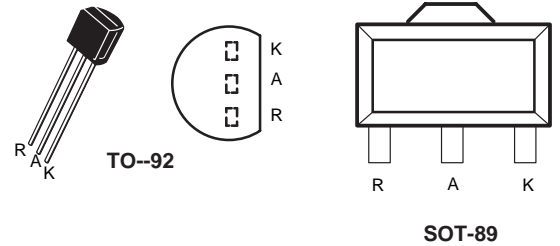


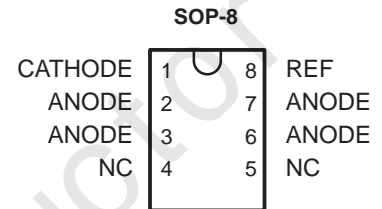
Device Description

The TL431 is a three-terminal adjustable shunt regulator offering excellent temperature stability. This device has a typical dynamic output impedance of 0.2Ω. The device can be used as a replacement for zener diodes in many applications.



FEATURES

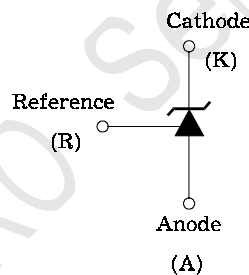
- The output voltage can be adjusted to 36V
- Low dynamic output impedance, its typical value is 0.2Ω
- Trapping current capability is 1 to 100mA
- Low output noise voltage
- Fast on-state response
- The effective temperature compensation in the working range of full temperature
- The typical value of the equivalent temperature factor in the whole temperature scope is 50 ppm/°C



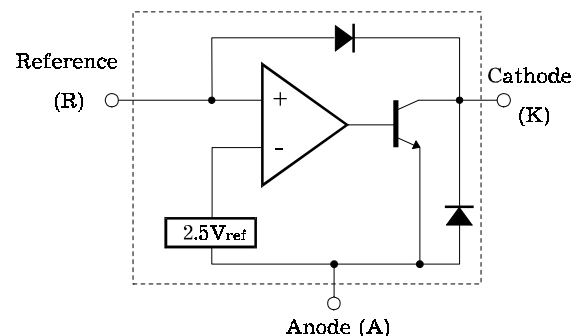
Applications

- Shunt Regulator
- High-Current Shunt Regulator
- Precision Current Limiter

SYMBOL



FUNCTIONAL BLOCK DIAGRAM



Limiting Values (Absolute Maximum Rating)

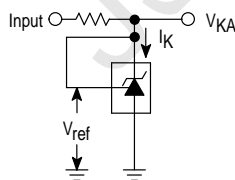
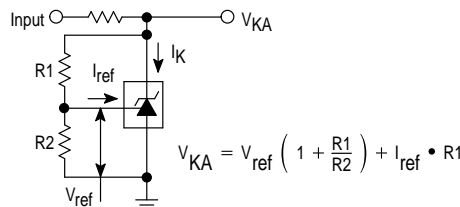
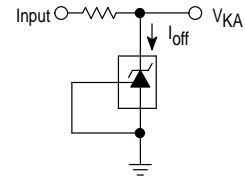
Parameter	Symbol	Value	Unit
Cathode Voltage	V_{KA}	37	V
Cathode Current Range (Continuous)	I_{KA}	-100~+150	mA
Reference Input Current Range	I_{ref}	0.05~+10	mA
Power Dissipation	P_D	300	mW
Thermal Resistance from Junction to Ambient	$R_{\theta JA}$	417	°C/W
Operating Junction Temperature	T_j	150	°C
Operating Ambient Temperature Range	T_{opr}	-25~+85	°C
Storage temperature Range	T_{stg}	-65~+150	°C

Electrical Characteristics ($T_A=25^\circ\text{C}$ unless otherwise noted)

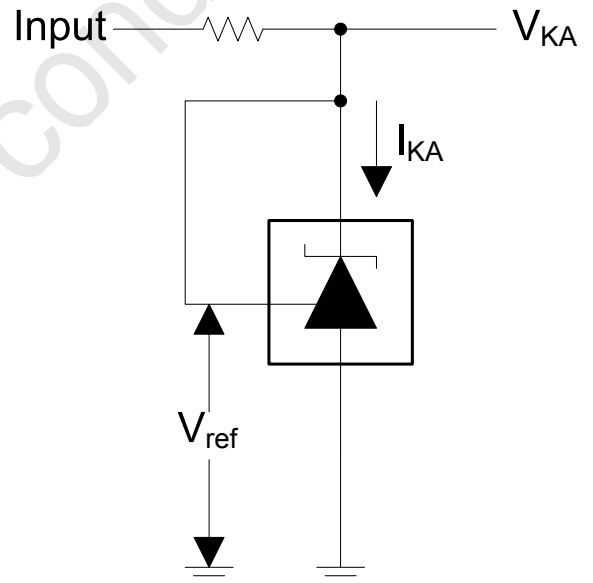
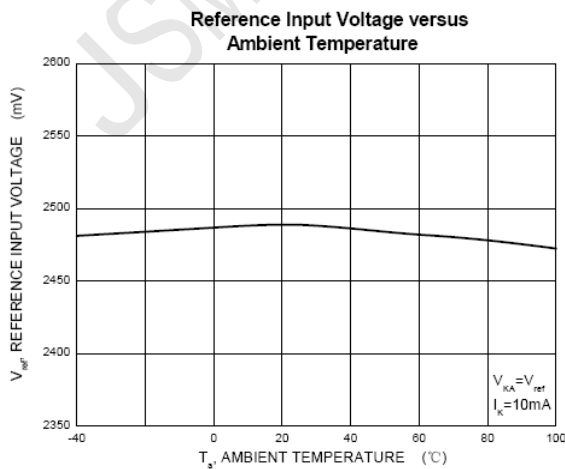
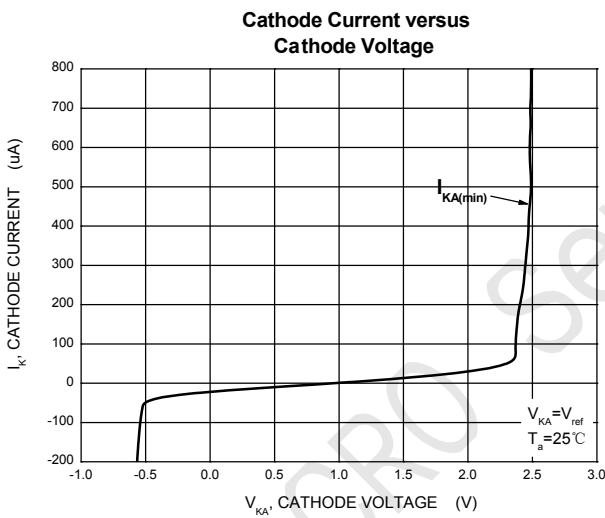
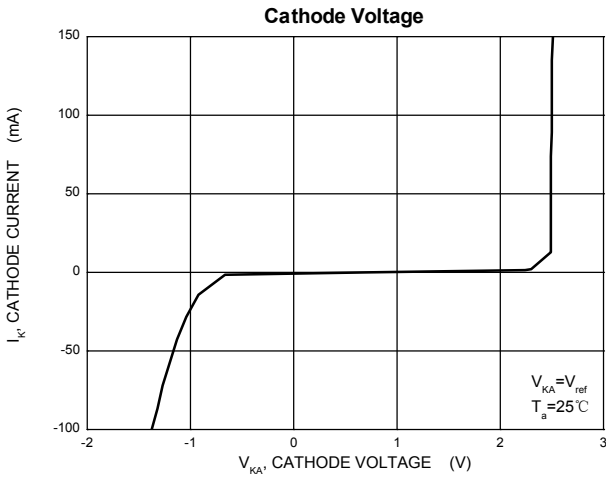
Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Reference input voltage (Fig.1)	V_{ref}	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}$	2.475	2.5	2.525	V
Deviation of reference input voltage over temperature (note) (Fig.1)	$\Delta V_{ref}/\Delta T$	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}$ $T_{MIN}\leq T_a\leq T_{MAX}$		4.5	17	mV
Ratio of change in reference input voltage to the change in cathode voltage (Fig.2)	$\Delta V_{ref}/\Delta V_{KA}$	$I_{KA}=10\text{mA}$	ΔV_{KA} $=10\text{V}\sim V_{REF}$	-1.0	-2.7	mV/V
			ΔV_{KA} $=36\text{V}\sim 10\text{V}$	-0.5	-2.0	mV/V
Reference input current (Fig.2)	I_{ref}	$I_{KA}=10\text{mA}, R_1=10\text{k}\Omega$ $R_2=\infty$		1.5	4	μA
Deviation Of reference input current over full temperature range (Fig.2)	$\Delta I_{ref}/\Delta T$	$I_{KA}=10\text{mA}, R_1=10\text{k}\Omega$ $R_2=\infty$ $T_A=-25$ to 85°C		0.4	1.2	μA
Minimum cathode current for regulation (Fig.1)	$I_{KA(\text{min})}$	$V_{KA}=V_{REF}$		0.45	1.0	mA
Off-state cathode Current (Fig.3)	$I_{KA(\text{OFF})}$	$V_{KA}=36\text{V}, V_{REF}=0$		0.05	1.0	μA
Dynamic impedance	Z_{KA}	$V_{KA}=V_{REF}, I_{KA}=1$ to 100mA $f\leq 1.0\text{kHz}$		0.15	0.5	Ω

 Note: $T_{MIN}=-25^\circ\text{C}, T_{MAX}=+85^\circ\text{C}$
CLASSIFICATION cZVref

Rank	*** 0.5%1%
Range	2.487-2.513	2.475-2.525

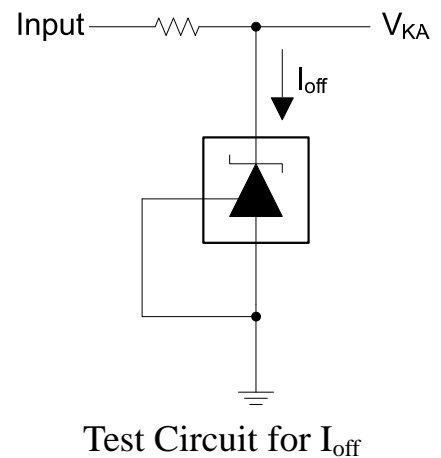
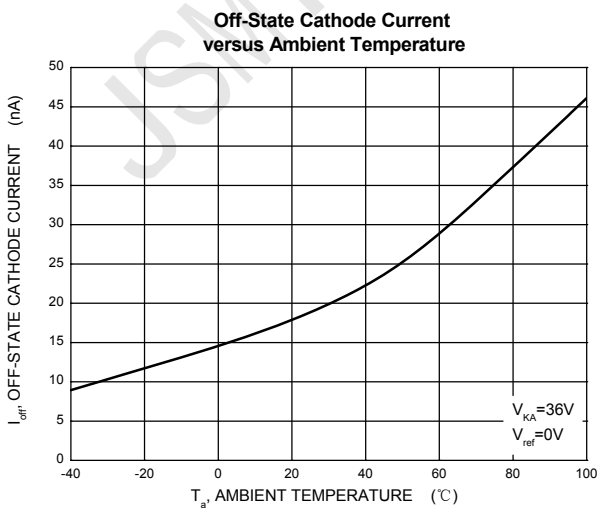
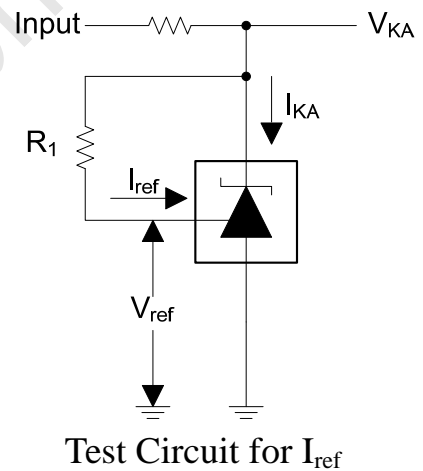
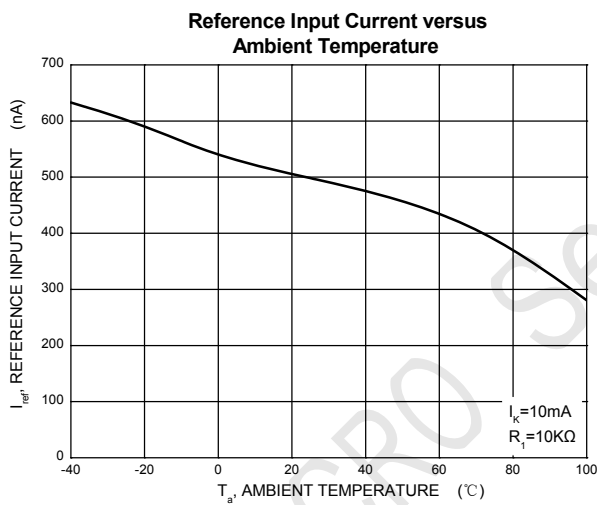
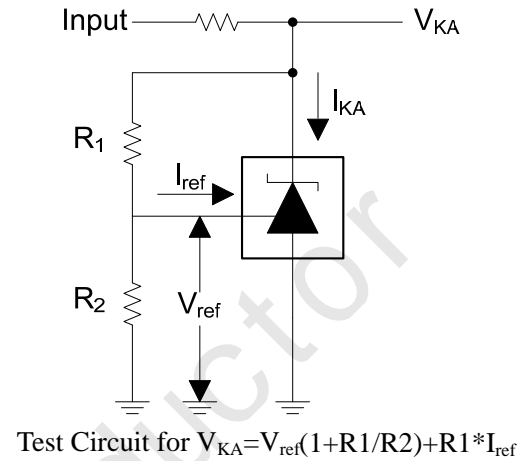
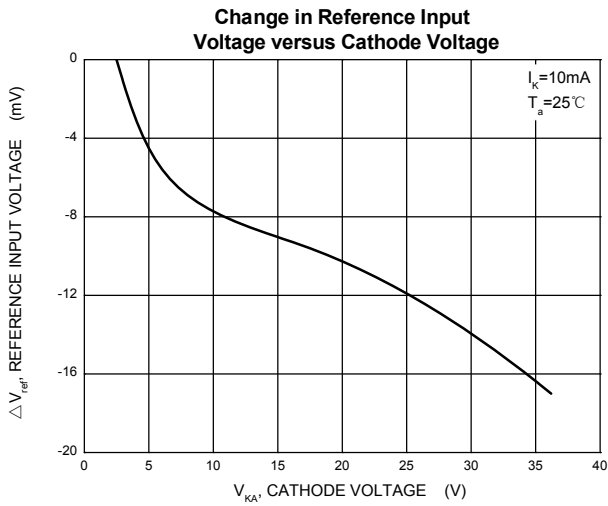
Figure 1. Test Circuit for $V_{KA} = V_{ref}$

Figure 2. Test Circuit for $V_{KA} > V_{ref}$

Figure 3. Test Circuit for I_{off}


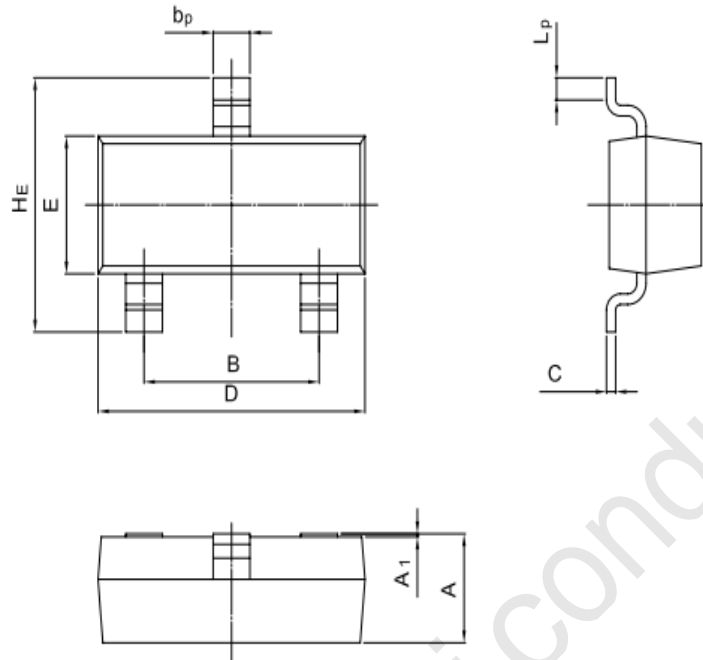
Typical Characteristics



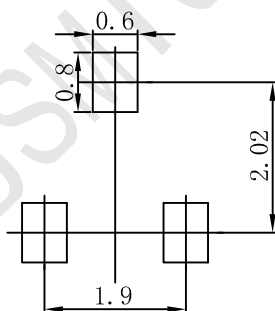
Test Circuit for $V_{KA} = V_{ref}$

Typical Characteristics

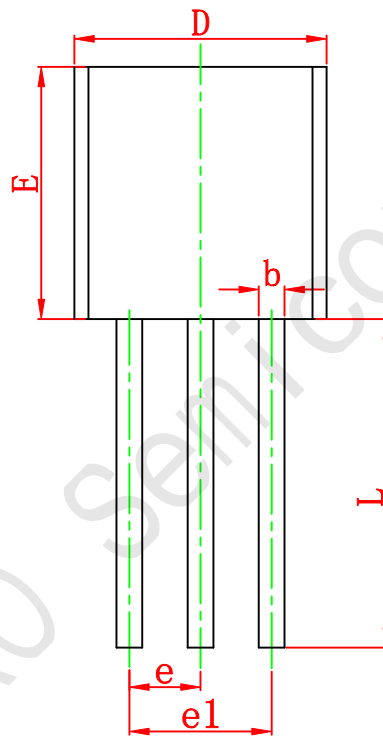
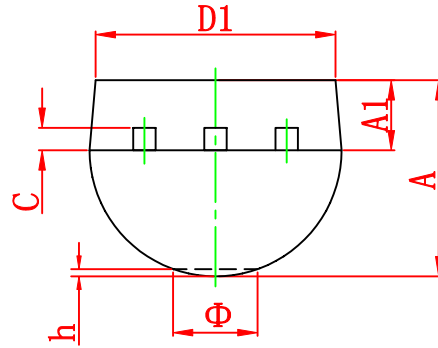


SOT-23 Package Outline Dimensions


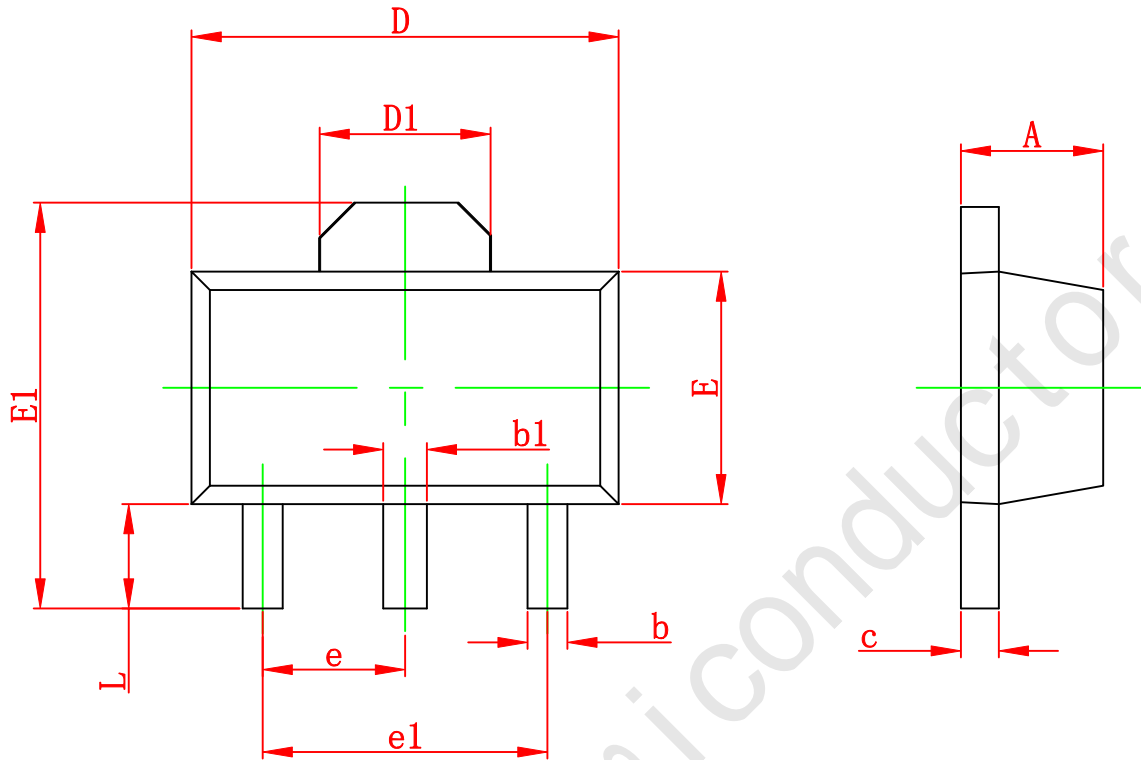
UNIT	A	B	bp	C	D	E	HE	A1	Lp
mm	1.40	2.04	0.50	0.19	3.10	1.65	3.00	0.100	0.50
	0.95	1.78	0.35	0.08	2.70	1.20	2.20	0.013	0.20

SOT-23 Suggested Pad Layout

Note:

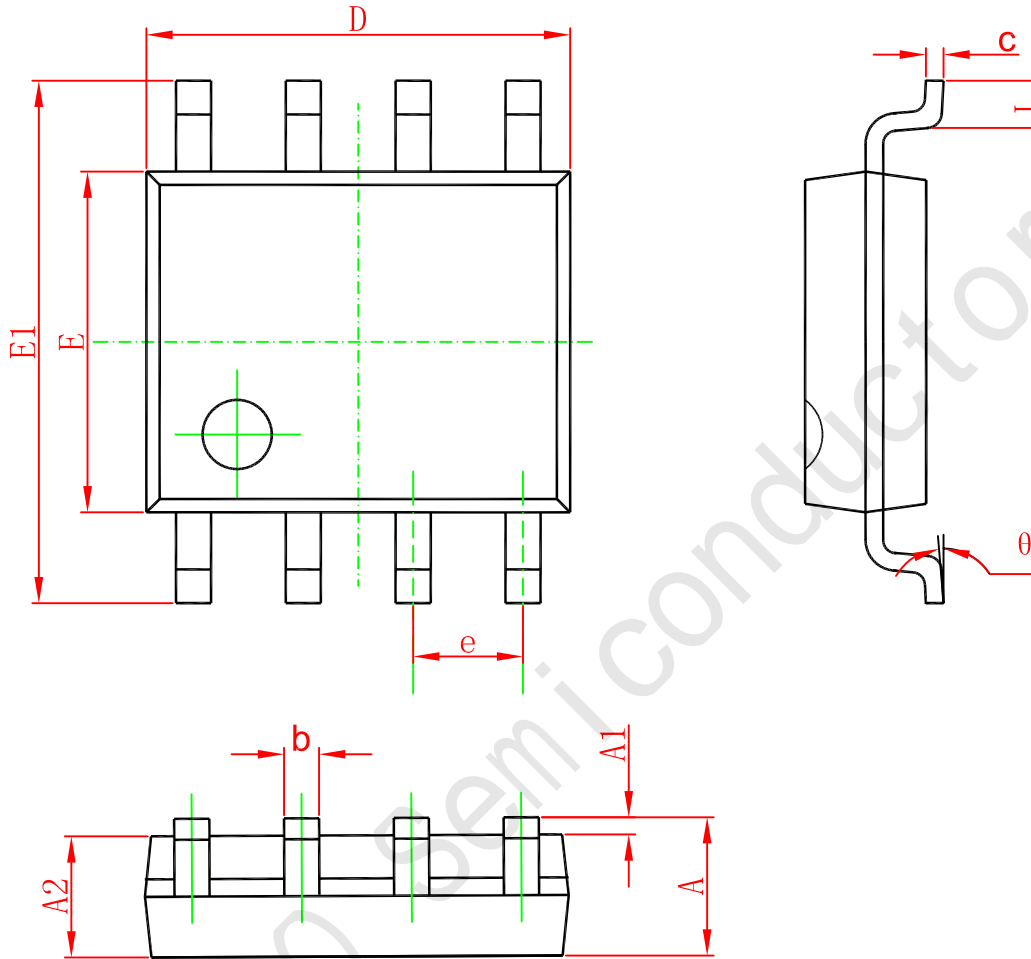
1. Controlling dimension: in millimeters.
2. General tolerance: ± 0.05 mm.
3. The pad layout is for reference purposes only.

TO-92 Package Outline Dimensions


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.300	3.700	0.130	0.146
A1	1.100	1.400	0.043	0.055
b	0.380	0.550	0.015	0.022
c	0.360	0.510	0.014	0.020
D	4.400	4.700	0.173	0.185
D1	3.430		0.135	
E	4.300	4.700	0.169	0.185
e	1.270 TYP		0.050 TYP	
e1	2.440	2.640	0.096	0.104
L	14.100	14.500	0.555	0.571
Φ		1.600		0.063
h	0.000	0.380	0.000	0.015

SOT-89 Package Outline Dimensions


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.197
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF		0.061 REF	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP		0.060TYP	
e1	3.000 TYP		0.118TYP	
L	0.900	1.200	0.035	0.047

SOP-8 Package Outline Dimensions


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°