

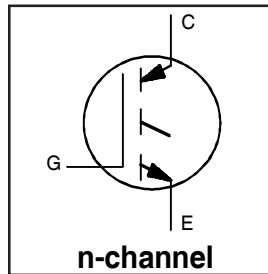
# IRG4BC30KPbF

Short Circuit Rated  
UltraFast IGBT

## INSULATED GATE BIPOLAR TRANSISTOR

### Features

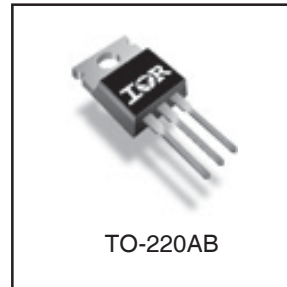
- High short circuit rating optimized for motor control,  $t_{sc} = 10\mu s$ , @360V  $V_{CE}$  (start),  $T_J = 125^\circ C$ ,  $V_{GE} = 15V$
- Combines low conduction losses with high switching speed
- Latest generation design provides tighter parameter distribution and higher efficiency than previous generations
- Lead-Free



$V_{CES} = 600V$
$V_{CE(on)} \text{ typ.} = 2.21V$
@ $V_{GE} = 15V, I_C = 16A$

### Benefits

- As a Freewheeling Diode we recommend our HEXFRED™ ultrafast, ultrasoft recovery diodes for minimum EMI / Noise and switching losses in the Diode and IGBT
- Latest generation 4 IGBTs offer highest power density motor controls possible
- This part replaces the IRGBC30K and IRGBC30M devices



### Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	28	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	16	
$I_{CM}$	Pulsed Collector Current ①	56	
$I_{LM}$	Clamped Inductive Load Current ②	56	
$t_{sc}$	Short Circuit Withstand Time	10	$\mu s$
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	V
$E_{ARV}$	Reverse Voltage Avalanche Energy ③	260	mJ
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	100	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	42	
$T_J$	Operating Junction and Storage Temperature Range	-55 to +150	$^\circ C$
$T_{STG}$			
	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	---	1.2	$^\circ C/W$
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.5	---	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	---	80	
$Wt$	Weight	1.44	---	g

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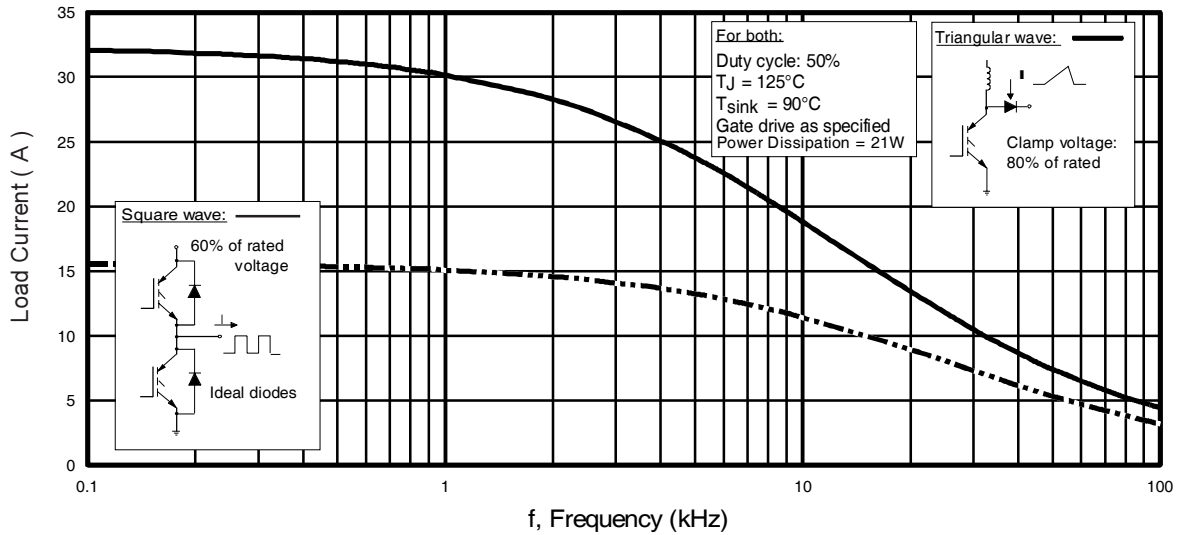
## Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

	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> = 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	—	0.54	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0mA
V <sub>CE(ON)</sub>	Collector-to-Emitter Saturation Voltage	—	2.21	—	V	I <sub>C</sub> = 14A I <sub>C</sub> = 16A I <sub>C</sub> = 28A I <sub>C</sub> = 16A, T <sub>J</sub> = 150°C V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA V <sub>GE</sub> = 15V See Fig.2, 5
		—	2.21	2.7		
		—	2.88	—		
		—	2.36	—		
V <sub>GE(th)</sub>	Gate Threshold Voltage	3.0	—	6.0		
ΔV <sub>GE(th)/ΔT<sub>J</sub></sub>	Temperature Coeff. of Threshold Voltage	—	-12	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
g <sub>fe</sub>	Forward Transconductance ⑤	5.4	8.1	—	S	V <sub>CE</sub> = 100V, I <sub>C</sub> = 16A
I <sub>CES</sub>	Zero Gate Voltage Collector Current	—	—	250	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V
		—	—	2.0		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 10V, T <sub>J</sub> = 25°C
		—	—	1100		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V, T <sub>J</sub> = 150°C
I <sub>GES</sub>	Gate-to-Emitter Leakage Current	—	—	±100	nA	V <sub>GE</sub> = ±20V

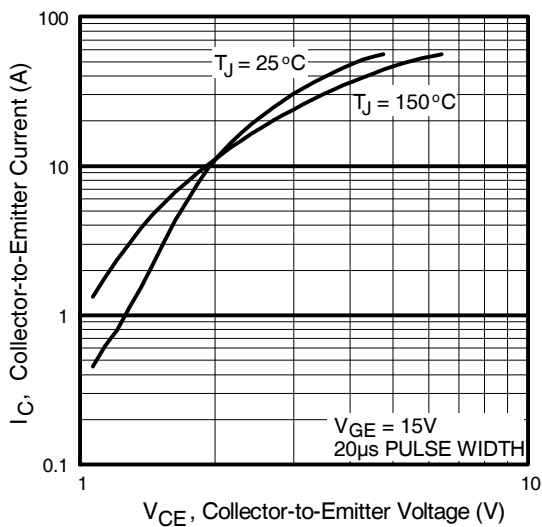
## Switching Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	67	100	nC	I <sub>C</sub> = 16A V <sub>CC</sub> = 400V V <sub>GE</sub> = 15V See Fig.8
Q <sub>ge</sub>	Gate - Emitter Charge (turn-on)	—	11	16		
Q <sub>gc</sub>	Gate - Collector Charge (turn-on)	—	25	37		
t <sub>d(on)</sub>	Turn-On Delay Time	—	26	—	ns	T <sub>J</sub> = 25°C I <sub>C</sub> = 16A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 23Ω Energy losses include "tail" See Fig. 9,10,14
t <sub>r</sub>	Rise Time	—	28	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	130	200		
t <sub>f</sub>	Fall Time	—	120	170		
E <sub>on</sub>	Turn-On Switching Loss	—	0.36	—	mJ	See Fig. 9,10,14
E <sub>off</sub>	Turn-Off Switching Loss	—	0.51	—		
E <sub>ts</sub>	Total Switching Loss	—	0.87	1.3		
t <sub>sc</sub>	Short Circuit Withstand Time	10	—	—	μs	V <sub>CC</sub> = 400V, T <sub>J</sub> = 125°C V <sub>GE</sub> = 15V, R <sub>G</sub> = 23Ω, V <sub>CPK</sub> < 500V
t <sub>d(on)</sub>	Turn-On Delay Time	—	25	—	ns	T <sub>J</sub> = 150°C, I <sub>C</sub> = 16A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 23Ω Energy losses include "tail" See Fig. 11,14
t <sub>r</sub>	Rise Time	—	29	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	190	—		
t <sub>f</sub>	Fall Time	—	190	—		
E <sub>ts</sub>	Total Switching Loss	—	1.2	—	mJ	T <sub>J</sub> = 25°C, V <sub>GE</sub> = 15V, R <sub>G</sub> = 23Ω I <sub>C</sub> = 14A, V <sub>CC</sub> = 480V Energy losses include "tail"
E <sub>on</sub>	Turn-On Switching Loss	—	0.26	—		
E <sub>off</sub>	Turn-Off Switching Loss	—	0.36	—		
E <sub>ts</sub>	Total Switching Loss	—	0.62	—		
L <sub>E</sub>	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C <sub>ies</sub>	Input Capacitance	—	920	—	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V f = 1.0MHz See Fig. 7
C <sub>oes</sub>	Output Capacitance	—	110	—		
C <sub>res</sub>	Reverse Transfer Capacitance	—	27	—		

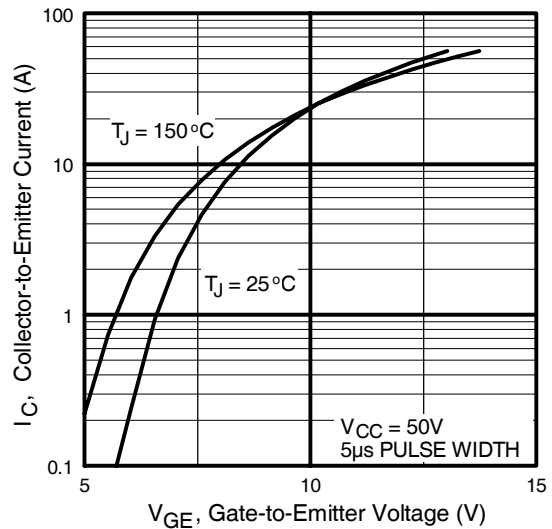
Details of note ① through ⑤ are on the last page



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

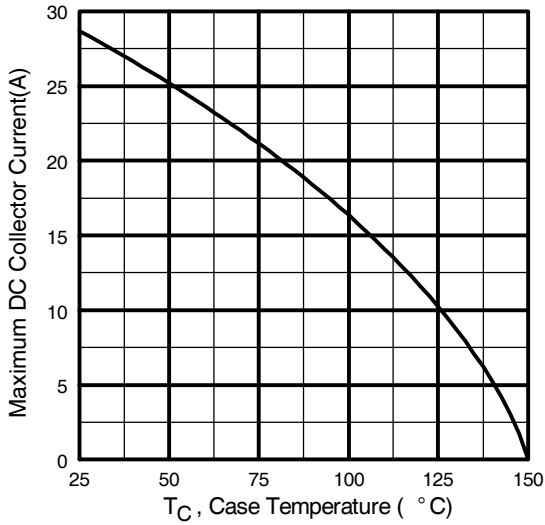


**Fig. 2 - Typical Output Characteristics**

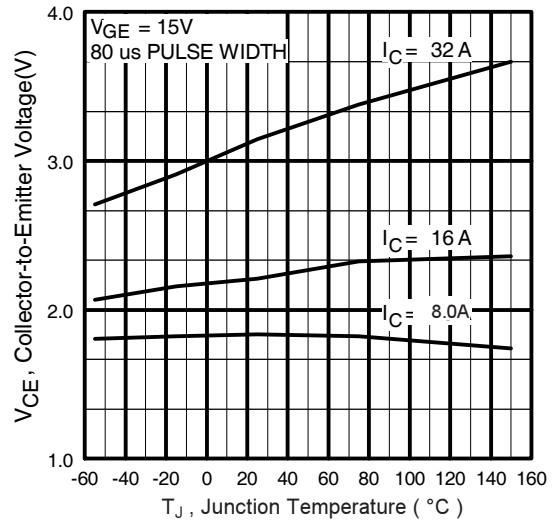


**Fig. 3 - Typical Transfer Characteristics**

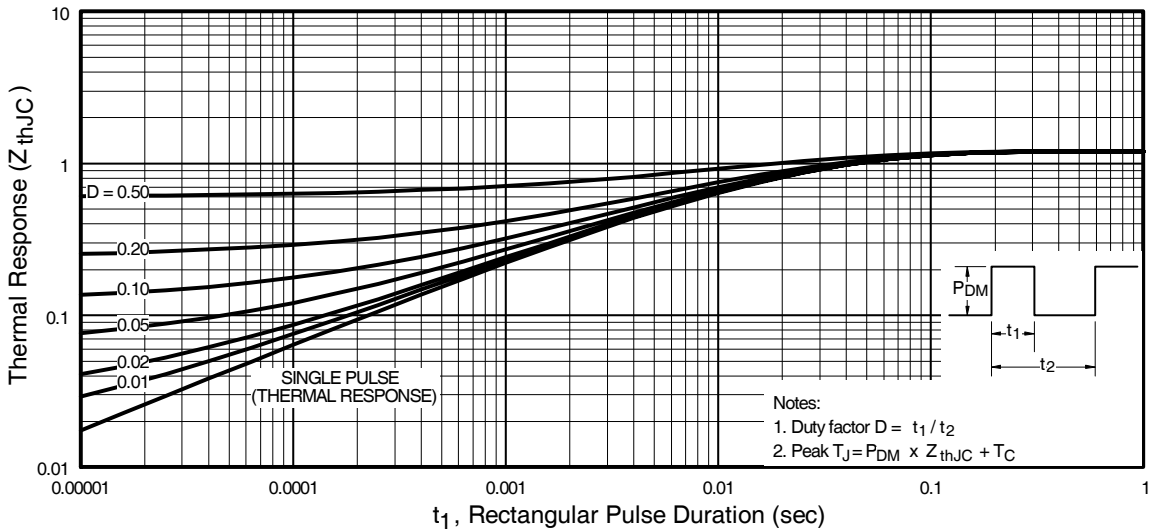
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**Fig. 4 - Maximum Collector Current vs. Case Temperature**

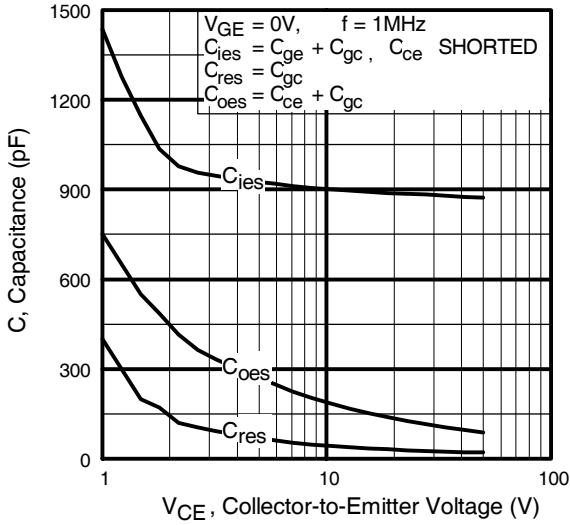


**Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature**

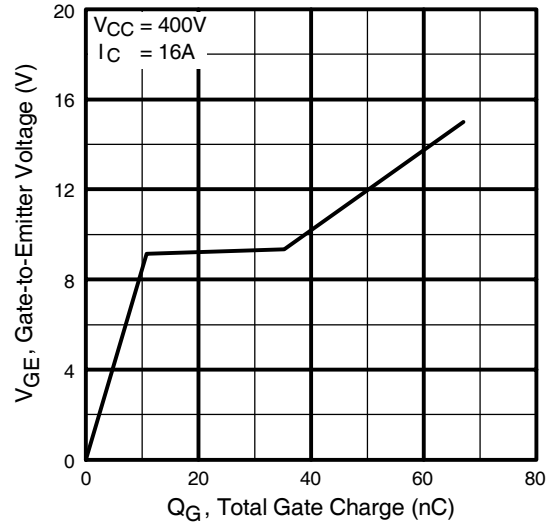


**Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case**

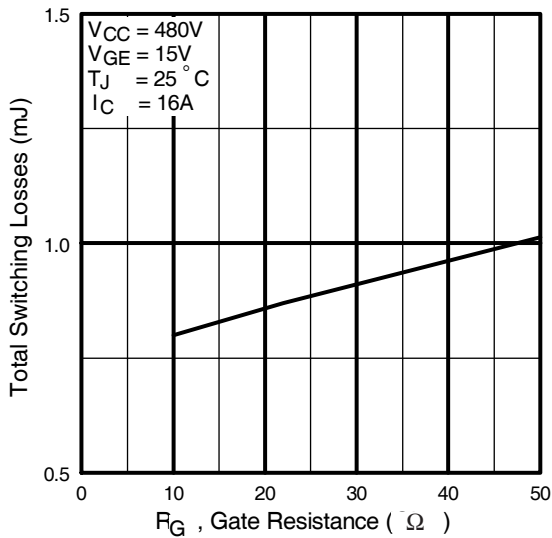
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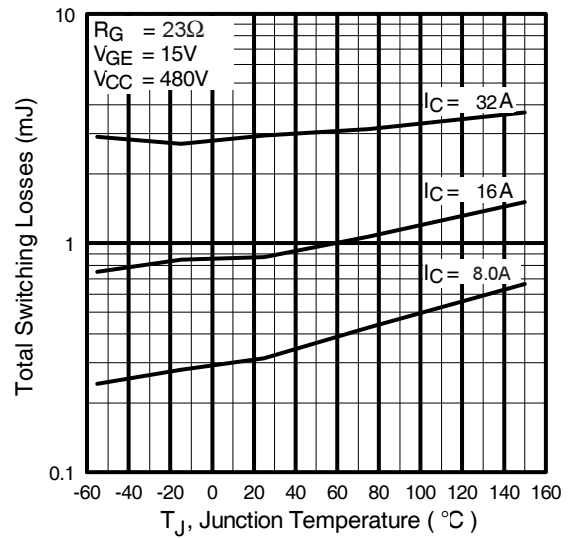
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



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

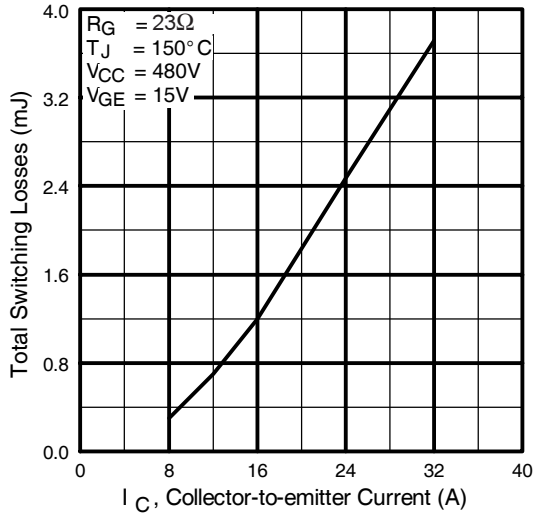


**Fig. 9** - Typical Switching Losses vs. Gate Resistance

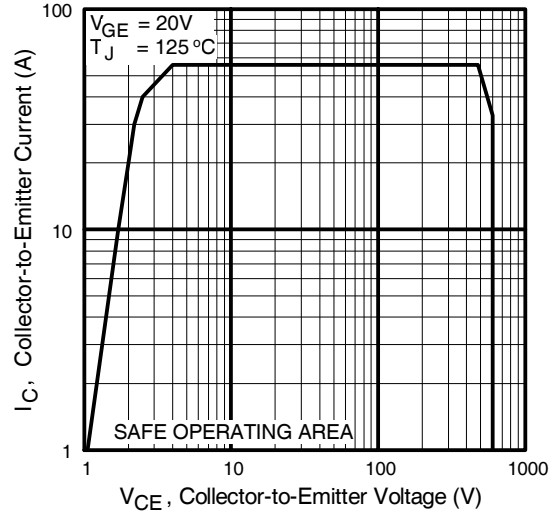


**Fig. 10** - Typical Switching Losses vs. Junction Temperature

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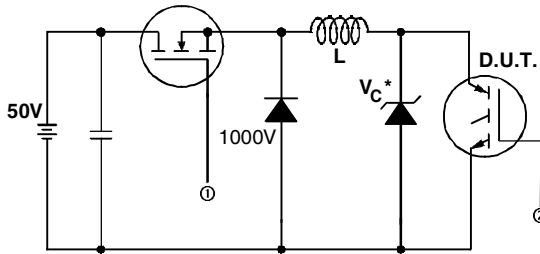


**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current



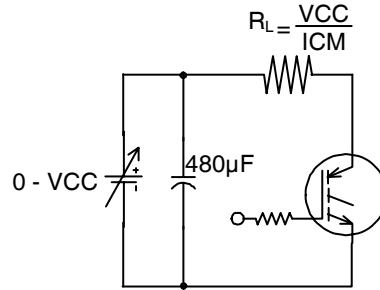
**Fig. 12** - Turn-Off SOA

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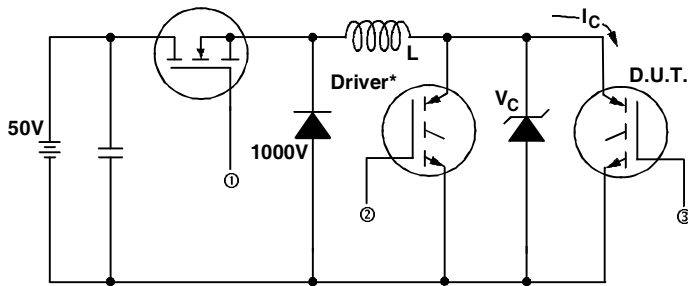
\* Driver same type as D.U.T.;  $V_c = 80\%$  of  $V_{ce(max)}$   
 \* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated  $I_d$ .

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



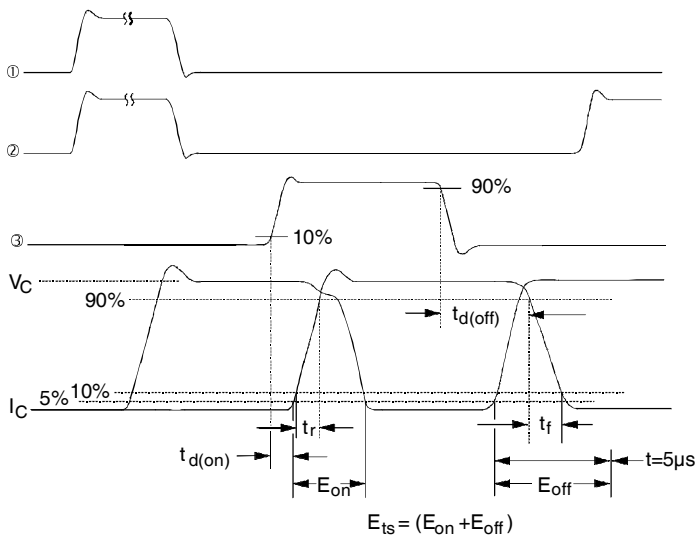
Pulsed Collector Current Test Circuit

**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

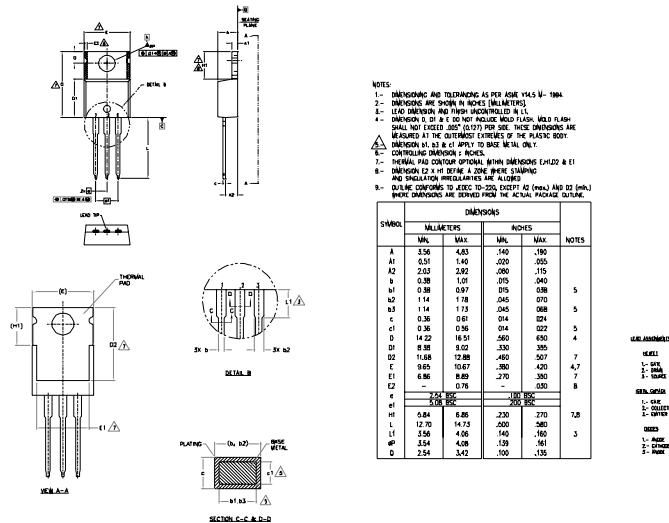
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### Notes:

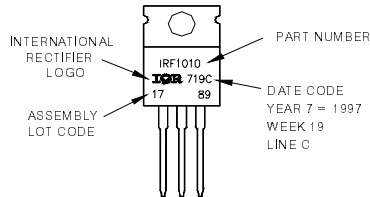
- ① Repetitive rating;  $V_{GE} = 20V$ , pulse width limited by max. junction temperature. ( See fig. 13b )
- ②  $V_{CC} = 80\%(V_{CES})$ ,  $V_{GE} = 20V$ ,  $L = 10\mu H$ ,  $R_G = 23\Omega$ , (See fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width  $\leq 80\mu s$ ; duty factor  $\leq 0.1\%$ .
- ⑤ Pulse width  $5.0\mu s$ , single shot.

### TO-220AB Package Outline (Dimensions are shown in millimeters (inches))



### TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010  
 LOT CODE 1789  
 ASSEMBLED ON WW 19, 1997  
 IN THE ASSEMBLY LINE 'C'  
**Note:** "P" in assembly line position indicates "Lead-Free"



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

Data and specifications subject to change without notice.



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