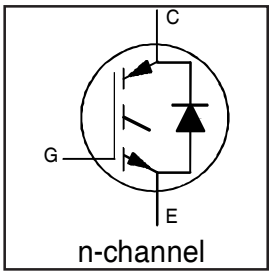
International
IOR Rectifier

IRG4IBC20KDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Short Circuit Rated
UltraFast IGBT



V_{CES} = 600V

$V_{CE(on)\ typ.}$ = 2.27V

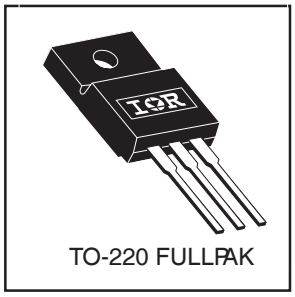
@V_{GE} = 15V, I_C = 6.3A

Features

- High switching speed optimized for up to 25kHz with low $V_{CE(on)}$
- Short Circuit Rating 10µs @ 125°C, V_{GE} = 15V
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than previous generation
- IGBT co-packaged with HEXFRED™ ultrafast, ultra-soft-recovery anti-parallel diodes for use in bridge configurations
- Industry standard TO-220 FULLPAK
- Lead-Free

Benefits

- Generation 4 IGBTs offer highest efficiencies available maximizing the power density of the system
- IGBTs optimized for specific application conditions
- HEXFRED™ diodes optimized for performance with IGBTs. Minimized recovery characteristics reduce noise EMI
- Designed to exceed the power handling capability of equivalent industry-standard IGBTs



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	11.5	A
I_C @ T_C = 100°C	Continuous Collector Current	6.3	
I_{CM}	Pulsed Collector Current ①	23	
I_{LM}	Clamped Inductive Load Current ②	23	
I_F @ T_C = 100°C	Diode Continuous Forward Current	6.3	
I_{FM}	Diode Maximum Forward Current	23	
t_{sc}	Short Circuit Withstand Time	10	µs
V_{ISOL}	RMS Isolation Voltage, Terminal to Case, t = 1 min	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 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	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	–––	3.7	°C/W
$R_{\theta CS}$	Junction-to-Case - Diode	–––	5.5	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	–––	65	
Wt	Weight	2.0 (0.07)	–––	g (oz)

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	—	0.49	—	V/°C	V_{GE} = 0V, I_C = 1.0mA
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.27	2.8	V	I_C = 9.0A V_{GE} = 15V
		—	3.01	—		I_C = 16A See Fig. 2, 5
		—	2.43	—		I_C = 9.0A, 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	—	-10	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA
g_{fe}	Forward Transconductance ④	2.9	4.3	—	S	V_{CE} = 100V, I_C = 9.0A
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	µA	V_{GE} = 0V, V_{CE} = 600V
		—	—	1000		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)	—	34	51	nC	I_C = 9.0A
Q_{ge}	Gate - Emitter Charge (turn-on)	—	4.9	7.4		V_{CC} = 400V See Fig.8
Q_{gc}	Gate - Collector Charge (turn-on)	—	14	21		V_{GE} = 15V
$t_{d(on)}$	Turn-On Delay Time	—	54	—	ns	
t_r	Rise Time	—	34	—		T_J = 25°C
$t_{d(off)}$	Turn-Off Delay Time	—	180	270		I_C = 9.0A, V_{CC} = 480V
t_f	Fall Time	—	72	110		V_{GE} = 15V, R_G = 50Ω
E_{on}	Turn-On Switching Loss	—	0.34	—	mJ	Energy losses include "tail"
E_{off}	Turn-Off Switching Loss	—	0.30	—		and diode reverse recovery
E_{ts}	Total Switching Loss	—	0.64	0.96		See Fig. 9,10,14
t_{sc}	Short Circuit Withstand Time	10	—	—	µs	V_{CC} = 360V, T_J = 125°C
						V_{GE} = 15V, R_G = 50Ω , V_{CPK} < 500V
$t_{d(on)}$	Turn-On Delay Time	—	51	—	ns	T_J = 150°C, See Fig. 10,11,14
t_r	Rise Time	—	37	—		I_C = 9.0A, V_{CC} = 480V
$t_{d(off)}$	Turn-Off Delay Time	—	220	—		V_{GE} = 15V, R_G = 50Ω
t_f	Fall Time	—	160	—		Energy losses include "tail"
E_{ts}	Total Switching Loss	—	0.85	—	mJ	and diode reverse recovery
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	450	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	61	—		V_{CC} = 30V See Fig. 7
C_{res}	Reverse Transfer Capacitance	—	14	—		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 = 200Aµs
$di_{(rec)M}/dt$	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

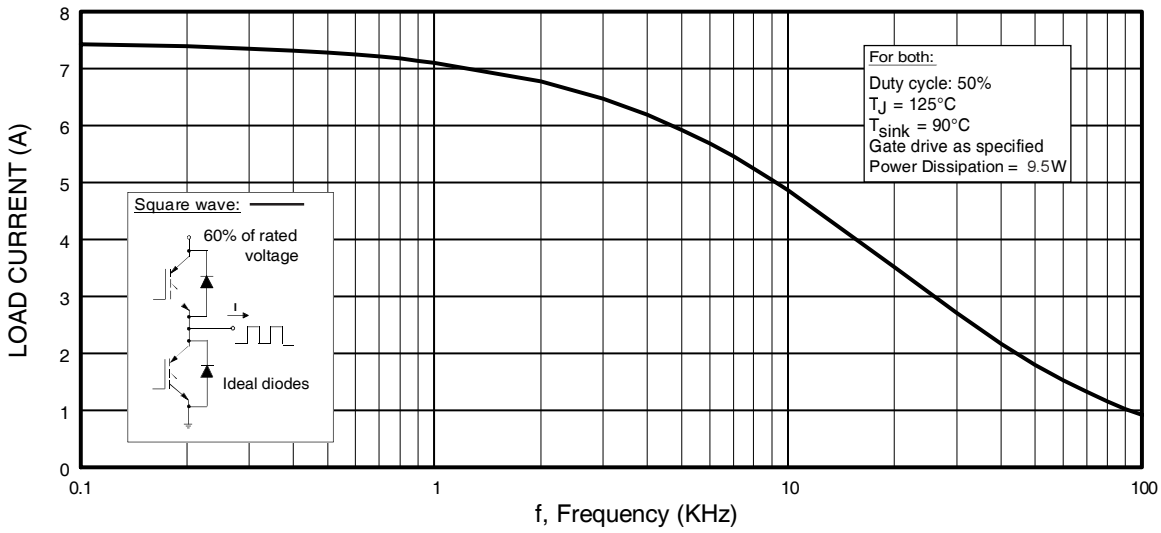


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

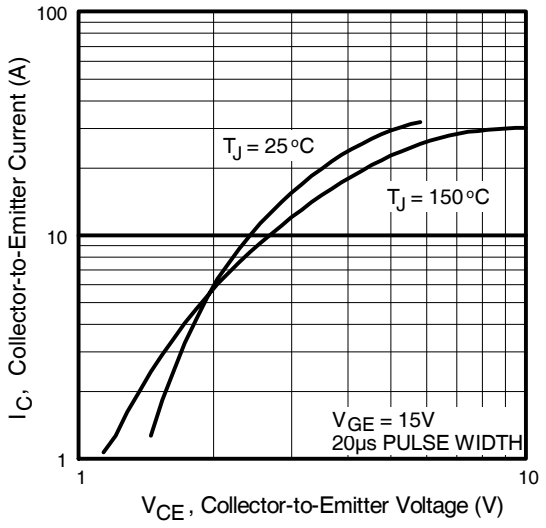


Fig. 2 - Typical Output Characteristics

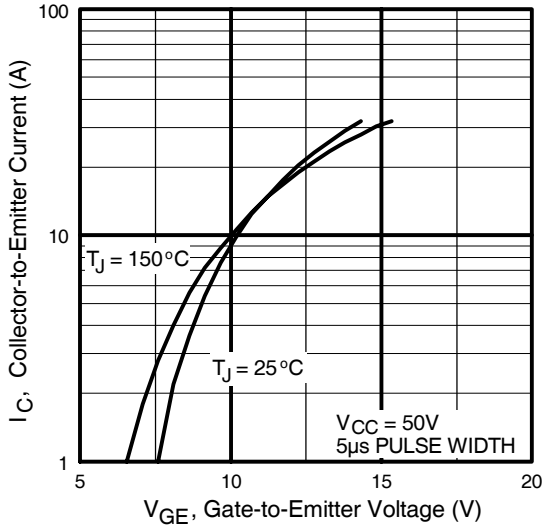


Fig. 3 - Typical Transfer Characteristics

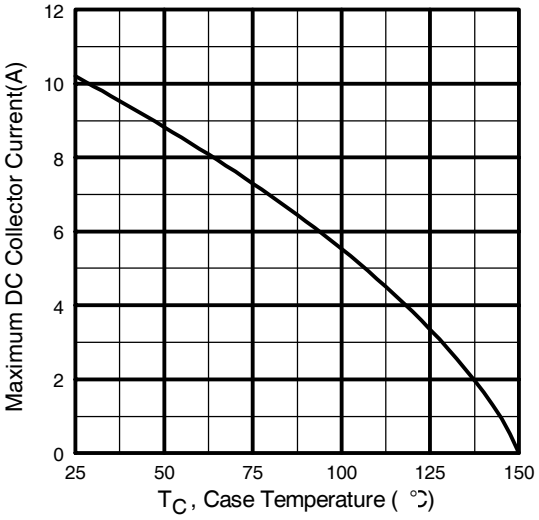


Fig. 4 - Maximum Collector Current vs. Case Temperature

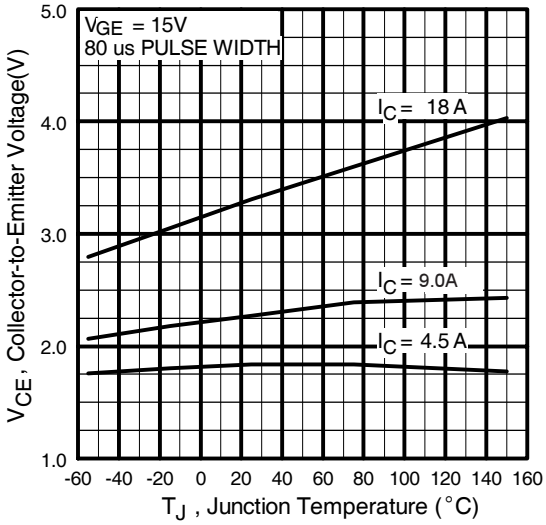


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

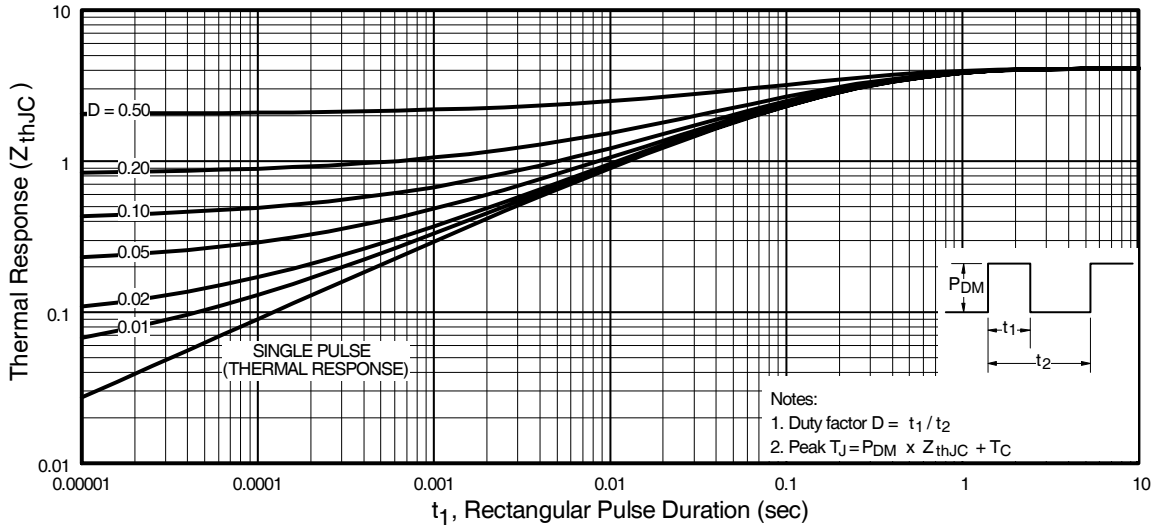


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

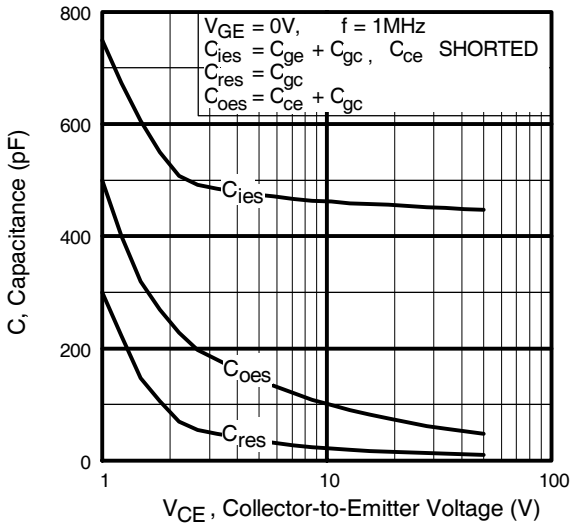


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

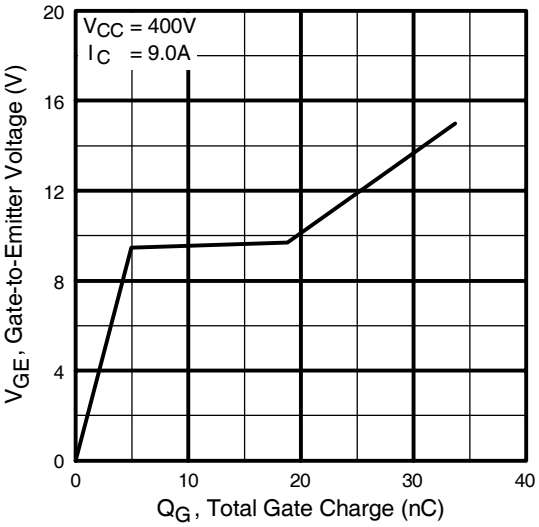


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

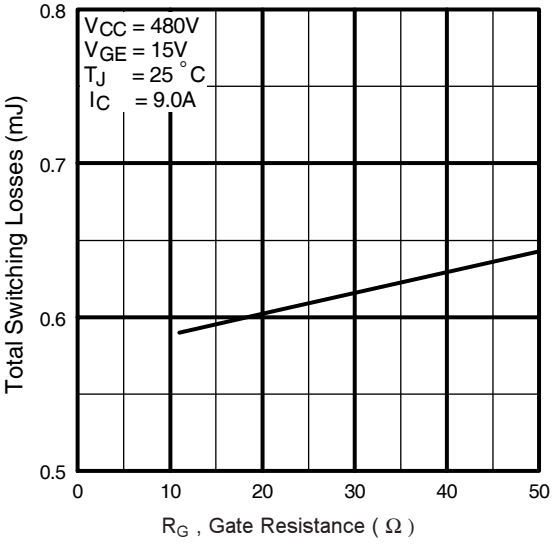


Fig. 9 - Typical Switching Losses vs. Gate Resistance

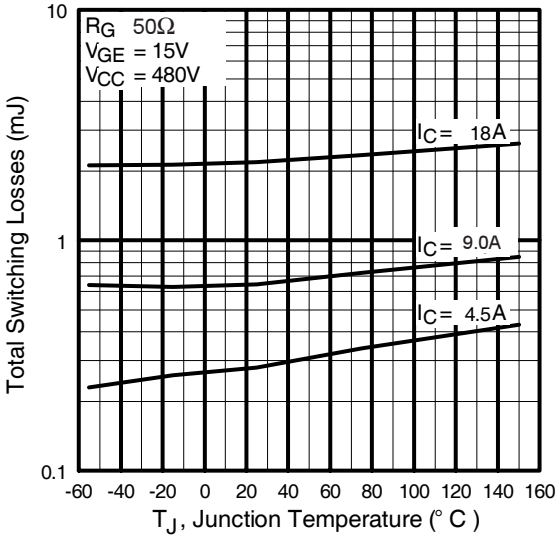


Fig. 10 - Typical Switching Losses vs. Junction Temperature

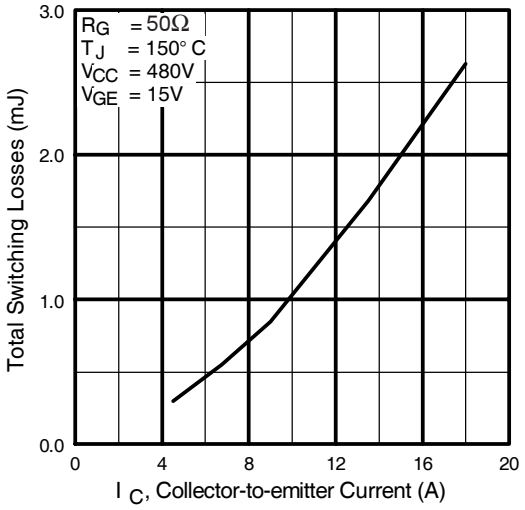


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

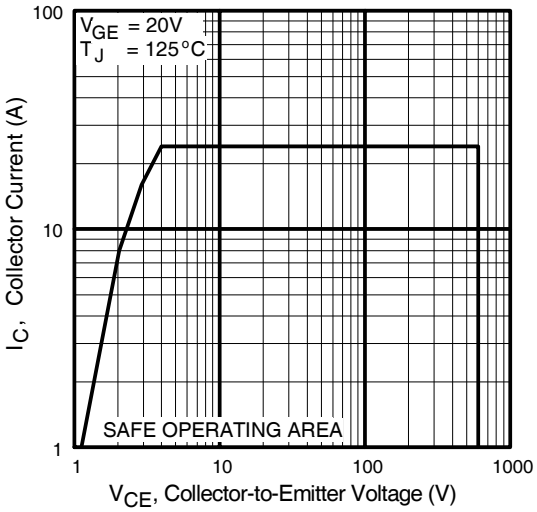


Fig. 12 - Turn-Off SOA

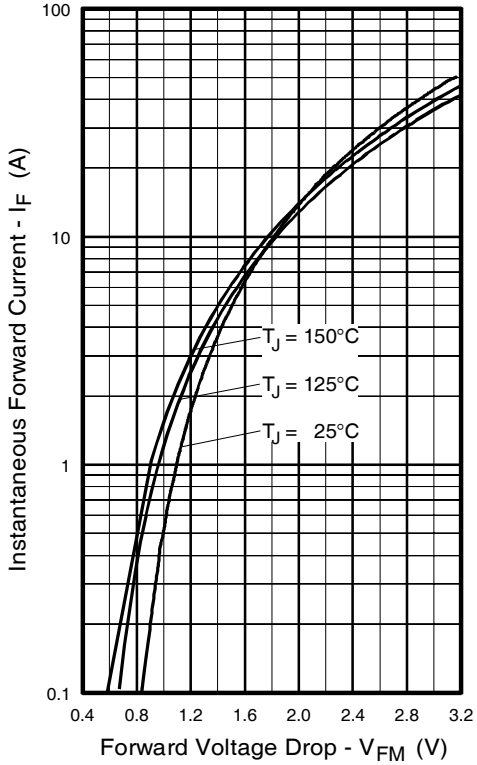


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

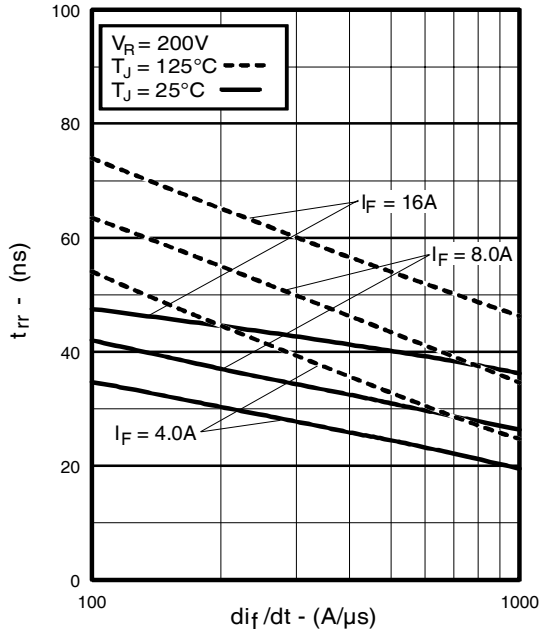


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

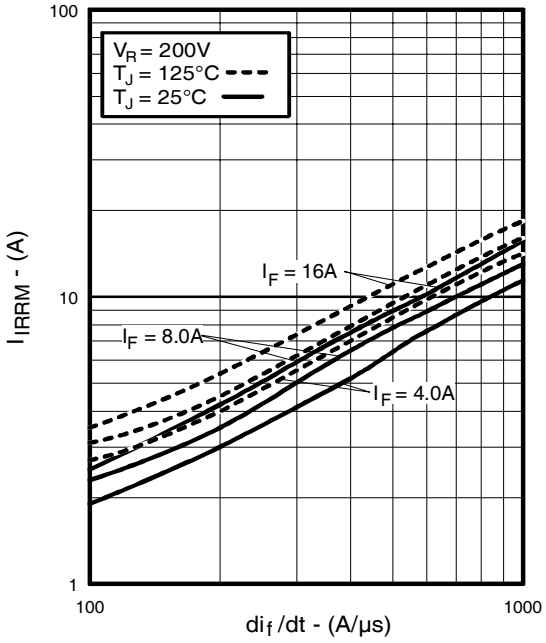


Fig. 15 - Typical Recovery Current vs. di_f/dt

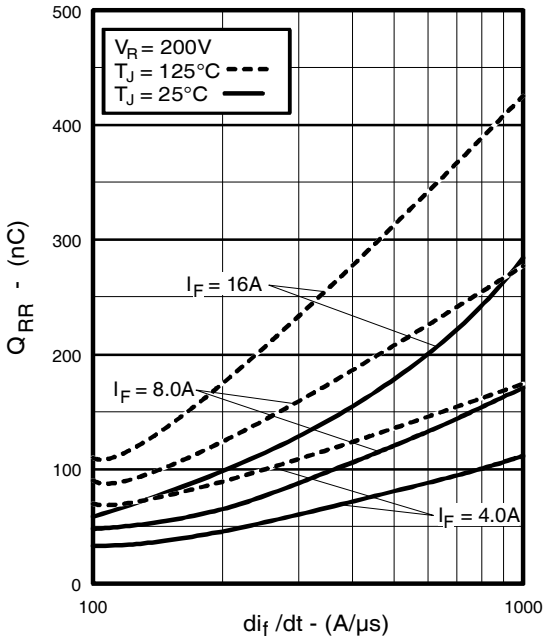


Fig. 16 - Typical Stored Charge vs. di_f/dt

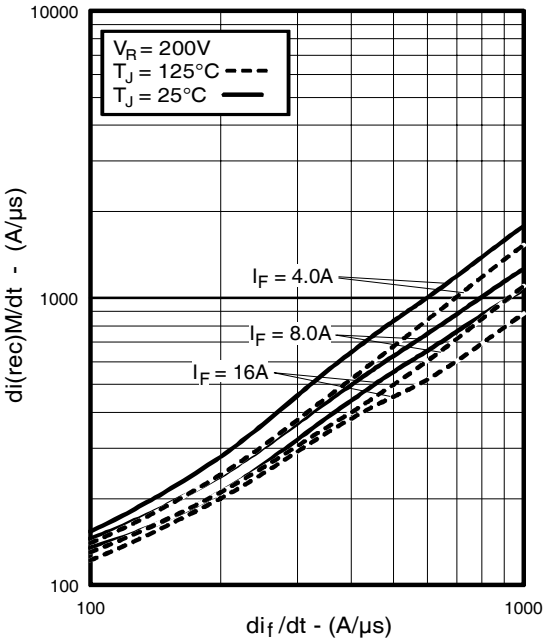


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

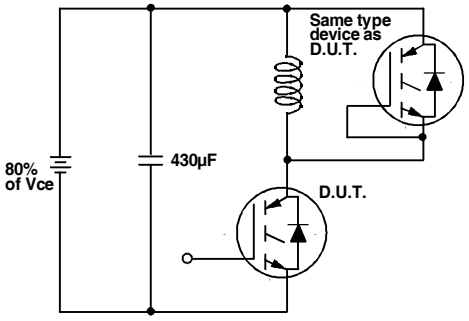


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

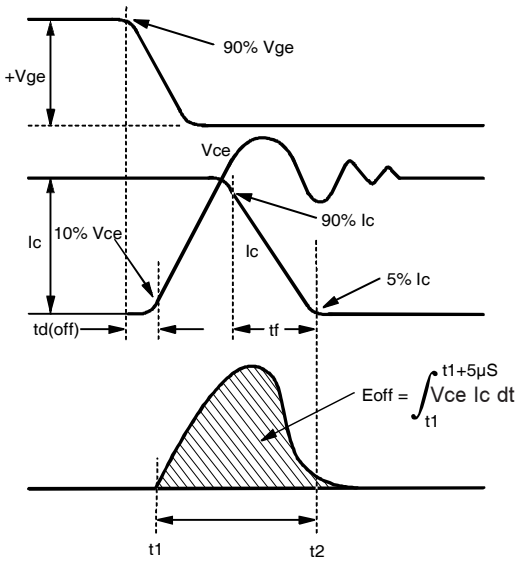


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

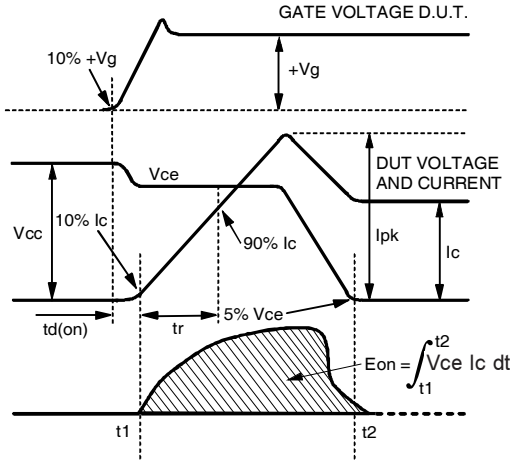


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

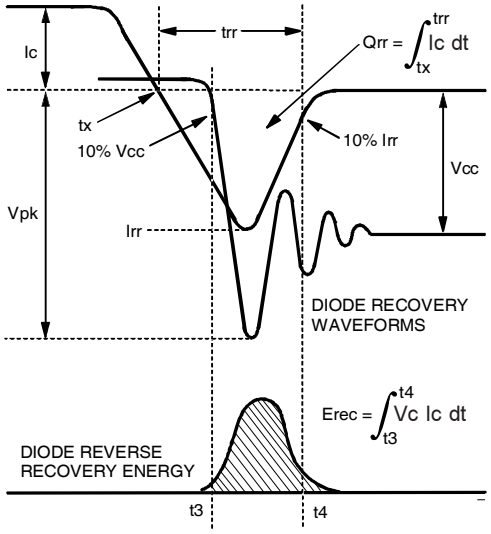


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

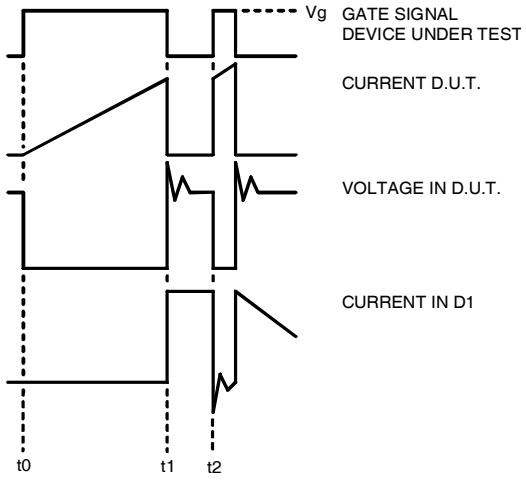


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

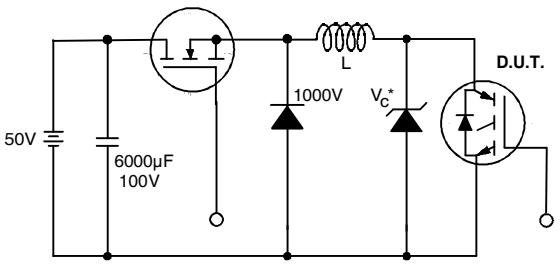


Figure 19. Clamped Inductive Load Test Circuit

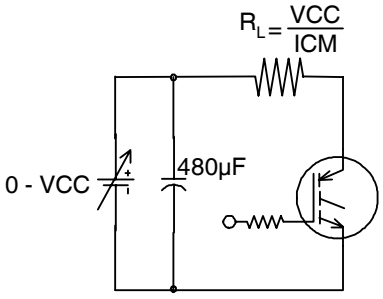
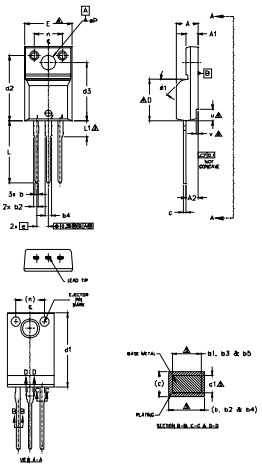


Figure 20. Pulsed Collector Current Test Circuit

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	.146	3
n	6.05	6.60	.238	.260	
øP	3.05	3.45	.120	.136	
u	2.40	2.60	.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 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
4 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 DIMENSION b1, b3, b5 & c1 APPLY TO BASE METAL ONLY.
6 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
7.0 CONTROLLING DIMENSION : INCHES.

LEAD ASSIGNMENTS

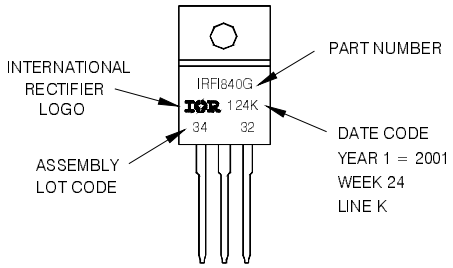
HEXFET
1.- GATE
2.- DRAIN
3.- SOURCE

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.

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.

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