

MMBT2222LT1G, MMBT2222ALT1G

General Purpose Transistors

NPN Silicon

Features

- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|--|-----------|------------|------|
| Collector - Emitter Voltage MMBT2222LT1G MMBT2222ALT1G | V_{CEO} | 30 40 | Vdc |
| Collector - Base Voltage MMBT2222LT1G MMBT2222ALT1G | V_{CBO} | 60 75 | Vdc |
| Emitter - Base Voltage MMBT2222LT1G MMBT2222ALT1G | V_{EBO} | 5.0 6.0 | Vdc |
| Collector Current - Continuous | I_C | 600 | mAdc |
| Collector Current - Peak (Note 3) | I_{CM} | 1100 | mAdc |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|--|-----------------|-------------|----------------------------|
| Total Device Dissipation FR-5 Board (Note 1) $T_A = 25^\circ\text{C}$ Derate above 25°C | P_D | 225 1.8 | mW mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 556 | $^\circ\text{C}/\text{W}$ |
| Total Device Dissipation Alumina Substrate (Note 2) $T_A = 25^\circ\text{C}$ Derate above 25°C | P_D | 300 2.4 | mW mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 417 | $^\circ\text{C}/\text{W}$ |
| Junction and Storage Temperature Range | T_J, T_{stg} | -55 to +150 | $^\circ\text{C}$ |

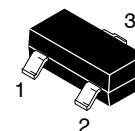
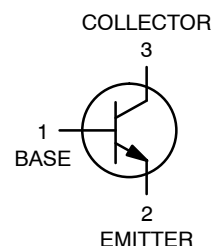
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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.
3. Reference SOA curve.



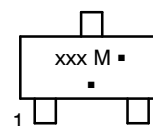
ON Semiconductor®

<http://onsemi.com>



SOT-23
CASE 318
STYLE 6

MARKING DIAGRAM



xxx = 1P or M1B
M = Date Code*
▪ = Pb-Free Package

(Note: Microdot may be in either location)

*Date Code orientation and/or overbar may vary depending upon manufacturing location.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

MMBT2222LT1G, MMBT2222ALT1G

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Max | Unit |
|--|--|---|--|--------------------|
| OFF CHARACTERISTICS | | | | |
| Collector – Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0) MMBT2222A | MMBT2222 V _{(BR)CEO} | 30 40 | – – | Vdc |
| Collector – Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0) MMBT2222A | MMBT2222 V _{(BR)CBO} | 60 75 | – – | Vdc |
| Emitter – Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0) MMBT2222A | MMBT2222 V _{(BR)EBO} | 5.0 6.0 | – – | Vdc |
| Collector Cutoff Current (V _{CE} = 60 Vdc, V _{EB(off)} = 3.0 Vdc) | MMBT2222A I _{CEX} | – | 10 | nAdc |
| Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0) (V _{CB} = 60 Vdc, I _E = 0) (V _{CB} = 50 Vdc, I _E = 0, T _A = 125°C) (V _{CB} = 60 Vdc, I _E = 0, T _A = 125°C) | MMBT2222 MMBT2222A MMBT2222 MMBT2222A I _{CBO} | – – – – | 0.01 0.01 10 10 | μAdc |
| Emitter Cutoff Current (V _{EB} = 3.0 Vdc, I _C = 0) | MMBT2222A I _{EBO} | – | 100 | nAdc |
| Base Cutoff Current (V _{CE} = 60 Vdc, V _{EB(off)} = 3.0 Vdc) | MMBT2222A I _{BL} | – | 20 | nAdc |
| ON CHARACTERISTICS | | | | |
| DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 10 Vdc) (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc, T _A = –55°C) (I _C = 150 mAdc, V _{CE} = 10 Vdc) (Note 4) (I _C = 150 mAdc, V _{CE} = 1.0 Vdc) (Note 4) (I _C = 500 mAdc, V _{CE} = 10 Vdc) (Note 4) | MMBT2222A only MMBT2222 MMBT2222A h _{FE} | 35 50 75 35 100 50 30 40 | – – – – 300 – – – | – |
| Collector – Emitter Saturation Voltage (Note 4) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc) | MMBT2222 MMBT2222A MMBT2222 MMBT2222A V _{CE(sat)} | – – – – | 0.4 0.3 1.6 1.0 | Vdc |
| Base – Emitter Saturation Voltage (Note 4) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc) | MMBT2222 MMBT2222A MMBT2222 MMBT2222A V _{BE(sat)} | – 0.6 – – | 1.3 1.2 2.6 2.0 | Vdc |
| SMALL-SIGNAL CHARACTERISTICS | | | | |
| Current – Gain – Bandwidth Product (Note 5) (I _C = 20 mAdc, V _{CE} = 20 Vdc, f = 100 MHz) | MMBT2222 MMBT2222A f _T | 250 300 | – – | MHz |
| Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz) | C _{obo} | – | 8.0 | pF |
| Input Capacitance (V _{EB} = 0.5 Vdc, I _C = 0, f = 1.0 MHz) | MMBT2222 MMBT2222A C _{ibo} | – – | 30 25 | pF |
| Input Impedance (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz) (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz) | MMBT2222A MMBT2222A h _{ie} | 2.0 0.25 | 8.0 1.25 | kΩ |
| Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz) (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz) | MMBT2222A MMBT2222A h _{re} | – – | 8.0 4.0 | X 10 ^{–4} |
| Small – Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz) (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz) | MMBT2222A MMBT2222A h _{fe} | 50 75 | 300 375 | – |
| Output Admittance (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz) (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz) | MMBT2222A MMBT2222A h _{oe} | 5.0 25 | 35 200 | μmhos |

MMBT2222LT1G, MMBT2222ALT1G

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Min | Max | Unit | |
|---|-----------|------------|-----|------|----|
| SMALL-SIGNAL CHARACTERISTICS | | | | | |
| Collector Base Time Constant ($I_E = 20 \text{ mAdc}$, $V_{CB} = 20 \text{ Vdc}$, $f = 31.8 \text{ MHz}$) | MMBT2222A | r_b, C_c | - | 150 | ps |
| Noise Figure ($I_C = 100 \mu\text{Adc}$, $V_{CE} = 10 \text{ Vdc}$, $R_S = 1.0 \text{ k}\Omega$, $f = 1.0 \text{ kHz}$) | MMBT2222A | NF | - | 4.0 | dB |

SWITCHING CHARACTERISTICS (MMBT2222A only)

| | | | | | |
|--------------|---|-------|---|-----|----|
| Delay Time | $(V_{CC} = 30 \text{ Vdc}$, $V_{BE(\text{off})} = -0.5 \text{ Vdc}$, $I_C = 150 \text{ mAdc}$, $I_{B1} = 15 \text{ mAdc}$) | t_d | - | 10 | ns |
| Rise Time | | t_r | - | 25 | |
| Storage Time | $(V_{CC} = 30 \text{ Vdc}$, $I_C = 150 \text{ mAdc}$, $I_{B1} = I_{B2} = 15 \text{ mAdc}$) | t_s | - | 225 | ns |
| Fall Time | | t_f | - | 60 | |

- Pulse Test: Pulse Width $\leq 300 \mu\text{s}$, Duty Cycle $\leq 2.0\%$.
- f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

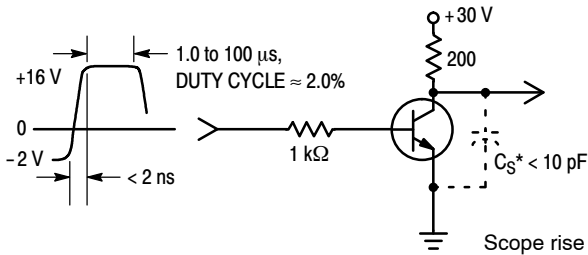


Figure 1. Turn-On Time

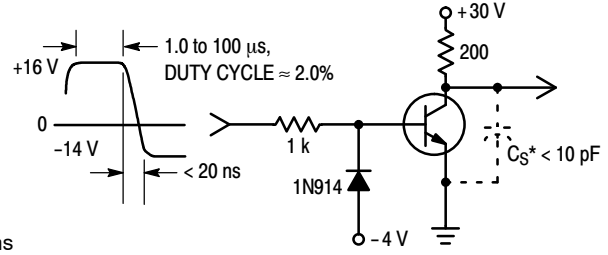


Figure 2. Turn-Off Time

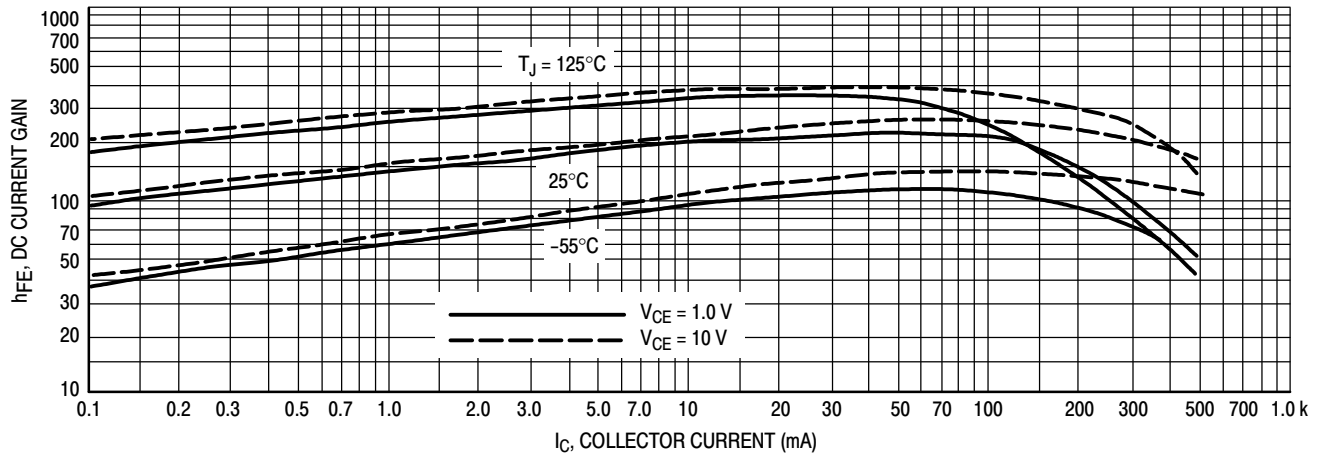


Figure 3. DC Current Gain

MMBT2222LT1G, MMBT2222ALT1G

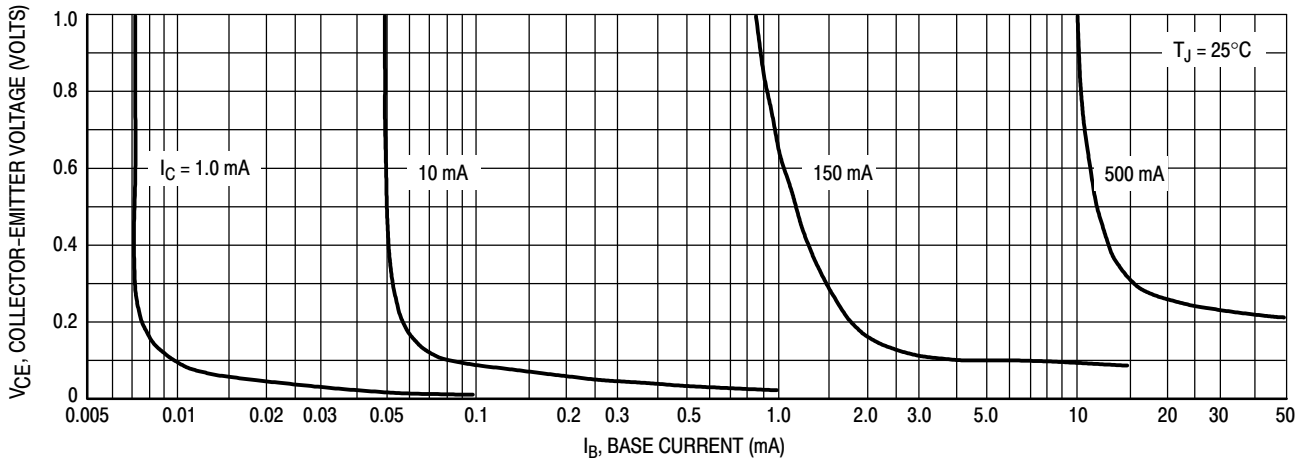


Figure 4. Collector Saturation Region

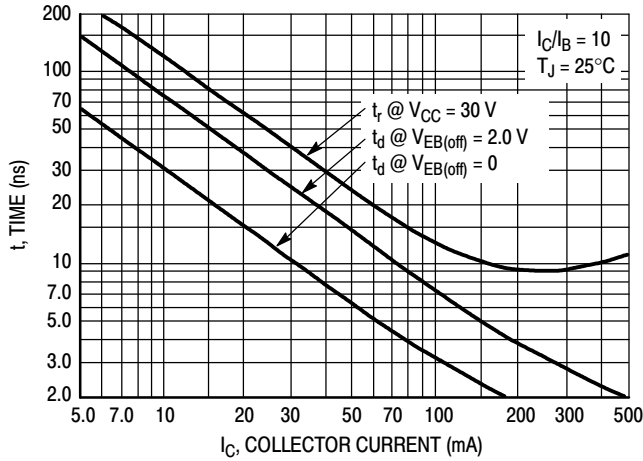


Figure 5. Turn-On Time

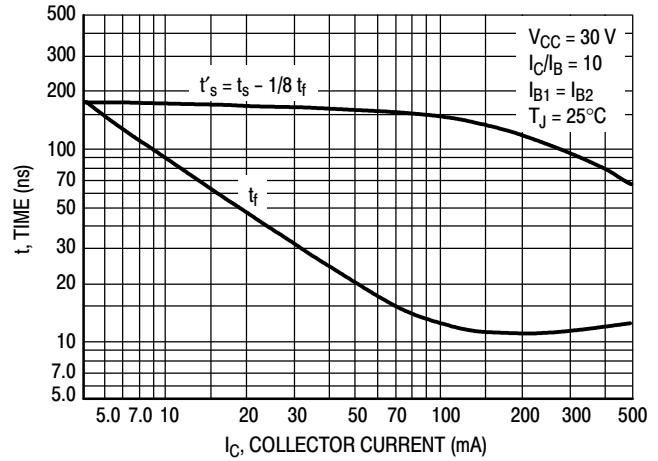


Figure 6. Turn-Off Time

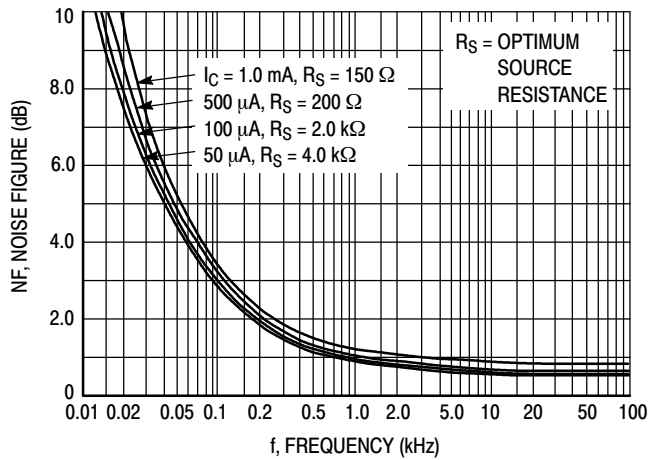


Figure 7. Frequency Effects

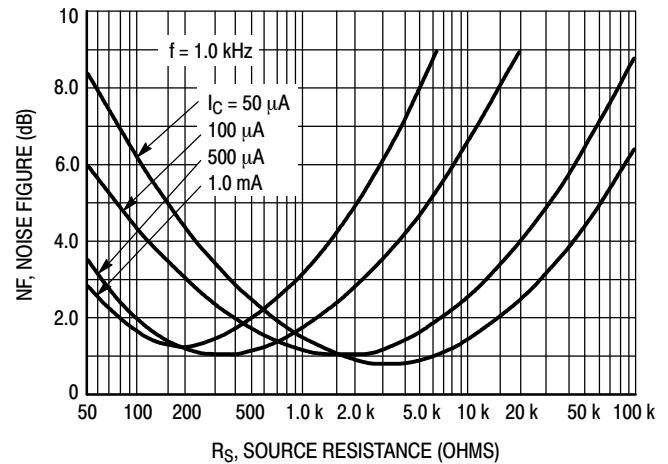


Figure 8. Source Resistance Effects

MMBT2222LT1G, MMBT2222ALT1G

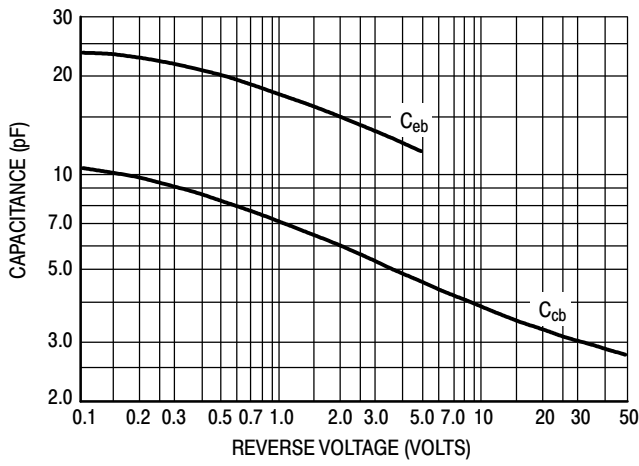


Figure 9. Capacitances

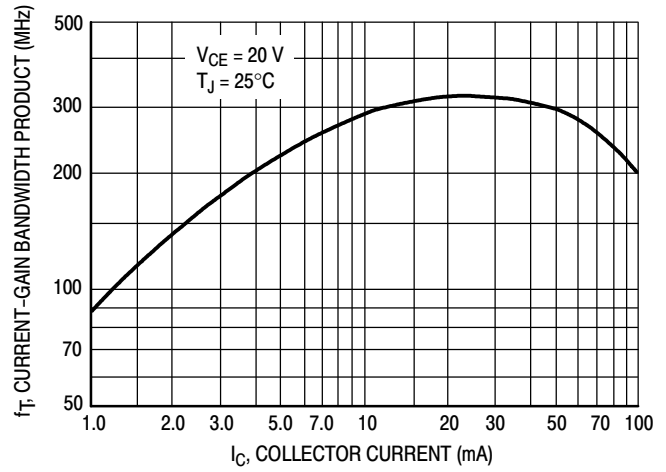


Figure 10. Current-Gain Bandwidth Product

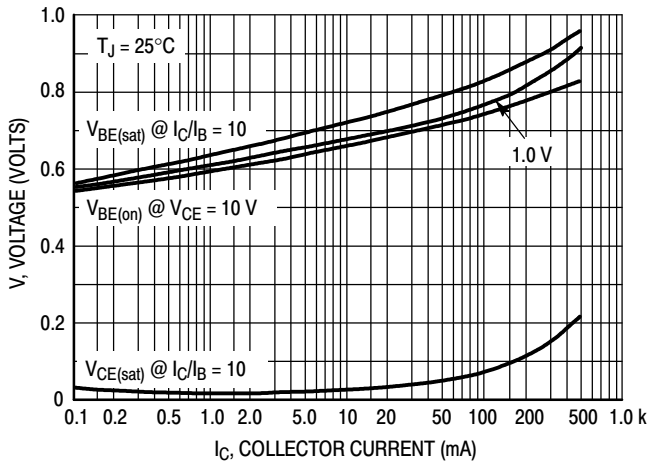


Figure 11. "On" Voltages

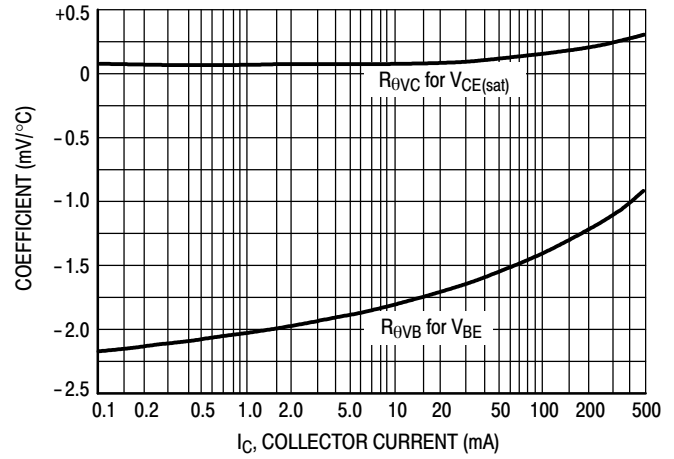


Figure 12. Temperature Coefficients

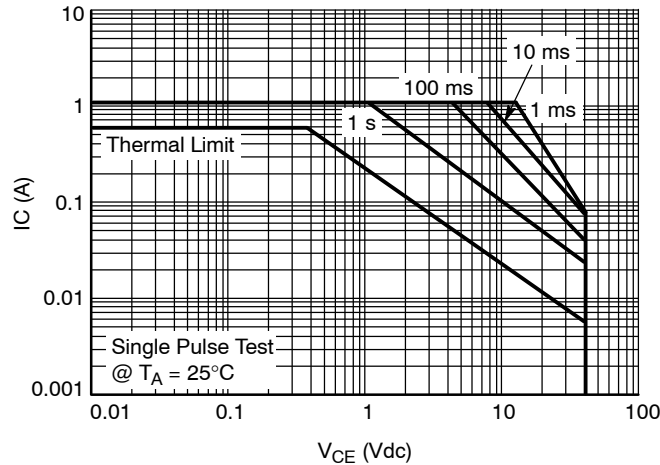


Figure 13. Safe Operating Area

MMBT2222LT1G, MMBT2222ALT1G

ORDERING INFORMATION

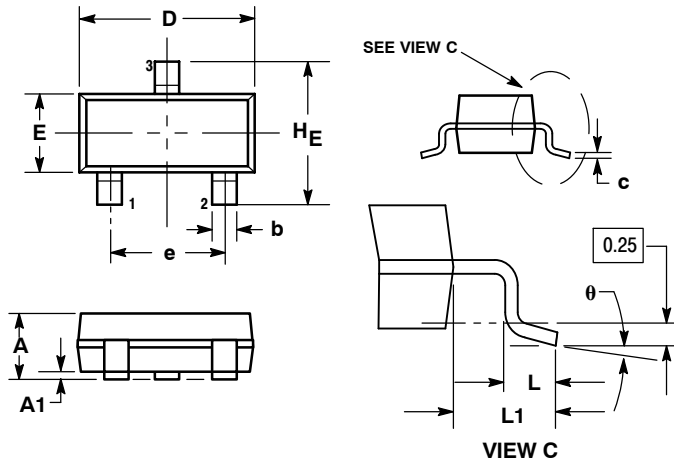
| Device | Specific Marking Code | Package | Shipping† |
|---------------|-----------------------|---------------------|----------------------|
| MMBT2222LT1G | M1B | SOT-23 (Pb-Free) | 3000 / Tape & Reel |
| MMBT2222ALT1G | 1P | SOT-23 (Pb-Free) | 3000 / Tape & Reel |
| MMBT2222LT3G | M1B | SOT-23 (Pb-Free) | 10,000 / Tape & Reel |
| MMBT2222ALT3G | 1P | SOT-23 (Pb-Free) | 10,000 / 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.

MMBT2222LT1G, MMBT2222ALT1G

PACKAGE DIMENSIONS

SOT-23 (TO-236)
CASE 318-08
ISSUE AN



NOTES:

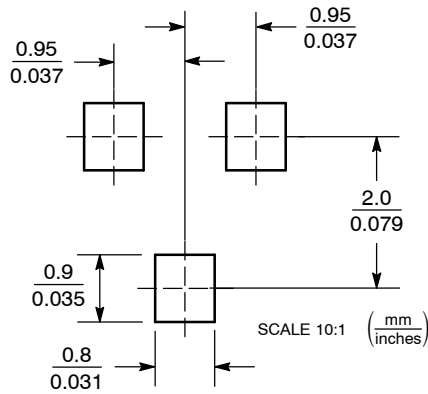
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318-01 THRU -07 AND -09 OBSOLETE, NEW STANDARD 318-08.

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|--------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.89 | 1.00 | 1.11 | 0.035 | 0.040 | 0.044 |
| A1 | 0.01 | 0.06 | 0.10 | 0.001 | 0.002 | 0.004 |
| b | 0.37 | 0.44 | 0.50 | 0.015 | 0.018 | 0.020 |
| c | 0.09 | 0.13 | 0.18 | 0.003 | 0.005 | 0.007 |
| D | 2.80 | 2.90 | 3.04 | 0.110 | 0.114 | 0.120 |
| E | 1.20 | 1.30 | 1.40 | 0.047 | 0.051 | 0.055 |
| e | 1.78 | 1.90 | 2.04 | 0.070 | 0.075 | 0.081 |
| L | 0.10 | 0.20 | 0.30 | 0.004 | 0.008 | 0.012 |
| L1 | 0.35 | 0.54 | 0.69 | 0.014 | 0.021 | 0.029 |
| HE | 2.10 | 2.40 | 2.64 | 0.083 | 0.094 | 0.104 |

STYLE 6:

1. BASE
2. EMITTER
3. 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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