MMBT2222L, MMBT2222AL, SMMBT2222AL

General Purpose Transistors

NPN Silicon

ON Semiconductor®

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

COLLECTOR
3

1
BASE

2
EMITTER

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 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 × 0.75 × 0.062 in.
2. Alumina = 0.4 × 0.3 × 0.024 in. 99.5% alumina.
3. Reference SOA curve.

MARKING DIAGRAM

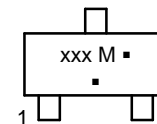xxx M ▪
▪

1
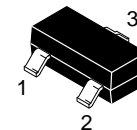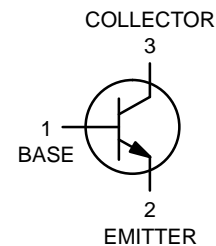
xxx = 1P or M1B
M = Date Code*
▪ = Pb−Free Package

(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.

October, 2016 − Rev. 11

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 MMBT2222A		$V_{(BR)CEO}$	30 40	– –	Vdc
Collector–Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0) MMBT2222 MMBT2222A		$V_{(BR)CBO}$	60 75	– –	Vdc
Emitter–Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0) MMBT2222 MMBT2222A		$V_{(BR)EBO}$	5.0 6.0	– –	Vdc
Collector Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc) MMBT2222A, SMMBT2222A		I_{CEX}	–￼	10	nAdc

Collector Cutoff Current (V_{CB} = 50 Vdc, I_E = 0)   MMBT2222
  (V_{CB} = 60 Vdc, I_E = 0)   MMBT2222A, SMMBT2222A
  (V_{CB} = 50 Vdc, I_E = 0, T_A = 125°C)   MMBT2222
  (V_{CB} = 60 Vdc, I_E = 0, T_A = 125°C)   MMBT2222A, SMMBT2222A
		I_{CBO}	–
			–
			–
			–
				0.01
				0.01
				10
				10
					μAdc

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
  (I_C = 0.1 mAdc, V_{CE} = 10 Vdc)
  (I_C = 1.0 mAdc, V_{CE} = 10 Vdc)
  (I_C = 10 mAdc, V_{CE} = 10 Vdc)
  (I_C = 10 mAdc, V_{CE} = 10 Vdc, T_A = –55°C)   MMBT2222A only
  (I_C = 150 mAdc, V_{CE} = 10 Vdc) (Note 4)
  (I_C = 150 mAdc, V_{CE} = 1.0 Vdc) (Note 4)
  (I_C = 500 mAdc, V_{CE} = 10 Vdc) (Note 4)   MMBT2222
MMBT2222A, SMMBT2222A
		h_{FE}	35
			50
			75
			35
			100
			50
			30
			40
				–
				–
				–
				–
				300
				–
				–
				–
					–

Collector–Emitter Saturation Voltage (Note 4)
  (I_C = 150 mAdc, I_B = 15 mAdc)   MMBT2222
MMBT2222A, SMMBT2222A
 	
  (I_C = 500 mAdc, I_B = 50 mAdc)   MMBT2222
MMBT2222A, SMMBT2222A
		$V_{CE(sat)}$	–
			–
			
			–
			–
				0.4
				0.3
				
				1.6
				1.0
					Vdc

Base–Emitter Saturation Voltage (Note 4)
  (I_C = 150 mAdc, I_B = 15 mAdc)   MMBT2222
MMBT2222A, SMMBT2222A
 	
  (I_C = 500 mAdc, I_B = 50 mAdc)   MMBT2222
MMBT2222A, SMMBT2222A
		$V_{BE(sat)}$	–
			0.6
			
			–
			–
				1.3
				1.2
				
				2.6
				2.0
					Vdc

SMALL–SIGNAL CHARACTERISTICS					
Current–Gain – Bandwidth Product (Note 5) (I_C = 20 mAdc, V_{CE} = 20 Vdc, f = 100 MHz) MMBT2222 MMBT2222A, SMMBT2222A		f_T	250 300	– –	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)		C_{obo}	–	8.0	pF
Input Capacitance (V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz) MMBT2222 MMBT2222A, SMMBT2222A		C_{ibo}	– –	30 25	pF

Input Impedance
  (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A, SMMBT2222A
  (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A, SMMBT2222A
		h_{ie}	2.0
			0.25
				8.0
				1.25
					kΩ

Voltage Feedback Ratio
  (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A, SMMBT2222A
  (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A, SMMBT2222A
		h_{re}	–
			–
				8.0
				4.0
					X 10^{-4}

Small–Signal Current Gain
  (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A, SMMBT2222A
  (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A, SMMBT2222A
		h_{fe}	50
			75
				300
				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) MMBT2222A, SMMBT2222A (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) 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	

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 μs, 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
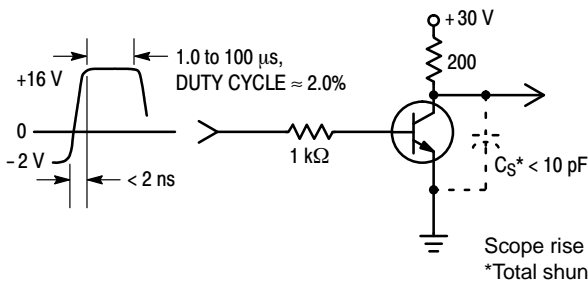
Figure 1. Turn−On Time
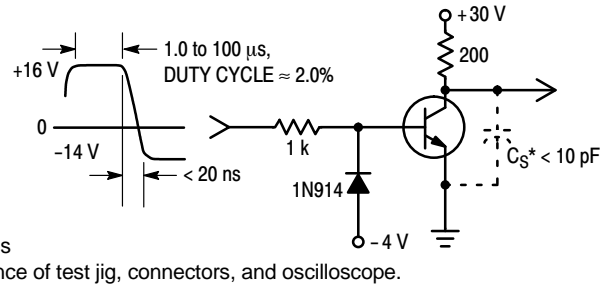
Figure 2. Turn−Off Time

Figure 3. DC Current Gain
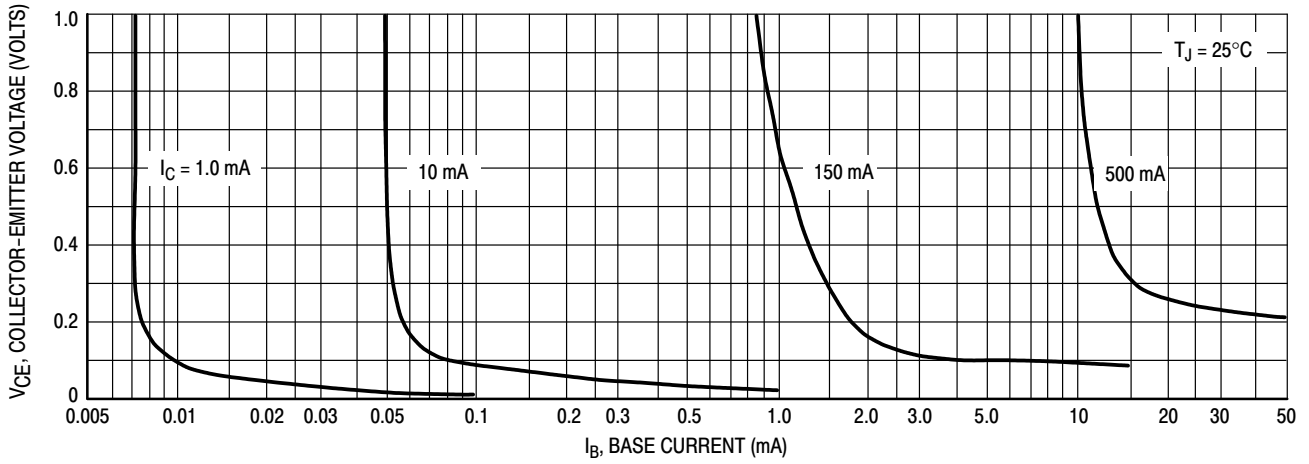
Figure 4. Collector Saturation Region
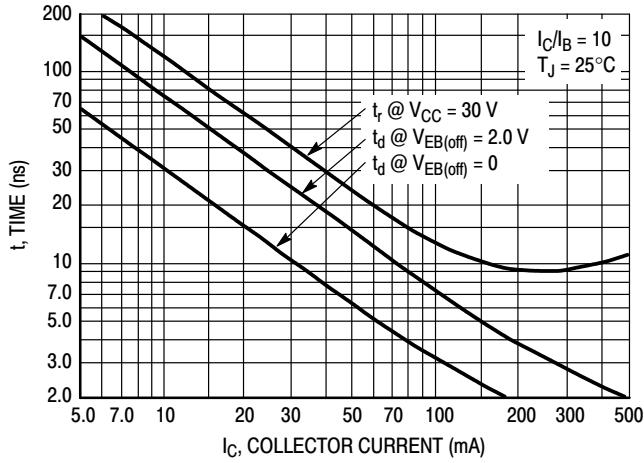
Figure 5. Turn–On Time
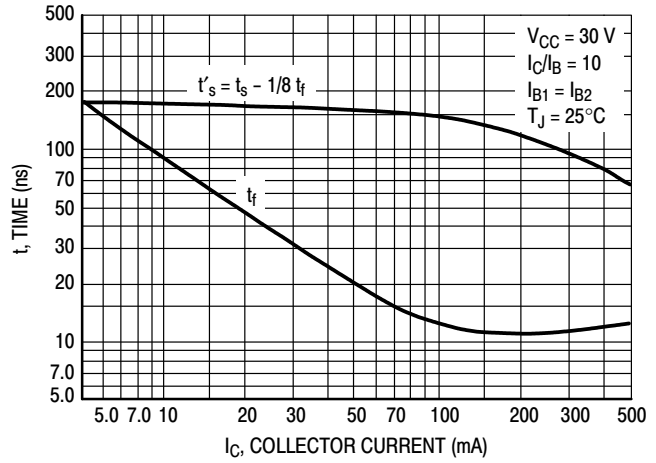
Figure 6. Turn–Off Time
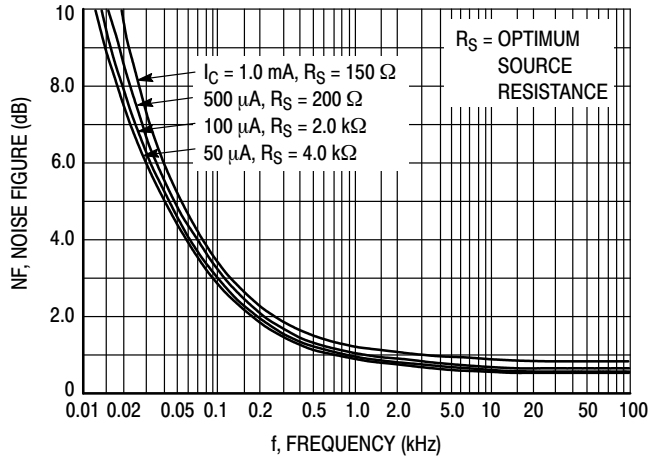
Figure 7. Frequency Effects
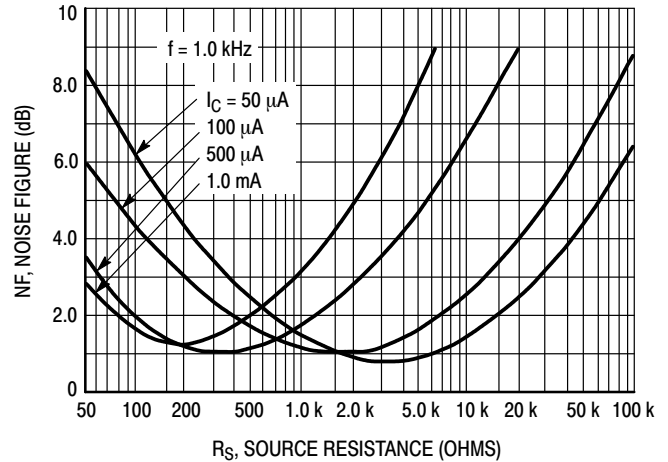
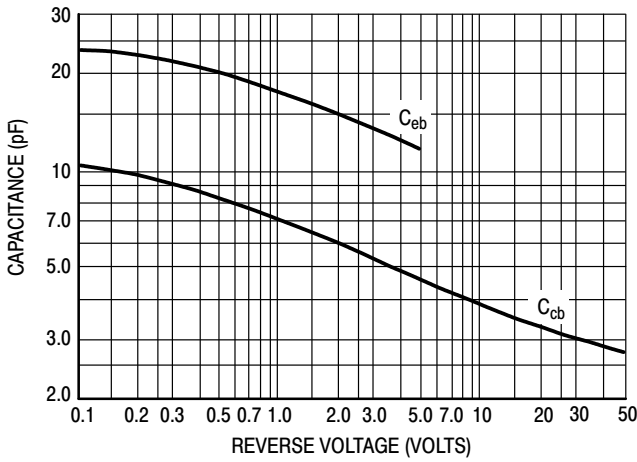**Figure 8. Source Resistance Effects**
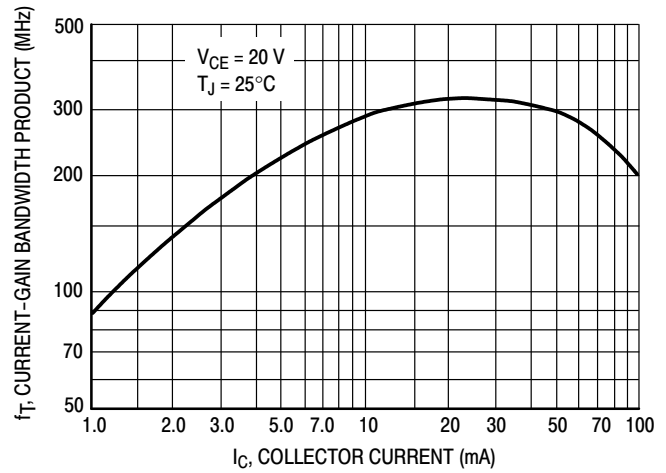
Figure 9. Capacitances
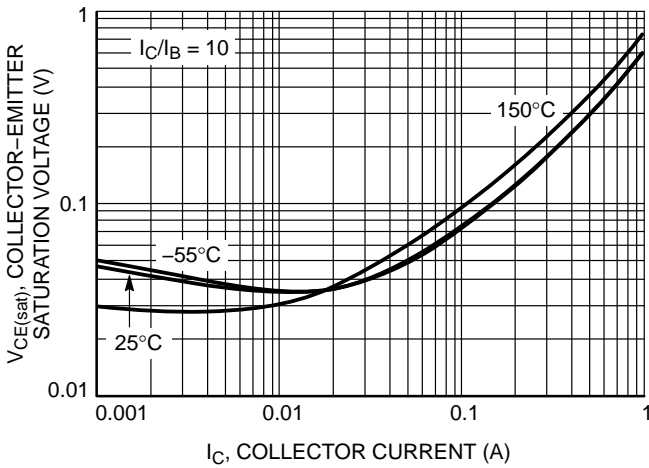

Figure 10. Current–Gain Bandwidth Product

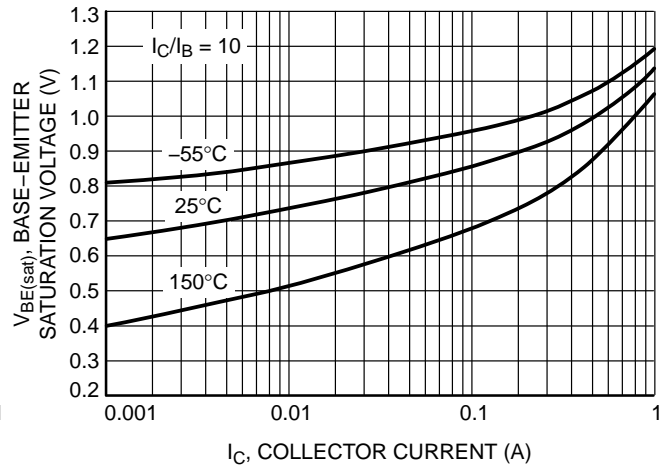Figure 11. Collector Emitter Saturation Voltage
vs. Collector Current

Figure 12. Base Emitter Saturation Voltage vs.
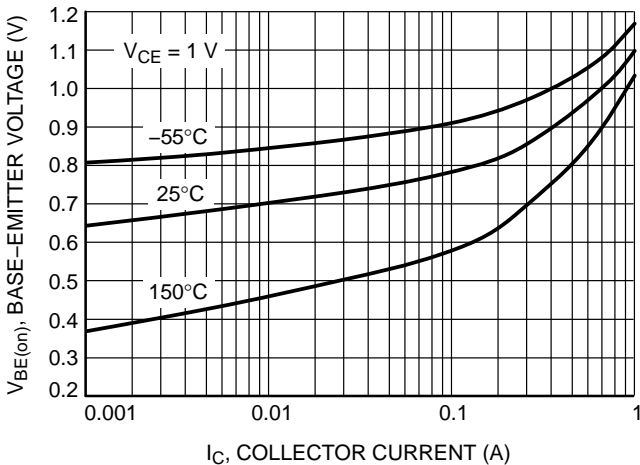Collector Current
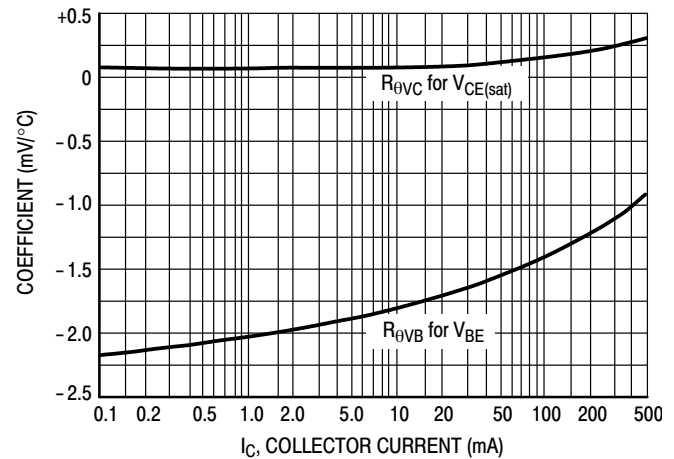

Figure 13. Base Emitter Voltage vs. Collector
Current

Figure 14. Temperature Coefficients

MMBT2222L, MMBT2222AL, SMMBT2222AL
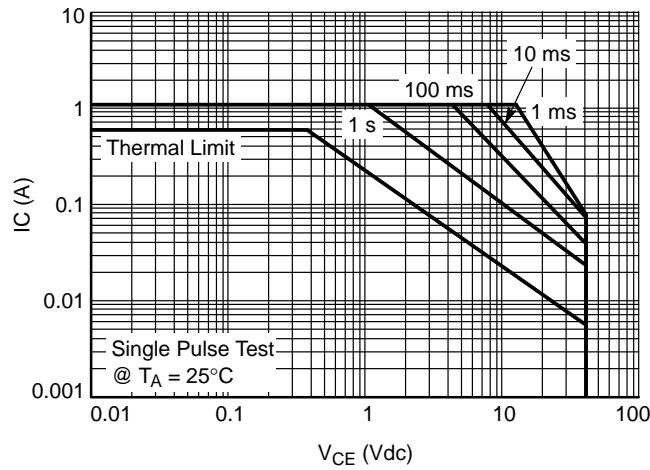
Figure 15. Safe Operating Area

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.

SOT−23 (TO−236)
CASE 318−08
ISSUE AS

DATE 30 JAN 2018

SCALE 4:1

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: 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.

TOP VIEW

VIEW C

SIDE VIEW

END VIEW

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.89	1.00	1.11	0.035	0.039	0.044
A1	0.01	0.06	0.10	0.000	0.002	0.004
b	0.37	0.44	0.50	0.015	0.017	0.020
c	0.08	0.14	0.20	0.003	0.006	0.008
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	0.080
L	0.30	0.43	0.55	0.012	0.017	0.022
L1	0.35	0.54	0.69	0.014	0.021	0.027
H$_E$	2.10	2.40	2.64	0.083	0.094	0.104
T	0°	---	10°	0°	---	10°

RECOMMENDED SOLDERING FOOTPRINT

2.90

3X 0.90

3X 0.80

0.95
PITCH

DIMENSIONS: MILLIMETERS

GENERIC MARKING DIAGRAM*

XXXM▪
▪

1

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.

STYLE 1 THRU 5:
CANCELLED

STYLE 6:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

STYLE 7:
PIN 1. EMITTER
2. BASE
3. COLLECTOR

STYLE 8:
PIN 1. ANODE
2. NO CONNECTION
3. CATHODE

STYLE 9:
PIN 1. ANODE
2. ANODE
3. CATHODE

STYLE 10:
PIN 1. DRAIN
2. SOURCE
3. GATE

STYLE 11:
PIN 1. ANODE
2. CATHODE
3. CATHODE−ANODE

STYLE 12:
PIN 1. CATHODE
2. CATHODE
3. ANODE

STYLE 13:
PIN 1. SOURCE
2. DRAIN
3. GATE

STYLE 14:
PIN 1. CATHODE
2. GATE
3. ANODE

STYLE 15:
PIN 1. GATE
2. CATHODE
3. ANODE

STYLE 16:
PIN 1. ANODE
2. CATHODE
3. CATHODE

STYLE 17:
PIN 1. NO CONNECTION
2. ANODE
3. CATHODE

STYLE 18:
PIN 1. NO CONNECTION
2. CATHODE
3. ANODE

STYLE 19:
PIN 1. CATHODE
2. ANODE
3. CATHODE−ANODE

STYLE 20:
PIN 1. CATHODE
2. ANODE
3. GATE

STYLE 21:
PIN 1. GATE
2. SOURCE
3. DRAIN

STYLE 22:
PIN 1. RETURN
2. OUTPUT
3. INPUT

STYLE 23:
PIN 1. ANODE
2. ANODE
3. CATHODE

STYLE 24:
PIN 1. GATE
2. DRAIN
3. SOURCE

STYLE 25:
PIN 1. ANODE
2. CATHODE
3. GATE

STYLE 26:
PIN 1. CATHODE
2. ANODE
3. NO CONNECTION

STYLE 27:
PIN 1. CATHODE
2. CATHODE
3. CATHODE

STYLE 28:
PIN 1. ANODE
2. ANODE
3. ANODE

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DESCRIPTION:	SOT−23 (TO−236)	PAGE 1 OF 1

PUBLICATION ORDERING INFORMATION

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