S neox

Five Axis

SENSOFAR
METROLOGY

Product Guide

Basic Features

■ Description

The S neox Five Axis 3D Optical profiler combines a high-accuracy rotational module with advanced inspection and analysis capabilities. This enables automatic 3D surface measurements at defined positions which are combined to create a complete 3D volumetric measurement. S neox 3D measurement technologies cover a wide range of scales, including form (Ai Focus Variation), sub nanometric roughness (Interferometry) or critical dimensions that require high lateral resolution as well as vertical resolution (Confocal).

The S neox Five Axis system makes it possible to take automatic 3D surface measurements at defined positions, and combine them to create a complete 3D volumetric measurement or to inspect the surface finish at specific positions around the sample.
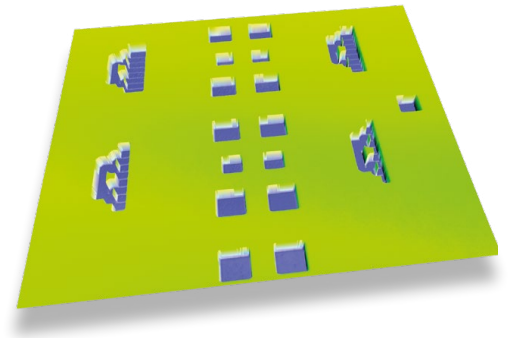
■ Technology

CONFOCAL

Confocal profilers have been developed to measure the surface height of 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 0.10 µm, which is ideal for critical dimension measurements. High numerical aperture (0.95) and magnification (150X) objectives are available to measure smooth surfaces with steep local slopes over 70° (for rough surfaces up to 86°).
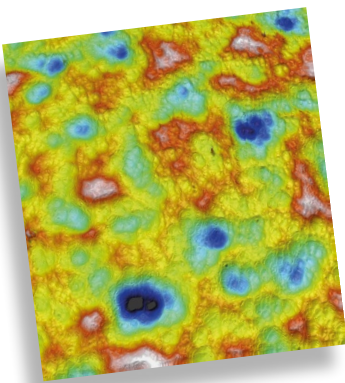
☐ **CONTINUOUS CONFOCAL** has been developed to acquire in Confocal technique using a continuous z-axis scan. Acquisition speed is roughly 3X faster than Sensofar's own Confocal approach while maintaining comparable repeatability and accuracy.

☐ **CONFOCAL FUSION** refers to new measurement technique that draws the best out of Sensofar's Confocal and Ai Focus Variation techniques by using a unique smart algorithm that yields the most reliable data from a single scan. It is ideal for highly complex or technical surfaces exhibiting both steep rough and steep smooth areas, and where a traditional confocal approach alone would fail to capture the surface adequately.

INTERFEROMETRY

- ☐ **PSI**: Phase shift interferometers have been developed to measure the surface height of very smooth and continuous surfaces with sub-nanometer resolution. PSI profiling provides sub-nanometer vertical 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.

- ☐ **ePSI**: The system scans the required range in Z. The PSI algorithm is applied in. Used for: Measuring ultra-polished / polished / flat surfaces with low / mid roughness, achieving high vertical resolution (down to 1 nm) independent of the magnification of the objective.

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

Ai FOCUS VARIATION^{NEW}

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 surface. Highlights of the technology include high slope surfaces (up to 86°), highest speeds (mm/s) and large vertical range measurements.
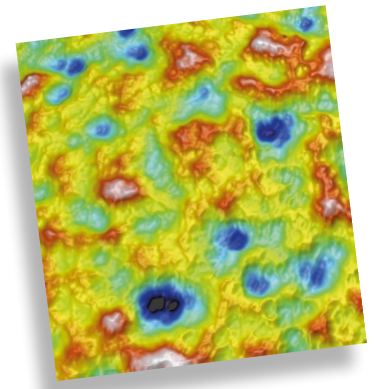
■ Configuration

The S neox Five Axis is a modular system with several optional parts. It is composed of a system unit, an electronic controller and a main controller.

HARDWARE OPTIONS

The sensorhead is mounted on an adjustable column supported by a standard base. The sample is clamped in the rotational module to be placed under the objective. The Five Axis rotational module is installed on the top of a motorized XY stage. A manual tip-tilt is an option on the system unit. Ring light is included in the system by default.

Finally, the system has a linear stage with 40 mm of travel length. Optionally, for highest accuracy and repeatability measurements a PZT vertical scanner with 200 µm travel length is recommended.

MECHANICAL DIMENSIONS

System weight: 77 kg (170 lbs)

945 mm (37.2")

610 mm (24")

635 mm (25")
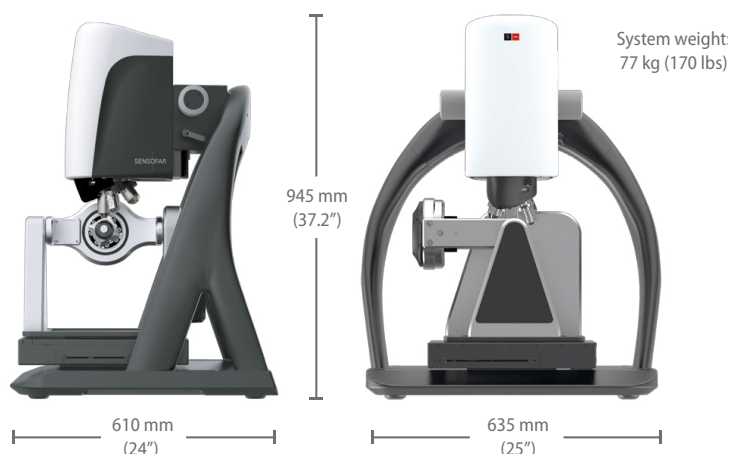
SYSTEM SPECIFICATIONS

Measuring principle	Confocal, PSI, ePSI, CSI, Ai Focus Variation and Thin Film
Observation types	Brightfield, Sequential Color RGB, Confocal, Interferential Phase Contrast
Measurement types	Image, 3D, 3D thickness, profile and coordinates
Camera	5Mpx: 2448x2048 pixels (60 fps)
Total magnification (27") / Display Res.	60X – 21600X / 0.001 nm
Field of view	from 0.018 to 6.7 mm (single shot)
Max. extended measurement area	10x12 (Max. Resolution); 175x175 (Low resolution) (500 Mpx)
Confocal frame rate	60 fps (5Mpx); 180 fps (1.2 Mpx)
Vertical scan range coarse	Linear stage: 40 mm range; 5 nm resolution
Vertical scan range fine	Piezoelectric scanner with capacitive sensor: 200 μm range; 1.25 nm resolution
Max. Z measuring range	PSI 20 μm; CSI 10 mm; Confocal & Ai Focus Variation 34 mm
XY stage range	Motorized: 154x154 mm
LED light sources	Red (630 nm); green (530 nm); blue (460 nm) and white (575 nm; center)
Ring light illumination	Green ring light compatible with 6 position nosepiece
Nosepiece	6 position fully motorized
Sample reflectivity	0.05 % to 100%
Sample weight	up to 3 Kg
User management rights	Administrator, supervisor, advanced operator, operator
Optional advanced software analysis	SensoMAP, SensoPRO, SensoMATCH, SensoCOMP, Geomagic®
Power	Line Voltage 100–240 V AC; frequency 50/60 Hz single phase
Computer	Latest INTEL processor; 3840x2160 pixels resolution (4K) (27")
Operating system	Microsoft Windows 10, 64 bit
Environment	Temperature 10 ºC to 35 ºC; Humidity <80 % RH; Altitude <2000 m

ACCURACY AND REPEATABILITY[1]

Standard	Value (nm)	Piezoelectric scanner U , σ	Linear scanner U , σ	Technique
Step height	48600 nm	U = 300 nm σ = 10 nm	U = 300 nm σ = 35 nm	Confocal & CSI
	7616 nm	U = 79 nm σ = 5 nm	U = 70 nm σ = 12 nm	Confocal & CSI
	941.6 nm	U = 7 nm σ = 1 nm	U = 14 nm σ = 4 nm	Confocal & CSI
	186 nm	U = 4 nm σ = 0.4 nm	U = 4 nm σ = 1 nm	Confocal & CSI
	44.3 nm	U = 0.5 nm σ = 0.1 nm	U = 0.5 nm σ = 0.15 nm	PSI
	10.8 nm	U = 0.5 nm σ = 0.05 nm	U = 0.5 nm σ = 0.15 nm	PSI
Areal roughness (Sa)[2]	0.79 μm	U = 0.04 μm σ = 0.0005 μm	U = 0.03 μm σ = 0.002 μm	Confocal, AiFV & CSI
Profile roughness (Sa)[3]	2.40 μm	U = 0.03 μm σ = 0.002 μm	U = 0.025 μm σ = 0.004 μm	Confocal, AiFV & CSI
	0.88 μm	U = 0.015 μm σ = 0.0005 μm	U = 0.015 μm σ = 0.004 μm	Confocal, AiFV & CSI
	0.23 μm	U = 0.005 μm σ = 0.0002 μm	U = 0.01 μm σ = 0.001 μm	Confocal, AiFV & CSI

1 Objective used for Confocal and Ai Focus Variation 50X 0.80 NA and for CSI and PSI 50X 0.55NA. Resolution 1220x1024 pixels. Uncertainty (U) according to ISO/IEC guide 98-3:2008 GUM:1995, K=1,96 (level of confidence 95%). **σ** according to 25 measures. **2** Area of 1x1 mm. **3** Profile of 4 mm length.

ROTATIONAL STAGE[4]

Max. measurable diameter	200 mm
Max. clamping diameter[5]	20 mm
Max. workpiece weight	3 kg
Accuracy (A)	5 Arc sec/º
Bidirectional repeatability (A)	10 Arc sec
Resolution (B)	0.5 Arc sec
Straightness error[6]	3.6 μm / 40 mm
Parellelism error[6]	53.9 μm / 40 mm
Flatness error[7]	20 μm

4 All values according to ISO1101 at 20ºC +/- 1º in an anti-vibration environment. **5** ER32 collet holder. **6** St Flatness deviation according to ISO25178-2 taken on a SiC reference flat mirror and 20X objective in Confocal acquisition mode. **7** All values are taken with a 20X objective in Confocal acquisition mode and 40 mm evaluation length.

Objective Lenses

■ Specifications

The S neox Five Axis uses premium CF60-2 Nikon objective lenses that have been designed to correct for chromatic aberrations and produce sharp, flat and clear images with high contrast and high resolution. Phase Fresnel lenses improve the operability and the working distance, meaning that S neox Five Axis lenses provide the largest available working distance for each NA.

The S neox Five Axis also uses interferometry objective lenses. The TI series are based on Michelson interferometer which has an external reference mirror mounted on two tip-tilt screws. The DI series are based on Mirau lenses that create interference internally by dividing the wave front with a beamsplitter. The TI series are ideal objective lenses for very flat and thin samples due to their low magnification and numerical aperture. The DI series can have up to 0.7 NA.

Brightfield objective lenses

Magnification	NA	WD (mm)	FOV (µm)	Spatial Sampling (µm)	Optical Resolution Green (µm)	Optical Resolution Blue (µm)	Optical Resolution Red (µm)	Optical Resolution White (µm)	Maximum Slope (º)	Vertical Resolution (nm)
1X EPI	0.03	3.80	16891 x 14131	6.90	5.41	4.68	6.43	5.85	2	-
2.5X EPI	0.075	6.50	6756 x 5652	2.76	2.16	1.87	2.57	2.34	4	300
5X EPI	0.15	23.50	3378 x 2826	1.38	1.08	0.94	1.29	1.17	9	100
10X EPI	0.30	17.50	1689 x 1413	0.69	0.54	0.47	0.64	0.58	17	30
20X EPI	0.45	4.50	845 x 707	0.34	0.36	0.31	0.43	0.39	27	8
50X EPI	0.80	1.00	338 x 283	0.13	0.20	0.18	0.24	0.22	53	4
50X EPI	0.80	2.00	338 x 283	0.13	0.20	0.18	0.24	0.22	53	4
50X EPI	0.95	0.35	338 x 283	0.13	0.17	0.15	0.20	0.18	72	4
100X EPI	0.90	1.00	169 x 141	0.07	0.18	0.16	0.21	0.19	64	3
100X EPI	0.90	2.00	169 x 141	0.07	0.18	0.16	0.21	0.19	64	3
100X EPI	0.95	0.32	169 x 141	0.07	0.17	0.15	0.20	0.18	72	3
150X EPI	0.90	1.50	113 x 94	0.05	0.18	0.16	0.21	0.19	64	2
150X EPI	0.95	0.20	113 x 94	0.05	0.17	0.15	0.20	0.18	72	2
20X ELWD	0.40	19.00	845 x 707	0.34	0.41	0.35	0.48	0.44	24	10

Magnification	NA	WD (mm)	FOV (µm)							
50X ELWD	0.60	11.00	338 x 283	0.13	0.27	0.23	0.32	0.29	37	5
100X ELWD	0.80	4.50	169 x 141	0.07	0.20	0.18	0.24	0.22	53	3
10X SLWD	0.20	37.00	1689 x 1413	0.69	0.81	0.70	0.96	0.88	12	50
20X SLWD	0.30	30.00	845 x 707	0.34	0.54	0.47	0.64	0.58	17	20
50X SLWD	0.40	22.00	338 x 283	0.13	0.41	0.35	0.48	0.44	24	15
100X SLWD	0.60	10.00	169 x 141	0.07	0.27	0.23	0.32	0.29	37	10

Interferometry objective lenses

Magnification	NA	WD (mm)	FOV (µm)	Spatial Sampling (µm)	Optical Resolution Green (µm)	Optical Resolution Blue (µm)	Optical Resolution Red (µm)	Optical Resolution White (µm)	Maximum Slope (º)
5X TI	0.13	9.30	3378 x 2826	1.38	1.25	1.08	1.48	1.35	7
10X DI	0.30	7.40	1689 x 1413	0.69	0.54	0.47	0.64	0.58	17
20X DI	0.40	4.70	845 x 707	0.34	0.41	0.35	0.48	0.44	24
50X DI	0.55	3.40	338 x 283	0.13	0.30	0.26	0.35	0.32	33
100X DI	0.70	2.00	169 x 141	0.07	0.23	0.20	0.28	0.25	44
System noise			PSI/ePSI 0.1 nm (0.01 nm with PZT *)			VSI 1 nm			

◼ Selection Guide

The selection of the objective lens depends on the application, the sample under test and the conditions of the 3D optical profiler placement.

S neox Five Axis uses brightfield and interferometry objective lenses. To perform interferometric measurements and confocal measurements at high magnifications, a vibration isolated environment is required. The following table tries to classify the sample under test by its surface finish and geometry to the best technique.

Surface under test description	Optical technique	Objective needed	Description
Smooth surface			
High local slope	Confocal	50X EPI to 150X EPI	High light efficiency and high numerical aperture
Low local slope with few nanometer features (flat samples)	Confocal and VSI	50X EPI to150X EPI 10X DI to 100X DI	High repeatability, moderate numerical aperture and low to high magnification
Low local slope and large FOV	PSI	5X TI	Low magnification and high repeatability
Rough surface			
Large FOV	Confocal and VSI	10X EPI to 20X EPI 10X DI to 20X DI	Extended measurements and moderate numerical aperture for low magnification

High local slope with few nanometer features	Confocal	50X EPI to150X EPI	High numerical aperture and magnification
High aspect ratio	Confocal	10X SLWD to 100X SLWD	Low numerical aperture and super long working distance
High local slope	Ai Focus Variation	5X EPI to 20X EPI	Low magnification
Form and shape	Ai Focus Variation	5X EPI to 20X EPI	Low magnitication

■ Techniques Comparison

	Confocal	Interferometry	Ai Fovus Variation
Magnification	High magnifications up to 150X	Low magnifications down to 5X (large FOVs with Armstrong vertical resolution)	High magnifications up to 150X
NA	Very high NA from 50X magnifications allowing measurement of slopes up to 70º for smooth surfaces (86º for rough surfaces)	Highest NA is 0.70 (100X)	Even NA slopes up to 86º with scattering surfaces can be measured
Vertical resolution	High repeatability (low noise) for high NA, from 0.90 NA the noise is close to 1 nm	High repeatability independently from the NA for PSI down to 0.01 nm and VSI down to 1 nm	Minimum vertical resolution is 10 nm
Optical resolution	Short wavelength and high NA, lateral resolutions up to 0.15 µm	Short wavelength, lateral resolutions up to 0.20 µm	Short wavelength and high NA, lateral resolutions up to 0.44 µm
Acquisition speed	Fast acquisition for 20 planes, 3 seconds	Speed does not depend on magnification	Really fast acquisition 200 planes in 3 seconds
Film thickness	Thick film (several mm) measured with low NA and thin film (2 µm) measured with high NA. Substrate image coincides with the focus position allowing measurement of the roughness substrate	Thin film (1 µm) measurements independently from the NA	Not applicable

Hardware Components

▮ Sensorhead, Main Controller, Stand and Positioning Stage

S neox Five Axis uses microdisplay technology to be able to acquire in Ai Focus Variation, Confocal and Interferometry modes.

The standard configuration includes:

- ☐ Sensorhead
  - ▪ Four high-power LEDs integrated into the light source (red, green, blue and white)
  - ▪ A Hi-Res CMOS camera with 2448x2048 pixels (5Mpx)
  - ▪ A Z stage with 40 mm of travel length
  - ▪ A 6-position motorized nosepiece
  - ▪ Ring light pack

- ☐ Postioning stage
  - ▪ 2-axis rotational module
  - ▪ Flat holder
  - ▪ Motorized XY stage 154x154 mm (6x6")

- ☐ High stand

- ☐ Main controller

- ☐ 4K monitor of 3840 x 2160 pixels (27")

- ☐ Electronic controller

- ☐ Joystick

- ☐ EMO

- ☐ Calibration pack

Options for sensorhead are as follows:

☐ Piezo: the PZT scanner z-axis is optional for S neox. This scanning device has a total travel length up to 200 µm with piezo resistive sensors for high position resolution of 0.7 nm and 1 nm of accuracy on the full travel range. It improves the interferential measurements with repeatability down to 0.01 nm.

PN SSN090FA00 | S neox Five Axis 3D Optical Profiler

PN SSN090FAP00 | S neox Five Axis 3D Optical Profiler w/Piezo

■ Rotational Module

The Five Axis rotational stage is made up of a high-precision motorized rotation axis with 360º endless rotation, 1 arc sec positioning repeatability and a motorized tilt axis, -30º to 110º, 1 arc min positioning repeatability, with limit switch. It is equipped with a System3R clamping system.

PN UPG5AXIS090 | S neox Five Axis Upgrade Kit

■ Main Controller

The main controller set an HP computer (latest INTEL processor) with Windows® 10 64-bit, a high-resolution display of 3840x2160 pixels (27"), keyboard and mouse.

PN PR001464 | HP computer Sneox 5Axis

Main controller features	
HP Z1 Entry Tower G5 RTX 2070	
Operating system	Windows® 10 Pro 64-bit
Processor	Intel® Core™ i7-9700 (3.00 GHz, 8 cores)
RAM Memory	32 Gb
Hard Drive	256 GB SSD PCIe® NVMe™ 1 Tb SATA (7200 rpm)
Graphics	NVIDIA® GeForce RTX™ 2070 (dedicated 8 GB GDDR5)
Network	Intel® I219LM GbE LOM
Dimensions (W x H x D)	15.4 x 37 x 36.5 cm // 6.06 x 14.56 x 14.37 in
Weight	9.86 Kg 21.73 lb
Power Supply	500 W

Monitor features	
LG 27UL500	
Dimensions (W x H x D)	62.2 x 45.9 x 20.8 cm - 24.5 x 18.1 x 8.2 in
Weight	5.13 Kg - 11.31 lb
Power Supply	29.5 W

■ XY Stage

Motorized XY stage optimized for 2D and 3D measurement. The user can center the sample by using a 3D external joystick (included) or the virtual joystick of the software. Travel range of 154x154 mm (6x6"). This stage allows measured extended measurements, the system automatically moves the sample and measures contiguous fields of view, stitching the results and getting larger measurements areas. Metric accuracy of 0.15 μm and unidirectional repeatability of ±0.7 μm. Maximum load capacity up to 20 kg (44 lbs). Sample plate with rotator to center the sample more easily is optional.

PN XYH10509000 | Motorized 154x154 mm (6x6") XY stage

■ Joystick

The joystick enables you to easily navigate digital models or camera positions in 3D space. Simply push, pull, twist or tilt the mouse controller cap to pan, zoom and rotate your model precisely and intuitively.

It features programmable function keys for access to application commands such as: Autofocus, Image view, Autolight, etc.

PN PR000724SV | Space Mouse

■ Ring Light Pack

Ring light is based on an LED ring for illuminating samples in a uniform and efficient manner. It is mounted above and around the objective, the ring light provides more signal for both Confocal and Ai Focus Variation techniques. Out of the box, this new illumination option is controlled through the SensoFIVE user interface to deliver white light to the sample.

There are two ring light models: one for 5X and 10X magnification and another for 2.5X and 20X magnification. The ring light pack includes two ring lights, controller and cabling.

The appropriate objective lenses are shown on the side of the light where the connector is attached. In addition, the light is designed to be placed fully over the objective. There is a mechanical stop at the appropriate position, so when you put it on, it is pushed all the way onto the objective. This ensures proper illumination at the focal plane.

PN RLN09001 | S neox Ring Light

EMO

Emergency stop function and emergency switching off function button.

PN PR001638 | Emergency Stop

Calibration Pack

The calibration pack is composed of a reference mirror and a calibration specimen. These two are attached to a specific fixture and this, in turn, is attached to the flat holder.

A reference mirror of high surface finish quality (lambda/10) is included. It is used to calibrate the brightfield and interferometry lenses.

PN ESPJCAL20 | 2 inch calibration mirror

Calibration specimen designed to calibrate Ai Focus Variation and Confocal Continuous techniques. The nominal roughness is Sa 0.80 µm. The engraved area size is 20x20 mm.

PN PR001417 | Calibration specimen

The calibration rod is a gage made of wear-resistant, hardened, multi-aged, ground and lapped steel under DIN 2269. Manufacturing tolerance is ±1.0 µm.

PN PR001484 | 5Axis Calibration Rod

Configurable & Optional Parts

■ Holders and Collets

In the rotational module there is a System 3R chuck where two holders, one for flat samples and the other for rotational ones, can be attached. Fifteen collets by Rego-Fix are included in a separate box to attach them to the rotational collet holder.

FLAT HOLDER

This holder is for flat samples. Surface measurements can be taken as in a regular S neox. There is a 2x4 array of M6 tapped holes. The distance between holes is 25 mm. Two thumbscrews (M3x12 DIN 464) are included to hold the calibration pack.
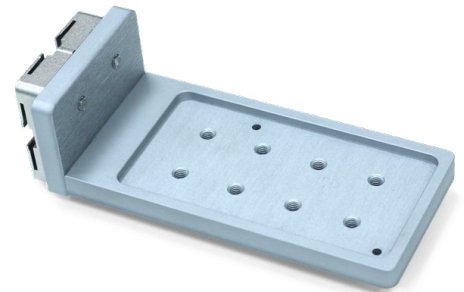
Flat holder	
Max. sample weight	3 kg (6.6 lbs)
Max. sample dimensions	117 x 60 mm (4.6 x 2.36 in)
Sample material	Solid surfaces
Sample preparation	None

PN HOLD3RFLAT00 | Flat sample holder (System3R Chuck)

ROTATIONAL COLLET HOLDER

The Rego-Fix ER is a cylindrical collet holder. A run-out of 10 μm is assured with the set ER16 and ER32, and 30 μm with the ER25.

Rotational Collet holder	
Max. sample weight	3 kg (6.6 lbs)
Max. sample lenght	150 mm (5.9 in)
Sample material	Solid surfaces
Sample preparation	None

A sets of precision collets made by Rego-Fix are included with each rotational holder.

Collets box	
Shank clamping range	1 - 20 mm
Tolerance	1 mm
Runout (TIR)	5 μm

PN HOLD3RER1100 | Collet chuck & collet set ER11 1-7mm

PN HOLD3RER1600 | Collet chuck & collet set ER16 1-10mm

PN HOLD3RER2500 | Collet chuck & collet set ER25 1-16mm

PN HOLD3RER3200 | Collet chuck & collet set ER32 10-20mm

Besides, there are two 3-jaw chuck holders that work with samples diameters from 0 to 32 mm and from 0 to 44 mm.

PN HOLD3R3J2000 | 3-Jaw Chuck 0-32mm

PN HOLD3R3J3000 | 3-Jaw Chuck 0-44mm

◼ Tip-tilt OPTION

A manual tip-tilt stage is used to balance the tilt of the surface under measurement. It allows the surface to be placed perpendicular to the optical axis. It is of great benefit when taking interferometric measurements, as it places the surface at a position called null fringes. It is placed over the XY stage.

PN 5AXISTIPTILT00 | Tip-tilt stage for H105 XY stage

◼ Scanning Devices OPTION

The PZT scanner z-axis is optional for S neox Five Axis. This scanning device has a total travel length up to 200 μm with piezo resistive sensors for high position resolution of 0.7 nm and 1 nm of accuracy on the full travel range. It improves the interferential measurements with repeatability down to 0.01 nm.

PN PIEZO200PI00 | Integrated piezo device 200 μm
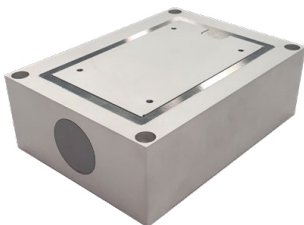
Sample Supports ^{OPTION}

Samples must be held by both the flat holder and rotation collet holder but a rotary plate can be used by removing the rotational module.
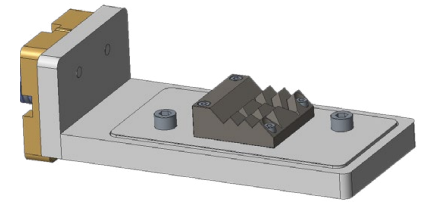
PN RPH105 | Rotary plate for 154x154 mm XY stage

Insert Holder ^{OPTION}

The insert holder helps position this kind of cutting tools. In this way, the insert remains ideally placed for correct measurement. The insert holder can only be installed on the flat holder.

PN PR001667 | Five Axis insert holder for flat holder

Basemounts ^{OPTION}

ACTIVE VIBRATION ISOLATION SUPPORT

When the S neox Five Axis is used in a vibration environment, it is required to isolate the vibrations. The active vibration-isolation table is an intelligent device that senses the vibration and compensates it actively by using fast actuators.

The AVIT 5 is a state-of-the-art active benchtop vibration isolation system. Aside from its low-profile carbon design, the AVIT 5 has expanded application capabilities. Main features are the automated transport locking mode and fully automatic load adjustment which makes the handling extremely straightforward. The control technology is based on piezoelectric type acceleration pickup, fast signal processing and electro-dynamic force transducers. Isolation starts at 0.6 Hz effectively isolating disturbing vibrations. Active isolation in all six degrees of freedom. The dimensions are 600x600x92 mm and the maximum load capacity is 105 Kg (232 lbs). Smooth top surface.

PN TAB25 | AVIT5 Active vibration isolation

Calibration Standard ^{OPTION}

Optional calibration standard can be used to check the accuracy of the system, as well as to calibrate the step height measurement. All calibration standards are made with monocrystalline silicon. There are several step heights available from a few nm to some tens of microns.

STEP HEIGHT

Step height standards designed to calibrate and check the accuracy of the systems. The nominal step height is 10 µm. The chip size is 16 mm x 16 mm. To improve handling, the standards are mounted on borosilicate glass measuring 50 x 50 mm as substrate and are stored in a membrane box. It is certificated by Sensofar or by PTB (Physikalisch-TechnischeBundesanstalt, the national metrology institute of Germany) .

PN PR001001 | Step height 10 µm (Sensofar traceable)

PN PR000853 | Step height 10 µm (PTB traceable)

PN PR000854 | Step height 1 µm (PTB traceable)

PN PR001685 | Step height 50 µm (PTB traceable)

LATERAL CALIBRATION STANDARD

The lateral calibration standard is manufactured with anti-reflective chromium on soda-lime glass using highly accurate semiconductor manufacturing equipment. The overall scale extends over 150 mm with 0.01 mm increments with all labeling in mm. The ruler is designed to be viewed from either side as the markings are both right-reading and mirror images. The overall size is 25 x 180 x 3 mm thick. They are ideal for measuring magnification simultaneously in X and Y directions or to determine image distortions such as skew, pincushion, barreling or other non-linearities. The measurement uncertainty (accuracy) is ± 0.5 µm over 0-10 mm and ± 2.5 µm over the entire 150 mm length as measured by the NPL (National Physical Laboratory). The standard is offered as a certified reference material (a traceable standard), recertification is recommended in 5-year intervals.

PN PR001149 | Lateral calibration standard (NPL traceable)

ROUGHNESS STANDARD

Areal roughness standard with typical roughness of Sa 790 nm. This traceable high precision areal standard, is designed to calibrate the metrological characteristics of areal surface topography measuring instruments. It is calibrated by NPL.

PN PR001641 | Roughness standard 790nm NPL calibrated

CERTIFIED CALIBRATION RODS

Set of 5 calibration rods from 1 to 5 mm certified by Tekniker.

PN PR001687 | Five calibration rods 1-5 mm with certificate (Tekniker)

Software

■ SensoSCAN Five Axis

SensoSCAN Five Axis is the 64-bit software dedicated to controlling the hardware in the Five Axis module and to managing the data obtained by the optical profiler. SensoSCAN Five Axis controls the S neox Five Axis system, its XYZ axis, light source, and measurement capabilities such as image and topography.
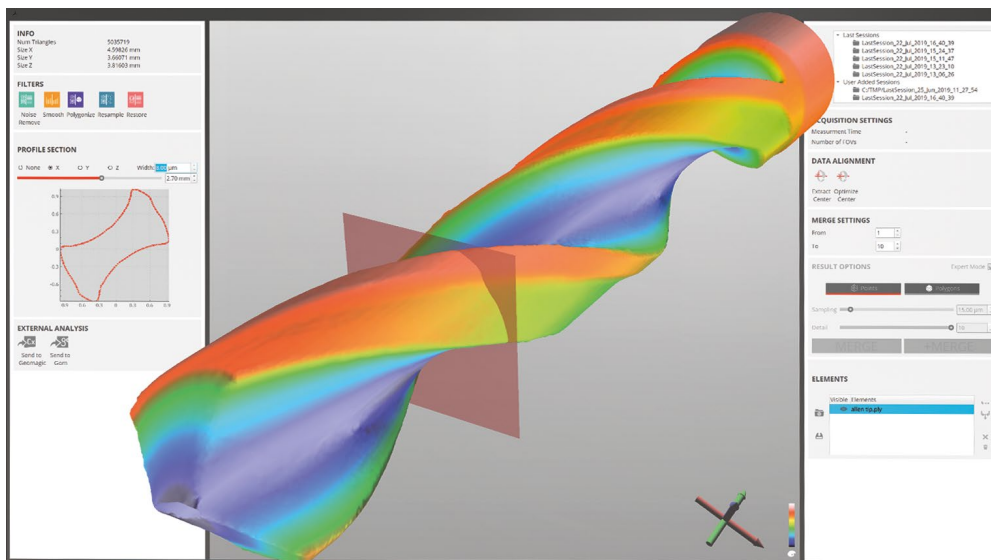
SensoSCAN Five Axis software provides an interface with which any measurement can easily be taken, as well as a comprehensive set of tools for displaying and analyzing data. The main ones include:

- ☐ The system is automatically optimized depending on the measurement technique selected (Confocal, Interferometry or Ai Focus Variation)

- ☐ Type of measurement: 3D, 3D auto, profile, RGB image and confocal image

- ☐ Sample viewing is very accessible and flexible with all live image options

- ☐ Allows automated measurements ideally for quality control procedures

☐ Multiple powerful acquisition settings can be adapted to best suit the intended measurement (customizable area selection interface, autofocus, multilevel light strategies, selectable Z-scan options, single or multiple recipes)

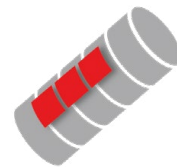☐ Several rotational 3D measurements options:

(a) Single position   (b) User defined positions

■ Discrete field of view (FOV)

(c) 3D sector   (d) 3D extended sector

(e) 3D circle   (f) 3D cylinder
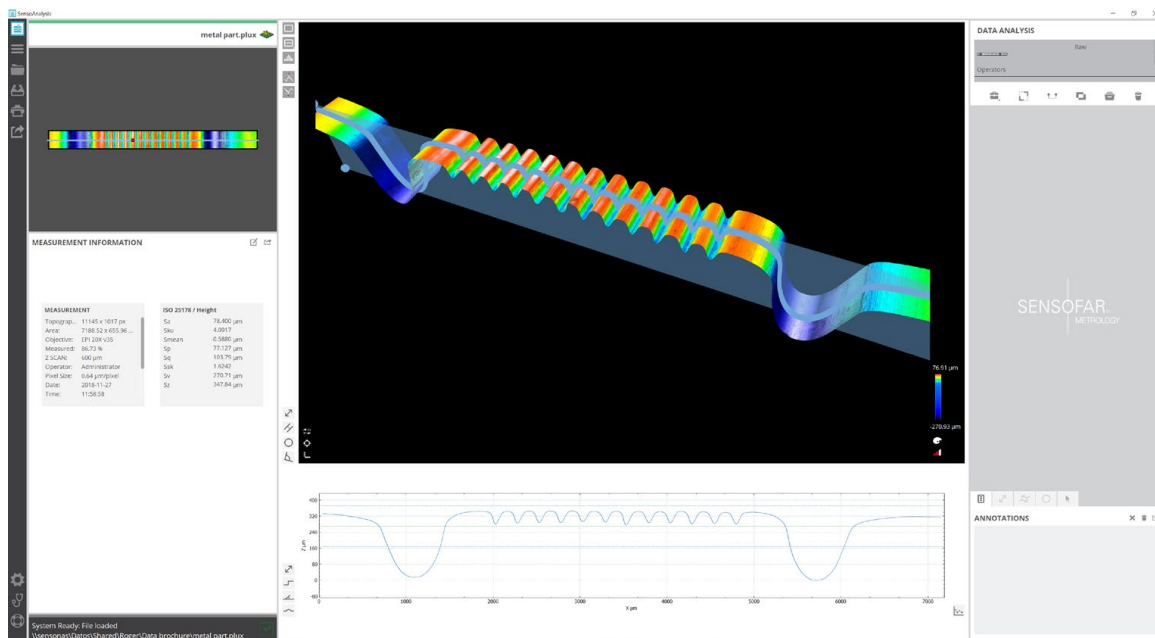
■ Five Axis Multiple Recipe (5MR)

☐ 3D and 2D (contour, profile, histogram and bearing curve) interactive views provide multiple scaling, display and render options in analysis mode.

☐ A comprehensive suite of operators and filters for examination and analysis of the measurement provides the opportunity to retouch data points, restore non-measureable data, form removal (plane, sphere or polynomial), apply a range of filers (thresholding, smart, kernel, ISO, FFT and rescale) and/or generate alternative layers by cropping, subtracting or extracting profile.

☐ Merge window: after the Five Axis Multiple Recipe (5MR) the software jumps into the merge window where the user is allowed to define how to merge all of the measurements, change individual settings, visualize the full 3D result, and apply several filters. The data is output as an STL, IGS, STEP or PLY file.

- Calculation of shape and roughness parameters. A complete selection of ISO 25178 3D areal surface texture parameters: height, spatial, hybrid, functional and volumetric

- Compatible with 3D software such as Geomagic, Gom, Polyworks and Kotem, and 2D software such as Mountains Map, Mark III, etc.

Your system will come with a fully functional license of SensoSCAN but you can install it in as many computers as you want to review, measure and report. These additional licenses are free of charge to share your findings with your colleagues and make your daily work easier.

SensoVIEW

SensoVIEW is an ideal software for a broad range of analysis tasks.

Main tasks are:

- 3D (isometric) and 2D (contour, profile, histogram and bearing curve) interactive views provide multiple scaling, display and render options.

- A comprehensive suite of operators and filters to retouch data points, restore non-measureable data, form removal (plane, sphere or polynomial), apply a range of filers (thresholding, smart, kernel, ISO, FFT and rescale) and/or generate alternative layer by cropping, subtracting or extracting profile for examination and analysis.

- Calculation of shape and roughness parameters. A complete selection of ISO 25178 3D areal surface texture parameters: height, spatial, hybrid, functional and volumetric.

☐ 3D measurement of distance, parallel, circle and angle.

☐ 2D measurements of distance, step height, radius and angle.

☐ Analysis templates.

☐ Customized reports.

☐ Compliance with Mountains Map and other analysis softwares.

☐ Multiple Results Analysis in Inspection Drives Knowledge.

☐ Export JPG, TXT, TIFF,…

The system will come with a fully functional license of SensoVIEW and can be installed in as many computers as you want to review, measure and report.

PN SENSOVIEW | SensoVIEW

■ Geomagic® Wrap OPTION

Geomagic Wrap delivers the most easy-to-use, affordable, fast, accurate path from point clouds to 3D polygonal and surface models that can be used instantly in downstream engineering, manufacturing, engineering, art, industrial design and more. As part of your 3D digital thread, Geomagic Wrap provides the digital bridge to allow you to create perfect data to use directly in 3D printing, milling, archiving and multiple other 3D uses. Features:

☐ Unroll geometry: Complex cylindrically-wrapped geometery can now be flattened for better analysis.

☐ Dimension tools: fundamental measuring tools to improve fast analysis of scanned parts.

PN GEOMAGICWRAP00 | Geomagic Wrap w/ 1st Year Maintenance

After the first year it is optional to renew the maintenance yearly. This allows the customer access to updates, new versions and technical support.
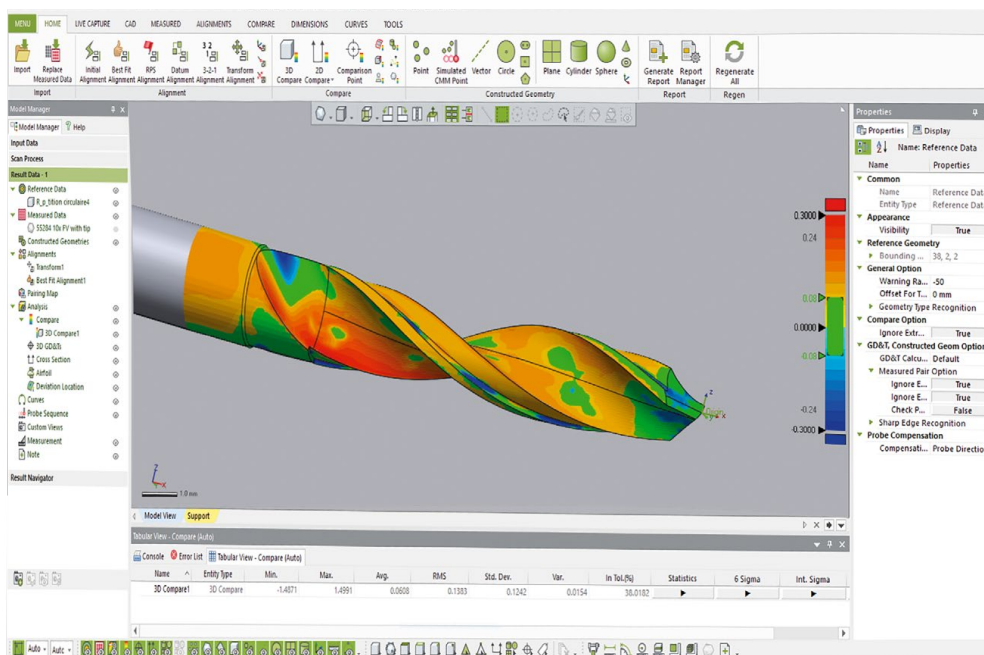
PN GEOMAGICWRAPREN | Geomagic Wrap Maintenance Renewal

■ Geomagic® Control X OPTION

Geomagic Control X is a comprehensive metrology software platform that delivers the industry's most powerful tools within straightforward

workflows. Features:

☐ Scan Processing Automation: scan registration, merging, clean-up, and other pre-inspection processes can now be designed and automated within Geomagic Control X.

☐ Deviation Location: with Geomagic Control X 2018 you can analyze the size, shape and location of deviation groups.

☐ Airfoil Analysis: whether you are working on turbines, blisks, blings or blades, Geomagic Control X 2018 provides a fast and intuitive way to gather profile measurements.

☐ Multi-Alignment Inspection: the new Multi-Alignment Inspection capability allows you to create repeatable inspection routines that require measurement in different alignment environments.

☐ Custom Reporting.

☐ Enhanced UI/UX.

☐ Enhanced Scanning and Import Capabilities.

PN GEOMAGICCONTROLX00 | Geomagic Control X w/ 1st Year Maintenance

Software maintenance renewal option after first year, including updates & support.

PN GEOMAGICCONTROLXREN | Geomagic Control X Maintenance Renewal

■ SensoPRO ^{OPTION}

SensoPRO is the 64-bit data analysis solution from Sensofar. It provides an environment for quality assurance (QA) engineers and technicians to quickly and easily analyze production parameters. When combined with SensoSCAN acquisition program, SensoPRO provides a one-click solution for data acquisition through to data analysis. Include three default plugins:

☐ Surface texture: Analyze surface texture in accordance with the surface texture parameters defined by the ISO 25178.

☐ Surface texture profile: Analyze amplitude parameters to center profile of the surface (X cut) in accordance with ISO 4287

☐ Step height: Analyze a single step height with any shape in the given FOV.

`PN` SENSOPRO | SensoPRO analysis software

OPTIONAL MODULES

Plugin	Description	PN
Bump	Analyze bumps across a surface	SENSOPROBUMP
Circle PAD	Analyze conductive circular pads present on the surface of a printed circuit board (PCB)	SENSOPROCIRCLEPAD
Cross kerf	Analyze kerf marks in the form of a cross present on a wafer	SENSOPROCROSSKERF
Double step height	Analyze a double step height in the given FOV	SENSOPRODOUBLESH
Dual hole	Analyze dual round hole structures (also known as vias), either individually or in any pattern	SENSOPRODUALHOLE
Edge	Analyze cutting edges	SENSOPROEDGE
F traces	Analyze all kind of trace marks across a surface, including diagonally oriented traces	SENSOPROFTRACE
Hole	Analyze round hole structures (aka vias), either individually or in any pattern	SENSOPROHOLE
Laser cut	Analyze laser cut across a surface	SENSOPROILASERCUT
Laser hole	Analyze laser holes structures (aka vias), either individually or in any given pattern	SENSOPROLASERHOLE
Pad	Analyze the pad structures found on PCBs, either individually or in any given pattern	SENSOPROPAD
Rectangular hole	Analyze rectangular hole structures (also known as vias), either individually or in any given pattern	SENSOPRORHOLE
Solder mask	Analyze Solder Mask traces. Solder Mask layers are usuallyapplied to printed circuit boards (PCB) as protective layers	SENSOPROSOLDERMASK

Spacer	Analyze spacers across a surface	SENSOPROSPACER
Trace	Analyze trace marks across a surface	SENSOPROTRACE
Trench	Analyze trenches across a surface	SENSOPROTRENCH

SensoCOMP OPTION

SensoCOMP is a 3D virtual microscopy solution for forensics analysis. SensoCOMP is able to load topographies in X3P, PLUX and SUR formats.
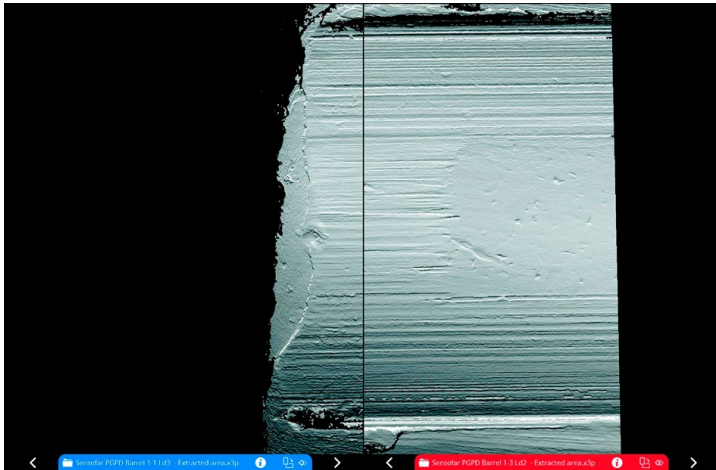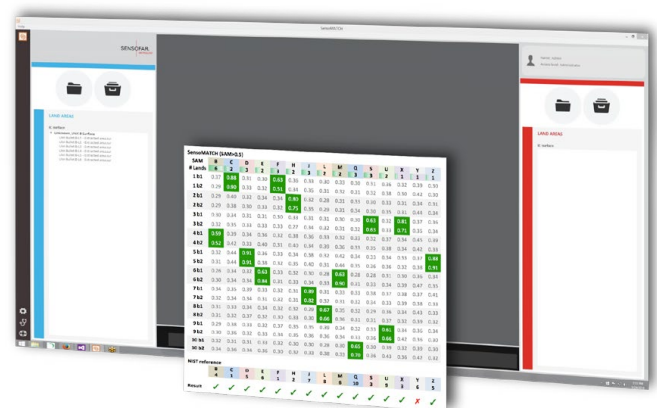

PN SENSOCOMP | SensoCOMP software license (beta)

SensoMATCH OPTION

SensoMATCH streamlines bullet comparison tasks by analyzing pairs of IC surfaces mathematically and extracting the mean profiles from each surface to calculate a cross correlation function (CCFmax).

PN SENSOMATCH | SensoMATCH software license (beta)

SensoMAP OPTION

Designed for use with the broadest range of research and industrial applications, SensoMAP software is the perfect surface imaging, analysis and metrology solution that is fully integrated with Sensofar 3D optical profilers. It includes:

☐ Imaging – visualization of surface data using cutting-edge imaging technology and intelligent filters.

☐ Metrology – analytical studies in accordance with the very latest standards and methods.

❑ Report Creation – creation of detailed, accurate multi-page surface analysis reports in a smart desktop publishing environment with powerful automation features to speed up analysis.

SensoMAP is a powerful 3D analysis, documentation and reporting tool. It contains a complete and comprehensive set of tools, surface transformations and measurements focused on obtaining 3D data for your sample. These include:

❑ Position adjustment (level, mirror, rotate...)

❑ Surface correction (spatial filtering, fill non-measured points...)

❑ Filtering (form, roughness, outliers...)

❑ Surface extraction (profile, contour, area, layers...)

❑ Surface comparison and stitching

❑ 2D and 3D advanced visualization modes

❑ Geometrical analysis (distance, step height, contour...)

❑ Structural Analysis (fractal, volume...)

❑ Roughness Analysis (2D and 3D roughness parameters)

❑ Frequency Analysis (Fourier, wavelet decomposition...)

❑ Functional analysis (Abbot curve, Rk parameters, histograms...)

SensoMAP is an scalable software available on two product levels:

SensoMAP Standard provides the features required for standard surface imaging and analysis. It comes with numerous optional modules that can be added at any time for advanced and specialized applications.

PN SENSOMAPV8 STD | SensoMAP Standard analysis software v8

SensoMAP Premium is a much more powerful solution in terms of features and includes all the modules except: *Advance contour*, *Shell extension*, *Lead (Twist) analysis* and *Scale-sensitive fractal analysis*. Other highly-specialized modules that can be added if required.

PN SENSOMAPV8 PRE | SensoMAP Premium analysis software v8

SensoMAP Software Network License allows to use the software on several computers on a network. The number of computers that can use the software simultaneously depends on the number of "seats" purchased with the network license.

PN SENSOMAPV8 NET | SensoMAP Software network license v8

OPTIONAL MODULES

Module	Description	PN
4D Series	Analyze surface evolution with respect to time, temperature, magnetic field or another dimension	SENSOMAPV8 M 4D
Contour	Basic geometric dimensioning & tolerancing of contour profiles and horizontal contours extracted from images	SENSOMAPV8 M CONT
Advanced contour	Advanced dimensioning and tolerancing, DXF CAD compare, Gothic arch	SENSOMAPV8 M ADVCONT
Advanced profile	Advanced profile filtering, fractal and Fourier analysis, statistical analysis of series of profiles	SENSOMAPV8 M ADVPROF
Advanced topography	Advanced studies, parameters & filters for 3D ("areal") surface texture analysis	SENSOMAPV8 M ADVTOPO
Automotive	Assess functional performance with a full set of 2D parameters developed by the automotive industry	SENSOMAPV8 M AUTO
Fourier & Wavelets	FFT-based texture analysis, advanced FFT filtering, multi-scale analysis by wavelets	SENSOMAPV8 M FFTWAVE
Particle Analysis	A comprehensive toolset for detecting and analyzing particles, pores, grains, islands etc. on structured surfaces	SENSOMAPV8 M PART
Shell Extension	Freeform surface management, complex shape analysis, high quality 3D visualization	SENSOMAPV8 M SHELL
Scale-sensitive fractal analysis	Implements a multi-scale analysis based on length-scale or area-scale analyses (formerly in Sfrax software)	SENSOMAPV8 M SSFA
Statistics	Automated statistics for multiple data populations, process capability	SENSOMAPV8 M STATS
Surface stitching	Increase profilometer range. Use stitching to expand range of all axes (including Z) and overcome instrument limitations.	SENSOMAPV8 M STITCH
Lead (Twist) Analysis	2nd generation lead (twist) analysis for the automotive industry	SENSOMAPV8 M TWIST

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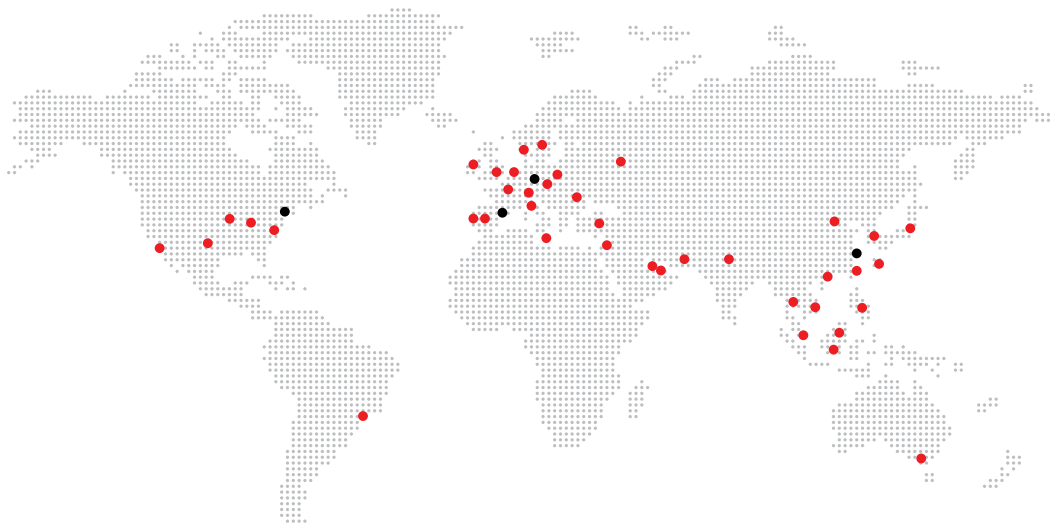
SENSOFAR is a leading-edge technology company that has the highest quality standards within the field of surface metrology

Sensofar Metrology provides high-accuracy optical profilers based on confocal, interferometry, focus variation and fringe projection techniques. Current portfolio ranges from standard setups for R&D and quality inspection laboratories to complete non-contact metrology solutions for in-line production processes. The Sensofar Group is headquartered 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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