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PD -91750A

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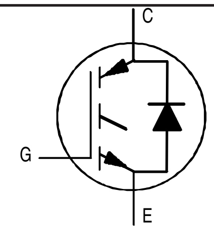
IRG4IBC20FD

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Fast CoPack IGBT

Features

- Very Low 1.66V votage drop
- 2.5kV, 60s insulation voltage ⑤
- 4.8 mm creapage distance to heatsink
- Fast: Optimized for medium operating frequencies (1-5 kHz in hard switching, >20 kHz in resonant mode).
- IGBT co-packaged with HEXFRED™ ultrafast, ultrasoft recovery antiparallel diodes
- Tighter parameter distribution
- Industry standard Isolated TO-220 Fullpak™ outline



n-channel

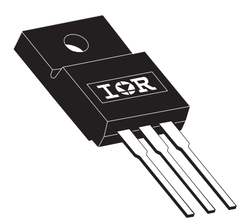
V_{CES} = 600V

$V_{CE(on)\ typ.}$ = 1.66V

@V_{GE} = 15V, I_C = 9.0A

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	14.3	A
I_C @ T_C = 100°C	Continuous Collector Current	7.7	
I_{CM}	Pulsed Collector Current ①	64	
I_{LM}	Clamped Inductive Load Current ②	64	
I_F @ T_C = 100°C	Diode Continuous Forward Current	6.5	
I_{FM}	Diode Maximum Forward Current	64	
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)

4/24/00

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	—	0.72	—	V/°C	V_{GE} = 0V, I_C = 1.0mA	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.66	2.0	V	I_C = 9.0A	V_{GE} = 15V
		—	2.06	—		I_C = 16A	See Fig. 2, 5
		—	1.76	—		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	—	-11	—	mV/°C	V_{CE} = V_{GE}, I_C = 250μA	
g_{fe}	Forward Transconductance ④	2.9	5.1	—	S	V_{CE} = 100V, I_C = 9.0A	
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	40	nC	I_C = 9.0A		
Qge	Gate - Emitter Charge (turn-on)	—	4.2	6.2		V_{CC} = 400V	See Fig. 8	
Q_{gc}	Gate - Collector Charge (turn-on)	—	9.9	15		V_{GE} = 15V		
$t_{d(on)}$	Turn-On Delay Time	—	43	—	ns	T_J = 25°C		
t_r	Rise Time	—	20	—		I_C = 9.0A, V_{CC} = 480V		
$t_{d(off)}$	Turn-Off Delay Time	—	240	360		V_{GE} = 15V, R_G = 50Ω		
t_f	Fall Time	—	150	220		Energy losses include "tail" and		
E_{on}	Turn-On Switching Loss	—	0.25	—	mJ	diode reverse recovery.		
E_{off}	Turn-Off Switching Loss	—	0.64	—		See Fig. 9, 10, 18		
E_{ts}	Total Switching Loss	—	0.89	1.3				
$t_{d(on)}$	Turn-On Delay Time	—	41	—	ns	T_J = 150°C,	See Fig. 11, 18	
t_r	Rise Time	—	22	—		I_C = 9.0A, V_{CC} = 480V		
$t_{d(off)}$	Turn-Off Delay Time	—	320	—		V_{GE} = 15V, R_G = 50Ω		
t_f	Fall Time	—	290	—		Energy losses include "tail" and		
E_{ts}	Total Switching Loss	—	1.35	—	mJ	diode reverse recovery.		
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package		
C_{ies}	Input Capacitance	—	540	—	pF	V_{GE} = 0V		
C_{oes}	Output Capacitance	—	37	—		V_{CC} = 30V	See Fig. 7	
C_{res}	Reverse Transfer Capacitance	—	7.0	—		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	

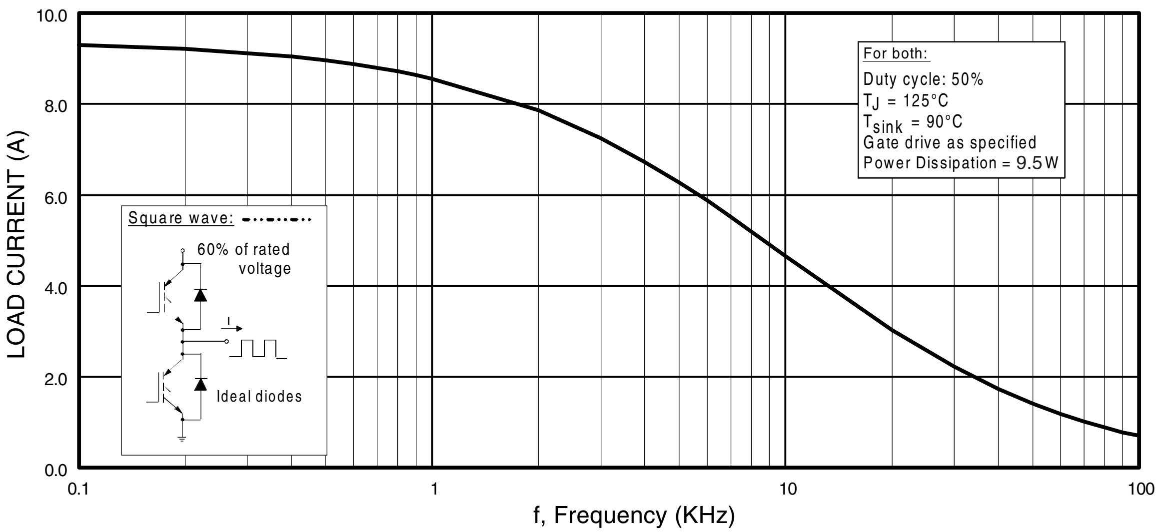


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

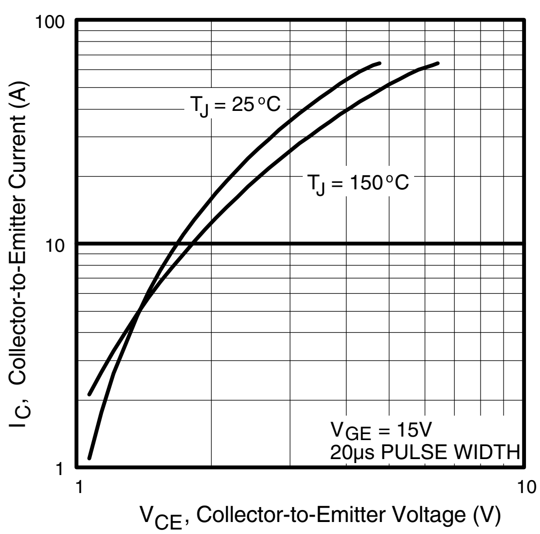


Fig. 2 - Typical Output Characteristics

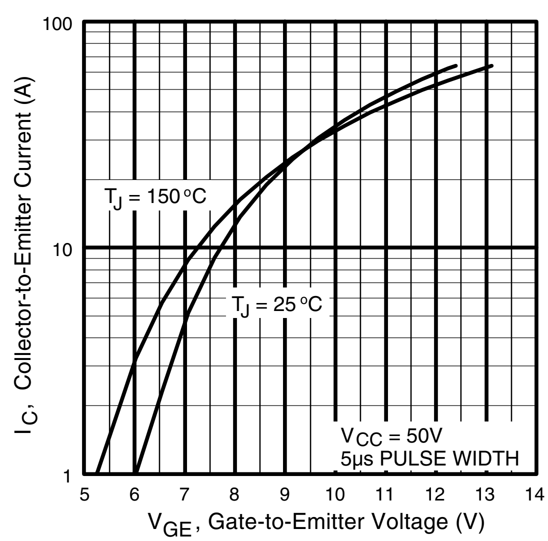


Fig. 3 - Typical Transfer Characteristics

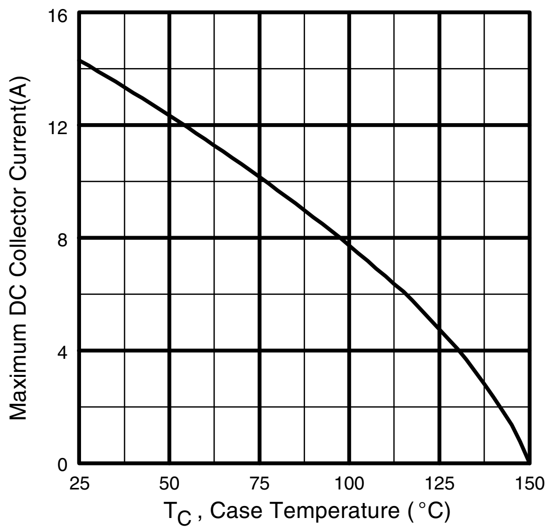


Fig. 4 - Maximum Collector Current vs. Case Temperature

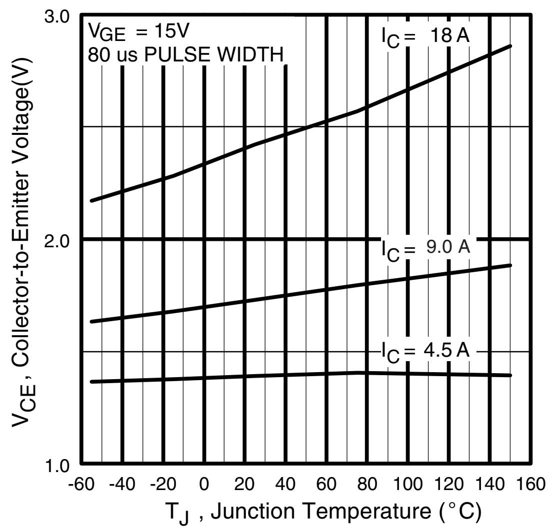


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

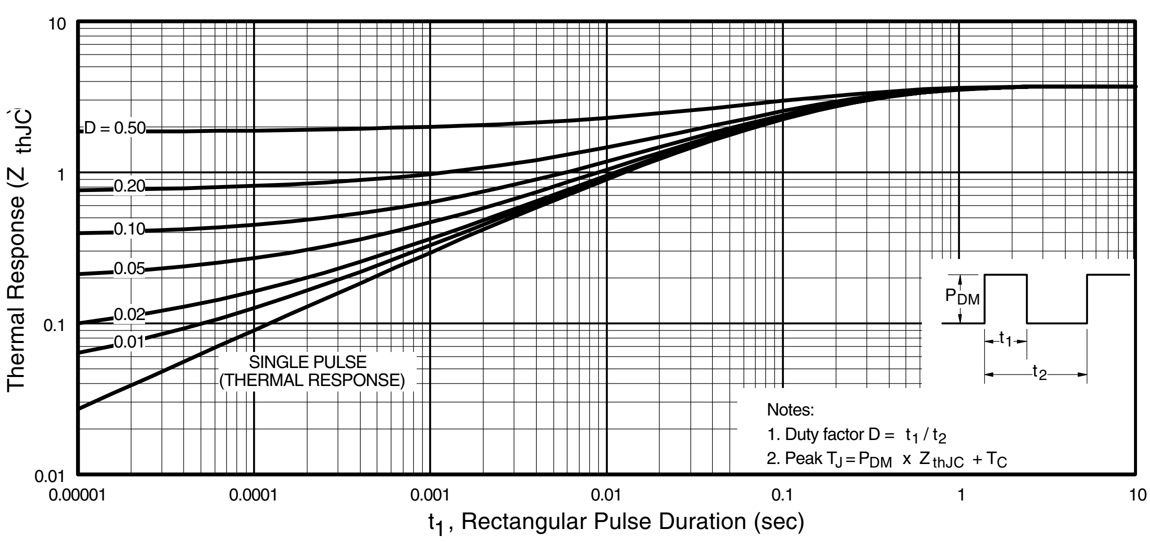


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

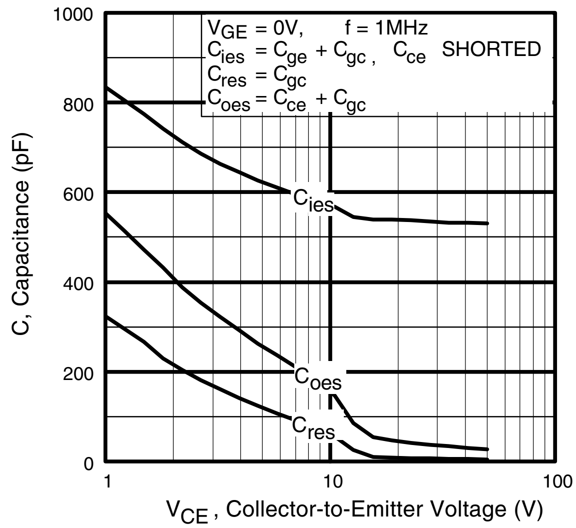


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

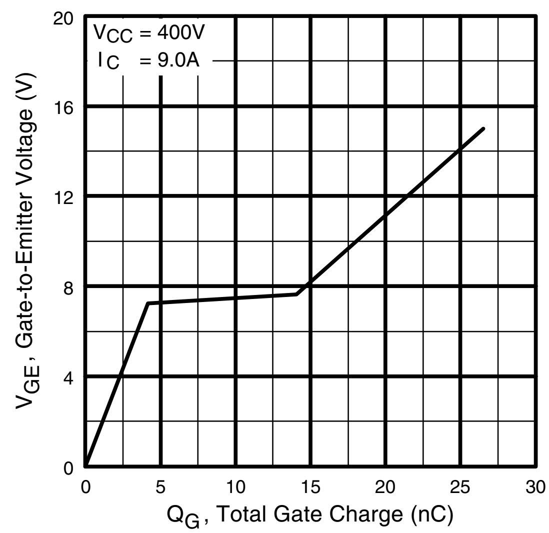


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

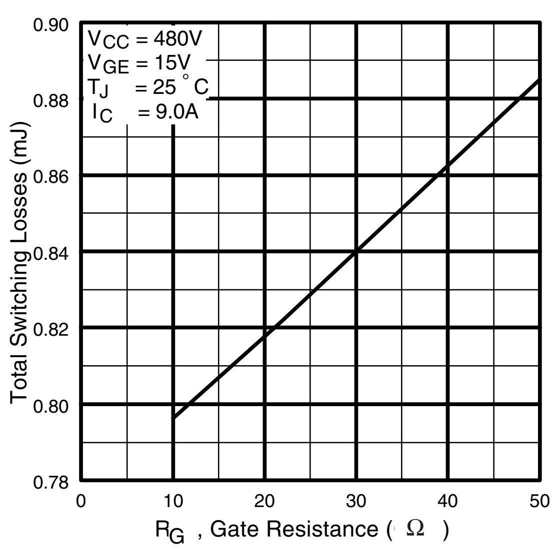


Fig. 9 - Typical Switching Losses vs. Gate Resistance

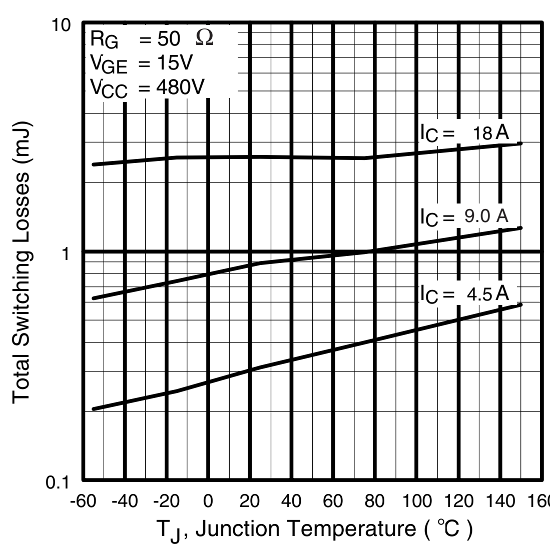


Fig. 10 - Typical Switching Losses vs. Junction Temperature

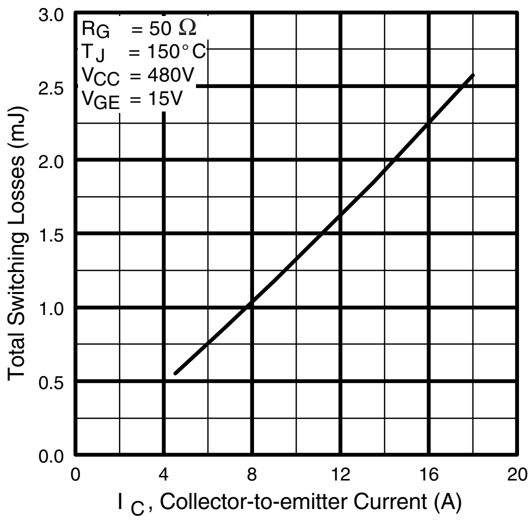


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

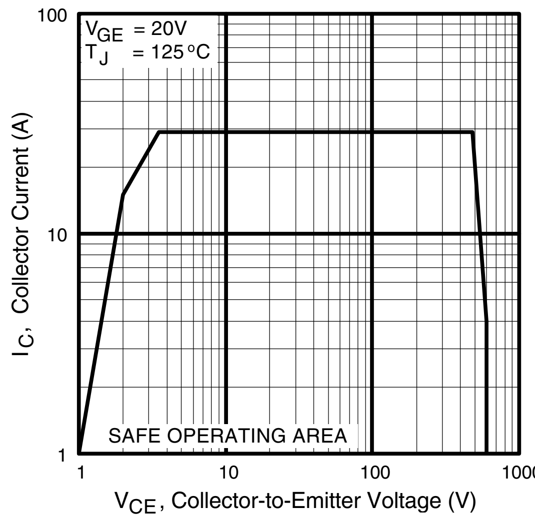


Fig. 12 - Turn-Off SOA

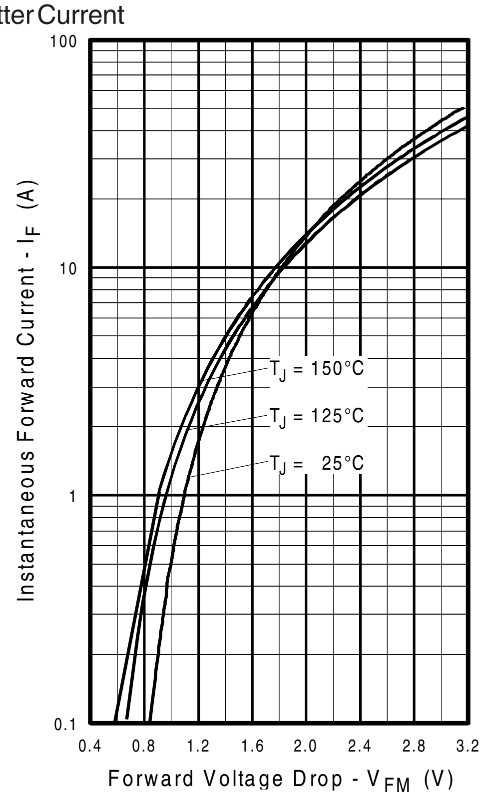


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

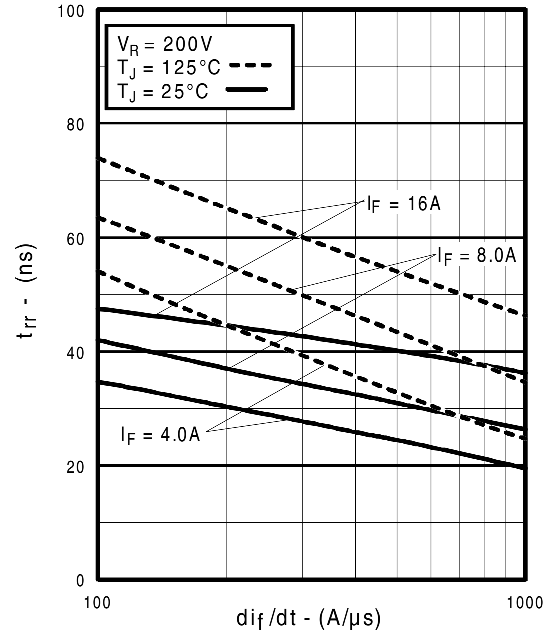


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

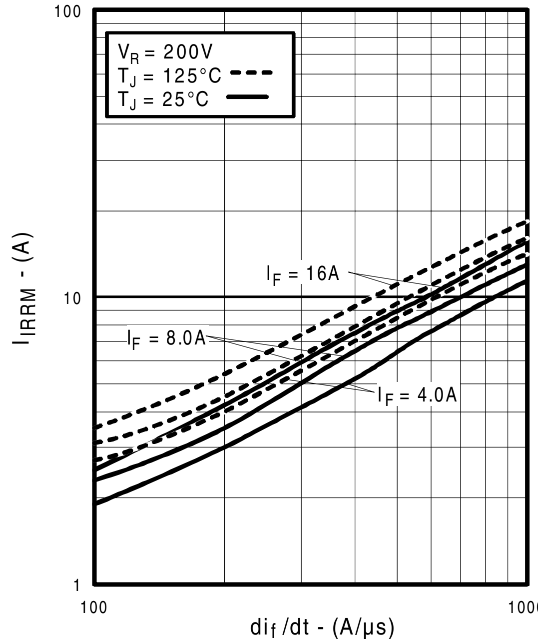


Fig. 15 - Typical Recovery Current vs. di_f/dt

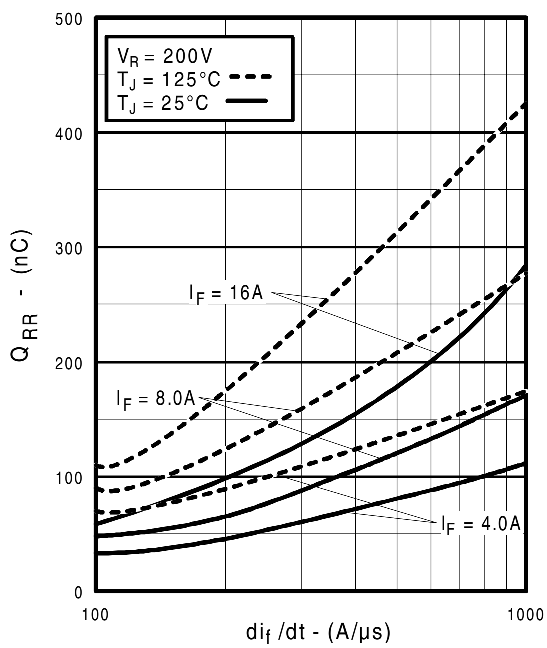


Fig. 16 - Typical Stored Charge vs. di_f/dt

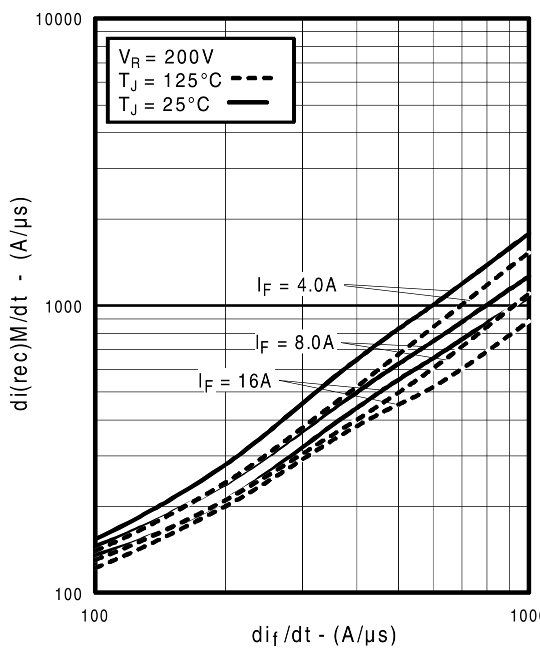


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

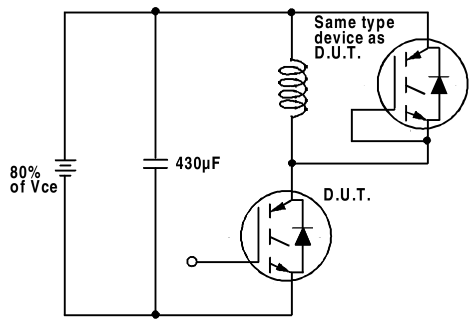


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

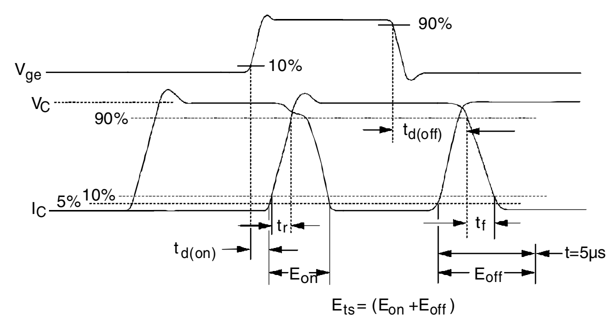


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

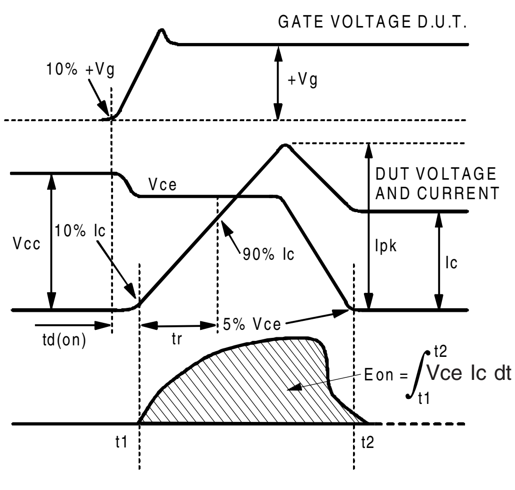


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

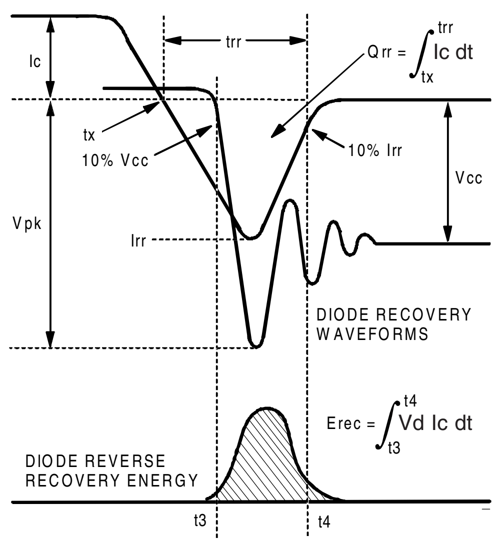


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

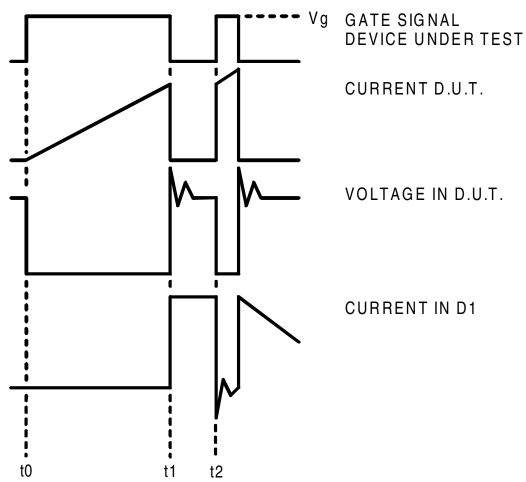


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

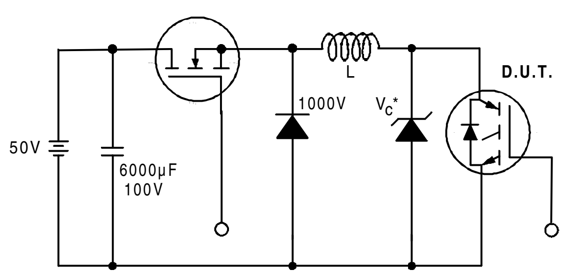


Figure 19. Clamped Inductive Load Test Circuit

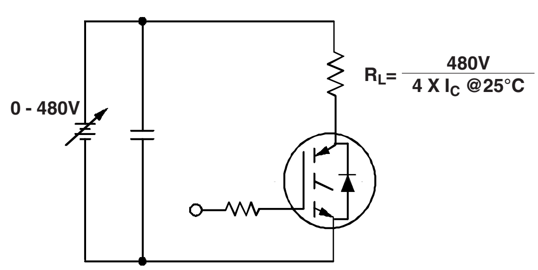


Figure 20. Pulsed Collector Current Test Circuit

Notes:

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

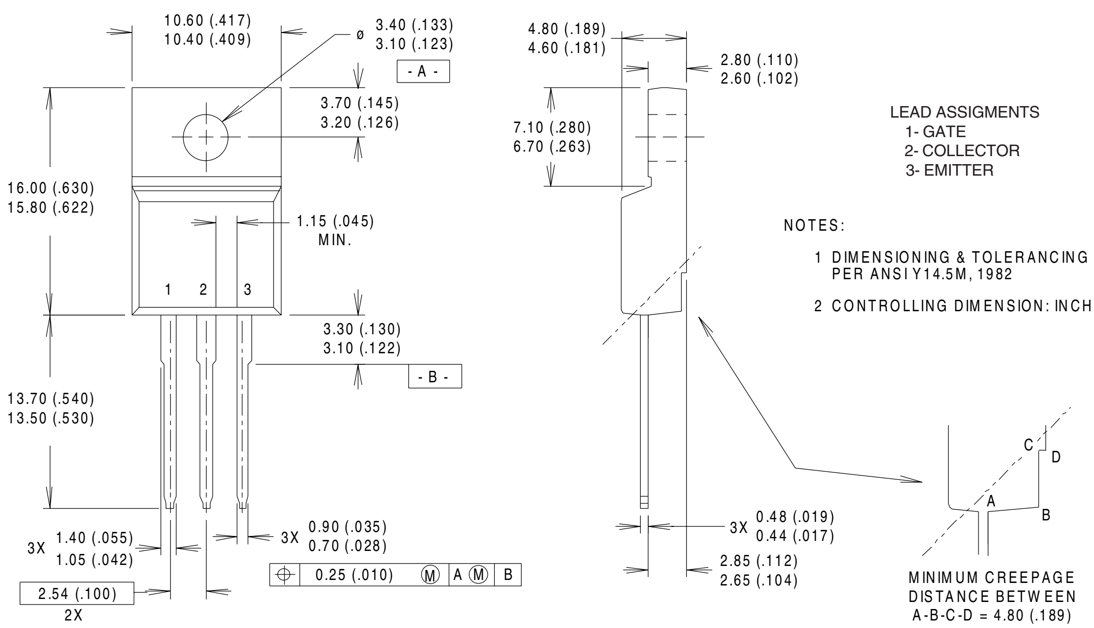
② V_{CC}=80%(V_{CES}), V_{GE}=20V, L=10µH, R_G = 50Ω (figure 19)

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

④ Pulse width 5.0µs, single shot.

⑤ t = 60s, f = 60Hz

Case Outline — TO-220 FULLPAK



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