

## Insulated Gate Bipolar Transistor (Ultrafast Speed IGBT), 100 A


**SOT-227**

**RoHS  
COMPLIANT**
**FEATURES**

- Ultrafast: Optimized for minimum saturation voltage and speed up to 40 kHz in hard switching, > 200 kHz in resonant mode
- Very low conduction and switching losses
- Fully isolate package (2500 V<sub>AC/RMS</sub>)
- Very low internal inductance (≤ 5 nH typical)
- Industry standard outline
- UL approved file E78996
- Designed and qualified for industrial level
- 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
- 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

PRODUCT SUMMARY	
V <sub>CES</sub>	600 V
V <sub>CE(on)</sub> (typical)	1.92 V
V <sub>GE</sub>	15 V
I <sub>C</sub>	100 A
Package	SOT-227
Circuit	Single Switch no Diode

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter breakdown voltage	V <sub>CES</sub>		600	V
Continuous collector current	I <sub>C</sub>	T <sub>C</sub> = 25 °C	200	A
		T <sub>C</sub> = 100 °C	100	
Pulsed collector current	I <sub>CM</sub>		400	
Clamped inductive load current	I <sub>LM</sub>	V <sub>CC</sub> = 80 % (V <sub>CES</sub> ), V <sub>GE</sub> = 20 V, L = 10 μH, R <sub>G</sub> = 2.0 Ω, See fig. 13a	400	
Gate to emitter voltage	V <sub>GE</sub>		± 20	V
Reverse voltage avalanche energy	E <sub>ARV</sub>	Repetitive rating; pulse width limited by maximum junction temperature	160	mJ
RMS isolation voltage	V <sub>ISOL</sub>	Any terminal to case, t = 1 minute	2500	V
Maximum power dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	500	W
		T <sub>C</sub> = 100 °C	200	
Operating junction and storage temperature range	T <sub>J</sub> , T <sub>Stg</sub>		- 55 to + 150	°C
Mounting torque		6-32 or M3 screw	1.3 (12)	N · m (lbf · in)



THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL		MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	$T_J, T_{STG}$		-55	-	150	°C/W
Thermal resistance, junction to case	$R_{thJC}$		-	-	0.25	
Thermal resistance case to heatsink	$R_{thCS}$	Flat, greased surface	-	0.05	-	
Weight			-	30	-	g
Mounting torque			-	-	1.3	Nm
Case style			SOT-227			

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
Emitter to collector breakdown voltage	$V_{(BR)ECS}$	$V_{GE} = 0\text{ V}, I_C = 1.0\text{ A}$ Pulse width $\leq 80\text{ }\mu\text{s}$ ; duty factor $\leq 0.1\%$	18	-	-	
Temperature coeff. of breakdown voltage	$\Delta V_{(BR)CES}/\Delta T_J$	$V_{GE} = 0\text{ V}, I_C = 10\text{ mA}$	-	0.38	-	V/°C
Collector to emitter saturation voltage	$V_{CE(on)}$	$I_C = 100\text{ A}$	-	1.60	1.9	V
		$I_C = 200\text{ A}$				
		$I_C = 100\text{ A}, T_J = 150\text{ }^\circ\text{C}$				
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$	3.0	-	6.0	
Temperature coeff. of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 2.0\text{ mA}$	-	-11	-	mV/°C
Forward transconductance	$g_{fe}$	$V_{CE} = 100\text{ V}, I_C = 100\text{ A}$ Pulse width $5.0\text{ }\mu\text{s}$ , single shot	79	-	-	S
Zero gate voltage collector current	$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$	-	-	1.0	mA
		$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	-	10	
Gate to emitter leakage current	$I_{GES}$	$V_{GE} = \pm 20\text{ V}$	-	-	$\pm 250$	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)	$Q_g$	$I_C = 100\text{ A}$ $V_{CC} = 400\text{ V}$ $V_{GE} = 15\text{ V}$ ; See fig. 8	-	770	1200	nC
Gate-emitter charge (turn-on)	$Q_{ge}$					
Gate-collector charge (turn-on)	$Q_{gc}$					
Turn-on delay time	$t_{d(on)}$	$T_J = 25\text{ }^\circ\text{C}$ $I_C = 100\text{ A}$ $V_{CC} = 480\text{ V}$ $V_{GE} = 15\text{ V}$	-	54	-	ns
Rise time	$t_r$					
Turn-off delay time	$t_{d(off)}$					
Fall time	$t_f$					
Turn-on switching loss	$E_{on}$	$R_g = 2.0\text{ }\Omega$ Energy losses include "tail" See fig. 9, 10, 14	-	0.98	-	mJ
Turn-off switching loss	$E_{off}$					
Total switching loss	$E_{ts}$					
Turn-on delay time	$t_{d(on)}$	$T_J = 150\text{ }^\circ\text{C}$ $I_C = 100\text{ A}, V_{CC} = 480\text{ V}$ $V_{GE} = 15\text{ V}, R_g = 2.0\text{ }\Omega$ Energy losses include "tail" See fig. 10, 11, 14	-	56	-	ns
Rise time	$t_r$					
Turn-off delay time	$t_{d(off)}$					
Fall time	$t_f$					
Total switching loss	$E_{ts}$					
Internal emitter inductance	$L_E$	Measured 5 mm from package	-	5.0	-	nH
Input capacitance	$C_{ies}$	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1.0\text{ MHz}$ ; See fig. 7	-	16 500	-	pF
Output capacitance	$C_{oes}$					
Reverse transfer capacitance	$C_{res}$					

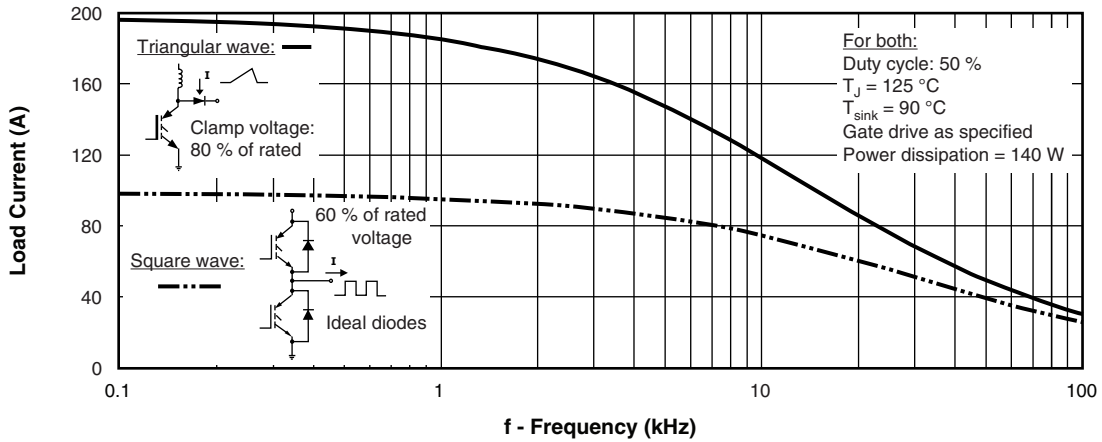


Fig. 1 - Typical Load Current vs. Frequency  
(Load Current =  $I_{RMS}$  of Fundamental)

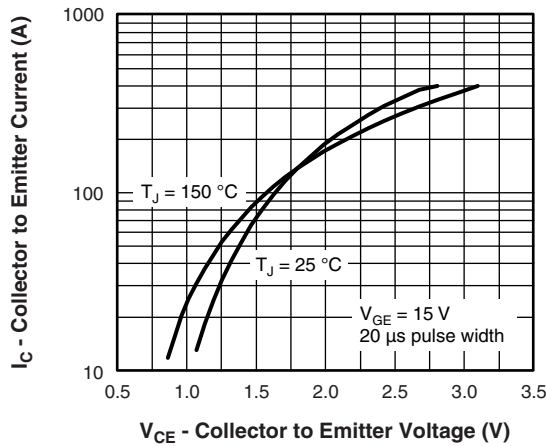


Fig. 2 - Typical Output Characteristics

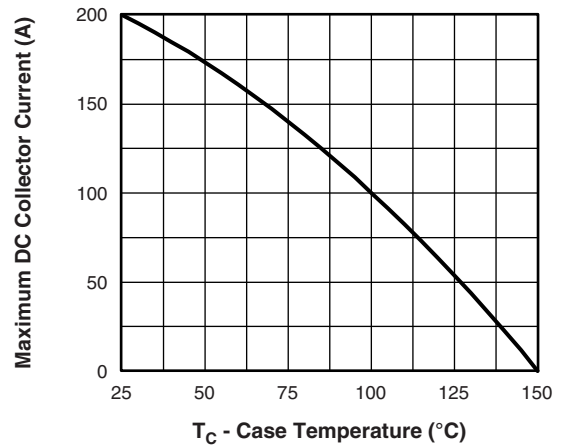


Fig. 4 - Maximum Collector Current vs. Case Temperature

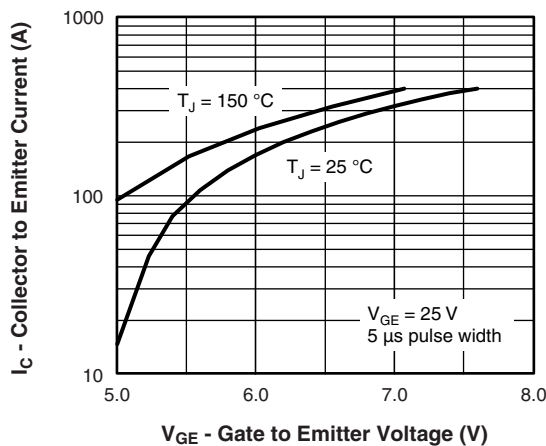


Fig. 3 - Typical Transfer Characteristics

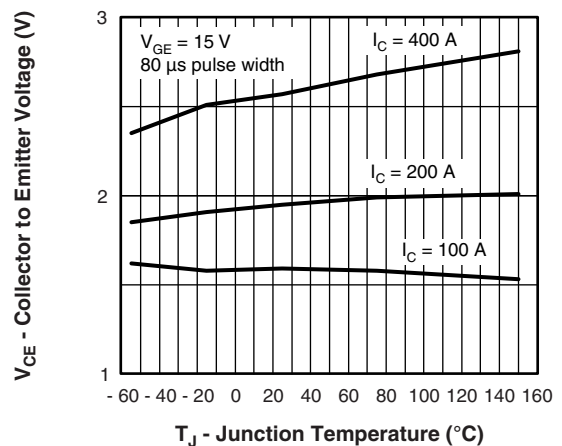


Fig. 5 - Typical Collector to Emitter Voltage vs. Junction Temperature

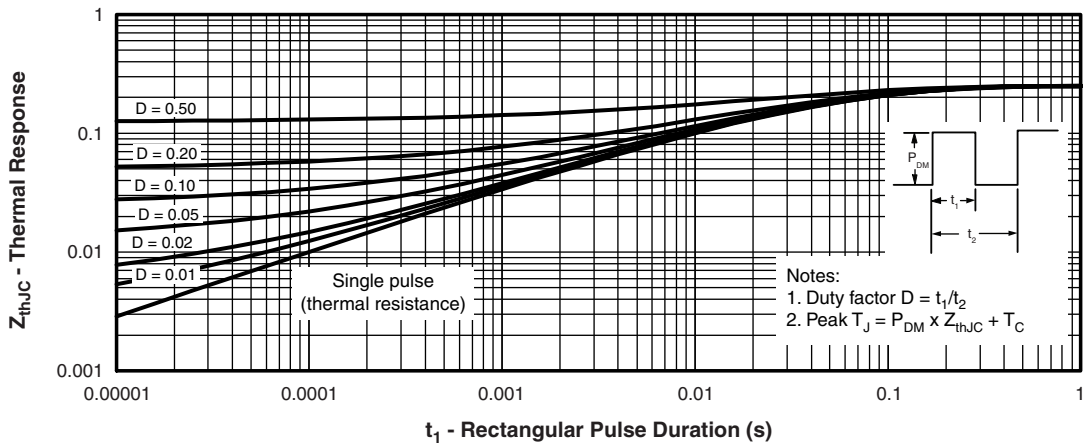


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction to Case

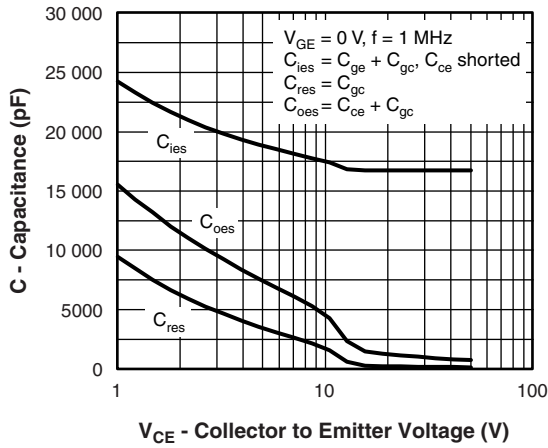


Fig. 7 - Typical Capacitance vs. Collector to Emitter Voltage

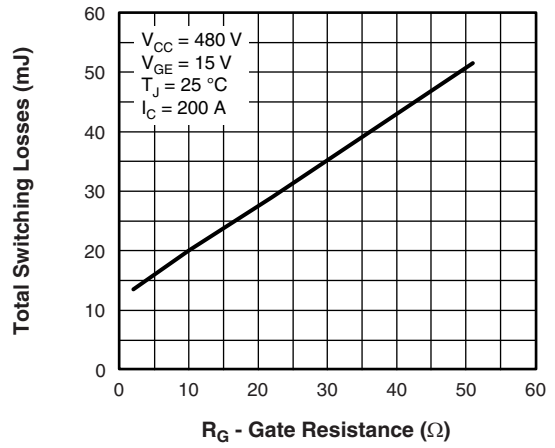


Fig. 9 - Typical Switching Losses vs. Gate Resistance

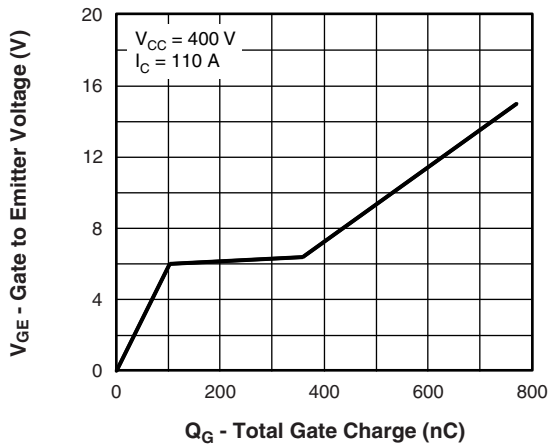


Fig. 8 - Typical Gate Charge vs. Gate to Emitter Voltage

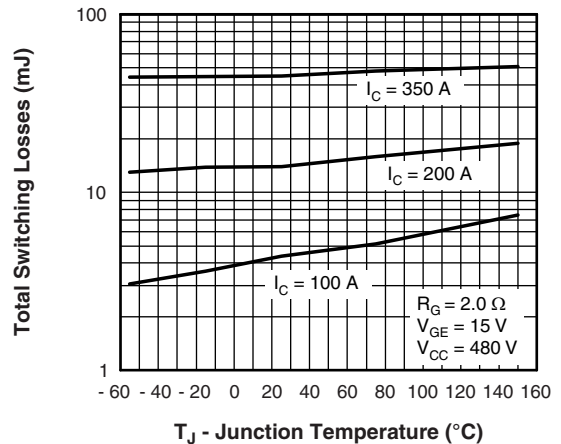


Fig. 10 - Typical Switching Losses vs. Junction Temperature

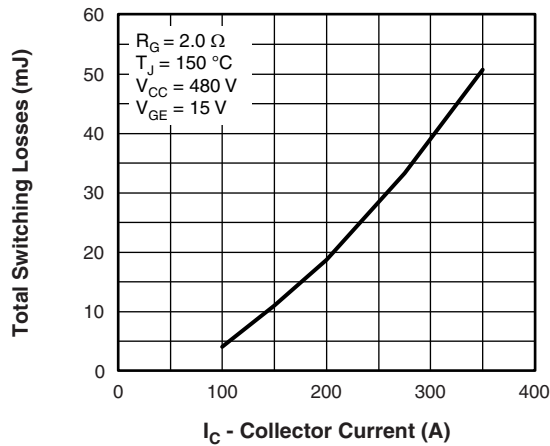


Fig. 11 - Typical Switching Losses vs. Collector Current

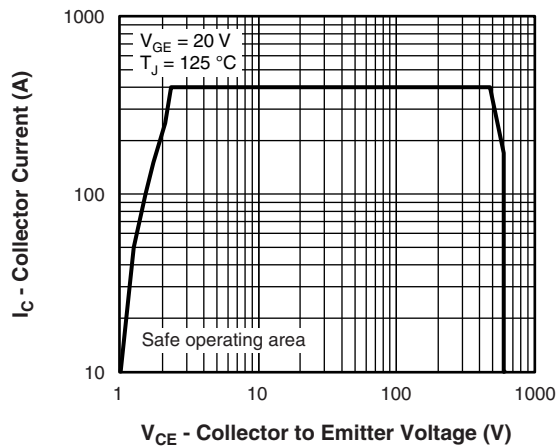
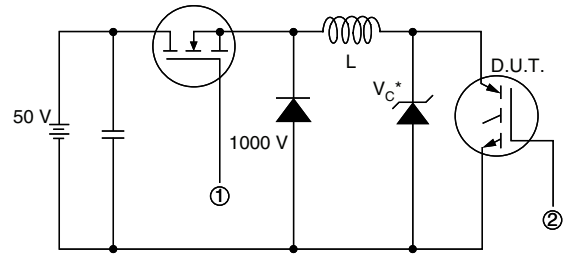


Fig. 12 - Turn-Off SOA



\* Driver same type as D.U.T.;  $V_C = 80\%$  of  $V_{CE}(\text{max})$

**Note:** Due to the 50 V power supply, pulse width and inductor will increase to obtain rated  $I_d$

Fig. 13a - Clamped Inductive Load Test Circuit

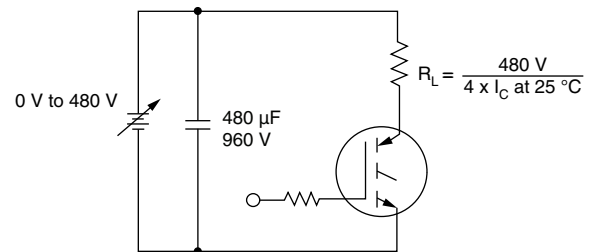
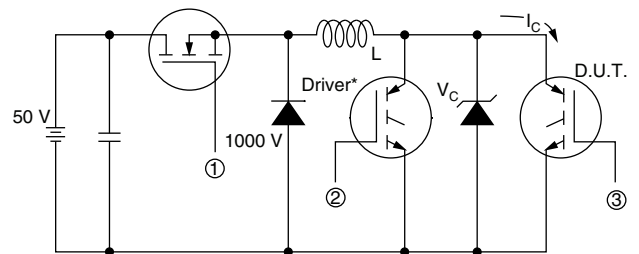


Fig. 13b - Pulsed Collector Current Test Circuit



\* Driver same type as D.U.T.,  $V_C = 480 \text{ V}$

Fig. 14a - Switching Loss Test Circuit

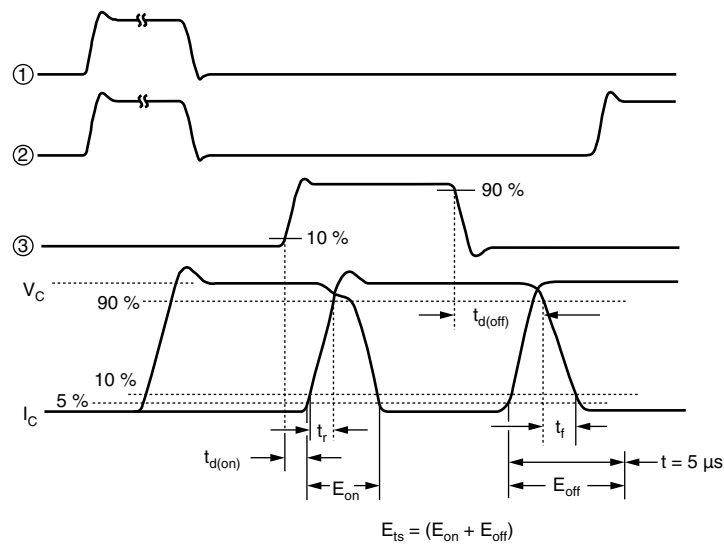
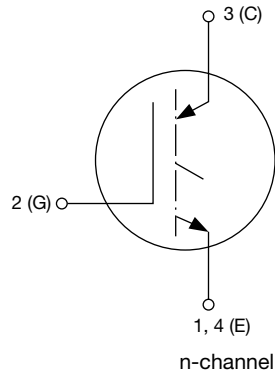


Fig. 14b - Switching Loss Waveforms

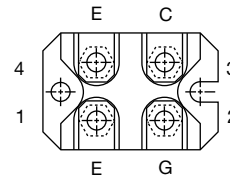
**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>G</b>	<b>A</b>	<b>200</b>	<b>S</b>	<b>A</b>	<b>60</b>	<b>U</b>	<b>P</b>
	①	②	③	④	⑤	⑥	⑦	⑧	⑨

- |   |   |  |
|---|---|--|
| 1 | - | Vishay Semiconductors product  |
| 2 | - | Insulated Gate Bipolar Transistor (IGBT)   |
| 3 | - | Generation 4, IGBT silicon, DBC construction   |
| 4 | - | Current rating (200 = 200 A)   |
| 5 | - | Single switch, no diode  |
| 6 | - | SOT-227  |
| 7 | - | Voltage rating (60 = 600 V)  |
| 8 | - | Speed/type (U = Ultrafast)   |
| 9 | - | <ul style="list-style-type: none"> <li>• None = Standard production</li> <li>• P = Lead (Pb)-free</li> </ul> |

**CIRCUIT CONFIGURATION**


Lead assignment

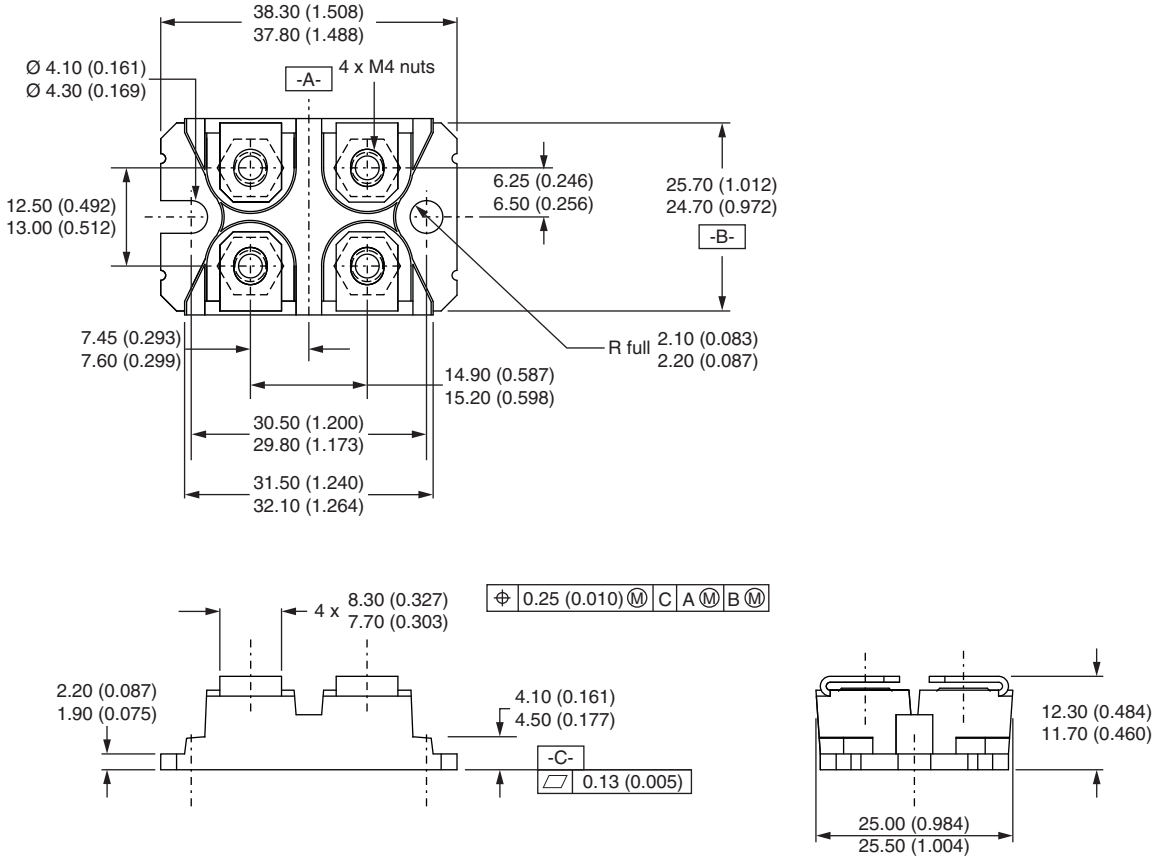


LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95036">www.vishay.com/doc?95036</a>
Packaging information	<a href="http://www.vishay.com/doc?95037">www.vishay.com/doc?95037</a>



### SOT-227 Generation II

**DIMENSIONS** in millimeters (inches)



**Note**

- Controlling dimension: millimeter



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