

# General Purpose Transistor

## NPN Silicon

### MMBT2222AWT1G, SMMBT2222AWT1G

These transistors are designed for general purpose amplifier applications. They are housed in the SOT-323/SC-70 package which is designed for low power surface mount applications.

#### Features

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

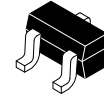
#### MAXIMUM RATINGS

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

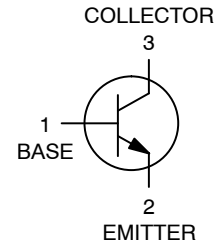
#### THERMAL CHARACTERISTICS

| Characteristic  | Symbol          | Max         | Unit                      |
|---|-----------------|-------------|---------------------------|
| Total Device Dissipation FR-5 Board<br>$T_A = 25^\circ\text{C}$ | $P_D$           | 150         | mW                        |
| Thermal Resistance, Junction-to-Ambient                         | $R_{\theta JA}$ | 280         | $^\circ\text{C}/\text{W}$ |
| Junction and Storage Temperature                                | $T_J, T_{stg}$  | -55 to +150 | $^\circ\text{C}$          |

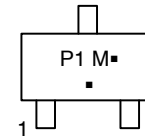
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.



SC-70  
CASE 419  
STYLE 3



#### MARKING DIAGRAM



P1 = Specific Device Code  
M = Date Code  
■ = Pb-Free Package

(Note: Microdot may be in either location)

#### ORDERING INFORMATION

| Device         | Package            | Shipping†              |
|----------------|--------------------|------------------------|
| MMBT2222AWT1G  | SC-70<br>(Pb-Free) | 3,000 /<br>Tape & Reel |
| SMMBT2222AWT1G | SC-70<br>(Pb-Free) | 3,000 /<br>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.

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

# MMBT2222AWT1G, SMMBT2222AWT1G

## 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 1)

|  |                      |                             |                         |     |
|--|----------------------|-----------------------------|-------------------------|-----|
| DC Current Gain (Note 1)<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>300<br>– | –   |
| Collector – Emitter Saturation Voltage (Note 1)<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 (Note 1)<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 kΩ, 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  |    |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

# MMBT2222AWT1G, SMMBT2222AWT1G

## SWITCHING TIME EQUIVALENT TEST CIRCUITS

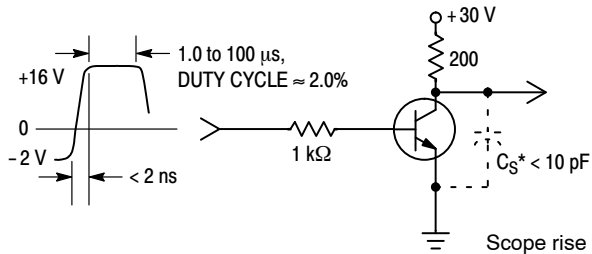


Figure 1. Turn-On Time

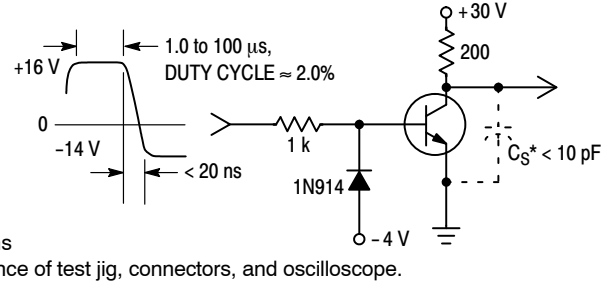


Figure 2. Turn-Off Time

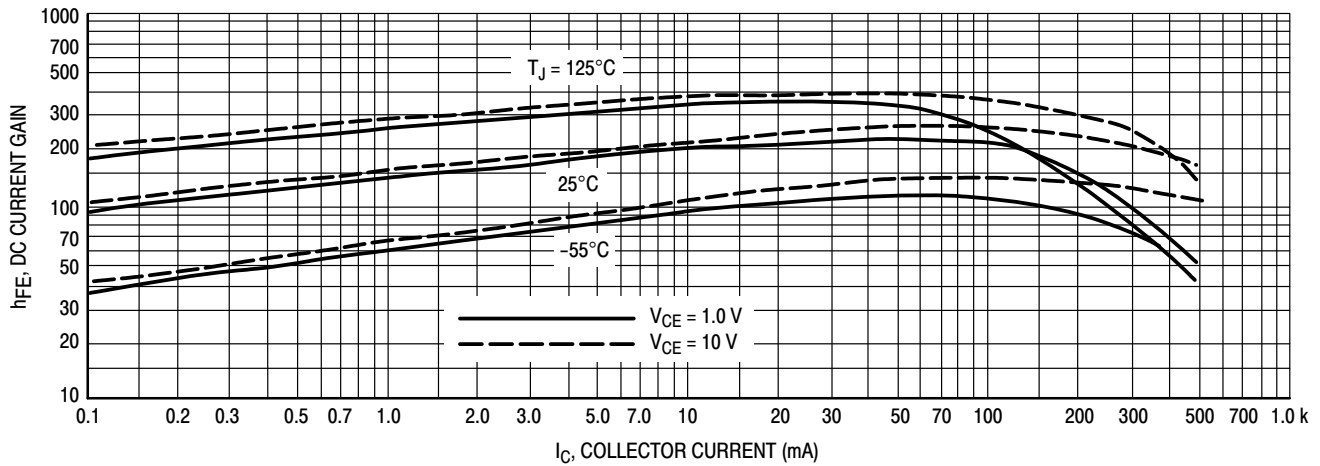


Figure 3. DC Current Gain

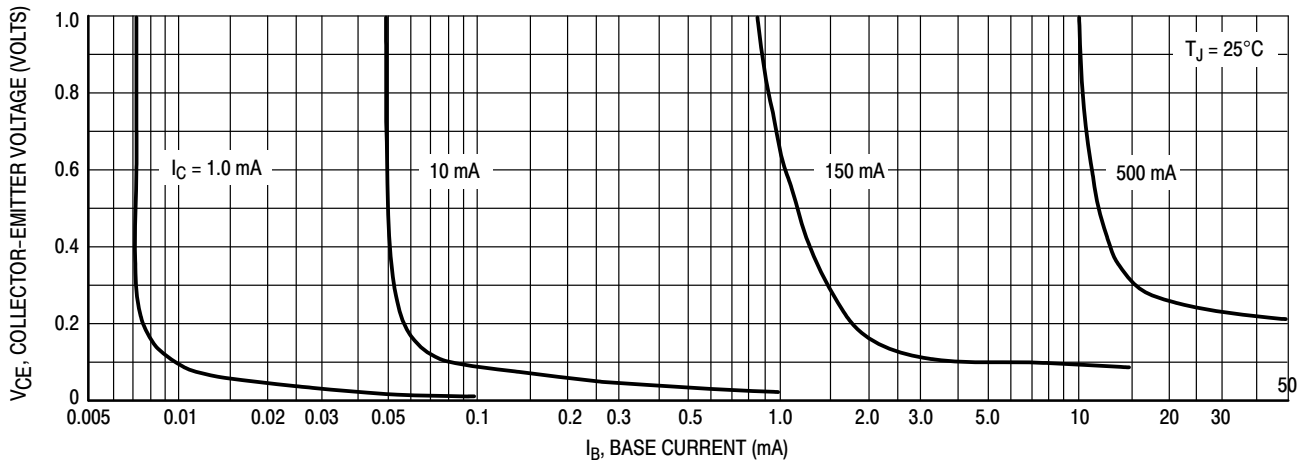


Figure 4. Collector Saturation Region

# MMBT2222AWT1G, SMMBT2222AWT1G

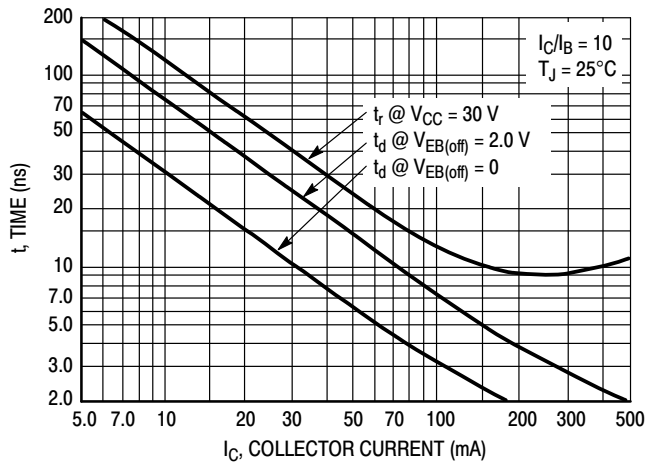


Figure 5. Turn-On Time

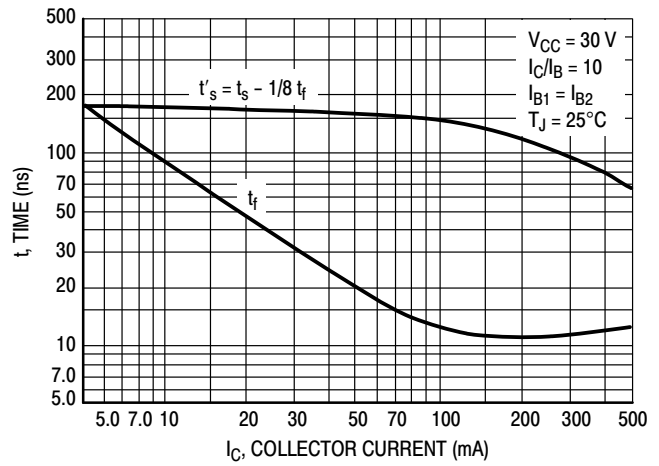


Figure 6. Turn-Off Time

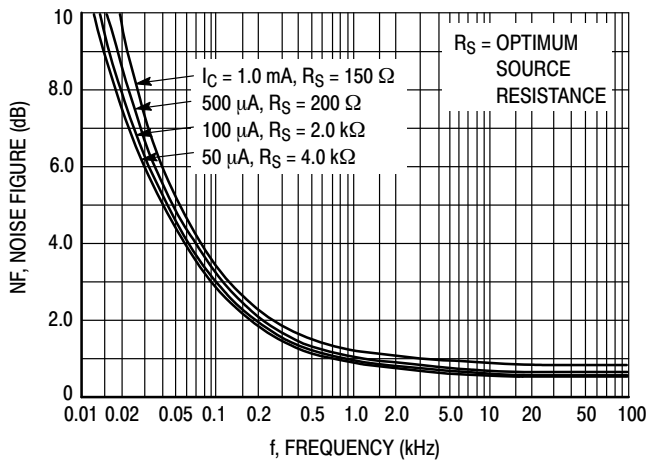


Figure 7. Frequency Effects

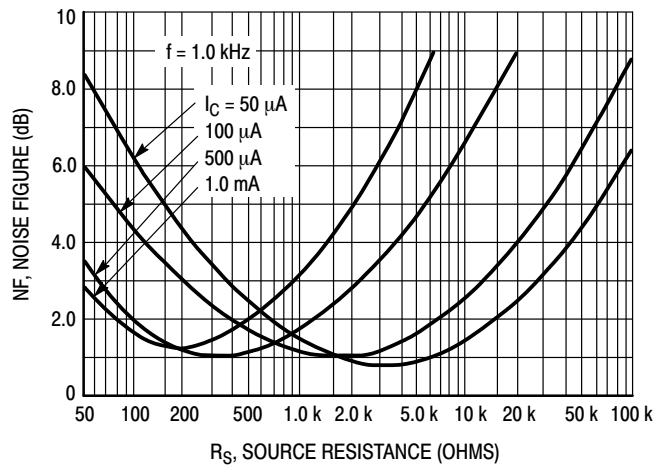


Figure 8. Source Resistance Effects

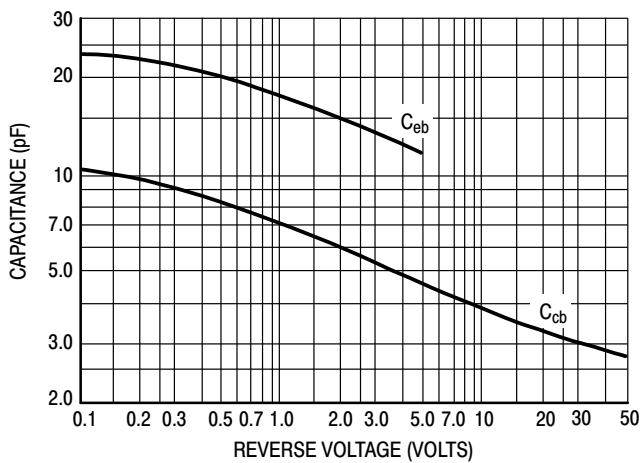


Figure 9. Capacitances

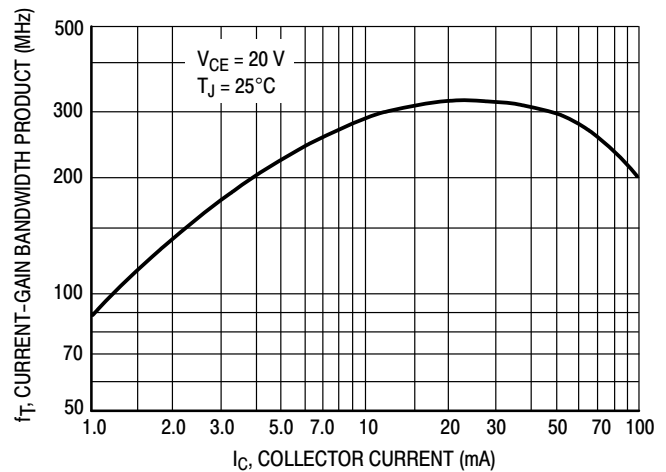
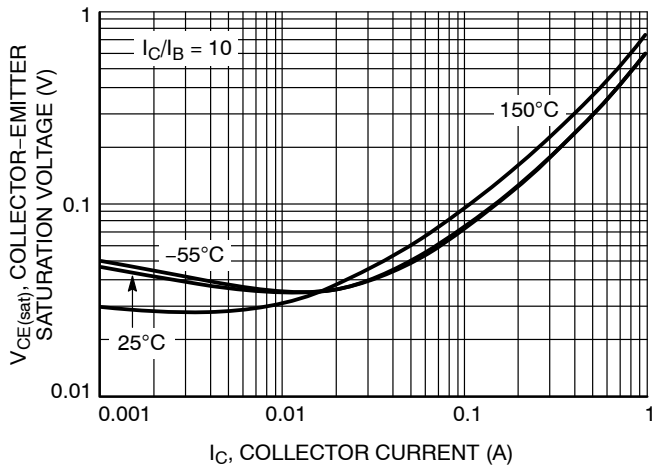
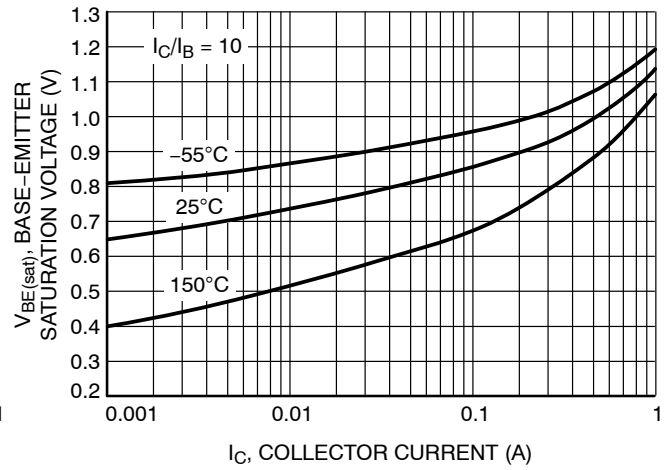


Figure 10. Current-Gain Bandwidth Product

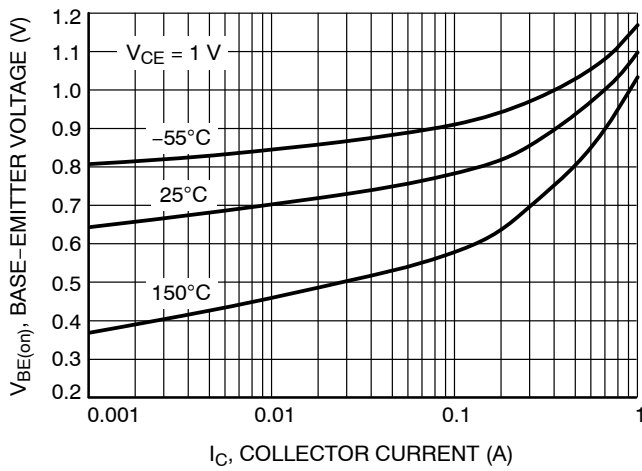
# MMBT2222AWT1G, SMMBT2222AWT1G



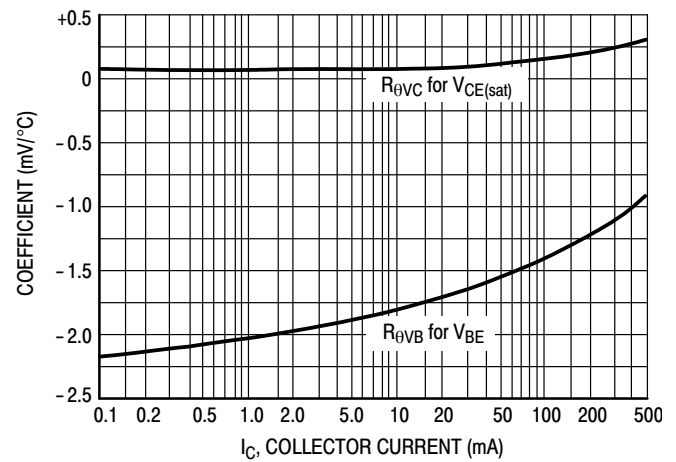
**Figure 11. Collector Emitter Saturation Voltage vs. Collector Current**



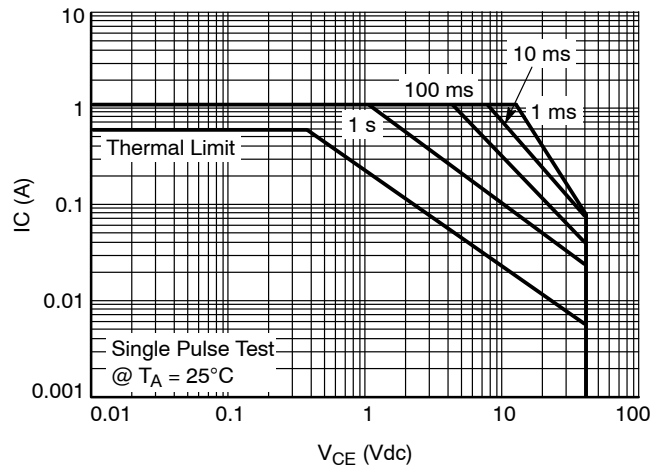
**Figure 12. Base Emitter Saturation Voltage vs. Collector Current**



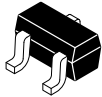
**Figure 13. Base Emitter Voltage vs. Collector Current**



**Figure 14. Temperature Coefficients**



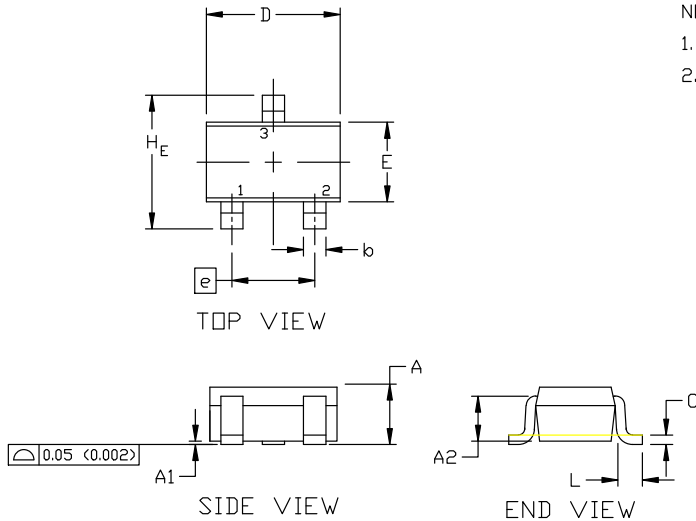
**Figure 15. Safe Operating Area**



SCALE 4:1

SC-70 (SOT-323)  
CASE 419  
ISSUE R

DATE 11 OCT 2022

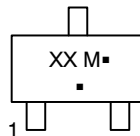


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH

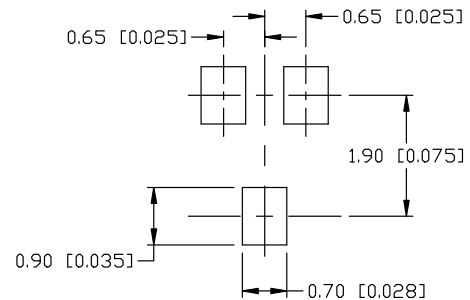
| DIM            | MILLIMETERS |      |      | INCHES    |       |       |
|----------------|-------------|------|------|-----------|-------|-------|
|                | MIN.        | NDM. | MAX. | MIN.      | NDM.  | MAX.  |
| A              | 0.80        | 0.90 | 1.00 | 0.032     | 0.035 | 0.040 |
| A1             | 0.00        | 0.05 | 0.10 | 0.000     | 0.002 | 0.004 |
| A2             | 0.70 REF    |      |      | 0.028 BSC |       |       |
| b              | 0.30        | 0.35 | 0.40 | 0.012     | 0.014 | 0.016 |
| c              | 0.10        | 0.18 | 0.25 | 0.004     | 0.007 | 0.010 |
| D              | 1.80        | 2.00 | 2.20 | 0.071     | 0.080 | 0.087 |
| E              | 1.15        | 1.24 | 1.35 | 0.045     | 0.049 | 0.053 |
| e              | 1.20        | 1.30 | 1.40 | 0.047     | 0.051 | 0.055 |
| e1             | 0.65 BSC    |      |      | 0.026 BSC |       |       |
| L              | 0.20        | 0.38 | 0.56 | 0.008     | 0.015 | 0.022 |
| H <sub>E</sub> | 2.00        | 2.10 | 2.40 | 0.079     | 0.083 | 0.095 |

GENERIC  
MARKING DIAGRAM



XX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.



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

SOLDERING FOOTPRINT

STYLE 1:  
CANCELLED

STYLE 2:  
PIN 1. ANODE  
2. N.C.  
3. CATHODE

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

STYLE 4:  
PIN 1. CATHODE  
2. CATHODE  
3. ANODE

STYLE 5:  
PIN 1. ANODE  
2. ANODE  
3. CATHODE

STYLE 6:  
PIN 1. EMITTER  
2. BASE  
3. COLLECTOR

STYLE 7:  
PIN 1. BASE  
2. EMITTER  
3. COLLECTOR

STYLE 8:  
PIN 1. GATE  
2. SOURCE  
3. DRAIN

STYLE 9:  
PIN 1. ANODE  
2. CATHODE  
3. CATHODE-ANODE

STYLE 10:  
PIN 1. CATHODE  
2. ANODE  
3. ANODE-CATHODE

STYLE 11:  
PIN 1. CATHODE  
2. CATHODE  
3. CATHODE

|                  |                 |   |
|------------------|-----------------|---|
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| DESCRIPTION:     | SC-70 (SOT-323) | PAGE 1 OF 1   |

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