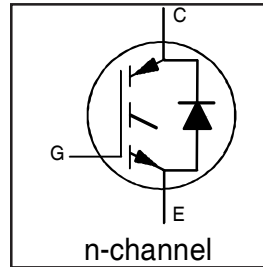


# IRG4IBC30UDPbF

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

## Features

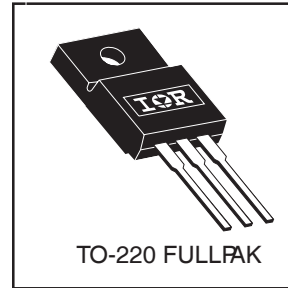
- 2.5kV, 60s insulation voltage ⑤
- 4.8 mm creepage distance to heatsink
- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- IGBT co-packaged with HEXFRED™ ultrafast, ultrasoft recovery antiparallel diodes
- Tighter parameter distribution
- Industry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

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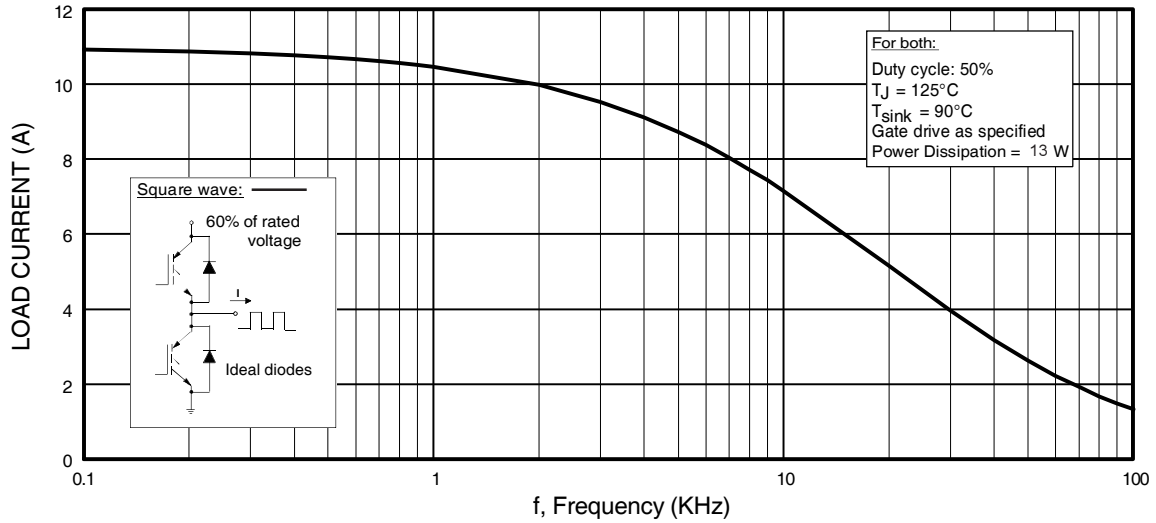
# IRG4IBC30UDPbF

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

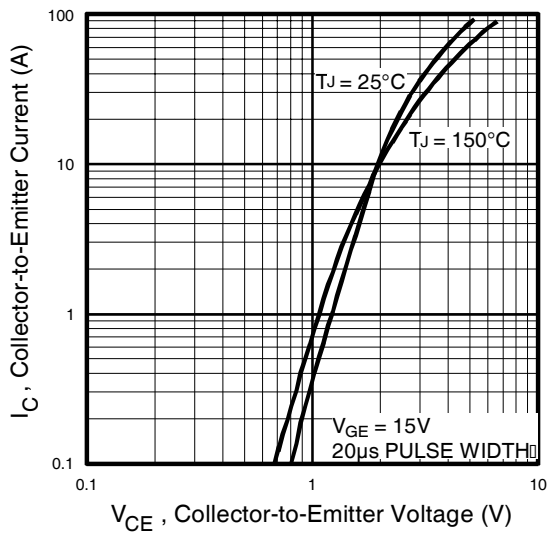
	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage <sub>f</sub>	600	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA
ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub>	Temperature Coeff. of Breakdown Voltage	—	0.63	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0mA
V <sub>CE(on)</sub>	Collector-to-Emitter Saturation Voltage	—	1.95	2.1	V	I <sub>C</sub> = 12A I <sub>C</sub> = 23A I <sub>C</sub> = 12A, T <sub>J</sub> = 150°C V <sub>GE</sub> = 15V 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)

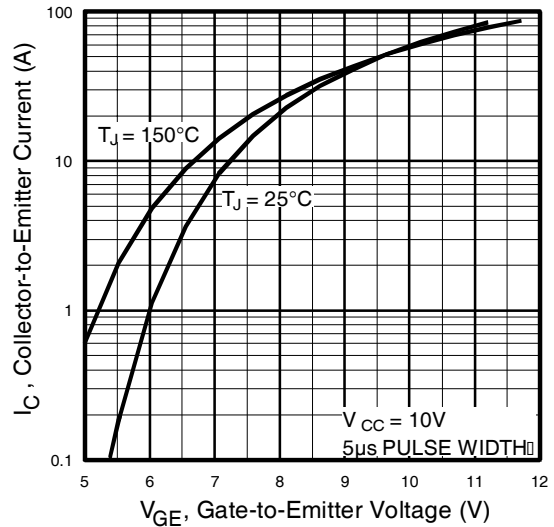
	Parameter	Min.	Typ.	Max.	Units	Conditions
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	50	75	nC	I <sub>C</sub> = 12A V <sub>CC</sub> = 400V V <sub>GE</sub> = 15V See Fig. 8
Q <sub>ge</sub>	Gate - Emitter Charge (turn-on)	—	8.1	12		
Q <sub>gc</sub>	Gate - Collector Charge (turn-on)	—	18	27		
t <sub>d(on)</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	See Fig. 9, 10, 11, 18
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)



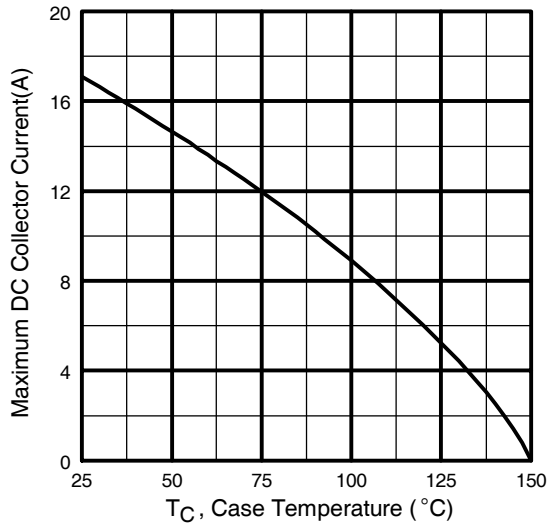
**Fig. 2 - Typical Output Characteristics**  
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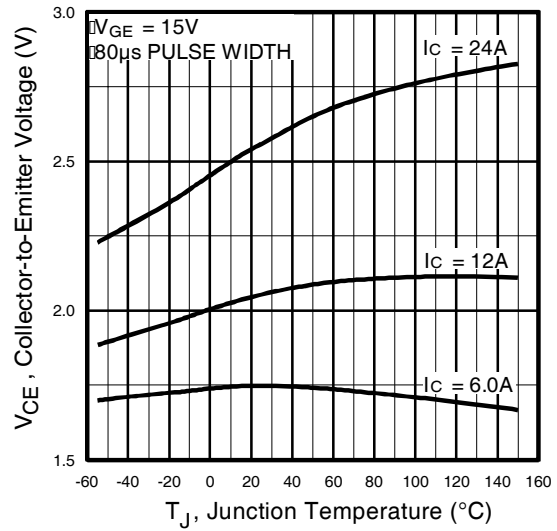
**Fig. 3 - Typical Transfer Characteristics**

# IRG4IBC30UDPbF

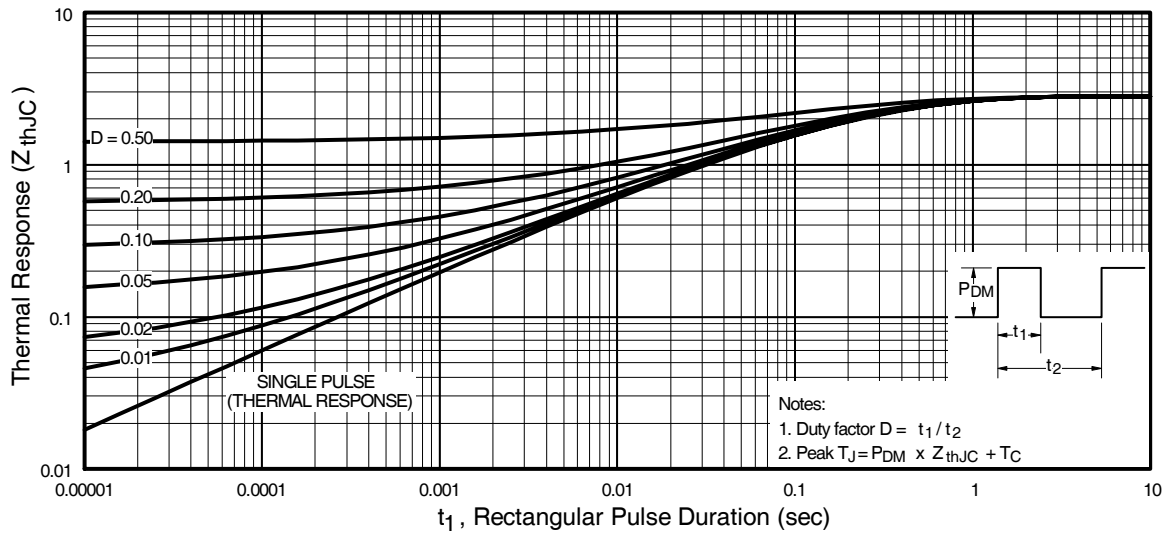
International  
**IR** Rectifier



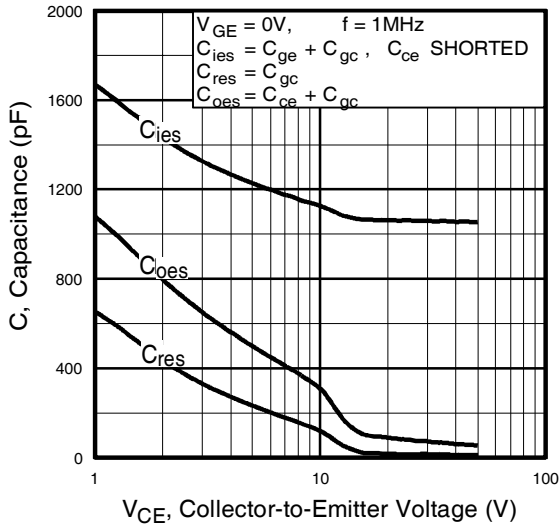
**Fig. 4** - Maximum Collector Current vs. Case Temperature



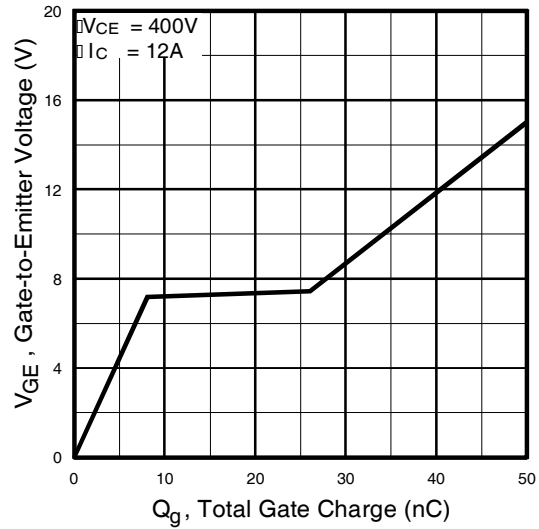
**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature



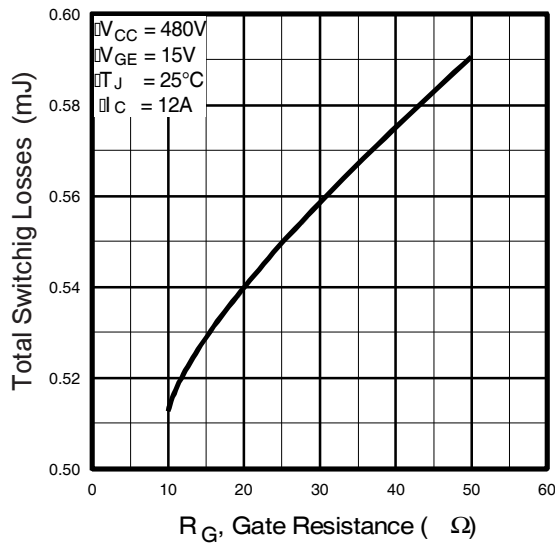
**Fig. 6** - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case



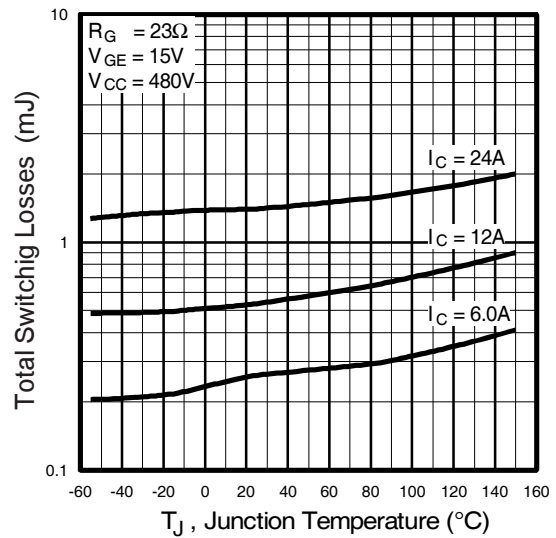
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



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



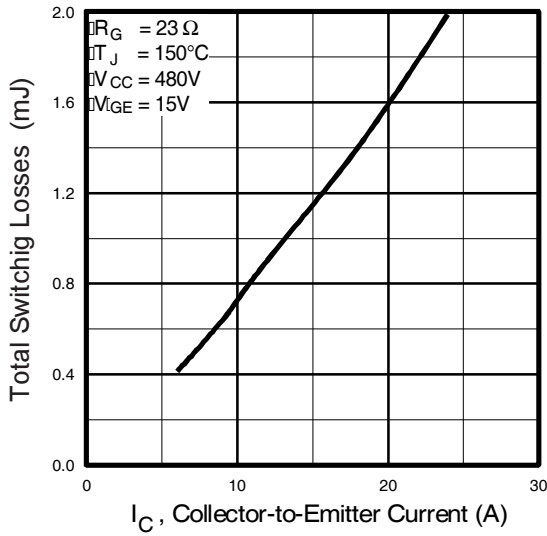
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



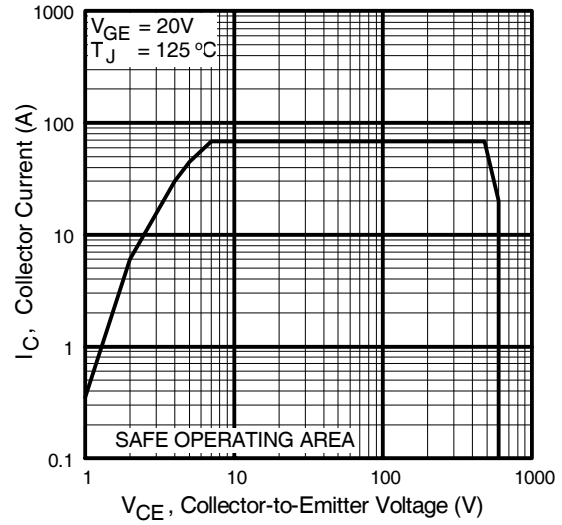
**Fig. 10** - Typical Switching Losses vs. Junction Temperature

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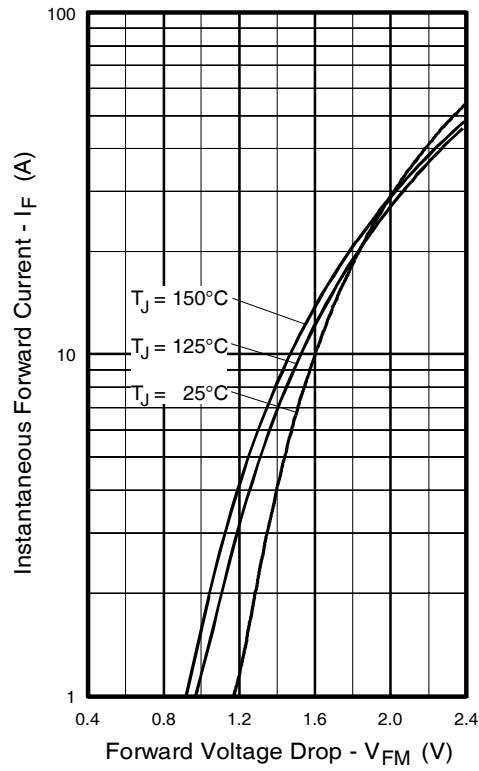
International  
**IR** Rectifier



**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

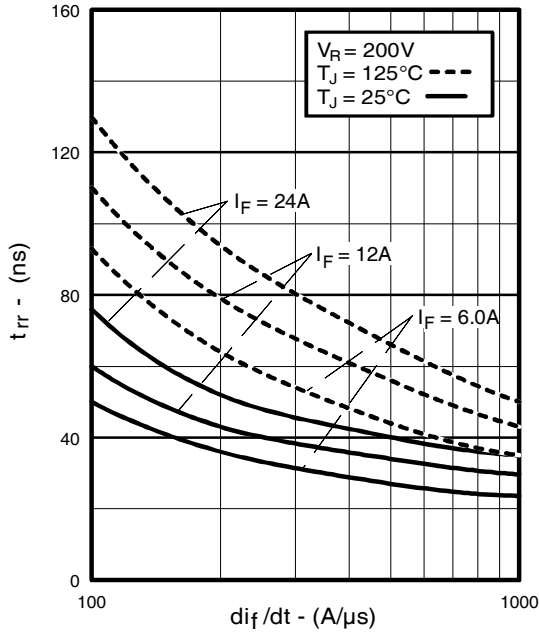


Fig. 14 - Typical Reverse Recovery vs.  $di_f/dt$

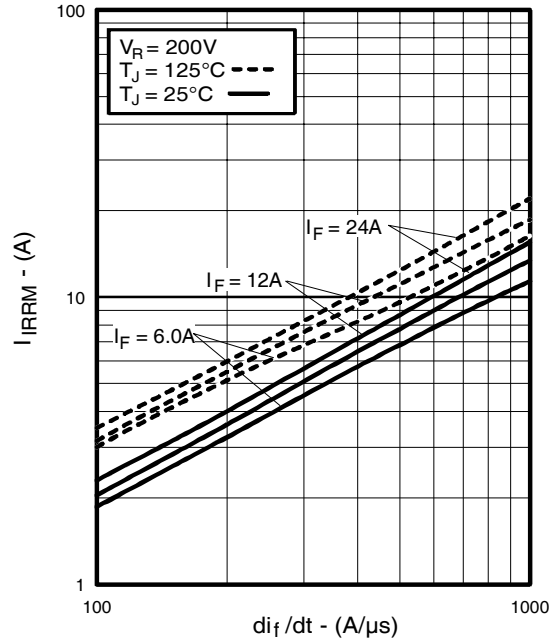


Fig. 15 - Typical Recovery Current vs.  $di_f/dt$

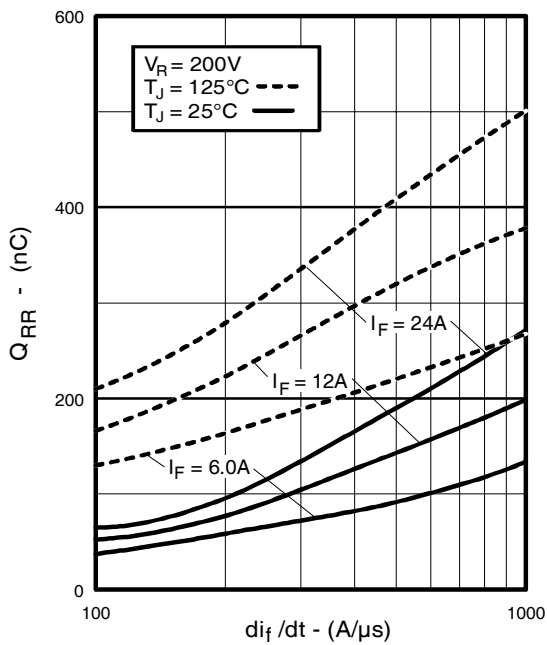


Fig. 16 - Typical Stored Charge vs.  $di_f/dt$

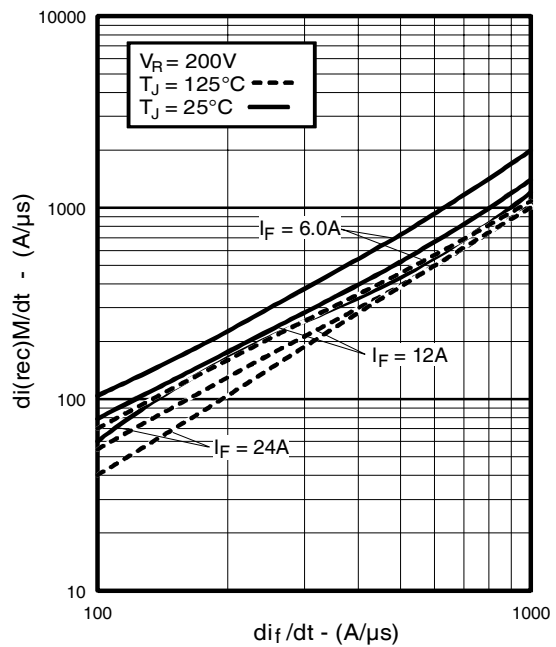
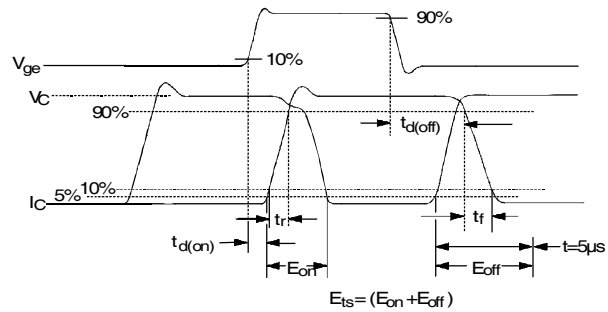


Fig. 17 - Typical  $di_{(rec)M}/dt$  vs.  $di_f/dt$

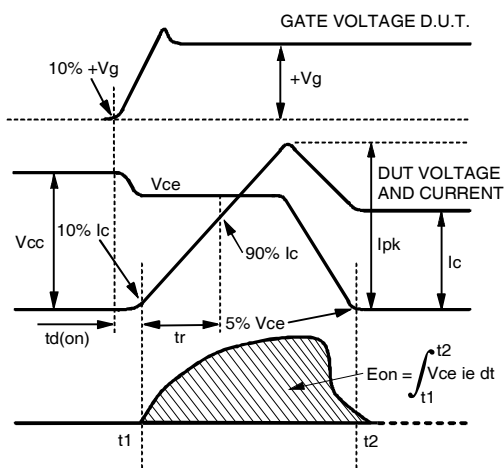
# IRG4IBC30UDPbF



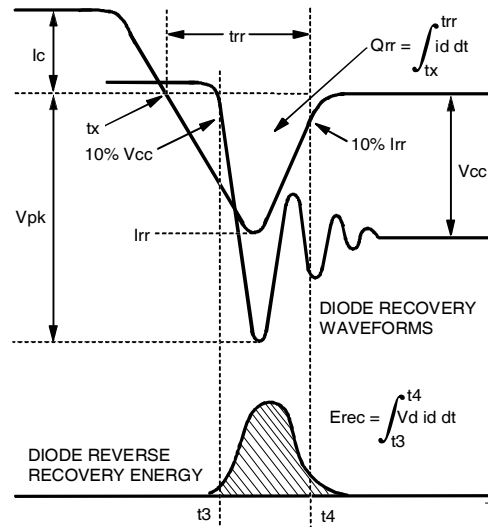
**Fig. 18a** - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{on}$ ,  $E_{off}(\text{diode})$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$ ,  $t_{d(on)}$ ,  $t_r$ ,  $t_{d(off)}$ ,  $t_f$



**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  $E_{rec}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$



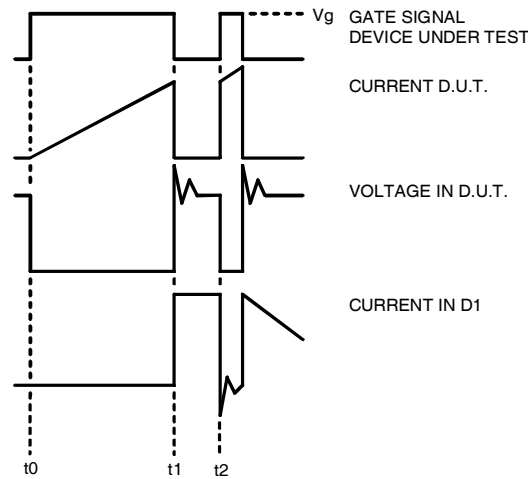


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

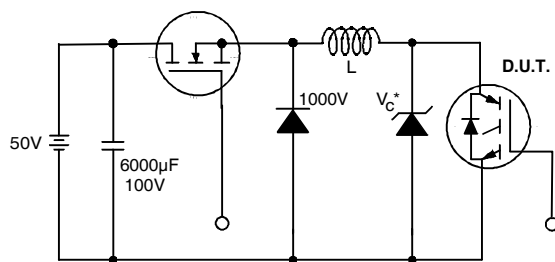


Figure 19. Clamped Inductive Load Test Circuit

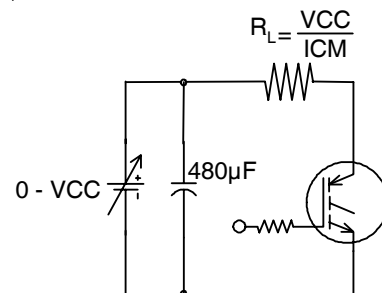


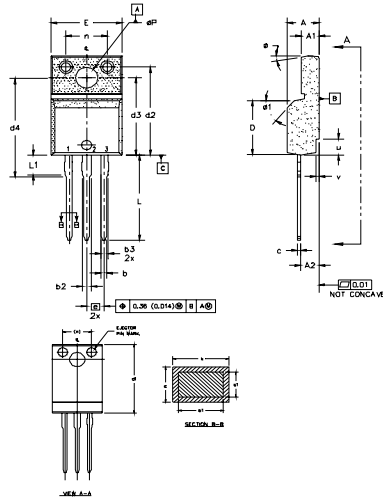
Figure 20. Pulsed Collector Current Test Circuit

# IRG4IBC30UDPbF

## TO-220AB Full-Pak Package Outline

Dimensions are shown in millimeters (inches)

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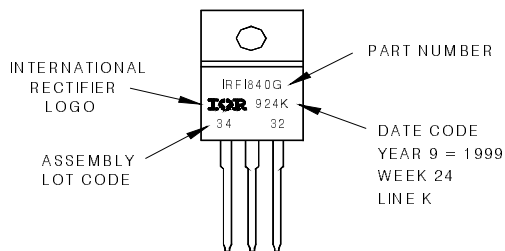
NOTES:  
1.0 DIMENSIONS AND TOLERANCING PER ASME Y14.5 M-1994.  
2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).  
3.0 LEAD DIMENSION AND FINISH UNCONTROLLED ALL L1.  
4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.025" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMITY OF THE PLASTIC BODY.  
5.0 DIMENSION D1 APPLYS TO BASE METAL ONLY.  
6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.  
7.0 CONTROLLING DIMENSION L INCHES.

SYMBOL	MILLIMETERS		INCHES		NOTES	LEAD ASSIGNMENTS
	MIN	MAX	MIN	MAX		
A	4.37	4.83	0.180	0.190		
A1	2.51	2.85	0.101	0.114		HEAT SINK
A2	2.51	2.85	0.099	0.112		
B	0.622	0.89	0.024	0.035	0	1- GATE 2- DRAIN 3- SOURCE
b1	0.622	0.828	0.024	0.032		
b2	1.229	1.400	0.048	0.055		
b3	1.229	1.400	0.048	0.055		
c	0.640	0.629	0.027	0.025		IRF184 G2PACK
d1	0.640	0.564	0.027	0.022		
D	8.65	9.80	0.341	0.386	4	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	7"	7"	7"	7"		
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

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

TAC Fax: (310) 252-7903

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