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Insulated Gate Bipolar Transistor (Ultrafast IGBT), 90 A


SOT-227

**RoHS
COMPLIANT**
FEATURES

- NPT Gen 5 IGBT technology
- Square RBSOA
- HEXFRED® low Q_{rr} , low switching energy
- Positive $V_{CE(on)}$ temperature coefficient
- 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

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

PRODUCT SUMMARY

V_{CES}	1200 V
I_C DC	90 A at 90 °C
$V_{CE(on)}$ typical at 75 A, 25 °C	3.3 V
Speed	8 kHz to 30 kHz
Package	SOT-227
Circuit	Single switch diode

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V_{CES}		1200	V
Continuous collector current	I_C ⁽¹⁾	$T_C = 25$ °C	149	A
		$T_C = 90$ °C	90	
Pulsed collector current	I_{CM}		200	
Clamped inductive load current	I_{LM}		200	
Diode continuous forward current	I_F	$T_C = 25$ °C	76	V
		$T_C = 90$ °C	46	
Gate to emitter voltage	V_{GE}		± 20	
Power dissipation, IGBT	P_D	$T_C = 25$ °C	862	W
		$T_C = 90$ °C	414	
Power dissipation, diode	P_D	$T_C = 25$ °C	357	
		$T_C = 90$ °C	171	
Isolation voltage	V_{ISOL}	Any terminal to case, $t = 1$ min	2500	V

Note

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



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	$V_{BR(CES)}$	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$	1200	-	-	
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 75\text{ A}$	-	3.3	3.8	V
		$V_{GE} = 15\text{ V}, I_C = 75\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	3.6	3.9	
		$V_{GE} = 15\text{ V}, I_C = 75\text{ A}, T_J = 150\text{ }^\circ\text{C}$	-	3.7	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$	4	5	6	
		$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}, T_J = 125\text{ }^\circ\text{C}$	-	3.2	-	
Temperature coefficient of threshold voltage	$V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$ ($25\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$)	-	-12	-	mV/°C
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$	-	7	250	μA
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	1.4	10	mA
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	6.5	20	
Forward voltage drop, diode	V_{FM}	$V_{GE} = 0\text{ V}, I_F = 75\text{ A}$	-	3.4	5.0	V
		$V_{GE} = 0\text{ V}, I_F = 75\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	3.2	5.2	
		$V_{GE} = 0\text{ V}, I_F = 75\text{ A}, T_J = 150\text{ }^\circ\text{C}$	-	3.05	-	
Gate to emitter leakage current	I_{GES}	$V_{GE} = \pm 20\text{ V}$	-	-	± 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	$I_C = 50\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}$	-	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	-	
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				
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}, dI_F/dt = 200\text{ A}/\mu\text{s}, V_R = 200\text{ V}$	-	140	-	ns	
Diode peak reverse current	I_{rr}		-	13	-	A	
Diode recovery charge	Q_{rr}		-	860	-	nC	
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}, dI_F/dt = 200\text{ A}/\mu\text{s}, V_R = 200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	210	-	ns	
Diode peak reverse current	I_{rr}		-	19	-	A	
Diode recovery charge	Q_{rr}		-	1880	-	nC	



THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	T_J, T_{Stg}		-40	-	150	°C
Junction to case	IGBT		-	-	0.145	°C/W
	Diode		-	-	0.35	
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				

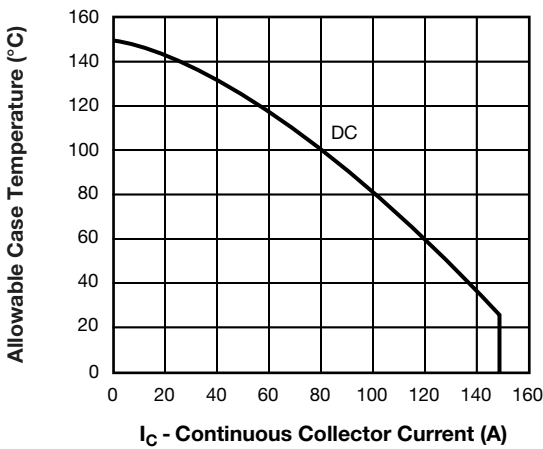


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

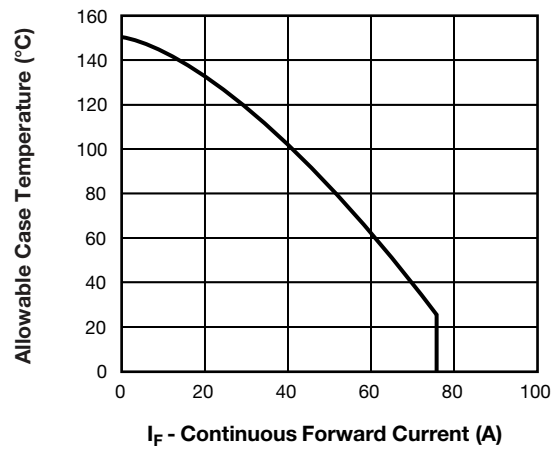


Fig. 3 - Allowable Forward Current vs. Case Temperature Diode Leg

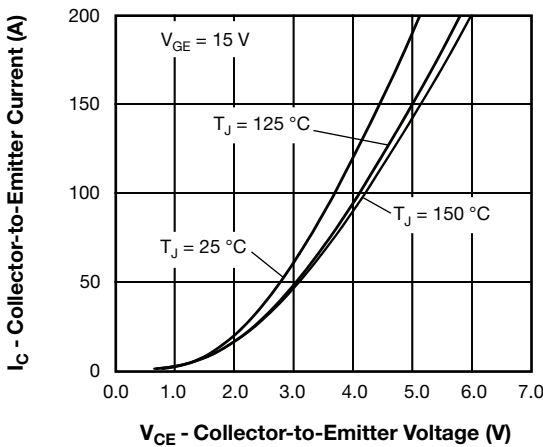


Fig. 2 - Typical Collector to Emitter Current Output Characteristics of IGBT

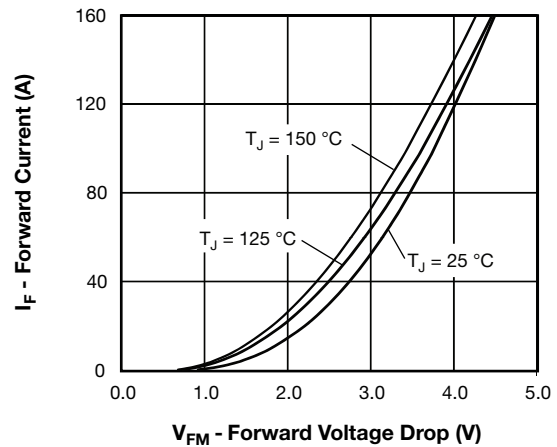


Fig. 4 - Typical Diode Forward Voltage Drop Characteristics

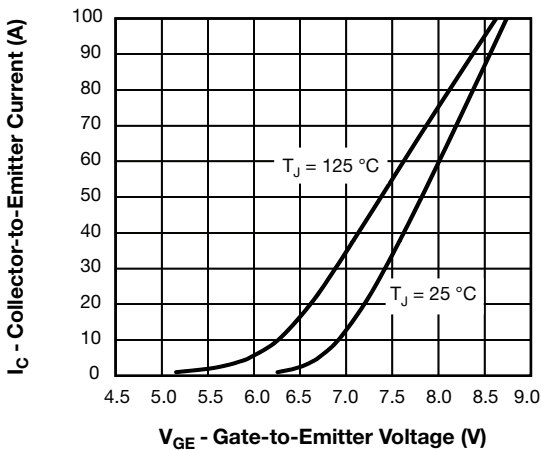


Fig. 5 - Typical IGBT Transfer Characteristics

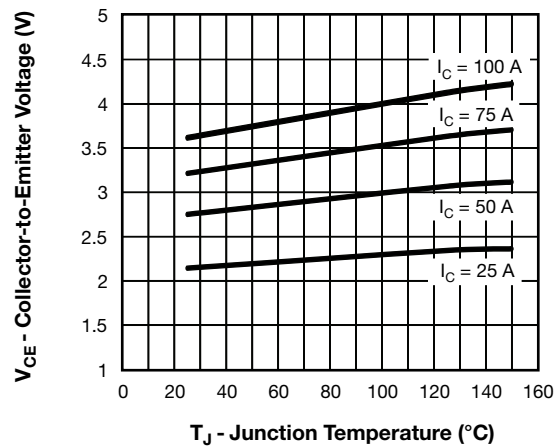


Fig. 8 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature, $V_{GE} = 15$ V

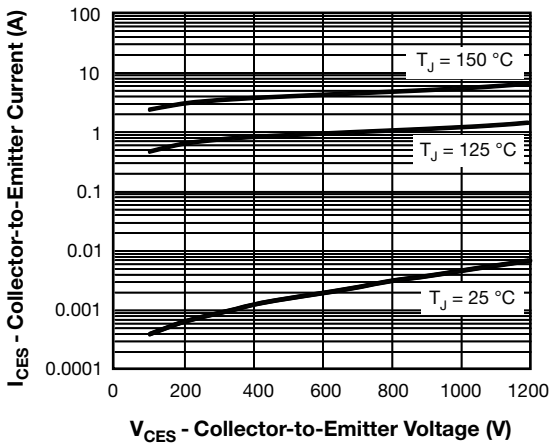


Fig. 6 - Typical IGBT Zero Gate Voltage Collector Current

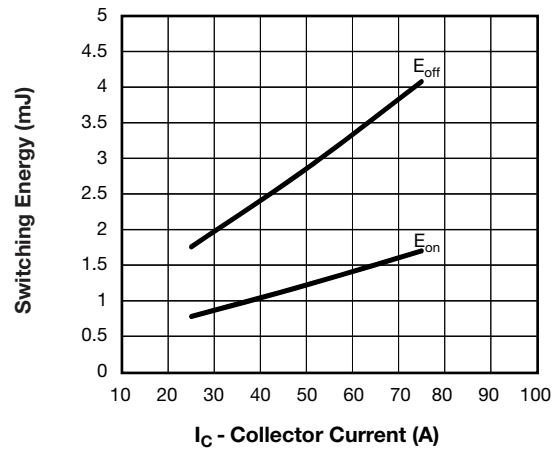


Fig. 9 - Typical IGBT Energy Losses vs. I_C
 $T_J = 125$ °C, $L = 500$ μ H, $V_{CC} = 600$ V,
 $R_g = 5$ Ω , $V_{GE} = 15$ V, Diode used HFA16PB120

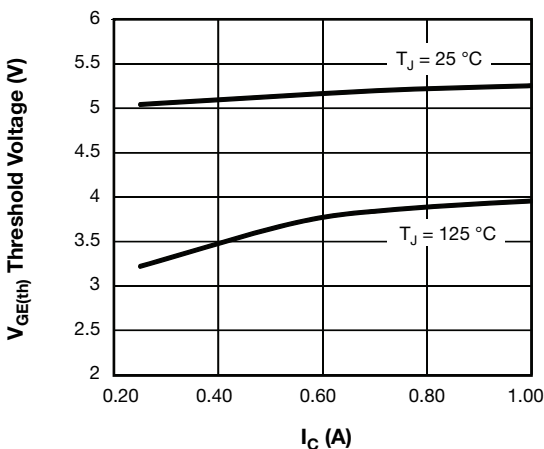


Fig. 7 - Typical IGBT Threshold Voltage

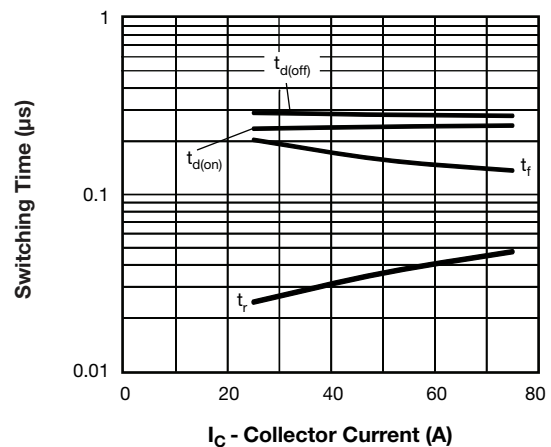


Fig. 10 - Typical IGBT Switching Time vs. I_C
 $T_J = 125$ °C, $L = 500$ μ H, $V_{CC} = 600$ V,
 $R_g = 5$ Ω , $V_{GE} = 15$ V, Diode used HFA16PB120

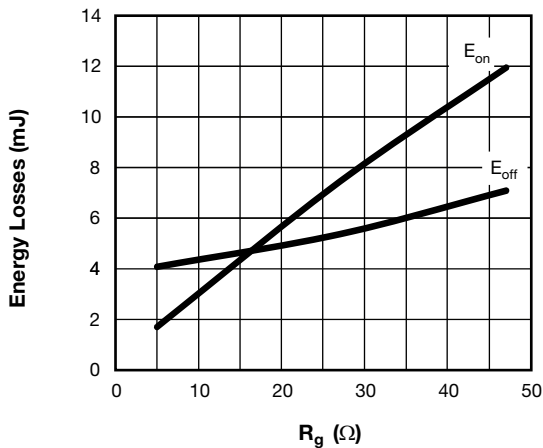


Fig. 11 - Typical IGBT Energy Loss vs. R_g ,
 $T_J = 125\text{ }^\circ\text{C}$, $I_C = 75\text{ A}$, $L = 500\text{ }\mu\text{H}$,
 $V_{CC} = 600\text{ V}$, $V_{GE} = 15\text{ V}$, Diode used HFA16PB120

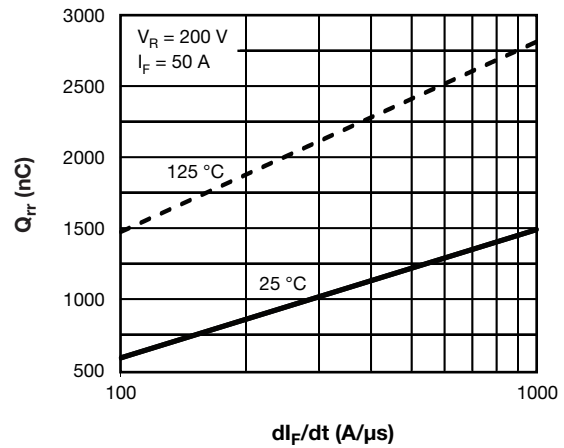


Fig. 14 - Stored Charge vs. di_F/dt of Diode

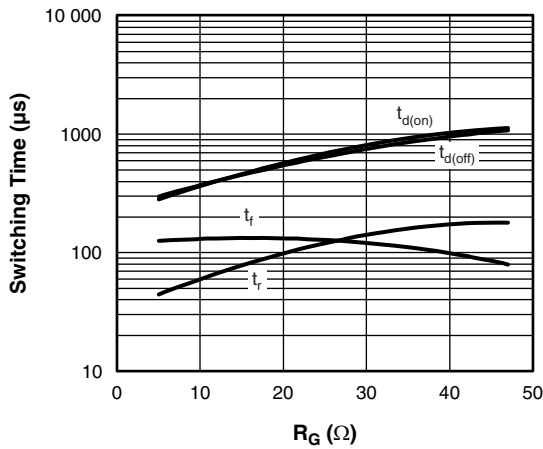


Fig. 12 - Typical IGBT Switching Time vs. R_g ,
 $T_J = 125\text{ }^\circ\text{C}$, $L = 500\text{ }\mu\text{H}$, $V_{CC} = 600\text{ V}$,
 $R_g = 5\text{ }\Omega$, $V_{GE} = 15\text{ V}$

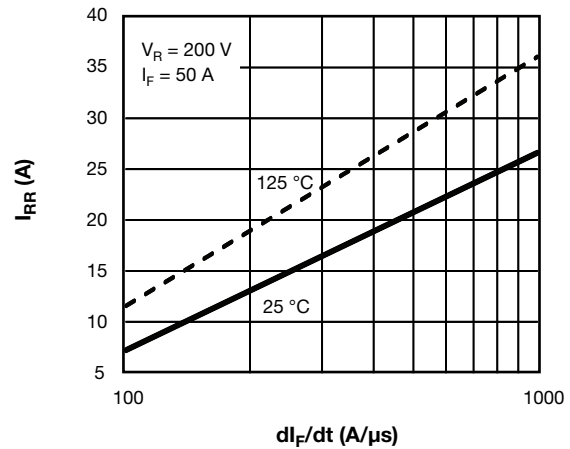


Fig. 15 - Typical Reverse Recovery Current vs. di_F/dt of Diode

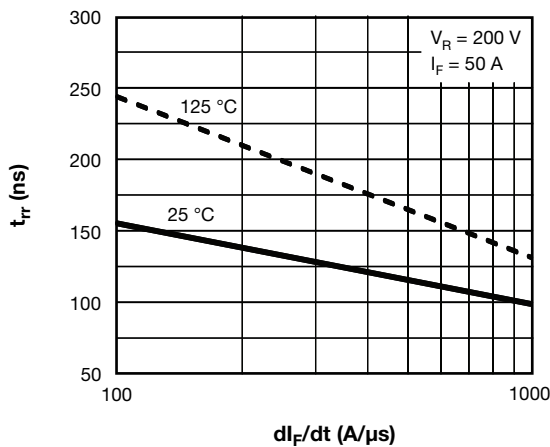


Fig. 13 - Typical t_{rr} Diode vs. di_F/dt
 $V_{RR} = 200\text{ V}$, $I_F = 50\text{ A}$

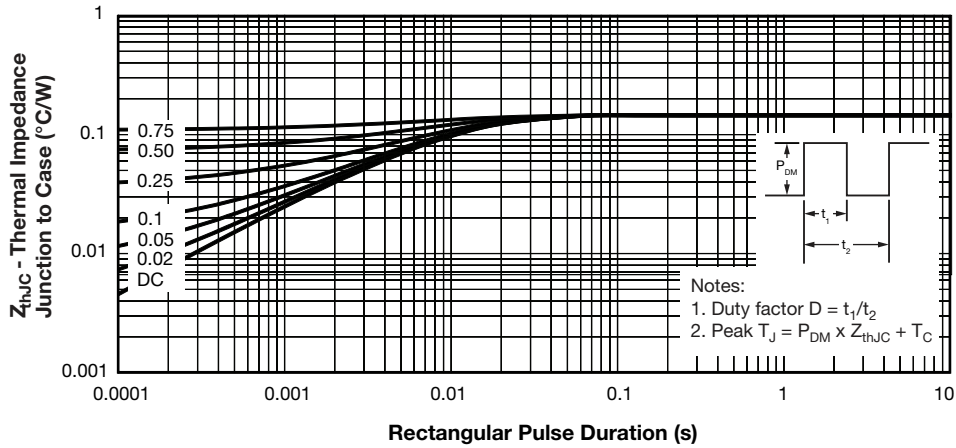


Fig. 16 - Maximum Thermal Impedance Z_{thJC} Characteristics (IGBT)

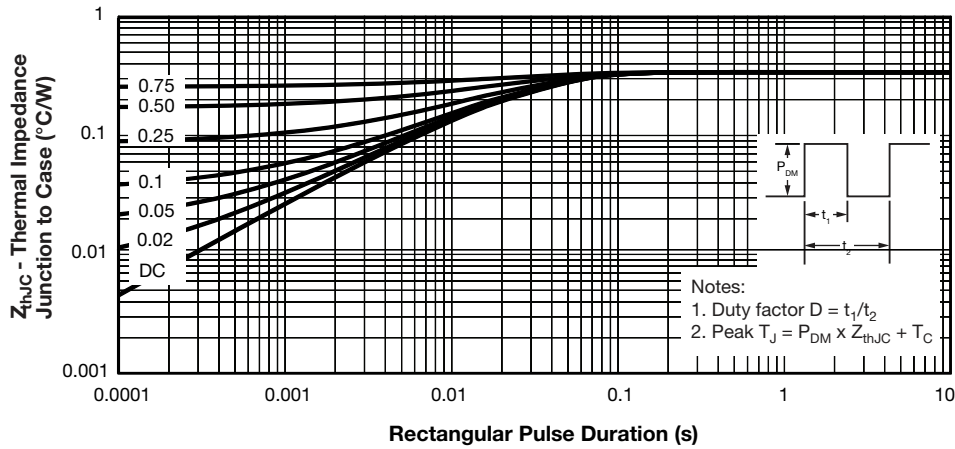


Fig. 17 - Maximum Thermal Impedance Z_{thJC} Characteristics (Diode)

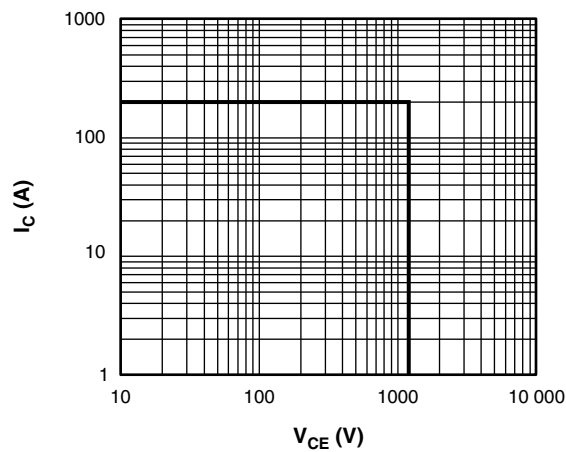


Fig. 18 - IGBT Reverse Bias SOA, $T_J = 150\text{ }^\circ\text{C}$, $V_{GE} = 15\text{ V}$,

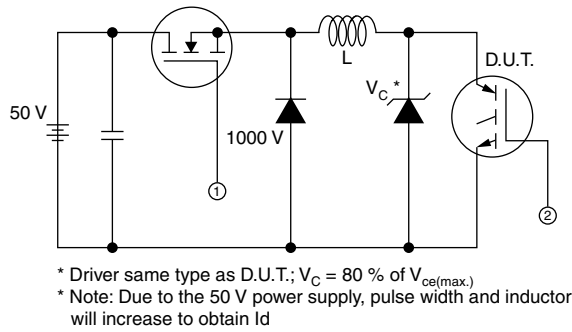


Fig. 19a - Clamped Inductive Load Test Circuit

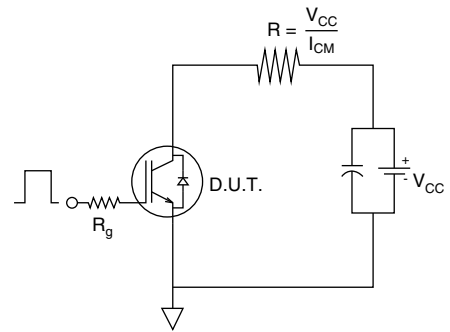


Fig. 19b - Pulsed Collector Current Test Circuit

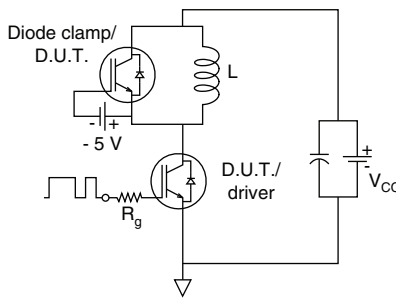


Fig. 20a - Switching Loss Test Circuit

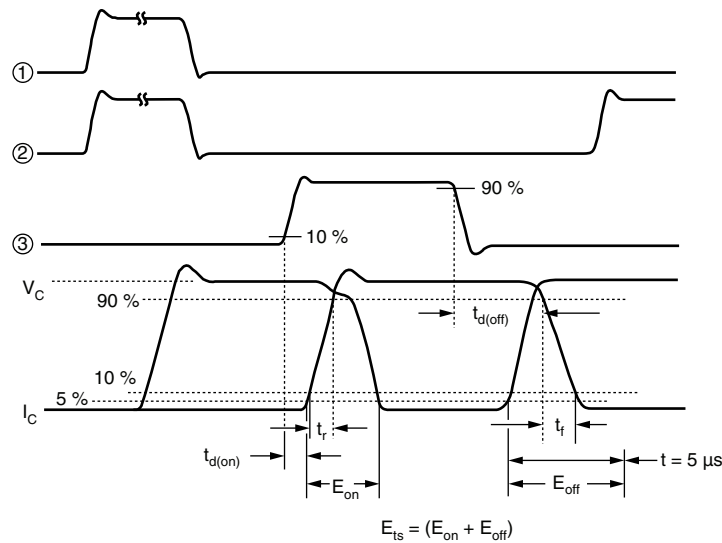


Fig. 20b - Switching Loss Waveforms Test Circuit

ORDERING INFORMATION TABLE

Device code	VS-	G	B	90	D	A	120	U
	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 (D = Single switch with antiparallel diode)
- 6** - Package indicator (A = SOT-227)
- 7** - Voltage rating (120 = 1200 V)
- 8** - Speed/type (U = Ultrafast IGBT)

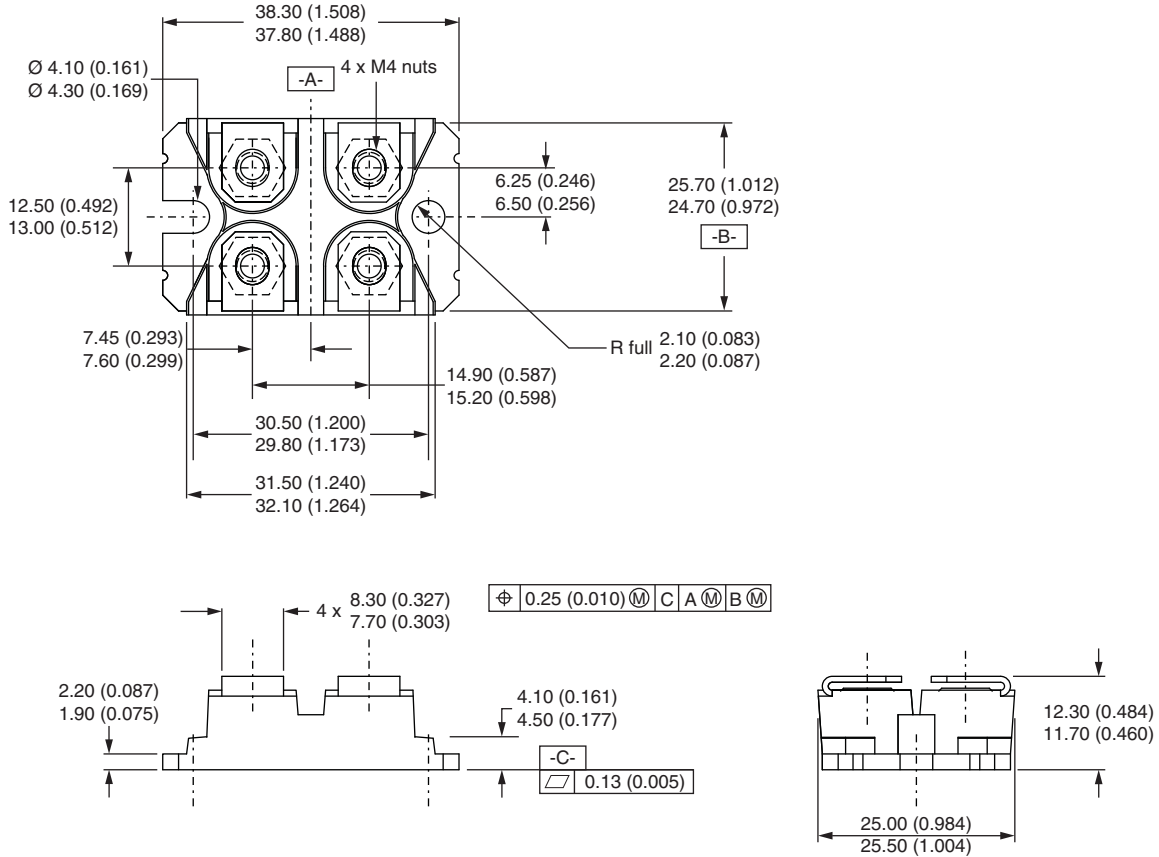
CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Single switch with antiparallel diode	D	<div style="display: inline-block; vertical-align: top; margin-left: 20px;"> <p>Lead Assignment</p> </div>

LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95423
Packaging information	www.vishay.com/doc?95425



SOT-227 Generation II

DIMENSIONS in millimeters (inches)



Note

- Controlling dimension: millimeter



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