

DIAP Trench IGBT Power Module - 1200 V, 300 A Current Fed Inverter Topology



Double INT-A-PAK

PRODUCT SUMMARY	
IGBT	
V_{CES}	1200 V
$V_{CE(on)}$ (typical) at 300 A, 25 °C	2.17 V
$I_{D(DC)}$ at $T_C = 48$ °C	300 A
HEXFRED® SERIES DIODE	
V_R	1200 V
V_F (typical) at 300 A, 25 °C	1.99 V
$I_{F(DC)}$ at 49 °C	300 A
IGBT AND HEXFRED® SERIES DIODE	
$V_{CE(on)} + V_F$ typical at 300 A	4.12 V
HEXFRED® ANTIPARALLEL DIODE	
V_F (typical) at 10 A, 25 °C	1.6 V
$I_{F(DC)}$ at 63 °C	40 A
Speed	8 kHz to 30 kHz
Package	Double INT-A-PAK
Circuit	Current fed inverter topology

FEATURES

- Trench IGBT technology with positive temperature coefficient
- Low switching losses
- Maximum junction temperature 150 °C
- 10 μ s short circuit capability
- Low inductance case
- HEXFRED® antiparallel and series diodes with soft reverse recovery
- Isolated copper baseplate using DCB (Direct Copper Bonding) technology
- Direct mounting to heatsink
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT

BENEFITS

- Short circuit ruggedness

ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C unless otherwise noted)				
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
IGBT				
Collector to emitter voltage	V_{CES}		1200	V
Collector current	I_C	$T_C = 80$ °C	234	A
		$T_C = 25$ °C	341	
Clamped inductive load current	I_{LM}		700	
Gate to emitter voltage	V_{GE}		± 30	V
Maximum power dissipation	P_D	$T_C = 80$ °C	583	W
		$T_C = 25$ °C	1042	
SERIES DIODE				
Cathode to anode breakdown voltage	V_{RRM}		1200	
Continuous forward current	I_F	$T_C = 80$ °C	232	A
		$T_C = 25$ °C	348	
Peak repetitive forward current	I_{FSM}	$T_C = 25$ °C	2200	A
Maximum power dissipation	P_D	$T_C = 80$ °C	438	W
		$T_C = 25$ °C	781	



ABSOLUTE MAXIMUM RATINGS ($T_C = 25\text{ }^\circ\text{C}$ unless otherwise noted)				
ANTIPARALLEL DIODE				
Continuous forward current	$I_F^{(1)}$	$T_C = 80\text{ }^\circ\text{C}$	36	A
		$T_C = 25\text{ }^\circ\text{C}$	51	
Peak repetitive forward current	I_{FSM}		n/a	A
Maximum power dissipation	P_D	$T_C = 80\text{ }^\circ\text{C}$	77	W
		$T_C = 25\text{ }^\circ\text{C}$	137	
MODULE				
RMS isolation voltage	V_{ISOL}	$f = 50\text{ Hz}$, $t = 1\text{ minute}$	4000	V
Junction temperature range	T_J		-40 to +150	$^\circ\text{C}$
Storage temperature range	T_{STG}		-40 to +150	

Note

(1) Max. RMS current admitted for the terminals 10 A

ELECTRICAL SPECIFICATIONS ($T_C = 25\text{ }^\circ\text{C}$ unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
IGBT						
Collector to emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0\text{ V}$, $I_C = 0.5\text{ mA}$, $T_J = 25\text{ }^\circ\text{C}$	1200	-	-	V
Collector to emitter saturation voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}$, $I_C = 300\text{ A}$, $T_J = 25\text{ }^\circ\text{C}$	-	2.17	-	
		$V_{GE} = 15\text{ V}$, $I_C = 300\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$	-	2.4	-	
Gate to emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 14\text{ mA}$, $T_J = 25\text{ }^\circ\text{C}$	4.7	5.6	7.8	
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$	-	0.003	0.3	mA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$	-	1.03	-	
Gate to emitter leakage current	I_{GES}	$V_{GE} = \pm 30\text{ V}$	-	-	400	nA
SERIES DIODE						
Cathode to anode breakdown voltage	V_R	$I_C = 1.0\text{ mA}$, $T_J = 125\text{ }^\circ\text{C}$	1200	-	-	
Cathode to anode leakage current	I_R	$V_R = 1200\text{ V}$	-	0.003	0.2	mA
		$V_R = 1200\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$	-	3.5	-	
Forward voltage	V_F	$I_F = 300\text{ A}$	-	1.99	-	V
		$I_F = 300\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$	-	2.02	-	
ANTIPARALLEL DIODE						
Forward voltage	V_F	$I_F = 10\text{ A}$	-	1.6	-	V
		$I_F = 10\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$	-	1.4	-	
IGBT AND HEXFRED® SERIES DIODE						
Collector to emitter saturation voltage + Forward voltage	$V_{CE(on)} + V_F$	$I_C = 300\text{ A}$	-	4.12	4.65	V



SWITCHING CHARACTERISTICS ($T_C = 25\text{ }^\circ\text{C}$ unless otherwise noted)									
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS			
IGBT									
Turn-on switching loss	E_{on}	$V_{CC} = 600\text{ V}, I_C = 300\text{ A}, R_g = 4.7\ \Omega,$ $V_{GE} = \pm 15\text{ V}$	-	35.2	-	mJ			
Turn-off switching loss	E_{off}		-	26.3	-				
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 600\text{ V}, I_C = 300\text{ A}, R_g = 4.7\ \Omega,$ $V_{GE} = \pm 15\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	776	-	ns			
Rise time	t_r		-	263	-				
Turn-off delay time	$t_{d(off)}$		-	816	-				
Fall time	t_f		-	131	-				
Turn-on switching loss	E_{on}		-	36.1	-			mJ	
Turn-off switching loss	E_{off}		-	32.1	-				
Input capacitance	C_{ies}	$V_{CE} = 30\text{ V}, f = 1.0\text{ MHz}$	-	36	-	nF			
Output capacitance	C_{oes}		-	1.4	-				
Reverse transfer capacitance	C_{res}		-	1.0	-				
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, R_g = 22\ \Omega,$ $V_{GE} = 15\text{ V to } 0\text{ V}, V_{CC} = 600\text{ V},$ $V_P = 1200\text{ V}, I_C = 700\text{ A}$	-	-	-				
Short circuit safe operating area	SCSOA	$T_J = 150\text{ }^\circ\text{C}, R_g = 22\ \Omega,$ $V_{GE} = 15\text{ V to } 0\text{ V}, V_{CC} = 600\text{ V},$ $V_P = 1200\text{ V}$	-	-	10	μs			
SERIES DIODE									
Diode reverse recovery charge	Q_{rr}	$I_F = 50\text{ A},$ $V_R = 400\text{ V},$ $di/dt = -500\text{ A}/\mu\text{s}$	$T_J = 25\text{ }^\circ\text{C}$	-	3.0	-	μC		
			$T_J = 125\text{ }^\circ\text{C}$	-	8.0	-			
Reverse recovery time	t_{rr}		$T_J = 25\text{ }^\circ\text{C}$	-	230	-	nS		
			$T_J = 125\text{ }^\circ\text{C}$	-	370	-			
Reverse recovery current	I_{rr}		$T_J = 25\text{ }^\circ\text{C}$	-	26	-	A		
		$T_J = 125\text{ }^\circ\text{C}$	-	43	-				
ANTIPARALLEL DIODE									
Diode reverse recovery charge	Q_{rr}	$I_F = 10\text{ A},$ $V_R = 400\text{ V},$ $di/dt = 500\text{ A}/\mu\text{s}$	$T_J = 25\text{ }^\circ\text{C}$	-	2.1	-	μC		
			$T_J = 125\text{ }^\circ\text{C}$	-	3.4	-			
Reverse recovery time	t_{rr}		$T_J = 25\text{ }^\circ\text{C}$	-	175	-	ns		
			$T_J = 125\text{ }^\circ\text{C}$	-	241	-			

THERMAL AND MECHANICAL SPECIFICATIONS							
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS	
Junction to case per 1/2 module	R_{thJC}	IGBT	-	-	0.12	$^\circ\text{C}/\text{W}$	
		Series Diode	-	-	0.16		
		Antiparallel Diode	-	-	0.91		
Case to sink	R_{thCS}	Conductive grease applied	-	0.035	-		
Mounting torque		Power terminal screw: M6	2.5 to 5.0			Nm	
		Mounting screw: M6	3.0 to 5.0				
Weight			300			g	

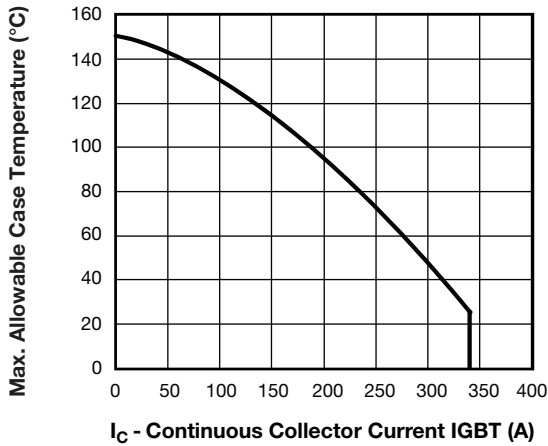


Fig. 1 - Maximum IGBT Continuous Collector Current vs. Case Temperature

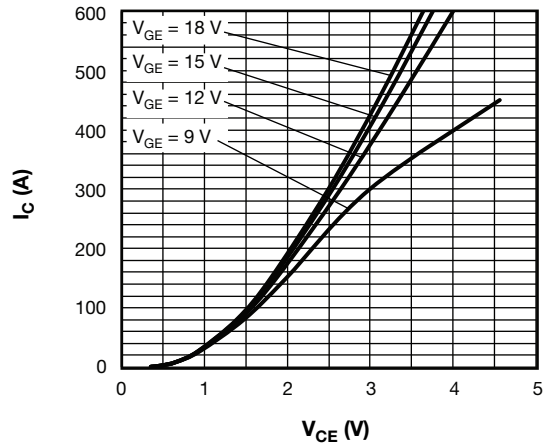


Fig. 4 - Typical IGBT Output Characteristics, $T_J = 150\text{ }^\circ\text{C}$

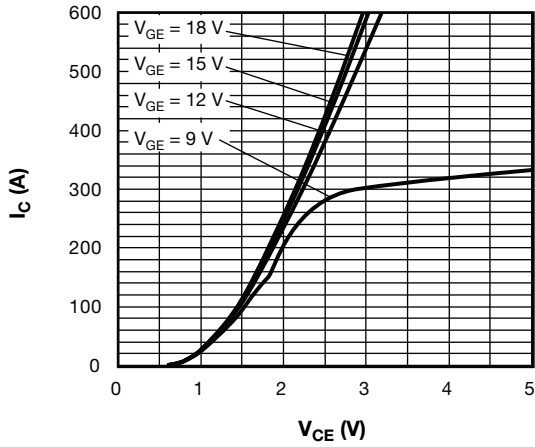


Fig. 2 - Typical IGBT Output Characteristics, $T_J = 25\text{ }^\circ\text{C}$

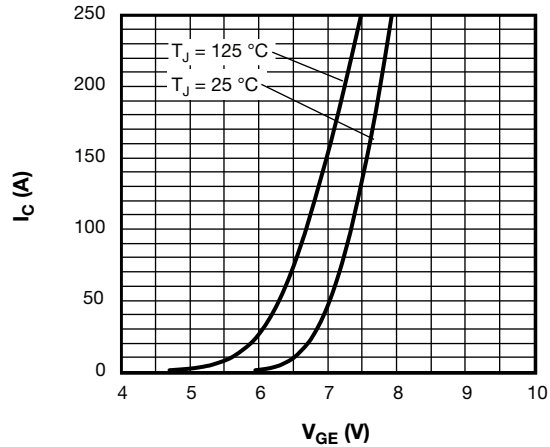


Fig. 5 - Typical IGBT Transfer Characteristics

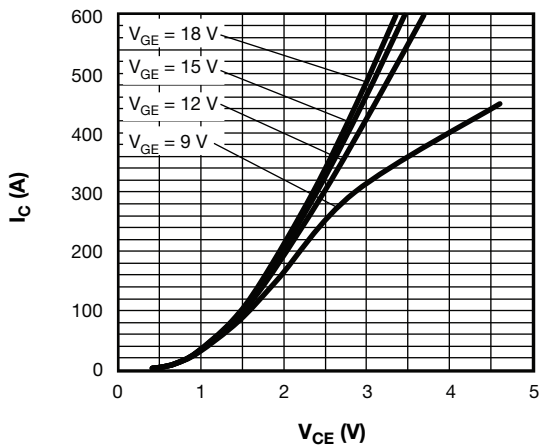


Fig. 3 - Typical IGBT Output Characteristics, $T_J = 125\text{ }^\circ\text{C}$

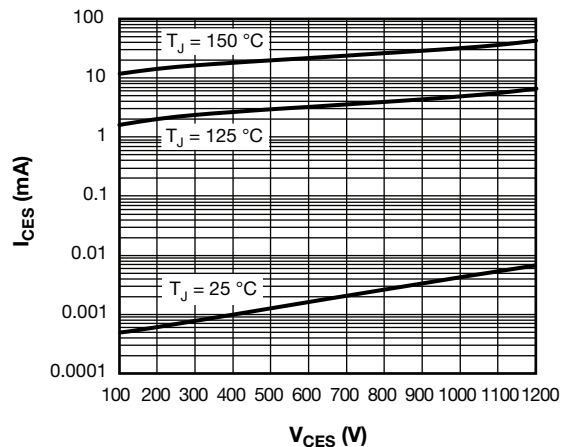


Fig. 6 - Typical IGBT Zero Gate Voltage Collector Current

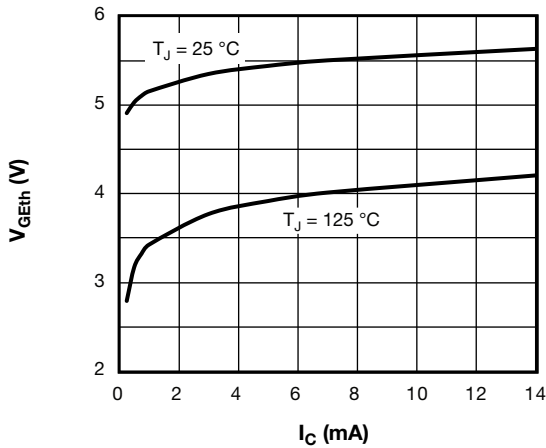


Fig. 7 - Typical IGBT Gate Threshold Voltage

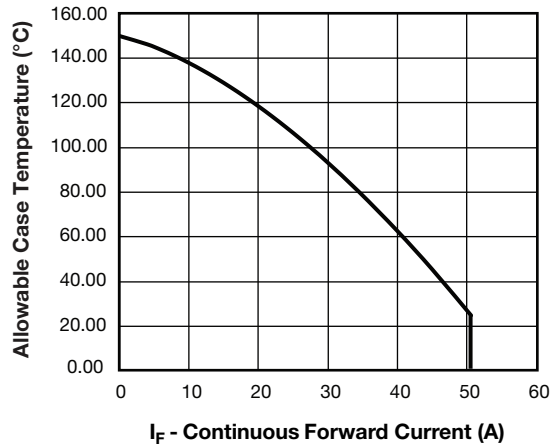


Fig. 10 - Maximum Continuous Forward Current vs. Case Temperature Antiparallel Diode

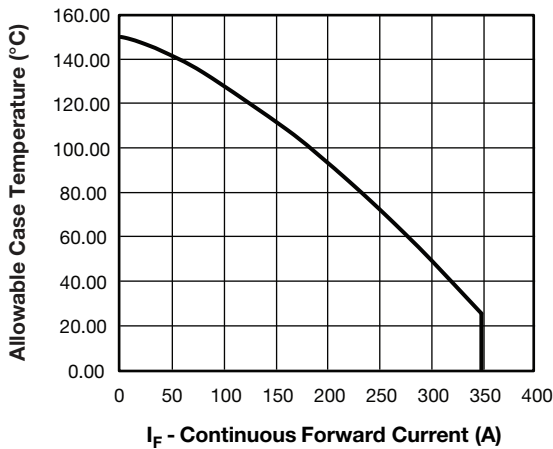


Fig. 8 - Maximum Continuous Forward Current vs. Case Temperature Series Diode

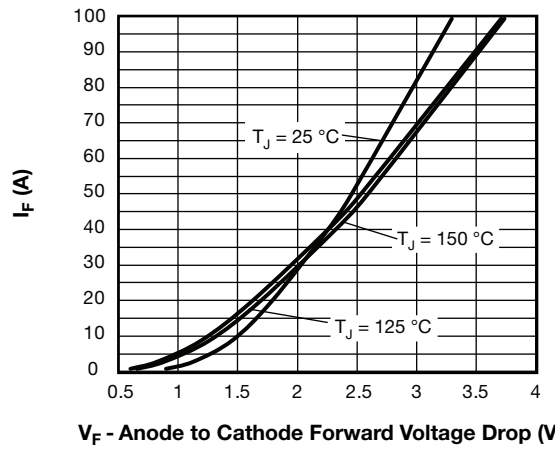


Fig. 11 - Typical Diode Forward Voltage Characteristics of Antiparallel Diode $t_p = 500 \mu s$

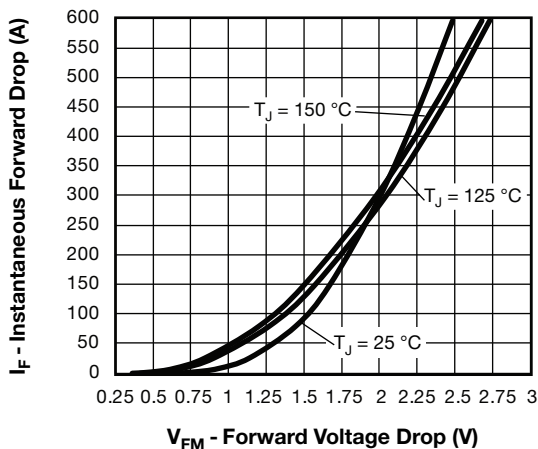


Fig. 9 - Typical Series Diode Forward Voltage

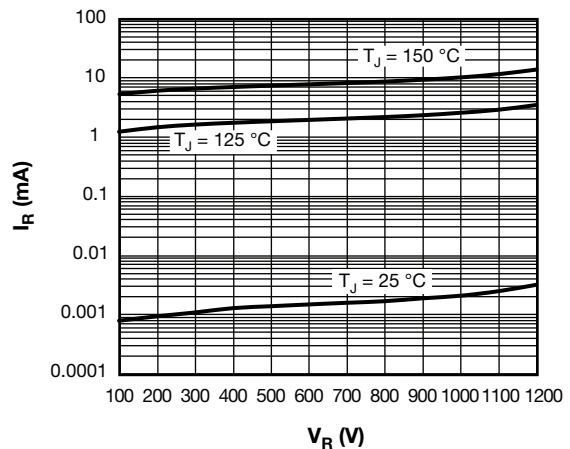


Fig. 12 - Typical Series Diode Leakage Current vs. Reverse Voltage

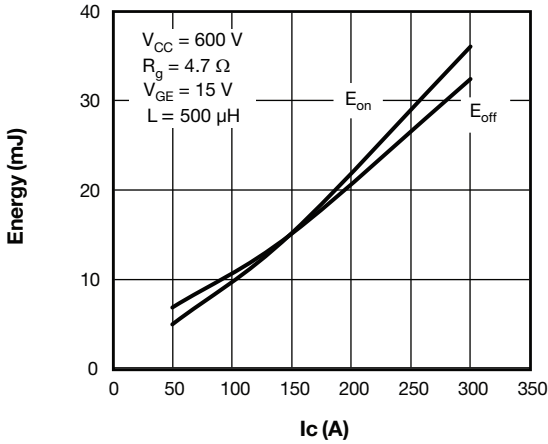


Fig. 13 - Typical IGBT Energy Loss vs. I_c , $T_J = 125\text{ }^\circ\text{C}$ - Freewheeling Diode VS-H3195D12A6B in TO-247 Package

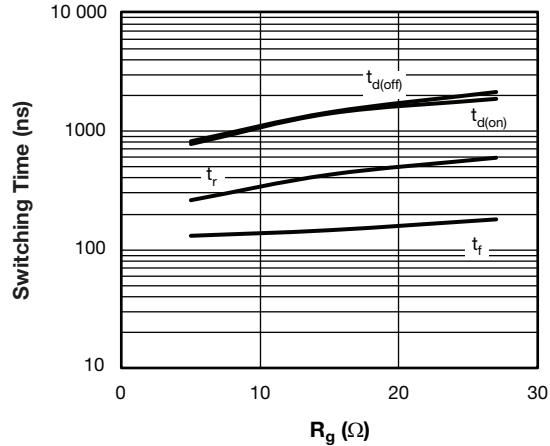


Fig. 16 - Typical IGBT Switching Time vs. R_g , $T_J = 125\text{ }^\circ\text{C}$, $I_c = 100\text{ A}$, $V_{CE} = 360\text{ V}$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$

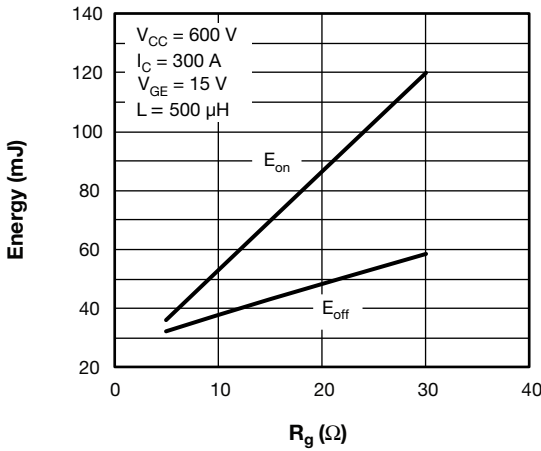


Fig. 14 - Typical IGBT Energy Loss vs. R_g , $T_J = 125\text{ }^\circ\text{C}$ - Freewheeling Diode VS-H3195D12A6B in TO-247 Package

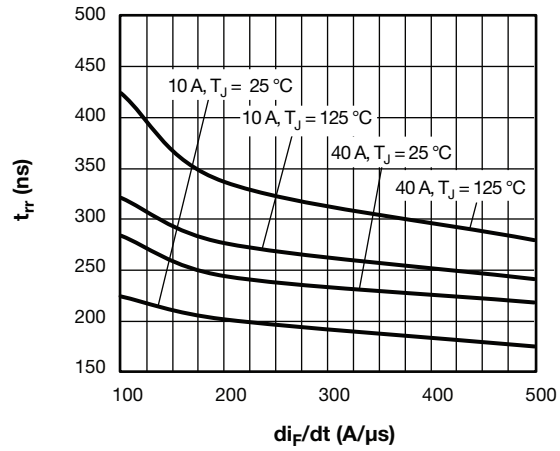


Fig. 17 - Typical t_{rr} Antiparallel Diode vs. di_F/dt , $V_{rr} = 400\text{ V}$

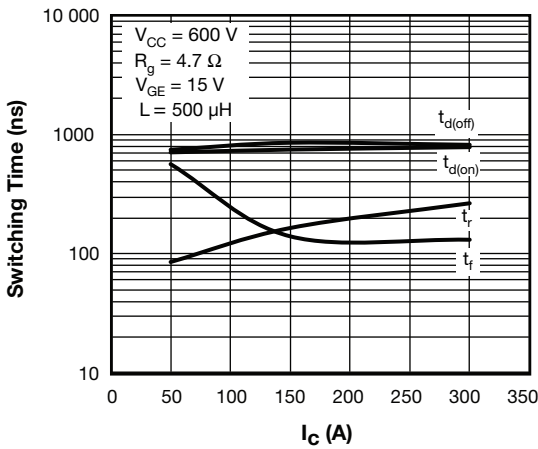


Fig. 15 - Typical IGBT Switching Time vs. I_c , $T_J = 125\text{ }^\circ\text{C}$ - Freewheeling Diode VS-H3195D12A6B in TO-247 Package

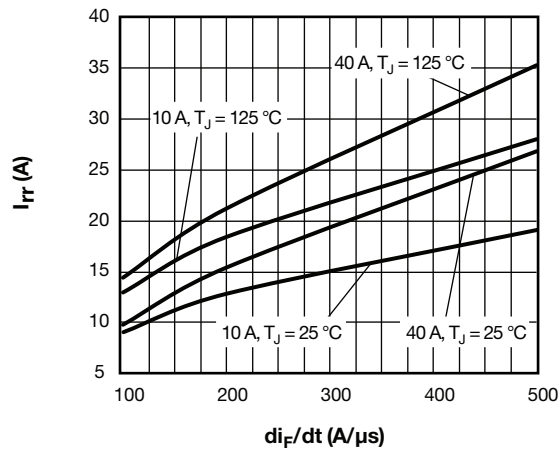


Fig. 18 - Typical I_{rr} Antiparallel Diode vs. di_F/dt , $V_{rr} = 400\text{ V}$

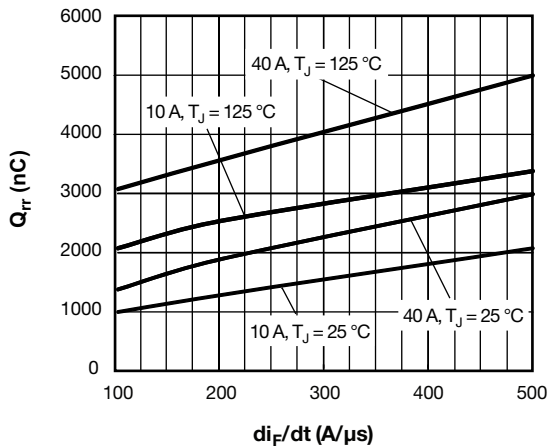


Fig. 19 - Typical Q_{rr} Antiparallel Diode vs. di_F/dt , $V_{rr} = 400$ V

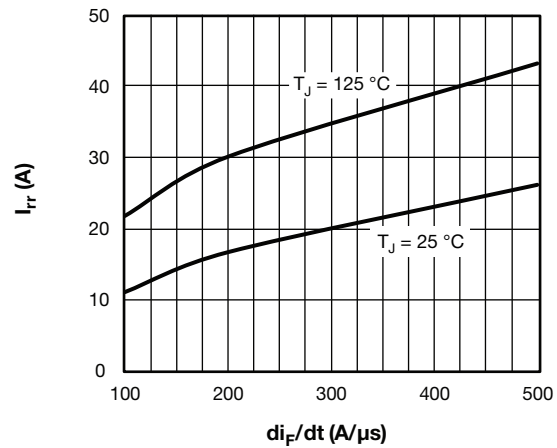


Fig. 21 - Typical I_{rr} Chopper Diode vs. di_F/dt , $V_{rr} = 400$ V, $I_F = 50$ A

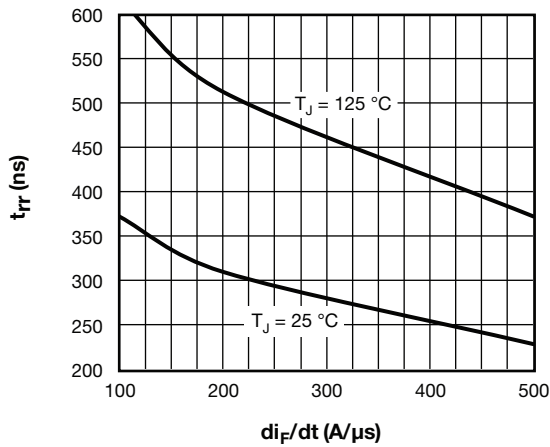


Fig. 20 - Typical t_{rr} Series Diode vs. di_F/dt , $V_{rr} = 400$ V, $I_F = 50$ A

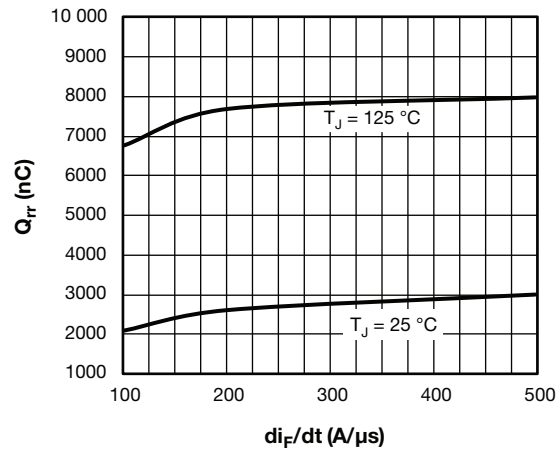


Fig. 22 - Typical Q_{rr} Chopper Diode vs. di_F/dt , $V_{rr} = 400$ V, $I_F = 40$ A

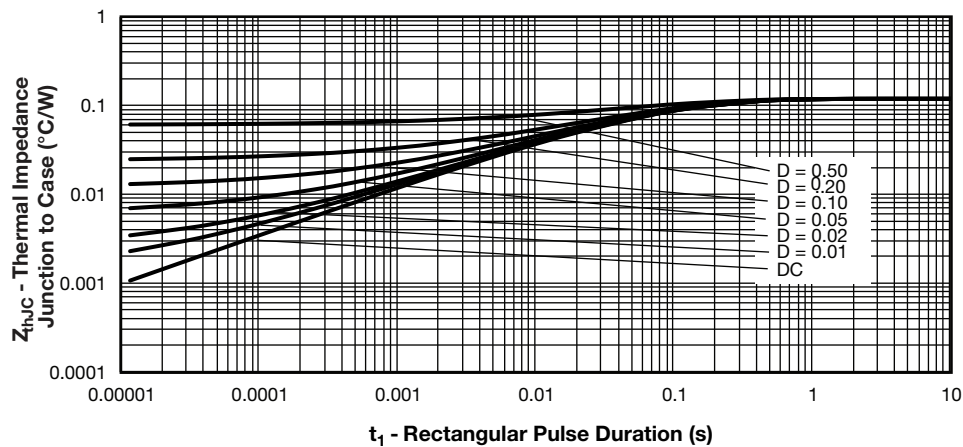


Fig. 23 - Maximum Thermal Impedance Z_{thJC} Characteristics IGBT

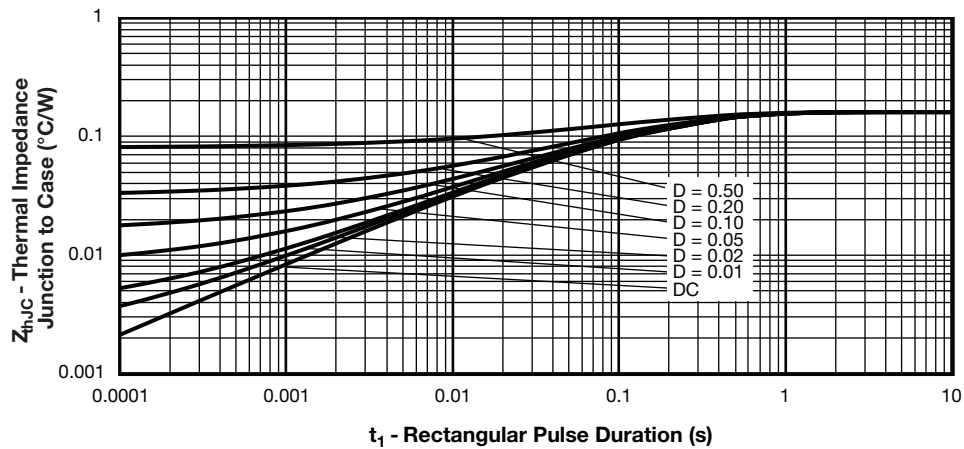
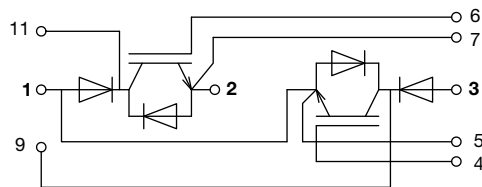


Fig. 24 - Maximum Thermal Impedance Z_{thJC} Characteristics Series Diode

CIRCUIT CONFIGURATION



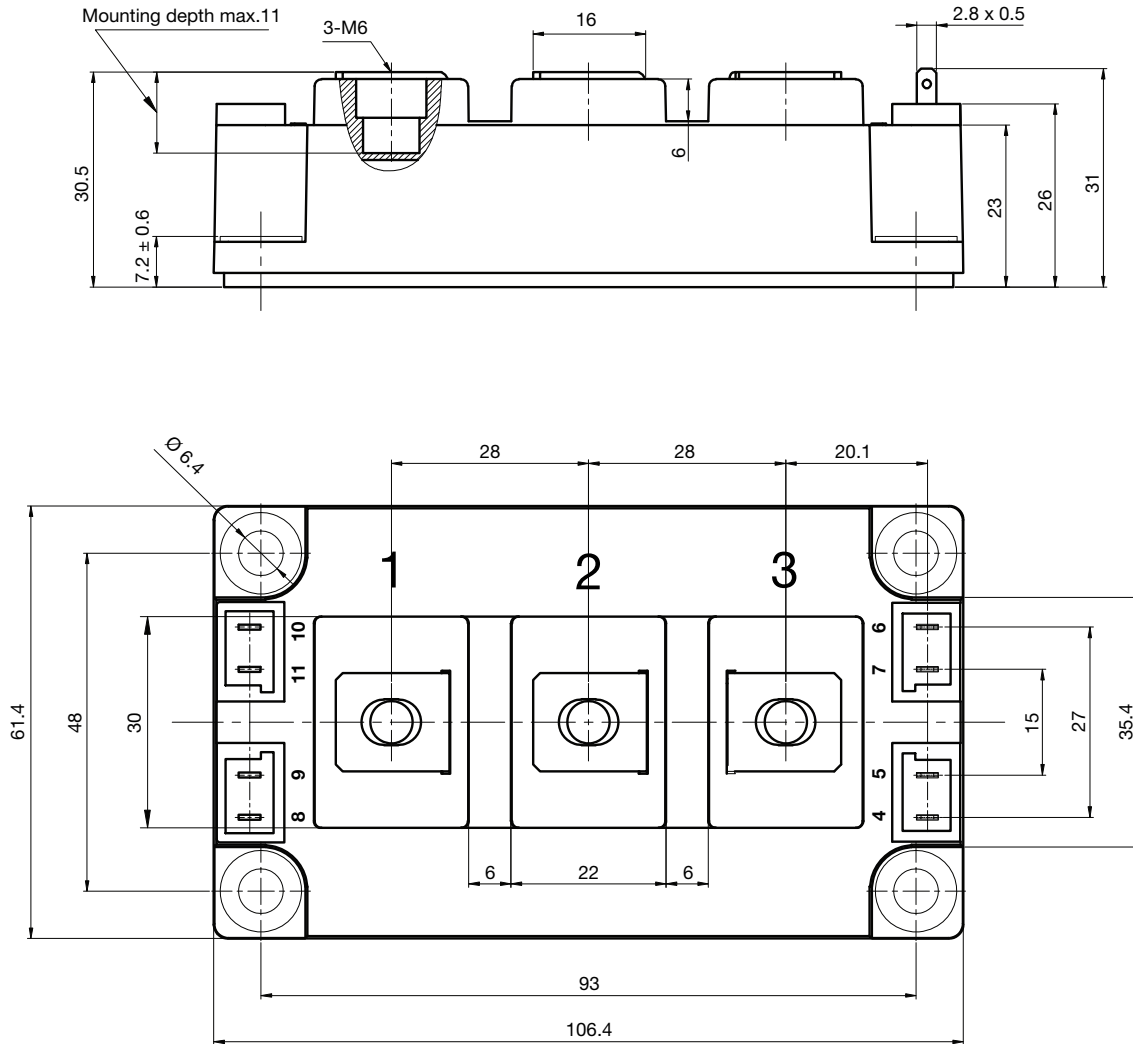
ORDERING INFORMATION TABLE

Device code	VS-	G	T	300	Y	H	120	N
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

- 1** - Vishay Semiconductors product
- 2** - Insulated Gate Bipolar Transistor (IGBT)
- 3** - T = Trench IGBT technology
- 4** - Current rating (300 = 300 A)
- 5** - Y = Current Fed Inverter
- 6** - Package indicator (Double INT-A-PAK)
- 7** - Voltage rating (120 = 1200 V)
- 8** - N = Ultrafast



DIMENSIONS in millimeters





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