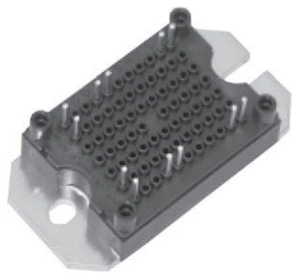
MTP IGBT Power Module
Primary Dual Forward



MTP
(Package example)

FEATURES

Pb-free
RoHS
COMPLIANT

- Buck PFC stage with warp 3 IGBT and FRED Pt® hyperfast diode
- Integrated thermistor
- Isolated baseplate
- UL approved file E78996
- Very low stray inductance design for high speed operation
- Ultrafast switching IGBT
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

BENEFITS

- Lower conduction losses and switching losses
- Optimized for welding, UPS, and SMPS applications
- PCB solderable terminals
- Direct mounting to heatsink

PRIMARY CHARACTERISTICS	
IGBT, T_J = 150 °C	
V_{CES}	600 V
$V_{CE(on)}$ at 25 °C at 80 A	2.11 V
I_C at 80°C	96 A
FRED Pt® AP DIODE, T_J = 150 °C	
V_{RRM}	600 V
$I_{F(DC)}$ at 80 °C	11 A
V_F at 25 °C at 5 A	1.1 V
FRED Pt® CHOPPER DIODE, T_J = 150 °C	
V_R	600 V
$I_{F(DC)}$ at 80 °C	22 A
V_F at 25 °C at 60 A	2.07 V
Speed	30 kHz to 150 kHz
Package	MTP
Circuit configuration	Dual forward

ABSOLUTE MAXIMUM RATINGS

	PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
IGBT	Collector to emitter voltage	V_{CES}		600	V
	Gate to emitter voltage	V_{GE}		± 20	V
	Maximum continuous collector current at V_{GE} = 15 V, T_J = 150 °C maximum	I_C	T_C = 25 °C	138	A
			T_C = 80 °C	96	
	Pulse collector current	I_{CM} (1)		330	
	Clamped inductive load current	I_{LM}		330	
	Maximum power dissipation	P_D	T_C = 25 °C	543	W
Antiparallel diode	Repetitive peak reverse voltage	V_{RRM}		600	V
	Maximum continuous forward current T_J = 150 °C maximum	$I_{F(DC)}$	T_C = 25 °C	17	A
			T_C = 80 °C	11	
	Maximum non-repetitive peak current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, T_J = 25 °C	60	
	Maximum power dissipation	P_D	T_C = 25 °C	24	W

ABSOLUTE MAXIMUM RATINGS					
	PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Chopper diode	Repetitive peak reverse voltage	V_{RRM}		600	V
	Maximum continuous forward current T_J = 150 °C maximum	I_F	T_C = 25 °C	33	A
			T_C = 80 °C	22	
	Maximum non-repetitive peak current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, T_J = 25 °C	135	
	Maximum power dissipation	P_D	T_C = 25 °C	57	W
	Maximum operating junction temperature	T_J		150	°C
	Storage temperature range	T_{Stg}		-40 to +150	
	Isolation voltage	V_{ISOL}	T_J = 25 °C, all terminals shorted, f = 50 Hz, t =1 s	3500	V

Notes

- Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur

(1) V_{CC} = 300 V, V_{GE} = 15 V, L = 500 μH, R_g = 4.7 Ω, T_J = 150 °C

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)							
	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
IGBT	Collector to emitter breakdown voltage	BV_{CES}	V_{GE} = 0 V, I_C = 1.5 mA	600	-	-	V
	Temperature coefficient of breakdown voltage	$\Delta V_{BR(CES)}/\Delta T_J$	I_C = 1.0 mA (25 °C to 125 °C)	-	0.6	-	V/°C
	Collector to emitter voltage	$V_{CE(on)}$	V_{GE} 15 V, I_C = 80 A	-	2.11	2.48	V
			V_{GE} = 15 V, I_C = 80 A, T_J = 125 °C	-	2.43	-	
	Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 750 μA	3.2	4.4	6.2	V
	Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 1.0 mA (25 °C to 125 °C)	-	-12	-	mV/°C
	Forward transconductance	g_{fe}	V_{CE} = 20 V, I_C = 80 A	-	97	-	S
	Transfer characteristics	V_{GE}	V_{CE} = 20 V, I_C = 80 A	-	6.6	-	V
	Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 600 V	-	8	100	μA
			V_{GE} = 0 V, V_{CE} = 600 V, T_J = 125 °C	-	0.1	-	mA
	Gate to emitter leakage	I_{GES}	V_{GE} = ± 20 V	-	-	± 250	nA
AP diode	Blocking voltage	BV_{RRM}	I_R = 100 μA	600	-	-	V
	Forward voltage drop	V_{FM}	I_F = 5 A	-	1.1	1.27	V
			I_F = 5 A, T_J = 125 °C	-	0.96	-	
Chopper diode	Forward voltage drop	V_{FM}	I_F = 60 A	-	2.07	2.53	V
			I_F = 60 A, T_J = 125 °C	-	1.87	-	
	Blocking voltage	BV_{RM}	I_R = 100 μA	600	-	-	
	Reverse leakage current	I_{RM}	V_{RRM} = 600 V	-	2	70	μA
			V_{RRM} = 600 V, T_J = 125 °C	-	12	-	

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise noted)							
	PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
PFC IGBT	Total gate charge (turn-on)	Q_g	I_C = 60 A V_{CC} = 400 V V_{GE} = 15 V	-	540	-	nC
	Gate to emitter charge (turn-on)	Q_{ge}		-	84	-	
	Gate to collector charge (turn-on)	Q_{gc}		-	192	-	
	Turn-on switching loss	E_{on}	I_C = 150 A, V_{CC} = 300 V, V_{GE} = 15 V, R_g = 4.7 Ω, L = 500 μH, T_J = 25 °C (1)	-	0.51	-	mJ
	Turn-off switching loss	E_{off}		-	2.66	-	
	Total switching loss	E_{tot}		-	3.17	-	
	Turn-on delay time	$t_{d(on)}$		-	173	-	ns
	Rise time	t_r		-	79	-	
	Turn-off delay time	$t_{d(off)}$		-	374	-	
	Fall time	t_f		-	66	-	
	Turn-on switching loss	E_{on}	I_C = 150 A, V_{CC} = 300 V, V_{GE} = 15 V, R_g = 4.7 Ω, L = 500 μH, T_J = 125 °C (1)	-	0.66	-	mJ
	Turn-off switching loss	E_{off}		-	2.75	-	
	Total switching loss	E_{tot}		-	3.41	-	
	Turn-on delay time	$t_{d(on)}$		-	167	-	ns
	Rise time	t_r		-	80	-	
	Turn-off delay time	$t_{d(off)}$		-	389	-	
	Fall time	t_f		-	69	-	
	Input capacitance	C_{ies}	V_{GE} = 0 V V_{CC} = 30 V f = 1 MHz	-	14 020	-	pF
	Output capacitance	C_{oes}		-	1010	-	
	Reverse transfer capacitance	C_{res}		-	174	-	
	Reverse bias safe operating area	RBSOA	I_C = 330 A, V_{CC} = 300 V, V_P = 600 V, R_g = 4.7 Ω, V_{GE} = 15 V, L = 500 μH, T_J = 150 °C	Full square			

Note

(1) Energy losses include "tail" and diode reverse recovery

RECOVERY PARAMETER (T_J = 25 °C unless otherwise noted)							
	PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
AP diode	Peak reverse recovery current	I_{rr}	I_F = 10 A dI/dt = 200 A/μs V_{rr} = 200 V	-	10	-	A
	Reverse recovery time	t_{rr}		-	104	-	ns
	Reverse recovery charge	Q_{rr}		-	537	-	nC
Chopper diode	Peak reverse recovery current	I_{rr}	I_F = 50 A dI/dt = 200 A/μs V_{rr} = 200 V	-	4.7	-	A
	Reverse recovery time	t_{rr}		-	73	-	ns
	Reverse recovery charge	Q_{rr}		-	171	-	nC
	Peak reverse recovery current	I_{rr}	I_F = 50 A dI/dt = 200 A/μs V_{rr} = 200 V, T_J = 125 °C	-	10.3	-	A
	Reverse recovery time	t_{rr}		-	140	-	ns
	Reverse recovery charge	Q_{rr}		-	716	-	nC

THERMISTOR ELECTRICAL CHARACTERISTICS (T_J = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Resistance	R	T_J = 25 °C	-	30 000	-	Ω
B value	B	T_J = 25 °C/T_J = 85 °C	-	4000	-	K

THERMAL AND MECHANICAL SPECIFICATIONS						
	PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
IGBT	Junction to case IGBT thermal resistance		-	-	0.23	
AP FRED Pt	Junction to case diode thermal resistance	R_{thJC}	-	-	5.1	°C/W
FRED Pt	Junction to case diode thermal resistance		-	-	2.2	
	Case to sink, flat, greased surface per module	R_{thCS}	-	0.06	-	°C/W
	Mounting torque ± 10 % to heatsink (1)		-	-	4	Nm
	Approximate weight		-	65	-	g

Note

(1) A mounting compound is recommended and the torque should be rechecked after a period of 3 hours to allow for the spread of the compound

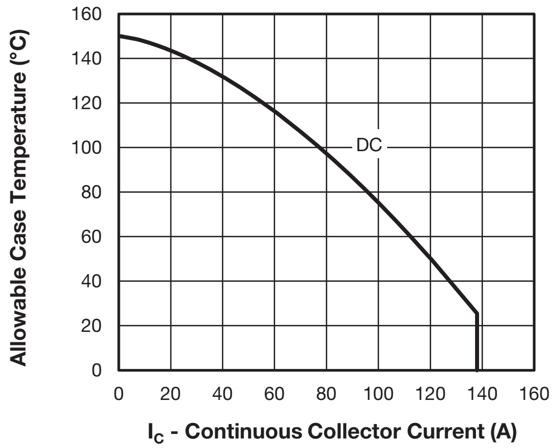


Fig. 1 - Allowable Case Temperature vs. Continuous Collector Current (Maximum IGBT Continuous Collector Current vs. Case Temperature)

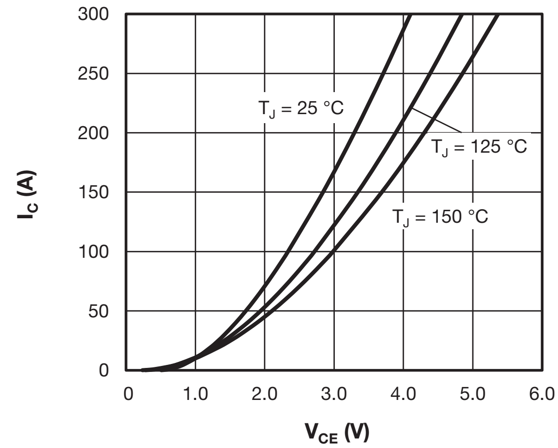


Fig. 3 - I_C vs. V_{CE} (Typical IGBT Output Characteristics, V_{GE} = 15 V)

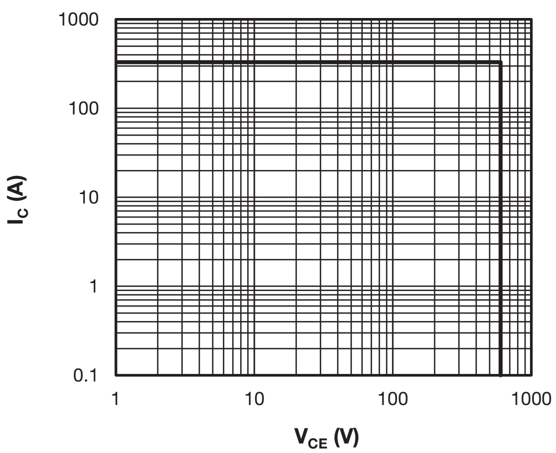


Fig. 2 - I_C vs. V_{CE} (IGBT Reverse BIAS SOA, T_J = 150 °C, V_{GE} = 15 V)

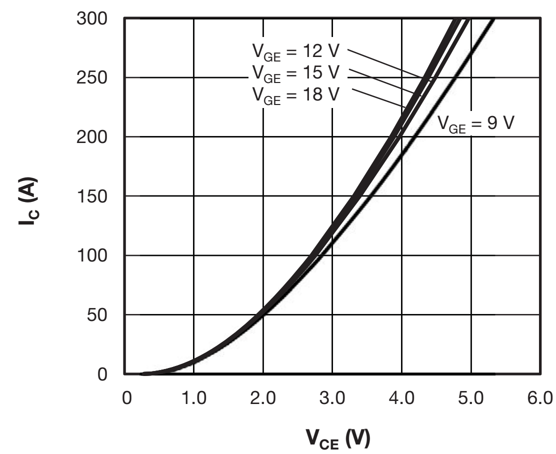


Fig. 4 - I_C vs. V_{CE} (Typical IGBT Output Characteristics, T_J = 125 °C)

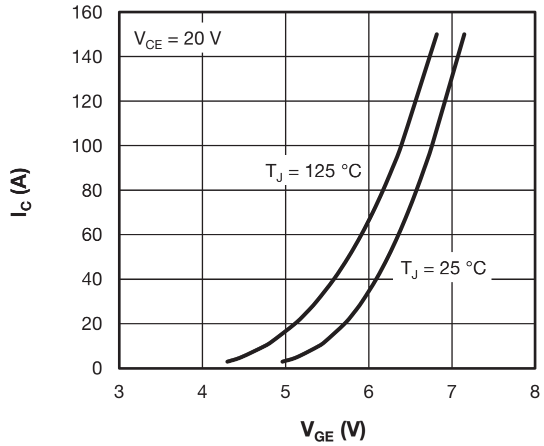


Fig. 5 - I_C vs. V_{GE}
(Typical IGBT Transfer Characteristics)

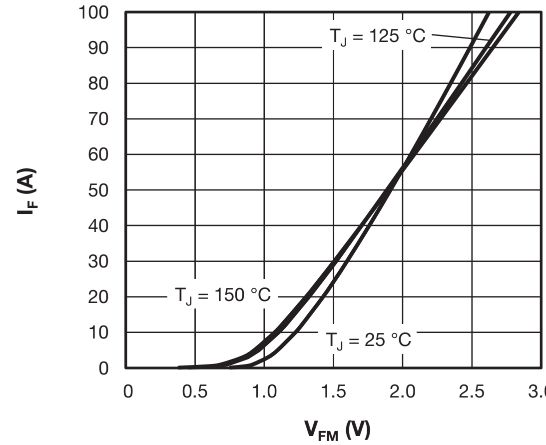


Fig. 8 - I_F vs. V_{FM}
(Typical Antiparallel Diode Forward Characteristics)

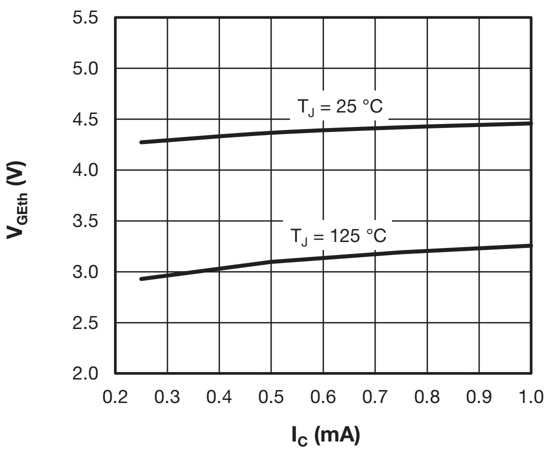


Fig. 6 - V_{GEth} vs. I_C
(Typical IGBT Gate Threshold Voltage)

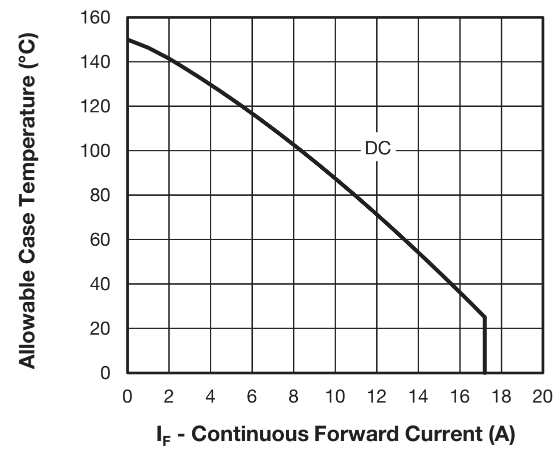


Fig. 9 - Allowable Case Temperature vs. Continuous Forward Current (Maximum Antiparallel Diode Continuous Forward Current vs. Case Temperature)

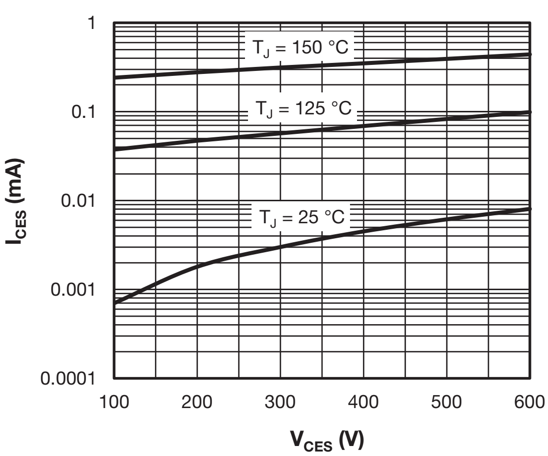


Fig. 7 - I_{CES} vs. V_{CES}
(Typical IGBT Zero Gate Voltage Collector Current)

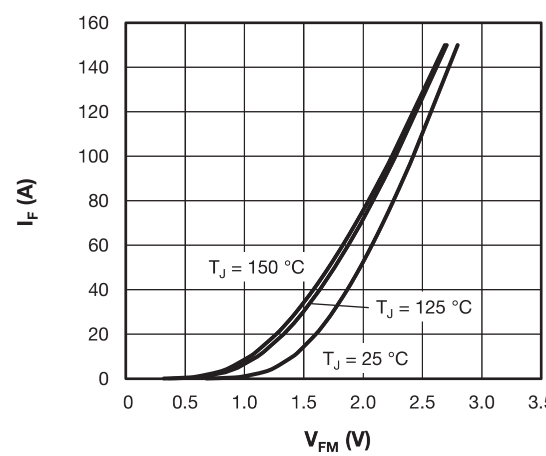


Fig. 10 - I_F vs. V_{FM}
(Typical Chopper Diode Forward Characteristics)

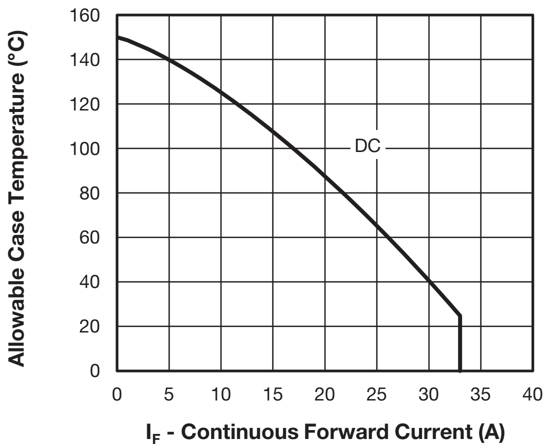


Fig. 11 - Allowable Case Temperature vs. Continuous Forward Current (Maximum Chopper Diode Continuous Forward Current vs. Case Temperature)

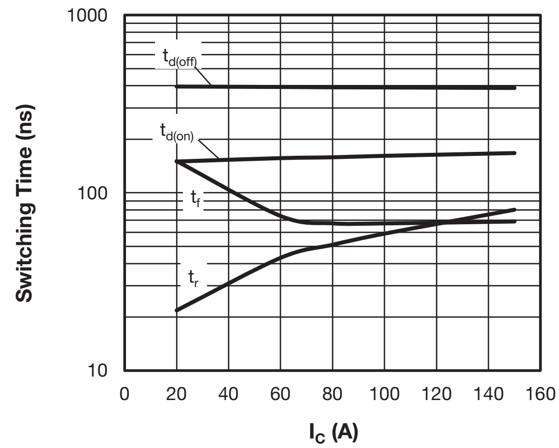


Fig. 14 - Switching Time vs. I_C
(Typical IGBT Switching Time vs. I_C)
T_J = 125 °C, V_{CC} = 300 V, R_g = 4.7 Ω, V_{GE} = 15 V, L = 500 µH

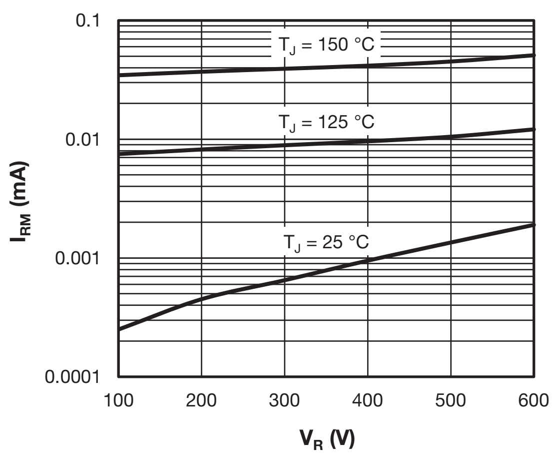


Fig. 12 - I_{RM} vs. V_R
(Typical Chopper Diode Reverse Leakage Current)

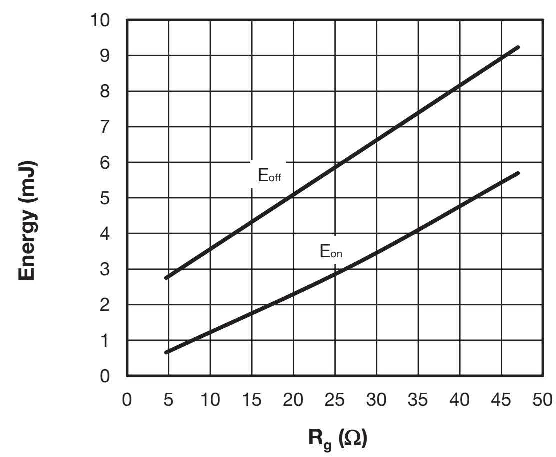


Fig. 15 - Energy Loss vs. R_g
(Typical IGBT Energy Loss vs. R_g)
T_J = 125 °C, V_{CC} = 300 V, I_C = 150 A, V_{GE} = 15 V, L = 500 µH

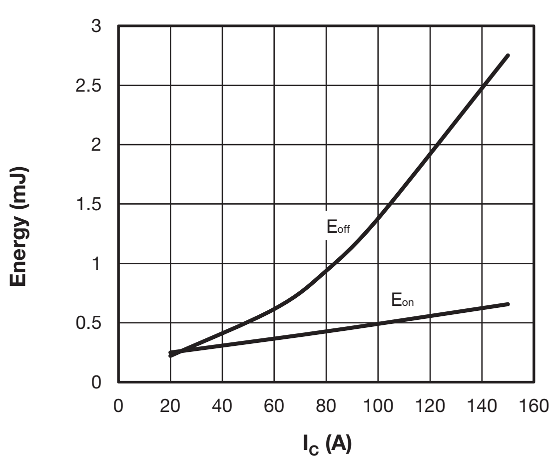


Fig. 13 - Energy Loss vs. I_C
(Typical IGBT Energy Loss vs. I_C)
T_J = 125 °C, V_{CC} = 300 V, R_g = 4.7 Ω, V_{GE} = 15 V, L = 500 µH

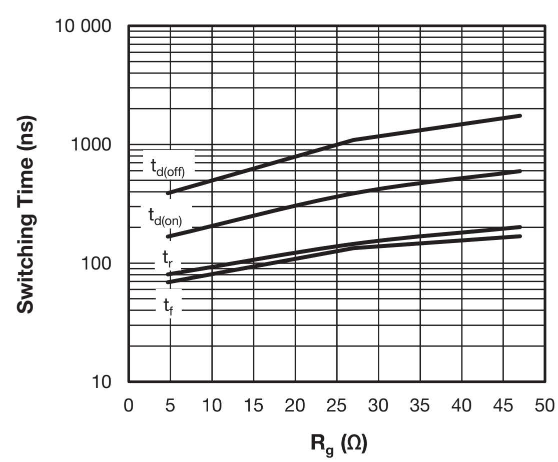


Fig. 16 - Switching Time vs. R_g
(Typical IGBT Switching Time vs. R_g)
T_J = 125 °C, V_{CC} = 300 V, I_C = 150 A, V_{GE} = 15 V, L = 500 µH

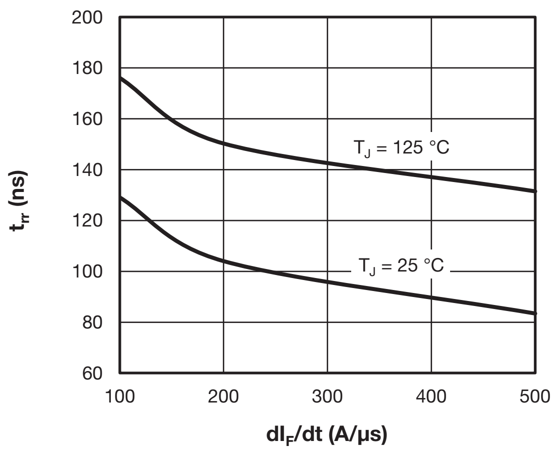


Fig. 17 - t_{rr} vs. dI_F/dt
(Typical Antiparallel Diode Reverse Recovery Time vs. dI_F/dt)
V_{rr} = 200 V, I_F = 10 A

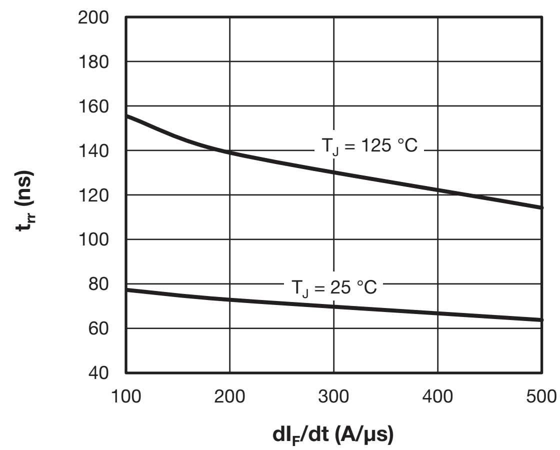


Fig. 20 - t_{rr} vs. dI_F/dt
(Typical Chopper Diode Reverse Recovery Time vs. dI_F/dt)
V_{rr} = 200 V, I_F = 50 A

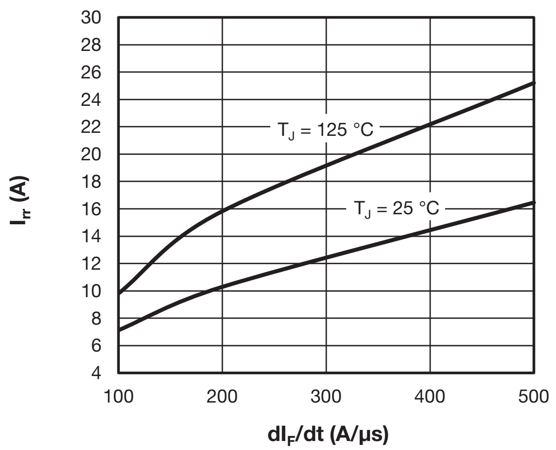


Fig. 18 - I_{rr} vs. dI_F/dt
(Typical Antiparallel Diode Reverse Recovery Current vs. dI_F/dt)
V_{rr} = 200 V, I_F = 10 A

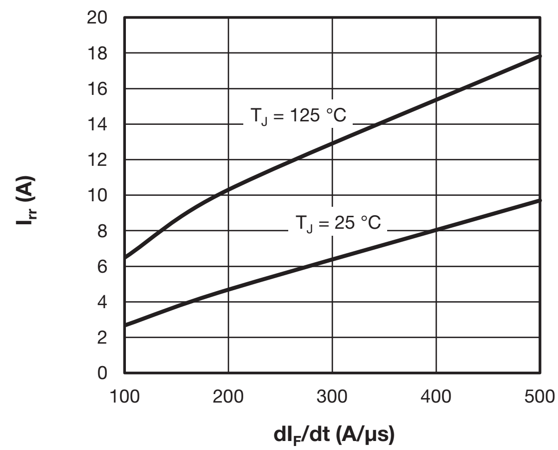


Fig. 21 - I_{rr} vs. dI_F/dt
(Typical Chopper Diode Reverse Recovery Current vs. dI_F/dt)
V_{rr} = 200 V, I_F = 50 A

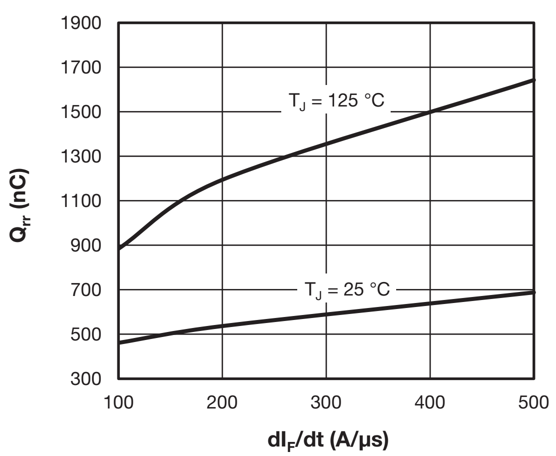


Fig. 19 - Q_{rr} vs. dI_F/dt
(Typical Antiparallel Diode Reverse Recovery Charge vs. dI_F/dt)
V_{rr} = 200 V, I_F = 10 A

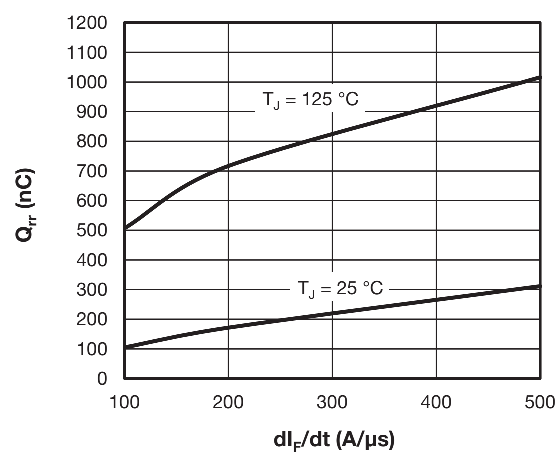


Fig. 22 - Q_{rr} vs dI_F/dt
(Typical Chopper Diode Reverse Recovery Charge vs. dI_F/dt)
V_{rr} = 200 V, I_F = 50 A

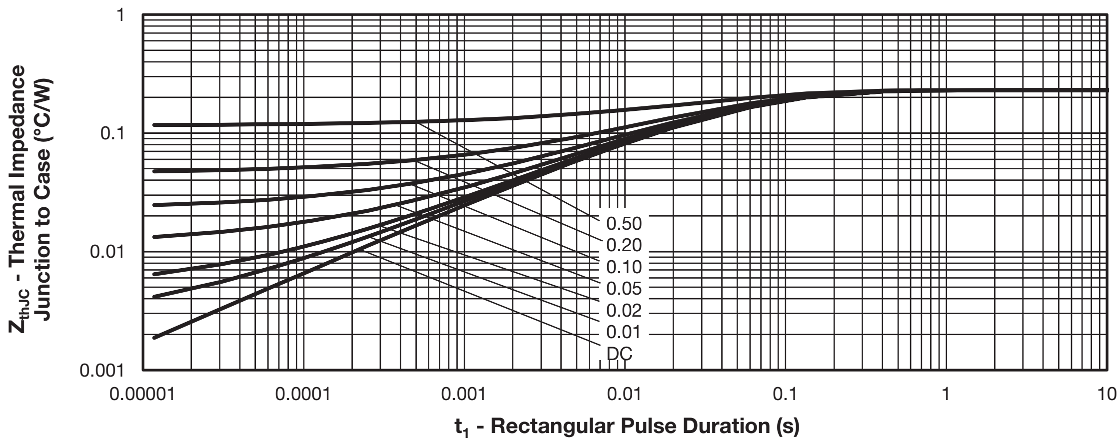


Fig. 23 - Z_{thJC} vs. t_1 Rectangular Pulse Duration
(Maximum Thermal Impedance Z_{thJC} Characteristics - (IGBT))

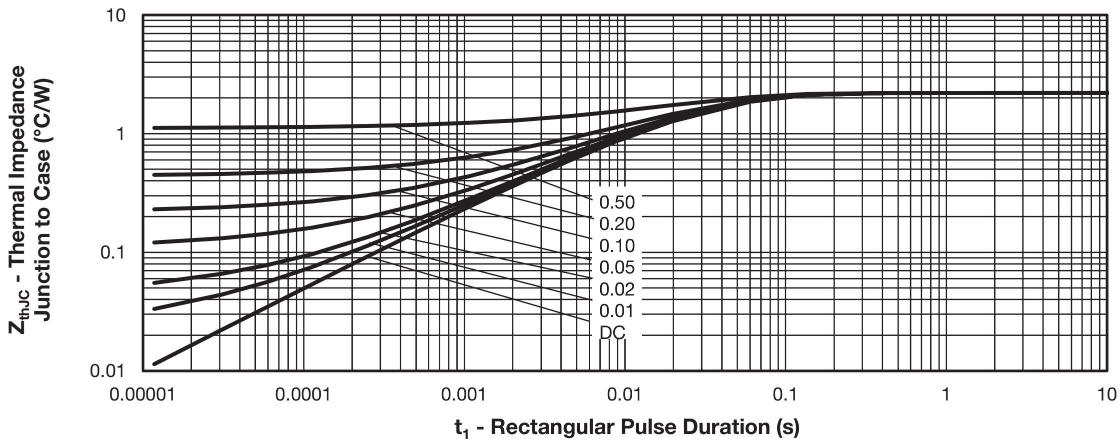
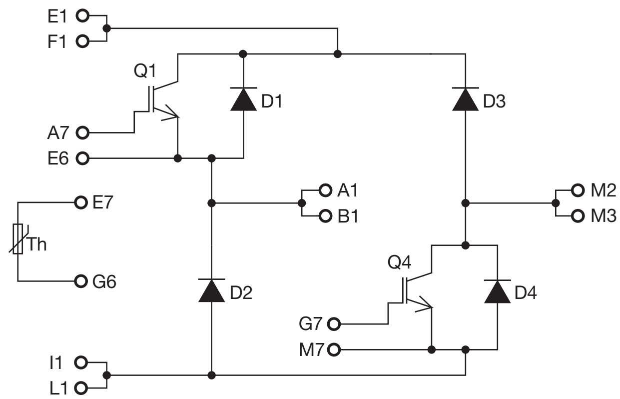


Fig. 24 - Z_{thJC} vs. t_1 Rectangular Pulse Duration
(Maximum Thermal Impedance Z_{thJC} Characteristics - (Chopper Diode))

CIRCUIT CONFIGURATION



ORDERING INFORMATION TABLE

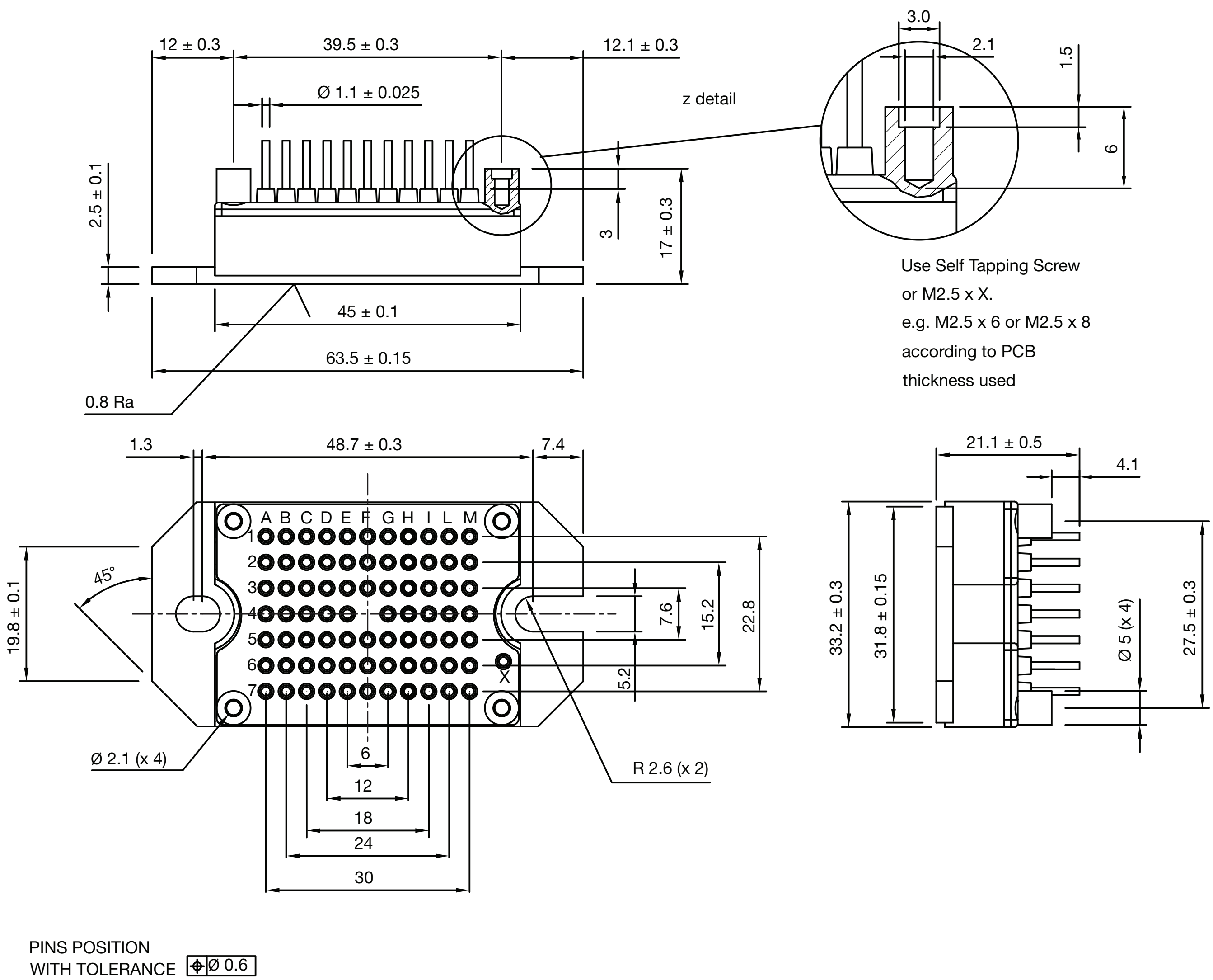
Device code	VS-	150	MT	060	W	DF
	1	2	3	4	5	6

1 - Vishay Semiconductors product
2 - Current rating (150 = 150 A)
3 - Essential part number (MT = MTP package)
4 - Voltage code x 10 = voltage rating (example: 060 = 600 V)
5 - Die IGBT technology (W = warp speed IGBT)
6 - Circuit configuration (DF = dual forward)

LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95383

MTP - Full Pin

DIMENSIONS in millimeters



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