Technical Specification
3kW – 6kW, PRISM Fiber Lasers

CONTENTS

1.1 Scope

High Power Fiber Lasers in Rack format, comprising one or more kW class OEM Modules along with a High Power Combiner (HPC) Unit, having a single multimode delivery fiber, and with FiberView Control Unit.

1.1.1 Applicable Product Code Families

SP - **2000 / 3000 / 4000 / 4500 / 6000** - R - W - **050 / 100 / 300** **15 / 20** - PIQ - **A / B / D** 10 - 001 - **0 / 1** 0 **0 / 2**

1.2 Optical Specification

Parameter	Value	Notes
Laser Powers	2kW, 3kW, 4kW, 4.5kW, 6kW	At the output connector
Efficiency	≥33%	SOL, DC to optical
Wavelength	1068 - 1082nm	±2nm
Polarisation	Random	
Laser Bandwidth	<10 nm	
Thermal Focus Shift	0.5 Z_R / kW (Rayleigh length per kW)	At the output connector
Pulse Duration	10µs - CW	
Rise Time	<5µs	10% to 90%
Fall Time	<6µs	90% to 10
Pulse Frequency	50kHz	Maximum frequency for zero interpulse power, above 500W output power.
Output Power Range	10%-105%	Normal operation. Relative to specified output power
Low Power Mode	30W -300W	Needs separate control mode activated
Warm Up Time	<10mins	To reach specified power stability from cold
Short Term Power Stability (1Hz – 1MHz)	<2.0% RMS	After warm up time, under constant coolant conditions. At specified output power
Long Term Power Stability (1 Sec – 10 Hours)	±2.0% peak	After warm up time, under constant coolant conditions. At specified output power
Fiber Laser Design Lifetime	>40,000 Hours	MTBF, Mean Time Before Failures. Assuming 25°C coolant temp

Laser Life Expectancy

SPI's fiber lasers are designed using active and passive components including active and passive fibers. The optical characteristics of the passive components do not age appreciably over time or with use, nor do the characteristics of the active fibers. The life expectancy of the fiber laser is therefore set by its other active components, and primarily by the pump diodes. The design lifetime for the pump diodes (an ensemble of fiber coupled laser diodes) is typically 100,000 hours MTBF. This MTBF is not until catastrophic failure, but to the time at which the current required to

maintain output power exceeds a design limit. The quoted MTBF is for the ensemble of all individual laser diodes. For individual laser diodes, the MTBF is considerably longer, of the order of 1,000,000 hours, but it is the ensemble MTBF that is important when considering the product lifetime.

1.3 Beam Delivery Fiber Specification

Parameter	Value				Notes
Output Fiber	50µm (3kW Only)	100µm enhanced	100µm	300 µm	PIPA-Q Output Connector
Beam Quality, BPP, (mm.mrad)	2.1±0.3	3.3±0.6	4.5±0.6	13±4	As defined ISO 11146
Beam Divergence (mrad) – 86% power enclosed	170±30	130±25	180±30	175±40	Full angle at specified power
Beam Divergence (mrad) – 99.5% power enclosed	<280mrad	<240mrad	<280mrad	≤300mrad	Full angle at specified power
Output Fiber Length Options	5m, 10m, 15m & 20m				Conduit may have occasional blemishes of purely cosmetic nature.

1.4 Alignment Laser

Parameter	Value	Notes
Power	1mW (max) Class 2	Fitted as standard
Wavelength	Red (630-680nm)	
Supply Voltage	24V +/-10%	

1.5 Power Distribution

Parameter	Value					Notes
Output Power	2000W	3000W	4000W	4500W	6000W	
Voltage	48V nominal (51V max. at specified output power)					
Power Connection Type	Bus Bars					
Frequency	DC					
Output Load Regulation	Max. 0.5%					Output Load Regulation
Output Line Regulation	Max. 0.5%					Output Line Regulation
Output Ripple & Noise	Max. 0.5%, 20Mhz measurement bandwidth. At full load, nominal input voltage. Power supply to be able to energise ≥4,000µF of load capacitance under direct on-line load power application (cold start).					Output Ripple & Noise
Hold Up Time	Min. 5ms. At full load, nominal input voltage.					Hold Up Time
Transient Response	Max. 0.5% Example: The input current can change from 0A to 135A in less than 5µs. If the PSU cannot respond fast enough additional capacitive support will be required to ensure that the output power is maintained over the first few milliseconds					Transient Response
Output Load Regulation	Max. 0.5%					Output Load

Parameter	Value					Notes
						Regulation
Max Current (A)	180	270	360	410	540	At EOL for specified output.
Power Consumption (kW)	8.0	12.0	16	18.0	24	
Auxiliary Power Supply	24 V dc ±5%, (2A for HPC + 1A per laser module)					

1.6 Water Cooling Requirements

Parameter	Value					Notes
Output Power (W)	2000	3000	4000	4500	6000	
Cooling Capacity (W) (Heat Load to be removed)	6000	9000	12000	13500	18000	At EOL for specified output
Coolant Temperature	18-30°C.					Non condensing
Coolant Max Pressure	6.0 Bar					
Coolant Min Differential Pressure	2.5 Bar					
Coolant Connection Diameter	10mm					
Coolant Flow Rate (l/min) FL Modules	20	30	40	45	60	The total flow through all pipes. At 25°C water temperature. The minimum flow rate for different inlet water temperature and rated powers is given by Figure 1.
Coolant Flow Rate (l/min) HPC Module	5					
Coolant Materials Compatibility	Copper & Plastic					DI Water NOT to be used
External Water Specification	**Minimum**		**Maximum**			Drinkable tap water is likely to meet these requirements, and water meeting the requirements of VDI3803. Additives for prevention of corrosion, scaling and microbial growth are available commercially, for example from NALCO and Optishield, and may be used if the manufacturer's instructions are followed. Where there is a need to protect the cooling water from freezing, inhibited ethylene glycol may be added.
Appearance	Clear & without sediment					
Particle size	-		100 µm			
Hardness (mg $CaCO_3$ per litre)	-		300 mg/l			
Electrical conductivity at 25°C	22 µScm^{-1}		2200 µScm^{-1}			
pH	6.5		9.0			

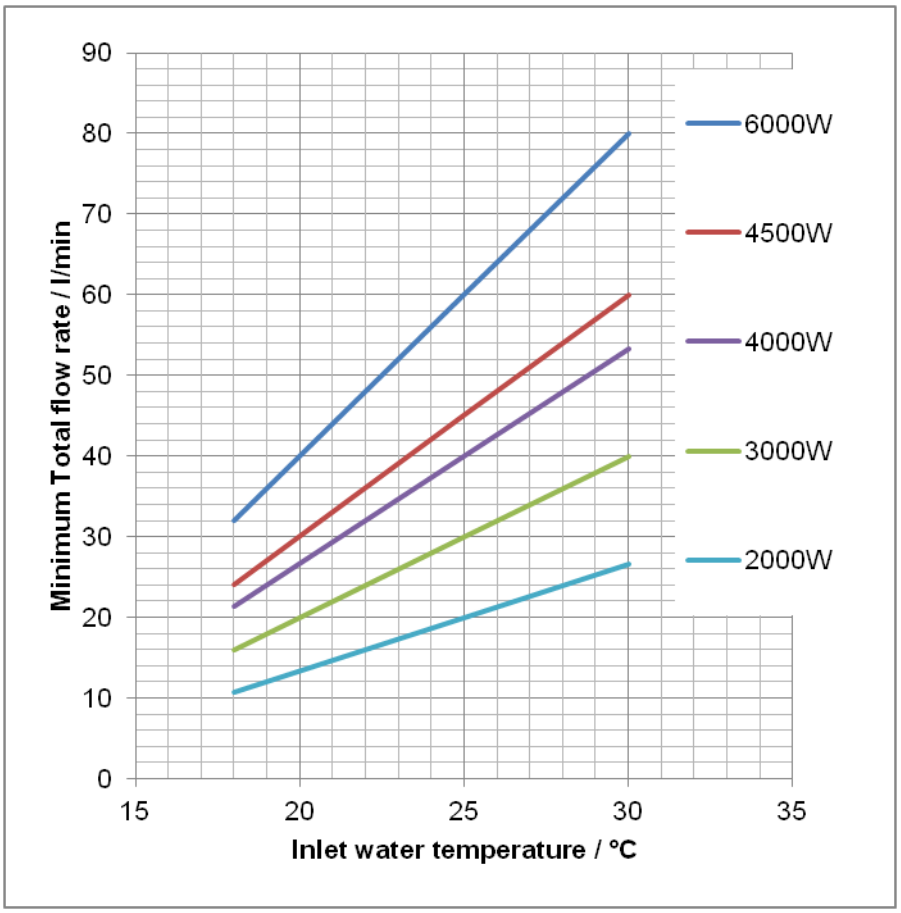

Figure 1 Minimum Flow Rate against Inlet Water Temperature

1.7 Control

Parameter	Value	Notes
Customer Interface	Serial - RS232, Ethernet, CAN bus Parallel – Digital (24V nominal) Analogue (0-10V) signals	CAN bus uses proprietary protocol.
GUI	FiberView	

1.8 Physical

Please see Dimension Drawings in Section 1.11

Parameter	Value				
Output Power	2000W	3000W	4000W	4500W	6000W
Width	19" Rack mount (445mm)				
Depth	702mm				
Height		6U (267mm)		8U (356mm)	10U (445mm)
Weight	94kg	90kg	130kg	130kg	165kg

1.9 Environment

Parameter	Value
IP Rating	IP52 (excluding Power Input / Control Interface which is IP50)
Range of ambient	5-45°C
Humidity	5-85% RH 35°C Max Dew Point
Storage	0 – 70°C, 0-95% RH
Storage	Drain coolant below 2°C

1.10 Compliance

1.1.2 Legal

For legal compliance the OEM shall comply with the following European Union (EU) directives:

EU Directive	Harmonised Standard	Notes
2011/65/EU		RoHS Directive
	EN 50581:2012	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances
2012/19/EU		WEEE Directive
	None	No Harmonised Standards apply

For legal compliance OEM shall comply with the following United States (US) Regulations:

US Regulation	Note
Title 21, Chapter I, Subchapter J, Rule §1040.10(a)(3)	FDA - Product listing regulation

1.1.3 Design Guidelines taken into consideration

The relevant sections of the following Harmonised Standards have been considered applicable to the design of this OEM laser.

Harmonised Standard	Title
EN 60529:1989	Degrees of protection provided by enclosures (IP code)
EN 61293:1995	Marking of electrical equipment with ratings related to electrical supply
EN13849-1:2015	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN13849-2:2012	Safety of machinery - Safety-related parts of control systems - Part 2: Validation
EN11554:2008	Optics and photonics - Lasers and laser-related equipment - Test methods for laser beam power, energy and temporal characteristics
EN 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 12198-1:2000+A1:2008	Safety of machinery — Assessment and reduction of risks arising from radiation emitted by machinery — Part 1: General principles.
EN 12198-2:2002+A1:2008	Safety of machinery — Assessment and reduction of risks arising from radiation emitted by machinery — Part 2: Radiation emission measurement Procedure
EN 12198-3:2002+A1:2008	Safety of machinery — Assessment and reduction of risks arising from radiation emitted by machinery — Part 3: Reduction of radiation by attenuation or screening
EN60825-1:2014	Safety of laser products — Part 1: Equipment classification and requirements
EN 60825-4:2006+A2:2011	Safety of laser products — Part 4: Laser guards

1.11 Dimension Drawing