Dual INT-A-PAK Low Profile 3-Level Half Bridge Inverter Stage, 300 A

PRIMARY CHARACTERISTICS	
V_{CES}	600 V
$V_{CE(on)}$ typical at I_C = 300 A	1.72 V
I_C at T_C = 25 °C	379 A
Speed	8 kHz to 30 kHz
Package	Dual INT-A-PAK low profile
Circuit configuration	3-level half bridge inverter stage

FEATURES

- Trench plus Field Stop IGBT technology
- FRED Pt® antiparallel and clamping diodes
- Short circuit capability
- Low stray internal inductances
- Low switching loss
- UL approved file E78996
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT

APPLICATION

- Solar converters
- Uninterruptible power supplies

BENEFITS

- Direct mounting on heatsink
- Low junction to case thermal resistance
- Easy paralleling due to positive T_C of $V_{CE(sat)}$

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Operating junction temperature	T_J		175	°C
Storage temperature range	T_{Stg}		-40 to +175	
RMS isolation voltage	V_{ISOL}	T_J = 25 °C, all terminals shorted, f = 50 Hz, t = 1 s	3500	V
Collector to emitter voltage	V_{CES}		600	
Gate to emitter voltage	V_{GES}		20	
Pulsed collector current	I_{CM}		650	A
Clamped inductive load current	I_{LM}		650	
Continuous collector current	I_C	T_C = 25 °C	379	
		T_C = 80 °C	288	
Power dissipation	P_D	T_C = 25 °C	1250	W
		T_C = 80 °C	792	
D5 - D6 CLAMPING DIODE				
Repetitive peak reverse voltage	V_{RRM}		600	V
Single pulse forward current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, T_J = 25 °C	800	A
Diode continuous forward current	I_F	T_C = 25 °C	215	
		T_C = 80 °C	161	
Power dissipation	P_D	T_C = 25 °C	500	W
		T_C = 80 °C	317	
D - D2 - D3 - D4 AP DIODE				
Single pulse forward current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, T_J = 25 °C	800	A
Diode continuous forward current	I_F	T_C = 25 °C	215	
		T_C = 80 °C	161	
Power dissipation	P_D	T_C = 25 °C	500	W
		T_C = 80 °C	317	

Note

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

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Q1 - Q2 - Q3 - Q4 TRENCH IGBT						
Collector to emitter breakdown voltage	BV_{CES}	V_{GE} = 0 V, I_C = 500 μA	600	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 300 A	-	1.72	2.5	
		V_{GE} = 15 V, I_C = 300 A, T_J = 125 °C	-	1.93	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 16.8 mA	2.9	4.8	7.5	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 1 mA (25 °C to 125 °C)	-	-17.8	-	mV/°C
Forward transconductance	g_{fe}	V_{CE} = 20 V, I_C = 300 A	-	315	-	S
Transfer characteristics	V_{GE}	V_{CE} = 20 V, I_C = 300 A	-	7.9	-	V
Zero gate voltage collector current	I_{CES}	V_{GE} = 0 V, V_{CE} = 600 V	-	0.4	250	μA
		V_{GE} = 0 V, V_{CE} = 600 V, T_J = 125 °C	-	300	-	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V, V_{CE} = 0 V	-	-	± 500	nA
D5 - D6 CLAMPING DIODE						
Cathode to anode blocking voltage	V_{BR}	I_R = 100 μA	600	-	-	V
Forward voltage drop	V_{FM}	I_F = 150 A	-	2.17	2.7	
		I_F = 150 A, T_J = 125 °C	-	1.61	-	
Reverse leakage current	I_{RM}	V_R = 600 V	-	0.25	200	μA
		V_R = 600 V, T_J = 125 °C	-	140	-	
D1 - D2 - D3 - D4 AP DIODE						
Forward voltage drop	V_{FM}	I_F = 150 A	-	2.17	2.7	V
		I_F = 150 A, T_J = 125 °C	-	1.61	-	

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Q1 - Q2 - Q3 - Q4 TRENCH IGBT						
Total gate charge (turn-on)	Q_g	I_C = 300 A V_{CC} = 400 V V_{GE} = 15 V	-	750	-	nC
Gate to emitter charge (turn-on)	Q_{ge}		-	210	-	
Gate to collector charge (turn-on)	Q_{gc}		-	300	-	
Turn-on switching loss	E_{on}	I_C = 150 A, V_{CC} = 300 V V_{GE} = 15 V, R_g = 10 Ω L = 500 μH, T_J = 25 °C	-	2.1	-	mJ
Turn-off switching loss	E_{off}		-	3.1	-	
Total switching loss	E_{tot}		-	5.2	-	
Turn-on switching loss	E_{on}	I_C = 300 A, V_{CC} = 300 V V_{GE} = 15 V, R_g = 22 Ω L = 500 μH, T_J = 25 °C	-	8.6	-	
Turn-off switching loss	E_{off}		-	15.4	-	
Total switching loss	E_{tot}		-	24	-	
Turn-on switching loss	E_{on}	I_C = 150 A V_{CC} = 300 V V_{GE} = 15 V R_g = 10 Ω L = 500 μH T_J = 125 °C	-	2.6	-	
Turn-off switching loss	E_{off}		-	3.7	-	
Total switching loss	E_{tot}		-	6.3	-	
Turn-on delay time	$t_{d(on)}$		-	453	-	ns
Rise time	t_r		-	120	-	
Turn-off delay time	$t_{d(off)}$		-	366	-	
Fall time	t_f		-	119	-	

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Q1 - Q2 - Q3 - Q4 TRENCH IGBT						
Turn-on switching loss	E_{on}	I_C = 300 A V_{CC} = 300 V V_{GE} = 15 V R_g = 22 Ω L = 500 μH T_J = 125 °C	-	10.7	-	mJ
Turn-off switching loss	E_{off}		-	15.6	-	
Total switching loss	E_{tot}		-	26.3	-	
Turn-on delay time	$t_{d(on)}$		-	840	-	ns
Rise time	t_r		-	279	-	
Turn-off delay time	$t_{d(off)}$		-	566	-	
Fall time	t_f		-	129	-	
Input capacitance	C_{ies}	V_{GE} = 0 V V_{CC} = 30 V f = 1 MHz	-	23.3	-	nF
Output capacitance	C_{oes}		-	1.7	-	
Reverse transfer capacitance	C_{res}		-	0.7	-	
Reverse bias safe operating area	RBSOA	T_J = 175 °C, I_C = 650 A V_{CC} = 270 V, V_P = 600 V R_g = 22 Ω, V_{GE} = 15 V to 0 V				
Short circuit safe operating area	SCSOA	V_{CC} = 400 V, V_p = 600 V R_g = 10 Ω, V_{GE} = 15 V to 0 V	-	-	5.0	μs
D5 - D6 CLAMPING DIODE						
Diode reverse recovery time	t_{rr}	V_R = 200 V I_F = 50 A dI/dt = 500 A/μs	-	105	-	ns
Diode peak reverse current	I_{rr}		-	13.5	-	A
Diode recovery charge	Q_{rr}		-	712	-	nC
Diode reverse recovery time	t_{rr}	V_R = 200 V I_F = 50 A dI/dt = 500 A/μs, T_J = 125 °C	-	166	-	ns
Diode peak reverse current	I_{rr}		-	24.5	-	A
Diode recovery charge	Q_{rr}		-	2050	-	nC
D1 - D2 - D3 - D4 AP DIODE						
Diode reverse recovery time	t_{rr}	V_R = 200 V I_F = 50 A dI/dt = 500 A/μs	-	105	-	ns
Diode peak reverse current	I_{rr}		-	13.5	-	A
Diode recovery charge	Q_{rr}		-	712	-	nC
Diode reverse recovery time	t_{rr}	V_R = 200 V I_F = 50 A dI/dt = 500 A/μs, T_J = 125 °C	-	166	-	ns
Diode peak reverse current	I_{rr}		-	24.5	-	A
Diode recovery charge	Q_{rr}		-	2050	-	nC

THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Junction to case IGBT thermal resistance (per switch)	R_{thJC}	-	-	0.12	°C/W
Junction to case diode thermal resistance (per diode)		-	-	0.3	
Case to sink, flat, greased surface (per module)	R_{thCS}	-	0.05	-	
Mounting torque, case to heatsink: M6 screw		4	-	6	Nm
Mounting torque, case to terminal: 1, 2, 3, 4: M5 screw		2	-	5	
Weight		-	270	-	g

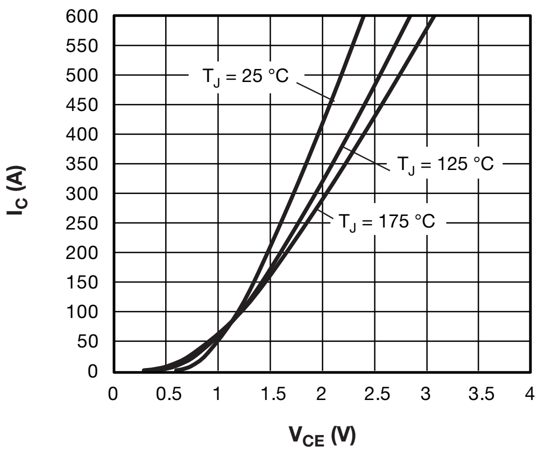


Fig. 1 - Typical Trench IGBT Output Characteristics, V_{GE} = 15 V

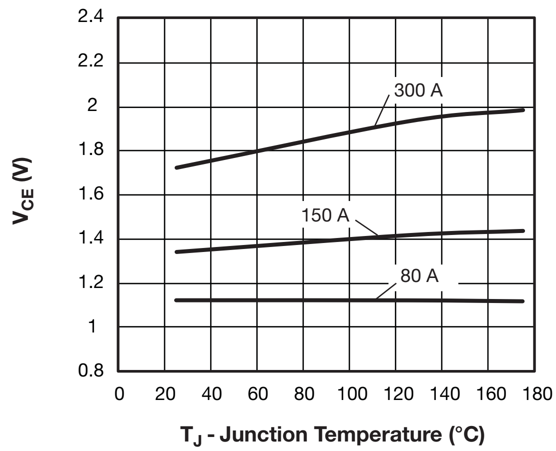


Fig. 4 - Typical Trench IGBT Collector to Emitter Voltage vs. Junction Temperature, V_{GE} = 15 V

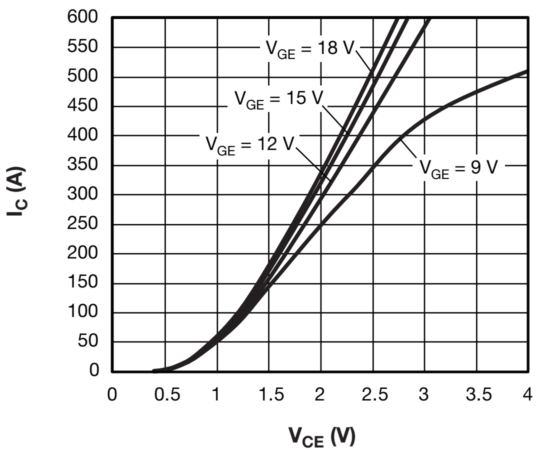


Fig. 2 - Typical Trench IGBT Output Characteristics, T_J = 125 °C

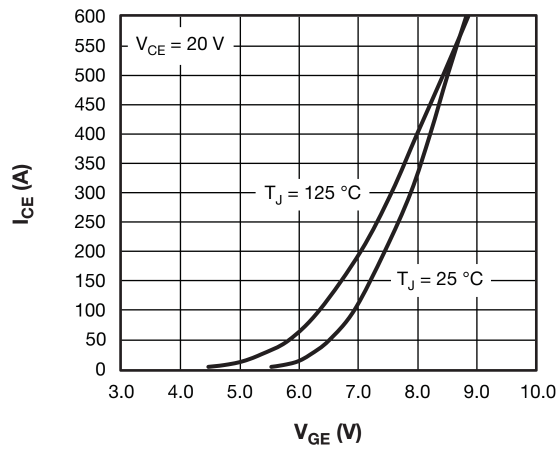


Fig. 5 - Typical Trench IGBT Transfer Characteristics

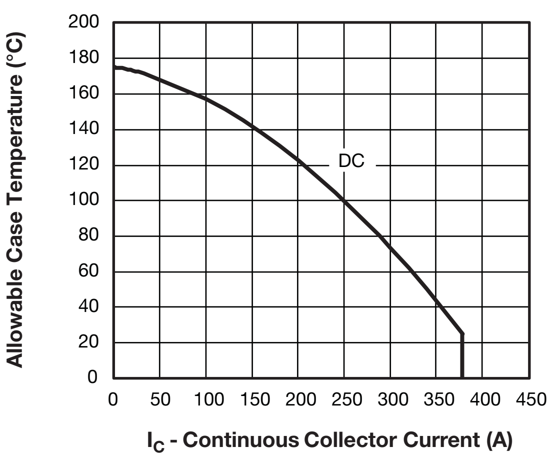


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature (per switch)

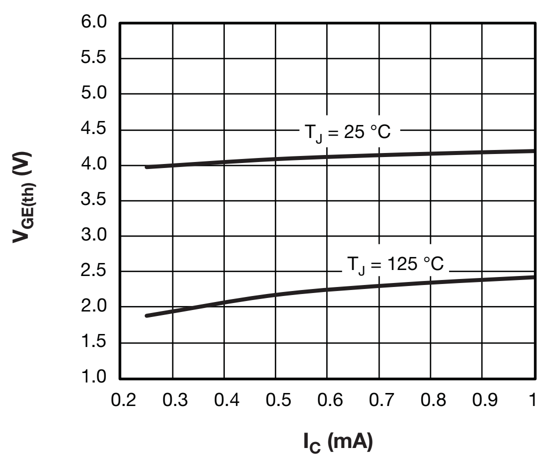


Fig. 6 - Typical Trench IGBT Gate Threshold Voltage

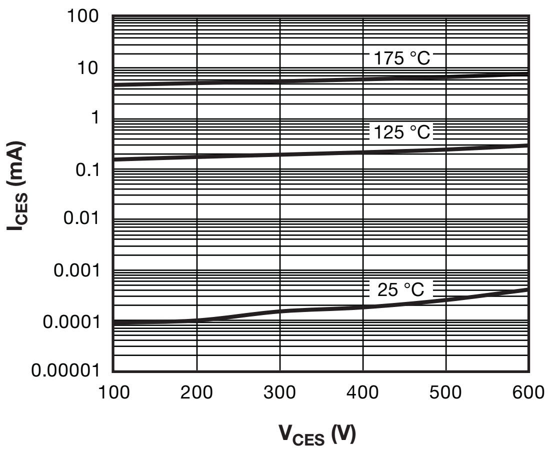


Fig. 7 - Typical Trench IGBT Zero Gate Voltage Collector Current

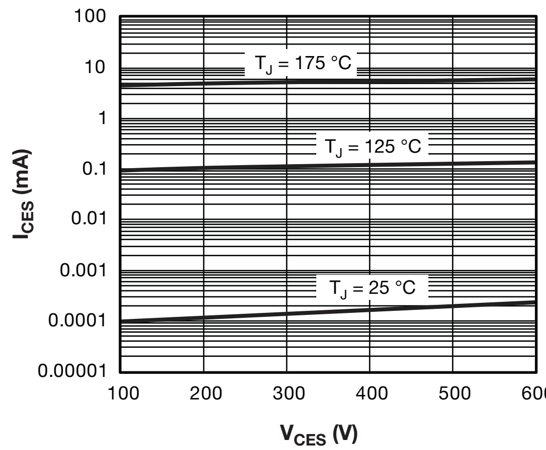


Fig. 10 - Typical Diode Reverse Leakage Current

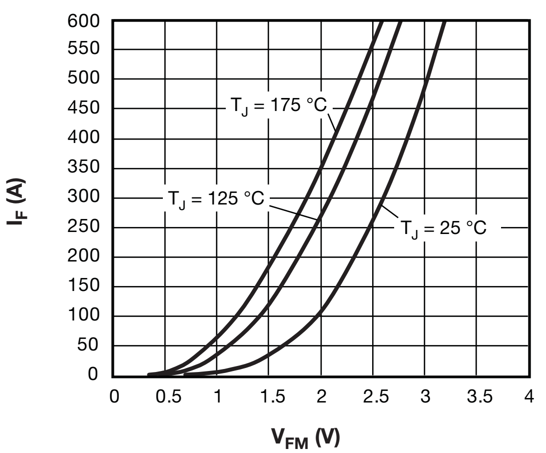


Fig. 8 - Typical Diode Forward Characteristics

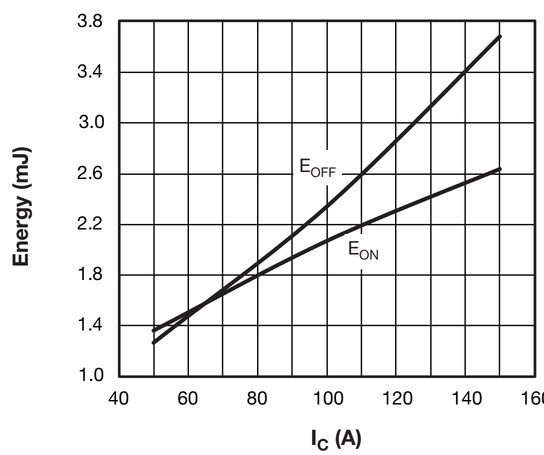


Fig. 11 - Typical Trench IGBT Energy Loss vs. I_C,
T_J = 125 °C, V_{CC} = 300 V, R_g = 10 Ω, V_{GE} = 15 V, L = 500 μH

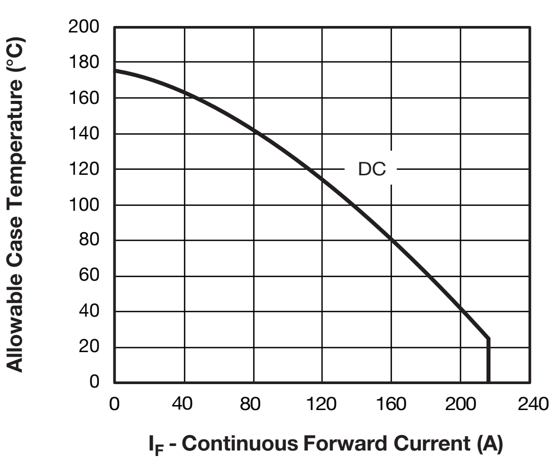


Fig. 9 - Maximum Diode Forward Current vs. Case Temperature

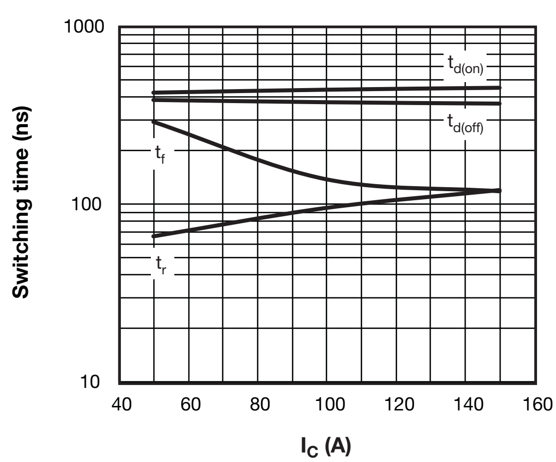


Fig. 12 - Typical IGBT Switching Time vs. I_C,
T_J = 125 °C, V_{CC} = 300 V, R_g = 10 Ω, V_{GE} = 15 V, L = 500 μH

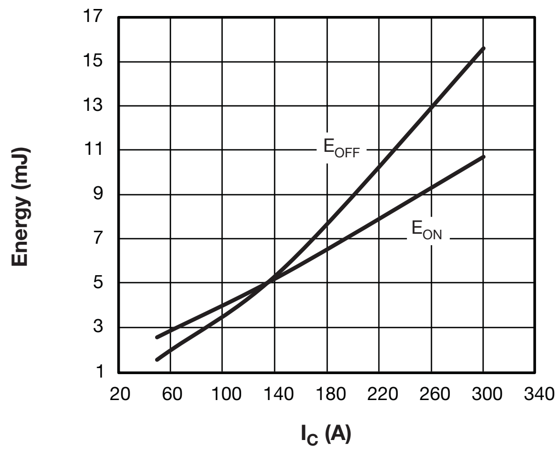


Fig. 13 - Typical Trench IGBT Energy Loss vs. I_C,
T_J = 125 °C, V_{CC} = 300 V, R_g = 22 Ω, V_{GE} = 15 V, L = 500 μH

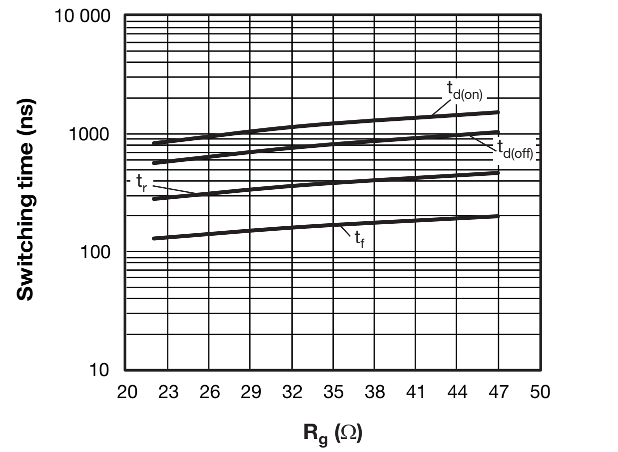


Fig. 16 - Typical Trench IGBT Switching Time vs.R_g,
T_J = 125 °C, V_{CC} = 300 V, I_C = 300 A, V_{GE} = 15 V, L = 500 μH

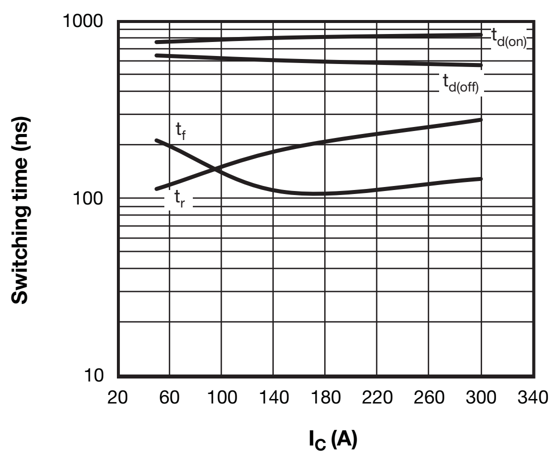


Fig. 14 - Typical IGBT Switching Time vs. I_C,
T_J = 125 °C, V_{CC} = 300 V, R_g = 22 Ω, V_{GE} = 15 V, L = 500 μH

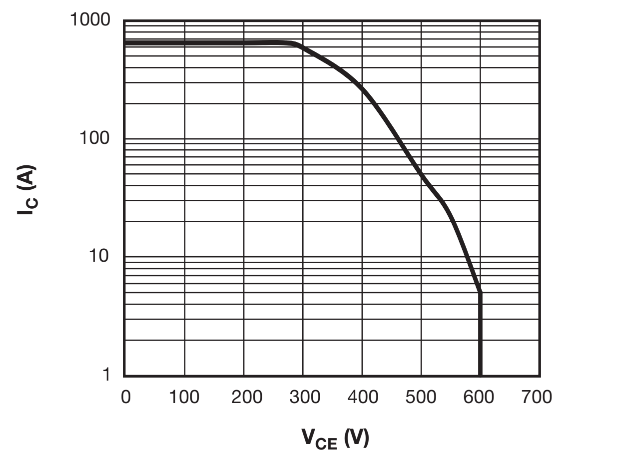


Fig. 17 - Trench IGBT Reverse Bias SOA
T_J = 175 °C, V_{GE} = 15 V, R_g = 22 Ω

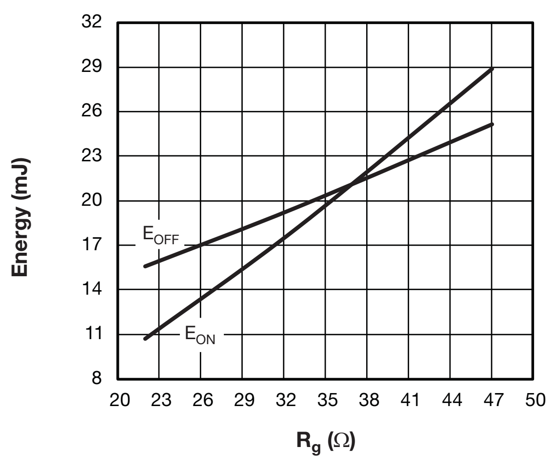


Fig. 15 - Typical Trench IGBT Energy Loss vs.R_g,
T_J = 125 °C, V_{CC} = 300 V, I_C = 300 A, V_{GE} = 15 V, L = 500 μH

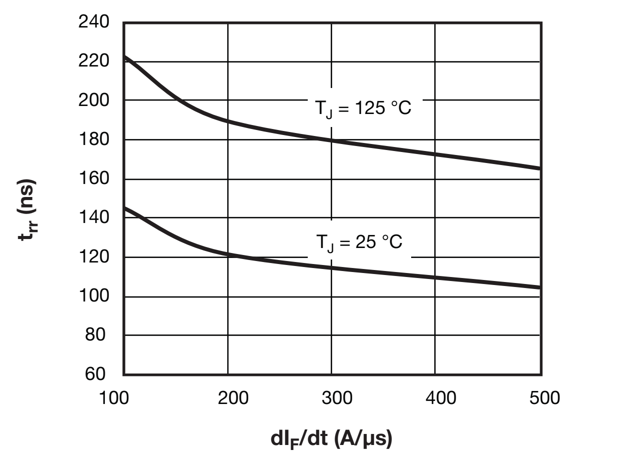


Fig. 18 - Typical Diode Reverse Recovery Time vs. dI_F/dt,
V_{rr} = 200 V, I_F = 50 A

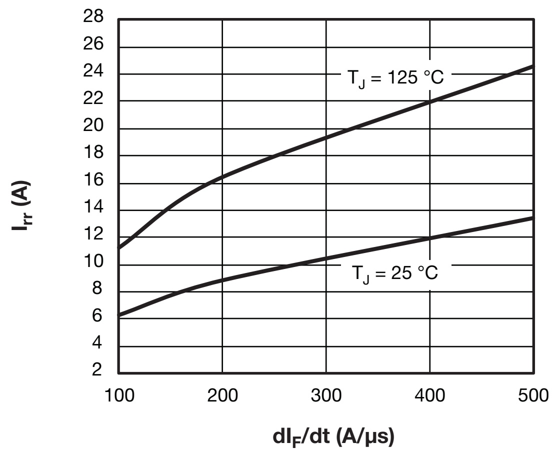


Fig. 19 - Typical Diode Reverse Recovery Current vs. dI_F/dt, V_{rr} = 200 V, I_F = 50 A

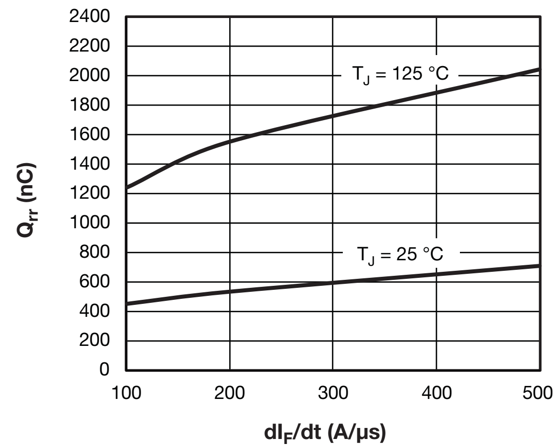


Fig. 20 - Typical Diode Reverse Recovery Charge vs. dI_F/dt, V_{rr} = 200 V, I_F = 50 A

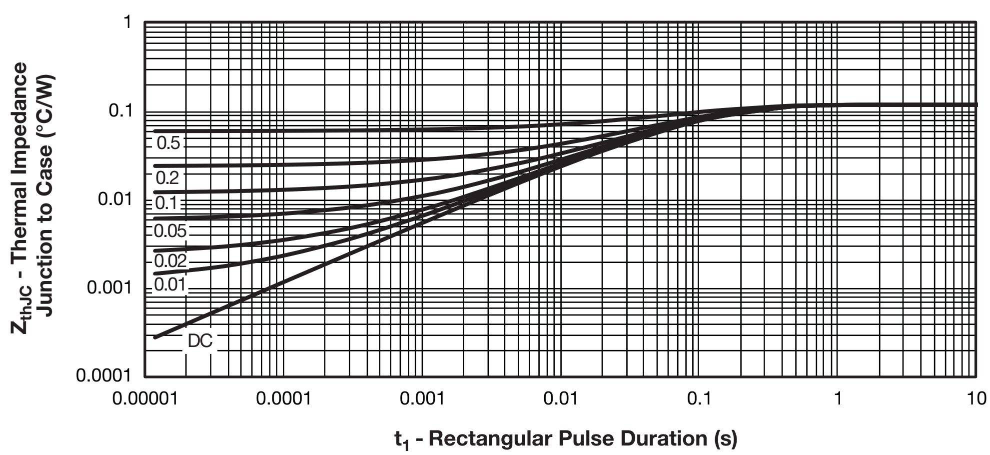


Fig. 21 - Maximum Thermal Impedance Z_{thJC} Characteristics (Trench IGBT)

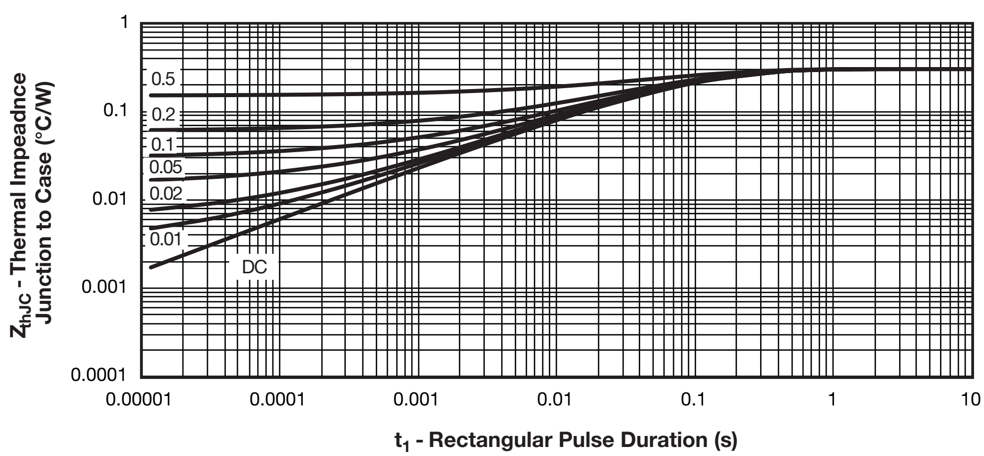


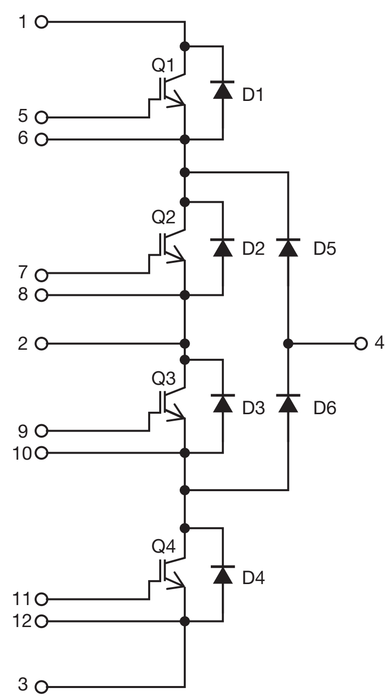
Fig. 22 - Maximum Thermal Impedance Z_{thJC} Characteristics (Diode)

ORDERING INFORMATION TABLE

Device code	VS-	G	T	300	F	D	060	N
	1	2	3	4	5	6	7	8

- **1** - Vishay Semiconductors product
- **2** - Insulated gate bipolar transistor
- **3** - T = trench IGBT
- **4** - Current rating (300 = 300 A)
- **5** - F = 3-level circuit configuration
- **6** - Package indicator D = dual INT-A-PAK low profile
- **7** - Voltage rating (060 = 600 V)
- **8** - N = ultrafast

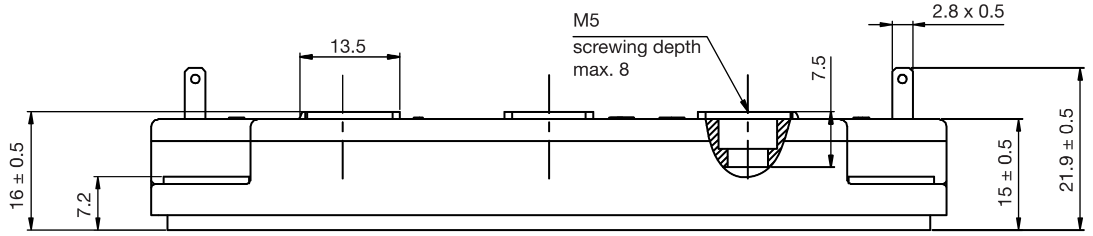
CIRCUIT CONFIGURATION

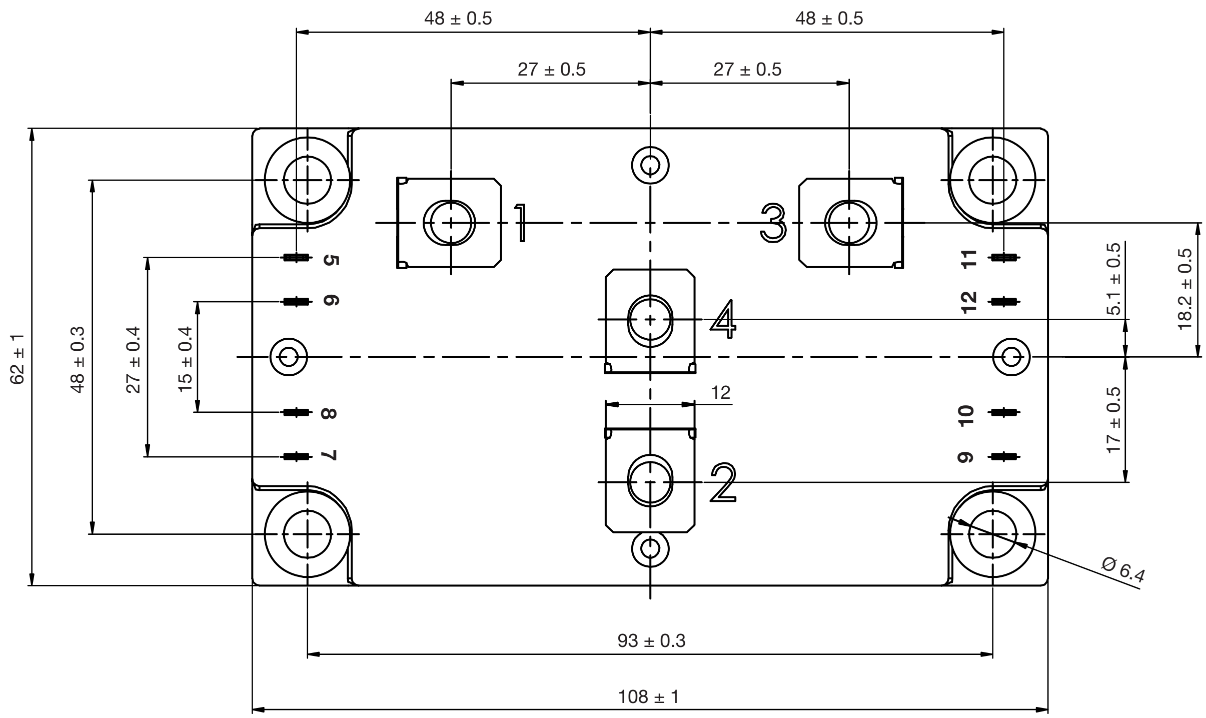


LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95515

DIAP Low Profile - 4 Leads

DIMENSIONS in millimeters





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