

# 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 MMBT2222LT1 MMBT2222ALT1	$V_{CEO}$	30 40	Vdc
Collector-Base Voltage MMBT2222LT1 MMBT2222ALT1	$V_{CBO}$	60 75	Vdc
Emitter-Base Voltage MMBT2222LT1 MMBT2222ALT1	$V_{EBO}$	5.0 6.0	Vdc
Collector Current - Continuous	$I_C$	600	mAdc

#### THERMAL CHARACTERISTICS

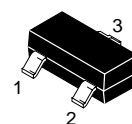
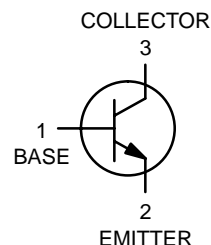
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board (Note 1) $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	225 1.8	mW mW/ $^\circ\text{C}$
Thermal Resistance Junction-to-Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{W}$
Total Device Dissipation Alumina Substrate (Note 2) $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	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	$^\circ\text{C}$

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



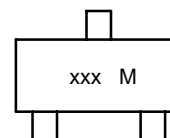
ON Semiconductor™

<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
MMBT2222ALT1	SOT-23	3000/Tape & Reel
MMBT2222ALT1G	SOT-23	3000/Tape & Reel
MMBT2222LT3	SOT-23	10,000/Tape & Reel
MMBT2222ALT3	SOT-23	10,000/Tape & Reel
MMBT2222ALT3G	SOT-23	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 MMBT2222A	$V_{(BR)CEO}$	30 40	– –	Vdc
Collector–Base Breakdown Voltage ( $I_C = 10\text{ }\mu\text{Adc}$ , $I_E = 0$ )	MMBT2222 MMBT2222A	$V_{(BR)CBO}$	60 75	– –	Vdc
Emitter–Base Breakdown Voltage ( $I_E = 10\text{ }\mu\text{Adc}$ , $I_C = 0$ )	MMBT2222 MMBT2222A	$V_{(BR)EBO}$	5.0 6.0	– –	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	$I_{CBO}$	–	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 ( $I_C = 0.1\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $T_A = -55^\circ\text{C}$ ) ( $I_C = 150\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) (Note 3) ( $I_C = 150\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ ) (Note 3) ( $I_C = 500\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ ) (Note 3)	MMBT2222A only	$h_{FE}$	35 50 75 35 100 50 30 40	– – – – 300 – – –	–
Collector–Emitter Saturation Voltage (Note 3) ( $I_C = 150\text{ mAdc}$ , $I_B = 15\text{ mAdc}$ )  ( $I_C = 500\text{ mAdc}$ , $I_B = 50\text{ mAdc}$ )	MMBT2222 MMBT2222A  MMBT2222 MMBT2222A	$V_{CE(sat)}$	– – – –	0.4 0.3 1.6 1.0	Vdc
Base–Emitter Saturation Voltage (Note 3) ( $I_C = 150\text{ mAdc}$ , $I_B = 15\text{ mAdc}$ )  ( $I_C = 500\text{ mAdc}$ , $I_B = 50\text{ mAdc}$ )	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 4) ( $I_C = 20\text{ mAdc}$ , $V_{CE} = 20\text{ Vdc}$ , $f = 100\text{ MHz}$ )	MMBT2222 MMBT2222A	$f_T$	250 300	– –	MHz
Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )		$C_{obo}$	–	8.0	pF
Input Capacitance ( $V_{EB} = 0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )	MMBT2222 MMBT2222A	$C_{ibo}$	– –	30 25	pF
Input Impedance ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	MMBT2222A MMBT2222A	$h_{ie}$	2.0 0.25	8.0 1.25	$k\Omega$
Voltage Feedback Ratio ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	MMBT2222A MMBT2222A	$h_{re}$	– –	8.0 4.0	$\times 10^{-4}$
Small–Signal Current Gain ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	MMBT2222A MMBT2222A	$h_{fe}$	50 75	300 375	–

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 ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	MMBT2222A MMBT2222A	$h_{oe}$	5.0 25	35 200	$\mu\text{hos}$
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 ( $I_C = 100\text{ }\mu\text{Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $R_S = 1.0\text{ k}\Omega$ , $f = 1.0\text{ kHz}$ )	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  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .
- $t_f$  is defined as the frequency at which  $|h_{fe}|$  extrapolates to unity.

## SWITCHING TIME EQUIVALENT TEST CIRCUITS

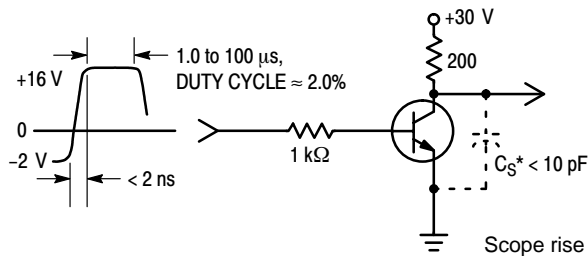


Figure 1. Turn-On Time

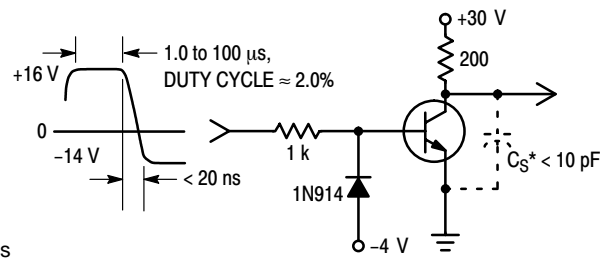


Figure 2. Turn-Off Time

# MMBT2222LT1, MMBT2222ALT1

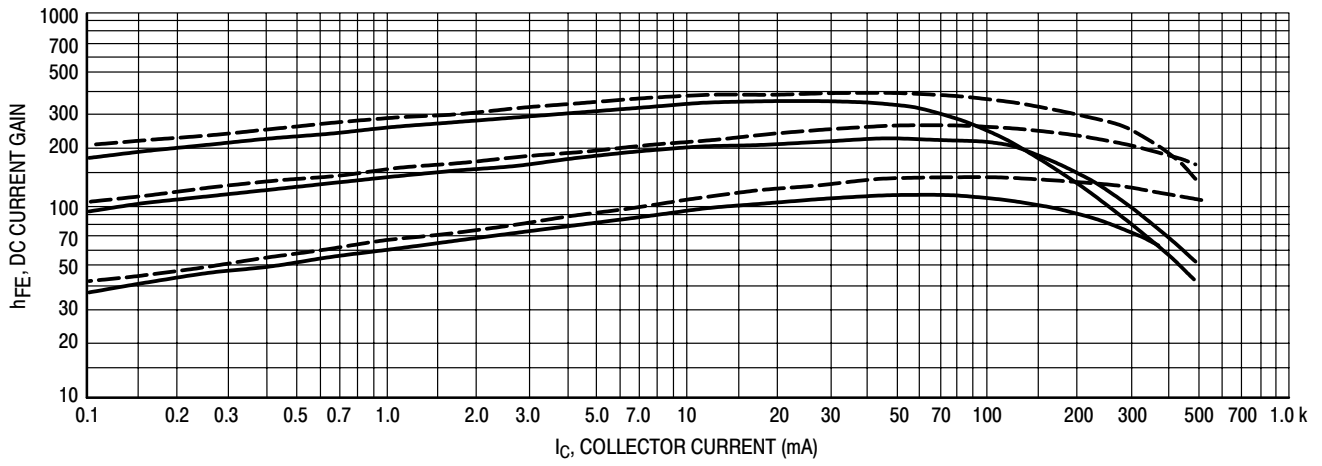


Figure 3. DC Current Gain

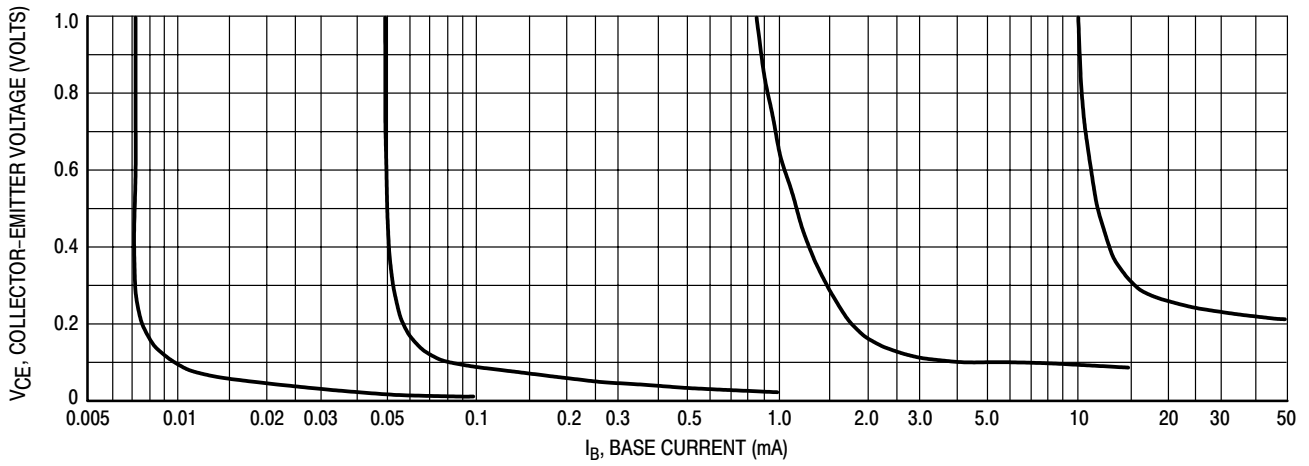


Figure 4. Collector Saturation Region

# MMBT2222LT1, MMBT2222ALT1

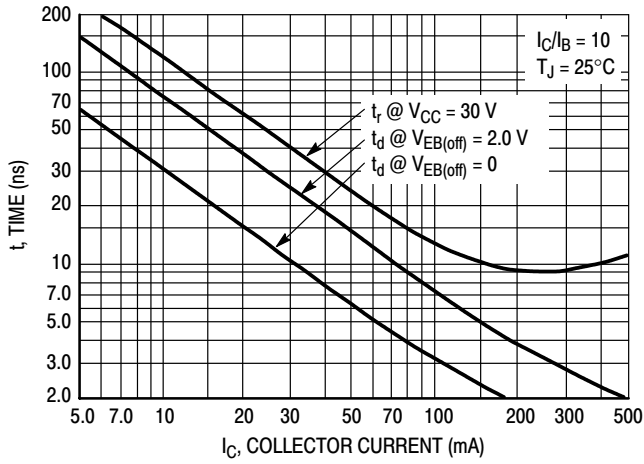


Figure 5. Turn-On Time

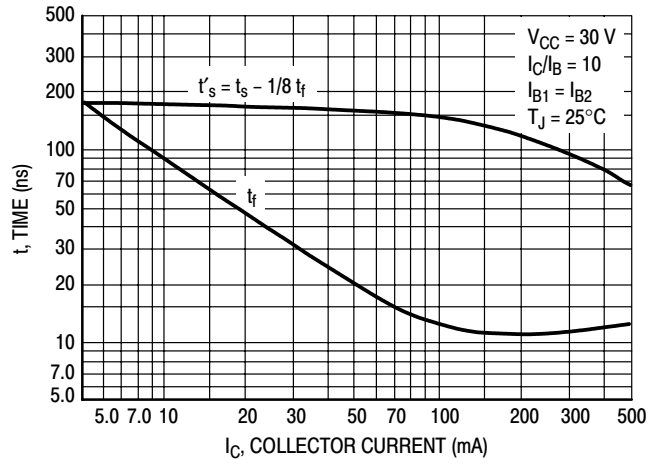


Figure 6. Turn-Off Time

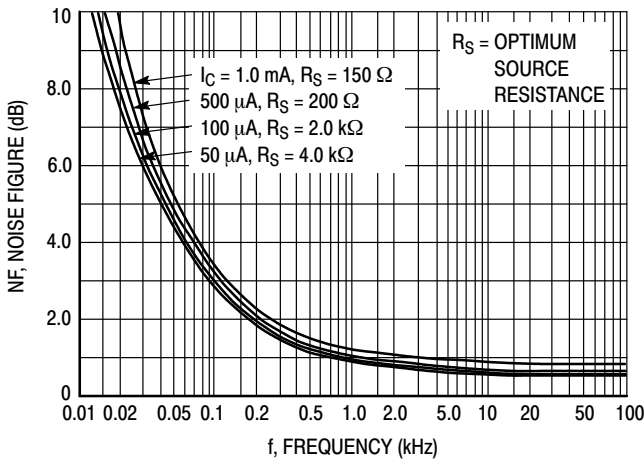


Figure 7. Frequency Effects

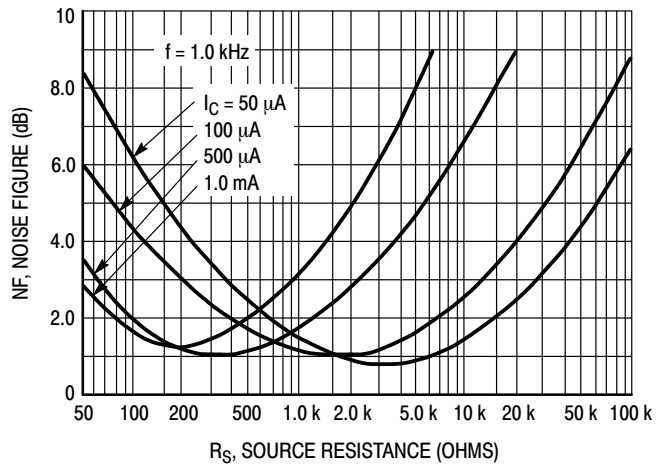


Figure 8. Source Resistance Effects

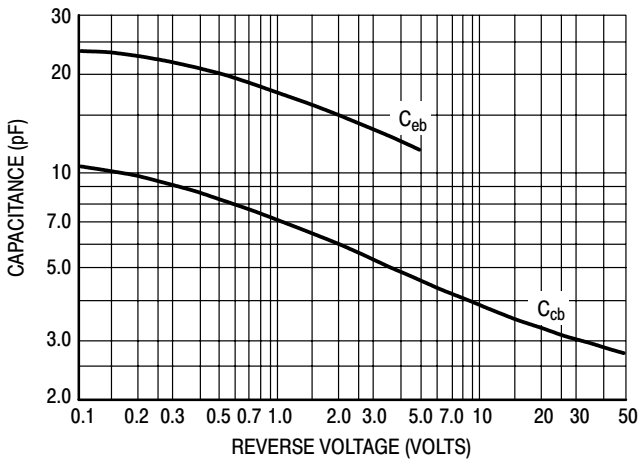


Figure 9. Capacitances

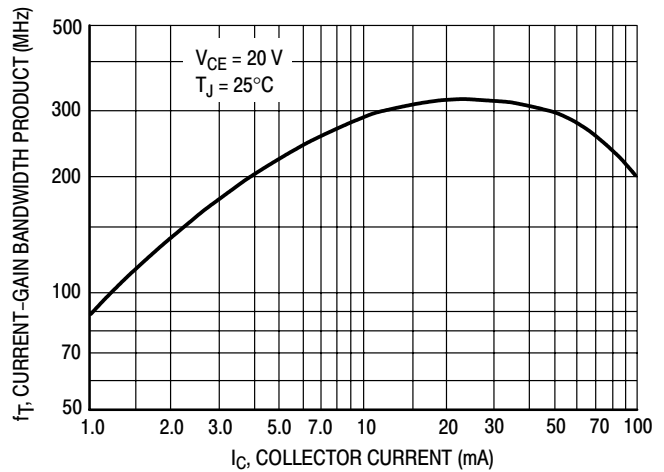


Figure 10. Current-Gain Bandwidth Product

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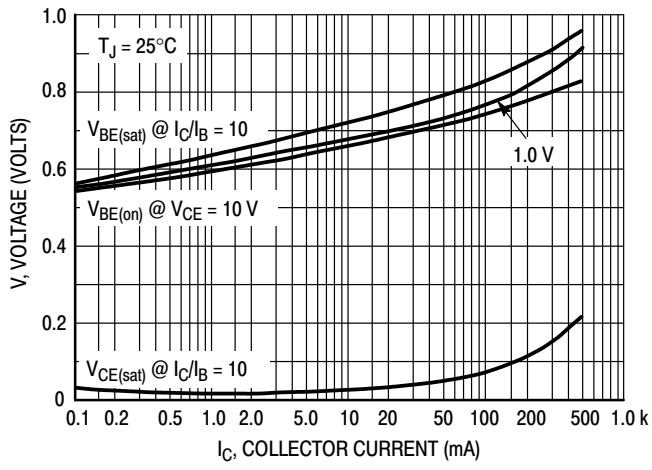


Figure 11. "On" Voltages

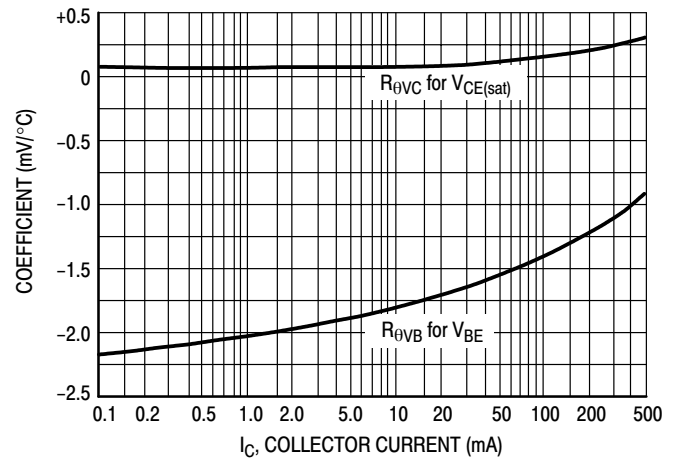
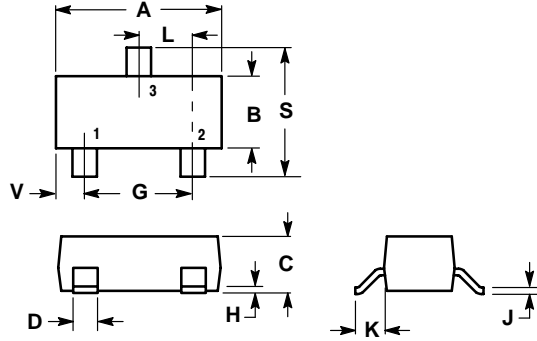


Figure 12. Temperature Coefficients

# 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
- EMITTER
- COLLECTOR

### SOLDERING FOOTPRINT\*

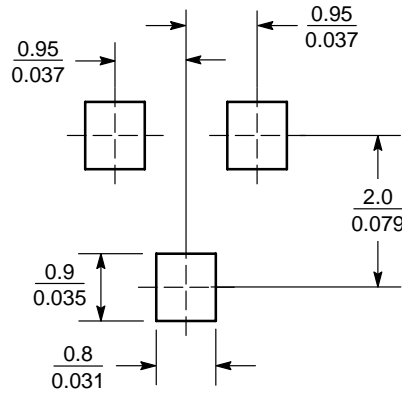


Figure 13. SOT-23

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

# MMBT2222LT1, MMBT2222ALT1

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