

IRGPC50MD2

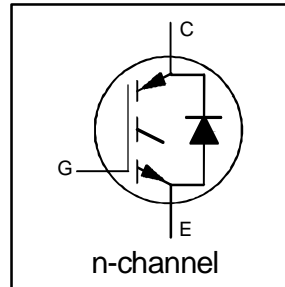
INSULATED GATE BIPOLAR TRANSISTOR
WITH ULTRAFAST SOFT RECOVERY

Short Circuit Rated
Fast CoPack IGBT

DIODE

Features

- Short circuit rated $-10\mu\text{s}$ @ 125°C , $V_{GE} = 15\text{V}$
- 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



$$V_{CES} = 600\text{V}$$

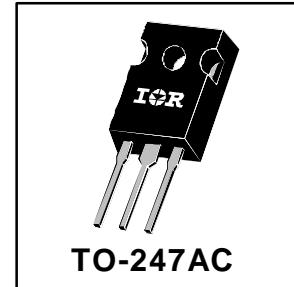
$$V_{CE(sat)} \leq 2.0\text{V}$$

@ $V_{GE} = 15\text{V}$, $I_C = 35\text{A}$

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	600	V
$I_C @ T_C = 25^\circ\text{C}$	Continuous Collector Current	60	A
$I_C @ T_C = 100^\circ\text{C}$	Continuous Collector Current	35	
I_{CM}	Pulsed Collector Current ①	120	
I_{LM}	Clamped Inductive Load Current ②	120	
$I_F @ T_C = 100^\circ\text{C}$	Diode Continuous Forward Current	25	
I_{FM}	Diode Maximum Forward Current	120	
t_{sc}	Short Circuit Withstand Time	10	μs
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ\text{C}$	Maximum Power Dissipation	200	W
$P_D @ T_C = 100^\circ\text{C}$	Maximum Power Dissipation	78	
T_J	Operating Junction and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
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	$^\circ\text{C}/\text{W}$
$R_{\theta JC}$	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	600	—	—	V	V _{GE} = 0V, I _C = 250μA
ΔV _{(BR)CES/ΔT_J}	Temp. Coeff. of Breakdown Voltage	—	0.62	—	V/°C	V _{GE} = 0V, I _C = 1.0mA
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	1.8	2.0	V	I _C = 35A V _{GE} = 15V
		—	2.3	—		I _C = 60A See Fig. 2, 5
		—	2.0	—		I _C = 35A, 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	—	-14	—	mV/°C	V _{CE} = V _{GE} , I _C = 250μA
g _{fe}	Forward Transconductance ④	11	20	—	S	V _{CE} = 100V, I _C = 35A
I _{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	V _{GE} = 0V, V _{CE} = 600V
		—	—	6500		V _{GE} = 0V, V _{CE} = 600V, T _J = 150°C
V _{FM}	Diode Forward Voltage Drop	—	1.3	1.7	V	I _C = 25A See Fig. 13
		—	1.2	1.5		I _C = 25A, 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)	—	120	180	nC	I _C = 35A V _{CC} = 400V See Fig. 8
Q _{ge}	Gate - Emitter Charge (turn-on)	—	25	38		
Q _{gc}	Gate - Collector Charge (turn-on)	—	40	60		
t _{d(on)}	Turn-On Delay Time	—	78	—	ns	T _J = 25°C I _C = 35A, V _{CC} = 480V V _{GE} = 15V, R _G = 5.0Ω Energy losses include "tail" and diode reverse recovery. See Fig. 9, 10, 11, 18
t _r	Rise Time	—	110	—		
t _{d(off)}	Turn-Off Delay Time	—	340	510		
t _f	Fall Time	—	265	400		
E _{on}	Turn-On Switching Loss	—	2.1	—	mJ	See Fig. 9, 10, 11, 18
E _{off}	Turn-Off Switching Loss	—	4.0	—		
E _{ts}	Total Switching Loss	—	6.1	9.5		
t _{sc}	Short Circuit Withstand Time	10	—	—	μs	V _{CC} = 360V, T _J = 125°C V _{GE} = 15V, R _G = 5.0Ω, V _{CPK} < 500V
t _{d(on)}	Turn-On Delay Time	—	80	—	ns	T _J = 150°C, See Fig. 9, 10, 11, 18 I _C = 35A, V _{CC} = 480V V _{GE} = 15V, R _G = 5.0Ω Energy losses include "tail" and diode reverse recovery.
t _r	Rise Time	—	110	—		
t _{d(off)}	Turn-Off Delay Time	—	610	—		
t _f	Fall Time	—	440	—		
E _{ts}	Total Switching Loss	—	9.4	—	mJ	Measured 5mm from package
L _E	Internal Emitter Inductance	—	13	—	nH	
C _{ies}	Input Capacitance	—	2900	—	pF	V _{GE} = 0V V _{CC} = 30V See Fig. 7 f = 1.0MHz
C _{oes}	Output Capacitance	—	230	—		
C _{res}	Reverse Transfer Capacitance	—	30	—		
t _{rr}	Diode Reverse Recovery Time	—	50	75	ns	T _J = 25°C See Fig. 14
		—	105	160		T _J = 125°C
I _{rr}	Diode Peak Reverse Recovery Current	—	4.5	10	A	T _J = 25°C See Fig. 15
		—	8.0	15		T _J = 125°C
Q _{rr}	Diode Reverse Recovery Charge	—	112	375	nC	T _J = 25°C See Fig. 16
		—	420	1200		T _J = 125°C
di _{(rec)M} /dt	Diode Peak Rate of Fall of Recovery During t _b	—	250	—	A/μs	T _J = 25°C See Fig. 17
		—	160	—		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.

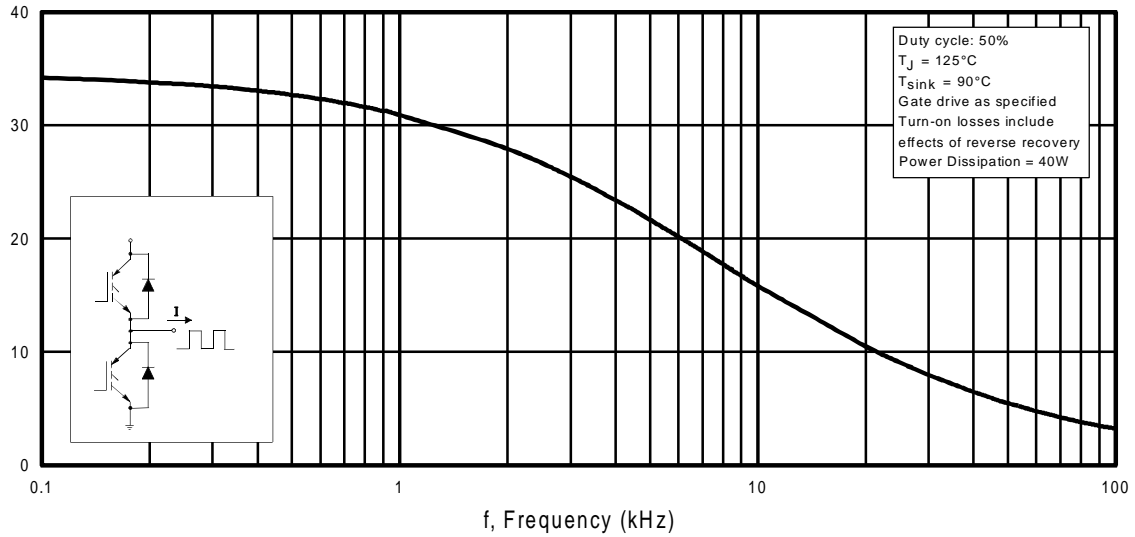


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

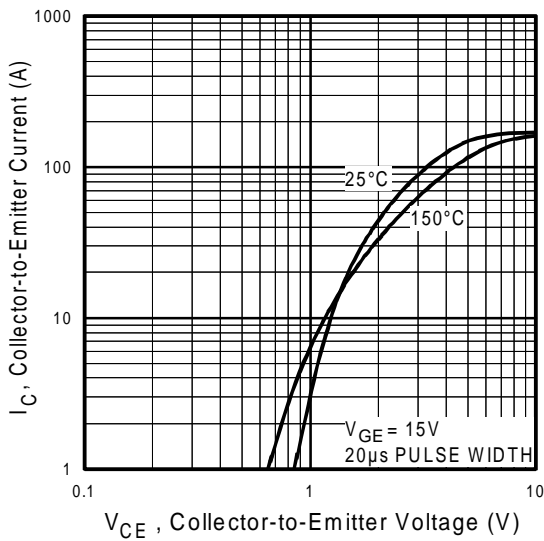


Fig. 2 - Typical Output Characteristics

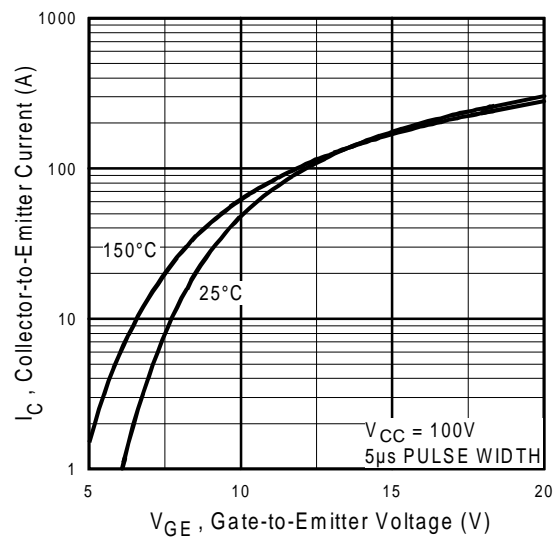


Fig. 3 - Typical Transfer Characteristics

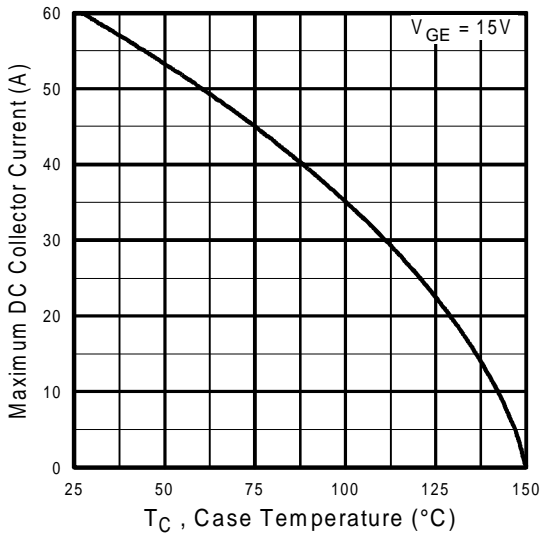


Fig. 4 - Maximum Collector Current vs. Case Temperature

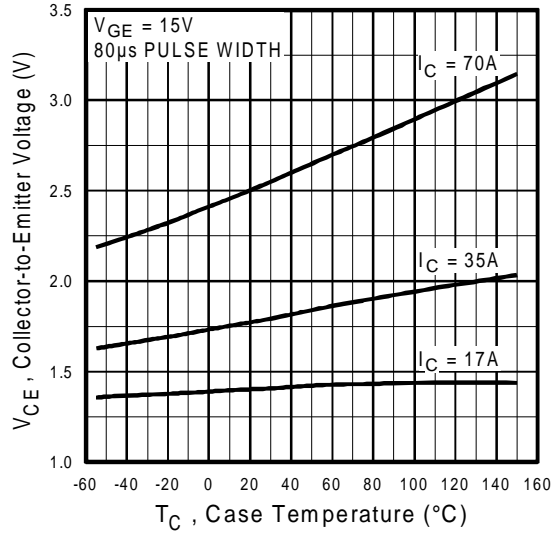


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

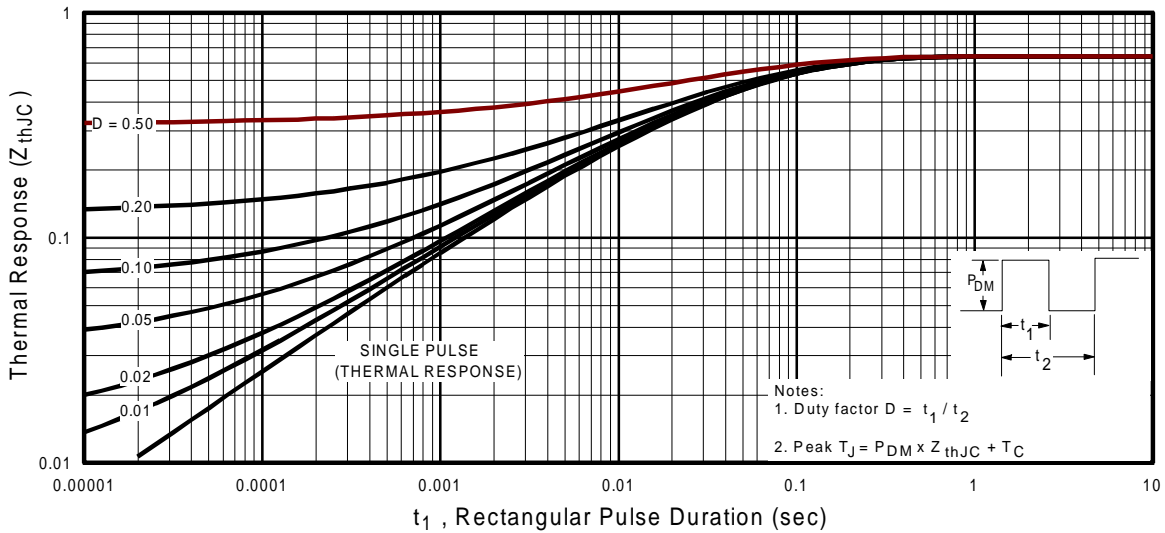


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

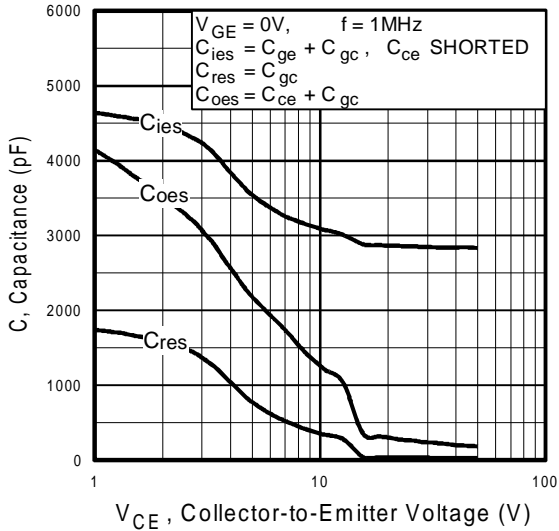


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

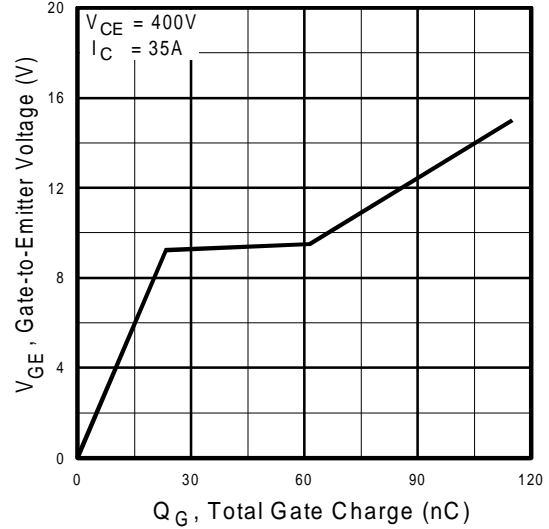


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

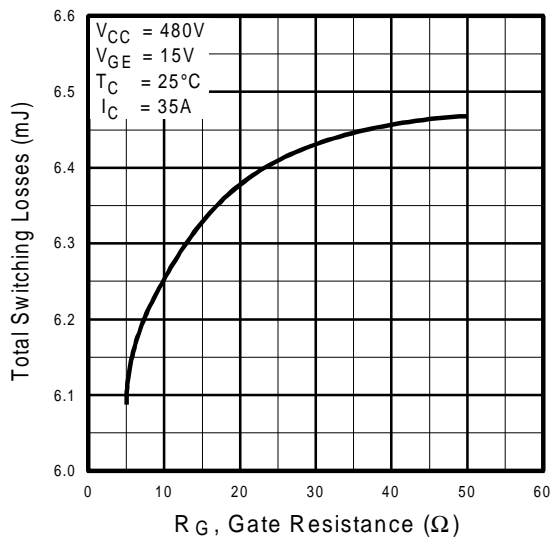


Fig. 9 - Typical Switching Losses vs. Gate Resistance

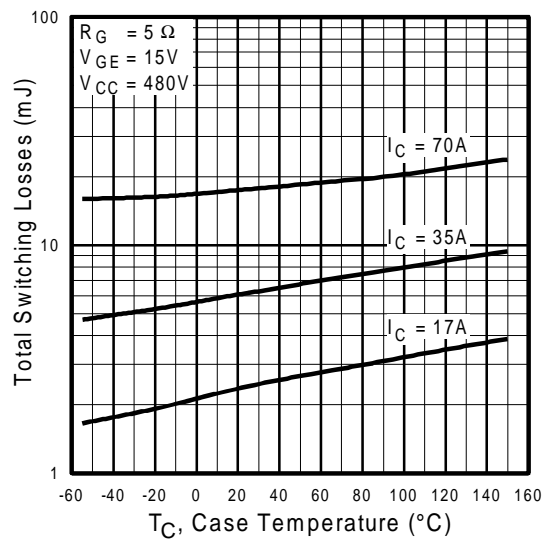


Fig. 10 - Typical Switching Losses vs. Case Temperature

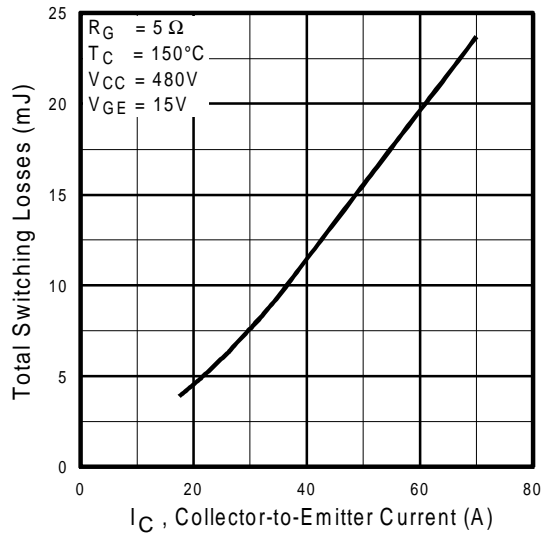


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

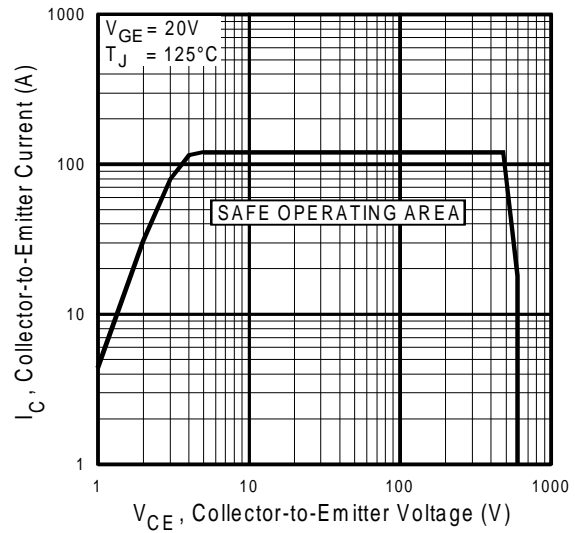


Fig. 12 - Turn-Off SOA

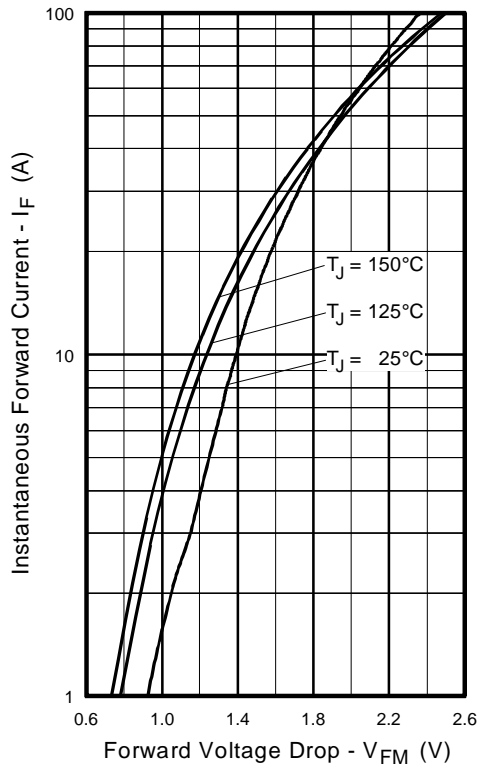


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

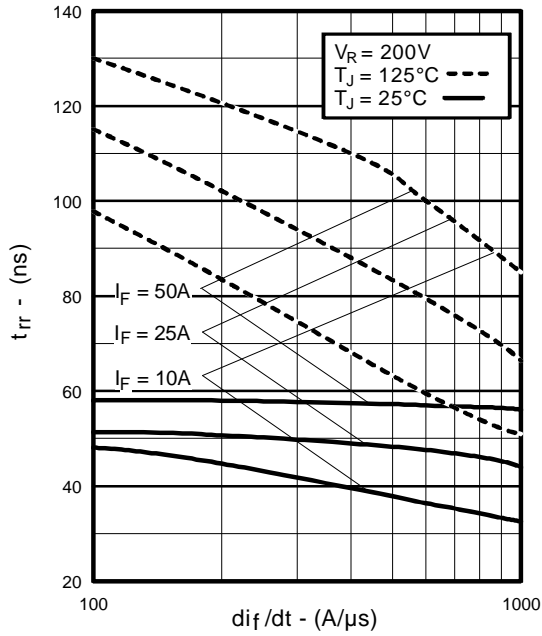


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

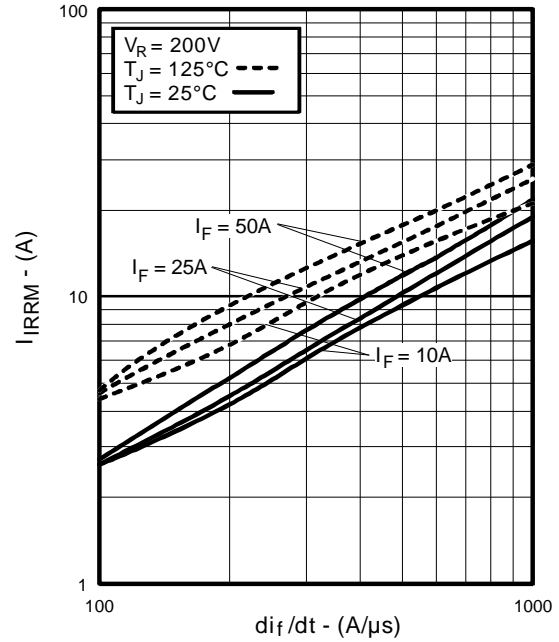


Fig. 15 - Typical Recovery Current vs. di_f/dt

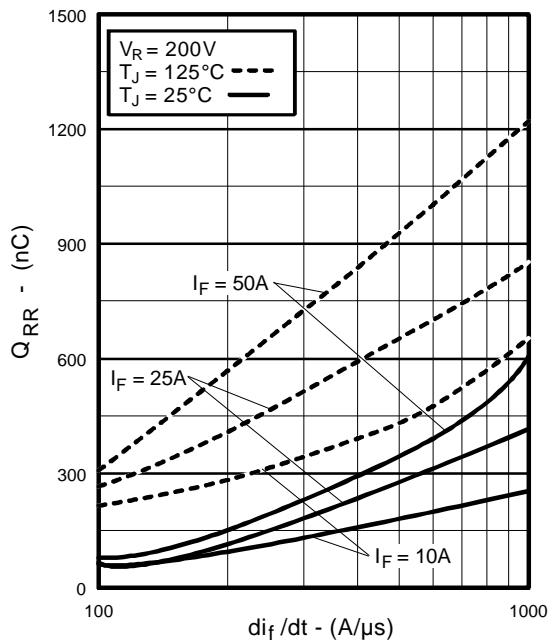


Fig. 16 - Typical Stored Charge vs. di_f/dt

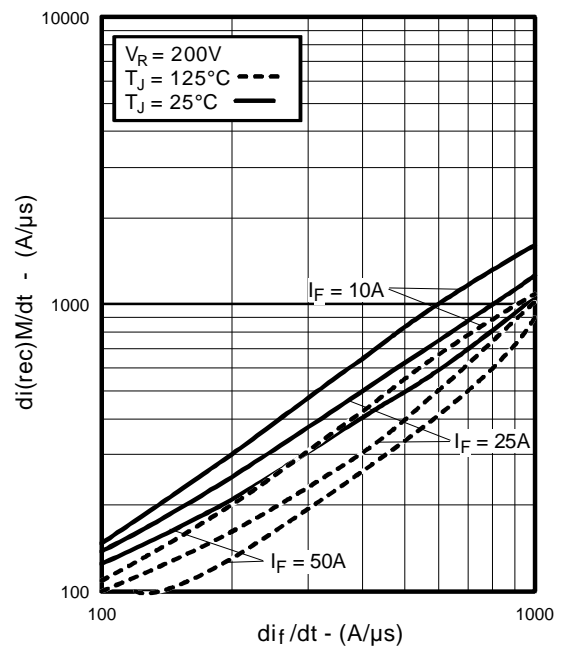


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

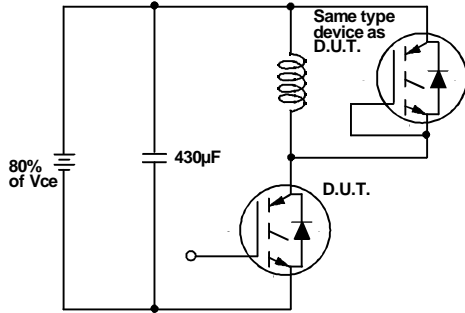


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

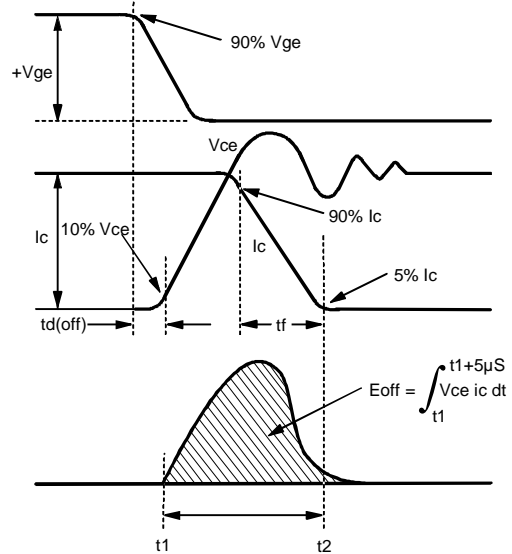


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

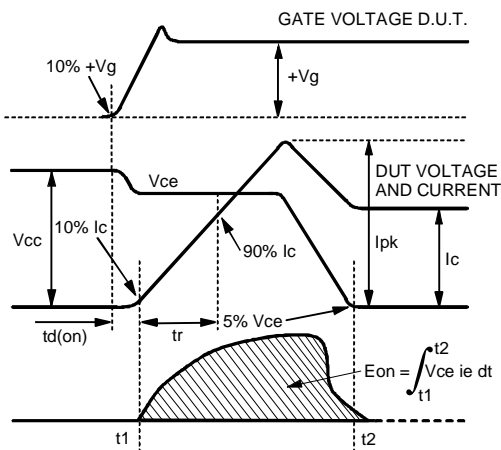


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

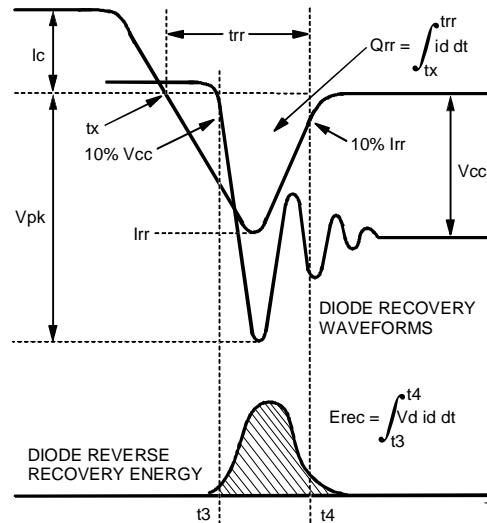


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

Refer to Section D for the following:

Appendix D: Section D - page D-6

- Fig. 18e - Macro Waveforms for Test Circuit of Fig. 18a
- Fig. 19 - Clamped Inductive Load Test Circuit
- Fig. 20 - Pulsed Collector Current Test Circuit