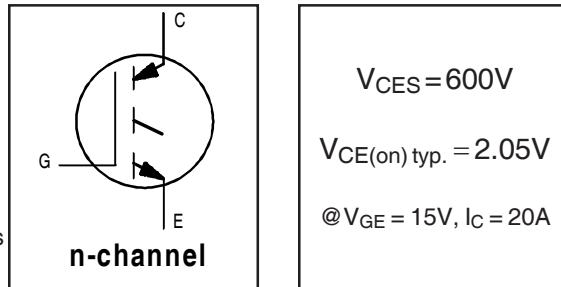


# IRG4PC40WPbF

## INSULATED GATE BIPOLEAR TRANSISTOR

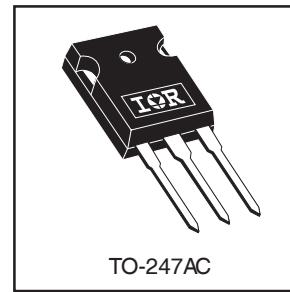
### Features

- Designed expressly for Switch-Mode Power Supply and PFC (power factor correction) applications
- Industry-benchmark switching losses improve efficiency of all power supply topologies
- 50% reduction of Eoff parameter
- Low IGBT conduction losses
- Latest-generation IGBT design and construction offers tighter parameters distribution, exceptional reliability
- Lead-Free



### Benefits

- Lower switching losses allow more cost-effective operation than power MOSFETs up to 150 kHz ("hard switched" mode)
- Of particular benefit to single-ended converters and boost PFC topologies 150W and higher
- Low conduction losses and minimal minority-carrier recombination make these an excellent option for resonant mode switching as well (up to >>300 kHz)



### 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	40	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	20	
$I_{CM}$	Pulsed Collector Current ①	160	
$I_{LM}$	Clamped Inductive Load Current ②	160	
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	V
$E_{ARV}$	Reverse Voltage Avalanche Energy ③	160	mJ
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	160	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	65	
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to + 150	$^\circ C$
	Soldering Temperature, for 10 seconds	300 (0.063 in. (1.6mm) from case )	
	Mounting torque, 6-32 or M3 screw.	10 lbf-in (1.1N-m)	

### Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.77	$^\circ C/W$
$R_{\theta CS}$	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  
Rectifier

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

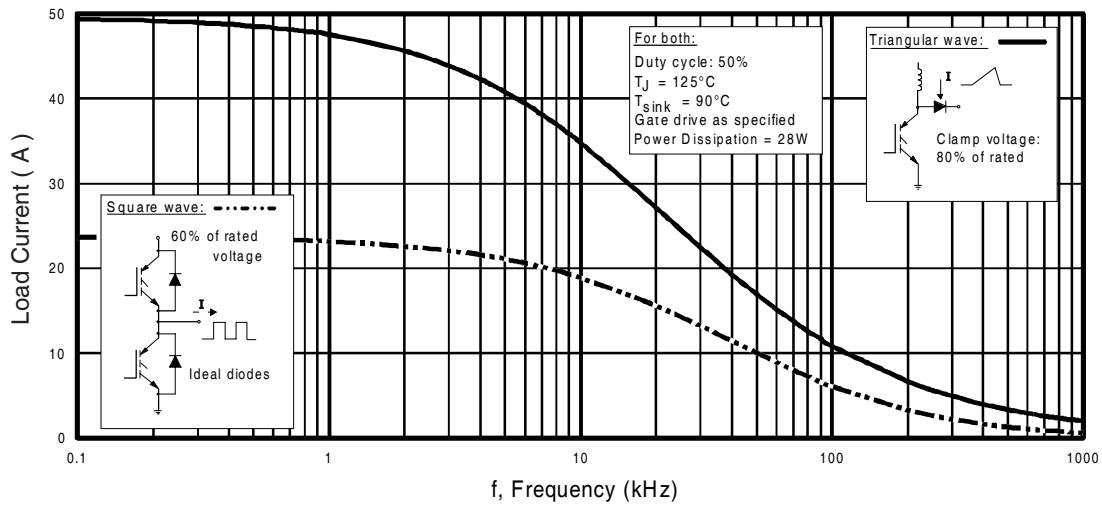
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(\text{BR})\text{CES}}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	$V_{\text{GE}} = 0\text{V}, I_C = 250\mu\text{A}$
$V_{(\text{BR})\text{ECS}}$	Emitter-to-Collector Breakdown Voltage ④	18	—	—	V	$V_{\text{GE}} = 0\text{V}, I_C = 1.0\text{A}$
$\Delta V_{(\text{BR})\text{CES}/\Delta T_J}$	Temperature Coeff. of Breakdown Voltage	—	0.44	—	V/ $^\circ\text{C}$	$V_{\text{GE}} = 0\text{V}, I_C = 1.0\text{mA}$
$V_{\text{CE}(\text{ON})}$	Collector-to-Emitter Saturation Voltage	—	2.05	2.5	V	$I_C = 20\text{A}$ $V_{\text{GE}} = 15\text{V}$
		—	2.36	—		$I_C = 40\text{A}$ See Fig.2, 5
		—	1.90	—		$I_C = 20\text{A}, T_J = 150^\circ\text{C}$
$V_{\text{GE}(\text{th})}$	Gate Threshold Voltage	3.0	—	6.0		$V_{\text{CE}} = V_{\text{GE}}, I_C = 250\mu\text{A}$
$\Delta V_{\text{GE}(\text{th})/\Delta T_J}$	Temperature Coeff. of Threshold Voltage	—	13	—	mV/ $^\circ\text{C}$	$V_{\text{CE}} = V_{\text{GE}}, I_C = 250\mu\text{A}$
$g_{\text{fe}}$	Forward Transconductance ⑤	18	28	—	S	$V_{\text{CE}} = 100\text{ V}, I_C = 20\text{A}$
$I_{\text{CES}}$	Zero Gate Voltage Collector Current	—	—	250	$\mu\text{A}$	$V_{\text{GE}} = 0\text{V}, V_{\text{CE}} = 600\text{V}$
		—	—	2.0		$V_{\text{GE}} = 0\text{V}, V_{\text{CE}} = 10\text{V}, T_J = 25^\circ\text{C}$
		—	—	2500		$V_{\text{GE}} = 0\text{V}, V_{\text{CE}} = 600\text{V}, T_J = 150^\circ\text{C}$
$I_{\text{GES}}$	Gate-to-Emitter Leakage Current	—	—	$\pm 100$	nA	$V_{\text{GE}} = \pm 20\text{V}$

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

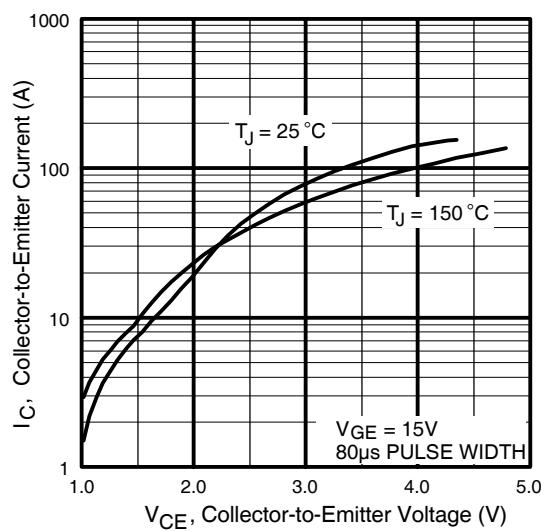
	Parameter	Min.	Typ.	Max.	Units	Conditions
$Q_g$	Total Gate Charge (turn-on)	—	98	147	nC	$I_C = 20\text{A}$
$Q_{ge}$	Gate - Emitter Charge (turn-on)	—	12	18		$V_{\text{CC}} = 400\text{V}$ See Fig.8
$Q_{gc}$	Gate - Collector Charge (turn-on)	—	36	54		$V_{\text{GE}} = 15\text{V}$
$t_{d(\text{on})}$	Turn-On Delay Time	—	27	—	ns	$T_J = 25^\circ\text{C}$ $I_C = 20\text{A}, V_{\text{CC}} = 480\text{V}$ $V_{\text{GE}} = 15\text{V}, R_G = 10\Omega$
$t_r$	Rise Time	—	22	—		
$t_{d(\text{off})}$	Turn-Off Delay Time	—	100	150		
$t_f$	Fall Time	—	74	110		
$E_{\text{on}}$	Turn-On Switching Loss	—	0.11	—	mJ	Energy losses include "tail" See Fig. 9,10, 14
$E_{\text{off}}$	Turn-Off Switching Loss	—	0.23	—		
$E_{ts}$	Total Switching Loss	—	0.34	0.45		
$t_{d(\text{on})}$	Turn-On Delay Time	—	25	—	ns	$T_J = 150^\circ\text{C}$ , $I_C = 20\text{A}, V_{\text{CC}} = 480\text{V}$ $V_{\text{GE}} = 15\text{V}, R_G = 10\Omega$
$t_r$	Rise Time	—	23	—		
$t_{d(\text{off})}$	Turn-Off Delay Time	—	170	—		
$t_f$	Fall Time	—	124	—		
$E_{ts}$	Total Switching Loss	—	0.85	—	mJ	Energy losses include "tail" See Fig.10,11, 14
$L_E$	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
$C_{\text{ies}}$	Input Capacitance	—	1900	—	pF	$V_{\text{GE}} = 0\text{V}$ $V_{\text{CC}} = 30\text{V}$ See Fig. 7 $f = 1.0\text{MHz}$
$C_{\text{oes}}$	Output Capacitance	—	140	—		
$C_{\text{res}}$	Reverse Transfer Capacitance	—	35	—		

### Notes:

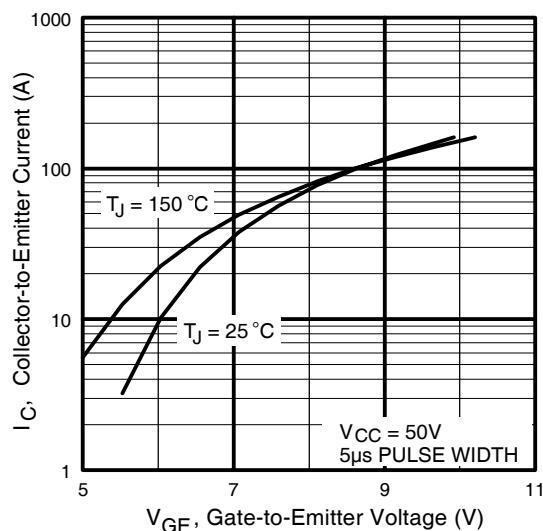
- ① Repetitive rating;  $V_{\text{GE}} = 20\text{V}$ , pulse width limited by max. junction temperature. ( See fig. 13b )
- ②  $V_{\text{CC}} = 80\%(V_{\text{CES}})$ ,  $V_{\text{GE}} = 20\text{V}$ ,  $L = 10\mu\text{H}$ ,  $R_G = 10\Omega$ , (See fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width  $\leq 80\mu\text{s}$ ; duty factor  $\leq 0.1\%$ .
- ⑤ Pulse width  $5.0\mu\text{s}$ , single shot.



**Fig. 1 - Typical Load Current vs. Frequency**  
 (Load Current =  $I_{RMS}$  of fundamental)



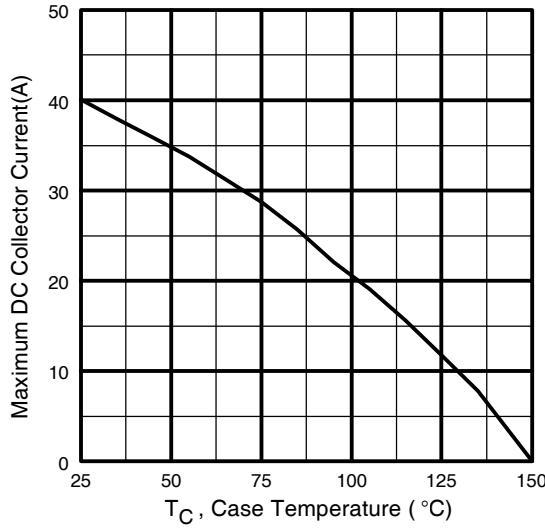
**Fig. 2 - Typical Output Characteristics**



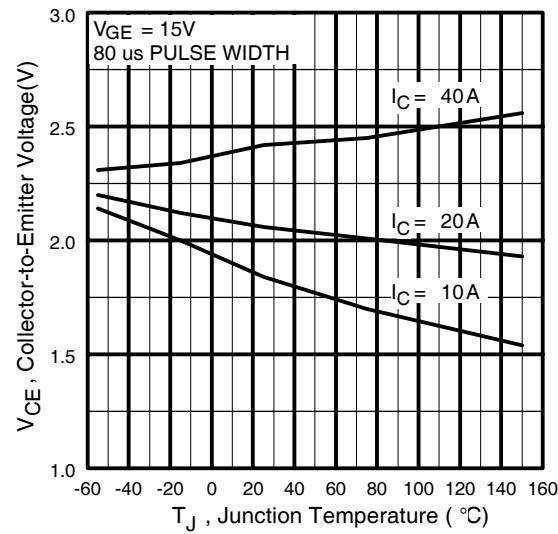
**Fig. 3 - Typical Transfer Characteristics**

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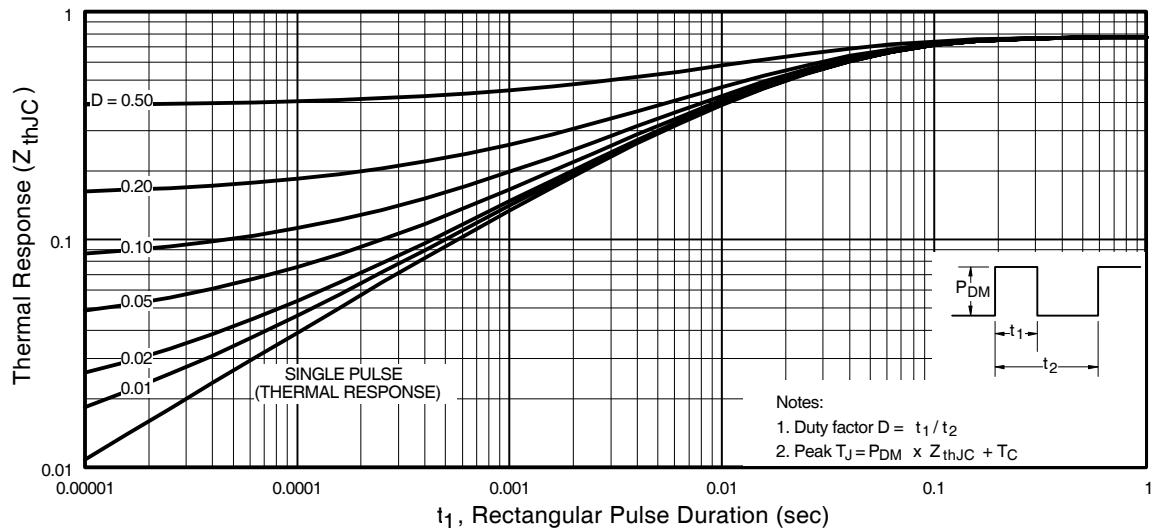
International  
**IR** Rectifier



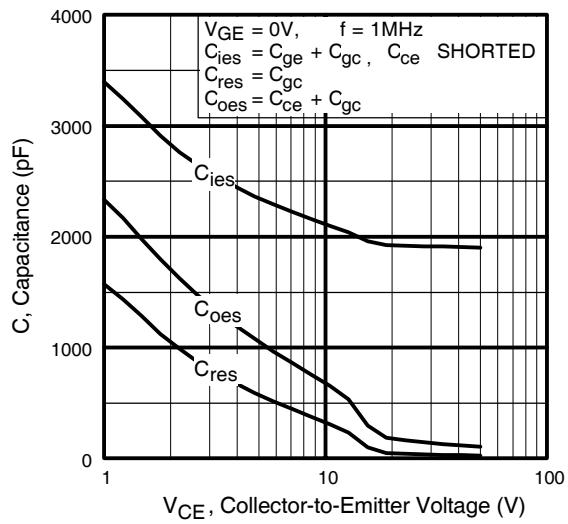
**Fig. 4** - Maximum Collector Current vs. Case Temperature



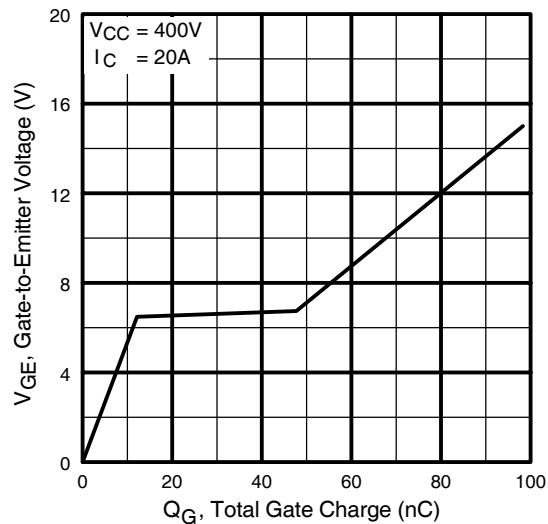
**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature



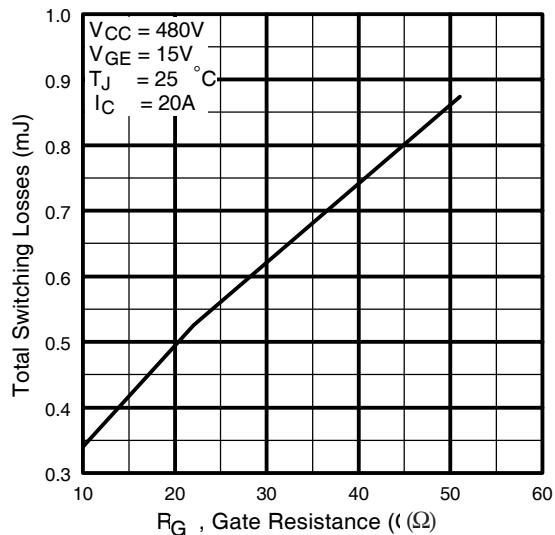
**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case



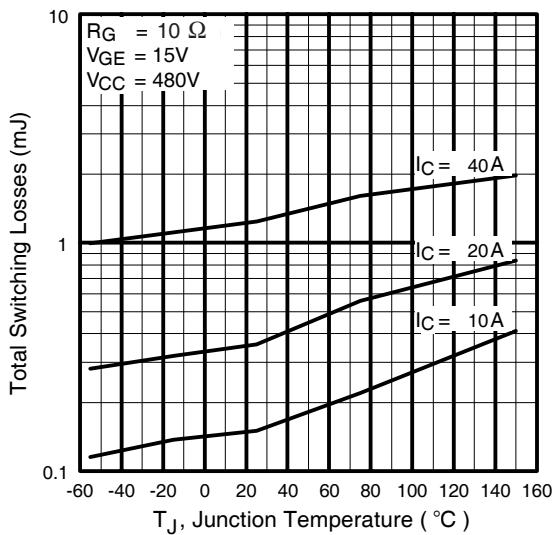
**Fig. 7** - Typical Capacitance vs.  
Collector-to-Emitter Voltage



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



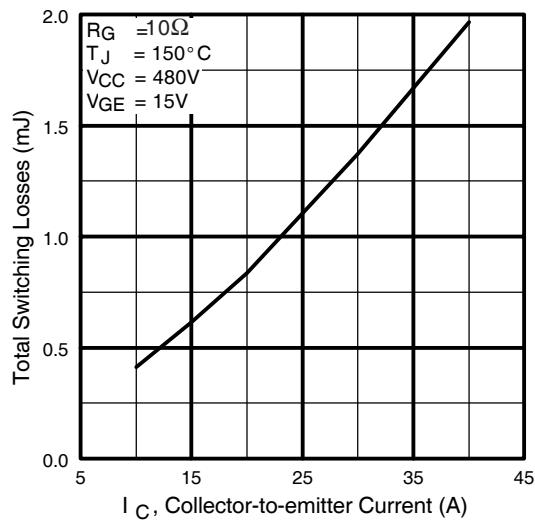
**Fig. 9** - Typical Switching Losses vs. Gate  
Resistance  
[www.irf.com](http://www.irf.com)



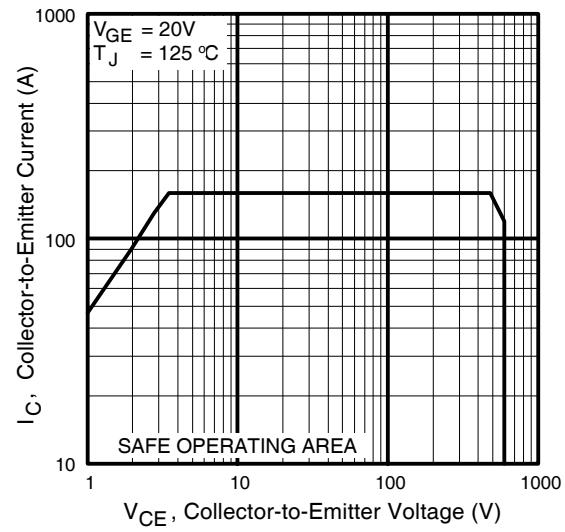
**Fig. 10** - Typical Switching Losses vs.  
Junction Temperature

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**IR** Rectifier

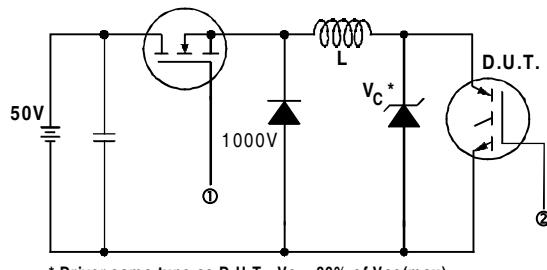


**Fig. 11** - Typical Switching Losses vs.  
Collector-to-Emitter Current



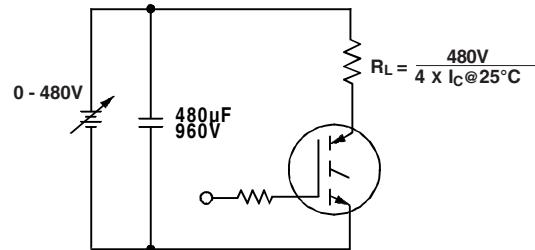
**Fig. 12** - Turn-Off SOA

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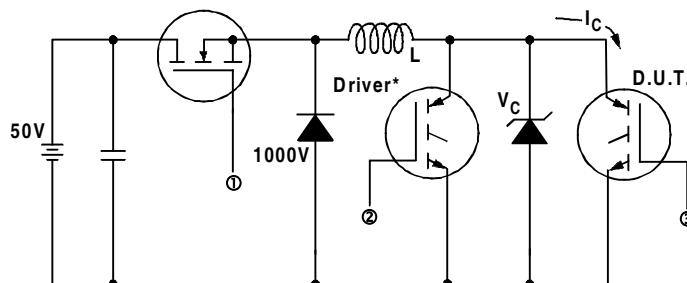


\* Driver same type as D.U.T.;  $V_C = 80\%$  of  $V_{ce(max)}$   
 \* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated  $I_d$ .

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

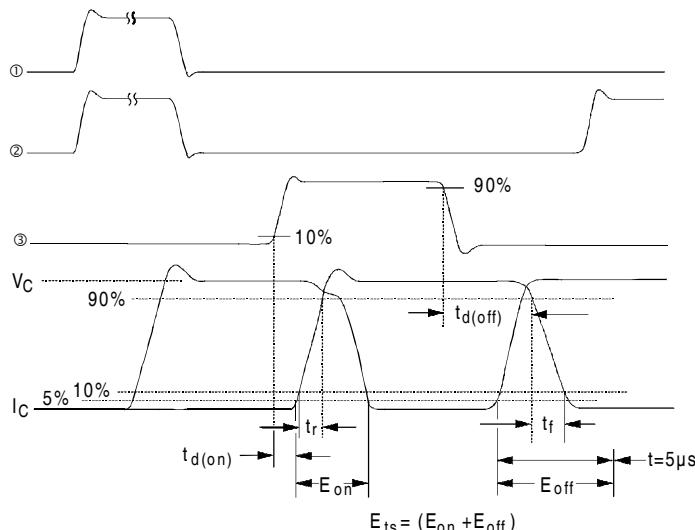


**Fig. 13b** - Pulsed Collector Current Test Circuit



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

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



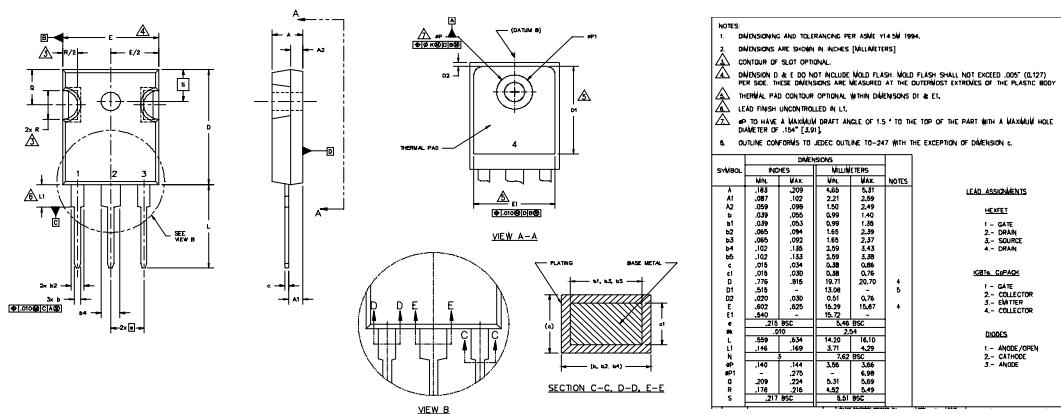
**Fig. 14b** - Switching Loss Waveforms

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## TO-247AC Package Outline

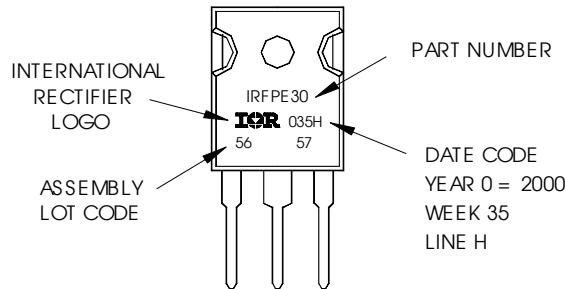
Dimensions are shown in millimeters (inches)



## TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFPE30  
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 **ICR** Rectifier

**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105  
TAC Fax: (310) 252-7903

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[www.irf.com](http://www.irf.com)

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



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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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Электронная почта: [org@eplast1.ru](mailto:org@eplast1.ru)

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