

# 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	$^\circ\text{C}$

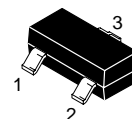
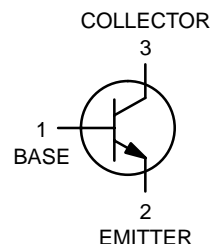
Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur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



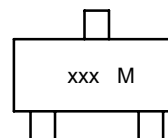
ON Semiconductor®

<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 (Pb-Free)	3000/Tape & Reel
MMBT2222ALT1	SOT-23	3000/Tape & Reel
MMBT2222ALT1G	SOT-23 (Pb-Free)	3000/Tape & Reel
MMBT2222LT3	SOT-23	10,000/Tape & Reel
MMBT2222ALT3	SOT-23	10,000/Tape & Reel
MMBT2222ALT3G	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.

**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 ( $I_C = 10\text{ mA}$ , $I_B = 0$ )	MMBT2222 MMBT2222A	$V_{(BR)CEO}$	30 40	– –	Vdc
Collector–Base Breakdown Voltage ( $I_C = 10\text{ }\mu\text{A}$ , $I_E = 0$ )	MMBT2222 MMBT2222A	$V_{(BR)CBO}$	60 75	– –	Vdc
Emitter–Base Breakdown Voltage ( $I_E = 10\text{ }\mu\text{A}$ , $I_C = 0$ )	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 ( $I_C = 0.1\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ ) ( $I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ ) ( $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ ) ( $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $T_A = -55^\circ\text{C}$ ) ( $I_C = 150\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ ) (Note 3) ( $I_C = 150\text{ mA}$ , $V_{CE} = 1.0\text{ Vdc}$ ) (Note 3) ( $I_C = 500\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ ) (Note 3)	MMBT2222A only      MMBT2222 MMBT2222A	$h_{FE}$	35 50 75 35 100 50 30 40	– – – – 300 – – –	–
Collector–Emitter Saturation Voltage (Note 3) ( $I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$ )  ( $I_C = 500\text{ mA}$ , $I_B = 50\text{ mA}$ )	MMBT2222 MMBT2222A  MMBT2222 MMBT2222A	$V_{CE(sat)}$	– – – –	0.4 0.3 1.6 1.0	Vdc
Base–Emitter Saturation Voltage (Note 3) ( $I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$ )  ( $I_C = 500\text{ mA}$ , $I_B = 50\text{ mA}$ )	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) ( $I_C = 20\text{ mA}$ , $V_{CE} = 20\text{ Vdc}$ , $f = 100\text{ MHz}$ )	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 ( $I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) ( $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	MMBT2222A MMBT2222A	$h_{ie}$	2.0 0.25	8.0 1.25	k $\Omega$
Voltage Feedback Ratio ( $I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) ( $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	MMBT2222A MMBT2222A	$h_{re}$	– –	8.0 4.0	$\times 10^{-4}$
Small–Signal Current Gain ( $I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) ( $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	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.

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

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

## SWITCHING CHARACTERISTICS (MMBT2222A only)

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

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

## SWITCHING TIME EQUIVALENT TEST CIRCUITS

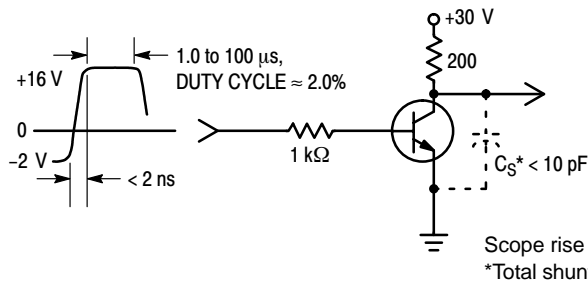


Figure 1. Turn-On Time

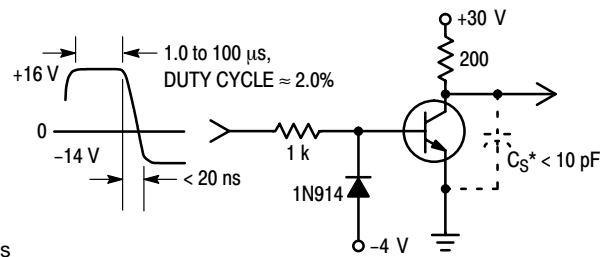


Figure 2. Turn-Off Time

# MMBT2222LT1, MMBT2222ALT1

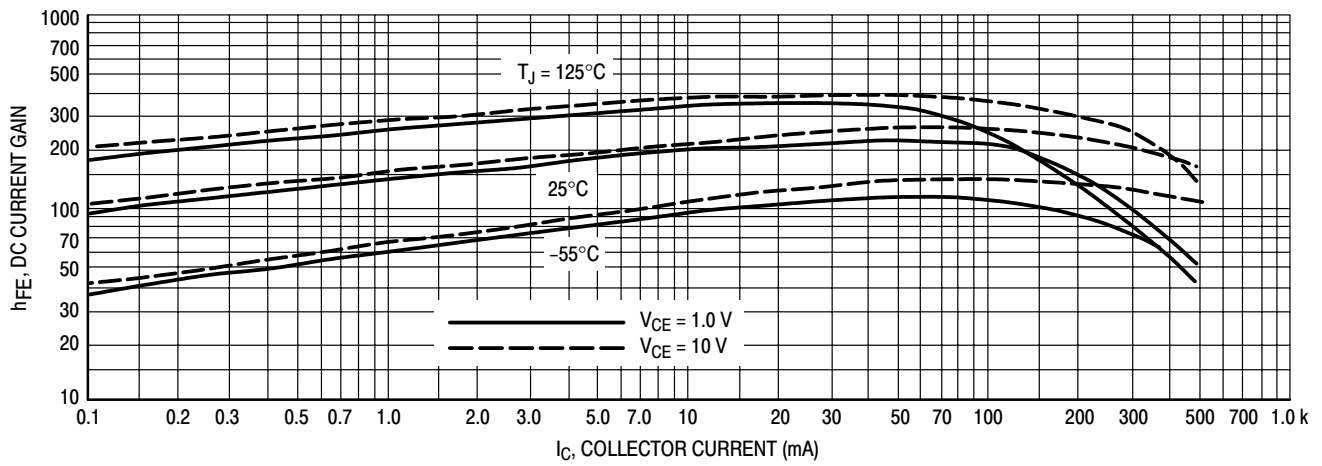


Figure 3. DC Current Gain

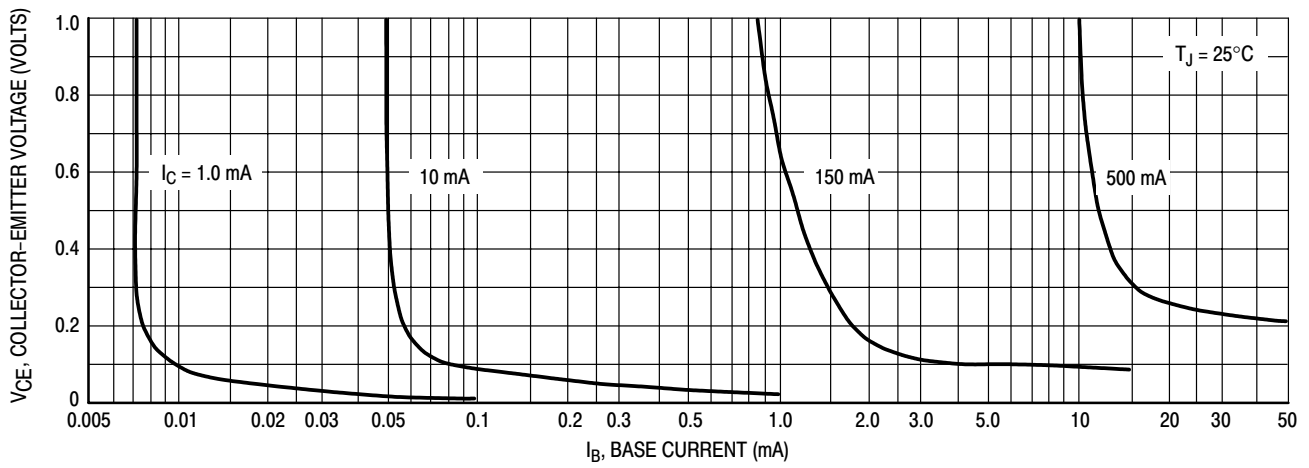


Figure 4. Collector Saturation Region

# MMBT2222LT1, MMBT2222ALT1

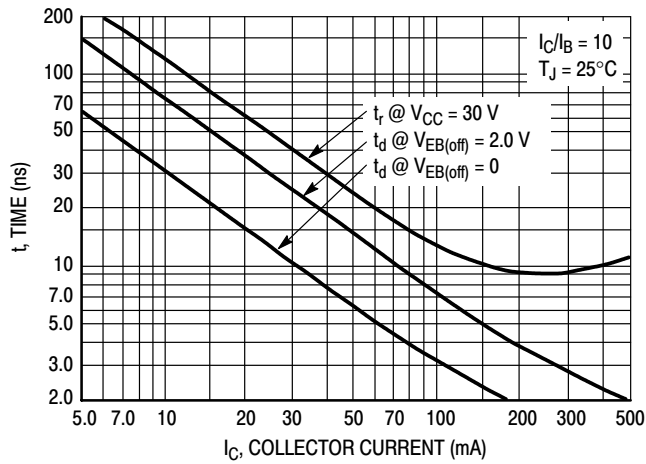


Figure 5. Turn-On Time

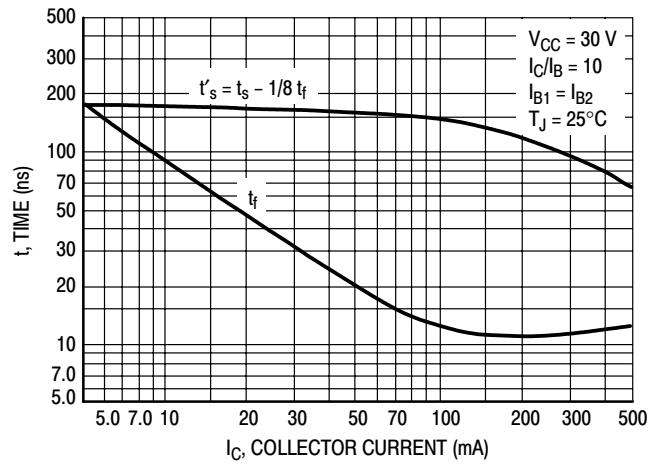


Figure 6. Turn-Off Time

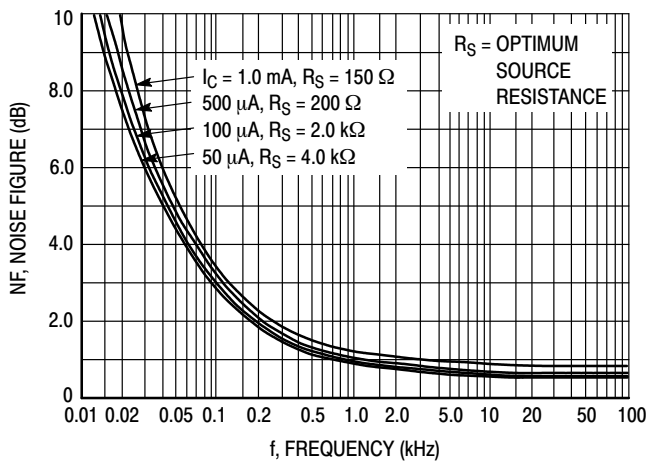


Figure 7. Frequency Effects

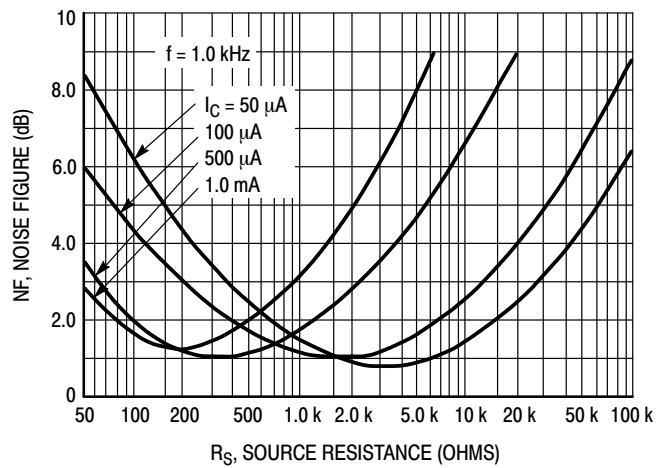


Figure 8. Source Resistance Effects

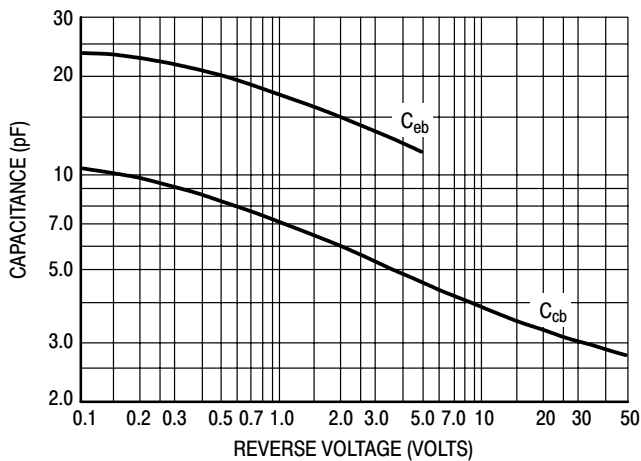


Figure 9. Capacitances

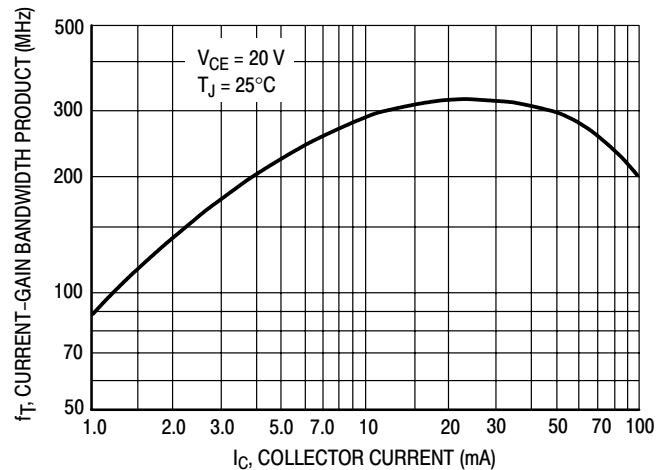


Figure 10. Current-Gain Bandwidth Product

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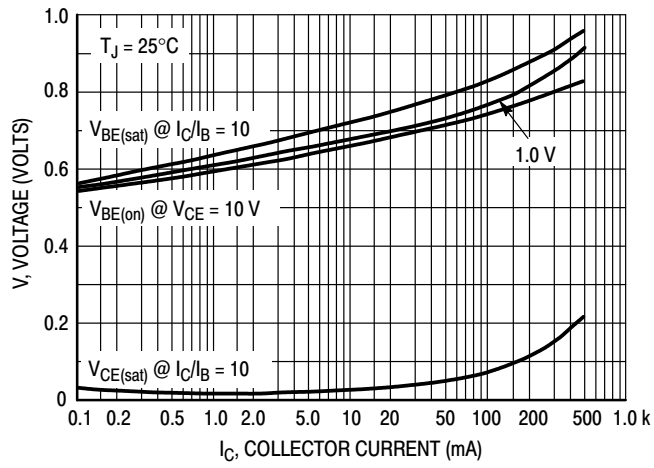


Figure 11. "On" Voltages

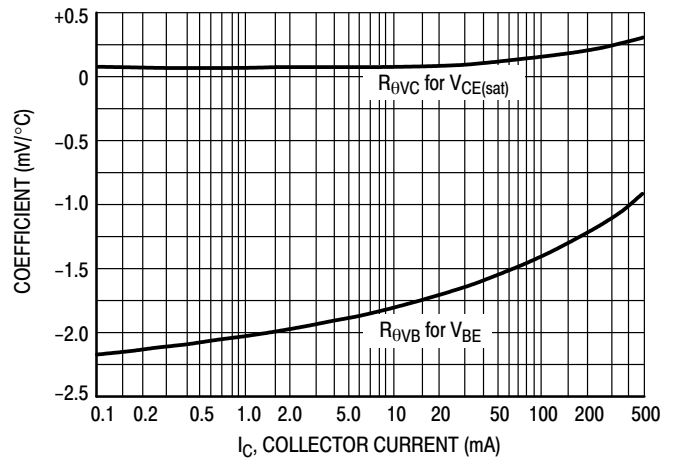


Figure 12. Temperature Coefficients

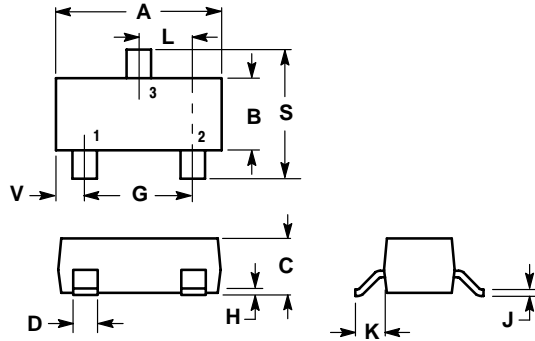
# MMBT2222LT1, MMBT2222ALT1

## PACKAGE DIMENSIONS

### SOT-23 (TO-236AB)

CASE 318-08

ISSUE AH



#### NOTES:

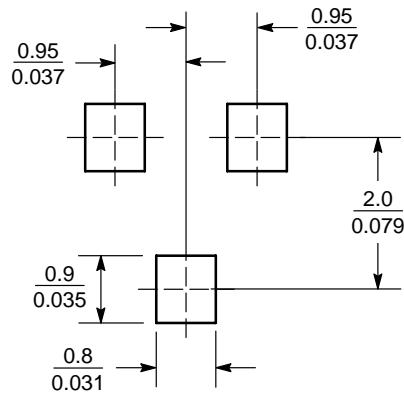
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318-03 AND -07 OBSOLETE, NEW STANDARD 318-08.

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  
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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