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



SOT-227



### 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	3.3 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	$I_F$	$T_C = 25\text{ °C}$	87	
		$T_C = 80\text{ °C}$	59	
Single pulse forward current	$I_{FSM}$	10 ms sine or 6 ms rectangular pulse, $T_J = 25\text{ °C}$	310	
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	$P_D$	$T_C = 25\text{ °C}$	338	
		$T_C = 80\text{ °C}$	190	
RMS isolation voltage	$V_{ISOL}$	Any terminal to case, $t = 1$ min	2500	V



ELECTRICAL SPECIFICATIONS (T <sub>J</sub> = 25 °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	V <sub>BR(CES)</sub>	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 500 μA	1200	-	-	V
Collector to emitter voltage	V <sub>CE(on)</sub>	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 25 A	-	2.5	2.8	
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 50 A	-	3.3	-	
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 25 A, T <sub>J</sub> = 125 °C	-	3.0	-	
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 50 A, T <sub>J</sub> = 125 °C	-	4.03	-	
Gate threshold voltage	V <sub>GE(th)</sub>	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 500 μA	4.0	5.5	7.1	
Temperature coefficient of threshold voltage	V <sub>GE(th)</sub> /ΔT <sub>J</sub>	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1 mA (25 °C to 125 °C)	-	-12.9	-	mV/°C
Collector to emitter leakage current	I <sub>CES</sub>	V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1200 V	-	8	50	μA
		V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1200 V, T <sub>J</sub> = 125 °C	-	0.15	-	mA
Diode reverse breakdown voltage	V <sub>BR</sub>	I <sub>R</sub> = 1 mA	1200	-	-	V
Diode forward voltage drop	V <sub>FM</sub>	I <sub>F</sub> = 25 A, V <sub>GE</sub> = 0 V	-	2.11	2.42	V
		I <sub>F</sub> = 50 A, V <sub>GE</sub> = 0 V	-	2.72	-	
		I <sub>F</sub> = 25 A, V <sub>GE</sub> = 0 V, T <sub>J</sub> = 125 °C	-	2.04	-	
		I <sub>F</sub> = 50 A, V <sub>GE</sub> = 0 V, T <sub>J</sub> = 125 °C	-	2.83	-	
Diode reverse leakage current	I <sub>RM</sub>	V <sub>R</sub> = 1200 V	-	4	50	μA
		T <sub>J</sub> = 125 °C, V <sub>R</sub> = 1200 V	-	0.8	-	mA
Gate to emitter leakage current	I <sub>GES</sub>	V <sub>GE</sub> = ± 20 V	-	-	± 200	nA

SWITCHING CHARACTERISTICS (T <sub>J</sub> = 25 °C unless otherwise specified)							
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS	
Total gate charge (turn-on)	Q <sub>g</sub>	I <sub>C</sub> = 50 A, V <sub>CC</sub> = 600 V, V <sub>GE</sub> = 15 V	-	400	-	nC	
Gate to emitter charge (turn-on)	Q <sub>ge</sub>		-	43	-		
Gate to collector charge (turn-on)	Q <sub>gc</sub>		-	187	-		
Turn-on switching loss	E <sub>on</sub>	I <sub>C</sub> = 50 A, V <sub>CC</sub> = 600 V, V <sub>GE</sub> = 15 V, R <sub>g</sub> = 4.7 Ω, L = 500 μH, T <sub>J</sub> = 25 °C	-	1.87	-	mJ	
Turn-off switching loss	E <sub>off</sub>		-	0.83	-		
Total switching loss	E <sub>tot</sub>		-	2.7	-		
Turn-on switching loss	E <sub>on</sub>		-	3.43	-		
Turn-off switching loss	E <sub>off</sub>		-	1.29	-		
Total switching loss	E <sub>tot</sub>		-	4.72	-		
Turn-on delay time	t <sub>d(on)</sub>		I <sub>C</sub> = 50 A, V <sub>CC</sub> = 600 V, V <sub>GE</sub> = 15 V, R <sub>g</sub> = 4.7 Ω, L = 500 μH, T <sub>J</sub> = 125 °C	-	147	-	ns
Rise time	t <sub>r</sub>			-	35	-	
Turn-off delay time	t <sub>d(off)</sub>			-	186	-	
Fall time	t <sub>f</sub>			-	119	-	
Reverse bias safe operating area	RBSOA	T <sub>J</sub> = 150 °C, I <sub>C</sub> = 150 A, R <sub>g</sub> = 22 Ω, V <sub>GE</sub> = 15 V to 0 V, V <sub>CC</sub> = 900 V, V <sub>P</sub> = 1200 V	Fullsquare				
Diode reverse recovery time	t <sub>rr</sub>	I <sub>F</sub> = 50 A, dI <sub>F</sub> /dt = 200 A/μs, V <sub>R</sub> = 200 V	-	129	-	ns	
Diode peak reverse current	I <sub>rr</sub>		-	11	-	A	
Diode recovery charge	Q <sub>rr</sub>		-	710	-	nC	
Diode reverse recovery time	t <sub>rr</sub>	I <sub>F</sub> = 50 A, dI <sub>F</sub> /dt = 200 A/μs, V <sub>R</sub> = 200 V, T <sub>J</sub> = 125 °C	-	208	-	ns	
Diode peak reverse current	I <sub>rr</sub>		-	17	-	A	
Diode recovery charge	Q <sub>rr</sub>		-	1768	-	nC	



THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	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		-	-	0.37	
Case to heatsink	$R_{thCS}$	Flat, greased surface	-	0.05	-	
Weight			-	30	-	g
Mounting torque		Torque to terminal	-	-	1.1 (9.7)	Nm (lb.in)
		Torque to heatsink	-	-	1.3 (11.5)	Nm (lb.in)
Case style	SOT-227					

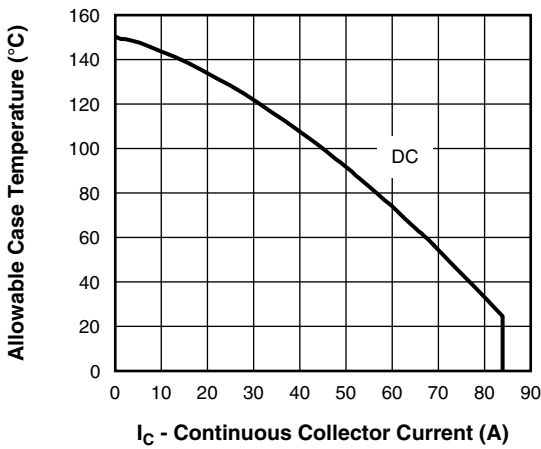


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

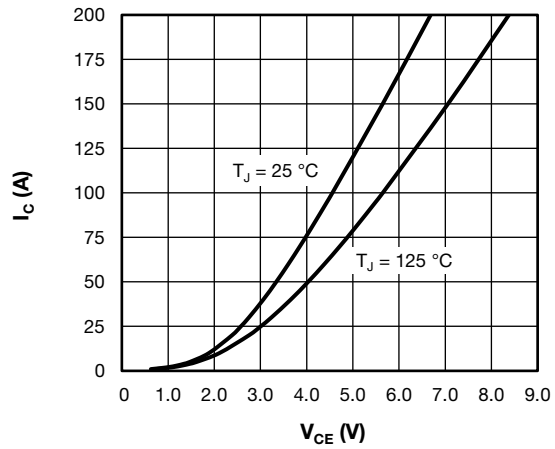


Fig. 3 - Typical IGBT Output Characteristics,  $V_{GE} = 15\text{V}$

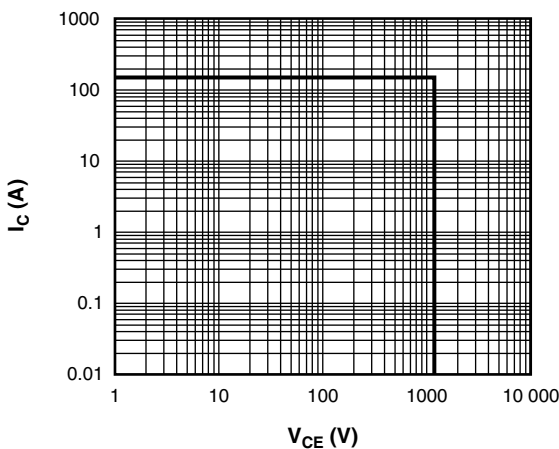


Fig. 2 - IGBT Reverse Bias SOA  
 $T_J = 150^\circ\text{C}, V_{GE} = 15\text{V}$

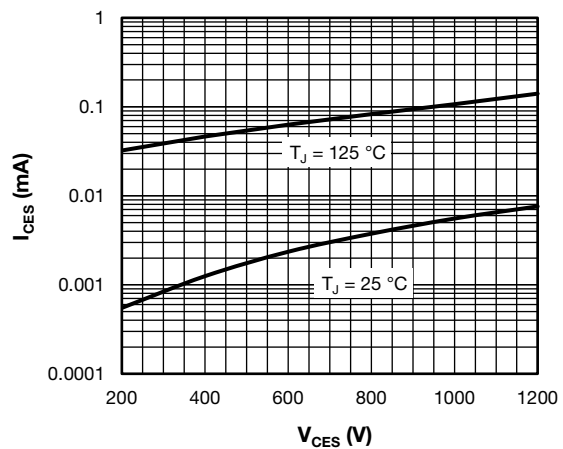


Fig. 4 - Typical IGBT Zero Gate Voltage Collector Current

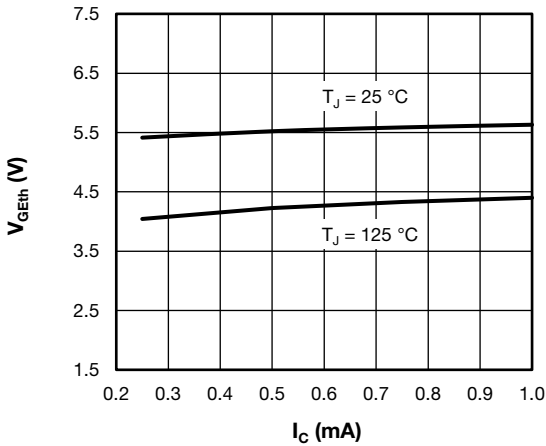


Fig. 5 - Typical IGBT Threshold Voltage

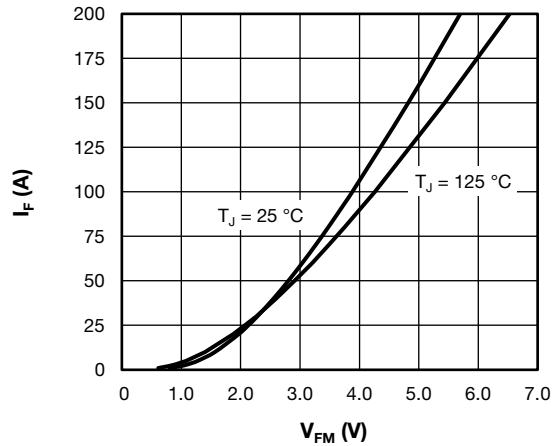


Fig. 8 - Typical Diode Forward Characteristics

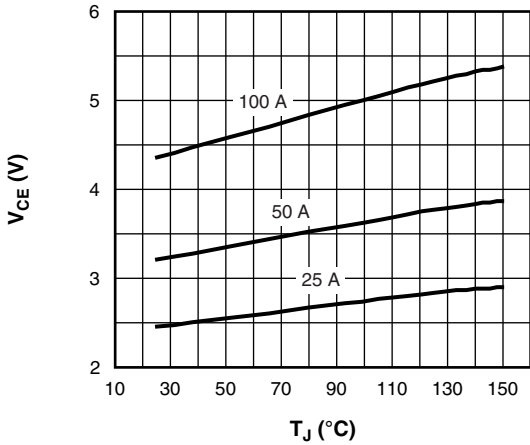


Fig. 6 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature,  $V_{GE} = 15\text{ V}$

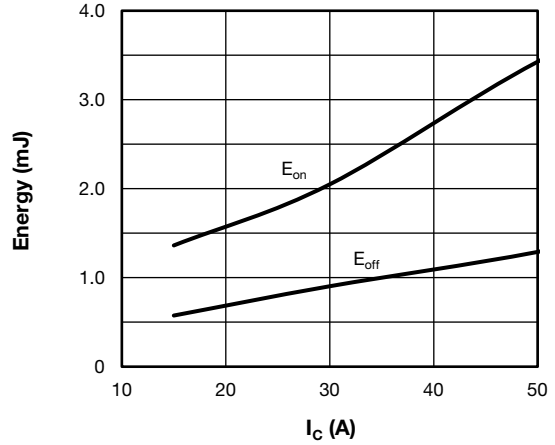


Fig. 9 - Typical IGBT Energy Losses vs.  $I_C$   
 $T_J = 125\text{ °C}$ ,  $V_{CC} = 600\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ }\mu\text{H}$ ,  $R_g = 4.7\text{ }\Omega$

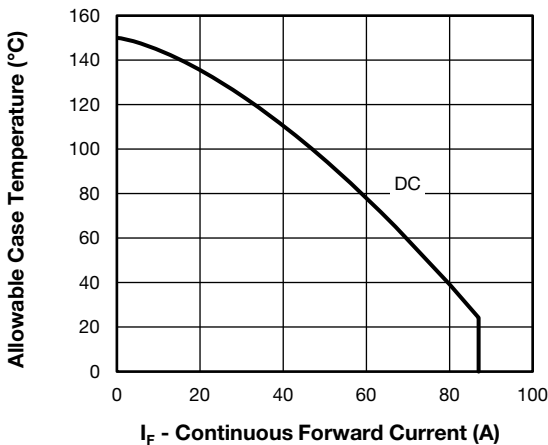


Fig. 7 - Maximum Diode Continuous Forward Current vs. Case Temperature

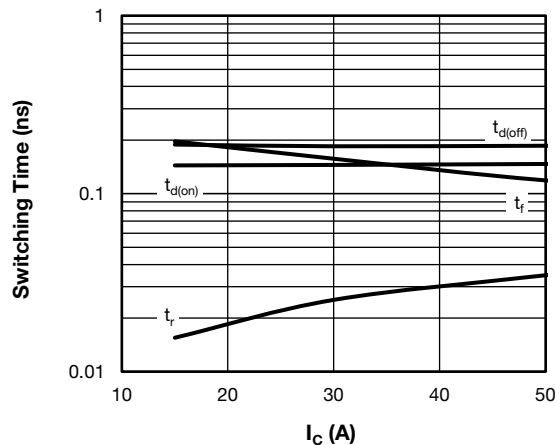


Fig. 10 - Typical IGBT Switching Time vs.  $I_C$   
 $T_J = 125\text{ °C}$ ,  $V_{CC} = 600\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ }\mu\text{H}$ ,  $R_g = 4.7\text{ }\Omega$

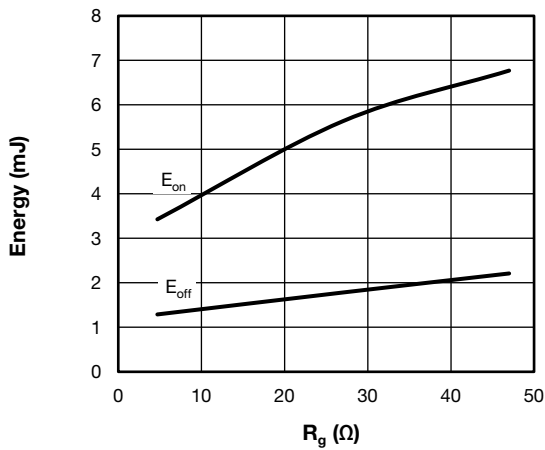


Fig. 11 - Typical IGBT Energy Losses vs.  $R_g$   
 $T_J = 125\text{ }^\circ\text{C}$ ,  $I_C = 50\text{ A}$ ,  $V_{CC} = 600\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ }\mu\text{H}$

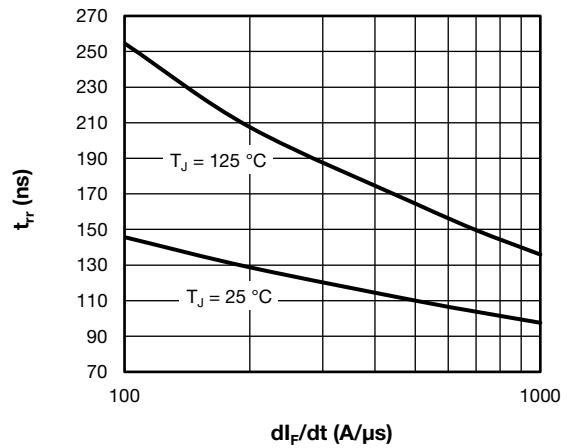


Fig. 13 - Typical  $t_{rr}$  Diode vs.  $dI_F/dt$   
 $V_R = 200\text{ V}$ ,  $I_F = 50\text{ A}$

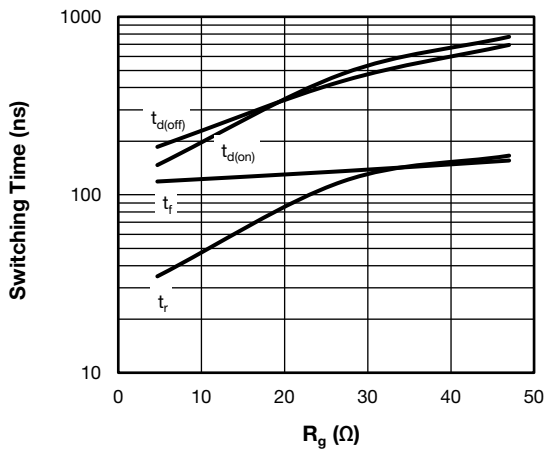


Fig. 12 - Typical IGBT Switching Time vs.  $R_g$   
 $T_J = 125\text{ }^\circ\text{C}$ ,  $I_C = 50\text{ A}$ ,  $V_{CC} = 600\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ }\mu\text{H}$

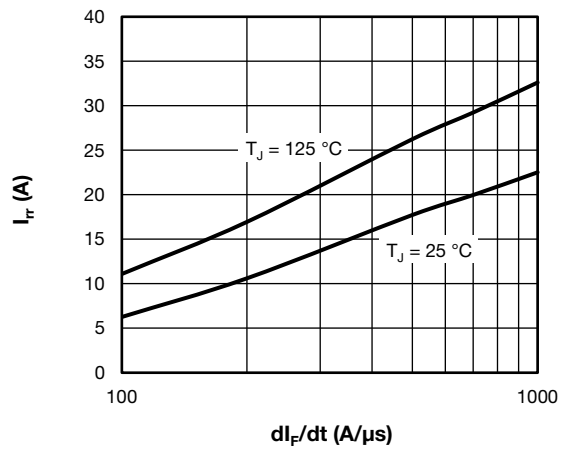


Fig. 14 - Typical  $I_{rr}$  Diode vs.  $dI_F/dt$   
 $V_R = 200\text{ V}$ ,  $I_F = 50\text{ A}$

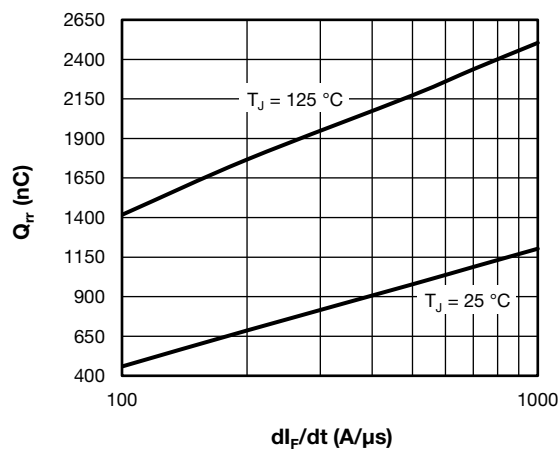


Fig. 15 - Typical  $Q_{rr}$  Diode vs.  $dI_F/dt$ ,  
 $V_R = 200\text{ V}$ ,  $I_F = 50\text{ A}$

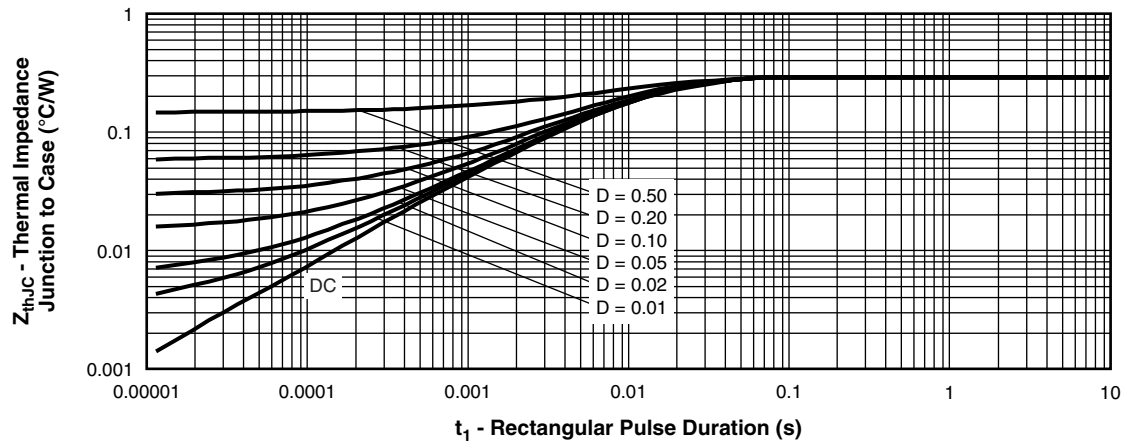


Fig. 16 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (IGBT)

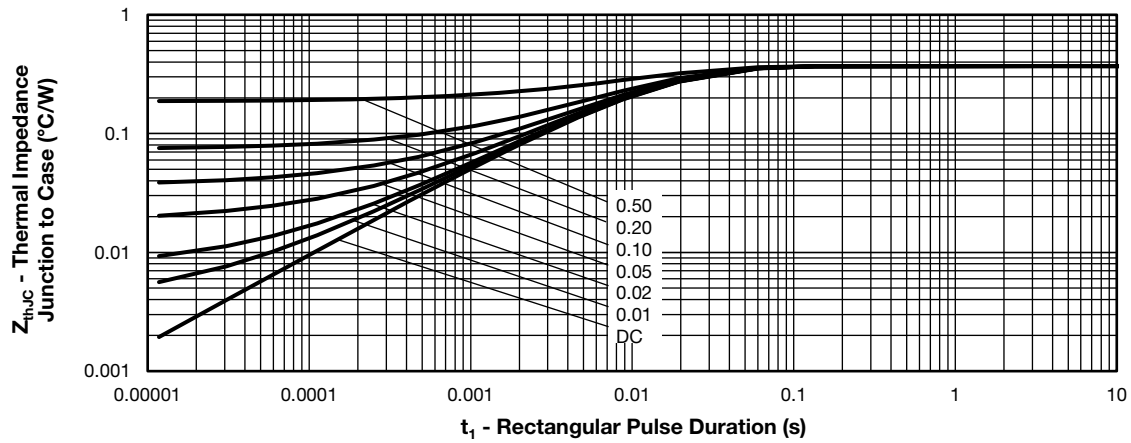


Fig. 17 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (Diode)

**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>G</b>	<b>B</b>	<b>55</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 (55 = 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** - Diode (X = HEXFRED® diode)

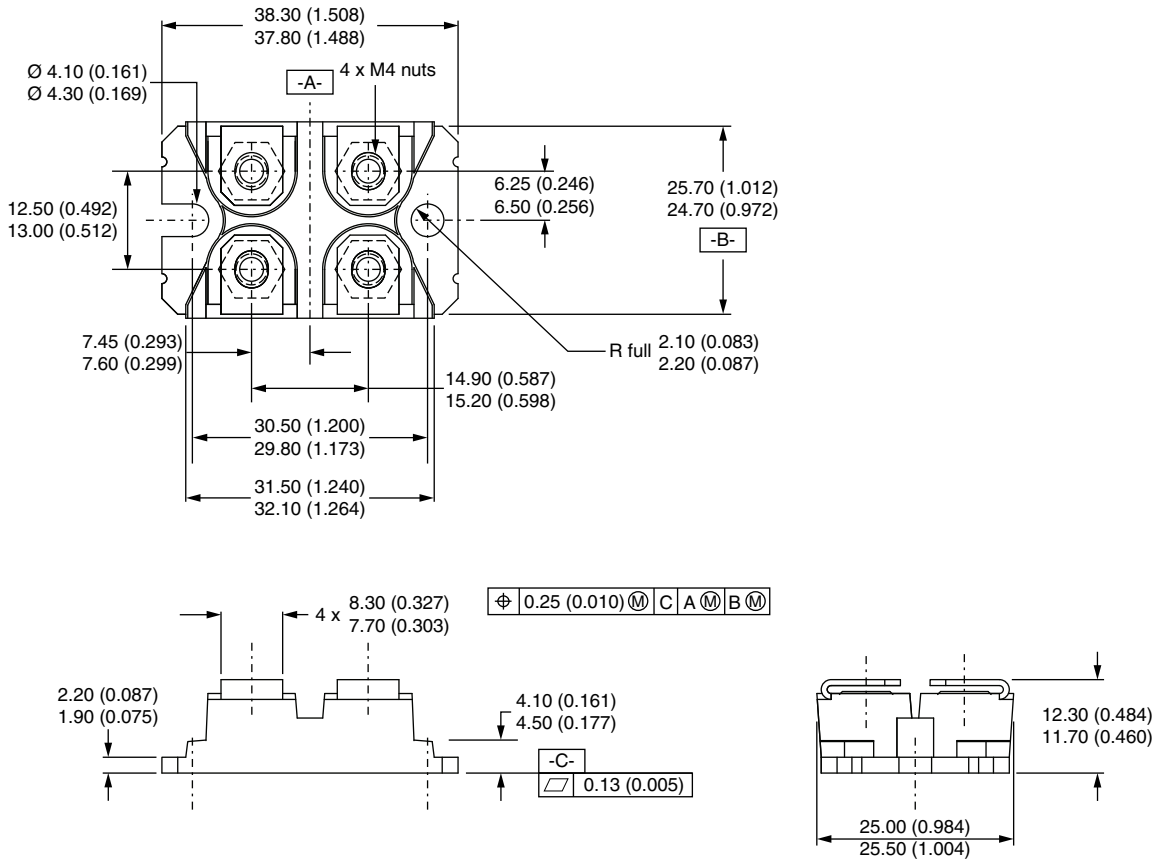
CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Low side chopper IGBT	L	 

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95423">www.vishay.com/doc?95423</a>
Packaging information	<a href="http://www.vishay.com/doc?95425">www.vishay.com/doc?95425</a>





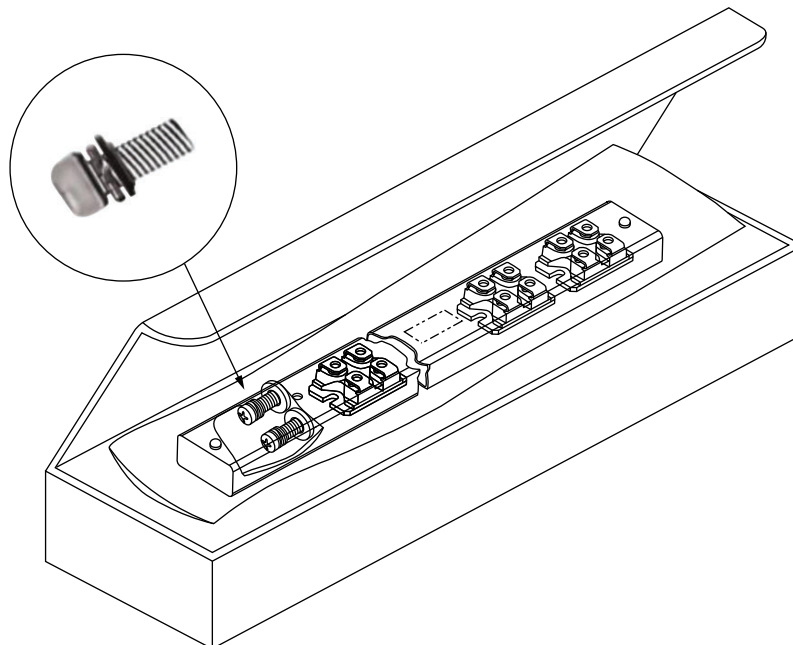
### DIMENSIONS in millimeters (inches)



### Note

- Controlling dimension: millimeter

### PACKAGING INFORMATION





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