# **High Voltage Power Transistor**

# **Isolated Package Applications**

Designed for line operated audio output amplifiers, switching power supply drivers and other switching applications, where the mounting surface of the device is required to be electrically isolated from the heatsink or chassis.

#### **Features**

- Electrically Similar to the Popular TIP47
- 250 V<sub>CEO(sus)</sub>
- 1 A Rated Collector Current
- No Isolating Washers Required
- Reduced System Cost
- UL Recognized, File #E69369, to 3500 V<sub>RMS</sub> Isolation
- This is a Pb-Free Device\*

#### **MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V <sub>CEO</sub>	250	Vdc
Collector-Base Voltage	V <sub>CB</sub>	350	Vdc
Emitter-Base Voltage	V <sub>EB</sub>	5	Vdc
RMS Isolation Voltage (Note 1) Test No. 1 Per Figure 10 Test No. 2 Per Figure 11 Test No. 3 Per Figure 12 (for 1 sec, R.H. < 30%, T <sub>A</sub> = 25°C)	V <sub>ISOL</sub>	4500 3500 1500	V
Collector Current - Continuous - Peak	I <sub>C</sub>	1 2	Adc
Base Current - Continuous	I <sub>B</sub>	0.6	Adc
Total Power Dissipation (Note 2) @ T <sub>C</sub> = 25°C Derate above 25°C	P <sub>D</sub>	28.4 0.227	W W/°C
Total Power Dissipation @ T <sub>A</sub> = 25°C Derate above 25°C	P <sub>D</sub>	2.0 0.016	W W/°C
Operating and Storage 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	$R_{\theta JA}$	62.5	°C/W
Thermal Resistance, Junction-to-Case (Note 2)	$R_{\theta JC}$	4.4	°C/W
Lead Temperature for Soldering Purposes	TL	260	°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. Proper strike and creepage distance must be provided.
- 2. 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  $\geq 6$  in. lbs.



#### ON Semiconductor®

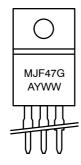
http://onsemi.com

# NPN SILICON POWER TRANSISTOR 1 AMPERE 250 VOLTS, 28 WATTS



TO-220 FULLPACK CASE 221D STYLE 2

#### MARKING DIAGRAM



G = Pb-Free Package A = Assembly Location

Y = Year

WW = Work Week

#### ORDERING INFORMATION

Device	Package	Shipping
MJF47G	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.

<sup>\*</sup>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** ( $T_C = 25^{\circ}C$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Sustaining Voltage (Note 3) $(I_C = 30 \text{ mAdc}, I_B = 0)$	V <sub>CEO(sus)</sub>	250	-	Vdc
Collector Cutoff Current $(V_{CE} = 150 \text{ Vdc}, I_B = 0)$	I <sub>CEO</sub>	-	0.2	mAdc
Collector Cutoff Current (V <sub>CE</sub> = 350 Vdc, V <sub>BE</sub> = 0)	I <sub>CES</sub>	-	0.1	mAdc
Emitter Cutoff Current $(V_{BE} = 5 \text{ Vdc}, I_C = 0)$	I <sub>EBO</sub>	-	1	mAdc
ON CHARACTERISTICS (Note 3)				
DC Current Gain $ (I_C = 0.3 \text{ Adc}, V_{CE} = 10 \text{ Vdc}) $ $ (I_C = 1 \text{ Adc}, V_{CE} = 10 \text{ Vdc}) $	h <sub>FE</sub>	30 10	150 -	-
Collector–Emitter Saturation Voltage ( $I_C = 1$ Adc, $I_B = 0.2$ Adc)	V <sub>CE(sat)</sub>	-	1	Vdc
Base–Emitter On Voltage (I <sub>C</sub> = 1 Adc, V <sub>CE</sub> = 10 Vdc)	V <sub>BE(on)</sub>	-	1.5	Vdc
DYNAMIC CHARACTERISTICS				
Current Gain – Bandwidth Product (I <sub>C</sub> = 0.2 Adc, V <sub>CE</sub> 10 Vdc, f = 2 MHz)	f <sub>T</sub>	10	-	MHz

<sup>3.</sup> Pulse Test: Pulse Width  $\leq$  300  $\mu$ s, Duty Cycle  $\leq$  2%.

#### **TYPICAL CHARACTERISTICS**

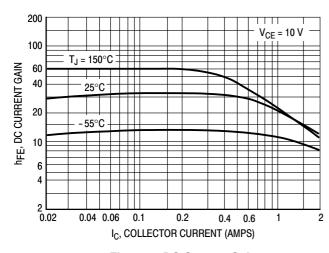


Figure 1. DC Current Gain

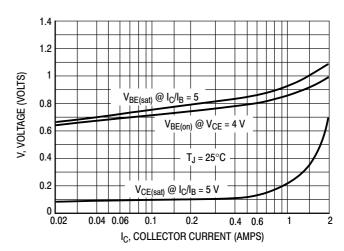


Figure 2. "On" Voltages

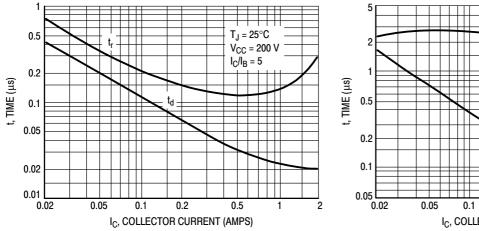


Figure 3. Turn-On Time

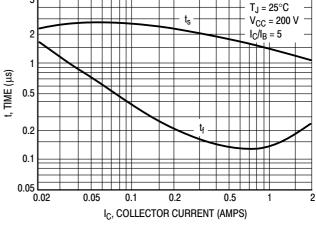


Figure 4. Turn-Off Time

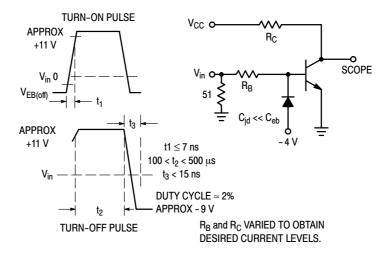


Figure 5. Switching Time Equivalent Circuit

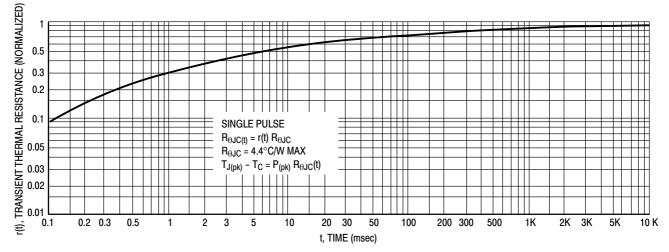


Figure 6. Thermal Response

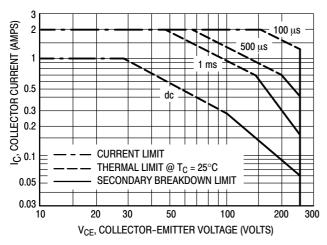


Figure 7. Maximum Forward Bias Safe Operating Area

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 7 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  $T_{J(pk)} \leq 150^{\circ}\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 6. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

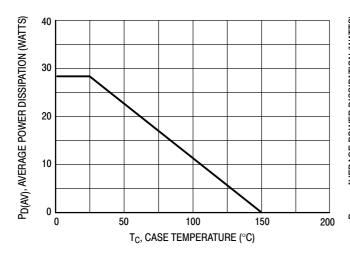


Figure 8. Power Derating

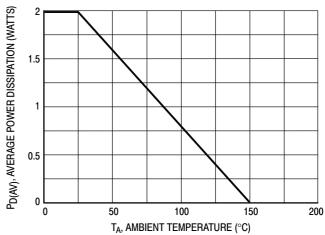


Figure 9. Power Derating

#### **TEST CONDITIONS FOR ISOLATION TESTS\***

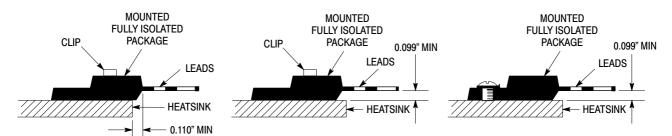


Figure 10. Clip Mounting Position for Isolation Test Number 1

Figure 11. Clip Mounting Position for Isolation Test Number 2

Figure 12. Screw Mounting Position for Isolation Test Number 3

#### **MOUNTING INFORMATION**

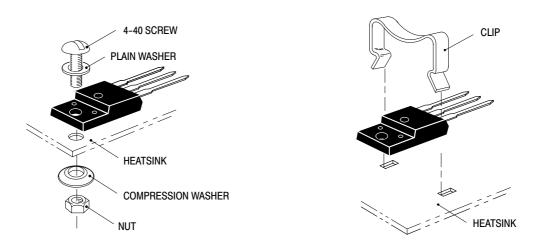


Figure 13. Typical Mounting Techniques\*

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  $\cdot$  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.

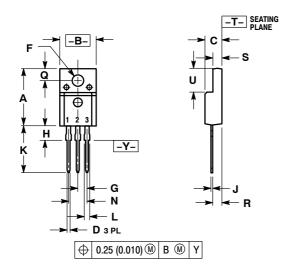
Additional tests on slotted 4–40 screws indicate that the screw slot fails between 15 to 20 in · lbs without adversely affecting the package. However, in order to positively ensure the package integrity of the fully isolated device, ON Semiconductor does not recommend exceeding 10 in · lbs of mounting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

<sup>\*</sup>Measurement made between leads and heatsink with all leads shorted together

<sup>\*\*</sup> For more information about mounting power semiconductors see Application Note AN1040.

#### PACKAGE DIMENSIONS

#### TO-220 FULLPAK CASE 221D-03 ISSUE K



#### NOTES:

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

	INCHES		MILLIN	IETERS
DIM	MIN	MAX	MIN	MAX
Α	0.617	0.635	15.67	16.12
В	0.392	0.419	9.96	10.63
С	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	
Н	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

STYLE 2:

PIN 1. BASE

- 2. COLLECTOR
- 3. EMITTER

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