EMIPAK 2B PressFit Full Bridge Inverter Silicon Carbide MOSFET Power Modules

EMIPAK 2B
(package example)

FEATURES

- Silicon carbide power MOSFET
- Very tight variation of on-resistance vs. temperature
- Slight variation of switching losses with temperature
- Very fast body diode
- PressFit pins technology
- Exposed Al_2O_3 substrate with low thermal resistance
- Low input capacitance
- Low internal inductance
- Easy to drive
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

PRIMARY CHARACTERISTICS	
FULL BRIDGE INVERTER - Q1 to Q6 MOSFET	
V_{DSS}	1200 V
$R_{DS(on)}$ typical at I_D = 20 A	71 mΩ
I_D at T_C = 80 °C	26 A
Type	Modules - MOSFET
Package	EMIPAK 2B
Circuit configuration	Full bridge

DESCRIPTION

The EMIPAK 2B package is easy to use thanks to the PressFit pins. The exposed substrate provides improved thermal performance.

The optimized layout also helps to minimize stray parameters, allowing for better EMI performance.

TYPICAL APPLICATIONS

- Solar inverter

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MAX.**	**UNITS**
Operating junction temperature	T_J		175	°C
Storage temperature range	T_{Stg}		-40 to +150	
RMS isolation voltage	V_{ISOL}	T_J = 25 °C, all terminals shorted, f = 50 Hz, t = 1 s	3500	V
Q1 to Q6 - MOSFET				
Drain to source voltage	V_{DSS}		1200	V
Gate to source voltage	V_{GSS}		-10 / +25	
Pulsed drain current	I_{DM} (1)		90	A
Continuous drain current	I_D	T_C = 25 °C	32	A
		T_C = 80 °C	26	
		T_{SINK} = 80 °C	22	
Power dissipation	P_D	T_C = 25 °C	143	W
		T_C = 80 °C	90	
Pulsed source current (body diode)	I_{SM}		90	A

Note

(1) Pulse width limited by safe operating area

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Q1 to Q6 - MOSFET						
Drain to source on resistance	$R_{DS(on)}$	V_{GS} = 20 V, I_D = 20 A	-	71	105	mΩ
		V_{GS} = 20 V, I_D = 20 A, T_J = 150 °C	-	79	-	
		V_{GS} = 20 V, I_D = 20 A, T_J = 175 °C	-	81	-	
Gate threshold voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 1.0 mA	1.6	3.6	6.5	V
Temperature coefficient of threshold voltage	$\Delta V_{GS(th)}/\Delta T_J$	V_{DS} = V_{GS}, I_D = 1.0 mA (25 °C to 125 °C)	-	-8.3	-	mV/°C
Forward transconductance	g_{fs}	V_{DS} = 20 V, I_D = 20 A	-	9.5	-	S
Transfer characteristics	V_{GS}	V_{DS} = 20 V, I_D = 20 A	-	12	-	V
Zero gate voltage drain current	I_{DSS}	V_{GS} = 0 V, V_{DD} = 1200 V	-	25	230	µA
		V_{GS} = 0 V, V_{DD} = 1200 V, T_J = 150 °C	-	50	-	
Gate to source leakage current	I_{GSS}	V_{GS} = +20 V / -10 V, V_{DS} = 0 V	-	-	150	nA
Q1 to Q6 - BODY DIODE						
Forward voltage drop	V_{SD}	I_{SD} = 10 A; V_{GS} = 0	-	3.2	-	V

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Q1 to Q6 - MOSFET						
Total gate charge (turn-on)	Q_g	I_D = 20 A V_{DD} = 800 V V_{GS} = 20 V	-	105	-	nC
Gate to source charge (turn-on)	Q_{gs}		-	16	-	
Gate to drain charge (turn-on)	Q_{gd}		-	40	-	
Turn-on delay time	$t_{d(on)}$	I_D = 20 A V_{DD} = 600 V V_{GS} = +20 V/-2 V R_g = 4.7 Ω, L = 500 µH	-	41	-	ns
Rise time	t_r		-	29	-	
Turn-off delay time	$t_{d(off)}$		-	79	-	
Fall time	t_f		-	62	-	
Turn-on delay time	$t_{d(on)}$	I_D = 20 A V_{DD} = 600 V V_{GS} = +20 V/-2 V R_g = 4.7 Ω, L = 500 µH, T_J = 150 °C	-	41	-	ns
Rise time	t_r		-	30	-	
Turn-off delay time	$t_{d(off)}$		-	91	-	
Fall time	t_f		-	75	-	
Input capacitance	C_{iss}	V_{GS} = 0 V V_{DS} = 400 V f = 1 MHz	-	1700	-	pF
Output capacitance	C_{oss}		-	130	-	
Reverse transfer capacitance	C_{rss}		-	25	-	
Q1 to Q6 - BODY DIODE						
Diode reverse recovery time	t_{rr}	V_R = 400 V, T_J = 25 °C I_S = 20 A dI/dt = 100 A/µs	-	140	-	ns
Diode reverse recovery current	I_{rr}		-	3.1	-	A
Diode reverse recovery charge	Q_{rr}		-	220	-	nC

INTERNAL NTC - THERMISTOR SPECIFICATIONS				
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**VALUE**	**UNITS**
Resistance	R_{25}	T_J = 25 °C	22 000 ± 5 %	Ω
	R_{150}	T_J = 150 °C	483.86 ± 5 %	
B constant	$B_{25/85}$		3800 ± 1 %	K
Operating temperature range at zero power			-40 to +150	°C
Maximum dissipation at 25 °C			210	mW
Dissipation factor	D		3.5	mW/K
Thermal time constant	τ		≈ 10	s

INTERNAL C1 / C3 DC LINK CAPACITOR - ELECTRICAL SPECIFICATIONS				
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**VALUE**	**UNITS**
Capacitance	C		0.047 ± 10 %	µF
Voltage			1000	V

THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Q1 to Q6 - MOSFET - Junction to case thermal resistance (per switch)	R_{thJC}	-	-	1.05	°C/W
Q1 to Q6 - MOSFET - Case to sink thermal resistance (per switch)	R_{thCS}	-	0.55	-	
Mounting torque (M4) (1)		2	-	3	Nm
Weight		-	45	-	g

Note

(1) See application note for further suggestion on mounting operation: www.vishay.com/doc?95580.

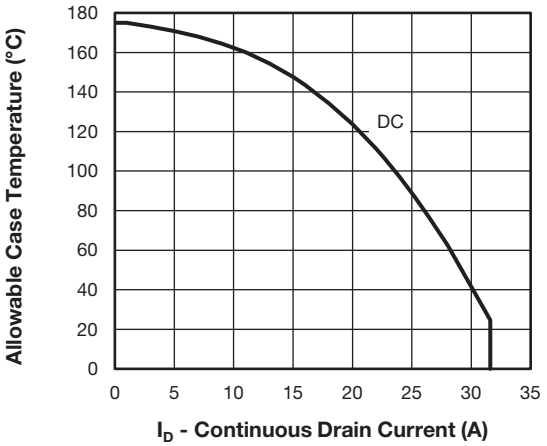


Fig. 1 - Maximum Continuous Drain Current vs. Case Temperature

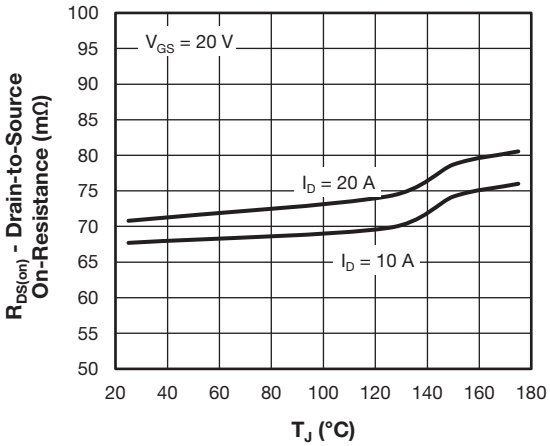


Fig. 4 - Typical Drain-to-Source On-Resistance vs. Temperature

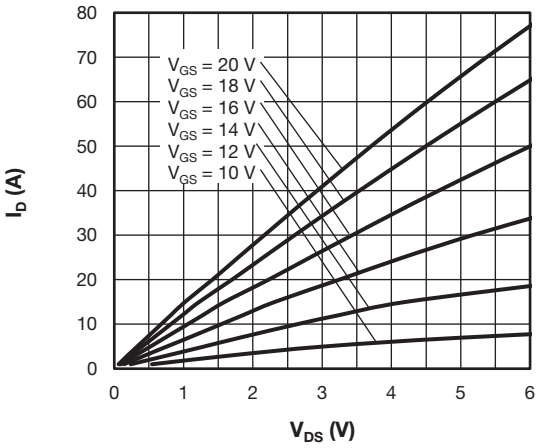


Fig. 2 - Typical Drain-to-Source Current Output Characteristics at T_J = 25 °C

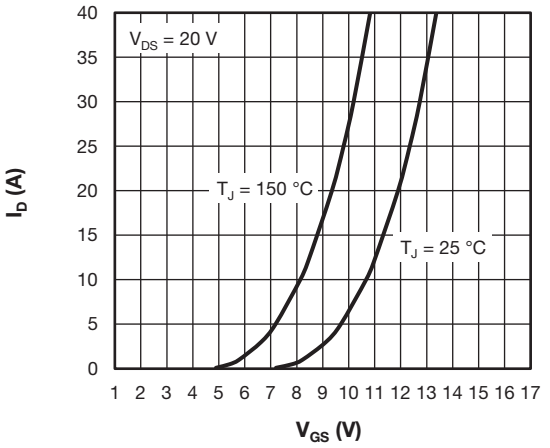


Fig. 5 - Typical Transfer Characteristics

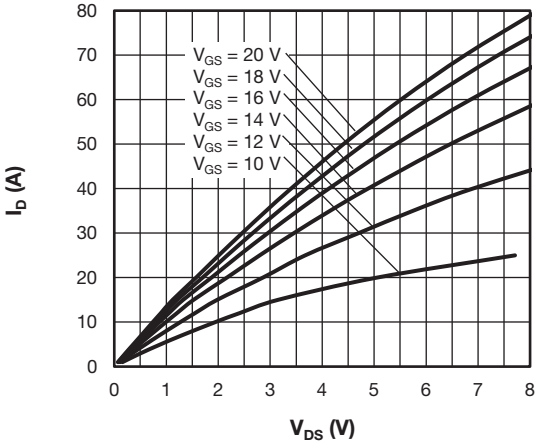


Fig. 3 - Typical Drain-to-Source Current Output Characteristics at T_J = 150 °C

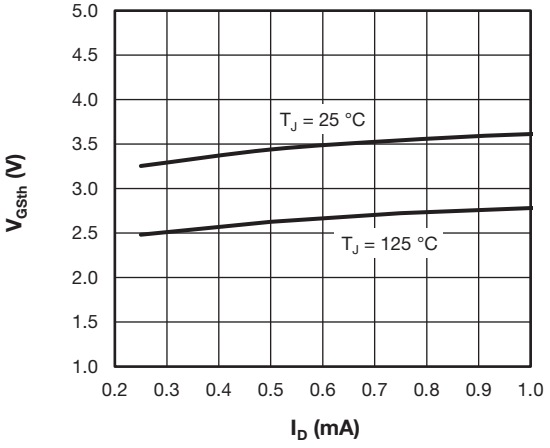


Fig. 6 - Typical Gate Threshold Voltage Characteristics

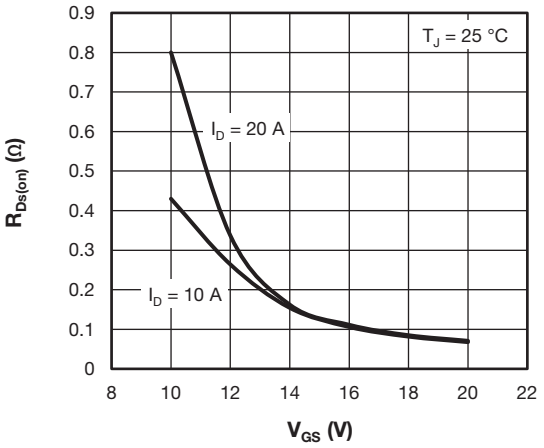


Fig. 7 - Typical Drain-State Resistance vs. Gate-to-Source Voltage

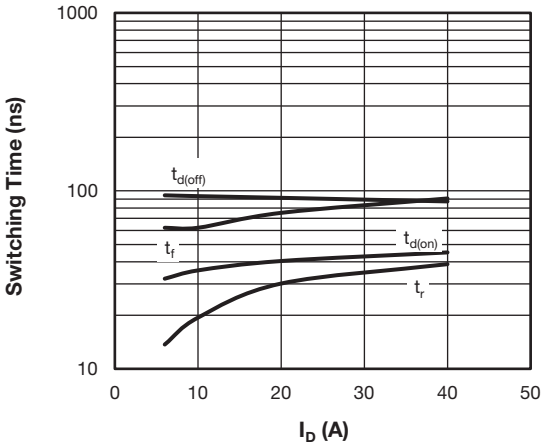


Fig. 10 - Typical Switching Time vs. I_D
T_J = 150 °C, V_{DD} = 600 V, R_g = 4.7 Ω, V_{GS} = +20 V/-2 V, L = 500 µH

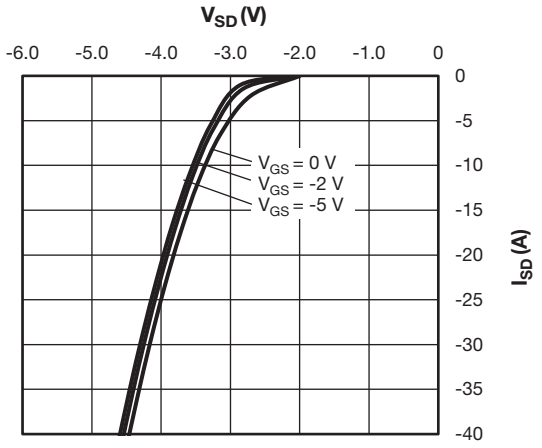


Fig. 8 - Typical Body Diode Source-to-Drain Current Characteristics
at T_J = 25 °C

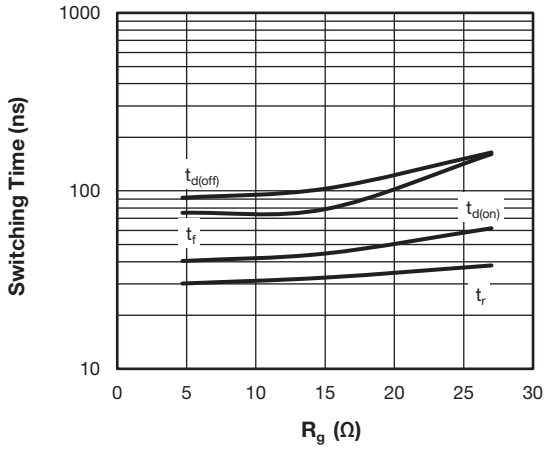


Fig. 11 - Typical Switching Time vs. R_g
T_J = 150 °C, V_{DD} = 600 V, I_D = 20 A, V_{GS} = +20 V / -2 V, L = 500 µH

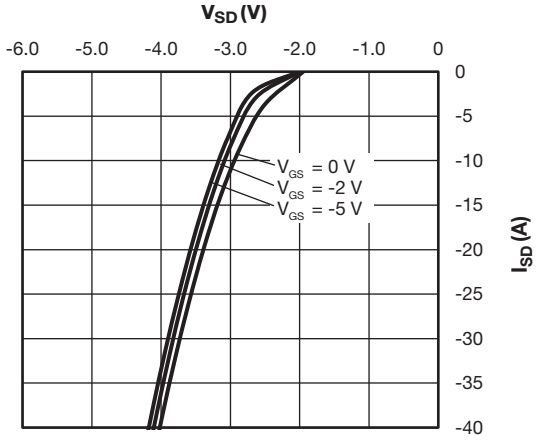


Fig. 9 - Typical Body Diode Source-to-Drain Current Characteristics
at T_J = 150 °C

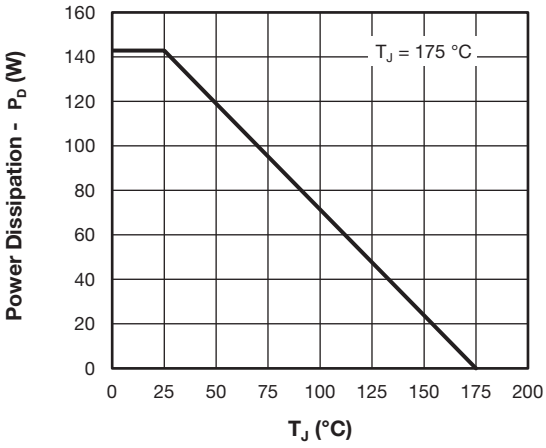


Fig. 12 - Power Dissipation Curve

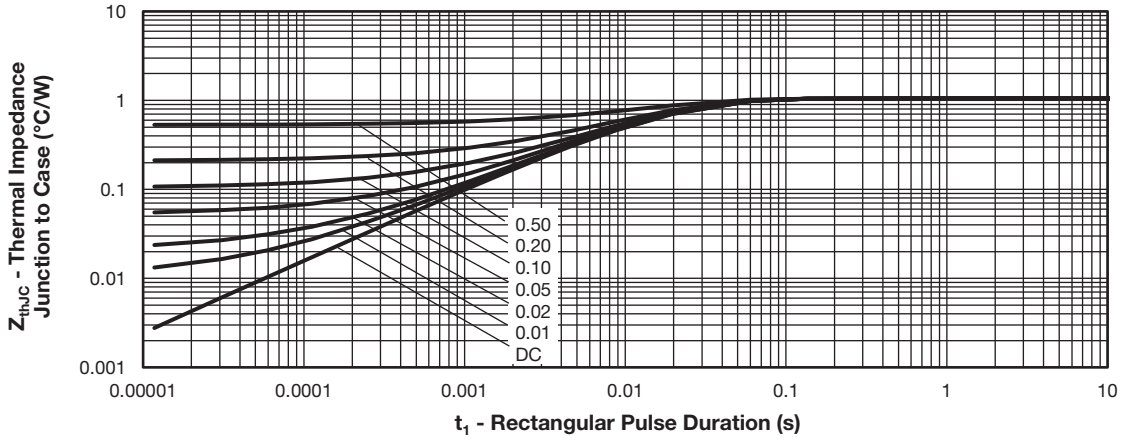


Fig. 13 - Maximum Thermal Impedance Junction-to-Case Characteristics

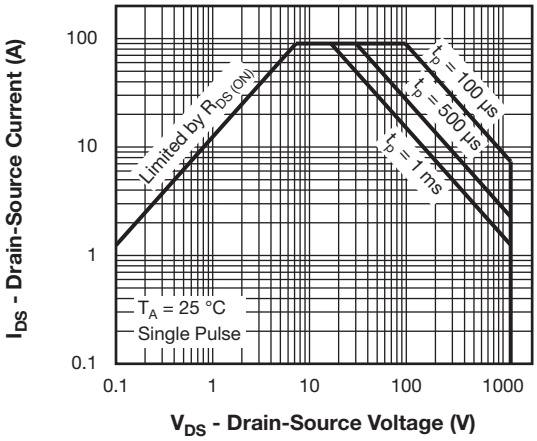
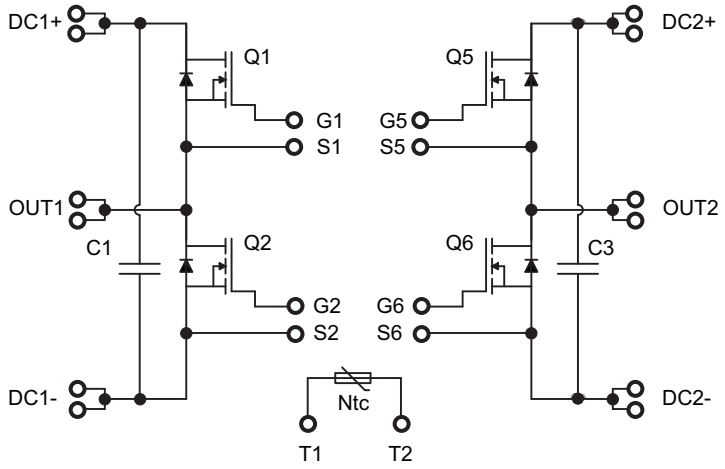


Fig. 14 - Safe Operating Area

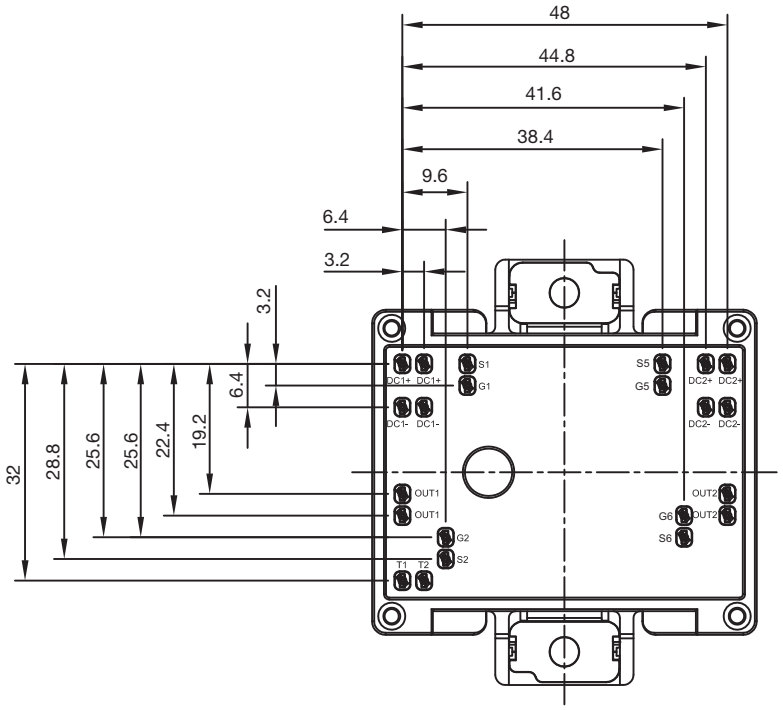
ORDERING INFORMATION TABLE

Device code	VS-	ET	Y	020	P	120	F
	1	2	3	4	5	6	7

- 1 - Vishay Semiconductors product
- 2 - Package indicator (ET = EMIPAK 2B)
- 3 - Circuit configuration (Y = full bridge inverter)
- 4 - Current rating (020 = 20 A)
- 5 - Switch die technology
- 6 - Voltage rating (120 = 1200 V)
- 7 - Diode die technology

CIRCUIT CONFIGURATION		
CIRCUIT	**CIRCUIT CONFIGURATION CODE**	**CIRCUIT DRAWING**
Full bridge inverter	Y	

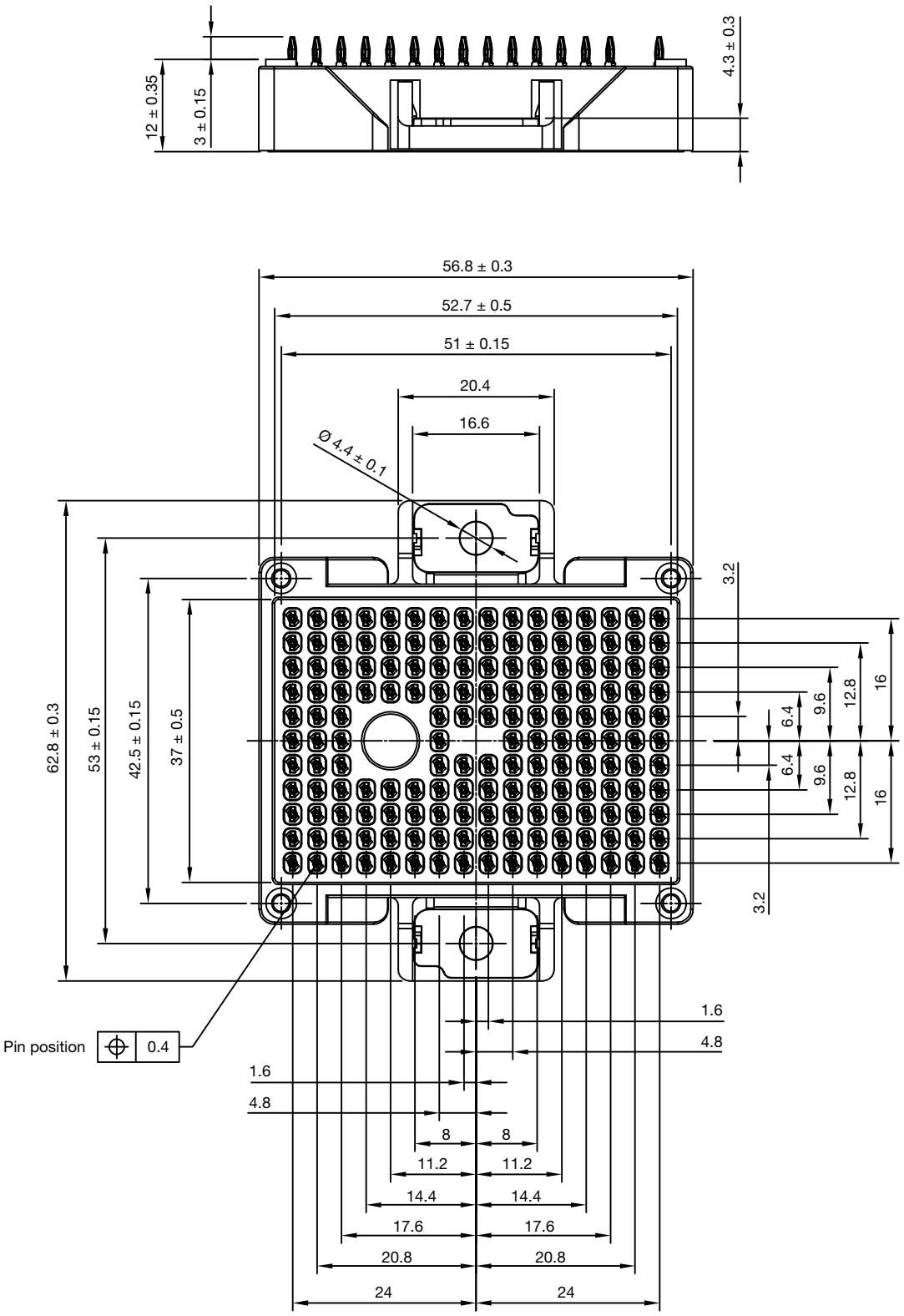
PACKAGE



LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95559

EMIPAK-2B PressFit

DIMENSIONS in millimeters



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