

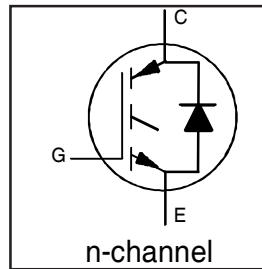
# IRG4BC30UDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH  
 ULTRAFast SOFT RECOVERY DIODE

UltraFast CoPack IGBT

## Features

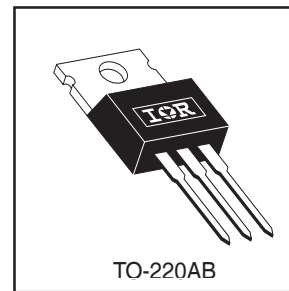
- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3
- IGBT co-packaged with HEXFRED™ ultrafast, ultra-soft-recovery anti-parallel diodes for use in bridge configurations
- Industry standard TO-220AB package
- Lead-Free



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

## Benefits

- Generation -4 IGBT's offer highest efficiencies available
- IGBTs optimized for specific application conditions
- HEXFRED diodes optimized for performance with IGBTs . Minimized recovery characteristics require less/no snubbing
- Designed to be a "drop-in" replacement for equivalent industry-standard Generation 3 IR IGBTs



## Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	23	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	12	
$I_{CM}$	Pulsed Collector Current ①	92	
$I_{LM}$	Clamped Inductive Load Current ②	92	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	12	
$I_{FM}$	Diode Maximum Forward Current	92	
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	100	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	42	
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to +150	°C
	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	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	-----	-----	1.2	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	-----	-----	2.5	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	-----	0.50	-----	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	-----	-----	80	
$W_t$	Weight	-----	2 (0.07)	-----	

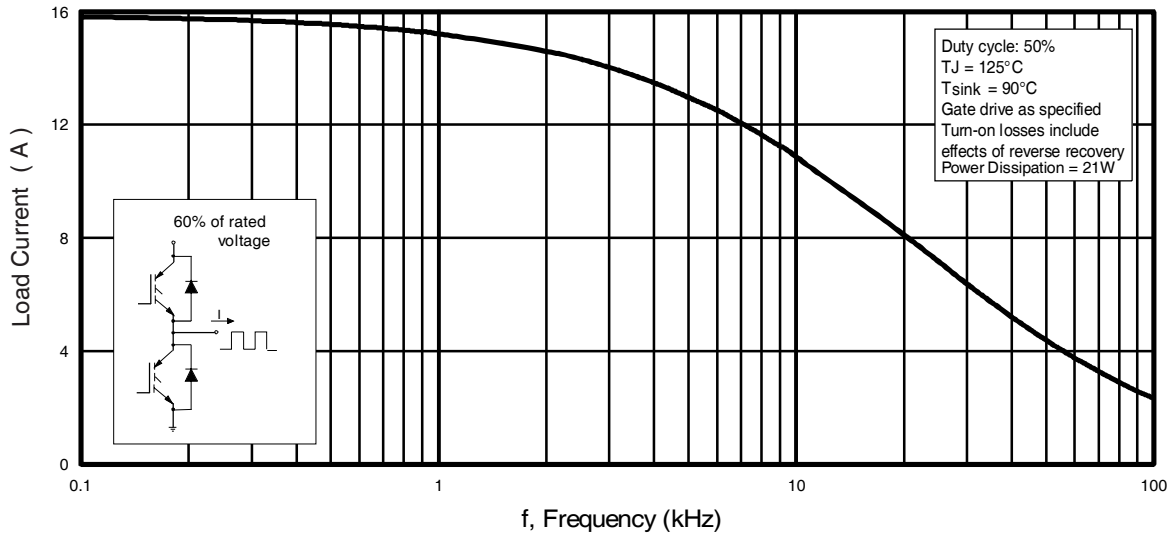
# IRG4BC30UDPbF

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

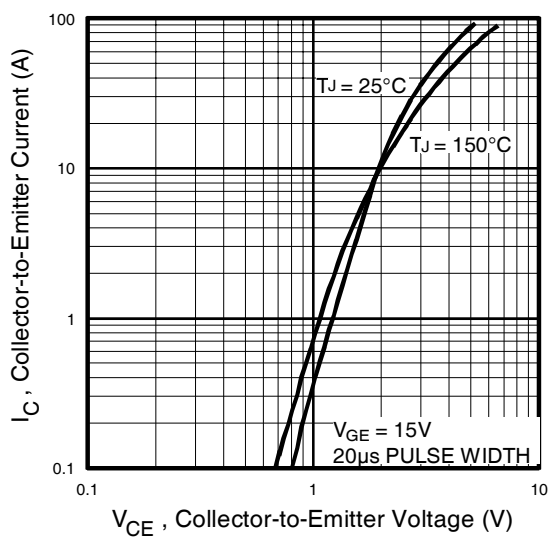
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage <sup>③</sup>	600	----	----	V	$V_{GE} = 0V, I_C = 250\mu A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	----	0.63	----	$V/^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	----	1.95	2.1	V	$I_C = 12A, V_{GE} = 15V$
		----	2.52	----		$I_C = 23A$
		----	2.09	----		$I_C = 12A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	----	6.0		$V_{CE} = V_{GE}, I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	----	-11	----	$mV/^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 250\mu A$
$g_{fe}$	Forward Transconductance <sup>④</sup>	3.1	8.6	----	S	$V_{CE} = 100V, I_C = 12A$
$I_{CES}$	Zero Gate Voltage Collector Current	----	----	250	$\mu A$	$V_{GE} = 0V, V_{CE} = 600V$
		----	----	2500		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
$V_{FM}$	Diode Forward Voltage Drop	----	1.4	1.7	V	$I_C = 12A$
		----	1.3	1.6		$I_C = 12A, T_J = 150^\circ\text{C}$
$I_{GES}$	Gate-to-Emitter Leakage Current	----	----	$\pm 100$	nA	$V_{GE} = \pm 20V$

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

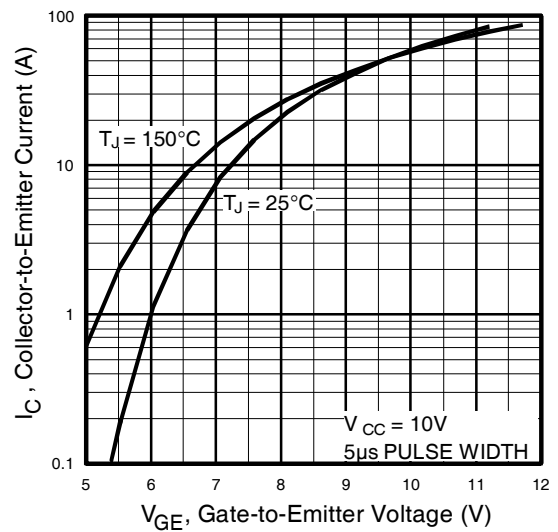
	Parameter	Min.	Typ.	Max.	Units	Conditions	
$Q_g$	Total Gate Charge (turn-on)	----	50	75		$I_C = 12A$	
$Q_{ge}$	Gate - Emitter Charge (turn-on)	----	8.1	12	nC	$V_{CC} = 400V$	
$Q_{gc}$	Gate - Collector Charge (turn-on)	----	18	27		$V_{GE} = 15V$	
$t_{d(on)}$	Turn-On Delay Time	----	40	----		$T_J = 25^\circ\text{C}$	
$t_r$	Rise Time	----	21	----	ns	$I_C = 12A, V_{CC} = 480V$	
$t_{d(off)}$	Turn-Off Delay Time	----	91	140		$V_{GE} = 15V, R_G = 23\Omega$	
$t_f$	Fall Time	----	80	130		Energy losses include "tail" and diode reverse recovery.	
$E_{on}$	Turn-On Switching Loss	----	0.38	----		mJ	See Fig. 9, 10, 11, 18
$E_{off}$	Turn-Off Switching Loss	----	0.16	----			
$E_{ts}$	Total Switching Loss	----	0.54	0.9			$T_J = 150^\circ\text{C},$ See Fig. 9, 10, 11, 18
$t_{d(on)}$	Turn-On Delay Time	----	40	----	ns	$I_C = 12A, V_{CC} = 480V$	
$t_r$	Rise Time	----	22	----		$V_{GE} = 15V, R_G = 23\Omega$	
$t_{d(off)}$	Turn-Off Delay Time	----	120	----		Energy losses include "tail" and diode reverse recovery.	
$t_f$	Fall Time	----	180	----		mJ	Measured 5mm from package
$E_{ts}$	Total Switching Loss	----	0.89	----			
$L_E$	Internal Emitter Inductance	----	7.5	----		nH	
$C_{ies}$	Input Capacitance	----	1100	----		$V_{GE} = 0V$	
$C_{oes}$	Output Capacitance	----	73	----	pF	$V_{CC} = 30V$	
$C_{res}$	Reverse Transfer Capacitance	----	14	----		$f = 1.0MHz$	
$t_{rr}$	Diode Reverse Recovery Time	----	42	60	ns	$T_J = 25^\circ\text{C}$ See Fig.	
$I_{rr}$	Diode Peak Reverse Recovery Current	----	80	120		A	$T_J = 125^\circ\text{C}$ 14
		----	3.5	6.0	$T_J = 25^\circ\text{C}$ See Fig.		
$Q_{rr}$	Diode Reverse Recovery Charge	----	5.6	10	nC	$T_J = 125^\circ\text{C}$ 15	
		----	80	180		$T_J = 25^\circ\text{C}$ See Fig.	
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery	----	220	600	A/ $\mu s$	$T_J = 125^\circ\text{C}$ 16	
		----	180	----		$T_J = 25^\circ\text{C}$ See Fig.	
	During $t_b$	----	120	----		$T_J = 125^\circ\text{C}$ 17	



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

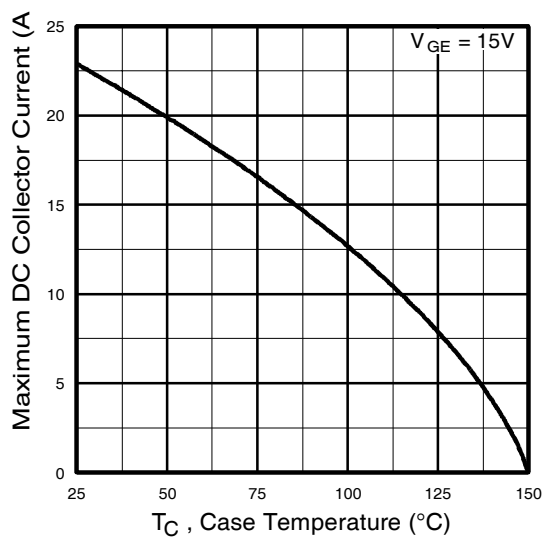


**Fig. 2 - Typical Output Characteristics**

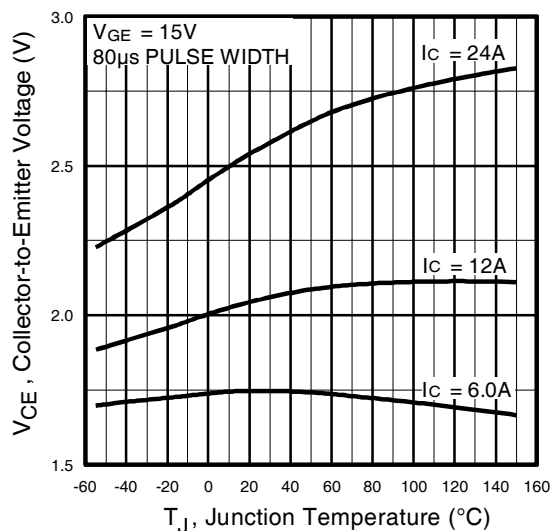


**Fig. 3 - Typical Transfer Characteristics**

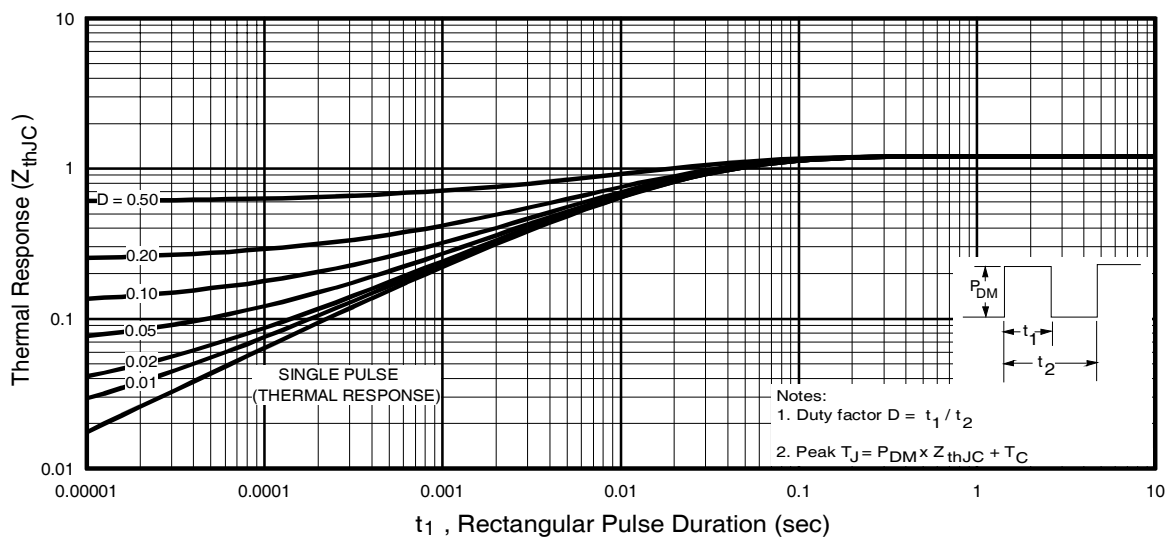
# IRG4BC30UDPbF



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

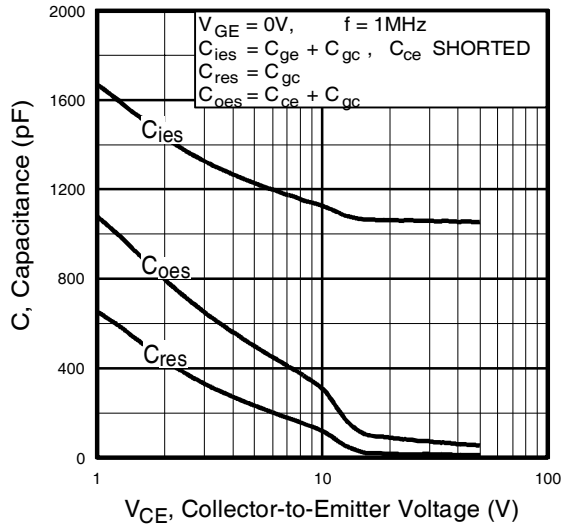


**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature

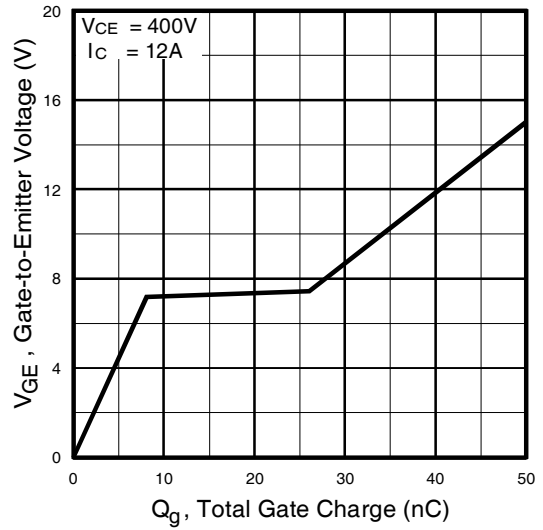


**Fig. 6** - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

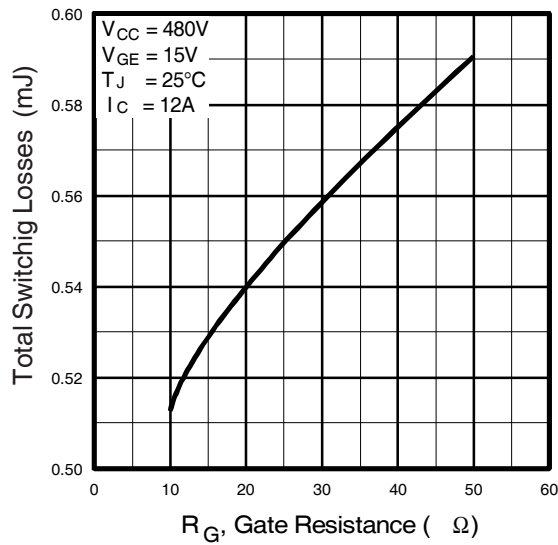
# IRG4BC30UDPbF



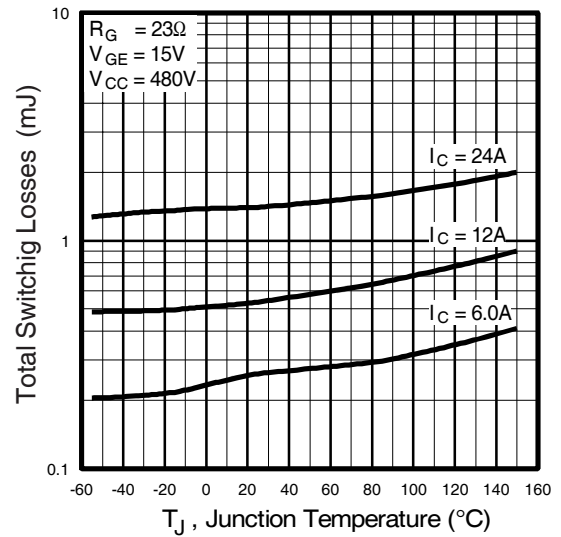
**Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage**



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

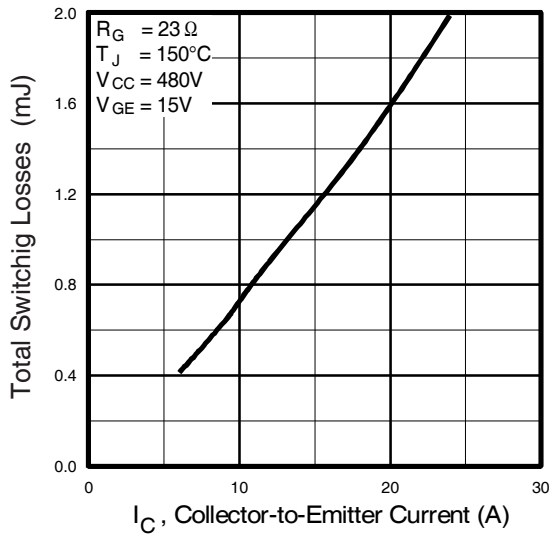


**Fig. 9 - Typical Switching Losses vs. Gate Resistance**

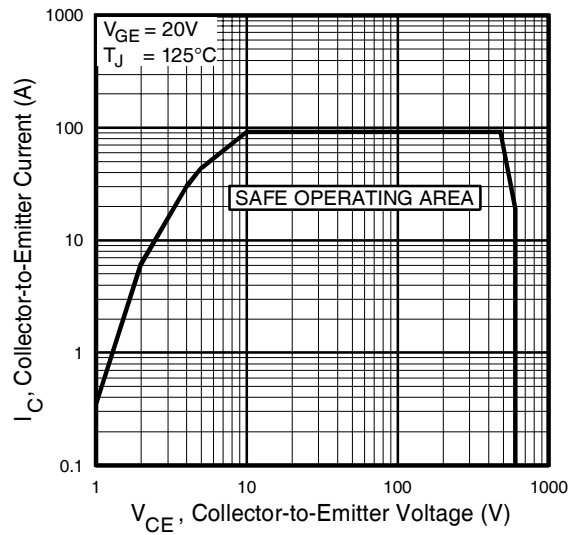


**Fig. 10 - Typical Switching Losses vs. Junction Temperature**

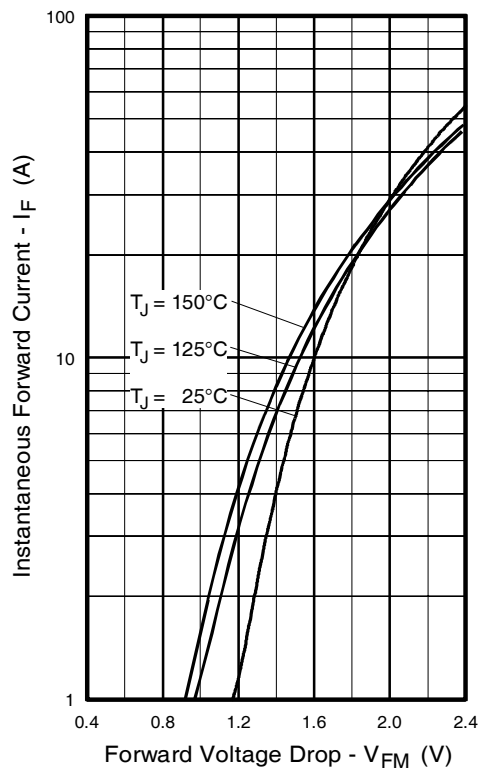
# IRG4BC30UDPbF



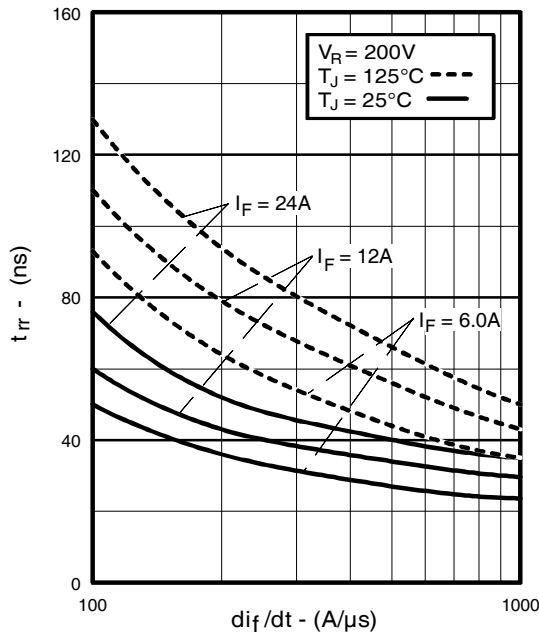
**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current



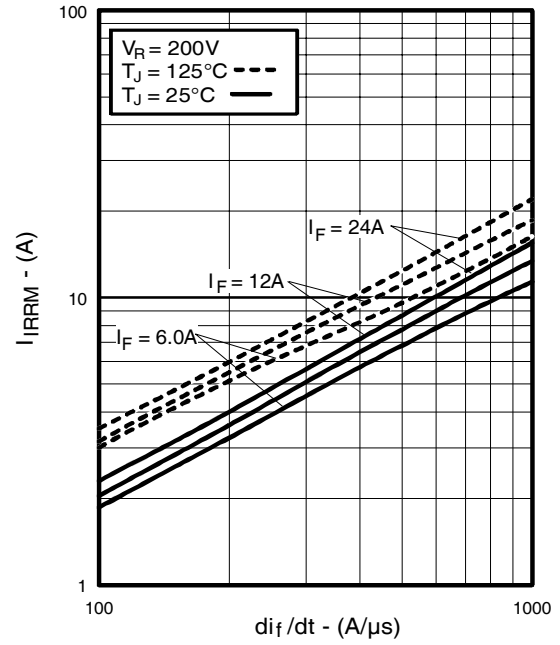
**Fig. 12** - Turn-Off SOA



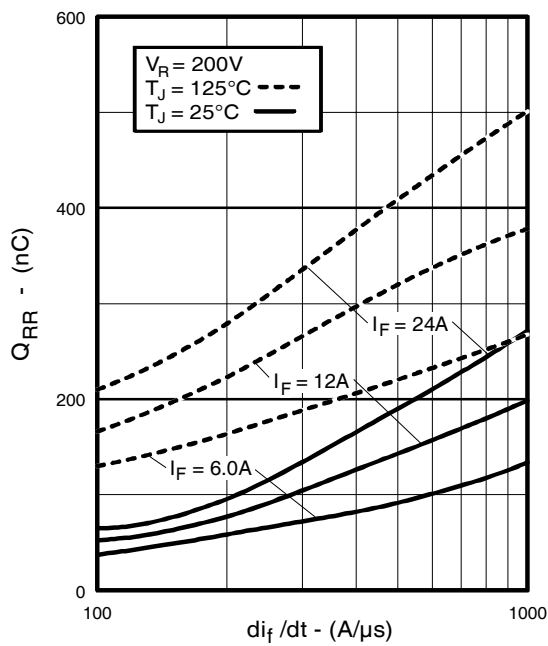
**Fig. 13** - Maximum Forward Voltage Drop vs. Instantaneous Forward Current



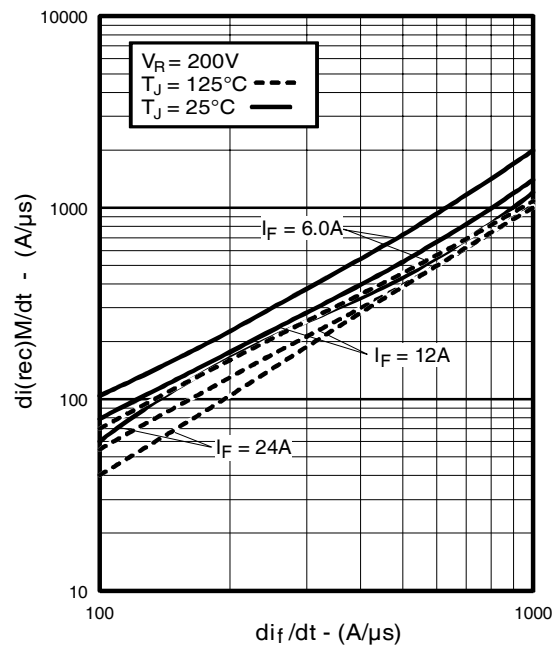
**Fig. 14 - Typical Reverse Recovery vs.  $di_f/dt$**



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

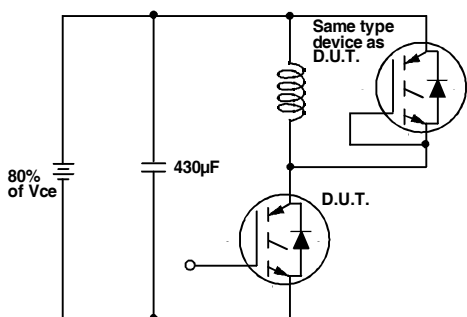


**Fig. 16 - Typical Stored Charge vs.  $di_f/dt$**

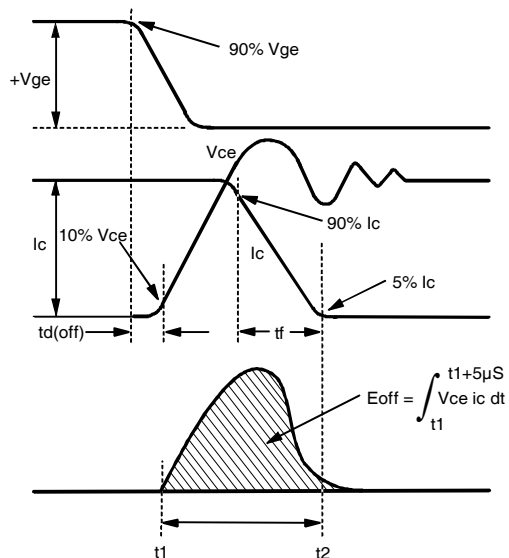


**Fig. 17 - Typical  $di_{(rec)M}/dt$  vs.  $di_f/dt$**

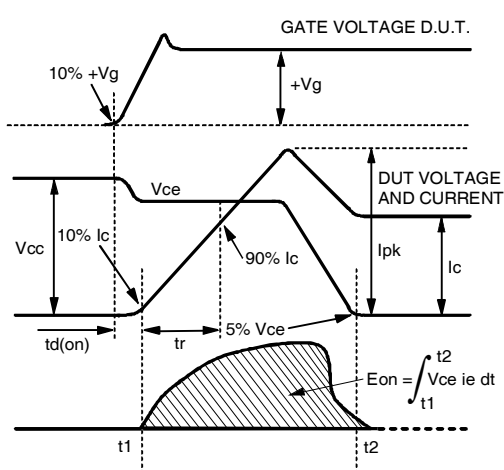
# IRG4BC30UDPbF



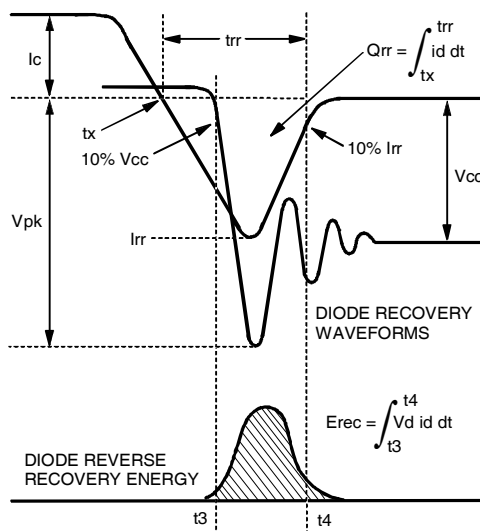
**Fig. 18a** - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{on}$ ,  $E_{off(diode)}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$ ,  $t_{d(on)}$ ,  $t_r$ ,  $t_{d(off)}$ ,  $t_f$



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

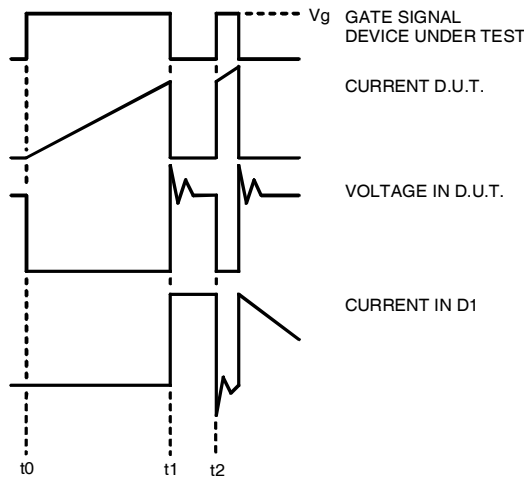


**Fig. 18c** - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{on}$ ,  $t_{d(on)}$ ,  $t_r$



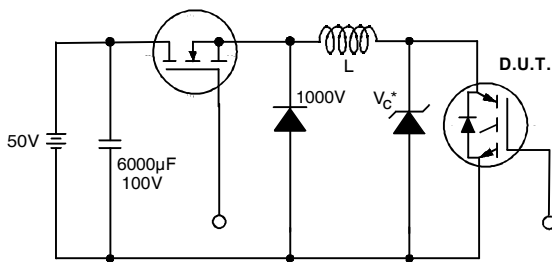
**Fig. 18d** - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{rec}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$



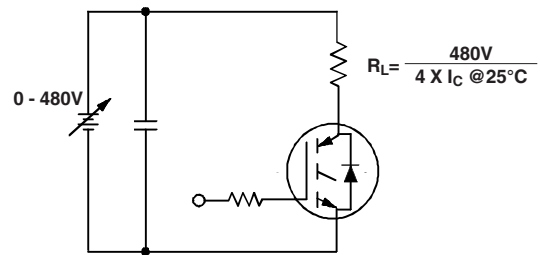


18.

18



19.



20.

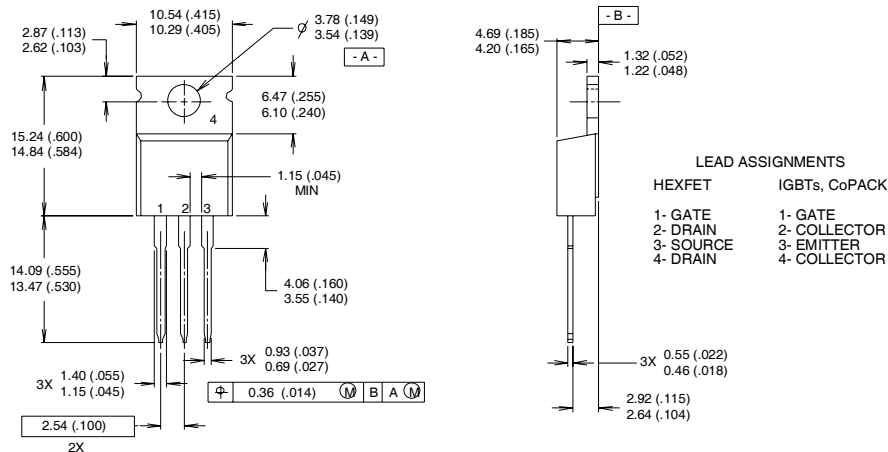
# IRG4BC30UDPbF

## 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.

## TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



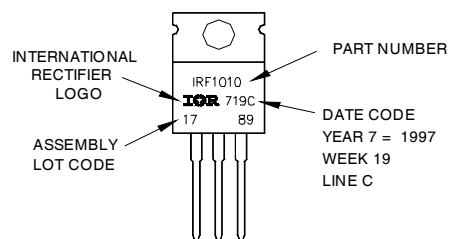
### NOTES:

- 1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
- 2 CONTROLLING DIMENSION : INCH

- 3 OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.
- 4 HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.

## 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"



Data and specifications subject to change without notice.

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