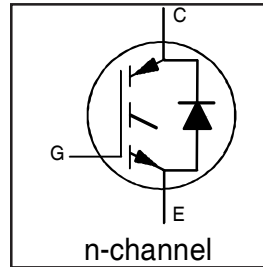


# IRG4IBC30UDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE UltraFast CoPack IGBT

## Features

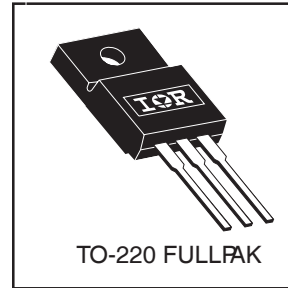
- 2.5kV, 60s insulation voltage ⑤
- 4.8 mm creepage distance to heatsink
- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- IGBT co-packaged with HEXFRED™ ultrafast, ultrasoft recovery antiparallel diodes
- Tighter parameter distribution
- Industry standard Isolated TO-220 Fullpak™ outline
- Lead-Free



$V_{CES} = 600V$
$V_{CE(on) typ.} = 1.95V$
@ $V_{GE} = 15V, I_C = 12A$

## Benefits

- Simplified assembly
- Highest efficiency and power density
- HEXFRED™ antiparallel Diode minimizes switching losses and EMI



## Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	17	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	8.9	
$I_{CM}$	Pulsed Collector Current ①	68	
$I_{LM}$	Clamped Inductive Load Current ②	68	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	8.5	
$I_{FM}$	Diode Maximum Forward Current	92	
$V_{isol}$	RMS Isolation Voltage, Terminal to Case ⑤	2500	V
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	45	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	18	
$T_J$	Operating Junction and	-55 to +150	°C
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	
	Mounting Torque, 6-32 or M3 Screw.	10 lbf•in (1.1 N•m)	

## Thermal Resistance

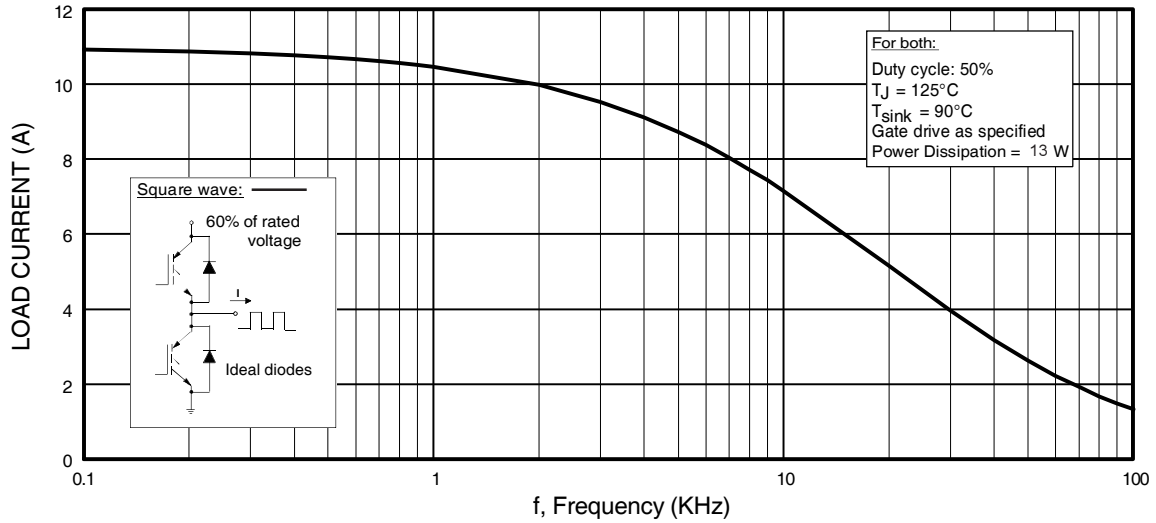
	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	—	2.8	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	—	4.1	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	65	
$W_t$	Weight	2.0 (0.07)	—	g (oz)

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

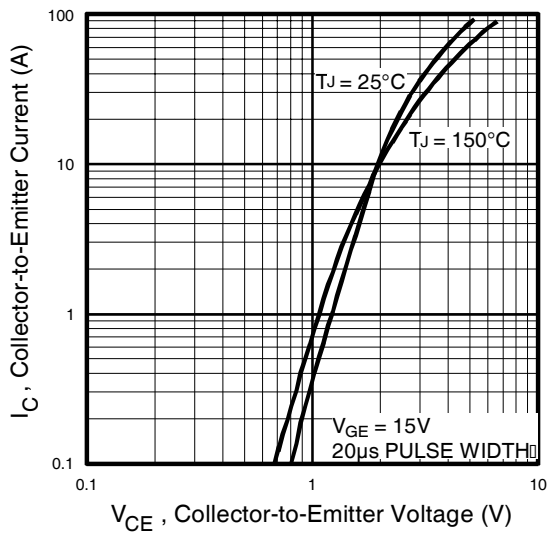
	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage <sub>f</sub>	600	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA
ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub>	Temperature Coeff. of Breakdown Voltage	—	0.63	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0mA
V <sub>CE(on)</sub>	Collector-to-Emitter Saturation Voltage	—	1.95	2.1	V	I <sub>C</sub> = 12A, V <sub>GE</sub> = 15V I <sub>C</sub> = 23A I <sub>C</sub> = 12A, T <sub>J</sub> = 150°C See Fig. 2, 5
		—	2.52	—		
		—	2.09	—		
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)</sub> /ΔT <sub>J</sub>	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
g <sub>fe</sub>	Forward Transconductance <sup>Ⓢ</sup>	3.1	8.6	—	S	V <sub>CE</sub> = 100V, I <sub>C</sub> = 12A
I <sub>CES</sub>	Zero Gate Voltage Collector Current	—	—	250	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V
		—	—	2500		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V, T <sub>J</sub> = 150°C
V <sub>FM</sub>	Diode Forward Voltage Drop	—	1.4	1.7	V	I <sub>C</sub> = 12A I <sub>C</sub> = 12A, T <sub>J</sub> = 150°C See Fig. 13
		—	1.3	1.6		
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)

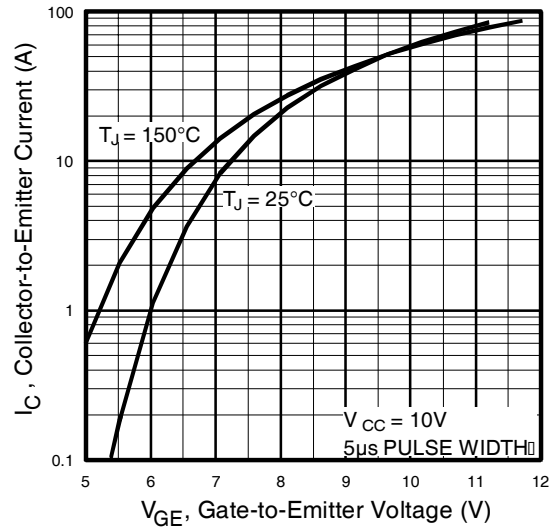
	Parameter	Min.	Typ.	Max.	Units	Conditions
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	50	75	nC	I <sub>C</sub> = 12A V <sub>CC</sub> = 400V V <sub>GE</sub> = 15V See Fig. 8
Q <sub>ge</sub>	Gate - Emitter Charge (turn-on)	—	8.1	12		
Q <sub>gc</sub>	Gate - Collector Charge (turn-on)	—	18	27		
t <sub>d(on)</sub>	Turn-On Delay Time	—	40	—	ns	T <sub>J</sub> = 25°C I <sub>C</sub> = 12A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 23Ω Energy losses include "tail" and diode reverse recovery. See Fig. 9, 10, 11, 18
t <sub>r</sub>	Rise Time	—	21	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	91	140		
t <sub>f</sub>	Fall Time	—	80	130		
E <sub>on</sub>	Turn-On Switching Loss	—	0.38	—	mJ	T <sub>J</sub> = 150°C, See Fig. 9, 10, 11, 18 I <sub>C</sub> = 12A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 23Ω Energy losses include "tail" and diode reverse recovery.
E <sub>off</sub>	Turn-Off Switching Loss	—	0.16	—		
E <sub>ts</sub>	Total Switching Loss	—	0.54	0.9		
t <sub>d(on)</sub>	Turn-On Delay Time	—	40	—	ns	T <sub>J</sub> = 150°C, See Fig. 9, 10, 11, 18 I <sub>C</sub> = 12A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 23Ω Energy losses include "tail" and diode reverse recovery.
t <sub>r</sub>	Rise Time	—	22	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	120	—		
t <sub>f</sub>	Fall Time	—	180	—		
E <sub>ts</sub>	Total Switching Loss	—	0.89	—	mJ	
L <sub>E</sub>	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C <sub>ies</sub>	Input Capacitance	—	1100	—	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V f = 1.0MHz See Fig. 7
C <sub>oes</sub>	Output Capacitance	—	73	—		
C <sub>res</sub>	Reverse Transfer Capacitance	—	14	—		
t <sub>rr</sub>	Diode Reverse Recovery Time	—	42	60	ns	T <sub>J</sub> = 25°C See Fig. 14 T <sub>J</sub> = 125°C
		—	80	120		
I <sub>rr</sub>	Diode Peak Reverse Recovery Current	—	3.5	6.0	A	T <sub>J</sub> = 25°C See Fig. 15 T <sub>J</sub> = 125°C
		—	5.6	10		
Q <sub>rr</sub>	Diode Reverse Recovery Charge	—	80	180	nC	T <sub>J</sub> = 25°C See Fig. 16 T <sub>J</sub> = 125°C
		—	220	600		
di <sub>(rec)</sub> M/dt	Diode Peak Rate of Fall of Recovery During t <sub>b</sub>	—	180	—	A/μs	T <sub>J</sub> = 25°C See Fig. 17 T <sub>J</sub> = 125°C
		—	120	—		



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

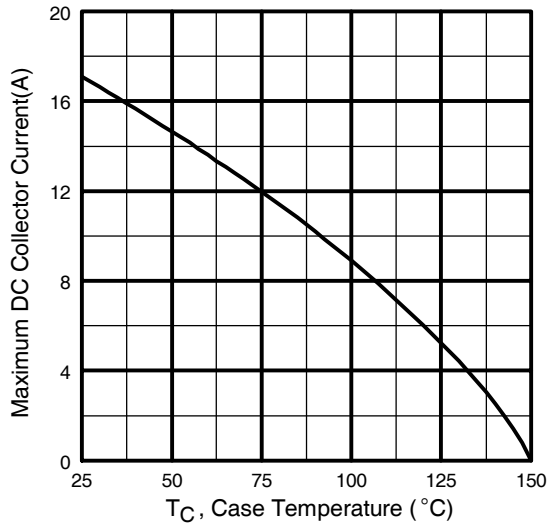


**Fig. 2** - Typical Output Characteristics  
[www.irf.com](http://www.irf.com)

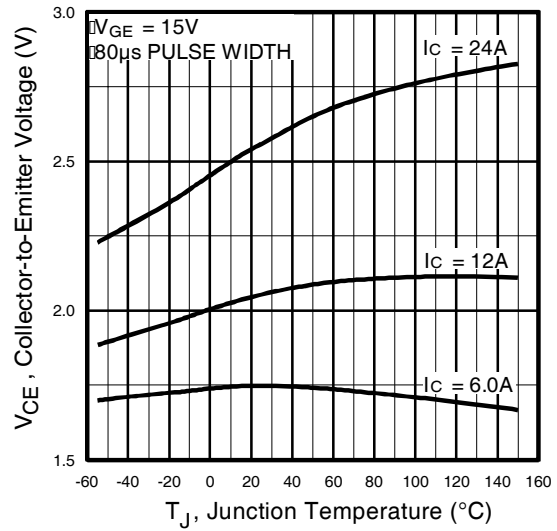


**Fig. 3** - Typical Transfer Characteristics

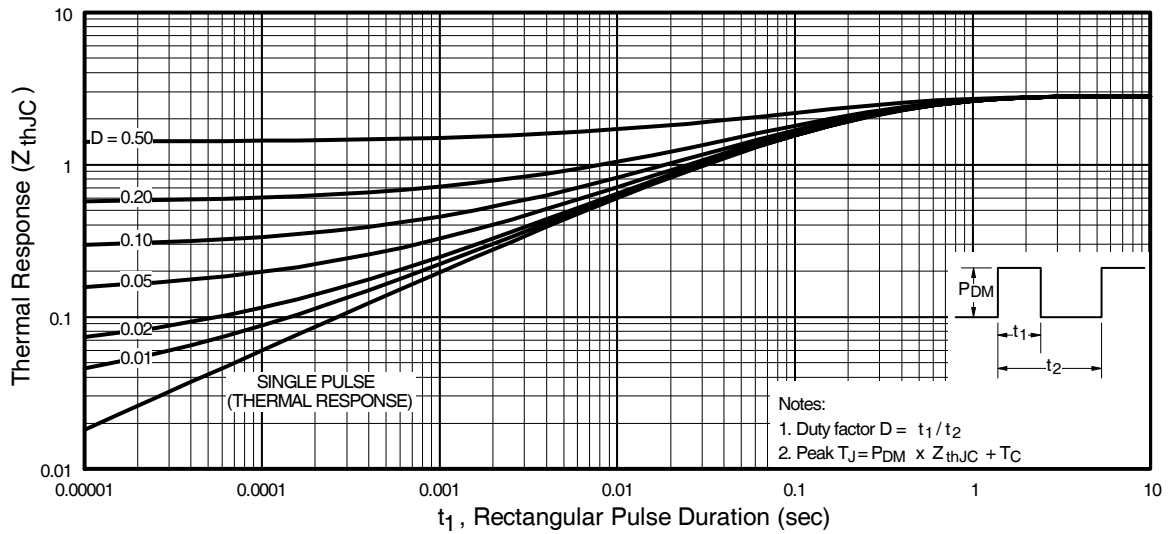
# IRG4IBC30UDPbF



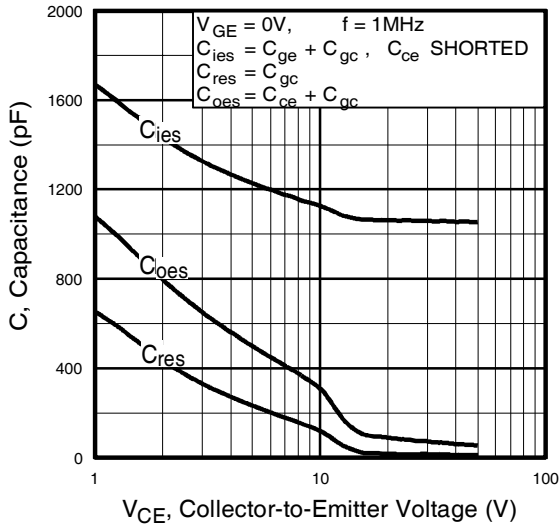
**Fig. 4** - Maximum Collector Current vs. Case Temperature



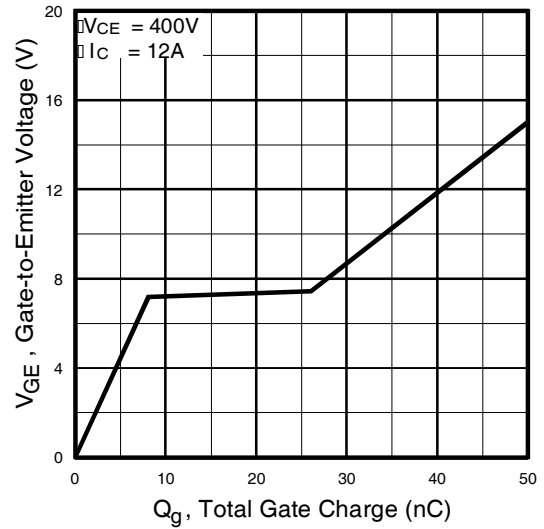
**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature



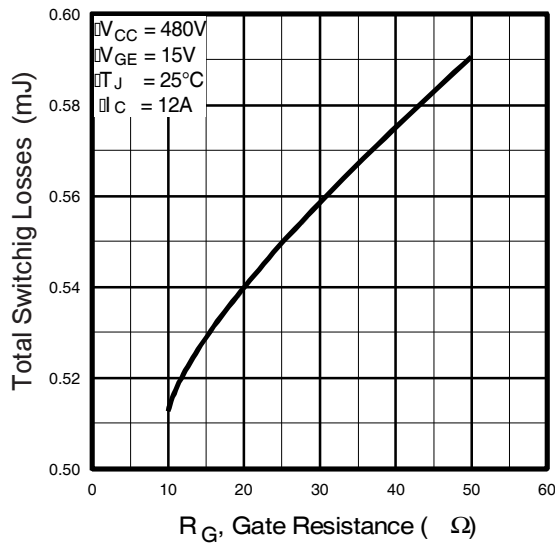
**Fig. 6** - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case



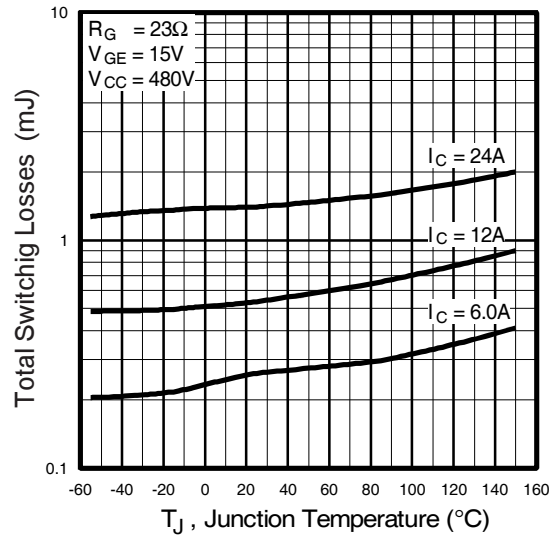
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



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

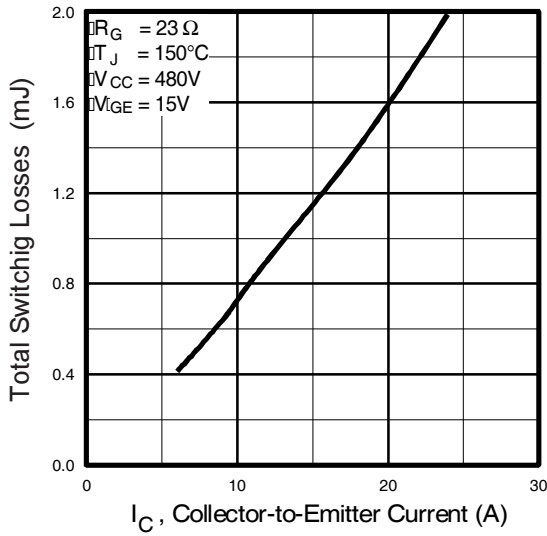


**Fig. 9** - Typical Switching Losses vs. Gate Resistance

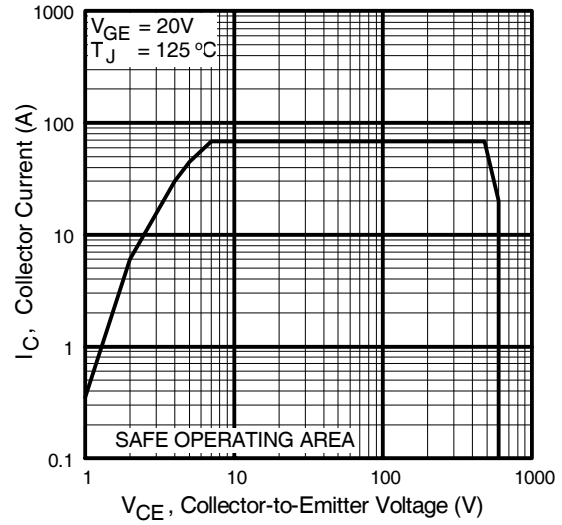


**Fig. 10** - Typical Switching Losses vs. Junction Temperature

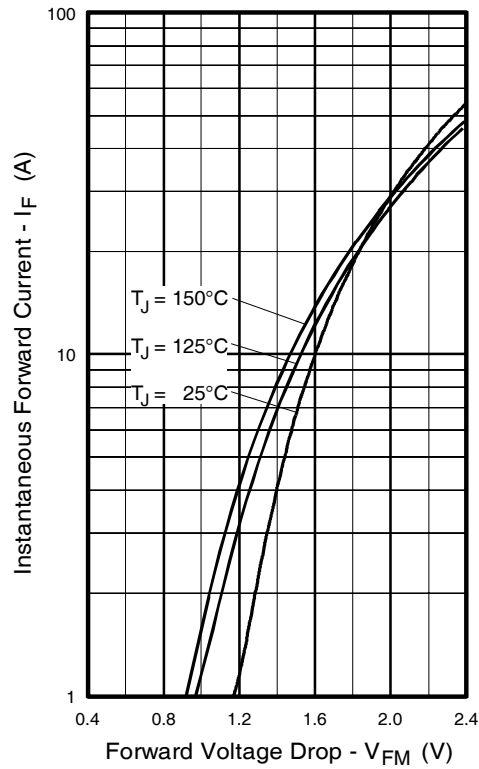
# IRG4IBC30UDPbF



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



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



**Fig. 13** - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

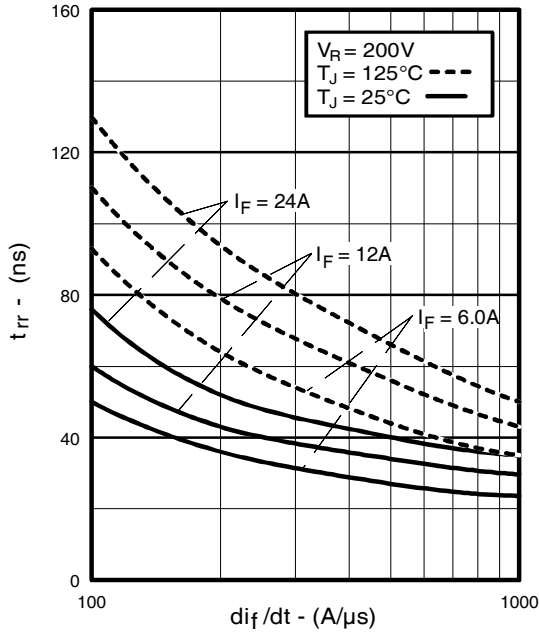


Fig. 14 - Typical Reverse Recovery vs.  $di_f/dt$

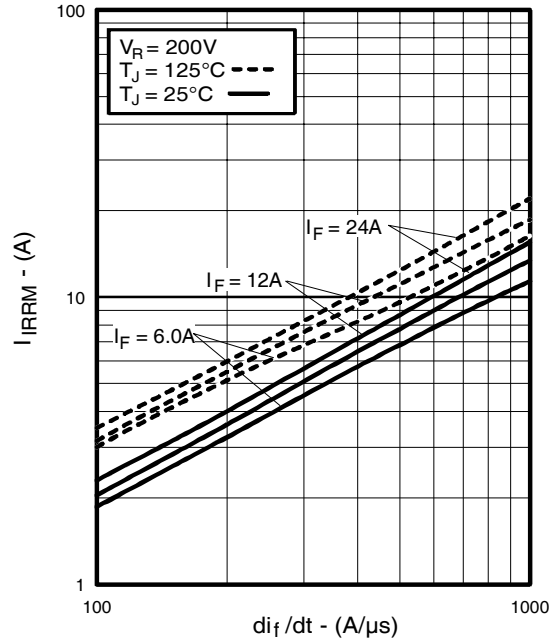


Fig. 15 - Typical Recovery Current vs.  $di_f/dt$

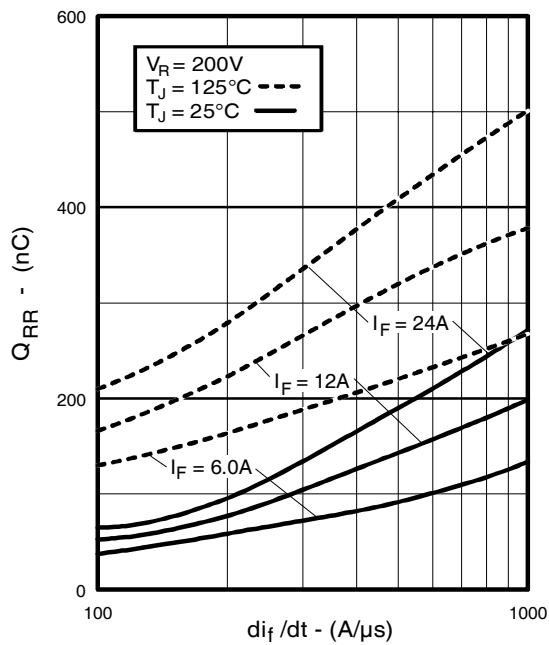


Fig. 16 - Typical Stored Charge vs.  $di_f/dt$

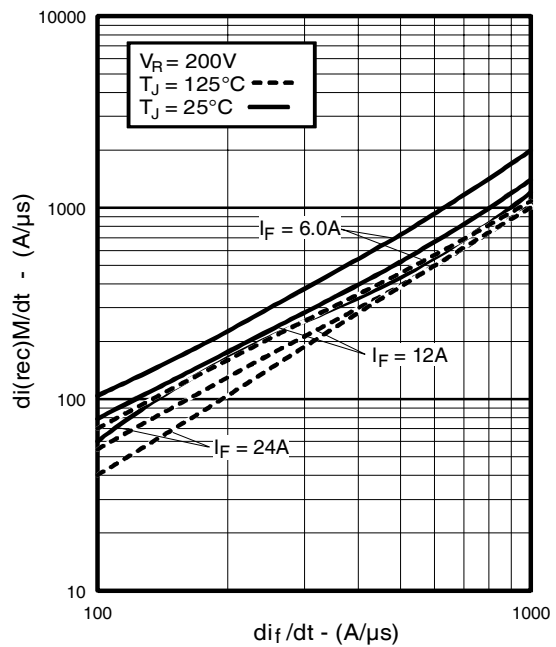
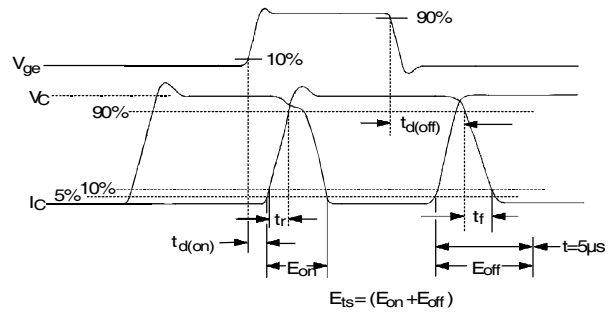


Fig. 17 - Typical  $di_{(rec)M}/dt$  vs.  $di_f/dt$

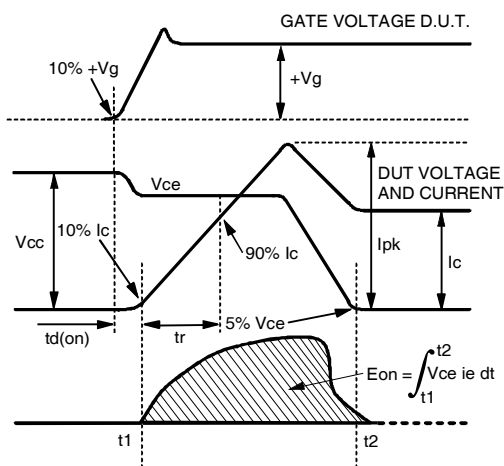
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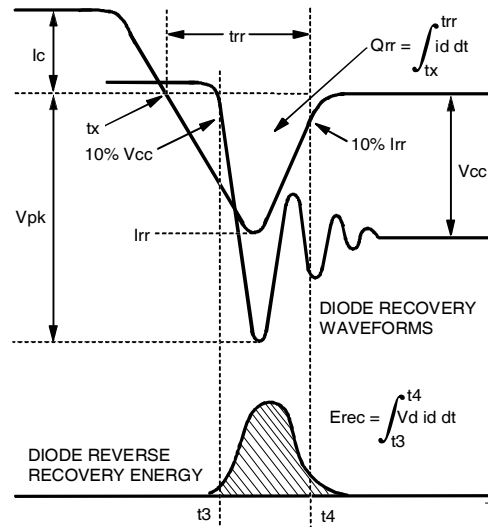
**Fig. 18a** - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{on}$ ,  $E_{off}(\text{diode})$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$ ,  $t_{d(on)}$ ,  $t_r$ ,  $t_{d(off)}$ ,  $t_f$



**Fig. 18b** - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{off}$ ,  $t_{d(off)}$ ,  $t_f$



**Fig. 18c** - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{on}$ ,  $t_{d(on)}$ ,  $t_r$



**Fig. 18d** - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{rec}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$



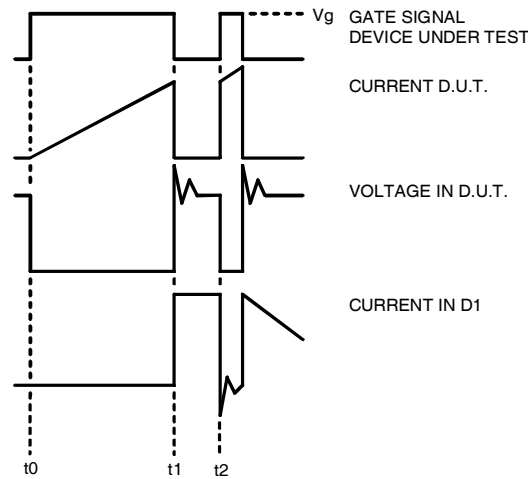


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

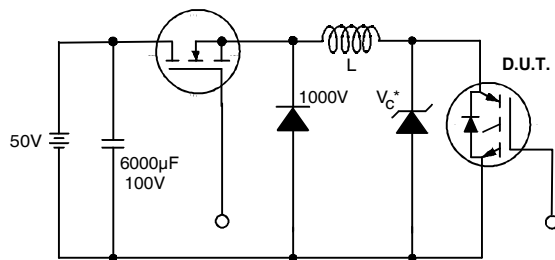


Figure 19. Clamped Inductive Load Test Circuit

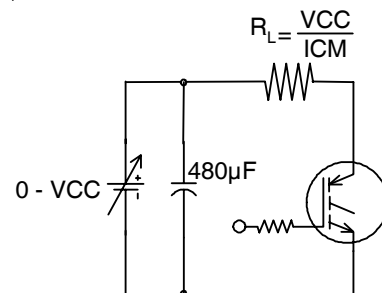


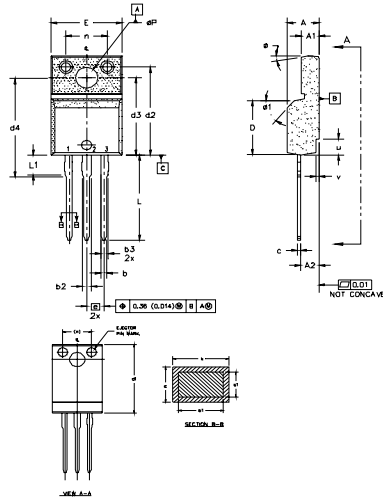
Figure 20. Pulsed Collector Current Test Circuit

# IRG4IBC30UDPbF

## TO-220AB Full-Pak Package Outline

Dimensions are shown in millimeters (inches)

International  
**IR** Rectifier



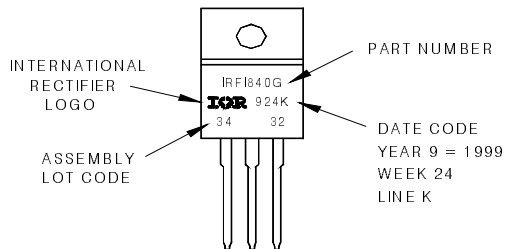
NOTES:  
1.0 DIMENSIONS AND TOLERANCING PER ASME Y14.5 M-1994.  
2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).  
3.0 LEAD DIMENSION AND FINISH UNCONTROLLED AT L1.  
4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH; MOLD FLASH SHALL NOT EXCEED 0.002" (0.025) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.  
5.0 DIMENSION H APPLYS TO BASE METAL ONLY.  
6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS U & V.  
7.0 CONTROLLING DIMENSION - INCHES.

SYMBOL	MILLIMETERS		INCHES		NOTES	LEAD ASSIGNMENTS
	MIN.	MAX.	MIN.	MAX.		
A	4.37	4.83	0.180	0.190		
A1	2.57	2.85	0.101	0.114		
A2	2.51	2.85	0.099	0.112		
b	0.622	0.889	0.024	0.035		
b1	0.622	0.828	0.024	0.032	0	1- GATE 2- DRAIN 3- SOURCE
b2	1.229	1.400	0.048	0.055		
b3	1.229	1.400	0.048	0.055		
c	0.640	0.629	0.025	0.025		
c1	0.640	0.564	0.025	0.022		
D	8.65	9.80	0.341	0.386	4	IRF1840G 1- GATE 2- COLLECTOR 3- EMITTER
d1	19.80	19.15	0.783	0.753		
d2	19.97	14.22	0.786	0.560		
d3	12.30	12.97	0.484	0.509		
d4	8.64	9.81	0.340	0.390		
E	10.36	10.63	0.408	0.419	4	
e	2.54	2.54	0.100	0.100		
L	13.20	13.73	0.520	0.541		
L1	3.10	3.50	0.122	0.138	3	
n	6.05	6.15	0.238	0.242		
np	3.05	3.40	0.120	0.136		
u	2.40	2.50	0.094	0.098	6	
v	0.40	0.50	0.016	0.020	6	
φ	3"	3"	3"	3"		
φ1	45°	45°	45°	45°		

## TO-220 Full-Pak Part Marking Information

EXAMPLE: THIS IS AN IRF1840G  
WITH ASSEMBLY  
LOT CODE 3432  
ASSEMBLED ON WW 24 1999  
IN THE ASSEMBLY LINE 'K'

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/>

### Notes:

- ① Repetitive rating:  $V_{GE}=20V$ ; pulse width limited by maximum junction temperature (figure 20)
- ②  $V_{CC}=80\%(V_{CES})$ ,  $V_{GE}=20V$ ,  $L=10\mu H$ ,  $R_G=23\Omega$  (figure 19)
- ③ Pulse width  $\leq 80\mu s$ ; duty factor  $\leq 0.1\%$ .
- ④ Pulse width  $5.0\mu s$ , single shot.
- ⑤  $t = 60s$ ,  $f = 60Hz$

Data and specifications subject to change without notice.

International  
**IR** Rectifier

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TAC Fax: (310) 252-7903

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