

# MMBT2222ATT1G, NSVMMBT2222ATT1G

## 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

- NSV 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 ( $T_A = 25^\circ\text{C}$ )

| 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         | $^\circ\text{C/W}$ |
| Operating and Storage Junction<br>Temperature Range           | $T_J, T_{stg}$  | -55 to +150 | $^\circ\text{C}$   |

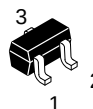
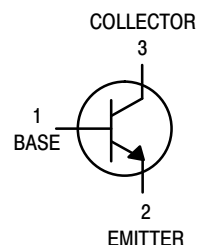
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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



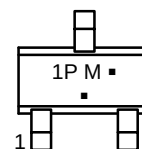
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CASE 463  
SOT-416/SC-75  
STYLE 1

#### MARKING DIAGRAM



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

#### ORDERING INFORMATION

| Device           | Package              | Shipping <sup>†</sup> |
|------------------|----------------------|-----------------------|
| MMBT2222ATT1G    | SOT-416<br>(Pb-Free) | 3000 / Tape &<br>Reel |
| NSVMMBT2222ATT1G | SOT-416<br>(Pb-Free) | 3000 / Tape &<br>Reel |

<sup>†</sup>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.

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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> = 10 mAdc, I <sub>B</sub> = 0) | V <sub>(BR)CEO</sub> | 40  | –  | Vdc  |
| Collector–Base Breakdown Voltage<br>(I <sub>C</sub> = 10 μAdc, I <sub>E</sub> = 0)             | V <sub>(BR)CBO</sub> | 75  | –  | Vdc  |
| Emitter–Base Breakdown Voltage<br>(I <sub>E</sub> = 10 μAdc, I <sub>C</sub> = 0)               | V <sub>(BR)EBO</sub> | 6.0 | –  | Vdc  |
| Base Cutoff Current<br>(V <sub>CE</sub> = 60 Vdc, V <sub>EB</sub> = 3.0 Vdc)                   | I <sub>BL</sub>      | –   | 20 | nAdc |
| Collector Cutoff Current<br>(V <sub>CE</sub> = 60 Vdc, V <sub>EB</sub> = 3.0 Vdc)              | I <sub>CEX</sub>     | –   | 10 | nAdc |

### ON CHARACTERISTICS (Note 2)

|                                                                                                                                                                                                                                                                                                             |                      |                             |                       |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------------|-----------------------|-----|
| DC Current Gain<br>(I <sub>C</sub> = 0.1 mAdc, V <sub>CE</sub> = 10 Vdc)<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc)<br>(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc)<br>(I <sub>C</sub> = 150 mAdc, V <sub>CE</sub> = 10 Vdc)<br>(I <sub>C</sub> = 500 mAdc, V <sub>CE</sub> = 10 Vdc) | 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 mAdc, I <sub>B</sub> = 15 mAdc)<br>(I <sub>C</sub> = 500 mAdc, I <sub>B</sub> = 50 mAdc)                                                                                                                                                      | V <sub>CE(sat)</sub> | –<br>–                      | 0.3<br>1.0            | Vdc |
| Base–Emitter Saturation Voltage<br>(I <sub>C</sub> = 150 mAdc, I <sub>B</sub> = 15 mAdc)<br>(I <sub>C</sub> = 500 mAdc, I <sub>B</sub> = 50 mAdc)                                                                                                                                                           | V <sub>BE(sat)</sub> | 0.6<br>–                    | 1.2<br>2.0            | Vdc |

### SMALL–SIGNAL CHARACTERISTICS

|                                                                                                                 |                  |      |      |                    |
|-----------------------------------------------------------------------------------------------------------------|------------------|------|------|--------------------|
| Current–Gain – Bandwidth Product<br>(I <sub>C</sub> = 20 mAdc, V <sub>CE</sub> = 20 Vdc, f = 100 MHz)           | f <sub>T</sub>   | 300  | –    | MHz                |
| Output Capacitance<br>(V <sub>CB</sub> = 10 Vdc, 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 Vdc, I <sub>C</sub> = 0, f = 1.0 MHz)                               | C <sub>ibo</sub> | –    | 30   | pF                 |
| Input Impedance<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 10 mAdc, f = 1.0 kHz)                            | h <sub>ie</sub>  | 0.25 | 1.25 | kΩ                 |
| Voltage Feedback Ratio<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 10 mAdc, 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 Vdc, I <sub>C</sub> = 10 mAdc, f = 1.0 kHz)                  | h <sub>fe</sub>  | 75   | 375  | –                  |
| Output Admittance<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 10 mAdc, f = 1.0 kHz)                          | h <sub>oe</sub>  | 25   | 200  | μmhos              |
| Noise Figure<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 100 μAdc, 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 Vdc, V <sub>BE</sub> = –0.5 Vdc,<br>I <sub>C</sub> = 150 mAdc, I <sub>B1</sub> = 15 mAdc) | t <sub>d</sub> | – | 10  | ns |
| Rise Time    |                                                                                                                  | t <sub>r</sub> | – | 25  |    |
| Storage Time | (V <sub>CC</sub> = 30 Vdc, I <sub>C</sub> = 150 mAdc,<br>I <sub>B1</sub> = I <sub>B2</sub> = 15 mAdc)            | t <sub>s</sub> | – | 225 | ns |
| Fall Time    |                                                                                                                  | t <sub>f</sub> | – | 60  |    |

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

# MMBT2222ATT1G, NSVMMBT2222ATT1G

## SWITCHING TIME EQUIVALENT TEST CIRCUITS

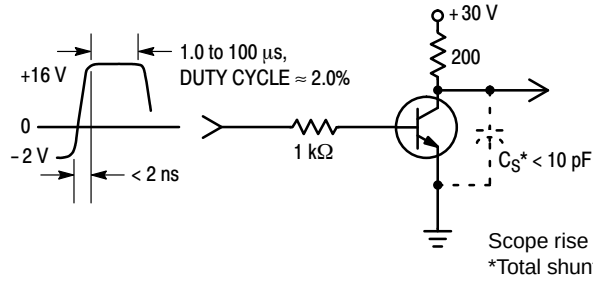


Figure 1. Turn-On Time

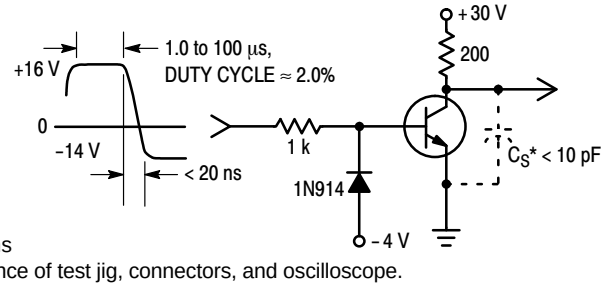


Figure 2. Turn-Off Time

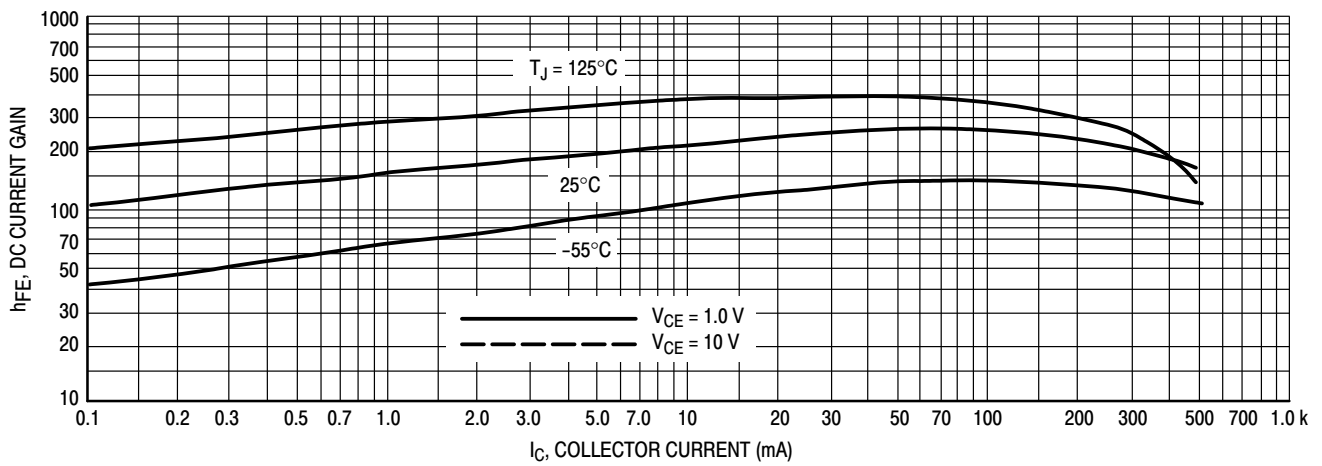


Figure 3. DC Current Gain

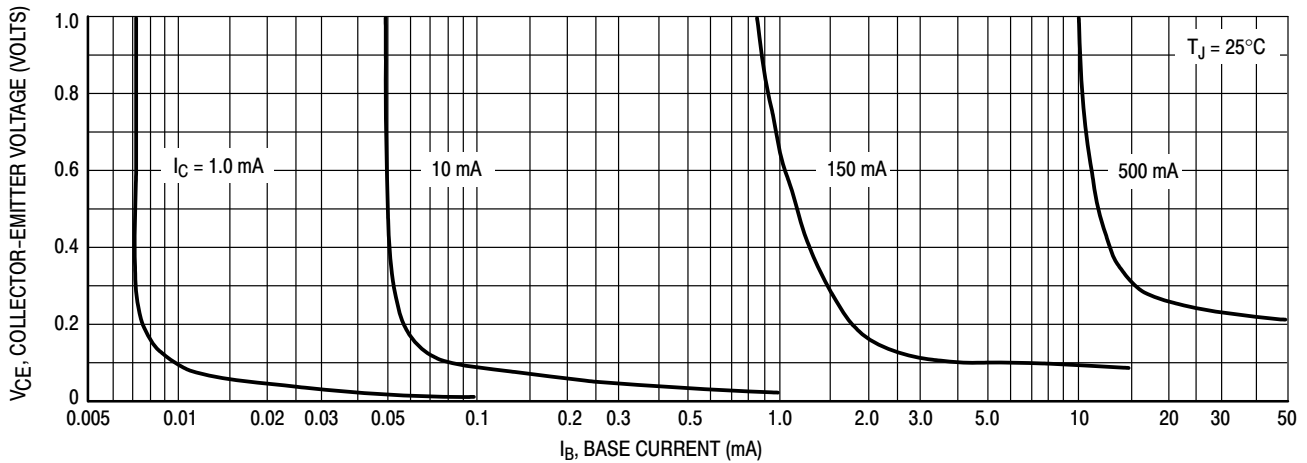


Figure 4. Collector Saturation Region

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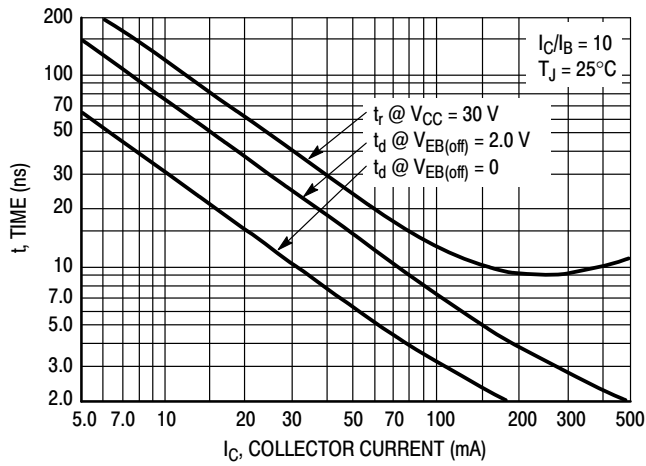


Figure 5. Turn-On Time

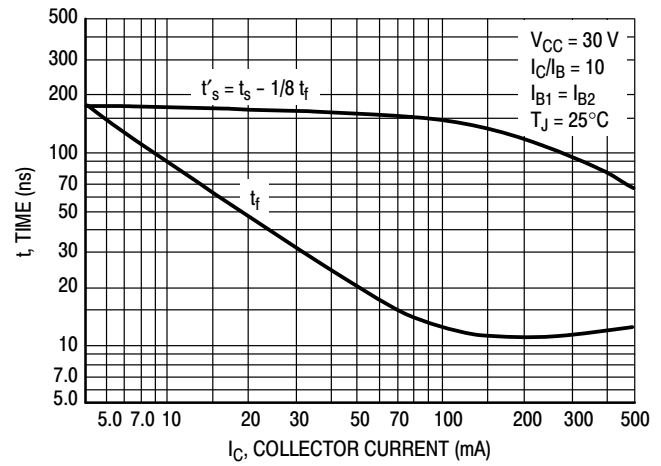


Figure 6. Turn-Off Time

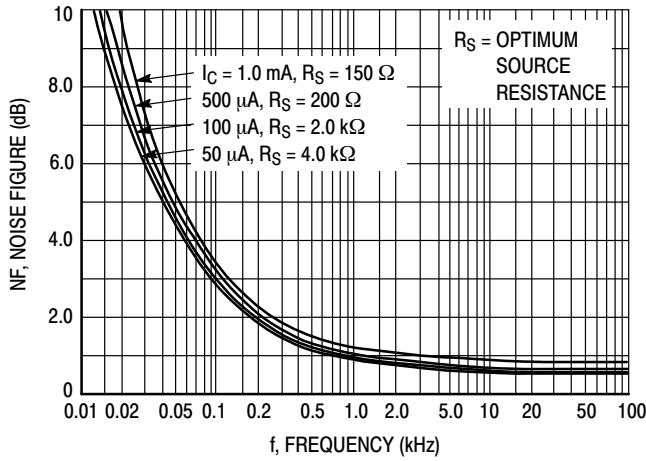


Figure 7. Frequency Effects

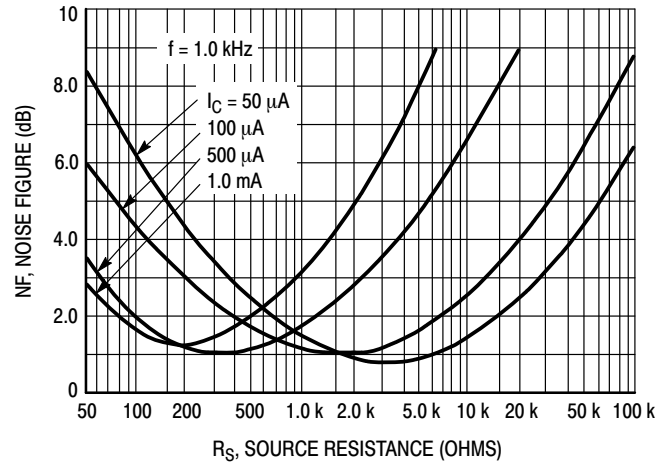


Figure 8. Source Resistance Effects

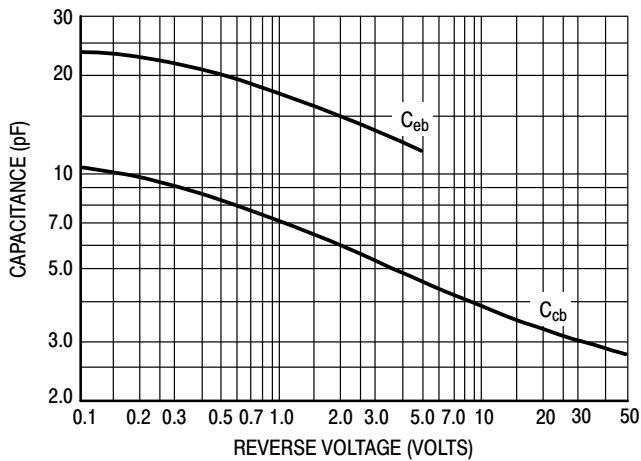


Figure 9. Capacitances

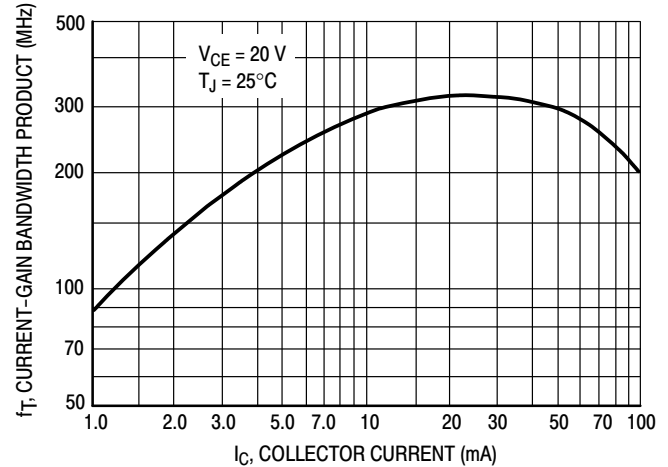


Figure 10. Current-Gain Bandwidth Product

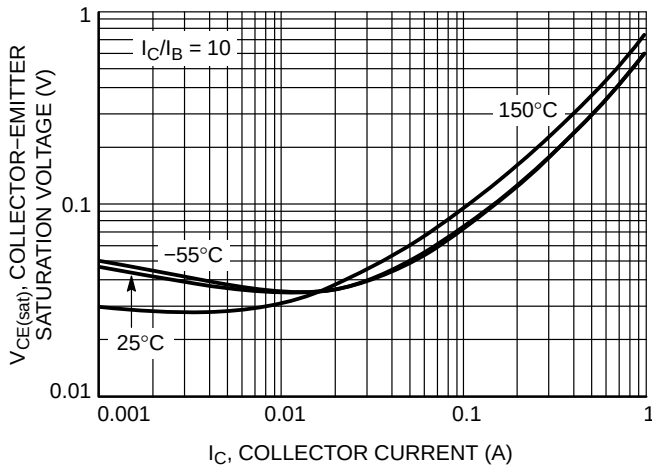


Figure 11. Collector Emitter Saturation Voltage vs. Collector Current

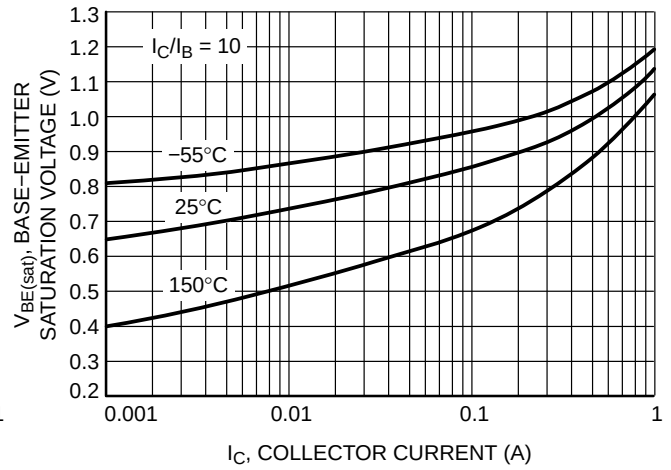


Figure 12. Base Emitter Saturation Voltage vs. Collector Current

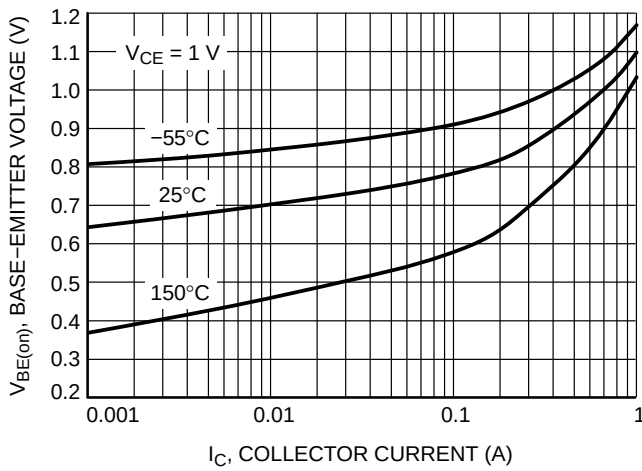


Figure 13. Base Emitter Voltage vs. Collector Current

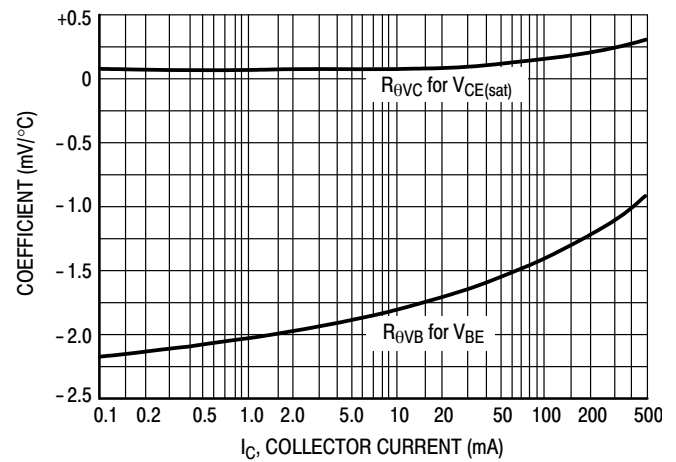


Figure 14. Temperature Coefficients

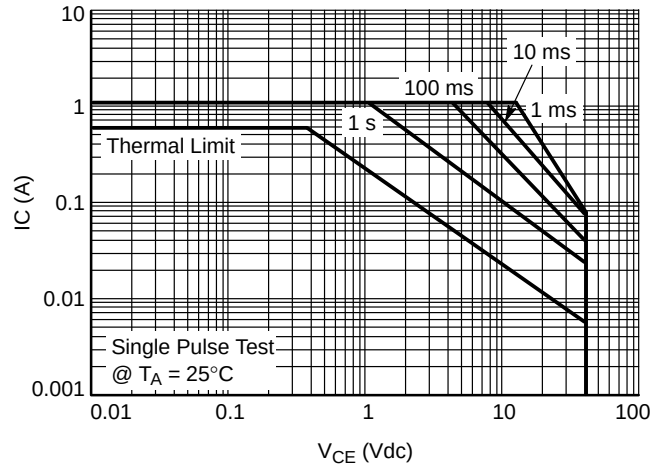
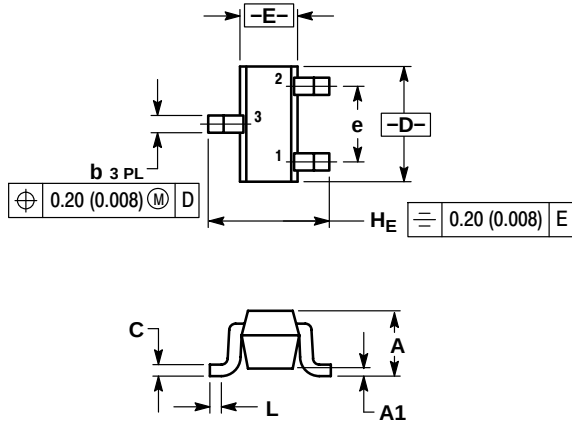


Figure 15. Safe Operating Area

# MMBT2222ATT1G, NSVMMBT2222ATT1G

## PACKAGE DIMENSIONS

SC-75/SOT-416  
CASE 463  
ISSUE G



### NOTES:

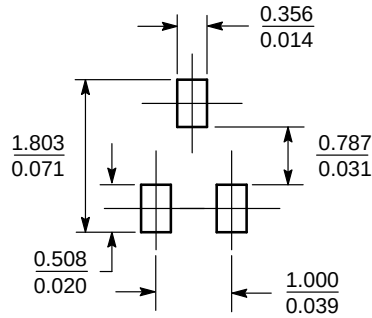
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

| 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 | 0.061    | 0.063 | 0.065 |
| 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 | 0.060    | 0.063 | 0.067 |

### STYLE 1:

- PIN 1. BASE
- EMITTER
- COLLECTOR

## SOLDERING FOOTPRINT\*



SCALE 10:1 (mm/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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