

# International IR Rectifier

INSULATED GATE BIPOLAR TRANSISTOR WITH  
HYPERFAST DIODE

PD - 94773

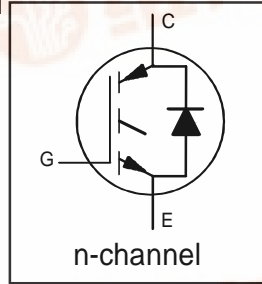
## IRG4BC30FD1 Fast CoPack IGBT

### Features

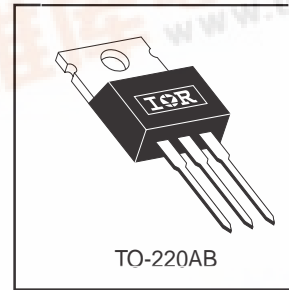
- Fast: optimized for medium operating frequencies (1-5 kHz in hard switching, >20kHz in resonant mode).
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3.
- IGBT co-packaged with Hyperfast FRED diodes for ultra low recovery characteristics.
- Industry standard TO-220AB package.

### Benefits

- Generation 4 IGBT's offer highest efficiency available.
- IGBT's optimized for specific application conditions.
- FRED diodes optimized for performance with IGBT's. Minimized recovery characteristics require less / no snubbing.



$V_{CES} = 600V$
$V_{CE(on) typ.} = 1.59V$
@ $V_{GE} = 15V, I_C = 17A$



### Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	31	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	17	
$I_{CM}$	Pulse Collector Current (Ref.Fig.C.T.5) ①	120	
$I_{LM}$	Clamped Inductive Load current ②	120	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	8	
$I_{FM}$	Diode Maximum Forward Current	16	
$V_{GE}$	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	
$T_J$	Operating Junction and	-55 to +150	°C
$T_{STG}$	Storage Temperature Range		
	Storage Temperature Range, 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 / Mechanical Characteristics

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case- IGBT	—	—	1.2	°C/W
$R_{\theta JC}$	Junction-to-Case- Diode	—	—	2.0	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	80	
Wt	Weight	—	2.0 (0.07)	—	g (oz.)



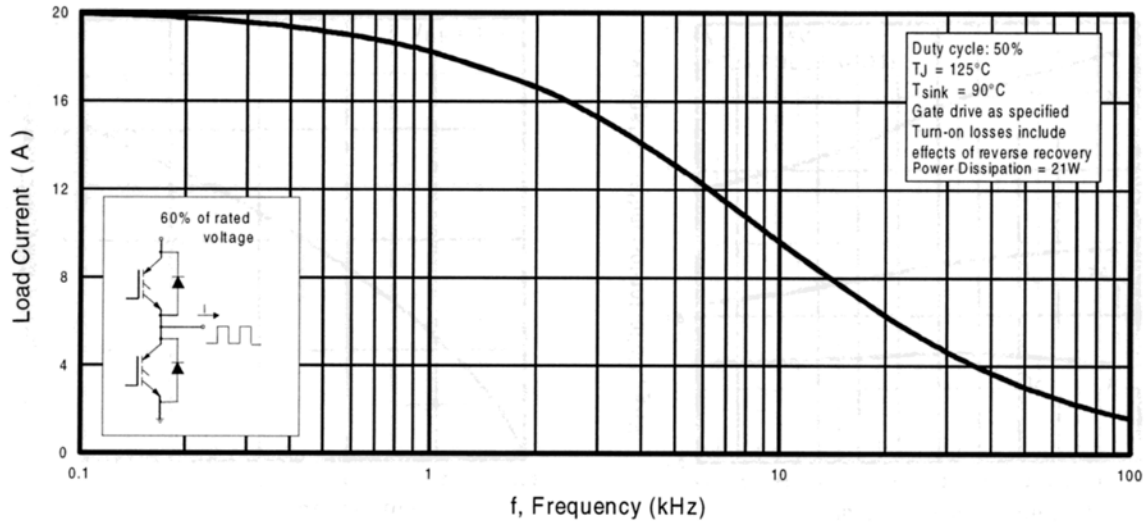
# IRG4BC30FD1

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

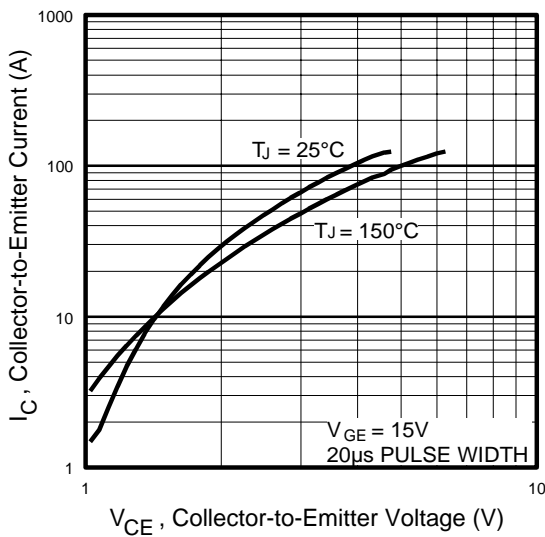
	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage ③	600	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA
ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub>	Temperature Coeff. of Breakdown Voltage	—	0.69	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA
V <sub>CE(on)</sub>	Collector-to-Emitter Voltage	—	1.59	1.8	V	I <sub>C</sub> = 17A V <sub>GE</sub> = 15V
		—	1.99	—		I <sub>C</sub> = 31A See Fig. 2, 5
		—	1.7	—		I <sub>C</sub> = 17A, T <sub>J</sub> = 150°C
V <sub>GE(th)</sub>	Gate Threshold Voltage	3.0	—	6.0	V	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
ΔV <sub>GE(th)</sub> /ΔT <sub>J</sub>	Threshold Voltage temp. coefficient	—	-11	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
g <sub>fe</sub>	Forward Transconductance ④	6.1	10	—	S	V <sub>CE</sub> = 100V, I <sub>C</sub> = 17A
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	—	2.0	2.4	V	I <sub>F</sub> = 8.0A See Fig. 13
		—	1.3	1.8		I <sub>F</sub> = 8.0A, 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)

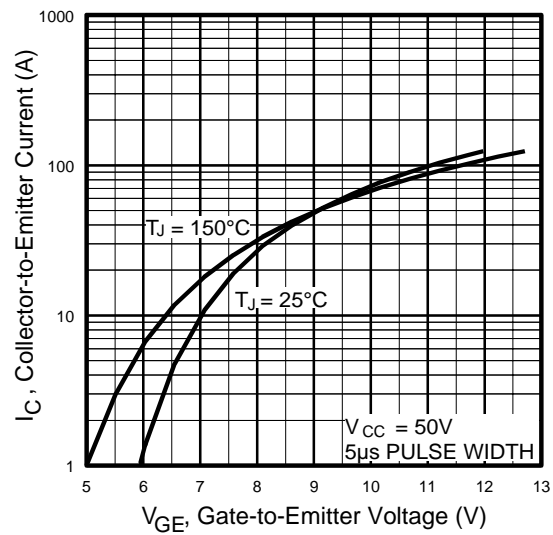
	Parameter	Min.	Typ.	Max.	Units	Conditions
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	57	62	nC	I <sub>C</sub> = 17A
Q <sub>ge</sub>	Gate-to-Emitter Charge (turn-on)	—	10	12		V <sub>CC</sub> = 400V See Fig. 8
Q <sub>gc</sub>	Gate-to-Collector Charge (turn-on)	—	21	24		V <sub>GE</sub> = 15V
t <sub>d(on)</sub>	Turn-On delay time	—	22	—	ns	T <sub>J</sub> = 25°C
t <sub>r</sub>	Rise time	—	24	—		I <sub>C</sub> = 17A, V <sub>CC</sub> = 480V
t <sub>d(off)</sub>	Turn-Off delay time	—	250	320		V <sub>GE</sub> = 15V, R <sub>G</sub> = 23Ω
t <sub>f</sub>	Fall time	—	160	210		Energy losses include "tail" and diode reverse recovery.
E <sub>on</sub>	Turn-On Switching Loss	—	370	—	μJ	See Fig. 9, 10, 11, 18
E <sub>off</sub>	Turn-Off Switching Loss	—	1420	—		
E <sub>ts</sub>	Total Switching Loss	—	1800	2290		
t <sub>d(on)</sub>	Turn-On delay time	—	21	—	ns	T <sub>J</sub> = 150°C See Fig. 9,10,11,18
t <sub>r</sub>	Rise time	—	25	—		I <sub>C</sub> = 17A, V <sub>CC</sub> = 480V
t <sub>d(off)</sub>	Turn-Off delay time	—	400	—		V <sub>GE</sub> = 15V, R <sub>G</sub> = 23Ω
t <sub>f</sub>	Fall time	—	340	—		Energy losses include "tail" and diode reverse recovery.
E <sub>ts</sub>	Total Switching Loss	—	3280	—	μJ	
L <sub>E</sub>	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C <sub>ies</sub>	Input Capacitance	—	1170	—	pF	V <sub>GE</sub> = 0V
C <sub>oes</sub>	Output Capacitance	—	100	—		V <sub>CC</sub> = 30V See Fig. 7
C <sub>res</sub>	Reverse Transfer Capacitance	—	11	—		f = 1.0MHz
t <sub>rr</sub>	Diode Reverse Recovery Time	—	46	61	ns	T <sub>J</sub> = 25°C See Fig. 14
		—	85	93		T <sub>J</sub> = 125°C
I <sub>rr</sub>	Diode Peak Reverse Recovery Current	—	4.8	6.5	A	T <sub>J</sub> = 25°C See Fig. 15
		—	8.5	10		T <sub>J</sub> = 125°C
Q <sub>rr</sub>	Diode Reverse Recovery Charge	—	110	190	nC	T <sub>J</sub> = 25°C See Fig. 16
		—	410	550		T <sub>J</sub> = 125°C
di <sub>(rec)M</sub> /dt	Diode Peak Rate of Fall of Recovery During t <sub>b</sub>	—	260	—	A/μs	T <sub>J</sub> = 25°C See Fig. 17
		—	270	—		T <sub>J</sub> = 125°C



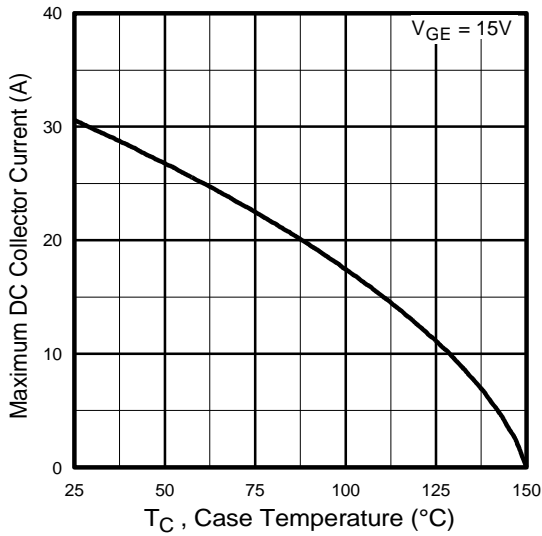
**Fig. 1 - Typical Load Current vs. Frequency**  
(For square wave,  $I = I_{RMS}$  of fundamental; for triangular wave,  $I = I_{PK}$ )



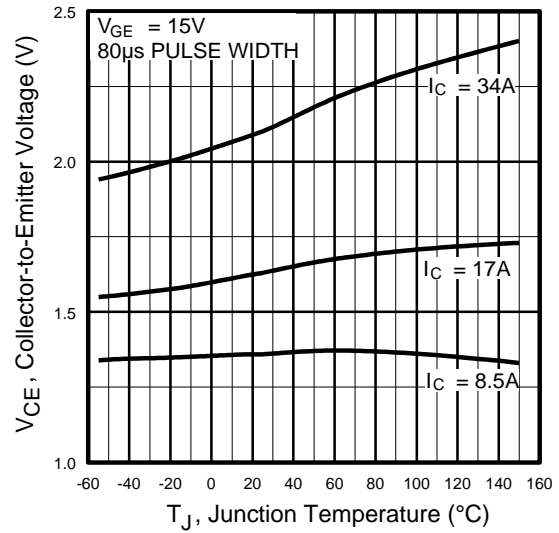
**Fig. 2 - Typical Output Characteristics**



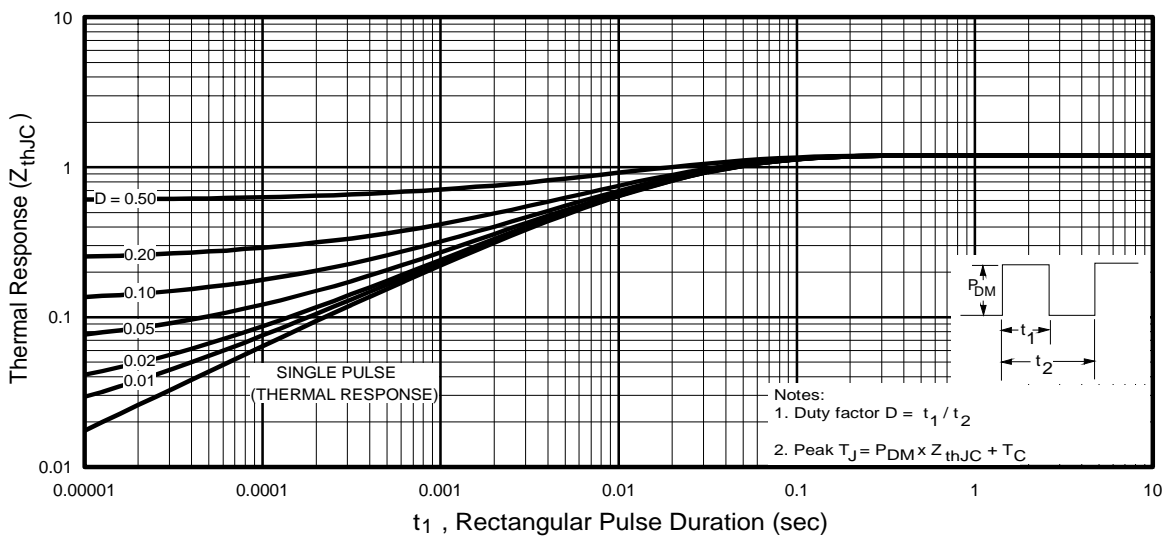
**Fig. 3 - Typical Transfer Characteristics**



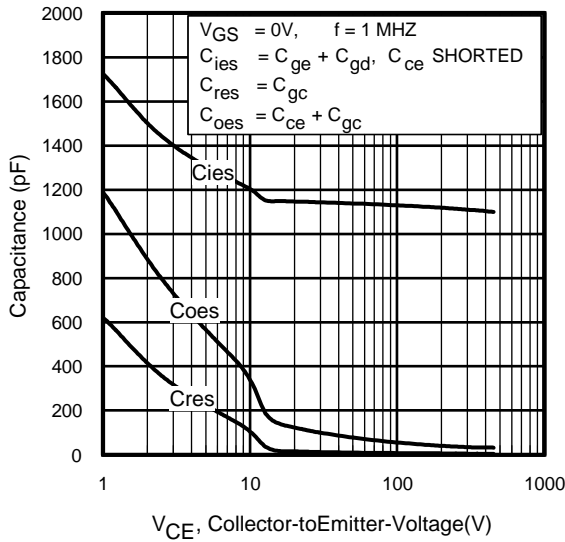
**Fig. 4** - Maximum Collector Current vs. Case Temperature



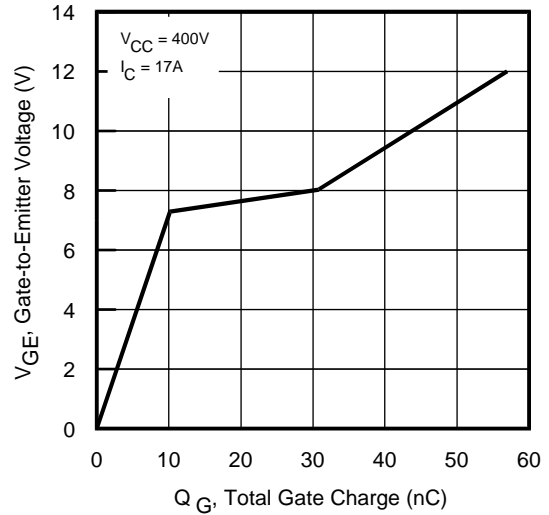
**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature



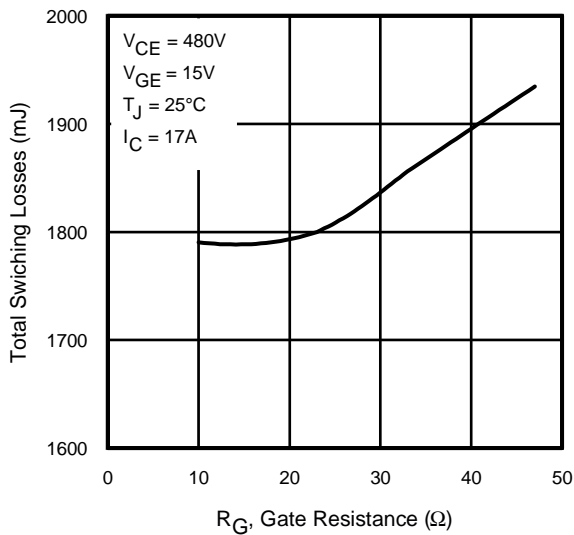
**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case



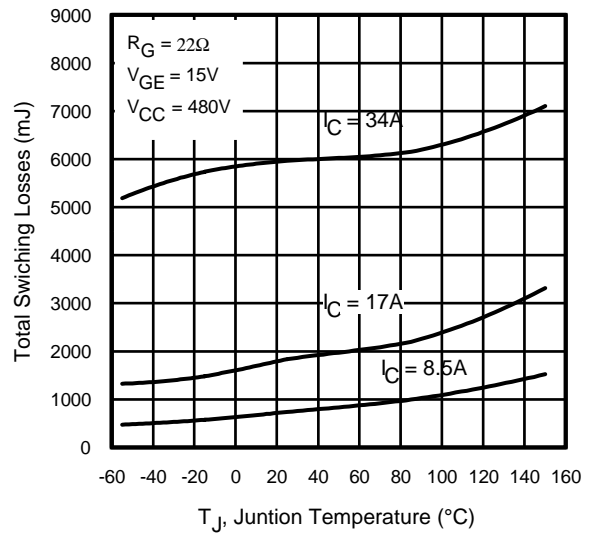
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



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

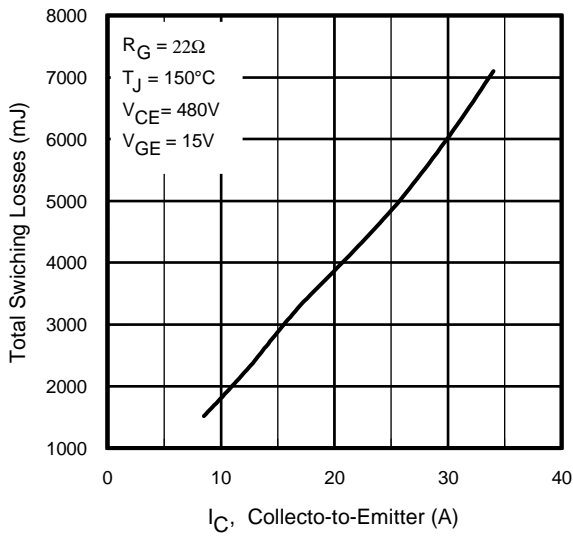


**Fig. 9** - Typical Switching Losses vs. Gate Resistance

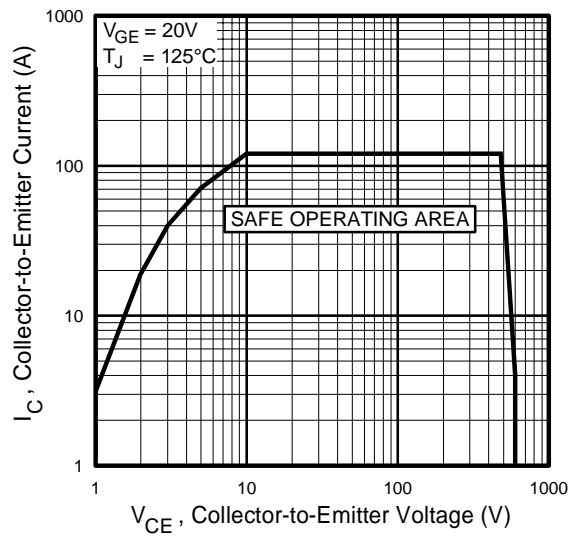


**Fig. 10** - Typical Switching Losses vs. Junction Temperature

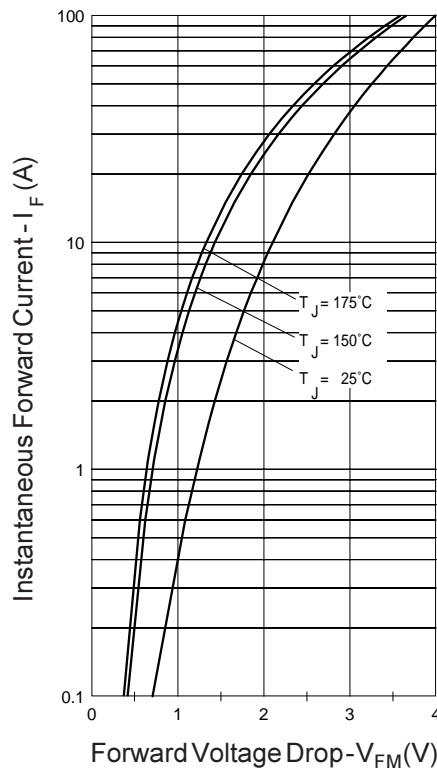
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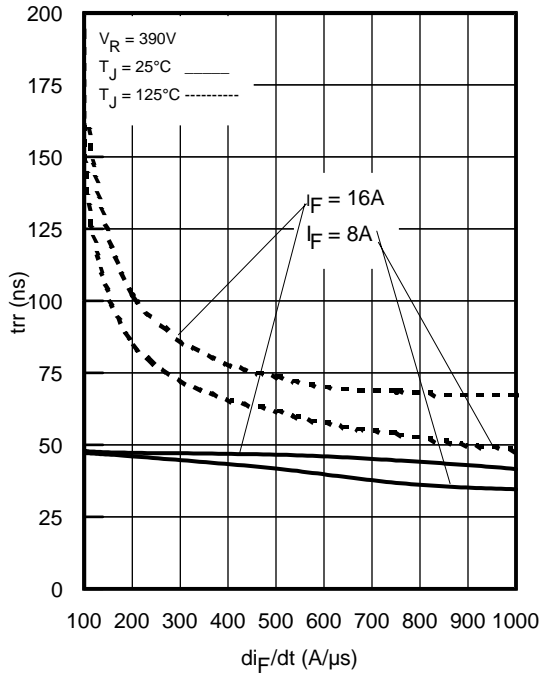
**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current



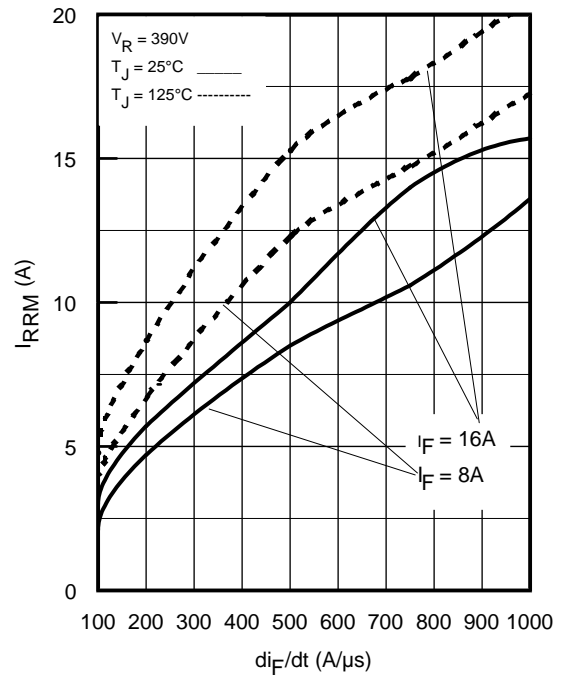
**Fig. 12** - Turn-Off SOA



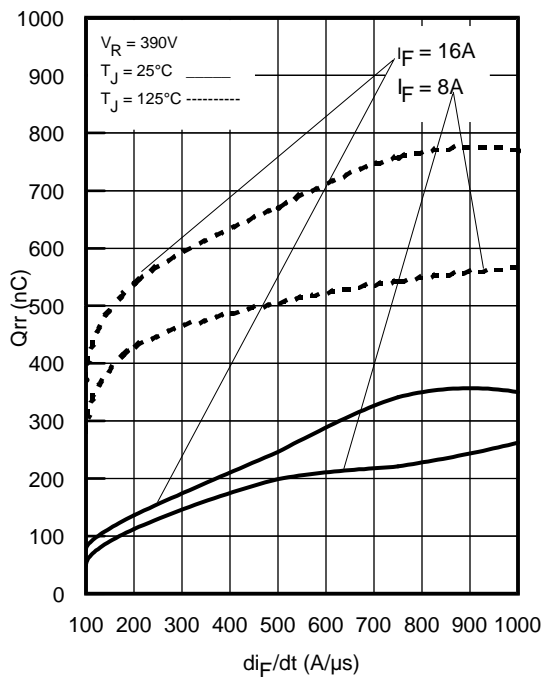
**Fig. 13** - Maximum Forward Voltage Drop vs. Instantaneous Forward Current



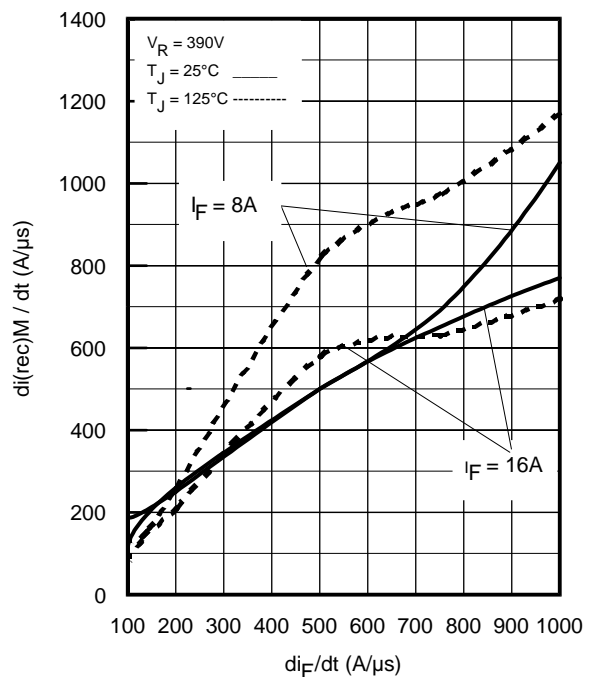
**Fig. 14** - Typical Reverse Recovery vs.  $di_F/dt$



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

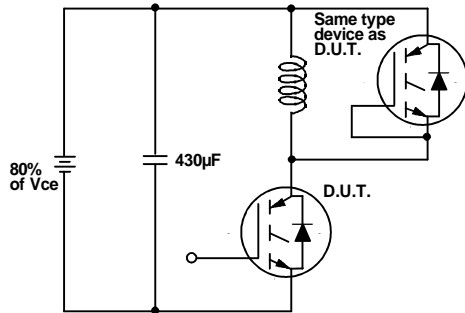


**Fig. 16** - Typical Stored Charge vs.  $di_F/dt$

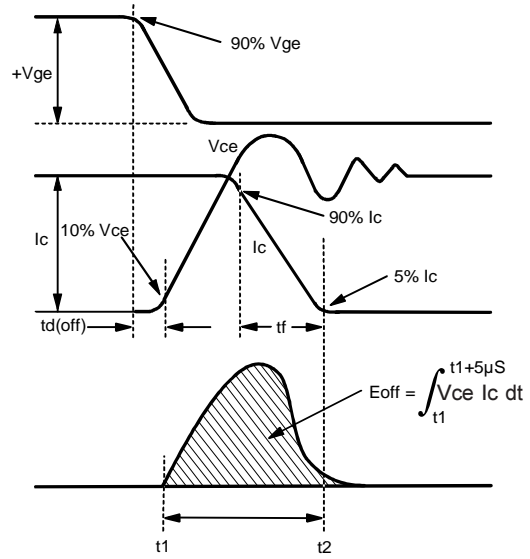


**Fig. 17** - Typical  $di_{(rec)M}/dt$  vs.  $di_F/dt$

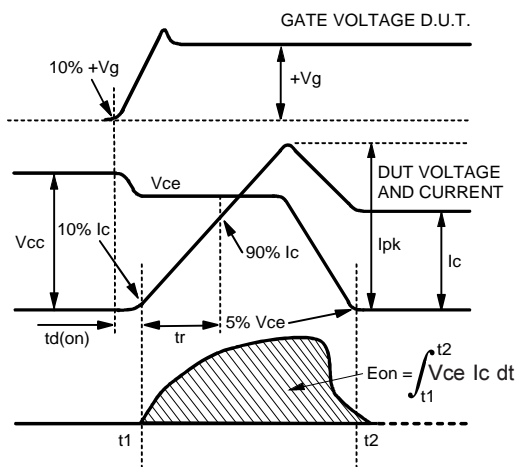
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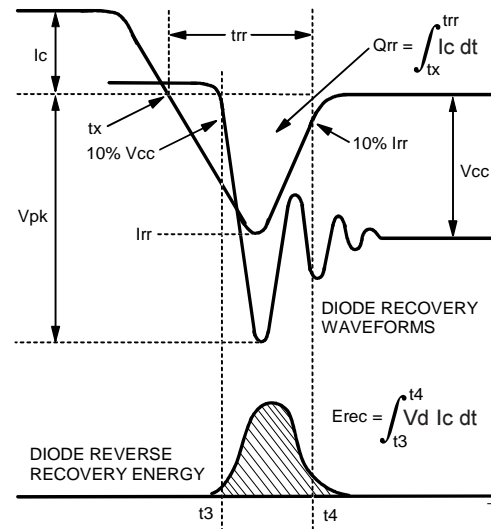
**Fig. 18a** - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{on}$ ,  $E_{off}(\text{diode})$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$ ,  $t_{d(on)}$ ,  $t_r$ ,  $t_{d(off)}$ ,  $t_f$



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

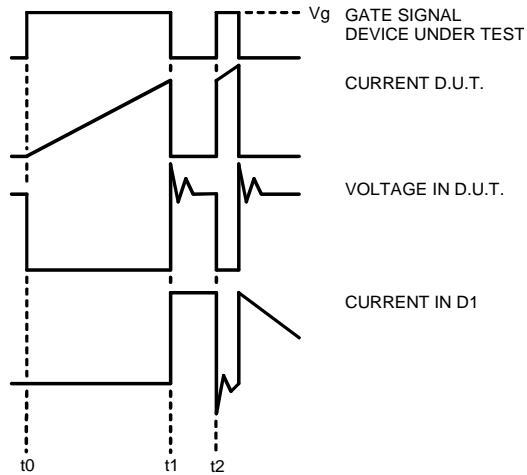


**Fig. 18c** - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{on}$ ,  $t_{d(on)}$ ,  $t_r$

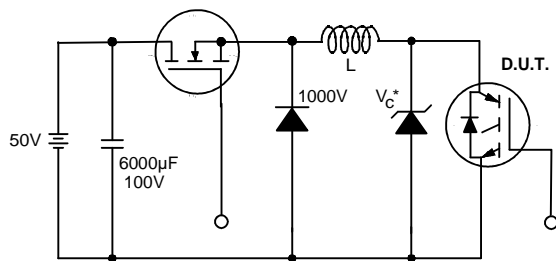


**Fig. 18d** - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{rec}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$

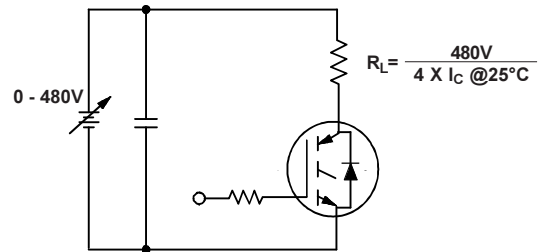




**Fig.18e** - Macro Waveforms for Figure 18a's Test Circuit



**Fig. 19** - Clamped Inductive Load Test Circuit



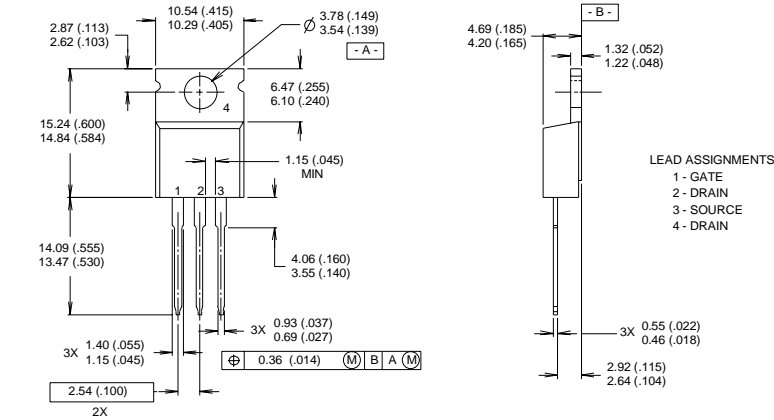
**Fig. 20** - Pulsed Collector Current Test Circuit

# IRG4BC30FD1

## TO-220AB Package Outline



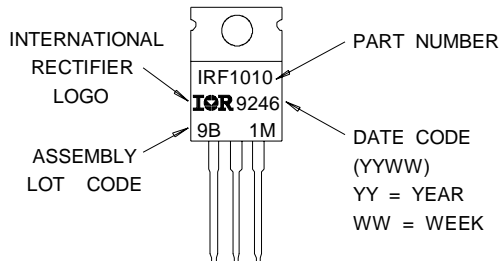
Dimensions are shown in millimeters (inches)



- 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  
WITH ASSEMBLY  
LOT CODE 9B1M



### 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 Energy losses include "tail" and diode reverse recovery, using Diode FD100H06A5.

**TO-220 package is not recommended for Surface Mount Application.**

Data and specifications subject to change without notice.  
This product has been designed and qualified for the Industrial market.  
Qualification Standards can be found on IR's Web site.



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