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 µs 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

Pb-free
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 °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 μA	1200	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 100 A	-	1.73	2.1	
		V_{GE} = 15 V, I_C = 100 A, T_J = 125 °C	-	1.98	2.2	
		V_{GE} = 15 V, I_C = 100 A, T_J = 150 °C	-	2.05	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 250 μA	-	5	-	
		V_{CE} = V_{GE}, I_C = 7.5 mA	4.9	5.9	7.9	
		V_{CE} = V_{GE}, I_C = 250 μA, T_J = 125 °C	-	2.9	-	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 1 mA (25 °C to 125 °C)	-	-17.6	-	mV/°C
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V	-	0.9	100	μA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 125 °C	-	0.85	10	mA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 150 °C	-	4	20	
Forward voltage drop, diode	V_{FM}	I_F = 40 A, V_{GE} = 0 V	-	3.12	3.44	V
		I_F = 40 A, V_{GE} = 0 V, T_J = 125 °C	-	3.15	3.47	
		I_F = 40 A, V_{GE} = 0 V, T_J = 150 °C	-	3.25	-	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	± 200	nA

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise specified)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNITS**
Total gate charge (turn-on)	Q_g	I_C = 150 A (t_p < 400 μs, D < 2 %), V_{CC} = 600 V, V_{GE} = 15 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 A, V_{CC} = 720 V, V_{GE} = 15 V, R_g = 2.2 Ω, L = 500 μH, T_J = 25 °C	Energy losses include tail and diode recovery Diode used HFA16PB120	-	4.8	-	mJ
Turn-off switching loss	E_{off}			-	7.0	-	
Total switching loss	E_{tot}			-	11.8	-	
Turn-on delay time	$t_{d(on)}$			-	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 A, V_{CC} = 720 V, V_{GE} = 15 V, R_g = 2.2 Ω, L = 500 μH, T_J = 125 °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 °C, I_C = 450 A, R_g = 4.7 Ω, V_{GE} = 15 V to 0 V, V_{CC} = 600 V, V_P = 1200 V, L = 500 μH		Fullsquare			
Diode reverse recovery time	t_{rr}	I_F = 50 A, dI_F/dt = 200 A/μs, V_R = 400 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 A, dI_F/dt = 200 A/μs, V_R = 400 V, T_J = 125 °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 °C, R_g = 22 Ω, V_{GE} = 15 V to 0 V, V_{CC} = 900 V, V_p = 1200 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	R_{thJC}		-	-	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					

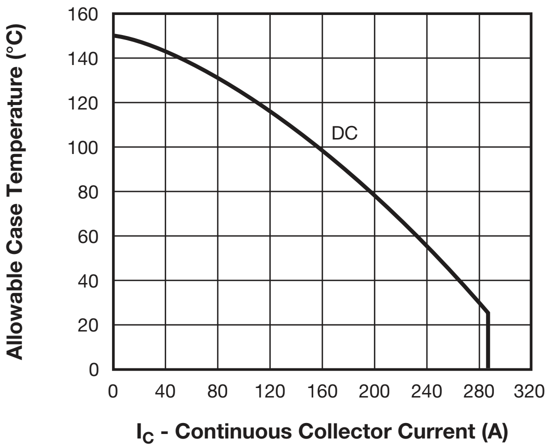


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

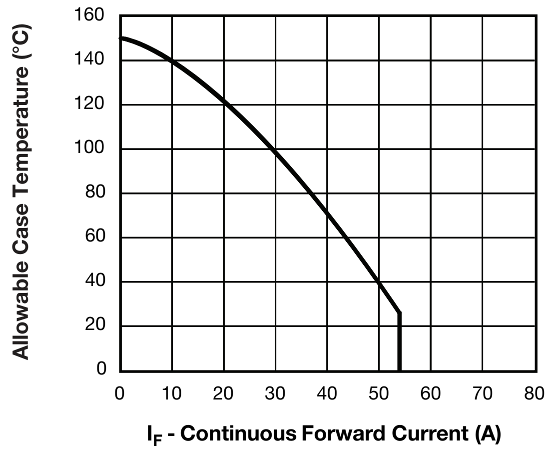


Fig. 3 - Maximum Allowable Forward Current vs. Case Temperature Diode Leg

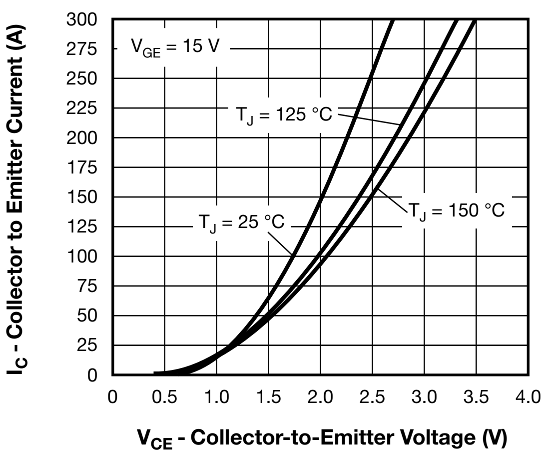


Fig. 2 - Typical Collector to Emitter Current Output Characteristics of IGBT

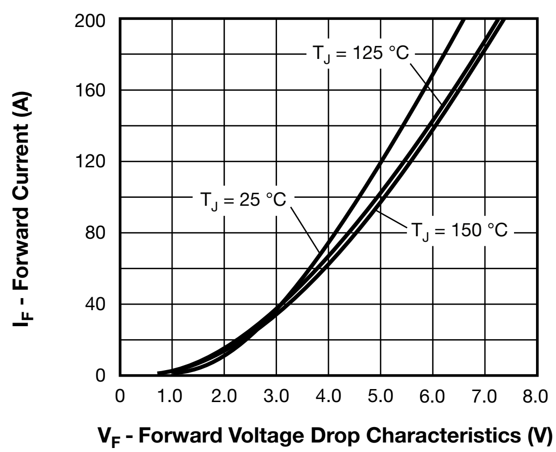


Fig. 4 - Typical Diode Forward Voltage Drop Characteristics

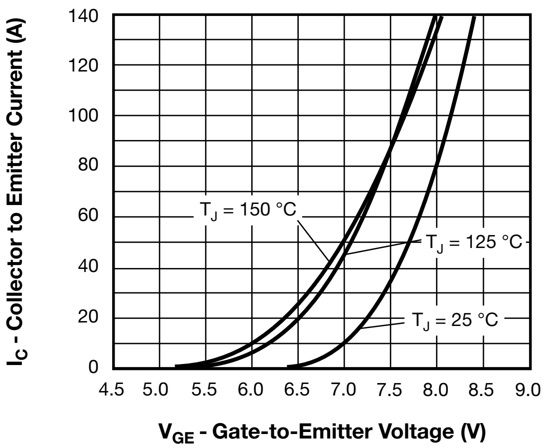


Fig. 5 - Typical IGBT Transfer Characteristics

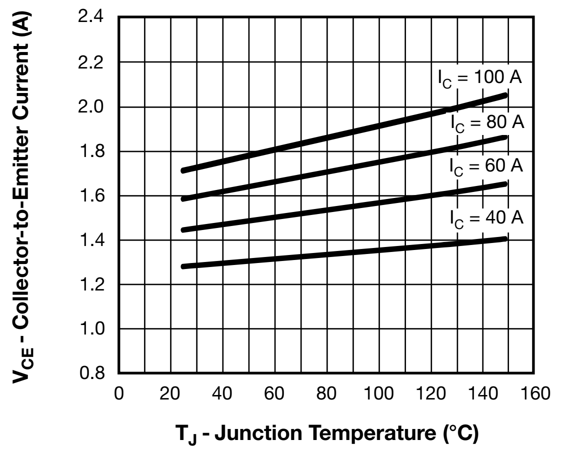


Fig. 8 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature, V_{GE} = 15 V

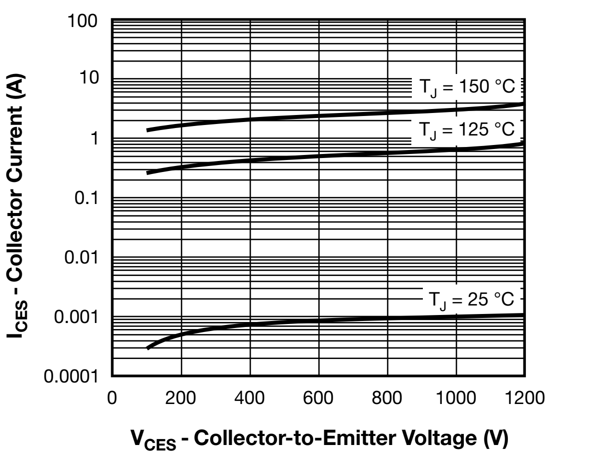


Fig. 6 - Typical IGBT Zero Gate Voltage Collector Current

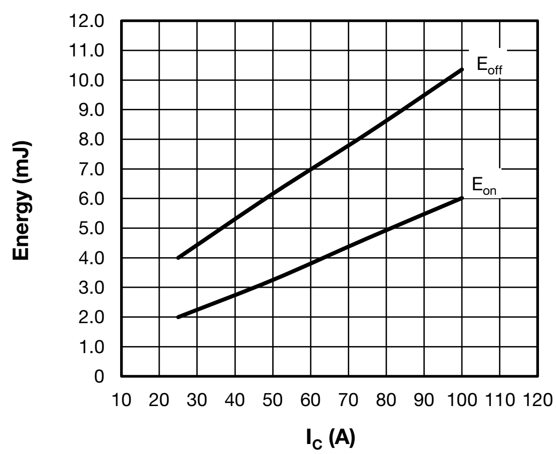


Fig. 9 - Typical IGBT Energy Losses vs. I_C
T_J = 125 °C, L = 500 µH, V_{CC} = 720 V, R_g = 2.2 Ω, V_{GE} = 15 V
Diode used: HFA16PB120

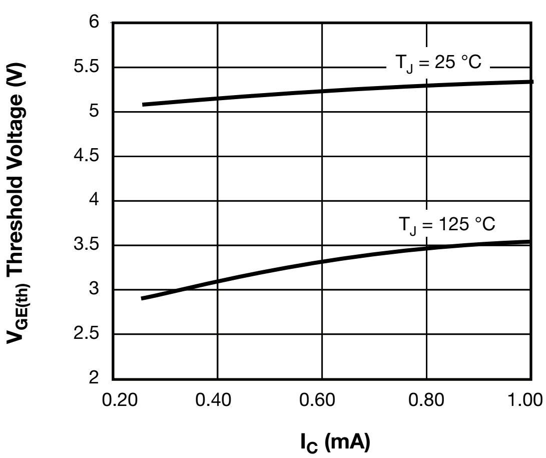


Fig. 7 - Typical IGBT Threshold Voltage

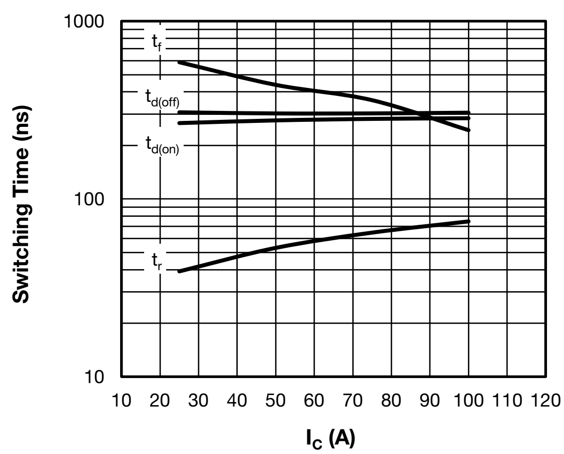


Fig. 10 - Typical IGBT Switching Time vs. I_C
T_J = 125 °C, L = 500 µH, V_{CC} = 720 V, R_g = 2.2 Ω, V_{GE} = 15 V
Diode used: HFA16PB120

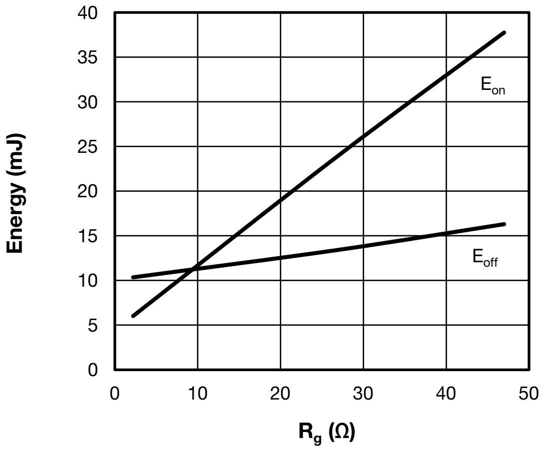


Fig. 11 - Typical IGBT Energy Losses vs. R_g
T_J = 125 °C, I_C = 100 A, L = 500 µH, V_{CC} = 720 V, V_{GE} = 15 V
Diode used: HFA16PB120

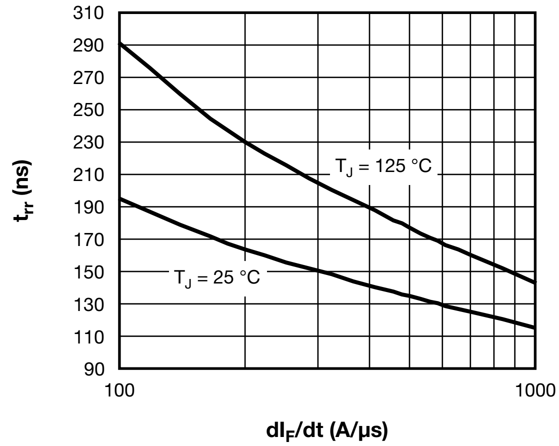


Fig. 13 - Typical Reverse Recovery Time vs. dI_F/dt, of Diode,
at I_F = 50 A, V_R = 400 V

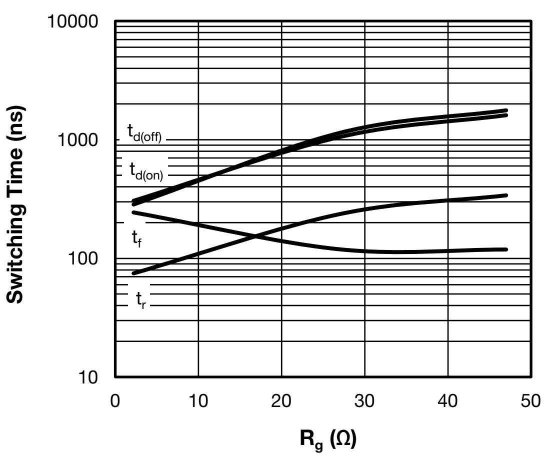


Fig. 12 - Typical IGBT Switching Time vs. R_g
T_J = 125 °C, L = 500 µH, V_{CC} = 720 V, I_C = 100 A, V_{GE} = 15 V
Diode used: HFA16PB120

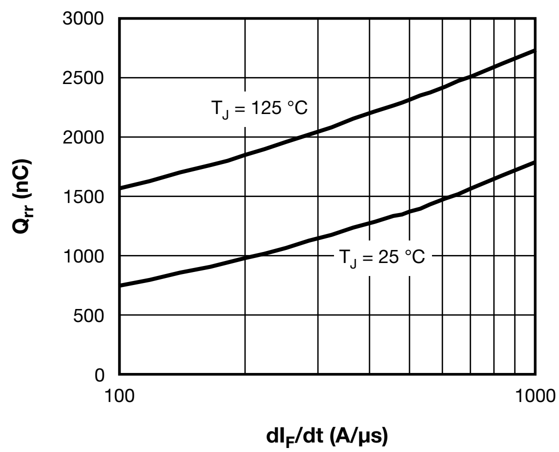


Fig. 14 - Typical Stored Charge vs. dI_F/dt of Diode,
at I_F = 50 A, V_R = 400 V

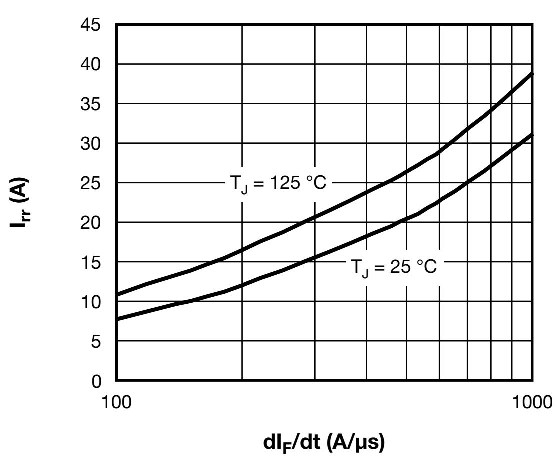


Fig. 15 - Typical Reverse Recovery Current vs. dI_F/dt, of Diode,
at I_F = 50 A, V_R = 400 V

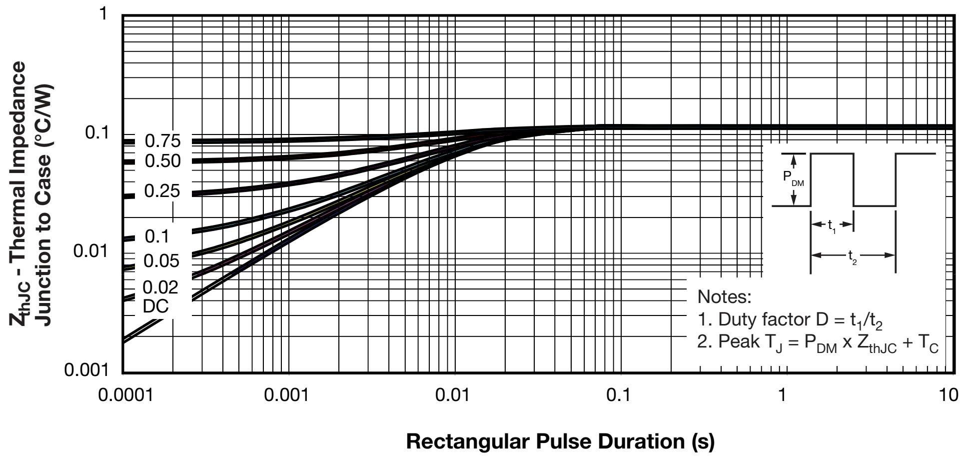


Fig. 16 - Maximum Thermal Impedance Z_{thJC} Characteristics (IGBT)

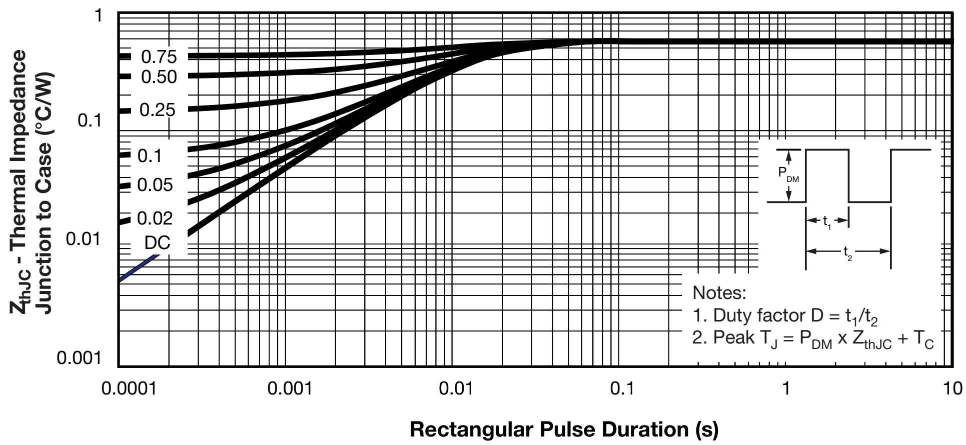


Fig. 17 - Maximum Thermal Impedance Z_{thJC} Characteristics (Diode)

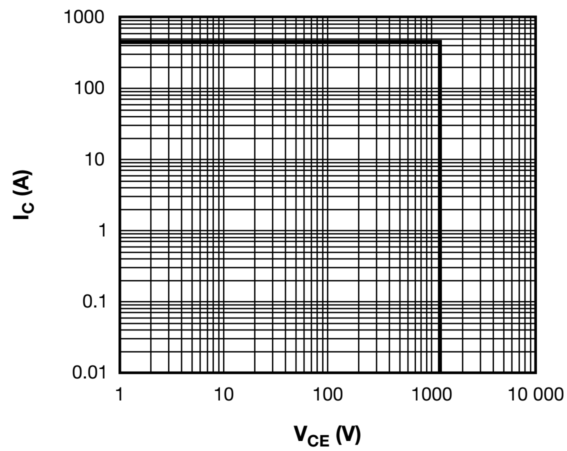


Fig. 18 - IGBT Reverse Bias SOA, T_J = 150 °C, V_{GE} = 15 V

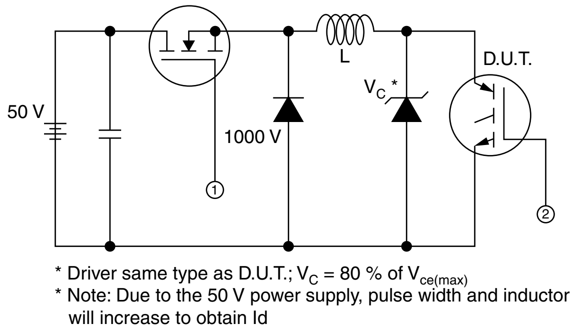


Fig. 19 - Clamped Inductive Load Test Circuit

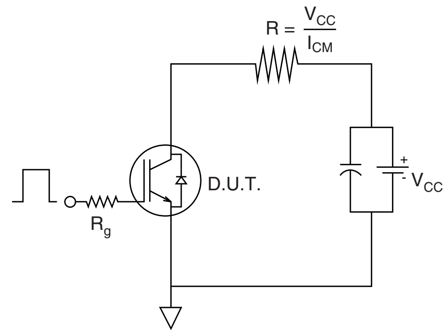


Fig. 19b - Pulsed Collector Current Test Circuit

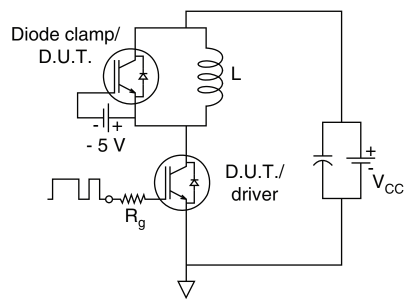


Fig. 20a - Switching Loss Test Circuit

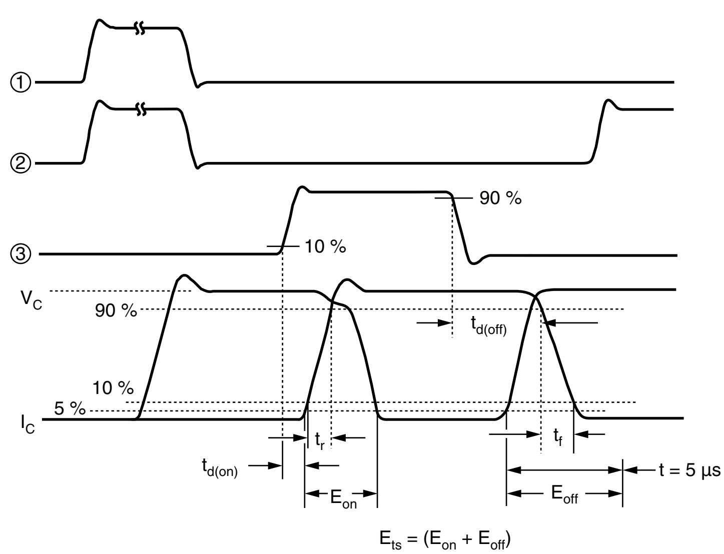
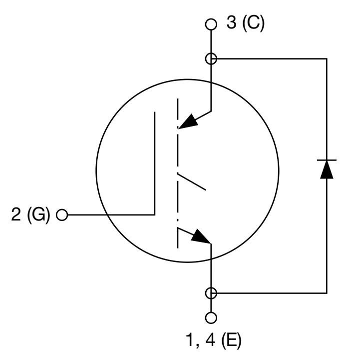
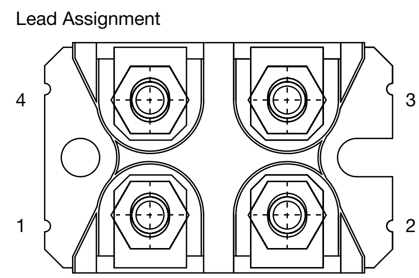


Fig. 20b - Switching Loss Waveforms Test Circuit

ORDERING INFORMATION TABLE

Device code	VS-	G	T	175	D	A	120	U
	1	2	3	4	5	6	7	8

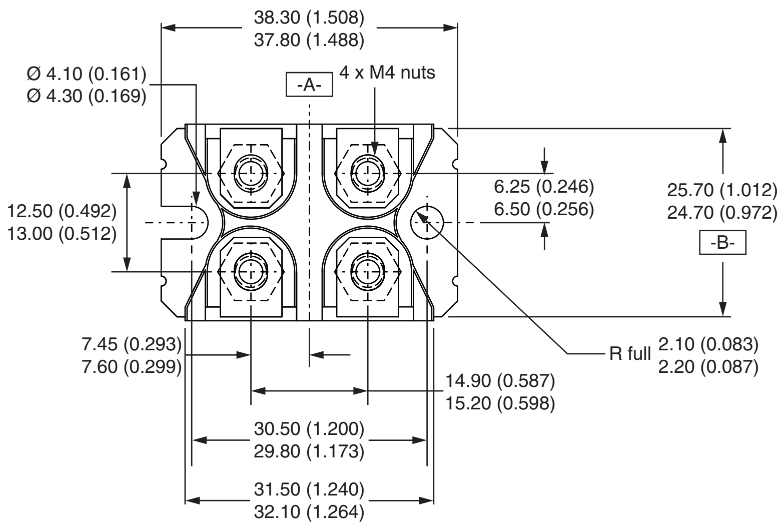
1	-	Vishay Semiconductors product
2	-	Insulated Gate Bipolar Transistor (IGBT)
3	-	Trench IGBT technology
4	-	Current rating (175 = 175 A)
5	-	Circuit configuration (D = Single switch with antiparallel diode)
6	-	Package indicator (A = SOT-227)
7	-	Voltage rating (120 = 1200 V)
8	-	Speed/type (U = Ultrafast)

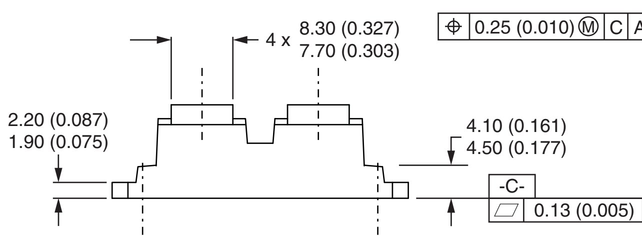
CIRCUIT CONFIGURATION		
CIRCUIT	**CIRCUIT CONFIGURATION CODE**	**CIRCUIT DRAWING**
Single switch diode	D	 

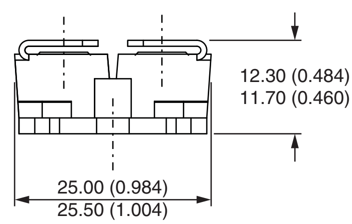
LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95423
Packaging information	www.vishay.com/doc?95425

SOT-227 Generation II

DIMENSIONS in millimeters (inches)







Note

- Controlling dimension: millimeter

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