

IRGPH50MD2

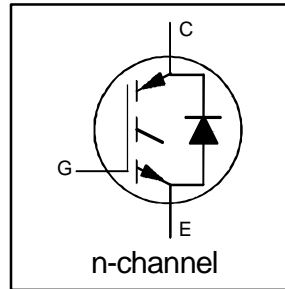
INSULATED GATE BIPOLAR TRANSISTOR
WITH ULTRAFAST SOFT RECOVERY

Short Circuit Rated
Fast CoPack IGBT

DIODE

Features

- Short circuit rated -10 μ s @125°C, $V_{GE} = 15V$
- Switching-loss rating includes all "tail" losses
- HEXFRED™ soft ultrafast diodes
- Optimized for medium operating frequency (1 to 10kHz) See Fig. 1 for Current vs. Frequency curve



$V_{CES} = 1200V$

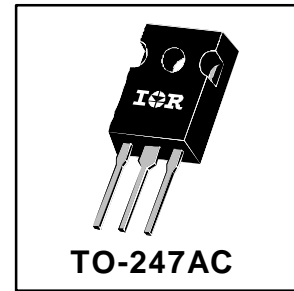
$V_{CE(sat)} \leq 2.9V$

@ $V_{GE} = 15V, I_C = 23A$

Description

Co-packaged IGBTs are a natural extension of International Rectifier's well known IGBT line. They provide the convenience of an IGBT and an ultrafast recovery diode in one package, resulting in substantial benefits to a host of high-voltage, high-current, applications.

These new short circuit rated devices are especially suited for motor control and other applications requiring short circuit withstand capability.



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	42	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	23	
I_{CM}	Pulsed Collector Current ①	84	
I_{LM}	Clamped Inductive Load Current ②	84	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	16	
I_{FM}	Diode Maximum Forward Current	84	μs
t_{sc}	Short Circuit Withstand Time	10	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	200	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	78	
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	—	—	0.64	$^\circ C/W$
$R_{\theta JC}$	Junction-to-Case - Diode	—	—	0.83	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	40	
Wt	Weight	—	6 (0.21)	—	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	1200	—	—	V	V _{GE} = 0V, I _C = 250μA
ΔV _{(BR)CES/ΔT_J}	Temperature Coeff. of Breakdown Voltage	—	1.1	—	V/°C	V _{GE} = 0V, I _C = 1.0mA
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	2.3	2.9	V	I _C = 23A
		—	3.0	—		I _C = 42A
		—	2.8	—		I _C = 23A, T _J = 150°C
V _{GE(th)}	Gate Threshold Voltage	3.0	—	5.5		V _{CE} = V _{GE} , I _C = 250μA
ΔV _{GE(th)/ΔT_J}	Temperature Coeff. of Threshold Voltage	—	-13	—	mV/°C	V _{CE} = V _{GE} , I _C = 250μA
g _{fe}	Forward Transconductance ④	11	15	—	S	V _{CE} = 100V, I _C = 23A
I _{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	V _{GE} = 0V, V _{CE} = 1200V
		—	—	6500		V _{GE} = 0V, V _{CE} = 1200V, T _J = 150°C
V _{FM}	Diode Forward Voltage Drop	—	2.5	3.0	V	I _C = 16A
		—	2.1	2.5		I _C = 16A, 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)	—	89	130	nC	I _C = 23A V _{CC} = 400V See Fig. 8
Q _{ge}	Gate - Emitter Charge (turn-on)	—	22	33		
Q _{gc}	Gate - Collector Charge (turn-on)	—	26	39		
t _{d(on)}	Turn-On Delay Time	—	100	—	ns	T _J = 25°C I _C = 23A, V _{CC} = 960V V _{GE} = 15V, R _G = 5.0Ω Energy losses include "tail" and diode reverse recovery.
t _r	Rise Time	—	140	—		
t _{d(off)}	Turn-Off Delay Time	—	510	770		
t _f	Fall Time	—	470	730		
E _{on}	Turn-On Switching Loss	—	3.0	—		
E _{off}	Turn-Off Switching Loss	—	8.0	—	mJ	See Fig. 9, 10, 11, 18
E _{ts}	Total Switching Loss	—	11	17		
t _{sc}	Short Circuit Withstand Time	10	—	—	μs	V _{CC} = 720V, T _J = 125°C V _{GE} = 15V, R _G = 5.0Ω
t _{d(on)}	Turn-On Delay Time	—	86	—	ns	T _J = 150°C, See Fig. 9, 10, 11, 18 I _C = 23A, V _{CC} = 960V V _{GE} = 15V, R _G = 5.0Ω Energy losses include "tail" and diode reverse recovery
t _r	Rise Time	—	130	—		
t _{d(off)}	Turn-Off Delay Time	—	800	—		
t _f	Fall Time	—	920	—		
E _{ts}	Total Switching Loss	—	20	—	mJ	
L _E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
C _{ies}	Input Capacitance	—	1900	—	pF	V _{GE} = 0V V _{CC} = 30V f = 1.0MHz
C _{oes}	Output Capacitance	—	140	—		
C _{res}	Reverse Transfer Capacitance	—	24	—		
t _{rr}	Diode Reverse Recovery Time	—	90	135	ns	T _J = 25°C See Fig. 14
		—	164	245		T _J = 125°C
I _{rr}	Diode Peak Reverse Recovery Charge	—	5.8	10	A	T _J = 25°C See Fig. 15
		—	8.3	15		T _J = 125°C
Q _{rr}	Diode Reverse Recovery Charge	—	260	675	nC	T _J = 25°C See Fig. 16
		—	680	1838		T _J = 125°C
di _(rec) M/dt	Diode Peak Rate of Fall of Recovery During t _b	—	120	—	A/μs	T _J = 25°C See Fig. 17
		—	76	—		T _J = 125°C

Notes:

① Repetitive rating; V_{GE}=20V, pulse width limited by max. junction temperature. (See fig. 20)

② V_{CC}=80%(V_{CES}), V_{GE}=20V, L=10μH, R_G= 5.0Ω, (See fig. 19)

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

④ Pulse width 5.0μs, single shot.

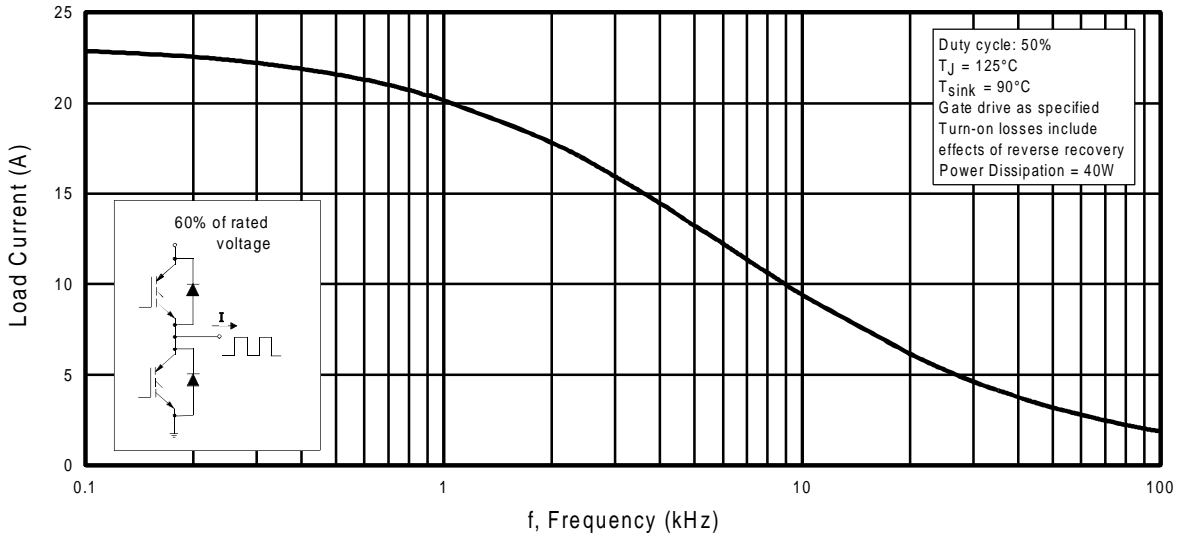


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

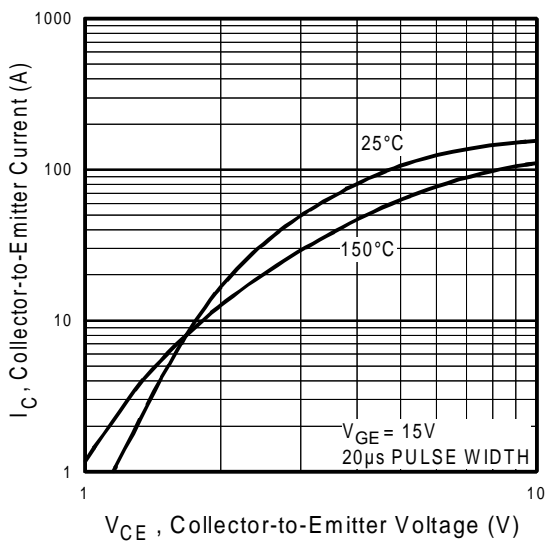


Fig. 2 - Typical Output Characteristics

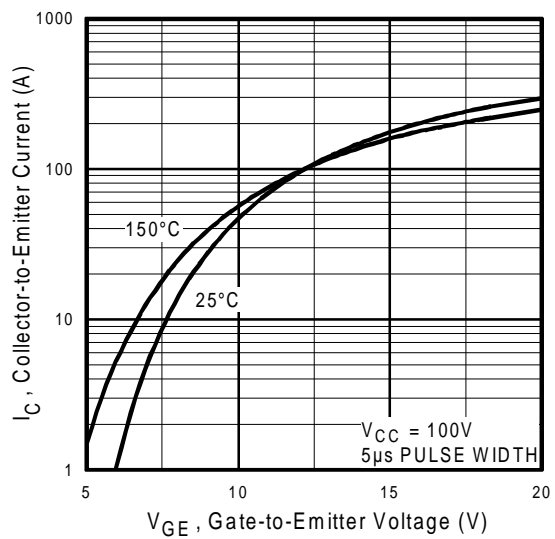


Fig. 3 - Typical Transfer Characteristics

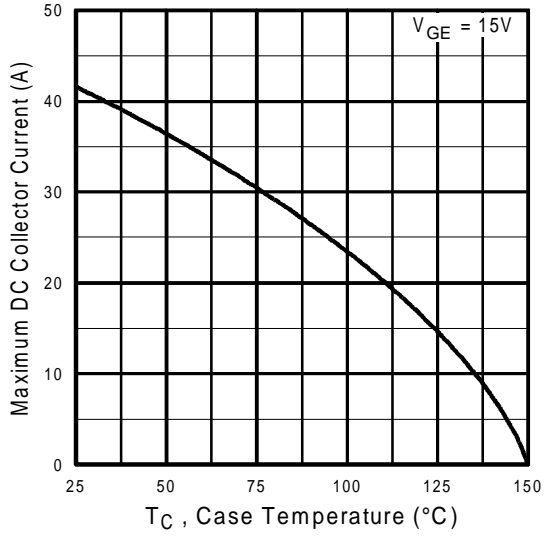


Fig. 4 - Maximum Collector Current vs. Case Temperature

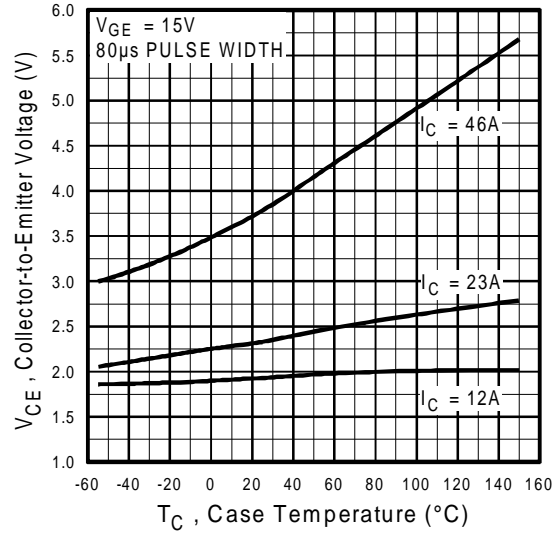


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

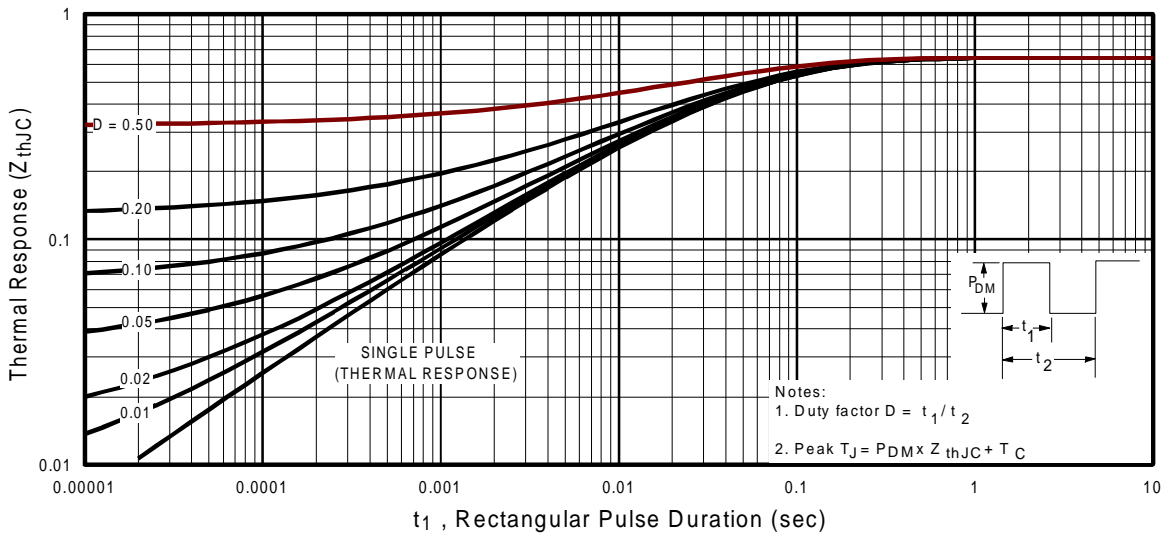


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

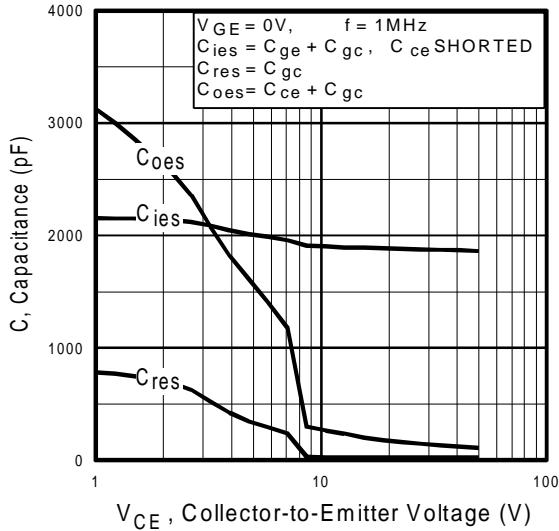


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

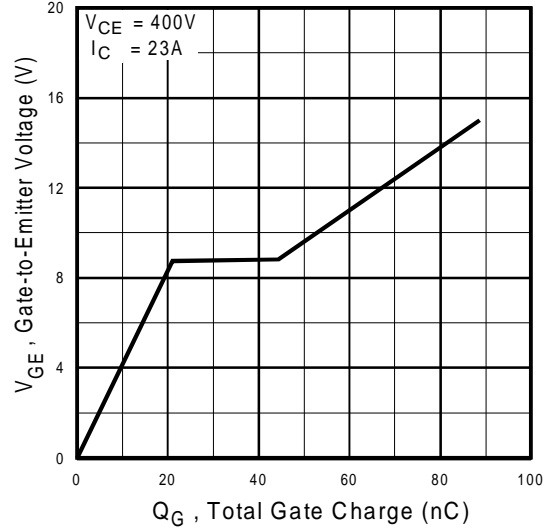


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

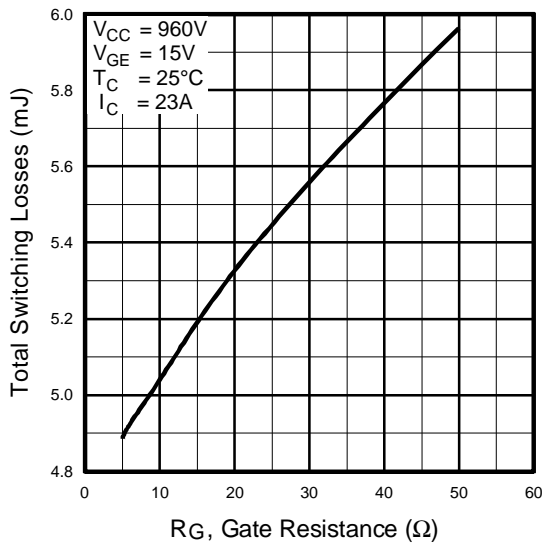


Fig. 9 - Typical Switching Losses vs. Gate Resistance

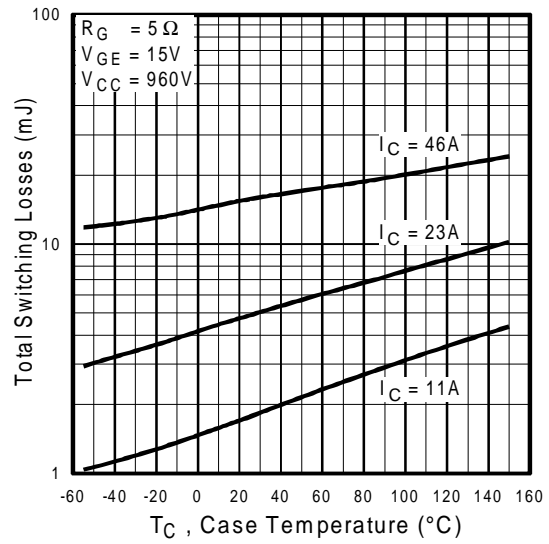


Fig. 10 - Typical Switching Losses vs. Case Temperature

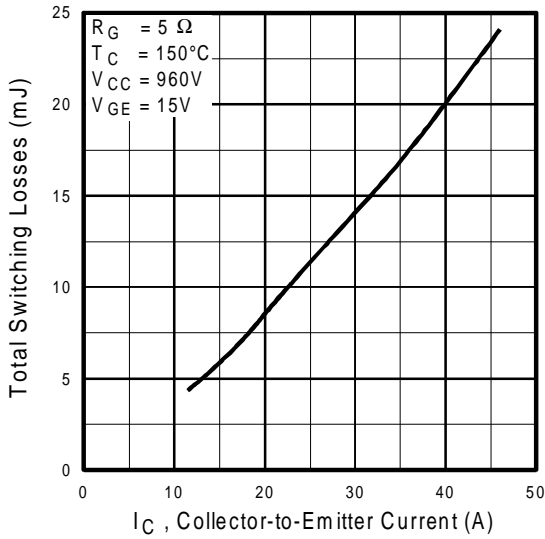


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

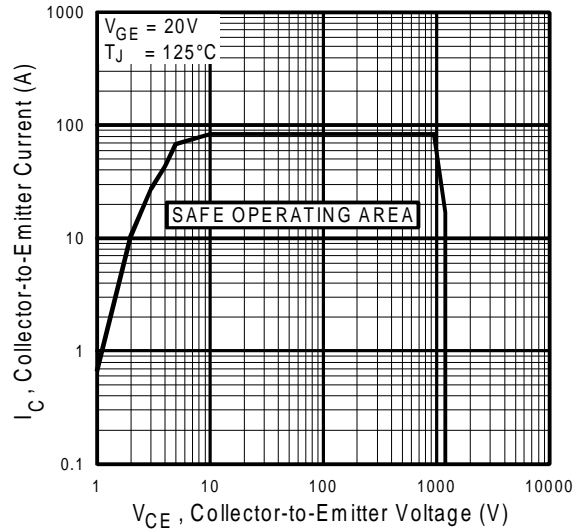


Fig. 12 - Turn-Off SOA

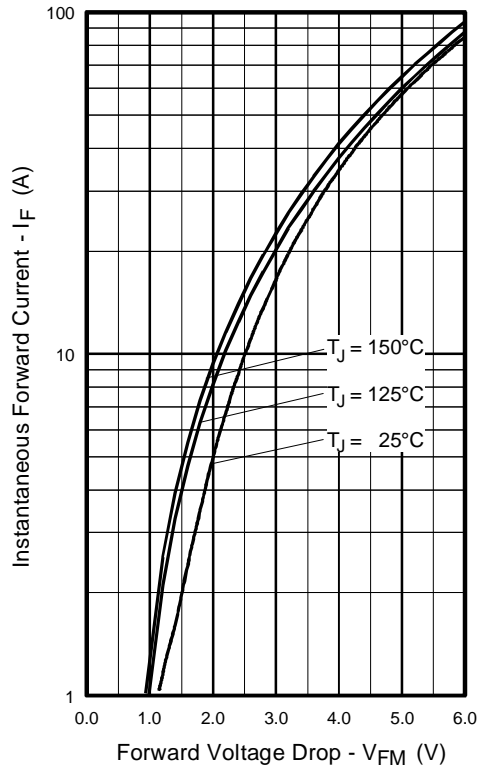


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

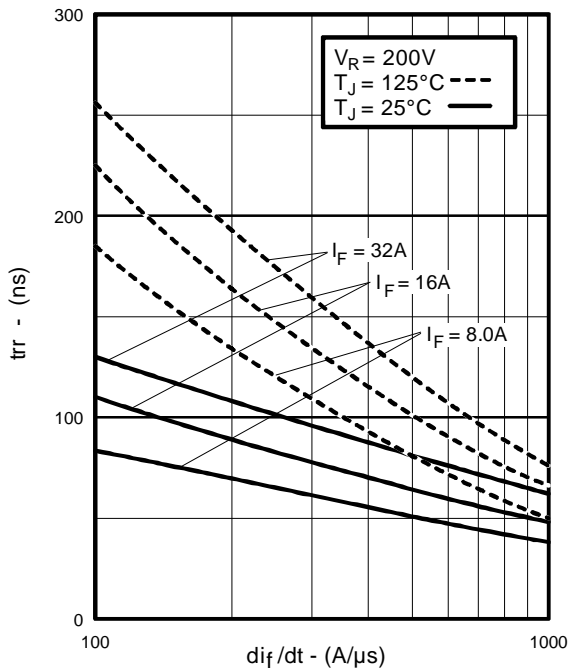


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

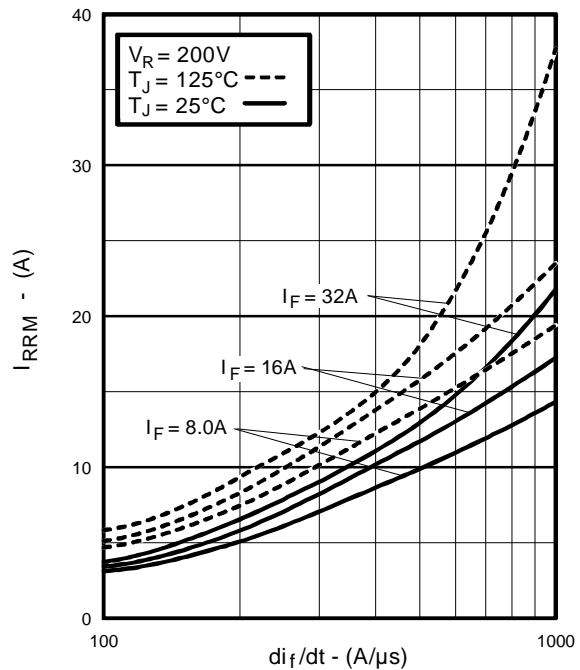


Fig. 15 - Typical Recovery Current vs. di_f/dt

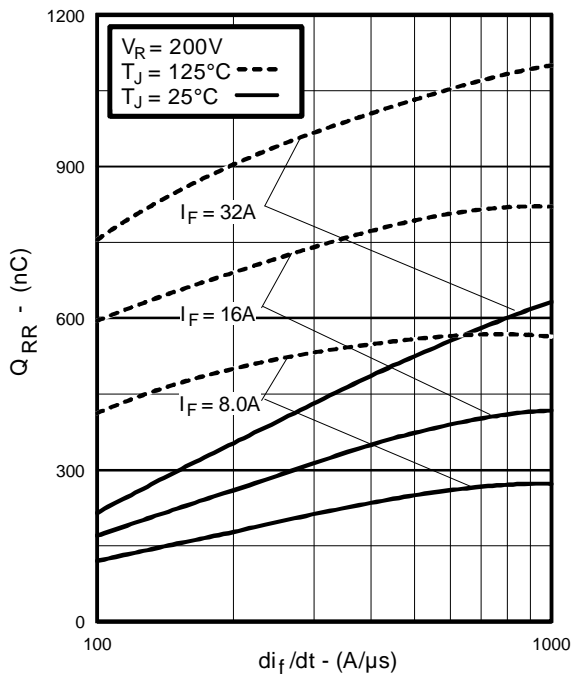


Fig. 16 - Typical Stored Charge vs. di_f/dt

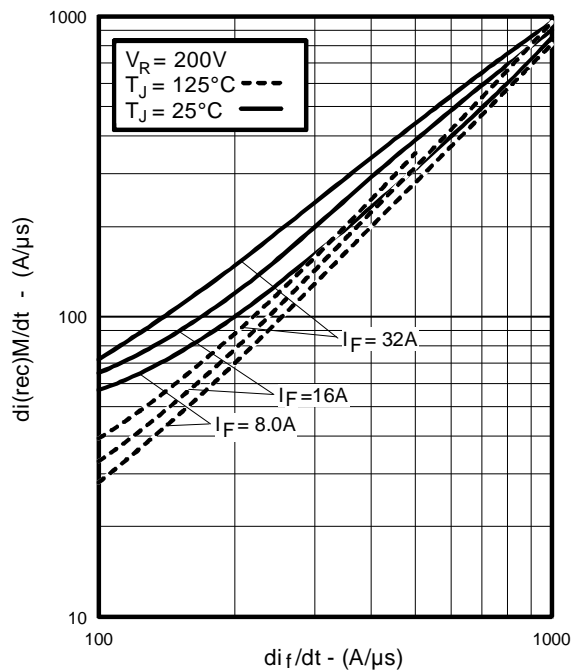


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

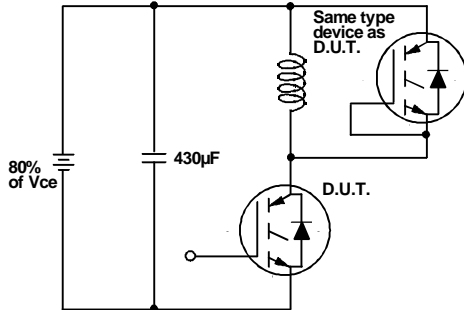


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

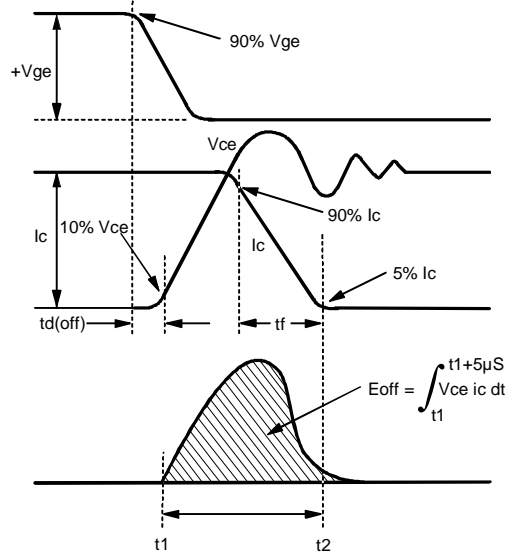


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

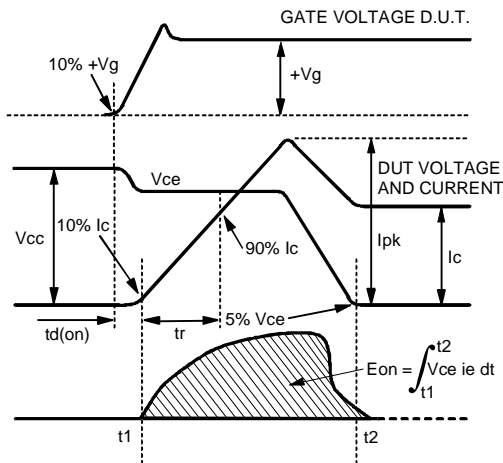


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

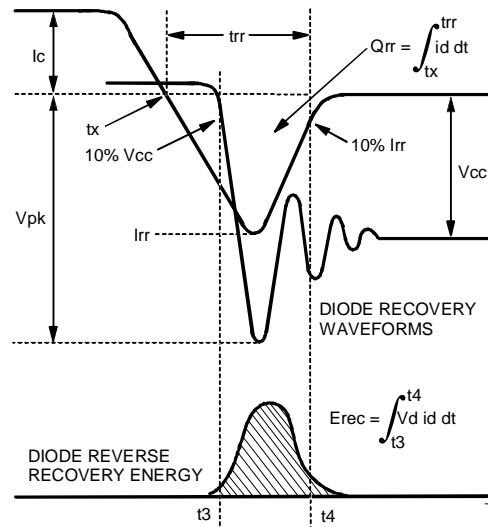


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

Refer to Section D for the following:

Appendix H: Section D - page D-10

Fig. 18e - Macro Waveforms for Test Circuit Fig. 18a

Fig. 19 - Clamped Inductive Load Test Circuit

Fig. 20 - Pulsed Collector Current Test Circuit