

# MMBT2222ATT1

Preferred Device

## General Purpose Transistor

### NPN Silicon

These transistors are designed for general purpose amplifier applications. They are housed in the SOT-416/SC-75 package which is designed for low power surface mount applications.

#### Features

- Pb-Free Package is Available

#### MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ )

| Rating                         | Symbol    | Max | Unit |
|--------------------------------|-----------|-----|------|
| Collector-Emitter Voltage      | $V_{CEO}$ | 40  | Vdc  |
| Collector-Base Voltage         | $V_{CBO}$ | 75  | Vdc  |
| Emitter-Base Voltage           | $V_{EBO}$ | 6.0 | Vdc  |
| Collector Current - Continuous | $I_C$     | 600 | mAdc |

#### THERMAL CHARACTERISTICS

| Characteristic  | Symbol          | Max         | Unit                      |
|---|-----------------|-------------|---------------------------|
| Total Device Dissipation (Note 1)<br>$T_A = 25^\circ\text{C}$ | $P_D$           | 150         | mW                        |
| Thermal Resistance,<br>Junction-to-Ambient                    | $R_{\theta JA}$ | 833         | $^\circ\text{C}/\text{W}$ |
| Operating and Storage Junction<br>Temperature Range           | $T_J, T_{stg}$  | -55 to +150 | $^\circ\text{C}$          |

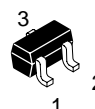
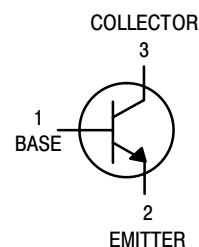
Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

- Device mounted on FR4 glass epoxy printed circuit board using the minimum recommended footprint.



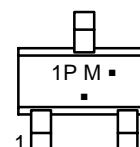
ON Semiconductor®

<http://onsemi.com>



CASE 463  
SOT-416/SC-75  
STYLE 1

#### MARKING DIAGRAM



1P = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package  
(Note: Microdot may be in either location)

#### ORDERING INFORMATION

| Device        | Package              | Shipping†          |
|---------------|----------------------|--------------------|
| MMBT2222ATT1  | SOT-416              | 3000 / Tape & Reel |
| MMBT2222ATT1G | SOT-416<br>(Pb-Free) | 3000 / Tape & Reel |

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

Preferred devices are recommended choices for future use and best overall value.

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

| Characteristic | Symbol | Min | Max | Unit |
|----------------|--------|-----|-----|------|
|----------------|--------|-----|-----|------|

### OFF CHARACTERISTICS

|  |                      |     |    |                  |
|--|----------------------|-----|----|------------------|
| Collector–Emitter Breakdown Voltage (Note 1)<br>(I <sub>C</sub> = 1.0 mA <sub>dc</sub> , I <sub>B</sub> = 0) | V <sub>(BR)CEO</sub> | 40  | –  | V <sub>dc</sub>  |
| Collector–Base Breakdown Voltage<br>(I <sub>C</sub> = 10 μA <sub>dc</sub> , I <sub>E</sub> = 0)              | V <sub>(BR)CBO</sub> | 75  | –  | V <sub>dc</sub>  |
| Emitter–Base Breakdown Voltage<br>(I <sub>E</sub> = 10 μA <sub>dc</sub> , I <sub>C</sub> = 0)                | V <sub>(BR)EBO</sub> | 6.0 | –  | V <sub>dc</sub>  |
| Base Cutoff Current<br>(V <sub>CE</sub> = 60 V <sub>dc</sub> , V <sub>EB</sub> = 3.0 V <sub>dc</sub> )       | I <sub>BL</sub>      | –   | 20 | nA <sub>dc</sub> |
| Collector Cutoff Current<br>(V <sub>CE</sub> = 60 V <sub>dc</sub> , V <sub>EB</sub> = 3.0 V <sub>dc</sub> )  | I <sub>CEX</sub>     | –   | 10 | nA <sub>dc</sub> |

### ON CHARACTERISTICS (Note 2)

|   |                      |                             |                       |                 |
|---|----------------------|-----------------------------|-----------------------|-----------------|
| DC Current Gain<br>(I <sub>C</sub> = 0.1 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> )<br>(I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> )<br>(I <sub>C</sub> = 10 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> )<br>(I <sub>C</sub> = 150 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> )<br>(I <sub>C</sub> = 500 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> ) | H <sub>FE</sub>      | 35<br>50<br>75<br>100<br>40 | –<br>–<br>–<br>–<br>– | –               |
| Collector–Emitter Saturation Voltage<br>(I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B</sub> = 15 mA <sub>dc</sub> )<br>(I <sub>C</sub> = 500 mA <sub>dc</sub> , I <sub>B</sub> = 50 mA <sub>dc</sub> )  | V <sub>CE(sat)</sub> | –<br>–                      | 0.3<br>1.0            | V <sub>dc</sub> |
| Base–Emitter Saturation Voltage<br>(I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B</sub> = 15 mA <sub>dc</sub> )<br>(I <sub>C</sub> = 500 mA <sub>dc</sub> , I <sub>B</sub> = 50 mA <sub>dc</sub> )   | V <sub>BE(sat)</sub> | 0.6<br>–                    | 1.2<br>2.0            | V <sub>dc</sub> |

### SMALL–SIGNAL CHARACTERISTICS

|   |                  |      |      |                    |
|---|------------------|------|------|--------------------|
| Current–Gain – Bandwidth Product<br>(I <sub>C</sub> = 20 mA <sub>dc</sub> , V <sub>CE</sub> = 20 V <sub>dc</sub> , f = 100 MHz)           | f <sub>T</sub>   | 300  | –    | MHz                |
| Output Capacitance<br>(V <sub>CB</sub> = 10 V <sub>dc</sub> , I <sub>E</sub> = 0, f = 1.0 MHz)  | C <sub>obo</sub> | –    | 8.0  | pF                 |
| Input Capacitance<br>(V <sub>EB</sub> = 0.5 V <sub>dc</sub> , I <sub>C</sub> = 0, f = 1.0 MHz)  | C <sub>ibo</sub> | –    | 30   | pF                 |
| Input Impedance<br>(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 10 mA <sub>dc</sub> , f = 1.0 kHz)                            | h <sub>ie</sub>  | 0.25 | 1.25 | kΩ                 |
| Voltage Feedback Ratio<br>(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 10 mA <sub>dc</sub> , f = 1.0 kHz)                     | h <sub>re</sub>  | –    | 4.0  | X 10 <sup>-4</sup> |
| Small–Signal Current Gain<br>(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 10 mA <sub>dc</sub> , f = 1.0 kHz)                  | h <sub>fe</sub>  | 75   | 375  | –                  |
| Output Admittance<br>(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 10 mA <sub>dc</sub> , f = 1.0 kHz)                          | h <sub>oe</sub>  | 25   | 200  | μmhos              |
| Noise Figure<br>(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 100 μA <sub>dc</sub> , R <sub>S</sub> = 1.0 k ohms, f = 1.0 kHz) | NF               | –    | 4.0  | dB                 |

### SWITCHING CHARACTERISTICS

|              |  |                |   |     |    |
|--------------|--|----------------|---|-----|----|
| Delay Time   | (V <sub>CC</sub> = 3.0 V <sub>dc</sub> , V <sub>BE</sub> = –0.5 V <sub>dc</sub> ,<br>I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B1</sub> = 15 mA <sub>dc</sub> ) | t <sub>d</sub> | – | 10  | ns |
| Rise Time    |  | t <sub>r</sub> | – | 25  |    |
| Storage Time | (V <sub>CC</sub> = 30 V <sub>dc</sub> , I <sub>C</sub> = 150 mA <sub>dc</sub> ,<br>I <sub>B1</sub> = I <sub>B2</sub> = 15 mA <sub>dc</sub> )                         | t <sub>s</sub> | – | 225 | ns |
| Fall Time    |  | t <sub>f</sub> | – | 60  |    |

1. Device mounted on FR4 glass epoxy printed circuit board using the minimum recommended footprint.
2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

# MMBT2222ATT1

## SWITCHING TIME EQUIVALENT TEST CIRCUITS

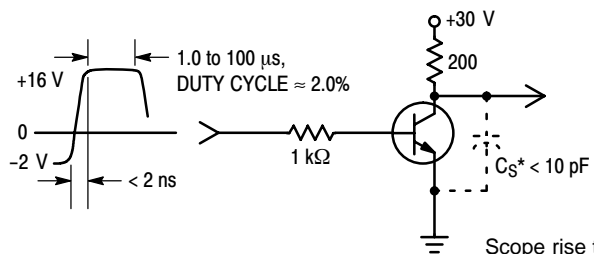


Figure 1. Turn-On Time

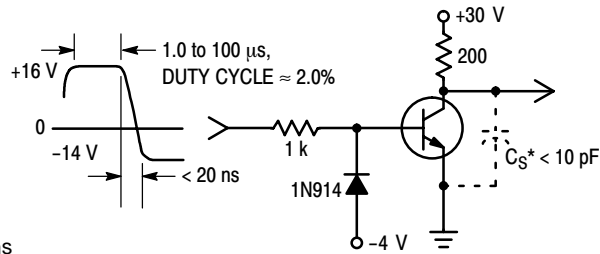


Figure 2. Turn-Off Time

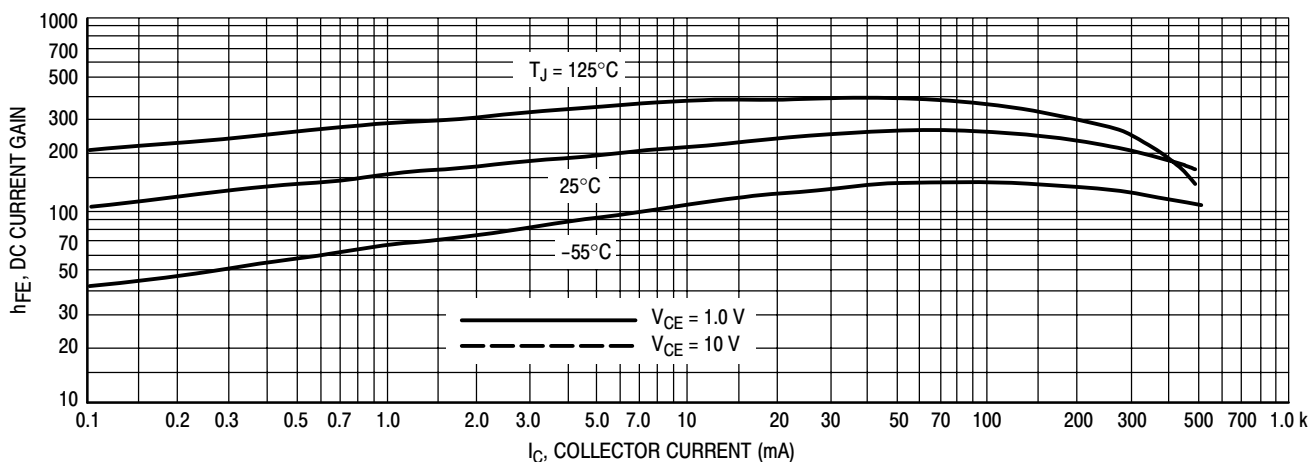


Figure 3. DC Current Gain

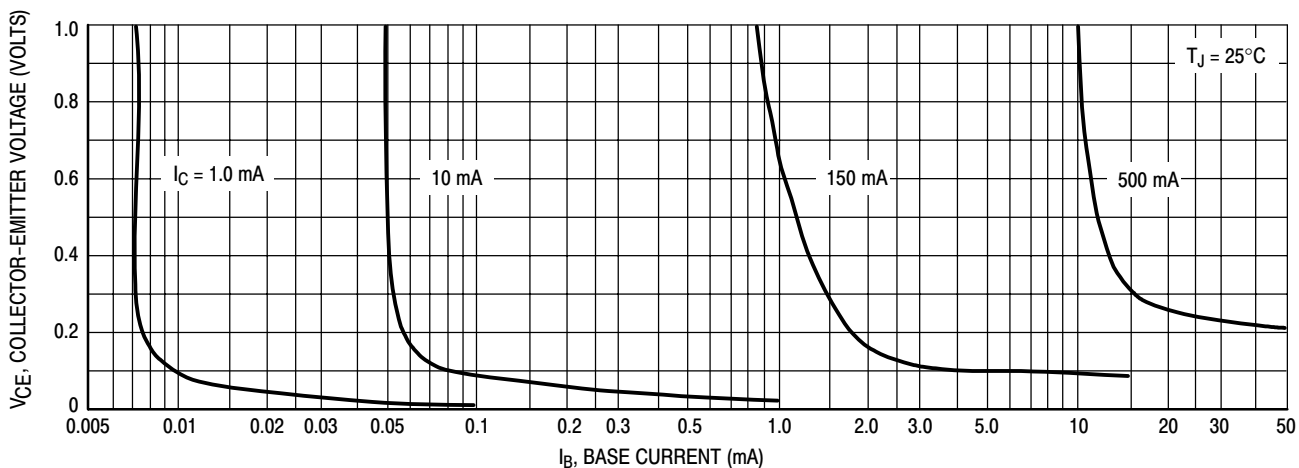


Figure 4. Collector Saturation Region

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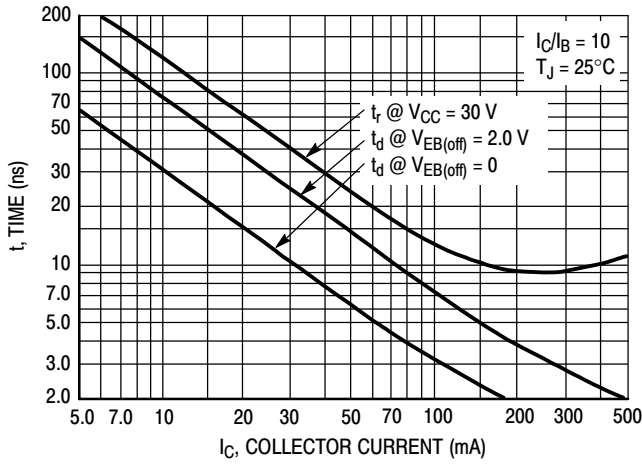


Figure 5. Turn-On Time

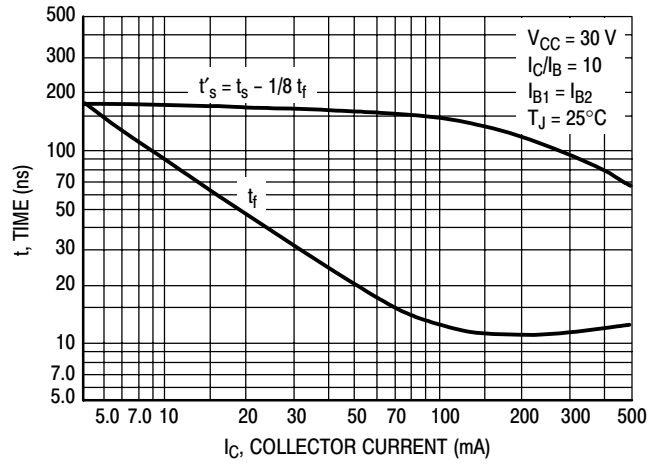


Figure 6. Turn-Off Time

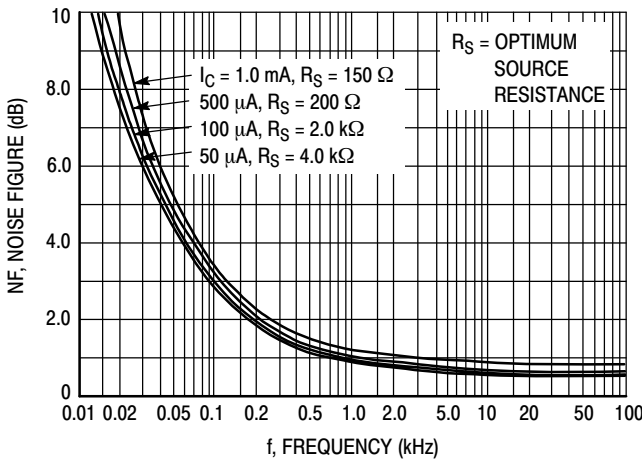


Figure 7. Frequency Effects

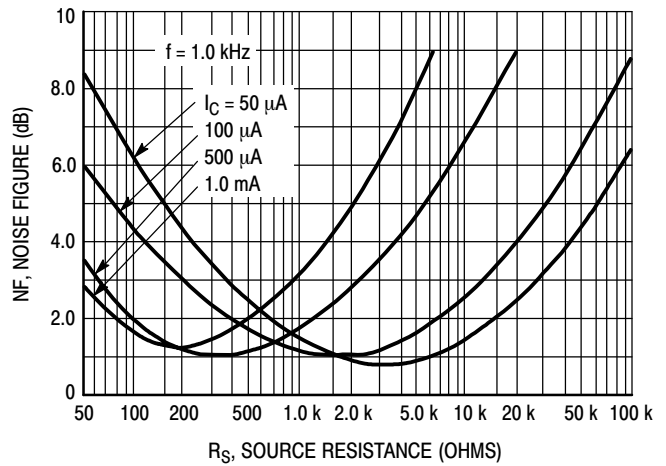


Figure 8. Source Resistance Effects

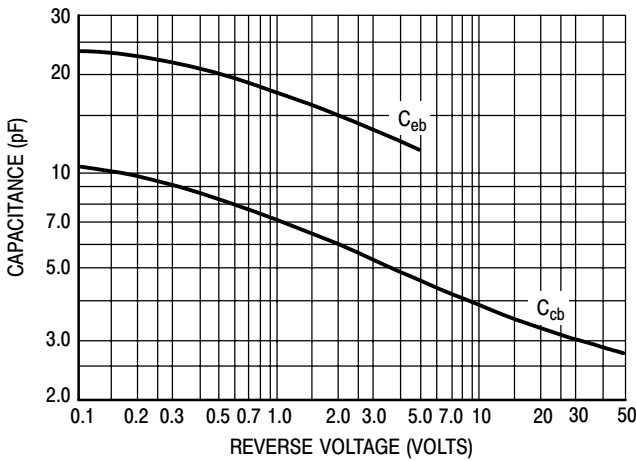


Figure 9. Capacitances

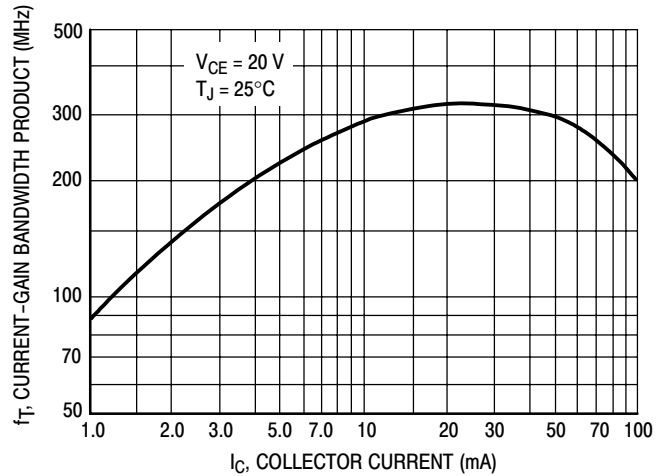


Figure 10. Current-Gain Bandwidth Product

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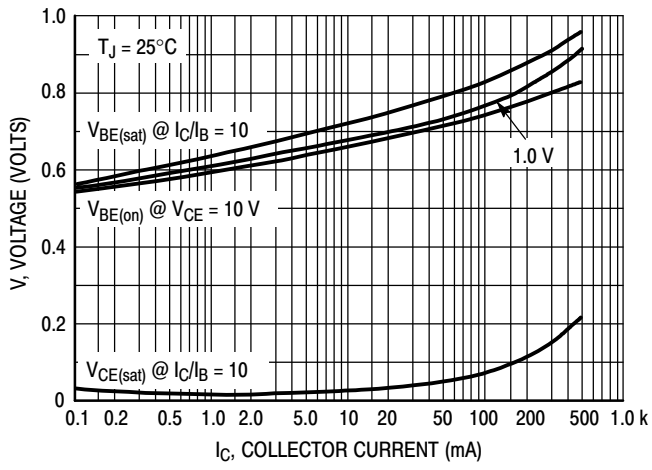


Figure 11. "On" Voltages

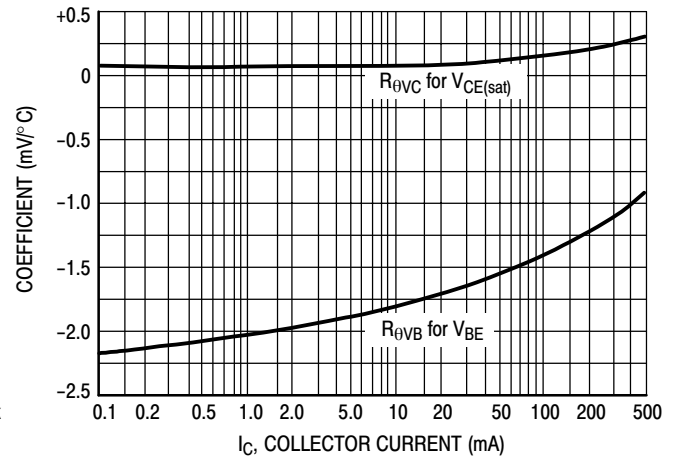
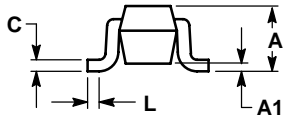
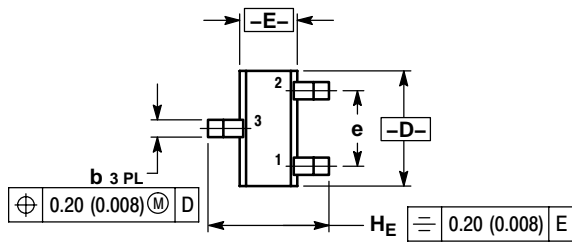


Figure 12. Temperature Coefficients

# MMBT2222ATT1

## PACKAGE DIMENSIONS

SC-75/SOT-416  
CASE 463-01  
ISSUE F

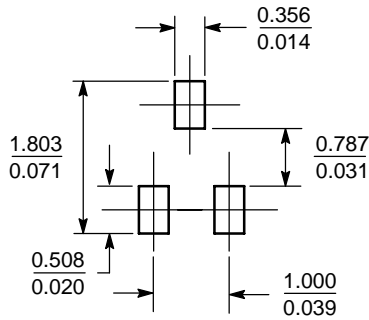


- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: MILLIMETER.

| DIM            | MILLIMETERS |      |      | INCHES   |       |       |
|----------------|-------------|------|------|----------|-------|-------|
|                | MIN         | NOM  | MAX  | MIN      | NOM   | MAX   |
| A              | 0.70        | 0.80 | 0.90 | 0.027    | 0.031 | 0.035 |
| A1             | 0.00        | 0.05 | 0.10 | 0.000    | 0.002 | 0.004 |
| b              | 0.15        | 0.20 | 0.30 | 0.006    | 0.008 | 0.012 |
| C              | 0.10        | 0.15 | 0.25 | 0.004    | 0.006 | 0.010 |
| D              | 1.55        | 1.60 | 1.65 | 0.059    | 0.063 | 0.067 |
| E              | 0.70        | 0.80 | 0.90 | 0.027    | 0.031 | 0.035 |
| e              | 1.00 BSC    |      |      | 0.04 BSC |       |       |
| L              | 0.10        | 0.15 | 0.20 | 0.004    | 0.006 | 0.008 |
| H <sub>E</sub> | 1.50        | 1.60 | 1.70 | 0.061    | 0.063 | 0.065 |

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

### SOLDERING FOOTPRINT\*



SCALE 10:1 ( $\frac{\text{mm}}{\text{inches}}$ )

\*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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