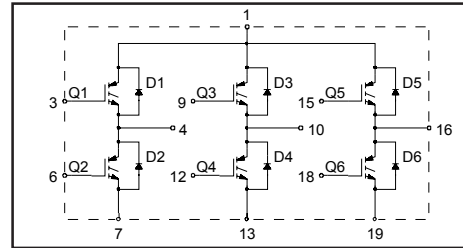


IGBT SIP MODULE

Short Circuit Rated UltraFast IGBT

Features

- Short Circuit Rated UltraFast: Optimized for high operating frequencies >5.0 kHz , and Short Circuit Rated to 10 μ s @ 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)
- Totally Lead-Free and RoHS Compliant



Product Summary

Output Current in a Typical 20 kHz Motor Drive

11 A_{RMS} per phase (3.1 kW total) with $T_C = 90^\circ\text{C}$, $T_J = 125^\circ\text{C}$, 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 (Isolated 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
$I_C @ T_C = 25^\circ\text{C}$	Continuous Collector Current	24	A
$I_C @ T_C = 100^\circ\text{C}$	Continuous Collector Current	13	
I_{CM}	Pulsed Collector Current ①	48	
I_{LM}	Clamped Inductive Load Current ②	48	
t_{sc}	Short Circuit Withstand Time	9.3	μ s
V_{GE}	Gate-to-Emitter Voltage	± 20	V
V_{ISOL}	Isolation Voltage, any terminal to case, 1 min	2500	V _{RMS}
$P_D @ T_C = 25^\circ\text{C}$	Maximum Power Dissipation, each IGBT	63	W
$P_D @ T_C = 100^\circ\text{C}$	Maximum Power Dissipation, each IGBT	25	
T_J	Operating Junction and	-55 to +150	$^\circ\text{C}$
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	—	2.2	$^\circ\text{C}/\text{W}$
$R_{\theta JC}$ (DIODE)	Junction-to-Case, each diode, one diode in conduction	—	3.7	
$R_{\theta CS}$ (MODULE)	Case-to-Sink, flat, greased surface	0.10	—	g (oz)
Wt	Weight of module	20 (0.7)	—	

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International
IR Rectifier

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	Temperature Coeff. of Breakdown Voltage	—	0.63	—	V/°C	V _{GE} = 0V, I _C = 1.0mA
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	1.80	2.3	V	I _C = 13A V _{GE} = 15V
		—	1.80	—		I _C = 24A See Fig. 2, 5
		—	1.56	1.73		I _C = 13A, 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	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)	—	110	170	nC	I _C = 13A
Q _{ge}	Gate - Emitter Charge (turn-on)	—	14	21		V _{CC} = 400V See Fig.8
Q _{gc}	Gate - Collector Charge (turn-on)	—	49	74		V _{GE} = 15V
t _{d(on)}	Turn-On Delay Time	—	50	—	ns	T _J = 25°C I _C = 13A, V _{CC} = 480V V _{GE} = 15V, R _G = 10Ω
t _r	Rise Time	—	30	—		
t _{d(off)}	Turn-Off Delay Time	—	110	170		
t _f	Fall Time	—	91	140		
E _{on}	Turn-On Switching Loss	—	0.56	—		
E _{off}	Turn-Off Switching Loss	—	0.28	—		
E _{is}	Total Switching Loss	—	0.84	1.1		See Fig. 9,10, 18
t _{sc}	Short Circuit Withstand Time	10	—	—	μs	V _{CC} = 360V, T _J = 125°C V _{GE} = 15V, R _G = 10Ω, V _{CPK} < 500V
t _{d(on)}	Turn-On Delay Time	—	47	—	ns	T _J = 150°C, See Fig. 11,18 I _C = 13A, V _{CC} = 480V V _{GE} = 15V, R _G = 10Ω Energy losses include "tail" and diode reverse recovery
t _r	Rise Time	—	30	—		
t _{d(off)}	Turn-Off Delay Time	—	250	—		
t _f	Fall Time	—	150	—		
E _{is}	Total Switching Loss	—	1.28	—		
L _E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C _{ies}	Input Capacitance	—	1600	—	pF	V _{GE} = 0V V _{CC} = 30V See Fig. 7 f = 1.0MHz
C _{oes}	Output Capacitance	—	130	—		
C _{res}	Reverse Transfer Capacitance	—	55	—		
t _{rr}	Diode Reverse Recovery Time	—	42	60	ns	T _J = 25°C See Fig. 14 T _J = 125°C
		—	74	120		
I _{rr}	Diode Peak Reverse Recovery Current	—	4.0	6.0	A	T _J = 25°C See Fig. 15 T _J = 125°C
		—	6.5	10		
Q _{rr}	Diode Reverse Recovery Charge	—	80	180	nC	T _J = 25°C See Fig. 16 T _J = 125°C
		—	220	600		
di _{(rec)M} /dt	Diode Peak Rate of Fall of Recovery During t _b	—	188	—	A/μs	T _J = 25°C See Fig. 17 T _J = 125°C
		—	160	—		

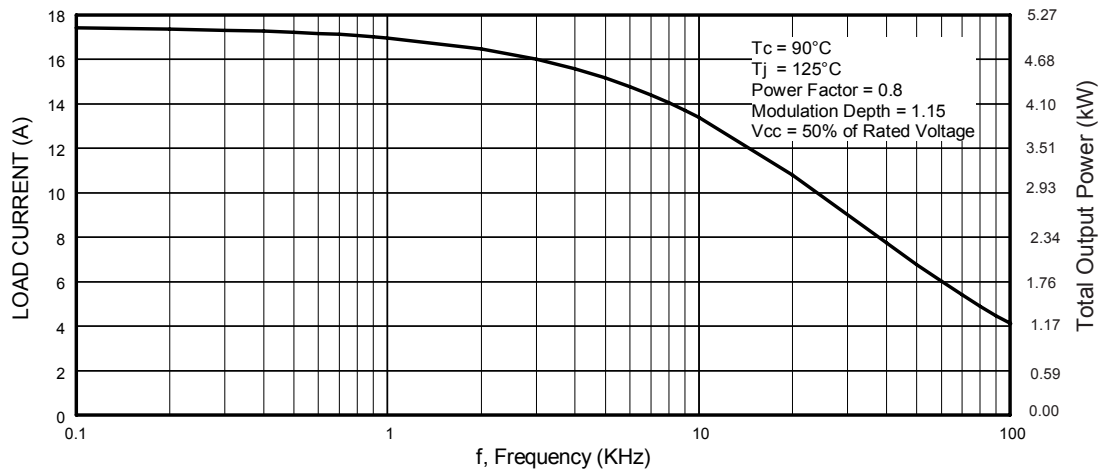


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

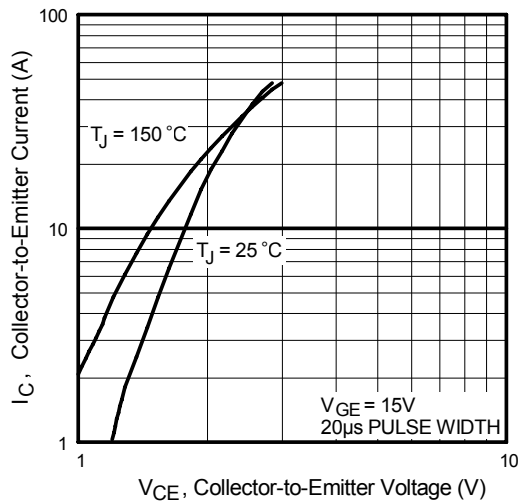


Fig. 2 - Typical Output Characteristics

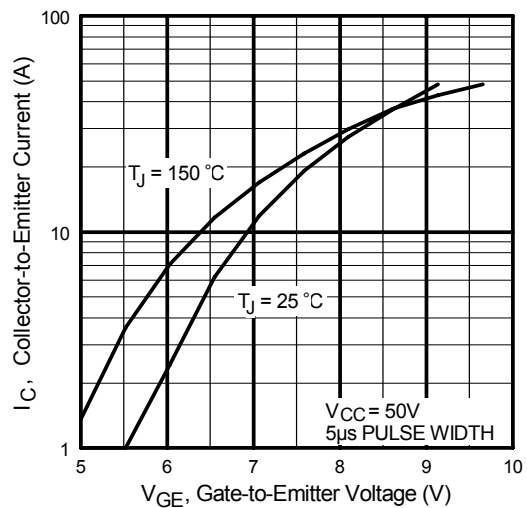


Fig. 3 - Typical Transfer Characteristics

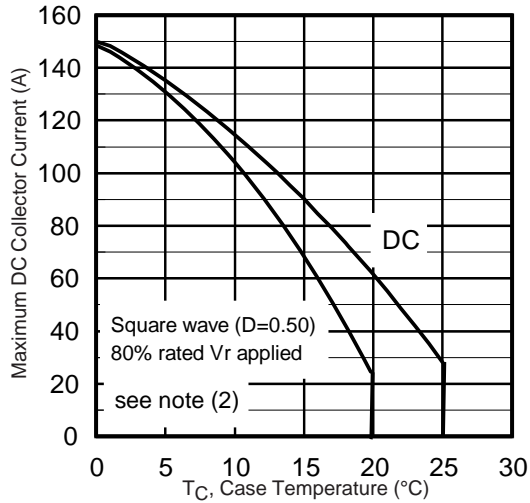


Fig. 4 - Maximum Collector Current vs. Case Temperature

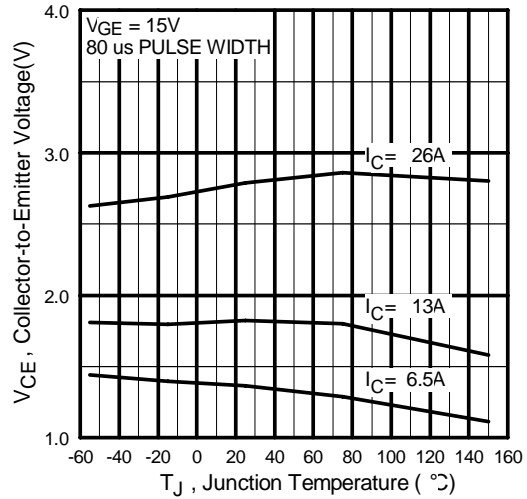


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

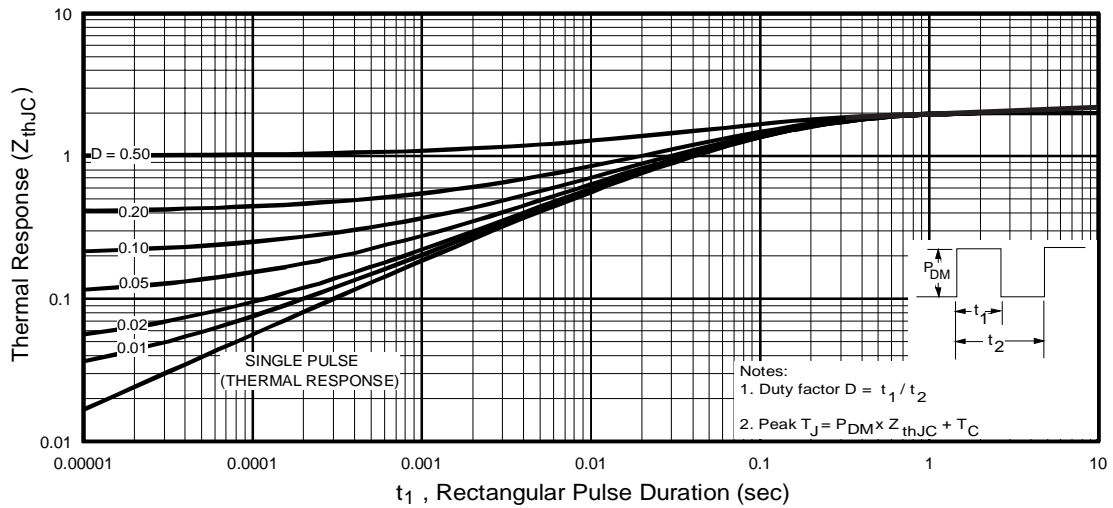


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

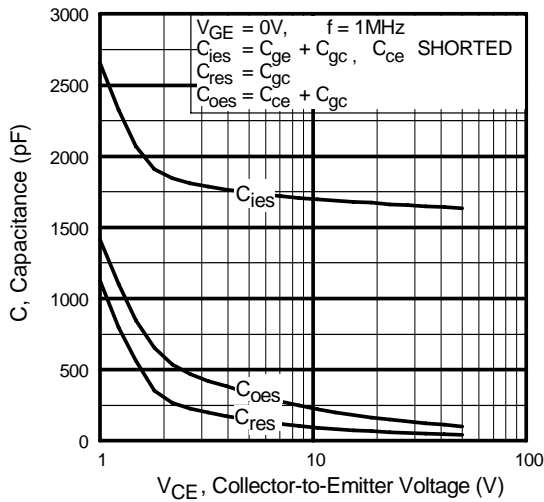


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

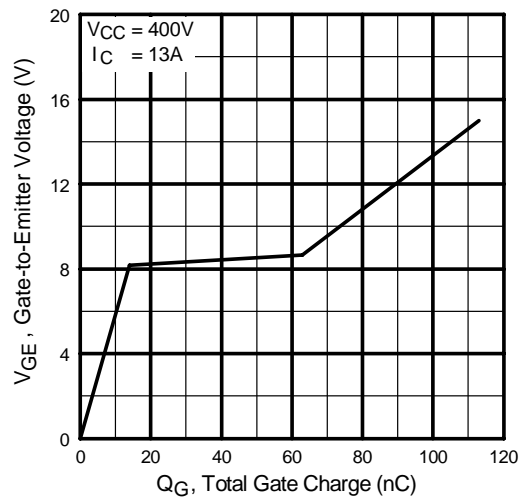


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

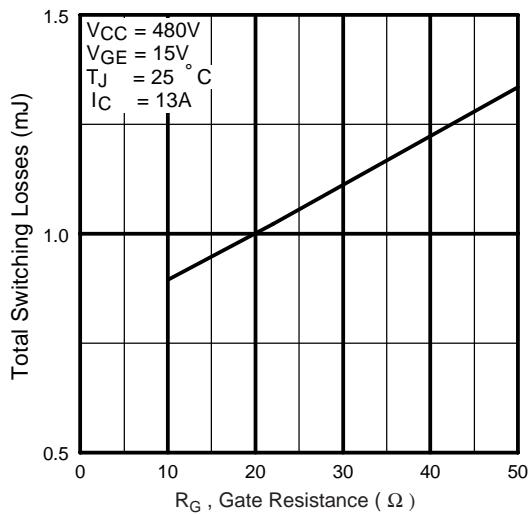


Fig. 9 - Typical Switching Losses vs. Gate Resistance

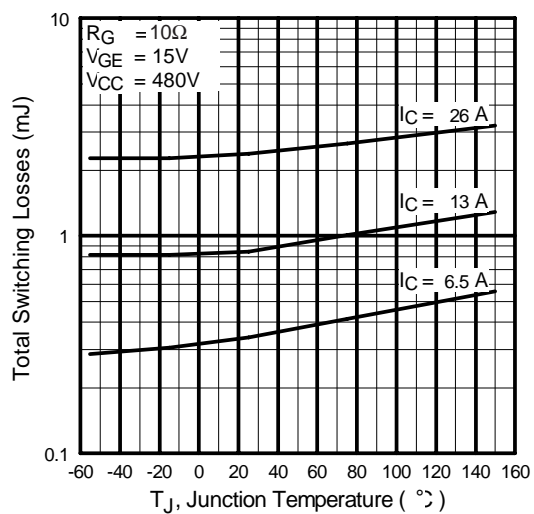


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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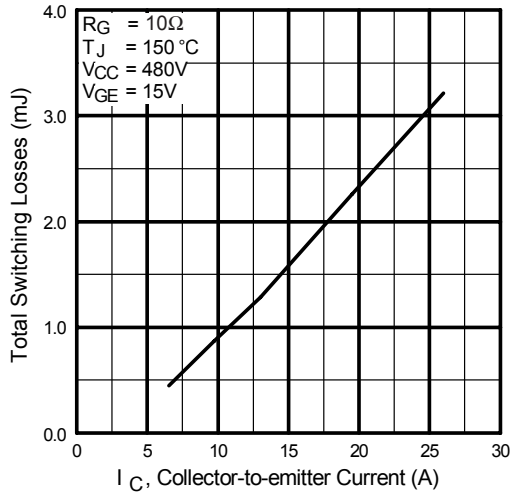


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

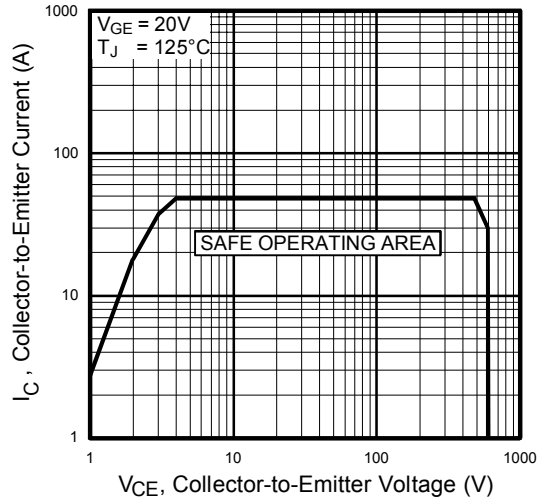


Fig. 12 - Turn-Off SOA

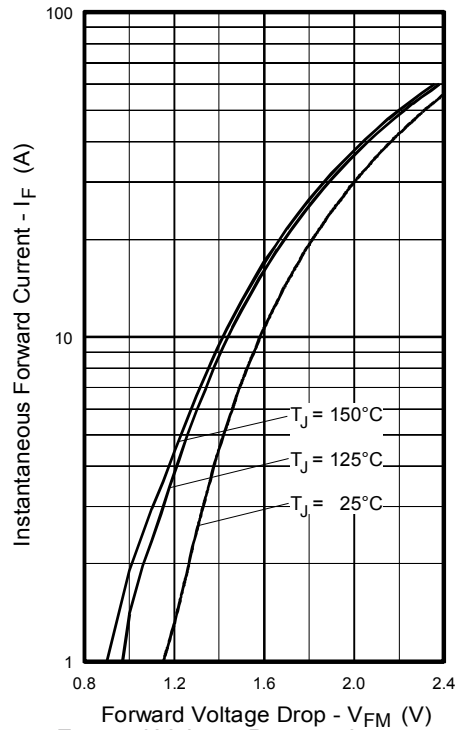


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

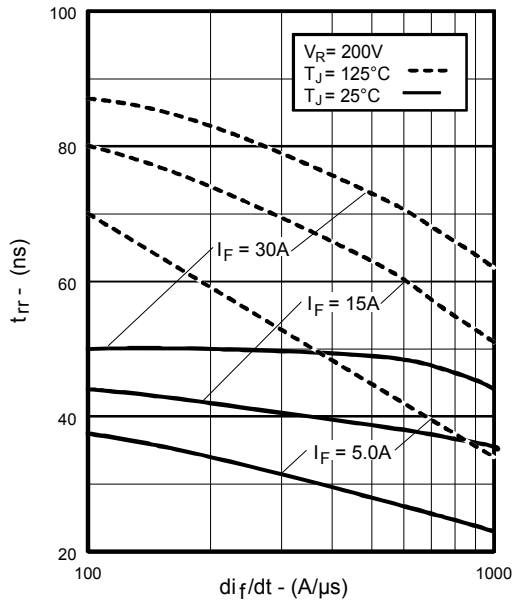


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

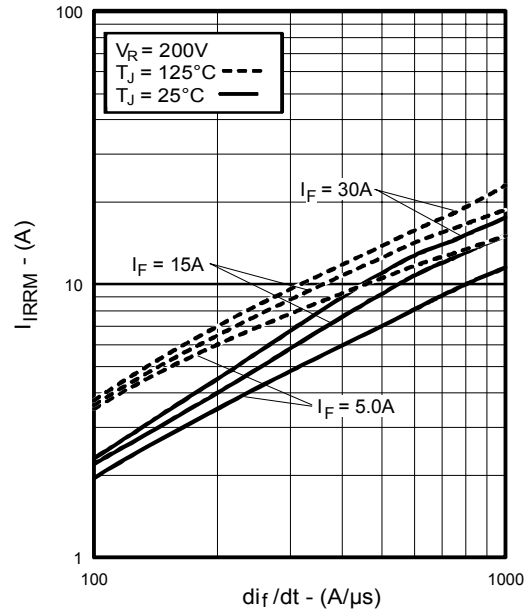


Fig. 15 - Typical Recovery Current vs. di_f/dt

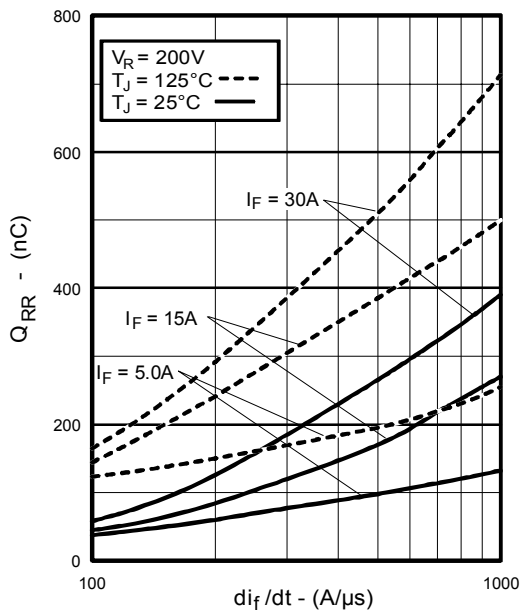


Fig. 16 - Typical Stored Charge vs. di_f/dt

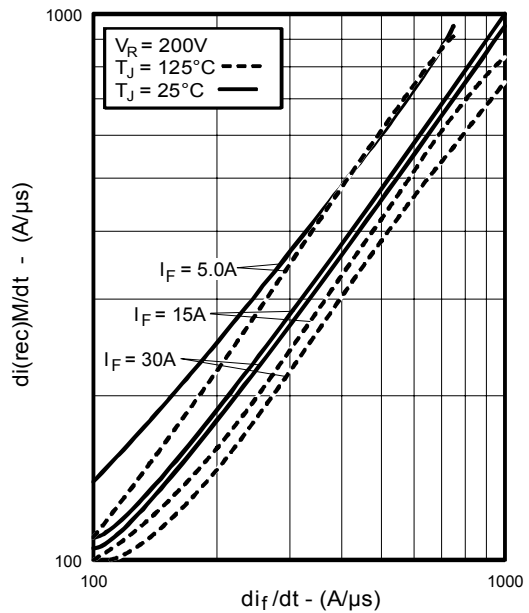


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

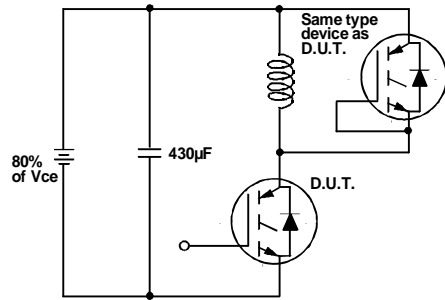


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

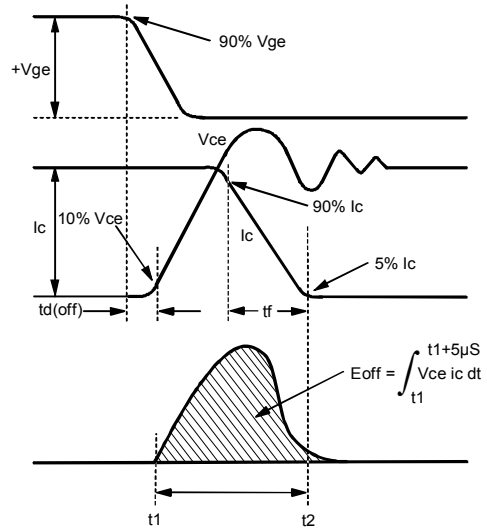


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

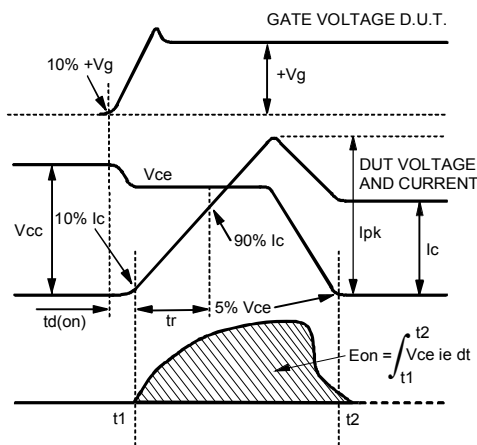


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

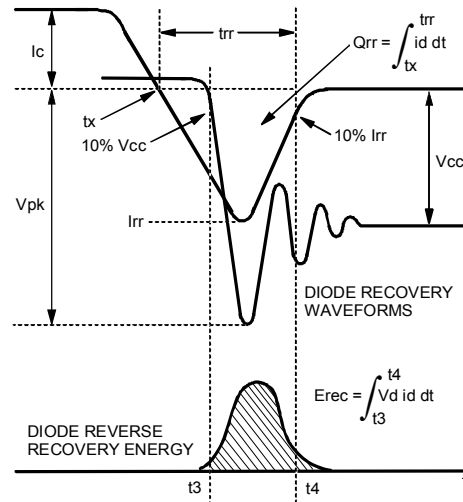


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

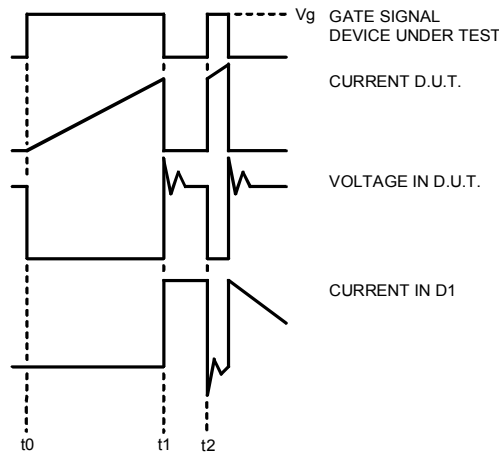


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

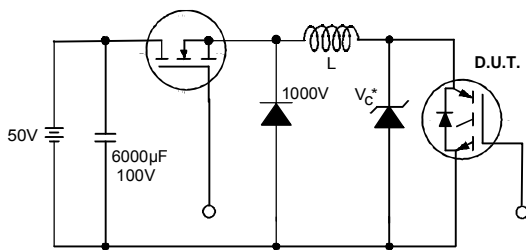


Figure 19. Clamped Inductive Load Test Circuit

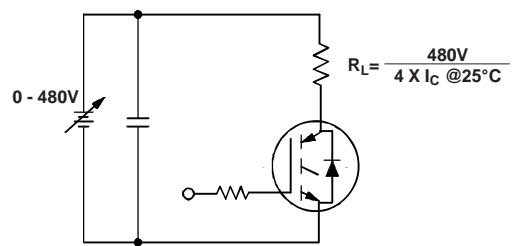


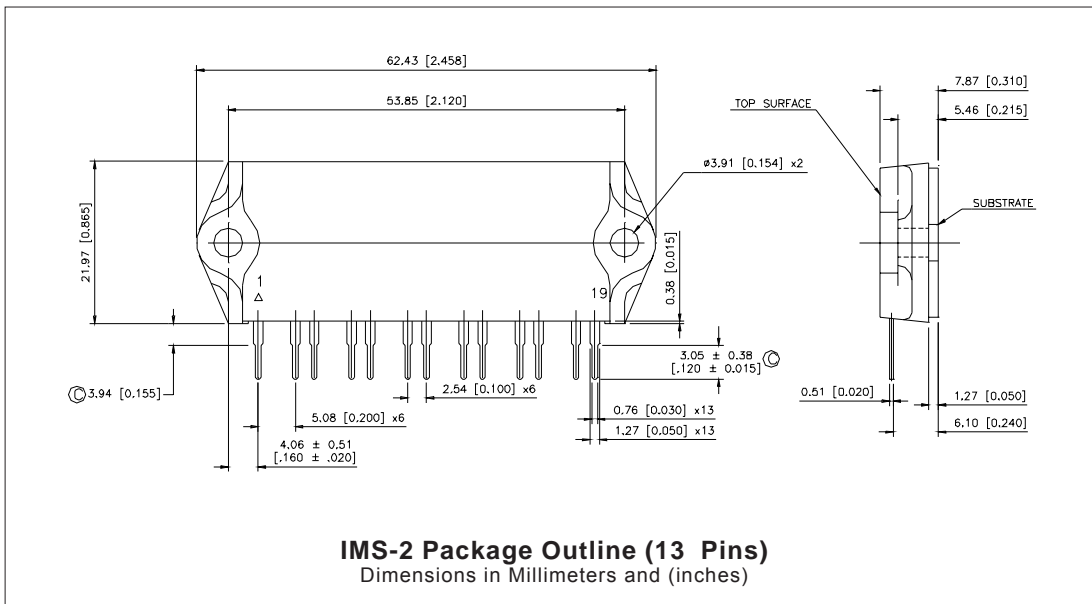
Figure 20. Pulsed Collector Current Test Circuit

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Notes:

- ① Repetitive rating: $V_{GE}=20V$; pulse width limited by maximum junction temperature (figure 20)
- ② $V_{CC}=80\%(V_{CES})$, $V_{GE}=20V$, $L=10\mu H$, $R_G = 10\Omega$ (Figure 19)
- ③ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ④ Pulse width $5.0\mu s$, single shot.

Case Outline — IMS-2



Data and specifications subject to change without notice.
This product has been designed and qualified for Industrial Level and Lead-Free.
Qualification Standards can be found on IR's Web site.