

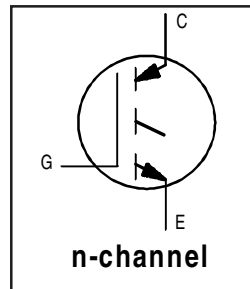
# IRGIH50F

## 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
- High operating frequency
- Switching-loss rating includes all "tail" losses

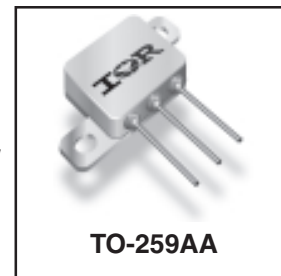


$V_{CES} = 1200V$
$V_{CE(on) \max} = 2.9V$
@ $V_{GE} = 15V, I_C = 25A$

### 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	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	45	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	25	
$I_{CM}$	Pulsed Collector Current ①	180	
$I_{LM}$	Clamped Inductive Load Current ②	90	
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	200	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	80	
$T_J$	Operating Junction and Storage Temperature Range	-55 to + 150	°C
$T_{STG}$			
	Lead Temperature	300 (0.063in./1.6mm from case for 10s)	
	Weight	10.5 (typical)	g

### Thermal Resistance

	Parameter	Min	Typ	Max	Units	Test Conditions
$R_{thJC}$	Junction-to-Case	—	—	0.625	°C/W	
$R_{thCS}$	Case-to-Sink	—	0.21	—		
$R_{thJA}$	Junction-to-Ambient	—	—	30		

For footnotes refer to the last page  
[www.irf.com](http://www.irf.com)

**Electrical Characteristics @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)**

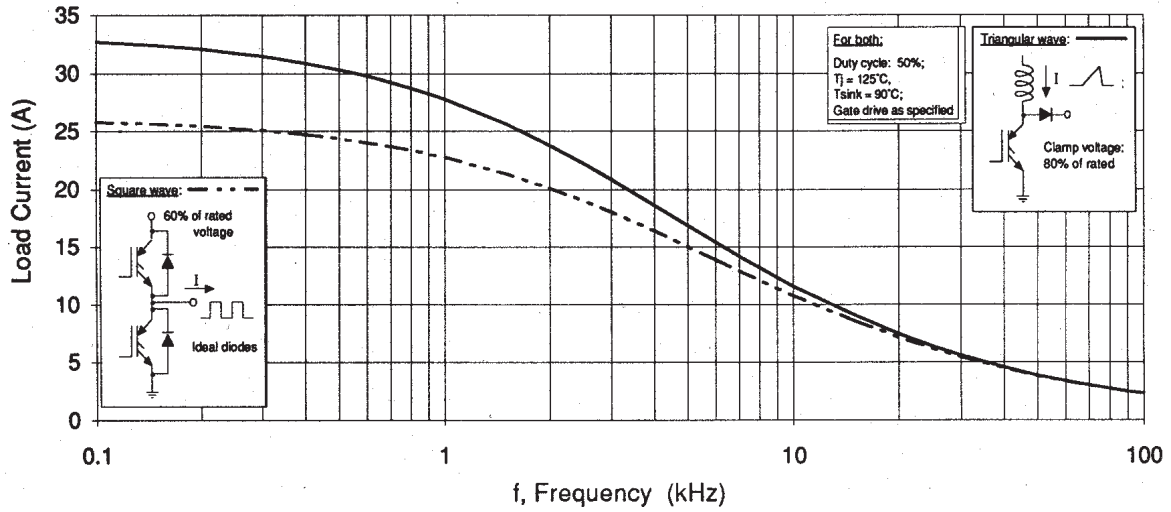
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	$V_{GE} = 0V, I_C = 100 \mu A$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage ③	22	—	—	V	$V_{GE} = 0V, I_C = 1.0 A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.1	—	V/°C	$V_{GE} = 0V, I_C = 1.0 mA$
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	2.1	2.9	V	$I_C = 25A, V_{GE} = 15V$
		—	2.5	—		$I_C = 45A$
		—	2.4	—		$I_C = 25A, T_J = 125^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	5.5		$V_{CE} = V_{GE}, I_C = 250 \mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-14	—	mV/°C	$V_{CE} = V_{GE}, I_C = 250 \mu A$
$g_{fe}$	Forward Transconductance ④	7.5	—	—	S	$V_{CE} = 100V, I_C = 25A$
$I_{CES}$	Zero Gate Voltage Collector Current	—	—	100	$\mu A$	$V_{GE} = 0V, V_{CE} = 960V$
		—	—	1200		$V_{GE} = 0V, V_{CE} = 960V, T_J = 125^\circ\text{C}$
$I_{GES}$	Gate-to-Emitter Leakage Current	—	—	$\pm 100$	nA	$V_{GE} = \pm 20V$

**Switching Characteristics @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)**

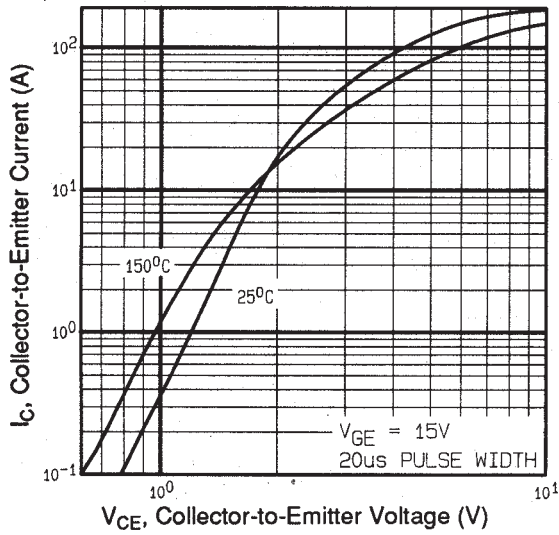
	Parameter	Min.	Typ.	Max.	Units	Conditions
$Q_g$	Total Gate Charge (turn-on)	—	—	100	nC	$I_C = 25A$
$Q_{ge}$	Gate - Emitter Charge (turn-on)	—	—	21		$V_{CC} = 400V$
$Q_{gc}$	Gate - Collector Charge (turn-on)	—	—	43		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	—	—	68	ns	$I_C = 25A, V_{CC} = 400V$
$t_r$	Rise Time	—	—	26		$V_{GE} = 15V, R_G = 2.35\Omega$
$t_{d(off)}$	Turn-Off Delay Time	—	—	480		Energy losses include "tail" ⑤
$t_f$	Fall Time	—	—	330		See Fig. 9, 10, 14
$E_{on}$	Turn-On Switching Loss	—	1.4	—		mJ
$E_{off}$	Turn-off Switching Loss	—	4.5	—		
$E_{ts}$	Total Switching Loss	—	5.9	8.2		
$t_{d(on)}$	Turn-On Delay Time	—	33	—	ns	$T_J = 125^\circ\text{C}$
$t_r$	Rise Time	—	15	—		$I_C = 25A, V_{CC} = 400V$
$t_{d(off)}$	Turn-Off Delay Time	—	590	—		$V_{GE} = 15V, R_G = 2.35\Omega$
$t_f$	Fall Time	—	500	—		Energy losses include "tail" ⑤
$E_{ts}$	Total Switching Loss	—	13	—		See Fig. 11, 14
$L_C+L_E$	Total Inductance	—	6.8	—	nH	Measured from Collector lead (6mm/0.25in. from package) to Emitter lead (6mm / 0.25in. from package)
$C_{ies}$	Input Capacitance	—	2400	—	pF	$V_{GE} = 0V$
$C_{oes}$	Output Capacitance	—	140	—		$V_{CC} = 30V$
$C_{res}$	Reverse Transfer Capacitance	—	28	—		$f = 1.0MHz$

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

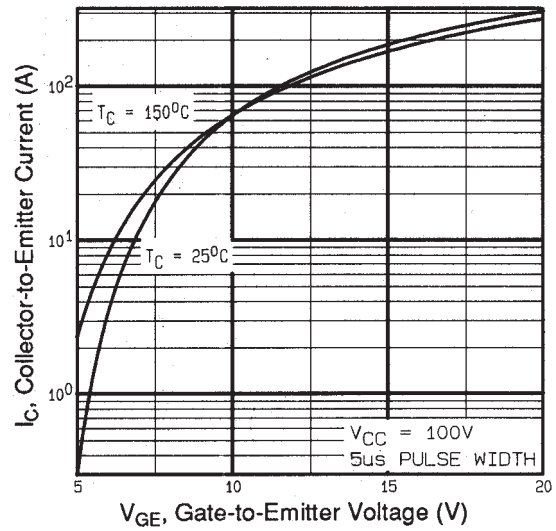
For footnotes refer to the last page



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



**Fig. 2 - Typical Output Characteristics**



**Fig. 3 - Typical Transfer Characteristics**

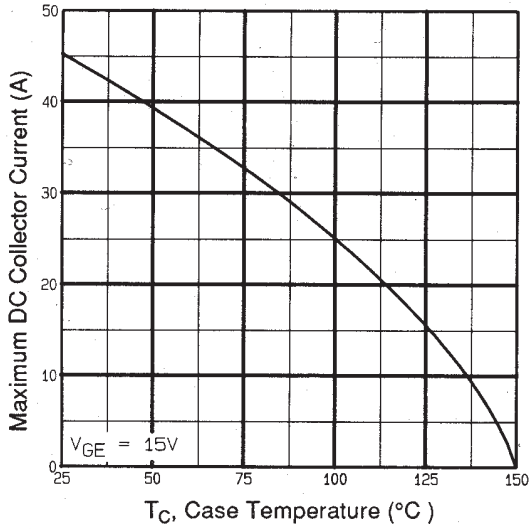


Fig. 4 - Maximum Collector Current vs. Case Temperature

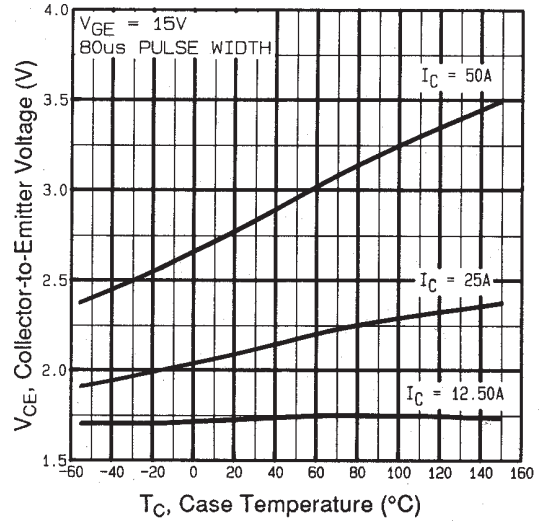


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

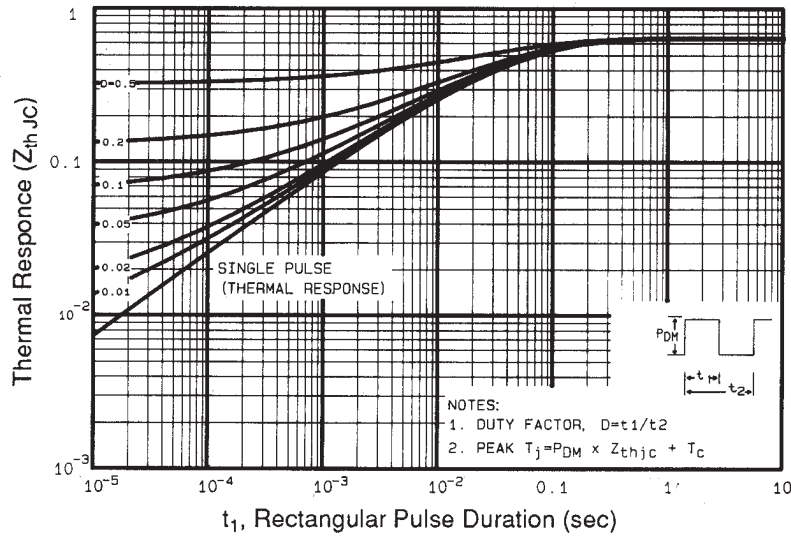


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

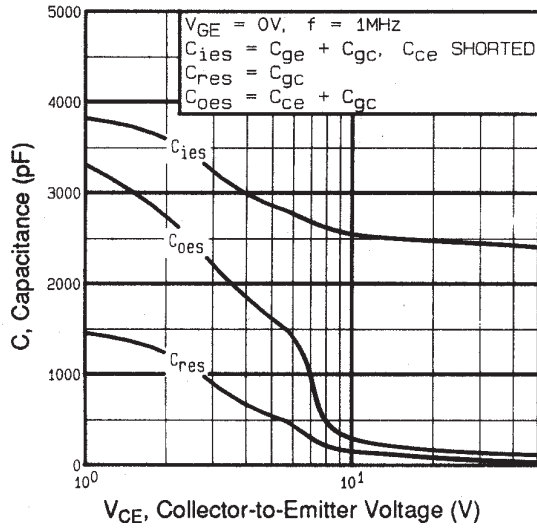


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

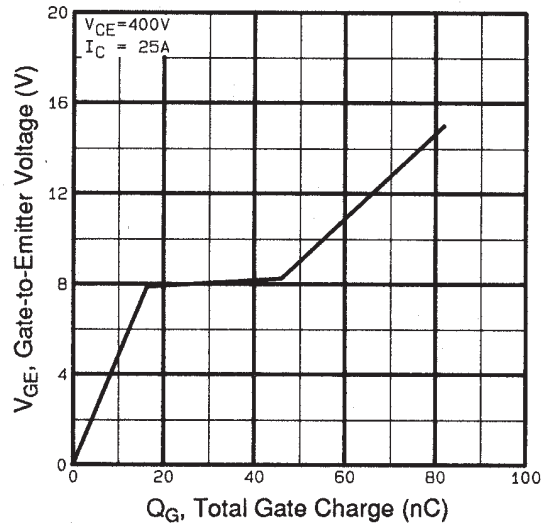


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

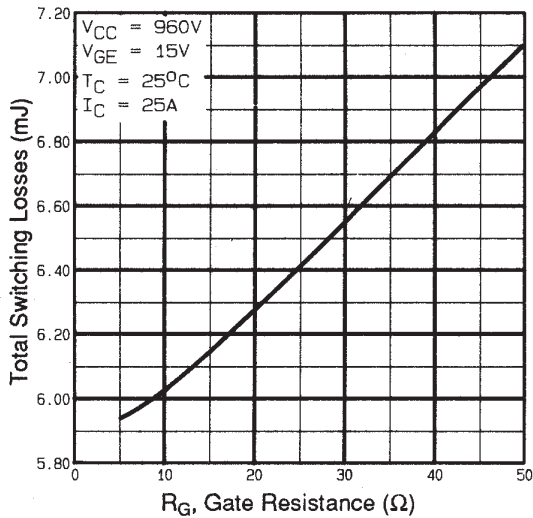


Fig. 9 - Typical Switching Losses vs. Gate Resistance

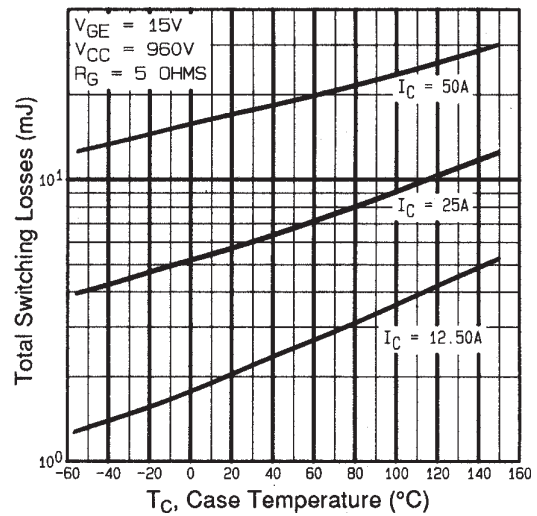
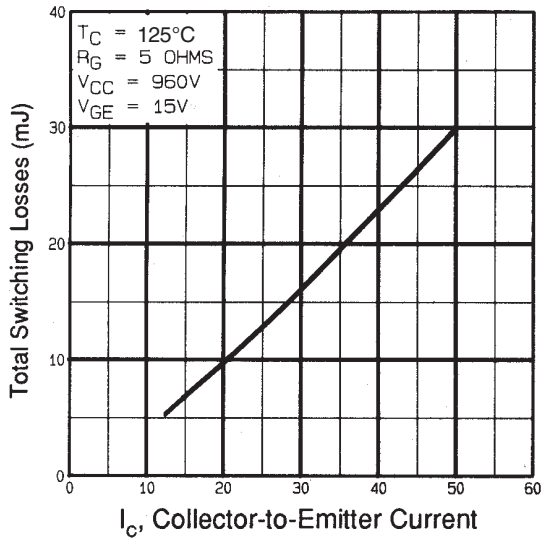
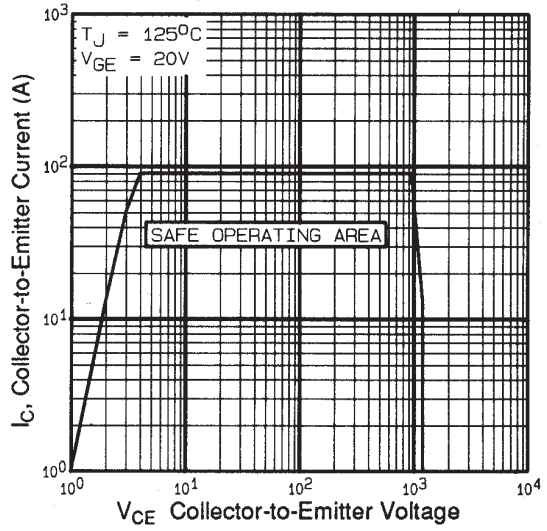


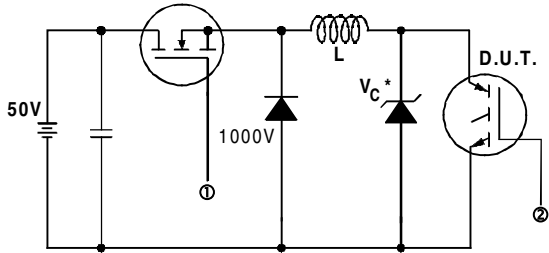
Fig. 10 - Typical Switching Losses vs. Junction Temperature



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

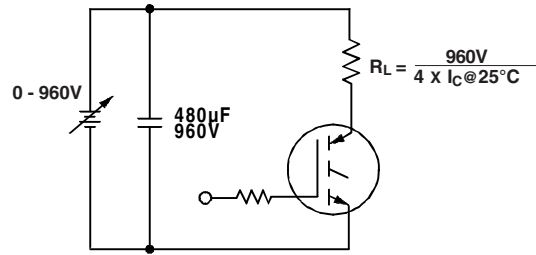


**Fig. 12** - Turn-Off SOA

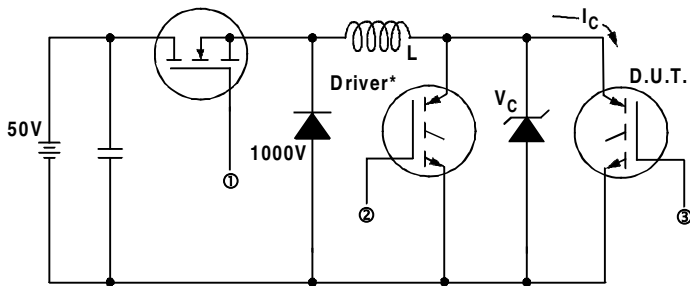


\* Driver same type as D.U.T.;  $V_c = 80\%$  of  $V_{ce(max)}$   
\* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated  $I_d$ .

**Fig. 13a** - Clamped Inductive Load Test Circuit



**Fig. 13b** - Pulsed Collector Current Test Circuit



**Fig. 14a** - Switching Loss Test Circuit

\* Driver same type as D.U.T.,  $V_C = 960V$



**Fig. 14b** - Switching Loss Waveforms

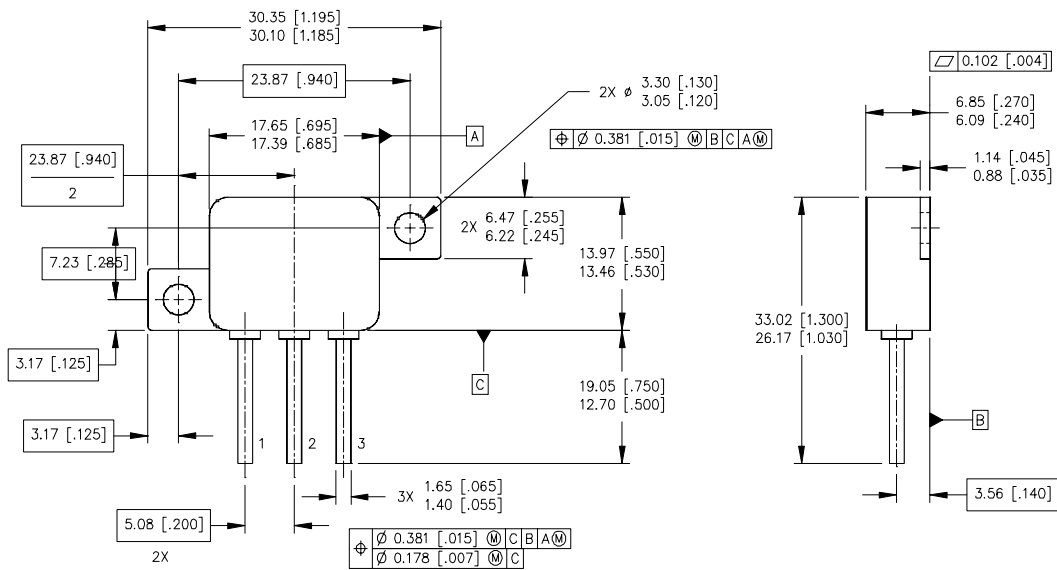
# IRGIH50F

International  
**IR** Rectifier

**Notes:**

- ① Repetitive rating;  $V_{GE} = 20V$ , pulse width limited by max. junction temperature.
- ②  $V_{CC} = 80\%(V_{CES})$ ,  $V_{GE} = 20V$ ,  $L = 10\mu H$ ,  $R_G = 5.0\Omega$
- ③ Pulse width  $\leq 80\mu s$ ; duty factor  $\leq 0.1\%$ .
- ④ Pulse width  $5.0\mu s$ , single shot.
- ⑤ Equipment limitation.

## Case Outline and Dimensions — TO-259AA



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME 14.5M-1994.
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. CONTROLLING DIMENSION: INCH
4. CONFORMS TO JEDEC OUTLINE TO-259AA.

**LEGEND**

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

International  
**IR** Rectifier

**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105  
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*Data and specifications subject to change without notice. 02/02*