MAACPAK PressFit Power Module
Three Phase Inverter 1200 V Silicon Carbide MOSFET, 75 mΩ

MAACPAK
(package example)

PRIMARY CHARACTERISTICS	
V_{DSS}	1200 V
$R_{DS(on)}$ at I_D = 20 A	69 mΩ
I_D at T_{sink} = 80 °C	18 A
Type	Modules - SiC MOSFET
Package	MAACPAK
Circuit configuration	Three phase inverter

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.

FEATURES

- Silicon carbide power MOSFET
- High blocking voltage with low on-resistance
- High speed switching with low capacitance
- Fast intrinsic diode with low reverse recovery (Q_{rr})
- Maximum 175 °C junction temperature
- PressFit pins locking technology
- UL pending
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT
HALOGEN FREE

TYPICAL APPLICATIONS

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

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_{sink} = 25 °C	22	A
		T_{sink} = 80 °C	18	
Pulsed drain current	I_{DM} (1)		100	
Power dissipation	P_D	T_{sink} = 80 °C	47.5	W
Gate to source voltage	V_{GS}		-8 / +19	V
MODULE				
Maximum junction temperature range	T_J max.	Instantaneous event	-55 to +175	°C
Operating junction temperature range	T_{JOp}	Continuous operation under switching	-40 to +150	°C
Operating storage temperature range	T_{Stg}		-40 to +150	
Insulation voltage (RMS)	V_{ISOL}	Any terminal to case, t = 1 min	3500	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

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
Static drain to source on-resistance	$R_{DS(on)}$	V_{GS} = 15 V, I_D = 20 A	-	69	97.5	mΩ
		V_{GS} = 15 V, I_D = 20 A, T_J = 175 °C	-	128	-	
Gate threshold voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 5 mA	1.6	2.86	3.8	V
		V_{DS} = V_{GS}, I_D = 5 mA, T_J = 175 °C	-	2.16	-	
Temperature coefficient of threshold voltage	$\Delta V_{GS(th)}/\Delta T_J$	V_{DS} = V_{GS}, I_D = 5 mA (25 °C to 125 °C)	-	-5.0	-	mV/°C
Forward transconductance	g_{fs}	V_{DS} = 20 V, I_D = 20 A	-	12.4	-	S
Drain to source leakage current	I_{DSS}	V_{DS} = 1200 V, V_{GS} = 0 V	-	0.01	60	μA
		V_{DS} = 1200 V, V_{GS} = 0 V, T_J = 150 °C	-	0.07	-	
Gate to source leakage	I_{GSS}	V_{GS} = ± 15 V	-	-	± 250	nA
Total gate charge	Q_g	V_{DS} = 800 V, I_D = 20 A, V_{GS} = -4 V / +15 V	-	56	-	nC
Gate to source charge	Q_{gs}		-	17	-	
Gate to drain ("Miller") charge	Q_{gd}		-	18	-	
Turn-on switching energy	E_{on}	V_{DD} = 800 V, I_D = 20 A, R_g = 1.0 Ω, V_{GS} = -4 V / +15 V	-	0.193	-	mJ
Turn-off switching energy	E_{off}		-	0.074	-	
Turn-on delay time	$t_{d(on)}$		-	13	-	ns
Rise time	t_r		-	12	-	
Turn-off delay time	$t_{d(off)}$		-	35	-	
Fall time	t_f		-	10	-	
Turn-on switching energy	E_{on}	V_{DD} = 800 V, I_D = 20 A, R_g = 1.0 Ω, V_{GS} = -4 V / +15 V, T_J = 125 °C	-	0.233	-	mJ
Turn-off switching energy	E_{off}		-	0.086	-	
Turn-on delay time	$t_{d(on)}$		-	13	-	ns
Rise time	t_r		-	12	-	
Turn-off delay time	$t_{d(off)}$		-	39	-	
Fall time	t_f		-	11	-	
Input capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 1000 V, f = 100 kHz	-	1489	-	pF
Output capacitance	C_{oss}		-	85	-	
Reverse transfer capacitance	C_{rss}		-	6.1	-	

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}	T_C = 25 °C, V_{GS} = 0 V, T_P = 6 ms	-	-	100	A
Diode forward voltage	V_{SD}	I_S = 20 A, V_{GS} = -4 V	-	5.75	-	V
Reverse recovery time	t_{rr}	T_J = 25 °C, I_F = I_S = 20 A, dI/dt = 4650 A/μs, V_R = 800 V	-	14.4	-	ns
Reverse recovery charge	Q_{rr}		-	198	-	nC
Reverse recovery current	I_{RRM}		-	26	-	A

THERMAL AND MECHANICAL SPECIFICATIONS							
PARAMETER		SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Thermal resistance junction to sink each (1)	MOSFET	R_{thJS}		-	1.8	-	°C/W
Thermal resistance case to sink (1)	Module	R_{thCS}	Flat, greased surface	-	0.1	-	
Mounting torque (M3)				0.7	1.2	1.7	Nm
Weight				-	16	-	g
Case style				MAACPAK			

Note

(2) Mounting surface flat, smooth, and greased λ_{grease} = 2.9 W/mK

INTERNAL NTC - THERMISTOR SPECIFICATIONS				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUE	UNITS
Resistance	R_{25}	T_J = 25 °C	10 000	Ω
B constant	$B_{25/85}$	$R_2 = R_{25}$ exp. ($B_{25/85}$ (1/T1 - 1/(298.15 K)))	3430 ± 3 %	K
Operating temperature range at zero power			-40 to +150	°C
Dissipation factor	D		3.5	mW/K
Thermal time constant	τ		≈ 10	s

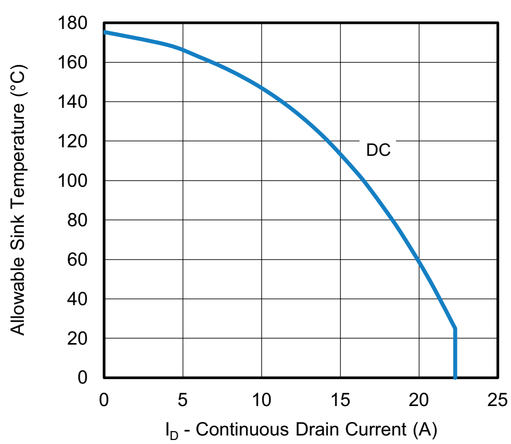


Fig. 1 - Max. Continuous Drain Current vs. Sink Temperature

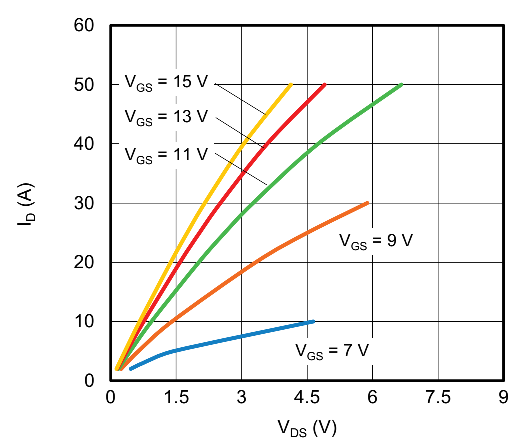


Fig. 2 - Typical Drain to Source Current Output Characteristics at T_J = 25 °C

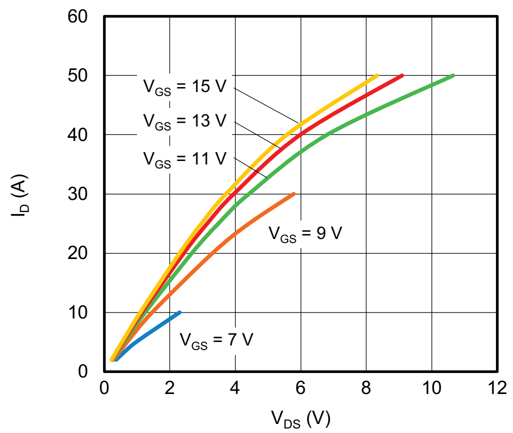


Fig. 3 - Typical Drain to Source Current Output Characteristics at T_J = 150 °C

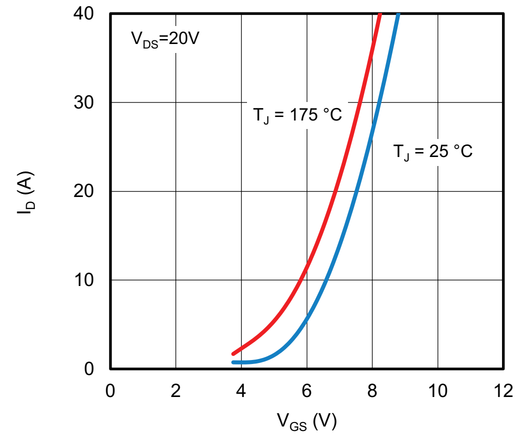


Fig. 6 - Typical Transfer Characteristics

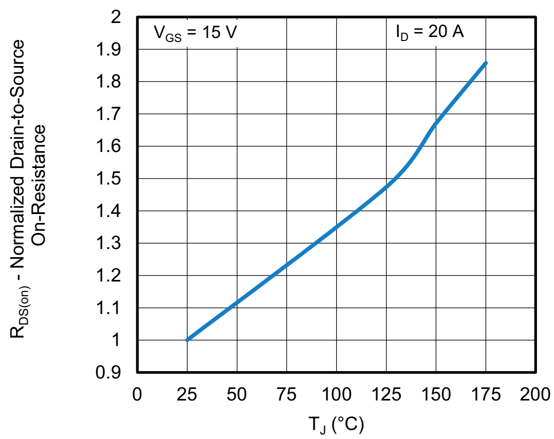


Fig. 4 - Normalized Drain-to-Source On-Resistance vs. Temperature

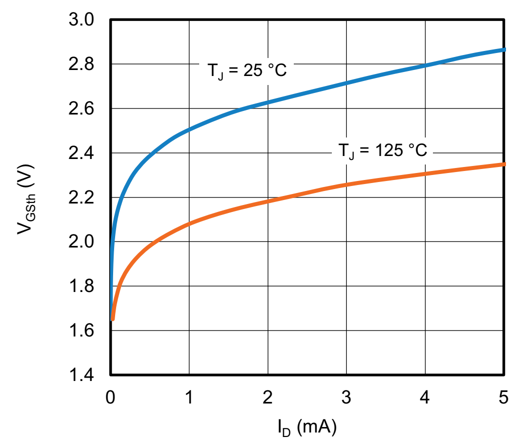


Fig. 7 - Typical Gate Threshold Voltage Characteristics

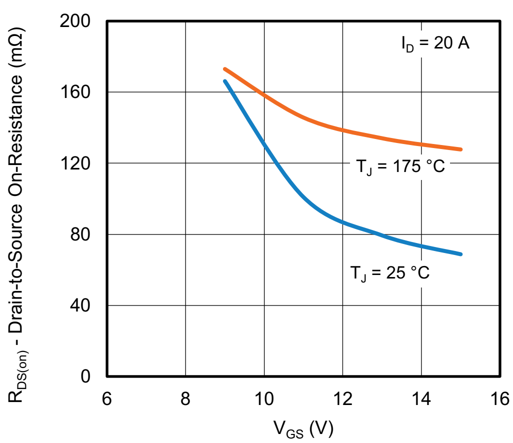


Fig. 5 - Typical Drain-to-Source On-Resistance vs. Gate to Source Voltage

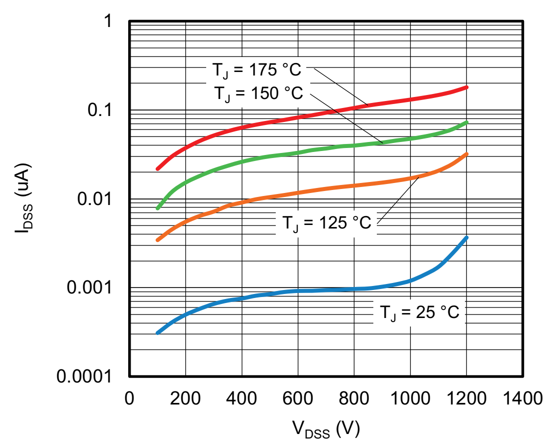


Fig. 8 - Typical Zero Gate Voltage Drain Current

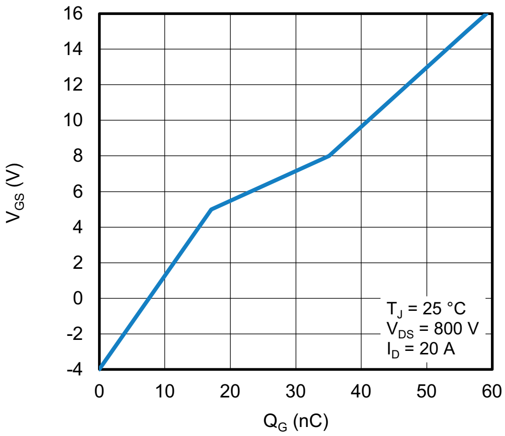


Fig. 9 - Typical Gate Charge vs. Gate to Source Voltage

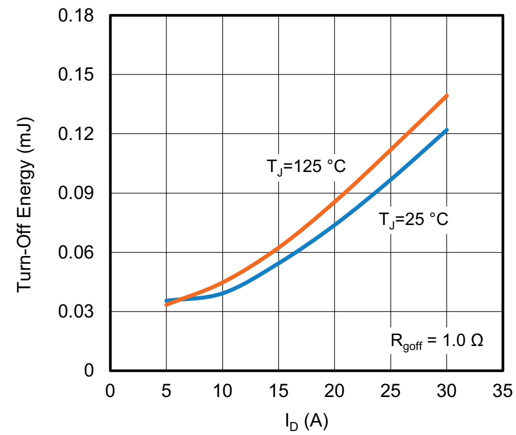


Fig. 12 - Typical Turn-Off Energy Loss vs. I_D

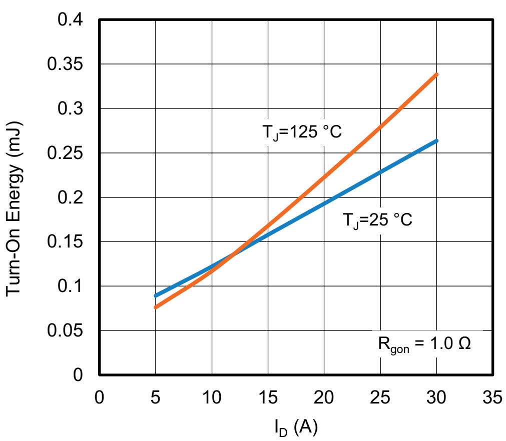


Fig. 10 - Typical Turn-On Energy Loss vs. I_D

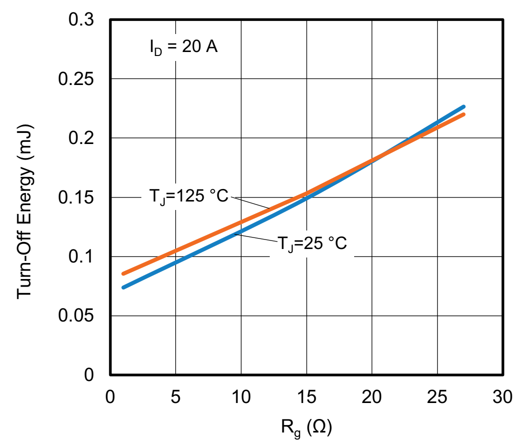


Fig. 13 - Typical Turn-Off Energy Loss vs. R_g

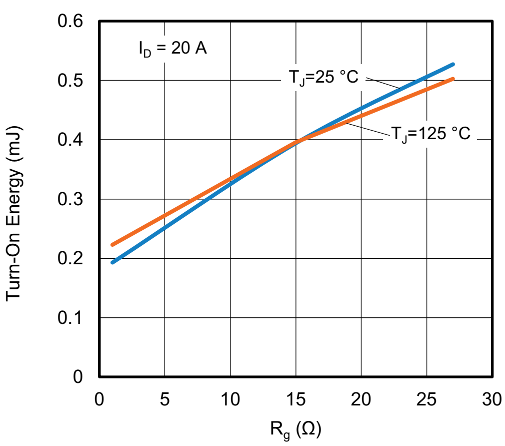


Fig. 11 - Typical Turn-On Energy Loss vs. R_g

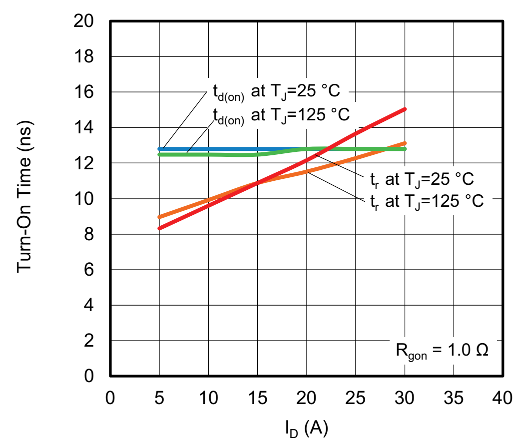


Fig. 14 - Typical Turn-On Switching Time vs. I_D

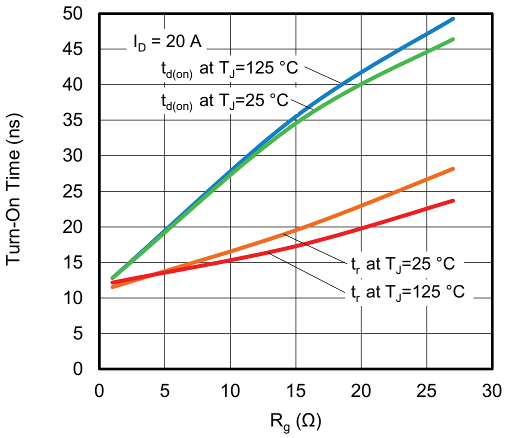


Fig. 15 - Typical Turn-On Switching Time vs. R_g

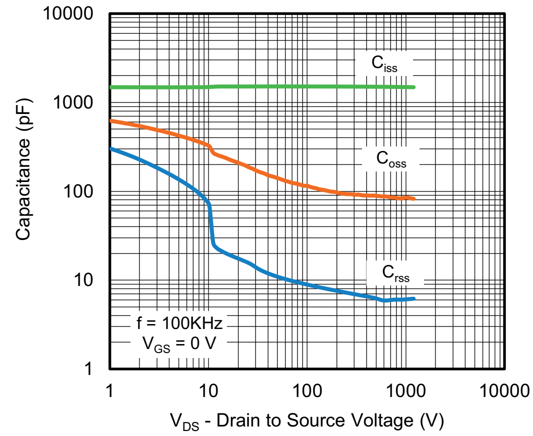


Fig. 18 - Typical Capacitance vs. Drain-to-Source Voltage

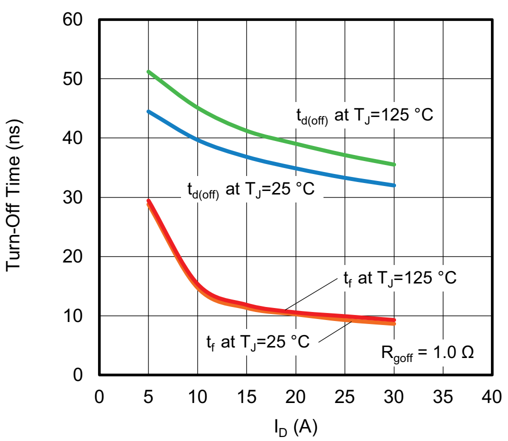


Fig. 16 - Typical Turn-Off Switching Time vs. I_D

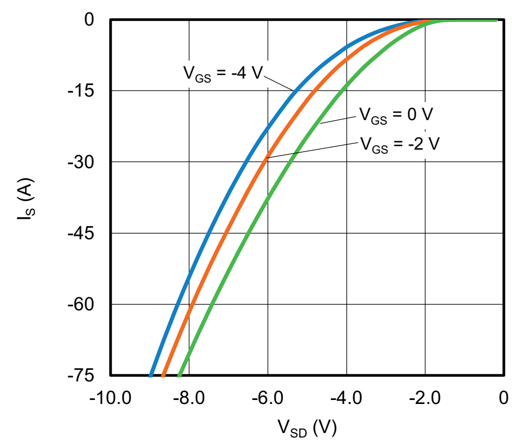


Fig. 19 - Typical Body Diode Source-to-Drain Current Characteristics, T_J = 25 °C

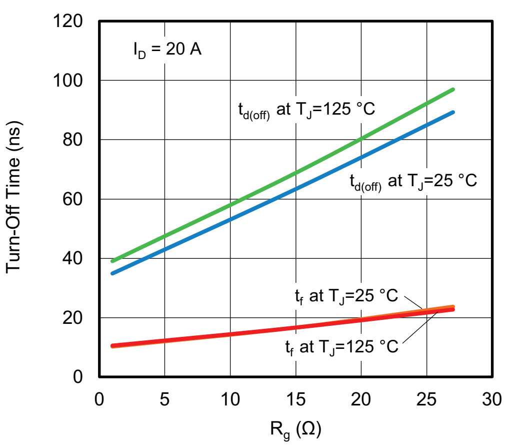


Fig. 17 - Typical Turn-Off Switching Time vs. R_g

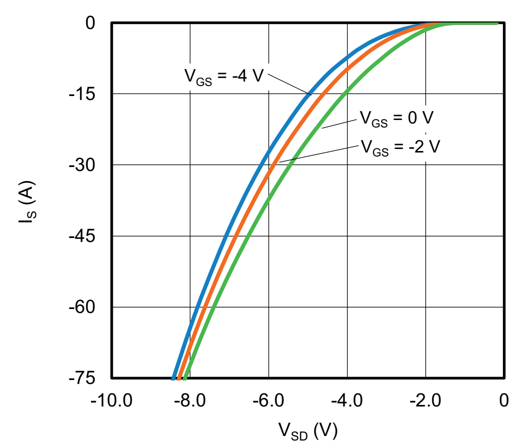


Fig. 20 - Typical Body Diode Source-to-Drain Current Characteristics T_J = 125 °C

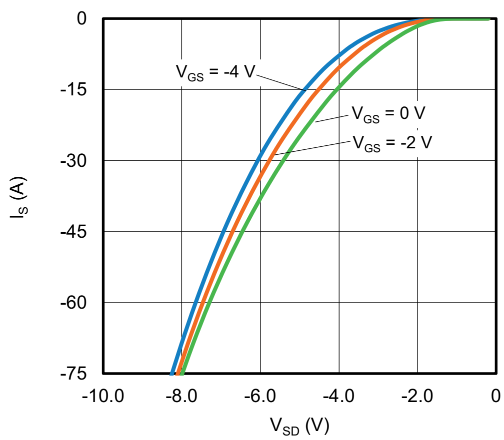


Fig. 21 - Typical Body Diode Source-to-Drain Current Characteristics T_J = 150 °C

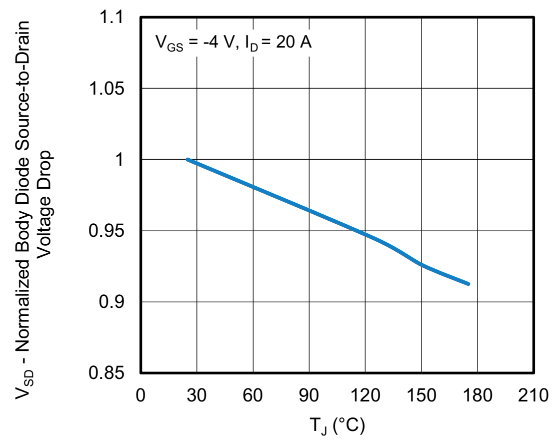


Fig. 22 - Normalized Body Diode Source-to-Drain Voltage Drop vs. Temperature

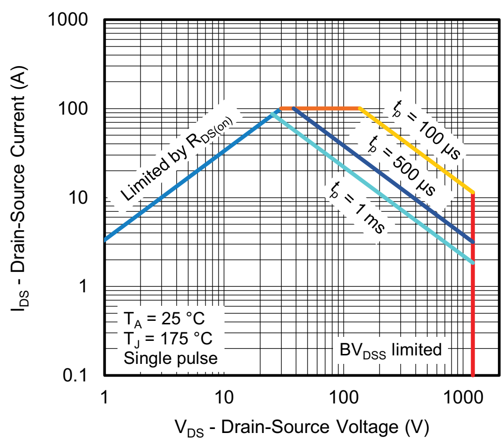


Fig. 23 - Safe Operating Area

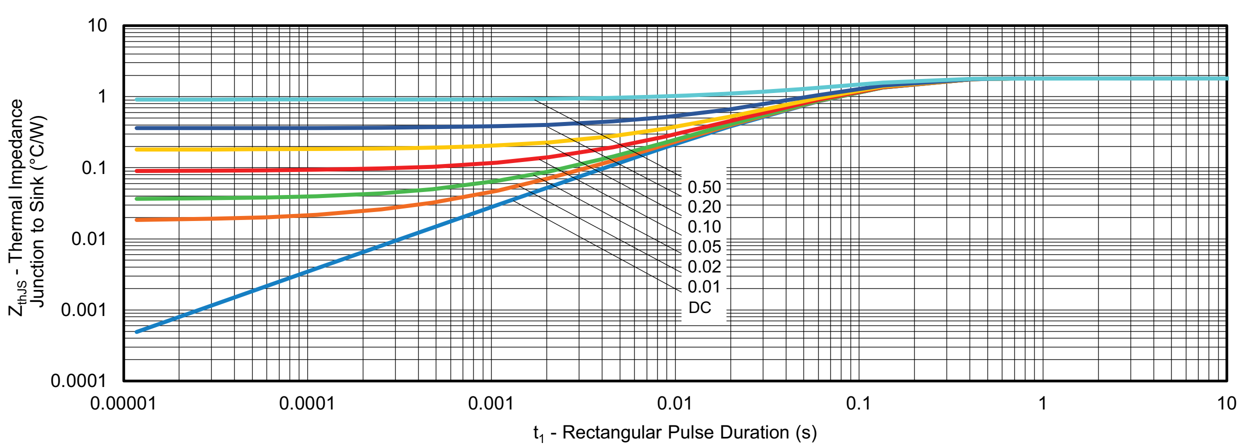
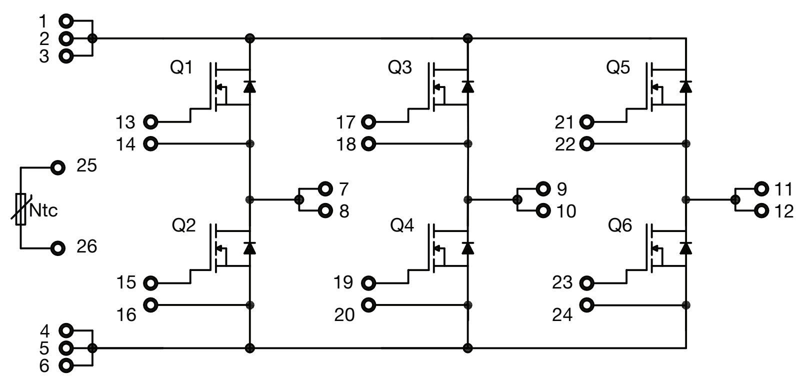


Fig. 24 - Typical Thermal Impedance Z_{thJS} Characteristics

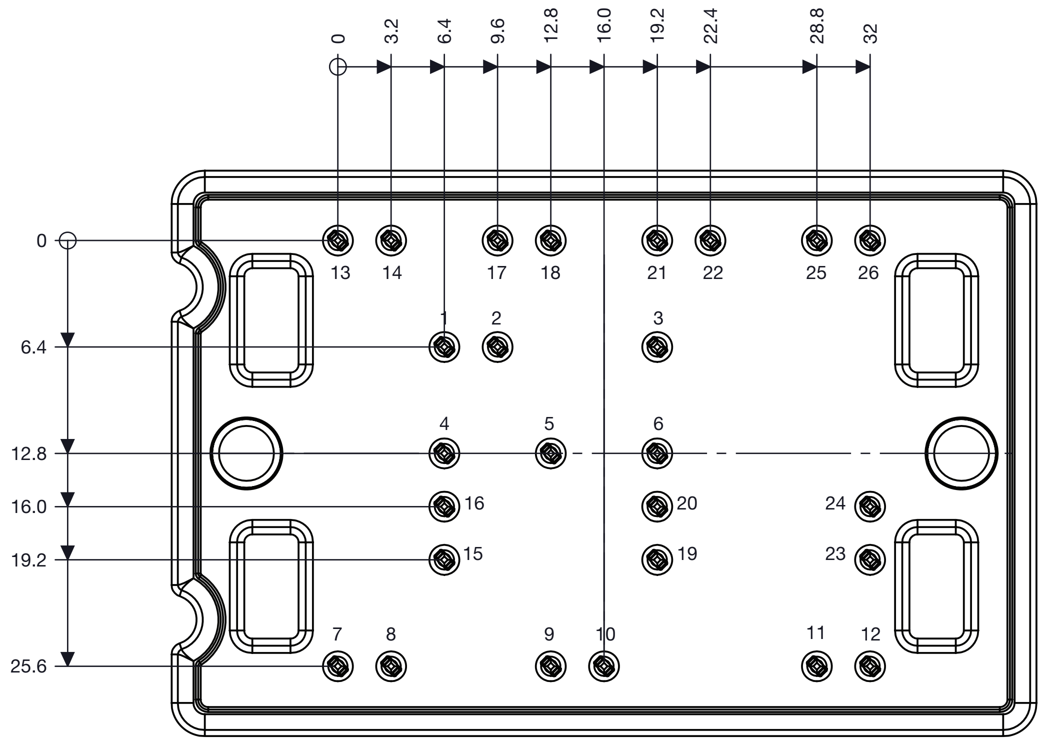
ORDERING INFORMATION TABLE

Device code	VS-	MP	X	075	P	120
	1	2	3	4	5	6

- **1** - Vishay Semiconductors product
- **2** - Package indicator (MP = MAACPAK)
- **3** - Circuit configuration (X = three phase inverter topology)
- **4** - $R_{DS(on)}$ in mΩ (075 = 75 mΩ)
- **5** - Die technology (P = SiC MOSFET)
- **6** - Voltage rating (120 = 1200 V)

CIRCUIT CONFIGURATION		
CIRCUIT	**CIRCUIT CONFIGURATION CODE**	**CIRCUIT DRAWING**
Three phase inverter	X	

PACKAGE



LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?97293

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