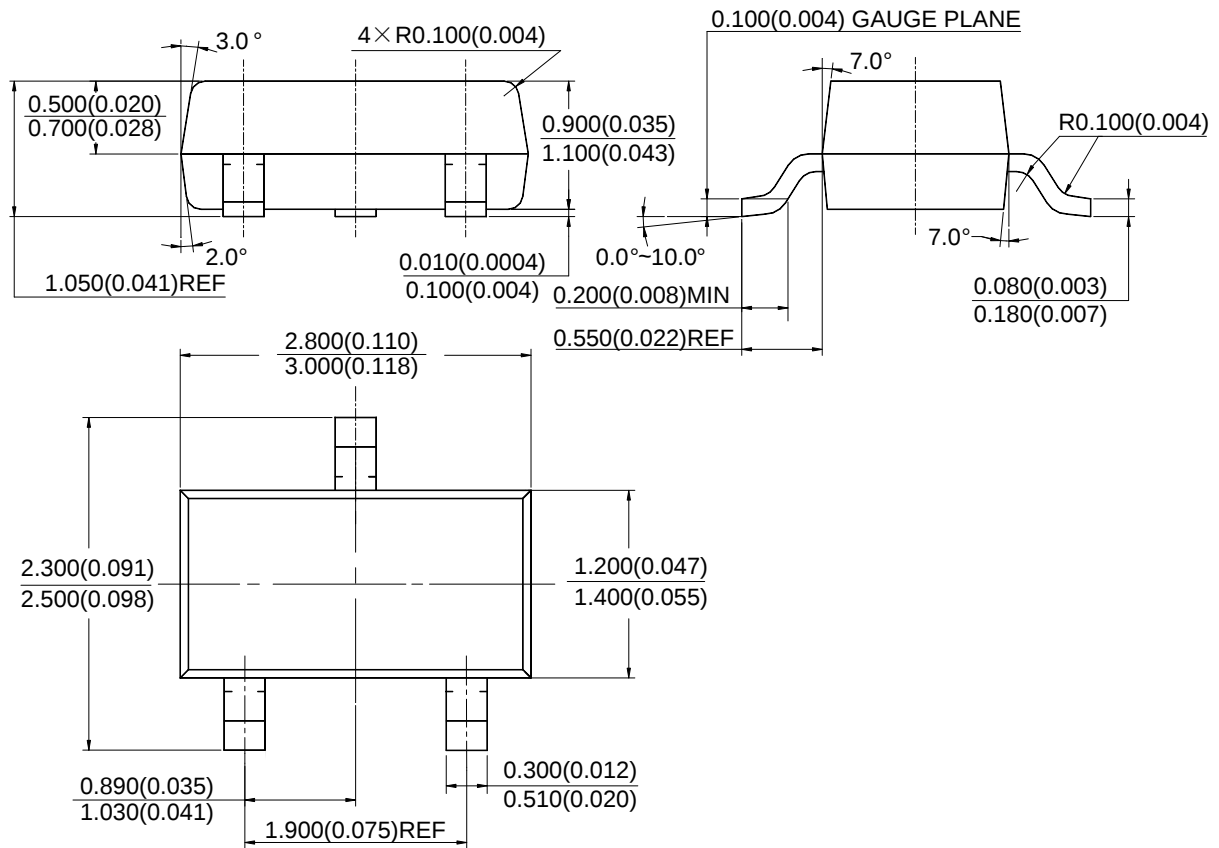


Package Outline Dimensions (Cont.)

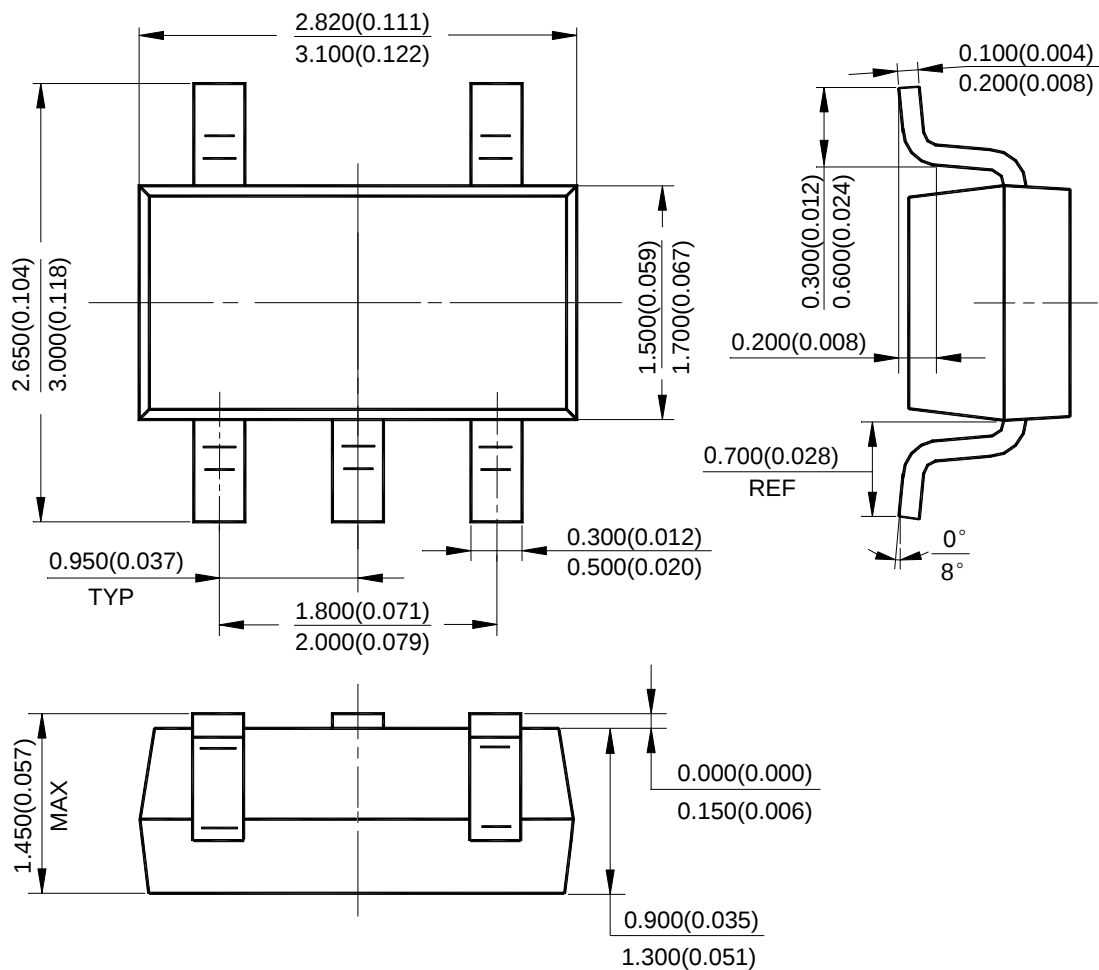
(2) Package Type: TO92 (Ammo Packing)



(3) Package Type: SOT23

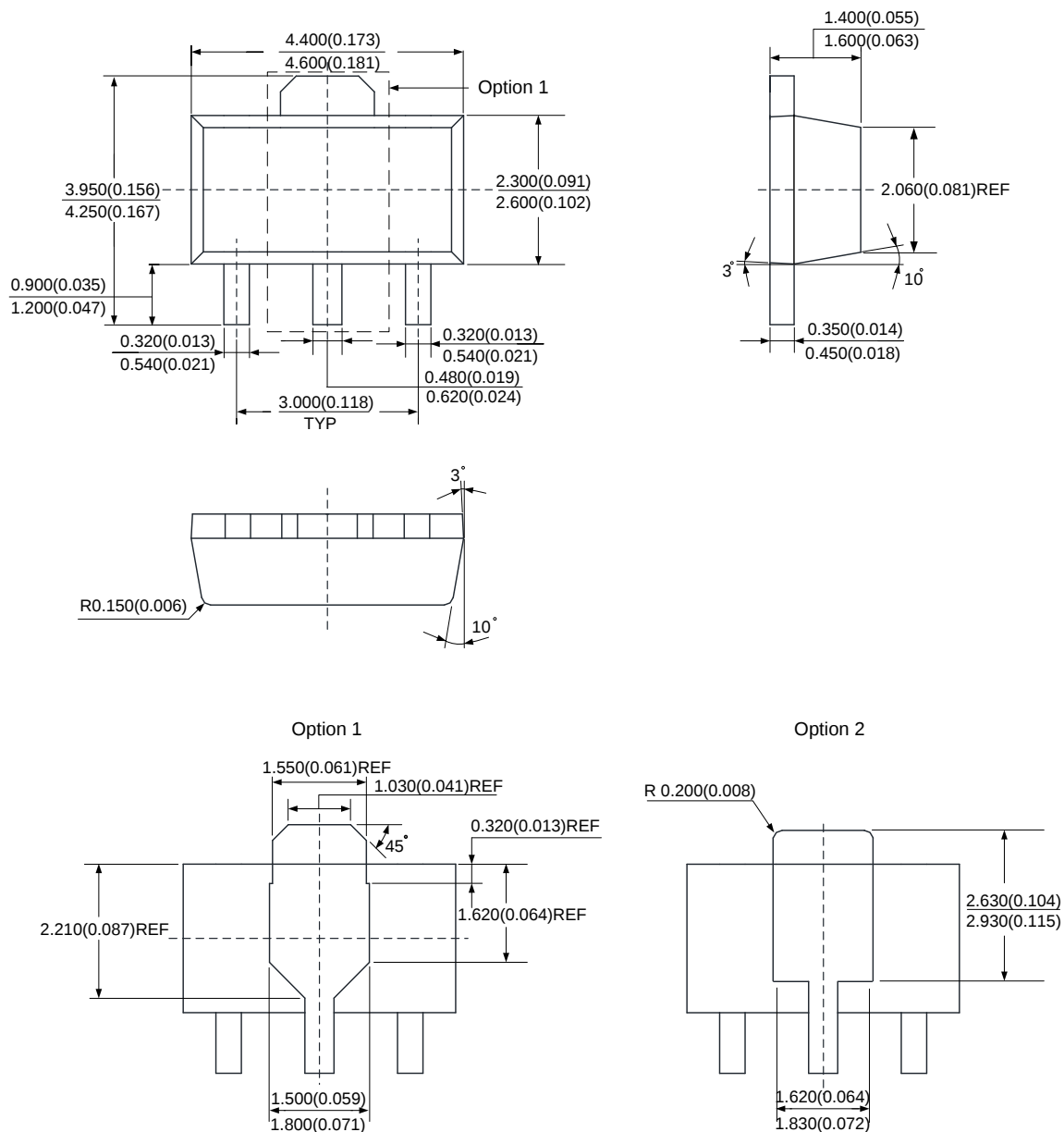


(4) Package Type: SOT25



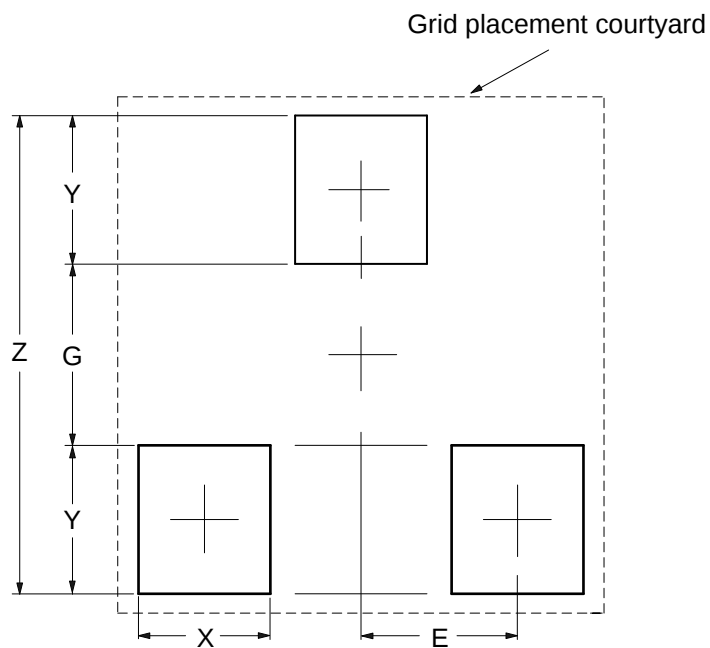
Package Outline Dimensions (Cont.)

(5) Package Type: SOT89



Suggested Pad Layout

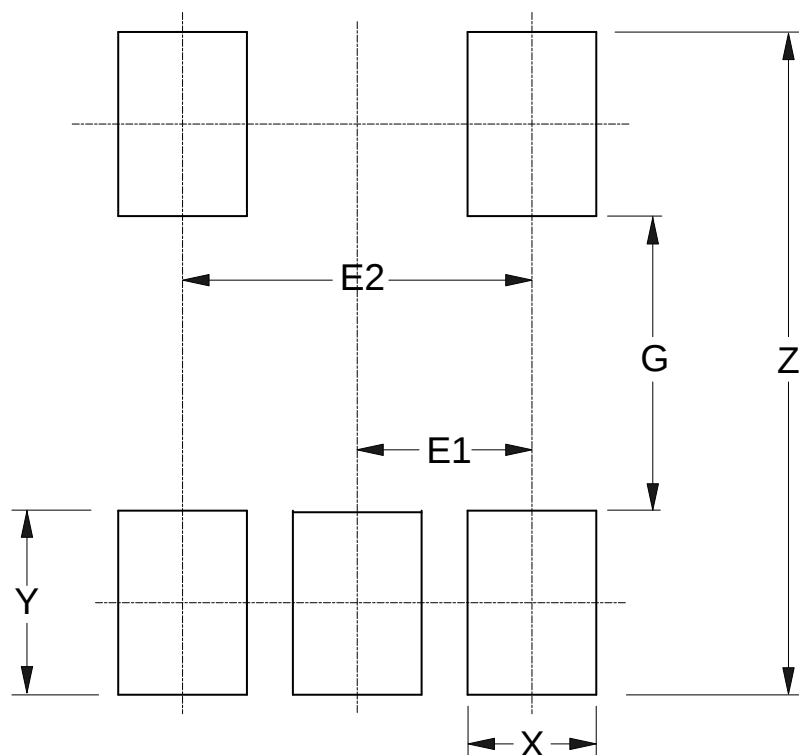
(1) Package Type: SOT23



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.)

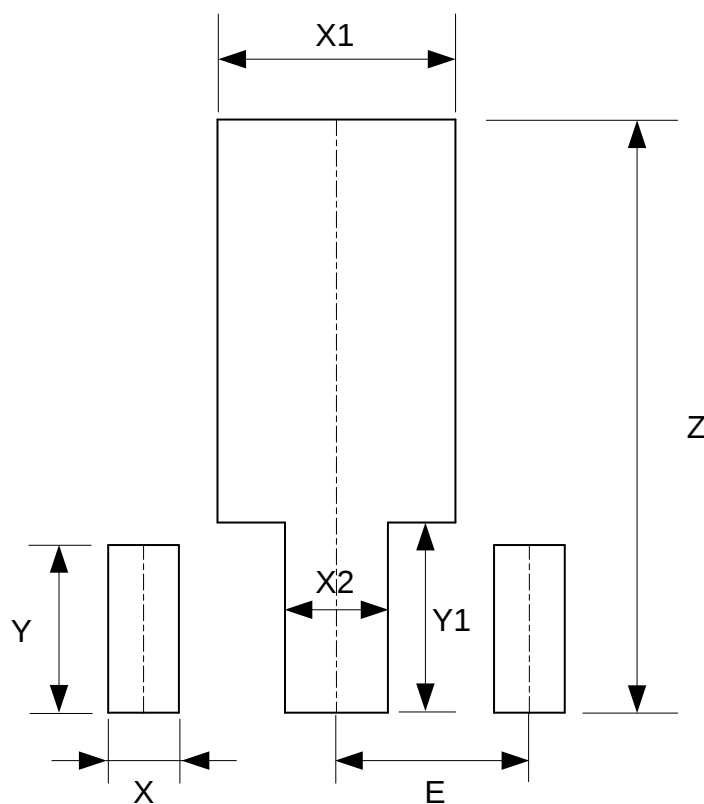
(2) Package Type: SOT25



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