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### Operating Instructions

### **surfaceCONTROL 2500**

surfaceCONTROL 2500-360  
surfaceCONTROL 2500-500  
surfaceCONTROL 2500-720

surfaceCONTROL 2500-360/ST  
surfaceCONTROL 2500-500/ST  
surfaceCONTROL 2500-720/ST

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## 1. Safety

System operation assumes knowledge of the operating instructions.

### 1.1 Symbols Used

The following symbols are used in these operating instructions:



Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.



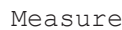
Indicates a situation that may result in property damage if not avoided.



Indicates a user action.



Indicates a tip for users.



Indicates hardware or a software button/menu.

### 1.2 Warnings



Do not look directly into the light source of the sensor.

> Risk of injury, damage to the eyes and skin

Connect the power supply and the display/output device according to the safety regulations for electrical equipment.

> Risk of injury

> Damage to or destruction of the sensor

The supply voltage must not exceed the specified limits.

> Risk of injury

> Damage to or destruction of the sensor



Avoid shocks and impacts to the sensor.

> Damage to or destruction of the sensor

The air inlets and outlets of the sensor must be kept clear and must not be covered

> Damage to or destruction of the sensor

Do not touch the lenses with your fingers. Remove any fingerprints immediately with pure alcohol and a clean cotton cloth without streaks.

> Damage to or destruction of the sensor

Never kink the cables and do not bend in small radii.

> Damage to or destruction of the cable; failure of the sensor

Protect the cables against damage

> Failure of the sensor

Avoid continuous exposure to splashes of water on the sensor.

> Damage to or destruction of the sensor

The sensor housing may only be opened by authorized persons.

> Damage to or destruction of the sensor

Only plug in or disconnect attached devices when disconnected from the power supply.

### 1.3 Notes on CE Marking

The following apply to the surfaceCONTROL 2500:

- EU Directive 2014/30/EU
- EU Directive 2011/65/EU

Products which carry the CE mark satisfy the requirements of the EU directives cited and the relevant applicable harmonized standards (EN). The measuring system is designed for use in industrial environments.

The EU Declaration of Conformity is available to the responsible authorities according to EU Directive, article 10.

### 1.4 Intended Use

- The surfaceCONTROL 2500 measurement system is designed for use in industry and laboratories. It is used for
  - non-contact optical measurement of diffuse reflective surfaces
  - quality monitoring and surface inspection
- The sensor must only be operated within the limits specified in the technical data, [see](#) .
- The sensor must be used in such a way that no persons are endangered or machines and other material goods are damaged in the event of malfunction or total failure of the sensor.
- Take additional precautions for safety and damage prevention in case of safety-related applications.

### 1.5 Foreseeable Misuse

Operation during high incidence of external light

- > Incorrect capture of the surface
- > Incorrect inspection result

Changing light conditions during the measurement

- > Incorrect capture of the surface
- > Incorrect inspection result

Operation with misaligned lens / shutter

- > Incorrect capture of the surface
- > Incorrect inspection result

## 1.6 Proper Environment

- Protection class 1: IP40 (only applies in the case of connected output connectors and/or installed protective caps)
- Temperature Range operation:
  - +5 ... +40 °C (+41 ... +104 °F); for free air circulation
  - It is recommended to recalibrate the sensor in case of temperature fluctuations during operation of more than 5 K.
  - For temperature differences of more than 10 K (e.g. after transport to another location), the sensor may only be put into operation after a period of approx. 1 h.
- Temperature range storage: -10 ... +50 °C (+14 ... +122 °F);  
at max. 90 % relative humidity
- Ambient pressure: Atmospheric pressure
- Humidity
  - Operation: 20 ... 80 % (non-condensing)
  - Storage: 10 ... 90 % (non-condensing)

## 2. Illumination

The surfaceCONTROL 2500 sensor has an LED lighting unit with a high-power LED of wavelength 462 nm (blue), 528 nm (green) or 612 nm (red) depending on the model. The LEDs belong to the risk group 2 according to EN 62471: 2010-06.



Do not look into the lens. Consciously close your eyes or immediately turn away if the optical radiation enters the eye.

> Risk of damage to the eyes by optical radiation!

The following information label is attached to the front of the sensor housing:



*Fig. 1 LED warning label*

1) The protection class does not apply for the optical sections during operation as their soiling / contamination results in adversely affecting or failure of the function.

### 3. Functional Principle, Technical Data

#### 3.1 Short Description

##### 3.1.1 Measuring Principle

The surfaceCONTROL 2500 sensor operates according to the optical triangulation principle (fringe projection):

- Using a matrix projector, a sequence of patterns is projected onto the test object surface.
- The light of the patterns diffusely reflected by the test object surface is recorded by two cameras.
- The three-dimensional surface of the test object is then calculated from the recorded image sequence and the arrangement of the two cameras to each other.

##### 3.1.2 System Design

The surfaceCONTROL 2500 is a sensor for non-contact and non-destructive optical and three-dimensional measurement of diffuse reflective surfaces.

The surfaceCONTROL 2500 sensor can only be operated in conjunction with a system computer with appropriate software for the configuration of the sensor, the data transfer as well as the data calculation and evaluation.

An inspection system for the optical surface inspection comprises at least

- a surfaceCONTROL 2500 sensor or surfaceCONTROL 2500/ST
- a system computer with preinstalled software

which are connected via

- a cable harness.
- several fiber optic cables (3x2), only applies for the 2500/ST model.

The surfaceCONTROL 2500 sensor consists of two cameras, a projector and a temperature-stable housing. The connectors for the data communication between camera, projector and system computer are on a common connector panel on the rear side of the sensor.



Fig. 2 surfaceCONTROL 2500 sensor



Fig. 3 surfaceCONTROL 2500/ST sensor

##### 3.1.3 Particular Performance Characteristics

- The sensors of the surfaceCONTROL 2500 product family cover measuring fields of different sizes for a wide range of applications and are characterized by a particularly large depth measuring range (Z-axis).
- surfaceCONTROL 2500 is characterized by a high image recording speed and high measurement accuracy.
- surfaceCONTROL 2500 has a compact, light and functional housing.
- The base support of the cameras is made of CFK which makes the sensor particularly temperature-stable.

##### 3.1.4 Other Advantages

- Use of USB2.0 and Gigabit Ethernet as fast standard connections to the PC for the control of the sensor and the transmission of the image data.
- Use of USB2.0 and Gigabit Ethernet (via fiber optic technology) as fast and robust standard connections to the PC for the control of the sensor and the transmission of the image data (model 2500/ST).



## 3.2 Technical Data

### 3.2.1 surfaceCONTROL 2500

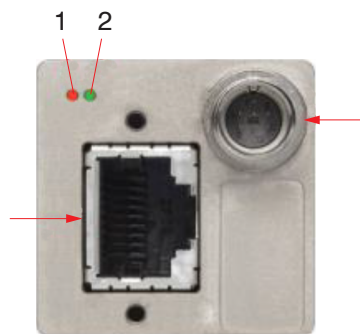
Model	surfaceCONTROL 2500	360	500	720
Measurement area x-/y-axis (Length / width)	Measurement area (close)	260 x 190 mm <sup>2</sup>	350 x 260 mm <sup>2</sup>	500 x 375 mm <sup>2</sup>
	Measurement area (center)	300 x 220 mm <sup>2</sup>	400 x 300 mm <sup>2</sup>	575 x 435 mm <sup>2</sup>
	Measurement area (far)	340 x 250 mm <sup>2</sup>	450 x 340 mm <sup>2</sup>	650 x 495 mm <sup>2</sup>
	Resolution	≥ 0.25 mm	≥ 0.3 mm	≥ 0.5 mm
Measuring range z-axis (Height)	Start of measuring range	475 mm	660 mm	950 mm
	Midrange	550 mm	760 mm	1100 mm
	End of measuring range	625 mm	860 mm	1250 mm
	Measuring range height	150 mm	200 mm	300 mm
Interfaces	Gigabit Ethernet	Image data output		
	USB 2.0	Sensor control		
Light source	/BL	LED, 462 nm (blue)		
	/GR	LED, 528 nm (green)		
	/RD	LED, 612 nm (red)		
Pattern frequency	Sequence (typ.)	up to 2 Hz		
Protection class	Sensor	IP40		
Temperature range	Operation	+5 ... +40 °C		
	Storage	-10 ... +50 °C, non-condensing		
Dimensions		626 x 290 x 144 mm <sup>3</sup>		
Sensor weight	Without cable	7.0 kg		
Power supply		18 - 24 VDC, max. 150 W		

### 3.2.2 surfaceCONTROL 2500/ST

Model	surfaceCONTROL 2500	360-ST	500-ST	720-ST
Measurement area x-/y-axis (Length / width)	Measurement area (close)	260 x 190 mm <sup>2</sup>	350 x 260 mm <sup>2</sup>	500 x 375 mm <sup>2</sup>
	Measurement area (center)	300 x 220 mm <sup>2</sup>	400 x 300 mm <sup>2</sup>	575 x 435 mm <sup>2</sup>
	Measurement area (far)	340 x 250 mm <sup>2</sup>	450 x 340 mm <sup>2</sup>	650 x 495 mm <sup>2</sup>
	Resolution	≥ 0.25 mm	≥ 0.3 mm	≥ 0.5 mm
Measuring range z-axis (Height)	Start of measuring range	450 mm	620 mm	850 mm
	Midrange	525 mm	720 mm	1000 mm
	End of measuring range	600 mm	820 mm	1150 mm
	Measuring range height	150 mm	200 mm	300 mm
Interfaces	Gigabit Ethernet LWL	Image data output		
	USB 2.0 LWL	Sensor control		
Light source	/BL	LED, 462 nm (blue)		
	/GR	LED, 528 nm (green)		
	/RD	LED, 612 nm (red)		
Pattern frequency	Sequence (typ.)	up to 2 Hz		
Protection class	Sensor	IP40		
Temperature range	Operation	0 ... +40 °C (+32 ... +104 °F)		
	Storage	-10 ... +50 °C (+10 ... +122 °F), non-condensing		
Dimensions		626 x 290 x 144 mm <sup>3</sup>		
Sensor weight	W+without cable	7.5 kg		
Power supply		18 - 24 VDC, max. 150 W		

### 3.3 LED Indicators

Each of the two cameras has two LEDs for status display on the rear side.



1	LED 1	Orange	Ethernet connection available
		Flashing orange	Ethernet data traffic
2	LED 2	Green	Power supply to the camera
		Flashing green	Boot process is running
		4 x fast flashing	Transmission error

Fig. 4 Table of LED indicators

## **4. Delivery**

### **4.1 Unpacking / Included in Delivery surfaceCONTROL 2500**

- surfaceCONTROL 2500 sensor
- Sensor acceptance report
- Cable harness, 5 m long; for supply and data transmission; Escha screw connector, LEMO PushPull on sensor side, as well as USB-A and RJ45 on PC side
- 19 VDC table power pack
- CD with programs, drivers, sensor-specific data and documentation
- Operating Instructions

### **4.2 Unpacking / Included in Delivery surfaceCONTROL 2500/ST**

- surfaceCONTROL 2500/ST sensor
- Sensor acceptance report
- Power supply cable, 5 m long; LEMO PushPull on sensor side
- 19 VDC table power pack
- CD with programs, drivers, sensor-specific data and documentation
- Operating Instructions

- ➡ Carefully remove the components of the measuring system from the packaging and ensure that the goods are forwarded in such a way that no damage can occur.
- ➡ Check the delivery for completeness and shipping damage immediately after unpacking.
- ➡ If there is damage or parts are missing, immediately contact the manufacturer or supplier.

Optional accessories are available in the appendix, [see A 1.1](#), [see A 1.2](#).

### **4.3 Storage**

- Temperature range storage: -10 ... +50 °C (+10 ... +122 °F)
- Humidity: 10 ... 90 % (non-condensing)

## 5. Installation

### 5.1 Sensor

All components of the sensor are preassembled at the factory.

► Before connecting the sensor to the power supply and the system computer, mount it on a tripod or robot with the appropriate mounting adapters.

#### 5.1.1 Dimensions

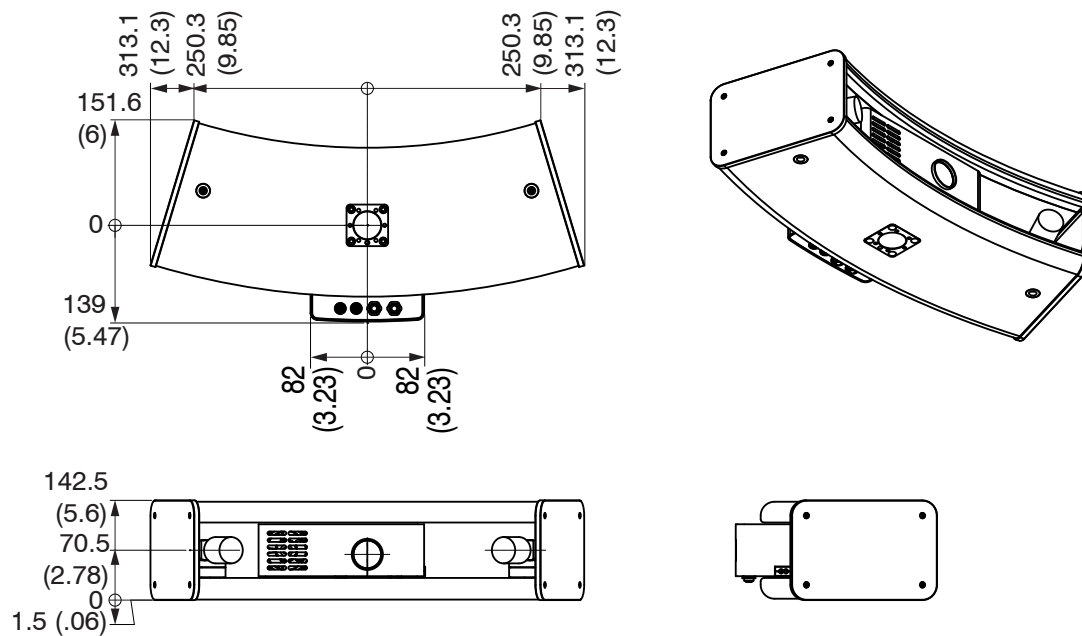


Fig. 5 surfaceCONTROL 2500 dimensions

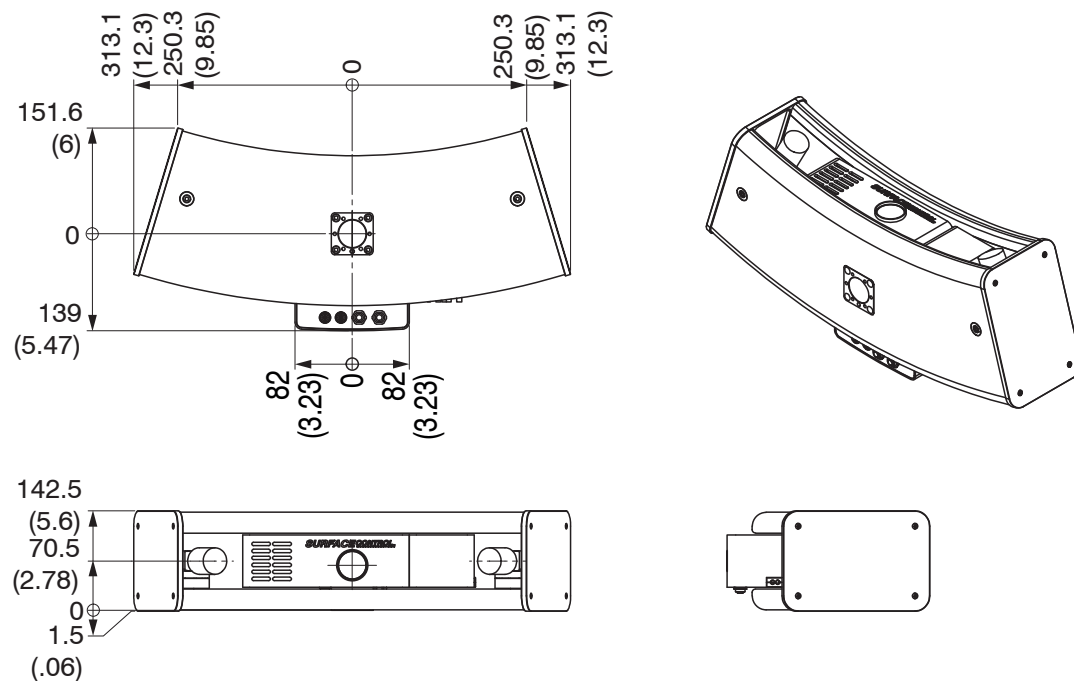


Fig. 6 surfaceCONTROL 2500/ST dimensions

### 5.1.2 Mounting Adapters

The sensor is attached either to a tripod, a robot or a portal.

For mounting the sensor on a tripod or a robot, corresponding mounting adapters (matt black anodized) are provided as separate accessories, [see A 1.2](#).

#### 5.1.2.1 General

The sensors are optical sensors that operate in the  $\mu\text{m}$  range.

**i** Pay attention to careful handling during mounting and operation.

The mounting adapters are always fastened to the sensor base with a total of 6 M6 screws. A metal pin on the underside of the sensor is used for unambiguous orientation of the adapter.

**➡** Mount the sensor to the mounting adapter ensuring full contact over the entire surface.

The sensor and mounting adapter must not be tilted to one another. All screws must be tightened. An improperly mounted adapter can cause the accurately reproducible positioning of the sensor to be impaired and the sensor, adapter and tripod connecting elements to be unevenly mechanically stressed.

#### 5.1.2.2 Assembly with Flange Adapter

An appropriate flange adapter must be used for mounting the sensor. The connection of the sensor base is shown in the following graphic.

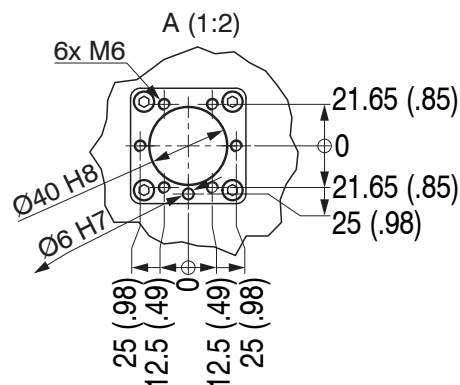


Fig. 7 View of flange adapter

5.2 Connectors

5.2.1 surfaceCONTROL 2500

5.2.1.1 General

All connectors of the sensor are located in the connector panel on the rear side.



Fig. 8 Rear view of sensor with connectors

1	Ethernet port Camera 1 (green)
2	Ethernet port Camera 2 (green)
3	USB port (blue)
4	Power port (red)

5.2.1.2 Supply Voltage (Power)

Pin	Signal	
1	VCC	
2	GND	

Fig. 9 Pin assignment connector power port, see Fig. 8

Range: 18 V - 24 V (rated value 19 V) DC; maximum load 8 A

The cable shield is connected to the connector housing.

A 2-pin LEMO PushPull connector is used on sensor side.

**i** For the power supply of the surfaceCONTROL 2500 sensor, only the supplied power supply is to be used.

5.2.1.3 Sensor Control (USB)

Pin	Signal	
1	USB D+	
2	USB D-	
3	USB VCC	
4	GND	

Fig. 10 Pin assignment connector USB port, see Fig. 8

The cable shield is connected to the connector housing.

The sensor is configured and controlled via the available USB 2.0 interface. Use only the supplied USB cable.

A 4-pin LEMO PushPull connector is used on sensor side.

The USB-A connector on PC side can be connected to a USB 2.0 or USB 3.0 port.

The operation of the sensor via USB requires the installation of the corresponding driver from the software CD.

### 5.2.1.4 Image Data Transmission (Gigabit Ethernet)

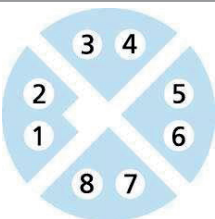
Pin	Signal	
1	Data1 +	
2	Data1 -	
3	Data2 +	
4	Data3 +	
5	Data3 -	
6	Data2 -	
7	Data4 +	
8	Data4 -	

Fig. 11 Pin assignment connector "Ethernet port", see Fig. 8

For the image data output of the cameras via Gigabit Ethernet, the sensor has two Gigabit Ethernet interfaces. The sensor supports only the transmission with 1 Gbit.

8-pin, X-coded, M12 round connectors with screwed connections are used on sensor side.

The connection and tightening of the Ethernet cable to the sensor can be done by hand and does not require any tools. Proceed as follows for this:

- ➡ Carefully insert the cable connector into the port on the sensor.
- ➡ Turn the cable connector until you feel the latching of the inner groove into the corresponding guide of the port.

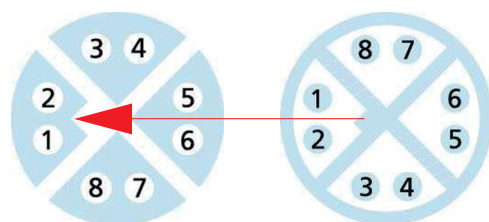


Fig. 12 Connecting Ethernet connector to port

- ➡ Tighten the cable connector.

#### NOTICE

Do not apply force when tightening.

> Damage to or destruction of the sensor

RJ45 connectors are used on the PC side.

• Use only the Ethernet cable supplied in the scope of delivery.

5.2.2 surfaceCONTROL 2500/ST

5.2.2.1 General

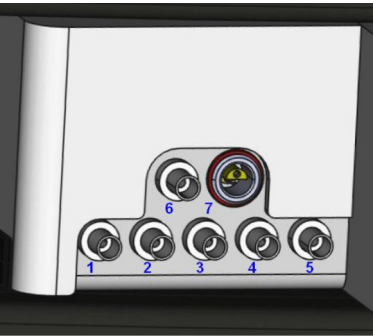


Fig. 13 Rear view of sensor with connectors

1	LWL-ST USB projector
2	LWL-ST camera A/1
3	LWL-ST camera A/2
4	LWL-ST camera B/1
5	LWL-ST camera B/2
6	NC
7	Power port (red)

5.2.2.2 Supply Voltage (Power)

Pin	Signal	
1	VCC	
2	GND	

Fig. 14 Pin assignment connector power port, see Fig. 13

Range: 18 V - 24 V (rated value 19 V) DC; maximum load 8 A

The cable shield is connected to the connector housing.

A 2-pin LEMO PushPull connector is used on sensor side.

For the power supply of the surfaceCONTROL 2500 sensor, only the supplied power supply is to be used.

5.2.2.3 Sensor Control (USB)

The sensor is configured and controlled via the available USB 2.0 interface.

On the PC side, a fiber-optic USB converter is used. It can be connected to a USB 2.0 or USB 3.0 port.

The operation of the sensor via USB requires the installation of the corresponding driver from the software CD.



Fig. 15 LWL USB converter

5.2.2.4 Image Data Transmission (Gigabit Ethernet)

On the PC side, a 2-port fiber-optic interface card is required.



5.2.3      Installation Instructions

surfaceCONTROL 2500	surfaceCONTROL 2500/ST
For all connection cables, use only the appropriate cables from the accessories, <a href="#">see A 1.1.</a>	As connection cable, use fiber optics with an OM class of at least OM2 or the corresponding cables from the accessories, <a href="#">see A 1.1.</a>
Lay all connection cables in accordance with the generally applicable measuring technology regulations, i.e. for example not directly next to pulse-carrying lines, preferably in a separate cable duct. The minimum bending radii of the recommended cables for flexible laying must not be less than 80 mm.	

**NOTICE**

Only use the included power pack for the power supply of the sensor.  
> Damage to or destruction of the sensor

## 6. Operation of the Sensor

### 6.1 Commissioning

- ➡ Mount the sensor according to the assembly instructions, [see 5.1](#).
- ➡ Connect the sensor
  - with the cables of the cable harness (surfaceCONTROL 2500).
  - with fiber optic cables (surfaceCONTROL 2500/ST).
- ➡ Connect the sensor to the PC and the power supply.
- ➡ Switch on the power supply.

### 6.2 Displays

- ➡ After getting ready for operation, switch on the external direct current power supply (19 VDC).

The LEDs of the cameras now display different states by flashing, [see 3.3](#). When using DHCP to establish the network connection of the cameras, the sensor requires a few seconds to one minute to be ready for operation.

- **l** The surfaceCONTROL 2500 and surfaceCONTROL 2500/ST sensor requires a warm-up time of typically 30 minutes for high precision measurements.

### 6.3 Operating Programs

Various applications are provided for the operation of the sensor:

- surfaceCONTROL Defmap3D for individual surface analysis supports all measurement tasks with surfaceCONTROL 2500 / surfaceCONTROL 2500/ST.
- surfaceCONTROL InspectionTools for automated inspection
- dimensionCONTROL CameraCalibration for sensor calibration

Depending on the characteristics of the measurement system, the corresponding CD, incl. documentation, is supplied.

### 6.4 Installation

#### 6.4.1 Requirements

The following minimum system requirements must be met for operating the surfaceCONTROL software packages:

- Windows 7 (32-bit and 64-bit), Windows 10 (32-bit and 64-bit)
- Intel Core-i5/Core-i7/Xeon
- 8 GB RAM
- Screen resolution: 1920 x 1080

The following procedure is necessary in order to install the software:

- ➡ Install the hardware of the Ethernet interface(s) if not present.
- ➡ Install the software and drivers according to the instructions on the CD.
- ➡ Connect and license the USB dongle if available.
- ➡ Connect the surfaceCONTROL 2500 / 2500/ST measurement system to the PC (Ethernet, USB).

### 6.4.2 Connecting surfaceCONTROL 2500 / 2500/ST to the PC

Proceed as follows to connect surfaceCONTROL 2500 / 2500/ST via Ethernet and USB to the PC:

surfaceCONTROL 2500	surfaceCONTROL 2500/ST
➡ Complete the installation of the software.	
➡ Connect surfaceCONTROL 2500 to the PC via the two Ethernet interfaces and the USB interface and switch on the power supply to the sensor.	➡ Connect the surfaceCONTROL 2500/ST to the PC via the fiber-optic Ethernet interface and the fiber-optic USB interface and switch on the power supply to the sensor.

➡ Wait until the surfaceCONTROL 2500 / 2500/ST measurement system is recognized by the PC.

This may take a few seconds.

You can now operate the surfaceCONTROL measurement system with surfaceCONTROL software packages.

### 6.4.3 Network

The cameras of the sensor are operated with a high data rate. Each camera fully utilizes the available transfer capacity of the Gigabit Ethernet connection.

For correct operation of the sensor, the following recommendations should be taken into account when selecting and configuring the network components.

#### 6.4.3.1 Components

Due to the high data rate, a high-quality Gigabit Ethernet interface card is recommended, for example Intel Pro/1000 PT. An independent Gigabit Ethernet interface must be available per camera. The use of a switch is not recommended.

The following network cards have been tested with the sensor:

Model	Designation	Standard	Bus type
2500	Intel® PRO/1000 PT Dual Port Server Adapter or Intel® 1350-T2 Dual Port Server Adapter	2x 1000BASE-T	PCIe 1.0 x4
2500/ST	Intel® PRO/1000 PF Dual Port Server Adapter	2x 1000BASE-SX	PCIe 2.1 x4

#### 6.4.3.2 Design

Operating the cameras via Ethernet requires no additional driver installation. The necessary performance drivers for the cameras are already installed with the software installation.

Note the following instructions when setting up the network:

- The cameras should be configured in a distinct network, separated from the Internet or a local network (LAN).
- The mixed use of the network (e.g. with printer, Internet/e-mail, etc.) is possible in principle, but can lead to loss of performance and data loss.
- Various network settings (e.g. firewall or packet filters) can interfere with communication with the cameras.

### 6.4.3.3 Configuration

The network card settings should be adjusted to improve system performance when using Gigabit Ethernet cameras. Goal of the optimization is to minimize CPU usage and to avoid packet loss.

➡ Adjust the network card settings according to the following table:

Property	Value
Packet size/maximum transmission unit (MTU)	8228 bytes or greater
Interrupt moderation	Enable
Interrupt moderation rate	Extreme
Receive buffer	Maximum value configurable
Transmit buffer	256 bytes

The naming and setting options can vary depending on the network card used.

#### Standard packet size

The standard packet size of the cameras is 8228 bytes. The network card in the PC must support at least this packet size to make use of the full performance capability of the cameras.

#### Enabling jumbo frames

For optimal performance of the two cameras, jumbo frames should be enabled on the network card. Depending on the manufacturer and type of the network card, the setting is referred to as “Jumbo Frames” or “Jumbo Packets”. If this setting cannot be found, the network card does not support this feature and should not be used with the sensor.

Proceed as follows to enable the jumbo frames:

- ➡ Locate the network card used for the camera in the device manager or in a comparable setting of your operating system.
- ➡ Go to the settings of the network card.
- ➡ Select the Jumbo Packet entry and set the value to 9014 bytes.
- ➡ Confirm the change with **OK**.

**i** After the change, an existing connection to the cameras is disconnected and rebuilt.

## 6.5 Operating Information

### 6.5.1 Measuring Range

The measuring range of the sensors is factory-set. It is not possible to change the measuring range by exchanging the lenses.

The area illuminated by the projector is relevant for the actual measuring range of the sensor. The cameras are arranged in such a way that both cameras capture the area illuminated by the projector within the complete measuring volume.

The measuring range in the Z-direction is trapezoidal due to the point-shaped light source of the projector and the fan-out over the lens.

### 6.5.2 Calibration

The calibration of the sensor serves to determine the orientation of the camera coordinates in the coordinate system of the inspection system and is carried out with the aid of a pre-calibrated calibration field.

The sensor is factory calibrated upon delivery. An acceptance report is included with each sensor and the necessary calibration data for the use of the sensor are provided on a separate CD.

When the sensor is operated under frequently and strongly changing ambient conditions, a new calibration of the sensor can be necessary at the beginning of a series of measurements. This also applies after transport or strong vibrations of the sensor.

The sensor is calibrated using the dimensionCONTROL CameraCalibration software. For further information and instructions for carrying out a calibration, see the operating instructions surfaceCONTROL 2500-500 Camera Calibration 4.1.

### 6.5.3 Positioning of Sensor and Test Object

**i** Note the following instructions for optimal positioning of the sensor to the test object:

- ➡ Observe an optimum distance between the sensor and the surface of the test object according to the Technical Data, [see 3.2.1](#), [see 3.2.2](#)<sup>1</sup>.
- ➡ Align the sensor with predominantly diffusely reflecting surfaces as perpendicular to the surface as possible.

In the case of partially glossy surfaces, reflections from the test object can be reduced by inclining the sensor by up to 30° with respect to the surface of the test object.

If the test object contains design edges, the sensor should be aligned as horizontally as possible to these.

The positioning of the sensor to the test object can be supported by means of the surfaceCONTROL Defmap3D software.

- ➡ Please refer to the corresponding instructions in the operating instructions of the software.

## 6.6 Error Influences

### 6.6.1 Reflection Factor of the Surface of the Target

The sensor evaluates the diffuse portion of the reflected light. Any statement about a minimum reflection factor is only possible with reservations. A preliminary examination is necessary for using the sensor on reflective or highly reflective objects.

### 6.6.2 Color Differences

Color differences between test objects result in apparent changes of the surface texture of the test object and thus also influence the calculation of the 3D data from the acquired images. Therefore color differences can result in increased measurement inaccuracies and reduced detection performance.

As the exposure parameters can only be changed as a whole, careful matching of the exposure to the target surface is recommended.

### 6.6.3 Temperature Influences

When the sensor is commissioned a warm-up time of at least 30 minutes is required to achieve uniform temperature distribution in the sensor. Large temperature fluctuations and changes of the ambient climate act directly on the sensor and its fixing elements and can thus change the detection performance.

- i** It is recommended to operate the sensor under as constant as possible ambient conditions. A new calibration is required if the ambient conditions change permanently.

1) Optimum distance is the mid of measuring range.

#### 6.6.4 External Light

For external light suppression, the sensor is equipped with corresponding filters in front of the camera lenses. They allow only a narrow (band-limited) wavelength range around the wavelength of the light projected onto the test object. In general, additional shielding of external light directly emitted on the target or reflected in the sensor is advisable.

- **i** Pay particular attention to unwanted reflections of the projected structured light outside the target area (background, object holder or similar) which can be reflected back again into the view area of the sensor.
- **i** Matt black surface coatings are recommended for all objects outside the measuring range (object holders, transport equipment, grippers or similar).

#### 6.6.5 Mechanical Vibrations

As high resolutions in the  $\mu\text{m}$  range will be achieved with the sensor, particular attention must be paid to as vibration-free as possible set-up of sensor and test object.

#### 6.6.6 Surface Roughness and Texture

Surface roughnesses of the order of  $5\ \mu\text{m}$  and more as well as textures on the surface result in increased “surface noise”. In addition, direct reflections of the projected light can also occur on grinding marks or small scratches on the surface. This can result in inaccurate measured values. Remedy can possibly be provided by adjusting the exposure or by other sensor settings, e.g. filter.

#### 6.6.7 Shadowing Effects and Multiple Reflections

Shadowing effects and multiple reflections occur particularly frequently on strongly curved surfaces. Steep edges and large differences in height lead to certain areas on the test object being underprojected. Furthermore, parts of the test object cannot be detected completely by the cameras, which leads to a loss of measuring points on the surface. This effect can be diminished by a change in orientation of the sensor to the surface.

Multiple reflections of the projected pattern from certain areas of the surface to other areas of the surface lead to overlaps of the original pattern. This can result in inaccurate measured values. Remedy can possibly be provided by selectively masking the projected pattern and not illuminating the undesirably reflecting areas. The procedure for masking certain areas is described in the operating instructions of the surfaceCONTROL Defmap3D software. However, if you want to check these areas anyway, repeated data acquisition with modified masking is necessary.

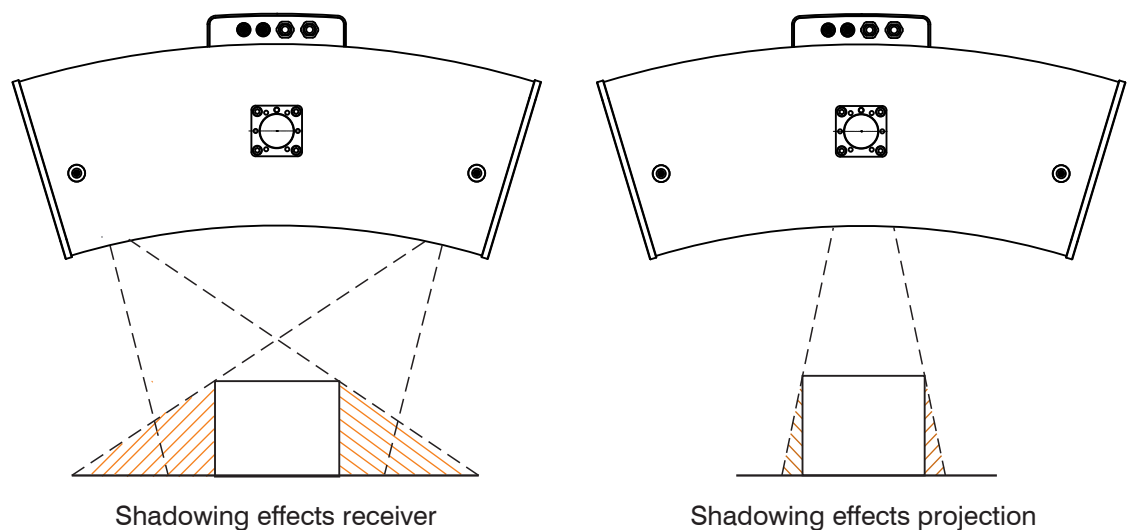


Fig. 16 Shadowing effects

## 6.7 Cleaning

### 6.7.1 Housing

It is not recommended to clean the housing. But if cleaning needs to be carried out, this can be done using water without additives and a soft cloth.

### 6.7.2 Protective Glasses / Filter

The lenses of the cameras and the projector are protected as standard by protective glass filters screwed onto the lenses. We recommend cleaning the protective filters regularly.

#### Dry cleaning

You can use an anti-static brush for lenses, or blow down the covers using dehumidified, clean, oil-free compressed air.

#### Wet cleaning

Use a clean, soft, lint-free cloth or a lens cleaning tissue and pure alcohol (isopropanol) to clean protective covers.

Never use commercial glass cleaners or other cleaning agents.

#### NOTICE

When cleaning the protective filters, make sure that you do not change the settings of the lenses and do not exert any strong pressure on the cameras or the lenses.

> Recalibration is possibly required

## 7. Liability for Material Defects

All components of the device have been checked and tested for functionality at the factory. However, if defects occur despite our careful quality control, INB Vision AG or your dealer must be notified immediately.

The liability for material defects is 12 months from delivery. Within this period, defective parts, except for wearing parts, will be repaired or replaced free of charge, if the device is returned to INB Vision AG with shipping costs prepaid. Any damage that is caused by improper handling, the use of force or by repairs or modifications by third parties is not covered by the liability for material defects. Repairs are carried out exclusively by INB Vision AG.

Further claims can not be made. Claims arising from the purchase contract remain unaffected. In particular, INB Vision AG shall not be liable for any consequential, special, indirect or incidental damage. In the interest of further development, INB Vision AG reserves the right to make design changes without notification.

For translations into other languages, the German version shall prevail.

## 8. Service, Repair

If the sensor or the cable harness is defective, please send the affected parts back for repair or exchange. Where the cause of a fault cannot be precisely defined, always send the entire sensor to:

INB Vision AG  
Brenneckestraße 20, ZENIT II  
39118 Magdeburg / Germany

Tel. +49 (0) 391 / 6117-300  
Fax +49 (0)391 / 6117-301  
info@inb-vision.com  
www.inb-vision.com

## 9. Decommissioning and Disposal

➡ Remove all cables from the sensor.



Incorrect disposal may cause harm to the environment.

➡ Dispose of the device, its components and accessories, as well as the packaging materials in compliance with the applicable country-specific waste treatment and disposal regulations of the region of use.




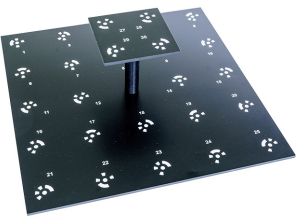
## Appendix

### A 1 Accessories and Spare Parts

#### A 1.1 Recommended Accessories, Spare Parts

Name		Description
Cable harness 5 m		Cable for connecting the sensor to the PC
Table power pack 19 V		Power supply for use with the sensor

#### A 1.2 Optional Accessories

Name	Photo	Description
X95/dovetail mounting adapter		Adapter for mounting on X95 profile (Qioptiq) or on tripod head with dovetail
47° dovetail mounting adapter		Adapter for mounting on tripod head with dovetail
Transport case		FlightCase for transporting sensors and accessories
Calibration target		Calibration target for calibrating the sensor



### A 1.3 Drawings Mounting Adapters

#### A 1.3.1 X95/Dovetail Mounting Adapter

The X95/dovetail mounting adapter is used to mount the sensor on a quick release plate with a dovetail profile of size 050/87 or to the profile system X95 of the manufacturer Linos (Qioptiq).

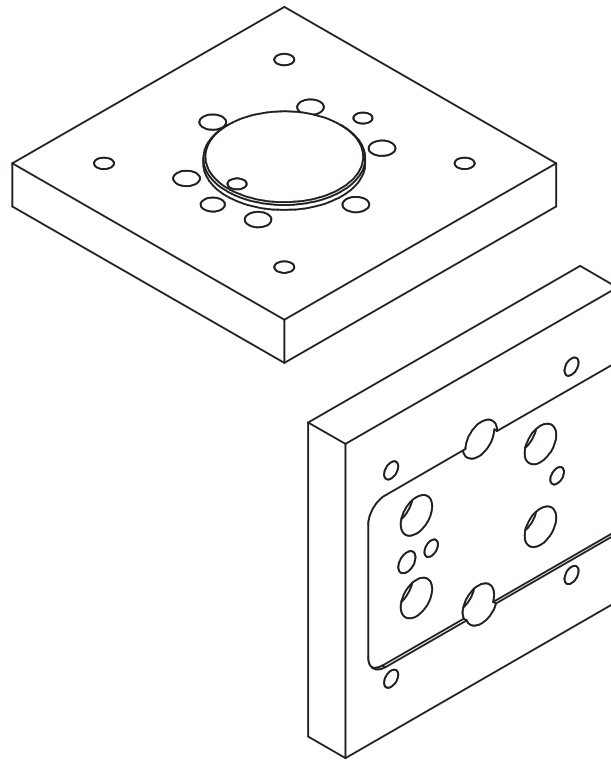


Fig. 17 View of X95/dovetail mounting adapter

The outer dimensions of the adapter are 95 mm x 95 mm x 15 mm.

#### A 1.3.2 47° Dovetail Mounting Adapter

The 47° dovetail mounting adapter is used to mount the sensor on a quick release plate with a dovetail profile of size 050/87. The adapter is an adjustment for the operation of the sensor with a 43° 2-way ball tilt head. The adapter angle of 47° allows to directly align the sensor perpendicular to the ground.

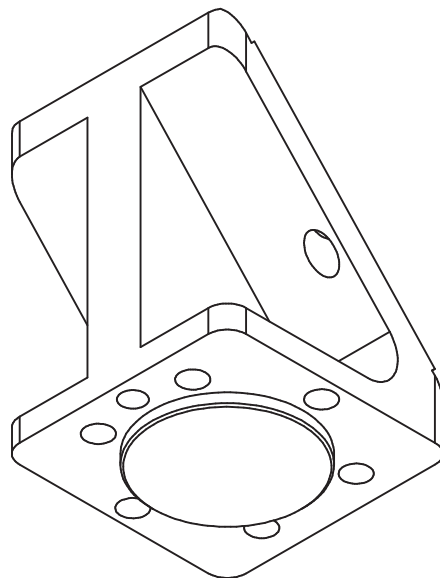


Fig. 18 View of 47° dovetail mounting adapter from below (sensor side)

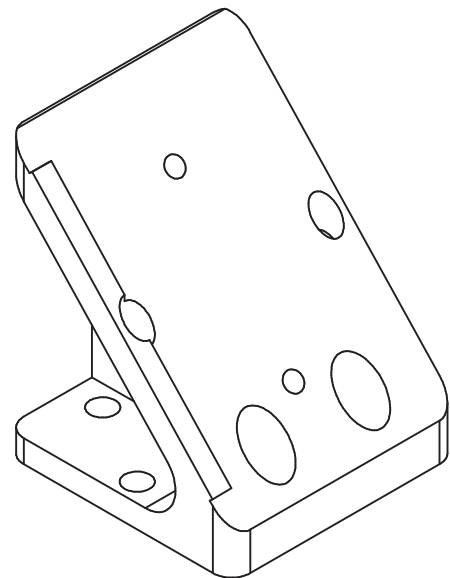


Fig. 19 View of 47° dovetail mounting adapter from above (tripod side)

The outer dimensions of the adapter are 60 mm x 60 mm x 76.6 mm.

