EN

wenglor
the innovative family

PNBC1xx

Laser Distance Sensors High-Precision

Operating Instructions

Available as PDF file only
Status: 16.03.2023
Version: 1.0.0
www.wenglor.com

EN

Table of Contents

1. Change Index, Operating Instructions

Version	Date	Description/Change	Version
1.0.0	16.03.2023	Initial version of the operating instructions	Hardware: 1.0 Firmware: 5.0.1 EtherCAT COM: 5.3.0 EtherCAT COM: 1.0.3

2. General

2.1 Information Concerning these Instructions

- These instructions enable safe and efficient use of the following products:

  » **PNBC1xx**
- These instructions are an integral part of the product and must be kept on hand for the entire duration of its service life.
- Local accident prevention regulations and national work safety regulations must be complied with as well.
- The product is subject to further technical development, and thus the information contained in these operating instructions may also be subject to change. The current version can be found at www.wenglor.com in the product's separate download area.

NOTE!
The operating instructions must be read carefully before using the product and must be kept on hand for later reference.

2.2 Explanations of Symbols

- Safety precautions and warnings are emphasized by means of symbols and attention-getting words.
- Safe use of the product is only possible if these safety precautions and warnings are adhered to.

The safety precautions and warnings are laid out in accordance with the following principle:

ATTENTION-GETTING WORD
Type and Source of Danger!
Possible consequences in the event that the hazard is disregarded.
- Measures for averting the hazard.

The meanings of the attention-getting words, as well as the scope of the associated hazards, are listed below.

DANGER!
This word indicates a hazard with a high degree of risk which, if not avoided, results in death or severe injury.

WARNING!
This word indicates a hazard with a medium degree of risk which, if not avoided, may result in death or severe injury.

CAUTION!
This word indicates a hazard with a low degree of risk which, if not avoided, may result in minor or moderate injury.

ATTENTION:
This word draws attention to a potentially hazardous situation which, if not avoided, may result in property damage.

NOTE!
A note draws attention to useful tips and suggestions, as well as information regarding efficient, error-free use.

2.3 Limitation of Liability

- The product has been developed taking into account the state of the art as well as the applicable standards and guidelines.
- We reserve the right to make technical changes.
- A valid declaration of conformity can be found at www.wenglor.com in the download area of the product.
- wenglor sensoric elektronische Geräte GmbH (hereinafter "wenglor") accepts no liability for:
  - » failure to observe the operating manual,
  - » unsuitable or improper use of the product,
  - » excessive use, incorrect or negligent treatment of the product,
  - » incorrect installation or commissioning,
  - » use of untrained personnel,
  - » use of unauthorized spare parts or
  - » Improper or unauthorized changes, modifications or repair work to the products.
- This operating manual does not contain any guarantees/warrantees from wenglor with regard to the processes described or certain product properties.
- wenglor assumes no liability with regard to printing errors or other inaccuracies contained in this operating manual, unless it can be proven that wenglor was aware of the errors at the time the operating manual was created.

2.4 Copyrights

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- Commercial reproduction or any other commercial use of the provided content and information, in particular graphics and images, is not permitted without previous written consent from wenglor.

3. For Your Safety

3.1 Use for Intended Purpose

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

Laser Distance Sensor High-Precision

This product group includes Laser Distance Sensors High-Precision for measuring distance, which function in accordance with various principles in scanning mode operation. Laser Distance Sensors High-Precision 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.

3.2 Use for Other than the Intended Purpose

- The product is not a safety component in accordance with the EG Machinery Directive.
- The product is not suitable for use in potentially explosive atmospheres.

DANGER!
Risk of personal injury or property damage in case of use for other than the intended purpose!
Use for other than the intended purpose may lead to hazardous situations.
- Instructions regarding use for intended purpose must be observed.

3.3 Personnel Qualifications

- Suitable technical training is a prerequisite.
- In-house electronics training is required.
- Trained personnel who use the product must have uninterrupted access to the operating instructions.
- Valid laser protection requirements must always be adhered to.

DANGER!
Risk of personal injury or property damage in case of incorrect initial start-up and maintenance!
Personal injury and damage to equipment may occur.
- Adequate training and qualification of personnel.

3.4 Modification of Products

DANGER!
Risk of personal injury or property damage if the product is modified!
Personal injury and damage to equipment may occur. Non-observance may result in loss of the CE marking and the guarantee may be rendered null and void.
- Modification of the product is impermissible.

3.5 General Safety Precautions

NOTE!

- These instructions are an integral part of the product and must be kept on hand for the entire duration of its service life.
- In the event of possible changes, the respectively current version of the operating instructions can be accessed at www.wenglor.com in the product's separate download area.
- Read the operating instructions carefully before using the product.
- The sensor must be protected against contamination and mechanical influences.

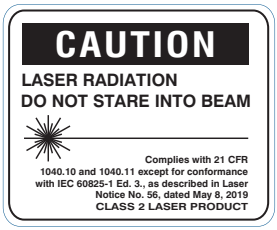
3.6 Laser/LED Warnings

LASER CLASS 2
EN60825-1

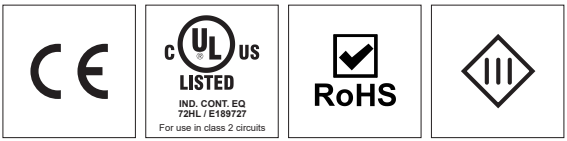
Laser Class 2 (EN 60825-1)
Observe all applicable standards and safety precautions.
The enclosed laser warning lables must be attached and visible at all time.
Do not stare into beam.

Attention!
If other operating or adjustment devices than those specified here are used or other procedures are carried out, this can lead to dangerous exposure to radiation.

3.6.1 Warnings According to Standard EN 60825-1:2014



3.7 Approvals and protection class



4. Technical Data

	PNBC101	PNBC102	PNBC103	PNBC104
Optical Characteristics				
Working range [mm]	20…24	25…35	40 to 60	58 to 108
Resolution	0.06 µm	0.15 µm	0.3 µm	0.8 µm
Linearity deviation	2 µm	5 µm	10 µm	25 µm
Reproducibility maximum	4 µm	5 µm	8 µm	20 µm
Reproducibility 1 Sigma	0,3 µm	0,6 µm	0,8 µm	2,5 µm
Light source	Laser (red)	Laser (red)	Laser (red)	Laser (red)
Wavelength	658 nm	658 nm	658 nm	658 nm
Service life (T = +25° C)	100,000 hours	100,000 hours	100,000 hours	100,000 hours
Laser class (EN 60825-1)	2	2	2	2
Max. ambient light	10,000 lux	10,000 lux	10,000 lux	10,000 lux
Light spot diameter	< 0.15 mm	< 0.20 mm	< 0.25 mm	< 0.35 mm
Electrical Characteristics				
Supply voltage	15 to 30 V DC	15 to 30 V DC	15 to 30 V DC	15 to 30 V DC
Current consumption (Ub=24V)	280 mA	280 mA	280 mA	280 mA
Switching frequency	15 kHz	15 kHz	15 kHz	15 kHz
Response time	<33 µs	<33 µs	<33 µs	<33 µs
Output rate	10...30000/s	10...30000/s	10...30000/s	10...30000/s
Temperature drift *	0.2 µm/K	0.5 µm/K	1 µm/K	2.5 µm/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
Number of switching outputs	4	4	4	4
Switching output voltage drop	< 1.5 V	< 1.5 V	< 1.5 V	< 1.5 V
Switching output/switching current	100 mA	100 mA	100 mA	100 mA
Switching input low level	< 2 V	< 2 V	< 2 V	< 2 V
Switching input high level	> 2.5 V	> 2.5 V	> 2.5 V	> 2.5 V
Switching input resistance **	> 24 kΩ	> 24 kΩ	> 24 kΩ	> 24 kΩ
Switchable to NC/NO	Yes	Yes	Yes	Yes
Configurable to PNP / NPN / push-pull	Yes	Yes	Yes	Yes
Analog output	0...10 V/4...20 mA	0...10 V/4...20 mA	0...10 V/4...20 mA	0...10 V/4...20 mA
Short-circuit protection	Yes	Yes	Yes	Yes
Reverse polarity protection	Yes	Yes	Yes	Yes
Overload protection	Yes	Yes	Yes	Yes
Teach-in-Modus	VT/FT	VT/FT	VT/FT	VT/FT
Interface	Ethernet TCP/IP EtherCAT	Ethernet TCP/IP EtherCAT	Ethernet TCP/IP EtherCAT	Ethernet TCP/IP EtherCAT
Baud rate	100 Mbit/s	100 Mbit/s	100 Mbit/s	100 Mbit/s
Protection class	III	III	III	III
Webserver	Yes	Yes	Yes	Yes
Mechanical Characteristics				
Setting method	Teach-in	Teach-in	Teach-in	Teach-in

	PNBC101	PNBC102	PNBC103	PNBC104
Housing material	Aluminum	Aluminum	Aluminum	Aluminum
Degree of protection	IP 67	IP 67	IP 67	IP 67
Connection	M12×1, 8-pin	M12×1, 8-pin	M12×1, 8-pin	M12×1, 8-pin
Type of connection Ethernet	M12× 1, 4-pin	M12×1, 4-pin	M12×1, 4-pin	M12×1, 4-pin
Optic cover	Glass	Glass	Glass	Glass

* At a sensor temperature of 20...40 °C

** only valid if input load is switched off

	PNBC105	PNBC106	PNBC107	PNBC108
Optical Characteristics				
Working range [mm]	90…190	200…400	250…650	200…1000
Measuring range	100 mm	200 mm	400 mm	800 mm
Linearity deviation	50 µm	100 µm	200 µm	375 µm
Reproducibility maximum	30 µm	60 µm	80 µm	100 µm
Reproducibility 1 Sigma	3,0 µm	13 µm	14 µm	15 µm
Light source	Laser (red)	Laser (red)	Laser (red)	Laser (red)
Wavelength	658 nm	658 nm	658 nm	658 nm
Service life (T = +25° C)	100,000 hours	100,000 hours	100,000 hours	100,000 hours
Laser class (EN 60825-1)	2	2	2	2
Max. ambient light	10,000 lux	10,000 lux	10,000 lux	10,000 lux
Light spot diameter	< 0.75 mm	< 0.90 mm	< 1.20 mm	< 1.60 mm
Electrical Characteristics				
Supply voltage	15 to 30 V DC	15 to 30 V DC	15 to 30 V DC	15 to 30 V DC
Current consumption (Ub=24V)	280 mA	280 mA	280 mA	280 mA
Switching frequency	15 kHz	15 kHz	15 kHz	15 kHz
Response time	<33 µs	<33 µs	<33 µs	<33 µs
Output rate	10...30000/s	10...30000/s	10...30000/s	10...30000/s
Temperature drift *	5 µm/K	10 µm/K	20 µm/K	37.5 µm/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
Number of switching outputs	4	4	4	4
Switching output voltage drop	< 1.5 V	< 1.5 V	< 1.5 V	< 1.5 V
Switching output/switching current	100 mA	100 mA	100 mA	100 mA
Switching input low level	< 2 V	< 2 V	< 2 V	< 2 V
Switching input high level	> 2.5 V	> 2.5 V	> 2.5 V	> 2.5 V
Switching input resistance **	> 24 kΩ	> 24 kΩ	> 24 kΩ	> 24 kΩ
Switchable to NC/NO	Yes	Yes	Yes	Yes
Configurable to PNP / NPN / push-pull	Yes	Yes	Yes	Yes
Analog output	0...10 V/4...20 mA	0...10 V/4...20 mA	0...10 V/4...20 mA	0...10 V/4...20 mA
Short-circuit protection	Yes	Yes	Yes	Yes
Reverse polarity protection	Yes	Yes	Yes	Yes

	PNBC105	PNBC106	PNBC107	PNBC108
Overload protection	Yes	Yes	Yes	Yes
Teach-in-Modus	VT/FT	VT/FT	VT/FT	VT/FT
Interface	Ethernet TCP/IP EtherCAT	Ethernet TCP/IP EtherCAT	Ethernet TCP/IP EtherCAT	Ethernet TCP/IP EtherCAT
Baud rate	100 Mbit/s	100 Mbit/s	100 Mbit/s	100 Mbit/s
Protection class	III	III	III	III
Webserver	Yes	Yes	Yes	Yes
Mechanical Characteristics				
Setting method	Teach-in	Teach-in	Teach-in	Teach-in
Housing material	Aluminum	Aluminum	Aluminum	Aluminum
Degree of protection	IP67	IP67	IP67	IP67
Connection	M12×1, 8-pin	M12×1, 8-pin	M12×1, 8-pin	M12×1, 8-pin
Type of connection Ethernet	M12×1, 4-pin	M12×1, 4-pin	M12×1, 4-pin	M12×1, 4-pin
Optic cover	Glass	Glass	Glass	Glass

* At a sensor temperature of 20...40 °C
** only valid if input load is switched off

4.1 Surface Effects

A measuring rate of 30 kHz is achieved at the reflectivities given in the following table.

Object colour	Reflectivity
white	90 %
grey	20 %
black	6 %

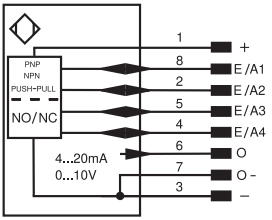
Values measured on Zenith Polymer Diffuser

NOTE!
These are typical measured values which may vary depending on surface characteristics and angle of incidence.

4.2 Wiring Diagram

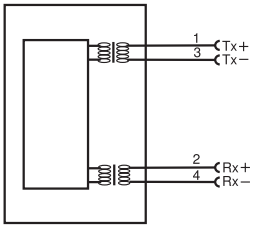
Pin assignment power supply:

134



Pin assignment Ethernet:

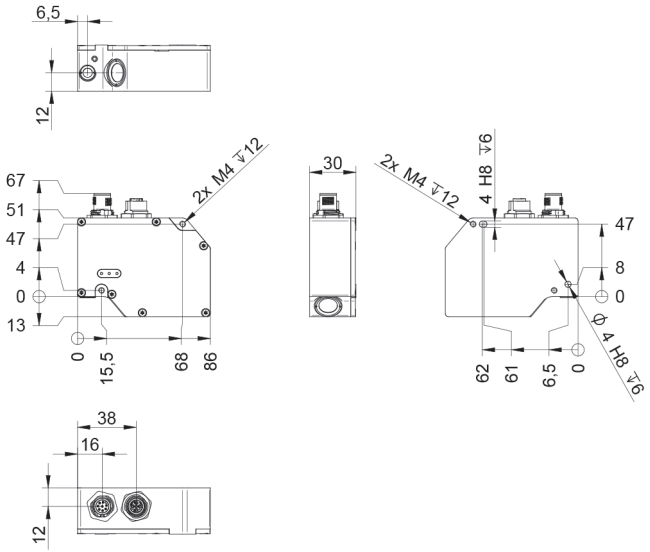
004



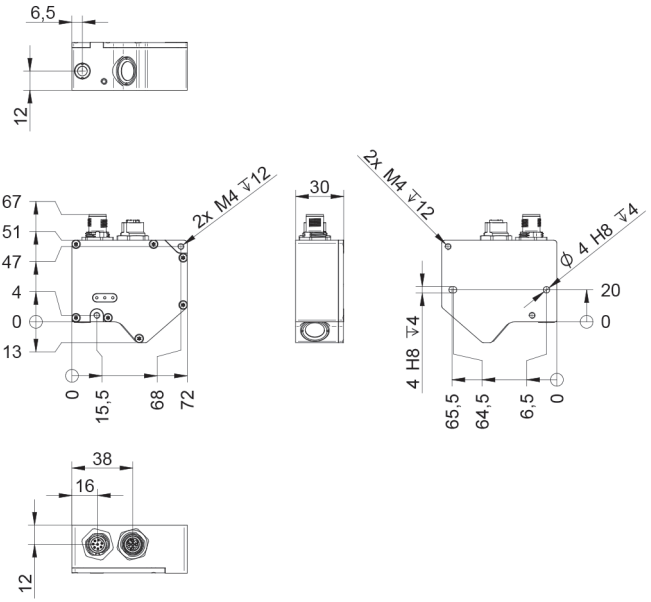
Legend					
+	Supply Voltage +	nc	Not connected	$EN_{B\,RS422}$	Encoder B/$\bar{B}$ (TTL)
–	Supply Voltage 0 V	U	Test Input	EN_A	Encoder A
~	Supply Voltage (AC Voltage)	Ū	Test Input inverted	EN_B	Encoder B
A	Switching Output (NO)	W	Trigger Input	A_{MIN}	Digital output MIN
Ā	Switching Output (NC)	W–	Ground for the Trigger Input	A_{MAX}	Digital output MAX
V	Contamination/Error Output (NO)	O	Analog Output	A_{OK}	Digital output OK
V̄	Contamination/Error Output (NC)	O–	Ground for the Analog Output	SY In	Synchronization In
E	Input (analog or digital)	BZ	Block Discharge	SY OUT	Synchronization OUT
T	Teach Input	A_{MV}	Valve Output	O_{LT}	Brightness output
Z	Time Delay (activation)	a	Valve Control Output +	M	Maintenance
S	Shielding	b	Valve Control Output 0 V	rsv	Reserved
RxD	Interface Receive Path	SY	Synchronization	Wire Colors according to DIN IEC 60757	
TxD	Interface Send Path	SY–	Ground for the Synchronization	BK	Black
RDY	Ready	E+	Receiver-Line	BN	Brown
GND	Ground	S+	Emitter-Line	RD	Red
CL	Clock	⏚	Grounding	OG	Orange
E/A	Output/Input programmable	SnR	Switching Distance Reduction	YE	Yellow
	IO-Link	Rx+/–	Ethernet Receive Path	GN	Green
PoE	ower over Ethernet	Tx+/–	Ethernet Send Path	BU	Blue
IN	Safety Input	Bus	Interfaces-Bus A(+)/B(–)	VT	Violet
OSSD	Safety Output	La	Emitted Light disengageable	GY	Grey
Signal	Signal Output	Mag	Magnet activation	WH	White
BI_D+/–	Ethernet Gigabit bidirect. data line (A-D)	RES	Input confirmation	PK	Pink
$EN_{0\,RS422}$	Encoder 0-pulse 0/$\bar{0}$ (TTL)	EDM	Contactor Monitoring	GNYE	Green/Yellow
PT	Platinum measuring resistor	$EN_{A\,RS422}$	Encoder A/$\bar{A}$ (TTL)		

4.3 Housing Dimensions

PNBC101

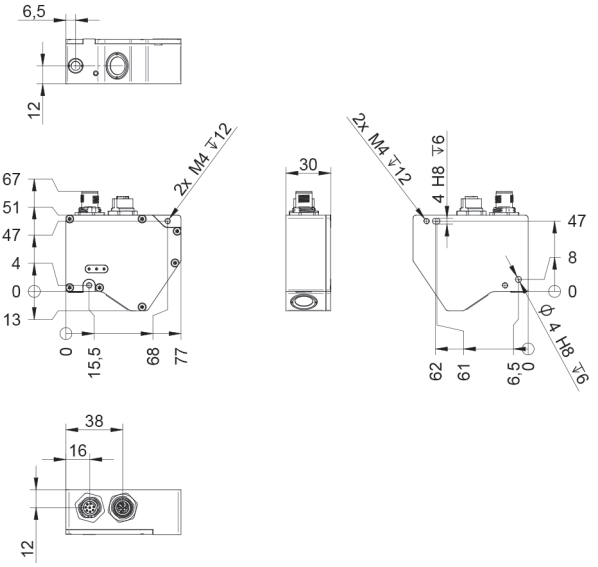


PNBC102

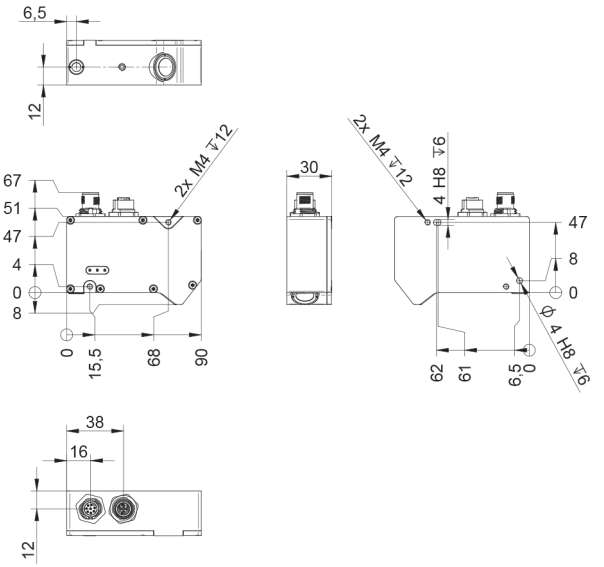


EN

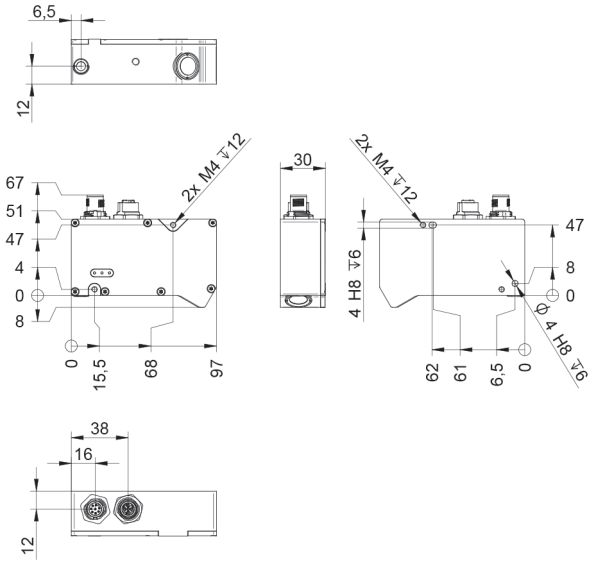
PNBC103



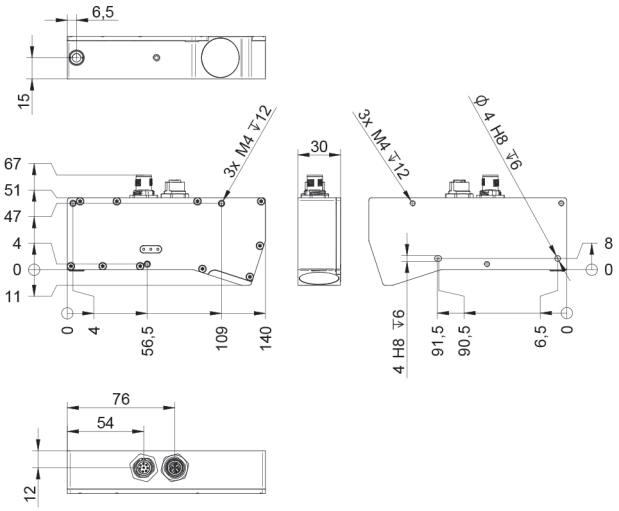
PNBC104



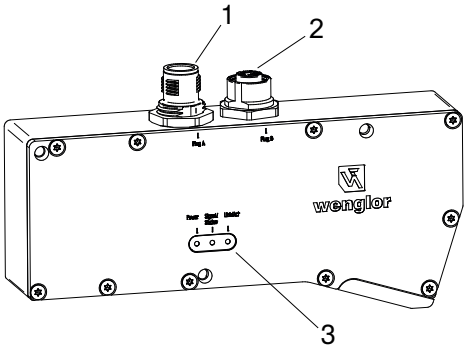
PNBC105

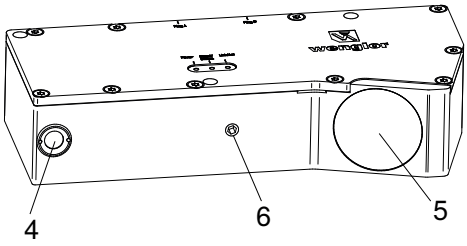


PNBC106 / PNBC107 / PNBC108



4.4 Sensor Construction

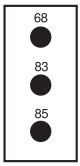




① = Connector power supply
② = Connector Ethernet
③ = LED display
④ = Laser exit
⑤ = Receiver
⑥ = Thread for fixing the screening grid retainer

4.5 Control Panel

A16



68 = Supply Power Indicator
8c = Signal/Status
85 = Link/Act LED

Description	Status	Function
Power	Blue	Operating voltage on
	Off	Operating voltage off
Signal/Status	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	Link available (TCP/IP)
	Blinking yellow	Communication

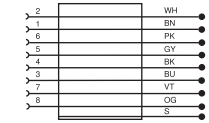
4.6 Complementary Products

wenglor offers Connection Technology for field wiring.

Suitable mounting technology no. 341
Suitable connection technology no.

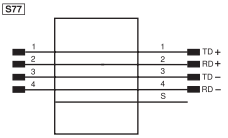
89

S74



51

S77



Switch ZAC51xN01
Cooling unit
Screening Grid Retainer
Screening Grids
Software wTeach2 DNNF005

5. System Overview

Connection Lines

M12, 8-polig to open end		
ZAS89R201	straight	2 m
ZAS89R501	straight	5 m
ZAS89R601	straight	10 m
ZAS89R701	straight	20 m
ZAS89R202	angled	2 m
ZAS89R502	angled	5 m
ZAS89R602	angled	10 m

Connection Cables

M12, 4-pin		
ZAV51R201	straight	2 m
ZAV51R601	straight	10 m

M12, 4-pin to RJ45		
ZAV51R202	straight	2 m
ZAV51R602	straight	10 m

M12, 8-pin		
BG88SG88V2-06M	straight	0,6 m
BG88SG88V2-2M	straight	2 m

Mounting System

ZNBZ001
ZNBZ002

Cooling Unit (optional)

ZNBK001	for PNBC101, PNBC102, PNBC103, PNBC104, PNBC105
ZNBK002	for PNBC106, PNBC107, PNBC108

Screening Grid Retainer (optional)

ZNBS001	for PNBC101
ZNBS004	for PNBC104
ZNBS005	for PNBC105
ZNBS007	for PNBC106, PNBC107, PNBC108
ZNBS008	for PNBC102
ZNBS009	for PNBC103

Screening Grid Sets (optional)

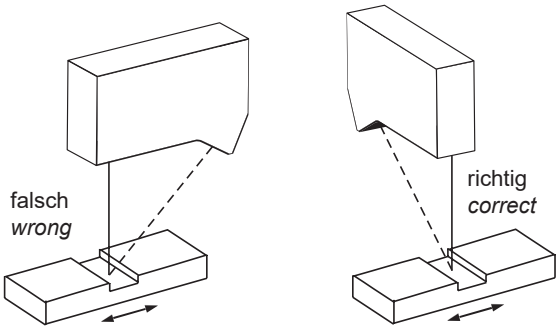
ZNBE002 (Plastic)	for ZNBS001, ZNBS002; ZNBS003, ZNBS004, ZNBS005
ZNBE003 (Plastic)	for ZNBS006
ZNBE004 (Glass)	for ZNBS001, ZNBS002; ZNBS003, ZNBS004, ZNBS005
ZNBE005 (Glass)	for ZNBS006

6. 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:



6.1 Default Settings

Description	Default value
IP address	192.168.0.225
Subnet mask	255.255.0.0
Evaluation method	COG
Average filter	0 (corresponds to the off state)
Sampling rate	Auto
Output rate	10 kHz
Laser	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

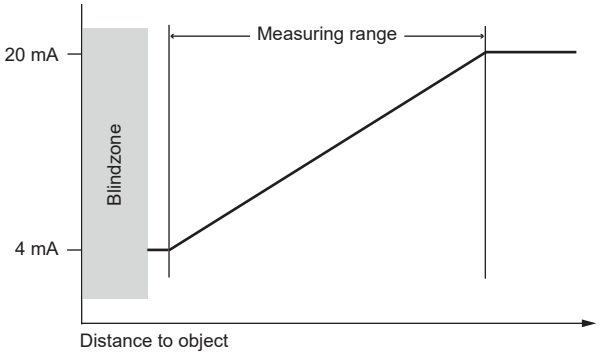
7. Initial Start-Up

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 (see pin assignment in section 4.2). We recommend the exclusive use of Ethernet switches in order to optimize data communication.

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 (crosslink), the sensor functions flawlessly via a PC network card. As an alternative, a commercially available 100 Mbit Ethernet switch can also be used.

8. Function Descriptions

PNCB Laser Distance Sensors High-Precision 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 with16-bit resolution.

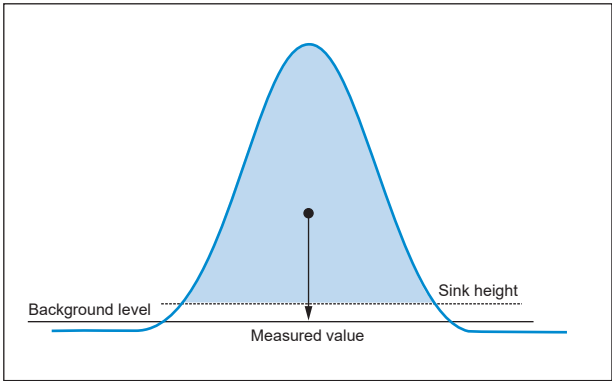


The diffusely reflected light from the measuring point is decisive for the measurement. Inadequate intensity of the remitted light is indicated by an LED signal lamp on the sensor's control panel. In the event of minimal remission, the sensor automatically reduces its sampling and output rates, in order to provide accurate measurement results. Signal strength is indicated on the website as a percentage (see "Status Display" in section 9.2).
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.

8.1 Evaluation method

8.1.1 Center of Gravity (Cog)

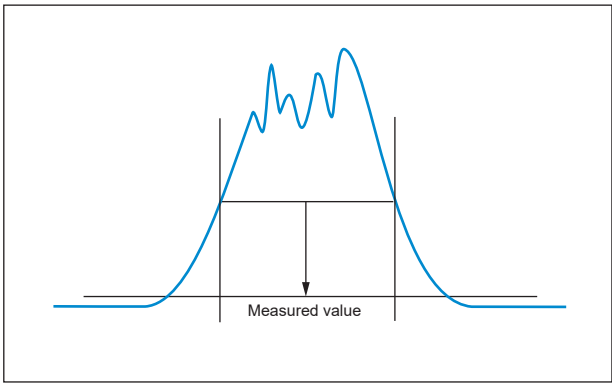
The Cog evaluation method calculates the peak's center of gravity, whose×-coordinate is the sought crude result. The peak has to be separated from the "sink" for the purpose of center of gravity analysis, which necessitates calculation of the threshold.



The threshold 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 threshold, 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.

8.1.2 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.

8.2 Measuring Accuracy and Error Influence

8.2.1 Calibration Report

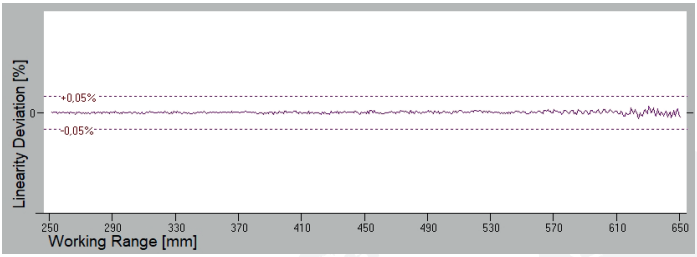
A calibration report is included with the sensor, which graphically represents linearity error as a percentage for the measured value on a matte white surface.

The following is an example of a calibration report:

Calibration Protocol

wenglor
the innovative family

Order Number: PNBC107
Serial Number: 001000
MAC Address: 00:07:AB:F0:0C:AB



Measurement Conditions:

Measuring Range	400 mm
Working Range	250...650 mm
Measured Surface	White Surface
Evaluation Method	COG
Temperature	20° C (+/-1° C)
Laser Class	2 (max 1.0 mW)

Differences to the above data can appear due to:

1. Target material and surface
2. Target geometry
3. Sensor mounting
4. Temperature fluctuation during the measurement
5. Strong circulation of warm air between sensor and target

Further statements in the datasheet and the operation instructions are valid.

Inspector: Klinkow
Date: 08.07.2022

8.2.2 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.

8.2.3 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.

8.2.4 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.

NOTE!
In order to achieve the highest possible resistance to extraneous light, the shortest possible maximum exposure time should be set (see section 9.3 or 10.4.8).

8.2.5 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.

8.2.6 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.

9. Settings

There are several different ways to enter settings to the device:

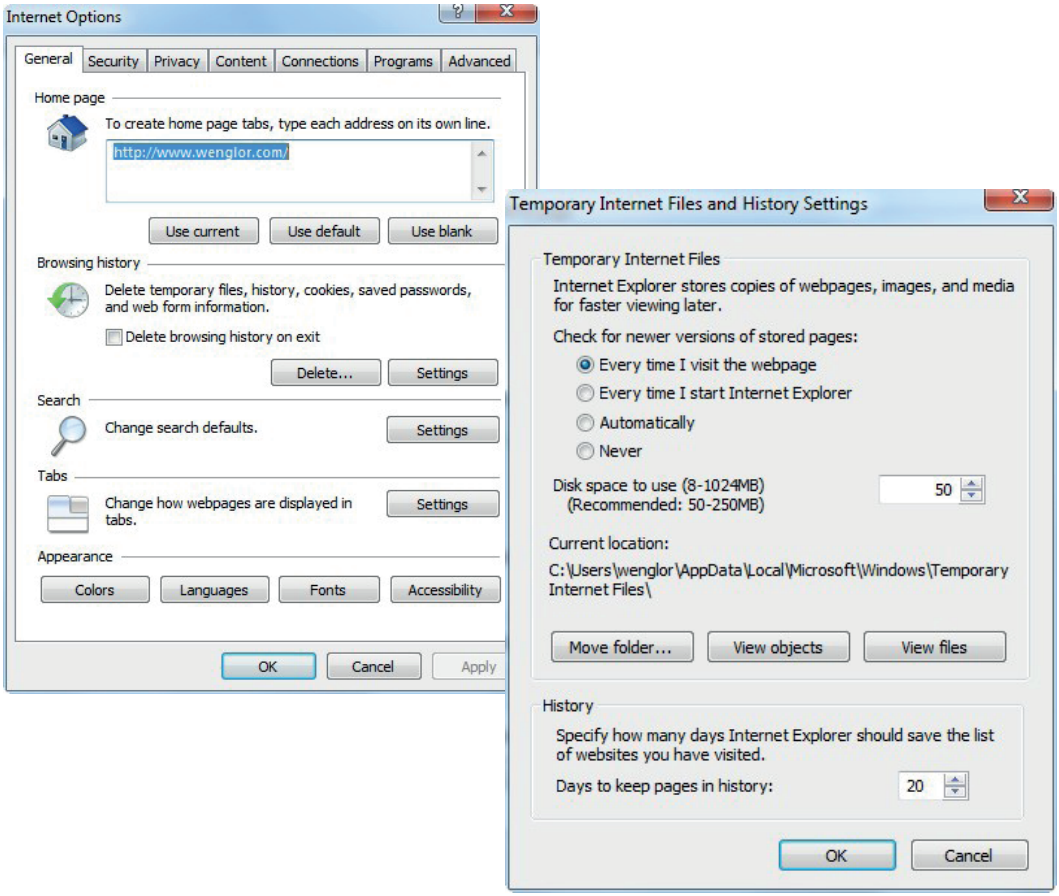
- Via the integrated website, with which PNBC Sensors are equipped. This website functions independent of the operating system and the sensor can be configured via a standard browser. The web-based configuration interface is not required for normal operation with a controller (the default IP address is listed in section 6.1).
- With the help of w-Teach configuration and display software which is available for download from www.wenglor.com

Settings are explained below based on the descriptive example provided by the website which is integrated into the sensor.

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

9.1 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.

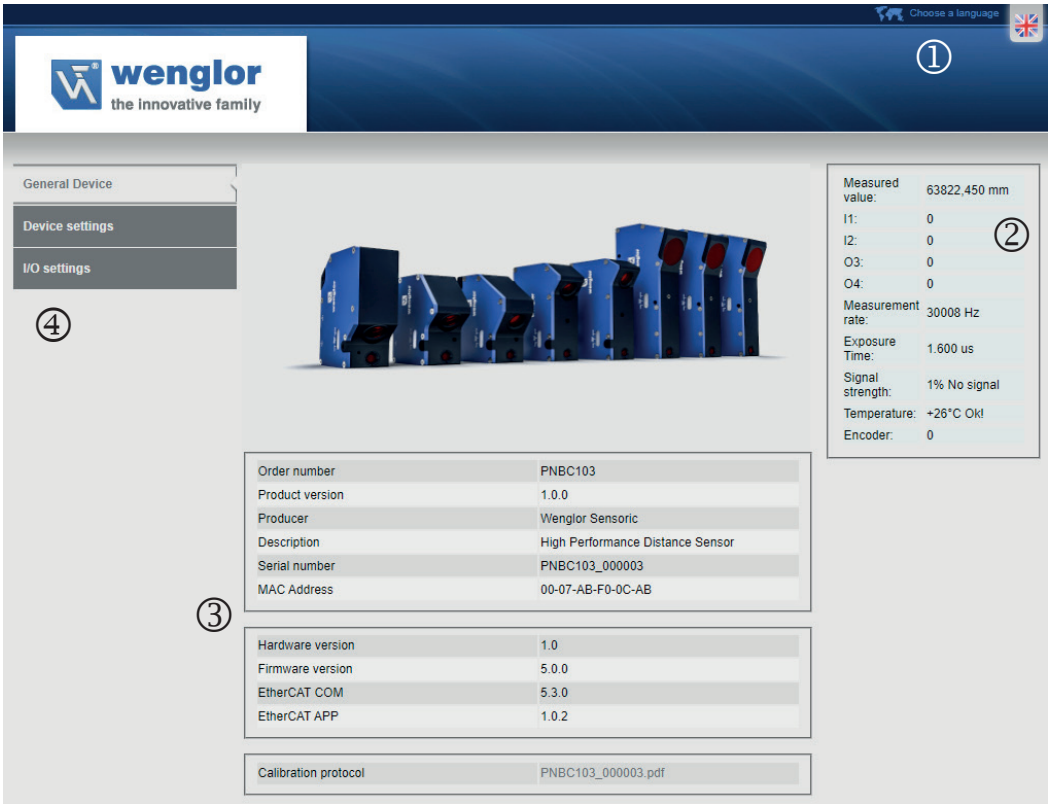

Internet Options
General
Security
Privacy
Content
Connections
Programs
Advanced
Home page
To create home page tabs, type each address on its own line.
http://www.wenglor.com/
Use current
Use default
Use blank
Browsing history
Delete temporary files, history, cookies, saved passwords, and web form information.
Delete browsing history on exit
Delete...
Settings
Search
Change search defaults.
Settings
Tabs
Change how webpages are displayed in tabs.
Settings
Appearance
Colors
Languages
Fonts
Accessibility
OK
Cancel
Apply
Temporary Internet Files and History Settings
Temporary Internet Files
Internet Explorer stores copies of webpages, images, and media for faster viewing later.
Check for newer versions of stored pages:
Every time I visit the webpage
Every time I start Internet Explorer
Automatically
Never
Disk space to use (8-1024MB)
(Recommended: 50-250MB)
50
Current location:
C:\Users\wenglor\AppData\Local\Microsoft\Windows\Temporary Internet Files\
Move folder...
View objects
View files
History
Specify how many days Internet Explorer should save the list of websites you have visited.
Days to keep pages in history:
20
OK
Cancel

In order to be able to access the product's website (in this example the PNBC102), 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 general information concerning the connected sensor.

9.2 Page Layout (website)



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**

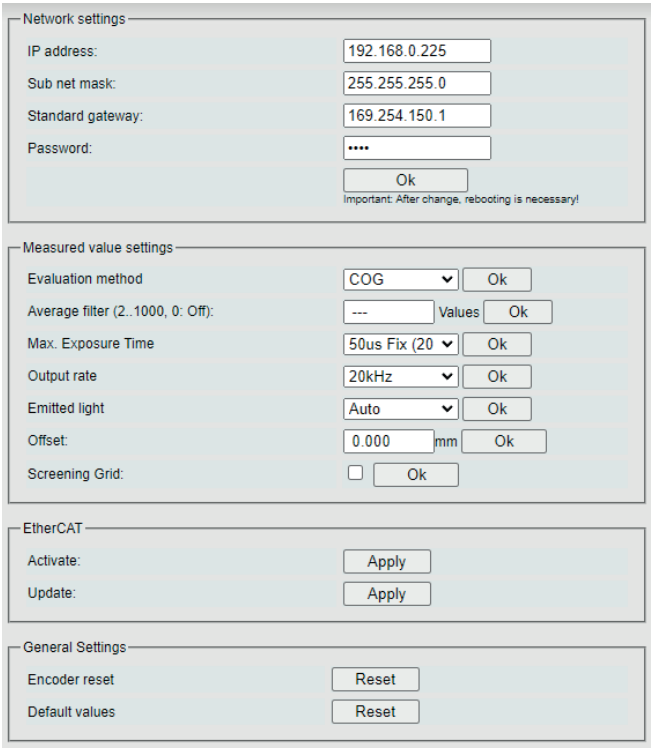
Measured value	Displays the current distance between the edge of the sensor's housing and the object..
I/O1...I/O4	Indicates the switching status of the respective input or output.
Measurement rate	Displays the current measurement rate
Exposure time	Displays the current exposure time
Signal strength	Indicates the intensity of received light. If luminious intensity is too low (<2 %), 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 housing. Depending on how the sensor is mounted, this temperature is 10 to 15° C above ambient temperature. “OK” appears next to the value in order to indicate that the sensor is being operated within its specified values **NOTE!** If the sensor's temperature is too high (>50 °C), the information "Too hot" is also displayed. In this case it is recommended to either cool the sensor or to mount it in such a way that the heat is better dissipated.
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**

General device	Overview page with general information regarding the sensor as a display without any setting options..
Device settings	• The sensor's network settings (see section 9.3) • The sensor's measured value settings (see section 9.3) • General settings (see section 9.3)
I/O settings	Settings for the digital inputs and outputs (see section 9.4).

9.3 Device Settings (website)



Network settings:
The IP address and the addresses for the subnet mask and the gateway can be changed in the respective fields. Changes are activated by entering the “admin” password and by restarting the device. Please make sure that the selected subnet mask is actually available within the network. Otherwise you might not be able to find the sensor in the network.

Measured value settings:

<table>
<tr><th>Evaluation method</th><th>Functions description (see section 8)</th></tr>
<tr><td>Average filter</td><td>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.</td></tr>
<tr><td>Max. exposure time</td><td>Setting of specific exposure times in fixed or auto mode with corrsponding measuring frequency:
<table>
<tr><th>Setting sensor website</th><th>Interface command (see section 10.4)</th></tr>
<tr><td>5 µs Auto (30 kHz)</td><td>set_regulator=0 oder 1
set_meas_freq=30000</td></tr>
<tr><td>29 µs Auto (30 kHz)</td><td>set_regulator=0 oder 1
set_meas_freq=30000
set_max_shutter=29</td></tr>
<tr><td>50 µs Auto (20 kHz)</td><td>set_regulator=0 oder 1
set_meas_freq=20000</td></tr>
<tr><td>100 µs Auto (10 kHz)</td><td>set_regulator=0 oder 1
set_meas_freq=10000</td></tr>
<tr><td>200 µs Auto (5 kHz)</td><td>set_regulator=0 oder 1
set_meas_freq=5000</td></tr>
<tr><td>1,6 µs Fix (30 kHz)</td><td>set_regulator=2 oder 3
set_meas_freq=30000</td></tr>
<tr><td>29 µs Fix (30 kHz)</td><td>set_regulator=2 oder 3
set_meas_freq=30000
set_shutter=29</td></tr>
<tr><td>50 µs Fix (20 kHz)</td><td>set_regulator=2 oder 3
set_meas_freq=20000</td></tr>
<tr><td>100 µs Fix (10 kHz)</td><td>set_regulator=2 oder 3
set_meas_freq=10000</td></tr>
<tr><td>200 µs Fix (5 kHz)</td><td>set_regulator=2 oder 3
set_meas_freq=5000</td></tr>
</table></td></tr>
<tr><td>Sampling rate</td><td>Possible settings include "Auto" (the sampling rate is adjusted automatically) or "= output rate" (sampling rate = output rate). Values can be selected within a range of 900 to 30,000 Hz as well.</td></tr>
<tr><td>Output rate</td><td>Values can be selected within a range of 10 to 30,000 Hz. The measured values are compiled indiviually as an Ethernet data packet at the selected rate.
Example: Using the "extended continuous measurement" evaluation method with 150 distance values and a selected output rate of 1 kHz (corresponds to 1 ms), you get the entire data packet every 150 ms (see section 10.6.2).</td></tr>
<tr><td>Emitted light</td><td>Laser power adjustable from 0.1 mW to 1.0 mW, or automatic</td></tr>
<tr><td>Offset</td><td>If desired, a zero-point offset can be entered here.</td></tr>
<tr><td>Screening grid</td><td>When activated, the effects of the screening grid on the measured distance value and linearity are compensated by this option.</td></tr>
</table>

EtherCAT

Activate	EtherCAT is activated by pressing the "Apply" button.
Update	Update of EtherCAT interface

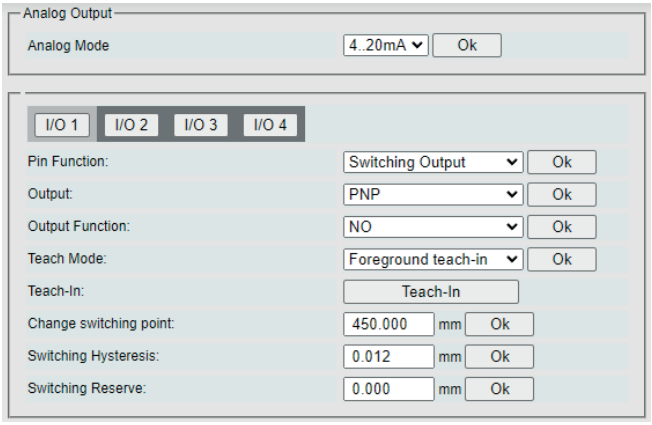
NOTE!
In the EtherCAT operating mode the sensor can only be configured via EtherCAT. The data can only be received via this interface.

NOTE!
To return from EtherCAT mode to TCP/IP mode, the configuration must be changed via the EtherCAT interface (see section 11).

General settings:

Encoder reset	Resets the encoder input to zero
Default values	Resets all values to their default settings (exception: network settings)

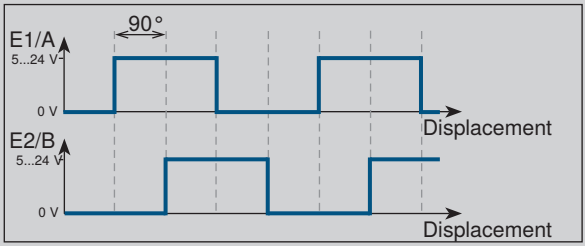
9.4 I/O Settings (website)



Analog output:
Selection of 0...10 V or 4...20 mA. Is the analog output used as a voltage source, the connected load should be 1 kΩ. Is the analog output configured as current output, the connected load should be 400 Ω.

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 operates as a swiching output
External teach-in	The switching input can be taught in again by applying an electrical signal
Encoder E1+E2	A 2-channel rotary encoder with HTL square-wave signal must be used. Channel A is displaced 90 ° relative to channel B. It must be assured that a shielded cable is used in order to avoid possible interference or crosstalk between the conductors.  **HINWEIS!** The maximum encoder frequency must not exceed 100 kHz.
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.
Error output	The output switches when the selected intensity is exceeded or not reached or when the target is outside the measuring range. **NOTE!** The set threshold values for the intensity are not identical to the specification of the signal strength in the status display (see section 9.2).

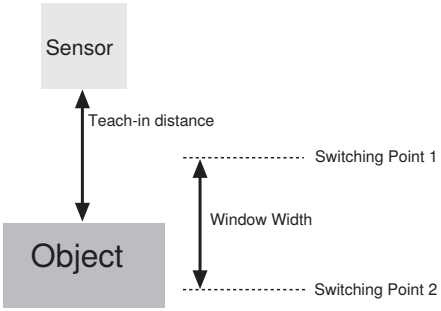
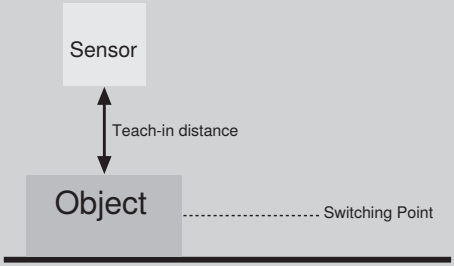
Output

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. A NPN output can also be equipped with a pull-up resistor.
Push-pull	Alternate PNP and NPN switching

Output function

NO	The output is configured as normally open
NC	The output is configured as normally closed

Teach-in mode

Teach-in	A function by means of which the sensor is caused to automatically calculate and save future settings based upon currently recorded values by pressing a button or applying a control signal.
FT 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 called the window. The size of the window is described as window width. The sensor is switched when an object is within the window. 
VT teach-in mode (foreground teach-in)	Teach-in is performed while the sensor is aligned to the object. The switching distance is then automatically set to a distance which is slightly larger than the clearance between the sensor and the object. So the sensor switches when the distance between sensor and object is smaller or equal to the distance to the object used for the teach-in procedure. 

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.

Switching Hysteresis:
Describes the distance between the switch-on and switch-off points. Due to the highly stable measured values provided by this range of sensors, hysteresis can be set very low – even down to 0.000 mm. This setting may be advisable in certain applications where an average filter is used.

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 PNP output).

Input setting:
Operating voltage active: Pending tasks are executed when input voltage is on.
Operating voltage inactive: Pending tasks are executed when input voltage is off.

10. Interface Protocol Ethernet TCP/IP

This section describes the structure and the function of the TCP commands for controlling and configuring the Laser Distance Sensor High-Precision PNBCxxx.
The commands are send via the port 3000. After opening the port, the sensor transmits data packets without any further prompting.
Further information regarding the header and the data format can be found in section 10.6.
It is advisable to stop measurement before configuring the parameters.
Upper and lower case letters must be observed.

HINWEIS!
Please note upper and lower case.

HINWEIS!
Set commands are only acknowledged with an answer when the reply mode is activated (see chapter 10.1.6).

10.1 General Measuring Commands

10.1.1 Selecting the “Continuous Distance Measurement” Data Format

Command	`set_measure_start<CR>`
Response	Data stream (see section 10.6.1)
Description	Starts the “Continuous Distance Measurement” data stream (distance data).

10.1.2 Selecting the “Extended Continuous Measurement” Data Format

Command	`set_ext_measure_start<CR>`
Response	Data stream (see section 10.6.2)
Description	Starts the “Extended Continuous Measurement” data stream (distance, intensity and encoder data).

10.1.3 Selecting the Data Format for Peak Data

Command	`set_peak<CR>`
Response	Data stream (see section 10.6.3)
Description	A peak is transmitted.

10.1.4 Setting Packet Length

Command (Set)	`set_packet_size=x<CR>`
Command (Get)	`get_packet_size<CR>`
Response	`OK:packet_size=x<CR>`
Description	The desired number of distance values per packet can be selected here. Possible values for “x” include: • 1...450 (continuous measurement) • 1...150 (extended continuous measurement) The entered value remains valid until the data format is changed. The values are then reset to the default values (150/450).

10.1.5 Stopping the Measurement

Command	`set_measure_stop<CR>`
Response	No response
Description	All measurement and transmission of measurement data is stopped.

10.1.6 Reply Mode

Command	`set_reply_echo_activate<CR>` `set_reply_echo_deactivate<CR>`
Response	Only in case of “reply echo activate”: `OK:reply_echo_activate<CR>`
Description	All commands are acknowledged (default setting: mode deactivated).

10.2 Sensor-specific Details

10.2.1 Querying the Order Number

Command	`get_name<CR>`
Response	Example: `OK:name=PNBC105<CR>`
Description	The order number is read out.

10.2.2 Querying the Product Version

Command	`get_pversion<CR>`
Response	Example: `OK:pversion=1.0.0<CR>`
Description	The product version is read out.

10.2.3 Querying the Manufacturer

Command	get_manufacturer<CR>
Response	OK:manufacturer=wenglor_sensoric_GmbH<CR>
Description	The manufacturer is read out. Blanks are replaced by underlines!

10.2.4 Querying the Description

Command	get_description<CR>
Response	OK:description=High_Performance_Distance_Sensor<CR>
Description	The description is read out. Blanks are replaced by underlines!

10.2.5 Querying the Serial Number

Command	get_serial<CR>
Response	Example: OK:serial=001020<CR>
Description	The serial number is read out.

10.2.6 Querying the MAC Address

Command	get_mac_address<CR>
Response	Example: OK:mac_address=0007ABF00CAB<CR>
Description	The MAC address is read out.

10.2.7 Querying the Hardware Version

Command	get_hwversion<CR>
Response	Example: OK:hw_version=3.0.0<CR>
Description	The hardware version is read out.

10.3 Network Settings

10.3.1 Setting the IP Address

Command (Set)	set_ip_addr=192.168.0.225<CR>
Command (Get)	get_ip_addr<CR>
Response	OK:ip_addr=192.168.0.225<CR>
Description	The new address becomes active after restarting the sensor.

10.3.2 Setting the Subnet Mask Address

Command (Set)	set_netmask_addr=255.255.0.0<CR>
Command (Get)	get_net_mask<CR>
Response	OK:net_mask=255.255.0.0<CR>
Description	The new subnet mask becomes active after restarting the sensor.

10.3.3 Setting the Gateway Address

Command (Set)	set_gateway_addr=192.168.0.1<CR>
Command (Get)	get_gateway<CR>
Response	OK:gateway_addr=192.168.0.1<CR>
Description	The new gateway address becomes active after restarting the sensor.

10.3.4 Reset the Network Settings to Default Values

Command	set_activate_network_default<CR>
Response	OK:activate_network_default<CR>
Description	Reset of IP address, gateway and subnet mask to default values.

10.4 Measurement Settings

10.4.1 Select the Evaluation Method

Command (Set)	set_calc_mode=x<CR>
Command (Get)	get_calc_mode<CR>
Response	OK:calc_mode=x<CR>
Description	The peak evaluation method can be selected with this command. Possible values for “x” include: 2: COG (default setting) 5: Edge

10.4.2 Adjusting the Average Filter

Command (Set)	set_avg_filter_cnt=x<CR>
Command (Get)	get_avg_filter_cnt<CR>
Response	OK:avg_filter_cnt=x<CR>
Description	The rolling average can be generated based on a value between 2 and 1 000. 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. Possible values for “x” include: 0/1: off (default setting: 0) 2...1 000

10.4.3 Setting the Sampling Rate

Command (Set)	`set_meas_freq=x<CR>`
Command (Get)	`get_meas_freq<CR>`
Response	`OK:meas_freq=x<CR>`
Description	The sampling rate is set in Hertz. Possible values for “x” include: 900...30 000 • Depending on the selected value, the measurement rate is set to the closest level (5 000, 10 000, 20 000, 30 000). • The maximum exposure time is set according to the measuring rate: » 30 kHz: 29 µs » 20 kHz: 50 µs » 10 kHz: 100 µs » 5 kHz: 200 µs

10.4.4 Setting the Output Rate

Command (Set)	`set_freq=x<CR>`
Command (Get)	`get_freq<CR>`
Response	`OK:freq=x<CR>`
Description	The output rate is set in Hertz (default setting: 10000 Hz). The measured values are compiled individually as an Ethernet data packet at the selected rate. Example: Using the “Extended Continuous Measurement” evaluation method with 150 distance values and a selected output rate of 1000 Hz (corresponds to 1 ms), you get the entire data packet every 150 ms. Possible values for “x” include: 10...30 000

10.4.5 Switching the Laser On/Off

Command	`set_activate_laser<CR>` `set_deactivate_laser<CR>`
Response	`OK:activate_laser<CR>` `OK:deactivate_laser<CR>`
Description	The laser is switched on or off by means of TCP commands (default setting: laser on). When the pin function of a USRIO ist set to the input function Laser on/off, then the pin level is dominant. This setting cannot be changed by the input command.

10.4.6 Setting Laser Power

Command (Set)	set_laser=x<CR>
Command (Get)	get_laser<CR>
Response	OK:laser=x<CR>
Description	Laser power can be adjusted in 1/10 mW steps. Possible values: 0: Auto (default setting) 1: (0,1 mW) ... 10: 1 mW This setting is only active in case of manual laser power regulation (see section 10.4.9)

10.4.7 Exposure Time

Command (Set)	set_shutter=x<CR>
Command (Get)	get_shutter<CR>
Response	OK:shutter=x<CR>
Description	Exposure time is set (in us), if the exposure time regulation is set to manual (set_regulator=2 or 3). Possible values for „x“ include: 30 kHz - 1,6 ... 29 µs / in steps of 0,025 µs (example: 1,6, 1,625 ... 29) 20 kHz - 1,6 ... 50 µs / in steps of 0,025 µs (example: 1,6, 1,625 ... 50) 10 kHz - 1,6 ... 100 µs / in steps of 0,025 µs (examplel: 1,6, 1,625 ... 100) 5 kHz - 1,6 ... 200 µs / in steps of 0,025 µs (example: 1,6, 1,625 ... 200) Example: set_shutter=1,625

10.4.8 Maximum Exposure Time

Command (Set)	set_max_shutter=x<CR>
Command (Get)	get_max_shutter<CR>
Response	OK:max_shutter=x<CR>
Description	The maximum exposure time is set (in us), if the exposure time regulation is set to automatic (set_regulator=0 or 1) Possible values for „x“ include: 30 kHz - 1,6 ... 29 µs / in steps of 0,025 µs (example: 1,6, 1,625 ... 29) 20 kHz - 1,6 ... 50 µs / in steps of 0,025 µs (example: 1,6, 1,625 ... 50) 10 kHz - 1,6 ... 100 µs / in steps of 0,025 µs (example: 1,6, 1,625 ... 100) 5 kHz - 1,6 ... 200 µs / in steps of 0,025 µs (example: 1,6, 1,625 ... 200) Example: set_max_shutter=4,025

10.4.9 Setting Regulation of Laser Power and Exposure Time

Command (Set)	set_regulator=x<CR>
Command (Get)	get_regulator<CR>
Response	OK:regulator=x<CR>
Description	Regulation of the exposure time and laser power is set here. Possible values for “x” include: 0: Automatic exposure time regulation AND laser power regulation (default setting) 1: Automatic exposure time , laser power manually adjustable 2: Automatic laser power, exposure time manually adjustable 3: Laser power and exposure time manually adjustable In case of laser power regulation and exposure time regulation, the sensor automatically selects the setting which results in the best intensity. Depending on the application, either exposure time or laser power regulation is preferable. If a constant exposure time is needed, then the laser power regulation is more suitabe, for a constant laser power the exposure time regulation is more suitable.

10.4.10 Adjusting Offset

Command	set_digout_offset=x<CR>
Response	OK:digout_offset=x<CR>
Description	A zero-point offset can be entered here as a 16-bit value (default setting: 0.000). Possible values for “x” include: -30,000...30,000 Conversion of digital offset to offset in mm: *Offset [mm] = x / 65536 × Messbereich [mm]*

10.4.11 Protective Screen Compensation

Command	set_compensation_activate<CR> set_compensation_deactivate<CR>
Response	No response
Description	Activation/deactivation of protective screen compensation

10.4.12 Encoder Reset

Command	set_clear_encoder<CR>
Response	OK:clear_encoder<CR>
Description	This command resets the internal encoder counter to zero.

10.4.13 Encoder Counter Right Shift

Command (Set)	set_enc_right_shift=x<CR>
Command (Get)	get_enc_rshift<CR>
Response	OK:enc_rshift=x<CR>
Description	The scaling factor of the encoder input can be set with this command. Possible values for “x” include: 0: Every encoder pulse is counted 1: Every 2nd encoder pulse is counted 2: Every 4th encoder pulse is counted (default setting) . . 8: Every 256th encoder pulse is counted

10.4.14 Reset to Default Values

Command	set_activate_default<CR>
Response	OK:activate_default<CR>
Description	Returns all settings to their default values. Exception: network settings.

10.5 I/O Settings

10.5.1 Selecting the Analog Mode

Command (Set)	set_anaout_mode=x<CR>
Command (Get)	get_anaout_mode<CR>
Response	OK:anaout_mode=x<CR>
Description	Selects the analog mode. Possible values for “x” include: 1: 0...10 V 8: 4...20 mA (default setting)

10.5.2 Quering the Input Status

Command	get_usr_io1<CR> get_usr_io2<CR> get_usr_io3<CR> get_usr_io4<CR>
Response	(e.g. I/O1): OK:usr_io1=1<CR>
Description	Reads out the input status at the pin. Possible values include: 0 and 1

10.5.3 Quering the Input/Output Status of All Inputs/Outputs

Command	`get_usr_allinputs<CR>`
Response	`OK:usr_io_allinputs=0110<CR>`
Description	Reads out the status of all inputs/outputs in the following order: IO4, IO3, IO2 and IO1. Possible values include: 0 and 1. The following applies to the example included above: IO4: 0 (inactive) IO3: 1 (active) IO2: 1 (active) IO1: 0 (inactive)

10.5.4 Setting the Pin Function

Command (Set)	`set_usrio1_pin_function=x<CR>`
	`set_usrio2_pin_function=x<CR>`
	`set_usrio3_pin_function=x<CR>`
	`set_usrio4_pin_function=x<CR>`

Command (Get)	`get_usrio1_pin_function<CR>`
	`get_usrio2_pin_function<CR>`
	`get_usrio3_pin_function<CR>`
	`get_usrio4_pin_function<CR>`

Response	(e.g. I/O1): `OK:usr_io1_pin_function=x<CR>`
Description	Sets the pin function. Possible values for “x” include: 1: Switching output 2: External teach-in input for O1 3: External teach-in input for O2 4: External teach-in input for O3 5: External teach-in input for O4 6: Encoder input (I1+I2) 7: Encoder reset input 10: Laser on/off input 11: Error output

10.5.5 Selecting the Output Mode

Command (Set)	`set_usrio1_output_mode=x<CR>`
	`set_usrio2_output_mode=x<CR>`
	`set_usrio3_output_mode=x<CR>`
	`set_usrio4_output_mode=x<CR>`

Command (Get)	`get_usrio1_output_mode<CR>`
	`get_usrio2_output_mode<CR>`
	`get_usrio3_output_mode<CR>`
	`get_usrio4_output_mode<CR>`

Response	(e.g. I/O1): `OK:usr_io1_output_mode=x<CR>`

Description	Sets the output mode. Possible values for “x” include: 1: PNP 2: NPN 3: Push-pull

10.5.6 Setting the Output Function

Command (Set)	set_usrio1_output_function=x<CR> set_usrio2_output_function=x<CR> set_usrio3_output_function=x<CR> set_usrio4_output_function=x<CR>
Command (Get)	get_usrio1_output_function<CR> get_usrio2_output_function<CR> get_usrio3_output_function<CR> get_usrio4_output_function<CR>
Response	(e.g. I/O1): OK:usr_io1_output_function=x<CR>
Description	Configures the output function. Possible values for “x” include: 1: Normally open (NO) 2: Normally closed (NC)

10.5.7 Selecting the Teach-In Mode

Command (Set)	set_usrio1_teach_mode=x<CR> set_usrio2_teach_mode=x<CR> set_usrio3_teach_mode=x<CR> set_usrio4_teach_mode=x<CR>
Command (Get)	get_usrio1_teach_mode<CR> get_usrio2_teach_mode<CR> get_usrio3_teach_mode<CR> get_usrio4_teach_mode<CR>
Response	(e.g. I/O1): OK:usr_io1_teach_mode=x<CR>
Description	Sets the teach-in mode. Possible values for “x” include: 1: Foreground teach-in (default setting) 2: Window teach-in Foreground teach-in: Teach-in is performed while the sensor is aligned to the object. The teach-in distance is set automatically, so that the sensor switches as soon as the distance between the sensor and the object is less than or equal to the previously taught in distance. 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 width. The sensor switches when the object is within the window.

10.5.8 Teaching the Switching Distance (Teach-in)

Command	`set_usrio1_teach_in=x<CR>`
	`set_usrio2_teach_in=x<CR>`
	`set_usrio3_teach_in=x<CR>`
	`set_usrio4_teach_in=x<CR>`

Response	(e.g. I/O3): `OK:usr_io3_switch_dist_mm=87.614<CR>`
Description	A function by means of which the sensor is caused to automatically calculate and save future settings based on momentarily acquired values by pressing a button or applying a control signal. **NOTE!** The pin function of the respective output must be configured as a switching output.

10.5.9 Setting Window Width

Command (Set)	`set_usrio1_window_size_mm=x<CR>`
	`set_usrio2_window_size_mm=x<CR>`
	`set_usrio3_window_size_mm=x<CR>`
	`set_usrio4_window_size_mm=x<CR>`

Command (Get)	`get_usrio1_window_size_mm<CR>`
	`get_usrio2_window_size_mm<CR>`
	`get_usrio3_window_size_mm<CR>`
	`get_usrio4_window_size_mm<CR>`

Response	(e.g. I/O1): `OK:usr_io1_window_size_mm=x<CR>`
Description	Sets the window width (see section 10.5.7 ➝ window teach-in). The entered value must be smaller than the sensor's measuring range. Example: 0.100 (specified in mm) **NOTE!** Decimal points must be used for non-whole numbers - not decimal commas.

10.5.10 Setting the Switching Point

Command (Set)	set_usrio1_switch_dist_mm=x<CR> set_usrio2_switch_dist_mm=x<CR> set_usrio3_switch_dist_mm=x<CR> set_usrio4_switch_dist_mm=x<CR>
Command (Get)	get_usrio1_switch_dist_mm<CR> get_usrio2_switch_dist_mm<CR> get_usrio3_switch_dist_mm<CR> get_usrio4_switch_dist_mm<CR>
Response	(e.g. I/O1): OK:usr_io1_switch_dist_mm=x<CR>
Description	The switching point is shifted to the entered distance. In the case of foreground teach-in, this is the teach-in distance (see section 10.5.7), while in the case of window teach-in, it is the distance to the middle of the window. The value selected for “x” must lie within the working range. Example: 22.123 (specified in mm) **NOTE!** Decimal points must be used for non-whole numbers - not decimal commas.

10.5.11 Setting Hysteresis

Command (Set)	set_usrio1_hysteresis_mm=x<CR> set_usrio2_hysteresis_mm=x<CR> set_usrio3_hysteresis_mm=x<CR> set_usrio4_hysteresis_mm=x<CR>
Command (Get)	get_usrio1_hysteresis_mm<CR> get_usrio2_hysteresis_mm<CR> get_usrio3_hysteresis_mm<CR> get_usrio4_hysteresis_mm<CR>
Response	(e.g. I/O1): OK:usr_io1_hysteresis_mm=x<CR>
Description	Hysteresis describes the distance between the switch-on and switch-off points. Possible values for “x” include: 0...1/4 of measuring range Example: 0.030 (specified in mm) **NOTE!** Decimal points must be used for non-whole numbers - not decimal commas.

10.5.12 Setting Switching Reserve

Command (Set)	set_usrio1_switch_res_mm=x<CR> set_usrio2_switch_res_mm=x<CR> set_usrio3_switch_res_mm=x<CR> set_usrio4_switch_res_mm=x<CR>
Command (Get)	get_usrio1_switch_res_mm<CR> get_usrio2_switch_res_mm<CR> get_usrio3_switch_res_mm<CR> get_usrio4_switch_res_mm<CR>
Response	(e.g. I/O1): OK:usr_io1_switch_res_mm=x<CR>
Description	Switching reserve describes the 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. Possible values for "x" include: 0...1/4 of measuring range Example: 0.120 (specified in mm) Switching reserve can only be set for foreground teach-in.  **NOTE!** Decimal points must be used for non-whole numbers - not decimal commas.

10.5.13 Setting Input Load

Command (Set)	set_usrio1_input_load=x<CR> set_usrio2_input_load=x<CR> set_usrio3_input_load=x<CR> set_usrio4_input_load=x<CR>
Command (Get)	get_usrio1_input_load<CR> get_usrio2_input_load<CR> get_usrio3_input_load<CR> get_usrio4_input_load<CR>
Response	(e.g. I/O1): OK:usr_io1_input_load=x<CR>
Description	Sets the input load. Possible values for "x" include: 1: Input load active (2 mA; default setting) 2: Input load inactive

10.5.14 Setting the Input Function

Command (Set)	set_usrio1_input_function=x<CR> set_usrio2_input_function=x<CR> set_usrio3_input_function=x<CR> set_usrio4_input_function=x<CR>
Command (Get)	get_usrio1_input_function<CR> get_usrio2_input_function<CR> get_usrio3_input_function<CR> get_usrio4_input_function<CR>
Response	(e.g. I/O1): OK:usr_io1_input_function=x<CR>
Description	Configures the input function. Possible values for “x” include: 1: Ub active (pending tasks are executed when input voltage is on, default setting) 2: Ub inactive (pending tasks are executed when input voltage = 0 V)

10.5.15 Minimum Intensity

Command (Set)	set_usrio1_min_err_intens=x<CR> set_usrio2_min_err_intens=x<CR> set_usrio3_min_err_intens=x<CR> set_usrio4_min_err_intens=x<CR>
Command (Get)	get_usrio1_min_err_intens<CR> get_usrio2_min_err_intens<CR> get_usrio3_min_err_intens<CR> get_usrio4_min_err_intens<CR>
Response	(e.g. I/O1): OK:usr_io1_min_err_intens=x<CR>
Description	Sets the minimum intensity value for the error output (see section 9.4). Possible values for “x” include: 0...4095

10.5.16 Maximum Intensity

Command (Set)	set_usrio1_max_err_intens=x<CR> set_usrio2_max_err_intens=x<CR> set_usrio3_max_err_intens=x<CR> set_usrio4_max_err_intens=x<CR>
Command (Get)	get_usrio1_max_err_intens<CR> get_usrio2_max_err_intens<CR> get_usrio3_max_err_intens<CR> get_usrio4_max_err_intens<CR>
Response	(z. B. I/O1): OK:usr_io1_max_err_intens=x<CR>
Description	Sets the maximum intensity value for the error output (see section 9.4). Possible values for “x” include: 0...4095

10.6 Header and Data Format

After opening port 3000, the sensor transmits data packets in the selected data format (exception: peak data, see section 10.6.3).

The following data formats are possible:

- Continuous distance measurement (default setting)
- Extended continuous measurement
- Peak data

The header and the data are distributed to two TCP/IP packages of roughly the same size. In the case of a header with 94 bytes and a data volume of 900 bytes (for a total of 994 bytes), the first package contains 496 bytes and the second package 498. The header is always at the beginning of the package and is followed by the data.

The data layout is described in the following tables. The respective data format is identified by means of the “Data Format” field.

Example: If a value of 17520 appears in the “Data Format” field, this corresponds to continuous distance measurement.

All values are little-endian, i. e. the least significant byte comes first.

In the case of zero-terminated strings, the entry ends with the first “0”. The last value must be a ‘0’ at the latest, i. e. one less byte is available for the entry. All zero-terminated strings are read out in ASCII code.

NOTE!
All registers are specified as a hexadecimal value.

10.6.1 Continuous Distance Measurement

This data format should be used for processes which do not require an encoder.
All measured distance values are transmitted uninterruptedly.

Designation	Offset [bytes]	Length [bytes]	Type	Read-out/Comment
Data format	0	4	unsigned int	17520
Internal	4	24		
Order number (zero-terminated)	28	12	string	PNBC102*
Serial number (zero-terminated)	40	12	string	001000*
Software version (zero-terminated)	52	10	string	V2.11*
Operating time counter in ms	62	4	unsigned int	1467*
Measuring range lower limit in mm	66	2	unsigned short	25*
Measuring range in mm	68	2	unsigned short	10*
Laser power in 0.1 mW	70	2	unsigned short	1...10
Sampling rate in Hz	72	2	unsigned short	900...30,000
Temperature in the sensor in °C	74	1	unsigned char	35*
Evaluation method	75	1	unsigned char	2, 5
Laser power/sampling rate regulation	76	1	unsigned char	0...3
EncRightShift	77	1	unsigned char	0...8
Status (see section 10.6.4)	78	1	unsigned char	0...255
Internal	79	8		
I/Ox status, laser (see section 10.6.4)	87	1	unsigned char	0...255
Output rate in Hz	88	2	unsigned short	10...30,000
Average filter	90	2	unsigned short	0...1000
Offset	92	2	signed short	–30,000...+30,000
Number of distance values per packet	94	2	unsigned short	1...450
Distance 1 (see section 10.6.4) Distance 2 ⋮ Distance 450	96 98 ⋮ 994	2		0...65,535

*) Example values

10.6.2 Extended Continuous Measurement (Distance, Intensity, Encoder)

This data format should be selected when an encoder is used in the application.
In this case, intensity and the encoder value (encoder counter in the PNBC Sensor) are transmitted for each individual measurement in addition to distance values. This makes it possible to obtain an actual position value synchronous to the distance values.

Designation	Offset [bytes]	Length [bytes]	Type	Read-out/Comment
Data format	0	4	unsigned int	17536
Internal	4	24		
Order number (zero-terminated)	28	12	string	PNBC102*
Serial number (zero-terminated)	40	12	string	001000*
Software version (zero-terminated)	52	10	string	V2.11*
Operating time counter in ms	62	4	unsigned int	1467*
Measuring range lower limit in mm	66	2	unsigned short	25*
Measuring range in mm	68	2	unsigned short	10*
Laser power in 0.1 mW	70	2	unsigned short	1...10
Sampling rate in Hz	72	2	unsigned short	900...30,000
Temperature in the sensor in °C	74	1	unsigned char	35*
Evaluation method	75	1	unsigned char	2, 5
Laser power/sampling rate regulation	76	1	unsigned char	0...3
EncRightShift	77	1	unsigned char	0...8
Status (see section 10.6.2)	78	1	unsigned char	0...255
Internal	79	8		
I/Ox status, laser (see section 10.6.4)	87	1	unsigned char	0...255
Output rate in Hz	88	2	unsigned short	10...30,000
Average filter	90	2	unsigned short	0...1000
Offset	92	2	signed short	–30,000...+30,000
Number of distance, intensity and encoder values per packet	94	2	unsigned short	1...150
Distance 1 (see section 10.6.4) Intensity 1 (see section 10.6.4) Encoder 1 (see section 10.6.4) : : Distance 150 Intensity 150 Encoder 150	96 98 100 : : 990 992 994	6	unsigned short	 0...65,535 0...4,095 0...65,535

*) Example values

10.6.3 Peak Data

This data format is suitable for diagnosis purposes.
All 1024 pixel intensities of the sensor's CMOS line array are transmitted.
This data format is not retained after a restart. The sensor is automatically reset to the previously selected format.

Designation	Offset [bytes]	Länge [bytes]	Type	Read-out/Comment
Data format	0	4	unsigned int	17488
Internal	4	24		
Order number (zero-terminated)	28	12	string	PNBC102*
Serial number (zero-terminated)	40	12	string	001000*
Software version (zero-terminated)	52	10	string	V2.11*
Operating time counter in ms	62	4	unsigned int	1467*
Measuring range lower limit in mm	66	2	unsigned short	25*
Measuring range in mm	68	2	unsigned short	10*
Laser power in 0.1 mW	70	2	unsigned short	1...10
Sampling rate in Hz	72	2	unsigned short	900...30,000
Temperature in the sensor in °C	74	1	unsigned char	35*
Evaluation method	75	1	unsigned char	2, 5
Laser power/sampling rate regulation	76	1	unsigned char	0...3
EncRightShift	77	1	unsigned char	0...8
Status (see section 10.6.4)	78	1	unsigned char	0...255
Internal	79	8		
I/Ox status, laser (see section 10.6.4)	87	1	unsigned char	0...255
Distance in digits	88	2	unsigned short	0...65,535
Intensity in digits	90	2	unsigned short	0...4,095
Encoder value in digits	92	2	unsigned short	0...65,535
Number of intensity values per packet	94	2	unsigned short	1,024
Intensity pixel 1 Intensity pixel 2 : : Intensity pixel 1024	96 98 : : 2142	2	unsigned short	0...4,095

*) Example values

10.6.4 Description of the Measurement Data

Status:
The status is represented as a 7-bit value:

7	6	5	4	3	2	1	0

Bit 0: Out of range error: intensity or distance is outside of the valid working range
Bit 1: Internal peak memory overflow error
Bit 2: Sensor FIFO overflow: CPU processing is unable to keep up with the measurement data
Bit 3...7: = 0

I/Ox and Laser Status:
The statuses of the inputs/outputs and the laser are represented as 7-bit values

7	6	5	4	3	2	1	0

Bit 0: Status of I/O1
Bit 1: Status of I/O2
Bit 2: Status of I/O3
Bit 3: Status of I/O4
Bit 7: Laser status: 1 = On; 0 = Off

Distance as Bit:
Distance is represented as a 16-bit value:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit 0...15: Measured distance value (0...65,535)

The following formula is used to obtain the value displayed on the website:

Measured value in mm = (distance in bits × sensor measuring range in mm / 65,536) + lower working range limit in mm

Example (PNBC105): Measured value = 35,721 × 100 mm / 65,536 + 90 mm = 144.5 mm

Intensity Value:
The intensity value is represented as a 16-bit value:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit 0 to 11: Intensity value (=peak value; 0...4095)
Bit 12: Reserved (=0)
Bit 13: Reserved (=0)
Bit 14: Error bit: intensity too low or too high
Bit 15: Error bit: distance outside of working range

The following formula for converting the digital value into a percentage is used to obtain the signal strength displayed on the website:

Signal strength as percentage = intensity value/16

If the intensity value is higher than 1600 the signal strength is limited to 100 %.

Encoder Value:
The encoder value is represented as a 16-bit value:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit 0 to 15: Encoder value (0...65,535)
A converted value in mm cannot be provided here because conversion depends on the utilized encoder and how it is installed.

11. Interface Protocoll EtherCAT

The Ethernet interface can be switched from TCP/IP to EtherCAT via the website (see section 9.3). EtherCAT is an industry standard that is real-time capable and offers easy connection to all EtherCAT compatible devices.

ATTENTION:
In the activated EtherCAT mode, the sensor website cannot be called up and no commands can be executed via TCP/IP. If the sensor should be switched from EtherCAT to TCP/IP, this must be done via the EtherCAT interface.

Index 0x1000 - Device Type

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
0		UDINT	32	ro		

Index 0x1018 - Identity Object

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
0	Number of elements	USINT	8	ro		04
1	Vendor ID	UDINT	32	ro		0x0000059B
2	Product Code	UDINT	32	ro	PNBC101 PNBC102 PNBC103 PNBC104 PNBC105 PNBC106 PNBC107 PNBC108	0x053F2B65 0x053F2B66 0x053F2B67 0x053F2B68 0x053F2B69 0x053F2B6A 0x053F2B6B 0x053F2B6C
3	Revision Number	UDINT	32	ro		
4	Serial Number	UDINT	32	ro		

Index 0x10F8 - Timestamp Object

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
0		ULINT	64	ro		

Index 0x1a00 - 1. TxPDO

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
0	Number of elements	USINT	8	rw		03
1	PDO Object 1	UDINT	32	rw		0x30000110
2	PDO Object 2	UDINT	32	rw		0x30000210
3	PDO Object 3	UDINT	32	rw		0x30000310

Index 0x1c12 - Sync Manager 1PDO Assignment

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
0	Number of elements	USINT	8	rw		0
	Subindex 001	DT1C12ARR	16	rw		#x0

Index 0x1c13 - Sync Manager 2PDO Assignment

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
0	Number of elements	USINT	8	rw		0
	Subindex 001	DT1C13ARR	16	rw		0x1A00

Index 0x3000 - Inputs

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
0	Number of elements	USINT	8	ro		03
1	Distance	UINT	16	ro	Distance value as 16 bit value. Conversion in 'mm' takes place via MeasurementRange and MeasurementBegin	0000
2	Intensity	UINT	16	ro	Intensity value as 16 bit value.	0000
3	Encoder	UINT	16	ro	Encoder value as 16 bit value.	0000

Index 0x4000 - Control

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
0	Number of elements	USINT	8	ro		24
1	Measure Start	BOOL	1	rw	Starts/stops measurement	0
2	EthernetEnable	BOOL	1	rw	Choose between TCP/IP and EtherCAT mode. Setting the register to "true" puts the sensor instantaneously into TCP/IP mode.	0
3	Frequency	UDINT	32	rw	Adjustment/output of output rate in Hertz. At values >1000 the sensor limits the output rate in EtherCAT mode to 1000 Hz. Values: ▪ 10...1 000	
4	MeasureFrequency	UDINT	32	rw	▪ The measuring rate is fixed to 5 kHz in EtherCAT mode. The maximum exposure time is fixed to 200 µs.	

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
5	CalcMode	UDINT	32	rw	Determination of Peak evaluation method. Values: ▪ 2: COG ▪ 5: Edge	2
6	LaserActive	BOOL	1	rw	Switching the laser on/off. When the pin function of a USRIO ist set to the input function Laser on/off, then the pin level is dominant. This setting cannot be changed by the input command. Values: ▪ 0: Laser off ▪ 1: Laser on	1
7	LaserPower	UDINT	32	rw	Laser power is set in in 1/10 mW steps. The setting is only effective with manual laser power control. Values: ▪ 0: 0,1 mW ... ▪ 10: 1 mW	
8	Regulator	UDINT	32	rw	Adjustment/output of the exposure time and laser power regulation. In case of laser power regulation and exposure time regulation, the sensor automatically selects the setting which results in the best pixel intensity. For a constant laser power the exposure time regulation is more suitable. Values: ▪ 0: Automatic regulation of exposure time and laser power. ▪ 1: Automatic exposure time regulation, laser power manually adjustable.	0
9	MeasurementRange	UINT	16	ro	Read out the measuring range in mm.	
10	MeasurementBegin	UINT	16	ro	Read out the begin of measuring range in mm.	
11	Temperature	USINT	8	ro	Read out the sensor temperature.	

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
12	IP Address *	UDINT	32	rw	Used only in TCP/IP mode. The new IP address becomes active after restarting the sensor. Input in hex format.	#C0A800E1
13	Subnet Mask *	UDINT	32	rw	Used only in TCP/IP mode. The new subnet mask becomes active after restarting the sensor. Input in hex format.	#FFFFFF00
14	Gateway Address *	UDINT	32	rw	Used only in TCP/IP mode. The new gateway address becomes active after restarting the sensor. Input in hex format.	#A9FE9601

*** Formats of IP address, subnet mask and gateway address:**

Hex format:	0x	00	|	00	|	00	|	01	bis	0x	FF	|	FF	|	FF	|	FE
Decimal format:		0	.	0	.	0	.	1	bis		255	.	255	.	255	.	254		

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
15	Set Network Defaults	BOOL	1	rw	IP address, gateway and subnet mask are reset.	0
16	Average Filter	UINT	16	rw	The rolling average is between 2 and 1 000. 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. Values: ▪ 0: off ▪ 1: off ▪ 2...1 000	0
17	Protective Screen	BOOL	1	rw	Activates/deactivates the protective screen compensation. Values: ▪ 0: deactivated ▪ 1: activated	0

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
18	Offset	INT	16	rw	Input of zero point shift. The offset is input as 16 bit value. Conversion of offset from digital to mm: *Offset [digits] = Offset [mm] / MeasurementRange × 65536* Values: ▪ -30 000...30 000	0
19	Reset Encoder	BOOL	1	rw	Internal encoder counter is reset to 0.	0
20	Encoder Shift	USINT	8	rw	Scaling factor of the encoder input. Values: ▪ 0: Every encoder pulse is counted ▪ 1: Every 2nd encoder pulse is counted. ▪ 2: Every 4th encoder pulse is counted. ... ▪ 8: Every 256th encoder pulse is counted.	2
21	Set Defaults	BOOL	1	rw	Resets all settings to factory settings except network settings.	0
22	FPGA FW Version	STRING(16)	128	ro		
23	COM FW Version	STRING(16)	128	ro		
24	APP FW Version	STRING(16)	128	ro		

Index 0x5000 - USRIO Common

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
0	Number of elements	USINT	8	ro		02
1	Analog Mode	USINT	8	rw	Analog mode selection. Values: ▪ 1: 0...10 V ▪ 8: 4...20 mA	8
2	USRIO Status	USINT	8	ro	Query of the input status at pin 1-4. The pin state is coded in bit 0-3.	0

Index 0x5100 - USRIO1

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
0	Number of elements	USINT	8	ro		11
1	Pin Function	USINT	8	rw	Selects the Pin function. Values: 0: Switching output 1: External teach-in input for O1 2: External teach-in input for O2 3: External teach-in input for O3 4: External teach-in input for O4 5: Encoder input (I1+I2) 6: Encoder reset input 9: Laser on/off input 10: Error output	3
2	Output Mode	USINT	8	rw	Output mode selection. Values: ▪ 0: PNP ▪ 1: NPN ▪ 2: Push-Pull	0
3	Output Function	USINT	8	rw	Output function selection. Values: ▪ 0: Normally open (NO) ▪ 1: Normally closed (NC)	0
4	Teach-in	BOOL	1	rw	Future setting values are automatically calculated and saved from the currently recorded values. The pin function of the respective output must be set as a switching output.	0

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
5	Teach Mode	USINT	8	rw	Teach-in mode selection. Foreground teach-in: Teach-in is performed while the sensor is aligned to the object. The teach-in distance is set automatically, so that the sensor switches as soon as the distance between the sensor and the object is less than or equal to the previously taught in distance. 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 width. The sensor switches when the object is within the window. Values: 0: Foreground teach-in 1: Window teach-in	0
6	Switching Point	UINT	16	rw	The switching point is shifted to the entered distance. In the case of foreground teach-in, this is the teach-in distance (see section 10.5.7), while in the case of window teach-in, it is the distance to the middle of the window. The switching point is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange and MeasurementBegin: *Switching Point [digits] = (Switching Point [mm] - MeasurementBegin [mm]) / MeasurementRange [mm] × 65536* Values: 0...65535	32 768

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
7	Hysteresis	UINT	16	rw	Distance in mm between switch-on and switch-off point. The hysteresis is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange: *Hysteresis [digits] = Hysteresis [mm] / MeasurementRange [mm] × 65536* Values: ▪ 2...16383	2
8	Switch Reserve	UINT	16	rw	Distance in mm 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. The switch reserve is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange: *Switch Reserve [digits] = Switch Reserve [mm] / MeasurementRange [mm] × 65536* Values: ▪ 0...16383	0
9	Window	UINT	16	rw	Determination of window width in mm (see section 10.5.9). Window is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange: *Window [digits] = Window [mm] / MeasurementRange [mm] × 65536* Values: ▪ 0...65535	1 300
10	Input Load	USINT	8	rw	Determination of input load, Values: ▪ 0: Input load active (2 mA) ▪ 1: Input load inactive	0

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
11	Input Function	USINT	8	rw	Determintation of input function. Ub active: Pending tasks are executed if Ub = on. Ub inactive: Pending tasks are executed if Ub = 0 V) Values: ▪ 0: Ub active ▪ 1: Ub inactive	0

Index 0x5200 - USRIO2

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
0	Number of elements	USINT	8	ro		11
1	Pin Function	USINT	8	rw	Selects the Pin function. Values: 0: Switching output 1: External teach-in input for O1 2: External teach-in input for O2 3: External teach-in input for O3 4: External teach-in input for O4 5: Encoder input (I1+I2) 6: Encoder reset input 9: Laser on/off input 10: Error output	4
2	Output Mode	USINT	8	rw	Output mode selection. Values: ▪ 0: PNP ▪ 1: NPN ▪ 2: Push-Pull	0
3	Output Function	USINT	8	rw	Output function selection. Values: ▪ 0: Normally open (NO) ▪ 1: Normally closed (NC)	0
4	Teach-in	BOOL	1	rw	Future setting values are automatically calculated and saved from the currently recorded values. The pin function of the respective output must be set as a switching output.	0

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
5	Teach Mode	USINT	8	rw	Teach-in mode selection. Foreground teach-in: Teach-in is performed while the sensor is aligned to the object. The teach-in distance is set automatically, so that the sensor switches as soon as the distance between the sensor and the object is less than or equal to the previously taught in distance. 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 width. The sensor switches when the object is within the window. Values: 0: Foreground teach-in 1: Window teach-in	0
6	Switching Point	UINT	16	rw	The switching point is shifted to the entered distance. In the case of foreground teach-in, this is the teach-in distance (see section 10.5.7), while in the case of window teach-in, it is the distance to the middle of the window. The switching point is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange and MeasurementBegin: *Switching Point [digits] = (Switching Point [mm] - MeasurementBegin [mm]) / MeasurementRange [mm] × 65536* Values: 0...65535	32 768

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
7	Hysteresis	UINT	16	rw	Distance in mm between switch-on and switch-off point. The hysteresis is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange: *Hysteresis [digits] = Hysteresis [mm] / MeasurementRange [mm] × 65536* Values: ▪ 2...16383	2
8	Switch Reserve	UINT	16	rw	Distance in mm 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. The switch reserve is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange: *Switch Reserve [digits] = Switch Reserve [mm] / MeasurementRange [mm] × 65536* Values: ▪ 0...16383	0
9	Window	UINT	16	rw	Determination of window width in mm (see section 10.5.9). Window is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange: *Window [digits] = Window [mm] / MeasurementRange [mm] × 65536* Values: ▪ 0...65535	1 300
10	Input Load	USINT	8	rw	Determination of input load, Values: ▪ 0: Input load active (2 mA) ▪ 1: Input load inactive	0

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
11	Input Function	USINT	8	rw	Determintation of input function. Ub active: Pending tasks are executed if Ub = on. Ub inactive: Pending tasks are executed if Ub = 0 V) Values: ▪ 0: Ub active ▪ 1: Ub inactive	0

Index 0x5300 - USRIO3

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
0	Number of elements	USINT	8	ro		11
1	Pin Function	USINT	8	rw	Selects the Pin function. Values: 0: Switching output 1: External teach-in input for O1 2: External teach-in input for O2 3: External teach-in input for O3 4: External teach-in input for O4 5: Encoder input (I1+I2) 6: Encoder reset input 9: Laser on/off input 10: Error output	0
2	Output Mode	USINT	8	rw	Output mode selection. Values: ▪ 0: PNP ▪ 1: NPN ▪ 2: Push-Pull	0
3	Output Function	USINT	8	rw	Output function selection. Values: ▪ 0: Normally open (NO) ▪ 1: Normally closed (NC)	0
4	Teach-in	BOOL	1	rw	Future setting values are automatically calculated and saved from the currently recorded values. The pin function of the respective output must be set as a switching output.	0

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
5	Teach Mode	USINT	8	rw	Teach-in mode selection. Foreground teach-in: Teach-in is performed while the sensor is aligned to the object. The teach-in distance is set automatically, so that the sensor switches as soon as the distance between the sensor and the object is less than or equal to the previously taught in distance. 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 width. The sensor switches when the object is within the window. Values: 0: Foreground teach-in 1: Window teach-in	0
6	Switching Point	UINT	16	rw	The switching point is shifted to the entered distance. In the case of foreground teach-in, this is the teach-in distance (see section 10.5.7), while in the case of window teach-in, it is the distance to the middle of the window. The switching point is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange and MeasurementBegin: *Switching Point [digits] = (Switching Point [mm] - MeasurementBegin [mm]) / MeasurementRange [mm] × 65536* Values: 0...65535	32 768

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
7	Hysteresis	UINT	16	rw	Distance in mm between switch-on and switch-off point. The hysteresis is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange: *Hysteresis [digits] = Hysteresis [mm] / MeasurementRange [mm] × 65536* Values: ▪ 2...16383	2
8	Switch Reserve	UINT	16	rw	Distance in mm 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. The switch reserve is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange: *Switch Reserve [digits] = Switch Reserve [mm] / MeasurementRange [mm] × 65536* Values: ▪ 0...16383	0
9	Window	UINT	16	rw	Determination of window width in mm (see section 10.5.9). Window is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange: *Window [digits] = Window [mm] / MeasurementRange [mm] × 65536* Values: ▪ 0...65535	1 300
10	Input Load	USINT	8	rw	Determination of input load, Values: ▪ 0: Input load active (2 mA) ▪ 1: Input load inactive	0

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
11	Input Function	USINT	8	rw	Determintation of input function. Ub active: Pending tasks are executed if Ub = on. Ub inactive: Pending tasks are executed if Ub = 0 V) Values: ▪ 0: Ub active ▪ 1: Ub inactive	0

Index 0x5400 - USRIO4

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
0	Number of elements	USINT	8	ro		11
1	Pin Function	USINT	8	rw	Selects the Pin function. Values: 0: Switching output 1: External teach-in input for O1 2: External teach-in input for O2 3: External teach-in input for O3 4: External teach-in input for O4 5: Encoder input (I1+I2) 6: Encoder reset input 9: Laser on/off input 10: Error output	0
2	Output Mode	USINT	8	rw	Output mode selection. Values: ▪ 0: PNP ▪ 1: NPN ▪ 2: Push-Pull	0
3	Output Function	USINT	8	rw	Output function selection. Values: ▪ 0: Normally open (NO) ▪ 1: Normally closed (NC)	0
4	Teach-in	BOOL	1	rw	Future setting values are automatically calculated and saved from the currently recorded values. The pin function of the respective output must be set as a switching output.	0

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
5	Teach Mode	USINT	8	rw	Teach-in mode selection. Foreground teach-in: Teach-in is performed while the sensor is aligned to the object. The teach-in distance is set automatically, so that the sensor switches as soon as the distance between the sensor and the object is less than or equal to the previously taught in distance. 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 width. The sensor switches when the object is within the window. Values: 0: Foreground teach-in 1: Window teach-in	0
6	Switching Point	UINT	16	rw	The switching point is shifted to the entered distance. In the case of foreground teach-in, this is the teach-in distance (see section 10.5.7), while in the case of window teach-in, it is the distance to the middle of the window. The switching point is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange and MeasurementBegin: *Switching Point [digits] = (Switching Point [mm] - MeasurementBegin [mm]) / MeasurementRange [mm] × 65536* Values: 0...65535	32 768

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
7	Hysteresis	UINT	16	rw	Distance in mm between switch-on and switch-off point. The hysteresis is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange: *Hysteresis [digits] = Hysteresis [mm] / MeasurementRange [mm] × 65536* Values: ▪ 2...16383	2
8	Switch Reserve	UINT	16	rw	Distance in mm 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. The switch reserve is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange: *Switch Reserve [digits] = Switch Reserve [mm] / MeasurementRange [mm] × 65536* Values: ▪ 0...16383	0
9	Window	UINT	16	rw	Determination of window width in mm (see section 10.5.9). Window is specified as a 16 bit value. Conversion to mm takes place via MeasurementRange: *Window [digits] = Window [mm] / MeasurementRange [mm] × 65536* Values: ▪ 0...65535	1 300
10	Input Load	USINT	8	rw	Determination of input load, Values: ▪ 0: Input load active (2 mA) ▪ 1: Input load inactive	0

Sub index	Name of element	Data type	Bit size	Access	Description	Factory settings
11	Input Function	USINT	8	rw	Determintation of input function. Ub active: Pending tasks are executed if Ub = on. Ub inactive: Pending tasks are executed if Ub = 0 V) Values: ▪ 0: Ub active ▪ 1: Ub inactive	0

12. Maintenance Instructions

- This wenglor sensor is maintenance-free.
- It is 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 product.

13. 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.

14. EU Declaration of Conformity

The EU declaration of conformity can be found on our website at www.wenglor.com in the product's separate download area.