FRED Pt® Gen 4 Doubler Ultrafast Diode, 500 A (INT-A-PAK Power Modules)

INT-A-PAK

FEATURES

- Gen 4 FRED Pt® dices technology
- Ultrasoft reverse recovery characteristics
- Low I_{RRM} and reverse recovery charge
- Very low forward voltage drop
- 175 °C operating junction temperature
- UL approved file E78996 for application with maximum case temperature up to 140 °C
- Large creepage distances
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT

PRIMARY CHARACTERISTICS	
V_R	600 V
$I_{F(AV)}$ at T_C	500 A at 55 °C
t_{rr} at 25 °C	104 ns
Type	Modules - diode, FRED Pt®
Package	INT-A-PAK
Circuit configuration	Diode doubler circuit

DESCRIPTION

Gen 4 FRED Pt technology, state of the art, ultra low V_F, soft switching optimized for IGBT F/W diode.
The minimized conduction loss, optimized storage charge, and low recovery current, minimized the switching losses and reduce the over dissipation in the switching element and snubbers.

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Cathode to anode voltage	V_R		600	V
Continuous forward current	I_F	T_C = 25 °C	772	A
		T_C = 90 °C	519	
Single pulse forward current	I_{FSM}	t_p = 10 ms, 50 Hz, sine half wave, initial T_J = 175 °C	4140	
Maximum power dissipation	P_D	T_C = 25 °C	1363	W
		T_C = 90 °C	772	
Operating junction temperature range	T_J		-40 to +175	°C
Storage temperature range	T_{Stg}		-40 to +150	
RMS insulation voltage	V_{INS}	50 Hz, circuit to base, all terminals shorted, t = 1 s	3500	V

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Cathode to anode breakdown voltage	V_{BR}	I_R = 500 μA	600	-	-	V
Forward voltage drop	V_{FM}	I_F = 250 A	-	1.25	-	
		I_F = 500 A	-	1.45	1.66	
		I_F = 250 A, T_J = 150 °C	-	1.06	-	
		I_F = 500 A, T_J = 150 °C	-	1.35	-	
Reverse leakage current	I_{RM}	V_R = 600 V	-	10	-	μA
		T_J = 150 °C, V_R = 600 V	-	2.5	-	mA

DYNAMIC RECOVERY CHARACTERISTICS (T_J = 25 °C unless otherwise specified)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNITS**
Reverse recovery time	t_{rr}	T_J = 25 °C	I_F = 150 A dI/dt = 1000 A/µs V_R = 400 V	-	104	-	ns
		T_J = 125 °C		-	193	-	
Peak recovery current	I_{rr}	T_J = 25 °C		-	59	-	A
		T_J = 125 °C		-	122	-	
Reverse recovery charge	Q_{rr}	T_J = 25 °C		-	3.5	-	µC
		T_J = 125 °C		-	13.8	-	

THERMAL - MECHANICAL SPECIFICATIONS					
PARAMETER		**SYMBOL**	**TEST CONDITIONS**	**VALUES**	**UNITS**
Maximum thermal resistance, junction to case per leg		R_{thJC}	DC operation	0.11	K/W
Typical thermal resistance, case to heat sink		R_{thCS}	Mounting surface, flat, smooth, and greased	0.035	
Mounting torque ± 10 %	to heat sink		A mounting compound is recommended and the torque should be rechecked after a period of 3 hours to allow the spread of the compound	4 to 6	Nm
	busbar				
Approximate weight				200	g
				7.1	oz.
Case style				INT-A-PAK	

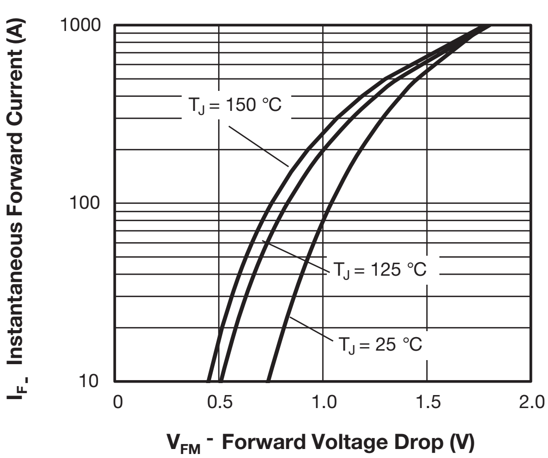


Fig. 1 - Typical Forward Voltage Drop Characteristics

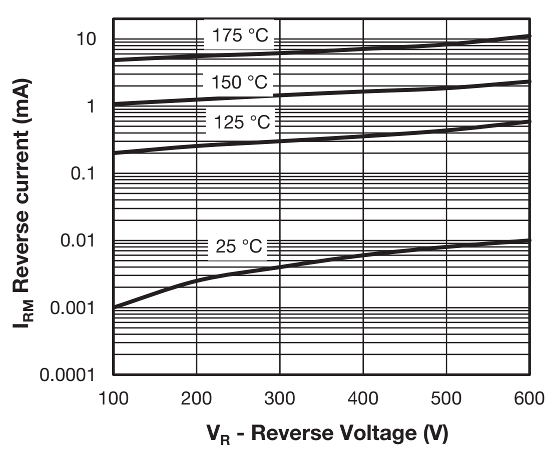


Fig. 2 - Typical Value of Reverse Current vs. Reverse Voltage

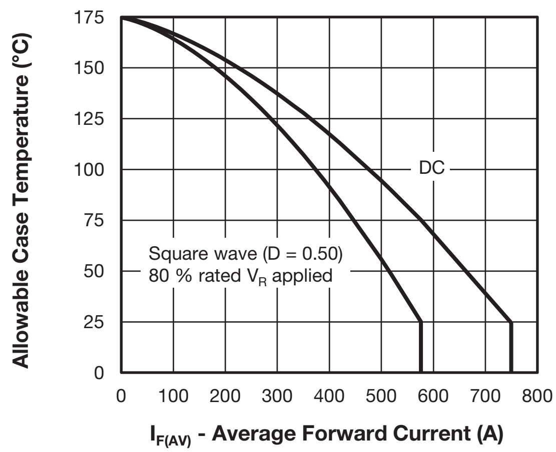


Fig. 3 - Maximum Allowable Case Temperature vs. Average Forward Current

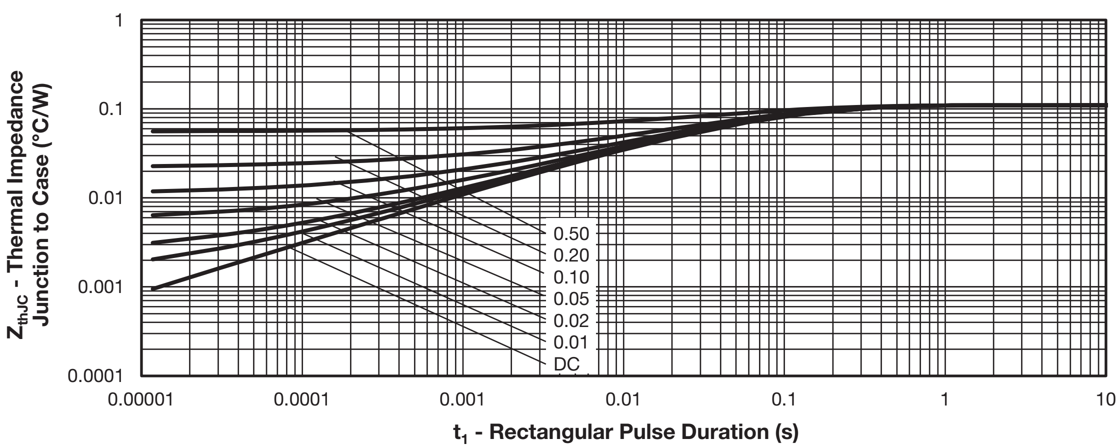


Fig. 4 - Maximum Thermal Impedance Z_{thJC} Characteristics

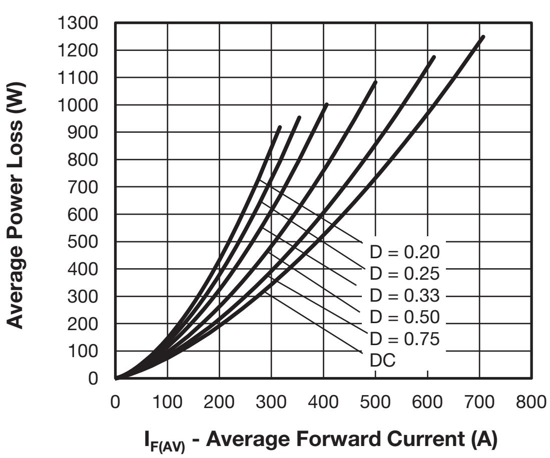


Fig. 5 - Forward Power Loss Characteristics

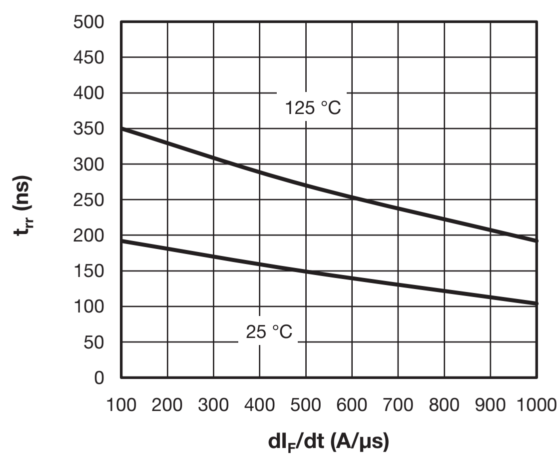


Fig. 6 - Typical Reverse Recovery Time vs. dI_F/dt
I_{FM} = 150 A, V_R = 300 V

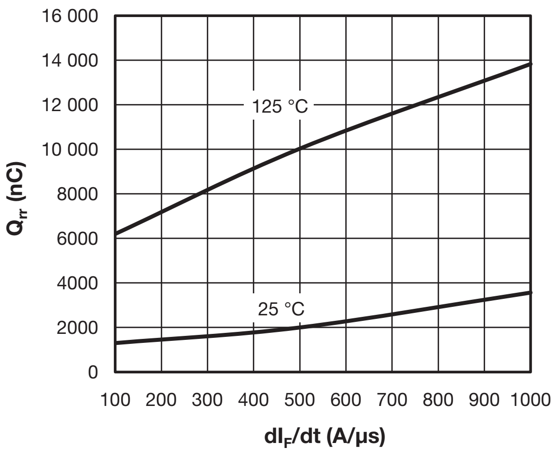


Fig. 7 - Typical Reverse Recovery Charge vs. dI_F/dt
I_{FM} = 150 A, V_R = 300 V

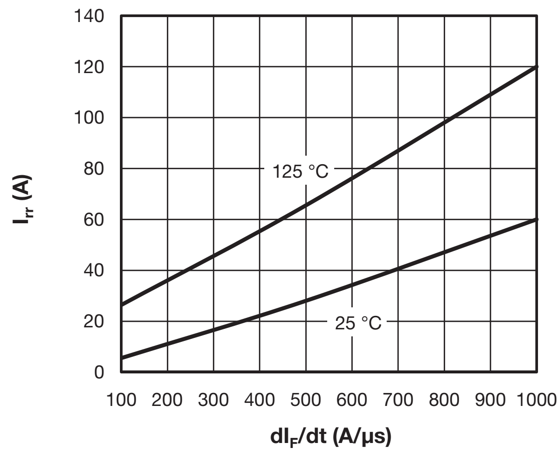
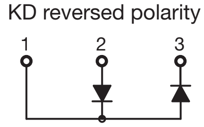


Fig. 8 - Typical Reverse Recovery Current vs. dI_F/dt
I_{FM} = 150 A, V_R = 300 V

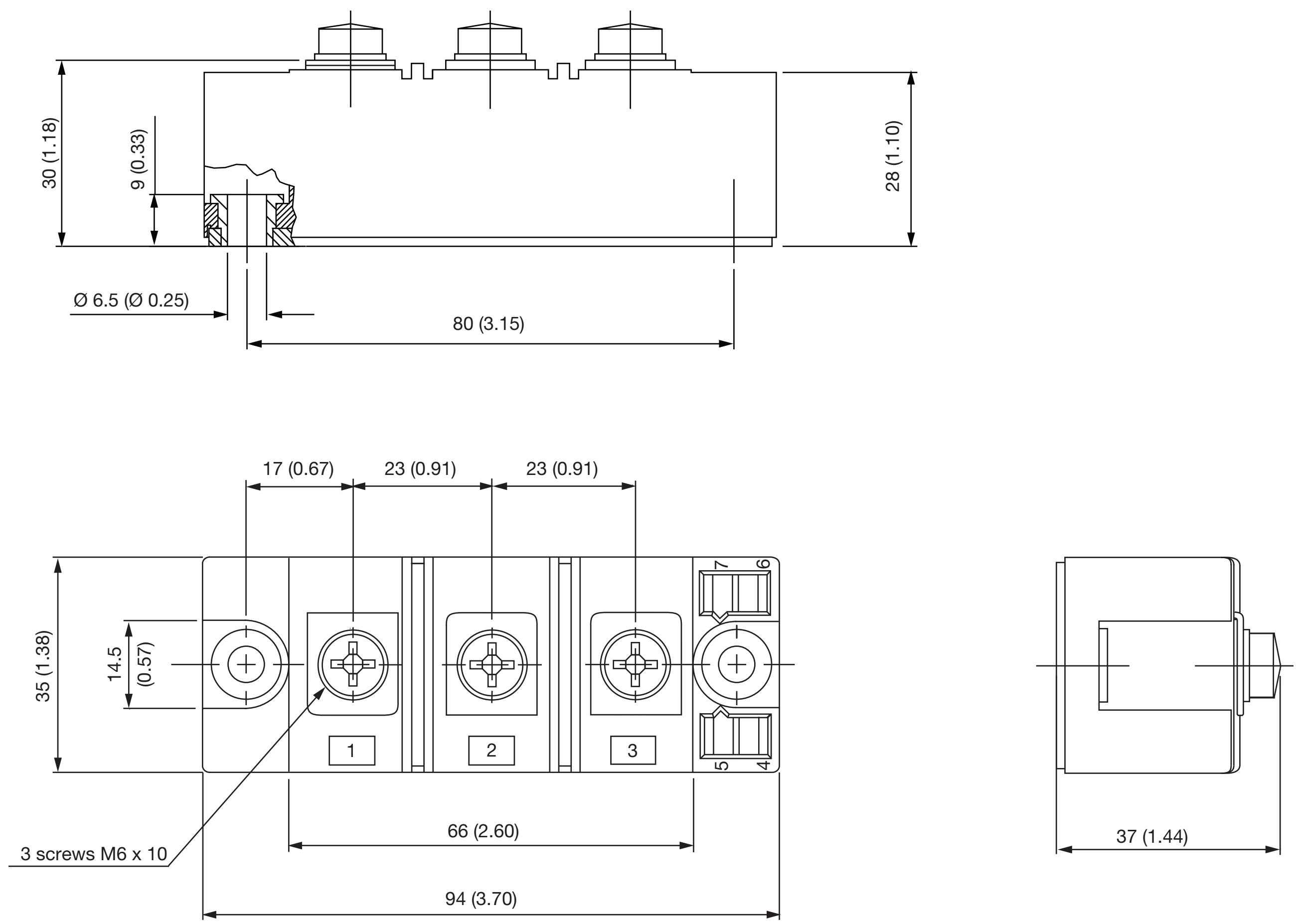
ORDERING INFORMATION TABLE

Device code	VS-VS	KD	F	500	06	PbF
	1	2	3	4	5	6

1 - Vishay Semiconductors product
2 - Circuit configuration: KD = doubler circuit
3 - F = FRED Pt® ultrafast diode
4 - Current rating (500 = 500 A)
5 - Voltage rating (06 = 600 V)
6 - PbF = lead (Pb)-free

CIRCUIT CONFIGURATION		
CIRCUIT	**CIRCUIT CONFIGURATION CODE**	**CIRCUIT DRAWING**
Diode doubler circuit	KD	KD reversed polarity 

DIMENSIONS in millimeters (inches)



Mounting Instructions for INT-A-PAK Modules

by Kevin Liu

This application note introduces Vishay´s INT-A-PAK (IAP) modules. It covers their key features and gives instructions for using heatsinks with the modules.

IAP modules are designed to provide reliable performance. A single housing is used to integrate power components, providing higher power density. Various die selections are available in several configurations.

INTRODUCTION

Vishay's IAP modules are distinguished by these key features:

- Fully isolated from the metal base, allowing common heatsink and compact assemblies to be built
- Wire-bonded internal connections
- Screwable electrical terminals secured against axial pull-out. They are fixed to the module housing via a click-stop feature
- Low junction-to-case thermal resistance

Important factors in the assembly process are:

- Heatsink design
- Power leads size/area
- Distance from adjacent heating parts
- Protection against electrostatic discharge (ESD)

Fig. 1 - Examples of IAP Modules

Recommendations for each of these items and requirements for mounting IAP modules to the heatsink are discussed in the following sections.

ESD PROTECTION

IGBT, MOSFET, and Ultrafast diode modules are sensitive to ESD. All IAP modules built with such configurations are protected against ESD during shipment; they are separated in a carton box and protected by an antistatic sponge. Anyone handling or working with the modules during the assembly process must wear a conductive grounded wristband.

HEATSINK SPECIFICATION

The contact surface of the heatsink must be flat, with a recommended tolerance of < 0.03 mm (< 1.18 mils) and a levelling depth (surface roughness) of < 0.02 mm (< 0.79 mils), according to DIN/ISO 1302. In general, a milled or machined surface is satisfactory if prepared with tools in good working condition. The heat sink mounting surface must be clean, with no dirt, corrosion, or surface oxides. It is very important to keep the mounting surface free from particles exceeding 0.05 mm (2 mils) in thickness.

Mounting Instructions for INT-A-PAK Modules

THERMAL COMPOUND

Coat the heatsink surface and the power module base plate uniformly with a good quality thermal compound. Apply uniform pressure on the package to force the compound to spread over the entire contact area. The purpose of thermal grease is to fill gaps at the base plate/heatsink interface, and its use is recommended to ensure low case-to-sink thermal resistance. The thermal conductivity of the compound should be not less than 0.5 W/mK. The suggested thermal grease is DC340 (Dow Corning), silicone-free HTCP (Electrolube), or an equivalent. Screen printing and rubber rolling are the preferred methods for applying the grease. A final grease layer thickness in the range of 80 μm to 100 μm is considered suitable for most applications.

MOUNTING TO HEATSINK

The module baseplate is typically slightly bended with convexity not exceeding 0.19 mm (7.8 mils) when measured between the two fixing holes. This provides an optimal contact area with the heatsink.

Confirm that there are not any foreign particles on the surface of the screen tooling and plate. Place a suitable amount of thermal compound on the plate and spread it equably by using a roller or spatula. Thermal grease contact and distribution will be improved during the first hours and after heating up the system for the first time.

Bolt the module to the heat sink using the fixing holes. An even amount of torque should be applied for each individual mounting screw. For proper mounting it is recommended to use M6 screws secured by a lock washer and flat washer. Please refer to each individual data sheet to find the maximum torque that can be applied. A torque wrench that is accurate in the specified range must be used in mounting the module to achieve optimum results.

The minimum suggested thread depth is 10 mm to 11 mm (0.40 in to 0.43 in) in heatsinks. All mounting holes should be free of burrs. The first mounting screw should be tightened to one third of the recommended torque; the second screw should then be tightened to the same torque.

Over-tightening the mounting screw may lead to deformation of the package, which would hence increase the thermal resistance and damage the semiconductors. After a period of three hours, check the torque with a final tightening in the opposite sequence to allow the spread of the compound.

POWER LEADS OR BUS BARS CONNECTION

An even amount of torque should be applied for each individual screw. For proper connection, it is recommended to use fit screws (refer to the individual datasheet or outline dimensions) secured by a lock washer and flat washer. The maximum thread depth into the module mounting studs should conform to each individual package outline drawing in the datasheet. Also refer to each individual datasheet to find the maximum torque that can be applied. A torque wrench that is accurate in the specified range must be used in fixing screws of the power leads or bus bars to achieve optimum results.

SIGNAL TERMINAL AND HOUSING CONNECTION

For IAPs built with black plastic housing, we recommend using receptacle fast-on terminals (with locking lance, for 2.8 x 0.8 tab (series 110) ref. PN.AMP 150571-2 or equivalent) and tinned copper stranded cable (UL 758, style 1558, AWG 22 (0.32 mm^2) laid 19 x 0.16 ETFE insulation, ext. dia. 1.25 mm, temperature rating 125 °C). In addition, a 2-way polarized connector housing can be used, as shown in the dimensional detail (the represented version refers to left “SX” and right “DX” connector housings) (Fig. 2).

For IAPs built with white plastic housing, we recommend using receptacle fast-on terminal with locking lance, for 2.8 x 0.5 tab (series 110) ref. PN.AMP 42067-1 or equivalent.

Mounting Instructions for INT-A-PAK Modules

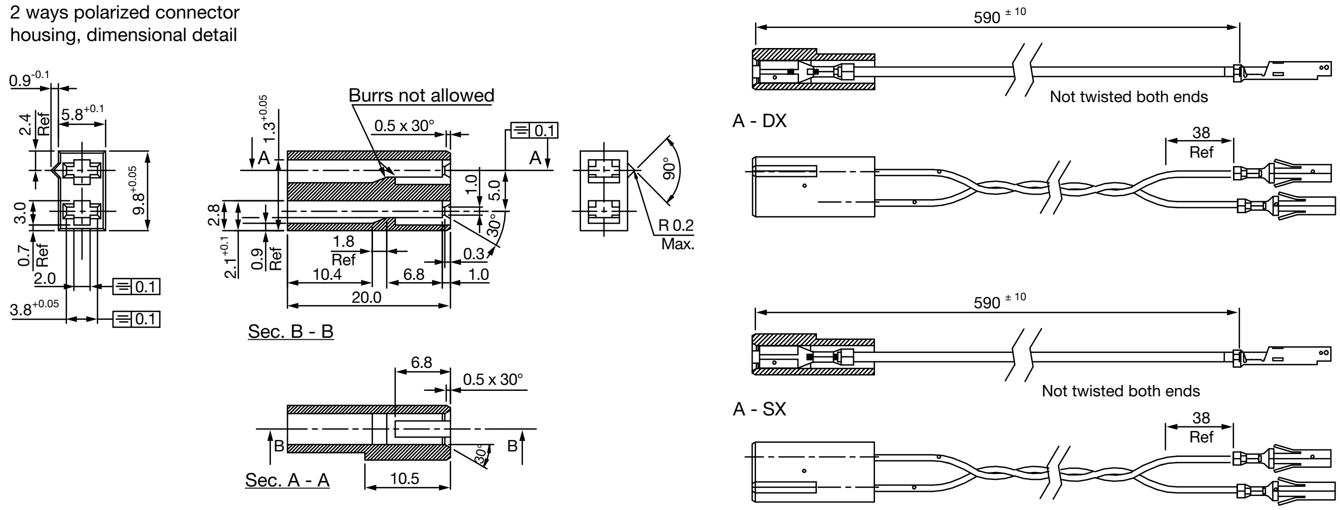


Fig. 2

END OF LIFE MODULE WASTE DISPOSAL RECOMMENDATION

Corporate social responsibility is more and more important for the environment protection, Vishay is certified by ISO 140001 and Vishay modules are always compliant with the Restriction of Hazardous Substances in Electrical and Electronic Equipment (RoHS) directive.

We recommend that the end of life modules (include components of the modules) shall be segregated by hazardous and collected in a labeled container (refer to CER code # 16.02.16) which should be put in a designated place.

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