

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


**RoHS
COMPLIANT**

PRIMARY CHARACTERISTICS	
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 configuration	Dual forward

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
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	



ELECTRICAL SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$ 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}	$I_F = 60\text{ A}$	-	2.08	2.43	V
$I_F = 60\text{ A}, T_J = 125\text{ }^\circ\text{C}$			-	2.05	2.3		
IGBT	Collector to emitter breakdown voltage	BV_{CES}	$V_{GE} = 0\text{ V}, I_C = 0.5\text{ mA}$	600	-	-	V
	Temperature coefficient of breakdown voltage	$\Delta V_{BR(CES)}/\Delta T_J$	$I_C = 0.5\text{ mA}$ (25 °C to 125 °C)	-	0.6	-	V/°C
	Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 60\text{ A}$	-	1.93	2.29	V
			$V_{GE} = 15\text{ V}, I_C = 60\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	2.36	2.80	
	Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 500\text{ }\mu\text{A}$	2.9	-	6.0	V
	Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$	-	-	100	μA
$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 125\text{ }^\circ\text{C}$			-	-	2.0	mA	
Gate to emitter leakage	I_{GES}	$V_{GE} = \pm 20\text{ V}$	-	-	± 100	nA	
FRED Pt chopper diode	Forward voltage drop	V_{FM}	$I_F = 60\text{ A}$	-	2.06	2.53	V
			$I_F = 60\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	1.83	2.26	
	Blocking voltage	BV_{RM}	0.5 mA	600	-	-	
	Reverse leakage current	I_{RM}	$V_{RRM} = 600\text{ V}$	-	-	75	μA
$V_{RRM} = 600\text{ V}, T_J = 125\text{ }^\circ\text{C}$			-	-	0.5	mA	

RECOVERY PARAMETER							
AP diode	Peak reverse recovery current	I_{rr}	$I_F = 60\text{ A}$ $di/dt = 200\text{ A}/\mu\text{s}$ $V_R = 200\text{ V}$	-	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}	$I_F = 60\text{ A}$ $di/dt = 200\text{ A}/\mu\text{s}$ $V_R = 200\text{ V}$	-	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}	$I_F = 60\text{ A}$ $di/dt = 200\text{ A}/\mu\text{s}$ $V_R = 200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	9.5	12.0	A
	Reverse recovery time	t_{rr}		-	128	165	ns
	Reverse recovery charge	Q_{rr}		-	601	900	nC

SWITCHING CHARACTERISTICS ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted)								
	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS	
PFC IGBT	Total gate charge	Q_g	$I_C = 60\text{ A}$ $V_{CC} = 480\text{ V}$ $V_{GE} = 15\text{ V}$	-	460	-	nC	
	Gate to source charge	Q_{gs}		-	160	-		
	Gate to drain (Miller) charge	Q_{gd}		-	70	-		
	Turn-on switching loss	E_{on}	$I_C = 100\text{ A}, V_{CC} = 360\text{ V}, V_{GE} = 15\text{ V}$ $R_g = 5\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$	-	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}	$I_C = 100\text{ A}, V_{CC} = 360\text{ V}, V_{GE} = 15\text{ V}$ $R_g = 5\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$	-	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}	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1\text{ MHz}$	-	9500	-	pF	
	Output capacitance	C_{oes}		-	780	-		
	Reverse transfer capacitance	C_{res}		-	120	-		

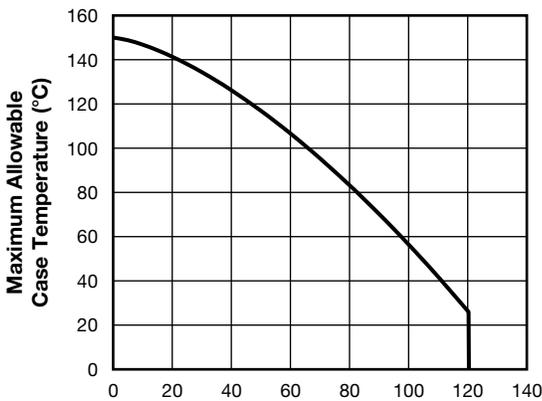


THERMISTOR ELECTRICAL CHARACTERISTICS ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Resistance	R	$T_J = 25\text{ }^\circ\text{C}$	-	30 000	-	Ω
B value	B	$T_J = 25\text{ }^\circ\text{C}/T_J = 85\text{ }^\circ\text{C}$	-	4000	-	K

THERMAL AND MECHANICAL SPECIFICATIONS						
	PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
AP FRED Pt diode	Junction to case diode thermal resistance	R_{thJC}	-	-	4.9	$^\circ\text{C}/\text{W}$
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	-	$^\circ\text{C}/\text{W}$
	Mounting torque $\pm 10\%$ to heatsink ⁽¹⁾		-	-	4	Nm
	Approximate weight		-	65	-	g

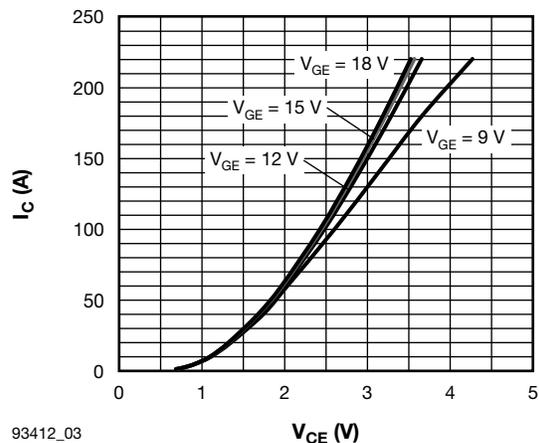
Note

⁽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.



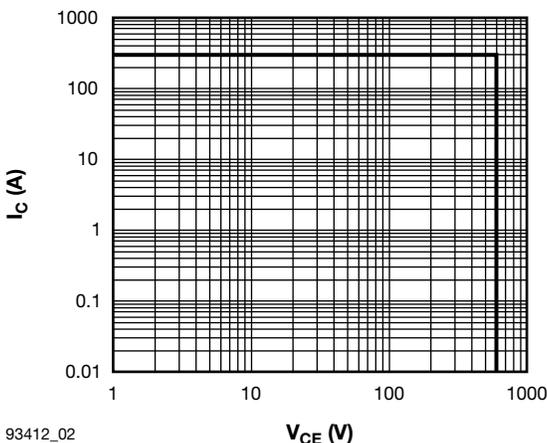
93412_01 I_C - Continuous Collector Current (A)

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



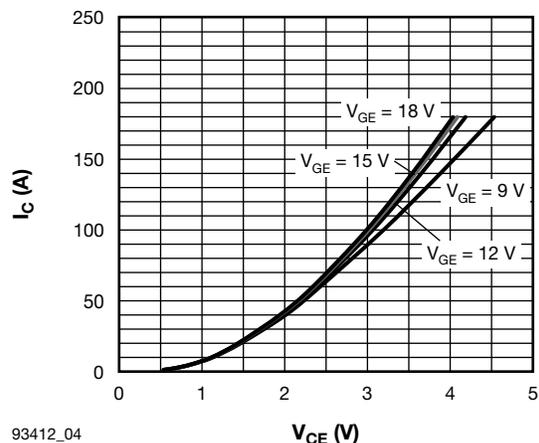
93412_03 V_{CE} (V)

Fig. 3 - Typical IGBT Output Characteristics, $T_J = 25\text{ }^\circ\text{C}$



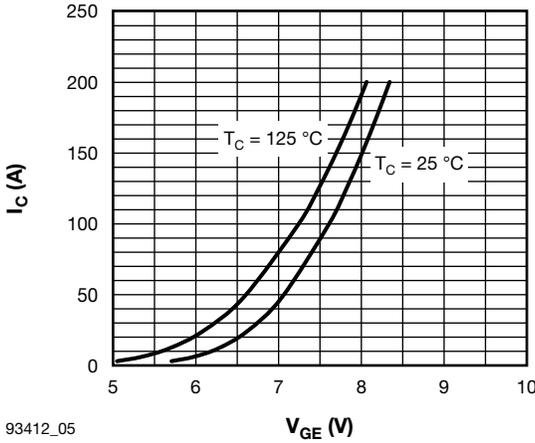
93412_02

Fig. 2 - IGBT Reverse BIAS SOA $T_J = 150\text{ }^\circ\text{C}$, $V_{GE} = 15\text{ V}$



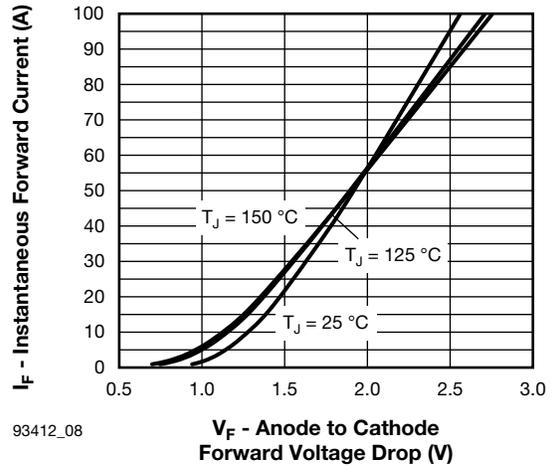
93412_04

Fig. 4 - Typical IGBT Output Characteristics, $T_J = 125\text{ }^\circ\text{C}$



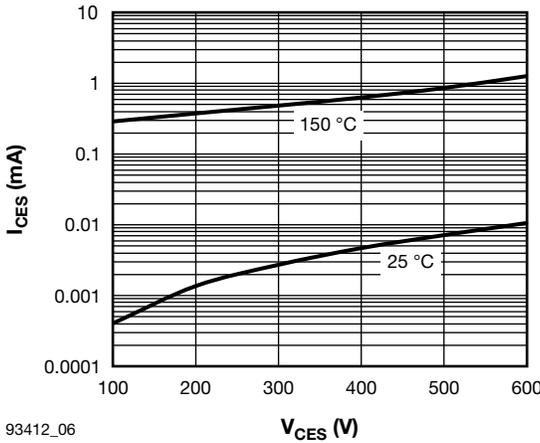
93412_05

Fig. 5 - Typical IGBT Transfer Characteristics, $T_J = 125\text{ }^\circ\text{C}$



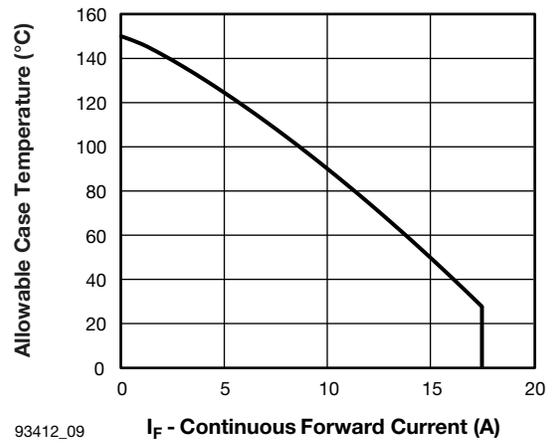
93412_08

Fig. 8 - Typical Diode Forward Voltage Characteristics of Antiparallel Diode, $t_p = 500\text{ }\mu\text{s}$



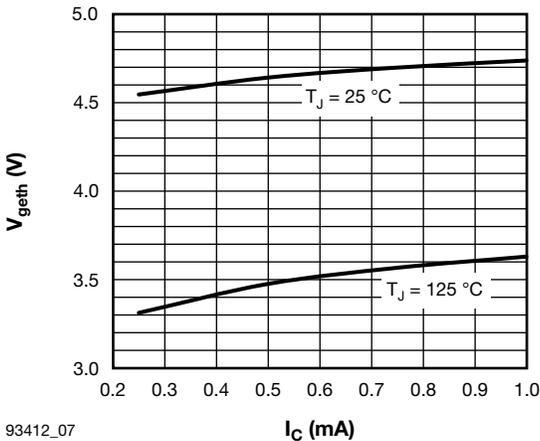
93412_06

Fig. 6 - Typical IGBT Zero Gate Voltage Collector Current



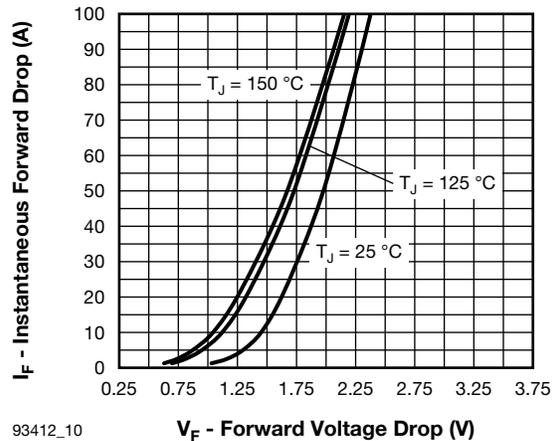
93412_09

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



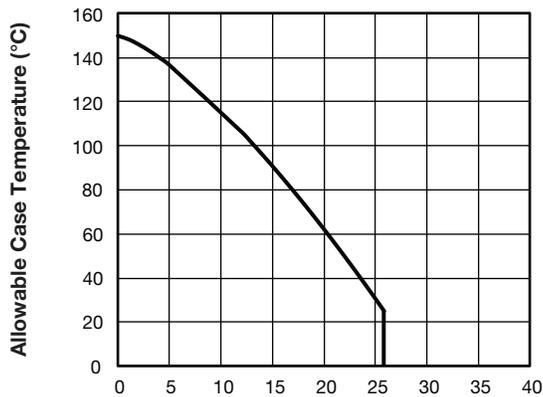
93412_07

Fig. 7 - Typical IGBT Gate Threshold Voltage



93412_10

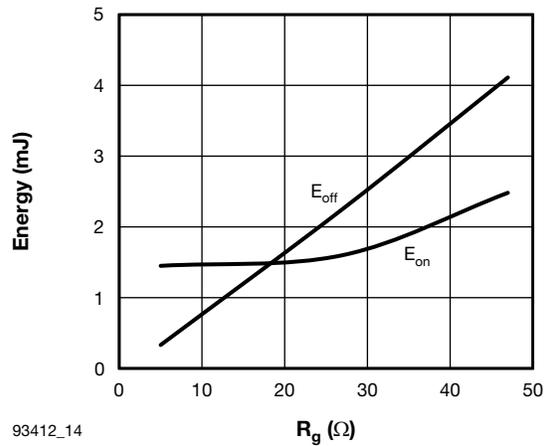
Fig. 10 - Typical PFC Diode Forward Voltage



93412_11

I_F - Continuous Forward Current (A)

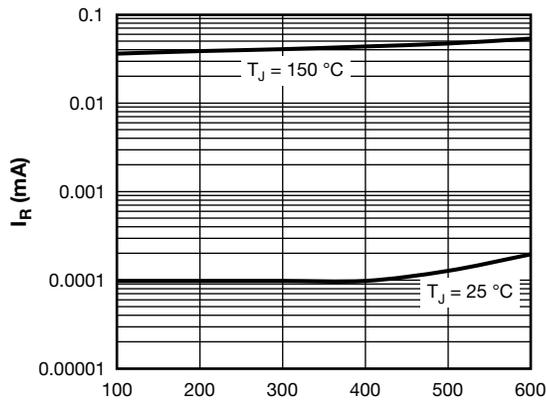
Fig. 11 - Maximum Continuous Forward Current vs. Case Temperature PFC Diode



93412_14

R_g (Ω)

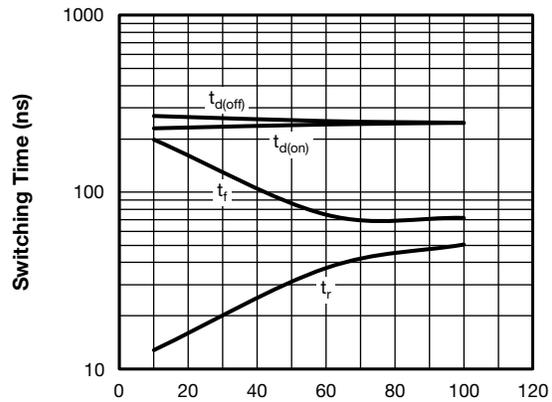
Fig. 14 - Typical IGBT Energy Loss vs. R_g , $T_J = 125^\circ\text{C}$
 $I_C = 100\text{ A}$, $V_{CC} = 360\text{ V}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$, $R_g = 5\ \Omega$



93412_12

V_R (V)

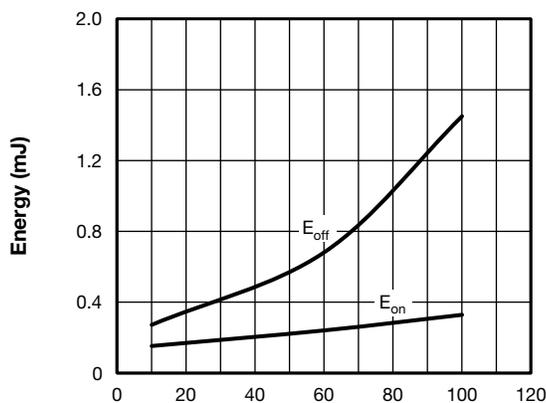
Fig. 12 - Typical FRED Pt Chopper Diode Reverse Current vs. Reverse Voltage



93412_15

I_C (A)

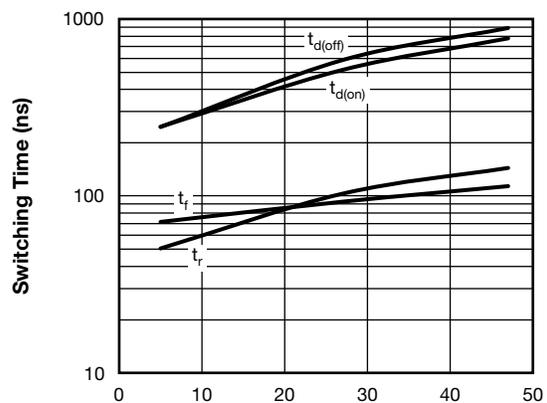
Fig. 15 - Typical IGBT Switching Time vs. I_C
 $T_J = 125^\circ\text{C}$, $V_{DD} = 360\text{ V}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$, $R_g = 5\ \Omega$



93412_13

I_C (A)

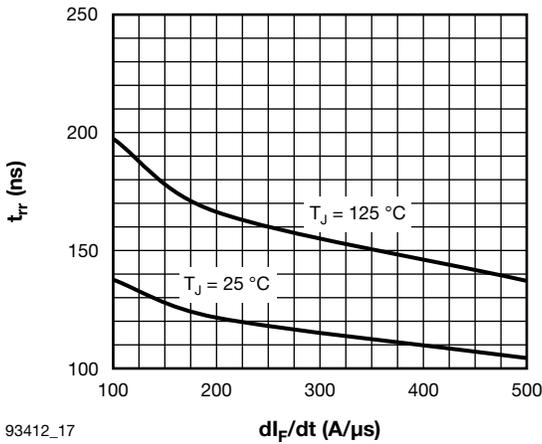
Fig. 13 - Typical IGBT Energy Loss vs. I_C
 $T_J = 125^\circ\text{C}$, $V_{CC} = 360\text{ V}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$, $R_g = 5\ \Omega$



93412_16

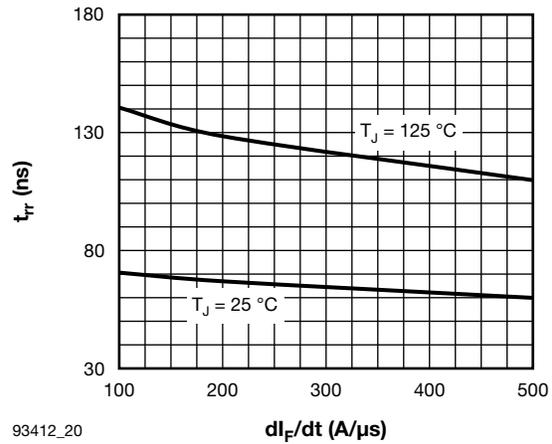
R_g (Ω)

Fig. 16 - Typical IGBT Switching Time vs. R_g , $T_J = 125^\circ\text{C}$
 $I_C = 100\text{ A}$, $V_{CE} = 360\text{ V}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$



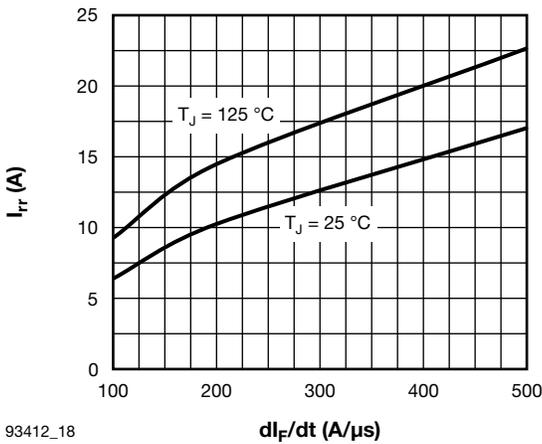
93412_17

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



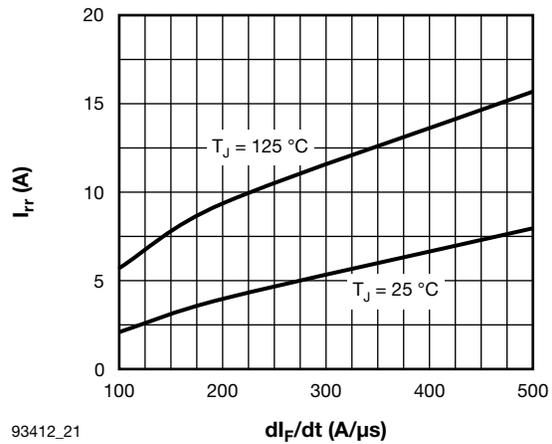
93412_20

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



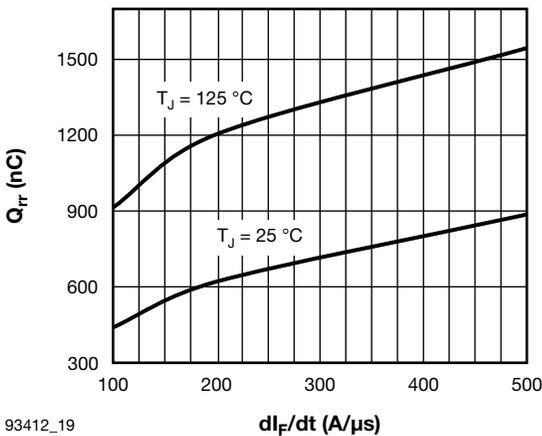
93412_18

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



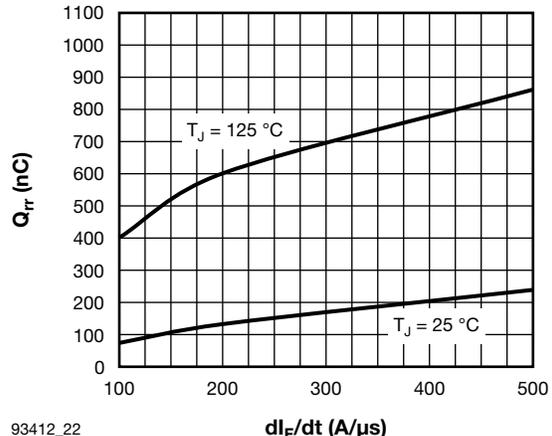
93412_21

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



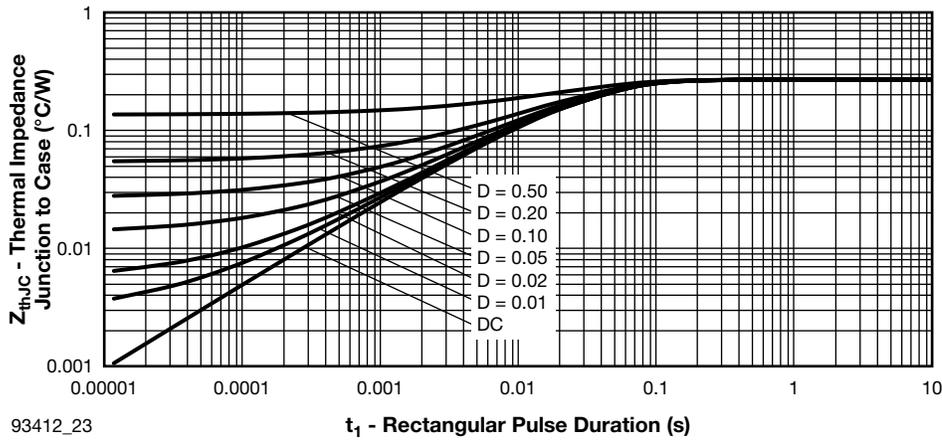
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Fig. 19 - Typical Q_{rr} Antiparallel Diode vs. dI_F/dt
 $V_{rr} = 200\text{ V}$, $I_F = 60\text{ A}$



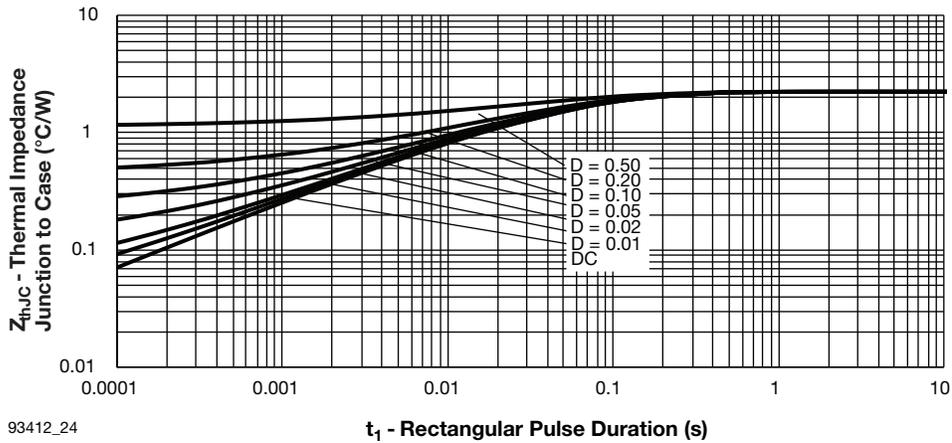
93412_22

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



93412_23

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



93412_24

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

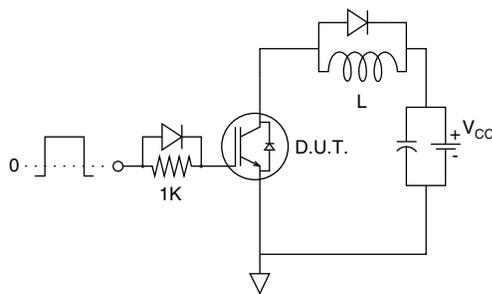


Fig. 25 - Gate Charge Circuit (Turn-Off)

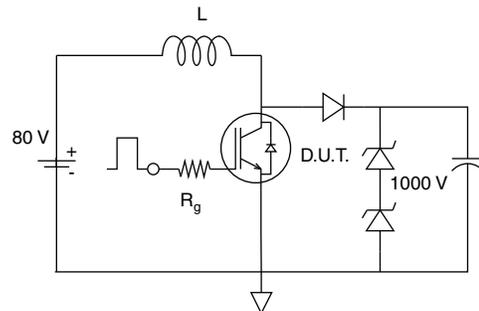


Fig. 26 - RBSOA Circuit

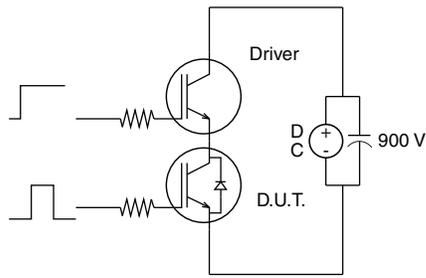


Fig. 27 - S.C. SOA Circuit

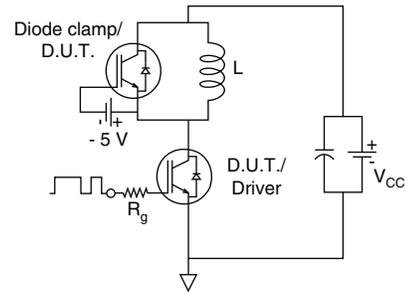


Fig. 28 - Switching Loss Circuit

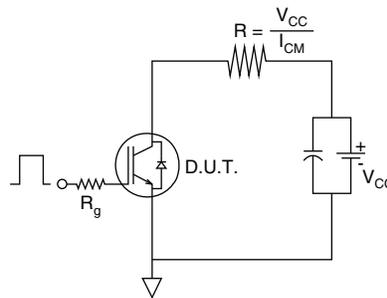
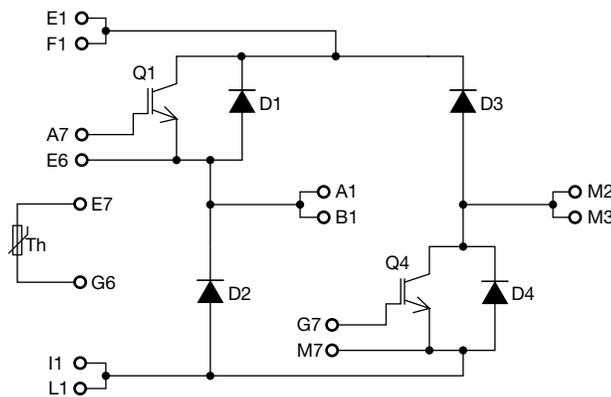


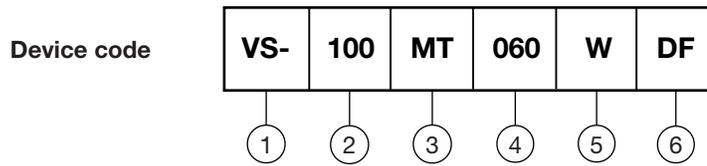
Fig. 29 - Resistive Load Circuit

CIRCUIT CONFIGURATION





ORDERING INFORMATION TABLE

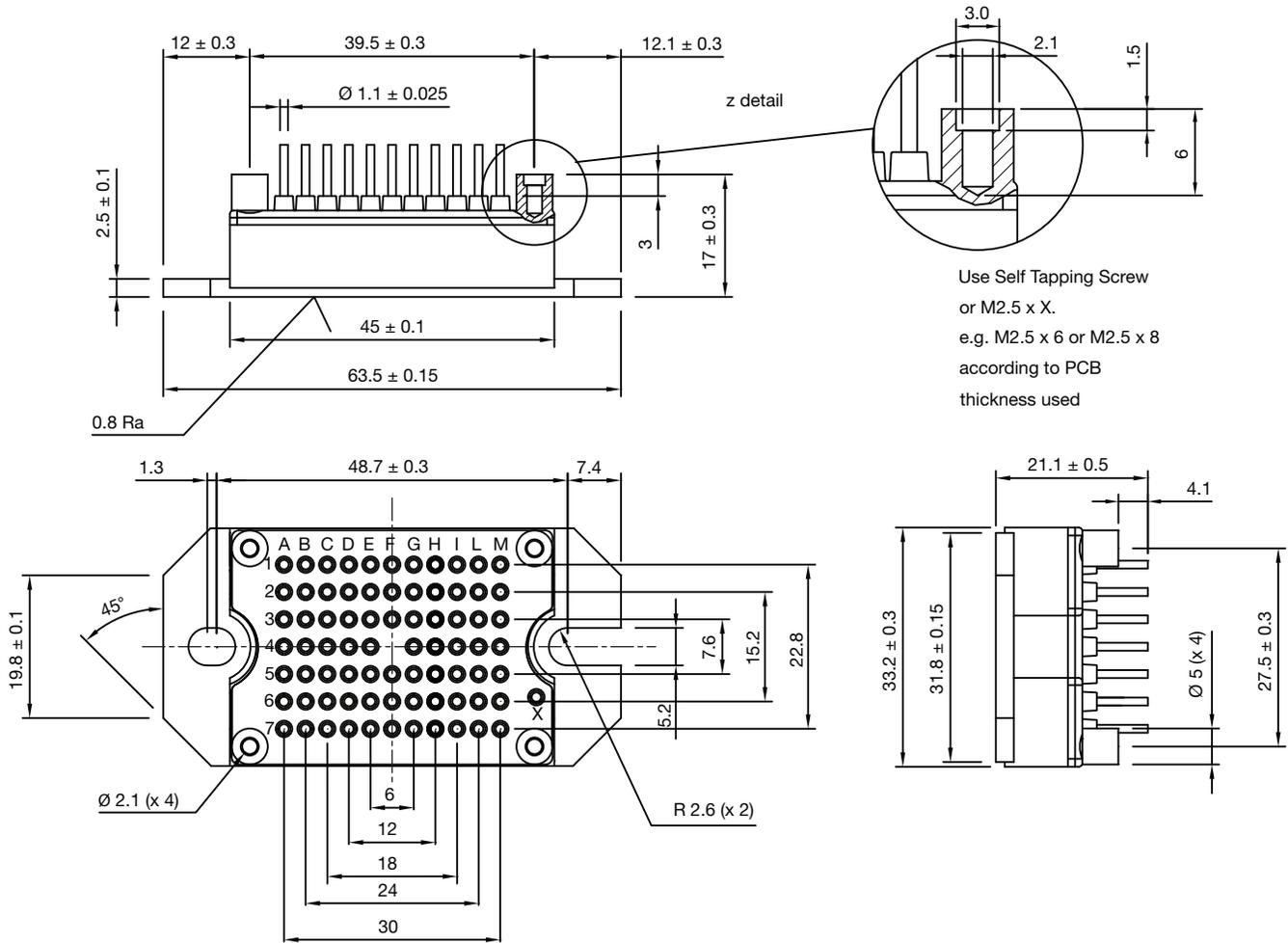


- 1** - Vishay Semiconductors product
- 2** - Current rating (100 = 100 A)
- 3** - Essential part number (MT = MTP package)
- 4** - Voltage code x 10 = voltage rating (example: 060 = 600 V)
- 5** - Die IGBT technology (W = warp speed IGBT)
- 6** - Circuit configuration (DF = dual forward)

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

MTP - Full Pin

DIMENSIONS in millimeters



Use Self Tapping Screw
or M2.5 x X.
e.g. M2.5 x 6 or M2.5 x 8
according to PCB
thickness used

PINS POSITION
WITH TOLERANCE $\text{Ø } 0.6$



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