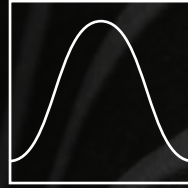


The background of the page is a close-up of a metallic surface with a bright green laser beam reflecting off it. In the center, there is a faint, glowing green wireframe diagram of a 3D object, possibly a part of a machine or a tool, with several lines extending from its base, suggesting a coordinate system or measurement points.

**PRODUCTS FOR LASER BEAM ANALYSIS  
IN ADDITIVE MANUFACTURING**

# Laser Powder Bed Fusion



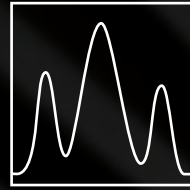
This technology is cutting-edge and has initiated a revolution in production halls. The ability to digitally reproduce shapes using 3D printing and “con-juring up” three-dimensional parts practically without tools just by building them up layer by layer has broken the mould for traditional production processes. The more complex a component is, the more economical it will be to produce it using additive processes, whether a dental prosthesis, a turbine unit or replacement parts for a car.

The requirements for beam diagnostics in Laser Powder Bed Fusion (LPBF) are as diverse as the possibilities of the process itself! Single-mode lasers, focused on a hair’s diameter, fly within narrow limits over a build chamber to produce safety-critical parts. However, especially when using multiple laser sources to increase productivity, the dynamic interaction of all lasers, scanners, and optics is crucial for the accuracy with which production can take place. As a result, introducing new laser sources offering tunable beam quality is attracting more and more attention.

A solution that targets the process’s needs and the users’ requirements must generate a holistic picture of the laser—measuring the actual power or the propagation of the laser (both centrally and at an angle) whilst in motion is, therefore, one of the main objectives.

Time is money: When developing unique solutions, our customer’s benefit is always one of our main objectives. PRIMES products have wireless communication and do not require any additional media. As a result, setup times are reduced to a minimum.

## Analysis of Ring Beams



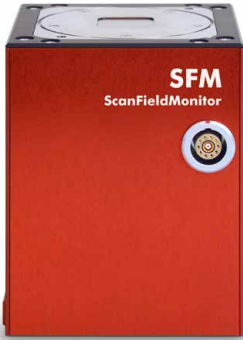
The development and industrial maturity of structured laser beams poses new challenges for laser beam diagnostics. Ring shaped laser beams have become widely established within additive manufacturing machines. Existing quality parameters for both single plane and caustic analysis set out in ISO 11146 are no longer applicable, or at least don't provide any meaningful results. For example, within one Rayleigh length – a standard measure for the focal depth of a laser beam – any beam structure or shape is completely lost.

To accommodate the growing market for shaped laser beam applications, PRIMES has developed a new set of parameters to describe such beams in a meaningful and useful way. The focus here lies primarily on ring-shaped laser beams, both with and without a central core beam. Parameters such as core diameter, ring diameter and ring width, as well as the power share between ring and core, enable the analysis of the focal plane. For caustic measurements, the parameters structure focus and structure depth help to analyse the propagation of structured beams and, in turn, help to define the processing window.

The analysis of the ring-shaped laser beam happens fully automatically within the LaserDiagnosticsSoftware LDS and works with all our beam diagnostic devices.

# Measuring in Confined Spaces – ScanFieldMonitor and Cube+ M

Two must-have tools for your Additive Manufacturing toolbox! Characterizing lasers and scanners according to current Additive Manufacturing standards has never been faster and more reliable.



The ScanFieldMonitor SFM was developed specifically to meet the requirements of Additive Manufacturing machines (SLM or LPBF). The SFM operates by detecting the scattered laser light on a structured glass plate and is independent of the beam intensity.

The SFM does not require any physical connections to operate. There is no need for a supply of cooling water. No cables need to be run into the process area. The SFM can measure process-oriented parameters (e.g. focus position (x,y,z), spot diameter, scanning speed, etc.) all across the build plate.



The Cube+ M is an advanced version of the well-established Cube, designed to meet the demands of high power densities in confined spaces. Laser power measurements at up to 2 kW, even in the corners of the build plate or the overlap region of multiple lasers, are the Cube+ M's strengths.

- Large storage capacity
- No water cooling
- Bluetooth, USB-C, API and Interlock
- Single button operation

In addition, the unique optical design allows power densities of up to 250 kW/cm<sup>2</sup> with an angle of incidence of up to ± 20° to be measured.



Caustic



Vector



Beam profile



Power



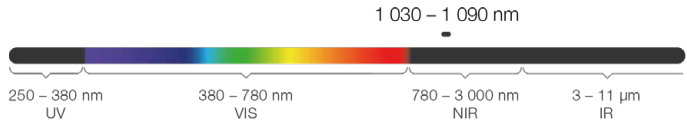
Focus shift



Pointing stability



Fiber and  
disc laser



	SFM	CUBE+ M
<b>POWER RANGE</b>	Up to 1.5 kW	Up to 2 kW
<b>ACCURACY</b>	± 5% on beam diameter	± 3% on laser power
<b>BEAM DIAMETER</b>	Focused 50 – 300 μm	1 – 4 mm
<b>HIGHLIGHT</b>	Marking Speed 0.1 – 10 m/s	Angle of incidence ±20° Power densities up to 250 kW/cm <sup>2</sup>
<b>INTERFACES</b>	WLAN, Ethernet	Bluetooth, USB-C

## Conclusion

The SFM and Cube+ M combine and streamline all measurement tasks needed for a quick and cost-efficient product calibration. The combination of both devices also provides detailed analytical options for research and development. The SFM enables you to analyze various process parameters of scanner systems under actual operating conditions. It is the only device in the market capable of measuring to the latest standards: ISO/ASTM 52941:2020.

The Cube+ M is a compact, robust and reliable solution for measuring laser power even at high power densities of up to 250 kW/cm<sup>2</sup>. Due to fast and easy measurements without cooling or cables, it's the perfect tool for your quality assurance between each build job.

# Specialists for your AM Application – FocusMonitor FMW+ and ScanFieldMonitor SFM 2D

**All-in-one beam analysis meets  
fast & easy scanner characterization**

The FocusMonitor FMW+ is a versatile optomechanically scanning diagnostics system for analyzing focused laser beams, specifically in additive manufacturing (AM) systems. The FMW+ utilizes the z-stage of the AM machine to measure full beam caustics. An integrated new Absorber with a capacity of up to 240kJ eliminates the need for external cooling. Together with our market-leading LaserDiagnosticsSoftware LDS, along with an OPC UA interface, user-independent measurements in accordance with ISO 11146-3 can be performed automatically. With a new generation of measuring tips, the lower limit of the beam size was shifted to 75 µm.



	FMW+
<b>POWER RANGE</b>	Up to 1000 W
<b>BEAM SHAPE</b>	Gaussian, Top-Hat, Ring
<b>BEAM DIAMETER</b>	75 – 3000 µm
<b>HIGHLIGHT</b>	Integrated and replaceable absorber
<b>INTERFACES</b>	Ethernet



Caustic



Vector



Beam profile



Power



Focus shift



Pointing stability



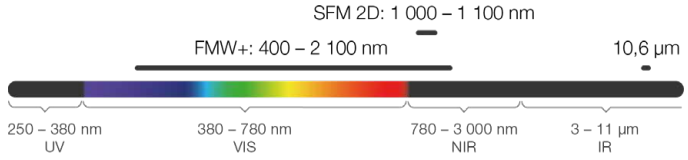
Fiber and disc laser



Diode laser



CO<sub>2</sub> laser



The proven measurement principle of the SFM, where the laser beam is scanned across a well-defined glass engraving, has been expanded to a two-dimensional array of engravings. This enables the quasi simultaneous analysis of the entire scanning area of an AM machine within a matter of seconds. Collect hundreds of focus spot sizes, caustics and other parameters at the same time. The SFM 2D makes the characterization of your scanner setup fast and easy. Detect any defects or misalignments in your marking field with the click of a button. In addition, verify and correct marking speed, vector path and delay times. All with one tool, the new SFM 2D.



	SFM 2D
POWER RANGE	10 W – 1.5 kW
BEAM SHAPE	Gaussian, Top-Hat, Ring
BEAM DIAMETER	Focused 50 – 300 μm
HIGHLIGHT	Marking speed 0.1 – 10 m/s
INTERFACES	WLAN

# Competence in Laser Beam Diagnostics

PRIMES offers innovative and process-optimized measurement devices for focus characterization and performance assessment of laser beams. Our comprehensive range of high-precision, durable products is essential in numerous industrial applications to realize the full potential of laser technology.

Our systems are highly regarded by researchers and developers in both industry and academia. With all hardware and software developed in-house, we deliver tailored solutions for a wide variety of laser measurement tasks, system characterization and failure analysis. Standardized interfaces ensure seamless integration of our instruments into production processes.

Since its founding in 1992, PRIMES has installed more than 35,000 systems worldwide, earning its reputation as a global pioneer in laser beam diagnostics.



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