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

EMIPAK 1B
(package example)

PRIMARY CHARACTERISTICS	
Q1 - Q4 MOSFET	
V_{DSS}	600 V
$R_{DS(on)}$ typical at I_C = 25 A	59 mΩ
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

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

RoHS COMPLIANT

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.

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 °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 °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	$\Delta V_{GS(th)}/\Delta T_J$	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 °C	5000	Ω
	R_{100}	T_C = 100 °C	493 ± 5 %	
B-value	$B_{25/50}$	$R_2 = R_{25}$ exp. [$B_{25/50}$(1/T2 - 1/(298.15K))]	3375 ± 5 %	K
Maximum operating temperature			220	°C
Dissipation constant			2	mW/°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	-	°C/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, λ_{grease} = 0.67 W/mK

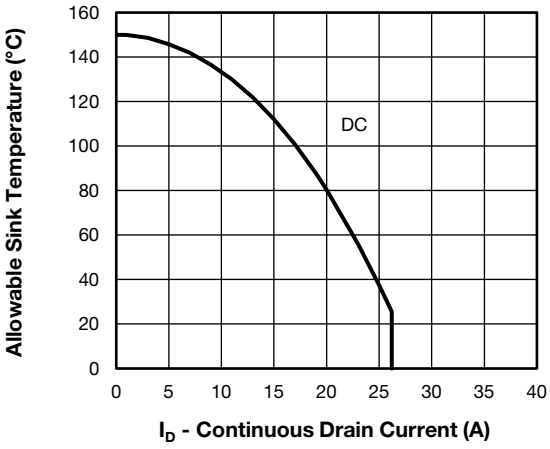


Fig. 1 - Maximum Continuous Drain Current vs. Sink Temperature

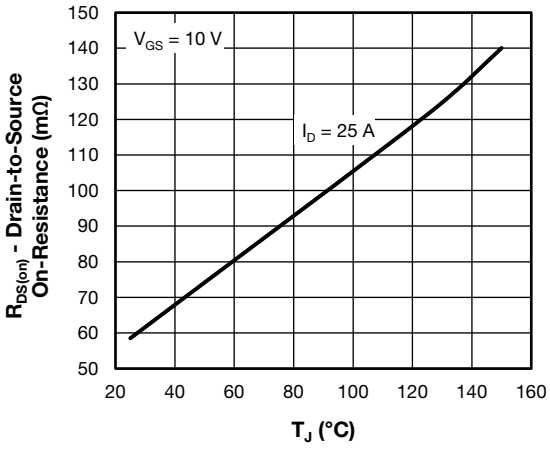


Fig. 4 - Typical Drain-to-Source On-Resistance vs. Temperature

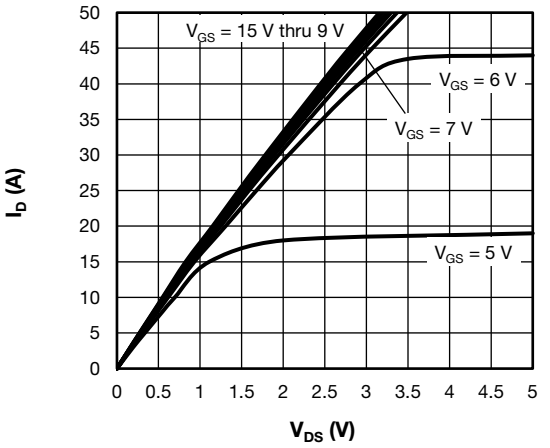


Fig. 2 - Typical Drain to Source Current Output Characteristics at T_J = 25 °C

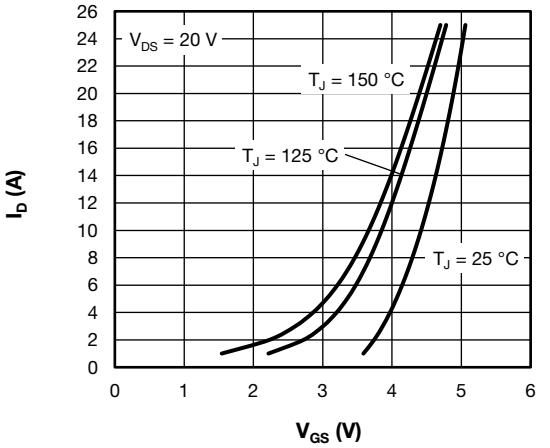


Fig. 5 - Typical Transfer Characteristics

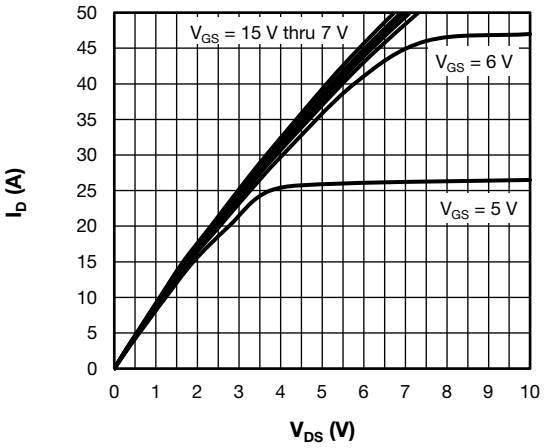


Fig. 3 - Typical Drain to Source Current Output Characteristics at T_J = 125 °C

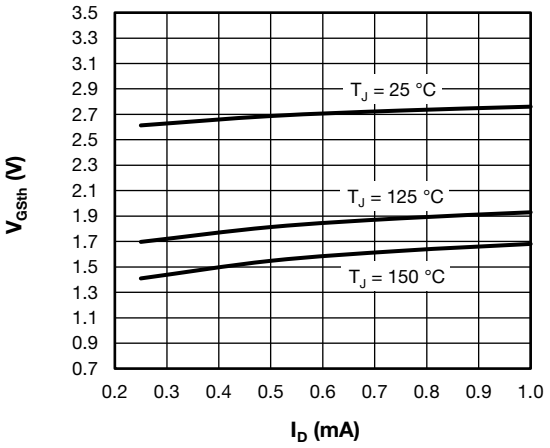


Fig. 6 - Typical Gate Threshold Voltage Characteristics

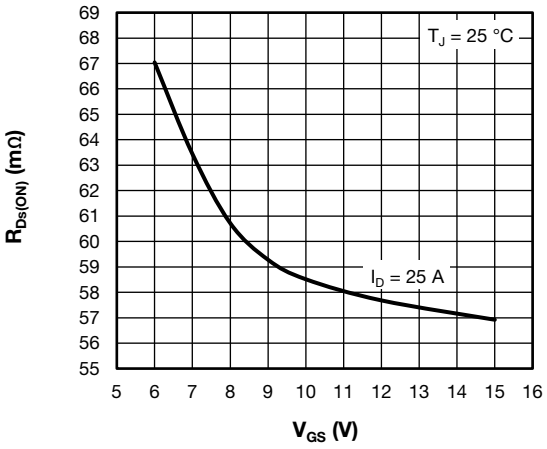


Fig. 7 - Typical Drain-State Resistance vs. Gate-to-Source Voltage

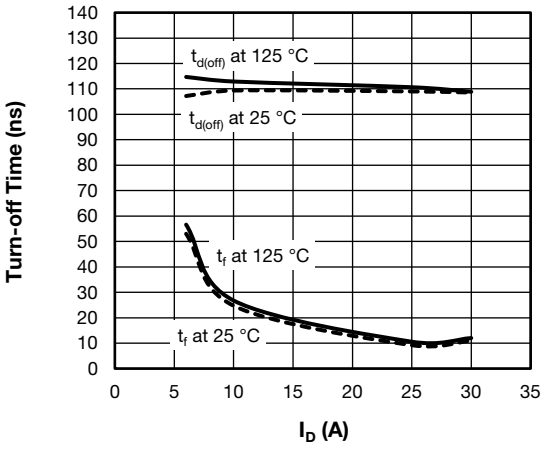


Fig. 10 - Typical Turn-off Switching Time vs. I_D
V_{DD} = 300 V, R_g = 4.7Ω, V_{GS} = ± 10 V, L = 500 µH

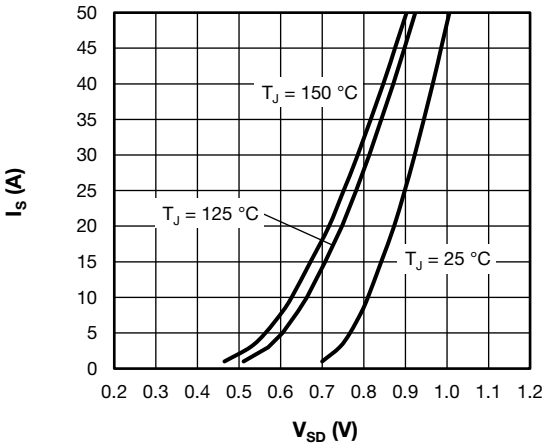


Fig. 8 - Typical Body Diode Source-to-Drain Current Characteristics

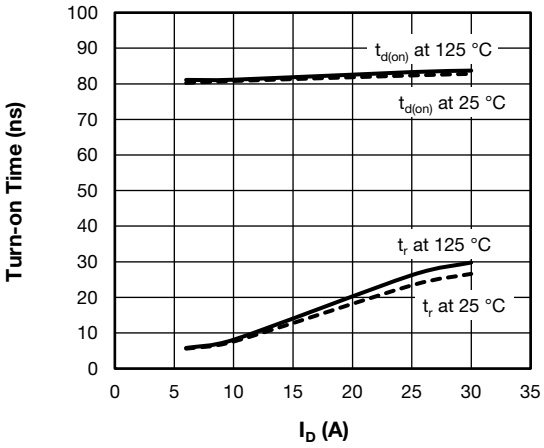


Fig. 11 - Typical Turn-on Switching Time vs. I_D
V_{DD} = 300 V, R_g = 4.7Ω, V_{GS} = ± 10 V, L = 500 µH

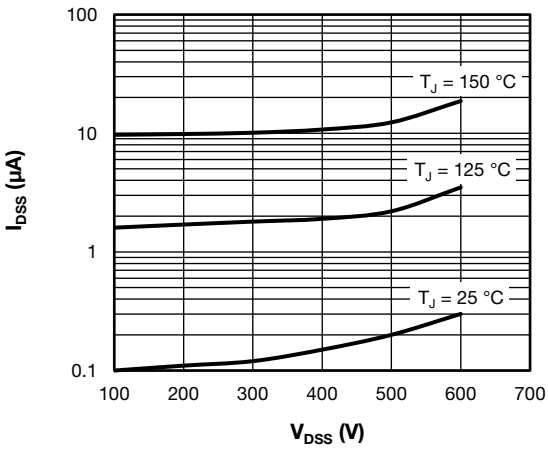


Fig. 9 - Typical Zero Gate Voltage Drain Current

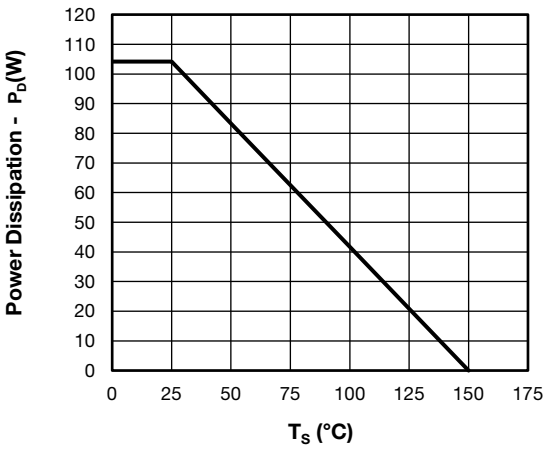


Fig. 12 - Power Dissipation Curve

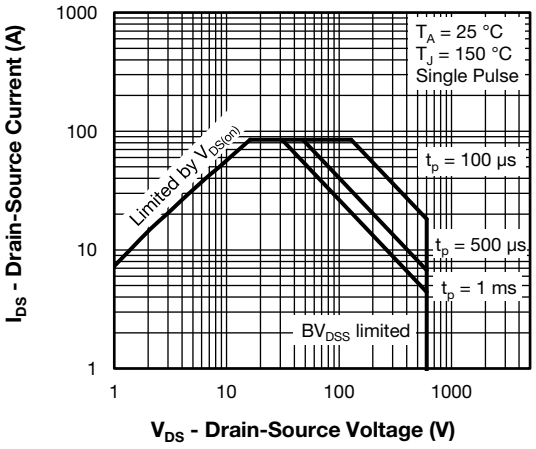


Fig. 13 - Safe Operating Area

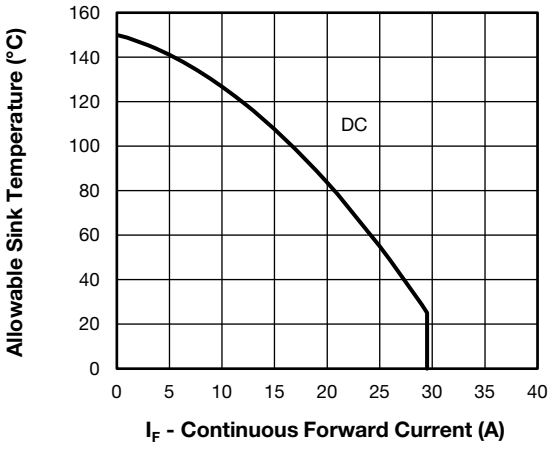


Fig. 16 - Maximum Da1-Da2 Diode
Continuous Forward Current vs. Sink Temperature

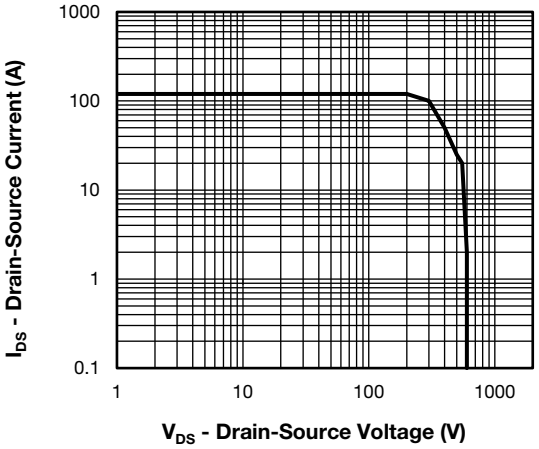


Fig. 14 - Reverse BIAS SOA

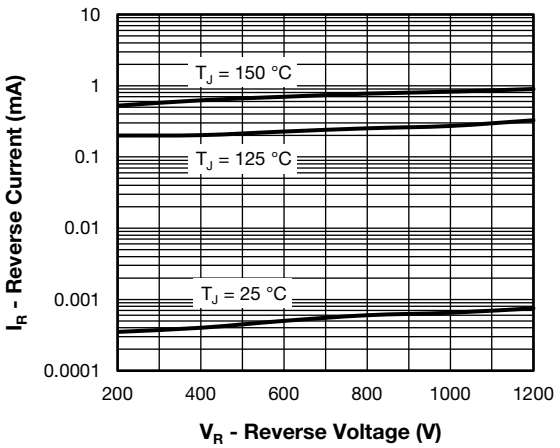


Fig. 17 - Typical Da1-Da2 Diode Reverse Leakage Current

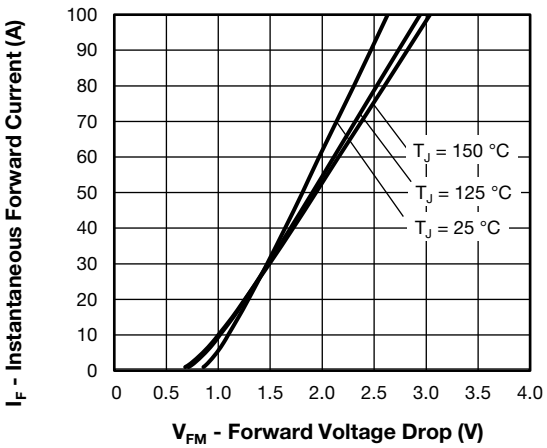


Fig. 15 - Typical Da1-Da2 Diode Forward Characteristics

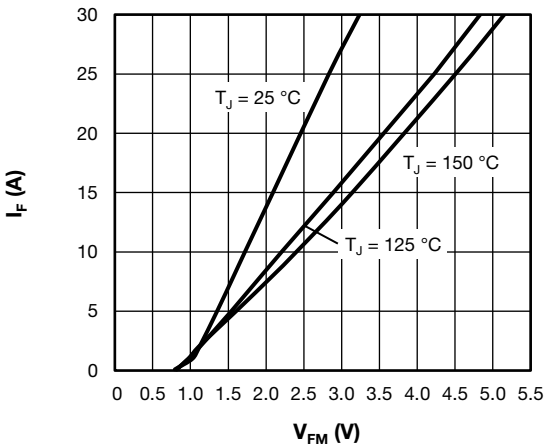


Fig. 18 - Typical D1-D4 Clamp Diode Forward Characteristics

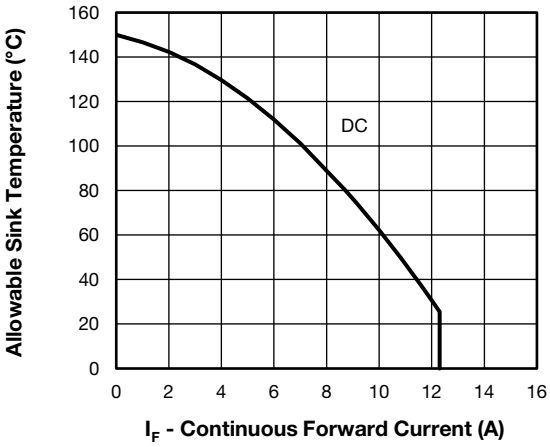


Fig. 19 - Maximum D1-D4 Clamp Diode
Continuous Forward Current vs. Sink Temperature

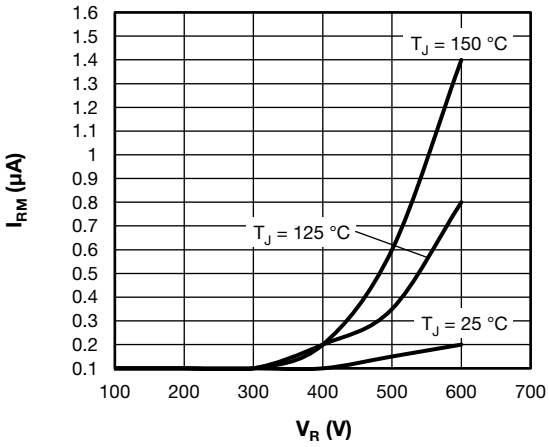


Fig. 20 - Typical D1-D4 Clamp Diode Reverse Leakage Current

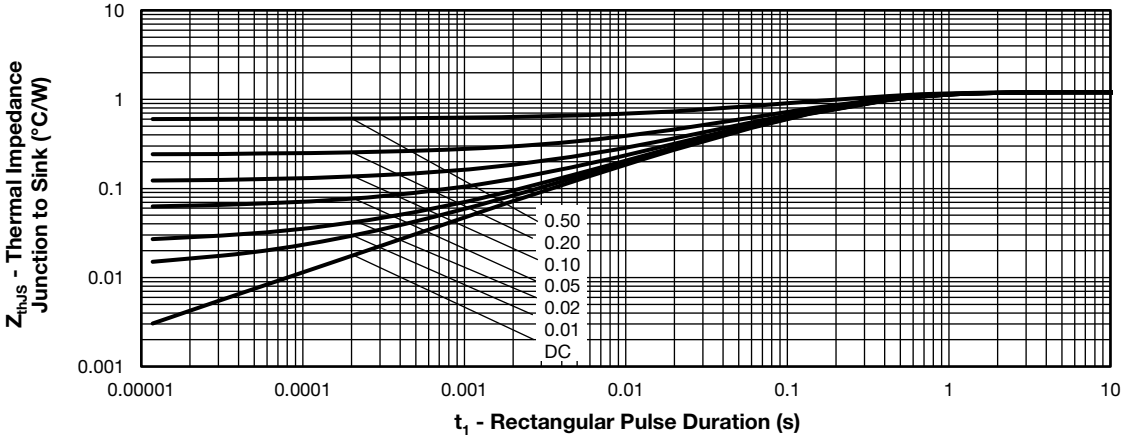


Fig. 21 - Maximum Thermal Impedance Z_{thJS} Characteristics - (Q1-Q4 MOSFET)

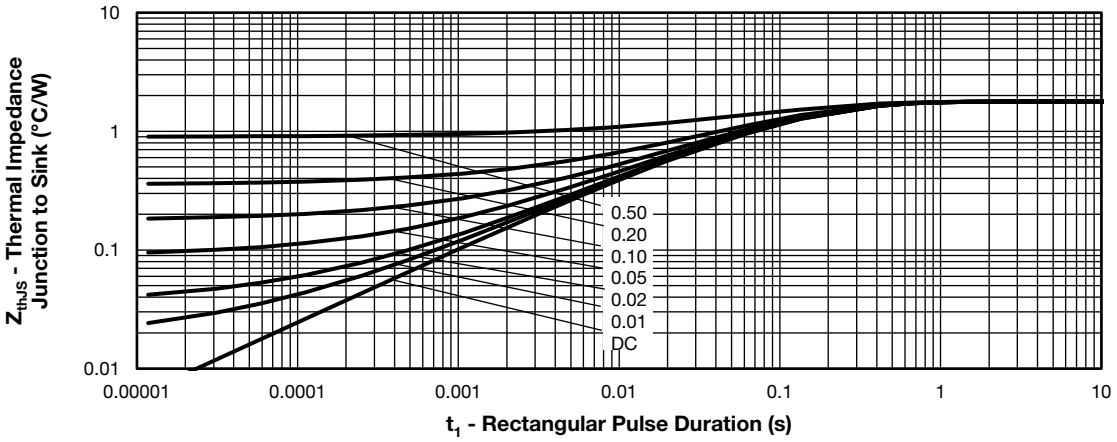


Fig. 22 - Maximum Thermal Impedance Z_{thJS} Characteristics - (Da1-Da2 Diode)

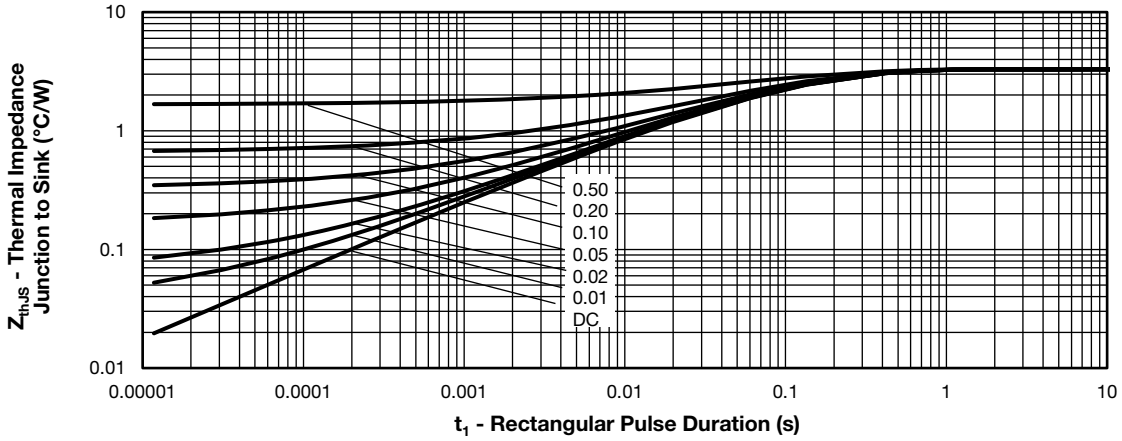
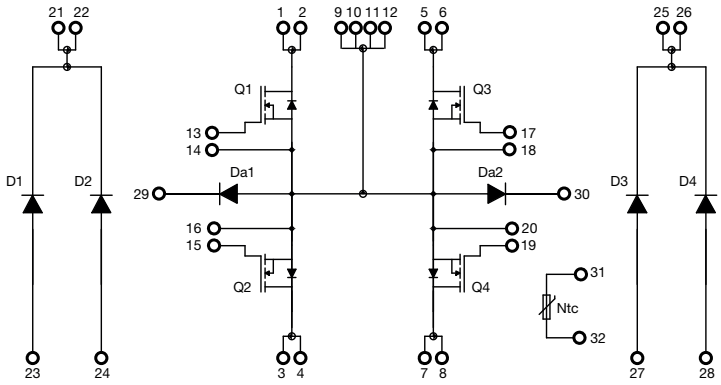


Fig. 23 - Maximum Thermal Impedance Z_{thJS} Characteristics - (D1-D4 Clamp Diode)

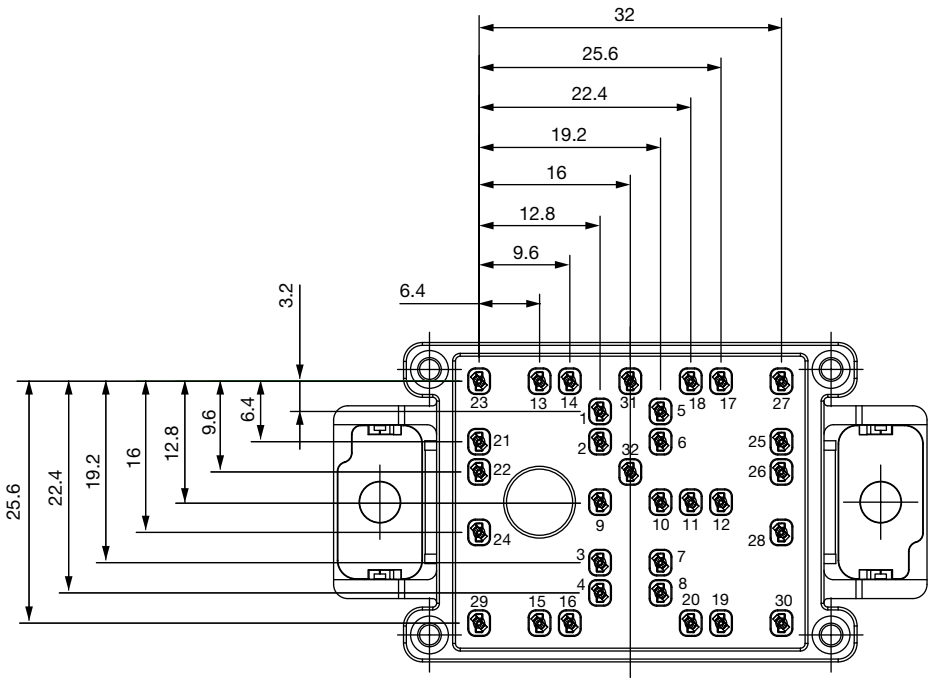
ORDERING INFORMATION TABLE

Device code	VS-	EN	Z	025	C	60	N
	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	

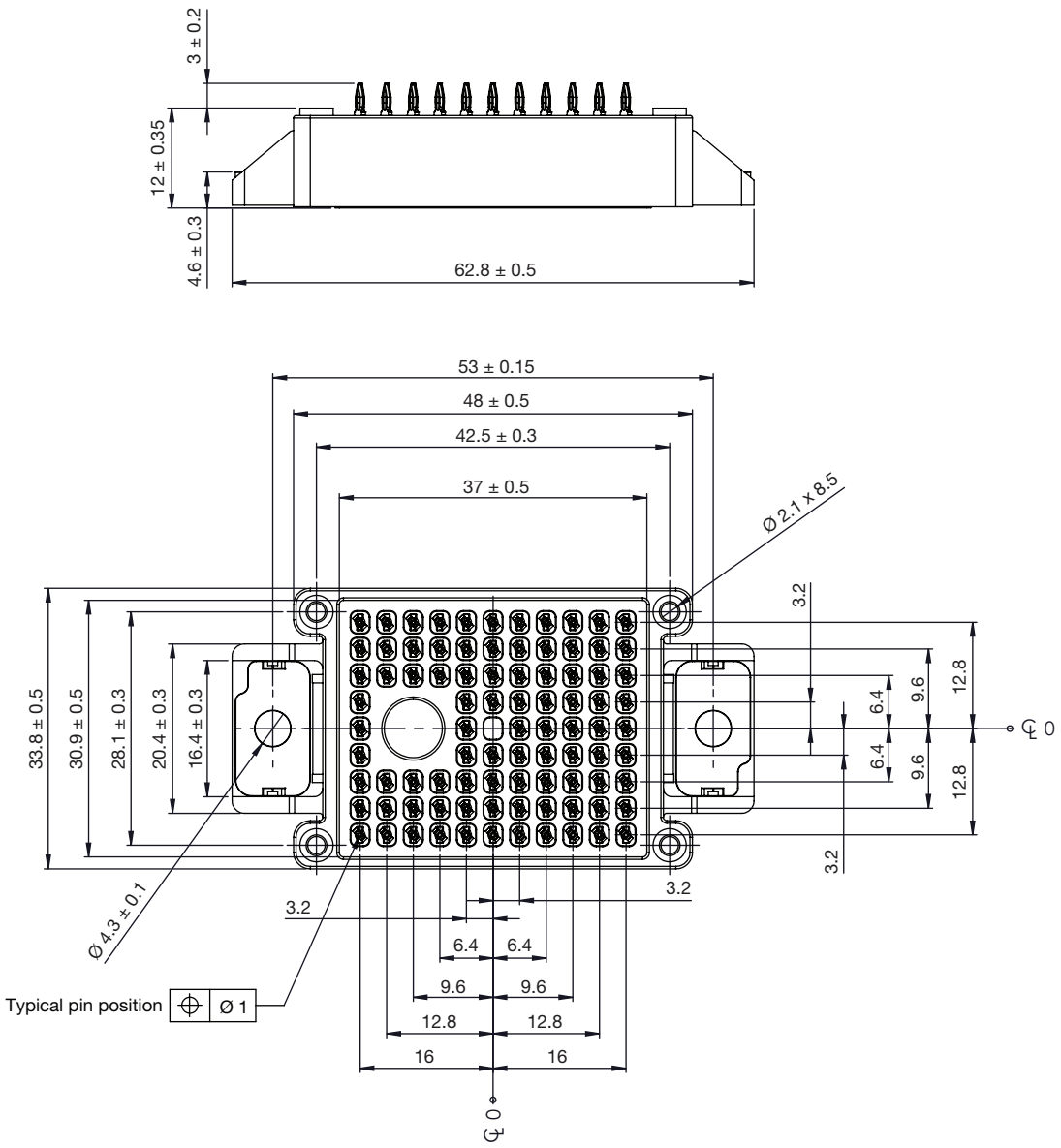
PACKAGE



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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