International
IOR Rectifier

PD - 5.029

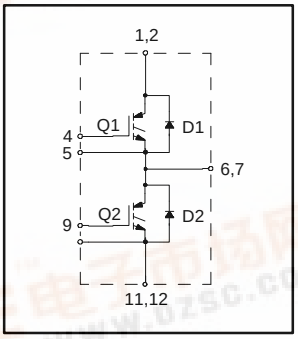
CPU165MU

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



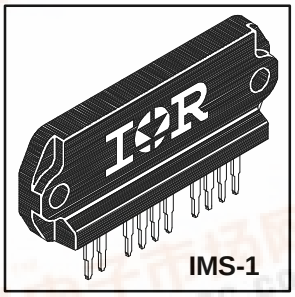
Product Summary

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.



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	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.	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)

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
$\Delta V_{(BR)CES}/\Delta T_J$	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 V_{GE} = 15V
		—	2.2	—		I_C = 33A See Fig. 2, 5
		—	1.6	—		I_C = 17A, T_J = 150°C
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	5.5		V_{CE} = V_{GE}, I_C = 250µA
$\Delta V_{GE(th)}/\Delta T_J$	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
Q_{ge}	Gate - Emitter Charge (turn-on)	—	17	21		V_{CC} = 400V
Q_{gc}	Gate - Collector Charge (turn-on)	—	52	70		See Fig. 8
$t_{d(on)}$	Turn-On Delay Time	—	23	—	ns	T_J = 25°C
t_r	Rise Time	—	28	—		I_C = 27A, V_{CC} = 480V
$t_{d(off)}$	Turn-Off Delay Time	—	100	200		V_{GE} = 15V, R_G = 5.0Ω
t_f	Fall Time	—	45	140		Energy losses include "tail" and
E_{on}	Turn-On Switching Loss	—	0.76	—	mJ	diode reverse recovery.
E_{off}	Turn-Off Switching Loss	—	0.26	—		See Fig. 9, 10, 11, 18
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
t_r	Rise Time	—	27	—		I_C = 27A, V_{CC} = 480V
$t_{d(off)}$	Turn-Off Delay Time	—	180	—		V_{GE} = 15V, R_G = 5.0Ω
t_f	Fall Time	—	130	—		Energy losses include "tail" and
E_{ts}	Total Switching Loss	—	3.7	—	mJ	diode reverse recovery.
C_{ies}	Input Capacitance	—	2900	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	330	—		V_{CC} = 30V See Fig. 7
C_{res}	Reverse Transfer Capacitance	—	41	—		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	—	250	—	A/µs	T_J = 25°C See Fig.
	During t_b	—	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.

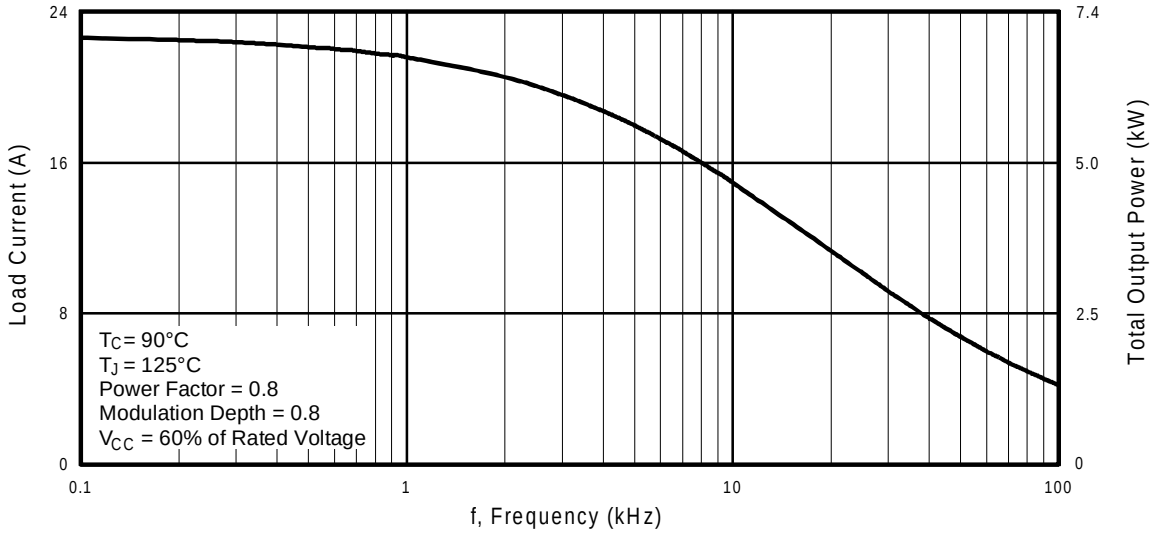


Fig. 1 - RMS Current and Output Power, Synthesized Sine Wave

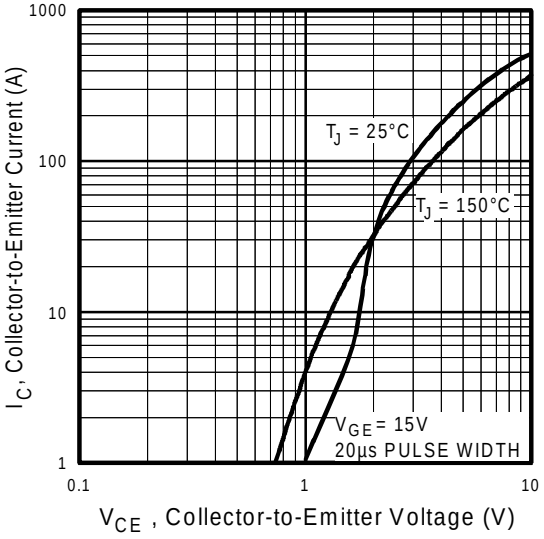


Fig. 2 - Typical Output Characteristics

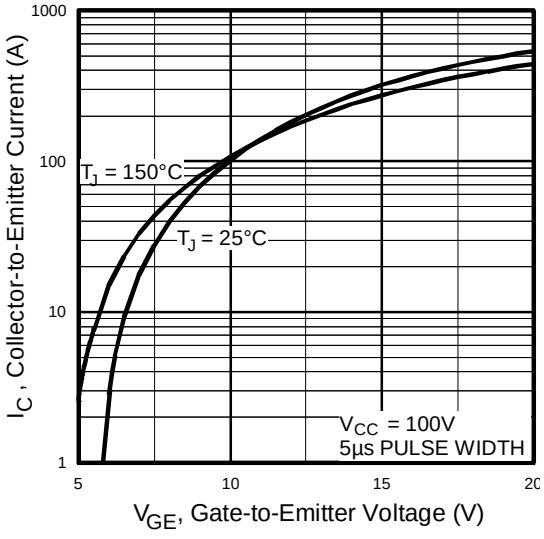


Fig. 3 - Typical Transfer Characteristics

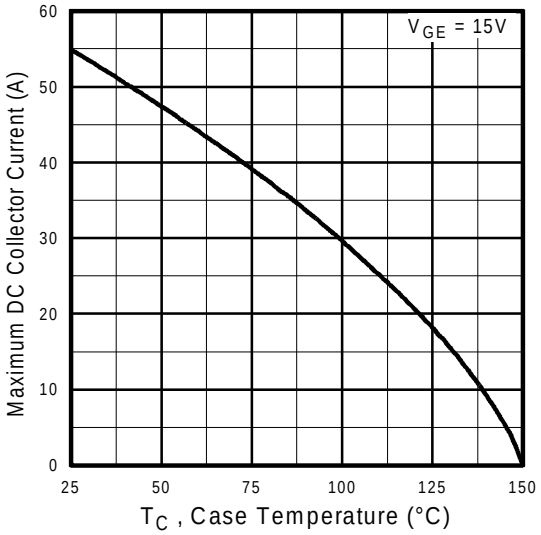


Fig. 4 - Maximum Collector Current vs. Case Temperature

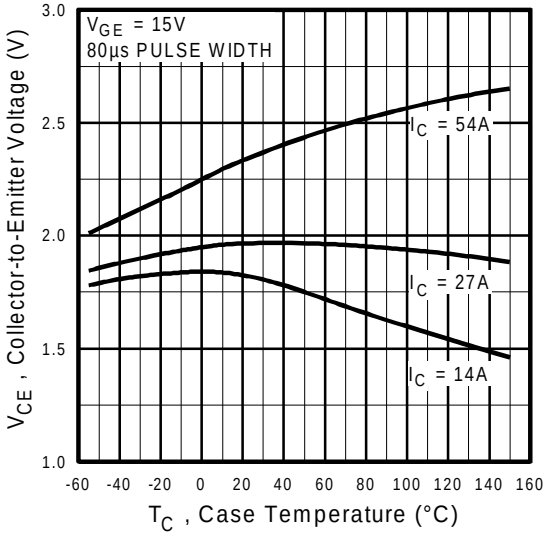


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

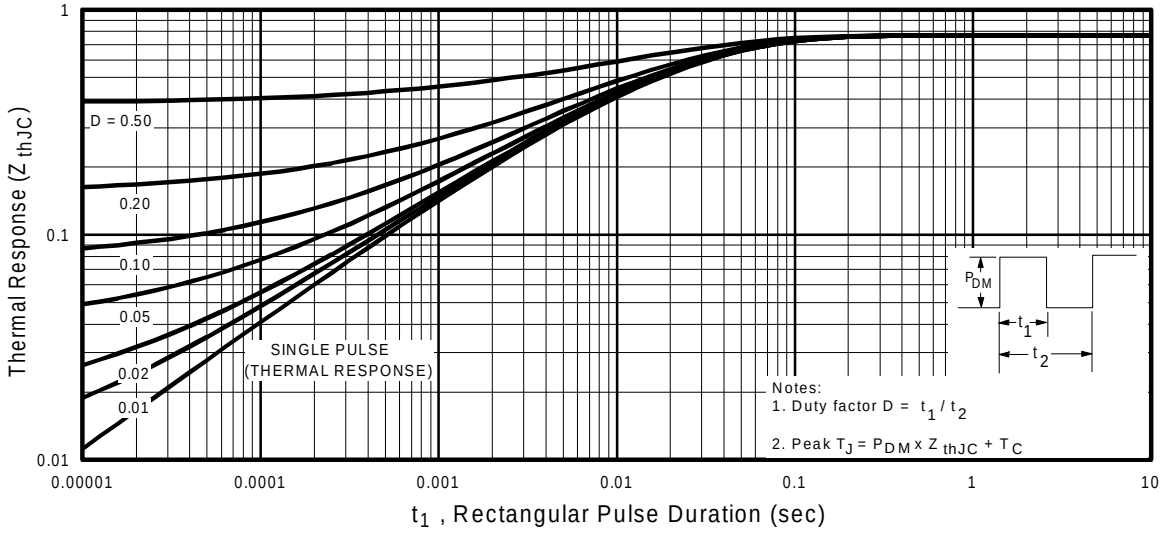


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

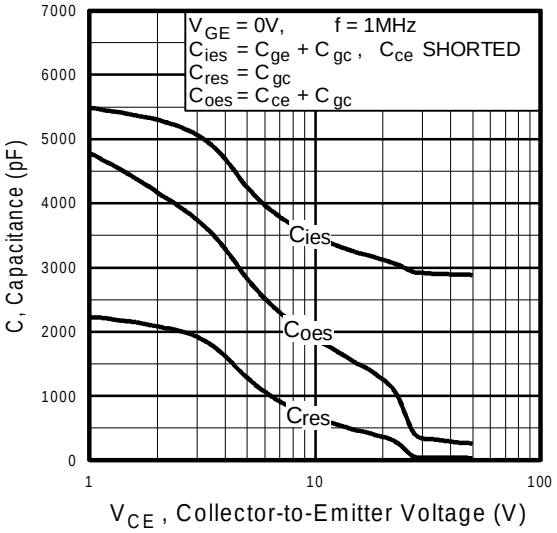


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

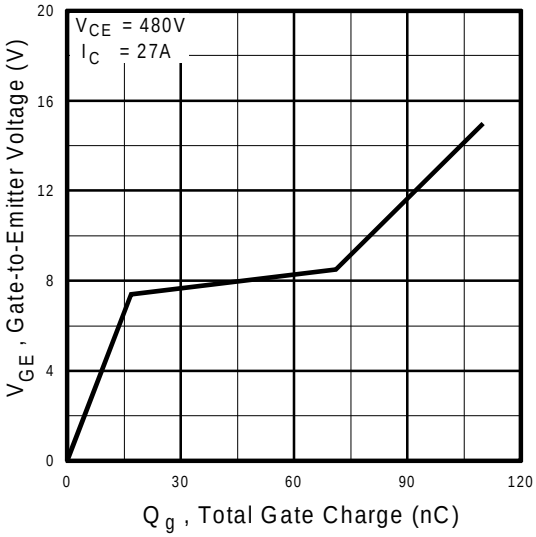


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

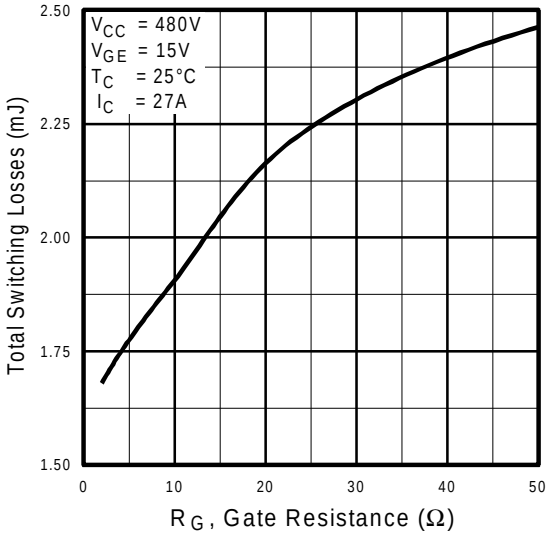


Fig. 9 - Typical Switching Losses vs. Gate Resistance

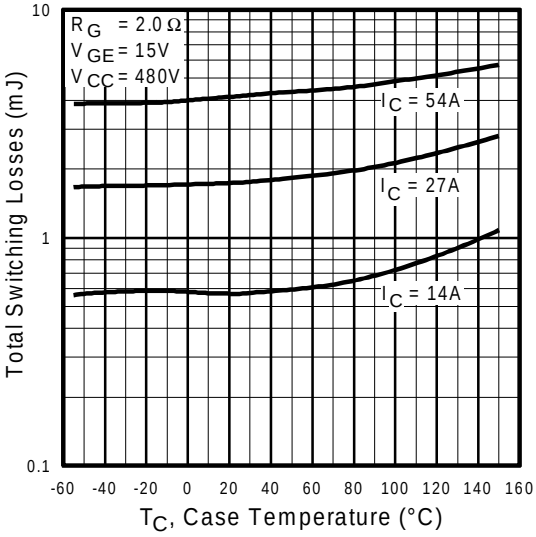


Fig. 10 - Typical Switching Losses vs. Case Temperature

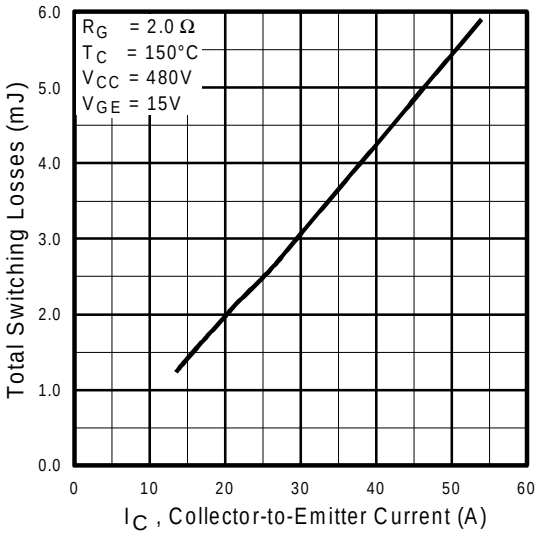


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

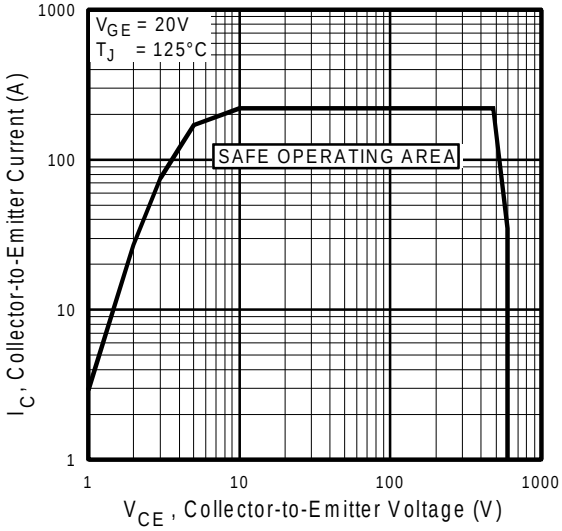


Fig. 12 - Turn-Off SOA

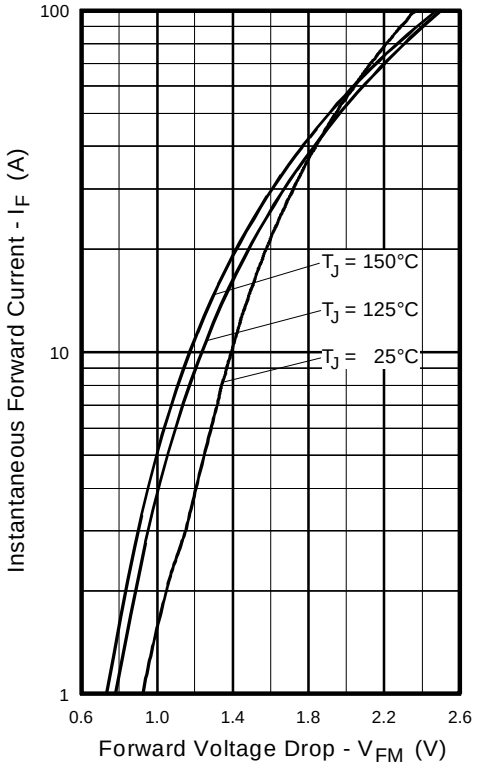


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

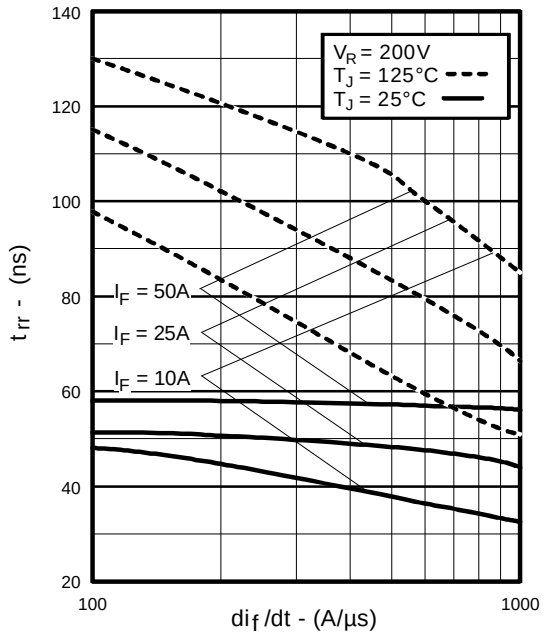


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

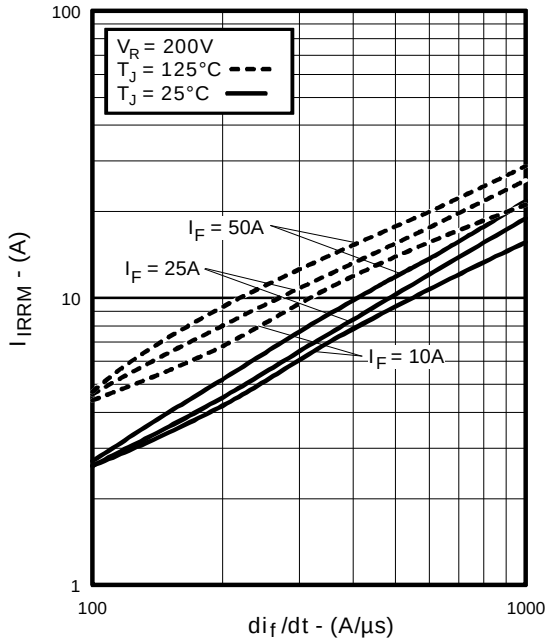


Fig. 15 - Typical Recovery Current vs. di_f/dt

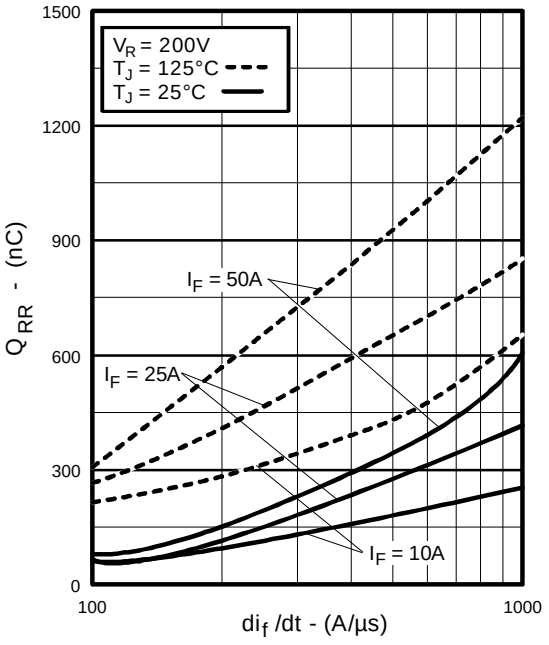


Fig. 16 - Typical Stored Charge vs. di_f/dt

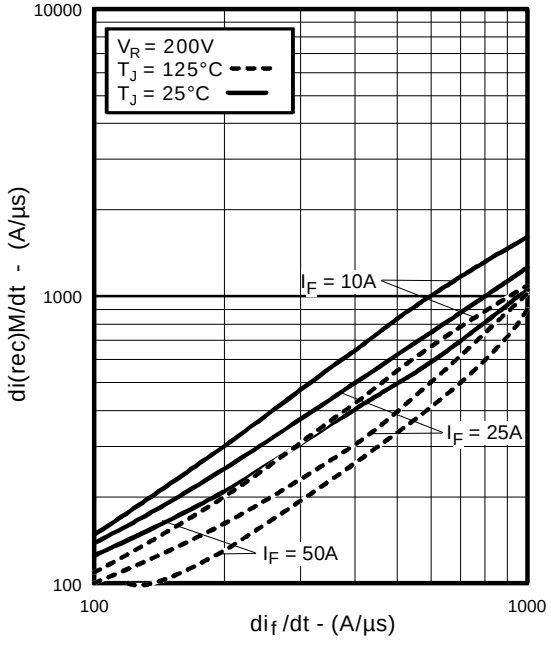


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

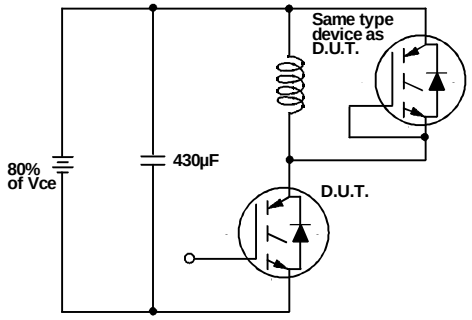


Fig.18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

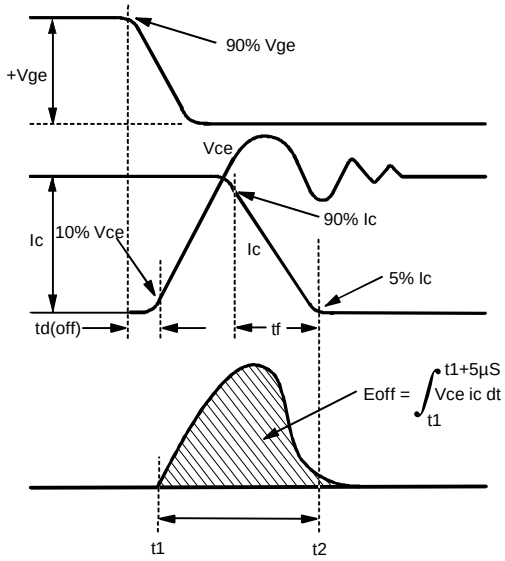


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

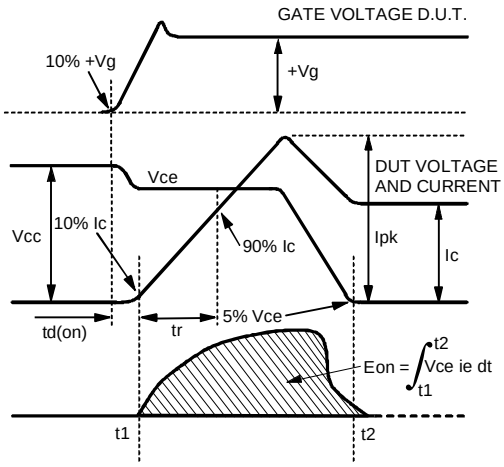


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

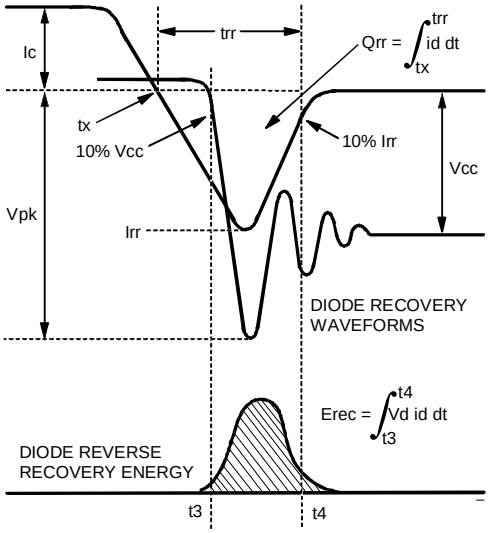


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

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

Fig. 18e - Macro Waveforms for Test Circuit of 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**