

## FIREFLY3D 3-AXIS LASER SCAN HEAD DATA SHEET

# HIGHEST PRINTED PART QUALITY FOR LASER POWDER BED FUSION WITH CLASS LEADING PRODUCTIVITY

Novanta develops photonics solutions through our globally recognized brands— Cambridge Technology, Laser Quantum and Synrad— specializing in cutting-edge components, laser controllers, software, and sub-systems for fine material processing, micromachining, and laser-based diagnostics and analytics.

### DESIGNED AND BUILT TO MAXIMIZE LPBF RESULTS AND PRODUCTIVITY



**Ultra-fast scan head improves productivity** - Advanced scan head design coupled with unique ScanMaster™ Controller features increase throughput by as much as 10%, reducing cycle time.

**Supreme accuracy optimizes surface quality and structural integrity** - Exacting laser spot placement and ultra-low drift delivers class leading replication with 5- 10% reduction in long-run failures and lowers post process requirements for FDA and FAA verification metrology.

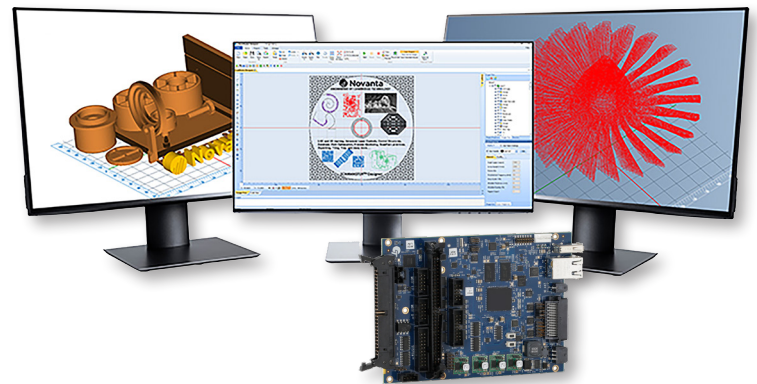
**Built-in quality control** - Two synchronized monitoring bands, real-time scanner data and an open sensor data stream enable immediate processing feedback.

**Radical calibration time reduction** - Unique Automatic Scan Field Calibration (ASFC) drastically reduces machine downtime for calibration from 8+ hours to < 15 minutes. ASFC delivers up to 50% more scan accuracy and eliminates the need for expensive metrology equipment.

**Faster, easier integration minimizes commissioning time** - True plug & play operation saves OEM integration costs with a IP65 rated enclosure with certified optical performance at full power.



### UNIQUE SCANNER/CONTROLLER/ SOFTWARE ECO-SYSTEM UNLOCKS UNMATCHED LPBF FEATURES



FIREFLY3D combined with Novanta ScanMaster™ Controller and ScanMaster™ Designer software package creates a unique, industry leading eco-system dedicated to maximizing output with extreme processing detail. The new eco-system when finely tuned for LPBF applications unleashes the power of an optimized additive manufacturing system.

BUILT FOR OPTIMAL LPBF RESULTS

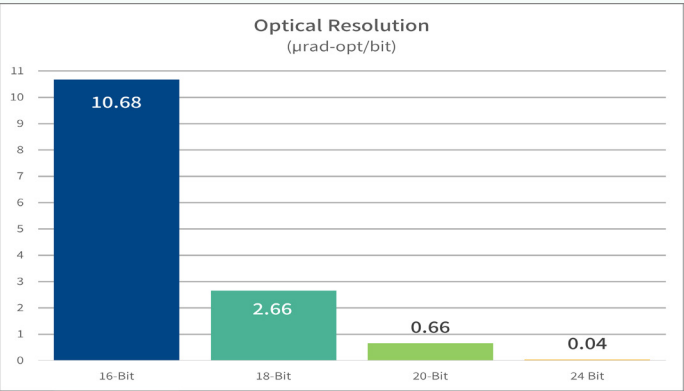
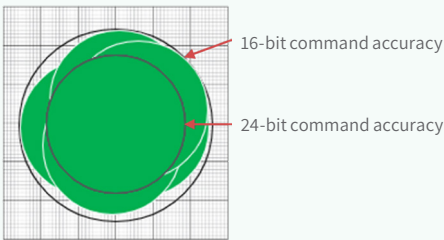
**Field proven Lightning™ II technology** - state-of-the-art scan head design includes a high-speed, high-accuracy Dynamic Focusing Module (DFM). Lightning™ II scan heads are primarily found in 3D LPBF systems used for precision medical device applications.



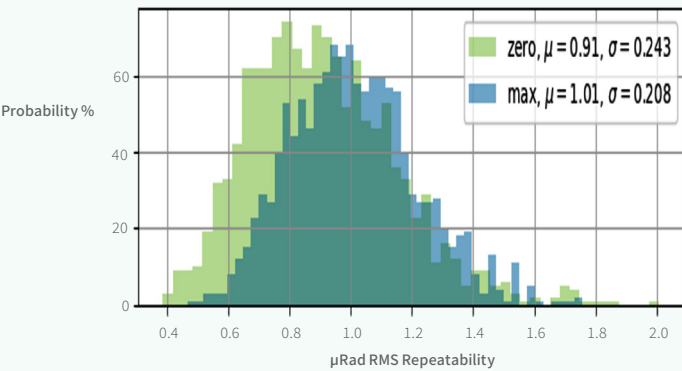
**Ultra-lightweight Beryllium mirrors** - matched with digital galvos deliver the fastest jump speed available in LPBF systems to reduce layer processing time.



**Industry leading 24-bit command protocol** - delivers best-in-class print replication with both 24-bit command data for greater position accuracy, and 24-bit status data for hi-definition feedback of position, velocity, current, voltage, temperature and more.



**Unmatched repeatability** - 1 µrad RMS repeatability achieves commanded position at center and maximum scan angle, over 60 second interval. Industry leading repeatability ensures consistent processing results over long print runs, delivering a 5 – 10% reduction in scrapped parts.



Description	Short Range	Mid-Range		Long Range	
Working Distance (mm)	200	450	650	650	1000
Field Size (mm)	215 x 215	430 x 430	620 x 620	620 x 620	920 x 920
Repeatability (µm)	0.20	0.45	0.65	0.65	1.00

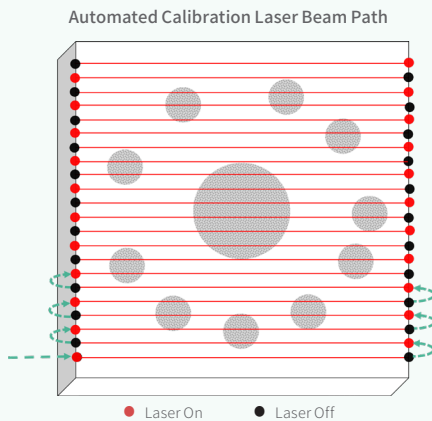
**Certified focus spot quality** - each production unit is evaluated using PRIMES micro spot monitor in a fully automated test bench with up to 1 KW laser power. Novanta optical certification process ensures consistent delivery of laser power for unmatched density of fused metal and part surface quality. Each FIREFLY3D is shipped with its Optical Certification report. Novanta is the only laser scan head supplier that provides full laser power acceptance testing.



## BUILT FOR OPTIMAL LPBF RESULTS

**Fully automated calibration system** - simplifies the complex, time-consuming calibration process and eliminates the need for expensive metrology equipment. Machine downtime due to calibration is reduced by as much as 90% and ensures a 5  $\mu\text{m}$  feature accuracy without the need for highly trained service personnel.

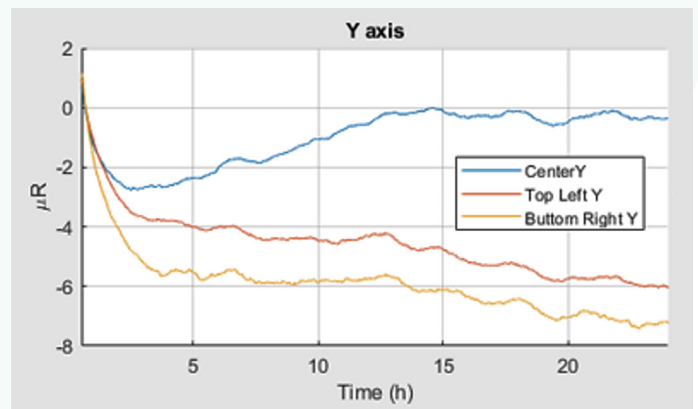
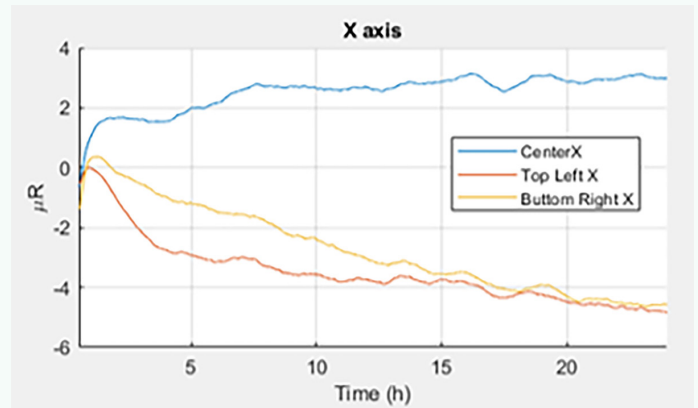
The Automated Calibration System is a one-button solution that initiates the scanning of a laser-structured glass target and recording back-reflected stray light with photo diodes. The system then correlates the photo diode signal with scanner coordinates. The Automation Calibration software then automatically creates a system correction file and the system is ready to use.



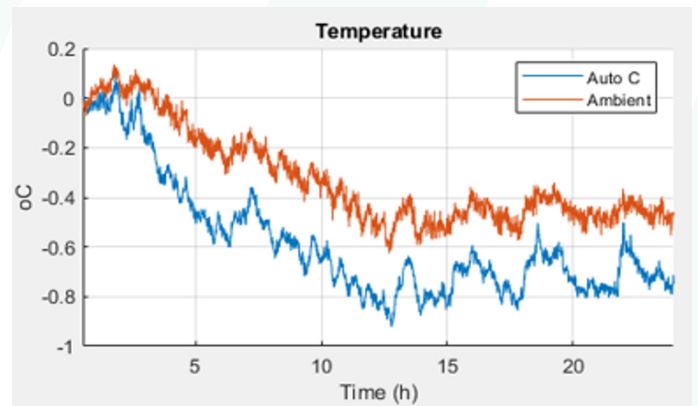
Automated Calibration Field Pattern Coverage



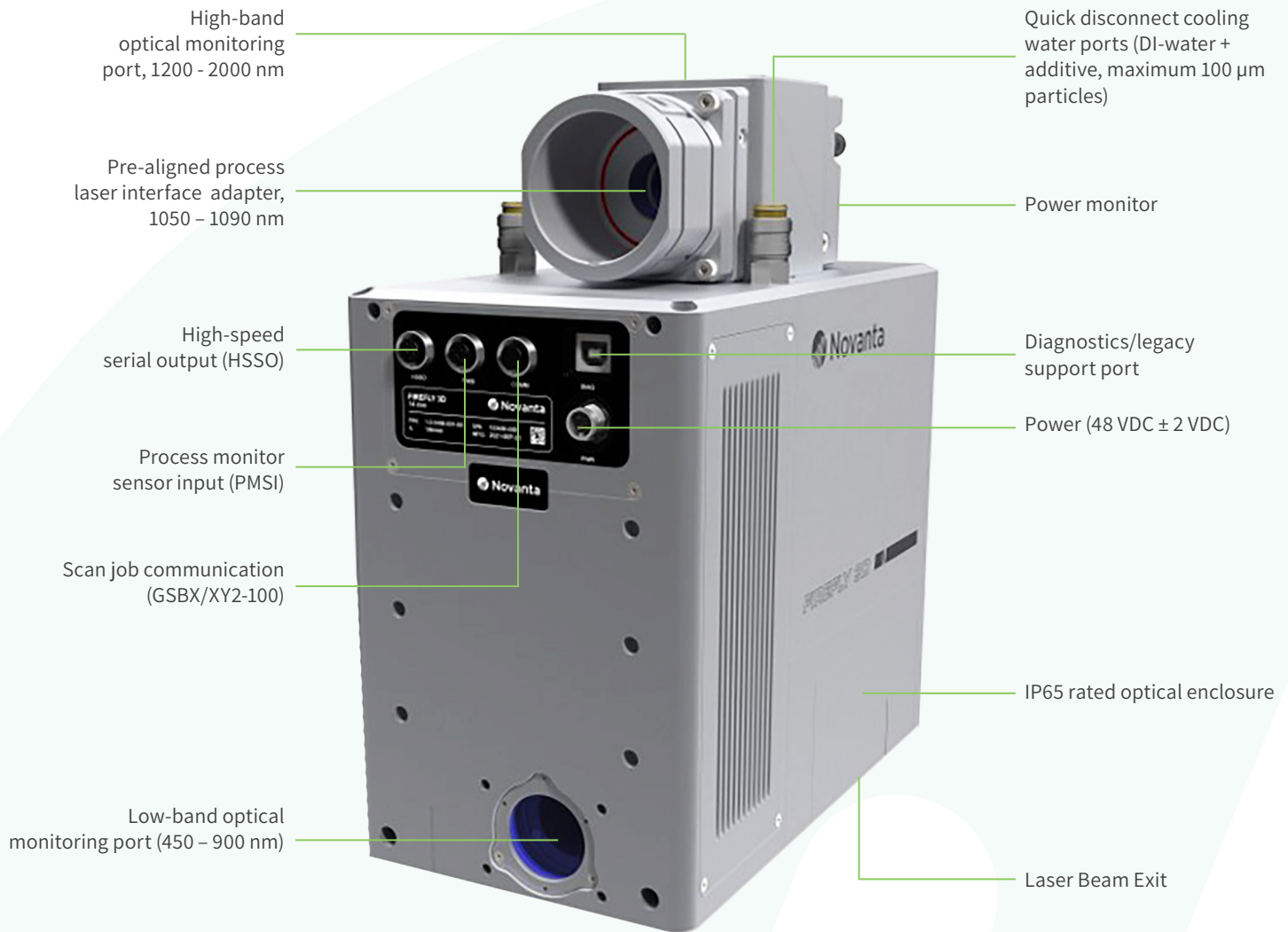
**Superior Low Drift** - precise and consistent laser beam placement ensures consistent processing results of high-quality part surface and density of fused metal. FIREFLY3D's industry leading galvos are field proven, exhibiting drift performance of less than 10  $\mu\text{rad}$  over 8 hours of operation after a 30-minute warm-up period.



Temperature is a critical part of maintaining low drift performance. FIREFLY3D's water cooling system can be enhanced with good thermal management of the LPBF system. Temperature induced drift is 10  $\mu\text{rad}/\text{K}$ .

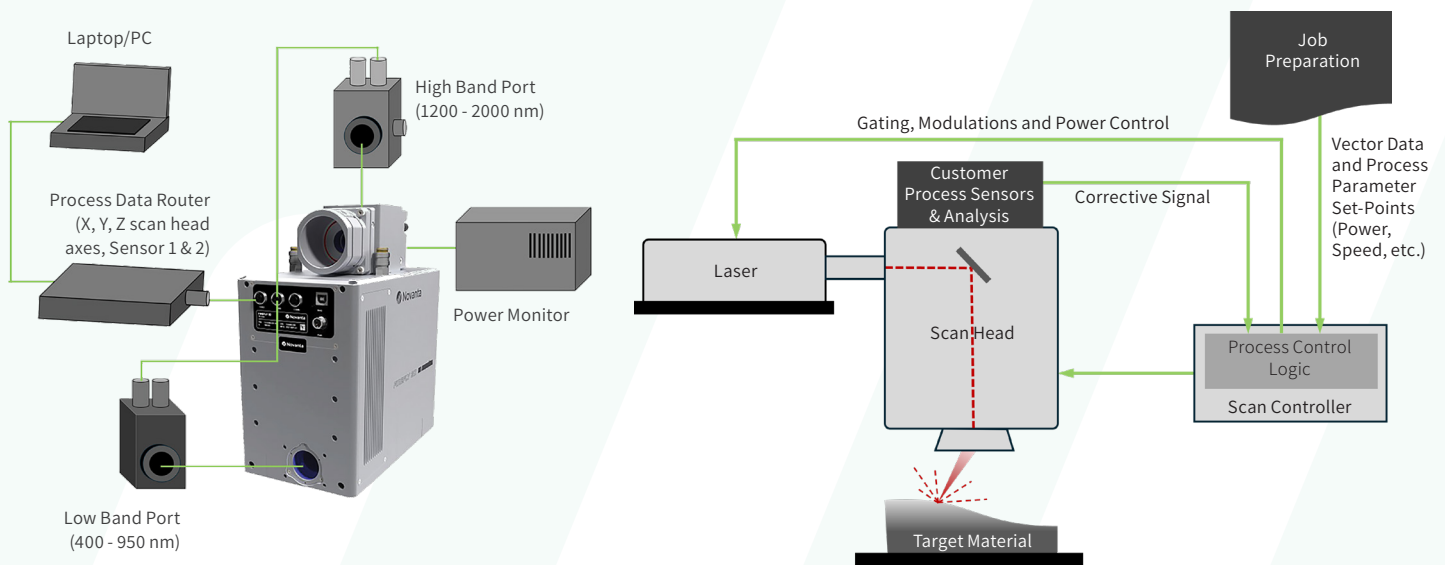


## FASTER, EASIER INTEGRATION



## USER SUPPLIED COMPONENTS & OPEN ARCHITECTURE

The open platform design intentionally enables easy integration of the user's sensing technology to address current and emerging in-process monitoring needs. Synchronized real time scanner position and sensor data are connected to a feedback loop that controls the laser power.



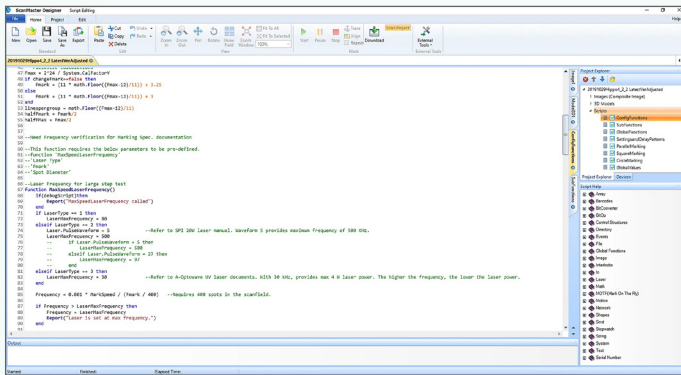


# SCANMASTER™ CONTROLLER & SCANMASTER™ DESIGNER

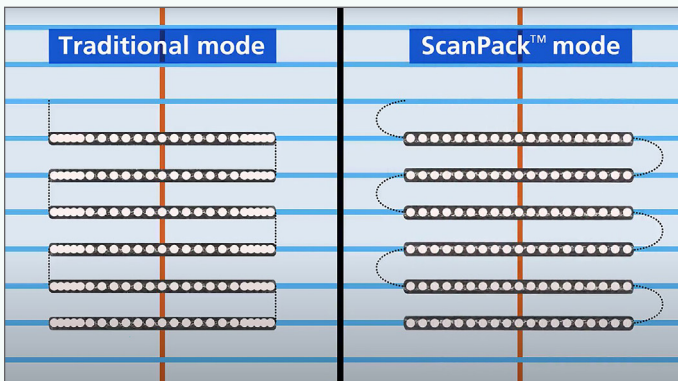
Single operator software and laser controller solution perfectly matched and designed in unison to optimize laser processing performance with advanced built-in application features to achieve...

- Precision, quality, and repeatability
- Throughput improvement
- System failure detection
- Process data archiving

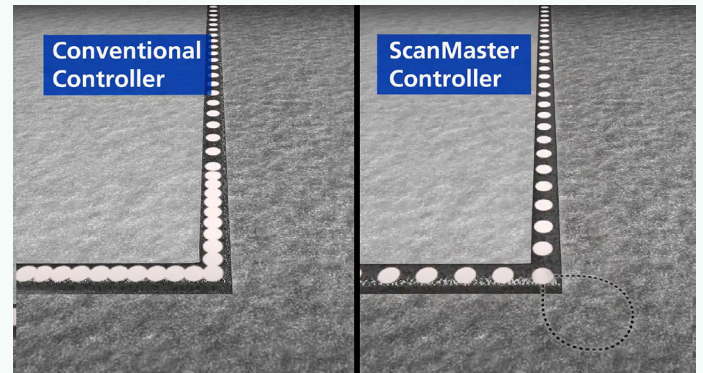
**Built-In ScanScript** – single solution for multiple applications includes unique application specific features including 3D model design capabilities and file importing.



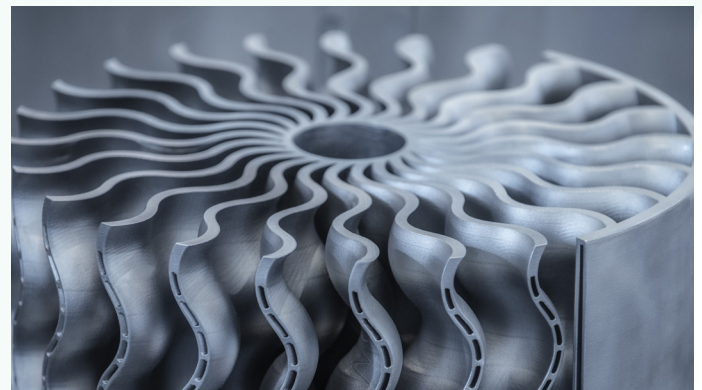
**ScanPack Trajectory Planning** – Fastest 3-axis scan head with advanced software controls including patented technology that optimizes the scan pattern to eliminate wasted galvanometer movement.



**Skywriting** – delivers uniform laser density when processing complex shapes and tight corners to avoid “burn marks” caused by over-processing.



**Extreme Processing Detail** - Industry leading 24-bit resolution controller combined with a precise, low-drift galvanometer set enables greater processing detail for best-in-class sintered metal structure and surface finish.



**Synchronization** – high degree of stitching accuracy for multi-scanning head systems.



# FIREFLY3D MULTI-HEAD CONFIGURATIONS

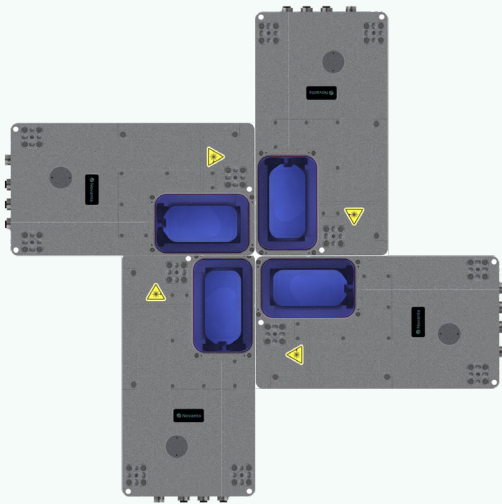
Creating larger LPBF objects or laser processing larger areas can be accomplished with FIREFLY3D and ScanMaster™ Controller/ Designer. Multiple FIREFLY3D scan heads can be configured into a multi-head system to expand the working field. The highly accurate beam placement combined with a synchronization feature delivers supreme stitching field accuracy, covering areas as large as 1800 x 1800 mm with an impressive laser spot size of 120 µm.

## Edge Offsets



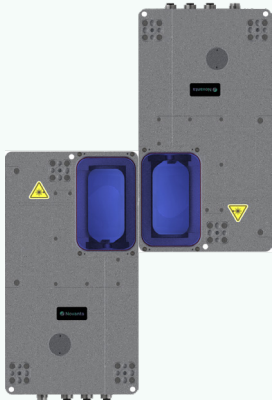
- Y: 34.2 mm
- X: 55.0 mm

## Quad Configuration



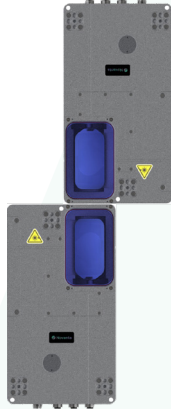
FIREFLY3D Configuration	Working Distance (mm)	Maximum Field Size (mm)	Laser Spot Size (M <sup>2</sup> = 1.1, µm)
SR Quad Head	200	430 x 430	25
MR Quad Head	450	860 x 860	46
MR Quad Head	650	1240 x 1240	63
LR Quad Head	650	1240 x 1240	63
LR Quad Head	1000	1840 x 1840	92

## Dual Head Configuration



FIREFLY3D Configuration	Working Distance (mm)	Maximum Field Size (mm)	Laser Spot Size (M <sup>2</sup> = 1.1, µm)
SR Dual Head	200	215 x 430	25
MR Dual Head	450	430 x 860	46
MR Dual Head	650	620 x 1240	63
LR Dual Head	650	620 x 1240	63
LR Dual Head	1000	920 x 1840	92

## Dual In-Line Configuration

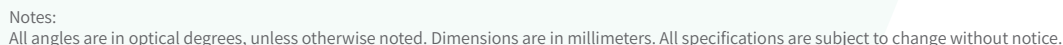


FIREFLY3D Configuration	Working Distance (mm)	Maximum Field Size (mm)	Laser Spot Size (M <sup>2</sup> = 1.1, µm)
SR Dual Head	200	430 x 215	25
MR Dual Head	450	860 x 430	46
MR Dual Head	650	1240 x 620	63
LR Dual Head	650	1240 x 620	63
LR Dual Head	1000	1840 x 920	92

## FIREFLY3D SPECIFICATIONS

Specifications	
Optical	
Wavelength	1050 nm - 1090 nm
Laser Power	Maximum 1100 W
Input Clear Aperture	20 mm
Maximum Angular Velocity	50 rad/s
Integrated Pointer Laser Wavelength	633 nm
Repeatability	1 $\mu$ rad RMS
Offset Drift	< 10 $\mu$ rad
Tracking Delay	0.2 ms
Command Resolution	24 bit for GSB
Step Response	10 mrad-opt step   100 $\mu$ sec
Maximum Acceleration	100,000 rad-opt/sec <sup>2</sup>
Automated Calibration Accuracy	5 $\mu$ m
Process Monitoring	
Low Monitoring Band	450 nm - 950 nm
High Monitoring Band	1200 nm - 2000 nm
Communications & Interfaces	
Laser Power Monitoring	Power Monitoring Port   Optional: Power Sensor
Protocols	XY2-100   XY2-100 (enhanced)   GSB
Process Monitoring Sensor Interface	High Speed Serial Output Analog Inputs
Analog Inputs	2 Analog Input Channels (0-10Vdc)
Diagnostics Port	USB or bridged access via SMC to allow access to servo driver function and status reporting
Cooling	
Cooling Method	Water Cooled
Cooling Water Inlet Temperature	18°C ~ 20°C
Inlet Pressure	3 Bar - 4 Bar
Volume Flow	1.2 l/min - 2.2 l/min
Humidity (non-condensing)	Maximum 80 %RH
Enclosure	
IP Rating	IP65
Max Dry Weight	12 Kg
Dimensions (L x W x H)	290 mm x 255 mm x 140 mm
Electrical Supply	48 Vdc +/- 2 Vdc

Dimensions are in mm



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