


## Insulated Gate Bipolar Transistor (Trench IGBT), 80 A



SOT-227


**FEATURES**

- Trench IGBT technology
- Positive  $V_{CE(on)}$  temperature coefficient
- Square RBSOA
- 10  $\mu$ s short circuit capability
- HEXFRED<sup>®</sup> low  $Q_{rr}$ , low switching energy
- $T_J$  maximum = 150 °C
- 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)

**BENEFITS**

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

**PRIMARY CHARACTERISTICS**

$V_{CES}$	1200 V
$I_C$ DC	80 A at 104 °C
$V_{CE(on)}$ typical at 80 A, 25 °C	2.0 V
Speed	8 kHz to 30 kHz
Package	SOT-227
Circuit configuration	Single switch with AP diode

**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	139	A
		$T_C = 90$ °C	93	
Pulsed collector current	$I_{CM}$		170	
Clamped inductive load current	$I_{LM}$		250	
Diode continuous forward current	$I_F$	$T_C = 25$ °C	98	
		$T_C = 90$ °C	61	
Single pulse forward current	$I_{FSM}$	10 ms sine or 6 ms rectangular pulse, $T_J = 25$ °C	350	
Gate to emitter voltage	$V_{GE}$		$\pm 20$	V
Power dissipation, IGBT	$P_D$	$T_C = 25$ °C	658	W
		$T_C = 90$ °C	316	
Power dissipation, diode	$P_D$	$T_C = 25$ °C	403	
		$T_C = 90$ °C	194	
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> = 2.6 mA	1200	-	-	V
Collector to emitter voltage	V <sub>CE(on)</sub>	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 80 A	-	2.0	2.55	
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 80 A, T <sub>J</sub> = 125 °C	-	2.4	-	
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 80 A, T <sub>J</sub> = 150 °C	-	2.5	-	
Gate threshold voltage	V <sub>GE(th)</sub>	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 2.6 mA	4.75	5.7	7.0	
Temperature coefficient of threshold voltage	ΔV <sub>GE(th)</sub> /ΔT <sub>J</sub>	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 2.6 mA (25 °C to 125 °C)	-	-12	-	mV/°C
Collector to emitter leakage current	I <sub>CES</sub>	V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1200 V	-	1.0	100	μA
		V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1200 V, T <sub>J</sub> = 125 °C	-	0.9	-	mA
Forward voltage drop	V <sub>FM</sub>	I <sub>F</sub> = 80 A, V <sub>GE</sub> = 0 V	-	2.9	3.5	V
		I <sub>F</sub> = 80 A, V <sub>GE</sub> = 0 V, T <sub>J</sub> = 125 °C	-	3.1	-	
		I <sub>F</sub> = 80 A, V <sub>GE</sub> = 0 V, T <sub>J</sub> = 150 °C	-	3.1	-	
Gate to emitter leakage current	I <sub>GES</sub>	V <sub>GE</sub> = ± 20 V	-	-	± 220	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>	V <sub>GE</sub> = -15 V, V <sub>GE</sub> = ± 15 V	-	570	-		
Input capacitance	C <sub>ies</sub>	V <sub>CE</sub> = 25 V, V <sub>GE</sub> = 0 V, f = 1 MHz	-	4400	-	pF	
Reverse transfer capacitance	C <sub>res</sub>		-	235	-		
Turn-on switching loss	E <sub>on</sub>	I <sub>C</sub> = 80 A, V <sub>CC</sub> = 600 V, V <sub>GE</sub> = 15 V, R <sub>g</sub> = 1.0 Ω, L = 500 μH, T <sub>J</sub> = 25 °C	-	3.0	-	mJ	
Turn-off switching loss	E <sub>off</sub>		-	3.2	-		
Total switching loss	E <sub>tot</sub>		-	6.2	-		
Turn-on switching loss	E <sub>on</sub>	I <sub>C</sub> = 80 A, V <sub>CC</sub> = 600 V, V <sub>GE</sub> = 15 V, R <sub>g</sub> = 1.0 Ω, L = 500 μH, T <sub>J</sub> = 125 °C	-	3.9	-	mJ	
Turn-off switching loss	E <sub>off</sub>		-	5.5	-		
Total switching loss	E <sub>tot</sub>		-	9.4	-		
Turn-on delay time	t <sub>d(on)</sub>		Energy losses include tail and diode recovery Diode used HFA16PB120	-	134	-	ns
Rise time	t <sub>r</sub>			-	65	-	
Turn-off delay time	t <sub>d(off)</sub>			-	281	-	
Fall time	t <sub>f</sub>	-		155	-		
Reverse bias safe operating area	RBSOA	T <sub>J</sub> = 150 °C, I <sub>C</sub> = 250 A, R <sub>g</sub> = 1.0 Ω, V <sub>GE</sub> = 15 V to 0 V, V <sub>CC</sub> = 800 V, V <sub>P</sub> = 1200 V, L = 500 μH	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> = 400 V	-	179	-	ns	
Diode peak reverse current	I <sub>rr</sub>		-	11.5	-	A	
Diode recovery charge	Q <sub>rr</sub>		-	1029	-	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>rr</sub> = 400 V, T <sub>J</sub> = 125 °C	-	275	-	ns	
Diode peak reverse current	I <sub>rr</sub>		-	17.8	-	A	
Diode recovery charge	Q <sub>rr</sub>		-	2451	-	nC	
Short circuit safe operating area	SCSOA	V <sub>GE</sub> = 15 V, V <sub>CC</sub> = 800 V, V <sub>CE</sub> max. = 1200 V, T <sub>J</sub> = 150 °C	10			μs	

THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	T <sub>J</sub> , T <sub>Stg</sub>		-40	-	150	°C
Junction to case	IGBT	R <sub>thJC</sub>	-	-	0.19	°C/W
	Diode		-	-	0.31	
Case to heatsink	R <sub>thCS</sub>	Flat, greased surface	-	0.1	-	
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				

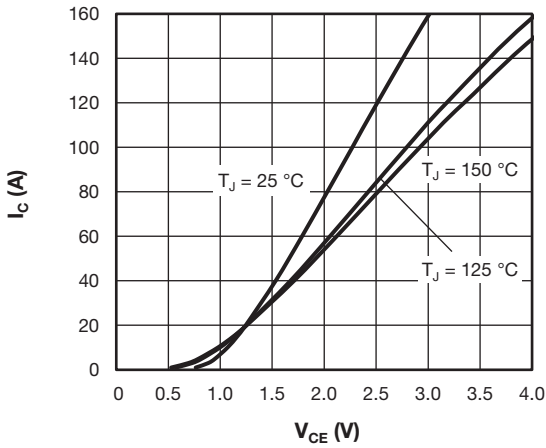


Fig. 1 - Typical IGBT Output Characteristics,  $V_{GE} = 15\text{ V}$

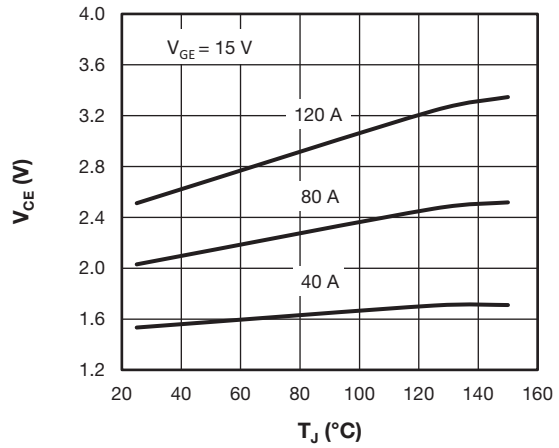


Fig. 4 - Collector to Emitter Voltage vs. Junction Temperature

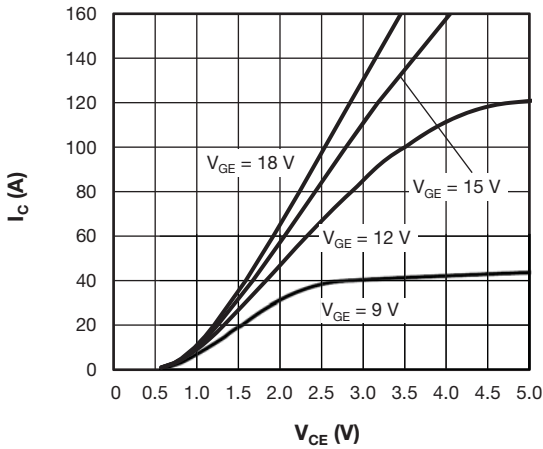


Fig. 2 - Typical IGBT Output Characteristics,  $T_J = 125\text{ °C}$

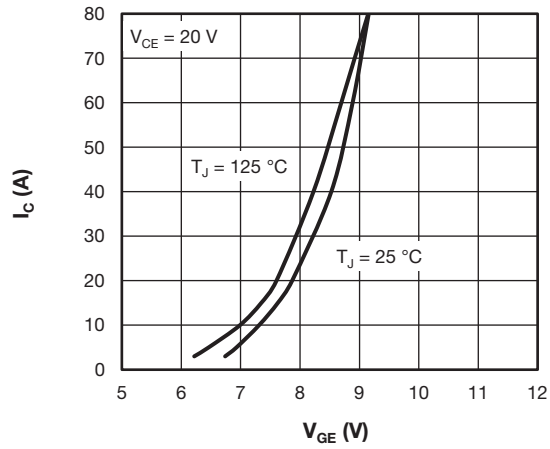


Fig. 5 - Typical IGBT Transfer Characteristics

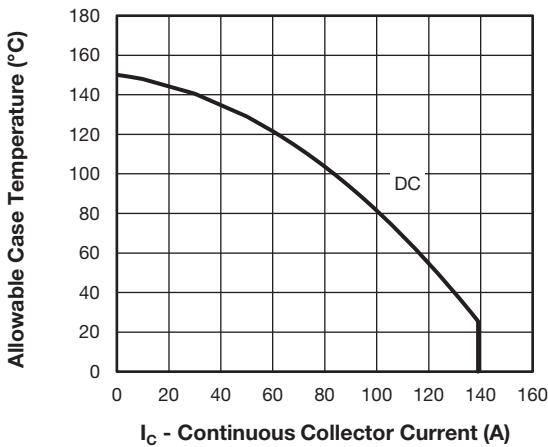


Fig. 3 - Maximum IGBT Continuous Collector Current vs. Case Temperature

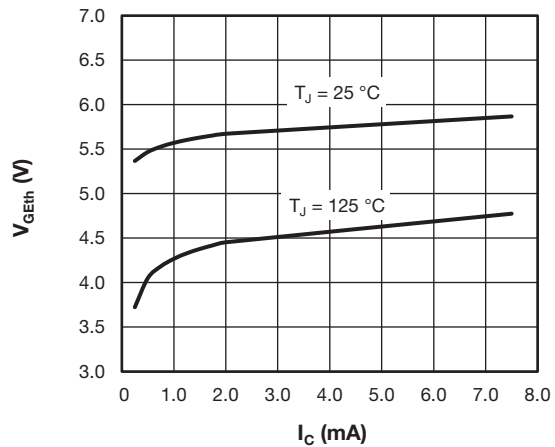


Fig. 6 - Typical IGBT Gate Threshold Voltage

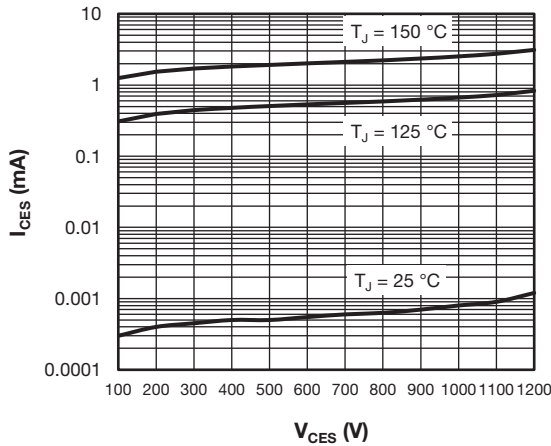


Fig. 7 - Typical IGBT Zero Gate Voltage Collector Current

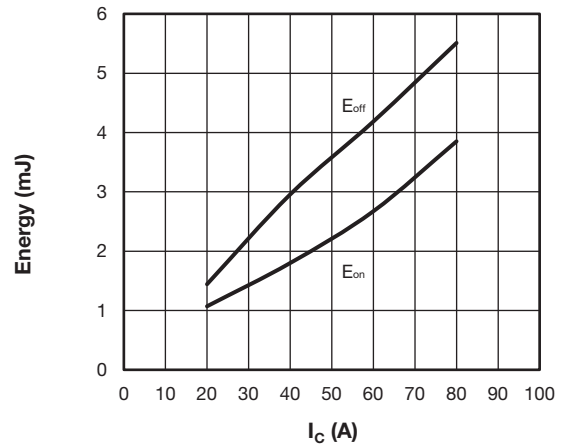


Fig. 10 - Typical IGBT Energy Loss vs  $I_C$   
 $T_J = 125\text{ °C}$ ,  $V_{CC} = 600\text{ V}$ ,  $R_g = 1.0\ \Omega$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\ \mu\text{H}$

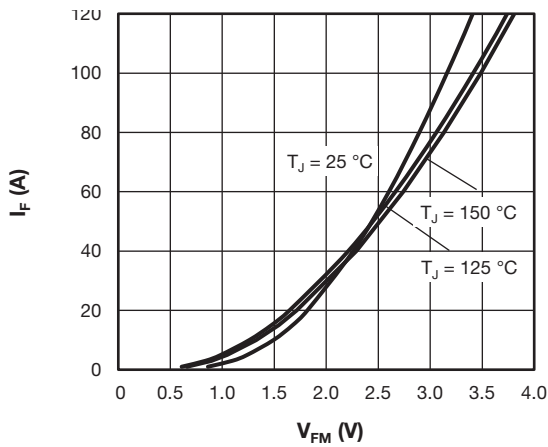


Fig. 8 - Typical Diode Forward Characteristics

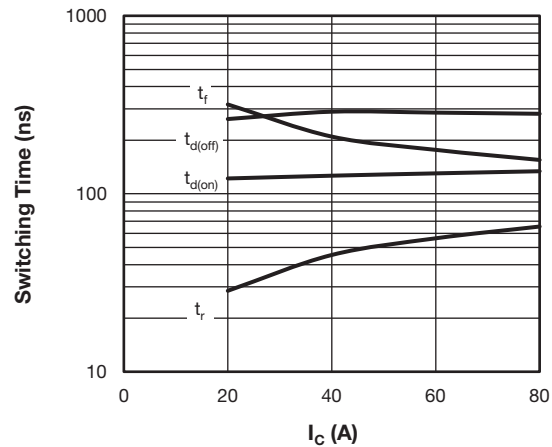


Fig. 11 - Typical IGBT Switching Time vs.  $I_C$   
 $T_J = 125\text{ °C}$ ,  $V_{CC} = 600\text{ V}$ ,  $R_g = 1.0\ \Omega$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\ \mu\text{H}$

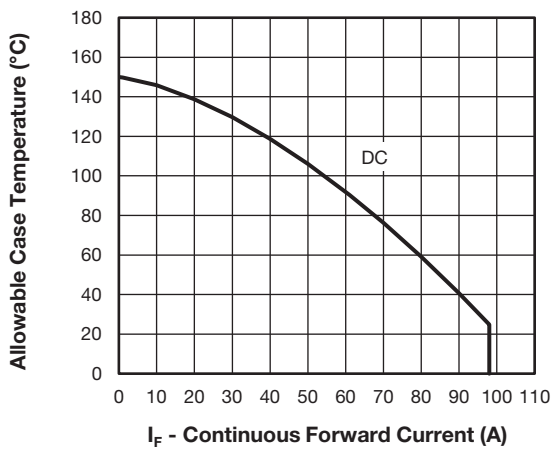


Fig. 9 - Maximum Diode Continuous Forward Current vs. Case Temperature

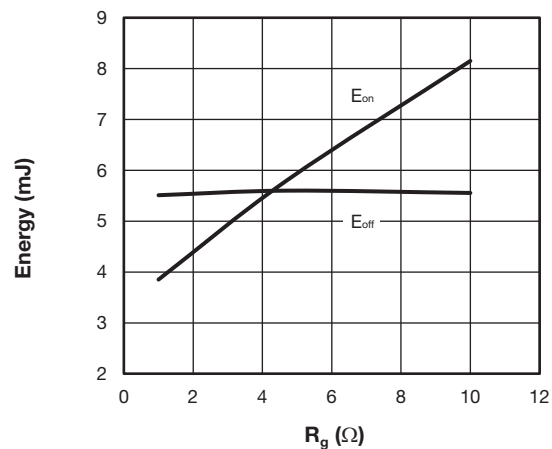


Fig. 12 - Typical IGBT Energy Loss vs.  $R_g$   
 $T_J = 125\text{ °C}$ ,  $V_{CC} = 600\text{ V}$ ,  $I_C = 80\text{ A}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\ \mu\text{H}$

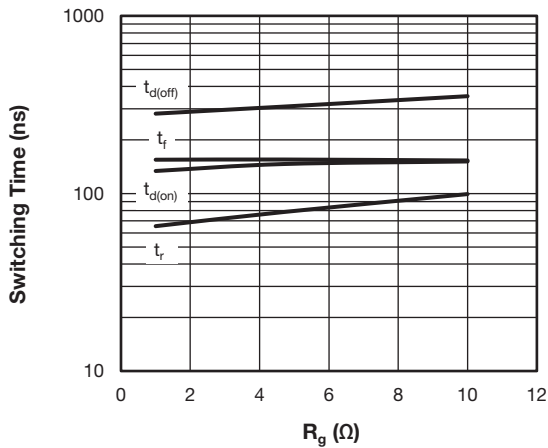


Fig. 13 - Typical IGBT Switching Time vs.  $R_g$   
 $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $I_C = 80\text{ A}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\ \mu\text{H}$

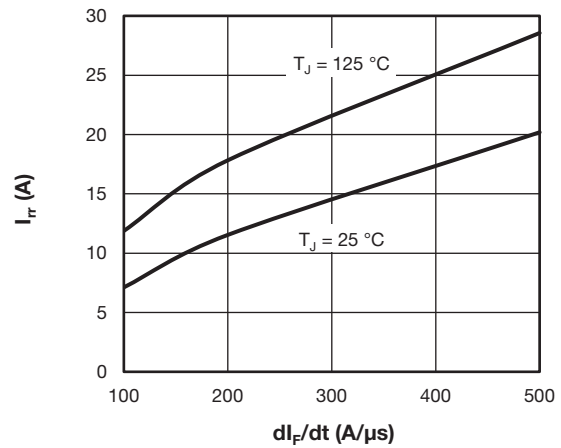


Fig. 15 - Typical Diode Reverse Recovery Current vs.  $di/dt$   
 $V_{rr} = 400\text{ V}$ ,  $I_F = 50\text{ A}$

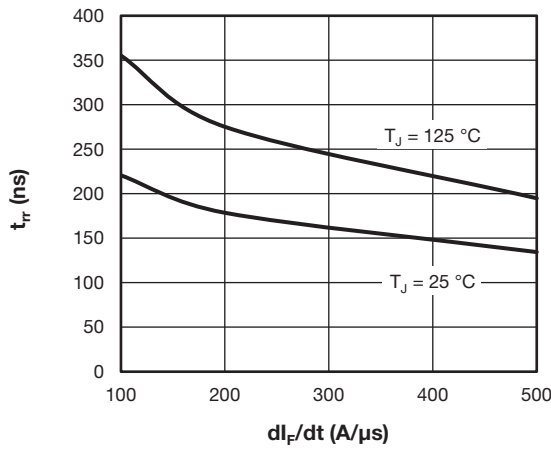


Fig. 14 - Typical Diode Reverse Recovery Time vs.  $di/dt$   
 $V_{rr} = 400\text{ V}$ ,  $I_F = 50\text{ A}$

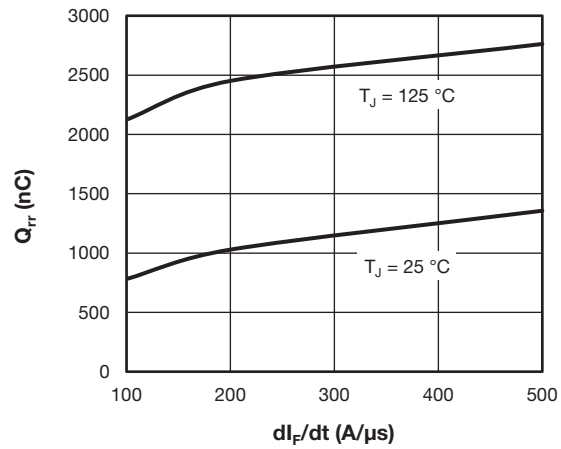


Fig. 16 - Typical Diode Reverse Recovery Charge vs.  $di/dt$   
 $V_{rr} = 400\text{ V}$ ,  $I_F = 50\text{ A}$

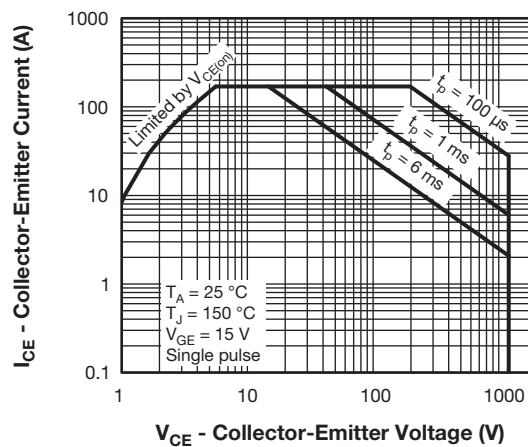


Fig. 17 - IGBT Safe Operating Area

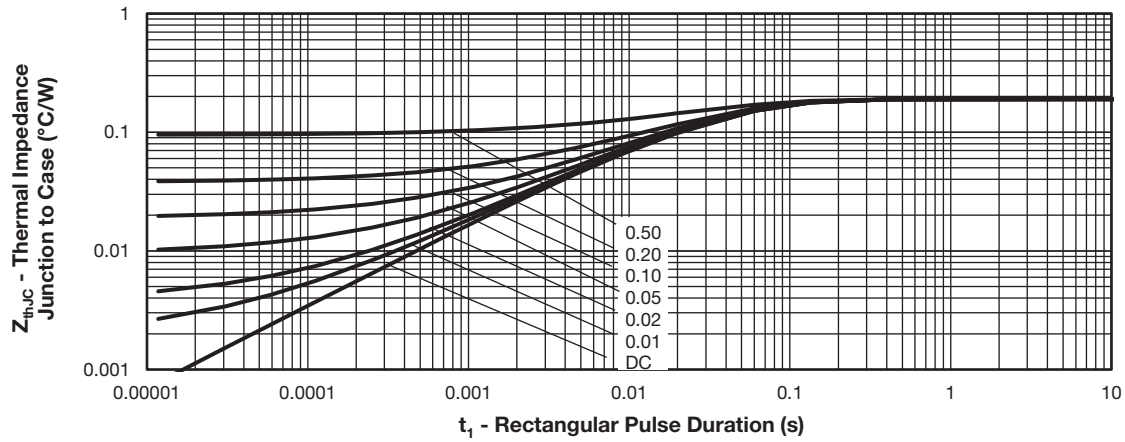


Fig. 18 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (IGBT)

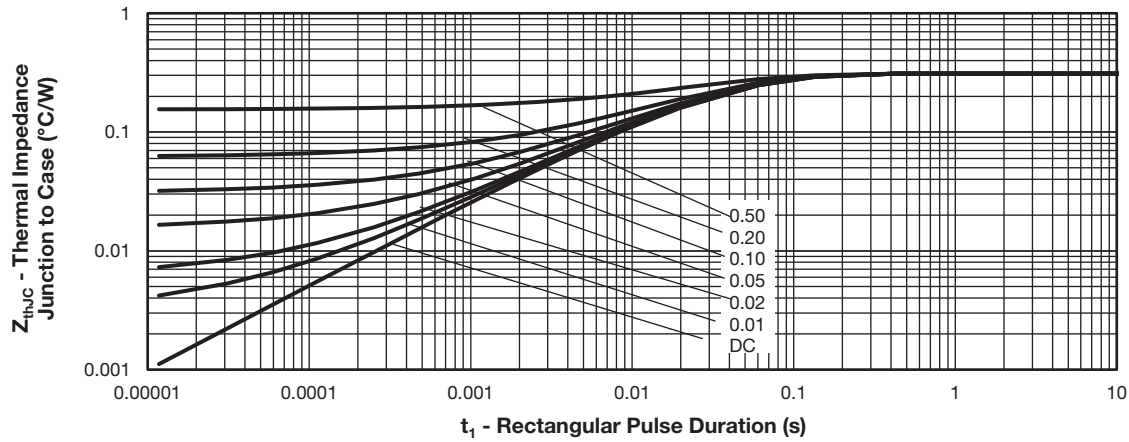


Fig. 19 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (Diode)

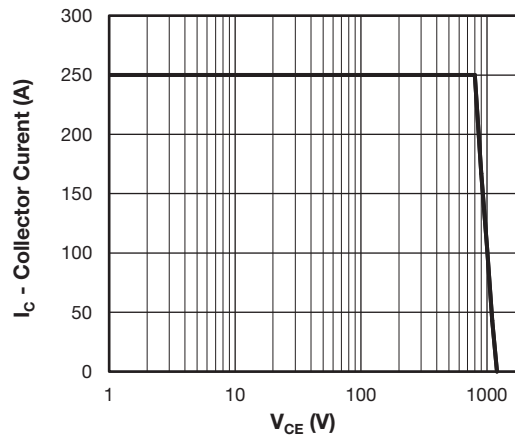
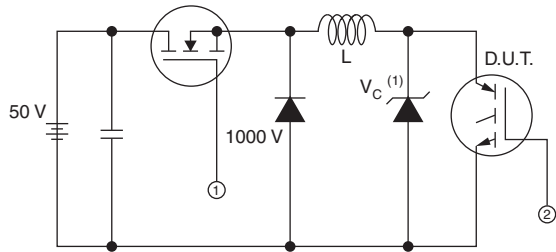


Fig. 20 - IGBT Reverse Bias SOA  
 $V_{GE} = 15\text{ V}$ ,  $T_J = 150\text{ °C}$



**Note:**

<sup>(1)</sup> Driver same type as D.U.T.;  $V_C = 80\%$  of  $V_{CE\ max}$ .  
Due to the 50 V power supply, pulse width, and inductor will increase to obtain  $I_D$

Fig. 21 - Clamped Inductive Load Test Circuit

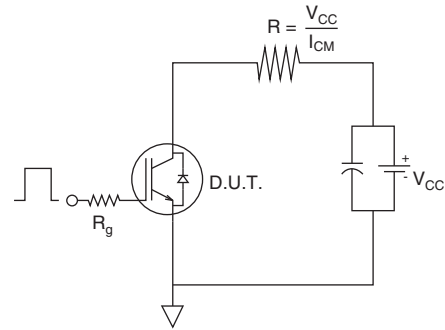


Fig. 22 - Pulsed Collector Current Test Circuit

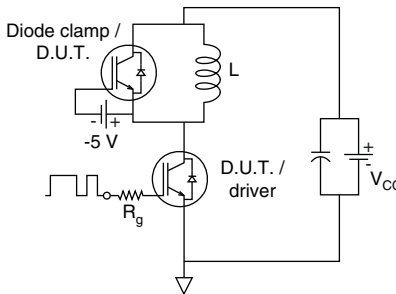


Fig. 23 - Switching Loss Test Circuit

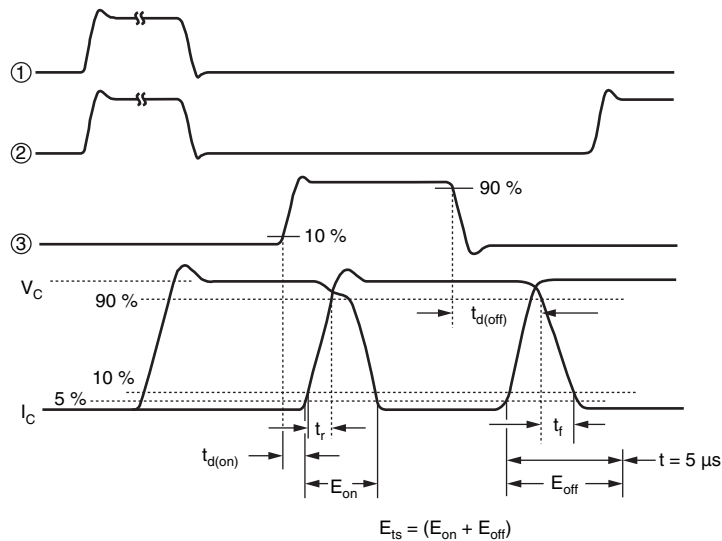


Fig. 24 - Switching Loss Waveforms Test Circuit

## ORDERING INFORMATION TABLE

Device code	<b>VS-</b>	<b>G</b>	<b>T</b>	<b>80</b>	<b>D</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** - Trench IGBT technology
- 4** - Current rating (80 = 80 A)
- 5** - Circuit configuration (D = single switch with antiparallel diode)
- 6** - Package indicator (A = SOT-227)
- 7** - Voltage rating (120 = 1200 V)
- 8** - Speed / type (U = ultrafast)

CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Single switch with AP diode	D	 

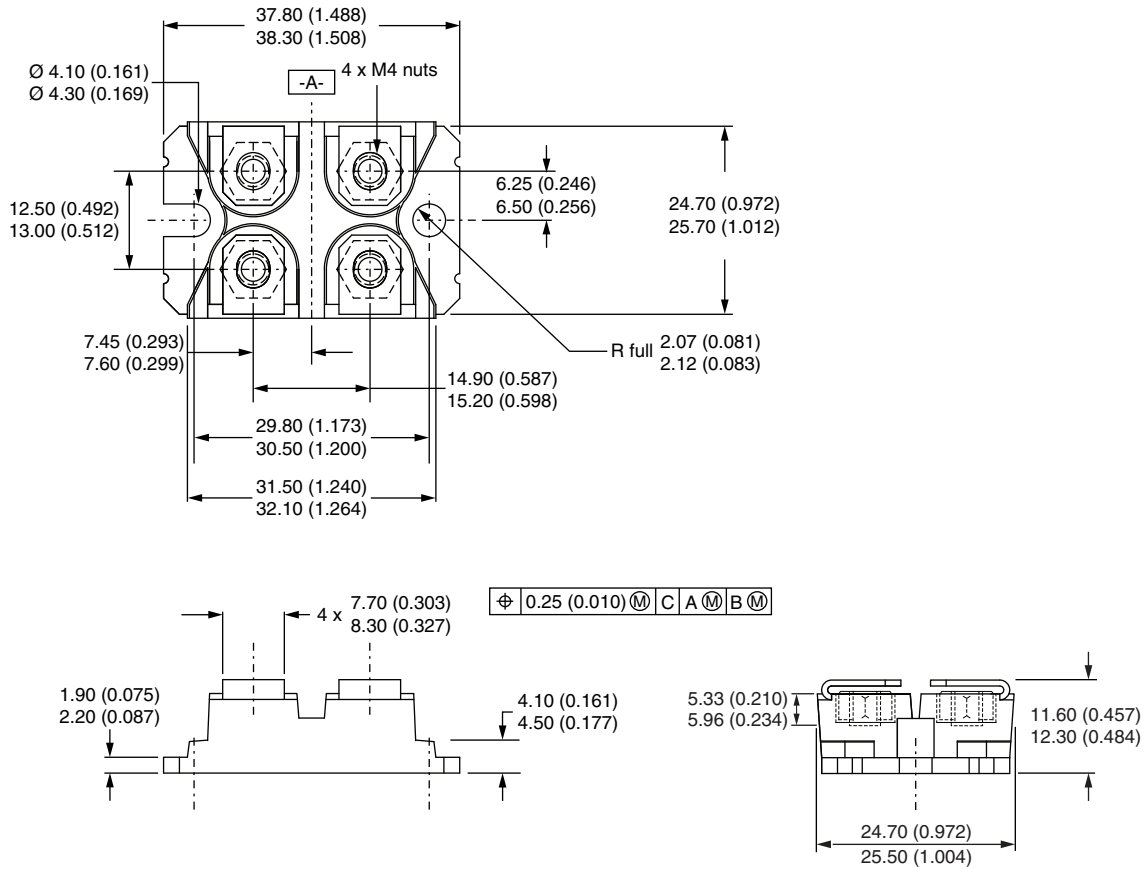
LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95423">www.vishay.com/doc?95423</a>
Packaging information	<a href="http://www.vishay.com/doc?95425">www.vishay.com/doc?95425</a>





## SOT-227 Generation 2

**DIMENSIONS** in millimeters (inches)



**Note**

- Controlling dimension: millimeter



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