

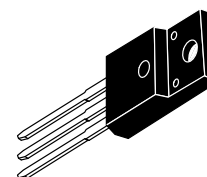
BUT11AF

Full Pak High Voltage NPN Power Transistor For Isolated Package Applications

The BUT11AF was designed for use in line operated switching power supplies in a wide range of end use applications. This device combines the latest state of the art bipolar fabrication techniques to provide excellent switching, high voltage capability and low saturation voltage.

- 1000 Volt V_{CES} Rating
- Low Base Drive Requirements
- Isolated Overmold Package
- Improved System Efficiency
- No Isolating Washers Required
- Reduced System Cost
- High Isolation Voltage Capability (4500 V_{RMS})

POWER TRANSISTOR
5.0 AMPERES
450 VOLTS
40 WATTS



CASE 221D-02
TO-220 TYPE

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Sustaining Voltage	$V_{CEO(sus)}$	450	Vdc
Collector-Emitter Breakdown Voltage	V_{CES}	1000	Vdc
Emitter-Base Voltage	V_{EBO}	9.0	Vdc
RMS Isolation Voltage (For 1 sec, $T_A = 25^\circ\text{C}$, Rel. Humidity < 30%) Per Figure 7 Per Figure 8 Per Figure 9	V_{ISOL1}	4500	V
	V_{ISOL2}	3500	
	V_{ISOL3}	2500	
Collector Current — Continuous — Pulsed (1)	I_C	5.0	Adc
	I_{CM}	10	
Base Current — Continuous — Pulsed (1)	I_B	2.0	Adc
	I_{BM}	4.0	
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ * Derated above 25°C	P_D	40 0.32	Watts W/ $^\circ\text{C}$
Operating and Storage Temperature Range	T_J, T_{stg}	- 65 to +150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case*	$R_{\theta JC}$	3.125	$^\circ\text{C/W}$
Maximum Lead Temperature for soldering purposes 1/8" from case for 5 sec.	T_L	260	$^\circ\text{C}$

(1) Pulse Test: Pulse Width = 5.0 ms, Duty Cycle $\leq 10\%$.

* Measurement made with thermocouple contacting the bottom insulated mounting surface of the package (in a location beneath the die), the device mounted on a heatsink, thermal grease applied, and a mounting torque of 6 to 8 in · lbs.

Full Pak is a registered trademark of Motorola Inc.

BUT11AF

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS (1)

Collector-Emitter Sustaining Voltage (Figures 1 & 2) ($I_C = 100\text{ mA}$, $I_B = 0$, $L = 25\text{ }\mu\text{H}$)	$V_{CE(sus)}$	450	—	—	Vdc
Collector Cutoff Current ($V_{CE} = 1000\text{ Vdc}$, $V_{BE} = 0$) ($V_{CE} = 1000\text{ Vdc}$, $V_{BE} = 0$, $T_J = 125^\circ\text{C}$)	I_{CES}	— —	— —	1.0 2.0	mA
Emitter-Base Leakage ($V_{EB} = 9.0\text{ Vdc}$, $I_C = 0$)	I_{EBO}	—	—	10	mA

ON CHARACTERISTICS (1)

Collector-Emitter Saturation Voltage ($I_C = 2.5\text{ A}$, $I_B = 0.5\text{ A}$)	$V_{CE(sat)}$	—	—	1.5	Vdc
Base-Emitter Saturation Voltage ($I_C = 2.5\text{ A}$, $I_B = 0.5\text{ A}$)	$V_{BE(sat)}$	—	—	1.5	Vdc
DC Current Gain ($I_C = 5.0\text{ mA}$, $V_{CE} = 5.0\text{ Vdc}$)	h_{FE}	10	— —	— —	—

DYNAMIC CHARACTERISTICS

Insulation Capacitance (Collector to External Heatsink)	C_{c-hs}	—	15	—	pF
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SWITCHING CHARACTERISTICS

Inductive Load (Figures 3 & 4)							
Storage	$I_C = 2.5 \text{ Adc}, I_{B1} = 0.5 \text{ Adc}$	$T_J = 25^{\circ}\text{C}$	t_s	—	1100	1400	ns
Fall Time			t_{fi}	—	80	150	
Storage		$T_J = 100^{\circ}\text{C}$	t_s	—	1200	1500	
Fall Time			t_{fi}	—	140	300	
Resistive Load (Figures 5 & 6)							
Turn-On Time	$I_C = 2.5 \text{ Adc}, I_{B1} = I_{B2} = 0.5 \text{ Adc}$	t_{on}	—	—	1000	ns	
Storage Time		t_s	—	—	4000		
Fall Time		t_f	—	—	800		

(1) Pulse Test: Pulse Width = 300 μs , Duty Cycle $\leq 2.0\%$.

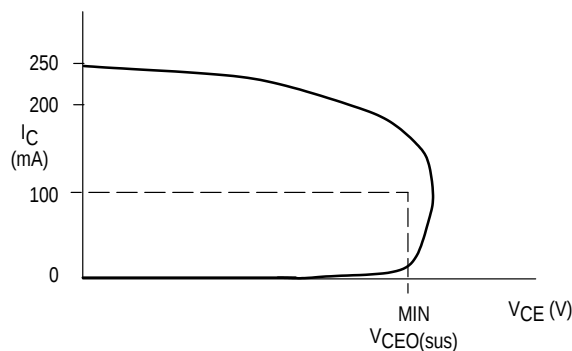


Figure 1. Oscilloscope Display for Sustaining Voltage

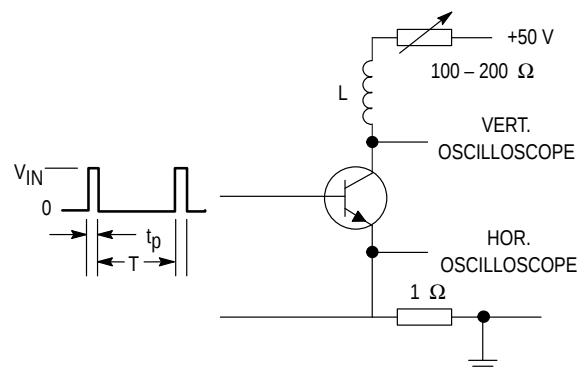


Figure 2. Test Circuit for $V_{CE(sus)}$

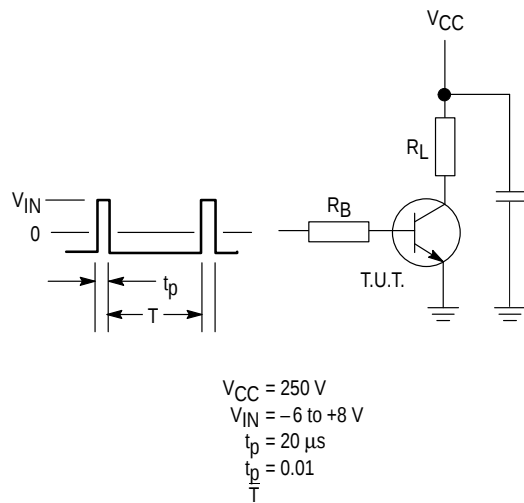


Figure 3. Test Circuit Resistive Load

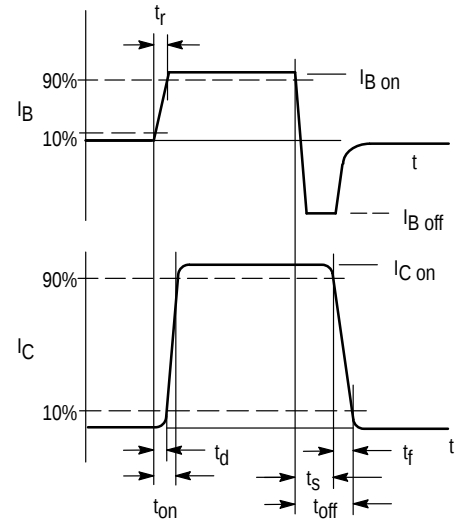


Figure 4. Switching Times Waveforms with Resistive Load

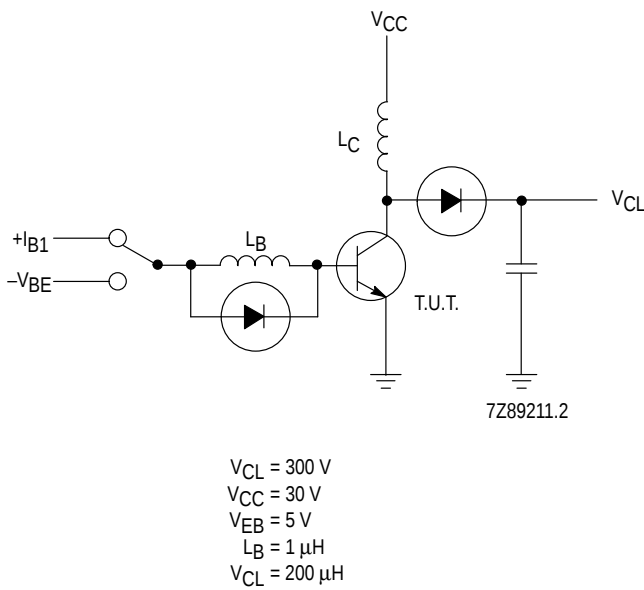


Figure 5. Test Circuit Inductive Load

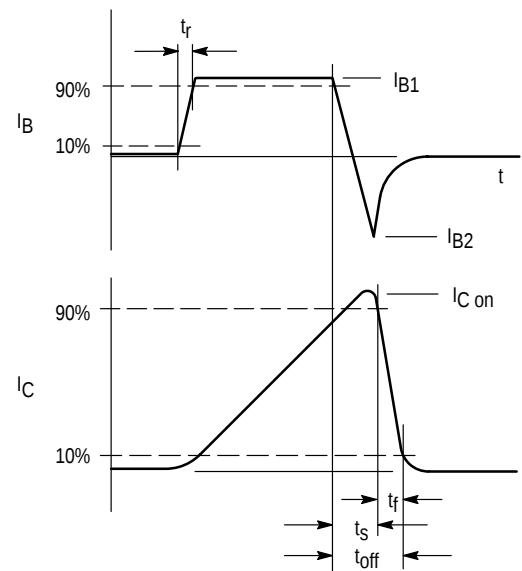


Figure 6. Switching Times Waveforms with Inductive Load

TEST CONDITIONS FOR ISOLATION TESTS*

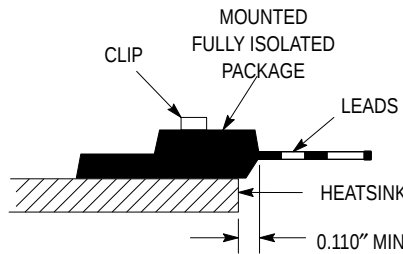


Figure 7. Screw or Clip Mounting Position for Isolation Test Number 1

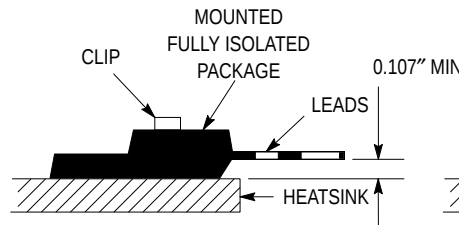


Figure 8. Clip Mounting Position for Isolation Test Number 2

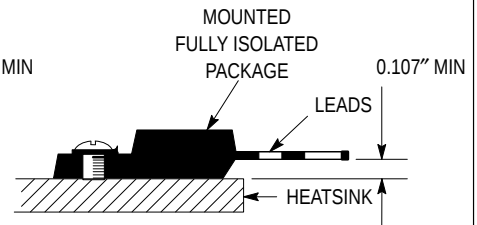


Figure 9. Screw Mounting Position for Isolation Test Number 3

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

MOUNTING INFORMATION

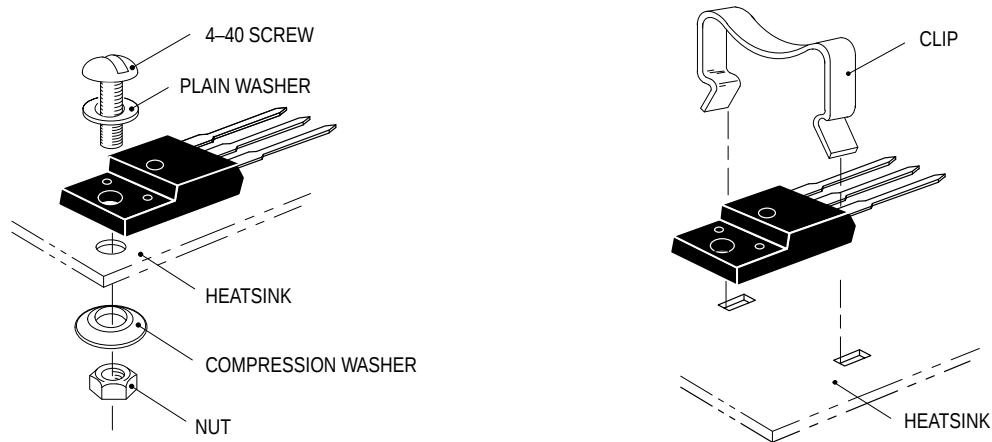


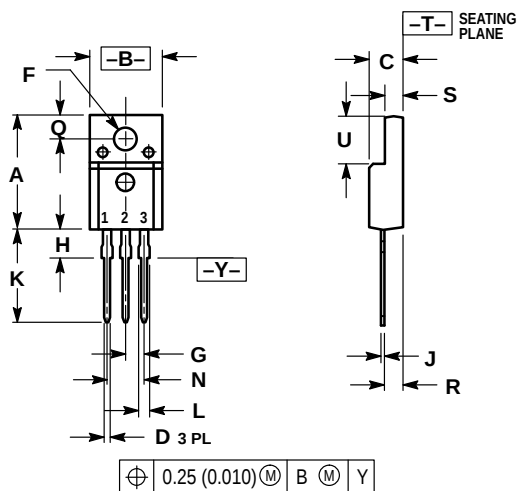
Figure 10. Typical Mounting Techniques for Isolated Package

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.

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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How to reach us:

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

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

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

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

