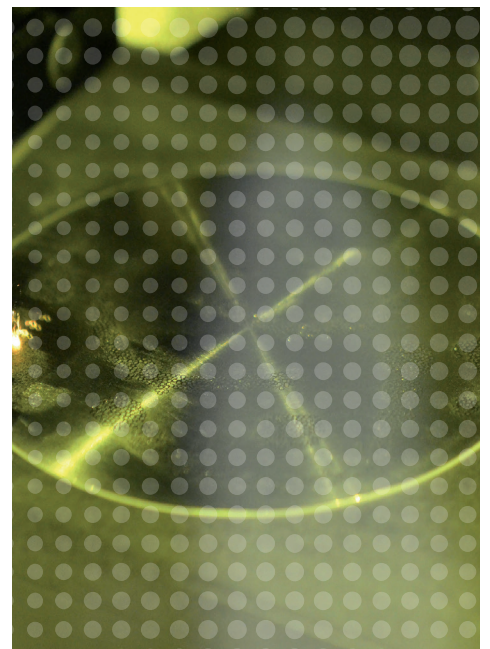
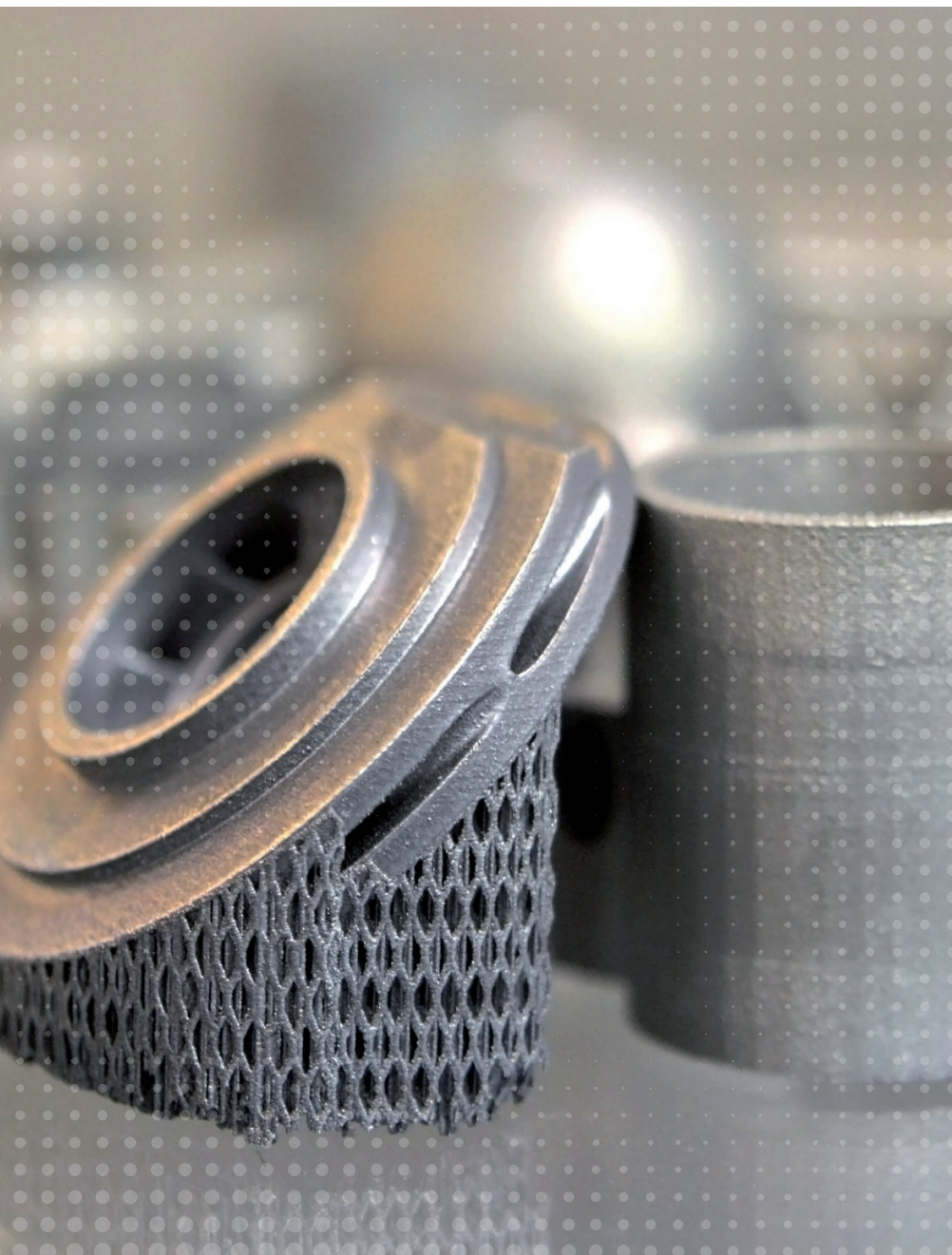


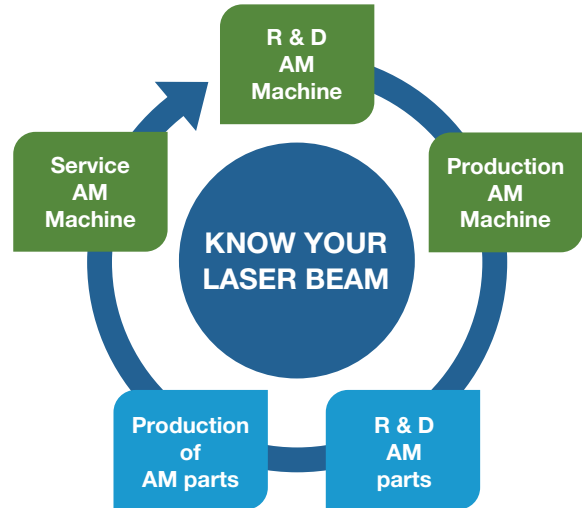
SMART MEASUREMENT TECHNOLOGY FOR LASERS IN ADDITIVE MANUFACTURING



KNOW YOUR LASER BEAM – ACHIEVE REPRODUCIBILITY

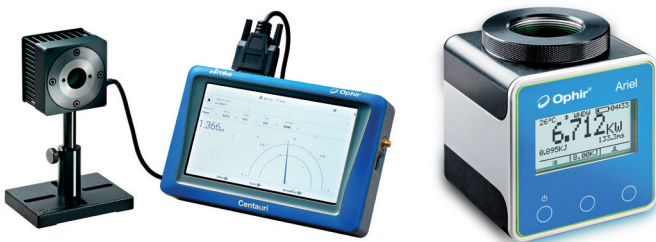
Laser-based additive manufacturing has transformed many industrial processes. But still, one of the most challenging tasks associated with the technology is to ensure reproducibility from one layer to another, between multiple laser sources within the same machine, and from one machine to the next.

The good news is that MKS Instruments has developed a variety of devices especially for additive manufacturing, enabling manufacturers and users alike to measure their laser systems continuously and reliably. We help our customers to record and evaluate ever more laser parameters in the shortest possible time. The Ophir® product portfolio offers the ideal solution for every AM application.



POWER MEASUREMENT

The first step in knowing whether a laser beam is working according to specifications is to measure the power of the beam. Traditionally, measurements are performed with different types of sensor heads combined with meters or PC interfaces. Designed for use in closed AM production chambers, the compact, robust Ophir Ariel was developed by MKS to work as a standalone power measurement device.

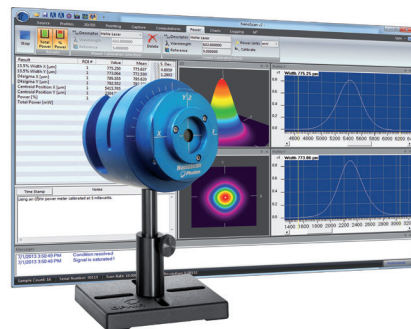


Laser power measurement

- Determine laser power and energy
- Solutions available for all power levels
- Compact, even with large apertures
- Fast reaction times

SLIT-BASED BEAM PROFILING

Slit-based beam profiling delivers additional information about the laser beam. The rotational scanning of the slit through the beam creates a 2D image of the beam profile. Our NanoScan beam profilers are compact devices that are ideally suited to measuring low to medium laser power in AM applications. The technology is ISO 11146 compliant.



Slit-based beam profiling

- Determines beam position and size, laser power
- Ideal for additive manufacturing of high-performance plastics
- Extremely compact, suitable for small AM solutions (dentistry, jewelry)

CAMERA-BASED BEAM PROFILING

Camera-based beam profiling is a popular option for taking a 2D picture of the beam profile. With Ophir BeamGage®, we offer the industry's most advanced beam analysis software; it can be combined with a wide variety of Ophir cameras to fit many applications. Even high-power laser beams can be measured using a camera profiler in conjunction with our Ophir LBS-300-HP-NIR attenuator.

Going one step further, we have developed a combined solution to measure power, focal position and beam profile in additive manufacturing chambers. The Ophir BeamPeek™ system delivers key parameters of the laser beam in only three seconds. With its innovative, replaceable passive beam dump there is no need for additional water and fan cooling. To simplify the usage of the system for field technicians, MKS developed a dedicated BeamPeek measurement software for fast, accurate, real-time measurement of the laser beam.



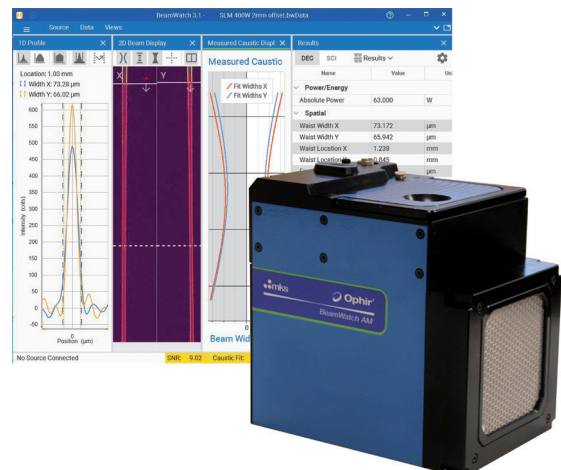
Camera-based beam profiling

- Focus size, laser power and laser power density
- Short measuring times
- No water cooling required
- The Ophir BeamPeek system combines beam profiling, focal spot analysis, and power measurement in a robust housing

NON-CONTACT CAUSTIC MEASUREMENT

Non-contact beam profiling offers several crucial advantages. First, the measurement technology itself has no power limitation. Even high-power densities upwards of 2 MW/cm², as frequently required in SLM processes, can easily be measured – directly and without attenuation. Secondly, every focus shift is immediately registered and displayed, as a camera detects the Rayleigh scattering of the focused beam in several measurements per second.

In addition, BeamWatch® AM ascertains a variety of beam parameters such as beam position, focus beam size, beam caustics, astigmatism and Rayleigh length. It quickly detects whether the beam is correctly aligned and focused. Powers up to 1kW can be measured over a period of two minutes without the need for active cooling.



Beam caustic measurement

- Designed expressly for additive manufacturing
- Non-contact approach to measuring beam profile
- Compact dimensions
- Industrial design with integrated power gauge
- Real-time monitoring of focus shift

WHY MKS?

CRITICAL TECHNOLOGIES	PROVEN PARTNER
<p>World-class technology and development capabilities for leading-edge processes</p>	<p>Recognized leader delivering innovative, reliable solutions for our customers' most complex problems</p>
OPERATIONAL EXCELLENCE	COMPREHENSIVE PORTFOLIO
<p>Consistent execution across all aspects of our business</p>	<p>Largest breadth of product and service solutions for the markets we serve</p>

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Why choose Ophir products? Ophir is a brand within the MKS Photonics Solutions division. The Ophir product portfolio consists of laser and LED measurement products including laser power and energy meters, beam profilers, high-performance IR thermal imaging lenses and optics for CO2 and high-power fiber laser applications.

- **Variety of products** – The range of Ophir products includes sensors to measure laser power and energy; beam profilers to measure focus shift and beam quality, including industry-leading non-contact measurement systems.
- **Individuality** – In addition to the continuously growing portfolio of standard sensors, MKS develops customer-specific Ophir OEM solutions for individual application requirements.
- **Service** – Ophir offers service and calibration centers worldwide that are ISO17025 certified or are in the process of accreditation.

For further information please visit www.ophiropt.com