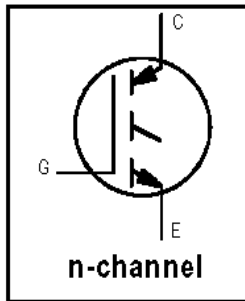


# IRG4PF50WPbF

## INSULATED GATE BIPOLAR TRANSISTOR

### Features

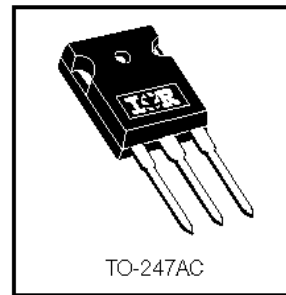
- Optimized for use in Welding and Switch-Mode Power Supply applications
- Industry benchmark switching losses improve efficiency of all power supply topologies
- 50% reduction of E<sub>off</sub> parameter
- Low IGBT conduction losses
- Latest technology IGBT design offers tighter parameter distribution coupled with exceptional reliability
- Lead-Free



$V_{CES} = 900V$
$V_{CE(on)} \text{ typ.} = 2.25V$
@ $V_{GE} = 15V, I_C = 28A$

### Benefits

- Lower switching losses allow more cost-effective operation and hence efficient replacement of larger-die MOSFETs up to 100kHz
- Of particular benefit in single-ended converters and Power Supplies 150W and higher
- Reduction in critical E<sub>off</sub> parameter due to minimal minority-carrier recombination coupled with low on-state losses allow maximum flexibility in device application



### Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Breakdown Voltage	900	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	51	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	28	
$I_{CM}$	Pulsed Collector Current $\text{\textcircled{1}}$	204	
$I_{LM}$	Clamped Inductive Load Current $\text{\textcircled{2}}$	204	
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	V
$E_{ARV}$	Reverse Voltage Avalanche Energy $\text{\textcircled{3}}$	186	mJ
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	200	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	78	
$T_J$	Operating Junction and	-55 to + 150	$^\circ C$
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (0.063 in. (1.6mm from case )	

### Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.64	$^\circ C/W$
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	40	
Wt	Weight	6 (0.21)	—	g (oz)

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International  
**IR** Rectifier

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

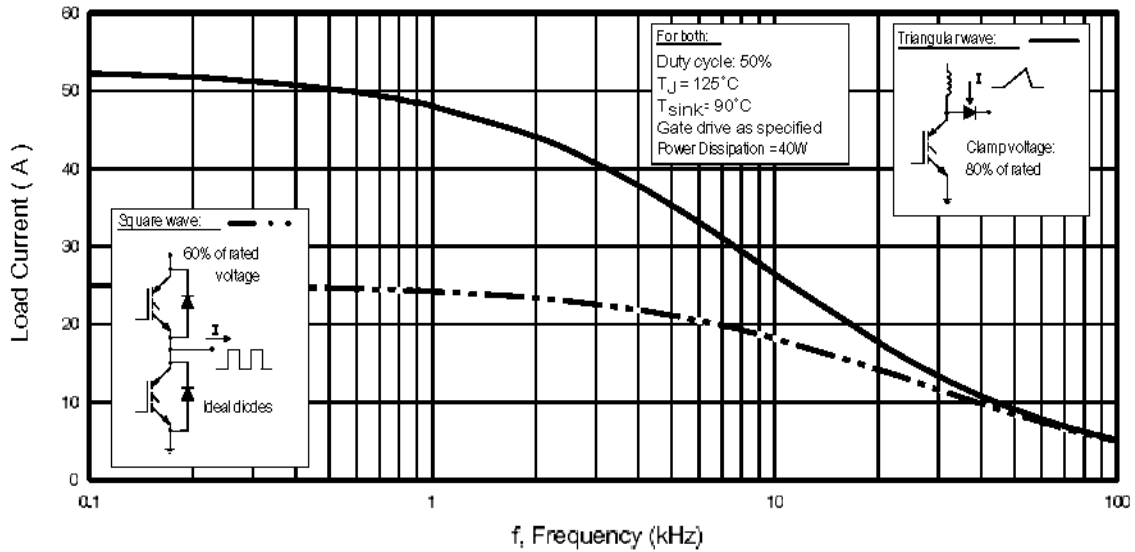
	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage	900	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA
V <sub>(BR)ECS</sub>	Emitter-to-Collector Breakdown Voltage ④	18	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0A
ΔV <sub>(BR)CES/ΔT<sub>J</sub></sub>	Temperature Coeff. of Breakdown Voltage	—	0.295	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 3.5mA
V <sub>CE(ON)</sub>	Collector-to-Emitter Saturation Voltage	—	2.25	2.7	V	I <sub>C</sub> = 28A, V <sub>GE</sub> = 15V
		—	2.74	—		I <sub>C</sub> = 60A, V <sub>GE</sub> = 15V
		—	2.12	—		I <sub>C</sub> = 28A, T <sub>J</sub> = 150°C
V <sub>GE(th)</sub>	Gate Threshold Voltage	3.0	—	6.0		V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
ΔV <sub>GE(th)/ΔT<sub>J</sub></sub>	Temperature Coeff. of Threshold Voltage	—	-13	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1.0mA
g <sub>fe</sub>	Forward Transconductance ⑤	26	39	—	S	V <sub>CE</sub> ≥ 15V, I <sub>C</sub> = 28A
I <sub>CES</sub>	Zero Gate Voltage Collector Current	—	—	500	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 900V
		—	—	2.0		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 10V, T <sub>J</sub> = 25°C
		—	—	5.0	mA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 900V, T <sub>J</sub> = 150°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)

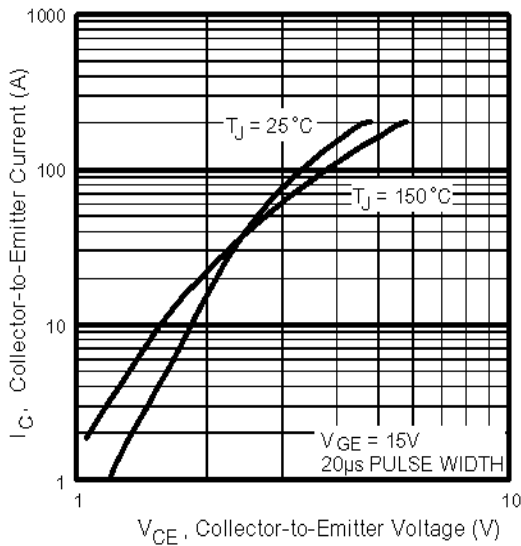
	Parameter	Min.	Typ.	Max.	Units	Conditions
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	160	240	nC	I <sub>C</sub> = 28A V <sub>CC</sub> = 400V V <sub>GE</sub> = 15V See Fig. 8
Q <sub>ge</sub>	Gate - Emitter Charge (turn-on)	—	19	29		
Q <sub>gc</sub>	Gate - Collector Charge (turn-on)	—	53	80		
t <sub>d(on)</sub>	Turn-On Delay Time	—	29	—	ns	T <sub>J</sub> = 25°C I <sub>C</sub> = 28A, V <sub>CC</sub> = 720V V <sub>GE</sub> = 15V, R <sub>G</sub> = 5.0Ω Energy losses include "tail"
t <sub>r</sub>	Rise Time	—	26	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	110	170		
t <sub>f</sub>	Fall Time	—	150	220		
E <sub>on</sub>	Turn-On Switching Loss	—	0.19	—	mJ	See Fig. 10, 11, 13, 14
E <sub>off</sub>	Turn-Off Switching Loss	—	1.08	—		
E <sub>ts</sub>	Total Switching Loss	—	1.25	1.7		
t <sub>d(on)</sub>	Turn-On Delay Time	—	28	—	ns	T <sub>J</sub> = 150°C, I <sub>C</sub> = 28A, V <sub>CC</sub> = 720V V <sub>GE</sub> = 15V, R <sub>G</sub> = 5.0Ω Energy losses include "tail"
t <sub>r</sub>	Rise Time	—	26	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	280	—		
t <sub>f</sub>	Fall Time	—	90	—		
E <sub>ts</sub>	Total Switching Loss	—	3.45	—	mJ	See Fig. 13, 14
L <sub>E</sub>	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
C <sub>ies</sub>	Input Capacitance	—	3300	—	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V f = 1.0MHz See Fig. 7
C <sub>oes</sub>	Output Capacitance	—	200	—		
C <sub>res</sub>	Reverse Transfer Capacitance	—	45	—		

### Notes:

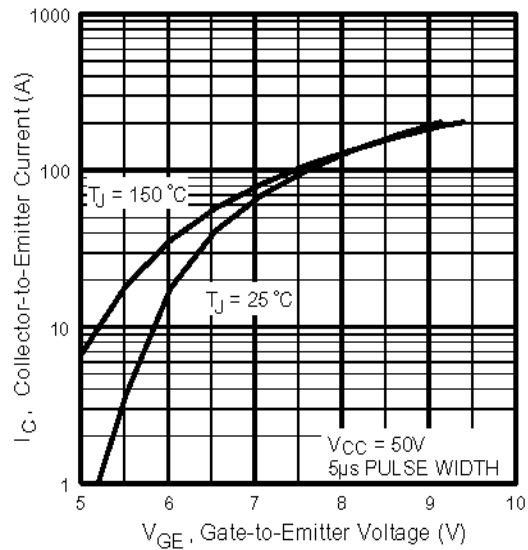
- ① Repetitive rating; V<sub>GE</sub> = 20V, pulse width limited by max. junction temperature. ( See fig. 13b )
- ② V<sub>CC</sub> = 80%(V<sub>CES</sub>), V<sub>GE</sub> = 20V, L = 10μH, R<sub>G</sub> = 5.0Ω, (See fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width ≤ 80μs; duty factor ≤ 0.1%.
- ⑤ Pulse width 5.0μs, single shot.



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



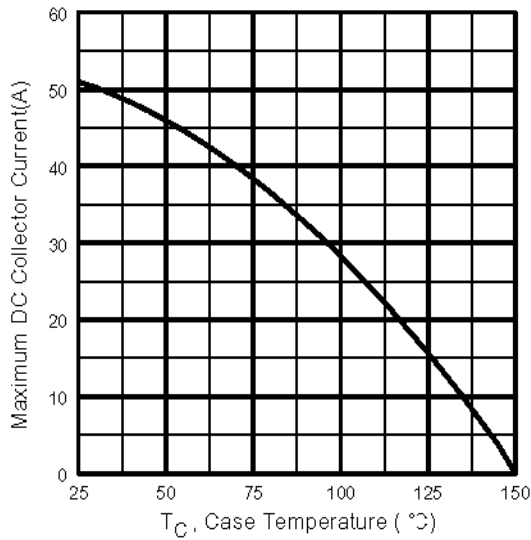
**Fig. 2 - Typical Output Characteristics**



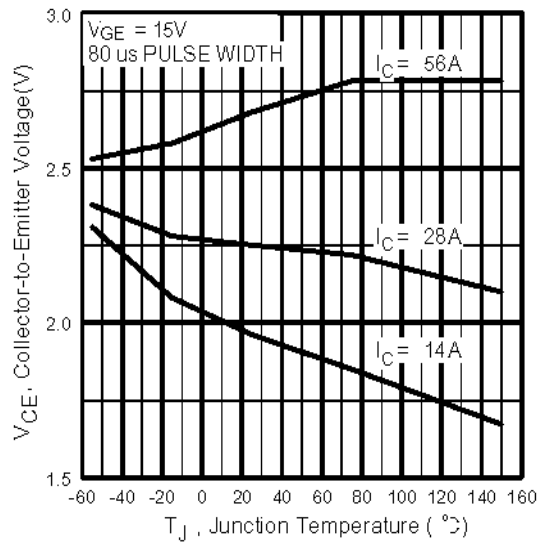
**Fig. 3 - Typical Transfer Characteristics**

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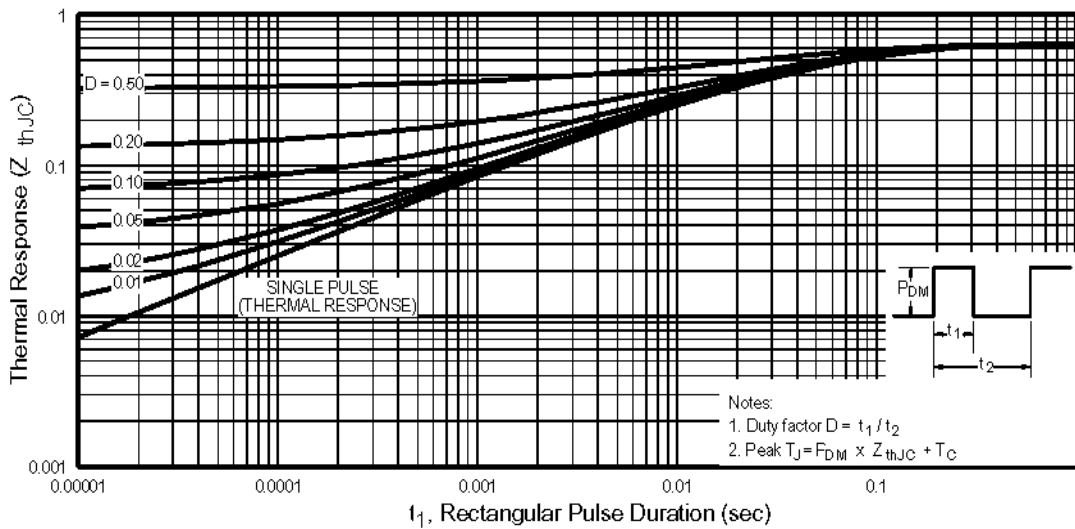
International  
**IR** Rectifier



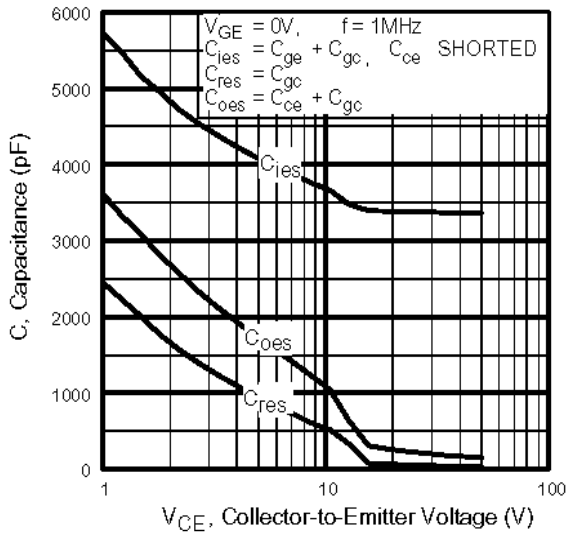
**Fig. 4** - Maximum Collector Current vs. Case Temperature



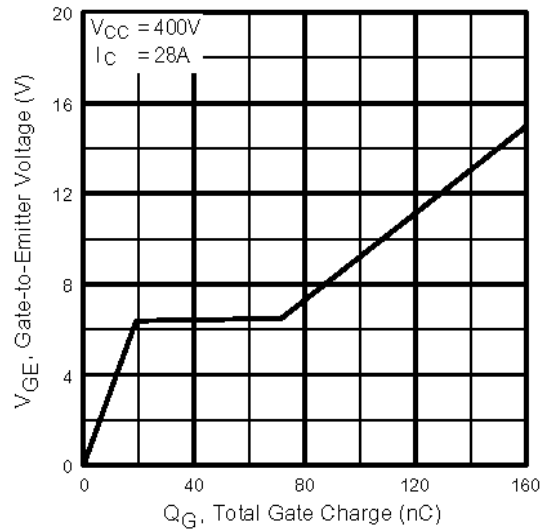
**Fig. 5** - Collector-to-Emitter Voltage vs. Junction Temperature



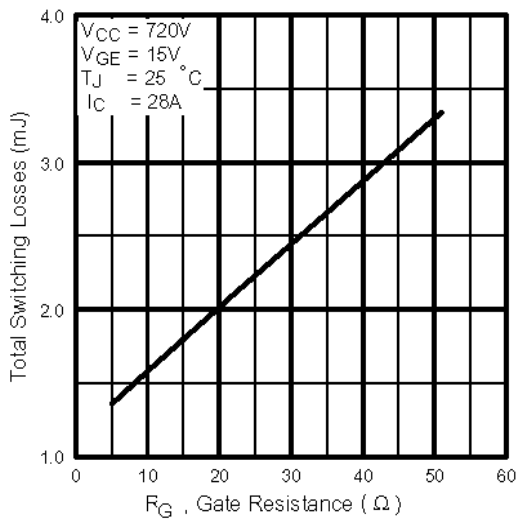
**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case



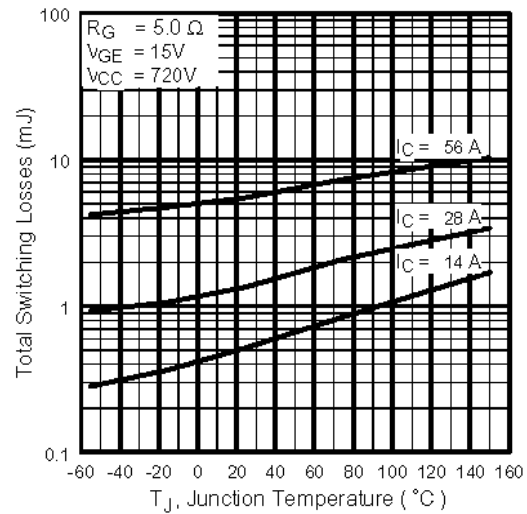
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



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



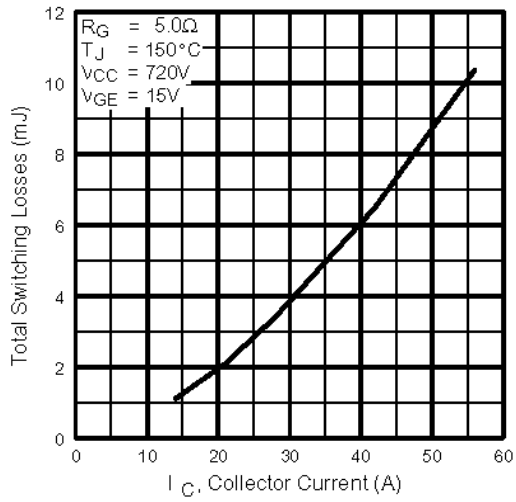
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



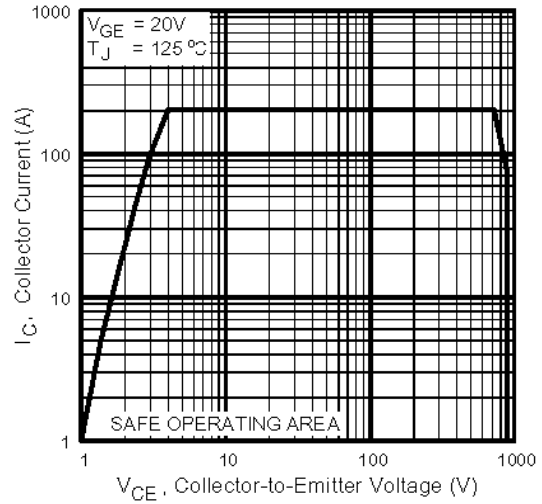
**Fig. 10** - Typical Switching Losses vs. Junction Temperature

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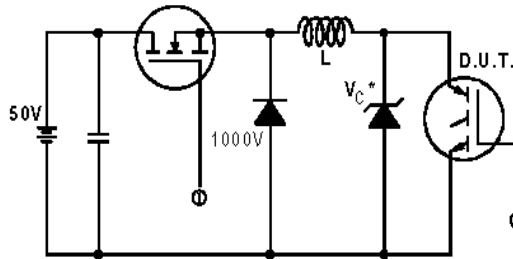
International  
**IR** Rectifier



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

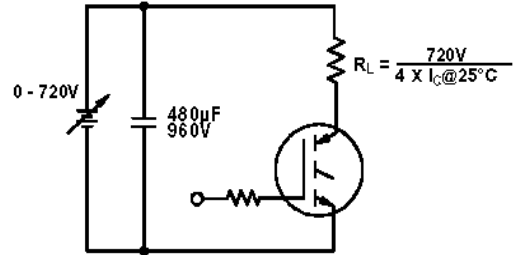


**Fig. 12** - Turn-Off SOA

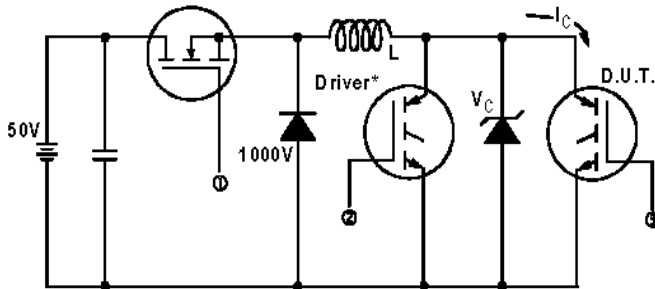


\* Driver same type as D.U.T.;  $V_c = 80\%$  of  $V_{ce(max)}$   
 \* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated  $I_d$ .

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

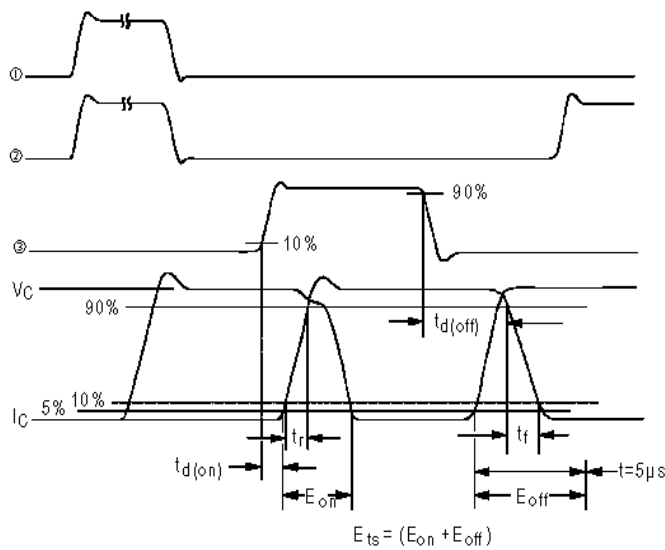


**Fig. 13b** - Pulsed Collector Current Test Circuit



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

\* Driver same type as D.U.T.,  $V_C = 720V$



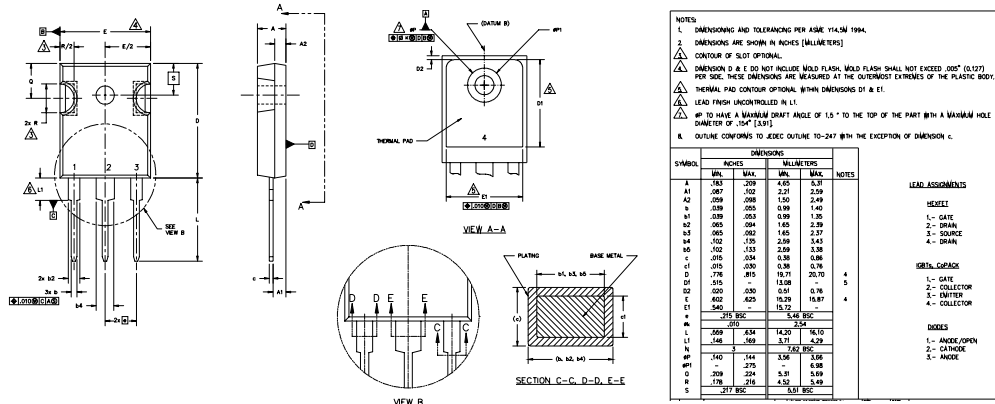
**Fig. 14b** - Switching Loss Waveforms

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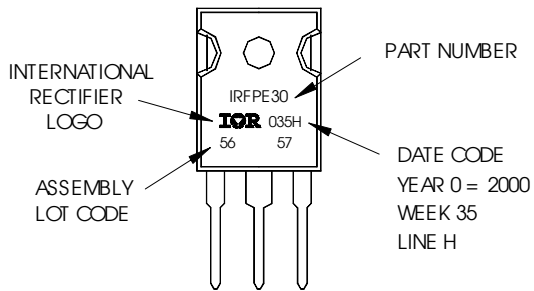
## TO-247AC Package Outline

Dimensions are shown in millimeters (inches)



## TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFP30  
 WITH ASSEMBLY  
 LOT CODE 5657  
 ASSEMBLED ON WW 35, 2000  
 IN THE ASSEMBLY LINE "H"  
**Note:** "P" in assembly line  
 position indicates "Lead-Free"



Data and specifications subject to change without notice.

International  
**IR** Rectifier

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 TAC Fax: (310) 252-7903

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Note: For the most current drawings please refer to the IR website at:  
<http://www.irf.com/package/>