

Compact  
3D optical  
sensors  
for in-line  
applications



**SENSOFAR**<sup>®</sup>  
METROLOGY



3D optical sensor



3D high speed sensor

# In-line metrology solutions

Sensofar's in-line metrology sensor systems represent the culmination of more than 14 years of experience in the development of surface metrology systems.

They have been designed right from the outset to be integrated into the harshest manufacturing environments. Compact, lightweight, and with flexible mounting options, the S mart and S onix sensors put high-performance surface metrology right where you need it – in the application.

## Applications

- | Additive manufacturing
- | Aerospace
- | Automotive
- | Consumer electronics
- | Laser marking
- | LCD
- | Microelectronics
- | Micromanufacturing
- | Paper
- | Semiconductors
- | Tooling

# Robust, rugged and reliable

Production environments are not always the most friendly – varying conditions, vibrations, aggressive materials, etc., all make measurement tasks considerably more difficult. But our in-line sensors have been designed with exactly this in mind. The sealed sensor head keeps out debris and particles while our optical assembly contains no moving parts – the sensors stay clean and aligned.



Our two in-line systems have primarily been designed to be compact, robust and easily integrated. One system, the S mart, then addresses the need for ultimate measurement flexibility in an in-line capable package, and is thus positioned as the most versatile industrial system on the market. The other, the S onix, addresses the need for outright speed and thus high throughput in-line surface metrology in production, and is positioned as the fastest industrial system available today.

# Versatile

## **S mart** Maximum measurement versatility

The S mart provides the necessary measurement versatility to cope with a diverse range of surface types and topographies. With Sensofar's 3-in-1 technology – three measurement technologies combined into a single sensor head via a patented microdisplay approach – the system can be easily switched to the most appropriate technique for the task at hand. This versatility provides not only for maximum measurement flexibility on any one surface, but it also means unparalleled adaptability for changing application requirements.

## Compact, light and orientation agnostic

Small size and low weight make designing for integration easy. Able to be mounted in any orientation, S mart and S onix can be positioned as the application dictates. Cable lengths can be up to 14 m. This makes them perfectly adaptable for both in-line production and robot-mounted sensing applications.

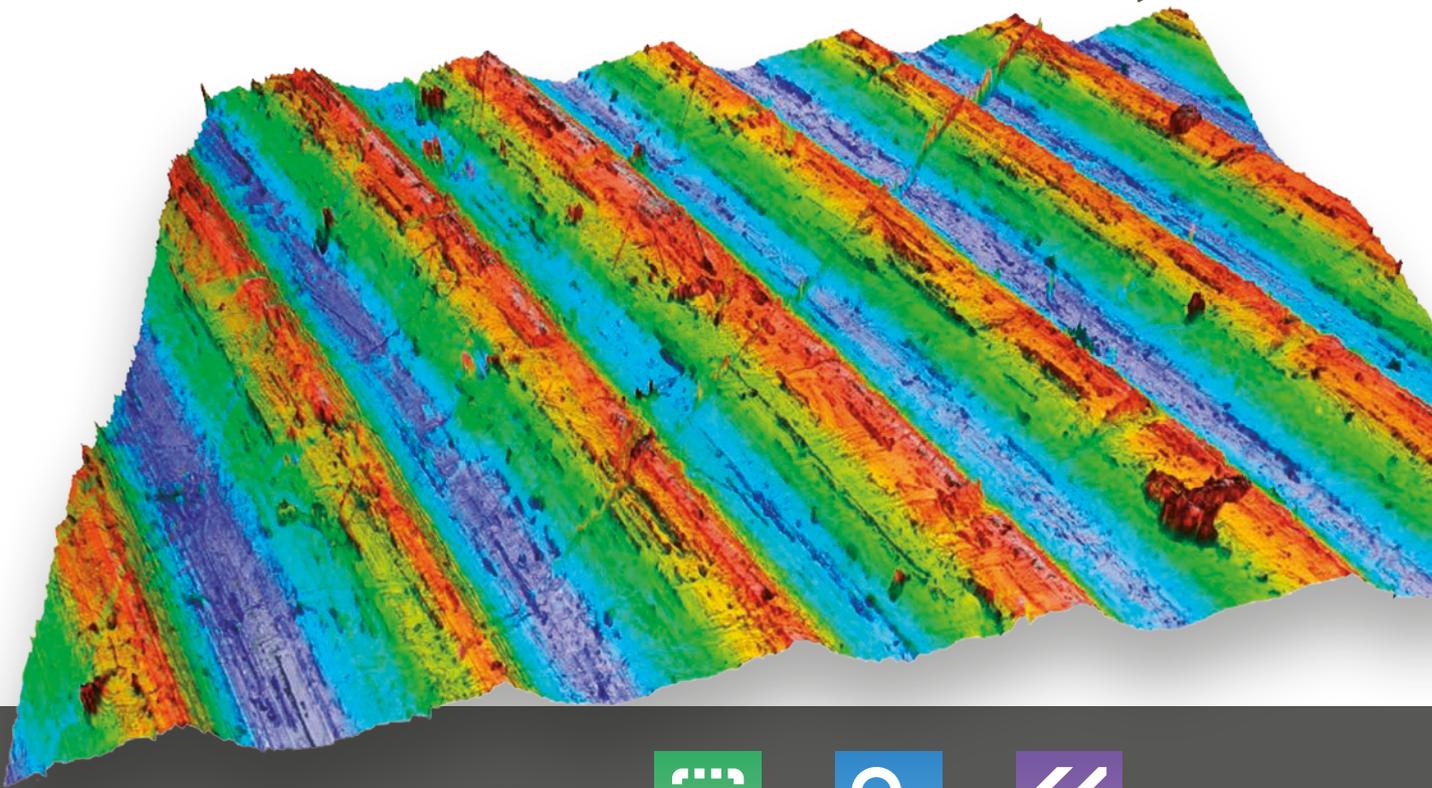
# Or Fast?

## **S onix** Unprecedented high speed

The S onix provides the speed needed in a high-throughput industrial metrology system. With its high-speed camera and optimized optical and mechanical design, S onix is up to 7 times faster than other interferometric systems available today. Vertical resolution has been maintained with the added bonus of improved resistance against vibration.



# Sensofar's technology



Rough samples



Smooth samples



Micro-scale features (XY/Z)



Nano-scale features (Z)



High local slopes



Thickness





## Focus Variation

Focus Variation is an optical technology that has been developed for measuring the shape of large rough surfaces. This technology is based on Sensofar's extensive expertise in the field of combined confocal and interferometric 3D measurements, and is specifically designed to complement confocal measurements at low magnification. Highlights of the technology include high slope surfaces (up to 86°), highest measurement speeds (mm/s) and large vertical range. This combination of measurement capabilities is mainly used for tooling applications.



## Confocal

Confocal profilers have been developed for measuring smooth to very rough surfaces. Confocal profiling provides the highest lateral resolution that can be achieved by an optical profiler. Thus, spatial sampling can be reduced to 0.01  $\mu\text{m}$ , which is ideal for critical dimension measurements. High NA (0.95) and magnification (150X) objectives are available to measure smooth surfaces with steep local slopes over 70° (for rough surfaces up to 86°). The proprietary confocal algorithms provide Sensofar's unique vertical repeatability on the nanometer scale.



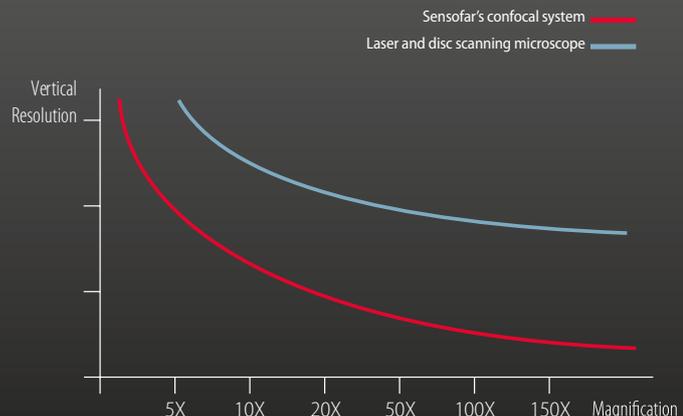
## Interferometry

White-light vertical scanning interferometry (VSI) is a widely used and powerful technique for measuring surface characteristics such as topography or transparent film structure. It is best suited for measuring smooth to moderately rough surfaces, and provides nanometer vertical resolution regardless of the objective's NA or magnification.

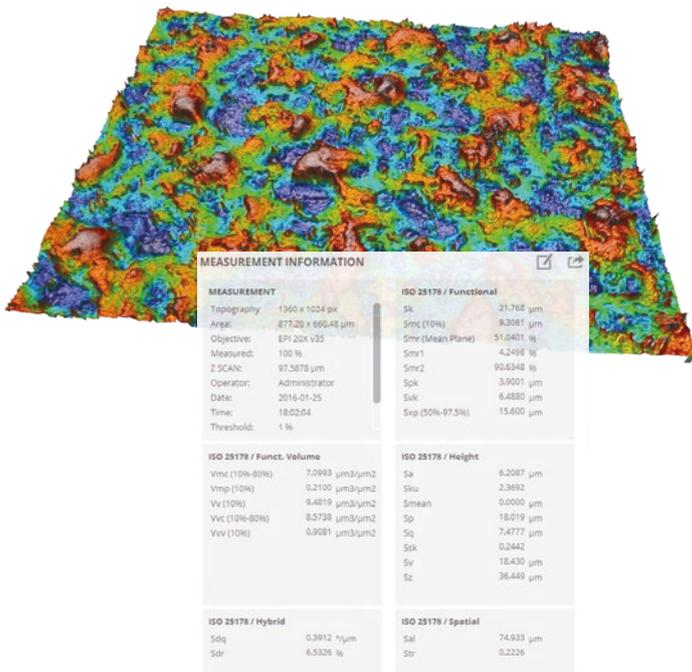
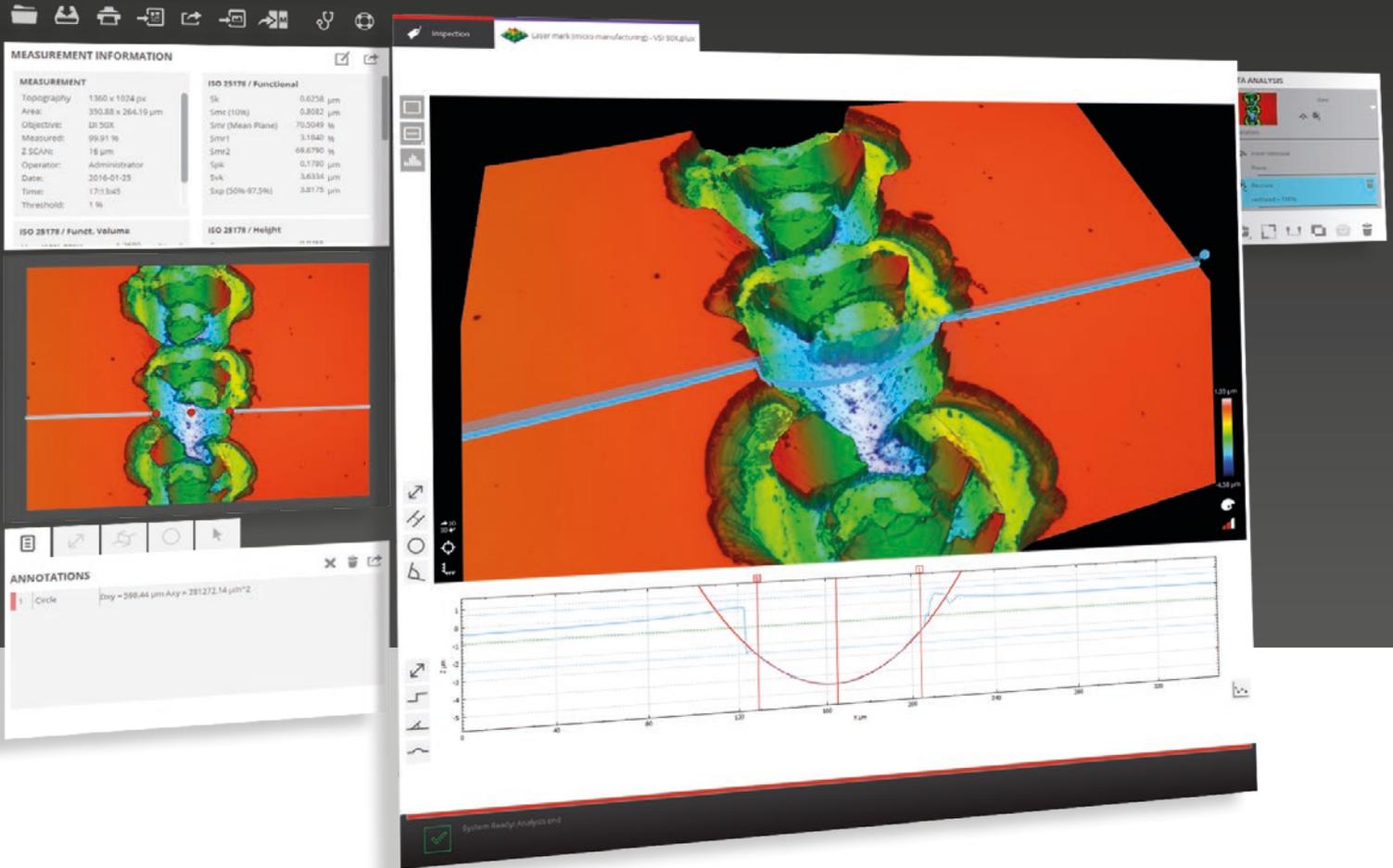


## Confocal with no moving parts

The confocal scanning technique implemented in Sensofar's systems utilizes a patented microdisplay scanning technology. The microdisplay is based on ferroelectric liquid crystal on silicon (FLCoS) technology, creating a rapidly switching device with no moving parts, making data acquisition fast, reliable and accurate. Due to this and the associated algorithms, Sensofar's confocal technique yields a class-leading vertical resolution, better than other confocal approaches and even better than laser scanning confocal systems.



# SensoSCAN



SensoSCAN software drives the systems with its clear and intuitive user-friendly interface. The user is guided through the 3D environment, delivering a unique user experience. SensoSCAN software provides an interface with which any measurement can easily be taken, as well as a comprehensive set of tools for displaying and analyzing data. For applications requiring a more complete analysis suite, advanced analysis software packages are optionally available – SensoMAP and SensoPRO.

## ISO parameters

All Sensofar software packages are compliant with ISO 25178. A complete selection of ISO 3D areal surface texture parameters is available: height, spatial, hybrid, functional and volumetric parameters.

## Sensor System



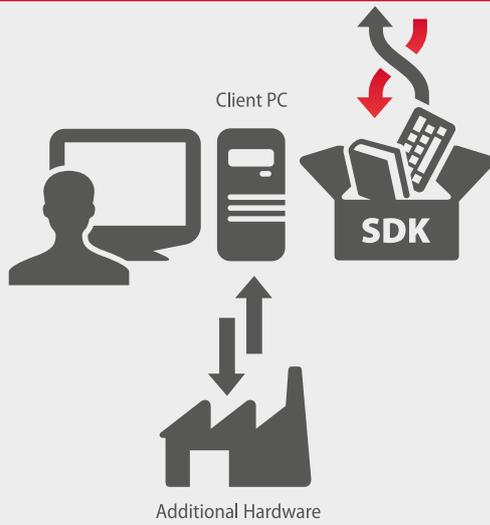
SENSOR



CONTROLLER



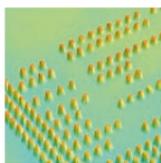
PC



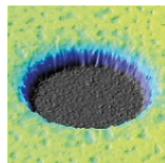
# SDK

SensoSCAN software development kit (SDK) offers the tools and protocols needed to create proprietary applications that are able to communicate and manage SensoSCAN. The developers can choose the platform and language for the development of their applications without any constraint. SensoSCAN SDK commands and events provide a means to remotely inspect a sample and perform measurements based on acquisition recipes. Once a proprietary application has been developed using SensoSCAN SDK, it can be used with multiple systems.

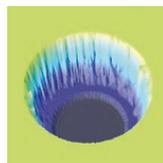
# SensoPRO



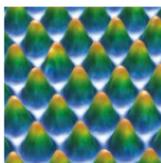
Bump



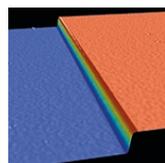
Hole



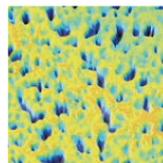
Double Hole



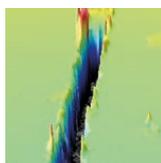
LEDs



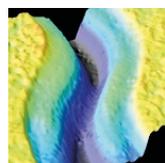
Step Height



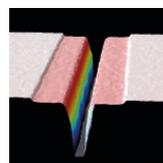
Surface Texture



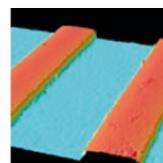
Trench



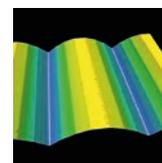
Silver Trench



Double Step Height



Trace



Prism

It has never been so easy to perform fast quality control in a production line. Thanks to SensoPRO, the operator in the production line only needs to load the sample and follow guided instructions. Plug-in-based data analysis algorithms provide a high degree of flexibility. Current capabilities include LED module (Conic, Mesa and Merging LEDs), Bump, Hole, Double Hole, Surface Texture, Step Height, Double Step Height, Trace, Trench, Silver Trench and Prisms. New modules can be easily customized to other industry needs.

# Objectives

Magnification	Brightfield							Interferometric				
	2.5X	5X	10X	20X	50X	100X	150X	5X	10X	20X	50X	100X
NA	0.075	0.15	0.30	0.45	0.80	0.90	0.95	0.13	0.30	0.40	0.55	0.70
WD (mm)	6.5	23.5	17.5	4.5	1.0	1.0	0.2	9.3	7.4	4.7	3.4	2.0
FOV <sup>1</sup> (µm)	6800x5675	3400x2837	1700x1420	850x710	340x284	170x142	113x95	3400x2837	1700x1420	850x710	340x284	170x142
Spatial sampling <sup>2</sup> (µm)	5.52	2.76	1.38	0.69	0.28	0.14	0.09	2.76	1.38	0.69	0.28	0.14
Optical resolution <sup>3</sup> (µm)	2.23	1.11	0.55	0.37	0.21	0.18	0.17	2.76	1.38	0.69	0.30	0.24
Measurement time <sup>4</sup> (s)	>3							>3				

Vertical resolution <sup>5</sup> (nm)	Confocal							VSI				
	Maximum slope <sup>6</sup> (°)	3	8	14	21	42	51	71	3	8	14	21

Focus variation	
Min. measurable roughness	Sa > 10 nm
Maximum slope (°)	up to 86°

**1** Maximum field of view with 2/3" camera and 0.5X optics. **2** Pixel size on the surface. **3** L&S: Line and Space, half of the diffraction limit according to the Rayleigh criterion. Values for white LED. Spatial sampling could limit the optical resolution for interferometric objectives. **4** For brightfield objectives, 21 scanning planes (confocal). **5** System noise measured as the difference between two consecutive measurements of a calibration mirror placed perpendicular to the optical axis. **6** On smooth surfaces. Up to 86° on rough surfaces. Other objectives are available.

# System specifications

Measurement array	1232 x 1028 pixels
LED light source	white (default, lifetime 40.000 h – other options available)
Z travel range	40 mm (1.6")
Z stage linearity	< 0.5 µm/mm
Z stage resolution	2 nm
Max. vertical scanning range	Focus Variation 25 mm; Confocal 36 mm; VSI 7 mm
Step height repeatability	< 3 nm
Sample reflectivity	0.05 % to 100 %
Display resolution	0.01 mm
Computer	Latest INTEL processor; 2560 x 1440 pixel resolution (27")
Operating system	Microsoft Windows 10, 64-bit
System	Line Voltage 100-240 V AC; frequency 50/60 Hz single phase
Environment	Temperature 10-35°C; Humidity < 80 % RH; Altitude < 2000 m

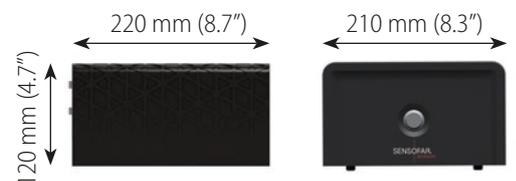
# Dimensions



Weight 5.5 kg (12.1 lbs)

# Software

User Management rights	Administrator, advanced operator, operator
Acquisition technologies	Confocal, VSI and Focus Variation
Measurement types	Image, 3D, 3D thickness, profile and coordinates
Advanced Software Analysis	SensoMAP and SensoPRO (optional)
Remote control	Software Development Kit (SDK) (optional)



Weight 2.4 kg (5.3 lbs)

# Objectives

## Interferometric

Magnification	2.5X	5X	10X	20X	50X	100X
NA	0.075	0.13	0.30	0.40	0.55	0.70
WD (mm)	10.3	9.3	7.4	4.7	3.4	2.0
FOV <sup>1</sup> (µm)	5040 x 3780	2520 x 1890	1260 x 945	630 x 472	252 x 189	126 x 94
Spatial sampling <sup>2</sup> (µm)	7.88	3.94	1.97	0.98	0.39	0.19
Optical resolution <sup>3</sup> (µm)	7.88	3.94	1.97	0.98	0.39	0.24
Measurement speed <sup>4</sup> (µm/s)	25					

## VSI

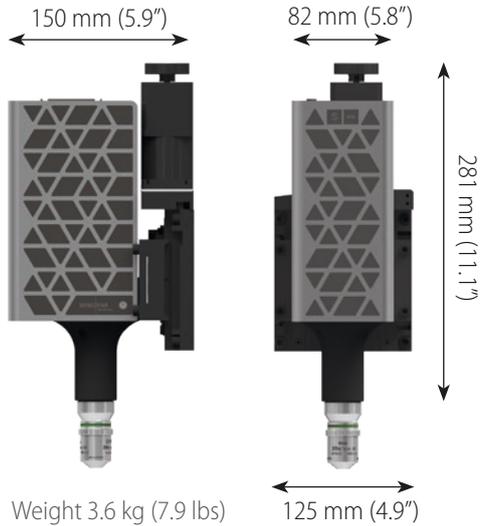
Vertical resolution <sup>5</sup> (nm)	1					
Maximum slope <sup>6</sup> (°)	3	8	14	21	25	42

**1** Maximum field of view with 1/3" camera and 0.375X optics. **2** Pixel size on the surface. **3** L&S: Line and Space, half of the diffraction limit according to the Rayleigh criterion. Values for white LED. Spatial sampling could limit the optical resolution. **4** Measurement speed 1X. **5** System noise measured as the difference between two consecutive measurements of a calibration mirror placed perpendicular to the optical axis. **6** On smooth surfaces.

# System specifications

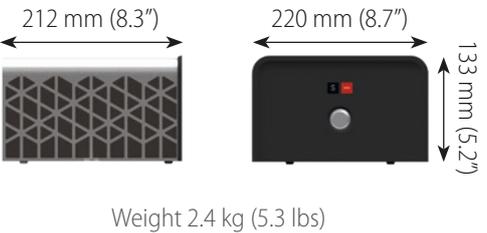
Measurement array	640 x 480 pixels
LED light source	white (lifetime 40.000 h)
Z travel range	40 mm (1.6")
Z stage linearity	< 0.5 µm/mm
Z stage resolution	2 nm
Max. vertical scanning range	7 mm
Step height repeatability	< 3 nm
Sample reflectivity	0.05 % to 100 %
Display resolution	0.01 nm
Computer	Latest INTEL processor; 1920 x 1080 pixel resolution (23")
Operating system	Microsoft Windows 10, 64-bit
System	Line Voltage 100-240 V AC; frequency 50/60 Hz single phase
Environment	Temperature 10-35°C; Humidity < 80 % RH; Altitude < 2000 m

## Dimensions



# Software

User Management rights	Administrator, advanced operator, operator
Acquisition technologies	VSI
Measurement types	Image, 3D and 3D thickness
Advanced Software Analysis	SensoMAP and SensoPRO (optional)
Remote control	Software Development Kit (SDK) (optional)





SENSOFAR is a leading-edge technology company that has the highest quality standards within the field of surface metrology.

Sensofar Metrology provides high-accuracy optical profilers based on confocal, interferometry and focus variation techniques, from standard setups for R&D and quality inspection laboratories to complete non-contact metrology solutions for in-line production processes. Sensofar Metrology offers technology that enables our customers to achieve real breakthroughs, particularly in the semiconductor, precision optics, data storage, display devices, thick and thin film and material testing technology fields.

The Sensofar Group has its headquarters in Barcelona, also known as Spain's technological heart. The Group is represented in over 30 countries through a global network of partners and has its own offices in Asia and USA.



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METROLOGY

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