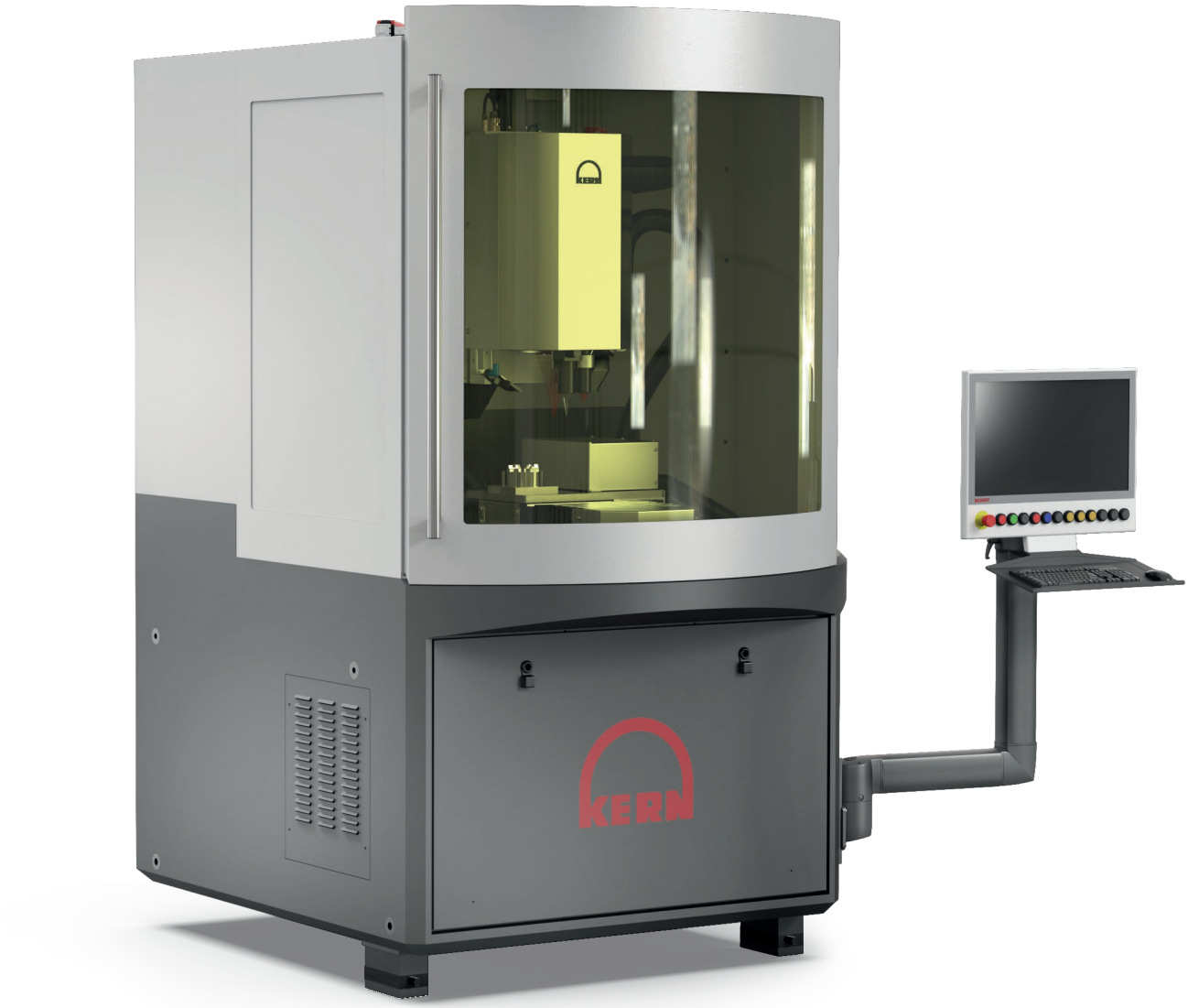


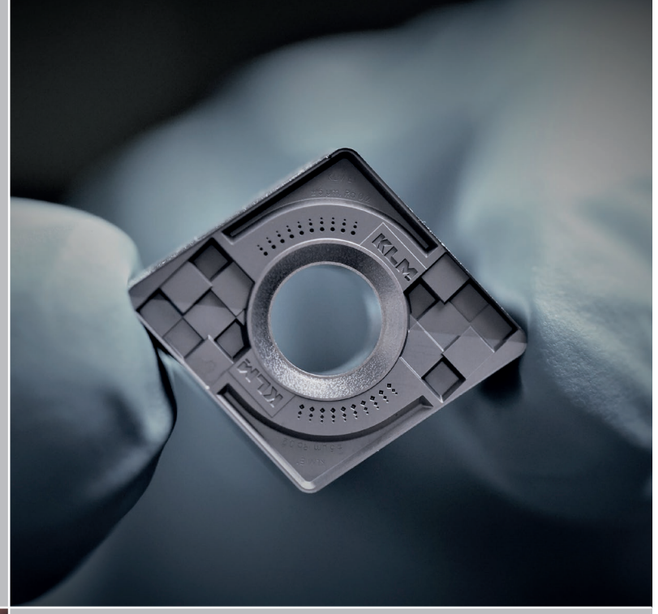
Manufacturing of extremely hard material

KERN Femto E3

KERN

HIGHEST PRECISION

using unique measurement systems



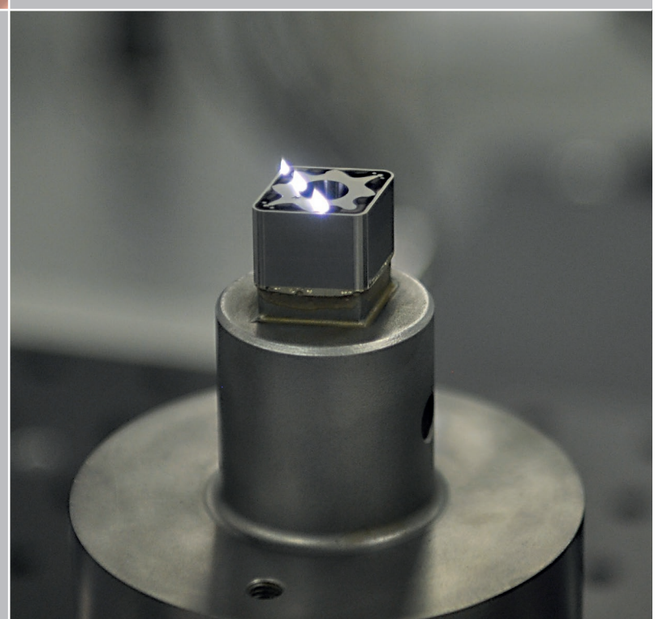
SMALLEST STRUCTURES

in hard materials

ENHANCED MANUFACTURING

without using tools

low energy rate



KERN Femto E3

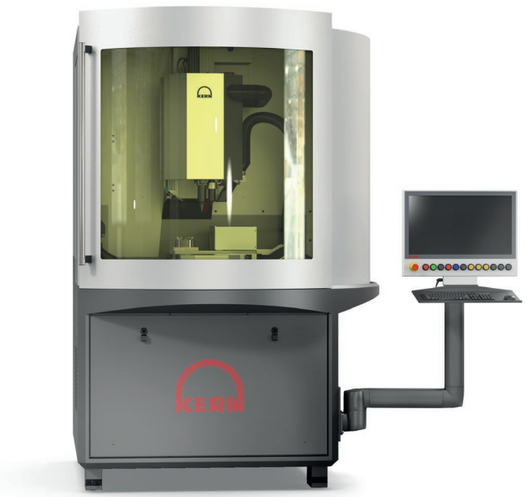
Ultra-short pulse laser manufacturing with highest precision

Kern Femto E3 is an ultra-short pulse laser machining center based on a reliable Kern machine platform and equipped with state-of-the-art laser control software. It is designed for precise surface processing of small and medium size parts.

While manufacturing, the surfaces are measured and the ablation power of the laser beam is adjusted. This permits highest accuracies on the part. While in use, the position of the laser beam in the scan field and the laser power are automatically calibrated. The result is an excellent repeatability and long-term stability of the machine.
Working with laser makes defined free-form geometries and fine structures on almost any material possible. Smallest edge radii < 5 µm can be achieved and extremely thin layers < 0.3 µm can be ablated. Since no mechanical tool is used, there are no tooling costs or processing forces. The technology is therefore suitable for processing a wide range of technical materials, especially very hard materials or sensitive parts.
This machine concept was developed in a collaboration between Kern Microtechnik GmbH and Lightmotif B.V.. It combines Kern's experience in high precision engineering with Lightmotif's expertise in laser micromachining.

AT A GLANCE

- Highest accuracy on the part with adaptive machining and automated machine calibration
- Contact-free laser manufacturing without tool wear
- Increased productivity with direct machining of hard materials
- Freeform surface textures and functional surfaces
- Digital CAD-CAM process with low operator influence
- Wide range of materials

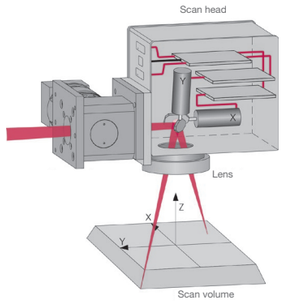


KERN Femto E3.
For applications where machining reaches its limits.

Automated spot and power measurement

Detecting and calibrating spot position, focus position and laser power

Integrated measurement systems in the workspace record the focus position and the power of the laser beam as well as the X and Y position across the entire scan field. Deviations of spot position and laser power are detected and calibrated directly on the part in a stable process. Thermal influences are compensated. The results are highest accuracies on the part as well as stability and repeatable long-term results.



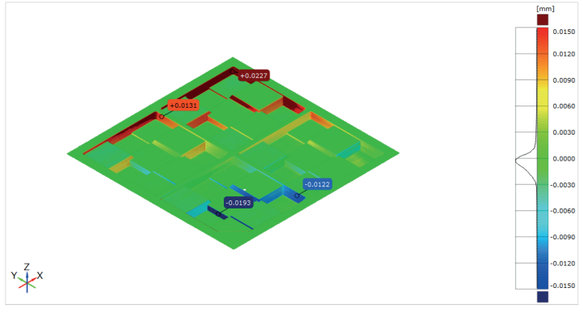
Scanner with scan field

THE ADVANTAGES AT A GLANCE

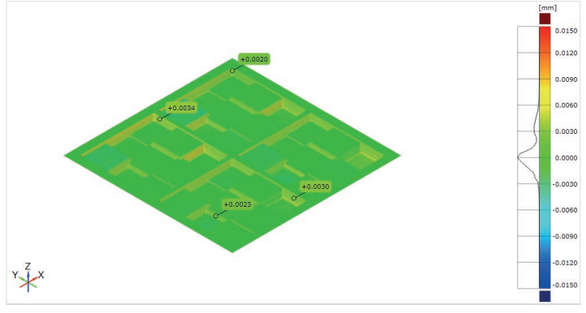
- Highest **accuracy** on the part with automatic spot and power measurement
- **Machine stability** regarding temperature and power with measurements on the machine table
- Best **repeatability**

Scan field calibration

Comparison of a machining operation without and with scan field calibration:



Machining operation without scan field calibration
Deviations in XY up to 20 µm



Machining operation with scan field calibration
Minimal deviations in XY

Adaptive Machining

For highest accuracy on the part

Laser machining removes material layer-by-layer. Adaptive Machining realizes the entire automatic measurement of the actual abrasion of the material - even during machining. The measurement results are compared with the target contour and further machining is adapted accordingly. This provides automatic compensation and reduces errors. It is possible to machine the tiniest shape tolerances.

The immediate availability of the measurement results provides information about the quality of the part and the long-term stability of the process.

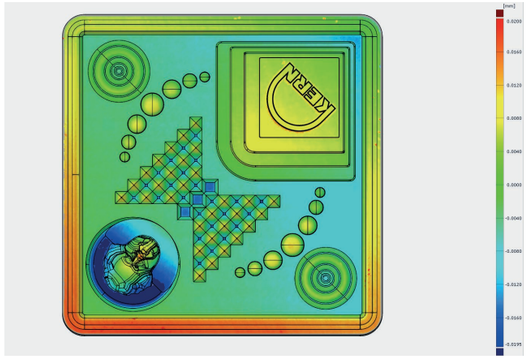
THE ADVANTAGES AT A GLANCE

- Non-stop **monitoring** and **compensation** of laser machining
- Highest **accuracy of parts**
- **Immediate availability** of machining protocol and results

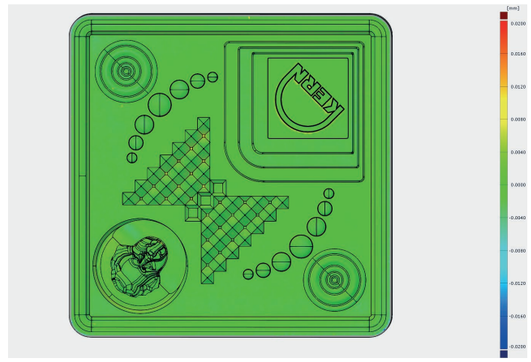
Automatic distribution of measuring points on the laser-machined surface

Interpolated surface of the last machining

Graphic of the correction performance



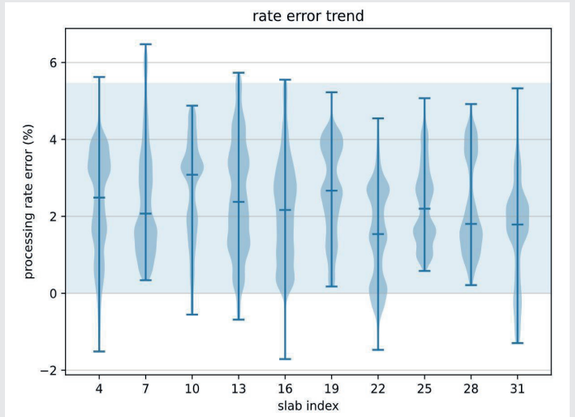
Result without Adaptive Machining
Deviations up to ± 20 µm



Result with Adaptive Machining
Deviations < ±3 µm

Availability of reports in real time

Temperature changes lead to changes in positioning and power of the laser beam. These deviations are being recognized and automatically compensated by the machine. All data, measurements, deviation and compensation are available in real time after machining. This log provides valuable information about the quality of the machining result. In addition to detailed information about the machining time, these specifications are displayed.

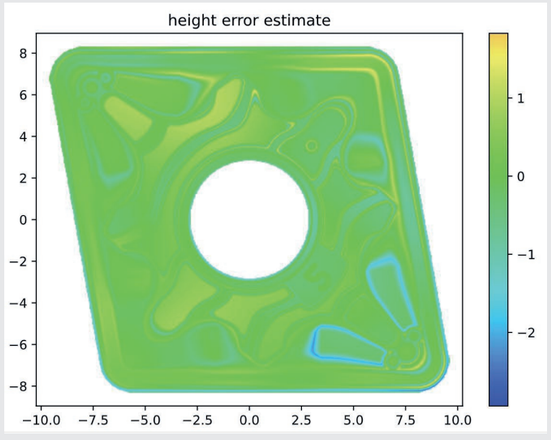


ABRASION RATE

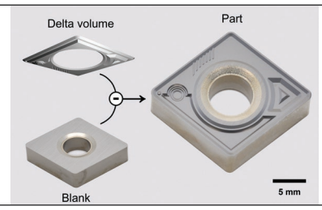
Deviation of the material abrasion rate: The difference between the expected and the actually measured material removal rate is visualized. This provides reliable information about the result.

HEIGHT ERROR

The height error estimate shows the expected height deviation. It is based on measurement data gained during machining.



CAD-CAM Workflow

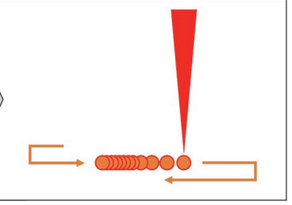


PREPARATION

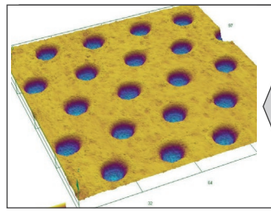
The volume to be removed is defined as a CAD file (.stl). The integrated CAM software automatically translates the abrasion volume into a corresponding laser machining program.

MACHINING

The laser pulses with a repetition rate of up to 40 MHz and a scanning speed of several m/s are lined up. By arranging the lines in parallel, material is removed layer by layer.



Microstructures

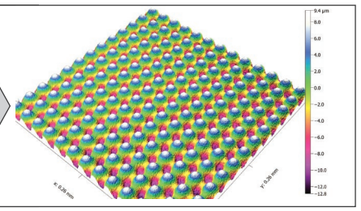


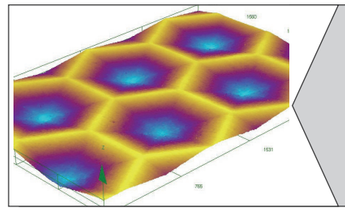
DIMPLE TEXTURES

The smallest structures can be produced by superimposing individual laser pulses. The laser can either be focused on one spot and emit a defined number of laser pulses or guided along a defined path to generate a specified hollow shape.

CROSS-HATCH TEXTURES

Dense columnar textures are created by superimposing line-shaped laser machining in a square grid. The selected line spacing is largely responsible for the shape of the resulting texture. Many directions can be used to create a wide variety of periodic column patterns.

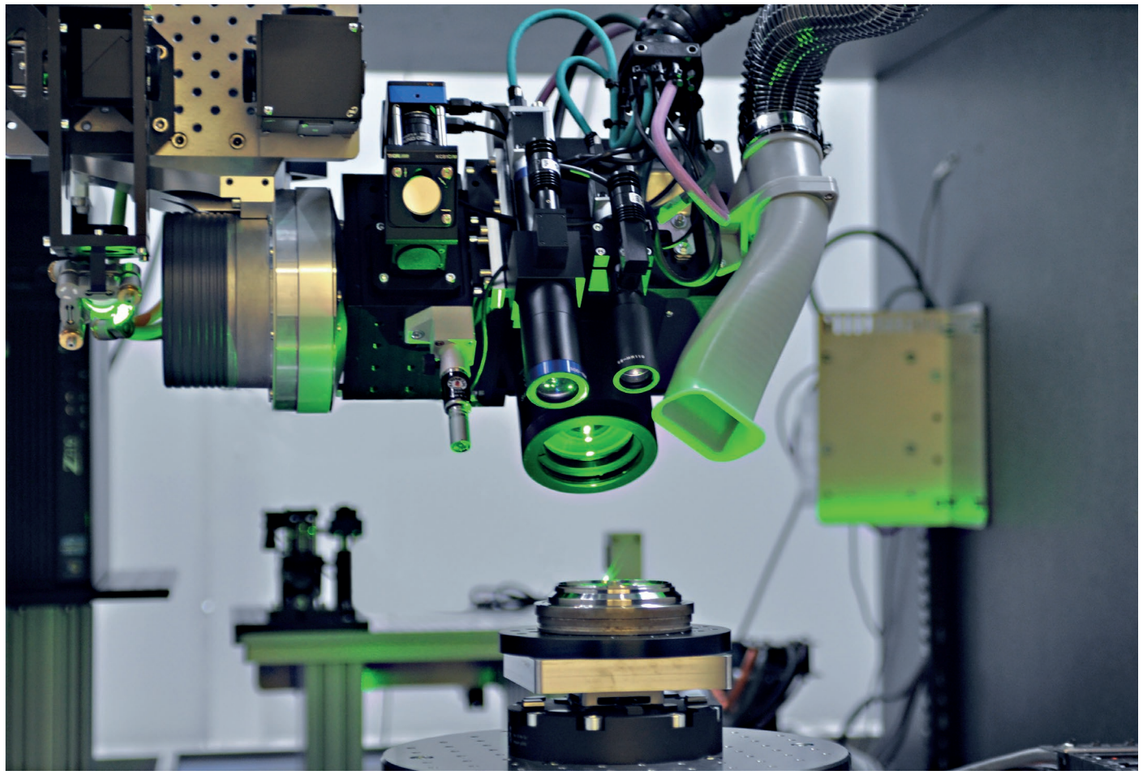




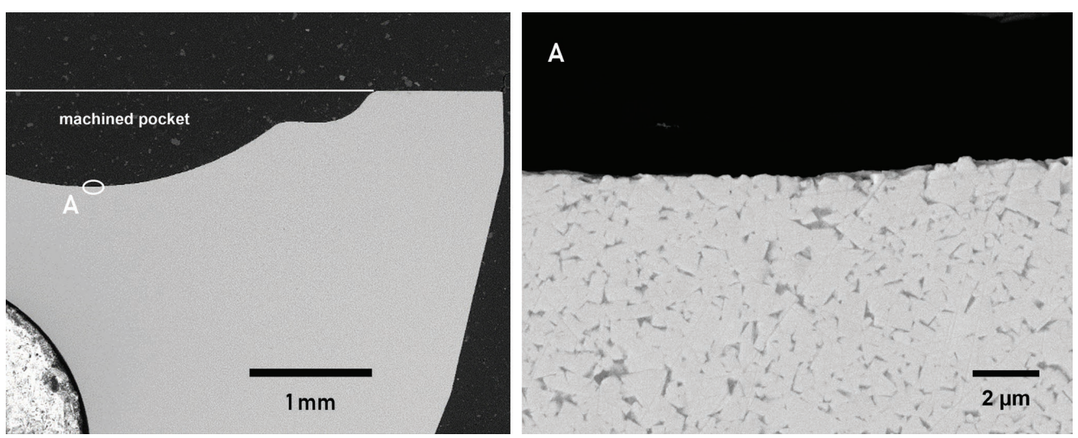
FREEFORM TEXTURES

Shapes defined by means of a CAD model can be applied to a component by laser processing into a surface structure. For this purpose, the material is abraised in layers to create the desired surface structure.

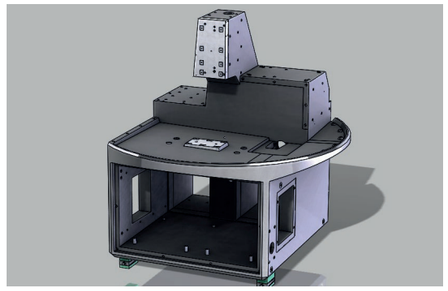
Ultra short pulse laser manufacturing



Working with laser allows to machine the hardest materials - without tool wear. The use of laser pulses in the femto- and picosecond range also enables cold machining - without heat, microcracks, material melting and heat-affected zones. Compared to machining with nanosecond lasers or electrical discharge machining, higher quality surfaces and part quality are achieved.



Cold machining
Ground through a laser-machined surface under the scanning electron microscope

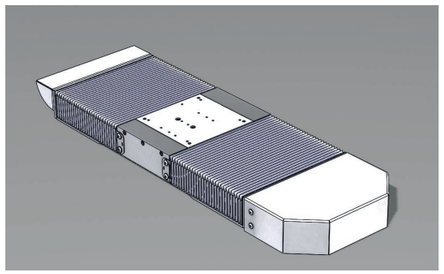


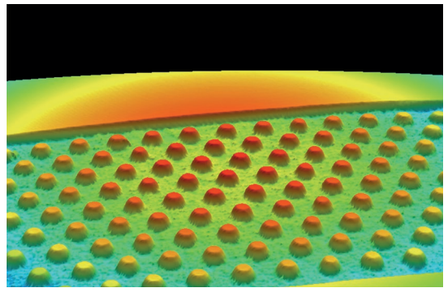
MACHINE CAST

Kern Femto E3 is built on the reliable Kern Evo machine platform, which provides extreme rigidity and thermal stability. Together with other components it creates perfect environment for micro-machining with highest precision.

AXES

The preloaded linear needle bearings enable highly reliable positioning accuracy with minimal heat input into the axis. With the improved design, the axes are low in wear and require little maintenance.





PROCESS DEVELOPMENT

The laser process used is largely responsible for the result. With a Kern Femto E3, not only a high-precision system is offered - there is also the possibility of customer-specific process development.

LASER SOURCE

A key component is the versatile, fully featured and compact ultrashort pulse laser. With a maximum repetition rate of 40 MHz and versatile configuration options, best productivity tailored to individual applications, is achieved.

Copyright: Amplitude Laser Group

Copyright: SCANLAB GmbH

SCAN SYSTEM

The scanner with digital encoders achieves higher precision and long-term stability. It is characterized by reliability and low heat generation.

Linear axes

Max. workpiece size X/Y/Z: 170/210/160 mm

Max. clamping weight: 35 kg

Pivot and rotational axes

Max. workpiece size D/L: 85/65 mm

Rotary axis: 360°

Swifel axis: 120°

Max. clamping weight: 5 kg

Accuracies (VDI/DGQ 3441)

Positioning accuracy P: < 2 µm

Repeatability Ps: < 1 µm

Scanner

Scan field: 50x50 mm

Spot size laser: infrared 30 µm / green 20 µm

Scanning speeds of several m/s possible

High dynamics and precision

Laser specification

Manufacturer: Amplitude Laser Group

Model: Satsuma HP²

Laser power: 20 W

Puls duration: 350 fs – 10 ps

Repetition rate: up to 40 MHz

Central wave length: infrared, 1030 ±5 nm

Optional by frequency doubling: green, 515 nm

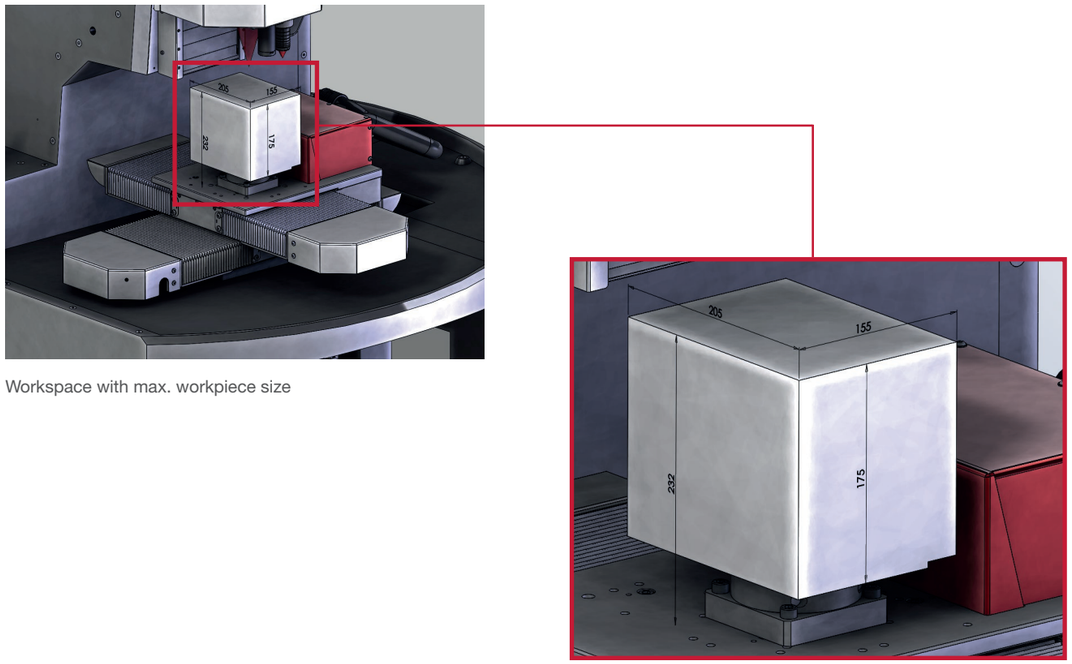
Dimensions and weight

Total weight: 3.200 kg

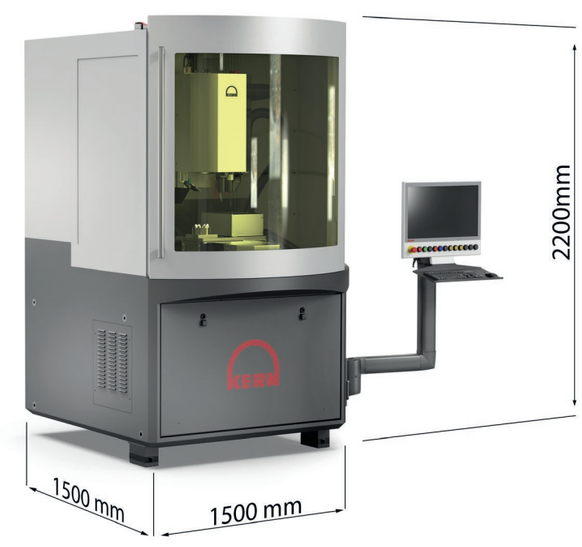
Min. space requirement B/T/H: 1,5 x 1,5 x 2,2 m

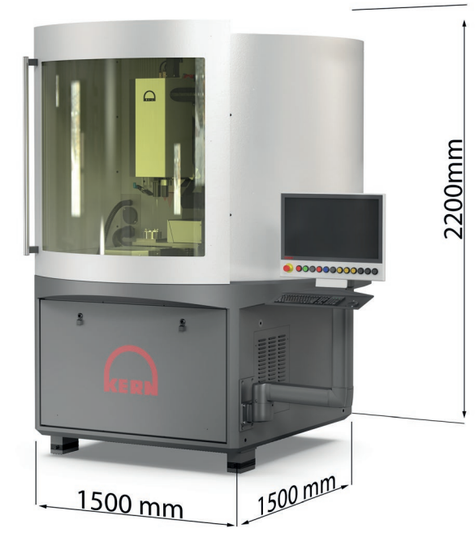
Published: 09/2022

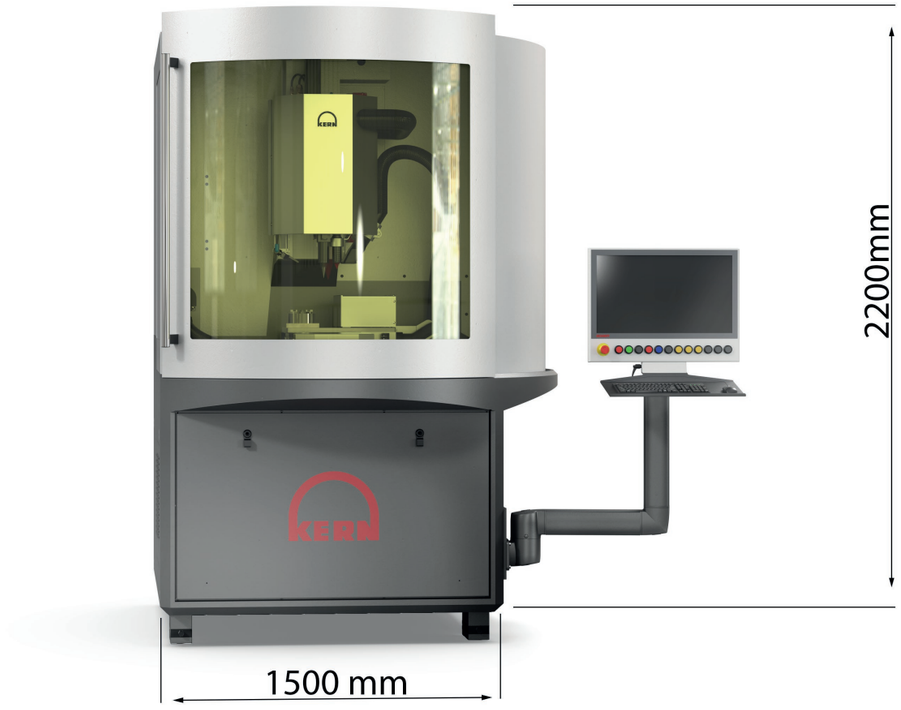
Technical details may change



Workspace with max. workpiece size







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Kern Microtechnik GmbH | Olympiastraße 2 | DE 82438 Eschenlohe
Tel: +49 (0) 8824 9101-0 | info@kern-microtechnik.com

www.kern-microtechnik.com