

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
$R_{\text{DS(on)}}$ typical at $I_{\text{D}} = 20 \text{ A}$	71 m Ω
I_{D} at $T_{\text{C}} = 80 \text{ }^{\circ}\text{C}$	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	$^{\circ}\text{C}$
Storage temperature range	T_{Stg}		-40 to +150	
RMS isolation voltage	V_{ISOL}	$T_{\text{J}} = 25 \text{ }^{\circ}\text{C}$, all terminals shorted, $f = 50 \text{ Hz}$, $t = 1 \text{ s}$	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	$I_{\text{DM}}^{(1)}$		90	A
Continuous drain current	I_{D}	$T_{\text{C}} = 25 \text{ }^{\circ}\text{C}$	32	A
		$T_{\text{C}} = 80 \text{ }^{\circ}\text{C}$	26	
		$T_{\text{SINK}} = 80 \text{ }^{\circ}\text{C}$	22	
Power dissipation	P_{D}	$T_{\text{C}} = 25 \text{ }^{\circ}\text{C}$	143	W
		$T_{\text{C}} = 80 \text{ }^{\circ}\text{C}$	90	
Pulsed source current (body diode)	I_{SM}		90	A

Note

⁽¹⁾ Pulse width limited by safe operating area


ELECTRICAL SPECIFICATIONS ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise noted)

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

SWITCHING CHARACTERISTICS ($T_J = 25\text{ }^{\circ}\text{C}$ 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.

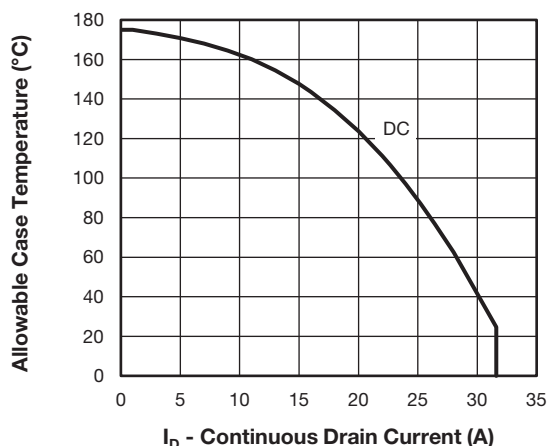


Fig. 1 - Maximum Continuous Drain Current vs. Case Temperature

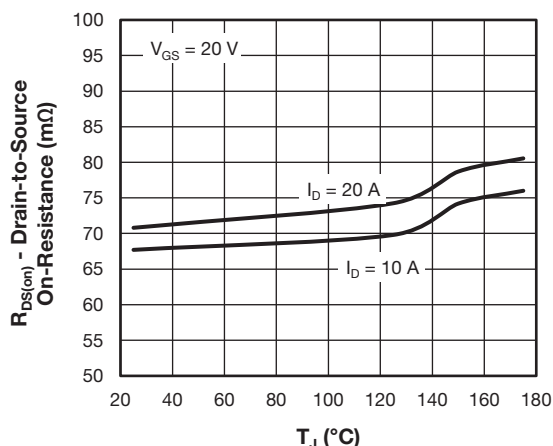


Fig. 4 - Typical Drain-to-Source On-Resistance vs. Temperature

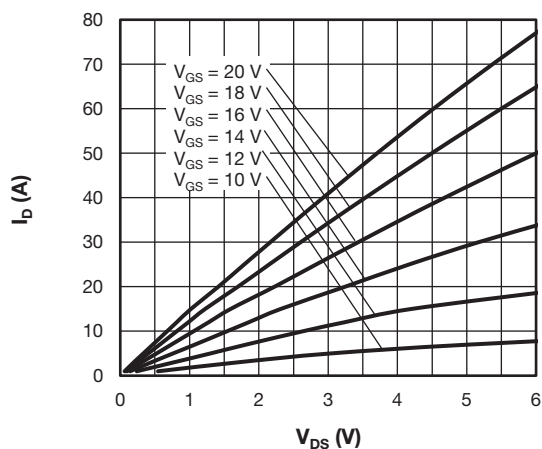


Fig. 2 - Typical Drain-to-Source Current Output Characteristics at $T_J = 25$ °C

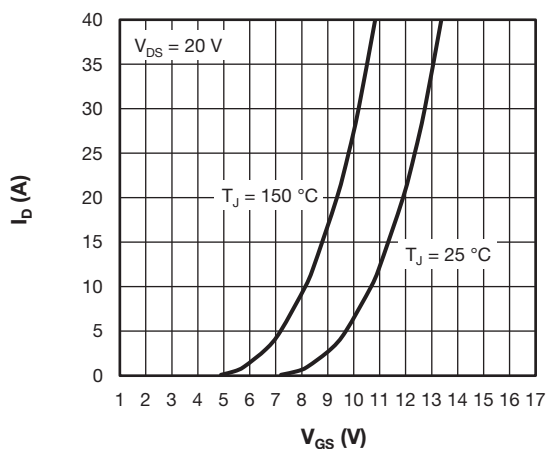


Fig. 5 - Typical Transfer Characteristics

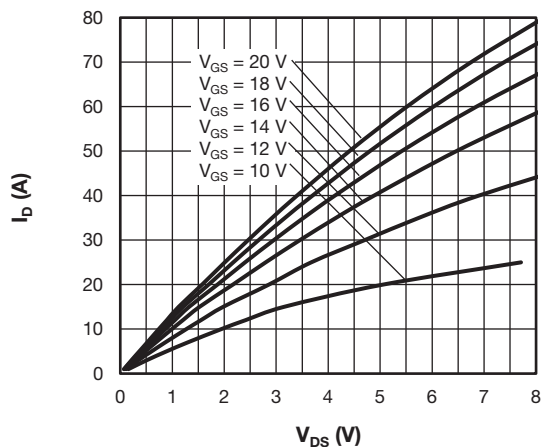


Fig. 3 - Typical Drain-to-Source Current Output Characteristics at $T_J = 150$ °C

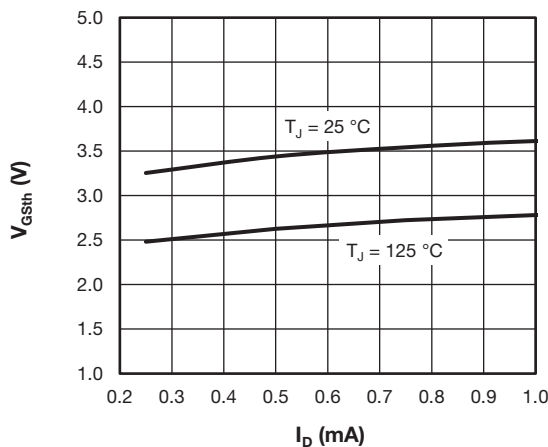


Fig. 6 - Typical Gate Threshold Voltage Characteristics

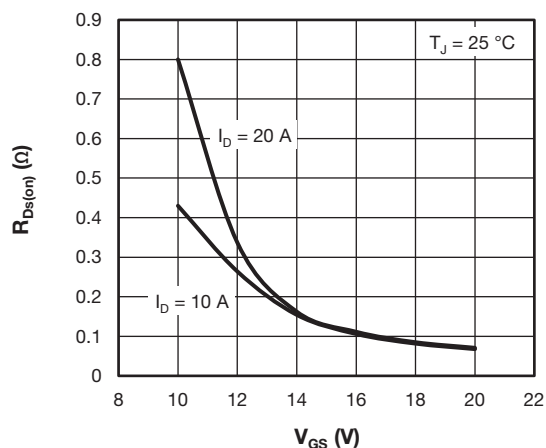


Fig. 7 - Typical Drain-State Resistance vs. Gate-to-Source Voltage

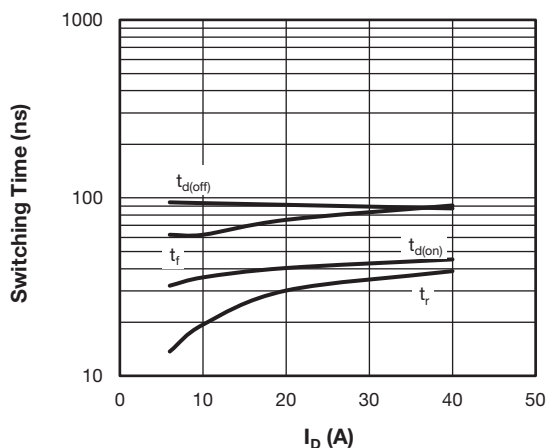


Fig. 10 - Typical Switching Time vs. I_D
 $T_J = 150^\circ\text{C}$, $V_{DD} = 600\text{ V}$, $R_g = 4.7\ \Omega$, $V_{GS} = +20\text{ V} / -2\text{ V}$, $L = 500\ \mu\text{H}$

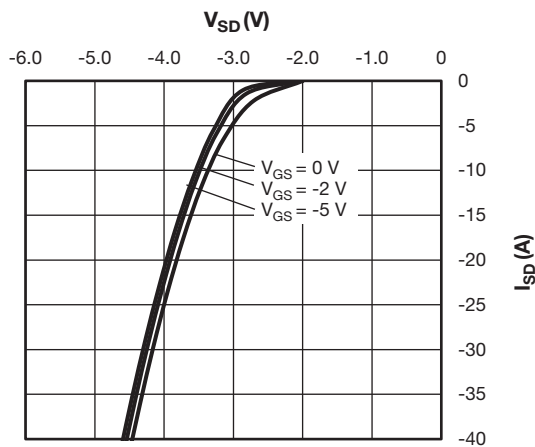


Fig. 8 - Typical Body Diode Source-to-Drain Current Characteristics at $T_J = 25^\circ\text{C}$

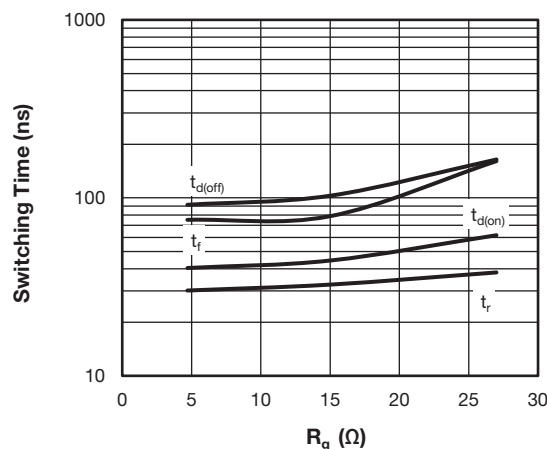


Fig. 11 - Typical Switching Time vs. R_g
 $T_J = 150^\circ\text{C}$, $V_{DD} = 600\text{ V}$, $I_D = 20\text{ A}$, $V_{GS} = +20\text{ V} / -2\text{ V}$, $L = 500\ \mu\text{H}$

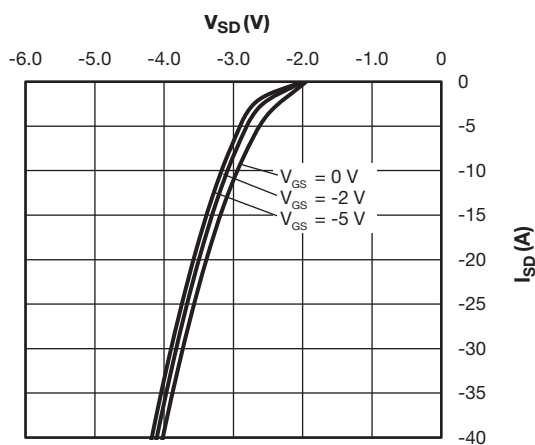


Fig. 9 - Typical Body Diode Source-to-Drain Current Characteristics at $T_J = 150^\circ\text{C}$

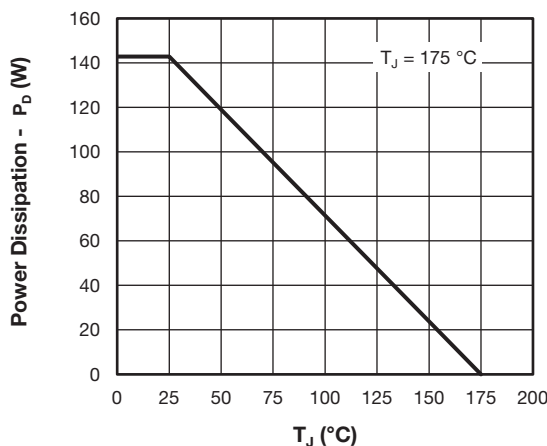


Fig. 12 - Power Dissipation Curve

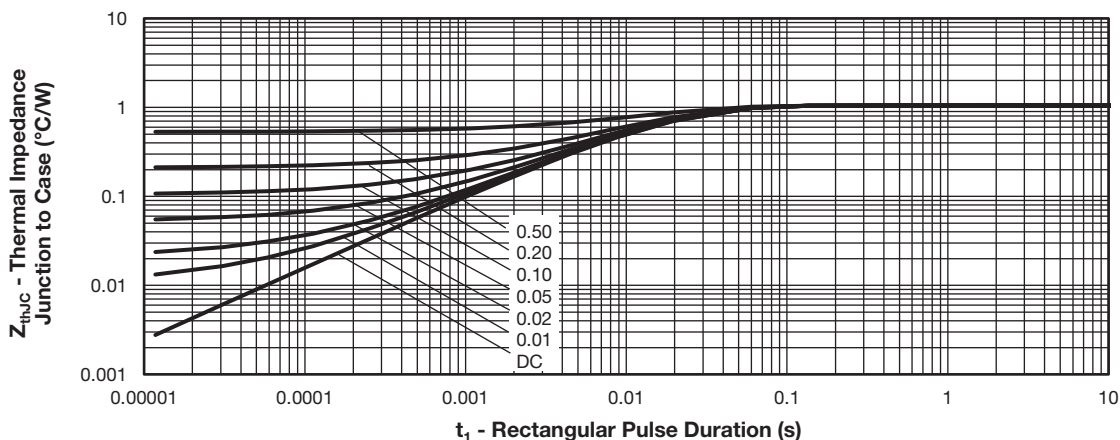


Fig. 13 - Maximum Thermal Impedance Junction-to-Case Characteristics

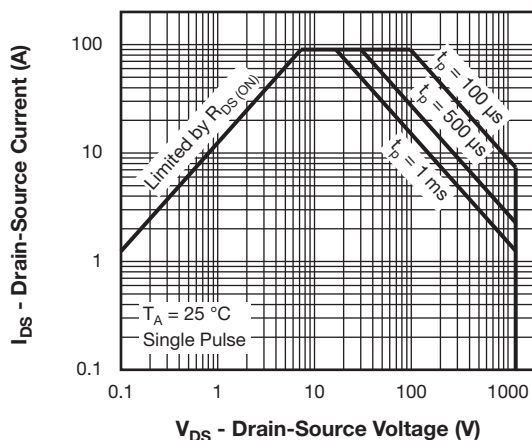
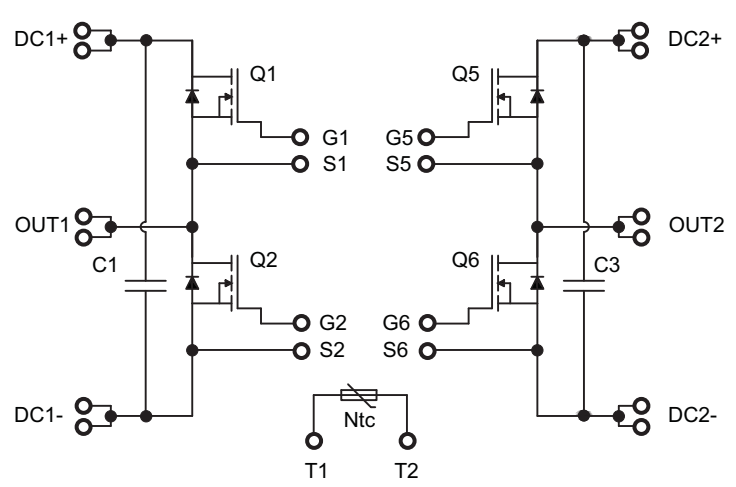


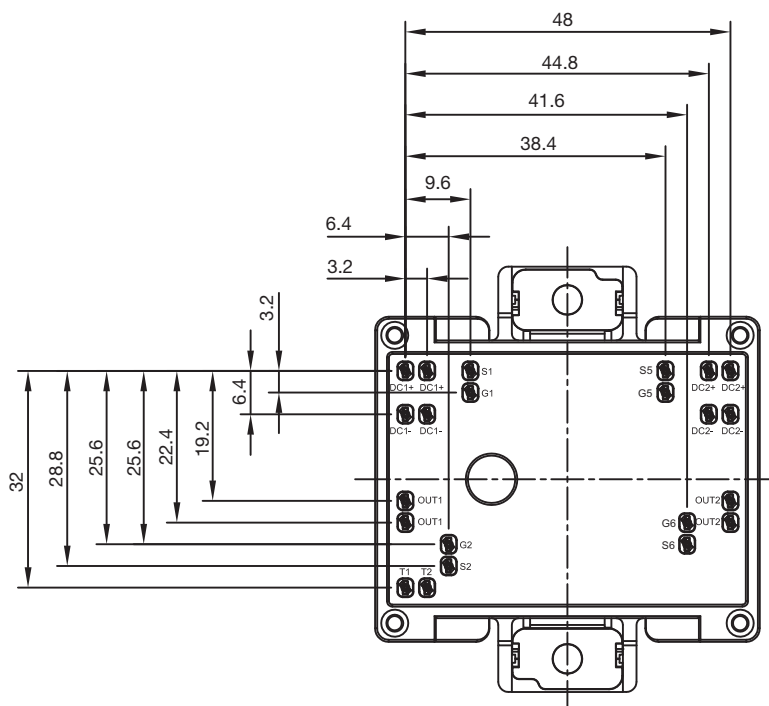
Fig. 14 - Safe Operating Area

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

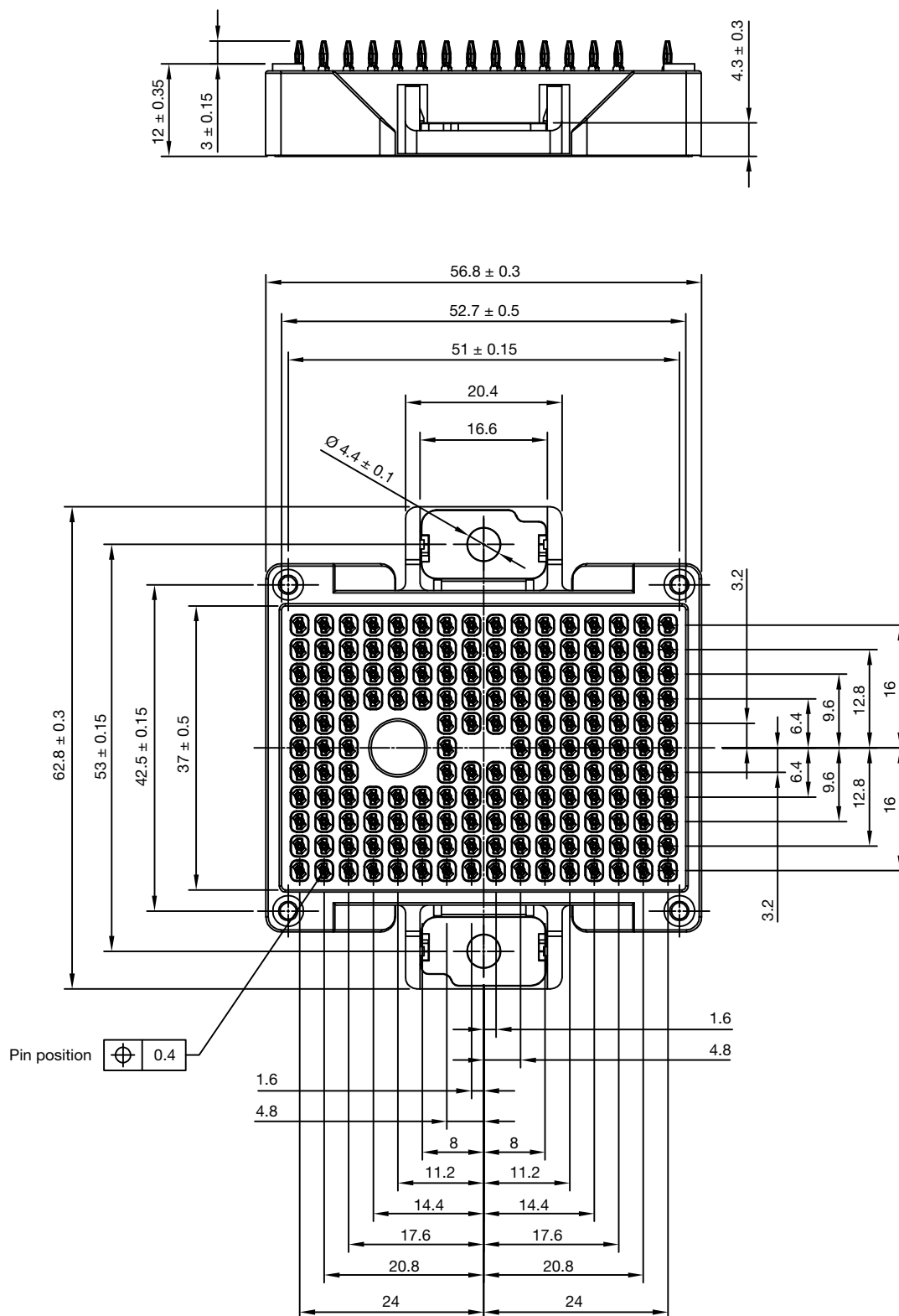


LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95559



EMIPAK-2B PressFit

DIMENSIONS in millimeters





Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.