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Insulated Gate Bipolar Transistor (Warp 2 Speed IGBT), 100 A



SOT-227

FEATURES

- Ultrafast: Optimized for minimum saturation voltage and speed 0 to 40 kHz in hard switching, > 200 kHz in resonant mode
- Very low conduction and switching losses
- Fully isolated package (2500 V_{AC}/RMS)
- Very low internal inductance (≤ 5 nH typical)
- Industry standard outline
- UL approved file E78996
- Compliant to RoHS Directive 2002/95/EC
- Designed and qualified for industrial market


**RoHS
COMPLIANT**

PRODUCT SUMMARY	
V _{CES}	600 V
I _C DC	100 A
V _{CE(on)} at 100 A, 25 °C	1.8 V

BENEFITS

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

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter breakdown voltage	V _{CES}		600	V
Continuous collector current	I _C	T _C = 25 °C	100	A
		T _C = 100 °C	50	
Pulsed collector current	I _{CM}		200	
Clamped inductive load current	I _{LM}	Repetitive rating: V _{GE} = 20 V; pulse width limited by maximum junction temperature (fig. 20)	200	
Gate to emitter voltage	V _{GE}		± 20	V
RMS isolation voltage	V _{ISOL}	Any terminal to case, t = 1 minute	2500	
Maximum power dissipation	P _D	T _C = 25 °C	250	W
		T _C = 100 °C	100	
Operating junction and storage temperature range	T _J , T _{Stg}		- 55 to + 150	°C
Mounting torque		6 to 32 or M3 screw	12 (1.3)	lbf · in (N · m)

THERMAL AND MECHANICAL SPECIFICATIONS				
PARAMETER	SYMBOL	TYP.	MAX.	UNITS
Junction to case, IGBT	R _{thJC}	-	0.50	°C/W
Thermal resistance, junction to case, diode	R _{thJC}	-	1.0	
Case to sink, flat, greased surface	R _{thCS}	0.05	-	
Weight of module		30	-	g



ELECTRICAL SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$		600	-	-	V
Temperature coefficient of breakdown voltage	$\Delta V_{(BR)CES}/\Delta T_J$	$V_{GE} = 0\text{ V}, I_C = 1.0\text{ mA}$		-	0.36	-	V/ $^\circ\text{C}$
Collector to emitter saturation voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 50\text{ A}$	See fig. 1, 4	-	1.49	2.1	V
		$V_{GE} = 15\text{ V}, I_C = 100\text{ A}$		-	1.80	-	
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}, T_J = 150\text{ }^\circ\text{C}$		-	1.47	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$		3.0	-	6.0	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$		-	- 7.6	-	mV/ $^\circ\text{C}$
Forward transconductance	g_{fe}	$V_{CE} = 100\text{ V}, I_C = 50\text{ A}$		34	52	-	S
Zero gate voltage collector current	I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$		-	-	250	μA
		$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 150\text{ }^\circ\text{C}$		-	-	1.3	mA
Diode forward voltage drop	V_{FM}	$I_C = 50\text{ A}$	See fig. 12	-	1.3	1.6	V
		$I_C = 50\text{ A}, T_J = 150\text{ }^\circ\text{C}$		-	1.16	1.3	
Gate to emitter leakage current	I_{GES}	$V_{GE} = \pm 20\text{ V}$		-	-	± 100	nA

SWITCHING CHARACTERISTICS ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)								
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNITS	
Total gate charge (turn-on)	Q_g	$I_C = 50\text{ A}$ $V_{CC} = 400\text{ V}$ $V_{GE} = 15\text{ V}$	See fig. 7	-	430	640	nC	
Gate emitter charge (turn-on)	Q_{ge}			-	48	72		
Gate collector charge (turn-on)	Q_{gc}			-	130	190		
Turn-on delay time	$t_{d(on)}$	$T_J = 25\text{ }^\circ\text{C}$ $I_C = 60\text{ A}, V_{CC} = 480\text{ V}$ $V_{GE} = 15\text{ V}, R_g = 5.0\text{ }\Omega$ energy losses include "tail" and diode reverse recovery		-	57	-	ns	
Rise time	t_r			-	80	-		
Turn-off delay time	$t_{d(off)}$			-	240	-		
Fall time	t_f			-	120	-		
Turn-on switching loss	E_{on}			-	0.41	-		mJ
Turn-off switching loss	E_{off}	-	2.51	-				
Total switching loss	E_{ts}	-	2.92	4.4				
Turn-on delay time	$t_{d(on)}$	$T_J = 150\text{ }^\circ\text{C}$ $I_C = 60\text{ A}, V_{CC} = 480\text{ V}$ $V_{GE} = 15\text{ V}, R_g = 5.0\text{ }\Omega$ energy losses include "tail" and diode reverse recovery		-	57	-	ns	
Rise time	t_r			-	80	-		
Turn-off delay time	$t_{d(off)}$			-	380	-		
Fall time	t_f			-	170	-		
Total switching loss	E_{ts}			-	4.78	-		mJ
Internal emitter inductance	L_E			-	2.0	-	nH	
Input capacitance	C_{ies}	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1.0\text{ MHz}$	See fig. 6	-	7400	-	pF	
Output capacitance	C_{oes}			-	730	-		
Reverse transfer capacitance	C_{res}			-	90	-		
Diode reverse recovery time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}$	See fig. 13	$I_F = 50\text{ A}$ $V_R = 200\text{ V}$ $di/dt = 200\text{ A}/\mu\text{s}$	-	90	140	ns
		$T_J = 125\text{ }^\circ\text{C}$			-	120	180	
Diode peak reverse recovery current	I_{rr}	$T_J = 25\text{ }^\circ\text{C}$	See fig. 14		-	7.3	11	A
		$T_J = 125\text{ }^\circ\text{C}$			-	11	16	
Diode reverse recovery charge	Q_{rr}	$T_J = 25\text{ }^\circ\text{C}$	See fig. 15		-	360	550	nC
		$T_J = 125\text{ }^\circ\text{C}$			-	780	1200	
Diode peak rate of fall recovery during t_b	$dl_{(rec)M}/dt$	$T_J = 25\text{ }^\circ\text{C}$	See fig. 16	-	370	-	A/ μs	
		$T_J = 125\text{ }^\circ\text{C}$		-	220	-		

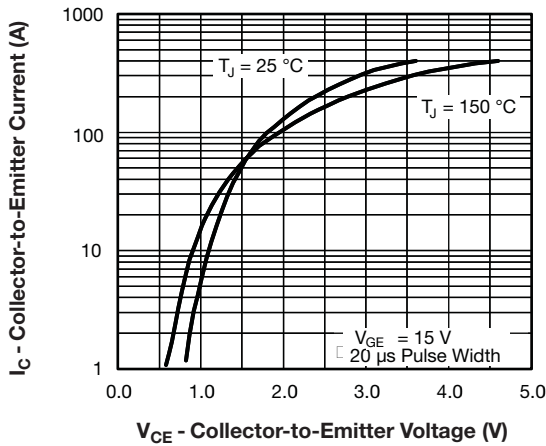


Fig. 1 - Typical Output Characteristics

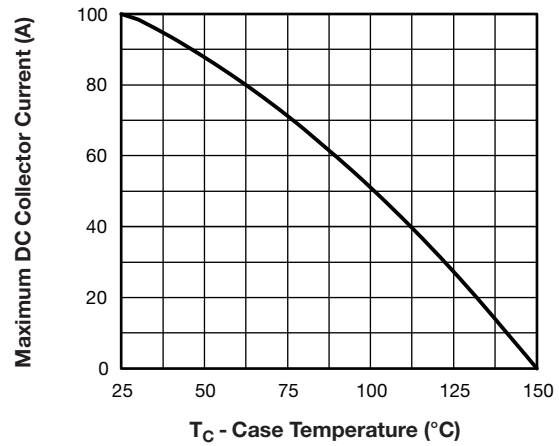


Fig. 3 - Maximum Collector Current vs. Case Temperature

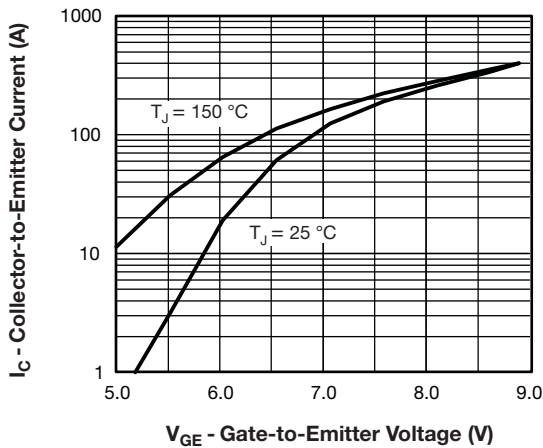


Fig. 2 - Typical Transfer Characteristics

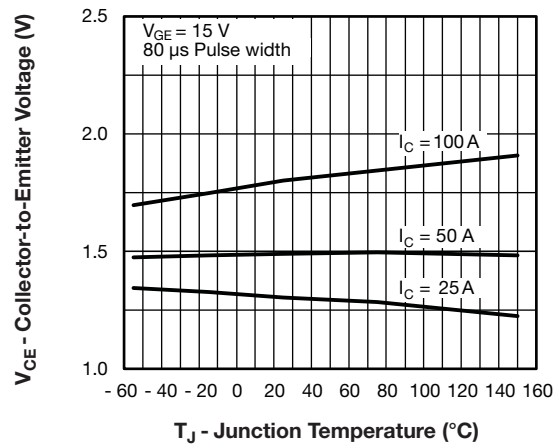


Fig. 4 - Typical Collector to Emitter Voltage vs. Junction Temperature

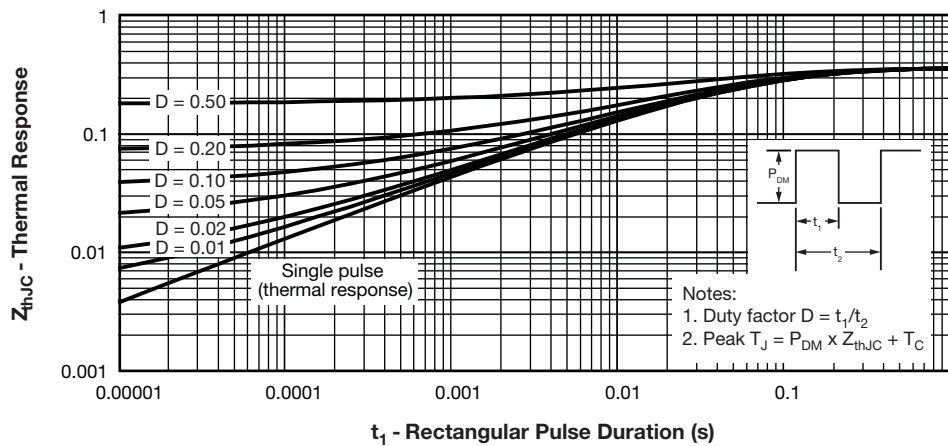


Fig. 5 - Maximum Effective Transient Thermal Impedance, Junction to Case

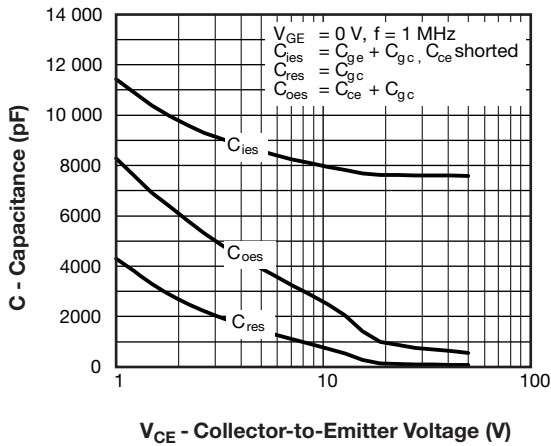


Fig. 6 - Typical Capacitance vs. Collector to Emitter Voltage

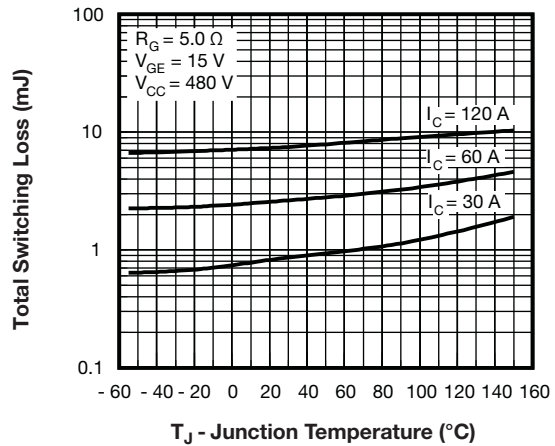


Fig. 9 - Typical Switching Losses vs. Junction Temperature

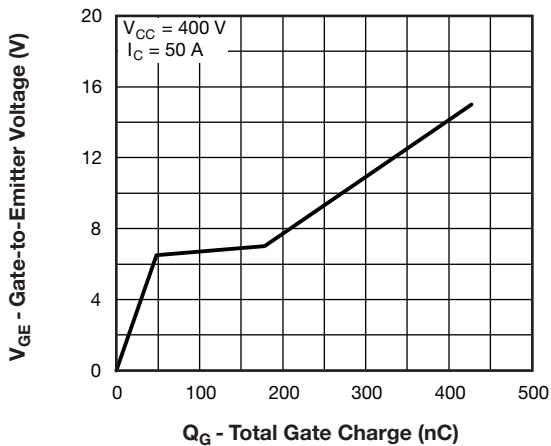


Fig. 7 - Typical Gate Charge vs. Gate to Emitter Voltage

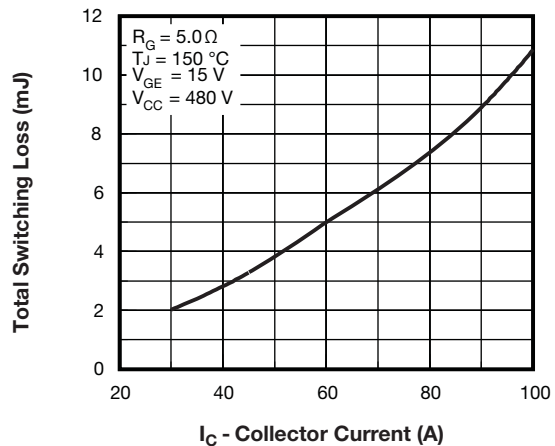


Fig. 10 - Typical Switching Losses vs. Collector to Emitter Current

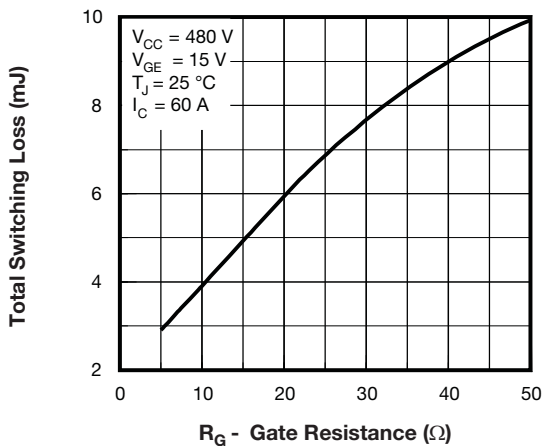


Fig. 8 - Typical Switching Losses vs. Gate Resistance

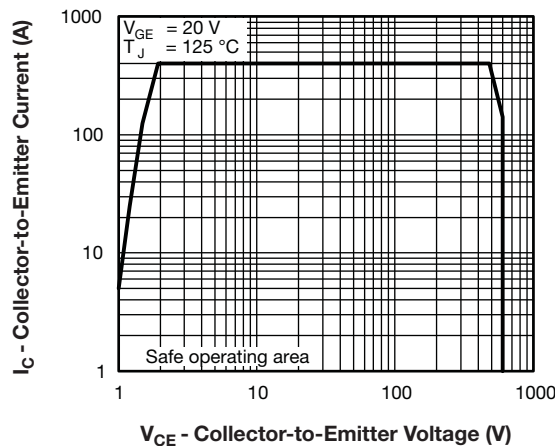


Fig. 11 - Turn-Off SOA

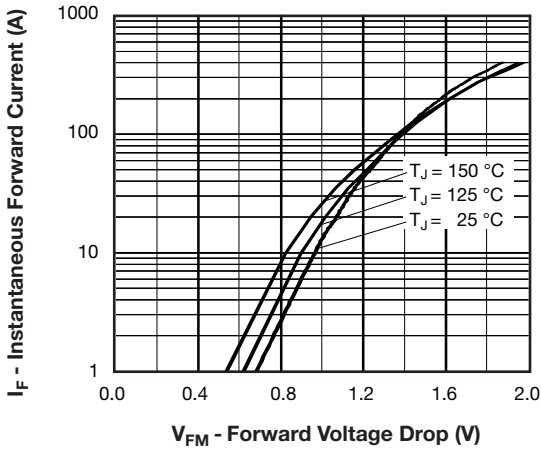


Fig. 12 - Typical Forward Voltage Drop vs. Instantaneous Forward Current

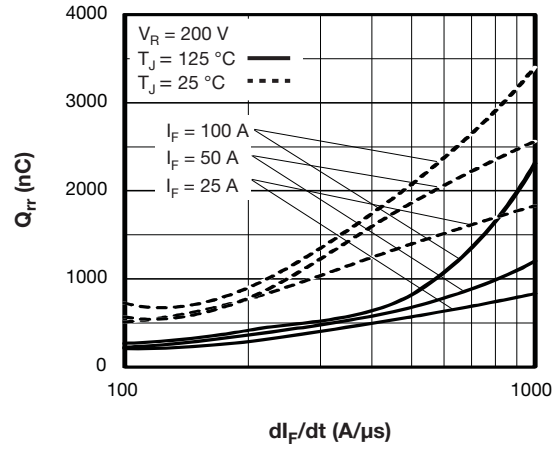


Fig. 15 - Typical Stored Charge vs. dI_F/dt

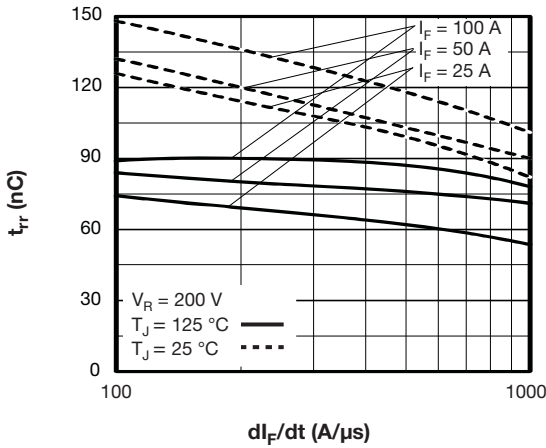


Fig. 13 - Typical Reverse Recovery vs. dI_F/dt

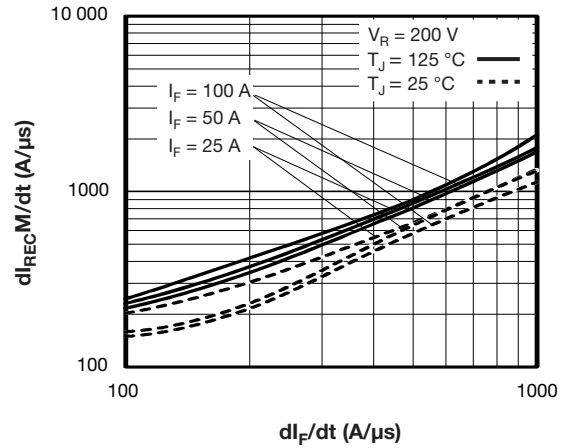


Fig. 16 - Typical $dI_{REC}/M/dt$ vs. dI_F/dt

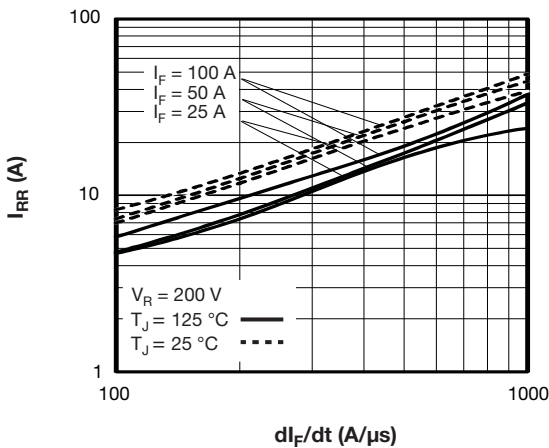


Fig. 14 - Typical Recovery Current vs. dI_F/dt

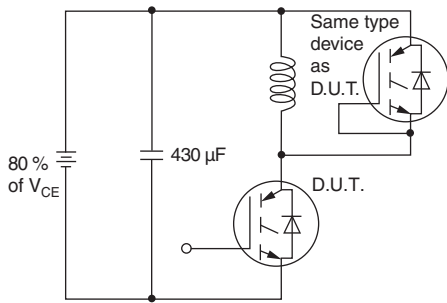


Fig. 17a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

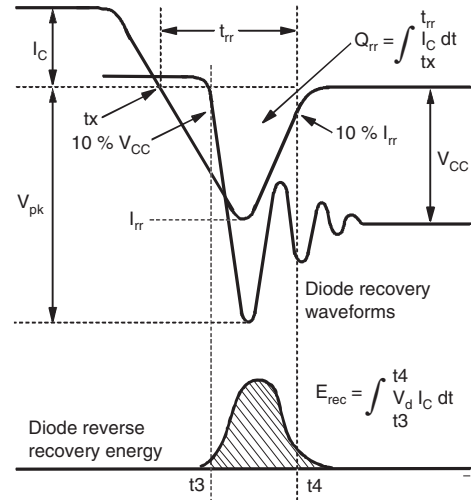


Fig. 1 - Test Waveforms for Circuit of Fig. 17a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

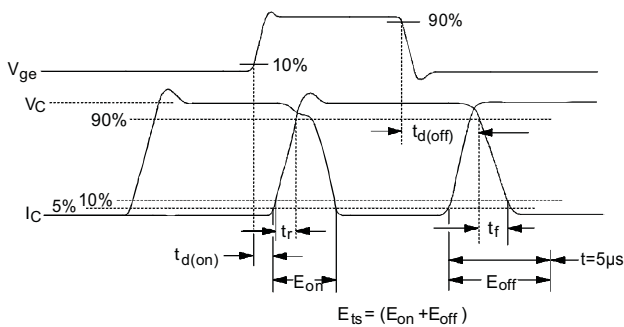


Fig. 17b - Test Waveforms for Circuit of Fig. 17a, Defining E_{off} , $t_{d(off)}$, t_f

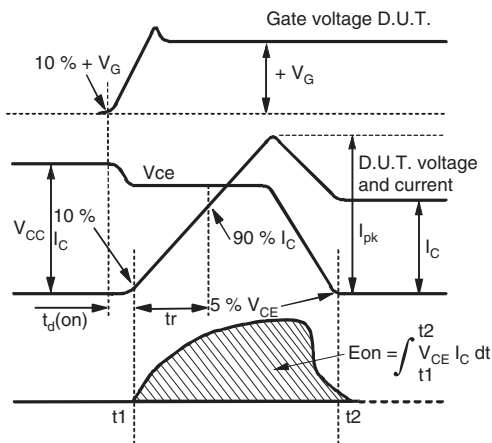


Fig. 17c - Test Waveforms for Circuit of Fig. 17a, Defining E_{on} , $t_{d(on)}$, t_r

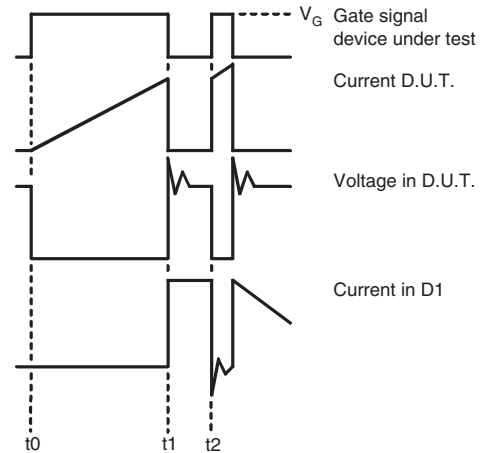


Fig. 17e - Macro Waveforms for Figure 17a's Test Circuit

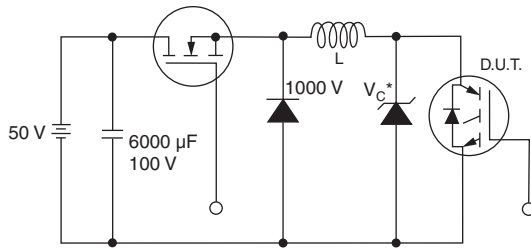


Fig. 18a - Clamped Inductive Load Test Circuit

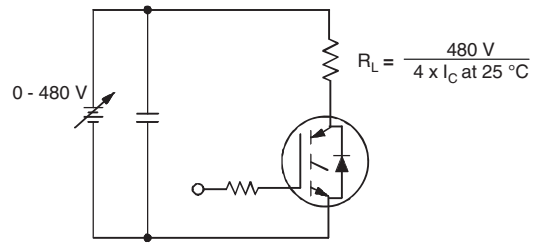


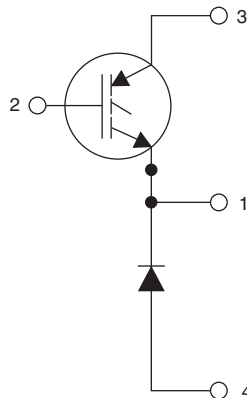
Fig. 18b - Pulsed Collector Current Test Circuit

ORDERING INFORMATION TABLE

Device code	VS-	G	A	100	N	A	60	U	P
	1	2	3	4	5	6	7	8	9

- 1** - Vishay Semiconductors product
- 2** - Device:
G = IGBT
- 3** - Silicon technology:
A = Generation 4 IGBT, Generation 2 HEXFRED®
- 4** - Current rating (100 = 100 A)
- 5** - N = High side chopper
- 6** - SOT-227
- 7** - Voltage rating (60 = 600 V)
- 8** - U = Ultrafast with matching diode
- 9** -
 - None = Standard production
 - P = Lead (Pb)-free

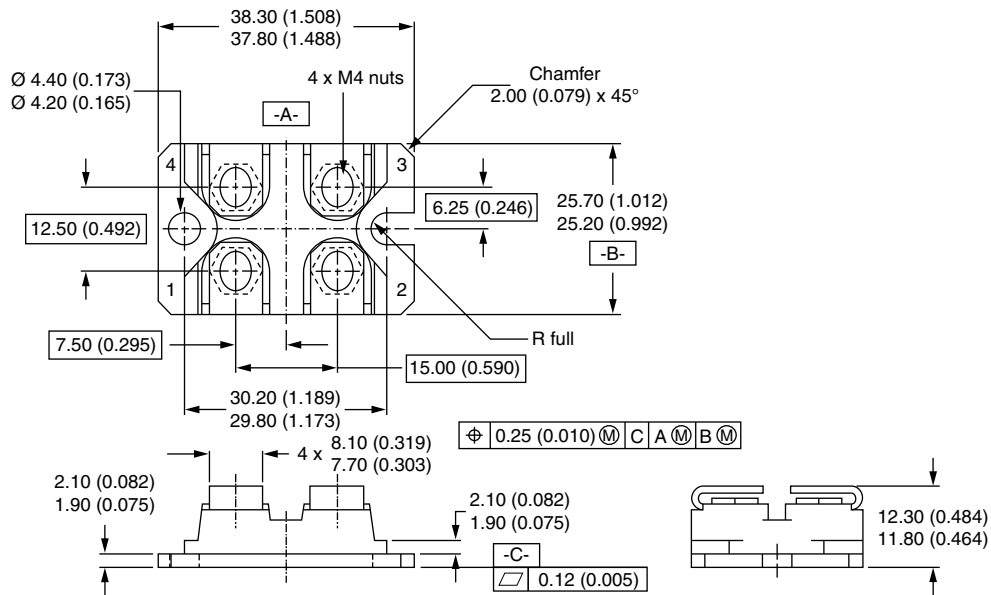
CIRCUIT CONFIGURATION



LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95036
Packaging information	www.vishay.com/doc?95037

SOT-227

DIMENSIONS in millimeters (inches)



Notes

- Dimensioning and tolerancing per ANSI Y14.5M-1982
- Controlling dimension: millimeter



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