

# MMBT2907AL, SMMBT2907AL

## General Purpose Transistors

### PNP Silicon

#### 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         | $V_{CEO}$ | -60   | Vdc  |
| Collector-Base Voltage            | $V_{CBO}$ | -60   | Vdc  |
| Emitter-Base Voltage              | $V_{EBO}$ | -5.0  | Vdc  |
| Collector Current - Continuous    | $I_C$     | -600  | mAdc |
| Collector Current - Peak (Note 3) | $I_{CM}$  | -1200 | 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         | $^\circ\text{C}/\text{W}$  |
| Total Device Dissipation - Heat Spreader<br>or equivalent, (Note 4) @ $T_A = 25^\circ\text{C}$                          | $P_D$           | 350         | mW                         |
| Thermal Resistance, Junction-to-Ambient   | $R_{\theta JA}$ | 357         | $^\circ\text{C}/\text{W}$  |
| Junction and Storage Temperature  | $T_J, T_{stg}$  | -55 to +150 | $^\circ\text{C}$           |

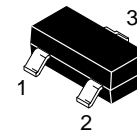
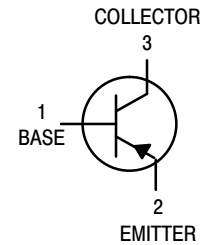
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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.
3. Reference SOA curve.
4. Heat Spreader or equivalent =  $450 \text{ mm}^2$ , 2 oz.



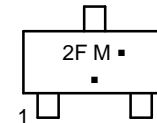
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SOT-23 (TO-236AB)  
CASE 318  
STYLE 6

#### MARKING DIAGRAM



2F = Device Code  
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†               |
|---------------------------------|---------------------|-------------------------|
| MMBT2907ALT1G<br>SMMBT2907ALT1G | SOT-23<br>(Pb-Free) | 3000 / Tape &<br>Reel   |
| MMBT2907ALT3G<br>SMMBT2907ALT3G | SOT-23<br>(Pb-Free) | 10,000 / Tape &<br>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.

# MMBT2907AL, SMMBT2907AL

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

| Characteristic   | Symbol        | Min        | Max           | Unit            |
|--|---------------|------------|---------------|-----------------|
| <b>OFF CHARACTERISTICS</b>   |               |            |               |                 |
| Collector-Emitter Breakdown Voltage (Note 5)<br>( $I_C = -1.0\text{ mA}$ , $I_B = 0$ )<br>( $I_C = -10\text{ mA}$ , $I_B = 0$ )                | $V_{(BR)CEO}$ | -60<br>-60 | -             | Vdc             |
| Collector-Base Breakdown Voltage ( $I_C = -10\text{ }\mu\text{A}$ , $I_E = 0$ )  | $V_{(BR)CBO}$ | -60        | -             | Vdc             |
| Emitter-Base Breakdown Voltage ( $I_E = -10\text{ }\mu\text{A}$ , $I_C = 0$ )  | $V_{(BR)EBO}$ | -5.0       | -             | Vdc             |
| Collector Cutoff Current ( $V_{CE} = -30\text{ Vdc}$ , $V_{EB(off)} = -0.5\text{ Vdc}$ )   | $I_{CEX}$     | -          | -50           | nAdc            |
| Collector Cutoff Current<br>( $V_{CB} = -50\text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = -50\text{ Vdc}$ , $I_E = 0$ , $T_A = 125^\circ\text{C}$ ) | $I_{CBO}$     | -          | -0.010<br>-10 | $\mu\text{Adc}$ |
| Base Cutoff Current ( $V_{CE} = -30\text{ Vdc}$ , $V_{EB(off)} = -0.5\text{ Vdc}$ )  | $I_{BL}$      | -          | -50           | nAdc            |

## ON CHARACTERISTICS

|   |               |                               |              |     |
|---|---------------|-------------------------------|--------------|-----|
| DC Current Gain<br>( $I_C = -0.1\text{ mA}$ , $V_{CE} = -10\text{ Vdc}$ )<br>( $I_C = -1.0\text{ mA}$ , $V_{CE} = -10\text{ Vdc}$ )<br>( $I_C = -10\text{ mA}$ , $V_{CE} = -10\text{ Vdc}$ )<br>( $I_C = -150\text{ mA}$ , $V_{CE} = -10\text{ Vdc}$ )<br>( $I_C = -500\text{ mA}$ , $V_{CE} = -10\text{ Vdc}$ ) (Note 5) | $h_{FE}$      | 75<br>100<br>100<br>100<br>50 | -            | -   |
| Collector-Emitter Saturation Voltage (Note 5)<br>( $I_C = -150\text{ mA}$ , $I_B = -15\text{ mA}$ ) (Note 5)<br>( $I_C = -500\text{ mA}$ , $I_B = -50\text{ mA}$ )  | $V_{CE(sat)}$ | -                             | -0.4<br>-1.6 | Vdc |
| Base-Emitter Saturation Voltage (Note 5)<br>( $I_C = -150\text{ mA}$ , $I_B = -15\text{ mA}$ )<br>( $I_C = -500\text{ mA}$ , $I_B = -50\text{ mA}$ )  | $V_{BE(sat)}$ | -                             | -1.3<br>-2.6 | Vdc |

## SMALL-SIGNAL CHARACTERISTICS

|  |           |     |     |     |
|--|-----------|-----|-----|-----|
| Current-Gain - Bandwidth Product (Notes 5, 6),<br>( $I_C = -50\text{ mA}$ , $V_{CE} = -20\text{ Vdc}$ , $f = 100\text{ MHz}$ ) | $f_T$     | 200 | -   | MHz |
| Output Capacitance ( $V_{CB} = -10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )  | $C_{obo}$ | -   | 8.0 | pF  |
| Input Capacitance ( $V_{EB} = -2.0\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )  | $C_{ibo}$ | -   | 30  |     |

## SWITCHING CHARACTERISTICS

|               |   |           |   |     |    |
|---------------|---|-----------|---|-----|----|
| Turn-On Time  | $(V_{CC} = -30\text{ Vdc}$ , $I_C = -150\text{ mA}$ ,<br>$I_{B1} = -15\text{ mA}$ )           | $t_{on}$  | - | 45  | ns |
| Delay Time    |   | $t_d$     | - | 10  |    |
| Rise Time     |   | $t_r$     | - | 40  |    |
| Turn-Off Time | $(V_{CC} = -6.0\text{ Vdc}$ , $I_C = -150\text{ mA}$ ,<br>$I_{B1} = I_{B2} = -15\text{ mA}$ ) | $t_{off}$ | - | 100 |    |
| Storage Time  |   | $t_s$     | - | 80  |    |
| Fall Time     |   | $t_f$     | - | 30  |    |

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

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

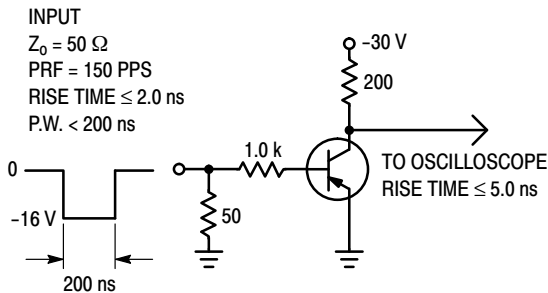


Figure 1. Delay and Rise Time Test Circuit

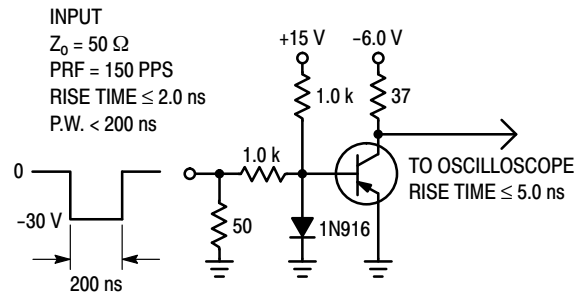


Figure 2. Storage and Fall Time Test Circuit

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## TYPICAL CHARACTERISTICS



Figure 3. DC Current Gain



Figure 4. Collector Saturation Region

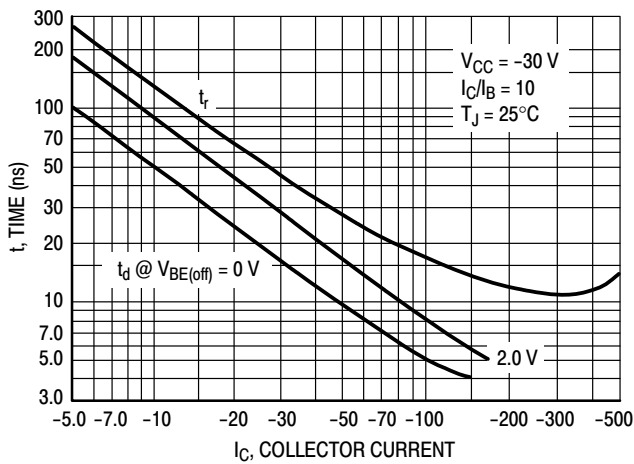


Figure 5. Turn-On Time

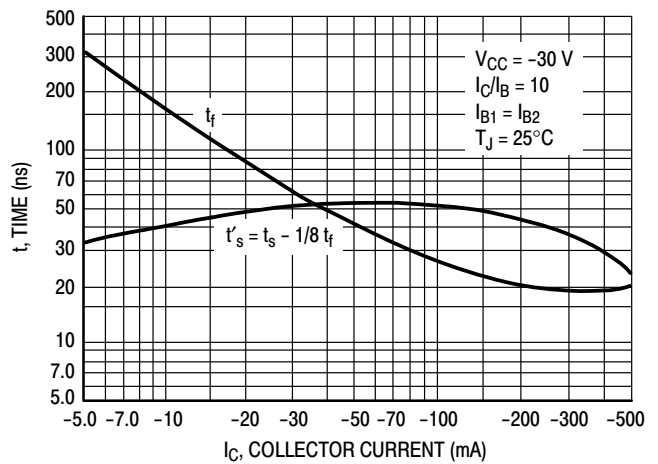


Figure 6. Turn-Off Time

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## TYPICAL SMALL-SIGNAL Characteristics NOISE FIGURE

$V_{CE} = 10 \text{ Vdc}$ ,  $T_A = 25^\circ\text{C}$

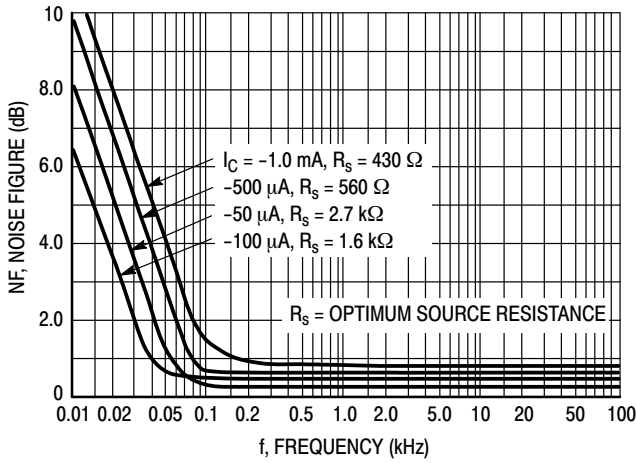


Figure 7. Frequency Effects

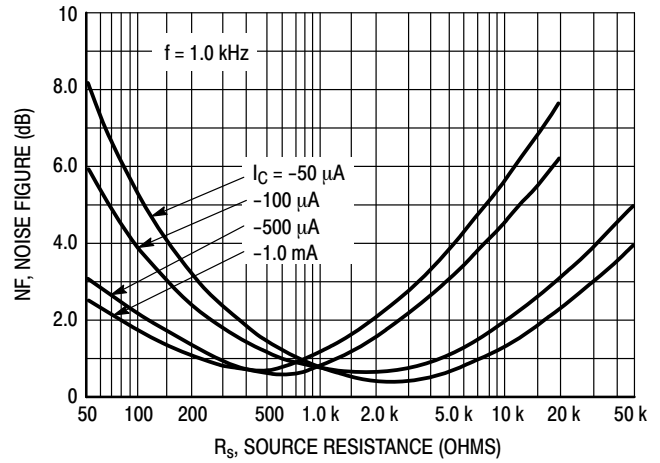


Figure 8. Source Resistance Effects

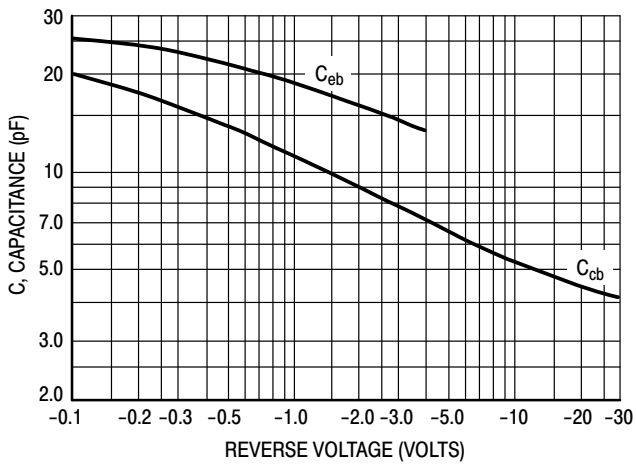


Figure 9. Capacitances

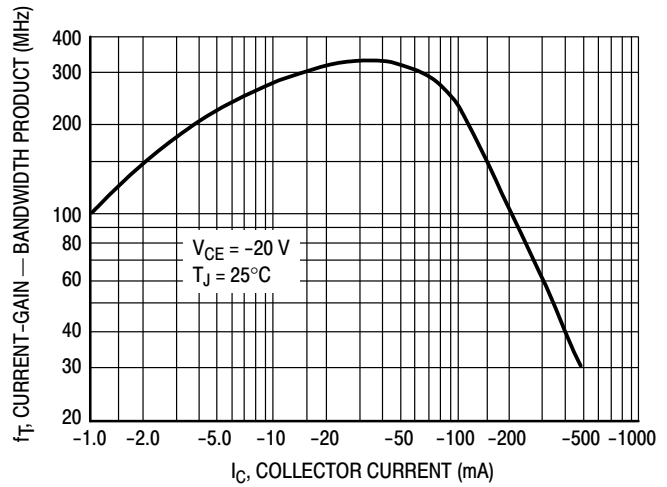


Figure 10. Current-Gain - Bandwidth Product

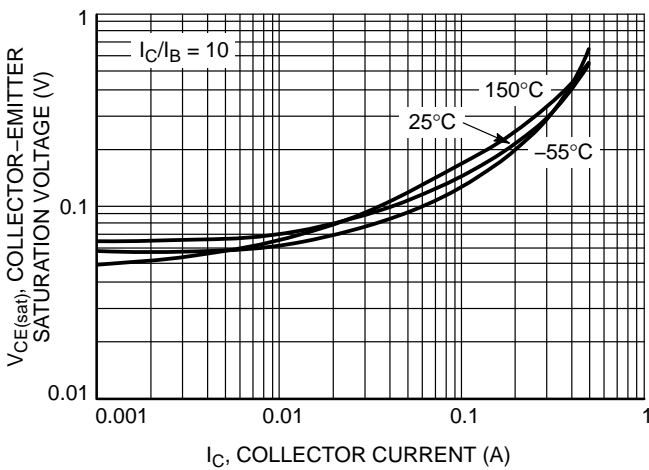


Figure 11. Collector-Emitter Saturation Voltage vs. Collector Current

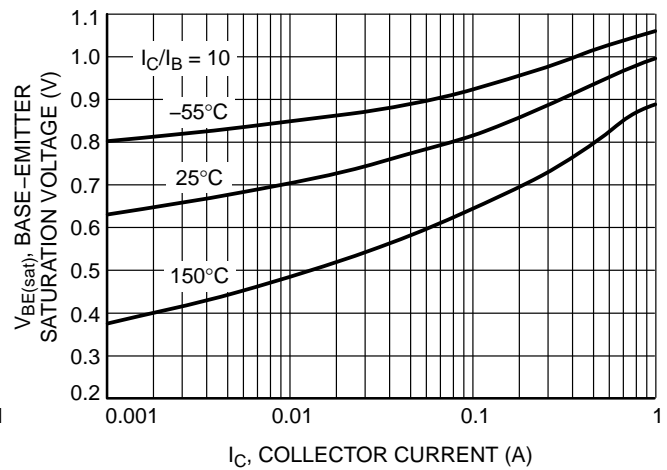
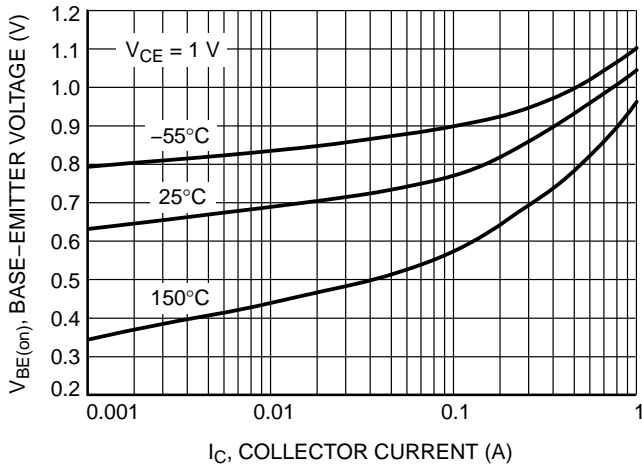


Figure 12. Base-Emitter Saturation Voltage vs. Collector Current

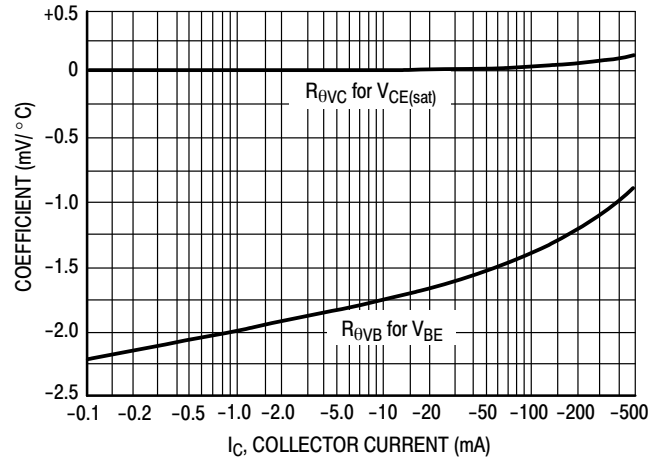
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## TYPICAL SMALL-SIGNAL Characteristics NOISE FIGURE

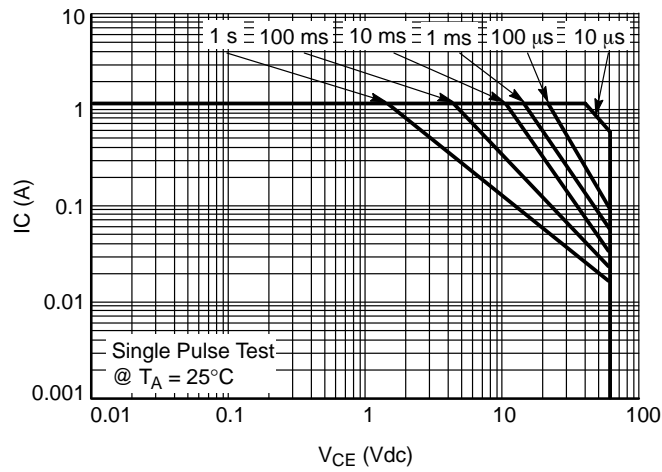
$V_{CE} = 10 \text{ Vdc}$ ,  $T_A = 25^\circ\text{C}$



**Figure 13. Base Emitter Voltage vs. Collector Current**



**Figure 14. Temperature Coefficients**



**Figure 15. Safe Operating Area**

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



**SOT-23 (TO-236)**  
CASE 318  
ISSUE AT

DATE 01 MAR 2023

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 |
| H <sub>E</sub> | 2.10        | 2.40 | 2.64 | 0.083  | 0.094 | 0.104 |
| T              | 0°          | ---  | 10°  | 0°     | ---   | 10°   |

**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.



**RECOMMENDED MOUNTING 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.

**STYLES ON PAGE 2**

|                         |                        |  |
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**MECHANICAL CASE OUTLINE**  
**PACKAGE DIMENSIONS**



**SOT-23 (TO-236)**  
**CASE 318**  
**ISSUE AT**

DATE 01 MAR 2023

- |   |   |   |   |   |   |
|---|---|---|---|---|---|
| STYLE 1 THRU 5:<br>CANCELLED                            | STYLE 6:<br>PIN 1. BASE<br>2. EMITTER<br>3. COLLECTOR | STYLE 7:<br>PIN 1. EMITTER<br>2. BASE<br>3. COLLECTOR       | STYLE 8:<br>PIN 1. ANODE<br>2. NO CONNECTION<br>3. CATHODE  |   |   |
| STYLE 9:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE      | STYLE 10:<br>PIN 1. DRAIN<br>2. SOURCE<br>3. GATE     | STYLE 11:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE-ANODE | STYLE 12:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. ANODE       | STYLE 13:<br>PIN 1. SOURCE<br>2. DRAIN<br>3. GATE           | STYLE 14:<br>PIN 1. CATHODE<br>2. GATE<br>3. ANODE          |
| STYLE 15:<br>PIN 1. GATE<br>2. CATHODE<br>3. ANODE      | STYLE 16:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE | STYLE 17:<br>PIN 1. NO CONNECTION<br>2. ANODE<br>3. CATHODE | STYLE 18:<br>PIN 1. NO CONNECTION<br>2. CATHODE<br>3. ANODE | STYLE 19:<br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE-ANODE | STYLE 20:<br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE          |
| STYLE 21:<br>PIN 1. GATE<br>2. SOURCE<br>3. DRAIN       | STYLE 22:<br>PIN 1. RETURN<br>2. OUTPUT<br>3. INPUT   | STYLE 23:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE         | STYLE 24:<br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE           | STYLE 25:<br>PIN 1. ANODE<br>2. CATHODE<br>3. GATE          | STYLE 26:<br>PIN 1. CATHODE<br>2. ANODE<br>3. NO CONNECTION |
| STYLE 27:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. CATHODE | STYLE 28:<br>PIN 1. ANODE<br>2. ANODE<br>3. ANODE     |   |   |   |   |

|                         |                        |   |
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