

Insulated Gate Bipolar Transistor (Trench IGBT), 80 A



SOT-227

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

FEATURES

- Trench IGBT technology
- Positive $V_{CE(on)}$ temperature coefficient
- Square RBSOA
- 10 μ s short circuit capability
- HEXFRED® low Q_{rr} , low switching energy
- T_J maximum = 150 °C
- Fully isolated package
- Very low internal inductance (≤ 5 nH typical)
- Industry standard outline
- UL approved file E78996 
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

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

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V_{CES}		1200	V
Continuous collector current	I_C	$T_C = 25\text{ °C}$	139	A
		$T_C = 90\text{ °C}$	93	
Pulsed collector current	I_{CM}		170	
Clamped inductive load current	I_{LM}		250	
Diode continuous forward current	I_F	$T_C = 25\text{ °C}$	98	
		$T_C = 90\text{ °C}$	61	
Single pulse forward current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, $T_J = 25\text{ °C}$	350	
Gate to emitter voltage	V_{GE}		± 20	V
Power dissipation, IGBT	P_D	$T_C = 25\text{ °C}$	658	W
		$T_C = 90\text{ °C}$	316	
Power dissipation, diode	P_D	$T_C = 25\text{ °C}$	403	
		$T_C = 90\text{ °C}$	194	
Isolation voltage	V_{ISOL}	Any terminal to case, $t = 1\text{ min}$	2500	V

**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	$V_{BR(CE)}$	$V_{GE} = 0\text{ V}$, $I_C = 2.6\text{ mA}$	1200	-	-	
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}$, $I_C = 80\text{ A}$	-	2.0	2.55	V
		$V_{GE} = 15\text{ V}$, $I_C = 80\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	2.4	-	
		$V_{GE} = 15\text{ V}$, $I_C = 80\text{ A}$, $T_J = 150\text{ }^{\circ}\text{C}$	-	2.5	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 2.6\text{ mA}$	4.75	5.7	7.0	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$, $I_C = 2.6\text{ mA}$ ($25\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$)	-	-12	-	mV/ $^{\circ}\text{C}$
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$	-	1.0	100	μA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	0.9	-	mA
Forward voltage drop	V_{FM}	$I_F = 80\text{ A}$, $V_{GE} = 0\text{ V}$	-	2.9	3.5	V
		$I_F = 80\text{ A}$, $V_{GE} = 0\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	3.1	-	
		$I_F = 80\text{ A}$, $V_{GE} = 0\text{ V}$, $T_J = 150\text{ }^{\circ}\text{C}$	-	3.1	-	
Gate to emitter leakage current	I_{GES}	$V_{GE} = \pm 20\text{ V}$	-	-	± 220	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	$V_{GE} = -15\text{ V}$, $V_{GE} = \pm 15\text{ V}$	-	570	-	
Input capacitance	C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$	-	4400	-	pF
Reverse transfer capacitance	C_{res}		-	235	-	
Turn-on switching loss	E_{on}	$I_C = 80\text{ A}$, $V_{CC} = 600\text{ V}$, $V_{GE} = 15\text{ V}$, $R_g = 1.0\text{ }\Omega$, $L = 500\text{ }\mu\text{H}$, $T_J = 25\text{ }^{\circ}\text{C}$	-	3.0	-	mJ
Turn-off switching loss	E_{off}		-	3.2	-	
Total switching loss	E_{tot}		-	6.2	-	
Turn-on switching loss	E_{on}	$I_C = 80\text{ A}$, $V_{CC} = 600\text{ V}$, $V_{GE} = 15\text{ V}$, $R_g = 1.0\text{ }\Omega$, $L = 500\text{ }\mu\text{H}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	3.9	-	mJ
Turn-off switching loss	E_{off}		-	5.5	-	
Total switching loss	E_{tot}		-	9.4	-	
Turn-on delay time	$t_{d(on)}$		-	134	-	ns
Rise time	t_r		-	65	-	
Turn-off delay time	$t_{d(off)}$		-	281	-	
Fall time	t_f		-	155	-	
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^{\circ}\text{C}$, $I_C = 250\text{ A}$, $R_g = 1.0\text{ }\Omega$, $V_{GE} = 15\text{ V}$ to 0 V , $V_{CC} = 800\text{ V}$, $V_P = 1200\text{ V}$, $L = 500\text{ }\mu\text{H}$	Fullsquare			
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}$, $di_F/dt = 200\text{ A}/\mu\text{s}$, $V_R = 400\text{ V}$	-	179	-	ns
Diode peak reverse current	I_{rr}		-	11.5	-	A
Diode recovery charge	Q_{rr}		-	1029	-	nC
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}$, $di_F/dt = 200\text{ A}/\mu\text{s}$, $V_{rr} = 400\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	275	-	ns
Diode peak reverse current	I_{rr}		-	17.8	-	A
Diode recovery charge	Q_{rr}		-	2451	-	nC
Short circuit safe operating area	SCSOA	$V_{GE} = 15\text{ V}$, $V_{CC} = 800\text{ V}$, $V_{CE\text{ max.}} = 1200\text{ V}$, $T_J = 150\text{ }^{\circ}\text{C}$	10			μs

THERMAL AND MECHANICAL SPECIFICATIONS

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	T_J , T_{Stg}		-40	-	150	$^{\circ}\text{C}$
Junction to case	IGBT	R_{thJC}	-	-	0.19	$^{\circ}\text{C}/\text{W}$
	Diode		-	-	0.31	
Case to heatsink	R_{thCS}	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				

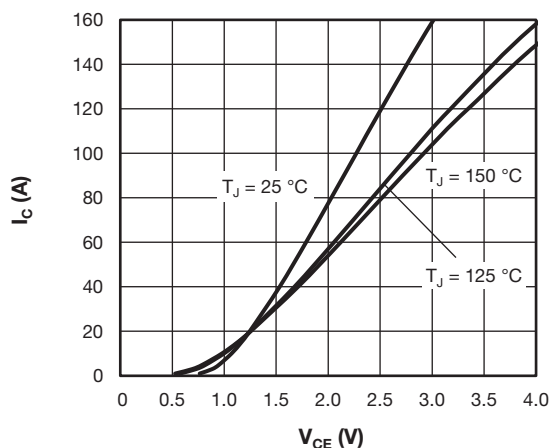


Fig. 1 - Typical IGBT Output Characteristics, $V_{GE} = 15 \text{ V}$

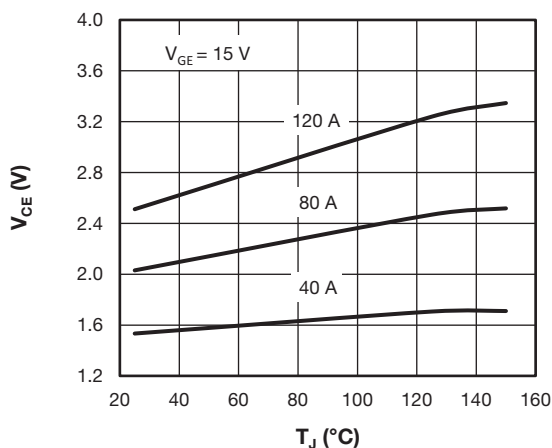


Fig. 4 - Collector to Emitter Voltage vs. Junction Temperature

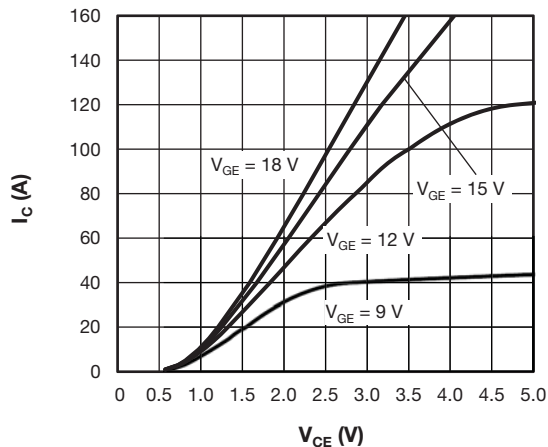


Fig. 2 - Typical IGBT Output Characteristics, $T_J = 125 \text{ }^{\circ}\text{C}$

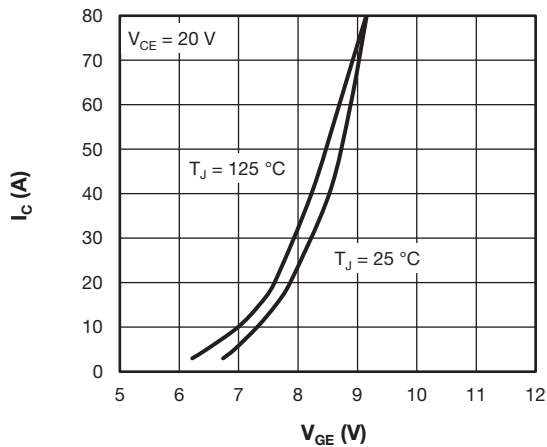


Fig. 5 - Typical IGBT Transfer Characteristics

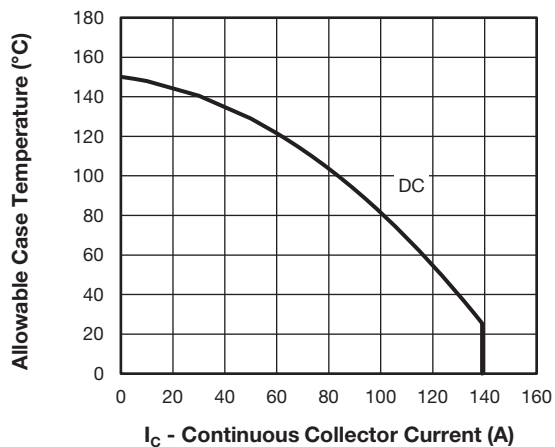


Fig. 3 - Maximum IGBT Continuous Collector Current vs. Case Temperature

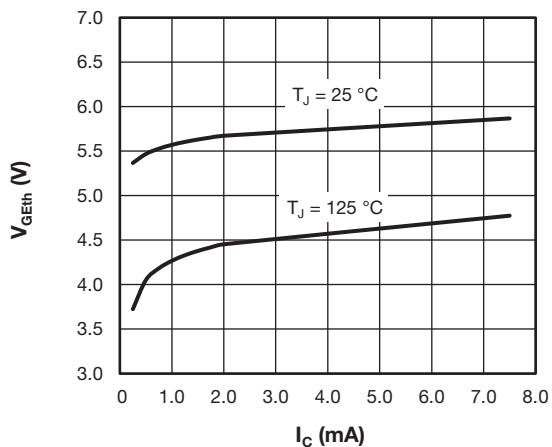


Fig. 6 - Typical IGBT Gate Threshold Voltage

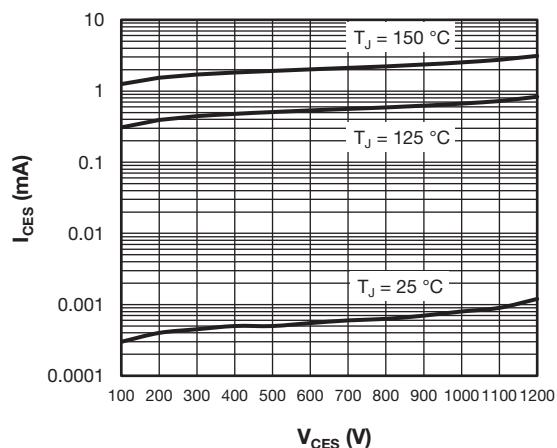


Fig. 7 - Typical IGBT Zero Gate Voltage Collector Current

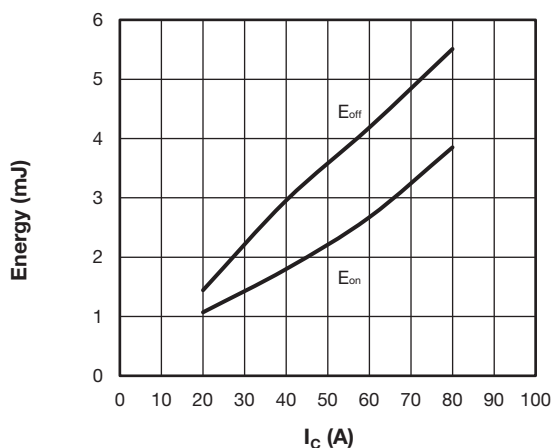
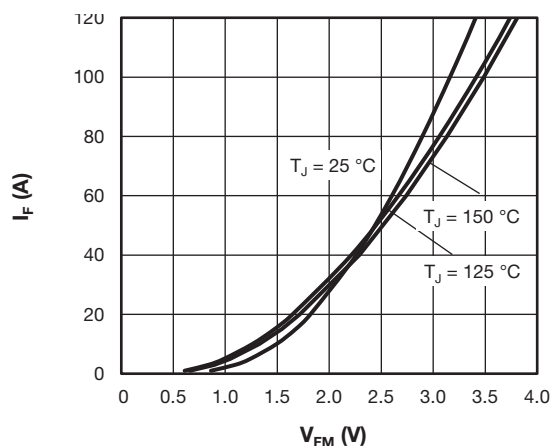

Fig. 10 - Typical IGBT Energy Loss vs I_C
 $T_J = 125\text{ °C}$, $V_{CC} = 600\text{ V}$, $R_g = 1.0\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$


Fig. 8 - Typical Diode Forward Characteristics

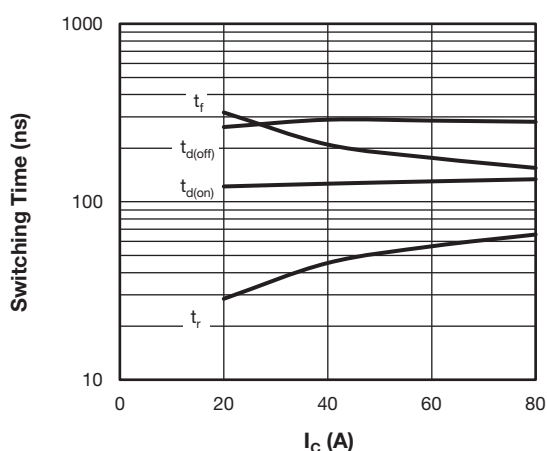
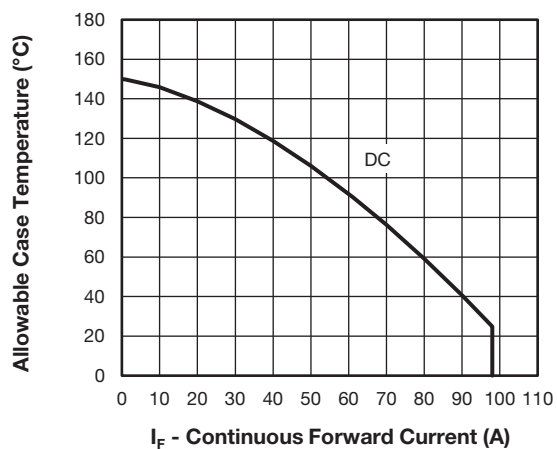
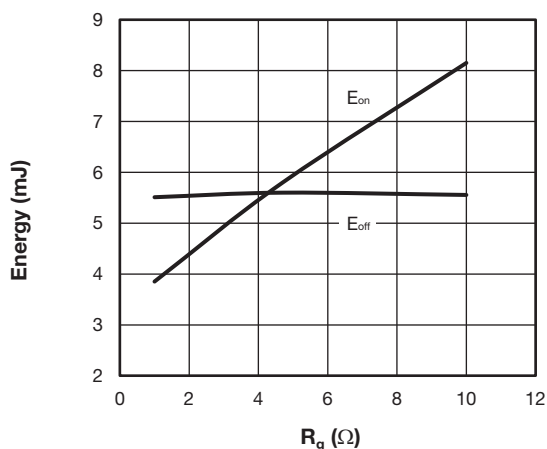

Fig. 11 - Typical IGBT Switching Time vs. I_C
 $T_J = 125\text{ °C}$, $V_{CC} = 600\text{ V}$, $R_g = 1.0\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$


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


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

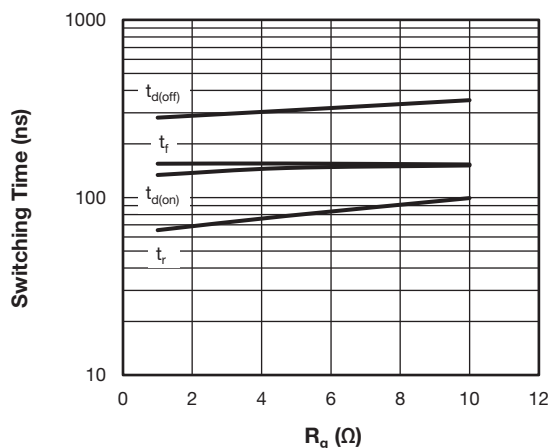


Fig. 13 - Typical IGBT Switching Time vs. R_g
 $T_J = 125^\circ\text{C}$, $V_{CC} = 600\text{ V}$, $I_C = 80\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$

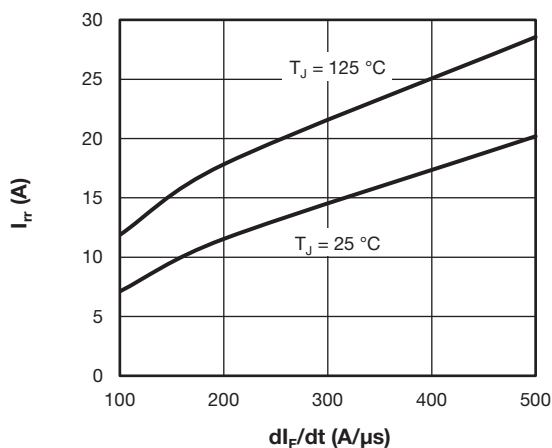


Fig. 15 - Typical Diode Reverse Recovery Current vs. di_F/dt
 $V_{rr} = 400\text{ V}$, $I_F = 50\text{ A}$

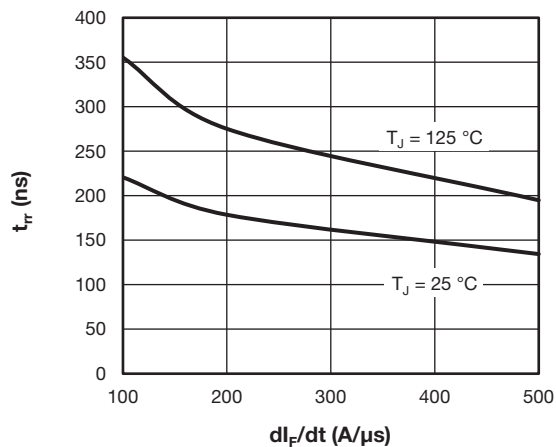


Fig. 14 - Typical Diode Reverse Recovery Time vs. di_F/dt
 $V_{rr} = 400\text{ V}$, $I_F = 50\text{ A}$

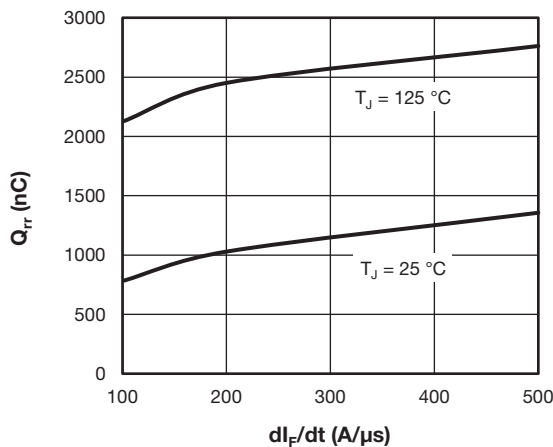


Fig. 16 - Typical Diode Reverse Recovery Charge vs. di_F/dt
 $V_{rr} = 400\text{ V}$, $I_F = 50\text{ A}$

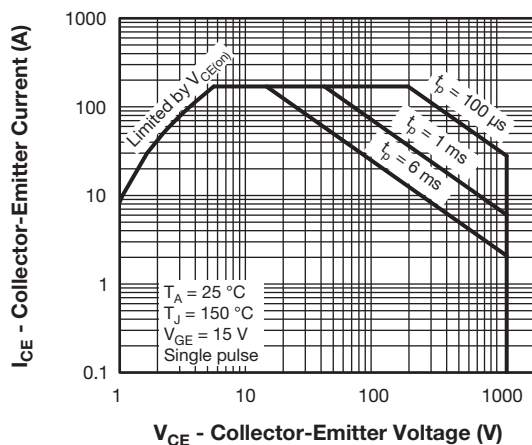


Fig. 17 - IGBT Safe Operating Area

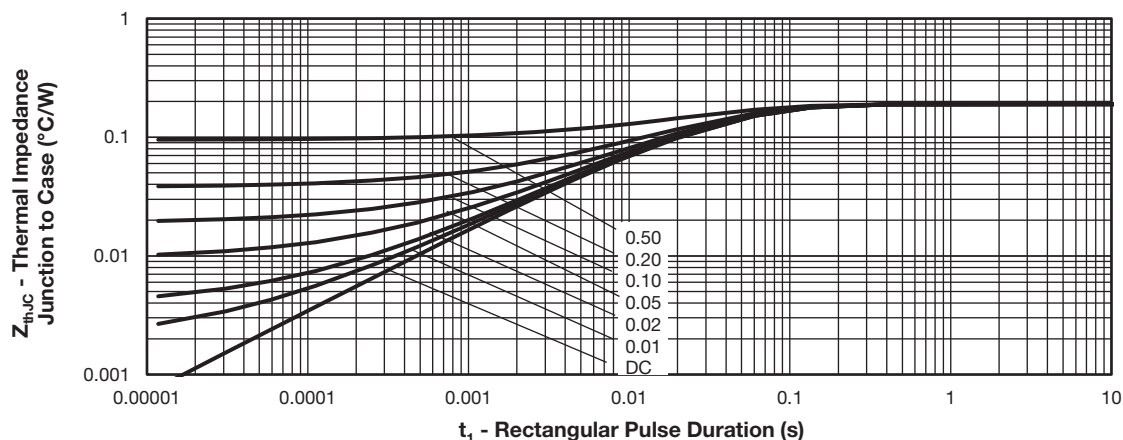


Fig. 18 - Maximum Thermal Impedance Z_{thJC} Characteristics (IGBT)

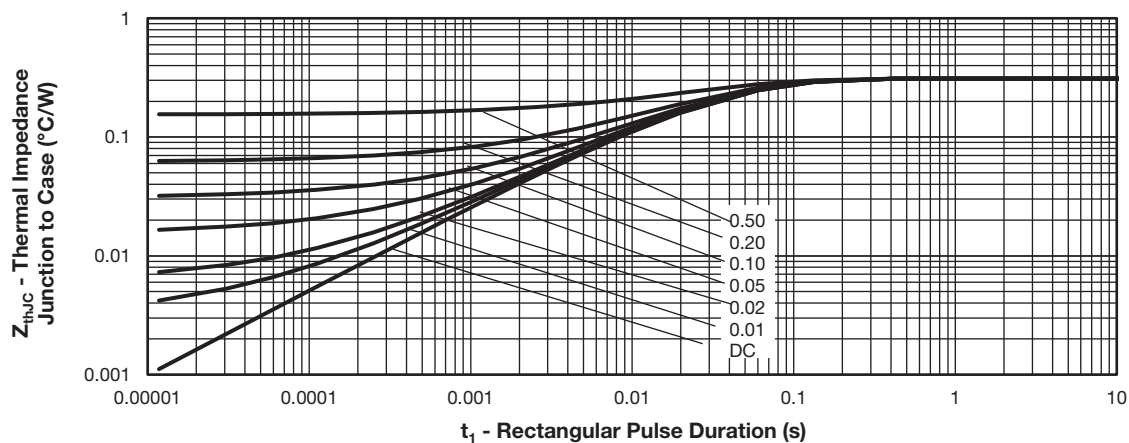


Fig. 19 - Maximum Thermal Impedance Z_{thJC} Characteristics (Diode)

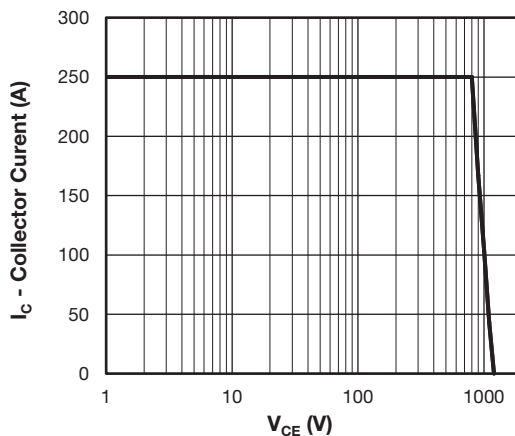
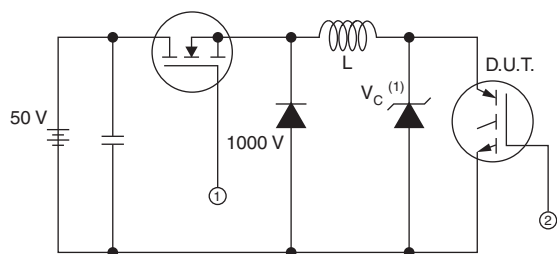


Fig. 20 - IGBT Reverse Bias SOA
 $V_{GE} = 15\text{ V}$, $T_J = 150\text{ }^{\circ}\text{C}$



Note:

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

Fig. 21 - Clamped Inductive Load Test Circuit

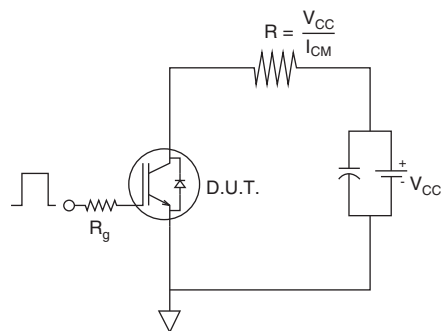


Fig. 22 - Pulsed Collector Current Test Circuit

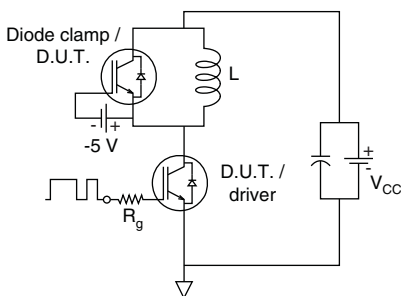


Fig. 23 - Switching Loss Test Circuit

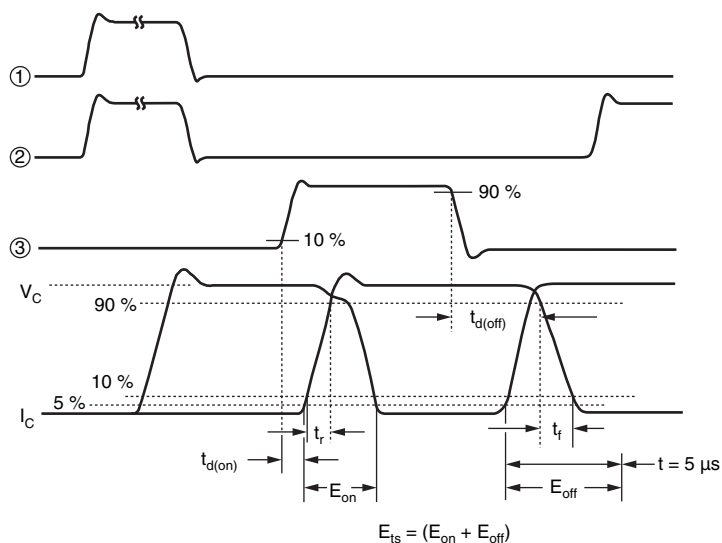
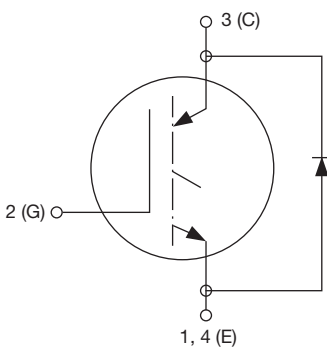
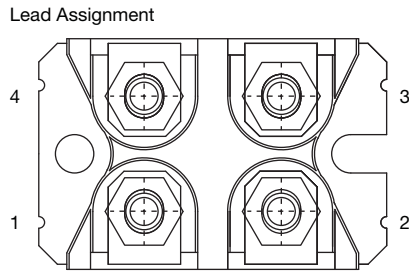


Fig. 24 - Switching Loss Waveforms Test Circuit

ORDERING INFORMATION TABLE

Device code	VS-	G	T	80	D	A	120	U
	1	2	3	4	5	6	7	8

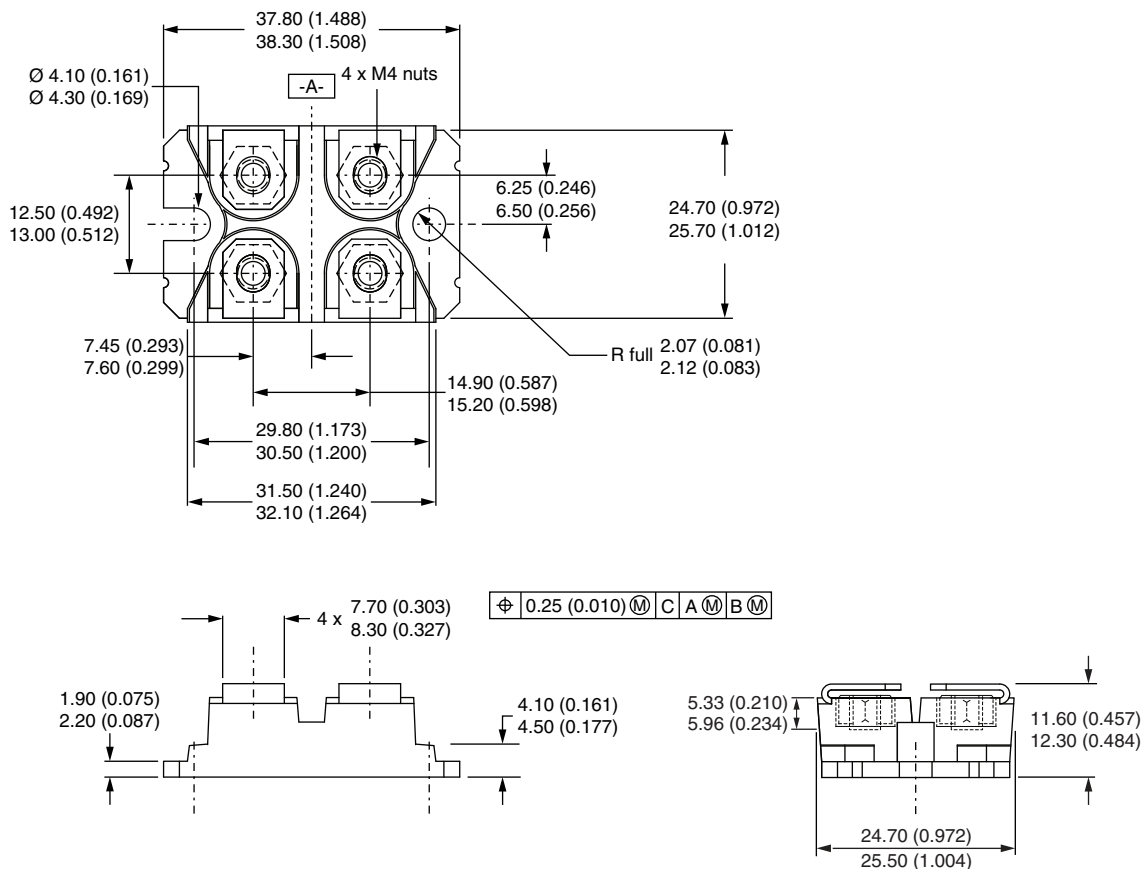
- | | | |
|----------|---|---|
| 1 | - | Vishay Semiconductors product |
| 2 | - | Insulated gate bipolar transistor (IGBT) |
| 3 | - | Trench IGBT technology |
| 4 | - | Current rating (80 = 80 A) |
| 5 | - | Circuit configuration (D = single switch with antiparallel diode) |
| 6 | - | Package indicator (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	www.vishay.com/doc?95423
Packaging information	www.vishay.com/doc?95425

SOT-227 Generation 2

DIMENSIONS in millimeters (inches)



Note

- Controlling dimension: millimeter



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