

ON Semiconductor

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FULL PAK™

High Voltage NPN Power Transistor

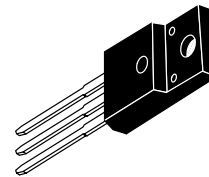
For Isolated Package Applications

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})

BUT11AF

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 V_{ISOL1}	4500	V
	Per Figure 8 V_{ISOL2}	3500	
	Per Figure 9 V_{ISOL3}	2500	
Collector Current — Continuous — Pulsed (1)	I_C I_{CM}	5.0 10	Adc
Base Current — Continuous — Pulsed (1)	I_B I_{BM}	2.0 4.0	Adc
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.

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) ($I_C = 100\text{ mA}$, $I_B = 0$, $L = 25\ \mu\text{H}$)	$V_{CE(sus)}$	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	mAdc
Emitter-Base Leakage ($V_{EB} = 9.0\text{ Vdc}$, $I_C = 0$)	I_{EBO}	–	–	10	mAdc

ON CHARACTERISTICS (1)

Collector-Emitter Saturation Voltage ($I_C = 2.5\text{ Adc}$, $I_B = 0.5\text{ Adc}$)	$V_{CE(sat)}$	–	–	1.5	Vdc
Base-Emitter Saturation Voltage ($I_C = 2.5\text{ Adc}$, $I_B = 0.5\text{ Adc}$)	$V_{BE(sat)}$	–	–	1.5	Vdc
DC Current Gain ($I_C = 5.0\text{ mAdc}$, $V_{CE} = 5.0\text{ Vdc}$)	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	ns
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 $\leq 2.0\%$.

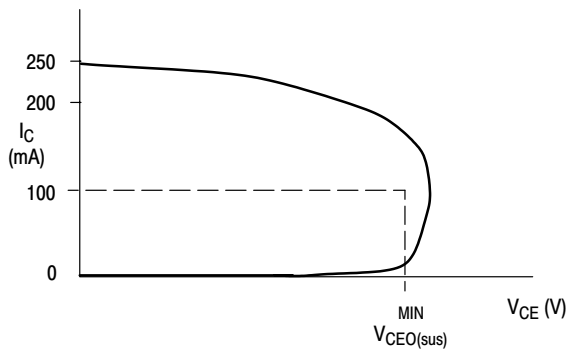


Figure 1. Oscilloscope Display for Sustaining Voltage

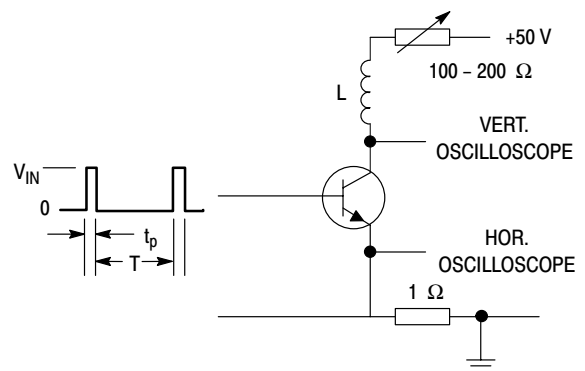


Figure 2. Test Circuit for $V_{CE(sus)}$

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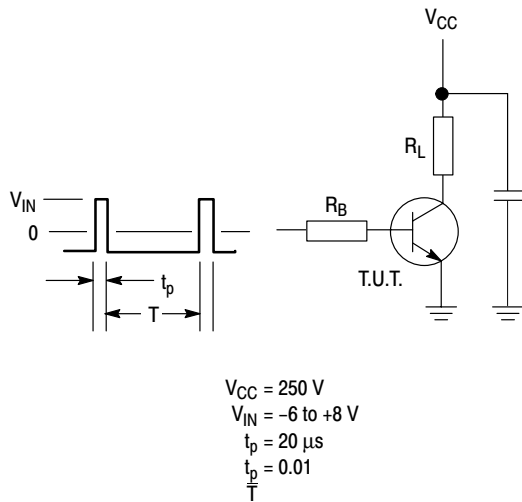


Figure 3. Test Circuit Resistive Load

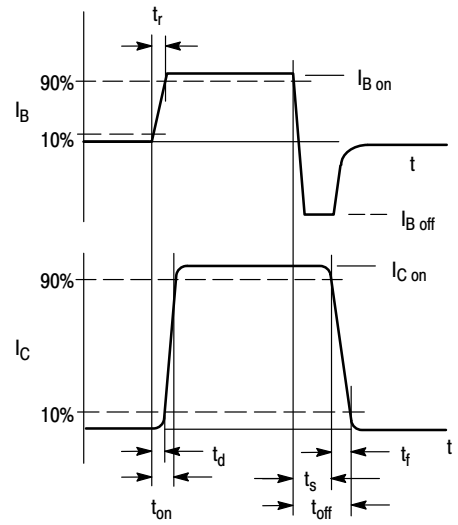


Figure 4. Switching Times Waveforms with Resistive Load

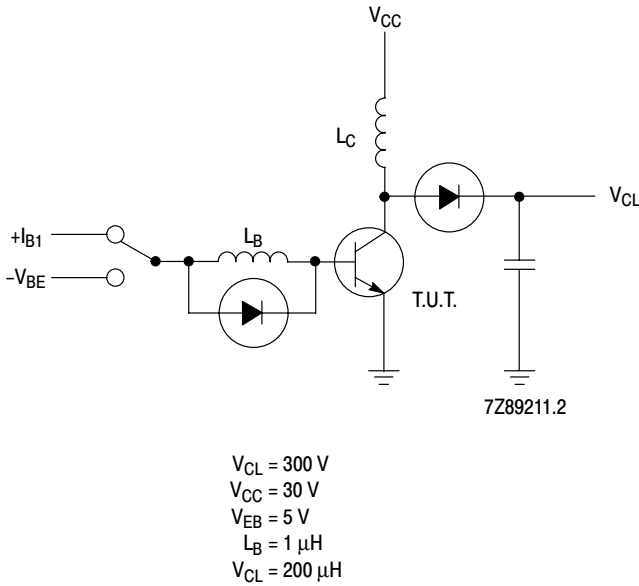


Figure 5. Test Circuit Inductive Load

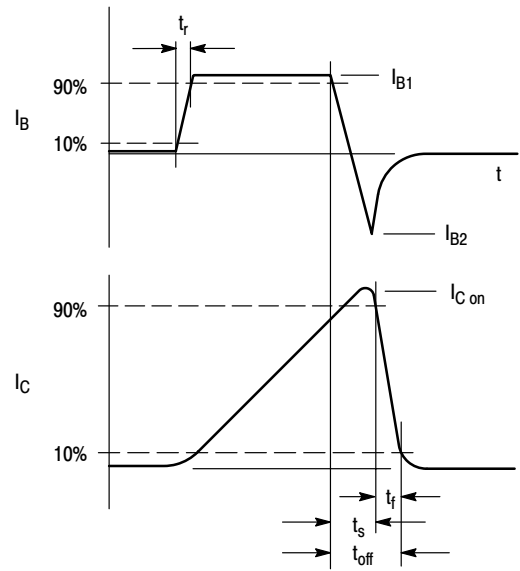


Figure 6. Switching Times Waveforms with Inductive Load

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TEST CONDITIONS FOR ISOLATION TESTS*

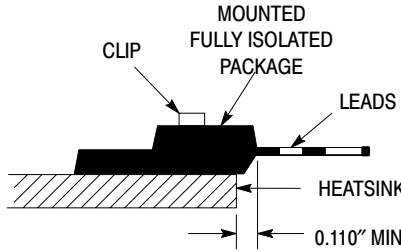


Figure 7. Screw or Clip Mounting Position for Isolation Test Number 1

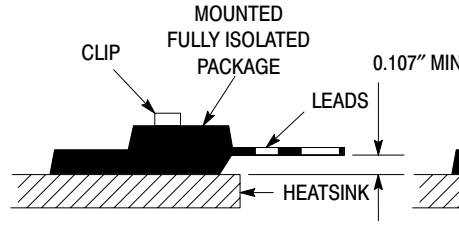


Figure 8. Clip Mounting Position for Isolation Test Number 2

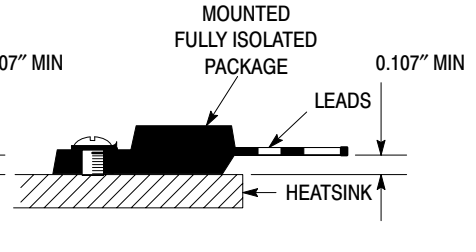


Figure 9. Screw Mounting Position for Isolation Test Number 3

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

MOUNTING INFORMATION

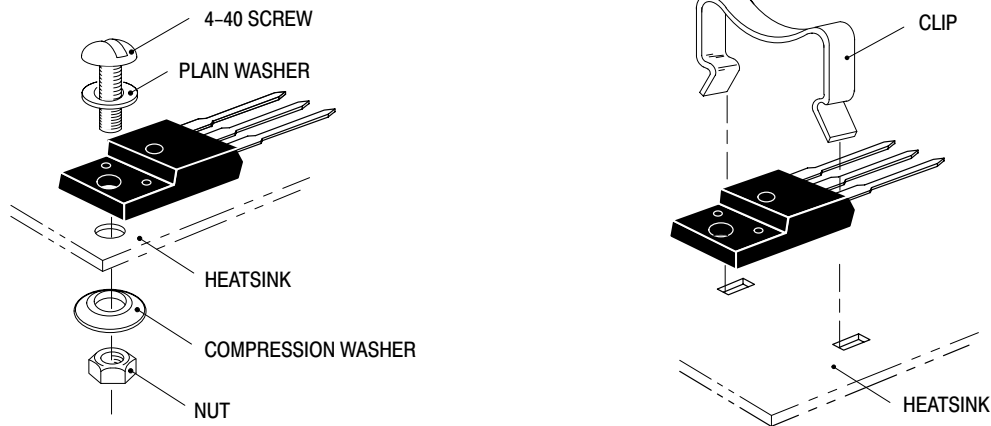


Figure 10. Typical Mounting Techniques for Isolated Package

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.

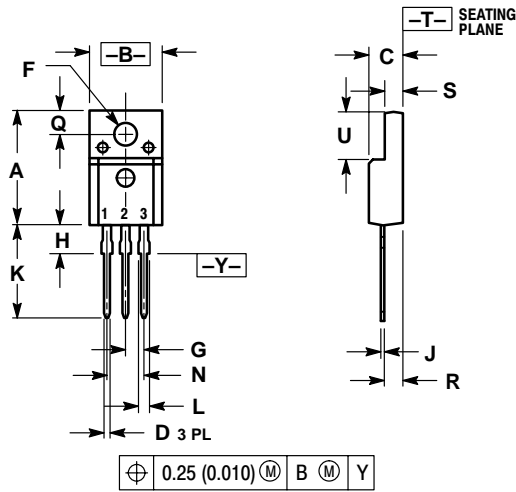
Destructive laboratory tests show that using a hex head 4–40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

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

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PACKAGE DIMENSIONS

TO-220 FULLPAK CASE 221D-02 ISSUE D



- 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

Notes

Notes

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