Optical metrology
for surface analysis

Optical systems for your surface analysis

Maximum precision, modern technologies and a worldwide presence – this is what Mahr stands for. As a manufacturer of innovative production metrology, we have been supporting our customers for more than 160 years, in the measuring room, in production, and with their research and development. All of our products are built on the passion and expertise of the 1800 Mahr employees.

This also applies to our optical measuring technologies: Our range includes confocal systems, profilometers, right through to the white light interferometer series with its highly innovative ICA algorithm. This ensures that exactly the right system is available for every optical measuring task and every surface. Our experts work with you to determine which measuring technology is best suited to your tasks.

Advantages of optical systems

- Three-dimensional
- Contactless
- Standard-compliant
- Material-independent surface detection
- High measuring speed
- Resolution into the subnanometer range
- Easy to handle

Contents

Applications

Sectors and

Page 7

3D measuring technologies

Scanning and evaluation of surfaces

Page 37

Special solutions

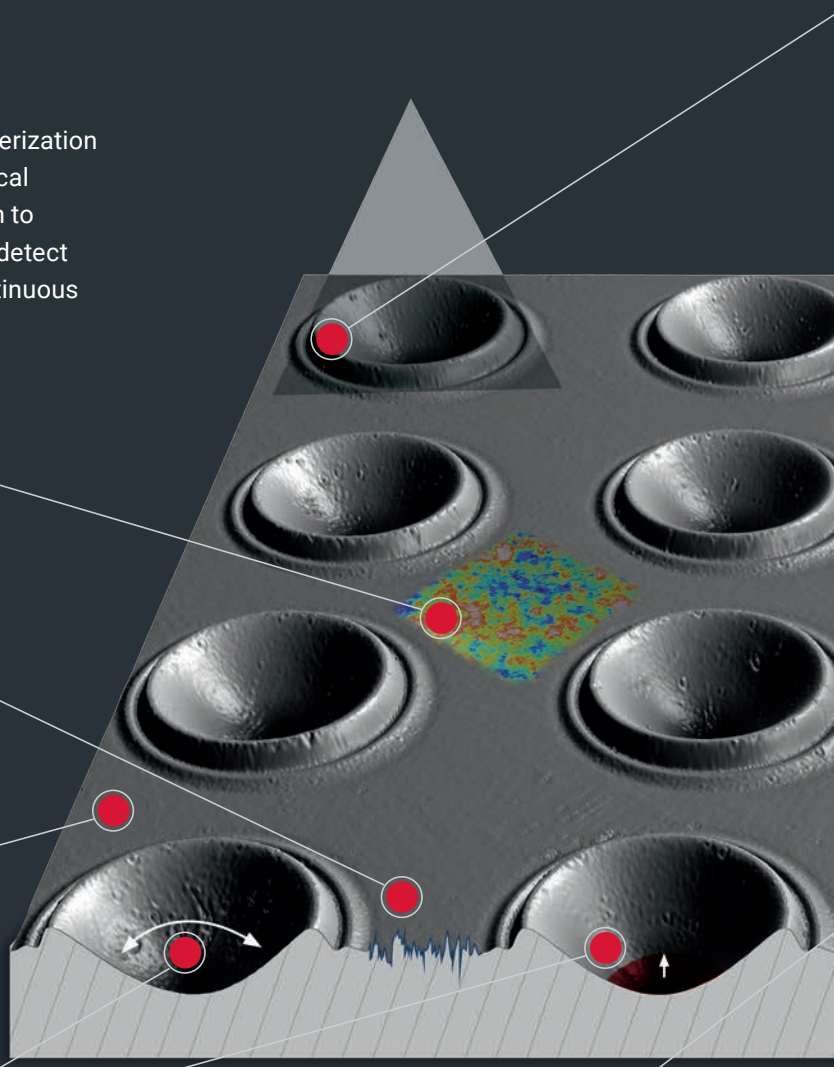
Tailor-made measuring technology

Page 83

Your surfaces in focus

To ensure each component exhibits the maximum performance, the surfaces must often have special characteristics. That applies to form deviations and roughness as well as waviness or geometric features.

Only then do components qualify for further processing – otherwise they are discarded immediately. Powerful Mahr metrology provides you with the entire portfolio of characterization options based on precise measuring data. The topographical analyses range from particle analysis to angles, right down to the determination of layer thicknesses. This allows you to detect potential errors and take counteract any waste during continuous production.



3D roughness (Sa, ...)

Extensive roughness evaluations as per ISO 25178

2D roughness (Ra, ...)

Profile roughness in accordance with ISO 4287, ISO 13565, ISO 21920, ASME B46.1,ISO 12085, SEP, VDA guidelines, and other standards

Profile trace errors ( )

Linear errors compared to a target contour as well as straightness parameters as per ISO 12780

Contour analysis (,R)

Determining radii, circles, segments of a circle and angle determination including evaluation of half or full angles

Flatness ( )

Determining the flatness of a full or partial surface, e.g. in accordance with ISO 12781

Visual inspection

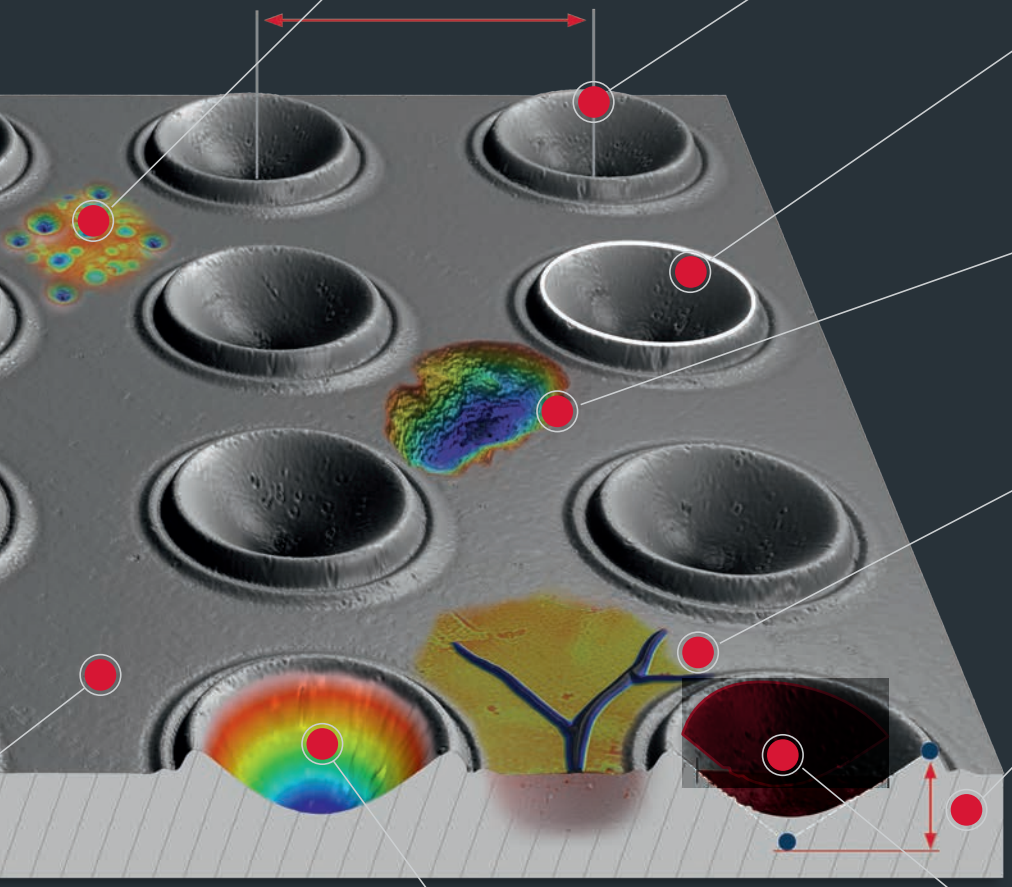
Microscope image or photo-simulated image in the evaluations as well as 3D depictions

Particle analysis

Detection and classification of particles, grains, furrows, textures, hills and valleys

Distance measurements (Δ)

Comprehensive horizontal distance measurements (x;y), angle positions and inclinations



Form

Form deviation from planar contours, target/actual comparison with CAD data, roundness evaluation in accordance with ISO 12181

Error

Detection and analysis of defects, surface imperfections and damage

Layer thickness

Direct determination of the thickness of transparent layers, step height analysis of opaque surfaces

Height (Δz)

Distance measurements (z), determination of maximum and average heights as well as differences in position

Volume (V)

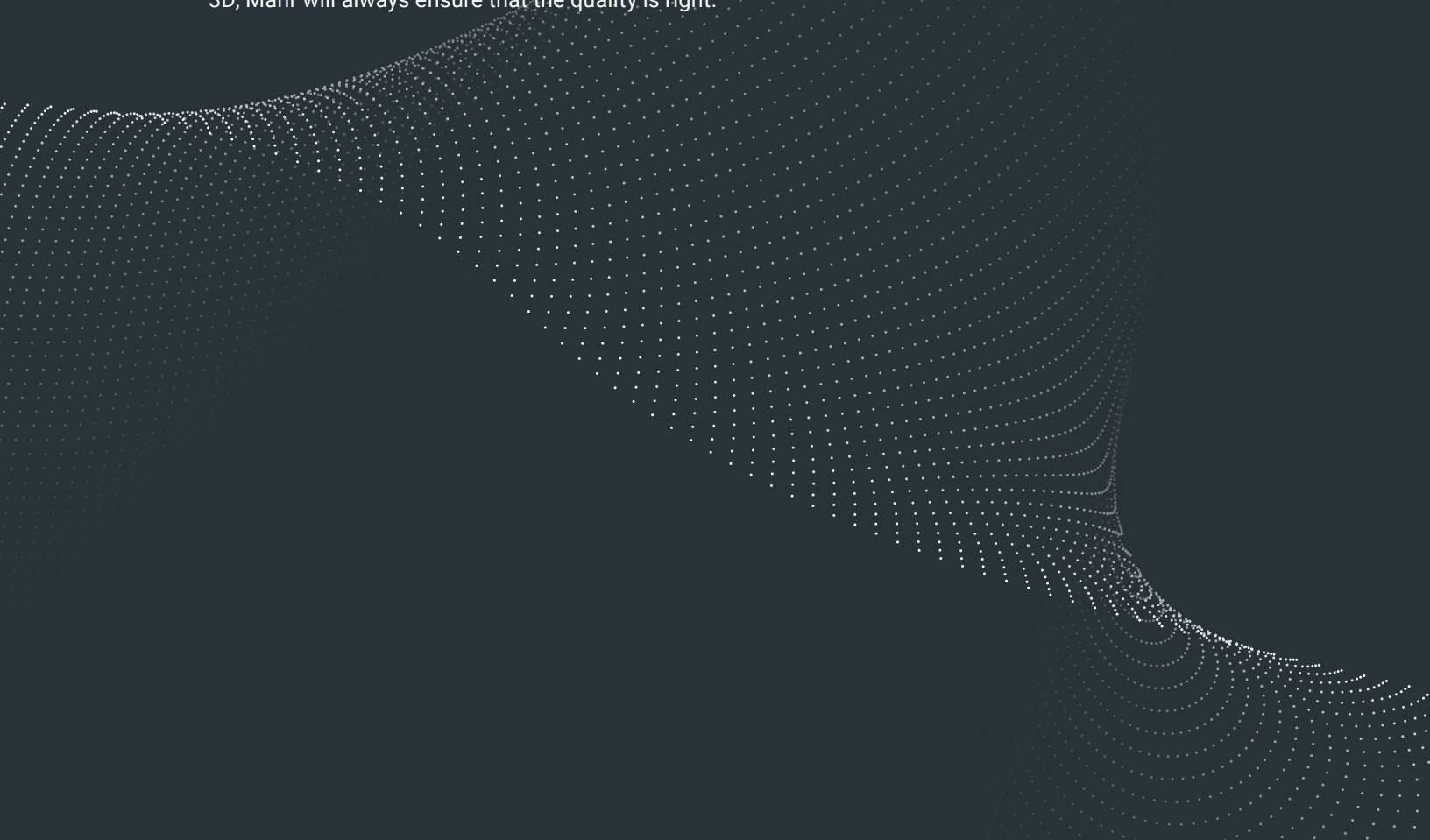
Volume calculations of hollows, hills, valleys, peaks, and particles

Area (A)

Calculation of surface area in peaks and hollows as well as determination of maximum elevations/depressions

Sectors and applications

Surfaces are becoming increasingly complex due to new manufacturing processes, new production processes, and new materials. To ensure that your structures and topographies are exactly right and meet the required values, Mahr offers a wide range of areal 3D surface metrology – and guarantees to have the right device for your measuring tasks. Regardless of whether it is stationary or mobile, 2D or 3D, Mahr will always ensure that the quality is right.



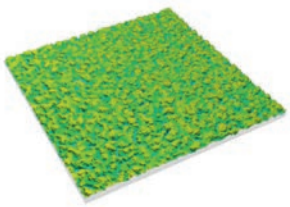
An eye catcher that is functional

Surfaces can be fascinating. They captivate you with flawless optics or well-developed haptics, for example, when things are pleasant to touch or lie comfortably in the hand. Operating elements and design surfaces, for example, thus have special textures that are achieved by blasting, polishing, etching, and using a laser. The spectrum ranges from finely structured housing surfaces made of metal with a homogenous appearance, through to rough plastic, or leather patterns made of distinct embossed structures.

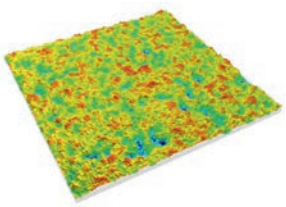
Optical measuring systems are particularly used for development and quality control processes: They check the surfaces of tool inserts during production and the final products for consumers.

The most common measuring tasks

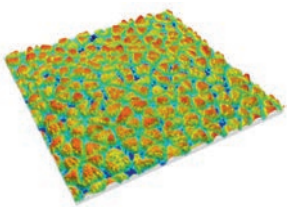
- Isotropy
- Structural evaluation
- Waviness
- Roughness



Topography of a lock handle



Surface of a switch



Embossed structure of artificial leather

The prototype
for perfection

When it comes to implants for the human body, no amount of work is too much and no quality checks are too accurate. All of the manufacturing processes are monitored and the production systems are set accurately. This is why manufacturers of medical implants depend on reliable key figures.

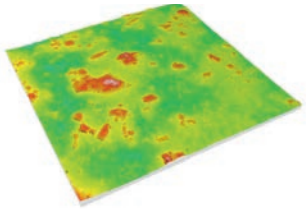
The optical 3D measuring systems from Mahr supply fast and highly accurate results – regardless of whether this relates to the measurement of complex geometries on dental implants, the roughness measurement on hip prostheses polished to the nanometer, or on roughened products used for trauma surgery. The high level of reproducibility and accuracy of measurements, that can be traced back to international guidelines and standards, ensures that it is not just polishing and blasting processes that you can monitor safely.

The most common measuring tasks

- Roughness 2D/3D
- Complex geometries
- Pore and particle analyses

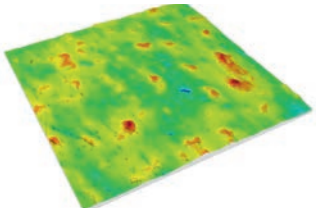
Dental prosthesis

Geometry of the roughened surface of a dental screw



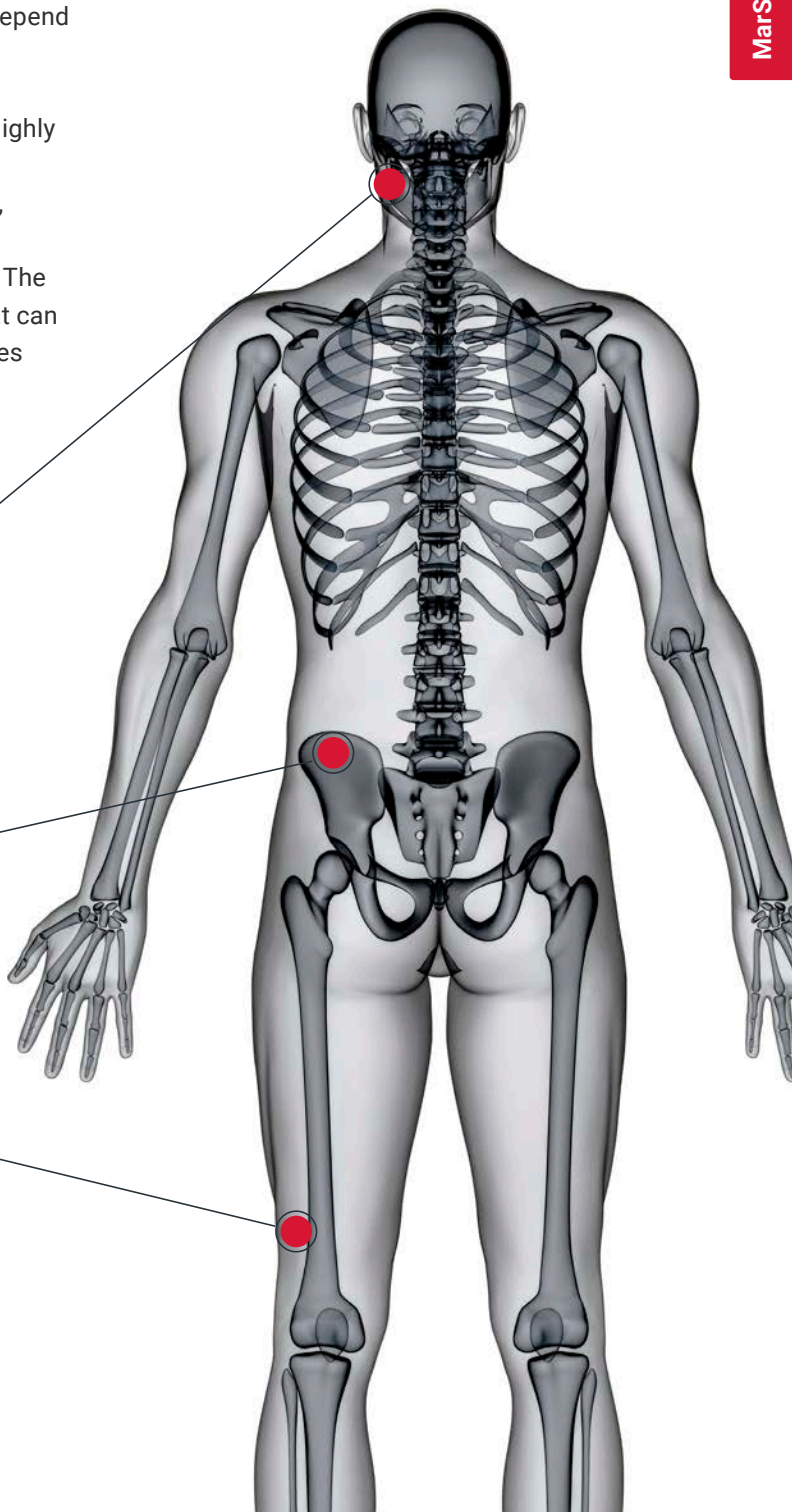
Hip joint

Carbides on an artificial hip joint



Knee joint

Polished articulating surface of a knee implant



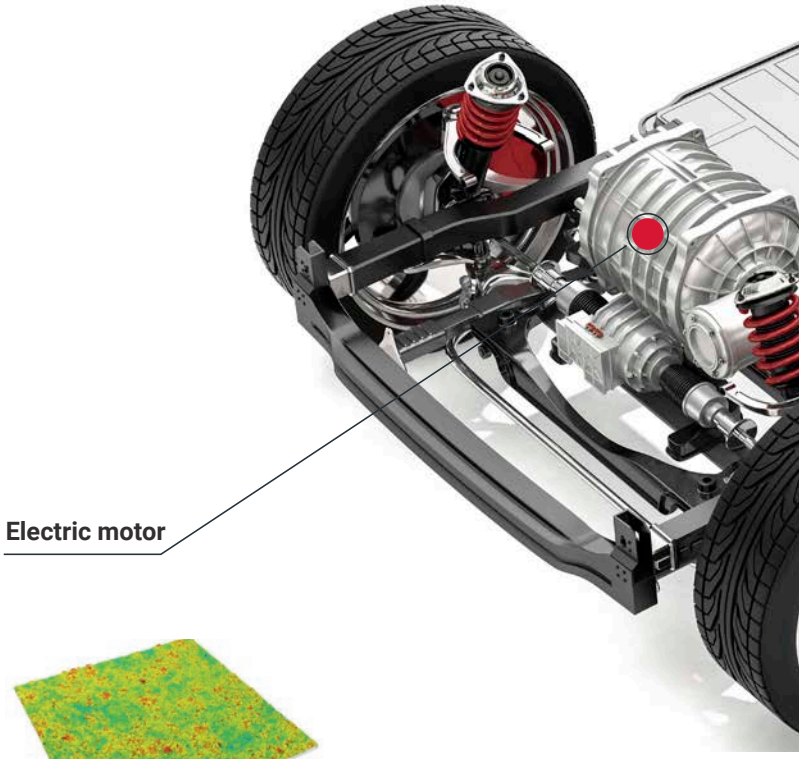
The start of new drive technologies

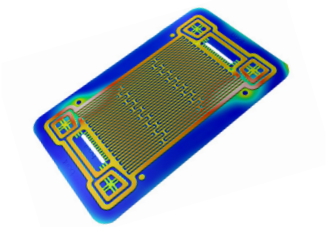
Regardless of whether it is a hybrid, fully electric, or powered with hydrogen: The triumph of alternative drives on our roads can no longer be stopped. These drives place new challenges on the quality of the component surfaces.

Optical measuring systems from Mahr ensure that every element has a perfect degree of roughness and is located in the correct position. Mahr metrology supports you from development right through to the production-related quality assurance process. This means that alternative drives can get off to a reliably good start.

The most common measuring tasks

- Geometry und microgeometry
- Roughness
- Fault detection
- Particle analysis
- Porosity



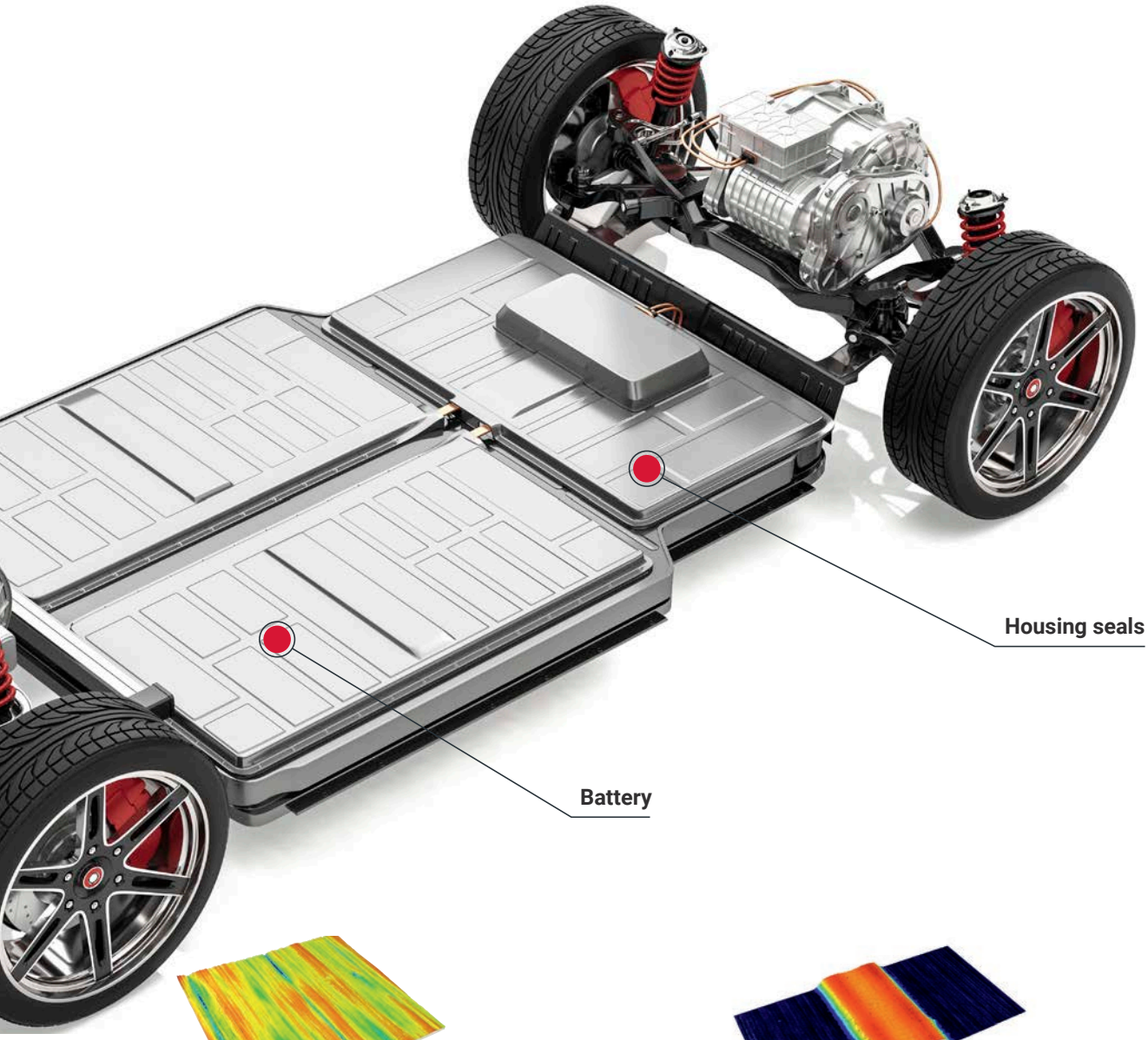


Fuel cell

Bipolar plates are the core of fuel cells. Stacked in layers, they provide precise energy flows, are safe to operate, and are thus ensuring the drive technology of the future. Bipolar plates place the highest demands on measuring technology: Roughness, geometry, form deviations, right through to the calibration with CAD models – everything must fit perfectly with nanometer precision.

Battery

To ensure that electric vehicles can achieve a high range, batteries with the highest possible energy density must be installed. One way to achieve this is a targeted structure of the electrode material. Different elements of the batteries are protected with an insulating varnish to prevent short circuits and increase safety. The coating thickness of just a few millimeters is particularly important. The roughness, porosity, and coating processes can be monitored using optical metrology, leading to savings on material
and energy costs.



Electric motor

The core of electric motors are rotors and stators. The production of the stator made up of electric sheets and induction coils is particularly complex. Optical metrology from Mahr can be used to determine the surface roughness of the housing and stator, which is important for the joining process. If the stator is impregnated with resin, then the coating thickness is checked in addition to the surface quality.

Housing and sealing surfaces

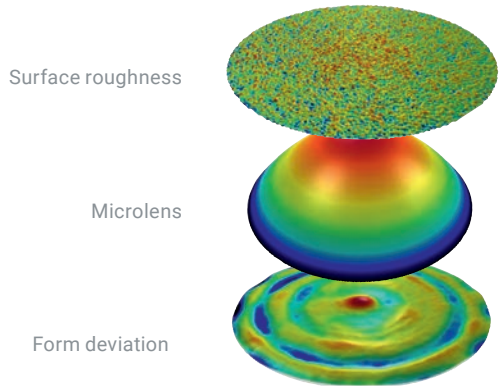
In conjunction with the electrification of the power train, the operational safety and durability of the installed high-performance electronics must be ensured. To prevent contact with liquids and any possible chemical reactions, nowadays the contact surfaces of housings and sealing surfaces are ground in such a way that they are positively connected and are permanently sealed. Inspecting the surface structures using optical systems from Mahr enables the measurement of profile depths, angles and processing increments.

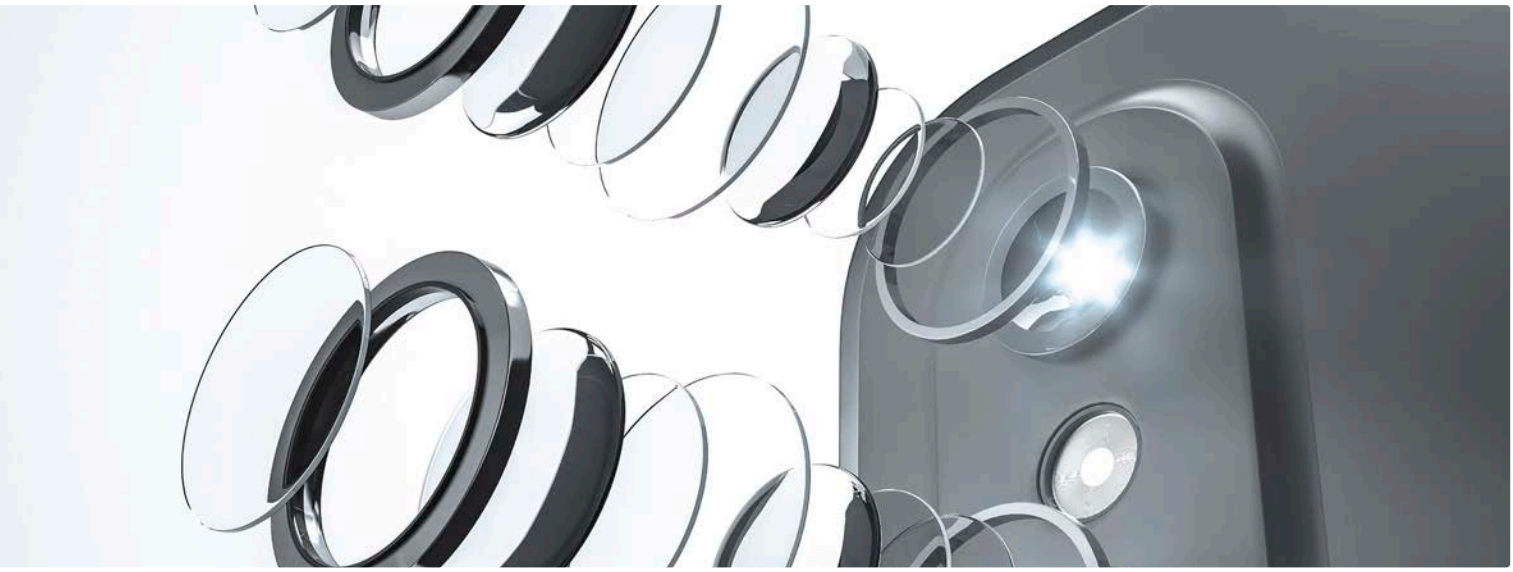
Providing the right overview

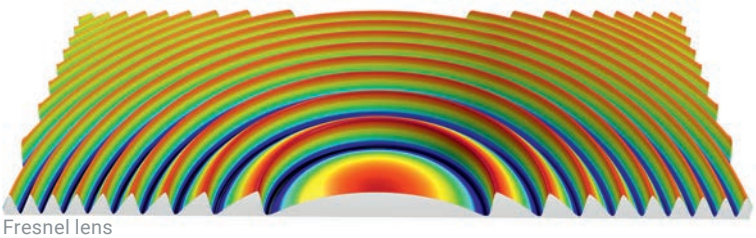
Modern production processes, such as die-casting, laser ablation, and lithography processes, enable high-quality micro-optics to be produced for the telecommunication sector, medical technology, or camera technology in very large quantities. As every deviation distorts the optics, the process-related checking of the microgeometry and surface roughness using 3D measuring systems from Mahr is indispensable. Microlenses for smartphone cameras, for example, are tested to check their dimensional accuracy. The radius of curvature is accurately measured within the nanometer range and the slightest deviations are detected.

The most common measuring tasks

- Form deviations
- Roughness 2D/3D
- Defects







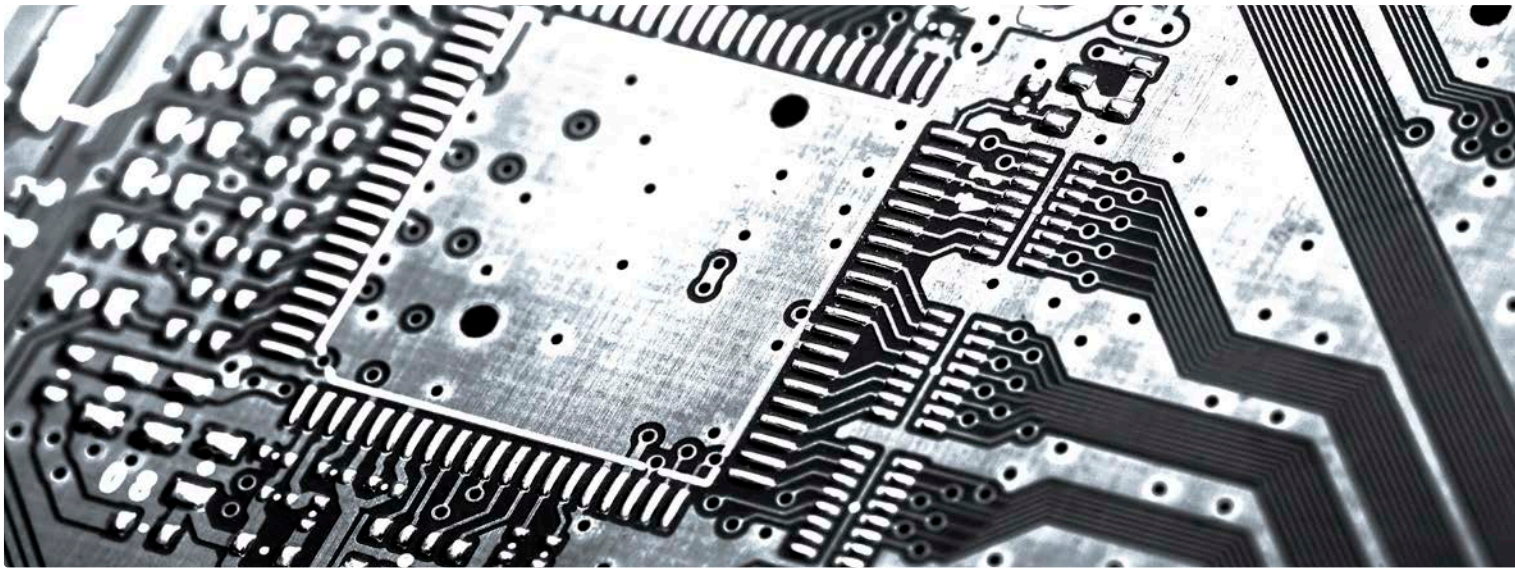
Fresnel lens

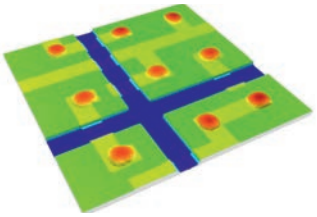
Providing a smooth **flow of information**

Regardless of whether in the mobility or communication sector, or in the household: Miniaturized components, such as highly complex printed circuit boards (PCB/FPC), have long been part of our everyday life. They are produced using different printing processes. In addition to checking for any form deviations, the structure height must also be analyzed accurately. If the components are made of ceramic substrates, measurements must be completed before and after the burning process. There is even a trend to minimize semiconductor elements, which provides a challenge for measuring devices. A higher lateral and axial resolution must be guaranteed, which can easily be achieved using the different optical technologies from Mahr.

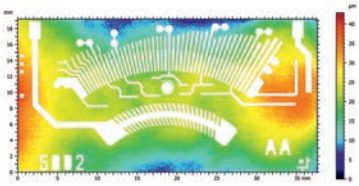
The most common measuring tasks

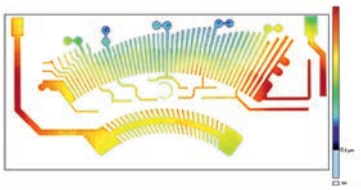
- Structure height, contour, layer thickness
- Coplanarity
- Flatness und probe bend





Solder bumps and circuit paths on PCBs





Unevenness of the ceramic substrate and thickness of the printed-on silver coating

From steel panel to highly complex body work

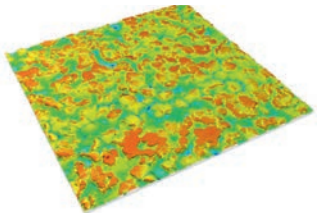
Steel has not just been steel for a long time. Modern thin sheet metals are real high-tech products, and their surface structure has a significant impact on the subsequent production. It is thus meticulously analyzed during all processing steps.

This starts with the optimization of the rollers that are used to structure the surface of the sheet metal. The focus is placed on setting the required surface parameters, detecting defects, and checking for wear.

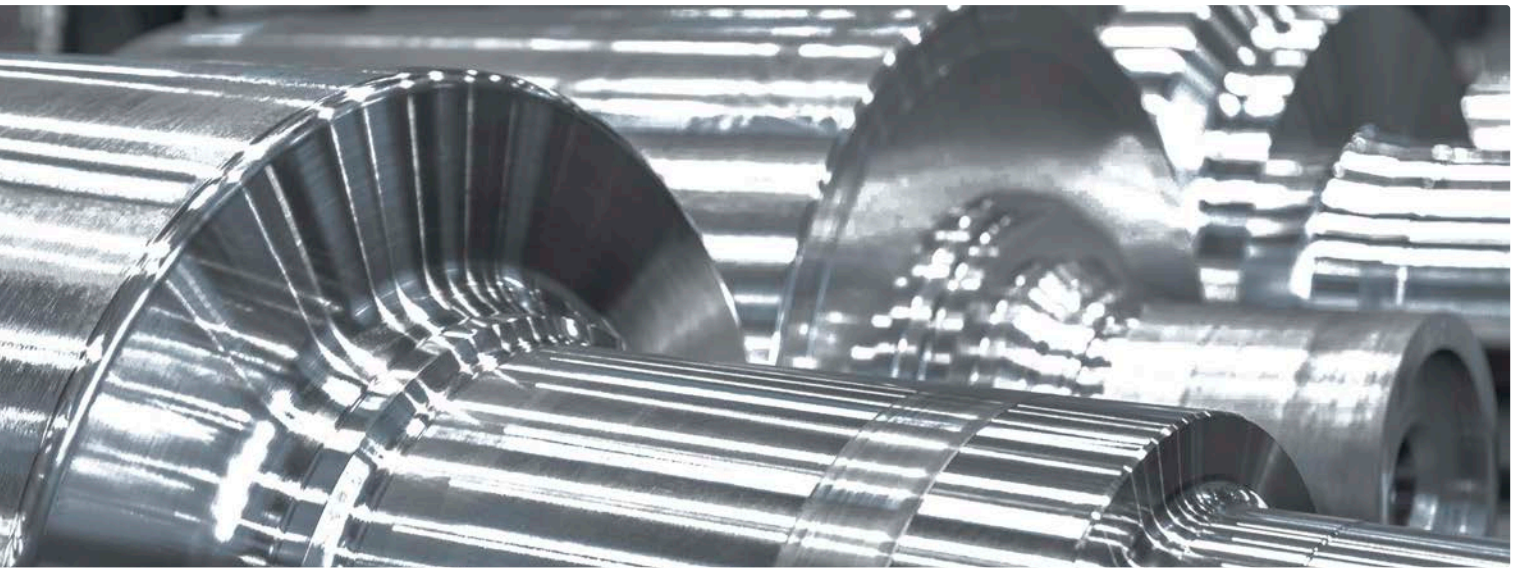
In the body work sector, the structure of the sheet metal surface also has a significant impact on the shaping process and other process steps such as painting, and ultimately on the appearance of the final product.

The most common measuring tasks

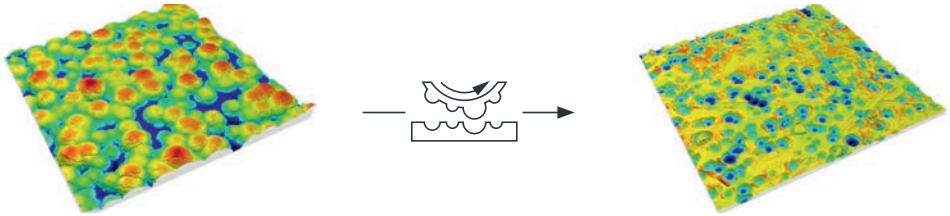
- Roughness
- Defects
- Wear/volumes
- Longitudinal waviness (SEP1941)



Topography of a hot-dip galvanized sheet metal



Structuring sheet metal using a roller



Roller topography

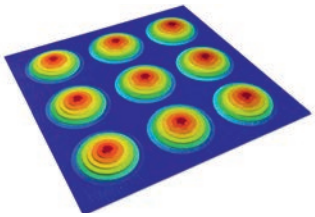
Sheet metal topography

Complex structures, maximum flexibility

The production of components using 3D printing has increased incredibly. Workpieces are not only produced using an abrasive process but are also produced directly in one piece. This promises to provide great savings potential and significantly increase flexibility, especially for complex components. The performance, however, must be right. The component quality may in no way be inferior to conventional processes. The surface quality of many components is significant for ensuring their long-term function. Mahr's optical metrology offers flexible solutions for fast determination of the necessary surface quality and required tolerances.

The most common measuring tasks

- Surface quality/roughness
- Geometry
- Step height
- Form deviation

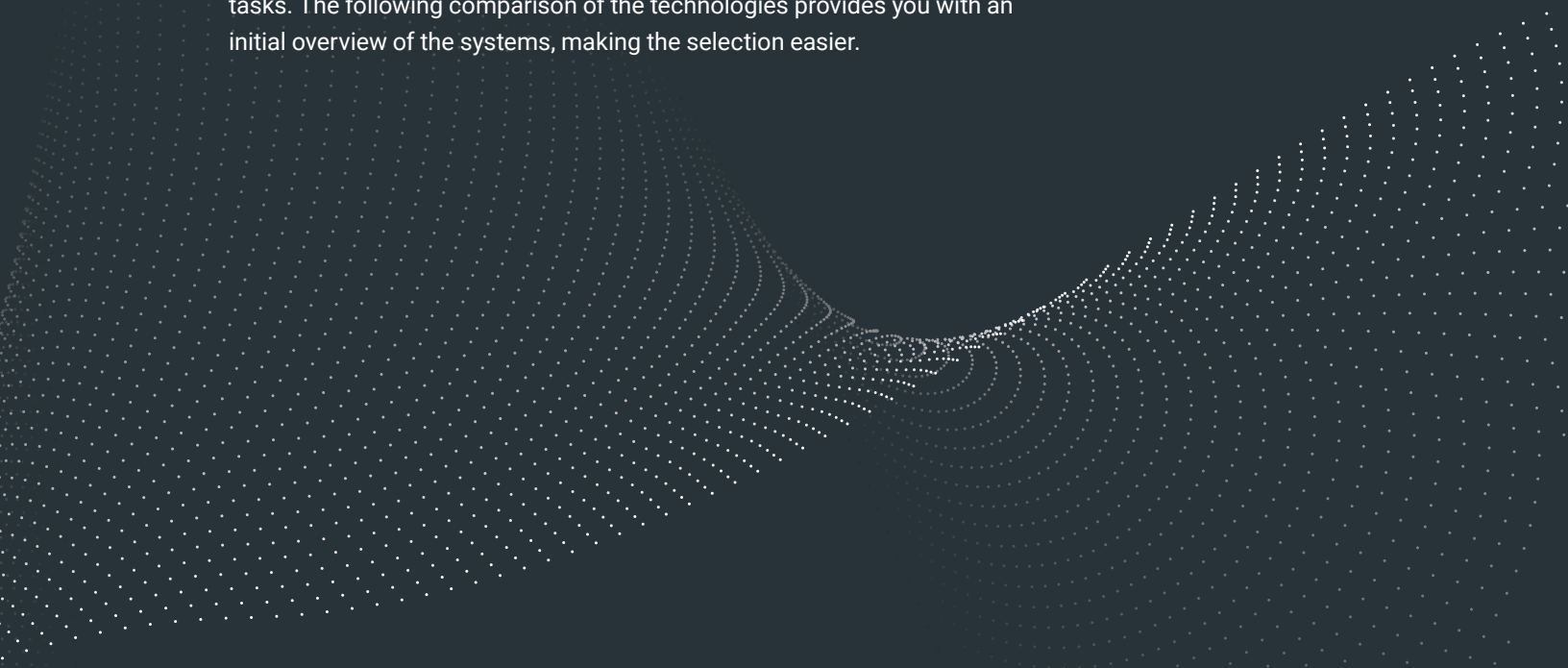


X-ray lenses

Gear

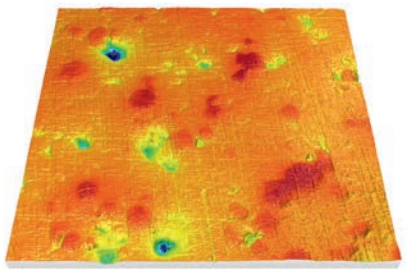
Measuring using the right technology

Do you need to measure roughness frequently? Do you value a fast measuring time when capturing large areas? Or do you require a high level of dynamics to measure geometries? Regardless of what is important to you: Mahr can provide you with a full range of technologies for all measuring tasks. The following comparison of the technologies provides you with an initial overview of the systems, making the selection easier.



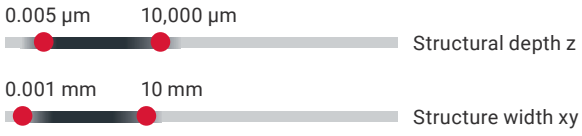
The right technology
for every measuring task

Patented confocal technology

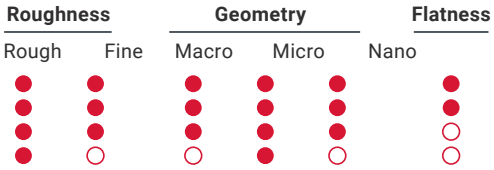


The robust MarSurf CM sensor technology is based on the patented Confocal Multi-Pinhole (CMP) technology. The light of a LED light source shines through the pinholes of a multi-pinhole disc (MPD) and is focused through the objective lens on to the surface of the specimen. The specimen reflects the light beams back to the measuring device. At every pinhole of the MPD, the reflected light is then reduced to the focused part. The rotation of the multi-pinhole disc ensures that the surface can be scanned fully. This principle prevents the scattered light from adjacent measuring points interfering with the camera pixels. When combined, these individual values provide the confocal curve from which the precise height value of a pixel is determined.

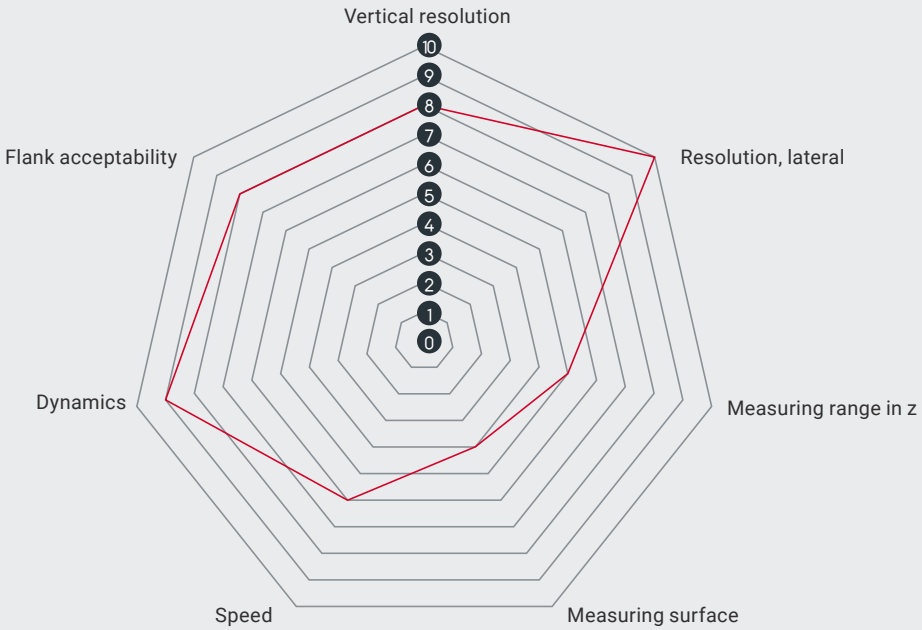
Typical structural sizes

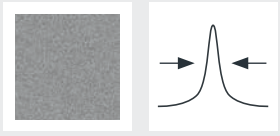


Confocal | **MarSurf** CM



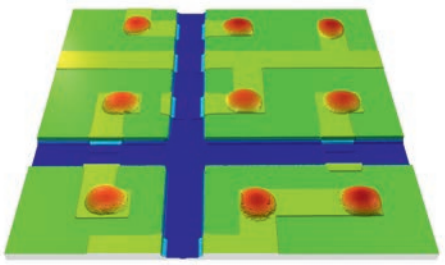
Confocal



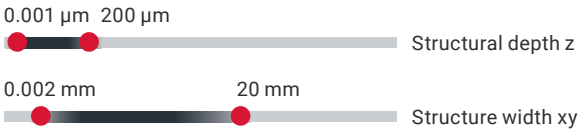


High precision white light interferometry

The MarSurf white light interferometers are based on the Mirau or Michelson principle, depending on the objective lens. Coherent light from a light source is split into a measurement and reference beam by a beam splitter. The measuring object reflects the measuring beam, while the reference beam is superimposed with the measuring beam via a mirror. A correlation diagram is generated from the intensity progression from which the new Mahr Intelligent Correlation Algorithm (ICA) determines the height values of the pixels.



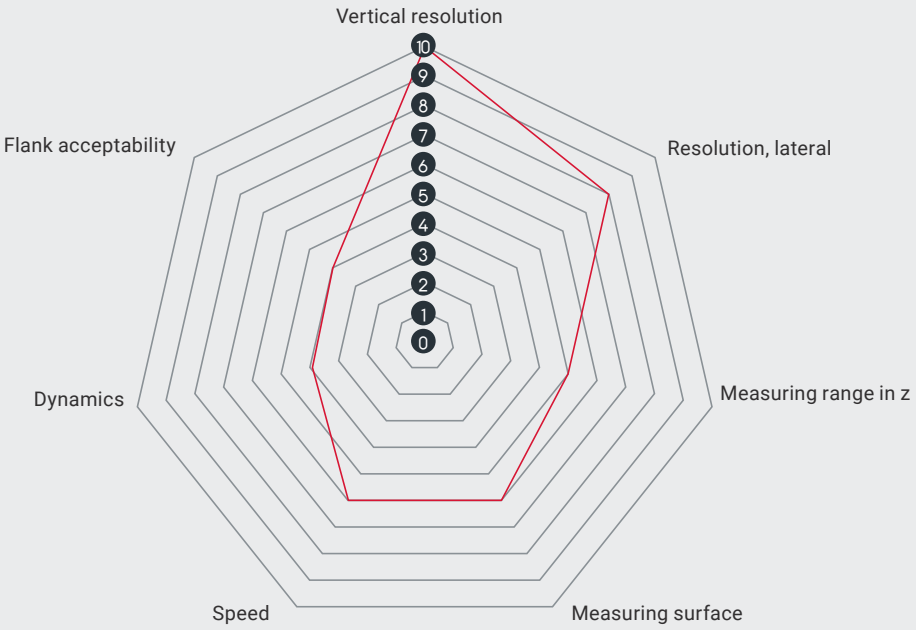
Typical structural sizes

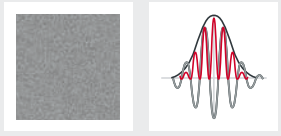


White light interferometry | **MarSurf** WI

Roughness		**Geometry**			**Flatness**
Rough	Fine	Macro	Micro	Nano	
●	●	●	●	●	●
●	●	○	●	●	●
○	●	○	●	●	●
○	●	○	○	●	●

Interferometry

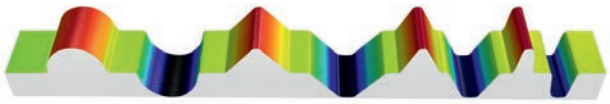




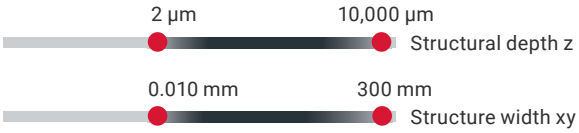
The right process
for your requirements

Profilometer with point sensor

The diffraction of white light in different wavelengths is used when recording measuring values to determine the height. Each of these wavelengths is assigned to a height value via a spectrometer.



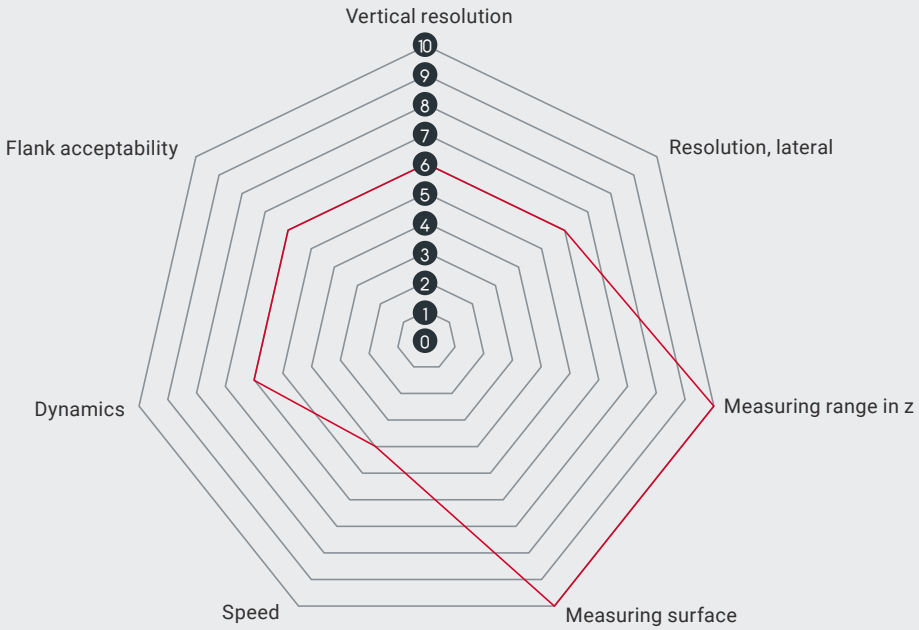
Typical structural sizes

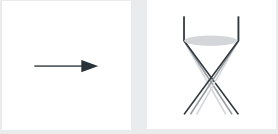


Point sensor | **MarSurf** CP

Roughness		**Geometry**		**Flatness**
Rough	Fine	Macro	Micro	
●	●	●	●	●
●	●	●	●	●
●	○	●	●	●
●	○	●	○	○

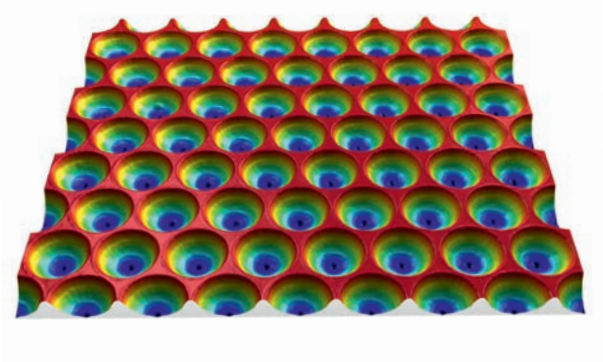
Profilometer (point sensor)



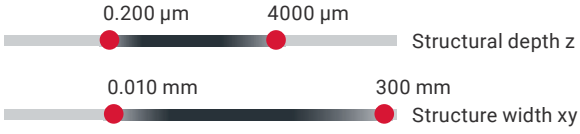


Profilometer with linear sensor

With the chromatic linear sensor CL, 192 points are focused along a linear line of the surface of the measuring object. The reflected light for each of these 192 channels can be analyzed spectrally and thus used to determine the height.



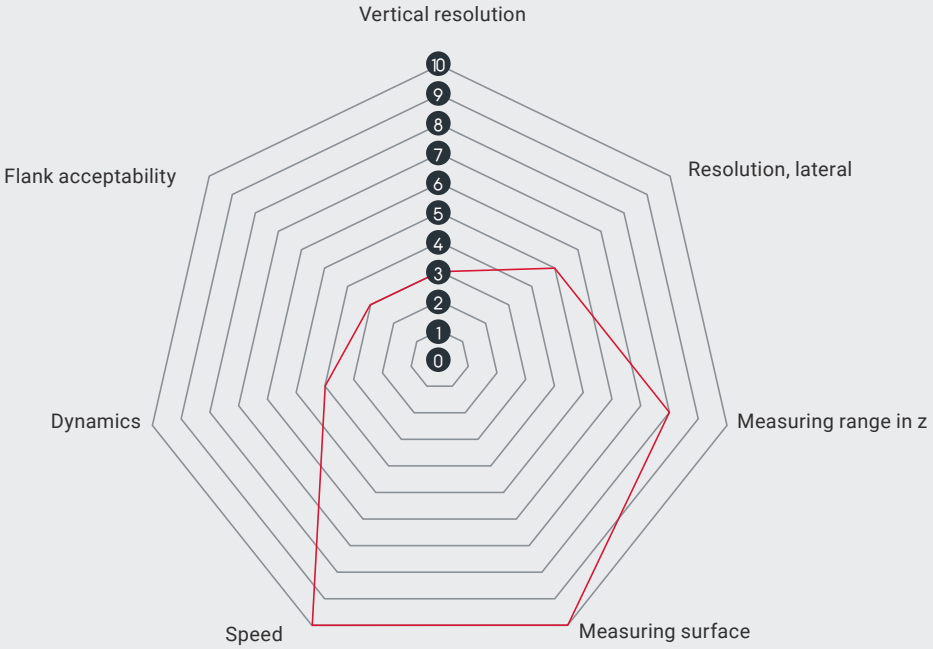
Typical structural sizes

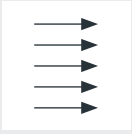


Linear sensor | **MarSurf** CL

Geometry		**Flatness**
Macro	Micro	
●	●	●
●	●	●
●	●	○
●	○	○

Profilometry (linear sensors)

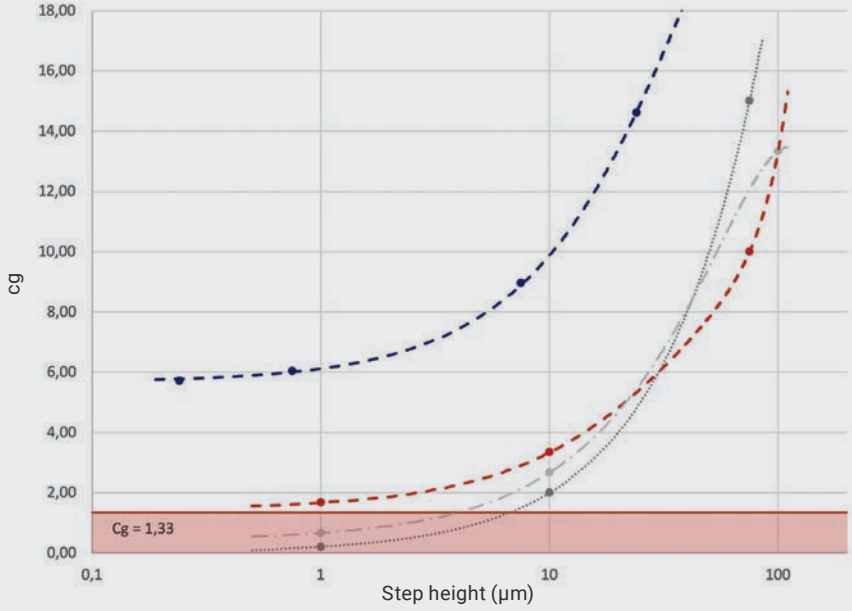


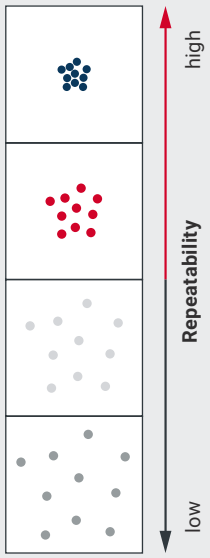


Maximum process stability
thanks to superior data quality

Measurements are not all the same – it depends on the quality of the data! It is best to get direct advice from a Mahr expert, who will be able to tell you exactly which optical technology, such as profilometry, white light interferometry, or confocal measurement method, is best suited to your requirements.

Measuring equipment functionality for the step height





Excellent cg values are achieved for the measuring equipment functionality due to the high level of repeatability of the Mahr systems – MarSurf CM and MarSurf WI.

MarSurf CM
MarSurf WI
Laser scanning
Focus variation

Highest repeatability

Patented hardware solutions, such as the multi-pinhole disc on the MarSurf CM, and innovative algorithms, such as the ICA evaluation of the MarSurf WI series, ensure that you always achieve the best possible quality of data. They stand for robust measurement data acquisition and stable measurement data evaluation and lead to maximum repeatability.

Minimum measuring uncertainty

All Mahr measuring instruments are accepted based on certified standards in accordance with strictly specified criteria from the valid ISO 25178 standard. This ensures minimum measuring deviations and the traceability of the results. You can be certain that your products will have the exact properties you expect.

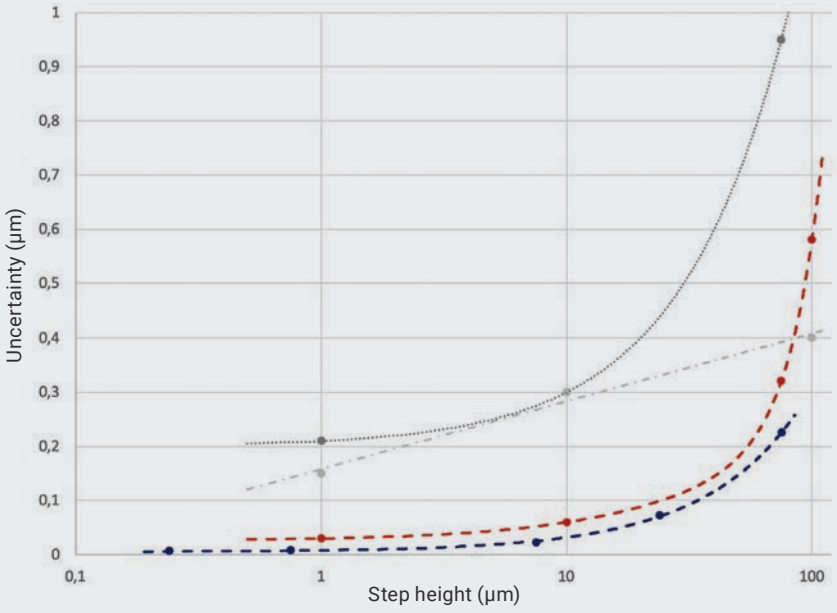
ISO

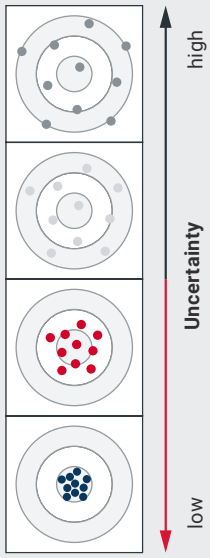
Specifications at a glance

Mahr has committed to observing the Initiative Fair Data Sheet. This means that all device properties are in a comprehensible and comparable format. By selecting high-quality components and accurate production processes, we ensure that Mahr measuring systems always meet the specifications.

Initiative Fair Data Sheet

Uncertainty of the step height measurement





The high quality of our measuring instruments 'Made in Germany' ensures an excellent level of repeatability of all measurements and stands for the verified functionality of the measuring equipment. For you as the user, this means maximum precision and minimum uncertainty.

The cg capability index was used to measure the level of repeatability.

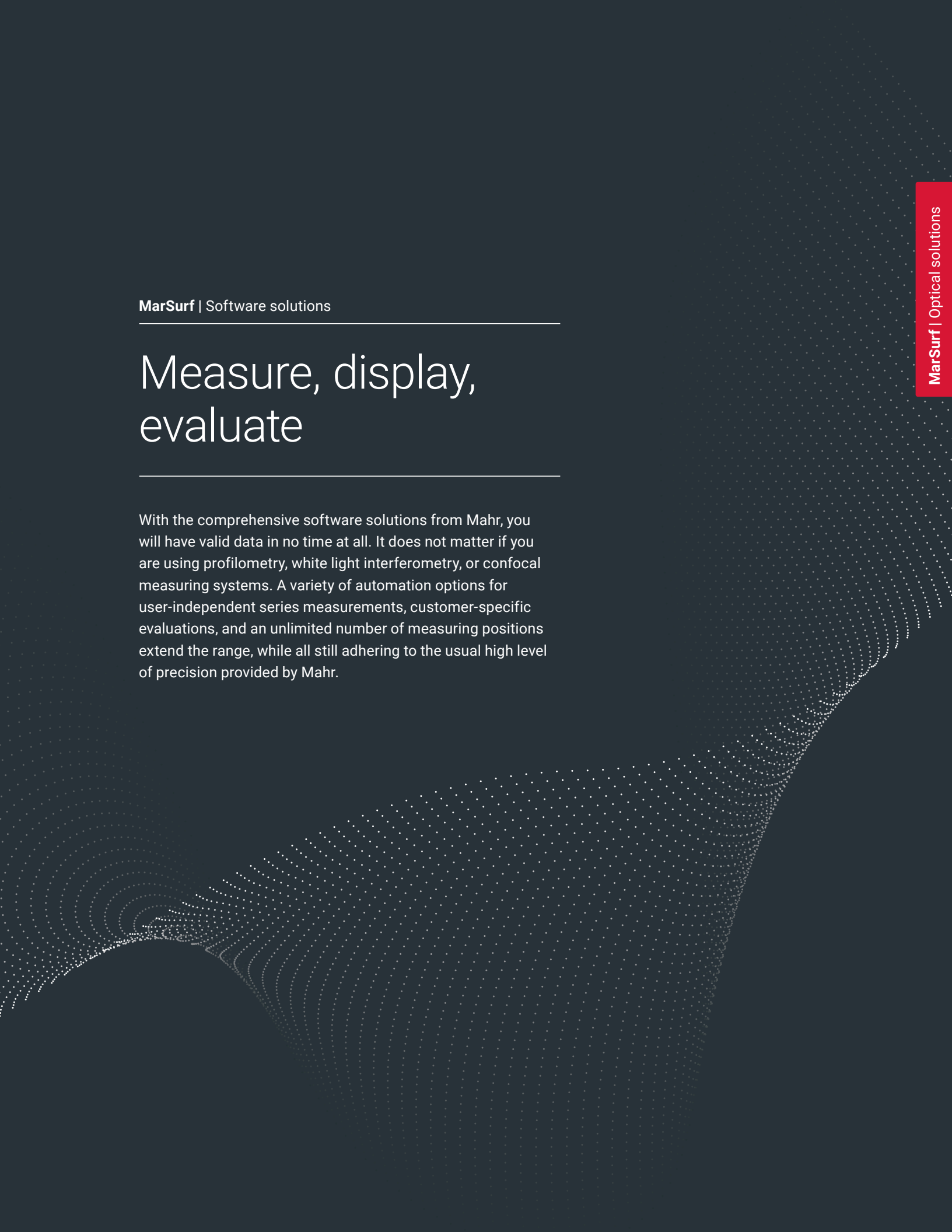
- Formula cg = 0.2 * T / (6 * s)
- Tolerance T = 10% of the step height
- MarSurf CM and MarSurf WI with 20x objective lens, laser scanning systems with 20x/50x, focus variation "xxx"


Measurement settings
Multi Spot To
X 111.371
115.30
114.5
1
2
3
4
5
110000
112000
114000 [µm]
116000
150000
152000
154000
156000
X: 110,131 mm Y: 148,535 mm
1
Objective
800XS (20x / 0.60)
Working distance
1 mm
2
Brightness
Manual
Exposure / Gain
40 ms 0 db
3
Measurement field XY
0.800 mm x 0.800 mm
4
Measurement Z
Auto
Range
107.8 µm
Parameter
Algorithm
Standard HDR
Data processing
5
Metrology SW
Spot Tool

MarSurf | Software solutions

Measure, display, evaluate

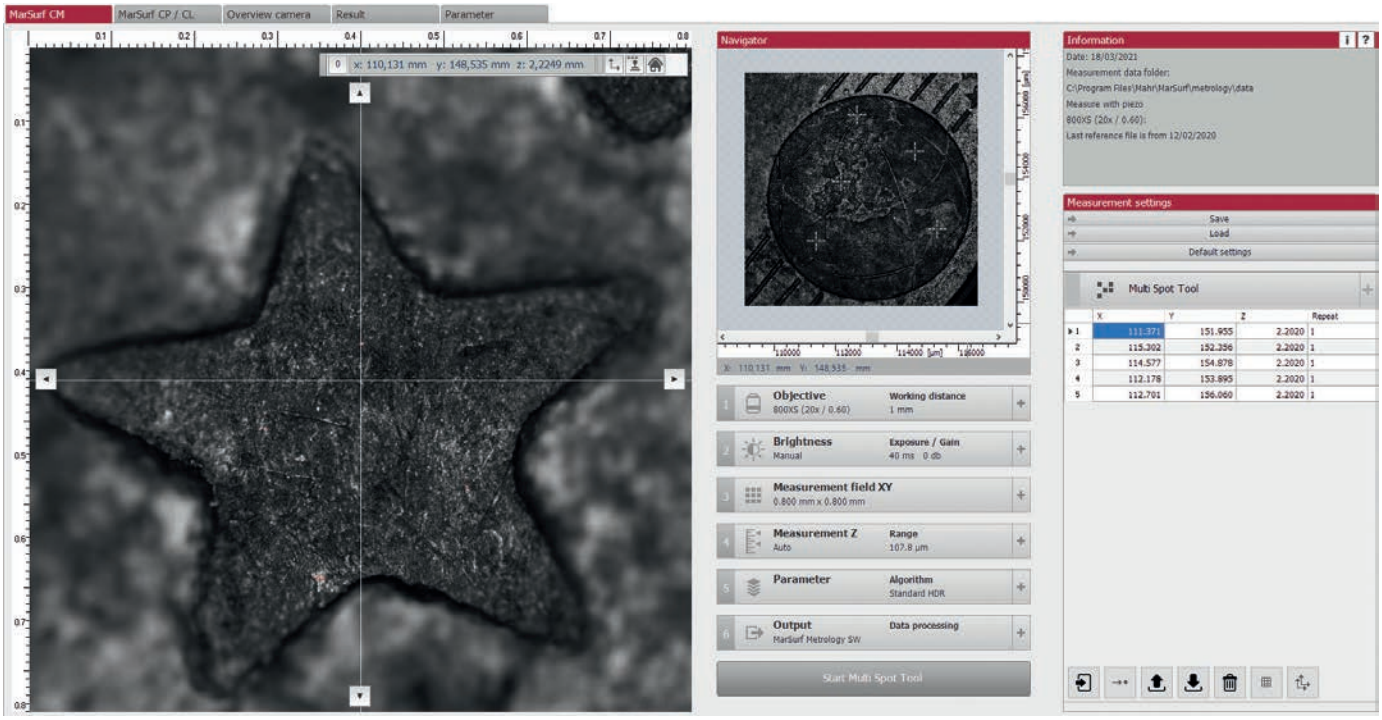
With the comprehensive software solutions from Mahr, you will have valid data in no time at all. It does not matter if you are using profilometry, white light interferometry, or confocal measuring systems. A variety of automation options for user-independent series measurements, customer-specific evaluations, and an unlimited number of measuring positions extend the range, while all still adhering to the usual high level of precision provided by Mahr.



One software, **all measuring systems**

Regardless of which measuring system from Mahr you choose, you will probably already be familiar with the software that comes with it. For all systems in the MarSurf 3D series, Mahr relies on the same, clearly structured software design that has proven itself many times over in practice.

The Mahr software consists of several components that work together perfectly. They provide you with an intuitive application that delivers fast and accurate results. Consistently high data quality is also guaranteed on large measuring surfaces.



Metrology Suite

MarSurf | Metrology

Intuitive measuring

The measurement and control software – MarSurf Metrology – ensures the efficient execution of all measurements

- Fast overview image (pre-scan function)
- Access the measurement in just a few clicks (snapshot technology)
- Multiple measurements can easily be completed (Multi-Spot Tool)
- Automatic setting of the measuring range (auto range)
- All parameters are saved as a template for repeat measuring tasks (template function)

MarSurf | MfM

Effective display and evaluation

Display and document structures, roughness, waviness, and much more using the MarSurf Mountains from Mahr

- Fast and high-quality 3D overview
- User-independent
- Can be automated
- 3D analysis, ISO 25178, ISO 13565, ISO 12781…
- 2D analysis, ISO 4287, ISO 21920...
- Geometry, volume, contour, CAD comparison

MarSurf | Automation

Individualized automation

Automate measurements and evaluations using the MarSurf Automation software

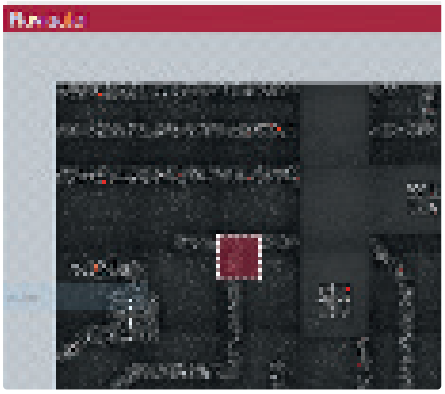
- User-independent serial measurements
- Rights management
- Record creation and SPC
- Registration mark detection and specimen position
- Information input using barcode/data matrix code
- QS-STAT output

One user interface, **many functions**

With the user-friendly measurement and control software – MarSurf Metrology (MSW) – all sensors and the overview camera can easily be controlled from one user interface. When switching between measuring heads, the selected measuring head automatically moves to the defined measuring position. Meaningful 3D overviews of the measuring results, including intensity overlay, are already available after just a few seconds.

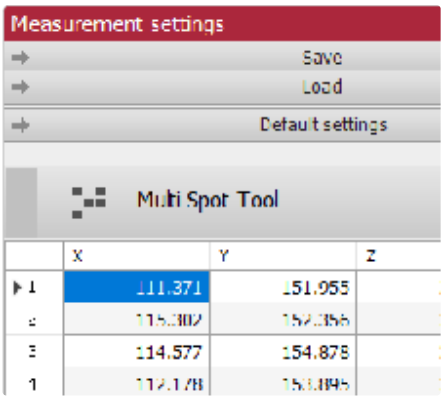
Measuring intuitively

The measurement and control software – MarSurf Metrology – ensures the efficient execution of all of the measurements



Navigator function

The navigator function generates a fast overview image, in which the required measuring range can easily be selected using the mouse.



Template function

The template function can be used to save measuring parameters as a template. Recurring measuring tasks can thus be implemented easily.

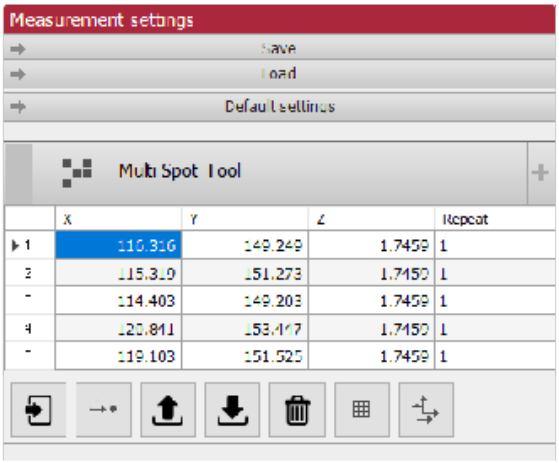
Snapshot technology

After you have arrived at the desired sample position, simply click for optimum measuring results. The MarSurf MSW automatically regulates all of the settings, including the focus range and brightness. At the same time there is enough room for individual settings.

Multi-Spot Tool

With the MarSurf Metrology software, you can approach several measuring positions individually, save them, or define them directly in the navigator overview. Alternatively, a fixed grid can be copied to the points, or a temporal instead of a local offset can be used at that point for the repeat measurement to monitor any changes. All points are recorded and saved in one measuring process.

Measuring processes using the Multi Spot Tool can be saved as a template for subsequent measurements. The tool includes all of the known, easy-to-use functions of the MarSurf MSW, including the Auto-Range and Stitching functions. Semi-automated processes can also be designed.



Free alignment

Measuring fields in any alignment

Height level

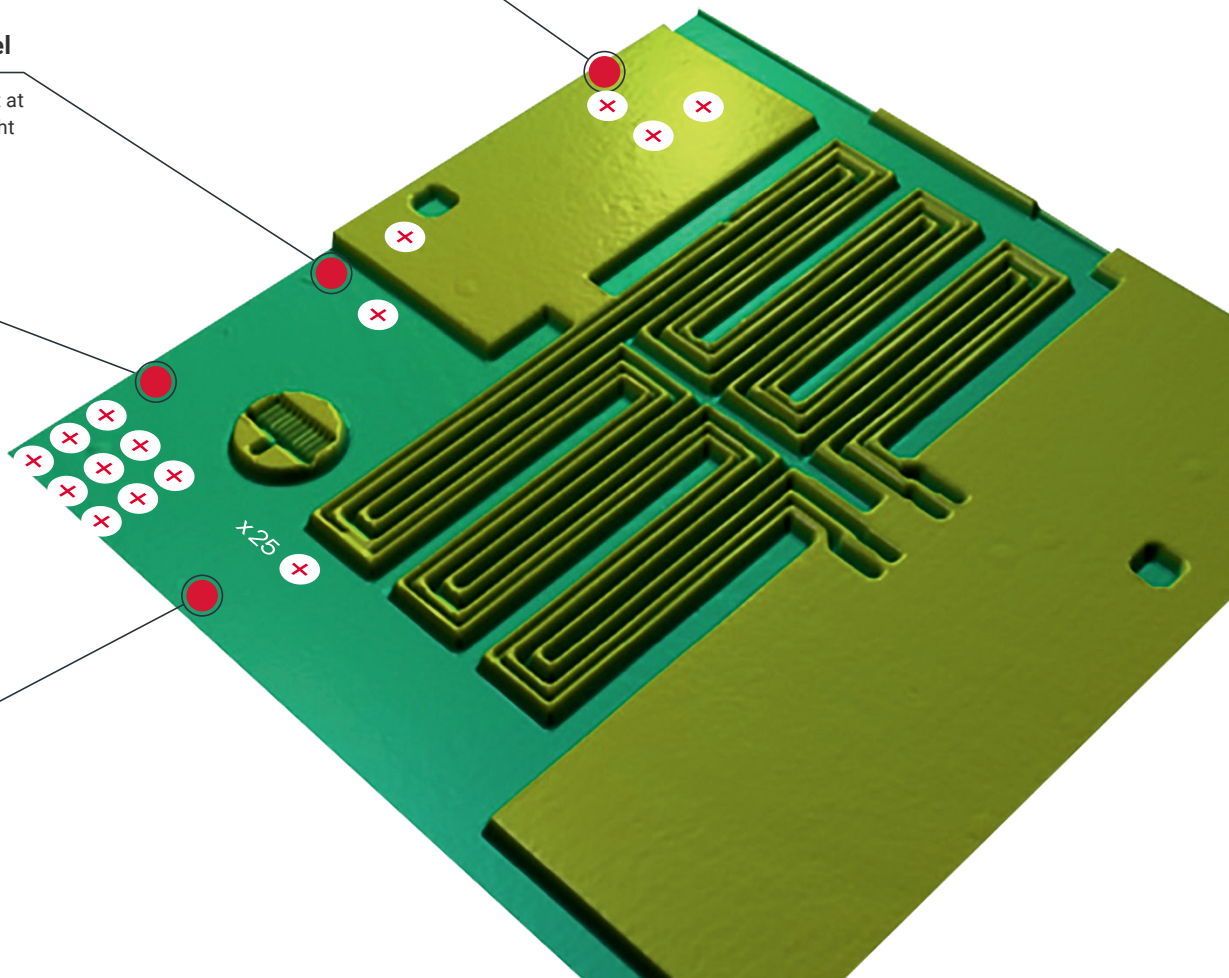
Measurement at different height level

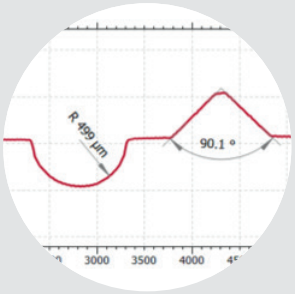
Regular alignment

Measuring field in regular alignment

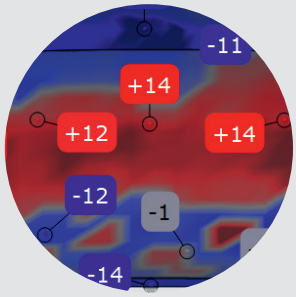
Repeat measurement

Completion of repeat measurements



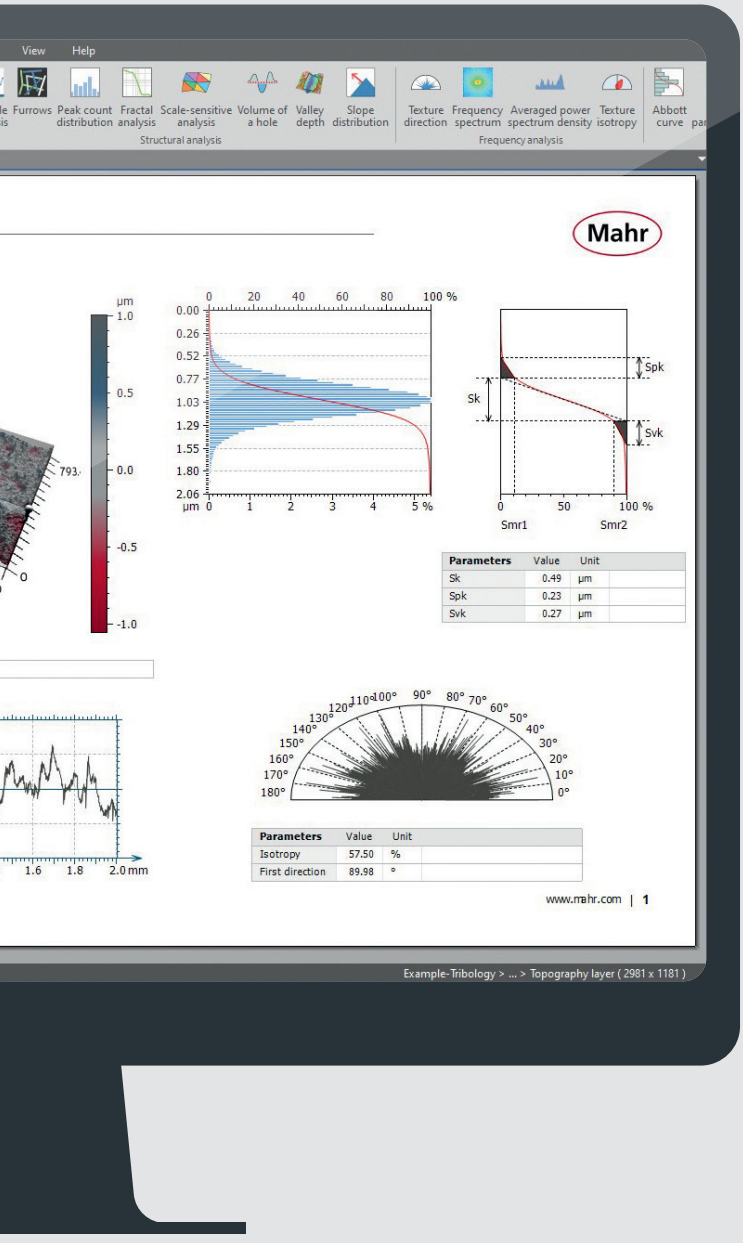


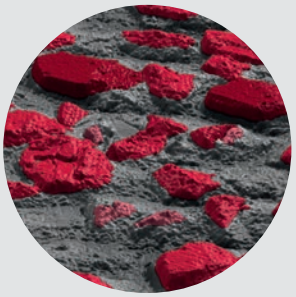
Geometry and contour evaluation in 2D



Nominal/actual value comparison using GOM Inspect

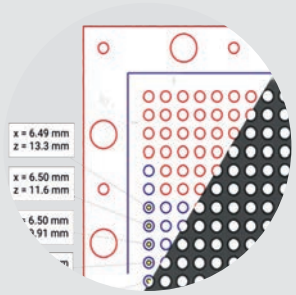
Roughness as per
ISO 25178, ISO 13565,
ISO 4287, ISO 21920





Particle/pore analysis including classification
Height/depth, area,
volume, diameter

Flatness as per
ISO 12781



Geometry and contour evaluation in 3D

Surface characteristics **at the press of a button**

The surface analysis software MarSurf Mountains for Mahr offers a comprehensive function package, which is required to display and analyze the structure, roughness, waviness, step height, contours, and other surface characteristics. The clearly structured, multilingual user interface makes it possible to create complex analytical reports at the touch of a button. A variety of display options, such as profile view, 3D reconstruction, or a reflectance image provide informative measuring records. It is easy for users to create individual evaluation template.

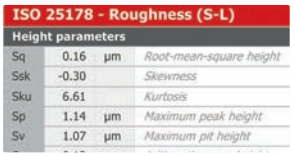
The software always contains the most up-to-date standard parameters and filter functions. It is available in the Standard, Extended, and Premium versions. Special modules, for example for particle analysis and individual evaluations, can also be integrated.

Effective display and evaluation

Display and document structures, roughness, waviness, and much more using the MarSurf Mountains from Mahr

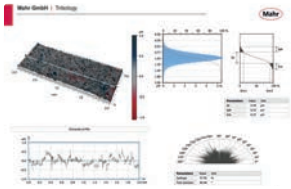
Edit →
Wide range of operators to:

- Remove form
- Select
- Filter



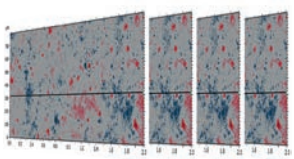
Evaluate →
Interactive analysis for:

- Roughness
- Geometry
- Tribology



Document →
Creation of individual templates:

- 2D and 3D images
- Profile
- Tables



Automate
Use of created templates for repeat measuring tasks:

- MiniDocs
- Batch processing

Measure, evaluate and automate

The MarSurf ASW software can be used to easily automate individual measurements and special, customer-specific special evaluations.

An unlimited number of measurement templates can thus be defined, for example, and saved in a database. They are then always ready to use. Users can define an unlimited number of measuring positions on every individual specimen and for every individual sensor setting. During series measurements, several specimens are approached and measured in the same way as an individual measurement. All specimens can be measured in the same way in accordance with the defined measurement settings. Evaluation features can also be defined specifically, activated,
or deactivated for each specimen.

Can be automated individually

Automate measurements and evaluations using the MarSurf Automation software

Database technology

The MarSurf ASW database technology has a comprehensive evaluation library. Measuring results and evaluations are stored on a continuous basis and are thus available for statistical process control. The central data base and templates stored within it can be accessed from several systems.

Suitable for industrial applications

The software meets current industrial standards by supporting registration mark detection and the transfer of measuring data to the statistic software (e.g., QS-Stat). The parallel recording and evaluation of measuring data by two computers is supported. A strict separation between user and administrator modes guarantees that it is very easy to operate and provides reliable results.

Recording specimen information

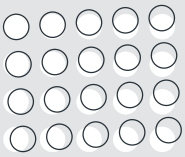
- Recording order-specific information, such as the user ID, component type, batch number, date/time, etc.
- Manual input of the information
- Digital input using data matrix code reader
- Measurement templates are automatically linked to the respective evaluation templates based on the specimen information

Rights management

- Hierarchical user administration including password protection
- Rights assigned for operational, process, and administrator levels

Series measurement

User-independent and automation



Check specimen position

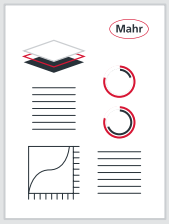
- Automatic detection and checking of the specimen position
- Optional correction using registration mark detection available
- Compensate for positioning inaccuracies when inserting the specimen
- Overcome component/size tolerances and corresponding correction of the measuring position

Measurement

- Start individual or series measurements

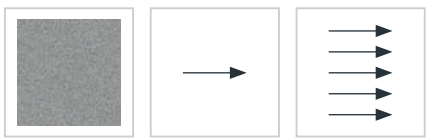
Evaluation

- Transfer of the measuring data to the analysis software and customer-specific algorithms
- Evaluation based on predefined evaluation templates or templates created by the user



Creation of a measurement report

- Comprehensive overview of the measuring result by means of informative measuring reports
- Output via MS Excel or as a PDF file



Multisensor system

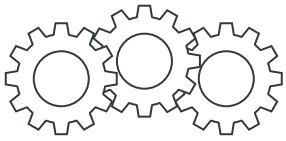
The measurement templates support acquisition with multiple sensors. A defined and automatic switch between the sensors can be specified for this purpose.

Process control
via integrated statistic functions

The flexibility of the different statistical evaluations and graphic display options is vast. Differences between production lines or a reduction of the quality caused by the wear of tools can thus be detected quickly. Other advantages: Quantitative evaluations can be completed and are immediately visible.

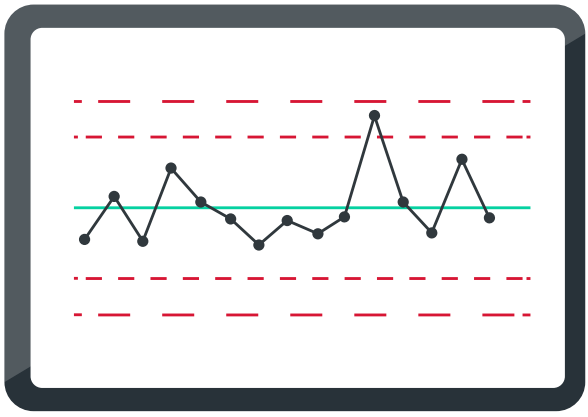
Advantages Mahr has to offer:

- Avoiding waste
- Avoiding complaints
- Avoiding time consuming and complex subsequent processes
- Time and cost savings

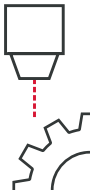


Produce
Optical measuring technology has now become the global standard for monitoring the commissioning of new manufacturing processes and for production processes with several production lines.

Readjust
The process control can, for example, be used to detect the wear of tools at an early stage and thus enables tools to be replaced in good time. If differences are detected between different production lines, timely readjustments can prevent and reduce waste.



Check
Fast detection of significant changes to the production process with regard to the position and control, thanks to the graphic overview of the measuring results. By setting control limits, as well as upper and lower product specifications, you will always have control of your production process.

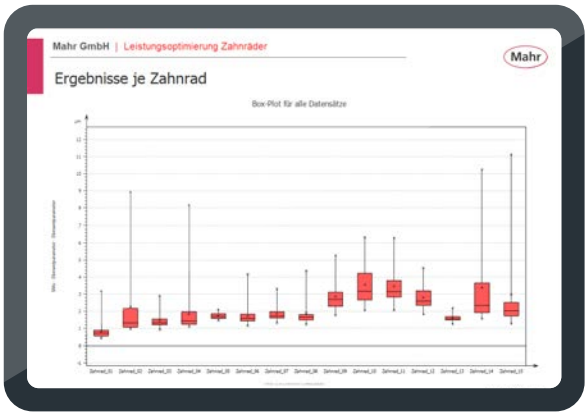


Measure
Optical measuring systems from Mahr are fast, contactless, and convince with the best data quality.

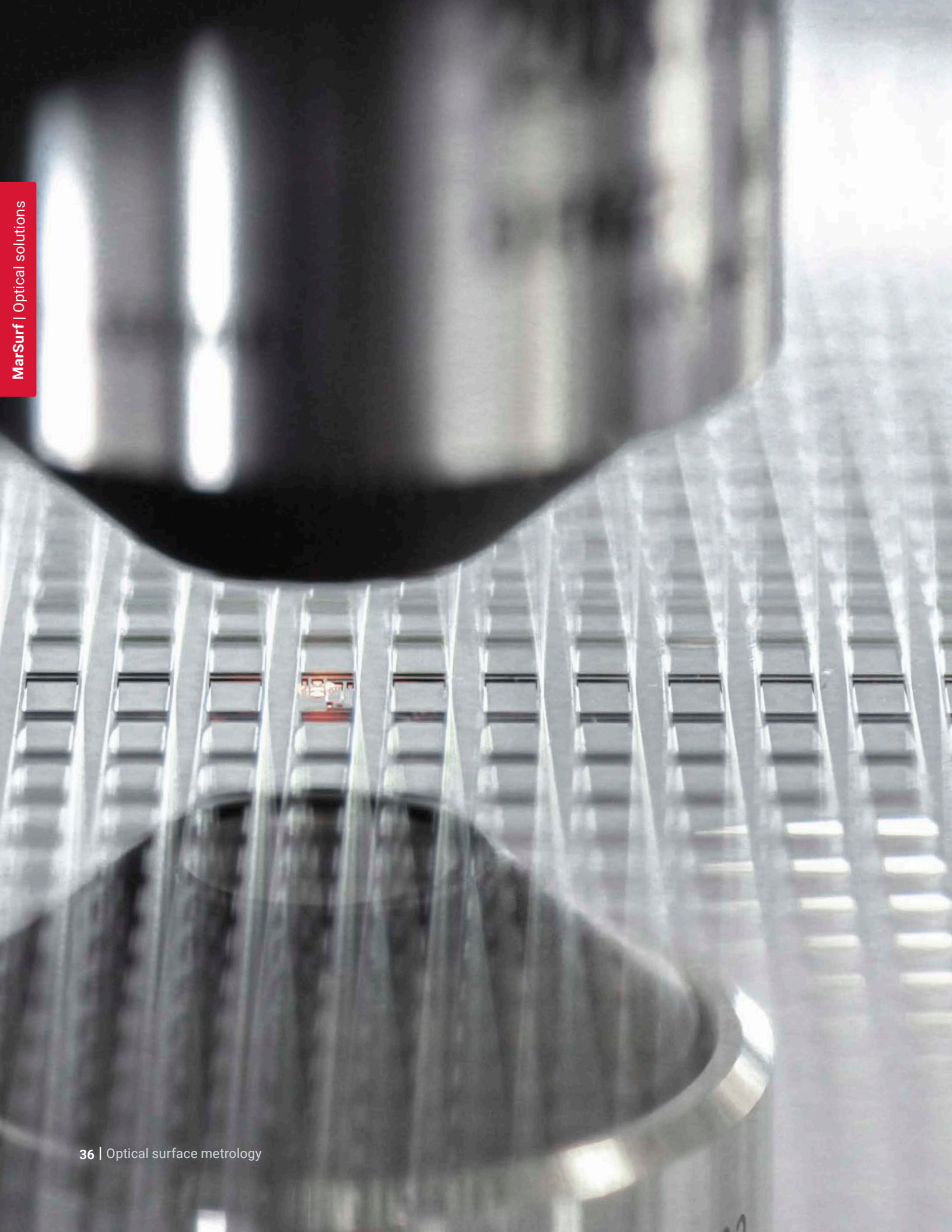
Sku	Rpc	Sa	S10z	Svk	Rpc	Sq
Rpk	Rk	Ra	Pa	Sdr	Rk	
Sq	Wa	Wt	Rz	Rpk		

Find the right parameter
We will happily support you in determining the informative parameters for your production process.

Evaluate
Integrated statistics functions make it easy to determine suitable parameters for process control.



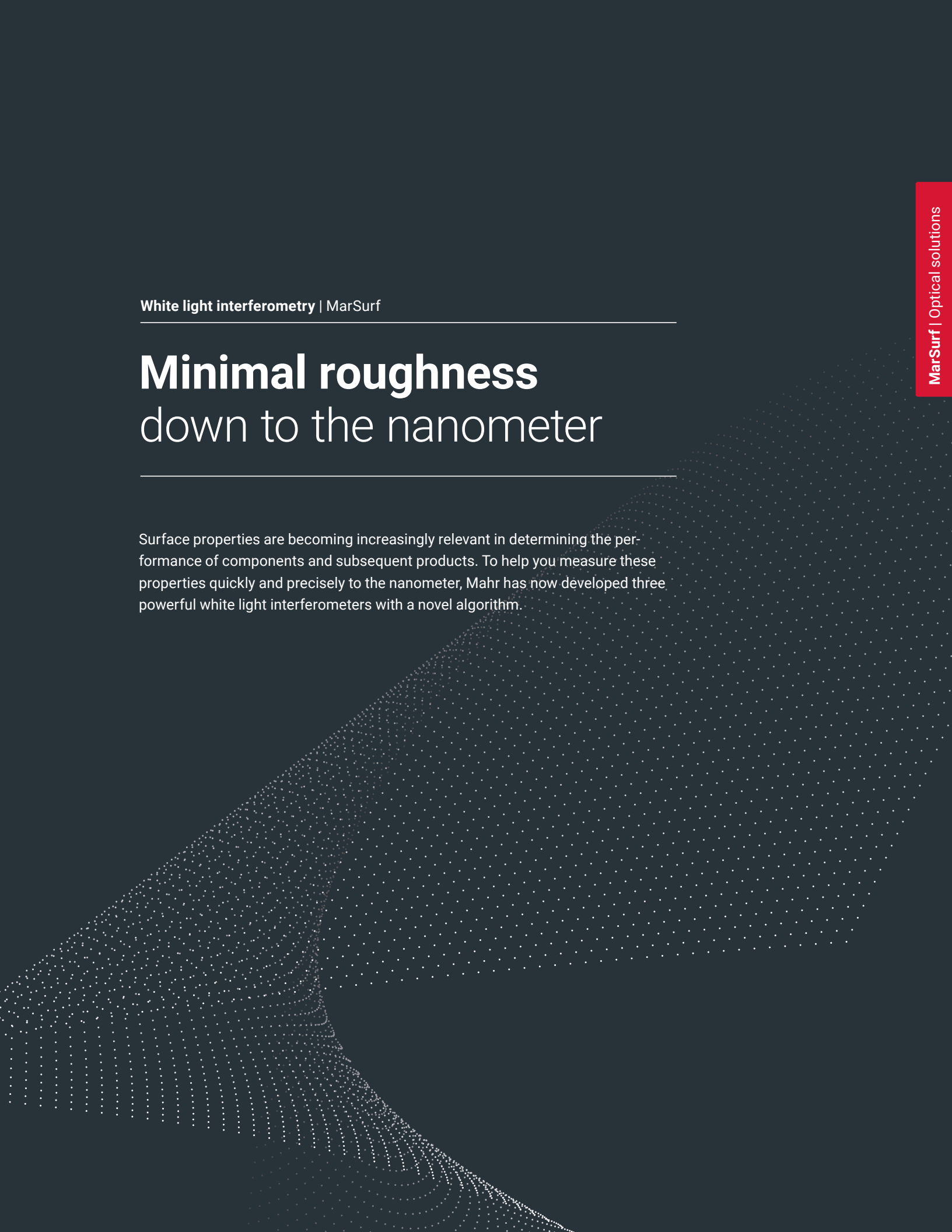
Export
In addition to the internal statistic functions in the evaluation software, Mahr also provides an automatic export of the results in a format of your choice. Common interfaces, such as QS-STAT, are of course supported.



White light interferometry | MarSurf

Minimal roughness down to the nanometer

Surface properties are becoming increasingly relevant in determining the performance of components and subsequent products. To help you measure these properties quickly and precisely to the nanometer, Mahr has now developed three powerful white light interferometers with a novel algorithm.



Record topographies in the sub-nanometer range

The new white light interferometer series from Mahr comprises three high-performance devices: MarSurf WI 50 M, MarSurf WI 50, and MarSurf WI 100. They stand out for having a very large positioning volume for large workpieces and the intuitive user software that Mahr customers know and value from the optical systems.

Your advantages

- Intelligent Correlation Algorithm (ICA technology)
- Minimal noise figure
- High level of accuracy
- Maximum stability

High-performance ICA technology

The new white light interferometers from Mahr are based on a new type of algorithm that combines the good properties of previous processes, such as PSI and VSI, in a single, large application range. This algorithm searches for the best correlation by comparing every single pixel. The calculated height values are very precise and robust. This minimizes noise, which consequently ensures unparalleled data quality. Laboratories and quality assurance processes can thus determine the finest roughness, step heights, or planes in the nanometer range in just a few seconds.

VDI/VDE 2655 | ISO 25178

Certified system acceptance

Low SNR

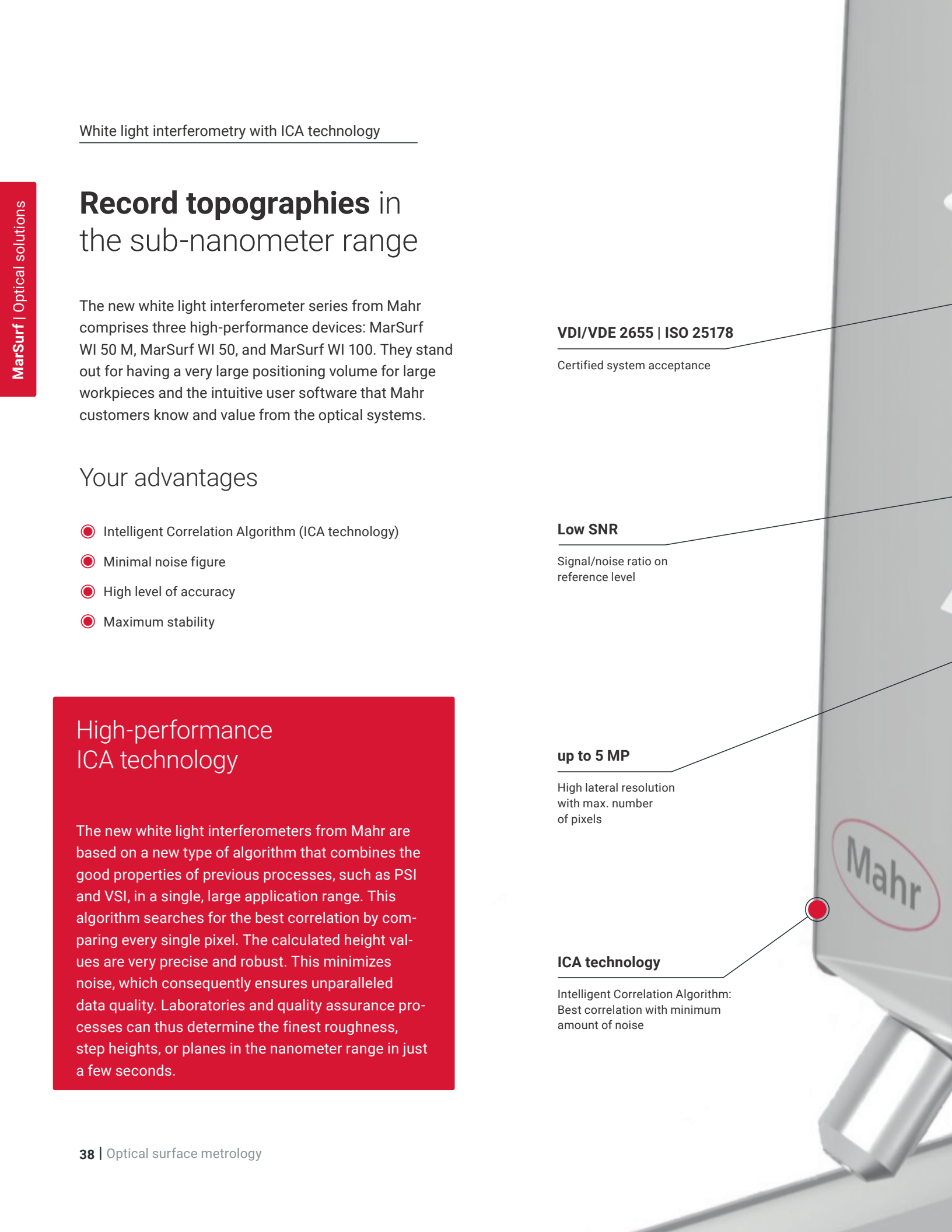
Signal/noise ratio on reference level

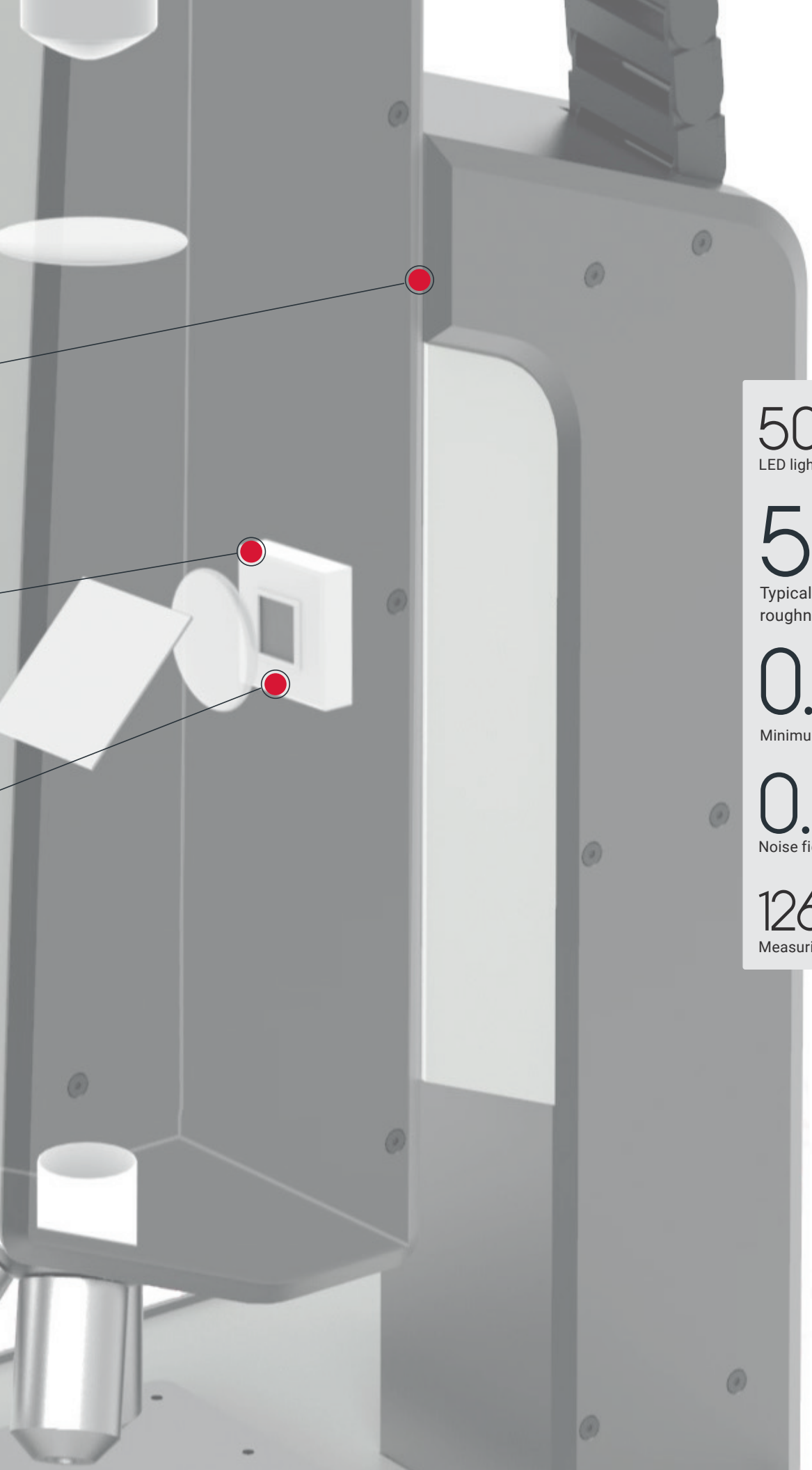
up to 5 MP

High lateral resolution with max. number of pixels

ICA technology

Intelligent Correlation Algorithm: Best correlation with minimum amount of noise





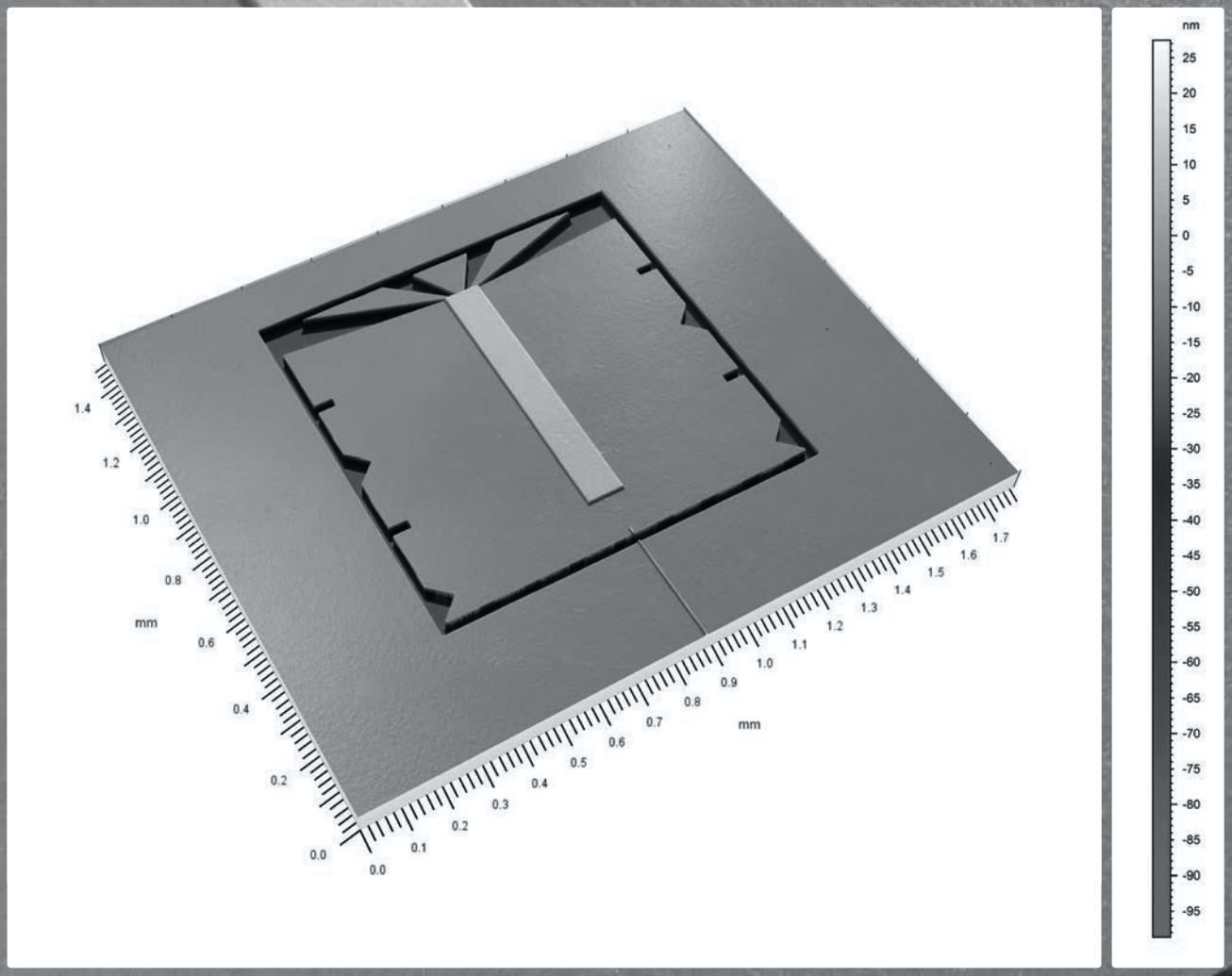
50,000 MTBF
LED light source

5 sec.
Typical measuring time for 3D roughness measurement

0.13 µm
Minimum measuring point level

0.08 nanometer
Noise figure as per STR

126,000,000
Measuring points per second


nm
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
-85
-90
-95
mm
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
mm
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4

High-performance entry-level solution

Precise measurement in the sub-nanometer range – easily achieved with the new MarSurf WI 50 M, the perfect entry-level solution into the new white light interferometry from Mahr. With an intuitive software user guide and very user-friendly design, this 3D measuring instrument is ideal for everyday use in the laboratory and quality management.

Reduced to the essentials, with compact design and large positioning volume: The new WI 50 M meets all the requirements of your measuring tasks in the nanometer range – offering maximum performance and impressive value for money. Adjustment and focusing are simple thanks to the functional tilting table and manual X-, Y- and Z-axes.

MarSurf WI 50 M

- Simple technology
- Intuitive operation
- Fast measurement
- Cost-effective
- Robust and reliable
- Max. sample height 220 mm
- Control unit integrated in tripod

Compact surface professionals

Flexible all-round measuring solutions whenever and wherever it comes down to the sub-nanometer: This is what the new MarSurf WI 50 and its big brother, the MarSurf WI 100, represent. The high-precision measuring tools for research and quality assurance deliver reliable 3D measuring values – quickly and easily in just a few steps. With its user-friendly design and high measuring speed at full resolution, the instruments reliably record the roughness, even on very smooth surfaces.

Due to its HD stitching function, the MarSurf WI 50 and MarSurf WI 100 boast consistently high resolution, even on large measuring surfaces. The integrated collision detection offers users a high level of safety in all directions – both for the workpiece and the instrument itself.

MarSurf WI 50

- High measuring speed – even at full resolution
- CNC functionality in all axes
- Safety through collision detection in all directions to protect the workpiece and measuring system
- HD stitching – consistently high resolution, even on large measuring surfaces
- HDR function, 16 bit

MarSurf WI 100

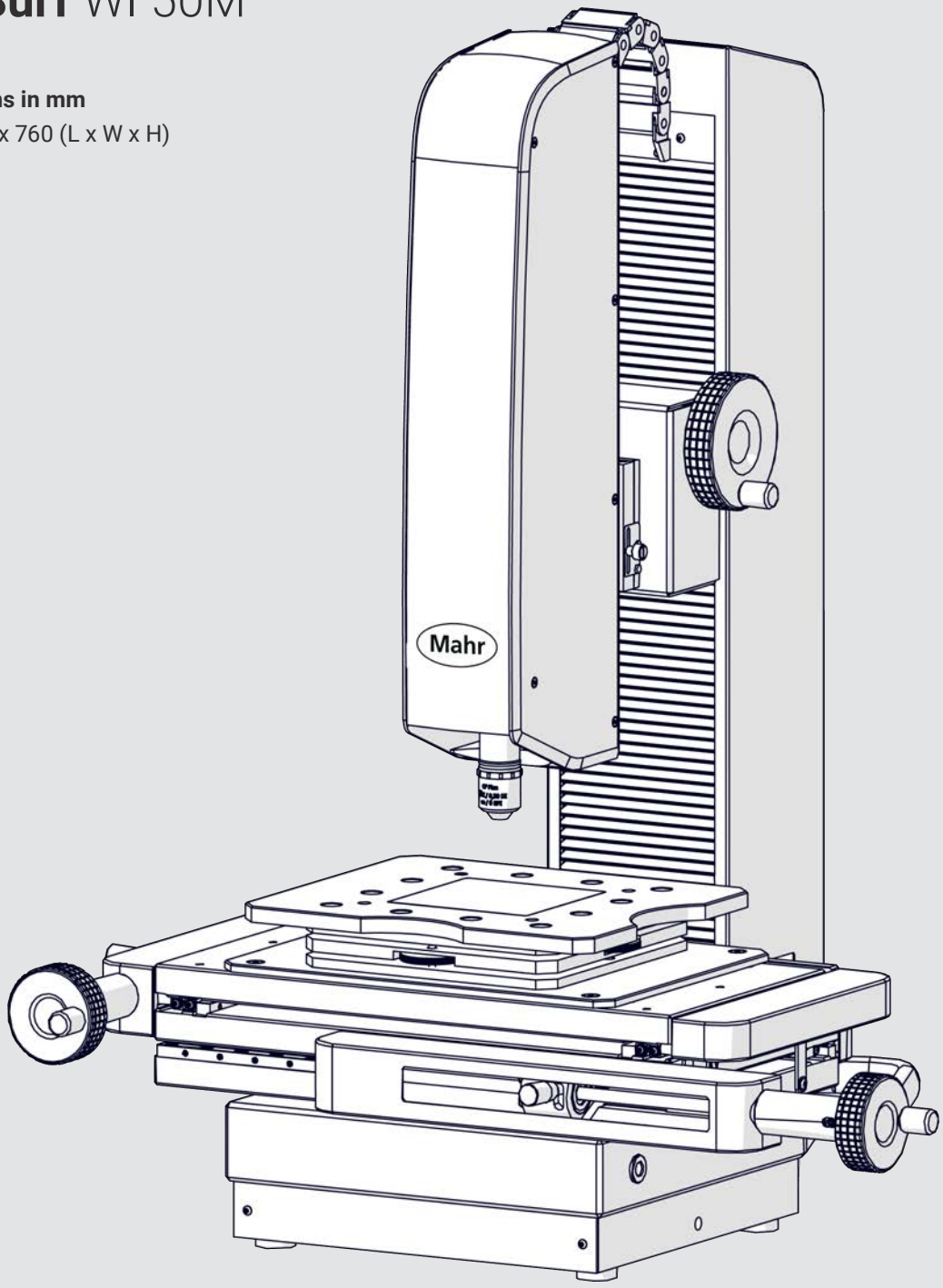
Automatable measuring system

The high-end MarSurf WI 100 instrument features an extended working area in XYZ direction for especially large sample volumes: Simply use the side adjustment used to move the additional manual Z-axis and measure the XXL components. With its special automation software, the WI 100 can also process user-independent and fully automated series measurements.

- High measuring speed – even at full resolution
- Safety through collision detection in all directions to protect the workpiece and measuring system
- HD stitching – consistently high resolution, even on large measuring surfaces
- CNC functionality in all axes
- User-independent serial measurements by automation software
- Extendable working area in XYZ direction, up to 160 mm in Z-direction
- Table load bearing capacity of 15 kg

MarSurf WI 50M

Dimensions in mm
520 x 650 x 760 (L x W x H)



Measuring head				
Image capturing module	Number of pixels		1440 x 1200	2448 x 2048
	max. number of measuring points in a single measurement x • y		1.728 million	5.013 million
	Max. image data at full resolution		140 Hz	35 (70[1]) Hz
	HDR function (16 bit)		standard	standard
Maximum number of measuring points[2] (million)			500	500
Vertical measuring module	Manual adjustment unit		220 mm	220 mm
	Motorized adjuster unit	Path length measuring system	–	–
		vertical adjustment range (mm)	–	–
	Fine adjuster (Piezoelectric module)	Vertical adjustment range	250 µm	250 µm
Collision detection x,y,z			–	–
Objective holder	4x revolver		–	–
	without revolver		standard	standard

1. On request
2. Maximum number of measuring points that can be recorded in a composite measurement. Option to add more.

Configuration	
Tripod form	L
Design of the axes	manual
Mass	55 kg
Positioning volume x • y • z	200 x 105 x 220 mm
Path length measuring system x,y	–
System controller	integrated
Active vibration dampening	optional

Software packages	
MarSurf MSW	standard
MarSurf ASW	–
MarSurf MfM	optional

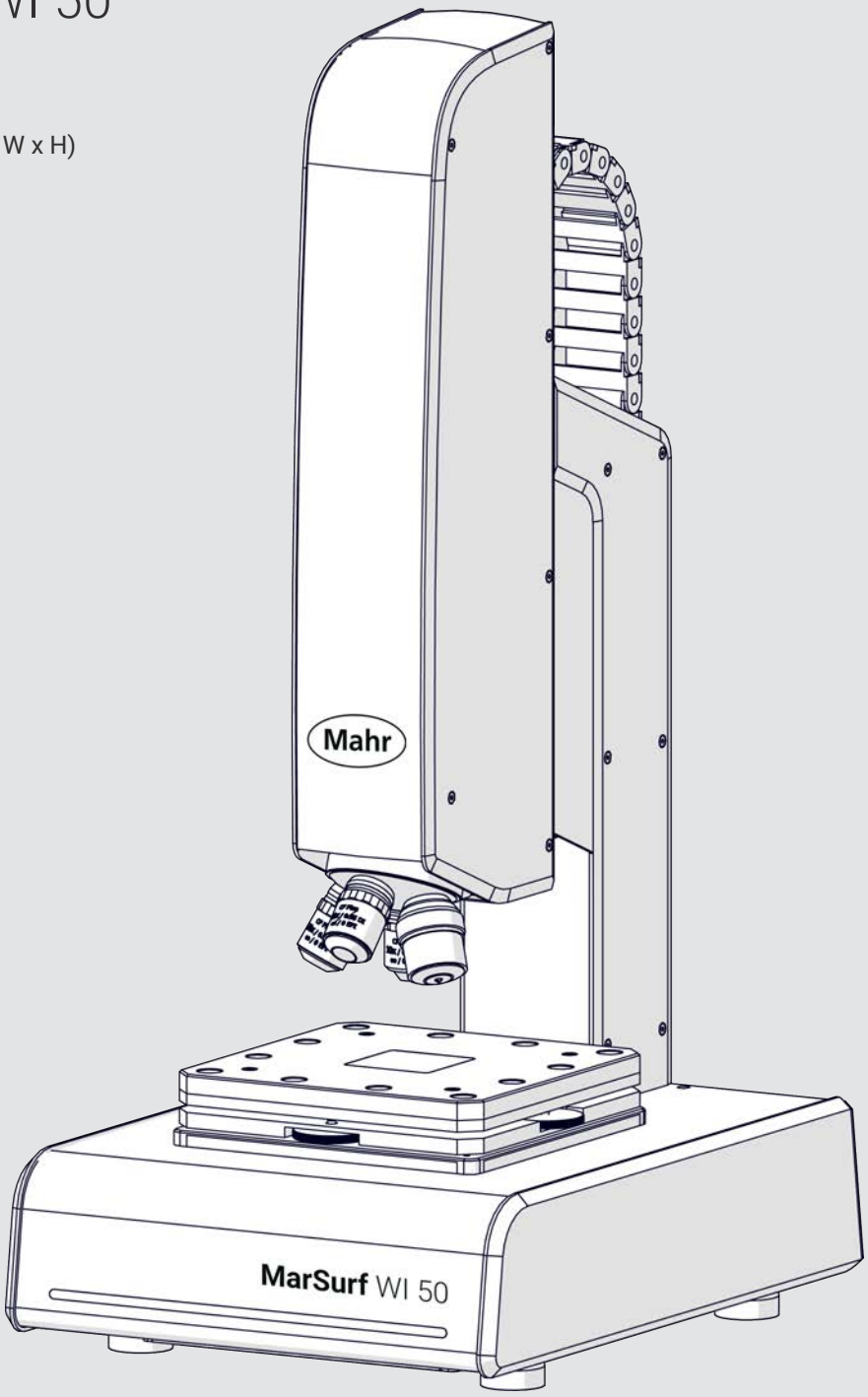
Export formats
FITS, NMS, OMS, X3P, ASCII, SDF, SUR, TIF, BMP, STL

SMarSurf MSW language packages
German, English, French, Italian, Spanish, Portuguese, Polish, Russian, Turkish, Japanese, Korean, Chinese

Sample properties	
Max. sample height	220 mm
Sample weight, max.	10 kg
Sample surface	Reflectivity: 0.1 – 100%, coated, uncoated, reflective to diffuse

MarSurf WI 50

Dimensions in mm
383 x 290 x 690 (L x W x H)



Measuring head				
Image capturing module	Number of pixels		1440 x 1200	2448 x 2048
	max. number of measuring points in a single measurement x • y		1.728 million	5.013 million
	Max. image data at full resolution		140 Hz	35 (70[1]) Hz
	HDR function (16 bit)		standard	standard
Maximum number of measuring points[2]			500 million	500 million
Vertical measuring module	Manual adjustment unit (mm)		–	–
	Motorized adjuster unit	Path length measuring system	standard	standard
		Vertical adjustment range	70 mm	70 mm
	Fine adjuster (Piezoelectric module)	Vertical adjustment range	250 µm	250 µm
Collision detection x,y,z			standard	standard
Objective holder	4x revolver		standard	standard
	without revolver		–	–

1. On request
2. Maximum number of measuring points that can be recorded in a composite measurement. Option to add more.

Configuration	
Tripod form	L
Design of the axes	motorized
Mass	25 kg
Positioning volume x • y • z	50 × 50 × 70 mm
Path length measuring system x,y	standard
System controller	integrated
Active vibration dampening	optional

Sample properties	
Max. sample height	70 / (optional 110) mm
Sample weight, max.	10 kg
Sample surface	Reflectivity: 0.1 – 100%, coated, uncoated, reflective to diffuse

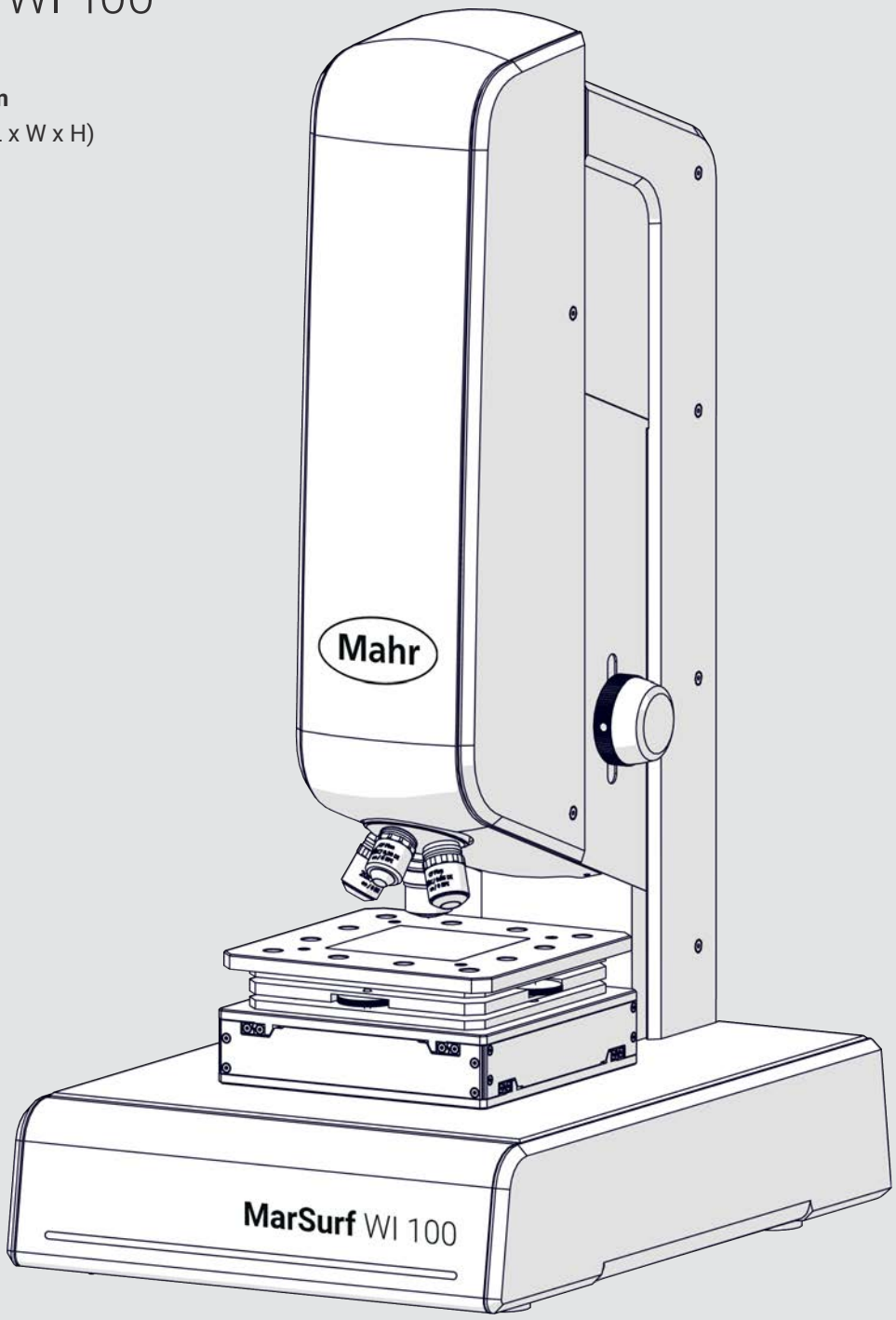
Software packages	
MarSurf MSW	standard
MarSurf ASW	optional
MarSurf MfM	optional

Export formats
FITS, NMS, OMS, X3P, ASCII, SDF, SUR, TIF, BMP, STL

MarSurf MSW language packages
German, English, French, Italian, Spanish, Portuguese, Polish, Russian, Turkish, Japanese, Korean, Chinese

MarSurf WI 100

Dimensions in mm
526 x 378 x 799 (L x W x H)



Measuring head				
Image capturing module	Number of pixels		1440 x 1200	2448 x 2048
	max. number of measuring points in a single measurement x • y		1,728 million	5,013 million
	Max. image data at full resolution		140 Hz	35 (70[1]) Hz
	HDR function (16 bit)		standard	standard
Maximum number of measuring points[2]			500 million	500 million
Vertical measuring module	Manual adjustment unit (mm)		–	–
	Motorized adjuster unit	Path length measuring system	standard	standard
		Vertical adjustment range	100 mm	100 mm
	Fine adjuster (Piezoelectric module)	Vertical adjustment range	250 µm	250 µm
Collision detection x,y,z			standard	standard
Objective holder	4x revolver		standard	standard
	without revolver		–	–

1. On request
2. Maximum number of measuring points that can be recorded

Configuration	
Tripod form	L
Design of the axes	motorisch
Mass	50 kg
Positioning volume x • y • z	100 x 100 x 70[1] mm
Path length measuring system x,y	standard
System controller	integrated
Active vibration dampening	optional

1 Can be expanded to 150 mm with integrated, manual Z-axis

Sample properties	
Max. sample height	160 mm
Sample weight, max.	15 kg
Sample surface	Reflectivity: 0.1 – 100%, coated, uncoated, reflective to diffuse

Software packages	
MarSurf MSW	standard
MarSurf ASW	optional
MarSurf MfM	optional

Export formats
FITS, NMS, OMS, X3P, ASCII, SDF, SUR, TIF, BMP, STL

MarSurf MSW language packages
German, English, French, Italian, Spanish, Portuguese, Polish, Russian, Turkish, Japanese, Korean, Chinese

Technical data
General information

General information	
Measuring principle	White light interferometry
Light source	High-power LED (650 nm), MTBF: 50,000 hours (high-performance white light LED)
Typical measuring time	2-8 s
Electrical power	Voltage: 100-240 V; frequency: 50-60 Hz, power consumption: approx. 90 W

Objectives		2,5x	5x
Objective lens magnification		2.5 ×	5 ×
Lateral measuring range x,y		7200 x 6000 µm	3600 x 3000 µm
Lateral measuring range x • y		43.2 mm²	10.8 mm²
Extended lateral measuring range (stitching without data reduction)[1]	x,y	139.7 x 97.0 mm	69.9 x 48.5 mm
	x • y	13,553.5 mm²	3,388.4 mm²
Numerical aperture NA		0.075	0.13
Working distance		10.3 mm	9.3 mm
Computational critical angle[2]		4.3 °	7.5 °
Vertical measuring range	with motorized adjuster unit	9 mm	8 mm
	with fine adjuster	0.24 mm	0.24 mm
Measuring noises[3]	STR[4]	0.14 nm	0.14 nm
	ISO 25178-604	0.28 nm	0.28 nm
Vertical resolution[5]	STR	0.4 nm	0.4 nm
	ISO 25178-604	0.8 nm	0.8 nm
Sampling rate	2 MP camera	5 µm	2.5 µm
	5 MP camera	2.93 µm	1.46 µm
Computational lateral optical critical resolution[6]		5.04 µm	2.91 µm

Initiative Fair Data Sheet

Accuracy[1,2]		Standard	Uncertainty, standard deviation
Measurement uncertainty based on the example of step height measurement[2,3,4,5,6]	with objective lens 20x	Level = 75 µm	U = 0.200 µm, σ = 0.0400 µm
		Level = 10 µm	U = 0.035 µm, σ = 0.0050 µm
		Level = 1 µm	U = 0.010 µm, σ = 0.0010 µm
		Level = 20 nm	U = 0.005 µm, σ = 0.0002 µm

1. VIM 2012
2. with image capturing module 2448 x 2048 and fine adjuster
3. U as per ISO/IEC GUIDE 98-3:2008(E), GUM:1995, K=1.96
4. σ determined for 25 measurements
5. measured under the best possible conditions using PTB-certified standards. Results only valid for used standards.
6. Evaluation according to ISO 4287

10x	20x	50x	100x
10 ×	20 ×	50 ×	100 ×
1800 x 1500 µm	900 x 750 µm	360 x 300 µm	180 x 150 µm
2.7 mm²	0.675 mm²	0.108 mm²	0.027 mm²
34.9 x 24.3 mm	17.5 x 12.1 mm	7.0 x 4.9 mm	3.5 x 2.4 mm
847.1 mm²	211.8 mm²	33.9 mm²	8.5 mm²
0.3	0.4	0.55	0.7
7.4 mm	4.7 mm	3.4 mm	2 mm
17.5 °	23.6 °	33.4 °	44.4 °
7 mm	4.2 mm	3 mm	1.6 mm
0.24 mm	0.24 mm	0.24 mm	0.24 mm
0.08 nm	0.08 nm	0.08 nm	0.08 nm
0.16 nm	0.16 nm	0.16 nm	0.16 nm
0.2 nm	0.2 nm	0.2 nm	0.2 nm
0.43 nm	0.43 nm	0.43 nm	0.43 nm
1.25 µm	0.62 µm	0.25 µm	0.13 µm
0.73 µm	0.37 µm	0.15 µm	0.07 µm
1.26 µm	0.95 µm	0.69 µm	0.54 µm

1. Based on example of image capturing module 2 MP at full resolution
2. theoretical critical angles on reflective surfaces, on real surfaces can achieve larger critical angles due to diffuse reflections.
3. with fine adjuster
4. Individual measurement with 3 x 3 median filter
5. specified according to "Fair Data Sheet" (measuring noises * 2.83)
6. 620 nm light source, calculated according to the Rayleigh criterion


1600 S
10x / 0,3 /
WD=11

Confocal technology | MarSurf CM

One technology, **many advantages**

Optical 3D microscopy stands for maximum performance by combining a high measuring point density with measurements that are completed in seconds. The latest image sensors, high-performance optics, and precise path length measurement systems provide accurate results. In short, technology you can rely on.

Highest signal quality thanks to multi-pinhole technology

The high-performance confocal microscopes from the MarSurf product range record images extremely quickly thanks to the patented multi-pinhole technology developed by Mahr. It represents an even stochastic distribution, as adjacent measuring points are not measured immediately after one another. Confocal microscopes from Mahr also stand out for generating an extremely low amount of scattered light and strong signals, while providing a high light output. The microscopes can thus achieve height resolutions into the nanometer range.

2 nm
Vertical optical resolution

99 CCF MAX
Highest correlation to tactile measuring data

50,000 MTBF
LED light source

MPD technology

Artifact-free, fast, lowest noise level, no preferred direction

TrueDetection technology

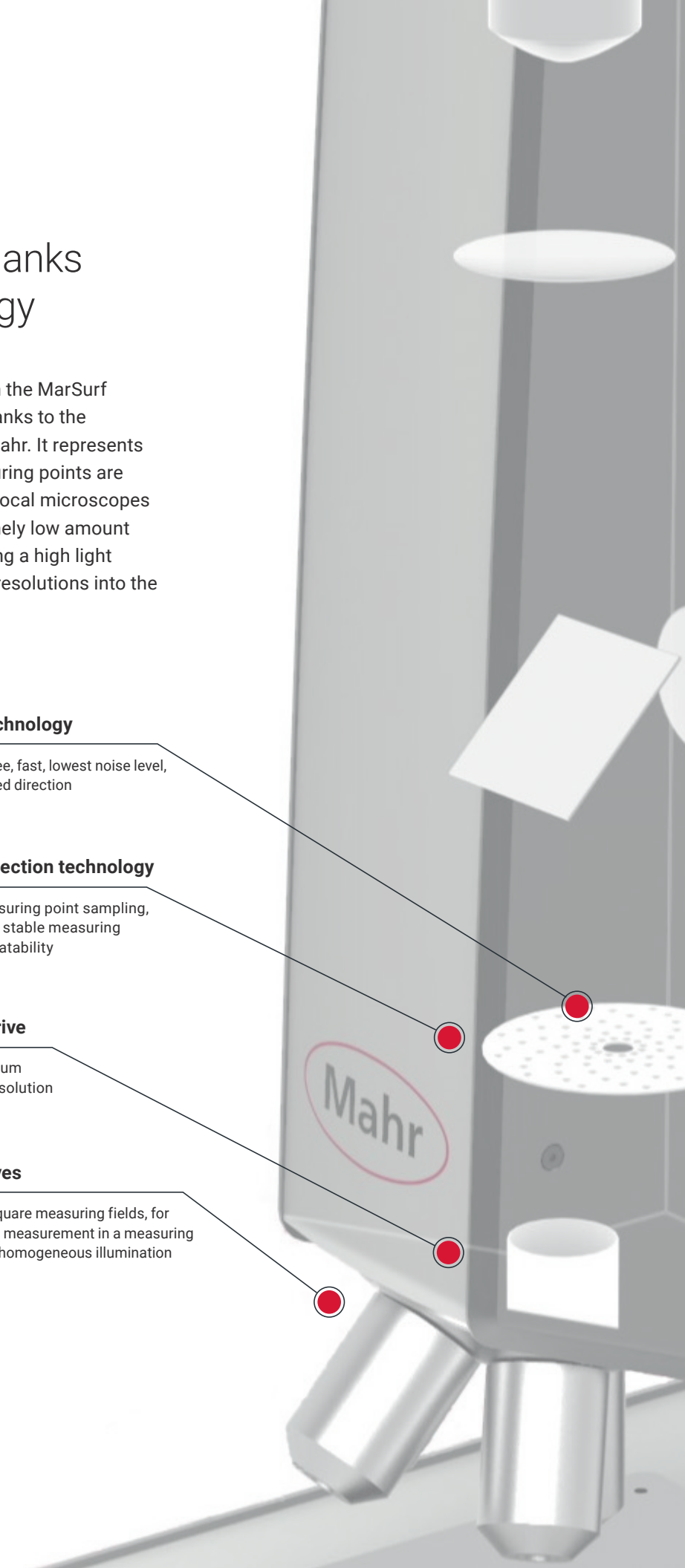
100x measuring point sampling, extremely stable measuring data/repeatability

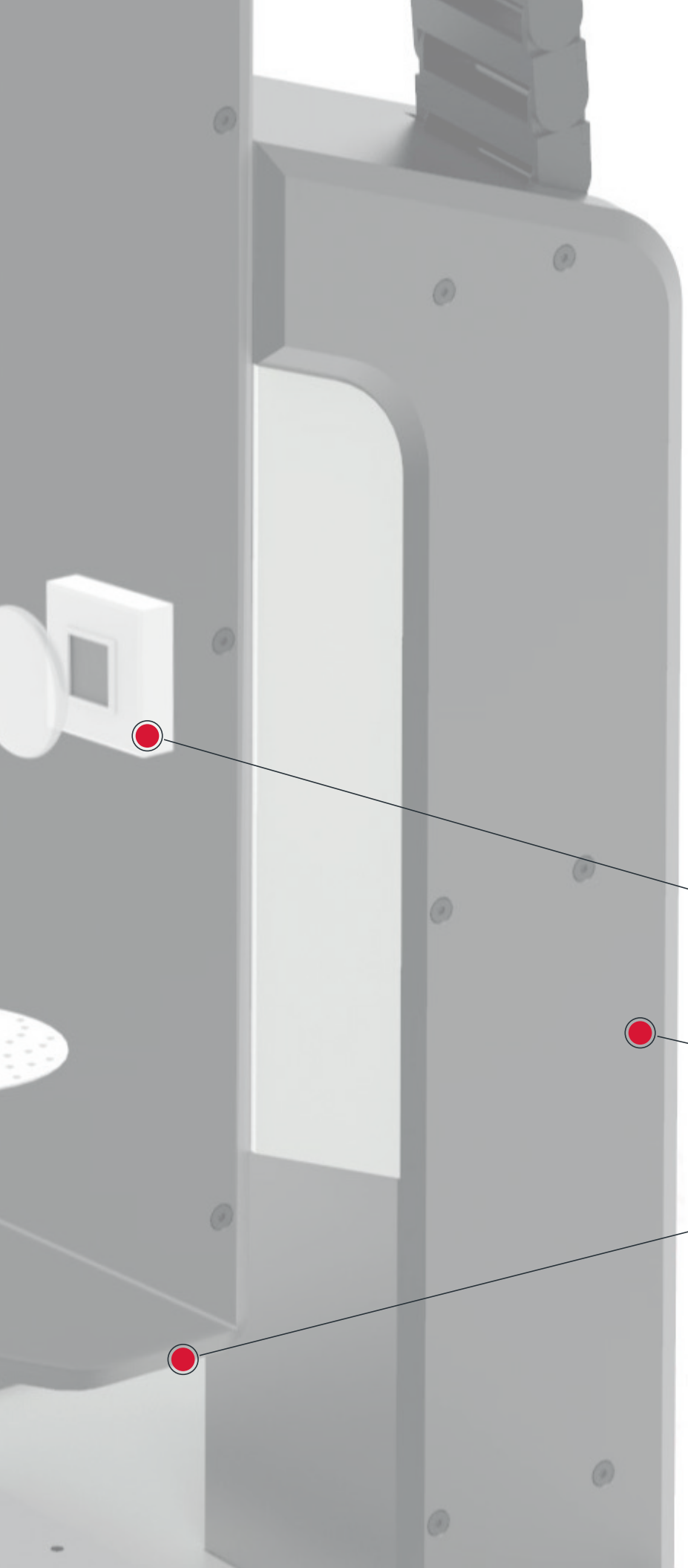
Piezo drive

for maximum vertical resolution

Objectives

Largest, square measuring fields, for roughness measurement in a measuring field/best homogeneous illumination





0.1 - 100%
Reflectivity of all the sample surfaces

126,000,000
Measuring points per second

5 sec
Typical measuring time for 3D roughness measurements

16-bit HDR camera

Optimum signal/noise ratio/ no increased amount of noise on small magnifications

Path length measuring system

Glass scales with path length measuring system in all axes

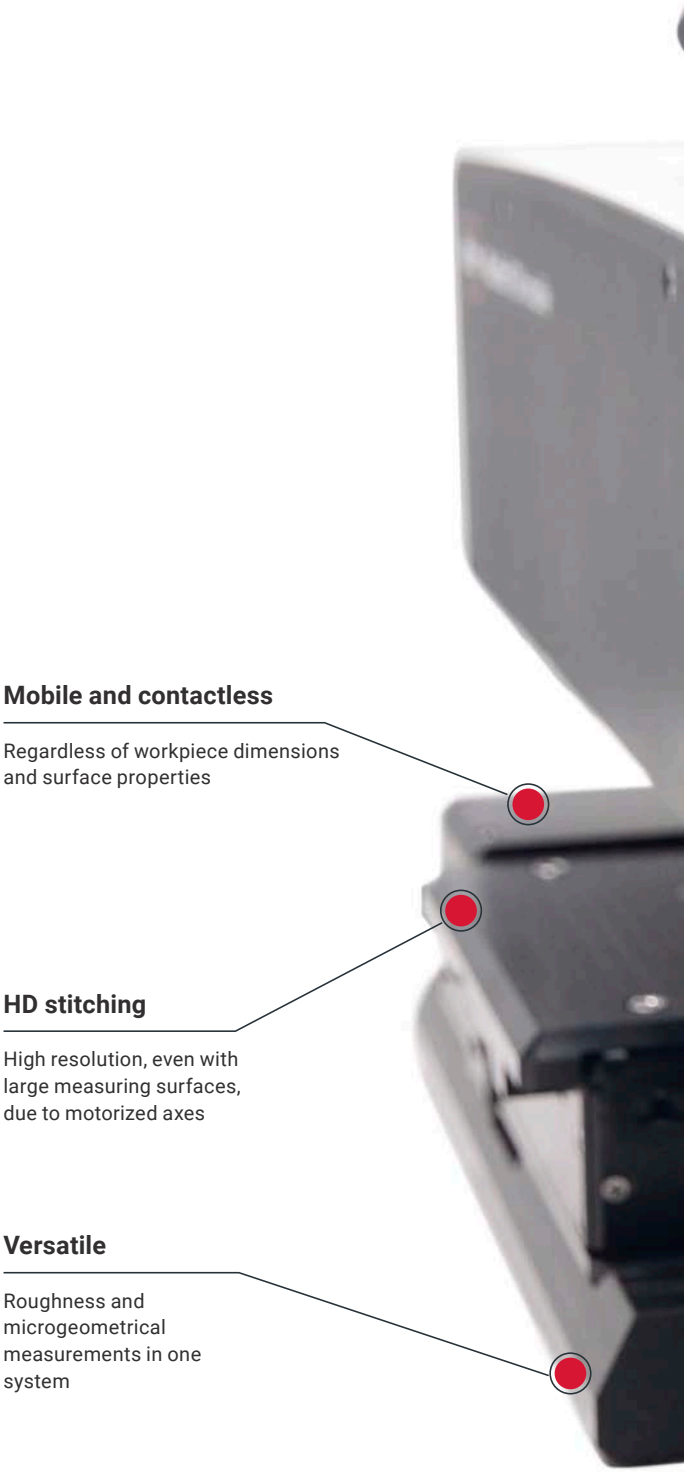
Collision detection

In all directions – safety for the sample and system

Mobile 3D surface measurement

Regardless of whether the surface is sensitive, very large, or even shiny: The MarSurf CM *mobile* combines the unique properties of a portable and robust measuring system for production with the established functionality of a stationary system. The MarSurf CM *mobile* provides reliable and accurate measurements. Thanks to confocal 3D metrology, your measurements are quick, contactless and material-independent.

In particular for measurements on large objects and specimens that are difficult to move, such as rollers and car bodies, the MarSurf CM *mobile* will impress you with its compact size, giving you the option to stitch larger measuring fields at a consistently high resolution thanks to the motorized axes. Featuring a lens revolver, the option of a color camera and application-specific software solutions, the measuring system fulfills the requirements of a wide range of measuring tasks and can be used wherever your work requires it.



Mobile and contactless

Regardless of workpiece dimensions and surface properties

HD stitching

High resolution, even with large measuring surfaces, due to motorized axes

Versatile

Roughness and microgeometrical measurements in one system

Get to know the entire MarSurf CM portfolio!

Do you require a stationary measuring station or want an automated solution? Visit our website!

Portable

Compact system for quick use

Robust

Reliable results, even in the production environment

1200 x 1200
Camera resolution

1.4 million
Measuring points per individual measurement

0.13 µm
Minimum measuring point level

100 fps
even at maximum resolution

16 Bit
High dynamic range camera

Unique specifications

Roughness measurements as per ISO 4287, ISO 21920, and ISO 25178

Quality manager
for all heights and depths

The high-performance MarSurf CM devices provide a reliable measurement on all surfaces, regardless of the surface quality, and a high level of flank acceptability and dynamics. The devices offer users an excellent resolution and the most robust design. In addition, the state-of-the-art tools provide ultrafast measurements with a large measuring point density, that provide high-quality and unfiltered raw data. The patented multi-pinhole disc ensures that the process emits a particularly low amount of scattered light.

MarSurf CM *explorer*

The flexible, versatilemeasuring solution

The MarSurf CM explorer is a compact and user-friendly complete package for the accurate measurement and analysis of surfaces. The measuring system is fully equipped with the HDR function, automatic objective lens recognition, and collision detection in all spatial directions. It stands out for its cost-effective use in laboratories, as well as assuring the quality in production settings.

- High measuring speed – even at full resolution
- User-friendly concept
- Safe thanks to collision detection
- HDR function 16 bit
- HD stitching – consistently high resolution, even on large measuring surfaces

MarSurf CM *expert*

The high-performance laboratory measuring system

The MarSurf CM *expert* offers user-independent and fully automatic measurements making it ideal for straightforward quality assurance applications. The measuring system provides a traverse path of 100 x 100 mm² and additional manual Z positioning for large sample volumes.

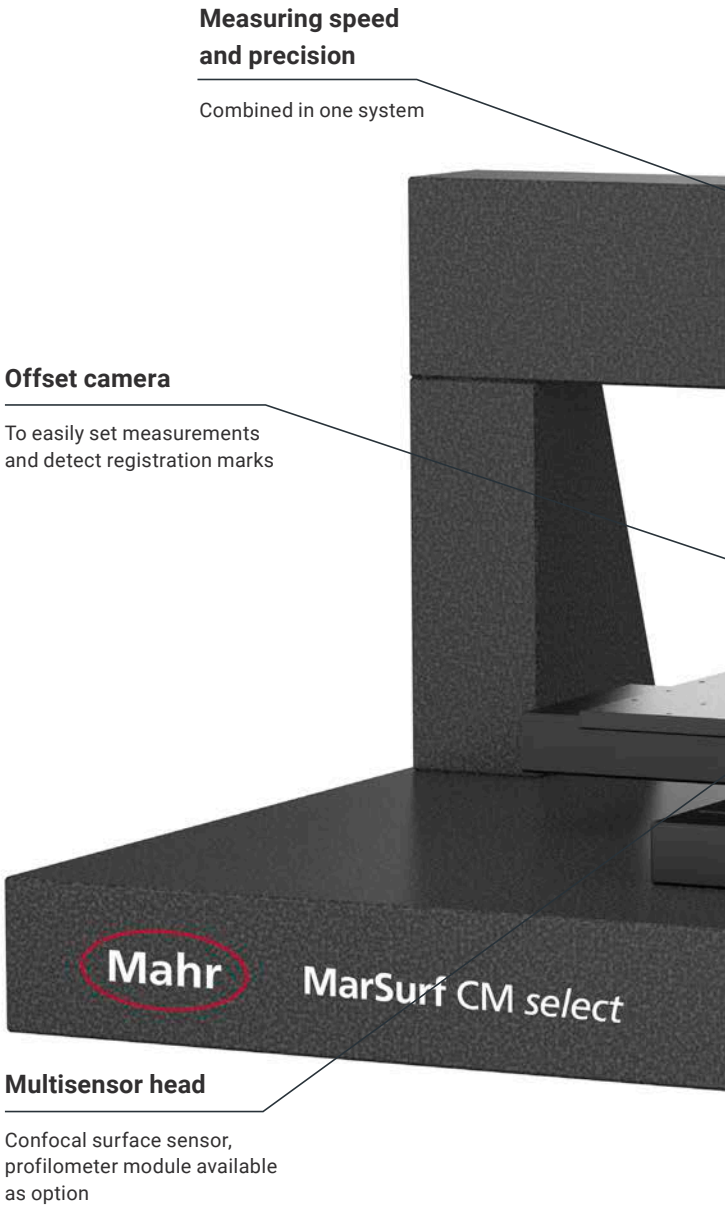
- Can be automated
- Max. sample volumes even of heavy components
- High measuring speed – even at full resolution
- Safe due to collision detection
- HDR function, 16 bit
- HD stitching – consistently high resolution, even on large measuring surfaces
- User-friendly concept

Modular
multisensor system

Thanks to its modular design, the MarSurf CM *select* can be assembled to meet your specific requirements and can be adjusted to your measuring tasks with regard to automation, measuring convenience, and accuracy requirements. A large selection of hardware and software components are available for individually tailored solutions.
The MarSurf CM *select* is thus the perfect solution for automated quality assurance processes and a variety of applications in research laboratories and production environments. As a multisensor system, the MarSurf CM *select* offers the possibility of combining different sensor technologies in one measuring device. Depending on the measuring task, users can flexibly select the optimal sensor. Practical and easy to use: The software controls all of the standard sensors.

MarSurf CM *select*

- Can be configured individually
- Fully automated
- Large traverse units
- Production-related interface
- Safe thanks to collision detection
- Designed for continuous operation



100%
Complete profilometer can be integrated as an option

2 nm
Vertical optical resolution

Bridge portals

Available in various sizes

X/Y-axes path length measuring system

Available in different sizes

Subframes

With active/passive vibration isolation for all ambient conditions

0,1 – 100

Reflectivity of all the sample surfaces

99 % CCF MAX

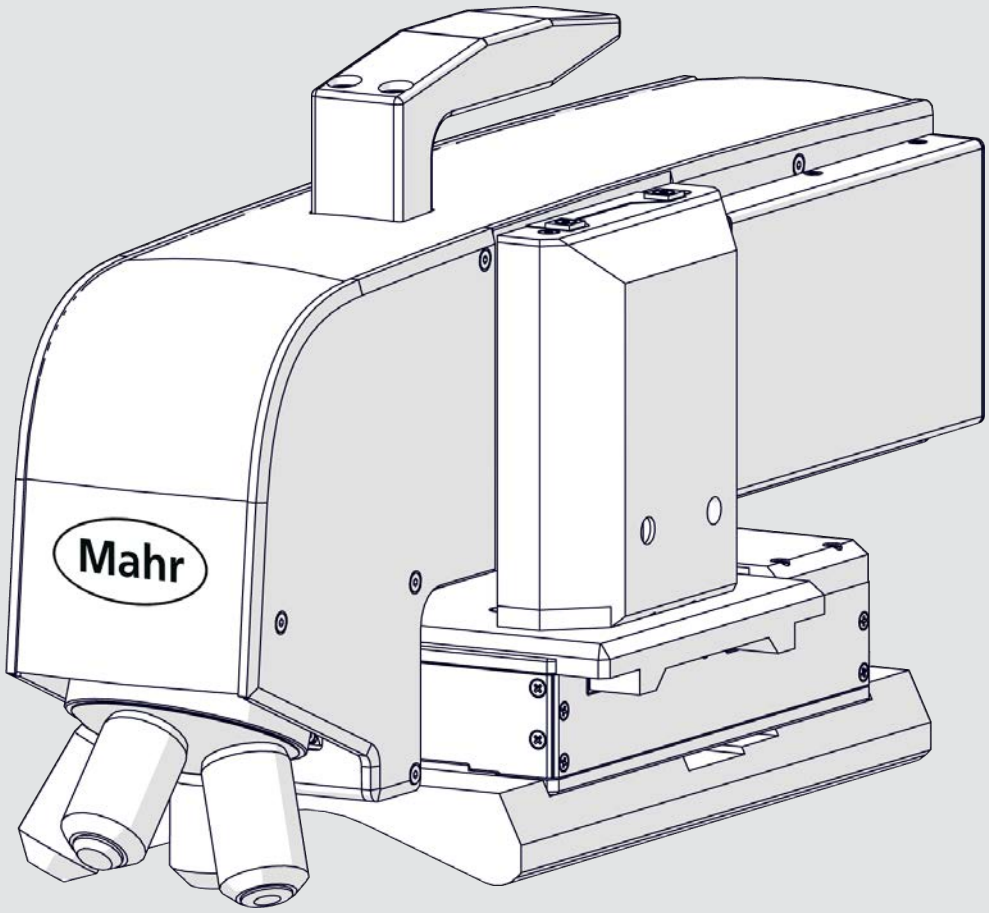
Highest correlation to tactile measuring data

4000 Hz

Maximum measuring frequency

MarSurf CM *mobile*

Dimensions in mm
417 × 136 × 234



Measuring head			
Image capturing module	max. number of measuring points in a single measurement x • y		1200 × 1200 = 1.44 million
	max. image data at full resolution[1]		25/(100) Hz
	HDR function (16 bit)		standard
	Color photo		optional
Maximum number of measuring points[2]			1213 million
Vertical measuring module	motorized adjuster unit	Path length measuring system	–
		vertical adjustment range	35 mm
	Fine adjuster (Piezoelectric module)	vertical adjustment range	350 µm
Collision detection x,y,z			–
Objective lens holder	4x revolver		standard
	motorized revolver		–
	without revolver		optional

1. On request
2. Maximum number of measuring points that can be recorded in a composite measurement.

Configuration	
Tripod form	mobile
Mass	8.3 kg
Positioning volume x • y • z	50 × 50 × 35 mm
Path length measuring system x,y	standard
System controller	integrated
Passive vibration dampening	optional
Active vibration dampening	optional

1. Can be expanded to 150 mm with integrated, manual Z-axis

Sample properties	
Sample height (mm)	flexible
Sample weight max. (kg)	flexible
Sample surface	Reflectivity: 0.1 – 100%, coated, uncoated, reflective to diffuse

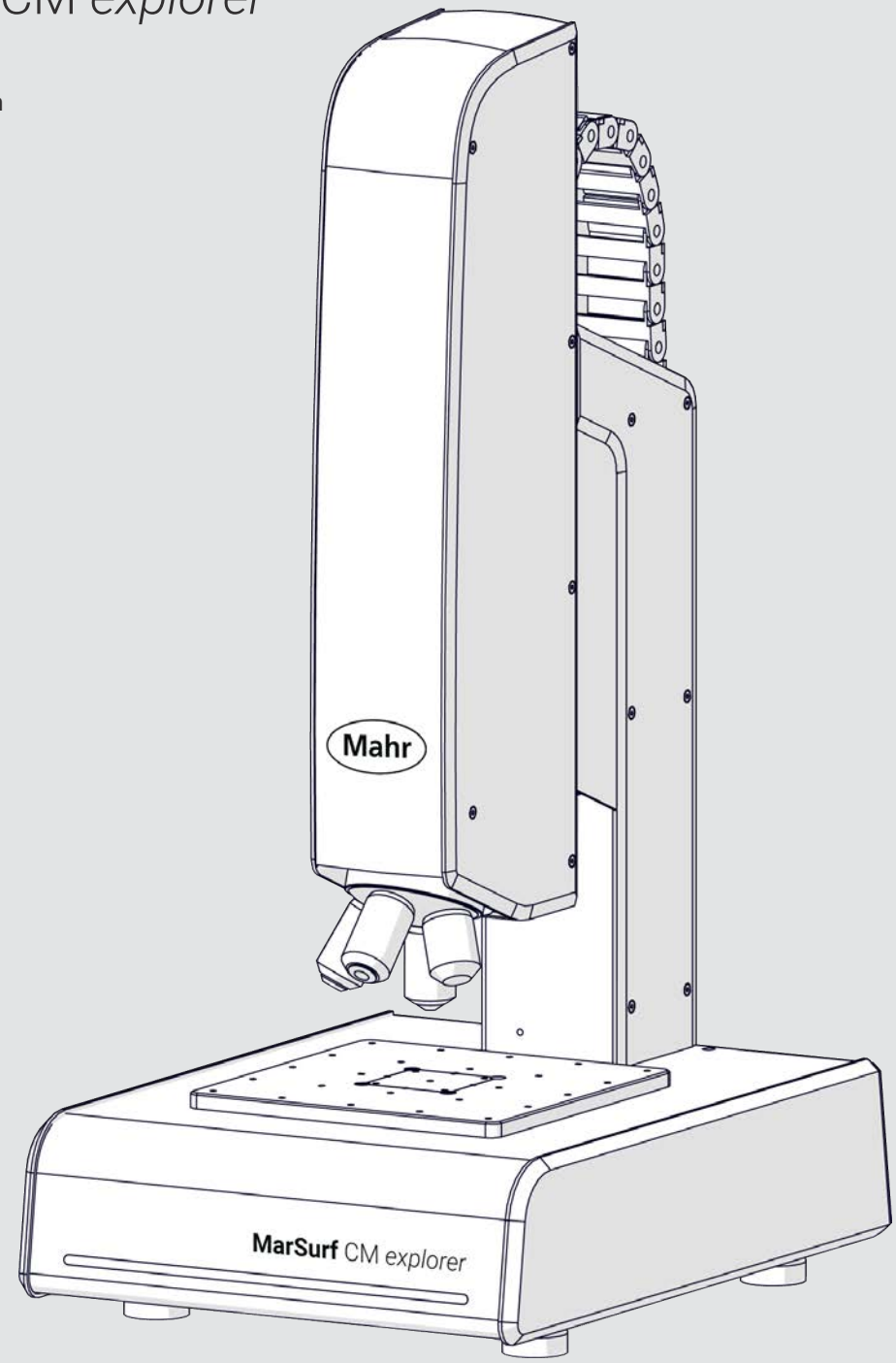
Software packages	
MarSurf MSW	standard
MarSurf ASW	–
MarSurf MfM	optional

Export formats
FITS, NMS, OMS, X3P, ASCII, SDF, SUR, TIF, BMP, STL

MarSurf MSW language packs
German, English, French, Italian, Spanish, Portuguese, Polish, Russian, Turkish, Japanese, Korean, Chinese

MarSurf CM *explorer*

Dimensions in mm
383 x 290 x 690



Measuring head			
Image capturing module	max. number of measuring points in a single measurement x • y		1200 × 1200 = 1.44 million
	max. image data at full resolution[1]		25/(100) Hz
	HDR function (16 bit)		standard
	Color photo		optional
Maximum number of measuring points[2]			1213 million
Vertical measuring module	motorized adjuster unit	Path length measuring system	standard
		vertical adjustment range	70 mm
	Fine adjuster (Piezoelectric module)	vertical adjustment range	350 µm
Collision detection x,y,z			standard
Objective lens holder	4x revolver		standard
	motorized revolver		optional
	without revolver		–

1. On request
2. Maximum number of measuring points that can be recorded in a composite measurement.

Configuration	
Tripod form	L
Mass	25 kg
Positioning volume x • y • z	50 × 50 × 70 mm
Path length measuring system x,y	standard
System controller	integrated
Passive vibration dampening	integrated
Active vibration dampening	optional

1. Can be expanded to 150 mm with integrated, manual Z-axis

Sample properties	
Sample height	70 / (optional 110) mm
Sample weight, max.	10 kg
Sample surface	Reflectivity: 0.1 – 100%, coated, uncoated, reflective to diffuse

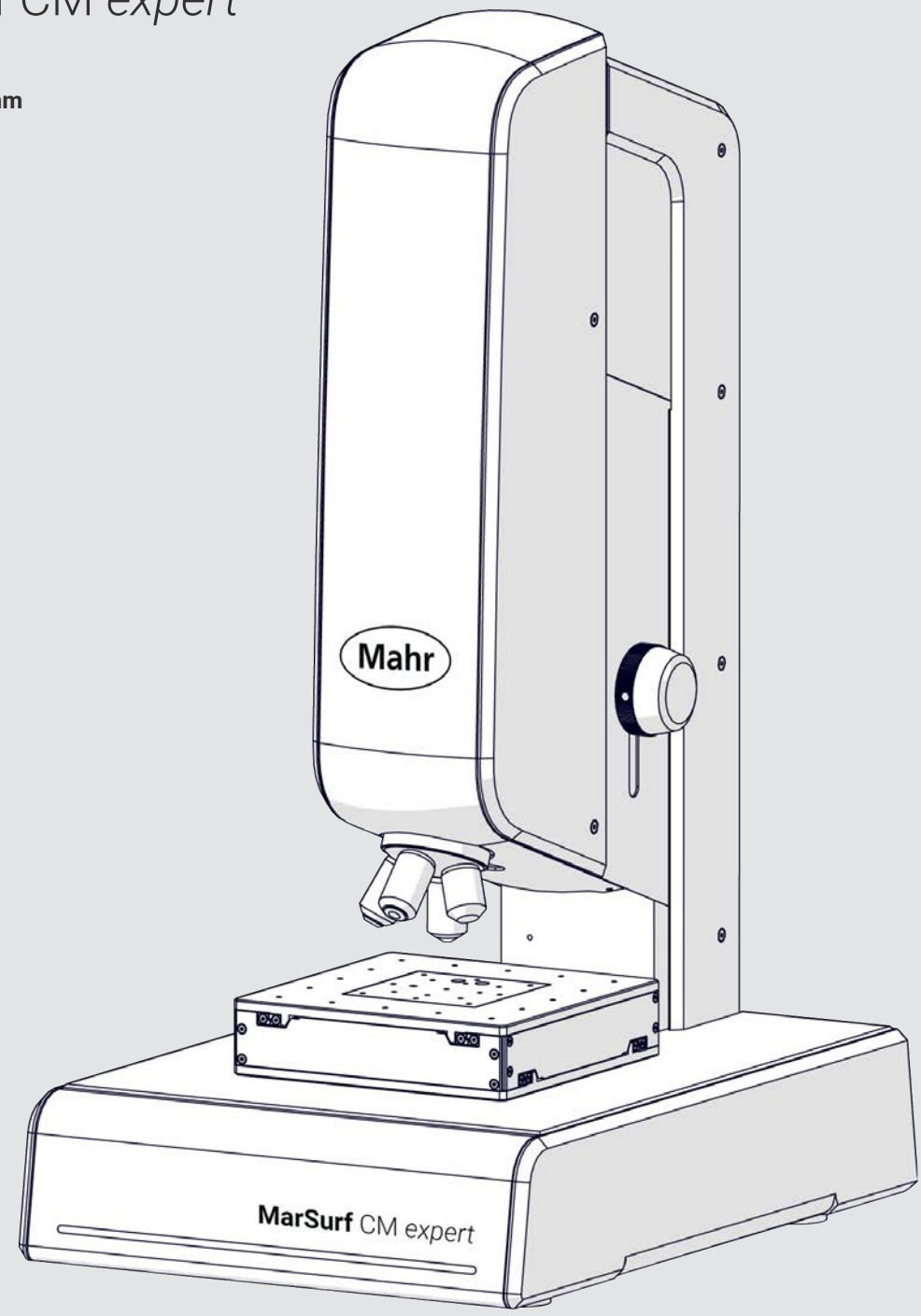
Software packages	
MarSurf MSW	standard
MarSurf ASW	–
MarSurf MfM	optional

Export formats
FITS, NMS, OMS, X3P, ASCII, SDF, SUR, TIF, BMP, STL

MarSurf MSW language packs
German, English, French, Italian, Spanish, Portuguese, Polish, Russian, Turkish, Japanese, Korean, Chinese

MarSurf CM *expert*

Dimensions in mm
526 x 378 x 799



Measuring head			
Image capturing module	max. number of measuring points in a single measurement x • y		1200 × 1200 = 1.44 million
	max. image data at full resolution[1]		25/(100) Hz
	HDR function (16 bit)		standard
	Color photo		optional
Maximum number of measuring points[2]			1213 million
Vertical measuring module	motorized adjuster unit	Path length measuring system	standard
		vertical adjustment range	70 mm
	Fine adjuster (Piezoelectric module)	vertical adjustment range	350 µm
Collision detection x,y,z			standard
Objective lens holder	4x revolver		standard
	motorized revolver		optional
	without revolver		optional

1. On request
2. Maximum number of measuring points that can be recorded in a composite measurement.

Configuration	
Tripod form	L
Mass	48 kg
Positioning volume x • y • z	100 × 100 × 70 mm
Path length measuring system x,y	standard
System controller	integrated
Passive vibration dampening	integrated
Active vibration dampening	optional

1. Can be expanded to 150 mm with integrated, manual Z-axis

Sample properties	
Sample height	160 / (optional 180) mm
Sample weight, max.	10 kg
Sample surface	Reflectivity: 0.1 – 100%, coated, uncoated, reflective to diffuse

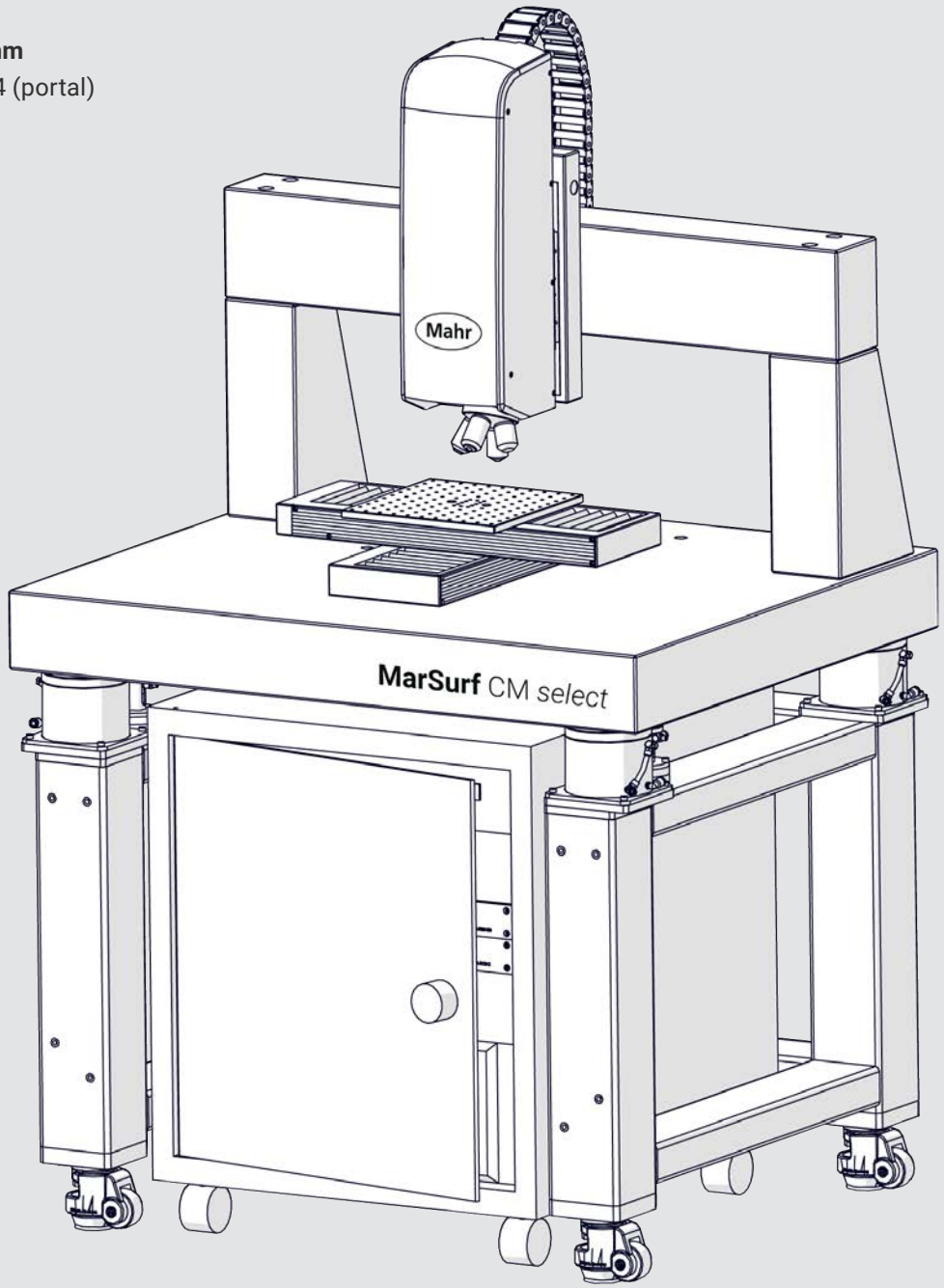
Software packages	
MarSurf MSW	standard
MarSurf ASW	optional
MarSurf MfM	optional

Export formats
FITS, NMS, OMS, X3P, ASCII, SDF, SUR, TIF, BMP, STL

MarSurf MSW language packs
German, English, French, Italian, Spanish, Portuguese, Polish, Russian, Turkish, Japanese, Korean, Chinese

MarSurf CM *select*

Dimensions in mm
900 x 750 x 1.614 (portal)



Measuring head			
Image capturing module	max. number of measuring points in a single measurement x • y		1200 x 1200 = 1.44 million
	max. image data at full resolution[1]		100/(25) Hz
	HDR function (16 bit)		standard
	Color photo		optional
Maximum number of measuring points[2]			1213 million
Vertical measuring module	motorized adjuster unit	Path length measuring system	optional
		vertical adjustment range	100 mm
	Fine adjuster (Piezoelectric module)	vertical adjustment range	350 µm
Collision detection x,y,z			optional
Objective lens holder	4x revolver		optional
	motorized revolver		optional
	without revolver		standard

1. On request
2. Maximum number of measuring points that can be recorded in a composite measurement.

Configuration	
Tripod form	Portal
Mass	~ 300 kg
Positioning volume x • y • z	200 x 200 × 100 mm
	300 × 300 × 100 mm
Path length measuring system x,y	optional
System controller	Roller container
Passive vibration dampening	standard
Active vibration dampening	optional

1. Can be expanded to 150 mm with integrated, manual Z-axis

Software packages	
MarSurf MSW	standard
MarSurf ASW	optional
MarSurf MfM	optional

Export formats
FITS, NMS, OMS, X3P, ASCII, SDF, SUR, TIF, BMP, STL

MarSurf MSW language packs
German, English, French, Italian, Spanish, Portuguese, Polish, Russian, Turkish, Japanese, Korean, Chinese

Sample properties	
Sample height (mm)	on request
Sample weight max. (kg)	15 / on request
Sample surface	Reflectivity: 0.1 – 100%, coated, uncoated, reflective to diffuse

Point sensors

Refer to specification page for MarSurf CP

Page 80/81

Technical data
General information

General information	
Measuring principle	Patented CMP technology (confocal multi-pinhole)
Light source	High-performance LED (505/475 nm), MTBF: 50,000 hours (color camera with high-performance white light LED)
Typical measuring time (s)	2-8
Dimensions	See technical drawings on the following pages

Objectives		3200S	1600S	800L
Objective lens magnification		5 ×	10 ×	20 ×
Lateral measuring range x,y		3200 µm	1600 µm	800 µm
Lateral measuring range x • y		10.24 mm²	2.56 mm²	0.64 mm²
Extended lateral measuring range (stitching without data reduction)²	x.y	92.8 mm	46.4 mm	23.2 mm
	x • y	8611 mm²	2152 mm²	538 mm²
Numerical aperture NA		0.15	0.3	0.4
Working distance		20 mm	11 mm	12 mm
Computational critical angle³		8.6 °	17.5 °	23.6 °
Vertical measuring range	with motorized adjuster unit	19.9 mm	10.9 mm	11.9 mm
	with fine adjuster	0.35 mm	0.35 mm	0.35 mm
Measuring noise	with motorized adjuster unit	354 nm	71 nm	25 nm
	with fine adjuster	–	14 nm	4 nm
Vertical resolution	with motorized adjuster unit	1000 nm	200 nm	70 nm
	with fine adjuster	–	40 nm	12 nm
Sampling rate	1200 x 1200 pixels	2.67 µm	1.33 µm	0.67 µm
Computational lateral optical critical resolution⁴		1.93 µm	0.96 µm	0.72 µm

Accuracy[1,2]		Standard	Uncertainty, standard deviation
Measurement uncertainty based on the example of step height measurement[2,3,4,5,6]	with objective lens 800XS	Level = 75 µm	U = 0.320 µm, σ = 0.050 µm
		Level = 10 µm	U = 0.060 µm, σ = 0.020 µm
		Level = 1 µm	U = 0.030 µm, σ = 0.004 µm
Measurement uncertainty based on the example of roughness measurement[2,3,4,5]	with objective lens 800XS	Ra = 1.63 µm	U = 0.040 µm, σ = 0.004 µm
		Ra = 0.58 µm	U = 0.024 µm, σ = 0.0066 µm
		Ra = 0.23 µm	U = 0.010 µm, σ = 0.0050 µm
	with objective lens 320S	Ra = 0.079 µm	U = 0.010 µm, σ = 0.0022 µm
	with objective lens 160XS	Ra = 0.079 µm	U = 0.003 µm, σ = 0.0004 µm

L: long working distance
S: standard working distance
XS: short working distance

1. VIM 2012
2. with image capturing module 1200x1200 and fine adjuster
3. U as per ISO/IEC GUIDE 98-3:2008(E), GUM:1995, K=1.96
4. σ determined for 25 measurements
5. measured under the best possible conditions using PTB-certified standards. Results only valid for used standards.
6. Evaluation according to ISO 4287

800S	800XS	320L	320S	320XS[1]	160L	160S	160XS[1]
20 ×	20 ×	50 ×	50 ×	50 ×	100 ×	100 ×	100 ×
800 µm	800 µm	320 µm	320 µm	320 µm	160 µm	160 µm	160 µm
0.64 mm²	0.64 mm²	0.1024 mm²	0.1024 mm²	0.1024 mm²	0.0256 mm²	0.0256 mm²	0.0256 mm²
23.2 mm	23.2 mm	9.2 mm	9.2 mm	9.2 mm	4.6 mm	4.6 mm	4.6 mm
538 mm²	538 mm²	84.6 mm²	84.6 mm²	84.6 mm²	21.1 mm²	21.1 mm²	21.1 mm²
0.45	0.6	0.5	0.8	0.95	0.8	0.9	0.95
3.1 mm	1 mm	10.6 mm	1 mm	0.35 mm	3.4 mm	1 mm	0.35 mm
26.7 °	36.9 °	30.0 °	53.1 °	71.8 °	53.1 °	64.2 °	71.8 °
3 mm	0.9 mm	10.5 mm	0.9 mm	0.25 mm	3.3 mm	0.9 mm	0.25 mm
0.35 mm	0.35 mm	0.35 mm	0.35 mm	0.34 mm	0.35 mm	0.35 mm	0.34 mm
25 nm	14 nm	14 nm	14 nm	14 nm	14 nm	14 nm	14 nm
4 nm	3 nm	3 nm	1 nm	1 nm	1 nm	1 nm	1 nm
70 nm	40 nm	40 nm	40 nm	40 nm	40 nm	40 nm	40 nm
10 nm	8 nm	8 nm	4 nm	4 nm	4 nm	2 nm	2 nm
0.67 µm	0.67 µm	0.27 µm	0.27 µm	0.27 µm	0.13 µm	0.13 µm	0.13 µm
0.64 µm	0.48 µm	0.58 µm	0.36 µm	0.30 µm	0.36 µm	0.32 µm	0.30 µm

1. not with MarSurf CM mobile
2. Based on example of image capturing module 1200 x 1200 at full resolution
3. theoretical critical angles on reflective surfaces, on real surfaces can achieve larger critical angles due to diffuse reflections.
4. Example of a 475 nm light source, calculated according to the Rayleigh criterion

High flexibility and **individual configuration**

The high-performance profilometer platform from Mahr, the MarSurf CP *select* and MarSurf CL select supplies users with accurate information about surface structures and production processes. Measuring processes and data analyses are fully automated and completed without intermediate steps, that take up a lot of time, thus guaranteeing maximum reproducibility. Their stable, mechanical design ensures that the tools minimize all environmental influences.

Flexible 3D profilometer
for quality control

The MarSurf CP *select* 3D profilometer has proven itself many times over when measuring topography, line roughness, height profiles, or layer thickness during the production process. Its modular design and ability to combine with different sensors mean that it can adapt to many different measuring tasks. The manual Z-adjuster with fine adjustment guarantees extreme ease of use. Alternatively, there is also a motorized Z-axis. The setup on granite and the use of top-quality components guarantee high repeatability of measurements. In addition, it is also possible to measure large and heavy samples effortlessly.

Point sensors

Sensors with vertical measuring ranges from 0.1 to 10 mm depending on the application as well as high vertical

X-Y axes

available in different sizes

Solid construction

for optimal measuring results / stability

40 mm/s
Maximum measuring speed

20 nm
Vertical optical resolution

Multi-sensor setup

e.g. for measuring roughness and contours in the millimeter range

Measuring range expansion

of large areas and structure heights in the millimeter range. Typical measuring tasks include flatness, probe bend, line roughness, contour, and height profile.

Bridge portals

can be individually configured in all sizes

Overview camera

for flexibly teaching measurements

2D and 3D

Measuring 2D and 3D parameters and structures

5 Sec
Typical measuring time for 2D roughness measurements

70 mm WD
Maximum working distance to the probe

up **1200** mm
Flexible axis lengths

Ultrafast linear sensor for large scale 3D measurement

The MarSurf CL select stands out for extremely fast, three dimensional recording of large measuring surfaces while also ensuring high measuring precision. The system does not just record one profile, but 192 profile lines in parallel. Topographies can thus be recorded in just a few seconds from the µm to the cm range. High measuring speed ensures that high throughput rates are achieved. This will save you a significant amount of time compared to classic profilometers.

Profile data on practically all surfaces with a variety of reflective properties and inclinations are recorded extremely accurately thanks to the high level of dynamics. The setup on granite and the use of top-quality components guarantee high repeatability of measurements. It is also possible to measure large and heavy samples effortlessly.

MarSurf CL *select*

- Large scale 3D measurements
- Very high measuring speed
- Excellent dynamics and precision
- Layer thickness measurement and measurement of transparent materials
- Can be automated

Non-contact and non-destructive measurement

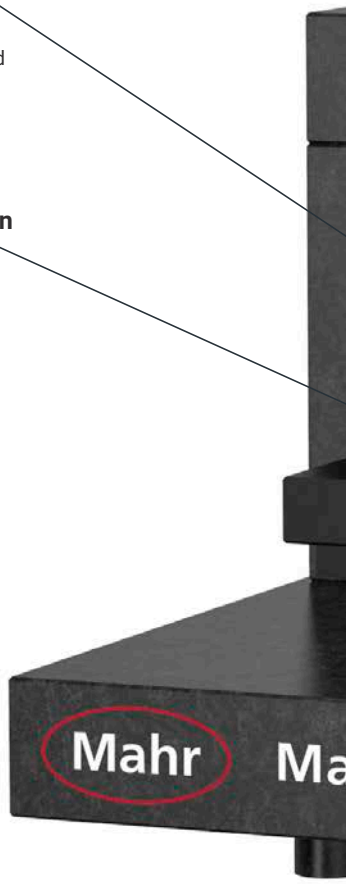
Profile data on practically all surfaces are recorded extremely accurately due to the high level of dynamics.

Adaptation to different measuring tasks

Thanks to modular design and Different sensors can be combined

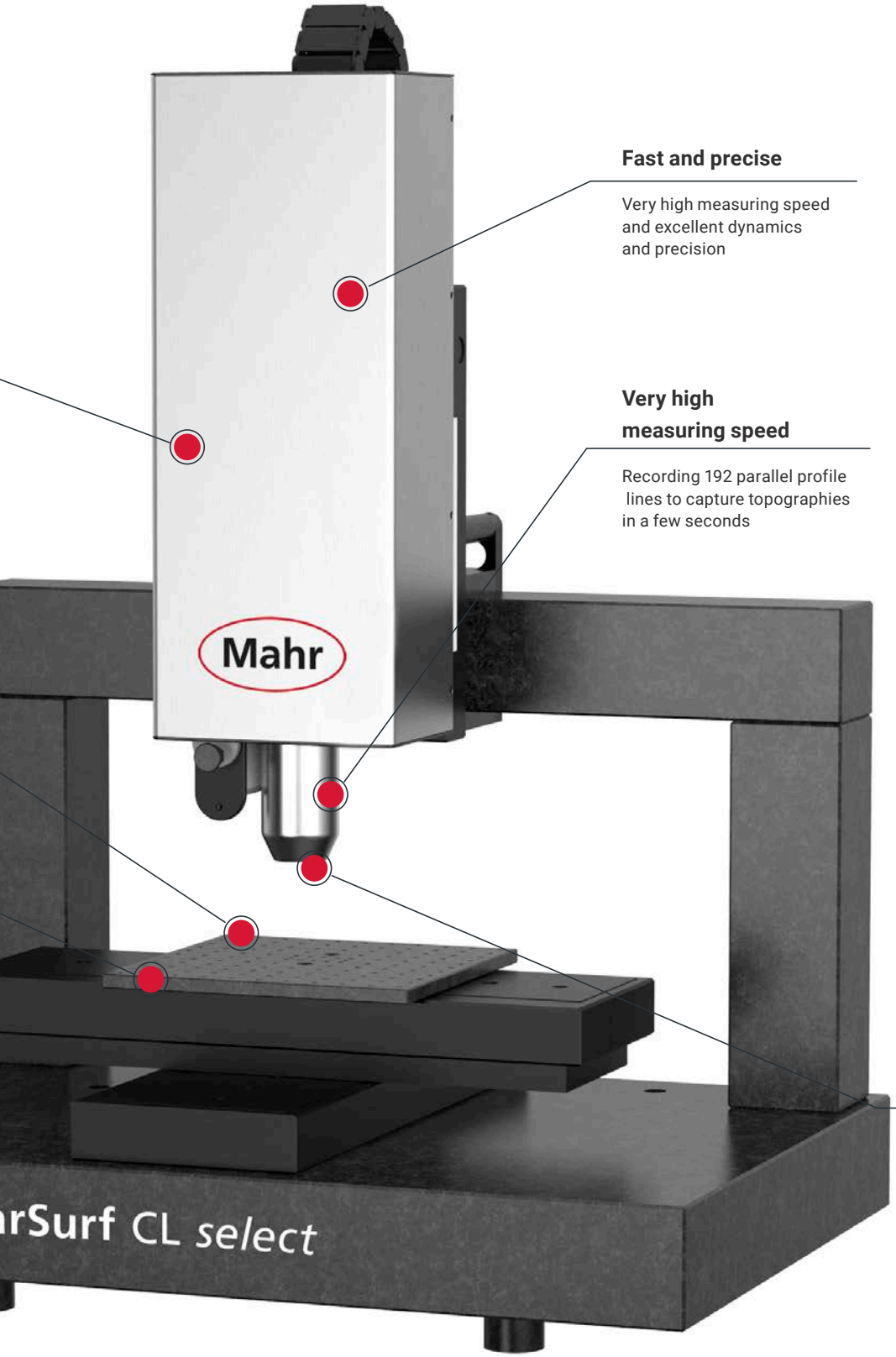
Measuring range expansion

Large scale 3D measurements



100 mm/s
Maximum measuring speed

20 nm
Maximum measuring speed



Fast and precise

Very high measuring speed and excellent dynamics and precision

Very high measuring speed

Recording 192 parallel profile lines to capture topographies in a few seconds

Complex surfaces

Non-contact and non-destructive layer thickness measurement and measurement of transparent materials

Available soon

1200
Profiles

11.9
Max. line width

Max. data rate
9,000,000
Measuring points/ second

192 Profiles
Parallel profile lines with linear sensor

4.8 mm
Maximum line width

384,000 Measuring points/ second
Max. data rate

MarSurf optical 3D profilometry

Sensors						
	Type	Name	Measuring range	Working distance	Measuring spot diameter	Lateral resolution
Point sensors	Chromatic sensors CP[3,4]	CP 0.6	0.6 mm	6.5 mm	4 µm	2 µm
		CP 1	1 mm	19.1 mm	3.5 µm	1.8 µm
		CP 3	3 mm	22.5 mm	12 µm	6 µm
		CP 6	6 mm	35 mm	16 µm	8 µm
		CP 10	10 mm	70 mm	24 µm	12 µm
	Chromatic sensors CPC	CPC 0.6	0.6 mm	6.5 mm	6 µm	3 µm
		CPC 4	4 mm	37.5 mm	16 µm	8 µm
		CPC 10	1 mm	69 mm	32 µm	16 µm

1. Larger probe arm angles possible for dispersed surfaces
2. Refractive index = 1.5
3. Other sensors available on request
4. Two sensors can be integrated in one holder

Sensors						
	Type	Name	Measuring range	Line length	Working distance	Measuring spot diameter
Line sensors	Chromatic sensors CL[3]	CL 0.2	0.2 mm	0.96 ± 0.01 mm	5.3 ± 0.2 mm	2 µm
		CL 1	0.95 mm	1.91 ± 0.01 mm	18.5 ± 0.2 mm	4 µm
		CL 4	3.9 mm	4.78 ± 0.02 mm	41 ± 0.2 mm	10 µm

1. Larger probe arm angles possible for dispersed surfaces
2. Refractive index = 1.5
3. Other sensors available on request

Camera		
Overview camera	Color off axis-camera	
	Monitoring area	up to 10 x 10 mm
	External bright field/dark field illumination[1]	optional

1. Only for MarSurf CL *select*

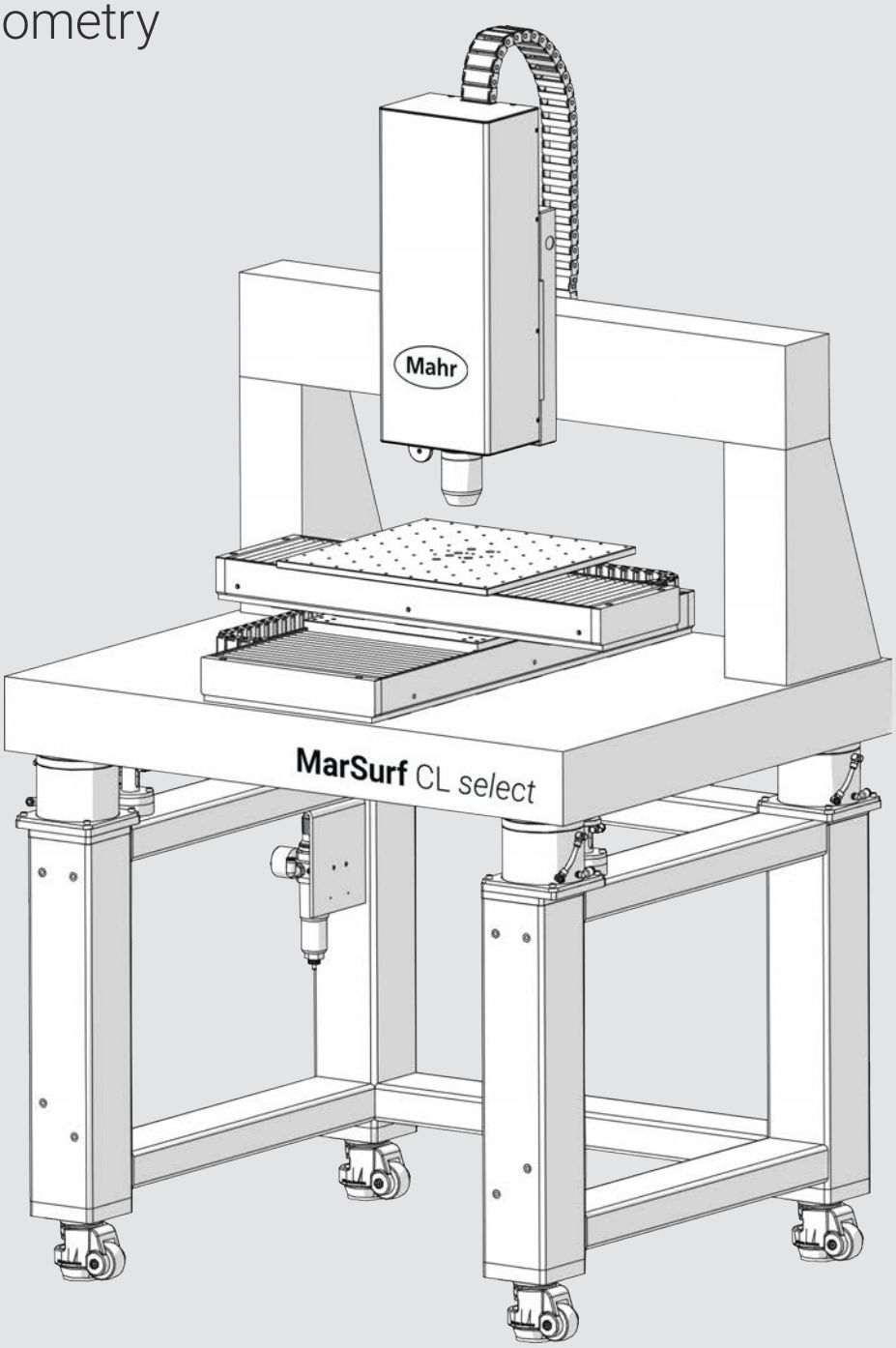
Vertical adjustment			
Adjusting unit z	Manual[1]	Displacement path	150 mm
		Fine adjustment	optional
	Motorized	Displacement path	100 mm
		Resolution z	0.1 µm

1. Only for MarSurf CP *select*

Vertical resolution	Linearity	Probe arm angle[1]	Thickness measuring range[2] up to	Max. measuring rate	Light source
3 nm	0.198 µm	90 ± 30 °	0.9 mm	4 kHz	LED
4 nm	0.33 µm	90 ± 45 °	1.5 mm		
8 nm	0.99 µm	90 ± 30 °	4.5 mm		
14 nm	2 µm	90 ± 25 °	9 mm		
22 nm	3.3 µm	90 ± 20 °	15 mm		
25 nm	0.22 µm	90 ± 30 °	0.9 mm	2 (4) kHz	
18 nm	1.4 µm	90 ± 20 °	6 mm		
400 nm	4 µm	90 ± 14 °	15 mm		

Lateral resolution	Vertical resolution	Probe arm angle[1]	Thickness measuring range[2] up to	Measuring rate	Light source
1 µm	0.020 µm	90 ± 44 °	0.28 mm	2 kHz	LED
2 µm	0.080 µm	90 ± 33 °	1.35 mm		
5 µm	0.320 µm	90 ± 20 °	5.5 mm		

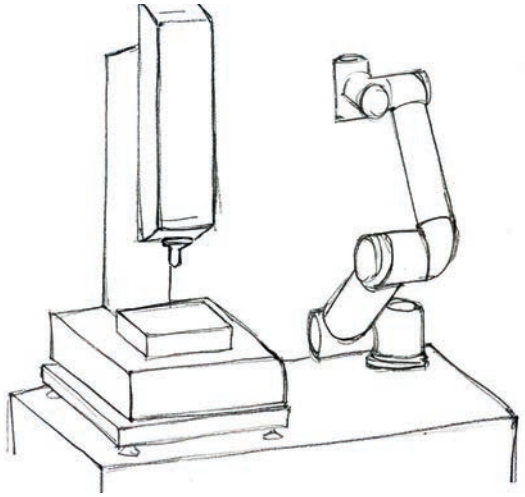
MarSurf optical 3D profilometry



Scan module						
Portal		S	M	L	XL	XXL+
Axis system x/y	Measuring range	100 x 150 mm	200 x 200 mm	200 x 300 mm	200 x 300 mm	300 x 300 mm
	Resolution x/y	0.5 µm	0.5 µm	0.5 µm	0.5 µm	0.05 µm
System controller	Standing container	standard	standard	standard	–	–
	Roller container	optional	optional	optional	standard	standard
Subframe with passive/ active vibration damping		–	–	–	standard / optional	standard / optional
MarSurf CP	Portal weight	100 kg	130 kg	150 kg	250 kg	350 kg
	max. sample height	125 mm	125 mm	125 mm	125 mm	125 mm
	max. transit width in X-direction	360 mm	500 mm	500 mm	720 mm	710 mm
	max. sample weight	10 kg	10 kg	10 kg	10 kg	50 kg
MarSurf CL	max. sample height	95 mm	95 mm	95 mm	95 mm	95 mm
	max. transit width in X-direction	360 mm	500 mm	500 mm	720 mm	710 mm
	max. sample weight	10 kg	10 kg	10 kg	10 kg	50 kg

General information	
Power supply	Voltage: 100-240 V; frequency: 50-60 Hz, power consumption: approx. 550 W
Type of computer	Industrial PC

Software packages	
MarSurf MSW	including
MarSurf ASW	optional
MarSurf MfM	optional
Export formats	FITS, X3P, NMS, OMS, ASCII, SDF, TIF, BMP, SUR



Mahr
Mahr
MarSurf CM expert

Mahr | Engineered Solutions

Beyond the standard – **your tailor-made measuring station**

Measuring solutions that are as individual as your measuring task. With Engineered Solutions, Mahr provides you with solutions that are perfectly tailored to your workpieces. Guaranteed to be tailored to your requirements for the handling, reliability, and speed of your production environment.

MarSurf | Optical solutions

From the special solution **to the tried and tested all-rounder**

What challenge are you facing? There are many reasons why an individual measuring solution may be required. There is generally a problem that cannot be solved or is very labor-intensive to solve with the usual standard measuring machines. Complex measuring tasks therefore strive for maximum efficiency. In addition, measuring results on site or the desire for maximum ease of use sometimes require solutions that have only been individually designed with these requirements in mind. With Engineered Solutions, Mahr consolidates its extensive product expertise to design tailor-made measuring

Typical customer demands we receive

- Measurement directly in production
- Measurements that are easy for on-site personnel to carry out
- Measuring results within a few seconds
- Reliable completion of complex and demanding measuring tasks
- Simplification of measuring tasks that occur on a daily basis
- 100% inline control – solutions for integration in the production line
- Measuring results that can be documented and traced

Dimensional metrology

Surface and contour measurement

Automation

Accessories

Sensor head to meet requirement

Depending on which technology you use to measure your workpieces, white light interferometers and confocal microscopes can be integrated in this case.

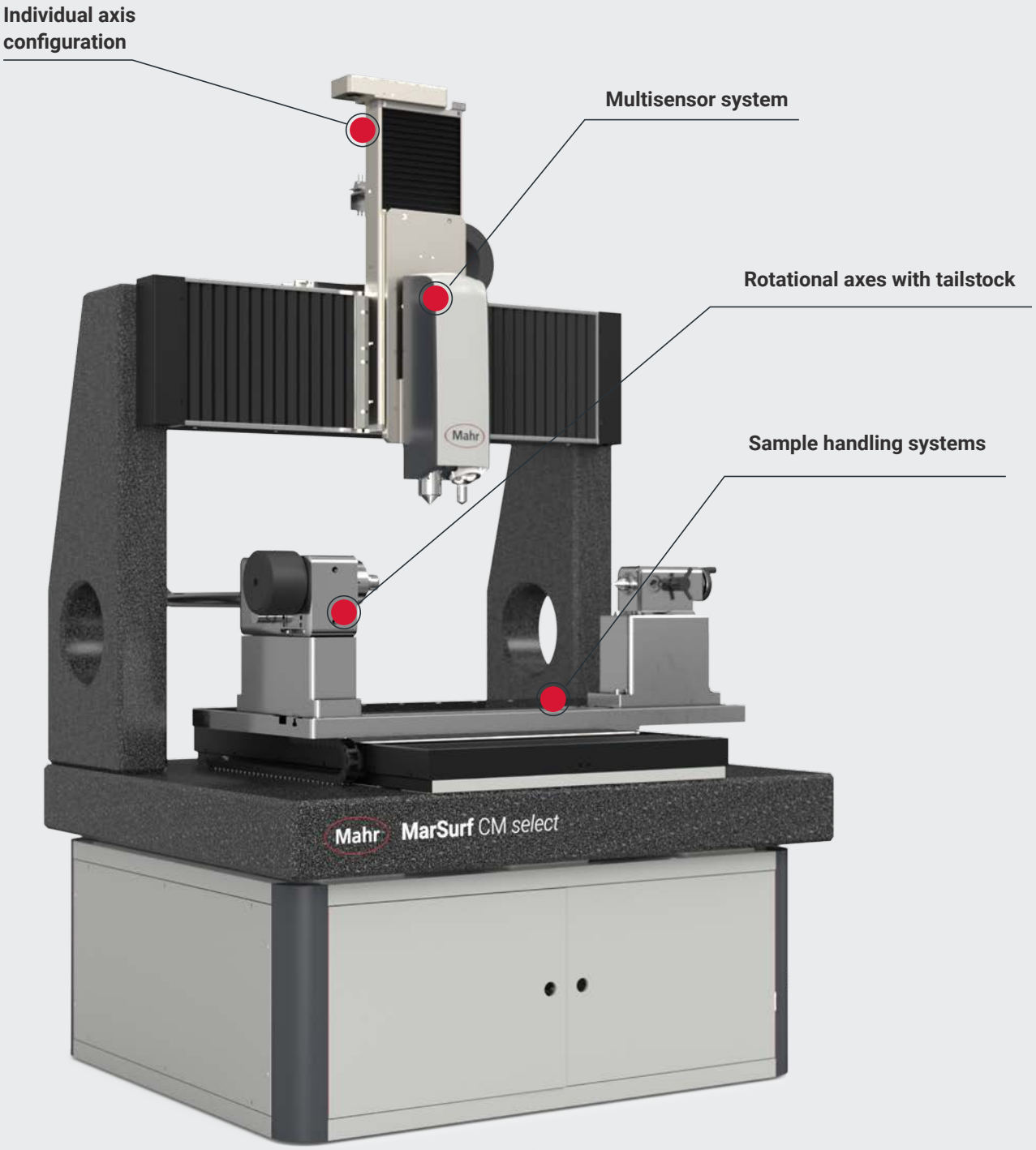
Flexible turning/swivel unit

Can be combined with a jaw chuck or individual clamps.

Compact design

You benefit from only requiring minimal space despite integrated special solutions and a personalized assembly.

One of our special solutions is now very well established: the Mahr five-axis system with integrated turning/swivel unit. It can be used to complete measurements on components with complex geometries, such as medical implants or extruded components.


Individual axis configuration
Multisensor system
Rotational axes with tailstock
Sample handling systems
Mahr
Mahr MarSurf CM select

Solutions can be so different

Do you have particularly large or particularly heavy workpieces, such as crankshaft housings? No worries! Then we will simply adjust the axis systems of your measuring instrument to your requirements. You will thus be able to quickly and easily complete your measuring tasks.

We create customer-specific sample holders and recording systems, or provide you with integration interfaces. We will also find the perfect automation solution tailored to your process. Talk to us!

Multisensor system

- Point/linear sensor
- 3D sensors
- Vision

Pick-place solutions

- Robot connection
- Palette solution

As a renowned manufacturer of metrology, we offer ideal conditions for joint individual projects with our customers. Indeed, when developing our customized solutions, we draw on a broad portfolio of proven sensor technology and tested technologies.
Your needs are our focus – without limitation.

Mahr worldwide – Our sites

With 20 Mahr locations in America, Asia and Europe and an additional 39 dealerships around the world, we have created a broad network to ensure an international presence on five continents: from South Africa, Brazil, Egypt, Argentina and Vietnam to Greece, Russia, the UK, and Australia.

>40	5	>60	39
Mahr sites around the world	Continents	Countries	Dealerships

Mahr product range Surface metrology

Handheld metrology
Calipers, micrometers, and dial indicators – analog or digital including integrated wireless transmission

Length metrology
Electric measuring probe, pneumatic length measuring systems right through to gages, as well as display and evaluation devices

Height measuring instruments
From manual to motorized: Height measuring instruments as well as scribing instruments for simple or complex 2D measurements

Optical metrology/ microscopes
From observation to measuring microscopes, profilometers and confocal microscopes through to white light interferometry

Contour metrology

Portfolio of tactile handheld metrology through to optical 3D measuring systems to measure the tightest tolerances

Form and position metrology

Various systems for testing form and position tolerances – manual or fully automated upon request

Dimensional metrology

From tactile and optical shaft measuring machines through to multisensor complete systems for rotationally symmetrical workpieces

Roughness metrology

The entire range regardless of whether mobile or stationary, optical or tactile, manual or automated

Metrology
to measure us by

For more than 160 years the name "Mahr" has stood for highly accurate measuring and sophisticated technology. The objective has always been to make measuring tasks as easy as possible for users. Using the highest quality devices and systems. Providing reliable and informative measuring results for the research and industry sectors. Our intelligent functions are implemented across all systems so that users can get running quickly and intuitively.

Due to its many years of expertise, Mahr is actively involved in all standardization bodies and is thus helping to further develop international metrology. This is just one of the reasons why we can guarantee that all of our systems and components are the most up-to-date. Measure us. We measure ourselves based on your requirements.

Traceability of results and auditability

- Acceptance of all measuring systems in accordance with international guidelines and certified standards

Standard-compliant

- Actively involved in international bodies to standardize optical measuring tasks
- Further development of our devices based on current standards
- Highest standard conformity of our measuring results

Environmental awareness

- Environmentally-friendly materials as well as auxiliary and operating materials
- Energy-optimized measuring instruments
- Corporate environment management

Qualified customer service team

- Comprehensive range of services with short and reliable reaction times tailored to the specific requirements of your application area.
- Continuous and regular maintenance of your measuring systems by our qualified service staff ensuring the highest level of precision and durability of your measuring system.
- Various service packages to ensure continuous, smooth operation

Mahr Inc.
1139 Eddy Street
Providence, RI 02905
United States

1 401-784-3100
1 800-343-2050
info@mahr.com
www.mahr.com

A-1062 0323