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

FEATURES

- 1200 V IGBT trench and field stop technology with positive temperature coefficient
- Low switching losses
- Maximum junction temperature 175 °C
- 10 μs short circuit capability
- Low inductance case
- HEXFRED® antiparallel and series diodes with soft reverse recovery
- Isolated copper baseplate using DCB (Direct Copper Bonding) technology
- Speed 4 kHz to 30 kHz
- Direct mounting to heatsink
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

BENEFITS

- Short circuit ruggedness

REMARKS

- Product reliability results valid for T_J = 150 °C
- Recommended operation temperature T_{op} = 150 °C

PRIMARY CHARACTERISTICS	
IGBT	
V_{CES}	1200 V
$V_{CE(on)}$ (typical) at 300 A, 25 °C	1.93 V
$I_{D(DC)}$ at T_C = 80 °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 80 °C	300 A
IGBT AND HEXFRED® SERIES DIODE	
$V_{CE(on)}$ + V_F typical at 300 A	3.92 V
HEXFRED® ANTIPARALLEL DIODE	
V_F (typical) at 10 A, 25 °C	1.6 V
$I_{F(DC)}$ at 88 °C	40 A
Package	Dual INT-A-PAK

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	300	A
		T_C = 25 °C	400	
Pulsed collector current	I_{CM}		720	
Clamped inductive load current	I_{LM} (1)		700	
Gate to emitter voltage	V_{GE}		± 20	V
Maximum power dissipation	P_D	T_C = 80 °C	791	W
		T_C = 25 °C	1250	
SERIES DIODE				
Cathode to anode breakdown voltage	V_{RRM}		1200	
Continuous forward current	I_F	T_C = 80 °C	300	A
		T_C = 25 °C	412	
Peak repetitive forward current	I_{FSM}	T_C = 25 °C	2200	A
Maximum power dissipation	P_D	T_C = 80 °C	593	W
		T_C = 25 °C	938	

ABSOLUTE MAXIMUM RATINGS (T_C = 25 °C unless otherwise noted)				
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MAX.**	**UNITS**
ANTPARALLEL DIODE				
Continuous forward current	I_F (2)	T_C = 80 °C	42	A
		T_C = 25 °C	57	
Peak repetitive forward current	I_{FSM}		n/a	A
Maximum power dissipation	P_D	T_C = 80 °C	106	W
		T_C = 25 °C	167	
MODULE				
RMS isolation voltage	V_{ISOL}	f = 50 Hz, t = 1 minute	4000	V
Junction temperature range	T_J	-40 °C to +175 °C		°C
Storage temperature range	T_{STG}	-40 °C to +150 °C		

Notes

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

(1) V_{CC} = 600 V, V_P = 1200 V, V_{GE} = 15 V, L = 500 μH, R_g = 4.7 Ω, T_J = 150 °C

(2) Maximum RMS current admitted for the terminals 10 A

ELECTRICAL SPECIFICATIONS (T_C = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
IGBT						
Collector to emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0 V, I_C = 11.4 mA, T_J = 25 °C	1200	-	-	V
Collector to emitter saturation voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 300 A, T_J = 25 °C	-	1.93	-	
		V_{GE} = 15 V, I_C = 300 A, T_J = 125 °C	-	2.24	-	
		V_{GE} = 15 V, I_C = 300 A, T_J = 150 °C	-	2.32	-	
Gate to emitter threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 11.4 mA, T_J = 25 °C	-	5.8	-	
Forward transconductance	g_{fe}	V_{CE} = 20 V, I_C = 300 A	-	130	-	S
Transfer characteristics	V_{GE}	V_{CE} = 20 V, I_C = 300 A	-	8.9	-	V
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V	-	1.3	-	mA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 125 °C	-	0.95	-	
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 150 °C	-	3.7	-	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	250	nA
SERIES DIODE						
Cathode to anode breakdown voltage	V_R	I_R = 1.0 mA, T_J = 125 °C	1200	-	-	V
Cathode to anode leakage current	I_R	V_R = 1200 V	-	0.05	0.2	mA
		V_R = 1200 V, T_J = 125 °C	-	3.5	-	
Forward voltage	V_F	I_F = 300 A	-	1.99	-	V
		I_F = 300 A, T_J = 125 °C	-	2.02	-	
ANTIPARALLEL DIODE						
Forward voltage	V_F	I_F = 10 A	-	1.6	-	V
		I_F = 10 A, T_J = 125 °C	-	1.4	-	
IGBT AND HEXFRED® SERIES DIODE						
Collector to emitter saturation voltage and Forward voltage	$V_{CE(on)} + V_F$	I_C = 300 A	-	3.92	-	V

SWITCHING CHARACTERISTICS (T_C = 25 °C unless otherwise noted)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNITS**
IGBT (with freewheeling diode VS-H3195D12A6B in TO-247 Package)							
Turn-on switching loss	E_{on}	I_C = 300 A, V_{CC} = 600 V, R_g = 4.7 Ω, L = 500 μH, V_{GE} = ± 15 V		-	29.7	-	mJ
Turn-off switching loss	E_{off}			-	30.3	-	
Total switching loss	E_{tot}			-	60.0	-	
Turn-on delay time	$t_{d(on)}$			-	132	-	ns
Rise time	t_r			-	188	-	
Turn-off delay time	$t_{d(off)}$			-	630	-	
Fall time	t_f			-	84	-	
Turn-on switching loss	E_{on}	I_C = 300 A, V_{CC} = 600 V, R_g = 4.7 Ω, L = 500 μH, V_{GE} = ± 15 V, T_J = 125 °C		-	33.2	-	mJ
Turn-off switching loss	E_{off}			-	37.4	-	
Total switching loss	E_{tot}			-	70.6	-	
Turn-on delay time	$t_{d(on)}$			-	147	-	ns
Rise time	t_r			-	195	-	
Turn-off delay time	$t_{d(off)}$			-	714	-	
Fall time	t_f			-	120	-	
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1.0 MHz		-	18.7	-	nF
Reverse transfer capacitance	C_{res}			-	0.7	-	
Reverse bias save operating area	RBSOA	T_J = 150 °C, R_g = 4.7 Ω, V_{GE} = 15 V, I_C = 600 A, V_{CC} = 600 V, V_P = 1200 V		Full square			
Short circuit save operating area	SCSOA	T_J = 150 °C, V_{GE} = 15 V, V_{CC} = 800 V		-	-	10	μs
SERIES DIODE							
Diode reverse recovery charge	Q_{rr}	I_F = 50 A, V_R = 400 V, di/dt = -500 A/μs	T_J = 25 °C	-	3.0	-	μC
			T_J = 125 °C	-	8.0	-	
Reverse recovery time	t_{rr}		T_J = 25 °C	-	230	-	nS
			T_J = 125 °C	-	370	-	
Reverse recovery current	I_{rr}		T_J = 25 °C	-	26	-	A
			T_J = 125 °C	-	43	-	
ANTIPARALLEL DIODE							
Diode reverse recovery charge	Q_{rr}	I_F = 10 A, V_R = 400 V, di/dt = 500 A/μs	T_J = 25 °C	-	2.1	-	μC
			T_J = 125 °C	-	3.4	-	
Reverse recovery time	t_{rr}		T_J = 25 °C	-	175	-	ns
			T_J = 125 °C	-	241	-	

THERMAL AND MECHANICAL SPECIFICATIONS							
PARAMETER		**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Junction to case per ½ module	IGBT	R_{thJC}		-	-	0.12	K/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

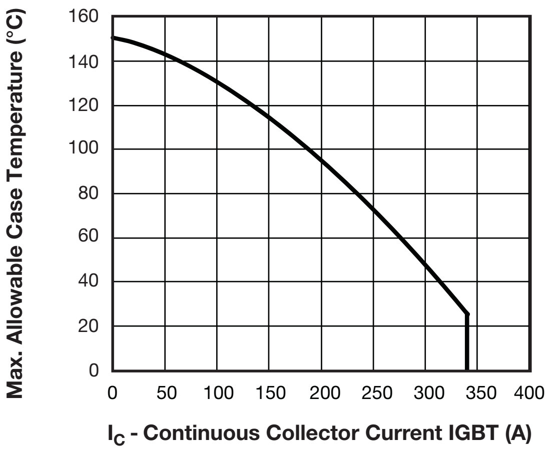


Fig. 1 - Maximum IGBT Continuous Collector Current vs. Case Temperature

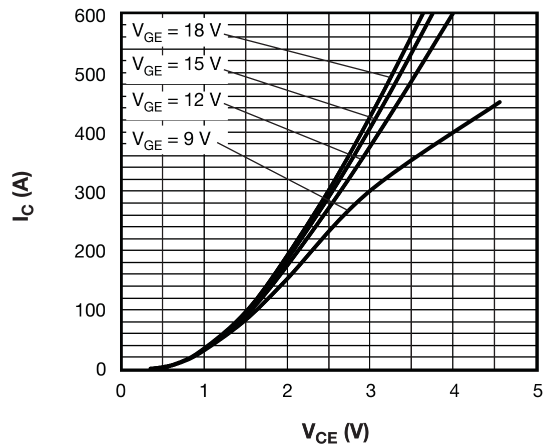


Fig. 4 - Typical IGBT Output Characteristics, T_J = 150 °C

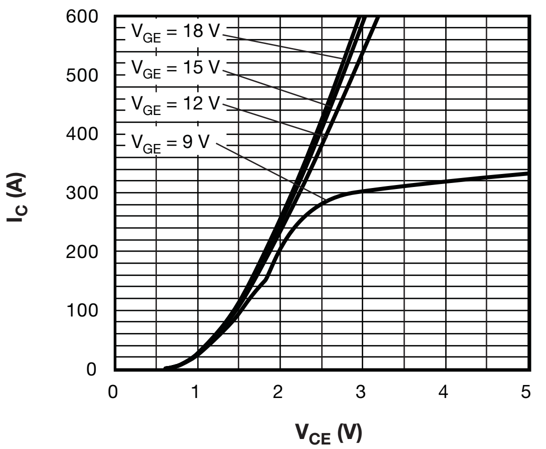


Fig. 2 - Typical IGBT Output Characteristics, T_J = 25 °C

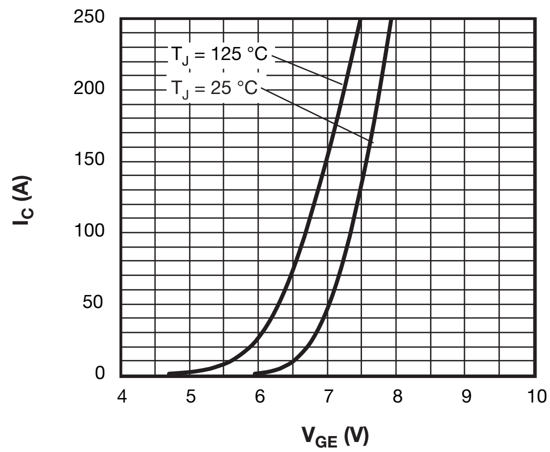


Fig. 5 - Typical IGBT Transfer Characteristics

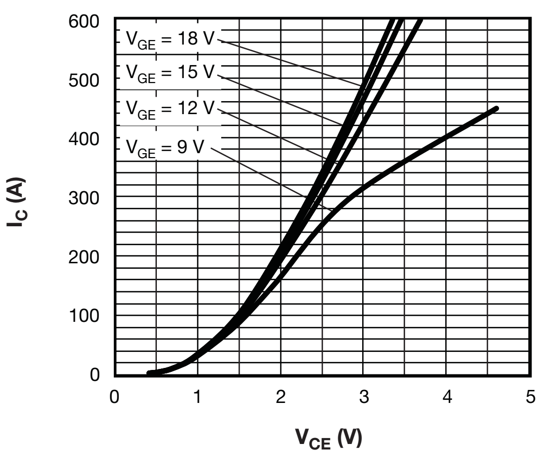


Fig. 3 - Typical IGBT Output Characteristics, T_J = 125 °C

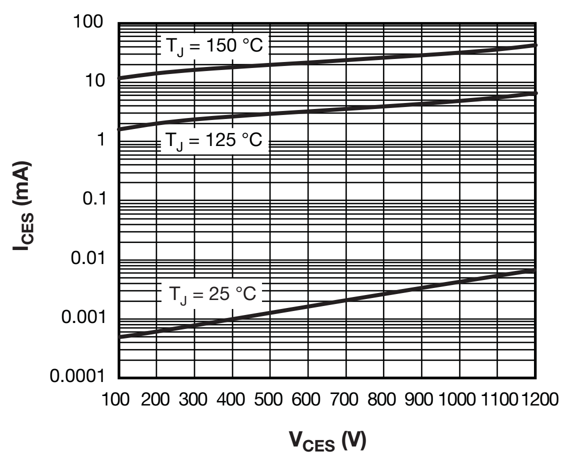


Fig. 6 - Typical IGBT Zero Gate Voltage Collector Current

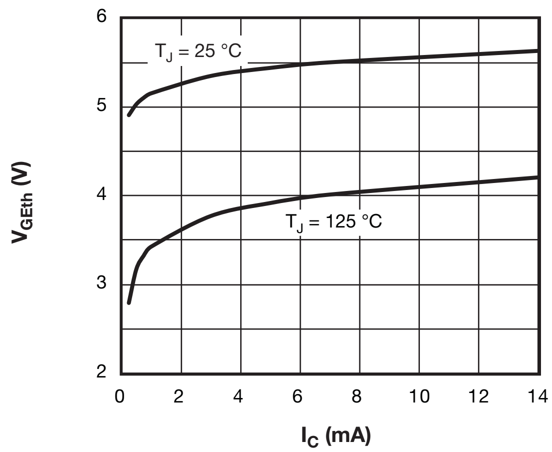


Fig. 7 - Typical IGBT Gate Threshold Voltage

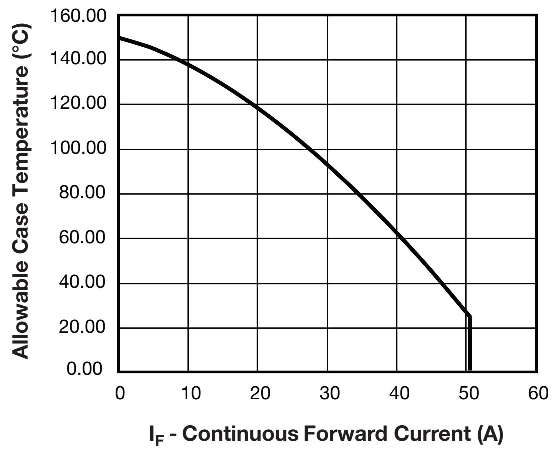


Fig. 10 - Maximum Continuous Forward Current vs. Case Temperature Antiparallel Diode

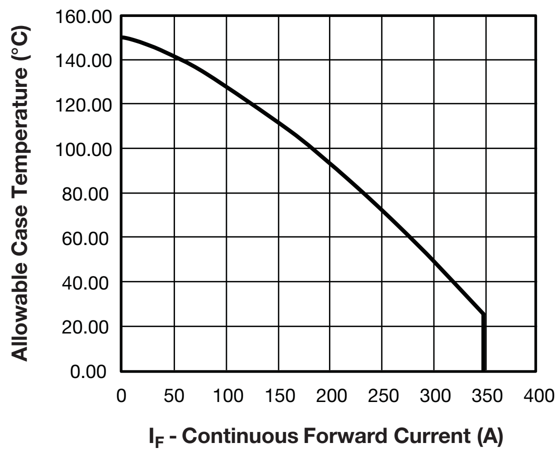


Fig. 8 - Maximum Continuous Forward Current vs. Case Temperature Series Diode

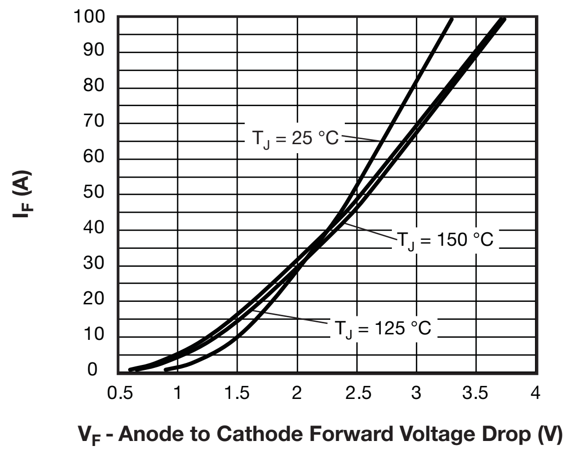


Fig. 11 - Typical Diode Forward Voltage Characteristics of Antiparallel Diode t_p = 500 μs

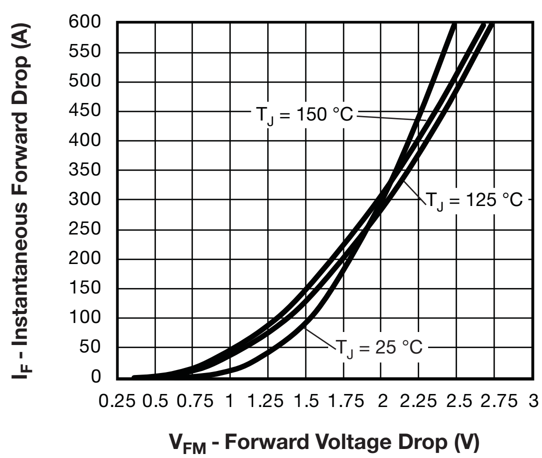


Fig. 9 - Typical Series Diode Forward Voltage

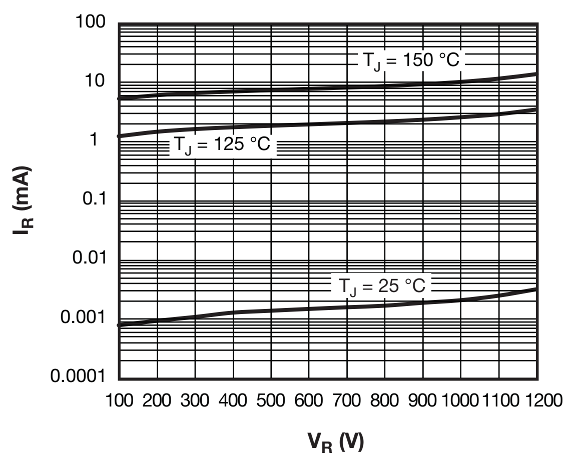


Fig. 12 - Typical Series Diode Leakage Current vs. Reverse Voltage

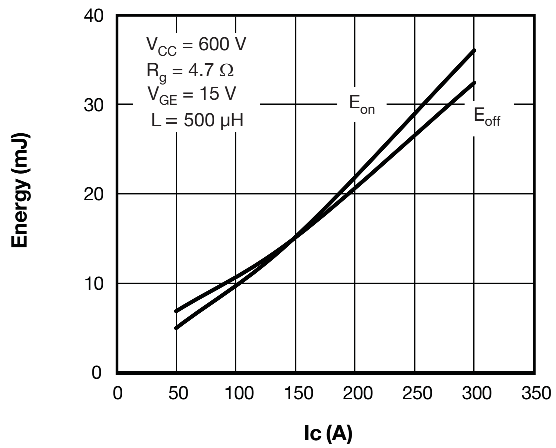


Fig. 13 - Typical IGBT Energy Loss vs. I_C, T_J = 125 °C - Freewheeling Diode VS-H3195D12A6B in TO-247 Package

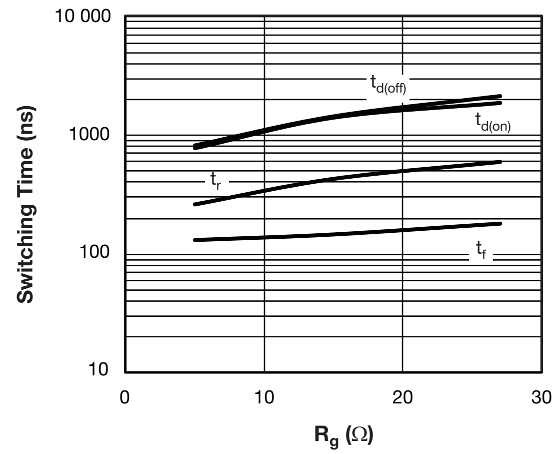


Fig. 16 - Typical IGBT Switching Time vs. R_g, T_J = 125 °C, I_C = 100 A, V_{CE} = 360 V, V_{GE} = 15 V, L = 500 μH

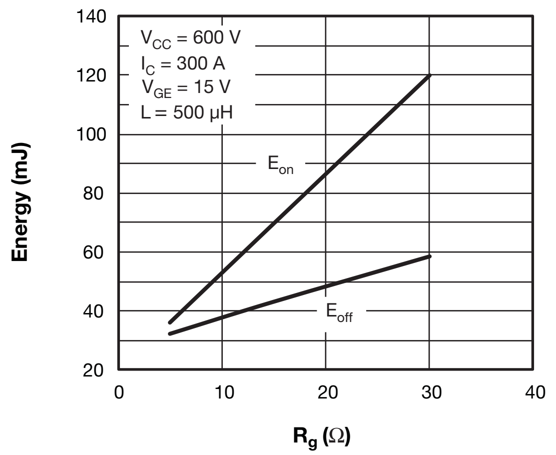


Fig. 14 - Typical IGBT Energy Loss vs. R_g, T_J = 125 °C - Freewheeling Diode VS-H3195D12A6B in TO-247 Package

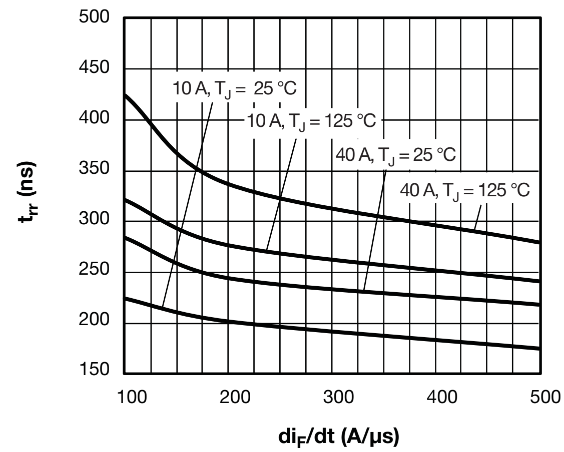


Fig. 17 - Typical t_{rr} Antiparallel Diode vs. di_F/dt, V_{rr} = 400 V

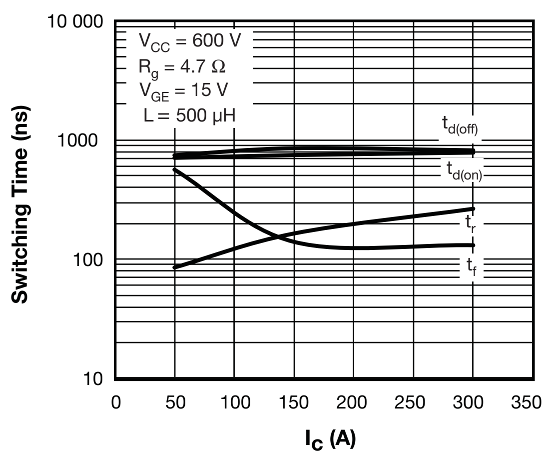


Fig. 15 - Typical IGBT Switching Time vs. I_C, T_J = 125 °C - Freewheeling Diode VS-H3195D12A6B in TO-247 Package

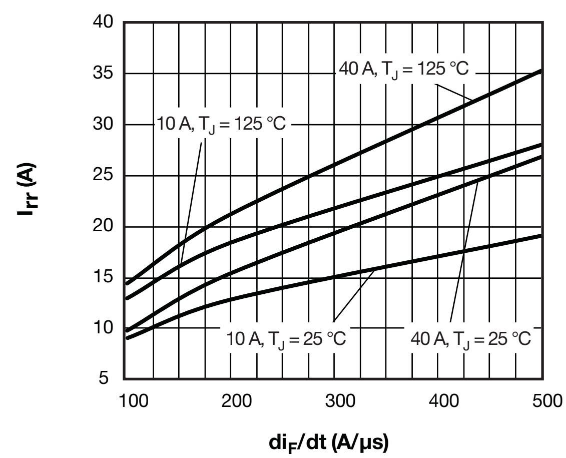


Fig. 18 - Typical I_{rr} Antiparallel Diode vs. di_F/dt, V_{rr} = 400 V

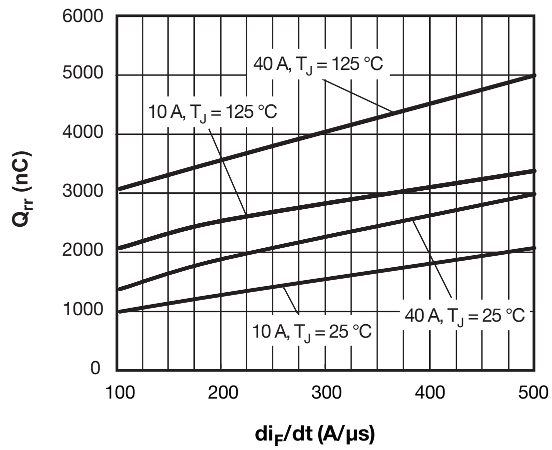


Fig. 19 - Typical Q_{rr} Antiparallel Diode vs. di_F/dt, V_{rr} = 400 V

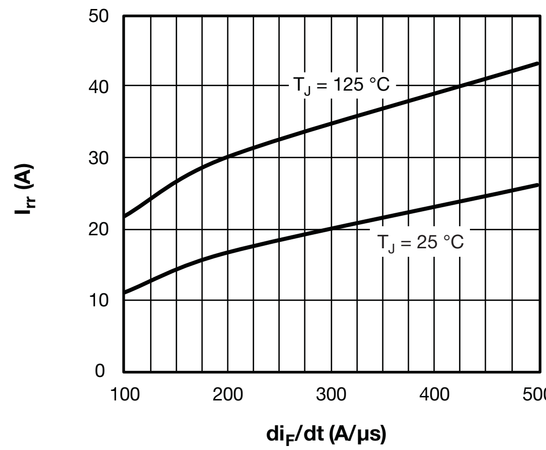


Fig. 21 - Typical I_{rr} Chopper Diode vs. di_F/dt, V_{rr} = 400 V, I_F = 50 A

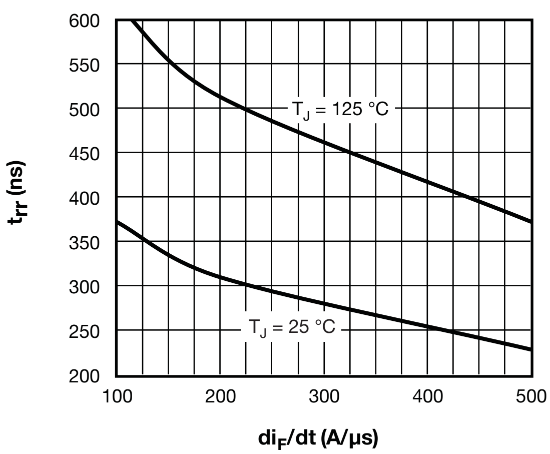


Fig. 20 - Typical t_{rr} Series Diode vs. di_F/dt, V_{rr} = 400 V, I_F = 50 A

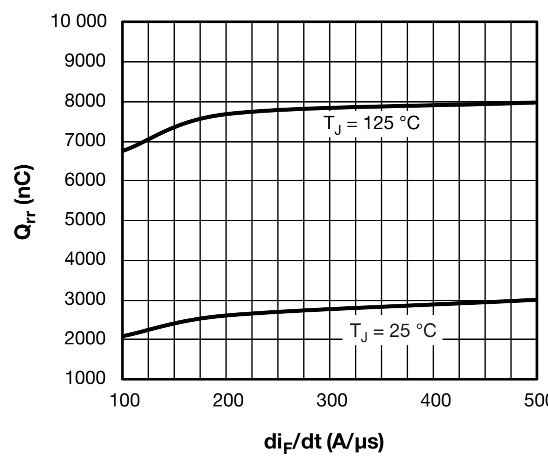


Fig. 22 - Typical Q_{rr} Chopper Diode vs. di_F/dt, V_{rr} = 400 V, I_F = 40 A

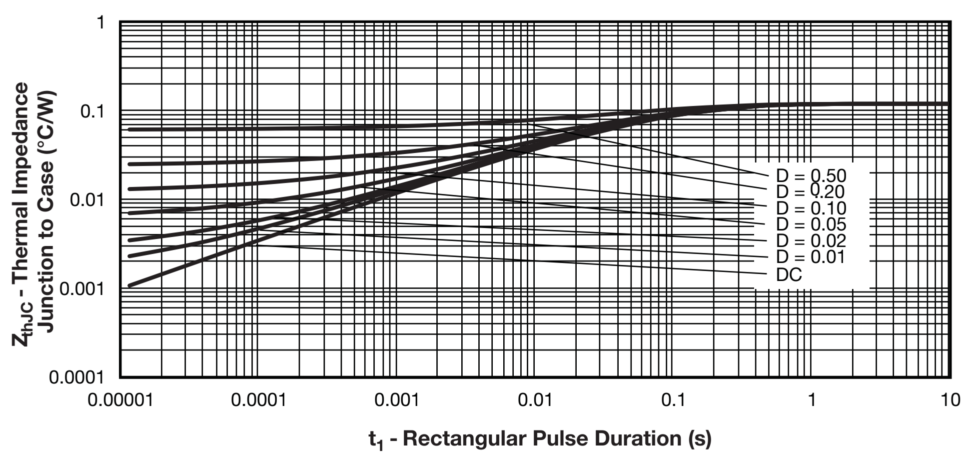


Fig. 23 - Maximum Thermal Impedance Z_{thJC} Characteristics IGBT

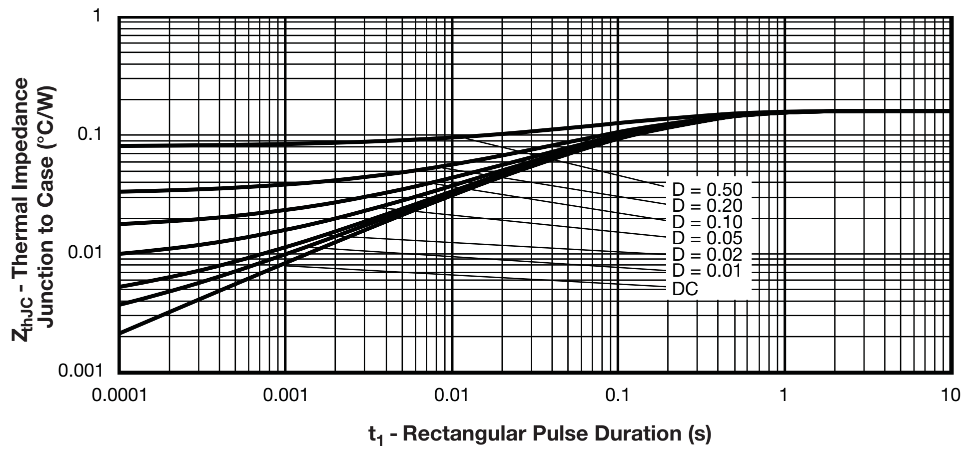


Fig. 24 - Maximum Thermal Impedance Z_{thJC} Characteristics Series Diode

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)

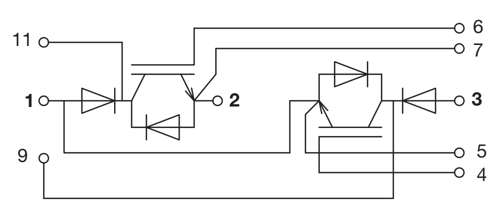
5 - Y = current fed inverter

6 - Package indicator (dual INT-A-PAK)

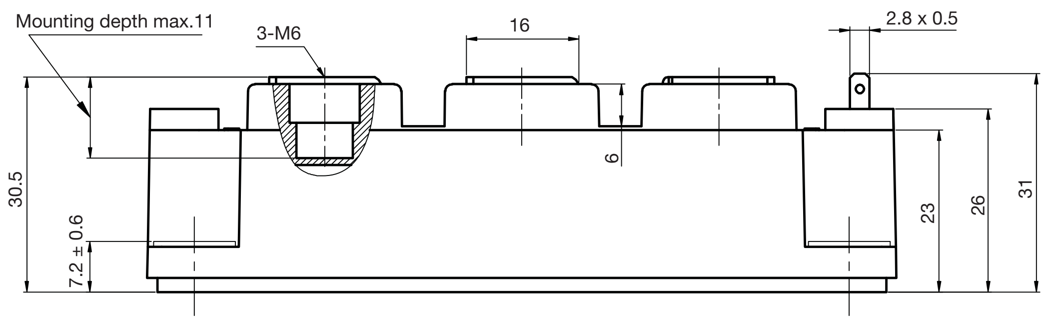
7 - Voltage rating (120 = 1200 V)

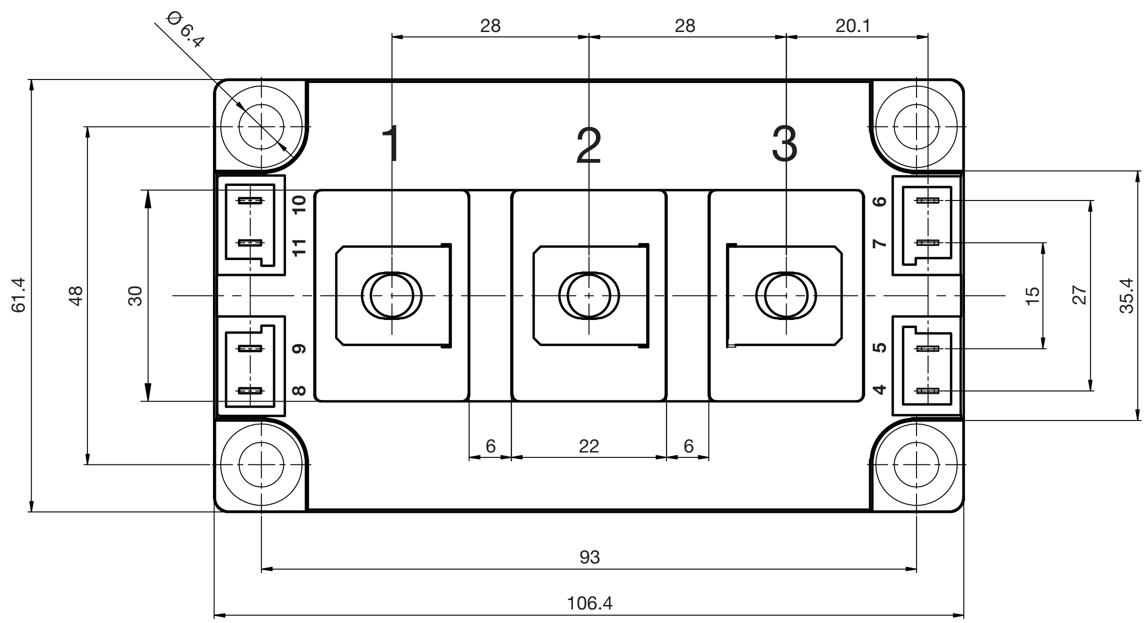
8 - N = ultrafast

CIRCUIT CONFIGURATION



DIMENSIONS in millimeters





Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “Vishay”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.