International
IOR Rectifier

PD - 95614A

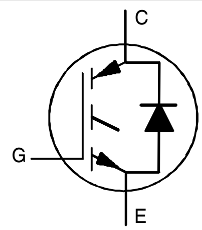
IRG4BC30FD1PbF

Fast CoPack IGBT

INSULATED GATE BIPOLAR TRANSISTOR WITH HYPERFAST DIODE

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.
- Lead-Free



n-channel

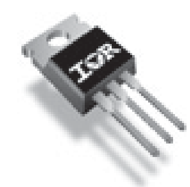
V_{CES} = 600V

$V_{CE(on)\ typ.}$ = 1.59V

@V_{GE} = 15V, I_C = 17A

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.



TO-220AB

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	31	A
I_C @ T_C = 100°C	Continuous Collector Current	17	
I_{CM}	Pulse Collector Current (Ref.Fig.C.T.5) ①	124	
I_{LM}	Clamped Inductive Load current ②	124	
I_F @ T_C = 100°C	Diode Continuous Forward Current	8	
I_{FM}	Diode Maximum Forward Current	16	
V_{GE}	Gate-to-Emitter Voltage	±20	V
P_D @ T_C = 25°C	Maximum Power Dissipation	100	W
P_D @ T_C = 100°C	Maximum Power Dissipation	42	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C
	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.)

01/27/10

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage ③	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 = 1mA
$V_{CE(on)}$	Collector-to-Emitter Voltage	—	1.59	1.8	V	I_C = 17A; V_{GE} = 15V
		—	1.99	—		I_C = 31A; See Fig. 2, 5
		—	1.7	—		I_C = 17A, T_J = 150°C
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0	V	V_{CE} = V_{GE}, I_C = 250μA
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-11	—	mV/°C	V_{CE} = V_{GE}, I_C = 250μA
gfe	Forward Transconductance ④	6.1	10	—	S	V_{CE} = 100V, I_C = 17A
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	V_{GE} = 0V, V_{CE} = 600V
		—	—	2500		V_{GE} = 0V, V_{CE} = 600V, T_J = 150°C
V_{FM}	Diode Forward Voltage Drop	—	2.0	2.4	V	I_F = 8.0A; See Fig. 13
		—	1.3	1.8		I_F = 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)	—	57	62	nC	I_C = 17A	
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	10	12		V_{CC} = 400V; See Fig. 8	
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	21	24		V_{GE} = 15V	
$t_{d(on)}$	Turn-On delay time	—	22	—	ns	T_J = 25°C	
t_r	Rise time	—	24	—		I_C = 17A, V_{CC} = 480V	
$t_{d(off)}$	Turn-Off delay time	—	250	320		V_{GE} = 15V, R_G = 23Ω	
t_f	Fall time	—	160	210		Energy losses inlcude "tail" and	
E_{on}	Turn-On Switching Loss	—	370	—	μJ	diode reverse recovery.	
E_{off}	Turn-Off Switching Loss	—	1420	—		See Fig. 9, 10, 11, 18	
E_{ts}	Total Switching Loss	—	1800	2290			
$t_{d(on)}$	Turn-On delay time	—	21	—	ns	T_J = 150°C; See Fig. 9,10,11,18	
t_r	Rise time	—	25	—		I_C = 17A, V_{CC} = 480V	
$t_{d(off)}$	Turn-Off delay time	—	400	—		V_{GE} = 15V, R_G = 23Ω	
t_f	Fall time	—	340	—		Energy losses inlcude "tail" and	
E_{ts}	Total Switching Loss	—	3280	—	μJ	diode reverse recovery.	
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package	
C_{ies}	Input Capacitance	—	1170	—	pF	V_{GE} = 0V	
C_{oes}	Output Capacitance	—	100	—		V_{CC} = 30V; See Fig. 7	
C_{res}	Reverse Transfer Capacitance	—	11	—		f = 1.0MHz	
t_{rr}	Diode Reverse Recovery Time	—	46	61	ns	T_J = 25°C; See Fig.	
		—	85	93		T_J = 125°C; 14	I_F = 12A
I_{rr}	Diode Peak Reverse Recovery Current	—	4.8	6.5	A	T_J = 25°C; See Fig.	
		—	8.5	10		T_J = 125°C; 15	V_R = 200V
Q_{rr}	Diode Reverse Recovery Charge	—	110	190	nC	T_J = 25°C; See Fig.	
			410	550		T_J = 125°C; 16	di/dt 200A/μs
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	—	260	—	A/μs	T_J = 25°C; See Fig.	
		—	270	—		T_J = 125°C; 17	

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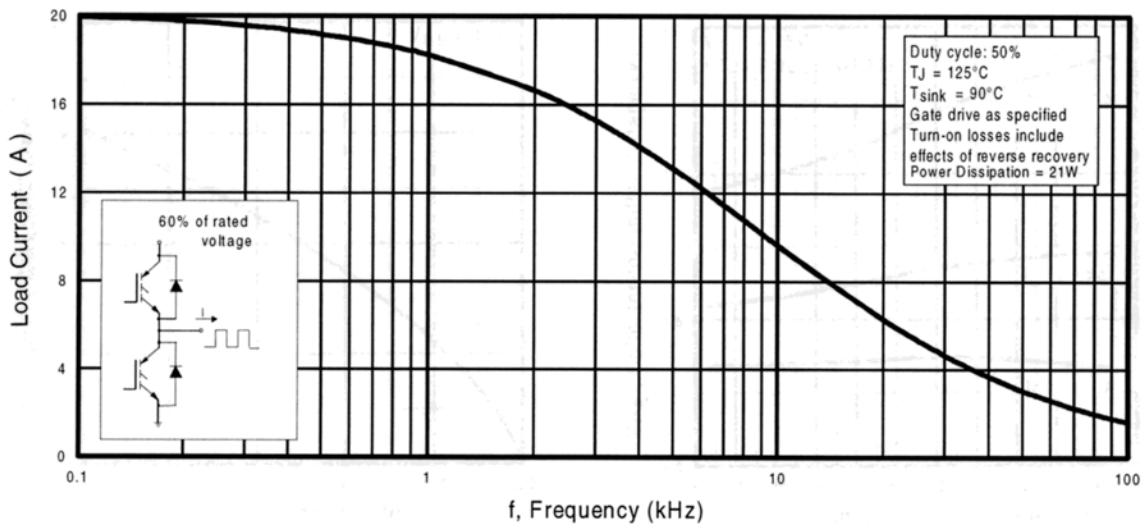

Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)

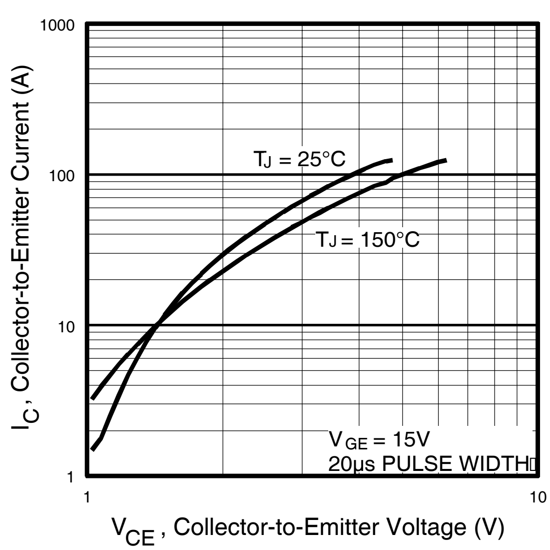

Fig. 2 - Typical Output Characteristics

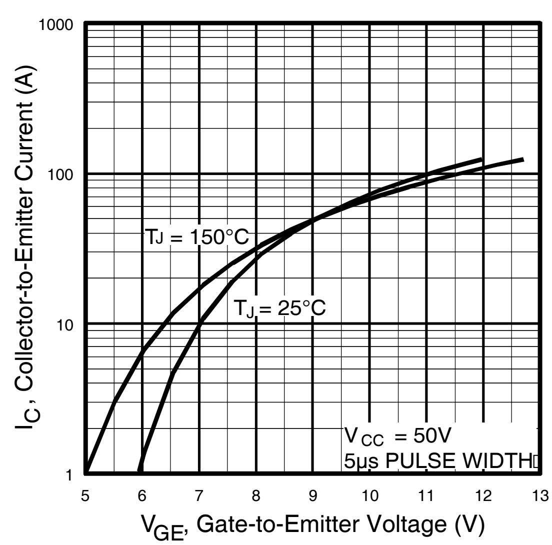

Fig. 3 - Typical Transfer Characteristics

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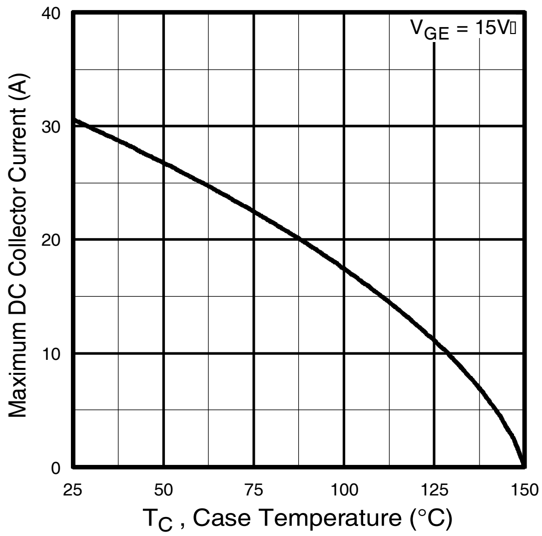

Fig. 4 - Maximum Collector Current vs. Case Temperature

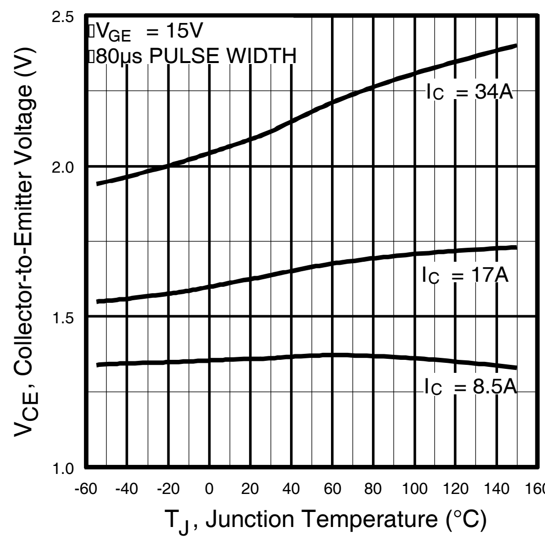

Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

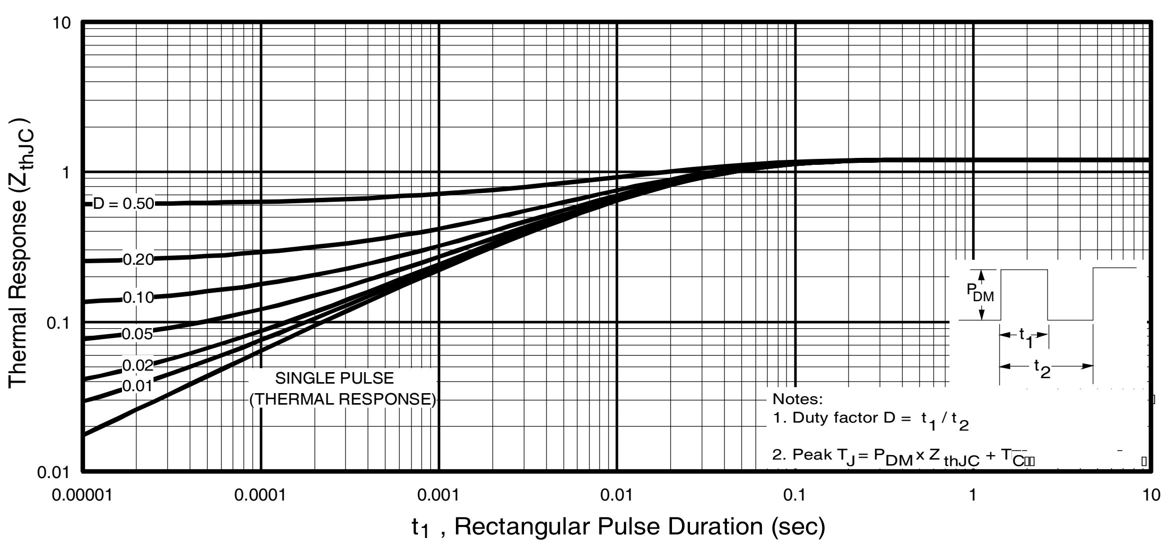

Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

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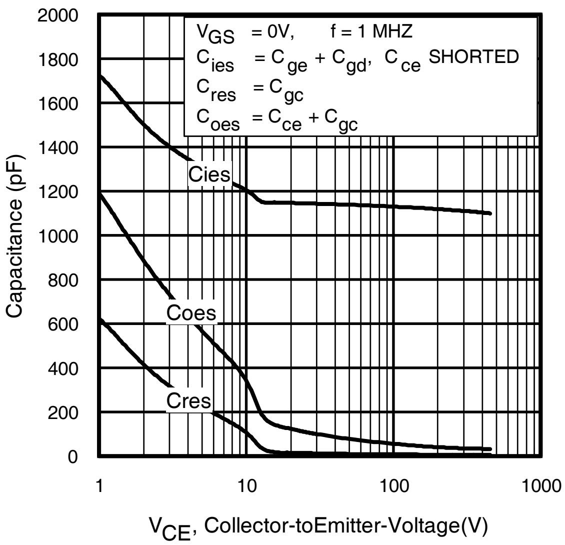

Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

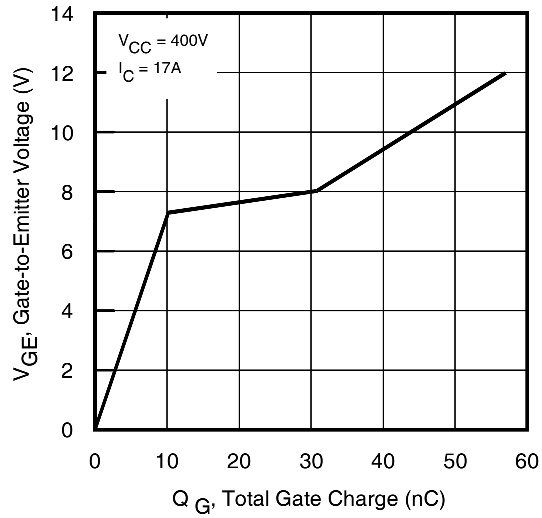

Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

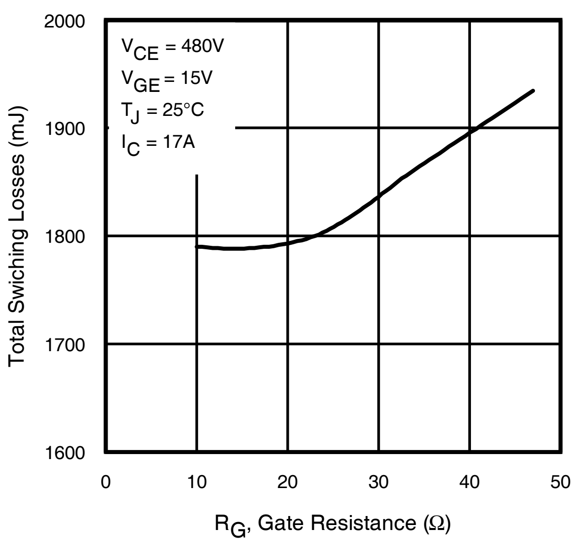

Fig. 9 - Typical Switching Losses vs. Gate Resistance

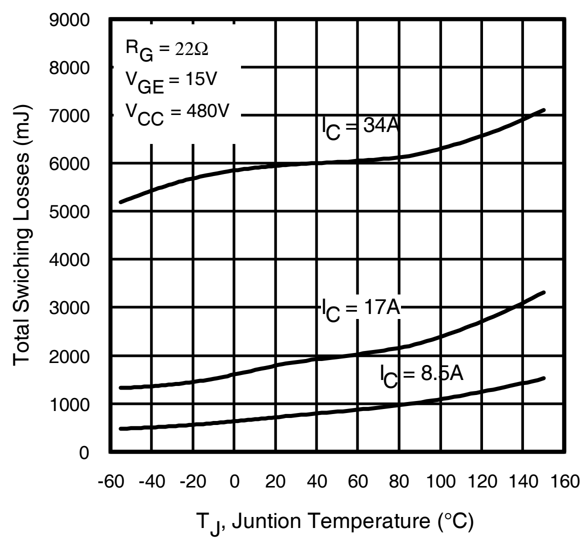

Fig. 10 - Typical Switching Losses vs. Junction Temperature

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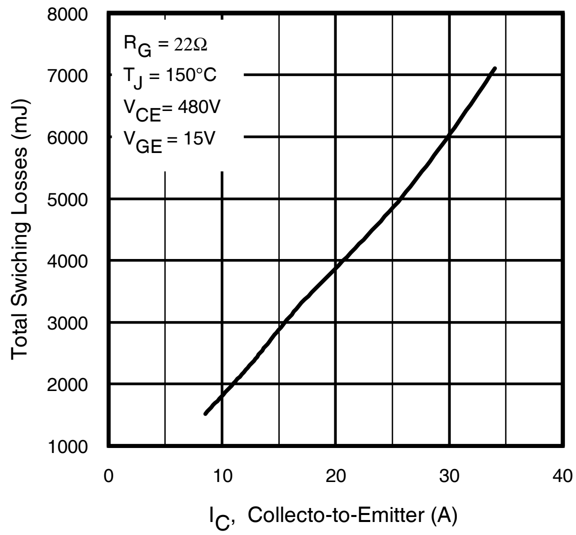

Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

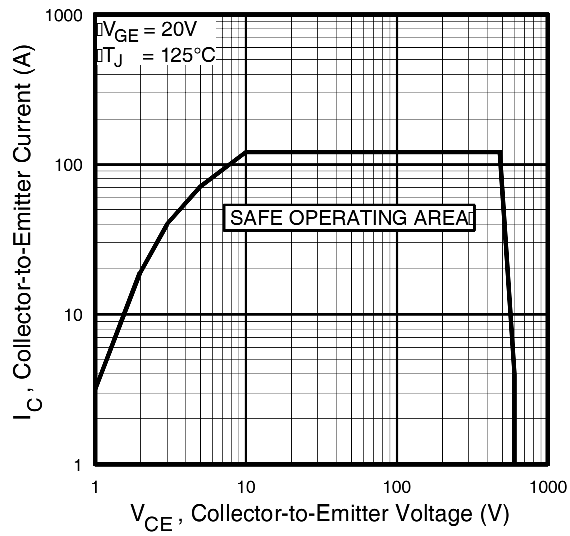

Fig. 12 - Turn-Off SOA

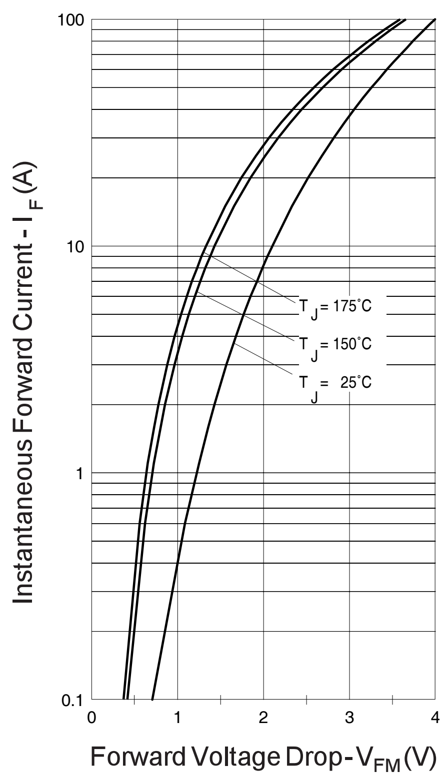

Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

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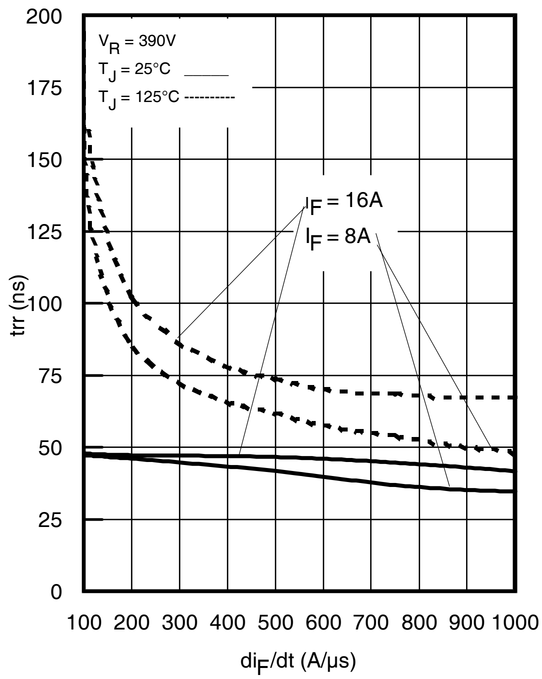

Fig. 14 - Typical Reverse Recovery vs. di_f/dt

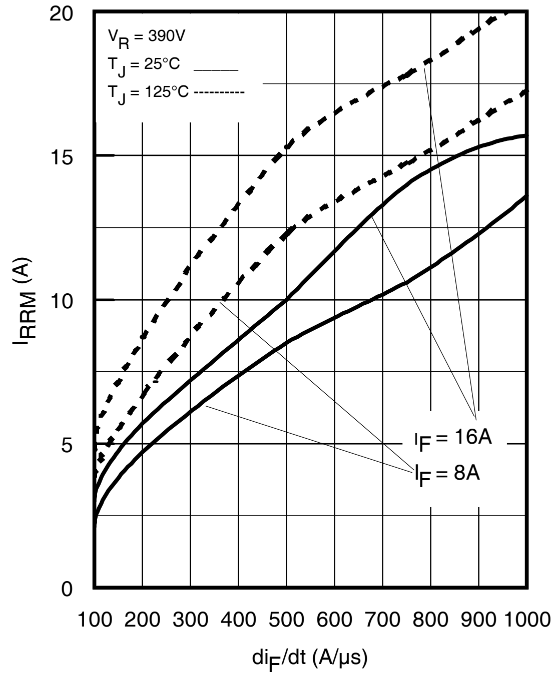

Fig. 15 - Typical Recovery Current vs. di_f/dt

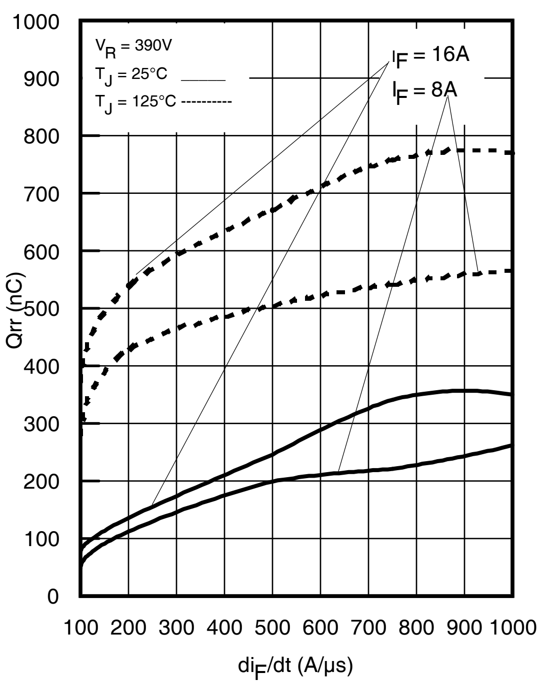

Fig. 16 - Typical Stored Charge vs. di_f/dt

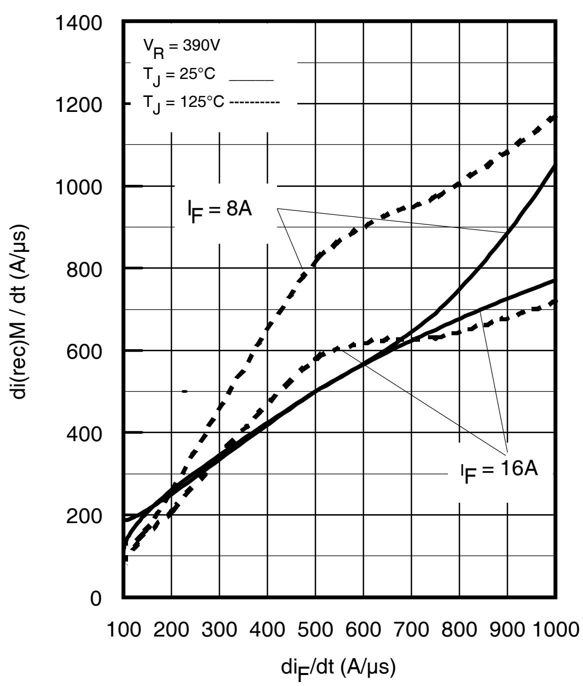

Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

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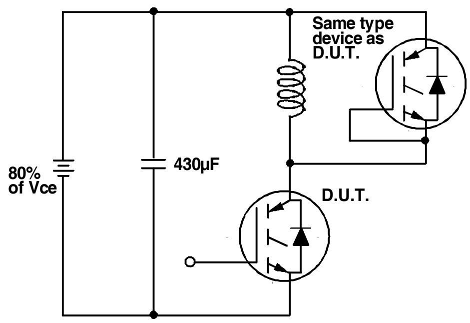

Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

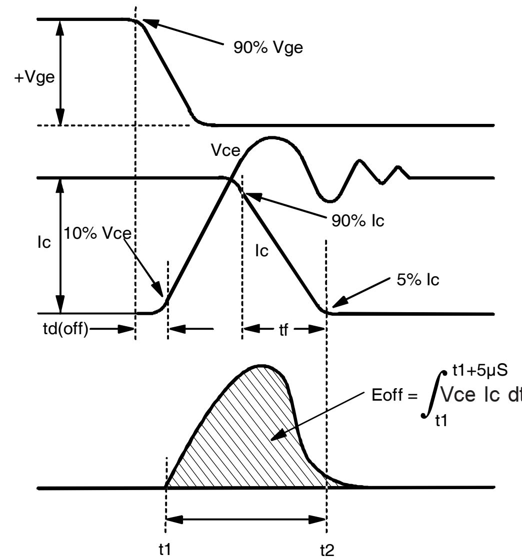

Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

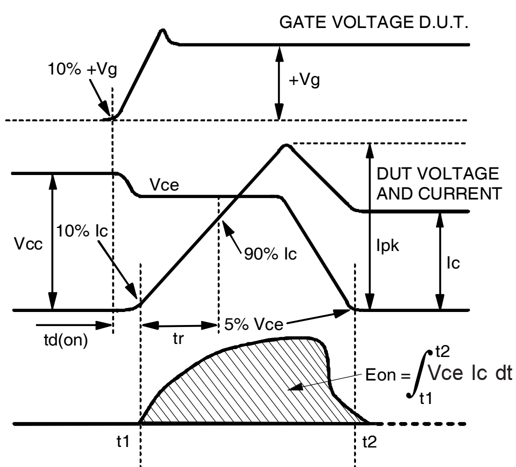

Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

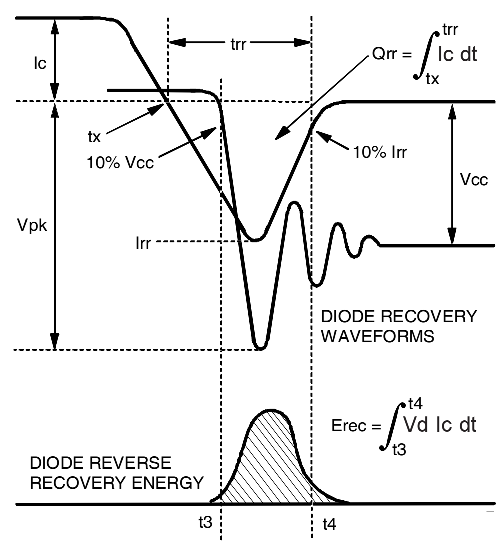

Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

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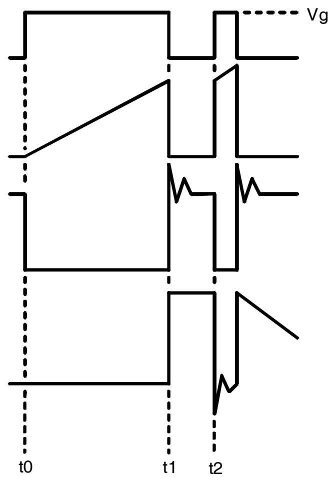


Fig.18e - Macro Waveforms for Figure 18a's Test Circuit

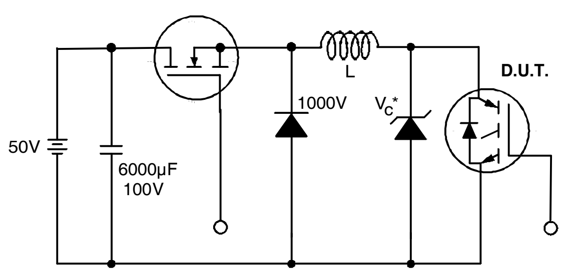
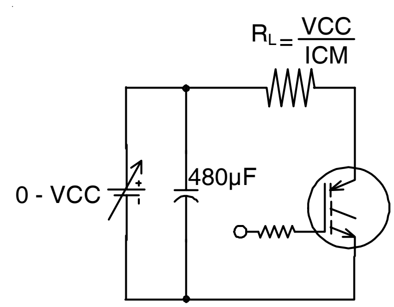


Fig. 19 - Clamped Inductive Load Test Circuit



Pulsed Collector Current
Test Circuit

Fig. 20 - Pulsed Collector Current Test Circuit

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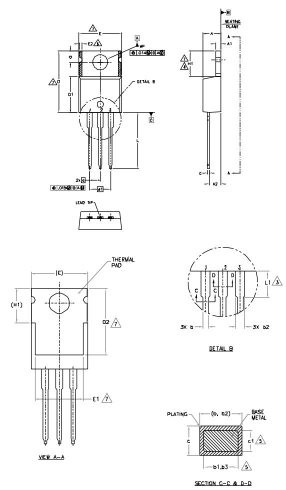
TO-220AB Package Outline (Dimensions are shown in millimeters (inches))



NOTES:

1.- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
2.- DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
3.- LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
4 - DIMENSION D, D1 & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5.- DIMENSION b1, b3 & c1 APPLY TO BASE METAL ONLY.
6 - CONTROLLING DIMENSION : INCHES
7.- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
8.- DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED
9 - OUTLINE CONFORMS TO JEDEC TO-220, EXCEPT A2 (max.) AND D2 (min.) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX	MIN	MAX.	
A	3.56	4.83	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.03	2.92	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.97	.015	.038	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	8.38	9.02	.330	.355	
D2	11.68	12.88	.460	.507	7
E	9.65	10.67	.380	.420	4,7
E1	6.86	8.89	.270	.350	7
E2	-	0.76	-	.030	8
e	2.54 BSC		.100 BSC		
e1	5.08 BSC		.200 BSC		
H1	5.84	6.86	.230	.270	7,8
L	12.70	14.73	.500	.580	
L1	3.56	4.06	.140	.160	3
øP	3.54	4.08	.139	.161	
Q	2.54	3.42	.100	.135	

LEAD ASSIGNMENTS

HEXFET
1 - GATE
2 - DRAIN
3 - SOURCE

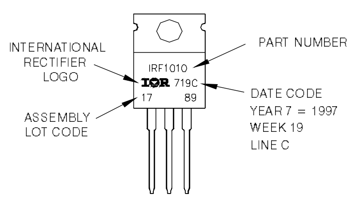
IGBTs, CoPACK
1.- GATE
2.- COLLECTOR
3.- EMITTER

DIODES
1 - ANODE
2 - CATHODE
3.- ANODE

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"



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=10µH, R_G = 23Ω (figure 19).

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

④ Pulse width 5.0µs, single shot.

⑤ Energy losses include "tail" and diode reverse recovery, using Diode FD100H06A5.

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.

International IOR Rectifier

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