PD -5039

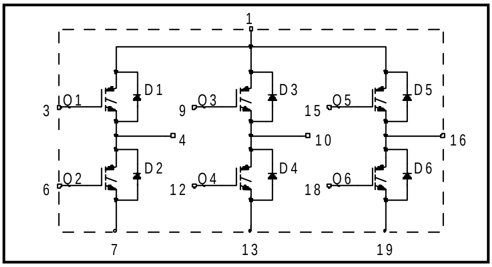
International
IOR Rectifier

PRELIMINARY

CPV363M4U

IGBT SIP MODULE

UltraFast 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

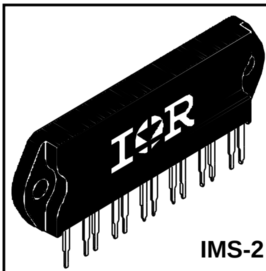
Product Summary

Output Current in a Typical 20 kHz Motor Drive

7.1 A_{RMS} per phase (2.1 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.



IMS-2

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	13	A
I_C @ T_C = 100°C	Continuous Collector Current, each IGBT	6.8	
I_{CM}	Pulsed Collector Current ①	40	
I_{LM}	Clamped Inductive Load Current ②	40	
I_F @ T_C = 100°C	Diode Continuous Forward Current	6.1	
I_{FM}	Diode Maximum Forward Current	40	
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	36	W
P_D @ T_C = 100°C	Maximum Power Dissipation, each IGBT	14	
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	–––	3.5	°C/W
$R_{\theta JC}$ (DIODE)	Junction-to-Case, each diode, one diode in conduction	–––	5.5	
$R_{\theta CS}$ (MODULE)	Case-to-Sink, flat, greased surface	0.10	–––	
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 Voltage③	600	——	——	V	V_{GE} = 0V, I_C = 250µA
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	——	0.63	——	V/°C	V_{GE} = 0V, I_C = 1.0mA
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	——	1.70	2.2	V	I_C = 6.8A; V_{GE} = 15V
		——	2.00	——		I_C = 13A; See Fig. 2, 5
		——	1.70	——		I_C = 6.8A, T_J = 150°C
$V_{GE(th)}$	Gate Threshold Voltage	3.0	——	6.0		$V_{CE} = V_{GE}$, I_C = 250µA
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	——	-11	——	mV/°C	$V_{CE} = V_{GE}$, I_C = 250µA
g_{fe}	Forward Transconductance ④	4.0	6.0	——	S	V_{CE} = 100V, I_C = 6.8A
I_{CES}	Zero Gate Voltage Collector Current	——	——	250	µA	V_{GE} = 0V, V_{CE} = 600V
		——	——	2500		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 Fig. 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)	——	53	79	nC	I_C = 6.8A	
Q_{ge}	Gate - Emitter Charge (turn-on)	——	7.7	12		V_{CC} = 400V	
Q_{gc}	Gate - Collector Charge (turn-on)	——	21	31		See Fig. 8	
$t_{d(on)}$	Turn-On Delay Time	——	43	——	ns	T_J = 25°C	
t_r	Rise Time	——	14	——		I_C = 6.8A, V_{CC} = 480V	
$t_{d(off)}$	Turn-Off Delay Time	——	95	140		V_{GE} = 15V, R_G = 23Ω	
t_f	Fall Time	——	83	190		Energy losses include "tail" and	
E_{on}	Turn-On Switching Loss	——	0.17	——	mJ	diode reverse recovery.	
E_{off}	Turn-Off Switching Loss	——	0.15	——		See Fig. 9, 10, 11, 18	
E_{ts}	Total Switching Loss	——	0.32	0.45			
$t_{d(on)}$	Turn-On Delay Time	——	41	——	ns	T_J = 150°C, See Fig. 9, 10, 11, 18	
t_r	Rise Time	——	16	——		I_C = 6.8A, V_{CC} = 480V	
$t_{d(off)}$	Turn-Off Delay Time	——	110	——		V_{GE} = 15V, R_G = 23Ω	
t_f	Fall Time	——	230	——		Energy losses include "tail" and	
E_{ts}	Total Switching Loss	——	0.52	——	mJ	diode reverse recovery.	
C_{ies}	Input Capacitance	——	1100	——	pF	V_{GE} = 0V	
C_{oes}	Output Capacitance	——	73	——		V_{CC} = 30V; See Fig. 7	
C_{res}	Reverse Transfer Capacitance	——	14	——		f = 1.0MHz	
t_{rr}	Diode Reverse Recovery Time	——	42	60	ns	T_J = 25°C; See Fig.	
		——	83	120		T_J = 125°C; 14	I_F = 12A
I_{rr}	Diode Peak Reverse Recovery Charge	——	3.5	6.0	A	T_J = 25°C; See Fig.	
		——	5.6	10		T_J = 125°C; 15	V_R = 200V
Q_{rr}	Diode Reverse Recovery Charge	——	80	180	nC	T_J = 25°C; See Fig.	
		——	220	600		T_J = 125°C; 16	di/dt =200Aµs
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery	——	180	——	A/µs	T_J = 25°C; See Fig.	
	During t_b	——	116	——		T_J = 125°C; 17	

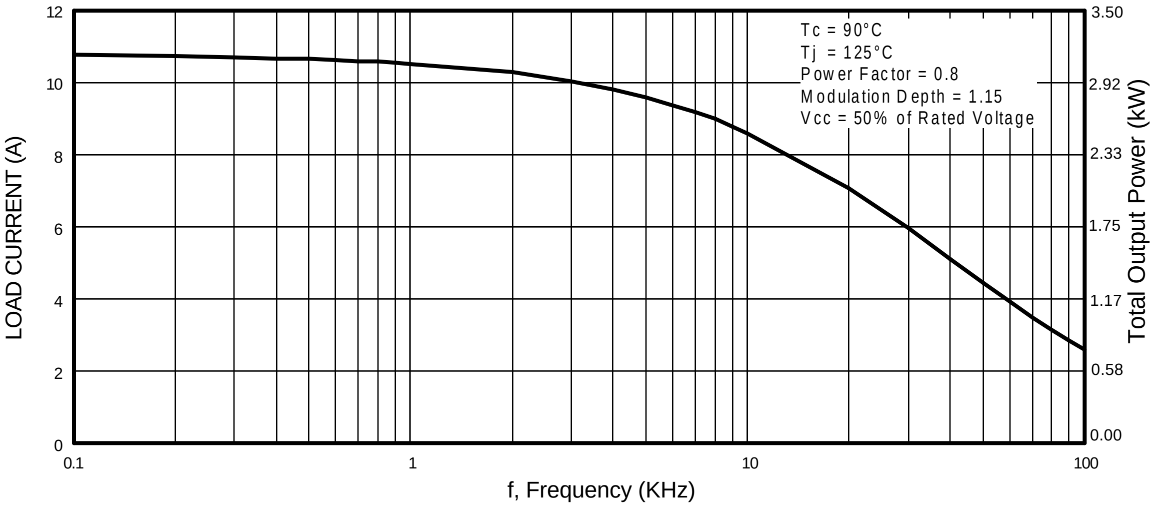


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

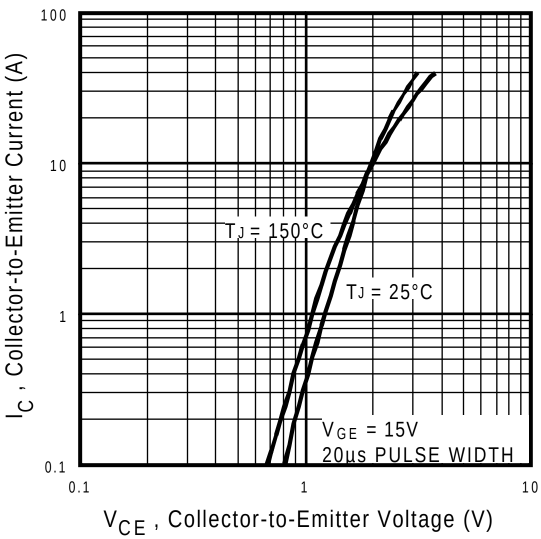


Fig. 2 - Typical Output Characteristics

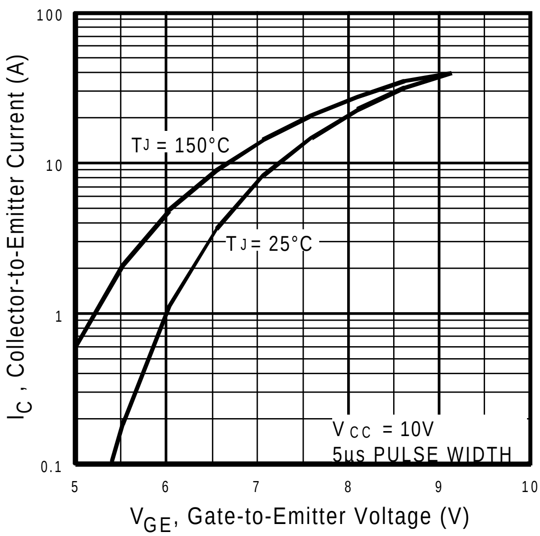
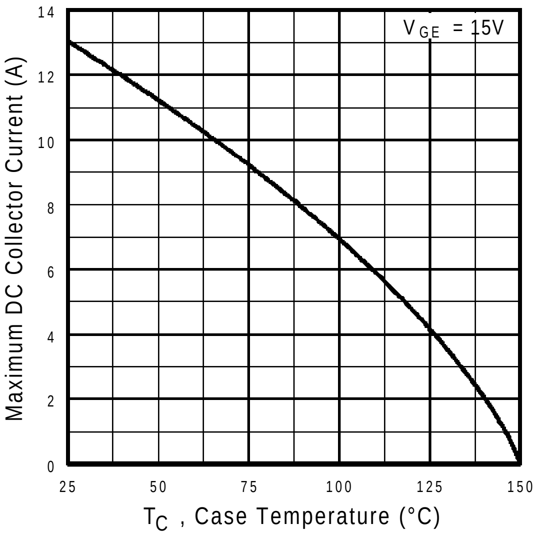


Fig. 3 - Typical Transfer Characteristics



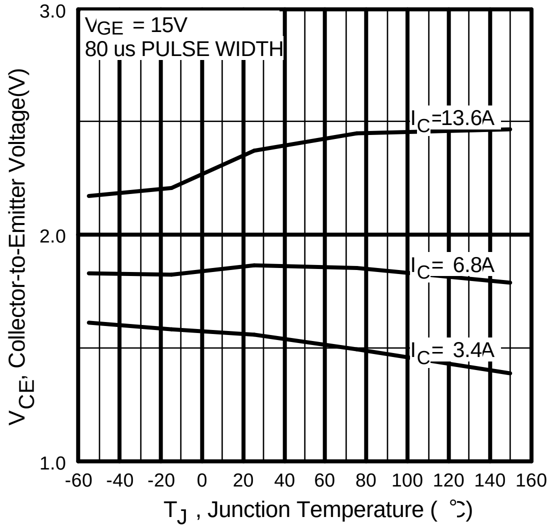


Fig. 4 - Maximum Collector Current vs. Case Temperature

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

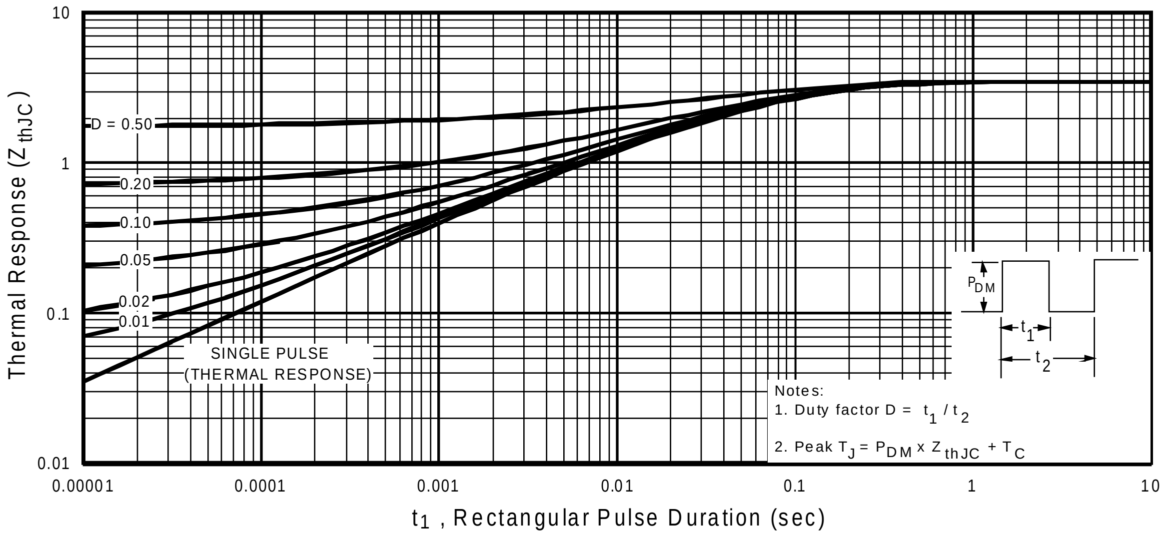


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

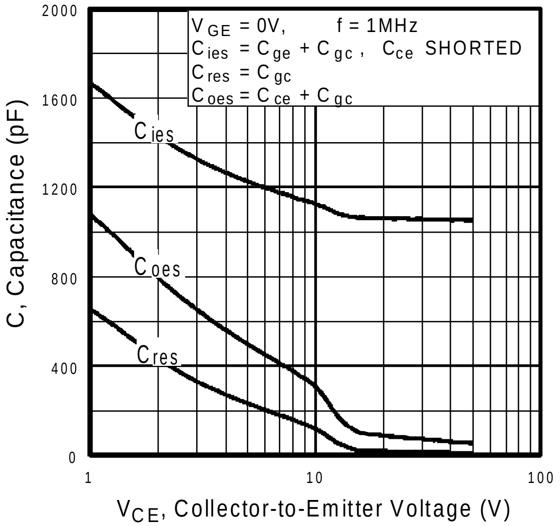


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

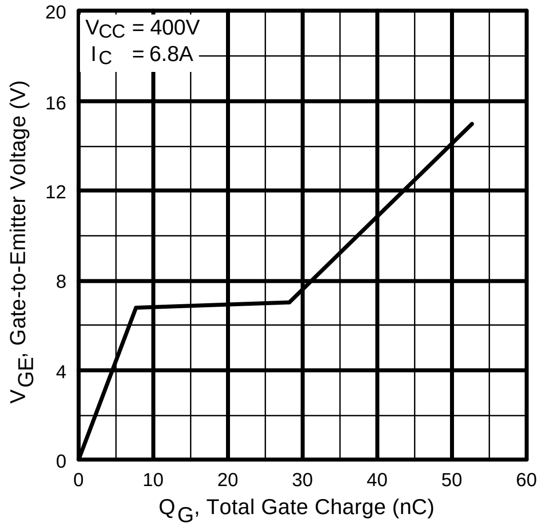


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

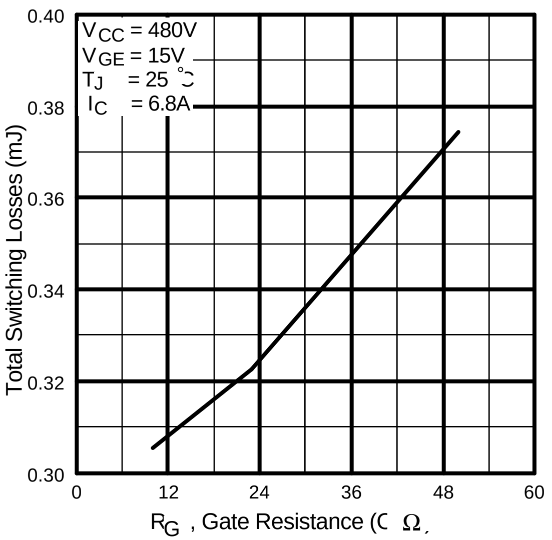


Fig. 9 - Typical Switching Losses vs. Gate Resistance

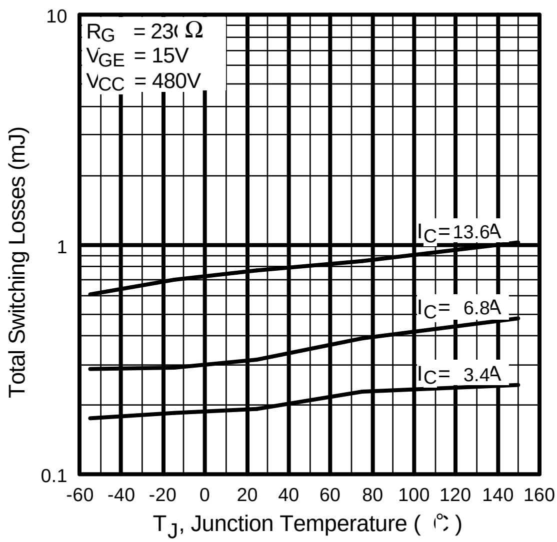


Fig. 10 - Typical Switching Losses vs. Junction Temperature

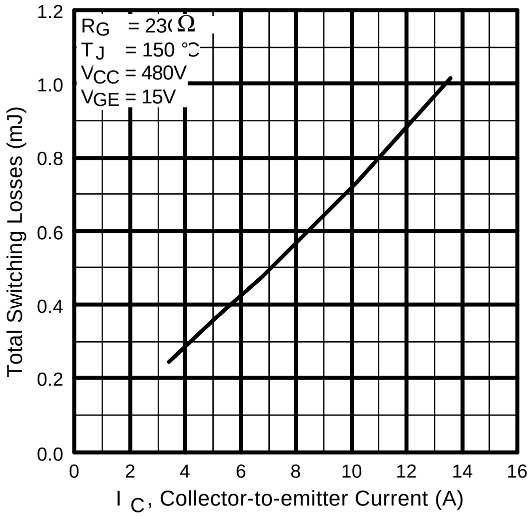


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

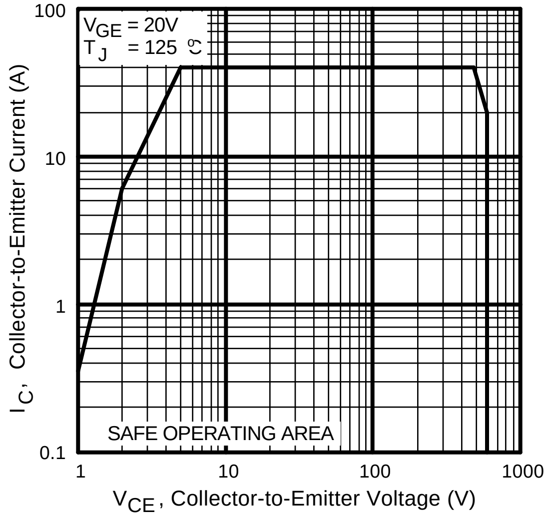


Fig. 12 - Turn-Off SOA

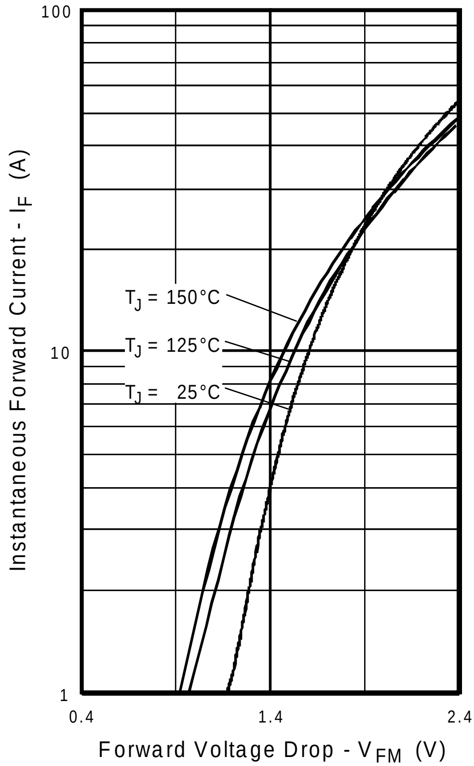


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

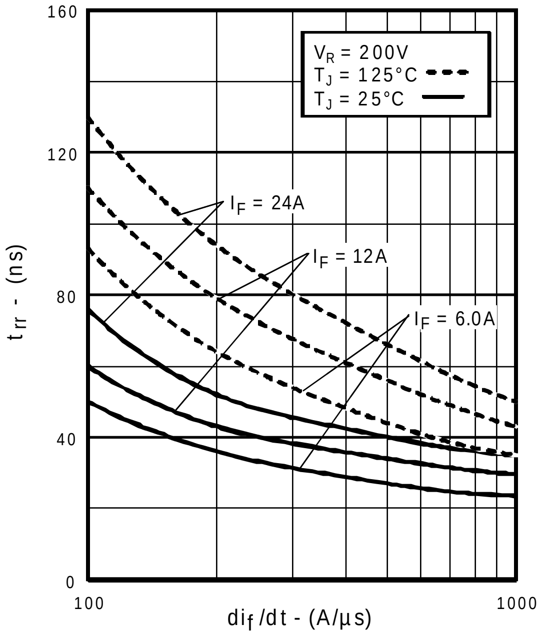


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

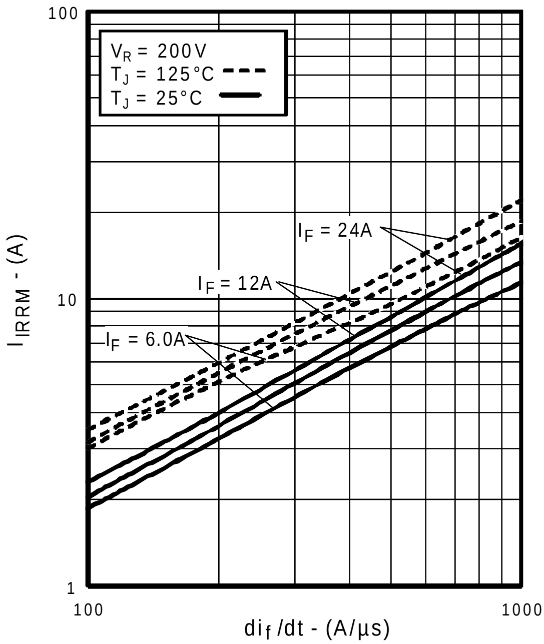


Fig. 15 - Typical Recovery Current vs. di_f/dt

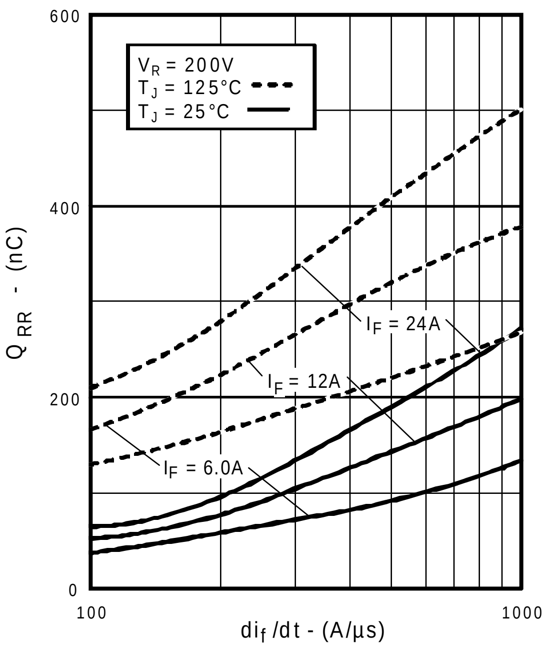


Fig. 16 - Typical Stored Charge vs. di_f/dt

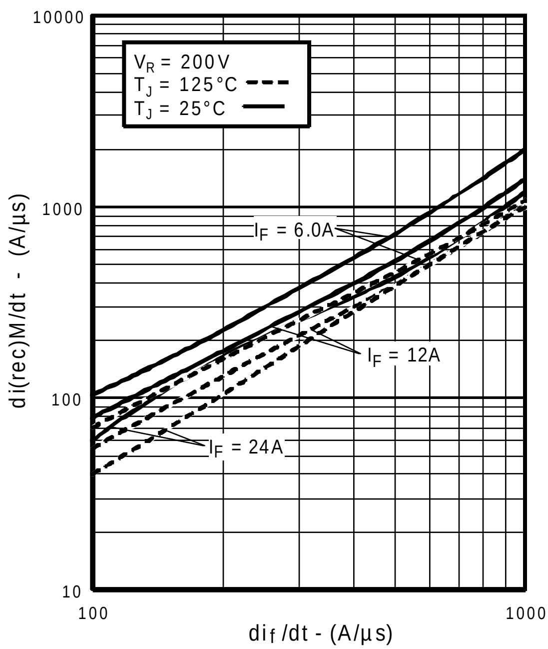


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

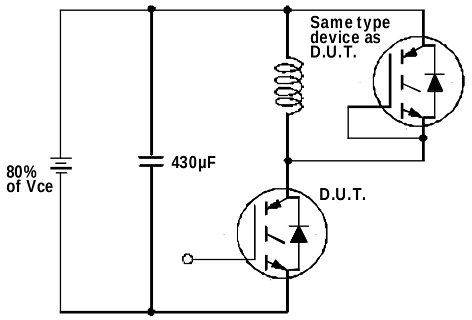


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

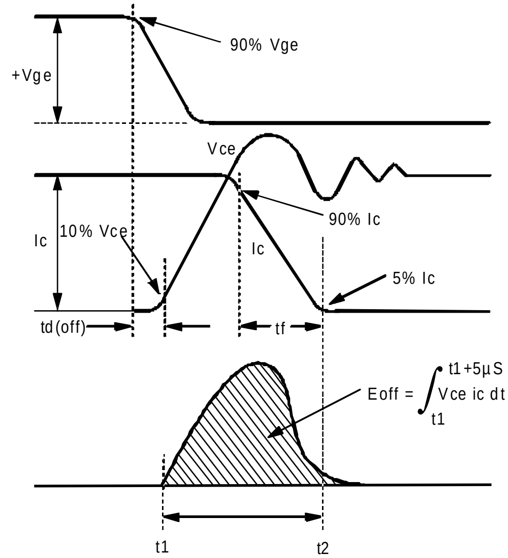


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

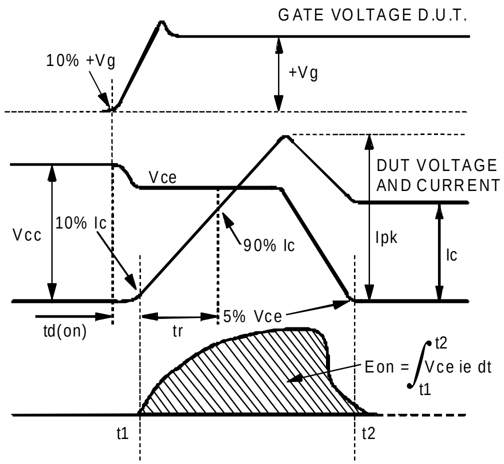


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

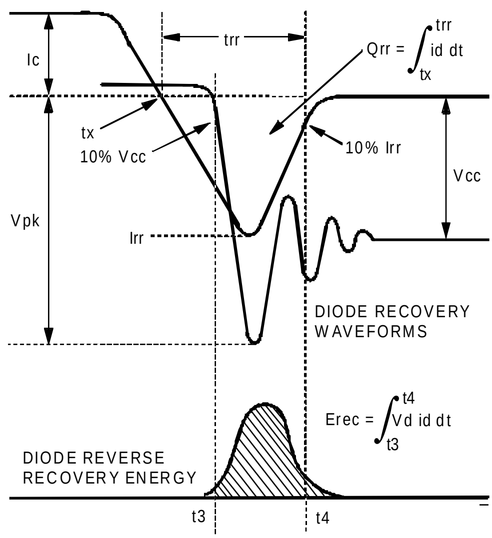


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

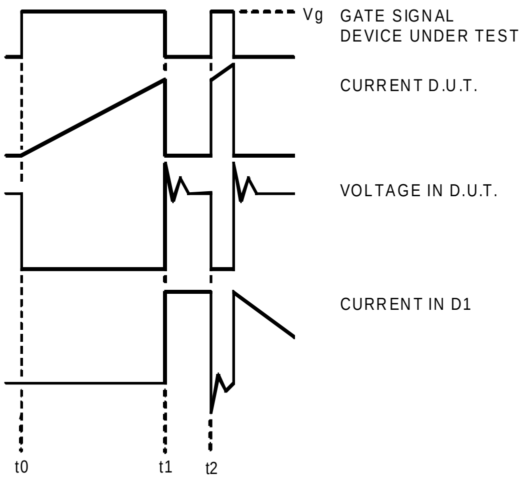


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

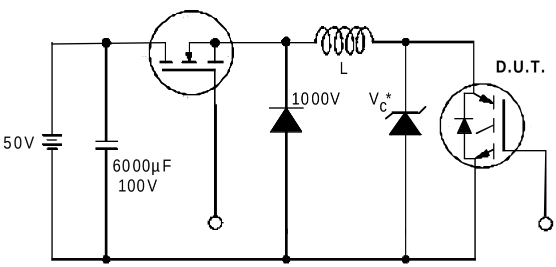


Figure 19. Clamped Inductive Load Test Circuit

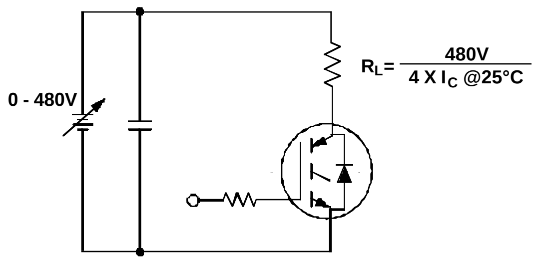


Figure 20. Pulsed Collector Current Test Circuit

Notes:

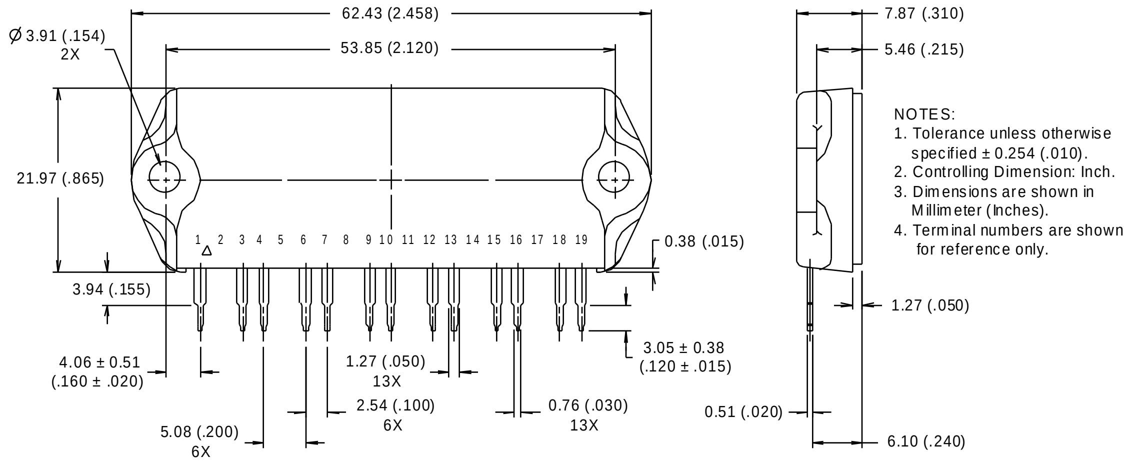
① Repetitive rating: V_{GE}=20V; pulse width limited by maximum junction temperature (figure 20)

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.

Case Outline — IMS-2



IMS-2 Package Outline (13 Pins)
Dimensions in Millimeters and (Inches)

International IOR Rectifier

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