

“Low Side Chopper” IGBT SOT-227, 650 V, 50 A




SOT-227



RoHS
COMPLIANT

FEATURES

- Trench IGBT technology
- Higher switching frequency up to 150 kHz
- Square RBSOA
- Low $V_{CE(on)}$
- FRED Pt® Gen 4 clamping diode
- 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 to heatsink
- Plug-in compatible with other SOT-227 packages
- Lower conduction losses and switching losses
- Low EMI, requires less snubbing

PRIMARY CHARACTERISTICS

V_{CES}	650 V
I_C DC	50 A at 59 °C
$V_{CE(on)}$ typical at 50 A, 25 °C	1.70 V
I_F DC	50 A at 25 °C
Package	SOT-227
Circuit configuration	Low side chopper

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V_{CES}		650	V
Continuous collector current	I_C	$T_C = 25$ °C	59	A
		$T_C = 80$ °C	44	
Pulsed collector current	I_{CM}	$V_{GE} = 15$ V	135	
Clamped inductive load current	I_{LM}		125	
Diode continuous forward current	I_F	$T_C = 25$ °C	50	
		$T_C = 80$ °C	38	
Single pulse forward current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, $T_J = 25$ °C	234	
Gate to emitter voltage	V_{GE}		± 20	V
Power dissipation, IGBT	P_D	$T_C = 25$ °C	163	W
		$T_C = 80$ °C	103	
Power dissipation, diode	P_D	$T_C = 25$ °C	127	
		$T_C = 80$ °C	81	
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	$V_{BR(CE)}$	$V_{GE} = 0\text{ V}, I_C = 0.2\text{ mA}$	650	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 50\text{ A}$	-	1.70	2.10	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = 15\text{ V}, I_C = 50\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	2.01	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 0.5\text{ mA}$	2.8	4.0	5.3	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 0.5\text{ mA}$ ($25\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$)	-	-9.8	-	mV/ $^\circ\text{C}$
Transfer characteristics	V_{GE}	$V_{CE} = 20\text{ V}, I_C = 50\text{ A}$	-	6.4	-	V
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}$	-	0.3	40	μA
		$V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	20	-	
Diode reverse breakdown voltage	V_{BR}	$I_R = 0.5\text{ mA}$	650	-	-	V
Diode forward voltage drop	V_{FM}	$I_F = 50\text{ A}, V_{GE} = 0\text{ V}$	-	1.96	3.01	V
		$I_F = 50\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	1.64	-	
Diode reverse leakage current	I_{RM}	$V_R = 650\text{ V}$	-	0.3	80	μA
		$T_J = 125\text{ }^\circ\text{C}, V_R = 650\text{ V}$	-	50	-	
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	$I_C = 50\text{ A}, V_{CC} = 520\text{ V}, V_{GE} = 15\text{ V}$	-	123	-	nC	
Gate to emitter charge (turn-on)	Q_{ge}		-	19	-		
Gate to collector charge (turn-on)	Q_{gc}		-	35	-		
Turn-on switching loss	E_{on}	$I_C = 50\text{ A}, V_{CC} = 325\text{ V}, V_{GE} = 15\text{ V}, R_g = 4.7\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$	-	0.53	-	mJ	
Turn-off switching loss	E_{off}		-	0.19	-		
Total switching loss	E_{tot}		-	0.72	-		
Turn-on delay time	$t_{d(on)}$		-	11	-		
Rise time	t_r		-	44	-		
Turn-off delay time	$t_{d(off)}$		-	80	-		
Fall time	t_f		-	13	-		
Turn-on switching loss	E_{on}		$I_C = 50\text{ A}, V_{CC} = 325\text{ V}, V_{GE} = 15\text{ V}, R_g = 4.7\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$	-	0.68		-
Turn-off switching loss	E_{off}			-	0.27		-
Total switching loss	E_{tot}			-	0.95		-
Turn-on delay time	$t_{d(on)}$	-		45	-		
Rise time	t_r	-		13	-		
Turn-off delay time	$t_{d(off)}$	-		88	-		
Fall time	t_f	-	19	-	ns		
Reverse bias safe operating area	RBSOA	$T_J = 175\text{ }^\circ\text{C}, I_C = 125\text{ A}, R_g = 4.7\text{ }\Omega, V_{GE} = 15\text{ V to } 0\text{ V}, V_{CC} = 325\text{ V}, V_P = 650\text{ V}$	Fullsquare				
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}, dI_F/dt = 500\text{ A}/\mu\text{s}, V_R = 400\text{ V}$	-	89	-	ns	
Diode peak reverse current	I_{rr}		-	7.3	-	A	
Diode recovery charge	Q_{rr}		-	294	-	nC	
Diode reverse recovery time	t_{rr}	$I_F = 50\text{ A}, dI_F/dt = 500\text{ A}/\mu\text{s}, V_R = 400\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	149	-	ns	
Diode peak reverse current	I_{rr}		-	16	-	A	
Diode recovery charge	Q_{rr}		-	1196	-	nC	



THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	T_J, T_{Stg}		-40	-	175	°C
Junction to case	IGBT	R_{thJC}	-	-	0.92	°C/W
	Diode		-	-	1.18	
Case to heatsink	R_{thCS}	Flat, greased surface	-	0.05	-	
Weight			-	30	-	g
Mounting torque		Torque to terminal	-	-	1.1 (9.7)	Nm (lb.in)
		Torque to heatsink	-	-	1.8 (15.9)	Nm (lb.in)
Case style	SOT-227					

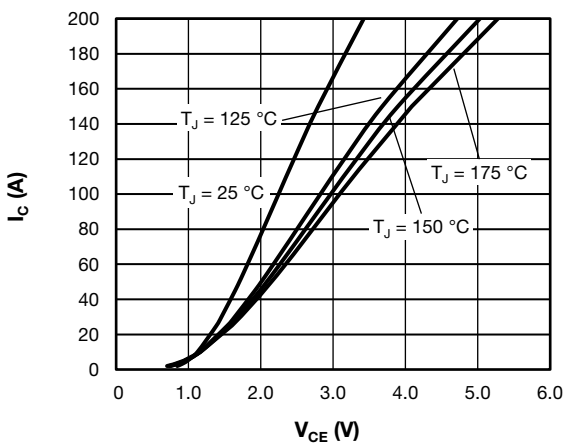


Fig. 1 - Typical Trench IGBT Output Characteristics, $V_{GE} = 15\text{ V}$

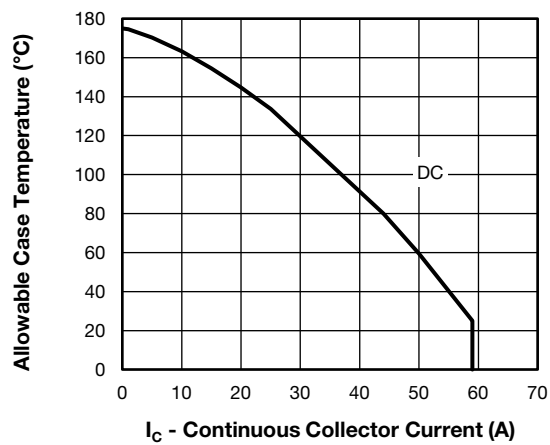


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature

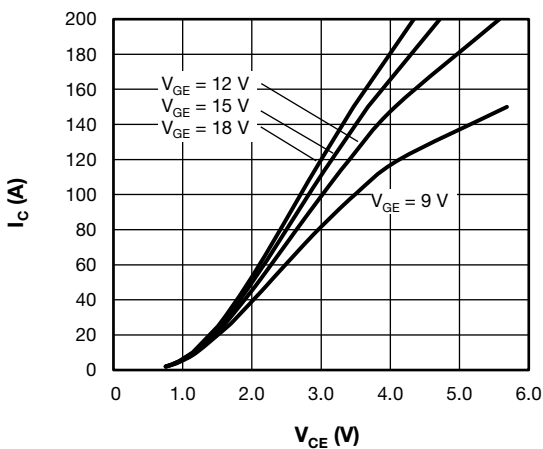


Fig. 2 - Typical Trench IGBT Output Characteristics, $T_J = 125\text{ °C}$

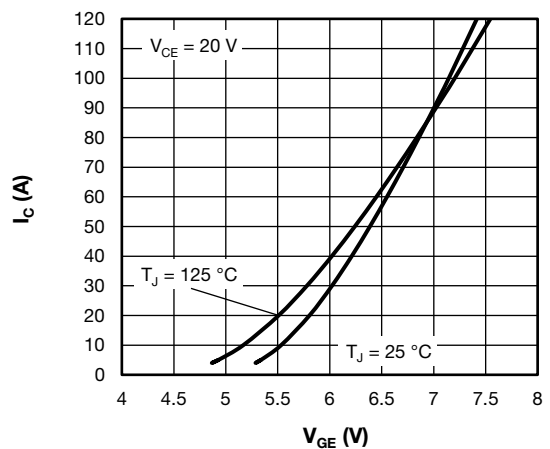


Fig. 4 - Typical Trench IGBT Transfer Characteristics

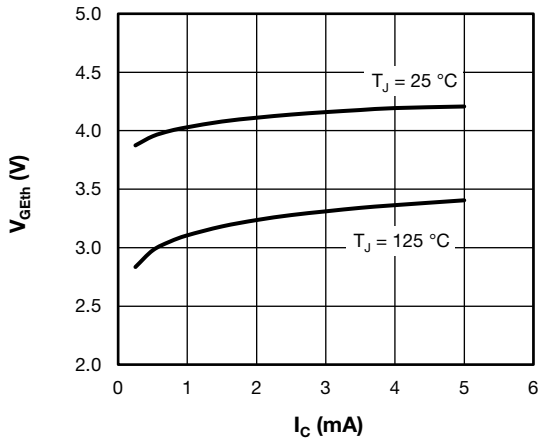


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

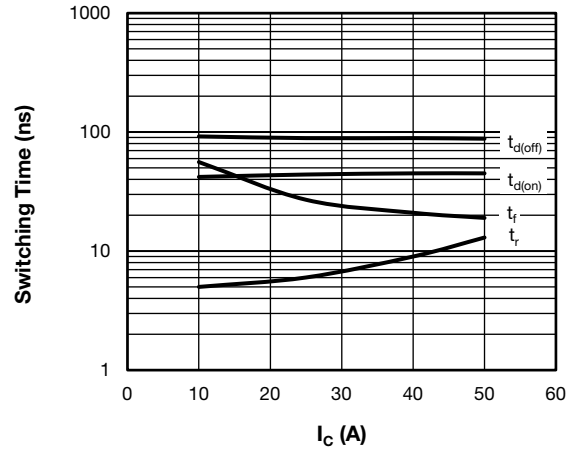


Fig. 8 - Typical Trench IGBT Switching Time vs. I_C
(with Antiparallel Diode)
 $T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 325\text{ V}$, $R_g = 4.7\text{ }\Omega$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\text{ }\mu\text{H}$

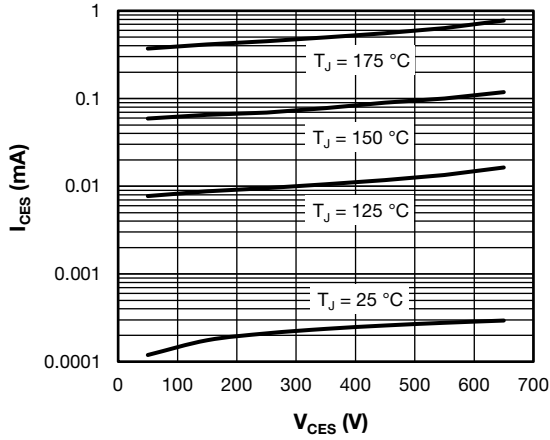


Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

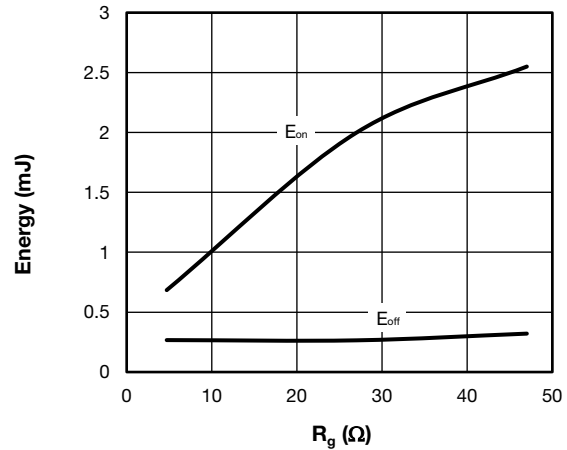


Fig. 9 - Typical Trench IGBT Energy Loss vs. R_g
(with Antiparallel Diode)
 $T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 325\text{ V}$, $I_C = 50\text{ A}$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\text{ }\mu\text{H}$

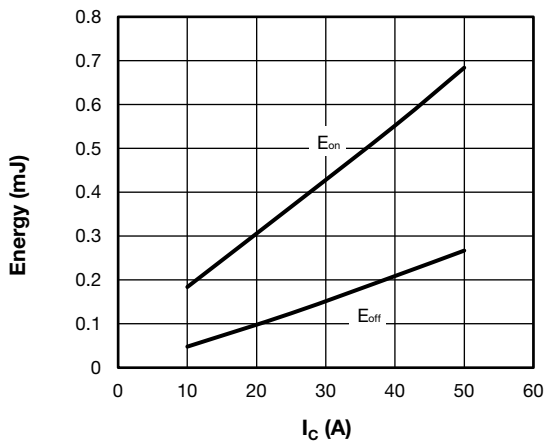


Fig. 7 - Typical Trench IGBT Energy Loss vs. I_C
(with Antiparallel Diode)
 $T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 325\text{ V}$, $R_g = 4.7\text{ }\Omega$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\text{ }\mu\text{H}$

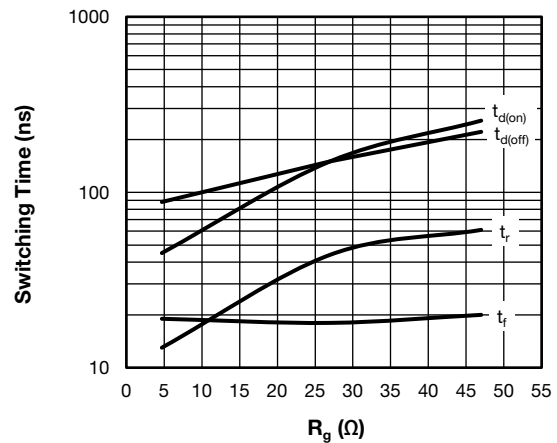


Fig. 10 - Typical Trench IGBT Switching Time vs. R_g
(with Antiparallel Diode)
 $T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 325\text{ V}$, $I_C = 50\text{ A}$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\text{ }\mu\text{H}$

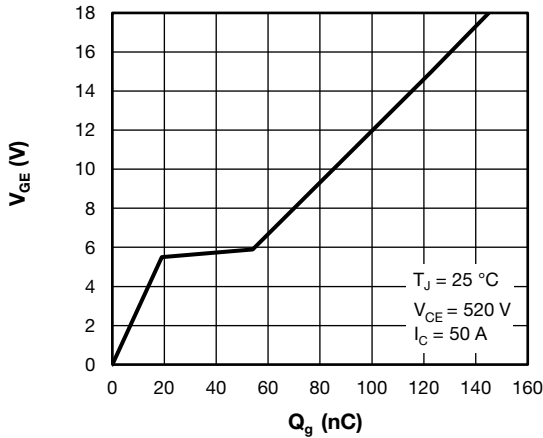


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Emitter Voltage

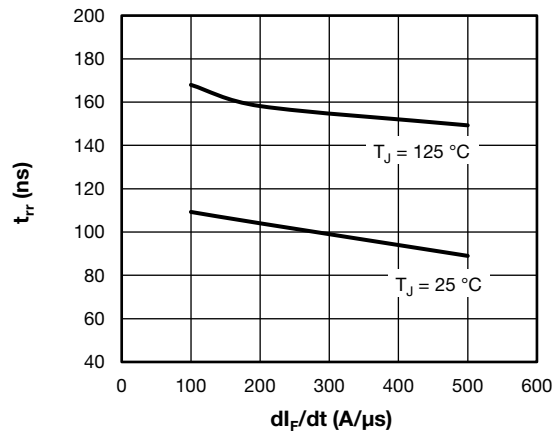


Fig. 14 - Typical Diode Reverse Recovery Time vs. di_F/dt
 $I_F = 50$ A, $V_{CC} = 400$ V

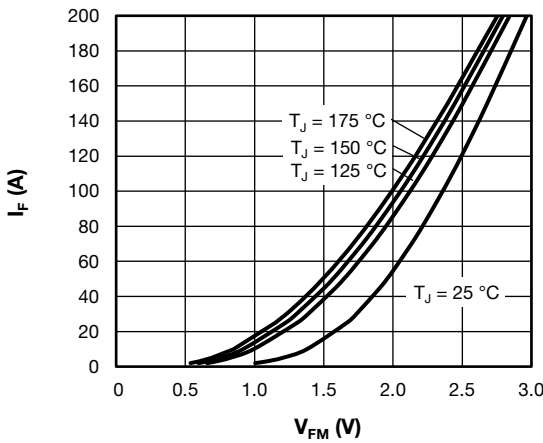


Fig. 12 - Typical Diode Forward Characteristics

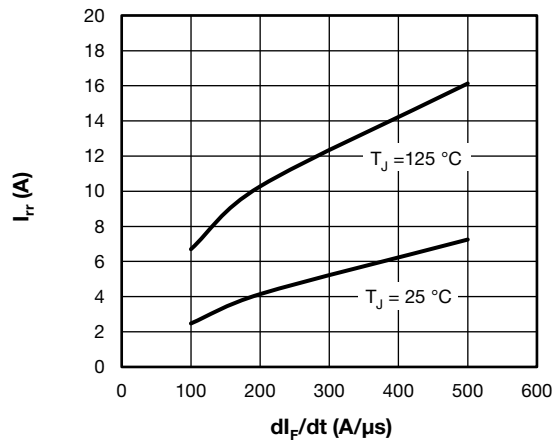


Fig. 15 - Typical Diode Reverse Recovery Current vs. di_F/dt
 $I_F = 50$ A, $V_{CC} = 400$ V

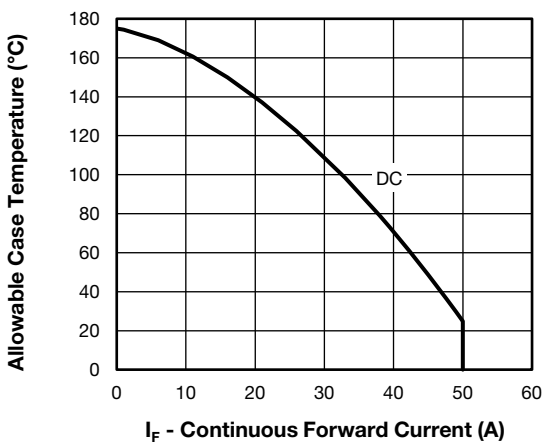


Fig. 13 - Maximum Diode Continuous Forward Current vs. Case Temperature

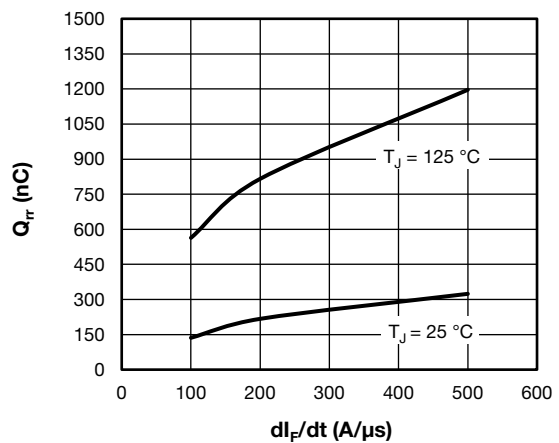


Fig. 16 - Typical Diode Reverse Recovery Charge vs. di_F/dt
 $I_F = 50$ A, $V_{CC} = 400$ V

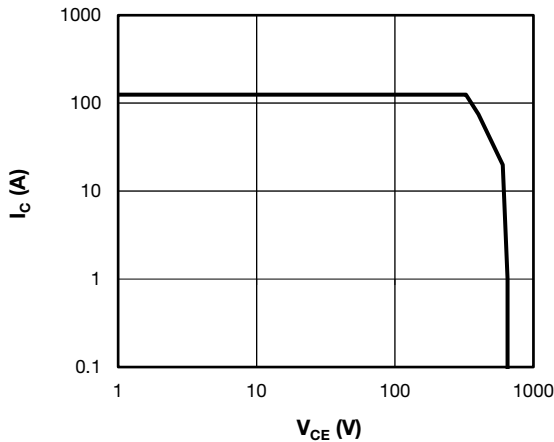


Fig. 17 - Trench IGBT Reverse BIAS SOA
 $T_J = 175\text{ }^\circ\text{C}$, $I_C = 125\text{ A}$, $R_g = 4.7\ \Omega$, $V_{GE} = +15\text{ V/0 V}$, $V_{CC} = 325\text{ V}$,
 $V_p = 650\text{ V}$

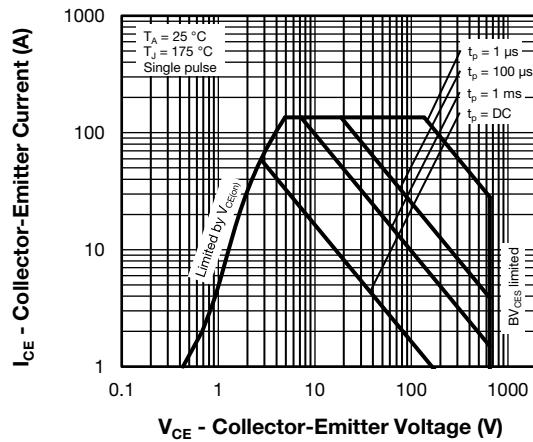


Fig. 18 - Trench IGBT Safe Operating Area

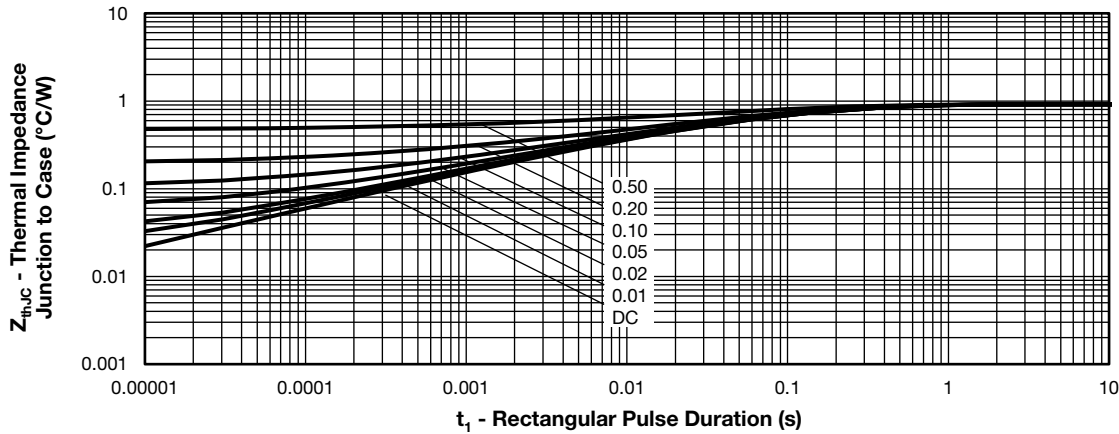


Fig. 19 - Maximum Trench IGBT Thermal Impedance Z_{thJC} Characteristics

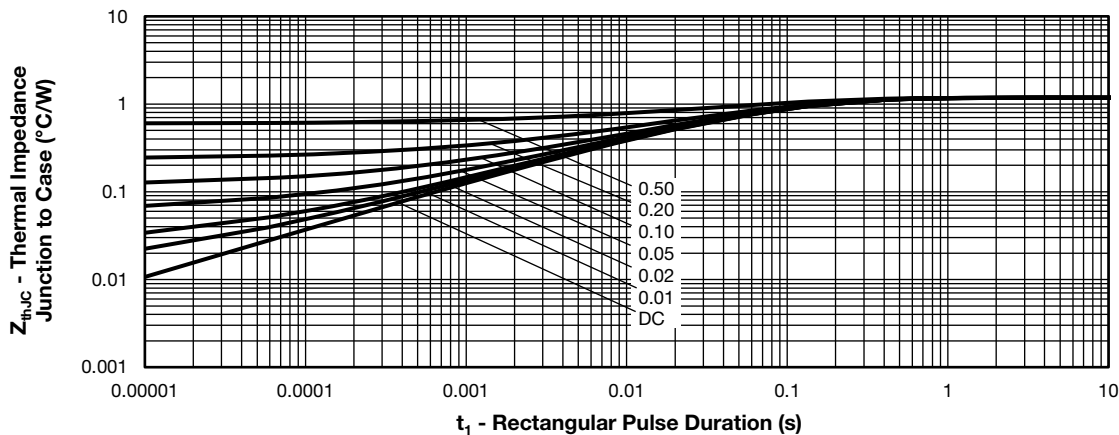


Fig. 20 - Maximum Diode Thermal Impedance Z_{thJC} Characteristics

ORDERING INFORMATION TABLE

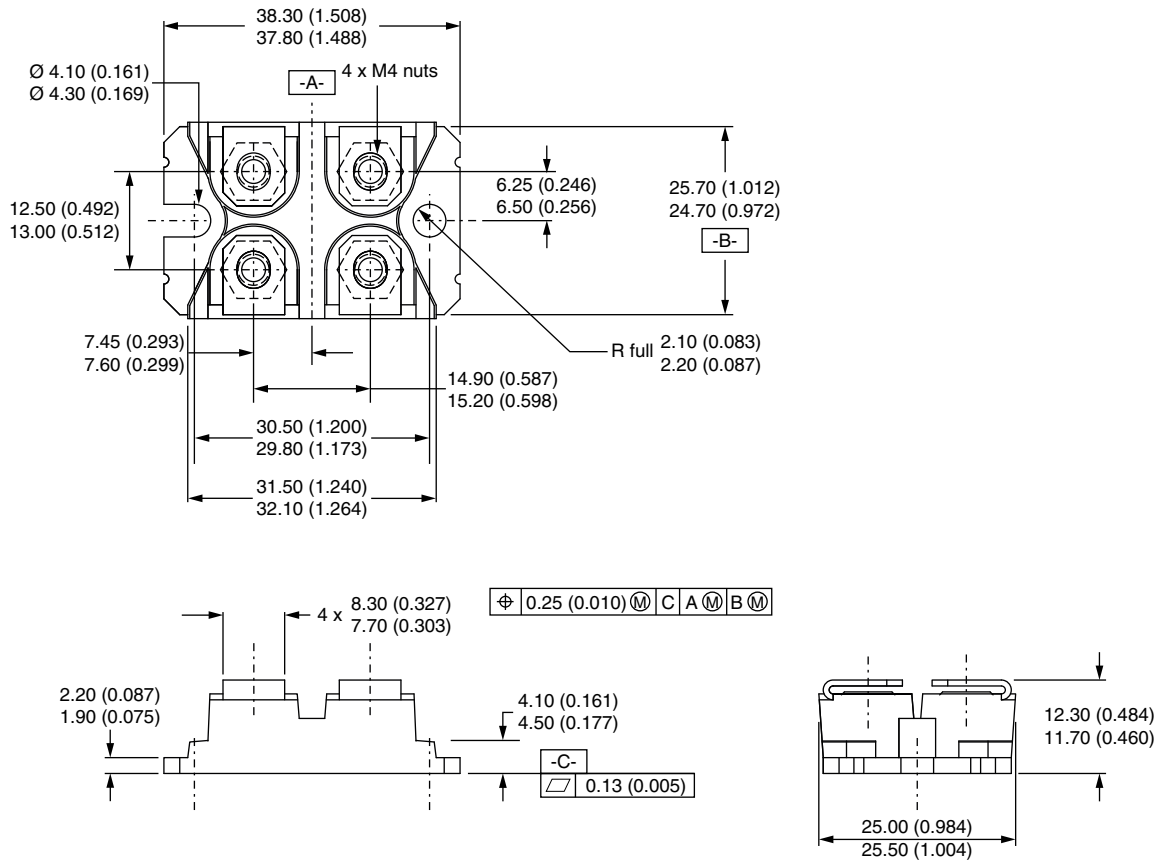
Device code	VS-	G	T	50	L	A	65	U	F
	①	②	③	④	⑤	⑥	⑦	⑧	⑨

- 1** - Vishay Semiconductors product
- 2** - Insulated gate bipolar transistor (IGBT)
- 3** - T = Trench IGBT technology
- 4** - Current rating (50 = 50 A)
- 5** - Circuit configuration (L = low side chopper)
- 6** - Package indicator (A = SOT-227)
- 7** - Voltage rating (65 = 650 V)
- 8** - Speed/type (U = ultrafast IGBT)
- 9** - Diode (F = FRED Pt[®] diode)

CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Low side chopper	L	<p>Lead Assignment</p>

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

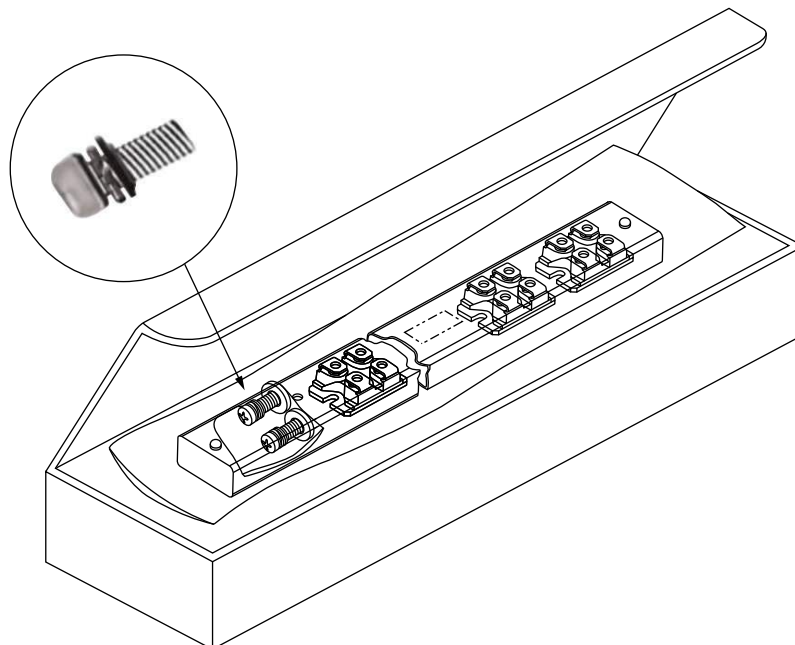
DIMENSIONS in millimeters (inches)



Note

- Controlling dimension: millimeter

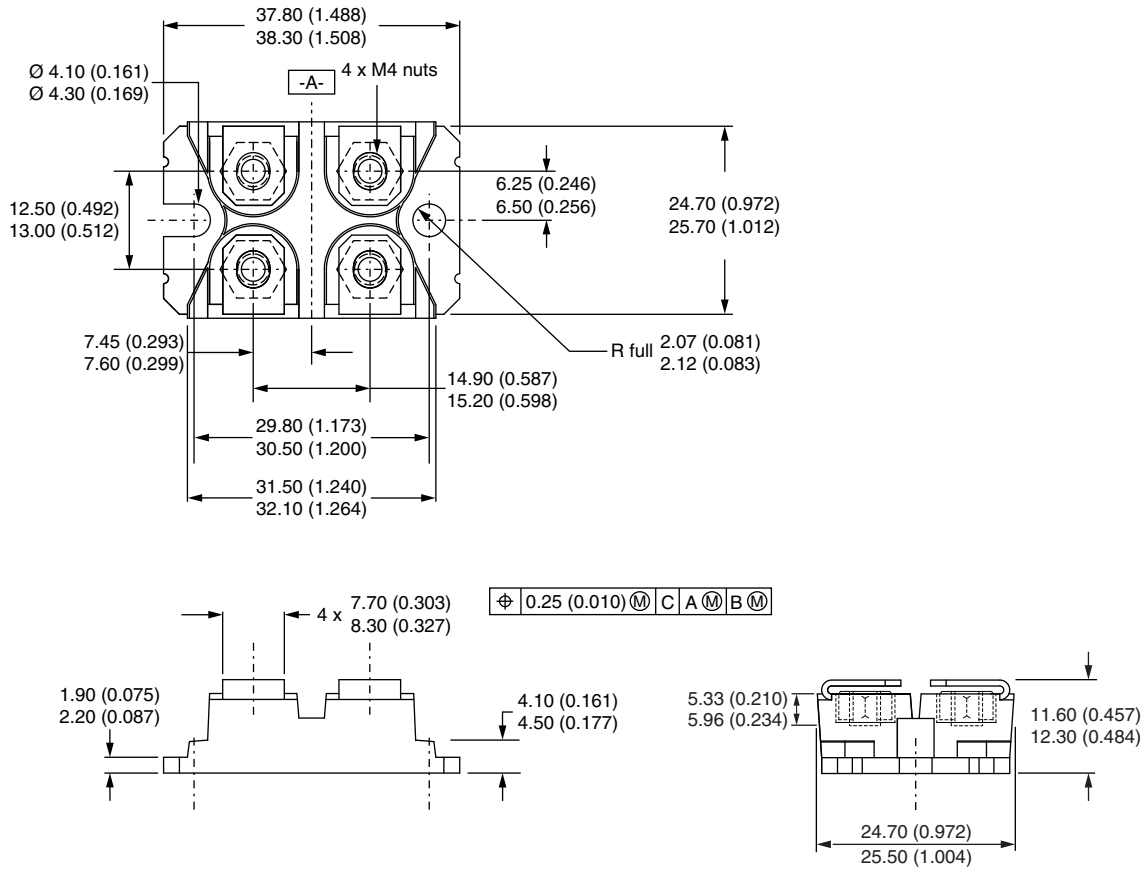
PACKAGING INFORMATION





SOT-227 Generation 2

DIMENSIONS in millimeters (inches)



Note

- Controlling dimension: millimeter



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