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International
IOR Rectifier

PD-91449C

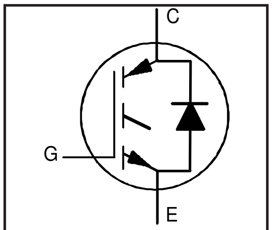
IRG4BC20UD

UltraFast CoPack IGBT

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Features

- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200kHz 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



N-Channel

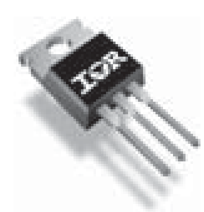
V_{CES} = 600V

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

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

Benefits

- Generation 4 IGBTs offers the highest efficiencies available
- 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


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	13	A
I_C @ T_C = 100°C	Continuous Collector Current	6.5	
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	7.0	
I_{FM}	Diode Maximum Forward Current	52	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
P_D @ T_C = 25°C	Maximum Power Dissipation	60	W
P_D @ T_C = 100°C	Maximum Power Dissipation	24	
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	——	——	2.1	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	——	——	3.5	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	——	0.50	——	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	——	——	80	
Wt	Weight	——	2 (0.07)	——	g (oz)

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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 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	0.37			
$t_{d(on)}$	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	——		ƒ = 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	

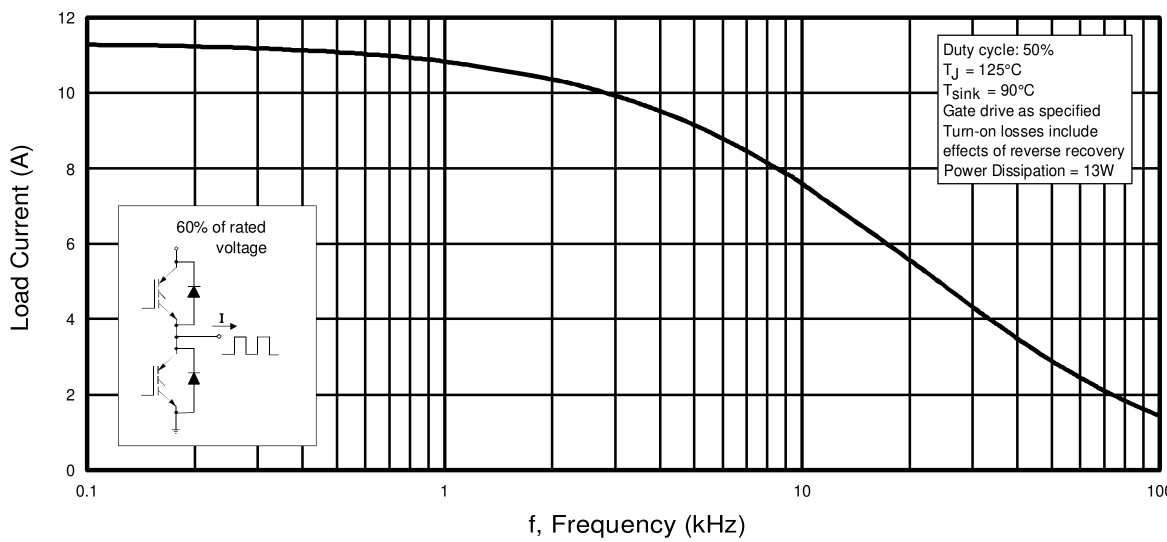


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

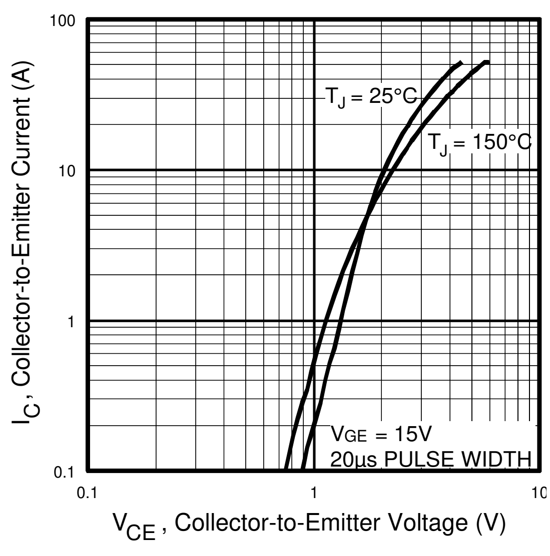


Fig. 2 - Typical Output Characteristics

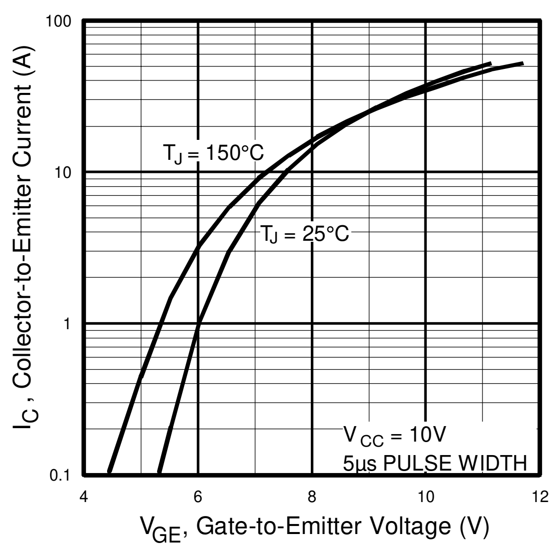


Fig. 3 - Typical Transfer Characteristics

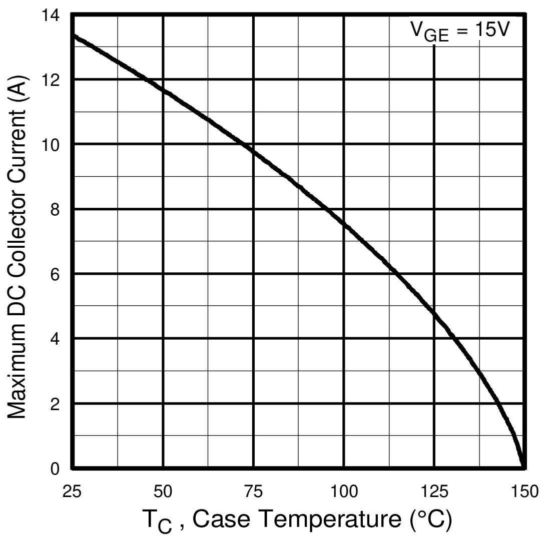


Fig. 4 - Maximum Collector Current vs. Case Temperature

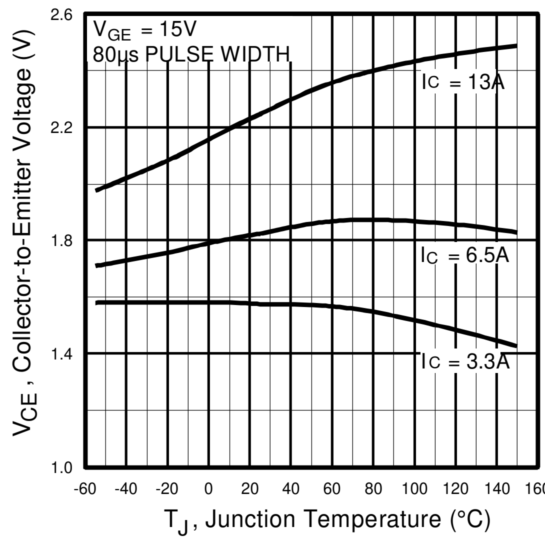


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

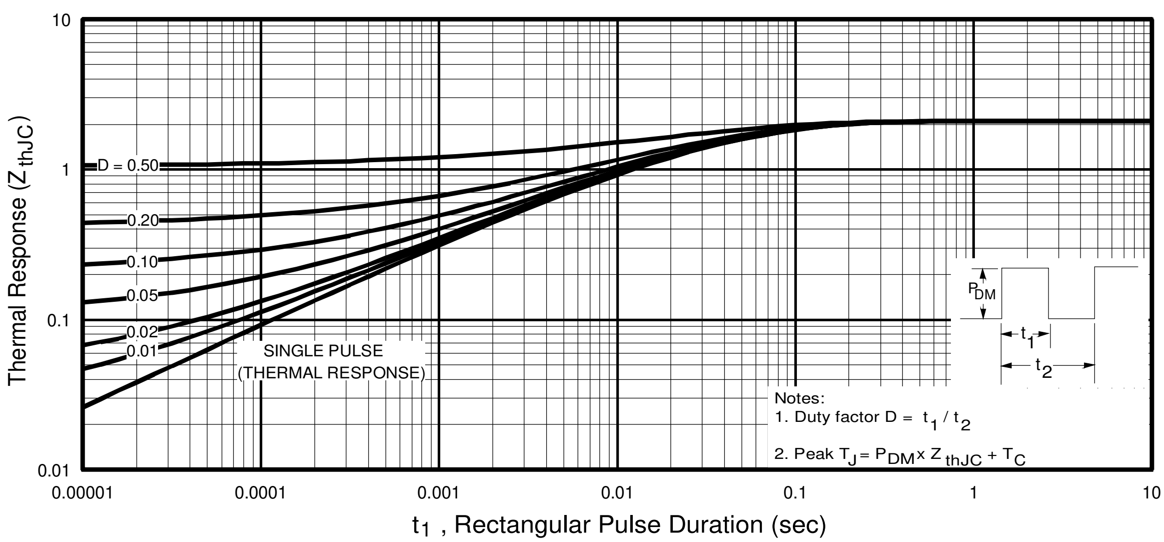


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

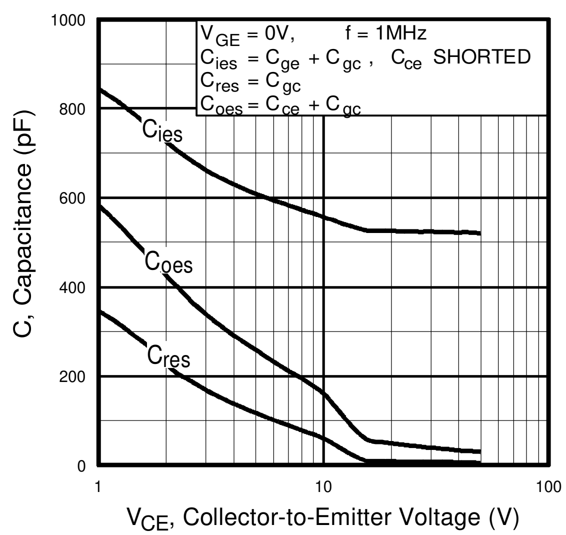


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

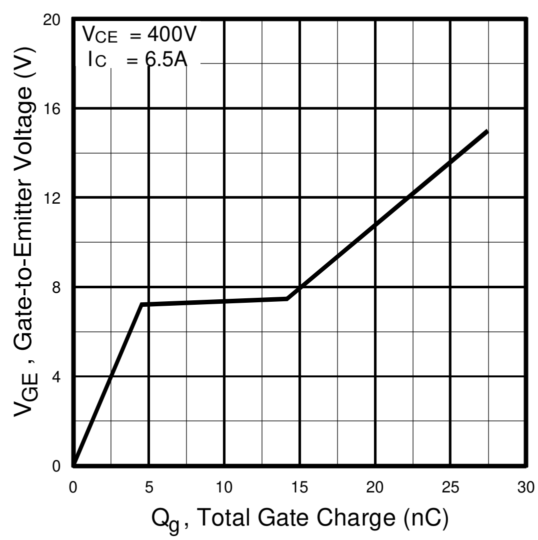


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

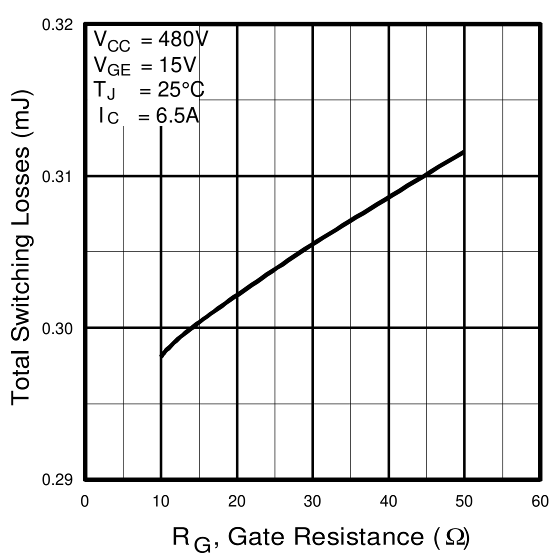


Fig. 9 - Typical Switching Losses vs. Gate Resistance

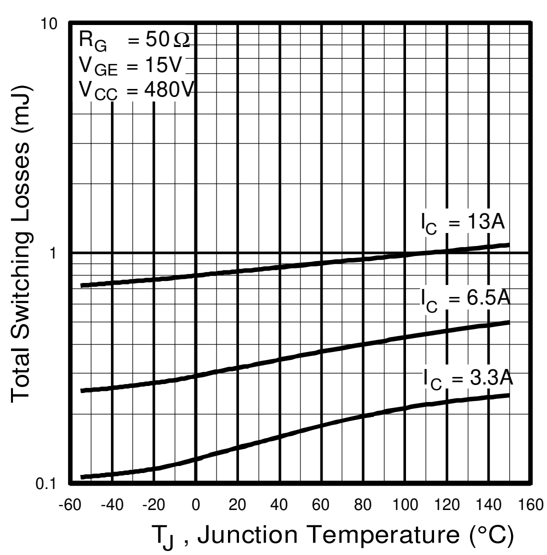


Fig. 10 - Typical Switching Losses vs. Junction Temperature

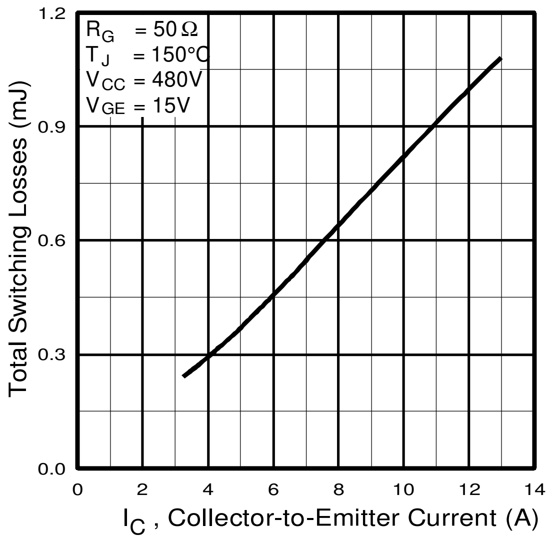


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

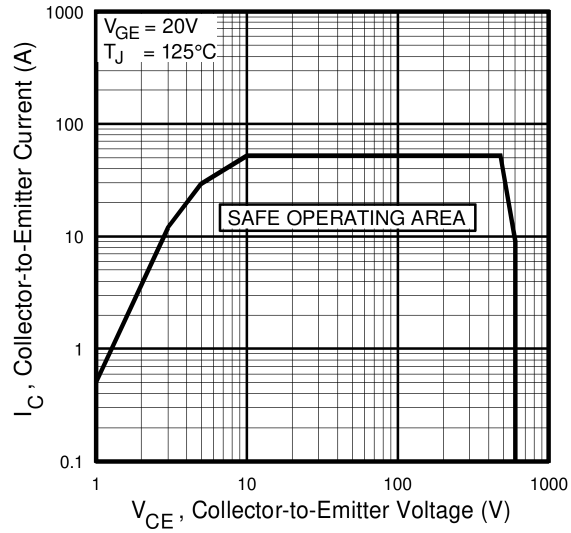


Fig. 12 - Turn-Off SOA

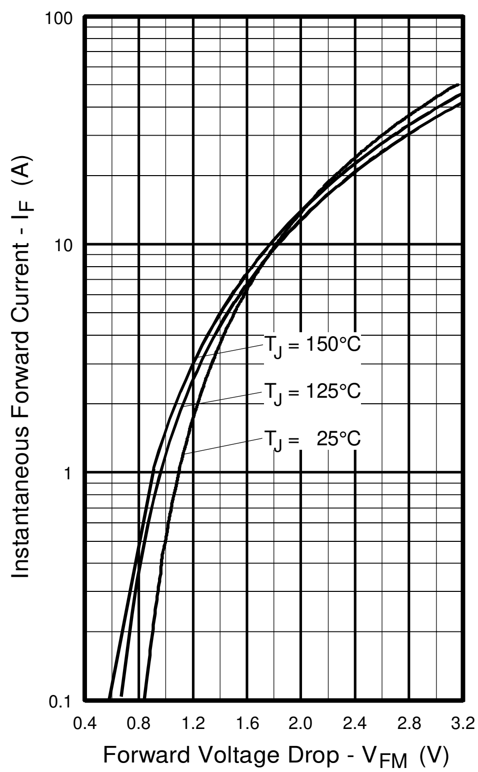


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

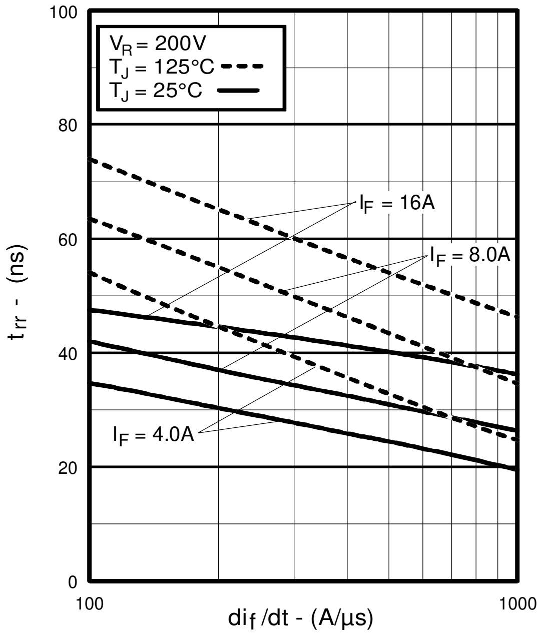


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

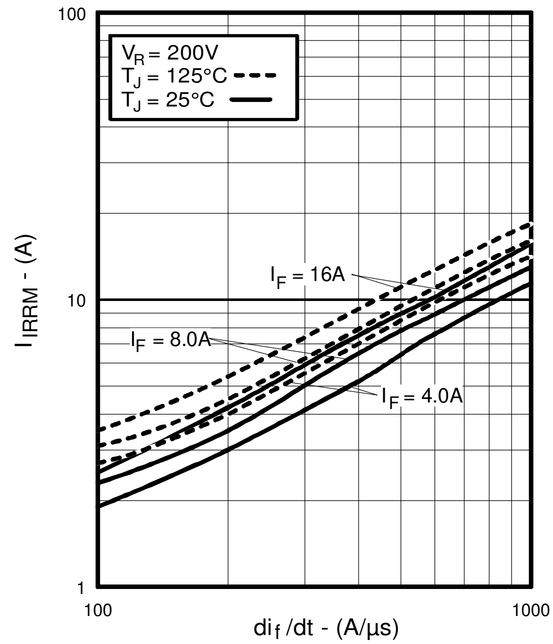


Fig. 15 - Typical Recovery Current vs. di_f/dt

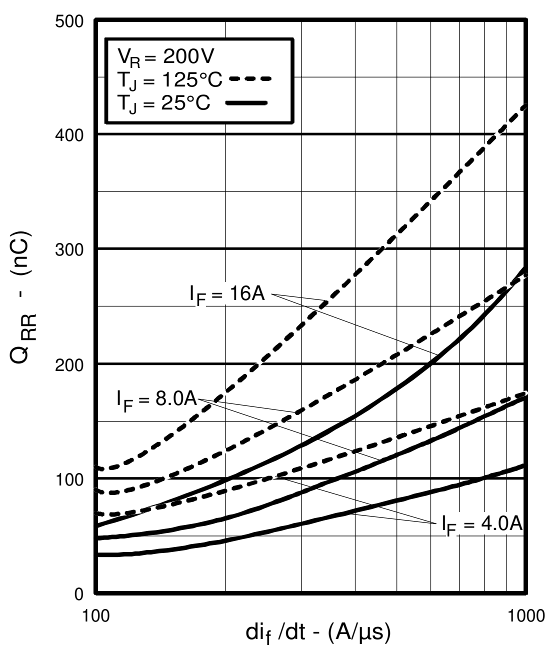


Fig. 16 - Typical Stored Charge vs. di_f/dt

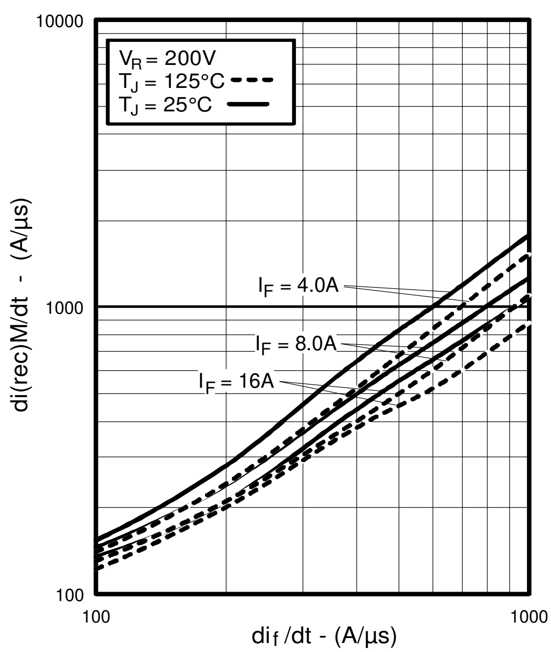


Fig. 17 - Typical $di_{(rec)M}$/dt vs. di_f/dt

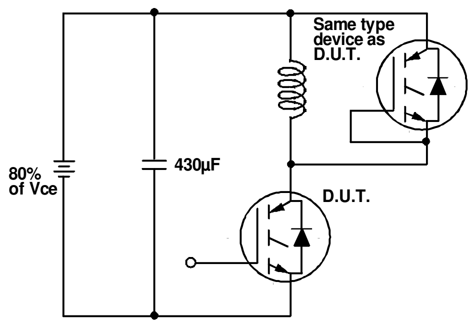


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

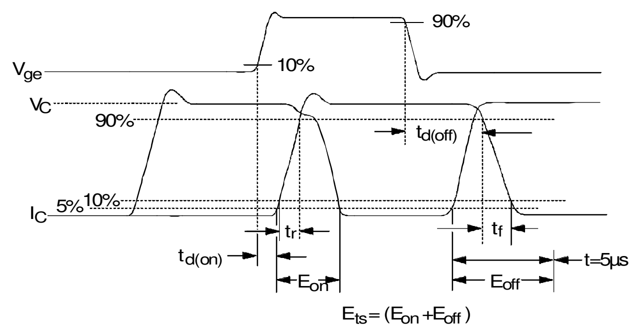


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

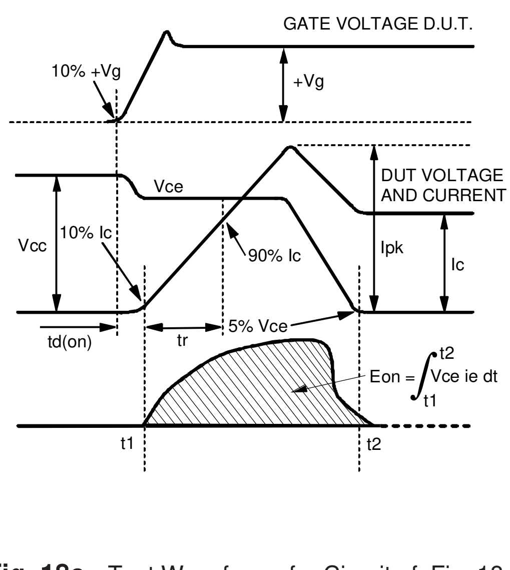


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

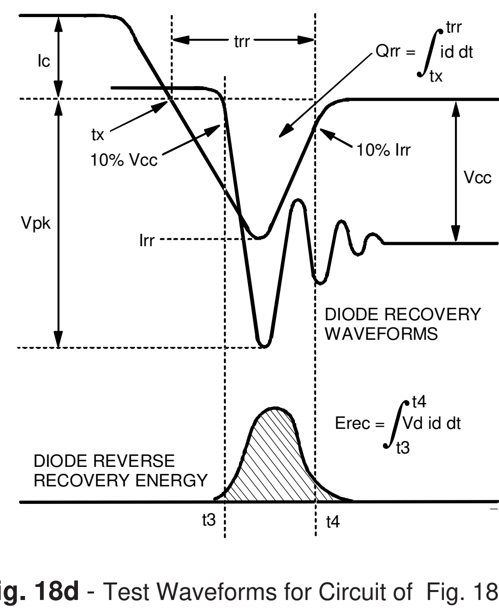


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

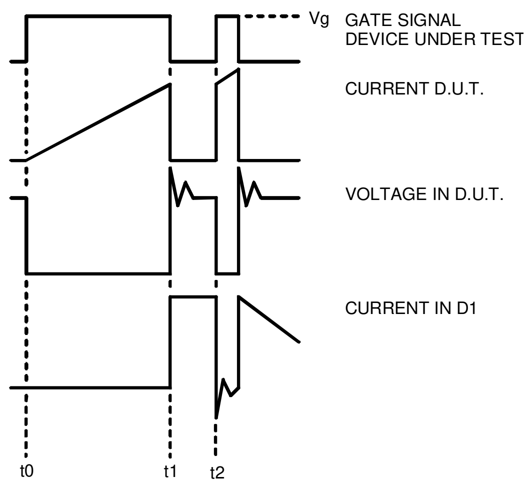


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

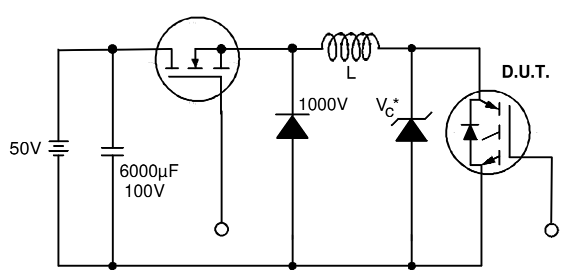


Figure 19. Clamped Inductive Load Test Circuit

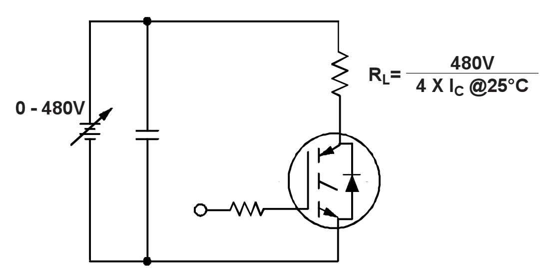


Figure 20. Pulsed Collector Current Test Circuit

Notes:

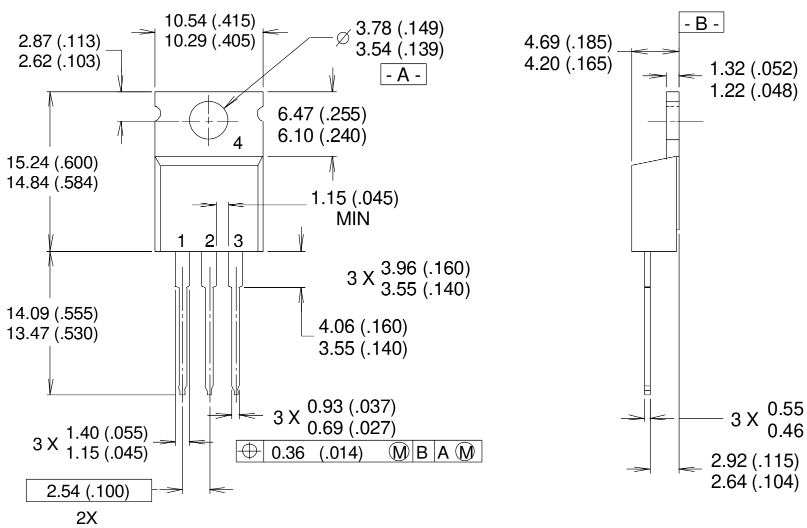
① Repetitive rating: V_{GE}=20V; pulse width limited by maximum junction temperature (figure 20)

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.

Case Outline — TO-220AB



NOTES:
1 DIMENSIONS & TOLERANCING PER ANSI Y14.5M, 1982.
2 CONTROLLING DIMENSION : INCH.
3 DIMENSIONS ARE SHOWN MILLIMETERS (INCHES).
4 CONFORMS TO JEDEC OUTLINE TO-220AB.

LEAD ASSIGNMENTS
1 - GATE
2 - COLLECTOR
3 - EMITTER
4 - COLLECTOR

CONFORMS TO JEDEC OUTLINE TO-220AB
Dimensions in Millimeters and (Inches)

International
IOR Rectifier

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Data and specifications subject to change without notice. 6/03

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