

Insulated Gate Bipolar Transistor (Trench IGBT), 175 A



SOT-227

PRODUCT SUMMARY	
V_{CES}	1200 V
$I_{C(DC)}$	175 A at 90 °C ⁽¹⁾
$V_{CE(on)}$ typical at 100 A, 25 °C	1.73 V
$I_{F(DC)}$	32 A at 90 °C
Speed	8 kHz to 30 kHz
Package	SOT-227
Circuit	Single switch diode

Note

⁽¹⁾ Maximum collector current admitted is 100 A, to not exceed the maximum temperature of terminals

FEATURES

- Trench IGBT technology with positive temperature coefficient
- Square RBSOA
- 10 μ s short circuit capability
- HEXFRED® antiparallel diodes with ultrasoft reverse recovery
- 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
- Very low $V_{CE(on)}$
- 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 ⁽¹⁾	$T_C = 25$ °C	288	A
		$T_C = 90$ °C	175	
Pulsed collector current	I_{CM}		450	
Clamped inductive load current	I_{LM}		450	
Diode continuous forward current	I_F	$T_C = 25$ °C	54	
		$T_C = 90$ °C	32	
Gate to emitter voltage	V_{GE}		± 20	V
Power dissipation, IGBT	P_D	$T_C = 25$ °C	1087	W
		$T_C = 90$ °C	522	
Power dissipation, diode	P_D	$T_C = 25$ °C	219	
		$T_C = 90$ °C	105	
Isolation voltage	V_{ISOL}	Any terminal to case, $t = 1$ min	2500	V

Note

⁽¹⁾ Maximum collector current admitted is 100 A, to do not 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	-	-	V	
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 100\text{ A}$	-	1.73	2.1		
		$V_{GE} = 15\text{ V}, I_C = 100\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	1.98	2.2		
		$V_{GE} = 15\text{ V}, I_C = 100\text{ A}, T_J = 150\text{ }^\circ\text{C}$	-	2.05	-		
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$	-	5	-		
		$V_{CE} = V_{GE}, I_C = 7.5\text{ mA}$	4.9	5.9	7.9		
		$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}, T_J = 125\text{ }^\circ\text{C}$	-	2.9	-		
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$ ($25\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$)	-	-17.6	-		mV/ $^\circ\text{C}$
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$	-	0.9	100		μA
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	0.85	10		mA
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	4	20		
Forward voltage drop, diode	V_{FM}	$I_F = 40\text{ A}, V_{GE} = 0\text{ V}$	-	3.12	3.44	V	
		$I_F = 40\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	3.15	3.47		
		$I_F = 40\text{ A}, V_{GE} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	3.25	-		
Gate to emitter leakage current	I_{GES}	$V_{GE} = \pm 20\text{ V}$	-	-	± 200	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	$I_C = 150\text{ A}$ ($t_p < 400\text{ }\mu\text{s}, D < 2\%$), $V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}$	-	830	-	nC		
Gate to emitter charge (turn-on)	Q_{ge}		-	180	-			
Gate to collector charge (turn-on)	Q_{gc}		-	380	-			
Turn-on switching loss	E_{on}	$I_C = 100\text{ A}, V_{CC} = 720\text{ V},$ $V_{GE} = 15\text{ V}, R_g = 2.2\text{ }\Omega,$ $L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$	-	4.8	-	mJ		
Turn-off switching loss	E_{off}		-	7.0	-			
Total switching loss	E_{tot}		-	11.8	-			
Turn-on delay time	$t_{d(on)}$		Energy losses include tail and diode recovery Diode used HFA16PB120	-	274	-	ns	
Rise time	t_r			-	67	-		
Turn-off delay time	$t_{d(off)}$			-	271	-		
Fall time	t_f			-	177	-		
Turn-on switching loss	E_{on}			$I_C = 100\text{ A}, V_{CC} = 720\text{ V},$ $V_{GE} = 15\text{ V}, R_g = 2.2\text{ }\Omega,$ $L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$	-	6.0	-	mJ
Turn-off switching loss	E_{off}				-	10.4	-	
Total switching loss	E_{tot}				-	16.4	-	
Turn-on delay time	$t_{d(on)}$	-			285	-	ns	
Rise time	t_r	-			75	-		
Turn-off delay time	$t_{d(off)}$	-			306	-		
Fall time	t_f	-	244	-				
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 450\text{ A}, R_g = 4.7\text{ }\Omega,$ $V_{GE} = 15\text{ V to } 0\text{ V}, V_{CC} = 600\text{ V},$ $V_P = 1200\text{ V}, L = 500\text{ }\mu\text{H}$	Fullsquare					
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}, dI_F/dt = 200\text{ A}/\mu\text{s}, V_R = 400\text{ V}$	-	164	-	ns		
Diode peak reverse current	I_{rr}		-	12	-	A		
Diode recovery charge	Q_{rr}		-	994	-	nC		
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}, dI_F/dt = 200\text{ A}/\mu\text{s},$ $V_R = 400\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	230	-	ns		
Diode peak reverse current	I_{rr}		-	16.5	-	A		
Diode recovery charge	Q_{rr}		-	1864	-	nC		
Short circuit safe operating area	SCSOA	$T_J = 150\text{ }^\circ\text{C}, R_g = 22\text{ }\Omega,$ $V_{GE} = 15\text{ V to } 0\text{ V}, V_{CC} = 900\text{ V},$ $V_P = 1200\text{ V}$	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	°C
Junction to case	IGBT		-	-	0.115	°C/W
	Diode		-	-	0.57	
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				

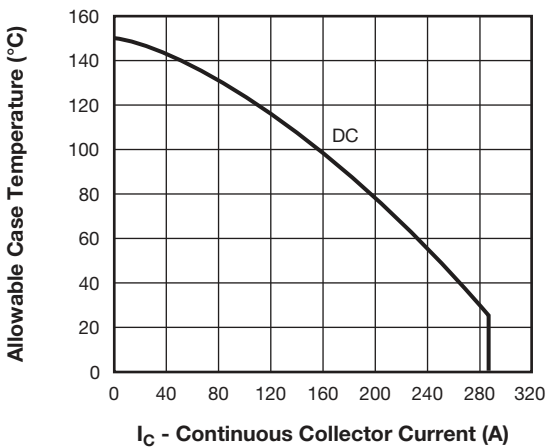


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

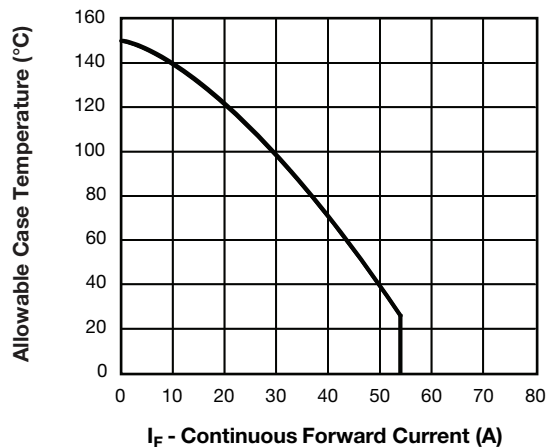


Fig. 3 - Maximum Allowable Forward Current vs. Case Temperature Diode Leg

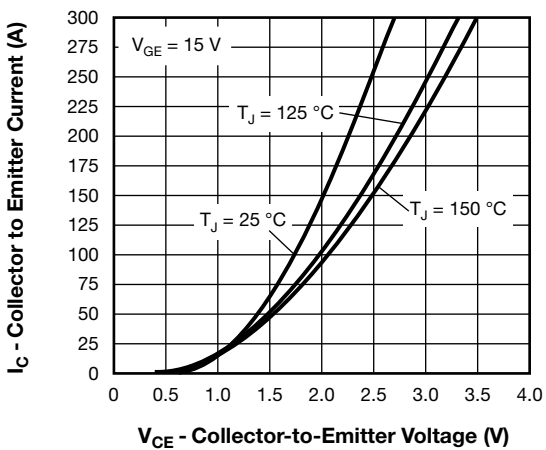


Fig. 2 - Typical Collector to Emitter Current Output Characteristics of IGBT

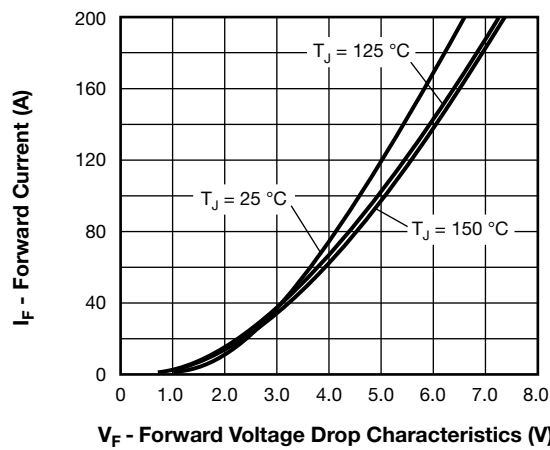


Fig. 4 - Typical Diode Forward Voltage Drop Characteristics

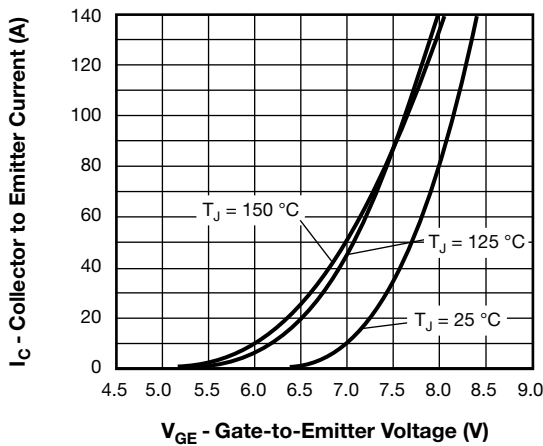


Fig. 5 - Typical IGBT Transfer Characteristics

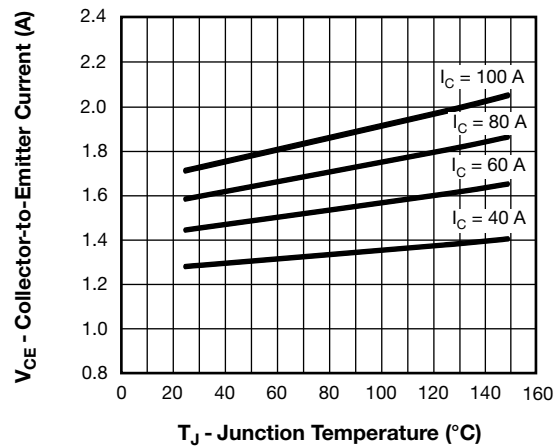


Fig. 8 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature, $V_{GE} = 15\text{ V}$

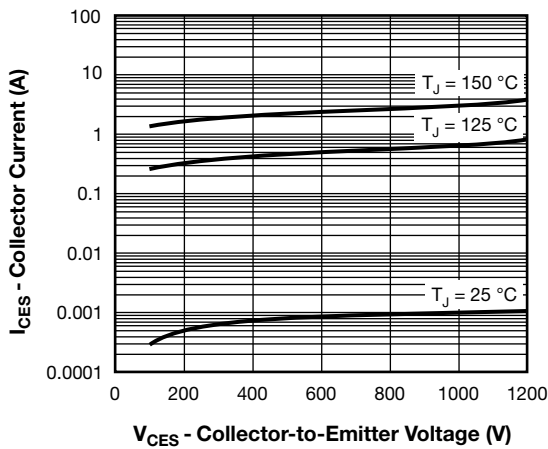


Fig. 6 - Typical IGBT Zero Gate Voltage Collector Current

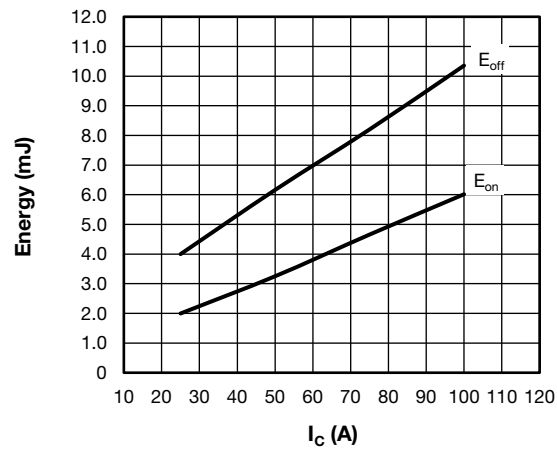


Fig. 9 - Typical IGBT Energy Losses vs. I_C
 $T_J = 125\text{ }^\circ\text{C}$, $L = 500\text{ }\mu\text{H}$, $V_{CC} = 720\text{ V}$, $R_g = 2.2\text{ }\Omega$, $V_{GE} = 15\text{ V}$
 Diode used: HFA16PB120

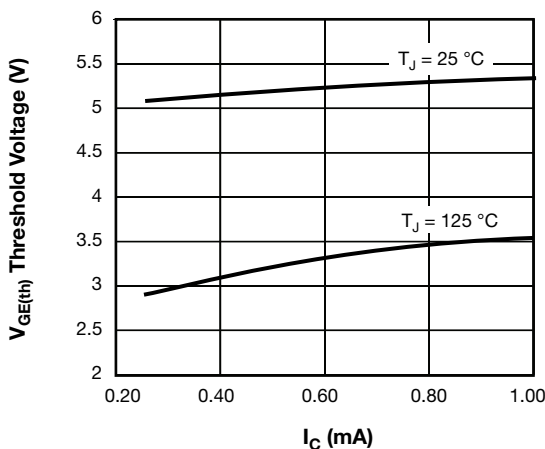


Fig. 7 - Typical IGBT Threshold Voltage

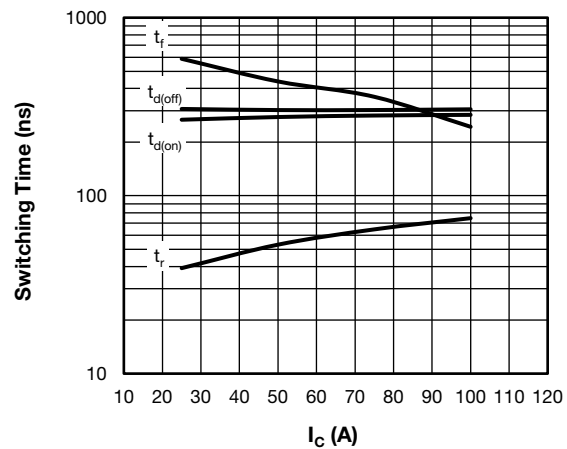


Fig. 10 - Typical IGBT Switching Time vs. I_C
 $T_J = 125\text{ }^\circ\text{C}$, $L = 500\text{ }\mu\text{H}$, $V_{CC} = 720\text{ V}$, $R_g = 2.2\text{ }\Omega$, $V_{GE} = 15\text{ V}$
 Diode used: HFA16PB120

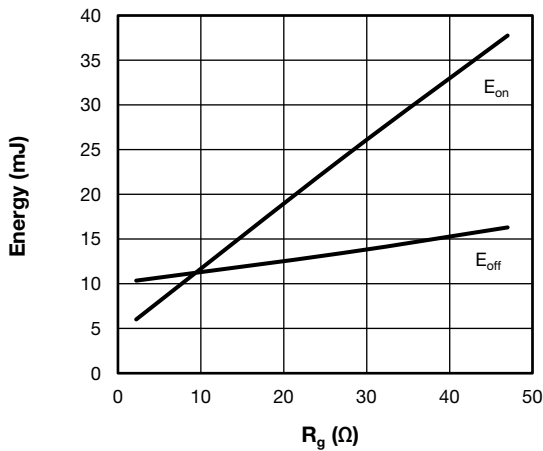


Fig. 11 - Typical IGBT Energy Losses vs. R_g
 $T_J = 125\text{ }^\circ\text{C}$, $I_C = 100\text{ A}$, $L = 500\text{ }\mu\text{H}$, $V_{CC} = 720\text{ V}$, $V_{GE} = 15\text{ V}$
 Diode used: HFA16PB120

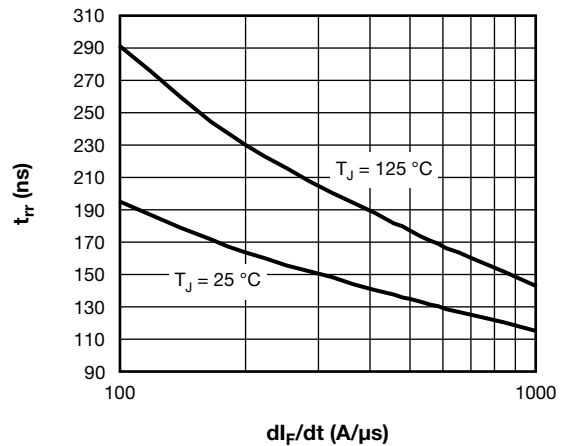


Fig. 13 - Typical Reverse Recovery Time vs. dI_F/dt , of Diode,
 at $I_F = 50\text{ A}$, $V_R = 400\text{ V}$

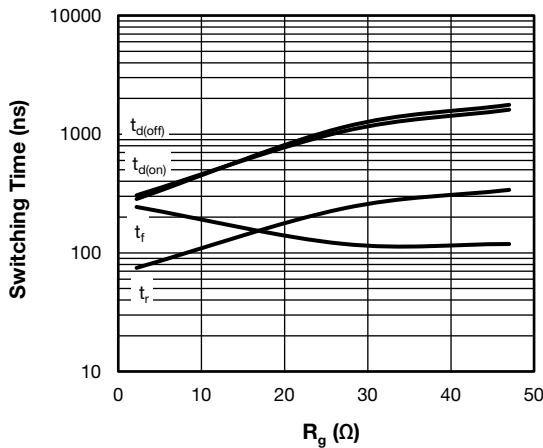


Fig. 12 - Typical IGBT Switching Time vs. R_g
 $T_J = 125\text{ }^\circ\text{C}$, $L = 500\text{ }\mu\text{H}$, $V_{CC} = 720\text{ V}$, $I_C = 100\text{ A}$, $V_{GE} = 15\text{ V}$
 Diode used: HFA16PB120

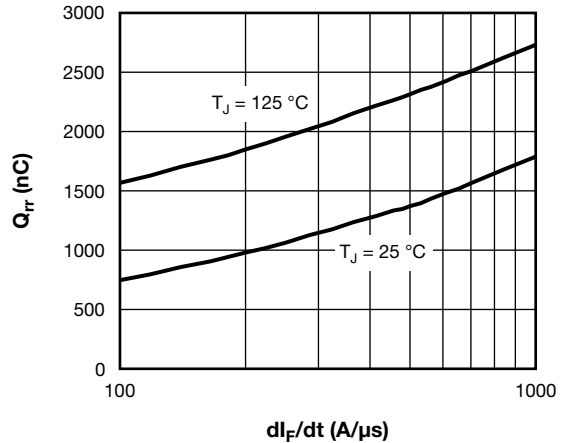


Fig. 14 - Typical Stored Charge vs. dI_F/dt of Diode,
 at $I_F = 50\text{ A}$, $V_R = 400\text{ V}$

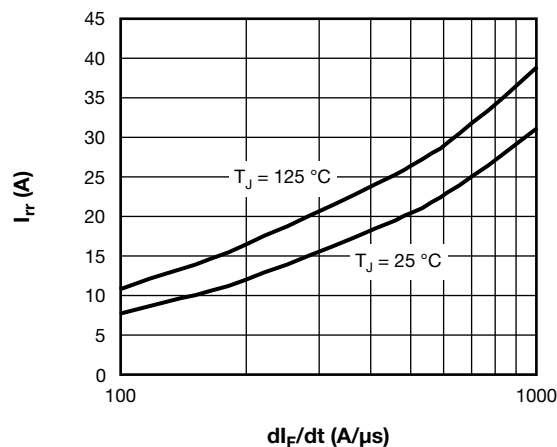


Fig. 15 - Typical Reverse Recovery Current vs. dI_F/dt , of Diode,
 at $I_F = 50\text{ A}$, $V_R = 400\text{ V}$

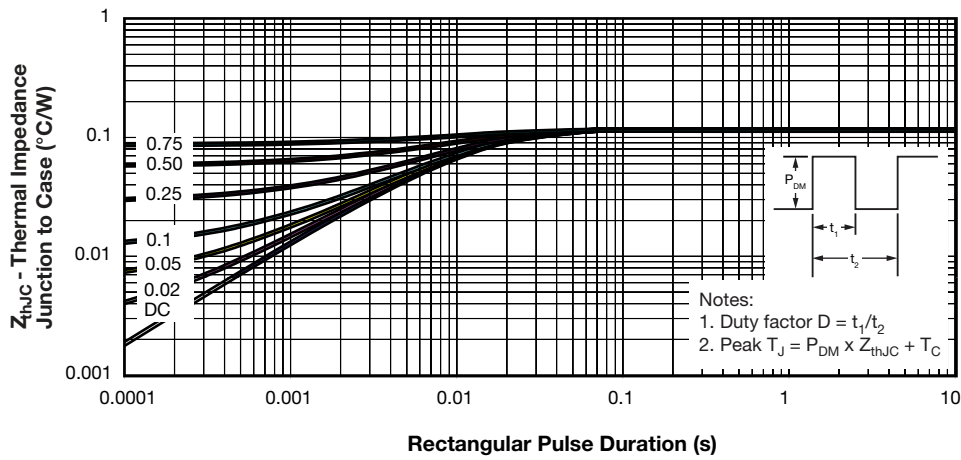


Fig. 16 - Maximum Thermal Impedance Z_{thJC} Characteristics (IGBT)

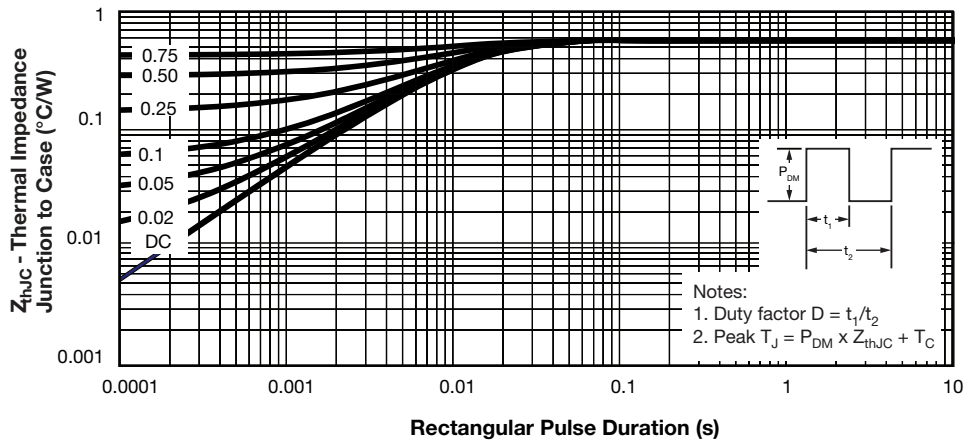


Fig. 17 - Maximum Thermal Impedance Z_{thJC} Characteristics (Diode)

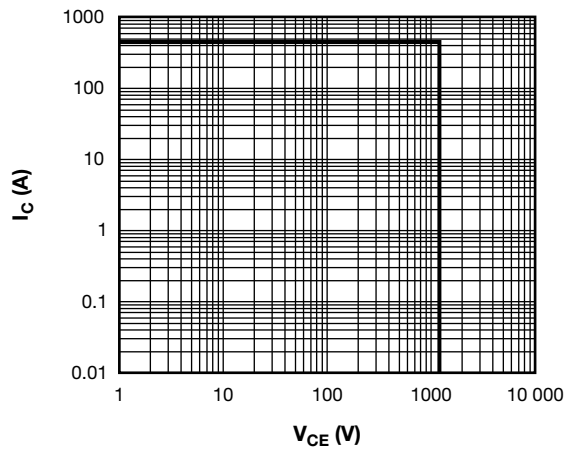


Fig. 18 - IGBT Reverse Bias SOA, $T_J = 150\text{ }^\circ\text{C}$, $V_{GE} = 15\text{ V}$

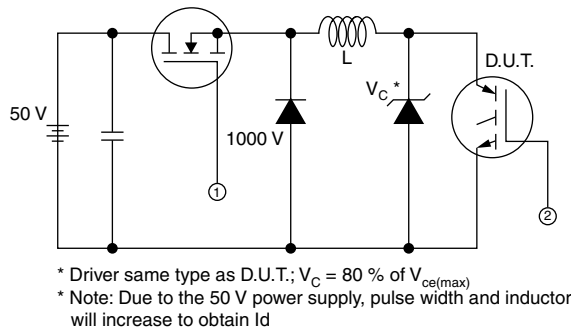


Fig. 19 - Clamped Inductive Load Test Circuit

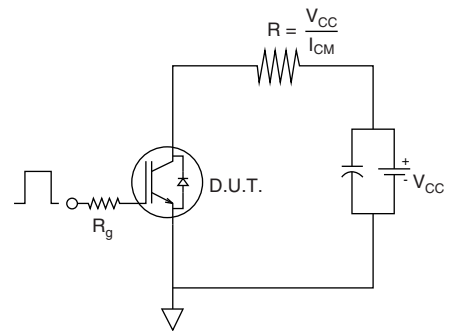


Fig. 19b - Pulsed Collector Current Test Circuit

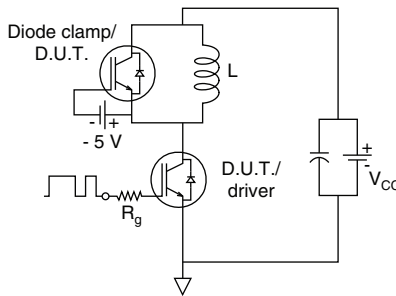


Fig. 20a - Switching Loss Test Circuit

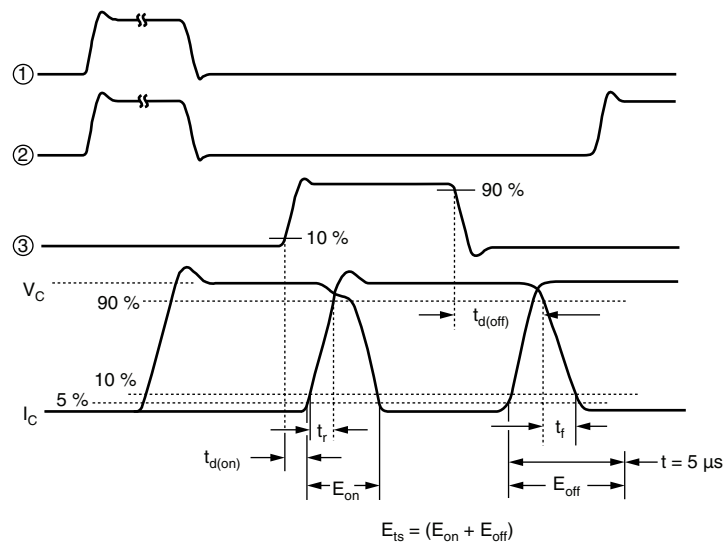
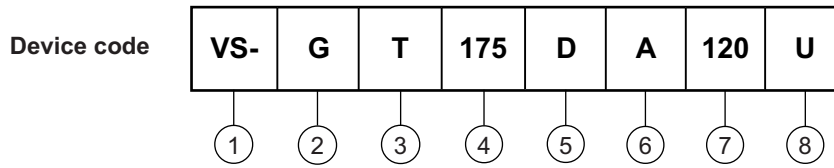


Fig. 20b - Switching Loss Waveforms Test Circuit



ORDERING INFORMATION TABLE



- 1** - Vishay Semiconductors product
- 2** - Insulated Gate Bipolar Transistor (IGBT)
- 3** - Trench IGBT technology
- 4** - Current rating (175 = 175 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)

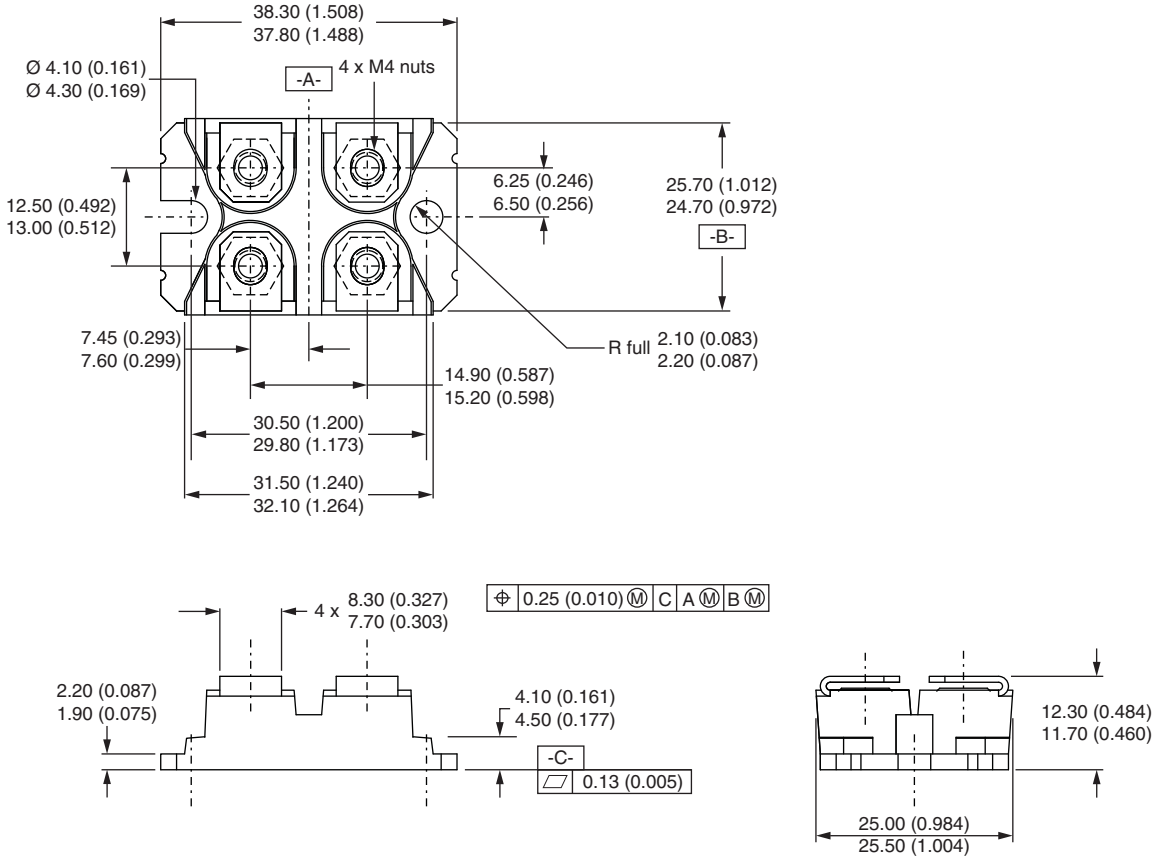
CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Single switch diode	D	

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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