

SENSOFAR

METROLOGY



INTEGRABLE  
HEADS



# Integrable solutions

## Robust and reliable

Production environments are not always the most friendly: variable conditions, vibrations, aggressive materials, etc. making measurement tasks more difficult. Our integrable sensors have been designed with exactly this in mind. The sealed sensor head keeps out debris and particles and our optical assembly contains no moving parts, so the sensors stay clean and aligned.

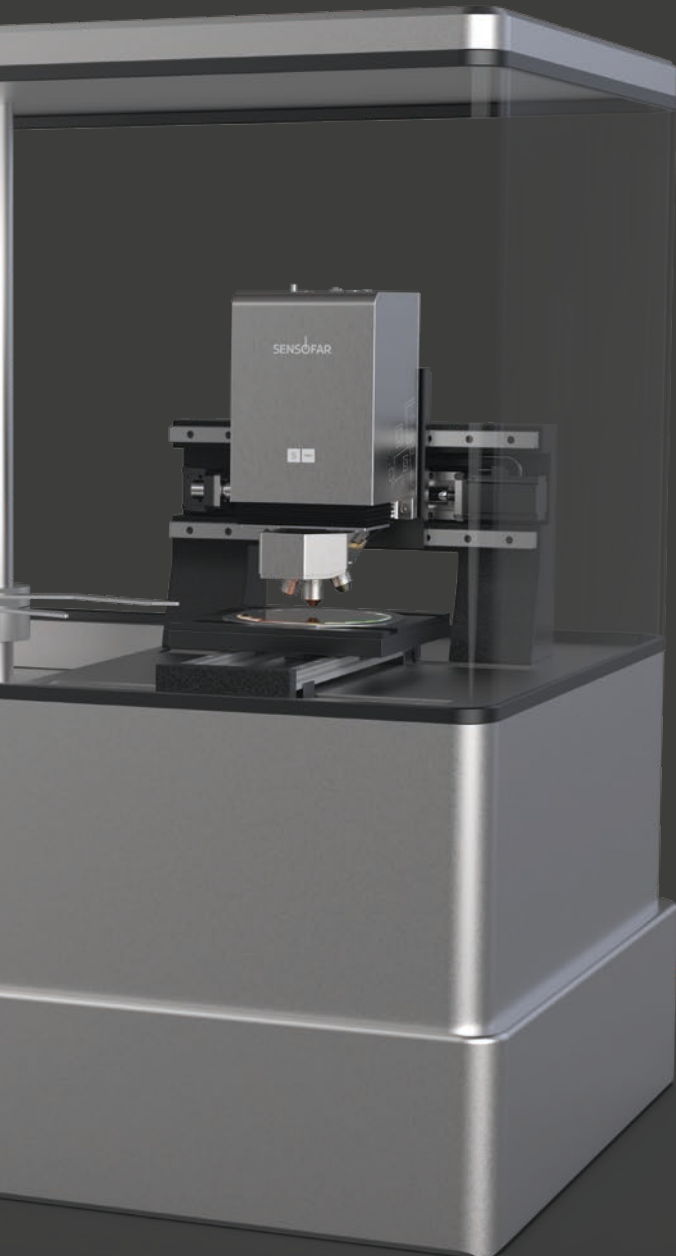
## Compact, light, and orientation independent

Small size and low weight make designing for integration easy. Functional in any orientation, Sensofar sensors can be positioned as the application requires. Cable lengths are up to 20 m. Our sensors are perfectly adaptable for both in-line production and robot-mounted sensing applications.



# metrology

**Sensofar's integrable metrology systems are the culmination of more than 20 years experience in surface metrology systems**



They are designed from the outset to be integrated into the harshest manufacturing environments. Compact, lightweight and with flexible mounting options, Sensofar sensors put high-performance surface metrology right where you need it – at the application.

## Applications

- Display
- Optics
- PCB
- Semiconductors
- Surface finish
- Tooling

## Cleanroom compatible



Some production environments such as those in semiconductor manufacturing are normally within strict conditions of particles. Now the S neox, our most powerful system, has the option to be ISO Class 1 thanks to a hardware innovation based on three main features: a stainless steel enclosure, a sealed PU bellow covering the gap between the sensor head and the nosepiece and air extraction system.

S

mart

S

neox



The S mart 2 is the only areal confocal sensor on the market which is also an autonomous sensor. It is the perfect combination between compact design and versatility.

The S neox addresses the need for maximum measurement flexibility in an integrable sensor and is thus the most versatile industrial system on the market.

Technologies



FOV (single shot)

Up to 2.8 x 2.8 mm<sup>1</sup>Up to 6.7 x 5.6 mm<sup>1</sup>

Speed acq.

2 s<sup>2</sup>3 s<sup>2</sup>

Optical Resolution

Down to 155 nm<sup>3</sup>Down to 148 nm<sup>3</sup>

Measurement noise

Down to 3 nm<sup>4</sup>Down to 0.01 nm<sup>4</sup>

Weight

5.3 kg<sup>5</sup>8.3 kg<sup>5</sup>

Cable length

5, 10 or 15 m

5 or 10 m

Computer

Embedded in the head

External

Range of magnifications

5X – 50X

2.5X – 150X

Software communication

DLL (C++ or C#, Windows 10® - 64 bits)

Export files

SensoSCAN: Data: .plux, .dat Images: bmp

<sup>1</sup> 2.5X EPI (NA 0.075, WD 6.50 mm) objective.

<sup>2</sup> Confocal, 20X EPI and Z range=200 µm, speed 4X. <sup>3</sup> 50X EPI (NA 0.95; L&S Line and Space values for blue LED) objective. <sup>4</sup> 50X EPI (NA 0.95, WD 0.35 mm objective). <sup>5</sup> This is the weight of the sensor head with one objective in the turret.

<sup>1</sup> 2.5X TI (NA 0.075, WD 10.3 mm) objective.

<sup>2</sup> Confocal, 20X EPI and Z range=200 µm, speed 5X. <sup>3</sup> 150X EPI (NA 0.95 L&S Line and Space values for blue LED) objective. <sup>4</sup> PSI with PZT using any interferometric objective. <sup>5</sup> This is the weight of the sensor head with one objective in the turret.



Fringe Projection



Ai Focus Variation



Confocal



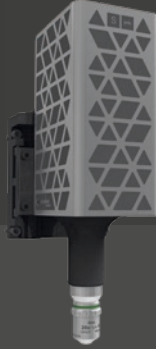
Interferometry



Spectroscopic Reflectometry



The S neox Cleanroom is the most versatile integrable head on the market and the only one to be ISO Class 1 compatible.



The S onix is an areal interferometer that fits perfectly in industrial environments because of its astonishing resolution and speed.



The S wide is designed to measure large areas in one single shot, suited for those applications where speed and shape measurement is the priority.



Up to 6.7 x 5.6 mm <sup>1</sup>

3 s <sup>2</sup>

Down to 148 nm <sup>3</sup>

Down to 0.01 nm <sup>4</sup>

13.6 kg <sup>5</sup>

5 or 10 m

External

2.5X – 150X



Up to 5.0 x 3.8 mm <sup>1</sup>

1 s <sup>2</sup>

Down to 190 nm <sup>3</sup>

Down to 1 nm <sup>4</sup>

3.6 kg

5, 15 or 20 m

External

5XTI – 100XDI



34.7 x 29.1 mm

1 s

9.35 µm

1 µm

8 kg

5 or 10 m

External

0.243X

XML (any operating system)

SensoVIEW: Data (SensoVIEW), .plux, .x3p, .dat, .pcl, .stl

<sup>1</sup> 2.5X TI (NA 0.075, WD 10.3 mm) objective.

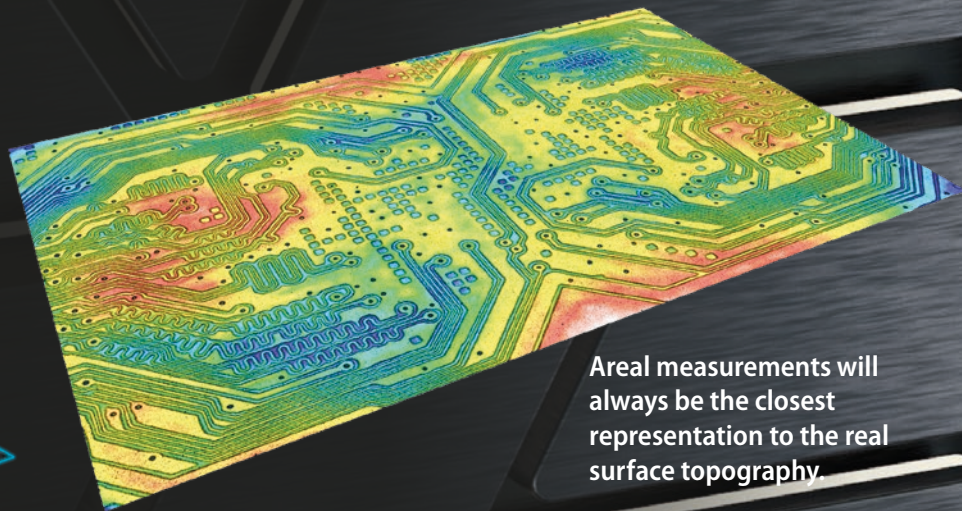
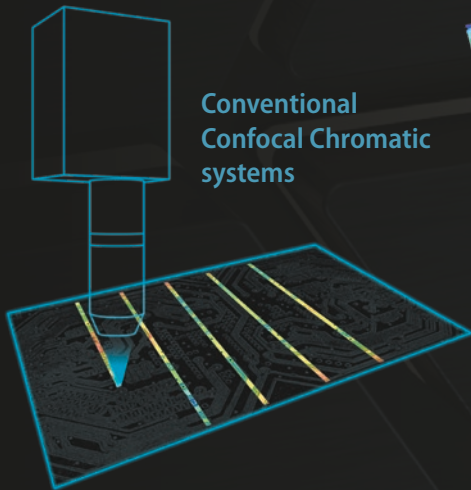
<sup>2</sup> Confocal, 20X EPI and Z range=200 µm, speed 5X. <sup>3</sup> 150X EPI (NA 0.95 L&S Line and Space values for blue LED) objective. <sup>4</sup> PSI with PZT using any interferometric objective. <sup>5</sup> This is the weight of the sensor head with one objective in the turret.

<sup>1</sup> 2.5X TI (NA 0.075, WD 10.3 mm) objective.

<sup>2</sup> CSI, 20X DI and z range=200 µm, speed 9X. <sup>3</sup> 100X DI (NA 0.70 L&S Line and Space values for green LED) objective. <sup>4</sup> CSI using any interferometric objective.

# The real areal confocal head

The **S mart 2** areal confocal capability images an area at a time, so the lateral resolution and X and Y remain the same, unlike point or line confocal chromatics. In addition, our areal measurements are traceable to certified calibration specimens from national measurement institutions such as PTB, NPL or NIST.



## Performance you'll want to see

To scan with the most suitable technology, the **S mart 2** comes with three technologies to measure in the same head: Ai Focus Variation, Confocal and Interferometry.

140 nm

Interferometry

Shape measured in 2s

Confocal

Ai Focus Variation

45°

## Easy to fit, easy to connect

The shape of the integrable head has been engineered to improve the fitting of the system. Its narrow width allows the integrable head to be installed in zones that will not interfere with the user or the manufacturing operations.

Designed to be exceptionally easy to integrate, the **S mart 2** has all the electronics inside the head, including the computing power. Never before has it been so easy to install a Sensofar system, the **S mart 2** has two single connections: an ethernet cable and a power supply.

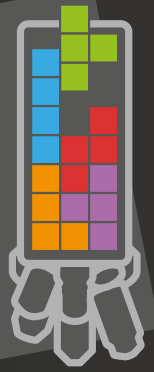


Our sensors product portfolio has been designed to fulfill the automatization typically required in manufacturing lines. The measurement is done with just one click, the sensor finds the focus, optimizes the light and Z range and the user gets the result.





Effizientes  
Design



**3-in-1**  
Konfokal  
Ai-Fokusvariation  
Interferometrische

AUTOMATIC  
**3D**

# Autonomous areal confocal

The **S mart 2** is the only autonomous areal confocal profilometer in the market and that is a must when high standards of lateral resolution, accuracy, and repeatability are required by the customer. Its powerful features and compact design turn it into a breakthrough in the optical field. The sensor head incorporates all the electronics, even the computing power, to facilitate its integration. Apart from Confocal, the **S mart 2** has in the same head two more optical technologies: Ai Focus Variation and Interferometry (CSI), which allow the customer to scan with the most appropriate technique for the task at hand.





## Objective lenses

### Brightfield

### Interferometric

	5X	10X	20X	50X	10X	20X	50X
Magnification	5X	10X	20X	50X	10X	20X	50X
NA	0.15	0.30	0.45	0.80	0.30	0.40	0.55
WD (mm)	20	15.8	3.0	1.0	7.4	4.7	3.4
FOV <sup>1</sup> (µm)	2820x2820	1410x1410	700x700	280x280	1410x1410	700x700	280x280
Spatial sampling <sup>2</sup> (µm)	2.76	1.38	0.69	0.27	1.38	0.69	0.27
Optical resolution <sup>3</sup> (µm)	1.11	0.55	0.37	0.21	1.38	0.69	0.30
Measurement noise <sup>4</sup> (nm)	90	35	10	4	< 5		
Maximum slope <sup>5</sup> (°)	9	17	27	53	17	24	33

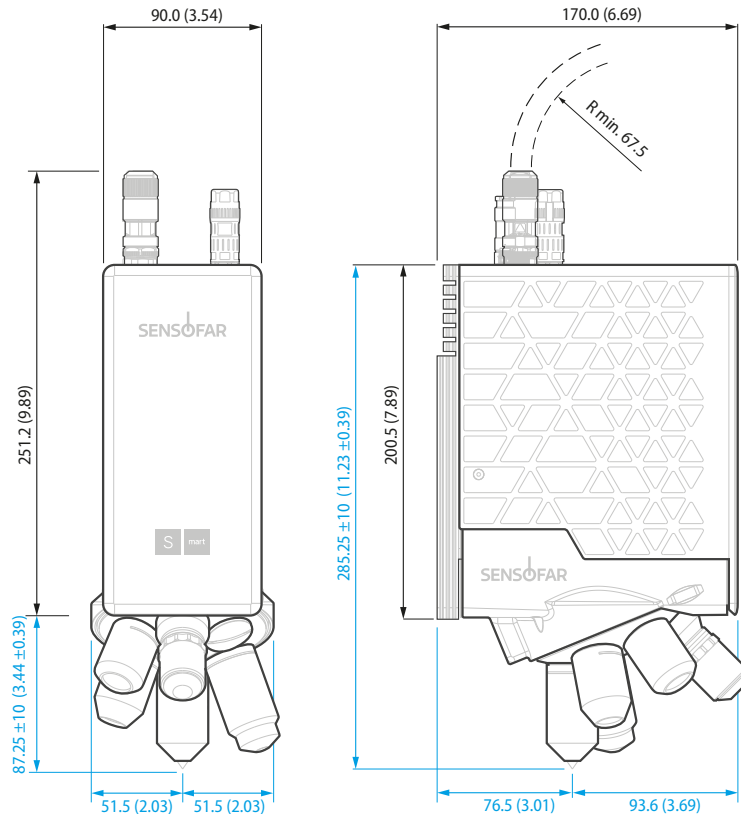
## System specifications

Measuring principle	Confocal, CSI and Ai Focus Variation
Measurement types	Image, 3D, 3D thickness
Camera	1 Mpx: 1024x1024 pixels (150 fps)
Confocal frame rate	60 fps
Vertical scan range	Linear stage: 20 mm range; 5 nm resolution
Max. Z measuring range	20 mm
LED light sources	Blue (460 nm); white (580 nm; center)
Nosepiece	6 positions fully motorized
Sample reflectivity	0.05 % to 100%

Advanced Software Analysis	Inc: SensoVIEW; Op: SensoPRO, SensoMAP
Communication protocol	DLL; gRPC (optional)
Operating system	Microsoft Windows 10®, 64 bit
Cable Length	3, 5 or 10 m (20 m optional)
Environment	Temperature 10 °C to 35 °C; Hum. <80 % RH; Alt. <2000 m

## Dimensions mm (inch)

Weight<sup>6</sup>: 5.3 kg (11.7 lbs)



Head dimensions

Working distances

<sup>1</sup> Maximum field of view with 2/3" camera and 0.25X optics. <sup>2</sup> Pixel size on the surface. <sup>3</sup> L&S: Line and Space, half of the diffraction limit according to the Rayleigh criterion. Spatial sampling could limit the optical resolution for interferometric objectives. Values for blue LED in brightfield objectives and white LED in interferometric objectives. <sup>4</sup> Measurement noise measured as the difference between two consecutive measurements of a calibration mirror placed perpendicular to the optical axis. Values obtained in a VC-E vibration environment. <sup>5</sup> On smooth surfaces. Up to 86° on rough surfaces. Other objectives are available. <sup>6</sup> This is the weight of the sensor head with one objective in the turret.

# Extreme versatility

with high performance



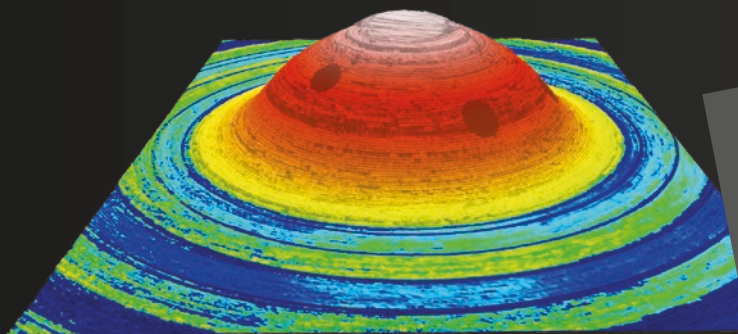
**4-in-1 technologies**

Ai Focus Variation | Confocal Interferometry | SR

**4 LEDs**

Red | Green | Blue | White

The **S neox** pushes versatility to the extreme with 4-in-1 technology, providing unparalleled adaptability for different application requirements and maximum measurement flexibility on any surface. The versatility of the S neox allows for having DIC that enhances contrast to spot surface defects while choosing from 37 different objectives. Also, the option to add a piezoelectric Z motor provides the S neox with the highest performance in optical metrology.



**0.01 nm**

System-  
rauschen

## Objective lenses

MAG	Brightfield						Interferometry					
	5X	10X	20X	50X	100X	150X	2.5X	5X	10X	20X	50X	100X
NA	0.15	0.30	0.45	0.80	0.90	0.95	0.075	0.13	0.30	0.40	0.55	0.70
WD (mm)	23.5	17.5	4.5	1.0	1.0	0.2	10.3	9.3	7.4	4.7	3.4	2.0
FOV <sup>1</sup> (µm)	3378x2826	1689x1413	845x707	338x283	169x141	113x94	6756x5652	3378x2826	1689x1413	845x707	338x283	169x141
Spatial sampling <sup>2</sup> (µm)	1.38	0.69	0.34	0.13	0.07	0.05	2.76	1.38	0.69	0.34	0.13	0.07
Optical resolution <sup>3</sup> (µm)	0.94	0.47	0.31	0.18	0.16	0.148	1.87	1.08	0.47	0.35	0.26	0.20
Measurement noise <sup>4</sup> (nm)	100	30	8	5	3	1	PSI/ePSI 0.1 nm (0.01 nm with PZT) CSI 1 nm					
Maximum slope <sup>5</sup> (°)	9	17	27	44	64	72	4	7	17	24	33	44

## System specifications

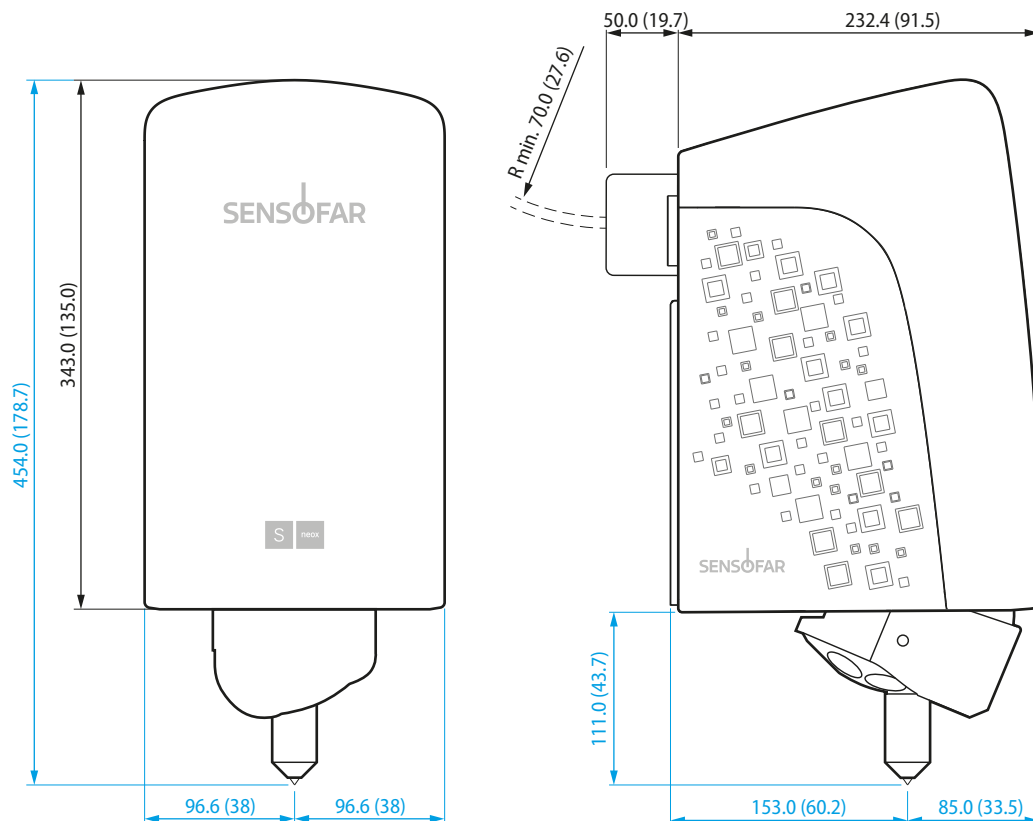
Measuring principle	Confocal, PSI, ePSI, CSI, Ai Focus Variation and Thin Film	Sample reflectivity	0.05 % to 100%
Measurement types	Image, 3D, 3D thickness, profile and coordinates	Advanced Software Analysis	Inc: SensoVIEW; Op: SensoPRO, SensoMAP
Camera	5 Mpx: 2448x2048 px (60 fps)	Communication protocol	DLL; XML (optional)
Confocal frame rate	60 fps (5 Mpx); 180 fps (1.2 Mpx)	Computer	Latest INTEL processor
Vertical scan range coarse	Linear stage: 40 mm range; 5 nm resolution	Operating system	Microsoft Windows 10®, 64 bit
Vertical scan range fine	Piezoelectric scanner with capacitive sensor: 200 µm range; 1.25 nm resolution	Cable Length	3 m (5 m, 10 m optional)
Max. Z measuring range	PSI 20 µm, ePSI 10 mm, CSI 10 mm; Confocal & Ai Focus Variation 34 mm	Environment	Temperature 10 °C to 35 °C; Humidity <80 % RH; Altitude <2000 m
LED light sources	Red (630 nm); green (530 nm); blue (460 nm) and white (575 nm; center)		
Nosepiece	6 positions fully motorized		

## Dimensions

mm (inch)

Weight<sup>6</sup>: 8.3 Kg  
(18.4 lbs)

Head dimensions  
Working distances



**1** Maximum field of view with 3/2" 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. Spatial sampling could limit the optical resolution for interferometric objectives. Values for blue LED. **4** Measurement noise measured as the difference between two consecutive measures on a calibration mirror placed perpendicular to the optical axis. For interferometry objectives, PSI, 10 phase averages. The 0.01 nm are achieved with Piezo stage scanner and temperature-controlled room. Values for green LED (white LED for CSI). Values obtained in a VC-E vibration environment. **5** On smooth surfaces. Up to 86° on rough surfaces. **6** This is the weight of the sensor head with one objective in the turret.



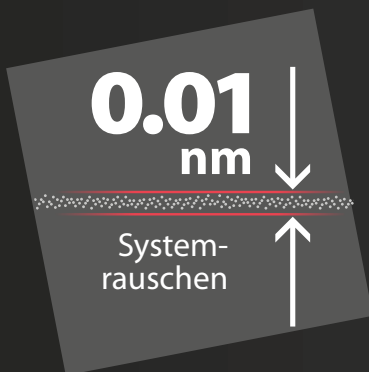
# Highest flexibility compatible with Cleanroom



**4-in-1 technologies**  
 Ai Focus Variation | Confocal Interferometry | SR

**4 LEDs**  
 Red | Green | Blue | White

The **S neox Cleanroom** is a technological milestone without precedent in optical metrology. This version of the S neox has been carefully engineered to overcome the strict test to be ISO Class 1 and ESD compatible. The S neox Cleanroom has all the versatility that comes with an S neox and matches with the production environments typical of medical devices, microfluidics, and semiconductors industries.



## Objective lenses

MAG	Brightfield						Interferometry					
	5X	10X	20X	50X	100X	150X	2.5X	5X	10X	20X	50X	100X
NA	0.15	0.30	0.45	0.80	0.90	0.95	0.075	0.13	0.30	0.40	0.55	0.70
WD (mm)	23.5	17.5	4.5	1.0	1.0	0.2	10.3	9.3	7.4	4.7	3.4	2.0
FOV <sup>1</sup> (µm)	3378x2826	1689x1413	845x707	338x283	169x141	113x94	6756x5652	3378x2826	1689x1413	845x707	338x283	169x141
Spatial sampling <sup>2</sup> (µm)	1.38	0.69	0.34	0.13	0.07	0.05	2.76	1.38	0.69	0.34	0.13	0.07
Optical resolution <sup>3</sup> (µm)	0.94	0.47	0.31	0.18	0.16	0.148	1.87	1.08	0.47	0.35	0.26	0.20
Measurement noise <sup>4</sup> (nm)	100	30	8	5	3	1	PSI/ePSI 0.1 nm (0.01 nm with PZT) CSI 1 nm					
Maximum slope <sup>5</sup> (°)	9	17	27	44	64	72	4	7	17	24	33	44

## System specifications

Measuring principle	Confocal, PSI, ePSI, CSI, Ai Focus Variation and Thin Film	Sample reflectivity	0.05 % to 100%
Measurement types	Image, 3D, 3D thickness, profile and coordinates	Advanced Software Analysis	Inc: SensoVIEW; Op: SensoPRO, SensoMAP
Camera	5Mpx: 2448x2048 pixels (60 fps)	Communication protocol	DLL; XML (optional)
Confocal frame rate	60 fps (5Mpx); 180 fps (1.2 Mpx)	Computer	Latest INTEL processor
Vertical scan range coarse	Linear stage: 40 mm range; 5 nm resolution	Operating system	Microsoft Windows 10®, 64 bit
Vertical scan range fine	Piezoelectric scanner with capacitive sensor: 200 µm range; 1.25 nm resolution	Cable Length	3 m (5 m, 10 m optional)
Max. Z measuring range	PSI 20 µm, ePSI 10 mm, CSI 10 mm; Confocal & Ai Focus Variation 34 mm	Environment	Temperature 10 °C to 35 °C; Humidity <80 % RH; Altitude <2000 m
LED light sources	Red (630 nm); green (530 nm); blue (460 nm) and white (575 nm; center)		
Nosepiece	6 positions fully motorized		

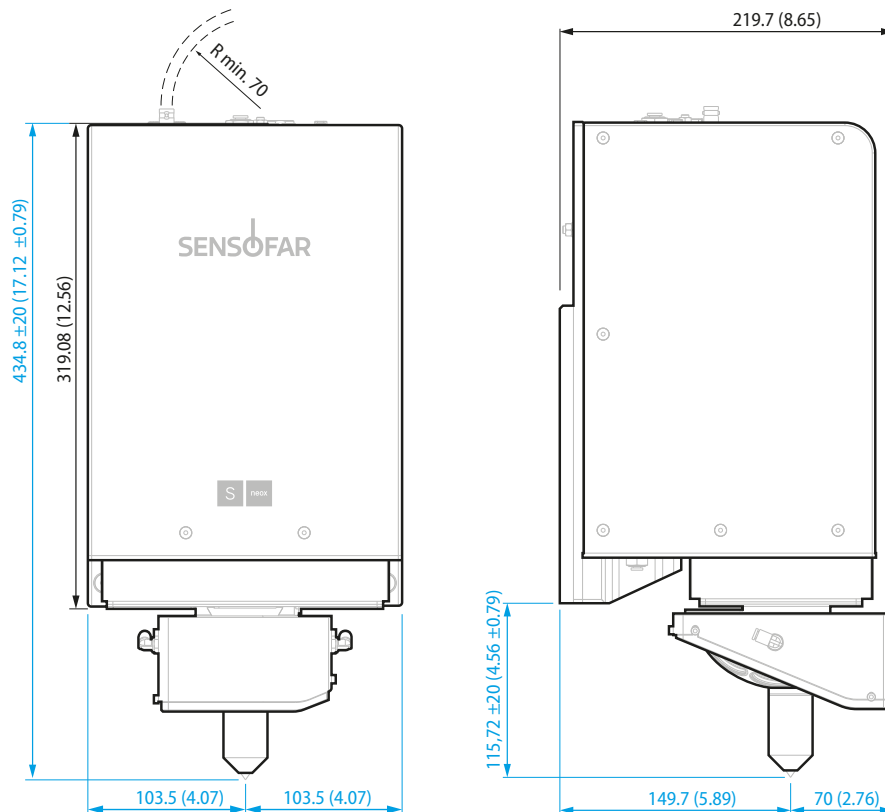
## Dimensions

mm (inch)

Weight<sup>6</sup>: 8.3 Kg  
(18.4 lbs)

Head dimensions

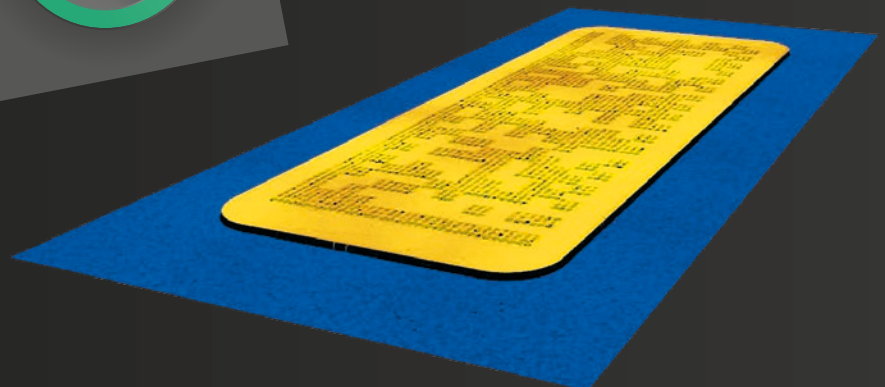
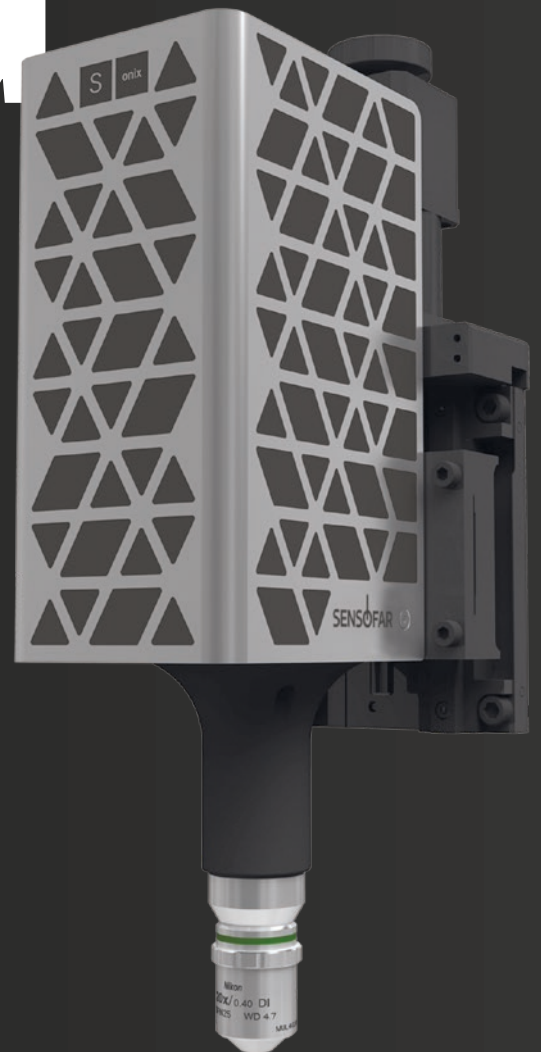
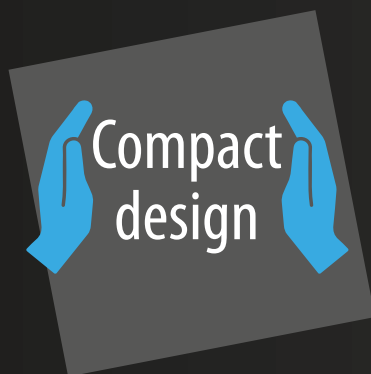
Working distances



**1** Maximum field of view with 3/2" 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. Spatial sampling could limit the optical resolution for interferometric objectives. Values for blue LED. **4** Measurement noise measured as the difference between two consecutive measures on a calibration mirror placed perpendicular to the optical axis. For interferometry objectives, PSI, 10 phase averages. The 0.01 nm are achieved with Piezo stage scanner and temperature-controlled room. Values for green LED (white LED for CSI). Values obtained in a VC-E vibration environment. **5** On smooth surfaces. Up to 86° on rough surfaces. **6** This is the weight of the sensor head with one objective in the turret.

# Unprecedented speed

The **S onix** provides the speed needed for a high-throughput industrial metrology system. With its high-speed camera and optimized optical and mechanical design, the **S onix** represents our fastest interferometric system. Measurement noise is maintained with the added bonus of improved resistance against vibration.



## Objective lenses

### Interferometric

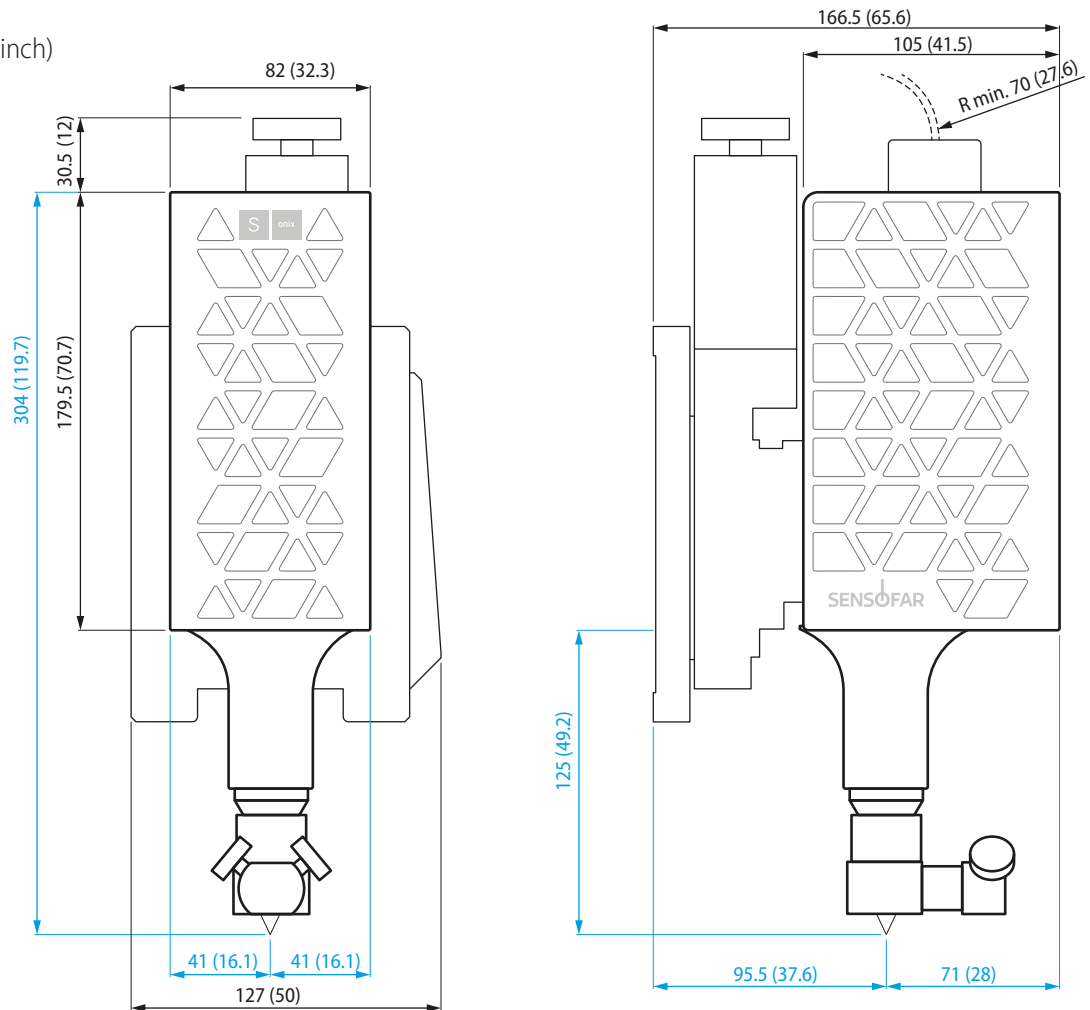
Magnification	2.5X	5X	10X	20X	50X	100X
NA	0.075	0.13	0.30	0.40	0.55	0.70
WD (mm)	10.3	9.3	7.4	4.7	3.4	2.0
FOV <sup>1</sup> (µm)	5040 x 3780	2520 x 1890	1260 x 945	630 x 472	252 x 189	126 x 94
Spatial sampling <sup>2</sup> (µm)	7.88	3.94	1.97	0.98	0.39	0.19
Optical resolution <sup>3</sup> (µm)	7.62	3.81	1.91	0.95	0.38	0.23
Measurement noise <sup>4</sup> (nm)	1					
Maximum slope <sup>5</sup> (°)	3	8	14	21	25	42

## System specifications

Measuring principle	CSI
Measurement types	Image, 3D and 3D thickness
Camera	0.3 Mpx: 640 x 480 px (350 fps)
Vertical scan range	Linear stage: 40 mm range; 2 nm resolution
Max. Z measuring range	7 mm
LED light sources	White (575 nm; center) and green (532 nm)
Nosepiece	1 position (default) or 6 manual positions (optional)
Sample reflectivity	0.05 % to 100%
Advanced Software Analysis	Inc: SensoVIEW; Op: SensoPRO, SensoMAP
Communication protocol	DLL; XML (optional)
Computer	Latest INTEL processor
Operating system	Microsoft Windows 10®, 64 bit
Cable Length	5, 15 or 20 m
Environment	Temperature 10 °C to 35 °C; Humidity <80 % RH; Altitude <2000 m

## Dimensions mm (inch)

Weight 3.6 kg (7.9 lbs)



Head dimensions

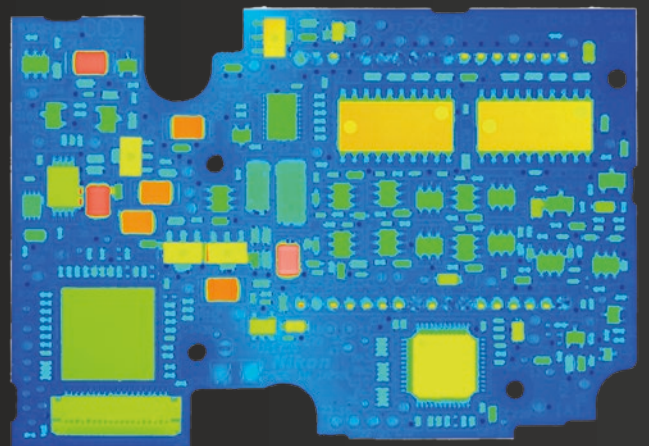
Working distances

**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 green LED. Spatial sampling could limit the optical resolution. **4** Measurement noise measured as the difference between two consecutive measurements of a calibration mirror placed perpendicular to the optical axis. Values obtained in a VC-E vibration environment. **5** On smooth surfaces.



# Single shot areal imaging

The S wide provides all the benefits of a digital microscope integrated into a high resolution measuring instrument. With only one shot, it acquires 35 x 29 mm of XY area and up to 40 mm of depth without any Z movement. The combination of proprietary Fringe Projection technology with telecentric lenses yields an excellent performance and 1  $\mu\text{m}$  measurement noise.



**Large**  
field of view  
in one single shot  
35 x 29 mm

**1  $\mu\text{m}$**   
Measurement noise

extremely fast  
calibration  
**Telecentric  
lenses**



## Objective lens

### Fringe Projection

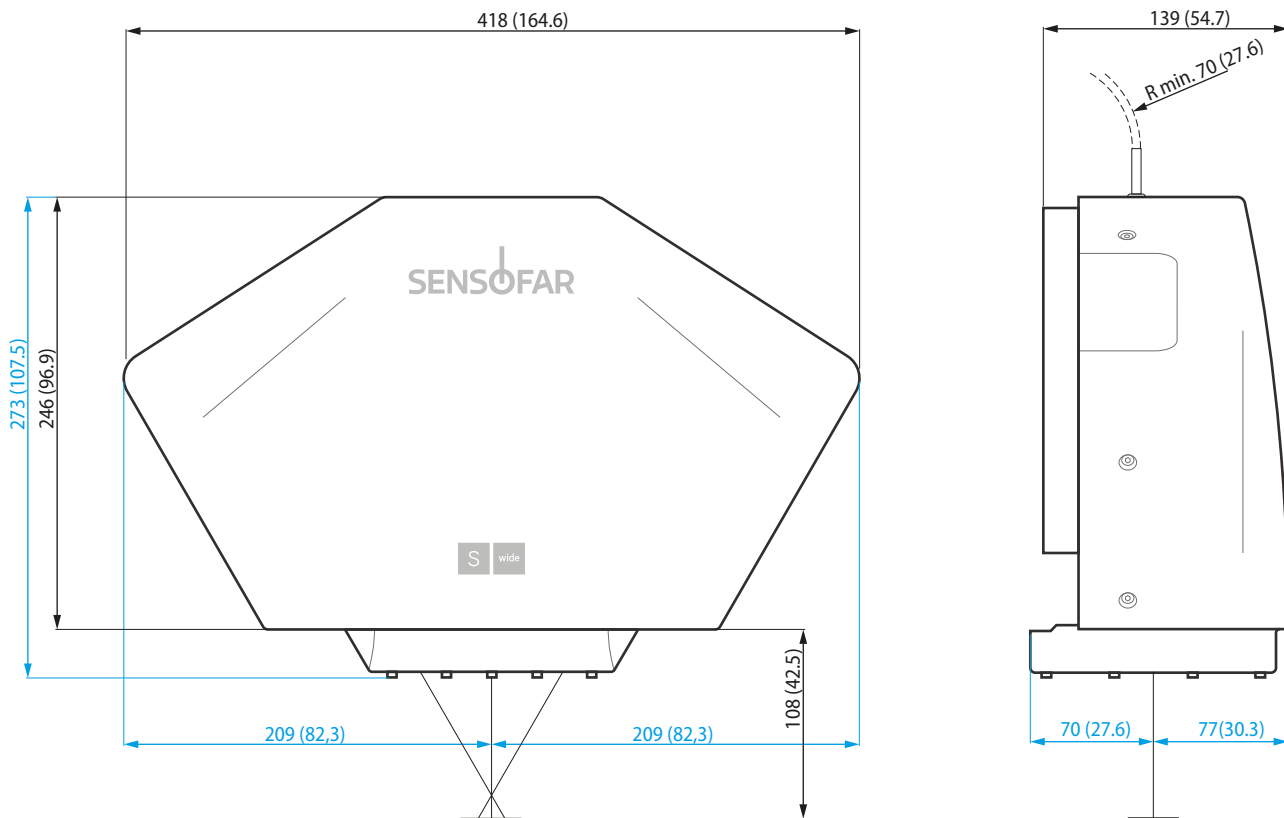
MAG	0.243X
NA	0.015
WD (mm)	80
FOV <sup>1</sup> (mm)	34.7 x 29.1
Spatial sampling <sup>2</sup> (µm)	14.2
Optical resolution <sup>3</sup> (µm)	9.35

## System specifications

Measuring principle	Fringe Projection (Gray code & Slit, Gray code & Phase Shift)
Observation types	Bi-telecentric lens with 0.243X magnification and 0.015 NA
Color camera	5Mpx: 2448x2048 pixels (60 fps)
Total magnification (27" screen)	11X
Vertical measuring range	10 mm (up to 40 mm)
LED light sources	Green (530 nm) and blue (460 nm)
Ring light illumination	White
Advanced software analysis	Inc: SensoVIEW; Op: SensoPRO, SensoMAP, Geomagic®
Power	Line Voltage 100-240 V AC; frequency 50/60 Hz single phase
Communication protocol	DLL; XML (optional)
Computer	Latest INTEL processor
Operating system	Microsoft Windows® 10, 64 bit
Cable length	5 or 10 m
Environment	Temperature 10 °C to 35 °C; Humidity <80 % RH; Altitude <2000 m

## Dimensions mm (inch)

Weight: 8 Kg (18 lbs)



Head dimensions

Working distances

# Sensofar tech

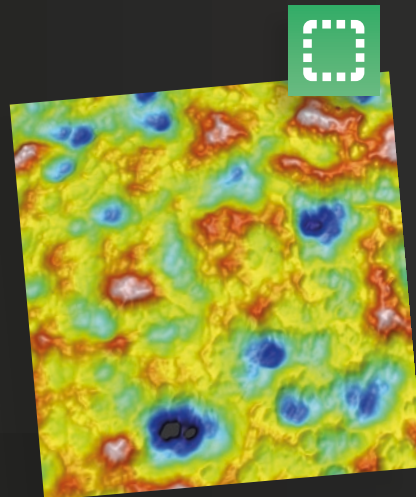
## Fringe projection

Fringe projection is ideal for large area measurements, providing high vertical accuracy and repeatability with low measurement noise. Highest about the technology include: true single shot acquisition, very large areas with high vertical accuracy and repeatability ( $\sigma = 0.01 \mu\text{m}$ ), and measurement noise down to  $1 \mu\text{m}$ , real image color and no Z-scanning.



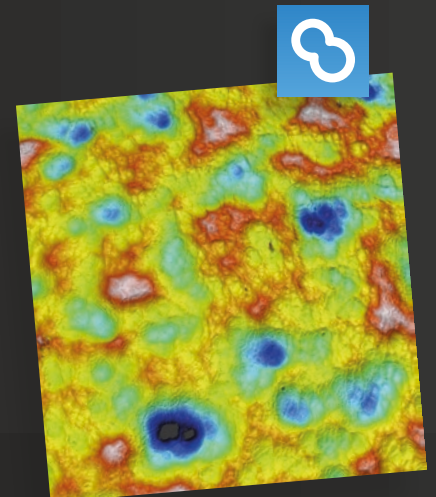
## Ai Focus Variation

**Active illumination 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. It has been improved with the use of active illumination to get more reliable focus location even on optically smooth surfaces. Highlights of the technology include high slope surfaces (up to  $86^\circ$ ), highest speed (up to  $3\text{mm/s}$ ) and large vertical range measurements.



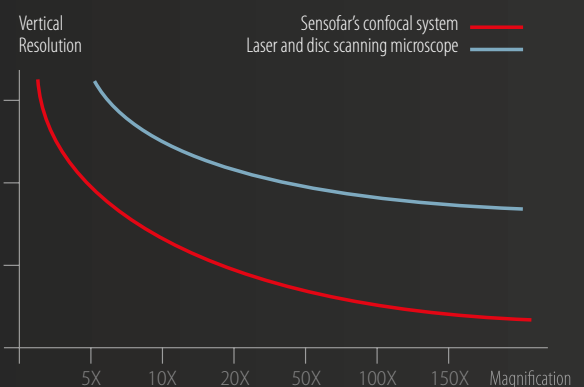
## Confocal

**Confocal** profilers have been developed to measure the surface height of smooth to very rough surfaces. Confocal profiling provides the highest lateral resolution, up to  $0.15 \mu\text{m}$  line & space, with spatial sampling can be reduced to  $0.01 \mu\text{m}$ , which is ideal for critical dimension measurements. High NA (0.95) and high magnification (150X) objectives are available to measure smooth surfaces with steep local slopes over  $70^\circ$  (for rough surfaces up to  $86^\circ$ ). The proprietary confocal algorithms provide vertical repeatability on the nanometer scale.



## No moving parts

The confocal scanning technique implemented in Sensofar's systems is a Microdisplay Scan Confocal Microscope (ISO 25178-607). The microdisplay creates 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.



# nologies

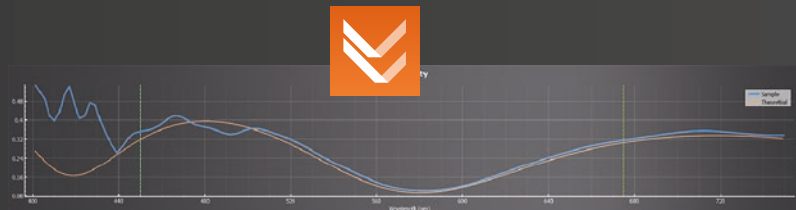
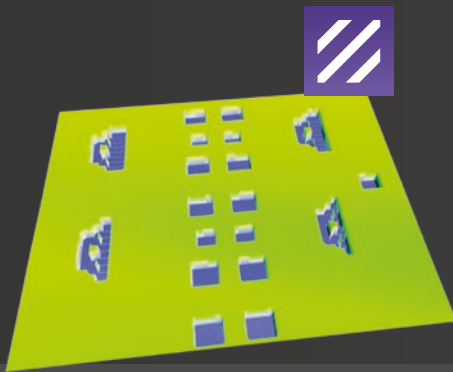
## Interferometry

**PSI** Phase Shift Interferometry has been developed to measure the surface height of very smooth and continuous surfaces with sub-Angstrom resolution, for all numerical apertures (NA). Very low magnifications (2.5X) can be employed to measure large fields of view with the same height resolution.

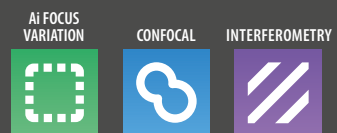
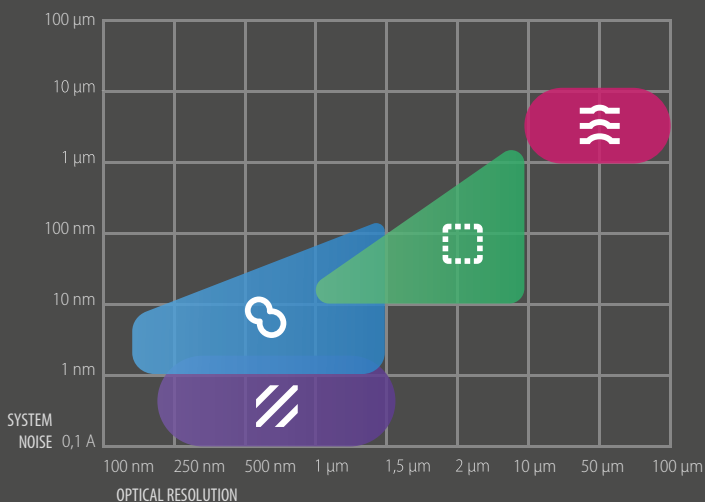
**CSI** Coherence Scanning Interferometry uses white light to scan the surface height of smooth to moderately rough surfaces, achieving 1 nm height resolution at any magnification.

## Spectroscopic Reflectometry

**Thin film** measurement technique measures the thickness of optically transparent layers quickly, accurately, non-destructively and requires no sample preparation. The system acquires the reflectance spectrum of the sample in the visible range, and is compared with a simulated spectra calculated by the software, with layer thickness modification until the best fit is found. Transparent films from 50 nm to 1.5  $\mu\text{m}$  can be measured in less than one second. Sample evaluation spot diameter is dependent on the objective magnification which can be as low as 0.5  $\mu\text{m}$  and up to 40  $\mu\text{m}$ .

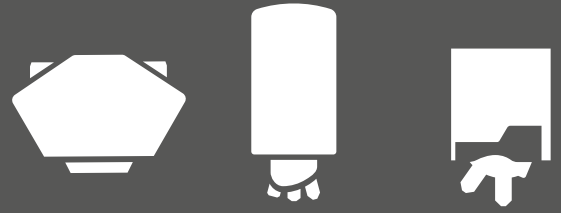


## Technology performance comparisons



	AI FOCUS VARIATION	CONFOCAL	INTERFEROMETRY
Rough samples	★ ★ ★	★ ★ ★	★
Smooth samples	★	★ ★	★ ★ ★
Micro-scale features	★ ★	★ ★ ★	★ ★ ★
Nano-scale features		★ ★	★ ★ ★
High local slopes	★ ★ ★	★ ★	★
Thickness		★ ★ ★	★ ★ ★

# Our Software Map



**SensoSCAN**  
Acquisition software works as a server

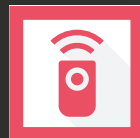


**External Hardware**

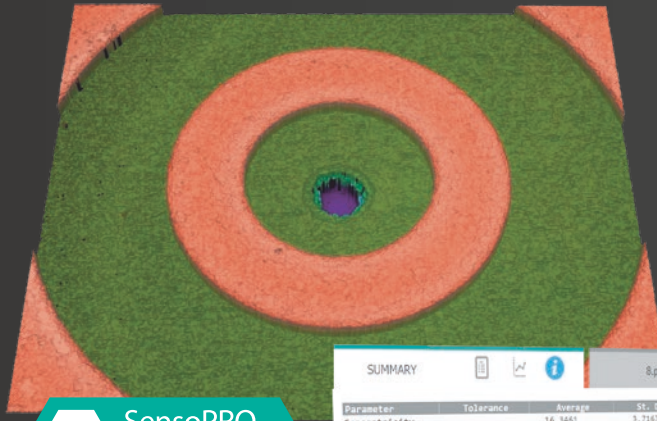


**RAW DATA**

**SDK**



Our Software Development Kit (SDK) is a set of tools that enable remote control of one or even several sensors. It generates and manages communication between the client's computer and the sensors, in addition to addressing the acquired data to analysis software.



Parameter	Tolerance	Average	St. Dev.	Median	Max.	Min.	Unit
Concentricity	16.3461	3.7167	17.3083	23.4405	21.0943		µm
R1	246.8011	0.2892	246.8554	247.1675	246.4837		µm
R2	33.8864	0.7835	33.8868	42.1932	38.4339		µm

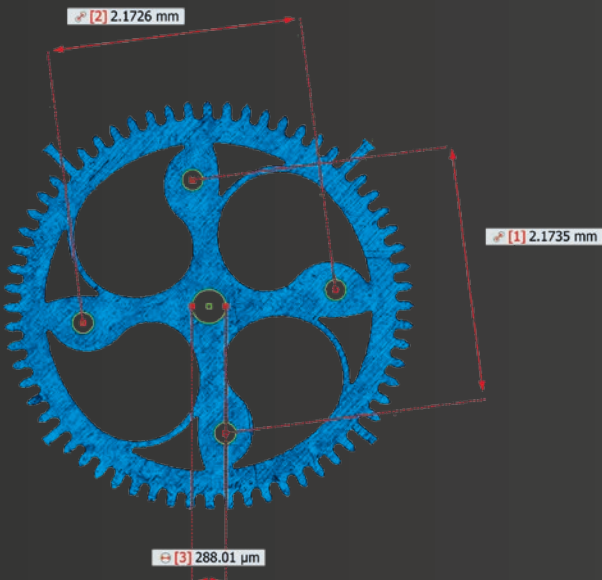
The speed of production line demands is matched by SensoPRO: with custom-based plugin data analysis algorithms, specific features will be automatically detected and analyzed, quickly creating a pass/fail report.



## SensoPRO



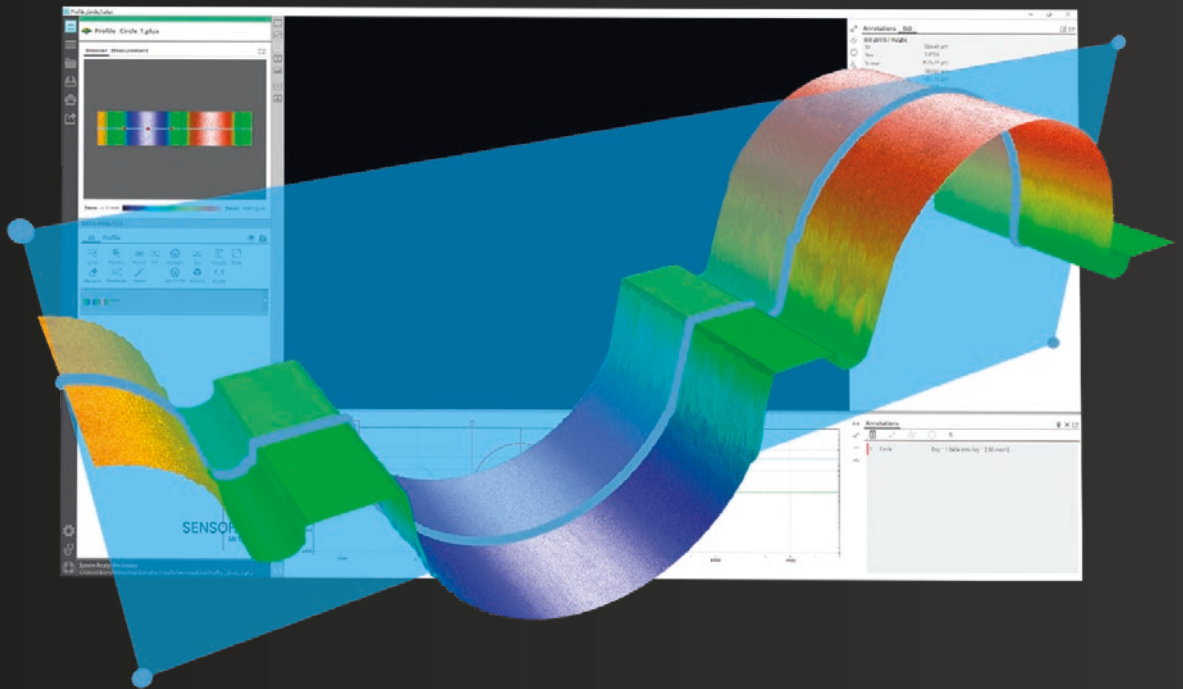
## SensoVIEW



SensoVIEW is the ideal software for a broad range of analysis tasks. It includes a comprehensive suite of tools for preliminary examination and analysis of 3D or 2D measurements, provides roughness or volume calculations and measures critical dimensions with a set of analysis tools, which can be exported as a report or data set (csv file). The analysis can be saved and applied to several measurements.

# SensoVIEW

# Powerful analysis software



Form removal



Smart



ISO



Rescale



Restore



Kernel



ISO 4287



Crop



Threshold



FFT



ISO 25178



Profile



Retouch



Rotate



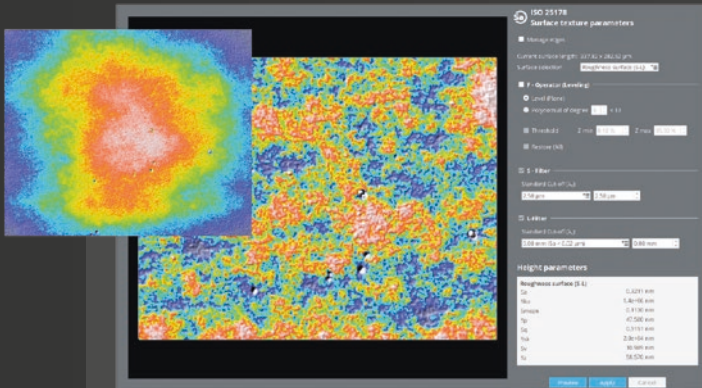
Volume

## Sequential operators

A smart suite of operators, which can be applied to 3D/2D measurements and profiles, provides the opportunity to remove form, apply a threshold, retouch data points, restore non-measurable data and apply a range of filters and/or generate alternative layers by cropping, subtracting or extracting a profile.

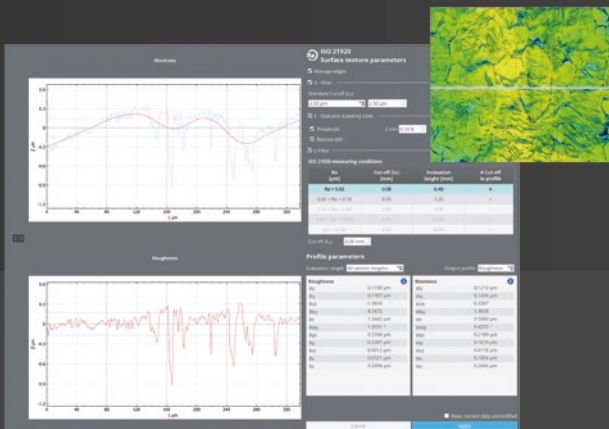
# Smart calculation tools for key parameters

SensoVIEW provides a specific step-by-step to get surface texture parameters according to ISO 4287 and 25178 with just one click.



## ISO 25178 calculations

Designed for users without a deep knowledge of ISO filters, who can now extract this information, by simply selecting the type of surface being analyzed. This operator filters the surface according to ISO 25178, returning the surface texture parameters.



## ISO 4287 calculations

It automatically filters the primary profile according to ISO 4287 and ISO 4288, returning the roughness (Rx) and waviness (Wx) parameters. The calculation of the parameters consists of a set of predefined operators, filters (F-Operator, S-Filter and L-Filter) and additional settings.

# Simple yet powerful, designed for you

This dynamic software provided with the system offers a complete set of user friendly tools for displaying and analyzing measurements. The user is trained and guided through the 3D environment, delivering a unique user experience: Access to operators in just one-click; icons with eye-catching design; a better function understanding; and simultaneous 3D, 2D and profile views are just some of the key features of the SensoVIEW software.



### Choose your own view

3D and 2D interactive views provide multiple scaling, display and render options.



### Process your data

Full set of operators to process the data information or generate alternative layers.



### Interact with analysis tools

Broad range of analysis tools for preliminary examination and analysis of 3D or 2D measurements.



### Apply your analysis

Create analysis templates to apply several presets to a series of topographies.

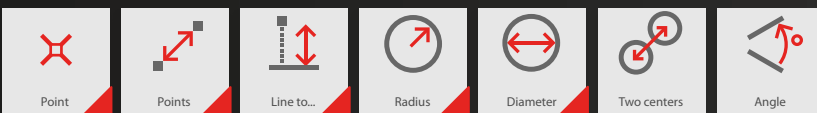
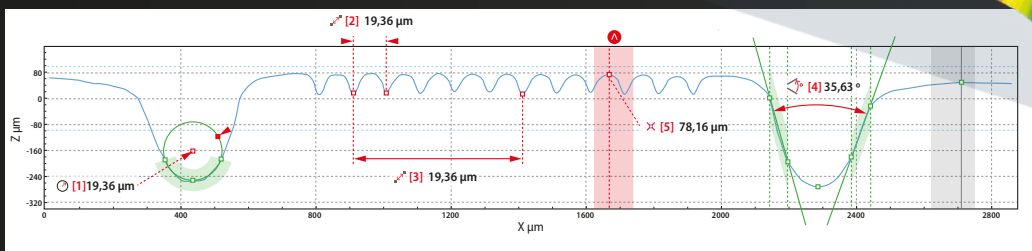
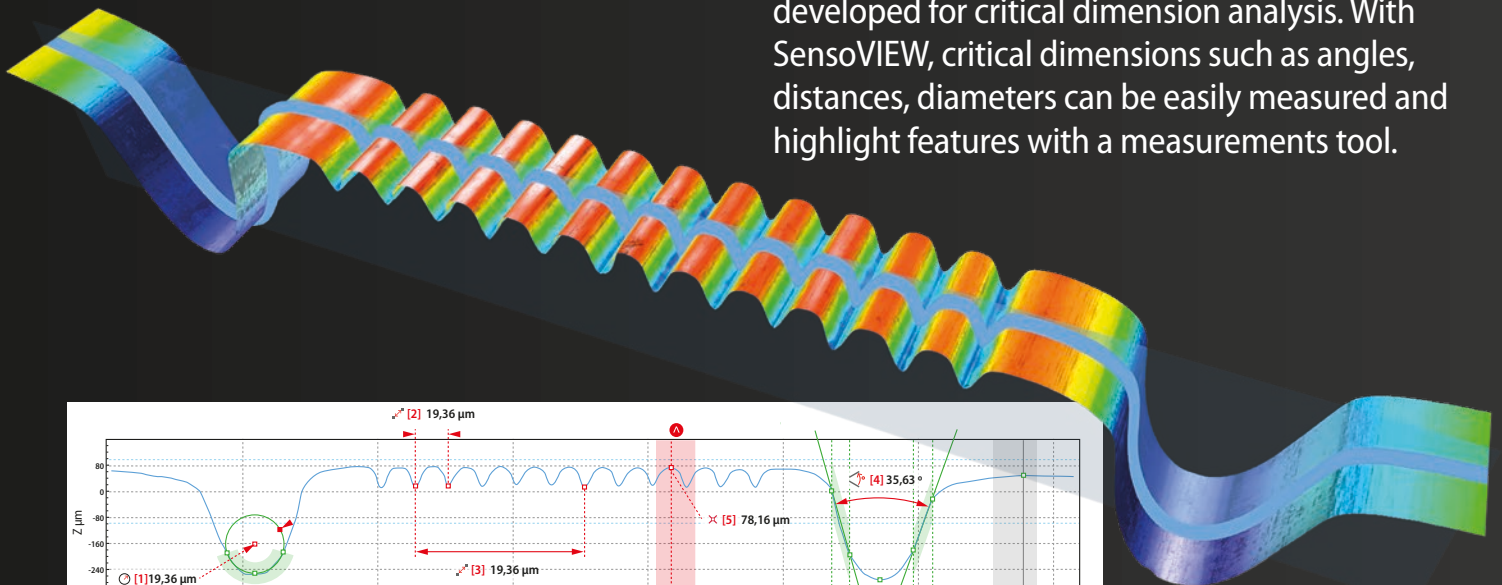


### Get your results

Get a customizable report or export the 3D measurement data in multiple formats.

# Measuring critical

Always with the priority of facilitating operations and procedures for the user, assist tools have been developed for critical dimension analysis. With SensoVIEW, critical dimensions such as angles, distances, diameters can be easily measured and highlight features with a measurements tool.

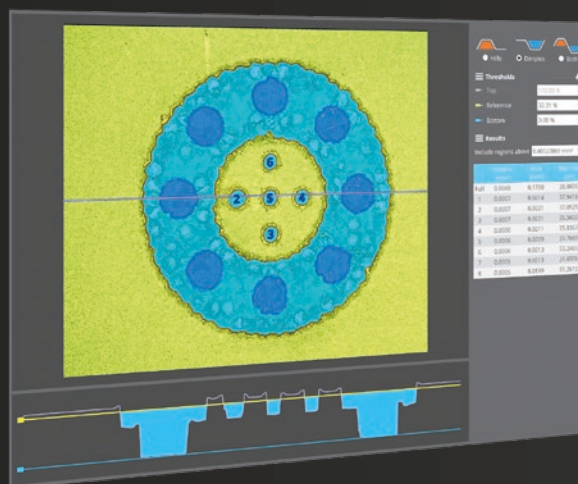


## Multiple measurement tools

A complete assortment of tools ready to add the most essential dimensions when measuring (radiuses, angles, diameters, step heights and perpendicular & parallel distances). These tools will return a numerical value for a particular dimension.

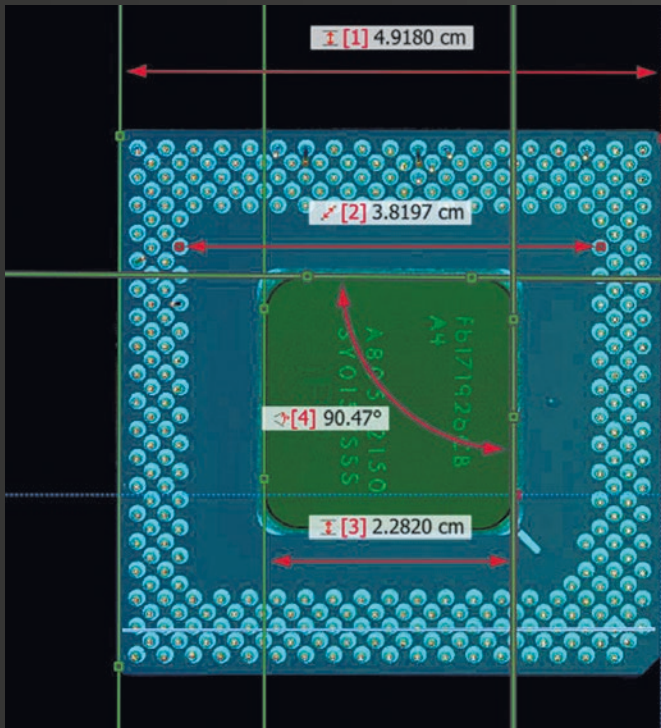
## Volume geometries

Our smart volume calculation allows the user to get the volume of a 3D topography. It does a smart segmentation based on thresholds applied in two profiles to obtain volume per each feature and total volume.






# dimensions in all axes



## Useful assist measurement tools

Assist tools facilitate the measurement of dimensions by drawing forms (points, lines, and circles) in the selected rendering view with the option of having the shape automatically detected within an area.

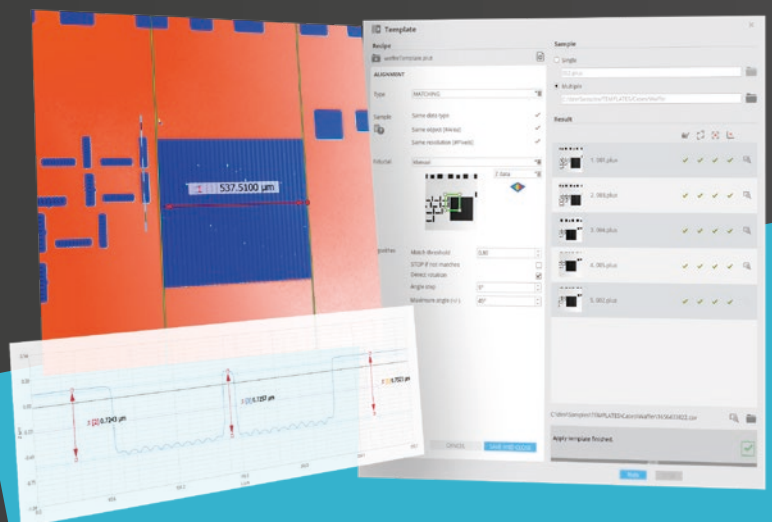


1	Parallel	4.9180 cm	✕
2	Two points	3.8197 cm	✕
3	Parallel	2.2820 cm	✕
4	Angle	90.47°	✕



## Customizable reports

With the possibility to choose from different report templates, the user can configure every section to fit as much as possible to their requirements. A flexible way to obtain clear and well-structured reports for each measurement, showing the acquisition information, 3D data, a 2D profile and all the ISO parameters, among others.



## Doing repetitive tasks, efficiently

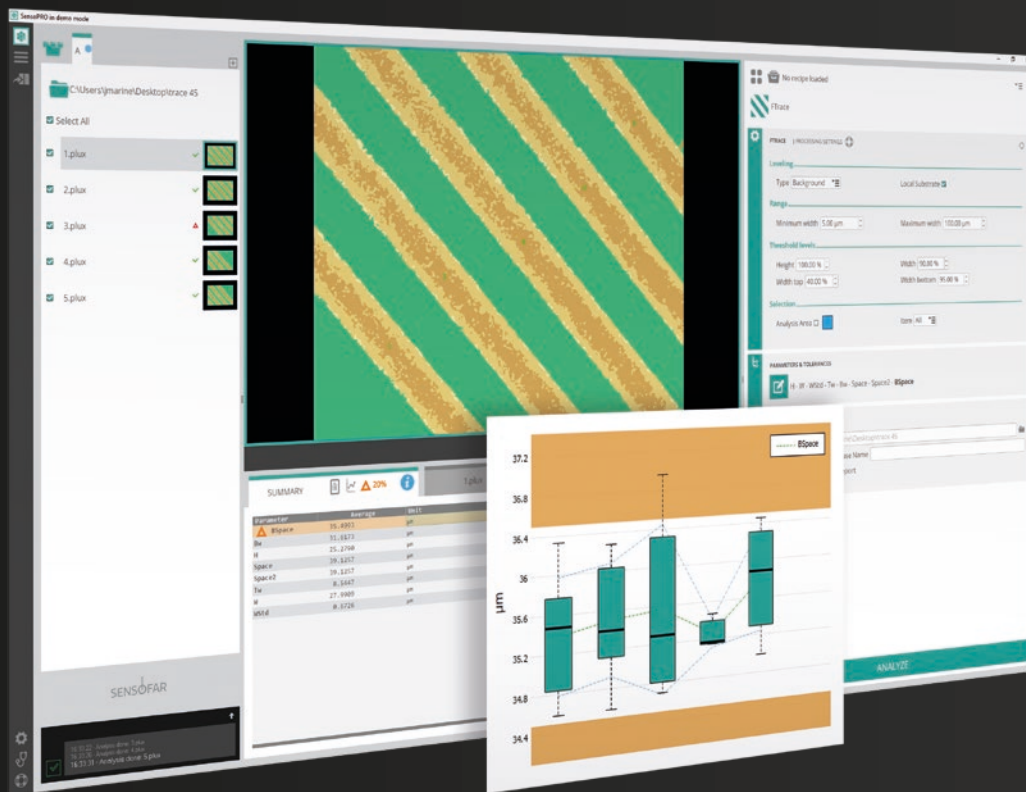
When a data process analysis is defined, it is possible to create analysis templates to apply these pre-determined filters and operator configurations to repetitive measurements.

# SensoPRO



24/7

# Rapid Quality Control



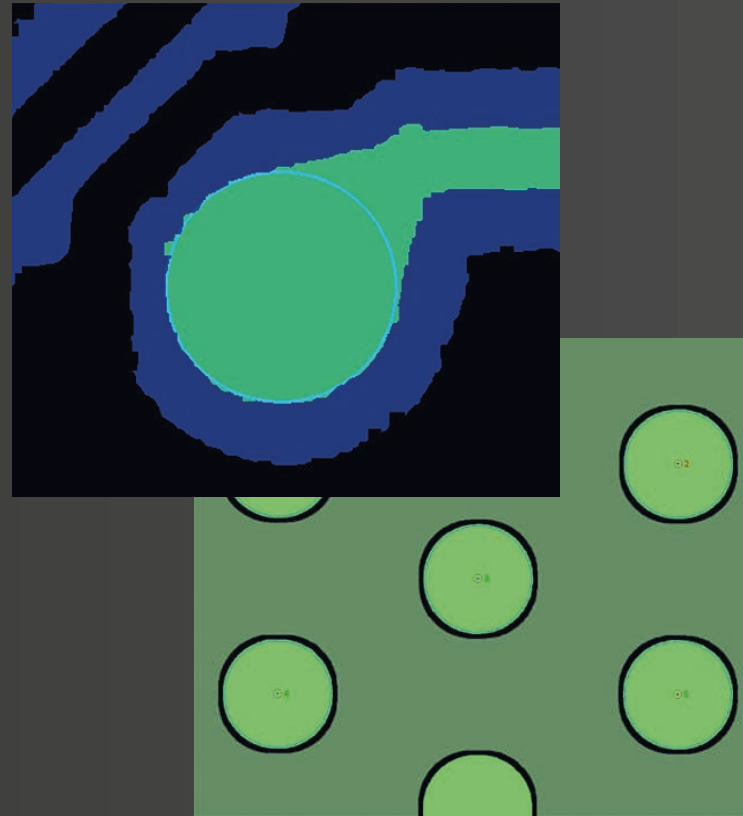
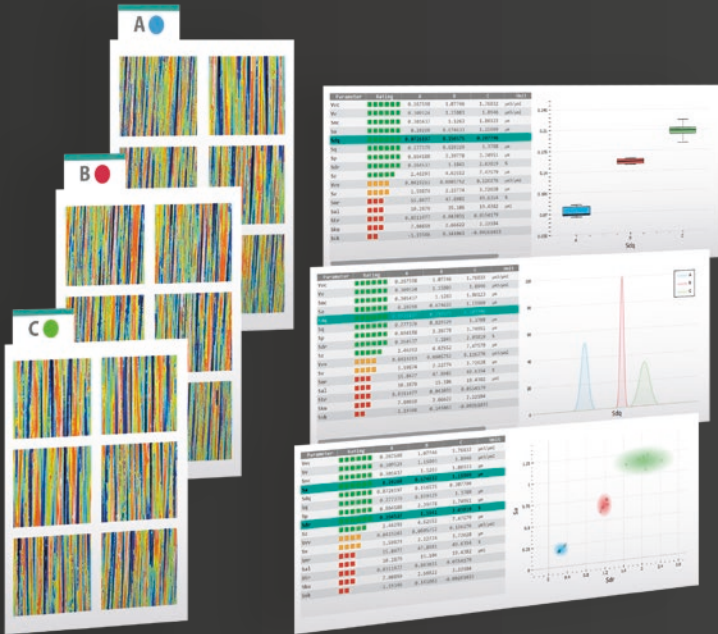
It has never been so easy to perform fast quality control in a production line. Thanks to SensoPRO, the operator in the production line only needs to load the sample and follow guided instructions. Plug-in-based data analysis algorithms provide a high degree of flexibility.



## Extremely fast

As multiple cores can now be fully utilized, a larger number of actions can be implemented in parallel, thus resulting in higher overall system performance. Easy to handle larger files, and/or larger multiple data sets.

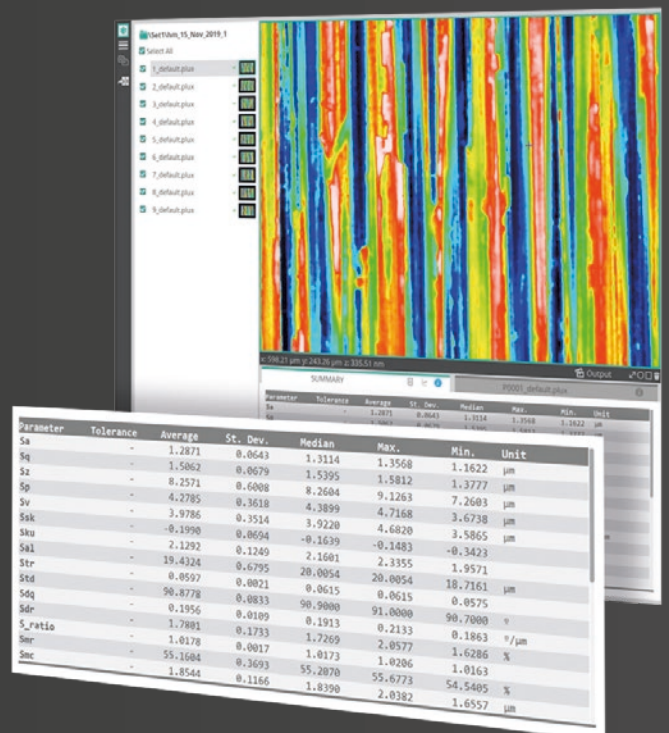
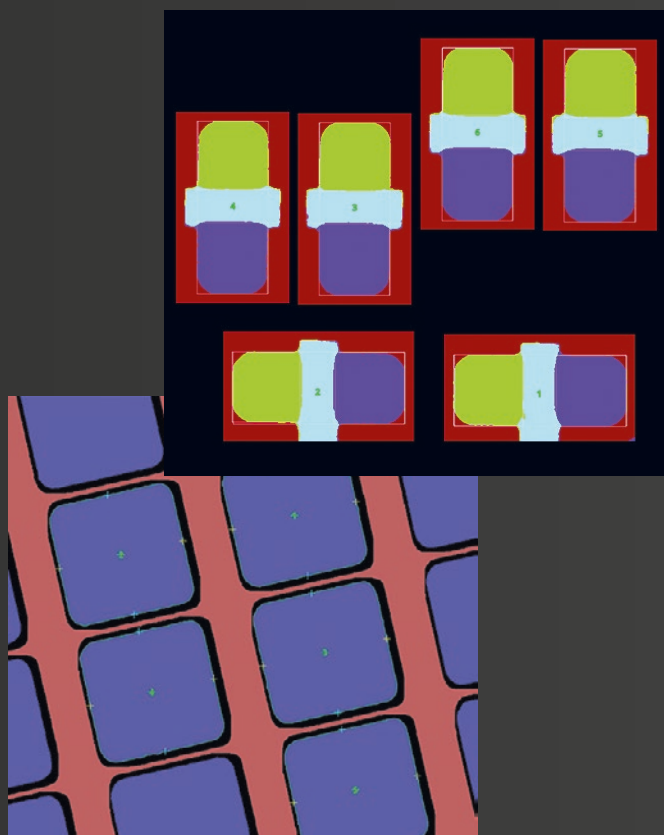
# Guided tool for the QC manager



A revolutionary innovation for optical profilometers which substantially improves its usability and simplifies the task of setting tolerances when creating a recipe, as well as deciding which are the key parameters to control the production line by comparing multiple sets of data. Specially conceived for non-expert users who need traceable production control.

## Results

Once the analysis is done, the results and the standard deviations for each parameter are shown on a table. If any tolerances are applied, these will be highlighted in the summary section. When multiple features are detected, they are numbered and can be selected to reveal the individual fit parameters. **SensoPRO** can export to Excel for user readability and CSV for programming integration.



# SensoPRO Plugins

This Plugin-based data analysis approach also provides a high degree of flexibility and specificity, making use of targeted algorithms that are optimized to the exact application needs.



## Processing settings

Comprising threshold settings, filters, operators, crop settings, etc., that can be applied to the measured data before the analysis. Each Plugin has its own suite of processing settings.



## Parameters & Tolerances

Set of fitting parameters and selection of tolerances for further analyses. Optimizes the results, e.g. according to known results, scaling, (manufacturing) conditions and tolerances.

Parameter	Average	St. Dev.	Unit
L1	182.965	1.26832	µm
W1	186.62	0.666153	µm
Z1	16.3865	0.195507	µm
Z2	15.8412	0.2756	µm
Z01	9.23902	0.539519	µm
Z02	9.78429	0.621179	µm
L2	192.425	2.06669	µm
W2	186.62	1.05328	µm
SL	455.8	1.94215	µm
SW	189.2	1.05328	µm
D	89.655	1.57992	µm
D1	1.29	1.15381	µm
D2	1.29	2.15858	µm
D3	0.86	1.33231	µm
D4	1.72	1.33231	µm

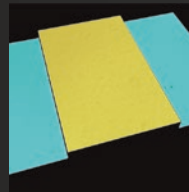
## Customizable Plugins

Sensofar adapts and develops all the analysis solutions you may need for your specific application.

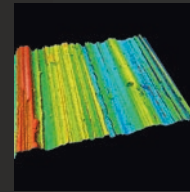
## Default Plugins



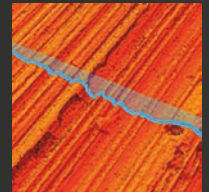
Step Height



Step Height ISO

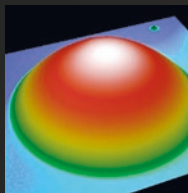


Surface Texture

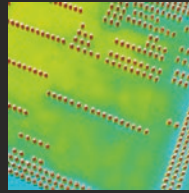


Surface Texture Profile

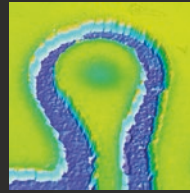
## Optional Plugins



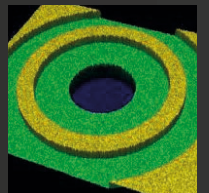
Aspheric



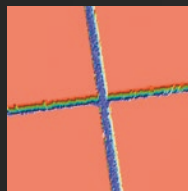
Bump



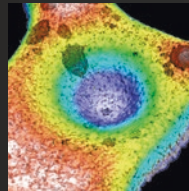
Circle Pad



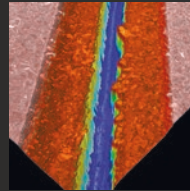
Concentricity



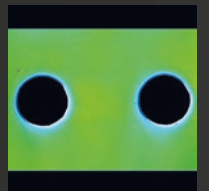
Cross Kerf



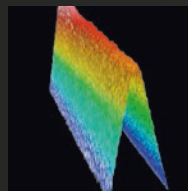
Dimple



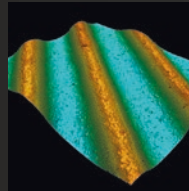
Double SH



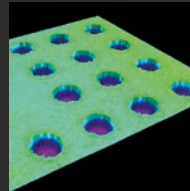
Dual Hole



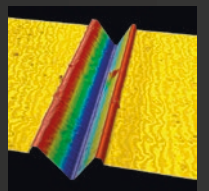
Edge



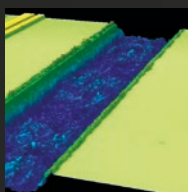
FTrace



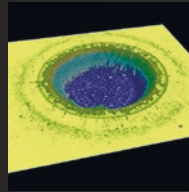
Hole



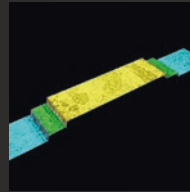
Laser Cut



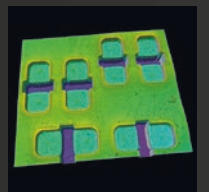
Laser Groove



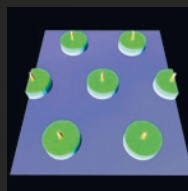
Laser Hole



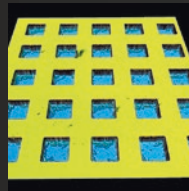
Multiple SH



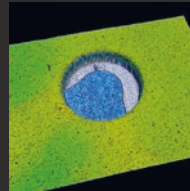
Pad



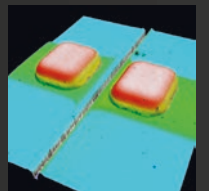
Pillar



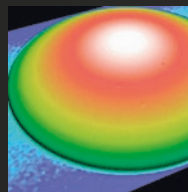
R Hole



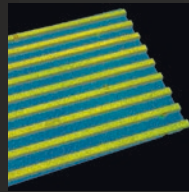
Solder Mask



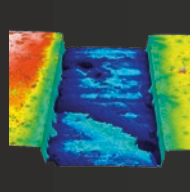
Spacer



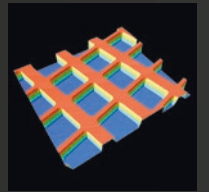
Spheric



Trace



Trench

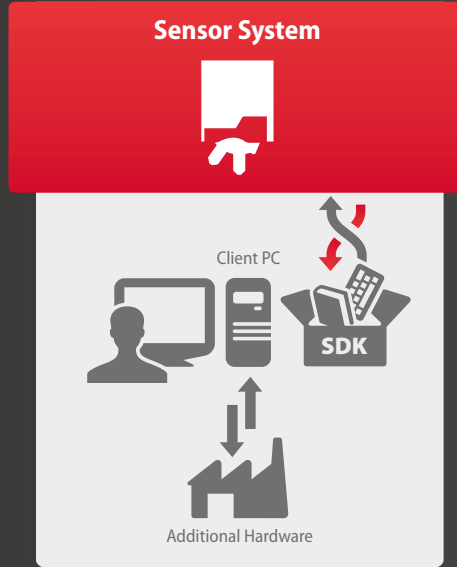


Wafer Pad



# SDK

The Software Development Kit (SDK) is an array of tools for creating proprietary applications to control our sensors. System integration is easy and provides the means to obtain automated measurements and to customize the acquisition interface. The SDK combines our sensor with additional hardware to create a metrology station.



# Fully automatic characterization

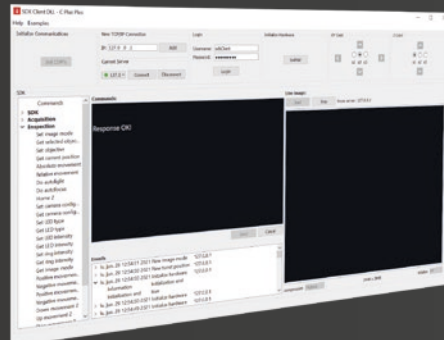
SDK and SensoPRO commands can automate measurements running several sensor heads at the same time while conducting the analysis. As a result, we get a pass and fail report of the feature of interest shortly after the last measurement is acquired, meeting requirements of high throughput applications.

Communication Protocol	Language	Operating system
Dll library	C++, C#	Windows® 8/10 64bits

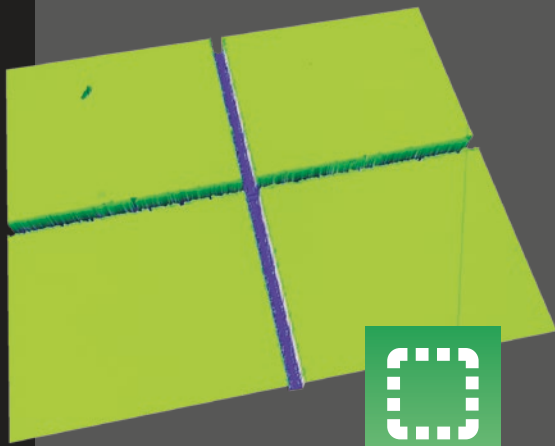
Using SDK you can manage our acquisition software SensoSCAN which works as a server. To do so, you can send SDK commands and subscribe to SDK events. SDK DLL (C++, C#, Windows 64 bits) reduces integration time.

## SDK client application

For both options, SDK Client application can be used to utilize SDK capabilities. It contains all the commands listed and it exemplifies what a specific command does exactly, how the commands are written and what are the resulting events. Furthermore, we also share the SDK client source code.



# Applications

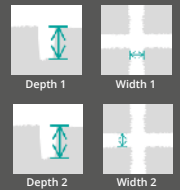


Ai Focus Variation

## SEMICONDUCTORS

### 3D Cross kerf

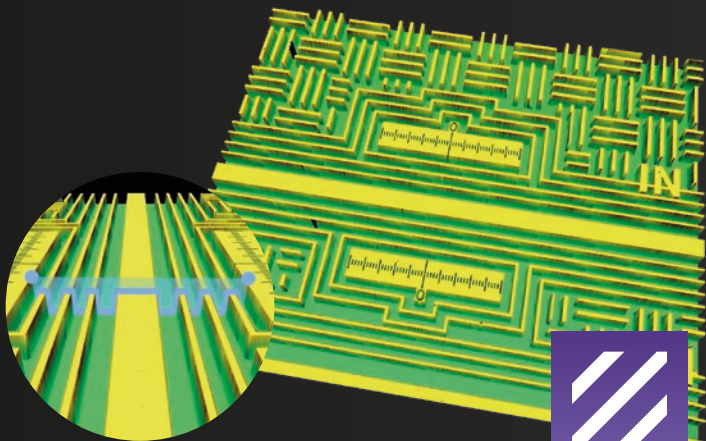
Chip segmentation has two main dimensions to characterize: height, to ensure that the bottom is not damaged, and width, which is a measure of the quality of the cut. The high aspect ratio of those dimensions is challenging and only Ai Focus Variation can resolve this application.



### Cross kerf

**SensoPRO Plugin**

This plugin not only detects the cross and extracts the desired parameters but also levels the surface to make sure that an existing angle in the wafer doesn't affect the extracted data.



Interferometry (CSI)

## SEMICONDUCTORS

### Etched circuit

After an etching process, it is typical to evaluate the height of the resulting features. To ensure the best accuracy on the measurement, interferometry is used.

### Step height

**SensoPRO Plugin**

Immediate recognition of the two levels of height regardless of the pattern analyzed.

## SEMICONDUCTORS

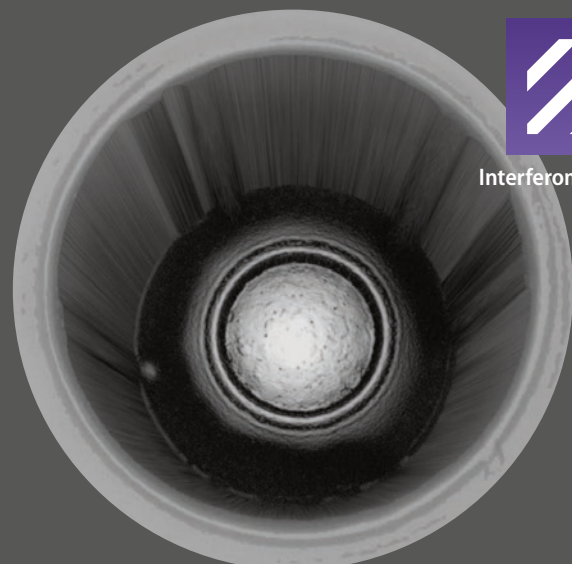
### Passivation layer hole

This passivated layer hole will be one connection point of the chip. Its dimensions should comply tight tolerances to ensure a good wire bond.

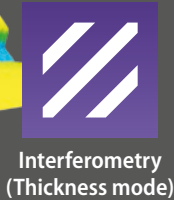
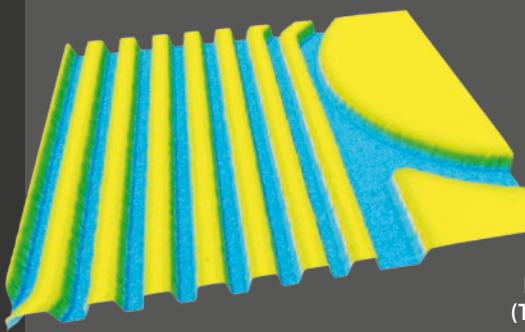
### Hole

**SensoPRO Plugin**

The Hole plugin is useful in this application since it can measure holes from 50  $\mu\text{m}$  to 2 mm in diameter.



Interferometry (CSI)



Interferometry  
(Thickness mode)

**PCB**

# Copper trace thickness under dry film

In the electroplating process, there is an area in which copper is deposited and another one that is covered in a resin. Traditionally, a part of the PCB panel was cut through to know the amount of copper deposited during the electroplating process. This can be avoided by using our Interferometry technique which can measure through optically transparent thick –films. Interferometry can image the substrate and the layer so the height of copper can be characterized, leading to a better yield of the manufacturing process.

## FTrace

**SensoPRO Plugin**

It automatically detects traces with different directions. All the plugins in SensoPRO have the possibility to see the tendency of values per each parameter.

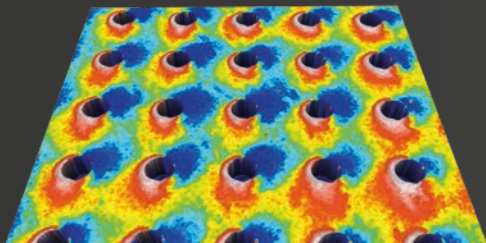


Sq values of background

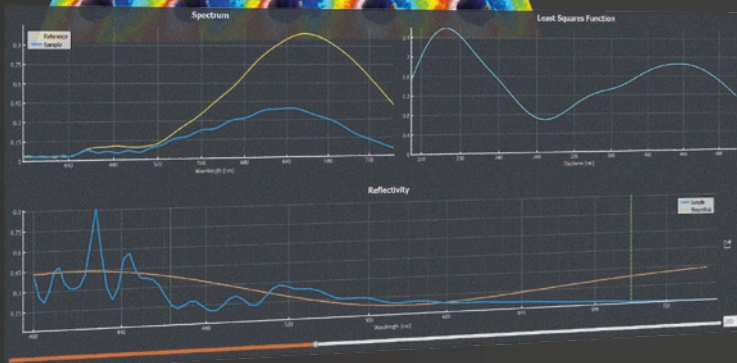
**SEMICONDUCTORS**

# Thin film inside holes

The S neox exceeds the applications for Spectroscopic Reflectometry since it can measure inside holes with very small diameters using a spot size down to 3 μm!

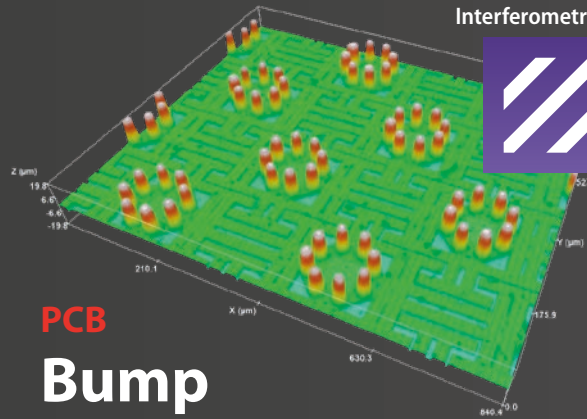


Spectroscopic Reflectometry



**INTEGRABLE HEADS**

Interferometry (CSI)



**PCB**

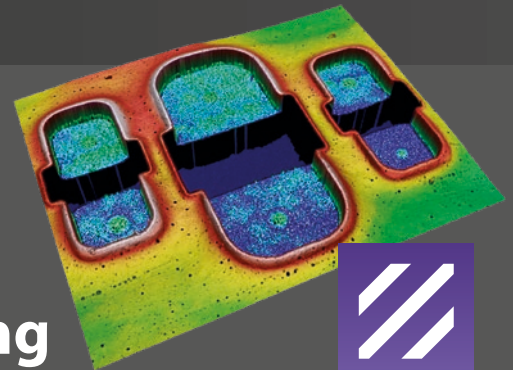
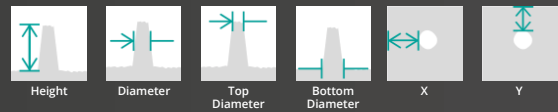
# Bump characterization

These structures are the base of the pins that the chip will have. Their position, height and diameter will determine the bump-pin union.

## Bumps

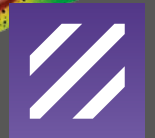
**SensoPRO Plugin**

The Bumps plugin can analyze up to 14.500 bumps.



**PCB**

# Welding opening pad



Interferometry (CSI)

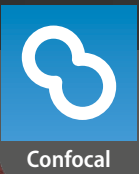
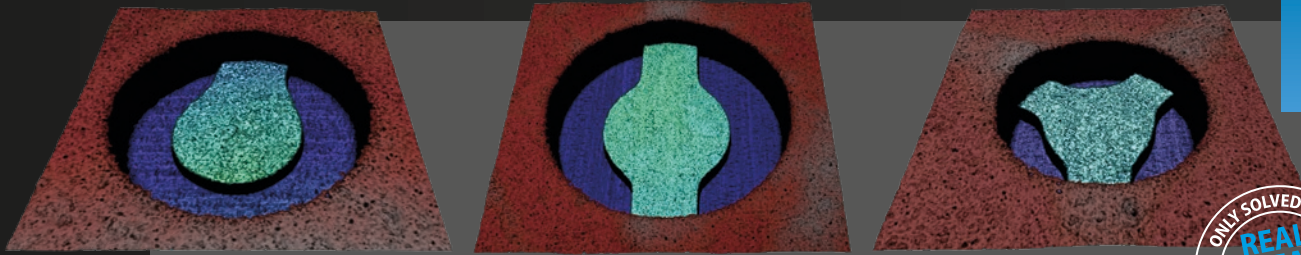
Knowing the most common disposition of pads, Sensofar has developed a specific plugin to recognize the individual pads or in any given pattern.

## Pads

**SensoPRO Plugin**



# Applications



PCB

## Solder mask welding

Solder Mask layers are usually applied to printed circuit boards (PCB) as protective layers. Openings for connections can have multiple number of connectors. The Solder mask plugin can easily recognize the different configurations and analyze the key parameters.

## Solder mask

**SensoPRO Plugin**



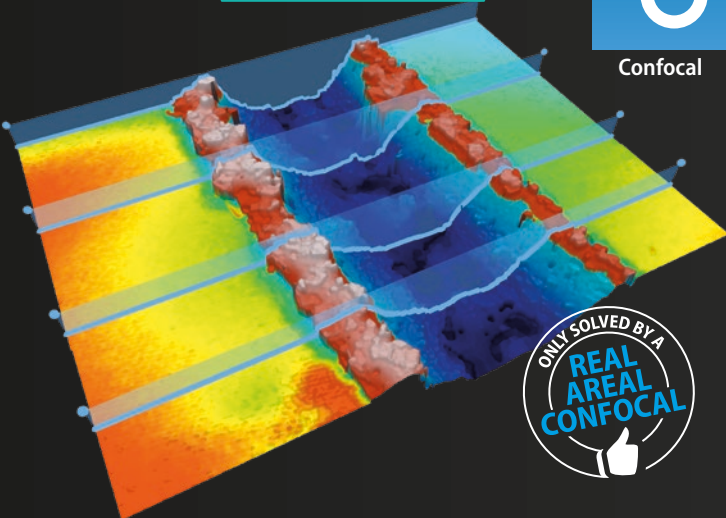
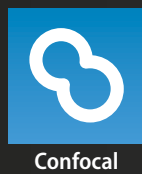
PCB

## Laser groove

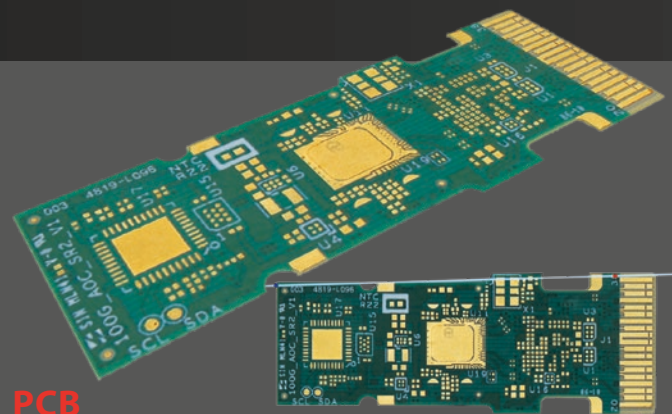
Laser cutting is one of the main front-end processes in the semiconductors field. In the case of PCBs, it is used for fabricating vias and channels of communication that need to be characterized (barbs, depth, etc.).

## Groove profile

**SensoPRO Plugin**



Groove profile plugin has been developed to analyze different structures generated with a laser.



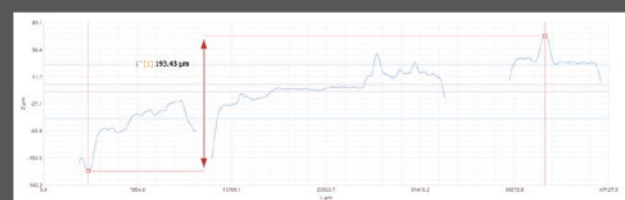
PCB

## Packaging compatibility

Laser cutting is one of the main front-end processes in the semiconductors field. In the case of PCBs, it is used for fabricating vias and channels of communication that need to be characterized (barbs, depth, etc.).



**SensoVIEW**



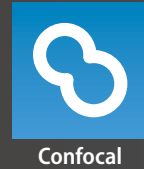
We can see where the highest and lowest points are located because SensoVIEW's profiling options include the possibility to draw profiles with the highest and lowest points included.



IC PACKING

# Thermal pad

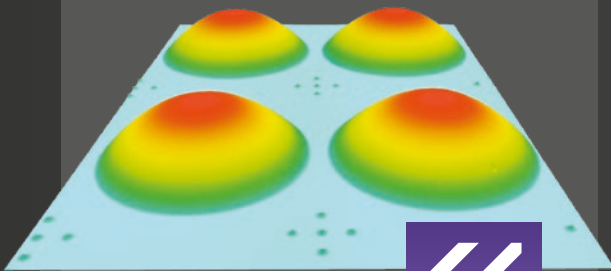
When there are parts that need an automatic and comprehensive characterization, SensoPRO can combine simultaneously different plugins. In the thermal pad case, the plugging of Surface Texture, Multiple SH and R Hole are combined to analyze the surface of the bottom, the height between the three pins' levels and the dimensions of the rectangular container, respectively.



OPTICS

# Microarray of aspheric lenses

Aspheric lenses, distinguished by their lower aberrations, are often used to build compact opto-electrical devices.



Interferometry (CSI)

# Aspheric

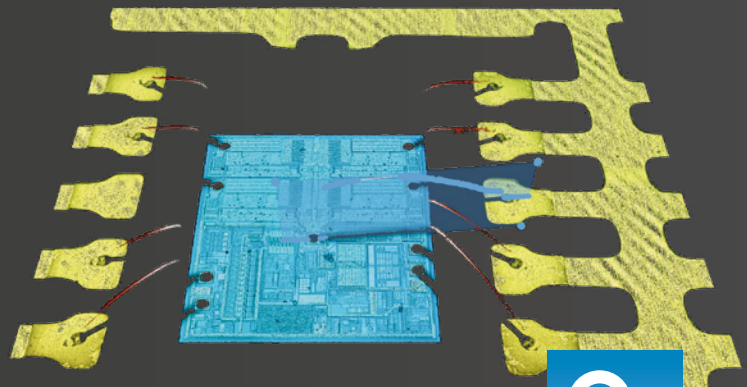


The Aspheric plugin calculates critical dimensions, 10 aspheric deformation coefficients and Sa, Sq and Sz roughness parameters.

# Spheric

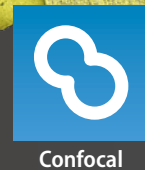


The Spheric plugin gives both dimensional parameters and residual roughness.

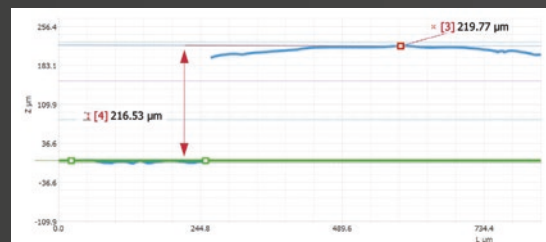


IC PACKING

# Wire bonding



Technology always pushes limits. Sensofar wants to be at the forefront. Vanguard technologies reduced the diameter of gold wires down to 30 μm, a significant improvement.



# SensoVIEW

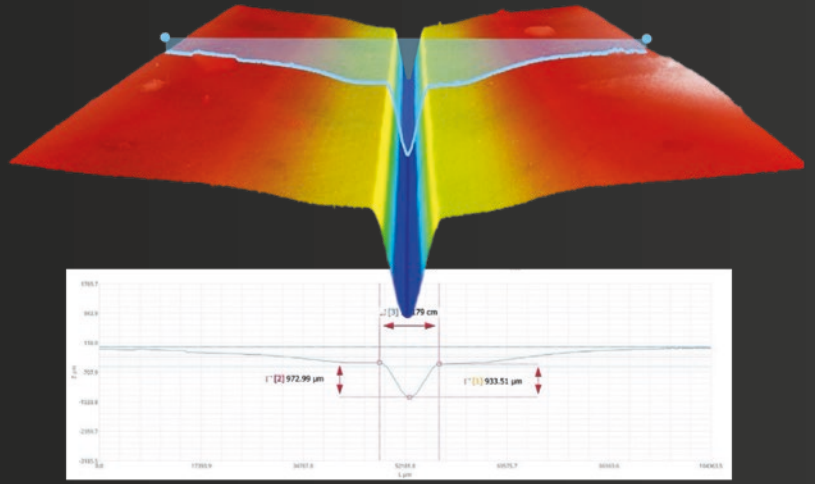
SensoVIEW can create as many profiles as needed and measure critical dimensions. This example shows the height difference between the maximum point of the wire and the chip since that parameter will determine whether or not the cable makes contact with the chip's cover.

# Applications

DISPLAY

## Foldable smartphone

The latest smartphones and tablets are starting to incorporate flexible screens that can be folded. Our S wide is used by screen manufacturers to characterize the depth and width of the foldable area. In this example, we have used 4x4 stitching.



Critical dimensions on the profile are allowed in this powerful analysis software.

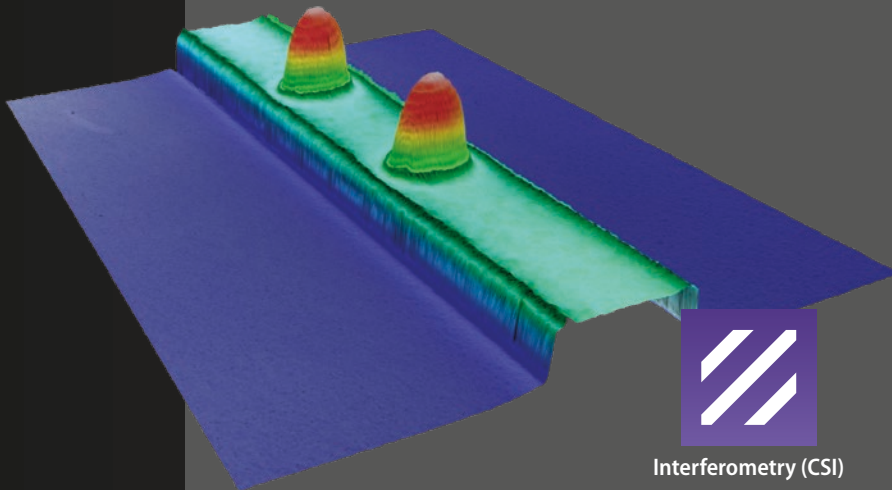


SensoVIEW

DISPLAY

## Spacer TFT

Displays are made of multiple layers that need to be separated a certain distance. Spacers are structures distributed all over the screen to ensure that gap.

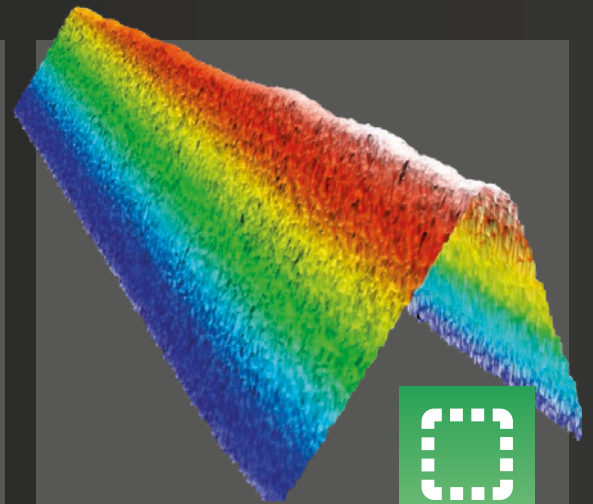


Interferometry (CSI)

## Spacer

SensoPRO Plugin

The Spacer plugin automatically detects different shapes of spacers: oval, round and square.



Ai Focus Variation

TOOLING

## Drill cutting edge

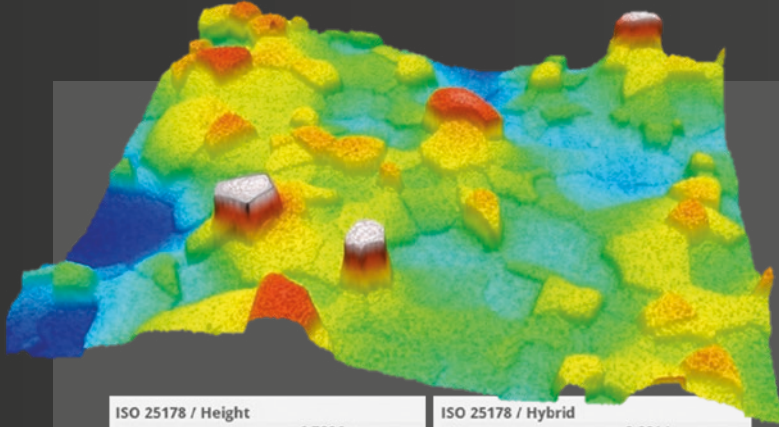
The edge of a cutting tool is directly related to the result of the cut part. Its characterization will then predict its performance.

## Edge

SensoPRO Plugin

The Cutting edge plugin measures the edge radius and other important parameters plus the top surface profile roughness (height parameters).





ISO 25178 / Height		ISO 25178 / Hybrid	
Sa	6.7096 nm	Sdq	0.0014
Sku	4.2318	Sdr	9.404e-5 %
Smean	6.0e-11 nm	Sratio	1.0000
Sp	41.547 nm		
Sq	8.6904 nm		
Ssk	0.3788		
Sv	24.305 nm		
Sz	65.852 nm		

ISO 25178 / Spatial	
Sal	34.320 μm
Std	118.0000 °
Str	0.5193



Interferometry (ePSI)

**SEMICONDUCTORS**

# SiC wafer roughness

Silicon Carbide (Si-C) wafers have astonishing electrical and thermal properties that know are a must for certain applications, like 5G chips. Since its production is using CVD (Chemical Vapor Deposition), characterizing their surface finish helps to understand if the lattice growth will be homogeneous.



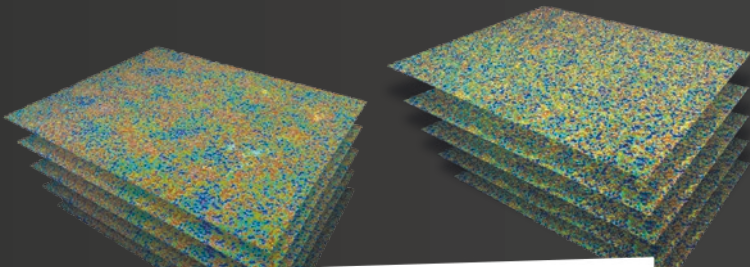
## SensoVIEW

Height, Lateral and hybrid and parameters will be very interesting to characterize well the crystals.

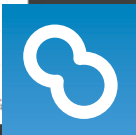
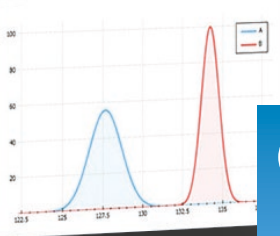
**SURFACE FINISH**

# Copper wire adhesion

The surface finish of a material impacts material behavior. In this case, the interesting property is the adhesion of copper with a conductive material used in the welding process.



Parameter	A	B	Unit	Rating
Bs	127.676	134.229	μm	★★★★★
Depth	119.734	131.028	μm	★★★★★
ECC	0.91321	0.636939		★★★★★
Y	230.027	254.88	μm	★★★★★
A	1.66038	9.81782	μm	★★★★★
X	326.351	301.986	μm	★★★★★
BX	326.572	305.282	μm	★★★★★
Ba	113.145	123.595	μm	★★★★★
TopDiameter	242.372	243.787	μm	★★★★★
BY	230.652	245.859	μm	★★★★★
BottomDiam.	170.07	158.078	μm	★★★★★
Bab	0.886856	0.923778	/	★★★★★

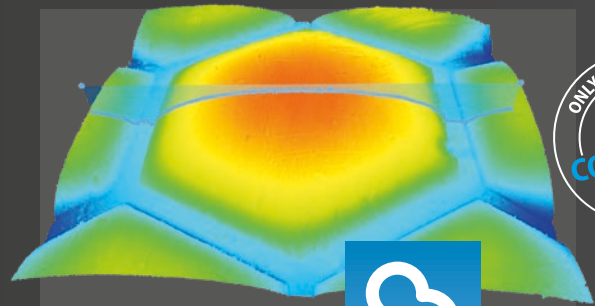


Confocal

# Surface Texture



Understanding which roughness parameter differentiates two sets of samples with different adhesion can help the user to correlate specific roughness parameters with adhesion.



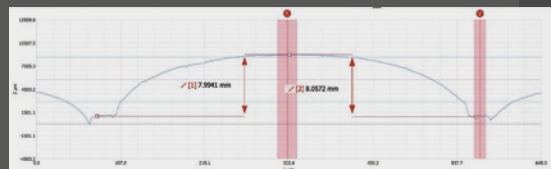
Confocal

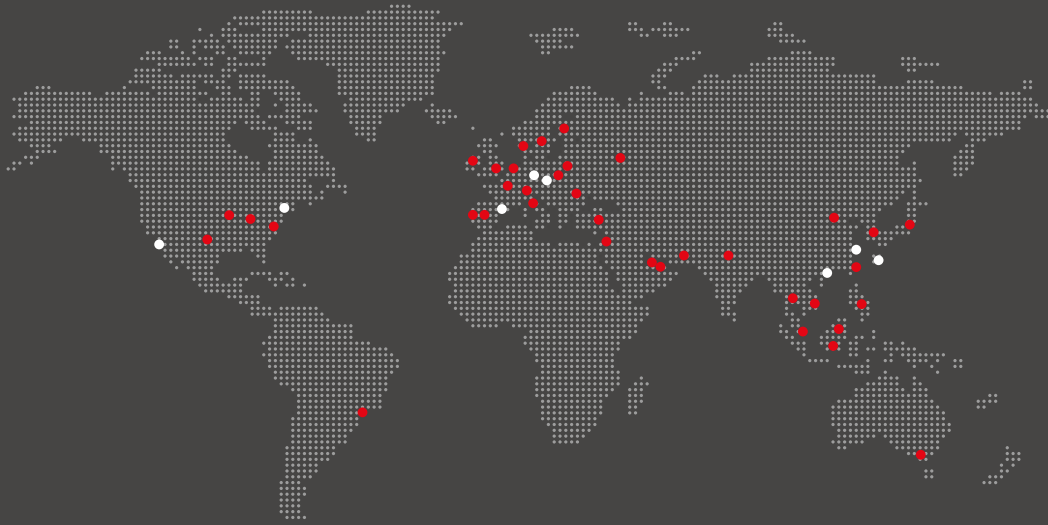
# Polygonal lenses

Hexagonal microlenses are a typical geometry used in lens microarrays and they stand out for their high density. Confocal technology is the best technology to measure the high slopes in this polished sample.



## SensoVIEW





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, focus variation and fringe projection techniques, from standard setups for R&D and quality inspection laboratories to complete non-contact metrology solutions for in-line production processes. The Sensofar Group has its headquarters in Barcelona, known as a technology and innovation hub in Europe. The Group is represented in over 30 countries through a global network of partners and has its own offices in Asia, Germany and the United States.

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