PD- 5041

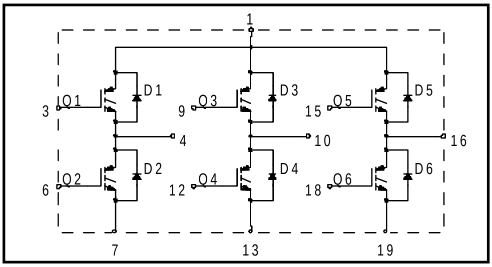
International
IOR Rectifier

PRELIMINARY

CPV364M4U

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

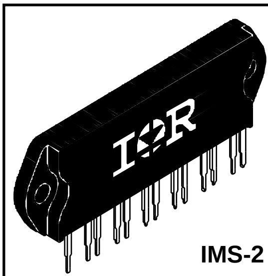
Product Summary

Output Current in a Typical 20 kHz Motor Drive

12 A_{RMS} per phase (3.5 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	20	A
I_C @ T_C = 100°C	Continuous Collector Current, each IGBT	10	
I_{CM}	Pulsed Collector Current ①	60	
I_{LM}	Clamped Inductive Load Current ②	60	
I_F @ T_C = 100°C	Diode Continuous Forward Current	9.3	
I_{FM}	Diode Maximum Forward Current	60	
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	63	W
P_D @ T_C = 100°C	Maximum Power Dissipation, each IGBT	25	
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	——	2.0	°C/W
$R_{\theta JC}$ (DIODE)	Junction-to-Case, each diode, one diode in conduction	——	3.0	
$R_{\theta CS}$ (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 Voltage ③	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	—	1.56	2.1	V	I_C = 10A; V_{GE} = 15V
		—	1.84	—		I_C = 20A; See Fig. 2, 5
		—	1.56	—		I_C = 10A, 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	—	-13	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA
g_{fe}	Forward Transconductance ④	11	18	—	S	V_{CE} = 100V, I_C = 10A
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	µA	V_{GE} = 0V, V_{CE} = 600V
		—	—	3500		V_{GE} = 0V, V_{CE} = 600V, T_J = 150°C
V_{FM}	Diode Forward Voltage Drop	—	1.3	1.7	V	I_C = 15A; See Fig. 13
		—	1.2	1.6		I_C = 15A, 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)	—	100	160	nC	I_C = 10A	
Q_{ge}	Gate - Emitter Charge (turn-on)	—	16	24		V_{CC} = 400V	
Q_{gc}	Gate - Collector Charge (turn-on)	—	40	55		V_{GE} = 15V See Fig. 8	
$t_{d(on)}$	Turn-On Delay Time	—	41	—	ns	T_J = 25°C	
t_r	Rise Time	—	13	—		I_C = 10A, V_{CC} = 480V	
$t_{d(off)}$	Turn-Off Delay Time	—	96	140		V_{GE} = 15V, R_G = 10Ω	
t_f	Fall Time	—	110	160		Energy losses include "tail" and	
E_{on}	Turn-On Switching Loss	—	0.26	—	mJ	diode reverse recovery.	
E_{off}	Turn-Off Switching Loss	—	0.18	—		See Fig. 9, 10, 11, 18	
E_{ts}	Total Switching Loss	—	0.44	0.7			
$t_{d(on)}$	Turn-On Delay Time	—	39	—	ns	T_J = 150°C, See Fig. 9, 10, 11, 18	
t_r	Rise Time	—	15	—		I_C = 10A, V_{CC} = 480V	
$t_{d(off)}$	Turn-Off Delay Time	—	220	—		V_{GE} = 15V, R_G = 10Ω	
t_f	Fall Time	—	160	—		Energy losses include "tail" and	
E_{ts}	Total Switching Loss	—	0.74	—	mJ	diode reverse recovery.	
C_{ies}	Input Capacitance	—	2100	—	pF	V_{GE} = 0V	
C_{oes}	Output Capacitance	—	110	—		V_{CC} = 30V See Fig. 7	
C_{res}	Reverse Transfer Capacitance	—	34	—		f = 1.0MHz	
t_{rr}	Diode Reverse Recovery Time	—	42	60	ns	T_J = 25°C See Fig.	
		—	74	120		T_J = 125°C 14	I_F = 15A
I_{rr}	Diode Peak Reverse Recovery Charge	—	4.0	6.0	A	T_J = 25°C See Fig.	
		—	6.5	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	—	188	—	A/µs	T_J = 25°C See Fig.	
	During t_b	—	160	—		T_J = 125°C 17	

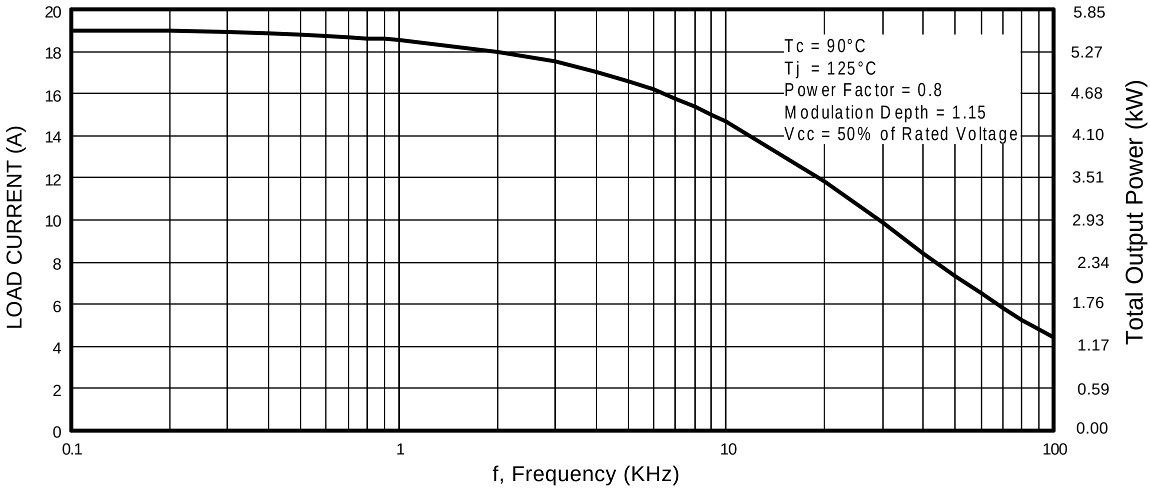


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

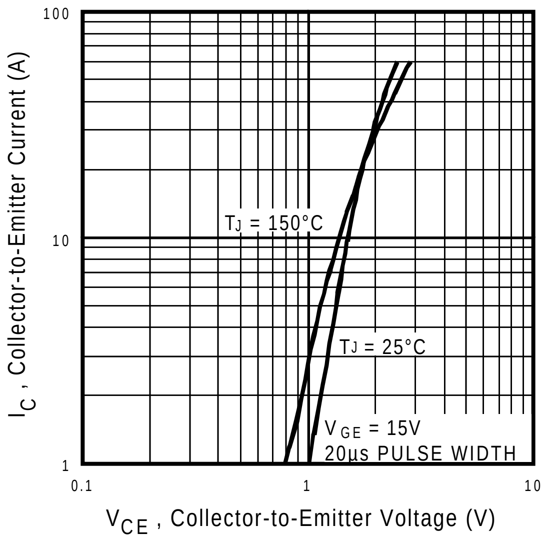


Fig. 2 - Typical Output Characteristics

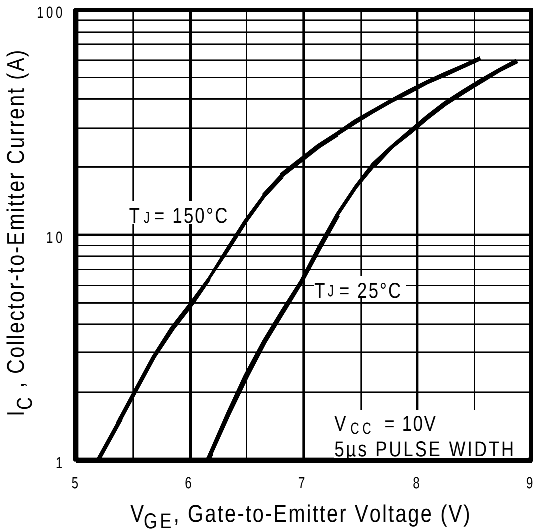


Fig. 3 - Typical Transfer Characteristics

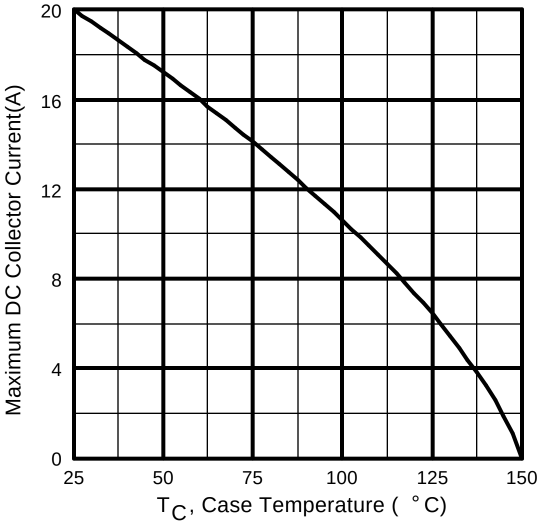


Fig. 4 - Maximum Collector Current vs. Case Temperature

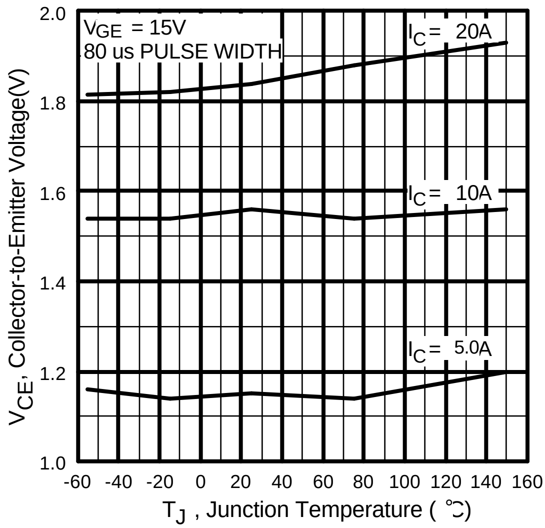


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

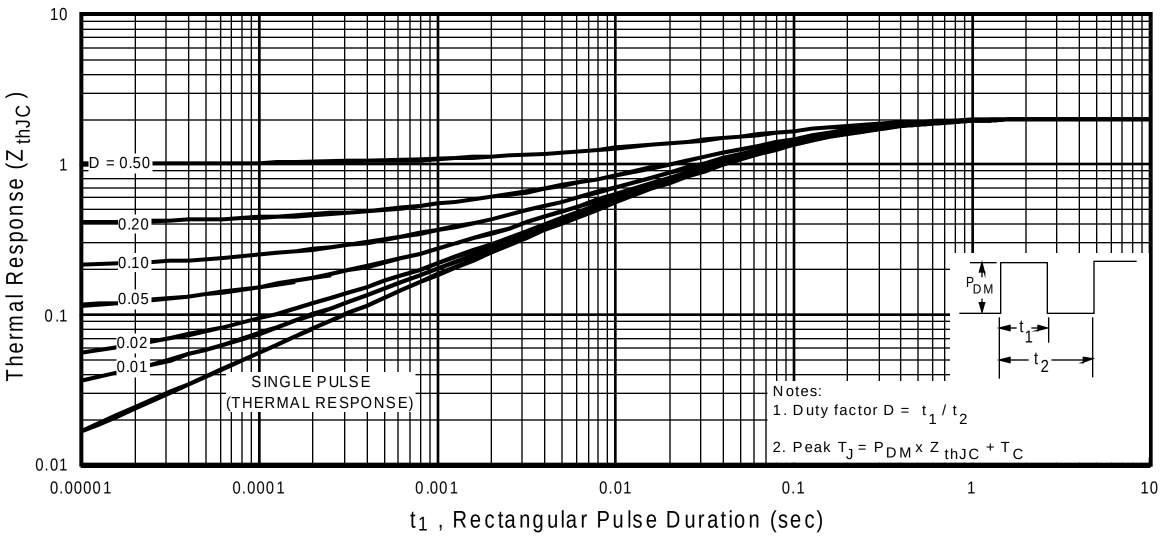


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

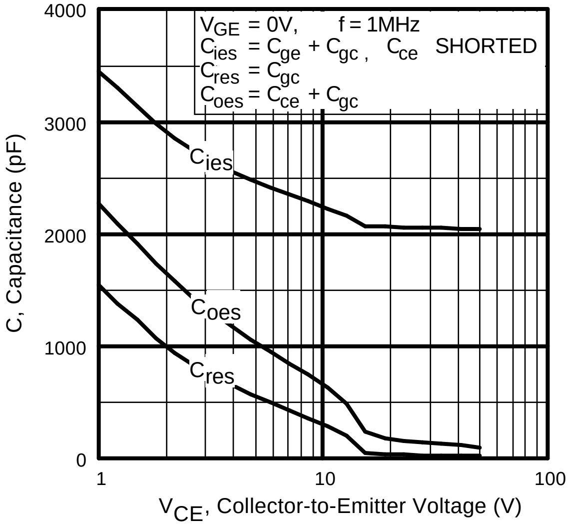


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

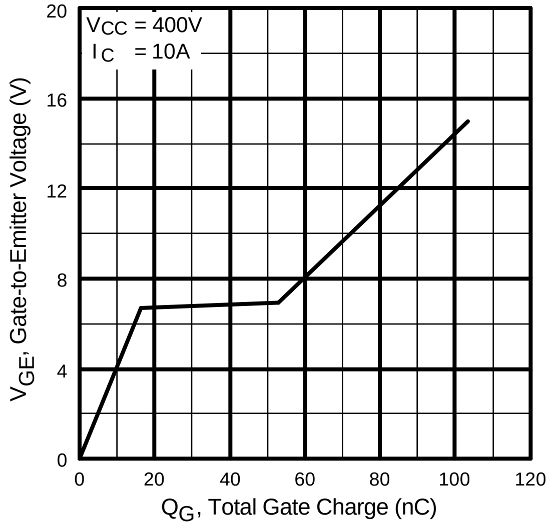


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

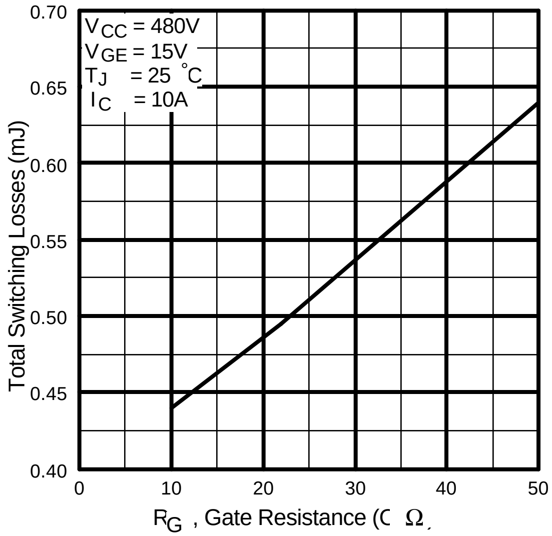


Fig. 9 - Typical Switching Losses vs. Gate Resistance

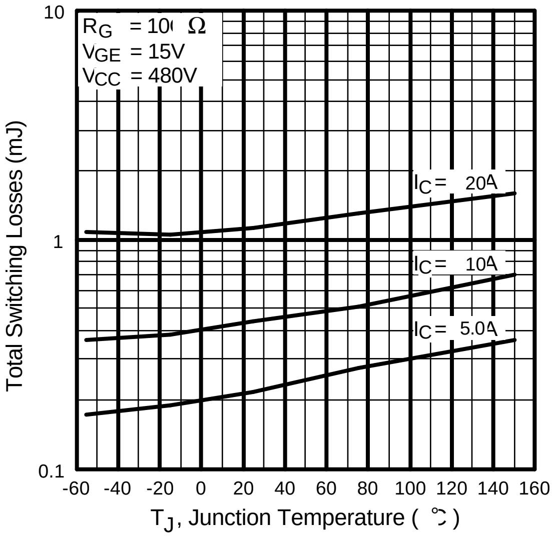


Fig. 10 - Typical Switching Losses vs. Junction Temperature

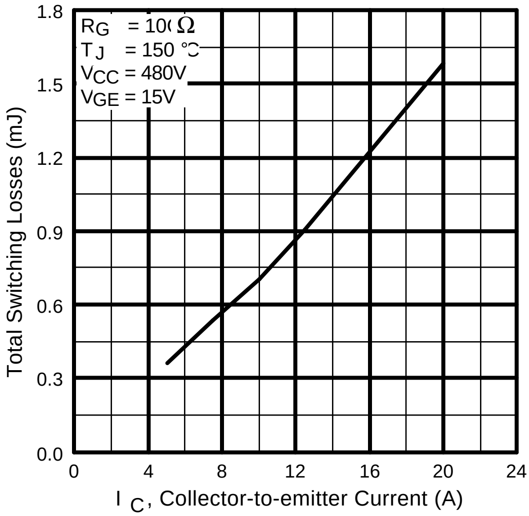


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

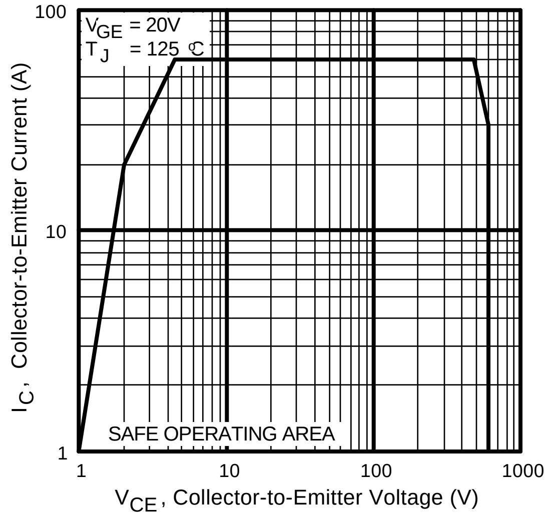


Fig. 12 - Turn-Off SOA

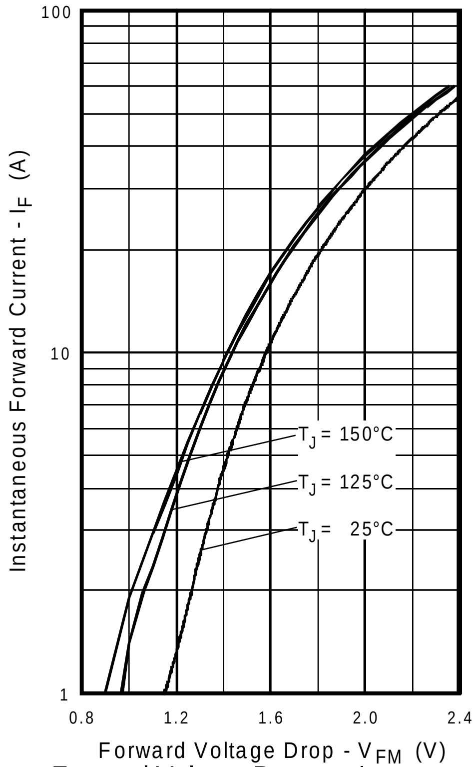


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

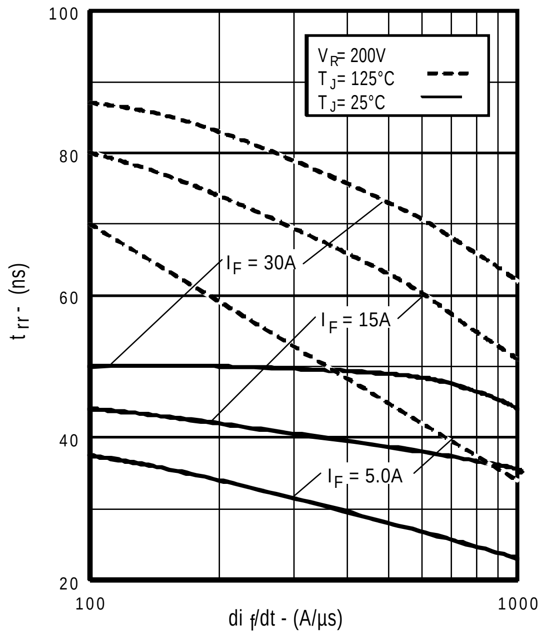


Fig. 14 - Typical Reverse Recovery vs. di$_f$/dt

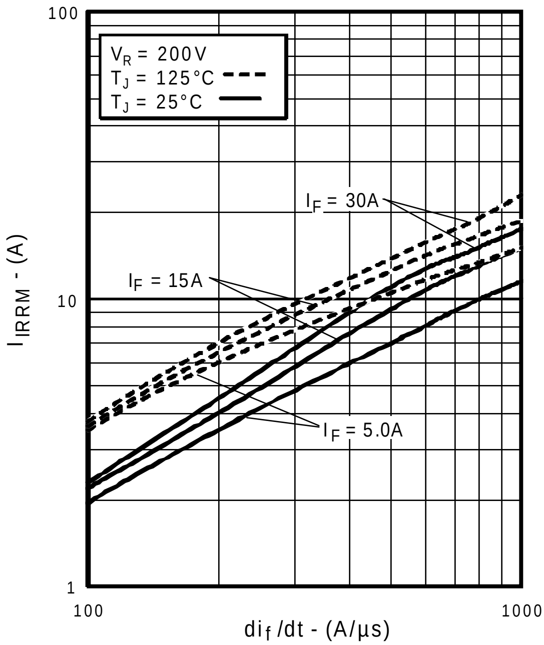


Fig. 15 - Typical Recovery Current vs. di$_f$/dt

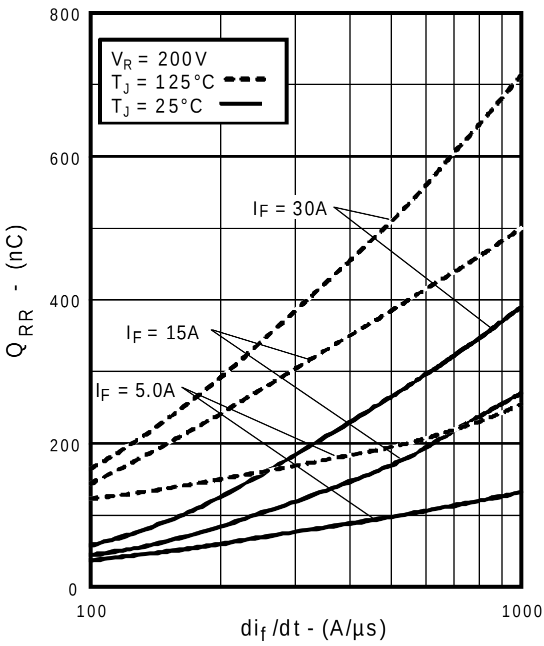


Fig. 16 - Typical Stored Charge vs. di$_f$/dt

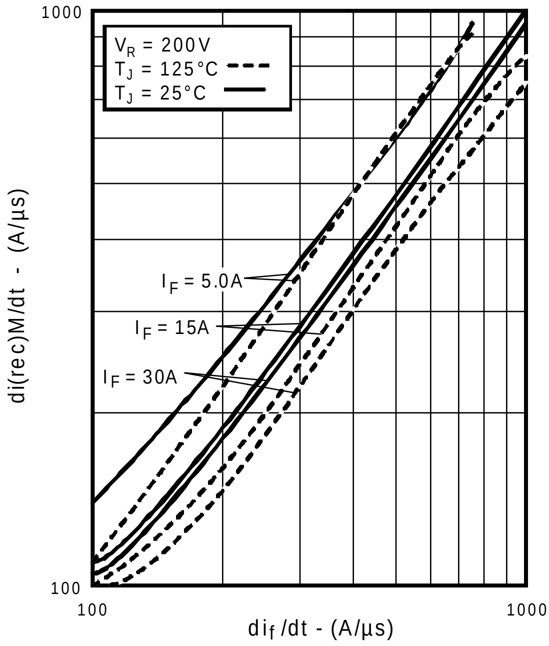


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di$_f$/dt

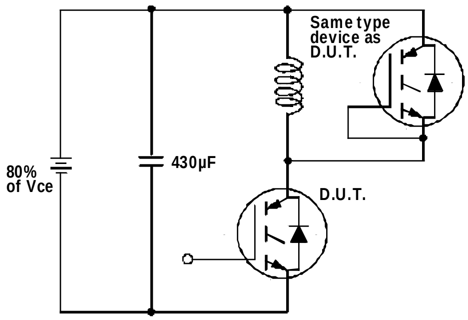


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

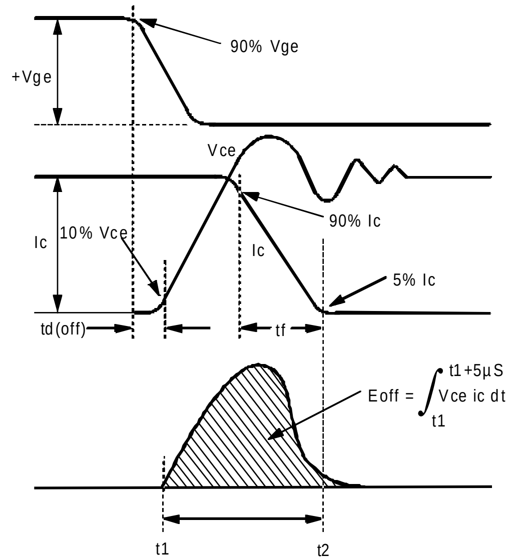


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

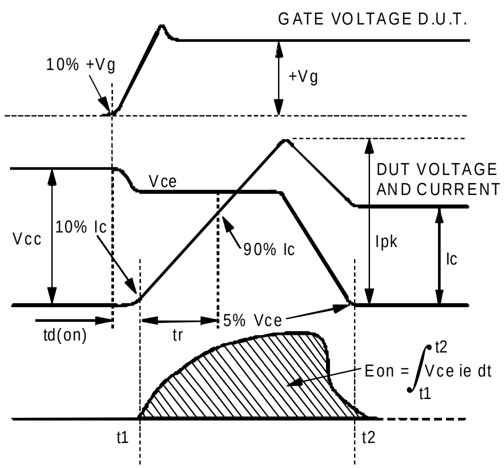


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

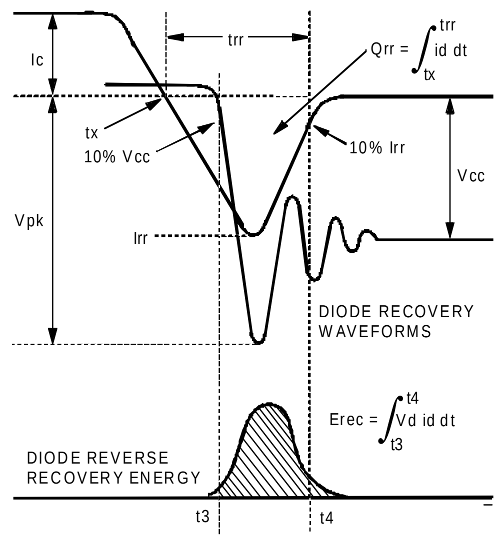


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

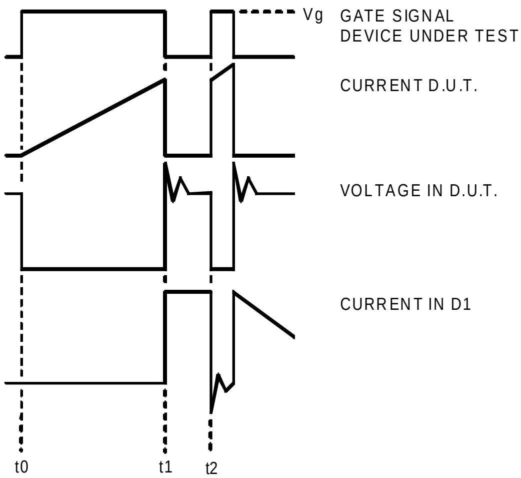


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

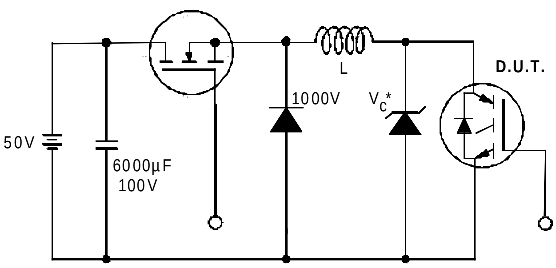


Figure 19. Clamped Inductive Load Test Circuit

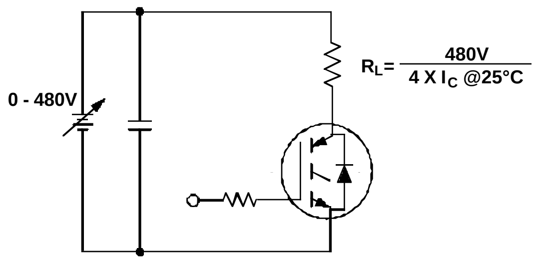


Figure 20. Pulsed Collector Current Test Circuit

Notes:

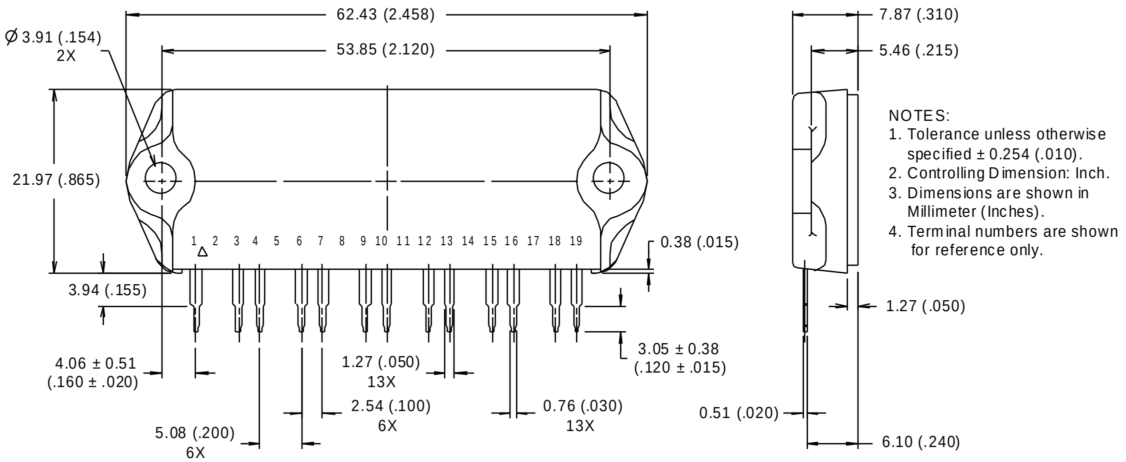
① Repetitive rating: V_{GE}=20V; pulse width limited by maximum junction temperature (figure 20)

② V_{CC}=80%(V_{CES}), V_{GE}=20V, L=10µH, R_G = 10Ω (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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EUROPEAN HEADQUARTERS: Hurst Green, Oxted, Surrey RH8 9BB, UK Tel: ++ 44 1883 732020
IR CANADA: 7321 Victoria Park Ave., Suite 201, Markham, Ontario L3R 2Z8, Tel: (905) 475 1897
IR GERMANY: Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590
IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 11 451 0111
IR FAR EAST: K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo Japan 171 Tel: 81 3 3983 0086
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