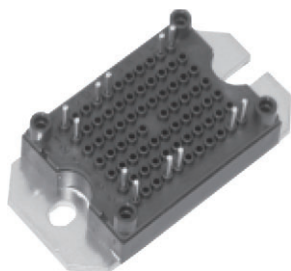


MTP IGBT Power Module Primary Rectifier and PFC



MTP
(Package example)

PRIMARY CHARACTERISTICS

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



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 $T_J = 150\text{ }^{\circ}\text{C}$ maximum	I_O	$T_C = 80\text{ }^{\circ}\text{C}$	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}	$T_J = 25\text{ }^{\circ}\text{C}$	600	V
	Gate to emitter voltage	V_{GE}		± 20	
	Maximum continuous collector current at $V_{GE} = 15\text{ V}$, $T_J = 150\text{ }^{\circ}\text{C}$ maximum	I_C	$T_C = 25\text{ }^{\circ}\text{C}$	107	A
			$T_C = 80\text{ }^{\circ}\text{C}$	73	
	Pulsed collector current	$I_{CM}^{(1)}$		300	
	Clamped inductive load current	I_{LM}		300	
	Maximum power dissipation	P_D	$T_C = 25\text{ }^{\circ}\text{C}$	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 $T_J = 150\text{ }^{\circ}\text{C}$ maximum	I_F	$T_C = 25\text{ }^{\circ}\text{C}$	121	A
			$T_C = 80\text{ }^{\circ}\text{C}$	79	
	Maximum power dissipation	P_D	$T_C = 25\text{ }^{\circ}\text{C}$	154	W
	Maximum non-repetitive peak current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, $T_J = 25\text{ }^{\circ}\text{C}$	480	A
AP diode	Repetitive peak reverse voltage	V_{RRM}		600	V
	Maximum continuous forward current $T_J = 150\text{ }^{\circ}\text{C}$ maximum	I_F	$T_C = 25\text{ }^{\circ}\text{C}$	17	A
			$T_C = 80\text{ }^{\circ}\text{C}$	11	
	Maximum power dissipation	P_D	$T_C = 25\text{ }^{\circ}\text{C}$	24	W
	Maximum non-repetitive peak current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, $T_J = 25\text{ }^{\circ}\text{C}$	60	A
	Maximum operating junction temperature	T_J		150	$^{\circ}\text{C}$
	Storage temperature range	T_{Stg}		-40 to +150	
	RMS isolation voltage	V_{ISOL}	$T_J = 25\text{ }^{\circ}\text{C}$, all terminals shorted, $f = 50\text{ Hz}$, $t = 1\text{ s}$	3500	W

Notes

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

(1) $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$, $R_g = 4.7\text{ }\Omega$, $T_J = 150\text{ }^{\circ}\text{C}$

 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	$^{\circ}\text{C}/\text{W}$

ELECTRICAL SPECIFICATIONS ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise noted)

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

RECOVERY PARAMETER

PFC diode	Peak reverse recovery current	I_{rr}	$I_F = 50\text{ A}$ $dI/dt = 200\text{ A}/\mu\text{s}$ $V_{rr} = 200\text{ V}$	-	5.4	-	A
	Reverse recovery time	t_{rr}		-	72	-	ns
	Reverse recovery charge	Q_{rr}		-	194	-	nC
	Peak reverse recovery current	I_{rr}	$I_F = 50\text{ A}, T_J = 125\text{ }^{\circ}\text{C}$ $dI/dt = 200\text{ A}/\mu\text{s}$ $V_{rr} = 200\text{ V}$	-	16	-	A
	Reverse recovery time	t_{rr}		-	159	-	ns
	Reverse recovery charge	Q_{rr}		-	1280	-	nC
AP diode	Peak reverse recovery current	I_{rr}	$I_F = 10\text{ A}$ $dI/dt = 200\text{ A}/\mu\text{s}$ $V_{rr} = 200\text{ V}$	-	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 ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Resistance	R	$T_J = 25\text{ }^{\circ}\text{C}$	-	30 000	-	Ω
B value	B	$T_J = 25\text{ }^{\circ}\text{C}/T_J = 85\text{ }^{\circ}\text{C}$	-	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 $\pm 10\%$ 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

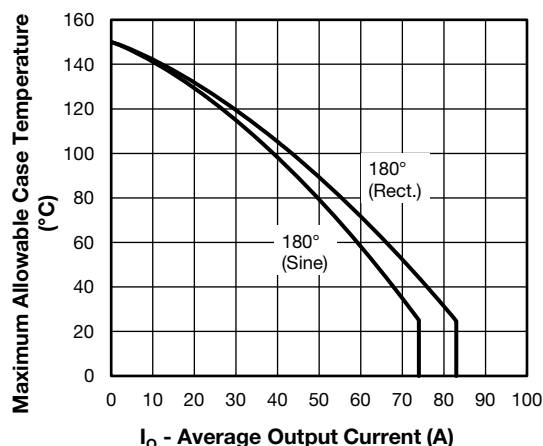


Fig. 1 - Maximum Allowable Case Temperature vs. Average Output Current (Single Phase Input Bridge Output Current Ratings Characteristics)

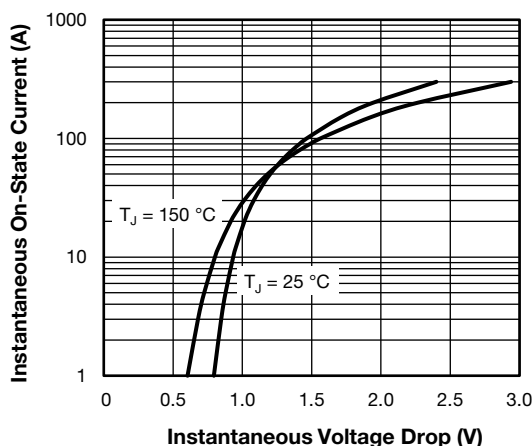


Fig. 3 - Instantaneous On-State Current vs. Instantaneous Voltage Drop (Single Phase Input Bridge On-State Voltage Drop Characteristics)

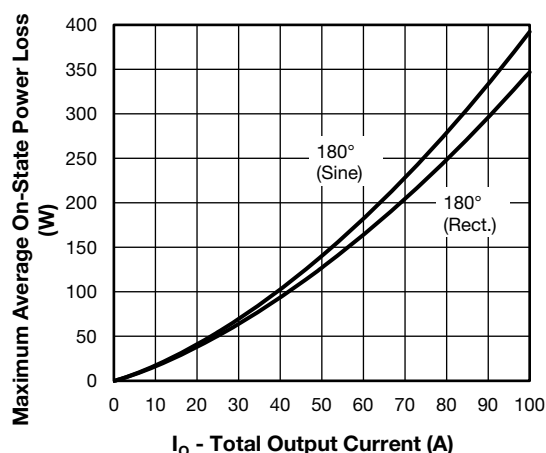


Fig. 2 - Maximum Average On-State Power Loss vs. Total Output Current (Single Phase Input Bridge On-State Power Loss Characteristics)

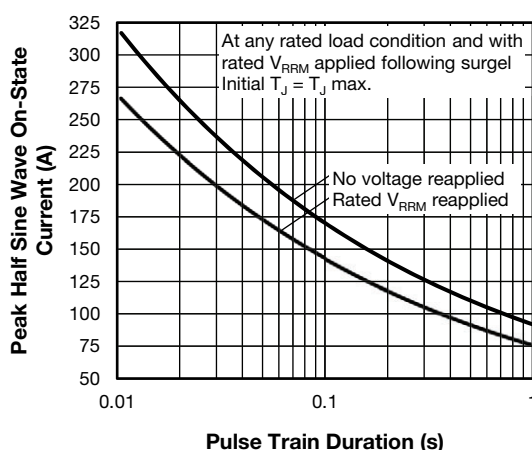


Fig. 4 - Peak Wave On-State Current vs. Pulse Train Duration (Single Phase Input Bridge Maximum Non-Repetitive Surge Current (per Junction))

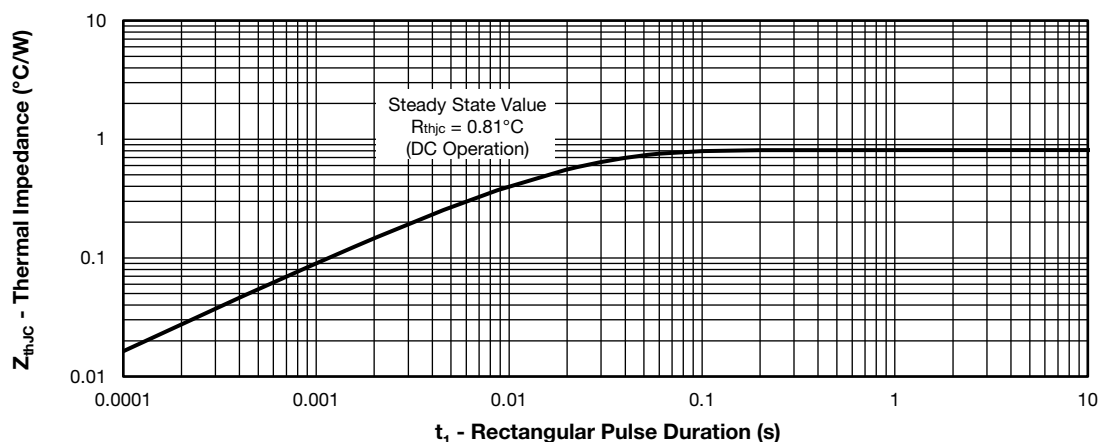


Fig. 5 - Z_{thJC} vs. t_1 Rectangular Pulse Duration
(Maximum Input Bridge Thermal Impedance Z_{thJC} Characteristics (per Junction))

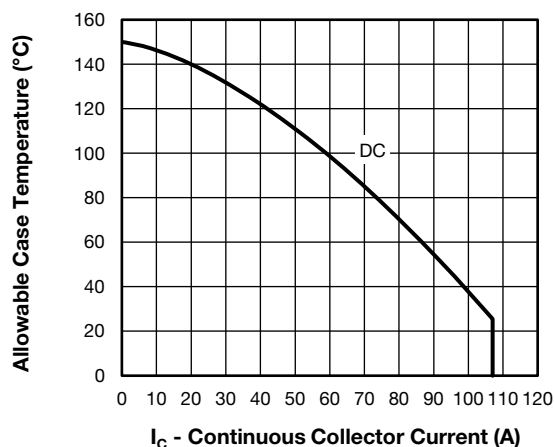


Fig. 6 - Allowable Case Temperature vs. Continuous Collector Current
(Maximum PFC IGBT Continuous Collector Current vs. Case Temperature)

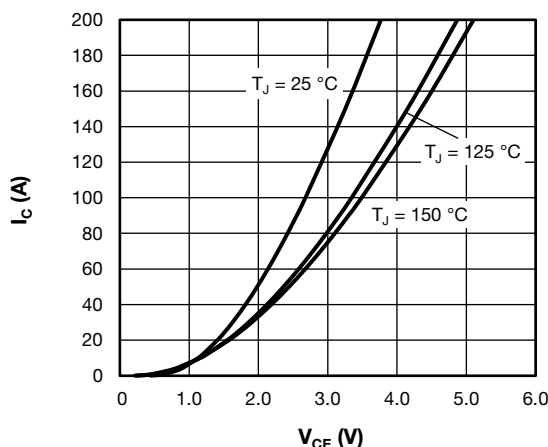


Fig. 8 - I_C vs. V_{CE}
(Typical PFC IGBT Output Characteristics, $V_{GE} = 15$ V)

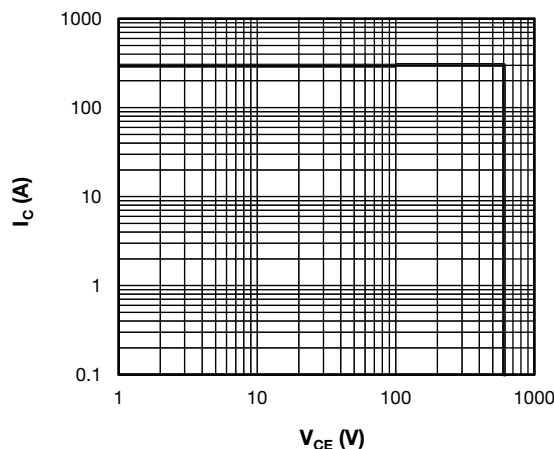


Fig. 7 - I_C vs. V_{CE}
(PFC IGBT Reverse BIAS SOA $T_J = 150$ °C, $V_{GE} = 15$ V)

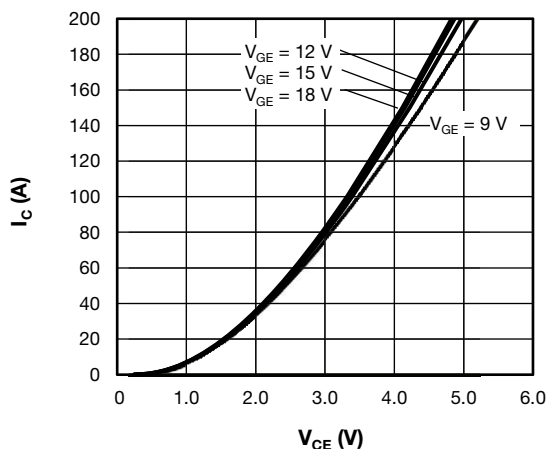


Fig. 9 - I_C vs. V_{CE}
(Typical PFC IGBT Output Characteristics, $T_J = 125$ °C)

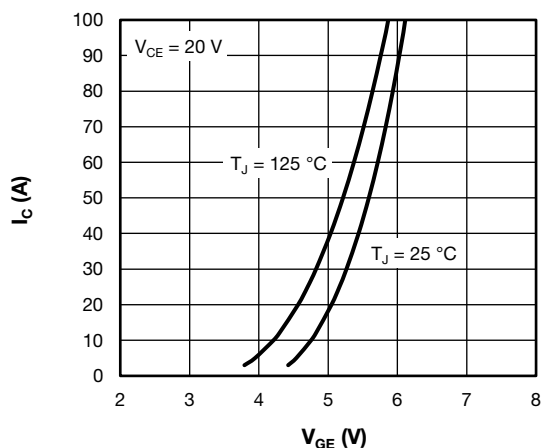


Fig. 10 - I_C vs. V_{GE}
(Typical PFC IGBT Transfer Characteristics)

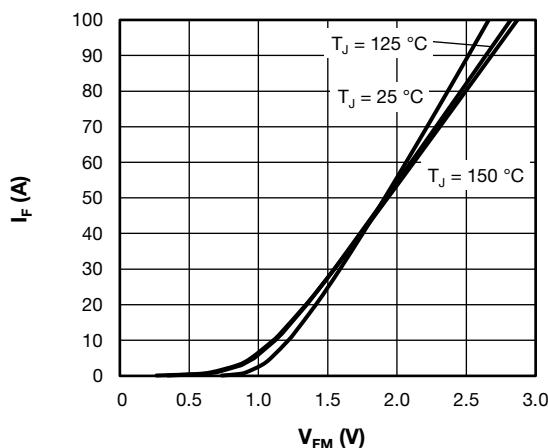


Fig. 13 - I_F vs. V_{FM}
(Typical Antiparallel Diode Forward Characteristics)

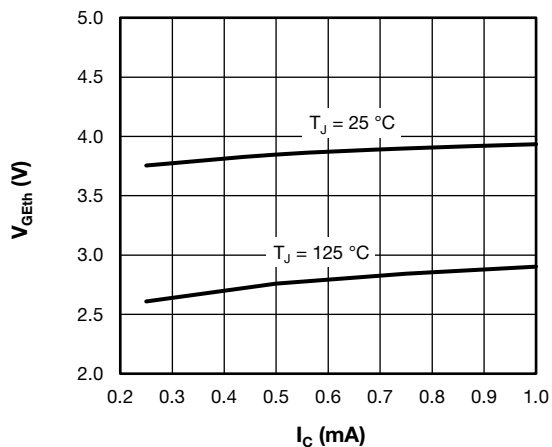


Fig. 11 - V_{GEth} vs. I_C
(Typical PFC IGBT Gate Threshold Voltage)

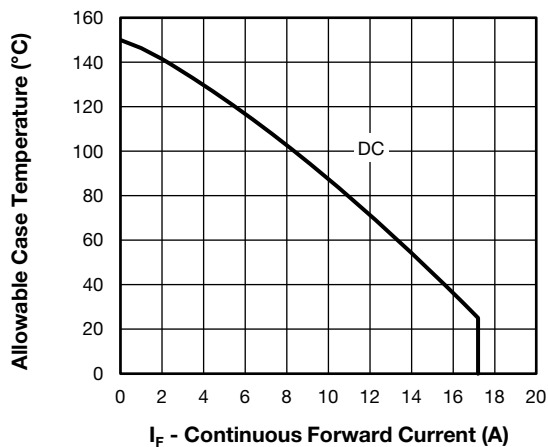


Fig. 14 - Allowable Case Temperature vs. Continuous Forward Current (Maximum Antiparallel Diode Continuous Forward Current vs. Case Temperature)

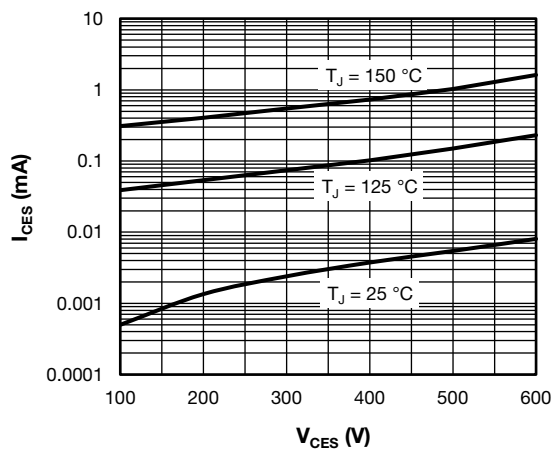


Fig. 12 - I_{CES} vs. V_{CES}
(Typical PFC IGBT Zero Gate Voltage Collector Current)

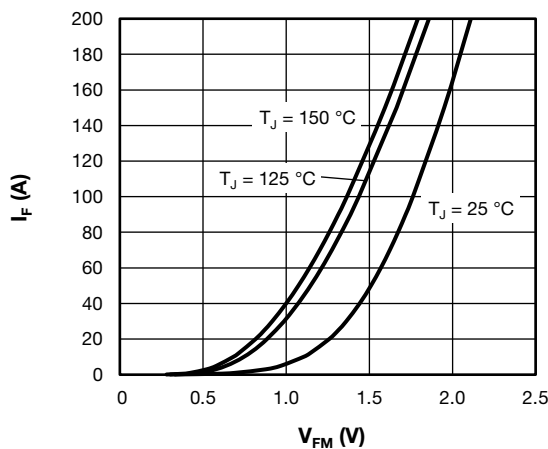


Fig. 15 - I_F vs. V_{FM}
(Typical PFC Diode Forward Characteristics)

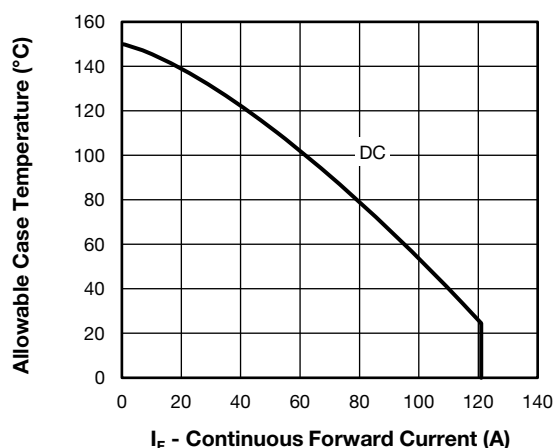


Fig. 16 - Allowable Case Temperature vs. Continuous Forward Current (Maximum PFC Diode Continuous Forward Current vs. Case Temperature)

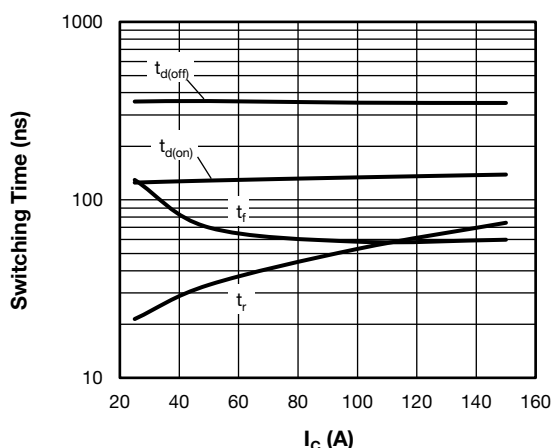


Fig. 19 - Switching Time vs. I_C
(Typical PFC IGBT Switching Time vs. I_C)
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 4.7\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

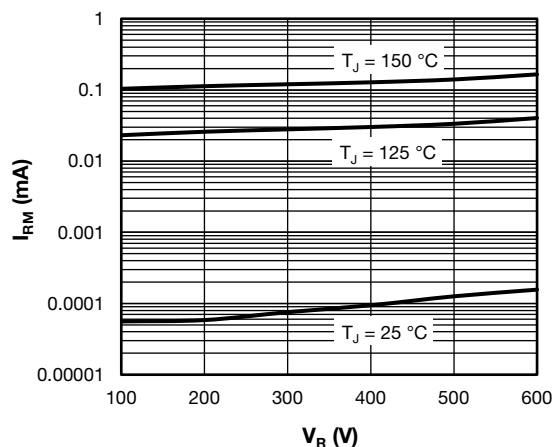


Fig. 17 - I_{RM} vs. V_R
(Typical PFC Diode Reverse Leakage Current)

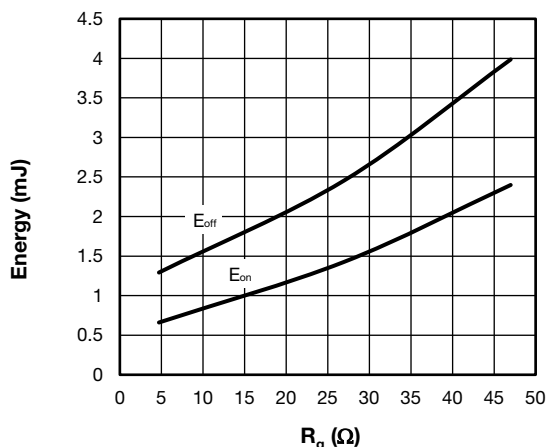


Fig. 20 - Energy Loss vs. R_g
(Typical PFC IGBT Energy Loss vs. R_g)
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 100\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

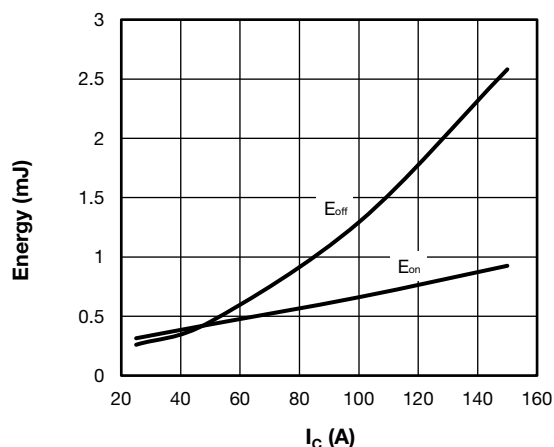


Fig. 18 - Energy Loss vs. I_C
(Typical PFC IGBT Energy Loss vs. I_C)
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 4.7\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

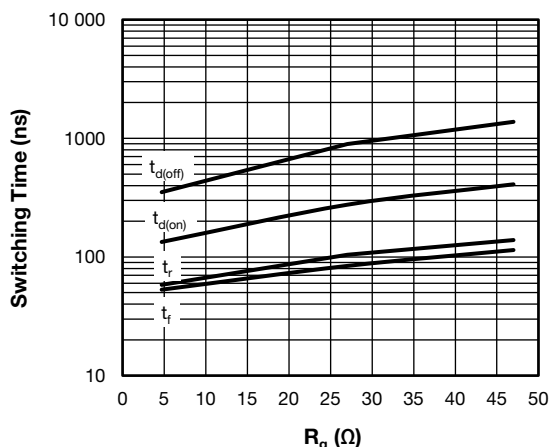


Fig. 21 - Switching Time vs. R_g
(Typical PFC IGBT Switching Time vs. R_g)
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 100\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

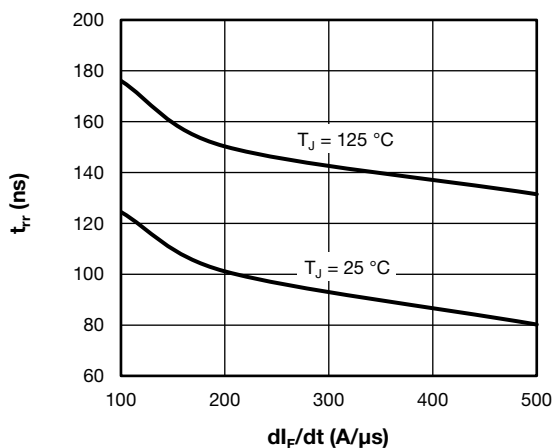


Fig. 22 - t_{rr} vs. dl_F/dt
(Typical Antiparallel Diode Reverse Recovery Time vs. dl_F/dt)
 $V_{rr} = 200\text{ V}$, $I_F = 10\text{ A}$

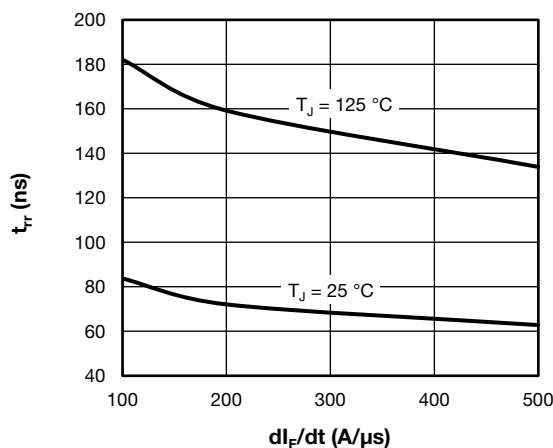


Fig. 25 - t_{rr} vs. dl_F/dt
(Typical PFC Diode Reverse Recovery Time vs. dl_F/dt)
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

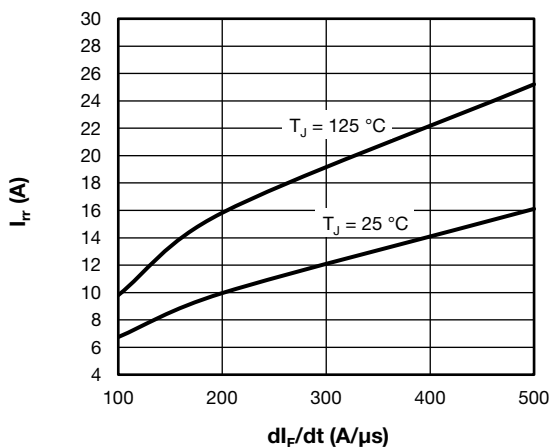


Fig. 23 - I_{rr} vs. dl_F/dt
(Typical Antiparallel Diode Reverse Recovery Current vs. dl_F/dt)
 $V_{rr} = 200\text{ V}$, $I_F = 10\text{ A}$

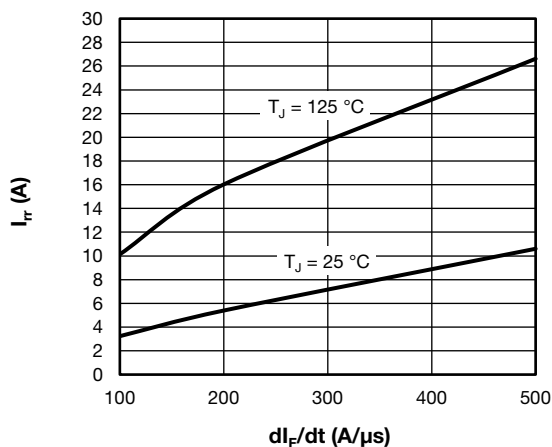


Fig. 26 - I_{rr} vs. dl_F/dt
(Typical PFC Diode Reverse Recovery Current vs. dl_F/dt)
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

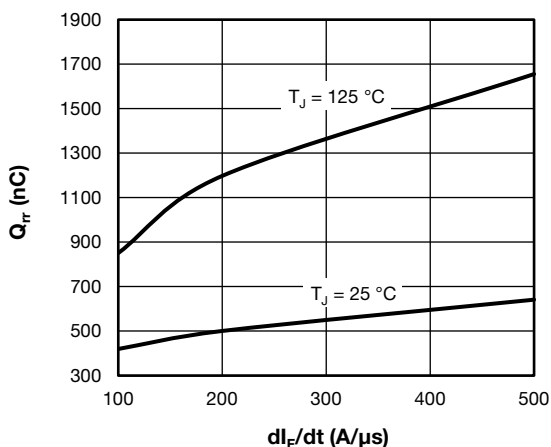


Fig. 24 - Q_{rr} vs. dl_F/dt
(Typical Antiparallel Diode Reverse Recovery Charge vs. dl_F/dt)
 $V_{rr} = 200\text{ V}$, $I_F = 10\text{ A}$

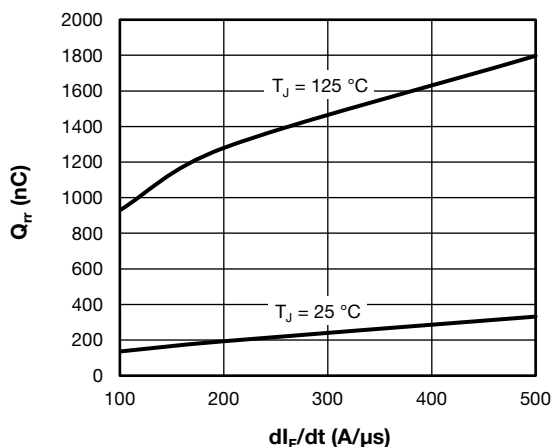


Fig. 27 - Q_{rr} vs. dl_F/dt
(Typical PFC Diode Reverse Recovery Charge vs. dl_F/dt)
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

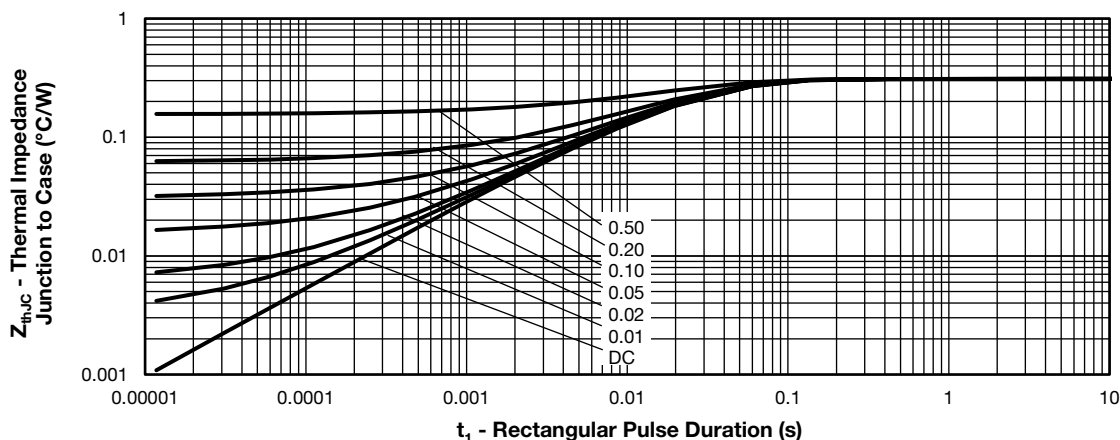


Fig. 28 - Z_{thJC} vs. t_1 Rectangular Pulse Duration
(Maximum Thermal Impedance Z_{thJC} Characteristics - (PFC IGBT))

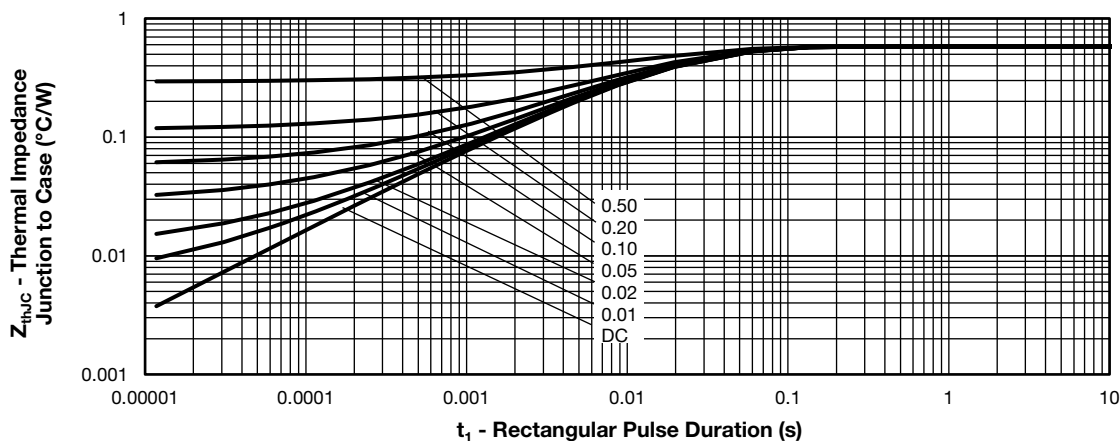
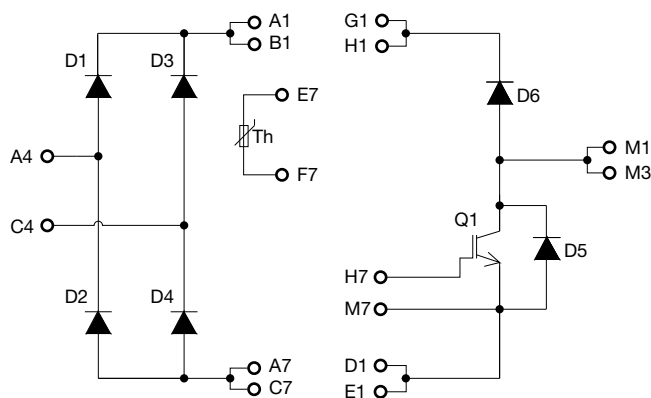


Fig. 29 - Z_{thJC} vs. t_1 Rectangular Pulse Duration
(Maximum Thermal Impedance Z_{thJC} Characteristics - (PFC Diode))

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

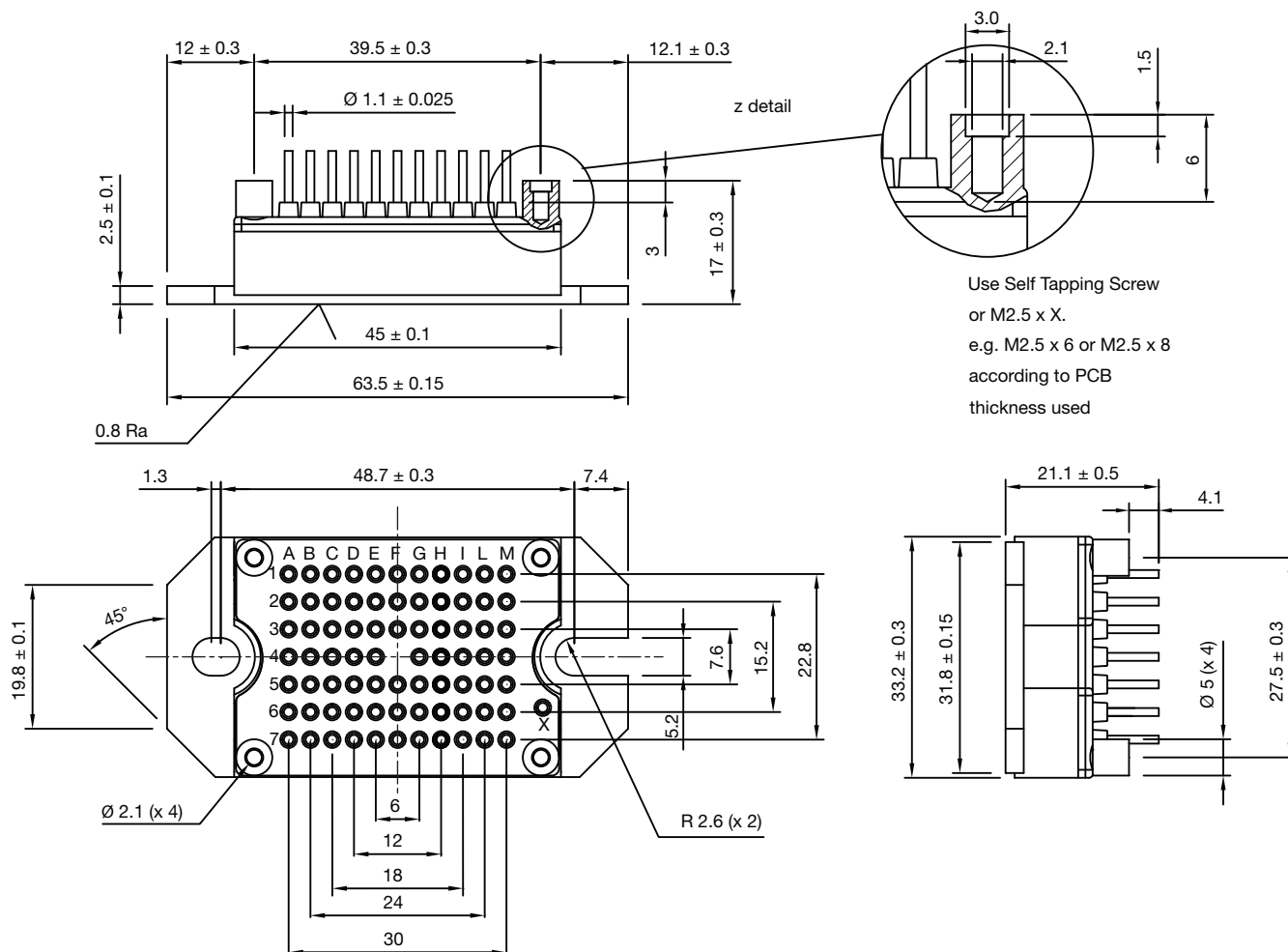
Dimensions

www.vishay.com/doc?95383



MTP - Full Pin

DIMENSIONS in millimeters



PINS POSITION
WITH TOLERANCE $\varnothing 0.6$



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