WP02
WP04

Druckmarkenleser
Print Mark Sensor

Bedienungsanleitung
Operating Instructions

SAP Nr. 80300
Stand: 2.7.2012

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1. Proper Use

This wenglor product has to be used according to the following functional principle:
Print Mark Sensors
These Sensors have been specially designed to recognize print marks. They have a very small spot, and use a white light LED with long service life. Only one Sensor is required for the recognition of all color combinations, as well as the difference in brightness between printed markings and the background.

2. Safety Precautions

- This operating instruction is part of the product and must be kept during its entire service life.
- Read this operating instruction carefully before using the product.
- Installation, start-up and maintenance of this product has only to be carried out by trained personal.
- Tampering with or modifying the product is not permissible.
- Protect the product against contamination during start-up.
- These products are not suited for safety applications.

3. EC Declaration of Conformity

The products are developed, constructed and manufactured according to the directive 2004/108/EC.
The following international standards and specifications apply:

EN 60947-5-2:2007	Low-voltage switchgear and controlgear Part 5-2: Control circuit devices and switching elements – Proximity switches

Any additional standards which are applicable for the given application must be observed.

ME 61

LISTED
IND. CONT. EQ.
72HL
For use in class 2 circuits
Environmental Type 1

RoHS

4. Technical Data

Optical Data	WP02	WP04
Working Range	12…16 mm	30…40 mm
Working Distance	14 mm	35 mm
Resolution	100 Gray Scale	100 Gray Scale
Switching Hysteresis	< 1 %	< 1 %
Light Source	White Light	White Light
Wave Length	400…700 nm	400…700 nm
Service Life (Tu = 25 °C)	100000 h	100000 h
max. Ambient Light	10000 Lux	10000 Lux
Light Spot Size a (a × b)	0,7 mm	1,4 mm
Light Spot Size b (a × b)	2 mm	4 mm

Electrical Data		
Supply Voltage	10…30 V DC	10…30 V
Current Consumption (Ub=24 V)	<50 mA	< 50 mA
Switching Frequency	25 kHz	25 kHz
Response Time	20 µs	20 µs
On-/Off-Delay	0…100 ms	0…100 ms
Temperature Drift	< 1 %	< 1 %
Temperature Range	–25…60 °C	–25…60 °C
Switching Outputs	2	2
Switching Output Voltage Drop	1,5 V	1,5 V
Short Circuit Protection	yes	yes
Reverse Polarity Protection	yes	yes
Lockable	yes	yes
Teach Mode	ZT, DT, TP	ZT, DT, TP
Interface	RS-232	RS-232
Baud Rate	38400 Bd	38400 Bd
Digital Inputs	2	2

Mechanical Data		
Adjustment	Teach-In	Teach-In
Housing	Plastic	Plastic
Protection Mode	IP67	IP67
Connection	M12 × 1	M12 × 1
Protection Class	III	III

Connection Diagram

WP02PAT80
WP04PAT80

WP02NAT80
WP04NAT80

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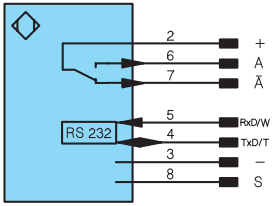

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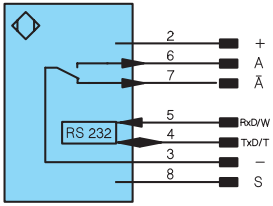

+	Supply Voltage +
A	Switching Output (NO)
A	Switching Output (NC)
RxD/W	RS-232 receive path/Trigger Input
TxD/T	RS-232 send path/Trigger Input
S	Shielding
–	Supply Voltage 0 V

Housing Dimensions

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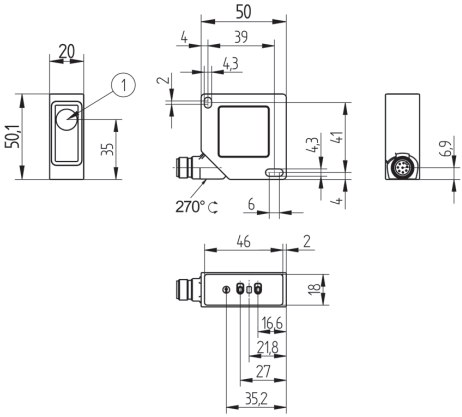
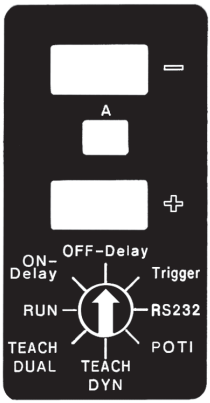


1 = optical axle

Control Panel

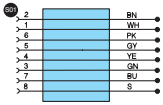


❶ –	= Minus key (with LED)
❷ A	= Output switching status display
❸ +	= Plus key (with LED)
❹ ON-Delay	= On-delay
❺ OFF-Delay	= Off-delay
❻ Trigger	= Trigger mode operation
❼ RS232	= Interface operation
❽ TEACH DUAL	= Two-point Teach-In
❾ TEACH DYN	= Dynamic Teach-In
❿ POTI	= Potentiometer function
⓫ RUN	= Run function
⓬	= Rotary selector switch

Complementary Products (see catalog)

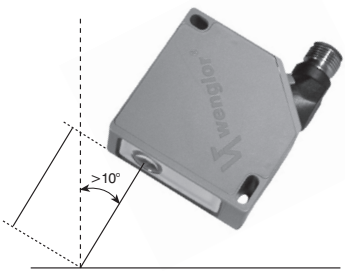
wenglor offers Connection Technology providing field wiring means.

Suiting Mounting Technolog No.	380
Suiting Connection Technology No.	80
Interface Cable S232W3	
Protection Housing Set ZSP-NN-02	
Protection Housing ZSV-0x-01	



5. Installation Instructions

Applicable electrical and mechanical regulations, standards and safety precautions must be adhered to during Sensor operation. The Sensor must be protected against mechanical influences. The Sensor must be securely mounted during operation.



6. Initial Start-Up

Connect the Sensor to supply power (10 to 30 V DC).

7. Functional Overview

7.1. Setting the Switching Threshold with the Teach-In Function

With the help of the integrated Teach-In technology, the Sensor automatically calculates setting values based upon currently acquired values and saves them to memory after the corresponding key has been activated, or a control signal has been received.

Two-Point Teach-In

Two grey-scale values are taught in to the Sensor: the grey-scale value of the marking to be recognized and the grey-scale value of the background. The Sensor then automatically calculates the ideal switching threshold based upon these two values.
The brightness relationship of the two grey-scale values is irrelevant as far as switching characteristics are concerned. Sensor output A is activated when the Sensor recognizes the grey-scale value which was taught in first. Sensor output A is deactivated when the Sensor recognizes the grey-scale value which was taught in second.

Teach in the first grey-scale value:

- Set the rotary selector switch ❶ to TEACH DUAL ❽
- Align the Sensor spot to the marking
- Press and hold the plus key ❸
  ➔ The LED at the plus key lights up
  ➔ The LED at the plus key goes out after 1 s, and the output switching status display ❷ blinks.
- Release the plus key❸
  ➔ The LED at the minus key blinks
  ➔ The grey-scale value of the marking is saved to temporary memory

Teach in the second grey-scale value:

- Align the Sensor spot to the background
- Briefly press the minus key ❶ and then release
  ➔ The switching threshold is calculated and saved to memory
  ➔ The LED at the minus key goes out
- Check for correct function

If the difference between the two acquired grey-scale values is too small, the output switching status display ❷ blinks rapidly for approximately 3 seconds, and switching thresholds are not updated.

Dynamic Teach-In

All grey-scale values from the background and the marking are continuously recorded with this function. The ideal switching threshold is calculated based upon these values.

This function is intended for applications where the objects to be scanned move continuously at a constant speed, and cannot be brought to a standstill within the production process.

Example 1

Recognition of adhesive strips on unprinted packaging material, which is fed in a continuous fashion: when Teach-In operation is initialized, the spot must be aligned to the background.

Example 2

Recognition of printed markings on rapidly rotating parts: dynamic Teach-In operation can be initialized regardless of spot alignment.

Initialize recording mode operation:

- Set the rotary selector switch ❶ to TEACH DYN ❾
- Press and hold the plus key ❸
  ➔ The LED at the plus key lights up
  ➔ The LED at the plus key goes out after 1 s, and the output switching status display ❷ blinks.
- Release the plus key
  ➔ The LED at the minus key blinks: recording mode operation is active
  ➔ Grey-scale values are continuously recorded

Exit recording mode operation:

- Briefly press the minus key ❶ and then release
  ➔ Recording is stopped
  ➔ The switching threshold is calculated and saved to memory
- Check for correct function

If the difference between the two acquired grey-scale values is too small, the output switching status display ❷ blinks rapidly for approximately 3 seconds, and switching thresholds are not updated.

Extern Teach-In

If the control panel is inaccessible, the Sensor can be configured with the external Teach-In input (pin 4). The last Teach-In mode selected at the control panel is always active (i.e. two-point or dynamic Teach-In).

Notice for Type FP, WP

Use of the external Teach-Input (Pin 4):

If you use the external Teach-Input (Pin 4) you have to connect a 1 kOhm/1 W-resistor between Pin 4 (external Teach-Input) and Pin 3 (GND).

Do not connect this resistor if you use the serial interface of the Sensor!

External Two-Point Teach-In

Teach in the first grey-scale value:

- Set the rotary selector switch ❶ to RUN ❿
- Apply a voltage of 10 to 30 V to external Teach-In input T (pin 4) for at least 0,3 s
- Disconnect voltage from external Teach-In input T (pin 4)
  ➔ The LED at the minus key blinks
  ➔ The grey-scale value of the marking is saved to temporary memory.

Teach in the second grey-scale value:
- Align the Sensor spot to the background.
- Apply a voltage of 10 to 30 V to external Teach-In input T (pin 4) for at least 0,3 s.
- Disconnect voltage from external Teach-In input T (pin 4).
  ➔ The switching threshold is calculated and saved to memory.
  ➔ The LED at the minus key goes out.
- Check for correct function.

If the difference between the two acquired grey-scale values is too small, the output switching status display ❷ blinks rapidly for approximately 3 seconds, and switching thresholds are not updated.

External Dynamic Teach-In

Objects to be scanned move at a constant speed.
If no continuous alternating back and forth between the marking and the background occurs during recording, the spot must be aligned to the background when the Teach-In mode is first initialized.

Initialise recording mode operation:
- Set the rotary selector switch ⓪ to RUN ⓫
- Apply a voltage of 10 to 30 V to external Teach-In input T (pin 4) for at least 0,3 s
- Disconnect voltage from external Teach-In input T (pin 4)
  ➔ The LED at the minus key blinks: recording mode operation is active
  ➔ Grey-scale values are continuously recorded

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Exit recording mode operation:
- Apply a voltage of 10 to 30 V to external Teach-In input T (pin 4) for at least 0,3 s
- Disconnect voltage from external Teach-In input T (pin 4)
  ➔ Recording is stopped
  ➔ The switching threshold is calculated and saved to memory
- Check for correct function

If the difference between the two acquired grey-scale values is too small, the output switching status display ❷ blinks rapidly for approximately 3 seconds, and switching thresholds are not updated.

7.2. Checking for Correct Function

- Move the object to be scanned.
  ➔ Sensor output A is activated when the spot is aligned to the marking.
  ➔ Sensor output A is deactivated when the spot is aligned to the background.
- Readjust the switching threshold with the potentiometer function if the Sensor does not respond correctly.

7.3. Readjusting the Switching Threshold with the Potentiometer Function

The switching threshold can be manually readjusted with the help of a key potentiometer. The LEDs at the plus and minus keys function as a light scale, and indicate the grey-scale range within which the configured switching threshold lies. For example, if the LED at the minus key is brighter than the LED at the plus key, the switching threshold is set to a darker grey-scale value. If the LED at the plus key is brighter than the LED at the minus key, the switching threshold is set to a brighter grey-scale value.

If the LED at the plus key blinks, the switching threshold is set within the brightest grey-scale range.
If the LED at the minus key blinks, the switching threshold is set within the darkest grey-scale range.

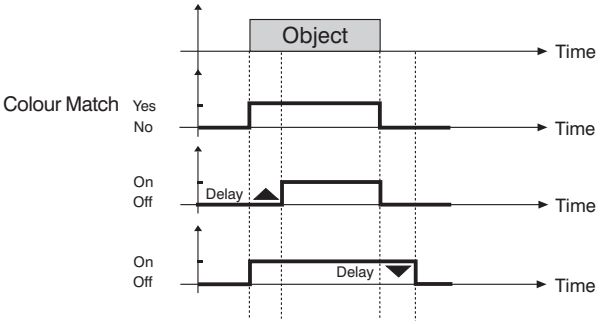
Approximating the Switching Threshold to the marking

- Set the rotary selector switch ⓪ to POTI ⑩
- Briefly press the plus key ❸ and then release
  ➔ The switching threshold is approximated to the marking by one step, or
  ➔ Press and hold the plus key ❸
  ➔ The switching threshold is continuously approximated to the marking
- Check for correct function

7.4. Approximating the Switching Threshold to the background

- Set the rotary selector switch ⓪ to POTI ⑩
- Briefly press the minus key ❶ and then release
  ➔ The switching threshold is approximated to the background by one step, or
  ➔ Press and hold the minus key ❶
  ➔ The switching threshold is continuously approximated to the background
- Check for correct function

7.5. Delay Times: On and Off-Delay



Adjusting On-Delay

- Set the rotary selector switch ⓪ to On-Delay ❹
  ➔ Current on-delay is displayed (see table 1).
- Briefly press the plus key ❸
  ➔ On-delay is increased.
- Briefly press the minus key ❶
  ➔ On-delay is decreased.
- Set the rotary selector switch ⓪ to RUN ⓫

Adjusting Off-Delay

- Set the rotary selector switch ⓪ to Off-Delay ❺
  ➔ Current off-delay is displayed (see table 1).
- Briefly press the plus key ❸
  ➔Off-delay is increased.
- Briefly press the minus key ❶
  ➔ Off-delay is decreased.
- Set the rotary selector switch ⓪ to RUN ⓫

Delay Time Setting Displays

Delay	LED at Minus Key ❶	LED at Plus Key ❸
0 ms*	1 × blink, pause, 1 × blink	off
1 ms	2 × blinks, pause, 2 × blinks	off
2 ms	3 × blinks, pause, 3 × blinks	off
5 ms	4 × blinks, pause, 4 ×blinks	off
10 ms	off	1 × blink, pause, 1 × blink
20 ms	off	2 × blinks, pause, 2 × blinks
50 ms	off	3 × blinks, pause, 3 × blinks
100 ms	off	4 × blinks, pause, 4 × blinks

*Default setting

7.6. Trigger Function at Pin 5

- Set the rotary selector switch ⓪ to Trigger ❻
- Apply the trigger signal (PNP) to input W (pin 5)
  ➔ Triggering is executed with a positive signal edge
  ➔ The Sensor performs a one-time measurement
  ➔ The outputs are updated once only
- Disconnect the signal from the trigger input

7.7. Returning All Sensor Settings to their Default Values

Sensor settings can be returned to their original factory default values.

- Set the rotary selector switch ⓪ to RS232 ❼
- Simultaneously press the plus ❸ and minus ❶ keys.
  ➔ The LEDs at both keys start blinking.
  ➔ The LEDs stop blinking after approximately 5 seconds
- Release both keys
- The Sensor has been returned to its factory default settings

7.8. Continuous Read-Out of Grey-Scale Values via the Interface

The Sensor can be configured such that it continuously reads out current grey-scale values via the interface every 15 ms.

Determine whether or not continuous read-out of grey-scale values is activated
- Set the rotary selector switch ⓪ to RS232 ❼

Switching Status Display	Continuous Read-Out of Grey-Scale Values
does not blink	deactivated
blinks	activated

Activate continuous read-out of grey-scale values
- Set the rotary selector switch ⓪ to RS232 ❼
- Press and hold the plus key ❸
- The LED at the plus key lights up
  ➔ The LED at the plus key goes out after 1 s and the switching status display blinks
- Release the plus key ❸
- The switching status display continues to blink
- Continuous read-out of grey-scale values is now activated

Deactivate continuous read-out of grey-scale values
- Set the rotary selector switch ⓪ to RS232 ❼
- Press and hold the minus key ❶
- The LED at the minus key lights up
  ➔ The LED at the minus key goes out after 1 s and the switching status display blinks
- Release the minus key ❶
- The switching status display goes out
- Continuous read-out of grey-scale values is now deactivated

8. Interface

The Sensor is equipped with an RS 232 interface for communication with a device such as a PC or a controller. The interface utilizes a software handshake procedure (see protocol specification below).
All Sensor settings can be selected digitally with a PC, and all values generated by the Sensor can be read out at a PC.

Interface Configuration

Baud Rate: 38,400 baud, 8 data bits, no parity, 1 stop bit

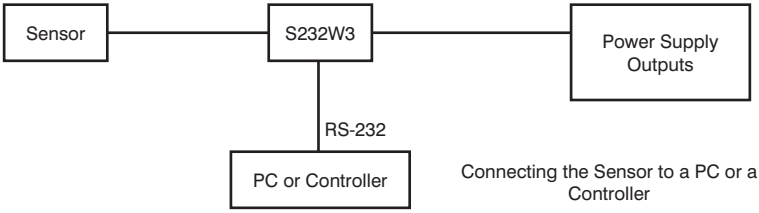
Connecting the Sensor to a PC, a Controller etc. with the wenglor S232W3 Plug Adapter

Plug connectors included with the wenglor S232W3 plug adapter:

- 8-pin M12 plug connector for connecting the power supply and the outputs
- 8-pin M12 socket connector for direct Sensor connection
- 9-pin M12 subminiature socket connector for connecting the Sensor directly to the RS 232 interface at the PC or the utilized controller

Installing the wenglor S232W3 plug adapter:

- Switch off the power supply
- Set the rotary selector switch ❶ to RS232 ❼
- Disconnect the 8-conductor connector cable (S80-xx) from the Sensor
- Connect the S232W3 plug adapter directly to the Sensor
- Connect the 8-conductor connector cable (S80-xx) to the plug adapter
- Connect the 9-pin subminiature socket connector at the PC to the serial interface
- Switch the power supply on



Connecting the Sensor to a PC or a Controller

Protocol for Communications via the RS 232 Interface

Control Characters

Character	ASCII	HEX	Significance
/	47	2Fh	Start bit
.	46	2Eh	Stop bit
NAK	21	15h	Negative Acknowledge
BCC	2 Byte	qq	Checksum

Frame Layout for Data Transmission

Transmitting Partner	Character (ASCII)		Receiving Partner	Frame Segment
Start bit	/(ASCII 47)	=>	Connect	Frame header
Length information	2 Byte	=>	„	
Command bytes	2 Byte	=>		
1st data bytes	2 Byte	=>	Data information	User data
2nd data bytes	2 Byte	=>		
..	..	=>	„	
nth data bytes	..	=>	„	
BCC	2 Byte	=>		Frame end
Stop bit	.(ASCII 46)	=>	Disconnect	

Connect (frame header):
In order to establish a connection with the communications partner, the Sensor transmits the start bit: “/” (ASCII 47), followed by length information and a command byte for the data bytes.

Transmitting Data (user data):
After establishing a connection, user data are transmitted.

Disconnect (frame end):
If the NAK character is transmitted during data transfer, the wenglor Sensor disconnects and establishes a new connection. After all data information has been transmitted, the wenglor Sensor transmits the checksum BCC and finally the stop bit: “.” (ASCII 46).

Data Format:
The data format for length information, user data and the checksum is always hexadecimal. The following range of ASCII characters may occur:

,0’ (ASCII 48) - ,9’ (ASCII 57)
,A’ (ASCII 65) - ,F’ (ASCII 70)

Example:
Data to be transmitted: decimal 123

Decimal		**Hexadecimal**		
123d	=	7Bh		
=> transmitted character string			„7“ (ASCII 55)	„B“ (ASCII 66)

At the command “Deactivate continuous read-out” a break of > 5 ms has to follow each sign.

Calculating the Checksum BCC
The checksum is generated from an EXOR link to the frame.
Calculation begins with the start bit and ends with the last character of the user data.

Example:
Transmitted Frame

Start bit	Lenght	Command	Data	BCC	Stop bit
/	02	0D	00	59	.
2FH	30H 32H	30H 44H	30H 30H	35H 39H	2EH
Data range utilized for calculation of the checksum					

/	2FH	=	0010	1111	
0	30H	=	0011	0000	
	XOR	=	0001	1111	
2	32H	=	0011	0010	
	XOR	=	0010	1101	
0	30H	=	0011	0000	
	XOR	=	0001	1101	
D	44H	=	0100	0100	
	XOR	=	0101	1001	
0	30H	=	0010	0000	
	XOR	=	0111	1001	
0	30H	=	0010	0000	
BCC	XOR	=	0101	1001	=> BCC = 59H

Setting Sensor Functions with Commands

Commands Overview:

Function	Command
Teach-In	T
Adjust on and off-delay	A
Read out grey-scale value	D
Query sensor status	W
Execute sensor reset	R
Query sensor version	V

Teach-In:

Function	Send Frame to the Sensor	Response Frame from the Sensor
Two-point object	/ 02 0T 00 49 .	/ 03 06 T 007E.
Two-point background	/ 02 0T 01 48 .	Signal difference OK: After approx. 1 sec: / 03 0M T 01 04. / 03 06 T 01 7F. Signal difference to small: / 03 06 T 11 7E.
Dynamic start	/ 02 0T 02 4AB.	/ 03 06 T 02 7C.
Dynamic stop	/ 02 0T 03 4A.	/ 03 0M T 03 06.
Potentiometer function threshold –1	/ 02 0T 04 4D.	/ 03 0M T a4 01.
Potentiometer funciton threshold +1	/ 02 0T 05 4C.	/ 03 0M T a5 00.
Potentiometer function threshold –16	/ 02 0T 06 4F.	/ 03 0M T a6 03.
Potentiometer function threshold +16	/ 02 0T 07 4E.	/ 03 0M T a7 02.

a: potentiometer limit stop = 1, otherwise 0
qq: checksum

Adjust On and Off-Delay:

Function	Send Frame to the Sensor	Response Frame from the Sensor
Adjust on-delay	/ 04 0A 01 bb qq.	/ 03 0M A 01 11 .
Adjust off-delay	/ 04 0A 00 bb qq.	/ 03 0M A 00 10 .

bb: delay value from 0 to 7
qq: checksum

Read Out Grey-Scale Values:

Function	Send Frame to the Sensor	Response Frame from the Sensor
Query single value	/ 02 0D 00 59 .	/ 0E 0D gggg oooo uuuu aa qq
Activate continuous read-out	/ 04 0A 00 bb qq.	/ 03 0M D 01 14 . / 04 0K gggg qq . *
Deactivate continuous read-out	/ 02 0D 02 5B .	/ 03 0M D 02 17 .

gggg:	Grey-scale value	Length:	4 Byte
oooo:	Upper threshold	Length:	4 Byte
uuuu:	Lower threshold	Length:	4 Byte
aa:	Status of switching outputs	Bit 0 : Output A, Bit 1 : Output A	
*:	Every 15 ms continuously		
qq:	Checksum		

Query Sensor Status:

Function	Send Frame to the Sensor	Response Frame from the Sensor
Query status	/ 00 0W 48 .	/ 0A 0W 00 00 00 dd ee qq .

dd: off-delay value
ee: on-delay value
qq: checksum

Execute Sensor Reset:

Function	Send Frame to the Sensor	Response Frame from the Sensor
Execute reset	/ 00 0R 4D .	/ 07 0V 8a : bb cc qq . / 05 0R OK 0007C . /03 0M R 4D 73 .

a: Software version
bb: Sensor group (printed marking scanner: 08)
cc: Sensor type (WP02: 01, WP04: 02)
qq: Checksum

Query Sensor Version:

Function	Send Frame to the Sensor	Response Frame from the Sensor
Query Sensor Version:	/ 00 0V 49 .	/ 07 0V 8a : bb cc qq .

a: Software version
bb: Sensor group (printed marking scanner: 08)
cc: Sensor type (WP02: 01, WP04: 02)
qq: Checksum

Transfer error message:
On receipt of incorrect data, e.g. wrong checksum or unknown command, the Sensor sends back an error message.

Function	Send Frame to the Sensor	Response Frame from the Sensor
Error message	incorrect data	/ 03 0X a bb qq.

a: Last valid command
bb: Last valid addition
qq: Checksum

9. 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 device.

10. 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.