International
IOR Rectifier

PD -94908

IRG4BC20MDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

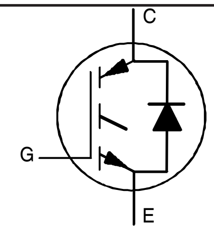
Short Circuit Rated Fast IGBT

Features

- Rugged: 10µsec short circuit capable at V_{GS}=15V
- Low $V_{CE(on)}$ for 4 to 10kHz applications
- IGBT Co-packaged with ultra-soft-recovery antiparallel diode
- Industry standard TO-220AB package
- Lead-Free

Benefits

- Offers highest efficiency and short circuit capability for intermediate applications
- Provides best efficiency for the mid range frequency (4 to 10kHz)
- Optimized for Appliance Motor Drives, Industrial (Short Circuit Proof) Drives and Intermediate Frequency Range Drives
- High noise immune "Positive Only" gate drive- Negative bias gate drive not necessary
- For Low EMI designs- requires little or no snubbing
- Single Package switch for bridge circuit applications
- Compatible with high voltage Gate Driver IC's
- Allows simpler gate drive

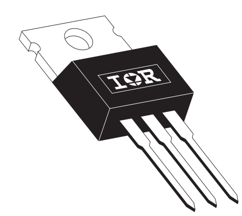


n-channel

V_{CES} = 600V

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

@V_{GE} = 15V, I_C = 11A



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	18	A
I_C @ T_C = 100°C	Continuous Collector Current	11	
I_{CM}	Pulsed Collector Current ①	36	
I_{LM}	Clamped Inductive Load Current ②	36	
I_F @ T_C = 100°C	Diode Continuous Forward Current	7.0	
t_{sc}	Short Circuit Withstand Time	10	µs
I_{FM}	Diode Maximum Forward Current	36	A
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	------	------	2.5	
$R_{\theta CS}$	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)

3/6/01

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	----	0.67	----	V/°C	V_{GE} = 0V, I_C = 1.0mA	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	----	1.85	2.1	V	I_C = 11A	V_{GE} = 15V
		----	2.46	----		I_C = 18A	See Fig. 2, 5
		----	2.07	----		I_C = 11A, T_J = 150°C	
$V_{GE(th)}$	Gate Threshold Voltage	4.0	----	6.5		$V_{CE} = V_{GE}$, 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	3.0	3.6	----	S	V_{CE} = 100V, I_C = 11A	
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	----	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)	----	39	59	nC	I_C = 11A		
Qge	Gate - Emitter Charge (turn-on)	----	5.3	8.0		V_{CC} = 400V	See Fig. 8	
Q_{gc}	Gate - Collector Charge (turn-on)	----	20	30		V_{GE} = 15V		
$t_{d(on)}$	Turn-On Delay Time	----	21	----	ns	T_J = 25°C		
t_r	Rise Time	----	37	----		I_C = 11A, V_{CC} = 480V		
$t_{d(off)}$	Turn-Off Delay Time	----	463	690		V_{GE} = 15V, R_G = 50Ω		
t_f	Fall Time	----	340	510		Energy losses include "tail" and		
E_{on}	Turn-On Switching Loss	----	0.41	----	mJ	diode reverse recovery.		
E_{off}	Turn-Off Switching Loss	----	2.03	----		See Fig. 9, 10, 11, 18		
E_{ts}	Total Switching Loss	----	2.44	3.7				
$t_{d(on)}$	Turn-On Delay Time	----	19	----	ns	T_J = 150°C,	See Fig. 9, 10, 11, 18	
t_r	Rise Time	----	41	----		I_C = 6.5A, V_{CC} = 480V		
$t_{d(off)}$	Turn-Off Delay Time	----	590	----		V_{GE} = 15V, R_G = 50Ω		
t_f	Fall Time	----	600	----		Energy losses include "tail" and		
E_{ts}	Total Switching Loss	----	3.49	----	mJ	diode reverse recovery.		
L_E	Internal Emitter Inductance	----	7.5	----	nH	Measured 5mm from package		
C_{ies}	Input Capacitance	----	460	----	pF	V_{GE} = 0V		
C_{oes}	Output Capacitance	----	54	----		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 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	

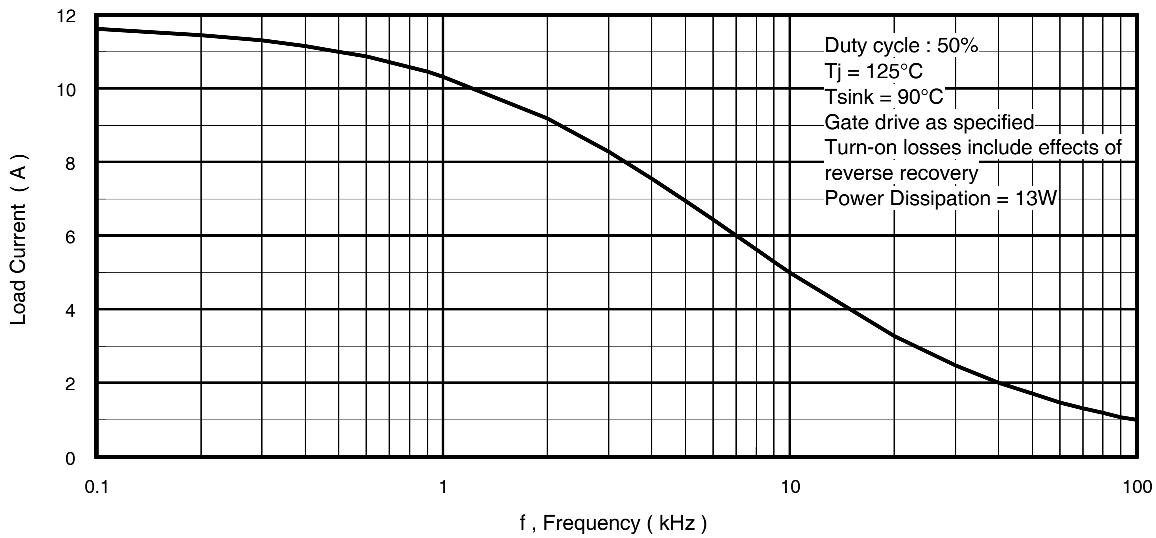


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

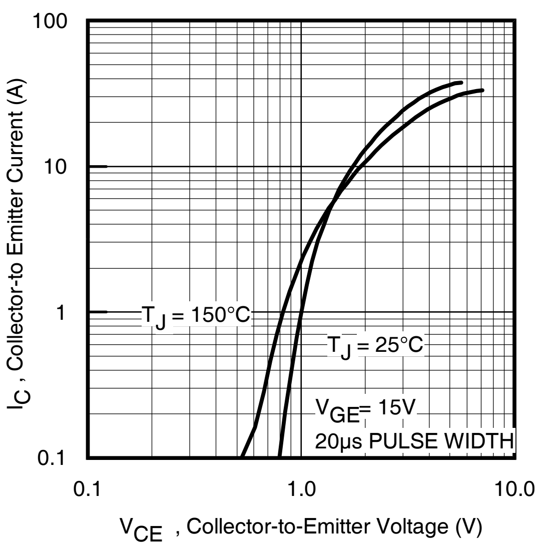


Fig. 2 - Typical Output Characteristics

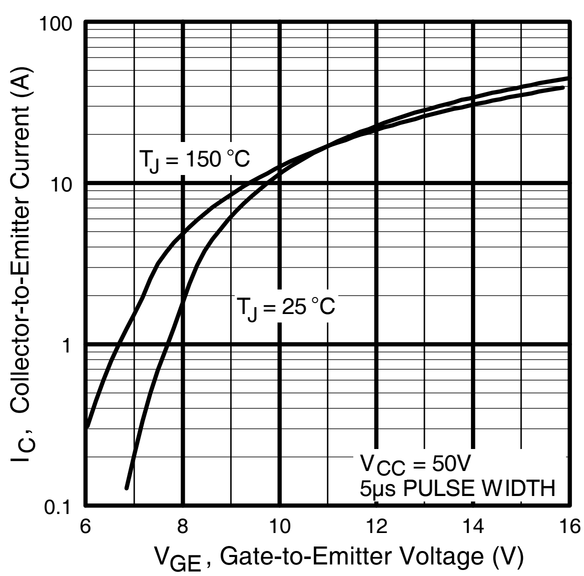


Fig. 3 - Typical Transfer Characteristics

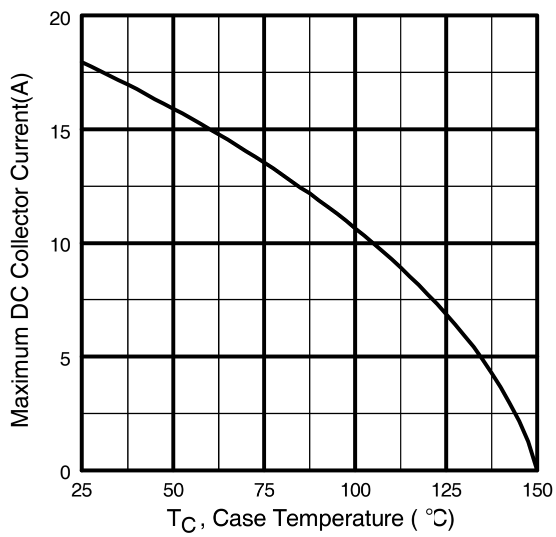


Fig. 4 - Maximum Collector Current vs. Case Temperature

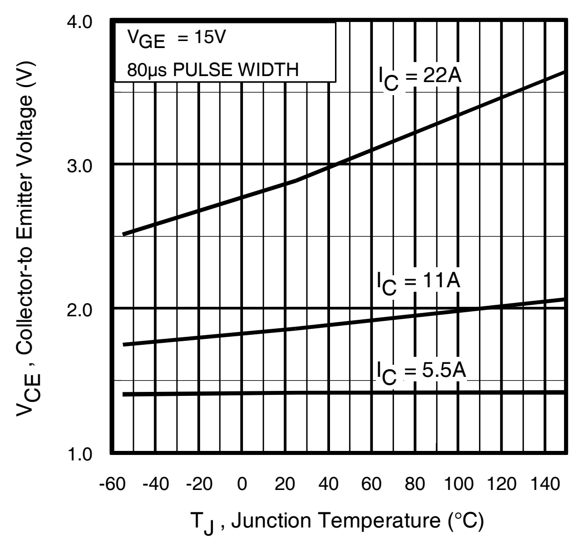


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

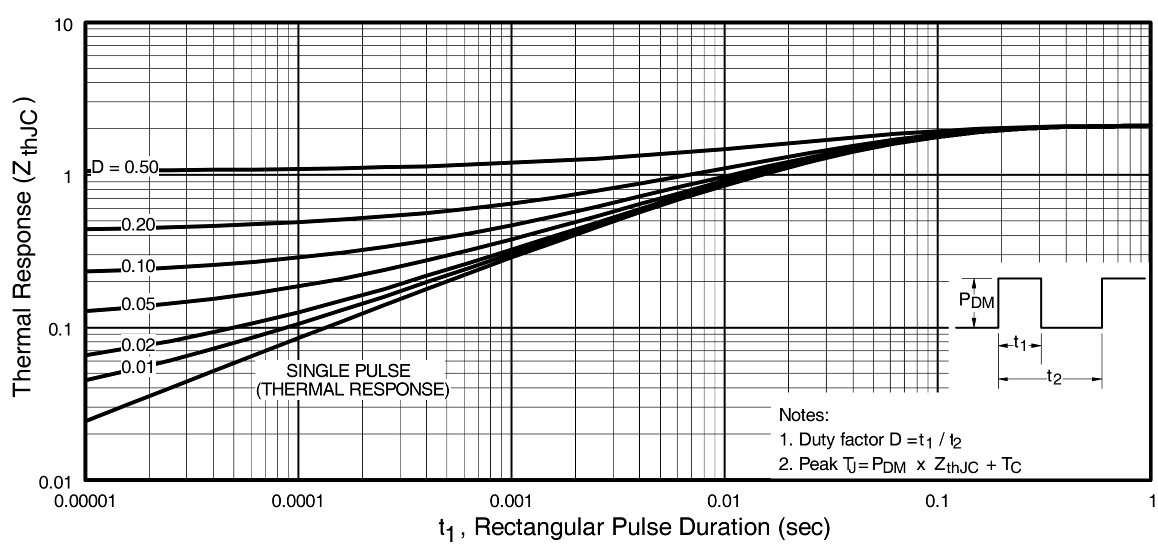


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

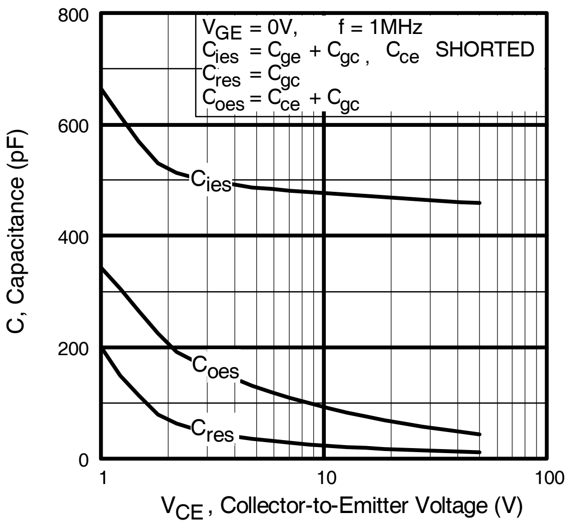


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

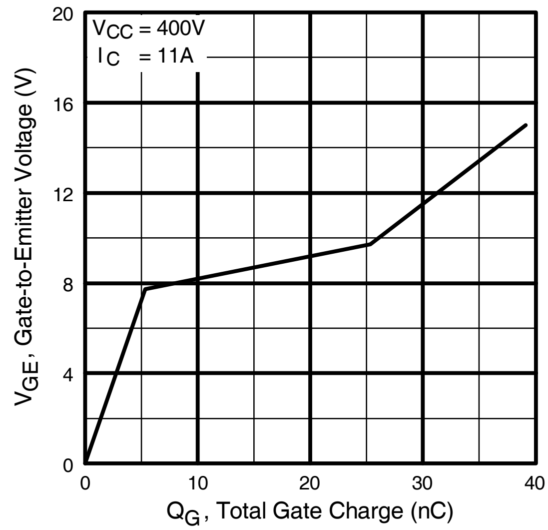


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

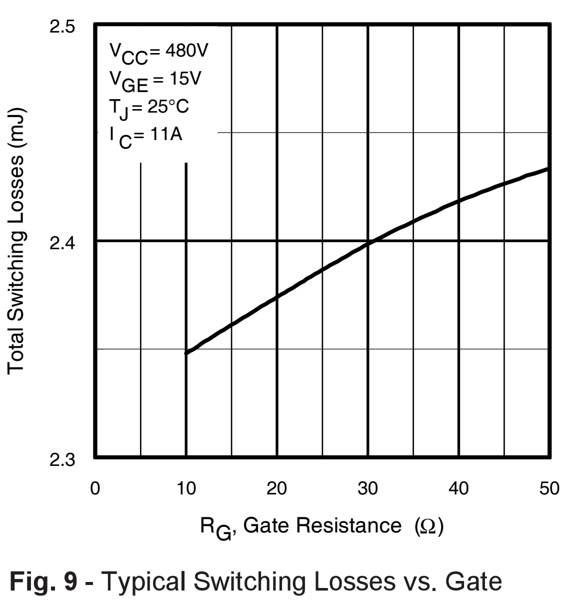


Fig. 9 - Typical Switching Losses vs. Gate Resistance

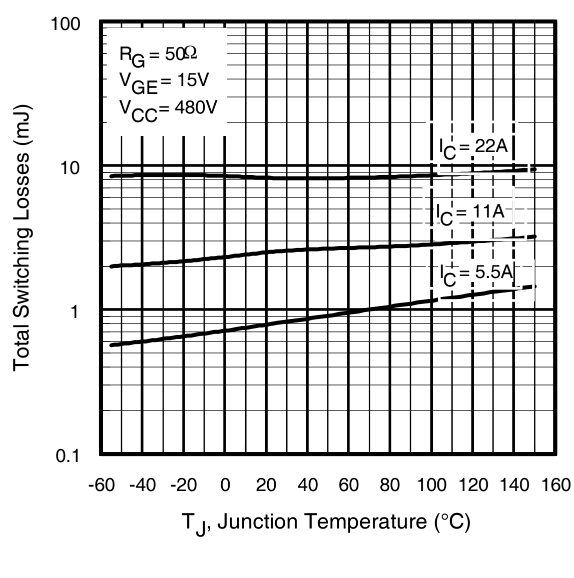


Fig. 10 - Typical Switching Losses vs. Junction Temperature

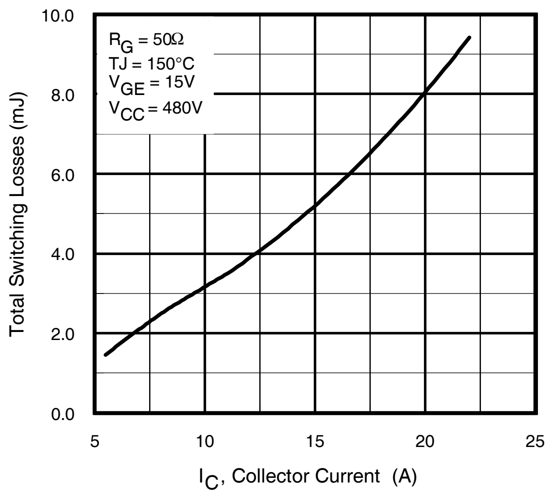


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

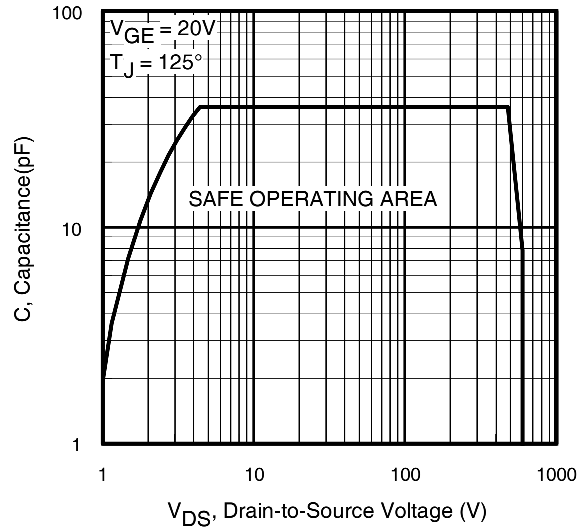


Fig. 12 - Turn-Off SOA

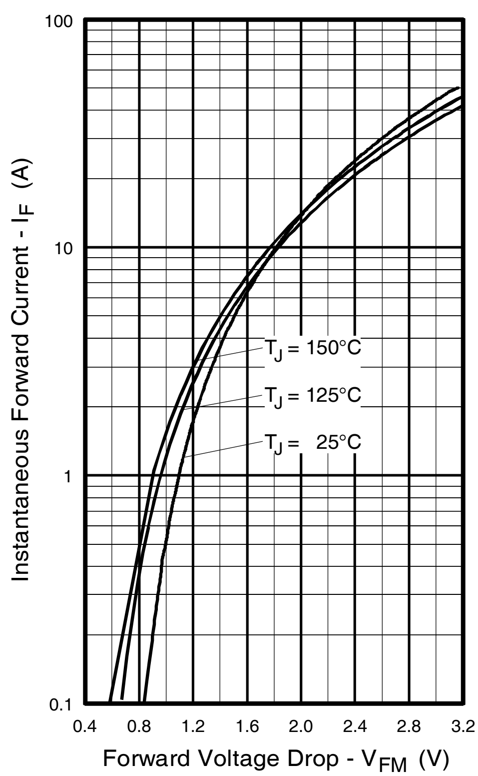


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

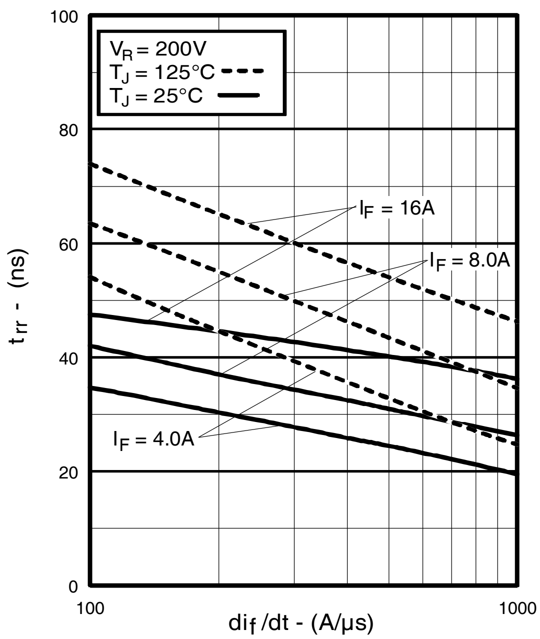


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

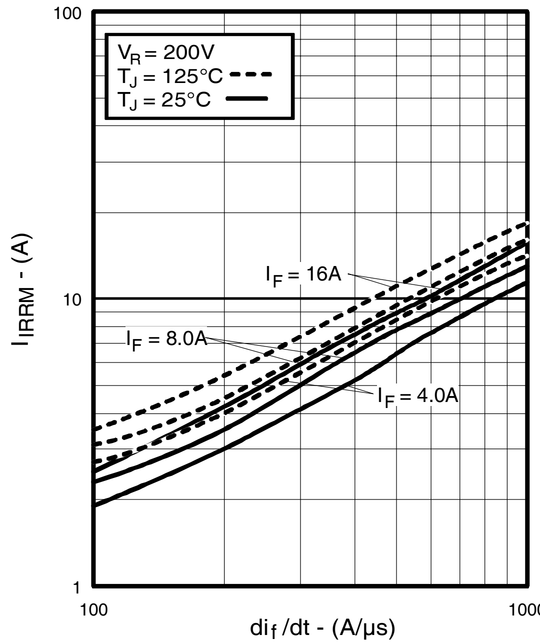


Fig. 15 - Typical Recovery Current vs. di_f/dt

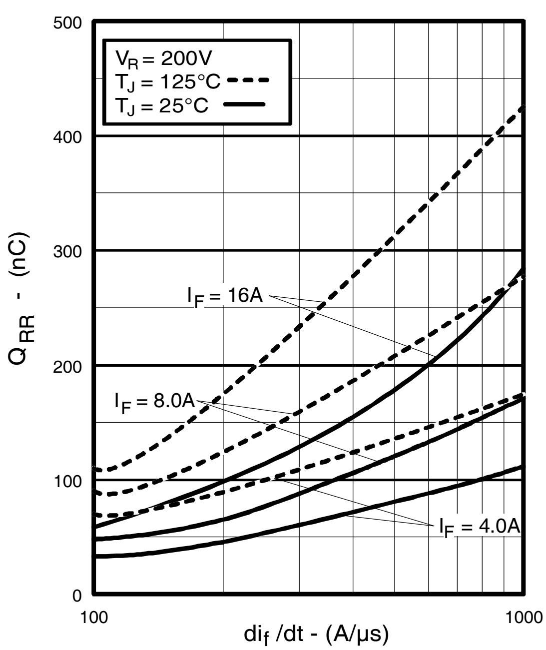


Fig. 16 - Typical Stored Charge vs. di_f/dt

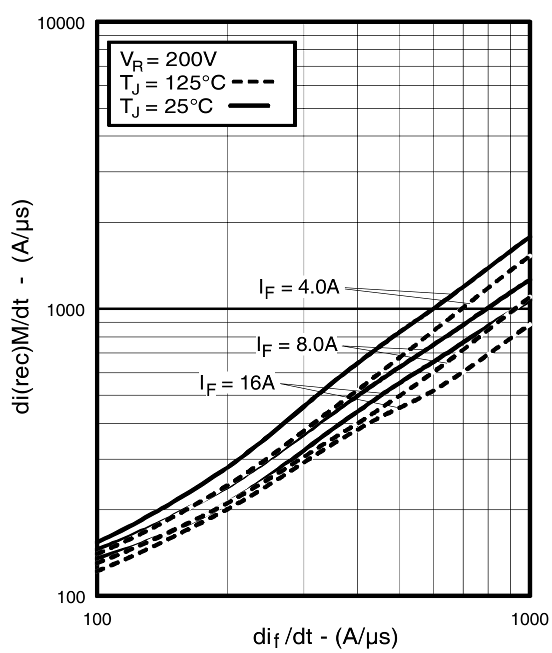


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

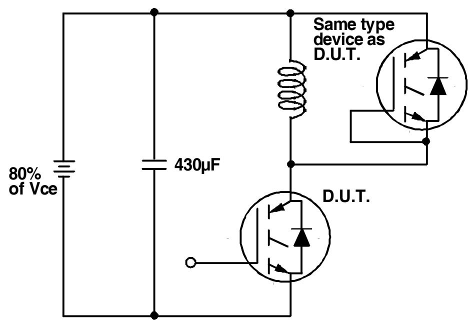


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

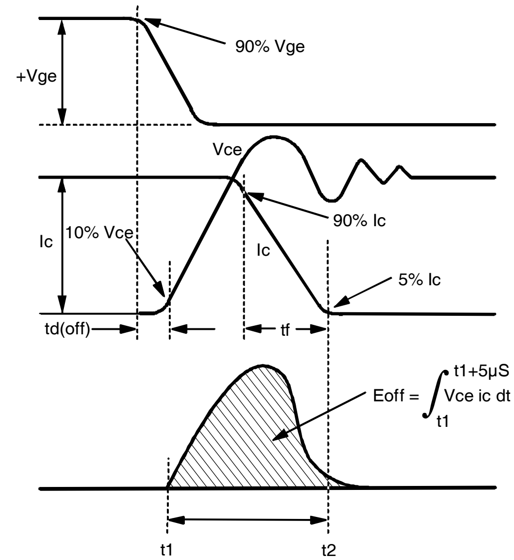


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

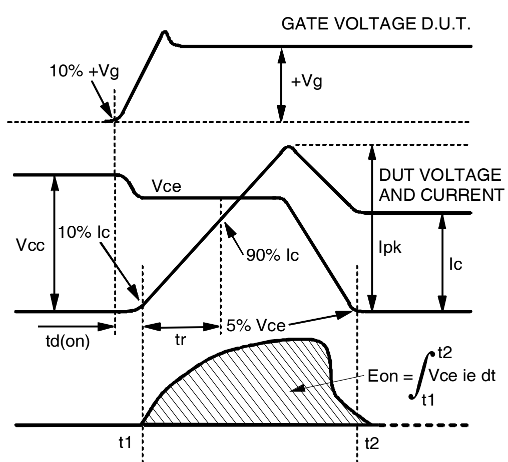


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

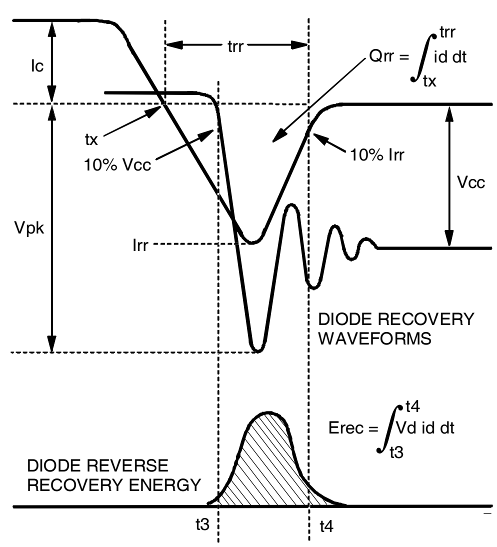


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

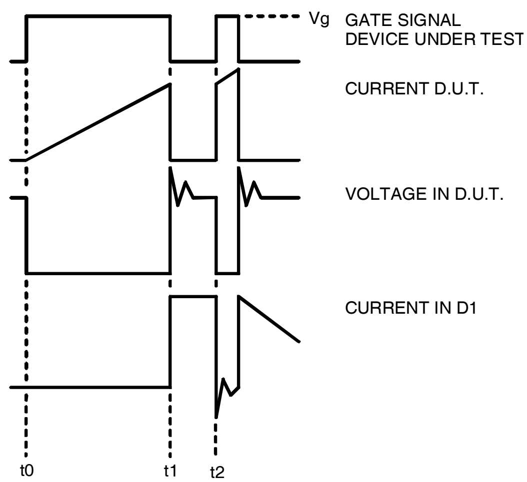


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

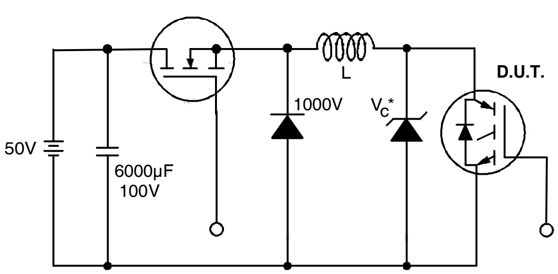


Figure 19. Clamped Inductive Load Test Circuit

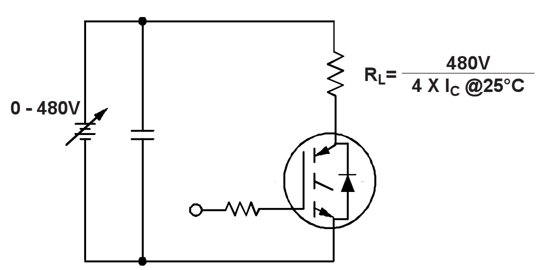


Figure 20. Pulsed Collector Current Test Circuit

Notes:

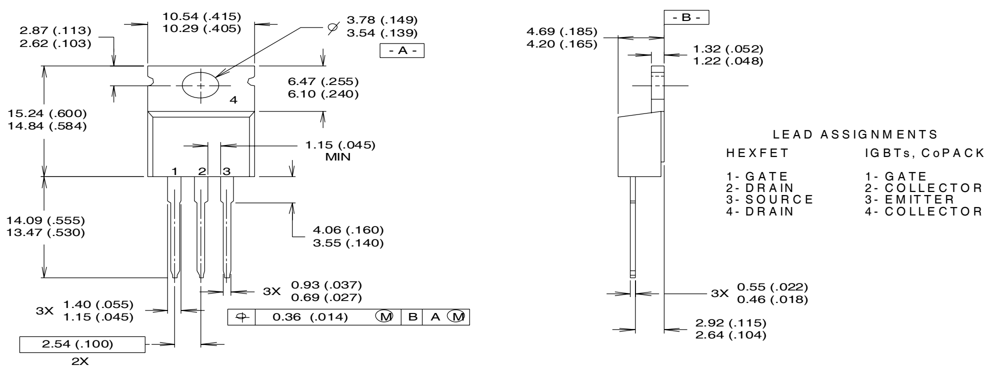
① Repetitive rating: V_{GE}=20V; pulse width limited by maximum junction temperature (figure 20)

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

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

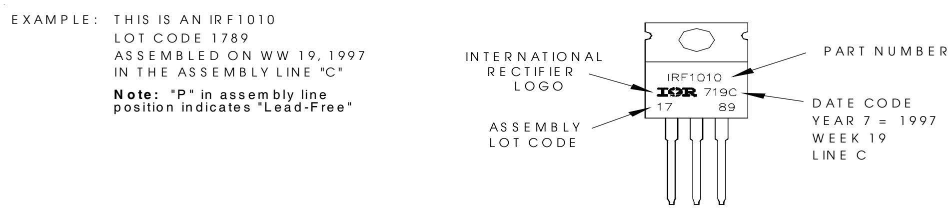
④ Pulse width 5.0µs, single shot.

TO-220AB Package Outline



NOTES:
1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
2 CONTROLLING DIMENSION : INCH
3 OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.
4 HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.

TO-220AB Part Marking Information



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.

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