

# Low Voltage Adjustable Precision Shunt Regulator

**TL432**

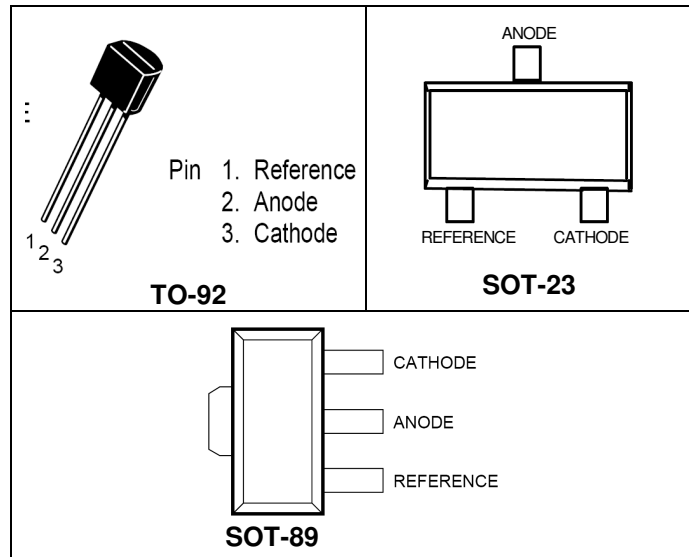
### Features

- 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

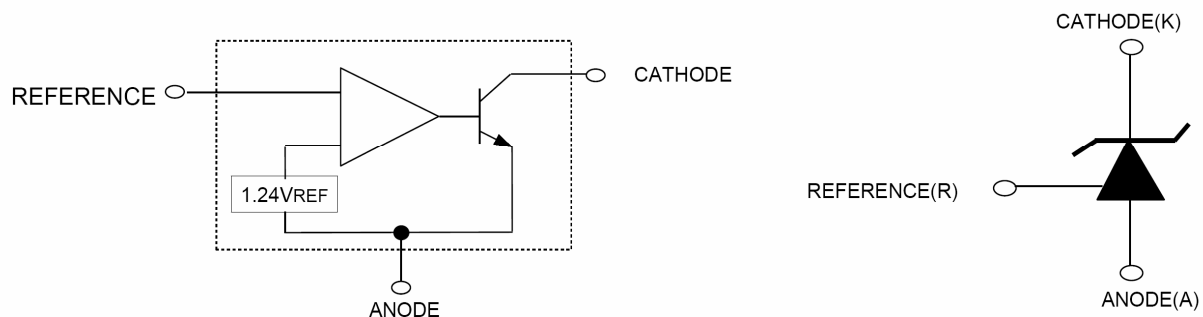
### PIN CONNECTIONS



### Ordering Information

| Product Number | Reference Input Voltage | Package |
|----------------|-------------------------|---------|
| TL432CLF       | 0.5%                    | TO-92   |
| TL432CLS       |                         | SOT-23  |
| TL432CS        |                         | SOT-89  |
| TL432CP        |                         |         |
| TL432ALF       | 1%                      | TO-92   |
| TL432ALS       |                         | SOT-23  |
| TL432AS        |                         | SOT-89  |
| TL432AP        |                         |         |
| TL432LF        | 2%                      | TO-92   |
| TL432LS        |                         | SOT-23  |
| TL432S         |                         | SOT-89  |
| TL432P         |                         |         |

### 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 | °C   |

| Pad # | Description |
|-------|-------------|
| 1     | REF         |
| 2     | ANODE       |
| 3     | CATHODE     |

**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)<br>$T_A=25^\circ\text{C}$<br>TL432 (2%)<br>TL432-A (1%)<br>TL432-C (0.5%) | 1.216<br>1.228<br>1.234 | 1.240<br>1.240<br>1.240 | 1.264<br>1.252<br>1.246 | V             |
| $V_{DEV}$                      | $V_{REF}$ Temp Deviation                                  | $T_A$ =full range (see Note1)<br>$V_{KA}=V_{REF}$ , $I_K=10\text{mA}$ (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),<br>$R_1 = 10\text{k}\Omega$ , $R_2=\infty$ , $I_K=10\text{mA}$ (Fig. 2)                 |                         | 0.05                    | 0.3                     | $\mu\text{A}$ |
| $I_{k(off)}$                   | Off-state cathode current                                 | $V_{REF}=0\text{V}$ , (Fig.3)<br>$V_K=15\text{V}$   |                         | 0.04                    | 0.5                     | $\mu\text{A}$ |
| $Z_{ka}$                       | Dynamic Output Impedance                                  | $V_{ka}=V_{ref}$ , $I_k=1\text{mA}$ to $100\text{mA}$<br>$F \leq 1\text{kHz}$ (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 TL432

TEST CIRCUITS

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

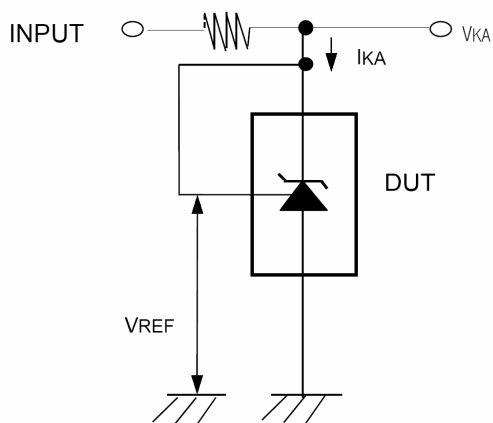


Fig. 2 Test Circuit for  $V_{KA} \geq V_{REF}$

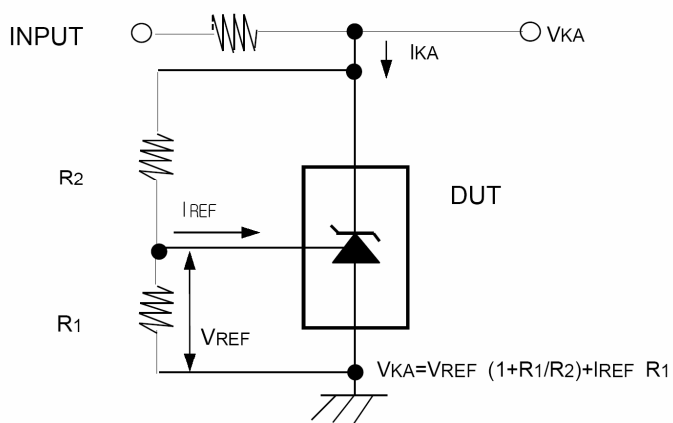
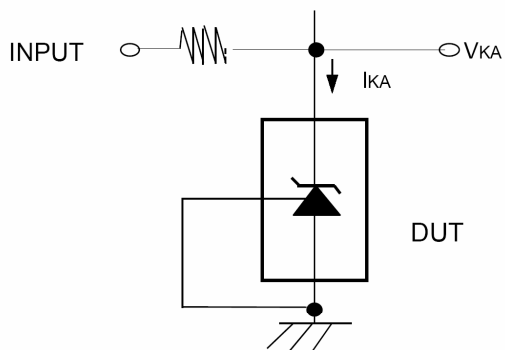
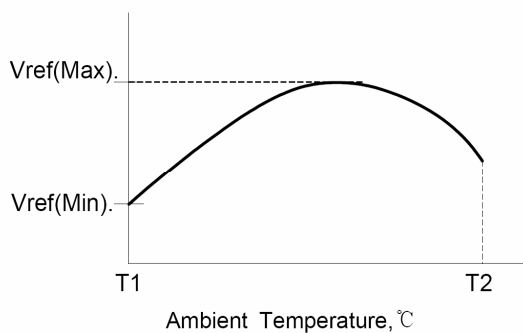


Fig. 3 Test Circuit for  $I_{KA}(\text{off})$



**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,  $\alpha V_{ref}$ . is defined as:

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

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

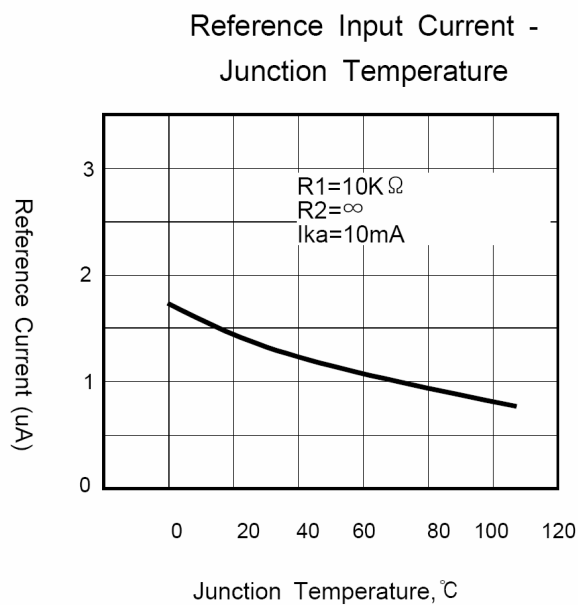
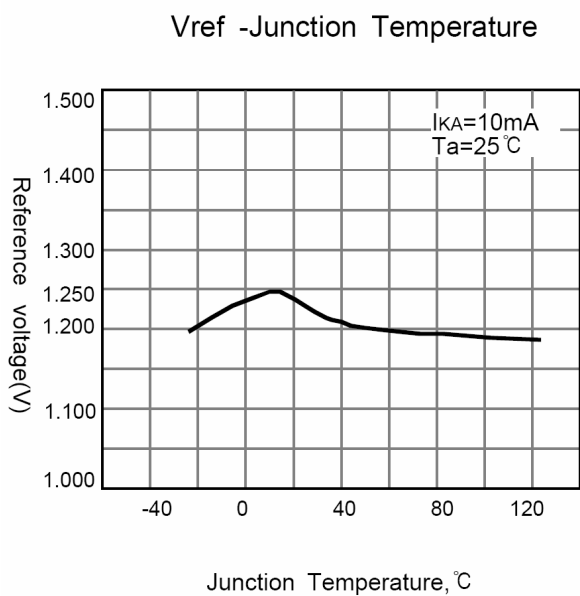
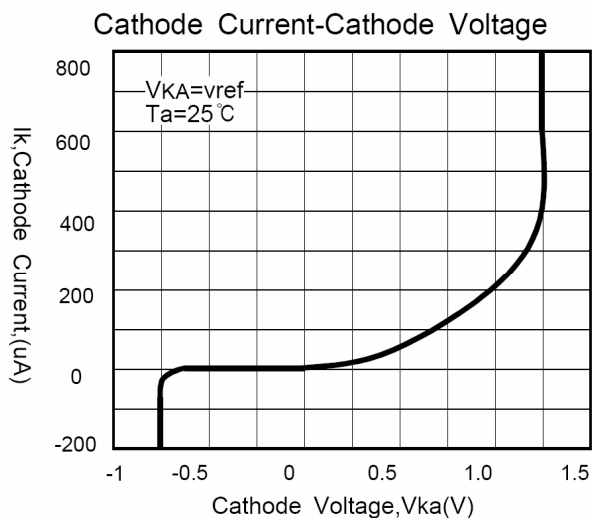
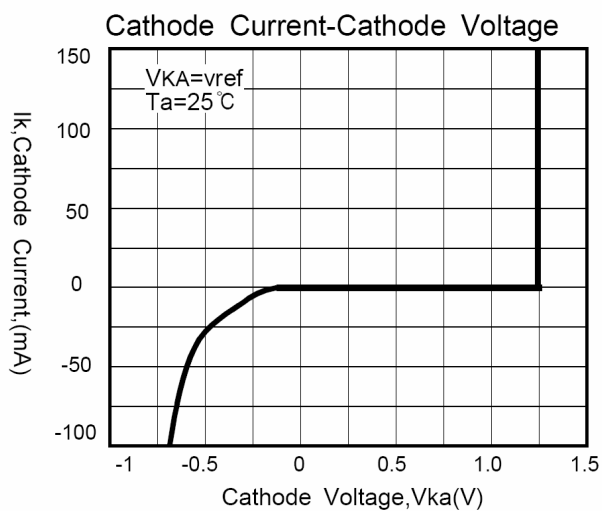
**Note2]** The dynamic impedance  $Z_{ka}$  is defined as:

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

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 :

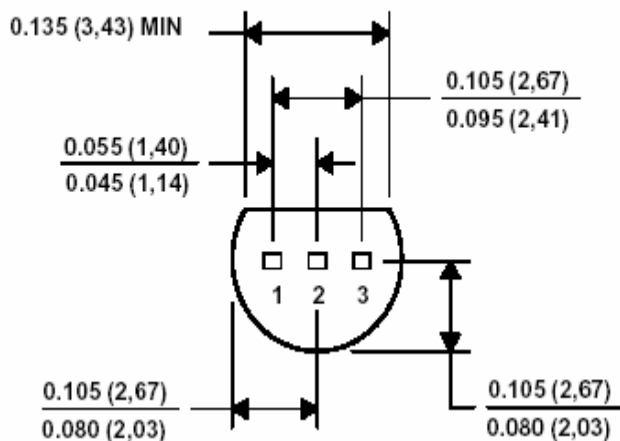
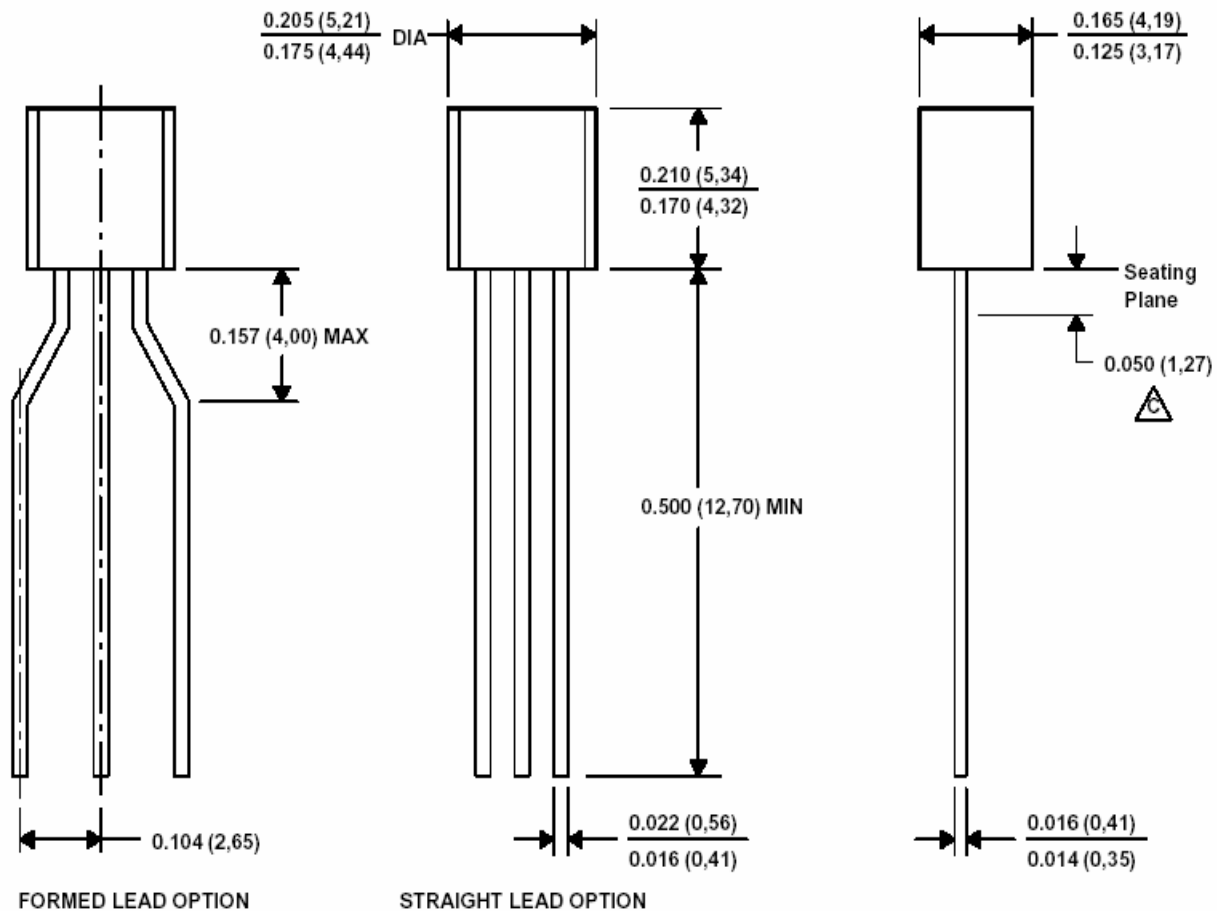
$$|Z_{ka}'| = |Z_{ka}| \left( 1 + \frac{R_1}{R_2} \right)$$

TYPICAL PERFORMANCE CHARACTERISTICS

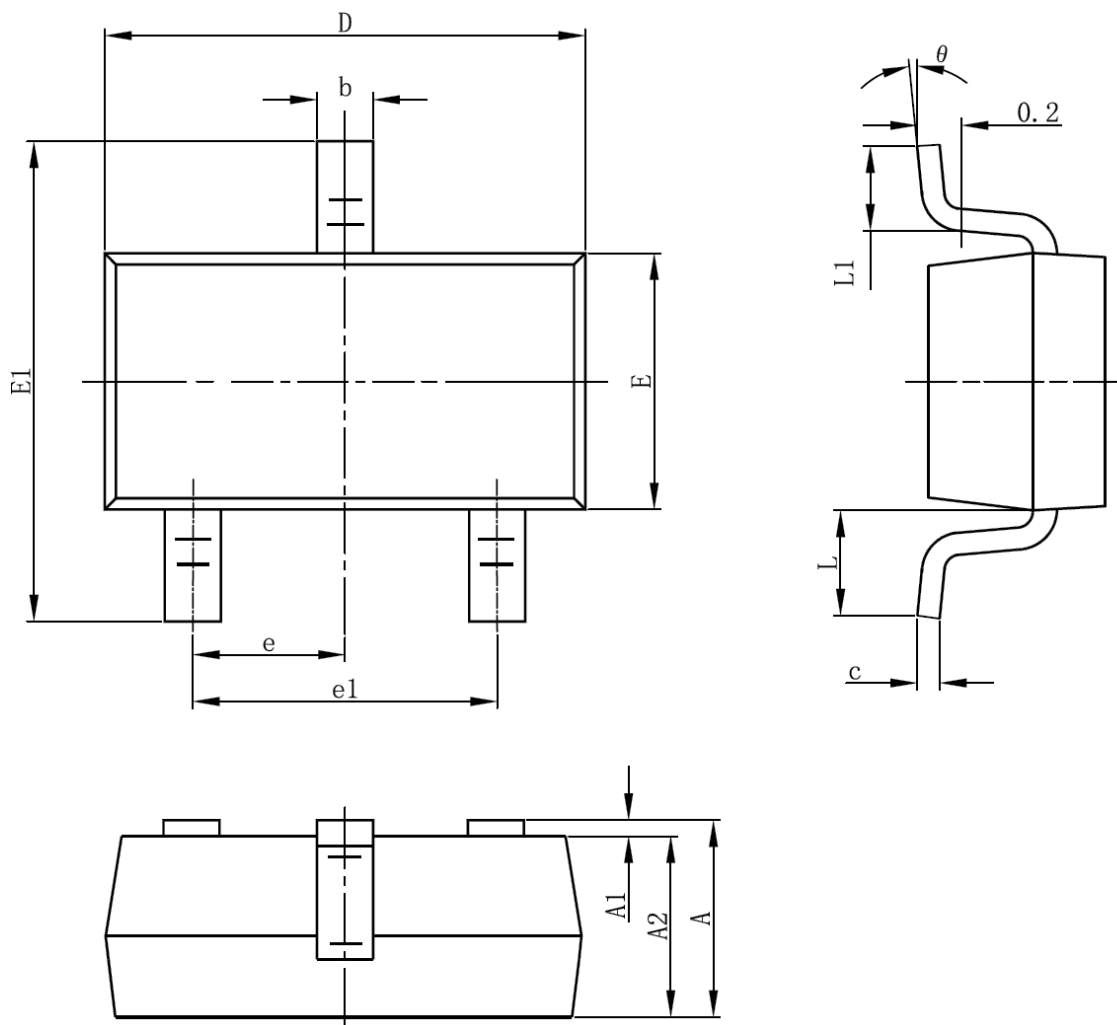


Package Dimensions

TO-92



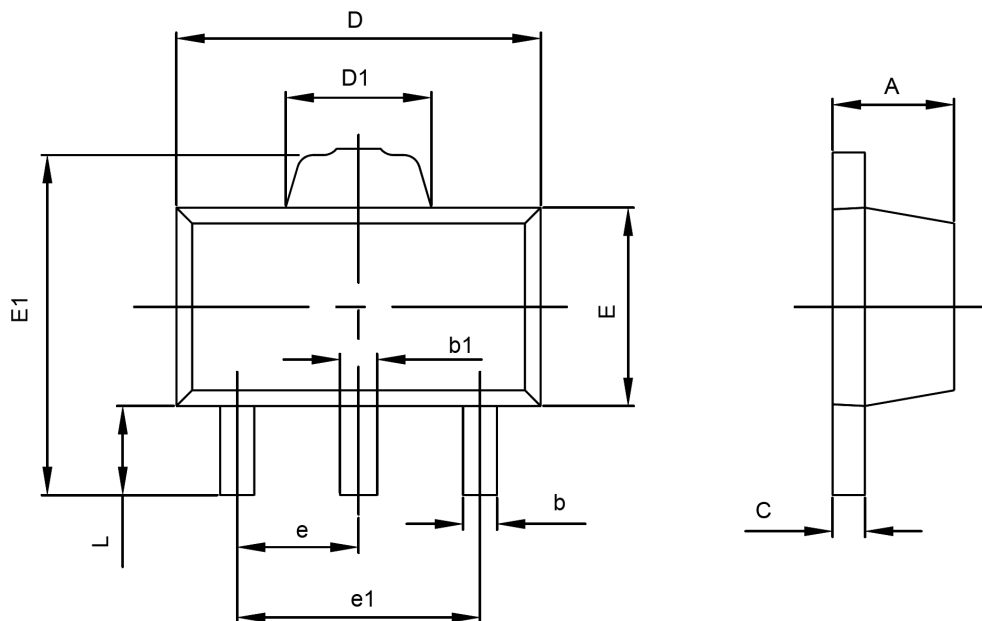
SOT-23-3L PACKAGE OUTLINE DIMENSIONS



| 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 |