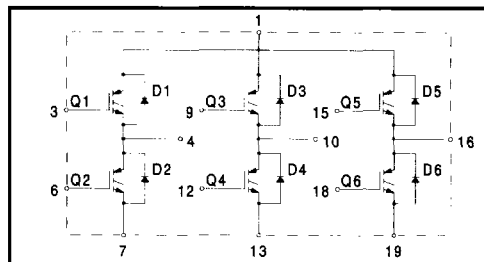


Short Circuit Rated UltraFast IGBT

Features

- Short Circuit Rated UltraFast: Optimized for high operating frequencies >5.0 kHz , and Short Circuit Rated to 10μs @125°C, V_{GE} = 15V
- 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



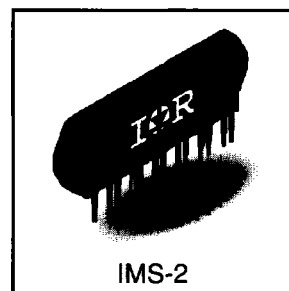
Product Summary

Output Current in a Typical 20 kHz Motor Drive

11 A_{RMS} per phase (3.1 kW total) with T_C = 90°C, T_J = 125°C, Supply Voltage 360Vdc, Power Factor 0.8, Modulation Depth 115% (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	5.7	A
I _C @ T _C = 100°C	Continuous Collector Current, each IGBT	3.0	
I _{CM}	Pulsed Collector Current ①	11	
I _{LM}	Clamped Inductive Load Current ②	11	
I _F @ T _C = 100°C	Diode Continuous Forward Current	3.4	
I _{FM}	Diode Maximum Forward Current	11	
t _{sc}	Short Circuit Withstand Time	10	μs
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	23	W
P _D @ T _C = 100°C	Maximum Power Dissipation, each IGBT	9.1	
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	—	5.5	°C/W
R _{θJC} (DIODE)	Junction-to-Case, each diode, one diode in conduction	—	9.0	
R _{θCS} (MODULE)	Case-to-Sink, flat, greased surface	0.1	—	
Wt	Weight of module	20 (0.7)	—	g (oz)

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	—	0.49	—	V/°C	V _{GE} = 0V, I _C = 1.0mA
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	1.70	1.93	V	I _C = 3.0A V _{GE} = 15V
		—	1.98	—		I _C = 5.7A see figures 2, 5
		—	1.65	—		I _C = 3.0A, 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}	Temp. Coeff. of Threshold Voltage	—	-13	—	mV/°C	V _{CE} = V _{GE} , I _C = 250μA
g _{fe}	Forward Transconductance ④	2.0	3.0	—	S	V _{CE} = 100V, I _C = 12A
I _{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	V _{GE} = 0V, V _{CE} = 600V
		—	—	1700		V _{GE} = 0V, V _{CE} = 600V, T _J = 150°C
V _{FM}	Diode Forward Voltage Drop	—	1.4	1.7	V	I _C = 12A see figure 13
		—	1.3	1.6		I _C = 12A, 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)	—	38	57	nC	I _C = 3.0A	
Q _{ge}	Gate - Emitter Charge (turn-on)	—	5.2	8		V _{CC} = 400V	
Q _{gc}	Gate - Collector Charge (turn-on)	—	18	27		See Fig. 8	
t _{d(on)}	Turn-On Delay Time	—	23	—	ns	T _J = 25°C	
t _r	Rise Time	—	54	—		I _C = 3.0A, V _{CC} = 480V	
t _{d(off)}	Turn-Off Delay Time	—	125	188		V _{GE} = 15V, R _G = 51Ω	
t _f	Fall Time	—	120	180		Energy losses include "tail" and diode reverse recovery.	
E _{on}	Turn-On Switching Loss	—	0.14	—		mJ	see figures 9, 10, 18
E _{off}	Turn-Off Switching Loss	—	0.07	—			
E _{ts}	Total Switching Loss	—	0.21	0.26			
t _{sc}	Short Circuit Withstand Time	10	—	—		μs	V _{CC} = 360V, T _J = 125°C V _{GE} = 15V, R _G = 51Ω, V _{CPK} < 500V
t _{d(on)}	Turn-On Delay Time	—	25	—		ns	T _J = 150°C, see figures 10, 11, 18
t _r	Rise Time	—	51	—	I _C = 3.0A, V _{CC} = 480V		
t _{d(off)}	Turn-Off Delay Time	—	308	—	V _{GE} = 15V; R _G = 51Ω		
t _f	Fall Time	—	166	—	Energy losses include "tail" and diode reverse recovery.		
E _{ts}	Total Switching Loss	—	0.33	—	mJ		
C _{ies}	Input Capacitance	—	450	—	pF	V _{GE} = 0V	
C _{oes}	Output Capacitance	—	61	—		V _{CC} = 30V see figure 7	
C _{res}	Reverse Transfer Capacitance	—	14	—		f = 1.0MHz	
t _{rr}	Diode Reverse Recovery Time	—	37	55	ns	T _J = 25°C see figure 14	
		—	55	90		T _J = 125°C	
I _{rr}	Diode Peak Reverse Recovery Current	—	3.5	5.0	A	T _J = 25°C see figure 15	
		—	4.5	8.0		T _J = 125°C	
Q _{rr}	Diode Reverse Recovery Charge	—	65	138	nC	T _J = 25°C see figure 16	
		—	124	360		T _J = 125°C	
di _(rec) /dt	Diode Peak Rate of Fall of Recovery During t _b	—	240	—	A/μs	T _J = 25°C see figure 17	
		—	210	—		T _J = 125°C	

Notes: ① Repetitive rating; V_{GE} = 20V; pulse width limited by maximum junction temperature (figure 20)
 ② V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 10μH, R_G = 23Ω (Figure 19)

③ Pulse width ≤ 80μs; duty factor ≤ 0.1%.
 ④ Pulse width 5.0μs, single shot.

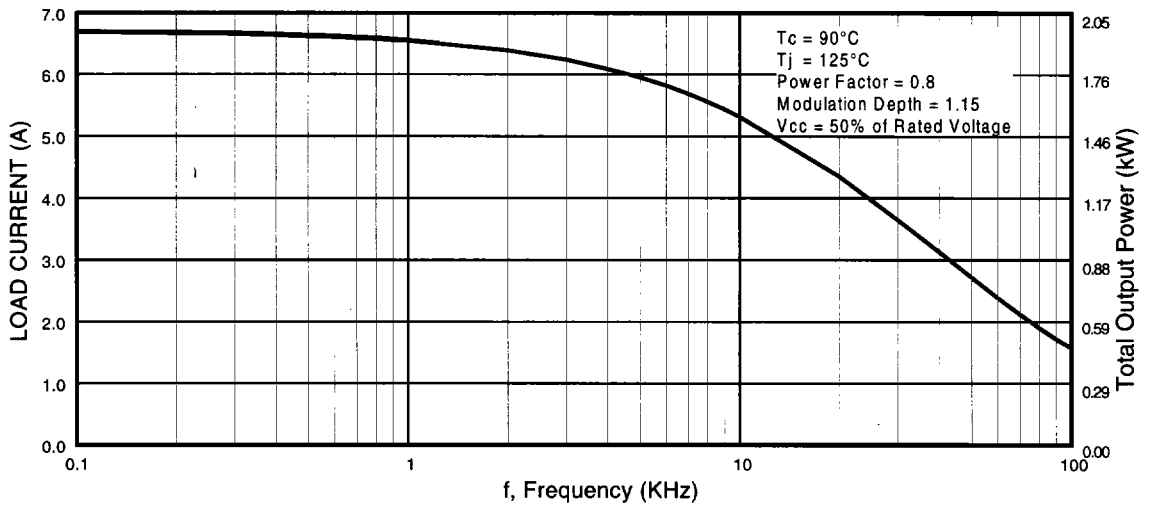


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

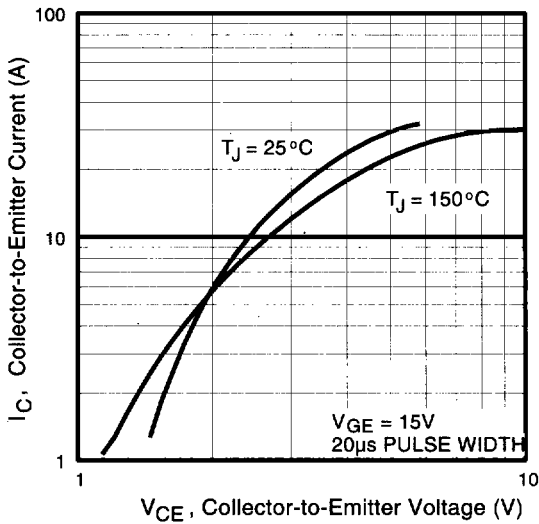


Fig. 2 - Typical Output Characteristics

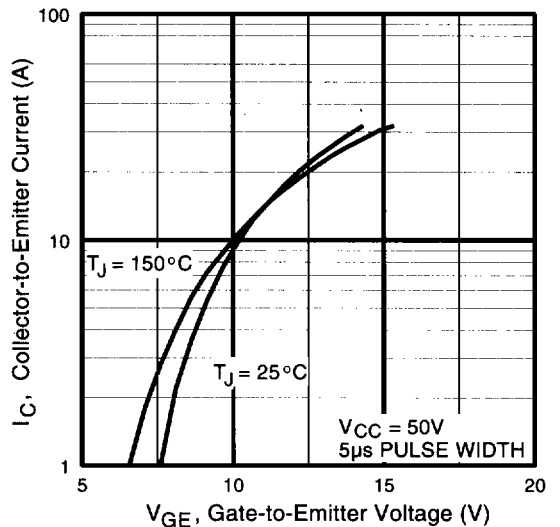


Fig. 3 - Typical Transfer Characteristics

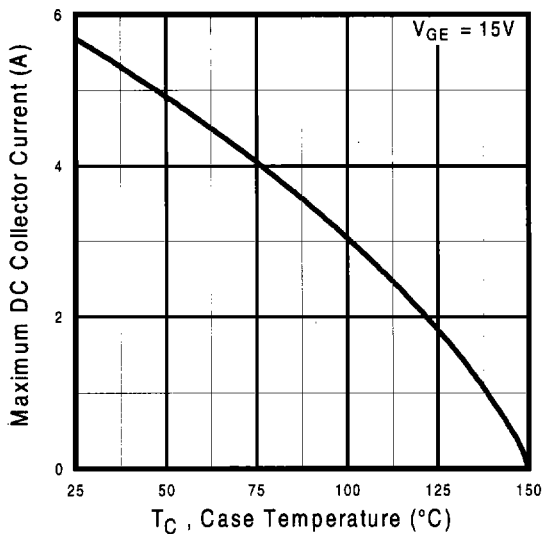


Fig. 4 - Maximum Collector Current vs. Case Temperature

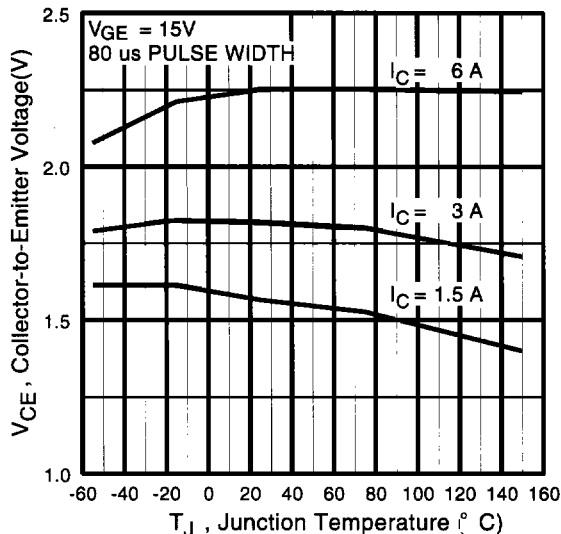


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

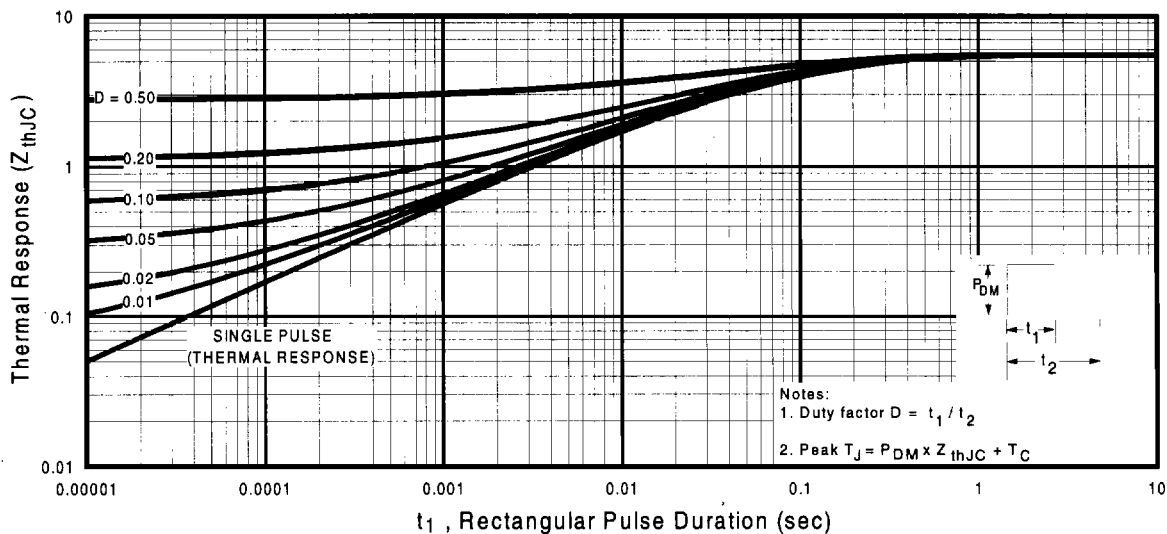


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

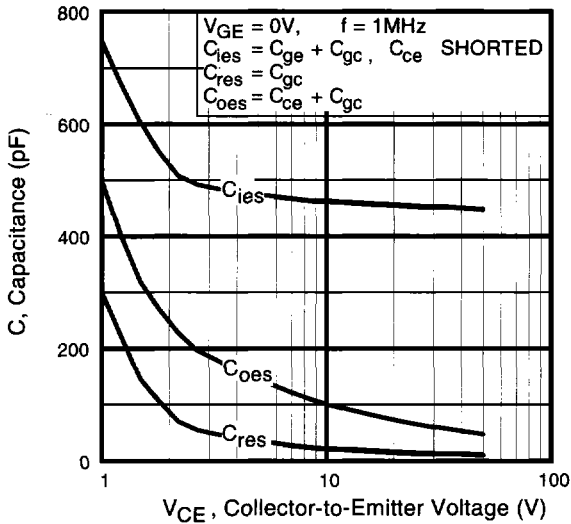


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

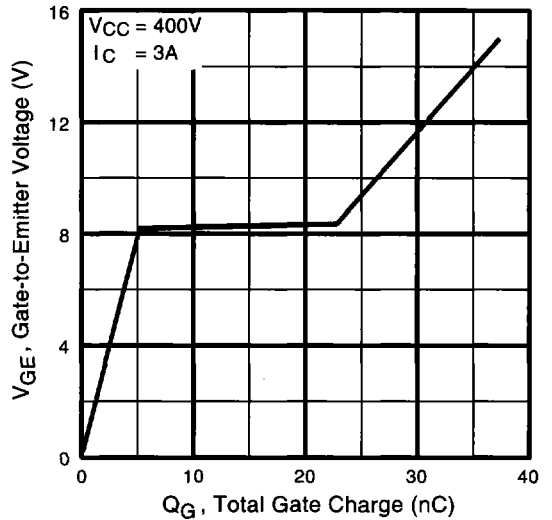


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

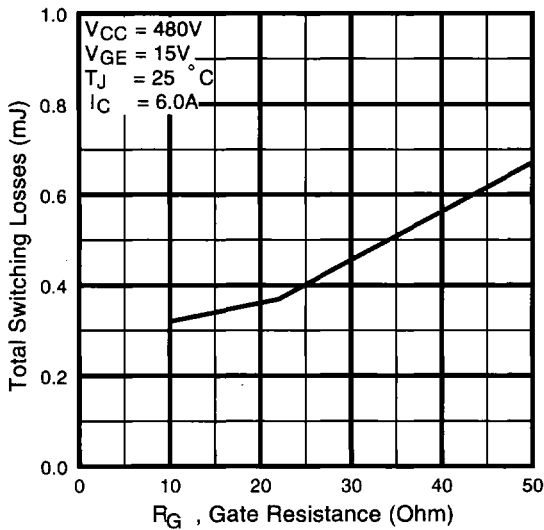


Fig. 9 - Typical Switching Losses vs. Gate Resistance

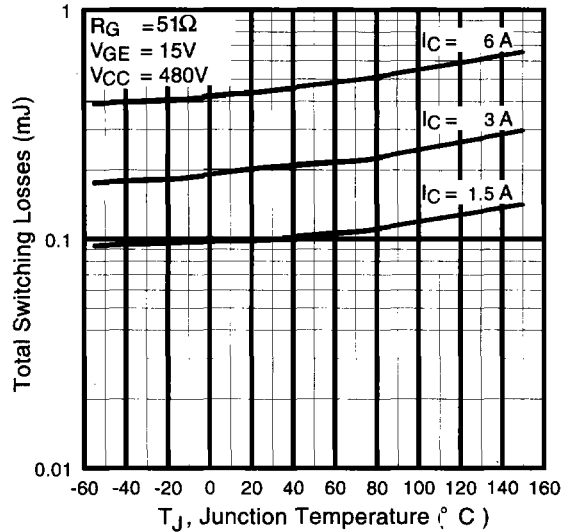


Fig. 10 - Typical Switching Losses vs. Junction Temperature

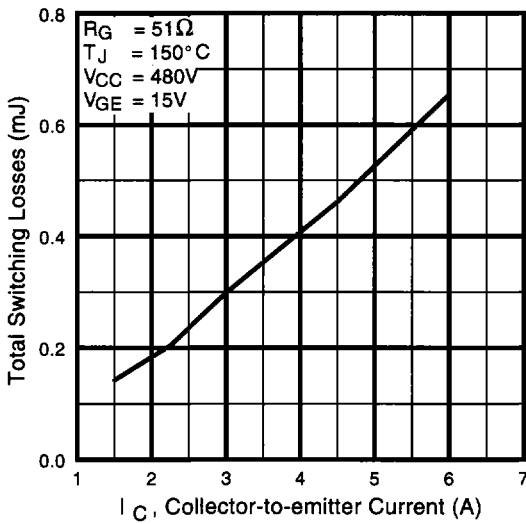


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

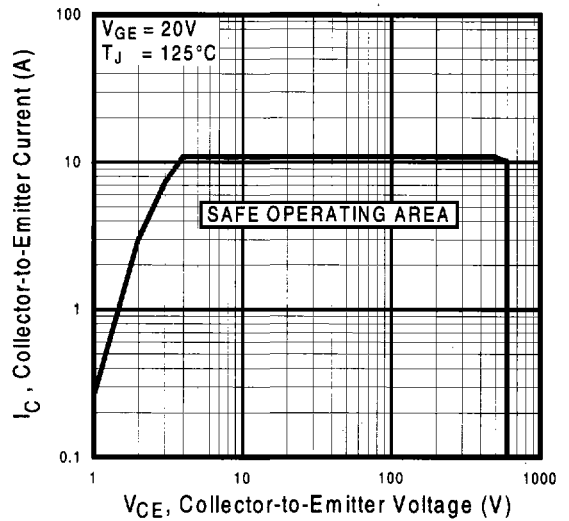


Fig. 12 - Turn-Off SOA

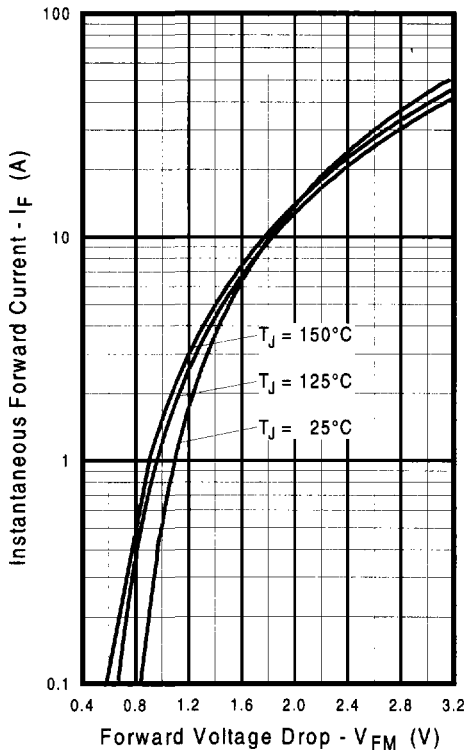


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

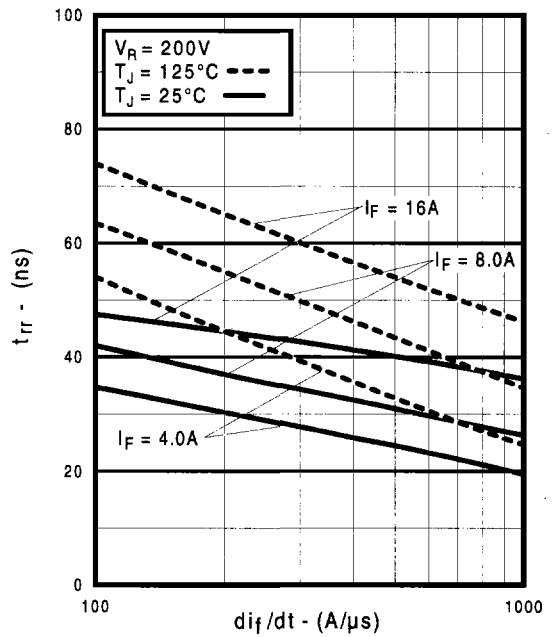


Fig. 14 - Typical Reverse Recovery vs. di/dt

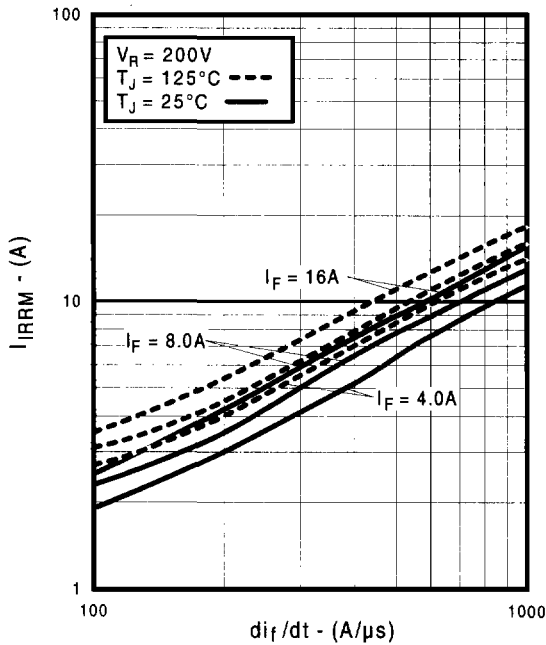


Fig. 15 - Typical Recovery Current vs. di_f/dt

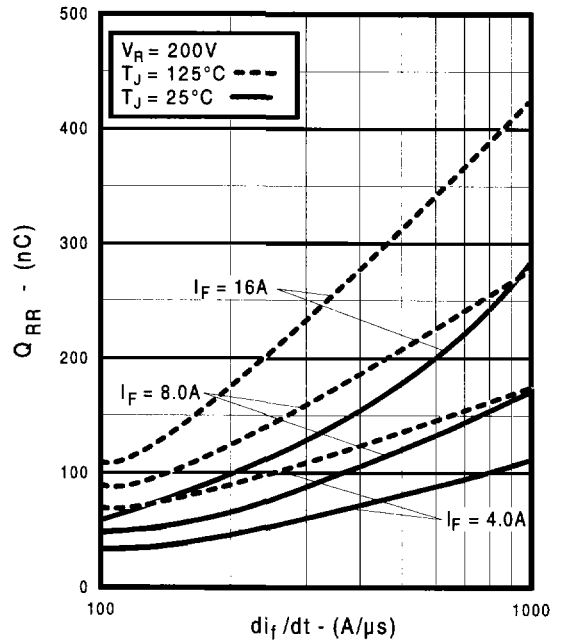


Fig. 16 - Typical Stored Charge vs. di_f/dt

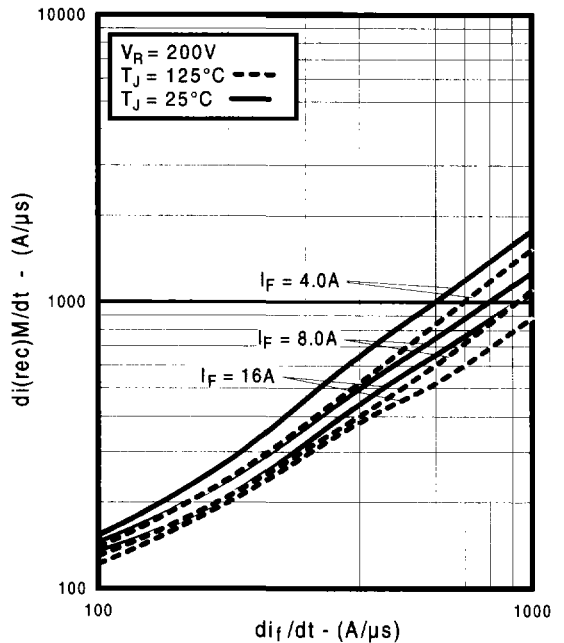


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

Mechanical drawings, Appendix A
Test Circuit diagrams, Appendix B
Switching Loss Waveforms, Appendix C