

# MJB5742T4G

## NPN Silicon Power Darlington Transistors

The Darlington transistors are designed for high-voltage power switching in inductive circuits.

### Features

- These Devices are Pb-Free and are RoHS Compliant

### Applications

- Small Engine Ignition
- Switching Regulators
- Inverters
- Solenoid and Relay Drivers
- Motor Controls

### MAXIMUM RATINGS

| Rating   | Symbol         | Value       | Unit                     |
|--|----------------|-------------|--------------------------|
| Collector-Emitter Voltage  | $V_{CEO(sus)}$ | 400         | Vdc                      |
| Collector-Emitter Voltage  | $V_{CEV}$      | 800         | Vdc                      |
| Emitter-Base Voltage   | $V_{EB}$       | 8           | Vdc                      |
| Collector Current – Continuous   | $I_C$          | 8           | Adc                      |
| Collector Current – Peak (Note 1)  | $I_{CM}$       | 16          | Adc                      |
| Base Current – Continuous  | $I_B$          | 2.5         | Adc                      |
| Base Current – Peak (Note 1)   | $I_{BM}$       | 5           | Adc                      |
| Total Device Dissipation @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 2<br>0.016  | W<br>W/ $^\circ\text{C}$ |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 100<br>0.8  | W<br>W/ $^\circ\text{C}$ |
| Operating and Storage Junction<br>Temperature Range                                    | $T_J, T_{stg}$ | -65 to +150 | $^\circ\text{C}$         |

### THERMAL CHARACTERISTICS

| Characteristics   | Symbol          | Max  | Unit                      |
|---|-----------------|------|---------------------------|
| Thermal Resistance, Junction-to-Case  | $R_{\theta JC}$ | 1.25 | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Ambient   | $R_{\theta JA}$ | 62.5 | $^\circ\text{C}/\text{W}$ |
| Maximum Lead Temperature for Soldering<br>Purposes 1/8" from Case for 5 Seconds | $T_L$           | 275  | $^\circ\text{C}$          |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

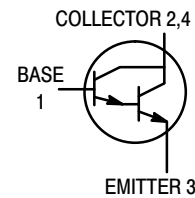
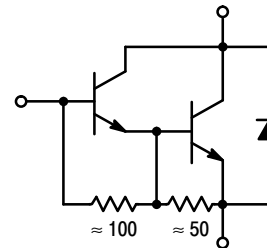
1. Pulse Test: Pulse Width = 5 ms, Duty Cycle  $\leq 10\%$ .



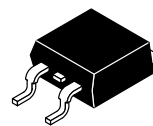
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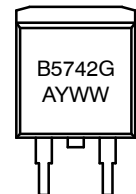
### POWER DARLINGTON TRANSISTORS 8 AMPERES, 400 VOLTS 100 WATTS



### MARKING DIAGRAM



D<sup>2</sup>PAK  
CASE 418B  
STYLE 1



B5742 = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package

### ORDERING INFORMATION

| Device     | Package                         | Shipping†         |
|------------|---------------------------------|-------------------|
| MJB5742T4G | D <sup>2</sup> PAK<br>(Pb-Free) | 800 / 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.

# MJB5742T4G

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS (Note 2)

|   |                       |     |   |        |      |
|---|-----------------------|-----|---|--------|------|
| Collector–Emitter Sustaining Voltage (I <sub>C</sub> = 50 mA, I <sub>B</sub> = 0)   | V <sub>CEO(sus)</sub> | 400 | – | –      | Vdc  |
| Collector Cutoff Current (V <sub>CEV</sub> = Rated Value, V <sub>BE(off)</sub> = 1.5 Vdc)<br>(V <sub>CEV</sub> = Rated Value, V <sub>BE(off)</sub> = 1.5 Vdc, T <sub>C</sub> = 100°C) | I <sub>CEV</sub>      | –   | – | 1<br>5 | mAdc |
| Emitter Cutoff Current (V <sub>EB</sub> = 8 Vdc, I <sub>C</sub> = 0)  | I <sub>EBO</sub>      | –   | – | 75     | mAdc |

### SECOND BREAKDOWN

|   |                  |              |  |  |  |
|---|------------------|--------------|--|--|--|
| Second Breakdown Collector Current with Base Forward Biased | I <sub>S/b</sub> | See Figure 6 |  |  |  |
| Clamped Inductive SOA with Base Reverse Biased              | RBSOA            | See Figure 7 |  |  |  |

### ON CHARACTERISTICS (Note 2)

|   |                      |             |             |                   |     |
|---|----------------------|-------------|-------------|-------------------|-----|
| DC Current Gain (I <sub>C</sub> = 0.5 Adc, V <sub>CE</sub> = 5 Vdc)<br>(I <sub>C</sub> = 4 Adc, V <sub>CE</sub> = 5 Vdc)  | h <sub>FE</sub>      | 50<br>200   | 100<br>400  | –<br>–            | –   |
| Collector–Emitter Saturation Voltage (I <sub>C</sub> = 4 Adc, I <sub>B</sub> = 0.2 Adc)<br>(I <sub>C</sub> = 8 Adc, I <sub>B</sub> = 0.4 Adc)<br>(I <sub>C</sub> = 4 Adc, I <sub>B</sub> = 0.2 Adc, T <sub>C</sub> = 100°C) | V <sub>CE(sat)</sub> | –<br>–<br>– | –<br>–<br>– | 2<br>3<br>2.2     | Vdc |
| Base–Emitter Saturation Voltage (I <sub>C</sub> = 4 Adc, I <sub>B</sub> = 0.2 Adc)<br>(I <sub>C</sub> = 8 Adc, I <sub>B</sub> = 0.4 Adc)<br>(I <sub>C</sub> = 4 Adc, I <sub>B</sub> = 0.2 Adc, T <sub>C</sub> = 100°C)      | V <sub>BE(sat)</sub> | –<br>–<br>– | –<br>–<br>– | 2.5<br>3.5<br>2.4 | Vdc |
| Diode Forward Voltage (Note 3) (I <sub>F</sub> = 5 Adc)   | V <sub>f</sub>       | –           | –           | 2.5               | Vdc |

### SWITCHING CHARACTERISTICS

| Typical Resistive Load (Table 1)  |   |                 |   |      |         |
|-----------------------------------|---|-----------------|---|------|---------|
| Delay Time                        | (V <sub>CC</sub> = 250 Vdc, I <sub>C(pk)</sub> = 6 A<br>I <sub>B1</sub> = I <sub>B2</sub> = 0.25 A, t <sub>p</sub> = 25 μs,<br>Duty Cycle ≤ 1%) | t <sub>d</sub>  | – | 0.04 | –<br>μs |
| Rise Time                         |   | t <sub>r</sub>  | – | 0.5  | –<br>μs |
| Storage Time                      |   | t <sub>s</sub>  | – | 8    | –<br>μs |
| Fall Time                         |   | t <sub>f</sub>  | – | 2    | –<br>μs |
| Inductive Load, Clamped (Table 1) |   |                 |   |      |         |
| Voltage Storage Time              | (I <sub>C(pk)</sub> = 6 A, V <sub>CE(pk)</sub> = 250 Vdc<br>I <sub>B1</sub> = 0.06 A, V <sub>BE(off)</sub> = 5 Vdc)                             | t <sub>sv</sub> | – | 4    | –<br>μs |
| Crossover Time                    |   | t <sub>c</sub>  | – | 2    | –<br>μs |

2. Pulse Test: Pulse Width 300 μs, Duty Cycle = 2%.

3. The internal Collector–to–Emitter diode can eliminate the need for an external diode to clamp inductive loads. Tests have shown that the Forward Recovery Voltage (V<sub>f</sub>) of this diode is comparable to that of typical fast recovery rectifiers.

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## TYPICAL CHARACTERISTICS

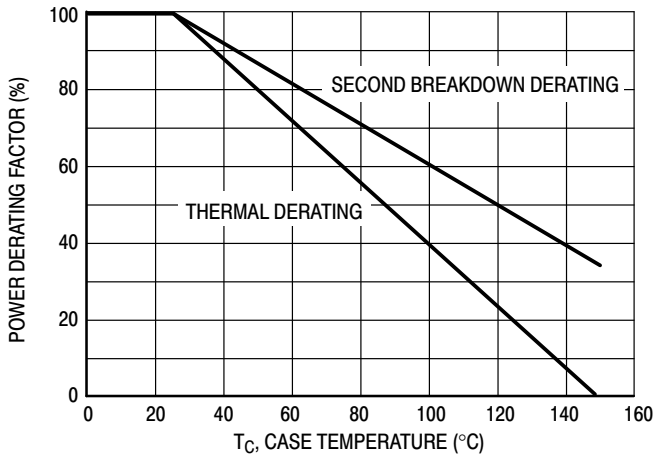


Figure 1. Power Derating

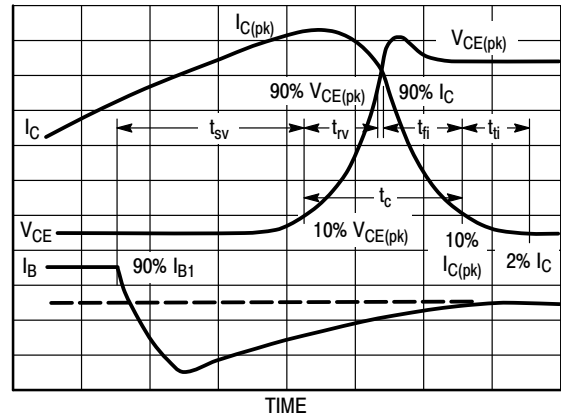


Figure 2. Inductive Switching Measurements

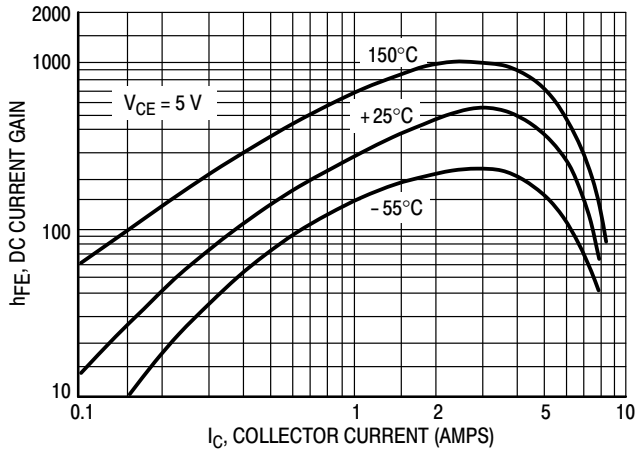


Figure 3. DC Current Gain

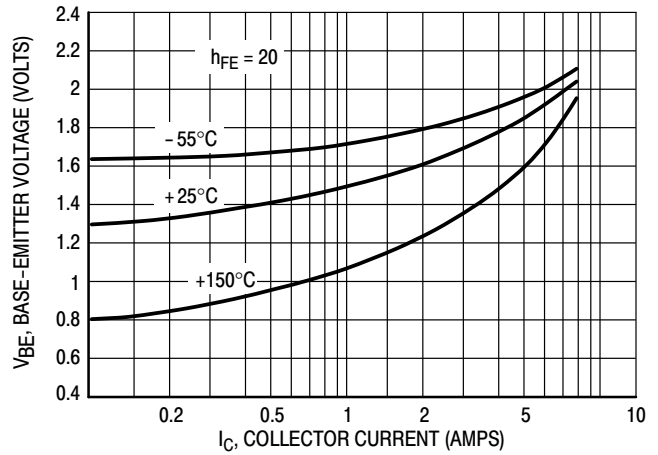


Figure 4. Base-Emitter Voltage

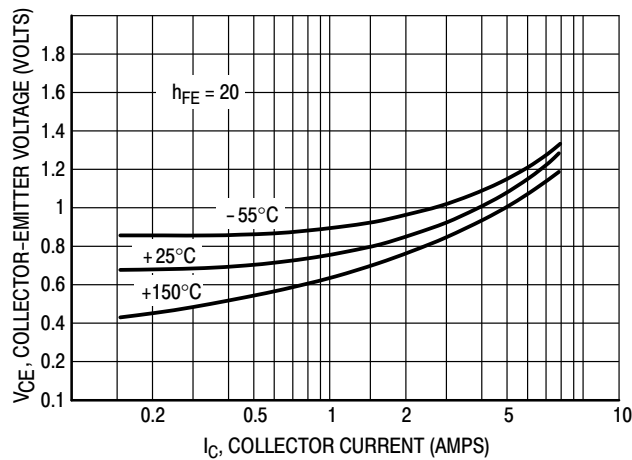


Figure 5. Collector-Emitter Saturation Voltage

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Table 1. Test Conditions for Dynamic Performance

| REVERSE BIAS SAFE OPERATING AREA AND INDUCTIVE SWITCHING |   | RESISTIVE SWITCHING  |
|--|---|--|
| TEST CIRCUITS  | <p>DUTY CYCLE <math>\leq 10\%</math><br/> <math>t_r, t_f \leq 10 \text{ ns}</math></p> <p>NOTE:<br/> PW and <math>V_{CC}</math> Adjusted for Desired <math>I_C</math><br/> <math>R_B</math> Adjusted for Desired <math>I_{B1}</math></p>  | <p>*SELECTED FOR <math>\geq 1 \text{ kV}</math></p>  |
| CIRCUIT VALUES   | <p>COIL DATA:<br/> FERROXCUBE CORE #6656<br/> FULL BOBBIN (~16 TURNS) #16</p> <p>GAP FOR 200 <math>\mu\text{H}/20 \text{ A}</math><br/> <math>L_{\text{coil}} = 200 \mu\text{H}</math></p> <p><math>V_{CC} = 30 \text{ V}</math><br/> <math>V_{CE(\text{pk})} = 250 \text{ Vdc}</math><br/> <math>I_{C(\text{pk})} = 6 \text{ A}</math></p> | <p><math>V_{CC} = 250 \text{ V}</math><br/> <math>D1 = 1\text{N}5820 \text{ OR EQUIV.}</math></p>  |
| TEST WAVEFORMS   | <p>OUTPUT WAVEFORMS</p> <p><math>t_1</math> ADJUSTED TO OBTAIN <math>I_C</math></p> $t_1 \approx \frac{L_{\text{coil}} (I_{C(\text{pk})})}{V_{CC}}$ <p>TEST EQUIPMENT<br/> SCOPE-TEKTRONICS 475 OR EQUIVALENT</p> $t_2 \approx \frac{L_{\text{coil}} (I_{C(\text{pk})})}{V_{\text{clamp}}}$   | <p><math>t_r, t_f &lt; 10 \text{ ns}</math><br/> DUTY CYCLE = 1%<br/> <math>R_B</math> AND <math>R_C</math> ADJUSTED FOR DESIRED <math>I_B</math> AND <math>I_C</math></p> |

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## SAFE OPERATING AREA INFORMATION

### FORWARD BIAS

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate  $I_C - V_{CE}$  limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 6 is based on  $T_C = 25^\circ\text{C}$ ;  $T_{J(pk)}$  is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated when  $T_C \geq 25^\circ\text{C}$ . Second breakdown limitations do not derate the same as thermal limitations. Allowable current at the voltages shown on Figure 6 may be found at any case temperature by using the appropriate curve on Figure 1.

### REVERSE BIAS

For inductive loads, high voltage and high current must be sustained simultaneously during turn-off, in most cases, with the base to emitter junction reverse biased. Under these conditions the collector voltage must be held to a safe level at or below a specific value of collector current. This can be accomplished by several means such as active clamping, RC snubbing, load line shaping, etc. The safe level for these devices is specified as Reverse Bias Safe Operating Area and represents the voltage-current condition allowable during reverse biased turnoff. This rating is verified under clamped conditions so that the device is never subjected to an avalanche mode. Figure 7 gives the complete RBSOA characteristics.

The Safe Operating Area figures shown in Figures 6 and 7 are specified ratings for these devices under the test conditions shown.

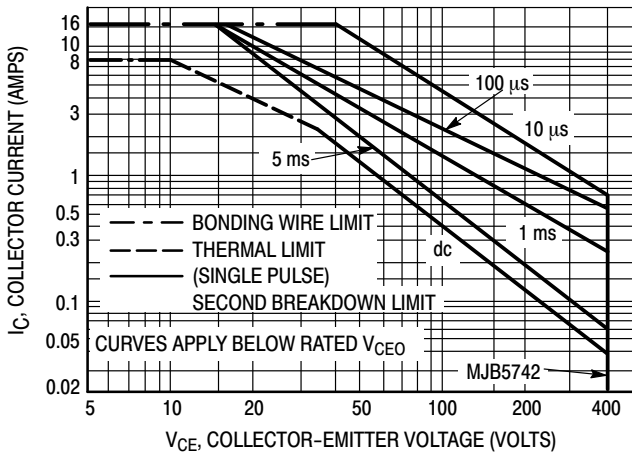


Figure 6. Forward Bias Safe Operating Area

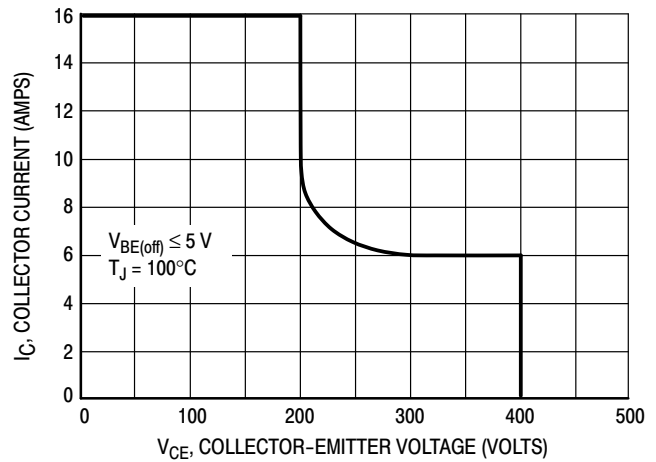


Figure 7. Reverse Bias Safe Operating Area

## RESISTIVE SWITCHING PERFORMANCE

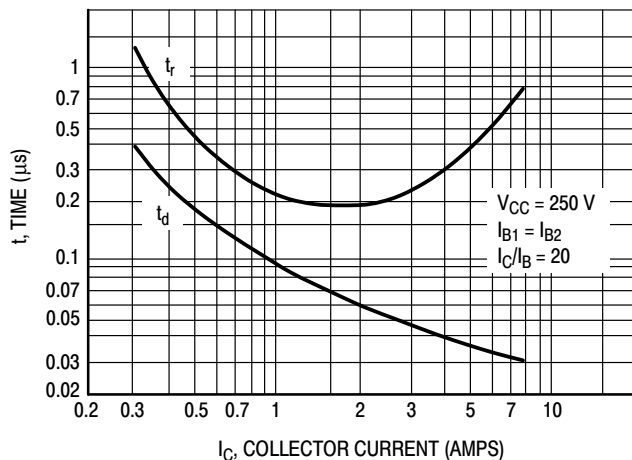


Figure 8. Turn-On Time

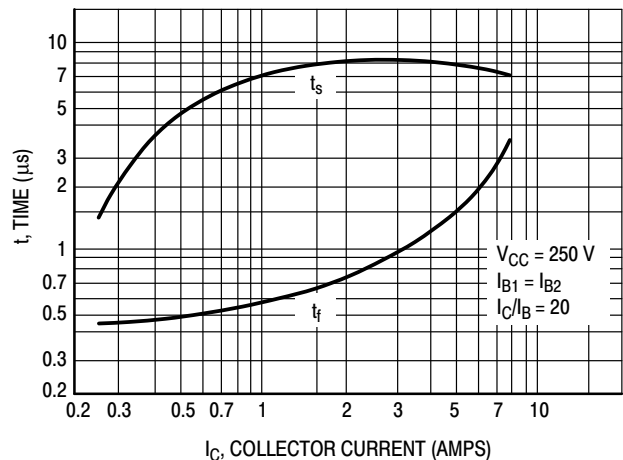
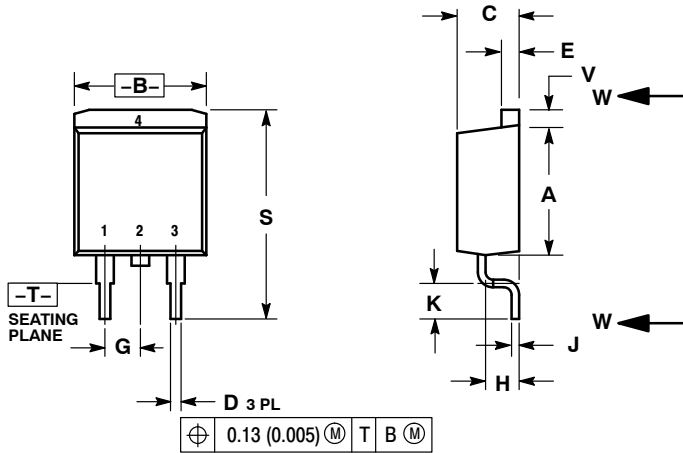


Figure 9. Turn-Off Time

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## PACKAGE DIMENSIONS

D<sup>2</sup>PAK 3  
CASE 418B-04  
ISSUE K



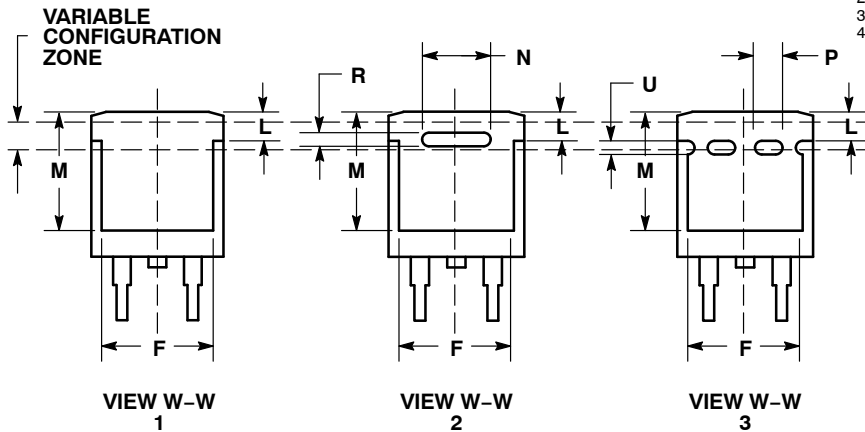
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 418B-01 THRU 418B-03 OBSOLETE, NEW STANDARD 418B-04.

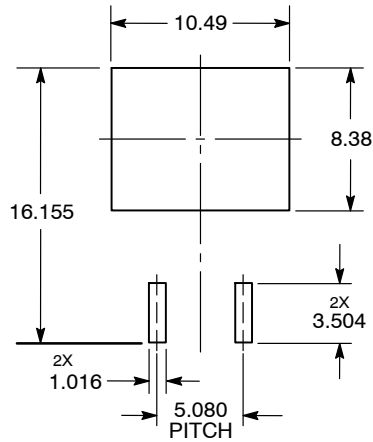
| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.340     | 0.380 | 8.64        | 9.65  |
| B   | 0.380     | 0.405 | 9.65        | 10.29 |
| C   | 0.160     | 0.190 | 4.06        | 4.83  |
| D   | 0.020     | 0.035 | 0.51        | 0.89  |
| E   | 0.045     | 0.055 | 1.14        | 1.40  |
| F   | 0.310     | 0.350 | 7.87        | 8.89  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.080     | 0.110 | 2.03        | 2.79  |
| J   | 0.018     | 0.025 | 0.46        | 0.64  |
| K   | 0.090     | 0.110 | 2.29        | 2.79  |
| L   | 0.052     | 0.072 | 1.32        | 1.83  |
| M   | 0.280     | 0.320 | 7.11        | 8.13  |
| N   | 0.197 REF |       | 5.00 REF    |       |
| P   | 0.079 REF |       | 2.00 REF    |       |
| R   | 0.039 REF |       | 0.99 REF    |       |
| S   | 0.575     | 0.625 | 14.60       | 15.88 |
| V   | 0.045     | 0.055 | 1.14        | 1.40  |

STYLE 1:

- PIN 1. BASE
- COLLECTOR
- EMITTER
- COLLECTOR




### SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*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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