



Dual INT-A-PAK Low Profile 3-Level 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

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

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	ΔV _{GE(th)} /ΔT _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	-	750	-	nC
Gate to emitter charge (turn-on)	Q _{ge}	V _{CC} = 400 V	-	210	-	
Gate to collector charge (turn-on)	Q _{gc}	V _{GE} = 15 V	-	300	-	
Turn-on switching loss	E _{on}	I _C = 150 A, V _{CC} = 300 V	-	2.1	-	mJ
Turn-off switching loss	E _{off}	V _{GE} = 15 V, R _g = 10 Ω	-	3.1	-	
Total switching loss	E _{tot}	L = 500 μH, T _J = 25 °C	-	5.2	-	
Turn-on switching loss	E _{on}	I _C = 300 A, V _{CC} = 300 V	-	8.6	-	
Turn-off switching loss	E _{off}	V _{GE} = 15 V, R _g = 22 Ω	-	15.4	-	
Total switching loss	E _{tot}	L = 500 μH, T _J = 25 °C	-	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 ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Q1 - Q2 - Q3 - Q4 TRENCH IGBT						
Turn-on switching loss	E_{on}	$I_C = 300\text{ A}$ $V_{CC} = 300\text{ V}$ $V_{GE} = 15\text{ V}$	-	10.7	-	mJ
Turn-off switching loss	E_{off}		-	15.6	-	
Total switching loss	E_{tot}		-	26.3	-	
Turn-on delay time	$t_{d(on)}$	$R_g = 22\text{ }\Omega$ $L = 500\text{ }\mu\text{H}$ $T_J = 125\text{ }^\circ\text{C}$	-	840	-	ns
Rise time	t_r		-	279	-	
Turn-off delay time	$t_{d(off)}$		-	566	-	
Fall time	t_f		-	129	-	
Input capacitance	C_{ies}	$V_{GE} = 0\text{ V}$	-	23.3	-	nF
Output capacitance	C_{oes}	$V_{CC} = 30\text{ V}$	-	1.7	-	
Reverse transfer capacitance	C_{res}	$f = 1\text{ MHz}$	-	0.7	-	
Reverse bias safe operating area	RBSOA	$T_J = 175\text{ }^\circ\text{C}$, $I_C = 650\text{ A}$ $V_{CC} = 270\text{ V}$, $V_P = 600\text{ V}$ $R_g = 22\text{ }\Omega$, $V_{GE} = 15\text{ V to } 0\text{ V}$				
Short circuit safe operating area	SCSOA	$V_{CC} = 400\text{ V}$, $V_P = 600\text{ V}$ $R_g = 10\text{ }\Omega$, $V_{GE} = 15\text{ V to } 0\text{ V}$	-	-	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	-	5	
Weight		-	270	-	g

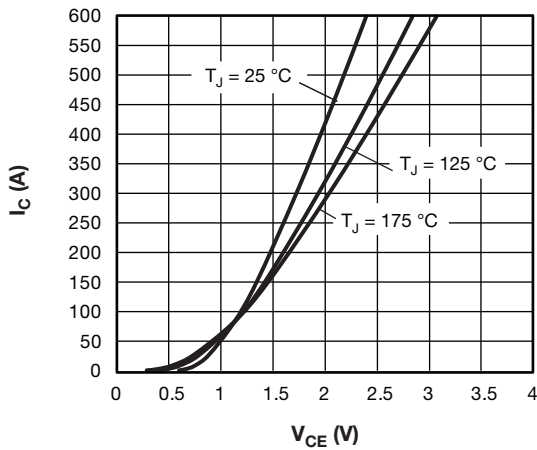


Fig. 1 - Typical Trench IGBT Output Characteristics, $V_{GE} = 15\text{ V}$

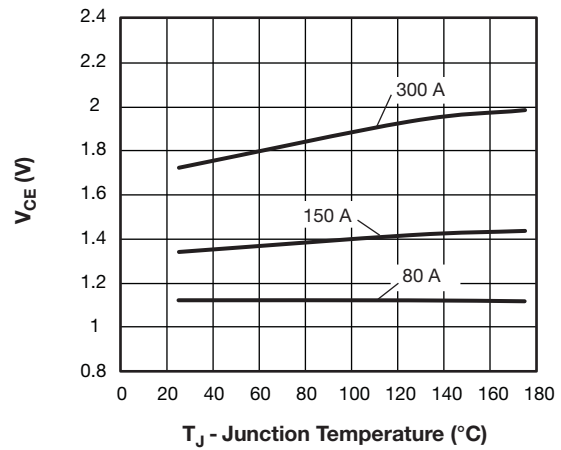


Fig. 4 - Typical Trench IGBT Collector to Emitter Voltage vs. Junction Temperature, $V_{GE} = 15\text{ V}$

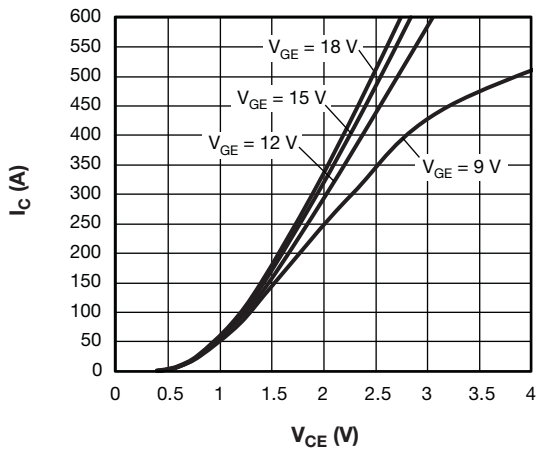


Fig. 2 - Typical Trench IGBT Output Characteristics, $T_J = 125\text{ °C}$

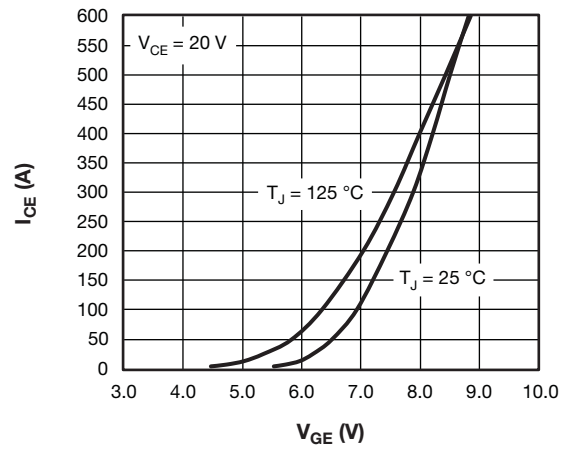


Fig. 5 - Typical Trench IGBT Transfer Characteristics

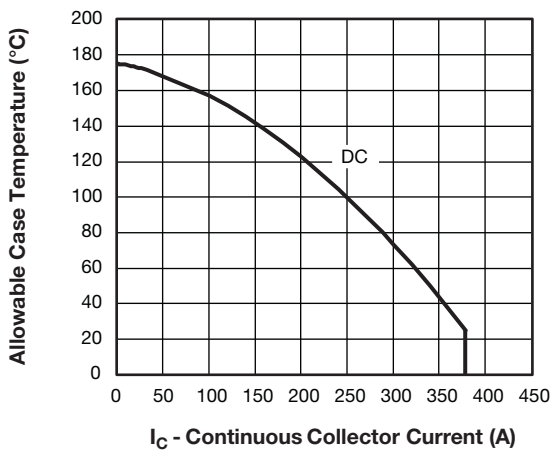


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature (per switch)

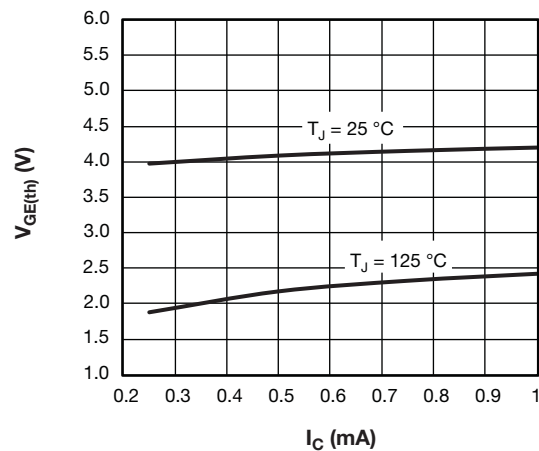


Fig. 6 - Typical Trench IGBT Gate Threshold Voltage

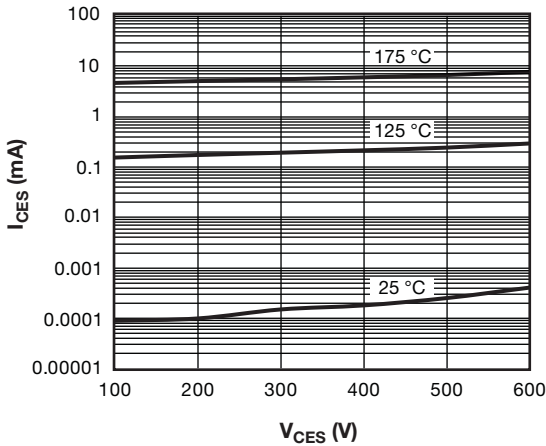


Fig. 7 - Typical Trench IGBT Zero Gate Voltage Collector Current

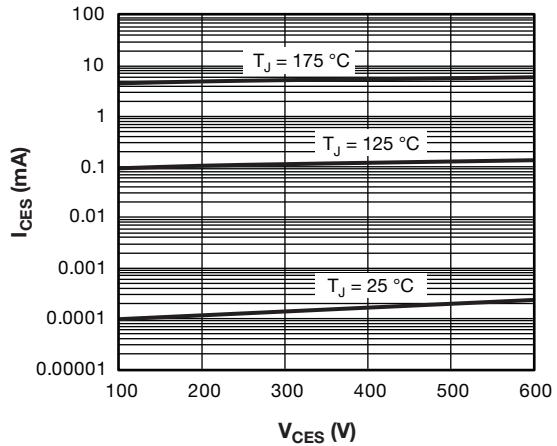


Fig. 10 - Typical Diode Reverse Leakage Current

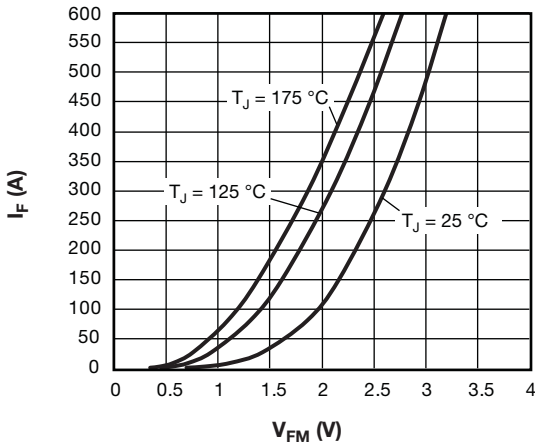


Fig. 8 - Typical Diode Forward Characteristics

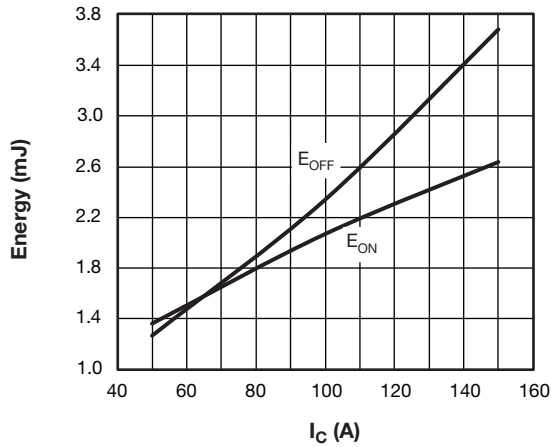


Fig. 11 - Typical Trench IGBT Energy Loss vs. I_C , $T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

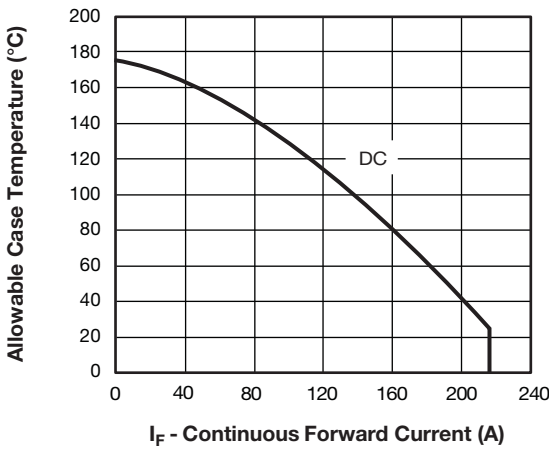


Fig. 9 - Maximum Diode Forward Current vs. Case Temperature

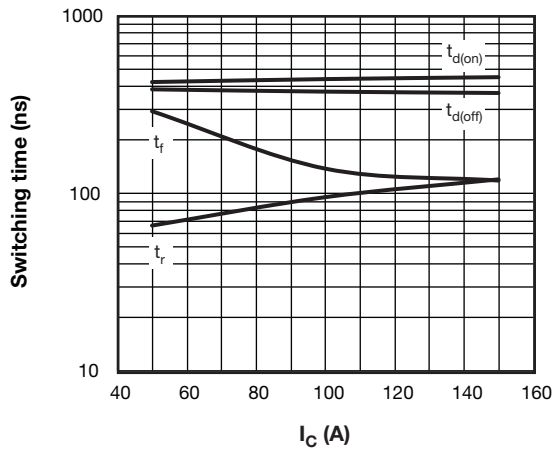


Fig. 12 - Typical IGBT Switching Time vs. I_C , $T_J = 125\text{ }^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

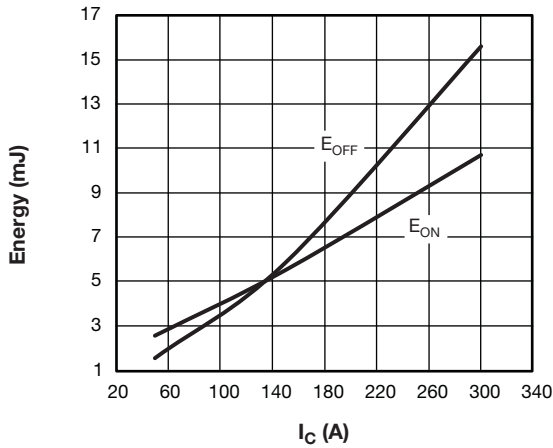


Fig. 13 - Typical Trench IGBT Energy Loss vs. I_C ,
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 22\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

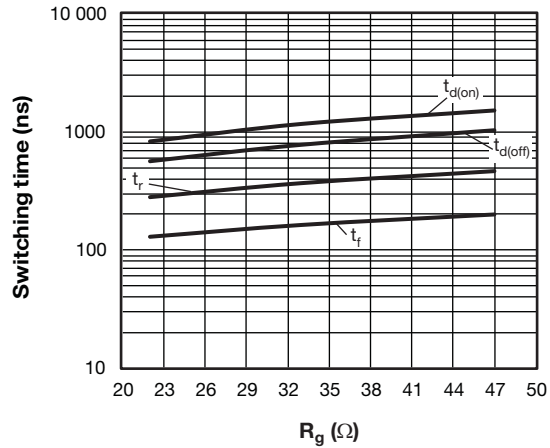


Fig. 16 - Typical Trench IGBT Switching Time vs. R_g ,
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 300\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

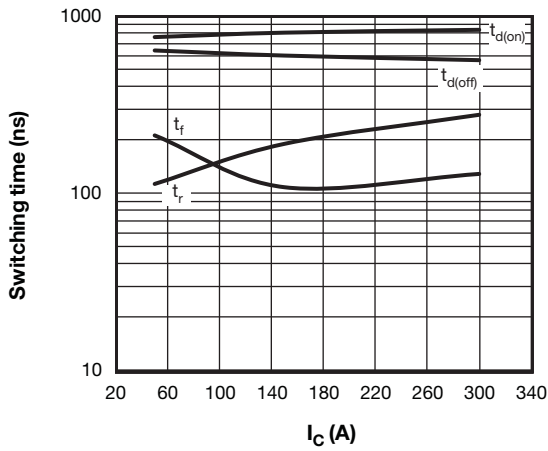


Fig. 14 - Typical IGBT Switching Time vs. I_C ,
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 22\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

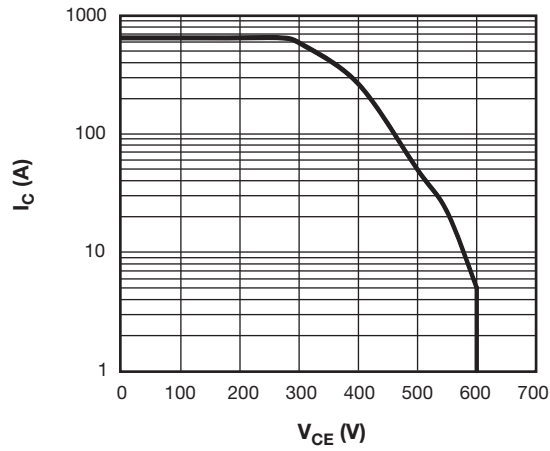


Fig. 17 - Trench IGBT Reverse Bias SOA
 $T_J = 175^\circ\text{C}$, $V_{GE} = 15\text{ V}$, $R_g = 22\ \Omega$

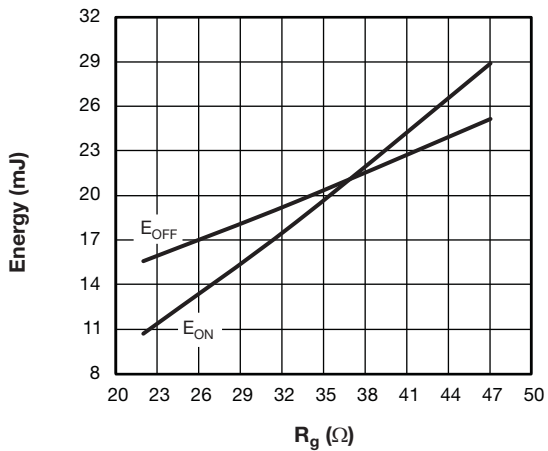


Fig. 15 - Typical Trench IGBT Energy Loss vs. R_g ,
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 300\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

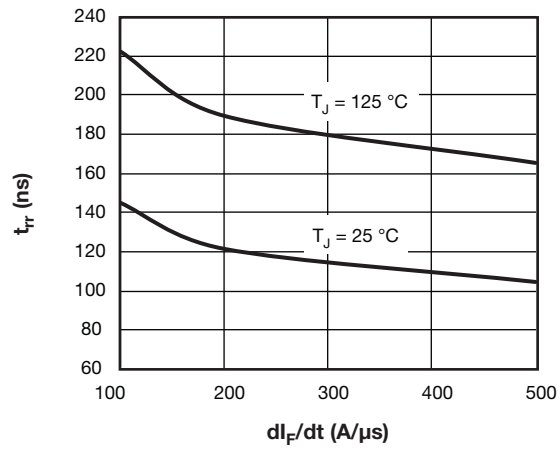


Fig. 18 - Typical Diode Reverse Recovery Time vs. dI_F/dt ,
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

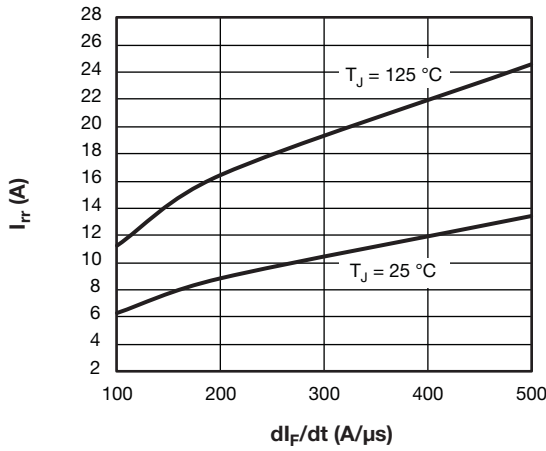


Fig. 19 - Typical Diode Reverse Recovery Current vs. di_F/dt , $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

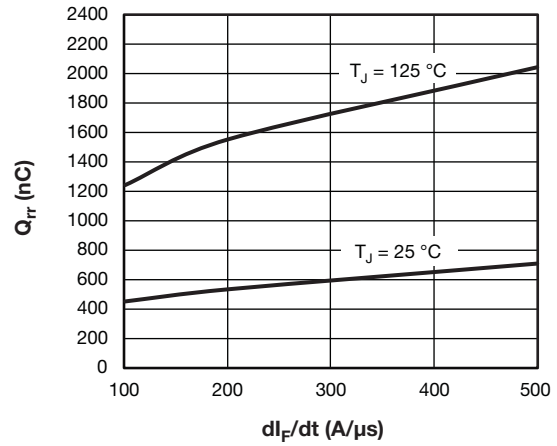


Fig. 20 - Typical Diode Reverse Recovery Charge vs. di_F/dt , $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

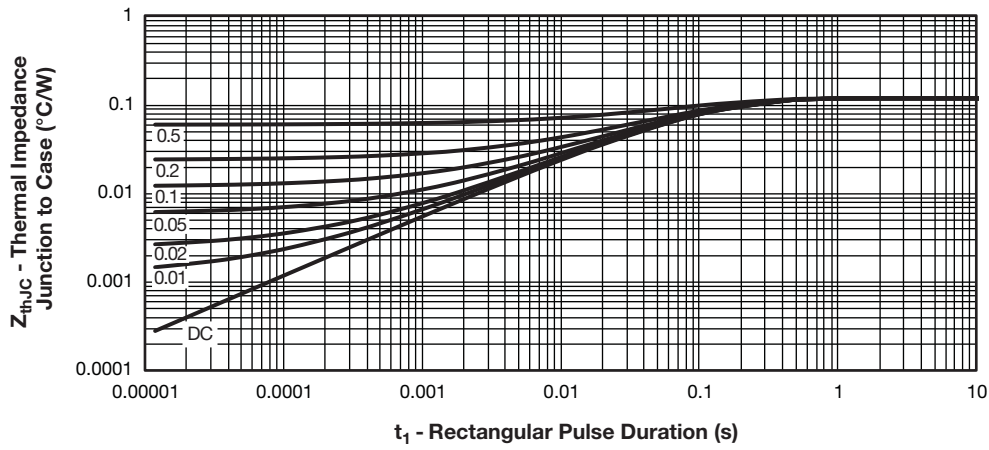


Fig. 21 - Maximum Thermal Impedance Z_{thJC} Characteristics (Trench IGBT)

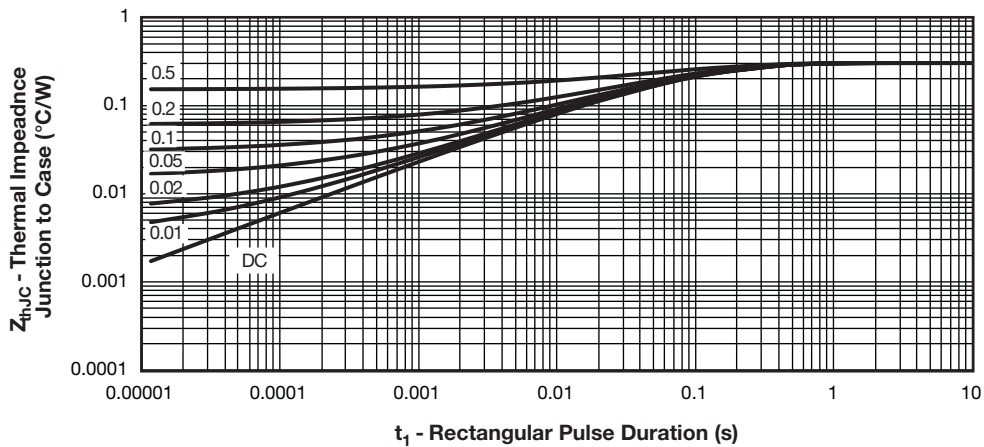
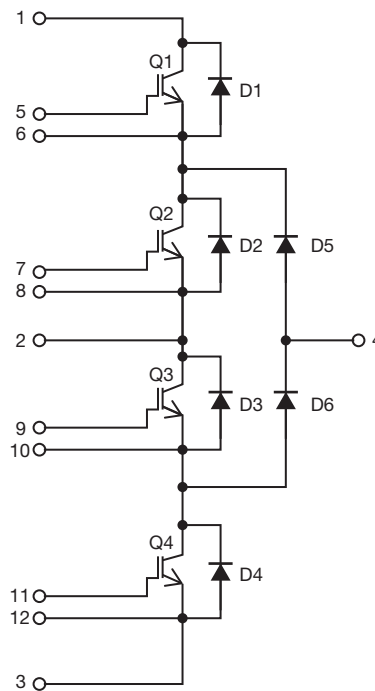


Fig. 22 - Maximum Thermal Impedance Z_{thJC} Characteristics (Diode)

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 = 3-level circuit configuration
- 6** - Package indicator D = dual INT-A-PAK low profile
- 7** - Voltage rating (060 = 600 V)
- 8** - N = ultrafast

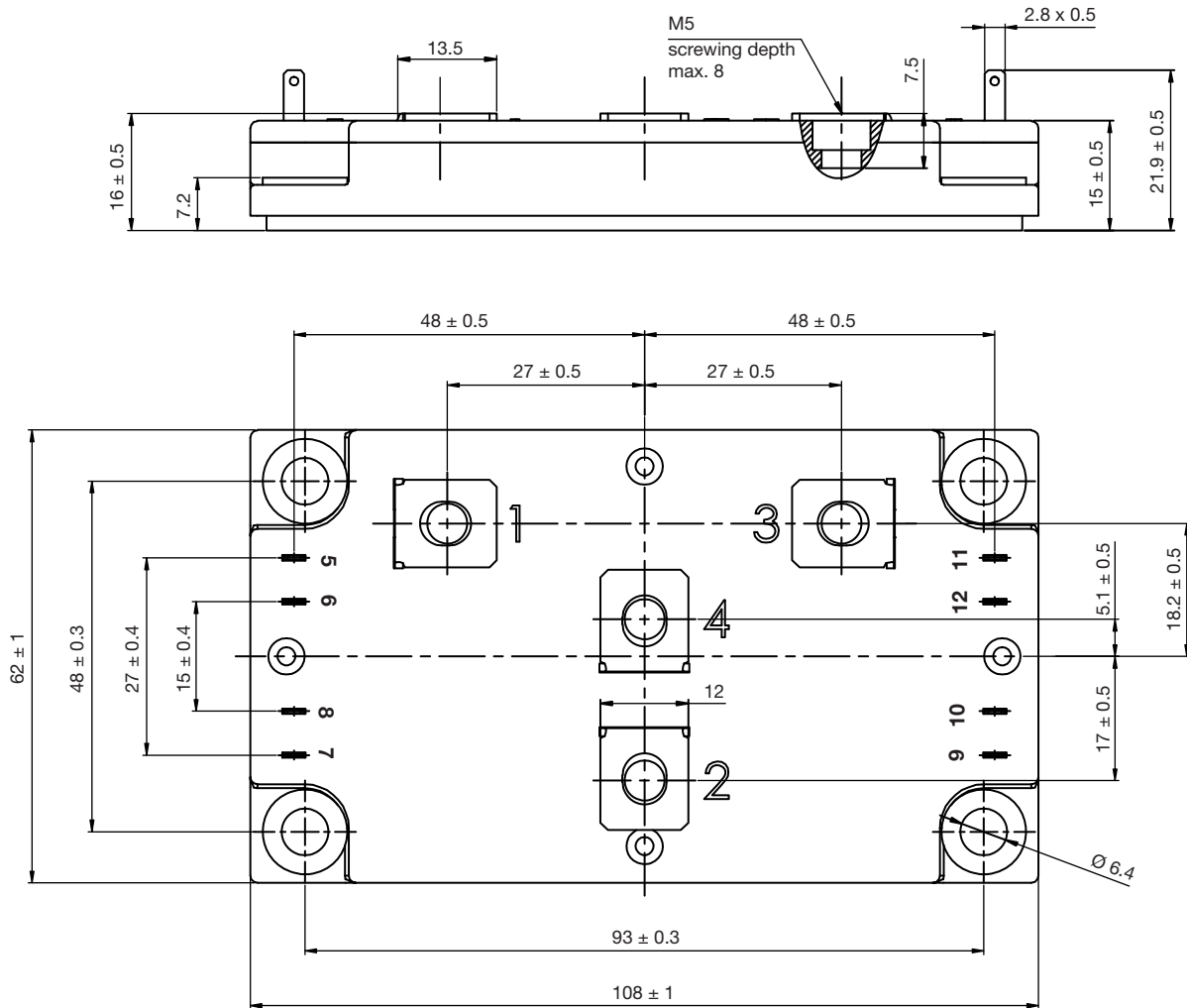
CIRCUIT CONFIGURATION

LINKS TO RELATED DOCUMENTS

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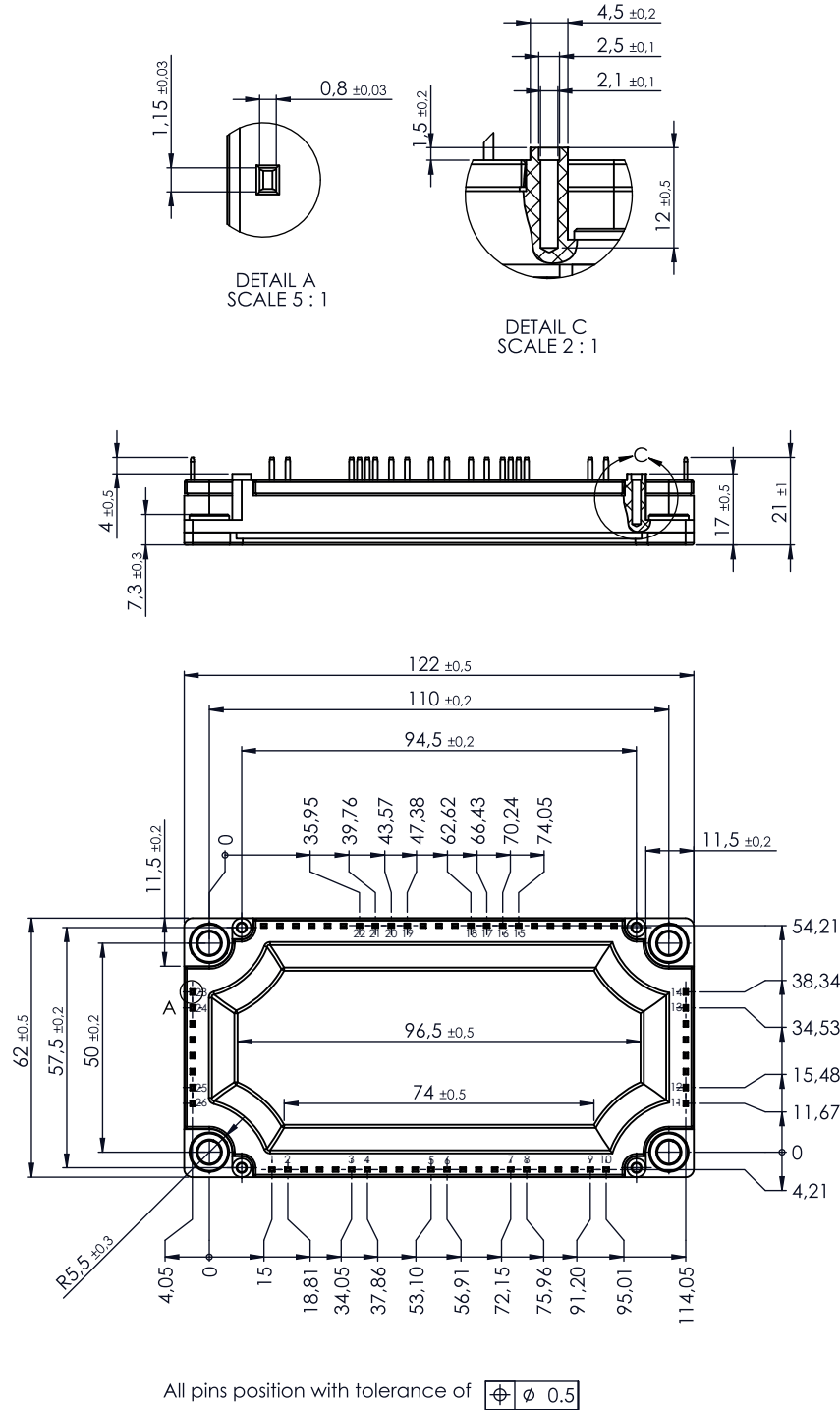
DIAP Low Profile - 4 Leads

DIMENSIONS in millimeters



ECONO3 4 Pack

DIMENSIONS in millimeters and inches





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