

# NPN General Purpose Transistor

## MMBT2222AM3T5G

The MMBT2222AM3T5G device is a spin-off of our popular SOT-23 three-leaded device. It is designed for general purpose amplifier applications and is housed in the SOT-723 surface mount package. This device is ideal for low-power surface mount applications where board space is at a premium.

### Features

- Reduces Board Space
- 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

| 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   | mA <sub>dc</sub> |

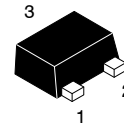
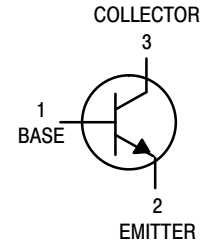
### THERMAL CHARACTERISTICS

| Characteristic  | Symbol          | Max         | Unit                       |
|---|-----------------|-------------|----------------------------|
| Total Device Dissipation<br>FR-5 Board (Note 1)<br>$T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$      | $P_D$           | 265<br>2.1  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance,<br>Junction-to-Ambient  | $R_{\theta JA}$ | 470         | $^\circ\text{C}/\text{W}$  |
| Total Device Dissipation<br>Alumina Substrate, (Note 2) $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$           | 640<br>5.1  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance,<br>Junction-to-Ambient  | $R_{\theta JA}$ | 195         | $^\circ\text{C}/\text{W}$  |
| Junction and Storage 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.

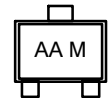
1. FR-5 =  $1.0 \times 0.75 \times 0.062$  in.

2. Alumina =  $0.4 \times 0.3 \times 0.024$  in. 99.5% alumina.



SOT-723  
CASE 631AA  
STYLE 1

### MARKING DIAGRAM



AA = Specific Device Code  
M = Date Code

### ORDERING INFORMATION

| Device            | Package           | Shipping†        |
|-------------------|-------------------|------------------|
| MMBT2222AM3T5G    | SOT-723 (Pb-Free) | 8000/Tape & Reel |
| NSVMMBT2222AM3T5G | SOT-723 (Pb-Free) | 8000/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.

# MMBT2222AM3T5G

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

| Characteristic   | Symbol               | Min    | Max        | Unit |
|--|----------------------|--------|------------|------|
| <b>OFF CHARACTERISTICS</b>   |                      |        |            |      |
| Collector – Emitter Breakdown Voltage (I <sub>C</sub> = 10 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> | 75     | –          | Vdc  |
| Emitter – Base Breakdown Voltage (I <sub>E</sub> = 10 μAdc, I <sub>C</sub> = 0)  | V <sub>(BR)EBO</sub> | 6.0    | –          | Vdc  |
| Collector Cutoff Current (V <sub>CE</sub> = 60 Vdc, V <sub>EB(off)</sub> = 3.0 Vdc)  | I <sub>CEX</sub>     | –      | 10         | nAdc |
| Collector Cutoff Current<br>(V <sub>CB</sub> = 60 Vdc, I <sub>E</sub> = 0)<br>(V <sub>CB</sub> = 60 Vdc, I <sub>E</sub> = 0, T <sub>A</sub> = 125°C) | I <sub>CBO</sub>     | –<br>– | 0.01<br>10 | μAdc |
| Emitter Cutoff Current (V <sub>EB</sub> = 3.0 Vdc, I <sub>C</sub> = 0)   | I <sub>EBO</sub>     | –      | 100        | nAdc |
| Base Cutoff Current (V <sub>CE</sub> = 60 Vdc, V <sub>EB(off)</sub> = 3.0 Vdc)   | I <sub>BL</sub>      | –      | 20         | nAdc |

## ON CHARACTERISTICS

|  |                      |   |                                   |     |
|--|----------------------|---|-----------------------------------|-----|
| 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> = 10 mAdc, V <sub>CE</sub> = 10 Vdc, T <sub>A</sub> = –55°C)<br>(I <sub>C</sub> = 150 mAdc, V <sub>CE</sub> = 10 Vdc) (Note 3)<br>(I <sub>C</sub> = 150 mAdc, V <sub>CE</sub> = 1.0 Vdc) (Note 3)<br>(I <sub>C</sub> = 500 mAdc, V <sub>CE</sub> = 10 Vdc) (Note 3) | h <sub>FE</sub>      | 35<br>50<br>75<br>35<br>100<br>50<br>40 | –<br>–<br>–<br>–<br>300<br>–<br>– | –   |
| Collector – Emitter Saturation Voltage (Note 3)<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 3)<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 (Note 4)<br>(I <sub>C</sub> = 20 mAdc, V <sub>CE</sub> = 20 Vdc, f = 100 MHz)   | f <sub>T</sub>                  | 300         | –           | MHz                |
| Output Capacitance (V <sub>CB</sub> = 10 Vdc, I <sub>E</sub> = 0, f = 1.0 MHz)   | C <sub>obo</sub>                | –           | 8.0         | pF                 |
| Input Capacitance (V <sub>EB</sub> = 0.5 Vdc, I <sub>C</sub> = 0, f = 1.0 MHz)   | C <sub>ibo</sub>                | –           | 25          | pF                 |
| Input Impedance<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)<br>(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)             | h <sub>ie</sub>                 | 2.0<br>0.25 | 8.0<br>1.25 | kΩ                 |
| Voltage Feedback Ratio<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)<br>(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)      | h <sub>re</sub>                 | –<br>–      | 8.0<br>4.0  | X 10 <sup>–4</sup> |
| Small – Signal Current Gain<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)<br>(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz) | h <sub>fe</sub>                 | 50<br>75    | 300<br>375  | –                  |
| Output Admittance<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)<br>(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)           | h <sub>oe</sub>                 | 5.0<br>25   | 35<br>200   | μmhos              |
| Collector Base Time Constant<br>(I <sub>E</sub> = 20 mAdc, V <sub>CB</sub> = 20 Vdc, f = 31.8 MHz)   | r <sub>b</sub> , C <sub>c</sub> | –           | 150         | ps                 |
| Noise Figure (I <sub>C</sub> = 100 μAdc, V <sub>CE</sub> = 10 Vdc, R <sub>S</sub> = 1.0 kΩ, f = 1.0 kHz)   | NF                              | –           | 4.0         | dB                 |

## SWITCHING CHARACTERISTICS

|              |  |                |   |     |    |
|--------------|--|----------------|---|-----|----|
| Delay Time   | (V <sub>CC</sub> = 30 Vdc, V <sub>BE(off)</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  |    |

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

4. f<sub>T</sub> is defined as the frequency at which |h<sub>fe</sub>| extrapolates to unity.

# MMBT2222AM3T5G

## SWITCHING TIME EQUIVALENT TEST CIRCUITS

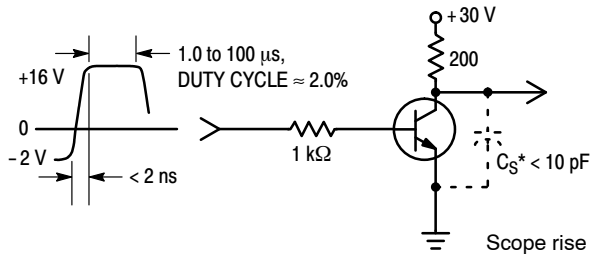


Figure 1. Turn-On Time

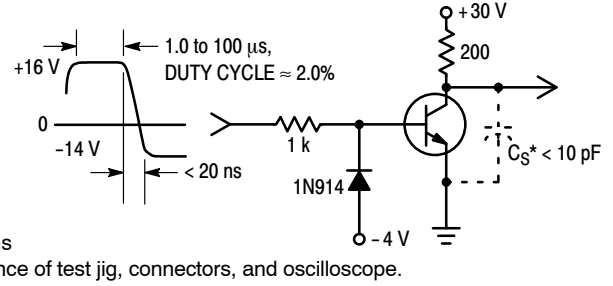


Figure 2. Turn-Off Time

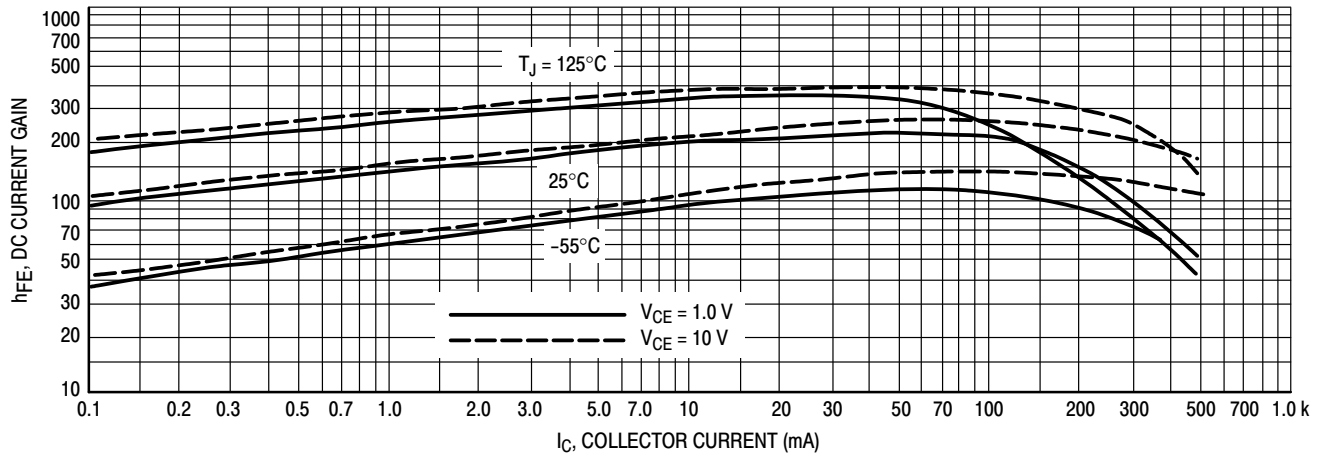


Figure 3. DC Current Gain

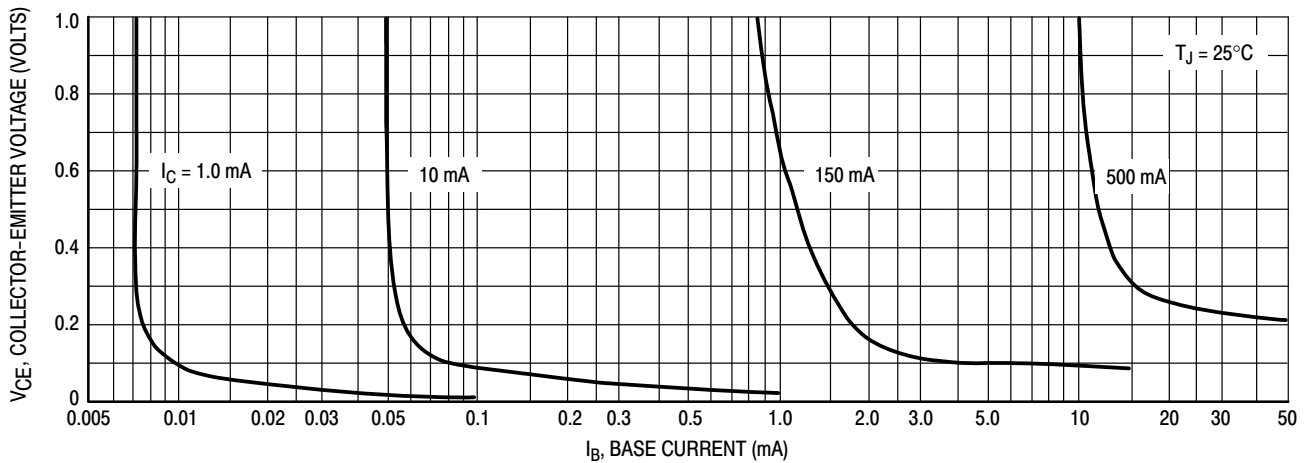


Figure 4. Collector Saturation Region

# MMBT2222AM3T5G

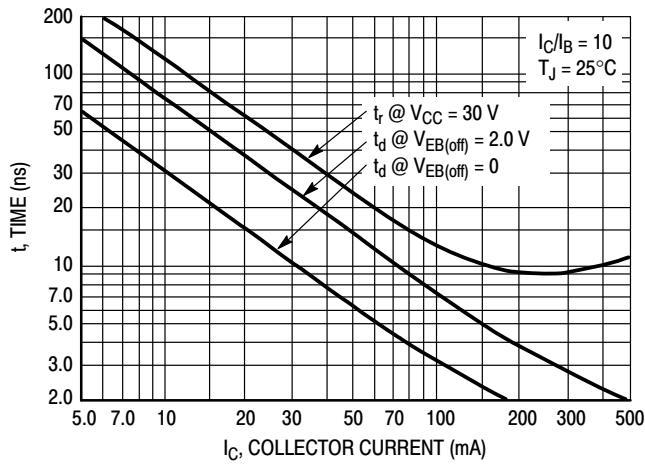


Figure 5. Turn-On Time

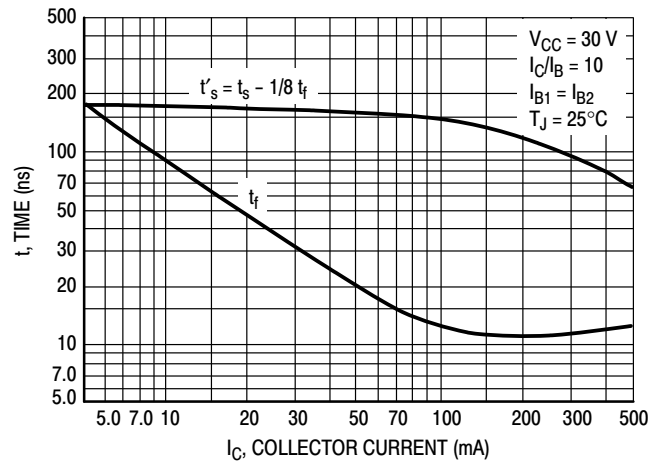


Figure 6. Turn-Off Time

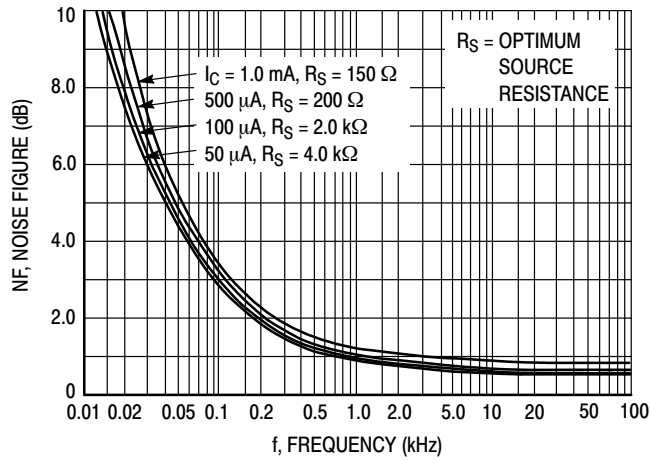


Figure 7. Frequency Effects

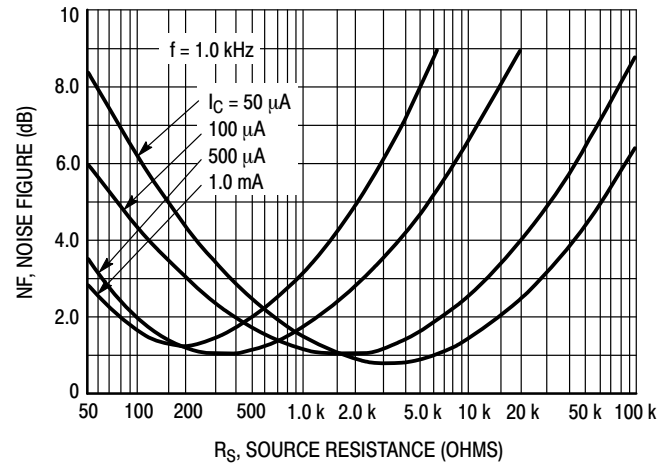


Figure 8. Source Resistance Effects

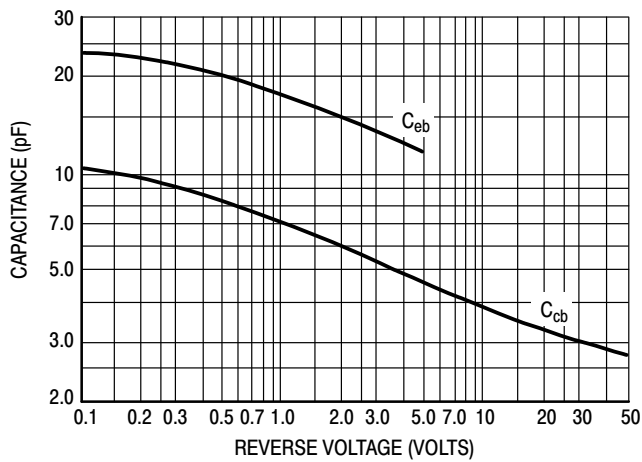


Figure 9. Capacitances

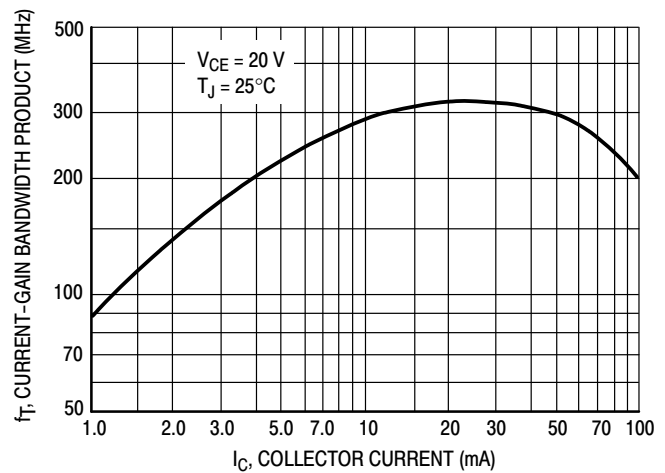


Figure 10. Current-Gain Bandwidth Product

MMBT2222AM3T5G

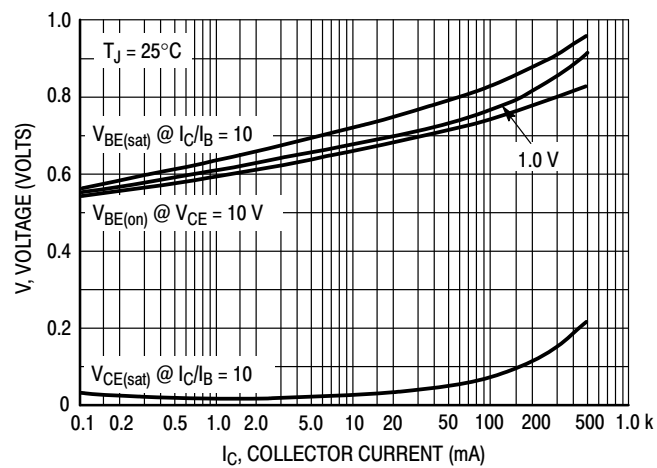


Figure 11. "On" Voltages

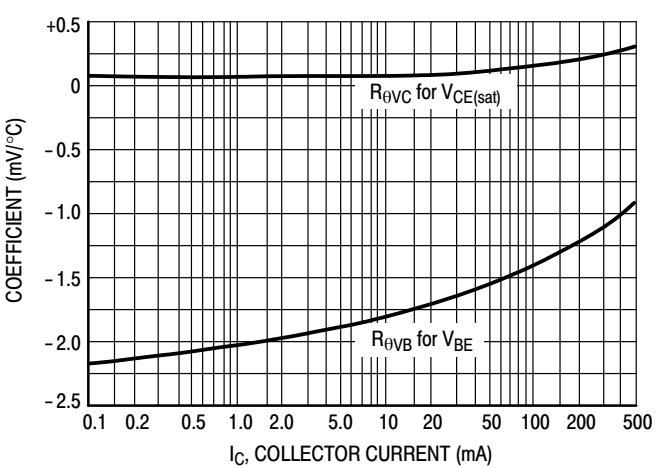
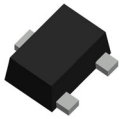


Figure 12. Temperature Coefficients

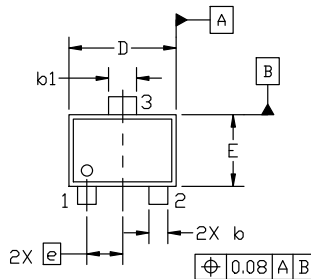


**SOT-723 1.20x0.80x0.50, 0.40P**  
**CASE 631AA**  
**ISSUE E**

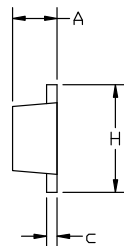
DATE 24 JAN 2024

NOTES:

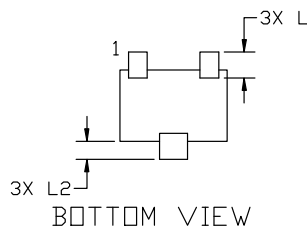
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.



TOP VIEW

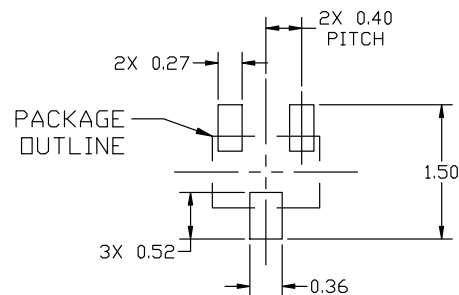


SIDE VIEW



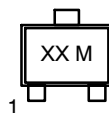
BOTTOM VIEW

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | 0.45        | 0.50 | 0.55 |
| b   | 0.15        | 0.21 | 0.27 |
| b1  | 0.25        | 0.31 | 0.37 |
| c   | 0.07        | 0.12 | 0.17 |
| D   | 1.15        | 1.20 | 1.25 |
| E   | 0.75        | 0.80 | 0.85 |
| e   | 0.40 BSC    |      |      |
| H   | 1.15        | 1.20 | 1.25 |
| L   | 0.29 REF    |      |      |
| L2  | 0.15        | 0.20 | 0.25 |



RECOMMENDED MOUNTING  
FOOTPRINT

**GENERIC  
MARKING DIAGRAM\***



XX = Specific Device Code  
M = Date Code

\*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, SOLDERM/D.

|   |  |  |  |  |
|---|--|--|--|--|
| STYLE 1:<br>PIN 1. BASE<br>2. EMITTER<br>3. COLLECTOR | STYLE 2:<br>PIN 1. ANODE<br>2. N/C<br>3. CATHODE | STYLE 3:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE | STYLE 4:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. ANODE | STYLE 5:<br>PIN 1. GATE<br>2. SOURCE<br>3. DRAIN |
|---|--|--|--|--|

|                         |                                      |  |
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| <b>DESCRIPTION:</b>     | <b>SOT-723 1.20x0.80x0.50, 0.40P</b> | <b>PAGE 1 OF 1</b>   |

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