

# MMBT2222AM3T5G

## NPN General Purpose Transistor

The MMBT2222AM3T5G device is a spin-off of our popular SOT-23 three-leaded device. It is designed for general purpose amplifier applications and is housed in the SOT-723 surface mount package. This device is ideal for low-power surface mount applications where board space is at a premium.

### Features

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

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	$V_{CEO}$	40	Vdc
Collector–Base Voltage	$V_{CBO}$	75	Vdc
Emitter–Base Voltage	$V_{EBO}$	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 $25^\circ\text{C}$	$P_D$	265 2.1	mW mW/°C
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	470	°C/W
Total Device Dissipation Alumina Substrate, (Note 2) $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	640 5.1	mW mW/°C
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	195	°C/W
Junction and Storage Temperature	$T_J, T_{stg}$	-55 to +150	°C

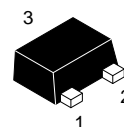
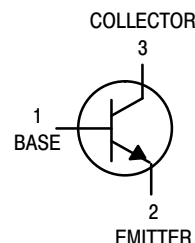
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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



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### MARKING DIAGRAM

SOT-723  
CASE 631AA  
STYLE 1



AA = Specific Device Code  
M = Date Code

### ORDERING INFORMATION

Device	Package	Shipping†
MMBT2222AM3T5G	SOT-723 (Pb-Free)	8000/Tape & Reel
NSVMMBT2222AM3T5G	SOT-723 (Pb-Free)	8000/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.

# MMBT2222AM3T5G

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector–Emitter Breakdown Voltage (I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 0)	V <sub>(BR)CEO</sub>	40	–	Vdc
Collector–Base Breakdown Voltage (I <sub>C</sub> = 10 μAdc, I <sub>E</sub> = 0)	V <sub>(BR)CBO</sub>	75	–	Vdc
Emitter–Base Breakdown Voltage (I <sub>E</sub> = 10 μAdc, I <sub>C</sub> = 0)	V <sub>(BR)EBO</sub>	6.0	–	Vdc
Collector Cutoff Current (V <sub>CE</sub> = 60 Vdc, V <sub>EB(off)</sub> = 3.0 Vdc)	I <sub>CEX</sub>	–	10	nAdc
Collector Cutoff Current (V <sub>CB</sub> = 60 Vdc, I <sub>E</sub> = 0) (V <sub>CB</sub> = 60 Vdc, I <sub>E</sub> = 0, T <sub>A</sub> = 125°C)	I <sub>CB0</sub>	– –	0.01 10	μAdc
Emitter Cutoff Current (V <sub>EB</sub> = 3.0 Vdc, I <sub>C</sub> = 0)	I <sub>EBO</sub>	–	100	nAdc
Base Cutoff Current (V <sub>CE</sub> = 60 Vdc, V <sub>EB(off)</sub> = 3.0 Vdc)	I <sub>BL</sub>	–	20	nAdc

## ON CHARACTERISTICS

DC Current Gain (I <sub>C</sub> = 0.1 mAdc, V <sub>CE</sub> = 10 Vdc) (I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc) (I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc) (I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc, T <sub>A</sub> = –55°C) (I <sub>C</sub> = 150 mAdc, V <sub>CE</sub> = 10 Vdc) (Note 3) (I <sub>C</sub> = 150 mAdc, V <sub>CE</sub> = 1.0 Vdc) (Note 3) (I <sub>C</sub> = 500 mAdc, V <sub>CE</sub> = 10 Vdc) (Note 3)	h <sub>FE</sub>	35 50 75 35 100 50 40	– – – – 300 – –	–
Collector–Emitter Saturation Voltage (Note 3) (I <sub>C</sub> = 150 mAdc, I <sub>B</sub> = 15 mAdc) (I <sub>C</sub> = 500 mAdc, I <sub>B</sub> = 50 mAdc)	V <sub>CE(sat)</sub>	– –	0.3 1.0	Vdc
Base–Emitter Saturation Voltage (Note 3) (I <sub>C</sub> = 150 mAdc, I <sub>B</sub> = 15 mAdc) (I <sub>C</sub> = 500 mAdc, I <sub>B</sub> = 50 mAdc)	V <sub>BE(sat)</sub>	0.6 –	1.2 2.0	Vdc

## SMALL–SIGNAL CHARACTERISTICS

Current–Gain–Bandwidth Product (Note 4) (I <sub>C</sub> = 20 mAdc, V <sub>CE</sub> = 20 Vdc, f = 100 MHz)	f <sub>T</sub>	300	–	MHz
Output Capacitance (V <sub>CB</sub> = 10 Vdc, I <sub>E</sub> = 0, f = 1.0 MHz)	C <sub>obo</sub>	–	8.0	pF
Input Capacitance (V <sub>EB</sub> = 0.5 Vdc, I <sub>C</sub> = 0, f = 1.0 MHz)	C <sub>ibo</sub>	–	25	pF
Input Impedance (I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz) (I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)	h <sub>ie</sub>	2.0 0.25	8.0 1.25	kΩ
Voltage Feedback Ratio (I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz) (I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)	h <sub>re</sub>	– –	8.0 4.0	X 10 <sup>–4</sup>
Small–Signal Current Gain (I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz) (I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)	h <sub>fe</sub>	50 75	300 375	–
Output Admittance (I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz) (I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)	h <sub>oe</sub>	5.0 25	35 200	μmhos
Collector Base Time Constant (I <sub>E</sub> = 20 mAdc, V <sub>CB</sub> = 20 Vdc, f = 31.8 MHz)	r <sub>b</sub> , C <sub>c</sub>	–	150	ps
Noise Figure (I <sub>C</sub> = 100 μAdc, V <sub>CE</sub> = 10 Vdc, R <sub>S</sub> = 1.0 kΩ, f = 1.0 kHz)	NF	–	4.0	dB

## SWITCHING CHARACTERISTICS

Delay Time	(V <sub>CC</sub> = 30 Vdc, V <sub>BE(off)</sub> = –0.5 Vdc, I <sub>C</sub> = 150 mAdc, I <sub>B1</sub> = 15 mAdc)	t <sub>d</sub>	–	10	ns
Rise Time		t <sub>r</sub>	–	25	
Storage Time	(V <sub>CC</sub> = 30 Vdc, I <sub>C</sub> = 150 mAdc, I <sub>B1</sub> = I <sub>B2</sub> = 15 mAdc)	t <sub>s</sub>	–	225	ns
Fall Time		t <sub>f</sub>	–	60	

3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

4. f<sub>T</sub> is defined as the frequency at which |h<sub>fe</sub>| extrapolates to unity.

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## SWITCHING TIME EQUIVALENT TEST CIRCUITS

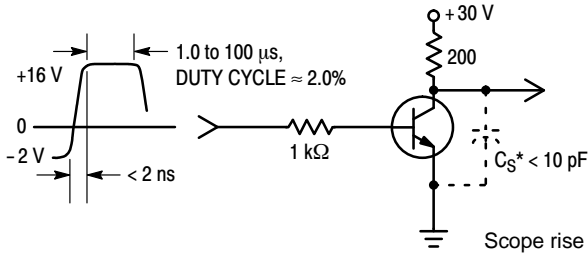


Figure 1. Turn-On Time

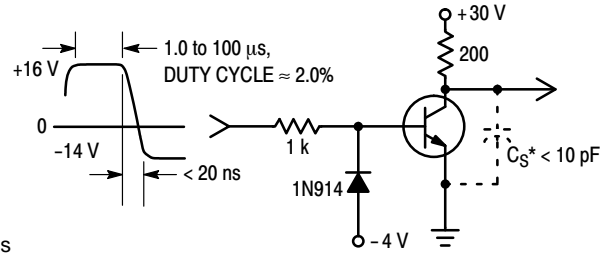


Figure 2. Turn-Off Time

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

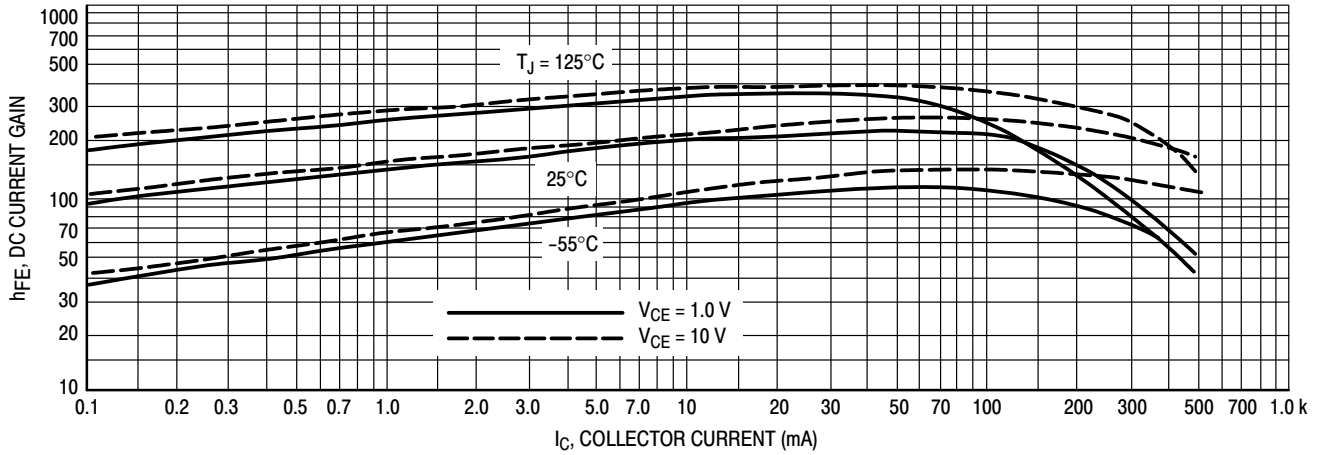


Figure 3. DC Current Gain

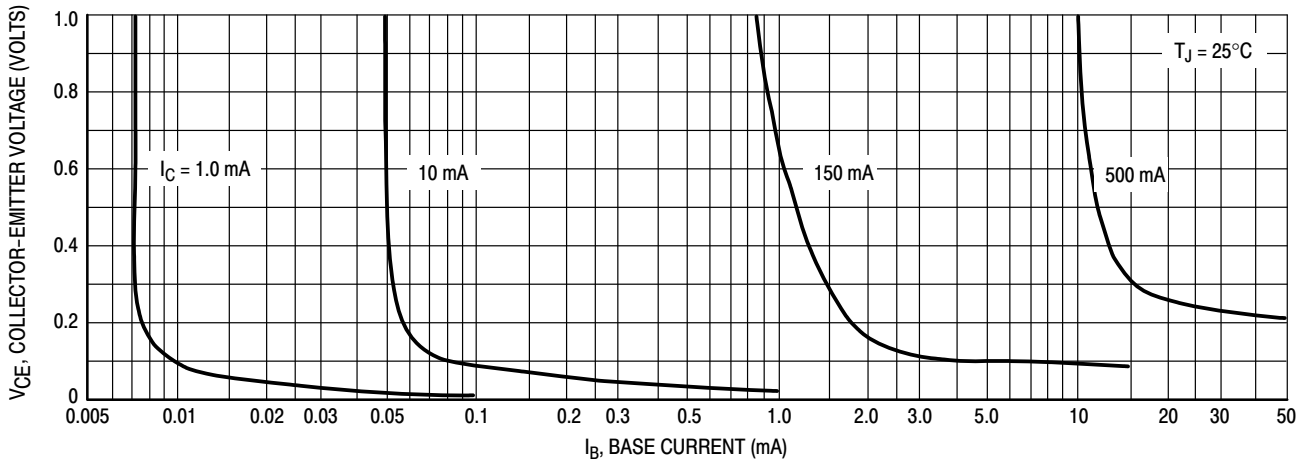


Figure 4. Collector Saturation Region

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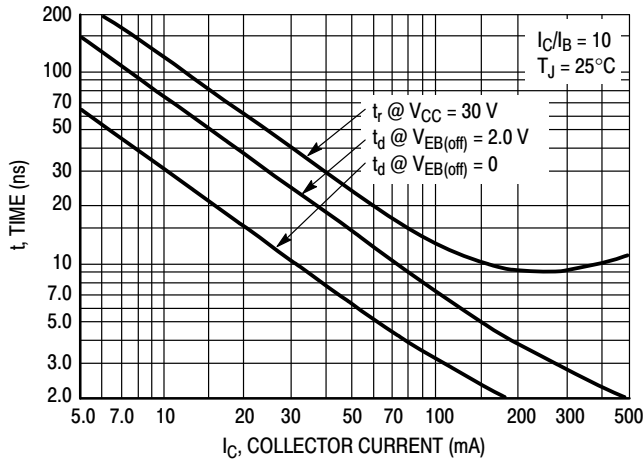


Figure 5. Turn-On Time

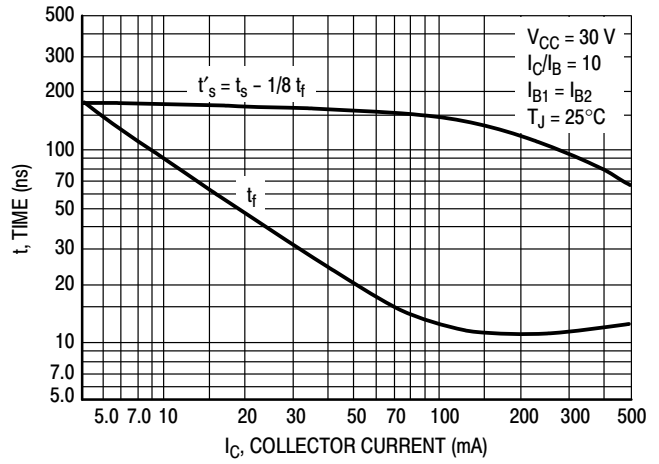


Figure 6. Turn-Off Time

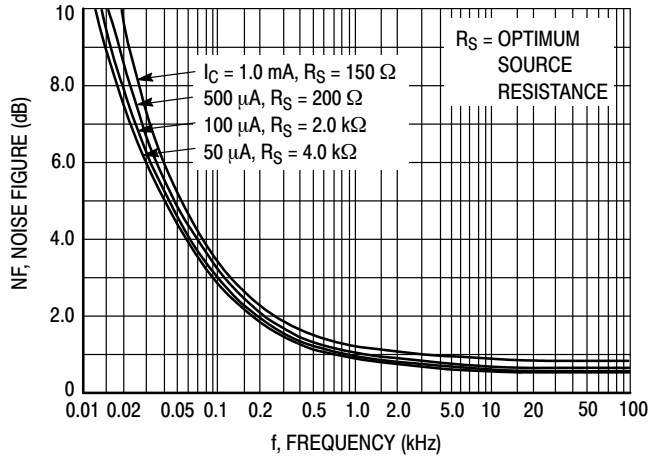


Figure 7. Frequency Effects

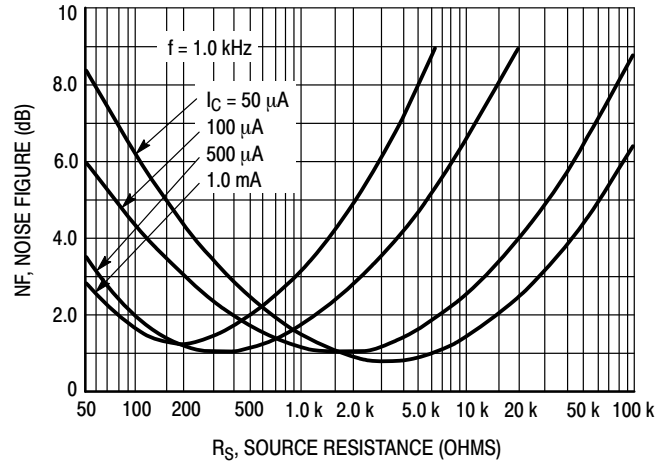


Figure 8. Source Resistance Effects

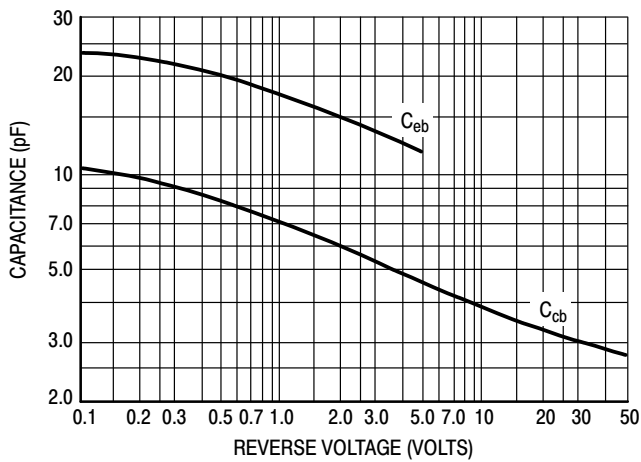


Figure 9. Capacitances

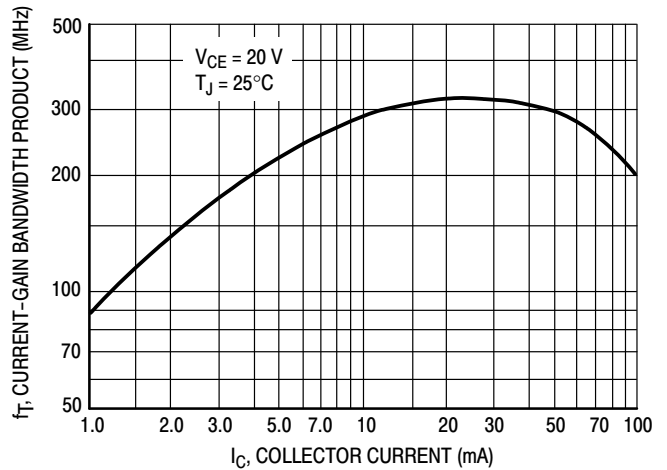


Figure 10. Current-Gain Bandwidth Product

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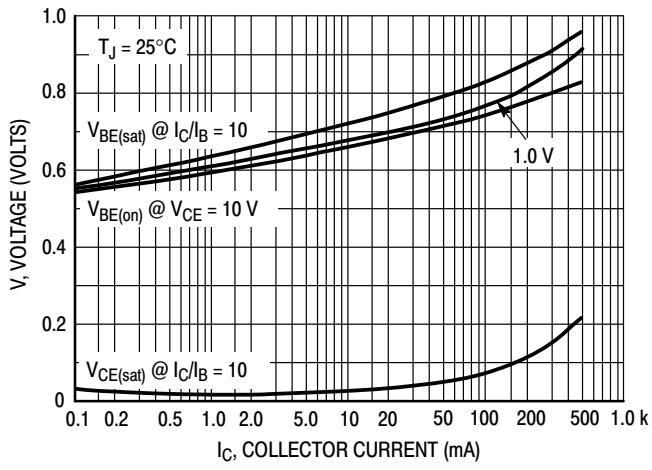


Figure 11. "On" Voltages

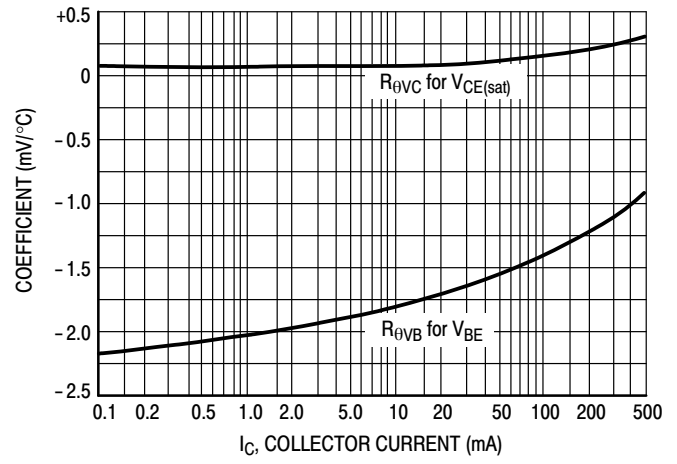


Figure 12. Temperature Coefficients

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

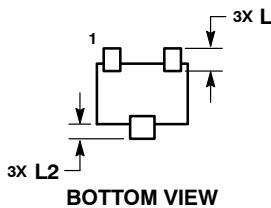
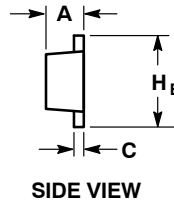
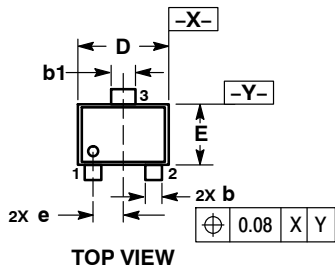
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SCALE 4:1

**SOT-723**  
CASE 631AA-01  
ISSUE D

DATE 10 AUG 2009

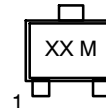


**NOTES:**

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 BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

MILLIMETERS			
DIM	MIN	NOM	MAX
A	0.45	0.50	0.55
b	0.15	0.21	0.27
b1	0.25	0.31	0.37
C	0.07	0.12	0.17
D	1.15	1.20	1.25
E	0.75	0.80	0.85
e	0.40 BSC		
H E	1.15	1.20	1.25
L	0.29 REF		
L2	0.15	0.20	0.25

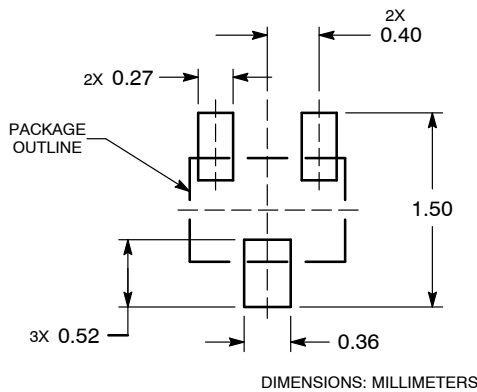
**GENERIC MARKING DIAGRAM\***



XX = Specific Device Code  
M = Date Code

- |   |  |  |  |  |
|---|--|--|--|--|
| STYLE 1:<br>PIN 1. BASE<br>2. EMITTER<br>3. COLLECTOR | STYLE 2:<br>PIN 1. ANODE<br>2. N/C<br>3. CATHODE | STYLE 3:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE | STYLE 4:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. ANODE | STYLE 5:<br>PIN 1. GATE<br>2. SOURCE<br>3. DRAIN |
|---|--|--|--|--|

**RECOMMENDED SOLDERING FOOTPRINT\***



DIMENSIONS: MILLIMETERS

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G", may or not be present.

\*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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<b>DESCRIPTION:</b>	<b>SOT-723</b>	<b>PAGE 1 OF 1</b>

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[NTE101](#) [NTE13](#) [NTE15](#)