

IRG4BC15UDPbF

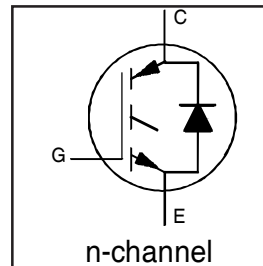
INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE UltraFast CoPack IGBT

Features

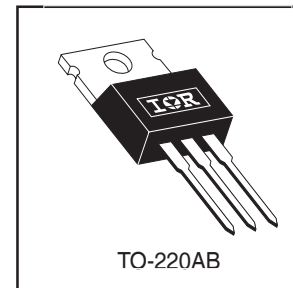
- UltraFast: Optimized for high frequencies from 10 to 30 kHz in hard switching
- IGBT Co-packaged with ultra-soft-recovery antiparallel diode
- Industry standard TO-220AB package
- Lead-Free

Benefits

- Best Value for Appliance and Industrial Applications
- 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



$V_{CES} = 600V$
$V_{CE(on)} \text{ typ.} = 2.02V$
@ $V_{GE} = 15V, I_C = 7.8A$



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	7.8	
I_{CM}	Pulsed Collector Current ①	42	
I_{LM}	Clamped Inductive Load Current ②	42	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	4.0	
I_{FM}	Diode Maximum Forward Current	16	
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	Operating Junction and Storage Temperature Range	-55 to +150	$^\circ C$
T_{STG}			
	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	$^\circ C/W$
$R_{\theta JC}$	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°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
ΔV _{(BR)CES} /ΔT _J	Temperature Coeff. of Breakdown Voltage	—	0.63	—	V/°C	V _{GE} = 0V, I _C = 1.0mA
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	2.02	2.4	V	I _C = 7.8A
		—	2.56	—		I _C = 14A
		—	2.21	—		I _C = 7.8A, T _J = 150°C
V _{GE(th)}	Gate Threshold Voltage	3.0	—	6.0	—	V _{CE} = V _{GE} , I _C = 250μA
ΔV _{GE(th)} /ΔT _J	Temperature Coeff. of Threshold Voltage	—	-10	—	mV/°C	V _{CE} = V _{GE} , I _C = 250μA
g _{fe}	Forward Transconductance ^④	4.1	6.2	—	S	V _{CE} = 100V, I _C = 7.8A
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°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°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)	—	23	35	nC	I _C = 7.8A	
Q _{ge}	Gate - Emitter Charge (turn-on)	—	4.0	6.0		V _{CC} = 400V	
Q _{gc}	Gate - Collector Charge (turn-on)	—	9.6	14		V _{GE} = 15V	
t _{d(on)}	Turn-On Delay Time	—	17	—	ns	T _J = 25°C	
t _r	Rise Time	—	20	—		I _C = 7.8A, V _{CC} = 480V	
t _{d(off)}	Turn-Off Delay Time	—	160	240		V _{GE} = 15V, R _G = 75Ω	
t _f	Fall Time	—	83	120		Energy losses include "tail" and diode reverse recovery.	
E _{on}	Turn-On Switching Loss	—	0.24	—		mJ	T _J = 150°C, I _C = 7.8A, V _{CC} = 480V V _{GE} = 15V, R _G = 75Ω Energy losses include "tail" and diode reverse recovery.
E _{off}	Turn-Off Switching Loss	—	0.26	—			
E _{ts}	Total Switching Loss	—	0.50	0.63			
t _{d(on)}	Turn-On Delay Time	—	16	—	ns	T _J = 150°C, I _C = 7.8A, V _{CC} = 480V V _{GE} = 15V, R _G = 75Ω Energy losses include "tail" and diode reverse recovery.	
t _r	Rise Time	—	21	—			
t _{d(off)}	Turn-Off Delay Time	—	180	—			
t _f	Fall Time	—	220	—			
E _{ts}	Total Switching Loss	—	0.76	—	mJ		
L _E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package	
C _{ies}	Input Capacitance	—	410	—	pF	V _{GE} = 0V V _{CC} = 30V f = 1.0MHz	
C _{oes}	Output Capacitance	—	37	—			
C _{res}	Reverse Transfer Capacitance	—	5.3	—			
t _{rr}	Diode Reverse Recovery Time	—	28	42	ns	T _J = 25°C	
		—	38	57		T _J = 125°C	
r _r	Diode Peak Reverse Recovery Current	—	2.9	5.2	A	T _J = 25°C	
		—	3.7	6.7		T _J = 125°C	
Q _{rr}	Diode Reverse Recovery Charge	—	40	60	nC	T _J = 25°C	
		—	70	110		T _J = 125°C	
di _(rec) M/dt	Diode Peak Rate of Fall of Recovery During t _b	—	280	—	A/μs	T _J = 25°C	
		—	240	—		T _J = 125°C	

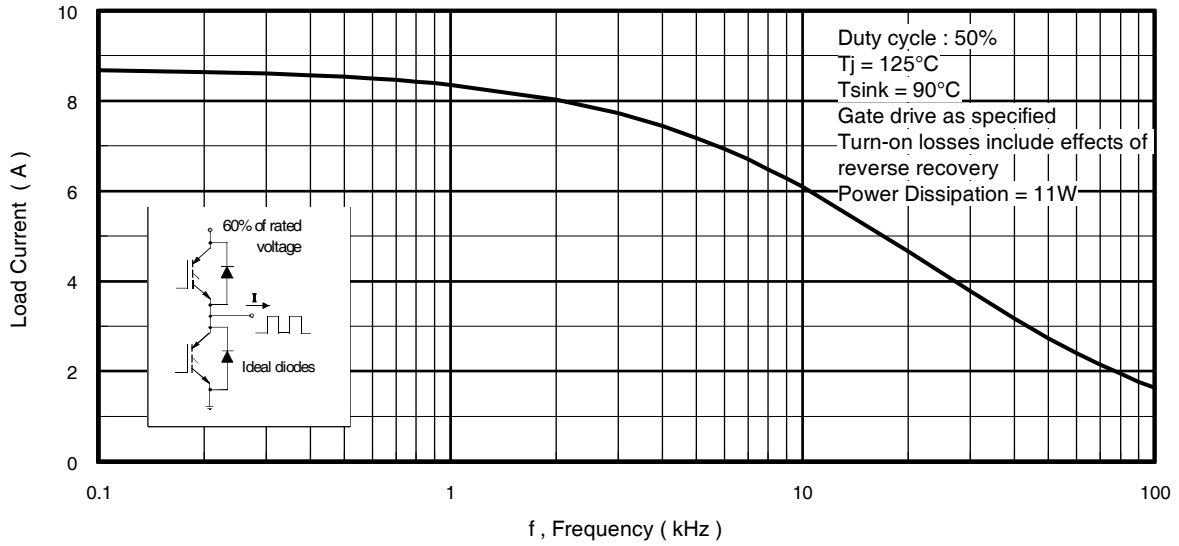


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

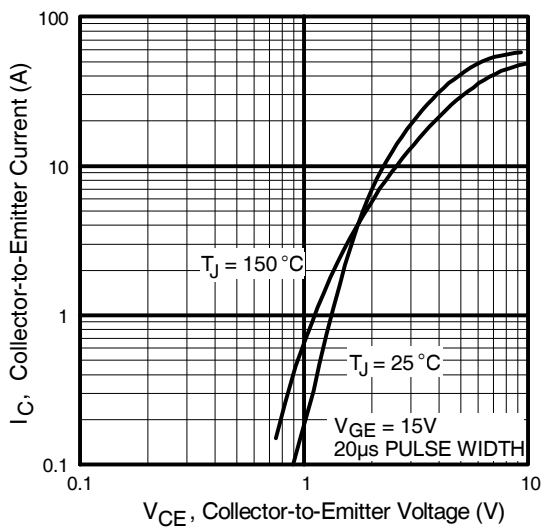


Fig. 2 - Typical Output Characteristics

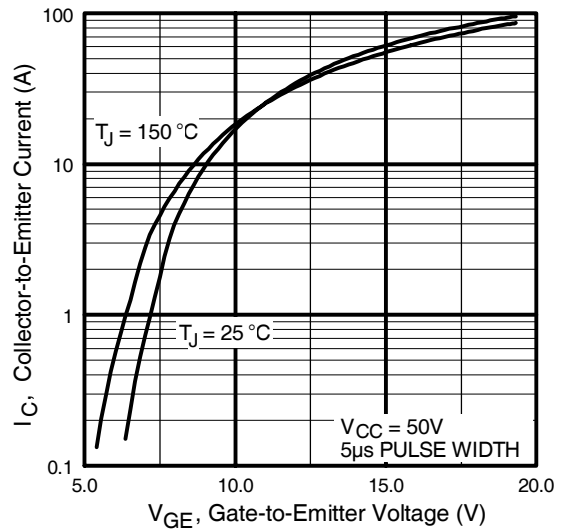


Fig. 3 - Typical Transfer Characteristics

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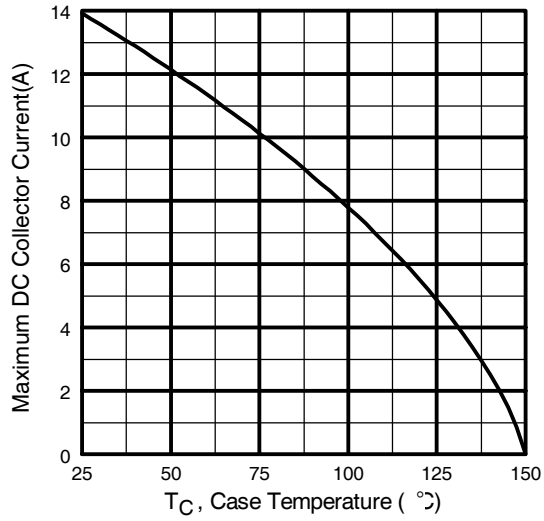


Fig. 4 - Maximum Collector Current vs. Case Temperature

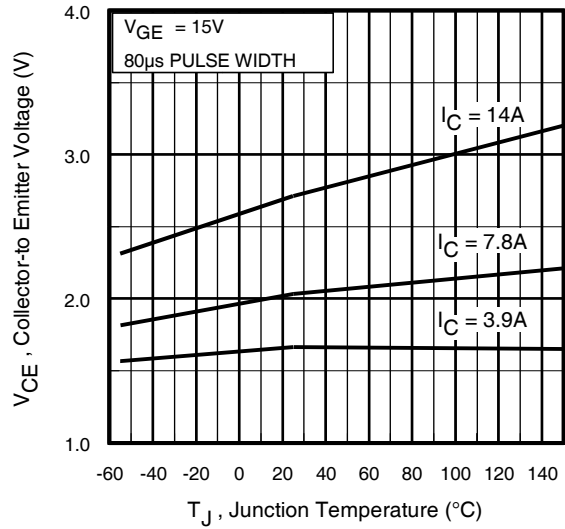


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

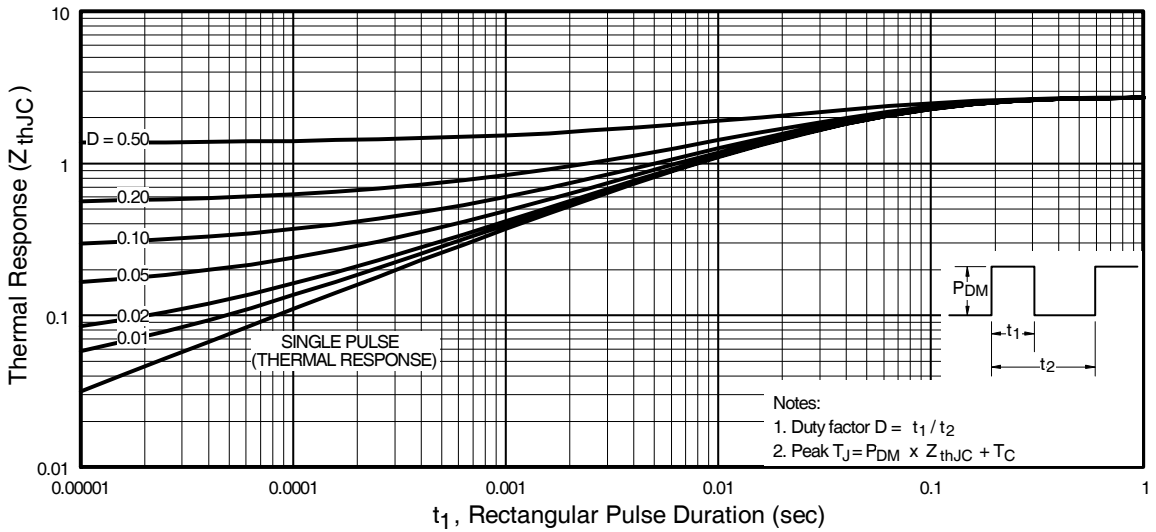


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

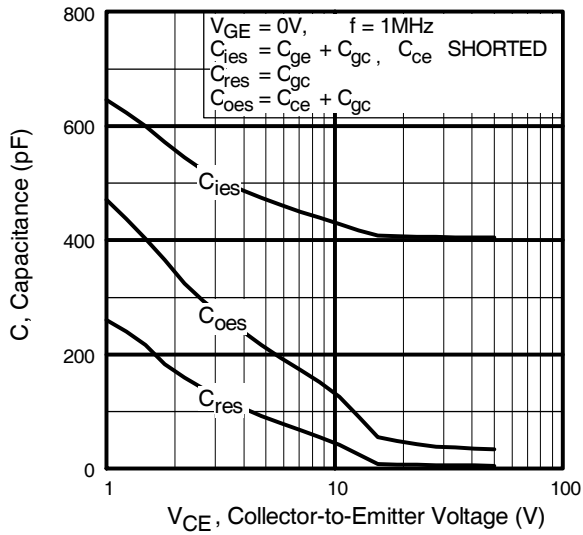


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

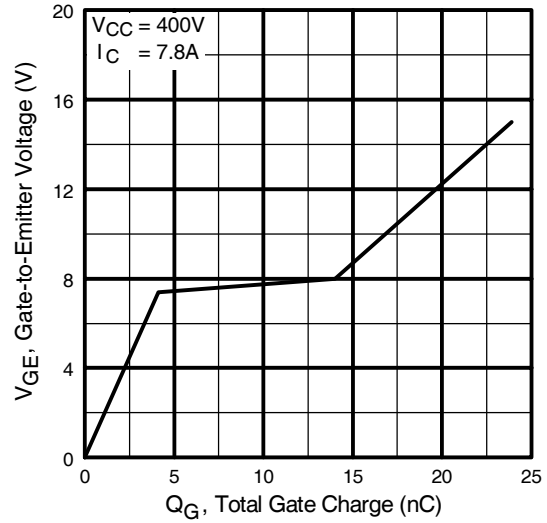


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

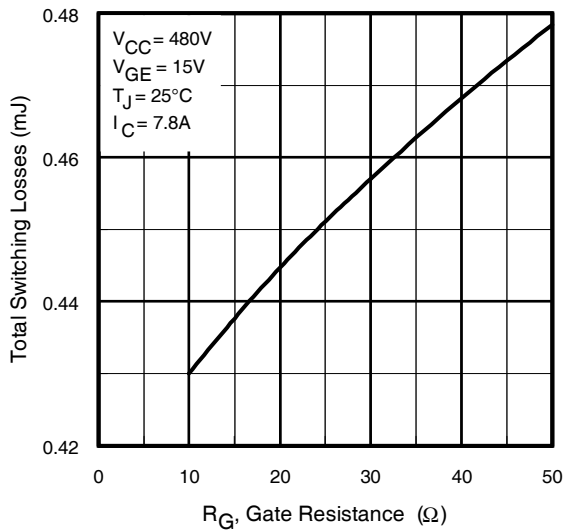


Fig. 9 - Typical Switching Losses vs. Gate Resistance

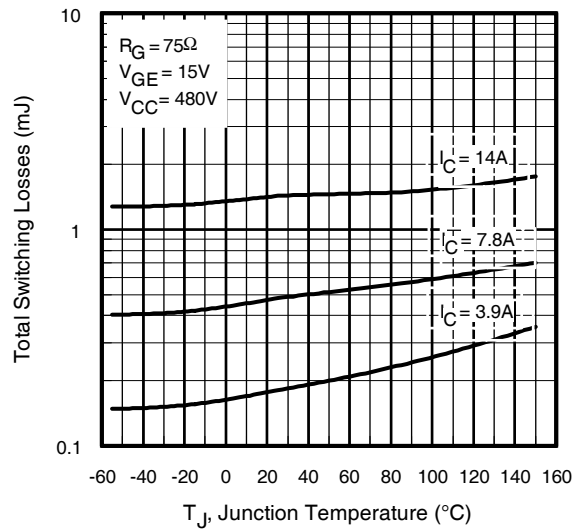


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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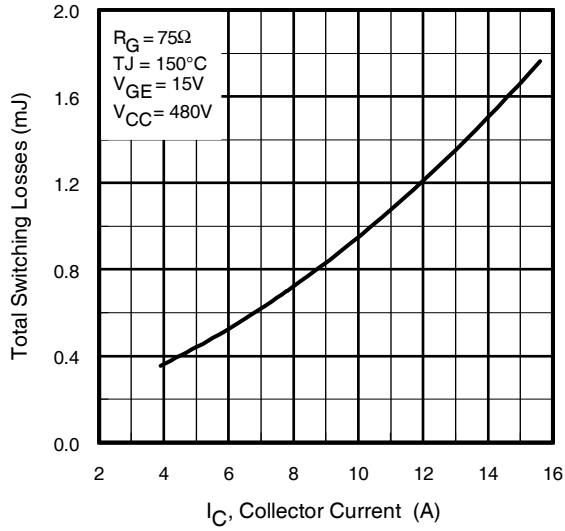


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

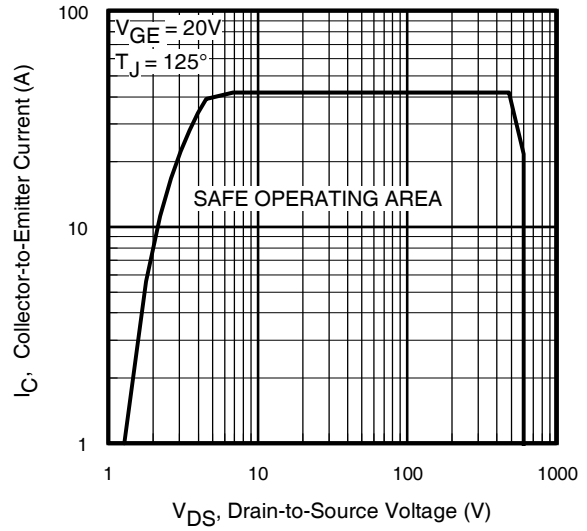


Fig. 12 - Turn-Off SOA

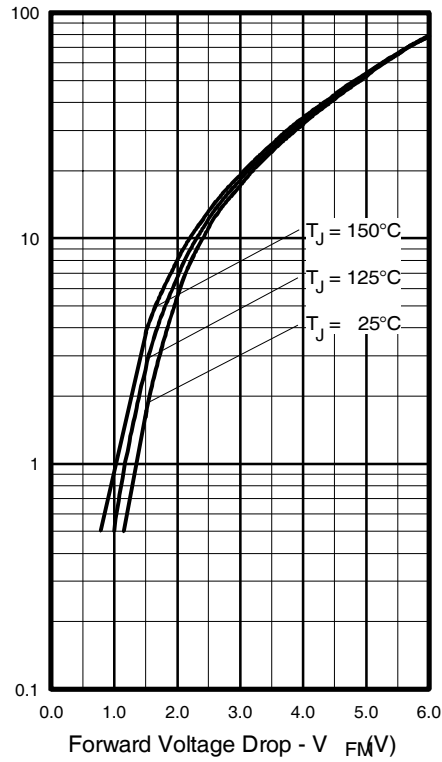


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

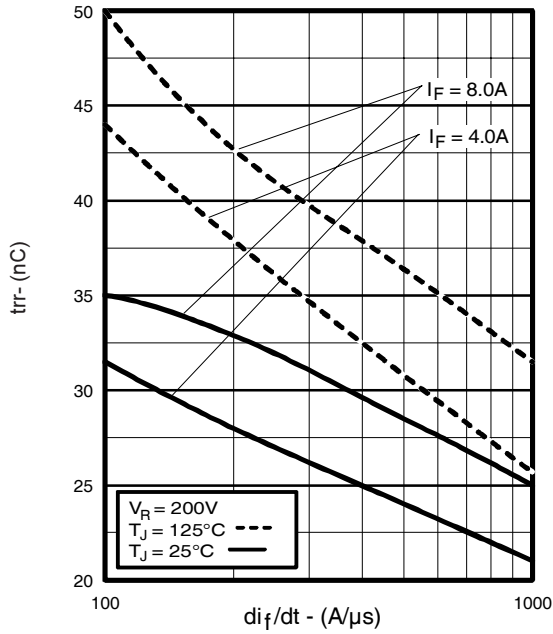


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

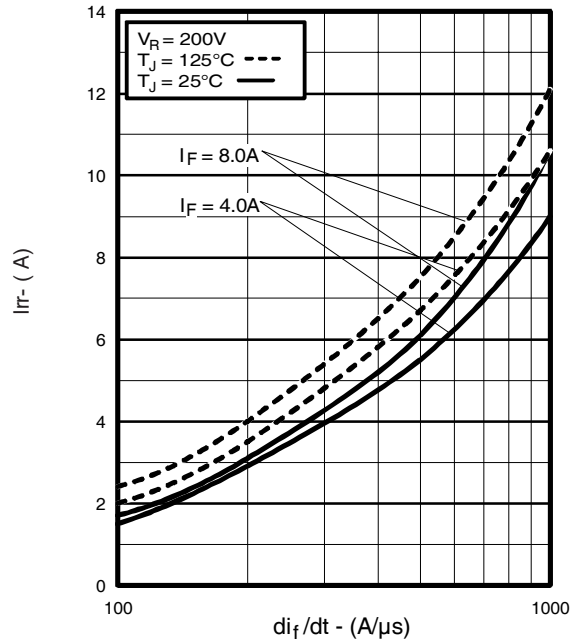


Fig. 15 - Typical Recovery Current vs. di_f/dt

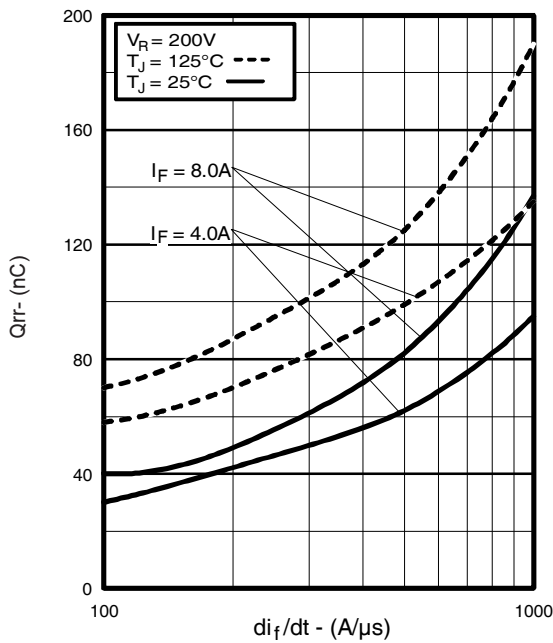


Fig. 16 - Typical Stored Charge vs. di_f/dt

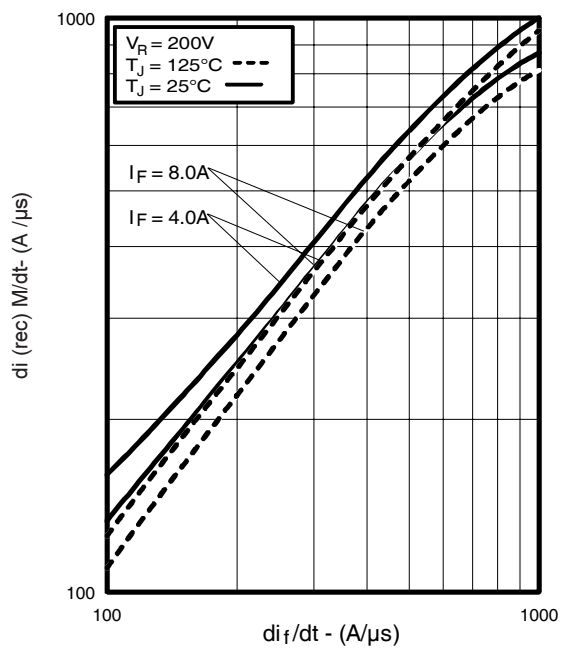


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt ,

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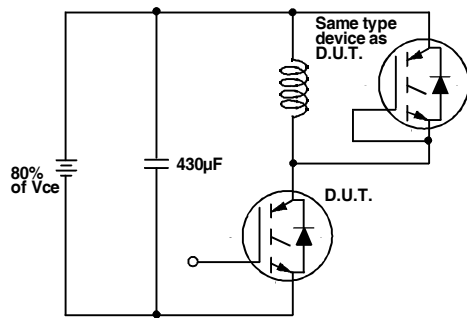


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

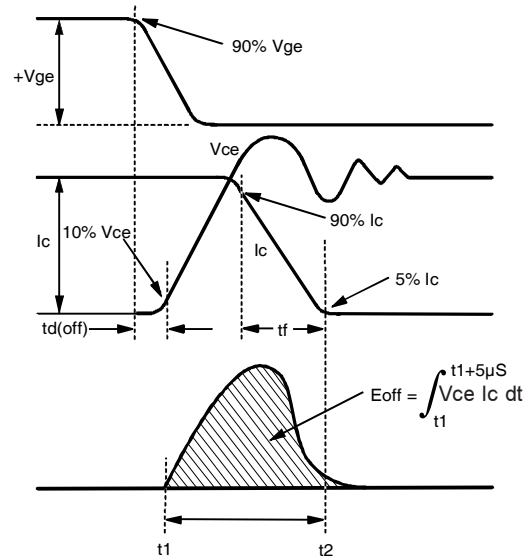


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

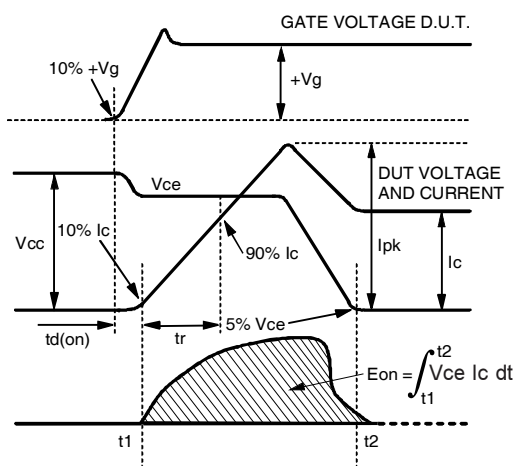


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

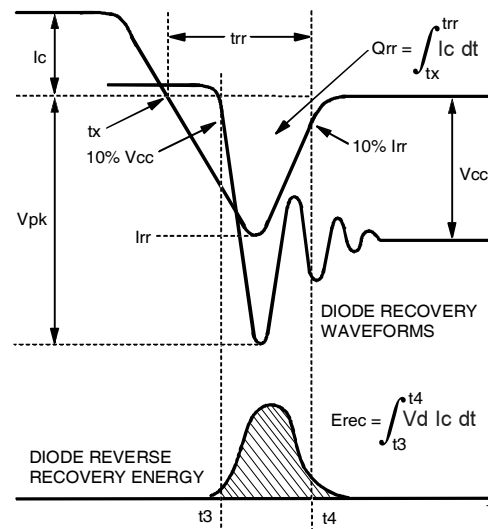


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

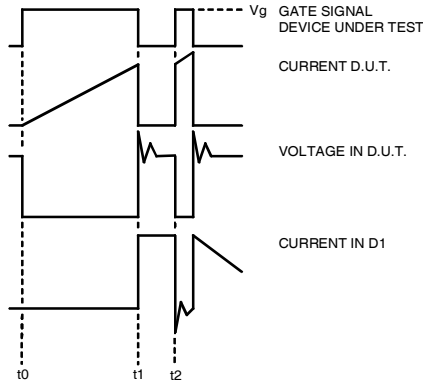


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

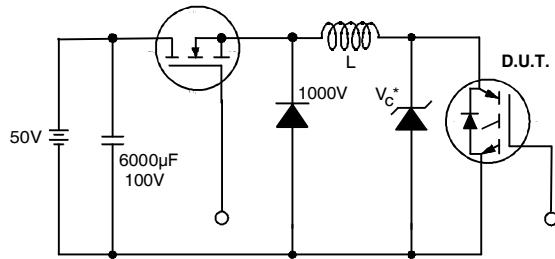


Figure 19. Clamped Inductive Load Test Circuit

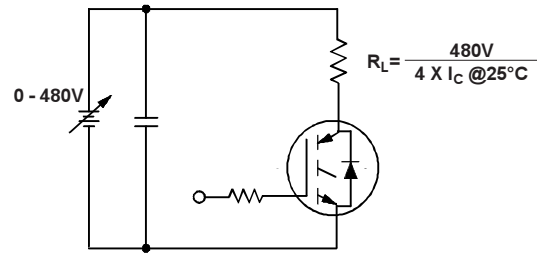


Figure 20. Pulsed Collector Current Test Circuit

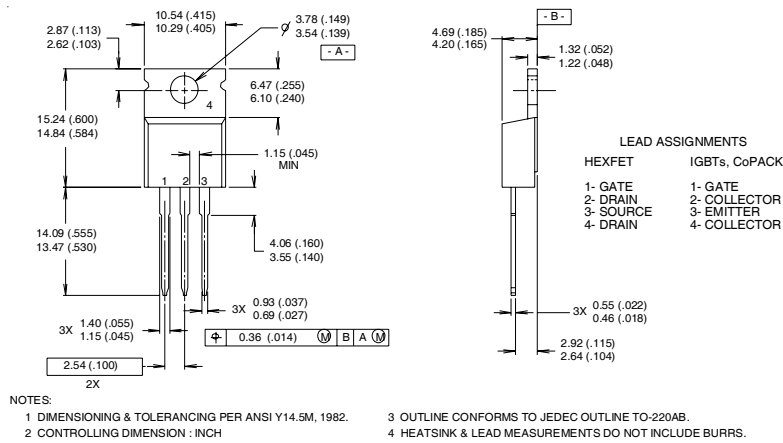
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Notes:

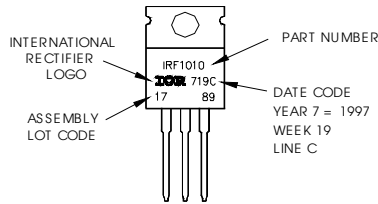
- ① Repetitive rating: $V_{GE}=20V$; pulse width limited by maximum junction temperature
- ② $V_{CC}=80\%(V_{CES})$, $V_{GE}=20V$, $L=10\mu H$, $R_G = 75\Omega$
- ③ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ④ Pulse width $5.0\mu s$, single shot.

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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