


## "Low Side Chopper" IGBT SOT-227 (Ultrafast IGBT), 50 A



SOT-227


**RoHS  
COMPLIANT**

### FEATURES

- NPT Generation V IGBT technology
- Square RBSOA
- HEXFRED® clamping diode
- Positive  $V_{CE(on)}$  temperature coefficient
- Fully isolated package
- Speed 8 kHz to 60 kHz
- Very low internal inductance ( $\leq 5$  nH typical)
- Industry standard outline
- UL approved file E78996 
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

### BENEFITS

- Designed for increased operating efficiency in power conversion: UPS, SMPS, welding, induction heating
- Easy to assemble and parallel
- Direct mounting on heatsink
- Plug-in compatible with other SOT-227 packages
- Low EMI, requires less snubbing

### PRODUCT SUMMARY

$V_{CES}$	1200 V
$I_C$ DC	50 A at 92 °C
$V_{CE(on)}$ typical at 50 A, 25 °C	3.22 V
Package	SOT-227
Circuit	Chopper low side switch

### ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	$V_{CES}$		1200	V
Continuous collector current	$I_C$	$T_C = 25\text{ °C}$	84	A
		$T_C = 80\text{ °C}$	57	
Pulsed collector current	$I_{CM}$		150	
Clamped inductive load current	$I_{LM}$		150	
Diode continuous forward current	$I_F$	$T_C = 25\text{ °C}$	76	
		$T_C = 80\text{ °C}$	52	
Gate to emitter voltage	$V_{GE}$		$\pm 20$	V
Power dissipation, IGBT	$P_D$	$T_C = 25\text{ °C}$	431	W
		$T_C = 80\text{ °C}$	242	
Power dissipation, diode	$P_D$	$T_C = 25\text{ °C}$	278	
		$T_C = 80\text{ °C}$	156	
RMS isolation voltage	$V_{ISOL}$	Any terminal to case, $t = 1$ min	2500	V



<b>ELECTRICAL SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{BR(CES)}$	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	1200	-	-	
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 25\text{ A}$	-	2.46	-	V
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}$	-	3.22	2.80	
		$V_{GE} = 15\text{ V}, I_C = 25\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	2.84	3.60	
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	3.78	3.00	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 500\text{ }\mu\text{A}$	4	5	4	
Temperature coefficient of threshold voltage	$V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$ ( $25\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$ )	-	- 10	-	mV/ $^\circ\text{C}$
Collector to emitter leakage current	$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$	-	6	50	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	0.7	2.0	mA
Diode reverse breakdown voltage	$V_{BR}$	$I_R = 1\text{ mA}$	1200	-	-	V
Diode forward voltage drop	$V_{FM}$	$I_C = 25\text{ A}, V_{GE} = 0\text{ V}$	-	1.99	2.42	V
		$I_C = 50\text{ A}, V_{GE} = 0\text{ V}$	-	2.53	3.00	
		$I_C = 25\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	1.96	2.30	
		$I_C = 50\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	2.66	3.08	
Diode reverse leakage current	$I_{RM}$	$V_R = V_R$ rated	-	4	50	$\mu\text{A}$
		$T_J = 125\text{ }^\circ\text{C}, V_R = V_R$ rated	-	0.6	3.0	mA
Gate to emitter leakage current	$I_{GES}$	$V_{GE} = \pm 20\text{ V}$	-	-	$\pm 200$	nA

<b>SWITCHING CHARACTERISTICS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)							
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS	
Total gate charge (turn-on)	$Q_g$	$I_C = 50\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}$	-	400	-	nC	
Gate to emitter charge (turn-on)	$Q_{ge}$		-	43	-		
Gate to collector charge (turn-on)	$Q_{gc}$		-	187	-		
Turn-on switching loss	$E_{on}$	$I_C = 50\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, R_g = 5\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$  Energy losses include tail and diode recovery (see fig. 18)	-	2.72	-	mJ	
Turn-off switching loss	$E_{off}$		-	1.11	-		
Total switching loss	$E_{tot}$		-	3.83	-		
Turn-on switching loss	$E_{on}$		-	3.94	-		
Turn-off switching loss	$E_{off}$		-	2.31	-		
Total switching loss	$E_{tot}$		-	6.25	-		
Turn-on delay time	$t_{d(on)}$		$I_C = 50\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, R_g = 5\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$	-	191	-	ns
Rise time	$t_r$			-	53	-	
Turn-off delay time	$t_{d(off)}$			-	223	-	
Fall time	$t_f$			-	143	-	
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 150\text{ A}, R_g = 22\text{ }\Omega, V_{GE} = 15\text{ V to } 0\text{ V}, V_{CC} = 900\text{ V}, V_P = 1200\text{ V}$	Fullsquare				
Diode reverse recovery time	$t_{rr}$	$I_F = 50\text{ A}, di_F/dt = 200\text{ A}/\mu\text{s}, V_R = 200\text{ V}$	-	129	161	ns	
Diode peak reverse current	$I_{rr}$		-	11	14	A	
Diode recovery charge	$Q_{rr}$		-	700	1046	nC	
Diode reverse recovery time	$t_{rr}$	$I_F = 50\text{ A}, di_F/dt = 200\text{ A}/\mu\text{s}, V_R = 200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	208	257	ns	
Diode peak reverse current	$I_{rr}$		-	17	21	A	
Diode recovery charge	$Q_{rr}$		-	1768	2698	nC	



THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL		MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	$T_J, T_{Stg}$		- 40	-	150	°C
Junction to case	IGBT	$R_{thJC}$	-	-	0.29	°C/W
	Diode		-	-	0.45	
Case to heatsink	$R_{thCS}$	Flat, greased surface	-	0.05	-	
Weight			-	30	-	g
Mounting torque			-	-	1.3	Nm
Case style	SOT-227					

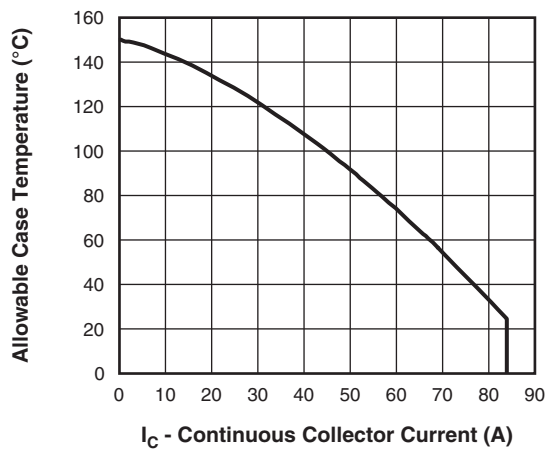


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

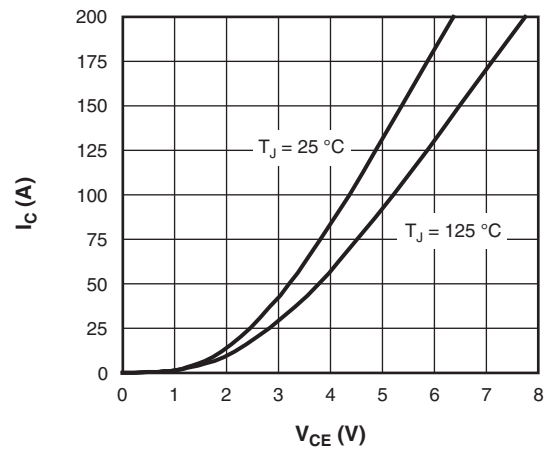


Fig. 3 - Typical IGBT Collector Current Characteristics

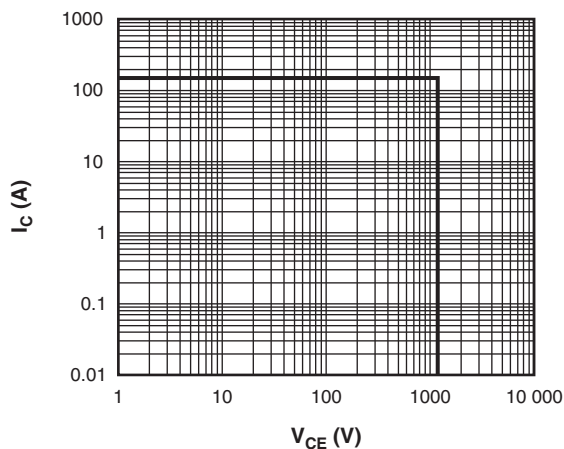


Fig. 2 - IGBT Reverse Bias SOA  
 $T_J = 150^\circ\text{C}, V_{GE} = 15\text{V}$

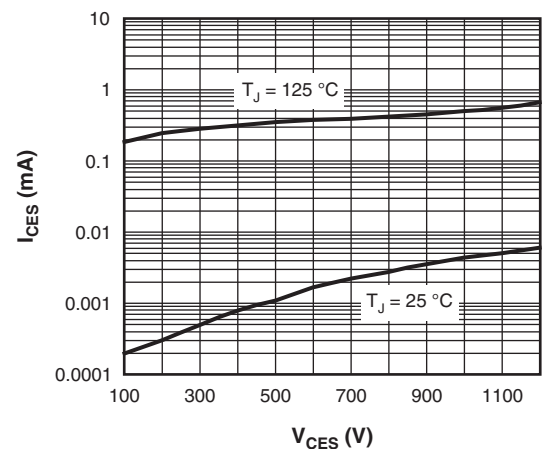


Fig. 4 - Typical IGBT Zero Gate Voltage Collector Current

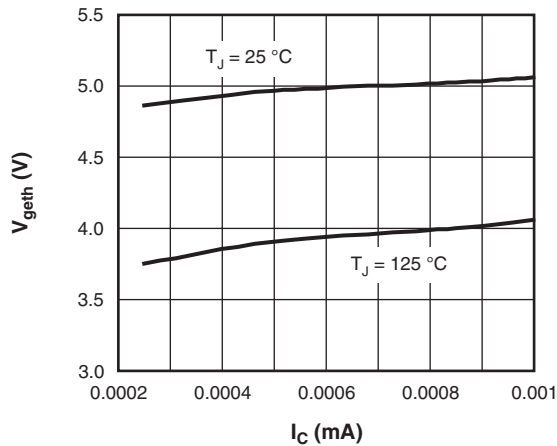


Fig. 5 - Typical IGBT Threshold Voltage

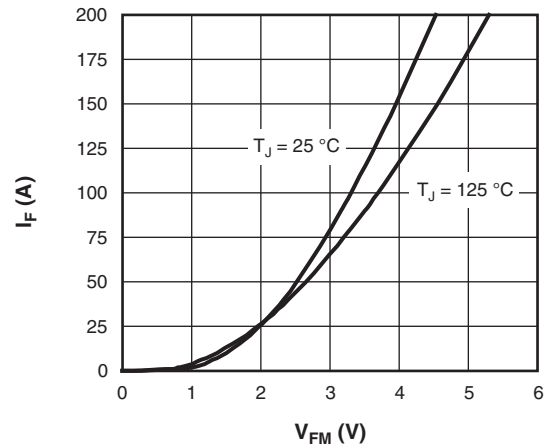


Fig. 8 - Typical Diode Forward Characteristics

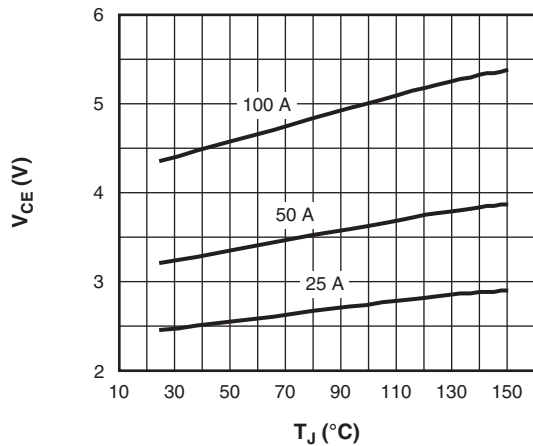


Fig. 6 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature,  $V_{GE} = 15\text{ V}$

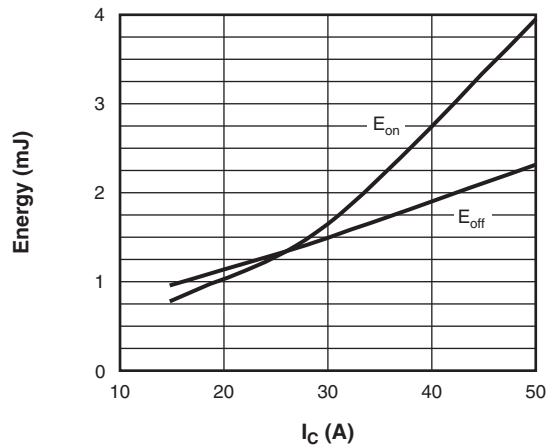


Fig. 9 - Typical IGBT Energy Loss vs.  $I_c$   
 $T_J = 125\text{ °C}$ ,  $L = 500\text{ }\mu\text{H}$ ,  $V_{CC} = 600\text{ V}$ ,  
 $R_g = 5\text{ }\Omega$ ,  $V_{GE} = 15\text{ V}$

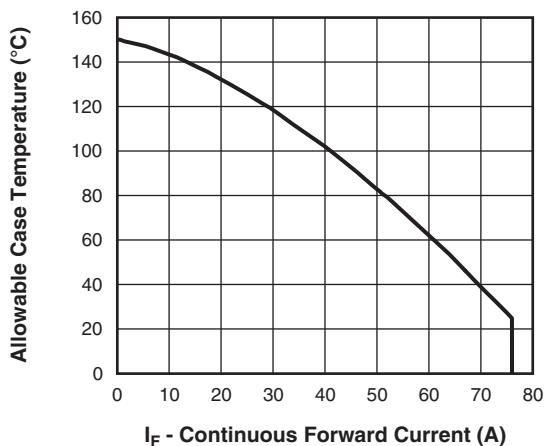


Fig. 7 - Maximum DC Forward Current vs. Case Temperature

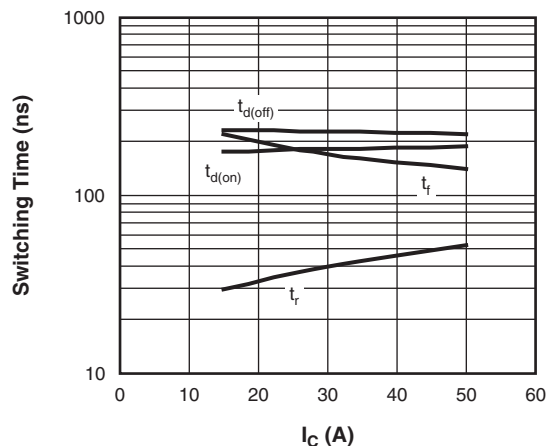


Fig. 10 - Typical IGBT Switching Time vs.  $I_c$   
 $T_J = 125\text{ °C}$ ,  $L = 500\text{ }\mu\text{H}$ ,  $V_{CC} = 600\text{ V}$ ,  
 $R_g = 5\text{ }\Omega$ ,  $V_{GE} = 15\text{ V}$

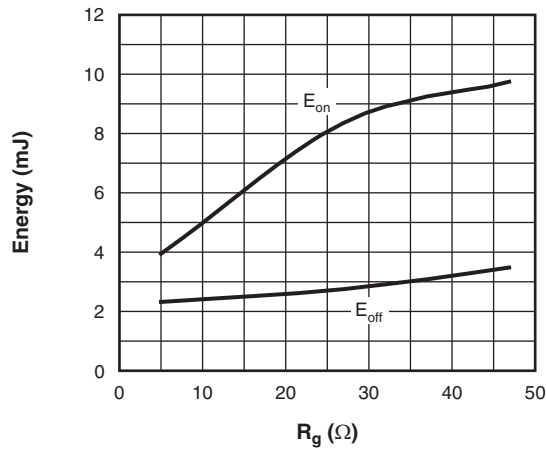


Fig. 11 - Typical IGBT Energy Loss vs.  $R_g$   
 $T_J = 125^\circ\text{C}$ ,  $I_C = 50\text{ A}$ ,  $L = 500\ \mu\text{H}$ ,  
 $V_{CC} = 600\text{ V}$ ,  $V_{GE} = 15\text{ V}$

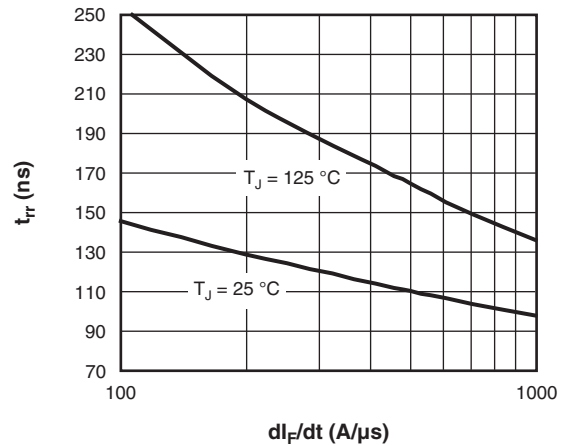


Fig. 13 - Typical  $t_{rr}$  Diode vs.  $dI_F/dt$   
 $V_R = 200\text{ V}$ ,  $I_F = 50\text{ A}$

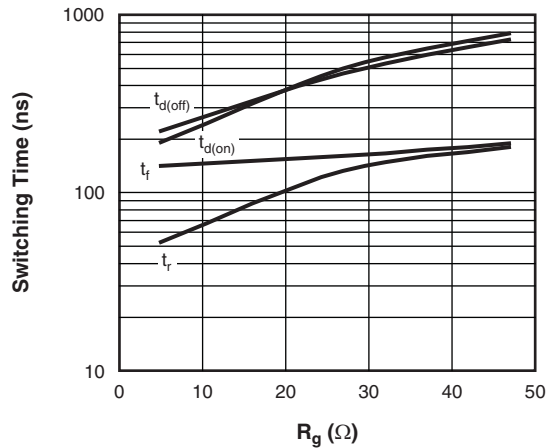


Fig. 12 - Typical IGBT Switching Time vs.  $R_g$   
 $T_J = 125^\circ\text{C}$ ,  $L = 500\ \mu\text{H}$ ,  $V_{CC} = 600\text{ V}$ ,  
 $I_C = 50\text{ A}$ ,  $V_{GE} = 15\text{ V}$

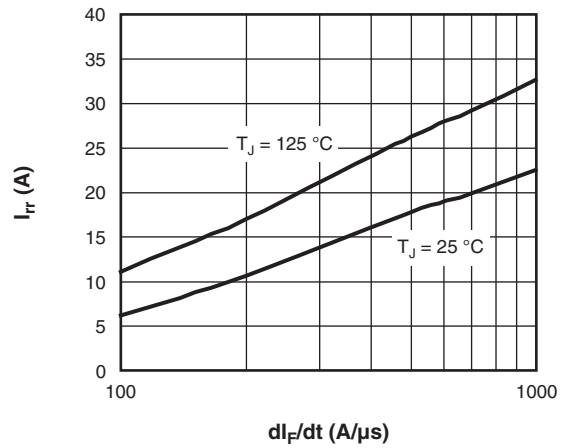


Fig. 14 - Typical  $I_{rr}$  Diode vs.  $dI_F/dt$   
 $V_R = 200\text{ V}$ ,  $I_F = 50\text{ A}$

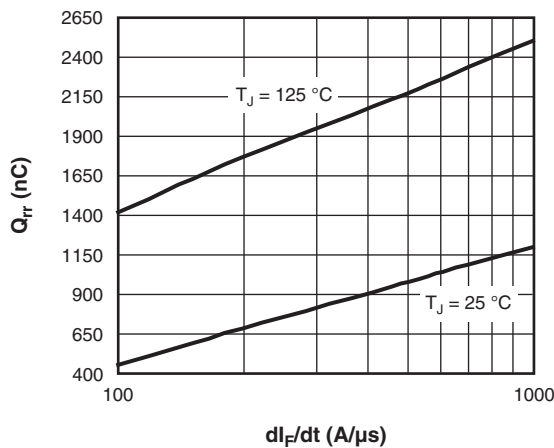


Fig. 15 - Typical  $Q_{rr}$  Diode vs.  $dI_F/dt$ ,  $V_R = 200\text{ V}$ ,  $I_F = 50\text{ A}$

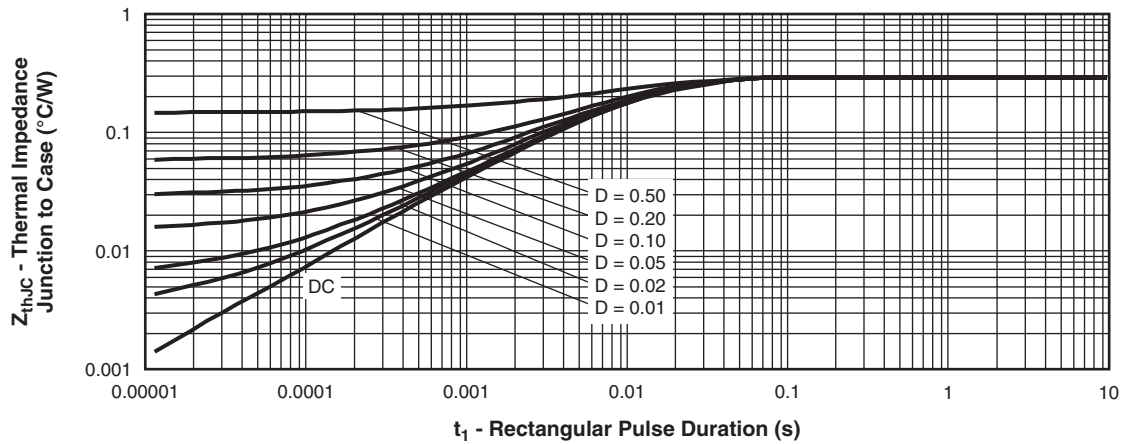


Fig. 16 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (IGBT)

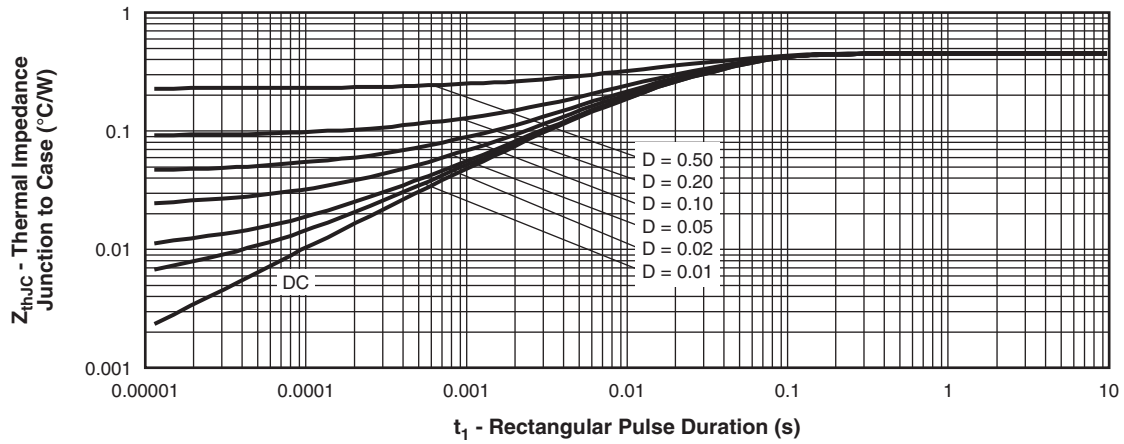
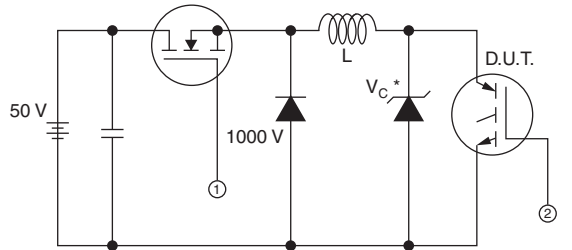


Fig. 17 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (Diode)



\* Driver same type as D.U.T.;  $V_C = 80\%$  of  $V_{ce(max)}$   
 \* Note: Due to the 50 V power supply, pulse width and inductor will increase to obtain  $I_d$

Fig. 18a - Clamped Inductive Load Test Circuit

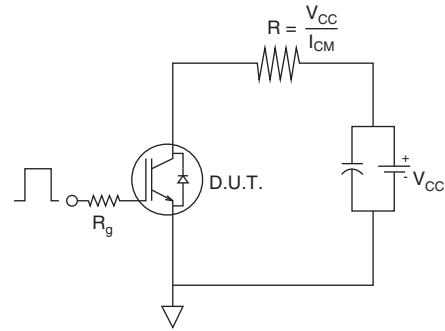


Fig. 18b - Pulsed Collector Current Test Circuit

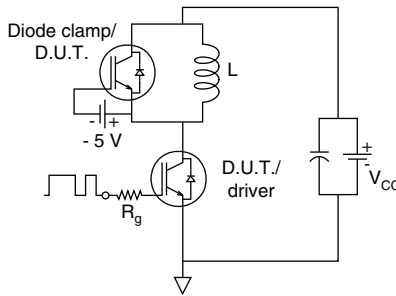


Fig. 19a - Switching Loss Test Circuit

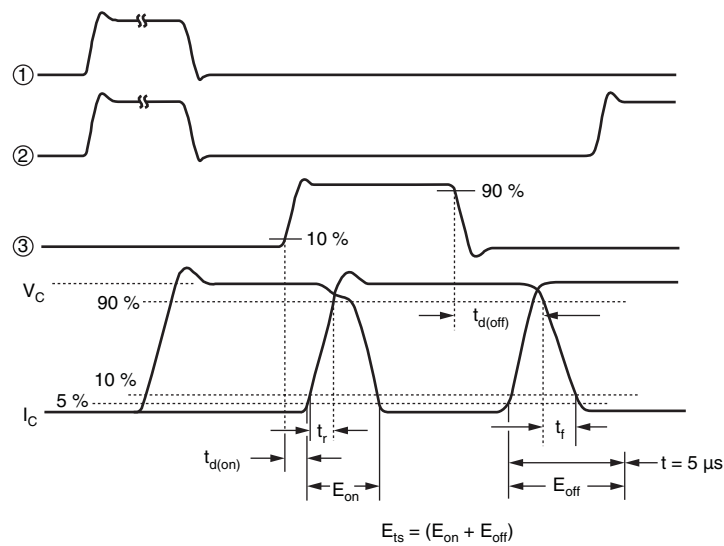


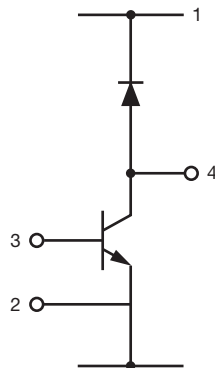
Fig. 19b - Switching Loss Waveforms Test Circuit

## ORDERING INFORMATION TABLE

Device code	<b>VS-</b>	<b>G</b>	<b>B</b>	<b>50</b>	<b>L</b>	<b>A</b>	<b>120</b>	<b>U</b>	<b>X</b>
	①	②	③	④	⑤	⑥	⑦	⑧	⑨

- 1** - Vishay Semiconductors product
- 2** - Insulated Gate Bipolar Transistor (IGBT)
- 3** - B = IGBT Generation 5
- 4** - Current rating (50 = 50 A)
- 5** - Circuit configuration (L = Low side chopper)
- 6** - Package indicator (A = SOT-227)
- 7** - Voltage rating (120 = 1200 V)
- 8** - Speed/type (U = Ultrafast IGBT)
- 9** - X = F/W HEXFRED® diode

## CIRCUIT CONFIGURATION



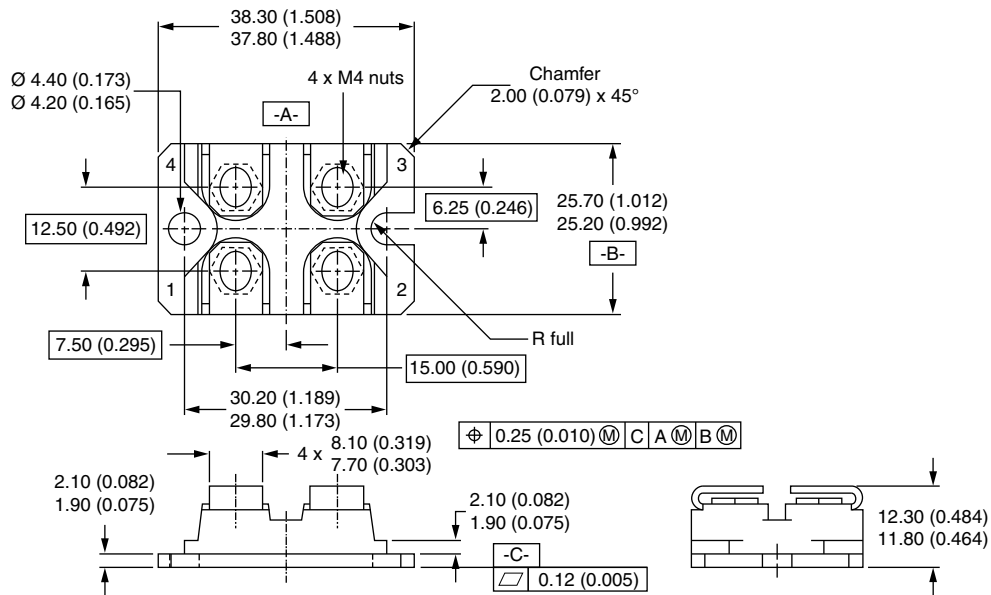
### LINKS TO RELATED DOCUMENTS

Dimensions	<a href="http://www.vishay.com/doc?95036">www.vishay.com/doc?95036</a>
Packaging information	<a href="http://www.vishay.com/doc?95037">www.vishay.com/doc?95037</a>



## SOT-227

**DIMENSIONS** in millimeters (inches)



### Notes

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



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