# 100mA, 4µA Quiescent Current CMOS LDO Regulator

## General Description

The RT9169/H series are 100mA ultra-low quiescent current CMOS low dropout (LDO) regulator designed for battery-powered equipments. The output voltages range from 1.2V to 5V with 0.1V per step.

The other features include 4µA ultra-low quiescent, low dropout voltage, high output accuracy, current limiting protection, and high ripple rejection ratio.

## Ordering Information

RT9169/H-□□ □ □

- Package Type
  - ZL : TO-92 (L-Type)
  - ZT : TO-92 (T-Type)
  - X : SOT-89
  - V : SOT-23-3
  - VL : SOT-23-3 (L-Type)
  - B : SOT-23-5
- Lead Plating System
  - P : Pb Free
  - G : Green (Halogen Free and Pb Free)
- Output Voltage
  - 12 : 1.2V
  - 13 : 1.3V
  - :
  - 49 : 4.9V
  - 50 : 5.0V
- Chip Enable High (SOT-23-5 Only)
- Chip Enable Low

Note :

1. RT9169H package type is available in SOT-23-5 only.
2. Richtek products are :
   - RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
   - Suitable for use in SnPb or Pb-free soldering processes.

## Marking Information

For marking information, contact our sales representative directly or through a Richtek distributor located in your area.

## Features

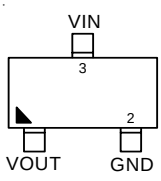
- **Ultra-Low Quiescent Current: 4µA**
- **Low Dropout: 450mV at 100mA**
- **Wide Operating Voltage Ranges: 2V to 6V**
- **Current Limiting Protection**
- **Only 1µF Output Capacitor Required for Stability**
- **High Power Supply Rejection Ratio**
- **RoHS Compliant and 100% Lead (Pb)-Free**

## Applications

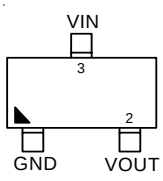
- Battery-Powered Equipment
- Palmtops, Notebook Computers
- Hand-held Instruments
- PCMCIA Cards

## Pin Configurations

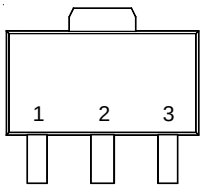
(TOP VIEW)



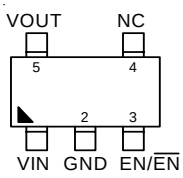

SOT-23-3



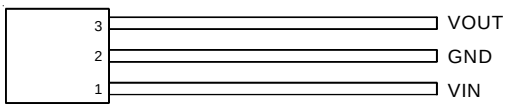

SOT-23-3 (L-Type)



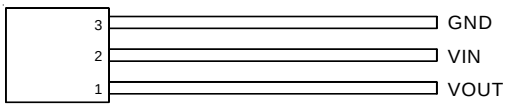

SOT-89




SOT-23-5

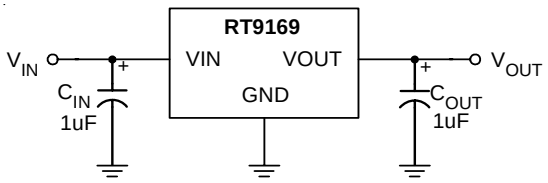


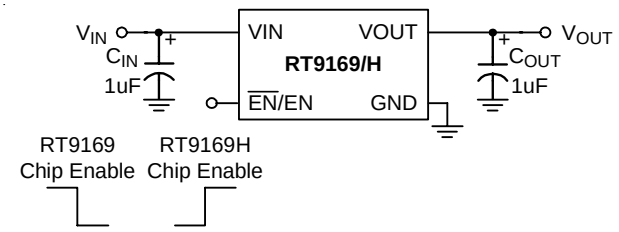

TO-92 (L-Type)



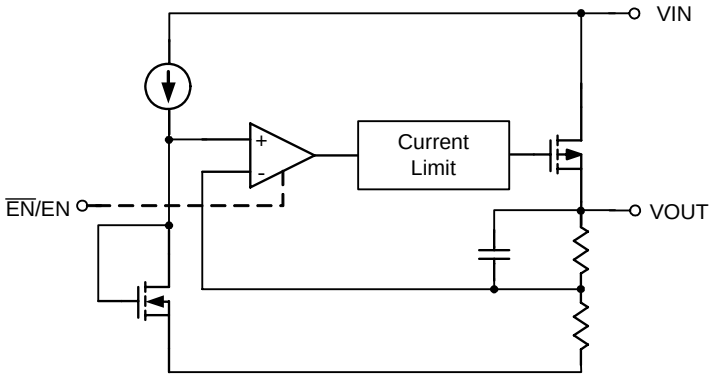

TO-92 (T-Type)

## Typical Application Circuit




## Function Block Diagram




## Functional Pin Description

| Pin Name | Pin Function |
|---|---|
| VIN | Power Input |
| VOUT | Output Voltage |
| GND | Ground |
| EN/EN | Chip Enable Control Input |

## Absolute Maximum Ratings (Note 1)

- Input Voltage ---------- 7V
- Power Dissipation, $P_D$ @ $T_A$ = 25°C
  - SOT-23-3 ---------- 0.4W
  - SOT-23-5 ---------- 0.4W
  - SOT-89 ---------- 0.571W
  - TO-92 ---------- 0.625W
- Junction Temperature ---------- 150°C
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- Storage Temperature Range ---------- –65°C to 150°C
- Package Thermal Resistance (Note 2)
  - SOT-23-3, $\theta_{JA}$ ---------- 250°C/W
  - SOT-23-5, $\theta_{JA}$ ---------- 250°C/W
  - SOT-89, $\theta_{JA}$ ---------- 175°C/W
  - TO-92, $\theta_{JA}$ ---------- 160°C/W
- ESD Susceptibility (Note 3)
  - HBM (Human Body Mode) ---------- 2kV
  - MM (Machine Mode) ---------- 200V

## Recommended Operating Conditions (Note 4)

- Junction Temperature Range ---------- –40°C to 125°C
- Ambient Temperature Range ---------- –40°C to 85°C

## Electrical Characteristics

($V_{IN}$ = 5.5V, $C_{IN}$ = 1µF, $C_{OUT}$ = 1µF, $T_A$ = 25°C, unless otherwise specified)

| Parameter | | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Input Voltage Range | | $V_{IN}$ | | 2 | -- | 6 | V |
| Output Voltage Accuracy | | $\Delta V_{OUT}$ | $I_L$ = 1mA | -2 | -- | +2 | % |
| Maximum Output Current | | $I_{MAX}$ | $V_{IN} = V_{OUT}$ + 0.6V, $V_{IN} \geq$ 3.6V | 100 | -- | -- | mA |
| Current Limit | | $I_{LIM}$ | $I_L$ = 100mA | 150 | 250 | -- | mA |
| GND Pin Current | | $I_G$ | No Load | -- | 4 | 7 | µA |
| | | | $I_{OUT}$ = 100mA | | 4 | 10 | µA |
| Dropout Voltage | | $V_{DROP}$ | $I_{OUT}$ = 1mA, $V_{IN} \geq$ 3.6V | -- | 4 | 10 | mV |
| | | | $I_{OUT}$ = 50mA, $V_{IN} \geq$ 3.6V | -- | 200 | 300 | |
| | | | $I_{OUT}$ = 100mA, $V_{IN} \geq$ 3.6V | -- | 450 | 600 | |
| Line Regulation | | $\Delta V_{LINE}$ | $V_{IN} = (V_{OUT}$ + 0.3V) to 6V, $V_{IN} \geq$ 3.6V, $I_{OUT}$ = 1mA | -0.2 | -- | +0.2 | %/V |
| Load Regulation | | $\Delta V_{LOAD}$ | $I_{LOUT}$ = 0mA to 100mA | -- | 0.01 | 0.04 | %/mA |
| Output Noise | | $e_{NO}$ | BW = 100Hz to 50kHz $C_{OUT}$ = 10µF | -- | 250 | -- | µV |
| Ripple Rejection | | PSRR | F = 1kHz, $C_{OUT}$ = 1µF | -- | 30 | -- | dB |
| Standby Current | RT9169/H (SOT-23-5) | | $\overline{EN} = V_{IN}$ or EN = 0 | -- | 0.1 | 1 | µA |
| $\overline{EN}$/EN Threshold | Logic High | $V_{IL}$ | | 0.6 | -- | -- | V |
| | Logic Low | $V_{IH}$ | | -- | -- | 2 | |
| Thermal Shutdown Protection | | | | 125 | -- | -- | °C |

**Note 1.** Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

**Note 2.** $\theta_{JA}$ is measured in the natural convection at $T_A$ = 25°C on a low effective thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

**Note 3.** Devices are ESD sensitive. Handling precaution is highly recommended.

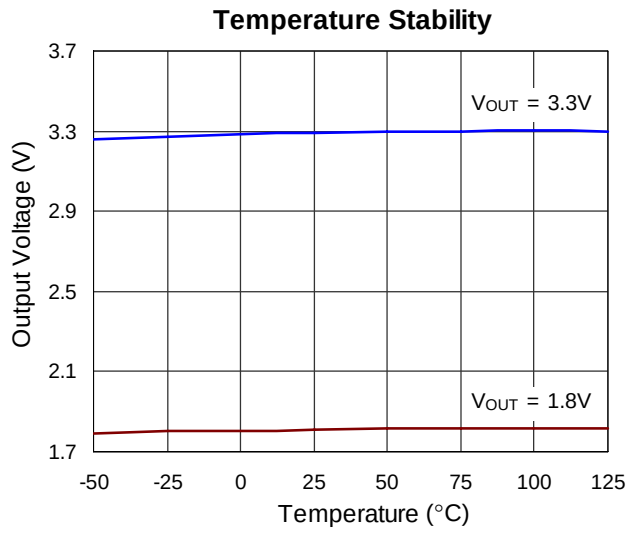
**Note 4.** The device is not guaranteed to function outside its operating conditions.

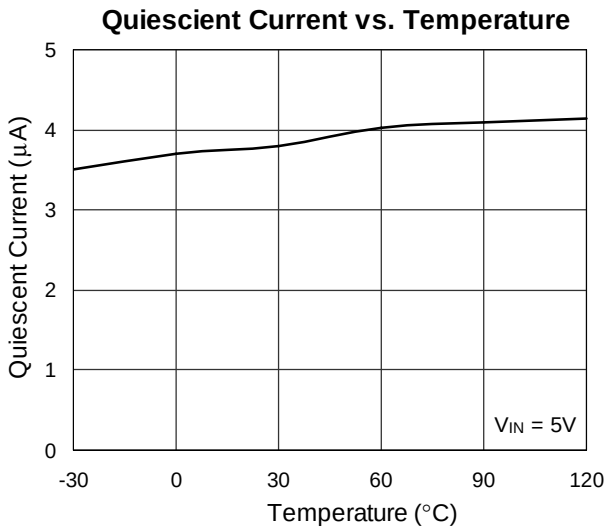
## Application Information

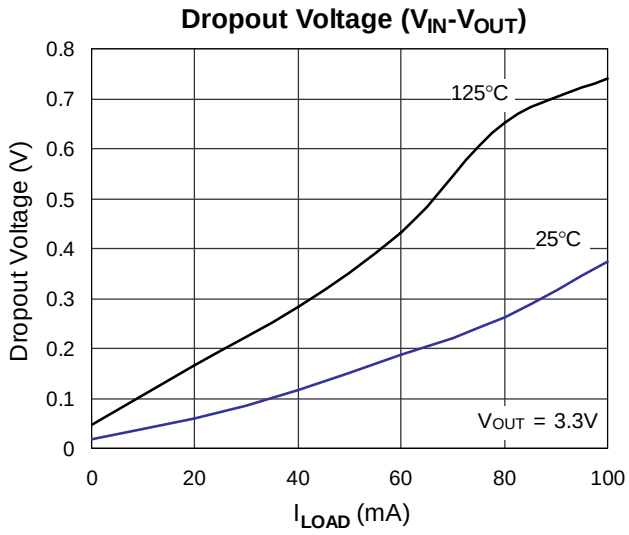
A 1µF (or larger) capacitor is recommended between $V_{OUT}$ and GND for stability. The part may oscillate without the capacitor. Any type of capacitor can be used, but not Aluminum electrolytes when operating below –25°C. The capacitance may be increased without limit.

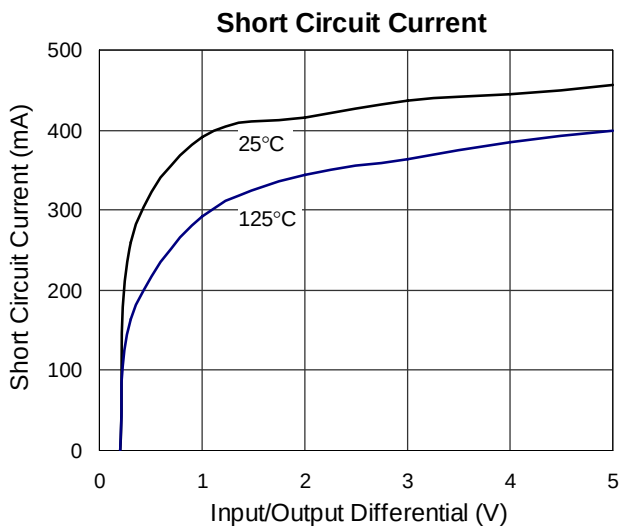
A 1µF capacitor (or larger) should be placed between $V_{IN}$ to GND.

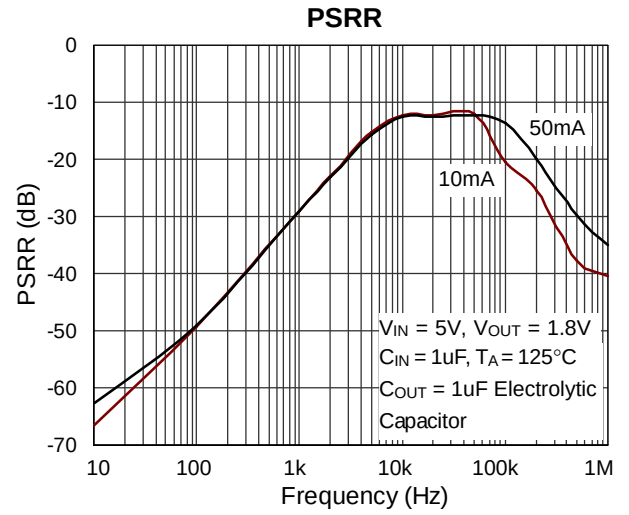
## Typical Operating Characteristics

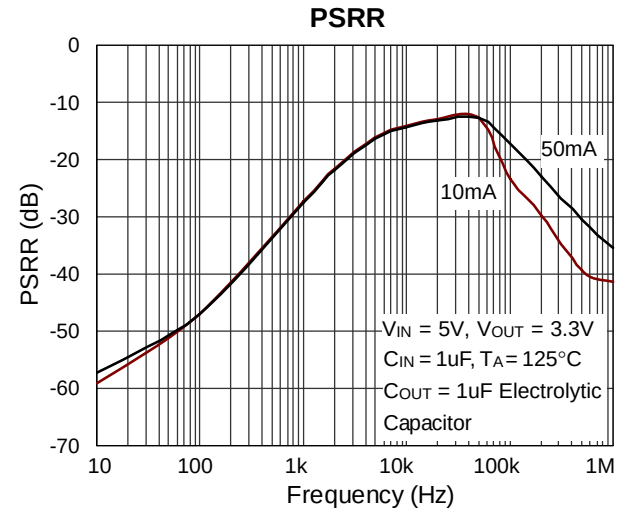


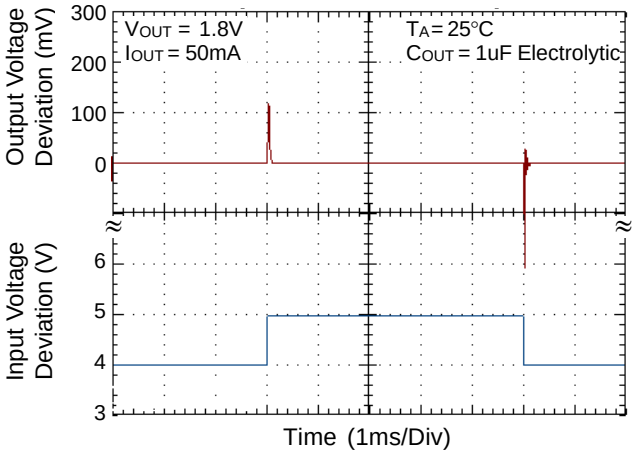



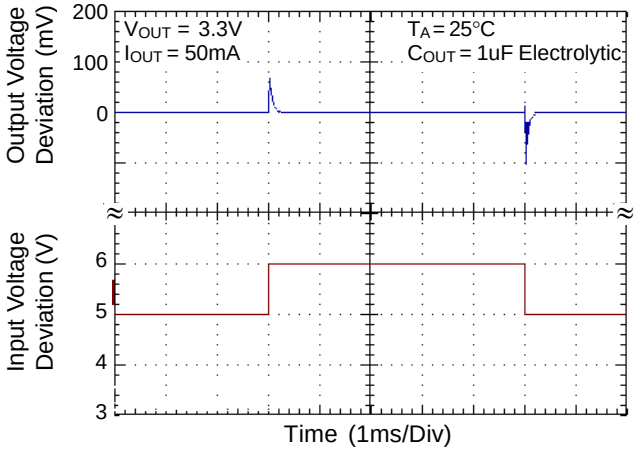



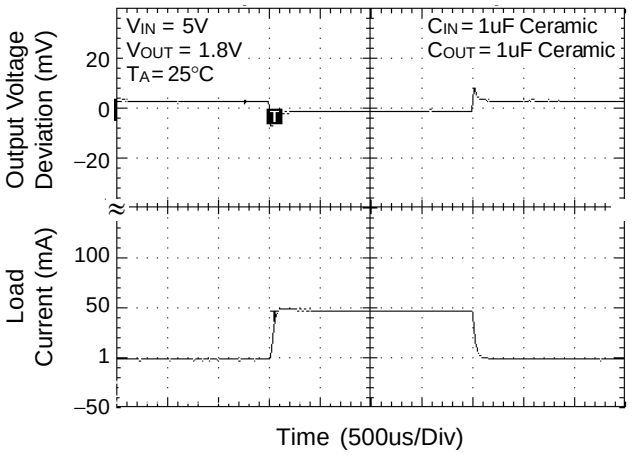
**Line Transient Response**



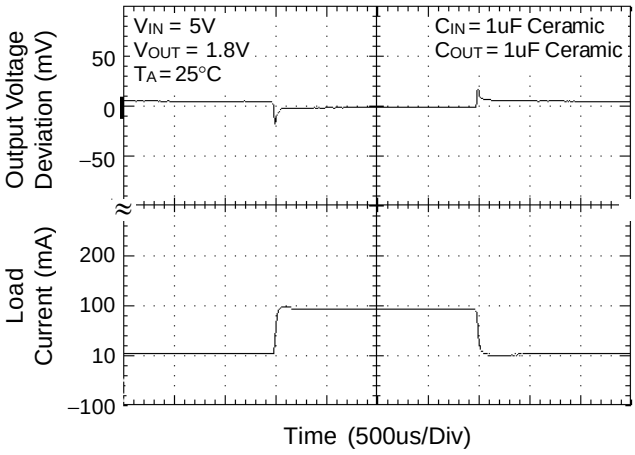

**Line Transient Response**



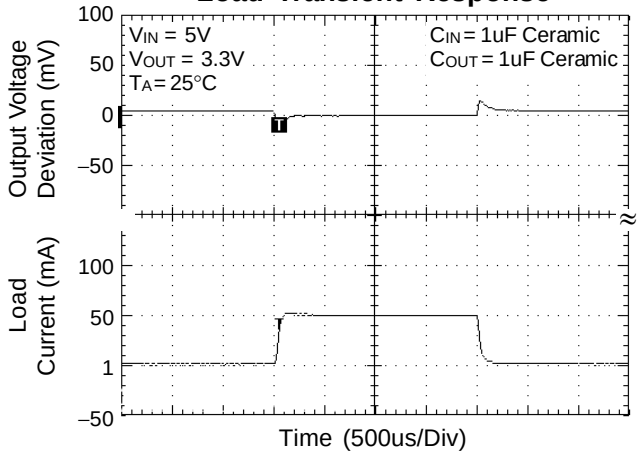

**Load Transient Response**



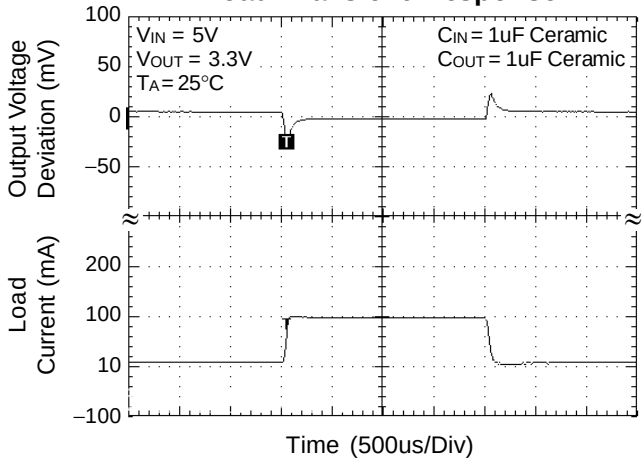

**Load Transient Response**



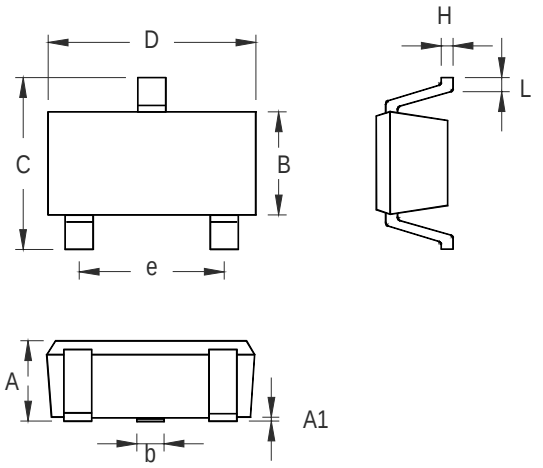

**Load Transient Response**




**Load Transient Response**

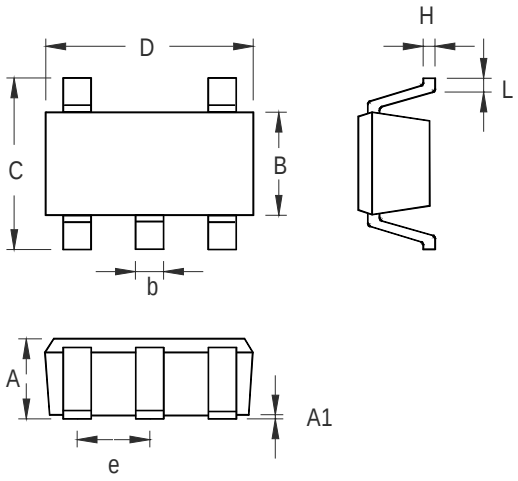


## Outline Dimension



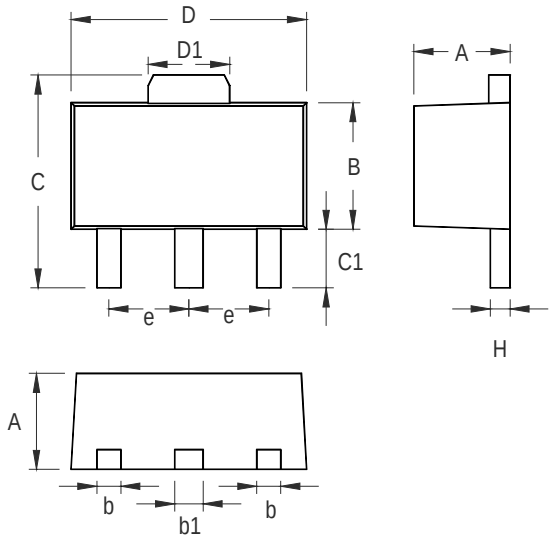

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 0.889 | 1.295 | 0.035 | 0.051 |
| A1 | 0.000 | 0.152 | 0.000 | 0.006 |
| B | 1.397 | 1.803 | 0.055 | 0.071 |
| b | 0.356 | 0.508 | 0.014 | 0.020 |
| C | 2.591 | 2.997 | 0.102 | 0.118 |
| D | 2.692 | 3.099 | 0.106 | 0.122 |
| e | 1.803 | 2.007 | 0.071 | 0.079 |
| H | 0.080 | 0.254 | 0.003 | 0.010 |
| L | 0.300 | 0.610 | 0.012 | 0.024 |

**SOT-23-3 Surface Mount Package**



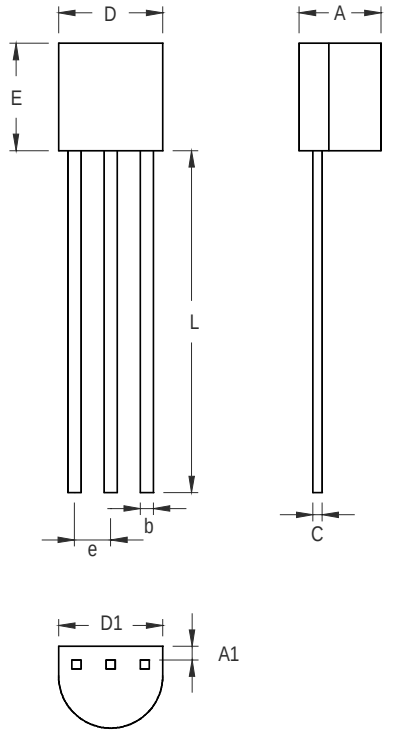

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 0.889 | 1.295 | 0.035 | 0.051 |
| A1 | 0.000 | 0.152 | 0.000 | 0.006 |
| B | 1.397 | 1.803 | 0.055 | 0.071 |
| b | 0.356 | 0.559 | 0.014 | 0.022 |
| C | 2.591 | 2.997 | 0.102 | 0.118 |
| D | 2.692 | 3.099 | 0.106 | 0.122 |
| e | 0.838 | 1.041 | 0.033 | 0.041 |
| H | 0.080 | 0.254 | 0.003 | 0.010 |
| L | 0.300 | 0.610 | 0.012 | 0.024 |

**SOT-23-5 Surface Mount Package**




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.397 | 1.600 | 0.055 | 0.063 |
| b | 0.356 | 0.483 | 0.014 | 0.019 |
| B | 2.388 | 2.591 | 0.094 | 0.102 |
| b1 | 0.406 | 0.533 | 0.016 | 0.021 |
| C | 3.937 | 4.242 | 0.155 | 0.167 |
| C1 | 0.787 | 1.194 | 0.031 | 0.047 |
| D | 4.394 | 4.597 | 0.173 | 0.181 |
| D1 | 1.397 | 1.753 | 0.055 | 0.069 |
| e | 1.448 | 1.549 | 0.057 | 0.061 |
| H | 0.356 | 0.432 | 0.014 | 0.017 |

**3-Lead SOT-89 Surface Mount Package**




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 3.175 | 4.191 | 0.125 | 0.165 |
| A1 | 1.143 | 1.372 | 0.045 | 0.054 |
| b | 0.406 | 0.533 | 0.016 | 0.021 |
| C | 0.406 | 0.533 | 0.016 | 0.021 |
| D | 4.445 | 5.207 | 0.175 | 0.205 |
| D1 | 3.429 | 5.029 | 0.135 | 0.198 |
| E | 4.318 | 5.334 | 0.170 | 0.210 |
| e | 1.143 | 1.397 | 0.045 | 0.055 |
| L | 12.700 | | 0.500 | |

**3-Lead TO-92 Plastic Package**


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