

# Darlington Amplifier Transistors

NPN Silicon



ON Semiconductor®

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## MMBTA13L, SMMBTA13L, MMBTA14L, SMMBTA14L

### Features

- S 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

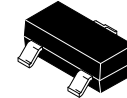
| Rating                         | Symbol    | Value | Unit |
|--------------------------------|-----------|-------|------|
| Collector - Emitter Voltage    | $V_{CES}$ | 30    | Vdc  |
| Collector - Base Voltage       | $V_{CBO}$ | 30    | Vdc  |
| Emitter - Base Voltage         | $V_{EBO}$ | 10    | Vdc  |
| Collector Current - Continuous | $I_C$     | 300   | mAdc |

### THERMAL CHARACTERISTICS

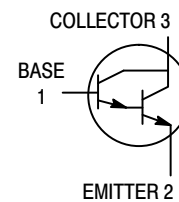
| Characteristic  | Symbol          | Max         | Unit                       |
|---|-----------------|-------------|----------------------------|
| Total Device Dissipation FR-5 Board<br>(Note 1) $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$         | $P_D$           | 225<br>1.8  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction-to-Ambient   | $R_{\theta JA}$ | 556         | $^\circ\text{C}/\text{W}$  |
| Total Device Dissipation Alumina<br>Substrate, (Note 2) $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$           | 300<br>2.4  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction-to-Ambient   | $R_{\theta JA}$ | 417         | $^\circ\text{C}/\text{W}$  |
| Junction and Storage Temperature  | $T_J, T_{stg}$  | -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.

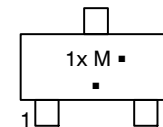
1. FR-5 =  $1.0 \times 0.75 \times 0.062$  in.
2. Alumina =  $0.4 \times 0.3 \times 0.024$  in. 99.5% alumina.



SOT-23 (TO-236)  
CASE 318  
STYLE 6



### MARKING DIAGRAM



- 1x = Device Code  
 x = M for MMBTA13LT1G,  
 SMMBTA13LT1G  
 x = N for MMBTA14LT1G,  
 SMMBTA14LT1G, T3G  
 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

| Device                       | Package             | Shipping†            |
|------------------------------|---------------------|----------------------|
| MMBTA13LT1G,<br>SMMBTA13LT1G | SOT-23<br>(Pb-Free) | 3,000 / Tape & Reel  |
| MMBTA14LT1G,<br>SMMBTA14LT1G | SOT-23<br>(Pb-Free) | 3,000 / Tape & Reel  |
| SMMBTA14LT3G                 | SOT-23<br>(Pb-Free) | 10,000 / Tape & Reel |

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

†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.

# MMBTA13L, SMMBTA13L, MMBTA14L, SMMBTA14L

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

| Characteristic  | Symbol        | Min | Max | Unit |
|---|---------------|-----|-----|------|
| <b>OFF CHARACTERISTICS</b>  |               |     |     |      |
| Collector – Emitter Breakdown Voltage<br>( $I_C = 100 \mu\text{Adc}$ , $V_{BE} = 0$ ) | $V_{(BR)CES}$ | 30  | –   | Vdc  |
| Collector Cutoff Current<br>( $V_{CB} = 30 \text{ Vdc}$ , $I_E = 0$ )                 | $I_{CBO}$     | –   | 100 | nAdc |
| Emitter Cutoff Current<br>( $V_{EB} = 10 \text{ Vdc}$ , $I_C = 0$ )                   | $I_{EBO}$     | –   | 100 | nAdc |

## ON CHARACTERISTICS (Note 3)

|  |               |                                    |                  |     |
|--|---------------|------------------------------------|------------------|-----|
| DC Current Gain<br>( $I_C = 10 \text{ mAdc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )<br>MMBTA13, SMMBTA13<br>MMBTA14, SMMBTA14<br>( $I_C = 100 \text{ mAdc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )<br>MMBTA13, SMMBTA13<br>MMBTA14, SMMBTA14 | $h_{FE}$      | 5000<br>10,000<br>10,000<br>20,000 | –<br>–<br>–<br>– | –   |
| Collector – Emitter Saturation Voltage<br>( $I_C = 100 \text{ mAdc}$ , $I_B = 0.1 \text{ mAdc}$ )  | $V_{CE(sat)}$ | –                                  | 1.5              | Vdc |
| Base – Emitter On Voltage<br>( $I_C = 100 \text{ mAdc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )   | $V_{BE}$      | –                                  | 2.0              | Vdc |

## SMALL – SIGNAL CHARACTERISTICS

|   |       |     |   |     |
|---|-------|-----|---|-----|
| Current – Gain – Bandwidth Product (Note 4)<br>( $I_C = 10 \text{ mAdc}$ , $V_{CE} = 5.0 \text{ Vdc}$ , $f = 100 \text{ MHz}$ ) | $f_T$ | 125 | – | MHz |
|---|-------|-----|---|-----|

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

4.  $f_T = |h_{fe}| \cdot f_{test}$ .

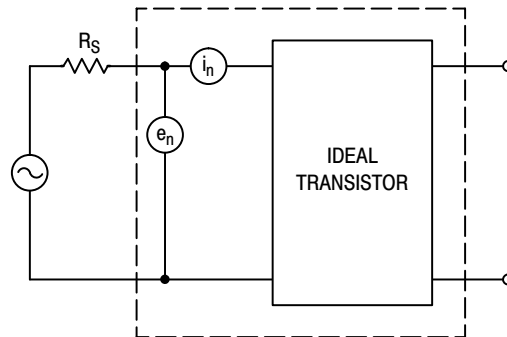


Figure 1. Transistor Noise Model

# MMBTA13L, SMMBTA13L, MMBTA14L, SMMBTA14L

## NOISE CHARACTERISTICS

( $V_{CE} = 5.0 \text{ Vdc}$ ,  $T_A = 25^\circ\text{C}$ )

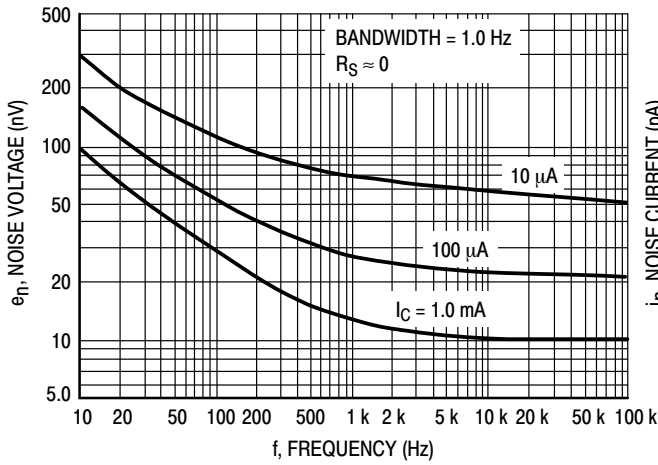


Figure 2. Noise Voltage

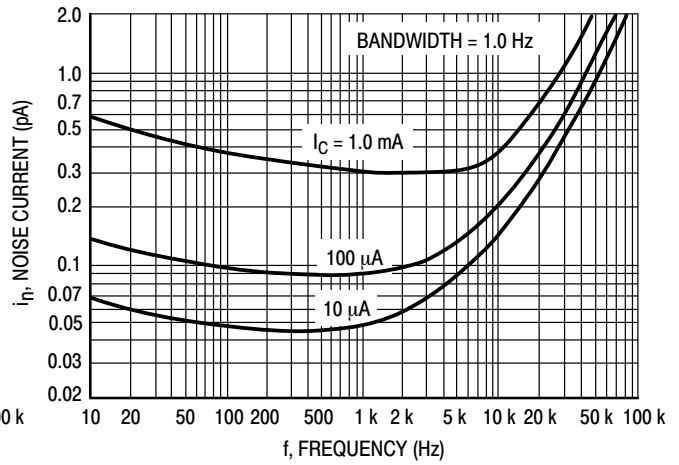


Figure 3. Noise Current

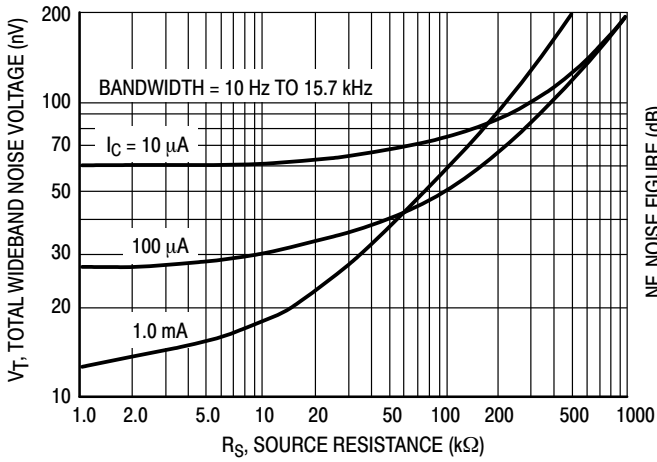


Figure 4. Total Wideband Noise Voltage

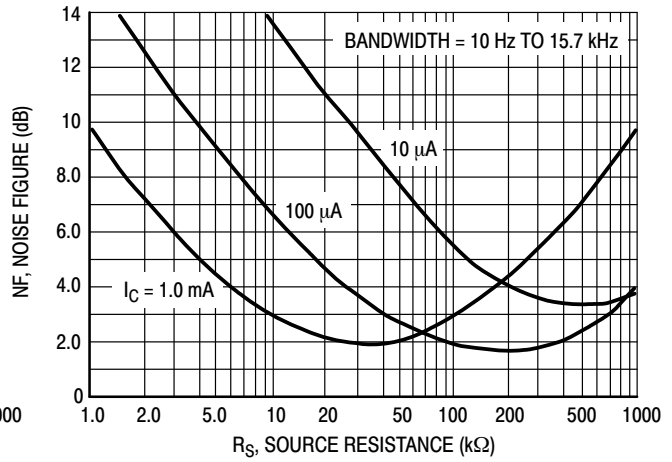


Figure 5. Wideband Noise Figure

SMALL-SIGNAL CHARACTERISTICS

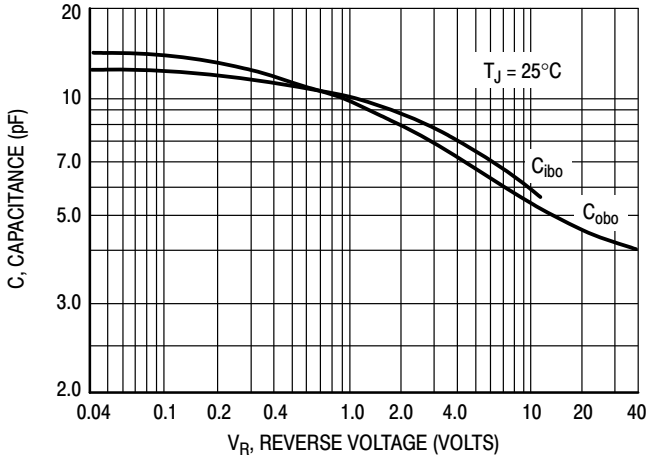


Figure 6. Capacitance

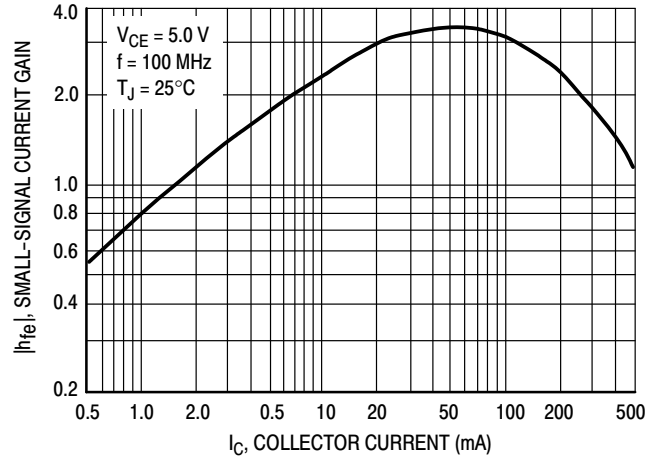


Figure 7. High Frequency Current Gain

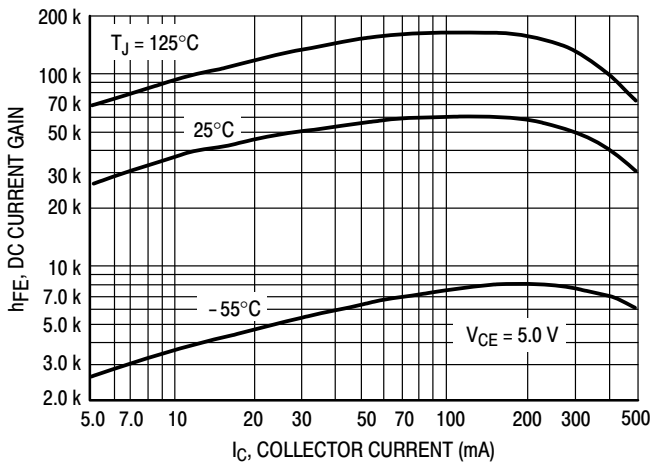


Figure 8. DC Current Gain

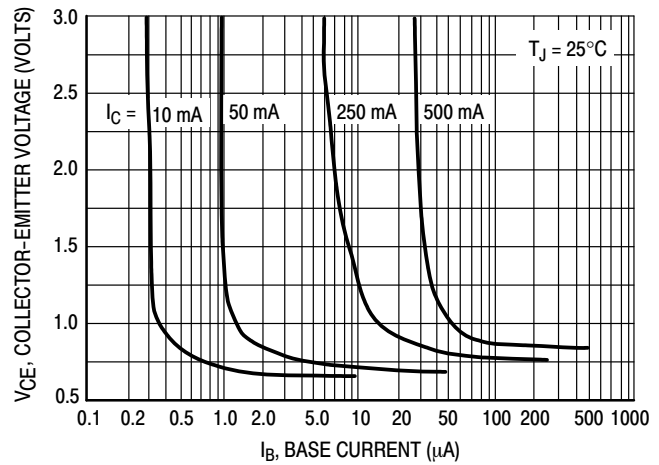


Figure 9. Collector Saturation Region

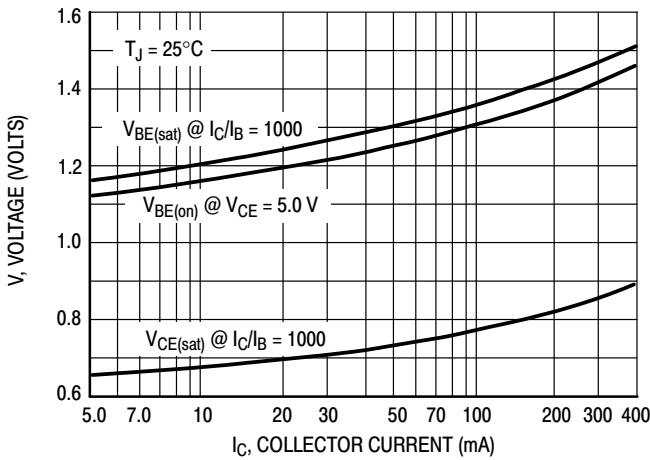


Figure 10. "On" Voltages

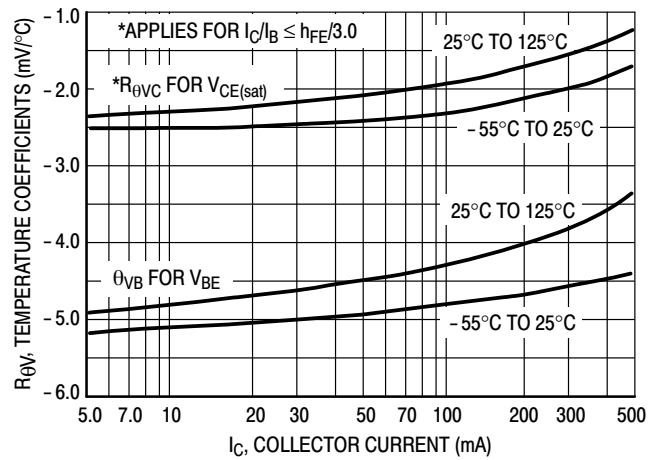


Figure 11. Temperature Coefficients

# MMBTA13L, SMMBTA13L, MMBTA14L, SMMBTA14L

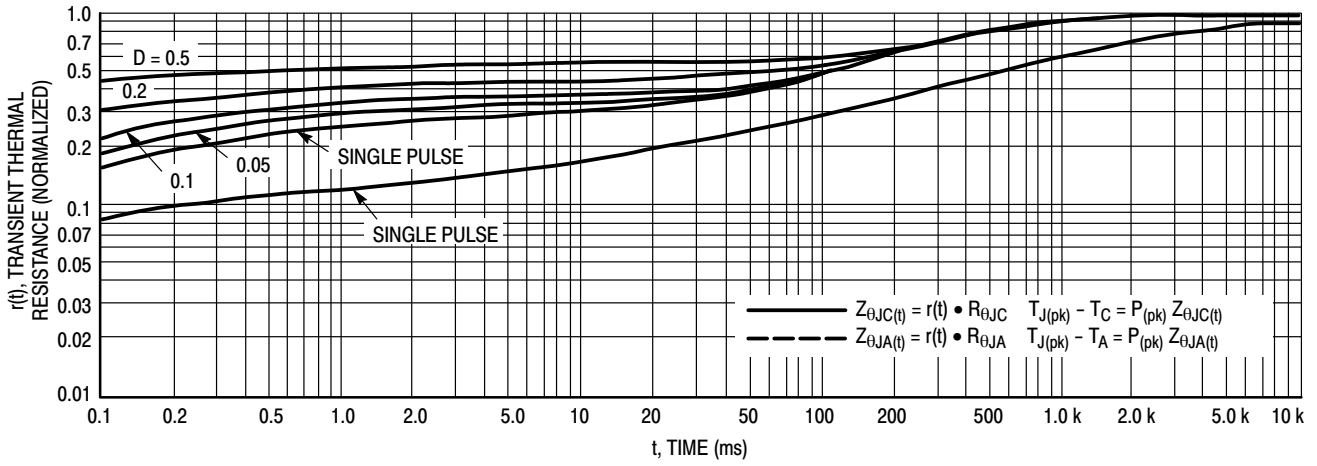


Figure 12. Thermal Response

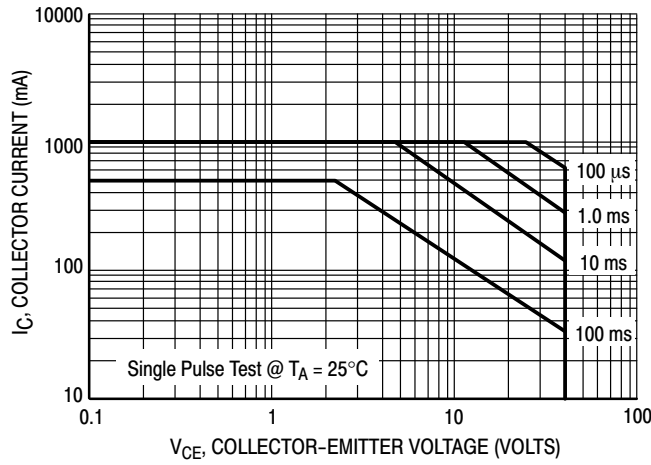
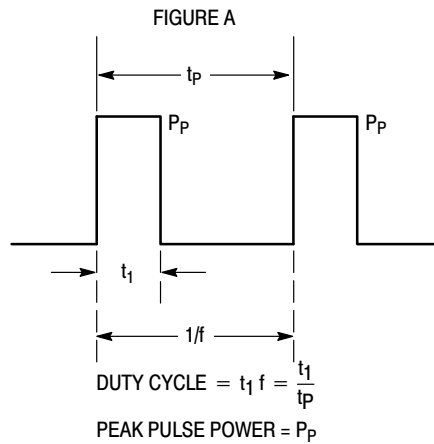


Figure 13. Active Region Safe Operating Area

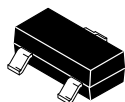


Design Note: Use of Transient Thermal Resistance Data

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

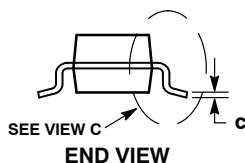
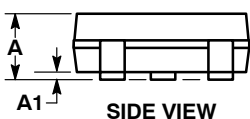
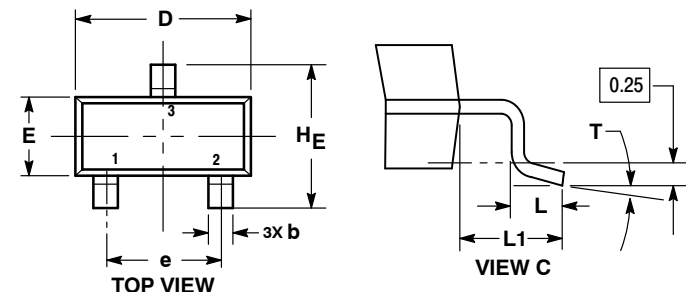
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**SOT-23 (TO-236)**  
CASE 318-08  
ISSUE AS

DATE 30 JAN 2018

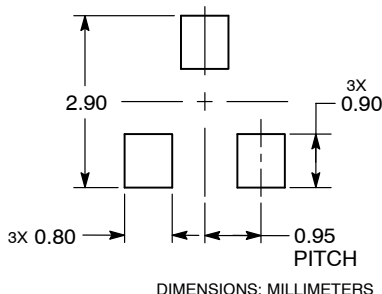
SCALE 4:1



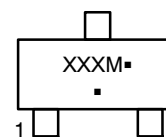
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
  4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| 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 |
| HE  | 2.10        | 2.40 | 2.64 | 0.083  | 0.094 | 0.104 |
| T   | 0°          | ---  | 10°  | 0°     | ---   | 10°   |

### RECOMMENDED SOLDERING FOOTPRINT



### 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.

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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