

IRG4BC15MDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST
SOFT RECOVERY DIODE

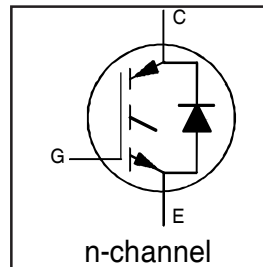
Short Circuit Rated
Fast IGBT

Features

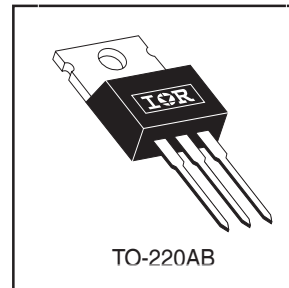
- Rugged: 10μsec short circuit capable at $V_{GS} = 15V$
- Low $V_{CE(on)}$ for 4 to 10kHz applications
- IGBT co-packaged with ultra-soft-recovery anti-parallel diodes
- Industry standard TO-220AB package

Benefits

- Best Value for Appliance and Industrial applications
- Offers highest efficiency and short circuit capability for intermediate applications
- Provides best efficiency for the mid range frequency (4 to 10kHz)
- Optimized for Appliance and Industrial applications up to 1HP
- 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 Drive IC's
- Allows simpler gate drive



$V_{CES} = 600V$
$V_{CE(on)} \text{ typ.} = 1.88V$
@ $V_{GE} = 15V, I_C = 8.6A$



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	14	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	8.6	
I_{CM}	Pulsed Collector Current ①	28	
I_{LM}	Clamped Inductive Load Current ②	28	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	4.0	
t_{sc}	Short Circuit Withstand Time	12	μs
I_{FM}	Diode Maximum Forward Current	16	A
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	49	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	19	
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	—	—	2.7	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	—	—	7.0	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	80	
Wt	Weight	—	2 (0.07)	—	g (oz)

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Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage ^③	600	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.65	—	V/°C	$V_{GE} = 0V, I_C = 1.0mA$	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.88	2.3	V	$V_{GE} = 15V$ $I_C = 8.6A$	
		—	2.6	—			$I_C = 14A$
		—	2.1	—			$I_C = 8.6A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	4.0	—	6.5		$V_{CE} = V_{GE}, I_C = 250\mu A$	
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-10	—	mV/°C	$V_{CE} = V_{GE}, I_C = 250\mu A$	
g_{fe}	Forward Transconductance ^④	2.3	3.4	—	S	$V_{CE} = 100V, I_C = 6.5A$	
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	$V_{GE} = 0V, V_{CE} = 600V$	
		—	—	1400		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$	
V_{FM}	Diode Forward Voltage Drop	—	1.5	1.8	V	$I_C = 4.0A$	
		—	1.4	1.7		$I_C = 4.0A, T_J = 150^\circ\text{C}$	
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA	$V_{GE} = \pm 20V$	

Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	
Q_g	Total Gate Charge (turn-on)	—	46	—	nC	$I_C = 8.6A$ $V_{CC} = 400V$ $V_{GE} = 15V$	
Q_{ge}	Gate - Emitter Charge (turn-on)	—	4.2	—			
Q_{gc}	Gate - Collector Charge (turn-on)	—	15	—			
$t_{d(on)}$	Turn-On Delay Time	—	21	—	ns	$T_J = 25^\circ\text{C}$ $I_C = 8.6A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 75\Omega$ Energy losses include "tail" and diode reverse recovery.	
t_r	Rise Time	—	38	—			
$t_{d(off)}$	Turn-Off Delay Time	—	540	810			
t_f	Fall Time	—	350	530			
E_{on}	Turn-On Switching Loss	—	0.32	—	mJ		
E_{off}	Turn-Off Switching Loss	—	1.93	—			
E_{ts}	Total Switching Loss	—	2.25	3.6			
$t_{d(on)}$	Turn-On Delay Time	—	20	—	ns	$T_J = 150^\circ\text{C}$, $I_C = 8.6A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 75\Omega$ Energy losses include "tail" and diode reverse recovery.	
t_r	Rise Time	—	42	—			
$t_{d(off)}$	Turn-Off Delay Time	—	650	—			
t_f	Fall Time	—	590	—			
E_{ts}	Total Switching Loss	—	3.0	—	mJ		
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package	
C_{ies}	Input Capacitance	—	340	—	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0MHz$	
C_{oes}	Output Capacitance	—	35	—			
C_{res}	Reverse Transfer Capacitance	—	8.8	—			
t_{rr}	Diode Reverse Recovery Time	—	28	42	ns	$T_J = 25^\circ\text{C}$	$I_F = 4.0A$ $V_R = 200V$ $di/dt 200A/\mu s$
		—	38	57		$T_J = 125^\circ\text{C}$	
I_{rr}	Diode Peak Reverse Recovery Current	—	2.9	5.2	A	$T_J = 25^\circ\text{C}$	
		—	3.7	6.7		$T_J = 125^\circ\text{C}$	
Q_{rr}	Diode Reverse Recovery Charge	—	40	60	nC	$T_J = 25^\circ\text{C}$	
		—	70	110		$T_J = 125^\circ\text{C}$	
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	—	280	—	A/ μs	$T_J = 25^\circ\text{C}$	
		—	240	—		$T_J = 125^\circ\text{C}$	

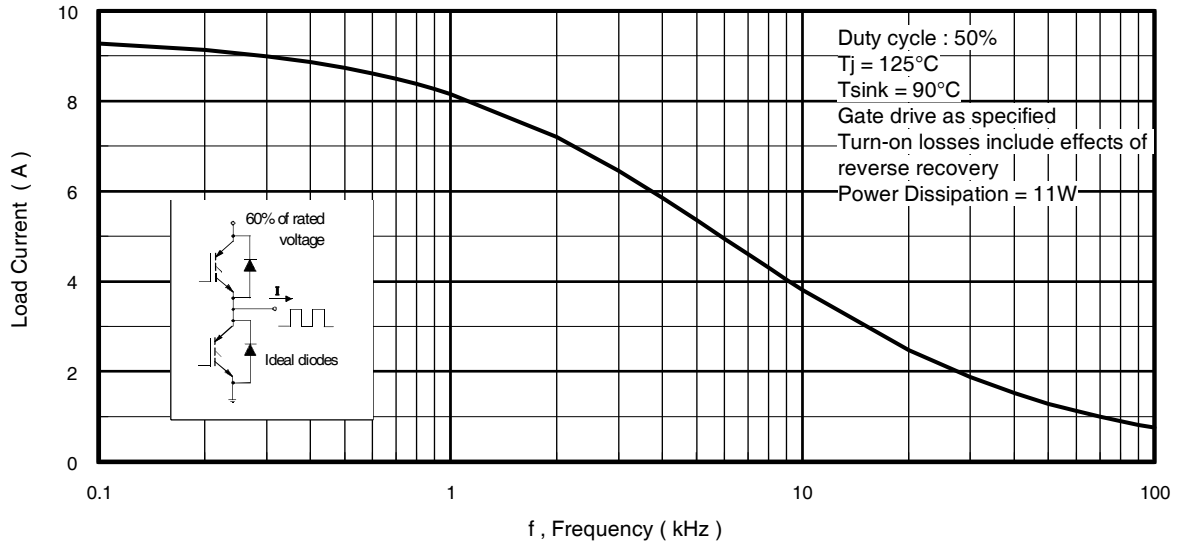


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

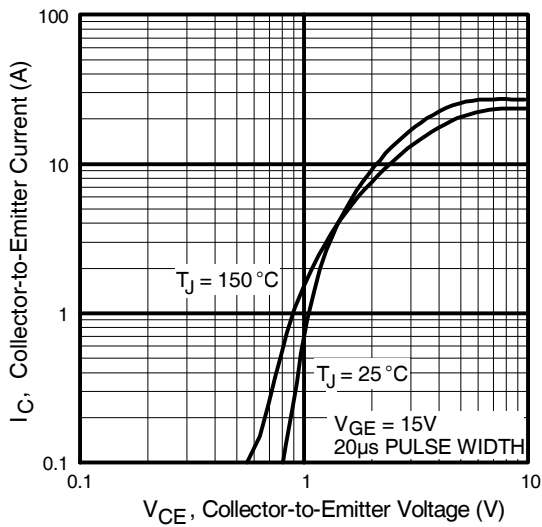


Fig. 2 - Typical Output Characteristics

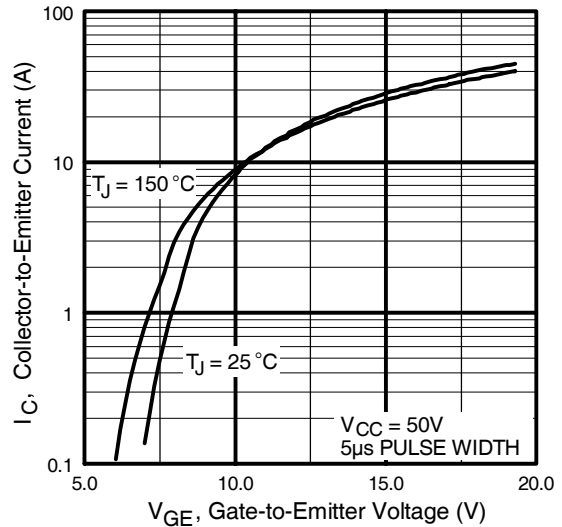


Fig. 3 - Typical Transfer Characteristics

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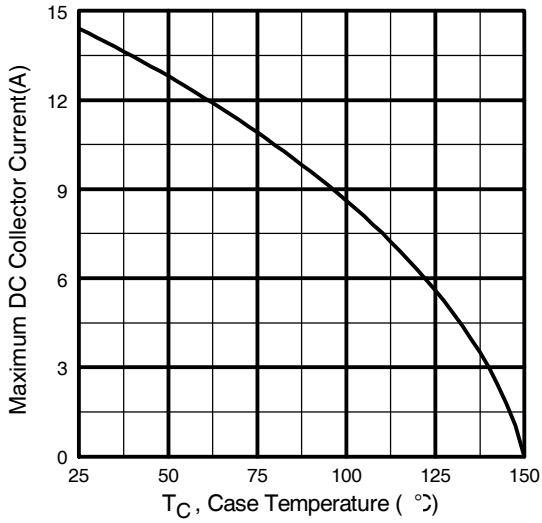


Fig. 4 - Maximum Collector Current vs. Case Temperature

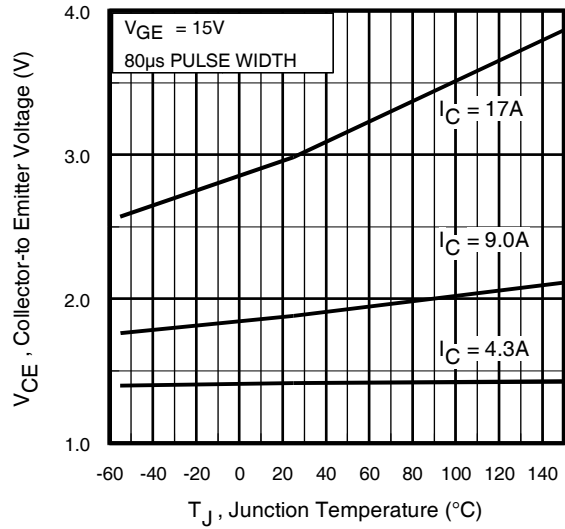


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

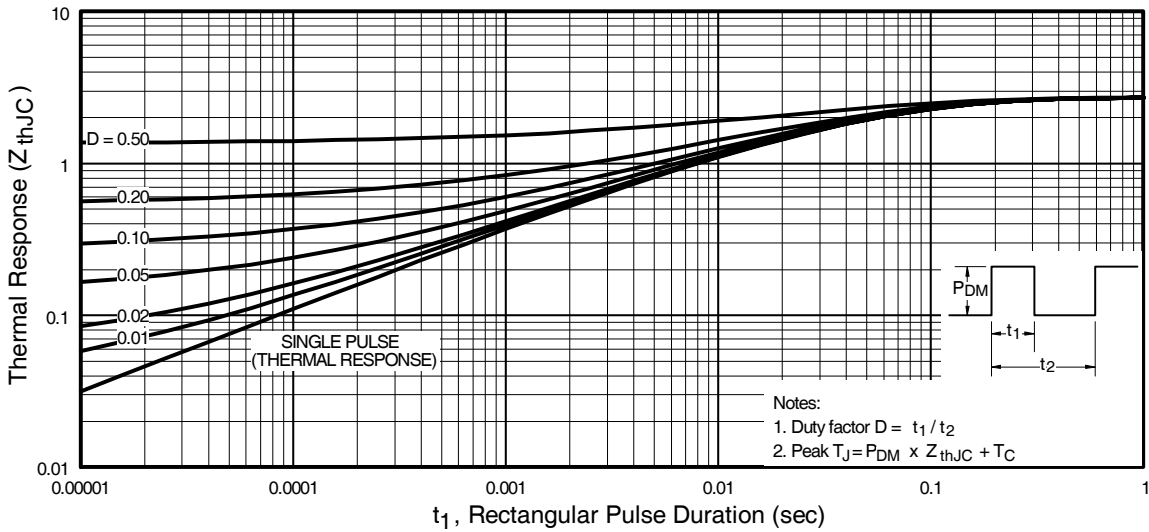


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

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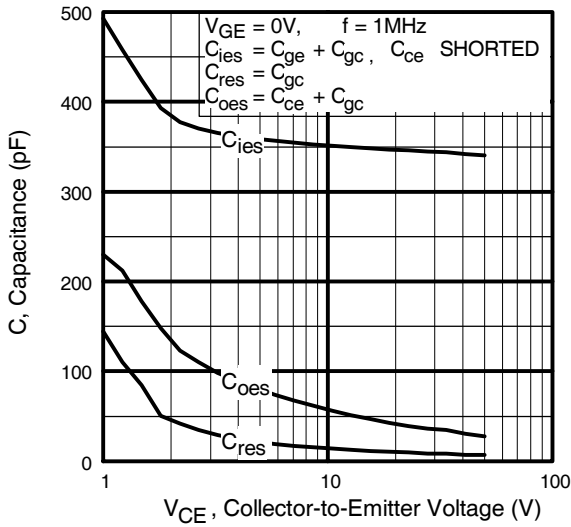


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

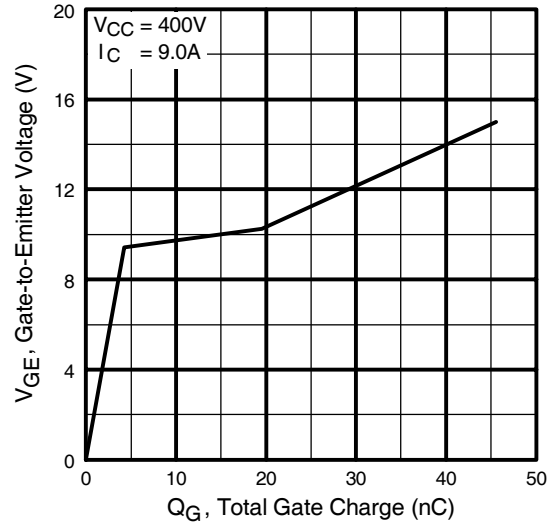


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

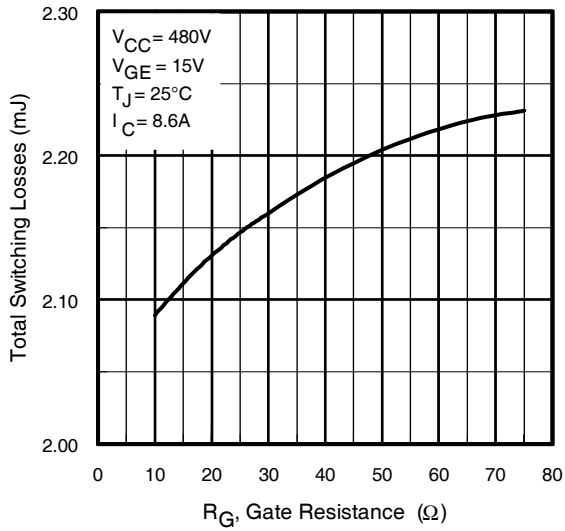


Fig. 9 - Typical Switching Losses vs. Gate Resistance

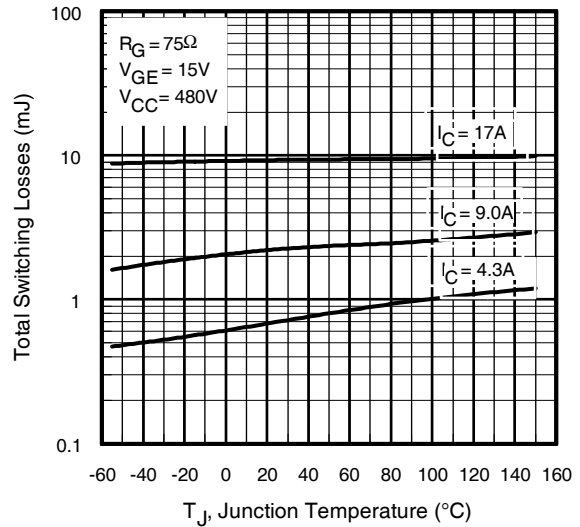


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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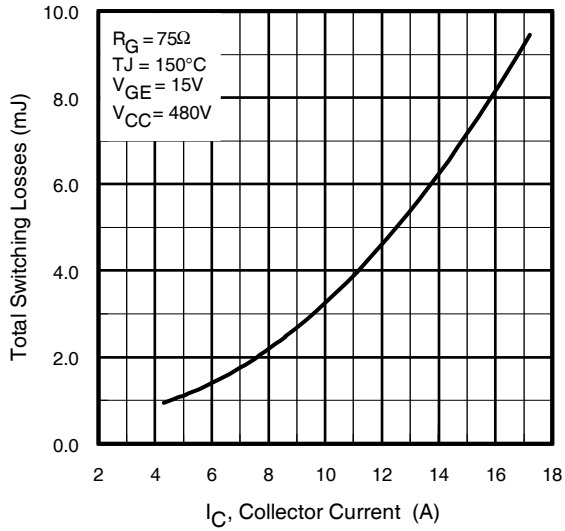


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

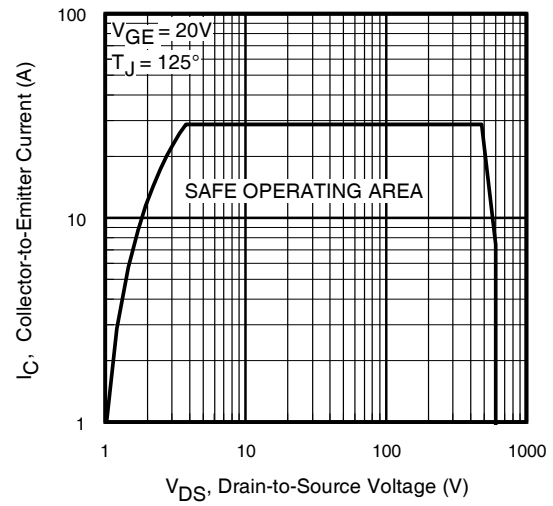
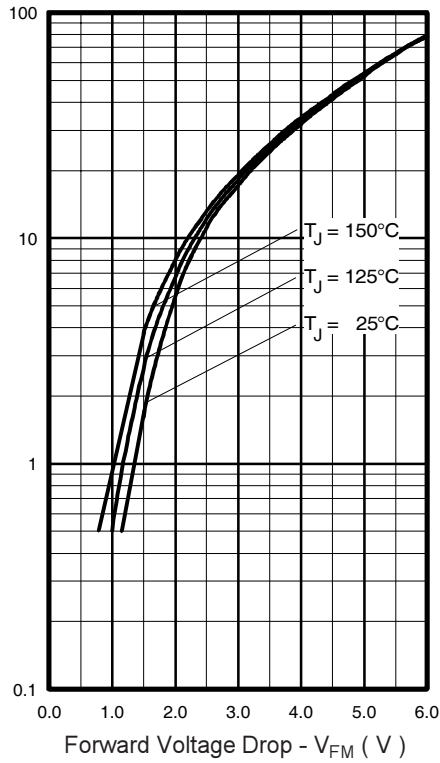


Fig. 12 - Turn-Off SOA



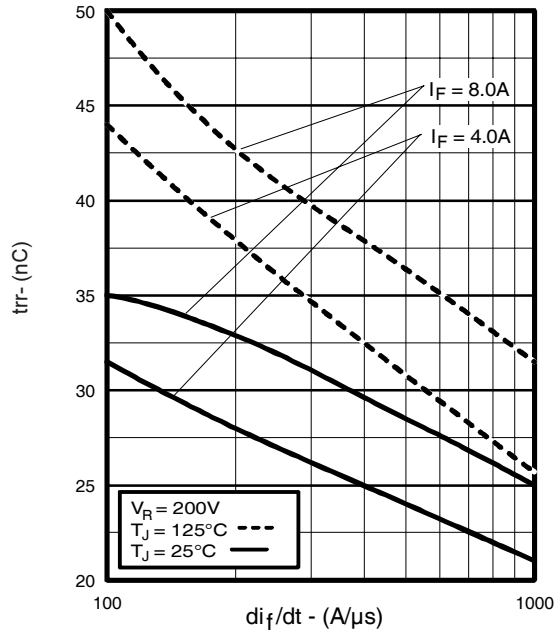


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

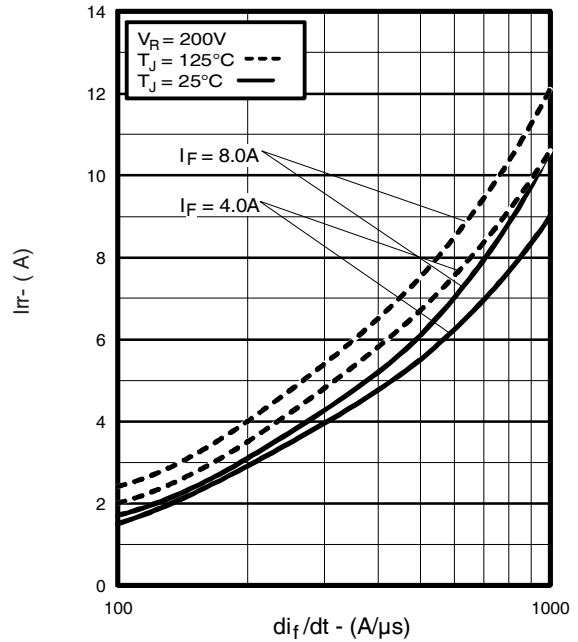


Fig. 15 - Typical Recovery Current vs. di_f/dt

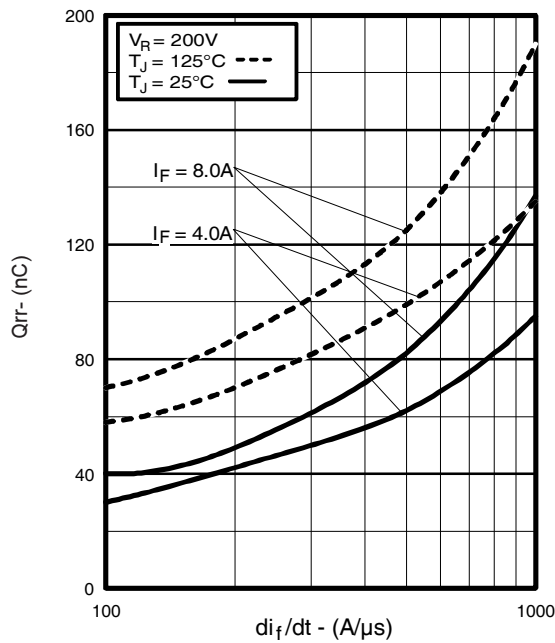


Fig. 16 - Typical Stored Charge vs. di_f/dt

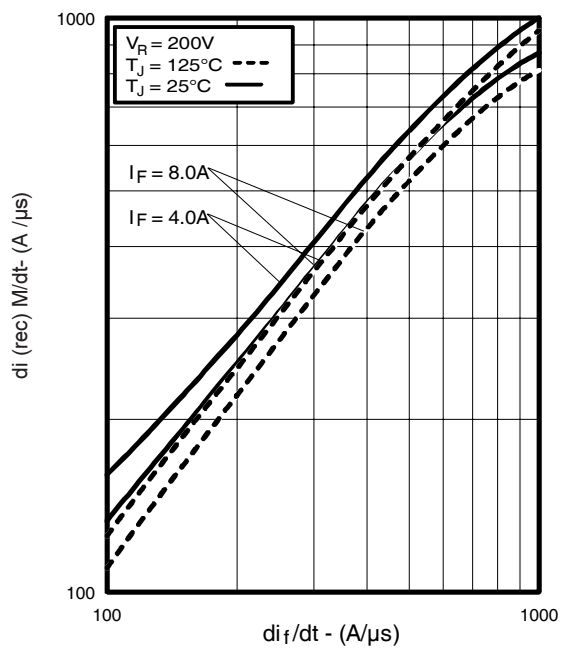


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt ,

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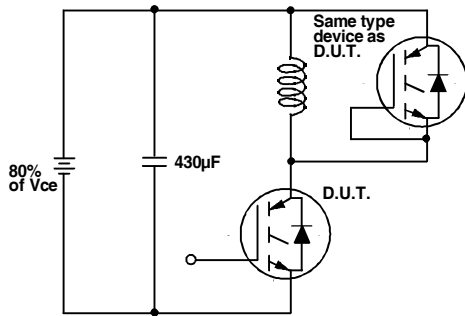


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off(diode)}$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

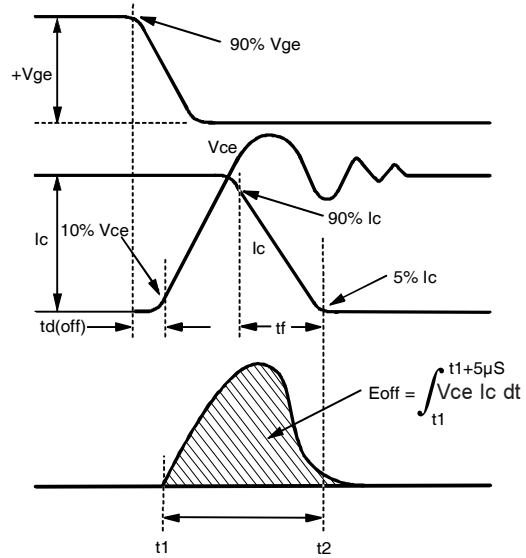


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

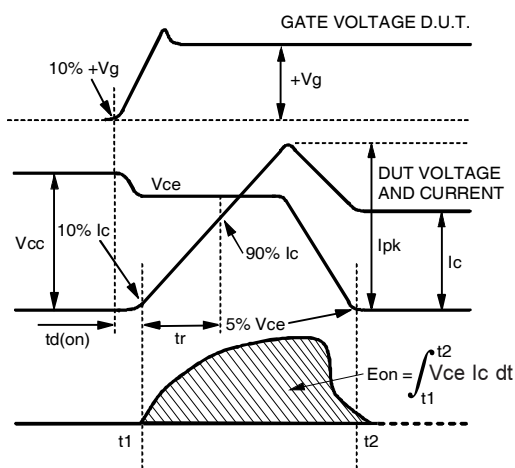


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

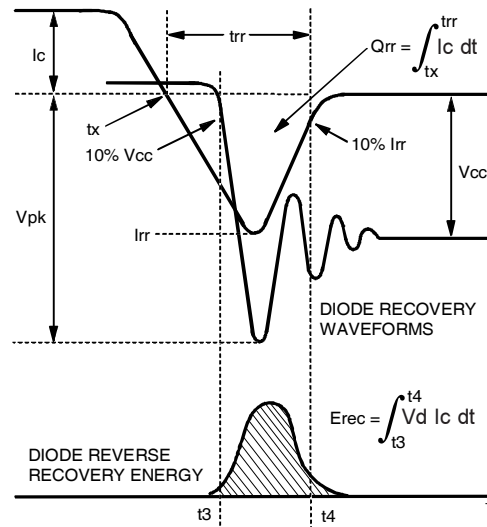


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

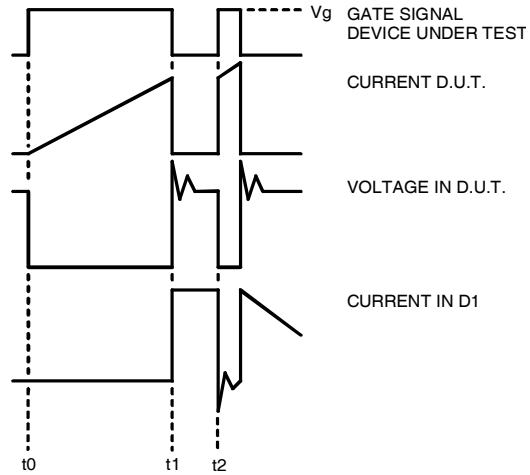


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

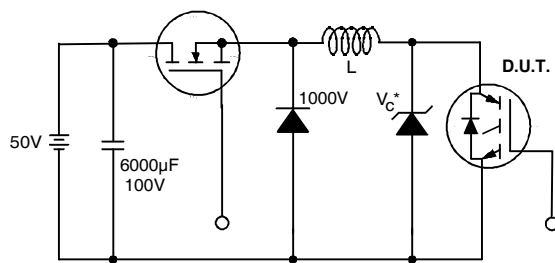


Figure 19. Clamped Inductive Load Test Circuit

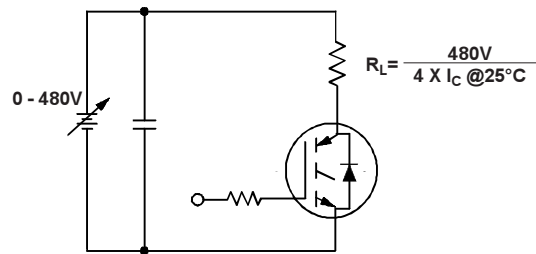


Figure 20. Pulsed Collector Current Test Circuit

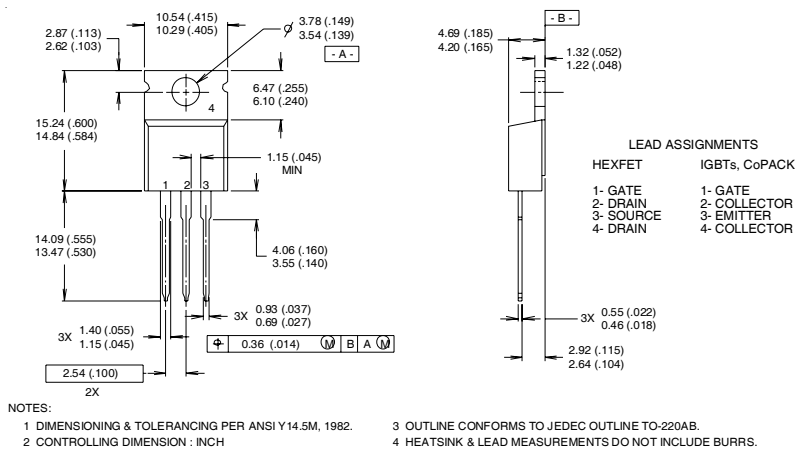
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Notes:

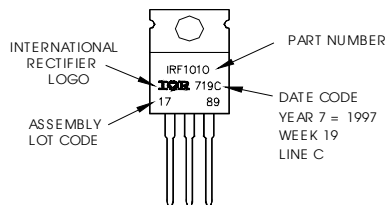
- ① Repetitive rating: $V_{GE}=20V$; pulse width limited by maximum junction temperature
- ② $V_{CC}=80\%(V_{CES})$, $V_{GE}=20V$, $L=10\mu H$, $R_G = 75\Omega$
- ③ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ④ Pulse width $5.0\mu s$, single shot.

TO-220AB Package Outline



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"



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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