

# Complementary Power Darlington

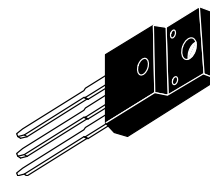
## For Isolated Package Applications

Designed for general-purpose amplifiers 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 TIP122 and TIP127
- 100 V<sub>CEO(sus)</sub>
- 5 A Rated Collector Current
- No Isolating Washers Required
- Reduced System Cost
- High DC Current Gain — 2000 (Min) @ I<sub>C</sub> = 3 Adc
- UL Recognized, File #E69369, to 3500 V<sub>RMS</sub> Isolation

**NPN**  
**MJF122**  
**PNP**  
**MJF127**

**COMPLEMENTARY**  
**SILICON**  
**POWER DARLINGTONS**  
**5 AMPERES**  
**100 VOLTS**  
**30 WATTS**



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

### MAXIMUM RATINGS

| Rating                                                                         | Symbol                            | Value                | Unit             |
|--------------------------------------------------------------------------------|-----------------------------------|----------------------|------------------|
| Collector-Emitter Voltage                                                      | V <sub>CEO</sub>                  | 100                  | Vdc              |
| Collector-Base Voltage                                                         | V <sub>CB</sub>                   | 100                  | 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>                    | 5<br>8               | Adc              |
| Base Current                                                                   | I <sub>B</sub>                    | 0.12                 | Adc              |
| Total Power Dissipation* @ T <sub>C</sub> = 25°C<br>Derate above 25°C          | P <sub>D</sub>                    | 30<br>0.24           | 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          | I <sub>C</sub>   |

### 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> | 4.1  | °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.

# MJF122 MJF127

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

| Characteristic                                                                            | Symbol                | Min | Max | Unit |
|-------------------------------------------------------------------------------------------|-----------------------|-----|-----|------|
| <b>OFF CHARACTERISTICS</b>                                                                |                       |     |     |      |
| Collector–Emitter Sustaining Voltage (1)<br>(I <sub>C</sub> = 100 mA, I <sub>B</sub> = 0) | V <sub>CEO(sus)</sub> | 100 | —   | Vdc  |
| Collector Cutoff Current<br>(V <sub>CE</sub> = 50 Vdc, I <sub>B</sub> = 0)                | I <sub>CEO</sub>      | —   | 10  | μAdc |
| Collector Cutoff Current<br>(V <sub>CB</sub> = 100 Vdc, I <sub>E</sub> = 0)               | I <sub>CBO</sub>      | —   | 10  | μAdc |
| Emitter Cutoff Current (V <sub>BE</sub> = 5 Vdc, I <sub>C</sub> = 0)                      | I <sub>EBO</sub>      | —   | 2   | mA   |

## ON CHARACTERISTICS (1)

|                                                                                                                                           |                      |              |          |     |
|-------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------|----------|-----|
| DC Current Gain (I <sub>C</sub> = 0.5 Adc, V <sub>CE</sub> = 3 Vdc)<br>(I <sub>C</sub> = 3 Adc, V <sub>CE</sub> = 3 Vdc)                  | h <sub>FE</sub>      | 1000<br>2000 | —        | —   |
| Collector–Emitter Saturation Voltage (I <sub>C</sub> = 3 Adc, I <sub>B</sub> = 12 mA)<br>(I <sub>C</sub> = 5 Adc, I <sub>B</sub> = 20 mA) | V <sub>CE(sat)</sub> | —            | 2<br>3.5 | Vdc |
| Base–Emitter On Voltage (I <sub>C</sub> = 3 Adc, V <sub>CE</sub> = 3 Vdc)                                                                 | V <sub>BE(on)</sub>  | —            | 2.5      | Vdc |

## DYNAMIC CHARACTERISTICS

|                                                                                        |                                     |   |            |    |
|----------------------------------------------------------------------------------------|-------------------------------------|---|------------|----|
| Small–Signal Current Gain (I <sub>C</sub> = 3 Adc, V <sub>CE</sub> = 4 Vdc, f = 1 MHz) | h <sub>fe</sub>                     | 4 | —          | —  |
| Output Capacitance<br>(V <sub>CB</sub> = 10 Vdc, I <sub>E</sub> = 0, f = 0.1 MHz)      | MJF127<br>MJF122<br>C <sub>ob</sub> | — | 300<br>200 | pF |

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

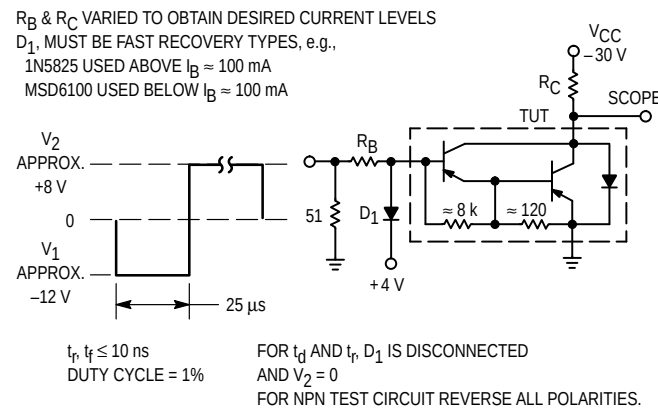


Figure 1. Switching Times Test Circuit

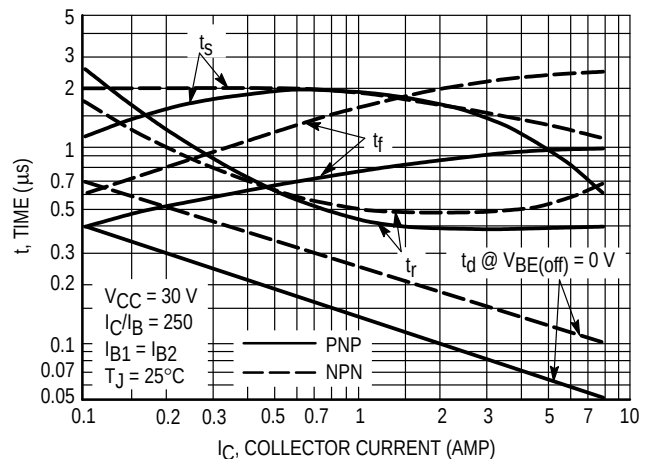


Figure 2. Typical Switching Times

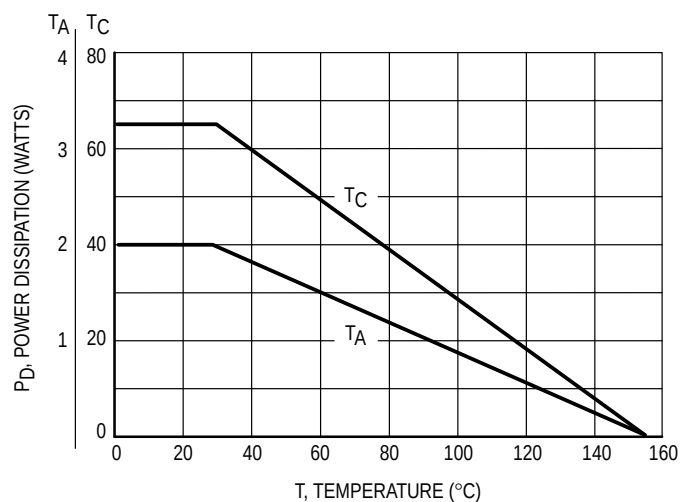


Figure 3. Maximum Power Derating

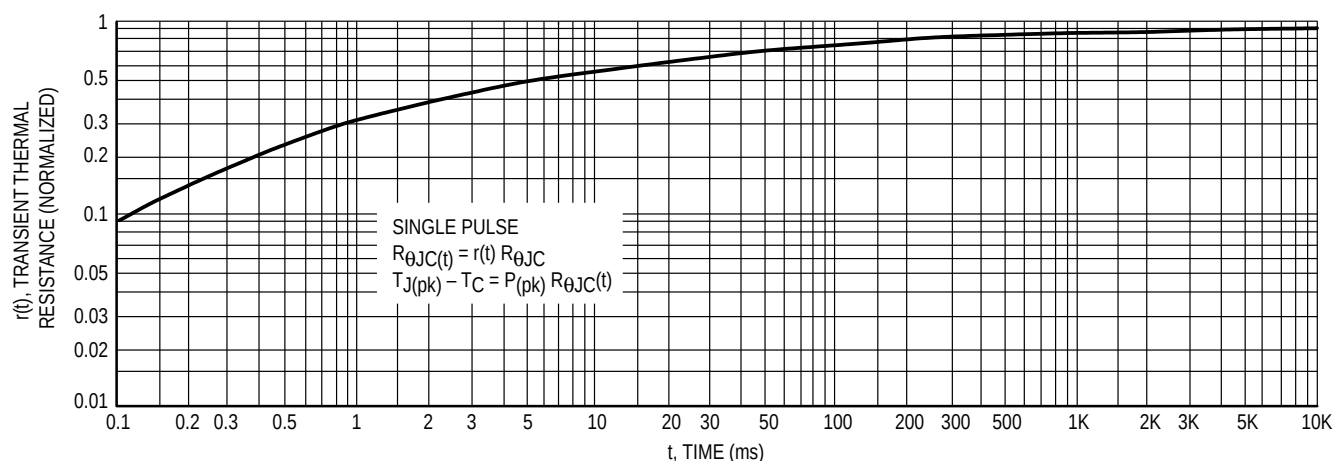
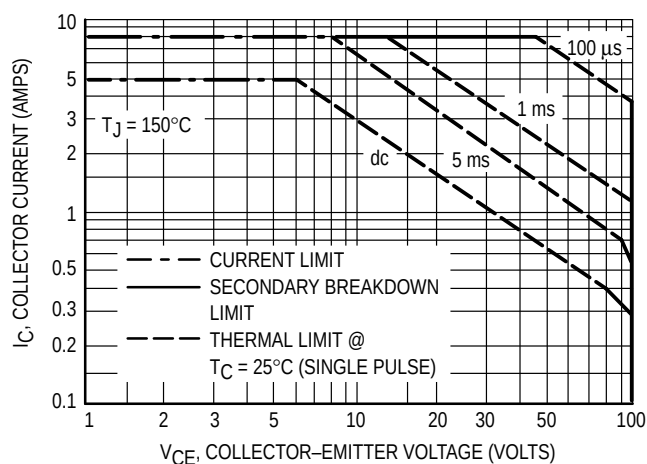


Figure 4. Thermal Response

Figure 5. Maximum 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 Figure 5 is based on  $T_{J(pk)} = 150^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. Secondary 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 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by secondary breakdown.

## MJF122 MJF127

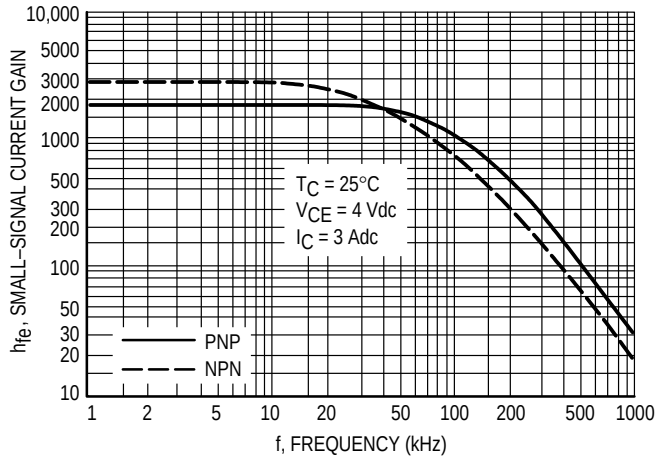


Figure 6. Typical Small-Signal Current Gain

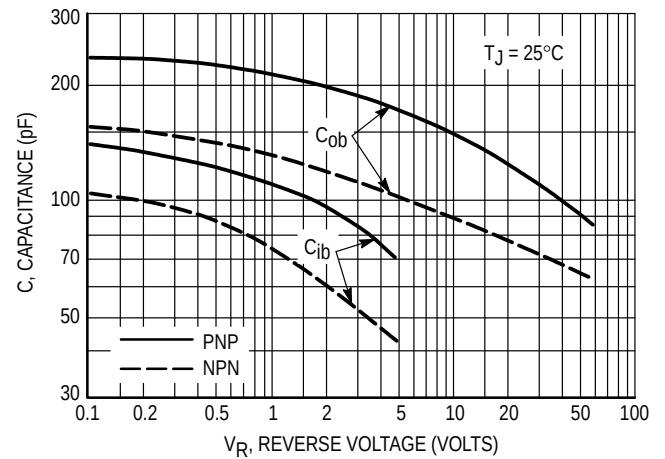


Figure 7. Typical Capacitance

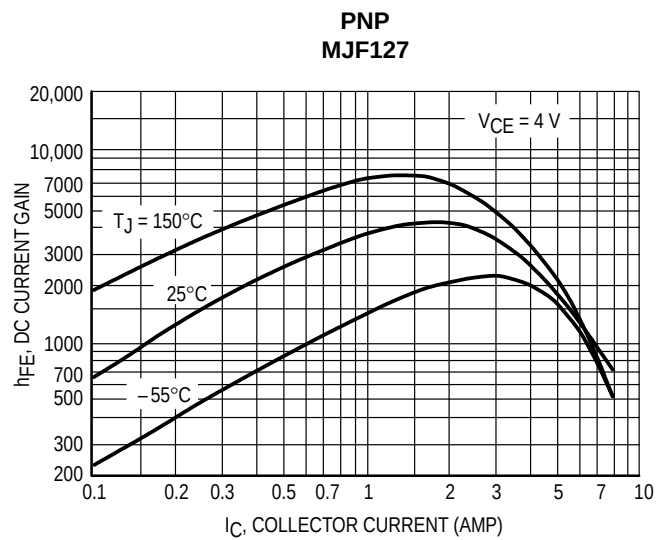
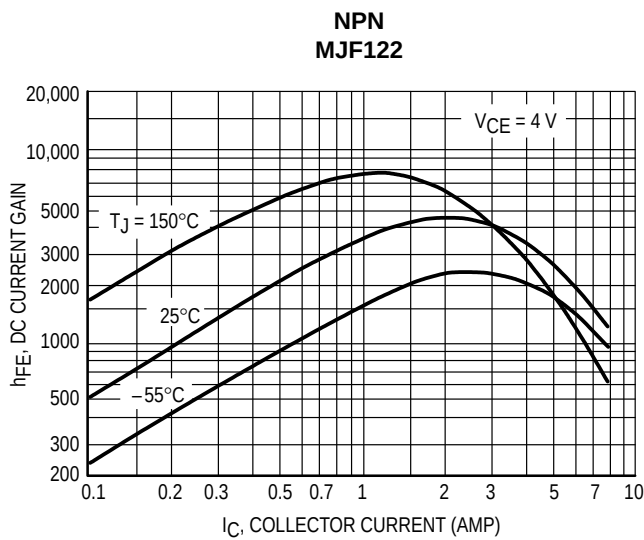


Figure 8. Typical DC Current Gain

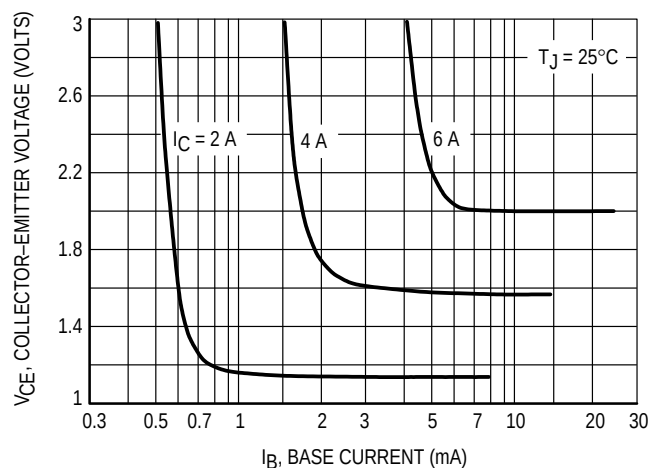
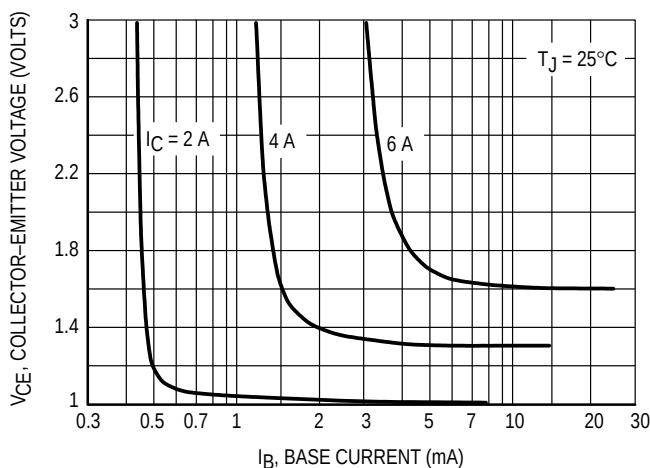


Figure 9. Typical Collector Saturation Region

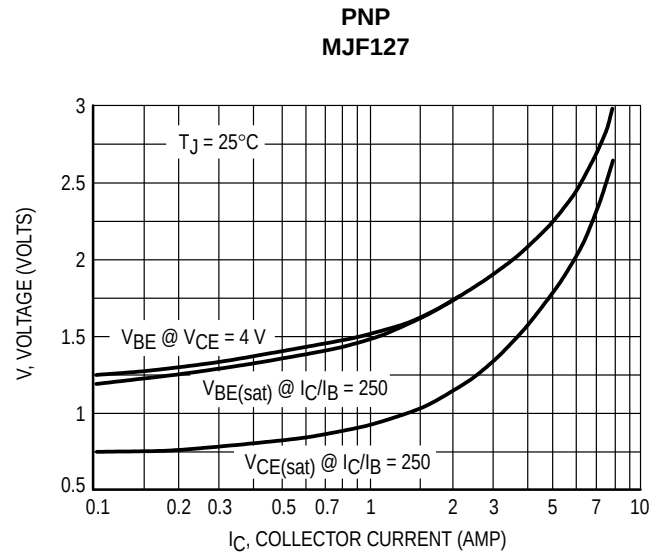
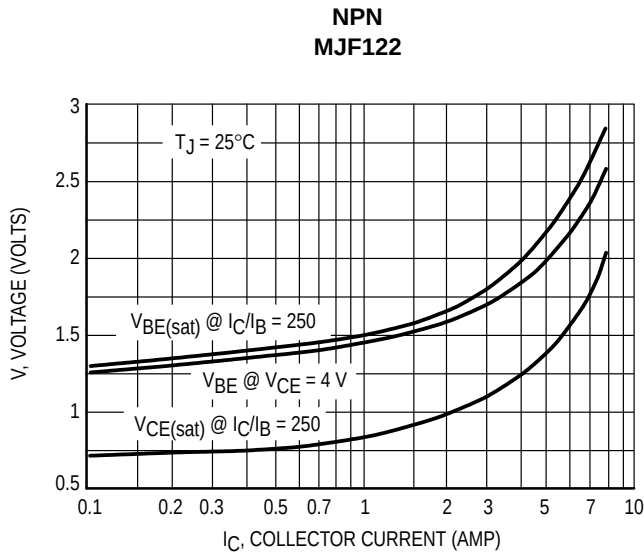


Figure 10. Typical "On" Voltages

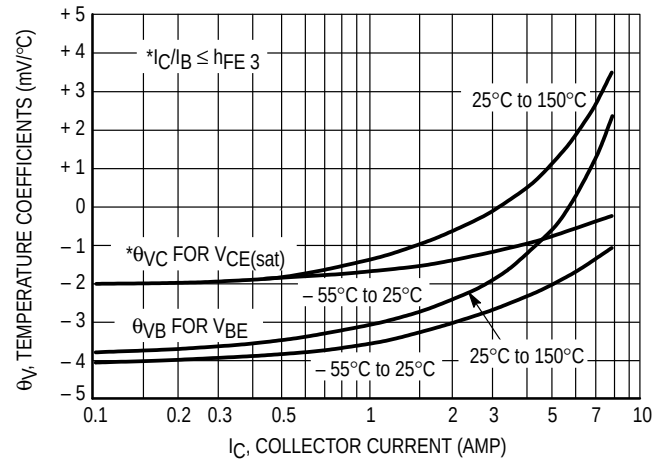
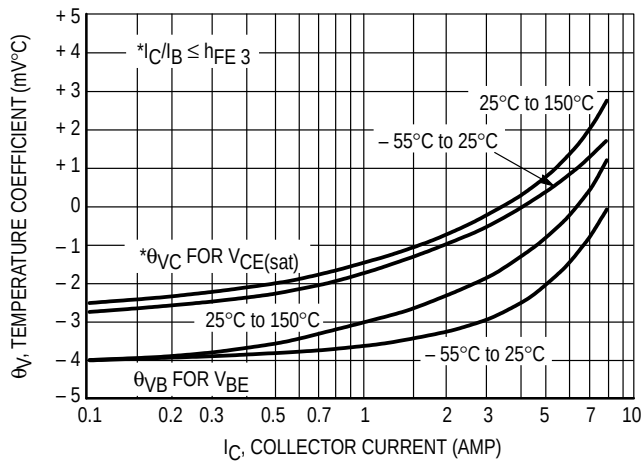


Figure 11. Typical Temperature Coefficients

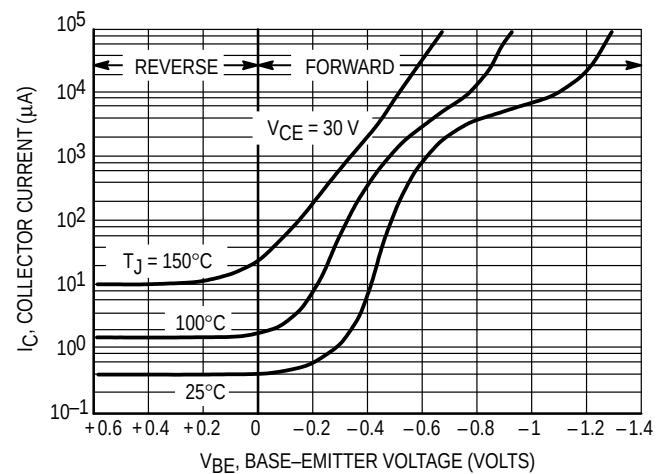
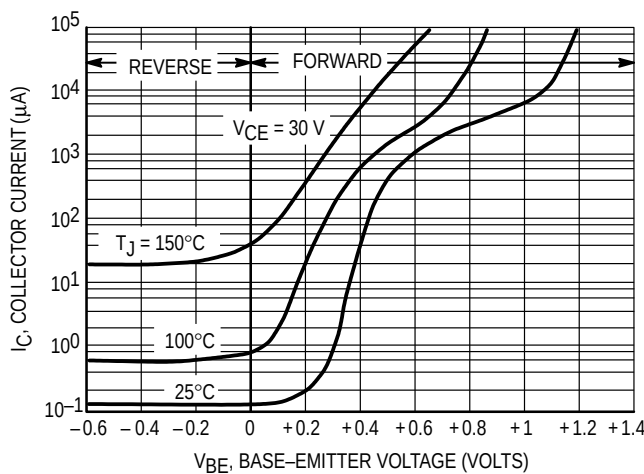


Figure 12. Typical Collector Cut-Off Region

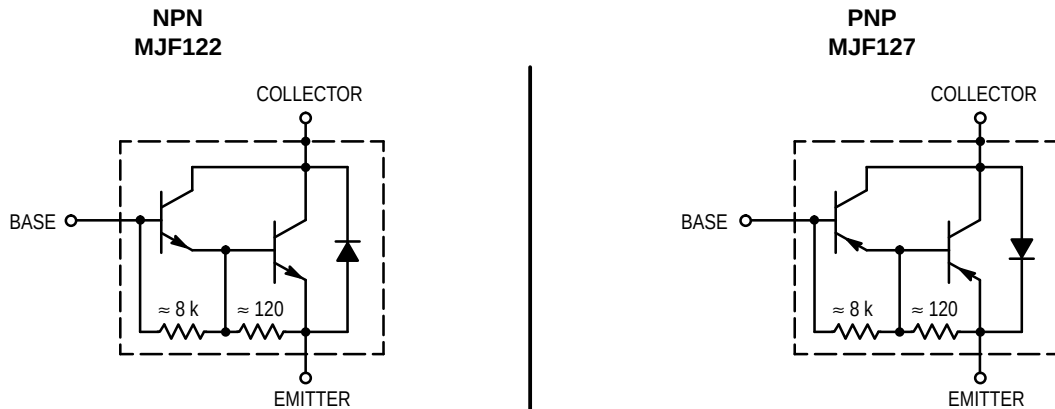


Figure 13. Darlington Schematic

### TEST CONDITIONS FOR ISOLATION TESTS\*

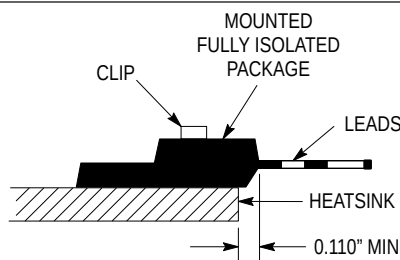


Figure 14. Clip Mounting Position for Isolation Test Number 1

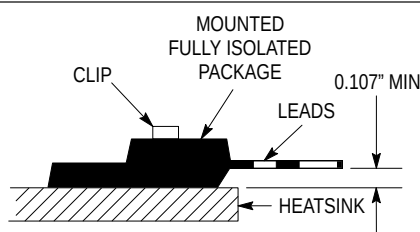


Figure 15. Clip Mounting Position for Isolation Test Number 2

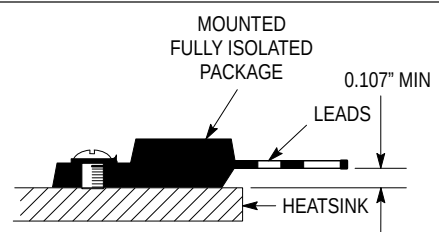


Figure 16. Screw Mounting Position for Isolation Test Number 3

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

### MOUNTING INFORMATION

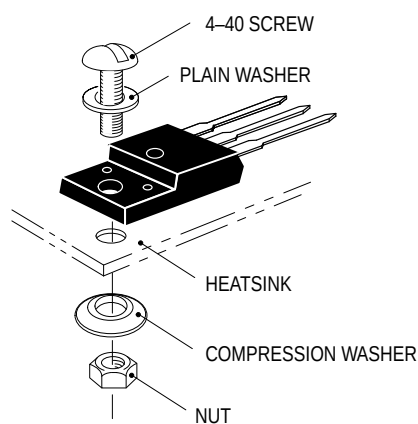


Figure 17. Typical Mounting Techniques\*

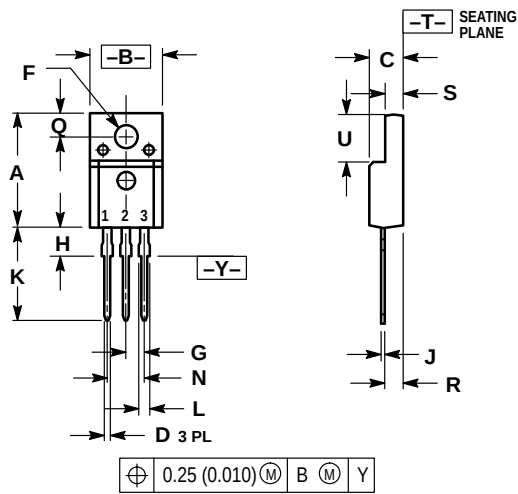
Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time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