International
IOR Rectifier

PD - 94290

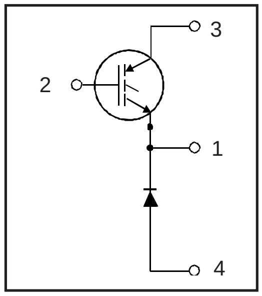
GA100NA60U

INSULATED GATE BIPOLAR TRANSISTOR

Ultra-Fast™ Speed IGBT

Features

- UltraFast™: Optimized for minimum saturation voltage and operating frequencies up to 40 kHz in hard switching, > 200 kHz in resonant mode
- Very low conduction and switching losses
- Fully isolated package (2,500 Volt AC/RMS)
- Very low internal inductance (≤ 5 nH typ.)
- Industry standard outline



V_{CES} = 600V

$V_{CE(on)\ typ.}$ = 1.49V

@V_{GE} = 15V, I_C = 50A

Benefits

- Designed for increased operating efficiency in power conversion: PFC, UPS, SMPS, Welding, Induction heating
- Lower overall losses available at frequencies ≥ 20kHz
- Easy to assemble and parallel
- Direct mounting to heatsink
- Lower EMI, requires less snubbing
- Plug-in compatible with other SOT-227 packages

SOT-227

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	100	A
I_C @ T_C = 100°C	Continuous Collector Current	50	
I_{CM}	Pulsed Collector Current	200	
I_{LM}	Clamped Inductive Load Current②	200	
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	250	W
P_D @ T_C = 100°C	Maximum Power Dissipation	100	
T_J	Operating Junction	-55 to + 150	°C
T_{STG}	Storage Temperature Range	-55 to + 150	
	Mounting Torque, 6-32 or M3 Screw	12 lbf •in(1.3N•m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case, IGBT	——	0.50	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case , Diode	——	1.0	
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.05	——	
Wt	Weight of Module	30	——	gm

7/27/01

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage③	600	—	—	V	V_{GE} = 0V, I_C = 250µA	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.36	—	V/°C	V_{GE} = 0V, I_C = 1.0mA	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.49	2.1	V	I_C = 50A	V_{GE} = 15V
		—	1.80	—		I_C = 100A	See Fig. 1, 4
		—	1.47	—		I_C = 50A, 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	—	-7.6	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA	
g_{fe}	Forward Transconductance ④	34	52	—	S	V_{CE} = 100V, I_C = 50A	
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	µA	V_{GE} = 0V, V_{CE} = 600V	
		—	—	1.3	mA	V_{GE} = 0V, V_{CE} = 600V, T_J = 150°C	
V_{FM}	Diode Forward Voltage Drop	—	1.3	1.6	V	I_C = 50A	See Fig. 12
		—	1.16	1.3		I_C = 50A, 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)	—	430	640	nC	I_C = 50A		
Qge	Gate - Emitter Charge (turn-on)	—	48	72		V_{CC} = 400V	See Fig. 7	
Q_{gc}	Gate - Collector Charge (turn-on)	—	130	190		V_{GE} = 15V		
$t_{d(on)}$	Turn-On Delay Time	—	57	—	ns	T_J = 25°C		
t_r	Rise Time	—	80	—		I_C = 60A, V_{CC} = 480V		
$t_{d(off)}$	Turn-Off Delay Time	—	240	—		V_{GE} = 15V, R_G = 5.0Ω		
t_f	Fall Time	—	120	—		Energy losses include "tail" and		
E_{on}	Turn-On Switching Loss	—	0.41	—	mJ	diode reverse recovery.		
E_{off}	Turn-Off Switching Loss	—	2.51	—				
E_{ts}	Total Switching Loss	—	2.92	4.4				
$t_{d(on)}$	Turn-On Delay Time	—	57	—	ns	T_J = 150°C,		
t_r	Rise Time	—	80	—		I_C = 60A, V_{CC} = 480V		
$t_{d(off)}$	Turn-Off Delay Time	—	380	—		V_{GE} = 15V, R_G = 5.0Ω		
t_f	Fall Time	—	170	—		Energy losses include "tail" and		
E_{ts}	Total Switching Loss	—	4.78	—	mJ	diode reverse recovery.		
L_E	Internal Emitter Inductance	—	2.0	—	nH			
C_{ies}	Input Capacitance	—	7400	—	pF	V_{GE} = 0V		
C_{oes}	Output Capacitance	—	730	—		V_{CC} = 30V	See Fig. 6	
C_{res}	Reverse Transfer Capacitance	—	90	—		f = 1.0MHz		
t_{rr}	Diode Reverse Recovery Time	—	90	140	ns	T_J = 25°C	See Fig.	
		—	120	180		T_J = 125°C	13	I_F = 50A
I_{rr}	Diode Peak Reverse Recovery Current	—	7.3	11	A	T_J = 25°C	See Fig.	
		—	11	16		T_J = 125°C	14	V_R = 200V
Q_{rr}	Diode Reverse Recovery Charge	—	360	550	nC	T_J = 25°C	See Fig.	
		—	780	1200		T_J = 125°C	15	di/dt = 200Aµs
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery	—	370	—	A/µs	T_J = 25°C	See Fig.	
	During t_b	—	220	—		T_J = 125°C	16	

Details of note ① through ④ are on the page 7

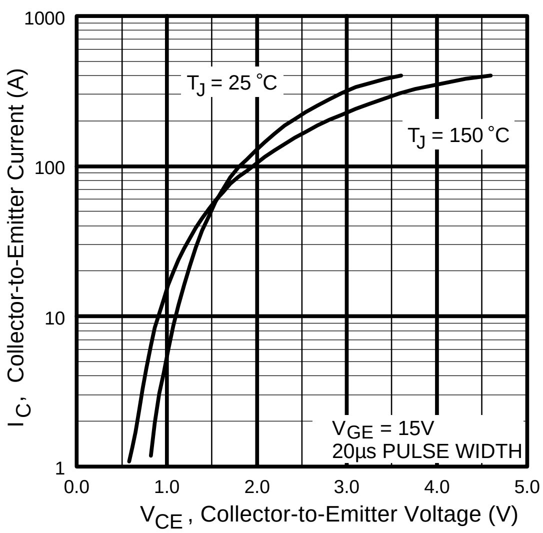


Fig. 1 - Typical Output Characteristics

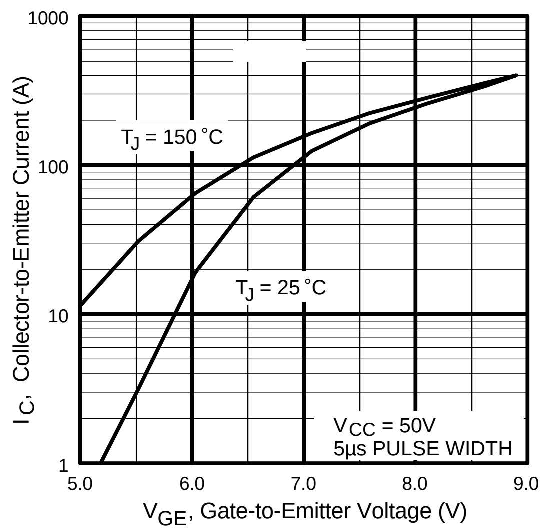


Fig. 2 - Typical Transfer Characteristics

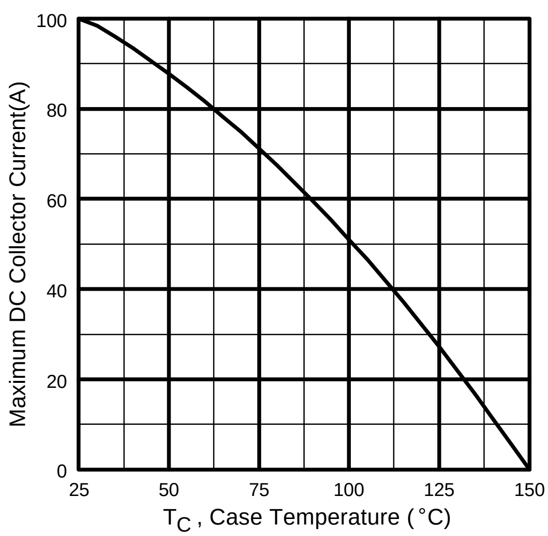


Fig. 3 - Maximum Collector Current vs. Case Temperature

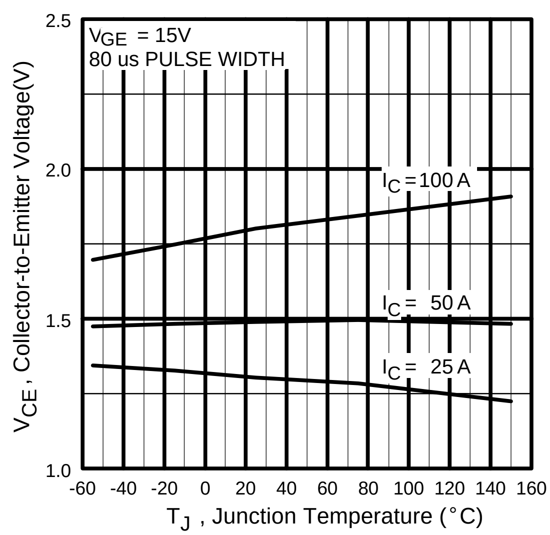


Fig. 4 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

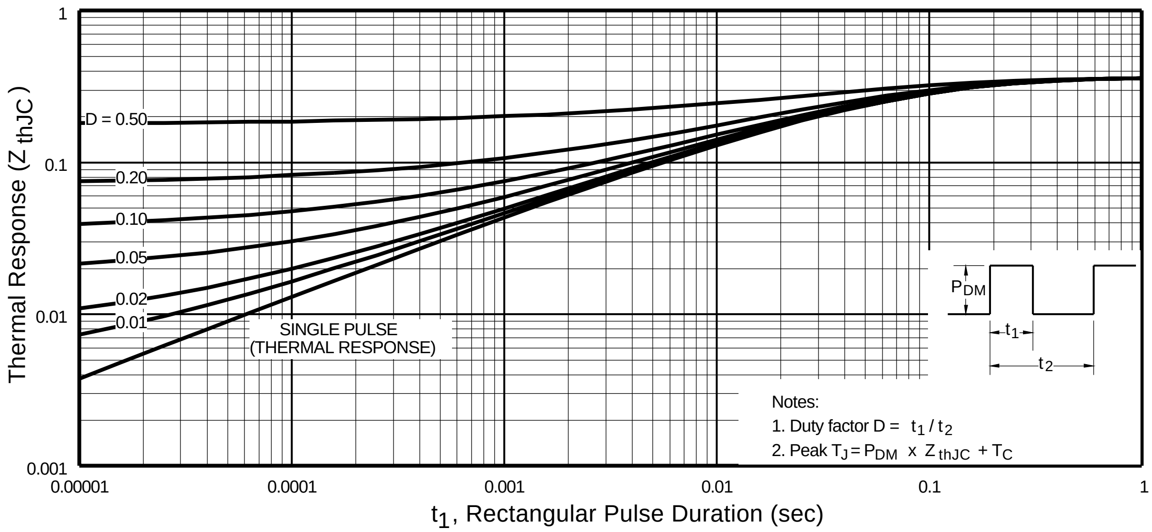
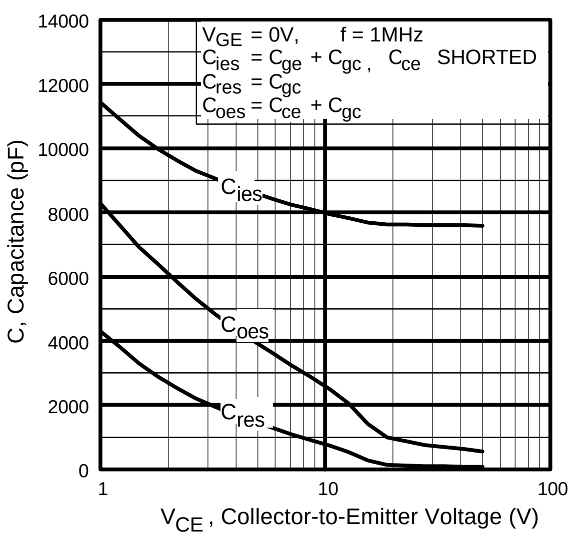


Fig. 5 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



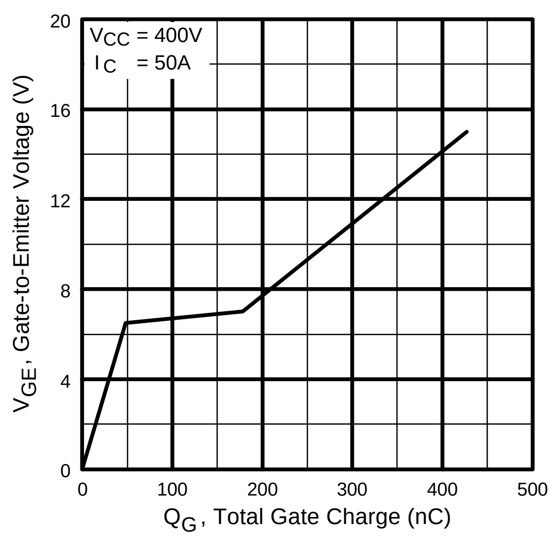


Fig. 6 - Typical Capacitance vs. Collector-to-Emitter Voltage

Fig. 7 - Typical Gate Charge vs. Gate-to-Emitter Voltage

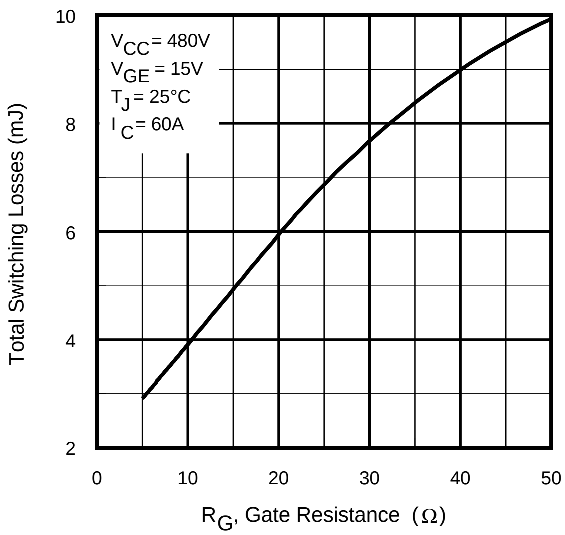


Fig. 8 - Typical Switching Losses vs. Gate Resistance

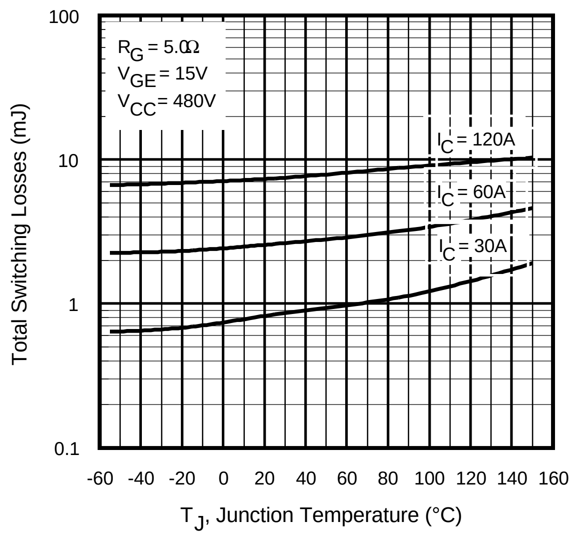


Fig. 9 - Typical Switching Losses vs. Junction Temperature

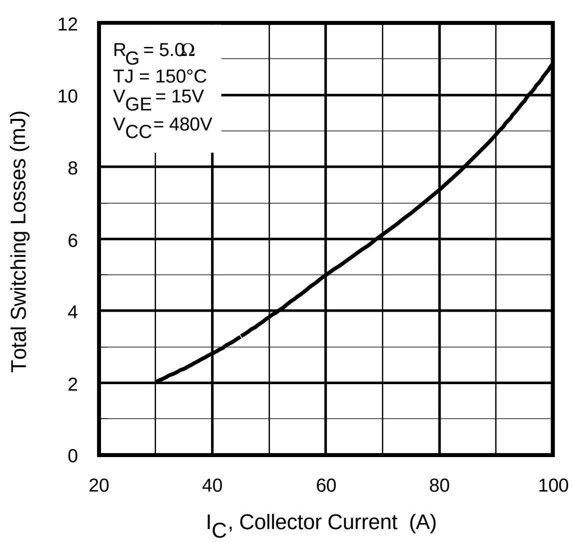


Fig. 10 - Typical Switching Losses vs. Collector-to-Emitter Current

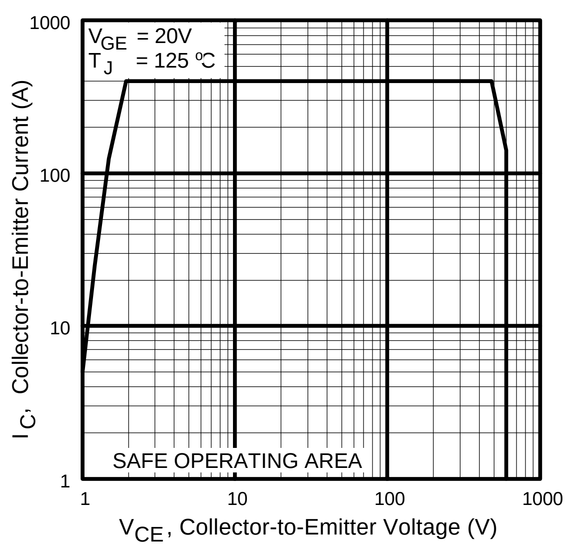


Fig. 11 - Turn-Off SOA

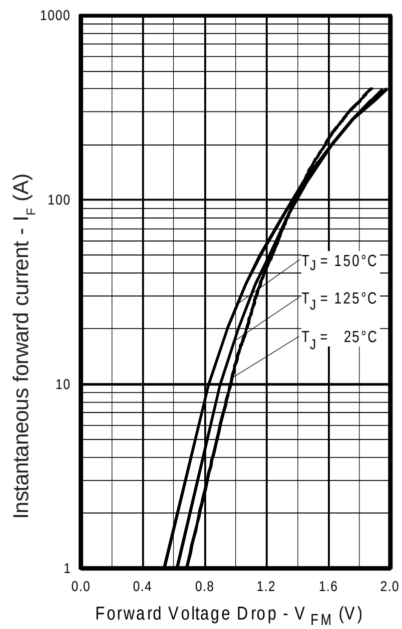


Fig. 12 - Typical Forward Voltage Drop vs. Instantaneous Forward Current

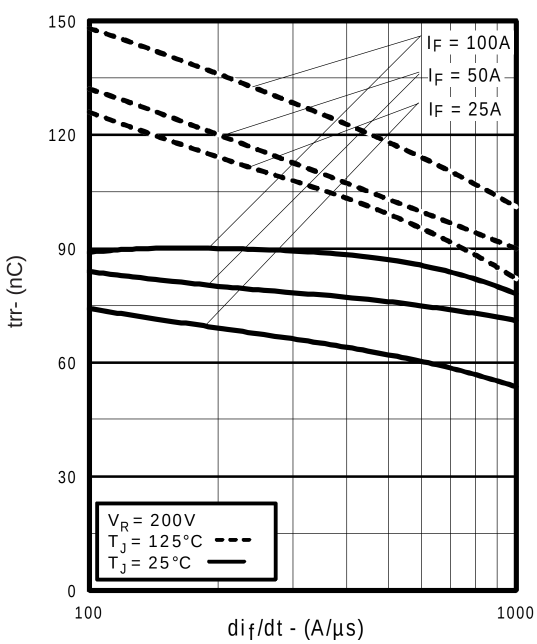


Fig. 13 - Typical Reverse Recovery vs. di_f/dt

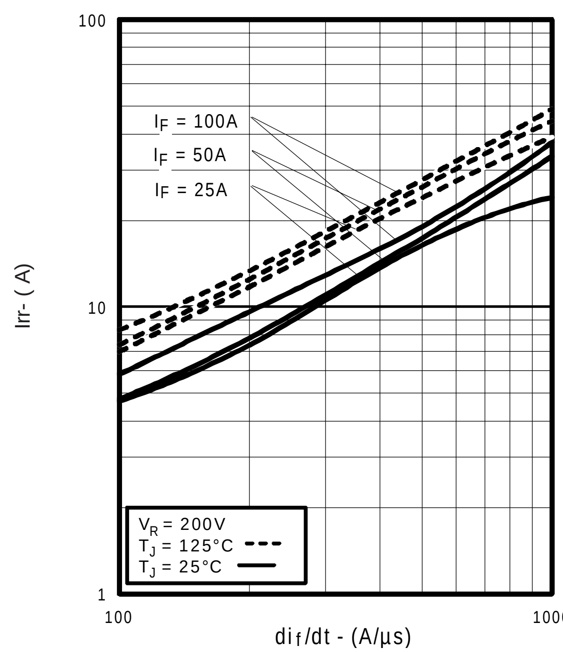


Fig. 14 - Typical Recovery Current vs. di_f/dt

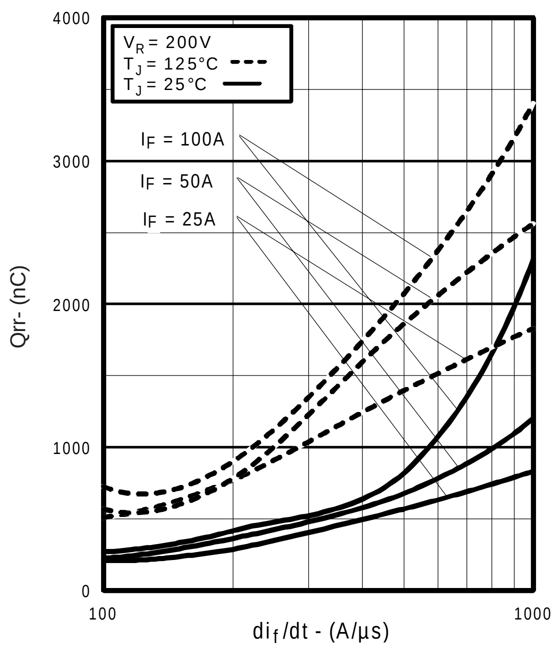


Fig. 15 - Typical Stored Charge vs. di_f/dt

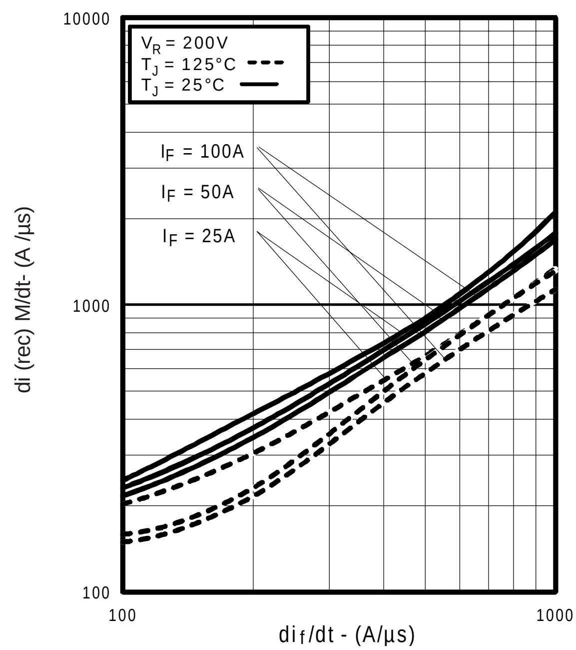


Fig. 16 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

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= 5.0Ω (figure 19)

③ Pulse width ≤ 80µs; duty factor ≤ 0.1%.

④ Pulse width 5.0µs, single shot.

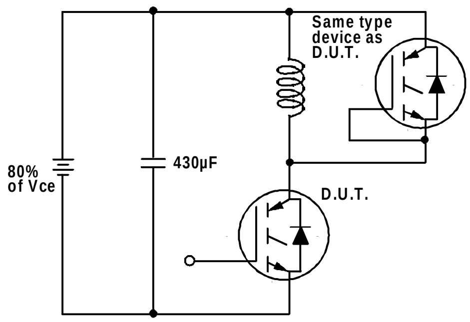


Fig. 17a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

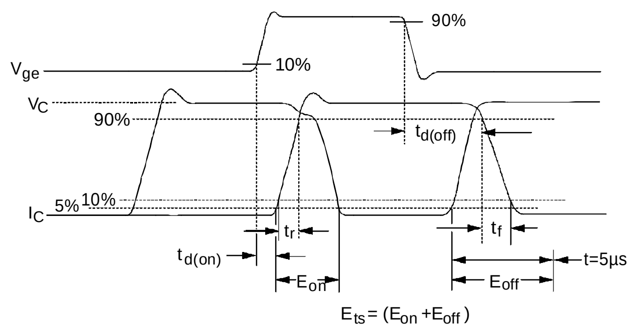


Fig. 17b - Test Waveforms for Circuit of Fig. 17a, Defining E_{off}, $t_{d(off)}$, t_f

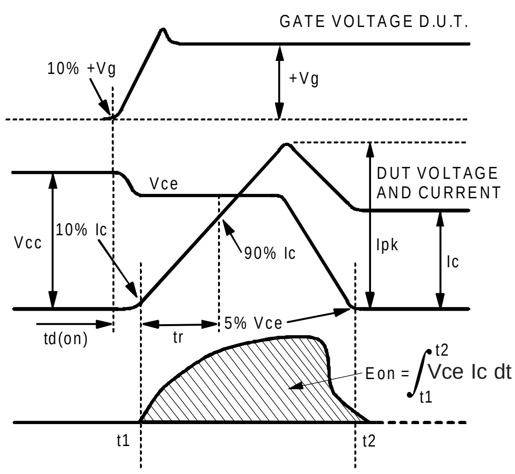


Fig. 17c - Test Waveforms for Circuit of Fig. 17a, Defining E_{on}, $t_{d(on)}$, t_r

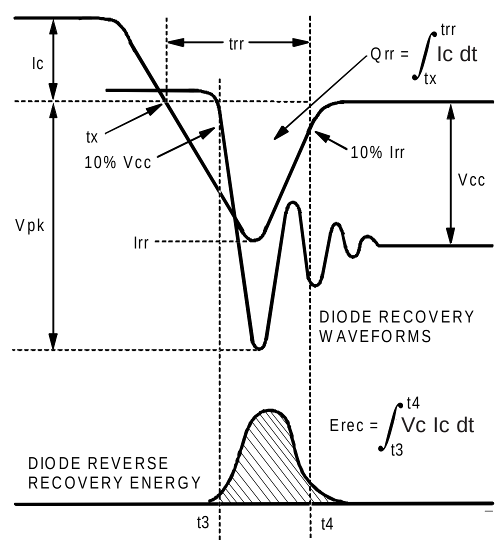


Fig. 17d - Test Waveforms for Circuit of Fig. 17a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

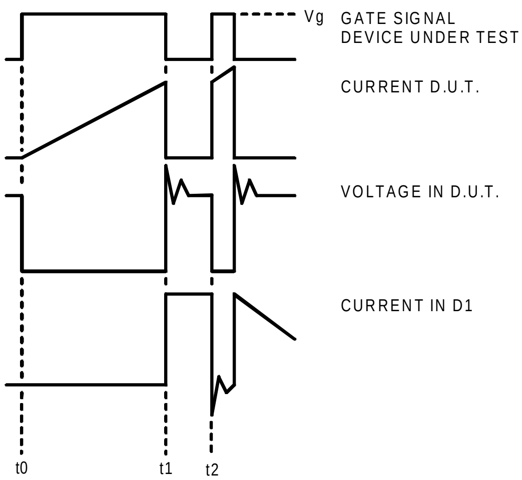


Figure 17e. Macro Waveforms for Figure 17a's Test Circuit

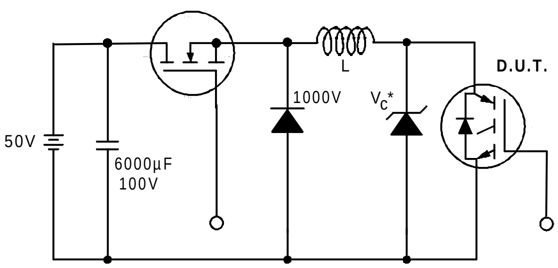


Figure 18. Clamped Inductive Load Test Circuit

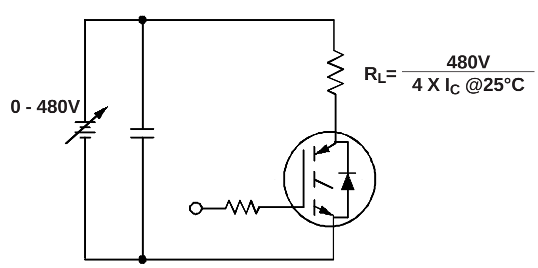
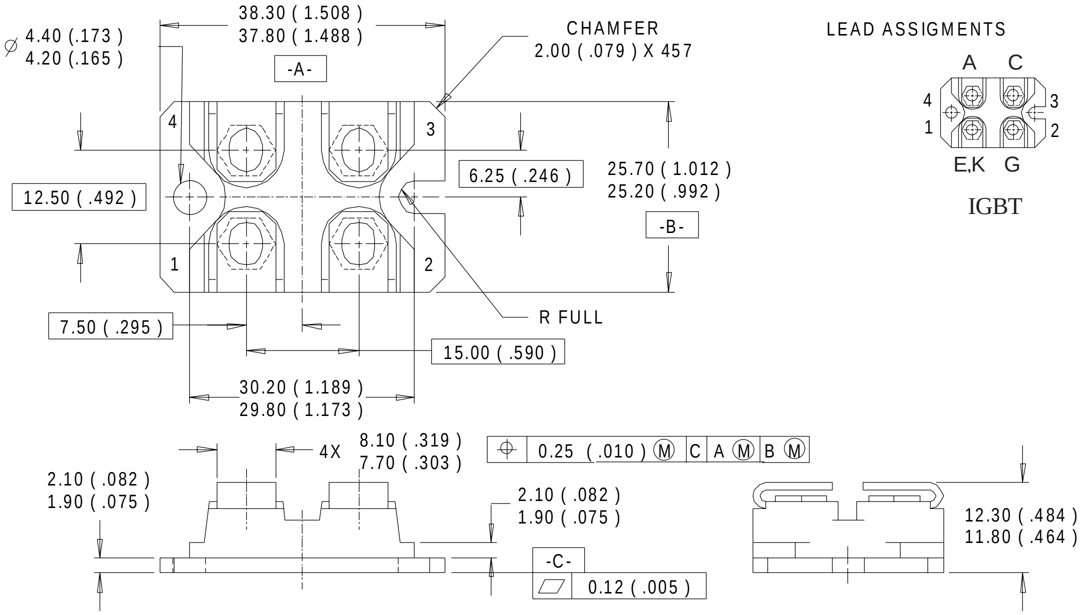


Figure 19. Pulsed Collector Current Test Circuit

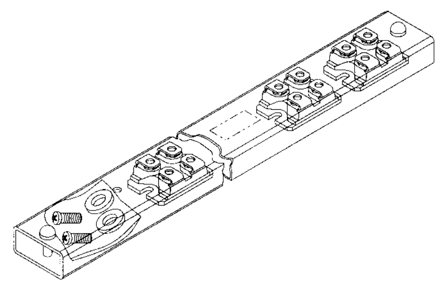
SOT-227 Package Details

Dimensions are shown in millimeters (inches)



Tube

QUANTITIES PER TUBE IS 10
M4 SCREW AND WASHER INCLUDED



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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