

Insulated Gate Bipolar Transistor (Trench IGBT), 180 A



SOT-227

PRIMARY CHARACTERISTICS	
V_{CES}	1200 V
$I_{C(DC)}$	185 A at 90 °C
$V_{CE(on)}$ typical at 100 A, 25 °C	1.55 V
$I_{F(DC)}$	32 A at 90 °C
Speed	8 kHz to 30 kHz
Package	SOT-227
Circuit configuration	Single switch with AP diode

FEATURES

- 1200 V trench and field stop technology
- Low switching losses
- Positive temperature coefficient
- Easy paralleling
- 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	$T_C = 25\text{ °C}$	281	A
		$T_C = 90\text{ °C}$	185	
Pulsed collector current	I_{CM}		390	
Clamped inductive load current	I_{LM}		450	
Gate to emitter voltage	V_{GE}		± 20	V
Diode continuous forward current	I_F	$T_C = 25\text{ °C}$	51	A
		$T_C = 90\text{ °C}$	32	
Single pulse forward current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, $T_J = 25\text{ °C}$	185	
Power dissipation, IGBT	P_D	$T_C = 25\text{ °C}$	1087	W
		$T_C = 90\text{ °C}$	522	
Power dissipation, diode	P_D	$T_C = 25\text{ °C}$	216	
		$T_C = 90\text{ °C}$	103	
Isolation voltage	V_{ISOL}	Any terminal to case, $t = 1$ 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	$V_{BR(CES)}$	$V_{GE} = 0\text{ V}, I_C = 5.7\text{ mA}$	1200	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 100\text{ A}$	-	1.55	2.05	
		$V_{GE} = 15\text{ V}, I_C = 100\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	1.71	-	
		$V_{GE} = 15\text{ V}, I_C = 100\text{ A}, T_J = 150\text{ }^\circ\text{C}$	-	1.76	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 5.7\text{ mA}$	4.75	5.8	7.0	
		$V_{CE} = V_{GE}, I_C = 5.7\text{ mA}, T_J = 125\text{ }^\circ\text{C}$	-	4.7	-	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 5.7\text{ mA}$ ($25\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$)	-	-11.4	-	mV/ $^\circ\text{C}$
Transfer characteristics	V_{GE}	$V_{DS} = 20\text{ V}, I_D = 100\text{ A}$	-	8.5	-	V
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$	-	0.6	100	μA
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	0.4	-	mA
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	1.6	-	
Forward voltage drop, diode	V_{FM}	$I_F = 40\text{ A}, V_{GE} = 0\text{ V}$	-	3.0	3.5	V
		$I_F = 40\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	3.2	-	
		$I_F = 40\text{ A}, V_{GE} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	3.2	-	
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			
Input capacitance	C_{ies}	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}, T_J = 25\text{ }^\circ\text{C}$	-	9350	-	pF			
Reverse transfer capacitance	C_{res}		-	350	-				
Turn-on switching loss	E_{on}	$I_C = 100\text{ A}, V_{CC} = 720\text{ V}, V_{GE} = 15\text{ V}, R_g = 1.0\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$	-	4.4	-	mJ			
Turn-off switching loss	E_{off}		-	7.3	-				
Total switching loss	E_{tot}		-	11.7	-				
Turn-on delay time	$t_{d(on)}$		Energy losses include tail and diode recovery	-	192	-	ns		
Rise time	t_r			-	59	-			
Turn-off delay time	$t_{d(off)}$			-	334	-			
Fall time	t_f			-	137	-			
Turn-on switching loss	E_{on}			$I_C = 100\text{ A}, V_{CC} = 720\text{ V}, V_{GE} = 15\text{ V}, R_g = 1.0\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$	-	5.7		-	mJ
Turn-off switching loss	E_{off}				-	11.6		-	
Total switching loss	E_{tot}				-	17.3		-	
Turn-on delay time	$t_{d(on)}$	-	200		-	ns			
Rise time	t_r	-	62		-				
Turn-off delay time	$t_{d(off)}$	-	485		-				
Fall time	t_f	-	138	-					
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 450\text{ A}, R_g = 1.0\text{ }\Omega, V_{GE} = 15\text{ V to } 0\text{ V}, V_{CC} = 600\text{ V}, V_P = 1200\text{ V}, L = 500\text{ }\mu\text{H}$	Fullsquare						
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}, dI_F/dt = 200\text{ A}/\mu\text{s}, V_R = 400\text{ V}$	-	163	-	ns			
Diode peak reverse current	I_{rr}		-	10.4	-	A			
Diode recovery charge	Q_{rr}		-	851	-	nC			
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}, dI_F/dt = 200\text{ A}/\mu\text{s}, V_R = 400\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	225	-	ns			
Diode peak reverse current	I_{rr}		-	14.9	-	A			
Diode recovery charge	Q_{rr}		-	1698	-	nC			
Short circuit safe operating area	SCSOA	$T_J = 150\text{ }^\circ\text{C}, V_{GE} = 15\text{ V to } 0\text{ V}, V_{CC} = 800\text{ V}, V_P = 1200\text{ V}$	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	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			

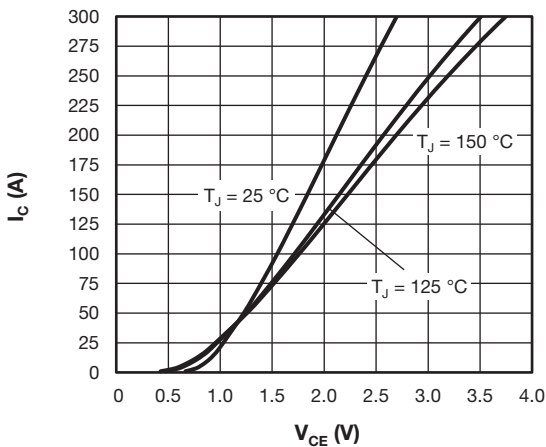


Fig. 1 - Typical IGBT Output Characteristics, $V_{GE} = 15\text{ V}$

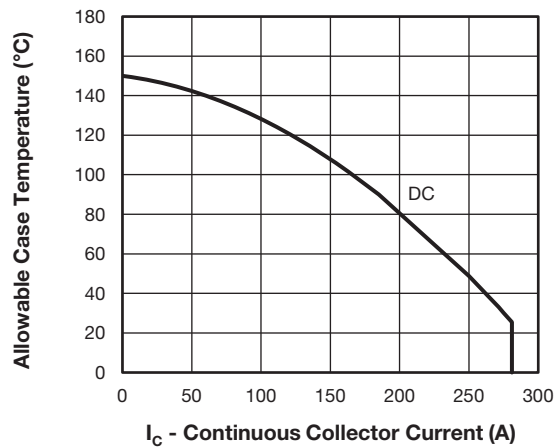


Fig. 3 - Maximum IGBT Continuous Collector Current vs. Case Temperature

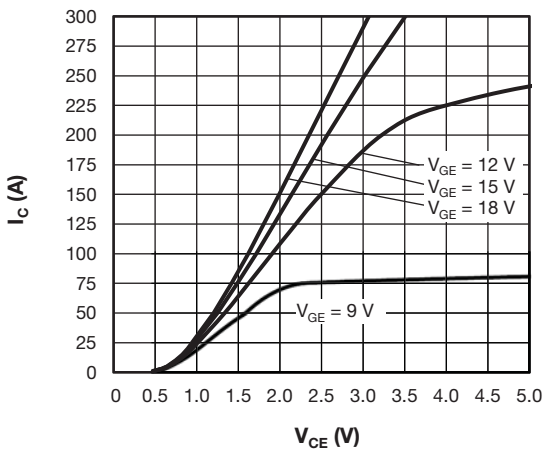


Fig. 2 - Typical IGBT Output Characteristics, $T_J = 125\text{ °C}$

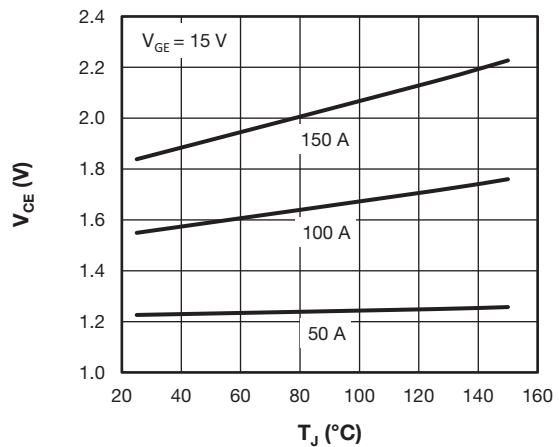


Fig. 4 - Collector to Emitter Voltage vs. Junction Temperature

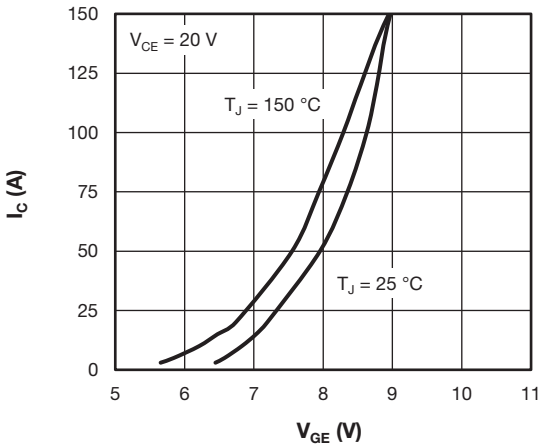


Fig. 5 - Typical IGBT Transfer Characteristics

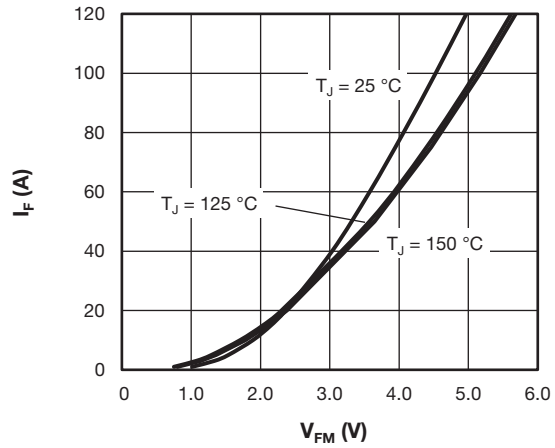


Fig. 8 - Typical Diode Forward Characteristics

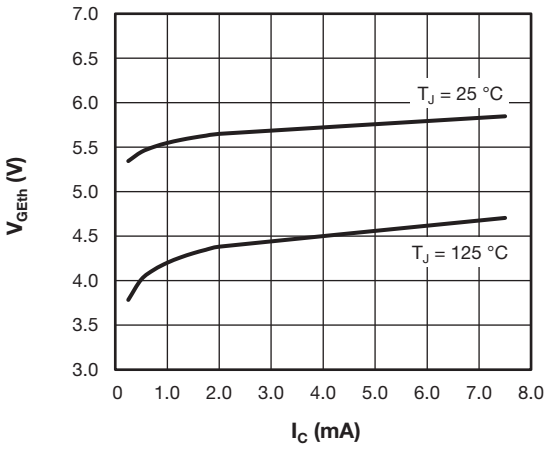


Fig. 6 - Typical IGBT Gate Threshold Voltage

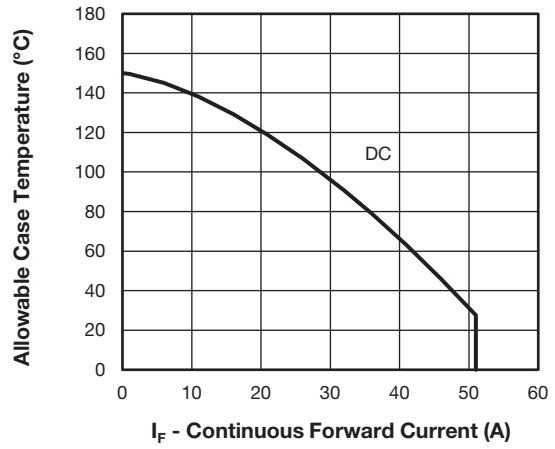


Fig. 9 - Maximum Diode Continuous Forward Current vs. Case Temperature

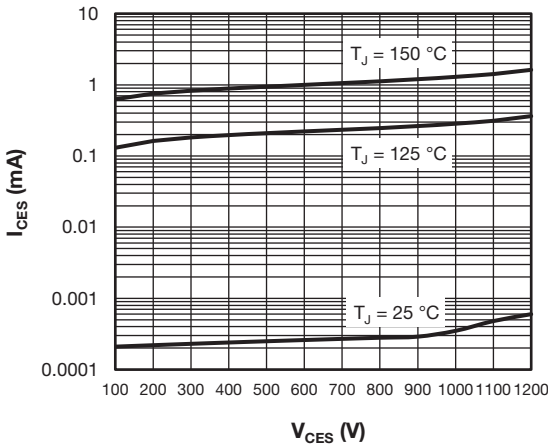


Fig. 7 - Typical IGBT Zero Gate Voltage Collector Current

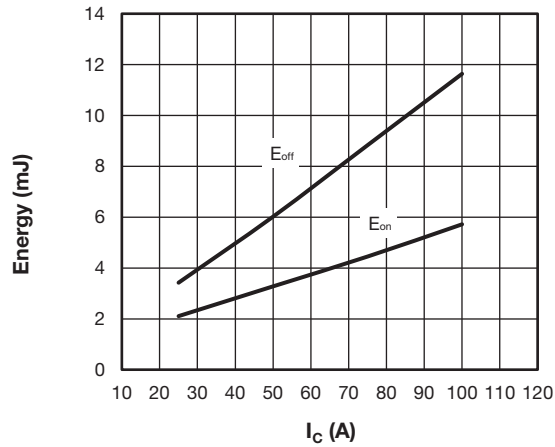


Fig. 10 - Typical IGBT Energy Loss vs. I_c
 $T_J = 125^\circ\text{C}$, $V_{CC} = 720\text{ V}$, $R_g = 1.0\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

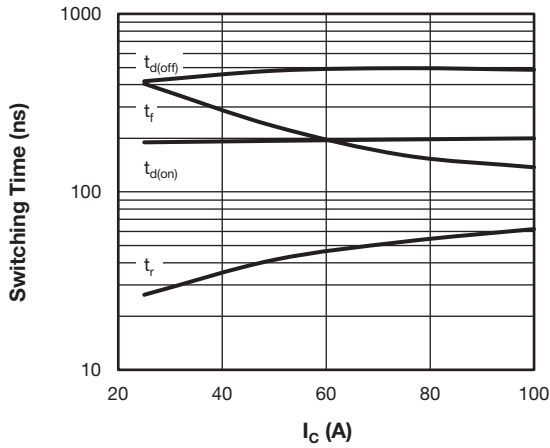


Fig. 11 - Typical IGBT Switching Time vs. I_C
 $T_J = 125^\circ\text{C}$, $V_{CC} = 720\text{ V}$, $R_g = 1.0\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

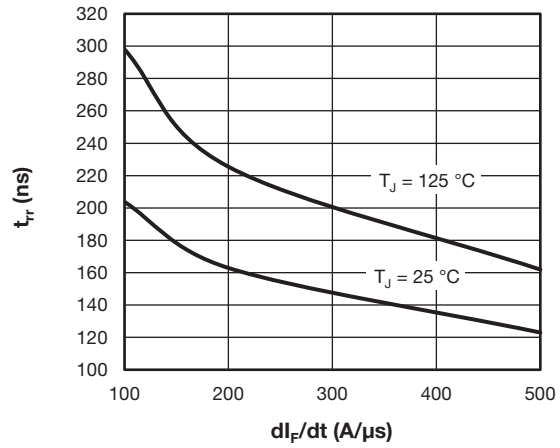


Fig. 14 - Typical Diode Reverse Recovery Time vs. di_F/dt
 $V_{rr} = 400\text{ V}$, $I_F = 50\text{ A}$

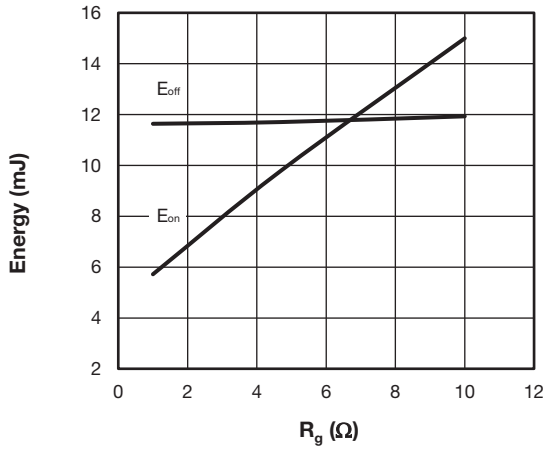


Fig. 12 - Typical IGBT Energy Loss vs. R_g
 $T_J = 125^\circ\text{C}$, $V_{CC} = 720\text{ V}$, $I_C = 100\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

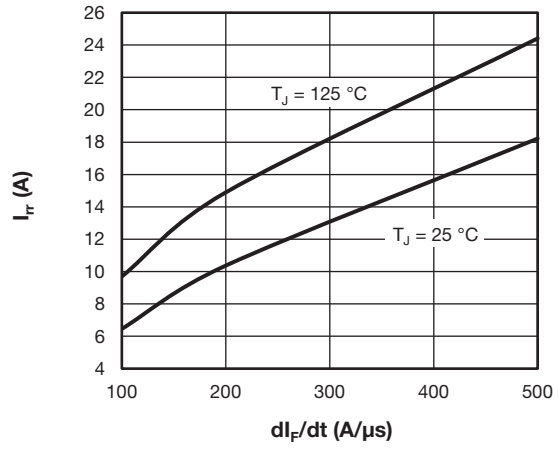


Fig. 15 - Typical Diode Reverse Recovery Current vs. di_F/dt
 $V_{rr} = 400\text{ V}$, $I_F = 50\text{ A}$

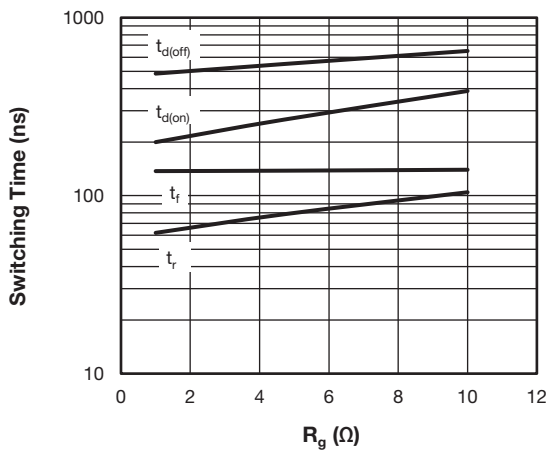


Fig. 13 - Typical IGBT Switching Time vs. R_g
 $T_J = 125^\circ\text{C}$, $V_{CC} = 720\text{ V}$, $I_C = 100\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

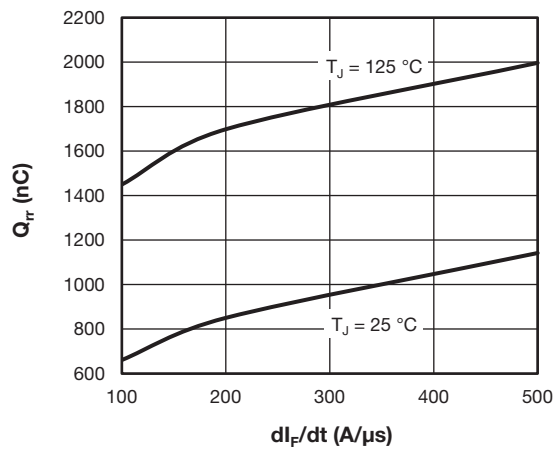


Fig. 16 - Typical Diode Reverse Recovery Charge vs. di_F/dt
 $V_{rr} = 400\text{ V}$, $I_F = 50\text{ A}$

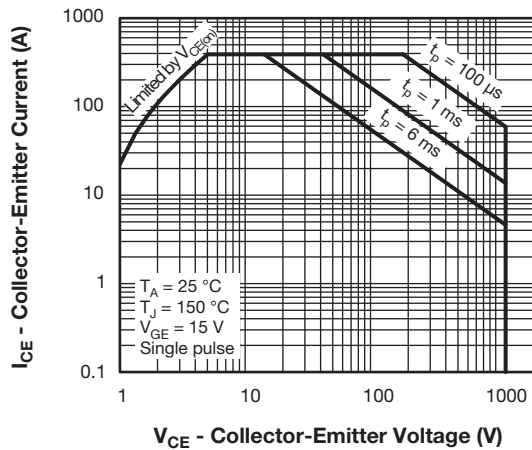


Fig. 17 - IGBT Safe Operating Area

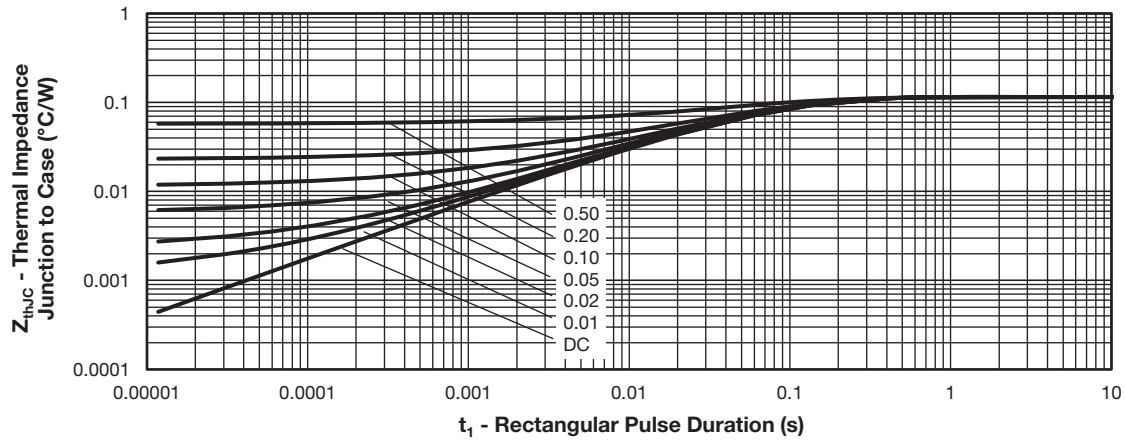


Fig. 18 - Maximum Thermal Impedance Z_{thJC} Characteristics - (IGBT)

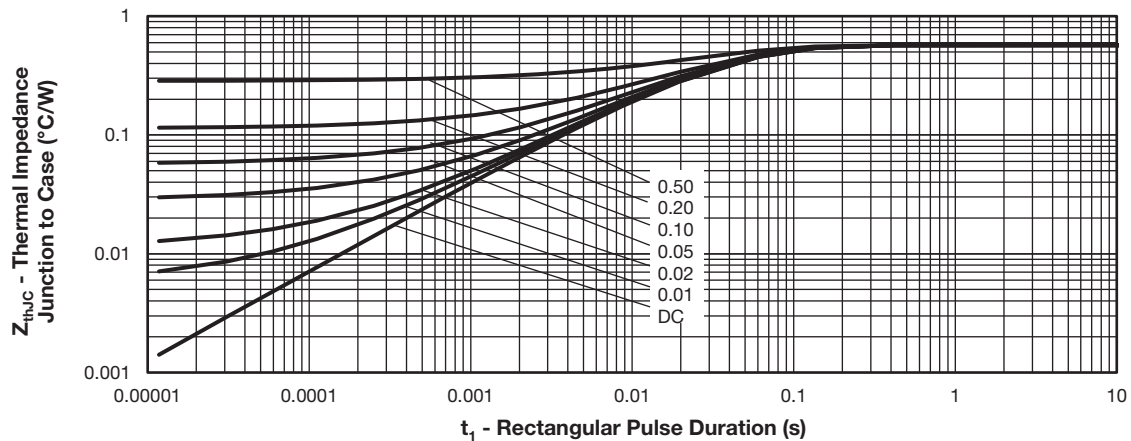


Fig. 19 - Maximum Thermal Impedance Z_{thJC} Characteristics - (Diode)

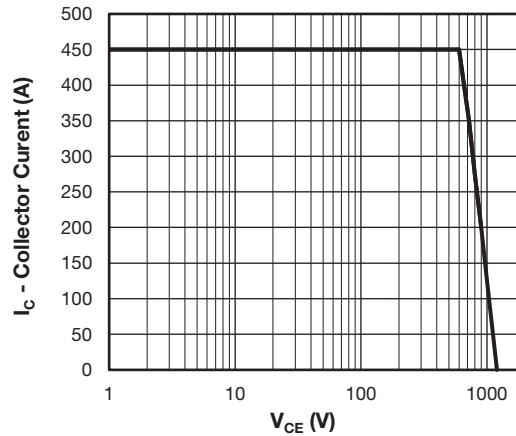


Fig. 20 - IGBT Reverse Bias SOA
 $V_{GE} = 15 \text{ V}$, $T_J = 150 \text{ }^\circ\text{C}$

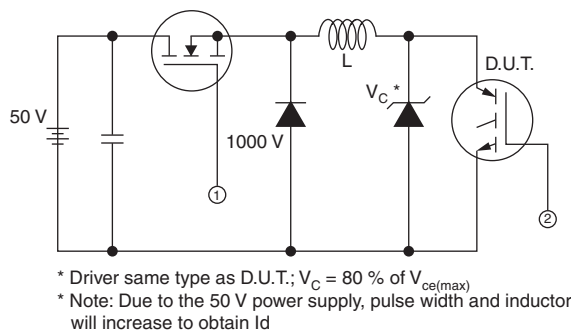


Fig. 21 - Clamped Inductive Load Test Circuit

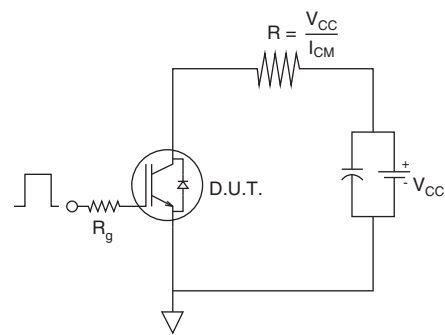


Fig. 22 - Pulsed Collector Current Test Circuit

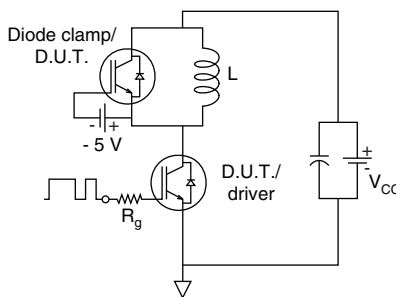


Fig. 23 - Switching Loss Test Circuit

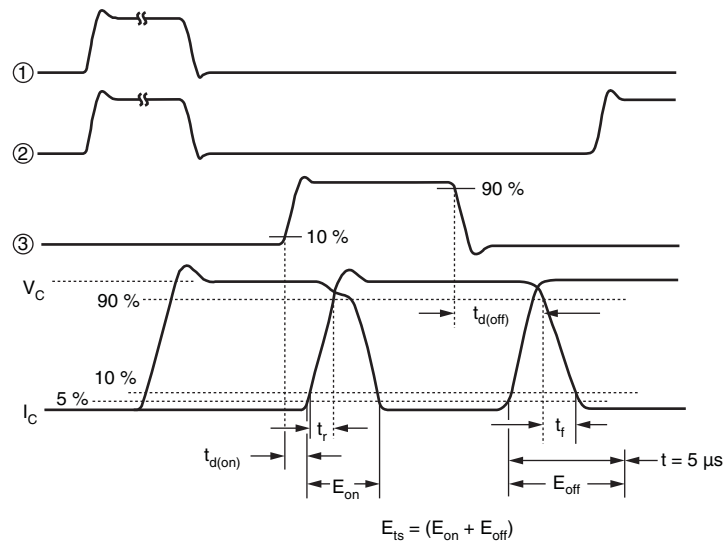


Fig. 24 - Switching Loss Waveforms Test Circuit

ORDERING INFORMATION TABLE

Device code	VS-	G	T	180	D	A	120	U
	①	②	③	④	⑤	⑥	⑦	⑧
	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 (180 = 180 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)

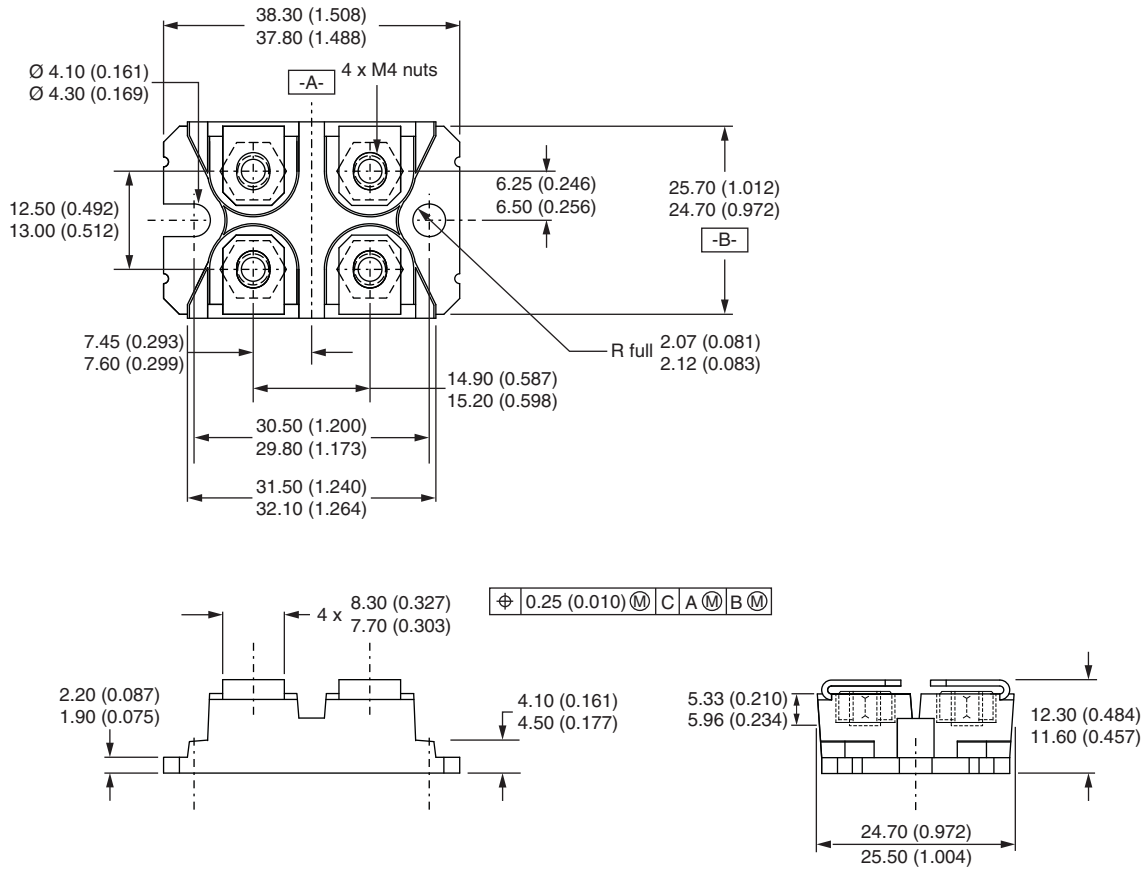
CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Single switch with AP diode	D	

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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