

General Purpose Transistors

NPN Silicon

MMBT2222L, MMBT2222AL, SMMBT2222AL

Features

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

MAXIMUM RATINGS

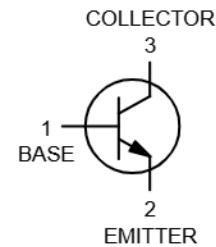
Rating	Symbol	Value	Unit
Collector-Emitter Voltage MMBT2222L MMBT2222AL, SMMBT2222AL	V_{CEO}	30 40	Vdc
Collector-Base Voltage MMBT2222L MMBT2222AL, SMMBT2222AL	V_{CBO}	60 75	Vdc
Emitter-Base Voltage MMBT2222L MMBT2222AL, SMMBT2222AL	V_{EBO}	5.0 6.0	Vdc
Collector Current – Continuous	I_C	600	mAdc
Collector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

THERMAL CHARACTERISTICS

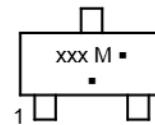
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board (Note 1) $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	225 1.8	mW mW/ $^\circ\text{C}$
Thermal Resistance, Junction-to-Ambient	R_{0JA}	556	$^\circ\text{C}/\text{W}$
Total Device Dissipation Alumina Substrate (Note 2) $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	300 2.4	mW mW/ $^\circ\text{C}$
Thermal Resistance, Junction-to-Ambient	R_{0JA}	417	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature Range	T_J, T_{Stg}	-55 to +150	$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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.



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.

MMBT2222L, MMBT2222AL, SMMBT2222AL

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

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

MMBT2222L, MMBT2222AL, SMMBT2222AL

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

Characteristic	Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS				
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	μmhos
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 ($I_C = 100 \mu\text{A}$, $V_{CE} = 10 \text{ Vdc}$, $R_S = 1.0 \text{ k}\Omega$, $f = 1.0 \text{ kHz}$)	NF	—	4.0	dB

SWITCHING CHARACTERISTICS (MMBT2222A only)

Delay Time	$(V_{CC} = 30 \text{ Vdc}, V_{BE(\text{off})} = -0.5 \text{ Vdc}, I_C = 150 \text{ mA}$, $I_{B1} = 15 \text{ mA}$)	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	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

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

SWITCHING TIME EQUIVALENT TEST CIRCUITS

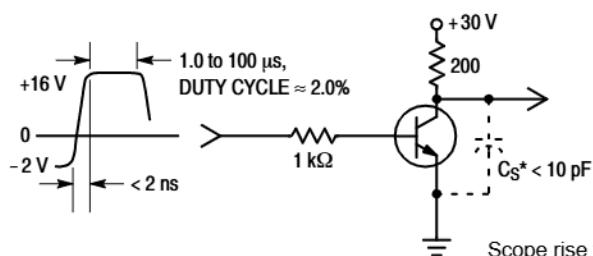


Figure 1. Turn-On Time

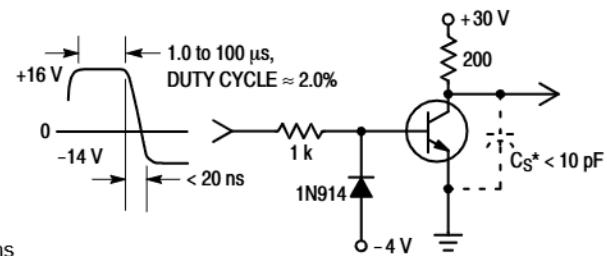


Figure 2. Turn-Off Time

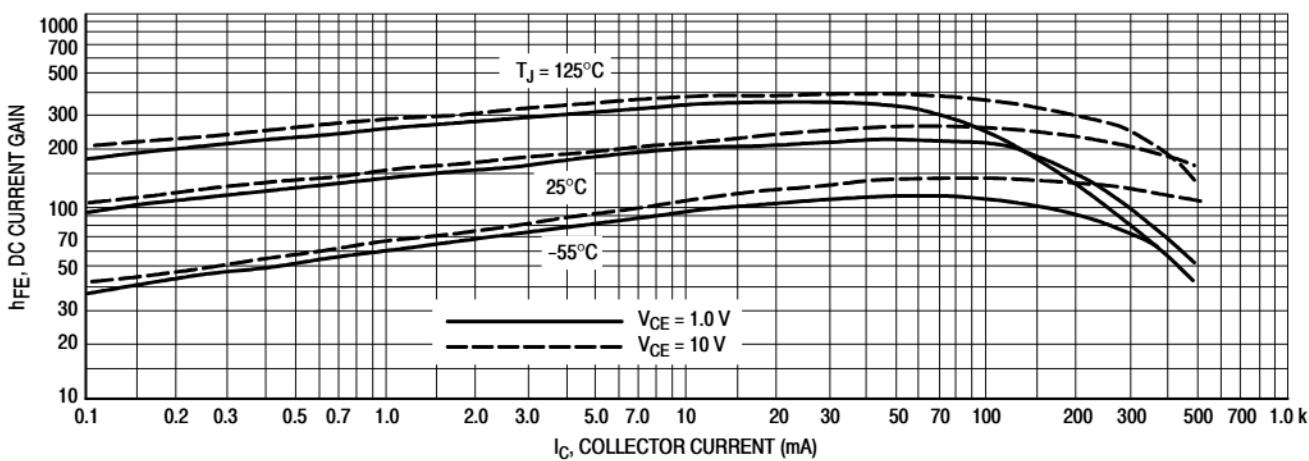


Figure 3. DC Current Gain

MMBT2222L, MMBT2222AL, SMMBT2222AL

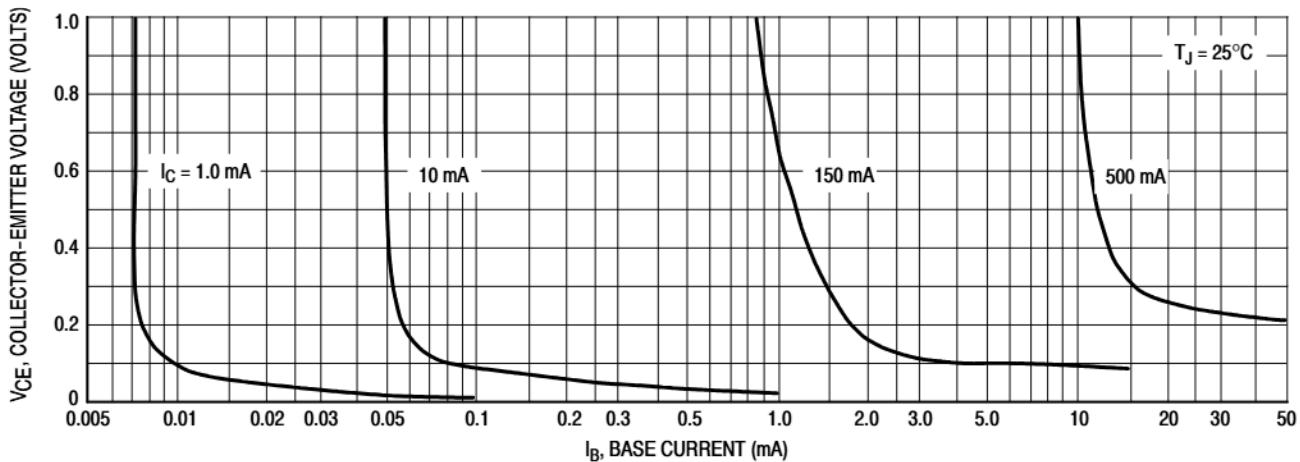


Figure 4. Collector Saturation Region

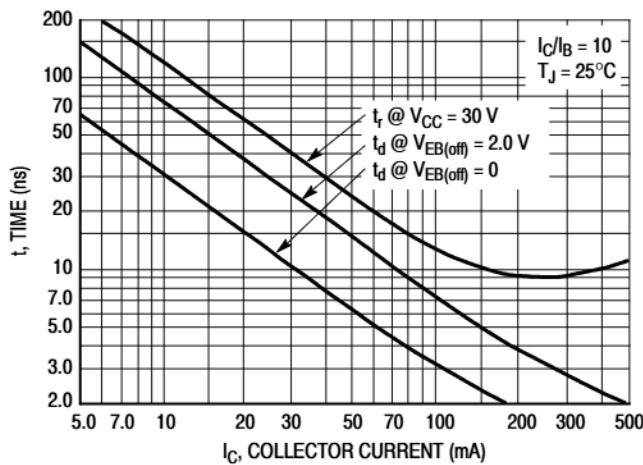


Figure 5. Turn-On Time

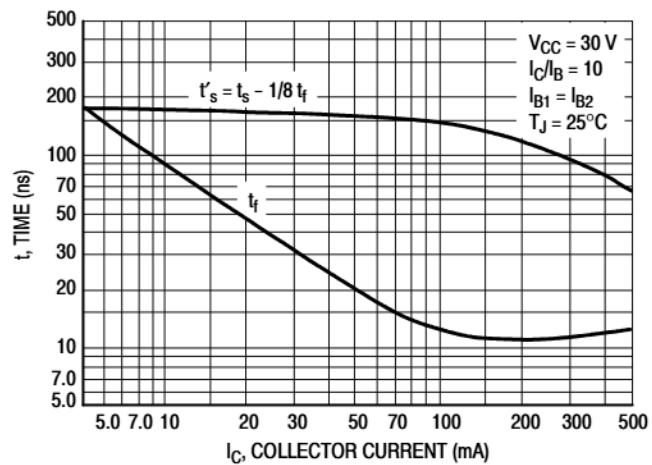


Figure 6. Turn-Off Time

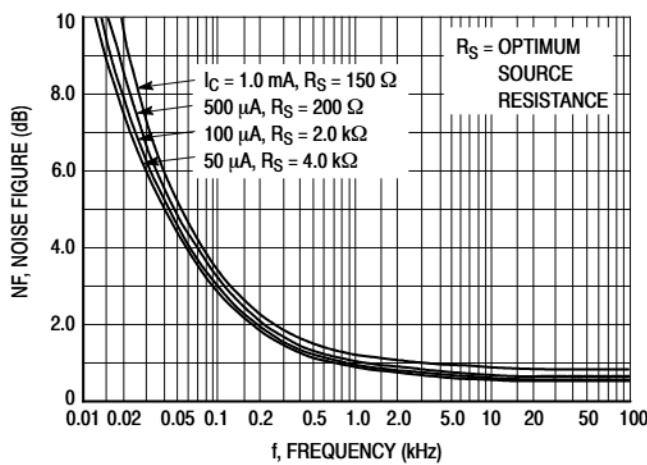


Figure 7. Frequency Effects

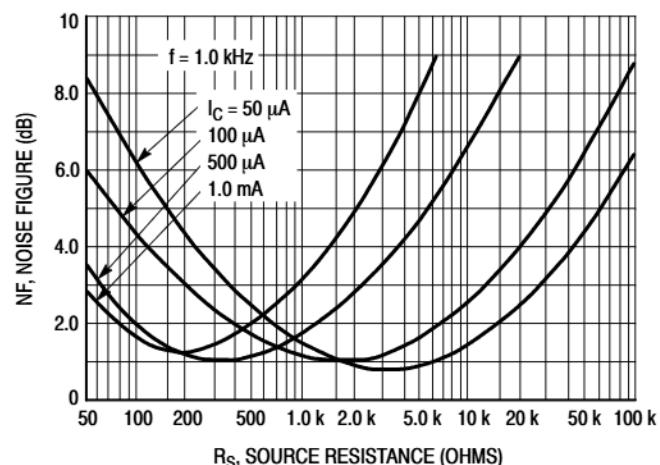


Figure 8. Source Resistance Effects

MMBT2222L, MMBT2222AL, SMMBT2222AL

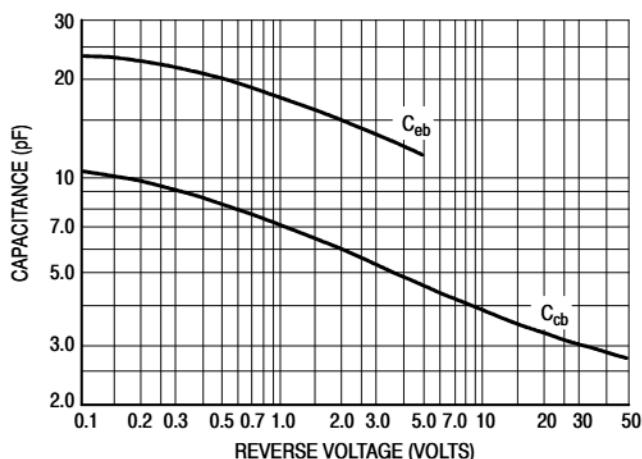


Figure 9. Capacitances

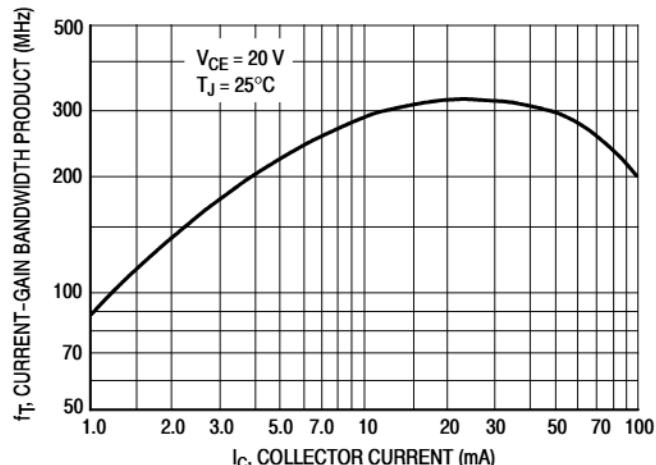


Figure 10. Current-Gain Bandwidth Product

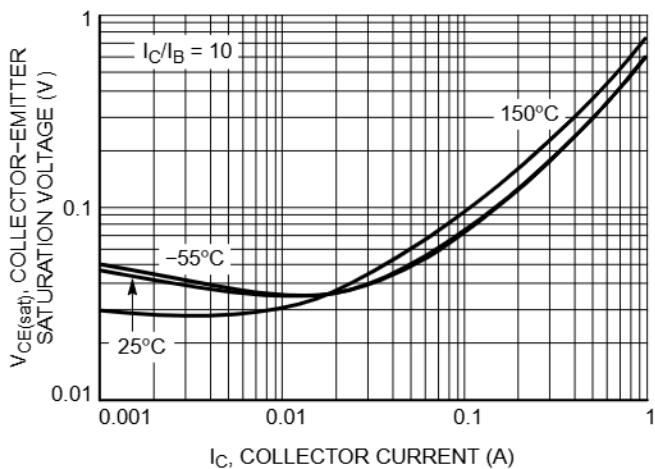


Figure 11. Collector Emitter Saturation Voltage vs. Collector Current

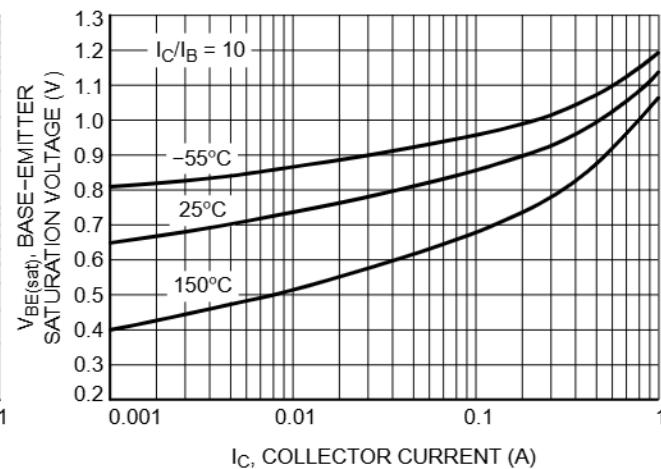


Figure 12. Base Emitter Saturation Voltage vs. Collector Current

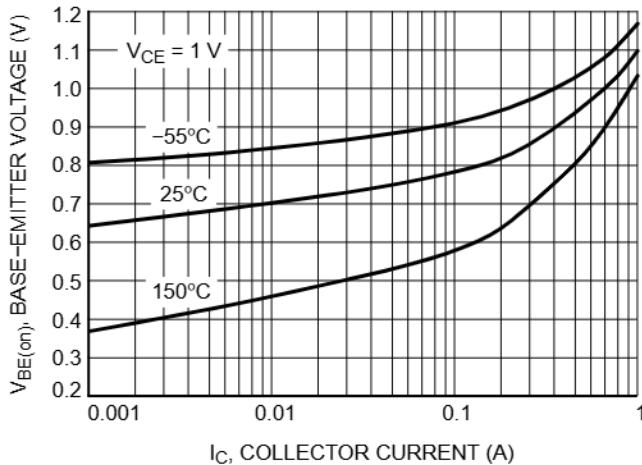


Figure 13. Base Emitter Voltage vs. Collector Current

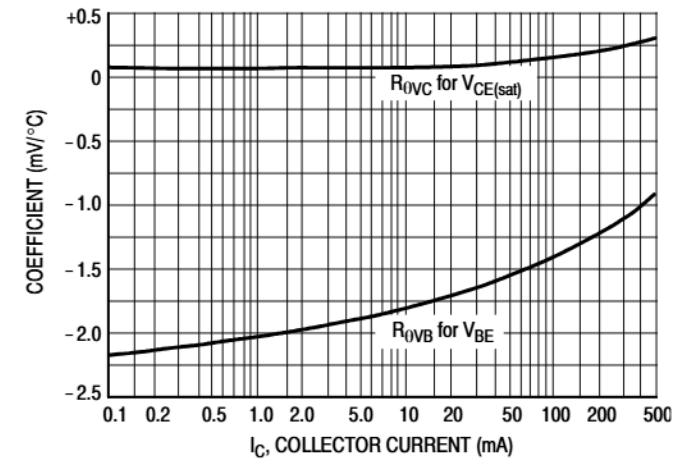


Figure 14. Temperature Coefficients

MMBT2222L, MMBT2222AL, SMMBT2222AL

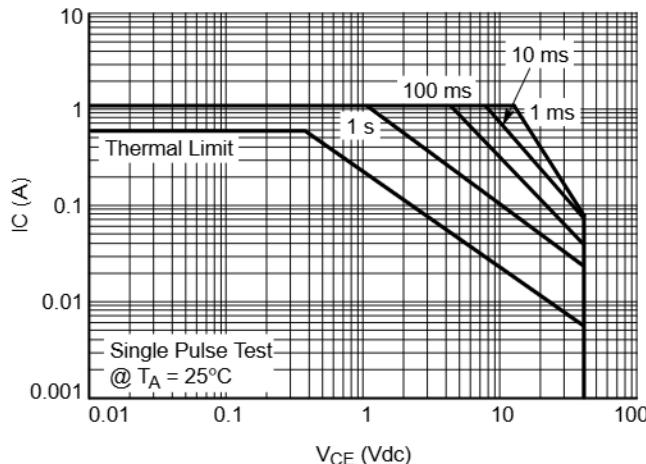


Figure 15. Safe Operating Area

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.

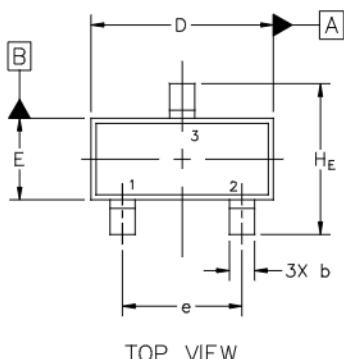
*S Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.



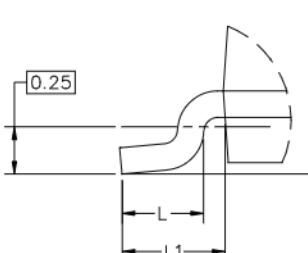
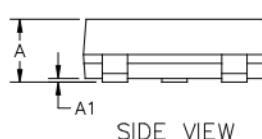
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SOT-23 (TO-236) 2.90x1.30x1.00 1.90P
CASE 318
ISSUE AU

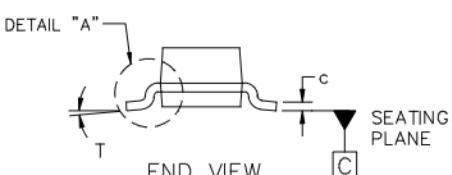
DATE 14 AUG 2024



TOP VIEW

DETAIL "A"
Scale 3:1

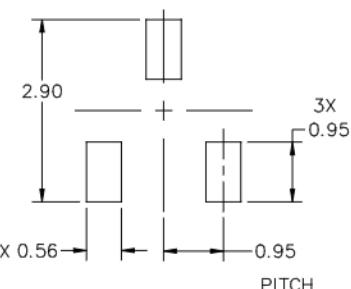
SIDE VIEW



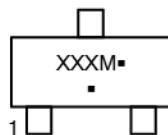
MILLIMETERS			
DIM	MIN	NOM	MAX
A	0.89	1.00	1.11
A1	0.01	0.06	0.10
b	0.37	0.44	0.50
c	0.08	0.14	0.20
D	2.80	2.90	3.04
E	1.20	1.30	1.40
e	1.78	1.90	2.04
L	0.30	0.43	0.55
L1	0.35	0.54	0.69
H _E	2.10	2.40	2.64
T	0°	---	10°

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSIONS: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

RECOMMENDED
MOUNTING FOOTPRINT

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

GENERIC
MARKING DIAGRAM*

XXX = Specific Device Code
M = Date Code
■ = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present. Some products may not follow the Generic Marking.

STYLES ON PAGE 2

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DESCRIPTION:	SOT-23 (TO-236) 2.90x1.30x1.00 1.90P	PAGE 1 OF 2

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SOT-23 (TO-236) 2.90x1.30x1.00 1.90P

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ISSUE AU

DATE 14 AUG 2024

STYLE 1 THRU 5:
CANCELLEDSTYLE 6:
PIN 1. BASE
2. Emitter
3. CollectorSTYLE 7:
PIN 1. Emitter
2. Base
3. CollectorSTYLE 8:
PIN 1. Anode
2. No Connection
3. CathodeSTYLE 9:
PIN 1. Anode
2. Anode
3. CathodeSTYLE 10:
PIN 1. Drain
2. Source
3. GateSTYLE 11:
PIN 1. Anode
2. Cathode
3. Cathode-AnodeSTYLE 12:
PIN 1. Cathode
2. Cathode
3. AnodeSTYLE 13:
PIN 1. Source
2. Drain
3. GateSTYLE 14:
PIN 1. Cathode
2. Gate
3. AnodeSTYLE 15:
PIN 1. Gate
2. Cathode
3. AnodeSTYLE 16:
PIN 1. Anode
2. Cathode
3. CathodeSTYLE 17:
PIN 1. No Connection
2. Anode
3. CathodeSTYLE 18:
PIN 1. No Connection
2. Cathode
3. AnodeSTYLE 19:
PIN 1. Cathode
2. Anode
3. Cathode-AnodeSTYLE 20:
PIN 1. Cathode
2. Anode
3. GateSTYLE 21:
PIN 1. Gate
2. Source
3. DrainSTYLE 22:
PIN 1. Return
2. Output
3. InputSTYLE 23:
PIN 1. Anode
2. Anode
3. CathodeSTYLE 24:
PIN 1. Gate
2. Drain
3. SourceSTYLE 25:
PIN 1. Anode
2. Cathode
3. GateSTYLE 26:
PIN 1. Cathode
2. Anode
3. No ConnectionSTYLE 27:
PIN 1. Cathode
2. Cathode
3. CathodeSTYLE 28:
PIN 1. Anode
2. Anode
3. Anode

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