

# Complementary Power Transistors

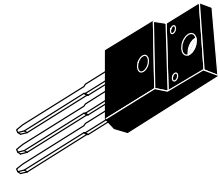
## For Isolated Package Applications

Designed for general-purpose amplifier and switching applications, where the mounting surface of the device is required to be electrically isolated from the heatsink or chassis.

- Electrically Similar to the Popular MJE15030 and MJE15031
- 150 V<sub>CEO(sus)</sub>
- 8 A Rated Collector Current
- No Isolating Washers Required
- Reduced System Cost
- High Current Gain-Bandwidth Product  
f<sub>T</sub> = 30 MHz (Min) @ I<sub>C</sub> = 500 mAdc
- UL Recognized, File #E69369, to 3500 V<sub>RMS</sub> Isolation

**NPN**  
**MJF15030**  
**PNP**  
**MJF15031**

**COMPLEMENTARY**  
**SILICON**  
**POWER TRANSISTORS**  
**8 AMPERES**  
**150 VOLTS**  
**36 WATTS**



**CASE 221D-02**  
**TO-220 TYPE**

### MAXIMUM RATINGS

| Rating   | Symbol                            | Value                | Unit             |
|--|-----------------------------------|----------------------|------------------|
| Collector-Emitter Voltage  | V <sub>CEO</sub>                  | 150                  | Vdc              |
| Collector-Base Voltage   | V <sub>CB</sub>                   | 150                  | Vdc              |
| Emitter-Base Voltage   | V <sub>EB</sub>                   | 5                    | Vdc              |
| RMS Isolation Voltage (1)<br>(for 1 sec, R.H. < 30%,<br>T <sub>A</sub> = 25°C) | V <sub>ISOL</sub>                 | 4500<br>3500<br>1500 | V <sub>RMS</sub> |
| Collector Current — Continuous<br>— Peak                                       | I <sub>C</sub>                    | 8<br>16              | Adc              |
| Base Current   | I <sub>B</sub>                    | 2                    | Adc              |
| Total Power Dissipation* @ T <sub>C</sub> = 25°C<br>Derate above 25°C          | P <sub>D</sub>                    | 36<br>0.29           | Watts<br>W/°C    |
| Total Power Dissipation @ T <sub>A</sub> = 25°C<br>Derate above 25°C           | P <sub>D</sub>                    | 2<br>0.016           | Watts<br>W/°C    |
| Operating and Storage Junction Temperature Range                               | T <sub>J</sub> , T <sub>stg</sub> | -65 to +150          | °C               |

### THERMAL CHARACTERISTICS

| Characteristic                          | Symbol           | Max  | Unit |
|---|------------------|------|------|
| Thermal Resistance, Junction to Ambient | R <sub>θJA</sub> | 62.5 | °C/W |
| Thermal Resistance, Junction to Case*   | R <sub>θJC</sub> | 3.5  | °C/W |
| Lead Temperature for Soldering Purpose  | T <sub>L</sub>   | 260  | °C   |

\* Measurement made with thermocouple contacting the bottom insulated mounting surface (in a location beneath the die), the device mounted on a heatsink with thermal grease and a mounting torque of ≥ 6 in. lbs.

(1) Proper strike and creepage distance must be provided.

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

| Characteristic  | Symbol         | Min | Max | Unit            |
|---|----------------|-----|-----|-----------------|
| <b>OFF CHARACTERISTICS</b>  |                |     |     |                 |
| Collector–Emitter Sustaining Voltage (1) ( $I_C = 10\text{ mAdc}$ , $I_B = 0$ ) | $V_{CEO(sus)}$ | 150 | —   | Vdc             |
| Collector Cutoff Current ( $V_{CE} = 150\text{ Vdc}$ , $I_B = 0$ )              | $I_{CEO}$      | —   | 10  | $\mu\text{Adc}$ |
| Collector Cutoff Current ( $V_{CB} = 150\text{ Vdc}$ , $I_E = 0$ )              | $I_{CBO}$      | —   | 10  | $\mu\text{Adc}$ |
| Emitter Cutoff Current ( $V_{BE} = 5\text{ Vdc}$ , $I_C = 0$ )                  | $I_{EBO}$      | —   | 10  | $\mu\text{Adc}$ |

**ON CHARACTERISTICS (1)**

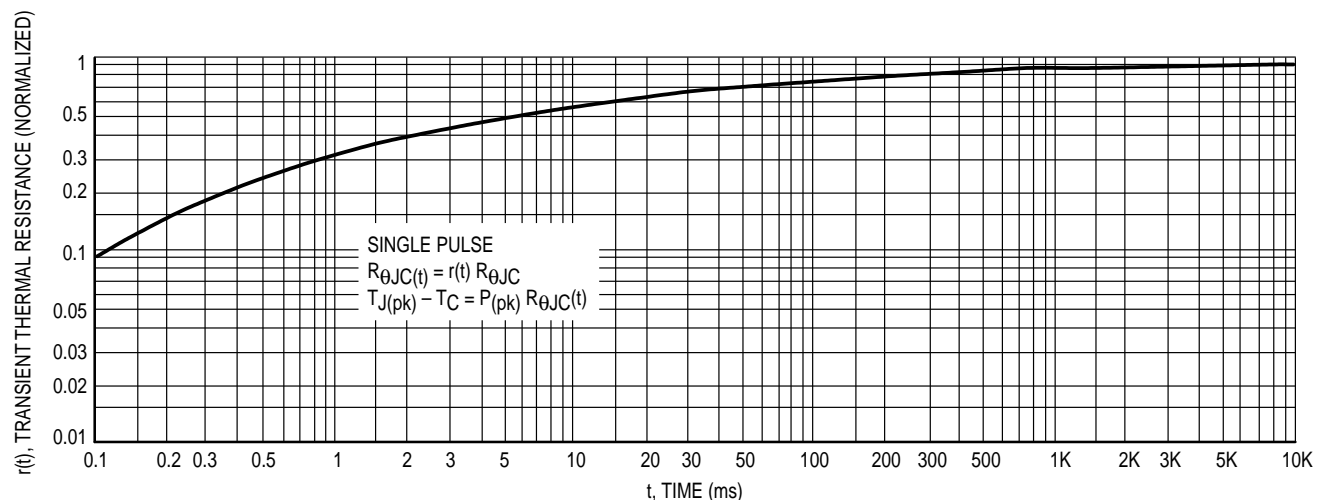
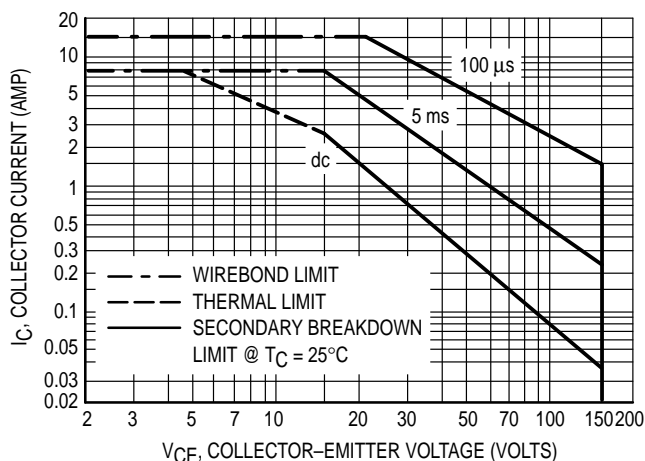
|  |               |  |                  |     |
|--|---------------|--|------------------|-----|
| DC Current Gain ( $I_C = 0.1\text{ Adc}$ , $V_{CE} = 2\text{ Vdc}$ )<br>( $I_C = 2\text{ Adc}$ , $V_{CE} = 2\text{ Vdc}$ )<br>( $I_C = 3\text{ Adc}$ , $V_{CE} = 2\text{ Vdc}$ )<br>( $I_C = 4\text{ Adc}$ , $V_{CE} = 2\text{ Vdc}$ ) | $h_{FE}$      | 40<br>40<br>40<br>20                     | —<br>—<br>—<br>— | —   |
| DC Current Gain Linearity<br>( $V_{CE}$ from 2 V to 20 V, $I_C$ from 0.1 A to 3 A) (NPN to PNP)  | $h_{FE}$      | <div>Typ</div> <div>2</div> <div>3</div> |                  |     |
| Collector–Emitter Saturation Voltage ( $I_C = 1\text{ Adc}$ , $I_B = 0.1\text{ Adc}$ )   | $V_{CE(sat)}$ | —  | 0.5              | Vdc |
| Base–Emitter On Voltage ( $I_C = 1\text{ Adc}$ , $V_{CE} = 2\text{ Vdc}$ )   | $V_{BE(on)}$  | —  | 1                | Vdc |

**DYNAMIC CHARACTERISTICS**

|  |       |    |   |     |
|--|-------|----|---|-----|
| Current Gain–Bandwidth Product (2) ( $I_C = 500\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f_{test} = 10\text{ MHz}$ ) | $f_T$ | 30 | — | MHz |
|--|-------|----|---|-----|

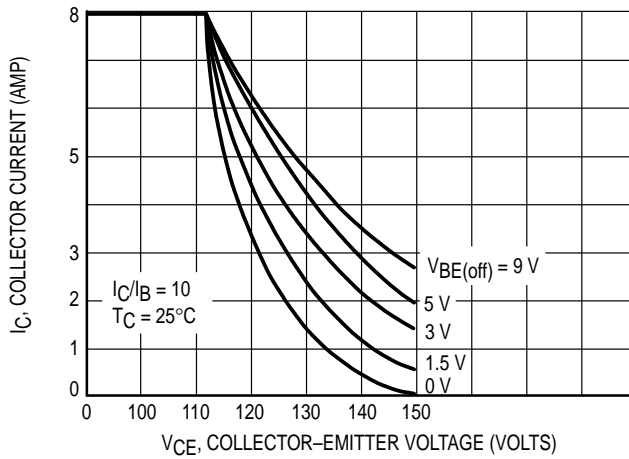
**NOTES:**

1. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
2.  $f_T = |h_{fe}| \cdot f_{test}$ .

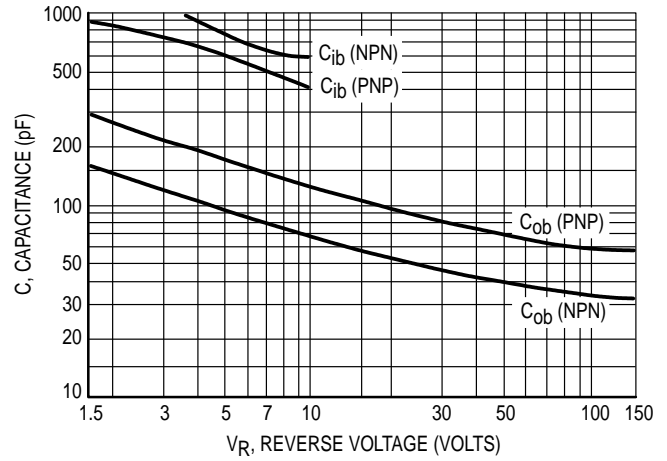

**Figure 1. Thermal Response**

**Figure 2. Forward Bias Safe Operating Area**

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.

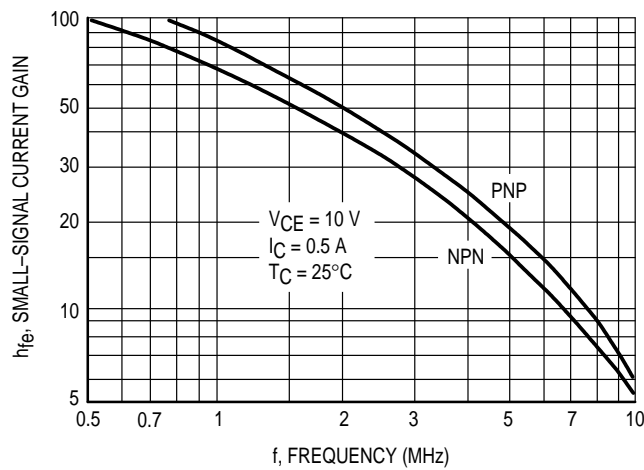
The data of Figures 2 and 3 is based on  $T_{J(pk)} = 150^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(pk)} < 150^\circ\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 1. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.



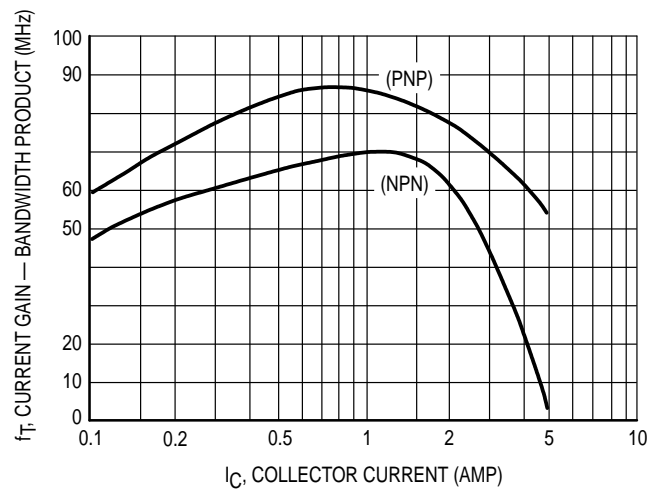
**Figure 3. Reverse Bias Switching Safe Operating Area**



**Figure 4. Capacitances**

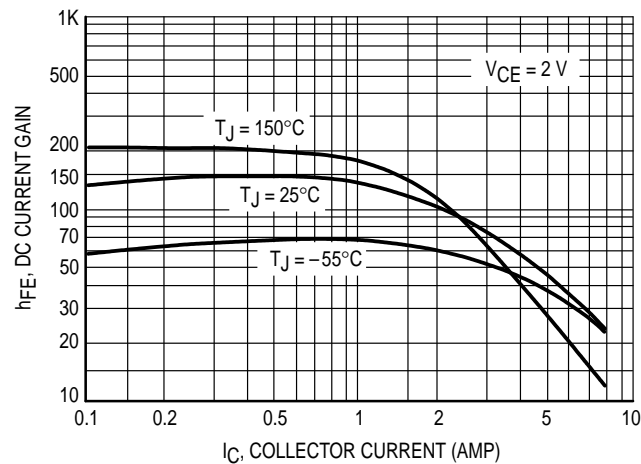


**Figure 5. Small-Signal Current Gain**

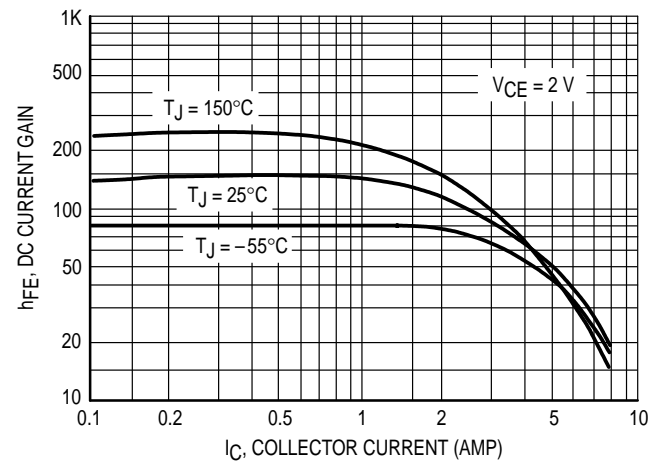


**Figure 6. Current Gain — Bandwidth Product**

## DC CURRENT GAIN



**Figure 7a. MJF15030 NPN**



**Figure 7b. MJF15031 PNP**

## “ON” VOLTAGE

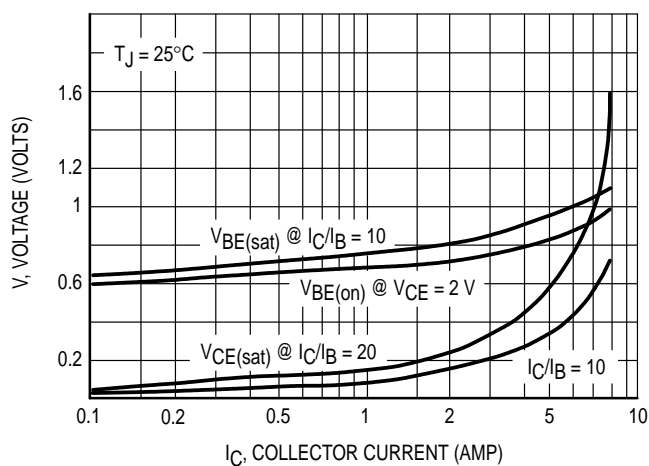


Figure 8a. MJF15030 NPN

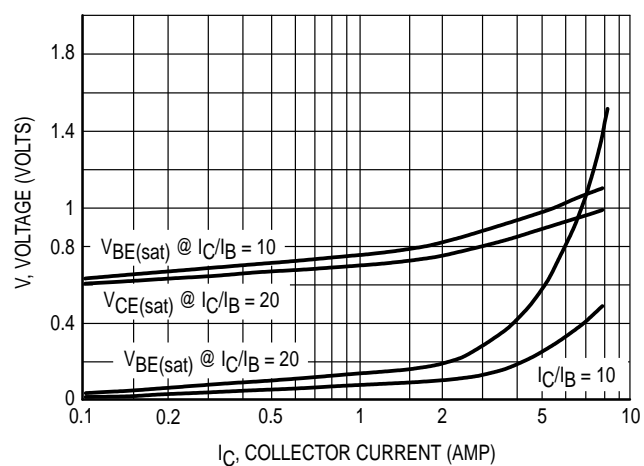


Figure 8b. MJF15031 PNP

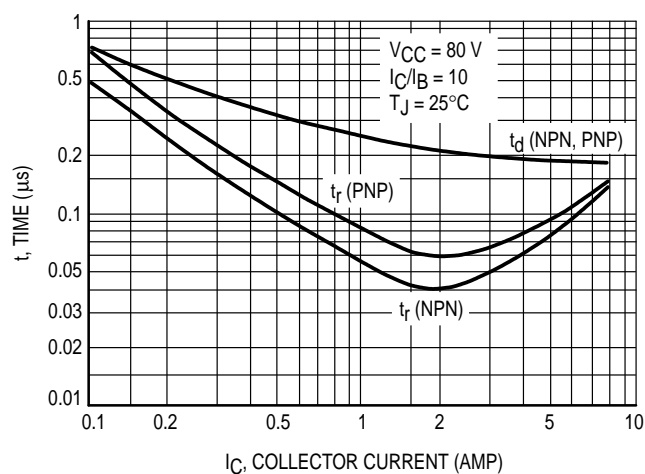


Figure 9. Turn-On Times

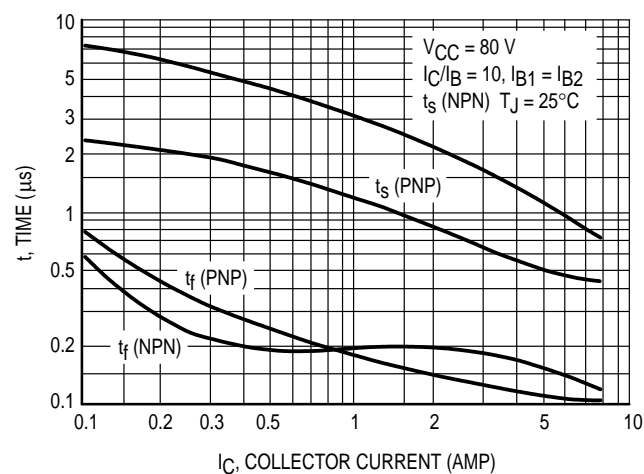
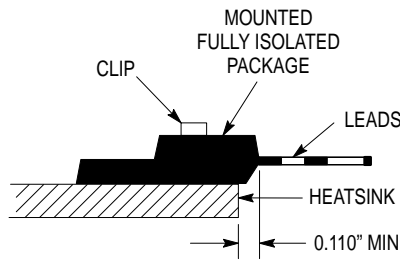
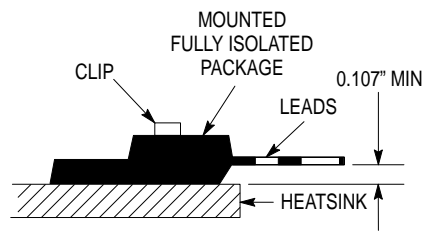


Figure 10. Turn-Off Times

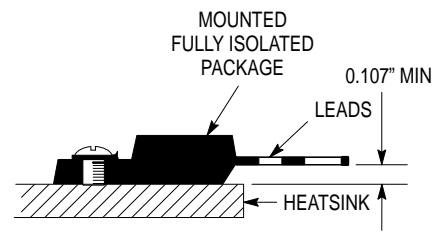
## TEST CONDITIONS FOR ISOLATION TESTS\*



**Figure 11. Clip Mounting Position for Isolation Test Number 1**



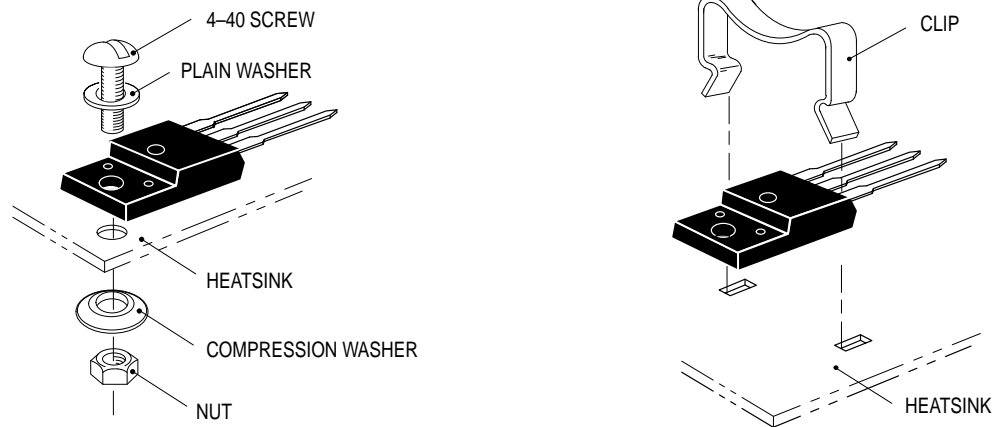
**Figure 12. Clip Mounting Position for Isolation Test Number 2**



**Figure 13. Screw Mounting Position for Isolation Test Number 3**

\* Measurement made between leads and heatsink with all leads shorted together

## MOUNTING INFORMATION



**Figure 14. Typical Mounting Techniques\***

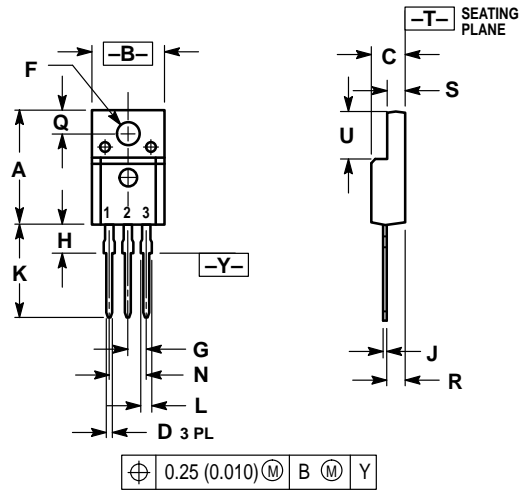
Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time and during large temperature excursions.

Destructive laboratory tests show that using a hex head 4-40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

Additional tests on slotted 4-40 screws indicate that the screw slot fails between 15 to 20 in · lbs without adversely affecting the package. However, in order to positively ensure the package integrity of the fully isolated device, Motorola does not recommend exceeding 10 in · lbs of mounting torque under any mounting conditions.

\*\* For more information about mounting power semiconductors see Application Note AN1040.

PACKAGE DIMENSIONS




- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.621     | 0.629 | 15.78       | 15.97 |
| B   | 0.394     | 0.402 | 10.01       | 10.21 |
| C   | 0.181     | 0.189 | 4.60        | 4.80  |
| D   | 0.026     | 0.034 | 0.67        | 0.86  |
| F   | 0.121     | 0.129 | 3.08        | 3.27  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.123     | 0.129 | 3.13        | 3.27  |
| J   | 0.018     | 0.025 | 0.46        | 0.64  |
| K   | 0.500     | 0.562 | 12.70       | 14.27 |
| L   | 0.045     | 0.060 | 1.14        | 1.52  |
| N   | 0.200 BSC |       | 5.08 BSC    |       |
| Q   | 0.126     | 0.134 | 3.21        | 3.40  |
| R   | 0.107     | 0.111 | 2.72        | 2.81  |
| S   | 0.096     | 0.104 | 2.44        | 2.64  |
| U   | 0.259     | 0.267 | 6.58        | 6.78  |

- STYLE 2:
- PIN 1. BASE
  - COLLECTOR
  - EMITTER

CASE 221D-02  
TO-220 TYPE  
ISSUE D

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