International Rectifier

PD - 5.028

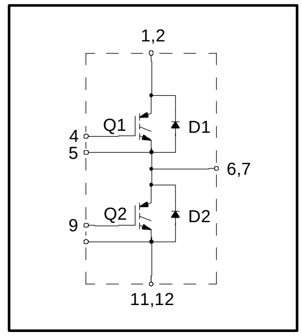
CPU165MF

IGBT SIP MODULE

Fast IGBT

Features

- Fully isolated printed circuit board mount package
- 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



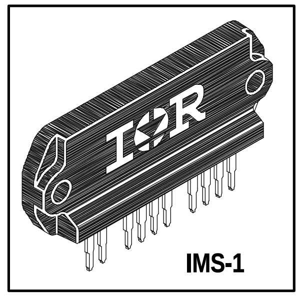
Product Summary

Output Current in a Typical 5.0 kHz Motor Drive

14 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.



IMS-1

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	42	A
I_C @ T_C = 100°C	Continuous Collector Current, each IGBT	23	
I_{CM}	Pulsed Collector Current ①	120	
I_{LM}	Clamped Inductive Load Current ②	120	
I_F @ T_C = 100°C	Diode Continuous Forward Current	15	
I_{FM}	Diode Maximum Forward Current	120	
V_{GE}	Gate-to-Emitter Voltage	±20	V
V_{ISOL}	Isolation Voltage, any terminal to case, 1 min.	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 T_{STG}	Operating Junction and Storage Temperature Range	-40 to +150	°C
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	
	Mounting torque, 6-32 or M3 screw.	5-7 lbf•in (0.55-0.8 N•m)	

Thermal Resistance

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

Revision 1

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	
$\Delta V_{(BR)CES}/\Delta T_J$	Temp. Coeff. of Breakdown Voltage	—	0.62	—	V/°C	V_{GE} = 0V, I_C = 1.0mA	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.3	1.5	V	I_C = 23A	V_{GE} = 15V
		—	1.7	—		I_C = 42A	See Fig. 2, 5
		—	1.4	—		I_C = 23A, T_J = 150°C	
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	5.5		V_{CE} = V_{GE}, I_C = 250µA	
$\Delta V_{GE(th)}/\Delta T_J$	Temp. Coeff. of Threshold Voltage	—	-14	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA	
g_{fe}	Forward Transconductance ④	21	30	—	S	V_{CE} = 100V, I_C = 39A	
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)	—	84	100	nC	I_C = 39A		
Q_{ge}	Gate - Emitter Charge (turn-on)	—	20	25		V_{CC} = 400V		
Q_{gc}	Gate - Collector Charge (turn-on)	—	51	67		See Fig. 8		
$t_{d(on)}$	Turn-On Delay Time	—	24	—	ns	T_J = 25°C		
t_r	Rise Time	—	50	—		I_C = 39A, V_{CC} = 480V		
$t_{d(off)}$	Turn-Off Delay Time	—	270	540		V_{GE} = 15V, R_G = 5.0Ω		
t_f	Fall Time	—	210	360		Energy losses include "tail" and		
E_{on}	Turn-On Switching Loss	—	1.1	—	mJ	diode reverse recovery		
E_{off}	Turn-Off Switching Loss	—	2.1	—		See Fig. 9, 10, 11, 18		
E_{ts}	Total Switching Loss	—	3.2	5.4				
$t_{d(on)}$	Turn-On Delay Time	—	25	—	ns	T_J = 150°C, See Fig. 9, 10, 11, 18		
t_r	Rise Time	—	49	—		I_C = 39A, V_{CC} = 480V		
$t_{d(off)}$	Turn-Off Delay Time	—	440	—		V_{GE} = 15V, R_G = 5.0Ω		
t_f	Fall Time	—	410	—		Energy losses include "tail" and		
E_{ts}	Total Switching Loss	—	5.8	—	mJ	diode reverse recovery		
C_{ies}	Input Capacitance	—	3000	—	pF	V_{GE} = 0V		
C_{oes}	Output Capacitance	—	340	—		V_{CC} = 30V See Fig. 7		
C_{res}	Reverse Transfer Capacitance	—	40	—		f = 1.0MHz		
t_{rr}	Diode Reverse Recovery Time	—	50	75	ns	T_J = 25°C	See Fig.	
		—	105	160		T_J = 125°C	14	I_F = 25A
I_{rr}	Diode Peak Reverse Recovery Current	—	4.5	10	A	T_J = 25°C	See Fig.	
		—	8.0	15		T_J = 125°C	15	V_R = 200V
Q_{rr}	Diode Reverse Recovery Charge	—	112	375	nC	T_J = 25°C	See Fig.	
		—	420	1200		T_J = 125°C	16	di/dt = 200A/µs
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	—	250	—	A/µs	T_J = 25°C	See Fig.	
		—	160	—		T_J = 125°C	17	

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.

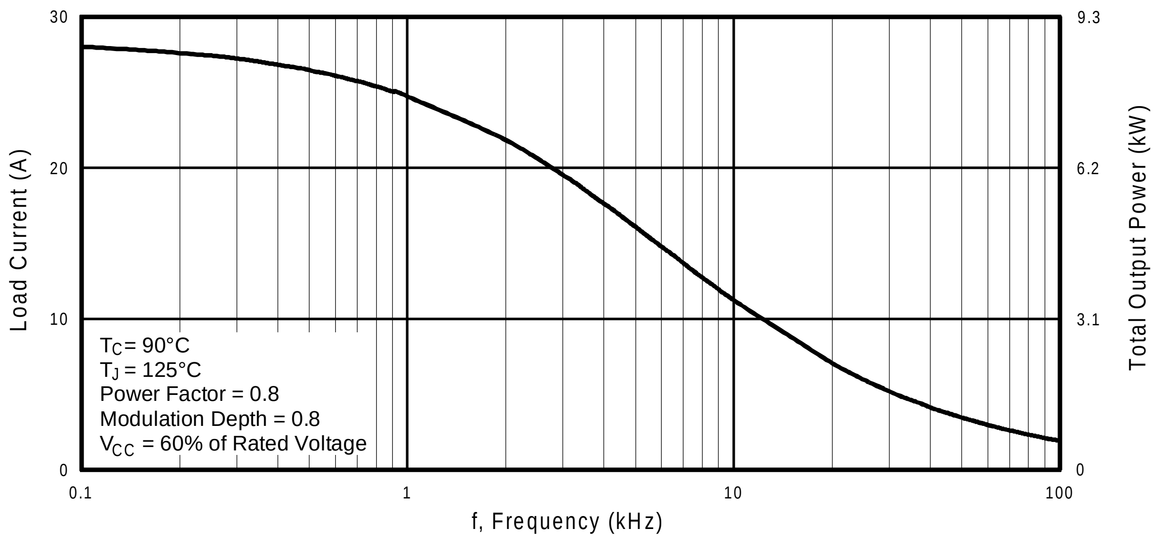


Fig. 1 - RMS Current and Output Power, Synthesized Sine Wave

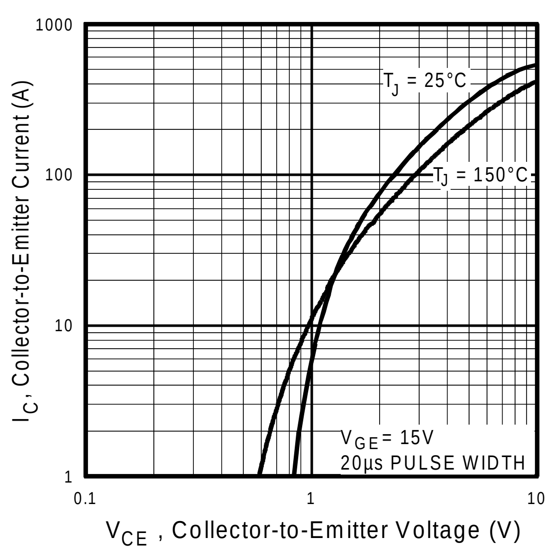


Fig. 2 - Typical Output Characteristics

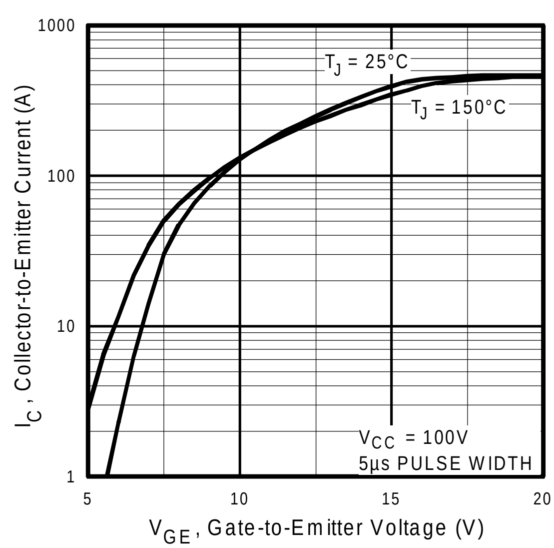


Fig. 3 - Typical Transfer Characteristics

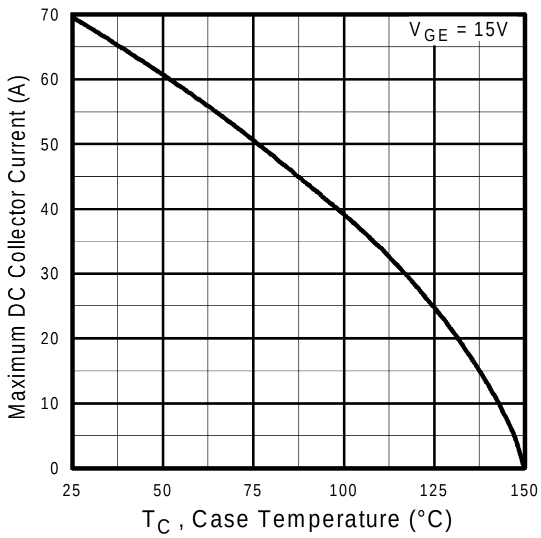


Fig. 4 - Maximum Collector Current vs. Case Temperature

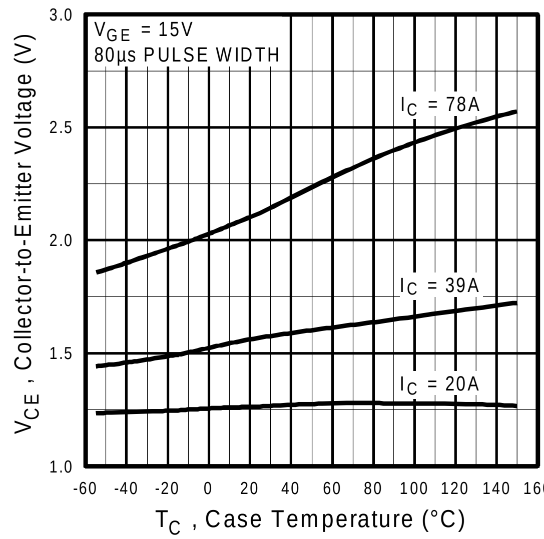


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

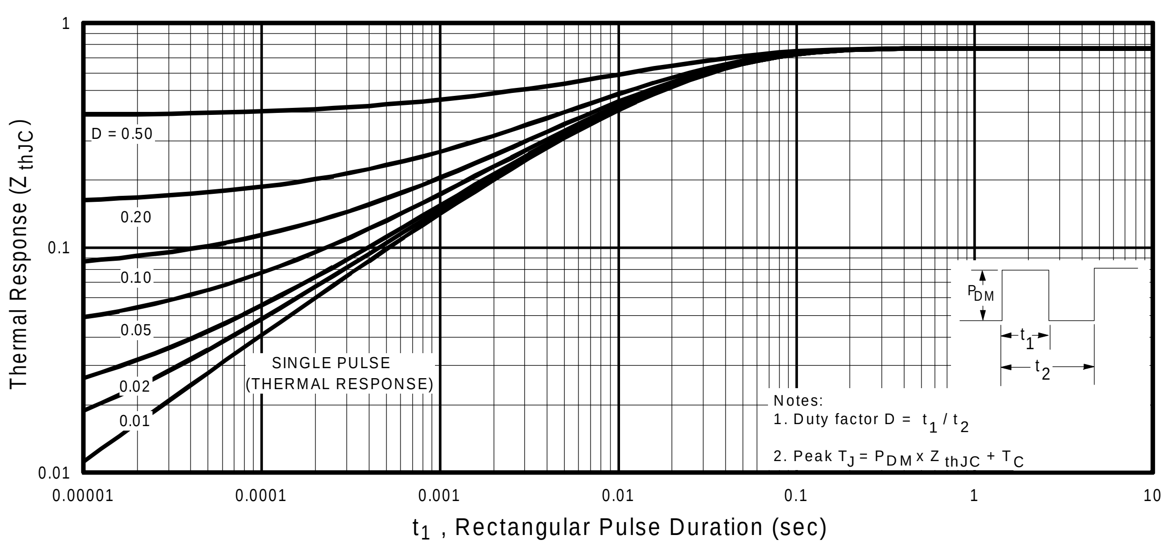


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

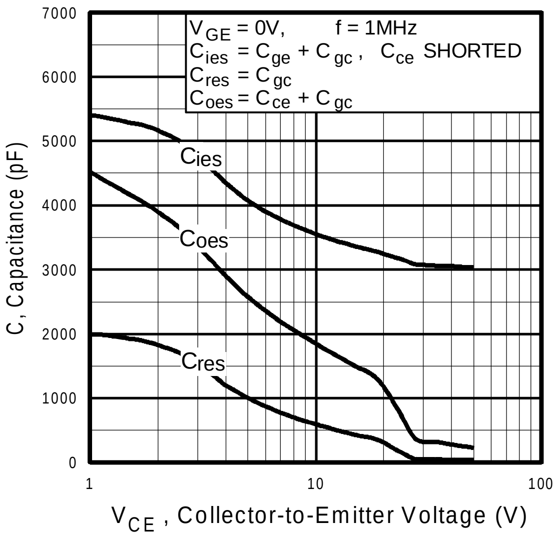


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

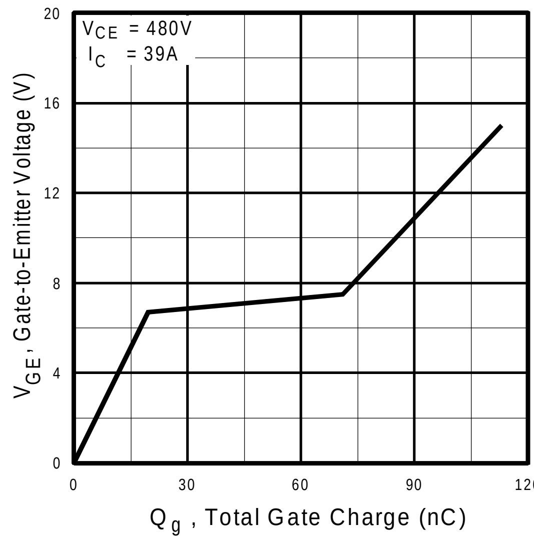


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

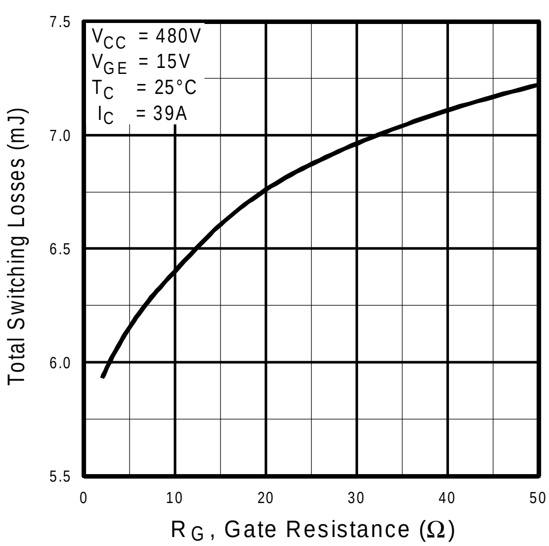


Fig. 9 - Typical Switching Losses vs. Gate Resistance

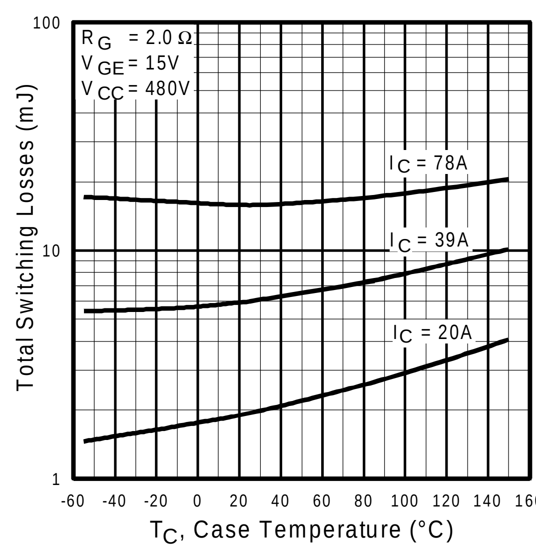


Fig. 10 - Typical Switching Losses vs. Case Temperature

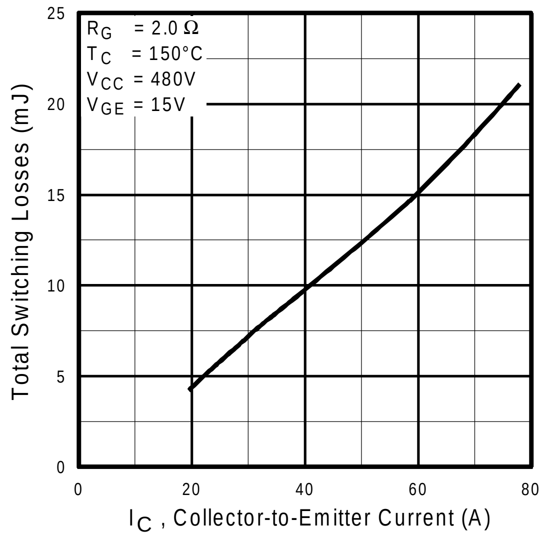


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

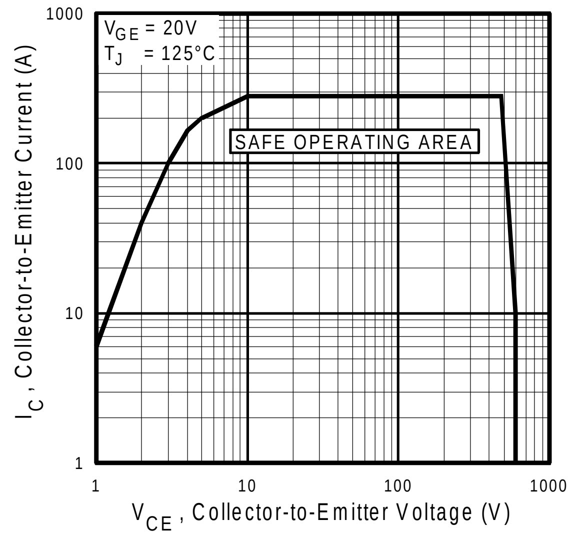


Fig. 12 - Turn-Off SOA

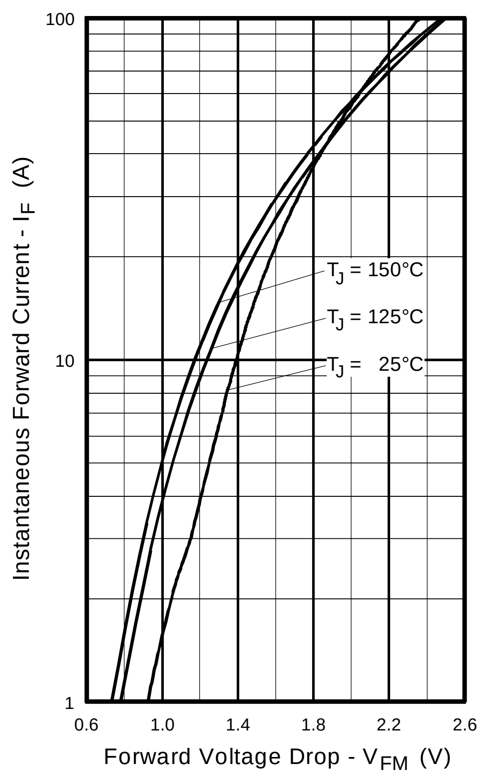


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

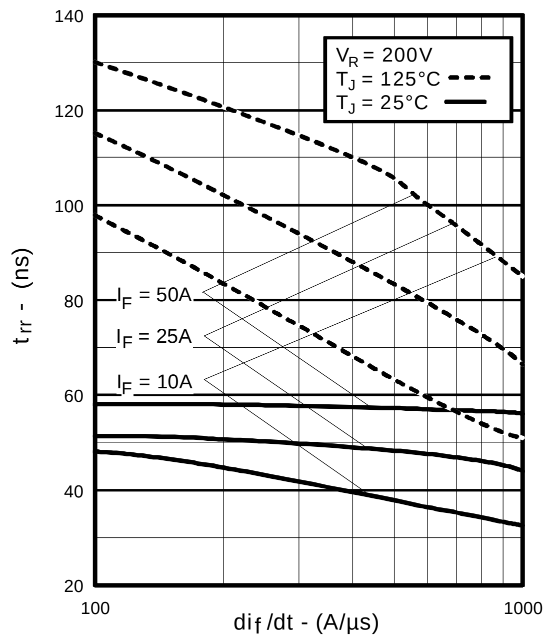


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

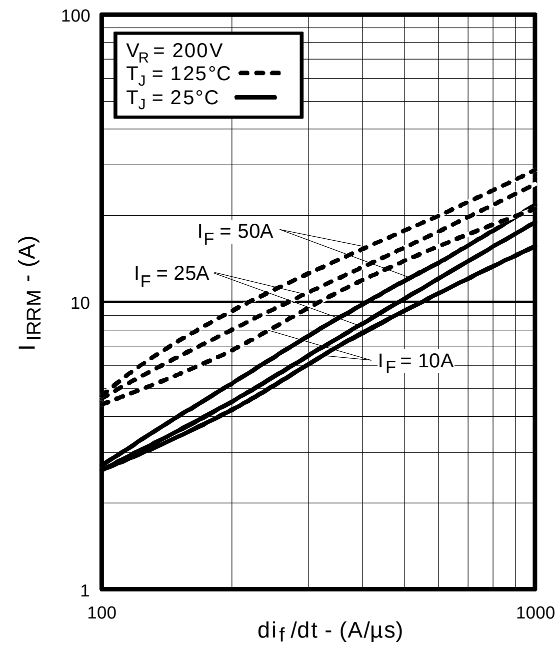


Fig. 15 - Typical Recovery Current vs. di_f/dt

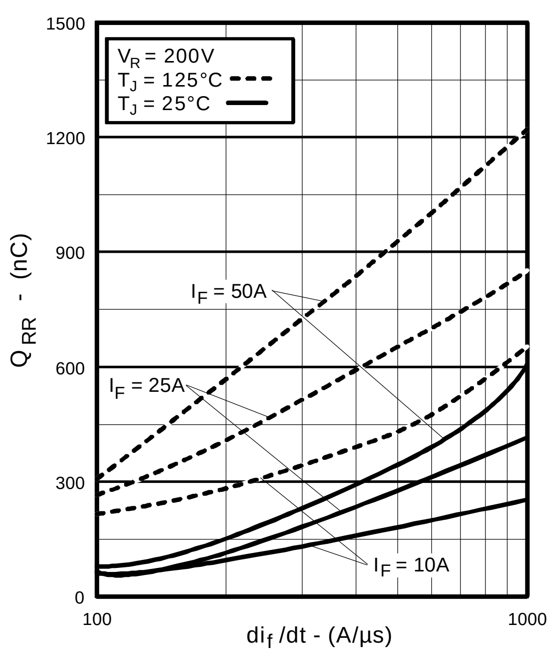


Fig. 16 - Typical Stored Charge vs. di_f/dt

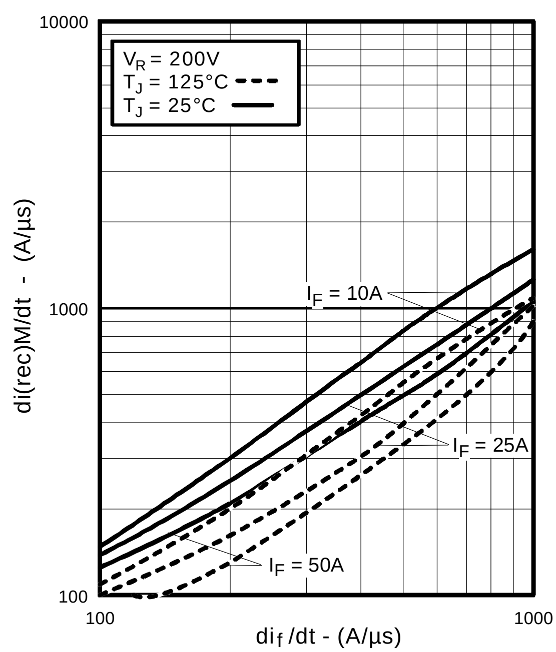


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

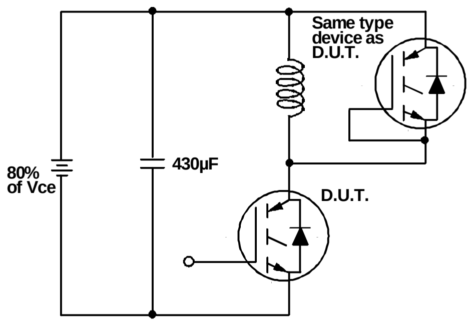


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

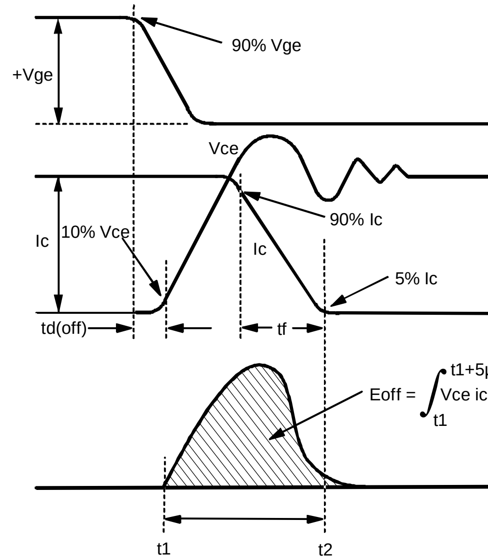


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

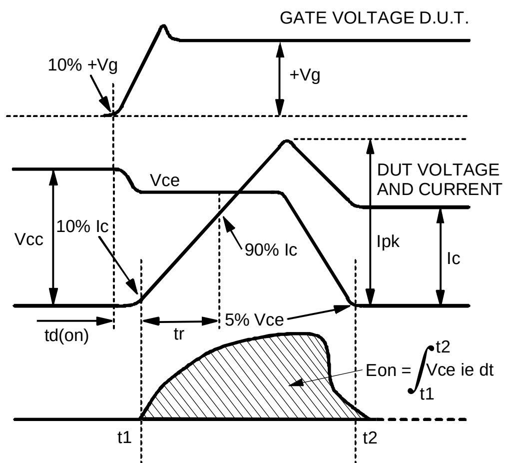


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

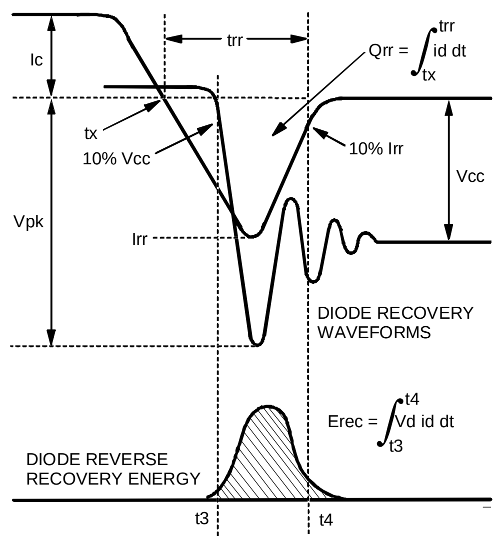


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

Refer to Section D for the following:
Appendix D: Section D - page D-6

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

Package Outline 4 - IMS-1 Package (10 pins) **Section D - page D-13**