

# International IOR Rectifier

PD -90718B

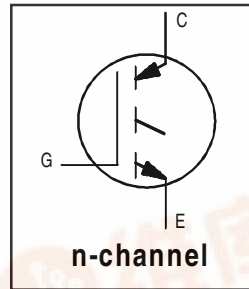
## IRGMC50F

INSULATED GATE BIPOLAR TRANSISTOR

Fast Speed IGBT

### Features

- Electrically Isolated and Hermetically Sealed
- Simple Drive Requirements
- Latch-proof
- Fast Speed operation 3 kHz - 8 kHz
- Switching-loss rating includes all "tail" losses



$V_{CES} = 600V$
$V_{CE(on) max} = 1.7V$
@ $V_{GE} = 15V, I_C = 30A$

### Description

Insulated Gate Bipolar Transistors (IGBTs) from International Rectifier have higher usable current densities than comparable bipolar transistors, while at the same time having simpler gate-drive requirements of the familiar power MOSFET. They provide substantial benefits to a host of high-voltage, high-current applications.

The performance of various IGBTs varies greatly with frequency. Note that IR now provides the designer with a speed benchmark ( $f_{IC/2}$ , or the "half-current frequency"), as well as an indication of the current handling capability of the device.



### Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Breakdown Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	35*	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	30	
$I_{CM}$	Pulsed Collector Current ①	210	
$I_{LM}$	Clamped Inductive Load Current ②	210	
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	150	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	60	
$T_J$	Operating Junction and Storage Temperature Range	-55 to + 150	°C
$T_{STG}$			
	Lead Temperature	300 (0.063in./1.6mm from case for 10s)	
	Weight	9.3 (typical)	g

\*Current is limited by pin diameter

### Thermal Resistance

	Parameter	Min	Typ	Max	Units	Test Conditions
$R_{thJC}$	Junction-to-Case	—	—	0.83	°C/W	
$R_{thCS}$	Case-to-Sink	—	0.21	—		
$R_{thJA}$	Junction-to-Ambient	—	—	48		

For footnotes refer to the last page

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**Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

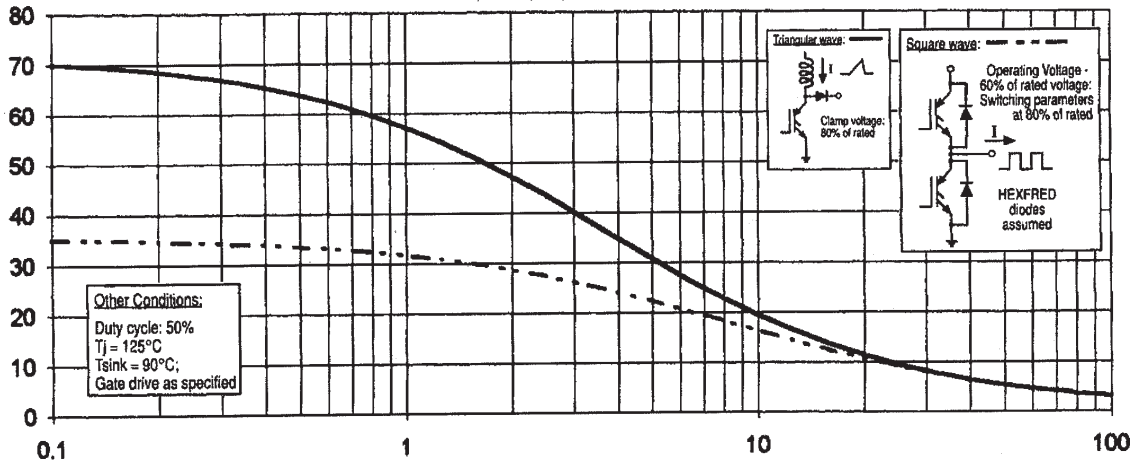
	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0 mA
V <sub>(BR)ECS</sub>	Emitter-to-Collector Breakdown Voltage ③	15	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0 A
ΔV <sub>(BR)CES/ΔT<sub>J</sub></sub>	Temperature Coeff. of Breakdown Voltage	—	0.62	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0 mA
V <sub>CE(ON)</sub>	Collector-to-Emitter Saturation Voltage	—	—	1.7	V	I <sub>C</sub> = 30A V <sub>GE</sub> = 15V
		—	2.0	—		I <sub>C</sub> = 35A See Fig.5
		—	1.7	—		I <sub>C</sub> = 30A, T <sub>J</sub> = 125°C
V <sub>GE(th)</sub>	Gate Threshold Voltage	3.0	—	5.5		V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250 μA
ΔV <sub>GE(th)/ΔT<sub>J</sub></sub>	Temperature Coeff. of Threshold Voltage	—	-14	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250 μA
g <sub>fe</sub>	Forward Transconductance ④	21	—	—	S	V <sub>CE</sub> ≥ 15V, I <sub>C</sub> = 30A
I <sub>CES</sub>	Zero Gate Voltage Collector Current	—	—	50	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 480V
		—	—	2000		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 480V, T <sub>J</sub> = 125°C
I <sub>GES</sub>	Gate-to-Emitter Leakage Current	—	—	±100	nA	V <sub>GE</sub> = ±20V

**Switching Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

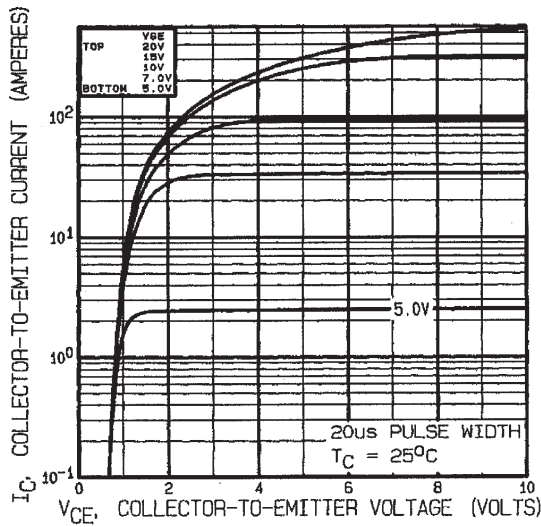
	Parameter	Min.	Typ.	Max.	Units	Conditions
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	120	140	nC	I <sub>C</sub> = 30A V <sub>CC</sub> = 300V See Fig. 8 V <sub>GE</sub> = 15V
Q <sub>ge</sub>	Gate - Emitter Charge (turn-on)	—	15	35		
Q <sub>gc</sub>	Gate - Collector Charge (turn-on)	—	35	70		
t <sub>d(on)</sub>	Turn-On Delay Time	—	—	48	ns	I <sub>C</sub> = 30A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 2.35Ω Energy losses include "tail" See Fig. 9, 10 & 13
t <sub>r</sub>	Rise Time	—	—	100		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	—	540		
t <sub>f</sub>	Fall Time	—	—	360		
E <sub>on</sub>	Turn-On Switching Loss	—	0.2	—	mJ	T <sub>J</sub> = 125°C I <sub>C</sub> = 30A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 2.35Ω Energy losses include "tail" See Fig. 11, 13
E <sub>off</sub>	Turn-off Switching Loss	—	5.8	—		
E <sub>ts</sub>	Total Switching Loss	—	6.0	10		
t <sub>d(on)</sub>	Turn-On Delay Time	—	25	—	ns	T <sub>J</sub> = 125°C I <sub>C</sub> = 30A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 2.35Ω Energy losses include "tail" See Fig. 11, 13
t <sub>r</sub>	Rise Time	—	49	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	440	—		
t <sub>f</sub>	Fall Time	—	410	—		
E <sub>ts</sub>	Total Switching Loss	—	10	—	mJ	
L <sub>C+LE</sub>	Total Inductance	—	6.8	—	nH	Measured from Collector lead (6mm/ 0.25in. from package) to Emitter lead (6mm / 0.25in. from package)
C <sub>ies</sub>	Input Capacitance	—	3000	—	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V See Fig. 7 f = 1.0MHz
C <sub>oes</sub>	Output Capacitance	—	340	—		
C <sub>res</sub>	Reverse Transfer Capacitance	—	40	—		

**Note: Corresponding Spice and Saber models are available on the Website.**

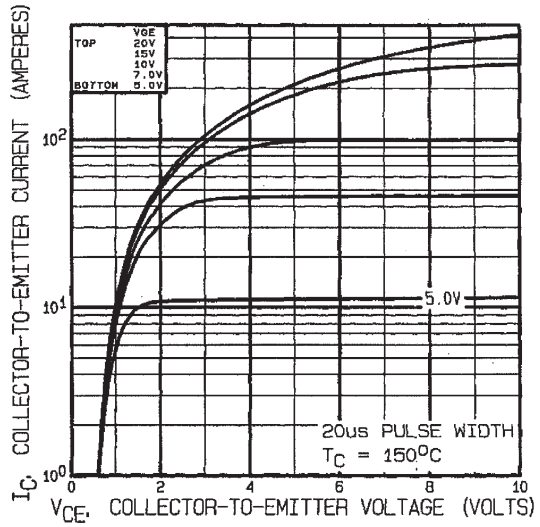
For footnotes refer to the last page



**Fig. 1 - Typical Load Current vs. Frequency**  
 (For square wave,  $I = I_{\text{RMS}}$  of fundamental; for triangular wave,  $I = I_{\text{PK}}$ )



**Fig. 2 - Typical Output Characteristics**



**Fig. 3 - Typical Transfer Characteristics**

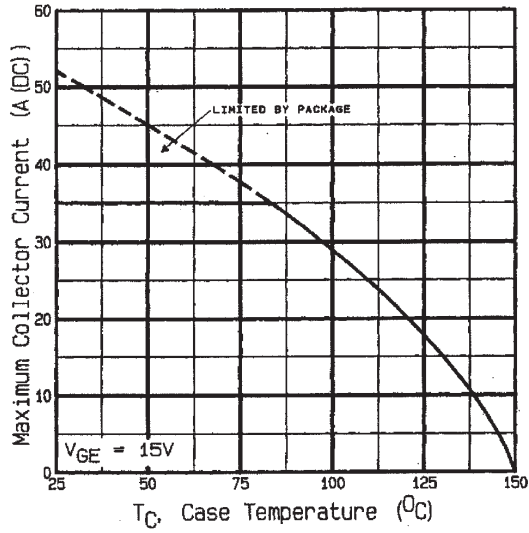


Fig. 4 - Maximum Collector Current vs. Case Temperature

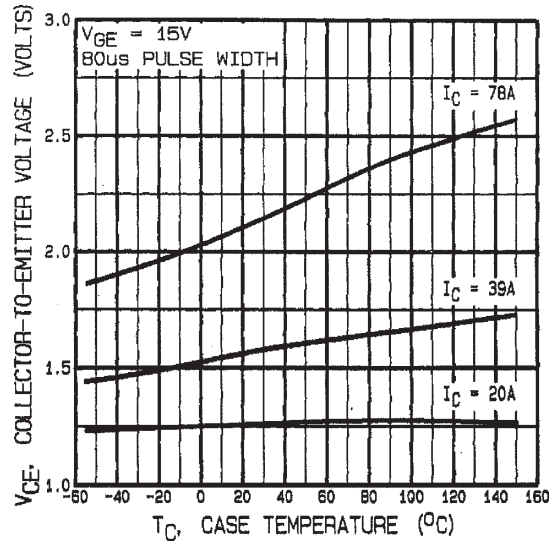


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

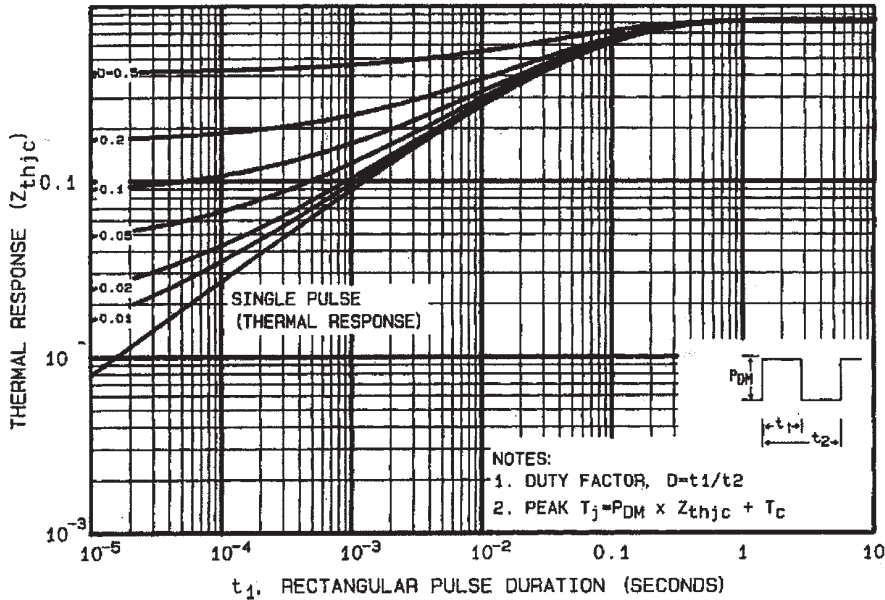


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

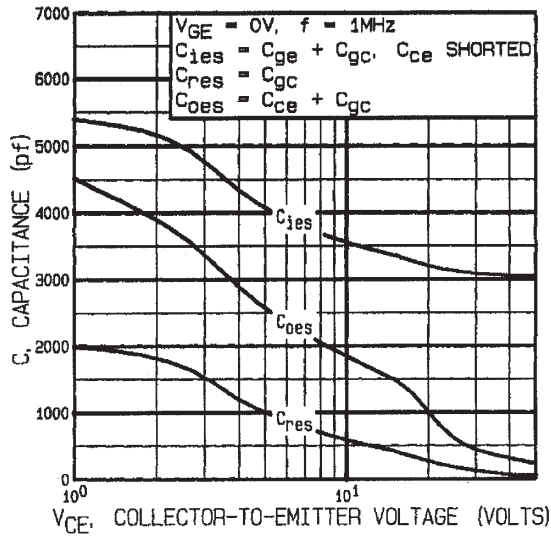


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

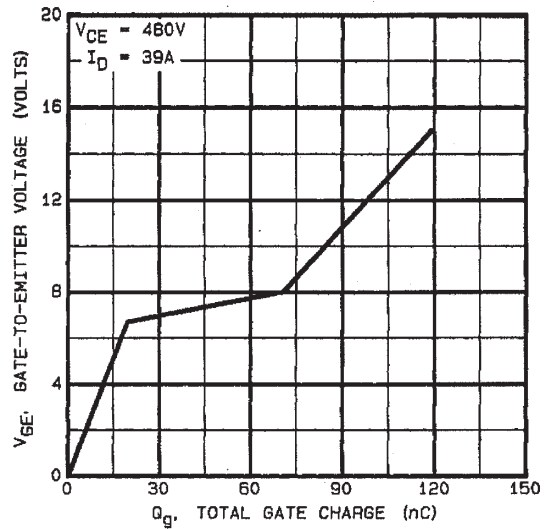


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

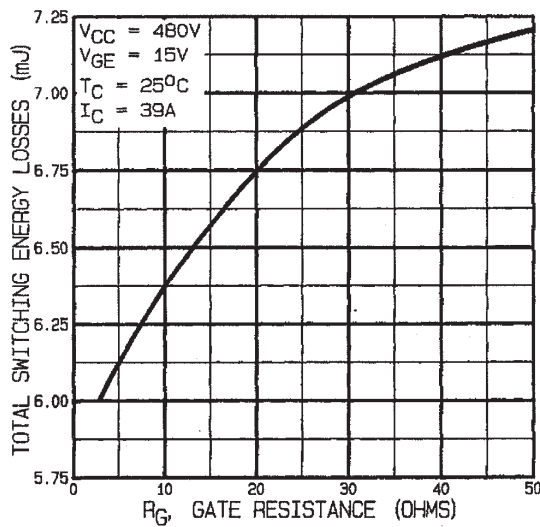


Fig. 9 - Typical Switching Losses vs. Gate Resistance

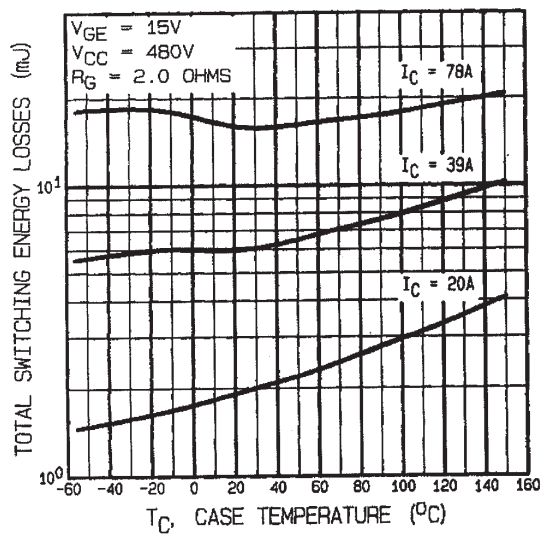
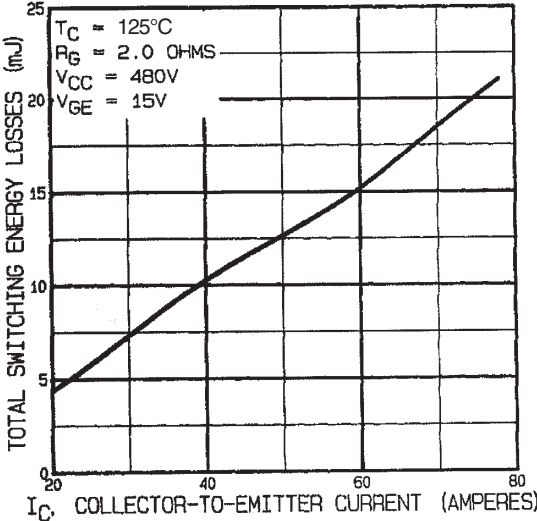
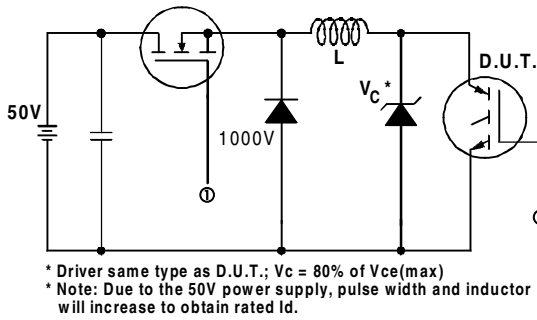


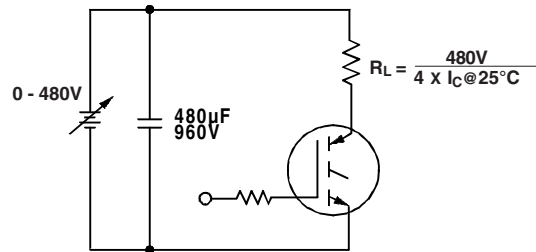
Fig. 10 - Typical Switching Losses vs. Junction Temperature



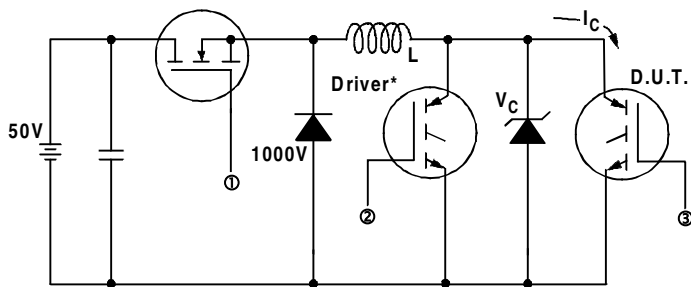
**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current



**Fig. 12a** - Clamped Inductive Load Test Circuit

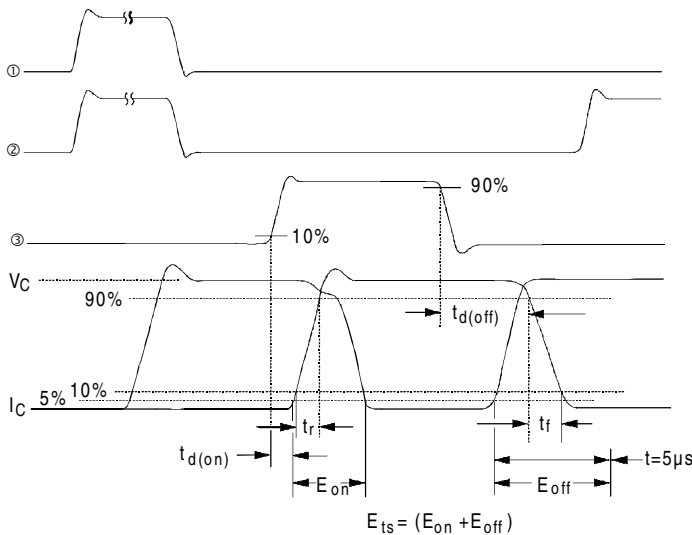


**Fig. 12b** - Pulsed Collector Current Test Circuit



**Fig. 13a** - Switching Loss Test Circuit

\* Driver same type as D.U.T.,  $V_C = 480V$



**Fig. 13b** - Switching Loss Waveforms

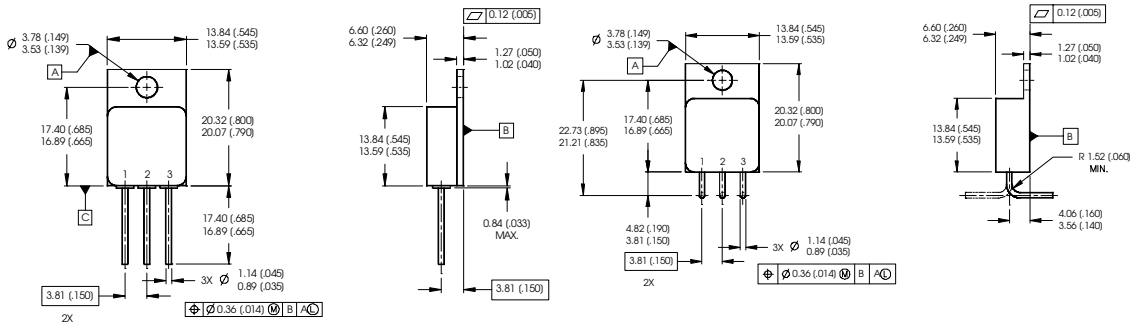
# IRGMC50F

International  
**IR** Rectifier

**Notes:**

- ① Repetitive rating;  $V_{GE} = 20V$ , pulse width limited by max. junction temperature.
- ②  $V_{CC} = 80\%(V_{CES})$ ,  $V_{GE} = 20V$ ,  $L = 10\mu H$ ,  $R_G = 10\Omega$
- ③ Pulse width  $\leq 80\mu s$ ; duty factor  $\leq 0.1\%$ .
- ④ Pulse width  $5.0\mu s$ , single shot.

## Case Outline and Dimensions — TO-254AA



**NOTES:**

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
3. CONTROLLING DIMENSION: INCH.
4. CONFORMS TO JEDEC OUTLINE TO-254AA.

**LEGEND**

- 1 = COLLECTOR
- 2 = EMITTER
- 3 = GATE

**CAUTION**

**BERYLLIA WARNING PER MIL-PRF-19500**

Packages containing beryllia shall not be ground, sandblasted, machined or have other operations performed on them which will produce beryllia or beryllium dust. Furthermore, beryllium oxide packages shall not be placed in acids that will produce fumes containing beryllium.

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