

EMIPAK 1B PressFit Power Module 600 V Double PFC MOSFET, 25 A



EMIPAK 1B
(package example)



RoHS
COMPLIANT

FEATURES

- E series Power MOSFET
- MOAT and SiC diode technology
- Exposed Al_2O_3 substrate with low thermal resistance
- Low input capacitance
- Low switching and conduction losses
- Ultra low gate charge Q_g
- Low internal inductances
- Qualified using AQG324 guideline as reference
- PressFit pins locking technology
PATENT(S): www.vishay.com/patents
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

DESCRIPTION

The EMIPAK 1B 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.

PRIMARY CHARACTERISTICS	
Q1 - Q4 MOSFET	
V_{DSS}	600 V
$R_{DS(on)}$ typical at $I_C = 25$ A	59 m Ω
I_D at $T_{SINK} = 37$ °C	25 A
Da1 - Da2 DIODE	
V_{RRM}	1200 V
V_{FM} typical at 20 A	1.29 V
I_F at $T_{SINK} = 83$ °C	20 A
D1 - D4 SILICON CARBIDE CLAMP DIODE	
V_{RRM}	600 V
V_{FM} typical at 10 A	1.72 V
I_F at $T_{SINK} = 62$ °C	10 A
Package	EMIPAK 1B
Circuit configuration	Double interleaved bridgless PFC (4 x channels) with individual return diodes
Type	Modules - MOSFET

ABSOLUTE MAXIMUM RATINGS ($T_J = 25$ °C unless otherwise noted)				
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Operating junction temperature	T_J		150	°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 - Q4 MOSFET				
Drain to source voltage	V_{DSS}		600	V
Gate to source voltage	V_{GS}		± 20	
Pulsed drain current	I_{DM}	$V_{GS} = 10$ V	85	A
Continuous drain current	I_D	$T_{SINK} = 25$ °C	26	A
		$T_{SINK} = 80$ °C	20	
Power dissipation	P_D	$T_{SINK} = 25$ °C	104	W
		$T_{SINK} = 80$ °C	58	
Single pulse avalanche energy	E_{AS}	$L = 10$ mH, $I_{AS} = 19$ A, $T_J = 25$ °C	1800	mJ
Pulsed source current (body diode)	I_{SM}		85	A

PATENT(S): www.vishay.com/patents

This Vishay product is protected by one or more United States and international patents.

**ABSOLUTE MAXIMUM RATINGS** ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise noted)

DA1 - DA2 DIODE				
Cathode to anode voltage	V _{RRM}		1200	V
Single pulse forward current	I _{FSM}		230	A
Diode continuous forward current	I _F	T _{SINK} = 25 °C	29	A
		T _{SINK} = 80 °C	21	
Power dissipation	P _D	T _{SINK} = 25 °C	70	W
		T _{SINK} = 80 °C	39	
D1 - D4 SILICON CARBIDE CLAMP DIODE				
Cathode to anode voltage	V _{RRM}		600	V
Single pulse forward current	I _{FSM}	10 ms sine or 6 ms rectangular pulse, T _J = 25 °C	80	A
Diode continuous forward current	I _F	T _{SINK} = 25 °C	12	A
		T _{SINK} = 80 °C	9	
Power dissipation	P _D	T _{SINK} = 25 °C	38	W
		T _{SINK} = 80 °C	21	

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Q1 - Q4 MOSFET						
Drain to source breakdown voltage	BV _{DSS}	V _{GS} = 0 V, I _D = 500 μA	600	-	-	mΩ
Drain to source on resistance	R _{DS(on)}	V _{GS} = 10 V, I _D = 25 A	-	59	71	
		V _{GS} = 10 V, I _D = 25 A, T _J = 150 °C	-	140	-	
Gate threshold voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA	1.8	2.6	4.4	V
Temperature coefficient of threshold voltage	ΔV _{GS(th)} /ΔT _J	V _{DS} = V _{GS} , I _D = 250 μA (25 °C to 125 °C)	-	-9.7	-	mV/°C
Forward transconductance	g _{fs}	V _{DS} = 20 V, I _D = 25 A	-	29	-	S
Transfer characteristics	V _{GS}	V _{DS} = 20 V, I _D = 25 A	-	5.1	-	V
Zero gate voltage drain current	I _{DSS}	V _{GS} = 0 V, V _{DS} = 600 V	-	0.3	5	μA
		V _{GS} = 0 V, V _{DS} = 600 V, T _J = 150 °C	-	19	-	
Gate to source leakage current	I _{GSS}	V _{GS} = ± 20 V, V _{DS} = 0 V	-	-	± 150	nA
Q1 - Q4 BODY DIODE						
Source-to-drain voltage drop	V _{SD}	I _{SD} = 25 A, V _{GS} = 0 V	-	0.9	1.32	V
Da1 - Da2 DIODE						
Forward voltage drop	V _{FM}	I _F = 20 A	-	1.29	1.90	V
		I _F = 20 A, T _J = 150 °C	-	1.26	-	
Breakdown voltage	V _{BR}	I _R = 500 μA	1200	-	-	V
Reverse leakage current	I _{RM}	V _R = 1200 V	-	1.0	100	μA
		V _R = 1200 V, T _J = 150 °C	-	900	-	
D1 - D4 SILICON CARBIDE CLAMP DIODE						
Forward voltage drop	V _{FM}	I _F = 10 A	-	1.72	1.98	V
		I _F = 10 A, T _J = 150 °C	-	2.21	-	
Breakdown voltage	V _{BR}	I _R = 500 μA	600	-	-	V
Reverse leakage current	I _{RM}	V _R = 600 V	-	0.2	100	μA
		V _R = 600 V, T _J = 150 °C	-	1.4	-	



SWITCHING CHARACTERISTICS (T _J = 25 °C unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Q1 - Q4 MOSFET WITH D1 - D4 CLAMP DIODE						
Total gate charge (turn-on)	Q _g	I _D = 24 A V _{DS} = 480 V V _{GS} = 10 V	-	147	-	nC
Gate to source charge (turn-on)	Q _{gs}		-	36	-	
Gate to drain charge (turn-on)	Q _{gd}		-	60	-	
Turn-on delay time	t _{d(on)}	I _D = 25 A V _{DD} = 300 V V _{GS} = 10 V R _g = 4.7 Ω, L = 500 μH	-	82	-	ns
Rise time	t _r		-	23	-	
Turn-off delay time	t _{d(off)}		-	109	-	
Fall time	t _f		-	9	-	
Turn-on delay time	t _{d(on)}	I _D = 25 A V _{DD} = 300 V V _{GS} = 10 V R _g = 4.7 Ω, L = 500 μH, T _J = 125 °C	-	83	-	ns
Rise time	t _r		-	26	-	
Turn-off delay time	t _{d(off)}		-	111	-	
Fall time	t _f		-	22	-	
Input capacitance	C _{iss}	V _{GS} = 0 V V _{DS} = 100 V f = 1 MHz	-	4810	-	pF
Output capacitance	C _{oss}		-	230	-	
Reverse transfer capacitance	C _{rss}		-	5	-	
Reverse bias safe operating area	RBSOA	T _J = 150 °C, I _D = 50 A, V _{DD} = 400 V, V _P = 600 V, R _g = 4.7 Ω, V _{GS} = +10 /0 V				
Q1 - Q4 BODY DIODE						
Diode reverse recovery time	t _{rr}	V _R = 30 V, T _J = 25 °C I _S = 30 A di/dt = 100 A/μs	-	500	-	ns
Diode reverse recovery current	I _{rr}		-	41	-	A
Diode reverse recovery charge	Q _{rr}		-	10.5	-	μC
D1 - D4 SILICON CARBIDE CLAMP DIODE						
Total capacitive charge	Q _C	V _R = 600 V I _F = 10 A di/dt = 500 A/μs	-	30	-	nC

INTERNAL NTC - THERMISTOR SPECIFICATIONS				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUE	UNITS
Resistance	R_{25}	$T_C = 25\text{ }^{\circ}\text{C}$	5000	Ω
	R_{100}	$T_C = 100\text{ }^{\circ}\text{C}$	$493 \pm 5\%$	
B-value	$B_{25/50}$	$R_2 = R_{25} \exp. [B_{25/50}(1/T_2 - 1/(298.15\text{ K}))]$	$3375 \pm 5\%$	K
Maximum operating temperature			220	$^{\circ}\text{C}$
Dissipation constant			2	$\text{mW}/^{\circ}\text{C}$
Thermal time constant			8	s

THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
Q1 - Q4 MOSFET - Junction to sink thermal resistance (per switch) ⁽¹⁾	R_{thJS}	-	1.00	-	$^{\circ}\text{C}/\text{W}$
Da1 - Da2 DIODE - Junction to sink thermal resistance (per diode) ⁽¹⁾		-	1.48	-	
D1 - D4 SILICON CARBIDE DIODE - Junction to sink thermal resistance (per diode) ⁽¹⁾		-	2.76	-	
Case to sink thermal resistance (per module) ⁽¹⁾		-	0.1	-	
Mounting torque (M4)		2	-	3	Nm
Weight		-	28	-	g

Note

⁽¹⁾ Mounting surface flat, smooth, and greased, $\lambda_{grease} = 0.67\text{ W/mK}$

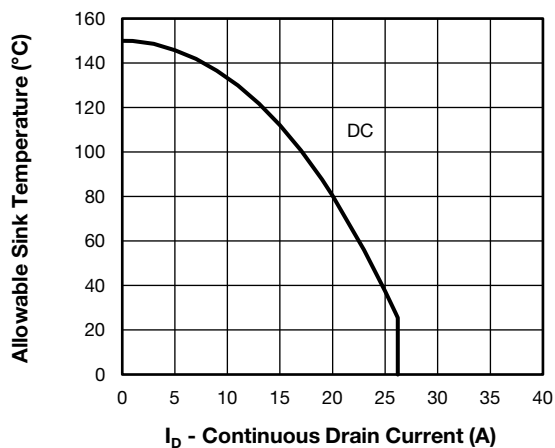


Fig. 1 - Maximum Continuous Drain Current vs. Sink Temperature

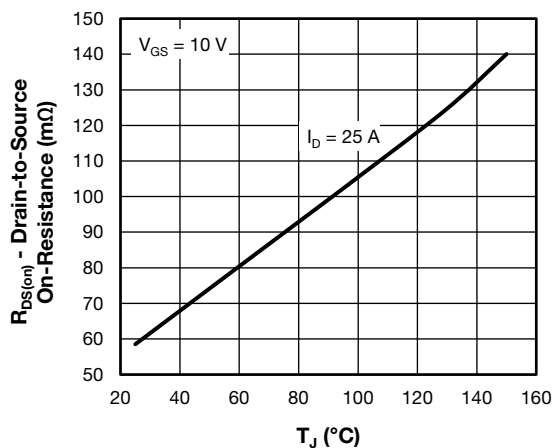


Fig. 4 - Typical Drain-to-Source On-Resistance vs. Temperature

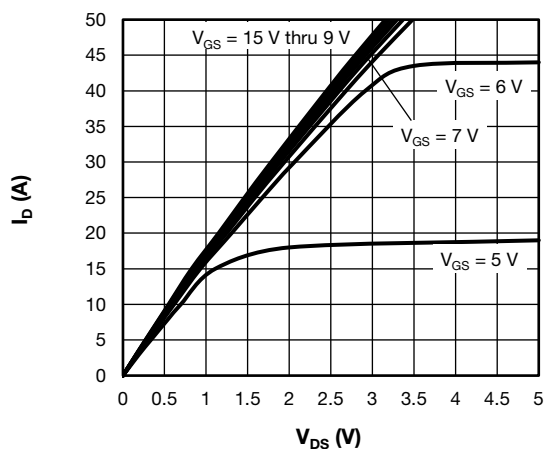


Fig. 2 - Typical Drain to Source Current Output Characteristics at $T_J = 25\text{ °C}$

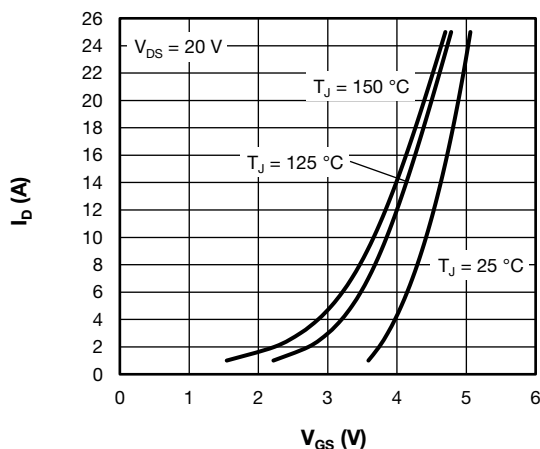


Fig. 5 - Typical Transfer Characteristics

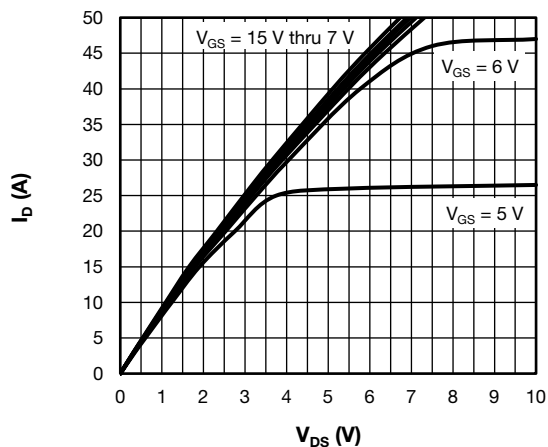


Fig. 3 - Typical Drain to Source Current Output Characteristics at $T_J = 125\text{ °C}$

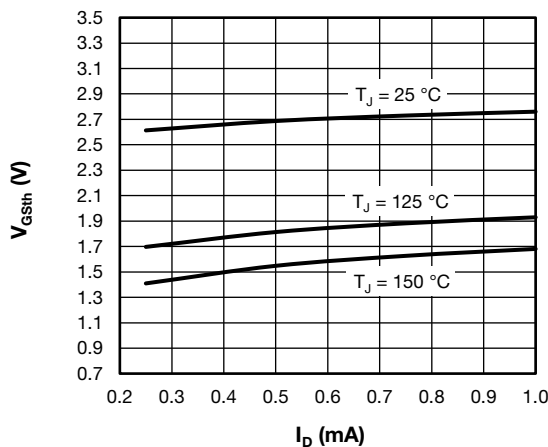


Fig. 6 - Typical Gate Threshold Voltage Characteristics

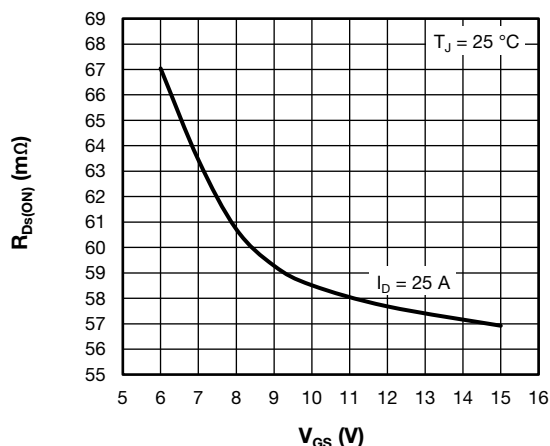


Fig. 7 - Typical Drain-State Resistance vs. Gate-to-Source Voltage

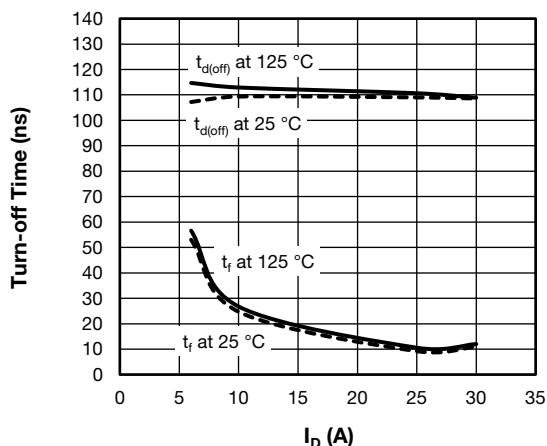
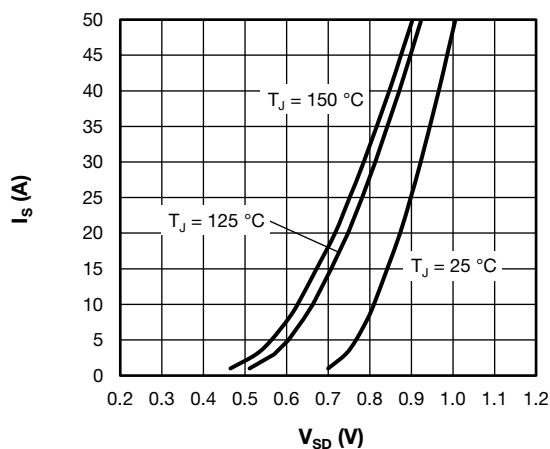

Fig. 10 - Typical Turn-off Switching Time vs. I_D
 $V_{DD} = 300\text{ V}$, $R_g = 4.7\Omega$, $V_{GS} = \pm 10\text{ V}$, $L = 500\text{ }\mu\text{H}$


Fig. 8 - Typical Body Diode Source-to-Drain Current Characteristics

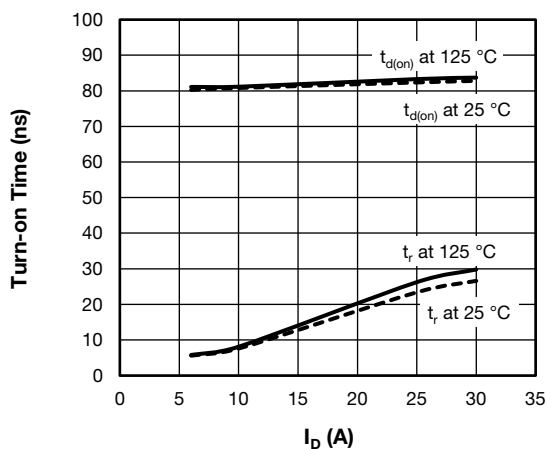
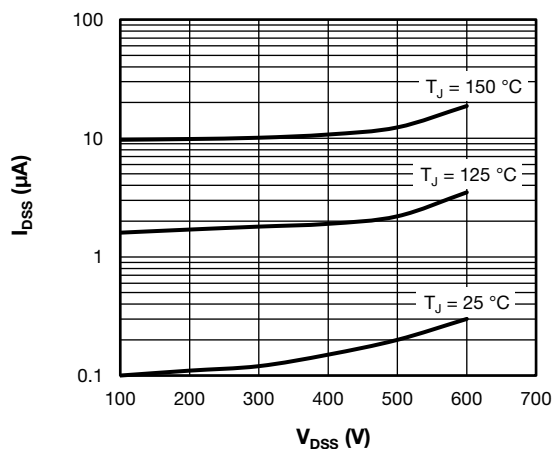

Fig. 11 - Typical Turn-on Switching Time vs. I_D
 $V_{DD} = 300\text{ V}$, $R_g = 4.7\Omega$, $V_{GS} = \pm 10\text{ V}$, $L = 500\text{ }\mu\text{H}$


Fig. 9 - Typical Zero Gate Voltage Drain Current

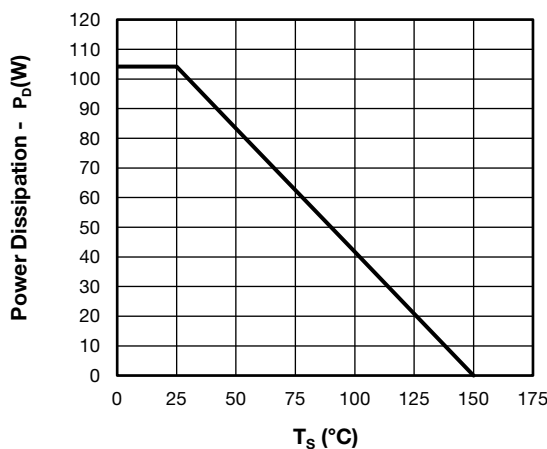


Fig. 12 - Power Dissipation Curve

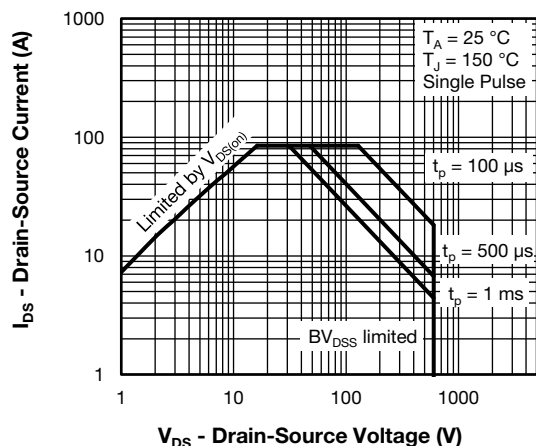


Fig. 13 - Safe Operating Area

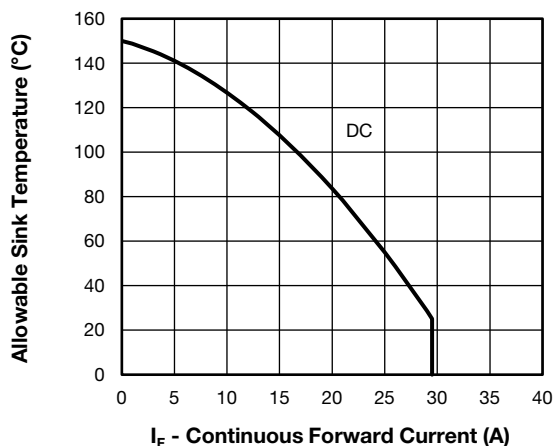


Fig. 16 - Maximum Da1-Da2 Diode Continuous Forward Current vs. Sink Temperature

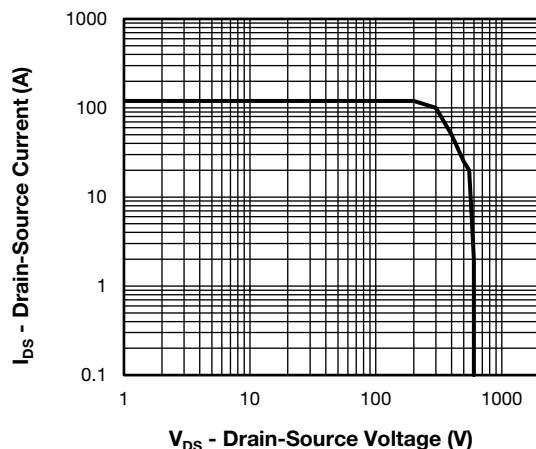


Fig. 14 - Reverse BIAS SOA

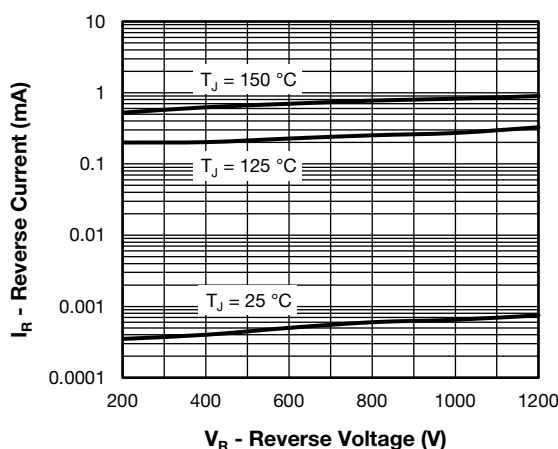


Fig. 17 - Typical Da1-Da2 Diode Reverse Leakage Current

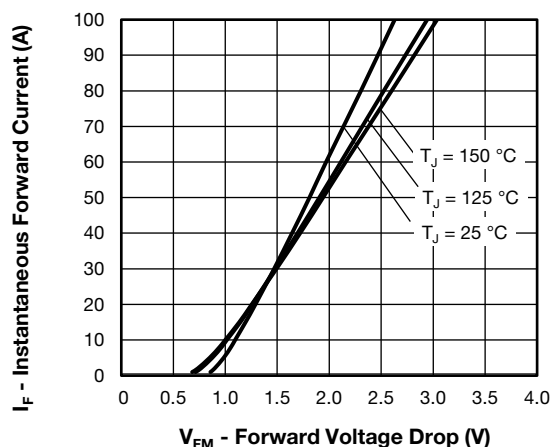


Fig. 15 - Typical Da1-Da2 Diode Forward Characteristics

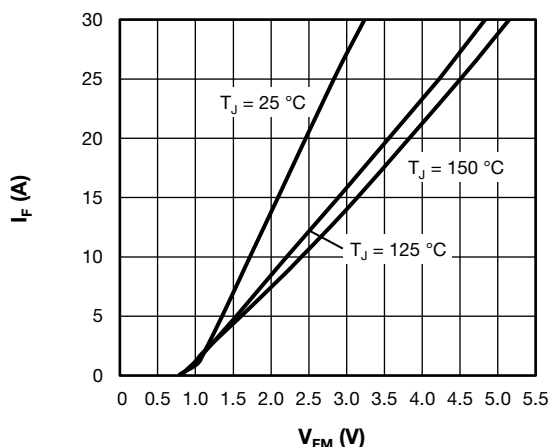


Fig. 18 - Typical D1-D4 Clamp Diode Forward Characteristics

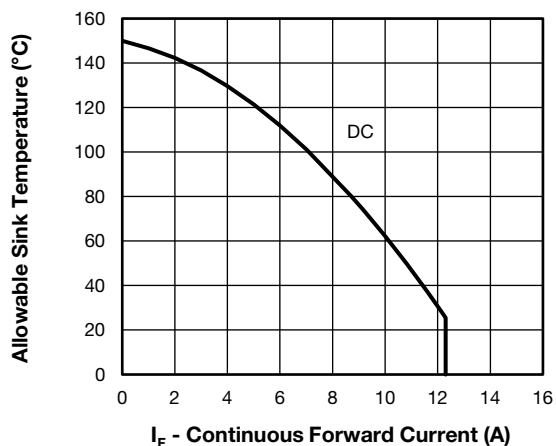


Fig. 19 - Maximum D1-D4 Clamp Diode Continuous Forward Current vs. Sink Temperature

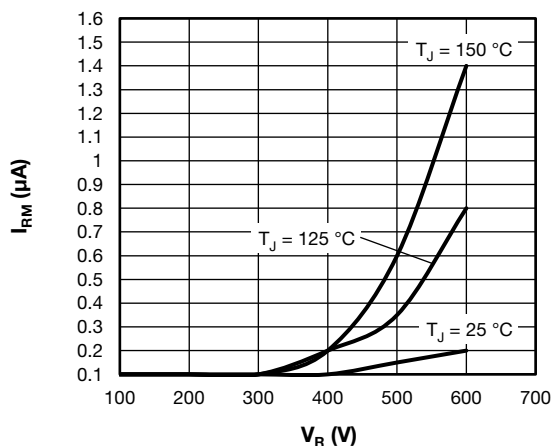


Fig. 20 - Typical D1-D4 Clamp Diode Reverse Leakage Current

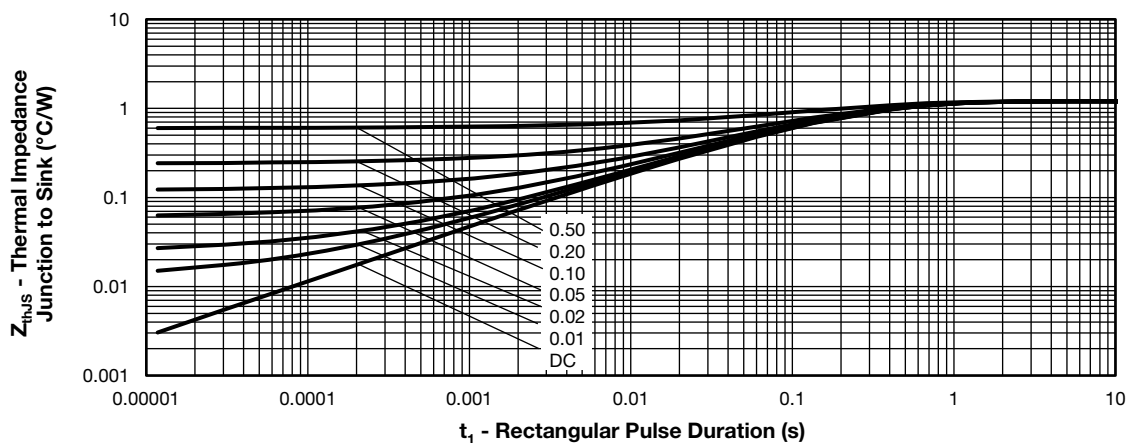


Fig. 21 - Maximum Thermal Impedance Z_{thJS} Characteristics - (Q1-Q4 MOSFET)

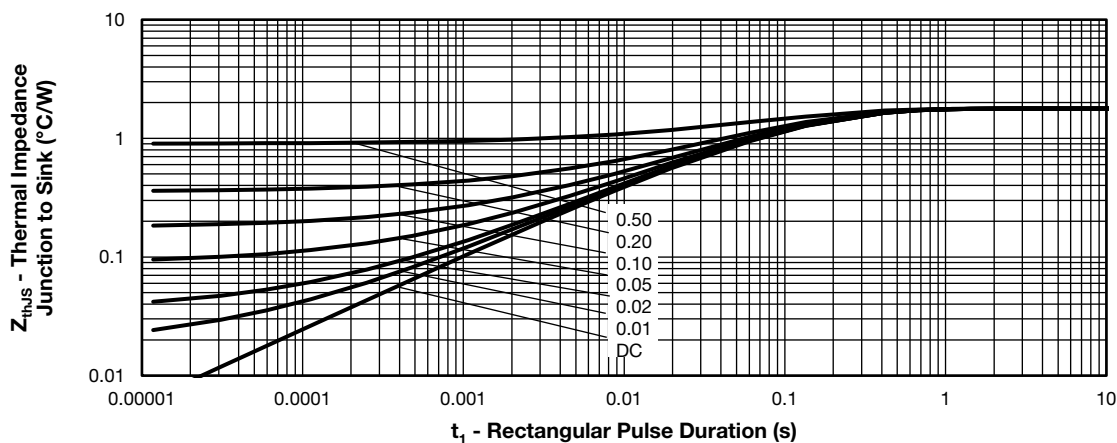


Fig. 22 - Maximum Thermal Impedance Z_{thJS} Characteristics - (Da1-Da2 Diode)

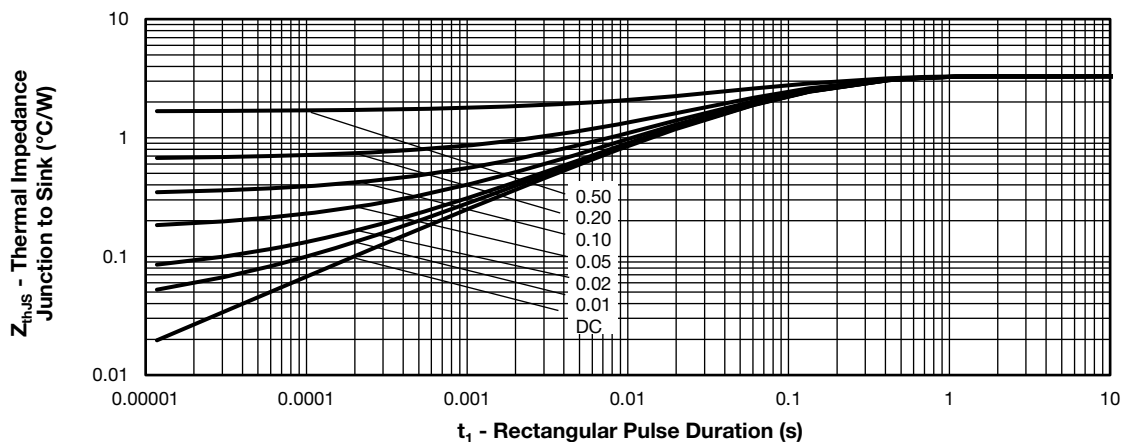


Fig. 23 - Maximum Thermal Impedance Z_{thJS} Characteristics - (D1-D4 Clamp Diode)

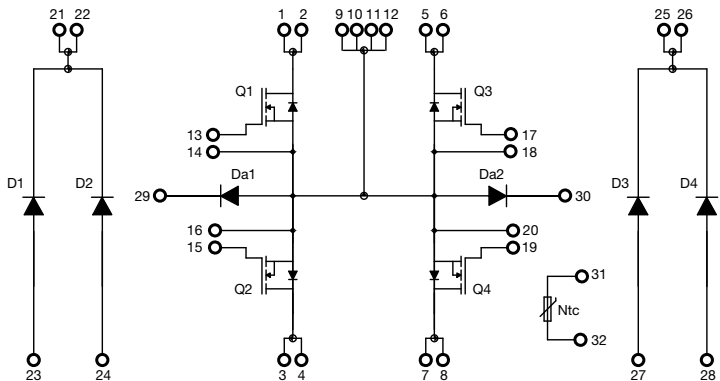
ORDERING INFORMATION TABLE

Device code

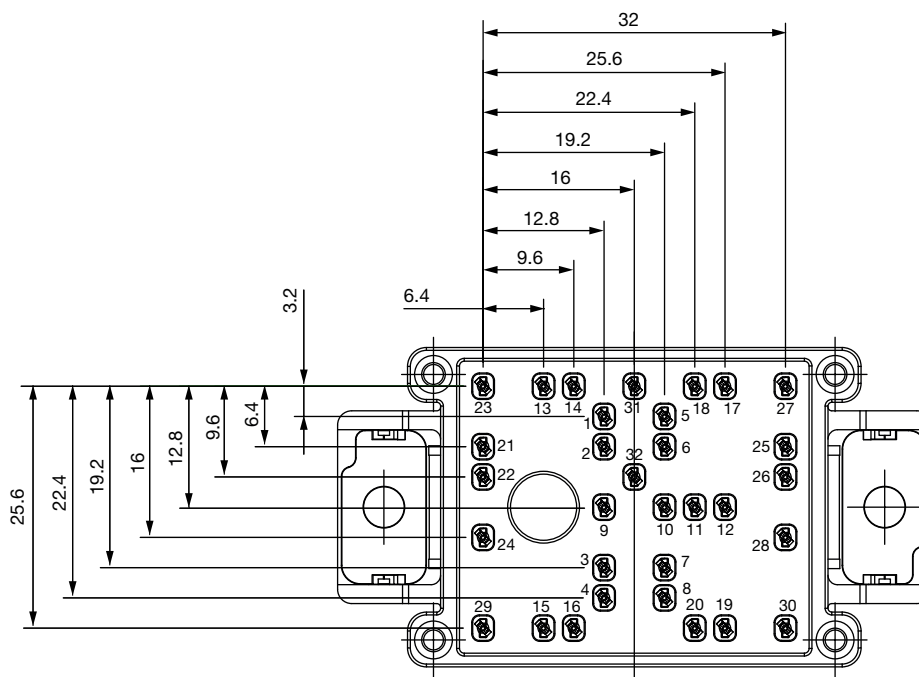
VS-	EN	Z	025	C	60	N
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1 2 3 4 5 6 7

- 1 - Vishay Semiconductors product
- 2 - Package indicator (EN = EMIPAK 1B)
- 3 - Circuit configuration (Z = Double interleaved bridgless PFC (4 x channels) with individual return diodes)
- 4 - Current rating (025 = 25 A)
- 5 - Switch die technology (C = PowerMOS)
- 6 - Voltage rating (60 = 600 V)
- 7 - Diode die technology

CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Double interleaved bridgless PFC (4 x channels) with individual return diodes	Z	

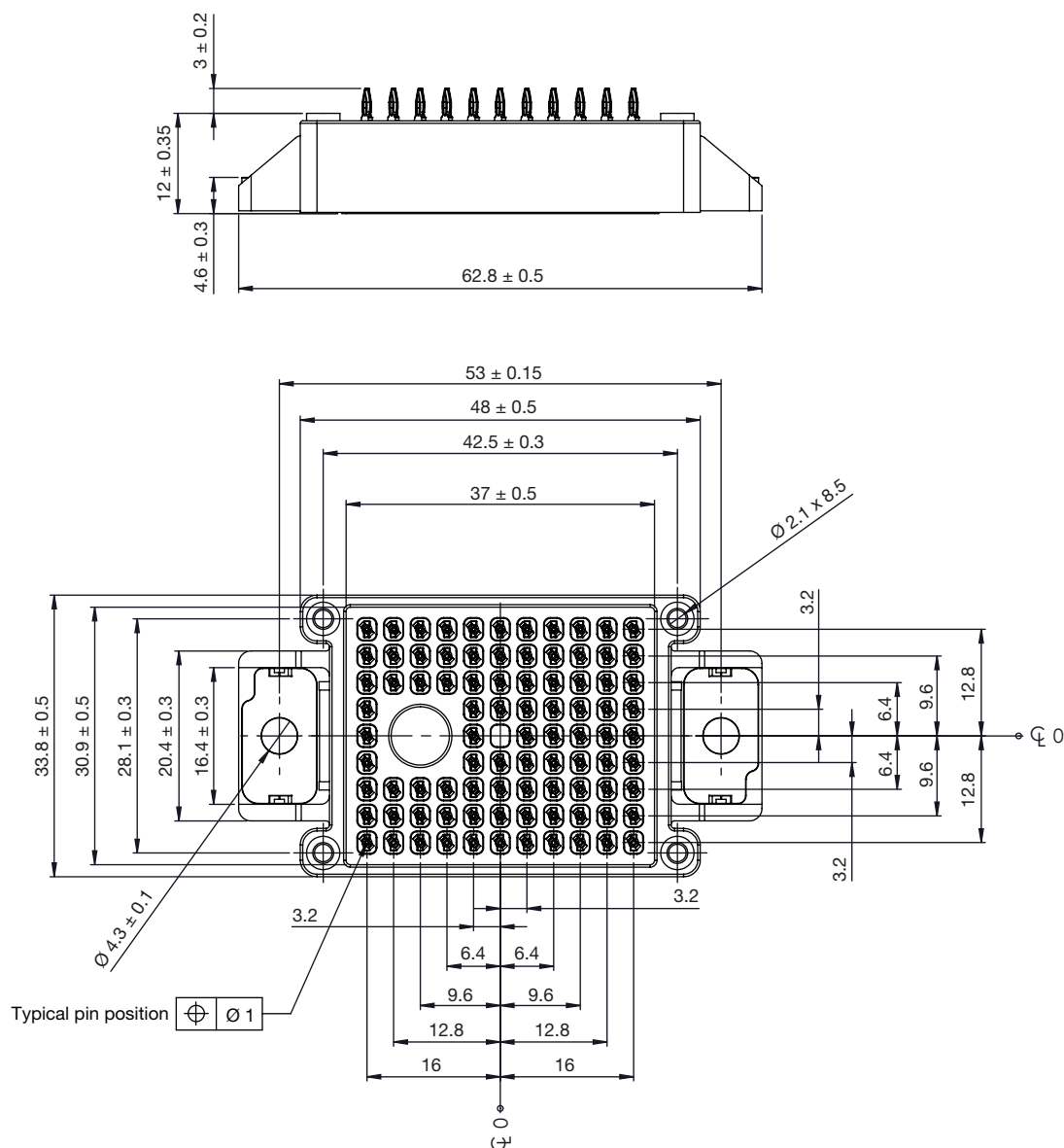
PACKAGE



LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95558
Application Note	www.vishay.com/doc?95580

EMIPAK-1B PressFit

DIMENSIONS in millimeters





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