SOT-227 Power Module
Low Side Chopper - Silicon Carbide Power MOSFET 50 A

SOT-227

FEATURES

- High blocking voltage with low on-resistance
- High speed switching with low capacitance
- Soft body diode with low reverse recovery
- Maximum 175 °C junction temperature
- UL approved file E78996
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

APPLICATIONS

- EV chargers
- Server and telecom PSU
- UPS
- Solar Inverters
- SMPS
- DC/DC converters

PRIMARY CHARACTERISTICS	
V_{DSS}	1200 V
$R_{DS(on)}$ at 50 A	43 mΩ
I_D	30 A at 90 °C
I_F	29 A at 90 °C
Type	Low side chopper - SiC MOSFET Modules
Package	SOT-227

DESCRIPTION

This is an high performance silicon carbide MOSFET. The high blocking voltage with low on-resistance, high speed switching with low capacitance make this MOSFET ideal for high frequency switching application including solar inverters and EV chargers.

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MAX.**	**UNITS**
MOSFET				
Drain to source voltage	V_{DSS}		1200	V
Continuous drain current, V_{GS} at 15 V	I_D	T_C = 25 °C	38	A
		T_C = 90 °C	30	
Pulsed drain current	I_{DM} (1)		100	
Diode continuous forward current	I_F	T_C = 25 °C	40	A
		T_C = 90 °C	29	
Single pulse foward current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, T_J = 25 °C	130	A
Power dissipation per MOSFET	P_D	T_C = 25 °C	136	W
Power dissipation per diode	P_D	T_C = 25 °C	125	W
Gate to source voltage	V_{GS}		-8 / +19	V
MODULE				
Operating junction temperature range	T_J		-55 to +175	°C
Operating storage temperature range	T_{Stg}		-40 to +150	
Insulation voltage (RMS)	V_{ISOL}	any terminal to case, t = 1 min	2500	V

Note

(1) Limited at max. junction temperature

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	RATING	UNITS
Recommended operating gate - source voltage	$V_{GS(op)}$	-4 / +15	V

THERMAL AND MECHANICAL SPECIFICATIONS

PARAMETER		SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating junction temperature range		T_J		-55	-	175	°C
Operating storage temperature range		T_{Stg}		-40	-	150	
Junction to case	MOSFET	R_{thJC}		-	-	1.1	°C/W
	diode	R_{thJC}		-	-	1.2	
Case to heatsink	Module	R_{thCS}	Flat, greased surface	-	0.1	-	
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			

ELECTRICAL CHARACTERISTICS (T_J = 25 °C unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Drain to source breakdown voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 100 µA	1200	-	-	V
Breakdown voltage temperature coefficient	$\Delta V_{(BR)DSS}/\Delta T_J$	I_D = 100 µA (25 °C to 125 °C)	-	0.45	-	mV/°C
Static drain to source on-resistance	$R_{DS(on)}$	V_{GS} = 15 V, I_D = 50 A	-	43	63	mΩ
		V_{GS} = 15 V, I_D = 50 A, T_J = 175 °C	-	85	-	
Gate threshold voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 7.11 mA	1.7	2.4	3.7	V
		V_{DS} = V_{GS}, I_D = 7.11 mA, T_J = 150 °C	-	2.1	-	
Temperature coefficient of threshold voltage	$\Delta V_{GS(th)}/\Delta T_J$	V_{DS} = V_{GS}, I_D = 7.11 mA (25 °C to 125 °C)	-	-2.2	-	mV/°C
Forward transconductance	g_{fs}	V_{DS} = 20 V, I_D = 50 A	-	32	-	S
Drain to source leakage current	I_{DSS}	V_{DS} = 1200 V, V_{GS} = 0 V	-	0.4	50	µA
		V_{DS} = 1200 V, V_{GS} = 0 V, T_J = 150 °C	-	1.5	-	
Gate to source leakage	I_{GSS}	V_{GS} = 15 V	-	-	250	nA
Diode reverse breakdown voltage	V_{BR}	I_R = 100 µA	1200	-	-	V
Diode forward voltage drop	V_{FM}	I_F = 50 A	-	1.96	3.05	V
Diode reverse leakage current	I_R	V_R = 1200 V	-	3.43	50	µA
Total gate charge	Q_g	I_D = 30 A, V_{DS} = 800 V, V_{GS} = -4 V / +15 V	-	87	-	nC
Gate to source charge	Q_{gs}		-	19	-	
Gate to drain (“Miller”) charge	Q_{gd}		-	36	-	
Turn-on switching energy	E_{on}	V_{DD} = 800 V, I_D = 50 A, R_g = 2.2 Ω, V_{GS} = -4 V / +15 V	-	0.649	-	mJ
Turn-off switching energy	E_{off}		-	0.346	-	
Turn-on delay time	$t_{d(on)}$		-	13.44	-	ns
Rise time	t_r		-	29.44	-	
Turn-off delay time	$t_{d(off)}$		-	27.52	-	
Fall time	t_f		-	9.28	-	
Turn-on switching energy	E_{on}	V_{DD} = 800 V, I_D = 50 A, R_g = 2.2 Ω, V_{GS} = -4 V / +15 V, T_J = 125 °C	-	0.507	-	mJ
Turn-off switching energy	E_{off}		-	0.408	-	
Turn-on delay time	$t_{d(on)}$		-	14.24	-	ns
Rise time	t_r		-	23.52	-	
Turn-off delay time	$t_{d(off)}$		-	30.24	-	
Fall time	t_f		-	9.28	-	
Input capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 1000 V, f = 100 kHz	-	2317	-	pF
Output capacitance	C_{oss}		-	49	-	
Reverse transfer capacitance	C_{rss}		-	13	-	

SOURCE-DRAIN RATINGS AND CHARACTERISTICS (T_J = 25 °C unless otherwise specified)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Pulsed source current (body diode)	I_{SM}	10 ms sine or 6 ms rectangular pulse, T_J = 175 °C	-	-	110	A
Diode forward voltage	V_{SD}	I_S = 50 A, V_{GS} = 0 V	-	5.67	6.0	V
Reverse recovery time	t_{rr}	T_J = 25 °C, I_F = I_S = 50 A, dI/dt = 6400 A/µs, V_R = 800 V	-	13	-	ns
Reverse recovery charge	Q_{rr}		-	121	-	nC
Reverse recovery current	I_{RRM}		-	18	-	A

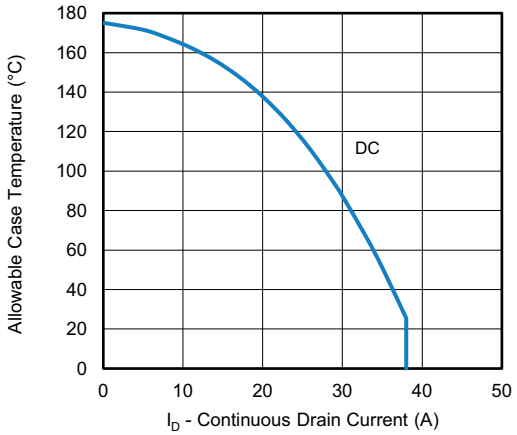


Fig. 1 - Max. Continuous Drain Current vs. Case Temperature

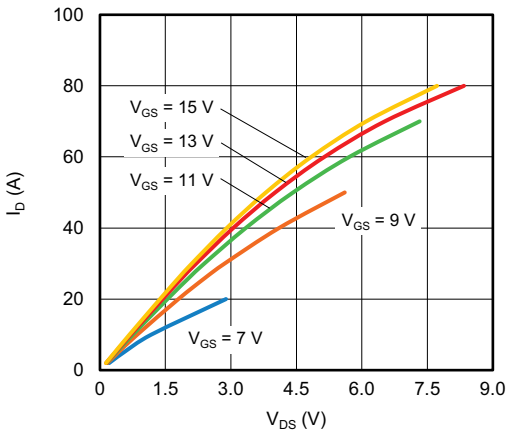


Fig. 3 - Typical Drain to Source Current Output Characteristics at T_J = 150 °C

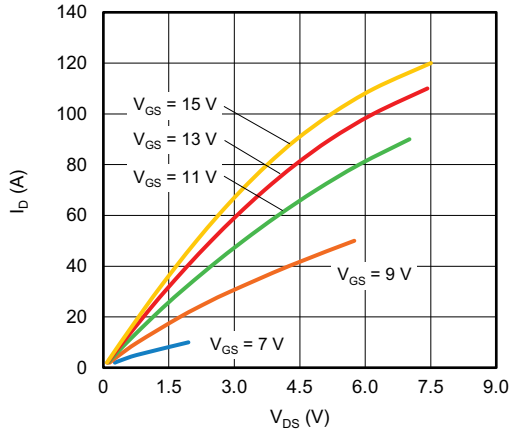


Fig. 2 - Typical Drain to Source Current Output Characteristics at T_J = 25 °C

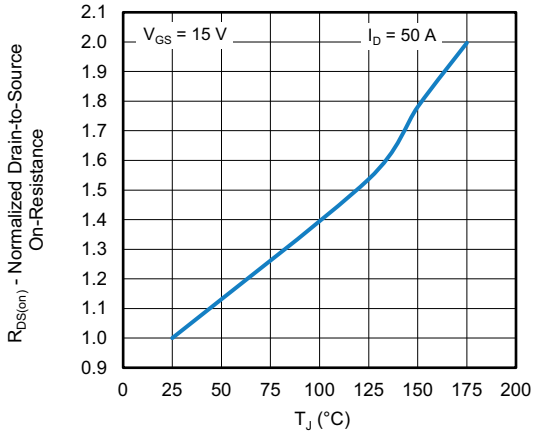


Fig. 4 - Normalized Drain-to-Source On-Resistance vs. Temperature

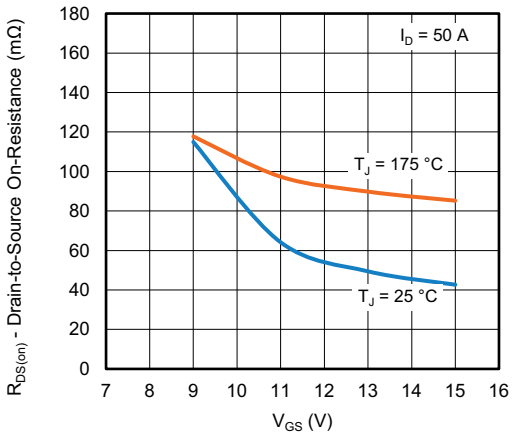


Fig. 5 - Typical Drain-to-Source On-Resistance vs. Gate to Source Voltage

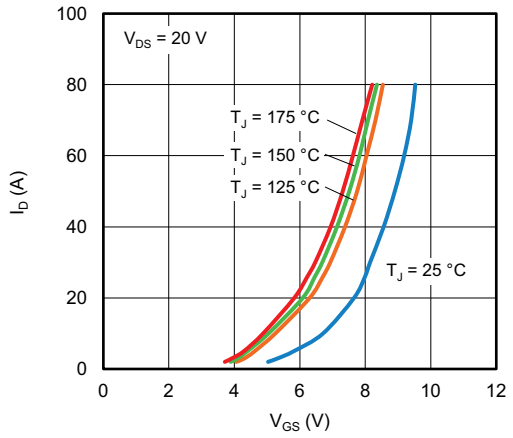


Fig. 6 - Typical Transfer Characteristics

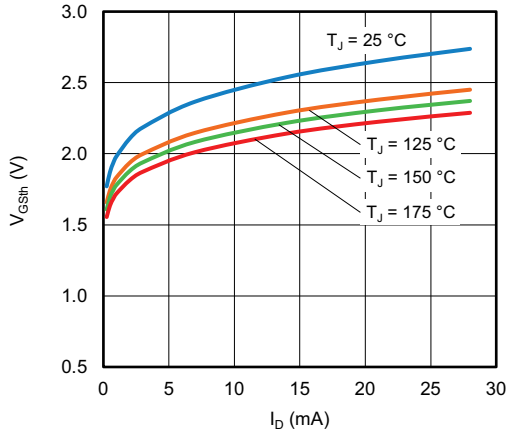


Fig. 7 - Typical Gate Threshold Voltage Characteristics

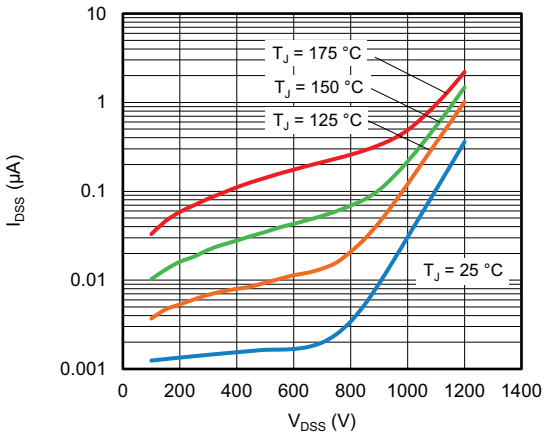


Fig. 8 - Typical Zero Gate Voltage Drain Current

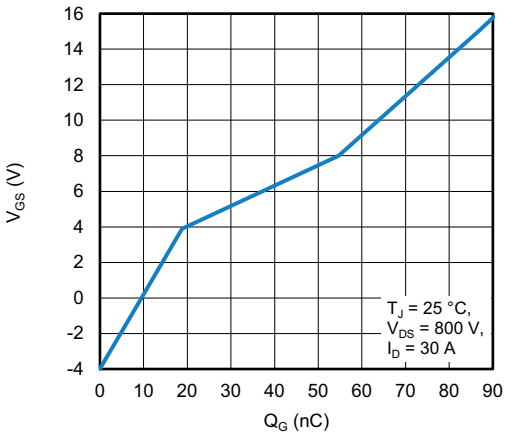


Fig. 9 - Typical Gate Charge vs. Gate to Source Voltage

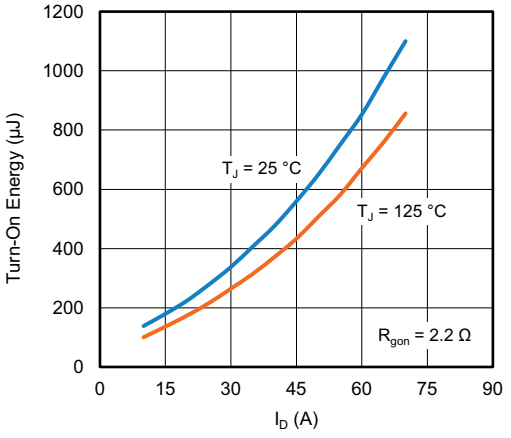


Fig. 10 - Typical Turn-On Energy Loss vs. I_D

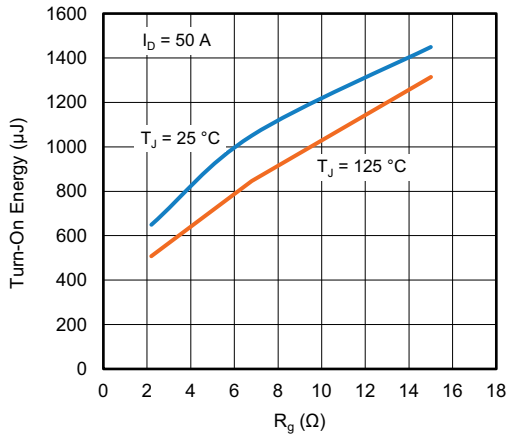


Fig. 11 - Typical Turn-On Energy Loss vs. R_g

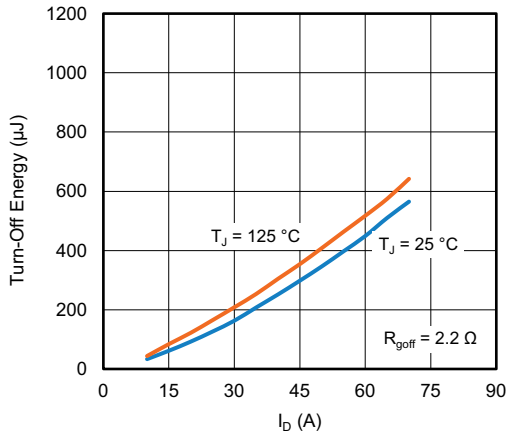


Fig. 12 - Typical Turn-Off Energy Loss vs. I_D

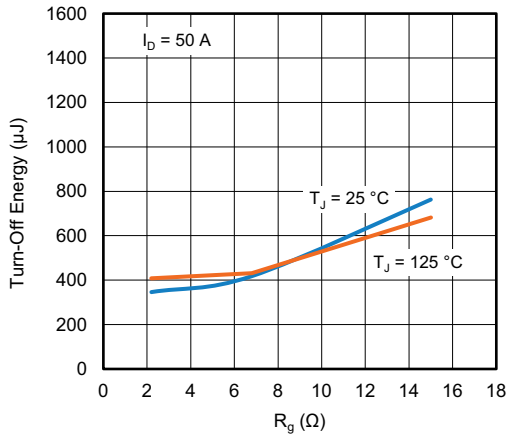


Fig. 13 - Typical Turn-Off Energy Loss vs. R_g

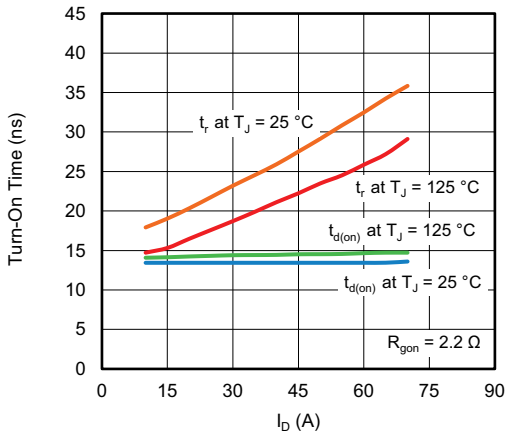


Fig. 14 - Typical Turn-On Switching Time vs. I_D

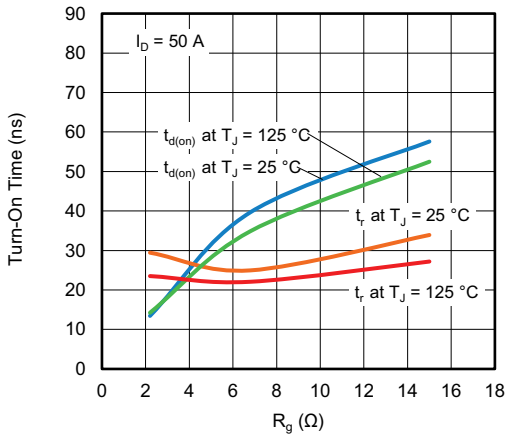


Fig. 15 - Typical Turn-On Switching Time vs. R_g

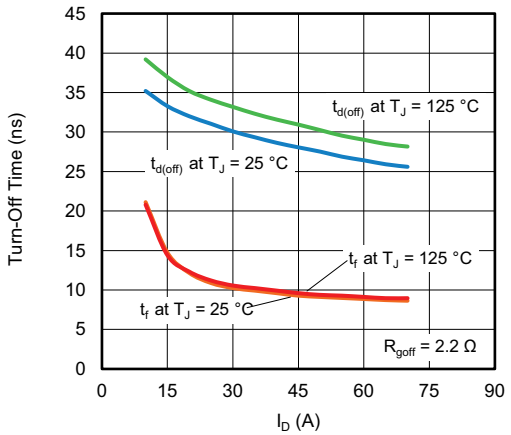


Fig. 16 - Typical Turn-Off Switching Time vs. I_D

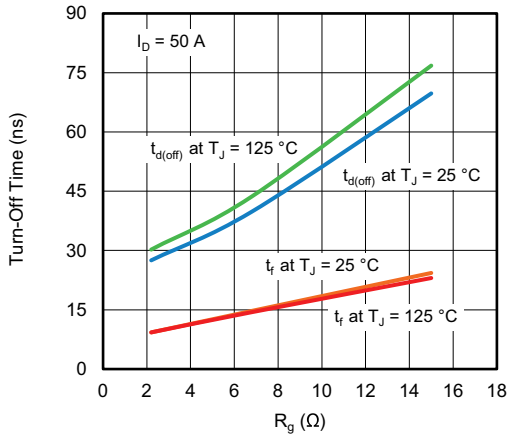


Fig. 17 - Typical Turn-Off Switching Time vs. R_g

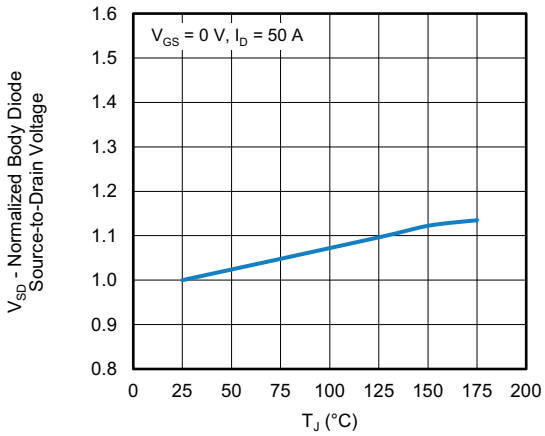


Fig. 20 - Normalized Body Diode Source-to-Drain vs. Temperature

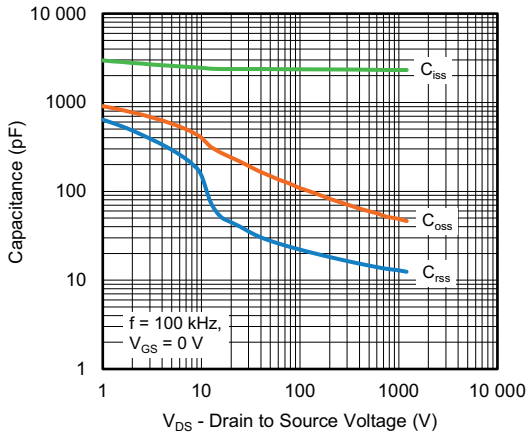


Fig. 18 - Capacitance vs. Drain-to-Source Voltage

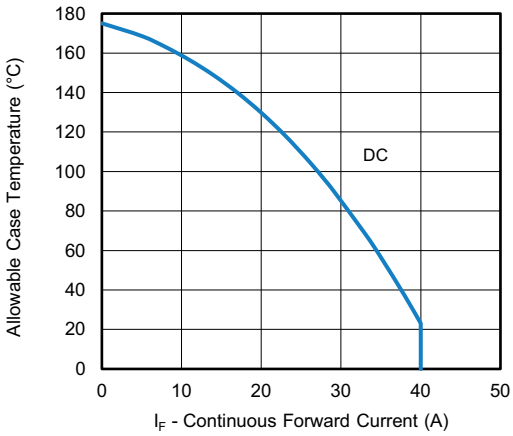


Fig. 21 - Allowable Case Temperature vs. Continuous Forward Current

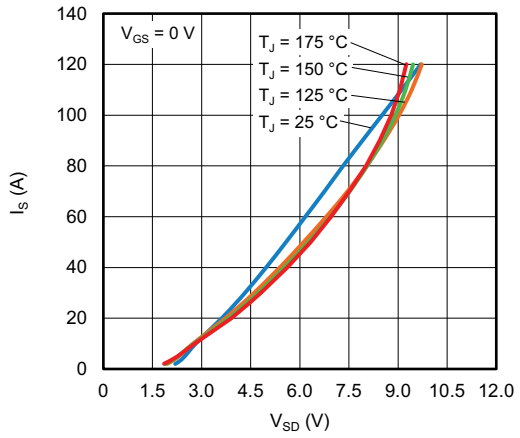


Fig. 19 - Typical Body Diode Source-to-Drain Current Characteristics

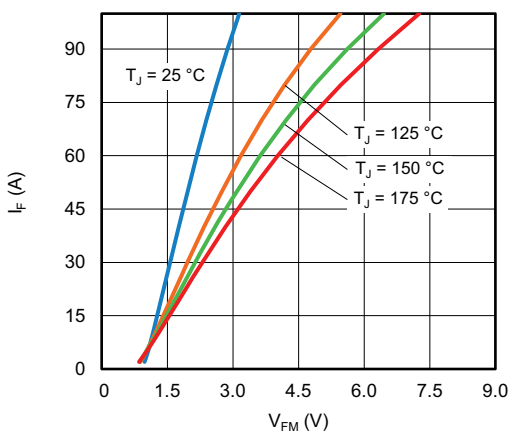


Fig. 22 - Diode Forward Characteristics

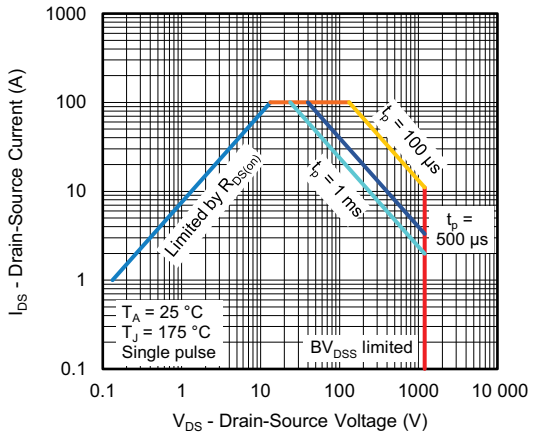


Fig. 23 - Safe Operating Area

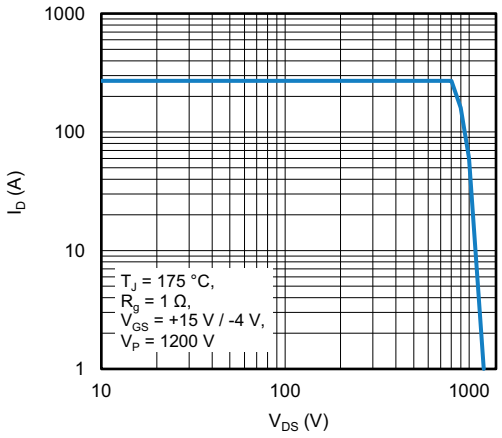


Fig. 24 - Reverse BIAS Safe Operating Area

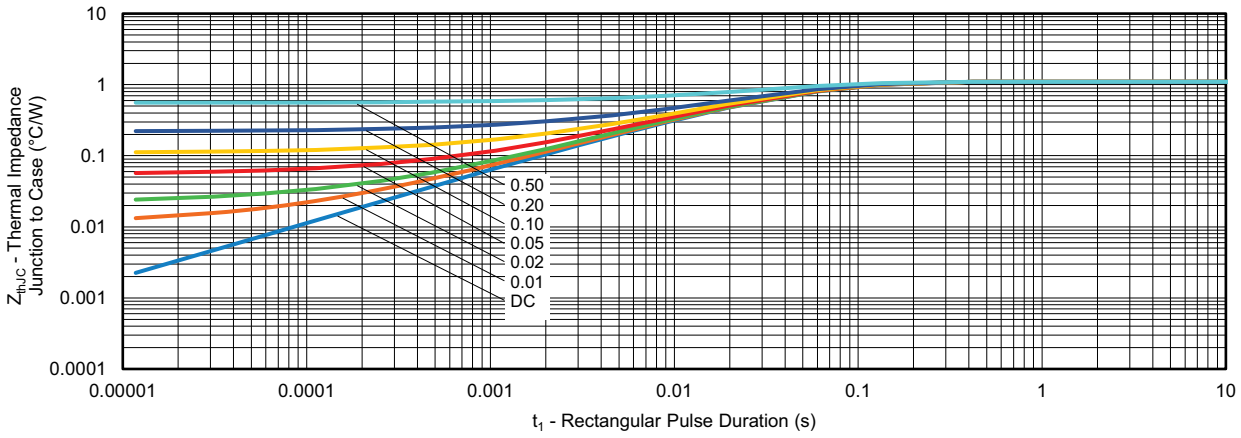


Fig. 25 - Maximum Thermal Impedance Z_{thJC} Characteristics - MOSFET

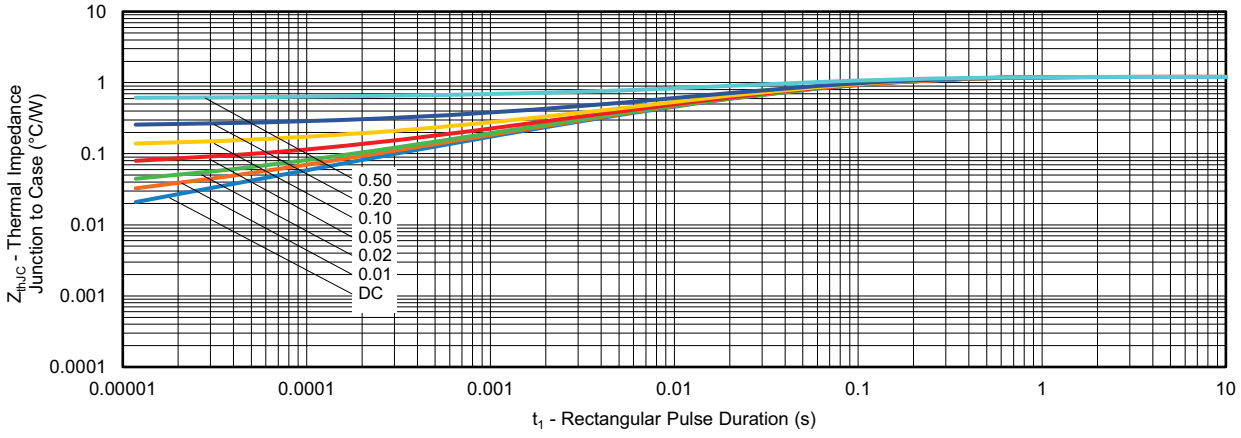


Fig. 26 - Maximum Thermal Impedance Z_{thJC} Characteristics - Diode

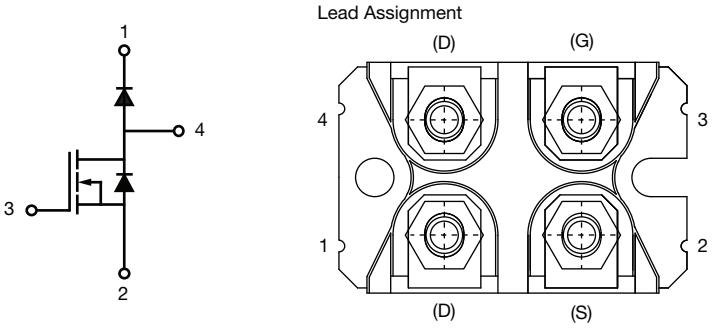
ORDERING INFORMATION TABLE

Device code

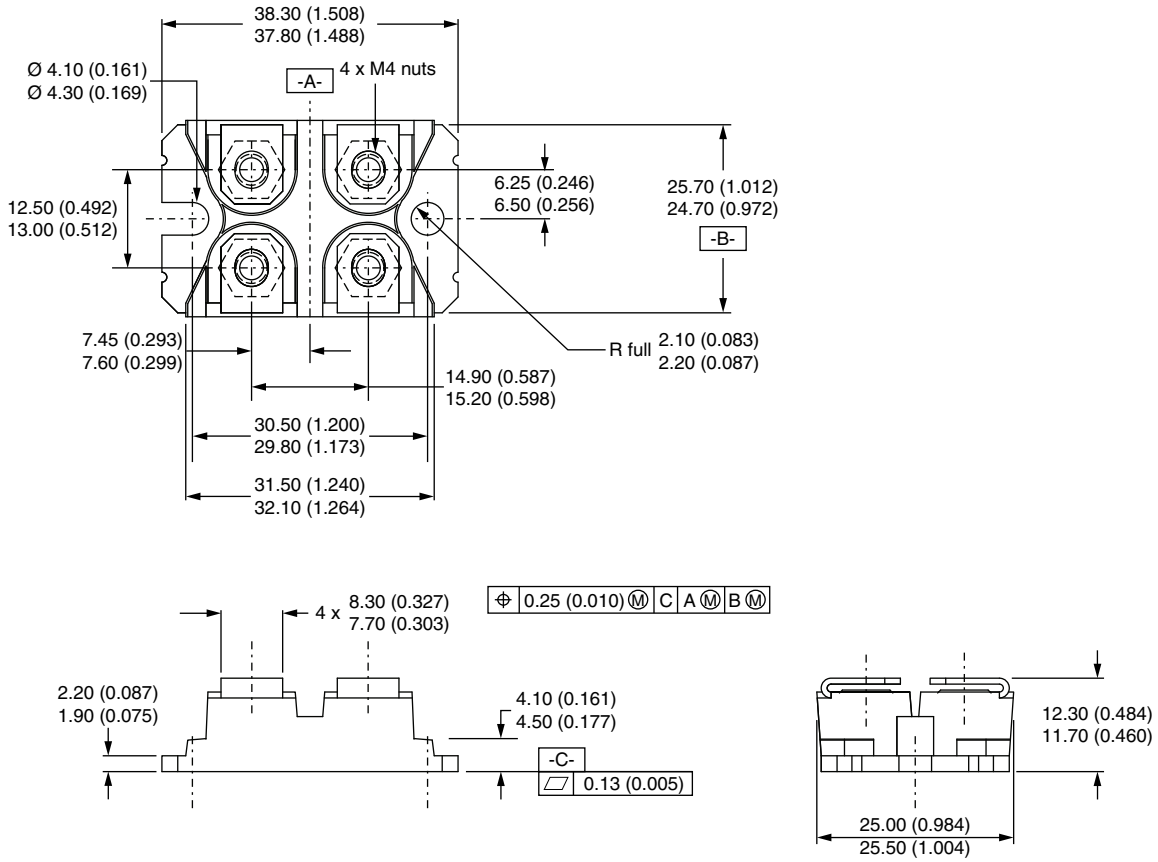
VS-	SF	50	L	A	120
1	2	3	4	5	6

1	-	Vishay Semiconductors product
2	-	SF = SiC MOSFET module
3	-	Current rating (50 = 50 A)
4	-	Circuit configuration (L = low side chopper)
5	-	Package indicator (SOT-227)
6	-	Voltage rating (120 = 1200 V)

CIRCUIT CONDIGURATION

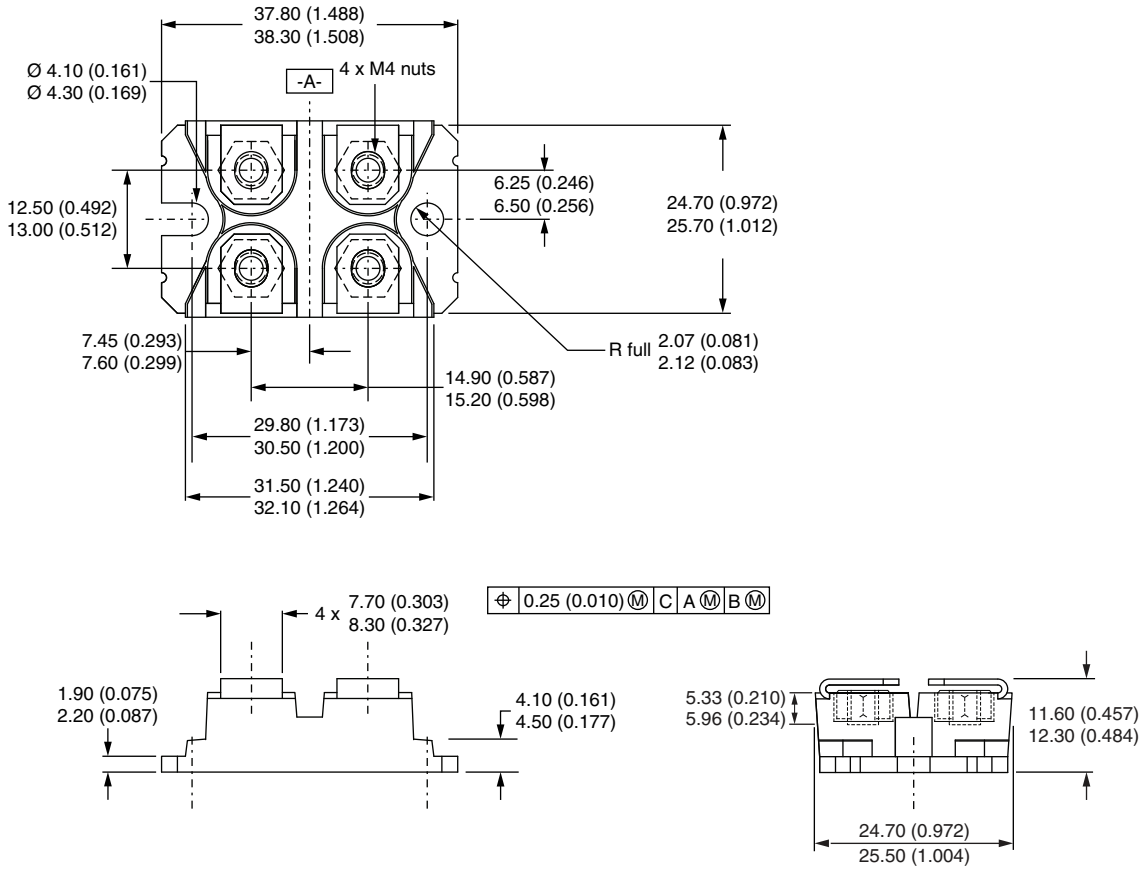
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Low side chopper	L	

DIMENSIONS in millimeters



SOT-227 Generation 2

DIMENSIONS in millimeters (inches)



Note

- Controlling dimension: millimeter

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