EMIPAK 1B PressFit Power Module Three Phase Inverter IGBT

Package example

PRIMARY CHARACTERISTICS	
THREE PHASE INVERTER STAGE	
V_{CES}	600 V
$V_{CE(ON)}$ typical at I_C = 30 A	1.60 V
I_C at T_{SINK} = 59 °C	30 A
ANTIPARALLEL DIODES	
V_{FM} typical at I_F = 30 A	1.83 V
I_F at T_{SINK} = 25 °C	30 A
Package	EMIPAK 1B
Circuit configuration	6 pack

FEATURES

RoHS COMPLIANT

- Trench and field stop IGBT technology
- Gen 4 FRED Pt® dices technology
- Ultrasoft reverse recovery characteristics, soft switching optimized for IGBT F/W diode
- PressFit pins technology
- Exposed Al_2O_3 substrate with low thermal resistance
- Low internal inductances
- UL approved file E78996
- 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 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		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 - TRENCH IGBT				
Collector to emitter voltage	V_{CES}		600	V
Gate to emitter voltage	V_{GES}		± 20	
Pulsed collector current	I_{CM}	T_J = 175 °C	72	A
Clamped inductive load current	I_{LM} (1)		90	
Continuous collector current	I_C	T_{SINK} = 25 °C	34	A
		T_{SINK} = 59 °C	30	
Power dissipation	P_D	T_{SINK} = 25 °C	94	W
		T_{SINK} = 59 °C	72	
D1 to D6 - ANTIPARALLEL DIODE				
Single pulse forward current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, $T_{J = 25\ °C}$	135	A
Diode continuous forward current	I_F	T_{SINK} = 25 °C	30	A
		T_{SINK} = 90 °C	21	A
Power dissipation	P_D	T_{SINK} = 25 °C	75	W
		T_{SINK} = 90°C	42	

Note

(1) V_{CC} = 400 V, V_P = 600 V, V_{GE} = 15 V, L = 500 μH, R_g = 10 Ω, T_J = 175 °C

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

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Q1 to Q6 - TRENCH IGBT						
Collector to emitter breakdown voltage	BV_{CES}	V_{GE} = 0 V, I_C = 2 mA	600	-	-	V
Collector to emitter voltage	$V_{CE(ON)}$	V_{GE} = 15 V, I_C = 30 A	-	1.60	2.10	V
		V_{GE} = 15 V, I_C = 30 A, T_J = 175 °C	-	1.95	-	V
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 0.43 mA	4.0	5.9	7.5	V
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 0.43 mA (25 °C to 125 °C)	-	-14	-	mV/°C
Forward transconductance	g_{fe}	V_{CE} = 20 V, I_C = 30 A	-	19.6	-	S
Transfer characteristics	V_{GE}	V_{CE} = 20 V, I_C = 30 A	-	9.4	-	V
Zero gate voltage collector current	I_{CES}	V_{GE} = 0 V, V_{CE} = 600 V	-	0.3	50	µA
		V_{GE} = 0 V, V_{CE} = 600 V, T_J = 175 °C	-	1.45	-	mA
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V, V_{CE} = 0 V	-	-	± 400	nA
D1 to D6 - ANTIPARALLEL DIODE						
Forward voltage drop	V_{FM}	I_F = 30 A	-	1.83	3.00	V
		I_F = 30 A, T_J = 175 °C	-	1.45	-	V

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Q1 to Q6 - TRENCH IGBT						
Total gate charge (turn-on)	Q_g	I_C = 30 A, V_{CC} = 480 V, V_{GE} = 15 V	-	190	-	nC
Gate to emitter charge (turn-on)	Q_{ge}		-	15	-	
Gate to collector charge (turn-on)	Q_{gc}		-	110	-	
Turn-on switching loss	E_{ON}	I_C = 30 A, V_{CC} = 300 V, V_{GE} = 15 V, R_g = 10 Ω, L = 500 µH (1)	-	0.38	-	mJ
Turn-off switching loss	E_{OFF}		-	0.56	-	
Total switching loss	E_{TOT}		-	0.94	-	
Turn-on delay time	$t_{d(on)}$		-	5	-	ns
Rise time	t_r		-	18	-	
Turn-off delay time	$t_{d(off)}$		-	121	-	
Fall time	t_f		-	129	-	
Turn-on switching loss	E_{ON}	I_C = 30 A, V_{CC} = 300 V, V_{GE} = 15 V, R_g = 10 Ω, L = 500 µH, T_J = 125 °C (1)	-	0.59	-	mJ
Turn-off switching loss	E_{OFF}		-	0.77	-	
Total switching loss	E_{TOT}		-	1.36	-	
Turn-on delay time	$t_{d(on)}$		-	5	-	ns
Rise time	t_r		-	21	-	
Turn-off delay time	$t_{d(off)}$		-	135	-	
Fall time	t_f		-	181	-	
Input capacitance	C_{ies}	V_{GE} = 0 V, V_{CC} = 25 V, f = 1 MHz	-	1630	-	pF
Output capacitance	C_{oes}		-	108	-	
Reverse transfer capacitance	C_{res}		-	50	-	
Reverse bias safe operating area	RBSOA	T_J = 175 °C, I_C = 90 A, V_{CC} = 400 V, V_P = 600 V, R_g = 10 Ω, V_{GE} = 15 V to -15 V	Fullsquare			
Short circuit safe operating area	SCSOA	V_{GE} = 15 V, V_{CC} = 360 V, T_{VJ} = 150 °C	-	-	5	µs
D1 to D6 - ANTIPARALLEL DIODE						
Diode reverse recovery time	t_{rr}	V_R = 200 V, I_F = 30 A, dI/dt = 500 A/µs	-	77	-	ns
Diode peak reverse current	I_{rr}		-	4.3	-	A
Diode recovery charge	Q_{rr}		-	167	-	nC
Diode reverse recovery time	t_{rr}	V_R = 200 V, I_F = 30 A, dI/dt = 500 A/µs, T_J = 125 °C	-	144	-	ns
Diode peak reverse current	I_{rr}		-	9.6	-	A
Diode recovery charge	Q_{rr}		-	688	-	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_J = 25 °C	5000	Ω
	R_{100}	T_J = 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 to Q6 - TRENCH IGBT - Junction to sink thermal resistance (per switch) (1)	R_{thJS}	-	1.33	-	°C/W
D1 to D6 - AP DIODE- Junction to sink thermal resistance (per diode) (1)		-	1.83	-	
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

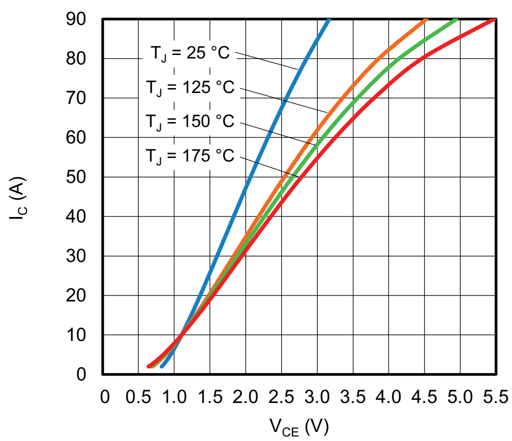


Fig. 1 - IGBT Output Characteristics, V_{GE} = 15 V

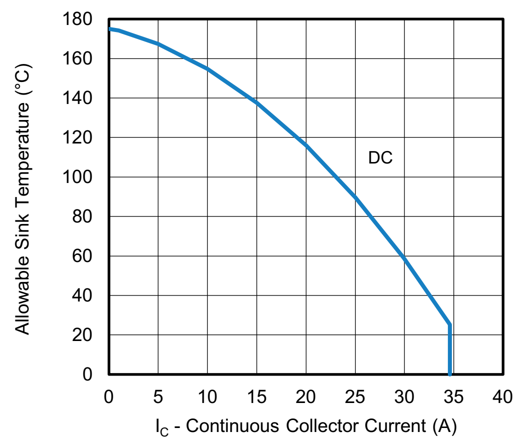


Fig. 3 - IGBT Continuous Collector Current vs. Sink Temperature

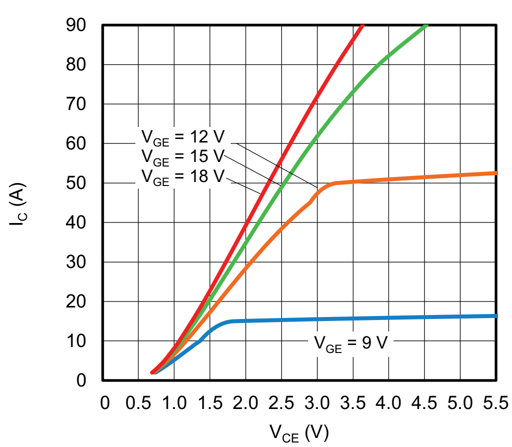


Fig. 2 - IGBT Output Characteristics, T_J = 125 °C

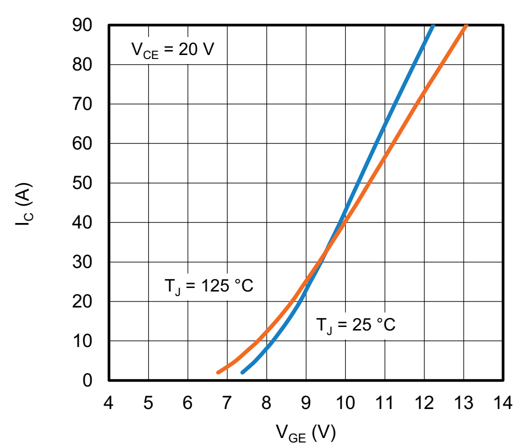


Fig. 4 - IGBT Transfer Characteristics

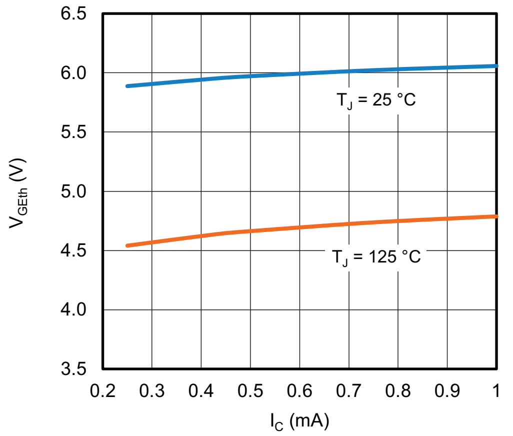


Fig. 5 - IGBT Gate Threshold Voltage

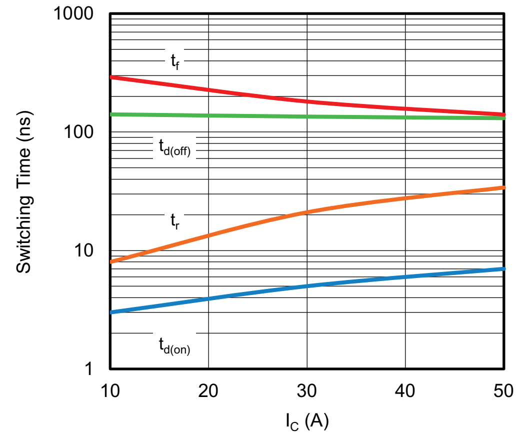


Fig. 8 - IGBT Switching Time vs. I_C
T_J = 125 °C, V_{CC} = 300 V, R_g = 10 Ω, V_{GE} = ± 15 V, L = 500 μH

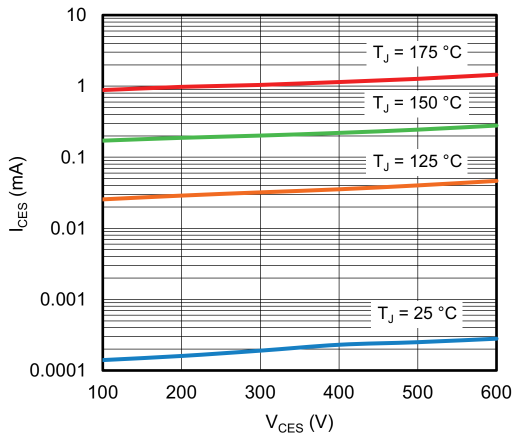


Fig. 6 - IGBT Zero Gate Voltage Collector Current

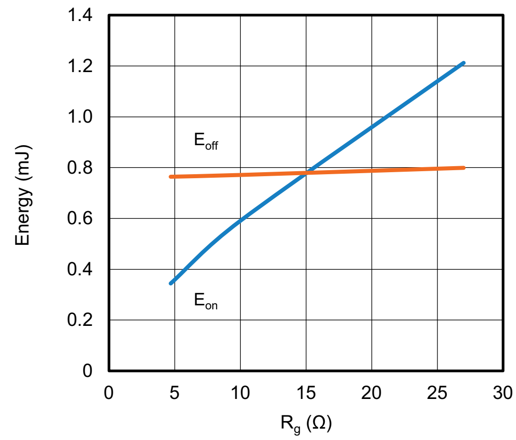


Fig. 9 - IGBT Energy Loss vs. R_g
T_J = 125 °C, V_{CC} = 300 V, I_C = 30 A, V_{GE} = ± 15 V, L = 500 μH

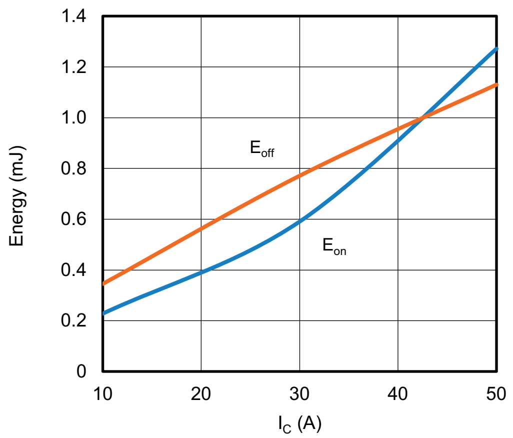


Fig. 7 - IGBT Energy Loss vs. I_C
T_J = 125 °C, V_{CC} = 300 V, R_g = 10 Ω, V_{GE} = ± 15 V, L = 500 μH

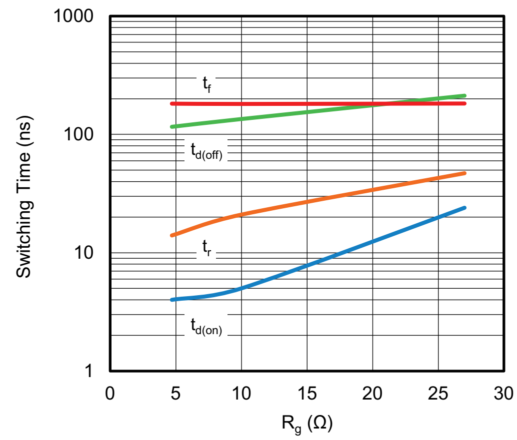


Fig. 10 - IGBT Switching Time vs. R_g
T_J = 125 °C, V_{CC} = 300 V, I_C = 30 A, V_{GE} = ± 15 V, L = 500 μH

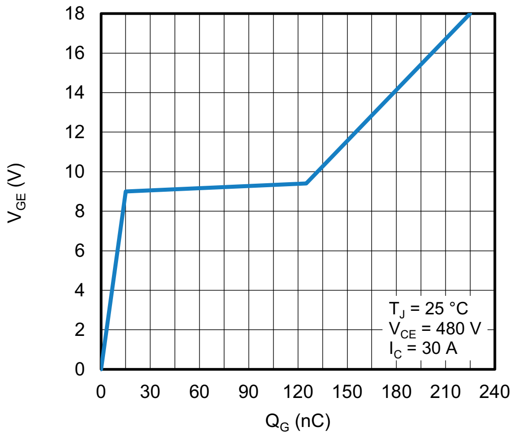


Fig. 11 - IGBT Gate Charge vs. Gate to Emitter Voltage

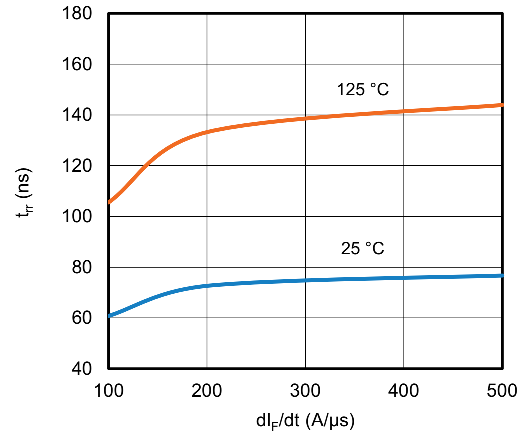


Fig. 14 - Diode Reverse Recovery Time vs. dI_F/dt
V_{rr} = 200 V, I_F = 30 A

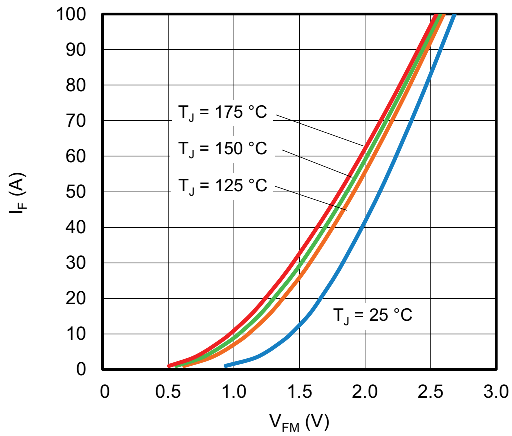


Fig. 12 - Diode Forward Characteristics

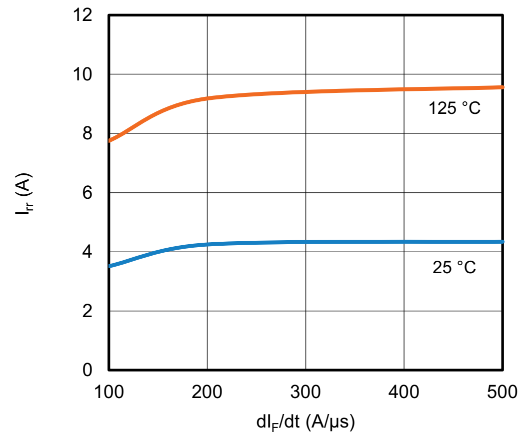


Fig. 15 - Diode Reverse Recovery Current vs. dI_F/dt
V_{rr} = 200 V, I_F = 30 A

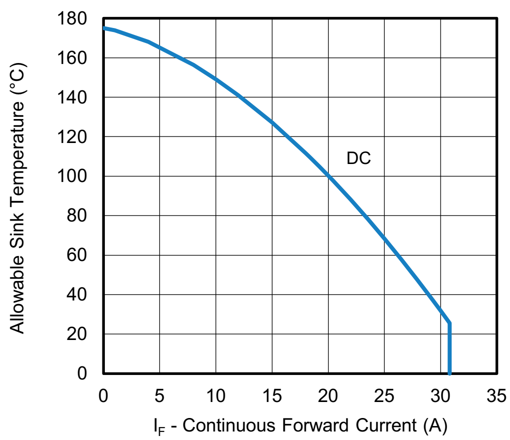


Fig. 13 - Diode Continuous Forward Current vs. Sink Temperature

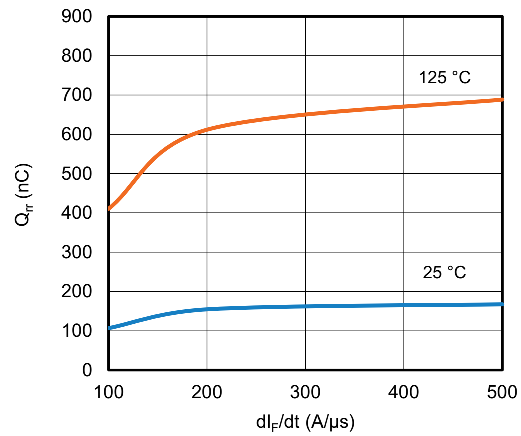


Fig. 16 - Diode Reverse Recovery Charge vs. dI_F/dt
V_{rr} = 200 V, I_F = 30 A

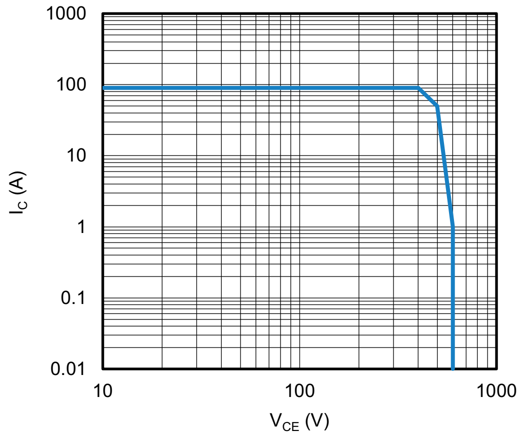


Fig. 17 - IGBT Reverse BIAS SOA
T_J = 175 °C, V_{GE} = 15 V

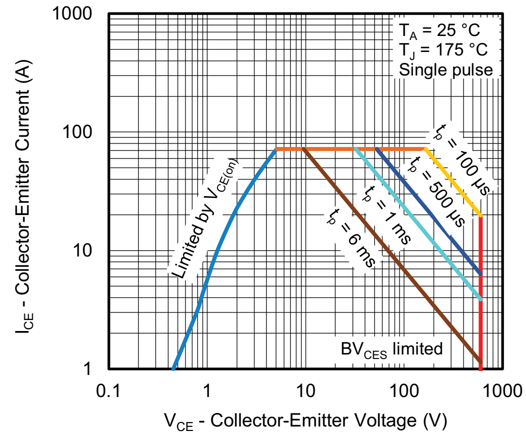


Fig. 18 - IGBT Safe Operating Area

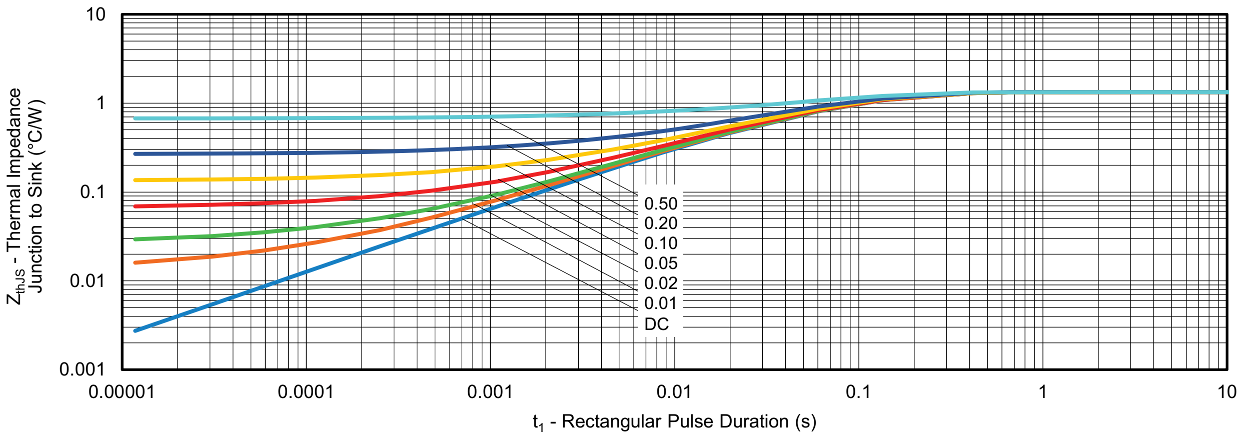


Fig. 19 - IGBT Typical Thermal Impedance Z_{thJS} Characteristics

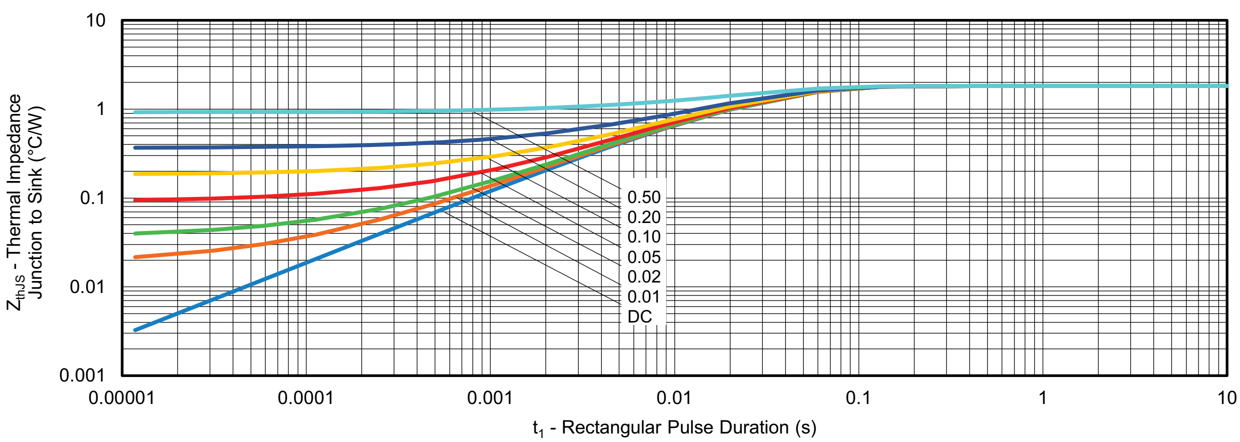


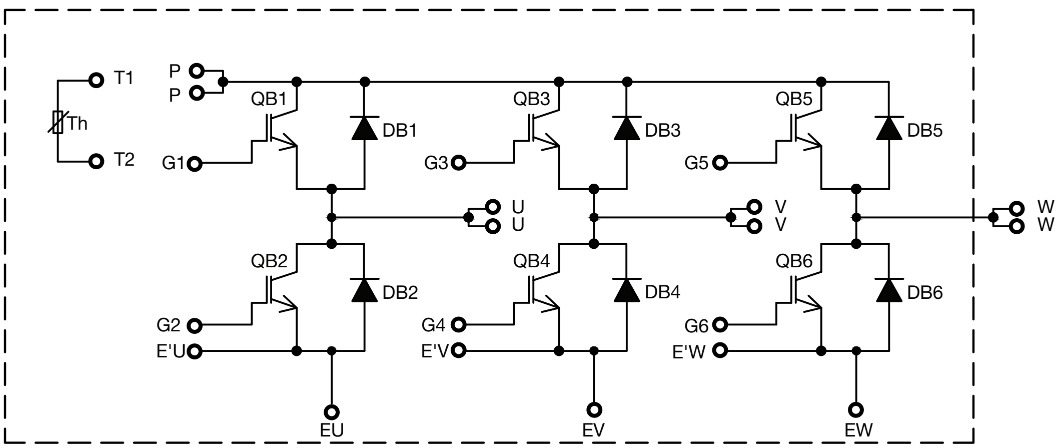
Fig. 20 - Diode Typical Thermal Impedance Z_{thJS} Characteristics

ORDERING INFORMATION TABLE

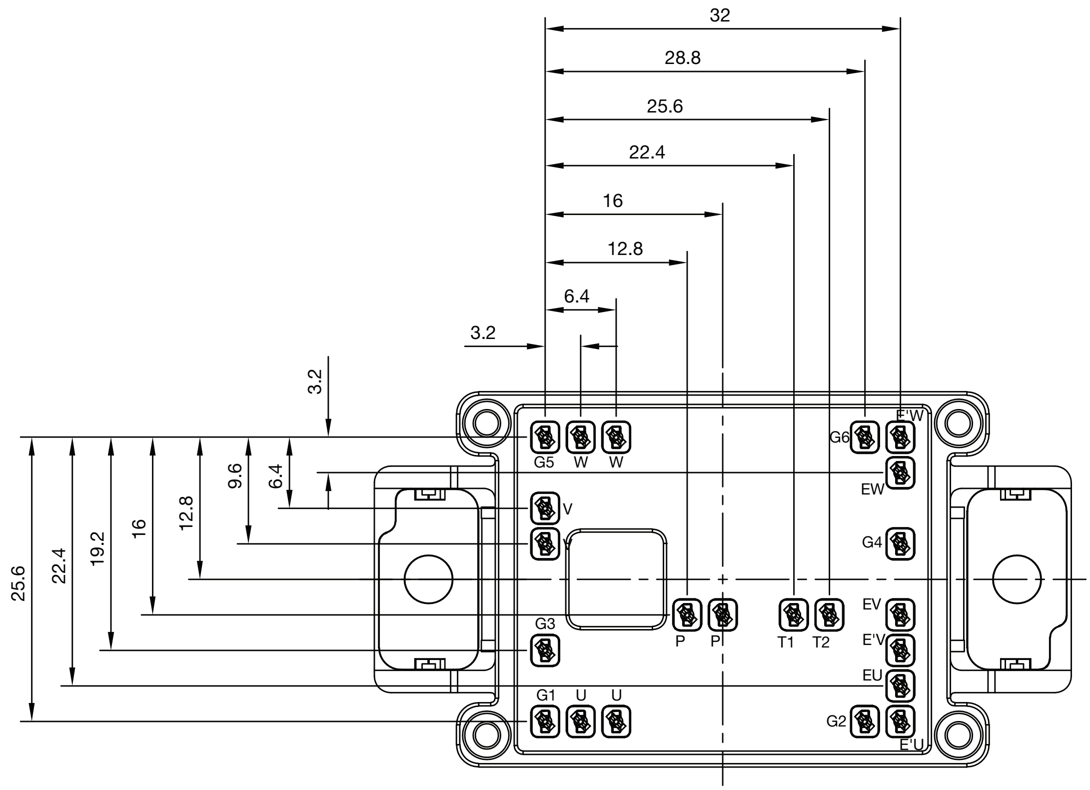
Device code	VS-	EN	X	030	Y	60	U
	1	2	3	4	5	6	7

- 1 - Vishay Semiconductors product
- 2 - Package indicator (EN = EMIPAK 1B)
- 3 - Circuit configuration (X = three phase inverter topology)
- 4 - Current rating (030 = 30 A)
- 5 - Switch die technology Y = trench IGBT
- 6 - Voltage rating (60 = 600 V)
- 7 - U = ultrafast

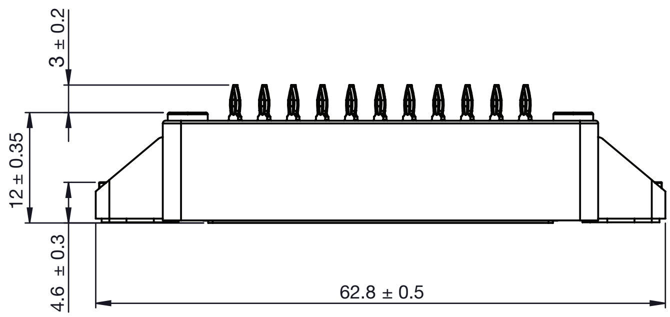
CIRCUIT CONFIGURATION



PACKAGE



LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?97125
Application Note	www.vishay.com/doc?95580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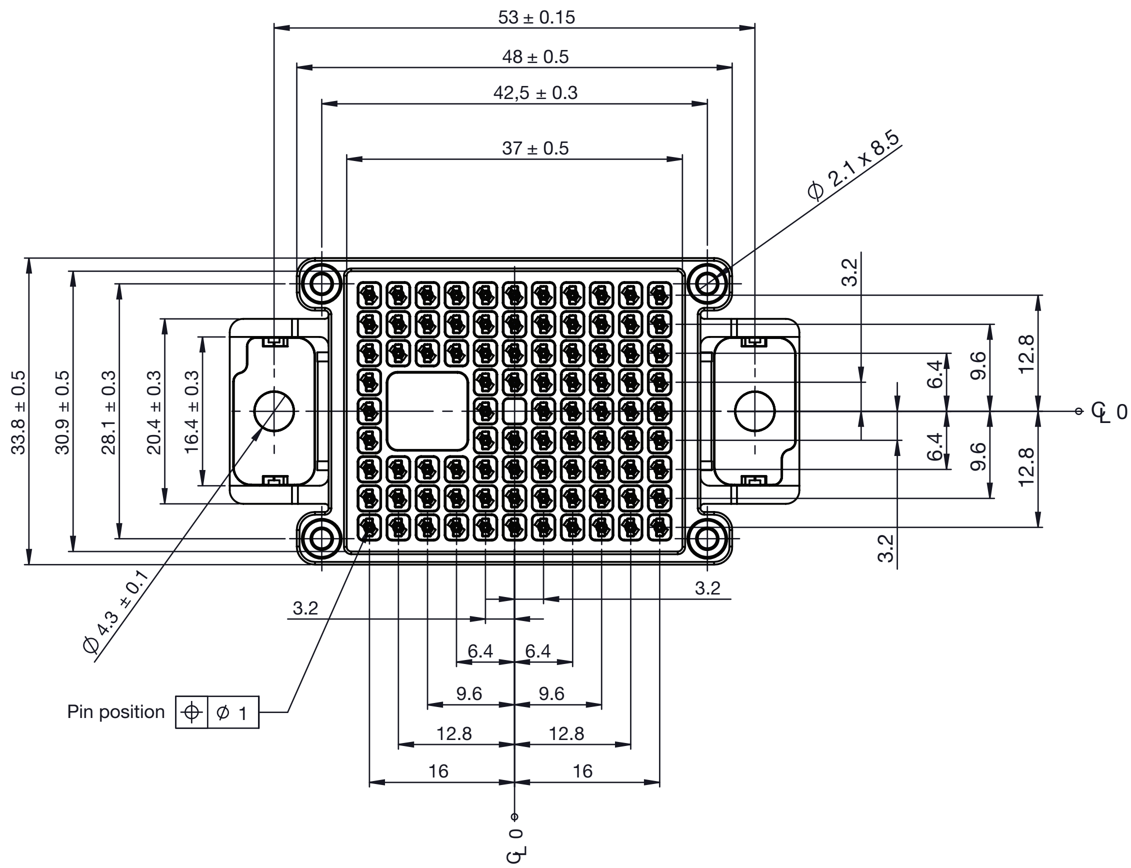
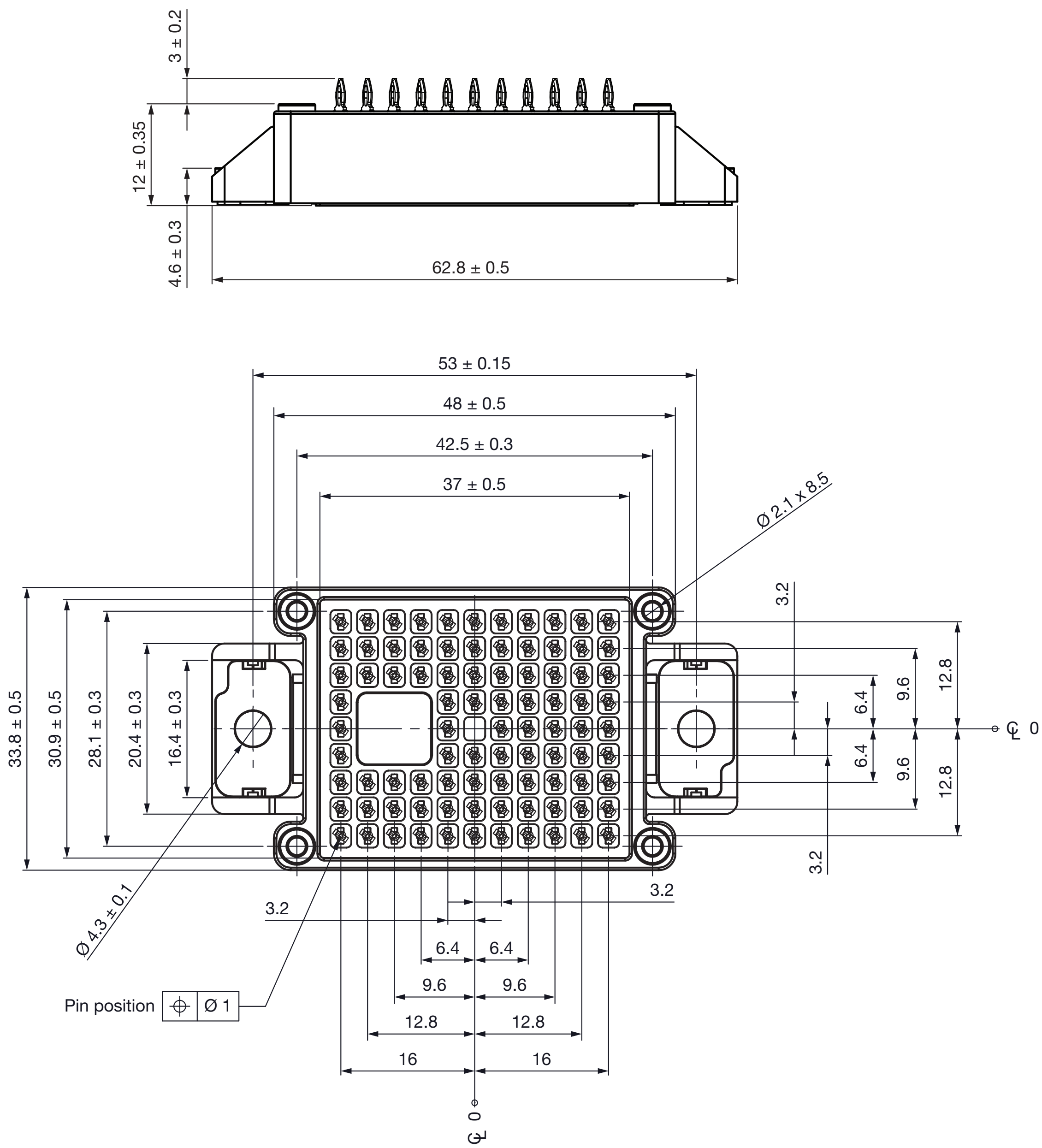
12 ± 0.35
4.6 ± 0.3
62.8 ± 0.5


53 ± 0.15
48 ± 0.5
42,5 ± 0.3
37 ± 0.5
Ø 2.1 x 8.5
3.2
6.4
9.6
12.8
6.4
9.6
12.8
3.2
33.8 ± 0.5
30.9 ± 0.5
28.1 ± 0.3
20.4 ± 0.3
16.4 ± 0.3
Ø 4.3 ± 0.1
3.2
3.2
6.4
6.4
9.6
9.6
12.8
12.8
16
16
Pin position
Ø 1

EMIPAK 1B

DIMENSIONS in millimeters (inches)



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