

Complementary Power Darlingtons

For Isolated Package Applications

MJF6388 (NPN), MJF6668 (PNP)

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
- Electrically Similar to the Popular 2N6388, 2N6668, TIP102, and TIP107
- No Isolating Washers Required, Reduced System Cost
- High DC Current Gain
- High Isolation Voltage
- UL Recognized at 3500 VRMS: File #E69369
- These Devices are Pb-Free and are RoHS Compliant*

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) ($t = 0.3$ sec, R.H. $\leq 30\%$, $T_A = 25^\circ\text{C}$) Per Figure 14	V_{ISOL}	4500	V
Collector Current – Continuous	I_C	10	Adc
Collector Current – Peak (Note 2)	I_{CM}	15	Adc
Base Current – Continuous	I_B	1.0	Adc
Total Power Dissipation (Note 3) @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	40 0.31	W W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	2.0 0.016	W W/ $^\circ\text{C}$
Operating and Storage Temperature Range	T_J, T_{stg}	-65 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. Proper strike and creepage distance must be provided.
2. Pulse Test: Pulse Width = 5.0 ms, Duty Cycle $\leq 10\%$.
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.

THERMAL CHARACTERISTICS

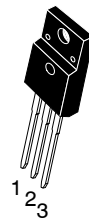
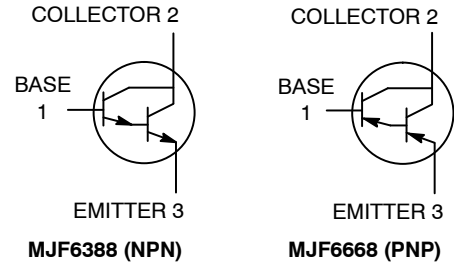
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case (Note 4)	$R_{\theta JC}$	4.0	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C}/\text{W}$
Lead Temperature for Soldering Purposes	T_L	260	$^\circ\text{C}$

4. 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.

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
MJF6388G	TO-220 FULLPACK (Pb-Free)	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 onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

MJF6388 (NPN), MJF6668 (PNP)

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Sustaining Voltage (Note 5) (I _C = 30 mA _{dc} , I _B = 0)	V _{CEO(sus)}	100	–	V _{dc}
Collector Cutoff Current (V _{CE} = 80 V _{dc} , I _B = 0)	I _{CEO}	–	10	μA _{dc}
Collector Cutoff Current (V _{CE} = 100 V _{dc} , V _{EB(off)} = 1.5 V _{dc}) (V _{CE} = 100 V _{dc} , V _{EB(off)} = 1.5 V _{dc} , T _C = 125°C)	I _{CEX}	– –	10 3.0	μA _{dc} mA _{dc}
Collector Cutoff Current (V _{CB} = 100 V _{dc} , I _E = 0)	I _{CBO}	–	10	μA _{dc}
Emitter Cutoff Current (V _{BE} = 5.0 V _{dc} , I _C = 0)	I _{EBO}	–	2.0	mA _{dc}
ON CHARACTERISTICS (Note 5)				
DC Current Gain (I _C = 3.0 A _{dc} , V _{CE} = 4.0 V _{dc}) (I _C = 5.0 A _{dc} , V _{CE} = 3.0 V _{dc}) (I _C = 8.0 A _{dc} , V _{CE} = 4.0 V _{dc}) (I _C = 10 A _{dc} , V _{CE} = 3.0 V _{dc})	h _{FE}	3000 1000 200 100	15000 – – –	–
Collector-Emitter Saturation Voltage (I _C = 3.0 A _{dc} , I _B = 6.0 mA _{dc}) (I _C = 5.0 A _{dc} , I _B = 0.01 A _{dc}) (I _C = 8.0 A _{dc} , I _B = 80 mA _{dc}) (I _C = 10 A _{dc} , I _B = 0.1 A _{dc})	V _{CE(sat)}	– – – –	2.0 2.0 2.5 3.0	V _{dc}
Base-Emitter Saturation Voltage (I _C = 5.0 A _{dc} , I _B = 0.01 A _{dc}) (I _C = 10 A _{dc} , I _B = 0.1 A _{dc})	V _{BE(sat)}	– –	2.8 4.5	V _{dc}
Base-Emitter On Voltage (I _C = 8.0 A _{dc} , V _{CE} = 4.0 V _{dc})	V _{BE(on)}	–	2.5	V _{dc}
DYNAMIC CHARACTERISTICS				
Small-Signal Current Gain (I _C = 1.0 A _{dc} , V _{CE} = 5.0 V _{dc} , f _{test} = 1.0 MHz)	h _{fe}	20	–	–
Output Capacitance (V _{CB} = 10 V _{dc} , I _E = 0, f = 1.0 MHz) MJF6388 MJF6668	C _{ob}	– –	200 300	pF
Insulation Capacitance (Collector-to-External Heatsink)	C _{C-hs}	–	3.0 Typ	pF
Small-Signal Current Gain (I _C = 1.0 A _{dc} , V _{CE} = 5.0 V _{dc} , f = 1.0 kHz)	h _{fe}	1000	–	–

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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



MJF6388 (NPN), MJF6668 (PNP)

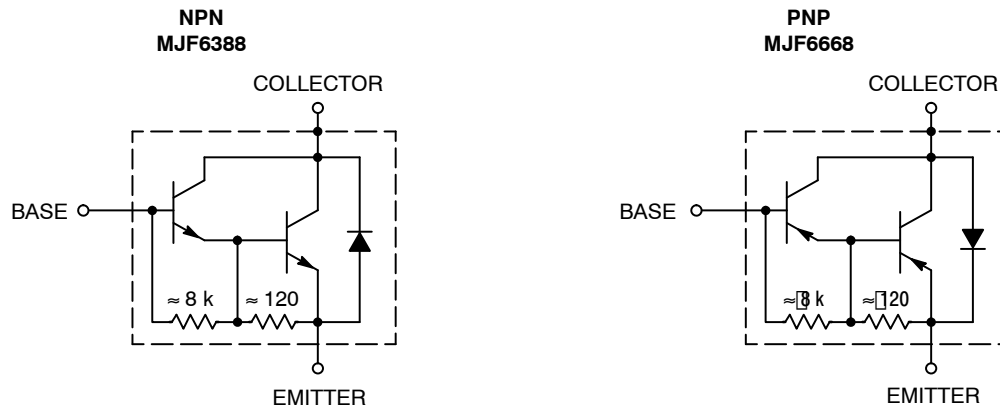


Figure 1. Darlington Schematic

MJF6388 (NPN), MJF6668 (PNP)

R_B & R_C VARIED TO OBTAIN DESIRED CURRENT LEVELS
 D_1 , MUST BE FAST RECOVERY TYPES, e.g.,
 MUR110 USED ABOVE $I_B \approx 100$ mA
 MSD6100 USED BELOW $I_B \approx 100$ mA

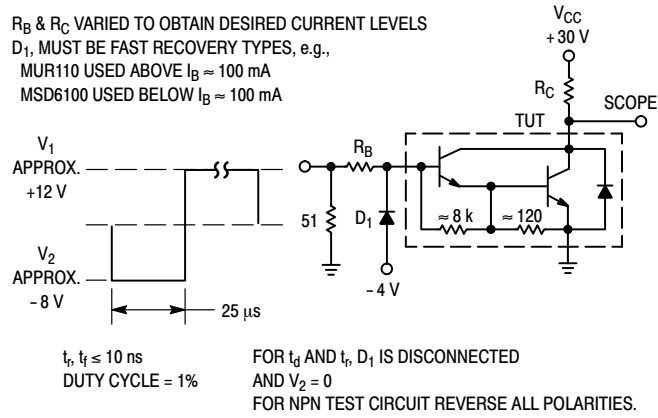


Figure 2. Switching Times Test Circuit

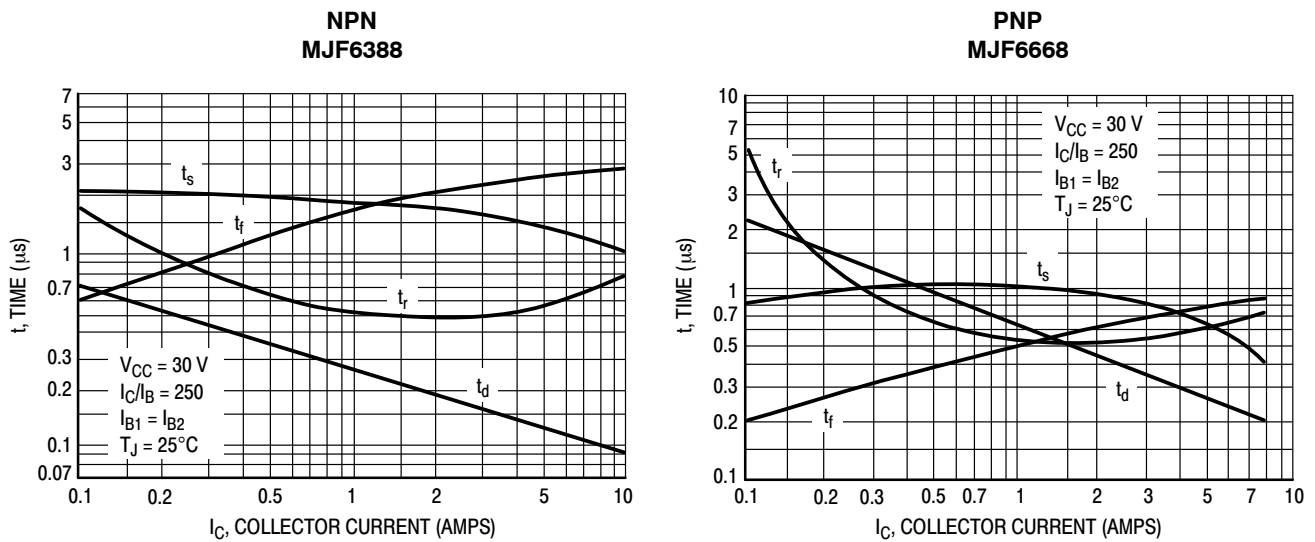


Figure 3. Typical Switching Times

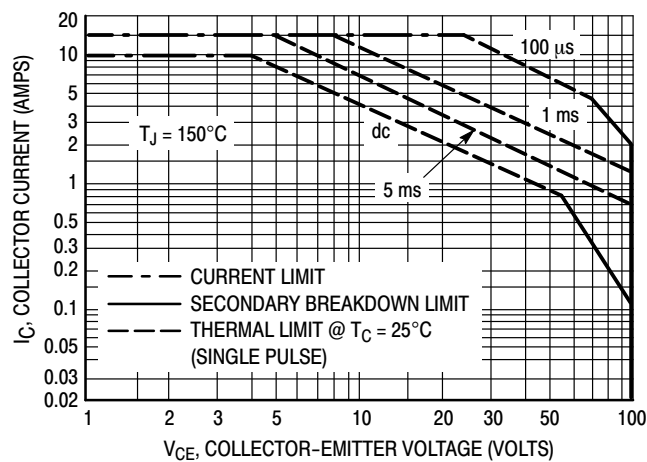


Figure 4. Maximum Forward Bias Safe Operating Area

MJF6388 (NPN), MJF6668 (PNP)

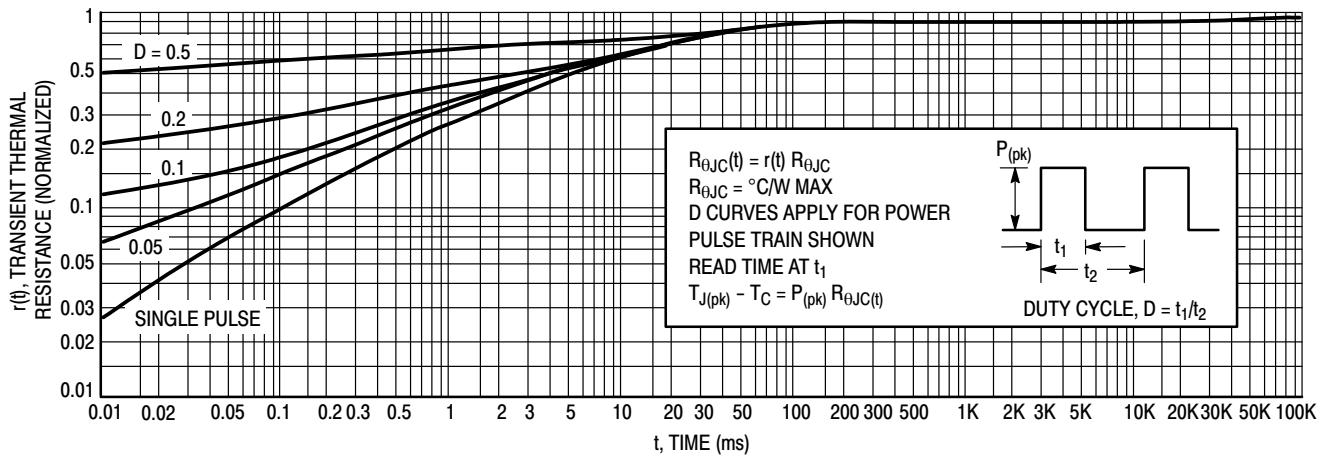


Figure 5. Thermal Response

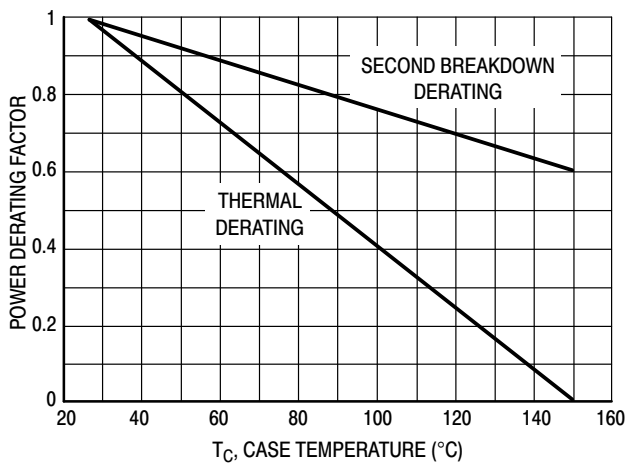
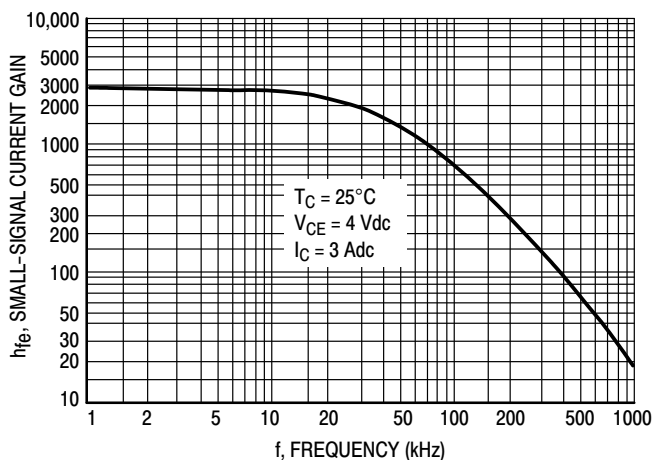


Figure 6. Maximum Power Derating

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 $T_{J(pk)} = 150^\circ\text{C}$; 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 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 MJF6388



PNP MJF6668

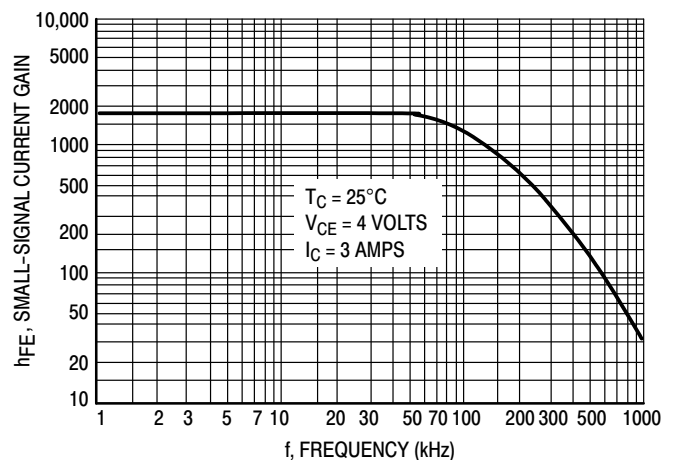


Figure 7. Typical Small-Signal Current Gain

MJF6388 (NPN), MJF6668 (PNP)

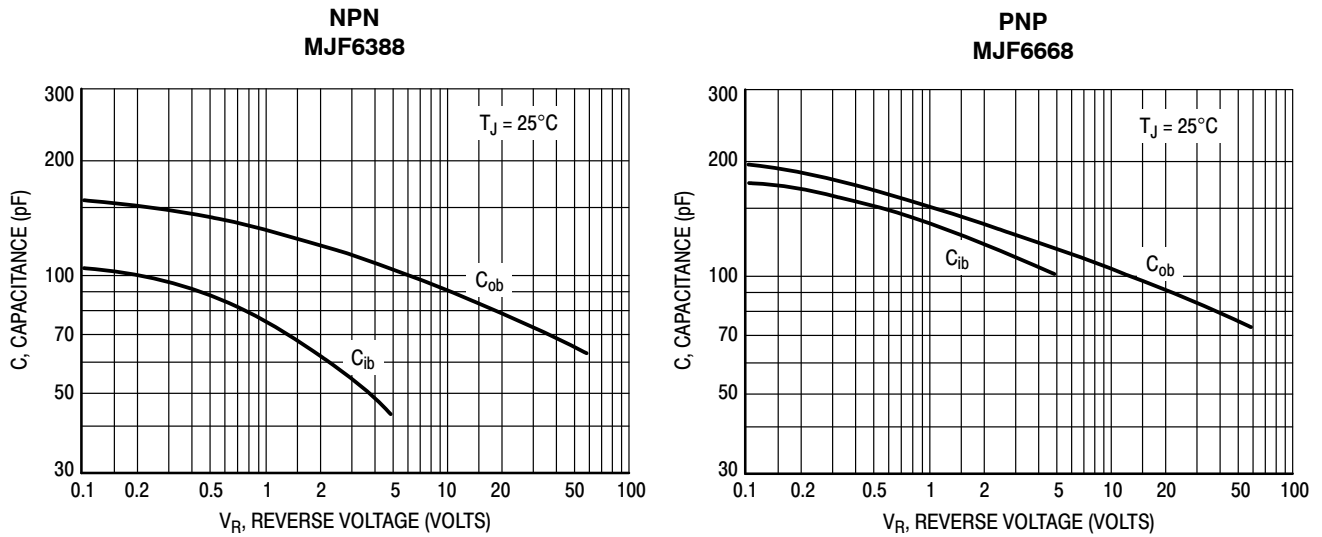


Figure 8. Typical Capacitance

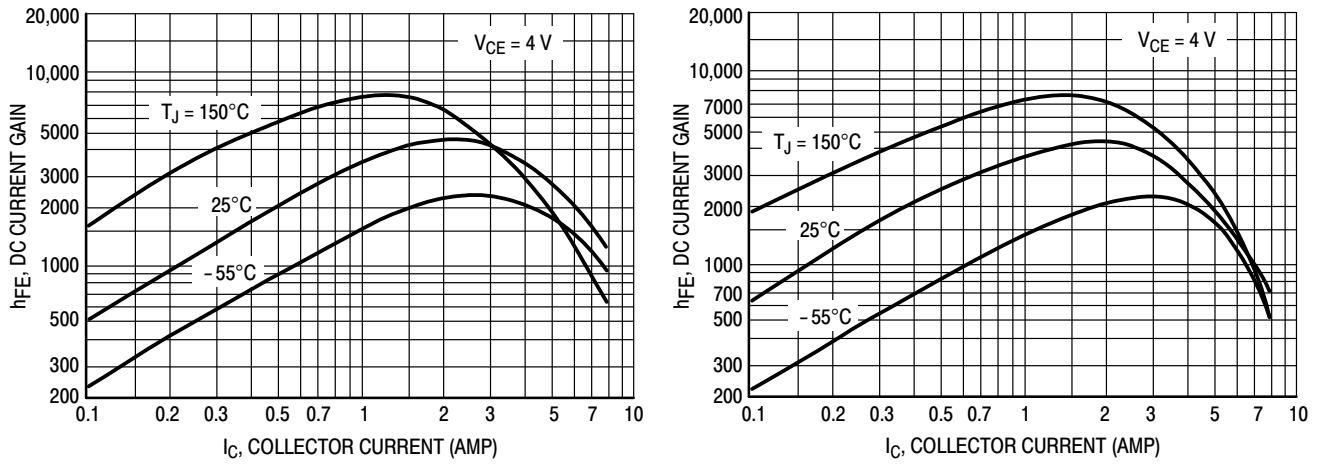


Figure 9. Typical DC Current Gain

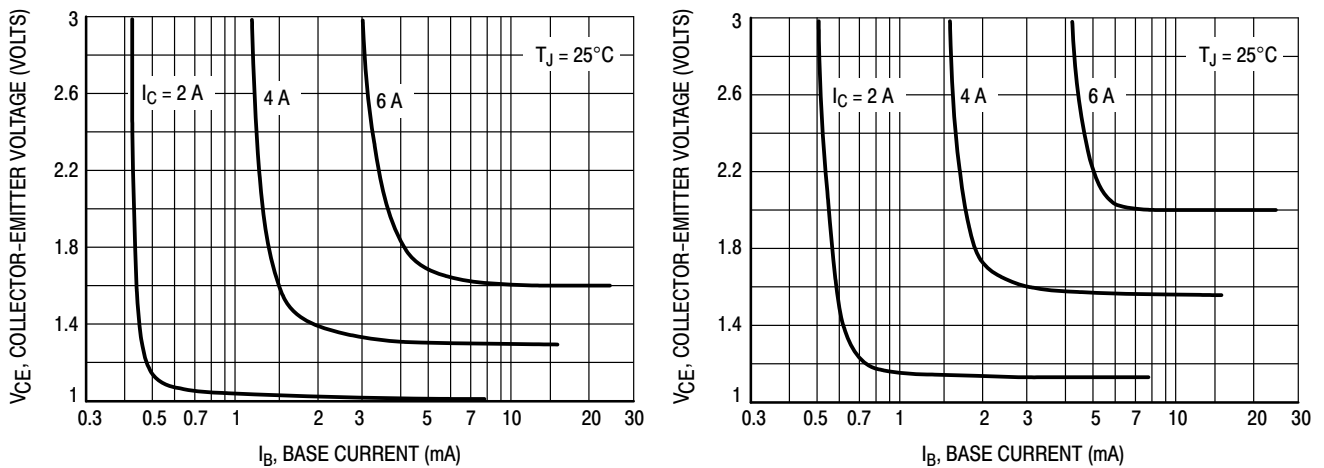


Figure 10. Typical Collector Saturation Region

MJF6388 (NPN), MJF6668 (PNP)

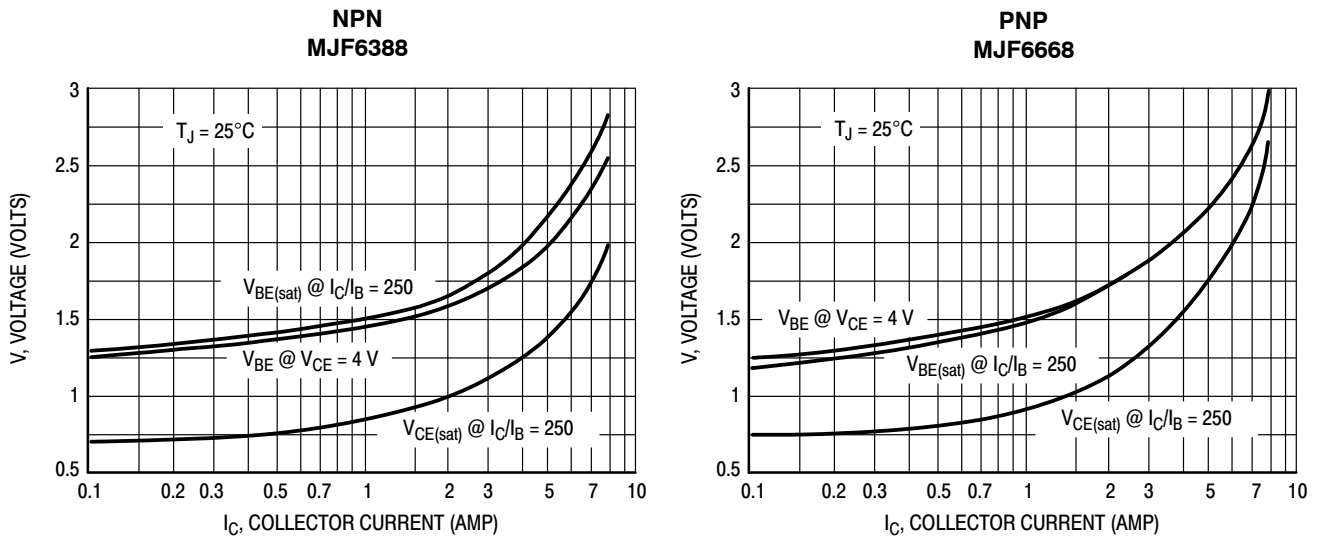


Figure 11. Typical "On" Voltages

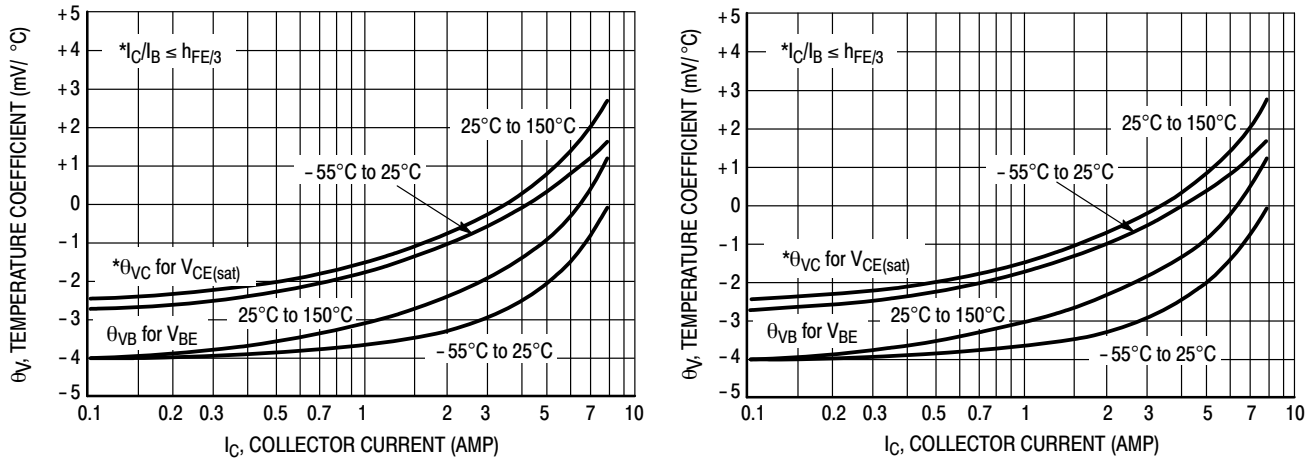


Figure 12. Typical Temperature Coefficients

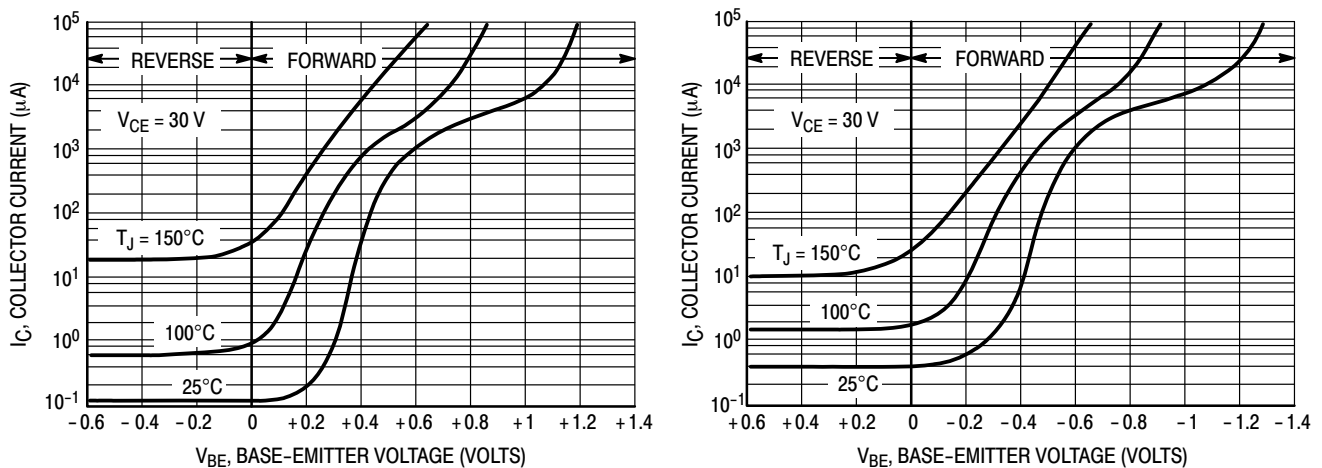


Figure 13. Typical Collector Cut-Off Region

MJF6388 (NPN), MJF6668 (PNP)

TEST CONDITION FOR ISOLATION TEST*

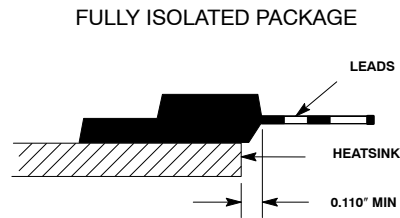


Figure 14. Mounting Position

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

MOUNTING INFORMATION

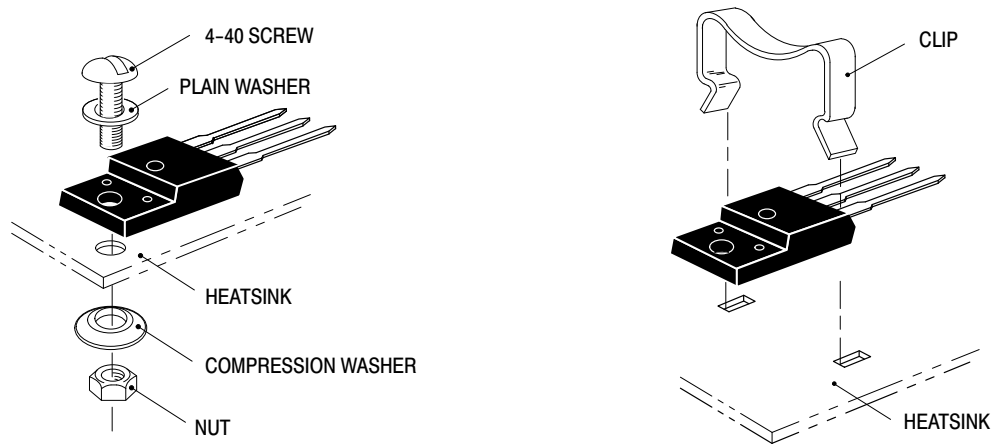


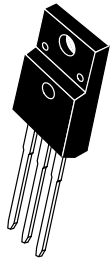
Figure 15. Typical Mounting Techniques*

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, **onsemi** does not recommend exceeding 10 in · lbs of mounting torque under any mounting conditions.

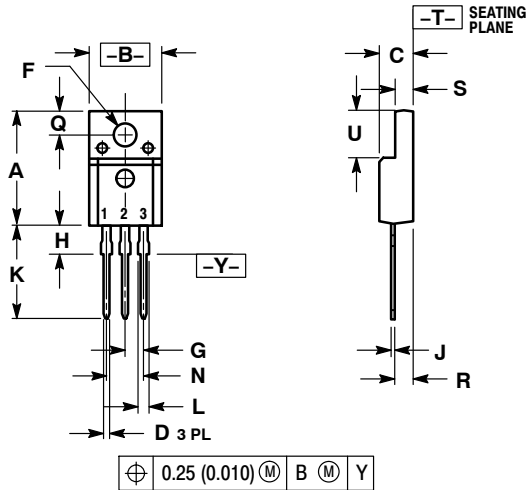
**For more information about mounting power semiconductors see [Application Note AN1040](#).



SCALE 1:1

TO-220 FULLPAK
CASE 221D-03
ISSUE K

DATE 27 FEB 2009



- 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.

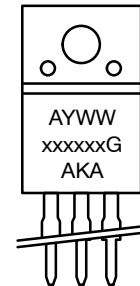
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.617	0.635	15.67	16.12
B	0.392	0.419	9.96	10.63
C	0.177	0.193	4.50	4.90
D	0.024	0.039	0.60	1.00
F	0.116	0.129	2.95	3.28
G	0.100 BSC		2.54 BSC	
H	0.118	0.135	3.00	3.43
J	0.018	0.025	0.45	0.63
K	0.503	0.541	12.78	13.73
L	0.048	0.058	1.23	1.47
N	0.200 BSC		5.08 BSC	
Q	0.122	0.138	3.10	3.50
R	0.099	0.117	2.51	2.96
S	0.092	0.113	2.34	2.87
U	0.239	0.271	6.06	6.88

MARKING
DIAGRAMS

- STYLE 1:
PIN 1. GATE
2. DRAIN
3. SOURCE
- STYLE 2:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
- STYLE 3:
PIN 1. ANODE
2. CATHODE
3. ANODE
- STYLE 4:
PIN 1. CATHODE
2. ANODE
3. CATHODE
- STYLE 5:
PIN 1. CATHODE
2. ANODE
3. GATE
- STYLE 6:
PIN 1. MT 1
2. MT 2
3. GATE



Bipolar



Rectifier

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

A = Assembly Location
Y = Year
WW = Work Week
xxxxxx = Device Code
G = Pb-Free Package
AKA = Polarity Designator

DOCUMENT NUMBER:	98ASB42514B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TO-220 FULLPAK	PAGE 1 OF 1

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at
www.onsemi.com/support/sales