

# International IR Rectifier

PD - 94341A

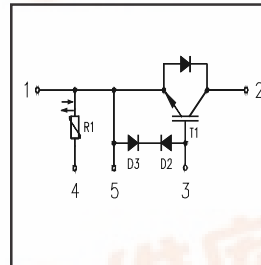
## GA600HD25S

Standard™ Speed IGBT

### SINGLE SWITCH IGBT DUAL INT-A-Pak

#### Features

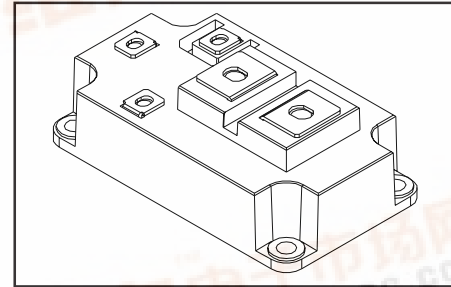
- Standard speed, optimized for battery powered application
- Very low conduction losses
- HEXFRED™ antiparallel diodes with ultra-soft recovery
- Industry standard package
- UL recognition pending
- Internal thermistor



$V_{CES} = 250V$
$V_{CE(on) typ.} = 1.20V$
@ $V_{GE} = 15V, I_C = 600A$

#### 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	250	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	600	A
$I_{CM}$	Pulsed Collector Current <sup>①</sup>	1200	
$I_{LM}$	Peak Switching Current <sup>②</sup>	1200	
$I_{FM}$	Peak Diode Forward Current	1200	
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 17$	V
$V_{ISOL}$	RMS Isolation Voltage, Any Terminal To Case, $t = 1 \text{ min}$	2500	W
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	1920	
$P_D @ T_C = 85^\circ C$	Maximum Power Dissipation	1000	
$T_J$	Operating Junction Temperature Range	-40 to +150	$^\circ C$
$T_{STG}$	Storage Temperature Range	-40 to +125	

### Thermal / Mechanical Characteristics

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case - IGBT	—	0.065	$^\circ C/W$
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case - Diode	—	0.20	
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink - Module	0.04	—	
	Mounting Torque, Case-to-Heatsink <sup>③</sup>	—	6.0	N·m
	Mounting Torque, Case-to-Terminal 1, 2 <sup>③</sup>	—	5.0	
	Mounting Torque, Case-to-Terminal 3,4,5	—	2.0	
	Weight of Module	400	—	g



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## 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	250	—	—		V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA
V <sub>CE(on)</sub>	Collector-to-Emitter Voltage	—	1.20	1.30	V	V <sub>GE</sub> = 15V, I <sub>C</sub> = 600A
		—	1.16	1.25		V <sub>GE</sub> = 15V, I <sub>C</sub> = 600A, T <sub>J</sub> = 125°C
		3.0	—	6.0		I <sub>C</sub> = 5.0mA, V <sub>CE</sub> = 6.0V
V <sub>GE(th)</sub>	Gate Threshold Voltage	3.0	—	6.0		I <sub>C</sub> = 5.0mA, V <sub>CE</sub> = 6.0V
ΔV <sub>GE(th)</sub> /ΔT <sub>J</sub>	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/°C	V <sub>CE</sub> = 6.0V, I <sub>C</sub> = 5.0mA, T <sub>C</sub> = 25/125°C
g <sub>fe</sub>	Forward Transconductance ③	—	720	—	S	V <sub>CE</sub> = 25V, I <sub>C</sub> = 600A
I <sub>CES</sub>	Collector-to-Emitter Leaking Current	—	—	2.0	mA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 250V
		—	—	20		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 250V, T <sub>J</sub> = 125°C
V <sub>FM</sub>	Diode Forward Voltage - Maximum	—	1.5	1.8	V	I <sub>F</sub> = 300A, V <sub>GE</sub> = 0V
		—	1.5	—		I <sub>F</sub> = 300A, V <sub>GE</sub> = 0V, T <sub>J</sub> = 125°C
I <sub>GES</sub>	Gate-to-Emitter Leakage Current	—	—	1.0	μA	V <sub>GE</sub> = ±14V (18V zeners gate-emitter)
ΔT <sub>DP</sub>	Pulse Diode Temp Rise	—	—	80	°C	I <sub>C</sub> = 300A, t = 150msec, T <sub>C</sub> = 70°C
R-T <sub>25</sub>	Thermistor, Positive Temp Coefficient	779	820	861	Ω	I = 100mA, P = 2.5mW/°C (see note 1)

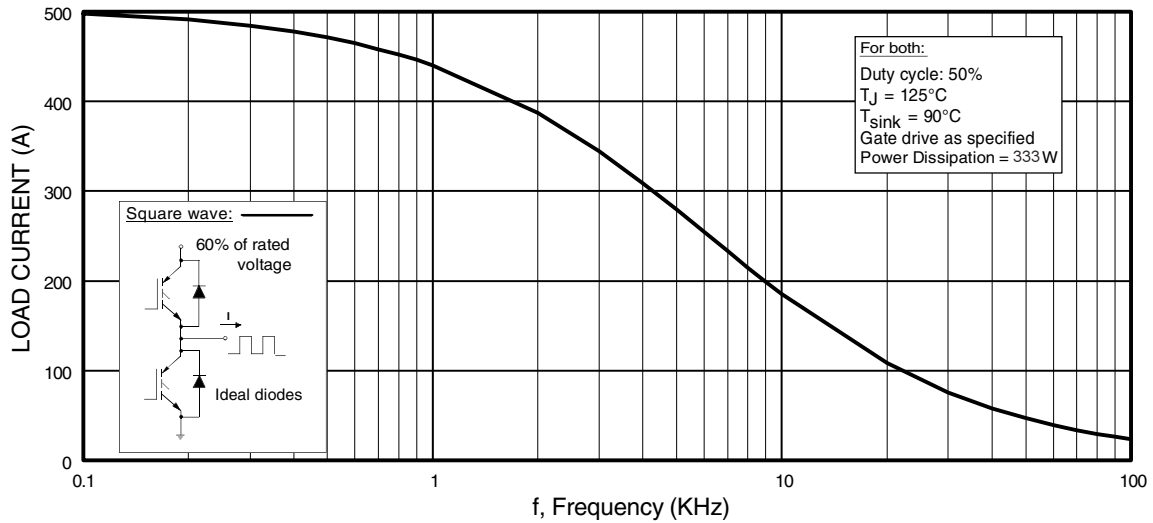
## Dynamic Characteristics - T<sub>J</sub> = 125°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	3825	5738	nC	V <sub>CC</sub> = 200V, V <sub>GE</sub> = 15V
Q <sub>ge</sub>	Gate - Emitter Charge (turn-on)	—	555	832		I <sub>C</sub> = 600A
Q <sub>gc</sub>	Gate - Collector Charge (turn-on)	—	1262	1893		T <sub>J</sub> = 25°C
t <sub>d(on)</sub>	Turn-On Delay Time	—	1060	—	ns	R <sub>G1</sub> = 15Ω, R <sub>G2</sub> = 0Ω,
t <sub>r</sub>	Rise Time	—	950	—		I <sub>C</sub> = 600A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	846	—		V <sub>CC</sub> = 150V, Inductor load
t <sub>f</sub>	Fall Time	—	934	—		V <sub>GE</sub> = ±15V
E <sub>on</sub>	Turn-On Switching Energy	—	17	—		See Fig. 18, 20
E <sub>off (1)</sub>	Turn-Off Switching Energy	—	105	—		
E <sub>ts (1)</sub>	Total Switching Energy	—	122	250		
C <sub>ies</sub>	Input Capacitance	—	86063	—	pF	V <sub>GE</sub> = 0V
C <sub>oes</sub>	Output Capacitance	—	9754	—		V <sub>CC</sub> = 30V
C <sub>res</sub>	Reverse Transfer Capacitance	—	1913	—		f = 1 MHz
t <sub>rr</sub>	Diode Reverse Recovery Time	—	314	—	ns	I <sub>C</sub> = 600A
I <sub>rr</sub>	Diode Peak Reverse Current	—	80	—		A
Q <sub>rr</sub>	Diode Recovery Charge	—	12513	—	μC	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>	—	632	—	A/μs	V <sub>CC</sub> = 150V di/dt = 500A/μs

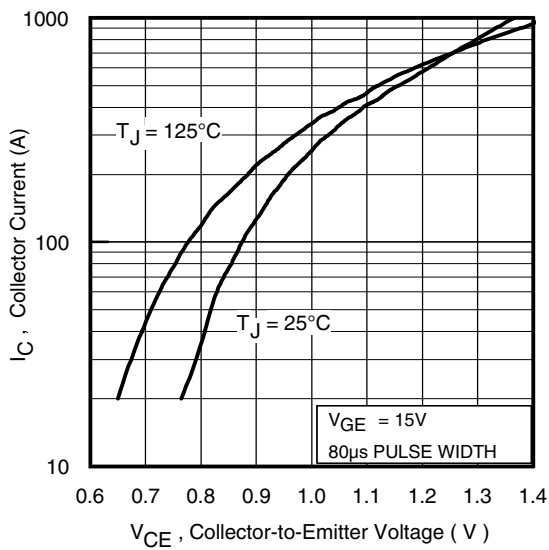
### Notes:

1. The thermistor has an average rate of change of 7Ω /°C between 20°C and 125°C.

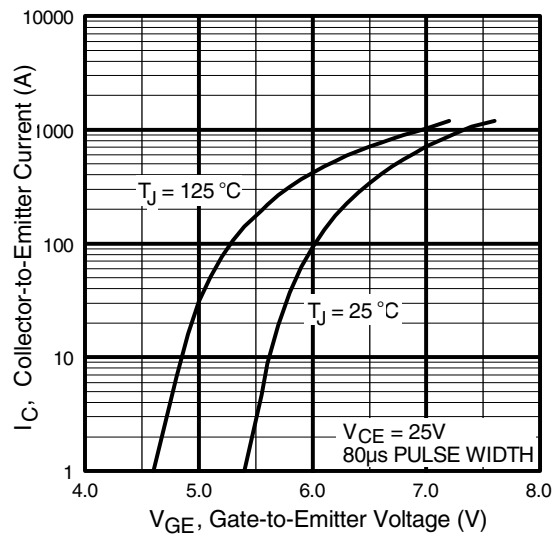
Consult Quality Thermistor Inc. data sheet QTI 0805-821J for details



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



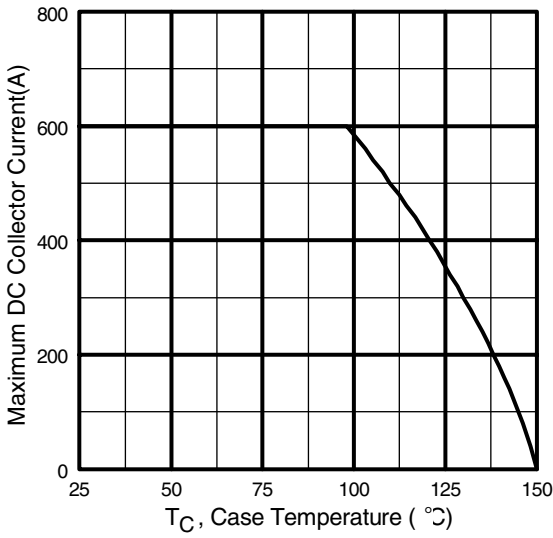
**Fig. 2 - Typical Output Characteristics**



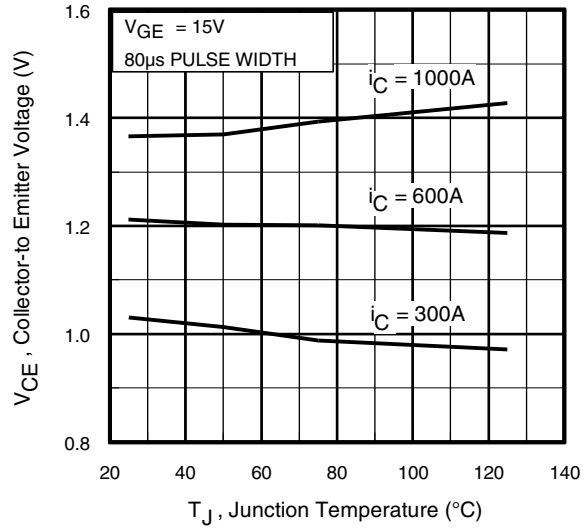
**Fig. 3 - Typical Transfer Characteristics**

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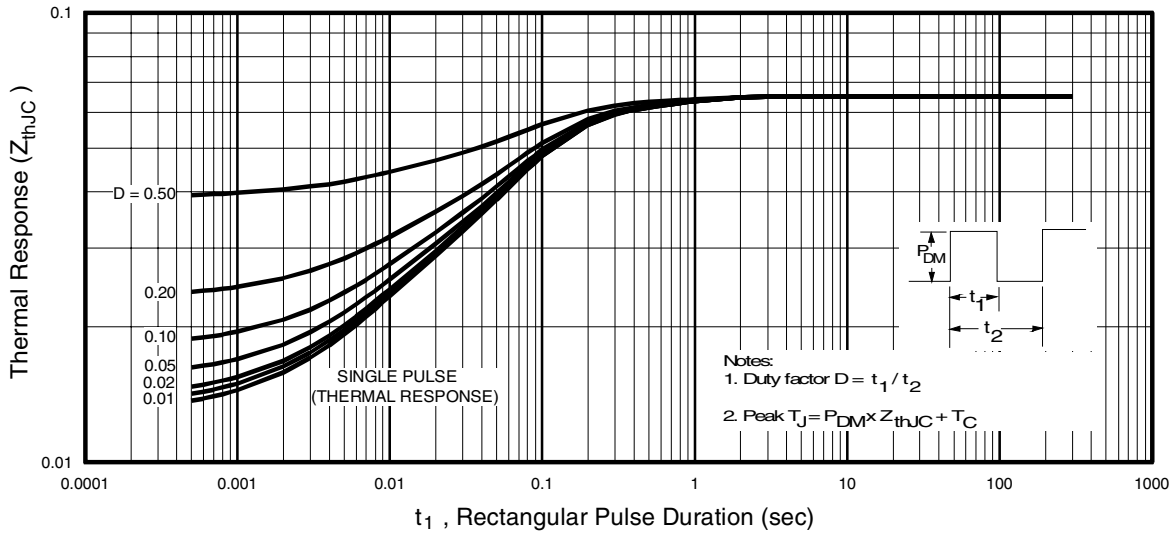
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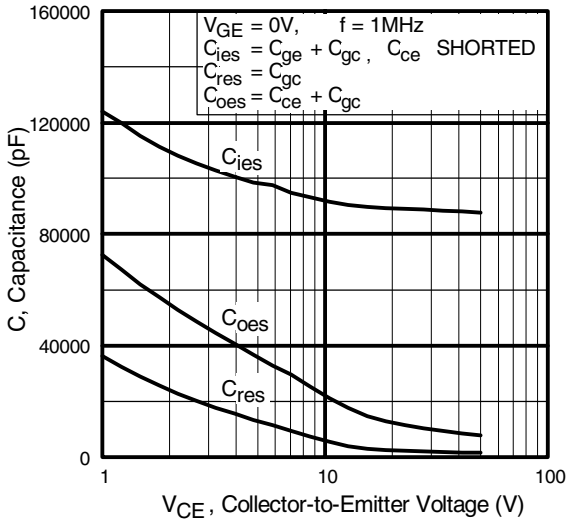
**Fig. 4** - Maximum Collector Current vs. Case Temperature



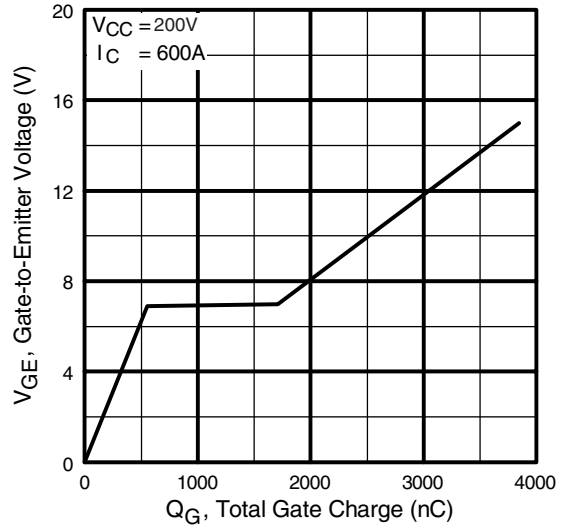
**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature



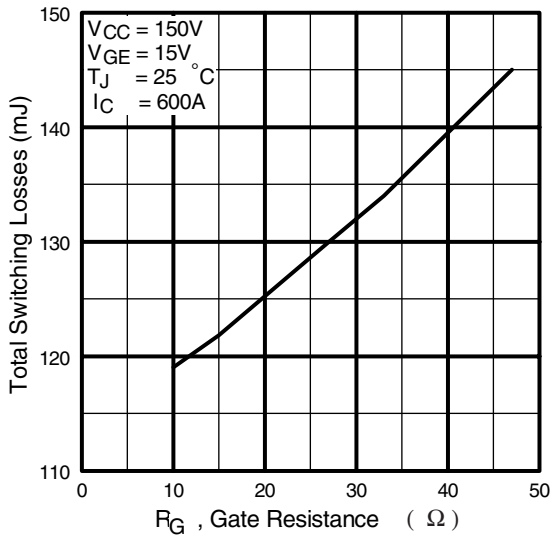
**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case



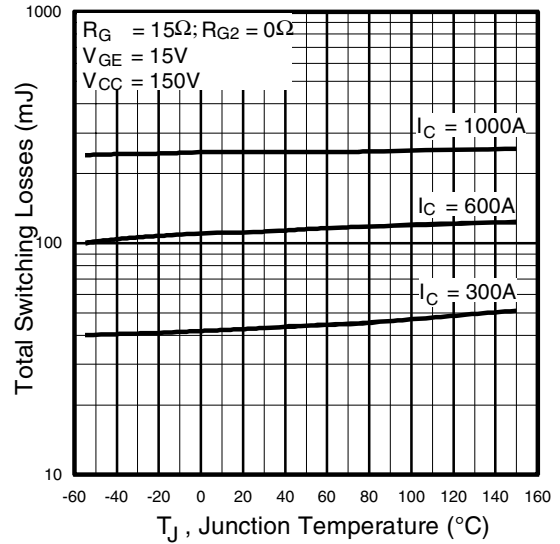
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



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



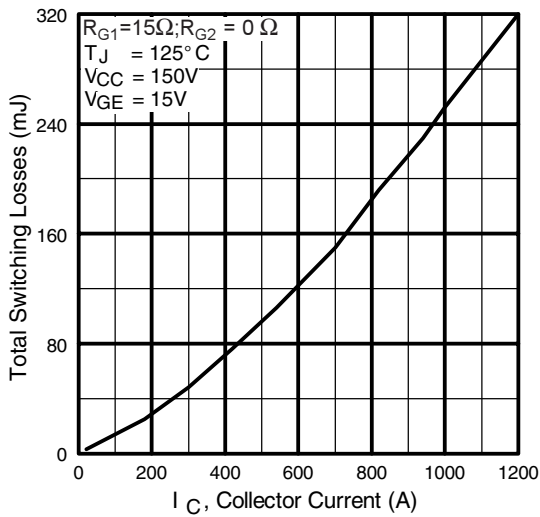
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



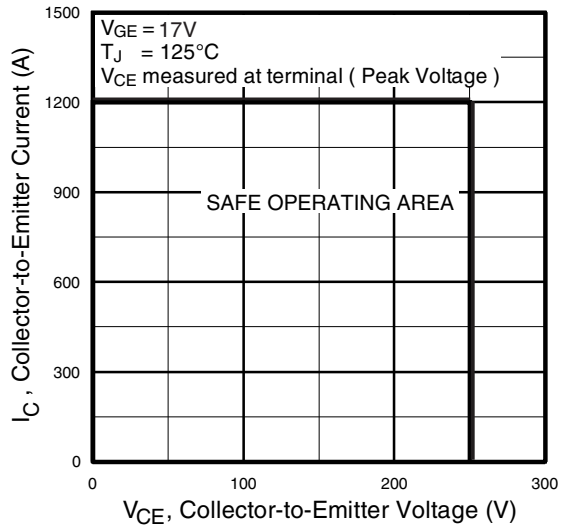
**Fig. 10** - Typical Switching Losses vs. Junction Temperature

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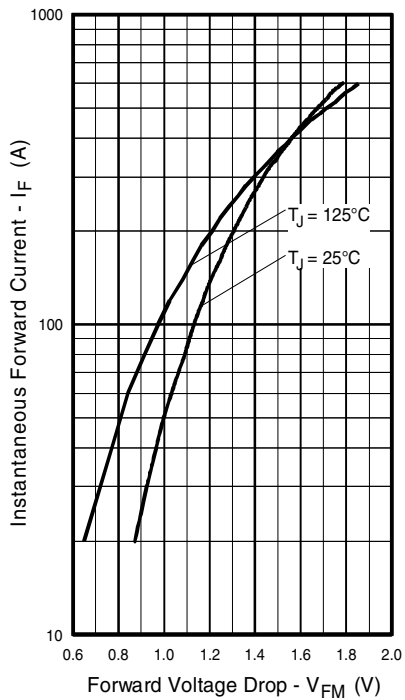
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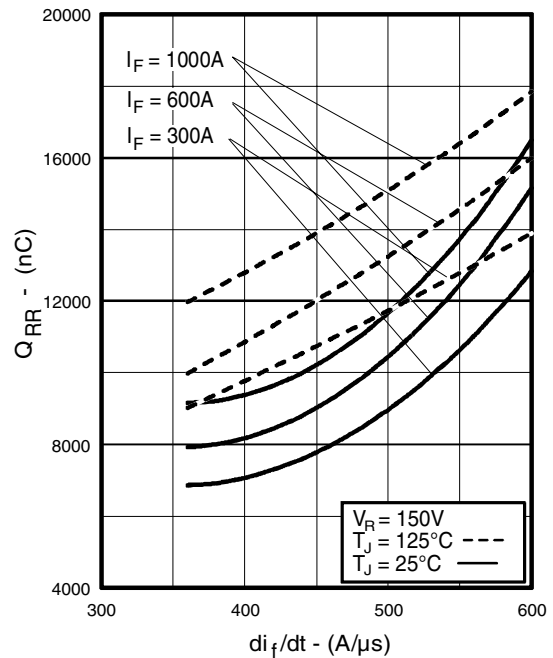
**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current



**Fig. 12** - Reverse Bias SOA



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



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

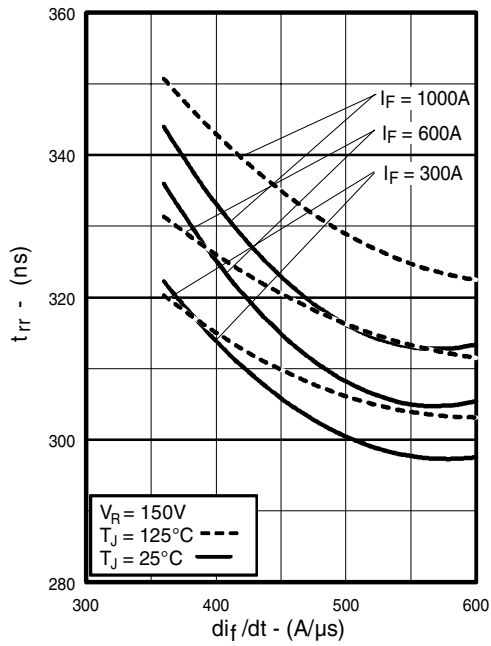


Fig. 15 - Typical Reverse Recovery vs.  $di_f/dt$

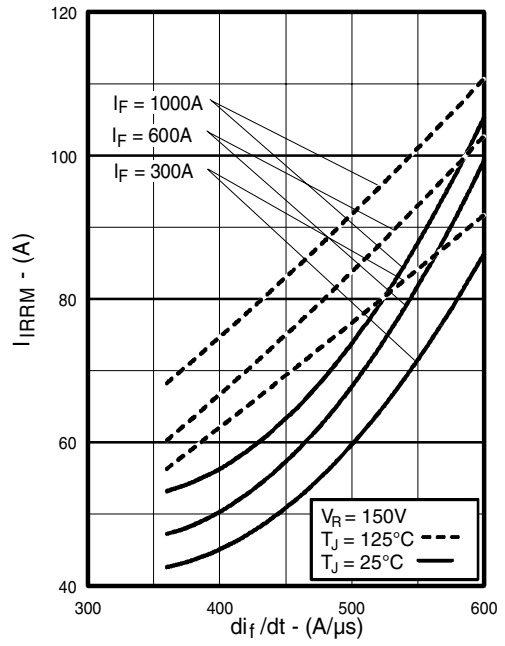


Fig. 16 - Typical Recovery Current vs.  $di_f/dt$

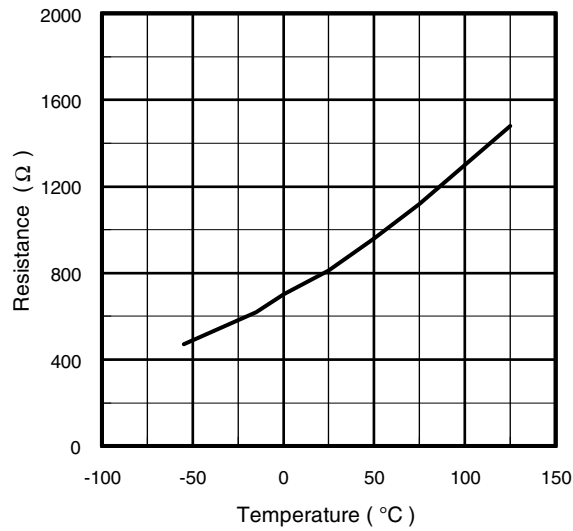
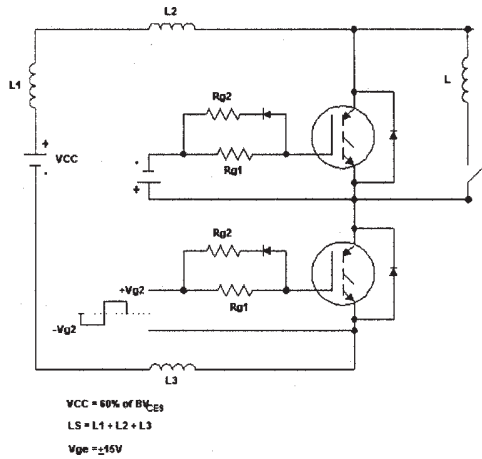


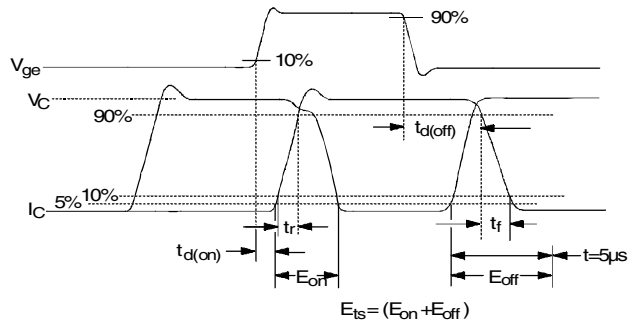
Fig. 17 - Typical Thermistor Characteristics  
(See Note1 on page 2)

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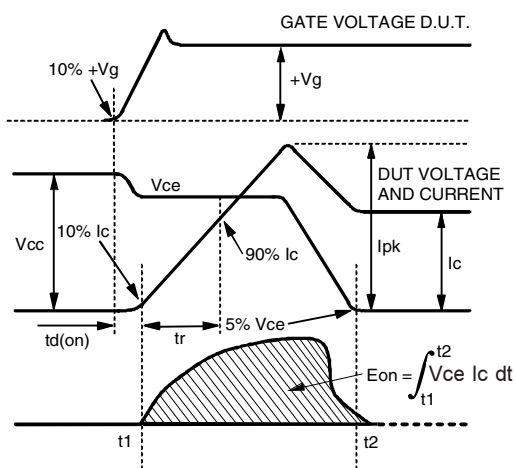
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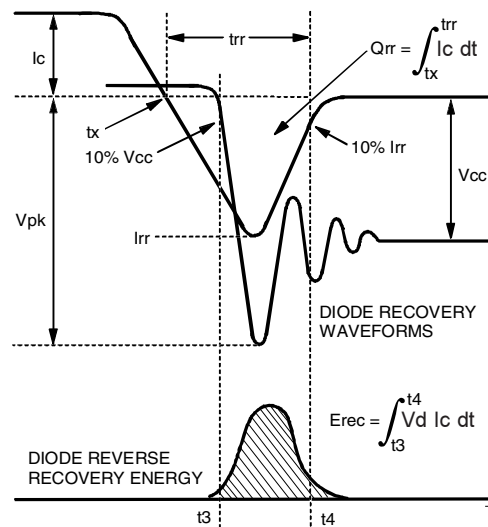
**Fig. 18a** - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{on}$ ,  $E_{off}(\text{diode})$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$ ,  $t_{d(on)}$ ,  $t_r$ ,  $t_{d(off)}$ ,  $t_f$



**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  $E_{rec}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$



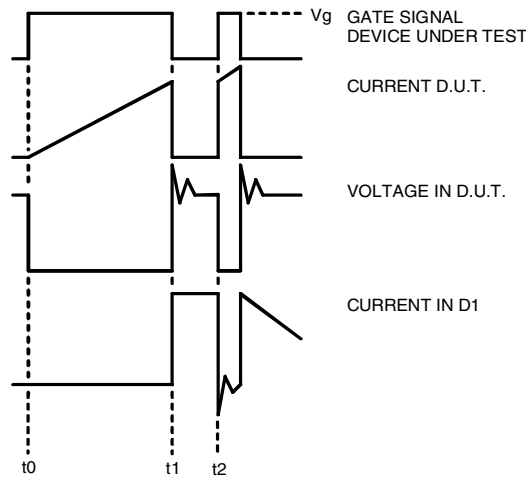


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

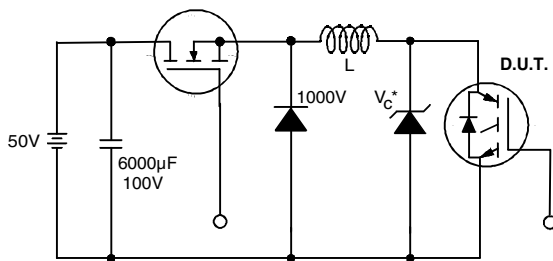


Figure 19. Clamped Inductive Load Test Circuit

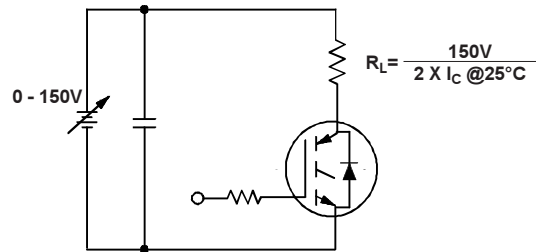


Figure 20. Pulsed Collector Current Test Circuit

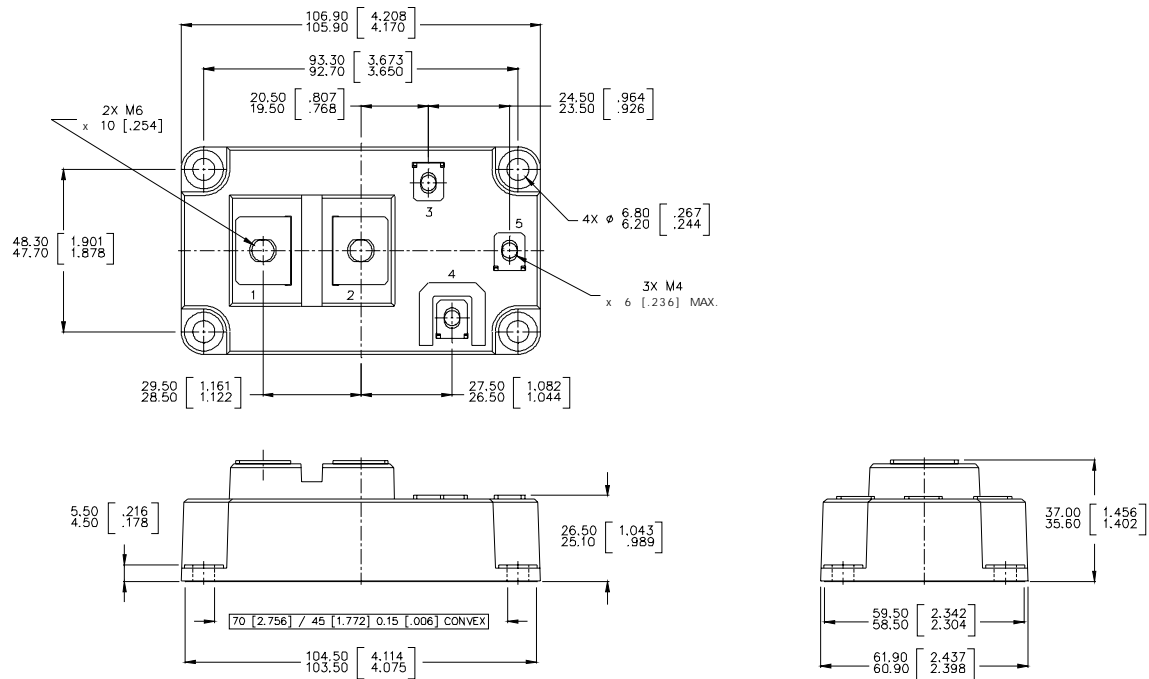
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**Notes:**

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

## Case Outline — DUAL INT-A-Pak



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.

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**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105  
TAC Fax: (310) 252-7903  
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