SENSOFAR

METROLOGY

Product Guide

S mart

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Basic features

Description

The S mart 2 is the only areal confocal profilometer on the market that excels in performance, speed, and resolution. Its powerful features and compact design make it a breakthrough in the optical field.

With the second generation of the S mart system, it is now easier to integrate (53% smaller than its predecessor), more intuitive, and faster. Additionally, the system can be managed with just one click, making it simple enough for a complete beginner. Software modules have been created to adapt the system to user requirements.

The computer is embedded into the S mart 2 without compromising its small size. A simplified integration is then achieved: only two cables are needed for the system to run.

Integrable head systems >

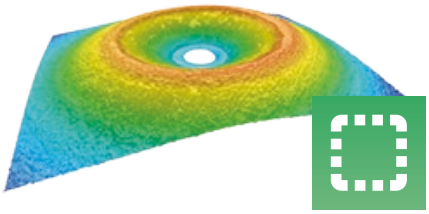
Technology

Our systems operate with different optical measurement techniques. Joining these technological benefits, incorporating the latest technology and the software which runs them, results in high-level equipment of maximum competitiveness in the market.

Learn more about Sensofar's technologies >

AI FOCUS VARIATION

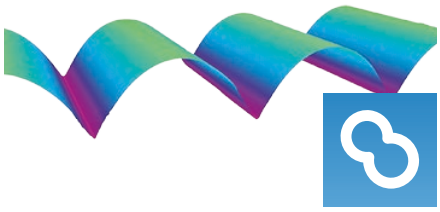
Active Illumination Focus Variation is an optical technology developed for measuring the shape of large rough surfaces. It has been improved with active illumination to get a more reliable focus location, even on an optically smooth surface. Highlights of the technology include high slope surfaces (72° in smooth samples), the highest speeds (1 mm/s), and large vertical range measurements.



CONFOCAL

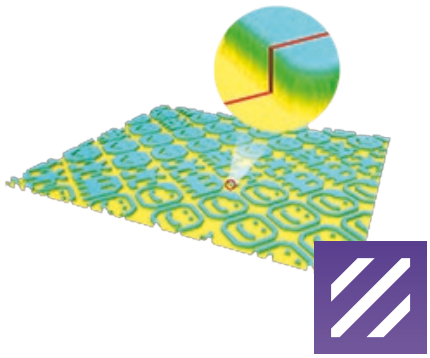
Confocal profilers have been developed to measure the surface height of smooth to very rough surfaces. Confocal profiling provides the highest

lateral resolution possible for an optical profiler. The proprietary Confocal algorithms provide vertical repeatability on the nanometer scale. The Confocal technology used in the S mart 2 is a continuous confocal, developed to acquire using a continuous Z-axis scan. Acquisition speed is increased while maintaining comparable repeatability and accuracy.



INTERFEROMETRY

Interferometry has been developed to measure the surface height of very smooth to moderately rough surfaces, achieving the same system noise at any magnification. Coherence Scanning Interferometry (CSI) profiling provides nanometer vertical resolution for all numerical apertures. The CSI algorithms enable the system to use all the available magnifications to profile shape features with the same height resolution.



■ Techniques comparison

	Ai Focus Variation	Confocal	Interferometry
Magnification	High magnifications up to 100X	High magnifications up to 100X	Low magnifications down to 2.5X (large FOVs with nanometer system noise)
NA	High NA from the 100X magnification allows to measure slopes up to 72º for smooth surfaces	High NA from 100X magnification allowing measurement of slopes up to 72º for smooth surfaces	The highest NA is 0.55 (50X)
System noise	High repeatability (low noise) for high NA, from 0.80 NA, the noise is close to 4 nm	High repeatability (low noise) for high NA, from 0.80 NA, the noise is close to 4 nm	High repeatability independently from the NA down to 5 nm
Optical resolution	Highest resolution is up to 0.21 µm	Highest resolution is up to 0.21 µm	Highest resolution is up to 0.30 µm
Acquisition speed	Speedy acquisition. It can be up to 1000 µm/s with a 10X lens.	Fast acquisition for 1000 planes, 4 seconds	Speed does not depend on the magnification
Film thickness	Not applicable	Thickness measurement from 100 µm to several milimeters.	Thickness measurement from 1.5 µm to 100µm

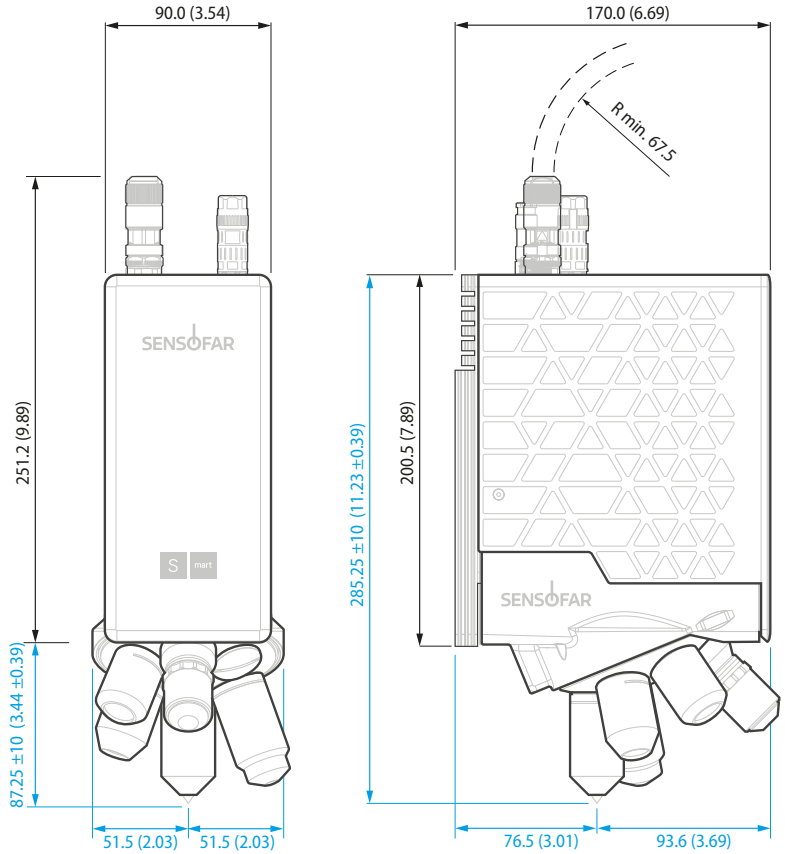
Configuration

The S mart 2 is a modular integration unit with several configurable and optional parts. It is composed of a head and a set of objectives.

The sensor head can be attached directly to the customer's station or into the "Integration Kit" module, which is used to mount heads during the development period or for demonstration purposes. The two connections of the S mart 2 are high-flex cables available in various lengths.

The S mart 2 can be configured with brightfield and interferometry objective lenses depending on the technique required. Optionally, for parcentricity between the lenses, a parcentricity lens adjuster is recommended.

■ Mechanical dimensions



mm (inches)
Head dimensions
Working distances

Specifications

■ System specifications

Measuring principle	Confocal, CSI and Ai Focus Variation
Observation types	Brightfield, Confocal, Interferential Phase Contrast
Measurement types	Image, 3D, 3D thickness
Camera	1Mpx: 1024x1024 pixels (150 fps)
Range of magnifications	2.5X - 100X
Field of view	from 0.14 to 5.6 mm (single shot)
Confocal frame rate	60 fps
Vertical scan range coarse	Linear stage: 20 mm range; 5 nm resolution
Max. Z measuring range	Confocal & Ai Focus Variation 12 mm; CSI 1 mm
LED light sources	Blue (460 nm) and white (580 nm; center)
Nosepiece	6 positions fully motorized
Sample reflectivity	0.05 % to 100%
Communication protocol	DLL; gRPC (optional)
Advance Software Analysis	Inc: SensoVIEW; Op: SensoPRO, SensoMAP
User management rights	Administrator, supervisor, advanced operator, operator
Computer	Embedded in the sensorhead
Processing power	Latest INTEL processor
Operating system	Microsoft Windows 10, 64 bit
Power	Line Voltage 100-240 V AC; frequency 50/60 Hz single phase
Environment	Temperature 10 ºC to 35 ºC; Humidity <80 % RH; Altitude <2000 m

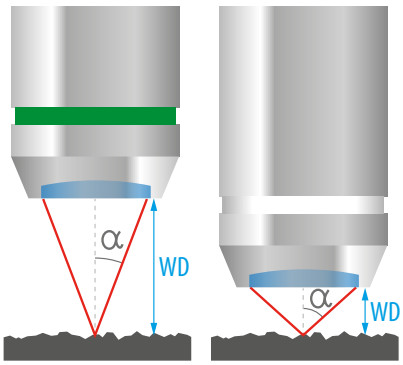
Objective lenses

The S mart 2 uses premium objective lenses designed to correct for chromatic aberrations and produce sharp, flat, and clear images with high contrast and high resolution. In addition, phase Fresnel lenses improve the operability and the working distance, meaning that S mart lenses provide the most extensive available working distance for each NA.

The S mart 2 also uses objective interferometry lenses. The TI series are based on a Michelson interferometer with 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 wavefront 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.

BASIC PARAMETERS FOR SYSTEM OPERATION

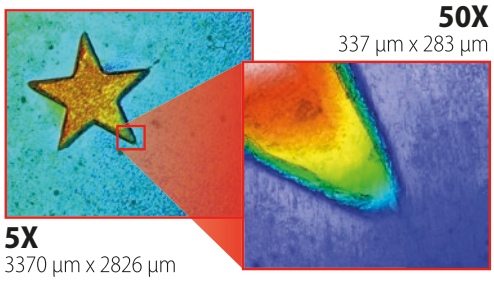
Here are some useful concepts that will help you through the operation of the S mart 2 system. These will help to understand all the product specifications of your optical metrology tool for surface measurement.



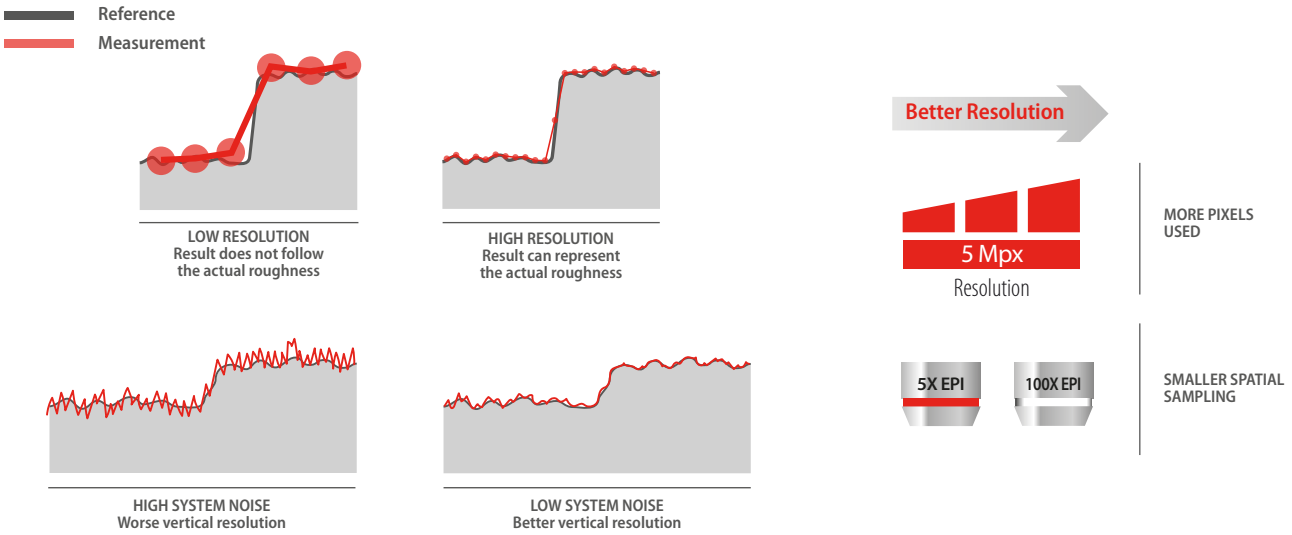
- **Numerical Aperture (NA)**: determines the largest slope angle on the surface that can be measured and affects optical resolution. Its mathematical expression is NA=n·sinα, where n is the index of refraction of the working medium (air, water, or oil) and α is the maximum half-angle of the cone of light that enters or exits the lens.

- **Working Distance (WD):** distance is taken from the end of the objective at which the focus plane is found.

- **Field of View (FOV)**: area of the sample that is measured; depends on the magnification.



- **Resolution**: smallest detectable distance between two features of the sample. For 2D images, the lateral resolution depends on: i) the number of used pixels of the camera and ii) the dimensions of the field of view. It can be pixel-size limited (spatial sampling) or optically limited (optical resolution). For the 3D case, the vertical resolution is related to the system noise.



SELECTION GUIDE

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

S mart 2 uses brightfield and interferometry objective lenses. Therefore, a vibration-isolated environment is required to perform interferometric and confocal measurements at high magnifications. 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 100X EPI	High light efficiency and high numerical aperture
Low local slope with few nanometer features (flat samples)	CSI	2.5X TI to 100X DI	High repeatability, moderate numerical aperture and low to high magnification
Low local slope and large FOV	CSI	2.5X TI to 10X DI	Low magnification and high repeatability
Rough surface			
Large FOV	Confocal and CSI	5X EPI to 20X EPI 2.5X TI to 10X DI	Extended measurements and moderate numerical aperture for low magnification
High local slope with few nanometer features	Confocal	50X EPI to 100X EPI	High numerical aperture and magnification
High aspect ratio	Confocal	10X SLWD to 50X 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
Transparent layers			
Thinner films (1.5µm - 100µm)	CSI and Confocal	2.5X TI to 100X DI 20X EPI to 100X EPI	All magnifications available for CSI. High NA for Confocal
Thicker films (100µm - 5mm)	Confocal	5X EPI to 20X EPI	Low magnification lenses

OBJECTIVE LIST

	Magnification	NA	WD (mm)	FOV[1] (µm)	Spatial Sampling[2] (µm)	Optical Resolution Blue[3] (µm)	Optical Resolution White (µm)	Maximum Slope[4] (º)	Measurement noise[5] (nm)
	2.5X EPI[6]	0.075	6.50	5652 x 5652	5.52	1.87		4	350
Brightfield	**5X EPI**	0.15	20.00	2826 x 2826	2.76	0.94	-	9	120
	10X EPI	0.30	15.80	1413 x 1413	1.38	0.47	-	17	45
	20X EPI	0.45	3.00	707 x 707	0.69	0.20	-	27	10
	50X EPI	0.80	1.00	283 x 283	0.27	0.18	-	53	4
	50X EPI	0.95	0.35	283 x 283	0.27	0.15	-	72	3
	100X EPI	0.90	1.00	141 x 141	0.07	0.16	-	64	3
	100X EPI	0.90	2.00	141 x 141	0.07	0.15	-	64	3
	100X EPI	0.95	0.32	141 x 141	0.07	0.16	-	72	2
	20X EPI	0.60	3.00	643 x 643	0.63	0.27	-	37	9
	20X ELWD	0.40	19.00	707 x 707	0.69	0.27	-	24	20
	50X ELWD	0.60	11.00	283 x 283	0.27	0.23	-	37	2
	100X ELWD	0.80	4.50	141 x 141	0.07	0.18		53	5
	10X SLWD	0.20	37.00	1413 x 1413	1.38	0.70	-	12	60
	22X WI	0.50	3.50	643 x 643	0.63	0.28	-	-	-
Interferometry	**2.5X TI[7]**	0.075	10.30	5652 x 5652	5.52	-	2.32	4	**CSI** <5 nm
	5X TI	0.13	9.30	2826 x 2826	2.76	-	1.34	7	
	10X DI	0.30	7.40	1413 x 1413	1.38	-	0.58	17	
	20X DI	0.40	4.70	707 x 707	0.69	-	0.44	24	
	50X DI	0.55	3.40	283 x 283	0.13	-	0.32	33	
	100X DI	0.70	2.00	141 x 141	0.07	-	0.25	44	

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.

4 On smooth surfaces, up to 71º. On scattering surfaces, up to 86º.

5 System noise is 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 with vibration isolation activated..

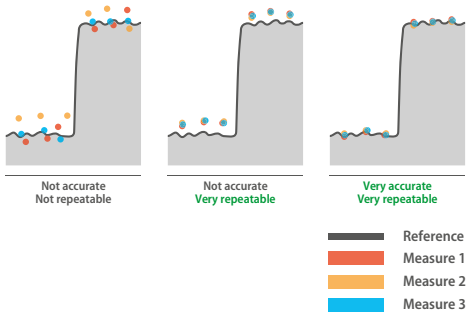
6 This objective should be only used for sample inspection.

7 Adding this objective means the turret is no longer motorized and neither parfocal.

Accuracy and repeatability

The following brief descriptions of statistical concepts are applied to metrology and will help you understand the performance specifications according to NPL (National Physical Laboratory).

- **Uncertainty**: generic term for the quantification of doubt in a measured value. It is shown as an expanded uncertainty U.
- **Precision**: dispersion of a number of measurements when repeated. More often called repeatability, quantified by the standard deviation σ.
- **Accuracy**: qualitative term describing the closeness of a measured value to the true value. Low values of U and σ concerning the measured value provide highly accurate systems.



Standard	Value	Uncertainty (U) [1]	Repeatability (σ)[1]	Technology
Step height (H)	<10 µm	U= (0.005 + H/50) µm	<10 nm	Confocal, AiFV & CSI
	>10 µm	U = (0.120 + H/120) µm	>10 nm	Confocal, AiFV & CSI
Area roughness (Sa)	0.79 µm	40 nm	6 nm	Confocal, AiFV & CSI

1 Values obtained in a VC-E vibration environment. Objective used for Confocal and Ai Focus Variation 50X 0.80 NA and for CSI 50X 0.55NA. Resolution 1024x1024 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. For steps smaller than 5 µm, σ < 5 nm.

Standard configuration

Sensor head

S mart 2, a non-contact 3D optical integrable head, measures and characterizes 3D surfaces using Confocal, Interferometry, and Ai Focus Variation technologies.

The standard configuration includes the following:

- Integrable head
  - Two high-power LEDs integrated into the light source (blue & white)
  - Z motor stage with 20 mm range
  - Full HD camera with 1024x1024 that goes up to 150 fps.
  - The computer power is embedded in the head. It processes the acquired images into topographies using proprietary algorithms.
  - A 6-position motorized nosepiece can hold up to six lenses simultaneously. The SensoSCAN software automatically handles the motorized change and corrects any possible parfocality adjustment.
  - High-efficiency passive cooling.
- Calibration mirror

PN SSMART200 | S mart 2

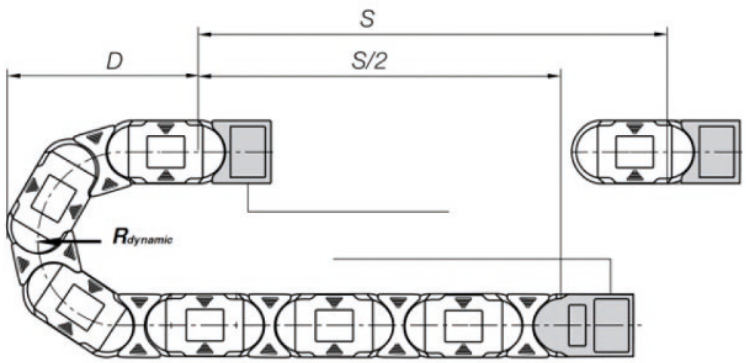
High-flex cables

The S mart 2 has two connections, one for the power supply and an Ethernet to PC port. The high-flex cables can endure fast movements, bending and other typical integration issues. The operating conditions of the lines are in the following table:

PN CABLE3MSMART200 | S mart 3 m high-flex cable set

PN CABLE5MSMART200 | S mart 5 m high-flex cable set

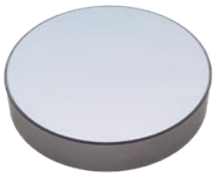
PN CABLE10MSMART200 | S mart 10 m high-flex cable set



High-flex cable set	Symbol	Min	Units
Static/Fixed bending radius	Rstatic	36.0	mm
Flex bending radius	Rflex	54.0	mm
Dynamic bending radius	Rdynamic	67.5	mm
Temperature	T	5	°C
Service life		5	million double strokes

■ Calibration mirror

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



PN ESPJCAL20 | 2 inch calibration mirror

Optional parts

Laptop

The S mart 2 is highly compatible with different controllers or computers. To ensure the fullest performance of the head, the computer for running the S mart 2 must meet specific requirements.

Minimum system requirements	
Operating system	Windows® 10
Processor	Intel® Core™ i5/i7
RAM Memory	16 GB
Hard Drive	512 GB SSD
Graphics	Integrated (dedicated is not necessary)
Ethernet	Yes, native or via USB
Display resolution	1920x1080 pixels (minimum)

We recommend the Dell Vostro (with latest INTEL processor) with Windows 11 64-bit, display full HD (15.6") which meets all the above requirements.

Laptop features	
	Vostro 5620
Operating system	Windows® 11 Pro 64-bit
Processor	Intel® Core™ i7-1260P (2.10 GHz)
RAM Memory	16 GB
Hard Drive	512 GB SSD NVMe
Graphics	Intel® Iris® Xe graphics
Dimensions	1.83 x 35.7 x 25.2 cm // 0.72 x 14.05 x 9.92 "
Weight	1.91 Kg // 4.21 lb

PN PR001752 | Dell Vostro 15 5510 Core i7 11390H Win 10 Pro 64

Power supply

The default configuration of the S mart 2 system does not include a power supply. The customer can use any power supply that is an AC/DC 15VDC 6.5A converter.

Additionally, Sensofar provides various power supplies designed specifically for the electrical requirement of the head.

Desktop power supply

The desktop power supply can be connected to any plug and has a switch to quickly turn the S mart 2 on or off. It allows setting up the S mart 2 independently before integration. It provides both AC and DC currents with 15VDC and 8.7A.

PN PR001801 | Desktop power supply

DIN rail for power supply

The rail power supply is the perfect match when set in the control cabinet of the integrator. It is an AC/DC 15VDC 6.5A rail.

PN PR001840 | DIN rail for power supply

Joystick

The joystick enables you to move the XY stage and the sensor head to navigate the sample. Simply twist or tilt the mouse controller cap to move up, down, left, right, forward, and backward precisely and intuitively.

PN PR001280 | Joystick S mart 2

Integration kit

The S mart 2 comes with a module to mount it during a development period or for demonstration purposes. The Integration Kit combines:

- Stand
- XY manual stage
- A manual goniometer.

To facilitate the insertion of the S mart 2, the integration kit has a sliding guide into a guiding block on the stand. In addition, if more range between the lens and the table is needed, the height can be modified with the hidden screw on the guiding block.

PN SMART2INKIT | S mart 2 integration kit

Portable stand

The S mart 2 has a portable stand with two handles for enhanced transportability. The portable stand is handy for characterizations performed in situ in manufacturing, as it is in CMP pad measurements.

PN 08600700 | S mart 2 portable stand

Parcentricity and parfocality adjuster

A parcentricity lens adjuster is an optional tool for adjusting and correcting the parcentricity error between lenses installed on the same nosepiece. Even though the optical components have extraordinary quality and tolerance, there are still some minor differences between the real optical axis between lenses and their position once assembled. The parcentric lens adjuster is very helpful in adjusting up to ±300 microns of deviation and requires specific tooling for its modification. There's a limit of 3 parcentric lens adjusters per nosepiece due to lack of space.

PN 08600519 | Parcentric lens assembly

PN PR001806 | Tooling assembly parcentric lens

The parfocality spacer is usually combined with the parcentricity lens adjuster. This 10 mm spacer compensates the lens's parfocality on a system with parcentric lens adjusters.

PN 8640534 | Lens spacer 10mm

Calibration standard

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. Several step heights are 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 20 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 CEM (the national metrology institute of Spain) .

PN PR001820 | Step height 1 µm (Sensofar traceable)

PN PR001820C | Step height 1 µm (CEM traceable)

PN PR001001 | Step height 10 µm (Sensofar traceable)

PN PR001001C | Step height 10 µm (CEM traceable)

PN PR001741 | Step height 20 µm (Sensofar traceable)

PN PR001741C | Step height 20 µm (CEM traceable)

PN PR001749 | Step height 50 µm (Sensofar traceable)

PN PR001749C | Step height 50 µm (CEM 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 simultaneously measuring magnification in X and Y directions or determining image distortions. 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), and recertification is recommended in 5-year intervals.

PN PR001149 | Lateral calibration standard (NPL traceable)

ROUGHNESS STANDARD

A traceable high-precision areal standard with typical roughness of Sa 790 nm. It 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

Software

SensoSCAN ML

SensoSCAN software puts you in control of the system with its user-friendly interface. The user is guided through the 3D environment, delivering a unique user experience.

The SensoSCAN S mart 2 software has been especially designed to consider the integrator's mindset. It is an intuitive interface with high-usability tools. The main ones are:

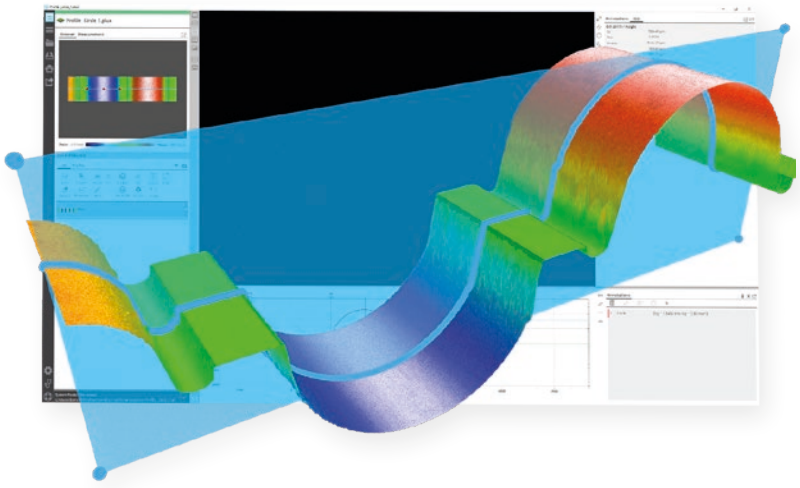
- The system is automatically optimized depending on the measurement technique selected (Confocal, Interferometry, or Ai Focus Variation).
- There are several measurement types: Image, 3D, and 3D auto.
- Samples can be visualized with three live options: Brightfield, Confocal, and Interferential Phase Contrast.
- Numerous acquisition parameters can be adapted to best suit the intended measurement: Z scan, light settings, data processing, and threshold.

- The software also comes with intelligent options that ensure the workability of the measurement recipe in different scenarios: Autolight, Autofocus, and the number of repetitions.
- Different speed settings: 1X, 2X, 3X and 4X.
- Recipe tools allow easy saving of all the acquisition parameters to apply them anytime.
- The acquired data can be directed to external software for further analysis (SensoVIEW, SensoMAP, and SensoPRO) or be exported as an image.

The system comes with a fully functional license of SensoSCAN S neox. It can be installed on as many computers as you want to review, measure and report.

SensoVIEW

SensoVIEW is an ideal software for a broad range of analysis tasks. The system comes with a fully functional license of SensoVIEW and can be installed on as many computers as you want to review, measure and report.



The main tasks are:

- 3D (isometric) and 2D (contour, profile, histogram & bearing curve) interactive views providing multiple scaling, display & render options.
- A comprehensive suite of operators and filters: retouch data points, restore non-measurable 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, retouching, rotating or extracting profile for examination and analysis.

- Profile surface texture parameters from ISO 4287 and ISO 21920 are also available.
- 3D measurement of points, distances, radius, and angles with automatic edge detection of circles and lines.
- 2D measurements of distance, step height, radius, and angle with smart fitting.
- Analysis templates and customized reports.
- Export JPG, TXT, TIFF, STL, and Normal Map.

Several packs of licenses are available depending on your needs. Choose the one that fits better for you. The educational license is only for universities.

PN SENSOVIEW23L | SensoVIEW 2 Bundle of 3 users[1]

PN SENSOVIEW210L | SensoVIEW 2 Bundle of 10 users

PN SENSOVIEW225L | SensoVIEW 2 Bundle of 25 users

PN SENSOVIEW250L | SensoVIEW 2 Bundle of 50 users

PN SENSOVIEW2200L | SensoVIEW 2 Bundle of 200 users

PN SENSOVIEW2EDU | SensoVIEW 2 Educational bundle

1 It is included, by default, three licenses with the system.

Optional softwares

SensoPRO

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 the SensoSCAN acquisition program, SensoPRO offers a one-click solution for data acquisition through data analysis.

Included by default plugins:

- **Step height**: analyze a single step height with any shape in the given FOV.
- **Step height ISO**: analyze single step height standards according to ISO 5436-1:2000 7.1 Type A1.
- **Surface texture**: analyze surface texture in accordance with the corresponding parameters defined by the ISO 25178: Geometric Product Specifications (GPS) –Surface texture: areal standard.
- **Surface texture profile**: analyze amplitude parameters of profile(s) on the surface, in accordance with either ISO 21920: Geometrical product specifications (GPS)-Surface texture: Profile Parts 1, 2 and 3 standard or the withdrawn ISO 4287: Geometrical product specifications (GPS)-Surface texture: profile standard.
- **Operator**: apply filters and other processing settings to a surface prior to analyzing it with other plugins.

PN SENSOPRO | SensoPRO analysis software

OPTIONAL PLUGINS

This plugin-based data analysis approach also provides high flexibility and specificity, using targeted algorithms optimized to the exact application needs

Plugin	Description	PN
Aspheric	Analysis of deformation coefficients and the residual roughness from aspheric surfaces.	SENSOPROASPHERIC
Barcode	Read a sample's barcode and calculate the desired dataset's flatness (Sz).	SENSOPROBARCODE
Blobs	Detection of blobs present on a surface.	SENSOPROBLOBS
Bolet	Analysis of squared-shaped structures of the MEMs.	SENSOPROBOLET
Bump	Analysis bumps across a surface.	SENSOPROBUMP
Center Dimple	This plugin enables the characterization of concave and convex dimples right at the center of the circular pad area.	SENSOPROCENTERDIMPLE
Chip Angle	This plugin provides the angle between each chip and its closest substrate area within a chip array.	SENSOPROCHIPANGLE
Circle Pad	Analysis of conductive circular pads on the surface of a printed circuit board (PCB).	SENSOPROCIRCLEPAD
Color Concentricity	Analysis of concentricity between three circles of the topography using color information.	SENSOPROCCONCENTRI
Concentricity	Analysis of the concentricity between two circles of different depths.	SENSOCONCETRI
Concentricity A	Analysis of concentricity of -two non-consecutive circles.	SENSOCONCETRIA
Concentricity B	Analysis of concentricity of checking structure in a PCB.	SENSOCONCETRIB
Cross A Pad	This plugin analyzes concentric cross-like pad structures in PCBs.	SENSOPROCROSSAPAD
Cross B Pad	This plugin analyzes cross-like pad structures with two different depths in PCBs.	SENSOPROCROSSBPAD
Cross Kerf	Analysis of kerf marks in the form of a cross present on a wafer.	SENSOPROCROSSKERF
Cruz	Analysis of cross-shaped structures of the MEMs.	SENSOPROCRUZ
C Trace	Analysis of trenches across a non-completely flat surface.	SENSOPROCTRACE
C Trench	Analysis of traces across a non-completely flat surface.	SENSOPROCTRENCH
D Distance	Analysis of the most and least prominent distance between the selected areas.	SENSOPRODDISTANCE
Dimple	Analysis of single dimple structures on a printed circuit board (PCB), both above the surface (bump) and below (hole).	SENSOPRODUALHOLE
Dimple T	Analysis of height of dimple as a control parameter for a good connection between PCB's layers.	SENSOPRODIMPLE
Double Step Height	Analysis of a double step height in the given FOV.	SENSOPRODOUBLESH
Dual SH	Analysis of double step height present on a surface.	SENSOPRODUALSH
Dual Hole	Analysis of dual round hole structures (also known as vias), either individually or in any pattern.	SENSOPRODUALHOLE
Edge	Analysis of cutting edges.	SENSOPROEDGE
Flatness	Analysis of flatness following ISO 12781.	SENSOPROFLATNESS

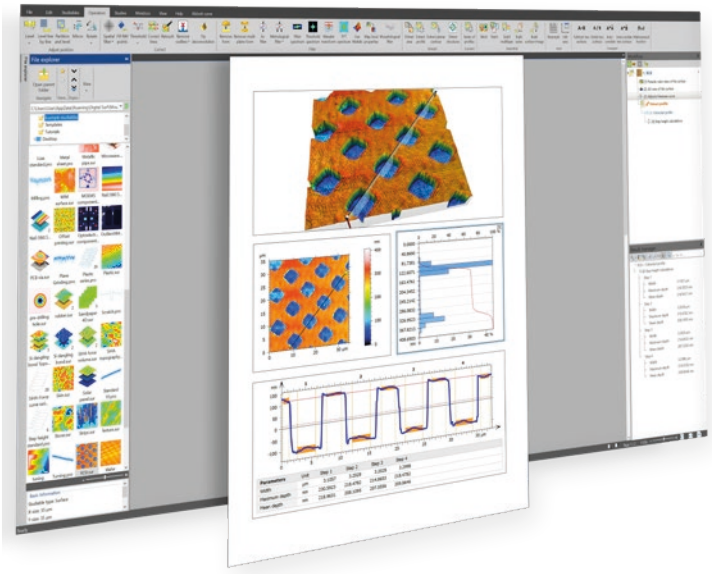
F Trace	Analysis of all kinds of trace marks across a surface, including diagonally oriented traces.	SENSOPROFTRACE
Four Step Height	Analysis of the height of the layers that compose a PCB.	SENSOPROFOURSH
Glass Bump Height	This plugin quantifies bumps between a glass plate sample and a photomask.	SENSOPROGBUMPHEIGHT
Glue Height	Analysis of different glue traces for optimizing glue dispense.	SENSOPROGLUE
Glue	Analysis of different glue traces for optimizing glue dispense.	SENSOPROGLUE
Groove Profile	Analysis of barbs and depths of a laser cut.	SENSOPROGROOVEPROF
Hole	Analysis of round hole structures (aka vias), either individually or in any pattern.	SENSOPROHOLE
Image trace	This plugin performs a mean and perpendicular profile analysis of a diagonal single trace.	SENSOPROITRACE
IMCC	Analysis of intermetallic layer coverage (IMC).	SENSOPROIMCC
Laser Cut	Analysis of laser cut across a surface.	SENSOPROLASERCUT
Laser Groove	This plugin is used to analyze the height and the width of laser grooves present on Flexible Printed Circuits (FPCs).	SENSOPROLASERGROOVE
Laser Hole	Analysis of laser hole structures (aka vias), either individually or in any given pattern.	SENSOPROLASERHOLE
Led Chip	This plugin analyzes several critical dimensions in PCBs for MicroLEDs.	SENSOPROLCHIP
L Groove	Dimensional analysis of an L structure present in semiconductors.	SENSOPROLGROOVE
L Pad	Analysis of L shaped pad structures found on PCBs.	SENSOPROLPAD
Multiple Step Height	Analysis of the height difference between five separate levels.	SENSOPROMULTIPLESTEP
Pad	Analysis of the pad structures found on PCBs, either individually or in any given pattern.	SENSOPROPAD
Pad Coplanarity	This powerful plugin detects and analyzes all rectangular pads on PCBs, providing data on their position, area, and coplanarity.	SENSOPROPADCOP
Panel slope	This plugin quantifies the slope on a panel's edge, as it can affect its light transmittance properties.	SENSOPROPANELSLOPE
Piller	Analysis of round piller structures, either individually or in any given pattern.	SENSOPROPILLER
Panel Particle Height	This plugin measures the height of airborne particles present in panels.	SENSOPROPPARTICLEHEIGHT
Panel Slope	This plugin quantifies the slope on a panel's edge, as it can affect its light transmittance properties.	SENSOPROPANELSLOPE
Piller	Analysis of round piller structures, either individually or in any given pattern.	SENSOPROPILLER
Power	This plugin determines the power and irregularity of flat lenses.	SENSOPROPOWER
Probe Mark Depth	Analysis of probe marks in PCB pads.	SENSOPROPROBEMARK
Profile Trace	This plugin is used to measure lateral distances between traces in a 2D image.	SENSOPROPROFILETRACE
PTV	Analysis of conformal structures to ensure all the other structures on the PCB are in the proper position.	SENSOPROPTV
Q Groove	This plugin analyzes the depth of a groove created by a small indentation or channel in quartz material.	SENSOPROQGROOVE
R Bump	Analysis of rectangular hole structures (also known as vias), either individually or in any given pattern.	SENSOPRORBUMP

Resist Bridge	Analysis of structures that prevent solder mask paste flow from one solder point to another.	SENSOPRORBRIDGE
R Hole	Analysis of rectangular hole structures (also known as vias), either individually or in any given pattern.	SENSOPRORHOLE
R Pad	Analysis of rectangular pad structures found on PCBs.	SENSOPRORPAD
Solder Mask	Analysis of Solder Mask traces. Solder Mask layers are usually applied to printed circuit boards (PCB) as protective layers.	SENSOPROSOLDERMASK
Spacer	Analysis of spacers across a surface.	SENSOPROSPACER
Spheric	Analysis of radius and the residual roughness from Spheric surfaces.	SENSOPROSPHERIC
Square	Automatic detection and analysis of squared pads with two different depths.	SENSOPROSQUARE
Square Pad	Analysis of square pads on Solder Resist Opening (SRO).	SENSOPROSQUAREPAD
Step Number	This plugin finds defects in optical surfaces and characterizes their size.	SENSOPROSTEPNUMBER
Three Step Height	Analysis of the height difference between three different levels.	SENSOPROMULTIPLESTEP
Trace	Analysis of trace marks across a surface.	SENSOPROTRACE
Trench	Analysis of trenches across a surface.	SENSOPROTRENCH
Trim	This plugin characterizes the blades that cut the wires after the wire bonding.	SENSOPROTRIM
V Hole	This plugin excels at detecting V-shaped holes as small as 200 nm, meticulously crafted using laser technology.	SENSOPROVHOLE
VPT	Analysis of conformal structures, to ensure all the other structures on the PCB are in the right position.	SENSOPROVPT
Wafer Glue	Analysis of the glue between the die and the PCB board.	SENSOPROWAFERGLUE
Wafer Groove	Analysis of key parameters for the cut practiced on a wafer for chip separation, known as Sawing process.	SENSOPROWGROOVE
Wafer Groove Single Line	Analysis of one dicing trace.	SENSOPROWGSL
Wafer Groove Single Line Far	Analysis of three dicing traces.	SENSOPROWGSLF
Wafer Groove Two Lines	Analysis of two dicing traces.	SENSOPROWGTL
Wafer Groove Two Lines Far	Analysis of three cuts made during dicing.	SENSOPROWGTLF
Wafer Pad	Analysis of pads on the surface of a wafer, either individually or in any given pattern.	SENSOPROWPAD
X Pad	Analysis of cross pad structures found on PCBs.	SENSOPROXPAD

SensoMAP

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

- Imaging – visualization of surface data using cutting-edge imaging technology and intelligent filters.
- Metrology – analytical studies in accordance with the latest standards and methods.
- Report Creation – a 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 (mirror, rotate)
- Surface correction (spatial filtering, fill non-measured points, threshold, outliers...)
- Filtering (metrological filter, remove form, morphological filter...)
- Extraction (profile, contour, area, channels, detect structures...)
- Assemble options (patch, stitch, create series of surfaces...)
- Comparison (subtraction, division or intercorrelation between surfaces)

- 2D and 3D advanced visualization modes (configurability of the frame style, palette, rendering, axis settings…)
- Geometrical analysis (manual measurements, step height, contour analysis in profiles...)
- Structural Analysis (fractal, volume, peak count distribution...)
- Roughness Analysis (2D and 3D roughness parameters)
- Frequency Analysis (texture direction, frequency spectrum, average power spectral density...)
- Functional analysis (Abbot curve, Sk parameters, volume parameters, histogram...)
- Shell analysis (freeform visualization and refining, shell roughness parameters, surface texture parameters, extraction of topographies and contours)
- CAD compare functionality, automatic or manual alignment options, and configurable color palette of the CAD compare deviation display.

SensoMAP is a scalable software available on two product levels:

SensoMAP Standard provides the features required for standard surface imaging and analysis. In addition, it has numerous optional modules that can be added anytime for advanced and specialized applications.

PN SENSOMAPV10 STD | SensoMAP Standard analysis software v10

SensoMAP Premium is a much more powerful solution in terms of features. It includes all the modules except Advanced contour, Shell extension, Shell topography, Shell CAD compare, Colocalization, Lead analysis (Twist), Fiber analysis, Scale-sensitive fractal analysis and Thickness analysis. Other highly specialized modules can be added if required.

PN SENSOMAPV10 PRE | SensoMAP Premium analysis software v10

SensoMAP Software Network License allows using 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 SENSOMAPV10 NET | SensoMAP Software network license v10

OPTIONAL MODULES

Module	Description	PN
4D Surface change	Analyze surface change with respect to time, temperature, or another dimension. Quantify wear & deposit.	SENSOMAPV10 M 4DSC
Advanced contour	Advanced dimensioning and tolerancing, DXF CAD compare, Gothic arch.	SENSOMAPV10 M ADVCONT
Advanced profile	Advanced profile filtering, fractal and Fourier analysis, statistical analysis of series of profiles.	SENSOMAPV10 M ADVPROF
Advanced topography	Advanced studies, parameters & filters for 3D ("areal") surface texture analysis.	SENSOMAPV10 M ADVTOPO
Automotive	Assess functional performance with a full set of profile parameters developed by the automotive industry.	SENSOMAPV10 M AUTO
Colocalization	Colocalize and adjust surface and image data from different detectors or instrument types.	SENSOMAPV10 M COL
Contour	Basic geometric dimensioning & tolerancing of contour profiles and horizontal contours extracted from images and surfaces.	SENSOMAPV10 M CONT
Fiber analysis	Analysis of fiber morphology, including diameter and direction, on topographical data, among other data types.	SENSOMAPV10 M FIBER
Fourier & Wavelets	FFT-based texture analysis, advanced FFT filtering and multi-scale analysis by wavelets.	SENSOMAPV10 M FFTWAVE
Lead analysis	2nd generation lead (twist) analysis for the automotive industry.	SENSOMAPV10 M TWIST
Particle analysis	A comprehensive toolset for detecting and analyzing particles, pores, grains, islands, etc. on structured surfaces.	SENSOMAPV10 M PART
Scale-sensitive analysis	Multi-scale analysis based on length-scale or area-scale analyses (formerly in Sfrax software).	SENSOMAPV10 M SSFA
Shell extension	Freeform surface management, complex shape analysis, high-quality 3D visualization.	SENSOMAPV10 M SHELL
Shell topography	A metrological toolbox for shell data (freeform surfaces). Visualize surface curvature and deviation as colors in 3D view. Apply Gaussian-like filtering to calculate a smooth reference surface. It gives access to all features contained in the Shell Extension module.	SENSOMAPV10 M SHELLT
Shell CAD compare	Compare measured Shell (freeform surface) data with CAD models (nominal) or generated meshes. It includes manual or automatic alignment, fine-tuned fitting, and deviation visualization using color coding. This module gives access to all features contained in the Shell Extension and Shell Topography modules.	SENSOMAPV10 M SHELLC
Thickness	Global or zone-specific interactive thickness characterization based on a pair of surfaces or profiles.	SENSOMAPV10 M THSS

SDK

SensoSCAN software development kit (SDK) offers a collection of tools for developing custom applications to manage the S mart 2. The SDK commands and events provide the means to create, modify, and eliminate acquisition recipes.

The available communication interface simplifies sensor integration and is compatible with any programming language that utilizes libraries. Other communication interfaces, like gRPC, are also available (for more information, contact Sensofar staff).

Interface of communication	Language	Operating system
Dll library	C++, C#	Windows 64 bits

The SDK provides the SDK Client application a demonstration GUI that helps programmers understand the functionality of all available commands. The SDK Client comes with its source code, providing integrators with a ready-made template for developing their own interface.

PN SSDKDLL | SDK DLL license

Additionally, there is the SDK stitching module. It provides different stitching algorithms so that integrators can stitch offline with the data acquired in their measuring station.

PN SDKST | SDK stitching

SENSOFAR

METROLOGY

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

Sensofar provides high-accuracy optical profilers based on confocal, interferometry, and focus variation techniques, from standard setups for R&D and quality inspection laboratories to complete non-contact metrology solutions for in-line production processes. The Sensofar Group has its headquarters in Barcelona, a European technology and innovation hub. 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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