

# MMBT2222LT1, MMBT2222ALT1

MMBT2222ALT1 is a Preferred Device

## General Purpose Transistors

### NPN Silicon

#### Features

- Pb-Free Package May be Available. The G-Suffix Denotes a Pb-Free Lead Finish

#### MAXIMUM RATINGS

| Rating   | Symbol    | Value      | Unit |
|--|-----------|------------|------|
| Collector–Emitter Voltage<br>MMBT2222LT1<br>MMBT2222ALT1 | $V_{CEO}$ | 30<br>40   | Vdc  |
| Collector–Base Voltage<br>MMBT2222LT1<br>MMBT2222ALT1    | $V_{CBO}$ | 60<br>75   | Vdc  |
| Emitter–Base Voltage<br>MMBT2222LT1<br>MMBT2222ALT1      | $V_{EBO}$ | 5.0<br>6.0 | Vdc  |
| Collector Current – Continuous                           | $I_C$     | 600        | mAdc |

#### 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 $25^\circ\text{C}$        | $P_D$           | 225<br>1.8     | mW<br>mW/°C |
| Thermal Resistance<br>Junction–to–Ambient   | $R_{\theta JA}$ | 556            | °C/W        |
| Total Device Dissipation<br>Alumina Substrate (Note 2)<br>$T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$           | 300<br>2.4     | mW<br>mW/°C |
| Thermal Resistance<br>Junction–to–Ambient   | $R_{\theta JA}$ | 417            | °C/W        |
| Junction and Storage<br>Temperature Range   | $T_J, T_{stg}$  | –55 to<br>+150 | °C          |

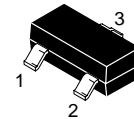
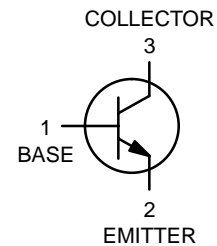
Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur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

- FR–5 =  $1.0 \times 0.75 \times 0.062$  in.
- Alumina =  $0.4 \times 0.3 \times 0.024$  in. 99.5% alumina.



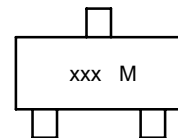
ON Semiconductor®

<http://onsemi.com>



SOT-23  
CASE 318  
Style 6

#### MARKING DIAGRAM



xxx = Specific Device Code  
(M1B = MMBT2222LT1,  
1P = MMBT2222ALT1)  
M = Date Code

#### ORDERING INFORMATION

| Device        | Package             | Shipping†          |
|---------------|---------------------|--------------------|
| MMBT2222LT1   | SOT-23              | 3000/Tape & Reel   |
| MMBT2222LT1G  | SOT-23<br>(Pb-Free) | 3000/Tape & Reel   |
| MMBT2222ALT1  | SOT-23              | 3000/Tape & Reel   |
| MMBT2222ALT1G | SOT-23<br>(Pb-Free) | 3000/Tape & Reel   |
| MMBT2222LT3   | SOT-23              | 10,000/Tape & Reel |
| MMBT2222ALT3  | SOT-23              | 10,000/Tape & Reel |
| MMBT2222ALT3G | SOT-23<br>(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.

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

# MMBT2222LT1, MMBT2222ALT1

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

| Characteristic   |                       | Symbol        | Min        | Max    | Unit            |
|--|-----------------------|---------------|------------|--------|-----------------|
| <b>OFF CHARACTERISTICS</b>   |                       |               |            |        |                 |
| Collector–Emitter Breakdown Voltage ( $I_C = 10\text{ mAdc}$ , $I_B = 0$ )             | MMBT2222<br>MMBT2222A | $V_{(BR)CEO}$ | 30<br>40   | –<br>– | Vdc             |
| Collector–Base Breakdown Voltage ( $I_C = 10\text{ }\mu\text{Adc}$ , $I_E = 0$ )       | MMBT2222<br>MMBT2222A | $V_{(BR)CBO}$ | 60<br>75   | –<br>– | Vdc             |
| Emitter–Base Breakdown Voltage ( $I_E = 10\text{ }\mu\text{Adc}$ , $I_C = 0$ )         | MMBT2222<br>MMBT2222A | $V_{(BR)EBO}$ | 5.0<br>6.0 | –<br>– | Vdc             |
| Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 3.0\text{ Vdc}$ ) | MMBT2222A             | $I_{CEX}$     | –          | 10     | nAdc            |
| Collector Cutoff Current ( $V_{CB} = 50\text{ Vdc}$ , $I_E = 0$ )                      | MMBT2222<br>MMBT2222A | $I_{CBO}$     | –          | 0.01   | $\mu\text{Adc}$ |
| ( $V_{CB} = 60\text{ Vdc}$ , $I_E = 0$ )   | MMBT2222A             |               | –          | 0.01   |                 |
| ( $V_{CB} = 50\text{ Vdc}$ , $I_E = 0$ , $T_A = 125^\circ\text{C}$ )                   | MMBT2222              |               | –          | 10     |                 |
| ( $V_{CB} = 60\text{ Vdc}$ , $I_E = 0$ , $T_A = 125^\circ\text{C}$ )                   | MMBT2222A             |               | –          | 10     |                 |
| Emitter Cutoff Current ( $V_{EB} = 3.0\text{ Vdc}$ , $I_C = 0$ )                       | MMBT2222A             | $I_{EBO}$     | –          | 100    | nAdc            |
| Base Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 3.0\text{ Vdc}$ )      | MMBT2222A             | $I_{BL}$      | –          | 20     | nAdc            |

## ON CHARACTERISTICS

|   |   |               |   |  |     |
|---|---|---------------|---|--|-----|
| DC Current Gain<br>( $I_C = 0.1\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )<br>( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )<br>( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ )<br>( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $T_A = -55^\circ\text{C}$ )<br>( $I_C = 150\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) (Note 3)<br>( $I_C = 150\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ ) (Note 3)<br>( $I_C = 500\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) (Note 3) | MMBT2222A only<br><br><br><br><br><br>MMBT2222<br>MMBT2222A | $h_{FE}$      | 35<br>50<br>75<br>35<br>100<br>50<br>30<br>40 | –<br>–<br>–<br>–<br>300<br>–<br>–<br>– | –   |
| Collector–Emitter Saturation Voltage (Note 3)<br>( $I_C = 150\text{ mAdc}$ , $I_B = 15\text{ mAdc}$ )<br><br>( $I_C = 500\text{ mAdc}$ , $I_B = 50\text{ mAdc}$ )   | MMBT2222<br>MMBT2222A<br><br>MMBT2222<br>MMBT2222A          | $V_{CE(sat)}$ | –<br>–<br>–<br>–                              | 0.4<br>0.3<br>1.6<br>1.0               | Vdc |
| Base–Emitter Saturation Voltage (Note 3)<br>( $I_C = 150\text{ mAdc}$ , $I_B = 15\text{ mAdc}$ )<br><br>( $I_C = 500\text{ mAdc}$ , $I_B = 50\text{ mAdc}$ )  | MMBT2222<br>MMBT2222A<br><br>MMBT2222<br>MMBT2222A          | $V_{BE(sat)}$ | –<br>0.6<br>–<br>–                            | 1.3<br>1.2<br>2.6<br>2.0               | Vdc |

## SMALL–SIGNAL CHARACTERISTICS

|  |                        |           |             |             |                  |
|--|------------------------|-----------|-------------|-------------|------------------|
| Current–Gain–Bandwidth Product (Note 4)<br>( $I_C = 20\text{ mAdc}$ , $V_{CE} = 20\text{ Vdc}$ , $f = 100\text{ MHz}$ )  | MMBT2222<br>MMBT2222A  | $f_T$     | 250<br>300  | –<br>–      | MHz              |
| Output Capacitance<br>( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )  |                        | $C_{obo}$ | –           | 8.0         | pF               |
| Input Capacitance<br>( $V_{EB} = 0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )  | MMBT2222<br>MMBT2222A  | $C_{ibo}$ | –<br>–      | 30<br>25    | pF               |
| Input Impedance<br>( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )<br>( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )           | MMBT2222A<br>MMBT2222A | $h_{ie}$  | 2.0<br>0.25 | 8.0<br>1.25 | $k\Omega$        |
| Voltage Feedback Ratio<br>( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )<br>( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )    | MMBT2222A<br>MMBT2222A | $h_{re}$  | –<br>–      | 8.0<br>4.0  | $\times 10^{-4}$ |
| Small–Signal Current Gain<br>( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )<br>( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) | MMBT2222A<br>MMBT2222A | $h_{fe}$  | 50<br>75    | 300<br>375  | –                |

3. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

4.  $f_T$  is defined as the frequency at which  $|h_{fe}|$  extrapolates to unity.

# MMBT2222LT1, MMBT2222ALT1

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

| Characteristic   | Symbol                 | Min        | Max       | Unit      |                 |
|--|------------------------|------------|-----------|-----------|-----------------|
| <b>SMALL-SIGNAL CHARACTERISTICS</b>  |                        |            |           |           |                 |
| Output Admittance<br>( $I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )<br>( $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) | MMBT2222A<br>MMBT2222A | $h_{oe}$   | 5.0<br>25 | 35<br>200 | $\mu\text{hos}$ |
| Collector Base Time Constant<br>( $I_E = 20\text{ mA}$ , $V_{CB} = 20\text{ Vdc}$ , $f = 31.8\text{ MHz}$ )  | MMBT2222A              | $r_b, C_c$ | -         | 150       | ps              |
| Noise Figure<br>( $I_C = 100\ \mu\text{A}$ , $V_{CE} = 10\text{ Vdc}$ , $R_S = 1.0\text{ k}\Omega$ , $f = 1.0\text{ kHz}$ )  | MMBT2222A              | NF         | -         | 4.0       | dB              |

## SWITCHING CHARACTERISTICS (MMBT2222A only)

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

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

## SWITCHING TIME EQUIVALENT TEST CIRCUITS

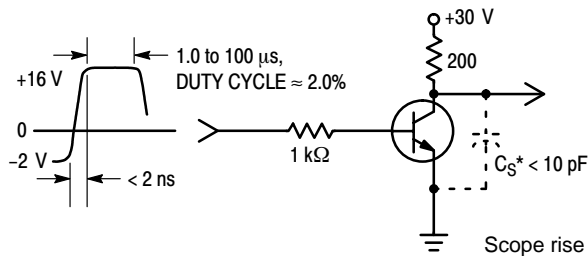


Figure 1. Turn-On Time

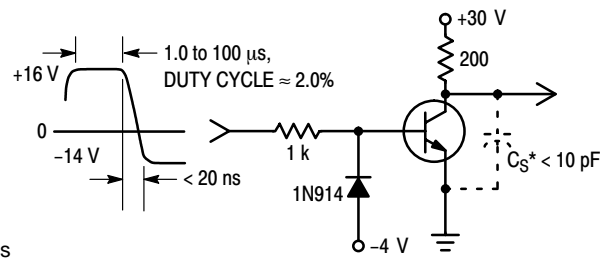


Figure 2. Turn-Off Time

# MMBT2222LT1, MMBT2222ALT1

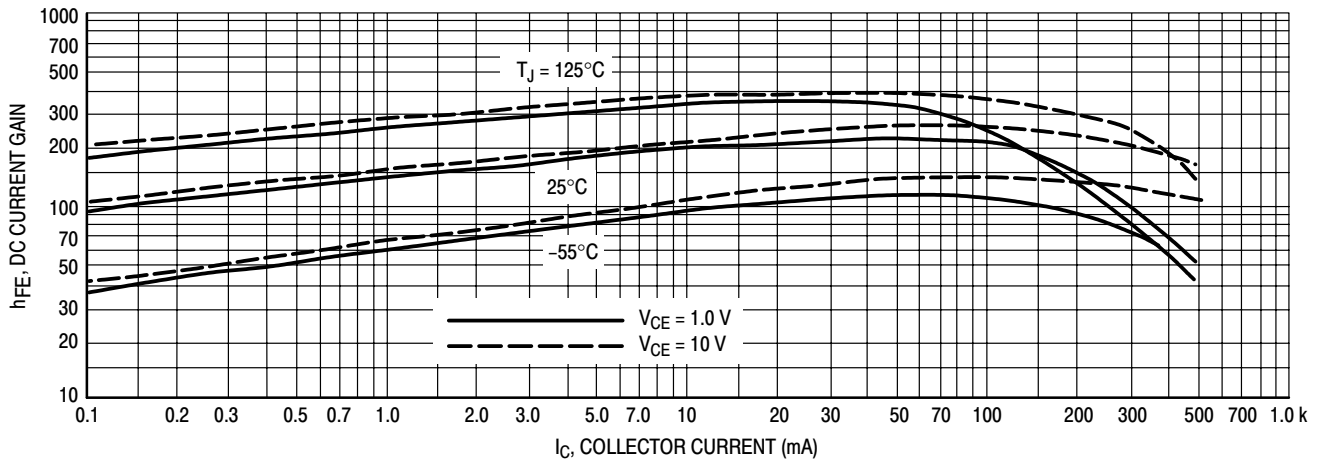


Figure 3. DC Current Gain

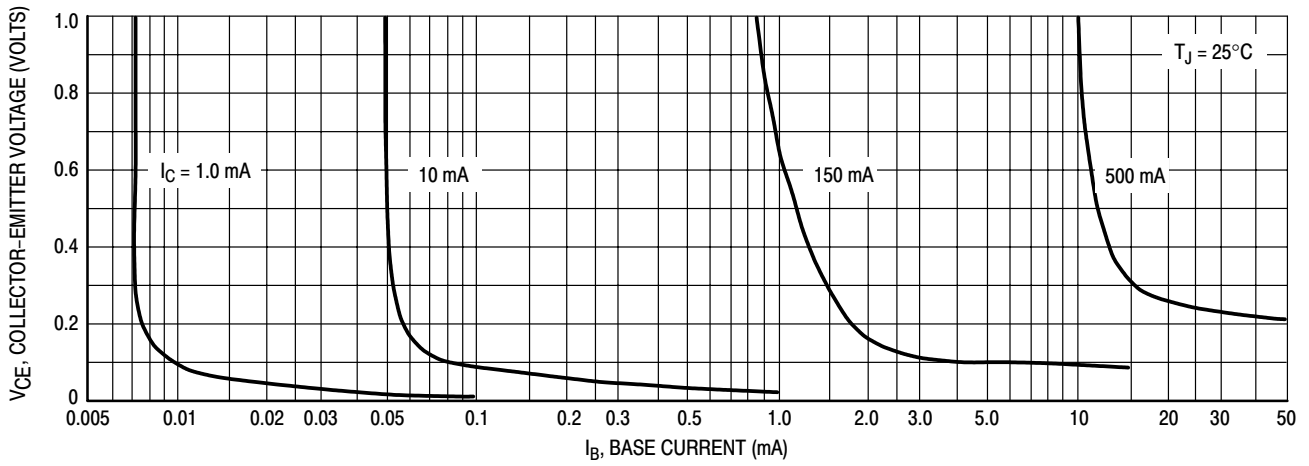


Figure 4. Collector Saturation Region

# MMBT2222LT1, MMBT2222ALT1

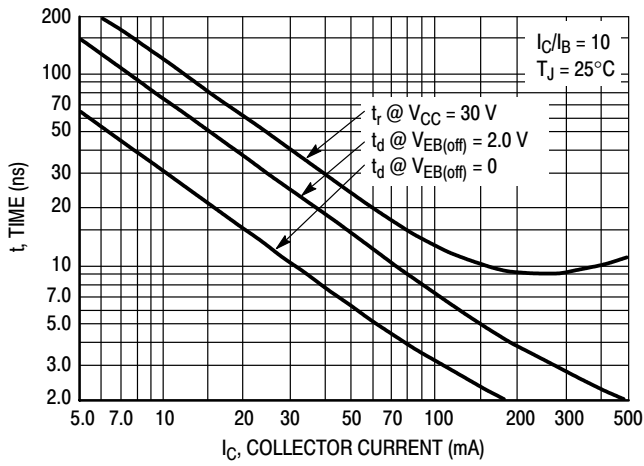


Figure 5. Turn-On Time

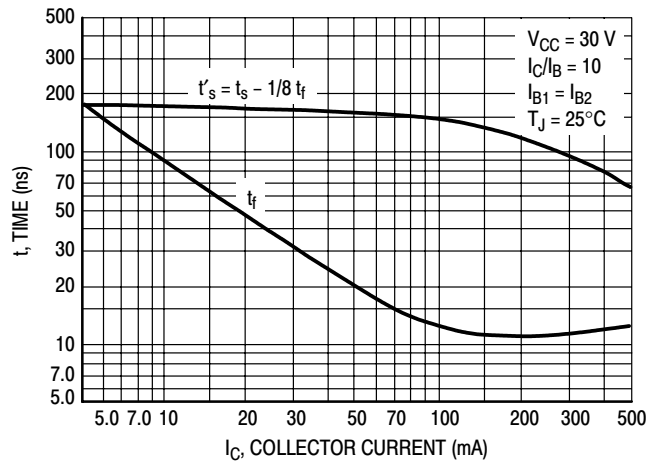


Figure 6. Turn-Off Time

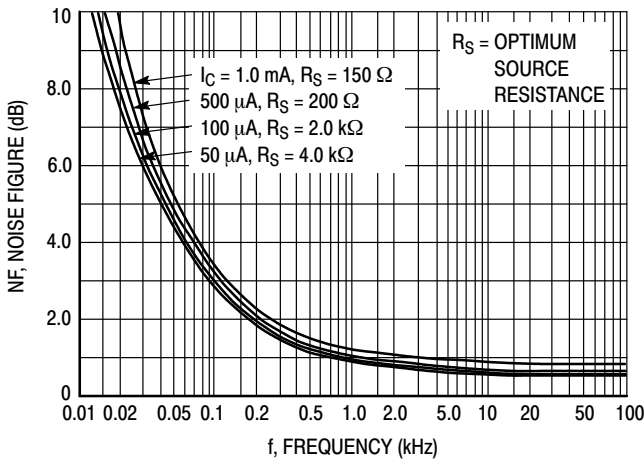


Figure 7. Frequency Effects

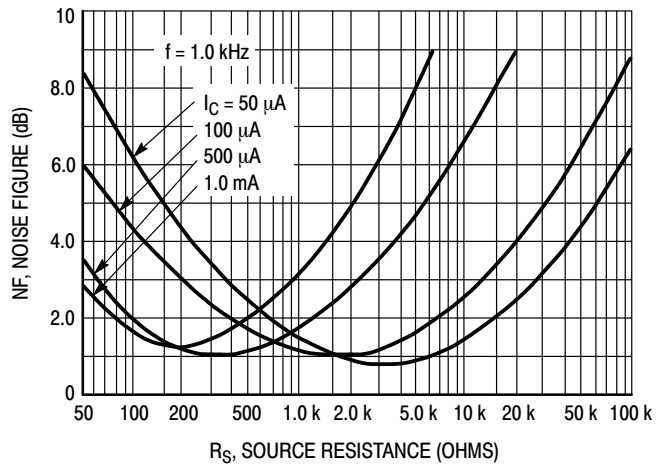


Figure 8. Source Resistance Effects

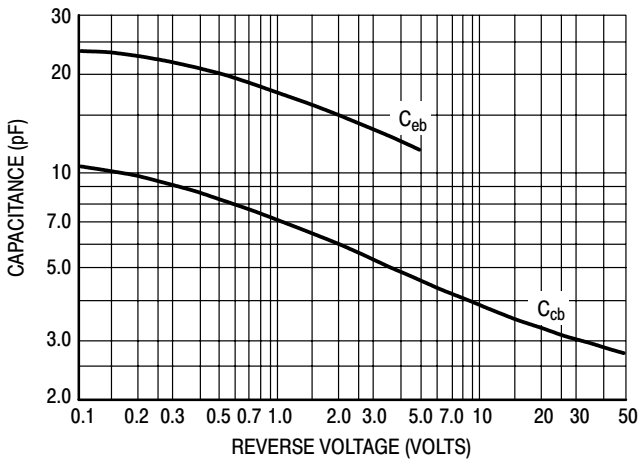


Figure 9. Capacitances

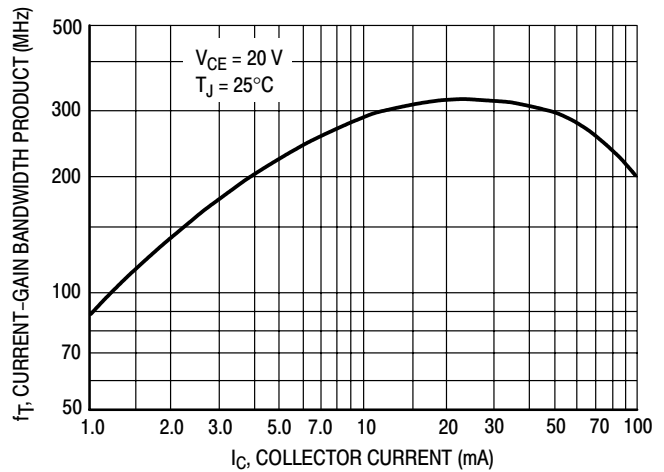


Figure 10. Current-Gain Bandwidth Product

# MMBT2222LT1, MMBT2222ALT1

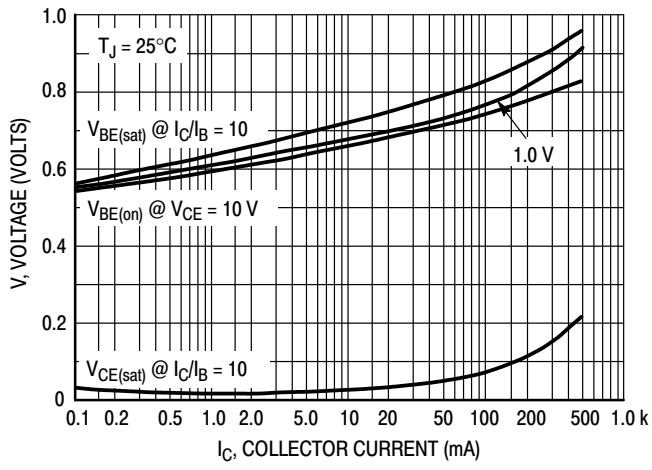


Figure 11. "On" Voltages

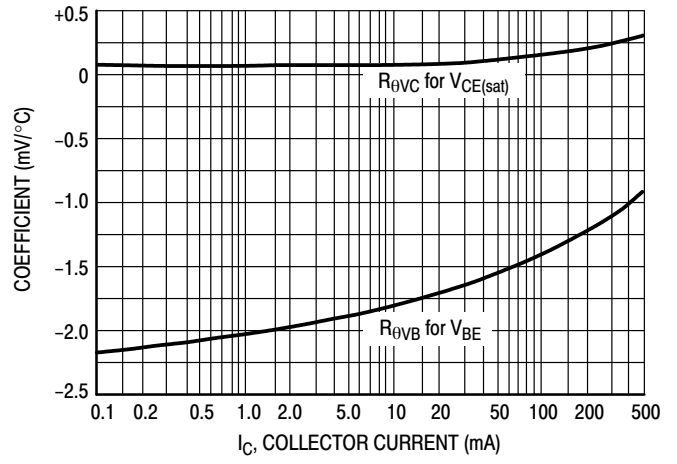
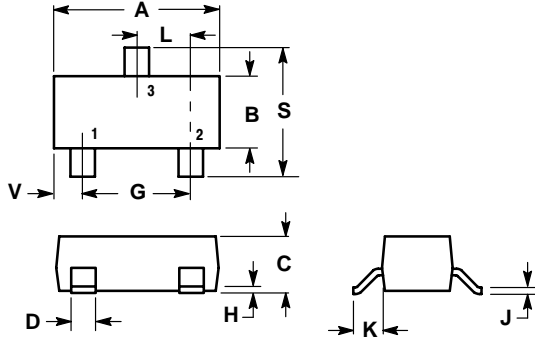


Figure 12. Temperature Coefficients

# MMBT2222LT1, MMBT2222ALT1

## PACKAGE DIMENSIONS

SOT-23 (TO-236AB)  
CASE 318-08  
ISSUE AH



NOTES:

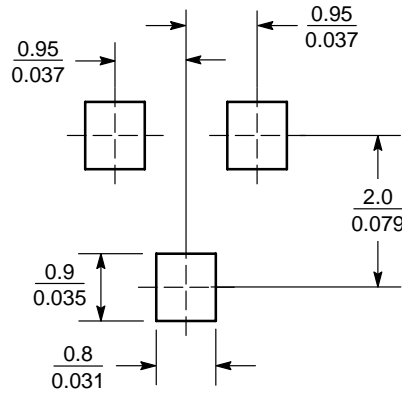
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318-03 AND -07 OBSOLETE, NEW STANDARD 318-08.

| DIM | INCHES |        | MILLIMETERS |       |
|-----|--------|--------|-------------|-------|
|     | MIN    | MAX    | MIN         | MAX   |
| A   | 0.1102 | 0.1197 | 2.80        | 3.04  |
| B   | 0.0472 | 0.0551 | 1.20        | 1.40  |
| C   | 0.0350 | 0.0440 | 0.89        | 1.11  |
| D   | 0.0150 | 0.0200 | 0.37        | 0.50  |
| G   | 0.0701 | 0.0807 | 1.78        | 2.04  |
| H   | 0.0005 | 0.0040 | 0.013       | 0.100 |
| J   | 0.0034 | 0.0070 | 0.085       | 0.177 |
| K   | 0.0140 | 0.0285 | 0.35        | 0.69  |
| L   | 0.0350 | 0.0401 | 0.89        | 1.02  |
| S   | 0.0830 | 0.1039 | 2.10        | 2.64  |
| V   | 0.0177 | 0.0236 | 0.45        | 0.60  |

STYLE 6:

- PIN 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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