

# PZT3904T1G

## General Purpose Transistor

### NPN Silicon

#### Features

- S Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

#### MAXIMUM RATINGS

| Rating                         | Symbol    | Value | Unit |
|--------------------------------|-----------|-------|------|
| Collector – Emitter Voltage    | $V_{CEO}$ | 40    | Vdc  |
| Collector – Base Voltage       | $V_{CBO}$ | 60    | Vdc  |
| Emitter – Base Voltage         | $V_{EBO}$ | 6.0   | Vdc  |
| Collector Current – Continuous | $I_C$     | 200   | mAdc |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

#### THERMAL CHARACTERISTICS

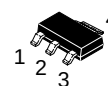
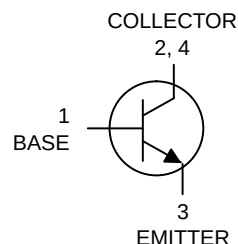
| Characteristic                                                | Symbol          | Max         | Unit       |
|---------------------------------------------------------------|-----------------|-------------|------------|
| Total Device Dissipation (Note 1)<br>$T_A = 25^\circ\text{C}$ | $P_D$           | 1.5<br>12   | W<br>mW/°C |
| Thermal Resistance<br>Junction-to-Ambient (Note 1)            | $R_{\theta JA}$ | 83.3        | °C/W       |
| Thermal Resistance<br>Junction-to-Lead #4                     | $R_{\theta JA}$ | 35          | °C/W       |
| Junction and Storage Temperature<br>Range                     | $T_J, T_{Stg}$  | -55 to +150 | °C         |

1. FR-4 with 1 oz and 713 mm<sup>2</sup> of copper area.



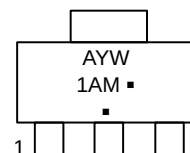
**ON Semiconductor®**

<http://onsemi.com>



**SOT-223  
CASE 318E  
STYLE 1**

#### MARKING DIAGRAM



1AM = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

#### ORDERING INFORMATION

| Device      | Package              | Shipping†           |
|-------------|----------------------|---------------------|
| PZT3904T1G  | SOT-223<br>(Pb-Free) | 1,000 / Tape & Reel |
| SPZT3904T1G | SOT-223<br>(Pb-Free) | 1,000 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# PZT3904T1G

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

| Characteristic                                                                                 | Symbol               | Min | Max | Unit |
|------------------------------------------------------------------------------------------------|----------------------|-----|-----|------|
| <b>OFF CHARACTERISTICS</b> (Note 2)                                                            |                      |     |     |      |
| Collector – Emitter Breakdown Voltage (Note 3) (I <sub>C</sub> = 1.0 mAdc, I <sub>B</sub> = 0) | V <sub>(BR)CEO</sub> | 40  | –   | Vdc  |
| Collector – Base Breakdown Voltage (I <sub>C</sub> = 10 μAdc, I <sub>E</sub> = 0)              | V <sub>(BR)CBO</sub> | 60  | –   |      |
| Emitter – Base Breakdown Voltage (I <sub>E</sub> = 10 μAdc, I <sub>C</sub> = 0)                | V <sub>(BR)EBO</sub> | 6.0 | –   |      |
| Base Cutoff Current (V <sub>CE</sub> = 30 Vdc, V <sub>EB</sub> = 3.0 Vdc)                      | I <sub>BL</sub>      | –   | 50  | nAdc |
| Collector Cutoff Current (V <sub>CE</sub> = 30 Vdc, V <sub>EB</sub> = 3.0 Vdc)                 | I <sub>CEX</sub>     | –   | 50  |      |

## ON CHARACTERISTICS (Note 3)

|                                                                                                                                                                                                                                                                                                                          |                      |                             |                         |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------------|-------------------------|-----|
| DC Current Gain (Note 2)<br>(I <sub>C</sub> = 0.1 mAdc, V <sub>CE</sub> = 1.0 Vdc)<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 1.0 Vdc)<br>(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 1.0 Vdc)<br>(I <sub>C</sub> = 50 mAdc, V <sub>CE</sub> = 1.0 Vdc)<br>(I <sub>C</sub> = 100 mAdc, V <sub>CE</sub> = 1.0 Vdc) | H <sub>FE</sub>      | 40<br>70<br>100<br>60<br>30 | –<br>–<br>300<br>–<br>– | –   |
| Collector – Emitter Saturation Voltage (Note 3)<br>(I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 1.0 mAdc)<br>(I <sub>C</sub> = 50 mAdc, I <sub>B</sub> = 5.0 mAdc)                                                                                                                                                        | V <sub>CE(sat)</sub> | –<br>–                      | 0.2<br>0.3              | Vdc |
| Base – Emitter Saturation Voltage (Note 3)<br>(I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 1.0 mAdc)<br>(I <sub>C</sub> = 50 mAdc, I <sub>B</sub> = 5.0 mAdc)                                                                                                                                                             | V <sub>BE(sat)</sub> | 0.65<br>–                   | 0.85<br>0.95            | Vdc |

## SMALL-SIGNAL CHARACTERISTICS

|                                                                                                           |                  |     |     |                    |
|-----------------------------------------------------------------------------------------------------------|------------------|-----|-----|--------------------|
| Current – Gain – Bandwidth Product (I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 20 Vdc, f = 100 MHz)      | f <sub>T</sub>   | 300 | –   | MHz                |
| Output Capacitance (V <sub>CB</sub> = 5.0 Vdc, I <sub>E</sub> = 0, f = 1.0 MHz)                           | C <sub>obo</sub> | –   | 5.0 | pF                 |
| Input Capacitance (V <sub>EB</sub> = 0.5 Vdc, I <sub>C</sub> = 0, f = 1.0 MHz)                            | C <sub>ibo</sub> | –   | 8.0 |                    |
| Input Impedance (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)                        | h <sub>ie</sub>  | 1.0 | 10  | kΩ                 |
| Voltage Feedback Ratio (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)                 | h <sub>re</sub>  | 0.5 | 8.0 | X 10 <sup>–4</sup> |
| Small – Signal Current Gain (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)            | h <sub>fe</sub>  | 100 | 400 | –                  |
| Output Admittance (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)                      | h <sub>oe</sub>  | 1.0 | 40  | μMhos              |
| Noise Figure (V <sub>CE</sub> = 5.0 Vdc, I <sub>C</sub> = 100 μAdc, R <sub>S</sub> = 1.0 kΩ, f = 1.0 kHz) | nF               | –   | 5.0 | dB                 |

## SWITCHING CHARACTERISTICS

|              |                                                                                                                  |                |   |     |    |
|--------------|------------------------------------------------------------------------------------------------------------------|----------------|---|-----|----|
| Delay Time   | (V <sub>CC</sub> = 3.0 Vdc, V <sub>BE</sub> = –0.5 Vdc,<br>I <sub>C</sub> = 10 mAdc, I <sub>B1</sub> = 1.0 mAdc) | t <sub>d</sub> | – | 35  | ns |
| Rise Time    |                                                                                                                  | t <sub>r</sub> | – | 35  |    |
| Storage Time | (V <sub>CC</sub> = 3.0 Vdc,<br>I <sub>C</sub> = 10 mAdc, I <sub>B1</sub> = I <sub>B2</sub> = 1.0 mAdc)           | t <sub>s</sub> | – | 200 |    |
| Fall Time    |                                                                                                                  | t <sub>f</sub> | – | 50  |    |

2. FR–5 = 1.0 × 0.75 × 0.062 in.

3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

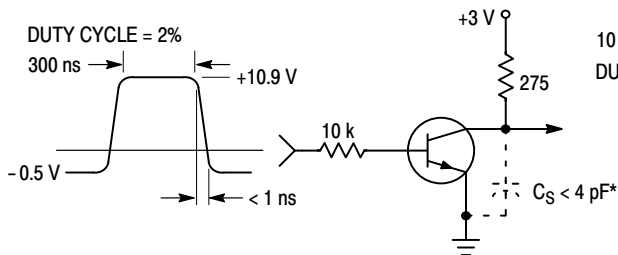


Figure 1. Delay and Rise Time  
Equivalent Test Circuit

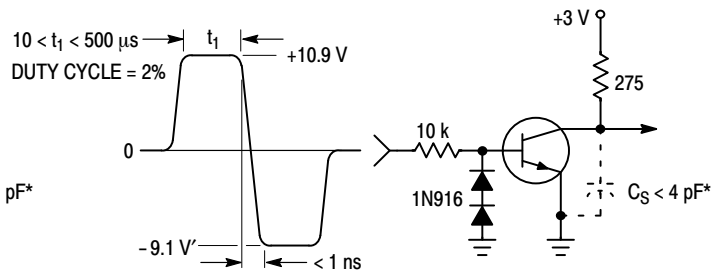


Figure 2. Storage and Fall Time  
Equivalent Test Circuit

\* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

—  $T_J = 25^\circ\text{C}$   
 - -  $T_J = 125^\circ\text{C}$

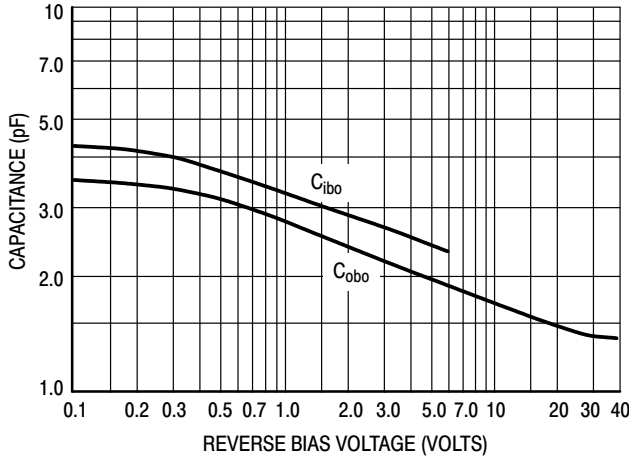


Figure 3. Capacitance

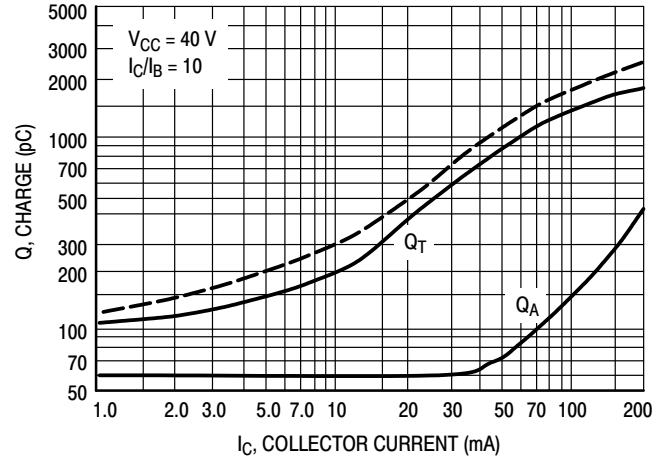


Figure 4. Charge Data

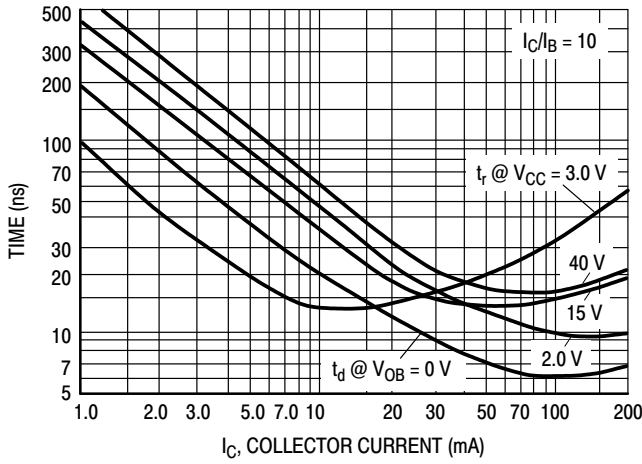


Figure 5. Turn-On Time

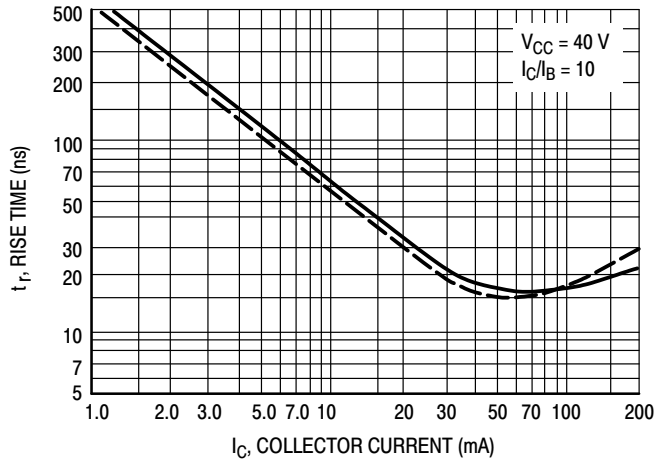


Figure 6. Rise Time

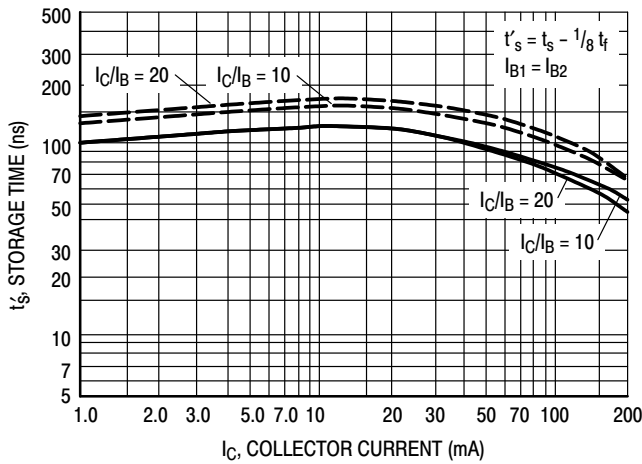


Figure 7. Storage Time

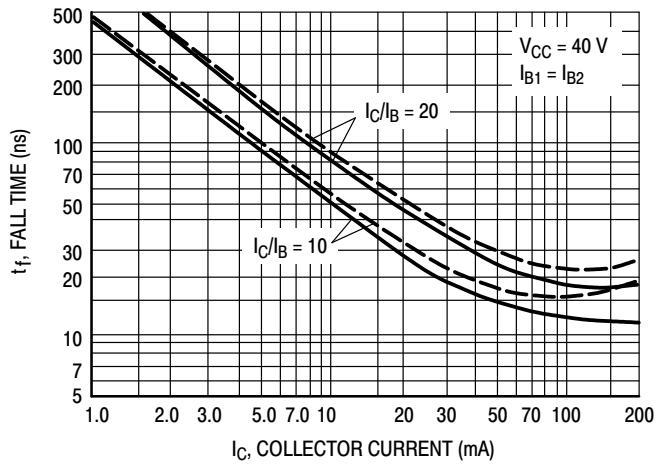


Figure 8. Fall Time

# TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

( $V_{CE} = 5.0$  Vdc,  $T_A = 25^\circ\text{C}$ , Bandwidth = 1.0 Hz)

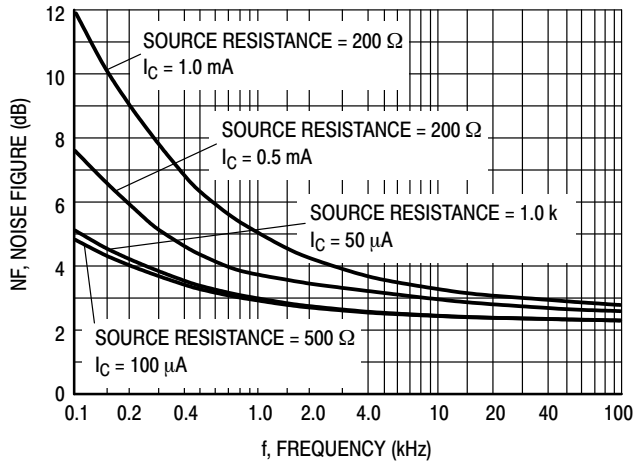


Figure 9.

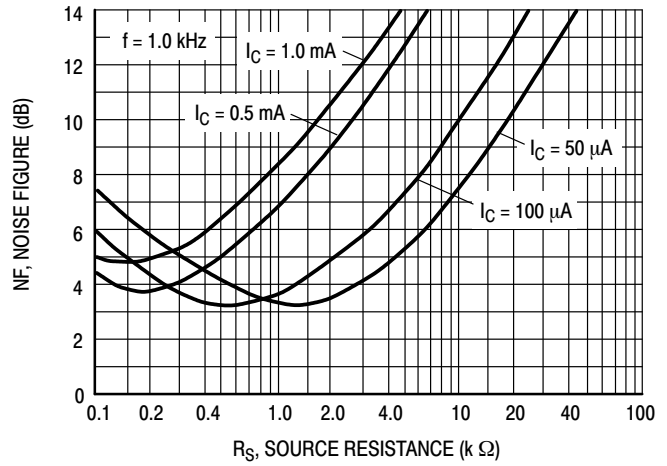


Figure 10.

## h PARAMETERS

( $V_{CE} = 10$  Vdc,  $f = 1.0$  kHz,  $T_A = 25^\circ\text{C}$ )

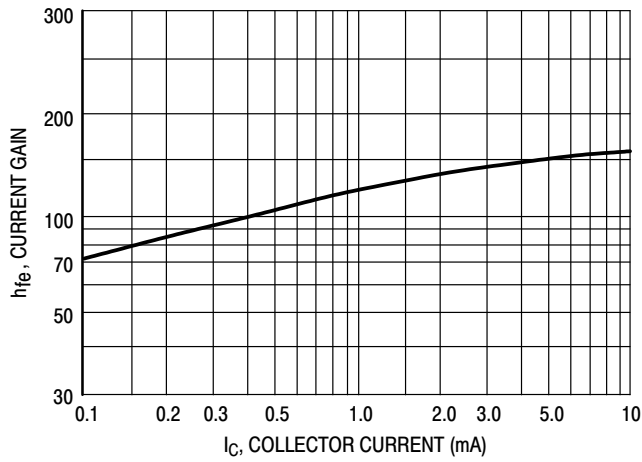


Figure 11. Current Gain

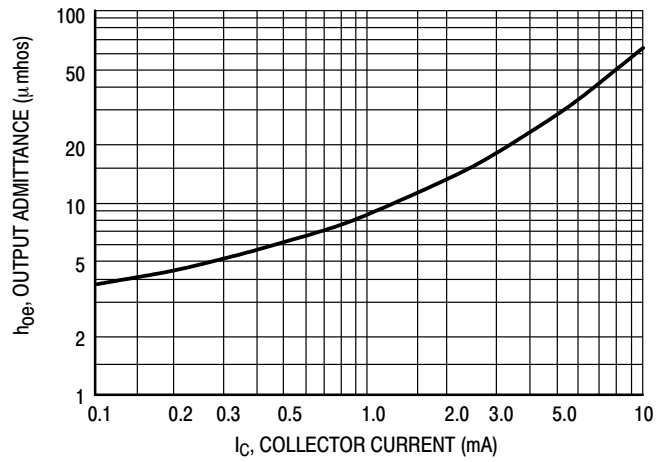


Figure 12. Output Admittance

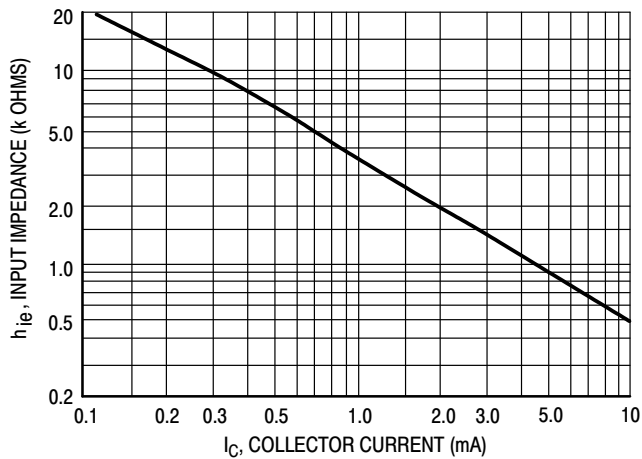


Figure 13. Input Impedance

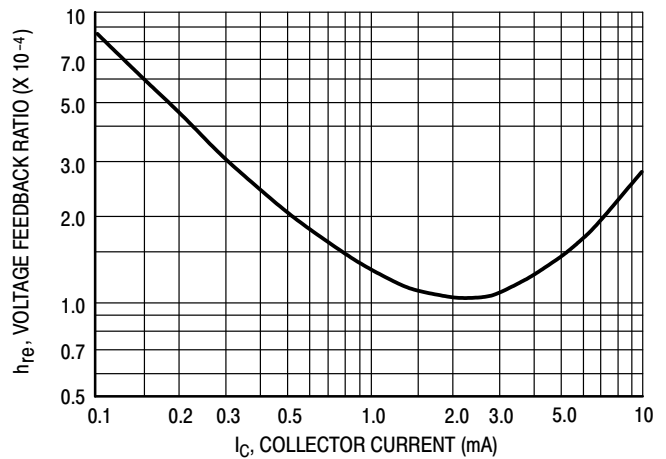


Figure 14. Voltage Feedback Ratio

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## TYPICAL STATIC CHARACTERISTICS

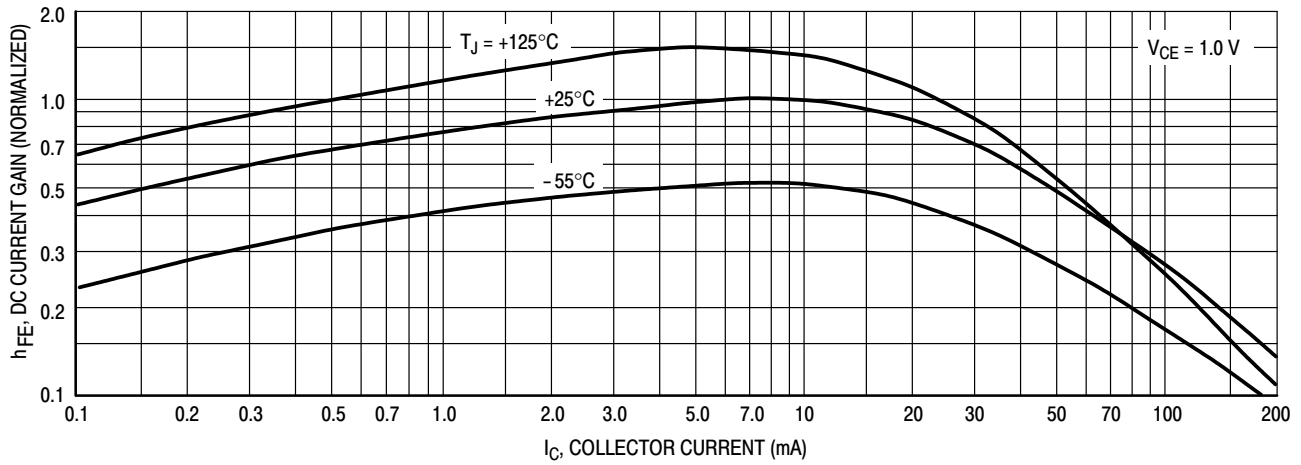


Figure 15. DC Current Gain

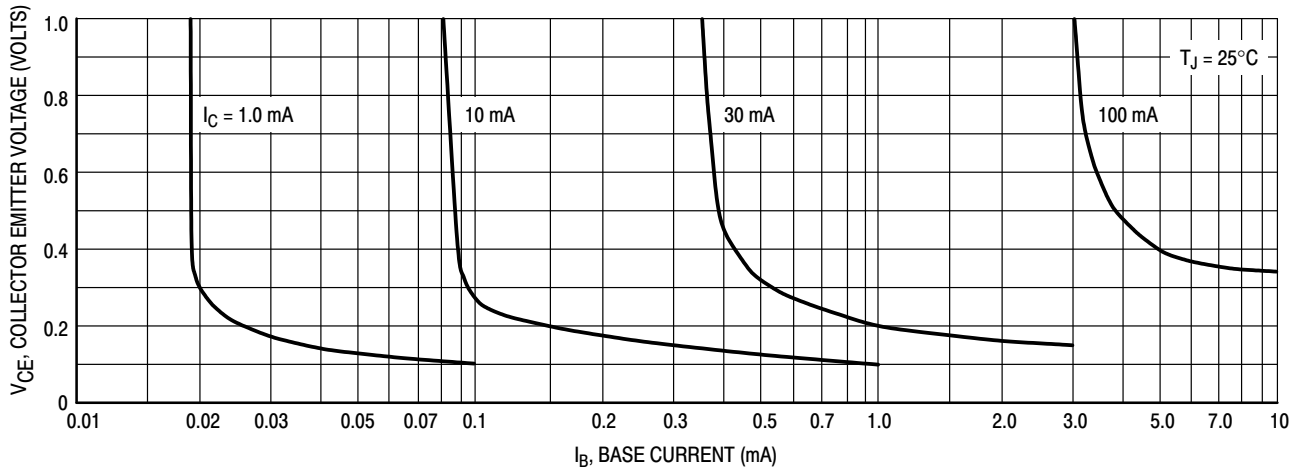


Figure 16. Collector Saturation Region

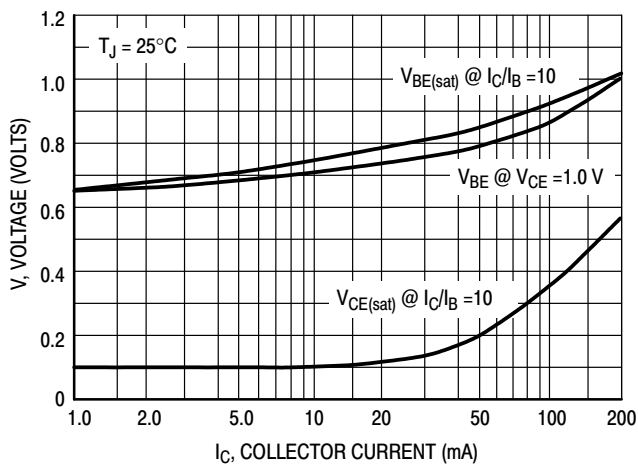


Figure 17. "ON" Voltages

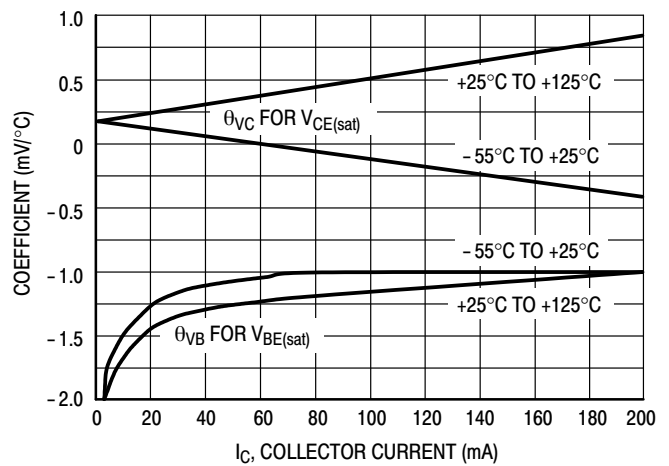


Figure 18. Temperature Coefficients

# PZT3904T1G

## TYPICAL CHARACTERISTICS

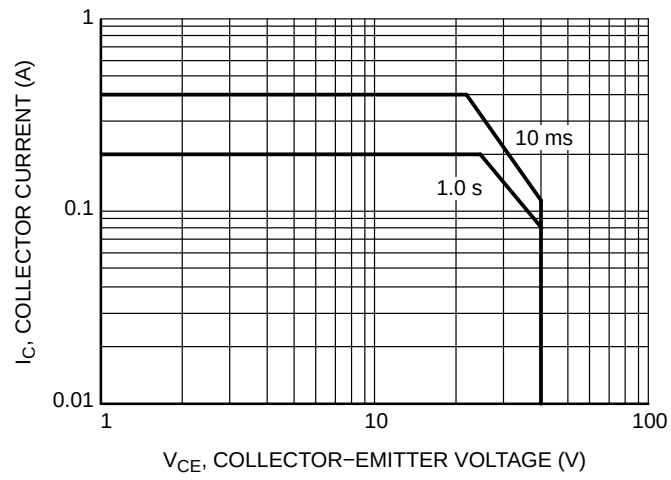
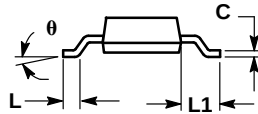
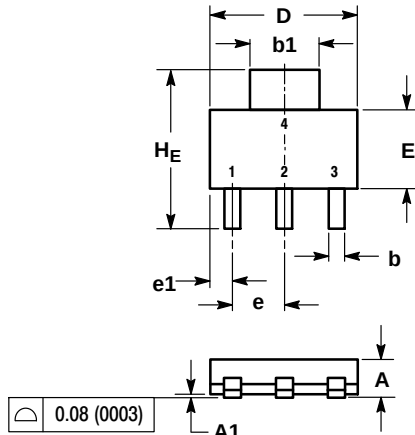


Figure 19. Safe Operating Area

# PZT3904T1G

## PACKAGE DIMENSIONS

SOT-223 (TO-261)  
CASE 318E-04  
ISSUE N

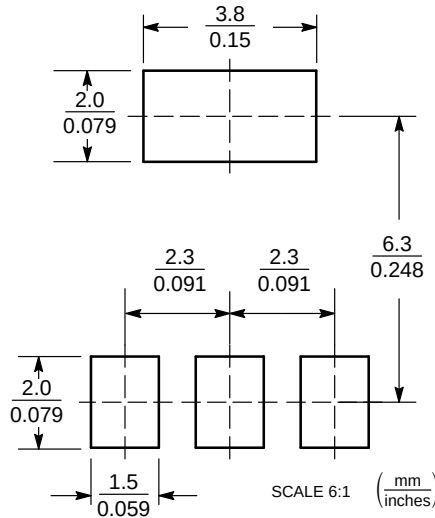


NOTES:  
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.  
2. CONTROLLING DIMENSION: INCH.

| DIM   | MILLIMETERS |      |      | INCHES |       |       |
|-------|-------------|------|------|--------|-------|-------|
|       | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A     | 1.50        | 1.63 | 1.75 | 0.060  | 0.064 | 0.068 |
| A1    | 0.02        | 0.06 | 0.10 | 0.001  | 0.002 | 0.004 |
| b     | 0.60        | 0.75 | 0.89 | 0.024  | 0.030 | 0.035 |
| b1    | 2.90        | 3.06 | 3.20 | 0.115  | 0.121 | 0.126 |
| c     | 0.24        | 0.29 | 0.35 | 0.009  | 0.012 | 0.014 |
| D     | 6.30        | 6.50 | 6.70 | 0.249  | 0.256 | 0.263 |
| E     | 3.30        | 3.50 | 3.70 | 0.130  | 0.138 | 0.145 |
| e     | 2.20        | 2.30 | 2.40 | 0.087  | 0.091 | 0.094 |
| e1    | 0.85        | 0.94 | 1.05 | 0.033  | 0.037 | 0.041 |
| L     | 0.20        | ---  | ---  | 0.008  | ---   | ---   |
| L1    | 1.50        | 1.75 | 2.00 | 0.060  | 0.069 | 0.078 |
| H_E   | 6.70        | 7.00 | 7.30 | 0.264  | 0.276 | 0.287 |
| theta | 0°          | ---  | 10°  | 0°     | ---   | 10°   |

STYLE 1:  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

### SOLDERING FOOTPRINT\*



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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