International
IOR Rectifier

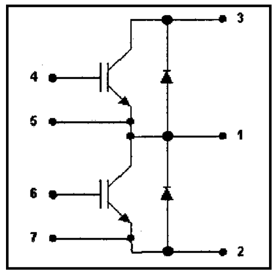
GA500TD60U

"HALF-BRIDGE" IGBT DOUBLE INT-A-PAK

Ultra-Fast™ Speed IGBT

Features

- Generation 4 IGBT technology
- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- Very low conduction and switching losses
- HEXFRED™ antiparallel diodes with ultra- soft recovery
- Industry standard package
- UL approved



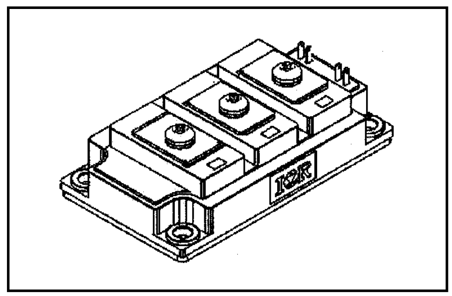
V_{CES} = 600V

$V_{CE(on)\ typ.}$ = 1.9V

@V_{GE} = 15V, I_C = 500A

Benefits

- Increased operating efficiency
- Direct mounting to heatsink
- Performance optimized for power conversion: UPS, SMPS, Welding
- Lower EMI, requires less snubbing



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	500	A
I_{CM}	Pulsed Collector Current①	1000	
I_{LM}	Peak Switching Current②	1000	
I_{FM}	Peak Diode Forward Current	500	
V_{GE}	Gate-to-Emitter Voltage	±20	V
V_{ISOL}	RMS Isolation Voltage, Any Terminal To Case, t = 1 min	2500	
P_D @ T_C = 25°C	Maximum Power Dissipation	1550	W
P_D @ T_C = 85°C	Maximum Power Dissipation	800	
T_J	Operating Junction Temperature Range	-40 to +150	°C
T_{STG}	Storage Temperature Range	-40 to +125	

Thermal / Mechanical Characteristics

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case - IGBT	—	0.08	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case - Diode	—	0.20	
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink - Module	0.1	—	
	Mounting Torque, Case-to-Heatsink	—	4.0	N·m
	Mounting Torque, Case-to-Terminal 1, 2 & 3ƒ	—	3.0	
	Weight of Module	400	—	g

4/24/2000

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V_{GE} = 0V, I_C = 1mA
$V_{CE(on)}$	Collector-to-Emitter Voltage	—	1.9	2.4		V_{GE} = 15V, I_C = 500A
		—	2.0	—		V_{GE} = 15V, I_C = 500A, T_J = 125°C
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0		I_C = 3.0mA
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/°C	V_{CE} = V_{GE}, I_C = 3.0mA
g_{fe}	Forward Transconductance ④	—	244	—	S	V_{CE} = 25V, I_C = 500A
I_{CES}	Collector-to-Emitter Leaking Current	—	—	2.0	mA	V_{GE} = 0V, V_{CE} = 600V
		—	—	20		V_{GE} = 0V, V_{CE} = 600V, T_J = 125°C
V_{FM}	Diode Forward Voltage - Maximum	—	4.0	—	V	I_F = 500A, V_{GE} = 0V
		—	4.1	—		I_F = 500A, V_{GE} = 0V, T_J = 125°C
I_{GES}	Gate-to-Emitter Leakage Current	—	—	250	nA	V_{GE} = ±20V

Dynamic Characteristics - T_J = 125°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge (turn-on)	—	2100	3200	nC	V_{CC} = 400V
Q_{ge}	Gate - Emitter Charge (turn-on)	—	292	440		I_C = 500A
Q_{gc}	Gate - Collector Charge (turn-on)	—	1050	1580		T_J = 25°C
$t_{d(on)}$	Turn-On Delay Time	—	1900	—	ns	R_{G1} = 15Ω, R_{G2} = 0Ω,
t_r	Rise Time	—	430	—		I_C = 500A
$t_{d(off)}$	Turn-Off Delay Time	—	800	—		V_{CC} = 360V
t_f	Fall Time	—	190	—		V_{GE} = ±15V
E_{on}	Turn-On Switching Energy	—	41	—	mJ	See Fig.17 through Fig.21
E_{off}	Turn-Off Switching Energy	—	56	—		
E_{ts}	Total Switching Energy	—	97	110		
C_{ies}	Input Capacitance	—	46800	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	2920	—		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance	—	600	—		f = 1 MHz
t_{rr}	Diode Reverse Recovery Time	—	246	—	ns	I_C = 500A
I_{rr}	Diode Peak ReverseCurrent	—	144	—	A	R_{G1} = 15Ω
Q_{rr}	Diode Recovery Charge	—	17655	—	µC	R_{G2} = 0Ω
$di_{(rec)}M/_{dt}$	Diode Peak Rate of Fall of Recovery During t_b	—	1386	—	A/µs	V_{CC} = 360V di/dt=1300A/µs

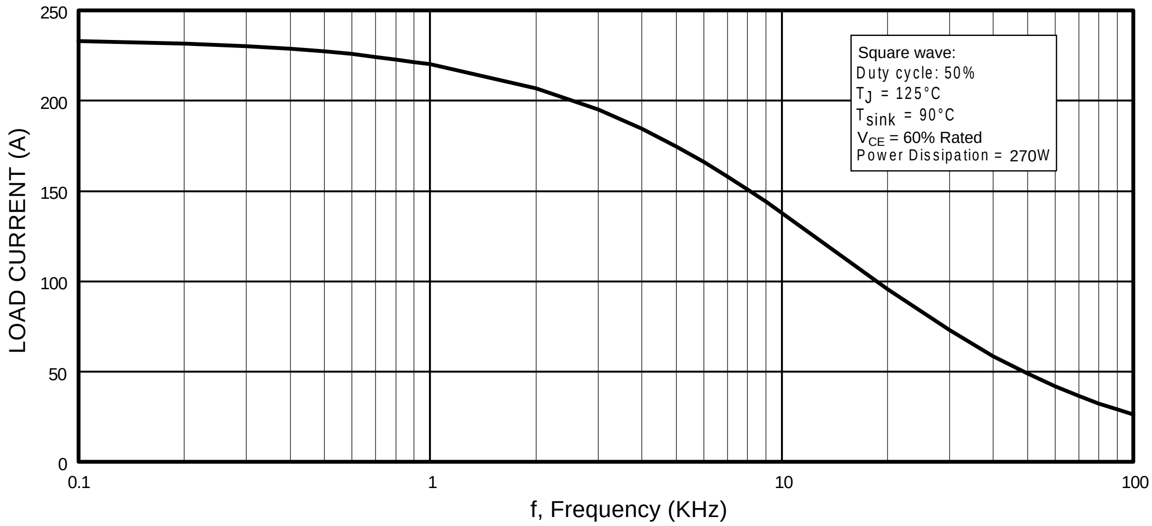


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

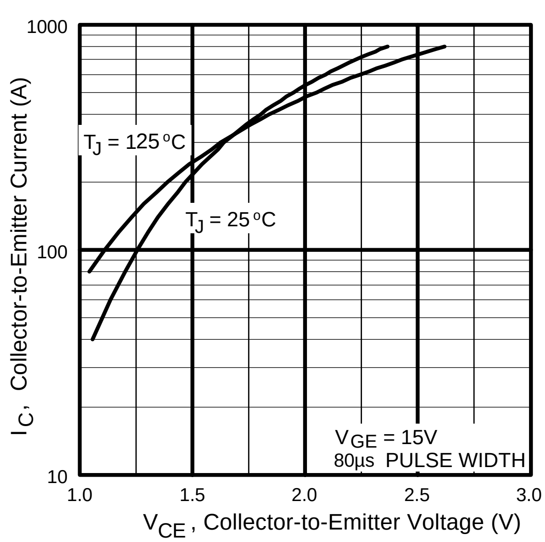


Fig. 2 - Typical Output Characteristics

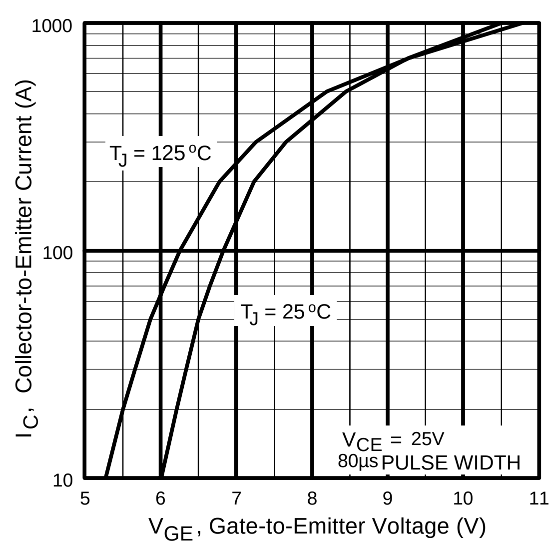


Fig. 3 - Typical Transfer Characteristics

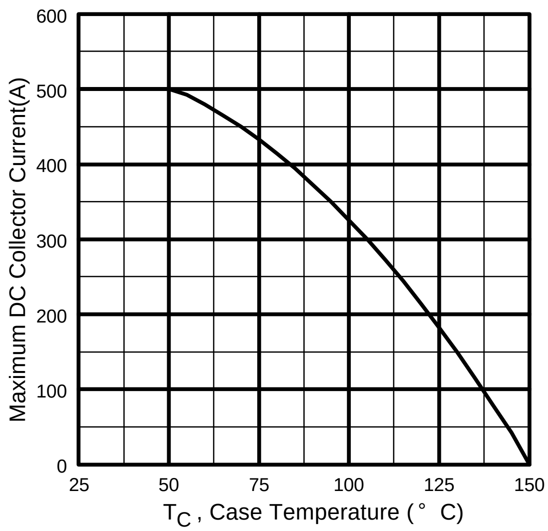


Fig. 4 - Maximum Collector Current vs. Case Temperature

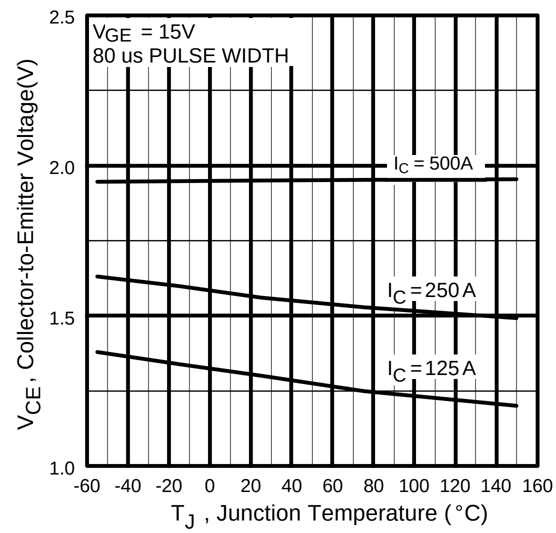


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

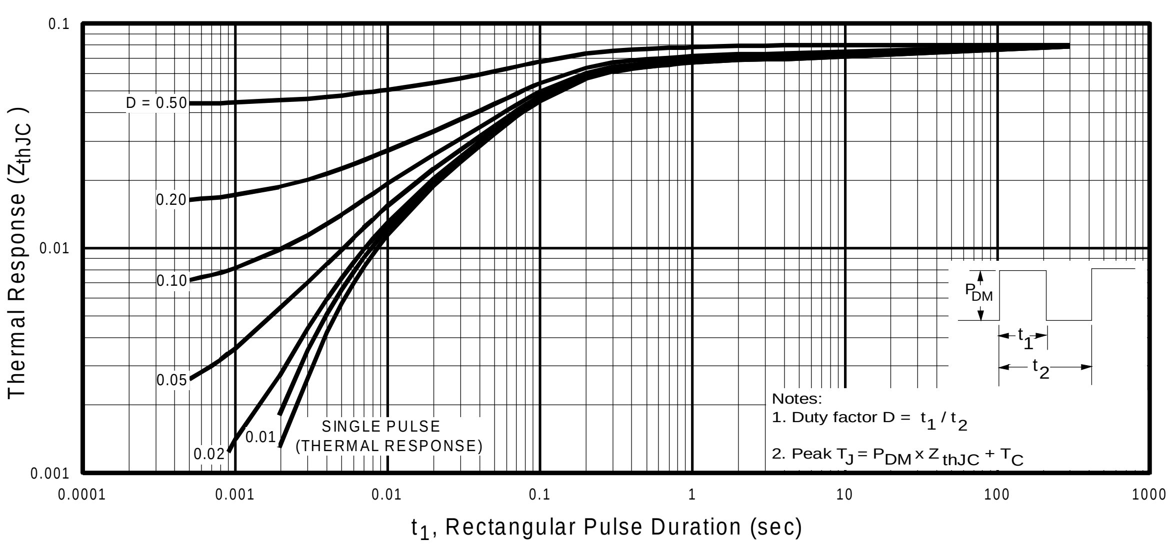


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

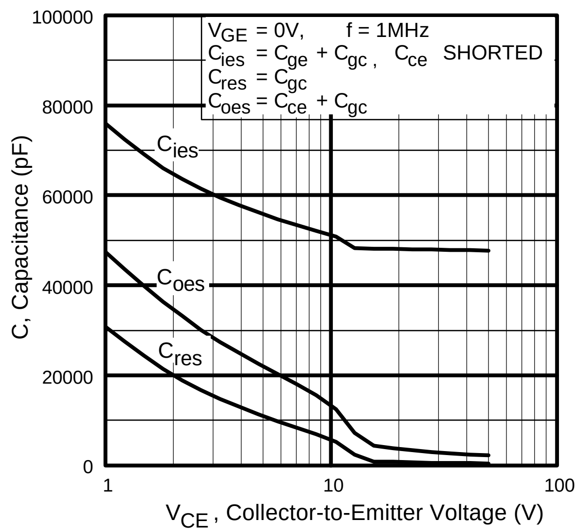


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

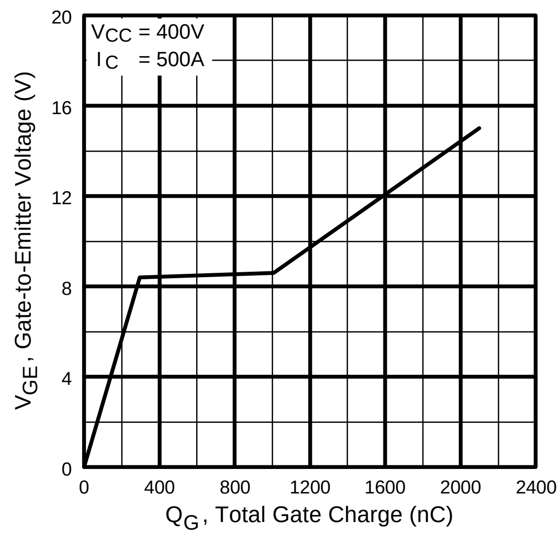


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

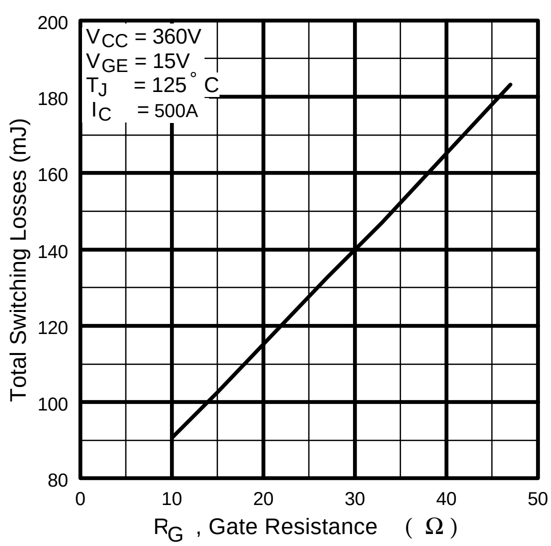


Fig. 9 - Typical Switching Losses vs. Gate Resistance

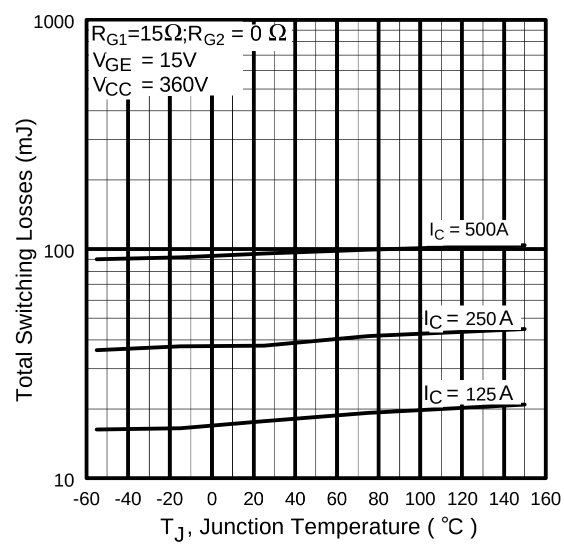


Fig. 10 - Typical Switching Losses vs. Junction Temperature

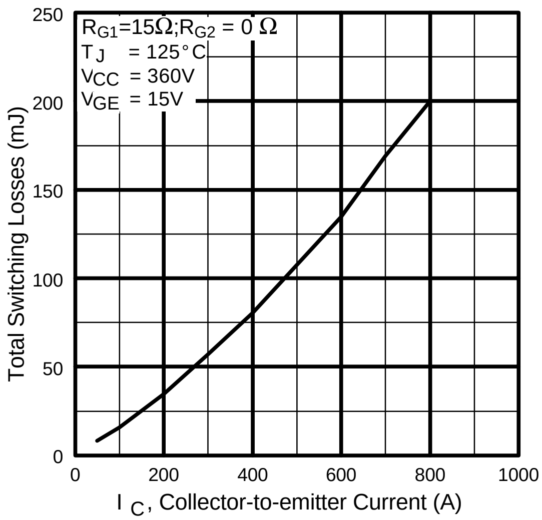


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

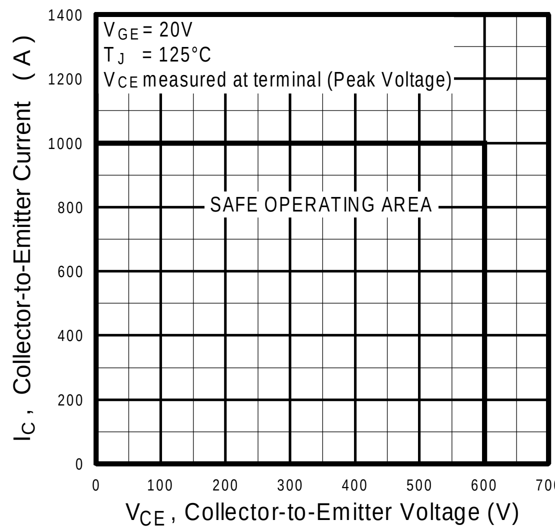


Fig. 12 - Reverse Bias SOA

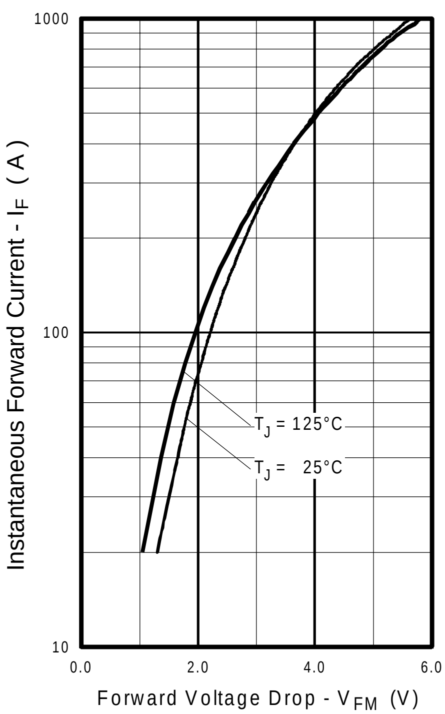


Fig. 13 - Typical Forward Voltage Drop vs. Instantaneous Forward Current

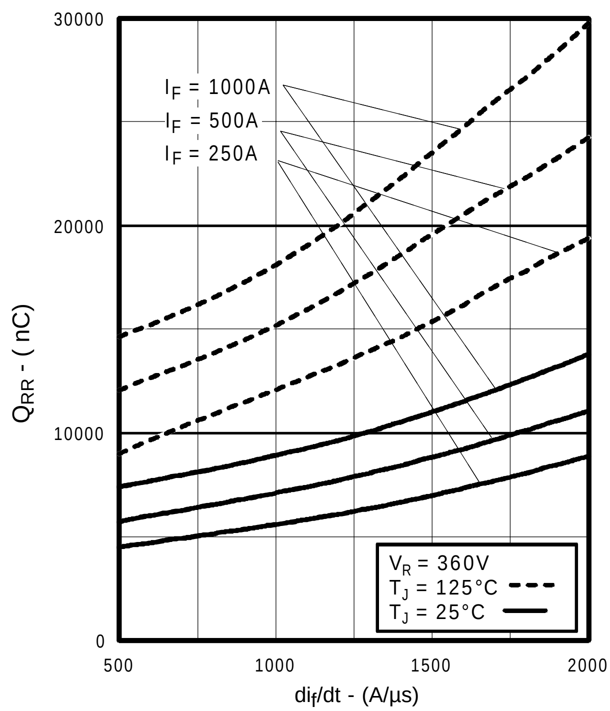


Fig. 14 - Typical Stored Charge vs. di_f/dt

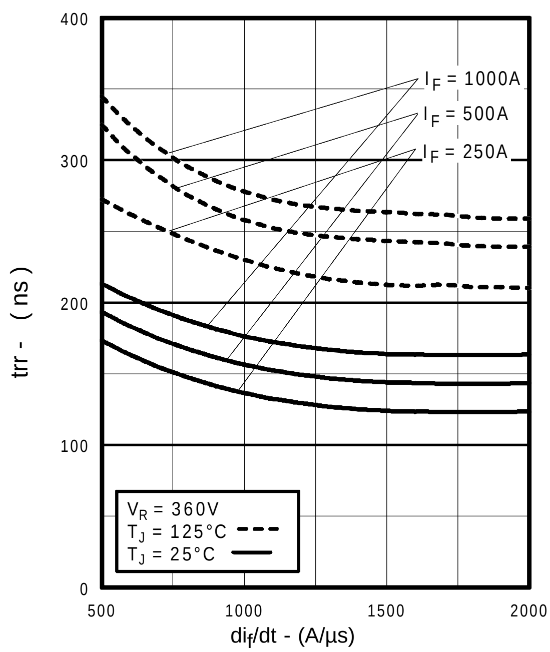


Fig. 15 - Typical Reverse Recovery vs. di_f/dt

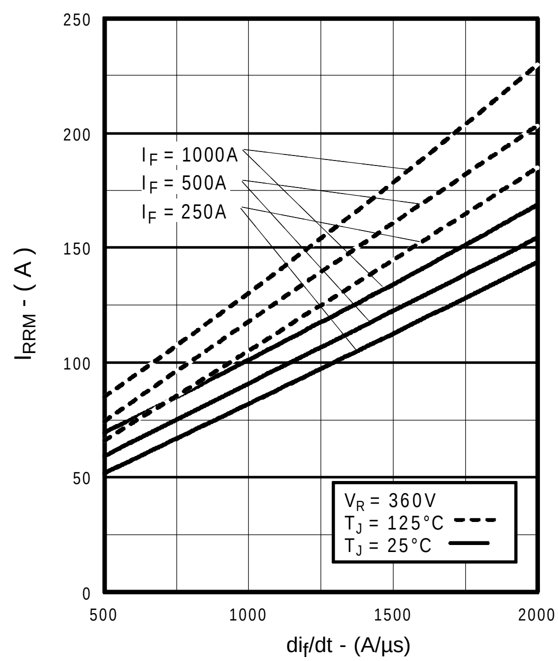


Fig. 16 - Typical Recovery Current vs. di_f/dt

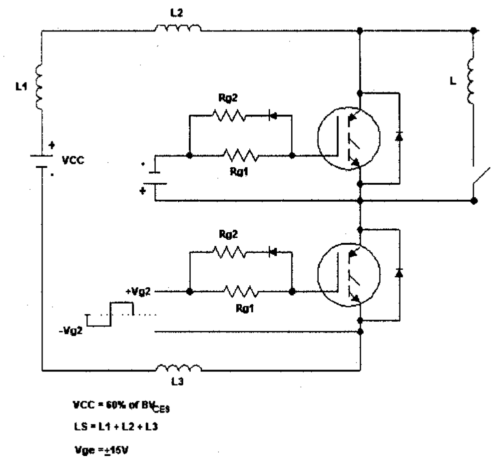


Fig. 17 - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

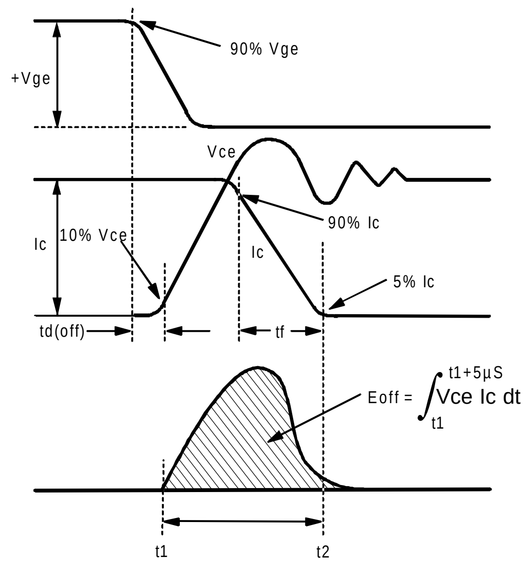


Fig. 18 - Test Waveforms for Circuit of Fig. 17, Defining E_{off}, $t_{d(off)}$, t_f

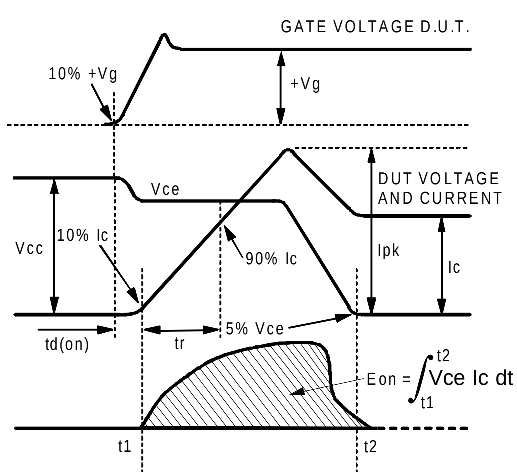


Fig. 19 - Test Waveforms for Circuit of Fig. 17, Defining E_{on}, $t_{d(on)}$, t_r

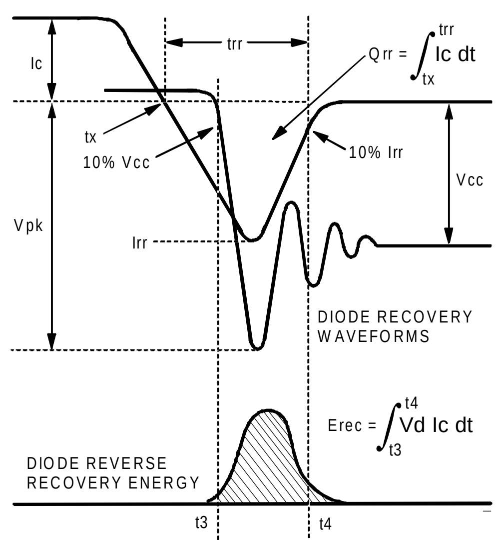


Fig. 20 - Test Waveforms for Circuit of Fig. 17, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

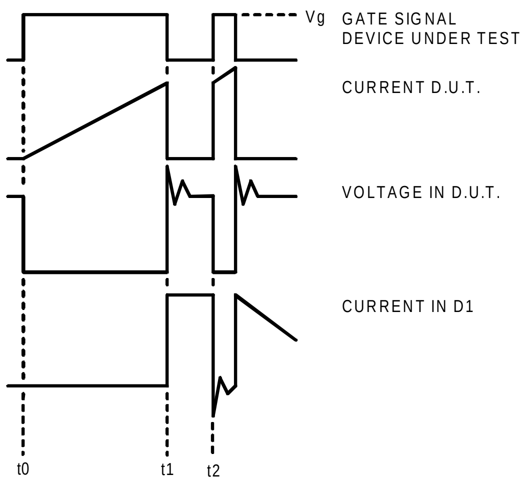


Figure 21. Macro Waveforms for Figure 17's Test Circuit

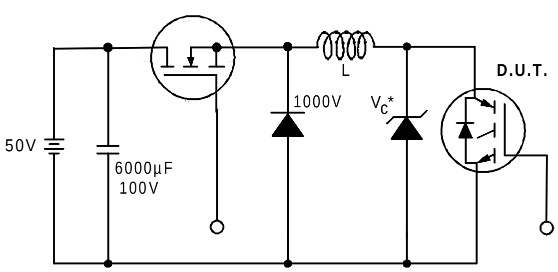


Figure 22. Clamped Inductive Load Test Circuit

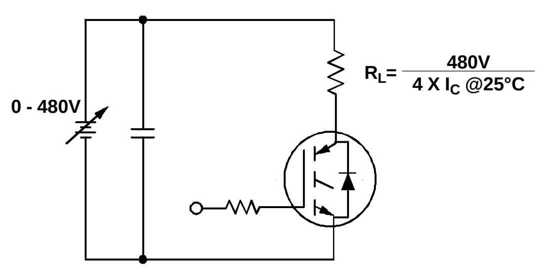


Figure 23. Pulsed Collector Current Test Circuit

Notes:

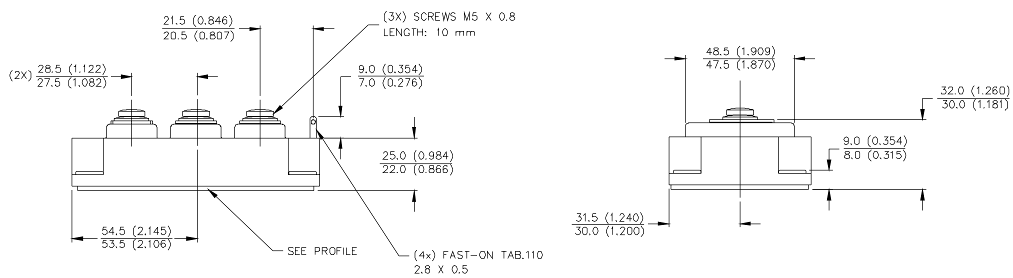
① Repetitive rating; V_{GE} = 20V, pulse width limited by max. junction temperature.

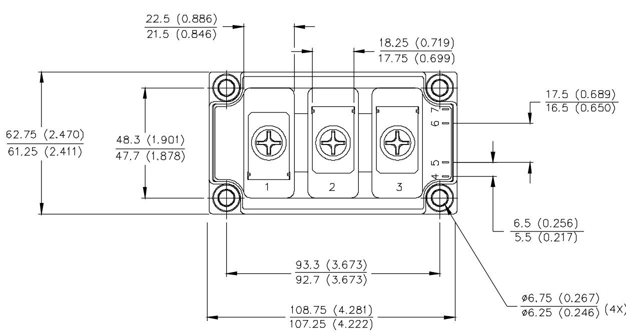
② See fig. 17

③ For screws M5x0.8

④ Pulse width 80µs; single shot.

Case Outline — DOUBLE INT-A-PAK





Dimensions are shown in millimeters (inches)

International
IOR Rectifier

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IR CANADA: 15 Lincoln Court, Brampton, Ontario L6T3Z2, Tel: (905) 453 2200
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IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 011 451 0111
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