

**ZMR Series**  
**FIXED 2.5, 3.3 AND 5 VOLT MINIATURE VOLTAGE REGULATORS**

## Description

The ZMR series of three terminal fixed positive voltage regulators feature internal current limit and will shut down under thermal overload conditions making the devices difficult to destroy.

The circuit design offers an exceptionally low quiescent current, only 30 $\mu$ A for the 2.5V device, ideal for low power applications. The initial devices in the series regulate to 2.5 or 5V with a drive capability up to 50mA.

The device is designed with space saving in mind and is available in the small outline SOT23 package. The ZMR250 has expanded its input voltage range to 22.5V and the ZMR500 has expanded its input voltage range to 25V; equaling that of the ZMR25H and ZMR50H respectively.

The ZMR330 provides a 3.3V output over an input range of 5V to 24V.

## Features

- Small outline SOT23 package
- 2.5V, 3.3V and 5V output
- Output current up to 50mA
- Very low quiescent current (30 $\mu$ A)
- Unconditionally stable
- Internal short circuit current limit

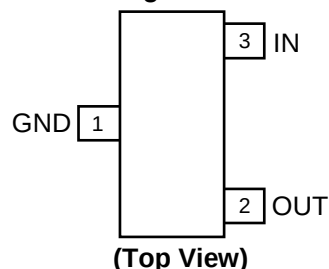
## Applications

- Small outline SOT23 package
- 2.5V, 3.3V, 5V output
- Output current up to 50mA
- Very low quiescent current (30 $\mu$ A)
- Unconditionally stable
- Internal short circuit current limit
- "Green" molding compound (No Br, Sb)

## Pin Assignments

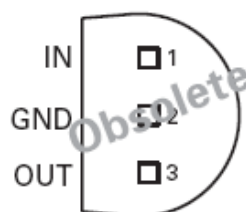
### SOT23

#### Package Suffix - F

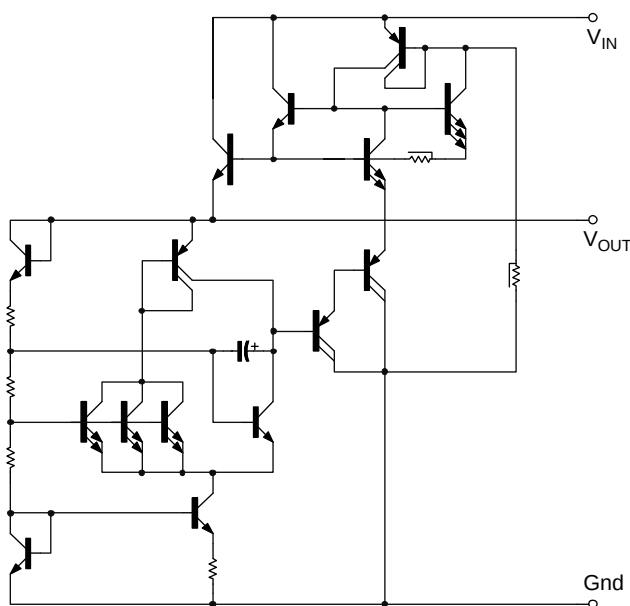


### TO92

#### Package Suffix - C



## Typical Application Circuit



## Absolute Maximum Ratings

| Parameter                                                              | Rating           | Unit               |
|------------------------------------------------------------------------|------------------|--------------------|
| Input Voltage<br>ZMR250<br>ZMR330<br>ZMR500                            | 22.5<br>24<br>25 | V                  |
| Power Dissipation ( $T_{AMB} = 25^{\circ}\text{C}$ ) (Note 3)<br>SOT23 | 500              | mW                 |
| Output Current ( $I_O$ )                                               | 100              | mA                 |
| Ambient Temperature                                                    | -55 to 125       | $^{\circ}\text{C}$ |
| Maximum Junction Temperature                                           | 125              | $^{\circ}\text{C}$ |
| Storage Temperature                                                    | -65 to 150       | $^{\circ}\text{C}$ |

- Notes:
1. The maximum operating input voltage and output current of the device will be governed by the maximum power dissipation of the selected package. Maximum package power dissipation is specified at  $25^{\circ}\text{C}$  and must be linearly derated to zero at  $T_{amb} = 125^{\circ}\text{C}$ .
  2. The following data represents pulse test conditions with junction temperatures as indicated at the initiation of the test. Continuous operation of the devices with the stated conditions might exceed the power dissipation limits of the chosen package.
  3. Maximum power dissipation for the SOT23 package, is calculated assuming that the device is mounted on a ceramic substrate measuring  $15 \times 15 \times 0.6\text{mm}$ .

## Recommended Operating Conditions

| Input Voltage Range | Min. | Max. | Unit |
|---------------------|------|------|------|
| ZMR250              | 4.2  | 22.5 | V    |
| ZMR330              | 4.8  | 24   | V    |
| ZMR500              | 7.0  | 25   | V    |

**Electrical Characteristics** (unless otherwise stated):  $T_J = 25^\circ\text{C}$ ,  $I_O = 10\text{mA}$ ,  $V_{IN} = 6.5\text{V}$

**ZMR250**

| Symbol                  | Parameter                                     | Condition                                                                                            | Min.  | Typ.     | Max.           | Unit                       |
|-------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------------------|-------|----------|----------------|----------------------------|
| $V_O$                   | Output voltage                                |                                                                                                      | 2.438 | 2.5      | 2.563          | V                          |
|                         |                                               | $I_O = 0$ to $50\text{mA}$<br>$T_J = -55$ to $125^\circ\text{C}$                                     | 2.360 |          | 2.640          | V                          |
|                         |                                               | $V_{IN} = 4.5$ to $22.5\text{V}$<br>$I_O = 0$ to $50\text{mA}$<br>$T_J = -55$ to $125^\circ\text{C}$ | 2.630 |          | 2.640          | V                          |
| $\Delta V_O$            | Line regulation                               | $V_{IN} = 4.5$ to $22.5\text{V}$                                                                     |       | 5        | 15             | mV                         |
| $\Delta V_O$            | Load regulation                               | $I_O = 0$ to $50\text{mA}$<br>$I_O = 0$ to $10\text{mA}$                                             |       | 20<br>12 | 30             | mV                         |
| $I_S$                   | Supply current                                | $T_J = -55$ to $125^\circ\text{C}$                                                                   |       | 30       | 40             | $\mu\text{A}$              |
| $\Delta I_S$            | Supply current change                         | $I_O = 0$ to $50\text{mA}$<br>$V_{IN} = 4.5$ to $22.5\text{V}$                                       |       | 1<br>2   | $\pm 10$<br>10 | $\mu\text{A}$              |
| $V_N$                   | Output noise voltage                          | $f = 10\text{Hz}$ to $10\text{kHz}$                                                                  |       | 65       |                | $\mu\text{V rms}$          |
| $\Delta V_{IN} / V_O$   | Ripple rejection                              | $V_{IN} = 6.3$ to $18\text{V}$<br>$f = 120\text{Hz}$                                                 | 55    | 75       |                | dB                         |
| $V_{IN}$                | Input voltage required to maintain regulation |                                                                                                      |       | 3.9      |                | V                          |
| $\Delta V_O / \Delta T$ | Average temperature coefficient of $V_O$      | $I_O = 5.0\text{mA}$<br>$T_J = -55$ to $125^\circ\text{C}$                                           |       | 0.275    | 0.700          | $\text{mV}/^\circ\text{C}$ |

**Electrical Characteristics** (unless otherwise stated):  $T_J = 25^\circ\text{C}$ ,  $I_O = 10\text{mA}$ ,  $V_{IN} = 7\text{V}$

**ZMR330**

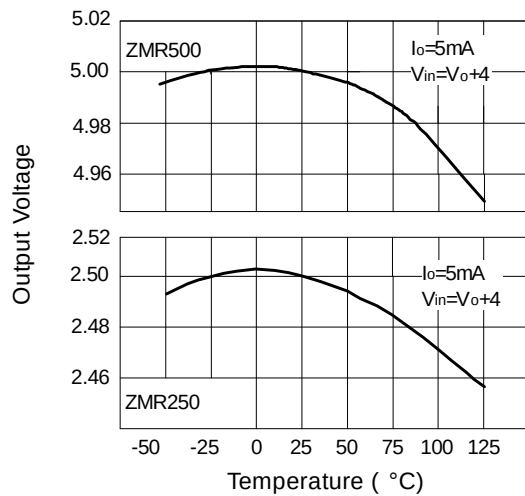
| Symbol                | Parameter                                     | Condition                                                                      | Min.  | Typ.     | Max.     | Unit              |
|-----------------------|-----------------------------------------------|--------------------------------------------------------------------------------|-------|----------|----------|-------------------|
| $V_O$                 | Output voltage                                |                                                                                | 3.217 | 3.3      | 3.383    | V                 |
|                       |                                               | $I_O = 0$ to 50mA<br>$T_J = -55$ to $125^\circ\text{C}$                        | 3.148 |          | 3.393    | V                 |
|                       |                                               | $V_{IN} = 5$ to 24V<br>$I_O = 0$ to 50mA<br>$T_J = -55$ to $125^\circ\text{C}$ | 3.148 |          | 3.408    | V                 |
| $\Delta V_O$          | Line regulation                               | $V_{IN} = 5$ to 24V                                                            |       | 5        | 15       | mV                |
| $\Delta V_O$          | Load regulation                               | $I_O = 0$ to 50mA<br>$I_O = 0$ to 10mA                                         |       | 20<br>13 | 30       | mV                |
| $I_S$                 | Supply current                                | $T_J = -55$ to $125^\circ\text{C}$                                             |       | 120      | 170      | $\mu\text{A}$     |
| $\Delta I_S$          | Supply current change                         | $I_O = 0$ to 50mA<br>$V_{IN} = 5$ to 20V                                       |       | 5<br>2   | 10<br>10 | $\mu\text{A}$     |
| $V_N$                 | Output noise voltage                          | $f = 10\text{Hz}$ to $10\text{kHz}$                                            |       | 80       |          | $\mu\text{V rms}$ |
| $\Delta V_{IN} / V_O$ | Ripple rejection                              | $V_{IN} = 6$ to 20V<br>$f = 120\text{Hz}$                                      | 55    |          |          | dB                |
| $V_{IN}$              | Input voltage required to maintain regulation | $V_{OUT} = 3.217\text{V}$                                                      |       | 4.74     |          | V                 |

**Electrical Characteristics** (unless otherwise stated):  $T_J = 25^\circ\text{C}$ ,  $I_O = 10\text{mA}$ ,  $V_{IN} = 10\text{V}$

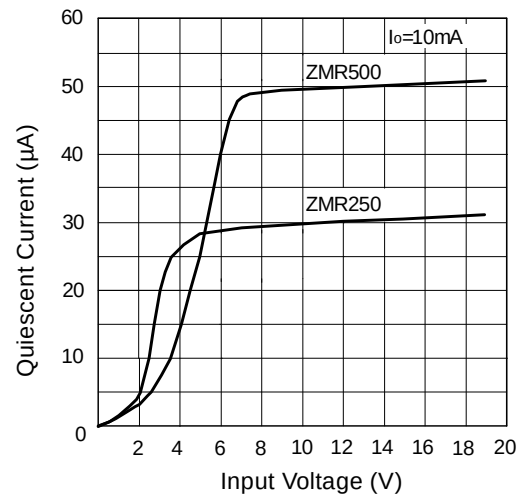
**ZMR500**

| Symbol                  | Parameter                                     | Condition                                                                                        | Min.  | Typ.     | Max.           | Unit                       |
|-------------------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------|-------|----------|----------------|----------------------------|
| $V_O$                   | Output voltage                                |                                                                                                  | 4.785 | 5        | 5.125          | V                          |
|                         |                                               | $I_O = 0$ to $50\text{mA}$<br>$T_J = -55$ to $125^\circ\text{C}$                                 | 4.780 |          | 5.160          | V                          |
|                         |                                               | $V_{IN} = 7$ to $25\text{V}$<br>$I_O = 0$ to $50\text{mA}$<br>$T_J = -55$ to $125^\circ\text{C}$ | 4.780 |          | 5.175          | V                          |
| $\Delta V_O$            | Line regulation                               | $V_{IN} = 7$ to $25\text{V}$                                                                     |       | 5        | 15             | mV                         |
| $\Delta V_O$            | Load regulation                               | $I_O = 0$ to $50\text{mA}$<br>$I_O = 0$ to $10\text{mA}$                                         |       | 25<br>15 | 40             | mV                         |
| $I_S$                   | Supply current                                | $T_J = -55$ to $125^\circ\text{C}$                                                               |       | 50       | 70             | $\mu\text{A}$              |
| $\Delta I_S$            | Supply current change                         | $I_O = 0$ to $50\text{mA}$<br>$V_{IN} = 7$ to $25\text{V}$                                       |       | 1<br>2   | $\pm 10$<br>10 | $\mu\text{A}$              |
| $V_N$                   | Output noise voltage                          | $f = 10\text{Hz}$ to $10\text{kHz}$                                                              |       | 90       |                | $\mu\text{V rms}$          |
| $\Delta V_{IN} / V_O$   | Ripple rejection                              | $V_{IN} = 8$ to $18\text{V}$<br>$f = 120\text{Hz}$                                               | 55    | 72       |                | dB                         |
| $V_{IN}$                | Input voltage required to maintain regulation |                                                                                                  |       | 6.7      |                | V                          |
| $\Delta V_O / \Delta T$ | Average temperature coefficient of $V_O$      | $I_O = 5.0\text{mA}$<br>$T_J = -55$ to $125^\circ\text{C}$                                       |       | 0.275    | 0.700          | $\text{mV}/^\circ\text{C}$ |

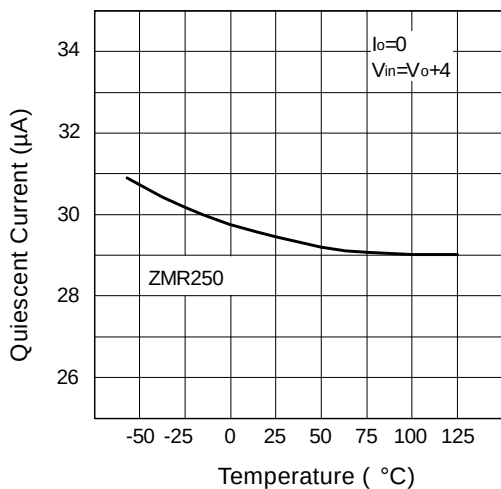
## Typical Characteristics



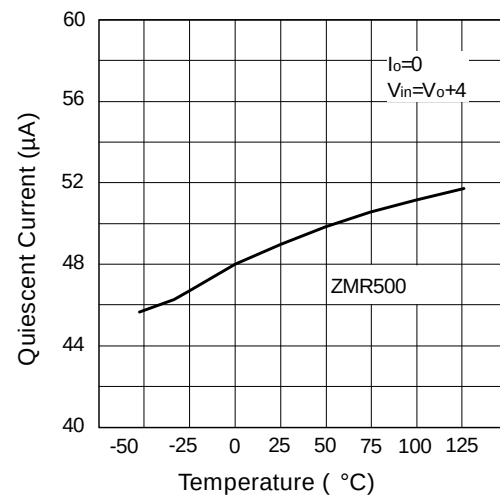
Output Voltage Temperature



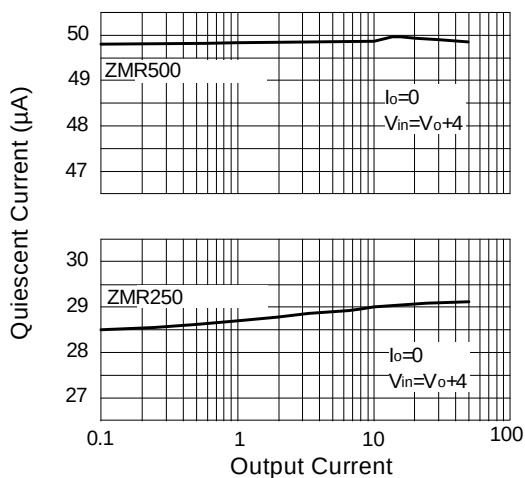
Quiescent Current v Voltage



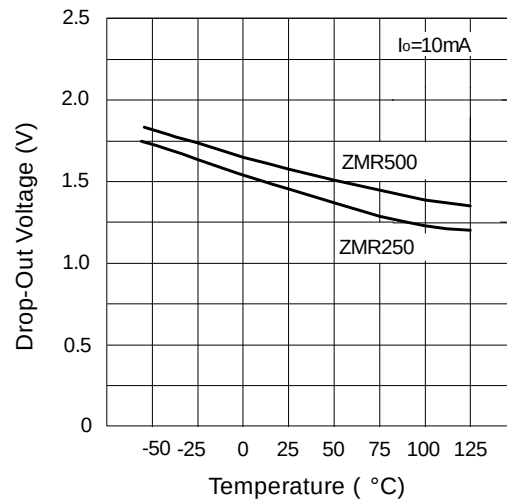
Quiescent Current v Temperature



Quiescent Current v Temperature

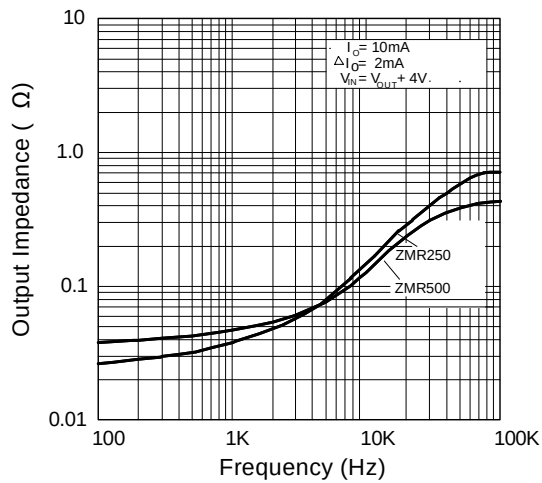


Quiescent Current v Output Current

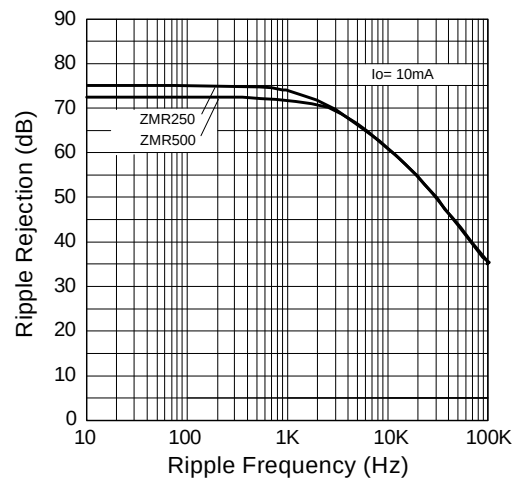


Drop-Out Voltage v Temperature

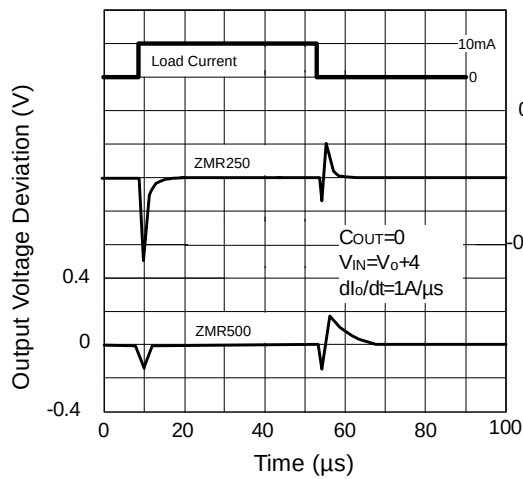
## Typical Characteristics (cont.)



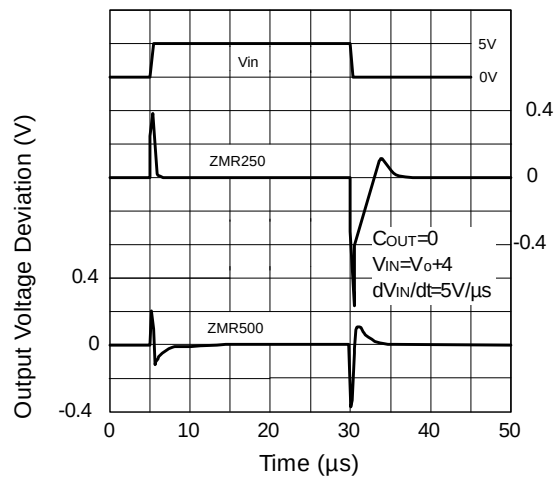
Output Impedance v Frequency



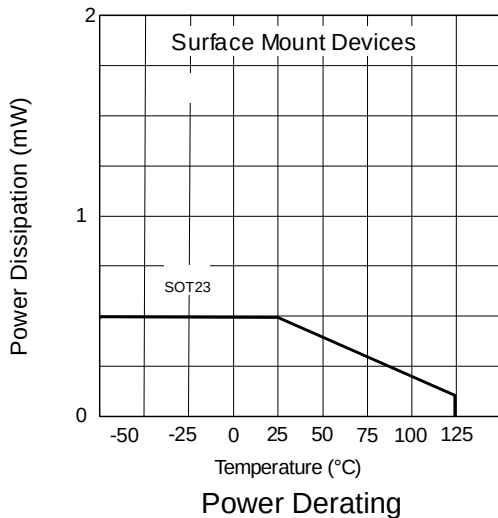
Ripple Rejection v Ripple Frequency



Load Transient Response



Line Transient Response



Power Derating

## Ordering Information

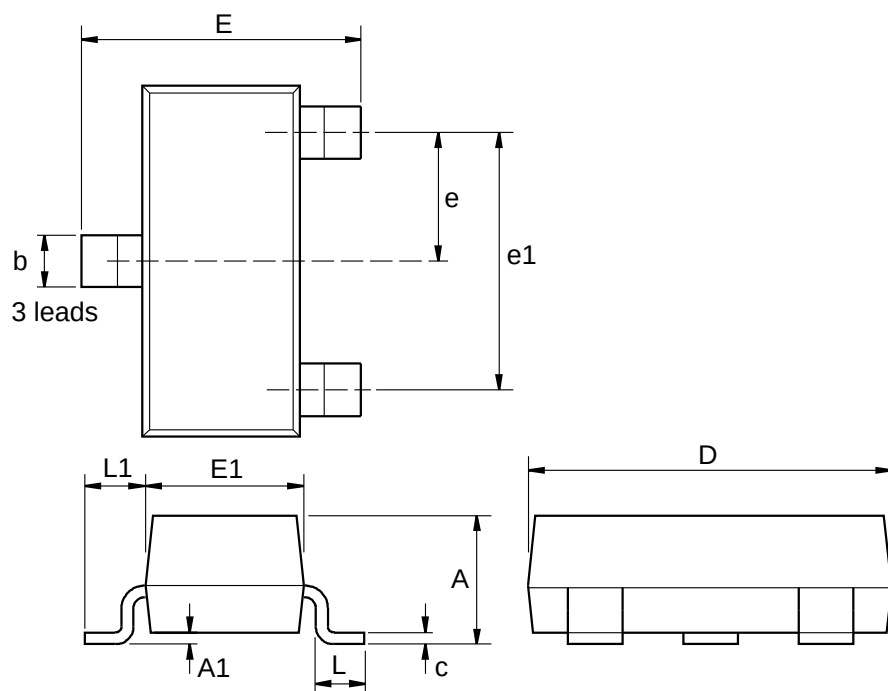
| Part Number | Package | Part Mark | Status                               | Reel Size (inches) | Quantity per reel | Tape Width (mm) |
|-------------|---------|-----------|--------------------------------------|--------------------|-------------------|-----------------|
| ZMR25HFTA   | SOT23   | 25X       | Obsolete<br>replaced by<br>ZMR250FTA | 7"                 | 3000              | 8mm             |
| ZMR50HFTA   | SOT23   | 50R       | Obsolete<br>replaced by<br>ZMR500FTA | 7"                 | 3000              | 8mm             |
| ZMR250FTA   | SOT23   | 25K       | Released                             | 7"                 | 3000              | 8mm             |
| ZMR330FTA   | SOT23   | 330       | Released                             | 7"                 | 3000              | 8mm             |
| ZMR330F-7*  | SOT23   | 330       | Released                             | 7"                 | 3000              | 8mm             |
| ZMT500FTA   | SOT23   | 50K       | Released                             | 7"                 | 3000              | 8mm             |

Notes: \*ZMR330F-7 is in Halogen free molding compound  
All TO92 variants (ZMRxxxC) are obsolete. Closest replacements are the ZMRxxxFTA.



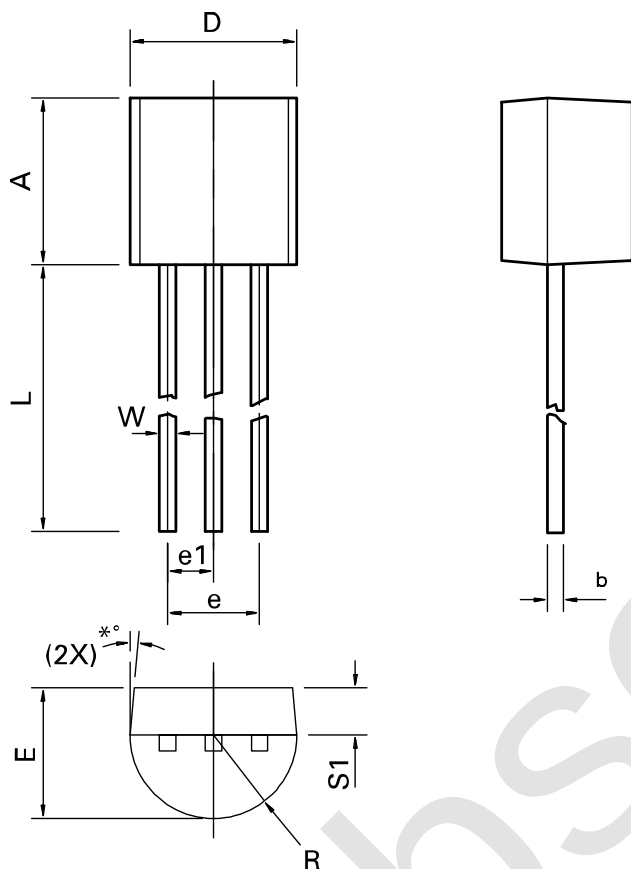
## Package Outline Dimensions

### SOT23



| Dim. | Millimeters |      | Inches    |       | Dim. | Millimeters |      | Inches    |        |
|------|-------------|------|-----------|-------|------|-------------|------|-----------|--------|
|      | Min.        | Max. | Min.      | Max.  |      | Min.        | Max. | Min.      | Max.   |
| A    | -           | 1.12 | -         | 0.044 | e1   | 1.90 NOM    |      | 0.075 NOM |        |
| A1   | 0.01        | 0.10 | 0.0004    | 0.004 | E    | 2.10        | 2.64 | 0.083     | 0.104  |
| b    | 0.30        | 0.50 | 0.012     | 0.020 | E1   | 1.20        | 1.40 | 0.047     | 0.055  |
| c    | 0.085       | 0.20 | 0.003     | 0.008 | L    | 0.25        | 0.60 | 0.0098    | 0.0236 |
| D    | 2.80        | 3.04 | 0.110     | 0.120 | L1   | 0.45        | 0.62 | 0.018     | 0.024  |
| e    | 0.95 NOM    |      | 0.037 NOM |       | -    | -           | -    | -         | -      |

Notes: Controlling dimensions are in millimeters. Approximate dimensions are provided in inches

**Package Outline Dimensions (cont.)**
**TO92**


| Dim. | Millimeters |       | Inches |       | Dim. | Millimeters |             | Inches |              |
|------|-------------|-------|--------|-------|------|-------------|-------------|--------|--------------|
|      | Min.        | Max.  | Min.   | Max.  |      | Min.        | Max.        | Min.   | Max.         |
| A    | 4.32        | 4.95  | 0.170  | 0.195 | R    | 2.16        | <b>2.41</b> | 0.085  | <b>0.095</b> |
| b    | 0.36        | 0.51  | 0.014  | 0.020 | S1   | 1.14        | 1.52        | 0.045  | 0.060        |
| E    | 3.30        | 3.94  | 0.130  | 0.155 | W    | 0.41        | 0.56        | 0.016  | 0.022        |
| e    | 2.41        | 2.67  | 0.095  | 0.105 | D    | 4.45        | 4.95        | 0.175  | 0.195        |
| e1   | 1.14        | 1.40  | 0.045  | 0.055 | *°   | 4°          | 6°          | 4°     | 6°           |
| L    | 12.70       | 15.49 | 0.500  | 0.610 |      |             |             |        |              |

Notes: Controlling dimensions are in millimeters. Approximate dimensions are provided in inches

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