

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

SOURCE-DRAIN RATINGS AND CHARACTERISTICS ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Pulsed source current (body diode)	I_{SM}	$T_C = 25\text{ }^{\circ}\text{C}$, $V_{GS} = 0\text{ V}$, $T_P = 6\text{ ms}$	-	-	100	A
Diode forward voltage	V_{SD}	$I_S = 20\text{ A}$, $V_{GS} = -4\text{ V}$	-	5.75	-	V
Reverse recovery time	t_{rr}	$T_J = 25\text{ }^{\circ}\text{C}$, $I_F = I_S = 20\text{ A}$, $di/dt = 4650\text{ A}/\mu\text{s}$, $V_R = 800\text{ V}$	-	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 $\lambda_{grease} = 2.9 \text{ W/mK}$

INTERNAL NTC - THERMISTOR SPECIFICATIONS

PARAMETER	SYMBOL	TEST CONDITIONS	VALUE	UNITS
Resistance	R_{25}	$T_J = 25 \text{ °C}$	10 000	Ω
B constant	$B_{25/85}$	$R_2 = R_{25} \exp. (B_{25/85} (1/T_1 - 1/(298.15 \text{ K})))$	$3430 \pm 3 \%$	K
Operating temperature range at zero power			-40 to +150	°C
Dissipation factor	D		3.5	mW/K
Thermal time constant	τ		≈ 10	s

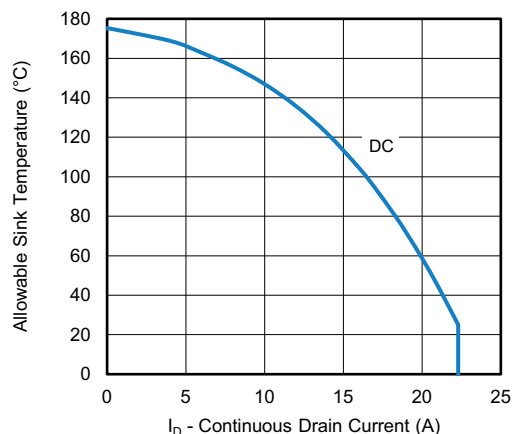


Fig. 1 - Max. Continuous Drain Current vs. Sink Temperature

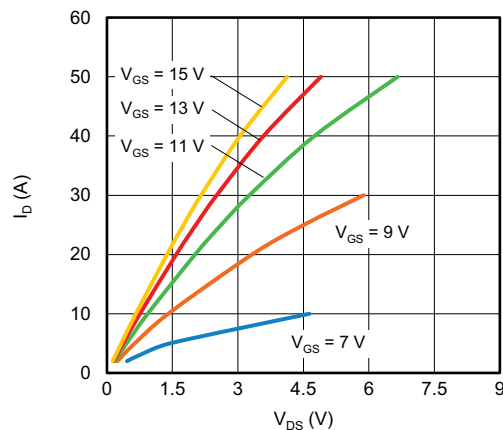


Fig. 2 - Typical Drain to Source Current Output Characteristics at $T_J = 25 \text{ °C}$

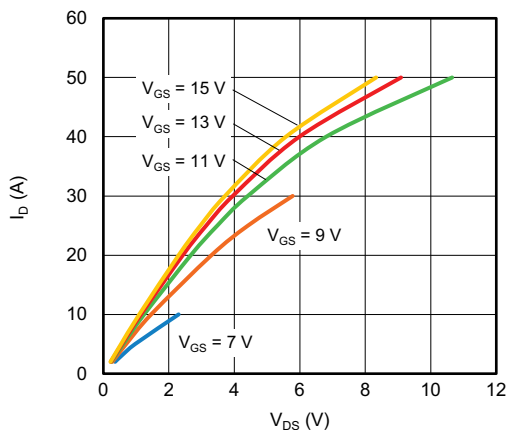


Fig. 3 - Typical Drain to Source Current Output Characteristics at $T_J = 150^\circ\text{C}$

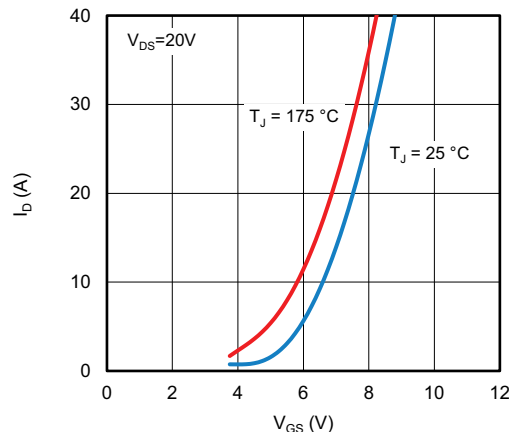


Fig. 6 - Typical Transfer Characteristics

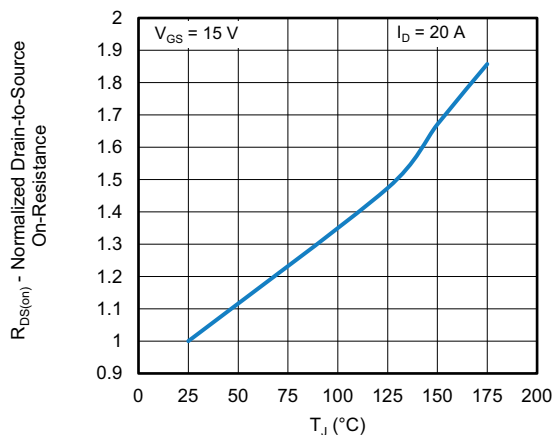


Fig. 4 - Normalized Drain-to-Source On-Resistance vs. Temperature

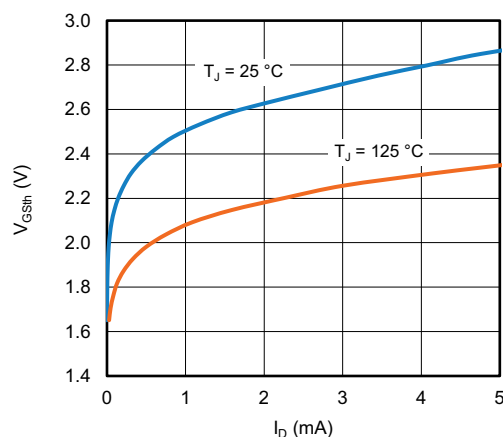


Fig. 7 - Typical Gate Threshold Voltage Characteristics

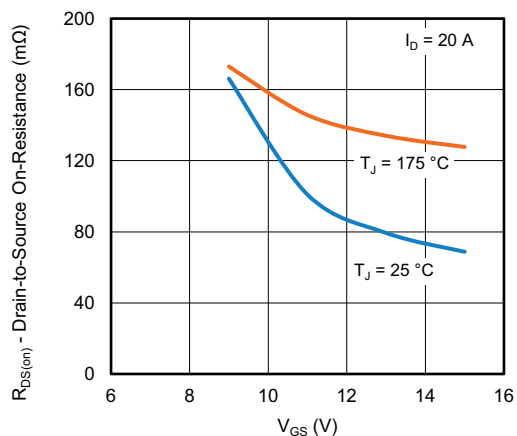


Fig. 5 - Typical Drain-to-Source On-Resistance vs. Gate to Source Voltage

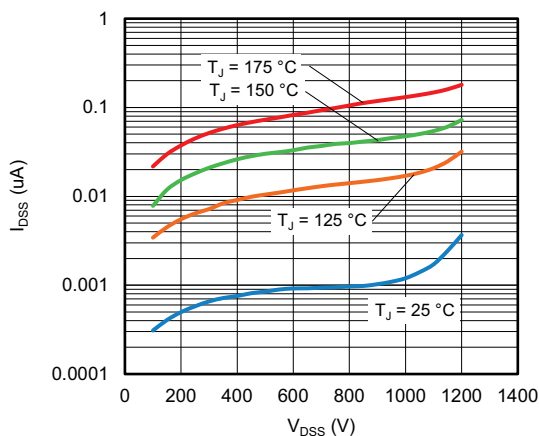


Fig. 8 - Typical Zero Gate Voltage Drain Current

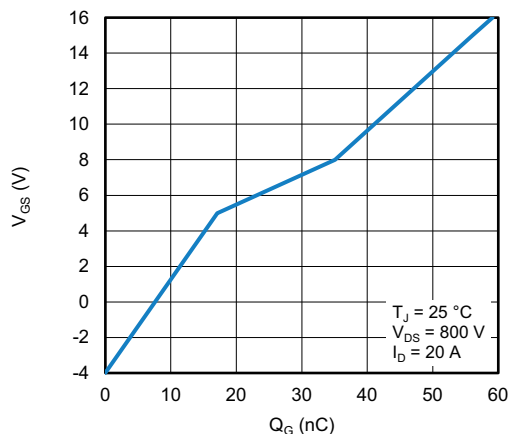


Fig. 9 - Typical Gate Charge vs. Gate to Source Voltage

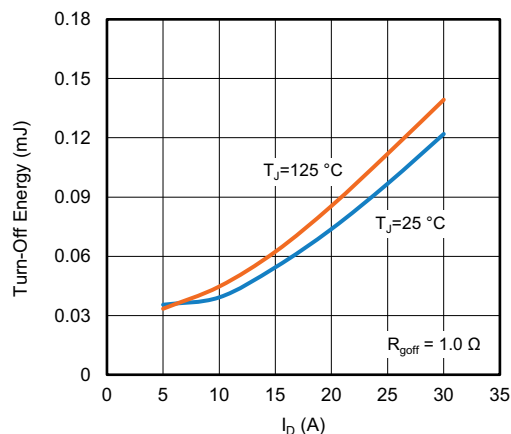


Fig. 12 - Typical Turn-Off Energy Loss vs. I_D

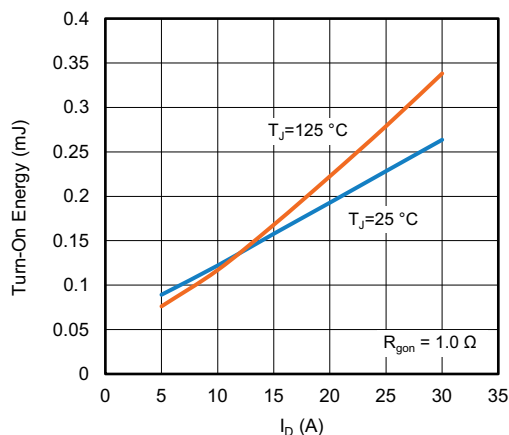


Fig. 10 - Typical Turn-On Energy Loss vs. I_D

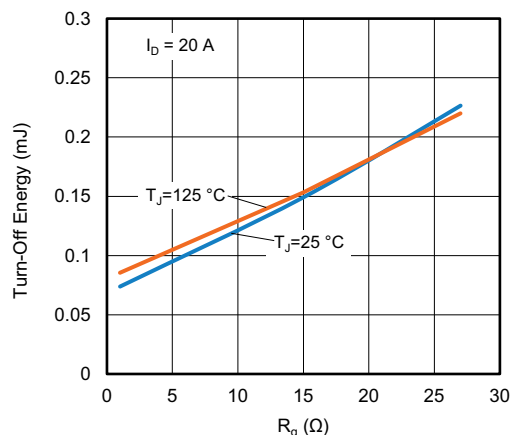


Fig. 13 - Typical Turn-Off Energy Loss vs. R_g

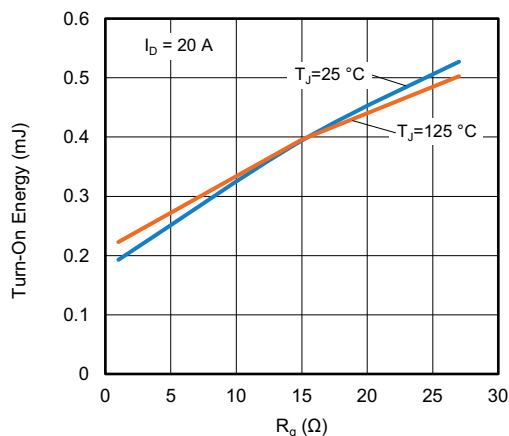


Fig. 11 - Typical Turn-On Energy Loss vs. R_g

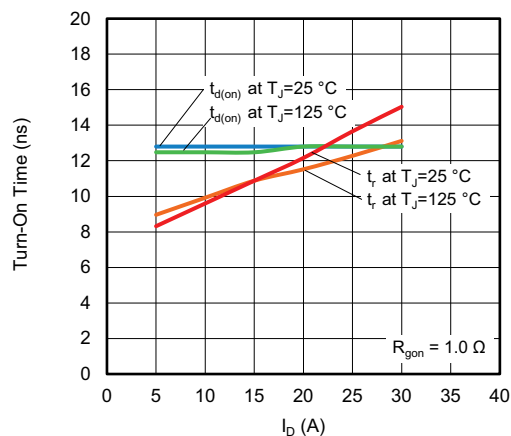


Fig. 14 - Typical Turn-On Switching Time vs. I_D

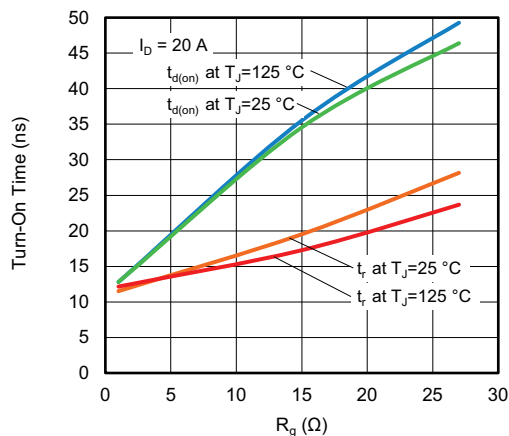


Fig. 15 - Typical Turn-On Switching Time vs. R_g

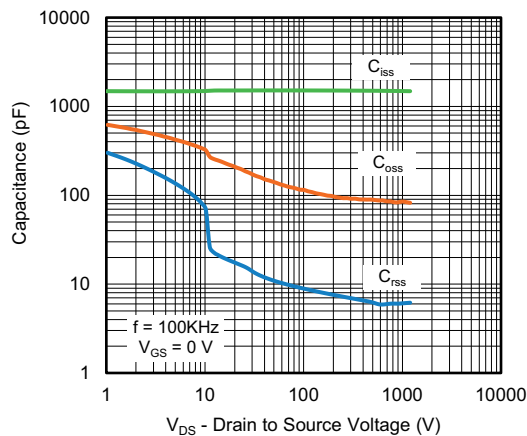


Fig. 18 - Typical Capacitance vs. Drain-to-Source Voltage

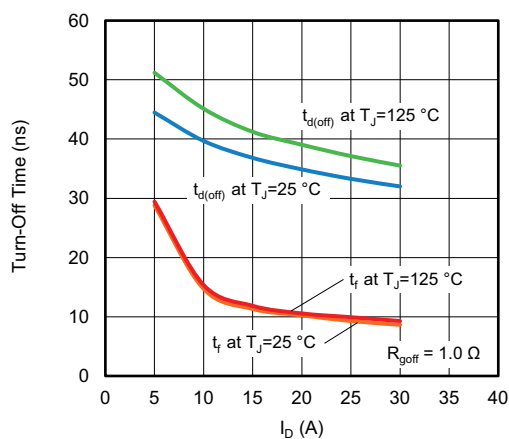


Fig. 16 - Typical Turn-Off Switching Time vs. I_D

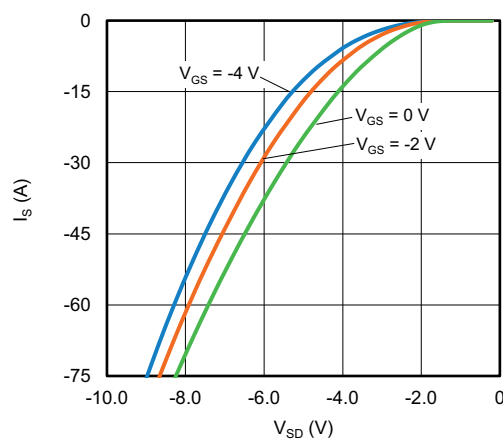


Fig. 19 - Typical Body Diode Source-to-Drain Current Characteristics, $T_J = 25\text{ }^{\circ}\text{C}$

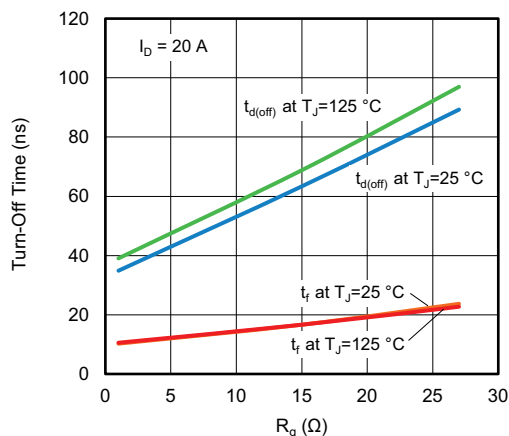


Fig. 17 - Typical Turn-Off Switching Time vs. R_g

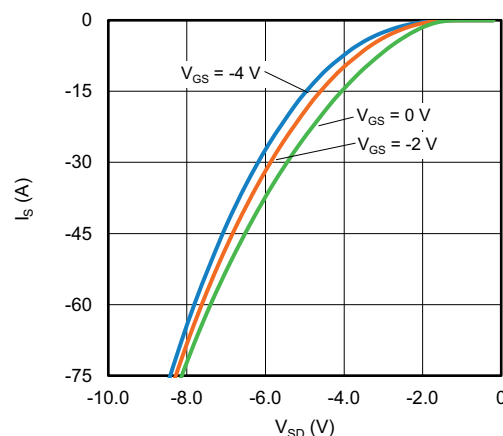


Fig. 20 - Typical Body Diode Source-to-Drain Current Characteristics $T_J = 125\text{ }^{\circ}\text{C}$

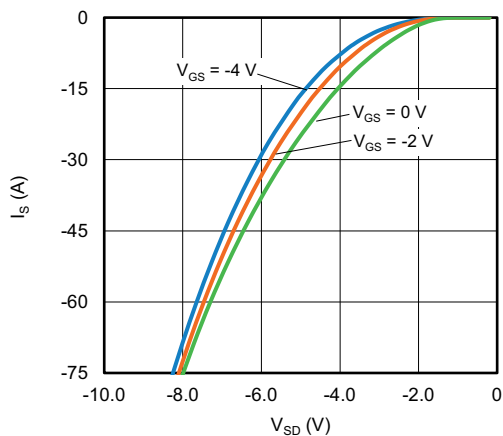


Fig. 21 - Typical Body Diode Source-to-Drain Current Characteristics $T_J = 150^\circ\text{C}$

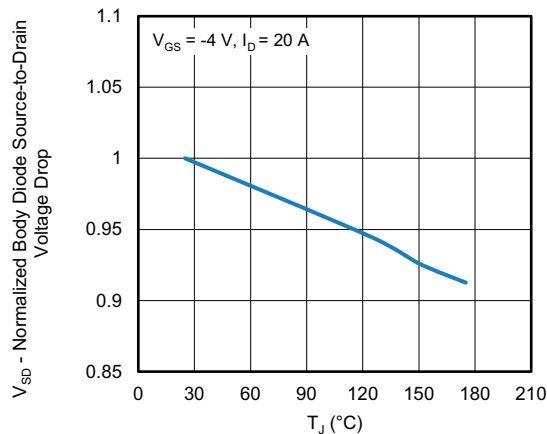


Fig. 22 - Normalized Body Diode Source-to-Drain Voltage Drop vs. Temperature

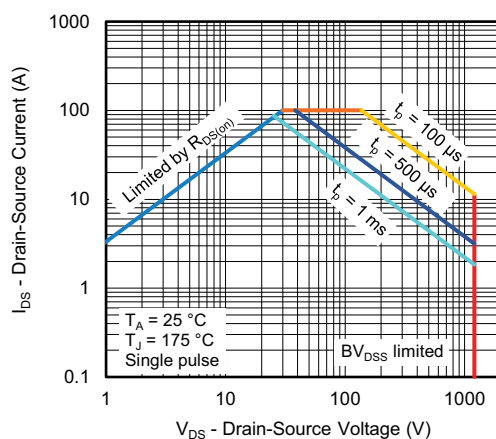


Fig. 23 - Safe Operating Area

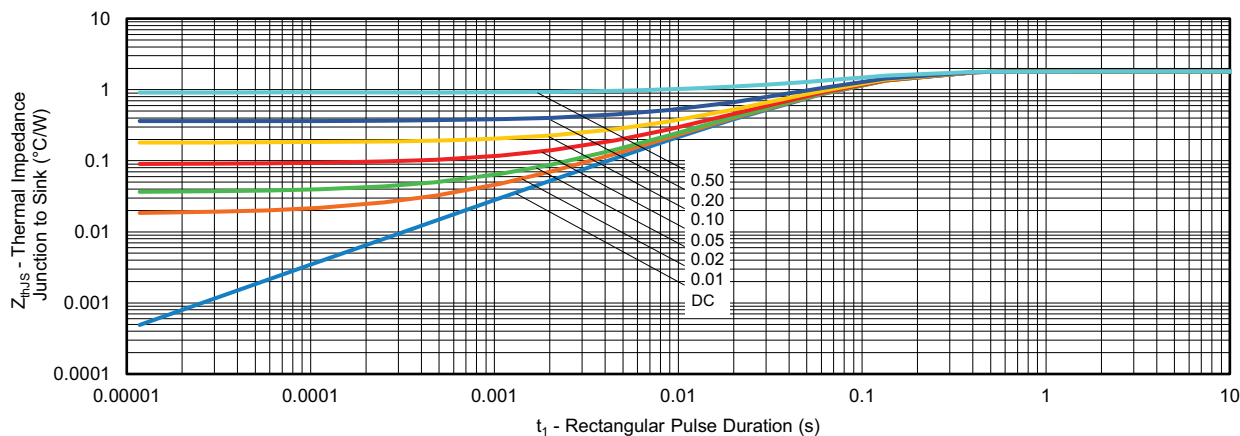


Fig. 24 - Typical Thermal Impedance Z_{thJS} Characteristics

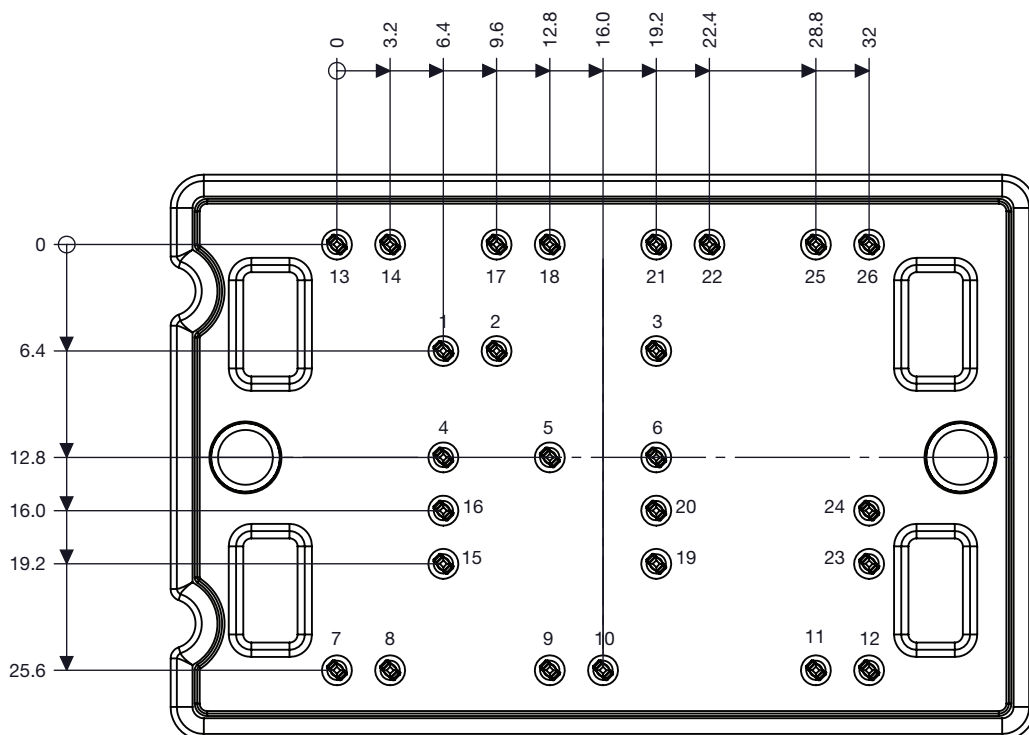


ORDERING INFORMATION TABLE

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 m Ω (075 = 75 m Ω) |
| 5 | - Die technology (P = SiC MOSFET) |
| 6 | - Voltage rating (120 = 1200 V) |

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

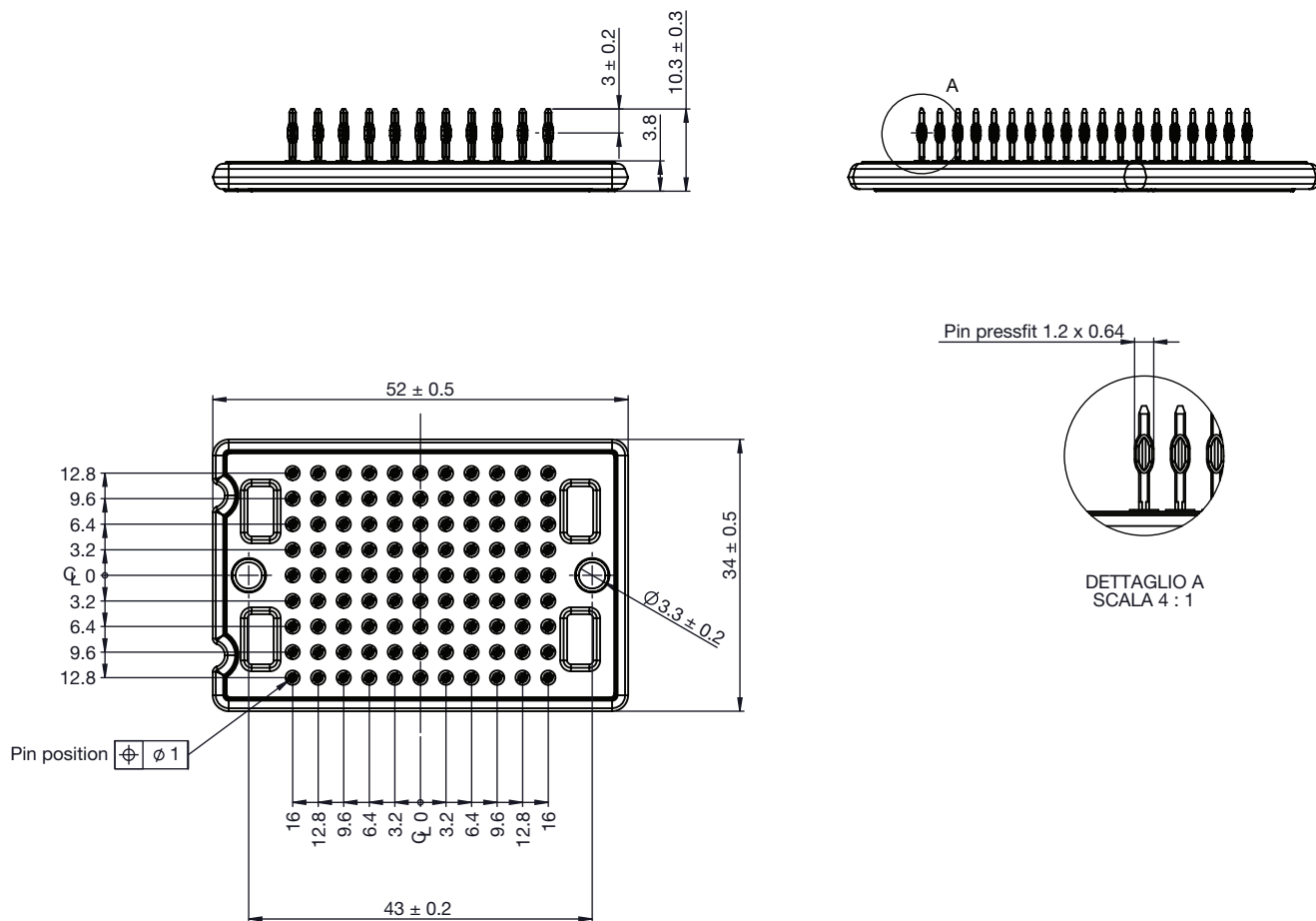
PACKAGE

LINKS TO RELATED DOCUMENTS

Dimensions

www.vishay.com/doc?97293

MAACPAK PressFit

DIMENSIONS in inches (millimeters)



Notes

- Tolerances (unless otherwise stated):
 - $x = \pm 0.3$
 - $x.x = \pm 0.1$
 - $x.xx = \pm 0.03$



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