


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



SOT-227

**FEATURES**

- NPT Gen 5 IGBT technology
- Square RBSOA
- HEXFRED® clamping diode
- Positive  $V_{CE(on)}$  temperature coefficient
- Fully isolated package
- 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)


**RoHS  
COMPLIANT**

PRIMARY CHARACTERISTICS	
$V_{CES}$	1200 V
$I_C$ DC	50 A at 92 °C
$V_{CE(on)}$ typical at 50 A, 25 °C	3.3 V
Speed	8 kHz to 60 kHz
Package	SOT-227
Circuit configuration	High side chopper

**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

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	$V_{CES}$		1200	V
Continuous collector current	$I_C$	$T_C = 25$ °C	84	A
		$T_C = 80$ °C	57	
Pulsed collector current	$I_{CM}$		150	
Clamped inductive load current	$I_{LM}$		150	
Diode continuous forward current	$I_F$	$T_C = 25$ °C	87	
		$T_C = 80$ °C	59	
Single pulse forward current	$I_{FSM}$	10 ms sine or 6 ms rectangular pulse, $T_J = 25$ °C	310	
Gate to emitter voltage	$V_{GE}$		$\pm 20$	V
Power dissipation, IGBT	$P_D$	$T_C = 25$ °C	431	W
		$T_C = 80$ °C	242	
Power dissipation, diode	$P_D$	$T_C = 25$ °C	338	
		$T_C = 80$ °C	190	
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	$V_{BR(CES)}$	$V_{GE} = 0\text{ V}, I_C = 500\text{ }\mu\text{A}$	1200	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 25\text{ A}$	-	2.5	2.8	
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}$	-	3.3	-	
		$V_{GE} = 15\text{ V}, I_C = 25\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	3.0	-	
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	4.03	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 500\text{ }\mu\text{A}$	4.0	5.5	7.1	
Temperature coefficient of threshold voltage	$V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$ (25 °C to 125 °C)	-	-12.9	-	mV/°C
Collector to emitter leakage current	$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$	-	8	50	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	0.15	-	mA
Diode reverse breakdown voltage	$V_{BR}$	$I_R = 1\text{ mA}$	1200	-	-	V
Diode forward voltage drop	$V_{FM}$	$I_F = 25\text{ A}, V_{GE} = 0\text{ V}$	-	2.11	2.42	V
		$I_F = 50\text{ A}, V_{GE} = 0\text{ V}$	-	2.72	-	
		$I_F = 25\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	2.04	-	
		$I_F = 50\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	2.83	-	
Diode reverse leakage current	$I_{RM}$	$V_R = 1200\text{ V}$	-	4	50	$\mu\text{A}$
		$T_J = 125\text{ }^\circ\text{C}, V_R = 1200\text{ V}$	-	0.8	-	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	$E_{on}$	$I_C = 50\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, R_g = 4.7\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$  Energy losses include tail and diode recovery	-	1.87	-	mJ	
Turn-off switching loss	$E_{off}$		-	0.83	-		
Total switching loss	$E_{tot}$		-	2.7	-		
Turn-on switching loss	$E_{on}$		-	3.43	-		
Turn-off switching loss	$E_{off}$		-	1.29	-		
Total switching loss	$E_{tot}$		-	4.72	-		
Turn-on delay time	$t_{d(on)}$		$I_C = 50\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, R_g = 4.7\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$	-	147	-	ns
Rise time	$t_r$			-	35	-	
Turn-off delay time	$t_{d(off)}$			-	186	-	
Fall time	$t_f$			-	119	-	
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	-	ns	
Diode peak reverse current	$I_{rr}$		-	11	-	A	
Diode recovery charge	$Q_{rr}$		-	710	-	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	-	ns	
Diode peak reverse current	$I_{rr}$		-	17	-	A	
Diode recovery charge	$Q_{rr}$		-	1768	-	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	$R_{thJC}$	IGBT	-	-	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 (lbf.in)
		Torque to heatsink	-	-	1.8 (15.9)	Nm (lbf.in)
Case style		SOT-227				

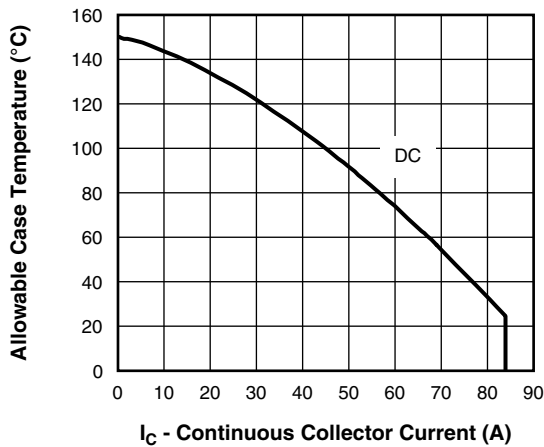


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

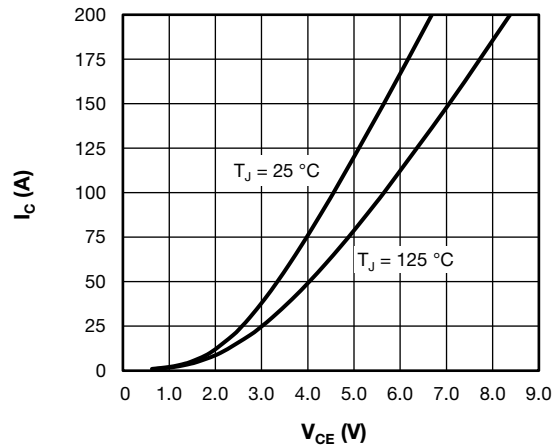


Fig. 3 - Typical IGBT Output Characteristics, V<sub>GE</sub> = 15V

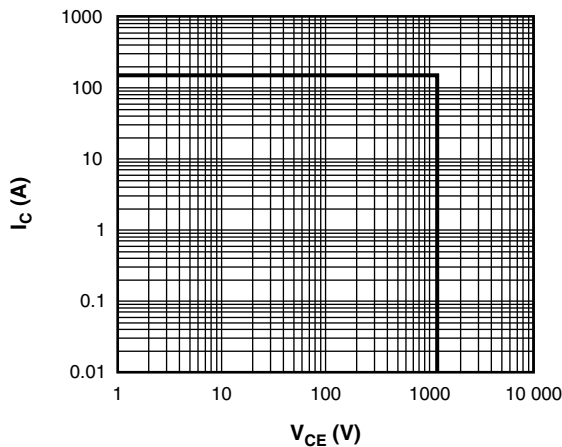


Fig. 2 - IGBT Reverse Bias SOA  
T<sub>J</sub> = 150 °C, V<sub>GE</sub> = 15 V

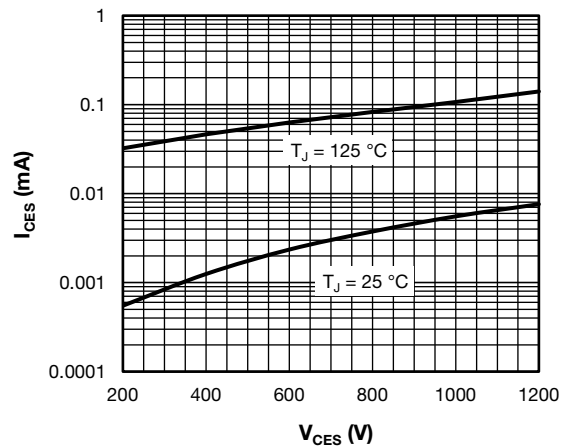


Fig. 4 - Typical IGBT Zero Gate Voltage Collector Current

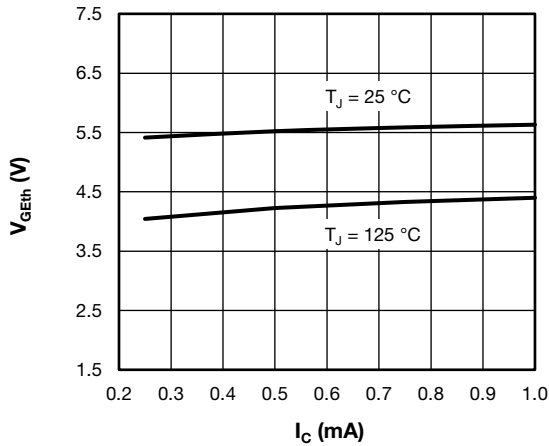


Fig. 5 - Typical IGBT Threshold Voltage

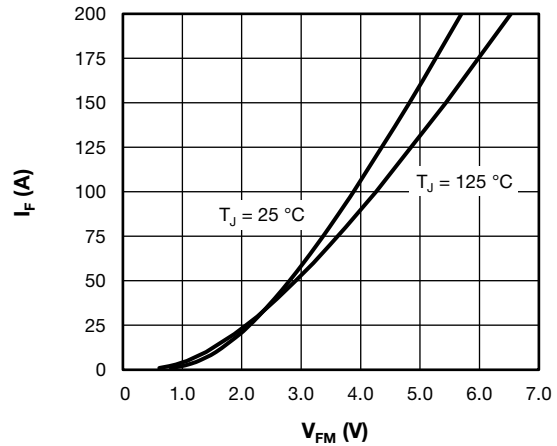


Fig. 8 - Typical Diode Forward Characteristics

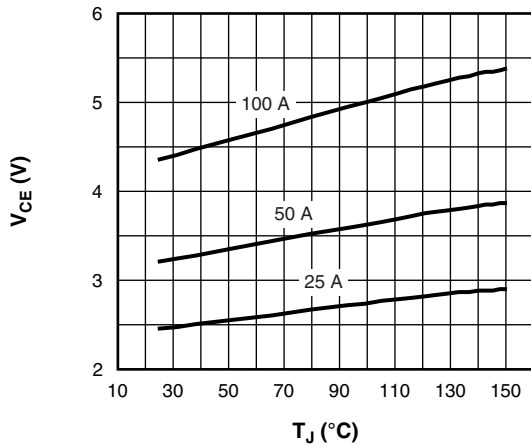


Fig. 6 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature,  $V_{GE} = 15\text{ V}$

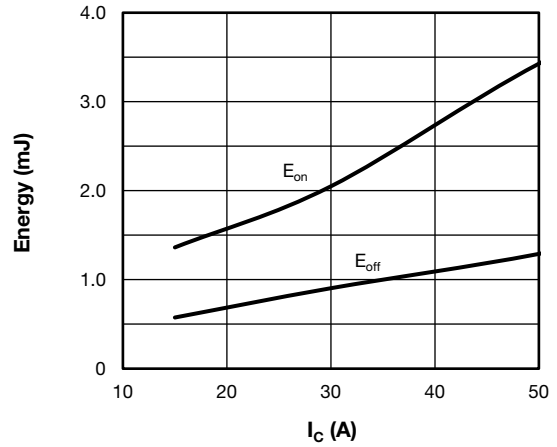


Fig. 9 - Typical IGBT Energy Losses vs.  $I_C$   
 $T_J = 125\text{ °C}$ ,  $V_{CC} = 600\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ }\mu\text{H}$ ,  $R_g = 4.7\text{ }\Omega$

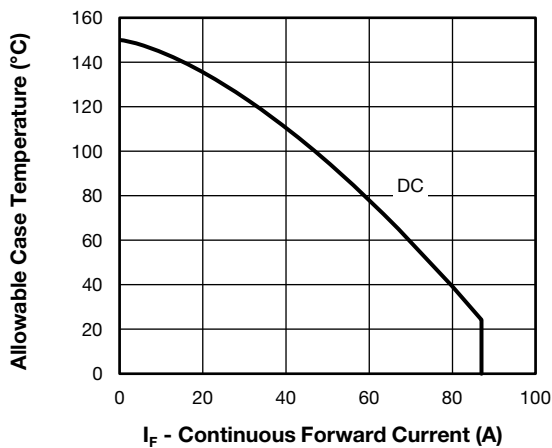


Fig. 7 - Maximum Diode Continuous Forward Current vs. Case Temperature

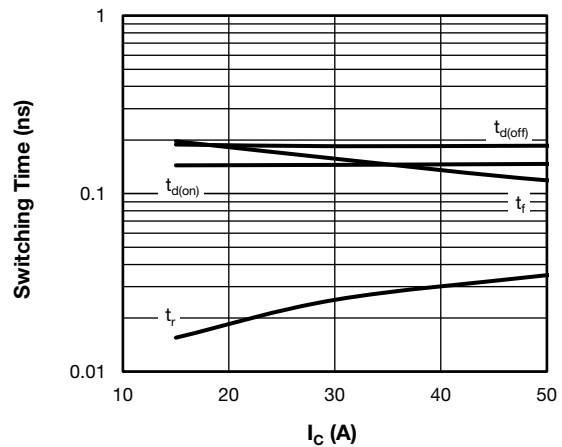


Fig. 10 - Typical IGBT Switching Time vs.  $I_C$   
 $T_J = 125\text{ °C}$ ,  $V_{CC} = 600\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ }\mu\text{H}$ ,  $R_g = 4.7\text{ }\Omega$

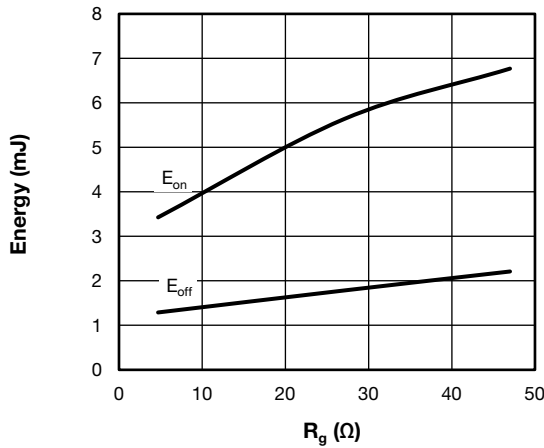


Fig. 11 - Typical IGBT Energy Losses vs.  $R_g$   
 $T_J = 125\text{ }^\circ\text{C}$ ,  $I_C = 50\text{ A}$ ,  $V_{CC} = 600\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ }\mu\text{H}$

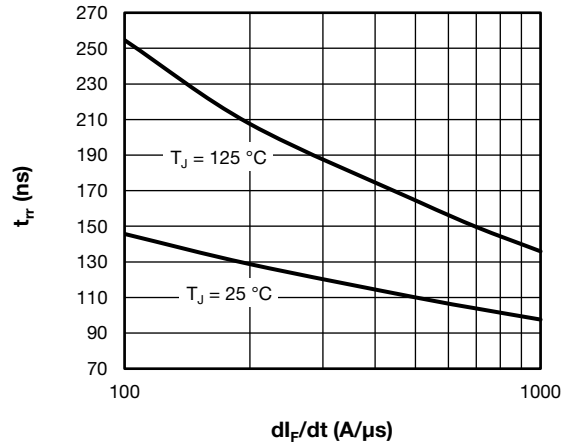


Fig. 13 - Typical  $t_{rr}$  Diode vs.  $dI_F/dt$   
 $V_R = 200\text{ V}$ ,  $I_F = 50\text{ A}$

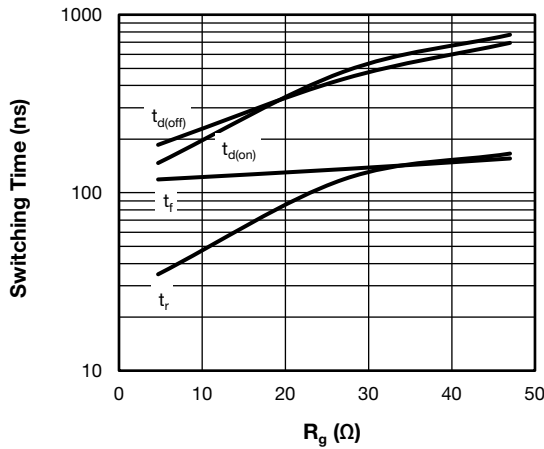


Fig. 12 - Typical IGBT Switching Time vs.  $R_g$   
 $T_J = 125\text{ }^\circ\text{C}$ ,  $I_C = 50\text{ A}$ ,  $V_{CC} = 600\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ }\mu\text{H}$

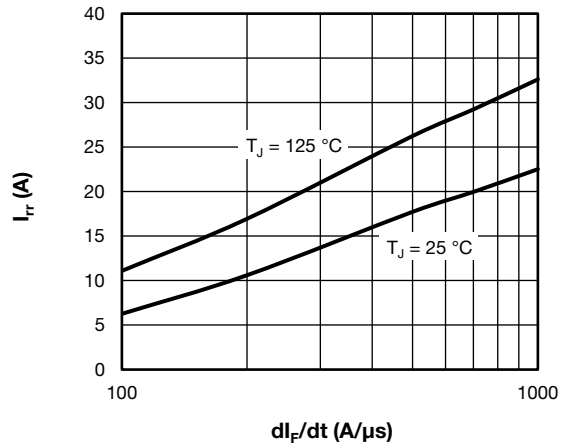


Fig. 14 - Typical  $I_{rr}$  Diode vs.  $dI_F/dt$   
 $V_R = 200\text{ V}$ ,  $I_F = 50\text{ A}$

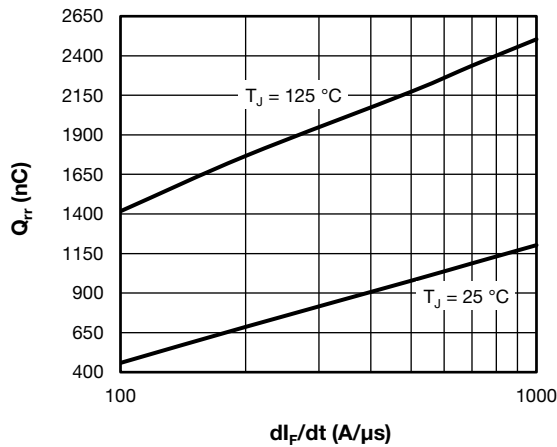


Fig. 15 - Typical  $Q_{rr}$  Diode vs.  $dI_F/dt$ ,  
 $V_R = 200\text{ V}$ ,  $I_F = 50\text{ A}$

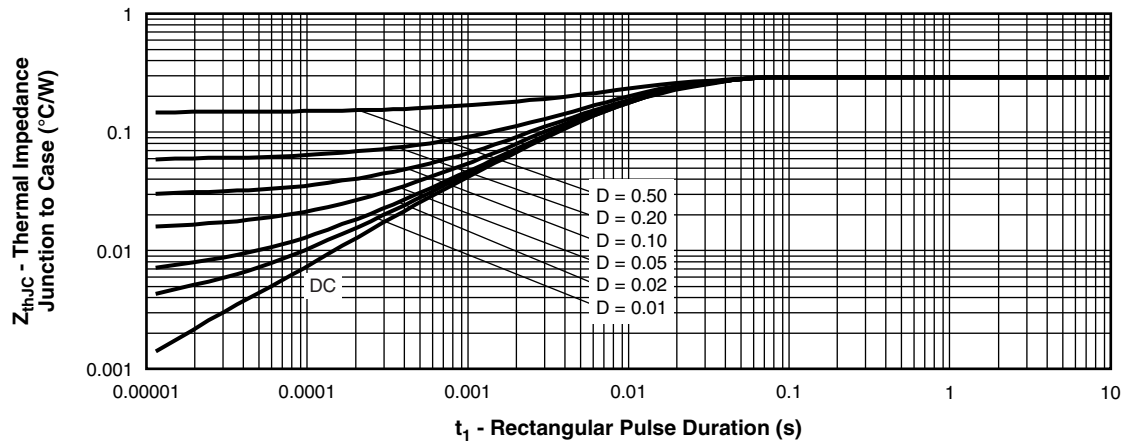


Fig. 16 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (IGBT)

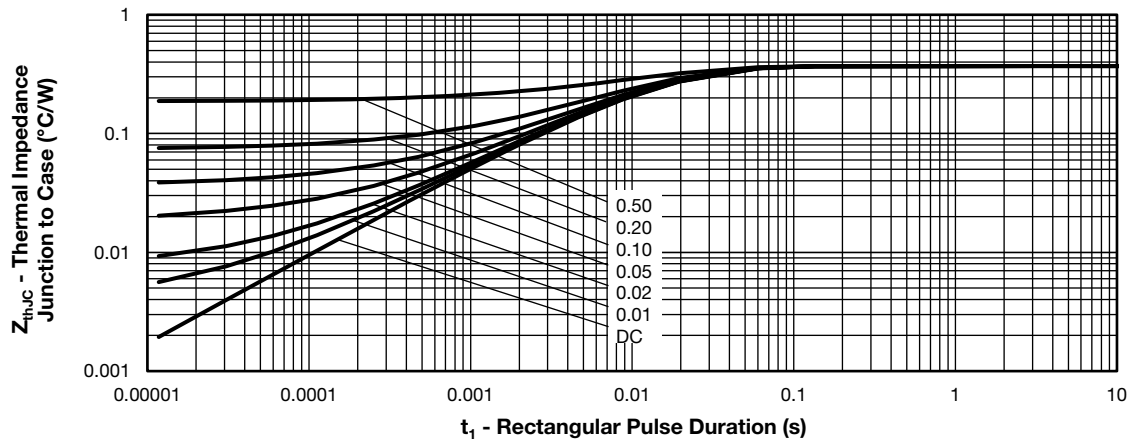


Fig. 17 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (Diode)

**ORDERING INFORMATION TABLE**

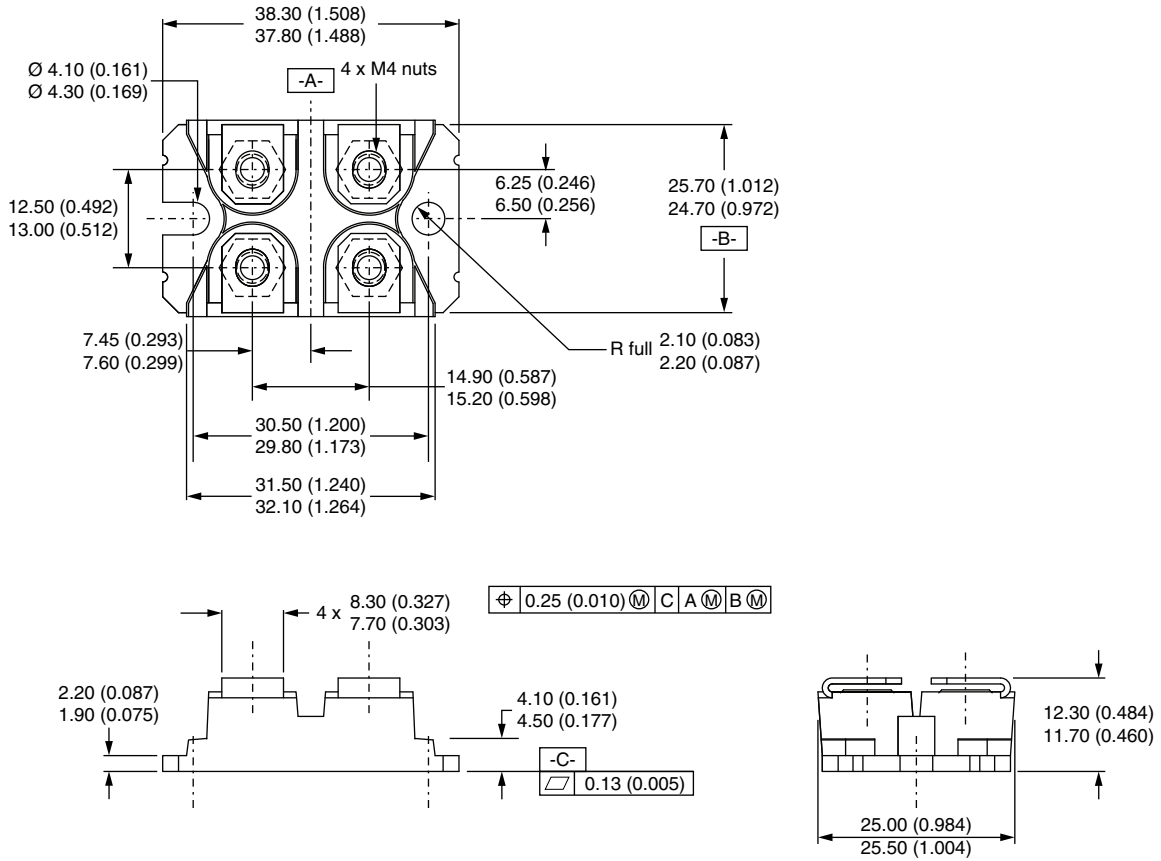
Device code	<b>VS-</b>	<b>G</b>	<b>B</b>	<b>55</b>	<b>N</b>	<b>A</b>	<b>120</b>	<b>U</b>	<b>X</b>
	①	②	③	④	⑤	⑥	⑦	⑧	⑨

- 1** - Vishay Semiconductors product
- 2** - Insulated gate bipolar transistor (IGBT)
- 3** - B = IGBT Gen 5
- 4** - Current rating (55 = 50 A)
- 5** - Circuit configuration (N = high 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
High side chopper	N	

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>

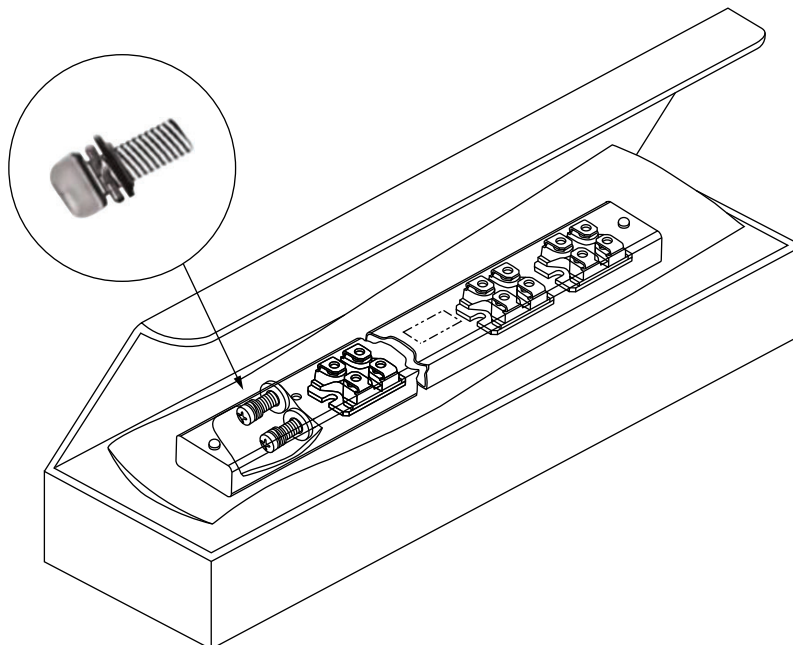
**DIMENSIONS** in millimeters (inches)



**Note**

- Controlling dimension: millimeter

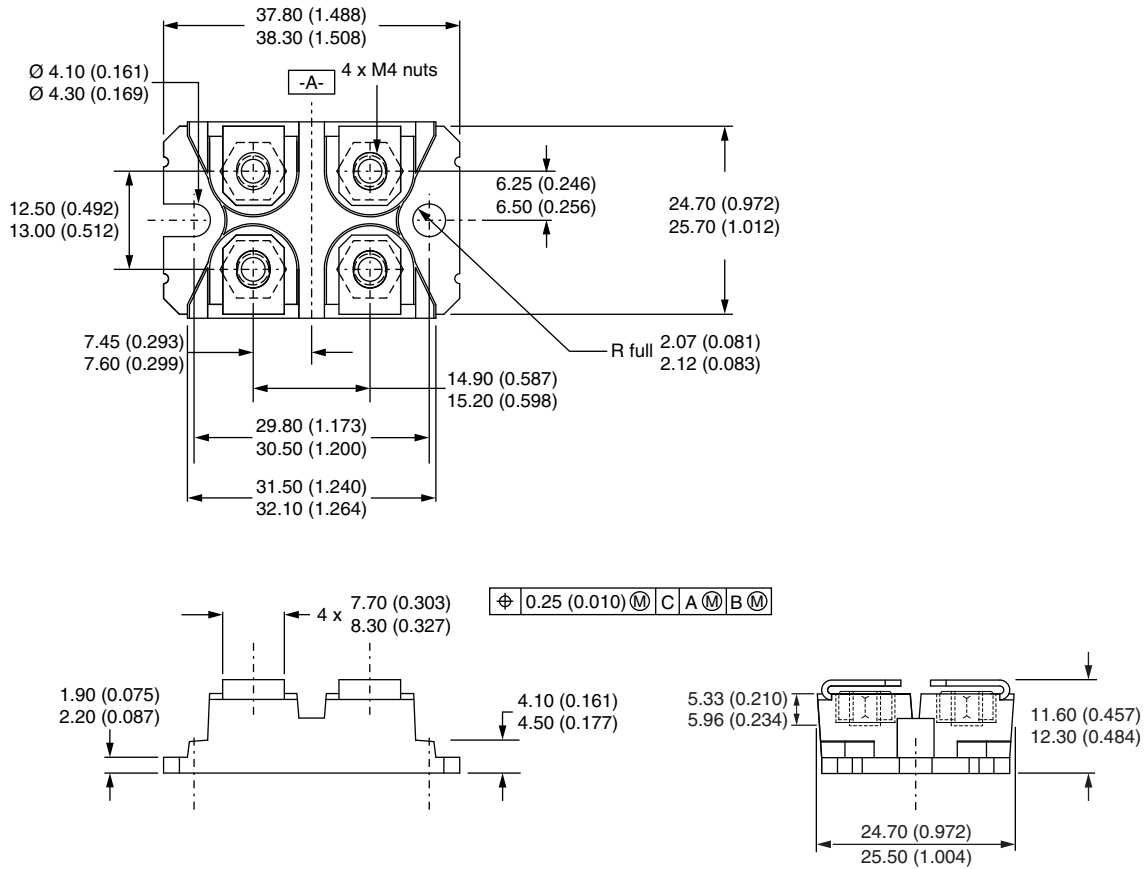
**PACKAGING INFORMATION**





## SOT-227 Generation 2

**DIMENSIONS** in millimeters (inches)



**Note**

- Controlling dimension: millimeter



## **Disclaimer**

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.