

## Low Voltage Adjustable Precision Shunt Regulator

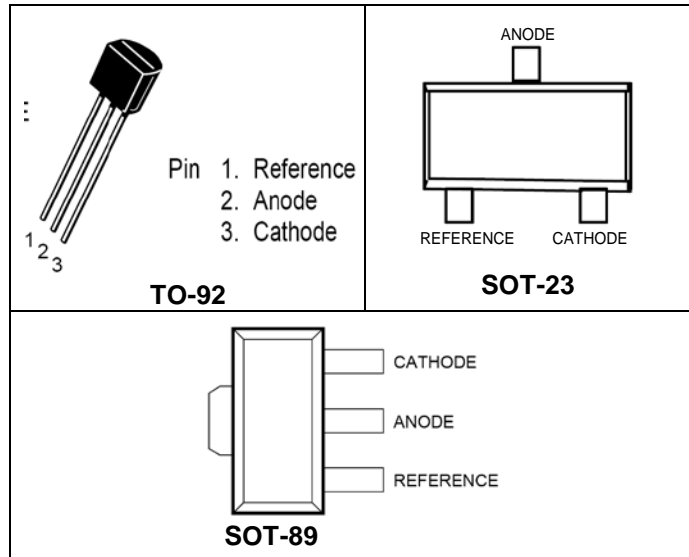
### Features

- Precise Reference Voltage to 1.24V
- Guaranteed 2%, 1% , 0.5% Reference Voltage Tolerance
- Sink Current Capability, 80 $\mu$ A to 100mA
- Quick Turn-on
- Adjustable Output Voltage,  $V_o = V_{REF}$  to 15V
- 0.2  $\Omega$  Typical Output Impedance
- TO-92, SOT-23, SOT-89 packages.

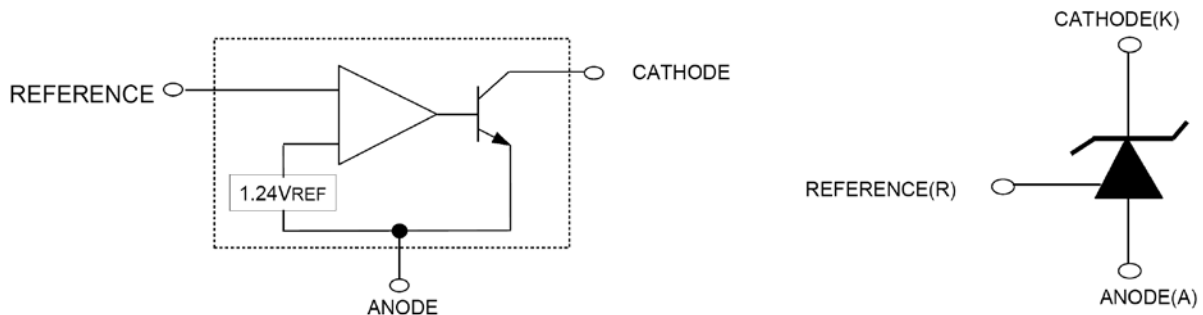
### Applications

- Linear Regulator
- Adjustable Supplies
- Switching Power Supplies
- Battery Charger
- Instrumentation
- Computer Disk Drives

### PIN CONNECTIONS



### Block Diagram



### Absolute Maximum Ratings

Symbol	Parameter	Symbol	Rating	Unit
$V_{KA}$	Cathode voltage	$V_{KA}$	18	V
$I_K$	Continuous cathode current range	$I_K$	100	mA
$I_{REF}$	Reference current range	$I_{REF}$	3	mA
$T_j$	Operating Junction Temperature Range	$T_j$	- 40 to 150	$^{\circ}$ C

Pad #	Description
1	REF
2	ANODE
3	CATHODE

\* Stresses beyond 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-rated conditions for extended periods may affect device reliability.

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

Symbol	Parameter	Test Conditions	TL432			Unit
			Min	Typ	Max	
$V_{REF}$	Reference voltage	$V_{KA}=V_{REF}$ , $I_K=10\text{mA}$ (Fig. 1) $T_A=25^\circ\text{C}$ HT432C (2%) HT432B (1%) HT432A (0.5%)	1.216 1.228 1.234	1.240 1.240 1.240	1.264 1.252 1.246	V
$V_{DEV}$	$V_{REF}$ Temp Deviation	$T_A$ =full range (see Note1) $V_{KA}=V_{REF}$ , $I_K=10\text{mA}$ (Fig. 1)		10	25	mV
$\Delta V_{REF}/\Delta V_{KA}$	Ratio of Change in $V_{REF}$ to Change in Cathode Voltage	$I_K=10\text{mA}$ , $V_{KA}=15\text{V}$ to $V_{REF}$ (Fig. 2)		-1	-2.7	mV / V
$I_{REF}$	Reference Input Current	$I_K=10\text{mA}$ , $R_1=10\text{k}\Omega$ $R_2=\infty$ (Fig.2)		0.5	1.0	$\mu\text{A}$
$I_{REF(DEV)}$	$I_{REF}$ Temp Deviation	$T_K$ =full range (see Note 1), $R_1=10\text{k}\Omega$ , $R_2=\infty$ , $I_K=10\text{mA}$ (Fig. 2)		0.05	0.3	$\mu\text{A}$
$I_{k(off)}$	Off-state cathode current	$V_{REF}=0\text{V}$ , (Fig.3) $V_k=15\text{V}$		0.04	0.5	$\mu\text{A}$
$Z_{ka}$	Dynamic Output Impedance	$V_{ka}=V_{ref}$ , $I_k=1\text{mA}$ to $100\text{mA}$ $F \leq 1\text{kHz}$ (Fig. 1)		0.2	0.4	$\Omega$
$I_{K(MIN)}$	Minimum Operating Current	$V_{KA}=V_{REF}$ (Fig. 1)		60	80	$\mu\text{A}$

 Notes: 1. Full temperature range is  $-40^\circ\text{C}$  to  $105^\circ\text{C}$  for HT432

TEST CIRCUITS

Fig. 1 Test Circuit for  $V_{KA}=V_{REF}$

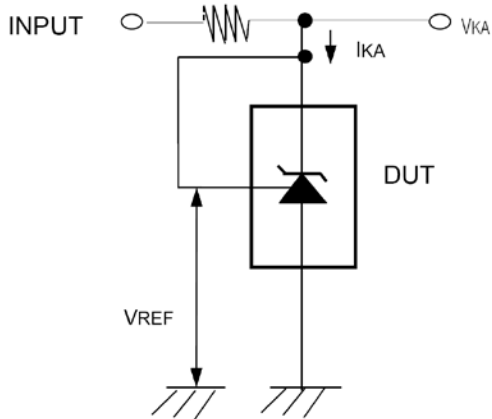


Fig. 2 Test Circuit for  $V_{KA} \geq V_{REF}$

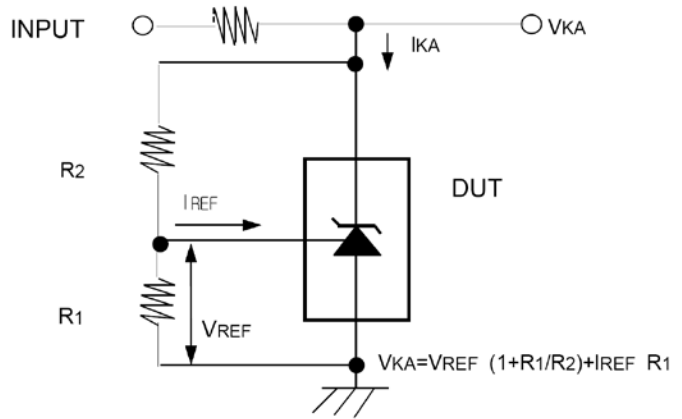
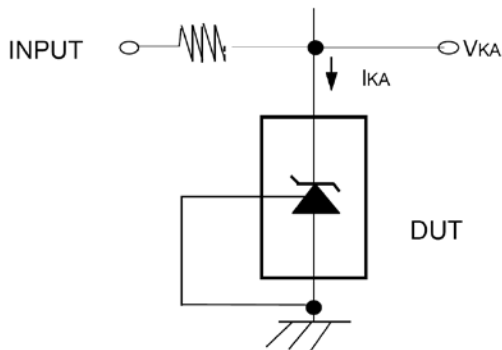
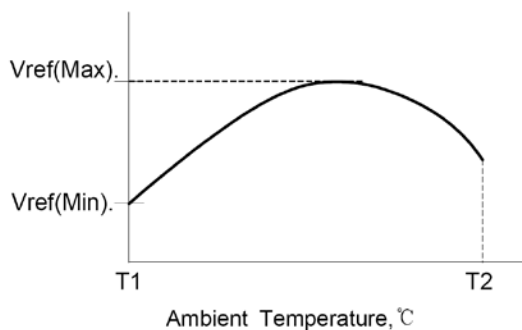


Fig. 3 Test Circuit for  $I_{KA}(\text{off})$



**Note1]** The deviation parameter  $\Delta V_{ref}$  is defined as the differences between the maximum and minimum values obtained over the full operating ambient temperature range that applies.



$$\Delta V_{ref} = V_{ref}(\text{Max.}) - V_{ref}(\text{Min.})$$

$$T_a = T_2 - T_1$$

The average temperature coefficient of the Reference input voltage,  $\alpha_{Vref}$ . is defined as:

$$\alpha_{Vref} = \frac{\text{ppm}}{^{\circ}\text{C}} = \frac{\left( \frac{\Delta V_{ref}}{V_{ref} @ 25^{\circ}\text{C}} \right) \times 10^6}{\Delta T_a} = \frac{\Delta V_{ref} \times 10^6}{\Delta T_a (V_{ref} @ 25^{\circ}\text{C})}$$

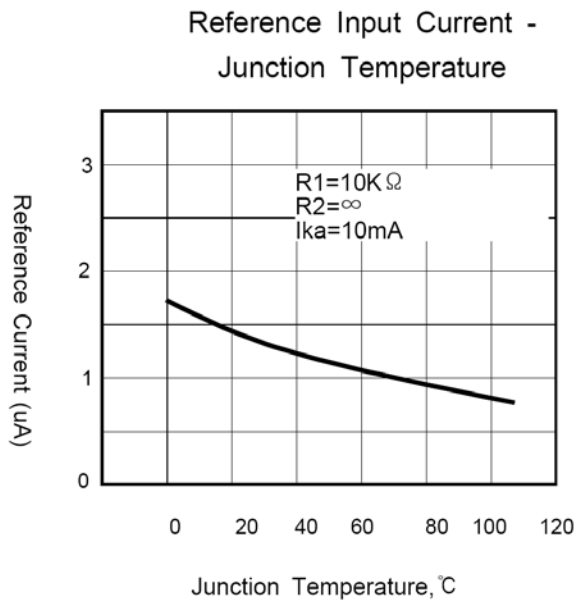
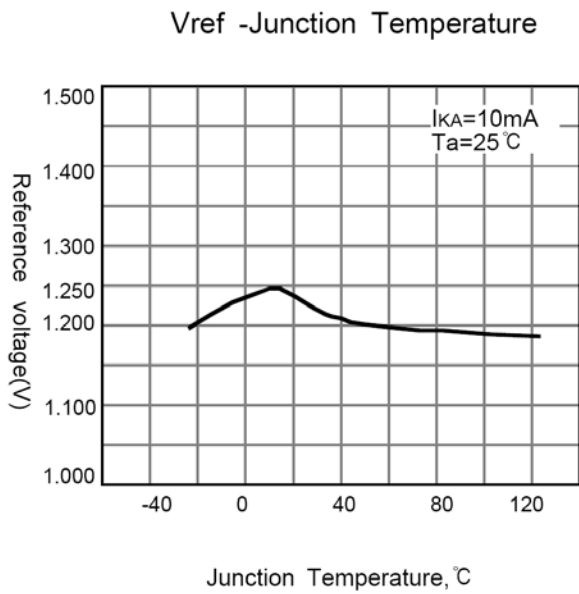
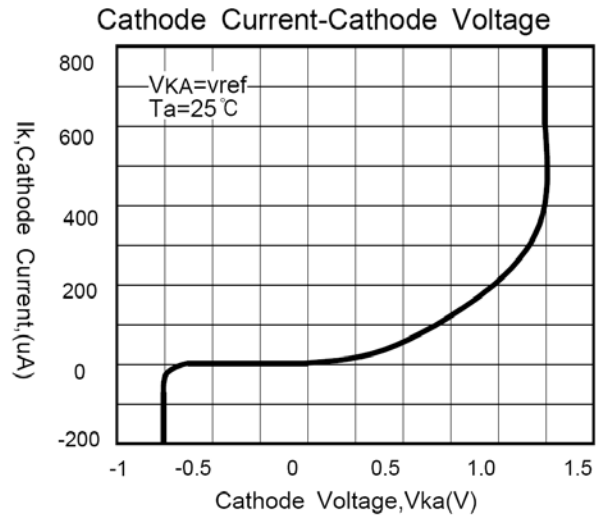
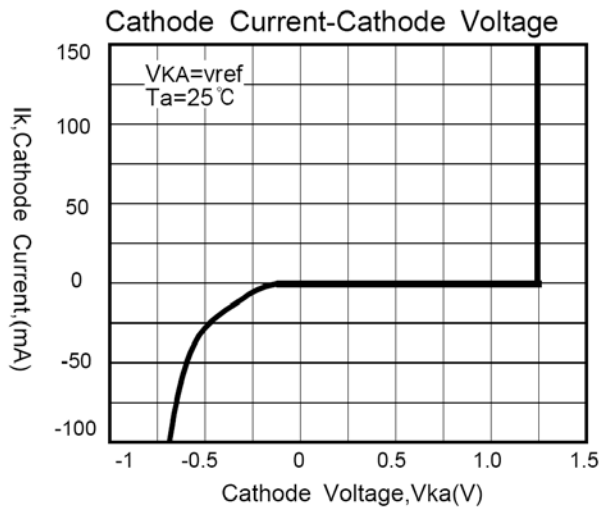
$\alpha_{Vref}$ . is can be positive or negative depending on whether  $V_{ref.Min.}$  or  $V_{ref.Max.}$  occurs at the lower ambient temperature.

**Note2]** The dynamic impedance  $Z_{ka}$  is defined as:

$$|Z_{ka}| = \frac{\Delta V_{KA}}{\Delta I_K}$$

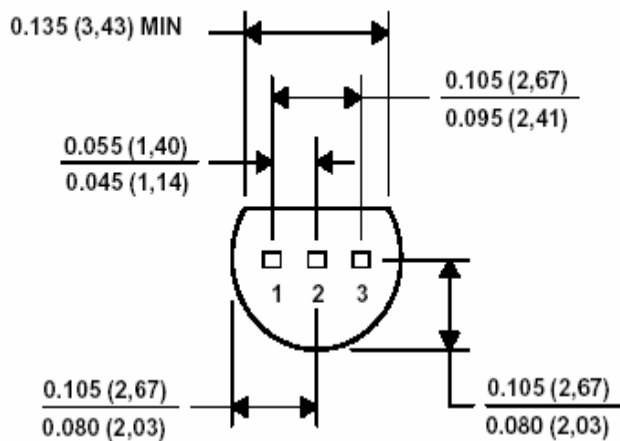
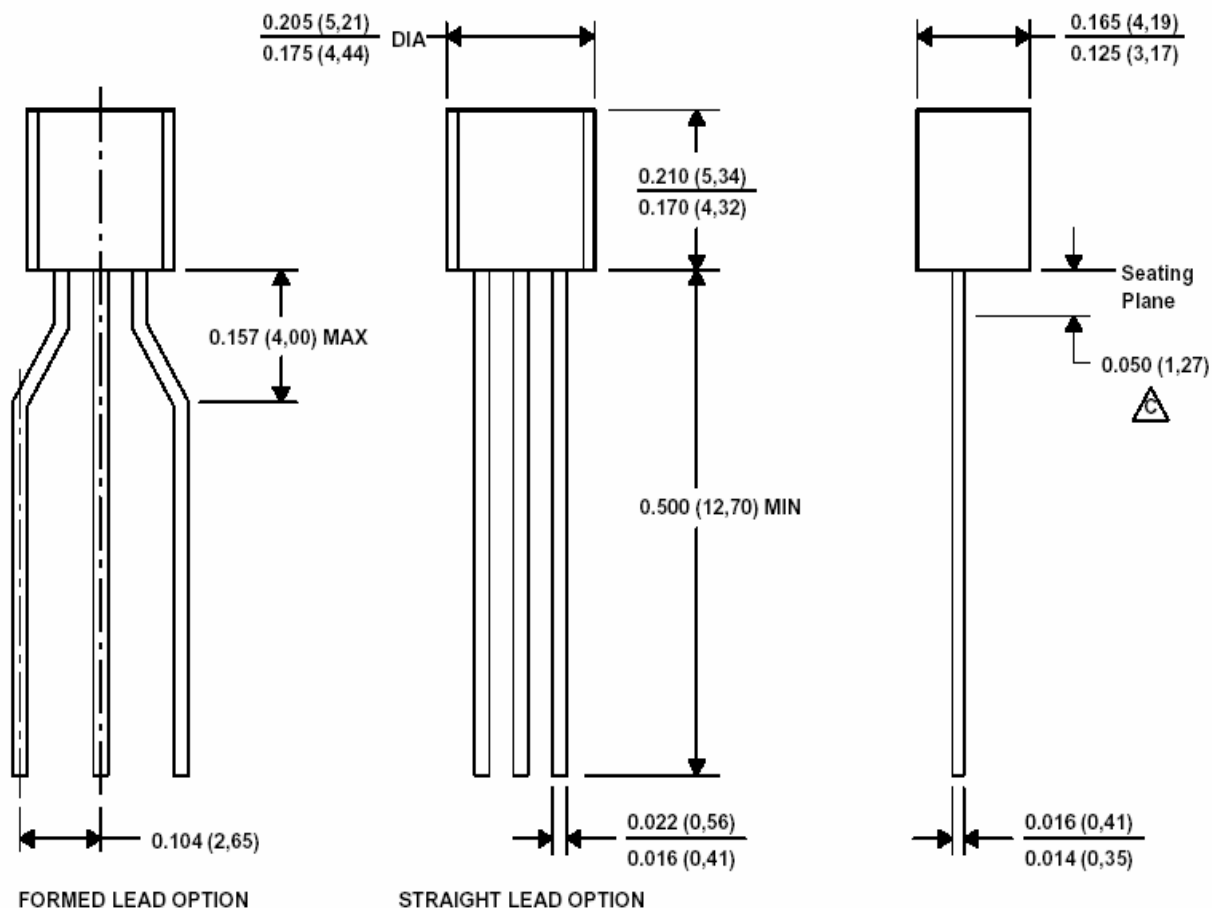
When the device is programmed with two external resistors,  $R_1$  an  $R_2$ , (Refer to Fig.2) the total dynamic impedance of the circuit is defined as :

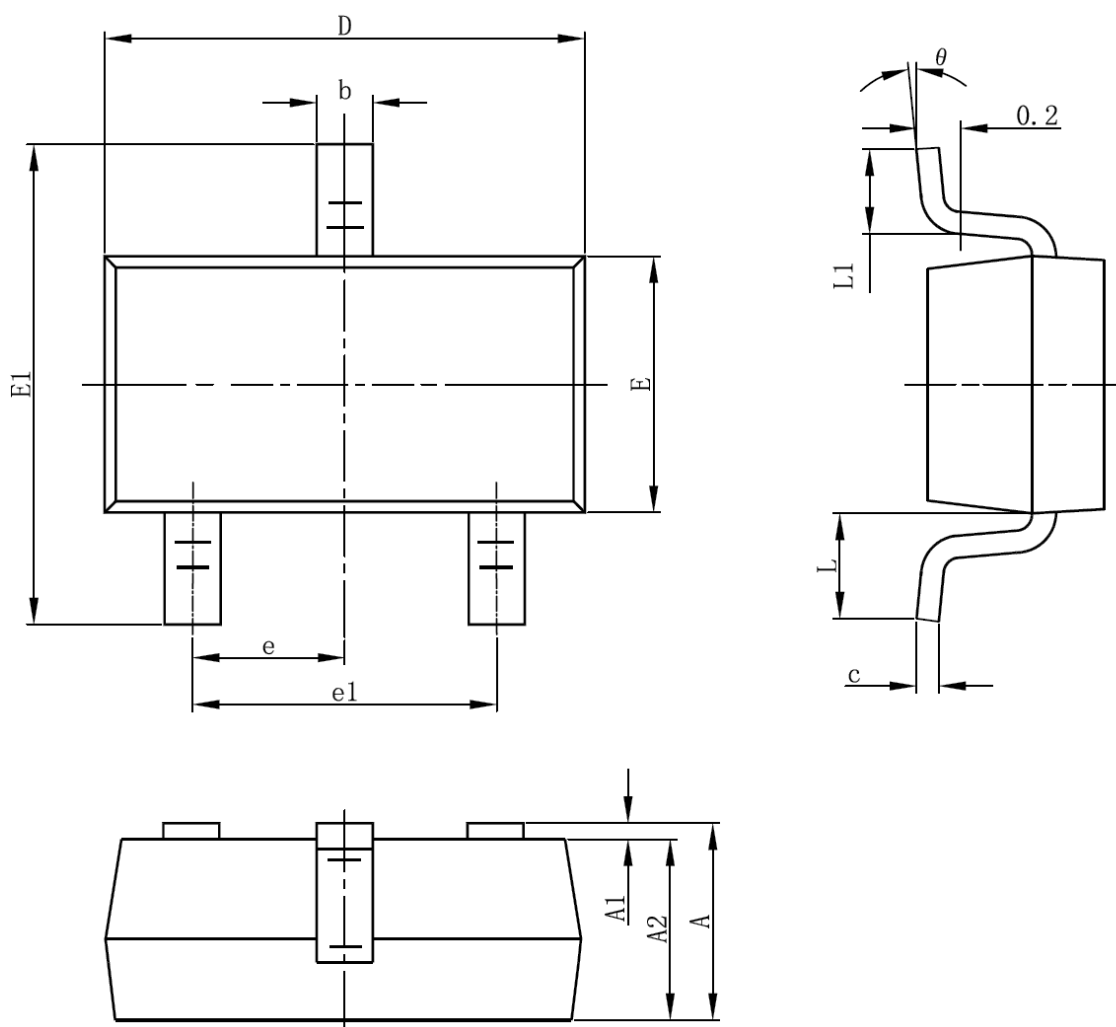
$$|Z_{ka}'| = |Z_{ka}| \left( 1 + \frac{R_1}{R_2} \right)$$

**TYPICAL PERFORMANCE CHARACTERISTICS**


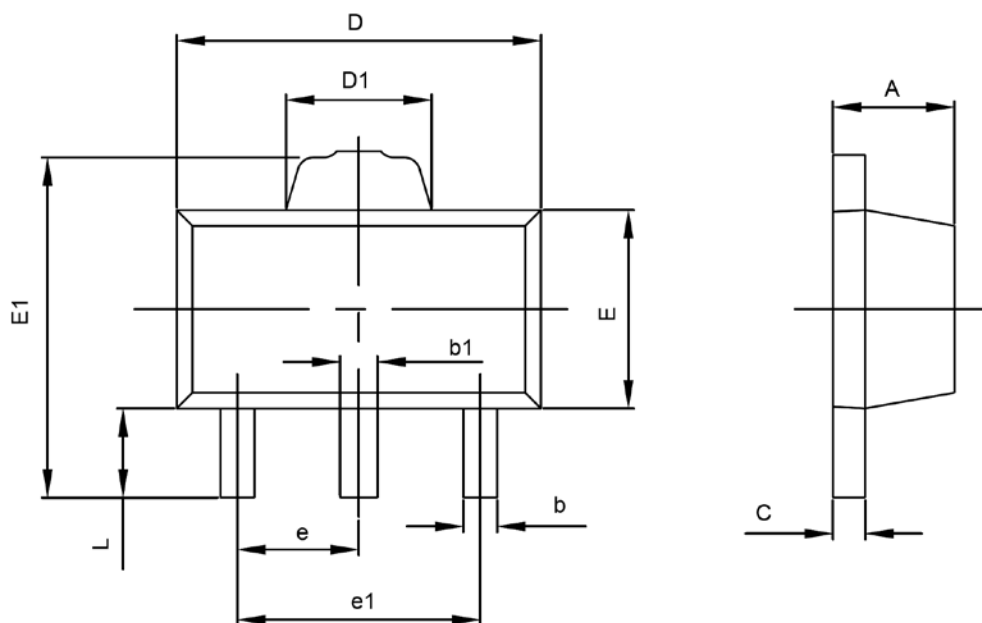
Package Dimensions

TO-92



**SOT-23-3L PACKAGE OUTLINE DIMENSIONS**


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

**SOT-89-3L 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	0.020
b1	0.360	0.560	0.014	0.022
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.400	1.800	0.055	0.071
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500TYP		0.060TYP	
e1	2.900	3.100	0.114	0.122
L	0.900	1.100	0.035	0.043