

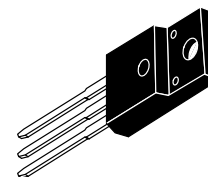
**MJF47**

## 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.

- Electrically Similar to the Popular TIP47
- 250  $V_{CEO(sus)}$
- 1 A Rated Collector Current
- No Isolating Washers Required
- Reduced System Cost
- UL Recognized, File #E69369, to 3500  $V_{RMS}$  Isolation

**NPN SILICON  
POWER TRANSISTOR  
1 AMPERE  
250 VOLTS  
28 WATTS**



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

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO}$	250	Vdc
Collector-Base Voltage	$V_{CB}$	350	Vdc
Emitter-Base Voltage	$V_{EB}$	5	Vdc
RMS Isolation Voltage (1) (for 1 sec, R.H. < 30%, $T_A = 25^\circ\text{C}$ )	$V_{ISOL}$	4500 3500 1500	$V_{RMS}$
Collector Current — Continuous Peak	$I_C$	1 2	Adc
Base Current	$I_B$	0.6	Adc
Total Power Dissipation* @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	28 0.23	Watts $\text{W}/^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	2 0.016	Watts $\text{W}/^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +150	$^\circ\text{C}$

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Case*	$R_{\theta JC}$	4.4	$^\circ\text{C}/\text{W}$
Lead Temperature for Soldering Purpose	$T_L$	260	$^\circ\text{C}$

\* 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  $\geq 6$  in. lbs.

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

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## 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) ( $I_C = 30\text{ mAdc}$ , $I_B = 0$ )	$V_{CEO(sus)}$	250	—	Vdc
Collector Cutoff Current ( $V_{CE} = 150\text{ Vdc}$ , $I_B = 0$ )	$I_{CEO}$	—	0.2	mAdc
Collector Cutoff Current ( $V_{CE} = 350\text{ Vdc}$ , $V_{BE} = 0$ )	$I_{CES}$	—	0.1	mAdc
Emitter Cutoff Current ( $V_{BE} = 5\text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	—	1	mAdc
<b>ON CHARACTERISTICS (1)</b>				
DC Current Gain ( $I_C = 0.3\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ ) ( $I_C = 1\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ )	$h_{FE}$	30 10	150 —	—
Collector–Emitter Saturation Voltage ( $I_C = 1\text{ Adc}$ , $I_B = 0.2\text{ Adc}$ )	$V_{CE(sat)}$	—	1	Vdc
Base–Emitter On Voltage ( $I_C = 1\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ )	$V_{BE(on)}$	—	1.5	Vdc
<b>DYNAMIC CHARACTERISTICS</b>				
Current Gain — Bandwidth Product ( $I_C = 0.2\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 2\text{ MHz}$ )	$f_T$	10	—	MHz

(1) Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

## TYPICAL CHARACTERISTICS

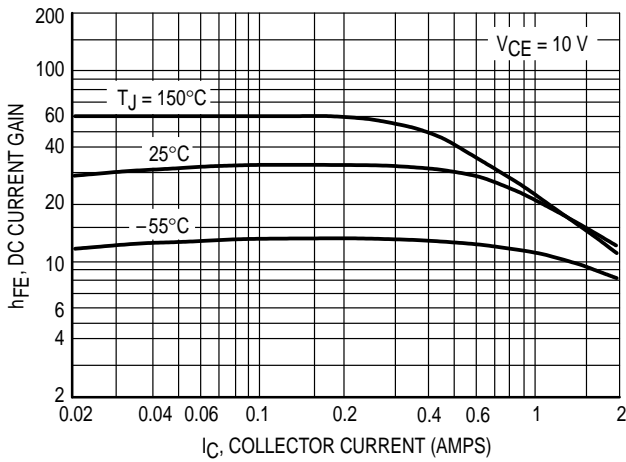


Figure 1. DC Current Gain

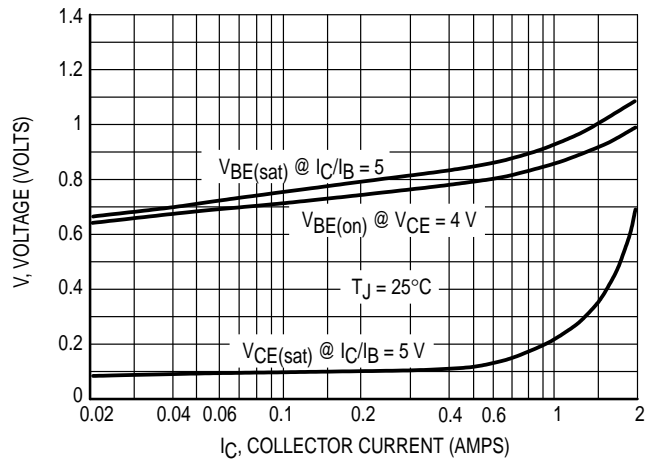


Figure 2. "On" Voltages

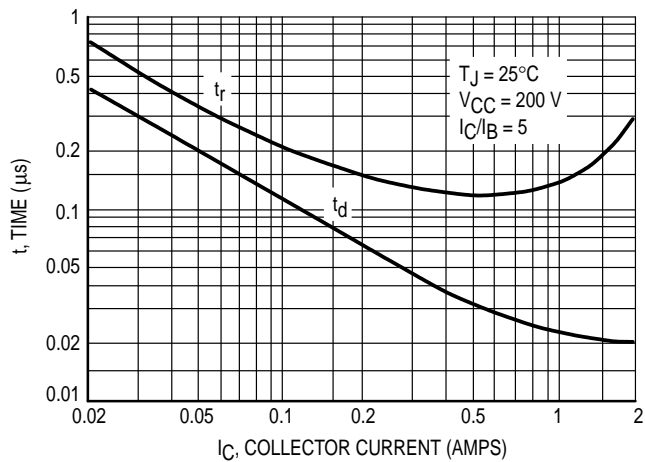


Figure 3. Turn-On Time

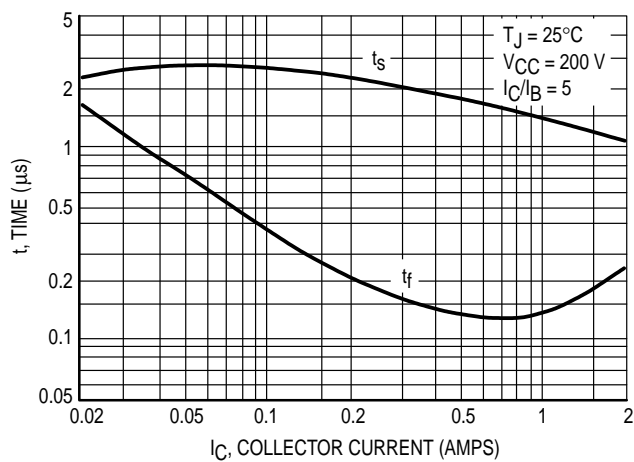


Figure 4. Turn-Off Time

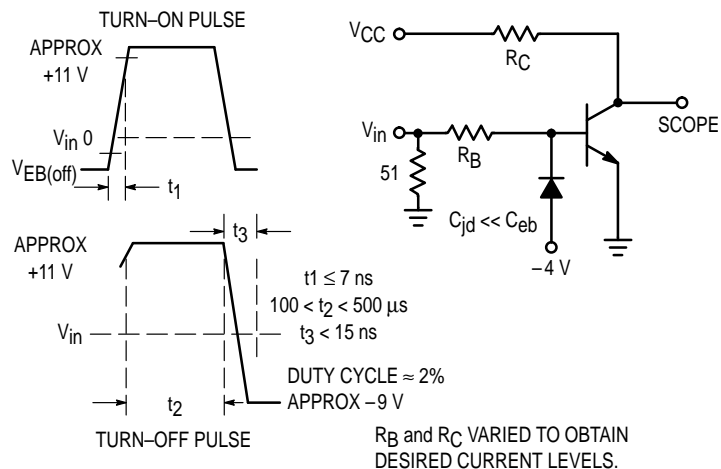


Figure 5. Switching Time Equivalent Circuit

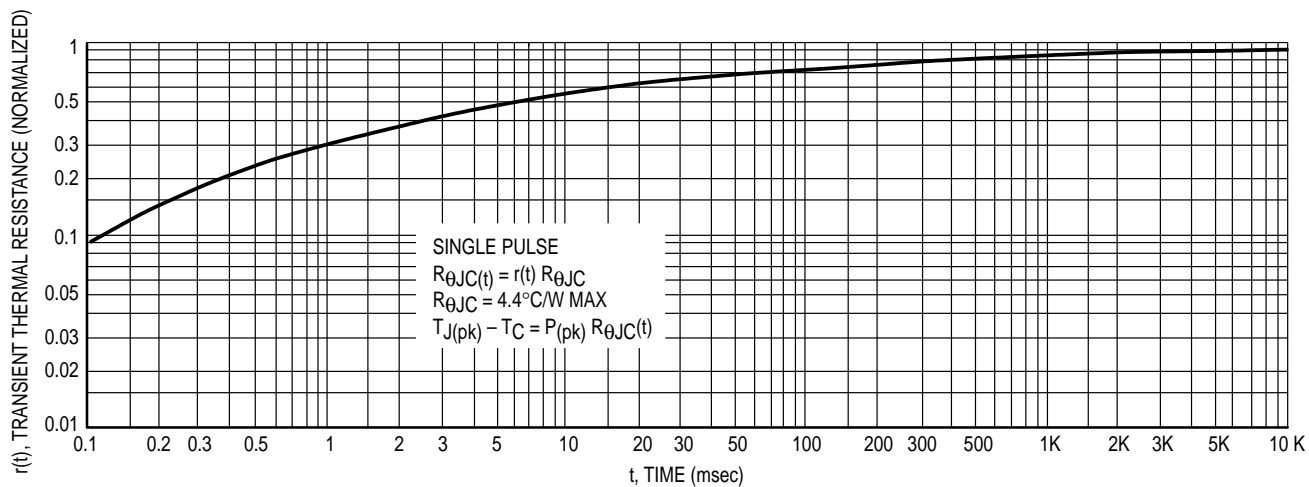
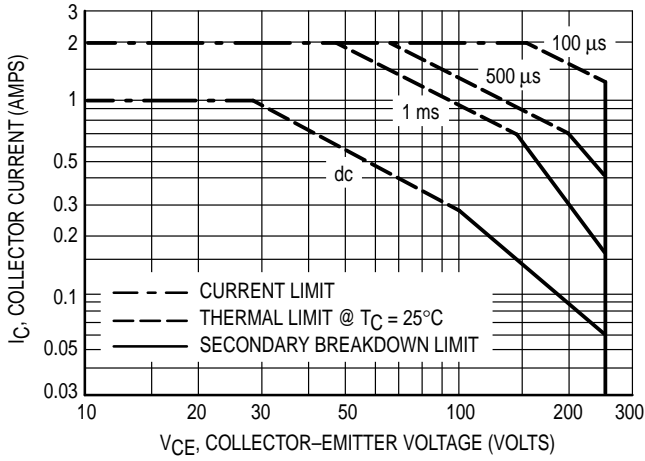


Figure 6. Thermal Response

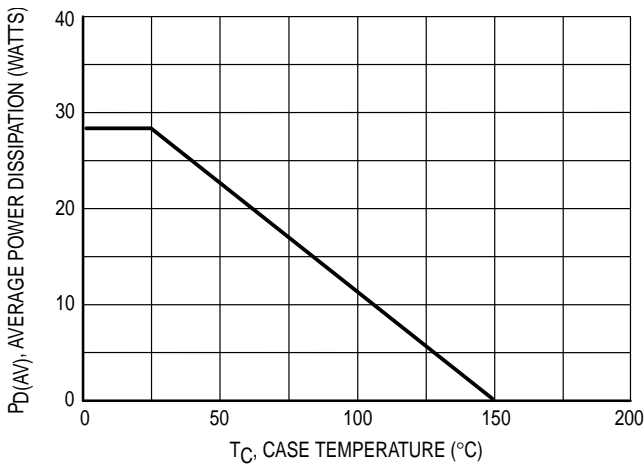
**MJF47**



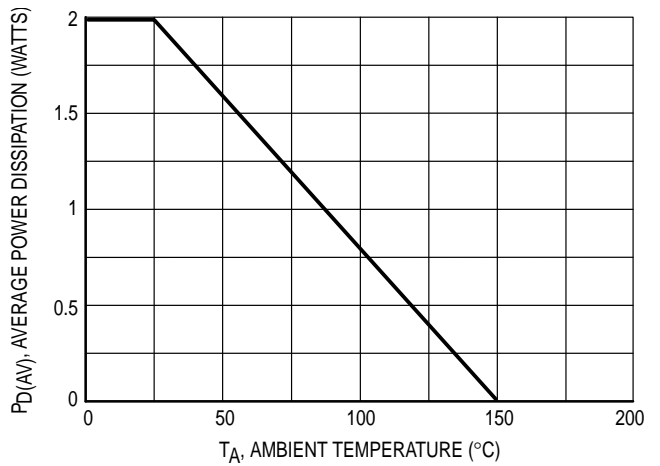
**Figure 7. Maximum Forward Bias Safe Operating Area**

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.

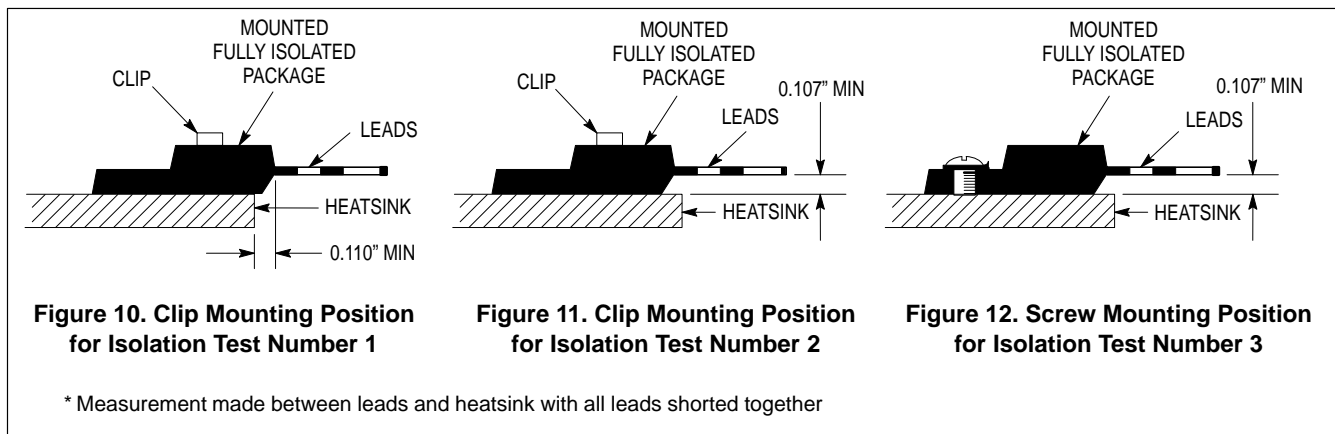


**Figure 8. Power Derating**



**Figure 9. Power Derating**

TEST CONDITIONS FOR ISOLATION TESTS\*



MOUNTING INFORMATION

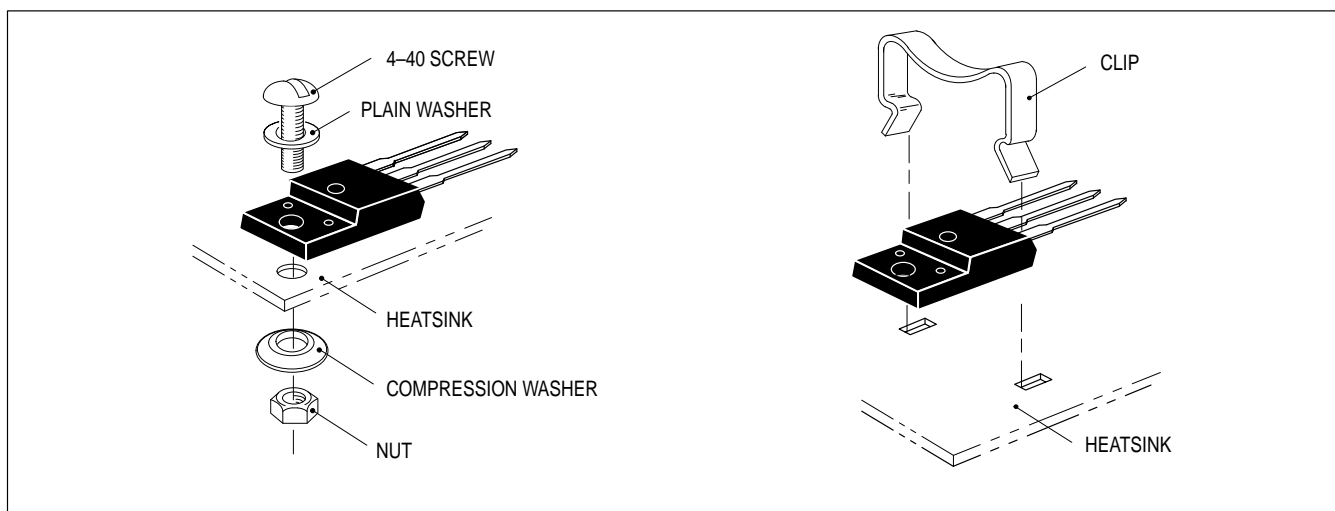


Figure 13. Typical Mounting Techniques\*

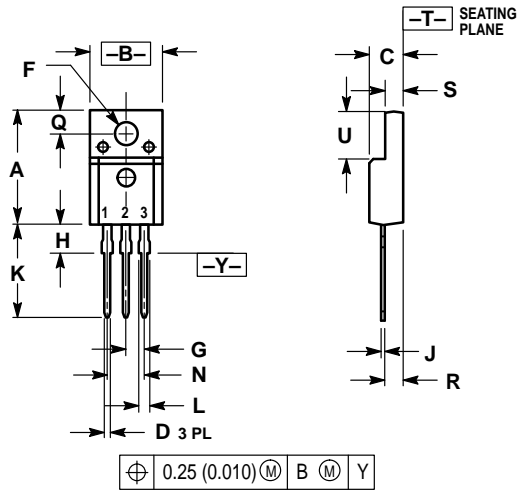
Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time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

CASE 221D-02  
 TO-220 TYPE  
 ISSUE D

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How to reach us:  
 USA / EUROPE: Motorola Literature Distribution;  
 P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447

JAPAN: Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, Toshikatsu Otsuki,  
 6F Seibu-Butsuryu-Center, 3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-3521-8315

MFAX: RMFAX0@email.sps.mot.com - TOUCHTONE (602) 244-6609  
 INTERNET: http://Design-NET.com

HONG KONG: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,  
 51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298

