MMBT2222L, MMBT2222AL, SMMBT2222AL

General Purpose Transistors

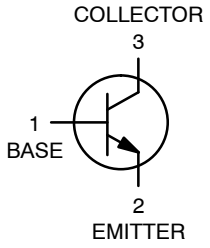
NPN Silicon

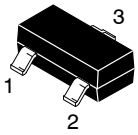
ON Semiconductor®

http://onsemi.com

Features

- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant
- AEC−Q101 Qualified and PPAP Capable
- S Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements





SOT−23
CASE 318
STYLE 6

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector − Emitter Voltage MMBT2222L MMBT2222AL, SMMBT2222AL	V_{CEO}	 30 40	Vdc
Collector − Base Voltage MMBT2222L MMBT2222AL, SMMBT2222AL	V_{CBO}	 60 75	Vdc
Emitter − Base Voltage MMBT2222L MMBT2222AL, SMMBT2222AL	V_{EBO}	 5.0 6.0	Vdc
Collector Current − Continuous	I_C	600	mAdc
Collector Current − Peak (Note 3)	I_{CM}	1100	mAdc

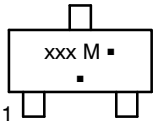
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR−5 Board (Note 1) T_A = 25°C Derate above 25°C	P_D	 225 1.8	 mW mW/°C
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	556	°C/W
Total Device Dissipation Alumina Substrate (Note 2) T_A = 25°C Derate above 25°C	P_D	 300 2.4	 mW mW/°C
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	417	°C/W
Junction and Storage Temperature Range	T_J, T_{stg}	−55 to +150	°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 × 0.75 × 0.062 in.
2. Alumina = 0.4 × 0.3 × 0.024 in. 99.5% alumina.
3. Reference SOA curve.

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.

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)	MMBT2222	$V_{(BR)CEO}$	30	–	Vdc
	MMBT2222A		40	–	
Collector – Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)	MMBT2222	$V_{(BR)CBO}$	60	–	Vdc
	MMBT2222A		75	–	
Emitter – Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)	MMBT2222	$V_{(BR)EBO}$	5.0	–	Vdc
	MMBT2222A		6.0	–	
Collector Cutoff Current		I_{CEX}			nAdc
(V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc)	MMBT2222A, SMMBT2222A		–	10	
Collector Cutoff Current (V_{CB} = 50 Vdc, I_E = 0)	MMBT2222	I_{CBO}	–	0.01	μAdc
(V_{CB} = 60 Vdc, I_E = 0)	MMBT2222A, SMMBT2222A		–	0.01	
(V_{CB} = 50 Vdc, I_E = 0, T_A = 125°C)	MMBT2222		–	10	
(V_{CB} = 60 Vdc, I_E = 0, T_A = 125°C)	MMBT2222A, SMMBT2222A		–	10	
Emitter Cutoff Current (V_{EB} = 3.0 Vdc, I_C = 0)	MMBT2222A, SMMBT2222A	I_{EBO}	–	100	nAdc
Base Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc)	MMBT2222A, SMMBT2222A	I_{BL}	–	20	nAdc
ON CHARACTERISTICS					
DC Current Gain		h_{FE}			–
(I_C = 0.1 mAdc, V_{CE} = 10 Vdc)			35	–	
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc)			50	–	
(I_C = 10 mAdc, V_{CE} = 10 Vdc)			75	–	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, T_A = −55°C)	MMBT2222A only		35	–	
(I_C = 150 mAdc, V_{CE} = 10 Vdc) (Note 4)			100	300	
(I_C = 150 mAdc, V_{CE} = 1.0 Vdc) (Note 4)			50	–	
(I_C = 500 mAdc, V_{CE} = 10 Vdc) (Note 4)	MMBT2222		30	–	
	MMBT2222A, SMMBT2222A		40	–	
Collector – Emitter Saturation Voltage (Note 4)		$V_{CE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)	MMBT2222		–	0.4	
	MMBT2222A, SMMBT2222A		–	0.3	
(I_C = 500 mAdc, I_B = 50 mAdc)	MMBT2222		–	1.6	
	MMBT2222A, SMMBT2222A		–	1.0	
Base – Emitter Saturation Voltage (Note 4)		$V_{BE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)	MMBT2222		–	1.3	
	MMBT2222A, SMMBT2222A		0.6	1.2	
(I_C = 500 mAdc, I_B = 50 mAdc)	MMBT2222		–	2.6	
	MMBT2222A, SMMBT2222A		–	2.0	
SMALL–SIGNAL CHARACTERISTICS					
Current – Gain – Bandwidth Product (Note 5)		f_T			MHz
(I_C = 20 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)	MMBT2222		250	–	
	MMBT2222A, SMMBT2222A		300	–	
Output Capacitance		C_{obo}			pF
(V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)			–	8.0	
Input Capacitance		C_{ibo}			pF
(V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	MMBT2222		–	30	
	MMBT2222A, SMMBT2222A		–	25	
Input Impedance		h_{ie}			kΩ
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MMBT2222A, SMMBT2222A		2.0	8.0	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MMBT2222A, SMMBT2222A		0.25	1.25	
Voltage Feedback Ratio		h_{re}			$X 10^{-4}$
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MMBT2222A, SMMBT2222A		–	8.0	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MMBT2222A, SMMBT2222A		–	4.0	
Small – Signal Current Gain		h_{fe}			–
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MMBT2222A, SMMBT2222A		50	300	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MMBT2222A, SMMBT2222A		75	375	

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

Characteristic		Symbol	Min	Max	Unit
SMALL−SIGNAL CHARACTERISTICS					
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, SMMBT2222A MMBT2222A, SMMBT2222A	h_{oe}	 5.0 25	 35 200	μmhos
Collector Base Time Constant (I_E = 20 mAdc, V_{CB} = 20 Vdc, f = 31.8 MHz)	 MMBT2222A, SMMBT2222A	rb, C_c	 –	 150	ps
Noise Figure (I_C = 100 μAdc, V_{CE} = 10 Vdc, R_S = 1.0 kΩ, f = 1.0 kHz)	MMBT2222A, SMMBT2222A	NF	–	4.0	dB
SWITCHING CHARACTERISTICS (MMBT2222A only)					
Delay Time	(V_{CC} = 30 Vdc, $V_{BE(off)}$ = −0.5 Vdc, I_C = 150 mAdc, I_{B1} = 15 mAdc)	t_d	–	10	ns
Rise Time		t_r	–	25	
Storage Time	(V_{CC} = 30 Vdc, I_C = 150 mAdc, I_{B1} = I_{B2} = 15 mAdc)	t_s	–	225	ns
Fall Time		t_f	–	60	

4. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
5. f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

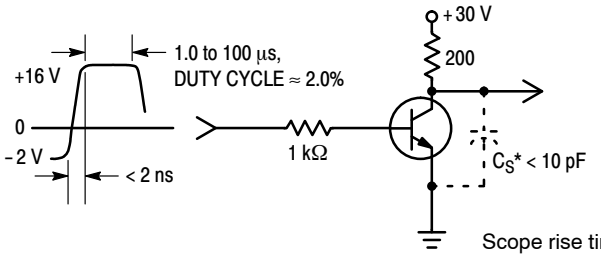


Figure 1. Turn−On Time

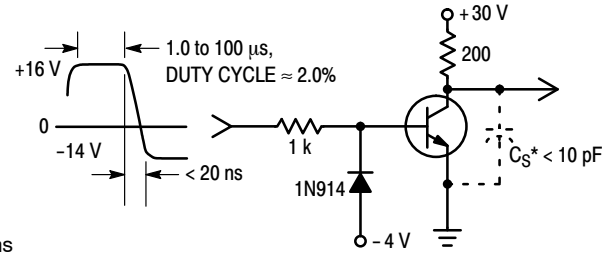


Figure 2. Turn−Off Time

Scope rise time < 4 ns
*Total shunt capacitance of test jig, connectors, and oscilloscope.

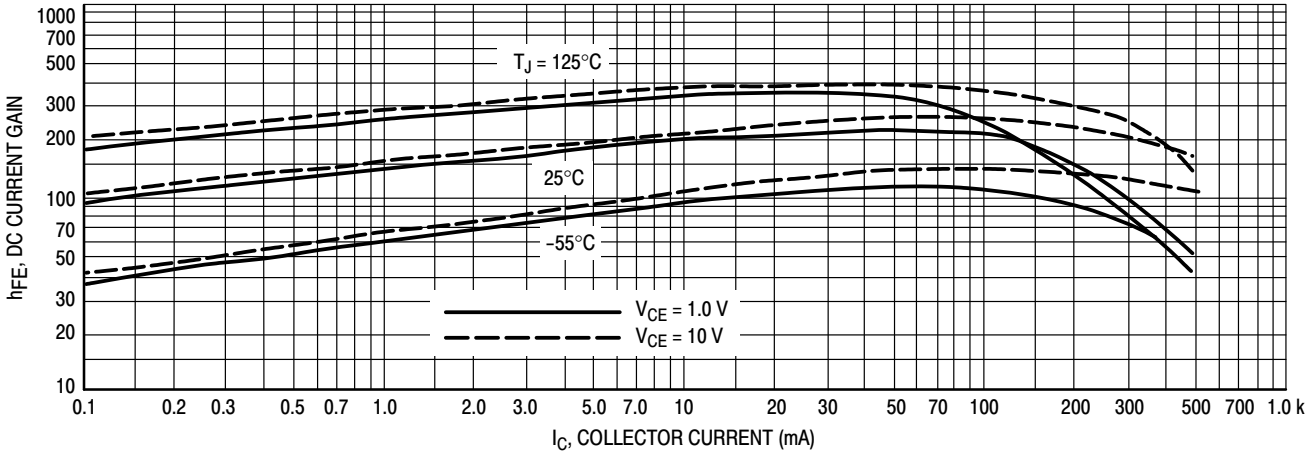


Figure 3. DC Current Gain

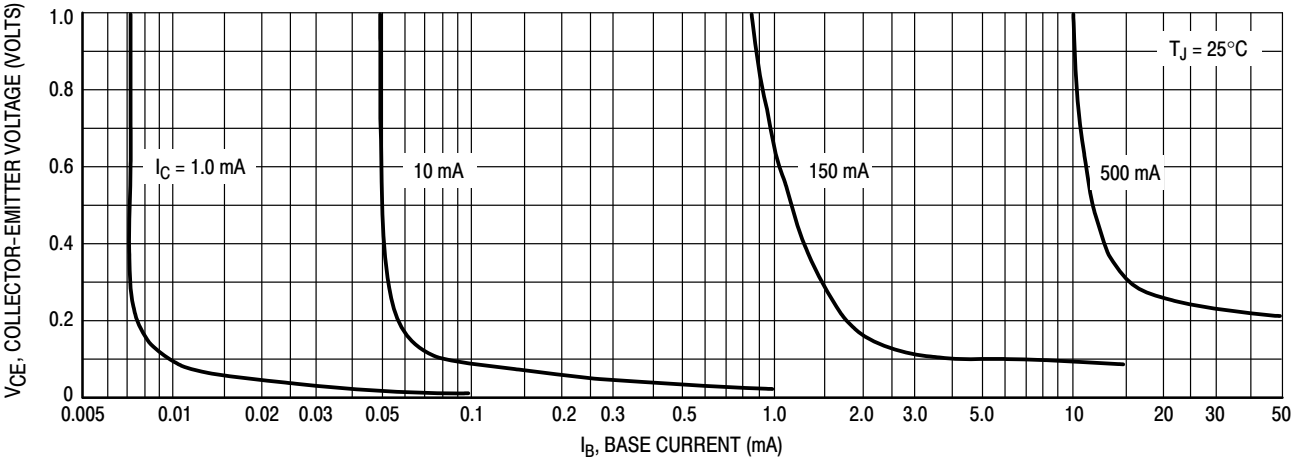


Figure 4. Collector Saturation Region

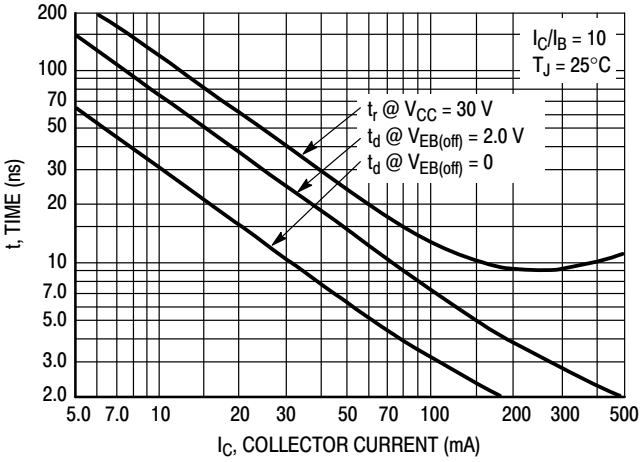


Figure 5. Turn – On Time

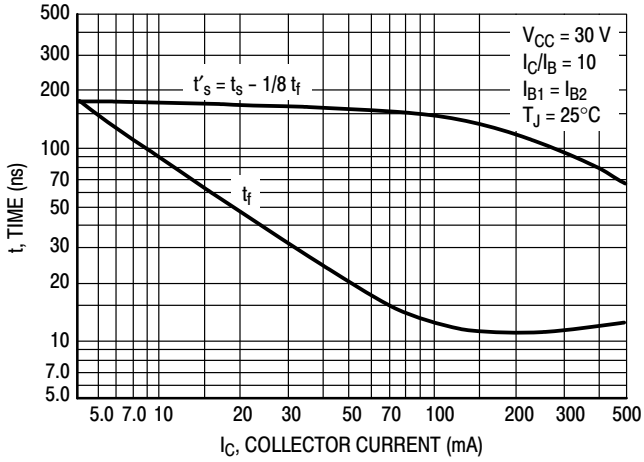


Figure 6. Turn – Off Time

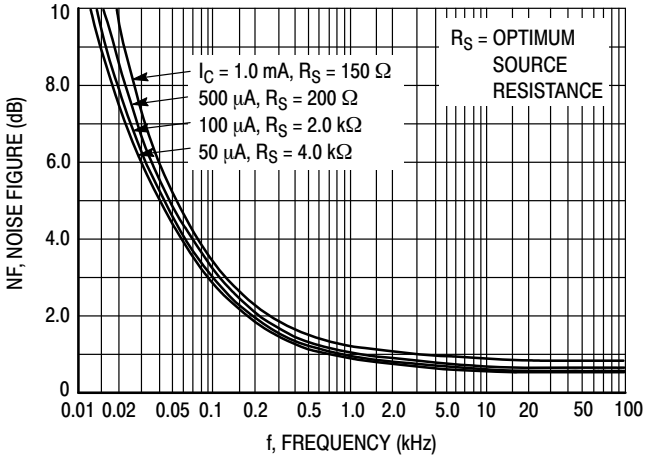


Figure 7. Frequency Effects

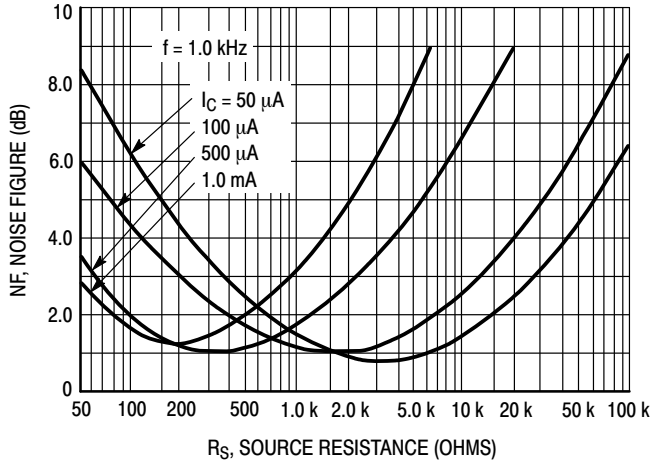


Figure 8. Source Resistance Effects

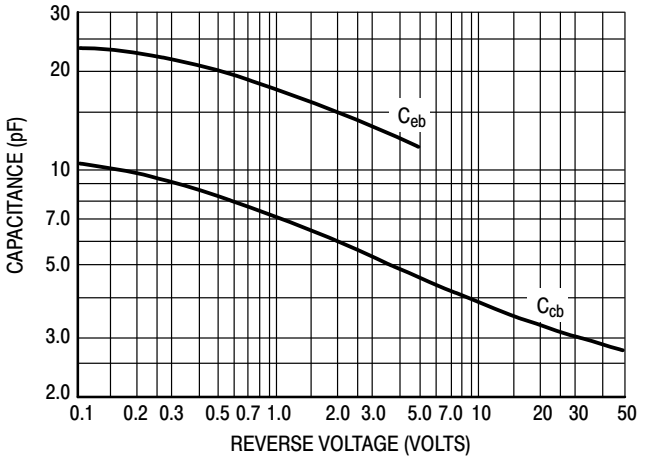


Figure 9. Capacitances

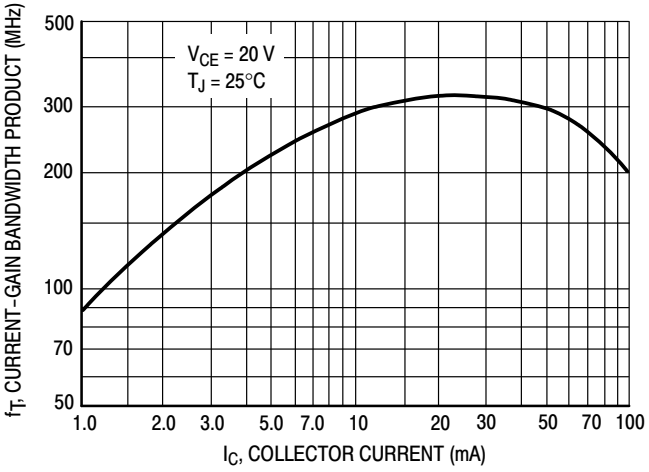


Figure 10. Current−Gain Bandwidth Product

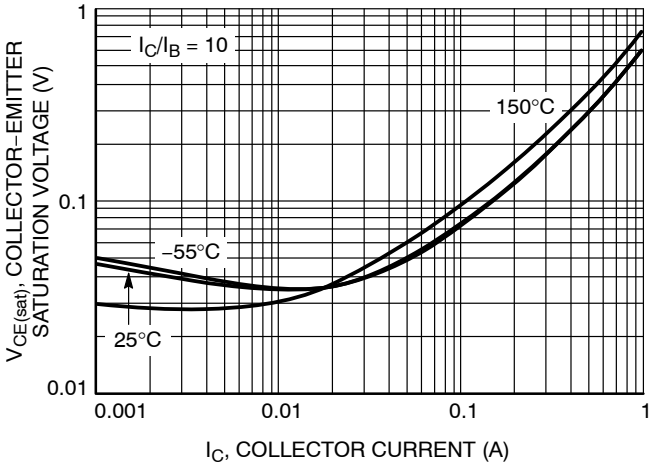


Figure 11. Collector Emitter Saturation Voltage vs. Collector Current

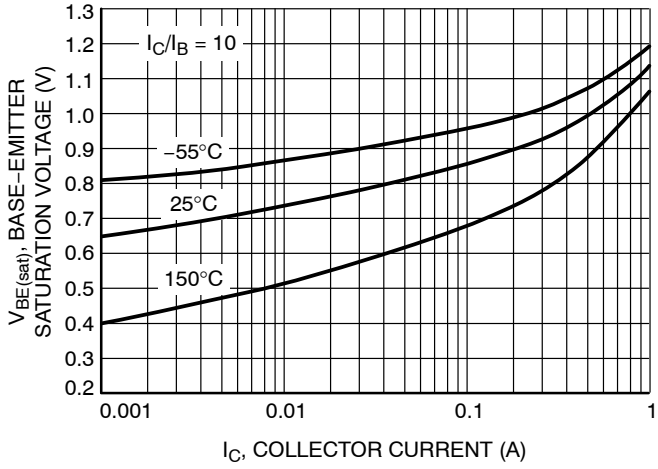


Figure 12. Base Emitter Saturation Voltage vs. Collector Current

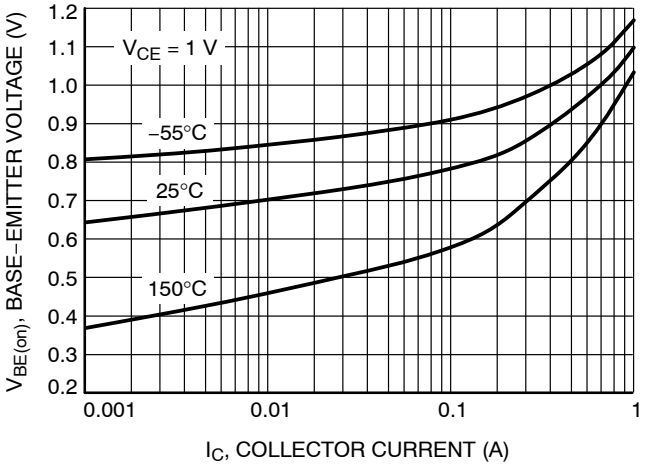


Figure 13. Base Emitter Voltage vs. Collector Current

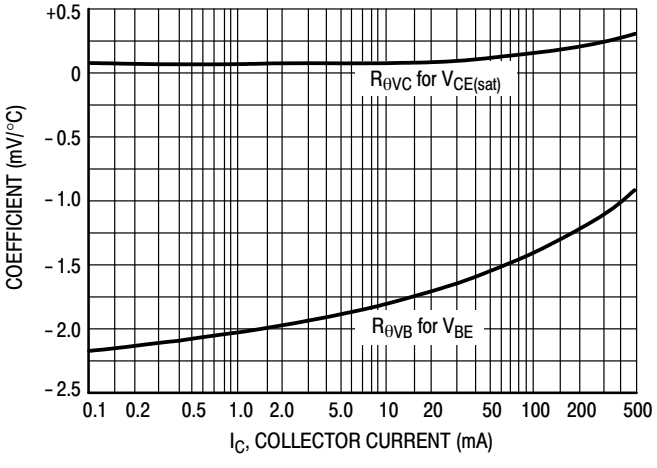


Figure 14. Temperature Coefficients

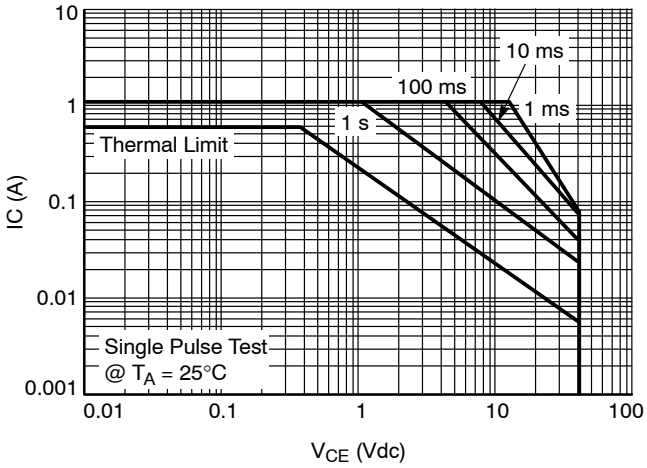


Figure 15. Safe Operating Area

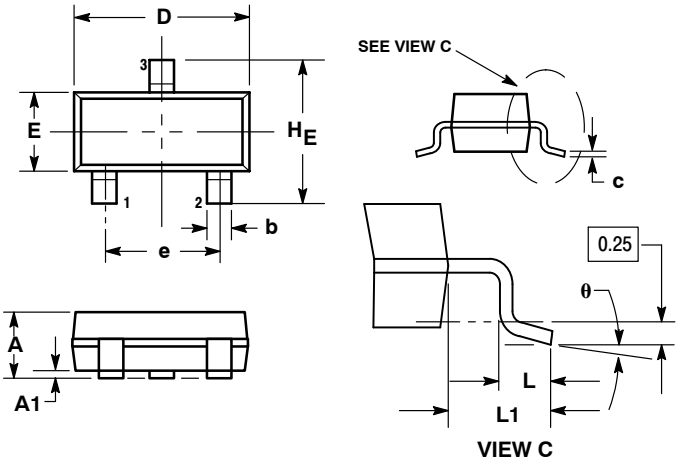
ORDERING INFORMATION

Device	Specific Marking Code	Package	Shipping†
MMBT2222LT1G	M1B	SOT−23 (Pb−Free)	3000 / Tape & Reel
MMBT2222ALT1G, SMMBT2222ALT1G	1P	SOT−23 (Pb−Free)	3000 / Tape & Reel
MMBT2222LT3G	M1B	SOT−23 (Pb−Free)	10,000 / Tape & Reel
MMBT2222ALT3G, SMMBT2222ALT3G	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.

PACKAGE DIMENSIONS

SOT−23 (TO−236)
CASE 318−08
ISSUE AP

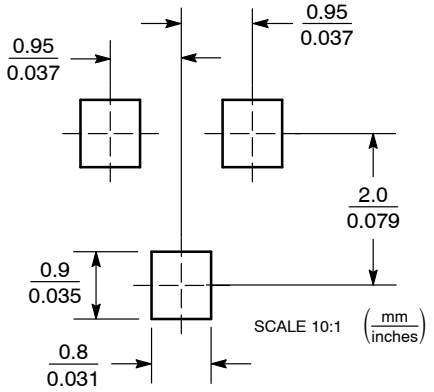


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

	MILLIMETERS			INCHES		
DIM	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
H_E	2.10	2.40	2.64	0.083	0.094	0.104
θ	0°	−−−	10°	0°	−−−	10°

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.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5817−1050

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

ON Semiconductor:

MMBT2222ALT1G MMBT2222LT1G MMBT2222ALT3G SMMBT2222ALT3G SMMBT2222ALT1G