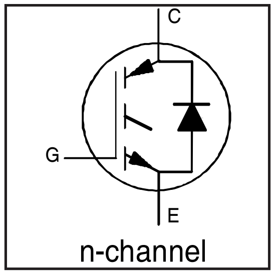
PD -94917A

International
IOR Rectifier

IRG4IBC20UDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

UltraFast CoPack IGBT



V_{CES} = 600V

$V_{CE(on)\ typ.}$ = 1.85V

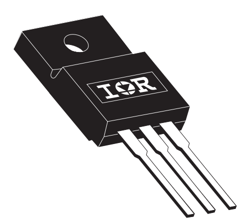
@V_{GE} = 15V, I_C = 6.5A

Features

- 2.5kV, 60s insulation voltage ⑤
- 4.8 mm creapage 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

Benefits

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



TO-220 FULLPAK

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	11.4	A
I_C @ T_C = 100°C	Continuous Collector Current	6.0	
I_{CM}	Pulsed Collector Current ①	52	
I_{LM}	Clamped Inductive Load Current ②	52	
I_F @ T_C = 100°C	Diode Continuous Forward Current	6.5	
I_{FM}	Diode Maximum Forward Current	52	
Visol	RMS Isolation Voltage, Terminal to Case⑤	2500	V
V_{GE}	Gate-to-Emitter Voltage	± 20	
P_D @ T_C = 25°C	Maximum Power Dissipation	34	W
P_D @ T_C = 100°C	Maximum Power Dissipation	14	
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	–––	3.7	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	–––	5.1	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	–––	65	
Wt	Weight	2.0 (0.07)	–––	g (oz)

01/28/2010

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage③	600	——	——	V	V_{GE} = 0V, I_C = 250µA	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	——	0.69	——	V/°C	V_{GE} = 0V, I_C = 1.0mA	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	——	1.85	2.1	V	I_C = 6.5A	V_{GE} = 15V
		——	2.27	——		I_C = 13A	See Fig. 2, 5
		——	1.87	——		I_C = 6.5A, T_J = 150°C	
$V_{GE(th)}$	Gate Threshold Voltage	3.0	——	6.0		V_{CE} = V_{GE}, I_C = 250µA	
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	——	-11	——	mV/°C	V_{CE} = V_{GE}, I_C = 250µA	
g_{fe}	Forward Transconductance ④	1.4	4.3	——	S	V_{CE} = 100V, I_C = 6.5A	
I_{CES}	Zero Gate Voltage Collector Current	——	——	250	µA	V_{GE} = 0V, V_{CE} = 600V	
		——	——	1700		V_{GE} = 0V, V_{CE} = 600V, T_J = 150°C	
V_{FM}	Diode Forward Voltage Drop	——	1.4	1.7	V	I_C = 8.0A	See Fig. 13
		——	1.3	1.6		I_C = 8.0A, T_J = 150°C	
I_{GES}	Gate-to-Emitter Leakage Current	——	——	±100	nA	V_{GE} = ±20V	

Switching Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	
Q_g	Total Gate Charge (turn-on)	——	27	41	nC	I_C = 6.5A	
Qge	Gate - Emitter Charge (turn-on)	——	4.5	6.8		V_{CC} = 400V See Fig. 8	
Q_{gc}	Gate - Collector Charge (turn-on)	——	10	16		V_{GE} = 15V	
$t_{d(on)}$	Turn-On Delay Time	——	39	——	ns	T_J = 25°C	
t_r	Rise Time	——	15	——		I_C = 6.5A, V_{CC} = 480V	
$t_{d(off)}$	Turn-Off Delay Time	——	93	140		V_{GE} = 15V, R_G = 50Ω	
t_f	Fall Time	——	110	170		Energy losses include "tail" and	
E_{on}	Turn-On Switching Loss	——	0.16	——	mJ	diode reverse recovery.	
E_{off}	Turn-Off Switching Loss	——	0.13	——		See Fig. 9, 10, 11, 18	
E_{ts}	Total Switching Loss	——	0.29	0.3			
$t_{d(on)}$	Turn-On Delay Time	——	38	——	ns	T_J = 150°C, See Fig. 9, 10, 11, 18	
t_r	Rise Time	——	17	——		I_C = 6.5A, V_{CC} = 480V	
$t_{d(off)}$	Turn-Off Delay Time	——	100	——		V_{GE} = 15V, R_G = 50Ω	
t_f	Fall Time	——	220	——		Energy losses include "tail" and	
E_{ts}	Total Switching Loss	——	0.49	——	mJ	diode reverse recovery.	
L_E	Internal Emitter Inductance	——	7.5	——	nH	Measured 5mm from package	
C_{ies}	Input Capacitance	——	530	——	pF	V_{GE} = 0V	
C_{oes}	Output Capacitance	——	39	——		V_{CC} = 30V See Fig. 7	
C_{res}	Reverse Transfer Capacitance	——	7.4	——		f = 1.0MHz	
t_{rr}	Diode Reverse Recovery Time	——	37	55	ns	T_J = 25°C See Fig.	
		——	55	90		T_J = 125°C 14	I_F = 8.0A
I_{rr}	Diode Peak Reverse Recovery Current	——	3.5	5.0	A	T_J = 25°C See Fig.	
		——	4.5	8.0		T_J = 125°C 15	V_R = 200V
Q_{rr}	Diode Reverse Recovery Charge	——	65	138	nC	T_J = 25°C See Fig.	
		——	124	360		T_J = 125°C 16	di/dt 200A/µs
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery	——	240	——	A/µs	T_J = 25°C See Fig.	
	During t_b	——	210	——		T_J = 125°C 17	

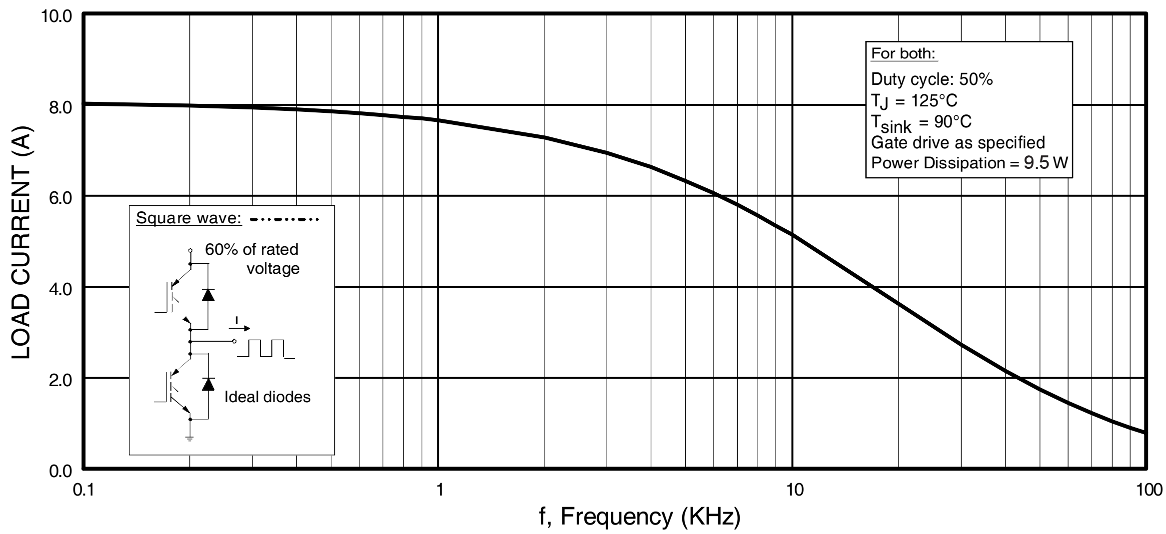


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

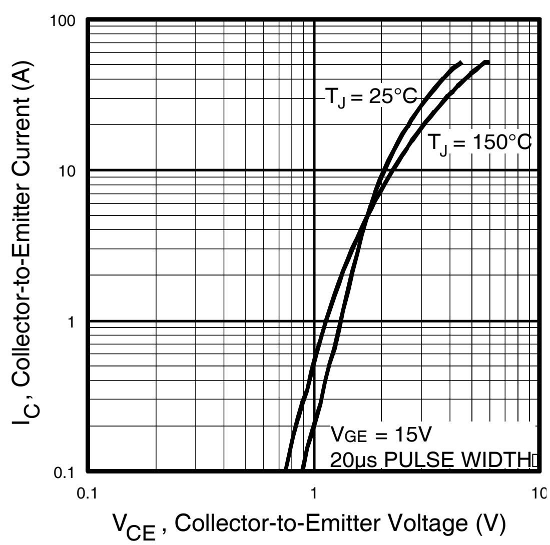


Fig. 2 - Typical Output Characteristics

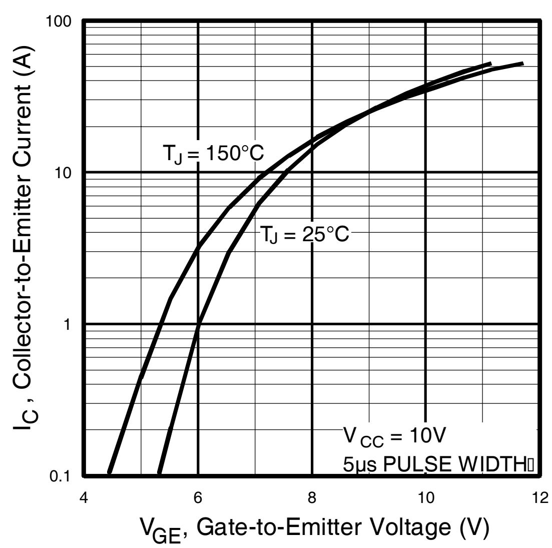


Fig. 3 - Typical Transfer Characteristics

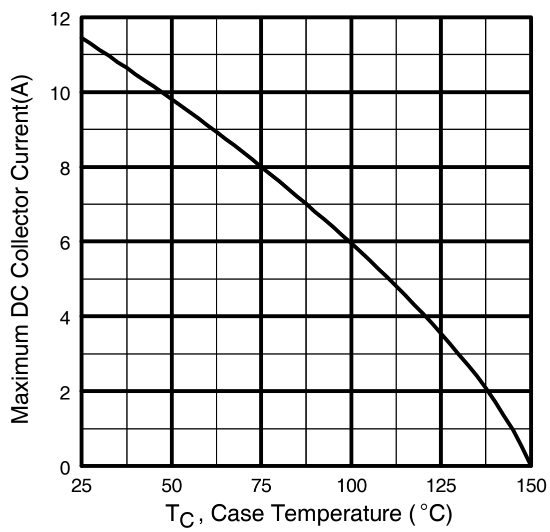


Fig. 4 - Maximum Collector Current vs. Case Temperature

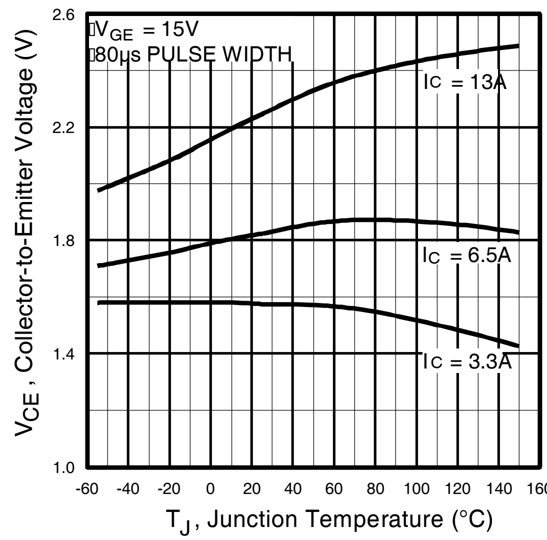


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

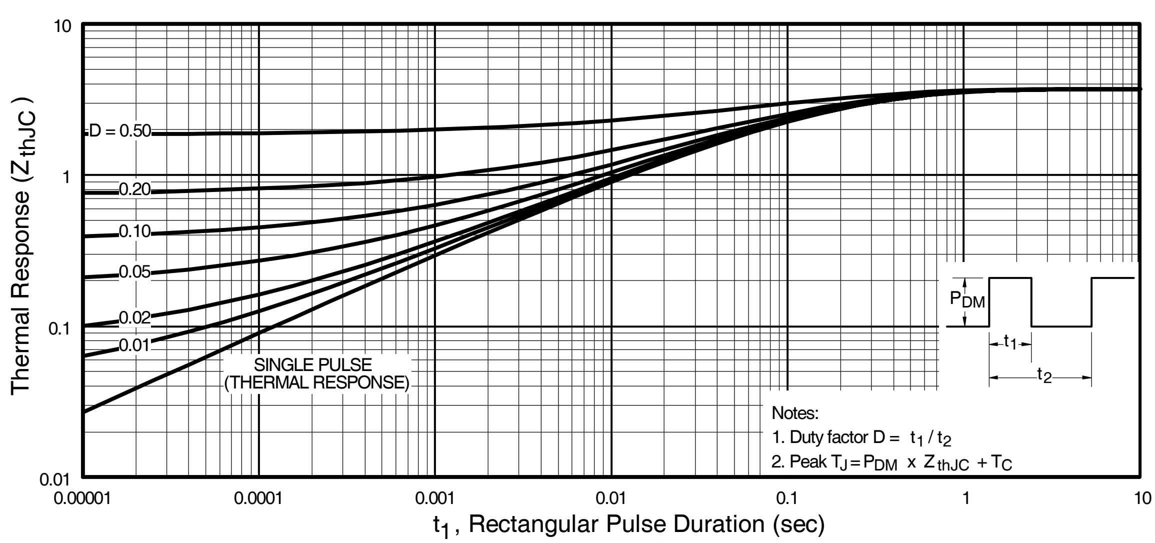


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

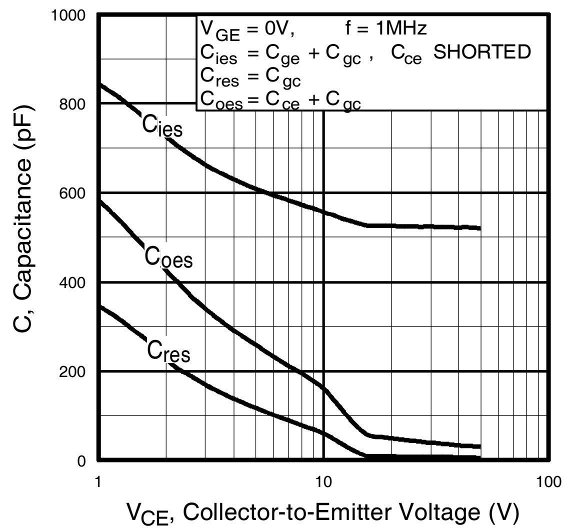


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

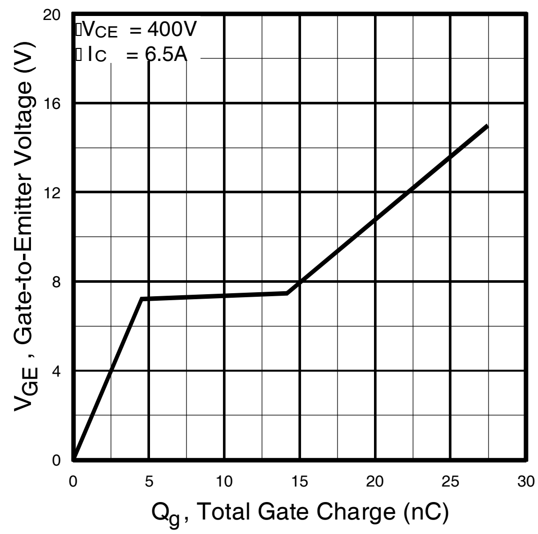


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

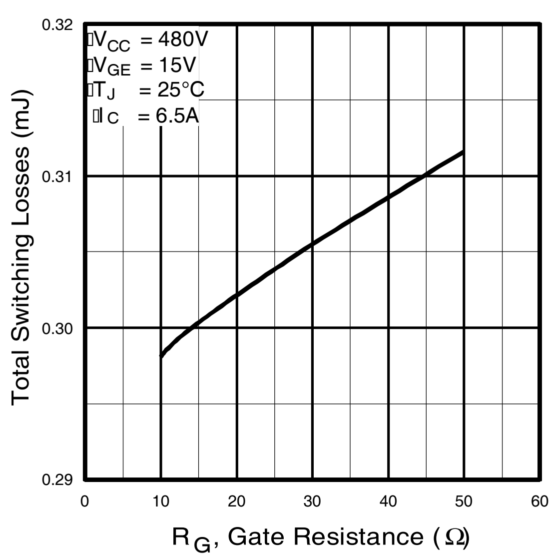


Fig. 9 - Typical Switching Losses vs. Gate Resistance

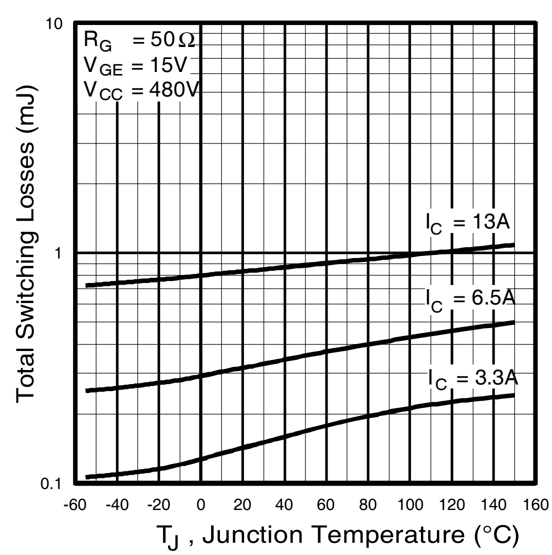


Fig. 10 - Typical Switching Losses vs. Junction Temperature

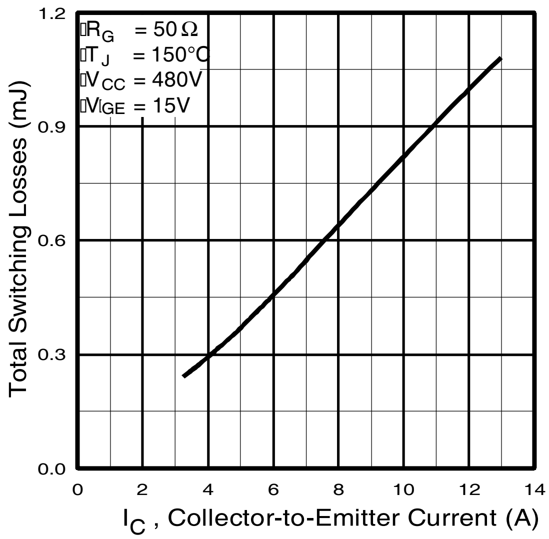


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

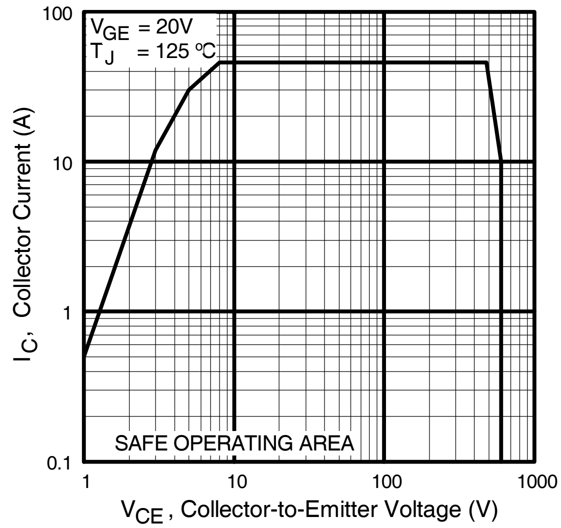


Fig. 12 - Turn-Off SOA

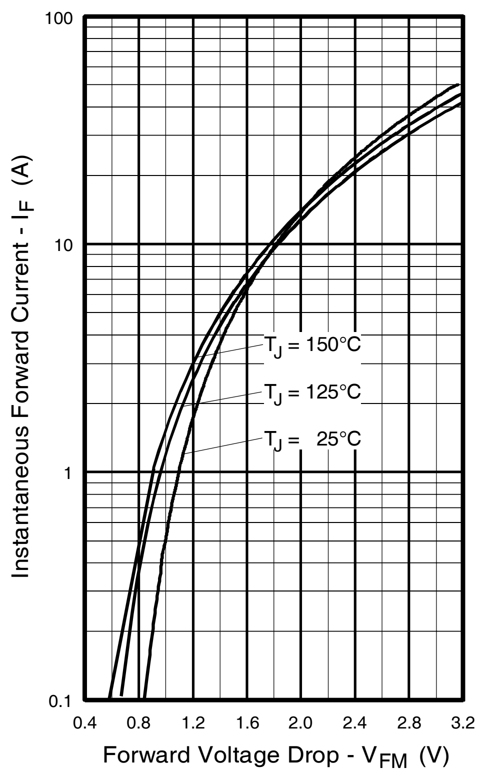


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

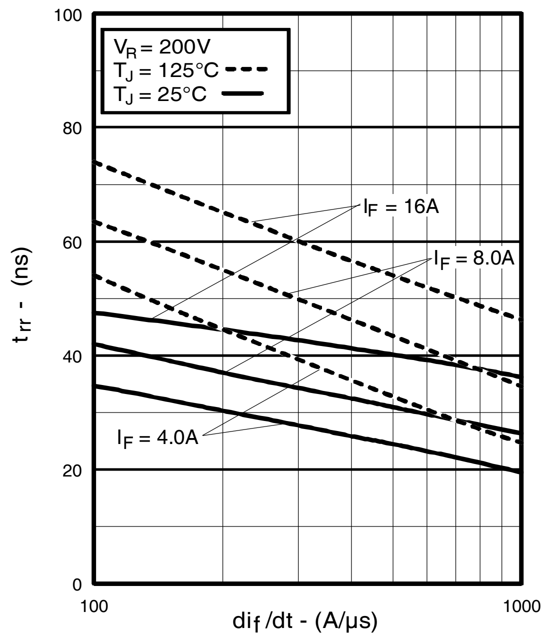


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

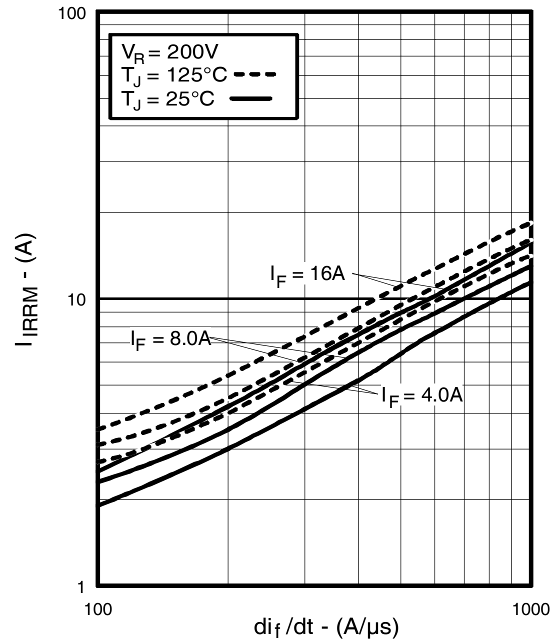


Fig. 15 - Typical Recovery Current vs. di_f/dt

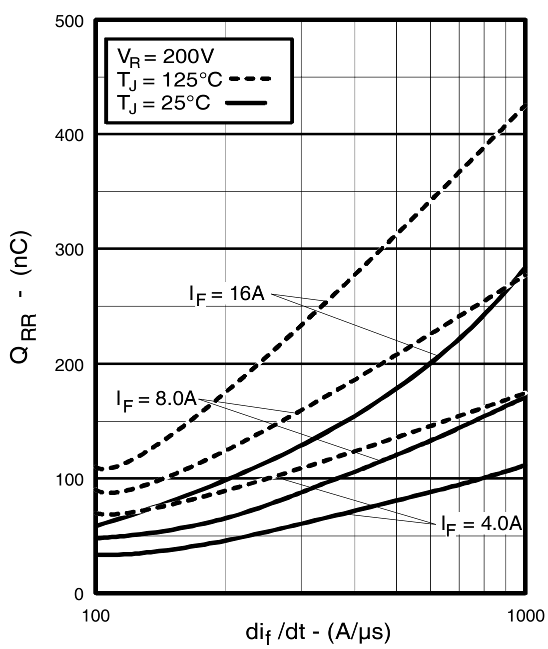


Fig. 16 - Typical Stored Charge vs. di_f/dt

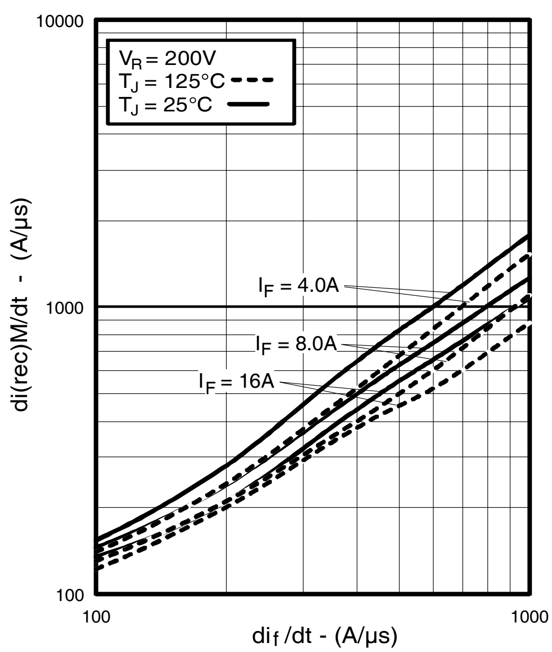


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

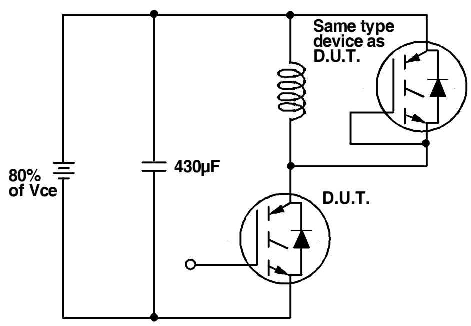


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

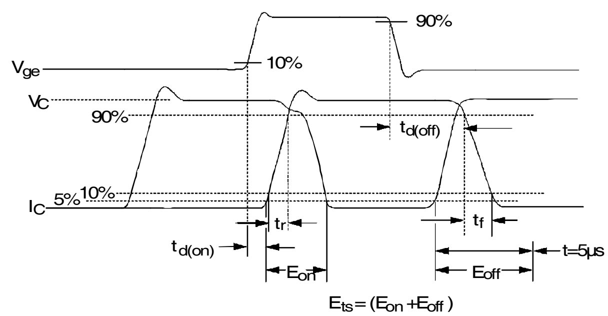


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

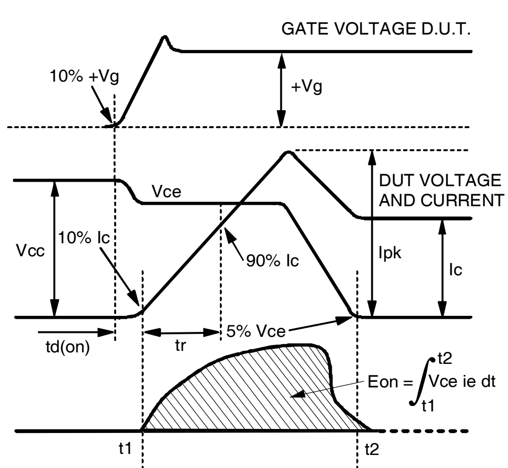


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

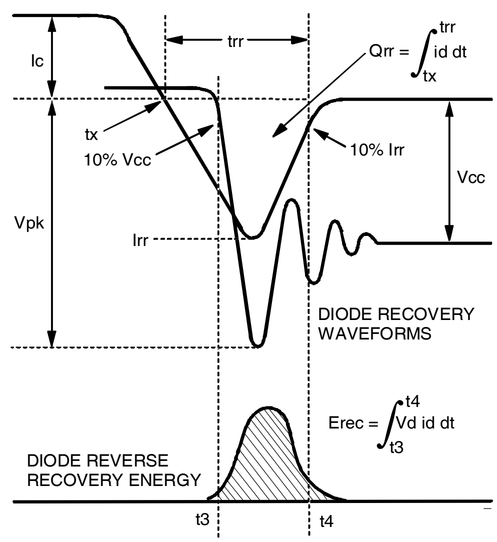


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

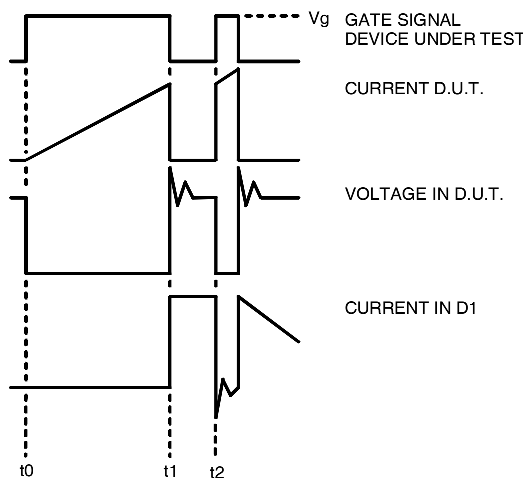


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

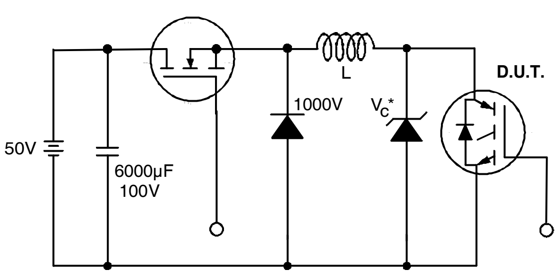


Figure 19. Clamped Inductive Load Test Circuit

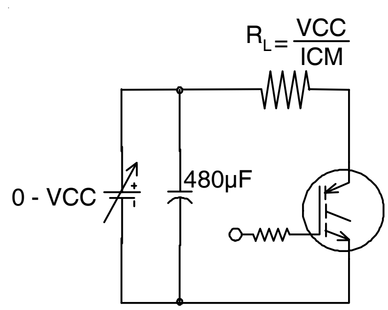
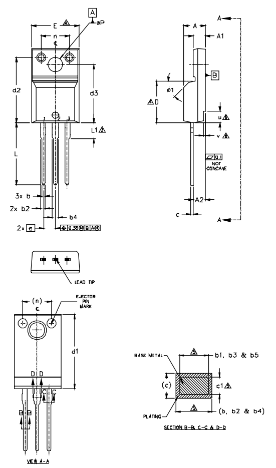


Figure 20. Pulsed Collector Current Test Circuit

TO-220AB Full-Pak Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.57	4.83	.180	.190	
A1	2.57	2.83	.101	.111	
A2	2.51	2.93	.099	.115	
b	0.61	0.94	.024	.037	
b1	0.61	0.89	.024	.035	5
b2	0.76	1.27	.030	.050	
b3	0.76	1.22	.030	.048	5
b4	1.02	1.52	.040	.060	
b5	1.02	1.47	.040	.058	5
c	0.33	0.63	.013	.025	
c1	0.33	0.58	.013	.023	5
D	8.66	9.80	.341	.386	4
d1	15.80	16.13	.622	.635	
d2	13.97	14.22	.550	.560	
d3	12.30	12.93	.484	.509	
E	9.63	10.75	.379	.423	4
e	2.54 BSC		.100 BSC		
L	13.20	13.72	.520	.540	
L1	3.37	3.67	.122	.145	3
n	6.05	6.60	.238	.260	
øP	3.05	3.45	.120	.136	
u	2.40	2.50	.094	.098	6
v	0.40	0.50	.016	.020	6
ø1	–	45°	–	45°	

NOTES:

1.0 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTER MOST EXTREMES OF THE PLASTIC BODY.
5.0 DIMENSION b1, b3, b5 & c1 APPLY TO BASE METAL ONLY.
6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
7.0 CONTROLLING DIMENSION : INCHES.

LEAD ASSIGNMENTS

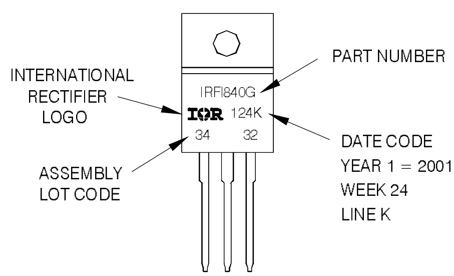
HEXFET
1.- GATE
2.- DRAIN
3.- SOURCE

IGBTs, CoPACK
1.- GATE
2.- COLLECTOR
3.- EMITTER

TO-220AB Full-Pak Part Marking Information

EXAMPLE: THIS IS AN IRFI840G
WITH ASSEMBLY
LOT CODE 3432
ASSEMBLED ON WW 24, 2001
IN THE ASSEMBLY LINE "K"

Note: "P" in assembly line position
indicates "Lead-Free"



TO-220AB Full-Pak package is not recommended for Surface Mount Application.

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=10µH, R_G = 50Ω (figure 19)

③ Pulse width ≤ 80µs; duty factor ≤ 0.1%.

④ Pulse width 5.0µs, single shot.

⑤ t = 60s, f = 60Hz

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.

International
IOR Rectifier

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