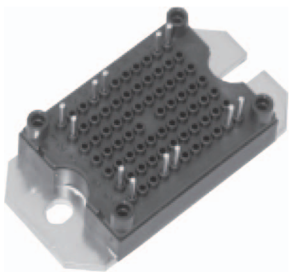
Primary MTP IGBT Power Module



MTP

FEATURES

- Buck PFC stage with warp 2 IGBT and FRED Pt® hyperfast diode
- Integrated thermistor
- Isolated baseplate
- Very low stray inductance design for high speed operation
- 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

PRODUCT SUMMARY	
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 60 A	2.08 V
IGBT, T_J = 150 °C	
V_{CES}	600 V
$V_{CE(ON)}$ at 25 °C at 60 A	1.98 V
I_C at 80°C	83 A
FRED Pt® CHOPPER DIODE, T_J = 150 °C	
V_R	600 V
$I_{F(DC)}$ at 80 °C	17 A
V_F at 25 °C at 60 A	2.06 V
Speed	30 kHz to 150 kHz
Package	MTP
Circuit	Dual forward

ABSOLUTE MAXIMUM RATINGS

	PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
FRED Pt 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 power dissipation	P_D	T_C = 25 °C	25	W
IGBT	Collector to emitter voltage	V_{CES}	T_J = 25 °C	600	V
	Gate to emitter voltage	V_{GE}	I_{GES} max. ± 250 ns	± 20	V
	Maximum continuous collector current at V_{GE} = 15 V, T_J = 150 °C maximum	I_C	T_C = 25 °C	121	A
			T_C = 80 °C	83	
	Clamped inductive load current	I_{LM}		300	
	Maximum power dissipation	P_D	T_C = 25 °C	462	W
FRED Pt 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	26	A
			T_C = 80 °C	17	
	Maximum power dissipation	P_D	T_C = 25 °C	56	W
	Maximum operating junction temperature	T_J		150	°C
	Storage temperature range	T_{Stg}		-40 to +150	
	Isolation voltage	V_{ISOL}	V_{RMS} t = 1 s, T_J = 25 °C	3500	V

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)							
	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
AP Diode	Blocking voltage	BV_{RRM}	0.5 mA	600	-	-	V
	Forward voltage drop	V_{FM}	I_F = 60 A	-	2.08	2.43	V
			I_F = 60 A, T_J = 125 °C	-	2.05	2.3	
IGBT	Collector to emitter breakdown voltage	BV_{CES}	V_{GE} = 0 V, I_C = 0.5 mA	600	-	-	V
	Temperature coefficient of breakdown voltage	$\Delta V_{BR(CES)}/\Delta T_J$	I_C = 0.5 mA (25 °C to 125 °C)	-	0.6	-	V/°C
	Collector to emitter voltage	$V_{CE(ON)}$	V_{GE} 15 V, I_C = 60 A	-	1.93	2.29	V
			V_{GE} = 15 V, I_C = 60 A, T_J = 125 °C	-	2.36	2.80	
	Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 500 μA	2.9	-	6.0	V
	Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 600 V	-	-	100	μA
			V_{GE} = 0 V, V_{CE} = 600 V, T_J = 125 °C	-	-	2.0	mA
	Gate to emitter leakage	I_{GES}	V_{GE} = ± 20 V	-	-	± 100	nA
FRED Pt Chopper Diode	Forward voltage drop	V_{FM}	I_F = 60 A	-	2.06	2.53	V
			I_F = 60 A, T_J = 125 °C	-	1.83	2.26	
	Blocking voltage	BV_{RM}	0.5 mA	600	-	-	
	Reverse leakage current	I_{RM}	V_{RRM} = 600 V	-	-	75	μA
			V_{RRM} = 600 V, T_J = 125 °C	-	-	0.5	mA
RECOVERY PARAMETER							
AP Diode	Peak reverse recovery current	I_{rr}	I_F = 60 A dI/dt = 200 A/μs V_R = 200 V	-	67	11	A
	Reverse recovery time	t_{rr}		-	120	160	ns
	Reverse recovery charge	Q_{rr}		-	620	850	nC
FRED Pt Chopper Diode	Peak reverse recovery current	I_{rr}	I_F = 60 A dI/dt = 200 A/μs V_R = 200 V	-	4.5	6.0	A
	Reverse recovery time	t_{rr}		-	67	85	ns
	Reverse recovery charge	Q_{rr}		-	130	250	nC
	Peak reverse recovery current	I_{rr}	I_F = 60 A dI/dt = 200 A/μs V_R = 200 V, T_J = 125 °C	-	9.5	12.0	A
	Reverse recovery time	t_{rr}		-	128	165	ns
	Reverse recovery charge	Q_{rr}		-	601	900	nC

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise noted)							
	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
PFC IGBT	Total gate charge	Q_g	I_C = 60 A V_{CC} = 480 V V_{GE} = 15 V	-	460	-	nC
	Gate to source charge	Q_{gs}		-	160	-	
	Gate to drain (Miller) charge	Q_{gd}		-	70	-	
	Turn-on switching loss	E_{on}	I_C = 100 A, V_{CC} = 360 V, V_{GE} = 15 V R_g = 5 Ω, L = 500 μH, T_J = 25 °C	-	0.2	-	mJ
	Turn-off switching loss	E_{off}		-	0.96	-	
	Total switching loss	E_{tot}		-	1.16	-	
	Turn-on delay time	$t_{d(on)}$		-	240	-	ns
	Rise time	t_r		-	47	-	
	Turn-off delay time	$t_{d(off)}$		-	240	-	
	Fall time	t_f		-	66	-	
	Turn-on switching loss	E_{on}	I_C = 100 A, V_{CC} = 360 V, V_{GE} = 15 V R_g = 5 Ω, L = 500 μH, T_J = 125 °C	-	0.33	-	mJ
	Turn-off switching loss	E_{off}		-	1.45	-	
	Total switching loss	E_{tot}		-	1.78	-	
	Turn-on delay time	$t_{d(on)}$		-	246	-	ns
	Rise time	t_r		-	50	-	
	Turn-off delay time	$t_{d(off)}$		-	246	-	
	Fall time	t_f		-	71	-	
	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}		-	120	-	

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
AP FRED Pt Diode	Junction to case diode thermal resistance	R_{thJC}	-	-	4.9	°C/W
IGBT	Junction to case IGBT thermal resistance		-	-	0.27	
FRED Pt Chopper Diode	Junction to case diode thermal resistance		-	-	2.25	
	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.

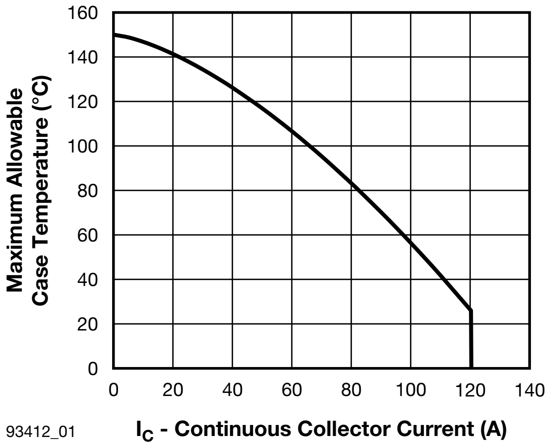


Fig. 1 - Maximum IGBT Continuous Collector Current vs. Case Temperature

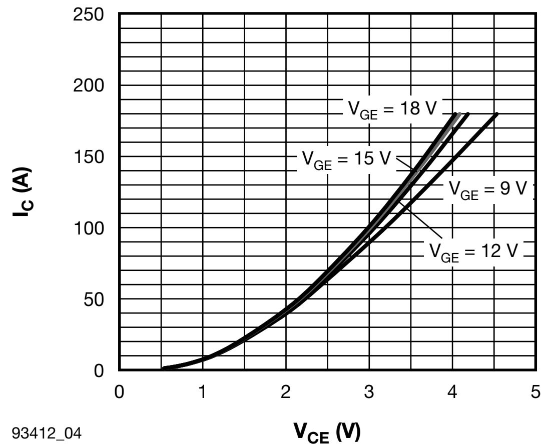


Fig. 4 - Typical IGBT Output Characteristics, T_J = 125 °C

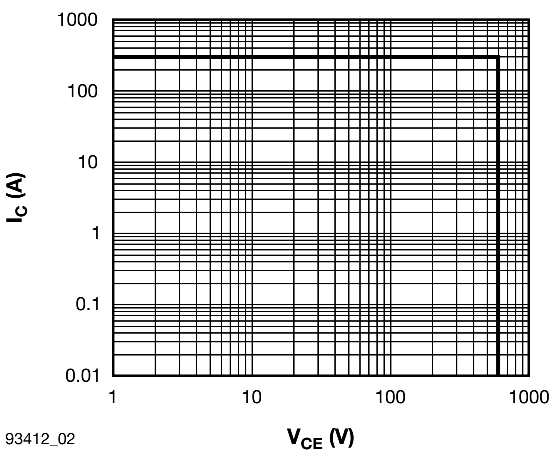


Fig. 2 - IGBT Reverse BIAS SOA T_J = 150 °C, V_{GE} = 15 V

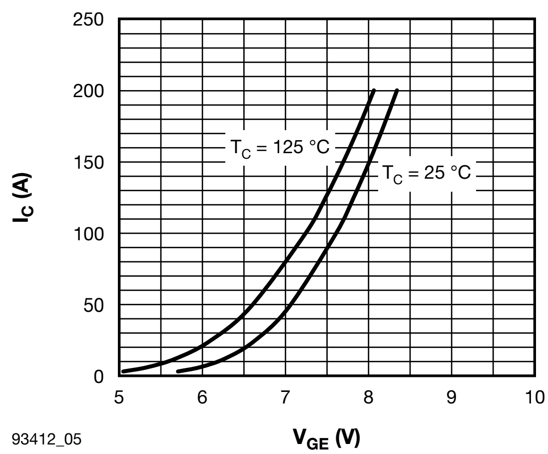


Fig. 5 - Typical IGBT Transfer Characteristics, T_J = 125 °C

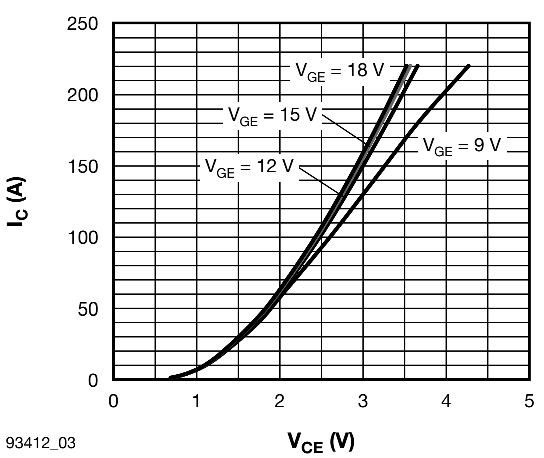


Fig. 3 - Typical IGBT Output Characteristics, T_J = 25 °C

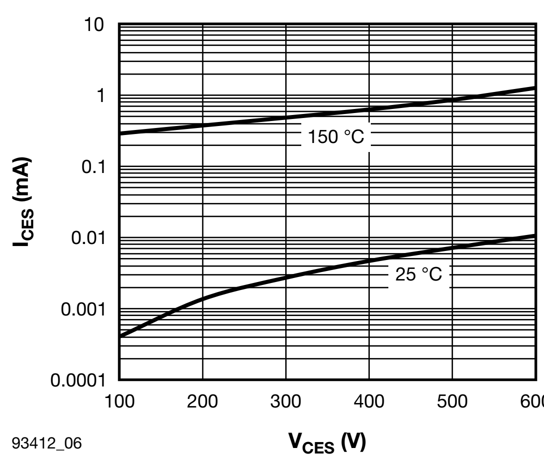


Fig. 6 - Typical IGBT Zero Gate Voltage Collector Current

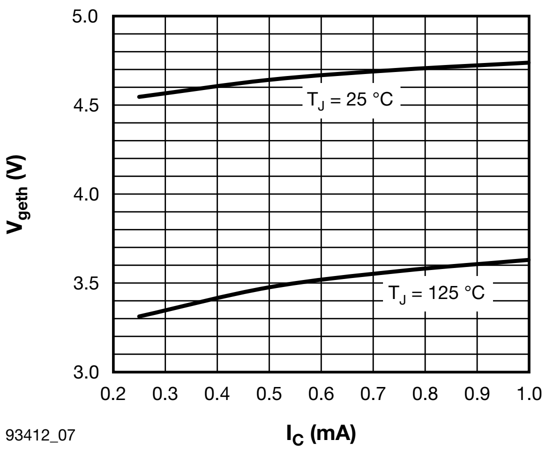


Fig. 7 - Typical IGBT Gate Thresold Voltage

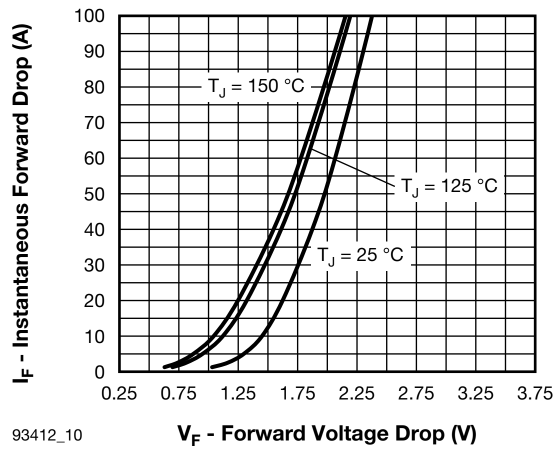


Fig. 10 - Typical PFC Diode Forward Voltage

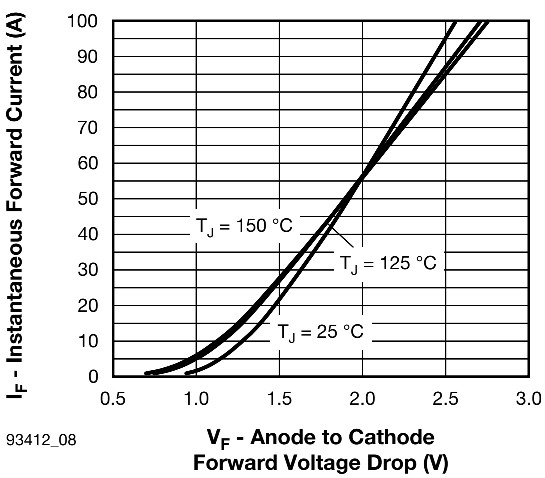


Fig. 8 - Typical Diode Forward Voltage Characteristics of Antiparallel Diode, t_p = 500 μs

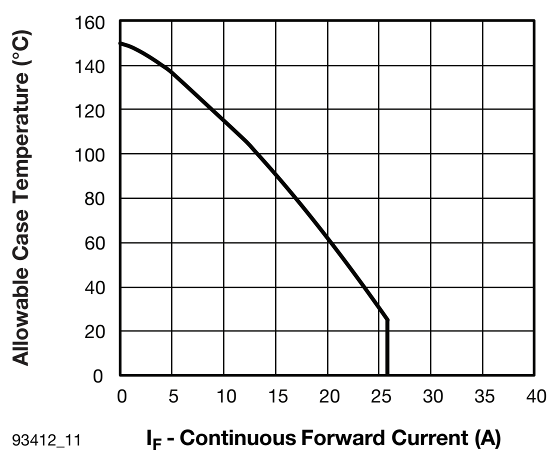


Fig. 11 - Maximum Continuous Forward Current vs. Case Temperature PFC Diode

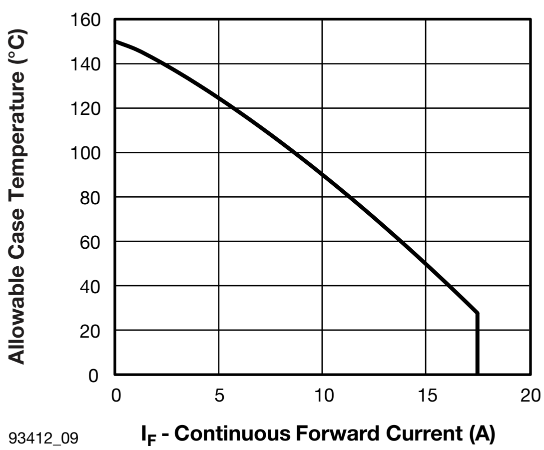


Fig. 9 - Maximum Continuous Forward Current vs. Case Temperature Antiparallel Diode

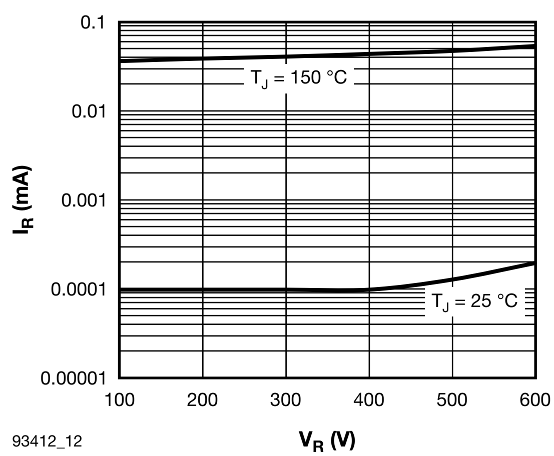


Fig. 12 - Typical FRED Pt Chopper Diode Reverse Current vs. Reverse Voltage

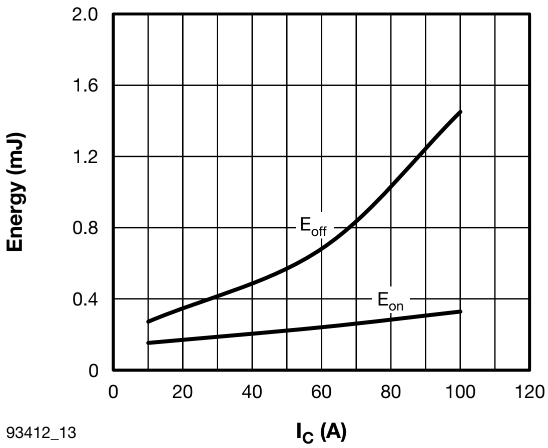


Fig. 13 - Typical IGBT Energy Loss vs. I_C
T_J = 125 °C, V_{CC} = 360 V, V_{GE} = 15 V, L = 500 µH, R_g = 5 Ω

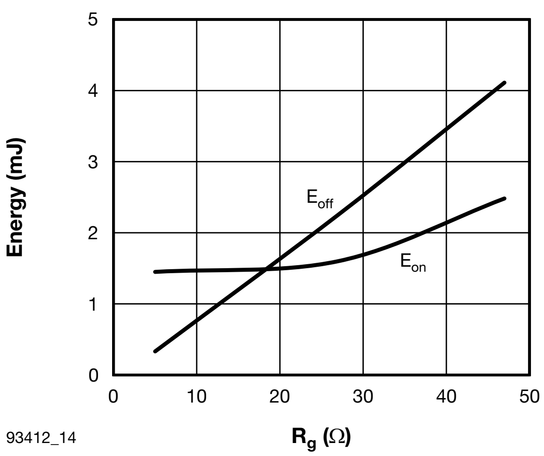


Fig. 14 - Typical IGBT Energy Loss vs. R_g, T_J = 125 °C
I_C = 100 A, V_{CC} = 360 V, V_{GE} = 15 V, L = 500 µH, R_g = 5 Ω

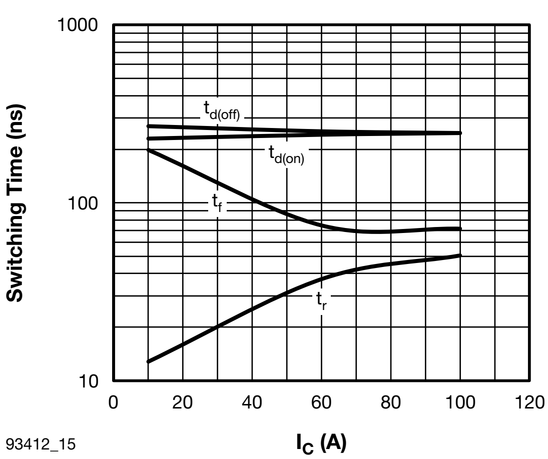


Fig. 15 - Typical IGBT Switching Time vs. I_C
T_J = 125 °C, V_{DD} = 360 V, V_{GE} = 15 V, L = 500 µH, R_g = 5 Ω

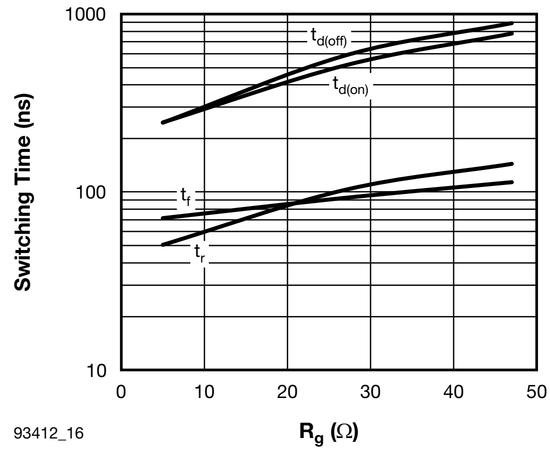


Fig. 16 - Typical IGBT Switching Time vs. R_g, T_J = 125 °C
I_C = 100 A, V_{CE} = 360 V, V_{GE} = 15 V, L = 500 µH

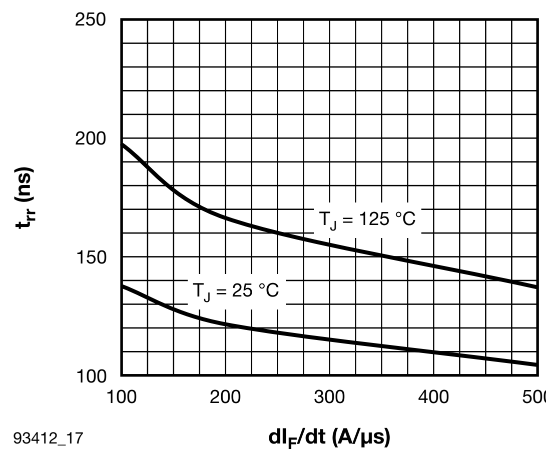


Fig. 17 - Typical t_{rr} Antiparallel Diode vs. dI_F/dt
V_{rr} = 200 V, I_F = 60 A

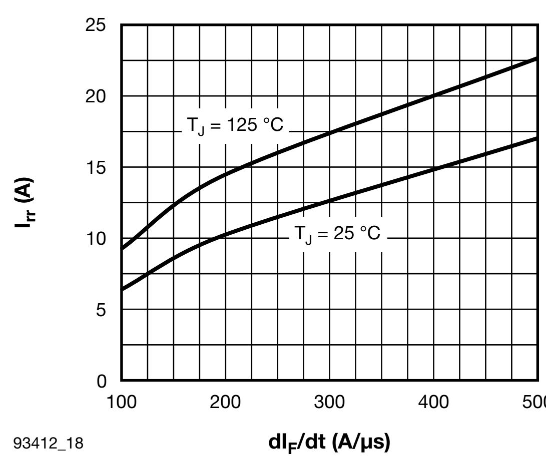


Fig. 18 - Typical I_{rr} Antiparallel Diode vs. dI_F/dt
V_{rr} = 200 V, I_F = 60 A

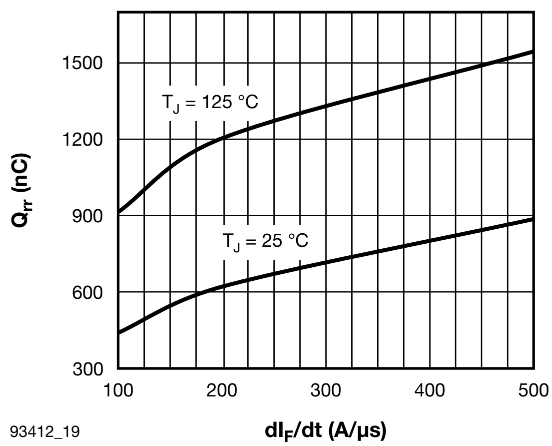


Fig. 19 - Typical Q_{rr} Antiparallel Diode vs. dI_F/dt
V_{rr} = 200 V, I_F = 60 A

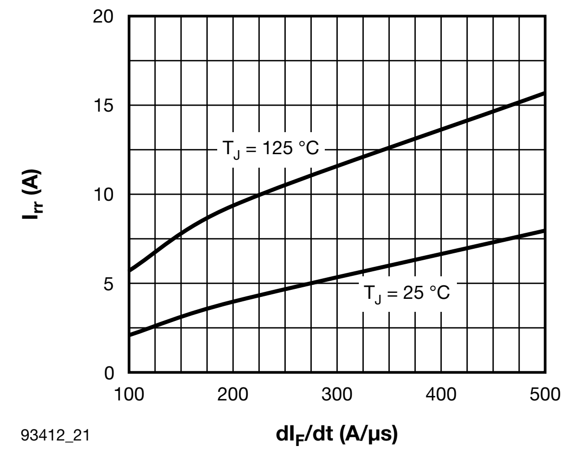


Fig. 21 - Typical I_{rr} Chopper Diode vs. dI_F/dt
V_{rr} = 200 V, I_F = 60 A

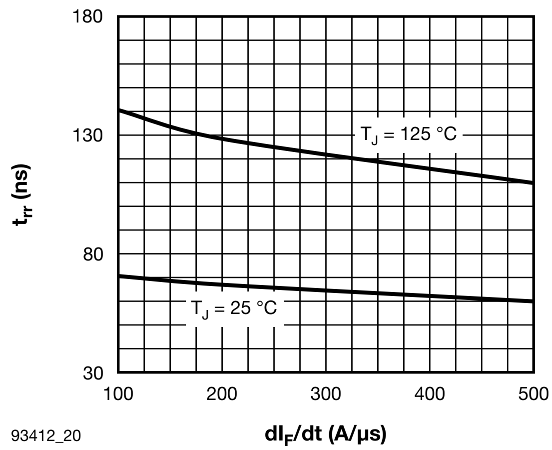


Fig. 20 - Typical t_{rr} Chopper Diode vs. dI_F/dt
V_{rr} = 200 V, I_F = 60 A

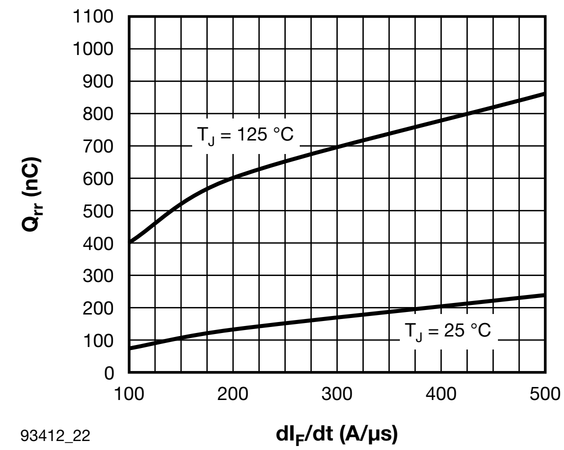


Fig. 22 - Typical Q_{rr} Chopper Diode vs. dI_F/dt
V_{rr} = 200 V, I_F = 40 A

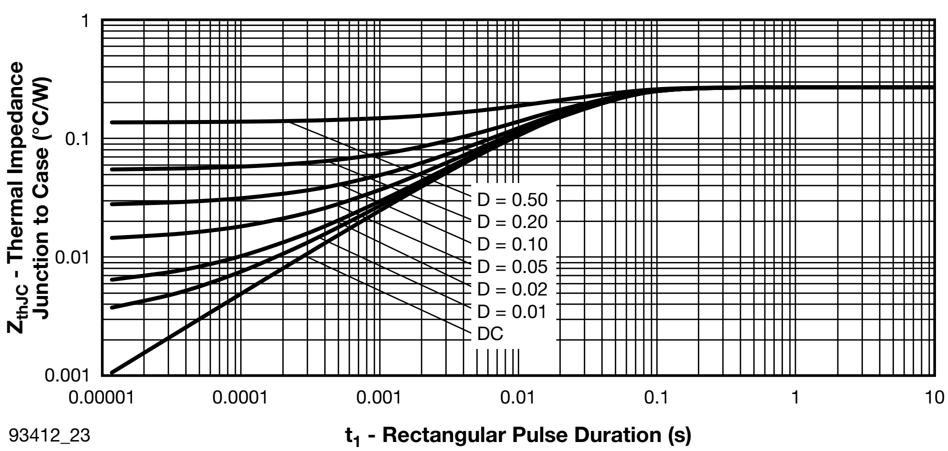


Fig. 23 - Maximum Thermal Impedance Z_{thJC} Characteristics (IGBT)

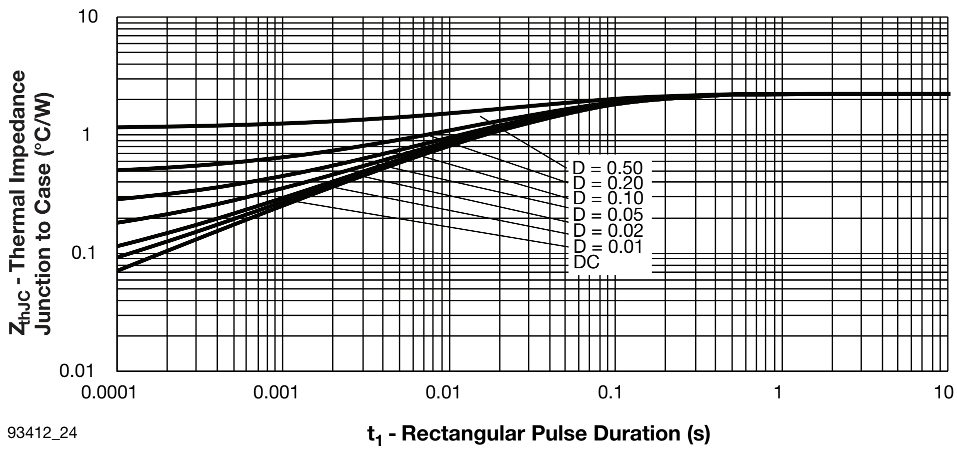


Fig. 24 - Maximum Thermal Impedance Z_{thJC} Characteristics (PFC Diode)

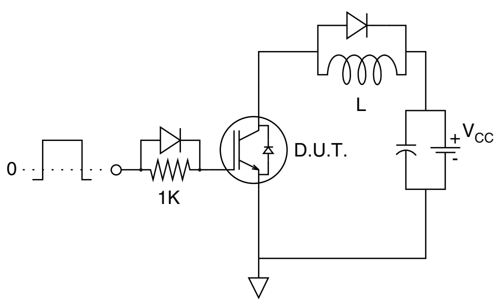


Fig. 25 - Gate Charge Circuit (Turn-Off)

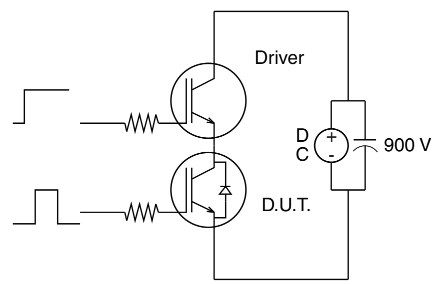


Fig. 27 - S.C. SOA Circuit

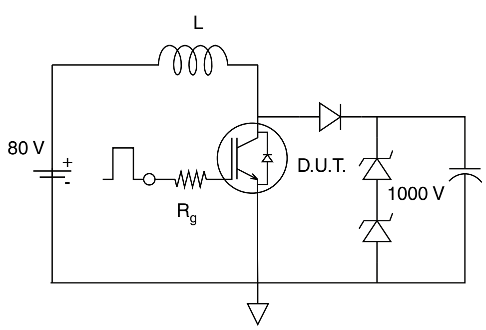


Fig. 26 - RBSOA Circuit

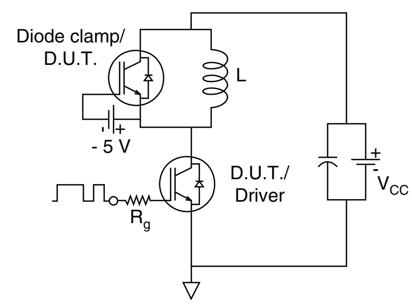


Fig. 28 - Switching Loss Circuit

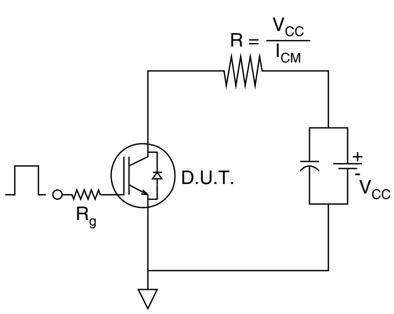
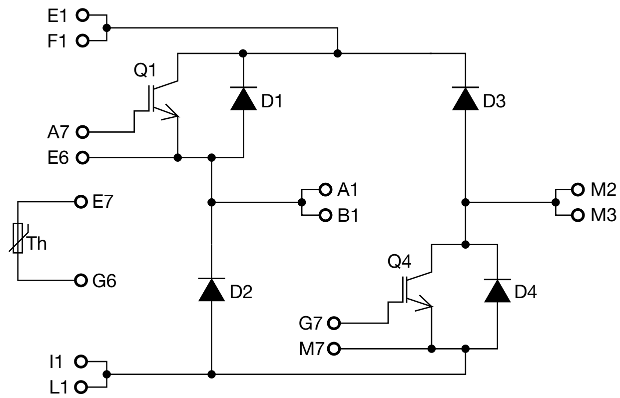


Fig. 29 - Resistive Load Circuit

CIRCUIT CONFIGURATION



ORDERING INFORMATION TABLE

Device code

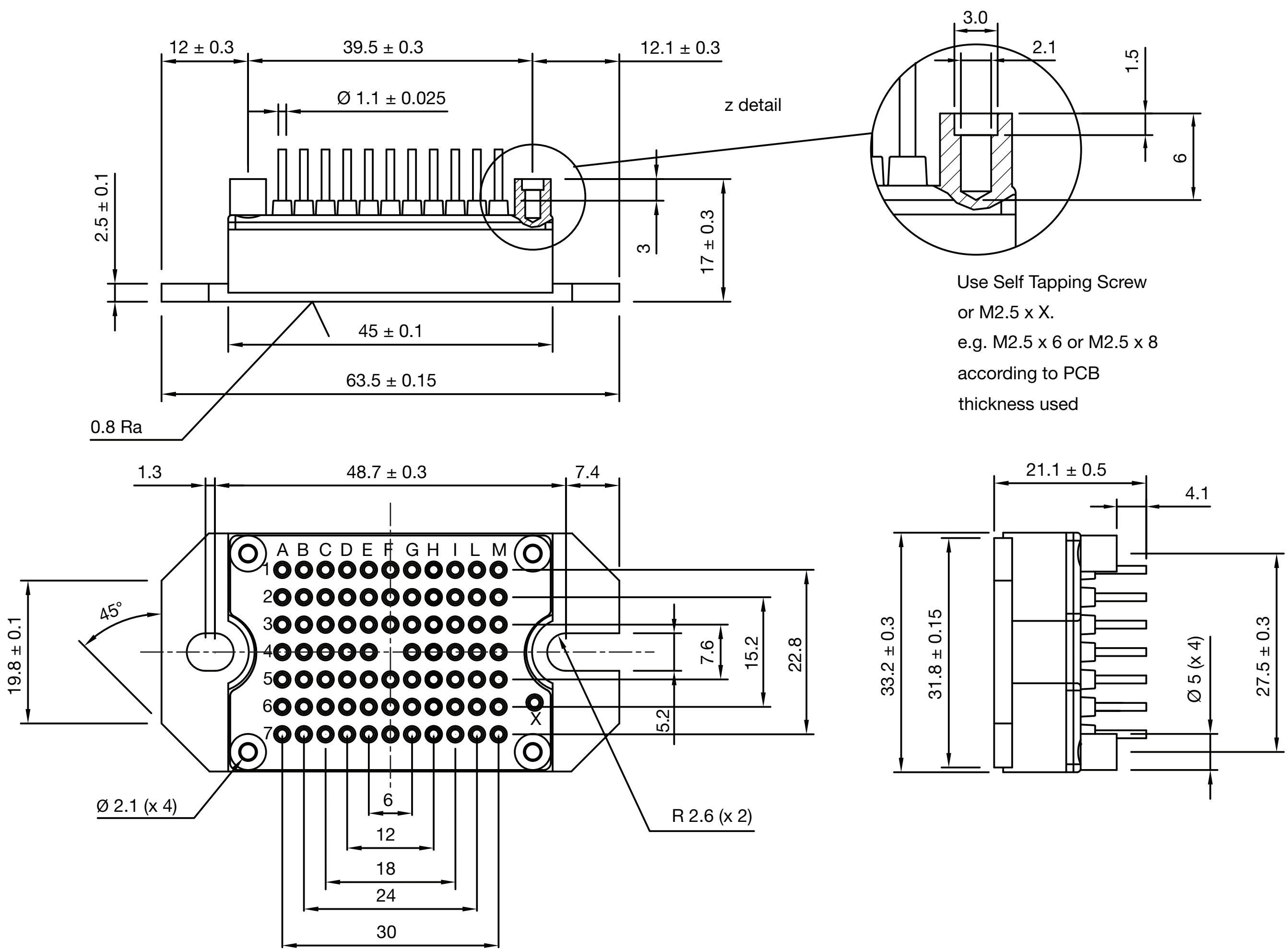
VS-	100	MT	060	W	DF
1	2	3	4	5	6

- **1** - Vishay Semiconductors product
- **2** - Current rating (100 = 100 A)
- **3** - Essential part number (MT = MTP package)
- **4** - Voltage code 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



PINS POSITION
WITH TOLERANCE ⌖ Ø 0.6

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