

## Insulated Gate Bipolar Transistor (Ultrafast IGBT), 90 A


**SOT-227**
**FEATURES**

- NPT Generation V IGBT technology
- Square RBSOA
- 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)


**RoHS  
COMPLIANT**

PRODUCT SUMMARY	
$V_{CES}$	1200 V
$V_{CE(on)}$ typical at 75 A, 25 °C	3.3 V
$I_C$ DC	90 A at 90 °C
Speed	8 kHz to 30 kHz
Package	SOT-227
Circuit	Single Switch no diode

**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	$I_C$ <sup>(1)</sup>	$T_C = 25$ °C	149	A
		$T_C = 90$ °C	90	
Pulsed collector current	$I_{CM}$		200	
Clamped inductive load current	$I_{LM}$		200	
Gate to emitter voltage	$V_{GE}$		$\pm 20$	V
Power dissipation, IGBT	$P_D$	$T_C = 25$ °C	862	W
		$T_C = 90$ °C	414	
Isolation voltage	$V_{ISOL}$	Any terminal to case, $t = 1$ min	2500	V

**Note**

<sup>(1)</sup> Maximum collector current admitted is 100 A, to do exceed the maximum temperature of terminals

ELECTRICAL SPECIFICATIONS ( $T_J = 25$ °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{BR(CES)}$	$V_{GE} = 0$ V, $I_C = 250$ $\mu$ A	1200	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15$ V, $I_C = 75$ A	-	3.3	3.8	
		$V_{GE} = 15$ V, $I_C = 75$ A, $T_J = 125$ °C	-	3.6	3.9	
		$V_{GE} = 15$ V, $I_C = 75$ A, $T_J = 150$ °C	-	3.7	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$ , $I_C = 250$ $\mu$ A	4	5	6	
		$V_{CE} = V_{GE}$ , $I_C = 250$ $\mu$ A, $T_J = 125$ °C	-	3.2	-	
Temperature coefficient of threshold voltage	$V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$ , $I_C = 1$ mA (25 °C to 125 °C)	-	-12	-	mV/°C
Collector to emitter leakage current	$I_{CES}$	$V_{GE} = 0$ V, $V_{CE} = 1200$ V	-	7	250	$\mu$ A
		$V_{GE} = 0$ V, $V_{CE} = 1200$ V, $T_J = 125$ °C	-	1.4	10	mA
		$V_{GE} = 0$ V, $V_{CE} = 1200$ V, $T_J = 150$ °C	-	6.5	20	
Gate to emitter leakage current	$I_{GES}$	$V_{GE} = \pm 20$ V	-	-	$\pm 250$	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)	$Q_g$	$I_C = 50\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}$		-	690	-	nC			
Gate to emitter charge (turn-on)	$Q_{ge}$			-	65	-				
Gate to collector charge (turn-on)	$Q_{gc}$			-	250	-				
Turn-on switching loss	$E_{on}$	$I_C = 75\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, R_g = 5\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$		-	1.2	-	mJ			
Turn-off switching loss	$E_{off}$			-	2.1	-				
Total switching loss	$E_{tot}$			-	3.3	-				
Turn-on delay time	$t_{d(on)}$			Energy losses include tail and diode recovery Diode used HFA16PB120		-	250	-	ns	
Rise time	$t_r$					-	38	-		
Turn-off delay time	$t_{d(off)}$					-	280	-		
Fall time	$t_f$	-	90			-				
Turn-on switching loss	$E_{on}$	$I_C = 75\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, R_g = 5\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$				-	1.7	-		mJ
Turn-off switching loss	$E_{off}$					-	4.08	-		
Total switching loss	$E_{tot}$			-	5.78	-				
Turn-on delay time	$t_{d(on)}$					-	245	-	ns	
Rise time	$t_r$					-	48	-		
Turn-off delay time	$t_{d(off)}$					-	280	-		
Fall time	$t_f$	-	140			-				
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 200\text{ A}, R_g = 22\text{ }\Omega, V_{GE} = 15\text{ V to } 0\text{ V}, V_{CC} = 900\text{ V}, V_P = 1200\text{ V}, L = 500\text{ }\mu\text{H}$				Fullsquare				

<b>THERMAL AND MECHANICAL SPECIFICATIONS</b>						
PARAMETER	SYMBOL		MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	$T_J, T_{Stg}$		-40	-	150	$^\circ\text{C}$
Thermal resistance junction to case	$R_{thJC}$		-	-	0.145	$^\circ\text{C/W}$
Thermal resistance 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	-	-	1.3 (11.5)	Nm (lbf.in)
Case style		SOT-227				

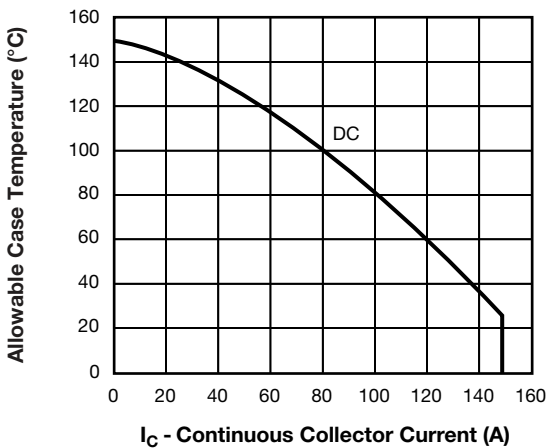


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

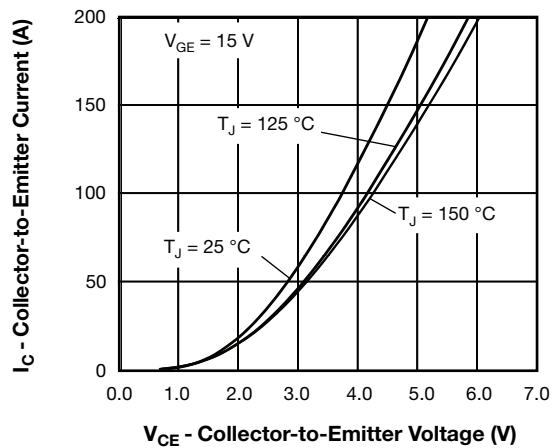


Fig. 2 - Typical Collector to Emitter Current Output Characteristics of IGBT

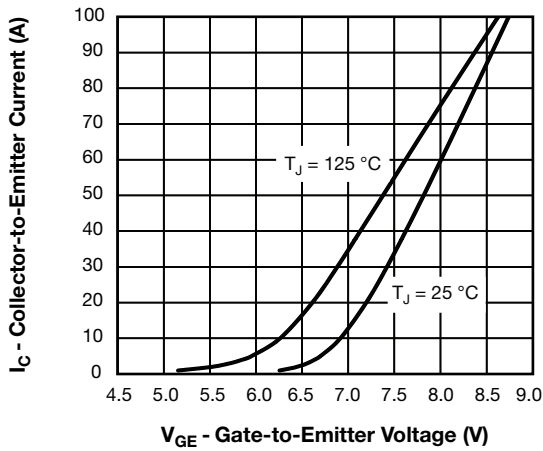


Fig. 3 - Typical IGBT Transfer Characteristics

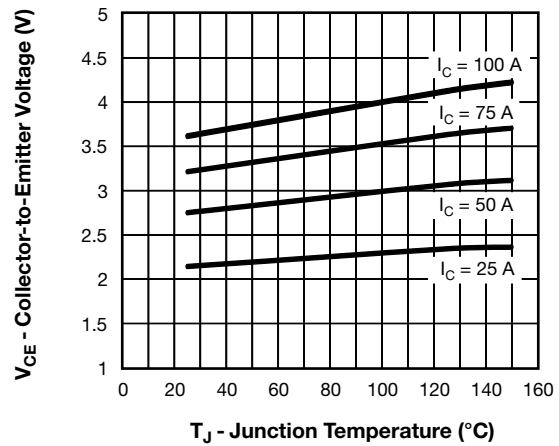


Fig. 6 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature,  $V_{GE} = 15\text{ V}$

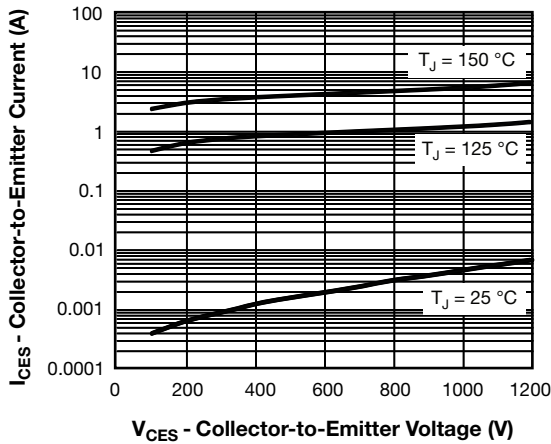


Fig. 4 - Typical IGBT Zero Gate Voltage Collector Current

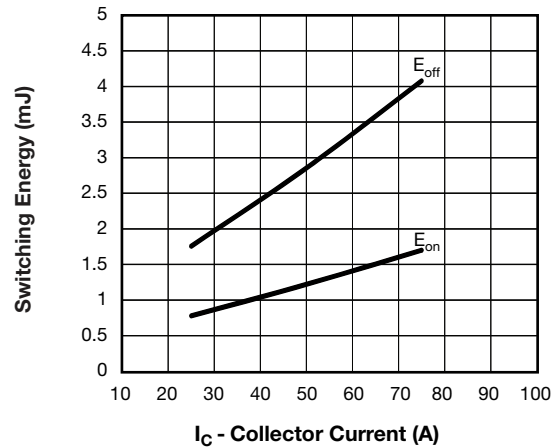


Fig. 7 - Typical IGBT Energy Losses vs.  $I_C$   
 $T_J = 125\text{ }^\circ\text{C}$ ,  $L = 500\text{ }\mu\text{H}$ ,  $V_{CC} = 600\text{ V}$ ,  
 $R_g = 5\text{ }\Omega$ ,  $V_{GE} = 15\text{ V}$ , Diode used HFA16PB120

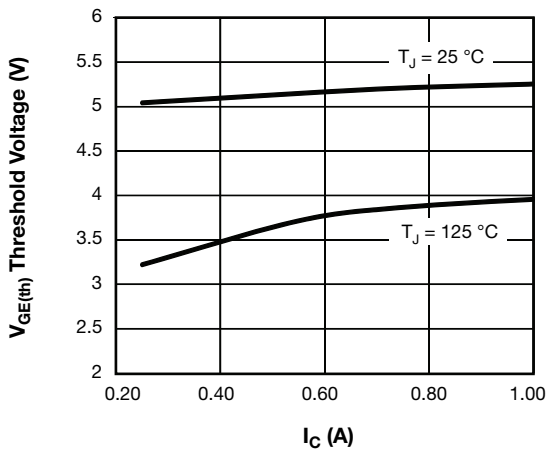


Fig. 5 - Typical IGBT Threshold Voltage

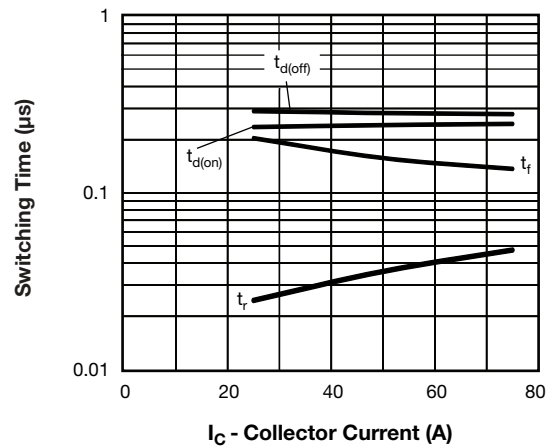


Fig. 8 - Typical IGBT Switching Time vs.  $I_C$   
 $T_J = 125\text{ }^\circ\text{C}$ ,  $L = 500\text{ }\mu\text{H}$ ,  $V_{CC} = 600\text{ V}$ ,  
 $R_g = 5\text{ }\Omega$ ,  $V_{GE} = 15\text{ V}$ , Diode used HFA16PB120

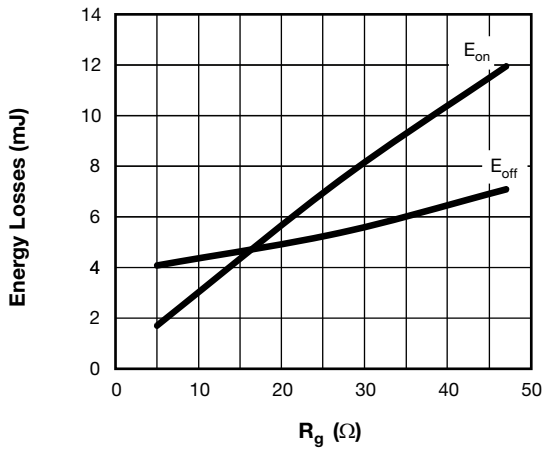


Fig. 9 - Typical IGBT Energy Loss vs.  $R_g$ ,  
 $T_J = 125\text{ }^\circ\text{C}$ ,  $I_C = 75\text{ A}$ ,  $L = 500\text{ }\mu\text{H}$ ,  
 $V_{CC} = 600\text{ V}$ ,  $V_{GE} = 15\text{ V}$ , Diode used HFA16PB120

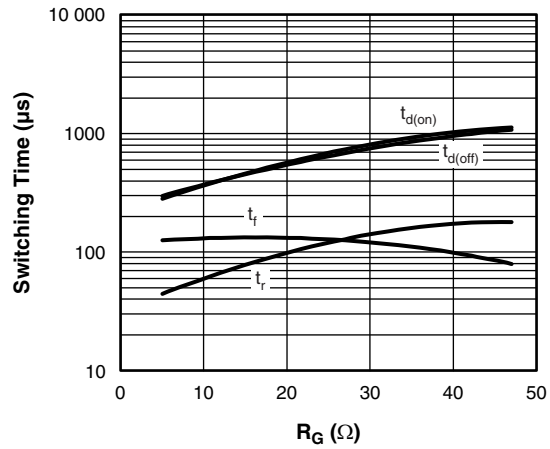


Fig. 10 - Typical IGBT Switching Time vs.  $R_g$ ,  
 $T_J = 125\text{ }^\circ\text{C}$ ,  $L = 500\text{ }\mu\text{H}$ ,  $V_{CC} = 600\text{ V}$ ,  
 $R_g = 5\text{ }\Omega$ ,  $V_{GE} = 15\text{ V}$

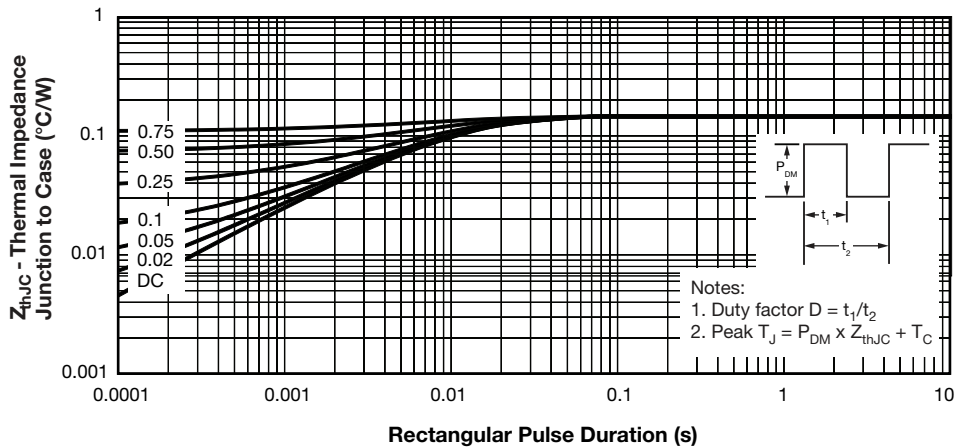


Fig. 11 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (IGBT)

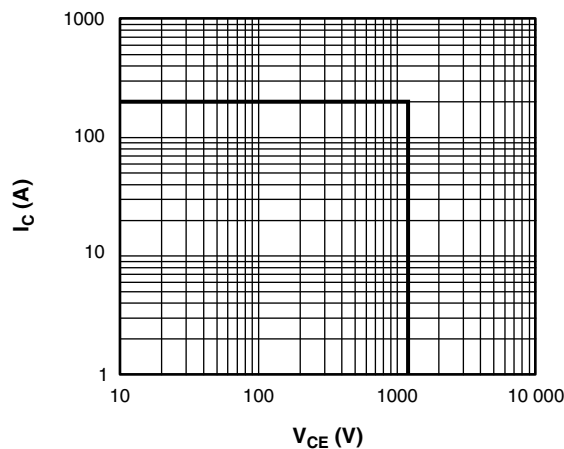


Fig. 12 - IGBT Reverse Bias SOA,  $T_J = 150\text{ }^\circ\text{C}$ ,  $V_{GE} = 15\text{ V}$

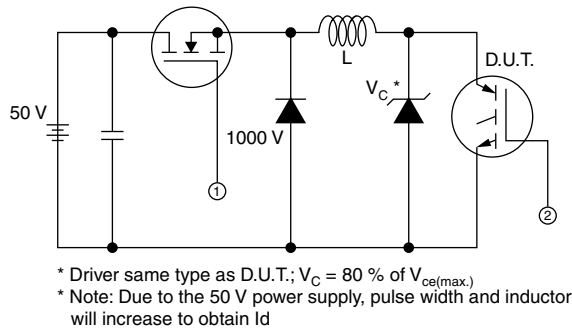


Fig. 13a - Clamped Inductive Load Test Circuit

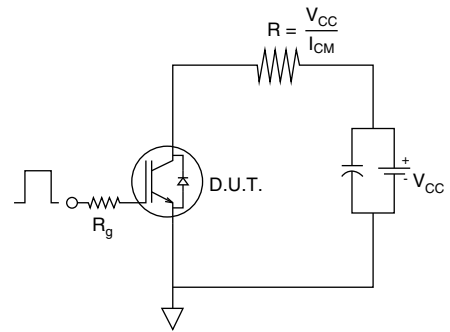


Fig. 13b - Pulsed Collector Current Test Circuit

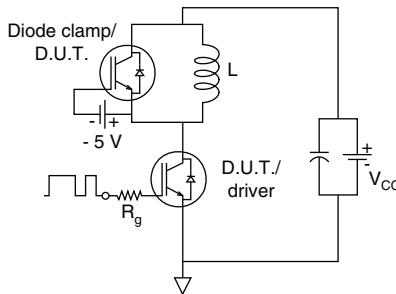


Fig. 14a - Switching Loss Test Circuit

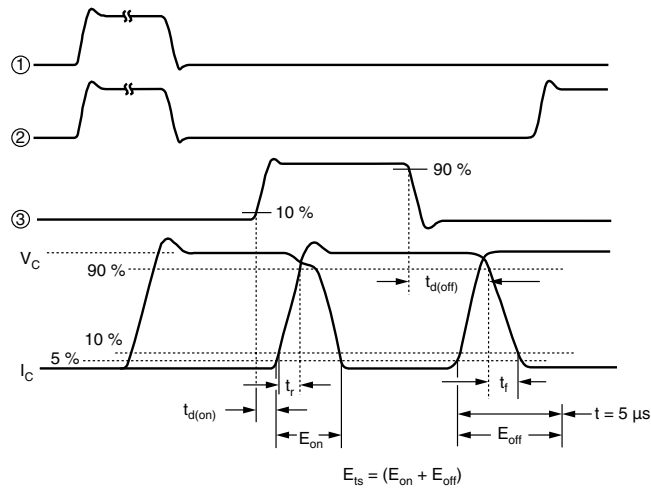


Fig. 14b - Switching Loss Waveforms Test Circuit

## ORDERING INFORMATION TABLE

Device code	<b>VS-</b>	<b>G</b>	<b>B</b>	<b>90</b>	<b>S</b>	<b>A</b>	<b>120</b>	<b>U</b>
	①	②	③	④	⑤	⑥	⑦	⑧

- 1** - Vishay Semiconductors product
- 2** - Insulated Gate Bipolar Transistor (IGBT)
- 3** - B = IGBT Generation 5
- 4** - Current rating (90 = 90 A)
- 5** - Circuit configuration (S = Single switch without antiparallel diode)
- 6** - Package indicator (A = SOT-227)
- 7** - Voltage rating (120 = 1200 V)
- 8** - Speed/type (U = Ultrafast IGBT)

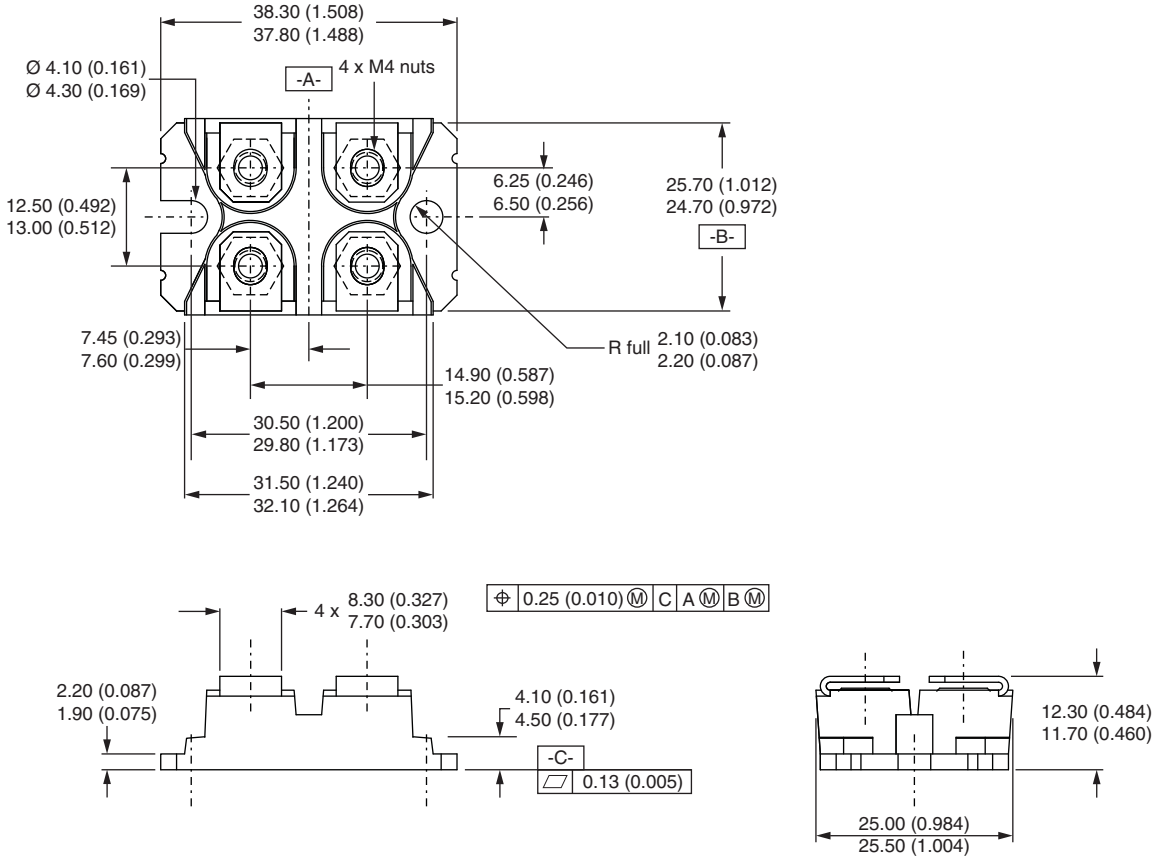
CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Single switch, no antiparallel diode	S	

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>



### SOT-227 Generation II

**DIMENSIONS** in millimeters (inches)



**Note**

- Controlling dimension: millimeter



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