

IGBT SIP MODULE

Ultra-Fast IGBT

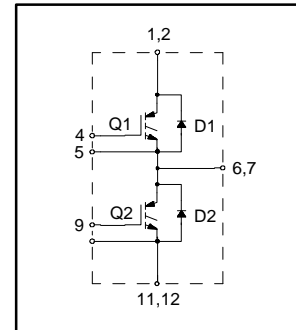
Features

- Fully isolated printed circuit board mount package
- Switching-loss rating includes all "tail" losses
- HEXFRED™ soft ultrafast diodes
- Optimized for high operating frequency (over 5kHz)
See Fig. 1 for Current vs. Frequency curve

Product Summary

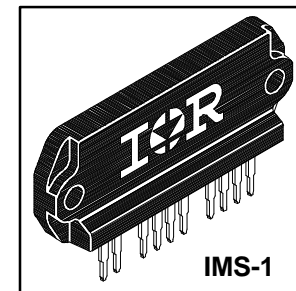
Output Current in a Typical 20 kHz Motor Drive

10 A_{RMS} with T_C = 90°C, T_J = 125°C, Supply Voltage 360Vdc,
Power Factor 0.8, Modulation Depth 80% (See Figure 1)



Description

The IGBT technology is the key to International Rectifier's advanced line of IMS (Insulated Metal Substrate) Power Modules. These modules are more efficient than comparable bipolar transistor modules, while at the same time having the simpler gate-drive requirements of the familiar power MOSFET. This superior technology has now been coupled to a state of the art materials system that maximizes power throughput with low thermal resistance. This package is highly suited to motor drive applications and where space is at a premium.



Absolute Maximum Ratings

	Parameter	Max.	Units
V _{CES}	Collector-to-Emitter Voltage	600	V
I _C @ T _C = 25°C	Continuous Collector Current, each IGBT	33	A
I _C @ T _C = 100°C	Continuous Collector Current, each IGBT	17	
I _{CM}	Pulsed Collector Current ①	100	
I _{LM}	Clamped Inductive Load Current ②	100	
I _F @ T _C = 100°C	Diode Continuous Forward Current	15	
I _{FM}	Diode Maximum Forward Current	100	
V _{GE}	Gate-to-Emitter Voltage	±20	V
V _{ISOL}	Isolation Voltage, any terminal to case, 1 minute	2500	V _{RMS}
P _D @ T _C = 25°C	Maximum Power Dissipation, each IGBT	83	W
P _D @ T _C = 100°C	Maximum Power Dissipation, each IGBT	33	
T _J	Operating Junction and	-40 to +150	°C
T _{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.		
	Mounting torque, 6-32 or M3 screw.	5-7 lbf•in (0.55-0.8 N•m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
R _{θJC} (IGBT)	Junction-to-Case, each IGBT, one IGBT in conduction	—	1.5	°C/W
R _{θJC} (DIODE)	Junction-to-Case, each diode, one diode in conduction	—	2.0	
R _{θCS} (MODULE)	Case-to-Sink, flat, greased surface	0.1	—	
Wt	Weight of module	20 (0.7)	—	g (oz)

CPU165MU



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	—	0.60	—	V/°C	V _{GE} = 0V, I _C = 1.0mA
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	1.8	2.3	V	I _C = 17A I _C = 33A I _C = 17A, T _J = 150°C V _{GE} = 15V See Fig. 2, 5
		—	2.2	—		
		—	1.6	—		
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	16	24	—	S	V _{CE} = 100V, I _C = 27A
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	—	—	±500	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)	—	108	140	nC	I _C = 27A V _{CC} = 400V See Fig. 8
Q _{ge}	Gate - Emitter Charge (turn-on)	—	17	21		
Q _{gc}	Gate - Collector Charge (turn-on)	—	52	70		
t _{d(on)}	Turn-On Delay Time	—	23	—	ns	T _J = 25°C I _C = 27A, V _{CC} = 480V V _{GE} = 15V, R _G = 5.0Ω Energy losses include "tail" and diode reverse recovery.
t _r	Rise Time	—	28	—		
t _{d(off)}	Turn-Off Delay Time	—	100	200	mJ	See Fig. 9, 10, 11, 18
t _f	Fall Time	—	45	140		
E _{on}	Turn-On Switching Loss	—	0.76	—	mJ	T _J = 150°C, See Fig. 9, 10, 11, 18 I _C = 27A, V _{CC} = 480V V _{GE} = 15V, R _G = 5.0Ω Energy losses include "tail" and diode reverse recovery.
E _{off}	Turn-Off Switching Loss	—	0.26	—		
E _{ts}	Total Switching Loss	—	1.0	2.0		
t _{d(on)}	Turn-On Delay Time	—	24	—	ns	T _J = 150°C, See Fig. 9, 10, 11, 18 I _C = 27A, V _{CC} = 480V V _{GE} = 15V, R _G = 5.0Ω Energy losses include "tail" and diode reverse recovery.
t _r	Rise Time	—	27	—		
t _{d(off)}	Turn-Off Delay Time	—	180	—	mJ	See Fig. 7
t _f	Fall Time	—	130	—		
E _{ts}	Total Switching Loss	—	3.7	—	pF	V _{GE} = 0V V _{CC} = 30V f = 1.0MHz
C _{ies}	Input Capacitance	—	2900	—		
C _{oes}	Output Capacitance	—	330	—		
C _{res}	Reverse Transfer Capacitance	—	41	—	ns	T _J = 25°C See Fig. 14 T _J = 125°C 14
		—	50	75		
t _{rr}	Diode Reverse Recovery Time	—	105	160	A	T _J = 25°C See Fig. 15 T _J = 125°C 15
I _{rr}	Diode Peak Reverse Recovery Current	—	4.5	10		
Q _{rr}	Diode Reverse Recovery Charge	—	8.0	15	nC	T _J = 25°C See Fig. 16 T _J = 125°C 16
		—	112	375		
di _(rec) M/dt	Diode Peak Rate of Fall of Recovery During t _b	—	420	1200	A/μs	T _J = 25°C See Fig. 17 T _J = 125°C 17
		—	250	—		

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.

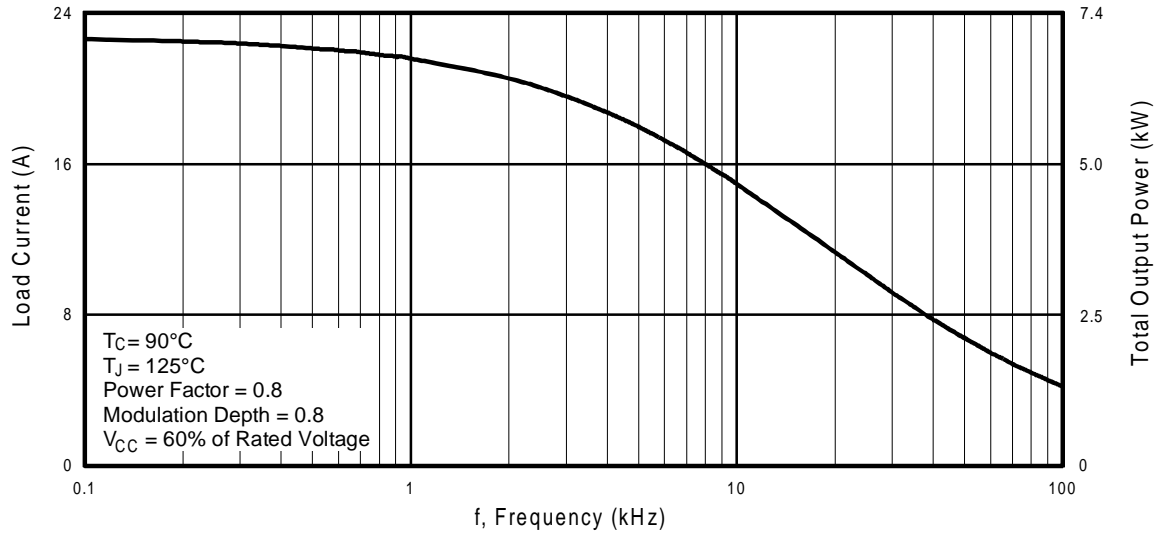


Fig. 1 - RMS Current and Output Power, Synthesized Sine Wave

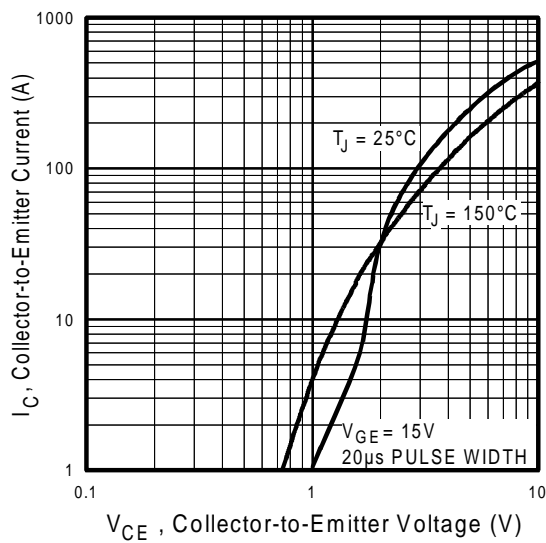


Fig. 2 - Typical Output Characteristics

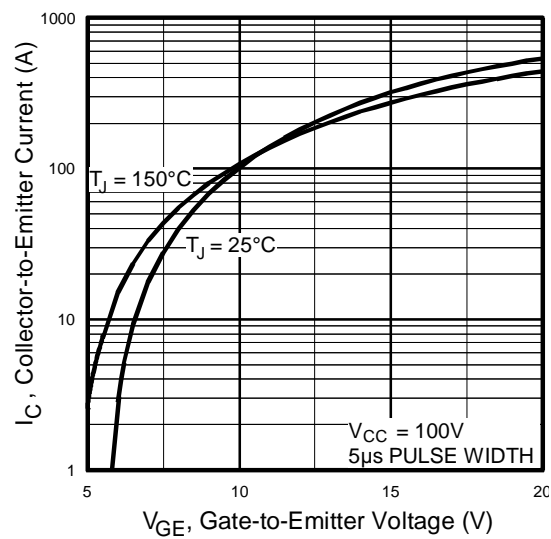


Fig. 3 - Typical Transfer Characteristics

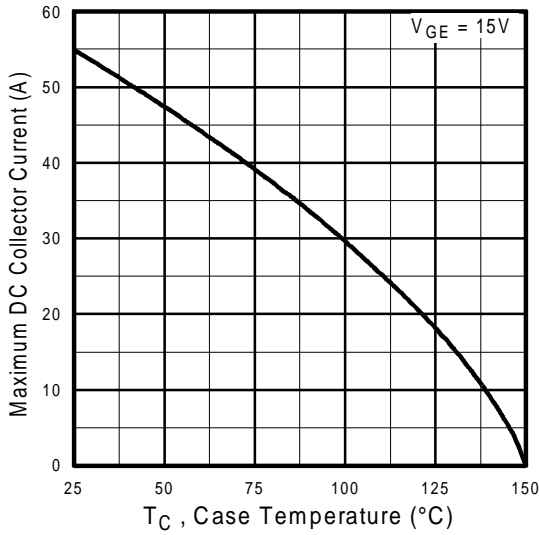


Fig. 4 - Maximum Collector Current vs. Case Temperature

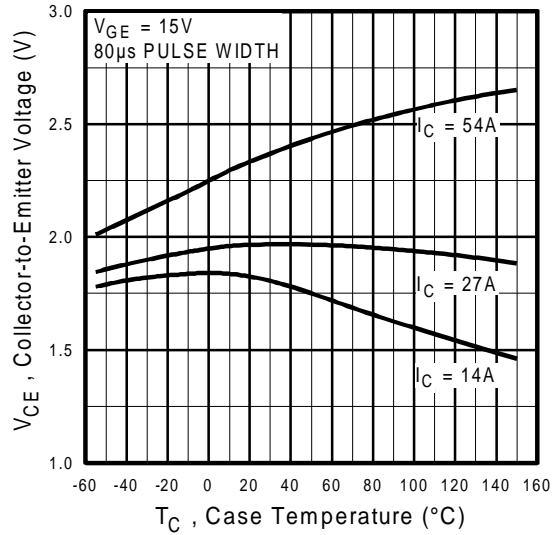


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

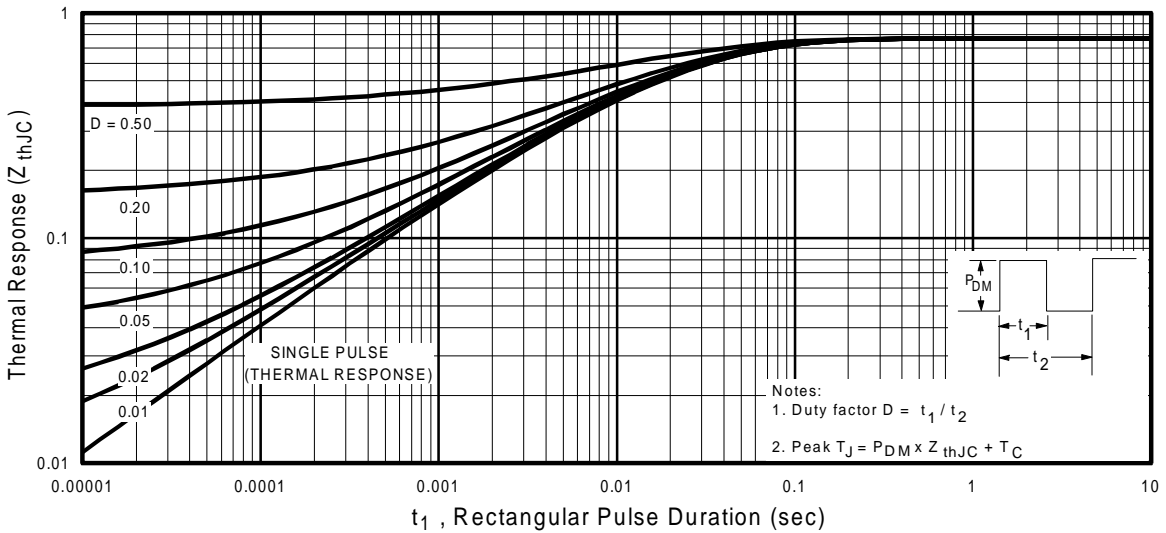


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

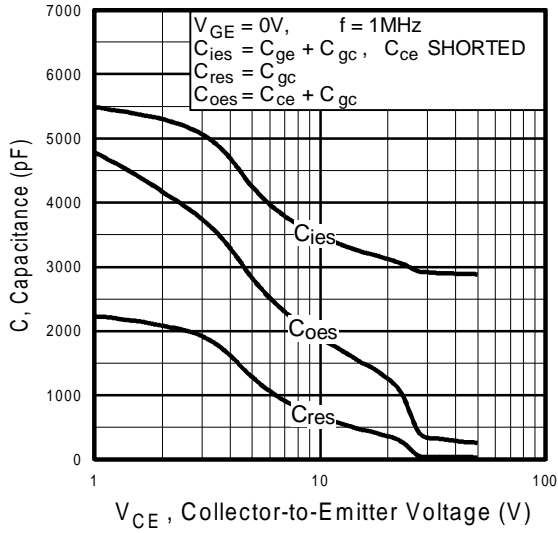


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

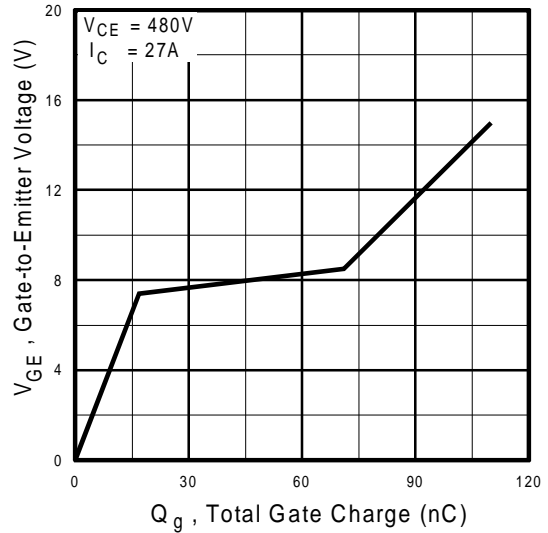


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

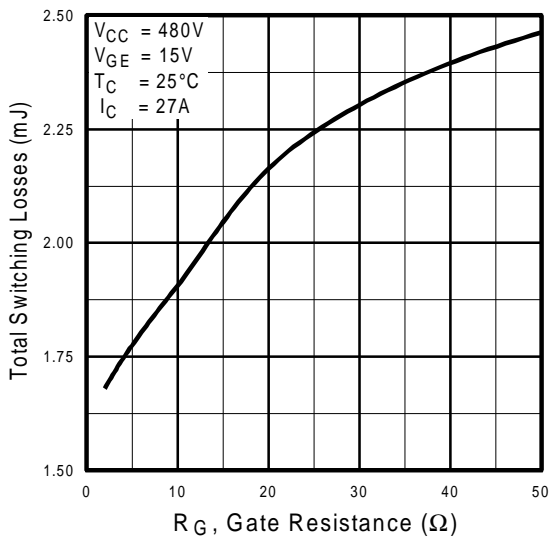


Fig. 9 - Typical Switching Losses vs. Gate Resistance

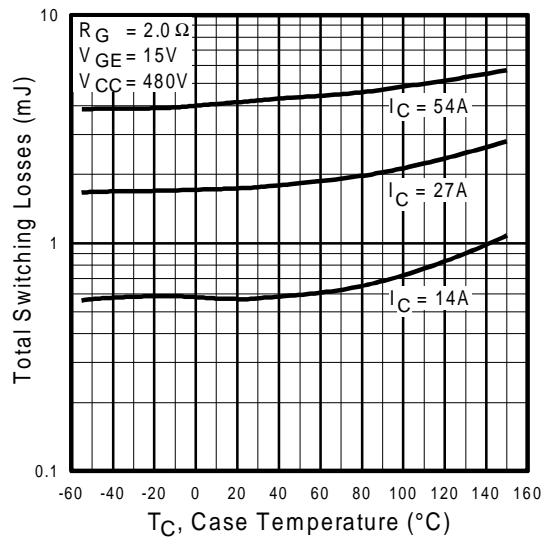


Fig. 10 - Typical Switching Losses vs. Case Temperature

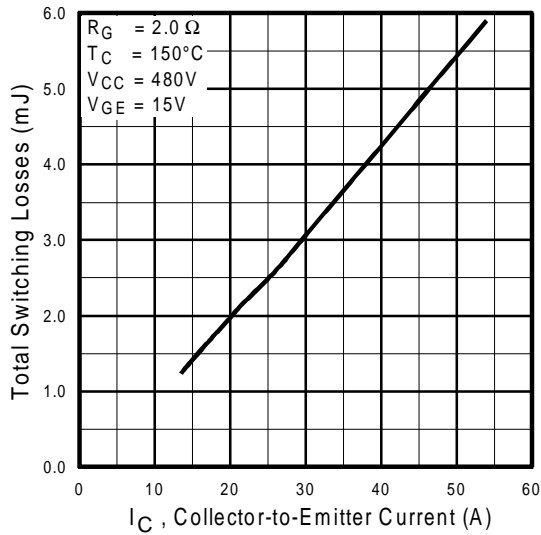


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

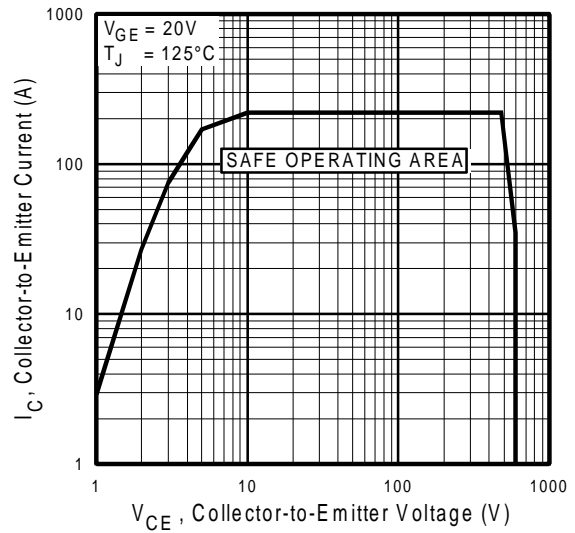


Fig. 12 - Turn-Off SOA

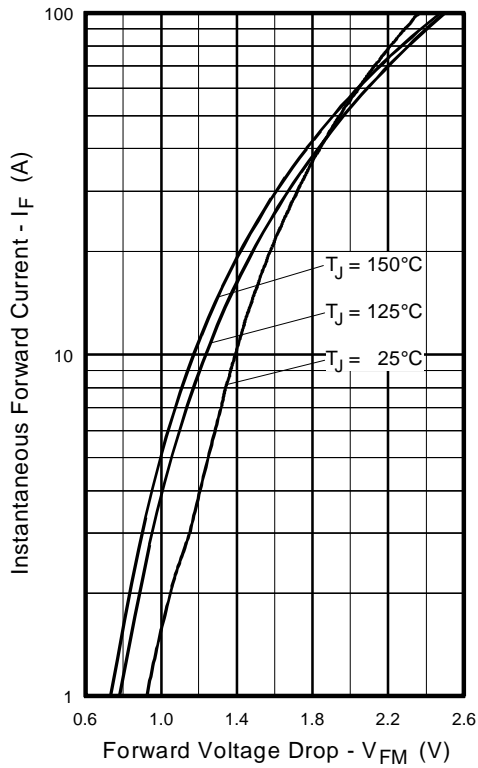


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

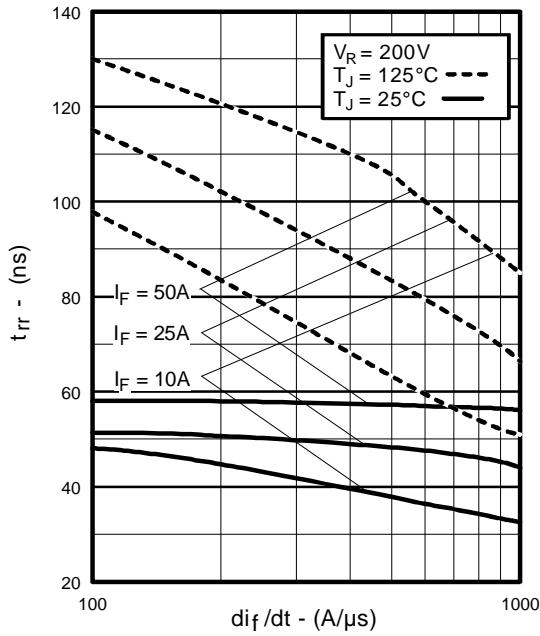


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

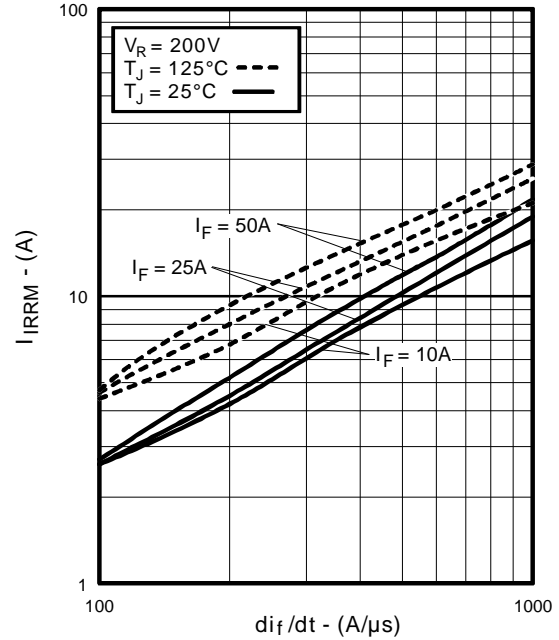


Fig. 15 - Typical Recovery Current vs. di_f/dt

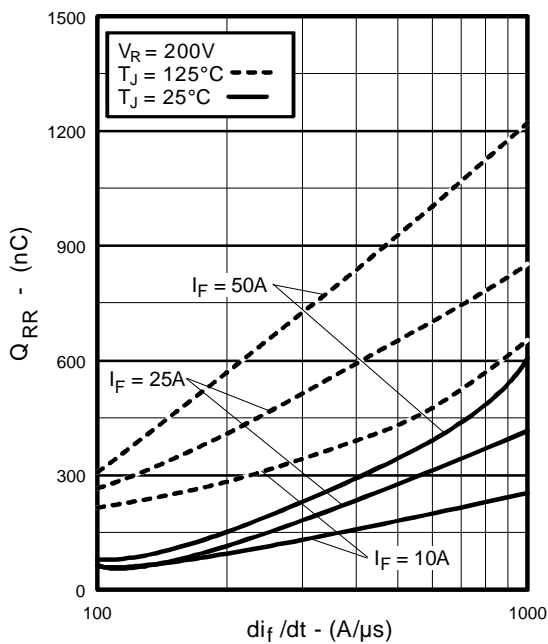


Fig. 16 - Typical Stored Charge vs. di_f/dt

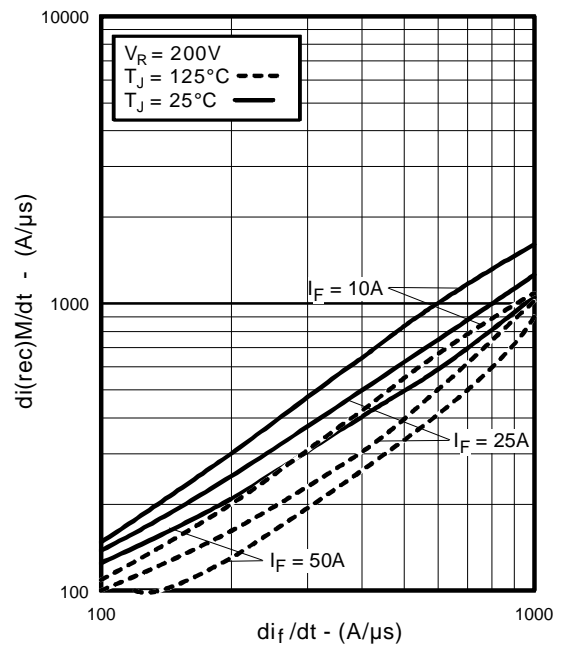


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

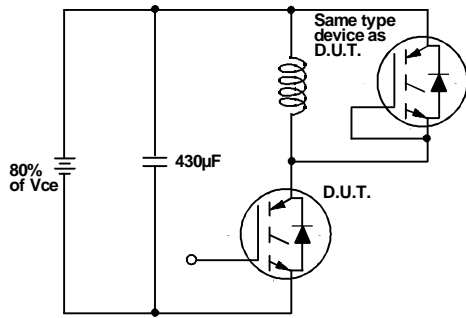


Fig.18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

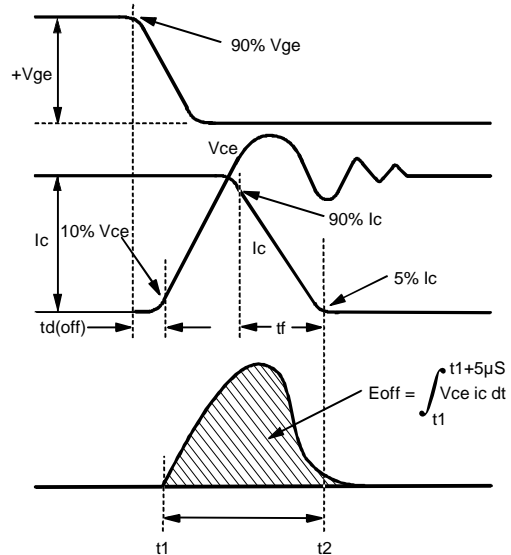


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

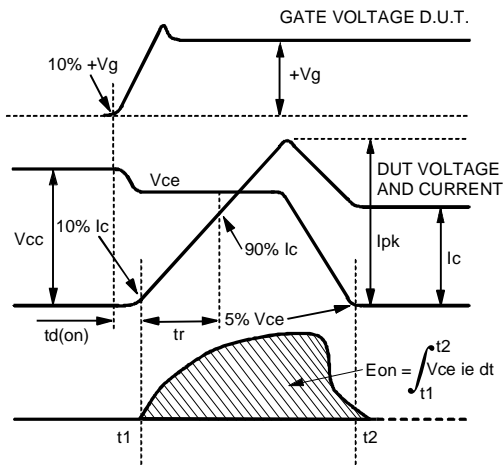


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

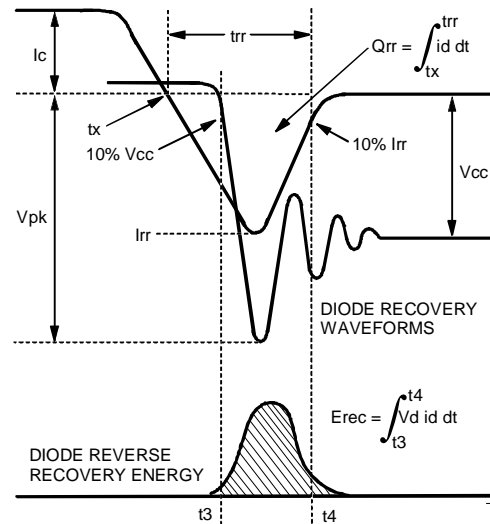


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

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