



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



## Contact us

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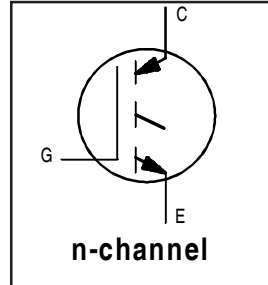
# IRG4PH40UPbF

INSULATED GATE BIPOLAR TRANSISTOR

Ultra Fast Speed IGBT

## Features

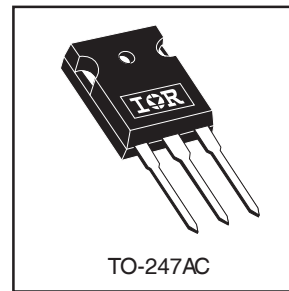
- UltraFast: Optimized for high operating frequencies up to 40 kHz in hard switching, >200 kHz in resonant mode
- New IGBT design provides tighter parameter distribution and higher efficiency than previous generations
- Optimized for power conversion; SMPS, UPS and welding
- Industry standard TO-247AC package
- Lead-Free



$V_{CES} = 1200V$
$V_{CE(on)} \text{ typ.} = 2.43V$
@ $V_{GE} = 15V, I_C = 21A$

## Benefits

- Higher switching frequency capability than competitive IGBTs
- Highest efficiency available
- Much lower conduction losses than MOSFETs
- More efficient than short circuit rated IGBTs



## 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	41	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	21	
$I_{CM}$	Pulsed Collector Current ①	82	
$I_{LM}$	Clamped Inductive Load Current ②	82	
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	V
$E_{ARV}$	Reverse Voltage Avalanche Energy ③	270	mJ
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	160	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	65	
$T_J$	Operating Junction and	-55 to + 150	°C
$T_{STG}$	Storage Temperature Range		
	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	°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)

# IRG4PH40UPbF

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

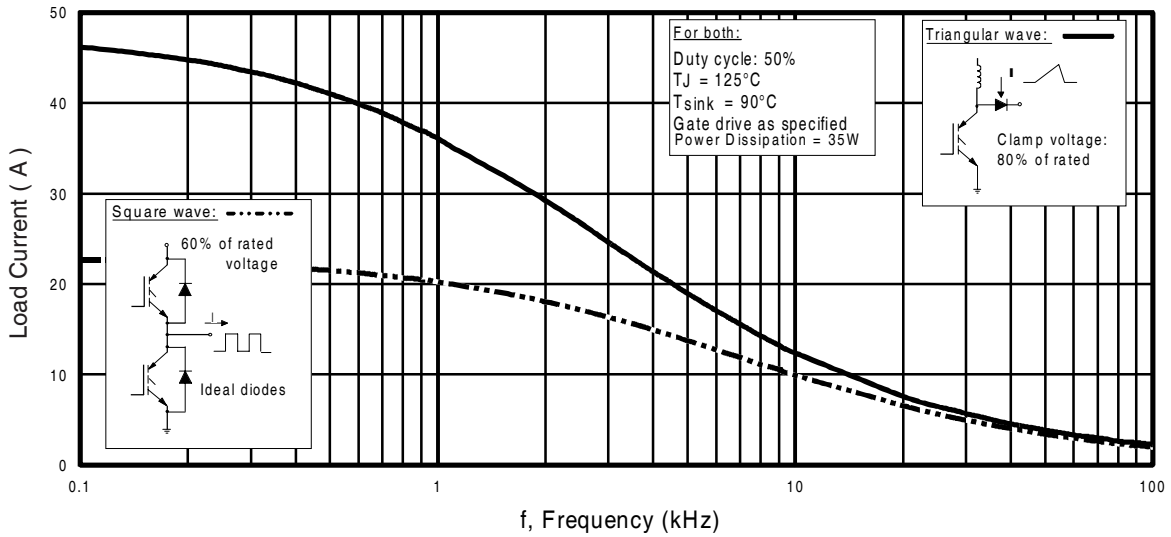
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage ④	18	—	—	V	$V_{GE} = 0V, I_C = 1.0A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.43	—	V/°C	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	2.43	3.1	V	$I_C = 21A$ $V_{GE} = 15V$ See Fig.2, 5
		—	2.97	—		
		—	2.47	—		
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0		$I_C = 21A, T_J = 150^\circ\text{C}$ $V_{CE} = V_{GE}, I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/°C	$V_{CE} = V_{GE}, I_C = 250\mu A$
$g_{fe}$	Forward Transconductance ⑤	16	24	—	S	$V_{CE} = 100V, I_C = 21A$
$I_{CES}$	Zero Gate Voltage Collector Current	—	—	250	$\mu A$	$V_{GE} = 0V, V_{CE} = 1200V$
		—	—	2.0		$V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ\text{C}$
		—	—	5000		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 150^\circ\text{C}$
$I_{GES}$	Gate-to-Emitter Leakage Current	—	—	$\pm 100$	nA	$V_{GE} = \pm 20V$

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

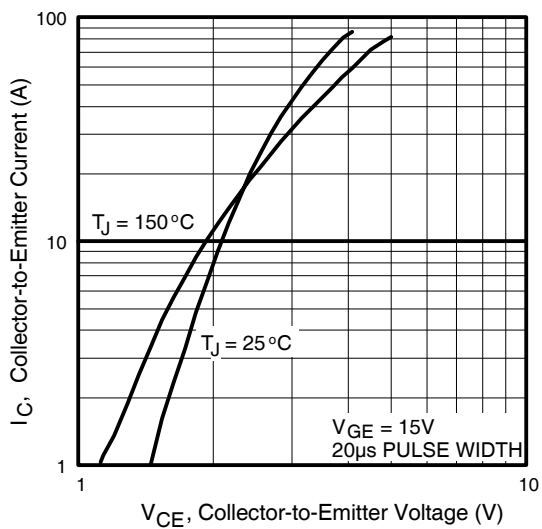
	Parameter	Min.	Typ.	Max.	Units	Conditions
$Q_g$	Total Gate Charge (turn-on)	—	86	130	nC	$I_C = 21A$ $V_{CC} = 400V$ $V_{GE} = 15V$ See Fig. 8
$Q_{ge}$	Gate - Emitter Charge (turn-on)	—	13	20		
$Q_{gc}$	Gate - Collector Charge (turn-on)	—	29	44		
$t_{d(on)}$	Turn-On Delay Time	—	24	—	ns	$T_J = 25^\circ\text{C}$ $I_C = 21A, V_{CC} = 960V$ $V_{GE} = 15V, R_G = 10\Omega$ Energy losses include "tail" See Fig. 9, 10, 14
$t_r$	Rise Time	—	24	—		
$t_{d(off)}$	Turn-Off Delay Time	—	220	330		
$t_f$	Fall Time	—	180	270	mJ	$T_J = 150^\circ\text{C}$ , $I_C = 21A, V_{CC} = 960V$ $V_{GE} = 15V, R_G = 10\Omega$ Energy losses include "tail" See Fig. 11, 14
$E_{on}$	Turn-On Switching Loss	—	1.04	—		
$E_{off}$	Turn-Off Switching Loss	—	3.40	—		
$E_{ts}$	Total Switching Loss	—	4.44	5.2	ns	$T_J = 150^\circ\text{C}$ , $I_C = 21A, V_{CC} = 960V$ $V_{GE} = 15V, R_G = 10\Omega$ Energy losses include "tail" See Fig. 11, 14
$t_{d(on)}$	Turn-On Delay Time	—	24	—		
$t_r$	Rise Time	—	25	—		
$t_{d(off)}$	Turn-Off Delay Time	—	310	—	mJ	Measured 5mm from package
$t_f$	Fall Time	—	380	—		
$E_{ts}$	Total Switching Loss	—	7.39	—		
$L_E$	Internal Emitter Inductance	—	13	—	nH	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0MHz$ See Fig. 7
$C_{ies}$	Input Capacitance	—	1800	—	pF	
$C_{oes}$	Output Capacitance	—	120	—		
$C_{res}$	Reverse Transfer Capacitance	—	18	—		

### Notes:

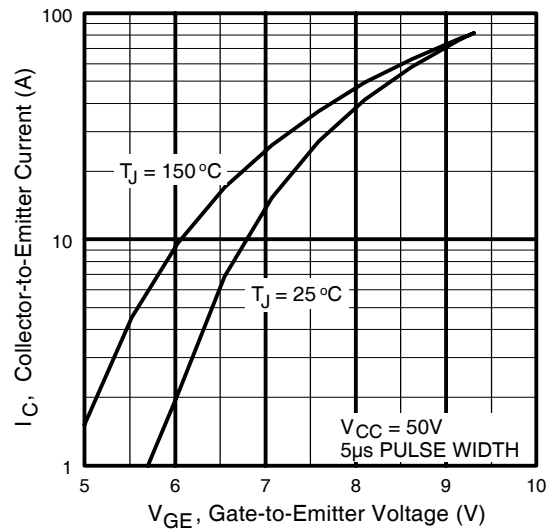
- ① Repetitive rating;  $V_{GE} = 20V$ , pulse width limited by max. junction temperature. ( See fig. 13b )
- ②  $V_{CC} = 80\%(V_{CES}), V_{GE} = 20V, L = 10\mu H, R_G = 10\Omega$ , (See fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width  $\leq 80\mu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



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



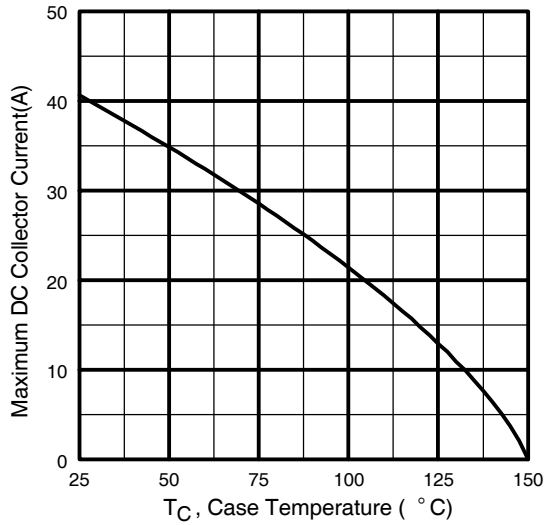
**Fig. 2 - Typical Output Characteristics**



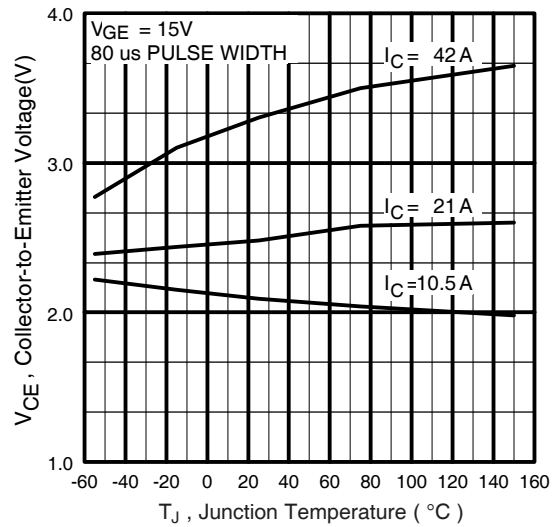
**Fig. 3 - Typical Transfer Characteristics**



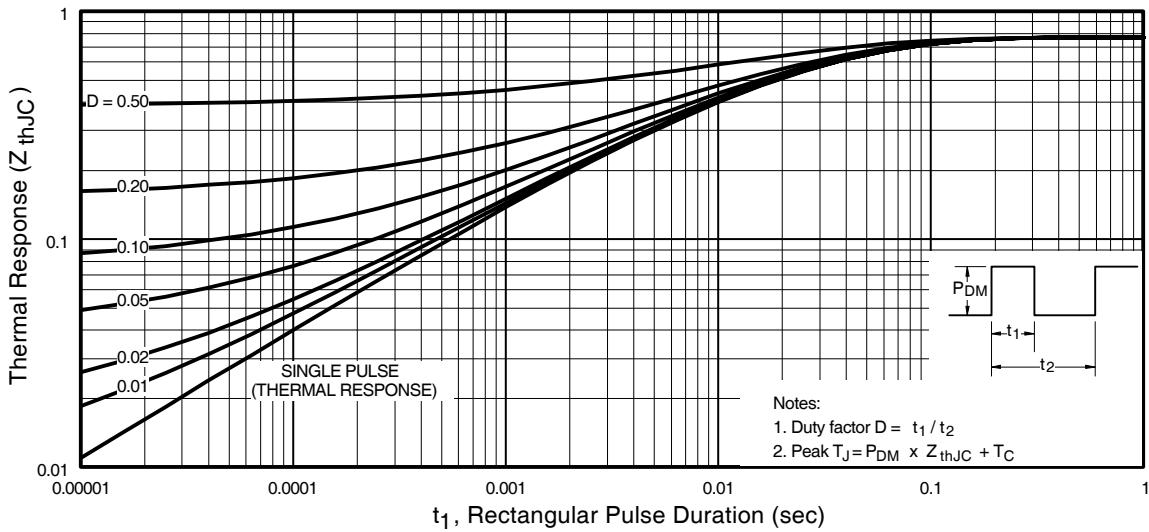
# IRG4PH40UPbF



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

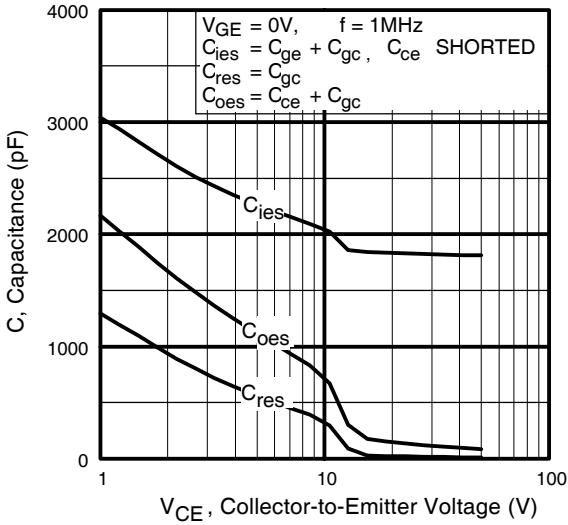


**Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature**

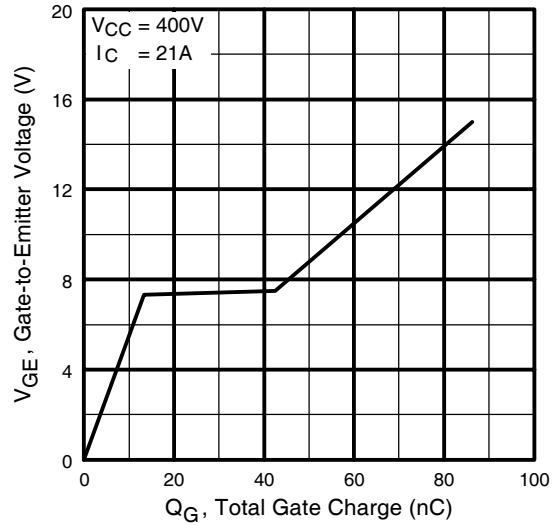


**Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case**

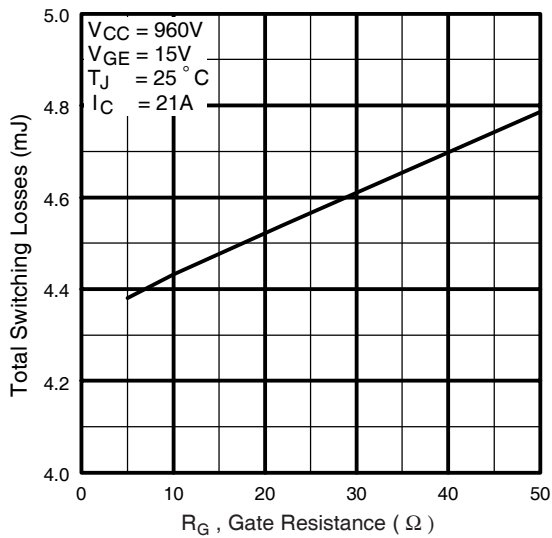
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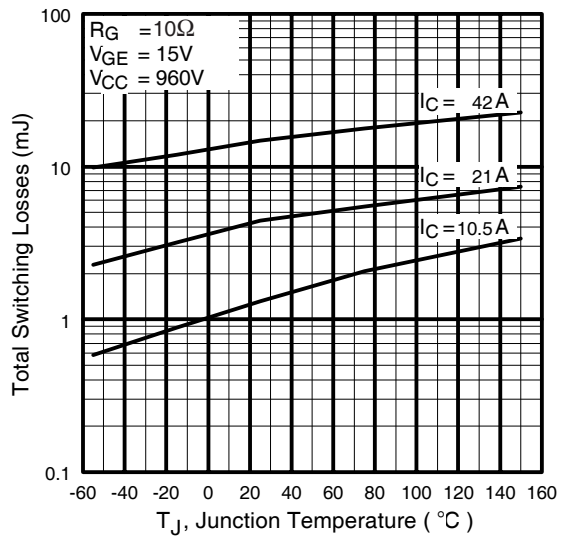
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



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

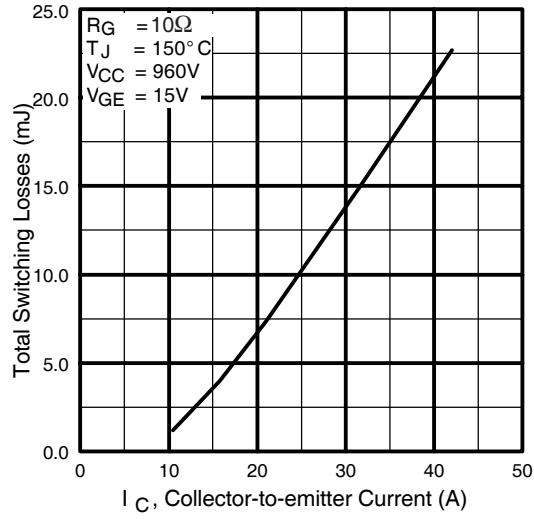


**Fig. 9** - Typical Switching Losses vs. Gate Resistance

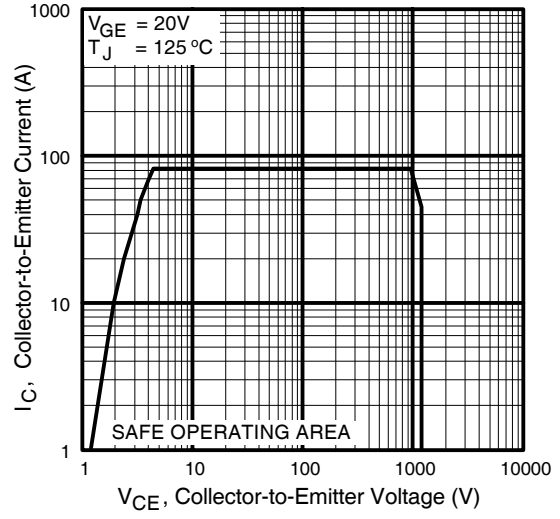


**Fig. 10** - Typical Switching Losses vs. Junction Temperature

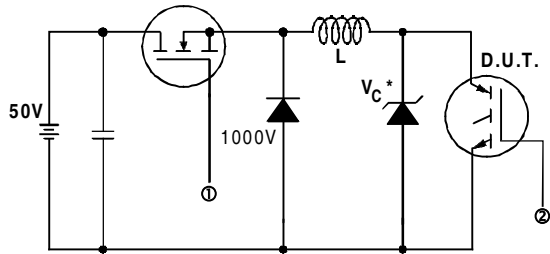
# IRG4PH40UPbF



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

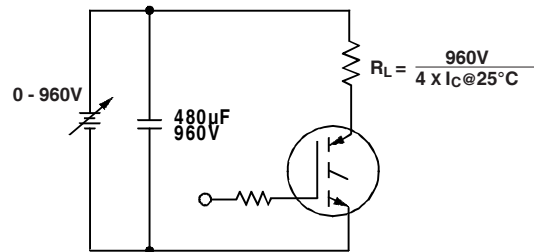


**Fig. 12** - Turn-Off SOA

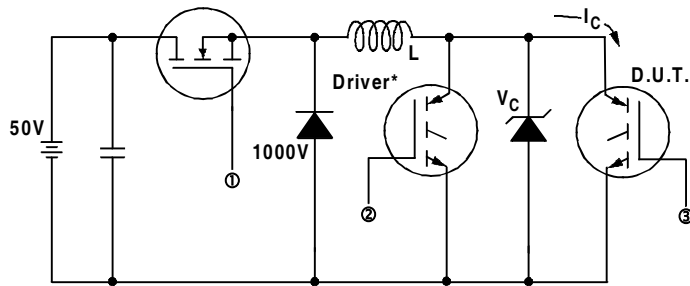


\* Driver same type as D.U.T.;  $V_c = 80\%$  of  $V_{ce(max)}$   
 \* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated  $I_d$ .

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

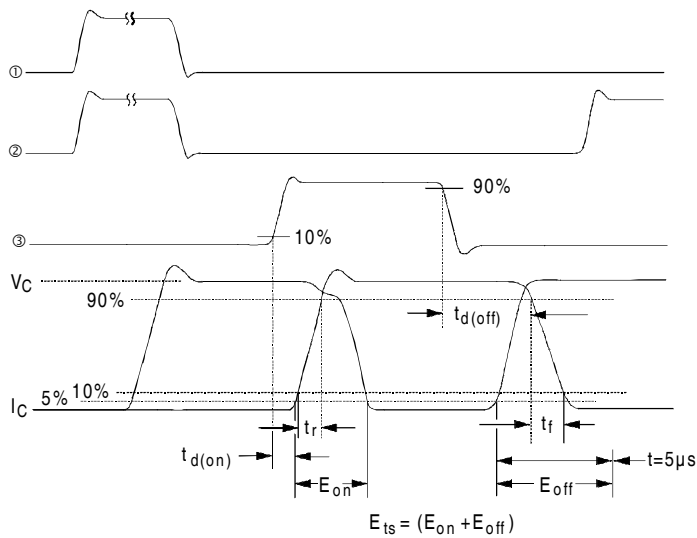


**Fig. 13b** - Pulsed Collector Current Test Circuit



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

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



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

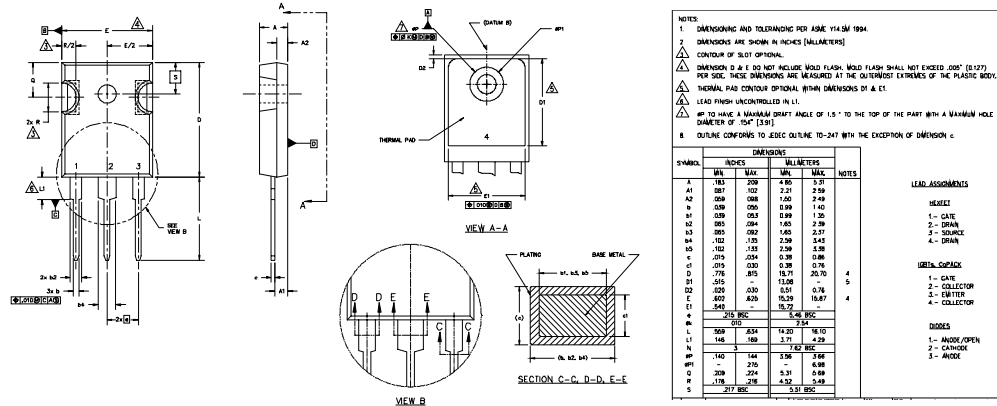


# IRG4PH40UPbF

International  
**IR** Rectifier

## TO-247AC Package Outline

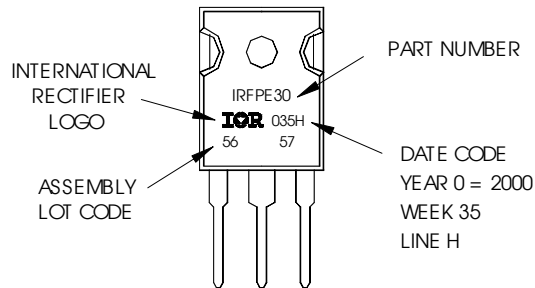
Dimensions are shown in millimeters (inches)



## 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/>