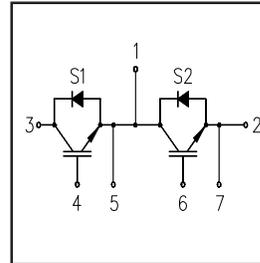


**Features**

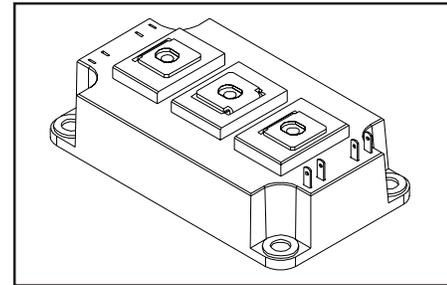
- Generation 4 IGBT technology
- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- Very low conduction and switching losses
- HEXFRED™ antiparallel diodes with ultra- soft recovery
- Industry standard package
- UL approved



$V_{CES} = 600V$   
 $V_{CE(on) typ.} = 1.70V$   
 @  $V_{GE} = 15V, I_C = 400A$

**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
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	400	A
$I_{CM}$	Pulsed Collector Current <sup>①</sup>	800	
$I_{LM}$	Peak Switching Current <sup>②</sup>	800	
$I_{FM}$	Peak Diode Forward Current	800	
$V_{GE}$	Gate-to-Emitter Voltage	±20	V
$V_{ISOL}$	RMS Isolation Voltage, Any Terminal To Case, t = 1 min	2500	W
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	1250	
$P_D @ T_C = 85^\circ C$	Maximum Power Dissipation	650	
$T_J$	Operating Junction Temperature Range	-40 to +150	°C
$T_{STG}$	Storage Temperature Range	-40 to +125	

**Thermal / Mechanical Characteristics**

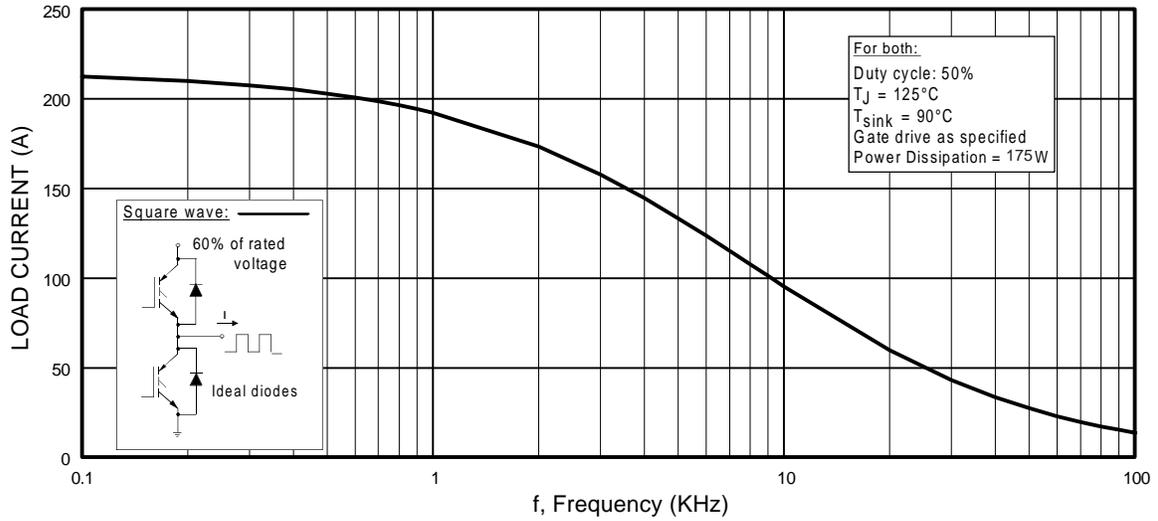
	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case - IGBT	—	0.10	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case - Diode	—	0.20	
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink - Module	0.1	—	N·m
	Mounting Torque, Case-to-Heatsink <sup>③</sup>	—	6.0	
	Mounting Torque, Case-to-Terminal 1, 2 & 3 <sup>③</sup>	—	5.0	
	Weight of Module	400	—	g

**Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

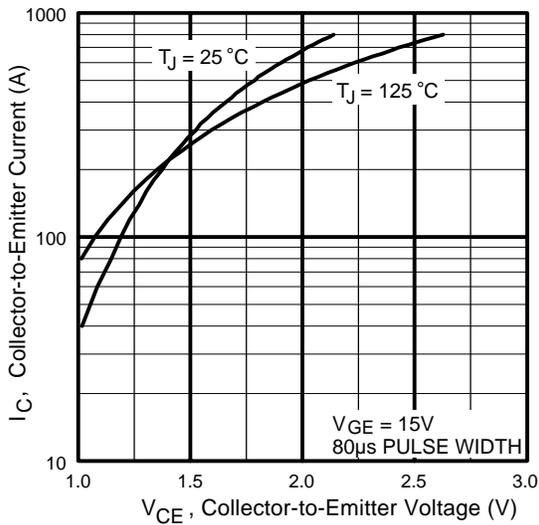
	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA
V <sub>CE(on)</sub>	Collector-to-Emitter Voltage	—	1.7	2.4		V <sub>GE</sub> = 15V, I <sub>C</sub> = 400A
		—	1.8	—		V <sub>GE</sub> = 15V, I <sub>C</sub> = 400A, T <sub>J</sub> = 125°C
V <sub>GE(th)</sub>	Gate Threshold Voltage	3.0	—	6.0		I <sub>C</sub> = 2.5mA
ΔV <sub>GE(th)/ΔT<sub>J</sub></sub>	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 2.5mA
g <sub>fe</sub>	Forward Transconductance ④	—	481	—	S	V <sub>CE</sub> = 25V, I <sub>C</sub> = 400A
I <sub>CES</sub>	Collector-to-Emitter Leaking Current	—	—	2.0	mA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V
		—	—	20		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V, T <sub>J</sub> = 125°C
V <sub>FM</sub>	Diode Forward Voltage - Maximum	—	3.7	—	V	I <sub>F</sub> = 400A, V <sub>GE</sub> = 0V
		—	3.6	—		I <sub>F</sub> = 400A, V <sub>GE</sub> = 0V, T <sub>J</sub> = 125°C
I <sub>GES</sub>	Gate-to-Emitter Leakage Current	—	—	500	nA	V <sub>GE</sub> = ±20V

**Dynamic Characteristics - T<sub>J</sub> = 125°C (unless otherwise specified)**

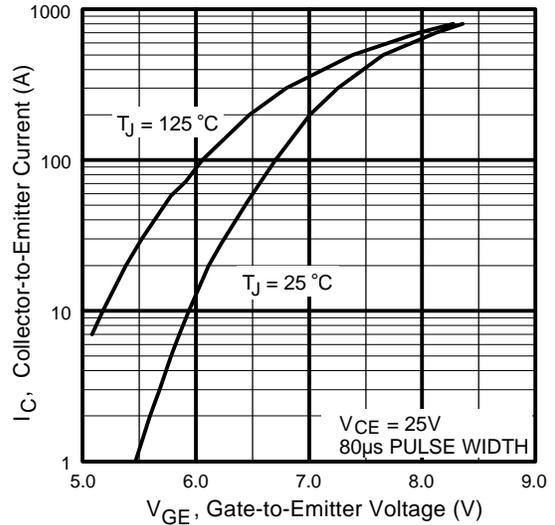
	Parameter	Min.	Typ.	Max.	Units	Conditions
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	1806	2709	nC	V <sub>CC</sub> = 400V
Q <sub>ge</sub>	Gate - Emitter Charge (turn-on)	—	251	376		I <sub>C</sub> = 270A, V <sub>GE</sub> = 15V
Q <sub>gc</sub>	Gate - Collector Charge (turn-on)	—	612	918		T <sub>J</sub> = 25°C
t <sub>d(on)</sub>	Turn-On Delay Time	—	1033	—	ns	R <sub>G1</sub> = 15Ω, R <sub>G2</sub> = 0Ω,
t <sub>r</sub>	Rise Time	—	335	—		I <sub>C</sub> = 400A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	688	—		V <sub>CC</sub> = 360V
t <sub>f</sub>	Fall Time	—	225	—		V <sub>GE</sub> = ±15V
E <sub>on</sub>	Turn-On Switching Energy	—	26	—	mJ	
E <sub>off (1)</sub>	Turn-Off Switching Energy	—	48	—		
E <sub>ts (1)</sub>	Total Switching Energy	—	74	89		
C <sub>ies</sub>	Input Capacitance	—	40136	—	pF	V <sub>GE</sub> = 0V
C <sub>oes</sub>	Output Capacitance	—	2509	—		V <sub>CC</sub> = 30V
C <sub>res</sub>	Reverse Transfer Capacitance	—	522	—		f = 1 MHz
t <sub>rr</sub>	Diode Reverse Recovery Time	—	232	—	ns	I <sub>C</sub> = 400A
I <sub>rr</sub>	Diode Peak Reverse Current	—	141	—		A
Q <sub>rr</sub>	Diode Recovery Charge	—	16292	—	nC	R <sub>G2</sub> = 0Ω
di <sub>(rec)</sub> M <sub>/dt</sub>	Diode Peak Rate of Fall of Recovery During t <sub>b</sub>	—	1641	—	A/μs	V <sub>CC</sub> = 360V di/dt = 1300A/μs



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



**Fig. 2** - Typical Output Characteristics



**Fig. 3** - Typical Transfer Characteristics

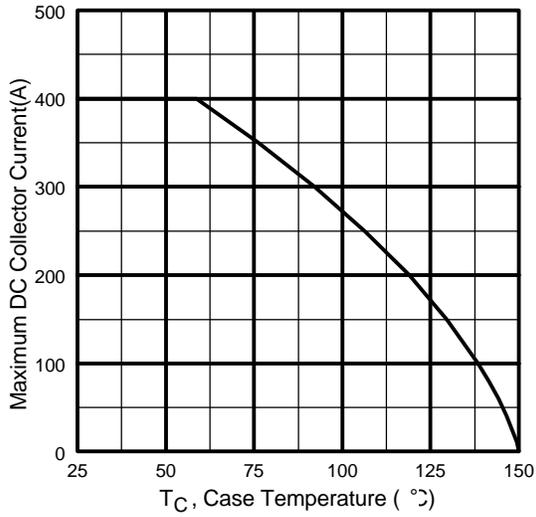


Fig. 4 - Maximum Collector Current vs. Case Temperature

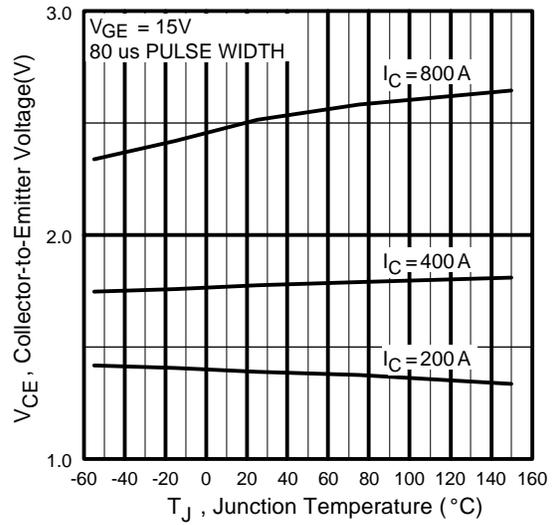


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

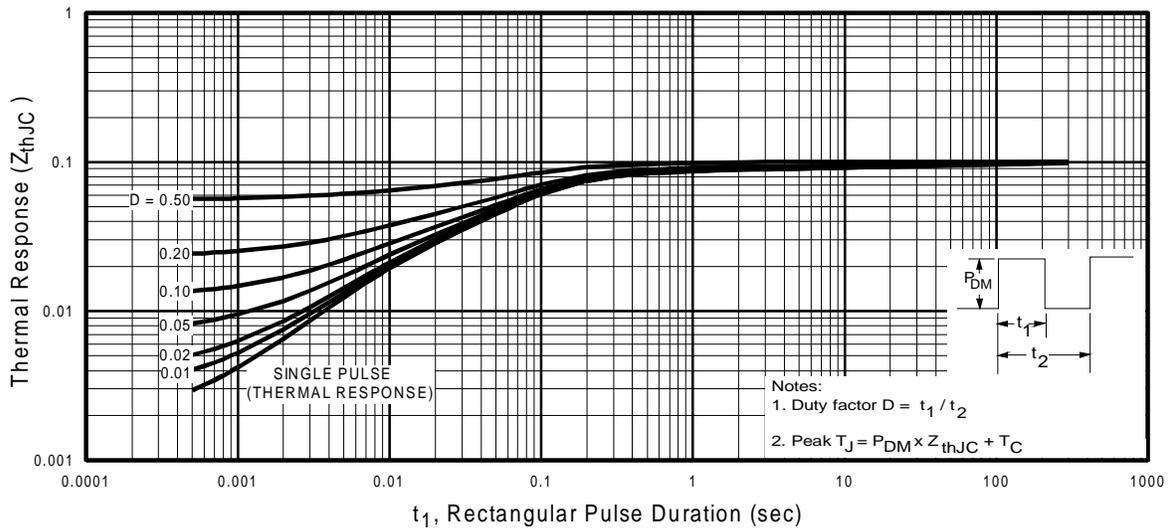


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

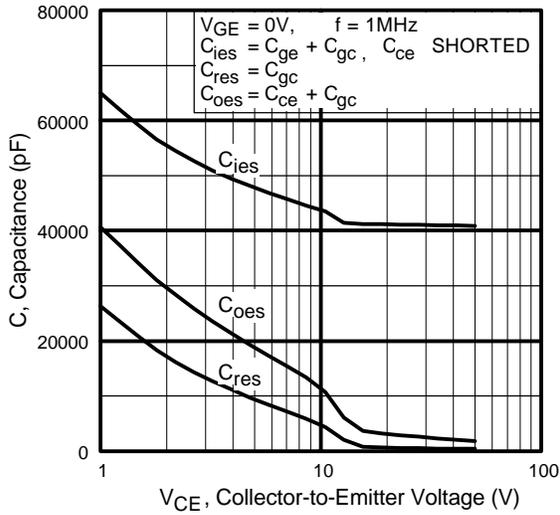


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

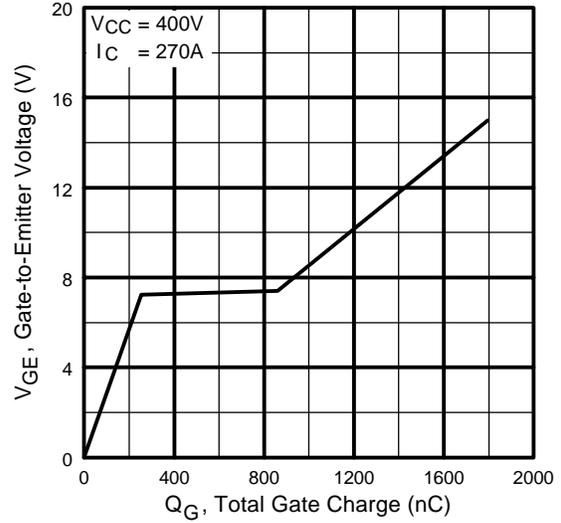


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

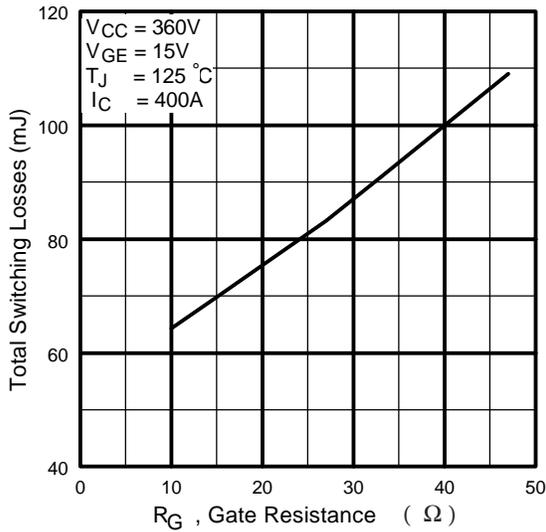


Fig. 9 - Typical Switching Losses vs. Gate Resistance

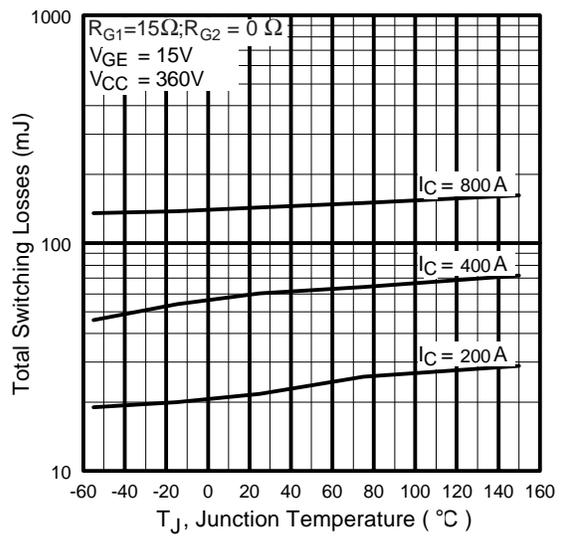
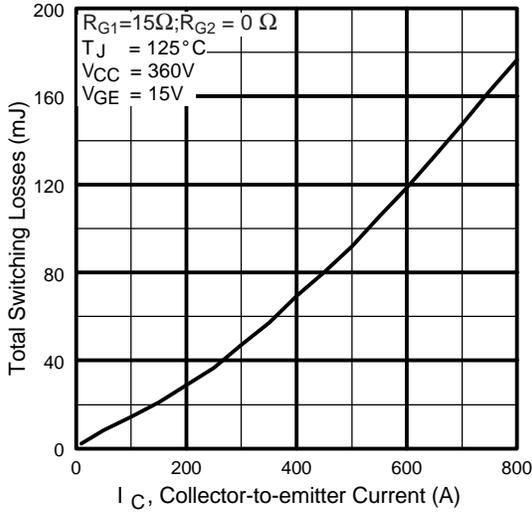
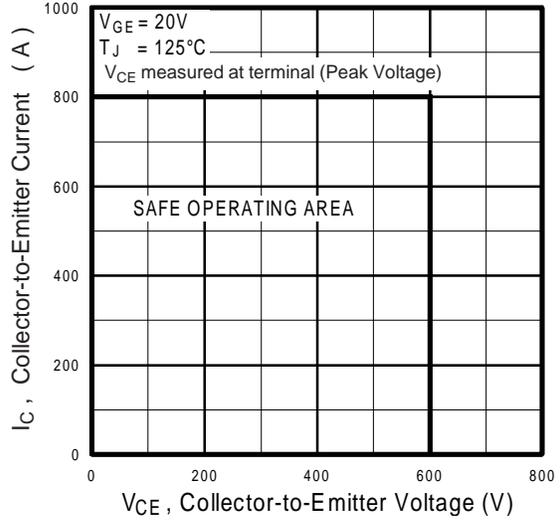


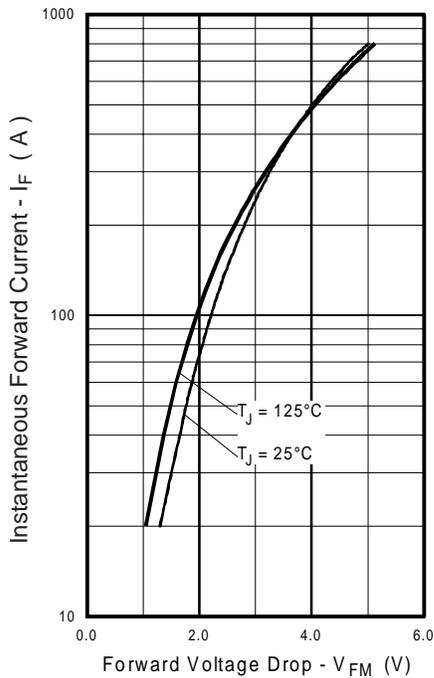
Fig. 10 - Typical Switching Losses vs. Junction Temperature



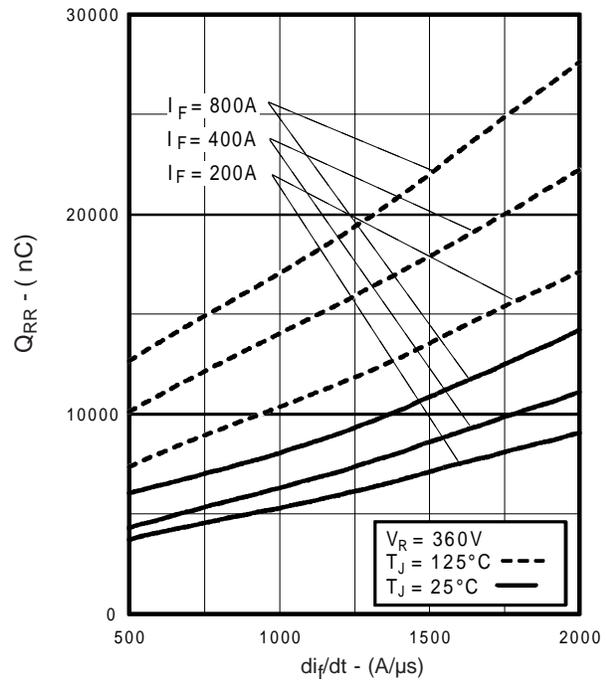
**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current



**Fig. 12** - Reverse Bias SOA



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



**Fig. 14** - Typical Stored Charge vs.  $di/dt$

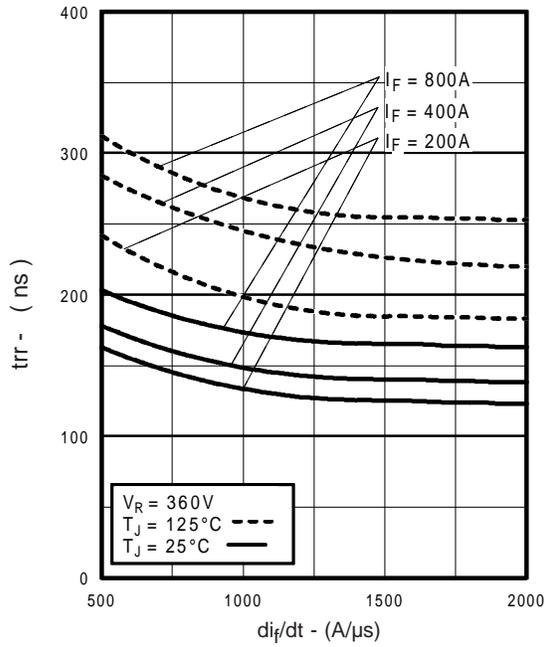


Fig. 15 - Typical Reverse Recovery vs.  $di_f/dt$

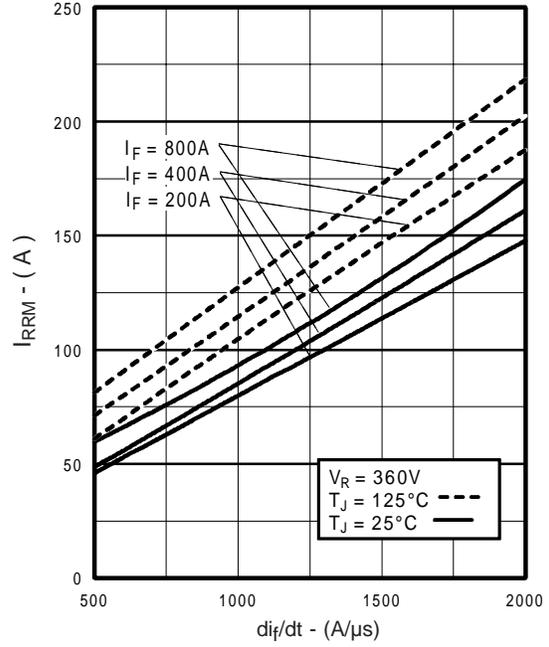
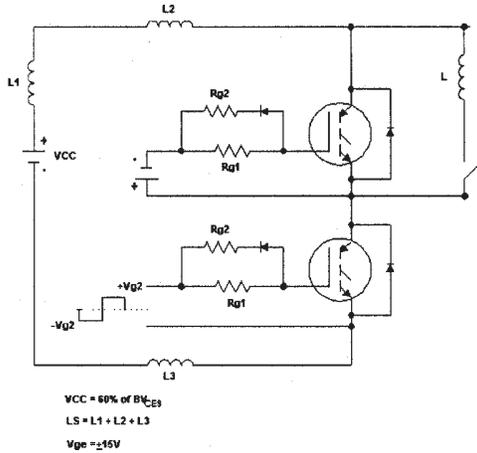
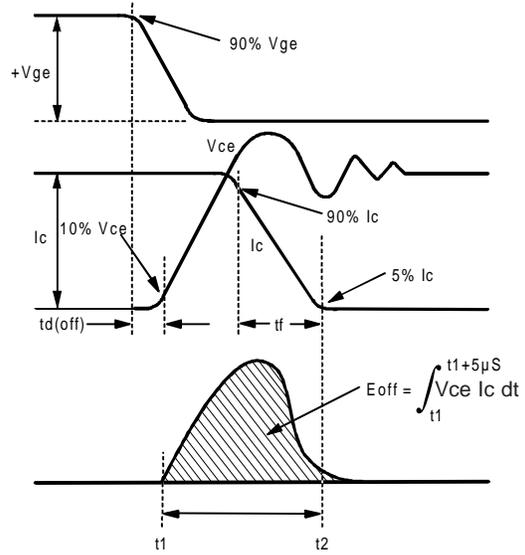


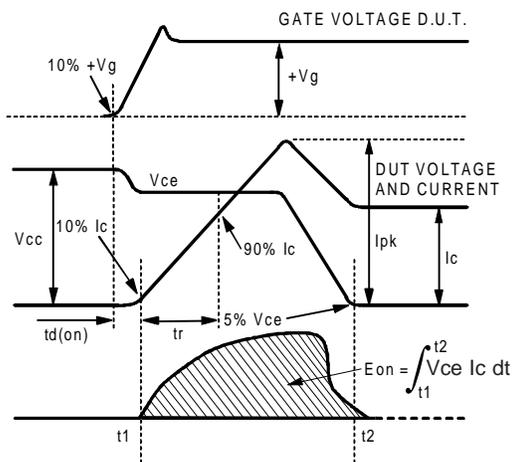
Fig. 16 - Typical Recovery Current vs.  $di_f/dt$



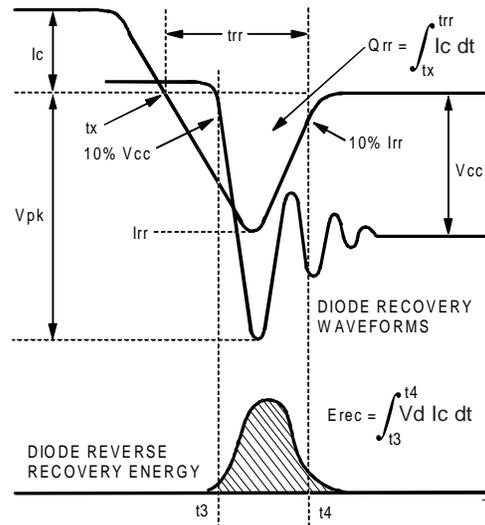
**Fig. 17a** - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{on}$ ,  $E_{off}(\text{diode})$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$ ,  $t_{d(on)}$ ,  $t_r$ ,  $t_{d(off)}$ ,  $t_f$



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



**Fig. 17c** - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{on}$ ,  $t_{d(on)}$ ,  $t_r$



**Fig. 17d** - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{rec}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$

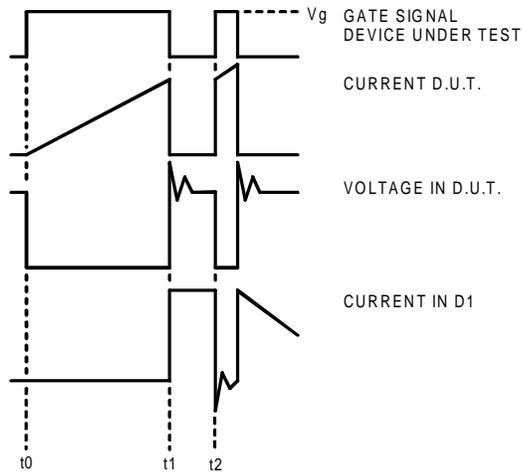


Figure 17e. Macro Waveforms for Figure 18a's Test Circuit

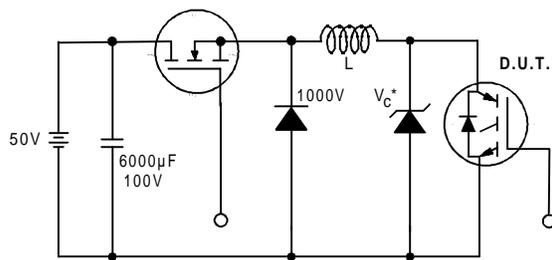


Figure 18. Clamped Inductive Load Test Circuit

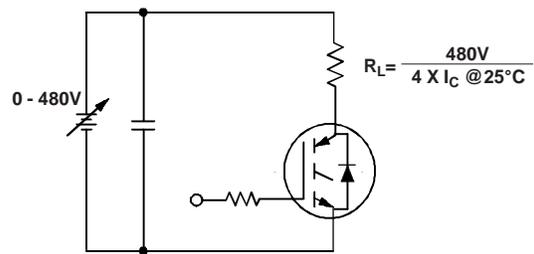


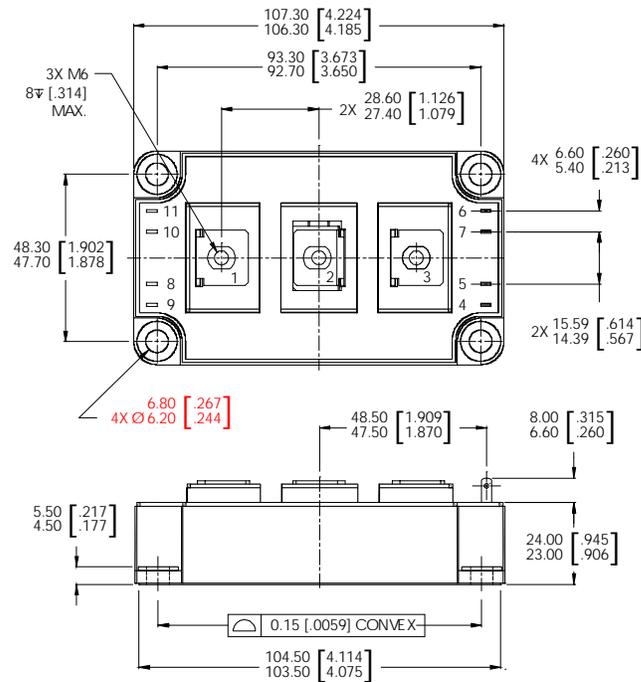
Figure 19. Pulsed Collector Current Test Circuit

# GA400TD60U

**Notes:**

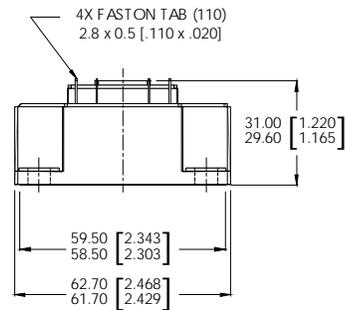
- ① Repetitive rating;  $V_{GE} = 20V$ , pulse width limited by max. junction temperature.
- ② See fig. 17
- ③ For screws M6.
- ④ Pulse width  $50\mu s$ ; single shot.

## Case Outline — DUAL INT-A-PAK



**NOTES:**

- 1. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- 2. CONTROLLING DIMENSION: MILLIMETER.



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