

## Primary MTP IGBT Power Module



MTP

### FEATURES

- Buck PFC stage with warp 2 IGBT and FRED Pt<sup>®</sup> hyperfast diode
- Integrated thermistor
- Isolated baseplate
- Compliant to RoHS Directive 2011/65/EU
- Very low stray inductance design for high speed operation
- Designed and qualified for industrial level


**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	
<b>FRED Pt<sup>®</sup> AP DIODE, T<sub>J</sub> = 150 °C</b>	
V <sub>RRM</sub>	600 V
I <sub>F(DC)</sub> at 80 °C	11 A
V <sub>F</sub> at 25 °C at 60 A	2.08 V
<b>IGBT, T<sub>J</sub> = 150 °C</b>	
V <sub>CES</sub>	600 V
V <sub>CE(ON)</sub> at 25 °C at 60 A	1.98 V
I <sub>C</sub> at 80 °C	83 A
<b>FRED Pt<sup>®</sup> CHOPPER DIODE, T<sub>J</sub> = 150 °C</b>	
V <sub>R</sub>	600 V
I <sub>F(DC)</sub> at 80 °C	17 A
V <sub>F</sub> at 25 °C at 60 A	2.06 V

ABSOLUTE MAXIMUM RATINGS					
	PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
FRED Pt Antiparallel Diode	Repetitive peak reverse voltage	V <sub>RRM</sub>		600	V
	Maximum continuous forward current T <sub>J</sub> = 150 °C maximum	I <sub>F(DC)</sub>	T <sub>C</sub> = 25 °C	17	A
			T <sub>C</sub> = 80 °C	11	
Maximum power dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	25	W	
IGBT	Collector to emitter voltage	V <sub>CES</sub>	T <sub>J</sub> = 25 °C	600	V
	Gate to emitter voltage	V <sub>GE</sub>	I <sub>GES</sub> max. ± 250 ns	± 20	V
	Maximum continuous collector current at V <sub>GE</sub> = 15 V, T <sub>J</sub> = 150 °C maximum	I <sub>C</sub>	T <sub>C</sub> = 25 °C	121	A
			T <sub>C</sub> = 80 °C	83	
	Clamped inductive load current	I <sub>LM</sub>		300	
Maximum power dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	462	W	
FRED Pt Chopper Diode	Repetitive peak reverse voltage	V <sub>RRM</sub>		600	V
	Maximum continuous forward current T <sub>J</sub> = 150 °C maximum	I <sub>F</sub>	T <sub>C</sub> = 25 °C	26	A
			T <sub>C</sub> = 80 °C	17	
Maximum power dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	56	W	
	Maximum operating junction temperature	T <sub>J</sub>		150	°C
	Storage temperature range	T <sub>Stg</sub>		- 40 to + 150	
	Isolation voltage	V <sub>ISOL</sub>	V <sub>RMS</sub> t = 1 s, T <sub>J</sub> = 25 °C	3500	



<b>ELECTRICAL SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ 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	$\mu\text{A}$
$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 125\text{ }^\circ\text{C}$			-	-	2.0	mA	
Gate to emitter leakage	$I_{GES}$	$V_{GE} = \pm 20\text{ V}$	-	-	$\pm 100$	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	$\mu\text{A}$
$V_{RRM} = 600\text{ V}, T_J = 125\text{ }^\circ\text{C}$			-	-	0.5	mA	
<b>RECOVERY PARAMETER</b>							
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



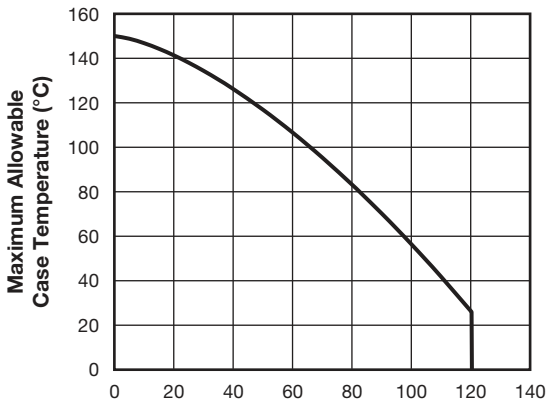
<b>SWITCHING CHARACTERISTICS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted)								
	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS	
PFC IGBT	Total gate charge	$Q_g$	$I_C = 60\text{ A}$ $V_{CC} = 480\text{ V}$ $V_{GE} = 15\text{ V}$	-	460	-	nC	
	Gate to source charge	$Q_{gs}$		-	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	-		

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

<b>THERMAL AND MECHANICAL SPECIFICATIONS</b>							
	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 <sup>(1)</sup>		-	-	4	Nm	
	Approximate weight		-	65	-	g	

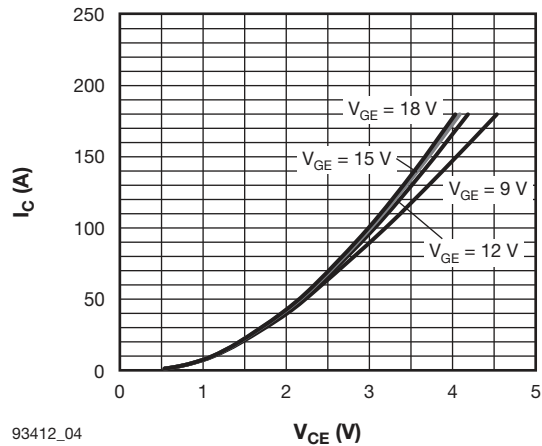
**Note**

<sup>(1)</sup> 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.



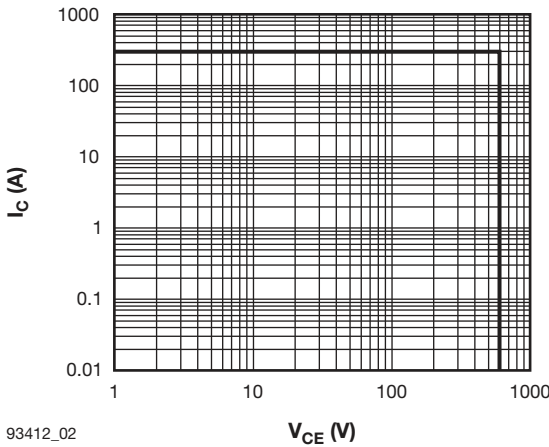
93412\_01 **IC - Continuous Collector Current (A)**

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



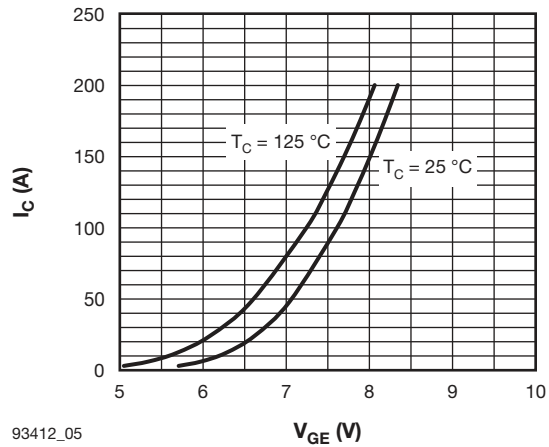
93412\_04

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



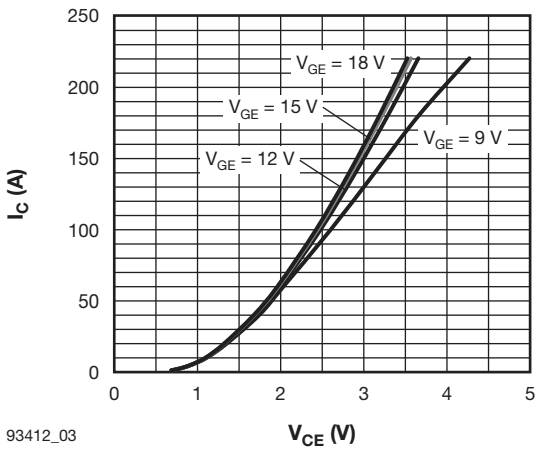
93412\_02

Fig. 2 - IGBT Reverse BIAS SOA TJ = 150 °C, VGE = 15 V



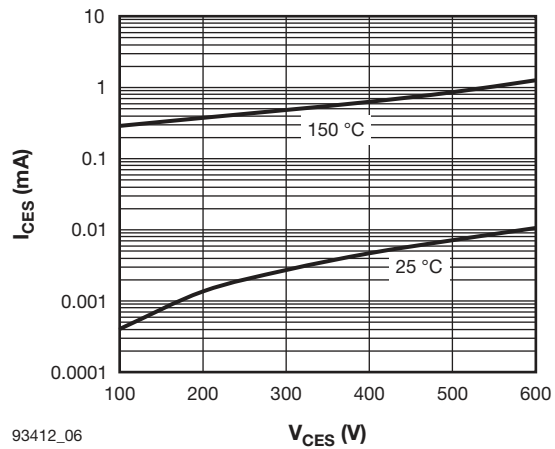
93412\_05

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



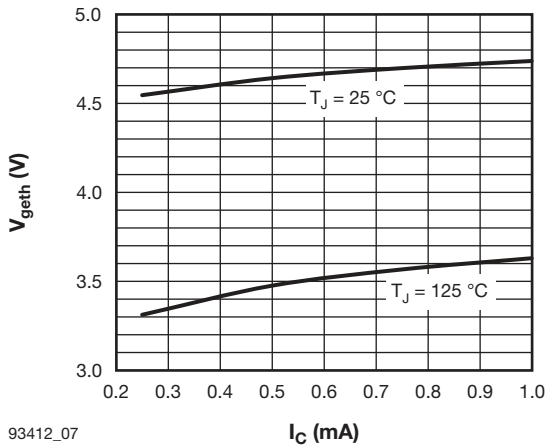
93412\_03

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



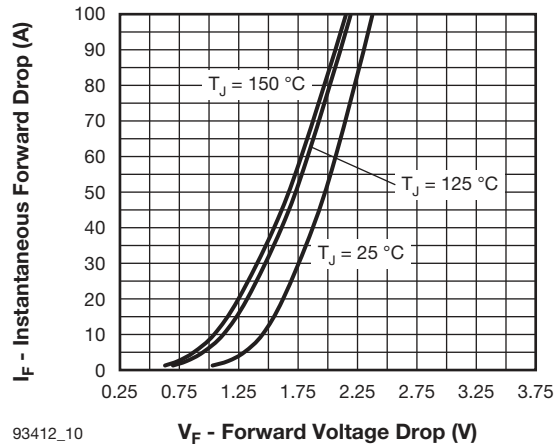
93412\_06

Fig. 6 - Typical IGBT Zero Gate Voltage Collector Current



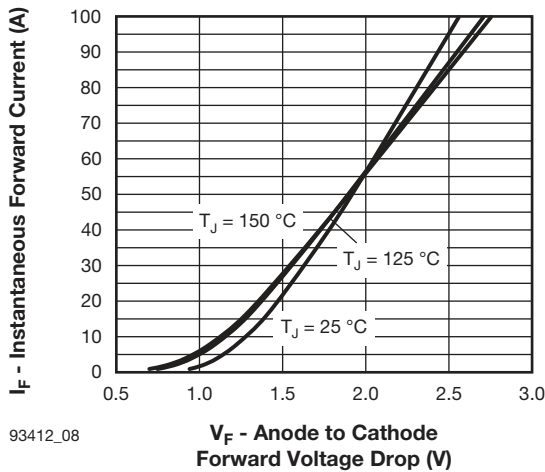
93412\_07

Fig. 7 - Typical IGBT Gate Threshold Voltage



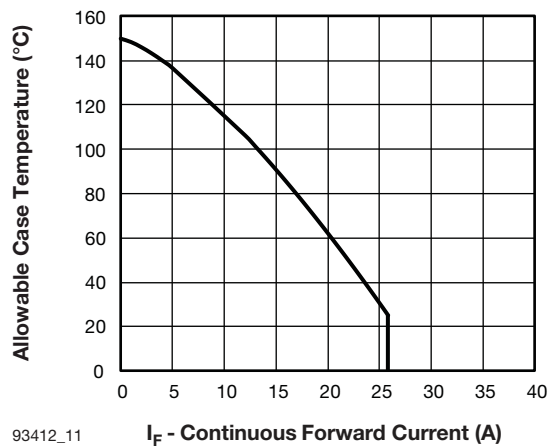
93412\_10

Fig. 10 - Typical PFC Diode Forward Voltage



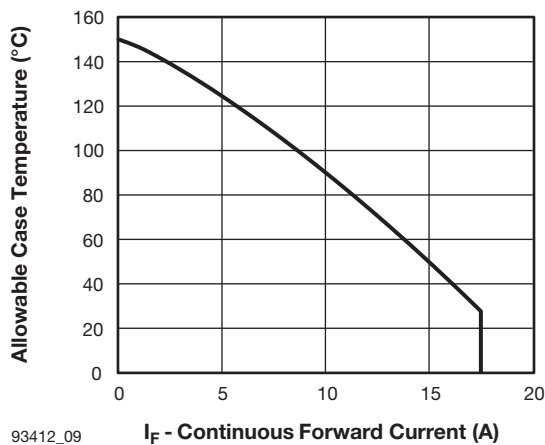
93412\_08

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



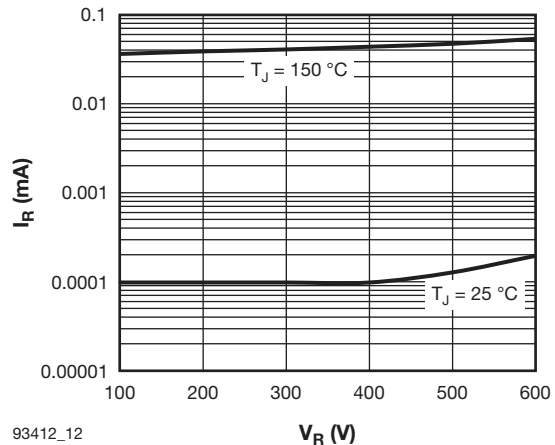
93412\_11

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



93412\_09

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



93412\_12

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

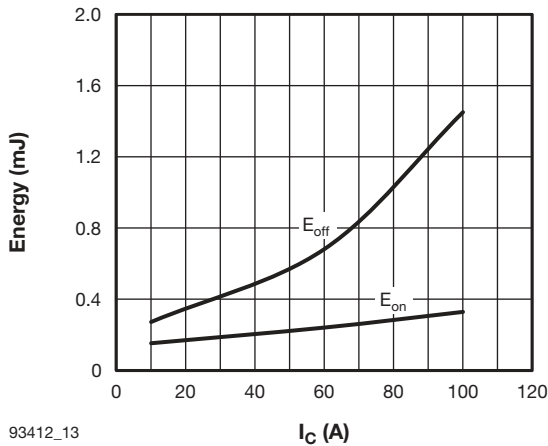


Fig. 13 - Typical IGBT Energy Loss vs.  $I_C$   
 $T_J = 125^\circ\text{C}$ ,  $V_{CC} = 360\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\ \mu\text{H}$ ,  $R_g = 5\ \Omega$

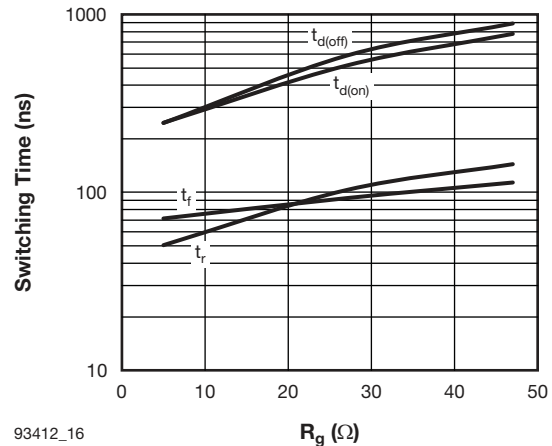


Fig. 16 - Typical IGBT Switching Time vs.  $R_g$ ,  $T_J = 125^\circ\text{C}$   
 $I_C = 100\text{ A}$ ,  $V_{CE} = 360\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\ \mu\text{H}$

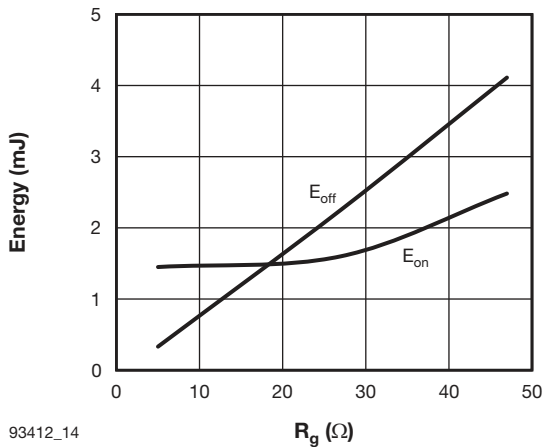


Fig. 14 - Typical IGBT Energy Loss vs.  $R_g$ ,  $T_J = 125^\circ\text{C}$   
 $I_C = 100\text{ A}$ ,  $V_{CC} = 360\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\ \mu\text{H}$ ,  $R_g = 5\ \Omega$

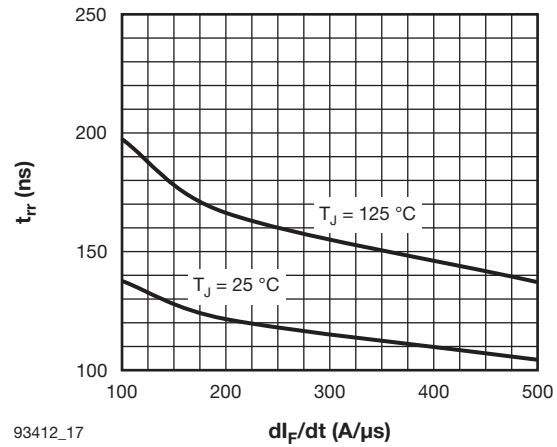


Fig. 17 - Typical  $t_{rr}$  Antiparallel Diode vs.  $di_F/dt$   
 $V_{rr} = 200\text{ V}$ ,  $I_F = 60\text{ A}$

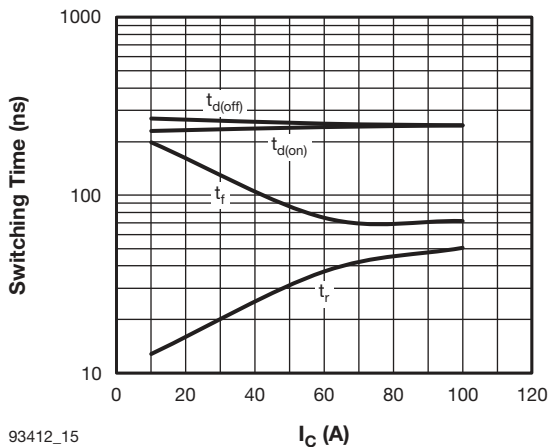


Fig. 15 - Typical IGBT Switching Time vs.  $I_C$   
 $T_J = 125^\circ\text{C}$ ,  $V_{DD} = 360\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\ \mu\text{H}$ ,  $R_g = 5\ \Omega$

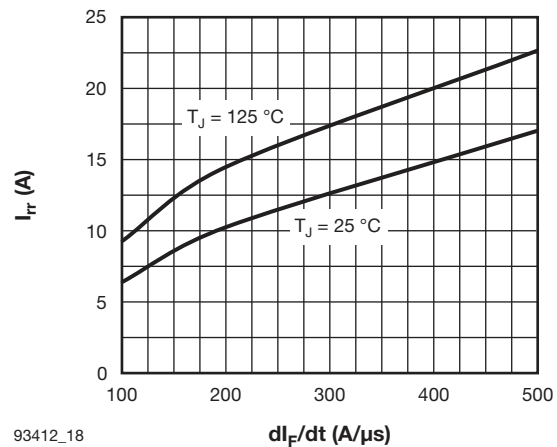
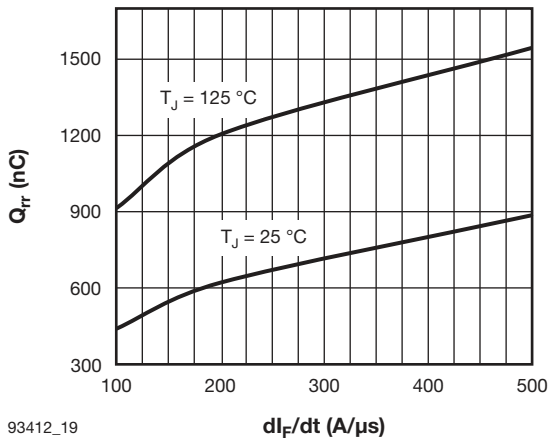
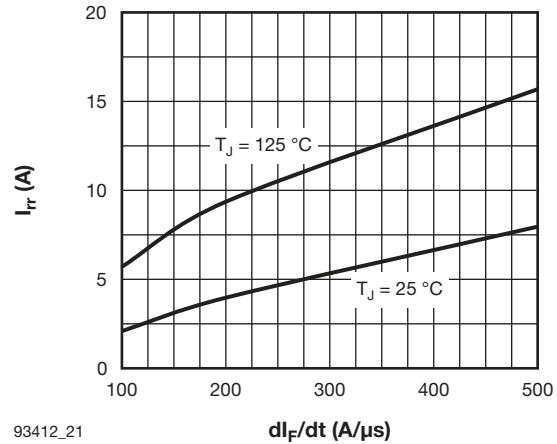


Fig. 18 - Typical  $I_{rr}$  Antiparallel Diode vs.  $di_F/dt$   
 $V_{rr} = 200\text{ V}$ ,  $I_F = 60\text{ A}$



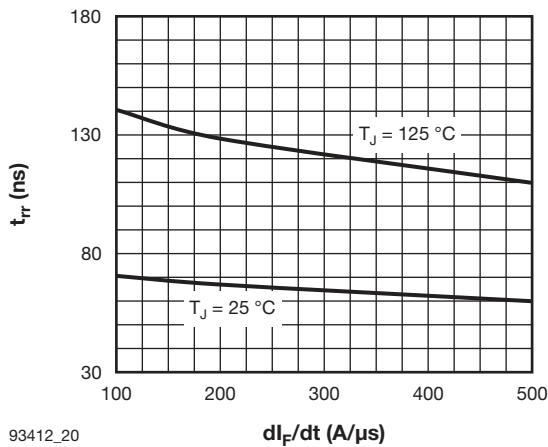
93412\_19

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



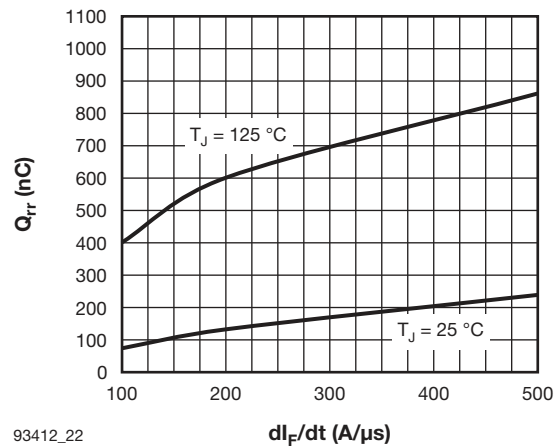
93412\_21

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



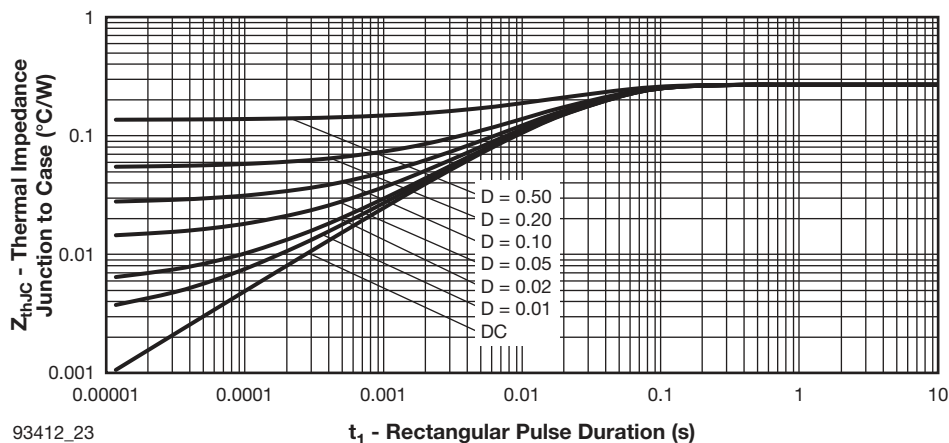
93412\_20

Fig. 20 - Typical  $t_{rr}$  Chopper 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)

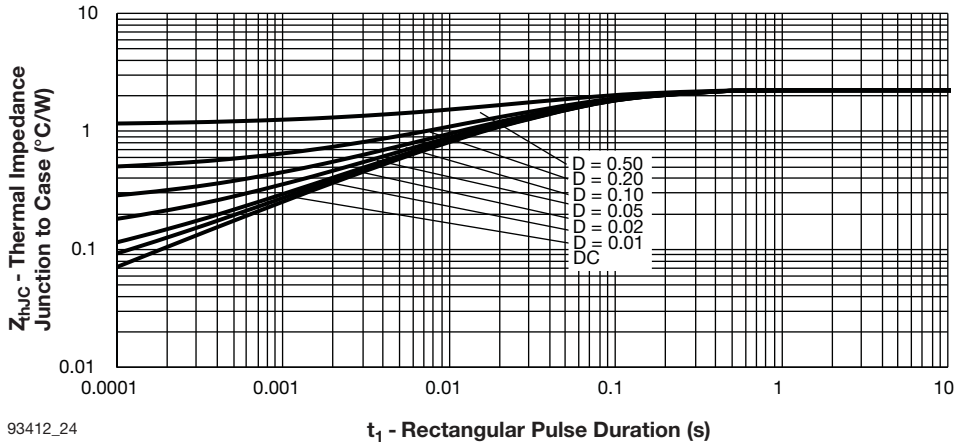


Fig. 24 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (PFC Diode)

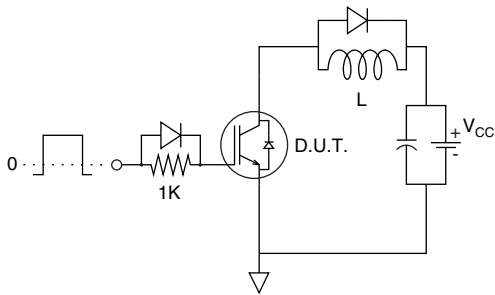


Fig. C.T.1 - Gate Charge Circuit (Turn-Off)

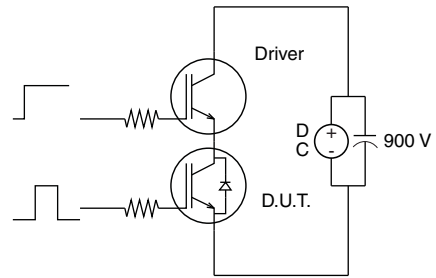


Fig. C.T.3 - S.C. SOA Circuit

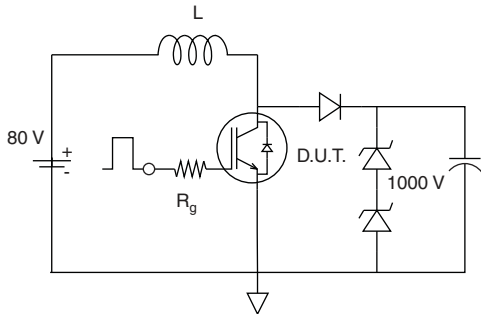


Fig. C.T.2 - RBSOA Circuit

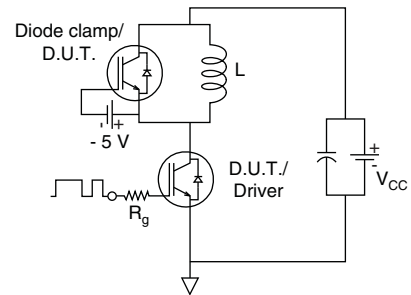


Fig. C.T.4 - Switching Loss Circuit

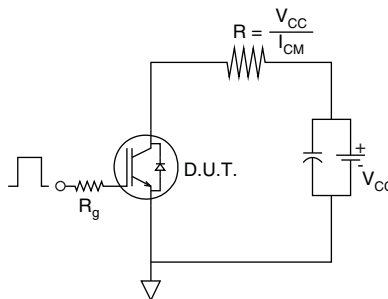
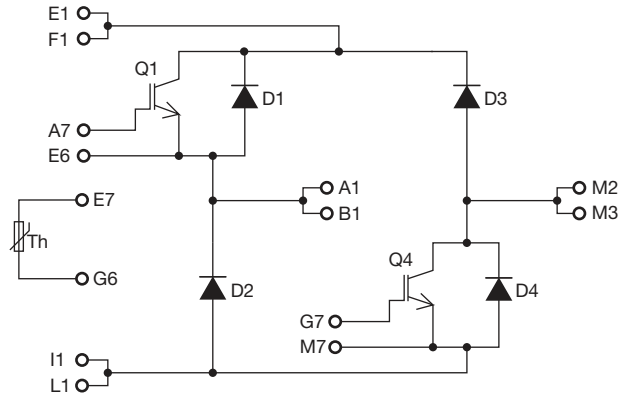


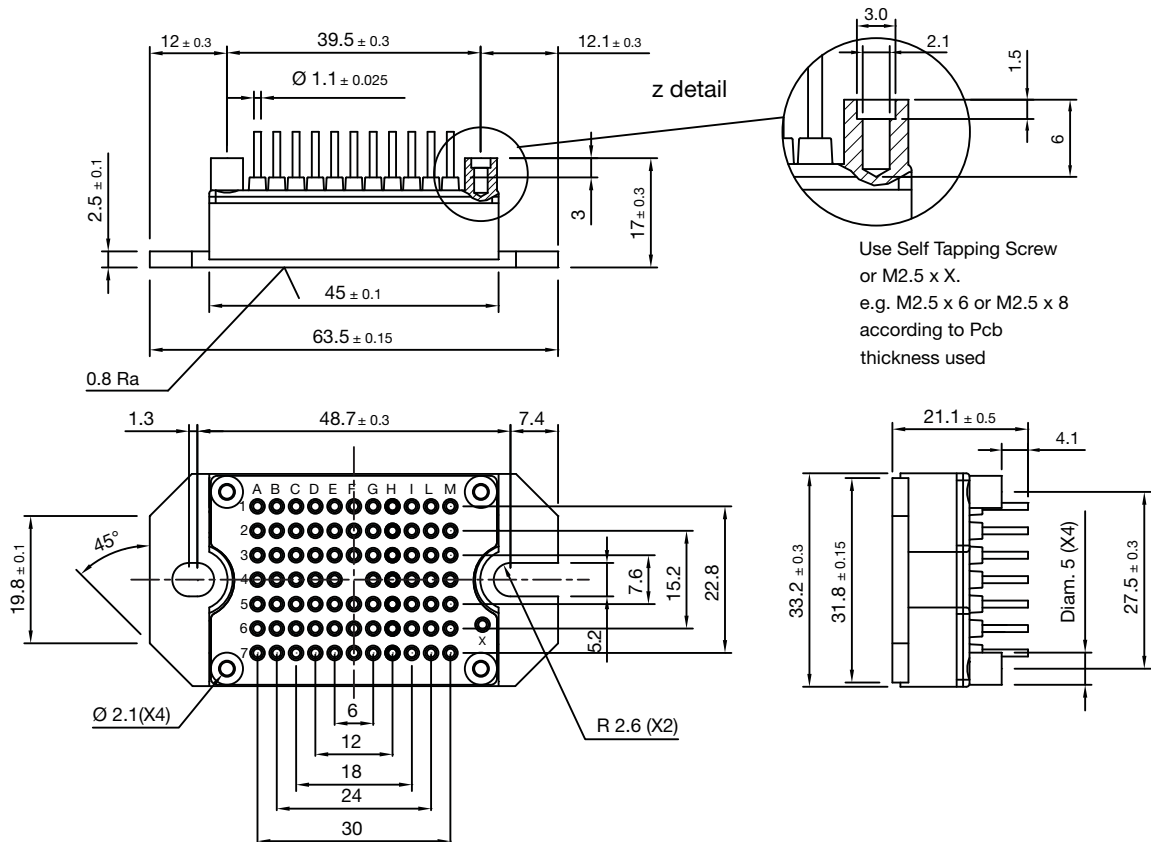
Fig. C.T.5 - Resistive Load Circuit



**CIRCUIT CONFIGURATION**



**DIMENSIONS** in millimeters



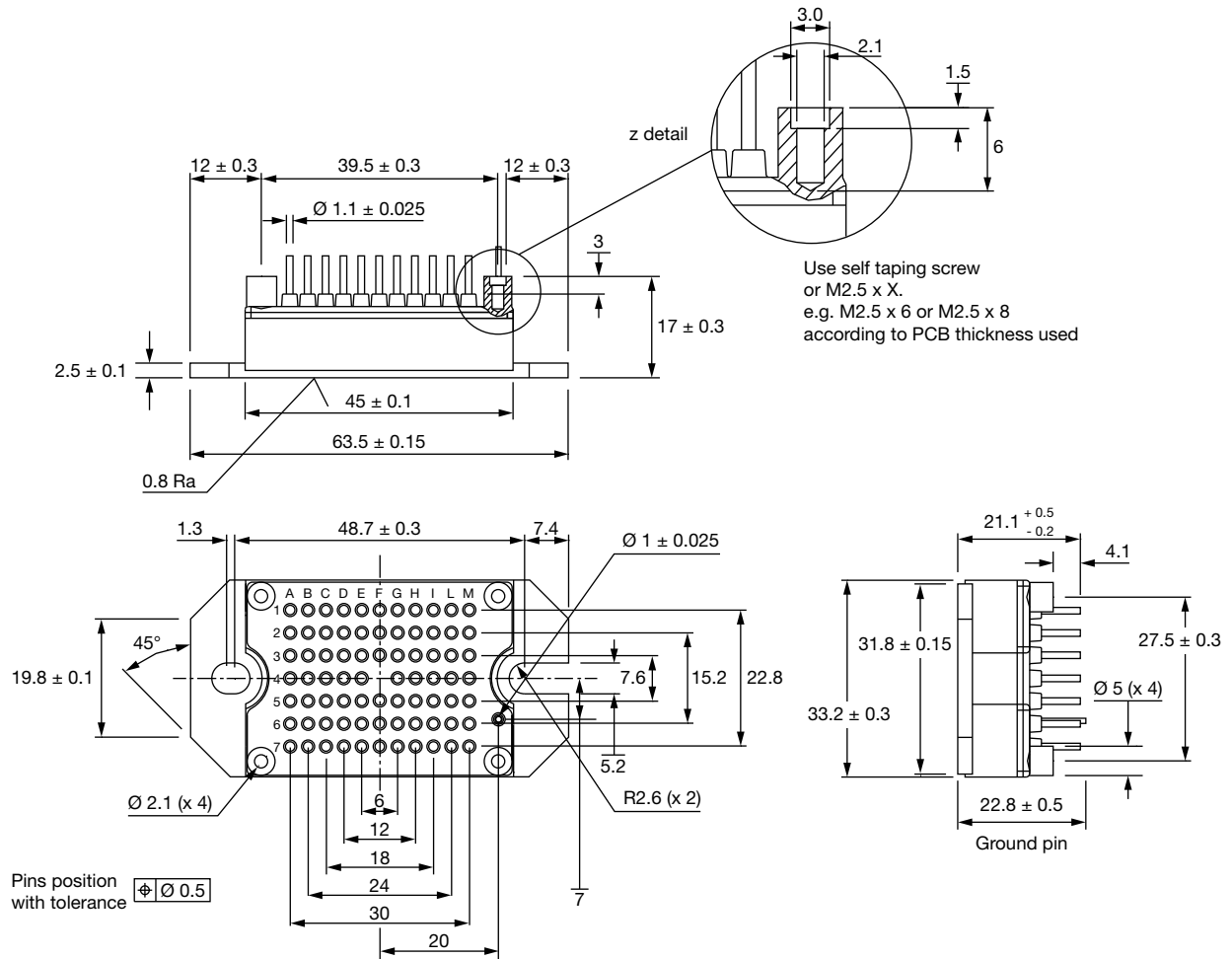
Use Self Tapping Screw  
or M2.5 x X.  
e.g. M2.5 x 6 or M2.5 x 8  
according to Pcb  
thickness used

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

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95383">www.vishay.com/doc?95383</a>

**MTP - Full Pin**

**DIMENSIONS** in millimeters





## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk and agree to fully indemnify and hold Vishay and its distributors harmless from and against any and all claims, liabilities, expenses and damages arising or resulting in connection with such use or sale, including attorneys fees, even if such claim alleges that Vishay or its distributor was negligent regarding the design or manufacture of the part. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**