# MJF6388 (NPN), MJF6668 (PNP)

**Preferred Device**

# Complementary Power Darlingtons

## 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.

### Features

- Isolated Overmold Package, TO−220 Type
- Electrically Similar to the Popular 2N6388, 2N6668, TIP102, and TIP107
- 100 $V_{CEO(sus)}$
- 10 A Rated Collector Current
- No Isolating Washers Required
- Reduced System Cost
- High DC Current Gain − 1000 (Min) @ $I_C$ = 5.0 Adc
- High Isolation Voltage (up to 4500 VRMS)
- Case 221D is UL Recognized at 3500 VRMS: File #E69369
- Pb−Free Packages are Available*

### MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector−Emitter Voltage | $V_{CEO}$ | 100 | Vdc |
| Collector−Base Voltage | $V_{CB}$ | 100 | Vdc |
| Emitter−Base Voltage | $V_{EB}$ | 5.0 | Vdc |
| RMS Isolation Voltage (Note 1)<br>Test No. 1 Per Figure 14<br>Test No. 2 Per Figure 15<br>Test No. 3 Per Figure 16<br>(for 1 sec, R.H. < 30%, $T_A$ = 25°C) | $V_{ISOL}$ | <br>4500<br>3500<br>1500 | V |
| Collector Current − Continuous<br>− Peak (Note 2) | $I_C$ | 10<br>15 | Adc |
| Base Current − Continuous | $I_B$ | 1.0 | Adc |
| Total Power Dissipation (Note 3) @ $T_C$ = 25°C<br>Derate above 25°C | $P_D$ | 40<br>0.31 | W<br>W/°C |
| Total Power Dissipation @ $T_A$ = 25°C<br>Derate above 25°C | $P_D$ | 2.0<br>0.016 | W<br>W/°C |
| Operating and Storage Temperature Range | $T_J$, $T_{stg}$ | −65 to +150 | °C |

### THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction−to−Case (Note 3) | $R_{\theta JC}$ | 4.0 | °C/W |
| Thermal Resistance, Junction−to−Ambient | $R_{\theta JA}$ | 62.5 | °C/W |
| Lead Temperature for Soldering Purposes | $T_L$ | 260 | °C |

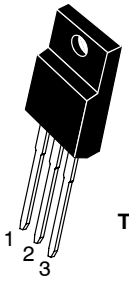
Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. Proper strike and creepage distance must be provided.
2. Pulse Test: Pulse Width = 5.0 ms, Duty Cycle ≤ 10%.
3. Measurement made with thermocouple contacting the bottom insulated surface (in a location beneath the die), the devices mounted on a heatsink with thermal grease and a mounting torque of ≥ 6 in. lbs.

**ON Semiconductor®**

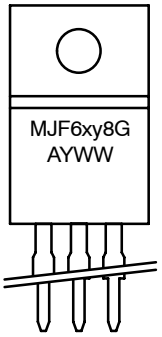
**http://onsemi.com**

## COMPLEMENTARY SILICON POWER DARLINGTONS 10 AMPERES 100 VOLTS, 40 WATTS




**TO−220 FULLPACK**
**CASE 221D**
**STYLE 2**
**UL RECOGNIZED**

**MARKING DIAGRAM**




MJF6xy8 = Specific Device Code
x = 3 or 6
y = 6 or 8
G = Pb−Free Package
A = Assembly Location
Y = Year
WW = Work Week

### ORDERING INFORMATION

| Device | Package | Shipping |
|---|---|---|
| MJF6388 | TO−220 FULLPACK | 50 Units/Rail |
| MJF6388G | TO−220 FULLPACK (Pb−Free) | 50 Units/Rail |
| MJF6668 | TO−220 FULLPACK | 50 Units/Rail |
| MJF6668G | TO−220 FULLPACK (Pb−Free) | 50 Units/Rail |

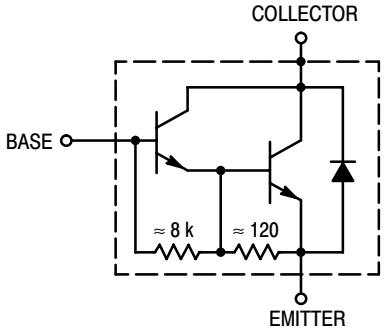
*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

**ELECTRICAL CHARACTERISTICS** ($T_C$ = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | |
| Collector−Emitter Sustaining Voltage (Note 4) ($I_C$ = 30 mAdc, $I_B$ = 0) | $V_{CEO(sus)}$ | 100 | – | Vdc |
| Collector Cutoff Current ($V_{CE}$ = 80 Vdc, $I_B$ = 0) | $I_{CEO}$ | – | 10 | μAdc |
| Collector Cutoff Current ($V_{CE}$ = 100 Vdc, $V_{EB(off)}$ = 1.5 Vdc)<br>($V_{CE}$ = 100 Vdc, $V_{EB(off)}$ = 1.5 Vdc, $T_C$ = 125°C) | $I_{CEX}$ | –<br>– | 10<br>3.0 | μAdc<br>mAdc |
| Collector Cutoff Current ($V_{CB}$ = 100 Vdc, $I_E$ = 0) | $I_{CBO}$ | – | 10 | μAdc |
| Emitter Cutoff Current ($V_{BE}$ = 5.0 Vdc, $I_C$ = 0) | $I_{EBO}$ | – | 2.0 | mAdc |
| **ON CHARACTERISTICS** (Note 4) | | | | |
| DC Current Gain ($I_C$ = 3.0 Adc, $V_{CE}$ = 4.0 Vdc)<br>($I_C$ = 5.0 Adc, $V_{CE}$ = 3.0 Vdc)<br>($I_C$ = 8.0 Adc, $V_{CE}$ = 4.0 Vdc)<br>($I_C$ = 10 Adc, $V_{CE}$ = 3.0 Vdc) | $h_{FE}$ | 3000<br>1000<br>200<br>100 | 15000<br>–<br>–<br>– | – |
| Collector−Emitter Saturation Voltage ($I_C$ = 3.0 Adc, $I_B$ = 6.0 mAdc)<br>($I_C$ = 5.0 Adc, $I_B$ = 0.01 Adc)<br>($I_C$ = 8.0 Adc, $I_B$ = 80 mAdc)<br>($I_C$ = 10 Adc, $I_B$ = 0.1 Adc) | $V_{CE(sat)}$ | –<br>–<br>–<br>– | 2.0<br>2.0<br>2.5<br>3.0 | Vdc |
| Base−Emitter Saturation Voltage ($I_C$ = 5.0 Adc, $I_B$ = 0.01 Adc)<br>($I_C$ = 10 Adc, $I_B$ = 0.1 Adc) | $V_{BE(sat)}$ | –<br>– | 2.8<br>4.5 | Vdc |
| Base−Emitter On Voltage ($I_C$ = 8.0 Adc, $V_{CE}$ = 4.0 Vdc) | $V_{BE(on)}$ | – | 2.5 | Vdc |
| **DYNAMIC CHARACTERISTICS** | | | | |
| Small−Signal Current Gain ($I_C$ = 1.0 Adc, $V_{CE}$ = 5.0 Vdc, $f_{test}$ = 1.0 MHz) | $\|h_{fe}\|$ | 20 | – | – |
| Output Capacitance ($V_{CB}$ = 10 Vdc, $I_E$ = 0, f = 1.0 MHz) MJF6388<br>MJF6668 | $C_{ob}$ | – | 200<br>300 | pF |
| Insulation Capacitance (Collector−to−External Heatsink) | $C_{c-hs}$ | – | 3.0 Typ | pF |
| Small−Signal Current Gain ($I_C$ = 1.0 Adc, $V_{CE}$ = 5.0 Vdc, f = 1.0 kHz) | $h_{fe}$ | 1000 | – | – |

4. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

**NPN**
**MJF6388**




**PNP**
**MJF6668**

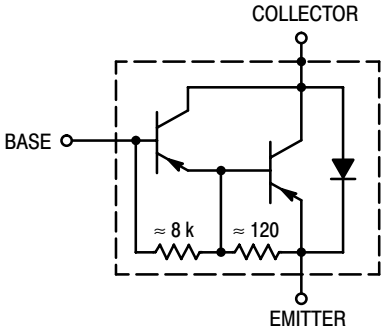



**Figure 1. Darlington Schematic**

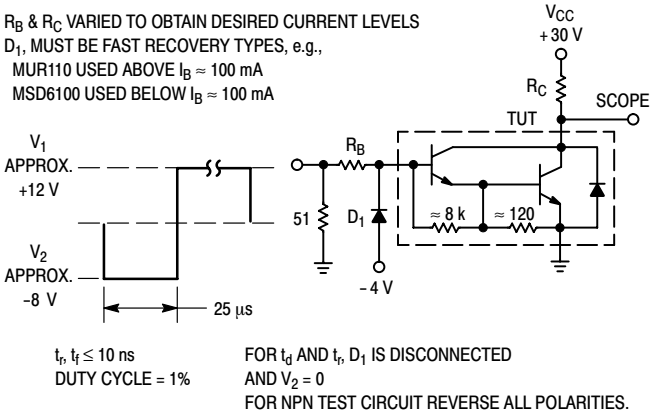
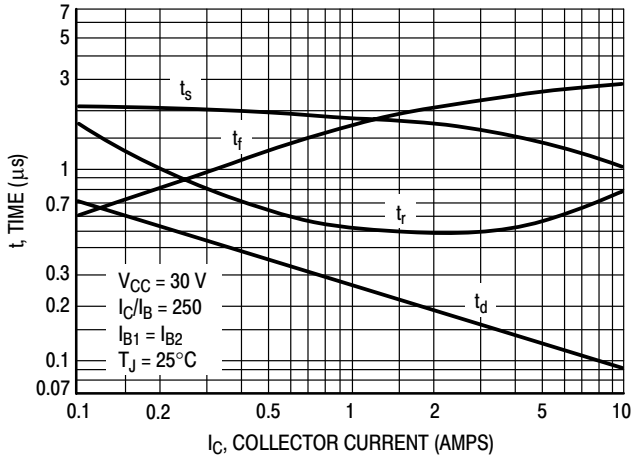



**Figure 2. Switching Times Test Circuit**

**NPN**
**MJF6388**

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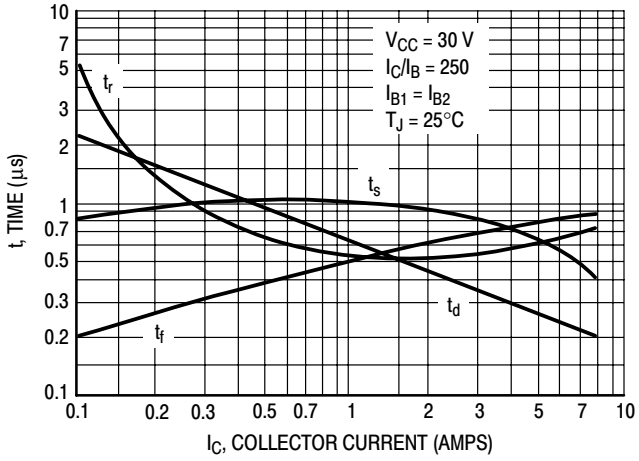


**Figure 3. Typical Switching Times**

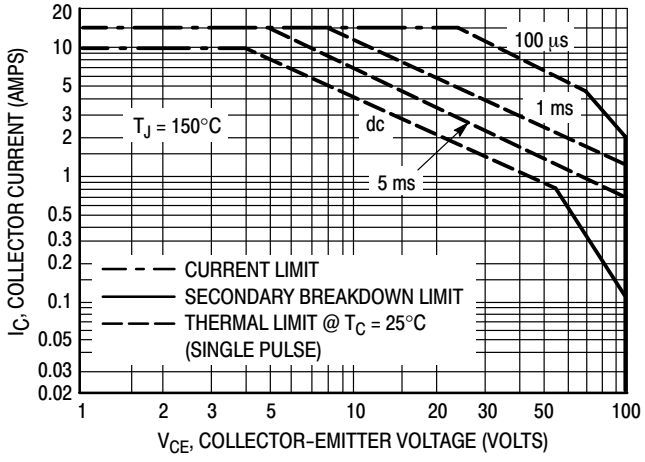


**Figure 4. Maximum Forward Bias Safe Operating Area**

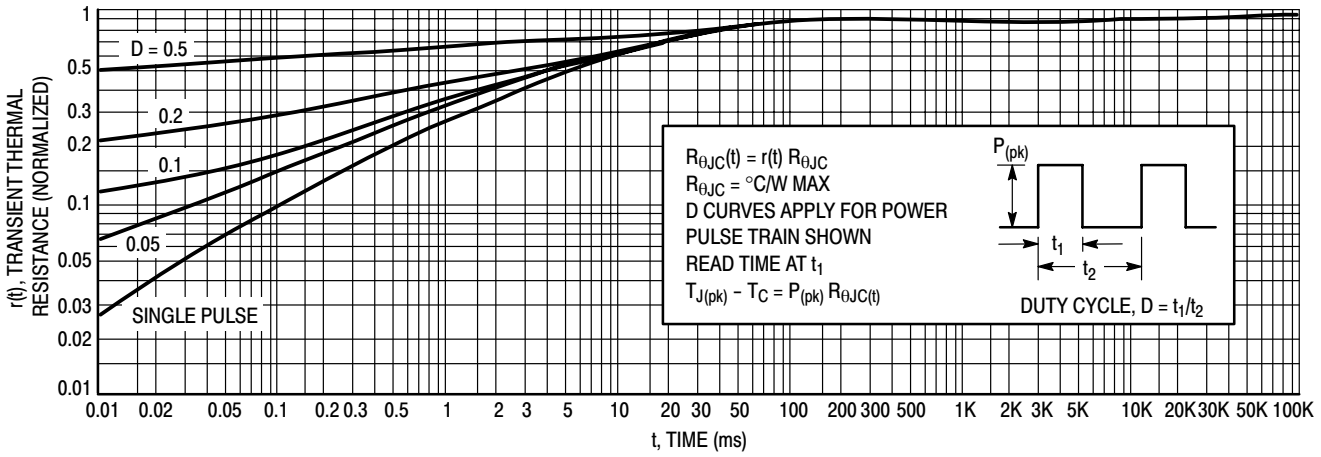


**Figure 5. Thermal Response**

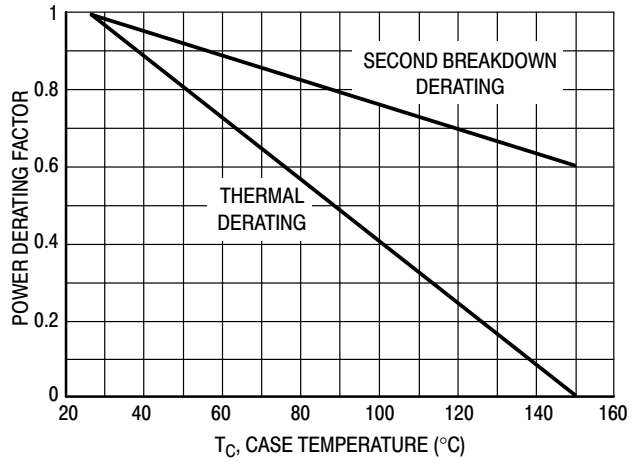


**Figure 6. Maximum Power Derating**

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 4 is based on $T_{J(pk)}$ = l50°C; $T_C$ is variable depending on conditions. Secondary breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)}$ < 150°C. $T_{J(pk)}$ may be calculated from the data in Figure 5. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by secondary breakdown.

**NPN**
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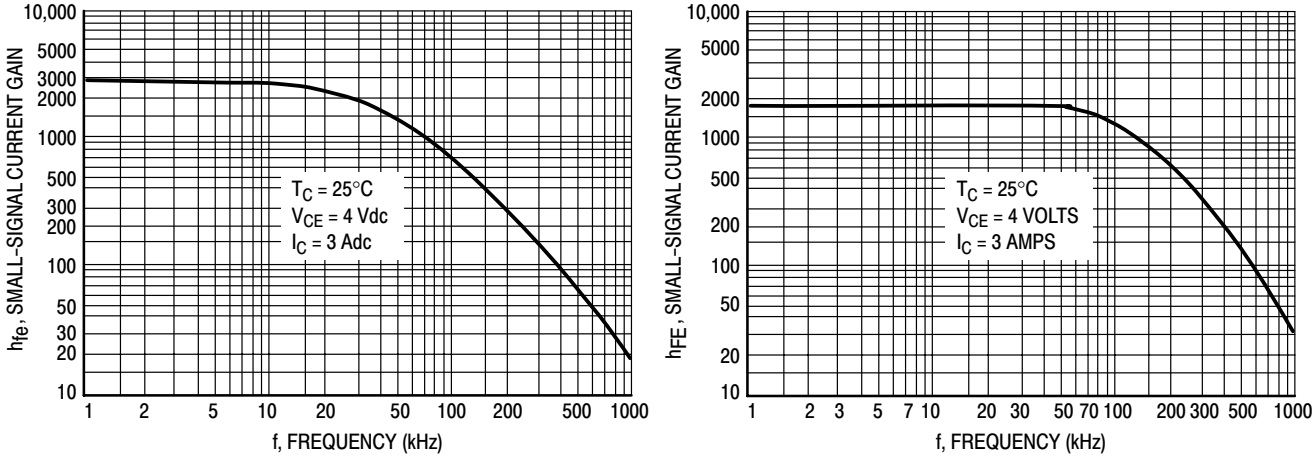
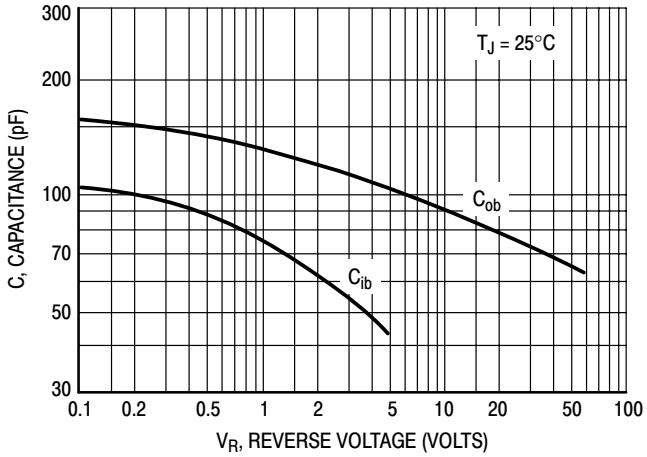



**Figure 7. Typical Small−Signal Current Gain**

**NPN**
**MJF6388**




**PNP**
**MJF6668**

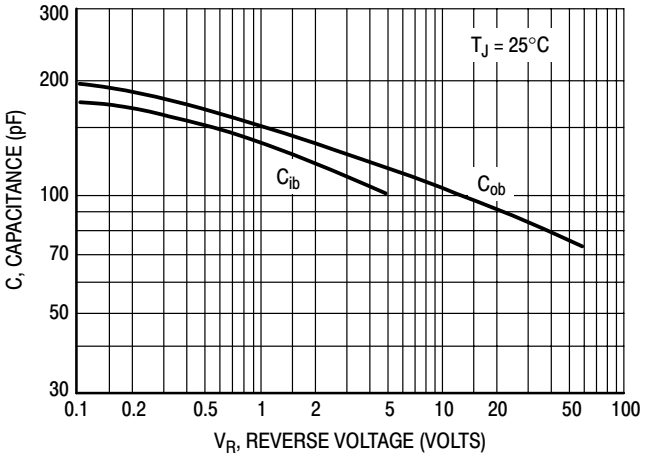
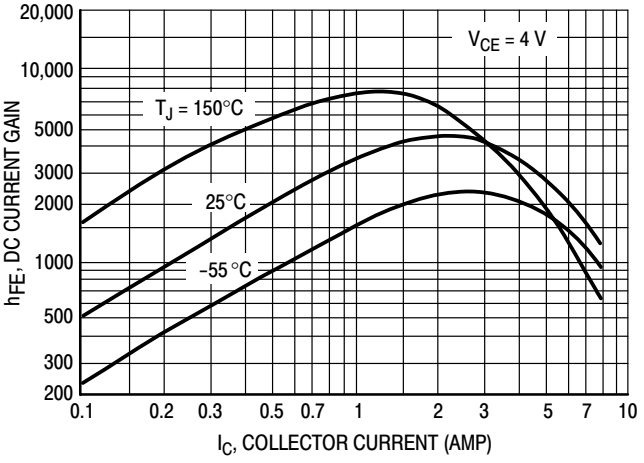



**Figure 8. Typical Capacitance**



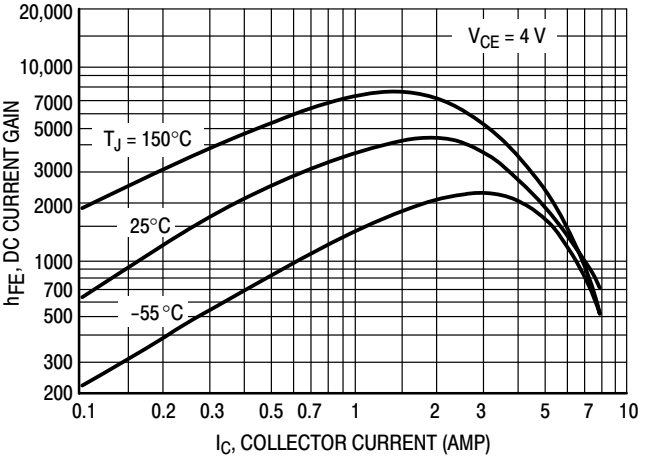
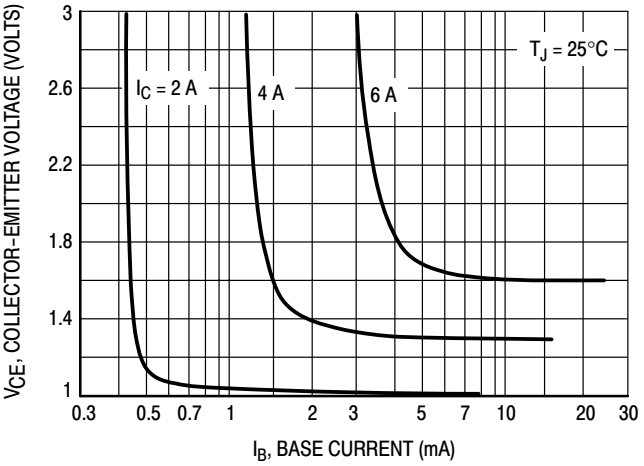




**Figure 9. Typical DC Current Gain**



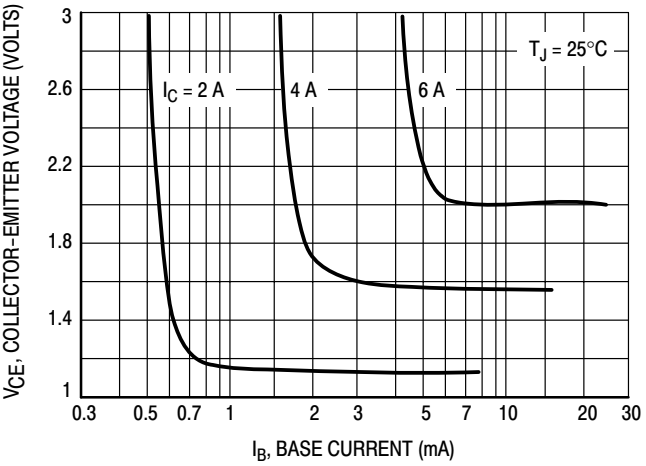
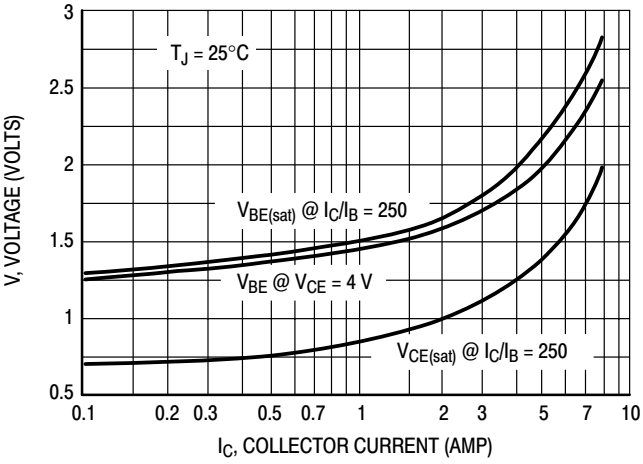




**Figure 10. Typical Collector Saturation Region**

**NPN**
**MJF6388**




**PNP**
**MJF6668**

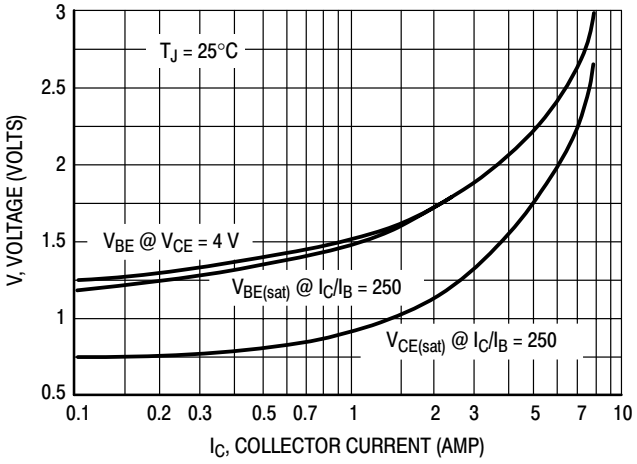
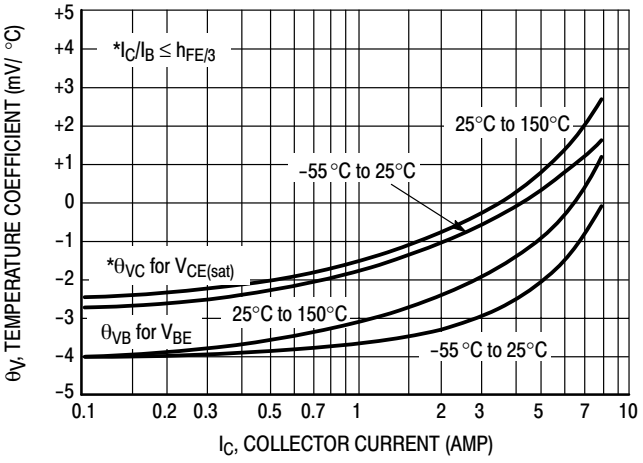



**Figure 11. Typical “On” Voltages**



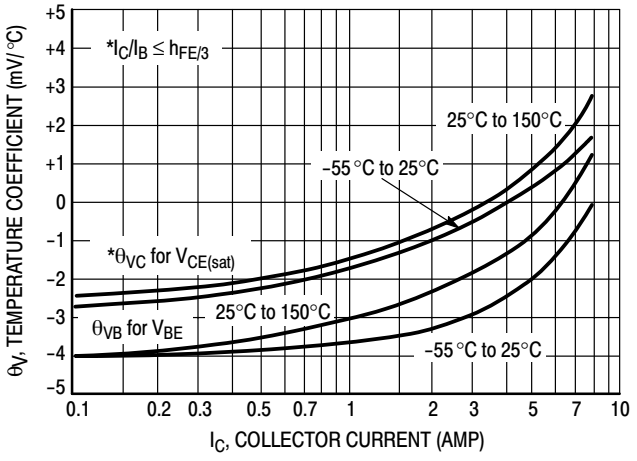
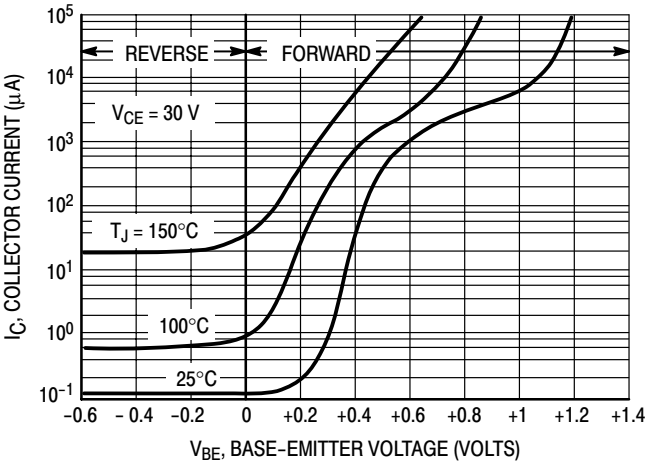




**Figure 12. Typical Temperature Coefficients**



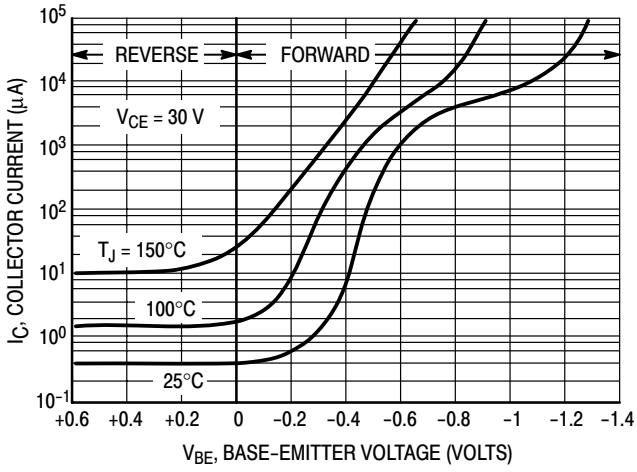




**Figure 13. Typical Collector Cut−Off Region**

## TEST CONDITIONS FOR ISOLATION TESTS*

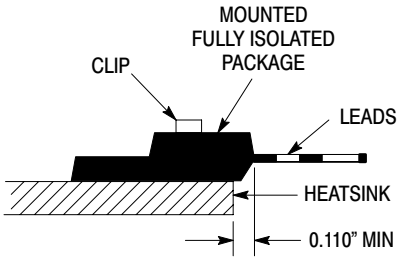



**Figure 14. Clip Mounting Position for Isolation Test Number 1**

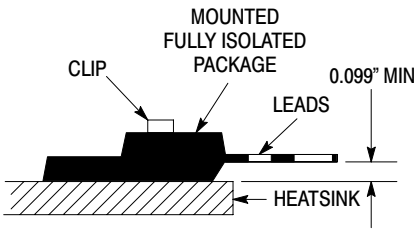



**Figure 15. Clip Mounting Position for Isolation Test Number 2**

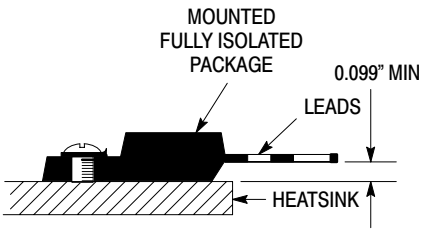



**Figure 16. Screw Mounting Position for Isolation Test Number 3**

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

## MOUNTING INFORMATION

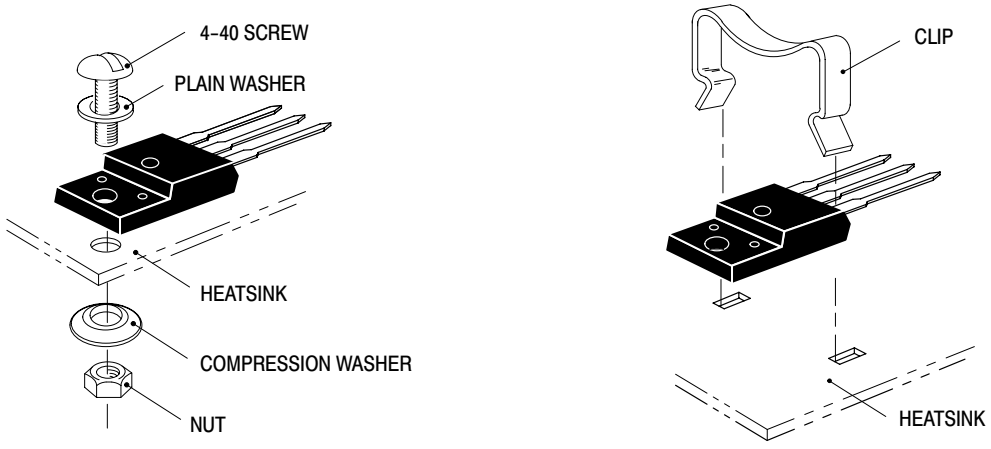



**Figure 17. Typical Mounting Techniques***

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.

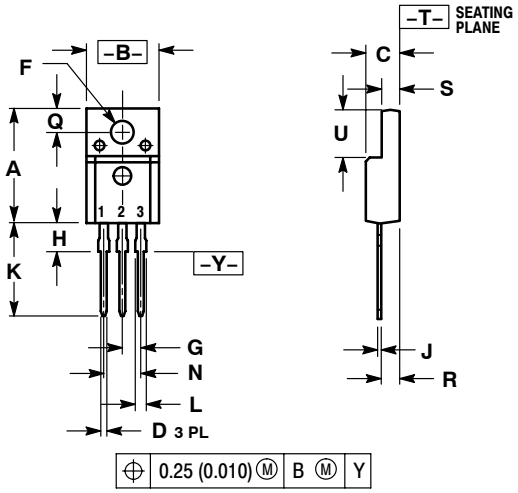
Destructive laboratory tests show that using a hex head 4−40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

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, ON Semiconductor 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

**TO−220 FULLPAK**
CASE 221D−03
ISSUE G




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH
3. 221D−01 THRU 221D−02 OBSOLETE, NEW STANDARD 221D−03.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.625 | 0.635 | 15.88 | 16.12 |
| B | 0.408 | 0.418 | 10.37 | 10.63 |
| C | 0.180 | 0.190 | 4.57 | 4.83 |
| D | 0.026 | 0.031 | 0.65 | 0.78 |
| F | 0.116 | 0.119 | 2.95 | 3.02 |
| G | 0.100 BSC | | 2.54 BSC | |
| H | 0.125 | 0.135 | 3.18 | 3.43 |
| J | 0.018 | 0.025 | 0.45 | 0.63 |
| K | 0.530 | 0.540 | 13.47 | 13.73 |
| L | 0.048 | 0.053 | 1.23 | 1.36 |
| N | 0.200 BSC | | 5.08 BSC | |
| Q | 0.124 | 0.128 | 3.15 | 3.25 |
| R | 0.099 | 0.103 | 2.51 | 2.62 |
| S | 0.101 | 0.113 | 2.57 | 2.87 |
| U | 0.238 | 0.258 | 6.06 | 6.56 |

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



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2−9−1 Kamimeguro, Meguro−ku, Tokyo, Japan 153−0051
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**MJF6388/D**