


"Low Side Chopper" IGBT SOT-227 (Ultrafast IGBT), 50 A



SOT-227


**RoHS
COMPLIANT**

FEATURES

- NPT Generation V IGBT technology
- Square RBSOA
- HEXFRED® clamping diode
- Positive $V_{CE(on)}$ temperature coefficient
- Fully isolated package
- Speed 8 kHz to 60 kHz
- 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	50 A at 92 °C
$V_{CE(on)}$ typical at 50 A, 25 °C	3.22 V
Package	SOT-227
Circuit	Chopper low side switch

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V_{CES}		1200	V
Continuous collector current	I_C	$T_C = 25\text{ °C}$	84	A
		$T_C = 80\text{ °C}$	57	
Pulsed collector current	I_{CM}		150	
Clamped inductive load current	I_{LM}		150	
Diode continuous forward current	I_F	$T_C = 25\text{ °C}$	76	
		$T_C = 80\text{ °C}$	52	
Gate to emitter voltage	V_{GE}		± 20	V
Power dissipation, IGBT	P_D	$T_C = 25\text{ °C}$	431	W
		$T_C = 80\text{ °C}$	242	
Power dissipation, diode	P_D	$T_C = 25\text{ °C}$	278	
		$T_C = 80\text{ °C}$	156	
RMS 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	$V_{BR(CES)}$	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	1200	-	-	
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 25\text{ A}$	-	2.46	-	V
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}$	-	3.22	2.80	
		$V_{GE} = 15\text{ V}, I_C = 25\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	2.84	3.60	
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	3.78	3.00	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 500\text{ }\mu\text{A}$	4	5	4	
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 $125\text{ }^\circ\text{C}$)	-	- 10	-	mV/ $^\circ\text{C}$
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$	-	6	50	μA
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	0.7	2.0	mA
Diode reverse breakdown voltage	V_{BR}	$I_R = 1\text{ mA}$	1200	-	-	V
Diode forward voltage drop	V_{FM}	$I_C = 25\text{ A}, V_{GE} = 0\text{ V}$	-	1.99	2.42	V
		$I_C = 50\text{ A}, V_{GE} = 0\text{ V}$	-	2.53	3.00	
		$I_C = 25\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	1.96	2.30	
		$I_C = 50\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	2.66	3.08	
Diode reverse leakage current	I_{RM}	$V_R = V_R$ rated	-	4	50	μA
		$T_J = 125\text{ }^\circ\text{C}, V_R = V_R$ rated	-	0.6	3.0	mA
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	$I_C = 50\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}$	-	400	-	nC
Gate to emitter charge (turn-on)	Q_{ge}		-	43	-	
Gate to collector charge (turn-on)	Q_{gc}		-	187	-	
Turn-on switching loss	E_{on}	$I_C = 50\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, R_g = 5\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$ Energy losses include tail and diode recovery (see fig. 18)	-	2.72	-	mJ
Turn-off switching loss	E_{off}		-	1.11	-	
Total switching loss	E_{tot}		-	3.83	-	
Turn-on switching loss	E_{on}		-	3.94	-	
Turn-off switching loss	E_{off}		-	2.31	-	ns
Total switching loss	E_{tot}		-	6.25	-	
Turn-on delay time	$t_{d(on)}$		-	191	-	
Rise time	t_r		-	53	-	
Turn-off delay time	$t_{d(off)}$		-	223	-	ns
Fall time	t_f		-	143	-	
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 150\text{ A}, R_g = 22\text{ }\Omega, V_{GE} = 15\text{ V to } 0\text{ V}, V_{CC} = 900\text{ V}, V_P = 1200\text{ V}$	Fullsquare			
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}, di_F/dt = 200\text{ A}/\mu\text{s}, V_R = 200\text{ V}$	-	129	161	ns
Diode peak reverse current	I_{rr}		-	11	14	A
Diode recovery charge	Q_{rr}		-	700	1046	nC
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}, di_F/dt = 200\text{ A}/\mu\text{s}, V_R = 200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	208	257	ns
Diode peak reverse current	I_{rr}		-	17	21	A
Diode recovery charge	Q_{rr}		-	1768	2698	nC



THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL		MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	T_J, T_{Stg}		- 40	-	150	°C
Junction to case	IGBT	R_{thJC}	-	-	0.29	°C/W
	Diode		-	-	0.45	
Case to heatsink	R_{thCS}	Flat, greased surface	-	0.05	-	
Weight			-	30	-	g
Mounting torque			-	-	1.3	Nm
Case style	SOT-227					

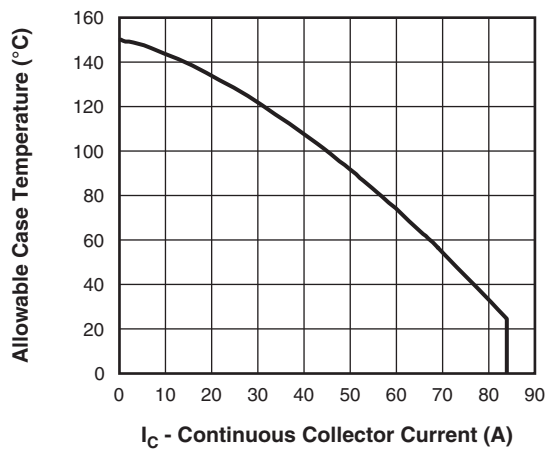


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

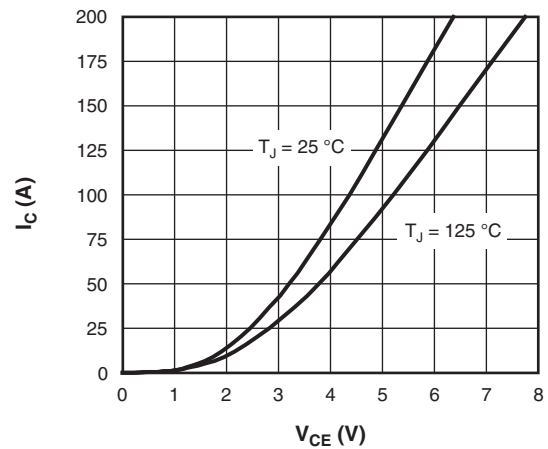


Fig. 3 - Typical IGBT Collector Current Characteristics

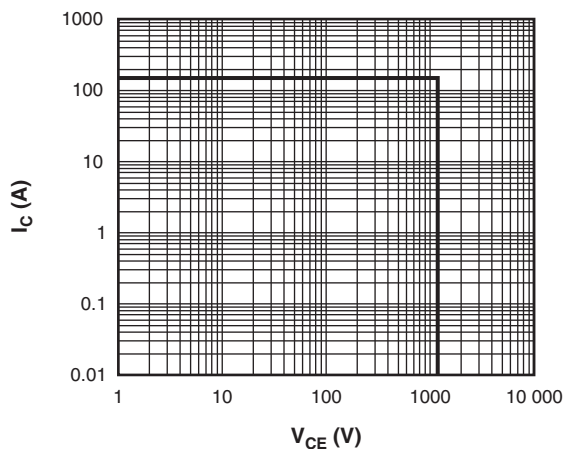


Fig. 2 - IGBT Reverse Bias SOA
T_J = 150 °C, V_{GE} = 15 V

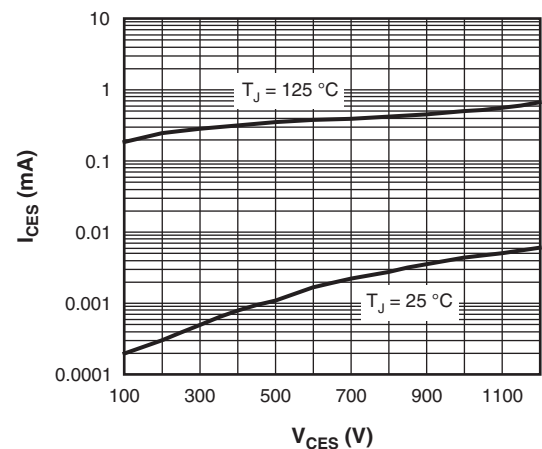


Fig. 4 - Typical IGBT Zero Gate Voltage Collector Current

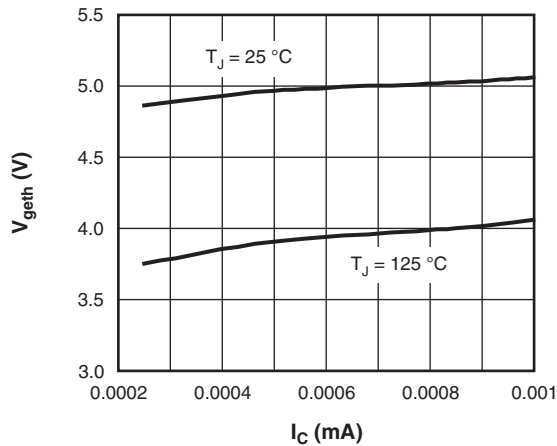


Fig. 5 - Typical IGBT Threshold Voltage

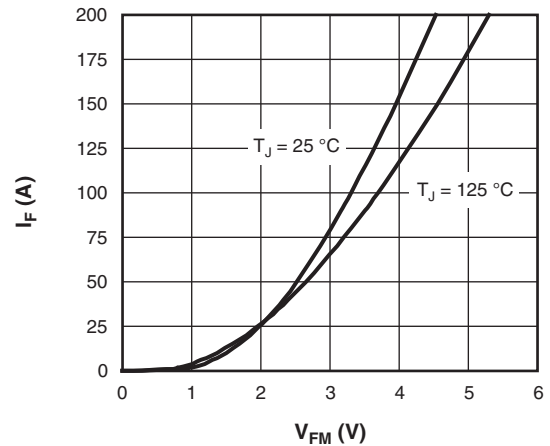


Fig. 8 - Typical Diode Forward Characteristics

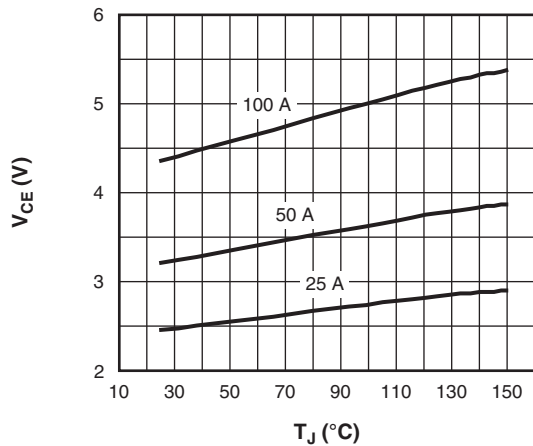


Fig. 6 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature, $V_{GE} = 15\text{ V}$

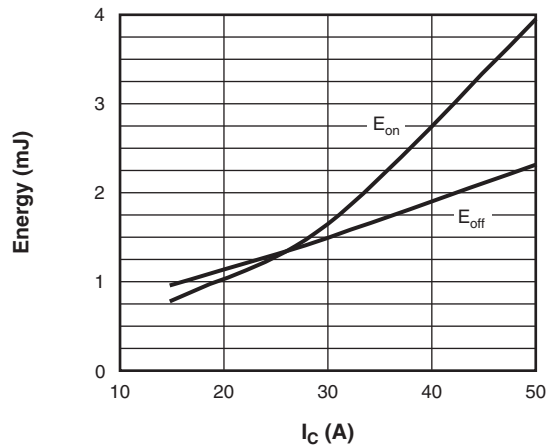


Fig. 9 - Typical IGBT Energy Loss vs. I_c
 $T_J = 125\text{ °C}$, $L = 500\text{ }\mu\text{H}$, $V_{CC} = 600\text{ V}$,
 $R_g = 5\text{ }\Omega$, $V_{GE} = 15\text{ V}$

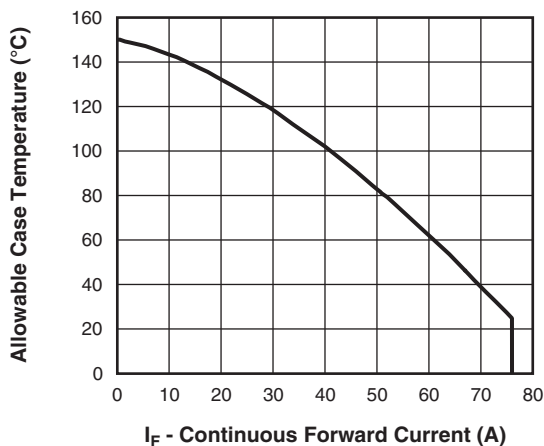


Fig. 7 - Maximum DC Forward Current vs. Case Temperature

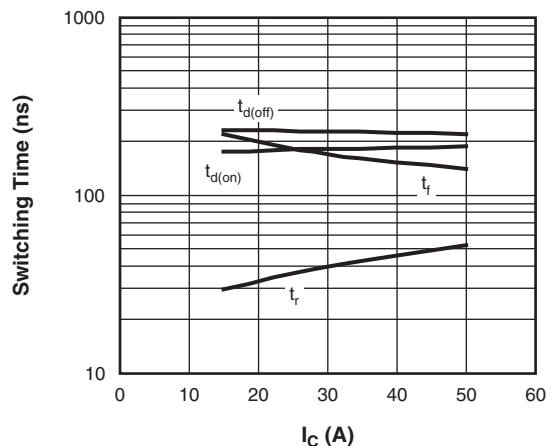


Fig. 10 - Typical IGBT Switching Time vs. I_c
 $T_J = 125\text{ °C}$, $L = 500\text{ }\mu\text{H}$, $V_{CC} = 600\text{ V}$,
 $R_g = 5\text{ }\Omega$, $V_{GE} = 15\text{ V}$

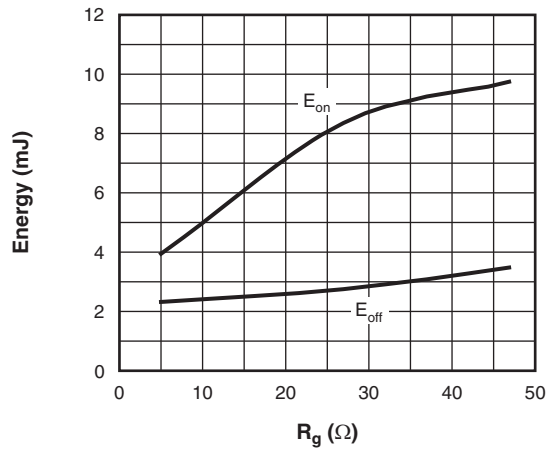


Fig. 11 - Typical IGBT Energy Loss vs. R_g
 $T_J = 125^\circ\text{C}$, $I_C = 50\text{ A}$, $L = 500\ \mu\text{H}$,
 $V_{CC} = 600\text{ V}$, $V_{GE} = 15\text{ V}$

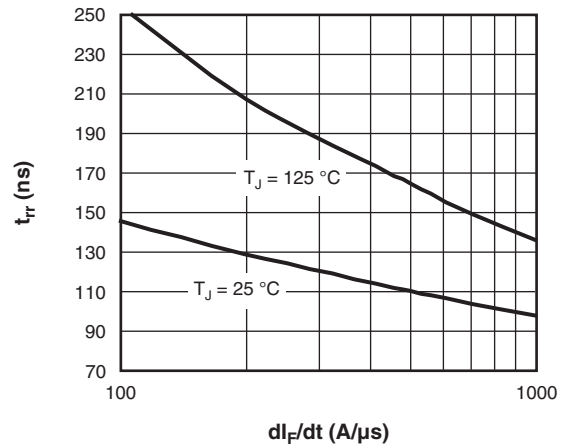


Fig. 13 - Typical t_{rr} Diode vs. dI_F/dt
 $V_R = 200\text{ V}$, $I_F = 50\text{ A}$

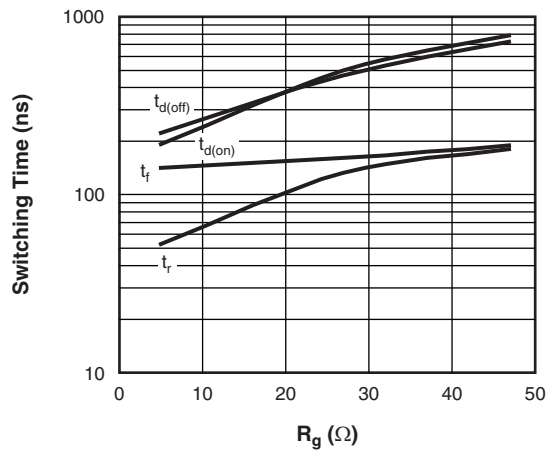


Fig. 12 - Typical IGBT Switching Time vs. R_g
 $T_J = 125^\circ\text{C}$, $L = 500\ \mu\text{H}$, $V_{CC} = 600\text{ V}$,
 $I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$

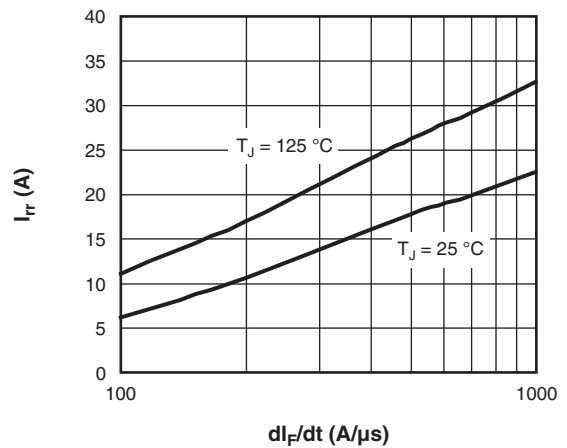


Fig. 14 - Typical I_{rr} Diode vs. dI_F/dt
 $V_R = 200\text{ V}$, $I_F = 50\text{ A}$

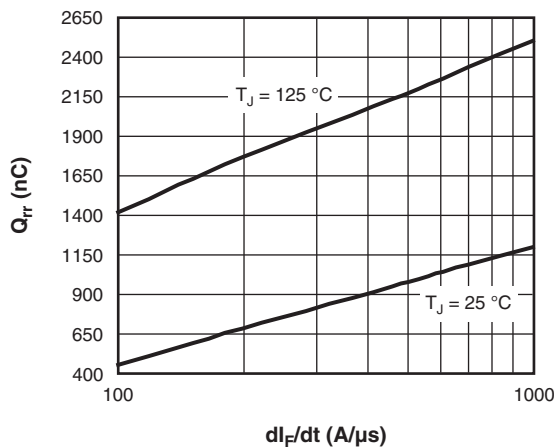


Fig. 15 - Typical Q_{rr} Diode vs. dI_F/dt , $V_R = 200\text{ V}$, $I_F = 50\text{ A}$

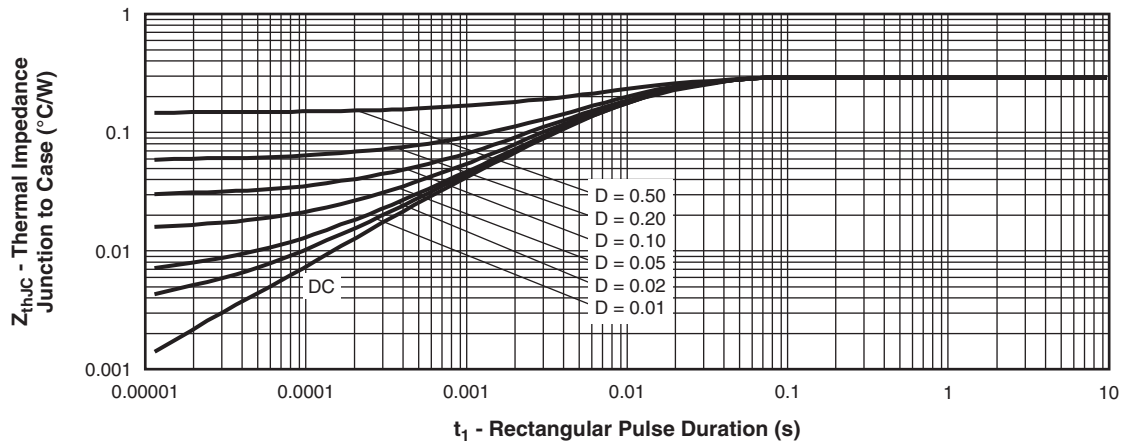


Fig. 16 - Maximum Thermal Impedance Z_{thJC} Characteristics (IGBT)

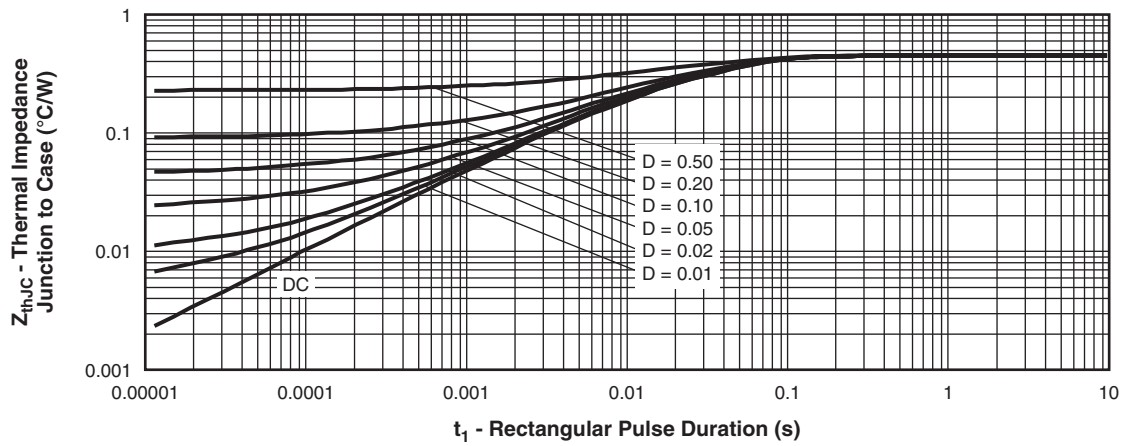
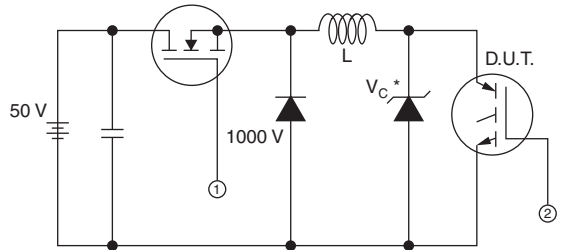


Fig. 17 - Maximum Thermal Impedance Z_{thJC} Characteristics (Diode)



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

Fig. 18a - Clamped Inductive Load Test Circuit

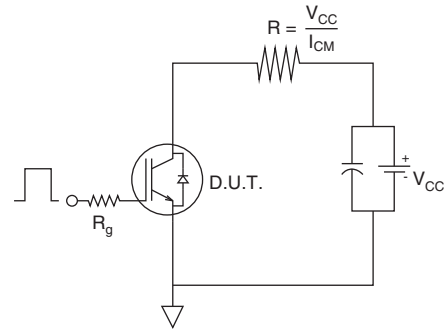


Fig. 18b - Pulsed Collector Current Test Circuit

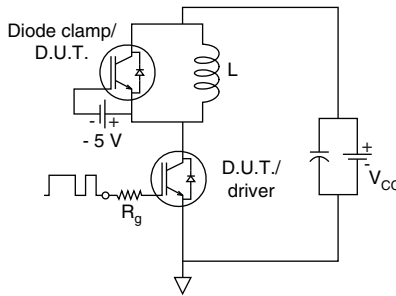


Fig. 19a - Switching Loss Test Circuit

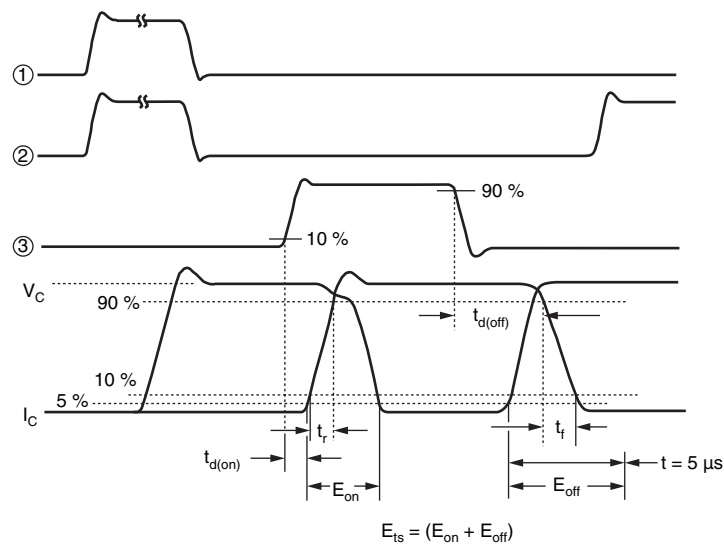
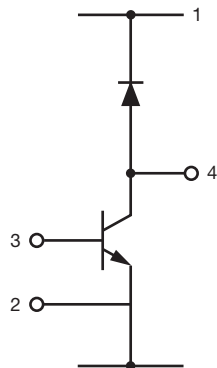


Fig. 19b - Switching Loss Waveforms Test Circuit

ORDERING INFORMATION TABLE

Device code	VS-	G	B	50	L	A	120	U	X
	①	②	③	④	⑤	⑥	⑦	⑧	⑨

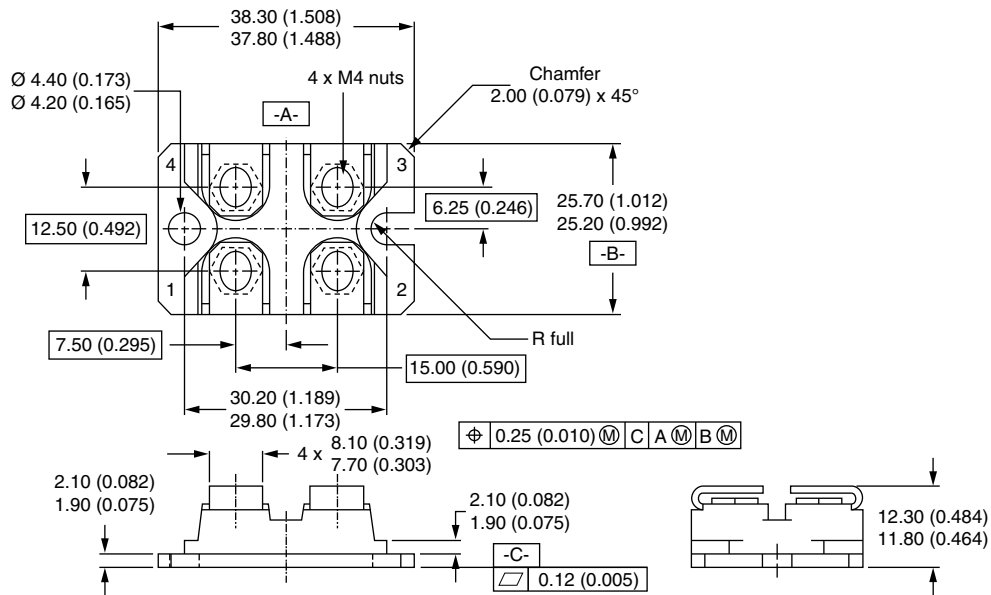
- 1** - Vishay Semiconductors product
- 2** - Insulated Gate Bipolar Transistor (IGBT)
- 3** - B = IGBT Generation 5
- 4** - Current rating (50 = 50 A)
- 5** - Circuit configuration (L = Low side chopper)
- 6** - Package indicator (A = SOT-227)
- 7** - Voltage rating (120 = 1200 V)
- 8** - Speed/type (U = Ultrafast IGBT)
- 9** - X = F/W HEXFRED® diode

CIRCUIT CONFIGURATION

LINKS TO RELATED DOCUMENTS

Dimensions	www.vishay.com/doc?95036
Packaging information	www.vishay.com/doc?95037

SOT-227

DIMENSIONS in millimeters (inches)



Notes

- Dimensioning and tolerancing per ANSI Y14.5M-1982
- Controlling dimension: millimeter



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