

2.5V MICROPOWER SHUNT VOLTAGE REFERENCE

- 2.5V OUTPUT VOLTAGE
- ULTRA LOW CURRENT CONSUMPTION:
40µA TYP.
- HIGH PRECISION @ 25°C
±2% and ±1%
- HIGH STABILITY WHEN USED WITH
CAPACITIVE LOAD
- INDUSTRIAL TEMPERATURE RANGE:
-40 to +85°C
- 150ppm/°C MAXIMUM TEMPERATURE
COEFFICIENT

DESCRIPTION

The TS4040 is a low power shunt voltage reference providing a stable 2.5V output voltage over the industrial temperature range (-40 to +85°C). Available in SOT23-3 surface mount package, it can be designed in applications where space saving is a critical issue.

The low operating current is a key advantage for power restricted designs. In addition, the TS4040 is very stable and can be used in a broad range of application conditions.

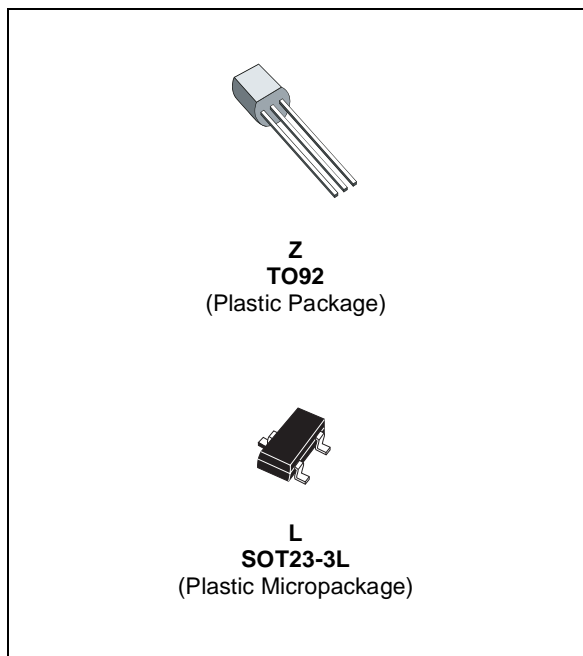
APPLICATION

- Computers
- Instrumentation
- Battery chargers
- Switch Mode Power Supply
- Battery operated equipments

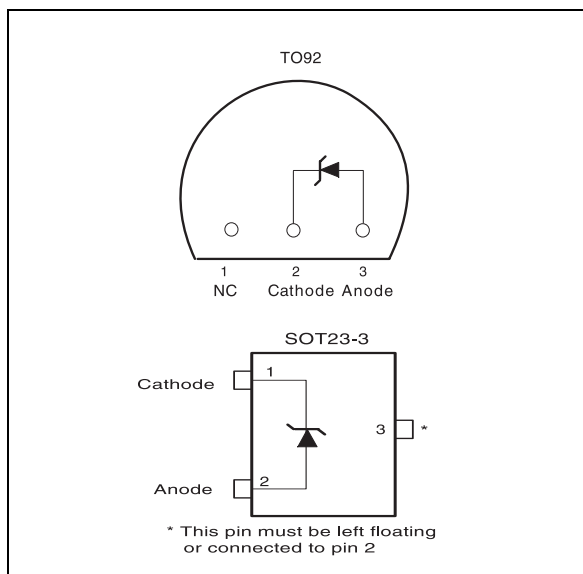
ORDER CODE

| Precision | TO92 | SOT23-3 | SOT23 Marking |
|--|---------------|----------------|---------------|
| 2% | TS4040EIZ-2.5 | TS4040EILT-2.5 | L243 |
| 1% | TS4040DIZ-2.5 | TS4040DILT-2.5 | L242 |
| Single temperature range: -40 to +85°C | | | |

Z = TO92 Plastic package - also available in Bulk (Z), Tape & Reel (ZT) and Ammo Pack (AP)
 LT = Tiny Package (SOT23-3) - only available in Tape & Reel (LT)



PIN CONNECTIONS (top view)



ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|-----------|--|-------------|------|
| I_k | Reverse Breakdown Current | 20 | mA |
| I_f | Forward Current | 10 | mA |
| P_d | Power Dissipation ¹⁾ SOT23-3 TO92 | 360 625 | mW |
| T_{std} | Storage Temperature | -65 to +150 | °C |
| ESD | Human Body Model (HBM) | 2 | kV |
| | Machine Model (MM) | 200 | V |
| Tlead | Lead Temperature (soldering, 10 seconds) | 260 | °C |

1. P_d has been calculated with $T_{amb} = 25^{\circ}\text{C}$, $T_{junction} = 150^{\circ}\text{C}$ and $R_{thja} = 200^{\circ}\text{C/W}$ for the TO92 package
 $R_{thja} = 340^{\circ}\text{C/W}$ for the SOT23-3 package

OPERATING CONDITIONS

| Symbol | Parameter | Value | Unit |
|------------|--------------------------------------|------------|---------------|
| I_{kmin} | Minimum Operating Current | 60 | μA |
| I_{kmax} | Maximum Operating Current | 15 | mA |
| T_{oper} | Operating Free Air Temperature Range | -40 to +85 | °C |

ELECTRICAL CHARACTERISTICS**TS4040E (2% Precision)**

Tamb = 25°C (unless otherwise specified)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|----------------------------------|---|---|------------|------|------------|----------------------------|
| Vk | Reverse Breakdown Voltage | $I_k = 100\mu\text{A}$ | 2.45 | 2.5 | 2.55 | V |
| | Reverse Breakdown Voltage Tolerance | $I_k = 100\mu\text{A}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$ | -50 -74 | | 50 74 | mV |
| Ikmin | Minimum Operating Current | $T = 25^\circ\text{C}$ | | 40 | 65 | μA |
| | | $-40^\circ\text{C} < T < +85^\circ\text{C}$ | | | 70 | |
| $\Delta V_{\text{ref}}/\Delta T$ | Average Temperature Coefficient | $I_k = 100\mu\text{A}$ | | 30 | 150 | ppm/°C |
| $\Delta V_k/\Delta I_k$ | Reverse Breakdown Voltage Change with Operating Current Range | $I_{k\text{min}} < I_k < 1\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$ | | 0.4 | 1 1.2 | mV |
| | | $1\text{mA} < I_k < 15\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$ | | 2.5 | 8 10 | |
| Rka | Reverse Static Impedance | $I_k = I_{k\text{min}} \text{ to } 1\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$ | | 0.4 | 1 1.2 | Ω |
| | | $I_k = 1 \text{ to } 15\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$ | | 0.2 | 0.6 0.7 | |
| Kvh | Long Term Stability | $I_k = 100\mu\text{A}$, $t = 1000\text{hrs}$ | | 120 | | ppm |
| En | Wide Band Noise | $I_k = 100\mu\text{A}$ $10\text{Hz} < f < 10\text{kHz}$ | | 35 | | μV_{rms} |

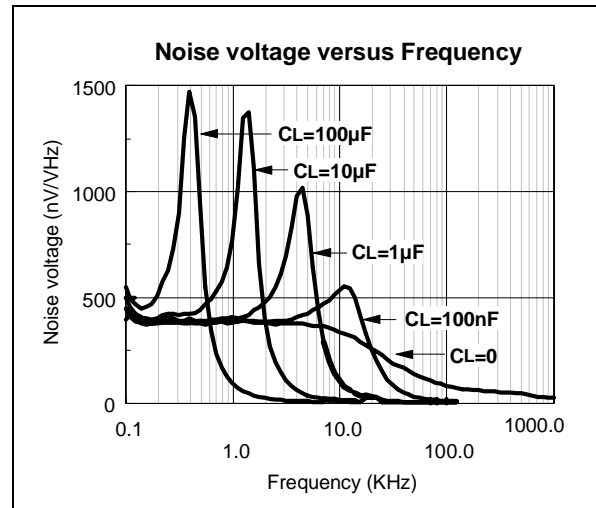
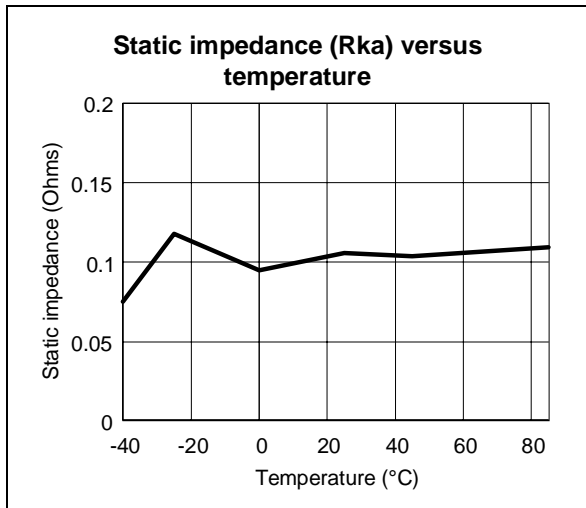
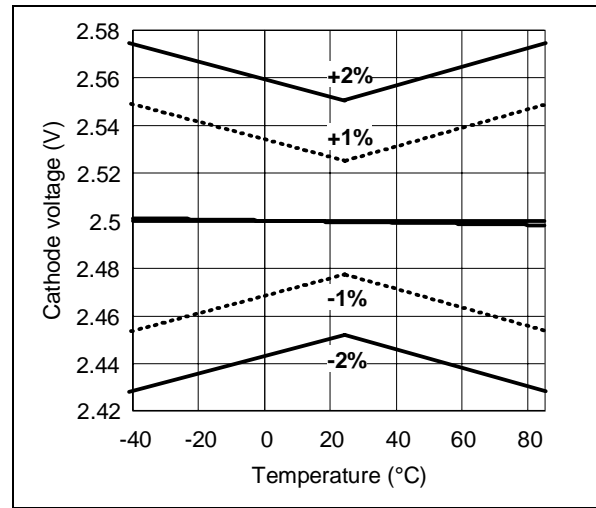
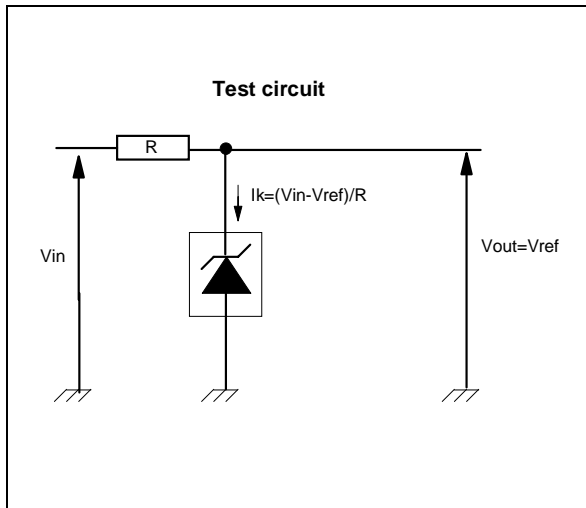
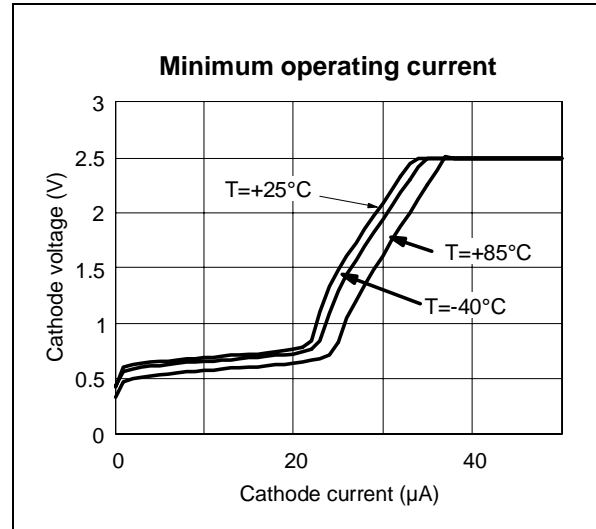
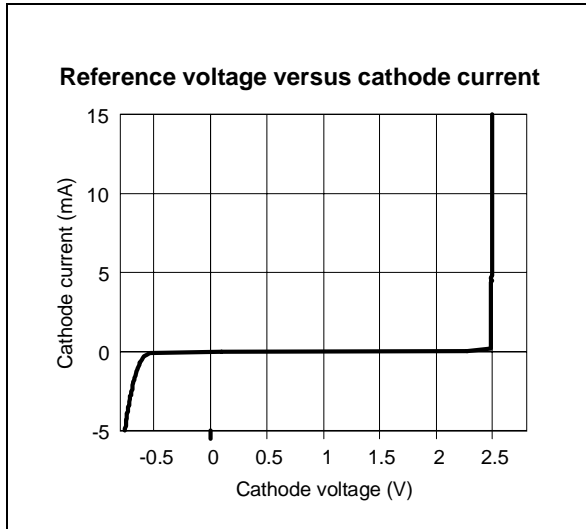
Note: Limits are 100% production tested at 25°C. Limits over temperature are guaranteed through correlation and by design.

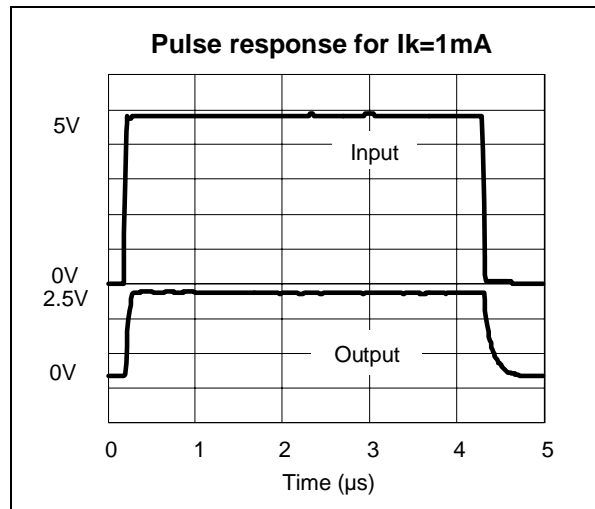
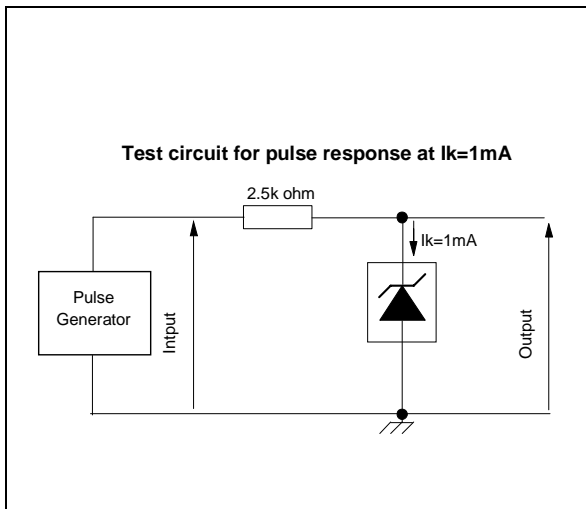
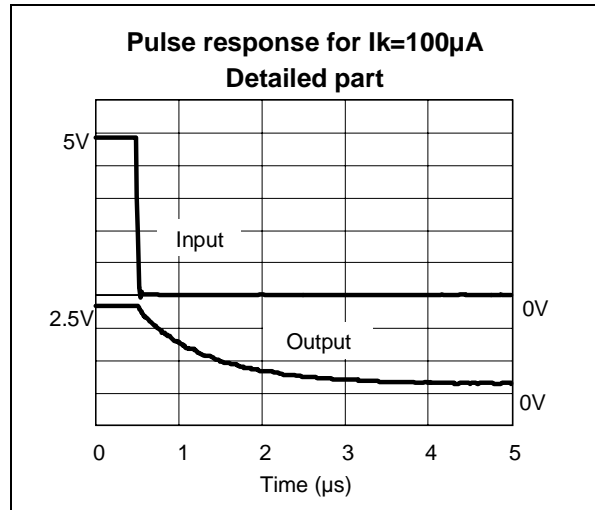
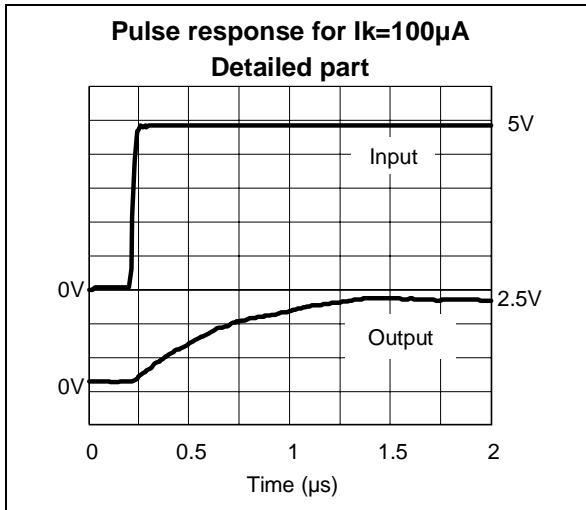
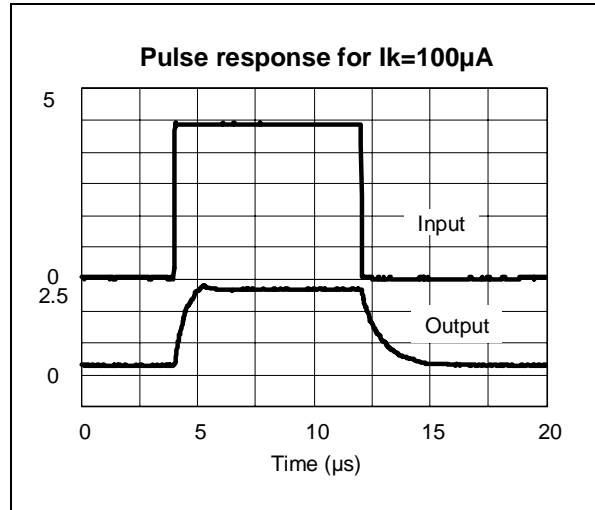
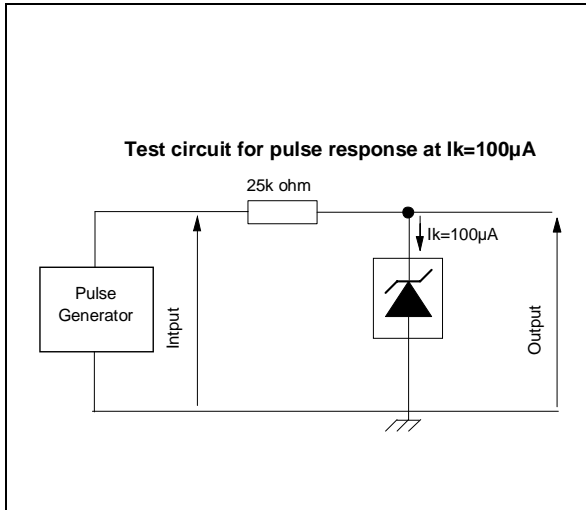
ELECTRICAL CHARACTERISTICS**TS4040D (1% Precision)**

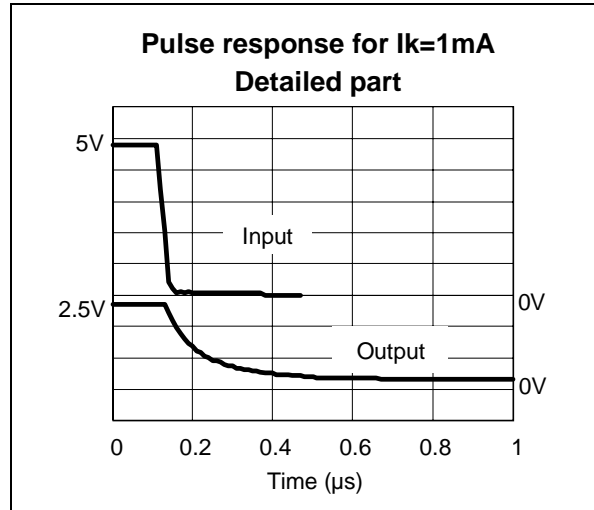
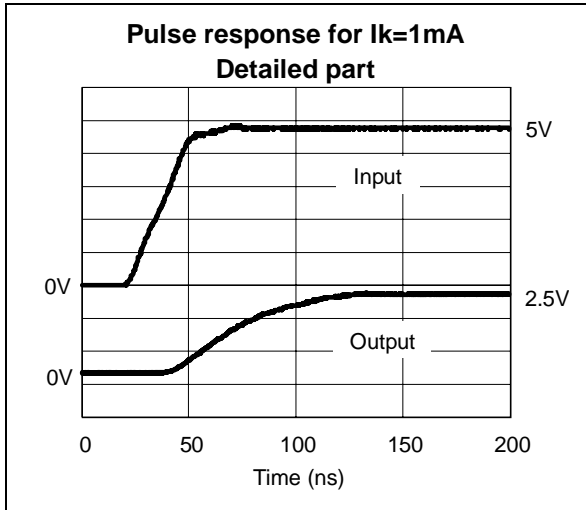
Tamb = 25°C (unless otherwise specified)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|----------------------------------|---|---|------------|------|------------|----------------------------|
| Vk | Reverse Breakdown Voltage | $I_k = 100\mu\text{A}$ | 2.475 | 2.5 | 2.525 | V |
| | Reverse Breakdown Voltage Tolerance | $I_k = 100\mu\text{A}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$ | -25 -49 | | 25 49 | mV |
| Ikmin | Minimum Operating Current | $T = 25^\circ\text{C}$ | | 40 | 65 | μA |
| | | $-40^\circ\text{C} < T < +85^\circ\text{C}$ | | | 70 | |
| $\Delta V_{\text{ref}}/\Delta T$ | Average Temperature Coefficient | $I_k = 100\mu\text{A}$ | | 30 | 150 | ppm/°C |
| $\Delta V_k/\Delta I_k$ | Reverse Breakdown Voltage Change with Operating Current Range | $I_{k\text{min}} < I_k < 1\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$ | | 0.4 | 1 1.2 | mV |
| | | $1\text{mA} < I_k < 15\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$ | | 2.5 | 8 10 | |
| Rka | Reverse Static Impedance | $I_k = I_{k\text{min}} \text{ to } 1\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$ | | 0.4 | 1 1.2 | Ω |
| | | $I_k = 1\text{mA} \text{ to } 15\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$ | | 0.2 | 0.6 0.7 | |
| Kvh | Long Term Stability | $I_k = 100\mu\text{A}$, $t = 1000\text{hrs}$ | | 120 | | ppm |
| En | Wide Band Noise | $I_k = 100\mu\text{A}$ $10\text{Hz} < f < 10\text{kHz}$ | | 35 | | μV_{rms} |

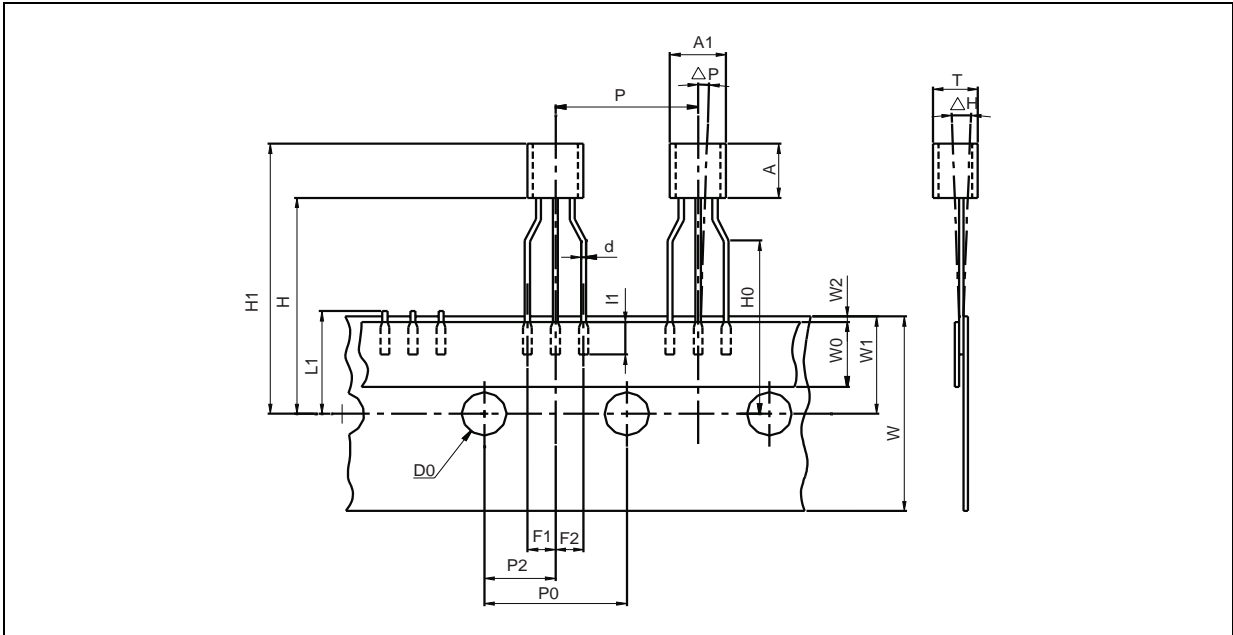
Note: Limits are 100% production tested at 25°C. Limits over temperature are guaranteed through correlation and by design.





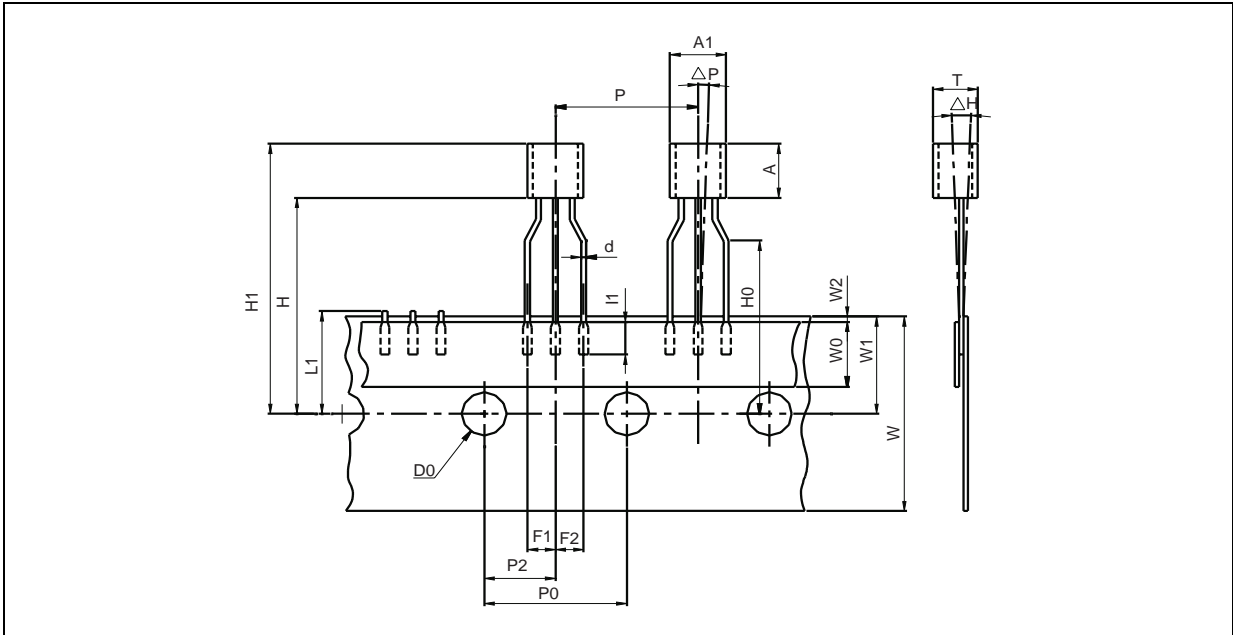


PACKAGE MECHANICAL DATA
3 PINS - PLASTIC PACKAGE TO92 (TAPE & REEL)



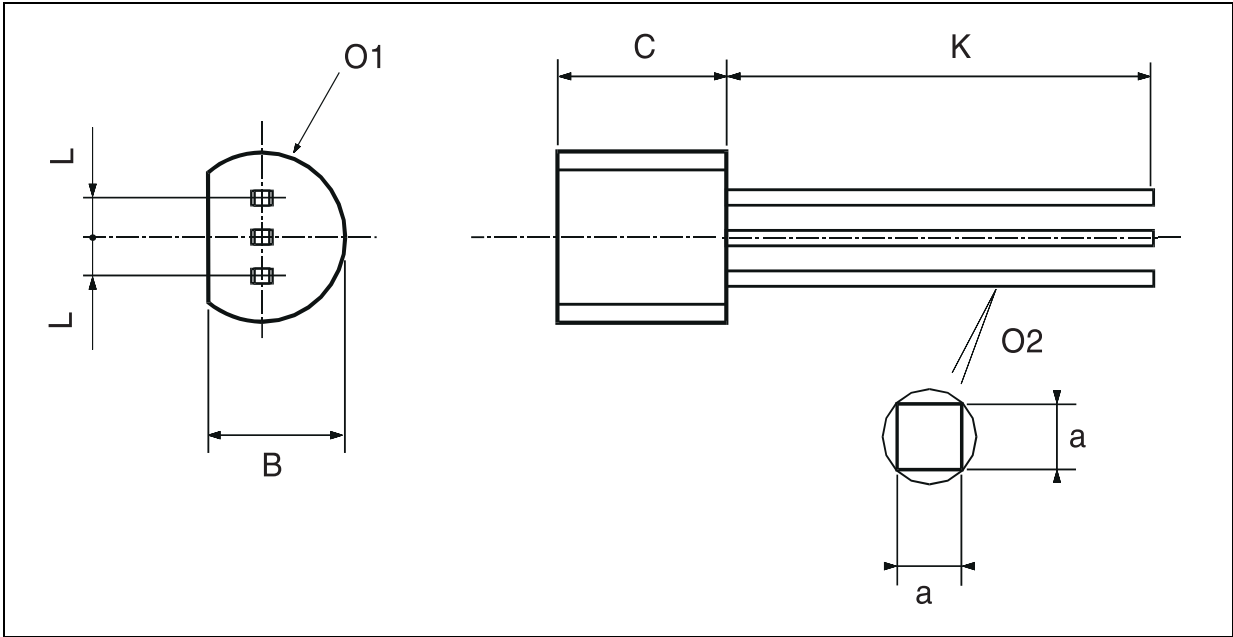
| Dim. | Millimeters | | | Inches | | |
|-------|-------------|------|------|--------|-------|-------|
| | Min | Typ. | Max. | Min. | Typ. | Max. |
| AL | | | 5.0 | | | 0.197 |
| A | | | 5.0 | | | 0.197 |
| T | | | 4.0 | | | 0.157 |
| d | | 0.45 | | | 0.018 | |
| l1 | 2.5 | | | 0.098 | | |
| P | 11.7 | 12.7 | 13.7 | 0.461 | 0.500 | 0.539 |
| PO | 12.4 | 12.7 | 13 | 0.488 | 0.500 | 0.512 |
| P2 | 5.95 | 6.35 | 6.75 | 0.234 | 0.250 | 0.266 |
| F1/F2 | 2.4 | 2.5 | 2.8 | 0.094 | 0.098 | 0.110 |
| Δh | -1 | 0 | 1 | -0.039 | 0 | 0.039 |
| ΔP | -1 | 0 | 1 | -0.039 | 0 | 0.039 |
| W | 17.5 | 18.0 | 19.0 | 0.689 | 0.709 | 0.748 |
| W0 | 5.7 | 6 | 6.3 | 0.224 | 0.236 | 0.248 |
| W1 | 8.5 | 9 | 9.75 | 0.335 | 0.354 | 0.384 |
| W2 | | | 0.5 | | | 0.020 |
| H | | | 20 | | | 0.787 |
| H0 | 15.5 | 16 | 16.5 | 0.610 | 0.630 | 0.650 |
| H1 | | | 25 | | | 0.984 |
| DO | 3.8 | 4.0 | 4.2 | 0.150 | 0.157 | 0.165 |
| L1 | | | 11 | | | 0.433 |

PACKAGE MECHANICAL DATA
3 PINS - PLASTIC PACKAGE TO92 (TAPE AMMO PACK)



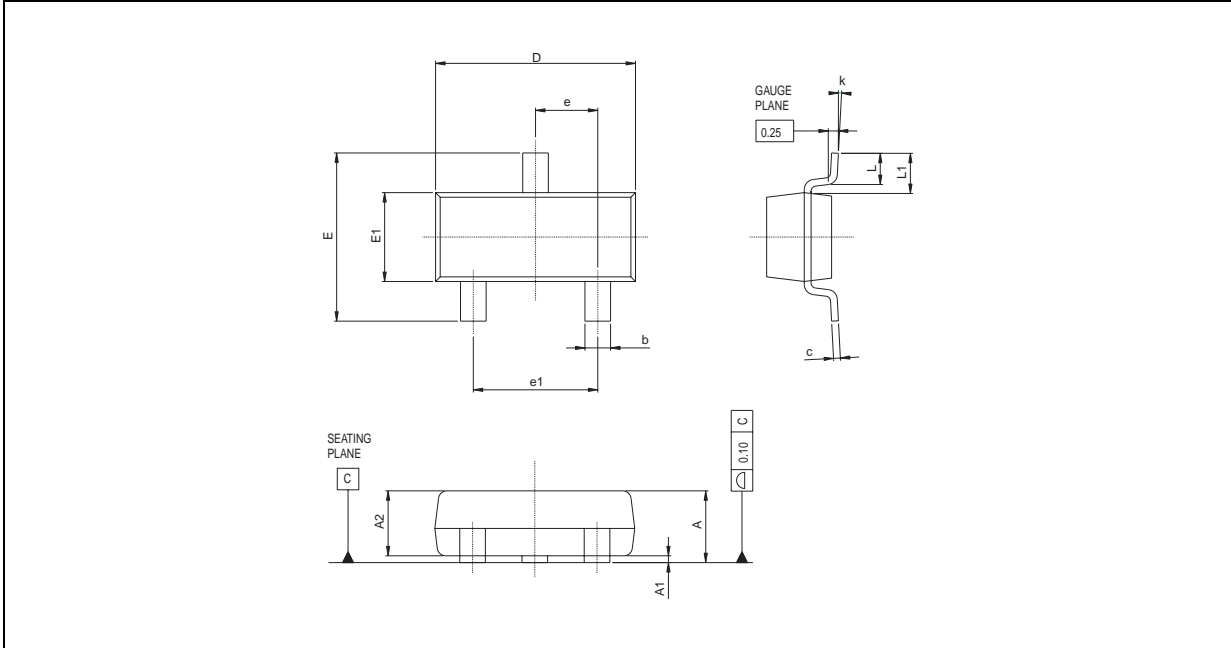
| Dim. | Millimeters | | | Inches | | |
|-------|-------------|------|------|--------|-------|-------|
| | Min | Typ. | Max. | Min. | Typ. | Max. |
| AL | | | 5.0 | | | 0.197 |
| A | | | 5.0 | | | 0.197 |
| T | | | 4.0 | | | 0.157 |
| d | | 0.45 | | | 0.018 | |
| l1 | 2.5 | | | 0.098 | | |
| P | 11.7 | 12.7 | 13.7 | 0.461 | 0.500 | 0.539 |
| PO | 12.4 | 12.7 | 13 | 0.488 | 0.500 | 0.512 |
| P2 | 5.95 | 6.35 | 6.75 | 0.234 | 0.250 | 0.266 |
| F1/F2 | 2.4 | 2.5 | 2.8 | 0.094 | 0.098 | 0.110 |
| Δh | -1 | 0 | 1 | -0.039 | 0 | 0.039 |
| ΔP | -1 | 0 | 1 | -0.039 | 0 | 0.039 |
| W | 17.5 | 18.0 | 19.0 | 0.689 | 0.709 | 0.748 |
| W0 | 5.7 | 6 | 6.3 | 0.224 | 0.236 | 0.248 |
| W1 | 8.5 | 9 | 9.75 | 0.335 | 0.354 | 0.384 |
| W2 | | | 0.5 | | | 0.020 |
| H | | | 20 | | | 0.787 |
| H0 | 15.5 | 16 | 16.5 | 0.610 | 0.630 | 0.650 |
| H1 | | | 25 | | | 0.984 |
| DO | 3.8 | 4.0 | 4.2 | 0.150 | 0.157 | 0.165 |
| L1 | | | 11 | | | 0.433 |

PACKAGE MECHANICAL DATA
3 PINS - PLASTIC PACKAGE TO92 (BULK)



| Dim. | Millimeters | | | Inches | | |
|------|-------------|------|-------|--------|--------|--------|
| | Min | Typ. | Max. | Min. | Typ. | Max. |
| L | | 1.27 | | | 0.05 | |
| B | 3.2 | 3.7 | 4.2 | 0.126 | 0.1457 | 0.1654 |
| O1 | 4.45 | 5.00 | 5.2 | 0.1752 | 0.1969 | 0.2047 |
| C | 4.58 | 5.03 | 5.33 | 0.1803 | 0.198 | 0.2098 |
| K | 12.7 | | | 0.5 | | |
| O2 | 0.407 | 0.5 | 0.508 | 0.016 | 0.0197 | 0.02 |
| a | 0.35 | | | 0.0138 | | |

PACKAGE MECHANICAL DATA
3 PINS - TINY PACKAGE (SOT23)



| Dimensions | Millimeters | | | Inches | | |
|------------|-------------|-------|-------|--------|-------|-------|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 0.890 | | 1.120 | 0.035 | | 0.044 |
| A1 | 0.010 | | 0.100 | 0.0004 | | 0.004 |
| A2 | 0.880 | 0.950 | 1.020 | | 0.037 | 0.040 |
| b | 0.300 | | 0.500 | 0.012 | | 0.020 |
| c | 0.080 | | 0.200 | 0.003 | | 0.008 |
| D | 2.800 | 2.900 | 3.040 | 0.110 | 0.114 | 0.120 |
| E | 2.100 | | 2.640 | 0.083 | | 0.104 |
| E1 | 1.200 | 1.300 | 1.400 | 0.047 | 0.051 | 0.055 |
| e | | 0.950 | | | 0.037 | |
| e1 | | 1.900 | | | 0.075 | |
| L | 0.400 | 0.500 | 0.600 | 0.016 | 0.020 | 0.024 |
| L1 | | 0.540 | | | 0.021 | |
| k | 0° | | 8° | | | |

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