

PNBCxxx

High-Performance Distance Sensors



Operating Instructions

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1. Use for Intended Purpose

This wenglor product is intended for use in accordance with the following functional principle:

High-Performance Distance Sensors

This product group includes high-performance sensors for measuring distance, which function in accordance with various principles in scanning mode operation. High-Performance Distance Sensors are especially fast or accurate, or have large working ranges. They're extremely well suited for demanding applications. Even black and glossy objects can be reliably detected. Ethernet technology is integrated into selected sensors.

2. Safety Precautions

2.1. Safety Precautions

- These instructions are an integral part of the product and must be kept on hand for the entire duration of its service life.
- Read the operating instructions carefully before using the product.
- Installation, initial start-up and maintenance of the product may only be carried out by qualified personnel.
- Tampering with or modifying the product is impermissible.
- Protect the product from contamination during initial start-up.
- Not a safety component in accordance with the EU machinery directive

2.2. Laser/LED Warnings

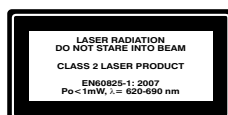


Laser Class 2
EN60825-1

Laser Class 2 (EN 60825-1)

Applicable standards and safety regulations must be observed.
The accompanying laser warnings must be attached.
Do not look into the laser beam.

Caution: Use of control and/or adjusting devices other than those specified here, as well as the execution of other procedures, may result in hazardous exposure to laser radiation.



3. EC Declaration of Conformity

The products have been developed, designed and manufactured in correspondence with directive 2004/108/EC. The following international standards and specifications apply:

EN 60947-5-2	Low-voltage switchgear and controlgear; Control circuit devices and switching elements – Proximity switches
EN 60825-1:2007	Safety of laser products
EN 61000-6-2:2005	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments

Other valid standards which are applicable for the given application must be observed.



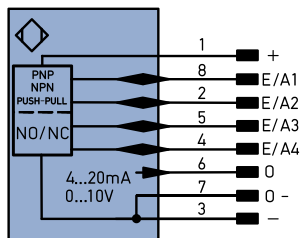
4. Technical Data

	PNBC001	PNBC002	PNBC003	PNBC004
Optical Characteristics				
Working range [mm]	20...24	25...35	40 to 60	58 to 108
Measuring range	4 mm	10 mm	20 mm	50 mm
Linearity error	2 μ m	5 μ m	10 μ m	25 μ m
Resolution	0.06 μ m	0.15 μ m	0.3 μ m	0.8 μ m
Type of Light	Laser (red)	Laser (red)	Laser (red)	Laser (red)
Wavelength	658 nm	658 nm	658 nm	658 nm
Service life (ambient temp. = +25° C)	100,000 hours	100,000 hours	100,000 hours	100,000 hours
Laser class (EN 60825-1)	2	2	2	2
Spot diameter	< 0.15 mm	< 0.20 mm	< 0.25 mm	< 0.35 mm
Max. allowable extraneous light	10,000 lux	10,000 lux	10,000 lux	10,000 lux
Electrical Characteristics				
Supply power	10 to 30 V DC	10 to 30 V DC	10 to 30 V DC	10 to 30 V DC
Current consumption (operating voltage = 24 V)	280 mA	280 mA	280 mA	280 mA
Output rate	1000 to 30,000/s	1000 to 30,000/s	1000 to 30,000/s	1000 to 30,000/s
Switching frequency	15 kHz	15 kHz	15 kHz	15 kHz
Temperature drift	0.2 μ m/K	0.5 μ m/K	1 μ m/K	2.5 μ m/K
Temperature range	-10 to 40° C	-10 to 40° C	-10 to 40° C	-10 to 40° C
Storage temperature	-20 to 70° C	-20 to 70° C	-20 to 70° C	-20 to 70° C
Interface	Ethernet TCP/IP	Ethernet TCP/IP	Ethernet TCP/IP	Ethernet TCP/IP
Transmission speed	10/100 Mbit/s	10/100 Mbit/s	10/100 Mbit/s	10/100 Mbit/s
Analog output	0 to 10 V / 4 to 20 mA	0 to 10 V / 4 to 20 mA	0 to 10 V / 4 to 20 mA	0 to 10 V / 4 to 20 mA
Website	Yes	Yes	Yes	Yes
Number of switching outputs	4	4	4	4
Can be switched to NC or NO operation	Yes	Yes	Yes	Yes
PNP / NPN / push-pull	Yes	Yes	Yes	Yes
Voltage drop at switching output	< 1.5 V	< 1.5 V	< 1.5 V	< 1.5 V
Switching output switching current	100 mA	100 mA	100 mA	100 mA
Short-circuit proof	Yes	Yes	Yes	Yes
Reverse polarity protected	Yes	Yes	Yes	Yes
Protection class	III	III	III	III
Mechanical Characteristics				
Setting method	Teach-in	Teach-in	Teach-in	Teach-in
Housing material	Aluminum	Aluminum	Aluminum	Aluminum
Protection	IP 67	IP 67	IP 67	IP 67
Connector type	M12 x1, 8-pin	M12 x1, 8-pin	M12 x1, 8-pin	M12 x1, 8-pin
Ethernet connector type	M12 x 1, 4-pin	M12 x 1, 4-pin	M12 x 1, 4-pin	M12 x 1, 4-pin

	PNBC005	PNBC006	PNBC007	PNBC008
Optical Characteristics				
Working range [mm]	90...190	200...400	250...650	200...1000
Measuring range	100 mm	200 mm	400 mm	800 mm
Linearity error	50 μ m	100 μ m	200 μ m	375 μ m
Resolution	1.5 μ m	3.1 μ m	6.1 μ m	12.2 μ m
Type of Light	Laser (red)	Laser (red)	Laser (red)	Laser (red)
Wavelength	658 nm	658 nm	658 nm	658 nm
Service life (ambient temp. = +25° C)	100,000 hours	100,000 hours	100,000 hours	100,000 hours
Laser class (EN 60825-1)	2	2	2	2
Spot diameter	< 0.75 mm	< 0.90 mm	< 1.20 mm	< 1.60 mm
Max. allowable extraneous light	10,000 lux	10,000 lux	10,000 lux	10,000 lux
Electrical Characteristics				
Supply power	10 to 30 V DC	10 to 30 V DC	10 to 30 V DC	10 to 30 V DC
Current consumption (operating voltage = 24 V)	280 mA	280 mA	280 mA	280 mA
Output rate	1000 to 30,000/s	1000 to 30,000/s	1000 to 30,000/s	1000 to 30,000/s
Switching frequency	15 kHz	15 kHz	15 kHz	15 kHz
Temperature drift	5 μ m/K	10 μ m/K	20 μ m/K	37.5 μ m/K
Temperature range	-10 to 40° C	-10 to 40° C	-10 to 40° C	-10 to 40° C
Storage temperature	-20 to 70° C	-20 to 70° C	-20 to 70° C	-20 to 70° C
Interface	Ethernet TCP/IP	Ethernet TCP/IP	Ethernet TCP/IP	Ethernet TCP/IP
Transmission speed	10/100 Mbit/s	10/100 Mbit/s	10/100 Mbit/s	10/100 Mbit/s
Analog output	0 to 10 V / 4 to 20 mA	0 to 10 V / 4 to 20 mA	0 to 10 V / 4 to 20 mA	0 to 10 V / 4 to 20 mA
Website	Yes	Yes	Yes	Yes
Number of switching outputs	4	4	4	4
Can be switched to NC or NO operation	Yes	Yes	Yes	Yes
PNP / NPN / push-pull	Yes	Yes	Yes	Yes
Voltage drop at switching output	< 1.5 V	< 1.5 V	< 1.5 V	< 1.5 V
Switching output switching current	100 mA	100 mA	100 mA	100 mA
Short-circuit proof	Yes	Yes	Yes	Yes
Reverse polarity protected	Yes	Yes	Yes	Yes
Protection class	III	III	III	III
Mechanical Characteristics				
Setting method	Teach-in	Teach-in	Teach-in	Teach-in
Housing material	Aluminum	Aluminum	Aluminum	Aluminum
Protection	IP67	IP67	IP67	IP67
Connector type	M12 x1, 8-pin	M12 x1, 8-pin	M12 x1, 8-pin	M12 x1, 8-pin
Ethernet connector type	M12 x 1, 4-pin	M12 x 1, 4-pin	M12 x 1, 4-pin	M12 x 1, 4-pin

4.1. Wiring Diagram

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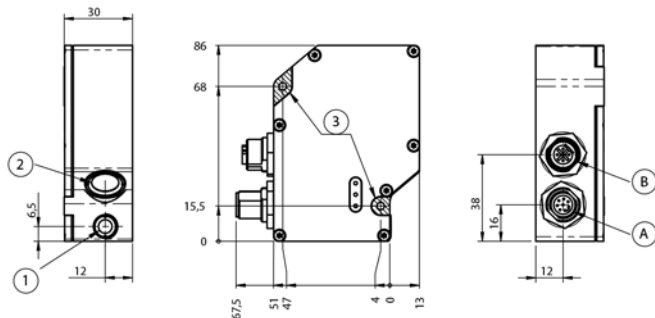
Legend

+	Supply Voltage +	nc	not connected
-	Supply Voltage 0 V	U	Test Input
~	Supply Voltage (AC Voltage)	U	Test Input inverted
A	Switching Output (NO)	W	Trigger Input
A	Switching Output (NC)	O	Analog Output
V	Contamination/Error Output (NO)	O-	Ground for the Analog Output
V	Contamination/Error Output (NC)	BZ	Block Discharge
E	Input (analog or digital)	AWV	Valve Output
T	Teach Input	a	Valve Control Output +
Z	Time Delay (activation)	b	Valve Control Output 0 V
S	Shielding	SY	Synchronization
RxD	Interface Receive Path	E+	Receiver-Line
TxD	Interface Send Path	S+	Emitter-Line
RDY	Ready	≡	Grounding
GND	Ground	SnR	Switching Distance Reduction
CL	Clock	Rx+/-	Ethernet Receive Path
E/A	Output/Input programmable	Tx+/-	Ethernet Send Path
IO-Link	IO-Link	Ba	Interfaces-Bus A(+)/B(-)
PE	Power over Ethernet	La	Emitted Light disengageable
IN	Safety Input	Mag	Magnet activation
OSD	Safety Output	RES	Input confirmation
Signal	Signal Output	EDM	Contactor Monitoring

ENa	Encoder A
ENb	Encoder B
AMIN	Digital output MIN
AMAX	Digital output MAX
AOK	Digital output OK
SY In	Synchronization In
SY OUT	Synchronization OUT
OLt	Brightness output
M	Maintenance
Wire Colors according to DIN IEC 757	
BK	Black
BN	Brown
RD	Red
OG	Orange
YE	Yellow
GN	Green
BU	Blue
VT	Violet
GY	Grey
WH	White
PK	Pink
GNYE	Green Yellow

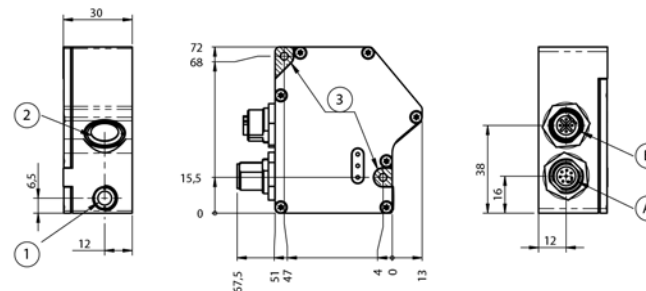
4.2. Housing Dimensions

PNBC001



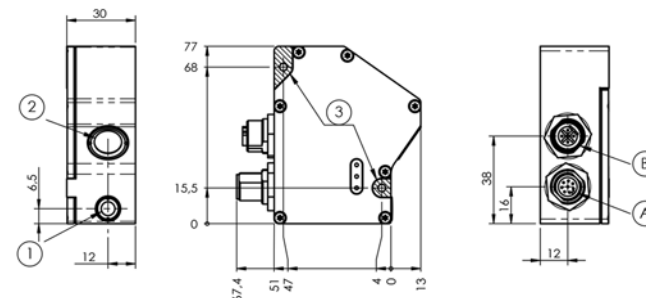
- 1 = Emitter Diode
- 2 = Receiving Diode
- 3 = Bearing Surface with M4 on Both Sides

PNBC002



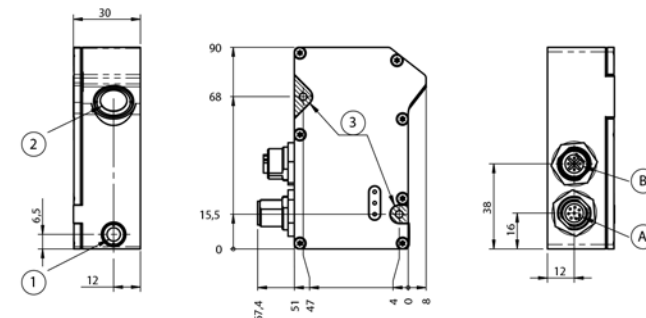
- 1 = Emitter Diode
- 2 = Receiving Diode
- 3 = Bearing Surface with M4 on Both Sides

PNBC003



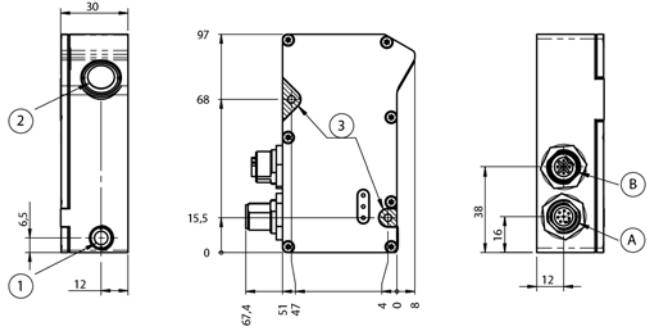
- 1 = Emitter Diode
- 2 = Receiving Diode
- 3 = Bearing Surface with M4 on Both Sides

PNBC004



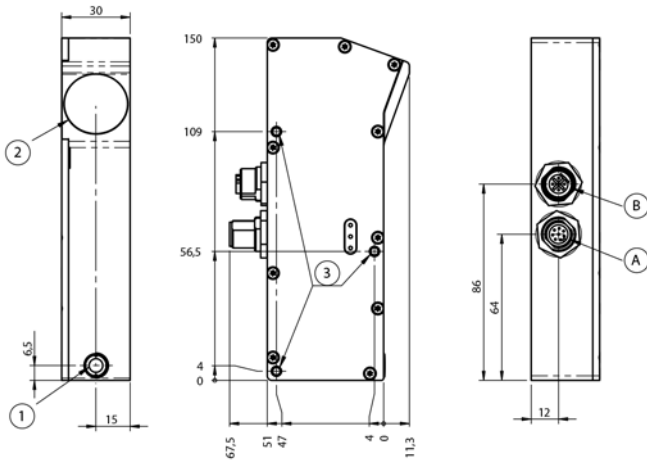
- 1 = Emitter Diode
- 2 = Receiving Diode
- 3 = Bearing Surface with M4 on Both Sides

PNBC005



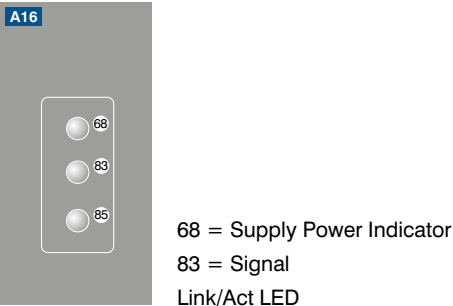
- 1 = Emitter Diode
- 2 = Receiving Diode
- 3 = Bearing Surface with M4 on Both Sides

PNBC006/007/008



- 1 = Emitter Diode
- 2 = Receiving Diode
- 3 = M4 on both sides

4.3. Control Panel



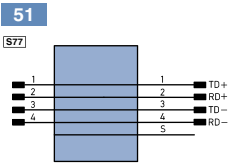
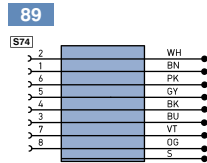
Designation	Status	Function
Power	Green	Operating voltage on
	Off	Operating voltage off
Signal	Green	Signal strength OK, sensor ready to measure
	Blinking green	Weak signal, unreliable measurement results
	Red	No signal, sensor contaminated and/or overranging
Link/Act	Yellow	Links available
	Blinking yellow	Communication

4.4. Complementary Products

wenglor offers Connection Technology for field wiring.

Suitable mounting technology no. 550

Suitable connection technology no.



Switch ZAC51xN01

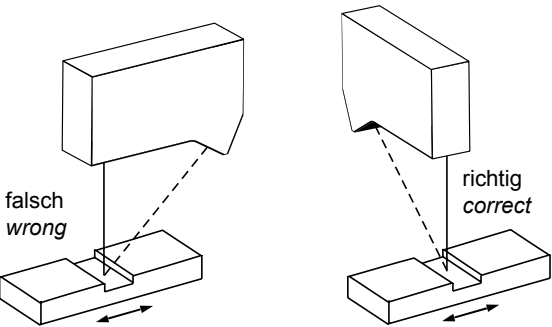
5. Installation Instructions

During use of the sensor, applicable electrical and mechanical regulations, standards and safety precautions must be adhered to. The sensor must be protected against mechanical influences.

When installing the sensor it must be ensured that direct eye contact with the laser beam is avoided. The laser warning must be plainly visible.
When installing the sensor it must be ensured that the measuring beam is exactly perpendicular to the surface to be measured in order to assure accurate measurement results. Tilting results in a geometrically longer measuring path.

Moving or Striped Objects

If moving or striped objects will be measured, the sensor head should be mounted with its long side perpendicular to the motion of direction or the stripes. In this way, better measurement results can be achieved in the corners because shadowing is avoided:



5.1. Default Settings

	PNBCxxx
IP address	192.168.0.225
Subnet mask	255.255.0.0
Evaluation method	Cog
Average filter	5
Sampling rate	Auto
Emitted light	Auto
Offset	0.0 mm
Analog mode	4 to 20 mA
E1	Ext. teach-in: O3
E2	Ext. teach-in: O4
A3	Switching output: PNP / NO
A4	Switching output: PNP / NO
Input load: 2 mA	On
Input	Operating voltage active
Teach-in mode	Foreground teach-in

6. Initial Start-Up

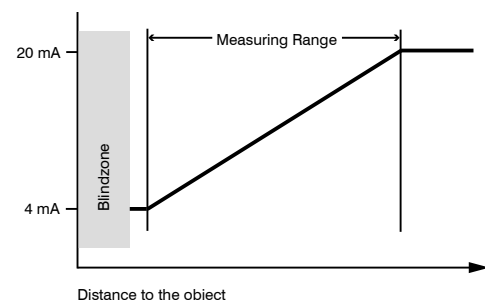
Two connector plugs are integrated in to the sensor's housing. The 8-pin plug supplies the sensor with +24 V operating voltage, whereas communication for parameters configuring and process data is conducted via the 4-pin socket. We recommend the exclusive use of Ethernet switches in order to optimize data communication.

Please note: If Gigabit Ethernet cards are used, the polarity of the Tx and Rx conductors might not be correctly detected. Connecting sensors directly may result in complications. With an Ethernet crossover cable (cross-link), the sensor functions flawlessly via a PC network card. As an alternative, a commercially available 100 Mbit Ethernet switch can also be used.

7. Function Descriptions

PNCB High-Performance Distance Sensors work with a high resolution CMOS line array and determine distance by means of an angular measurement at a sampling rate of up to 30 kHz. The sensor is equipped with integrated electronics and no additional controller is required as a result.

Ascertained distance values are read out as process data via the interface and at the analogue output with 16-bit resolution.



The diffusely reflected light from the measuring point is decisive for the measurement. Inadequate intensity of the remitted light is indicated by an LED signal lamp on the sensor's control panel. In the event of minimal remission, the sensor automatically reduces its sampling and output rates, in order to provide accurate measurement results. Signal strength is indicated on the website as a percentage (see "Status Display" in section "8.1. Page Layout" on page 19).

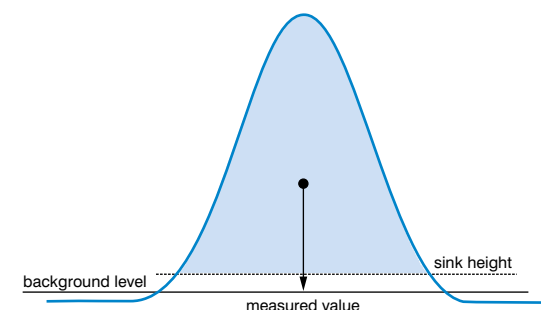
Not only does the laser spot produce an illuminated pixel on the CMOS line array, it also generates an intensity curve which is distributed over several pixels. This intensity curve is called the peak, and ideally it's steep at both ends, monotonically non-decreasing and symmetrical. The curve depends on distance, internal optics and the surface of the object to be measured. The evaluation method is decisive with regard to attainable measuring accuracy. Some surfaces require an evaluation method which is especially suited to them.

The following peak evaluation methods (algorithms) are available:

7.1. Evaluation method

7.1.1. Center of Gravity (Cog)

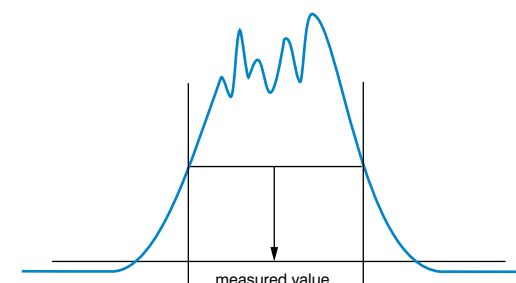
The Cog evaluation method calculates the peak's center of gravity, whose X-coordinate is the sought crude result. The peak has to be separated from the "sink" for the purpose of center of gravity analysis, which necessitates calculation of the so-called sink height.



Sink height is the mean value of all pixel intensities and is thus somewhat higher than the background level. All pixels to the left and to the right of the maximum, whose intensity is greater than the sink height, are used in order to calculate the center of gravity. With 16-bit resolution, the measured values are highly precise thanks to this evaluation method.

7.1.2. Edge Evaluation

In this evaluation method, the peak's edges are evaluated. The advantage of this evaluation method is the fact that the peak's asymmetrical crests, caused for example by speckle effects resulting from a sheet metal panel, are excluded from the evaluation.



With edge evaluation as well, the measured values achieve highly precise 13-bit resolution.

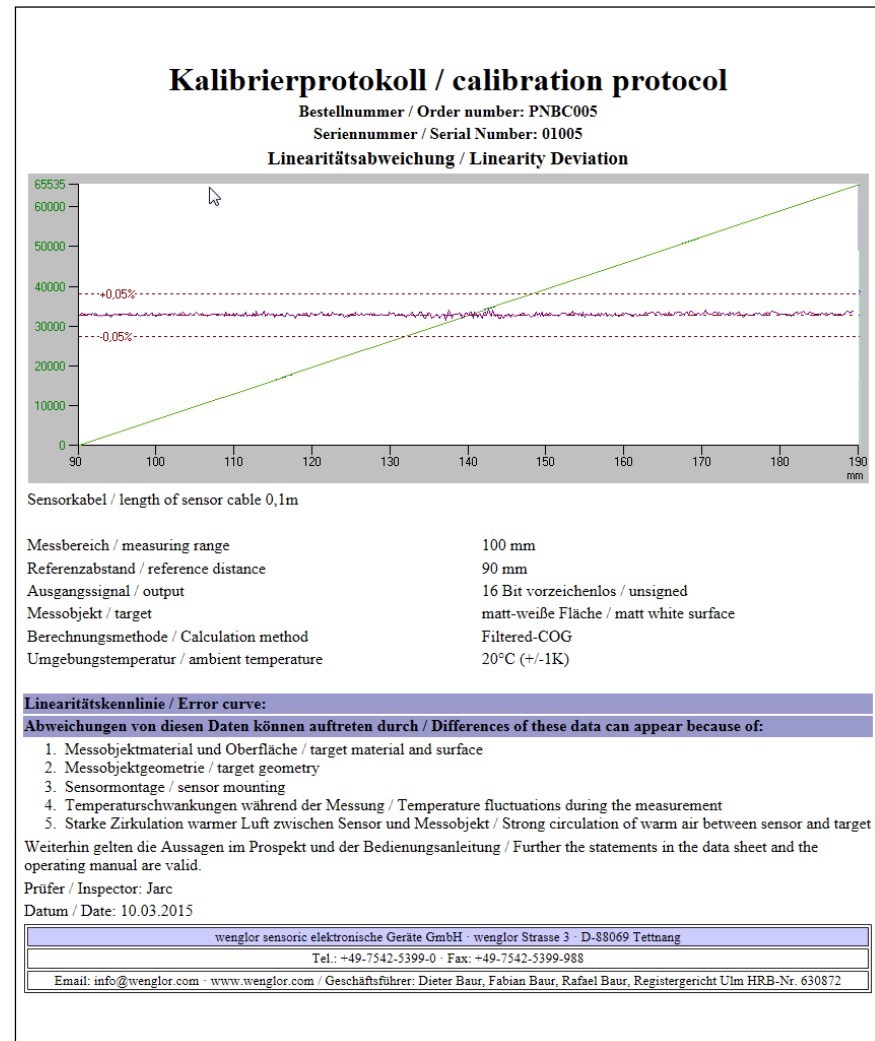
7.2. Measuring Accuracy and Error Influence

7.2.1. Calibration Report

A calibration report is included with each sensor, which graphically depicts the sensor's relative linearity deviation on a matte white surface.

For the purpose of improved illustration, measured value difference relative to the reference line is amplified in the diagram.

The following is the linearity report for a PNBC005:



7.2.2. Surface Material

Possible objects to be measured include all sorts of materials such as metal, plastic, ceramic, rubber and paper. Suitability for use only needs to be tested individually for highly reflective surfaces and liquids.

7.2.3. Surface Damage on the Object to be Measured

A scratch on the surface of the object to be measured which runs perpendicular to the axis of the lens may cause stronger light emissions, whose maxima are located next to the center of the spot. An incorrect distance is simulated as a result.

If a moving object is involved, the mean (integral) measured value remains constant when the damaged surface is scanned, i.e. the positive and negative edges cancel each other out due to the damage.

Undesired deflection can be minimized by selecting a suitable average filter.

7.2.4. Extraneous Light

When installing the sensor it must be assured that no direct or reflected sunlight can shine into the receiver optics. Where difficult applications are involved, this "extraneous light" may interfere with measured value recording. The measuring point should be correspondingly shaded in such cases.

7.2.5. Changes in Remission

The sensors are equipped with luminous intensity control which is automatically adjusted to the level of remission from the object to be measured. If remission from the surface changes during measurement, the sensor compensates for any fluctuation. By selecting a fixed sampling rate, measured values remain accurate even if surface remission changes.

7.2.6. Dependence of Measurement on Angle

Measurement is minimally dependent on angle if the sensor is not aligned at a right angle to the object to be measured. Tilting the sensor results in a greater distance to the object. This change in distance can be set to zero by means of a corresponding offset shift.

8. Web-Based Configuration

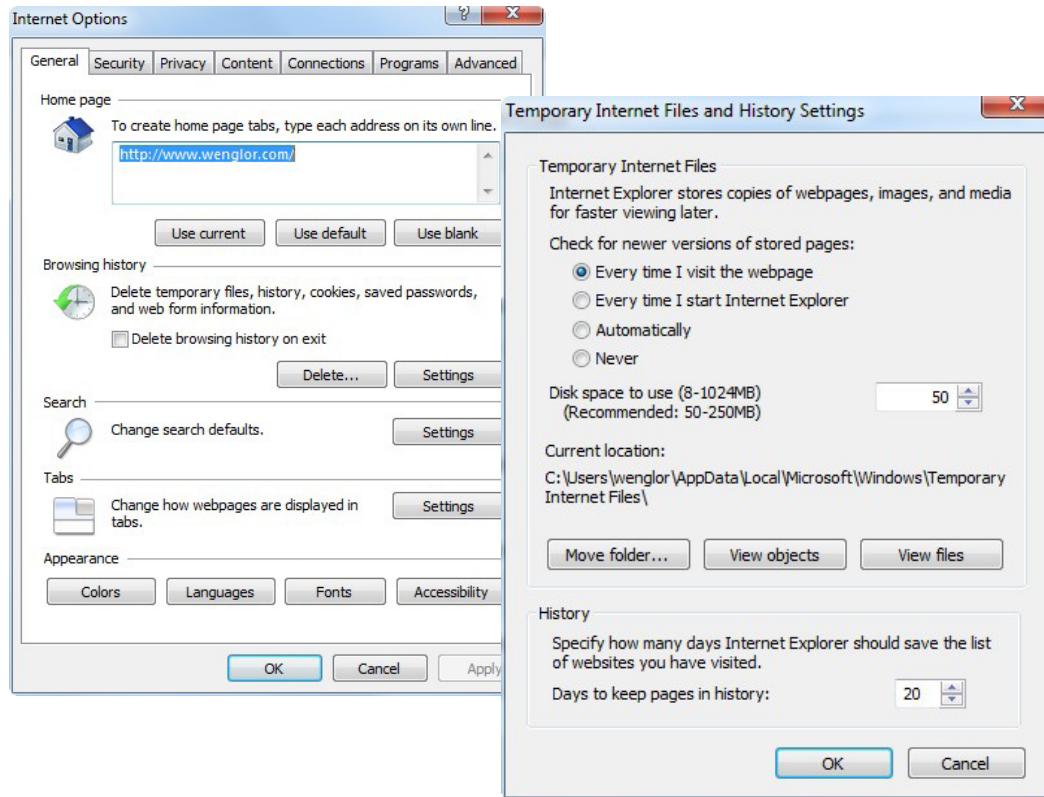
The device is equipped with a website, which functions independent of the operating system. You can configure the product conveniently at a standard web browser. The web-based configuration interface is not required for normal operation with a controller (the default IP address is listed in section "5.1. Default Settings" on page 13).

Attention:

If the sensor is connected to a controller, the settings which have been selected via the website are overwritten by the controller.

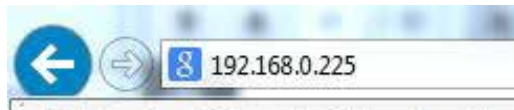
Accessing the Website

Start the web browser. Enter the sensor's manually selected IP address to the address line in your browser and press the enter key. In order to ensure that the browser displays the current settings on the website, the website has to be automatically reloaded whenever changes are made. This setting must be changed in a browser-specific manner which is described here using the Internet Explorer as an example. Select **Every time I visit the webpage** under **Tools → Internet options → General → Settings**. Otherwise, changes might not be correctly displayed via the website.



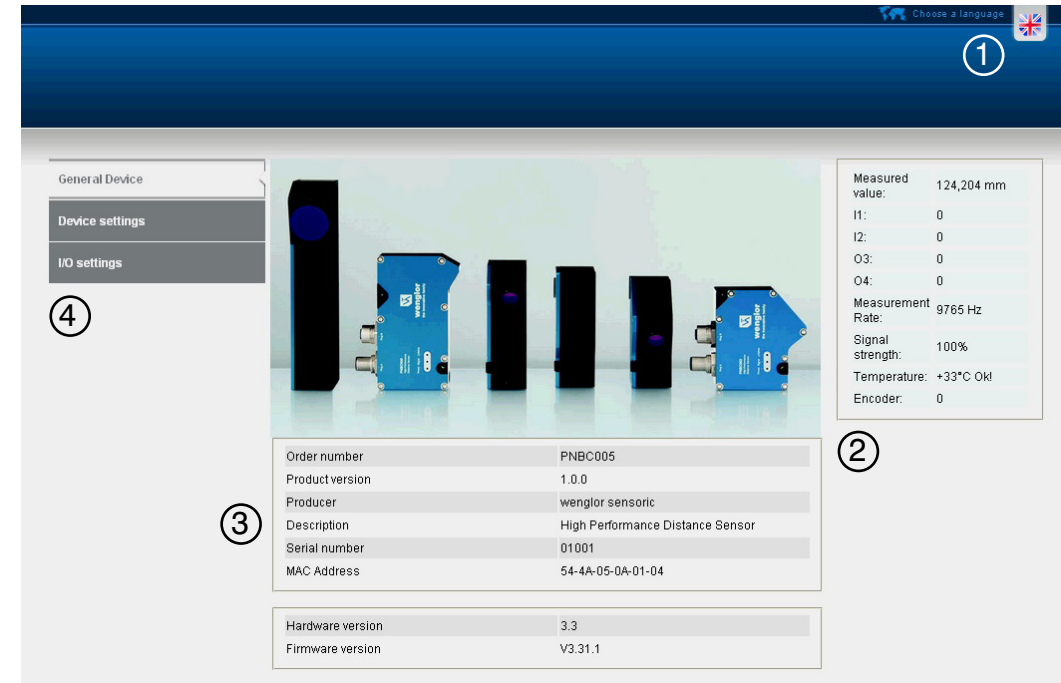
In order to be able to access the product's website (in this example the PNBC005), the IP address must be entered to the browser's address line as described.

Default IP address: 192.168.0.225



The initial page appears with information concerning the connected sensor. If necessary, the IP address can be changed on the **Settings** page. Any change to the IP address must be confirmed by entering the password "admin".

8.1. Page Layout



The website is subdivided into the following areas:

1. Language selection

The website can be changed from English (default language) to other languages with the language selection function.

2. Status display

Current status messages are displayed:

Measured value:	Displays the current distance between the edge of the sensor's housing and the object.
I/O1...I/O4:	Indicates the switching status of the respective input or output.
Sampling rate:	Displays the current sampling rate.
Signal strength:	Indicates the intensity of received light. If luminous intensity is too low, the object is either outside of the measuring range or the emitted light setting is not high enough.
Temperature:	Displays current temperature inside the sensor.
Encoder:	Displays the current encoder value.

3. Page content

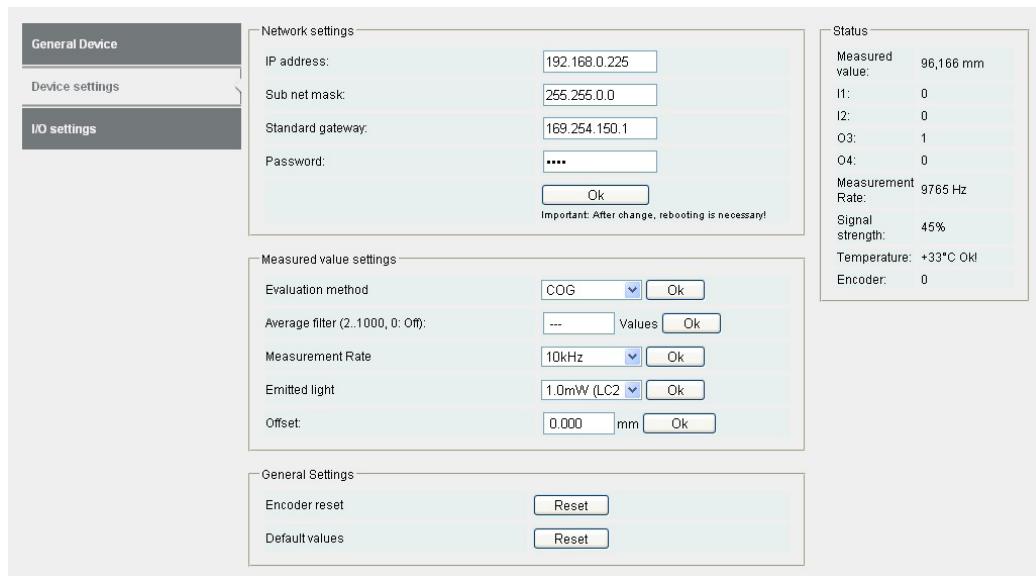
Depending on which category is selected in the menu at the left-hand side of the page, respective page content appears here.

4. Category selection

The settings are subdivided into the following categories:

- **General device information:** Overview page with general information regarding the sensor as a display without any setting options.
- **Device settings:**
 - The sensor's network settings (see section 8.2)
 - The sensor's measured value settings (see section 8.2)
 - General settings (see section 8.2)
- **I/O settings:** Settings for the digital inputs and outputs (see section 8.3)

8.2. Settings



The screenshot shows the 'Settings' menu with three main sections: General Device, Device settings, and I/O settings. The 'Device settings' section is expanded, showing 'Network settings', 'Measured value settings', and 'General Settings'.

Network settings:

- IP address: 192.168.0.225
- Sub net mask: 255.255.0.0
- Standard gateway: 169.254.150.1
- Password: ****
- Ok button
- Important: After change, rebooting is necessary!

Measured value settings:

- Evaluation method: COG (dropdown) Ok
- Average filter (2..1000, 0: Off): --- Values Ok
- Measurement Rate: 10kHz (dropdown) Ok
- Emitted light: 1.0mW (LC2) (dropdown) Ok
- Offset: 0.000 mm Ok

General Settings:

- Encoder reset: Reset
- Default values: Reset

Status:

- Measured value: 96,166 mm
- I1: 0
- I2: 0
- O3: 1
- O4: 0
- Measurement Rate: 9765 Hz
- Signal strength: 45%
- Temperature: +33°C Ok!
- Encoder: 0

1. Network settings

As described above, the IP address can be changed here.

2. Measured value settings

Evaluation method: functions description (see section "7. Function Descriptions" on page 14)

Average filter: Adjustable, rolling average filter from 1 to 1000 measured values

- The smaller the selected value, the faster the measured value reacts to jumps.
- The larger the selected value, the more smoothed the measured value becomes.

Sampling rate: Adjustable from 1000 Hz to 30 kHz, or automatic

Emitted light: Laser power adjustable from 0.1 to 1.0 mW, or automatic

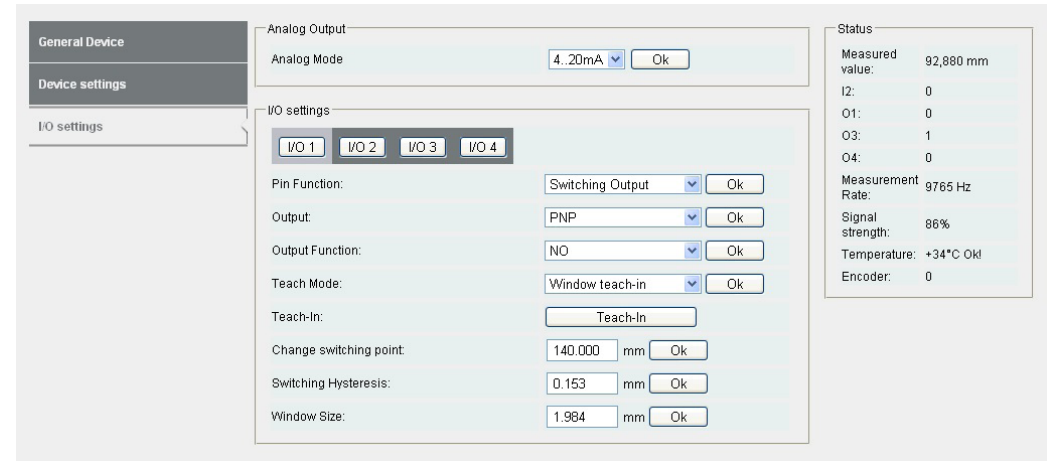
Offset: If desired, a zero-point offset can be entered here.

3. General settings

Encoder reset: Resets the encoder input to zero.

Default values: Resets all values to their default settings.

8.3. I/O Settings



The screenshot shows the 'I/O settings' section of the sensor settings interface. It includes tabs for I/O 1, I/O 2, I/O 3, and I/O 4. The 'I/O 1' tab is selected.

Analog Output:

- Analog Mode: 4..20mA (dropdown) Ok

I/O settings:

- Pin Function: Switching Output (dropdown) Ok
- Output: PNP (dropdown) Ok
- Output Function: NO (dropdown) Ok
- Teach Mode: Window teach-in (dropdown) Ok
- Teach-In: Teach-In button
- Change switching point: 140.000 mm Ok
- Switching Hysteresis: 0.153 mm Ok
- Window Size: 1.984 mm Ok

Status:

- Measured value: 92,880 mm
- I2: 0
- O1: 0
- O3: 1
- O4: 0
- Measurement Rate: 9765 Hz
- Signal strength: 86%
- Temperature: +34°C Ok!
- Encoder: 0

1. Analog output

Selection of 0 to 10 V or 4 to 20 mA

2. I/O settings

Various pin functions can be selected for the individual inputs/outputs.

Depending on the selected setting, context menus offer corresponding selection options.

Pin function:

- Switching output: The selected output functions as a switching output.
- Ext. Teach: Sensor functions can be adjusted by applying an electrical signal to this input.
- Encoder E1+E2: Any incremental/rotary encoder with two phase-shifted outputs and an output voltage of 4 to 24 V can be used.
- Encoder reset: The encoder is reset to "0".
- Laser off: The laser can be switched on or off by activating the input load or the input voltage.

Output:

- PNP output: The load or the analysis module is connected between the minus pole (reference) and the output. When switched, the output is connected to the plus pole via an electronic switch. A PNP output can also be equipped with a pull-down resistor.
- NPN output: The load or the analysis module is connected between the plus pole (reference) and the output. When the sensor is switched, the output is connected to the minus pole via an electronic switch. An NPN output can also be equipped with a pull-up resistor.
- Push-pull: alternate PNP and NPN switching

Output function:

- The output can be configured as NO (normally open) or NC (normally closed).

Teach-in mode:

- Window teach-in: There are two switching points in the case of window teach-in. The distance between the two switching points is the window size. The sensor is switched when the object is within the window.
- Foreground teach-in: Teach-in is performed while the sensor is aligned to the object. The teach-in distance is then set automatically, so that the sensor is switched as soon as distance between the sensor and the object is less than or equal to the previously taught in distance.
- Change switching point: Shifts the switching point to the entered distance. In the case of foreground teach-in this is the teach-in distance described above, and in the case of window teach-in it's the distance to the middle of the window.
- Hysteresis: Describes the distance between the switch-on and switch-off points.
- Switching reserve: Clearance between the teach-in distance and the sensor's switching point. Switching reserve ensures reliable object detection even in the case of slightly fluctuating distances between the objects and the sensor.
- Window size: see window "teach-in".

2 mA input load:

- Input load is set to 2 mA as a default value, but it can be switched off in the dropdown menu (e.g. if the PLC has a high-impedance NPN output).

Input setting:

- (Ub active/inactive): input voltage on/off

9. Data Format and Interface Description

9.1. Sensor Controller

TCP Commands

Several commands are available at port 3000 for controlling and configuring the product. Upper and lower case letters must be adhered to as shown below. After opening port 3000, the device transmits data packets without any further prompting.

Syntax	Response (example)	Command	Meaning
get /peak	Header and peak data	Request peak data	Peak data are transmitted, see separate description for header.
get /measre_start	Header and distance data	Start measurement	Distance data are transmitted continuously, see separate description for header.
get /ext_measure_start	Header and expanded distance data	Request expanded continuous measurement	Expanded distance data are transmitted continuously, see separate description for header.
get /measure_stop	No response	Stop measurement	All measurement and transmission of measurement data is stopped.
get /laser=10	No response	Set laser power	Set laser power in mW steps. In this case laser power is set to 1 mW.
get /freq=10000	No response	Sampling rate (exposure time)	Set the sensor's pixel frequency in kilohertz. In this case frequency is set to 10,000 kHz. This corresponds to a line frequency of 9765 kHz (due to 1024 pixels per line). And this, in turn, corresponds to an exposure time of 0.1024 ms. Values within a range of 900 to 30,000 are permissible.
get /regulator=1	No response	Set measuring regulator	Exposure time / laser power regulation is set here. The following values are possible: 0: exposure time regulation AND laser power regulation 1: Automatic exposure time, laser power (manually) adjustable 2: Automatic laser power, exposure time (manually) adjustable 3: Exposure time and laser power manually adjustable In the case of laser power regulation and exposure time regulation, the sensor automatically selects the setting which results in the best pixel intensity. Depending on the application, either exposure time or laser power regulation is preferable. If constant measurement times are desired, laser power regulation should be selected. If constant laser power is desired, exposure time regulation is more suitable.

Syntax	Response (example)	Command	Meaning
get /calcmode=3	No response	Select the evaluation method	The peak evaluation method can be selected with this command. The following values are possible: 1: Cog 2: Edge
get /clear_encoder	No response	Reset encoder counter	This command resets the internal encoder counter to zero. If both USR I/Os are used as encoder inputs, the zero position should be set with this command.
get /enc_right_shift=2	No response	Encoder counter right shift	The format of the internal encoder counter can be set with this command. If both USR I/Os are used as encoder inputs, the format should be set with this command. The internal encoder counter has a 32-bit width. However, only 16 bits are transmitted externally. Which bits are transmitted externally can be selected here. How many bits have to be shifted to the right, and are thus lost, depends on travel distance and the encoder's step size. Values of 0 through 8 are possible.
get /activate_laser	No response	Switch laser on	Switch the laser on by means of TCP command.
get /deactivate_laser	No response	Switch laser off	Switch the laser off by means of TCP command.
get /ip_addr=192.168.0.225	No response	Set IP address	Set the IP address and the subnet mask or the gateway address. The new IP address does not become active until after restarting.
get /netmask_addr=255.255.0.0	No response	Set the subnet mask	Set the IP address and the subnet mask or the gateway address. The new IP address does not become active until after restarting.
get /gateway_addr=192.168.0.1	No response	Set the gateway address	Set the IP address and the subnet mask or the gateway address. The new IP address does not become active until after restarting.
get /anaout_mode=1	No response	Select the analog output mode	Selecting the analog output mode: 1: 0 to 10 V 11: 4 to 20 mA
get /digout_offset=100	No response	Set digital offset	Digital offset can be set as a 16-bit value: minimum: -30,000, maximum: +30,000
get /anaout_offset=100	No response	Set analog offset	Analog offset can be set as a 16-bit value: minimum: -30,000, maximum: +30,000
get /avg_filter_cnt=123	No response	Adjust average filter	Number of measured values which are displayed as a mean value. Possible values include 2 to 1000//0, 1=off

Syntax	Response (example)	Command	Meaning
get usrio1_pin_function=1	No response	Set pin function	Possible values include: 1: switching output 2: ext. teach-in input for O1 3: ext. teach-in input for O2 4: ext. teach-in input for O3 5: ext. teach-in input for O4 6: encoder input (I1+I2) 7: encoder reset input 8: laser off input
get usrio2_pin_function=1			
get usrio3_pin_function=1			
get usrio4_pin_function=9			
get /usrio1_output_mode=1	No response	Set output	Possible values include: 1: PNP 2: NPN 3: push-pull
get /usrio2_output_mode=2			
get /usrio3_output_mode=3			
get /usrio4_output_mode=1			
get /usrio1_output_function=1	No response	Set output function	Possible values include: 1: normally open 2: normally closed
get /usrio2_output_function=1			
get /usrio3_output_function=2			
get /usrio4_output_function=1			
get /usrio1_teach_mode=1	No response	Select teach-in mode	Possible values include: 1: foreground teach-in 2: window teach-in
get /usrio2_teach_mode=1			
get /usrio3_teach_mode=1			
get /usrio4_teach_mode=1			
get /usrio1_input_function=1	No response	Set input function	Possible values include: 1: high-active 2: low-active
get /usrio2_input_function=1			
get /usrio3_input_function=1			
get /usrio4_input_function=1			

Syntax	Response (example)	Command	Meaning
get /usr101_in-put_load=1	No response	Set input load	Possible values include: 1: input load active (2 mA) 2: input load inactive
get /usr102_in-put_load=1			
get /usr103_in-put_load=1			
get /usr104_in-put_load=1			
get /usr101_teach_in	No response	Teach-in switching output	Teach-in switching distance for USR I/O 1 Important: The pin function must be switching output!
get /usr101_teach_in			
get /usr101_teach_in			
get /usr101_teach_in			
get /usr101_switch_dist_mm=12.3	No response	Set switching distance	Possible values in mm include: Measuring range lower limit...measuring range upper limit in mm! Important: Use decimal point instead of comma!
get /usr102_switch_dist_mm=21			
get /usr103_switch_dist_mm=30.5			
get /usr104_switch_dist_mm=41.2			
get /usr101_hyster-esis_mm=0.3	No response	Set hysteresis	Possible values in mm include: 0.0...measuring range/4 in mm! Important: Use decimal point instead of comma!
get /usr102_hyster-esis_mm=1			
get /usr103_hyster-esis_mm=0.5			
get /usr104_hyster-esis_mm=3.14			

Syntax	Response (example)	Command	Meaning
get /usr101_window_size_mm=2.3	No response	Setting Window size	Possible values in mm include: 0.0...measuring range in mm! Important: Use decimal point instead of comma!
get /usr101_window_size_mm=3.2			
get /usr101_win-dow_size_mm=1			
get /usr101_window_size_mm=3.14			
get /usr101_switch_res_mm=0.3	No response	Set switching reserve	Possible values include: 0.0...measuring range/4 in mm! Important: Use decimal point instead of comma!
get /usr102_switch_res_mm=0.2			
get /usr103_switch_res_mm=1			
get /usr104_switch_res_mm=0.14			
get /activate_default	No response	Activate default values (factory settings)	All setting values are reset except for name, description, versions, serial number, password, IP address and MAC address.

With the exception of intensity, distance and encoder, all values remain unchanged after restarting. After entering the set command, it's written to RAM and initially has no effect on the sensor's functions. The set command is written to non-volatile memory after 3 seconds. The product is unavailable for a duration of 1 to 3 seconds until the write operation has been completed.

Query Commands

Syntax	Response (example)	Command	Meaning
get /get_freq	OK:freq=26667	Query: sampling rate setting	The device returns the sampling rate in kHz (as a zero-terminated string). Sampling rate = pixel frequency / 1024 (due to 1024 pixels per line)
get /get_laser	OK:laser=10	Query: laser power setting	The device returns laser power in mW.
get /get_calc_mode	OK:calc_mode=6	Query: evaluation method setting	The device returns the evaluation method (0...6, see above).
get /get_regulator	OK:regulator=0	Query: measuring regulator setting	The device returns the measuring regulator method (0...3, see above).
get /get_enc_rshift	OK:enc_rshift=2	Query: encoder right shift setting	The device returns the number of bits by which the encoder value is shifted to the right.
get /get_anaout_mode	OK:anaout_mode=1	Query: analog mode setting	The device returns the analog output mode (0...11, see above).
get /get_anaout_offset	K:anaout_offset=0	Query: analog offset setting	The device returns analog offset in digits (0...65,535)
get /get_digout_offset	OK:digout_offset=0	Query: digital offset setting	The device returns digital offset in digits (0...65,535).
get /get_name	OK:name=PNBC005	Query: product name	The device returns the product name as a zero-terminated ASCII string.
get /get_pversion	OK:pversion=1.0.0	Query: product version	The device returns the product version.
get /get_serial	OK:serial=12345	Query: serial number	The device returns the serial number.
get /get_manufacturer	OK:manufacturer=wenglor_sensoric GmbH	Query: manufacturer	The device returns the name of the manufacturer. Note: Blanks are replaced with underscores!
get /get_description	OK:description=High_Performance_Distance_Sensor	Query: description	The device returns the description. Note: Blanks are replaced with underscores!
get /get_hwversion	OK:hw_version=3.0.0	Query: hardware version	
get /get_mac_address	OK:mac_address=0007ABF00CAB	Query: MAC address	
get /get_ip_addr	OK:ip_addr=192.168.0.225	Query: IP address	
get /get_net_mask	OK:net_mask=255.255.0.0	Query: subnet mask	
get /get_gateway	OK:gateway_addr=169.254.150.1	Query: gateway	
get /get_ohc	OK:ohc=41:09:23	Query: Operating hours counter	The device returns operating hours (hours:minutes:seconds).

Syntax	Response (example)	Command	Meaning
get /get_avg_filter_cnt	OK:avg_filter_cnt=345	Query: average filter	
get /get_usrio1_pin_function	OK:usr_io1_pin_function=1	Query pin function	Same values as above under "Set"
get /get_usrio4_output_mode	OK:usr_io4_output_mode=1	Query output mode	Same values as above under "Set"
get /get_usrio1_output_function	OK:usr_io1_output_function=1	Query output function	Same values as above under "Set"
get /get_usrio1_teach_mode	OK:usr_io1_teach_mode=1	Query teach-in mode	Same values as above under "Set"
get /get_usrio2_input_function	OK:usr_io2_input_function=1	Query input function	Same values as above under "Set"
get /get_usrio1_input_load	OK:usr_io1_input_load=2	Query input load	Same values as above under "Set"
get /get_usrio3_switch_dist mm	OK:usr_io3_switch_dist mm=30.000	Query switch-switching distance	Same values as above under "Set"
get /get_usrio1_hysteresis mm	OK:usr_io1_hysteresis mm=0.000	Query hysteresis	Same values as above under "Set"
get /get_usrio1_window_size mm	OK:usr_io1_window_size mm=0.188	Query window size	Same values as above under "Set"
get /get_usrio1_switch_res mm	OK:usr_io1_switch_res mm=0.188	Query switch-switching reserve	Same values as above under "Set"
get /get_usr_io1	OK:usr_io=5	Status query	The device returns the I/O status of the input/output line. The status includes an 8-bit value and the individual bits have the following meanings: Bit 0: input status Bit 1: output status Bit 2: output enabling (OE) Bit 3: current sink enabling (SK)
get /get_usr_io2	OK:usr_io=1		
get /get_usr_io3			
get /get_usr_io4			

9.2. Measurement and Data Packets

After opening port 3000, the device transmits data packets containing the previously selected data type. The following data types are possible:

- Peak data
- Continuous distance measurement
- Expanded continuous distance measurement

Peak Data

Peak data are raw data for the 1024 pixel intensities of the sensor's CMOS line array.

Continuous Distance Measurement

In the case of continuous distance measurement, all measured distance values are transmitted uninterruptedly. Each data packet is laid out so that the header is transmitted first. This is followed by the actual data (distance value ...). The header indicates how the data are to be interpreted.

Expanded Continuous Distance Measurement

In this case, intensity and the encoder value (encoder counter in the PNBC) for each individual measurement are transmitted in addition to distance values. This makes it possible to obtain an actual position value synchronous to the distance values.

In this case as well, each data packet contains a header with interpretation instructions which precedes the rows of data.

9.3. Header Data Format

Each data packet consists of a header and the subsequent data. Header data have the following formats:

• Measurement (peak):

Designation	Offset [bytes]	Length [bytes]	Type	Sample Value
Identification	0	4	unsigned int	4450
Text (zero-terminated)	4	24	string	...
Product name (zero-terminated)	28	12	string	PNBC005
Serial number (zero-terminated)	40	12	string	12345
Software version (zero-terminated)	52	10	string	V2.11
System time	62	4	unsigned int	0 ...
Measuring range lower limit in mm	66	2	unsigned short	0 ...
Measuring range in mm	68	2	unsigned short	10 ...
Laser power	70	2	unsigned short	3...32
Sampling rate	72	2	unsigned short	1000...30000
Temperature (internal)	74	1	unsigned char	48
Evaluation method	75	1	unsigned char	Cog/Edge
Regulator mode	76	1	unsigned char	0...3
EncRightShift	77	1	unsigned char	0...8
Status	78	1	unsigned char	0...255
Error codes	79	1	unsigned char	0...255
Sensor length in pixels	80	2	unsigned short	1024
Accuracy	82	1	unsigned char	12
Error code	83	1	unsigned char	15
Unused	84	1	unsigned char	0
Unused	85	1	unsigned char	0
Number of bytes per value	86	1	unsigned char	2
Unused	87	1	unsigned char	0
Distance	88	2	unsigned short	0...65,535
Intensity	90	2	unsigned short	0...4095
Encoder value	92	2	unsigned short	0...65,535
Number of values per packet	94	2	unsigned short	1024
Pixel 1	96	2	unsigned short	0...4095
Pixel 2	98			
...	...			
Pixel 1024	2142			

• Continuous Measurement (distance)

Designation	Offset [bytes]	Length [bytes]	Type	Sample Value
Identification	0	4	unsigned int	4470
Text (zero-terminated)	4	24	string	...
Product name (zero-terminated)	28	12	string	PNBC005
Serial number (zero-terminated)	40	12	string	12345
Software version (zero-terminated)	52	10	string	V2.11
System time	62	4	unsigned int	0 ...
Measuring range lower limit in mm	66	2	unsigned short	0 ...
Measuring range in mm	68	2	unsigned short	10 ...
Laser power	70	2	unsigned short	3...32
Sampling rate	72	2	unsigned short	1000...30000
Temperature (internal)	74	1	unsigned char	48
Evaluation method	75	1	unsigned char	Cog/Edge
Regulator mode	76	1	unsigned char	0...3
EncRightShift	77	1	unsigned char	0...8
Status	78	1	unsigned char	0...255
Error codes	79	1	unsigned char	0...255
Sensor length in pixels	80	2	unsigned short	1024
Intensity accuracy	82	1	unsigned char	12
Intensity error bit	83	1	unsigned char	14
Distance accuracy	84	1	unsigned char	16
Distance error bit	85	1	unsigned char	31
Number of bytes per value	86	1	unsigned char	2
Unused	87	1	unsigned char	0
Unused	88	2	unsigned short	0...65,535
Unused	90	2	unsigned short	0...4095
Unused	92	2	unsigned short	0...65,535
Number of values per packet	94	2	unsigned short	450
Distance 1	96	2		0...65,535
Distance 2	98			
...	...			
Distance 450	994			

• Expanded Continuous Measurement (distance, intensity, encoder)

Designation	Offset [bytes]	Length [bytes]	Type	Sample Value
Identification	0	4	unsigned int	4480
Text (zero-terminated)	4	24	string	...
Product name (zero-terminated)	28	12	string	PNBC005
Serial number (zero-terminated)	40	12	string	12345
Software version (zero-terminated)	52	10	string	V2.11
System time	62	4	unsigned int	0 ...
Measuring range lower limit in mm	66	2	unsigned short	0 ...
Measuring range in mm	68	2	unsigned short	10 ...
Laser power	70	2	unsigned short	3...32
Sampling rate	72	2	unsigned short	1000...30000
Temperature (internal)	74	1	unsigned char	48
Evaluation method	75	1	unsigned char	Cog/Edge
Regulator mode	76	1	unsigned char	0...3
EncRightShift	77	1	unsigned char	0...8
Status	78	1	unsigned char	0...255
Error codes	79	1	unsigned char	0...255
Sensor length in pixels	80	2	unsigned short	1024
Intensity accuracy	82	1	unsigned char	12
Intensity error bit	83	1	unsigned char	14
Distance accuracy	84	1	unsigned char	16
Distance error bit	85	1	unsigned char	31
Number of bytes per value	86	1	unsigned char	6
Unused	87	1	unsigned char	0
Unused	88	2	unsigned short	0...65,535
Unused	90	2	unsigned short	0...4095
Unused	92	2	unsigned short	0...65,535
Number of values per packet	94	2	unsigned short	150
Distance 1	96	2		0...65,535
Intensity 1	98			0...1023
Encoder 1	100			0...65,535
...
Distance 150	990			0...65,535
Intensity 150	992			0...1023
Encoder 150	994			0...65,535

All values are little-endian, i.e. the LSB comes first.

Comments	
Identification:	Peak: 0x00004450, cont.: 0x00004470, Exp.cont.: 0x00004480
Length:	in bytes
System time:	since start in ms
Laser power:	in tenths of watts
Sampling rate:	in Hz
Temperature:	in degrees Celsius
Distance:	16-bit value, bit 31 is error bit
Intensity:	16-bit value, bits 0 to 11: intensity, bits 14 and 15 are error bits (see below)
Accuracy:	number of bits of a distance/intensity value, fixed value depending on method
Error bit:	Bit which indicates the pixel or sum error
EncRightShift:	8-bit value
Status:	8 sensor status bits (bits 7 and 6: USR-IO-1/2)
Sensor length in pixels:	constant, always 1024
Intensity accuracy:	constant, always 12
Intensity error bits:	bit 14: intensity too low or too high bit 15: distance outside of the measuring range (too close or too far away)
Distance accuracy:	constant, always 16
Distance error bit:	constant, always 31
Number of bytes per value:	constant during continuous measurement = 2 constant during expanded continuous measurement = 6
Number of bytes per packet:	constant during continuous measurement = 450 constant during expanded continuous measurement = 150

9.4. Diagnostics Messages

Diagnostics messages appear as a display of the last internal error, which may have occurred hours or days ago. This error is only interesting for diagnosis purposes and only indicates a defective device in exceptional cases. The respective meanings of the error codes are listed in the following table.

Code	Designation	Severity	Meaning
0	no error		No errors have occurred
1	internal error	Fatal	Error during self-testing phase (boot phase)
2	temp.-chip error	Fatal	IC temperature error (boot phase)
3	no system clock	Fatal	No system clock was detected (boot phase)
4	no epcs flash found	Fatal	No system EPCS flash was detected (boot phase)
5	tse mac init error	Fatal	Error during TSE MAC initialization (boot phase)
6	measure fifo failure	Fatal	Error during initialization of the measurement FIFO (boot phase)
15	over temperature	Fatal	Overtemperature error (as yet no shutdown)
16	iic bus error		A general IIC bus querying error has occurred.
17	tempchip error		An IIC bus querying error has occurred for IC temperature.
18	over temp. resolved		Overtemperature error resolved (normal operation)

Code	Designation	Severity	Meaning
19	tse mac rx error		Ethernet data receiving: MAC error, packet lost
20	tse mac rx packet too long		Ethernet data receiving: packet length too large, packet lost
21	tse mac rx dma restart not possible		Ethernet data receiving: DMA restart not possible
22	tse mac rx no valid interrupt		Ethernet data receiving: no valid packet receipt
23	tse m ac rx overflow		Ethernet data receiving: not enough memory, packet lost
24	tse max tx overflow		Ethernet transmission: too many packets in too little time, packet lost
25	tse mac tx packet too small		Ethernet transmission: packet is too small, packet lost
26	tse mac tx packet too big		Ethernet transmission: packet is too large, packet lost
27	tse mac tx not all transferred		Ethernet transmission: not all packet data were transmitted
28	peak ram wait request error		Measurement: Peak RAM write/read error
29	measure fifo overflow		Measurement: FIFO overflow, CPU too slow, measurement aborted
30	measure timeout		Measurement: CPU indicates timeout, measurement aborted
31	measure illegal unlimited		Measurement: CPU indicates impermissible, unlimited data recording
32	measure buffer underflow		Measurement: too few data recorded
33	continued meas. buffer overflow		Measurement: data are no longer being processed, measurement aborted. The data can no longer be forwarded by the CPU, perhaps because the Ethernet connection has been interrupted. Continuous overflow of the measured value buffer results (code 101). If this goes on for more than 5 seconds, measurement is aborted and this error is indicated.
34	flash read error		Flash read error (settings, parameters)
35	flash write error		Flash write error (settings, parameters, software image)
36	flash erase block error		Flash write error while deleting a data block
37	operating hour counter error		IIC bus write/read error, operating hours counter
38	analog output spi tx error		Write error at analog output
39	analog output spi rx error		Read error at analog output
40	sys-id error		System ID error: software revision does not correspond with the status of the FPGA core.
41	usr-io config error		Error in configuring the USR I/Os

Code	Designation	Severity	Meaning
100	measure fifo almost full		Measurement: measured value-FIFO is about to overflow (code 29).
101	measure buffer overflow		Measurement: measured value buffer overflow, some measured values lost

Codes 1 to 15

Error codes 1 to 15 designate fatal errors and indicate a defective device. All other errors are only relevant if they occur repeatedly. In this case a user error may be involved. Errors codes as of 100 are less important messages and warnings and have no effect on device functions.

Code 15

The overtemperature warning is triggered when internal temperature exceeds 70° C. As soon as temperature drops to below 60° C, the overtemperature warning is cleared.

Code 33

Data can no longer be forwarded by the CPU. This may be caused by a defective Ethernet connection. This results in continuous overflow of the measured value buffer (code 101). If this goes on for more than 5 seconds, measurement is aborted and this error is indicated.

10. Maintenance Instructions

- This wenglor sensor is maintenance-free.
- It's advisable to clean the lens and the display, and to check the plug connections at regular intervals.
- Do not clean with solvents or cleansers which could damage the device.

11. Proper Disposal

wenglor sensoric GmbH does not accept the return of unusable or irreparable products. Respectively valid national waste disposal regulations apply to product disposal.

Subject to change without notice