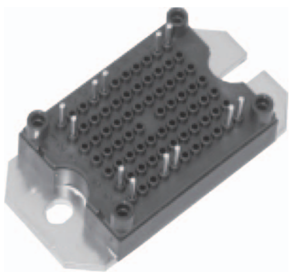
MTP IGBT Power Module
Primary Rectifier and PFC



MTP
(Package example)

PRODUCT SUMMARY	
INPUT BRIDGE DIODE, T_J = 150 °C	
V_{RRM}	1200 V
I_O at 80 °C	50 A
V_{FM} at 25 °C at 70 A	1.31 V
PFC IGBT, T_J = 150 °C	
V_{CES}	600 V
$V_{CE(on)}$ at 25 °C at 60 A	2.14 V
I_C at 80°C	73 A
FRED Pt® PFC DIODE, T_J = 150 °C	
V_R	600 V
$I_{F(DC)}$ at 80 °C	79 A
V_F at 25 °C at 40 A	1.44 V
FRED Pt® AP DIODE, T_J = 150 °C	
V_R	600 V
$I_{F(DC)}$ at 80 °C	11 A
V_F at 25 °C at 5 A	1.1 V
Speed	30 kHz to 150 kHz
Package	MTP
Circuit	Input rectifier bridge

FEATURES

- Input rectifier bridge
- PFC stage with warp 2 IGBT and FRED Pt® hyperfast diode
- Very low stray inductance design for high speed operation
- Integrated thermistor
- Isolated baseplate
- UL approved file E78996
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS
COMPLIANT

BENEFITS

- Lower conduction losses and switching losses
- Higher switching frequency up to 150 kHz
- Optimized for welding, UPS, and SMPS applications
- PCB solderable terminals
- Direct mounting to heatsink

ABSOLUTE MAXIMUM RATINGS

	PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Input Rectifier Bridge	Repetitive peak reverse voltage	V_{RRM}		1200	V
	Maximum average output current T_J = 150 °C maximum	I_O	T_C = 80 °C	50	A
	Surge current (Non-repetitive)	I_{FSM}	Rated V_{RRM} applied	270	
	Maximum I^2t for fusing	I^2t	10 ms, sine pulse	364	A^2s
PFC IGBT	Collector to emitter voltage	V_{CES}	T_J = 25 °C	600	V
	Gate to emitter voltage	V_{GE}		± 20	
	Maximum continuous collector current at V_{GE} = 15 V, T_J = 150 °C maximum	I_C	T_C = 25 °C	107	A
			T_C = 80 °C	73	
	Pulsed collector current	I_{CM} (1)		300	
	Clamped inductive load current	I_{LM}		300	
	Maximum power dissipation	P_D	T_C = 25 °C	403	W

ABSOLUTE MAXIMUM RATINGS					
	PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
PFC Diode	Repetitive peak reverse voltage	V_{RRM}		600	V
	Maximum continuous forward current T_J = 150 °C maximum	I_F	T_C = 25 °C	121	A
			T_C = 80 °C	79	
	Maximum power dissipation	P_D	T_C = 25 °C	154	W
	Maximum non-repetitive peak current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, T_J = 25 °C	480	A
AP Diode	Repetitive peak reverse voltage	V_{RRM}		600	V
	Maximum continuous forward current T_J = 150 °C maximum	I_F	T_C = 25 °C	17	A
			T_C = 80 °C	11	
	Maximum power dissipation	P_D	T_C = 25 °C	24	W
	Maximum non-repetitive peak current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, T_J = 25 °C	60	A
	Maximum operating junction temperature	T_J		150	°C
	Storage temperature range	T_{Stg}		-40 to +150	
	RMS isolation voltage	V_{ISOL}	T_J = 25 °C, all terminals shorted, f = 50 Hz, t = 1 s	3500	W

Notes

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

(1) V_{CC} = 400 V, V_{GE} = 15 V, L = 500 μH, R_g = 4.7 Ω, T_J = 150 °C

ΔR CONDUCTION PER JUNCTION - INPUT RECTIFIER BRIDGE											
DEVICES	SINE HALF WAVE CONDUCTION					RECTANGULAR WAVE CONDUCTION					UNITS
	180°	120°	90°	60°	30°	180°	120°	90°	60°	30°	
100MT060WSP	0.396	0.454	0.563	0.763	1.099	0.290	0.471	0.599	0.782	1.107	°C/W

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)							
	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Input Rectifier Bridge (per diode)	Blocking voltage	BV_{RRM}	I_R = 100 μA	1200	-	-	V
	Reverse leakage current	I_{RRM}	V_{RRM} = 1200 V	-	0.0015	0.13	mA
			V_{RRM} = 1200 V, T_J = 150 °C	-	1.0	-	
	Forward voltage drop	V_{FM}	I_F = 70 A	-	1.31	1.45	V
			I_F = 70 A, T_J = 150 °C	-	1.34	-	
	Forward slope resistance	rt	T_J = 150 °C	-	-	8.92	mΩ
	Conduction threshold voltage	V_T		-	-	0.83	V
PFC IGBT	Collector to emitter breakdown voltage	BV_{CES}	V_{GE} = 0 V, I_C = 1 mA	600	-	-	V
	Temperature coefficient of breakdown voltage	$\Delta V_{BR(CES)}/\Delta T_J$	I_C = 500 μA (25 °C to 125 °C)	-	0.6	-	V/°C
	Collector to emitter voltage	$V_{CE(ON)}$	V_{GE} = 15 V, I_C = 60 A	-	2.14	2.49	V
			V_{GE} = 15 V, I_C = 60 A, T_J = 125 °C	-	2.58	-	
	Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 500 μA	2.9	3.8	6.0	V
	Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 1 mA (25 °C to 125 °C)	-	-10.3	-	mV/°C
	Forward transconductance	g_{fe}	V_{CE} = 20 V, I_C = 60 A	-	75	-	S
	Transfer characteristics	V_{GE}	V_{CE} = 20 V, I_C = 60 A	-	5.7	-	V
	Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 600 V	-	0.008	0.1	mA
			V_{GE} = 0 V, V_{CE} = 600 V, T_J = 125 °C	-	0.23	-	
	Gate to emitter leakage	I_{GES}	V_{GE} = ± 20 V	-	-	± 200	nA

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)							
	PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
PFC Diode	Forward voltage drop	V_{FM}	I_F = 40 A	-	1.44	2.38	V
			I_F = 40 A, T_J = 125 °C	-	1.07	-	
	Blocking voltage	BV_{RM}	I_R = 200 μA	600	-	-	
	Reverse leakage current	I_{RM}	V_{RRM} = 600 V	-	0.16	120	μA
			V_{RRM} = 600 V, T_J = 125 °C	-	0.04	-	mA
AP Diode	Forward voltage drop	V_{FM}	I_F = 5 A	-	1.1	1.27	V
			I_F = 5 A, T_J = 125 °C	-	0.97	-	

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 = 50 A V_{CC} = 400 V V_{GE} = 15 V	-	480	-	nC
	Gate to emitter charge (turn-on)	Q_{ge}		-	82	-	
	Gate to collector charge (turn-on)	Q_{gc}		-	168	-	
	Turn-on switching loss	E_{on}	I_C = 100 A, V_{CC} = 300 V, V_{GE} = 15 V, R_g = 4.7 Ω, L = 500 μH, T_J = 25 °C (1)	-	0.4	-	mJ
	Turn-off switching loss	E_{off}		-	1.12	-	
	Total switching loss	E_{tot}		-	1.52	-	
	Turn-on delay time	$t_{d(on)}$		-	137	-	ns
	Rise time	t_r		-	52	-	
	Turn-off delay time	$t_{d(off)}$		-	341	-	
	Fall time	t_f		-	52	-	
	Turn-on switching loss	E_{on}	I_C = 100 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}		-	1.29	-	
	Total switching loss	E_{tot}		-	1.95	-	
	Turn-on delay time	$t_{d(on)}$		-	134	-	ns
	Rise time	t_r		-	53	-	
	Turn-off delay time	$t_{d(off)}$		-	352	-	
	Fall time	t_f		-	58	-	
	Input capacitance	C_{ies}	V_{GE} = 0 V V_{CC} = 30 V f = 1 MHz	-	9500	-	pF
	Output capacitance	C_{oes}		-	780	-	
	Reverse transfer capacitance	C_{res}		-	116	-	
	Reverse bias safe operating area	RBSOA	I_C = 300 A, V_{CC} = 400 V, V_P = 600 V, R_g = 22 Ω, V_{GE} = 15 V, L = 500 μH, T_J = 150 °C	Full square			
RECOVERY PARAMETER							
PFC Diode	Peak reverse recovery current	I_{rr}	I_F = 50 A dI/dt = 200 A/μs V_{rr} = 200 V	-	5.4	-	A
	Reverse recovery time	t_{rr}		-	72	-	ns
	Reverse recovery charge	Q_{rr}		-	194	-	nC
	Peak reverse recovery current	I_{rr}	I_F = 50 A, T_J = 125 °C dI/dt = 200 A/μs V_{rr} = 200 V	-	16	-	A
	Reverse recovery time	t_{rr}		-	159	-	ns
	Reverse recovery charge	Q_{rr}		-	1280	-	nC
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}		-	101	-	ns
	Reverse recovery charge	Q_{rr}		-	500	-	nC

Note

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

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
Input Rectifier Bridge	Junction to case thermal resistance per diode	R_{thJC}	-	-	0.81	°C/W
PFC IGBT	Junction to case IGBT thermal resistance		-	-	0.31	
PFC Diode	Junction to case PFC diode thermal resistance		-	-	0.58	
AP Diode	Junction to case AP diode thermal resistance		-	-	5.1	
	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. Lubricated threads.

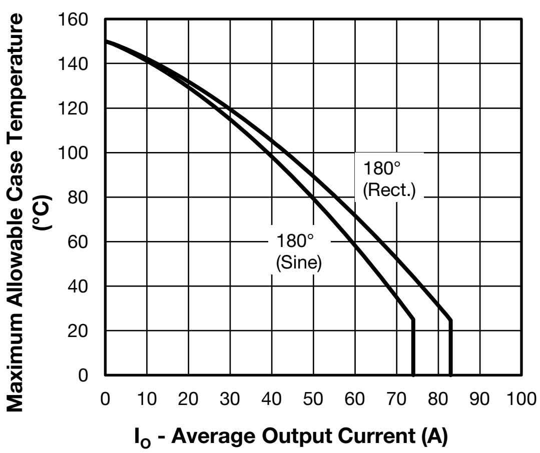


Fig. 1 - Maximum Allowable Case Temperature vs. Average Output Current (Single Phase Input Bridge Output Current Ratings Characteristics)

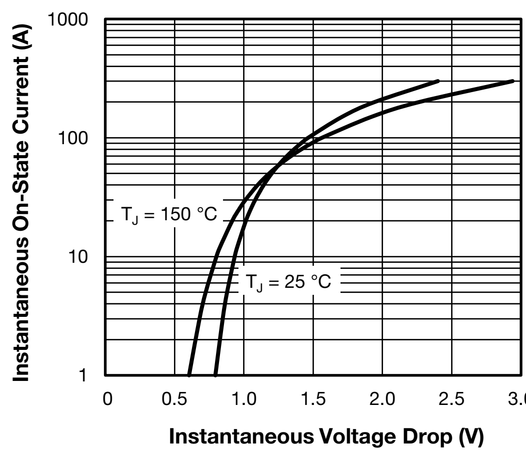


Fig. 3 - Instantaneous On-State Current vs. Instantaneous Voltage Drop (Single Phase Input Bridge On-State Voltage Drop Characteristics)

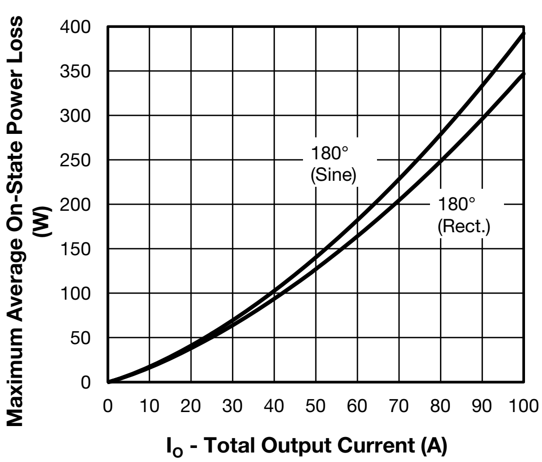


Fig. 2 - Maximum Average On-State Power Loss vs. Total Output Current (Single Phase Input Bridge On-State Power Loss Characteristics)

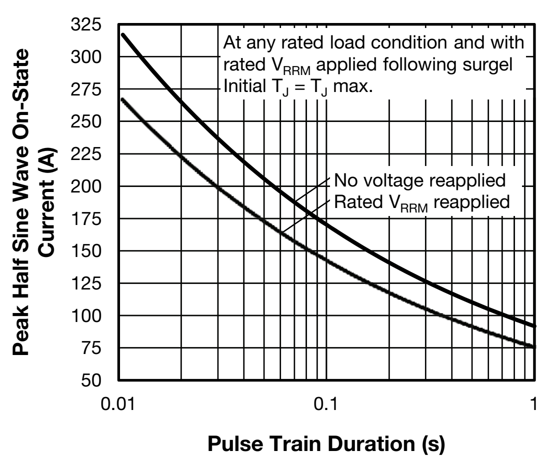


Fig. 4 - Peak Wave On-State Current vs. Pulse Train Duration (Single Phase Input Bridge Maximum Non-Repetitive Surge Current (per Junction))

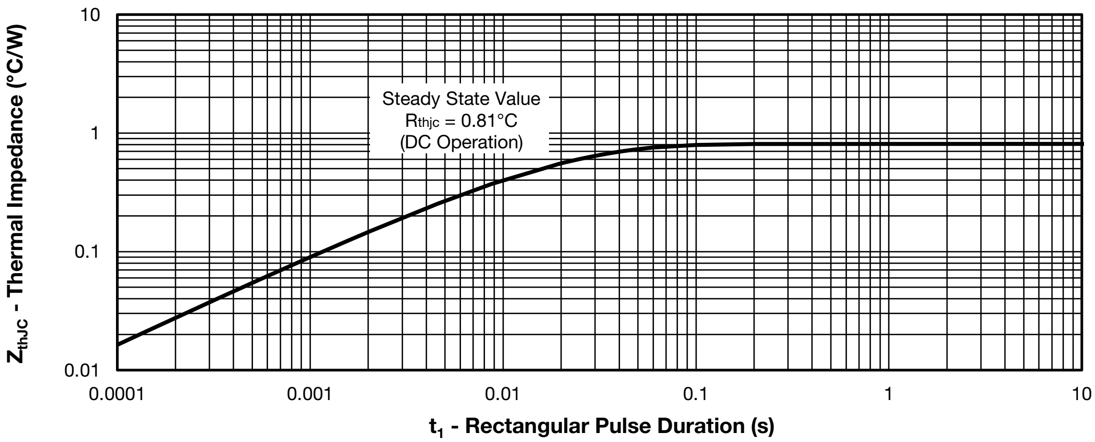


Fig. 5 - Z_{thJC} vs. t_1 Rectangular Pulse Duration
(Maximum Input Bridge Thermal Impedance Z_{thJC} Characteristics (per Junction))

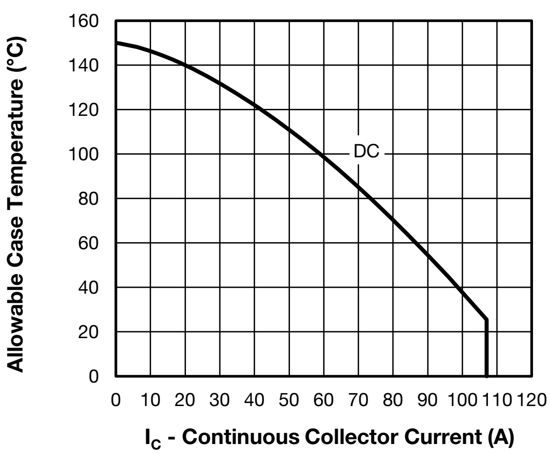


Fig. 6 - Allowable Case Temperature vs. Continuous Collector Current (Maximum PFC IGBT Continuous Collector Current vs. Case Temperature)

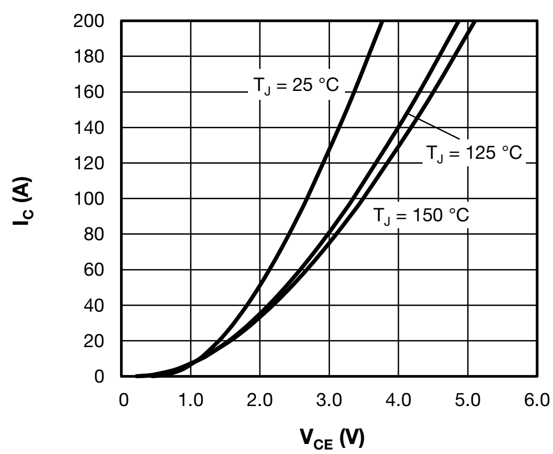


Fig. 8 - I_C vs. V_{CE}
(Typical PFC IGBT Output Characteristics, V_{GE} = 15 V)

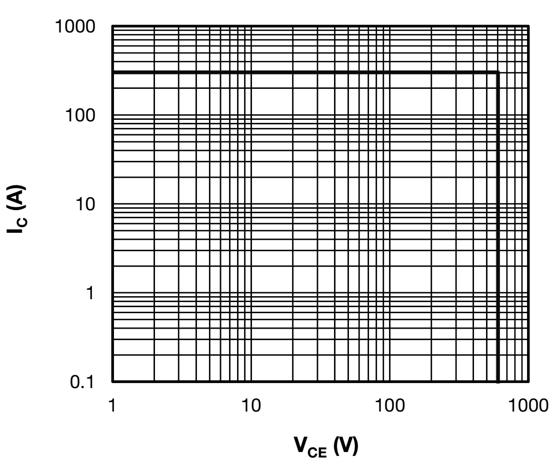


Fig. 7 - I_C vs. V_{CE}
(PFC IGBT Reverse BIAS SOA T_J = 150 °C, V_{GE} = 15 V)

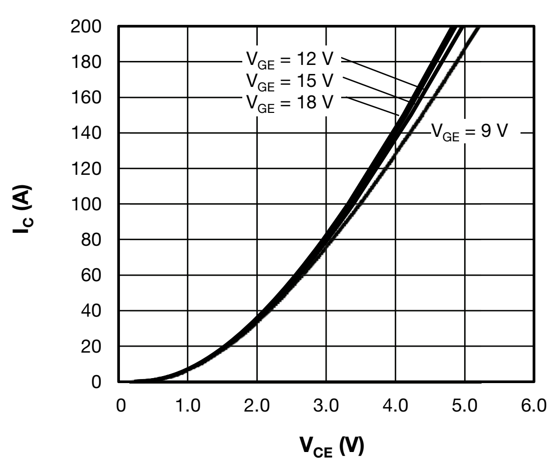


Fig. 9 - I_C vs. V_{CE}
(Typical PFC IGBT Output Characteristics, T_J = 125 °C)

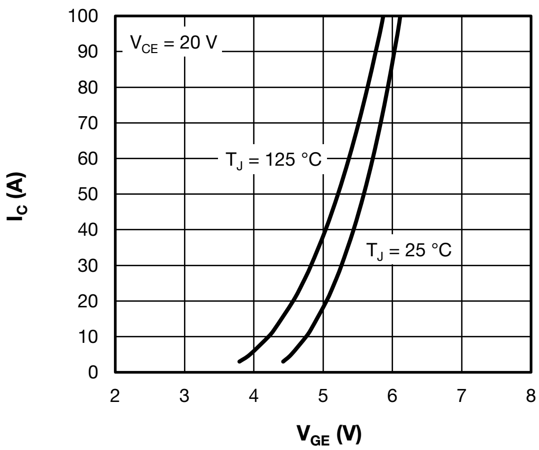


Fig. 10 - I_C vs. V_{GE}
(Typical PFC IGBT Transfer Characteristics)

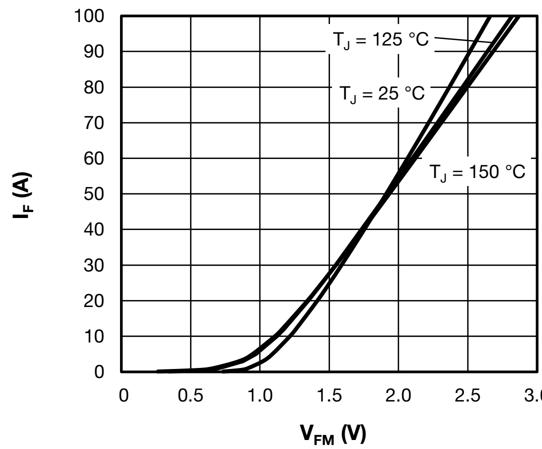


Fig. 13 - I_F vs. V_{FM}
(Typical Antiparallel Diode Forward Characteristics)

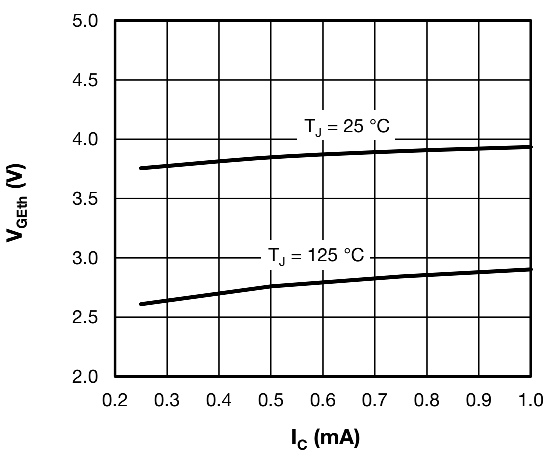


Fig. 11 - V_{GEth} vs. I_C
(Typical PFC IGBT Gate Threshold Voltage)

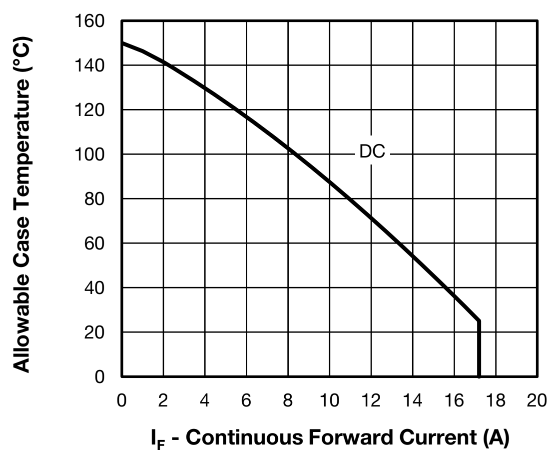


Fig. 14 - Allowable Case Temperature vs. Continuous Forward Current (Maximum Antiparallel Diode Continuous Forward Current vs. Case Temperature)

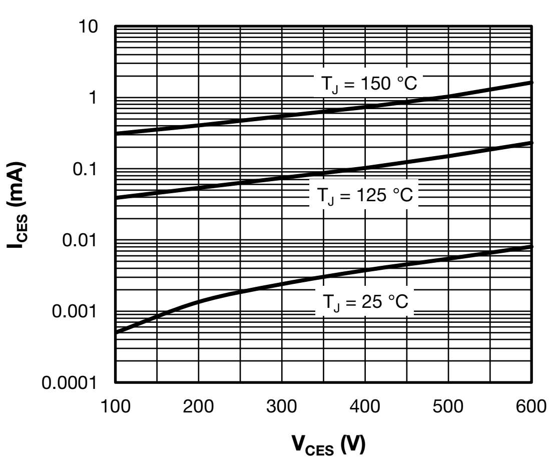


Fig. 12 - I_{CES} vs. V_{CES}
(Typical PFC IGBT Zero Gate Voltage Collector Current)

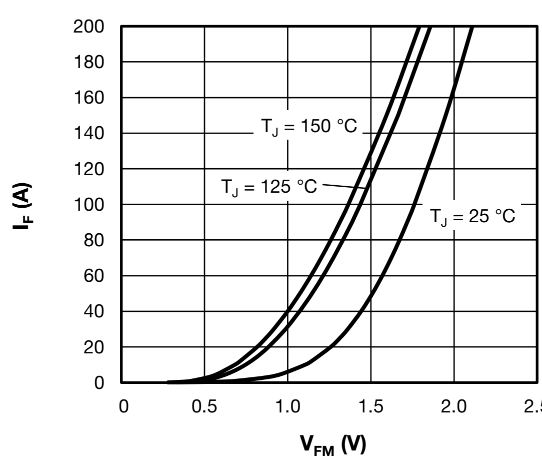


Fig. 15 - I_F vs. V_{FM}
(Typical PFC Diode Forward Characteristics)

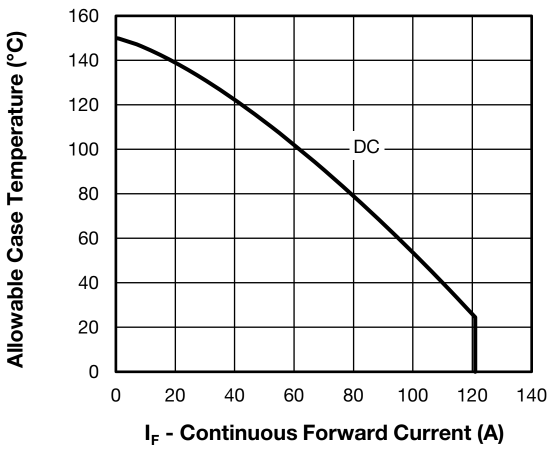


Fig. 16 - Allowable Case Temperature vs. Continuous Forward Current (Maximum PFC Diode Continuous Forward Current vs. Case Temperature)

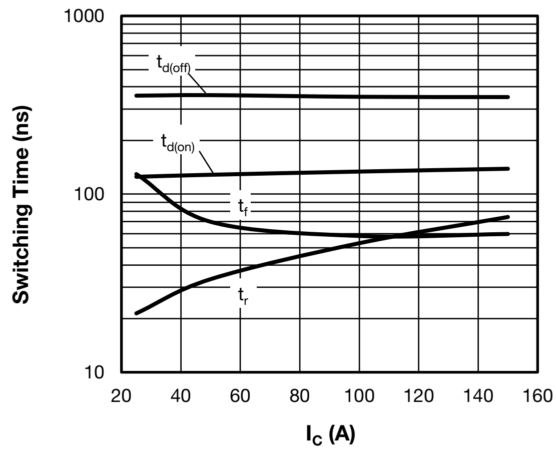


Fig. 19 - Switching Time vs. I_C
(Typical PFC IGBT Switching Time vs. I_C)
T_J = 125 °C, V_{CC} = 300 V, R_g = 4.7 Ω, V_{GE} = 15 V, L = 500 μH

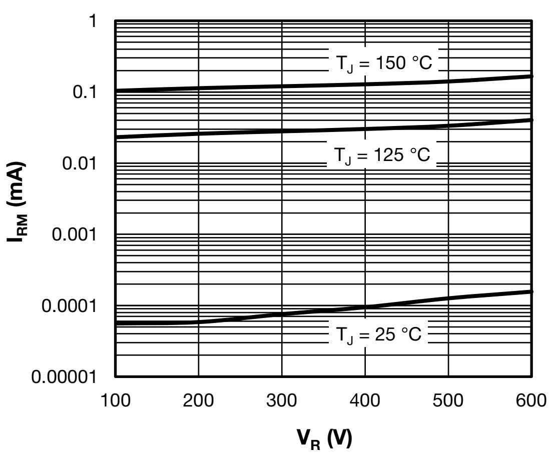


Fig. 17 - I_{RM} vs. V_R
(Typical PFC Diode Reverse Leakage Current)

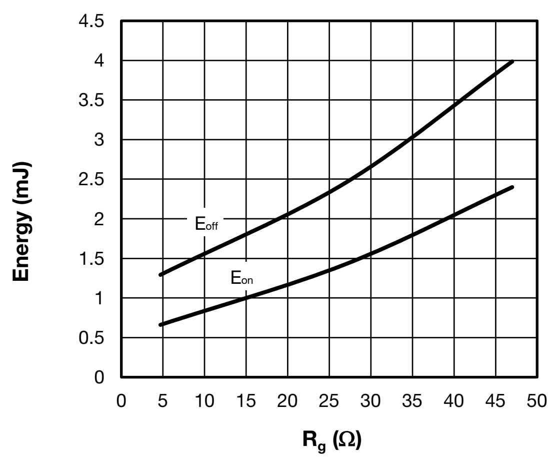


Fig. 20 - Energy Loss vs. R_g
(Typical PFC IGBT Energy Loss vs. R_g)
T_J = 125 °C, V_{CC} = 300 V, I_C = 100 A, V_{GE} = 15 V, L = 500 μH

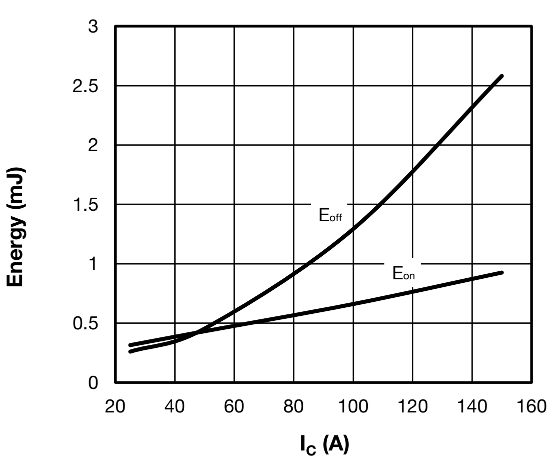


Fig. 18 - Energy Loss vs. I_C
(Typical PFC IGBT Energy Loss vs. I_C)
T_J = 125 °C, V_{CC} = 300 V, R_g = 4.7 Ω, V_{GE} = 15 V, L = 500 μH

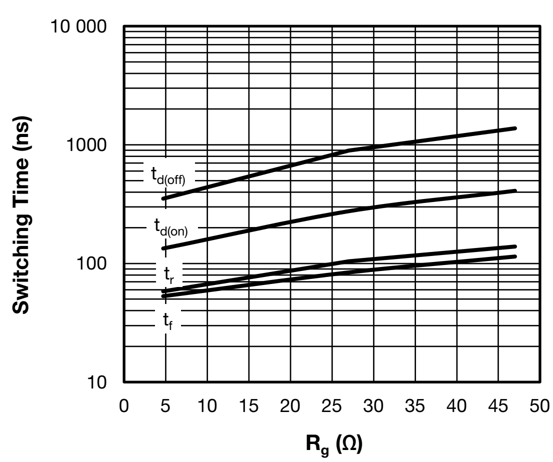


Fig. 21 - Switching Time vs. R_g
(Typical PFC IGBT Switching Time vs. R_g)
T_J = 125 °C, V_{CC} = 300 V, I_C = 100 A, V_{GE} = 15 V, L = 500 μH

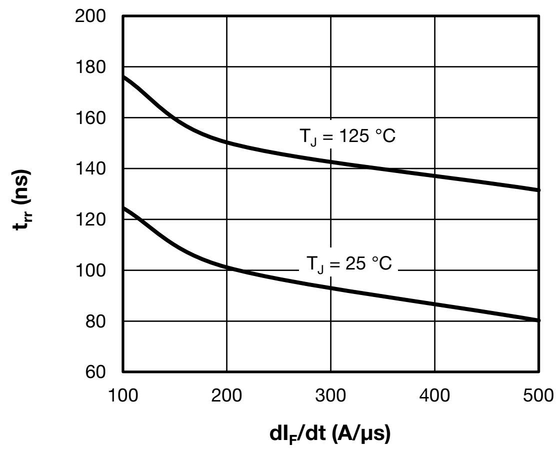


Fig. 22 - t_{rr} vs. dI_F/dt
(Typical Antiparallel Diode Reverse Recovery Time vs. dI_F/dt)
V_{rr} = 200 V, I_F = 10 A

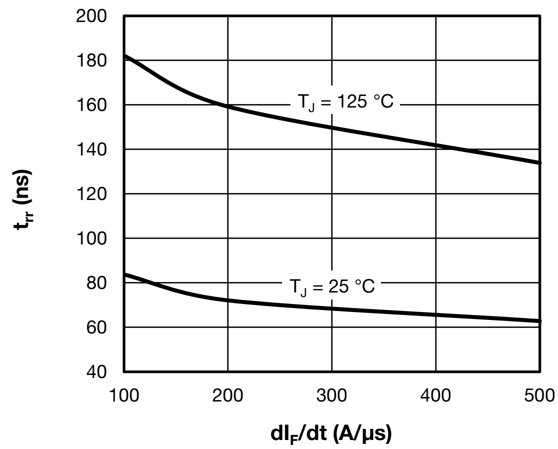


Fig. 25 - t_{rr} vs. dI_F/dt
(Typical PFC Diode Reverse Recovery Time vs. dI_F/dt)
V_{rr} = 200 V, I_F = 50 A

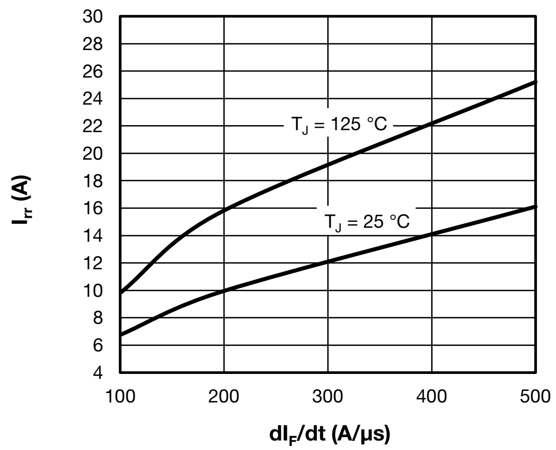


Fig. 23 - I_{rr} vs. dI_F/dt
(Typical Antiparallel Diode Reverse Recovery Current vs. dI_F/dt)
V_{rr} = 200 V, I_F = 10 A

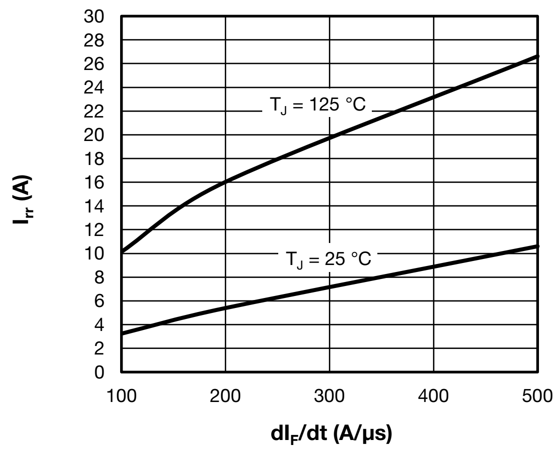


Fig. 26 - I_{rr} vs. dI_F/dt
(Typical PFC Diode Reverse Recovery Current vs. dI_F/dt)
V_{rr} = 200 V, I_F = 50 A

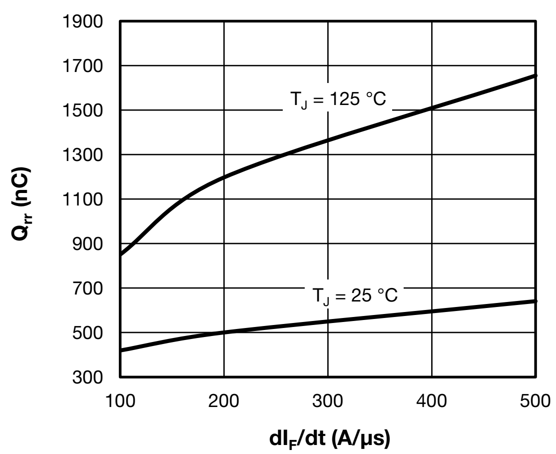


Fig. 24 - Q_{rr} vs. dI_F/dt
(Typical Antiparallel Diode Reverse Recovery Charge vs. dI_F/dt)
V_{rr} = 200 V, I_F = 10 A

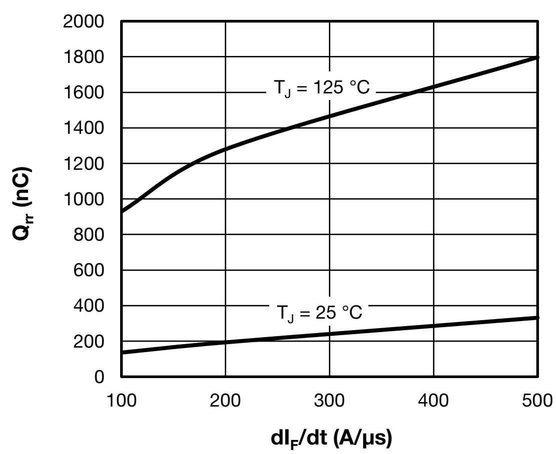


Fig. 27 - Q_{rr} vs dI_F/dt
(Typical PFC Diode Reverse Recovery Charge vs. dI_F/dt)
V_{rr} = 200 V, I_F = 50 A

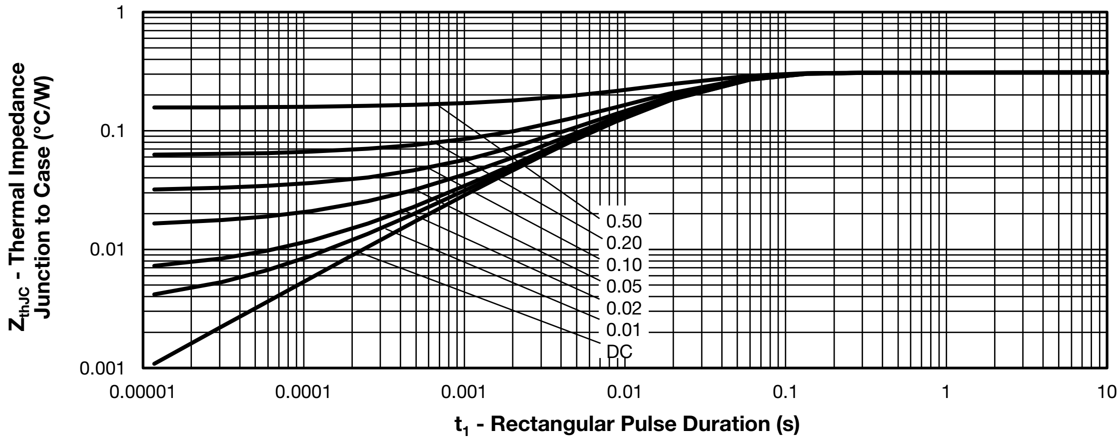


Fig. 28 - Z_{thJC} vs. t_1 Rectangular Pulse Duration
(Maximum Thermal Impedance Z_{thJC} Characteristics - (PFC IGBT))

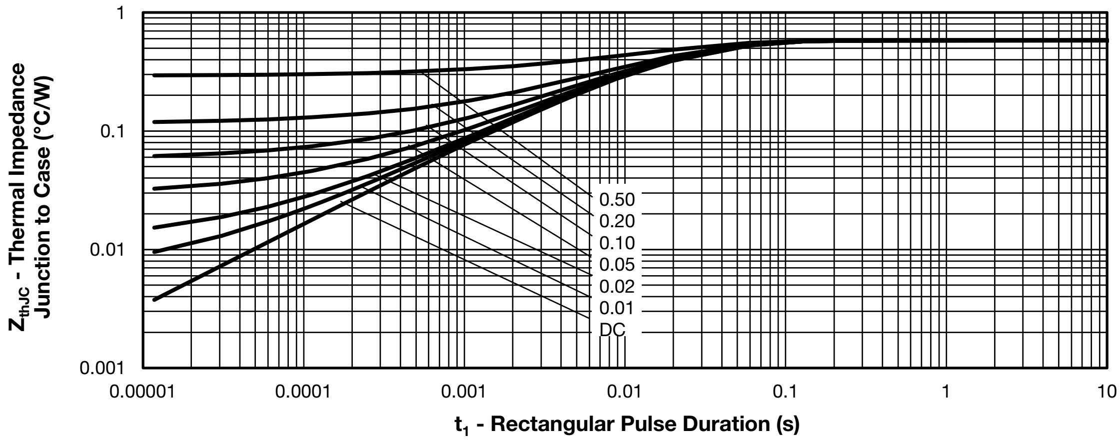
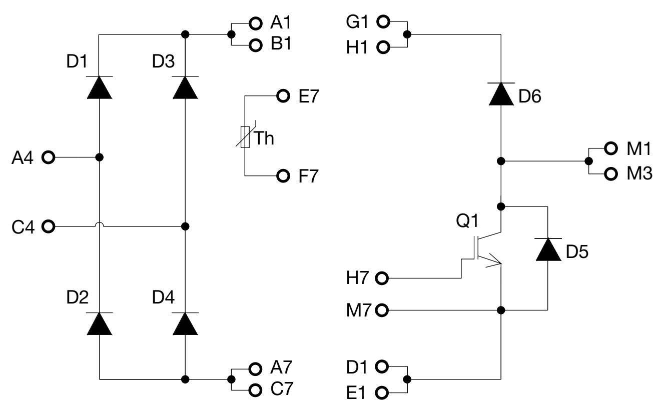


Fig. 29 - Z_{thJC} vs. t_1 Rectangular Pulse Duration
(Maximum Thermal Impedance Z_{thJC} Characteristics - (PFC Diode))

CIRCUIT CONFIGURATION



ORDERING INFORMATION

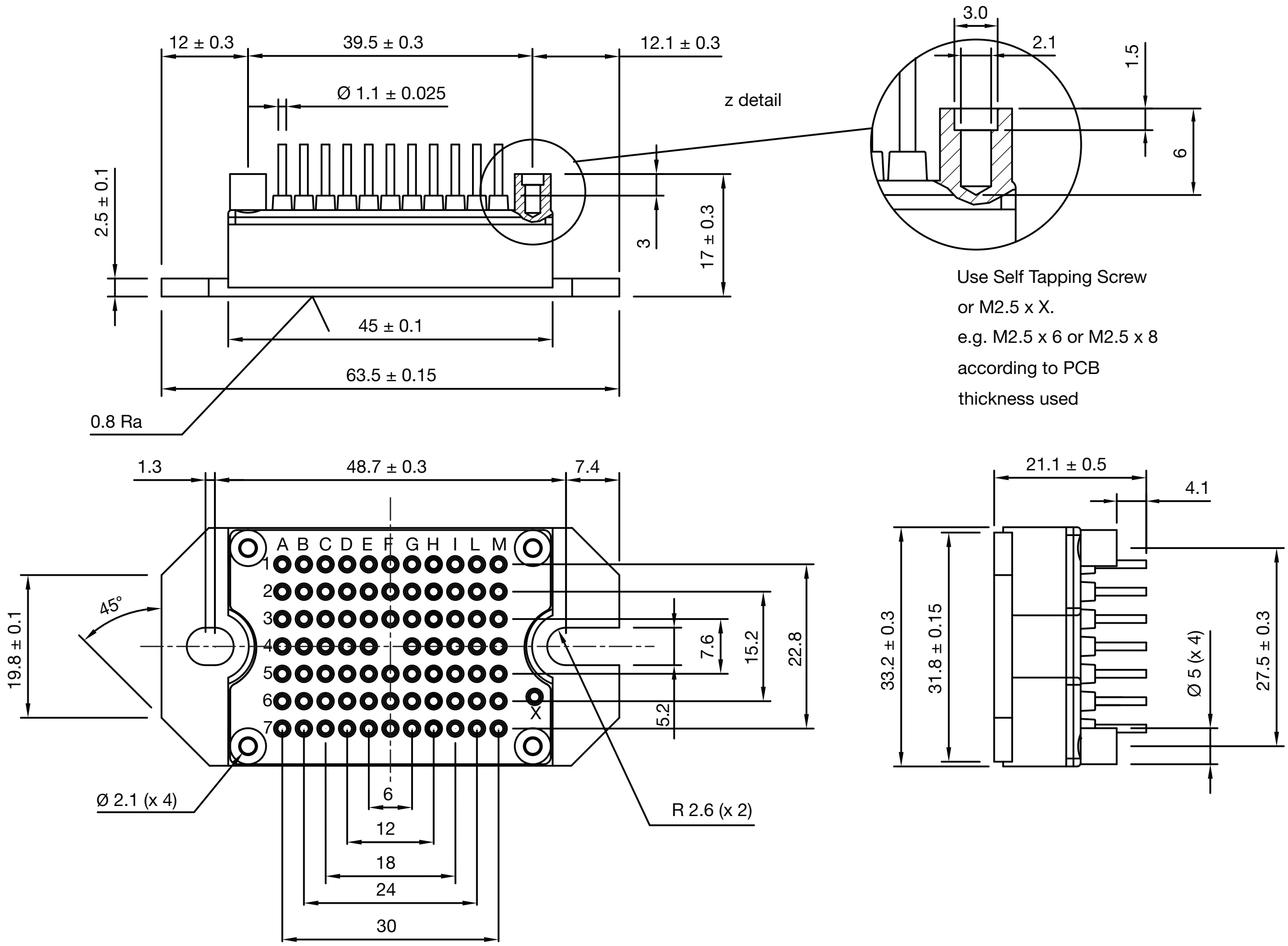
Device code	VS-	100	MT	060	W	SP
	1	2	3	4	5	6

1 - Vishay Semiconductors product
2 - Current rating (100 = 100 A)
3 - Essential part number (MT = MTP package)
4 - Voltage code (060 = 600 V)
5 - Die IGBT technology (W = Warp Speed IGBT)
6 - Circuit configuration (SP = Single Phase Bridge plus PFC)

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

MTP - Full Pin

DIMENSIONS in millimeters



PINS POSITION
WITH TOLERANCE ⌖ Ø 0.6

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