




DIAP Low Profile 3-Levels Half Bridge Inverter Stage, 300 A



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



RoHS COMPLIANT

PRODUCT SUMMARY	
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	DIAP low profile
Circuit	3-levels half bridge inverter stage

APPLICATION

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

SWITCHING CHARACTERISTICS ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Q1 - Q2 - Q3 - Q4 TRENCH IGBT						
Total gate charge (turn-on)	Q_g	$I_C = 300\text{ A}$ $V_{CC} = 400\text{ V}$ $V_{GE} = 15\text{ V}$	-	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}	$I_C = 150\text{ A}, V_{CC} = 300\text{ V}$ $V_{GE} = 15\text{ V}, R_g = 10\text{ }\Omega$ $L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$	-	2.1	-	mJ
Turn-off switching loss	E_{OFF}		-	3.1	-	
Total switching loss	E_{TOT}		-	5.2	-	
Turn-on switching loss	E_{ON}	$I_C = 300\text{ A}, V_{CC} = 300\text{ V}$ $V_{GE} = 15\text{ V}, R_g = 22\text{ }\Omega$ $L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$	-	8.6	-	
Turn-off switching loss	E_{OFF}		-	15.4	-	
Total switching loss	E_{TOT}		-	24	-	
Turn-on switching loss	E_{ON}	$I_C = 150\text{ A}$ $V_{CC} = 300\text{ V}$ $V_{GE} = 15\text{ V}$ $R_g = 10\text{ }\Omega$ $L = 500\text{ }\mu\text{H}$ $T_J = 125\text{ }^\circ\text{C}$	-	2.6	-	
Turn-off switching loss	E_{OFF}		-	3.7	-	
Total switching loss	E_{TOT}		-	6.3	-	
Turn-on delay time	$t_{d(on)}$	$V_{GE} = 15\text{ V}$ $R_g = 10\text{ }\Omega$ $L = 500\text{ }\mu\text{H}$ $T_J = 125\text{ }^\circ\text{C}$	-	453	-	ns
Rise time	t_r		-	120	-	
Turn-off delay time	$t_{d(off)}$		-	366	-	
Fall time	t_f		-	119	-	
Q1 - Q2 - Q3 - Q4 TRENCH IGBT						



SWITCHING CHARACTERISTICS ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted)							
Turn-on switching loss	E_{ON}	$I_C = 300\text{ A}$ $V_{CC} = 300\text{ V}$ $V_{GE} = 15\text{ V}$ $R_g = 22\ \Omega$ $L = 500\ \mu\text{H}$ $T_J = 125\text{ }^\circ\text{C}$	-	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}	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1\text{ MHz}$	-	23.3	-	nF	
Output capacitance	C_{oes}		-	1.7	-		
Reverse transfer capacitance	C_{res}		-	0.7	-		
Reverse bias safe operating area	RBSOA	$T_J = 175\text{ }^\circ\text{C}$, $I_C = 650\text{ A}$ $V_{CC} = 270\text{ V}$, $V_p = 600\text{ V}$ $R_g = 22\ \Omega$, $V_{GE} = 15\text{ V to } 0\text{ V}$					
Short circuit safe operating area	SCSOA	$V_{CC} = 400\text{ V}$, $V_p = 600\text{ V}$ $R_g = 10\ \Omega$, $V_{GE} = 15\text{ V to } 0\text{ V}$	-	-	5.0	μs	
D5 - D6 CLAMPING DIODE							
Diode reverse recovery time	t_{rr}	$V_R = 200\text{ V}$ $I_F = 50\text{ A}$ $di/dt = 500\text{ A}/\mu\text{s}$	-	105	-	ns	
Diode peak reverse current	I_{rr}		-	13.5	-	A	
Diode recovery charge	Q_{rr}		-	712	-	nC	
Diode reverse recovery time	t_{rr}	$V_R = 200\text{ V}$ $I_F = 50\text{ A}$ $di/dt = 500\text{ A}/\mu\text{s}$, $T_J = 125\text{ }^\circ\text{C}$	-	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}	$V_R = 200\text{ V}$ $I_F = 50\text{ A}$ $di/dt = 500\text{ A}/\mu\text{s}$	-	105	-	ns	
Diode peak reverse current	I_{rr}		-	13.5	-	A	
Diode recovery charge	Q_{rr}		-	712	-	nC	
Diode reverse recovery time	t_{rr}	$V_R = 200\text{ V}$ $I_F = 50\text{ A}$ $di/dt = 500\text{ A}/\mu\text{s}$, $T_J = 125\text{ }^\circ\text{C}$	-	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	$^\circ\text{C}/\text{W}$
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	-	4	
Weight		-	270	-	g

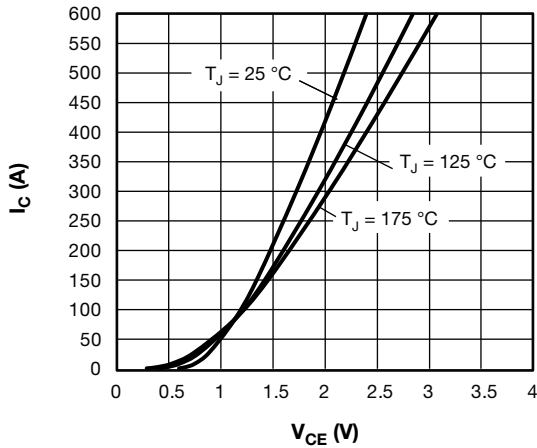


Fig. 1 - Typical Trench IGBT Output Characteristics, $V_{GE} = 15\text{ V}$

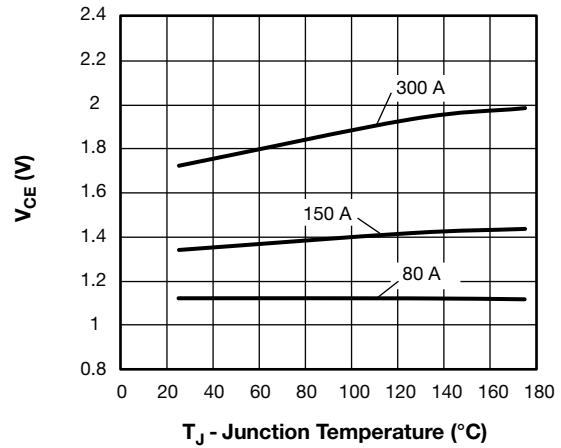


Fig. 4 - Typical Trench IGBT Collector to Emitter Voltage vs. Junction Temperature, $V_{GE} = 15\text{ V}$

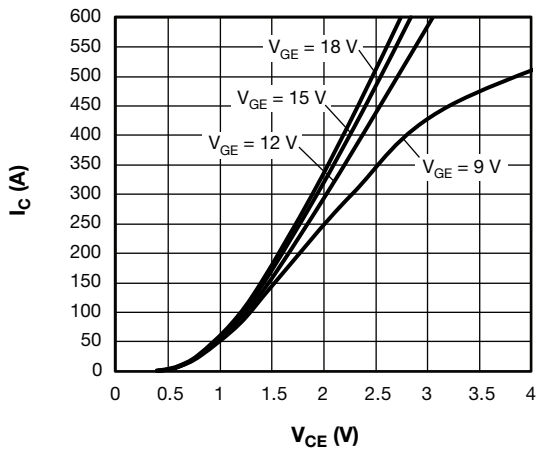


Fig. 2 - Typical Trench IGBT Output Characteristics, $T_J = 125\text{ }^\circ\text{C}$

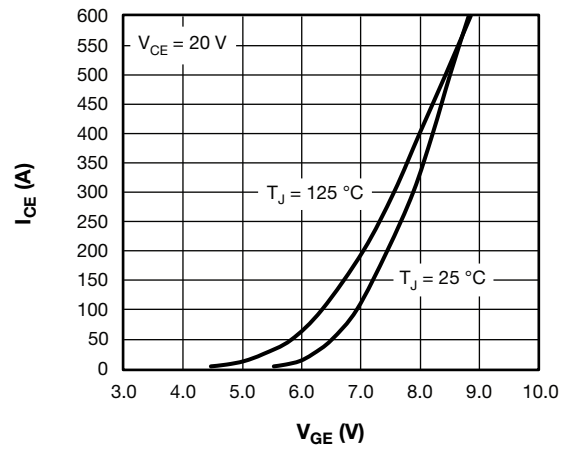


Fig. 5 - Typical Trench IGBT Transfer Characteristics

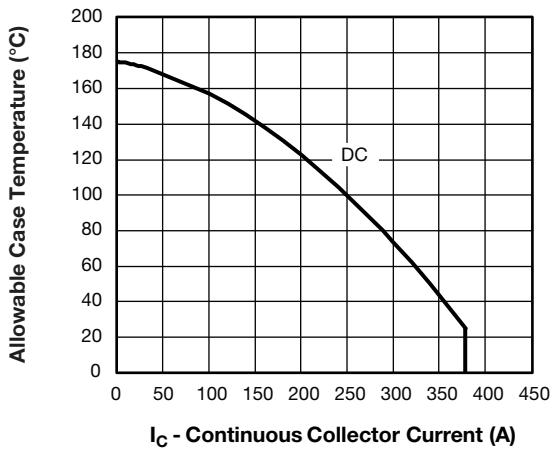


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature (per switch)

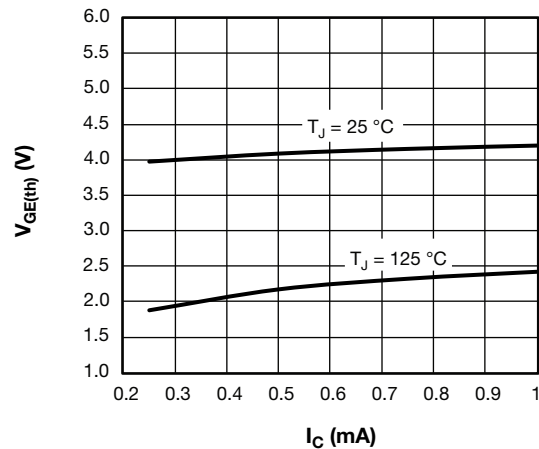


Fig. 6 - Typical Trench IGBT Gate Threshold Voltage

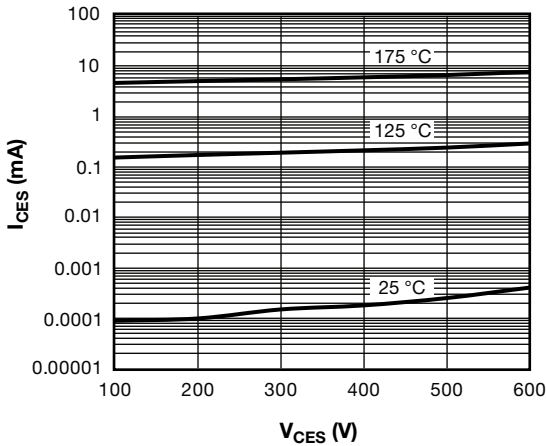


Fig. 7 - Typical Trench IGBT Zero Gate Voltage Collector Current

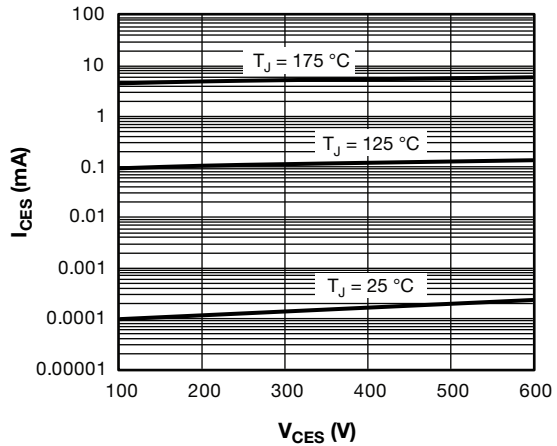


Fig. 10 - Typical Diode Reverse Leakage Current

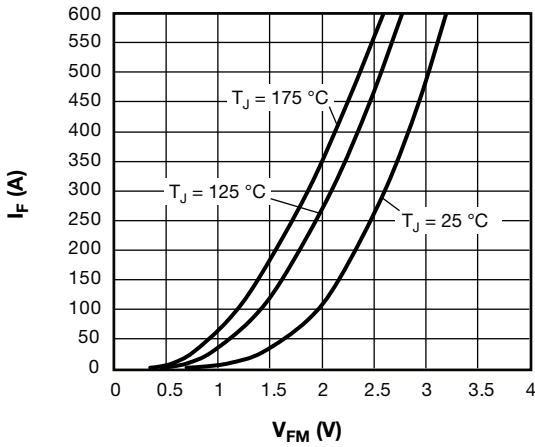


Fig. 8 - Typical Diode Forward Characteristics

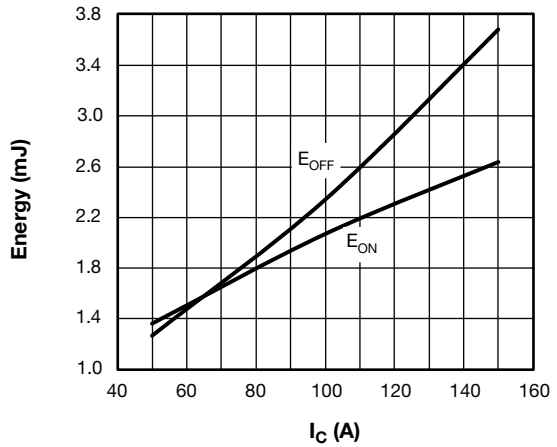


Fig. 11 - Typical Trench IGBT Energy Loss vs. I_C , $T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$

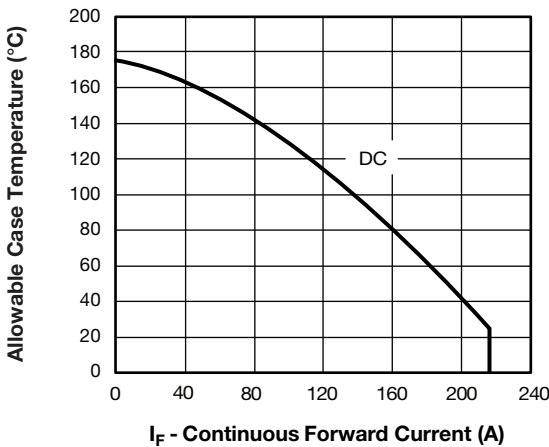


Fig. 9 - Maximum Diode Forward Current vs. Case Temperature

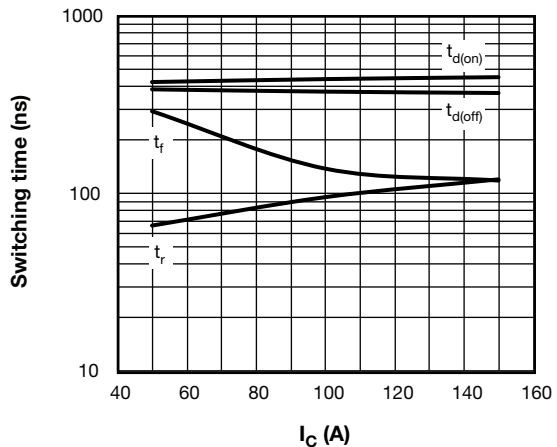


Fig. 12 - Typical IGBT Switching Time vs. I_C , $T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$

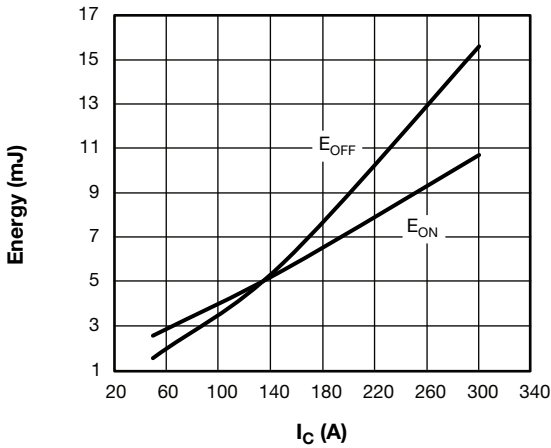


Fig. 13 - Typical Trench IGBT Energy Loss vs. I_C ,
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 22\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

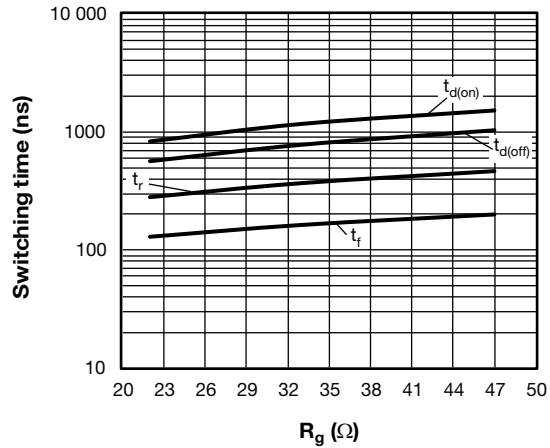


Fig. 16 - Typical Trench IGBT Switching Time vs. R_g ,
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 300\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

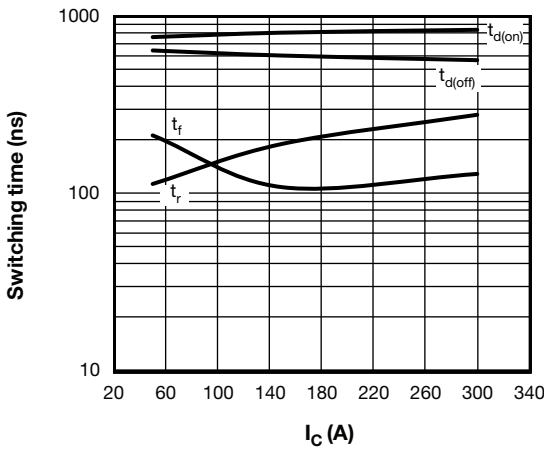


Fig. 14 - Typical IGBT Switching Time vs. I_C ,
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 22\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

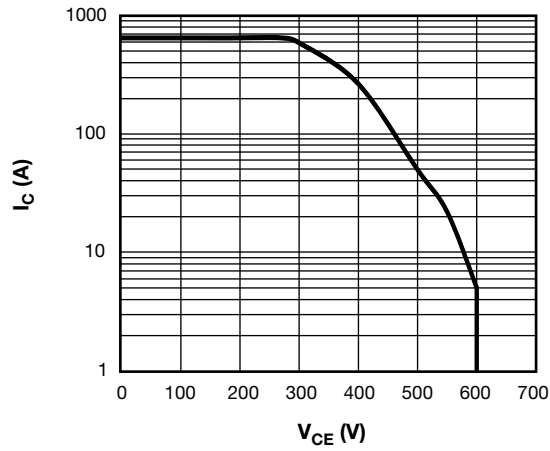


Fig. 17 - Trench IGBT Reverse Bias SOA
 $T_J = 175^\circ\text{C}$, $V_{GE} = 15\text{ V}$, $R_g = 22\ \Omega$

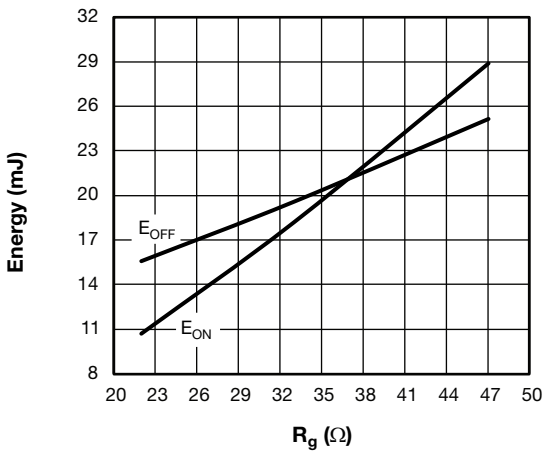


Fig. 15 - Typical Trench IGBT Energy Loss vs. R_g ,
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 300\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

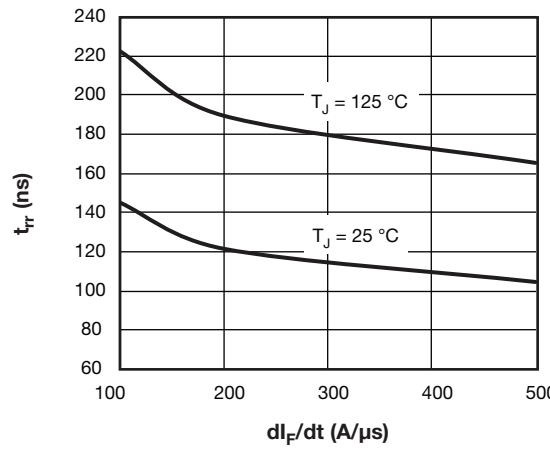


Fig. 18 - Typical Diode Reverse Recovery Time vs. di_F/dt ,
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

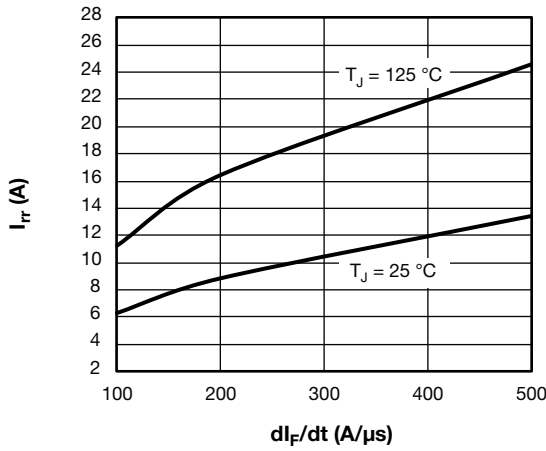


Fig. 19 - Typical Diode Reverse Recovery Current vs. di_F/dt , $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

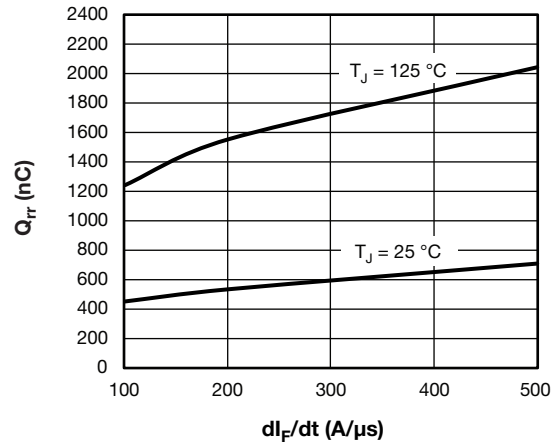


Fig. 20 - Typical Diode Reverse Recovery Charge vs. di_F/dt , $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

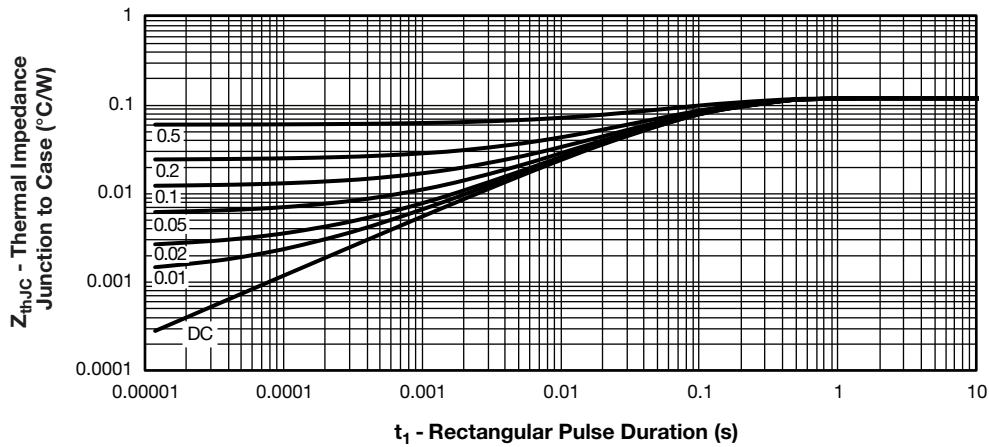


Fig. 21 - Maximum Thermal Impedance Z_{thJC} Characteristics (Trench IGBT)

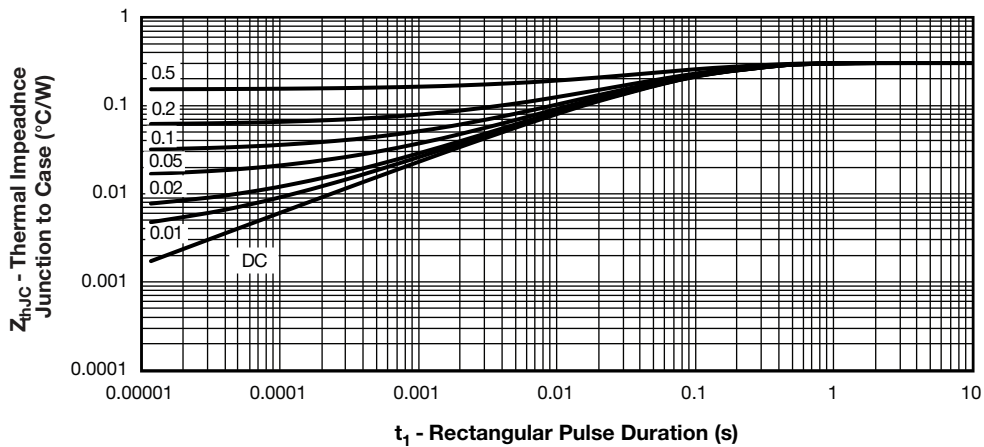
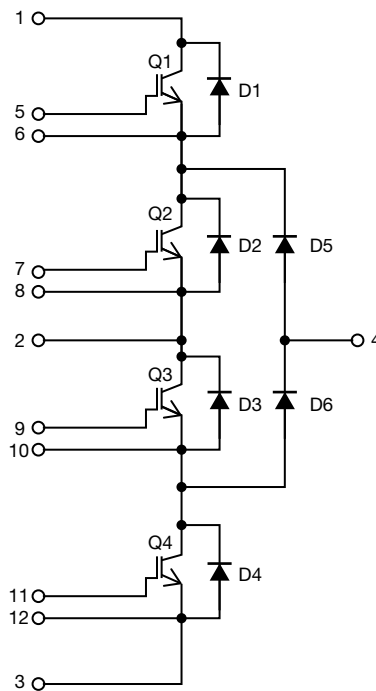


Fig. 22 - Maximum Thermal Impedance Z_{thJC} Characteristics (Diode)

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 = Three level circuit configuration
- 6** - Package Indicator D = Dual INT-A-PAK Low Profile
- 7** - Voltage rating (060 = 600 V)
- 8** - N = Ultrafast

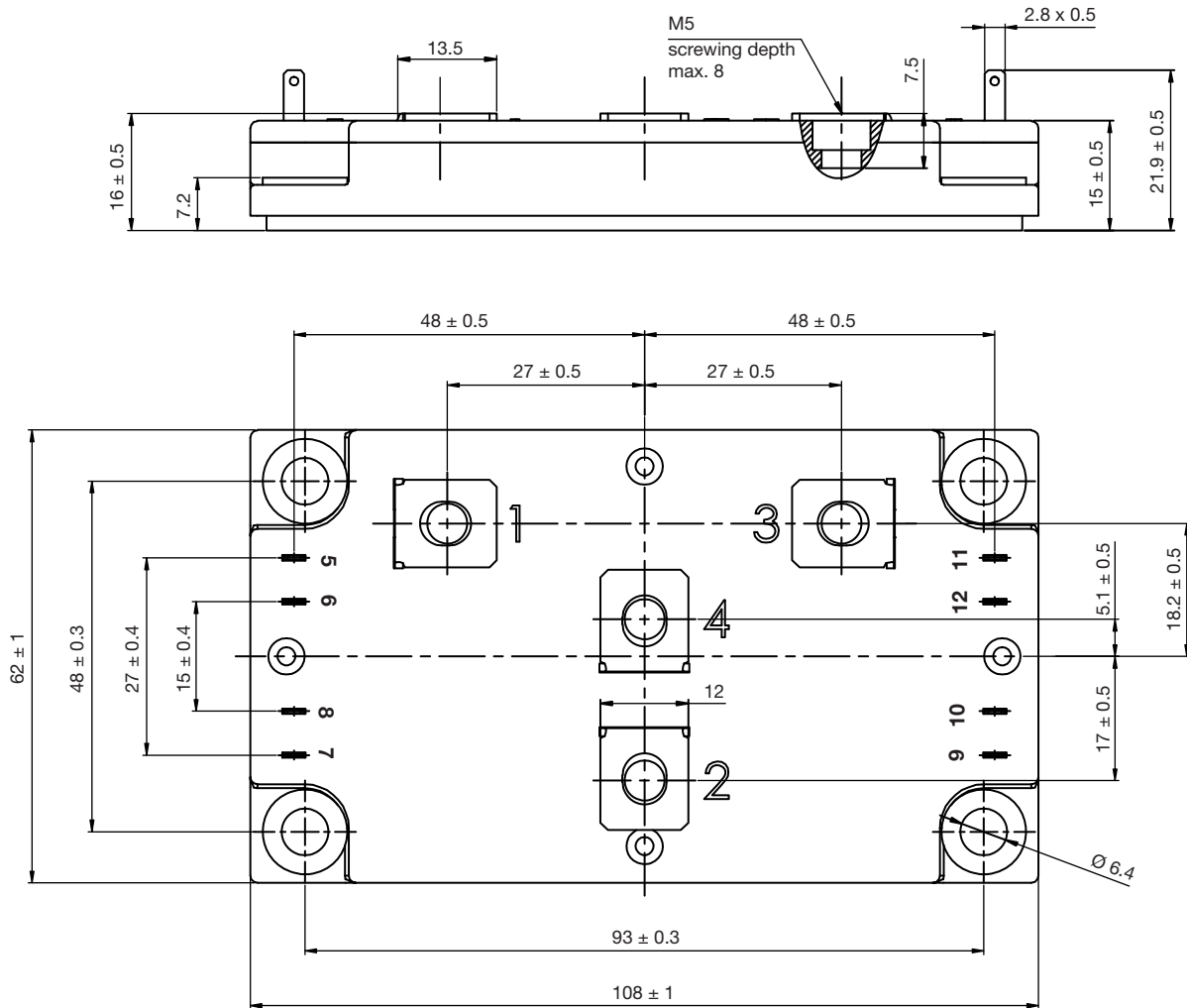
CIRCUIT CONFIGURATION

LINKS TO RELATED DOCUMENTS

Dimensions	www.vishay.com/doc?95515
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DIAP Low Profile - 4 Leads

DIMENSIONS in millimeters





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