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

SOT-227

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

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

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
- Lower conduction losses and switching losses
- Low EMI, requires less snubbing

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 °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 = 0.2 mA	650	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 50 A	-	1.70	2.10	
		V_{GE} = 15 V, I_C = 50 A, T_J = 125 °C	-	2.01	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 0.5 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 mA (25 °C to 125 °C)	-	-9.8	-	mV/°C
Transfer characteristics	V_{GE}	V_{CE} = 20 V, I_C = 50 A	-	6.4	-	V
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 650 V	-	0.3	40	μA
		V_{GE} = 0 V, V_{CE} = 650 V, T_J = 125 °C	-	20	-	
Diode reverse breakdown voltage	V_{BR}	I_R = 0.5 mA	650	-	-	V
Diode forward voltage drop	V_{FM}	I_F = 50 A, V_{GE} = 0 V	-	1.96	3.01	V
		I_F = 50 A, V_{GE} = 0 V, T_J = 125 °C	-	1.64	-	
Diode reverse leakage current	I_{RM}	V_R = 650 V	-	0.3	80	μA
		T_J = 125 °C, V_R = 650 V	-	50	-	
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 = 50 A, V_{CC} = 520 V, V_{GE} = 15 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 A, V_{CC} = 325 V, V_{GE} = 15 V, R_g = 4.7 Ω, L = 500 μH, T_J = 25 °C	Energy losses include tail and diode recovery	-	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 A, V_{CC} = 325 V, V_{GE} = 15 V, R_g = 4.7 Ω, L = 500 μH, T_J = 125 °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	-	ns
Rise time	t_r			-	13	-	
Turn-off delay time	$t_{d(off)}$			-	88	-	
Fall time	t_f			-	19	-	
Reverse bias safe operating area	RBSOA	T_J = 175°C, I_C = 125 A, R_g = 4.7 Ω, V_{GE} = 15 V to 0 V, V_{CC} = 325 V, V_P = 650 V		Fullsquare			
Diode reverse recovery time	t_{rr}	I_F = 50 A, dI_F/dt = 500 A/μs, V_R = 400 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 A, dI_F/dt = 500 A/μs, V_R = 400 V, T_J = 125 °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 (lbf.in)
			Torque to heatsink	-	-	1.8 (15.9)	Nm (lbf.in)
Case style		SOT-227					

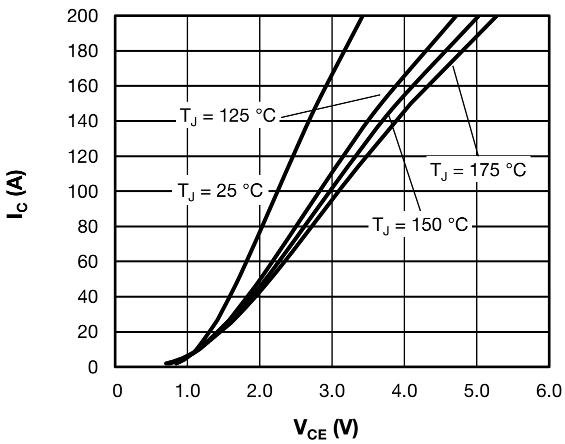


Fig. 1 - Typical Trench IGBT Output Characteristics, V_{GE} = 15 V

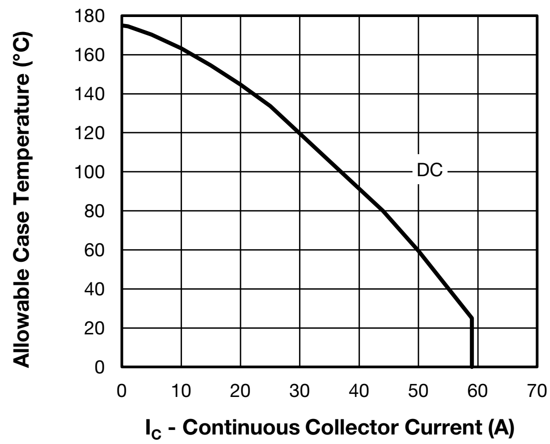


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature

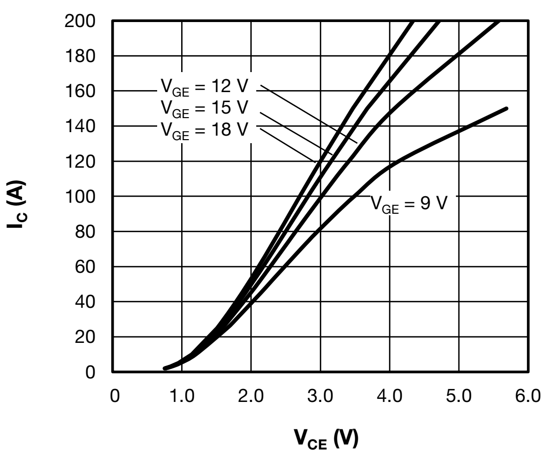


Fig. 2 - Typical Trench IGBT Output Characteristics, T_J = 125 °C

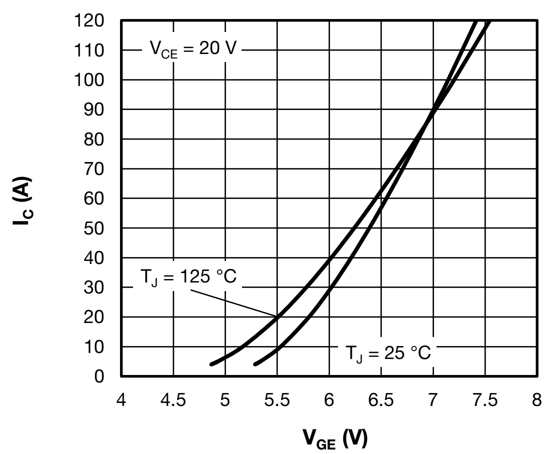


Fig. 4 - Typical Trench IGBT Transfer Characteristics

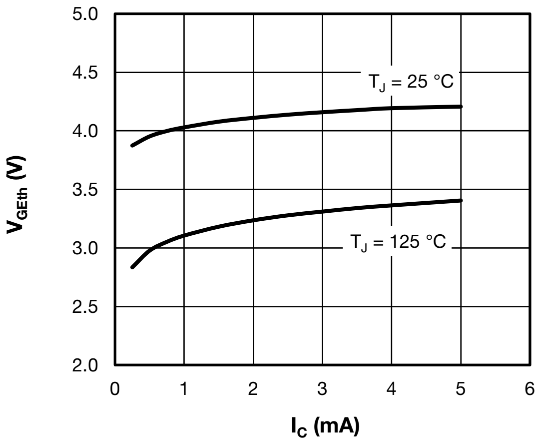


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

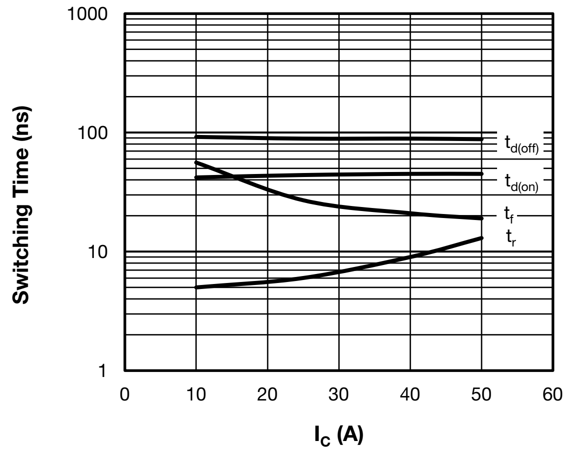


Fig. 8 - Typical Trench IGBT Switching Time vs. I_C
(with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 325 V, R_g = 4.7 Ω, V_{GE} = +15 V/-15 V, L = 500 μH

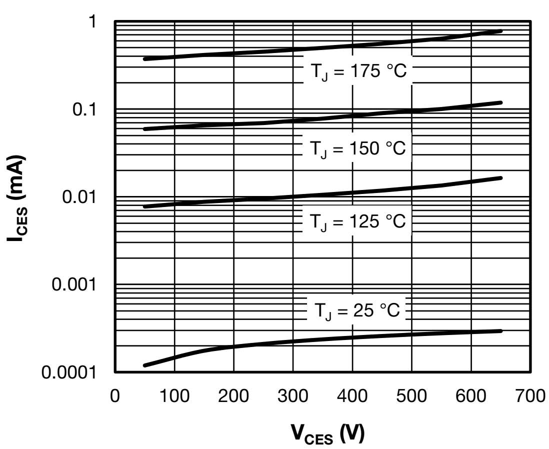


Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

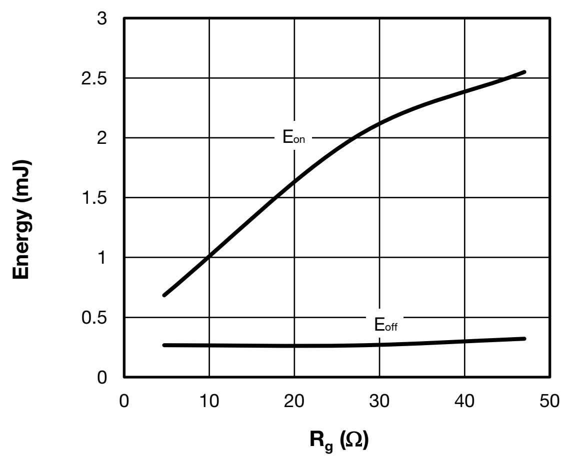


Fig. 9 - Typical Trench IGBT Energy Loss vs. R_g
(with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 325 V, I_C = 50 A, V_{GE} = +15 V/-15 V, L = 500 μH

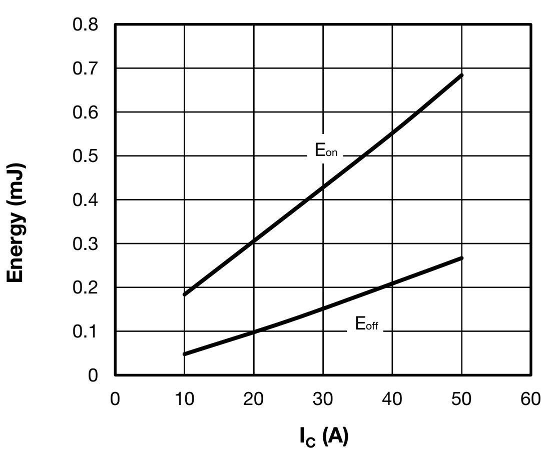


Fig. 7 - Typical Trench IGBT Energy Loss vs. I_C
(with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 325 V, R_g = 4.7 Ω, V_{GE} = +15 V/-15 V, L = 500 μH

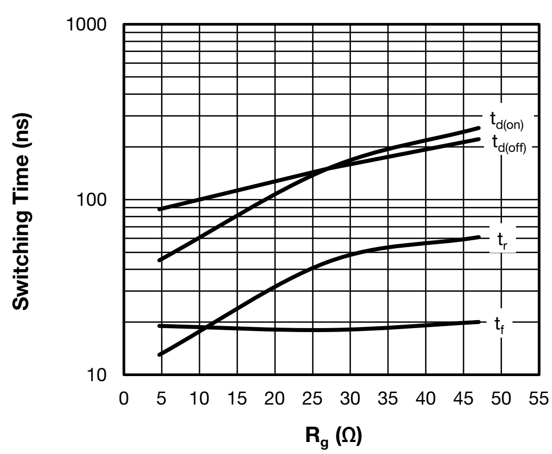


Fig. 10 - Typical Trench IGBT Switching Time vs. R_g
(with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 325 V, I_C = 50 A, V_{GE} = +15 V/-15 V, L = 500 μH

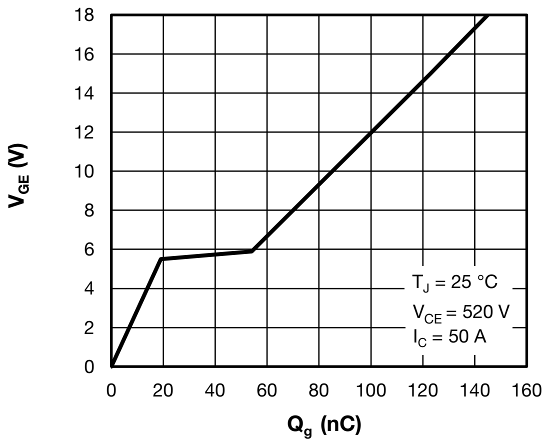


Fig. 11 - Typical Trench IGBT Gate Charge vs.
Gate to Emitter Voltage

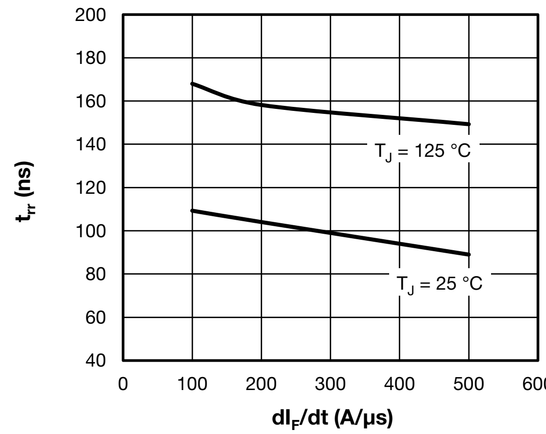


Fig. 14 - Typical Diode Reverse Recovery Time vs. dI_F/dt
$I_F = 50$ A, $V_{CC} = 400$ V

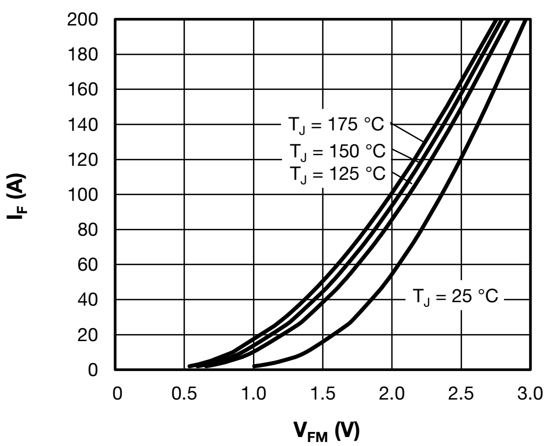


Fig. 12 - Typical Diode Forward Characteristics

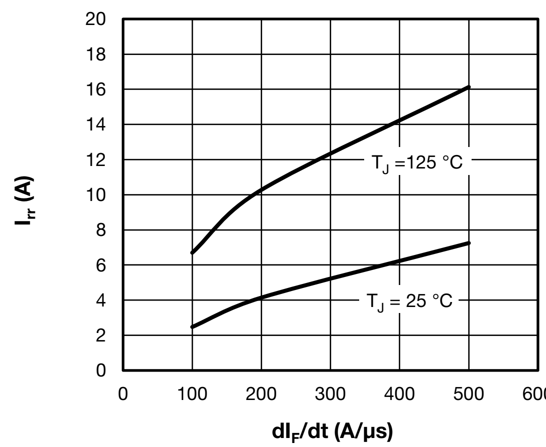


Fig. 15 - Typical Diode Reverse Recovery Current vs. dI_F/dt
$I_F = 50$ A, $V_{CC} = 400$ V

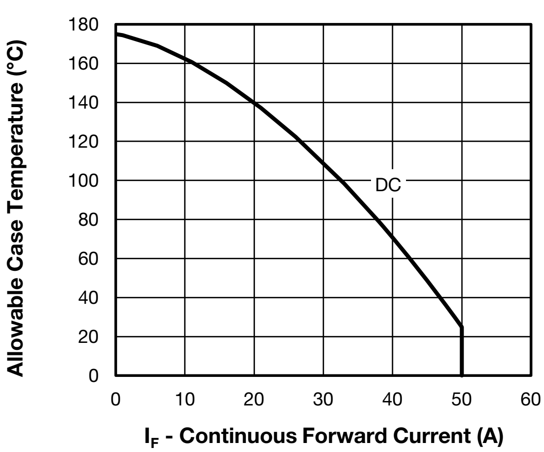


Fig. 13 - Maximum Diode Continuous Forward Current vs.
Case Temperature

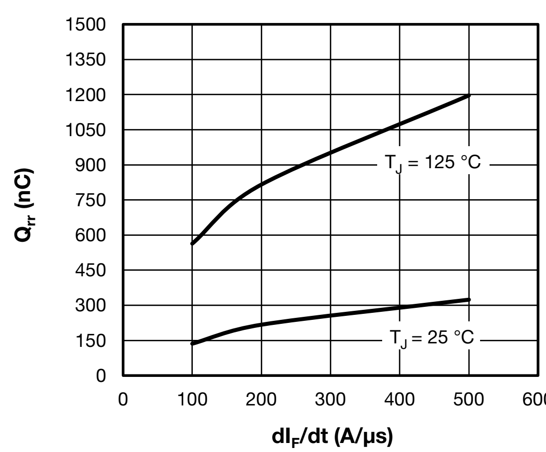


Fig. 16 - Typical Diode Reverse Recovery Charge vs. dI_F/dt
$I_F = 50$ A, $V_{CC} = 400$ V

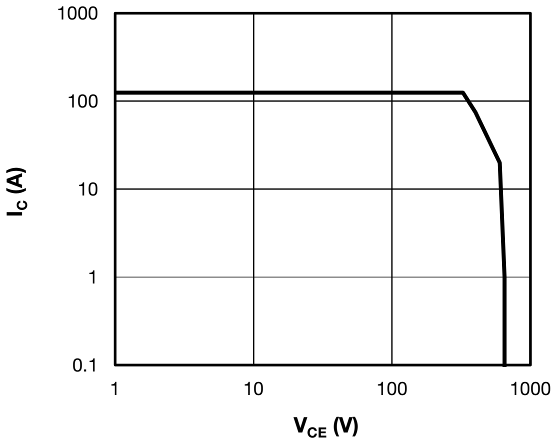


Fig. 17 - Trench IGBT Reverse BIAS SOA
T_J = 175 °C, I_C = 125 A, R_g = 4.7 Ω, V_{GE} = +15 V/0 V, V_{CC} = 325 V, V_p = 650 V

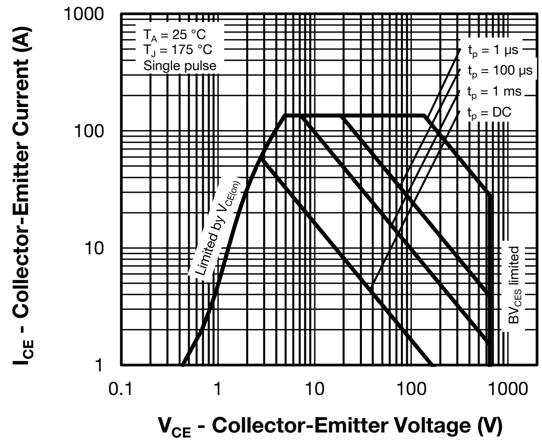


Fig. 18 - Trench IGBT Safe Operating Area

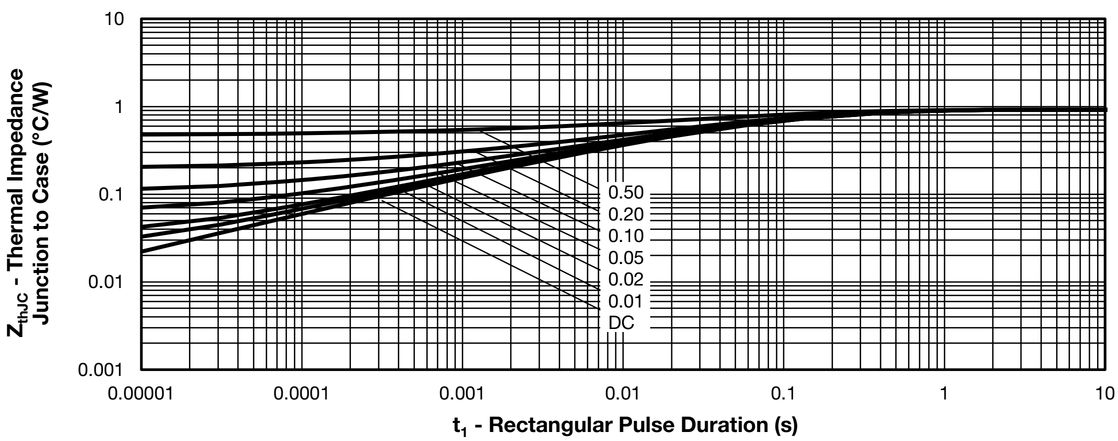


Fig. 19 - Maximum Trench IGBT Thermal Impedance Z_{thJC} Characteristics

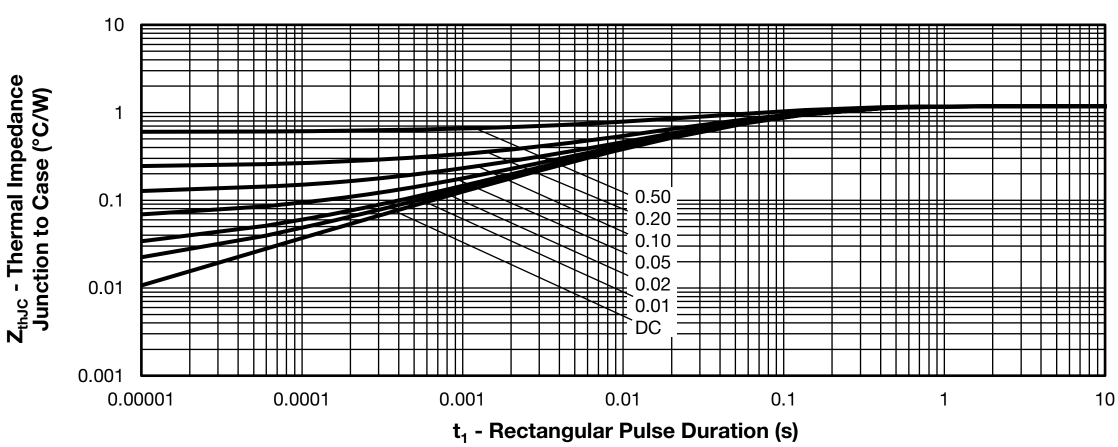
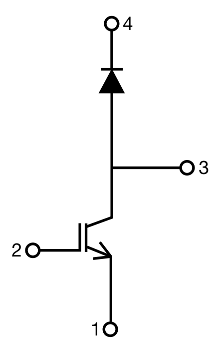
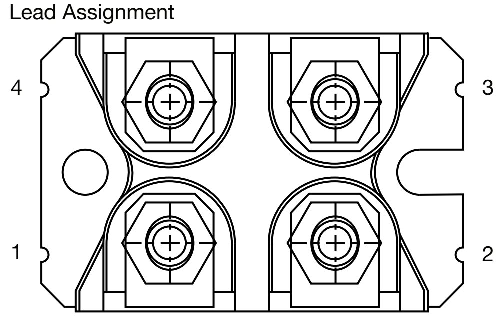


Fig. 20 - Maximum Diode Thermal Impedance Z_{thJC} Characteristics

ORDERING INFORMATION TABLE

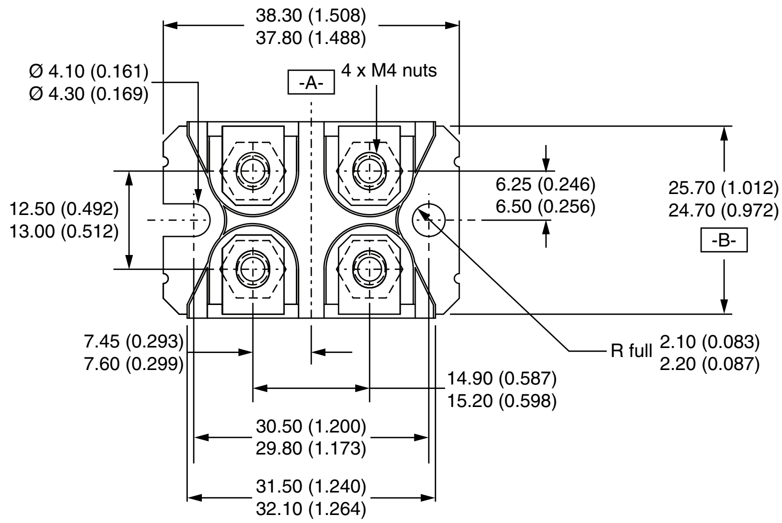
Device code	VS-	G	T	50	L	A	65	U	F
	1	2	3	4	5	6	7	8	9

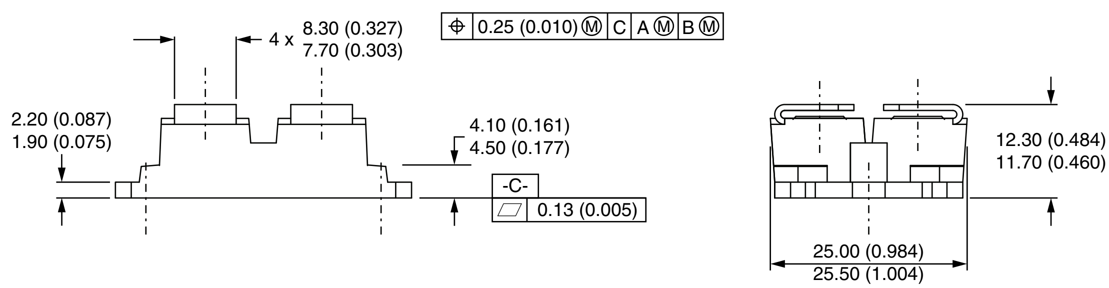
1 - Vishay Semiconductors product
2 - Insulated gate bipolar transistor (IGBT)
3 - T = Trench IGBT technology
4 - Current rating (50 = 50 A)
5 - Circuit configuration (L = low side chopper)
6 - Package indicator (A = SOT-227)
7 - Voltage rating (65 = 650 V)
8 - Speed/type (U = ultrafast IGBT)
9 - Diode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

CIRCUIT CONFIGURATION			
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING	
Low side chopper	L		Lead Assignment 

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

DIMENSIONS in millimeters (inches)

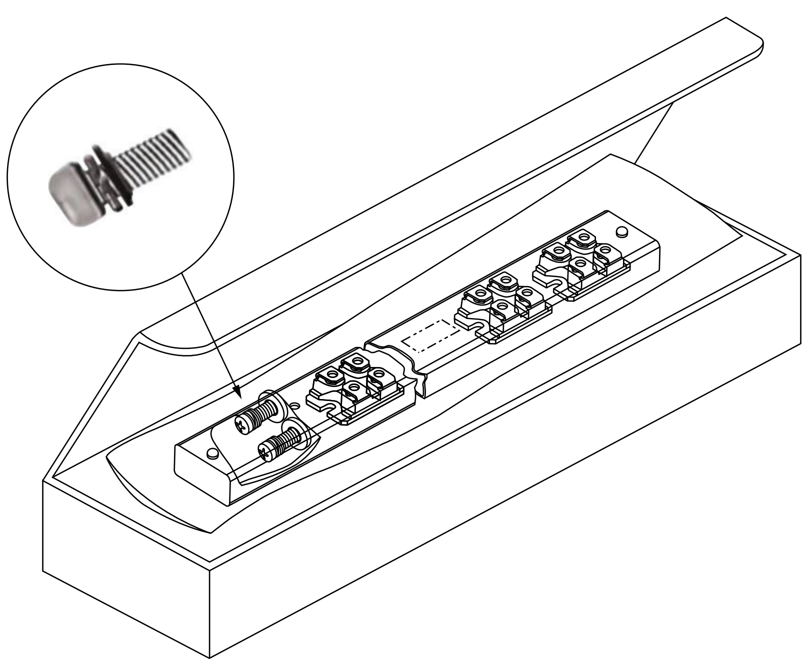




Note

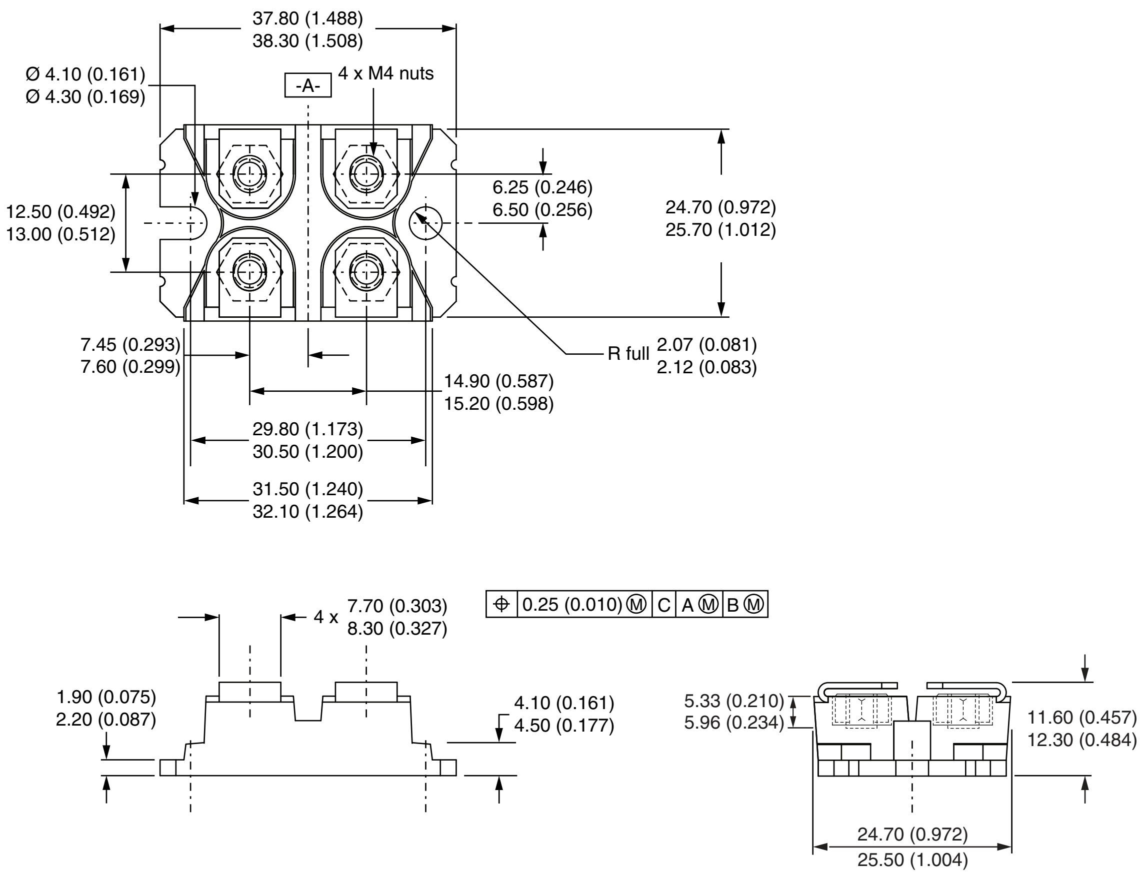
- Controlling dimension: millimeter

PACKAGING INFORMATION



SOT-227 Generation 2

DIMENSIONS in millimeters (inches)



Note

- Controlling dimension: millimeter

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