OPERATING INSTRUCTIONS

CSS/CSX High Speed

Color Sensor

SICK
Sensor Intelligence.

Described product

CSS / CSX High Speed

Manufacturer

SICK AG
Erwin-Sick-Str. 1
79183 Waldkirch
Germany

Legal information

Original document

This document is an original document of SICK AG.

Contents

1 About this document

1.1 Information on the operating instructions

Read these operating instructions carefully before starting any work in order to familiarize yourself with the product and its functions.

The operating instructions are an integral part of the product and should remain accessible to the personnel at all times. When handing this product over to a third party, include these operating instructions.

These operating instructions do not provide information on the handling and safe operation of the machine or system in which the product is integrated. Information on this can be found in the operating instructions for the machine or system.

1.2 Scope

These operating instructions serve to incorporate the device into a customer system. Step-by-step instructions are given for all required actions.

These instructions apply to all listed device variants of the product.

Available device variants are listed on the online product page.

www.sick.com/CSS_CSX_High_Speed

Commissioning is described using one particular device variant as an example.

Simplified device designation in the document

In the following, the sensor is referred to simply as “CSS/CSX” or “device”.

1.3 Further information

You can find the product page with further information via the SICK Product ID: pid.sick.com/{P/N}/{S/N}.

The following information is available depending on the product:

- This document in all available language versions
- Data sheets
- Other publications
- CAD files and dimensional drawings
- Certificates (e.g., declaration of conformity)
- Software
- Accessories

1.4 Explanation of symbols

Warnings and important information in this document are labeled with symbols. The warnings are introduced by signal words that indicate the extent of the danger. These warnings must be observed at all times and care must be taken to avoid accidents, personal injury, and material damage.

DANGER
... indicates a situation of imminent danger, which will lead to a fatality or serious injuries if not prevented.

WARNING
... indicates a potentially dangerous situation, which may lead to a fatality or serious injuries if not prevented.

CAUTION
... indicates a potentially dangerous situation, which may lead to minor/slight injuries if not prevented.

NOTICE
... indicates a potentially harmful situation, which may lead to material damage if not prevented.

NOTE
... highlights useful tips and recommendations as well as information for efficient and trouble-free operation.

2 Safety information

2.1 Basic safety notes

Please observe the safety notes and the warnings listed here and in other sections of this product documentation to reduce the possibility of risks to health and avoid dangerous situations.

CAUTION
Failure to observe the relevant work safety regulations may lead to physical injury or cause damage to the system.

LED notes

NOTICE EYE SAFETY
The product is equipped with an LED illumination unit. The sensor meets the criteria of risk group 1 according to IEC 62471:2006. No special measures are required (e.g., eye protection).

Repairs and modifications

DANGER
Improper work on the product

A modified product may not offer the expected protection if it is integrated incorrectly.

► Apart from the procedures described in this document, do not repair, open, manipulate or otherwise modify the product.

2.2 Intended use

The CSS/CSX High Speed color sensor is an opto-electronic sensor for the optical, non-contact detection of colored objects.

A CSS/CSX is designed for mounting and may only be operated according to its intended function. For this reason, a CSS/CSX is not equipped with direct safety devices.

The system designer must provide measures to ensure the safety of persons and systems in accordance with the legal guidelines.

SICK AG assumes no liability for losses or damage arising from the use of the product, either directly or indirectly. This applies in particular to use of the product that does not conform to its intended purpose and is not described in this documentation.

2.3 Improper use

- The device does not constitute a safety-relevant device according to the EC Machinery Directive (2006/42/EC).
- The device must not be used in explosion-hazardous areas.
- Any other use that is not described as intended use is prohibited.
- Any use of accessories not specifically approved by SICK AG is at your own risk.

The device is not suitable for the following applications (this list is not exhaustive):

- As a safety device to protect persons, their hands, or other body parts
- Underwater
- In explosion-hazardous areas
- Outdoors, without additional protection

NOTICE
Danger due to improper use!

Any improper use can result in dangerous situations.

Therefore, observe the following information:

- ► The device should be used only in line with intended use specifications.
- ► All information in these operating instructions must be strictly complied with.

2.4 Limitation of liability

Applicable standards and regulations, the latest state of technological development, and our many years of knowledge and experience have all been taken into account when assembling the data and information contained in these operating instructions. The manufacturer accepts no liability for damage caused by:

- Failure to observe the operating instructions
- Improper use
- Use by untrained personnel
- Unauthorized conversions
- Technical modifications
- Use of unauthorized spare parts, wear and tear parts, and accessories

With special variants, where optional extras have been ordered, or owing to the latest technical changes, the actual scope of delivery may vary from the features and illustrations shown here.

2.5 Requirements for skilled persons and operating personnel

WARNING
Risk of injury due to insufficient training!

Improper handling of the device may result in considerable personal injury and material damage.

- All work must only ever be carried out by the stipulated persons.

The operating instructions state the following qualification requirements for the various areas of work:

- **Instructed personnel** have been briefed by the operating entity about the tasks assigned to them and about potential dangers arising from improper action.
- **Skilled personnel** have the specialist training, skills, and experience, as well as knowledge of the relevant regulations, to be able to perform tasks assigned to them and to detect and avoid any potential dangers independently.
- **Electricians** have the specialist training, skills, and experience, as well as knowledge of the relevant standards and provisions to be able to carry out work on electrical systems and to detect and avoid any potential dangers independently. In Germany, electricians must meet the specifications of the DGUV V3 Work Safety Regulations (e.g., Master Electrician). Other relevant regulations applicable in other countries must be observed.

The following qualifications are required for various activities:

Activities	Qualification
Mounting, maintenance	■ Basic practical technical training ■ Knowledge of the current safety regulations in the workplace

Activities	Qualification
Electrical installation, device replacement	■ Practical electrical training ■ Knowledge of current electrical safety regulations ■ Knowledge of the operation and control of the devices in their particular application
Commissioning, configuration	■ Basic knowledge of the design and setup of the described connections and interfaces ■ Basic knowledge of data transmission ■ Knowledge of the operation and control of the devices in their particular application
Operation of the devices in their particular application	■ Knowledge of the operation and control of the devices in their particular application ■ Knowledge of the software and hardware environment in the application

3 Product description

3.1 Product ID

3.1.1 Product identification via the SICK product ID

SICK product ID

The SICK product ID uniquely identifies the product. It also serves as the address of the web page with information on the product.

The SICK product ID comprises the host name pid.sick.com, the part number (P/N), and the serial number (S/N), each separated by a forward slash.

The SICK product ID is displayed as text and QR code on the type label and/or on the packaging.

Figure 1: SICK product ID

3.1.2 Type label

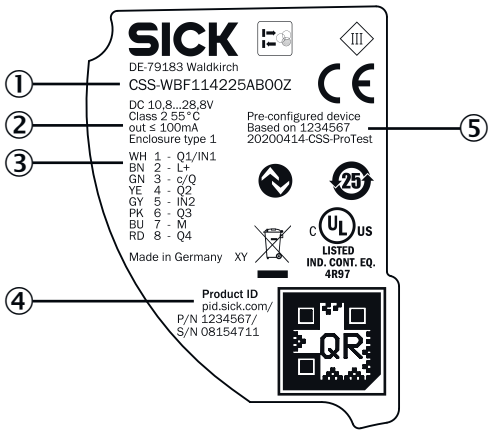


Figure 2: Type label is an example

① Device name
② Electrical data and environmental data
③ Pin assignment
④ PID with QR code
⑤ Specification for pre-configured devices

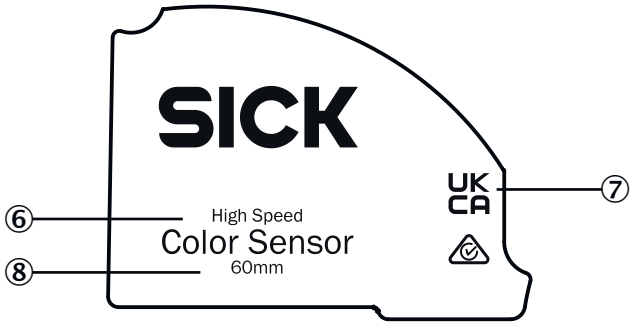


Figure 3: Type label is an example

⑥ Device name
⑦ Approvals
⑧ Sensing distance

3.1.3 Type code

Table 1: Type code

1	2	-	3	4	5	6	7	8	9	10	11	12	13	14
CS	S	-	W	B	F	A	1	4	2	2	5	A	A	10

Position	Meaning	
1	Basic type	CS = Color sensor
2	Form factor	S = Small X = Large
3	Light sender	W = RGB
4	Digital output	B = Push-pull N = NPN
5	Function	F = High Speed
6	Light spot direction	1 = Longitudinal A = Round, large
7	Sensing distance	1 = Sensing distance 13 mm 5 = Sensing distance 60 mm
8	Filtering	4 = No filter
9	Light emission	1 = Long side 2 = Short side
10	Operation	2 = Short side
11	Connection type	5 = M12; male connector, 5-pin 8 = M12; male connector, 8-pin
12	Communication	A = IO-Link R = RS485 2 = No communication
13	Device type	A = Smart Task C = Preconfigured Z = Standard
14	Serial no. ATF/Special	10 = AFC10 (logic functions) ZZ = Standard

3.2 Product features and functions

3.2.1 Device view

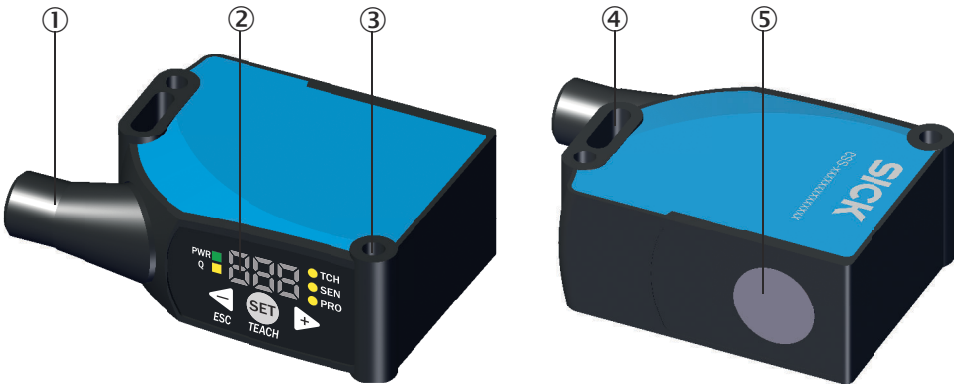


Figure 4: CSS High Speed, light emission on long side

① Connection
② Display and control panel
③ Fixing hole
④ Fixing hole
⑤ Light emission

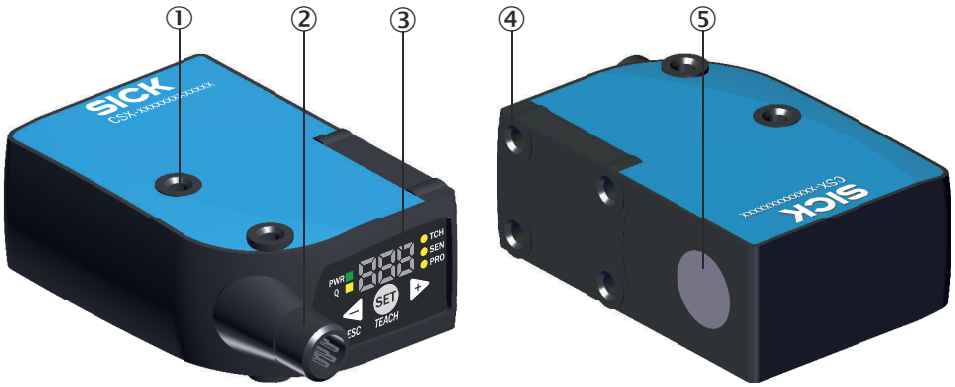


Figure 5: CSX High Speed, light emission on long side

① M5 threaded mounting hole
② Connection
③ Display and control panel
④ M5 threaded mounting hole
⑤ Light emission

3.2.2 Product characteristics

Color sensors are used to detect, separate or verify objects based on their color.

3.3 IO-Link communication interface

The xxxxxxxxxA variants have an IO-Link communication interface.

IO-Link communication is a **master-device** communication system.

The product can be operated in standard I/O mode (SIO) or IO-Link mode (IOL). All automation functions and other parameter settings are effective in IO-Link mode and in standard I/O mode.

The following functions are supported via the standard IO-Link communication interface:

- Flexible sensor settings
- Digital transmission of sensor signals to the **IO-Link Master**
- Visualization and configuration of the sensor
- Diagnostics /**condition monitoring**
- Device identification
- Easy device replacement
- **Events**

A detailed description of the configurable functions and associated indices can be found in the “IO-Link description” technical Information: **Technical Information: CSS/CSX**.

3.3.1 Documentation and accessories

Accessory components and additional information are available for integrating and setting the IO-Link device. You can find documentation and software, accessories and links using the **SICK Product ID**.

NOTE
A description of SOPAS ET is stored in the system folder with the download:
C:\Program Files (x86)\SOPAS ET\help

Documentation and software

- IODD: Device description file
- IODD overview: List of IODD contents
- IO-Link description: Detailed description of the process data and service data of the IO-Link device
  Technical Information: CSS/CSX
- SDD: Graphical user interface
- **Function Block Factory**
- SOPAS ET: Configuration software

Accessories

- **IO-Link master**
- Connecting cables

4 Mounting

4.1 Scope of delivery

- Color sensor in the type ordered
- Quickstart
- Safety notes

4.2 Mounting requirements

- For the typical space requirements for the device, see the type-specific dimensional drawing, see "Dimensional drawing", page 66.
- Comply with technical data, such as the permitted ambient conditions for operation of the device (e.g., temperature range, EMC interference emissions, ground potential) see "Technical data", page 65
- To prevent condensation, avoid exposing the device to rapid changes in temperature.
- Protect the device from direct sunlight, spotlights, or flashlights.
- The device must only be mounted using the pairs of (CSS), or threaded mounting holes (CSX) provided for this purpose.
- Shock and vibration resistant mounting.

4.3 Mounting the device

The CSS/CSX High Speed is equipped with an elongated or round light spot, depending on the variant. The sensor must be mounted in the nominal sensing distance and preferred direction.

table 2 gives an overview of the sensing distances and light spot sizes.

In the case of high-gloss materials, the sensor should be angled at 15° to the side for better detection reliability.

The object should be moved sideways into the light spot.

Table 2: Sensing distance / Light spot size

CSS / CSX-	xxxx1xxxxxxxx	xxxx5xxxxxxxx
Working range	13 mm	60 mm
Light spot size	2x4 mm	12 mm round

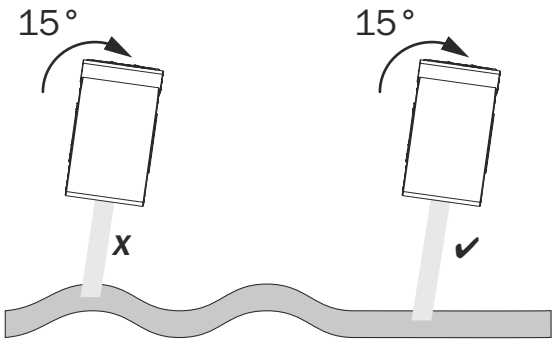


Figure 6: Mounting the CSS/CSX High Speed

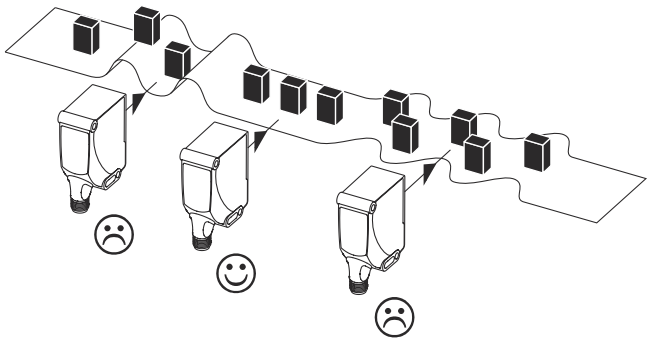


Figure 7: Mounting the CSS/CSX High Speed

5 Electrical installation

5.1 Notes on electrical installation

NOTICE
Equipment damage due to incorrect supply voltage!

An incorrect supply voltage may result in damage to the equipment.

- Only operate the device with safety/protective extra-low voltage (SELV/PELV).
- The sensor is a device of protection class III.

NOTICE
Equipment damage due to incorrect supply voltage!

An incorrect supply voltage may result in damage to the equipment.

- Only operate the device with an LPS (limited power source) in accordance with IEC 62368-1 or an NEC Class 2 power supply unit.

NOTICE
Equipment damage or unpredictable operation due to working with live parts!

Working with live parts may result in unpredictable operation.

- Only carry out wiring work when the power is off.
- Only connect and disconnect electrical connections when the power is off.

- **The electrical installation must only be performed by electrically qualified personnel.**
- **Standard safety requirements must be observed when working on electrical systems!**
- Only switch on the supply voltage for the device when the connection tasks have been completed and the wiring has been thoroughly checked.
- When using extension cables with open ends, ensure that bare wire ends do not come into contact with each other (risk of short-circuit when supply voltage is switched on!). Wires must be appropriately insulated from each other.
- Wire cross-sections in the supply cable from the user's power system must be selected in accordance with the applicable standards.
- The sensor must be protected with a fuse suitable for the cross-circuit of the connecting cable.
- Only operate the device with an LPS (limited power source) in accordance with IEC 62368-1 or an NEC Class 2 power supply unit.
- All circuits connected to the device must be designed as SELV/PELV circuits.

NOTE
Layout of data cables

- Implement the shielding design correctly and completely.
- To avoid interference, e.g., from switching power supplies, motors, clocked drives, and contactors, always use cables and layouts that are suitable for EMC.
- Do not lay cables over long distances in parallel with voltage supply cables and motor cables in cable channels.

The IP enclosure rating for the device is only achieved under the following conditions:

- The cables plugged into the connections are screwed tight.

If these instructions are not complied with, the IP enclosure rating for the device is not guaranteed!

5.2 Note on the swivel connector

NOTICE

Damage to the connector unit from over-tightening!

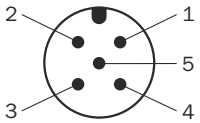
The connector unit on the device has two opposite end positions.

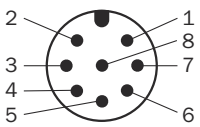
- Do not rotate the connector unit from either of the two end positions by more than 270°.

5.3 Pin assignment of the connections

The pin assignment varies depending on the device variant.

U_B= 10.8 V ... 28.8 V DC

CSS/CSX	xBxxxxxx5A Push/Pull	xNxxxxxx52 NPN
1 - BN	L+	L+
2 - WH	QL/IN1	QL2 / IN1
3 - BU	M	M
4 - BK	QL1 / C	QL1
5 - GY	IN2	IN2
	 I_N = 2 A	

CSS / CSX	xBxxxxxx8A Push/Pull	xNxxxxxx82 NPN	xBxxxxxx8R RS485
1 - WH	QL1 / IN1	IN1	IN1
2 - BN	L+	L+	L+
3 - GN	QL1 / C	QL1	QL1 / C
4 - YE	QL2	QL2	QL2
5 - GY	IN2	IN2	IN2
6 - PK	QL3	QL3	RS485_A
7 - BU	M	M	M
8 - RD	QL4	QL4	RS485_B
	 I_N = 2 A		

NOTE

The wire colors are not standardized for 8-pin sensor cables. Please also observe the pin assignment of the cable used.

Legend

L+ = Supply voltage

QL(1)/IN1 = Digital output or input 1 (configurable, factory setting is digital output)

QL1/C = Communication and digital output (can be used for communication via IO-Link, factory setting is digital output)

QL1 = Digital output 1

QL2 = Digital output 2

QL3 = Digital output 3

QL4 = Digital output 4

M = Ground

IN1 = Input 1 (factory setting is blanking = triggering of the sensor via an external synchronization pulse)

IN2 = Input 2 (factory setting is external teach-in)

RS485_A/RS485_B= RS485 communication

5.4 Connecting the supply voltage

NOTICE
Risk of damage to the device!

The device can become damaged if it is connected to a voltage supply that is already switched on.

- Only connect the device when the supply cable is de-energized.

The device must be connected to a power supply unit with the following properties:

- Supply voltage DC 10.8 V – 28.8 V (SELV/PELV according to the currently applicable standards)
- Power consumption (without load on the outputs) = max. 1.5 W

To ensure protection against short-circuits/overload in the customer's supply cables, the wire cross-sections used must be appropriately selected and protected.

5.5 Wiring the interfaces

5.5.1 Wiring the digital inputs

Voltage level at the input starts the corresponding function of the device.

Electrical values

Push-pull

Level active: 10 V ≤ U_{IN} ≤ U_V

Level inactive: U_{IN} ≤ 2 V

NPN

Level active: U_{in}≤2 V

Level inactive: U_{in}≥ 10 V ... U_v

5.5.2 Wiring the digital outputs

In each case, the digital outputs are short-circuit protected and overcurrent protected.

Push-pull switching behavior

Electrical values

The total current (100 mA) must be observed for all digital outputs.

Push-pull

Level high: U_V – 3 V

Level low: ≤ 3 V

In the case of a push/pull sensor with PNP switching behavior, the signal must be inverted in order to obtain the same result as a sensor with NPN switching behavior.

NPN

Level high: U_V

Level low: ≤ 3 V

Table 3: Push-pull

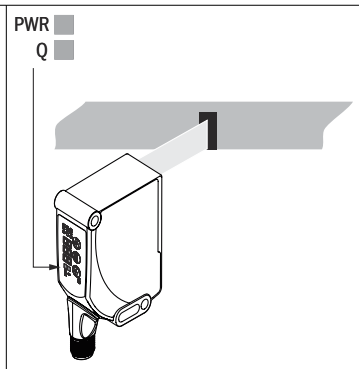
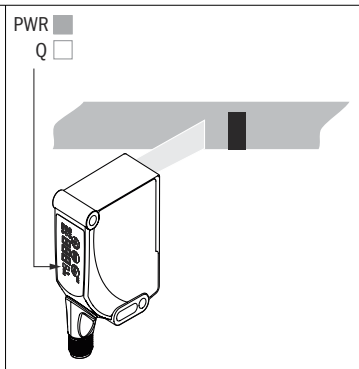
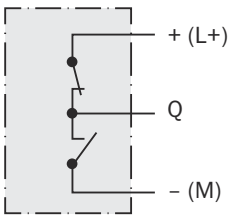
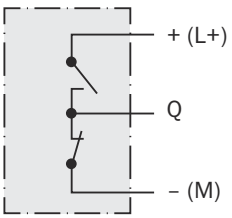
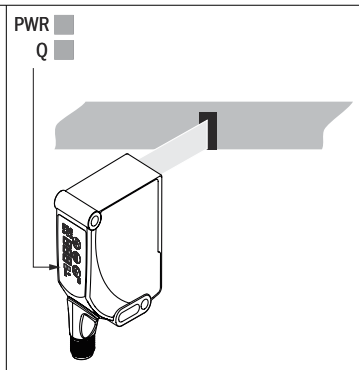
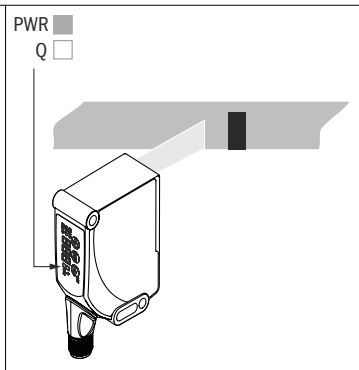
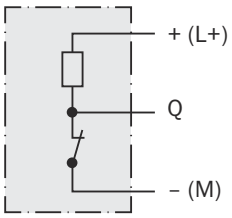
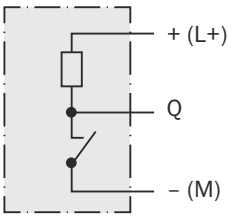
		
Q Push-pull (≤ 100 mA)		

Table 4: NPN

		
Q NPN (≤ 100 mA)		

5.6 Integration of the sensor in IO-Link mode

To operate the xxxxxxxxA variants in IO-Link mode, they need to be connected to a suitable **IO-Link Master**. This is used for further integration into the control system.

NOTE

The cable length between the **IO-Link Master** and **IO-Link device**: maximum 20 m.

Details on integration can be found in the detailed IO-Link description: **Technical Information: CSS/CSX**.

NOTE

After successful connection of the product to the **IO-Link Master**, the green (Power) LED flashes to indicate a functioning IO-Link communication between the **master** and **device.**

6 Commissioning

One or more colors can be taught in via the operating menu. The sensor then outputs the color matching value (CMV) in the process. This indicates how close the detected color value is to the taught-in color value (teach-in).

- 999 absolutely same color value
- 000 greatest possible dissimilarity

Teach-in method

- Single Value Teach-in = one color point
- Multi Value Teach-in = dynamic teach-in with multiple color points
- Teach-in quick access = In the RUN menu, select the view of the switching output that is to be taught in (e.g. q_1). Press and hold the SET pushbutton for > 1 s = the sensor switches to Multi Value Teach-in (factory setting). If a Single Value Teach-in is performed via the display, the sensor also applies this teach-in method for teach-in quick access.

Other settings can be set on the SEN and PRO menu level.

NOTE
If no settings are made on the sensor for 5 minutes, standby mode (display off) is activated to save electricity. The settings made – and not confirmed via the SET pushbutton – are not saved. To quit standby mode, one of the operating keys must be pushed.

The following menu sequence indicates how the teach-in can be performed:

Position the object/mark in the light spot.
Only the object/mark needs to be taught in, not the background.

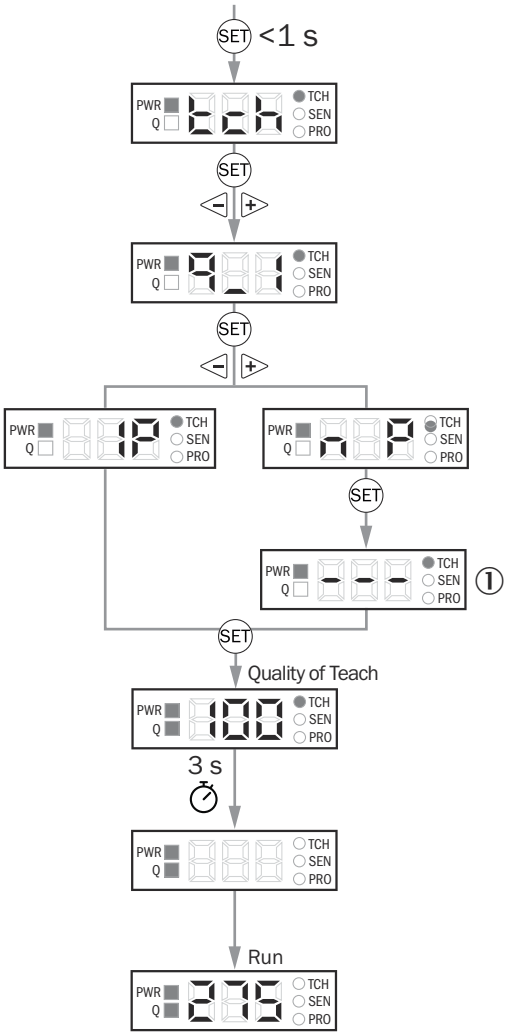


Figure 8: Commissioning of CSS/CSX High Speed

① Move object/mark through the light spot.

6.1 Extended commissioning

Another teach-in can be added to the existing teach-in (Add).
This enables different colors (Qints) to be taught-in for the same digital output (QL). This is especially recommended if objects of different characteristics (e.g., slightly different color gradients) are to be distinguished from other objects/from the background with high sensitivity.

Up to 20 colors can be added to the basic colors on QL1-QL2 or QL4 using Add-Teach-ins. If an Add Teach-in is added via the control panel, the Basic Teach-in and Add Teach-in are linked with the logical operator OR. The logic can only be changed via SOPAS, see "Setting Teach-in", page 58. In Run mode, the **Color Matching Value** for the more similar color is output: For example, if the currently detected color is more similar to the Add color tone than to the Basic color tone, then the **Color Matching Value** of the Add color tone is output.

NOTE
Due to memory capacities, the Add function is only available if a response time of 150 ms or higher is set.

6.2 Configuration via IO-Link

In addition to the manual setting on the device, the xxxxxxxxA variants can also be configured via IO-Link.

Configuration via IO-Link can be performed in two ways:

- Configuration via the SiLink box (required software: SOPAS ET from SICK)
  To do this, connect the sensor to a computer via USB using the SiLink box.
- Configuration via an **IO-Link Master** (PLC), e.g. SIG350

You can quickly and easily test and parameterize the connected products using the SOPAS ET program (SICK Engineering Tool with graphic user navigation and convenient visualization).

Details on configuration can be found in the detailed IO-Link description: **Technical Information: CSS/CSX**.

6.3 First steps for commissioning with Modbus RTU (xxxxxxxxR variants)

6.3.1 Radio interference

NOTE
Using the device in residential areas may cause radio interference. The operating entity is responsible for taking appropriate measures (e.g., shielding).

The following describes the first steps for commissioning with Modbus RTU. In the description, we refer to the “Modbus application protocol specification V1.1” Modbus standard as well as “Modbus over serial line specification and implementation guide V1.02” available at **www.modbus.org**.

6.3.2 Setting the ID and baud rate

NOTE
The SOPAS software can be used to configure the interface, see "Operation via SOPAS (xxxxxxxxA variants)", page 37

The following conditions must be met for communication with the Modbus client

- A correct server address must be set on the CSS/CSX.
  Correct is:
  - A server address that has not been allocated in the Modbus network
  - A server address that the client expects
- The same baud rate must be set in the CSS/CSX as in the client.

The following parameters are factory set on the CSS/CSX

- Server address: 10
- Baud rate: 19,200 bps
- Parity: even

NOTE
The CSS/CSX does not have an internal termination resistor, which serves as a bus terminator. This must be taken into account when operating the device in a Modbus network:

- For a point-to-point connection, an additional external bus terminator must therefore be used.
- If a variant with bus terminator is required, you can get in touch with your SICK contact person.

The following communication parameters can be allocated to the sensor

- Server address: 1 to 247 (0 is usually assigned to the client)
- Baud rate:
  3: 9,600 bps
  4: 19,200 bps
  5: 38,400 bps
  6: 57,600 bps
  7: 115,200 bps
- Parity bit:
  0 = No parity
  1 = Even parity
  2 = Odd parity

6.3.3 Basic information about Modbus and reading out code information

Modbus is based on RS-485 with a Modbus RTU protocol structure. Data exchange is always based on requests from the client and responses from the server devices.

NOTE
Examples and details of requests and responses can be found in the appendix: "Modbus RTU (xxxxxxxxR variants)", page 74.

7 Operation

7.1 Operation via the control panel

Simultaneous operation via IO-Link and the control panel are not possible.

NOTE
If no settings are made on the sensor for 5 minutes, standby mode (display off) is activated to save electricity. The settings made – and not confirmed via the SET pushbutton – are not saved. To quit standby mode, one of the operating keys must be pushed.

7.1.1 Control elements

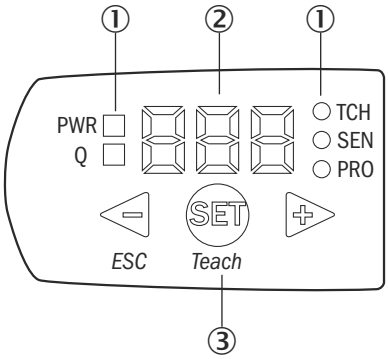


Figure 9: Display and setting elements

Table 5: Display and setting elements and functions

Number	Name	Function
1	PWR	Lights up when the voltage supply is connected. Flashes when IO-Link communication is active.
	Q	Lights up when a color is taught in within the field of view.
	TCH	Illuminates when the “teach-in” menu is selected.
	SEN	Illuminates when the “sensitivity” menu is selected.
	PRO	Illuminates when the “advanced settings” menu is selected.
2	Segment display	Shows menu item, values, or qualities.
3	Plus	Scrolls through menu items or increases values.
	SET/Teach	Press < 1 s: Opens the menu, confirms entries, or switches to lower-level menus. Press > 1 s: Triggers teach-in quick access. The last selected teach-in mode (Single Value or Multi Value) is run on Q1.
	Minus/ESC	Switches to the previous menu item, decreases values, or cancels the current operation (press for > 3 s).

7.1.2 Navigation tree

Example for CSS with M12/8-pin male connector.

Table 6: List of abbreviations

Display	Meaning
1P	Single Value Teach-in
Add	Add another teach-in to the existing teach-in
At	Blanking
b-F	Best Fit mode
bSY	Busy
Cod	Coded mode
CoL	Color
dlY	Delay
dSP	Display switch
Err	Error
FUll	Number of colors that can be taught in exceeded
In	Inverted
Job	Parameter sets
Jo1	Parameter set 1
Jo2	Parameter set 2
Jo3	Parameter set 3
Jo4	Parameter set 4
LoA	Loading
LoC	Locked
LOG	Input function for Smart Task
nF	Deactivate pin
nIn	Not inverted
n P	Multi-Value teach-in
oFF	Off
PI2	Pin 2 configuration
PI5	Pin 5 configuration
PIL	Pin logic inversion
Pro	Pro level (advanced settings)
q_1	Switching output 1
q_2	Switching output 2
q_3	Switching output 3
q_4	Switching output 4
q-F	Output Mode
rES	Reset
rSP	Response time
Sen	Sensitivity
Std	Standard
Sto	Store
tch	Teach-in
toF	Timer – OFF delay
ton	Timer – ON delay
tP	Pulse generator

Display	Meaning
tq1	Teach-in switching output 1
tq2	Teach-in switching output 2
tSh	Switch-on/switch-off delay (on/off delay)
tur	Turn (display)

7.1.3 Activating or deactivating the pushbutton lock

1. Press and hold the plus button for 10 seconds.

2. The pushbutton lock is active or deactivated.

7.1.4 Resetting the device (factory setting)

Resetting to factory settings deletes all saved settings (jobs).

Figure 10: Factory Reset menu

In the Settings menu

1. Open the menu with the SET pushbutton
2. Select Pro with the +/- pushbutton.
3. Confirm the selection with the SET pushbutton
4. Select rES with the +/- pushbutton
5. Open the Factory Reset menu with the SET pushbutton
6. Select Factory Reset YES with the +/- pushbutton
7. Confirm the selection with the SET pushbutton
   – The display shows Factory Reset. The factory settings are active.

7.1.5 Teach-in

7.1.5.1 Teach-in modes

The CSS color sensor offers two different teach-in modes:

Single Value Teach-in
For a single value teach-in, one teach-in point is recorded. The sensor then has exactly one teach-in color available. Deviations from the teach-in are always determined against this one color.
This teach-in is recommended when:

- the color is uniform.
- the conditions are stable
  - no gloss
  - constant distance
  - uniformly aligned objects (position and angle)
- the detection of this teach-in value needs be very accurate, i.e., a high-resolution color comparison is desired.

Multi Value Teach-in
For a multi value teach-in, several teach-in values can be recorded dynamically. Deviations from the teach-in are always determined against this taught-in color range.
This teach-in is particularly suitable for structured or fluctuating color gradients. Structured surfaces such as wood can thus be distinguished from each other in a very stable manner.

7.1.5.2 Teach-in via control panel

7.1.5.2.1 Single Value Teach-in

A **Single Value Teach-in** is used to teach in a single color. To do so, the object must be in the field of view, i.e. within the light spot. The light spot should only capture the color to be taught in. Because only the object needs to be taught in, not the background.

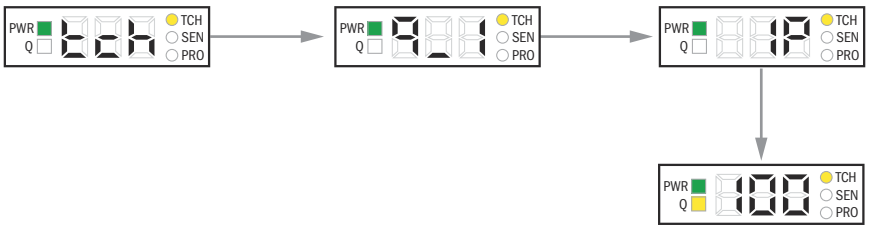


*Figure 11: **Single Value Teach-in***

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton
2. Select the **tch** menu with the **SET** pushbutton
3. Confirm the selection with the **SET** pushbutton
4. Select the desired digital output, e.g., **q_1**, with the +/- pushbutton
5. Confirm the selection with the **SET** pushbutton
6. Select **1P** with the +/- pushbutton
7. Confirm the selection with the **SET** pushbutton

✓ A value between 0 and 100 indicates the quality of the teach-in process.

A low quality value indicates that the color has changed significantly during the teach-in process. The object may have been unintentionally moved out of the light spot during teach-in. The switching range of the sensor should be checked.

7.1.5.2.2 Multi Value Teach-in

For a **Multi Value Teach-in**, the object is taught in on the basis of a color range; this can be particularly helpful for structured surfaces or surfaces that are not completely monochromatic (such as wood). Various color points are used to define a target space, around which a tolerance zone (**Sensitivity**) is also defined. This teach-in is therefore not a single color point, but rather an area in the color space.

Move object/mark through the light spot during teach-in.

Only the object needs to be taught in, not the background.

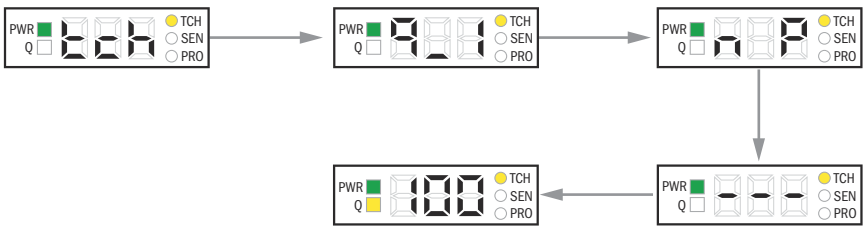


Figure 12: Multi Value Teach-in

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton
2. Select the **tch** menu with the **SET** pushbutton
3. Confirm the selection with the **SET** pushbutton
4. Select the desired digital output, e.g., **q_1**, with the +/- pushbutton
5. Confirm the selection with the **SET** pushbutton
6. Select **n P** with the +/- pushbutton

7. Confirm the selection with the **SET** pushbutton
✓ A value between 0 and 100 indicates the quality of the teach-in process.

A high value indicates that an uniform color has been taught in; the value decreases, however, as the color variance increases. A low quality value indicates that the color has changed significantly during the teach-in process. The object may have been unintentionally moved out of the light spot during teach-in. The switching range of the sensor should be checked.

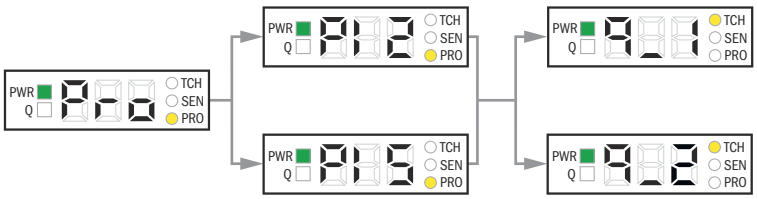
7.1.5.3 Teach-in - external teach-in

To perform the teach-in via an external input, an IO pin must be suitably configured. The external teach-in is always a **Single Value Teach-in**.

The following pins can be used for an external teach-in:

Table 7: External teach-in pin

xBxxxxxx5A	xBxxxxxx8A
Pin 2 Teach QL1: External teach-in for QL1 Teach QL2: External teach-in for QL2	**Pin 1** Teach QL1: External teach-in for QL1 Teach QL2: External teach-in for QL2
Pin 5 Teach QL1: External teach-in for QL1 Teach QL2: External teach-in for QL2	**Pin 5** Teach QL1: External teach-in for QL1 Teach QL2: External teach-in for QL2

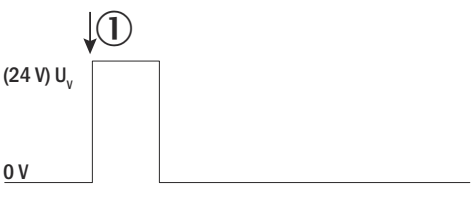
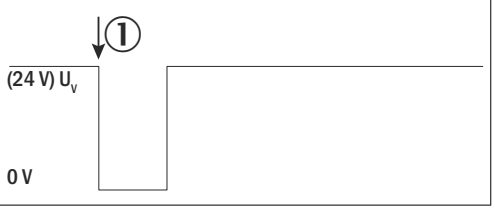


Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton.
2. Select **Pro** with the +/- pushbutton.
3. Confirm the selection with the **SET** pushbutton.
4. Select **PI 2** or **PI 5** with the +/- pushbutton.
5. Confirm the selection with the **SET** pushbutton.
6. Select **q_1** (External teach-in for QL1) or **q_2** (External teach-in for QL2) with the +/- button
7. Confirm the selection with the **SET** pushbutton.
8. Position the object in the light spot.
9. Activate teach-in via the control cable (ET). (Level active, see table 8, page 30)

✓ The teach-in process is complete.

Table 8: External teach-in

Push-pull	NPN
	

① Teach point

7.1.6 Additional settings (Settings menu)

7.1.6.1 Output Mode

The color sensor has 24 color memory locations. These can be assigned to up to four digital outputs. One color can be taught-in at each color memory location. During the process (RUN mode), the sensor compares the detected color with the active color memory location.
The sensor is preset to **Standard** mode (delivery state as well as state after resetting the device ((factory settings)).

Output Mode Standard (Std)

One or more colors are assigned to each of the digital outputs QL1-QL2 and QL1-QL4. If the colors of two digital outputs need to be detected, both digital outputs are active.

Output Mode Best Fit (b-F)

The sensor selects the color with the highest CMV (= Color Matching Value). Only the digital output to which this color is assigned switches.

Output Mode Coded (Cod)

The digital outputs are considered to be binary coded. This means up to 16 states (= 15 colors) can be distinguished via 4 QL. The table below provides an overview of this.

	QL4	QL3	QL2	QL1
Color 1	-	-	-	X
Color 2	-	-	X	-
Color 3	-	-	X	X
Color 4	-	X	-	-
...				
Color 15	X	X	X	X
No Teach-in color active	-	-	-	-

For the xBxxxxxx5A variants, only three colors and the “**No Teach-in color active**” status can be mapped in **Coded Mode**.

For the xBxxxxxx8 variants, only four colors and the “No Teach-in color active” status can be mapped in Coded Mode as long as the response time is set to 36 µs or 72 µs. For response times of 150 µs and higher, 15 colors are available.

Selecting the Output mode on the display

*Figure 13: **Output Mode***

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton.
2. Select **Pro** with the +/- pushbutton.
3. Confirm with the **SET** pushbutton.
4. Select **q-F** with the +/- pushbutton.
5. Confirm with the **SET** pushbutton.
6. Select the desired output mode, e.g., Std, with the +/- pushbutton.
7. Confirm the selection with the **SET** pushbutton.

7.1.6.2 Setting the sensitivity

The sensitivity is specified as the threshold of the CMV (= **C**olor **M**atching **V**alue). This indicates how close the detected color value is to the taught-in color value (teach-in):

- 999 = Absolutely same color values
- 000 = Greatest possible dissimilarity

The sensitivity can therefore be set as the threshold of the CMV from 000 to 999. The preset value is 900 (delivery state as well as state after resetting the device ((factory settings)).

Selecting the sensitivity via the control panel

*Figure 14: **Sensitivity***

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton.
2. Select the **SEn** menu with the +/- pushbutton.
3. Confirm the selection with the **SET** pushbutton.
4. Select the desired switching output, e.g., **q_1**, with the +/- pushbutton.
5. Select the desired sensitivity with the +/- pushbutton.
6. Confirm the selection with the **SET** pushbutton.

7.1.6.3 Setting the switch-on and switch-off delay

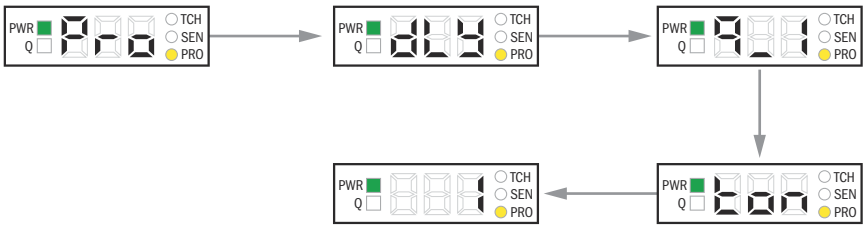


*Figure 15: **Sensitivity***

Table 9: List of abbreviations

Display	Meaning
oFF	Off
toF	Timer – OFF delay
ton	Timer – ON delay
tP	Pulse generator
tSh	Switch-on/switch-off delay (on/off delay)

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton.
2. Select **Pro** with the +/- pushbutton.
3. Confirm the selection with the **SET** pushbutton.
4. Select the **dLY** menu with the +/- pushbutton.
5. Confirm the selection with the **SET** pushbutton.
6. Select the desired switching output, e.g., **q_1**, with the +/- pushbutton.
7. Confirm the selection with the **SET** pushbutton.
8. Select the desired delay type, e.g., **ton**, with the +/- pushbutton.
9. Set the delay time in ms with the +/- pushbutton.
10. Confirm the selection with the **SET** pushbutton.

NOTE
The maximum value that can be set is 999 ms via the control panel, and 30,000 ms via IO-Link.

7.1.6.4 Setting the response time

The sensor offers the following response times for selection:

- 36 µs
- 72 µs
- 150 µs
- 300 µs
- 600 µs

The preset value is 36 µs (delivery state as well as state after resetting the device ((factory settings)).

As a general rule, the color resolution of the sensor is most accurate at high response times. The response time should therefore be set as high as possible, and as low as necessary.

Selecting the response time via the control panel

*Figure 16: **Response time***

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton.
2. Select **Pro** with the +/- pushbutton.
3. Confirm the selection with the **SET** pushbutton.
4. Select **rSP** with the +/- pushbutton.
5. Confirm with the **SET** pushbutton.
6. Select the desired response time with the +/- pushbutton
7. Confirm with the **SET** pushbutton.

7.1.6.5 Pin settings

Multifunctional pins are available to which different functions can be assigned.

*Table 10: **Pin settings** fpr xBxxxxxx5A*

xBxxxxxx5A	Function
Pin 2	Output or input (IN1)
Pin 5	Input (IN2)

*Table 11: **Pin settings** for xBxxxxxx8A:*

xBxxxxxx8A:	Function
Pin 1	Output or input (IN1)
Pin 5	Input (IN2)

Available configurations are:

Pin 2 (xBxxxxxx5A) / pin 1 (xBxxxxxx8A)

- **Ext. Input Smart Task** (LoC): Input function for the **Smart Task A10**
- **Blanking** (At): If the level of the input signal is active, no digital output is activated when a taught-in color is detected.
- Output QL1 (q_1): QL1 digital output
- Output QL2 (q_2): QL2 digital output (only available for xBxxxxxx5A)

- Teach QL1 (tq1): External teach-in for QL1
- Teach-in QL2: External teach-in for QL2
- **Activate Job** (Job): Input for switching jobs. This selection must be activated if you want to switch between different “jobs” (sensor states with stored colors and configurations) via external digital inputs on the multifunctional pins. This function supports easy format management in the customer application.
- Deactivated (nF)

The pin is preset to the “Output QL1” function (delivery state as well as state after resetting the device ((factory settings)).
For CSX sensors, the “Blanking” function is preset.

Pin 5

- **Ext. Input Smart Task** (LoC): Input function for the **Smart Task A10**
- **Blanking** (At): If the pin is HIGH (tq1), no digital outputs are active
- Teach QL1 (q_1): External teach-in for QL1
- Teach QL2 (q_2): External teach-in for QL2
- **Activate Job** (Job): Input for switching jobs. This selection must be activated if you want to switch between different “jobs” (sensor states with stored colors and configurations) via external digital inputs on the multifunctional pins. This function supports easy format management in the customer application.
- Deactivated (nF)

The pin is preset to the “Teach QL1” function (delivery state as well as state after resetting the device ((factory settings))

If job switching is configured via input pins, job switching via the control panel is not possible.

If both input lines are configured for job switching, switching between jobs is performed according to the following table:

Table 12: Jobs

IN2 Low		IN2 High	
Job 1 ↓↑ Job 3	←→	Job 2 ↓↑ Job 4	IN1 Low IN1 High

IN1 = Activate Job, IN2 = Activate Job

IN2 = Activate Job, IN1 = Activate Job

As long as only one input line is configured for job selection, it is only possible to switch between two jobs:
At IN2 between the columns in the table.
Between the rows for IN1.
For example, with IN2 between job 1 and 2 or with IN1 between job 1 and 3.

Selecting the Pin Setting via the control panel

*Figure 17: **Pin 2 Setting***

*Figure 18: **Pin 5 Setting***

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton.

2. Select **Pro** with the +/- pushbutton.
3. Confirm with the **SET** pushbutton.
4. Select **PI 2** or **PI 5** with the +/- pushbutton.
5. Confirm with the **SET** pushbutton.
6. Select the desired function with the +/- pushbutton.
7. Confirm with the **SET** pushbutton.

7.1.6.6 Aligning display

If the sensor is mounted at a 180° rotated position, the display can be rotated accordingly.

The available options are

- 

- 

*Figure 19: **Display Direction** menu*

In the Settings menu

1. Open the menu with the **SET** pushbutton.
2. Select **Pro** with the +/- pushbutton.
3. Confirm the selection with the **SET** pushbutton.
4. Select **dSP** with the +/- pushbutton.
5. Confirm the selection with the **SET** pushbutton.
6. Select the desired direction with the +/- pushbutton.
7. Confirm the selection with the **SET** pushbutton.
   – The display shows **tur** in the respective direction

7.1.6.7 Activating jobs

The sensor continuously saves the current configuration to the job selected here. The job will therefore be saved in all cases. 4 jobs are available.

The following parameters are not included when the job is saved

- **Device specific tag**
- **Sender configuration**
- **Process data select**
- **Pin 2/1 configuration**
- **Pin 5 configuration**
- **Key lock type**
- **Alarm thresholds for diagnostic parameters**
- **Find me**
- **Notification handling**
- **Display direction**
- **Modbus RTU slave address**
- **Modbus RTU baud rate**
- **Modbus RTU parity setting**

- **Device ID setup**
- **Output Delay**

Selecting Activate jobs via the control panel

*Figure 20: **Activate Job***

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton.
2. Select **Pro** with the +/- pushbutton.
3. Confirm with the **SET** pushbutton.
4. Select **Job** with the +/- pushbutton.
5. Confirm with the **SET** pushbutton.
6. Select the desired job with the +/- pushbutton.
7. Confirm the selection with the **SET** pushbutton.

7.1.6.8 Other displays and functions

Control panel locked

Figure 21: Busy

If the device is undergoing an internal process (e.g., reading or storing parameter sets or teaching-in via IO-Link), the control panel is locked and the device shows “bSY” on the segment display.

Short-circuit and overcurrent detection

Figure 22: Error

In the event of a short-circuit, Err appears on the display and the Q LED flashes.

Number of colors that can be taught in exceeded

Figure 23: Full

For response times of 32 µs and 72 µs, 4 colors can be taught in. Only if a response time of 150 ms or higher is set, up to 24 colors can be taught in.
(Via the control panel: 4 basic colors (QL1 - QL2 or QL4) plus up to 20 colors using Add-Teach-ins)

Live measured value (run mode)

In run mode, the device displays the current value.

Figure 24: Run

Display standby

NOTE
Control panel standby mode is not activated when a teach-in process is ongoing or while an error message is displayed.

If no settings are made on the device for 5 minutes, standby mode is activated to save electricity. Any settings made which have not been confirmed are not adopted.

To quit standby mode, one of the operating keys must be pushed.

7.2 Operation via SOPAS (xxxxxxxxxA variants)

The SDD drivers for the SOPAS ET configuration software can be found at www.sick.com/CSS_High_Resolution and www.sick.com/CSS_CSX_High_Speed (as well as at www.sick.com).
SOPAS ET can be used to configure and analyze the sensor.

NOTICE
Simultaneous operation via SOPAS / IO-Link and the control panel is not possible.

7.2.1 Overview of SOPAS

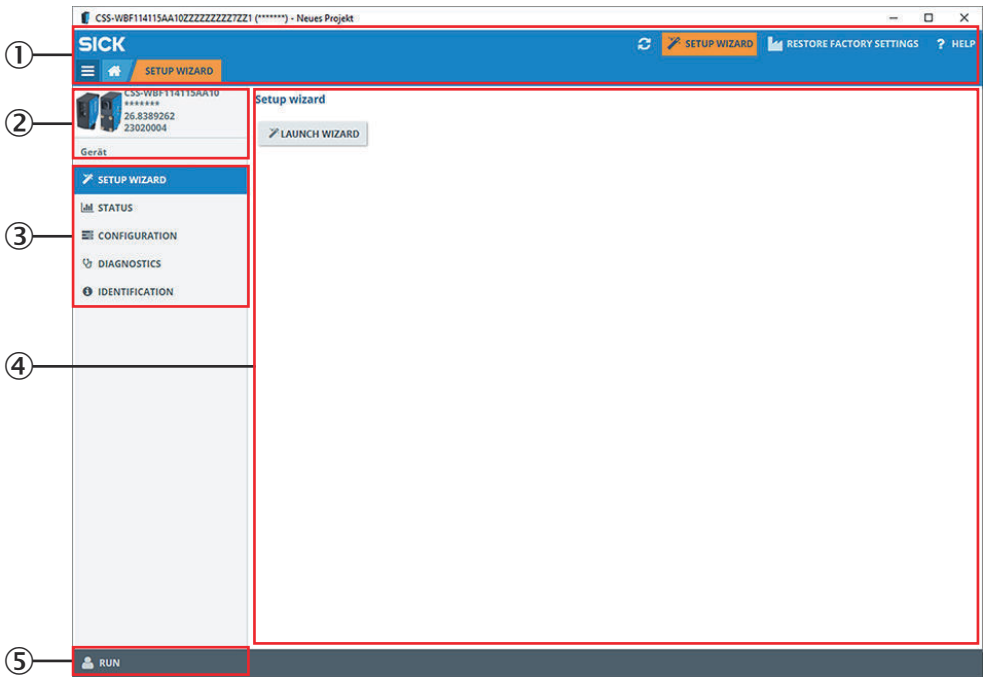


Figure 25: Overview of the SOPAS user interface

1 Header showing the navigation level and providing quick access to Update, **Setup Wizard**, **Restore Factory Settings** and **Help**
2 Information about the device, e.g. type, part number, and device details.
3 Navigation area

4 Display of the respective functions and adjustments
5 Display of the operating mode

7.2.1.1 Overview of the Setup Wizard

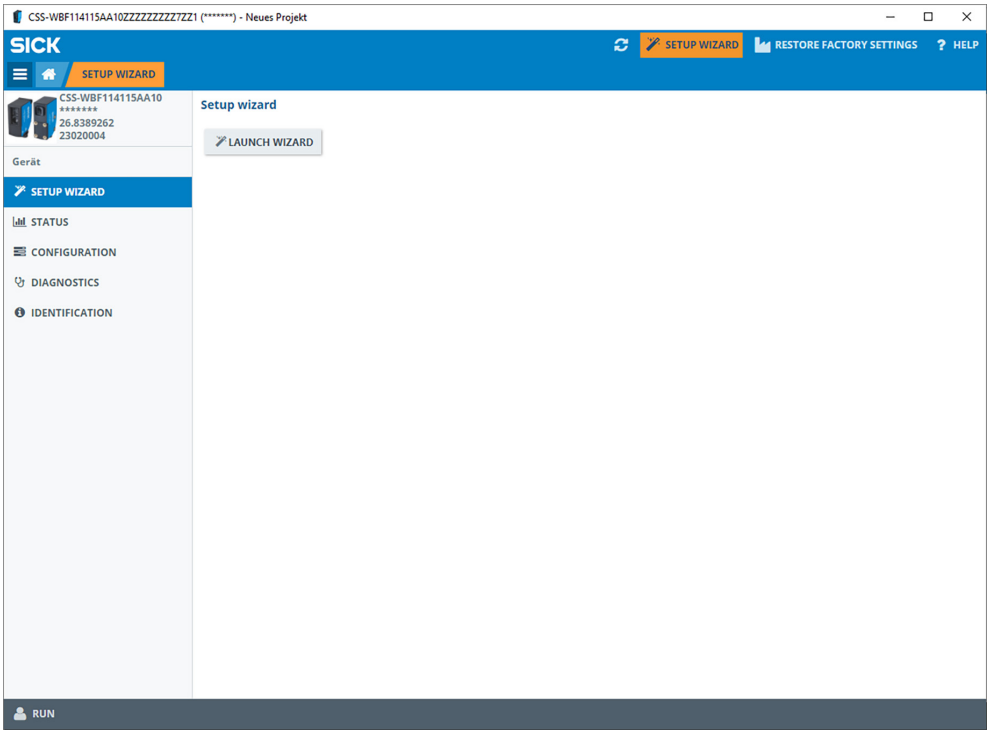


Figure 26: Overview of the Setup Wizard

The **Setup Wizard** makes it easy to teach-in and parameterize the sensor to suit the application.

7.2.1.2 Overview of status

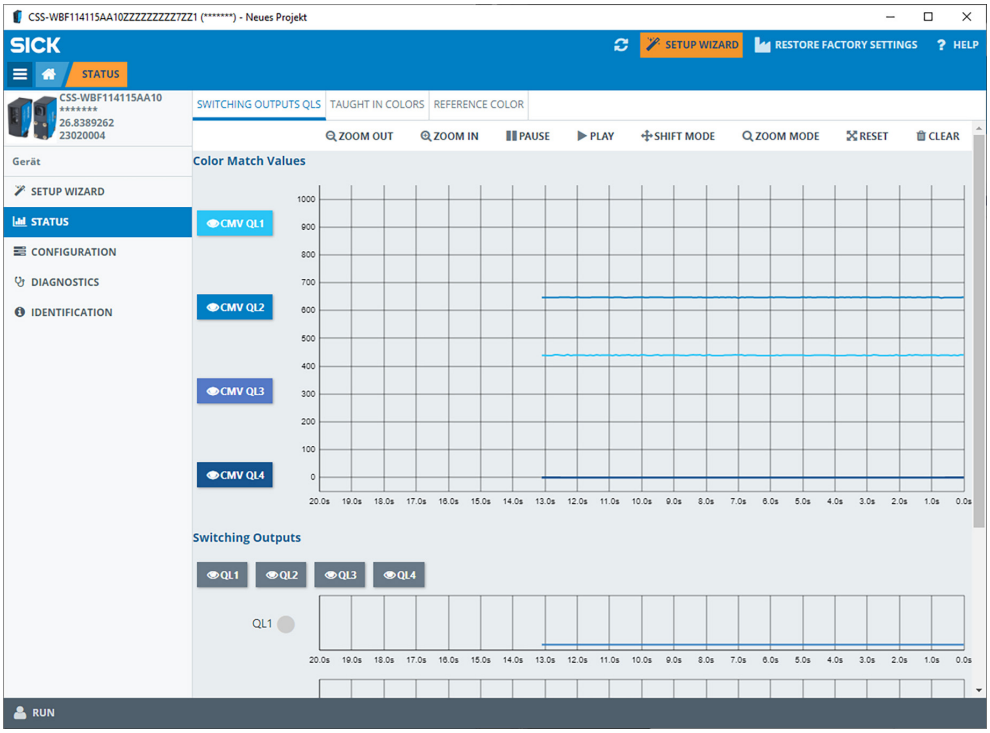


Figure 27: Overview of the Switching Output QLS status

The current process data are displayed in the **Status** area.

They are divided into the tabs:

- **Switching Outputs QLS**
- **Teach-In Colors**
- **Reference Color**

The display of the respective diagrams can be changed using the controls.

- **Zoom out / in** = Dynamic zoom in the x and y direction
- **Pause / Play** = Stops / continues the display of new sensor values.
- **Shift Mode** = The diagram can be shifted in the x and y directions using the mouse.
- **Zoom Mode** = Zoom into the diagram using the mouse.
- **Reset** = Resets the zoom to the initial setting.
- **Clear** = Deletes all previously recorded measurement data.
- **CMV QLx** = Show/hide the curve of a CMV
- **QLx** = Show/hide the curve of a switching output

Status Switching Outputs QLS

The Color Matching Values (CMV) and switching events of the physical digital outputs (QLs) are displayed in the **Switching Outputs QLs** tab.

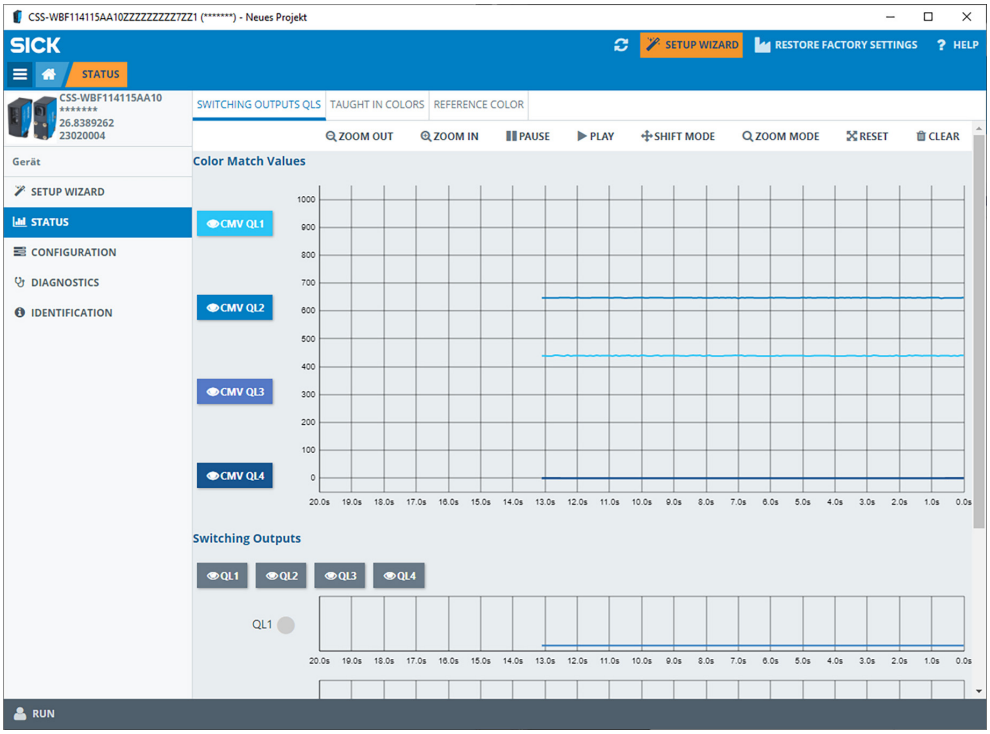


Figure 28: Status Switching Outputs QLS

Status Teach-In Colors

The Color Matching Values (CMV) and switching events of the internal digital outputs (Qints) = taught-in objects (colors) are displayed in the **Teach-In colors** tab.

The CMV specifies the color match to the taught-in color:

- 999 absolutely same color value
- 000 greatest possible dissimilarity

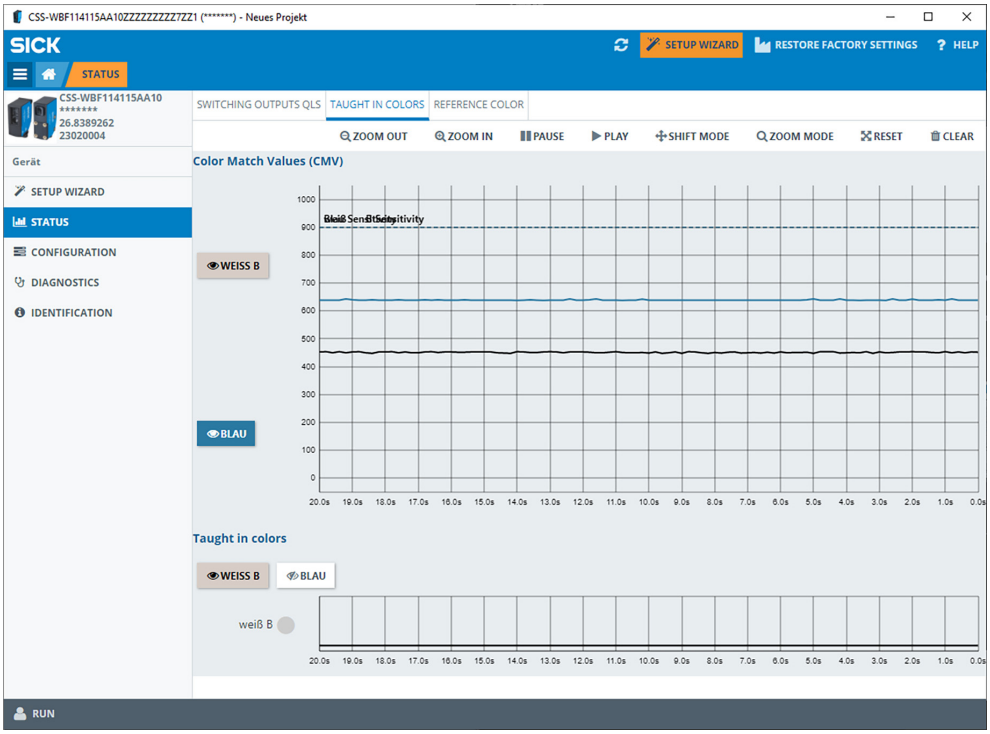


Figure 29: Status Taught-in Colors

Status Reference Color

The current values of the detected color (RGB or L*a*b) and a color indication are output in the **Reference color** tab.
RGB = Output of the color tone based on the proportions of the primary colors red (R), green (G) and blue (B)
L*a*b = Output of the color tone based on the lightness (L), value between green and red (A), and value between blue and yellow (B).

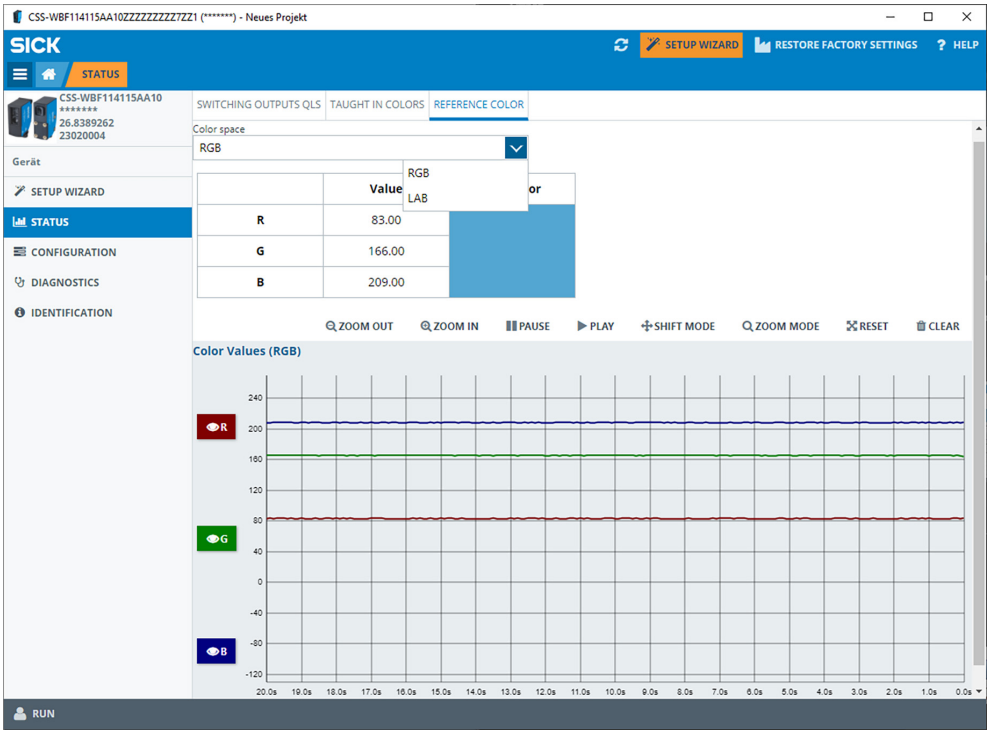


Figure 30: Status Reference Color

7.2.1.3 Overview of Configuration

Various adjustments are available in the **Configuration** area.

They are divided into the tabs:

- **Settings**
- **Teach-in**
- **Smart Tasks and switching output assignment**
- **Pin settings**

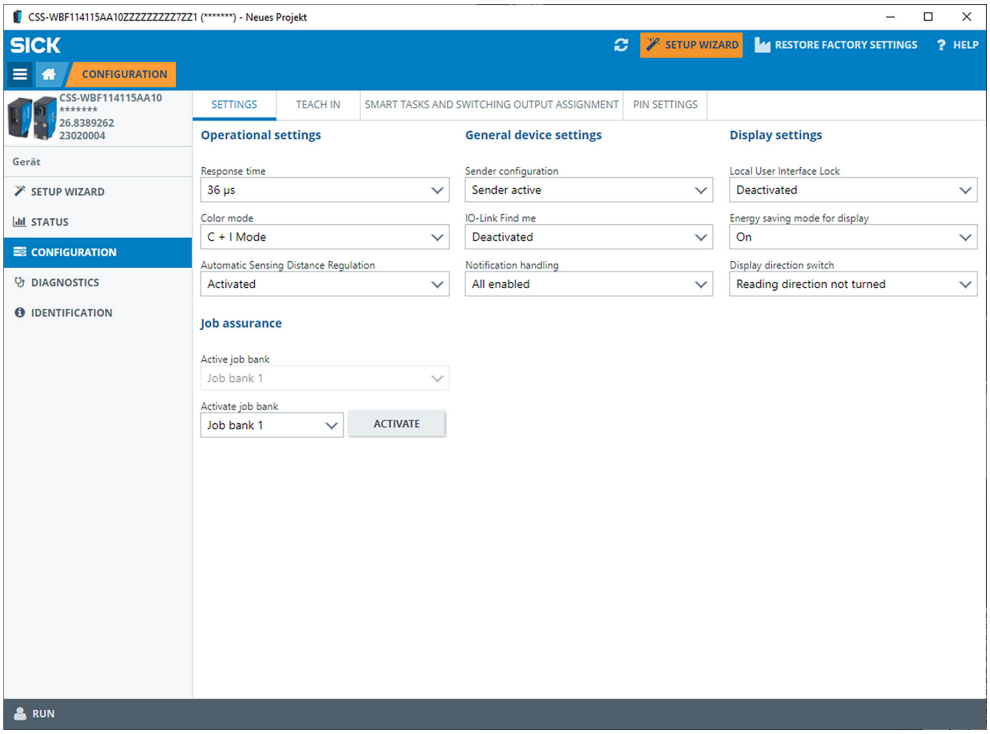


Figure 31: Overview of ***Configuration***

Configuration Settings

The Settings tab is divided into several sections where the relative settings can be configured.

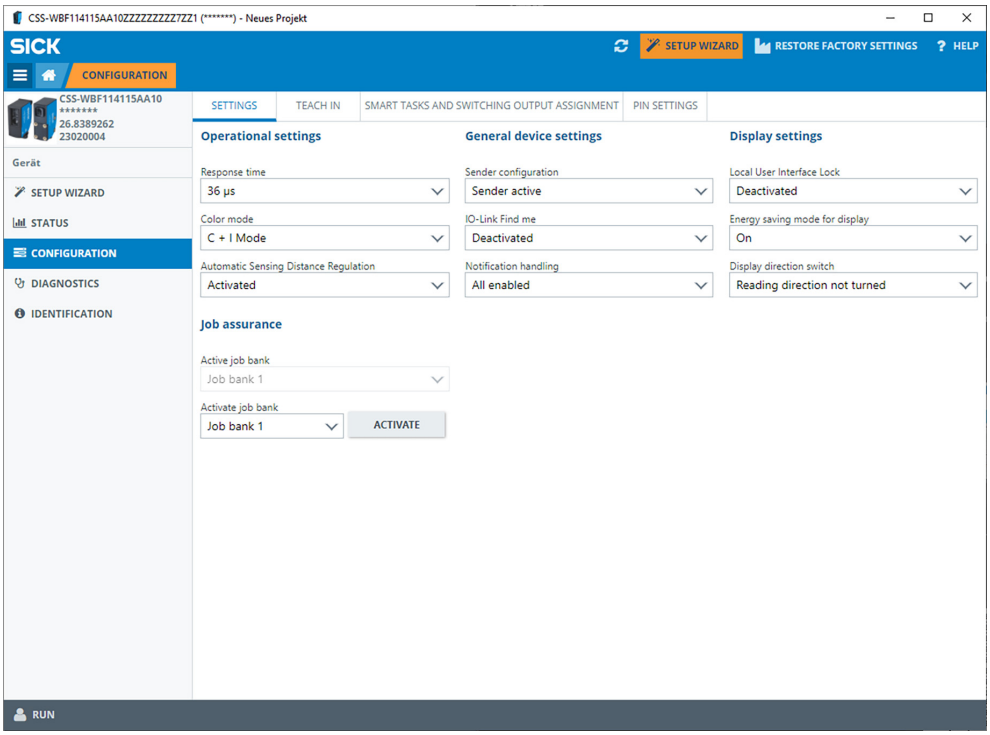


Figure 32: ***Configuration Settings***

Operational settings

- **Response time** (see "Setting the response time", page 33)
- **Color mode** (see "Setting the Color mode", page 57)

General device settings

- **Sender active** (see "Sender configuration", page 57)
- **IO-Link Find me** (see "Setting Find me", page 57)
- **Notification handling** (see "Setting Notification handling", page 58)

Display settings

- **Local User interface Lock** (see "Setting Local User Interface Lock", page 58)
- **Energy saving mode for display** (see "Setting Energy saving mode for display", page 58)
- **Display direction switch** (see "Setting Display direction switch", page 58)

Job assurance

- **Active job bank** (see "Setting Job assurance", page 58)

Configuration Teach-in

The **Teach-in** tab is used to select the teach-in mode and perform a teach-in. It can also be used to adjust the sensitivity and change the naming.

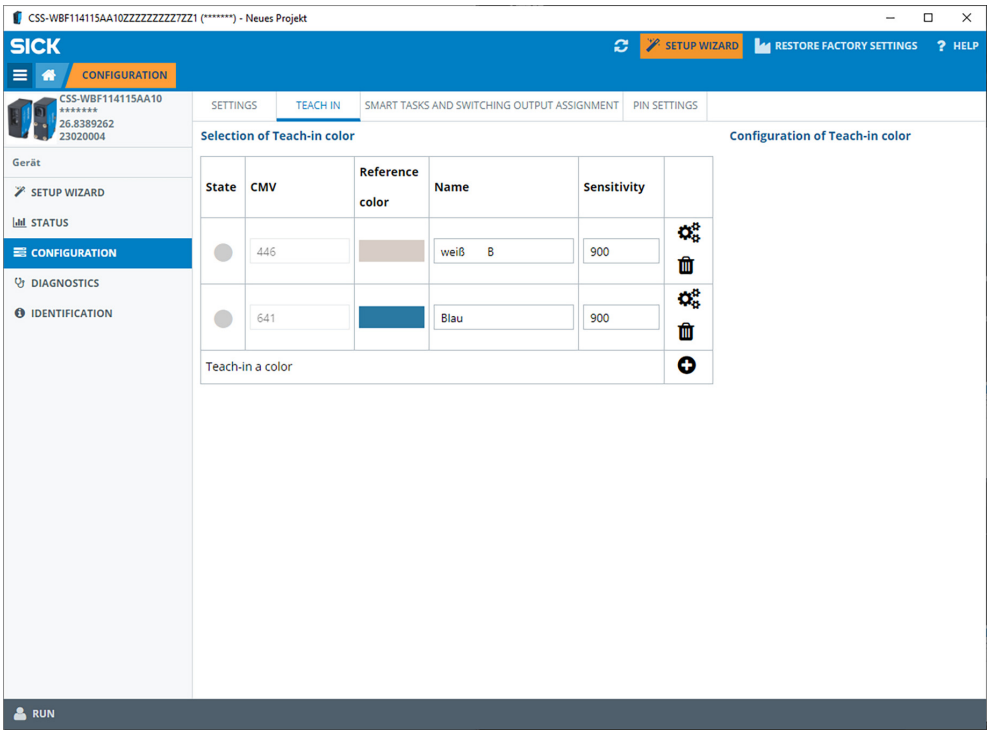


Figure 33: ***Configuration Teach-in***

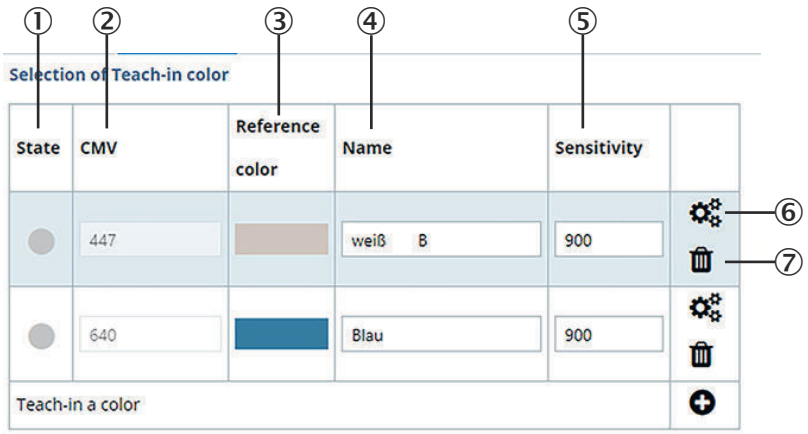


Figure 34: ***Configuration Teach-in legend***

① State = Switching output state
② CMV = Value of the Color Matching Value
③ Reference color = Taught-in color
④ Name = Assigned name
⑤ Sensitivity = Threshold of the CMV (000 - 999)
⑥ Open settings
⑦ Discard taught-in color
(the color is deleted under “Available colors” **and** the corresponding QL.)

Configuration Smart Tasks and switching output assignment

The **Smart Tasks and switching output assignment** tab can be used to set the **Output mode** (**Standard**, **Best fit mode**, **Coded mode**) and assign the taught-in colors to the switching outputs.

Colors can be moved to the switching outputs using drag & drop.

Output Mode Standard (Std)
One or more colors are assigned to each of the digital outputs QL1-QL2 and QL1-QL4. If the colors of two digital outputs need to be detected, both digital outputs are active.

Output Mode Best Fit (b-F)
The sensor selects the color with the highest CMV (= Color Matching Value). Only the digital output to which this color is assigned switches.

Output Mode Coded (Cod)
The digital outputs are considered to be binary coded. This means up to 16 states (= 15 colors) can be distinguished via 4 QL.

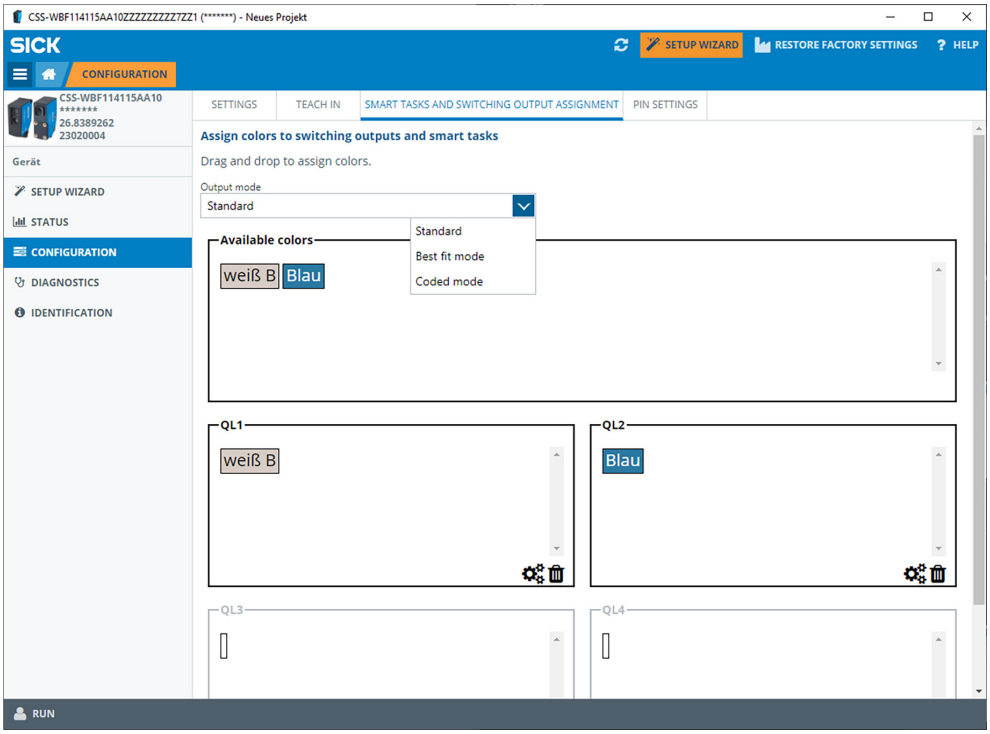


Figure 35: ***Configuration Smart Tasks and switching output assignment***

Configuration Pin settings

The **Pin settings** tab is used to assign a function to pin 2 and pin 5.

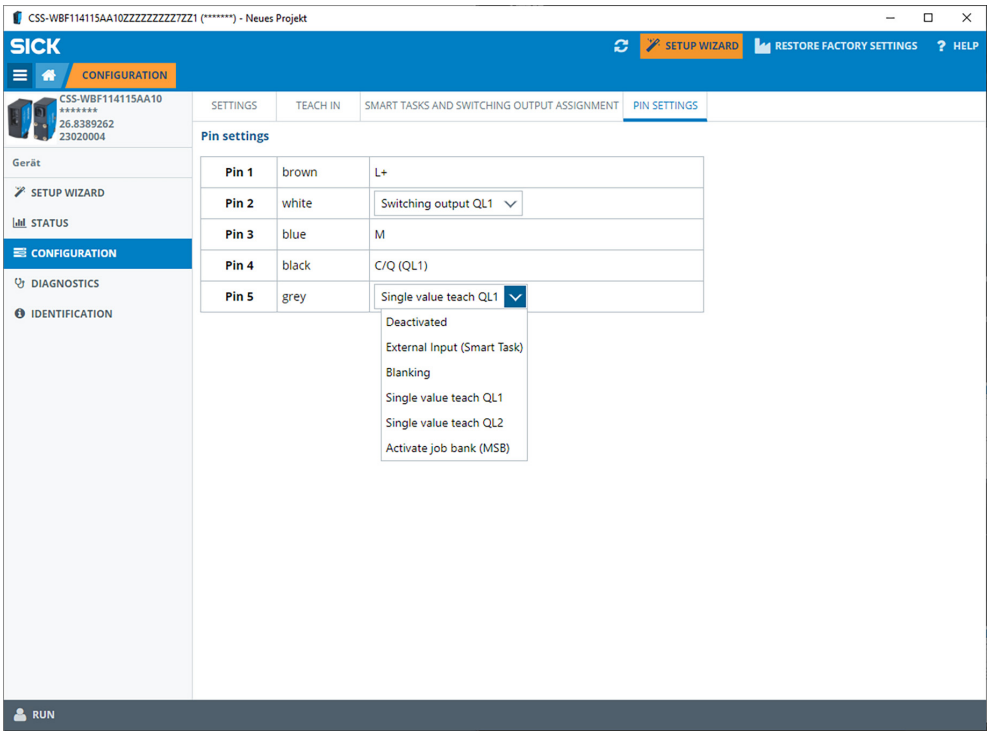


Figure 36: ***Configuration Pin settings***

7.2.1.4 Overview of Diagnostics

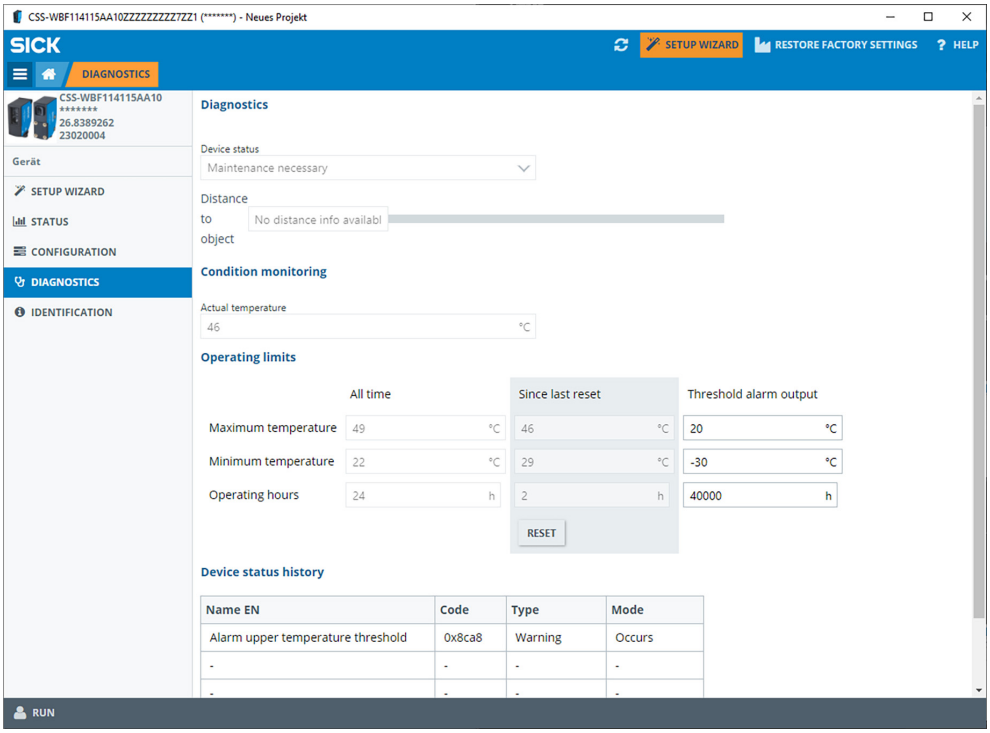


*Figure 37: Overview of **Diagnostics***

The **Diagnostics** area is divided into various subareas. The sensor diagnostics information is displayed here, and the error messages are also listed.

Thresholds can also be set and the measured values can be reset.

- **Diagnostics**
  Device status = Indicates whether the sensor requires maintenance or whether it is still fully functional.
- **Distance to object** This function is only available for CSS High Resolution devices.
- **Condition monitoring/Operating limits** = Displays internal temperature values and the uptime of the sensor to date
- **Device status history** = List of active error and warning messages

7.2.1.5 Overview of Identification

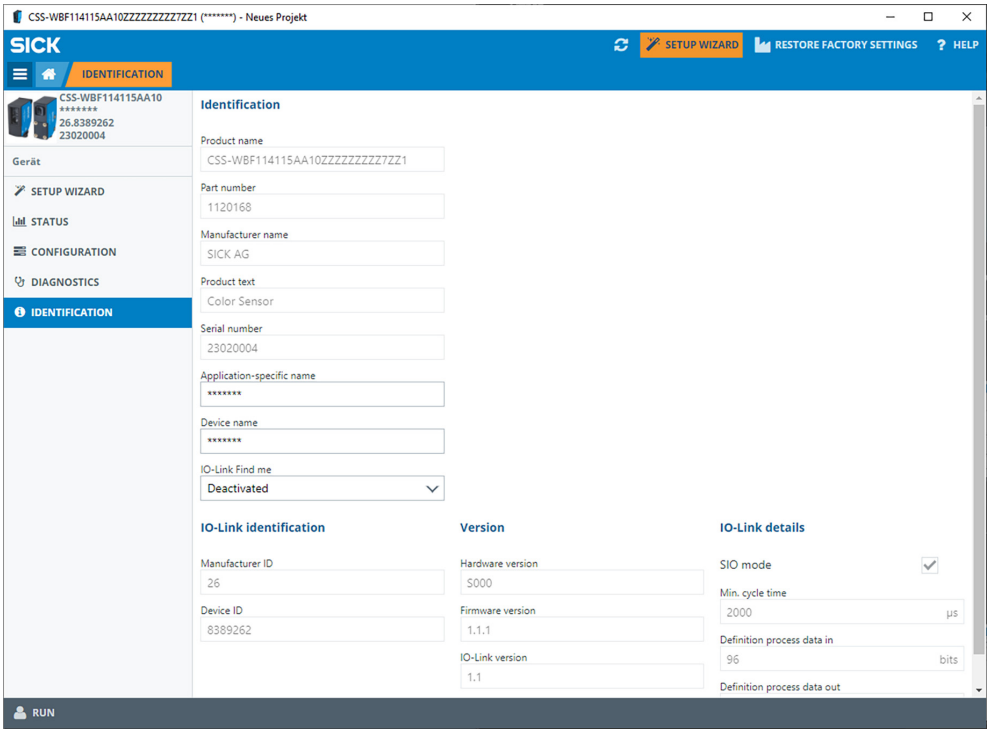


*Figure 38: Overview of **Identification***

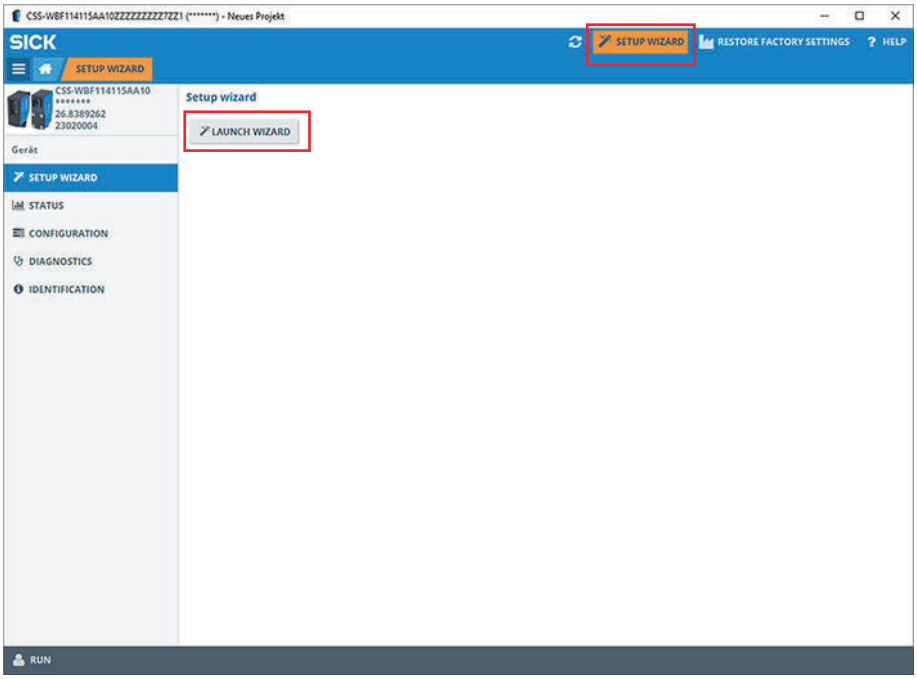
The **Identification** area displays the individual data of the selected sensor. The **IO-Link Find me** function can also be set again here (see "Setting Find me", page 57).

7.2.2 Using the Setup Wizard

The Setup Wizard makes it possible to quickly teach-in and parameterize the sensor to suit the application.

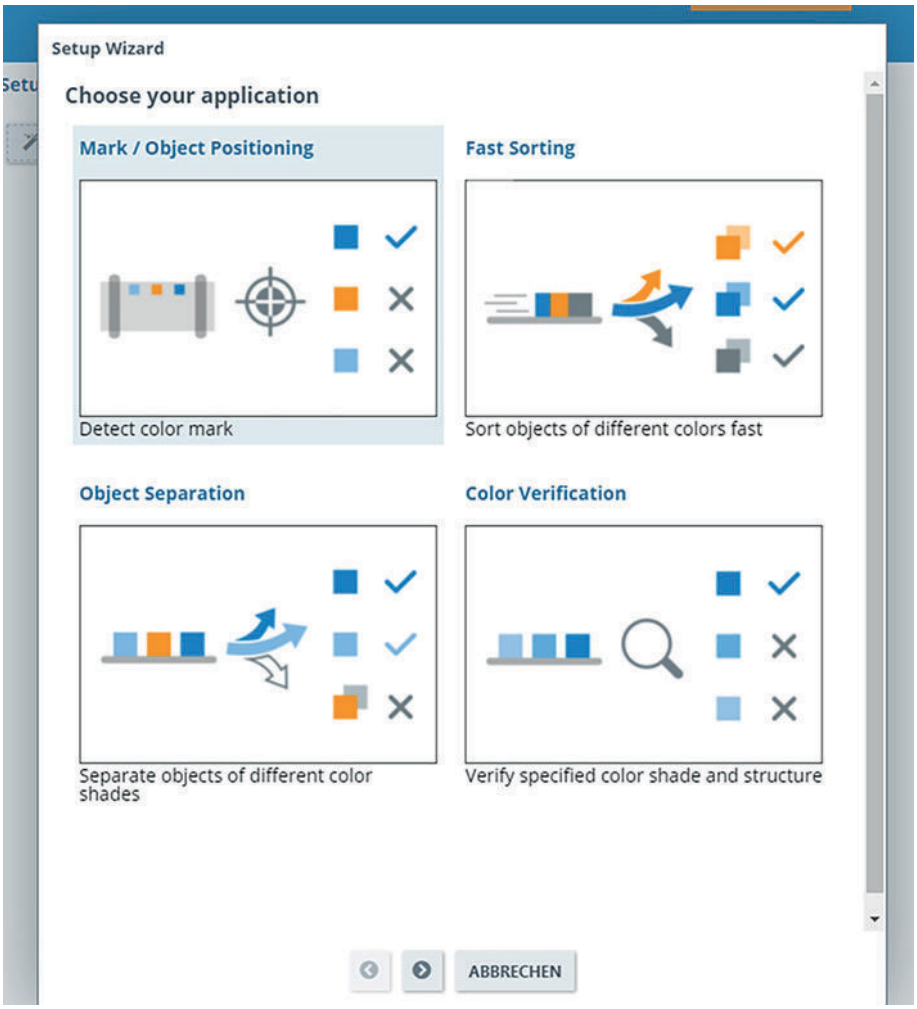
7.2.2.1 Selecting the Setup Wizard

Select **Setup Wizard** in the toolbar or in the navigation area.



7.2.2.2 Selecting the application

Select the task for which the sensor is to be used .



The sensor offers four different operating modes. When an **Operating Mode** is selected, various application-specific parameters are already preconfigured. This simplifies setup and saves time.
Below we describe four operating modes and explain their respective default settings and intended uses.

Mark/Object Positioning

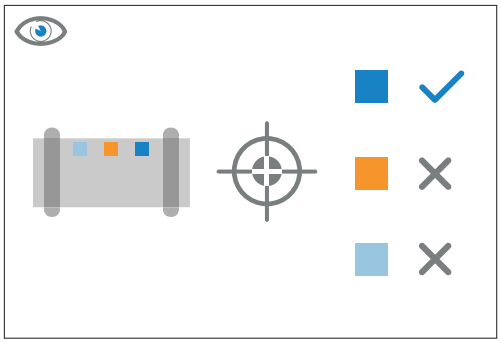


*Figure 39: **Mark/Object Positioning***

This mode is recommended when the sensor is used as a color mark sensor, e.g., in packaging machines. The sensor is preset to the shortest response time (36 µs) and medium sensitivity (CMV threshold of 900). This makes the sensor a very fast color mark sensor with a 13.8 kHz switching frequency. (see "Output Mode Standard", page 31)

Fast Sorting

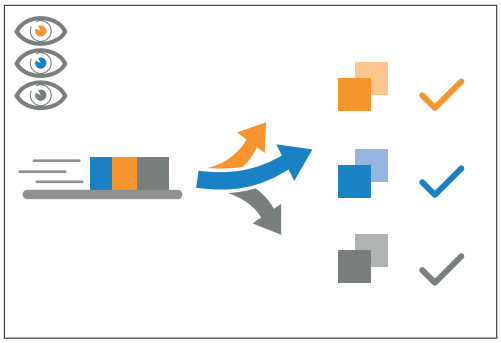


*Figure 40: **Fast Sorting***

This mode is recommended when the sensor is used as a sorting sensor, i.e., if objects are to be sorted quickly on the basis of their distinguishing feature: color. A fast response time of 72 µs and the **Best Fit** mode (see "Output Mode Best Fit", page 31) are also preset here. The sensitivity is set to a CMV threshold of 800. This turns the sensor into a fast color sorting sensor.

Object Separation

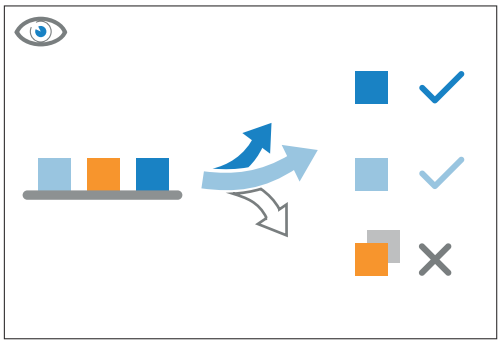


*Figure 41: **Object Separation***

This mode is recommended when objects are to be separated with high precision on the basis of their color. In this case a higher response time of 300 ms and thus high color resolution is set.
Example applications include verifying a component in a handling process based on a similarly colored identical part, e.g., the correct gripping of a vehicle interior part or upholstery with small color differences. **Best Fit** mode (see "Output Standard Best Fit", page 31) is also activated. The sensitivity is set to a CMV threshold of 800.

Color Verification

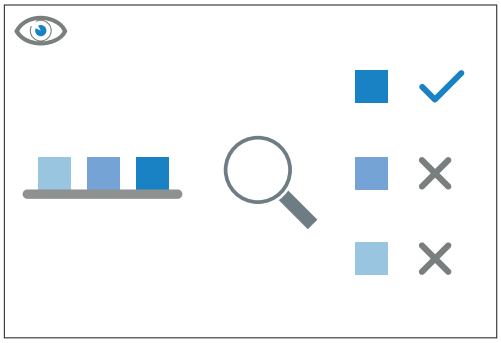


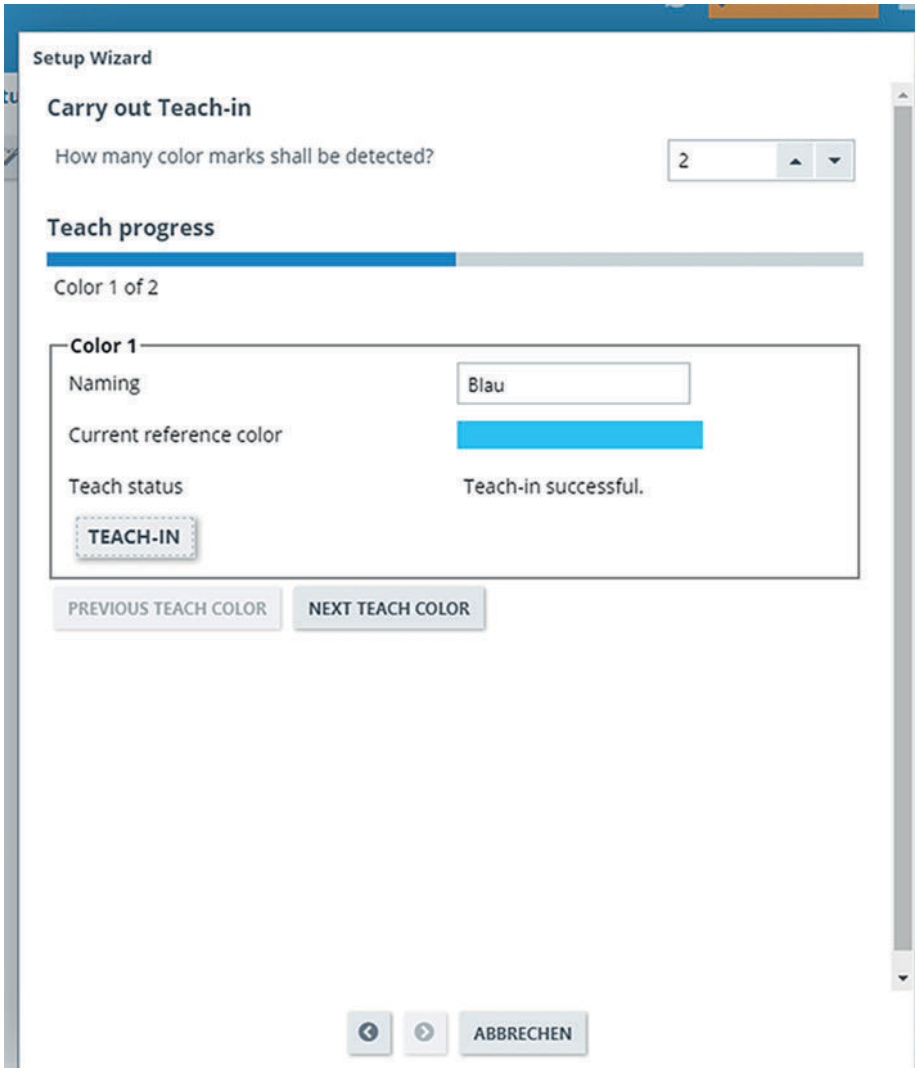
*Figure 42: **Color Verification***

This mode is recommended if a taught-in color is to be verified or detected very precisely. This involves, for example, precise quality checks of an object based on its color. The focus is not on distinguishing the object from a bad part, but on an exact recognition of the color values. In this mode, the sensor has a slow response time of 600 ms and a very high color resolution. Best Fit mode is deactivated and the sensitivity is set to a CMV threshold of 950. (see "Output Mode Standard", page 31)

7.2.2.3 Teach-in

Set teach-in

- How many objects need to be taught in?
- Teach in objects according to the instructions in the Setup Wizard.



7.2.2.4 Assignment and configuration of the digital outputs

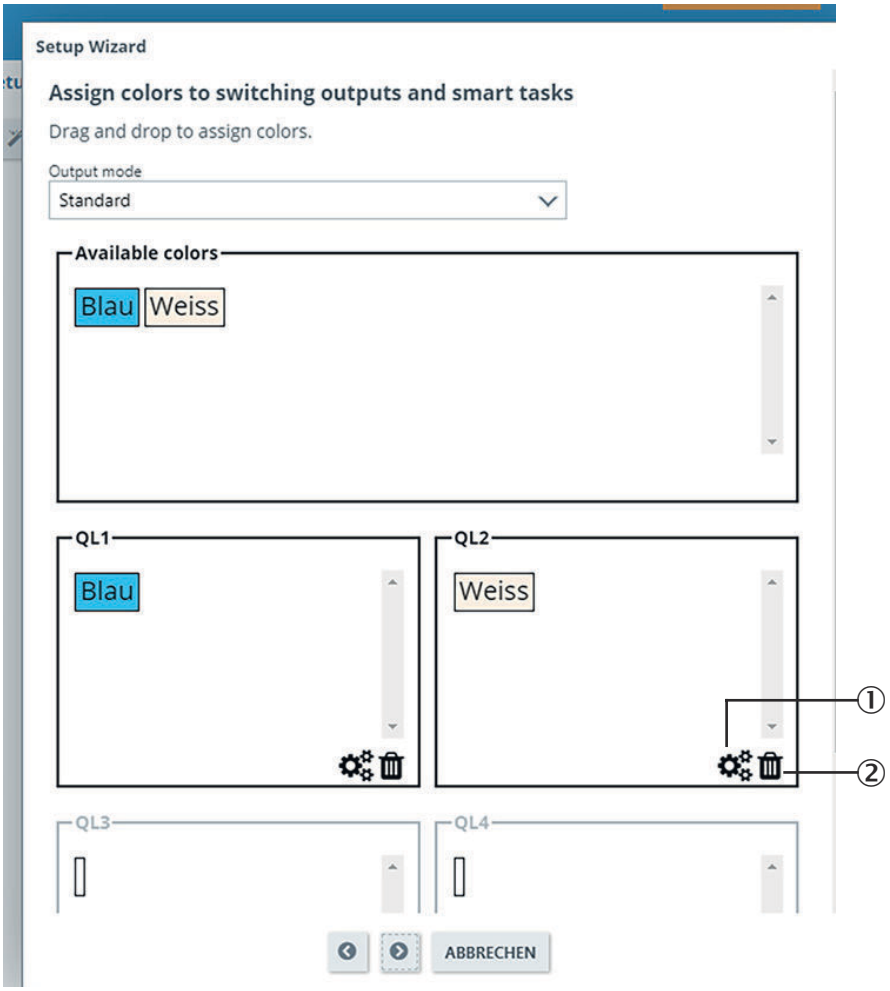
Assignment and configuration of the digital outputs via drag & drop

Option 1

Assignment to 2 and 4 digital outputs (see "Output Mode", page 31)

- **Output Mode Standard**
- **Output Mode Best Fit**

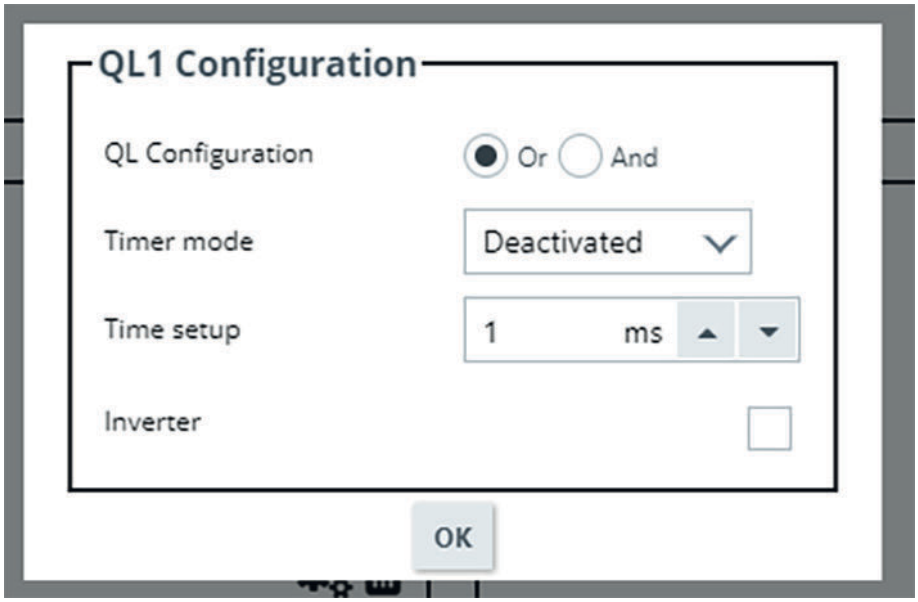
In **Output Mode Standard** and **Output Mode Best Fit**, the taught-in objects can be assigned to the digital outputs (QL) as required.
The CSx-xBxxxxx5A variants only have two physical digital outputs.
The grayed-out QL3 and QL4 are virtual digital outputs that can only be output via IO-Link.



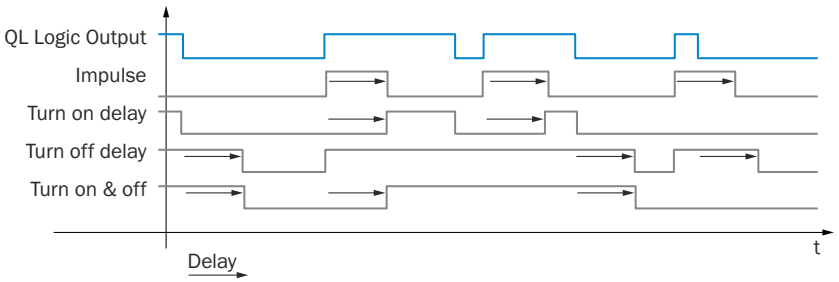
① Open settings
Opens the QL Configuration.

② Discard QL assignment
The assignment of all colors linked to the QL is deleted.

Further configurations of a switching output can be set via “Open settings” (①). The logical link between the colors can be set via the QL Configuration.



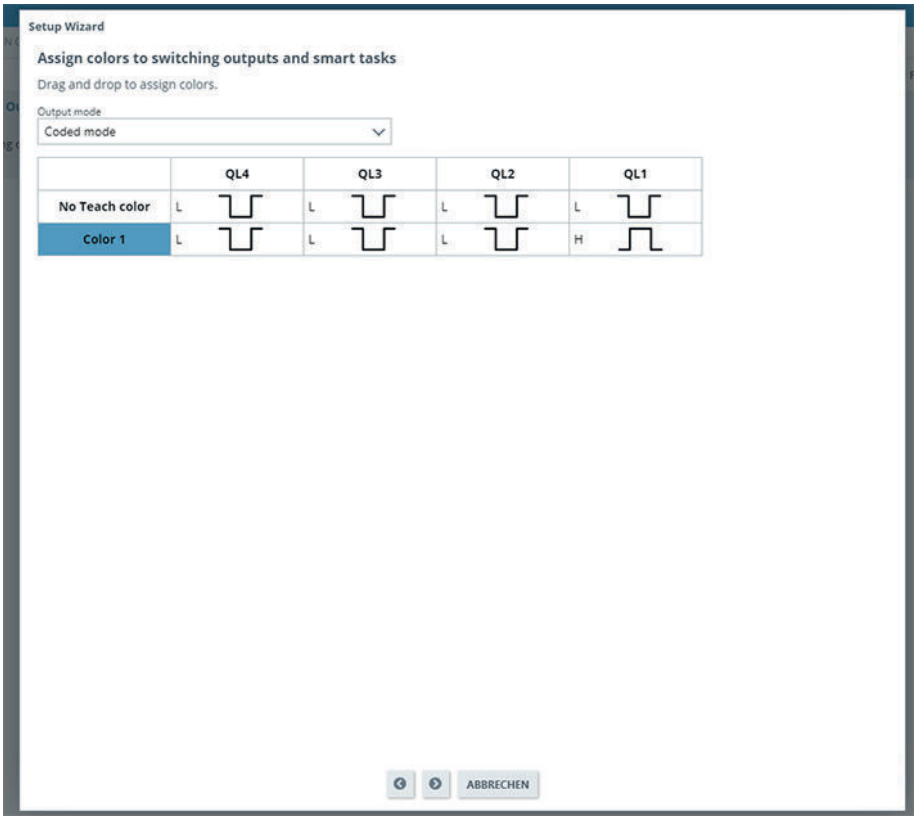
- QL Configuration
  Or At least one of the colors linked to the QL must be detected in order to trigger switching of the QL. This is the default option for the CSS/CSX, and is suitable if any one of the taught-in colors should lead to the QL being switched.
  And
  All of the taught-in colors must be detected simultaneously in order to trigger switching of the QL. This option is suitable, for example, for triggering switching of the QL in the transition area between two colors.
- Timer mode and Time setup can be used together to configure a switch-on or switch-off delay for the QL. The various delays have the following effect:



- Inverting the QL reverses the switching behavior of the switching output (Active / Inactive).

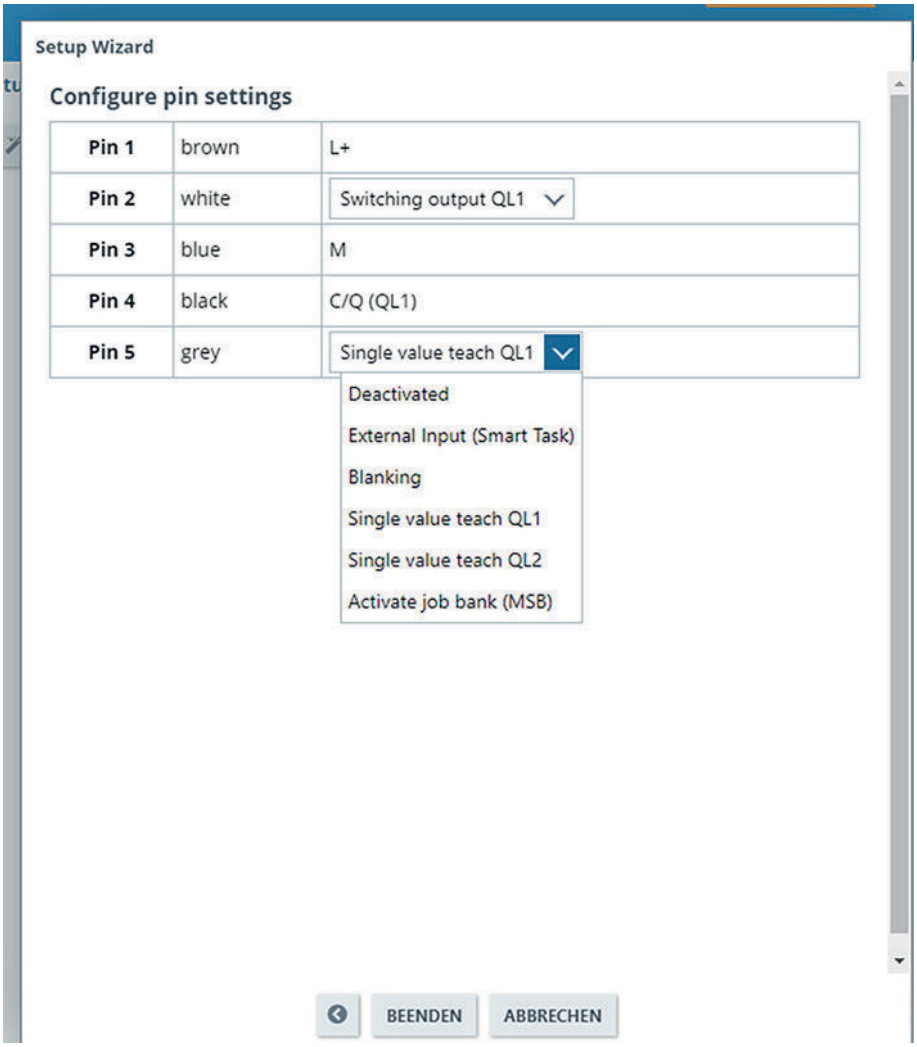
Option 2

Binary linking of the digital outputs: “Coded” mode
In “Coded” mode, the digital outputs are linked together using binary coding. Thus, up to 16 states can be distinguished via 4 QL. For the CSx-xBxxxxxx5A variants, only three colors and the “No Teach-in color active” status can be mapped in “Coded” mode. The digital outputs are linked automatically for an individual assignment (e.g., one object on two digital outputs), configurations (e.g., T-on Delay) and logic operations (e.g., AND linking of the digital outputs), the “Standard” mode is preferable.



7.2.2.5 Configuring the pins

In the final step, different functions can be assigned to the multifunctional pins (see "Pin settings", page 33).



If at least one of the IO pins is set to “External Input (Smart Task)”, an additional table for linking the input pin with the QL switching outputs is displayed. Here it is possible to use the pin corresponding to one of the taught-in colors as an input to a QL. This means that the level of the input pin is monitored and the logic state is included in the And / Or logic calculation. This option is suitable, for example, for linking several sensors. If the logical operator And is set, the QL only becomes active if the linked color is detected and the level at the input pin (e.g., the switching output of a photoelectric sensor) is active at the same time.

External Input (Smart Task)

Link external input to QI output logic, like an available color.

	QL1	QL2	QL3	QL4
Pin 1	☐	☐	☐	☐
Pin 5	☐	☐	☐	☐

7.2.3 Adjustments

NOTICE
Simultaneous operation via SOPAS / IO-Link and the control panel is not possible.

7.2.3.1 Setting the response time

1. Select the **Configuration** area.
2. Select the **Settings** tab.
3. Click on the arrow next to **Response time**.
4. Select the desired **Response time**.

For a response time of 36 µs and 72 µs, 4 colors can be taught in.

For a response time of 150 µs or higher, up to 24 colors can be taught in.

7.2.3.2 Setting the Color mode

The CSS distinguishes between two color modes:

C-Mode (Color Mode)
In C Mode, only the color and not the brightness (illumination) of the color is decisive for color recognition and differentiation. This means, for example, that no distinction will be made between light green and dark green, but only between green and non-green. Faded colors, contaminated objects, or even fluctuating distances of an object will therefore play a minor role, since they only affect the color intensity (illumination) but not the color value itself.

C+I Mode (Color and Illumination Mode)
In C+I Mode, however, the intensity (illumination) is also taken into account, i.e., light green is distinguished from dark green, for example. Sensing distances and gloss are therefore also included in the color evaluation. This mode is suitable for especially accurate color detection, but not for rugged applications with fluctuating conditions.

1. Select the **Configuration** area.
2. Select the **Settings** tab.
3. Click on the arrow next to **Color mode**.
4. Select the desired **Color mode**.

7.2.3.3 Sender configuration

While the sender is inactive, no measured values or switching signals are output.

1. Select the **Configuration** area.
2. Select the **Settings** tab.
3. Click on the arrow next to **Sender configuration**.
4. Select **Sender active** or **Sender not active**.

7.2.3.4 Setting Find me

The sensor can be uniquely identified using **Find me**. For applications with several identical sensors, it is therefore possible to uniquely identify the device with which communication is currently taking place.

1. Select the **Configuration** area.
2. Select the **Settings** tab.
3. Click on the arrow next to **IO-Link Find me**.
4. Deactivate the function or select **Yellow LED blinks with 1 Hz**

NOTE
IO-Link Find me can also be set in the **Identification** area (see figure 38, page 48).

7.2.3.5 Setting Notification handling

Controls the IO-Link functions.

1. Select the **Configuration** area.
2. Select the **Settings** tab.
3. Click on the arrow next to **Notification handling**.
4. Select the desired setting.

The following functions can be selected:

- All enabled = IO-Link Events are set, PD invalid flag is used by the sensor.
- All disabled = IO-Link Events are not set, PD invalid flag is not used by the sensor.
- Events enabled, PD invalid flag disabled = IO Link Events are switched on, PD Invalid flags are not used.
- Events disabled, PD invalid flag enabled = IO Link Events are switched off, PD Invalid flags are used.

7.2.3.6 Setting Local User Interface Lock

1. Select the **Configuration** area.
2. Select the **Settings** tab.
3. Click on the arrow next to **Local User Interface Lock**.
4. Activate or deactivate the function.

7.2.3.7 Setting Energy saving mode for display

1. Select the **Configuration** area.
2. Select the **Settings** tab.
3. Click on the arrow next to **Energy saving mode for display**.
4. Activate or deactivate the function.

7.2.3.8 Setting Display direction switch

1. Select the **Configuration** area.
2. Select the **Settings** tab.
3. Click on the arrow next to **Display direction switch**.
4. Select the desired setting.

7.2.3.9 Setting Job assurance

1. Select the **Configuration** area.
2. Select the **Settings** tab.
3. Click on the arrow next to **Activate job bank**.
4. Select a **Job bank**.
5. Click Activate.
6. The selected **Job bank** is activated and the associated settings are displayed.

7.2.3.10 Setting Teach-in

teaching in a new color

1. Select the **Configuration** area.
2. Select the **Teach-in** tab.
3. Click on + in the table.
4. Set the sensitivity, teach-in type, and the name of the taught-in color.
5. Align the sensor with the object to be taught-in.
6. Click **Teach-in**.
7. The new color is taught in and displayed in the table.

changing a taught-in color

1. Select the **Configuration** area.
2. Select the **Teach-in** tab.
3. Click on the cogwheel next to the taught-in color that is to be configured.
4. Set the sensitivity, teach-in type, and the name of the taught-in color.
5. Align the sensor with the object to be taught-in.
6. Click **Teach-in**.
7. The changes are applied.

7.2.3.11 Assigning taught-in colors to the switching outputs and setting Output mode

1. Select the **Configuration** area.
2. Select the **Smart Tasks and switching output assignment** tab.
3. Select the desired mode in the **Output mode** line.
4. The taught-in colors can be **dragged and dropped** to the switching outputs to assign them.

7.2.3.12 Setting pin 2 and pin 5

1. Select the **Configuration** area.
2. Select the **Pin setting** tab.
3. Press the arrow next to the desired PIN.
4. Select the function.

7.2.4 Diagnostic settings

7.2.4.1 Setting thresholds

1. Select the **Diagnostics** area.
2. The individual thresholds for **Maximum temperature**, **Minimum temperature** and **Operating hours** can be set for **Threshold alarm output**.

7.2.4.2 Resetting the operating hours

1. Select the **Diagnostics** area.
2. Click on **Reset** next to **Since last reset**.

✓ The operating hours counter is set to 0 and the status history table is cleared.

8 Troubleshooting

8.1 Possible errors during commissioning

LED indicator/fault pattern	Cause	Measures
- Q-LED flashes - Indicator on display “Err”	- Short-circuit / Overcurrent - Sensor is not connected properly	- Disconnect sensor from the power network - Check pin assignment - Reconnect sensor - Check the current at the switching output
Low quality of teach after teach-in	Variance of the individual teach-in values for a multi-value teach-in is too large.	Teach in object again

8.2 Troubleshooting

Troubleshooting after teach-in

Table 13: Troubleshooting after teach-in

Display, error situation	Cause	Measure
Sensor does not switch for an object of the taught-in color	Sensitivity not set appropriately for the application	Check the Color Matching Value (CMV), if necessary adjust the sensitivity based on the CMV. Example: CMV of taught-in color: 980, CMV of background: 700, Suitable sensitivity: 950
Sensor switches to another taught-in color when transitioning to an object	Sensor registers a mixed color that is within the tolerance range of another taught-in object	Add T-on Delay, if possible change the color of the background
Sensor cannot distinguish the object from the background	Colored object: The more colors in a teach-in, the larger the tolerance range	Teach-in individual colors of the object using Add-Teach-in instead of Multi-Value Teach-in
Isolated faulty switching	Direct light / reflection from the sun, spotlights or flashlights	Check light sources and reflections (e.g. from metal) in the field of view and shield the sensor
Strongly fluctuating Color Matching Value (CMV) when an object moves into view	Deviation from recommended entry direction	Ensure a lateral entry of the object
Unstable switching and strongly fluctuating (color & CMV) values on an object surface at a constant distance	Shiny object	Tilt the sensor sideways by 15°, select C mode if necessary (see "Color Mode (C Mode, C+I Mode)")
Sensor does not switch for every taught-in color (e.g. Color 3 or Add-Teach-in)	Response time is set to 36/72 µs, which limits the memory capacity	Set the response time to min. 150 ms or select Multi Value Teach-in instead of the Add function
Transparent objects cannot be distinguished	Signal loss due to opacity	Attach reflective tape in the background to amplify the signal

Display, error situation	Cause	Measure
FULL!	Number of colors that can be taught in exceeded. This depends on the selected response time. Only if a response time of 150 ms or higher is set, up to 24 colors can be taught in.	If possible, change the response time to 150 ms or higher

Troubleshooting during operation

Table 14: Troubleshooting during operationf

Display, error situation	Cause	Measure
Quality of Run decreases over time / Color Matching Values (CMV) become lower for the same object	Contamination of front screen	Check front screen, clean if necessary

8.3 Troubleshooting integrated IO-Link devices (xxxxxxxxxA variants)

Notes on malfunctions can be found in the service data.

Details of the available service data can be found in the detailed IO-Link description: **Technical Information: CSS/CSX**.

9 Maintenance

9.1 Maintenance

During operation, the device works maintenance-free.

Depending on the assignment location, the following preventive maintenance tasks may be required for the device at regular intervals:

Table 15: Maintenance schedule

Maintenance work	Interval	Implementation
Clean housing and front screen	Cleaning interval depends on ambient conditions and climate	Specialist
Check screw connections and plug connectors	Every 6 months	Specialist

9.2 Cleaning the device

At regular intervals (e.g., weekly), check the light emission window and the housing of the device for dirt. This is especially relevant in harsh operating environments (dust, abrasion, damp, fingerprints, etc.). The lens of the light emission window must be kept clean and dry during operation.

NOTICE
Device damage due to improper cleaning!
Improper cleaning may result in device damage.

- Only use suitable cleaning agents.
- Never use sharp objects for cleaning.

Cleaning the light emission window

NOTICE
Damage to the light emission window!
Reduced reading performance due to scratches or streaks on the light emission window!

- ► Clean the light emission window only when wet.
- ► Use a mild cleaning agent that does not contain powder additives. Do not use aggressive cleaning agents, such as acetone, etc.
- ► Avoid any movements that could cause scratches or abrasions on the light emission window.
- ► Only use cleaning agents suitable for the lens material.

NOTE
Static charge may cause dust particles to stick to the light emission window. This effect can be avoided by using an anti-static glass cleaner in combination with the SICK lens cloth (can be obtained from www.sick.com).

NOTE
If the light emission window is scratched or damaged (cracked or broken), the device must be replaced. Contact SICK Service to arrange this.

Cleaning the housing

In order to ensure that the heat produced by the internal power loss is adequately dissipated, the housing surface must be kept clean.

9.3 Repair

The product is replaced if defective. The device is not intended to be repaired. Interference with or modifications to the device on the part of the customer will invalidate any warranty claims against SICK AG.

10 Decommissioning

10.1 Disassembly and disposal

Disassembling the device

1. Switch off the supply voltage to the device.
2. Detach all connecting cables from the device.
3. If the device is being replaced, mark its position and alignment on the bracket or surroundings.
4. Detach the device from the bracket.

Disposing of the device

Any device which can no longer be used must be disposed off in an environmentally friendly manner in accordance with the applicable country-specific waste disposal regulations.

NOTE

Disposal of batteries, electric and electronic devices

- According to international directives, batteries, accumulators and electrical or electronic devices must not be disposed of in general waste.
- The owner is obliged by law to return this devices at the end of their life to the respective public collection points.
-  This symbol on the product, its package or in this document, indicates that a product is subject to these regulations.

10.2 Returning devices

► Do not dispatch devices to the SICK Service department without consultation.

NOTE

To enable efficient processing and allow us to determine the cause quickly, please include the following when making a return:

- Details of the contact person
- Description of the application
- Description of the fault that occurred

10.3 Sensor replacement/data storage

All IO-Link devices (xxxxxxxxA variants) have a backup and restore functionality - **Data Storage** (DS). The IO-Link **Data Storage** function can be used to save previous parameters and transmit them to the replacement device.

The prerequisite for this is connection of the device to an **IO-Link Master**, and activation of the **storage** function in the **IO-Link Master**.

Details on sensor replacement can be found in the detailed IO-Link description: **Technical Information: CSS/CSX**.

11 Technical data

11.1 Technical data

The “Technical Data” section contains only an extract of the technical data of the sensor.

The complete technical data can be found on the homepage www.sick.com under the part number of the sensor.

Features

Table 16: Features

CSS/CSX	xxxx1	xxxx5
Sensing distance	13 mm	60 mm
Light sender	LED, RGB	
LED risk group according to IEC 62471:2006	1	
Wavelength	460 nm, 530 nm, 625 nm	
Light emission	Short device side/long device side	
Light spot size	2 mm x 4 mm	12 mm
Light spot direction	Round	Round, large
Teach-in method	Single Value Teach-in Multi Value Teach-in	
Color mode	C (Color) C+I (Color + Illumination)	
Output mode	2 or 4 colors in Standard/Best Fit output mode 3 or 15 colors in Coded output mode (depends on variant)	
Adjustment of the sensitivity	Continuous: 0...999	
Available job banks	4	

Mechanics/Electronics

Table 17: Mechanics/Electronics

CSS/CSX	xxxxxxxx5	xxxxxxxx8
Supply voltage	10.8 V DC ... 28.8 V DC[1]	
Ripple	≤ 5 V_{SS}[2]	
Current consumption without load	< 150 mA	
Initialization time	< 2 s	
Switching frequency max.	13.8 kHz	
Response time min.	36 µs	
Jitter min.	18 µs	
Switching output	Push-pull: PNP/NPN or NPN (depends on variant)	
Digital output (voltage)	Push-pull Level high: UV – 3 V Level low: ≤3 V or NPN Level high: U_V Level low: ≤3 V (depends on variant)	

CSS/CSX	xxxxxxxx5	xxxxxxxx8
Output current $I_{max.}$	100 mA[3]	
Channel output	2x hardware switching outputs	4x hardware switching outputs
Input, teach-in (ET)	Push-pull Level active: 10 V ≤ U_{IN} ≤ U_V Level inactive: U_{IN} ≤ 2 V or NPN Level active: U_{in} ≤ 2 V Level inactive: U_{in} ≥ 10 V ... U_v (depends on variant)	
Input, blanking input (AT)	Push-pull Level active: 10 V ≤ U_{IN} ≤ U_V Level inactive: U_{IN} ≤ 2 V or NPN Level active: U_{IN} ≤ 2 V Level inactive: U_{IN} ≥ 10 V ... U_V (depends on variant)	
Storage time (ET)	3 sec, non-volatile memory	
Connection type	Male connector, M12, 5-pin	Male connector, M12, 8-pin
Protection class	III	
Circuit protection	U_V connections, reverse polarity protected Output Q, short-circuit protected Interference pulse suppression	
Enclosure rating	IP67	

1 Limit values: 12 V DC (–10%) ... 24 V DC (+20%). Operation in short-circuit protected network max. 8 A.
2 Must not exceed or fall below U_V tolerances.
3 Total current of all outputs.

Interfaces

Table 18: Interfaces

CSS/CSX	xxxxxxxxxA	xxxxxxxxxR
Communication interface	IO-Link	Modbus RS-485
Maximum cable length between IO-Link Master and IO-Link device	20 m	

Ambient data

Table 19: Ambient data

Ambient temperature, operation	–20 °C ... +60 °C
Ambient temperature, storage	– 25 °C ... + 75 °C
Impact load	According to IEC 60068-2-27 (30 g / 11 ms)
UL file no.	E181493

11.2 Dimensional drawing

NOTE
All dimensions in mm (inch).

CSX High Speed TW 13 mm, light emission on long side

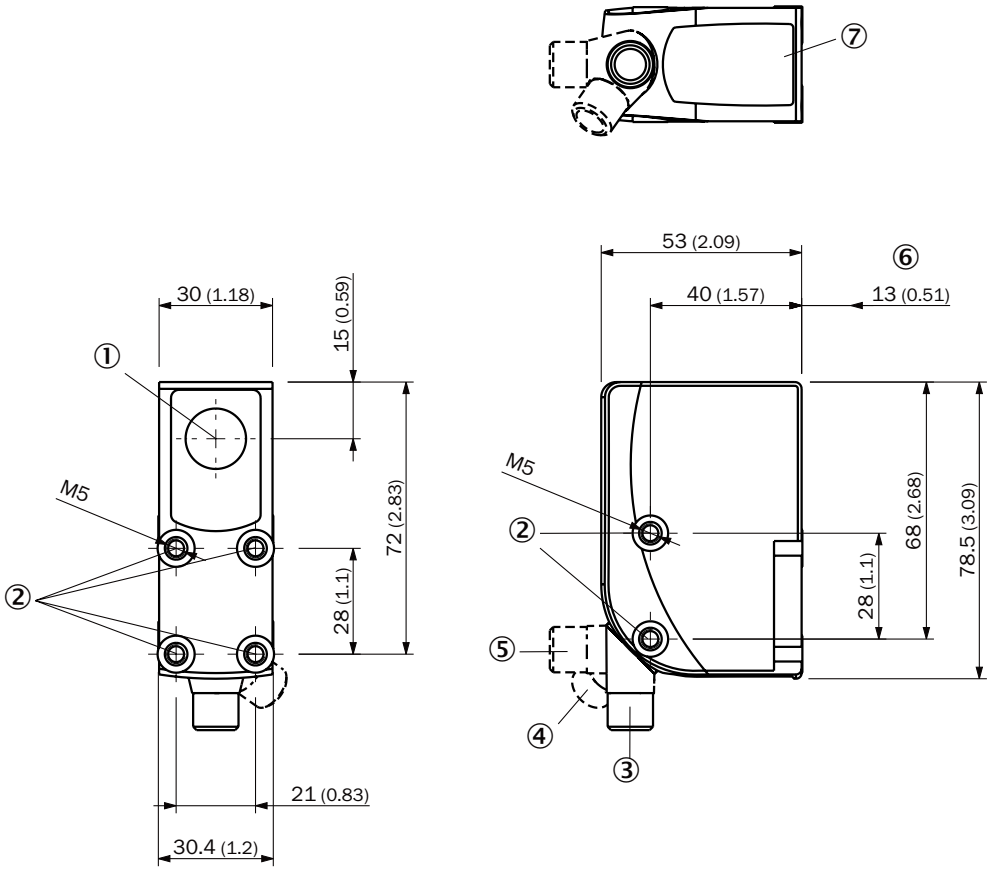


Figure 43: CSX High Speed TW 13 mm, light emission on long side

① Optical axis light emission long housing side
② M5 threaded mounting hole
③ Male connector M12, delivery state
④ M12 male connector, end stop right
⑤ M12 male connector, end stop left
⑥ Sensing distance
⑦ Display and setting elements

CSX High Speed TW 13 mm, light emission on short side

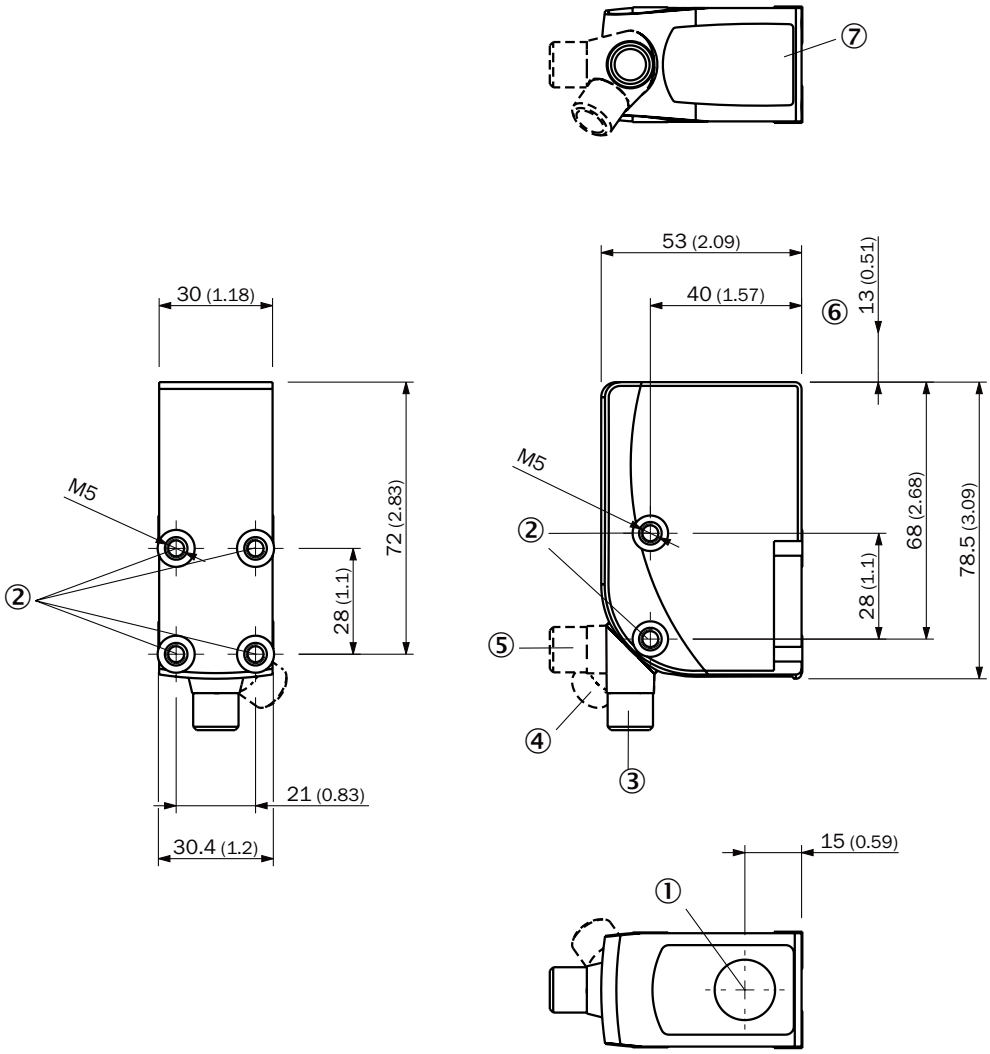


Figure 44: CSX High Speed TW 13 mm, light emission on short side

① Optical axis light emission short housing side
② M5 threaded mounting hole
③ Male connector M12, delivery state
④ M12 male connector, end stop right
⑤ M12 male connector, end stop left
⑥ Sensing distance
⑦ Display and setting elements

CSX High Speed TW 60 mm, light emission on long side

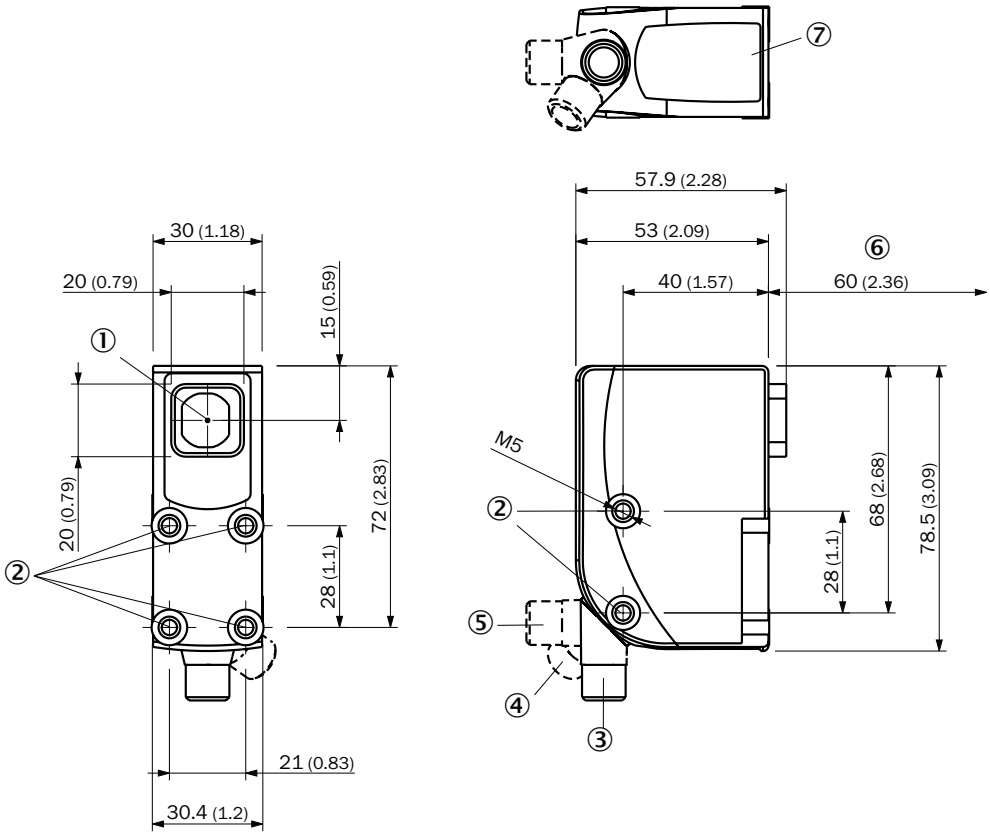


Figure 45: CSX High Speed TW 60 mm, light emission on long side

① Optical axis light emission long housing side
② M5 threaded mounting hole
③ Male connector M12, delivery state
④ M12 male connector, end stop right
⑤ M12 male connector, end stop left
⑥ Sensing distance
⑦ Display and setting elements

CSX High Speed TW 60 mm, light emission on short side

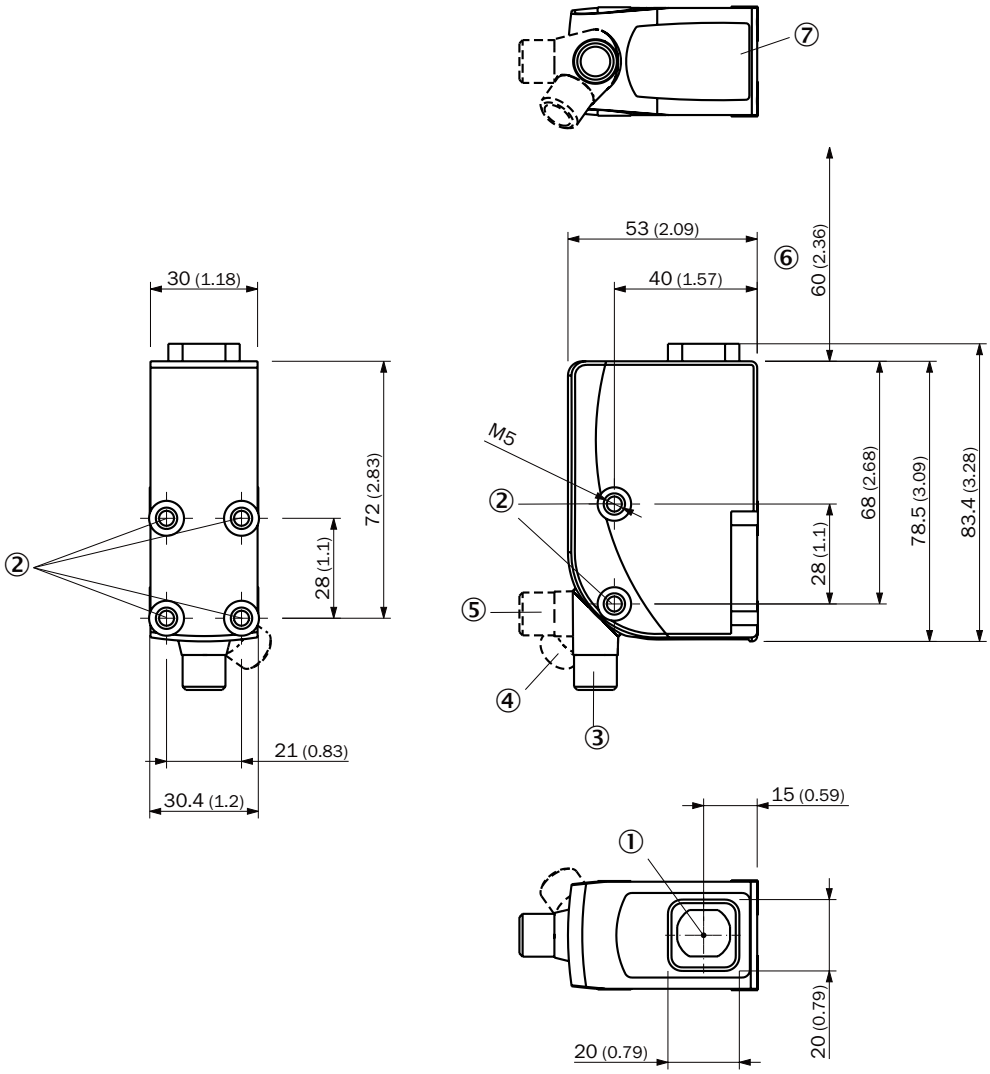


Figure 46: CSX High Speed TW 60 mm, light emission on short side

① Optical axis light emission short housing side
② M5 threaded mounting hole
③ Male connector M12, delivery state
④ M12 male connector, end stop right
⑤ M12 male connector, end stop left
⑥ Sensing distance
⑦ Display and setting elements

CSS High Speed TW 13 mm, light emission on long side

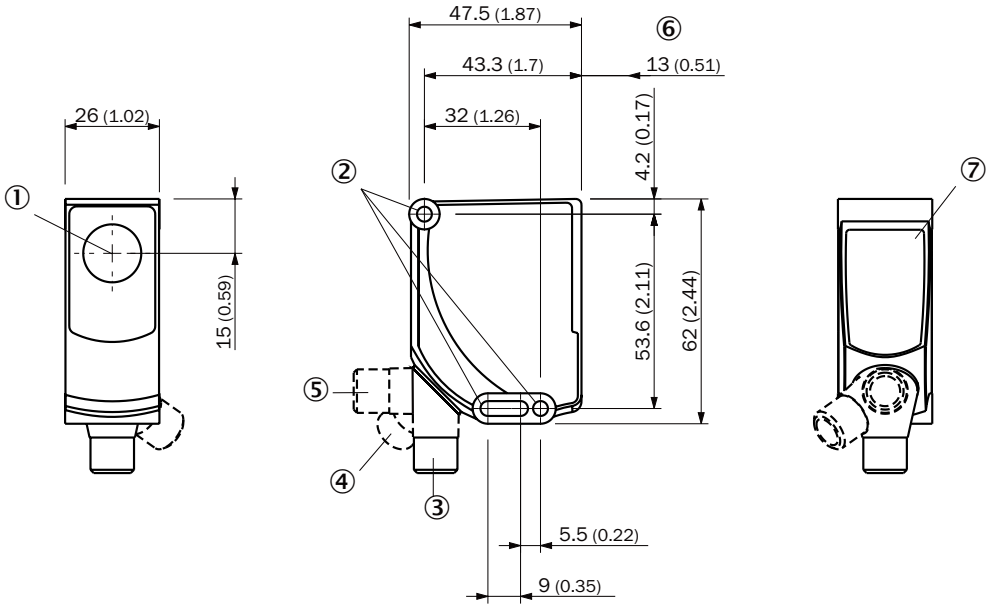


Figure 47: CSS High Speed TW 13 mm, light emission on long side

① Optical axis
② Fixing hole
③ Male connector M12, delivery state
④ M12 male connector, end stop right
⑤ M12 male connector, end stop left
⑥ Sensing distance
⑦ Display and setting elements

CSS High Speed TW 60 mm

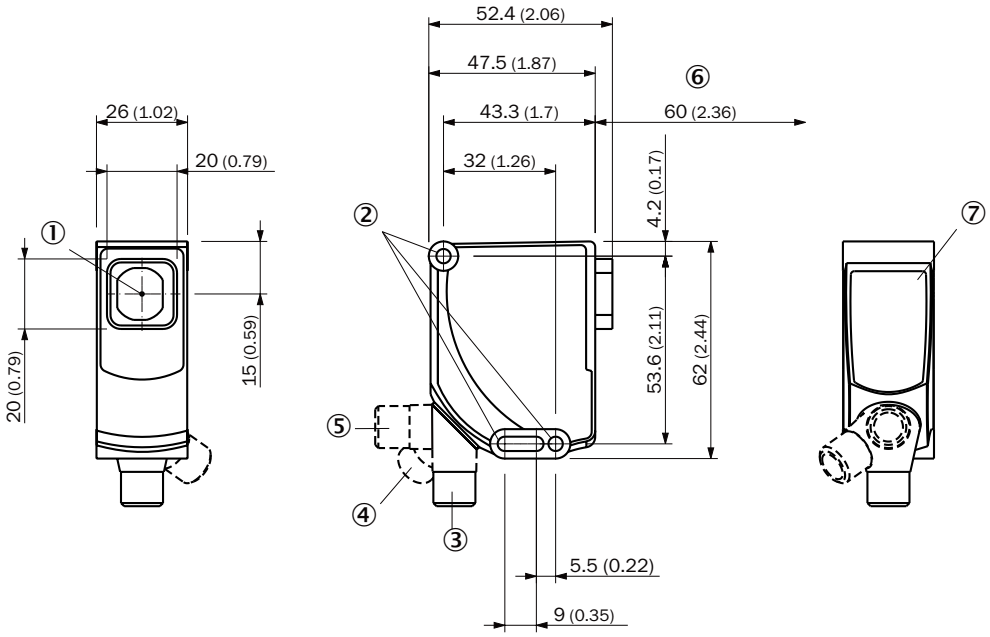


Figure 48: CSS High Speed TW 60 mm

① Optical axis
② Fixing hole
③ Male connector M12, delivery state
④ M12 male connector, end stop right
⑤ M12 male connector, end stop left
⑥ Sensing distance
⑦ Display and setting elements

12 accessories

NOTE

Accessories can be found on the online product page at:

► www.sick.com/CSS_CSX_High_Speed

13 Annex

13.1 Modbus RTU (xxxxxxxxR variants)

NOTE
Modbus is a client/server protocol (formerly master/slave).

13.1.1 Radio interference

NOTE
Using the device in residential areas may cause radio interference. It is the responsibility of the operating entity to take appropriate measures (e.g. shielding).

The following describes the first steps for commissioning with Modbus RTU. In the description, we refer to the “Modbus application protocol specification V1.1” Modbus standard as well as the “Modbus over serial line specification and implementation guide V1.02", available at www.modbus.org.

13.1.2 Setting the ID and baud rate

NOTE
The SOPAS software can be used to configure the interface, see "Operation via SOPAS (xxxxxxxxA variants)", page 37

The following conditions must be met for communication with the Modbus client

- A correct server address must be set on the CSS/CSX.
  Correct is:
  - A server address that has not been allocated in the Modbus network
  - A server address that the client expects
- The same baud rate must be set in the CSS/CSX as in the client.

The following parameters are factory set on the CSS/CSX

- Server address: 10
- Baud rate: 19,200 bps
- Parity: even

NOTE
The CSS/CSX does not have an internal termination resistor, which serves as a bus terminator. This must be taken into account when operating the device in a Modbus network:

- For a point-to-point connection, an additional external bus terminator must therefore be used.
- If a variant with bus terminator is required, you can get in touch with your SICK contact person.

The following communication parameters can be allocated to the sensor

- Server address: 1 to 247 (0 is usually assigned to the client)
- Baud rate:
  3: 9,600 bps
  4: 19,200 bps
  5: 38,400 bps
  6: 57,600 bps
  7: 115,200 bps
- Parity bit:
  0 = No parity
  1 = Even parity
  2 = Odd parity

13.1.3 Modbus basic information and reading code information

Modbus RTU is based on RS-485 with a Modbus RTU protocol structure. All data exchange involves requests from the server to the client and responses from the client to the server.

The corresponding request/response string consists of four parts

- Server address: Address of the sensor in the Modbus network (allowed values: 1 to 247)
- Function code: Type of request / response
- Data: Data content of the read or write request
- CRC: Checksum for validating the request / response

Function code

Table 20: CSS function codes

Function Code	Register Type	Comment	Description
3	Read Holding Registers	Read/write (r/w) register	for reading r/w configuration parameters
4	Read Input Registers	Read only (ro) register	for reading the ro process data
6	Write Single Holding Register	Write one parameter - only 1 register	for writing a single configuration parameter or a command (only 1 register = 16 bits)
16	Write Multiple Holding Registers	Write a block of parameters	for blockwise writing of several configuration parameters or parameters consisting of several registers.

13.1.4 Examples

Example 1: Register 202 - 204 = Read RGB color information

Table 21: Example 1: Register 202 - 204 = Read RGB color information

	Field 1	Field 2	Field 3		Field 4
Parameter value	Server address	Function code	Start address	Number of registers Register = 16 Bit	CRC
Request from server	Delivery address 10	Read process data 4	Result section 202	Number of registers 3	Telegram check
Server → Client	0x0A	0x04	0x00CA	0x0003	0x914E

	Field 1	Field 2	Field 3		Field 4
Response from CSS	Address repeated	Code repeated	Number of bytes	Data	CRC
Client → Server	0x0A	0x04	0x06	0x000900350 08A	0x5E0B
Result in Dec				Red = 9	Blue
				Green = 53	
				Blue = 138	

Example 2: Register 133 - Single Value Teach-in for QL1

Table 22: Example 2: Register 133 - Single Value Teach-in for QL1

	Field 1	Field 2	Field 3		Field 4
	Server address	Function code	Register address	Parameter value	CRC
Command from the server	Delivery address 10	Write Single Register 6	Result section 133	Teach-in command for QL1 0	Telegram check
Server → Client	0x0A	0x06	0x0085	0x0000	0x9958
Response from CSS	Address repeated	Code repeated	Start address repeated	Parameters repeated	CRC
Client → Server	0x0A	0x06	0x0085	0x0000	0x9958

Device identification

Table 23: "Device Identification" section

Device identification section valid function code 4 = Read Input Registers				
Register address	**Name**	**Number of registers**	**Data type**	**Description / default**
0	Vendor name	4	String	SICK AG
4	Product Code	4	String	Order no. 7-digit
8	Firmware version	6	String	n.n.n**
14	Vendor URL	6	String	www.sick.com
20	Product Name	16	String	Color Sensor
36	Model Name	9	String	Full model designation
45	Serial No.	4	String	JJWWnnnn
49	Application Name	16	String	**********
65	SickModbus ProfileVersion	6	String	
71	Hardware version	2	String	
73	Device-specific name	16	String	**********

Result

Table 24: Result

Result Section valid function code 4 = Read Input Registers				
Register	**Name**	**Number of registers**	**Data type**	**Description / default**
192	QL and Status	1	UINT16	Siehe Abb.
193	Qint	2	UINT32	Bit pattern shows the Qint status
195	CMV QL1	1	UINT16	ColorMatchValue for QL1 (match)
196	CMV QL2	1	UINT16	ColorMatchValue for QL2
197	CMV QL3	1	UINT16	ColorMatchValue for QL3
198	CMV QL4	1	UINT16	ColorMatchValue for QL4
199	Color Value L	1	INT16	Each of the Lab values have 2 decimal places, each of the values must be divided by 100 L = Brightness value (1/100)
200	Color Value a	1	INT16	a = Green - red scale (1/100)
201	Color Value b	1	INT16	b = Blue - yellow scale (1/100)
202	Color Value R	1	INT16	R = Red Intensity
203	Color Value G	1	INT16	G = Green Intensity
204	Color Value B	1	INT16	B = Blue Intensity

Table 25: QL and status

	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Status	Not used		PD invalid	QoR Alarm	QL4	QL3	QL2	QL1
	0 = False / OFF 1 = True / ON							

Table 26: Qint byte 0

Byte no.	**Byte 0**							
Bit offset	31	30	29	28	27	26	25	24
Bitmap	Not used							

Table 27: Qint byte 1

Byte no.	**Byte 1**							
Bit offset	23	22	21	20	19	18	17	16
Bitmap	Qint24	Qint23	Qint22	Qint21	Qint20	Qint19	Qint18	Qint17

Table 28: Qint byte 2

Byte no.	**Byte 2**							
Bit offset	15	14	13	12	11	10	9	8
Bitmap	Qint16	Qint15	Qint14	Qint13	Qint12	Qint11	Qint10	Qint9

Table 29: Qint byte 3

Byte no.	**Byte 3**							
Bit offset	7	6	5	4	3	2	1	0

Byte no.	Byte 3							
Bitmap	Qint8	Qint7	Qint6	Qint5	Qint4	Qint3	Qint2	Qint1

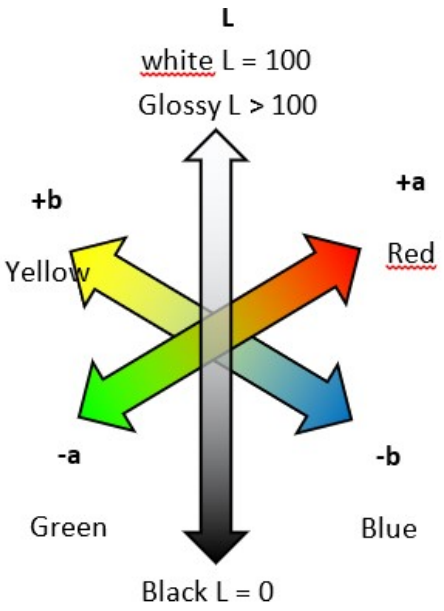


Figure 49: Lab color measurement

Status

Table 30: Status

Status Section valid function code 4 = Read Input Registers				Description
4096	Device Status	1	UINT16	1 = Device is OK 1= Action required (e.g. teach-in) 2 = Outside specification 3 = Function check-out 4 = Error
4097	Current Temperature	1	INT16	Internal device temperature in °C
4098	Max. Temperature all time	1	INT16	Maximum internal device temperature since production of the sensor in °C
4099	Min. Temperature all time	1	INT16	Minimum internal device temperature since production of the sensor in °C
4100	Total Operating Hours	2	UINT32	Operating hours since production of the sensor in h
4102	Max. Temperature since last Reset	1	INT16	Maximum internal device temperature since the last reset via a system command in °C
4103	Min. Temperature since last Reset	1	INT16	Minimum internal device temperature since the last reset via a system command in °C
4104	Operating Hours since last Reset	2	UINT32	Operating hours since the last reset via a system command in h
4106	Distance to Object	1	UINT16	Distance to the object in 0.1 mm increments
4107	Currently selected Operating Mode	1	UINT16	The operating mode currently set in the device (see address no. 132)

Status Section valid function code 4 = Read Input Registers				Description
4108	Quality Levels	12	Array24	Display of the process quality (QoR) for all 24 taught-in objects Byte0 = QoR for Qint1 Byte1 = QoR for Qint2 ... Byte23 = QoR for Qint24
4120	Color Matching Values	24	Array48	Match level (CMV) for all 24 taught-in objects Byte0-1 = CMV for Qint1 Byte2-3 = CMV for Qint2 ... Byte46-47 = CMV for Qint24
4144	Teach-in Status	1	UINT16	0 = Idle - no teach-in performed since last device start 1 = SP1 - not relevant 2 = SP2 - not relevant 3 = SP12 - teach-in successful 4 = Wait for command 5 = Busy (teach-in process in progress) 7 = Teach error
4145	Quality of Run	1	UINT16	Process quality in percent
4146	Active Job Bank	1	UINT16	The currently active job bank in the sensor 0 = Job bank 1 1 = Job bank 2 2 = Job bank 3 3 = Job bank 5
4147	Quality of Teach	1	UINT16	Teach-in quality in percent

Commands

Table 31: Commands

Command Section valid Function Code 6 = Write Single Register				Description
96	Set Application Name	16	String	Entry for arbitrary 32-character text for the name of the application
113	Restore factory settings	1	UINT16	any value >= 1 for reset to factory setting
114	Application Reset	1	UINT16	any value >= 1 for resetting the application parameters
115	Reset diagnostic parameters	1	UINT16	any value >= 1 for resetting the diagnostic parameters
116	Set Device Name	16	String	Entry for arbitrary 32-character text for the device name
132	Set operating mode	1	UINT16	Selection of different operating modes with customized configuration parameters for different applications
133	Single Value Teach-in	1	UINT16	The value (0 to 23) determines the associated Q output for the single-value-teach-in
134	Start Multi Value Teach-in	1	UINT16	The value (0 to 23) determines the associated Q output for starting the multi-value-teach-in

Command Section valid Function Code 6 = Write Single Register				Description
135	Stop Multi Value Teach-in	1	UINT16	any value >= 1 to end the dynamic multi-value teach-in
136	Abort Teach-in Sequence	1	UINT16	any value >= 1 to abort the dynamic multi-value teach-in
137	Remove Teach Object	1	UINT16	To interrupt the multi-value teach-in when the teach object is removed The value (0 to 23) determines the associated Q output
138	Active Job Bank	1	UINT16	To activate the job banks available in the sensor. The current settings are stored in the last selected job bank. (see address 4146). 0 = Job bank 1 will be activated 1 = Job bank 2 will be activated 2 = Job bank 3 will be activated 3 = Job bank 4 will be activated

Configuration

Table 32: Configuration

Configuration Section valid Function Code 3 = Read Holding Registers 6 = Write Single Register 16 = Write a block of parameters				Description
144	Modbus RTU Slave Address	1	UINT16	1 - 247 (factory setting: **10**)
145	Modbus RTU Baud Rate	1	UINT16	3 = 9,600 bps **4 = 19200 bps** (factory setting) 5 = 38,400 bps 6 = 57,600 bps 7 = 115,200 bps
146	Modbus RTU Parity Setting	1	UINT16	0 = No parity **1 = Even parity** 2 = Odd parity
147	Local User Interface Lock	1	UINT16	**0 = Control panel unlocked** 1 = Control panel completely locked 2 = Teach-in available, configuration locked
148	Sender configuration	1	UINT16	**0 = Sender light source active** 1 = Sender switched off
149	Pin 2 configuration	1	UINT16	0 = Deactivated 39 = Switching output QL1 34 = Switching output QL2 Standard inputs: 1 = External input (Smart Task) Device-specific: **20 = Blanking** 80 = Single value teach-in QL1 81 = Single value teach-in QL2 90 = Job bank activation (LSB = least significant bit)

Configuration Section valid Function Code 3 = Read Holding Registers 6 = Write Single Register 16 = Write a block of parameters				Description
150	Pin 5 configuration	1	UINT16	0 = Deactivated 39 = Switching output QL1 34 = Switching output QL2 Standard inputs: 1 = External input (Smart Task) Device-specific: 20 = Blanking **80 = Single value teach-in QL1** 81 = Single value teach-in QL2 90 = Job bank activation (MSB = most significant bit)
151	Find Me	1	UINT16	**0 = Deactivated** 1 = All LEDs flash at 1 Hz 16 = All LEDs + QLs flash at 1 Hz
152	Energy saving mode for display	1	UINT16	0 = OFF **1 = ON**
153	Turn Display	1	UINT16	**0 = Not rotated** 1 = Rotated by 180°
154	Measurement averaging	1	UINT16	**0 = No averaging** 1 = Low averaging 2 = Medium averaging 3 = High averaging 4 = Highest averaging
155	Output mode	1	UINT16	**0 = Standard** 1 = Best fit mode 2 = Coded mode
156	Distance regulation enabled	1	UINT16	Distance regulation 0 = Deactivated **1 = Activated**
157	Color Mode	1	UINT16	**0 = C + I mode** = Color and brightness equal 1 = C mode = Color dominates 2 = I mode = Brightness dominates
158	Quality of Run alarm threshold	1	UINT16	Switching threshold for a warning if the process quality is not reached in percent 0 - 90 (factory setting: **50**)

Configuration Section valid Function Code 3 = Read Holding Registers 6 = Write Single Register 16 = Write a block of parameters				Description
160 - Qint 1 184 - Qint 2 208 - Qint 3 232 - Qint 4 256 - Qint 5 280 - Qint 6 304 - Qint 7 328 - Qint 8 352 - Qint 9 376 - Qint 10 400 - Qint 11 424 - Qint 12 448 - Qint 13 472 - Qint 14 496 - Qint 15 520 - Qint 16 544 - Qint 17 568 - Qint 18 592 - Qint 19 616 - Qint 20 640 - Qint 21 664 - Qint 22 688 - Qint 23 712 - Qint 24	Qint. Teach Data	22	Record44	Teach-in data content for Qint, see table 33 the 3-dimensional color data for the switching behavior of the Qint outputs are stored here.
182 - Qint 1 206 - Qint 2 230 - Qint 3 254 - Qint 4 278 - Qint 5 302 - Qint 6 326 - Qint 7 350 - Qint 8 374 - Qint 9 398 - Qint 10 422 - Qint 11 446 - Qint 12 470 - Qint 13 494 - Qint 14 518 - Qint 15 542 - Qint 16 566 - Qint 17 590 - Qint 18 614 - Qint 19 638 - Qint 20 662 - Qint 21 686 - Qint 22 710 - Qint 23 734 - Qint 24	Qint. Configuration	2	UINT32	Byte 0-1: Reference to the teach object linked to the Qint. Byte 2: Sensitivity of the switching output
736	Inverter ext. input	1	UINT16	**0 = Not inverted** 1 = Inverted Bit 0: Inverter Ext. Input 1 (pin 2) Bit 1: Inverter Ext. Input 2 (pin 5)

Configuration Section valid Function Code 3 = Read Holding Registers 6 = Write Single Register 16 = Write a block of parameters				Description
737	Input selector 1	2	UINT32	**0 = No input selected** 1 = Logic input selected Bit 0: Qint. 1 Bit 1: Qint. 2 ... Bit 23: Qint. 24 Bit 24: Ext. Input 1 (pin 2) Bit 25: Ext. Input 2 (pin 5)
739	Logic 1	1	UINT16	1 = AND **2 = OR**
740	Timer 1 Mode	1	UINT16	**0 = Deactivated** 1 = T-on delay = ON delay 2 = T-off delay = OFF delay 3 = T-on / T-off delay = ON / OFF delay 4 = Pulse time
741	Time 1 Setup	1	UINT16	Delay time in ms 1 - 30,000 Factory setting: **1**
742	Inverter 1	1	UINT16	**0 = Not inverted** 1 = Inverted
743	Input selector 2	2	UINT32	**0 = No input selected** 1 = Logic input selected Bit 0: Qint. 1 Bit 1: Qint. 2 ... Bit 23: Qint. 24 Bit 24: Ext. Input 1 (pin 2) Bit 25: Ext. Input 2 (pin 5)
745	Logic 2	1	UINT16	1 = AND **2 = OR**
746	Timer 2 Mode	1	UINT16	**0 = Deactivated** 1 = T-on delay = ON delay 2 = T-off delay = OFF delay 3 = T-on / T-off delay = ON / OFF delay 4 = Pulse time
747	Time 2 Setup	1	UINT16	Delay time in ms 1 - 30,000 Factory setting: **1**
748	Inverter 2	1	UINT16	**0 = Not inverted** 1 = Inverted
749	Input selector 3	2	UINT32	**0 = No input selected** 1 = Logic input selected Bit 0: Qint. 1 Bit 1: Qint. 2 ... Bit 23: Qint. 24 Bit 24: Ext. Input 1 (pin 2) Bit 25: Ext. Input 2 (pin 5)
751	Logic 3	1	UINT16	1 = AND **2 = OR**

Configuration Section valid Function Code 3 = Read Holding Registers 6 = Write Single Register 16 = Write a block of parameters				Description
752	Timer 3 Mode	1	UINT16	**0 = Deactivated** 1 = T-on delay = ON delay 2 = T-off delay = OFF delay 3 = T-on / T-off delay = ON / OFF delay 4 = Pulse time
753	Time 3 Setup	1	UINT16	Delay time in ms 1 - 30,000 Factory setting: **1**
754	Inverter 3	1	UINT16	**0 = Not inverted** 1 = Inverted
755	Input selector 4	2	UINT32	**0 = No input selected** 1 = Logic input selected Bit 0: Qint. 1 Bit 1: Qint. 2 ... Bit 23: Qint. 24 Bit 24: Ext. Input 1 (pin 2) Bit 25: Ext. Input 2 (pin 5)
757	Logic 4	1	UINT16	1 = AND **2 = OR**
758	Timer 4 Mode	1	UINT16	**0 = Deactivated** 1 = T-on delay = ON delay 2 = T-off delay = OFF delay 3 = T-on / T-off delay = ON / OFF delay 4 = Pulse time
759	Time 4 Setup	1	UINT16	Delay time in ms 1 - 30,000 Factory setting: **1**
760	Inverter 4	1	UINT16	**0 = Not inverted** 1 = Inverted

Qint Teach-in data

Table 33: Qint Teach-in data

Byte no.	Byte 0-3	Byte 4-7	Byte 8-11	Byte 12-15	Byte 16-19	Byte 20-23	Byte 24-27	Byte 28-31	Byte 32-35	Byte 36-37	Byte 38-39	Byte 40-41	Byte 42-43
Contents	Nucleus L	Nucleus a	Nucleus b	Rotation L	Rotation a	Rotation b	Extend L	Extend a	Extend b	Hysteresis R	Hysteresis G	Hysteresis B	Signal Damping
Data type	Float	Float	Float	Float	Float	Float	Float	Float	Float	UINT 16	UINT 16	UINT 16	UINT 16

13.2 EU declaration of conformity

You can obtain declarations of conformity, certificates, and the current operating instructions for the product at www.sick.com. To do so, enter the product part number in the search field (part number: see the entry in the “P/N” or “Ident. no.” field on the type label).

13.3 Certification according to UL60947-5-2

The CSS/CSX color sensors are certified in accordance with UL60947-5-2 if it is supplied with power by LPS or Class 2 power supply units.

The certification is only valid with corresponding device identification on the type label of the respective device.

13.4 Licenses

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