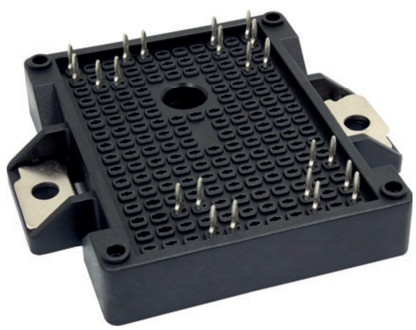
EMIPAK-2B PressFit Power Module Double Interleaved Boost Converter, 15 A



EMIPAK-2B
(package example)

PRODUCT SUMMARY	
RECTIFIER BYPASS DIODE	
V_{RRM}	1200 V
V_{FM} typical at I_F = 20 A	1.04 V
I_F at T_C = 80 °C	62 A
PFC IGBT	
V_{CES}	1200 V
$V_{CE(ON)}$ typical at I_C = 15 A	2.61 V
I_C at T_C = 80 °C	15 A
Speed (max.)	20 kHz
Speed	8 kHz to 30 kHz
Package	EMIPAK-2B
Circuit	Double interleaved boost converter

FEATURES

- Trench IGBT technology
- HEXFRED clamping diode technology
- Rectifier bypass diode
- PressFit pins technology
- Exposed Al_2O_3 substrate with low thermal resistance
- Integrated thermistor
- 10 µs short circuit capability
- Square RBSOA
- Low internal inductances
- Low switching loss
- PressFit pins locking technology. Patent # US.263.820 B2
- UL approved file E78996
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

DESCRIPTION

VS-ETL015Y120H is an integrated solution for a double interleaved boost converter. The EMIPAK-2B package is easy to use thanks to the PressFit pins and the exposed substrate provides improved thermal performance. The optimized layout also helps to minimize stray parameters, allowing for better EMI performance.

ABSOLUTE MAXIMUM RATINGS				
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
DbpA - DbpB BYPASS DIODE				
Repetitive peak reverse voltage	V_{RRM}		1200	V
Continuous output current	I_F	T_C = 25 °C	94	A
		T_C = 80 °C	62	
		T_{SINK} = 80 °C	39	
Surge current (non- repetitive)	I_{FSM}	Rated V_{RRM} applied	250	
Power dissipation	P_D	T_C = 25 °C	167	W
		T_C = 80 °C	93	

PATENT(S): www.vishay.com/patents
This Vishay product is protected by one or more United States and International patents.

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MAX.**	**UNITS**
Ta1 - Ta2 - Tb1 - Tb2 PFC IGBT				
Collector to emitter voltage	V_{CES}		1200	V
Gate to emitter voltage	V_{GES}		20	
Pulsed collector current	I_{CM}		40	A
Clamped inductive load current	I_{LM} (1)		40	
Continuous collector current	I_C	T_C = 25 °C	22	A
		T_C = 80 °C	15	
		T_{SINK} = 80 °C	11	
Power dissipation	P_D	T_C = 25 °C	89	W
		T_C = 80 °C	50	
Da1 - Da2 - Db1 - Db2 CLAMPING DIODE				
Repetitive peak reverse voltage	V_{RRM}		1200	V
Single pulse forward current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, T_J = 25 °C	95	A
Diode continuous forward current	I_F	T_C = 25 °C	22	
		T_C = 80 °C	14	
		T_{SINK} = 80 °C	10	
Power dissipation	P_D	T_C = 25 °C	80	W
		T_C = 80 °C	45	
DTa1 - DTa2 - DTb1 - DTb2 AP DIODE				
Single pulse forward current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, T_J = 25 °C	95	A
Diode continuous forward current	I_F	T_C = 25 °C	22	
		T_C = 80 °C	14	
		T_{SINK} = 80 °C	10	
Power dissipation	P_D	T_C = 25 °C	80	W
		T_C = 80 °C	45	

Notes

- Absolute Maximum Ratings indicate sustained limits beyond which damage to the device may occur.

(1) V_{CC} = 600 V, V_{GE} = 15 V, L = 500 μH, R_g = 4.7 Ω, T_J = 150 °C

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
DbpA - DbpB BYPASS DIODE						
Reverse leakage current	I_{RRM}	V_{RRM} = 1200 V	-	-	0.14	mA
		V_{RRM} = 1200 V, T_J = 150 °C	-	-	3.0	
Forward voltage drop	V_{FM}	I_F = 20 A	-	1.04	1.23	V
		I_F = 20 A, T_J = 150 °C	-	0.95	-	
Forward slope resistance	rt	T_J = 150 °C	-	-	6.6	mΩ
Conduction threshold voltage	V_T		-	-	0.73	V
Ta1 - Ta2 -Tb1 - Tb2 PFC IGBT						
Collector to emitter breakdown voltage	BV_{CES}	V_{GE} = 0 V, I_C = 250 μA	1200	-	-	V
Collector to emitter voltage	$V_{CE(ON)}$	V_{GE} = 15 V, I_C = 15 A	-	2.61	3.03	
		V_{GE} = 15 V, I_C = 15 A, T_J = 125 °C	-	3.05	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 400 μA	4.5	5.8	8.1	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 1.0 mA (25 °C to 125 °C)	-	-14	-	mV/°C
Forward transconductance	g_{fe}	V_{CE} = 20 V, I_C = 15 A	-	8	-	S
Transfer characteristics	V_{GE}	V_{CE} = 20 V, I_C = 15 A	-	10	-	V
Zero gate voltage collector current	I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V	-	0.0003	0.075	mA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 125 °C	-	0.24	-	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V, V_{CE} = 0 V	-	-	± 200	nA

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)						
Da1 - Da2 - Db1 - Db2 CLAMPING DIODE						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Cathode to anode blocking voltage	V_{BR}	I_R = 100 μA	1200	-	-	V
Forward voltage drop	V_{FM}	I_F = 10 A	-	2.09	2.77	
		I_F = 10 A, T_J = 125 °C	-	2.16	-	
Reverse leakage current	I_{RM}	V_R = 1200 V	-	0.0004	0.075	mA
		V_R = 1200 V, T_J = 125 °C	-	0.25	-	
DTa1 - DTa2 - DTb1 - DTb2 AP DIODE						
Forward voltage drop	V_{FM}	I_F = 20 A	-	2.59	3.25	V
		I_F = 20 A T_J = 125 °C	-	2.86	-	

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
PFC IGBT (WITH FREEWHEELING CLAMPING DIODE)						
Total gate charge (turn-on)	Q_g	I_C = 9 A V_{CC} = 600 V V_{GE} = 15 V	-	45	-	nC
Gate to emitter charge (turn-on)	Q_{ge}		-	8.7	-	
Gate to collector charge (turn-on)	Q_{gc}		-	20	-	
Turn-on switching loss	E_{ON}	I_C = 15 A V_{CC} = 600 V V_{GE} = 15 V R_g = 4.7 Ω L = 500 μH (1)	-	0.95	-	mJ
Turn-off switching loss	E_{OFF}		-	0.47	-	
Total switching loss	E_{TOT}		-	1.42	-	
Turn-on delay time	$t_{d(on)}$		-	23	-	ns
Rise time	t_r		-	22	-	
Turn-off delay time	$t_{d(off)}$		-	58	-	
Fall time	t_f		-	178	-	
Turn-on switching loss	E_{ON}	I_C = 15 A V_{CC} = 600 V V_{GE} = 15 V R_g = 4.7 Ω L = 500 μH T_J = 125 °C (1)	-	1.18	-	mJ
Turn-off switching loss	E_{OFF}		-	0.72	-	
Total switching loss	E_{TOT}		-	1.89	-	
Turn-on delay time	$t_{d(on)}$		-	24	-	ns
Rise time	t_r		-	23	-	
Turn-off delay time	$t_{d(off)}$		-	60	-	
Fall time	t_f		-	219	-	
Input capacitance	C_{ies}	V_{GE} = 0 V V_{CC} = 30 V f = 1 MHz	-	1070		pF
Output capacitance	C_{oes}		-	63		
Reverse transfer capacitance	C_{res}		-	26		
Reverse bias safe operating area	RBSOA	T_J = 150 °C, I_C = 40 A, V_{CC} = 600 V, V_P = 1200 V, R_g = 4.7 Ω, V_{GE} = 15 V to 0 V	Fullsquare			
Short circuit safe operating area	SCSOA	R_g = 22 Ω, V_{CC} = 900 V, V_P = 1200 V V_{GE} = 15 V to 0	-	-	10	μs
Da1 - Da2 - Db1 - Db2 CLAMPING DIODE						
Diode reverse recovery time	t_{rr}	V_R = 400 V I_F = 10 A dI/dt = 500 A/μs	-	103	-	ns
Diode peak reverse current	I_{rr}		-	14	-	A
Diode recovery charge	Q_{rr}		-	711	-	nC
Diode reverse recovery time	t_{rr}	V_R = 400 V I_F = 10 A dI/dt = 500 A/μs, T_J = 125 °C	-	126	-	ns
Diode peak reverse current	I_{rr}		-	17	-	A
Diode recovery charge	Q_{rr}		-	1047	-	nC

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
DTa1 - DTa2 - DTb1 - DTb2 AP DIODE						
Diode reverse recovery time	t_{rr}	V_R = 400 V I_F = 20 A dI/dt = 500 A/μs	-	127	-	ns
Diode peak reverse current	I_{rr}		-	16	-	A
Diode recovery charge	Q_{rr}		-	1020	-	nC
Diode reverse recovery time	t_{rr}	V_R = 400 V I_F = 20 A dI/dt = 500 A/μs, T_J = 125 °C	-	153	-	ns
Diode peak reverse current	I_{rr}		-	19	-	A
Diode recovery charge	Q_{rr}		-	1464	-	nC

Note
(1) Energy losses include “tail” and diode reverse recovery.

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. $[B_{25/50} (1/T_2 - 1/(298.15\ K))]$	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**
DbpA - DbpB Bypass diode - Junction to case thermal resistance (per diode)	R_{thJC}	-	-	0.75	°C/W
Ta1 - Ta2 - Tb1 - Tb2 PFC IGBT - Junction to case thermal resistance (per switch)		-	-	1.4	
Da1 - Da2 - Db1 - Db2 Clamping diode - Junction to case thermal resistance (per diode)		-	-	1.56	
DTa1 - DTa2 - DTb1 - DTb2 AP diode - Junction to case thermal resistance (per diode)		-	-	1.56	
DbpA - DbpB Bypass diode - Case to sink thermal resistance (per diode)	R_{thCS} (1)	-	0.63	-	
Ta1 - Ta2 - Tb1 - Tb2 PFC IGBT - Case to sink thermal resistance (per switch)		-	0.96	-	
Da1 - Da2 - Db1 - Db2 Clamping diode - Case to sink thermal resistance (per diode)		-	1.1	-	
DTa1 - DTa2 - DTb1 - DTb2 AP diode - Case to sink thermal resistance (per diode)		-	1.1	-	
Case to sink thermal resistance per module		-	0.1	-	
Mounting torque (M4)		2	-	3	Nm
Weight		-	45	-	g

Note
(1) Mounting surface flat, smooth, and greased

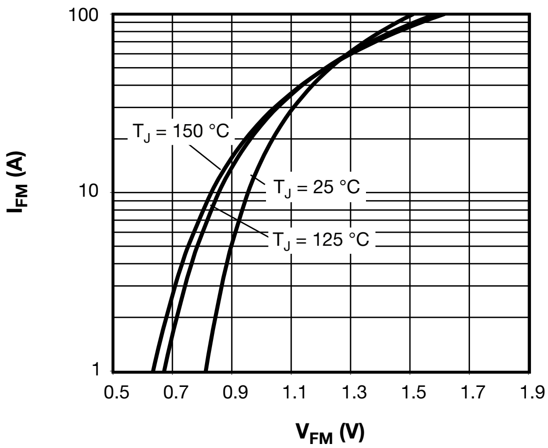


Fig. 1 - Typical DbpA -DbpB Bypass Diode Forward Characteristics

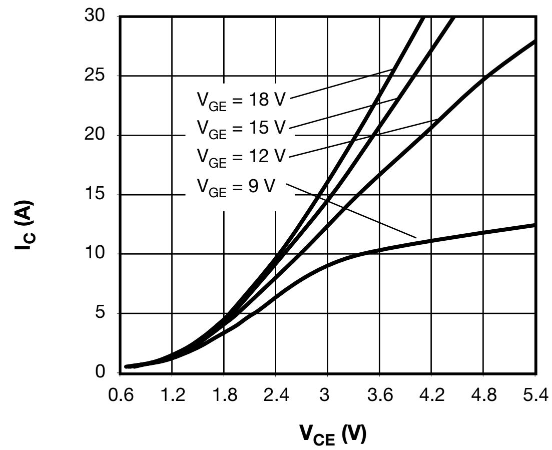


Fig. 4 - Typical Ta1 - Ta2 - Tb1 - Tb2 PFC IGBT Output Characteristics, T_J = 125 °C

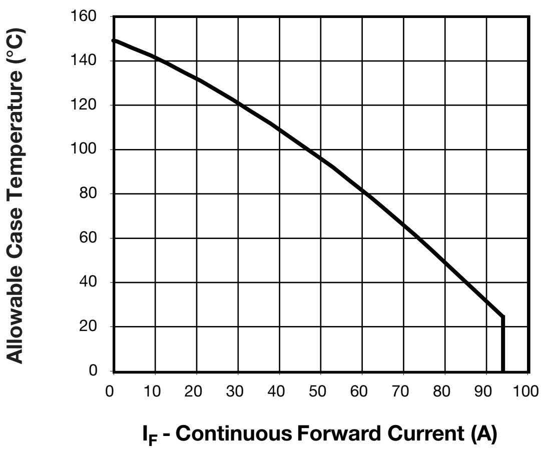


Fig. 2 - Maximum DbpA -DbpB Bypass Diode Forward Current vs. Case Temperature

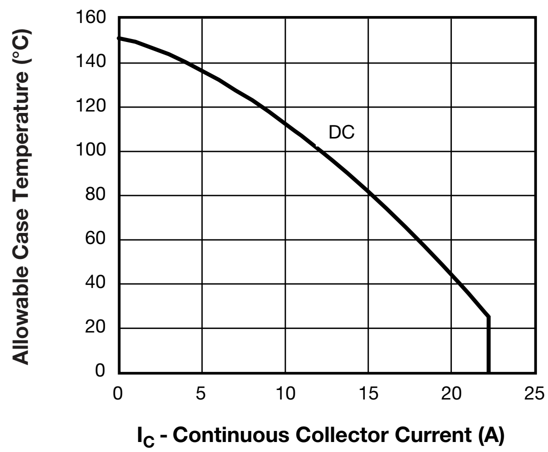


Fig. 5 - Maximum Ta1 - Ta2 - Tb1 - Tb2 PFC IGBT Continuous Collector Current vs. Case Temperature

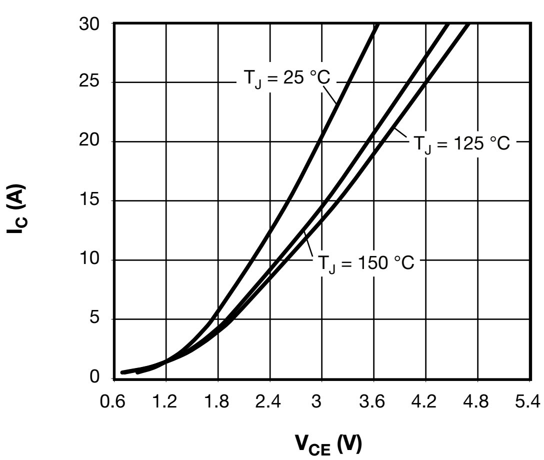


Fig. 3 - Typical Ta1 - Ta2 - Tb1 - Tb2 PFC IGBT Output Characteristics, V_{GE} = 15 V

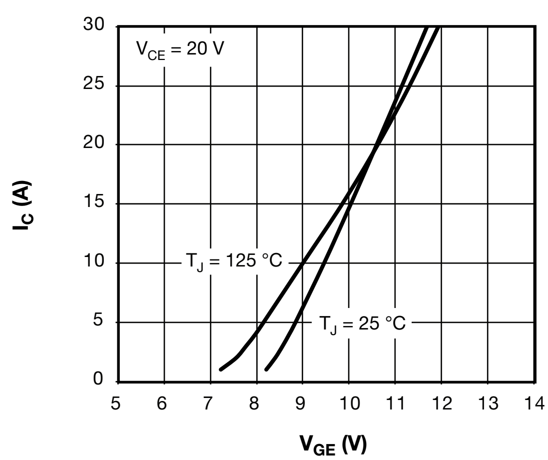


Fig. 6 - Typical Ta1 - Ta2 - Tb1 - Tb2 PFC IGBT Transfer Characteristics

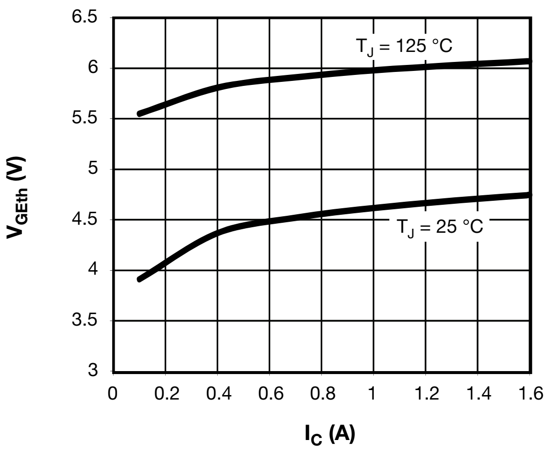


Fig. 7 - Typical Q1 - Q4 Trench IGBT Energy Loss vs. I_C
(with D5 - D6 Clamping Diode)
T_J = 125 °C, V_{CC} = 300 V, R_g = 4.7 Ω, V_{GE} = 15 V, L = 500 µH

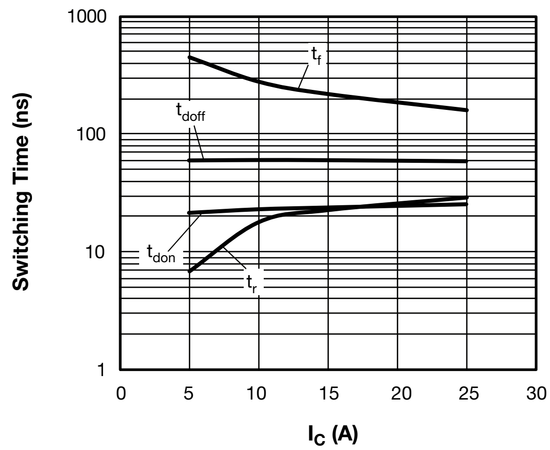


Fig. 10 - Typical PFC IGBT Switching Time vs. I_C
(with Freewheeling Clamping Diode)
T_J = 125 °C, V_{CC} = 600 V, R_g = 4.7 Ω, V_{GE} = 15 V, L = 500 µH

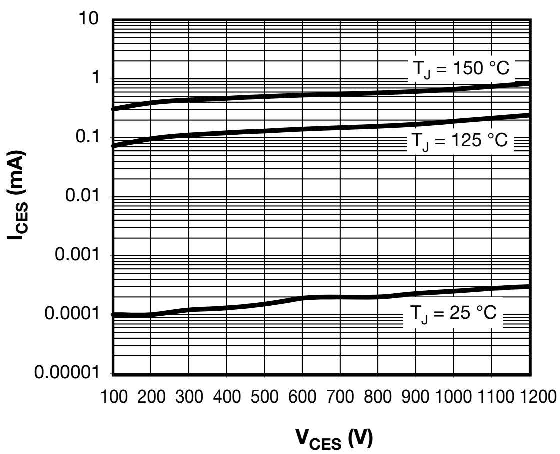


Fig. 8 - Typical Ta1 - Ta2 - Tb1 - Tb2 PFC IGBT
Zero Gate Voltage Collector Current

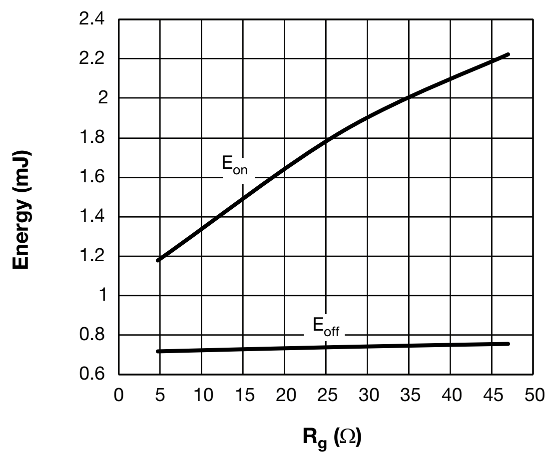


Fig. 11 - Typical PFC IGBT Energy Loss vs. R_g
(with Freewheeling Clamping Diode)
T_J = 125 °C, V_{CC} = 600 V, I_C = 15 A, V_{GE} = 15 V, L = 500 µH

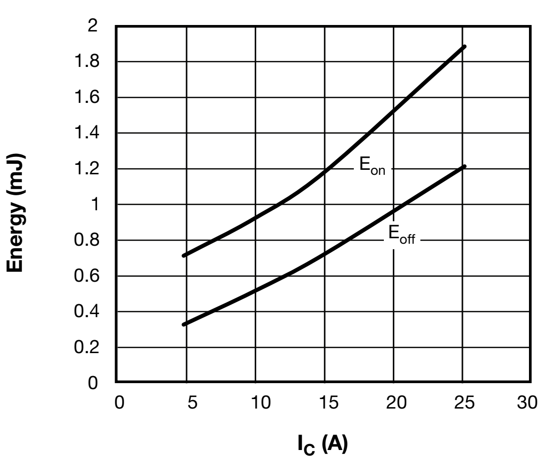


Fig. 9 - Typical PFC IGBT Energy Loss vs. I_C
(with Freewheeling Clamping Diode)
T_J = 125 °C, V_{CC} = 600 V, R_g = 4.7 Ω, V_{GE} = 15 V, L = 500 µH

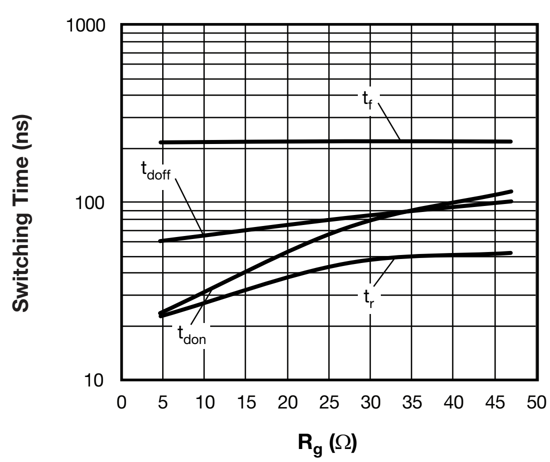


Fig. 12 - Typical PFC IGBT Switching Time vs. R_g
(with Freewheeling Clamping Diode)
T_J = 125 °C, V_{CC} = 600 V, I_C = 15 A, V_{GE} = 15 V, L = 500 µH

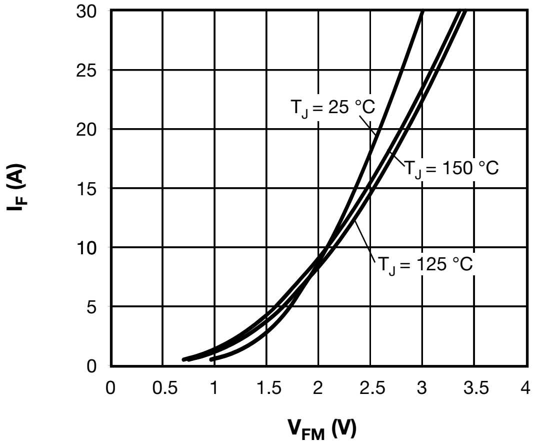


Fig. 13 - Typical Da1 - Da2 - Db1 - Db2 Clamping Diode Forward Characteristics

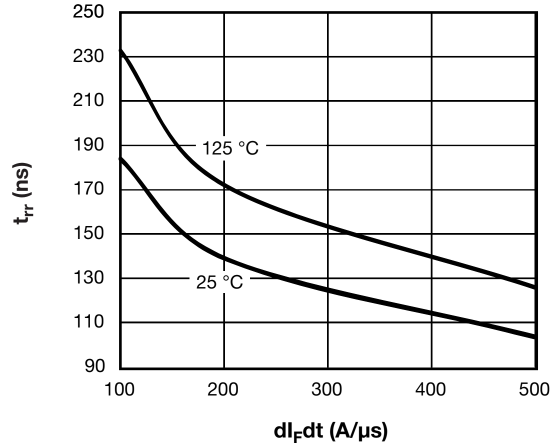


Fig. 16 - Typical Da1 - Da2 - Db1 - Db2 Clamping Diode Reverse Recovery Time vs. dI_F/dt, V_{rr} = 400 V, I_F = 10 A

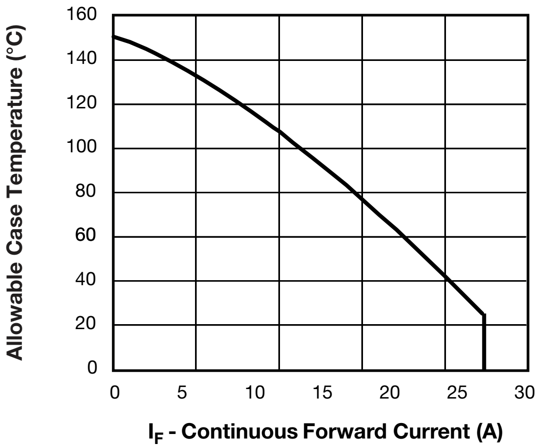


Fig. 14 - Maximum Da1 - Da2 - Db1 - Db2 Clamping Diode Forward Current vs. Case Temperature

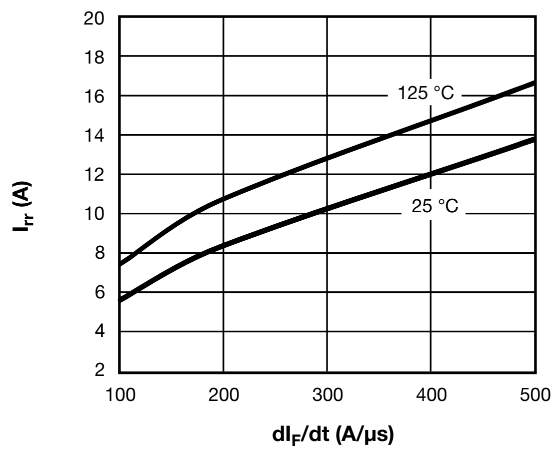


Fig. 17 - Typical Da1 - Da2 - Db1 - Db2 Clamping Diode Reverse Recovery Current vs. dI_F/dt, V_{rr} = 400 V, I_F = 10 A

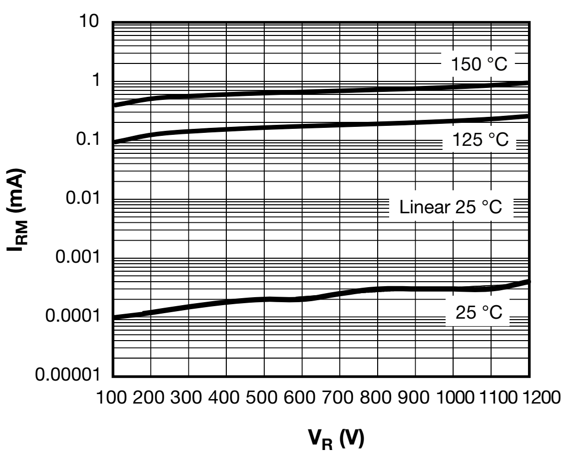


Fig. 15 - Typical Da1 - Da2 - Db1 - Db2 Clamping Diode Reverse Leakage Current

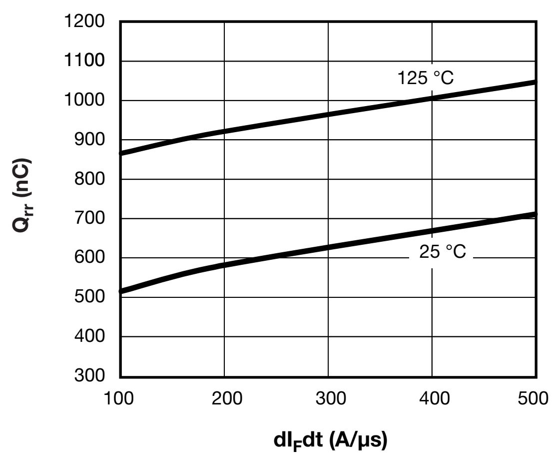


Fig. 18 - Typical Da1 - Da2 - Db1 - Db2 Clamping Diode Reverse Recovery Charge vs. dI_F/dt, V_{rr} = 400 V, I_F = 10 A

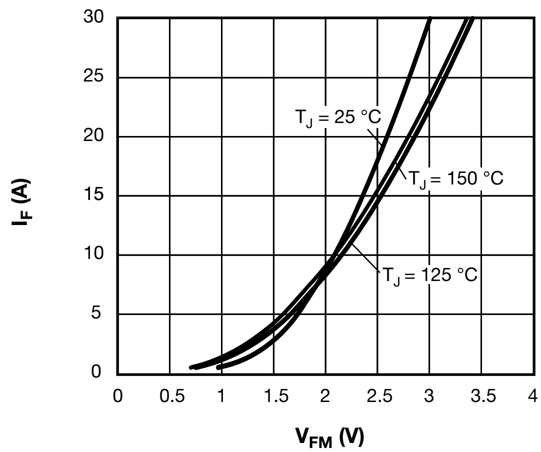


Fig. 19 - Typical DTa1 - DTa2 - DTb1 - DTb2 Antiparallel Diode Forward Characteristics

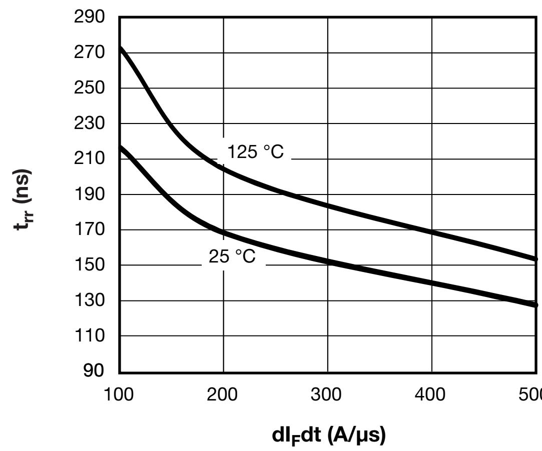


Fig. 21 - Typical DTa1 - DTa2 - DTb1 - DTb2 Antiparallel Diode Reverse Recovery Time vs. dI_F/dt
V_{rr} = 400 V, I_F = 20 A

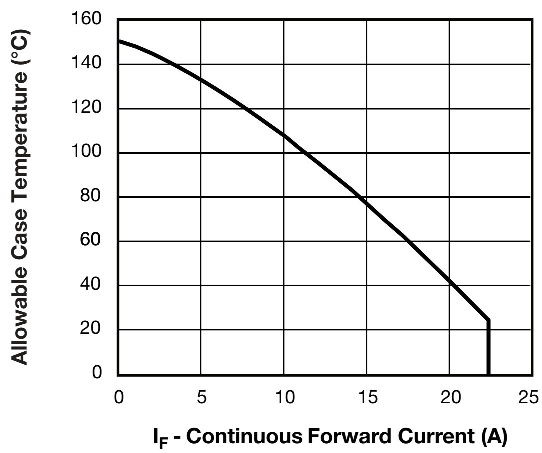


Fig. 20 - Maximum DTa1 - DTa2 - DTb1 - DTb2 Antiparallel Diode Forward Current vs. Case Temperature

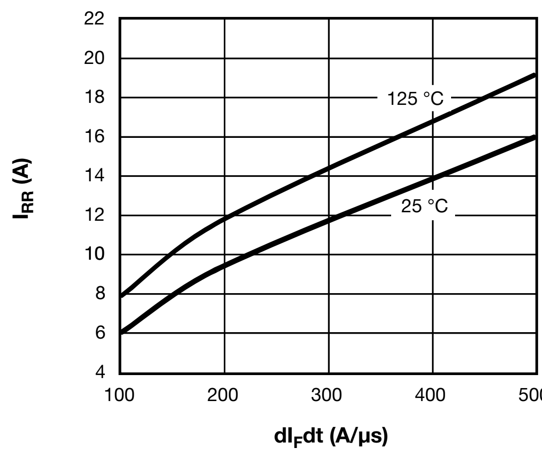


Fig. 22 - Typical DTa1 - DTa2 - DTb1 - DTb2 Antiparallel Diode Reverse Recovery Current vs. dI_F/dt
V_{rr} = 400 V, I_F = 10 A

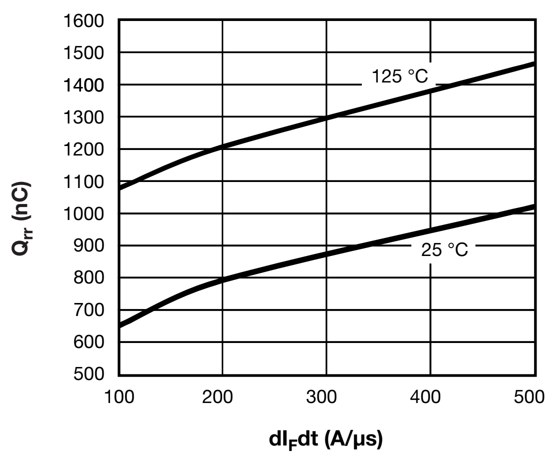


Fig. 23 - Typical DTa1 - DTa2 - DTb1 - DTb2 Antiparallel Diode Reverse Recovery Charge vs. dI_F/dt
V_{rr} = 400 V, I_F = 20 A

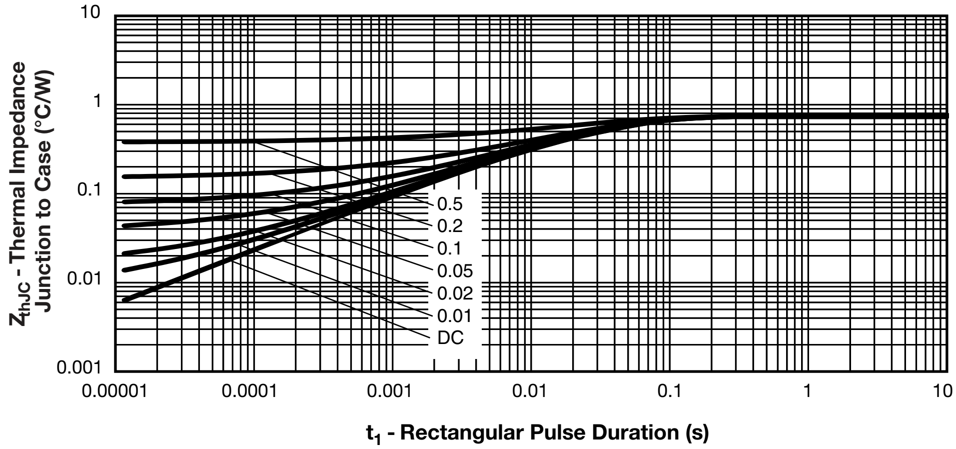


Fig. 24 - Maximum Thermal Impedance Z_{thJC} Characteristics (DbPa - DbpB Bypass Diode)

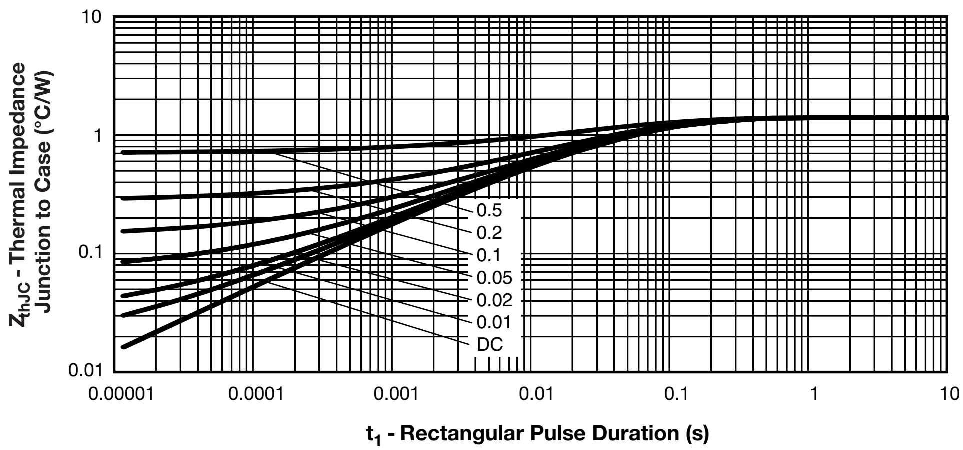


Fig. 25 - Maximum Thermal Impedance Z_{thJC} Characteristics (Ta1 - Ta2 - Tb1 - Tb2 PFC IGBT)

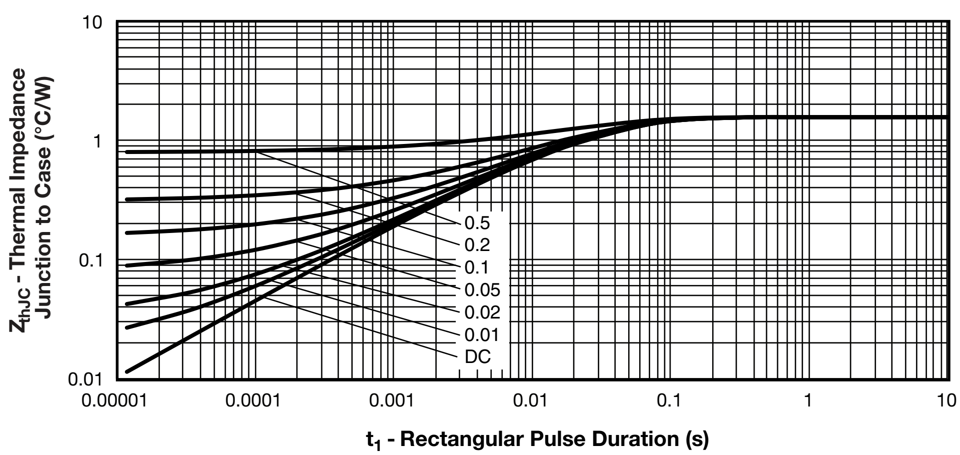


Fig. 26 - Maximum Thermal Impedance Z_{thJC} Characteristics (Da1 - Da2 - Db1 - Db2 Clamping diode)

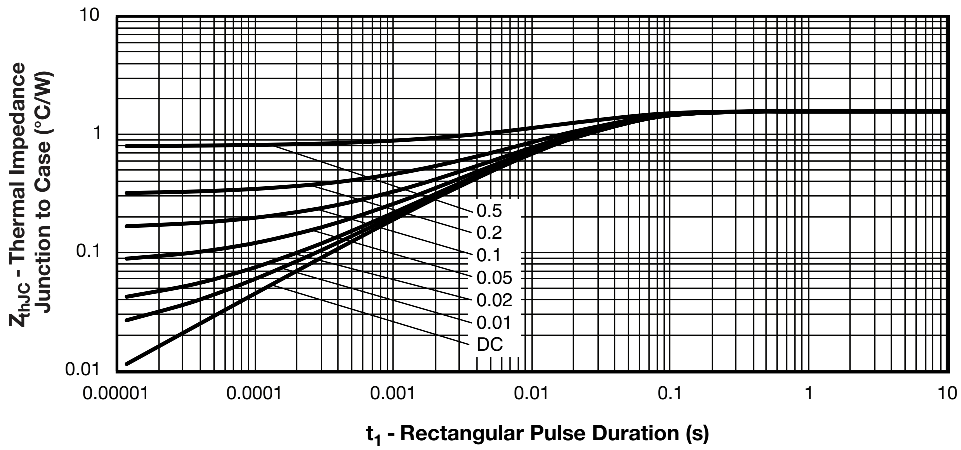


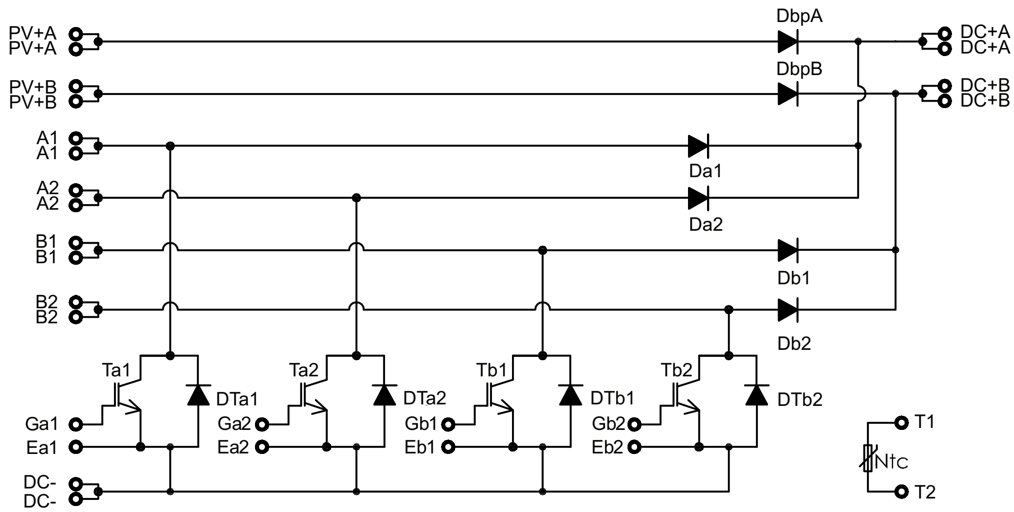
Fig. 27 - Maximum Thermal Impedance Z_{thJC} Characteristics (DTa1 - DTa2 - DTb1 - DTb2 Antiparallel Diode)

ORDERING INFORMATION TABLE

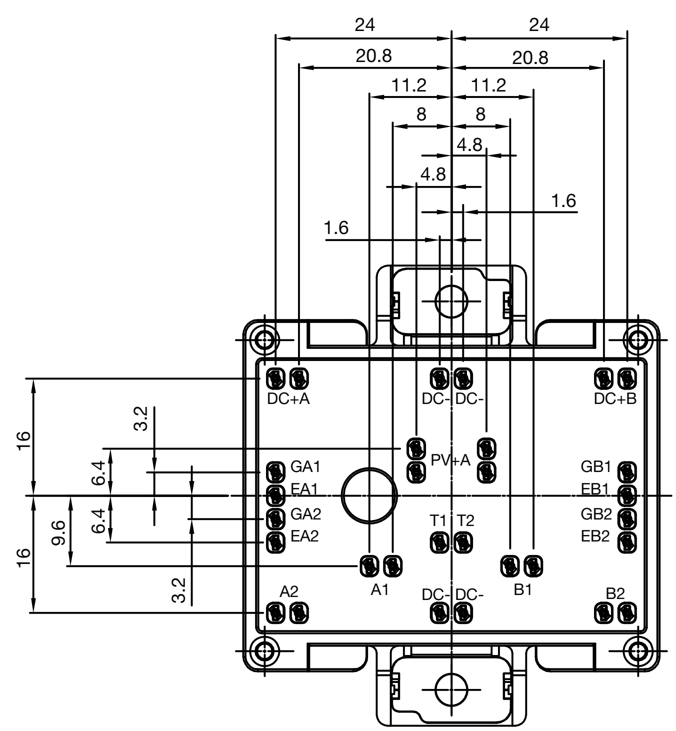
Device code	VS-	ET	L	015	Y	120	H
	1	2	3	4	5	6	7

1 - Vishay Semiconductors product
2 - Package indicator (ET = EMIPAK-2B)
3 - Circuit configuration (L = double interleaved boost converter)
4 - Current rating (015 = 15 A)
5 - Switch die technology (Y = trench IGBT)
6 - Voltage rating (120 = 1200 V)
7 - Diode die technology (H = HEXFRED diode)

CIRCUIT CONFIGURATION



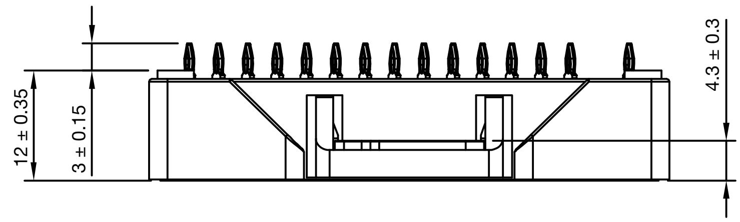
PACKAGE

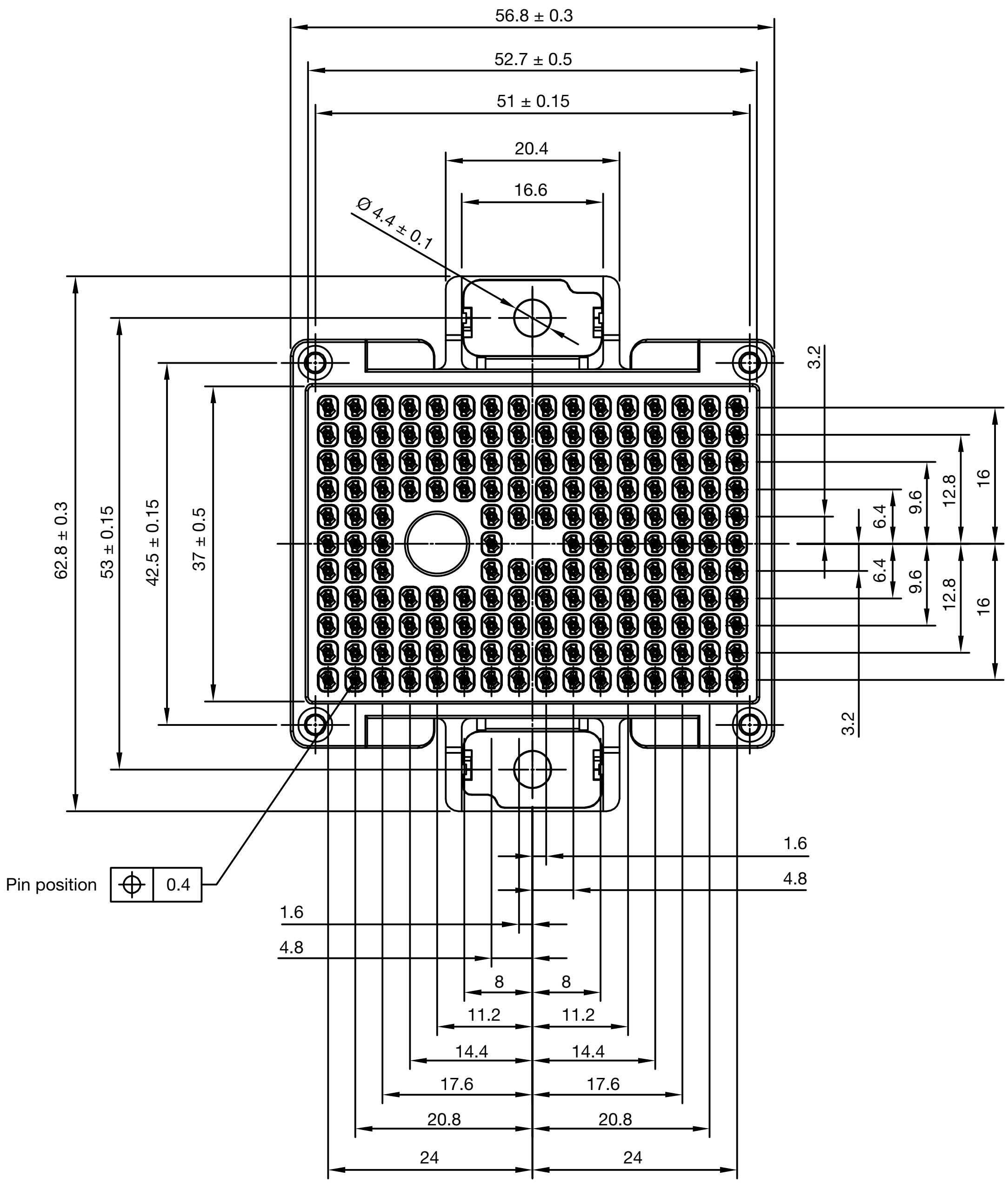


LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95559

EMIPAK-2B PressFit

DIMENSIONS in millimeters





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