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

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

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

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

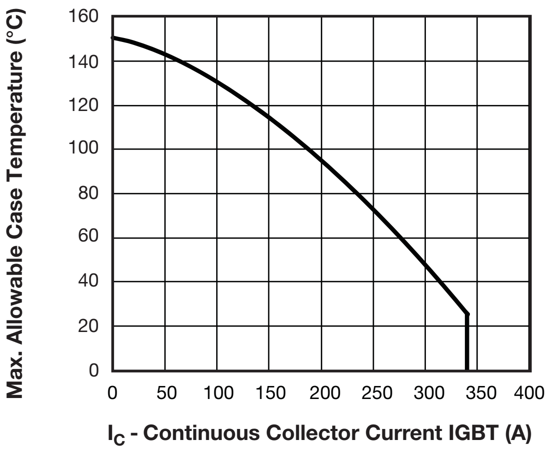


Fig. 1 - Maximum IGBT Continuous Collector Current vs. Case Temperature

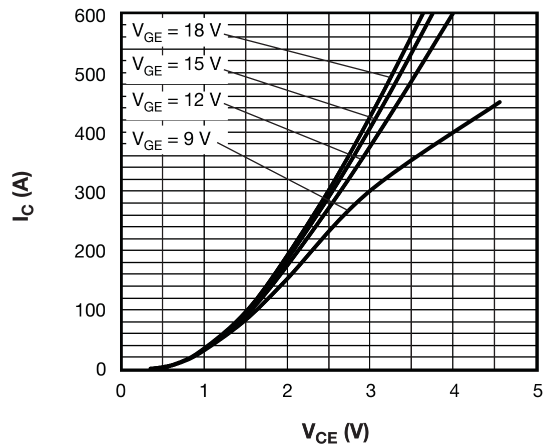


Fig. 4 - Typical IGBT Output Characteristics, T_J = 150 °C

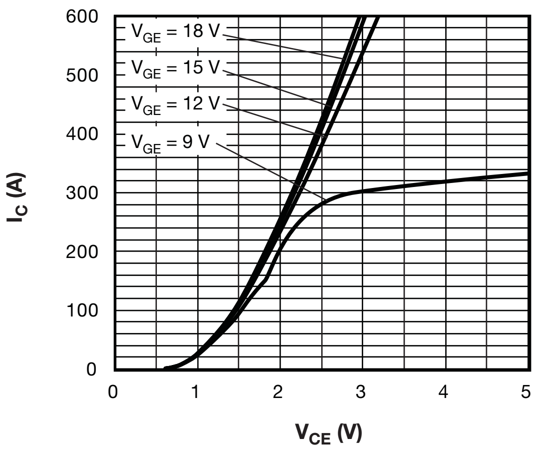


Fig. 2 - Typical IGBT Output Characteristics, T_J = 25 °C

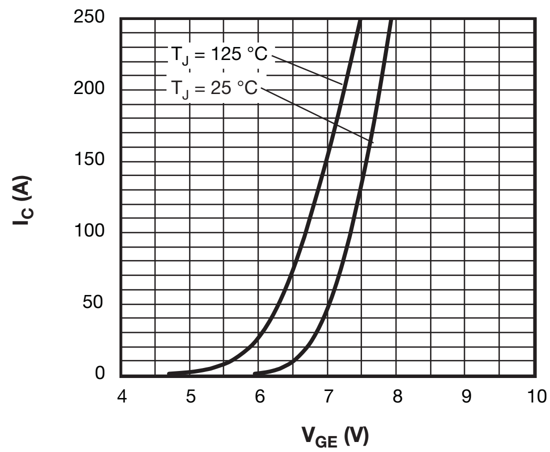


Fig. 5 - Typical IGBT Transfer Characteristics

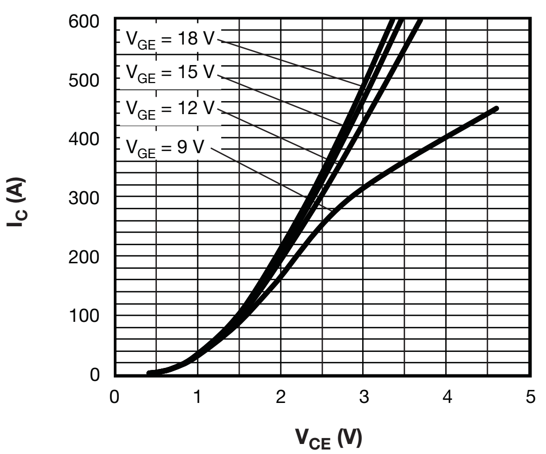


Fig. 3 - Typical IGBT Output Characteristics, T_J = 125 °C

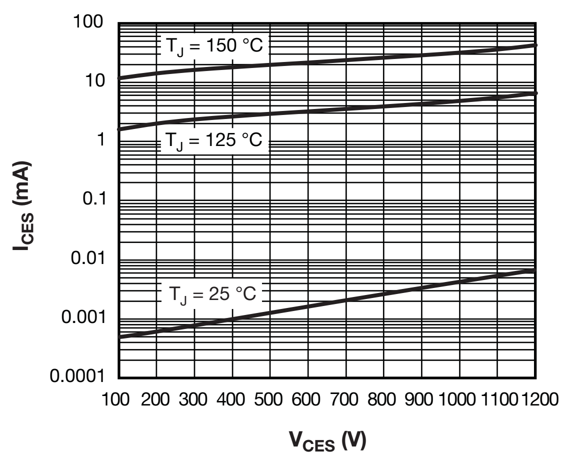


Fig. 6 - Typical IGBT Zero Gate Voltage Collector Current

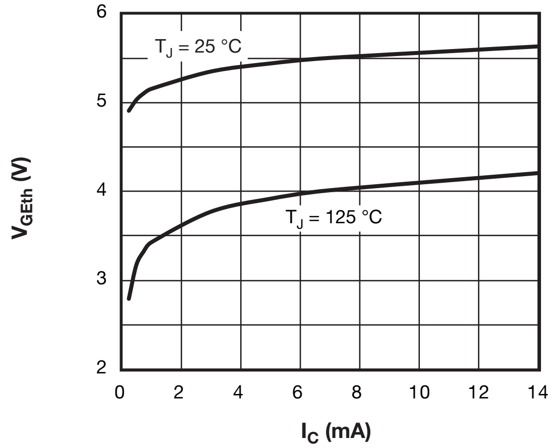


Fig. 7 - Typical IGBT Gate Threshold Voltage

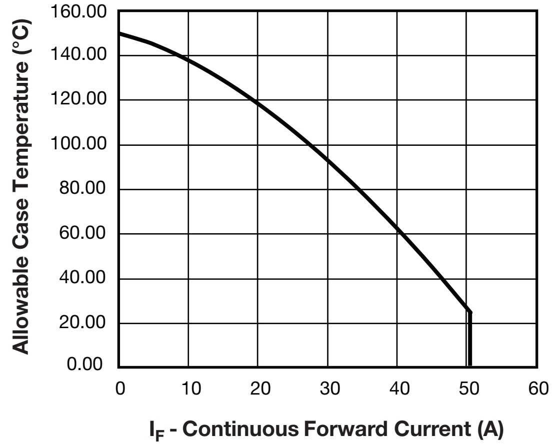


Fig. 10 - Maximum Continuous Forward Current vs. Case Temperature Antiparallel Diode

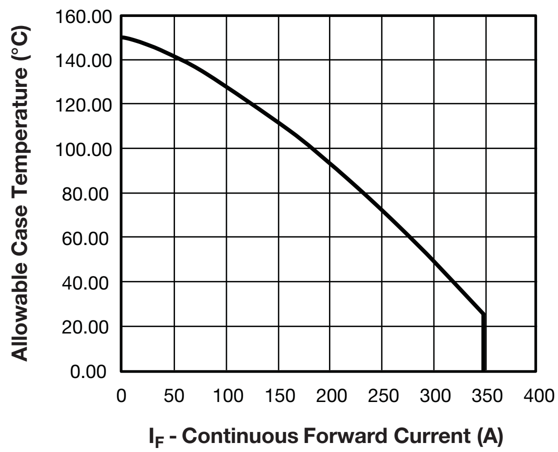


Fig. 8 - Maximum Continuous Forward Current vs. Case Temperature Series Diode

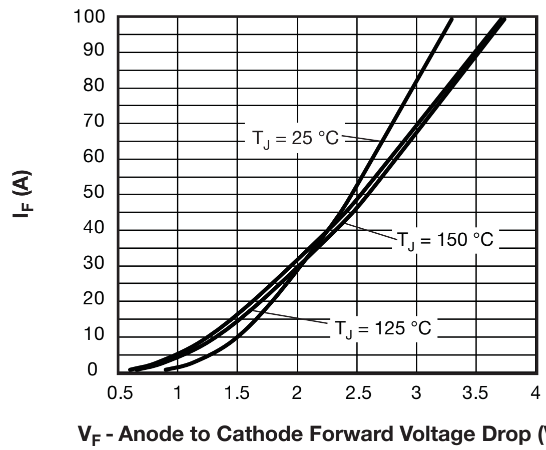


Fig. 11 - Typical Diode Forward Voltage Characteristics of Antiparallel Diode t_p = 500 µs

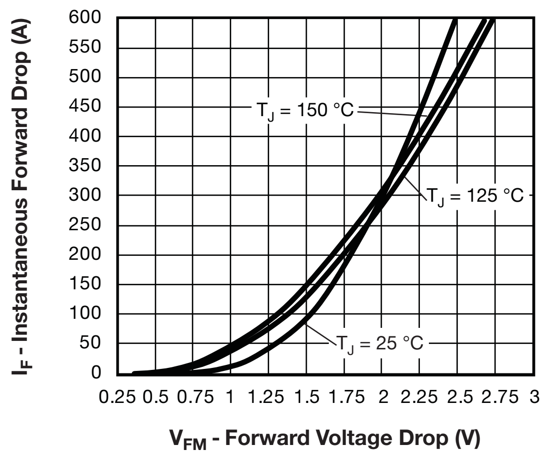


Fig. 9 - Typical Series Diode Forward Voltage

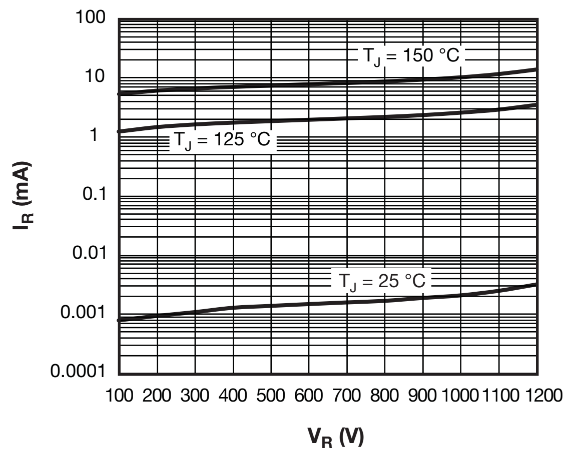


Fig. 12 - Typical Series Diode Leakage Current vs. Reverse Voltage

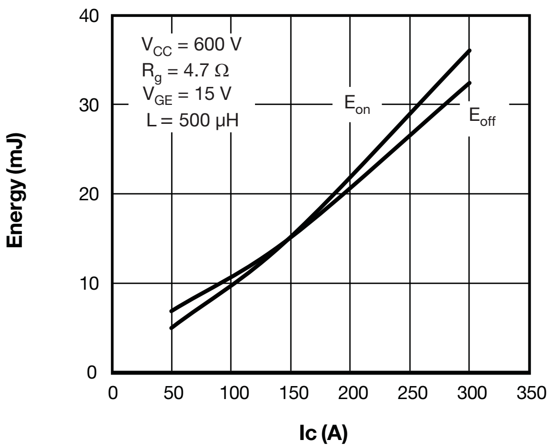


Fig. 13 - Typical IGBT Energy Loss vs. I_C, T_J = 125 °C - Freewheeling Diode VS-H3195D12A6B in TO-247 Package

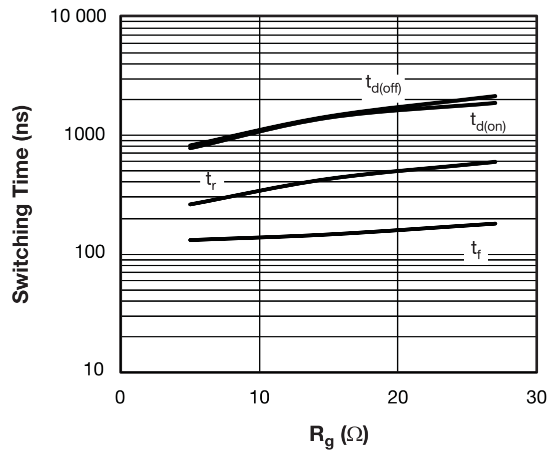


Fig. 16 - Typical IGBT Switching Time vs. R_g, T_J = 125 °C, I_C = 100 A, V_{CE} = 360 V, V_{GE} = 15 V, L = 500 µH

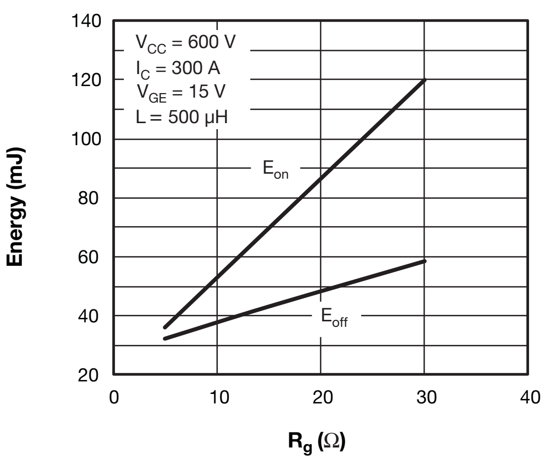


Fig. 14 - Typical IGBT Energy Loss vs. R_g, T_J = 125 °C - Freewheeling Diode VS-H3195D12A6B in TO-247 Package

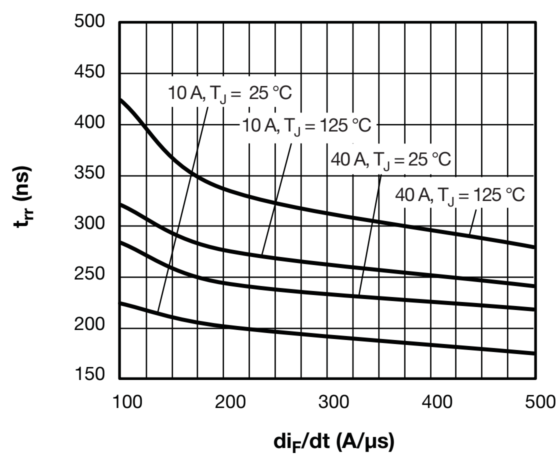


Fig. 17 - Typical t_{rr} Antiparallel Diode vs. di_F/dt, V_{rr} = 400 V

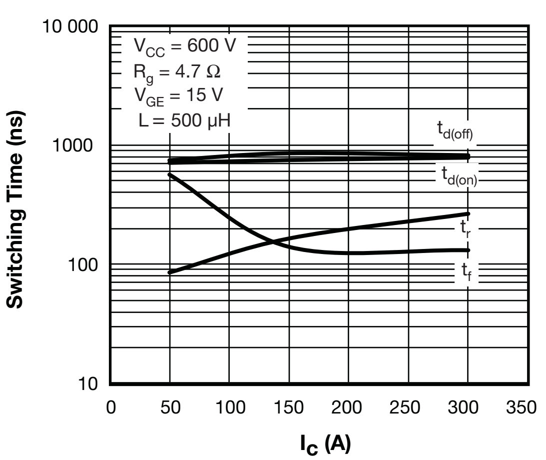


Fig. 15 - Typical IGBT Switching Time vs. I_C, T_J = 125 °C - Freewheeling Diode VS-H3195D12A6B in TO-247 Package

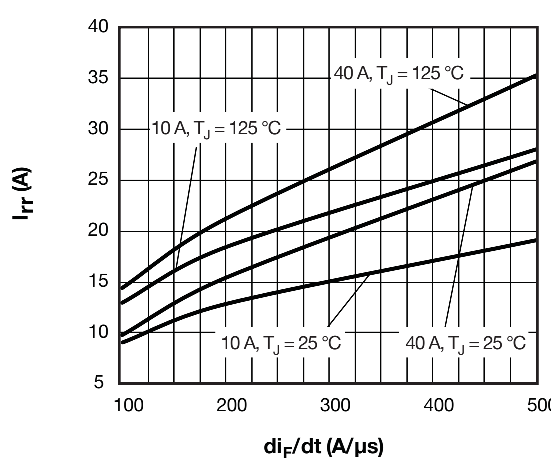


Fig. 18 - Typical I_{rr} Antiparallel Diode vs. di_F/dt, V_{rr} = 400 V

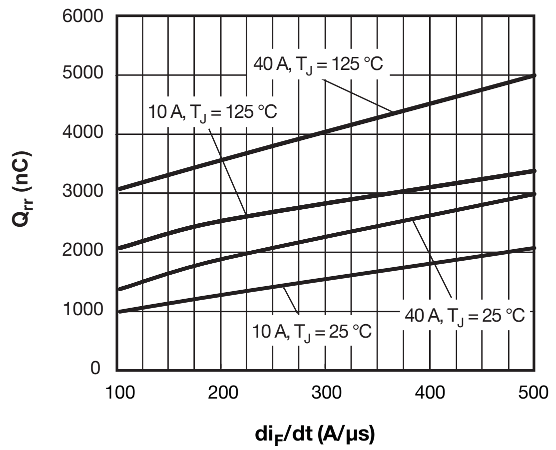


Fig. 19 - Typical Q_{rr} Antiparallel Diode vs. di_F/dt, V_{rr} = 400 V

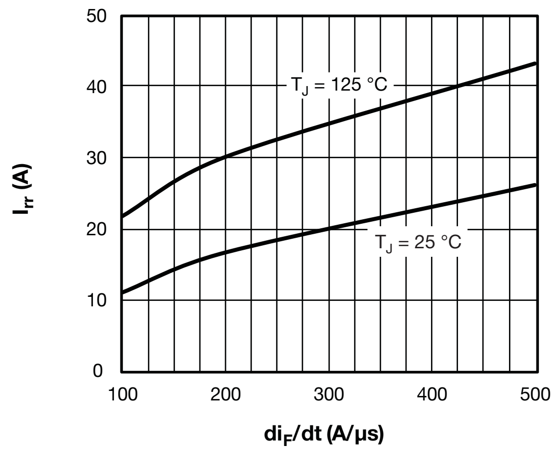


Fig. 21 - Typical I_{rr} Chopper Diode vs. di_F/dt, V_{rr} = 400 V, I_F = 50 A

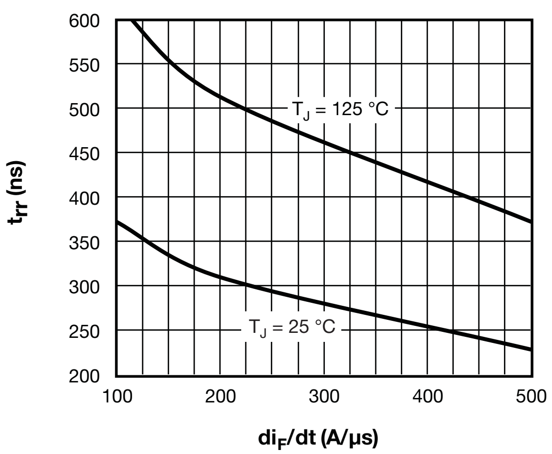


Fig. 20 - Typical t_{rr} Series Diode vs. di_F/dt, V_{rr} = 400 V, I_F = 50 A

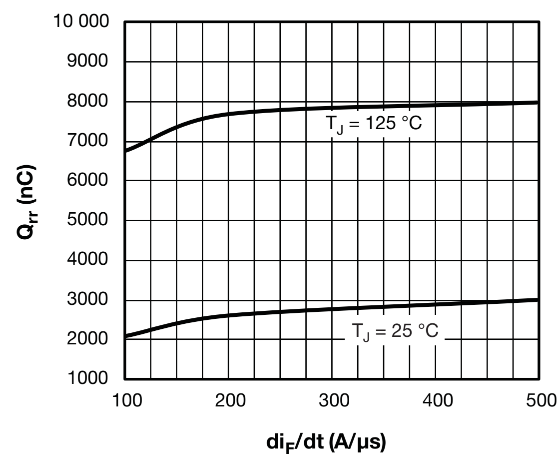


Fig. 22 - Typical Q_{rr} Chopper Diode vs. di_F/dt, V_{rr} = 400 V, I_F = 40 A

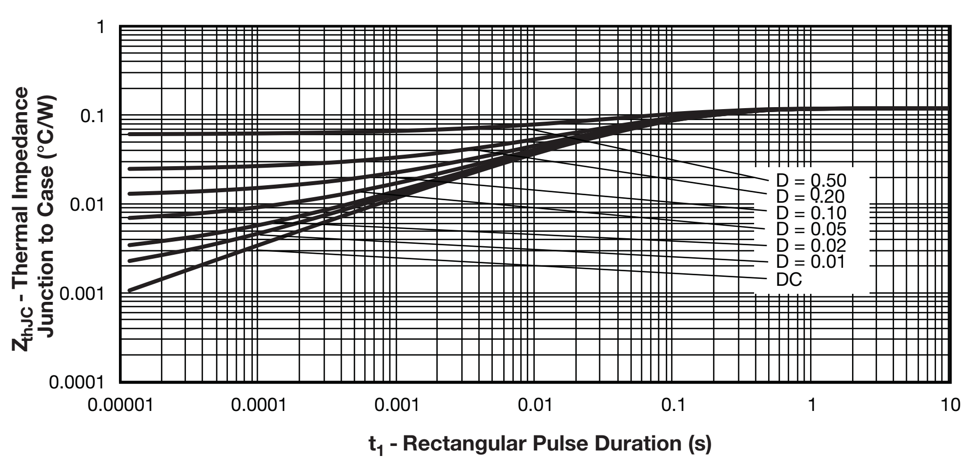


Fig. 23 - Maximum Thermal Impedance Z_{thJC} Characteristics IGBT

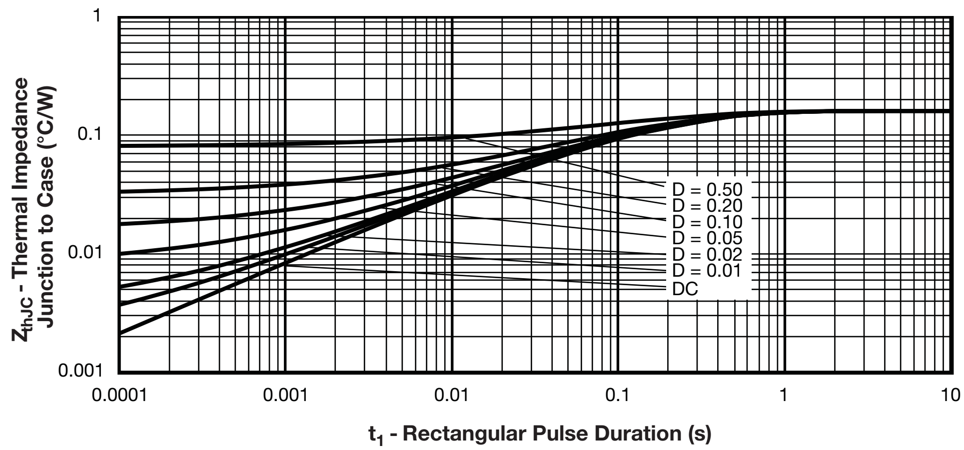


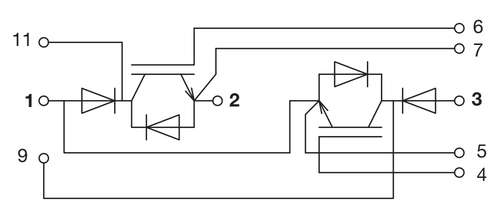
Fig. 24 - Maximum Thermal Impedance Z_{thJC} Characteristics Series Diode

ORDERING INFORMATION TABLE

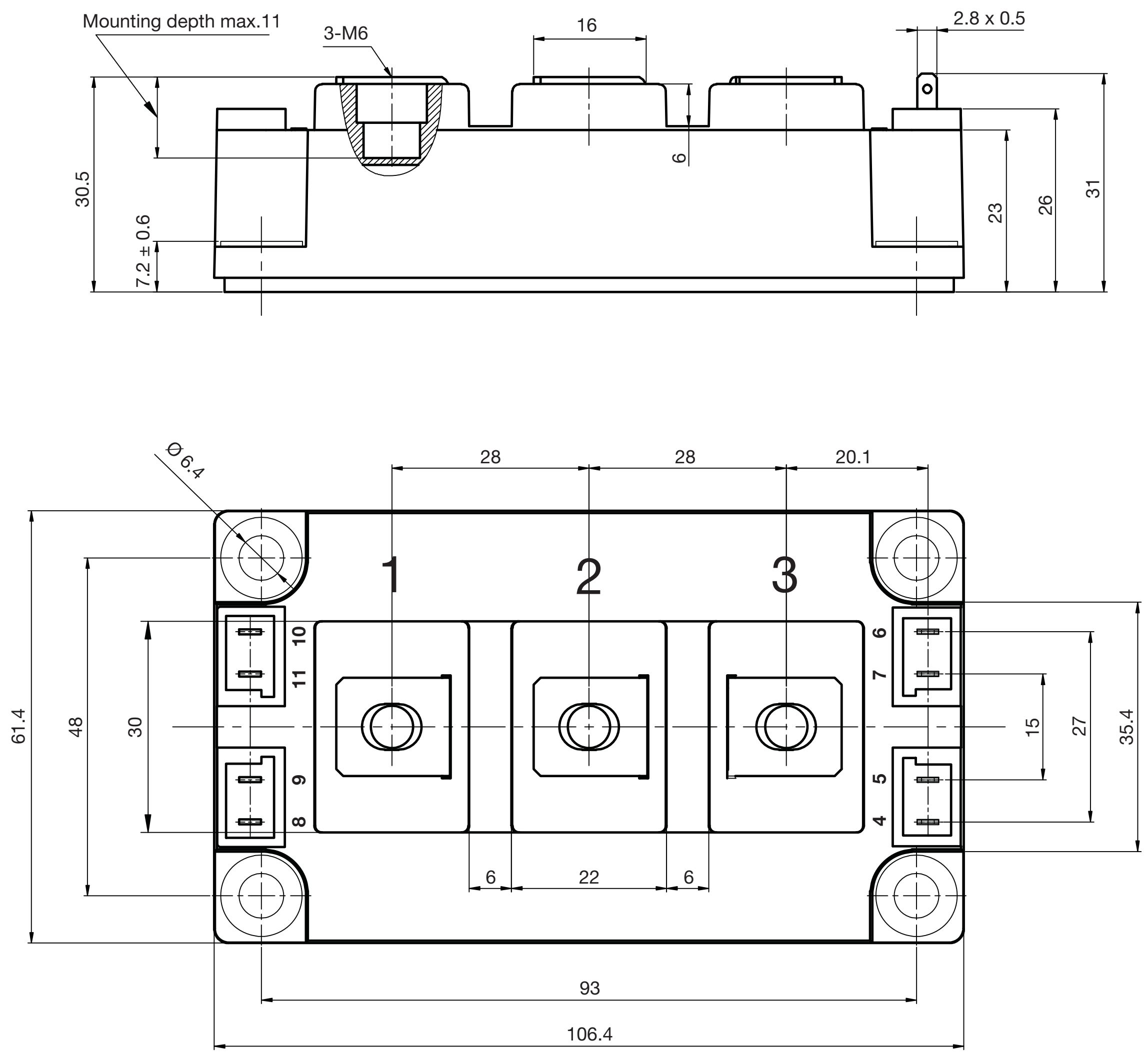
Device code	VS-	G	T	300	Y	H	120	N
	1	2	3	4	5	6	7	8

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



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