OPERATING INSTRUCTIONS

CSS High Resolution

Color Sensor

SICK
Sensor Intelligence.

Described product

CSS High Resolution

Manufacturer

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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

These operating instructions provide important information on how to use devices from SICK AG.

Prerequisites for safe work are:

- Compliance with all safety notes and handling instructions supplied
- Compliance with local work safety regulations and general safety regulations for device applications

The operating instructions are intended to be used by qualified personnel and electrical specialists.

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

The instructions constitute an integral part of the product and are to be stored in the immediate vicinity of the device so they remain accessible to staff at all times. Should the device be passed on to a third party, these operating instructions should be handed over with it.

These operating instructions do not provide information on operating the machine in which the device is integrated. For information about this, refer to the operating instructions of the specific machine.

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_High_Resolution

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” or “device”.

1.3 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.

1.4 Additional information

NOTE
All the documentation available for the device can be found on the online product page at:

► www.sick.com/CSS_High_Resolution

The following information is available for download from this page:

- Type-specific online data sheets for device variants, containing technical data and dimensional drawings
- EU declaration of conformity for the product family
- Dimensional drawings and 3D CAD dimension models in various electronic formats
- These operating instructions, available in English and German, and in other languages if necessary
- Other publications related to the devices described here
- Publications dealing with accessories
- IO-Link device description IODD, driver file SDD for configuration software SOPAS ET and technical information IO-Link v1.1

1.5 Customer service

If you require any technical information, our customer service department will be happy to help. To find your agency, see the final page of this document.

NOTE
Before calling, make a note of all type label data such as type code, serial number, etc., to ensure faster processing.

2 Safety information

2.1 Intended use

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

A CSS is designed for mounting and may only be operated according to its intended function. For this reason, a CSS 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.

2.2 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.

2.3 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.

2.4 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
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

2.5 Hazard warnings and operational safety

Please observe the safety notes and the warnings listed here and in other chapters of these operating instructions to reduce the possibility of risks to health and avoid dangerous situations.

2.6 Eye safety

CAUTION EYE SAFETY

The CSS is equipped with an LED illumination unit. The sensor meets the criteria of risk group 2 according to IEC 62471:2006. The device emits potentially dangerous optical radiation. Do not look into the light sender for extended periods of time during operation. This could damage your eyes.

2.7 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.

3 Product description

3.1 Product ID

3.1.1 Type label

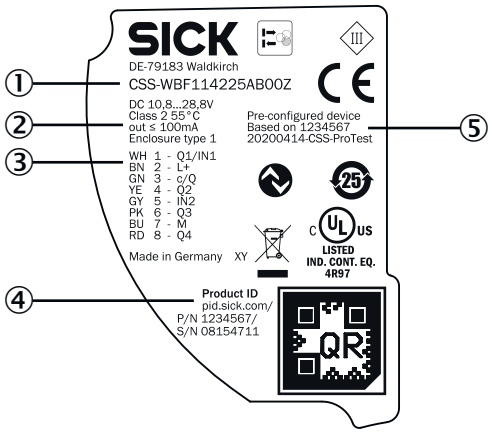


Figure 1: Type label is an example

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

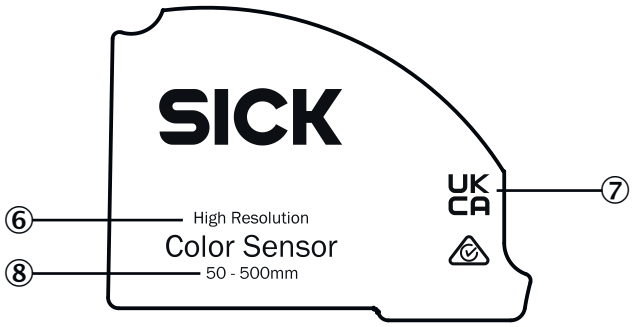


Figure 2: Type label is an example

⑥ Device name
⑦ Approvals
⑧ Sensing distance

3.1.2 Type code

Table 1: Type code

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

Position	Meaning	
1	Basic type	CS = Color sensor
2	Form factor	S = Small
3	Light sender	W = RGB
4	Digital output	B = Push-pull

Position	Meaning	
5	Function	G = High Resolution
6	Light spot direction	4 = Round A = Round, large
7	Sensing distance	C = Sensing distance 50-150 mm D = Sensing distance 50-500 mm
8	Filtering	4 = No filter
9	Light emission	1 = Long side
10	Operation	1 = Long side
11	Connection type	5 = M12; male connector, 5-pin 8 = M12; male connector, 8-pin
12	Communication	A = IO-Link R = RS485
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

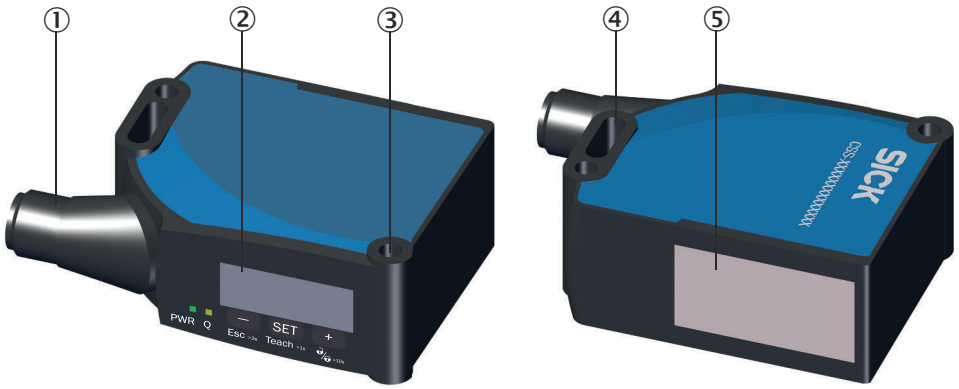


Figure 3: CSS High Resolution

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

3.2.2 Product characteristics

Color sensors are used to detect, separate or verify objects based on their color. The color sensors output the detected color as RGB or L*a*b values.

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 71.
- 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 70
- 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 fixing holes provided for this purpose.
- Shock and vibration resistant mounting.

4.3 Mounting the device

The CSS is equipped with a round light spot. The size of the light spot varies depending on the variant and sensing distance. Install the sensor via the fixing hole so that the light spot falls on the object.

The sensing distance can be freely selected within the working range. The integrated automatic sensing distance regulation allows the sensing distance to be changed without affecting the color assignment. The best color resolution can be achieved at close range and with the lowest response time.

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 (see figure 4, page 12).

Table 2: Sensing distance / Light spot size

CSS	xxxxDxxxxxx	xxxxCxxxxxx
Working range	50...500 mm	50...150 mm
Light spot size	8...32 mm round	3.5...7 mm round

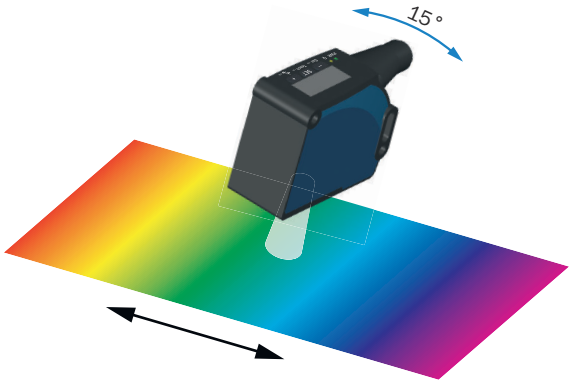


Figure 4: Mounting the CSS High Resolution

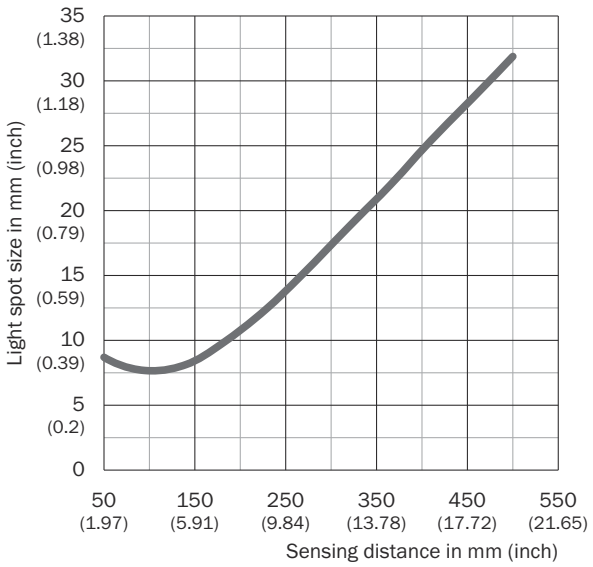


Figure 5: Light spot size for CSS-xxxxxxDxxxxxxxxxx

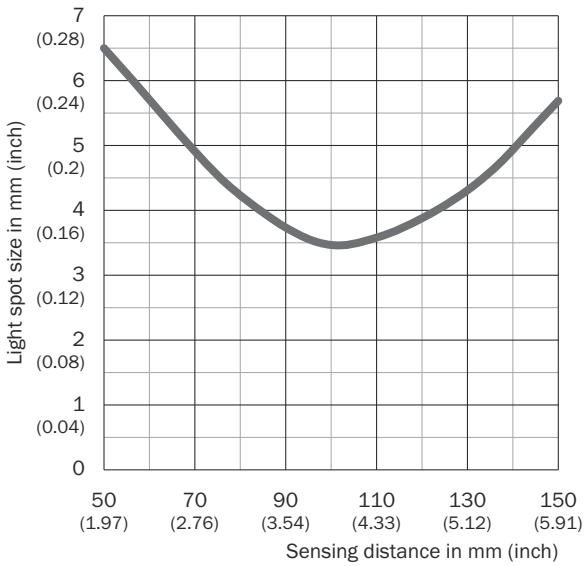


Figure 6: Light spot size for CSS-xxxxCxxxxxxxxxx

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!

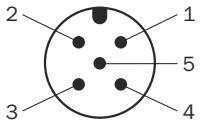
The connector unit on the device has two opposite end positions.

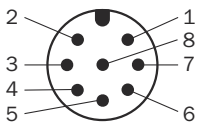
- Do not rotate the connector unit from either of the two end positions by more than 270°.

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	xBxxxxxx5A
1 - BN	L+
2 - WH	QL/IN1
3 - BU	M
4 - BK	QL1 / C
5 - GY	IN2
	 I_N = 2 A

CSS	xBxxxxxx8A	xBxxxxxx8R
1 - WH	QL1/IN1	IN1
2 - BN	L+	L+
3 - GN	QL1 / C	QL1 / C
4 - YE	QL2	QL2
5 - GY	IN2	IN2
6 - PK	QL3	RS485_A
7 - BU	M	M
8 - RD	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. 2 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: $10\ V \leq U_{IN} \leq U_V$

Level inactive: $U_{IN} \leq 2\ V$

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.

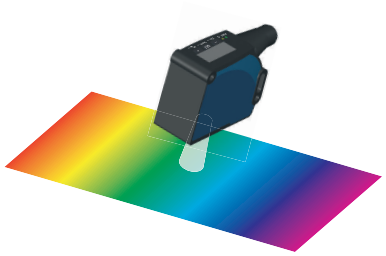
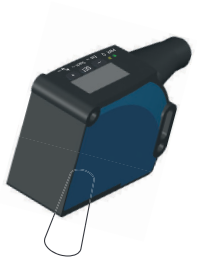
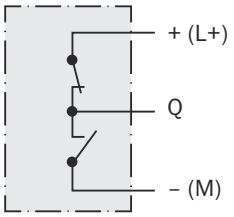
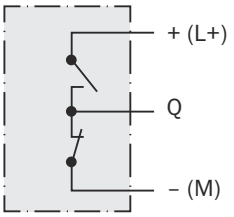
Push-pull

High: $U_V - 3\ V$

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.

Table 3: Push-pull

		
Q Push-pull (≤ 100 mA)		

6 Commissioning

For quick commissioning of the device, it is sufficient to perform a teach-in on the QL1 digital output.
The sensor switches to QL1 when the color is detected.
The sensor then also outputs the so-called CMV :**C**olor **M**atching **V**alue" in the process. This specifies the color match to the taught-in color:

- 999 absolutely same color value
- 000 greatest possible dissimilarity

Teach-in method

- **Single Value Teach-in** = One teach-in point
- **Multi Value Teach-in** = Several dynamic values (e.g., to detect structures / color gradients / different distances and angles)
- Teach-in quick access = In the RUN menu, select the view of the digital output that is to be taught in (e.g., QL1). 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 control panel, the sensor also applies this teach-in procedure for teach-in quick access.

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

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

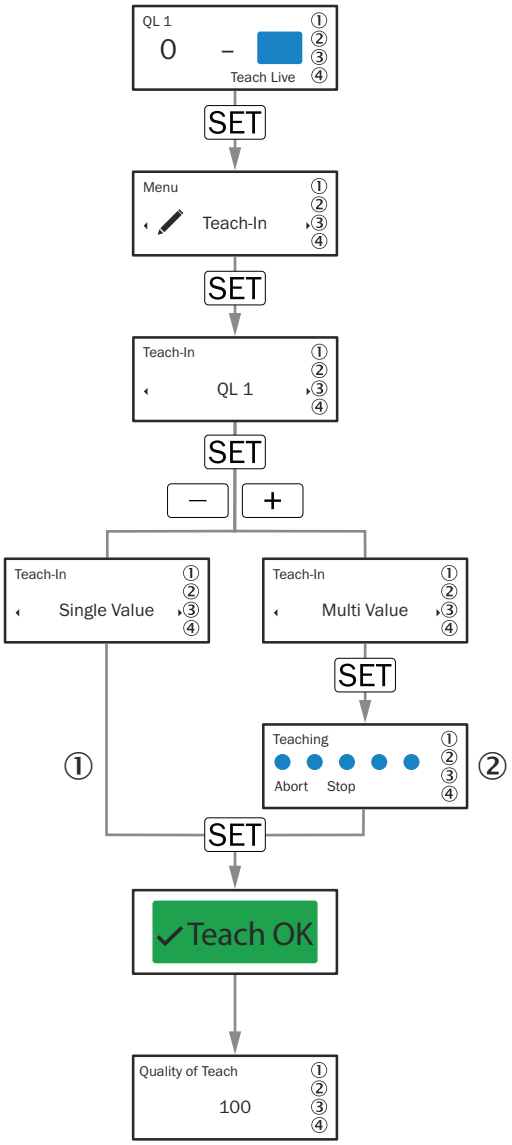


Figure 7: Commissioning the CSS High Resolution

① Keep the color to be taught in statically positioned (v = 0 mm/s) within the light spot
② Move the color to be taught in into the light spot so that structures/color gradients are detected. If different distances, object sizes or shapes occur during operation, these angles and distances must be taught in during teach-in.

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 64. 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** and the color indication (Teach-in color field) of the Add color tone is output.

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

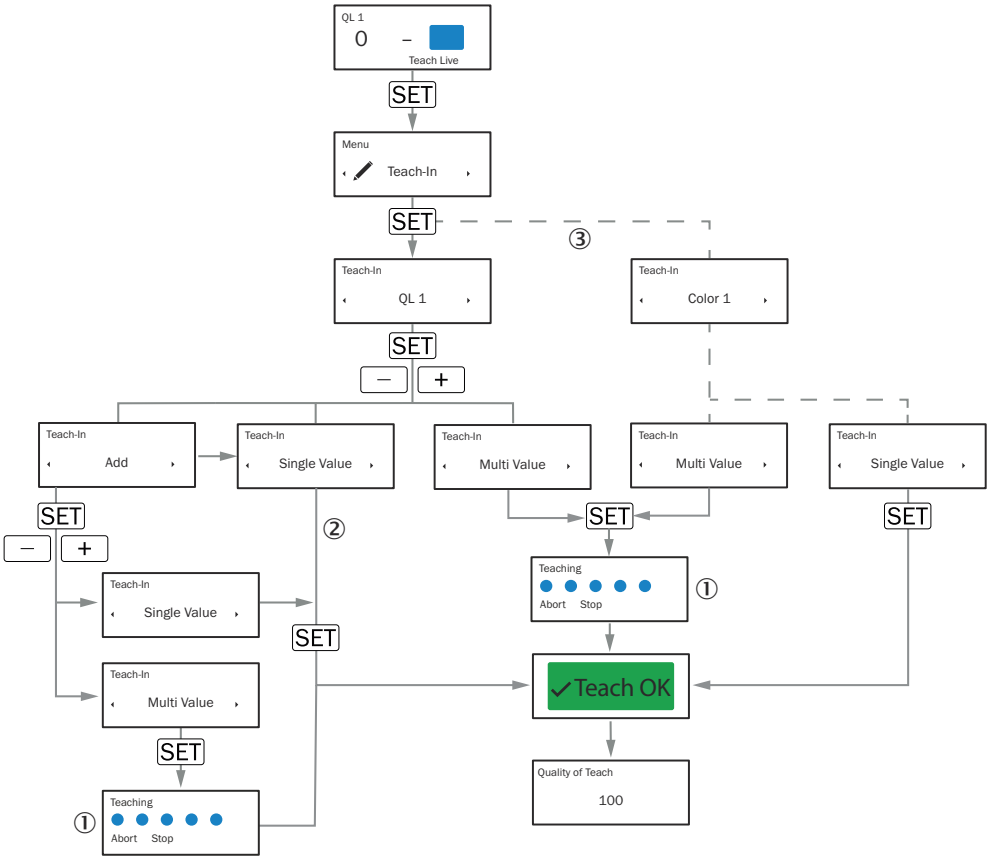


Figure 8: Extended commissioning

① Move the color to be taught in into the light spot so that structures/color gradients are detected. If different distances, object sizes or shapes occur during operation, these angles and distances must be taught in during teach-in.
② Keep the color to be taught in statically positioned (v = 0 mm/s) within the light spot.
③ If **Output Mode Coded** is activated

6.2 First step to commissioning with Modbus RTU

6.2.1 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.

6.2.2 Setting the ID and baud rate

NOTE
The SOPAS software can be used to configure the interface, see "Operation via SOPAS", page 44

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

6.2.3 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", 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

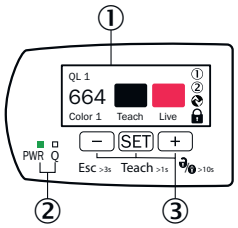


Figure 9: Display and setting elements

Table 4: Display and setting elements and functions

Number	Name	Function
1	TFT display	Shows menu item, values, or qualities.
2	PWR LED display	Lights up when the voltage supply is connected. Flashes during IO-Link operation
2	LED Q display	Lights up when a color is taught in within the field of view.
3	Plus (+) pushbutton	Navigates between menu items, increases values or (de)activates the pushbutton lock (press > 10 s).
3	SET pushbutton	Opens the menu, confirms entries, switches to lower-level menus or switches to teach-in quick access (press > 1 s).
3	Minus (-)/ESC pushbutton	Switches to the previous menu item, decreases values or changes to Run mode (press for > 3 s).

7.1.2 TFT displays

The sensor is equipped with a multicolor TFT display. The following information is output during operation:

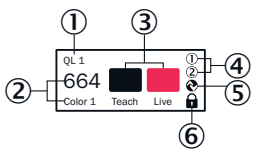
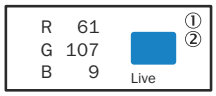


Figure 10: TFT display RUN view

By pressing the Plus (+) and Minus (-) pushbuttons, it is possible to switch from the view of the digital outputs to the current values of the detected color.

- RGB



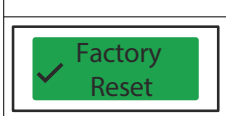
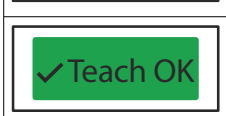
- L*a*b

RGB or L*a*b values are different ways to describe a color. You can choose the one that is more familiar to you. Both values describe the same, currently detected color values.

Table 5: TFT display indicators

Number	Name	Function
1	Digital output	By pressing the Plus (+) and Minus (-) pushbuttons, it is possible to switch between the digital outputs.
2	CMV/color memory space (Qint)	The **Color Matching Value** of the named color memory location (**Color 1**) is displayed. This is the similarity of the currently detected color to the taught-in color value in the color memory location.
3	Teach/Live	Gives a color indication of the taught-in color (teach-in) and the currently detected color (live).
4	Digital outputs	Status of the available digital outputs: Active (yellow) or not active (gray).
5	IO-LINK	Connection active
6	Pushbutton lock	Key lock active

Table 6: Standard TFT displays

TFT	Action	Result
	--	Setting saved Back to the Run view
	To lock the pushbutton, press + for > 10 s	Locked, the setting cannot be changed
	To unlock the pushbutton, press + for > 10 s	Unlocked, this setting can be changed
	This message appears if more than 24 colors are taught in.	Perform the teach-in for a switching output again. Do not use the “Add” function for the first color.
	Appears when an attempt is made to select a job via the control panel when “Activate Job” is set in the IN1 / IN2 configuration.	Select the job via the IN1 / IN2 input lines, or deactivate the job selection via the input line in the pin configuration.
	-	The factory settings are active.
	-	Teach-in was successfully completed.

7.1.3 Navigation tree

Example for CSS with M12 / 5-pin male connector.

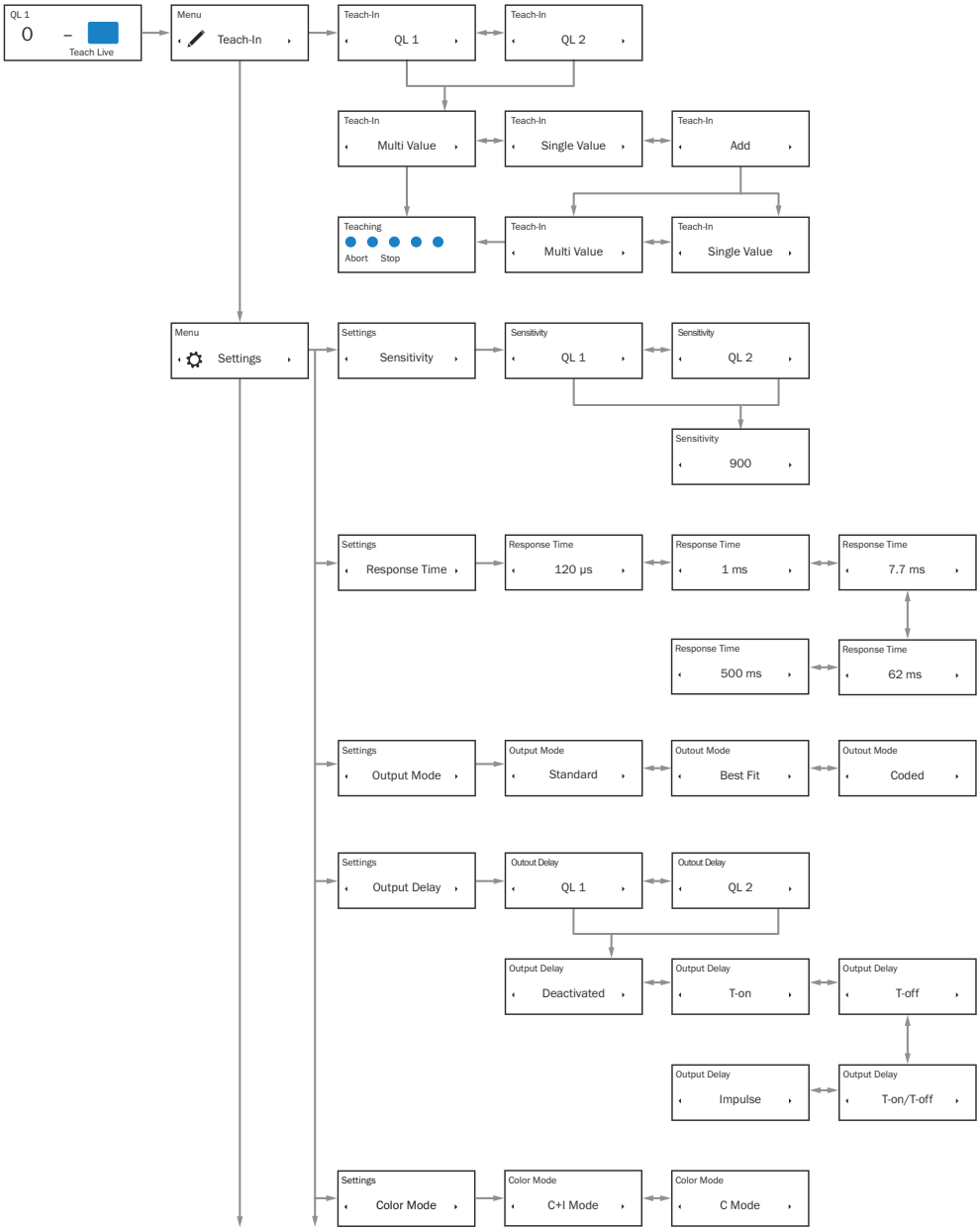


Figure 11: Navigation tree

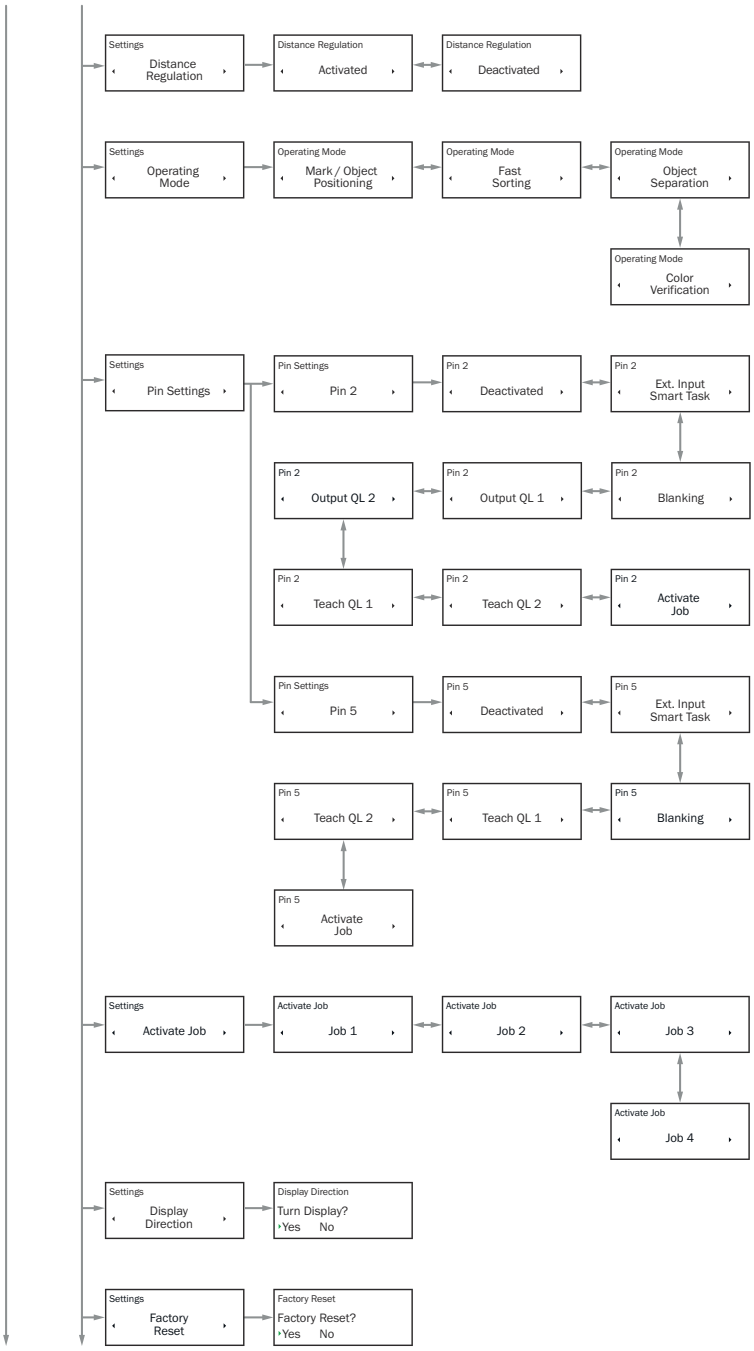


Figure 12: Navigation tree

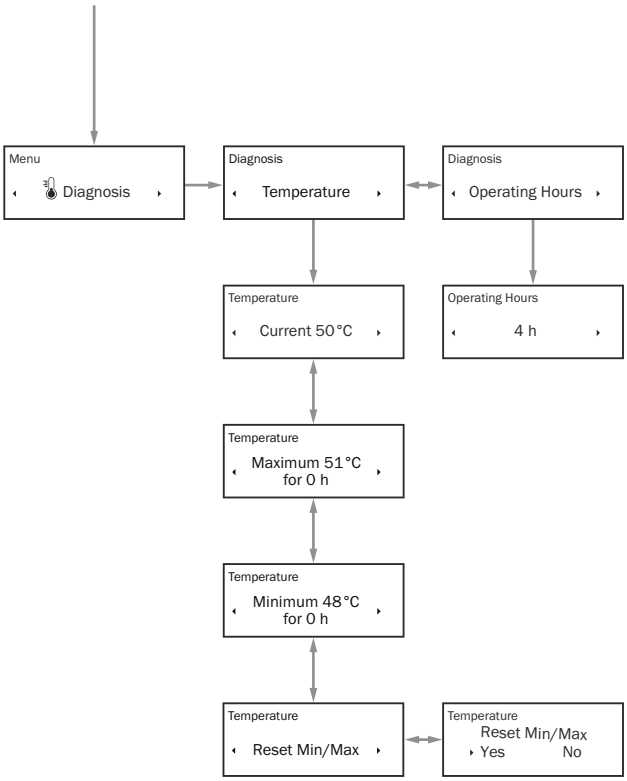


Figure 13: Navigation tree

Navigating

Selecting menu

1. Open the menu selection with the SET pushbutton
2. Select the desired menu with the +/- pushbutton
3. Open the desired menu with the SET pushbutton

Exiting the menu with Back

1. Select Back with the +/- pushbutton
2. Confirm with the SET pushbutton
   – The higher-level menu is active

Cancel and go back in RUN mode

1. Press ESC/- pushbutton for > 3 s
   – The sensor shows the start screen in RUN mode

7.1.4 Activating or deactivating the pushbutton lock

Activating pushbutton lock

1. Press and hold the + pushbutton > 10 s
   – Pushbutton lock activated

Deactivating pushbutton lock

1. Press and hold the + pushbutton > 10 s
   – Pushbutton lock deactivated

7.1.5 Resetting the device (factory setting)

Resetting to factory settings deletes all saved settings.

Figure 14: Factory Reset menu

In the Settings menu

1. Open the menu with the SET pushbutton
2. Select settings with the +/- pushbutton
3. Confirm the selection with the SET pushbutton
4. Select the Factory Reset menu 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.

7.1.6 Teach-in

7.1.6.1 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.

7.1.6.2 Teach-in via control panel

7.1.6.2.1 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.

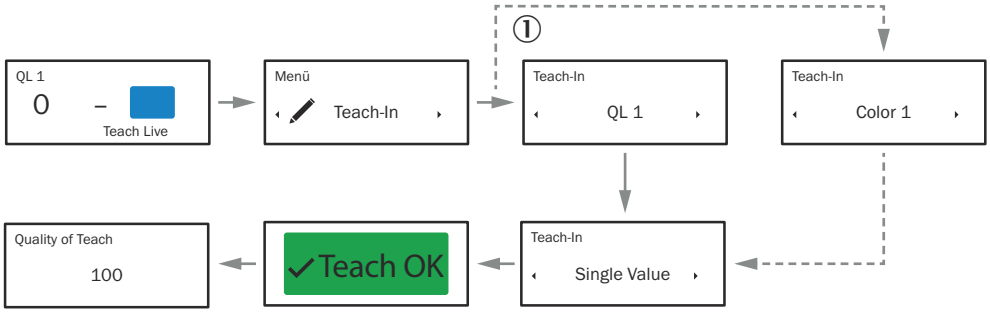


*Figure 15: **Single Value Teach-in***

① If Output Mode Coded is activated

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton
2. Select the **Teach-in** menu with the **SET** pushbutton
3. Select the desired **QL** digital output (or the desired color in **Coded** mode) with the +/- pushbutton
4. Confirm the selection with the **SET** pushbutton
5. Select **Single Value Teach-in** with the +/- pushbutton
6. 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.

7.1.6.2.2 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 the color to be taught in into the light spot so that structures/color gradients are detected. If different distances, object sizes or shapes occur during operation, these angles and distances must be taught in during teach-in.

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

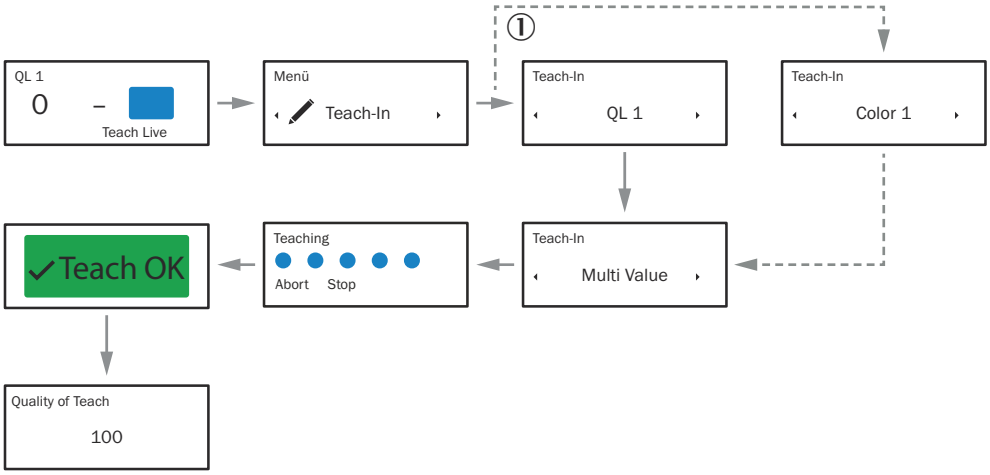


Figure 16: Multi Value Teach-in

① If Output Mode Coded is activated.

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton
2. Select the **Teach-in** menu with the **SET** pushbutton
3. Select the desired **QL** digital output (or the desired color in **Coded** mode) with the +/- pushbutton
4. Confirm the selection with the **SET** pushbutton
5. Select **Multi Value** with the +/- pushbutton
6. Confirm the selection with the **SET** pushbutton

✓ Teach-in begins

7. Cancel the teach-in with the - pushbutton or end the teach-in 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.

7.1.6.3 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

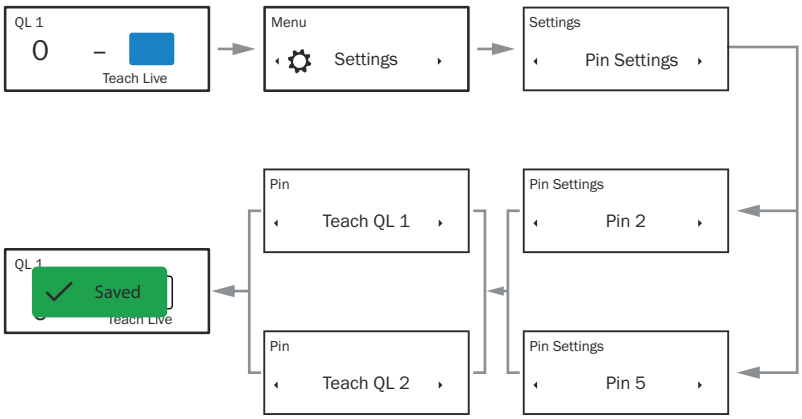


Figure 17: Ext. Teach-in

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton.
2. Select the **Settings** menu with the +/- pushbutton.
3. Confirm the selection with the **SET** pushbutton.
4. Select the **PIN Settings** menu with the +/- pushbutton.
5. Confirm the selection with the **SET** pushbutton.
6. Select the desired PIN with the +/- pushbutton.

7. Set the desired pin to “Teach QL”.
8. Confirm the selection with the **SET** pushbutton.
9. Position the object in the light spot.
10. Activate teach-in via the control cable (ET). (Level HIGH: U_B, 24 V)

✓ The teach-in process is complete.

7.1.7 Additional settings (Settings menu)

NOTE
Active settings are indicated by a green tick.

7.1.7.1 Color Mode (C Mode, C+I 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.

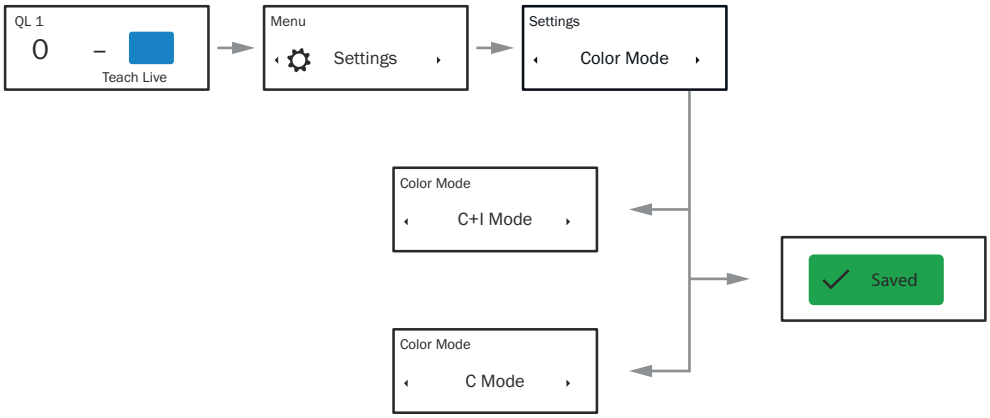


*Figure 18: **Color Mode***

Coming from the RUN menu:

1. Open the menu with the SET pushbutton
2. Select the **Settings** menu with the +/- pushbutton.
3. Confirm with the SET pushbutton.
4. Select the **Color Mode** menu with the +/- pushbutton
5. Confirm with the SET pushbutton
6. Select the desired mode with the +/- pushbutton
7. Confirm the selection with the SET pushbutton

7.1.7.2 Operating Mode

The CSS 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

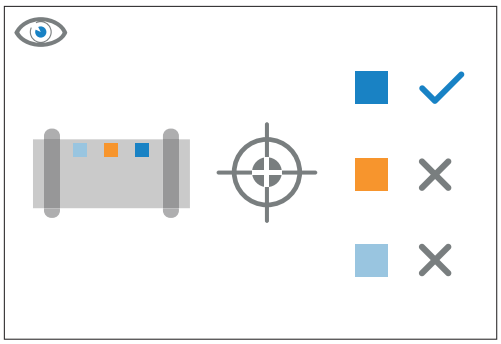


*Figure 19: **Mark/Object Positioning***

This mode is recommended when the CSS is used as a color mark sensor, e.g., in packaging machines. The sensor is preset to the shortest response time (120µs) and medium sensitivity (CMV threshold of 900). This makes the sensor a very fast color mark sensor with a 4.1 kHz switching frequency. (see "Output Mode Standard", page 33)

Fast Sorting

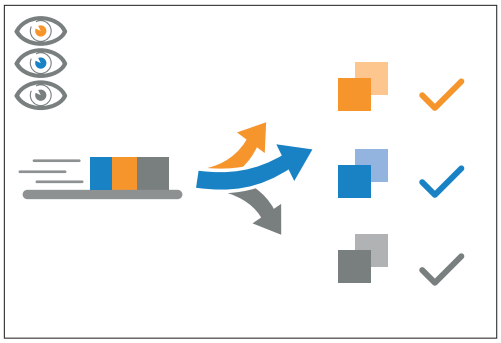


*Figure 20: **Fast Sorting***

This mode is recommended when the CSS 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 1 ms and the **Best Fit** mode (see "Output Mode Best Fit", page 33) are also preset here. The sensitivity is set to a CMV threshold of 800. This turns the CSS into a fast color sorting sensor.

Object Separation

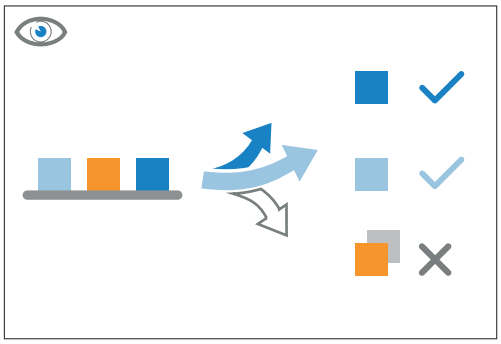


*Figure 21: **Object Separation***

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 62 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 33) is also activated. The sensitivity is set to a CMV threshold of 800.

Color Verification

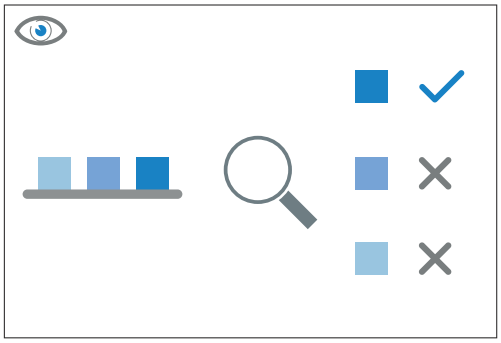


*Figure 22: **Color Verification***

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 500 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 33)

Selecting the Operating Mode via the control panel:

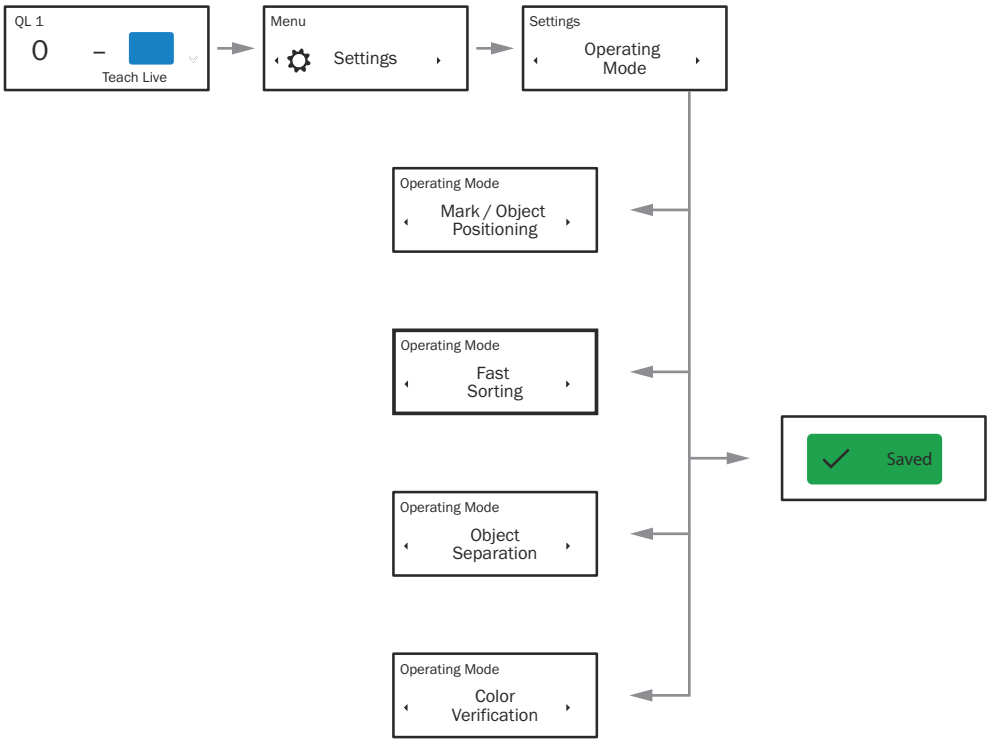


*Figure 23: **Operating Mode***

Coming from the RUN menu:

1. Open the menu with the SET pushbutton
2. Select the **Settings** menu with the +/- pushbutton.
3. Confirm with the SET pushbutton.
4. Select the **Operating Mode** menu with the +/- pushbutton
5. Confirm with the SET pushbutton
6. Select the desired mode with the +/- pushbutton
7. Confirm the selection with the SET pushbutton

7.1.7.3 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.

Output Mode Standard

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

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

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**.

Selecting the Output mode via the control panel

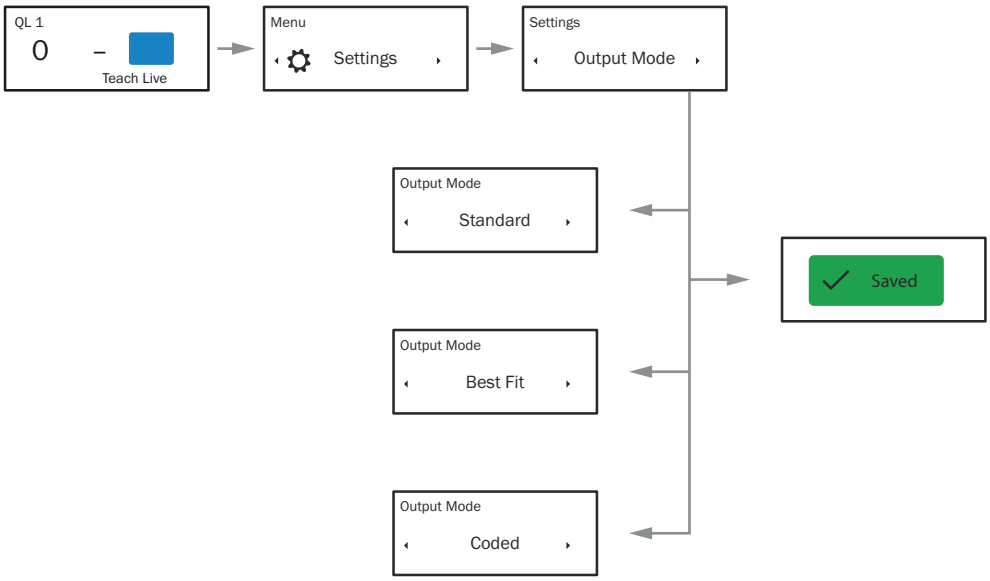


*Figure 24: **Output Mode***

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton
2. Select the **Settings** menu with the +/- pushbutton.
3. Confirm with the **SET** pushbutton.
4. Select the **Output Mode** menu with the +/- pushbutton.
5. Confirm with the **SET** pushbutton.
6. Select the desired **Output Mode** with the +/- pushbutton
7. Confirm the selection with the **SET** pushbutton

7.1.7.4 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.

Selecting the sensitivity via the control panel

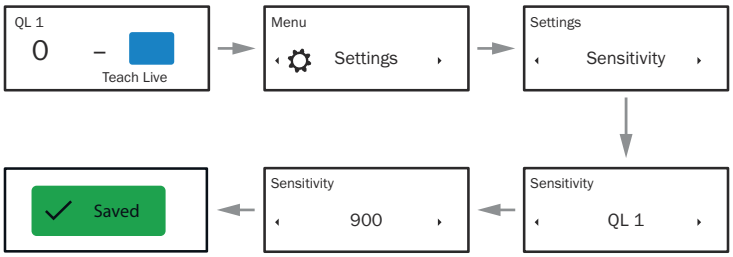


*Figure 25: **Sensitivity***

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton
2. Select the **Settings** menu with the +/- pushbutton.
3. Open the **Sensitivity** menu with the +/- pushbutton
4. Select the desired **QL** digital output with the +/- pushbutton
5. Confirm the selection with the **SET** pushbutton
6. Select the desired sensitivity value (CMV threshold) with the +/- pushbutton
7. Confirm the selection with the **SET** pushbutton

7.1.7.5 Output delay

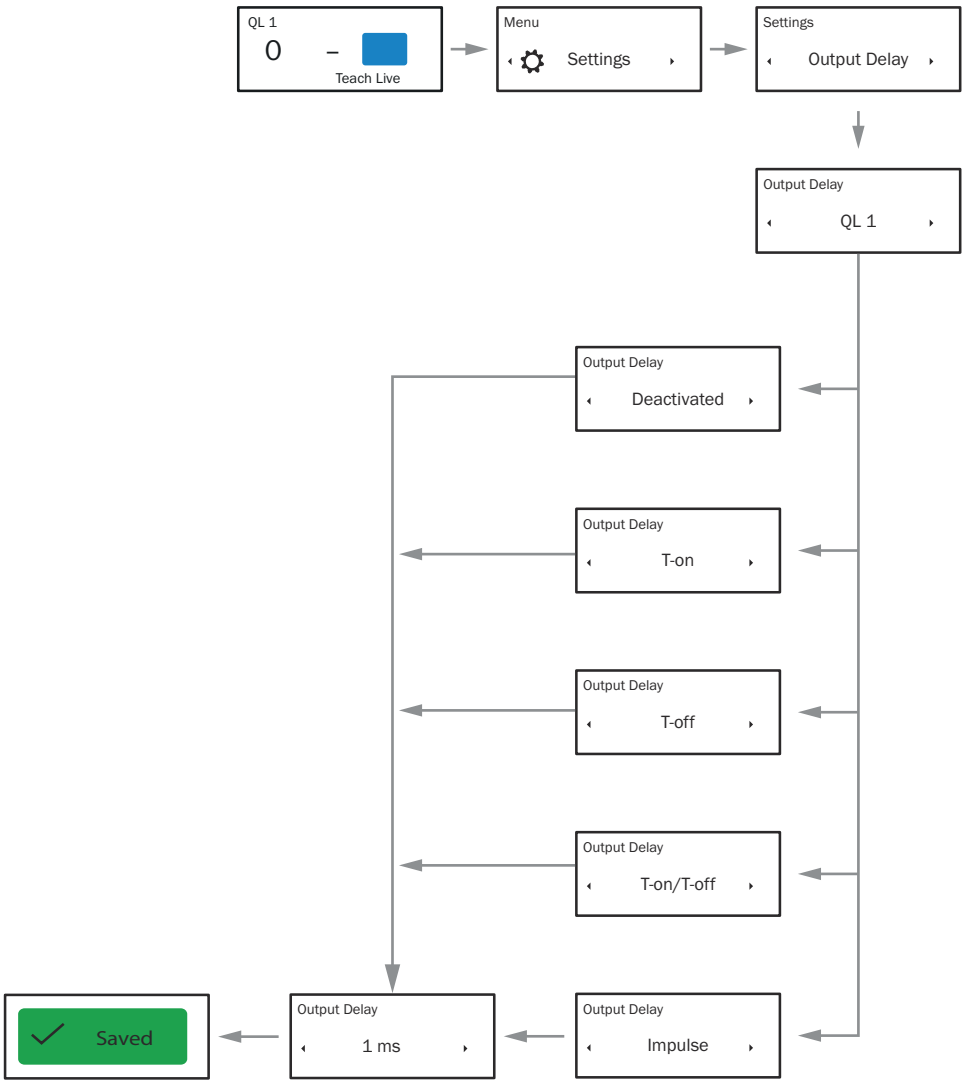


*Figure 26: **Output delay***

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton
2. Select the **Settings** menu with the +/- pushbutton.
3. Open the **Output delay** menu with the +/- pushbutton
4. Select the desired **QL** digital output with the +/- pushbutton
5. Confirm the selection with the **SET** pushbutton
6. Select the desired switch-on or switch-off delay with the +/- pushbutton
7. Select **Pulse** and select the time, e.g., 1 'ms', with the +/- pushbutton
8. 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.

7.1.7.6 Setting the response time

The response times of the sensor are preset in the respective **Operating Modes**. This setting can, however, also be freely configured in the menu.

The sensor offers the following response times for selection:

- 120 µs
- 1 ms
- 7.7 ms
- 62 ms
- 500 ms

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

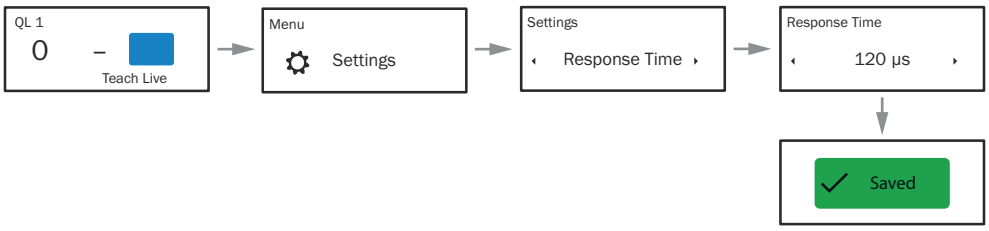


*Figure 27: **Response time***

Coming from the RUN menu:

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

7.1.7.7 Automatic sensing distance regulation

The sensor has an automatic sensing distance regulation feature.

This means that the sensor correctly assigns colors regardless of the sensing distance. An object of the same color produces the same color match value (CMV) at the sensor, regardless of whether the object is positioned at a sensing distance of 50 mm or 150 mm.

The minimum remission for determining the distance is shown in the following table.

Table 8: Minimum remission for determining the distance

Variant	CSS-xxxxC	CSS-xxxxD		
Sensing distance	50 ... 150 mm	50 ... 250 mm	250 ... 350 mm	350 ... 500 mm
Minimum remission	10%	5%	10%	25%

This function can be very helpful for different object sizes or fluctuating sensing distances. However, if the CSS is used at a constant distance (e.g. for web material), the automatic sensing distance regulation is not required and can be deactivated. It is not preset in **Operating Modes**.

Selecting Automated Sensing Distance Regulation via the control panel

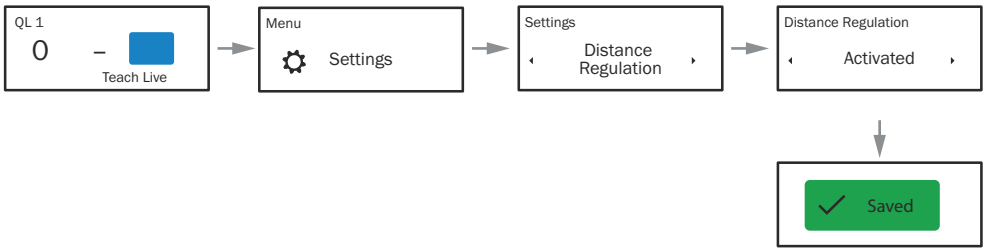


*Figure 28: **Automated Distance Regulation***

Coming from the RUN menu:

1. Open the menu with the SET pushbutton
2. Select the **Settings** menu with the +/- pushbutton.
3. Confirm with the SET pushbutton.
4. Select the **Distance Regulation** menu with the +/- pushbutton
5. Confirm with the SET pushbutton
6. Select either **activated** or **deactivated** with the +/- pushbutton
7. Confirm with the SET pushbutton

7.1.7.8 Pin settings

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

*Table 9: **Pin settings** fpr xBxxxxxx5A*

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

*Table 10: **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** : Input function for the **Smart Task A10**
- **Blanking**: If the level of the input signal is active, no digital output is activated when a taught-in color is detected.
- Output QL1 : QL1 digital output
- Output QL2 : QL2 digital output (only available for xBxxxxxx5A)
- Teach QL1 : External teach-in for QL1
- Teach-in QL2: External teach-in for QL2
- **Activate 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

Pin 5

- **Ext. Input Smart Task**: Input function for the **Smart Task A10**
- **Blanking**: If the pin is HIGH , no digital outputs are active
- Teach QL1 : External teach-in for QL1
- Teach QL2 : External teach-in for QL2

- **Activate 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

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 11: 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

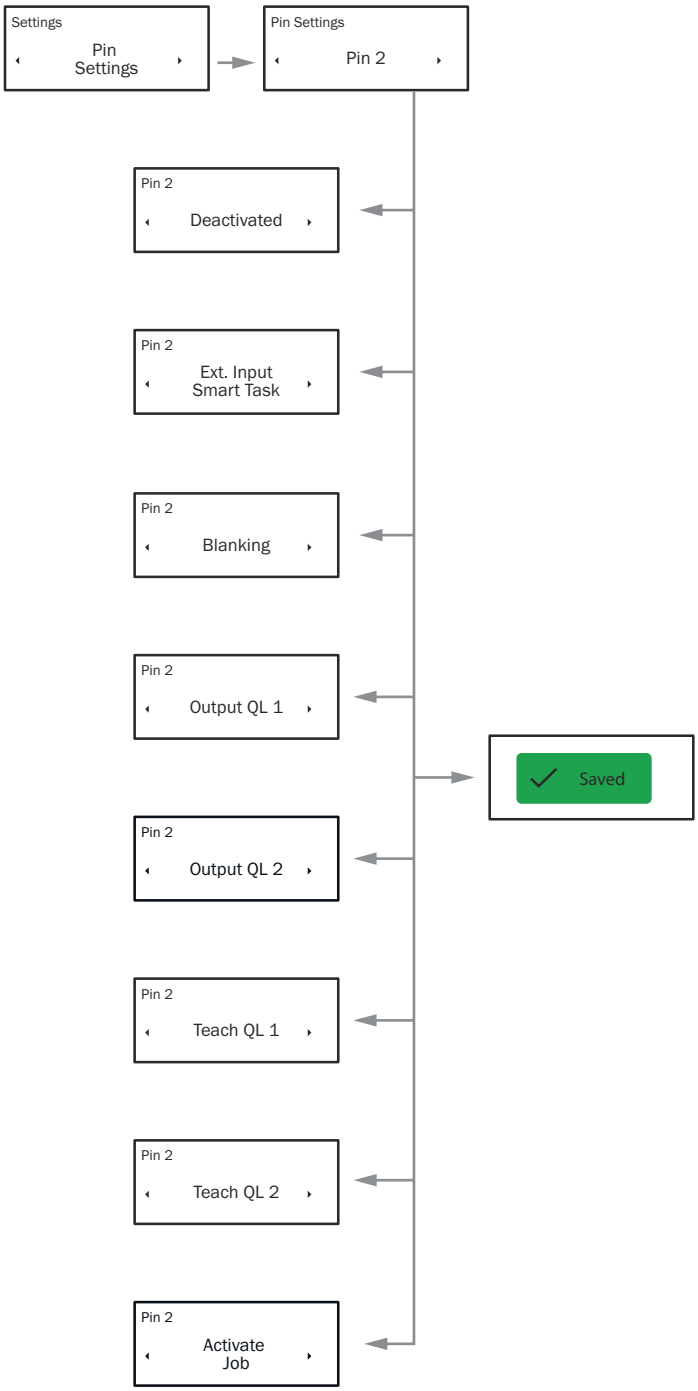


Figure 29: ***Pin 2 Setting***

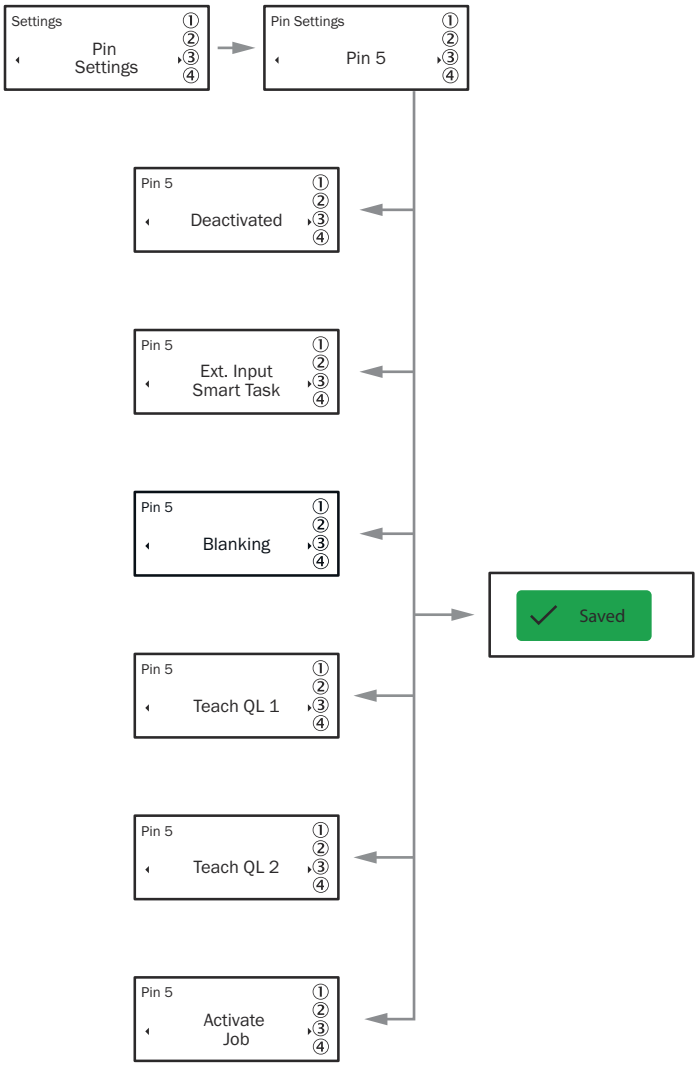


Figure 30: ***Pin 5 Setting***

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton
2. Select the **Settings** menu with the +/- pushbutton.
3. Confirm with the **SET** pushbutton.
4. Select the **Pin Settings** menu with the +/- pushbutton
5. Confirm with the **SET** pushbutton
6. Select pin 2 or pin 5 with the +/- pushbutton
7. Confirm the selection with the **SET** pushbutton
8. Select the **Pin Configuration** menu with the +/- pushbutton
9. Confirm the selection with the **SET** pushbutton

7.1.7.9 Aligning display

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

The available options are

- Turn Display YES

- Turn Display NO

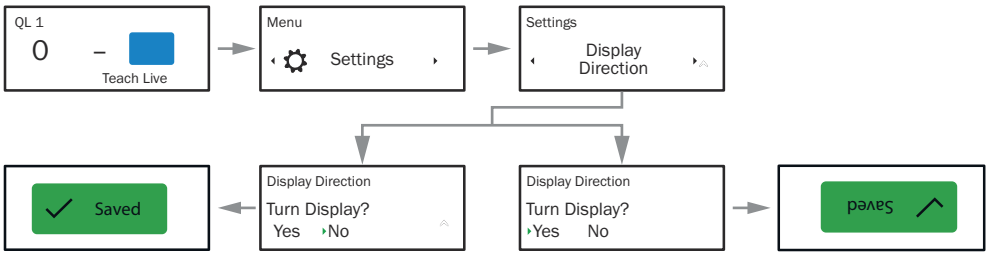


*Figure 31: **Display Direction** menu*

In the Settings menu

1. Select the **Display Direction** menu with the +/- pushbutton
2. Open the **Display Direction** menu with the **SET** pushbutton
3. Select the desired direction with the +/- pushbutton
4. Confirm the selection with the **SET** pushbutton
   – The display shows **saved** in the respective direction.

7.1.7.10 Activating jobs

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

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

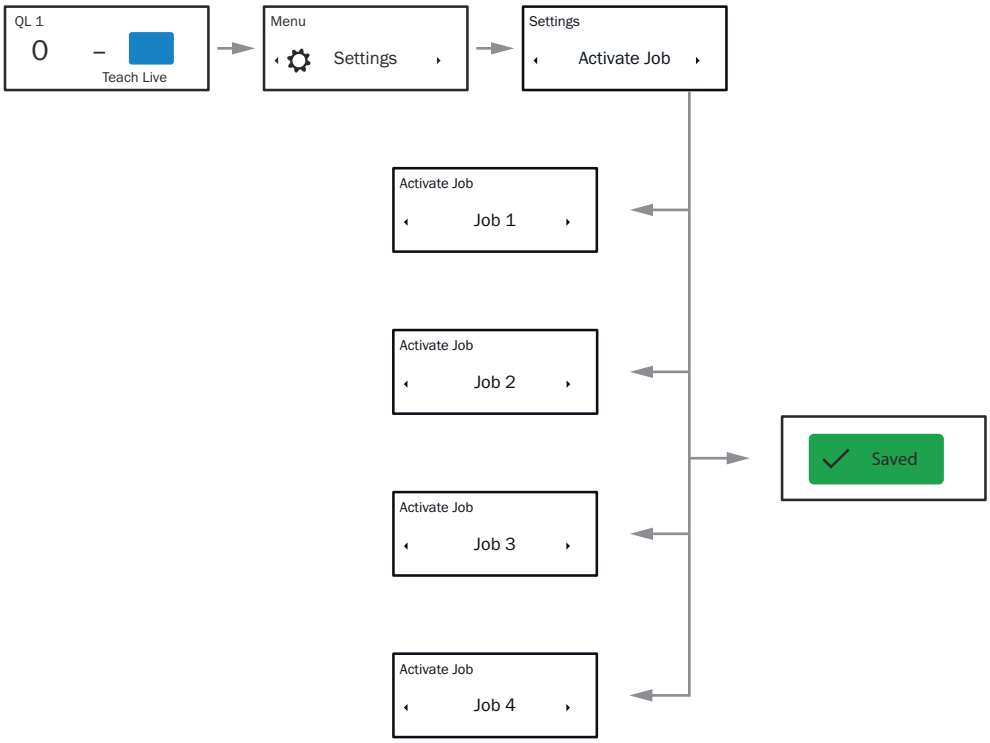


Figure 32: ***Activate Job***

Coming from the RUN menu:

1. Open the menu with the **SET** pushbutton
2. Select the **Settings** menu with the +/- pushbutton.
3. Confirm with the **SET** pushbutton.
4. Select the **Activate Job** menu 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
8. Select the Pin configuration menu with the +/- pushbutton

7.1.7.11 Diagnostics

The “Diagnostics” menu can be used to obtain information on the operating temperature (current temperature, maximum and minimum temperature) and the operating hours.

It can also be used to reset the minimum and maximum temperature. The display “for ... h” shows how many hours ago the last reset was performed.

Selecting diagnostics via the control panel

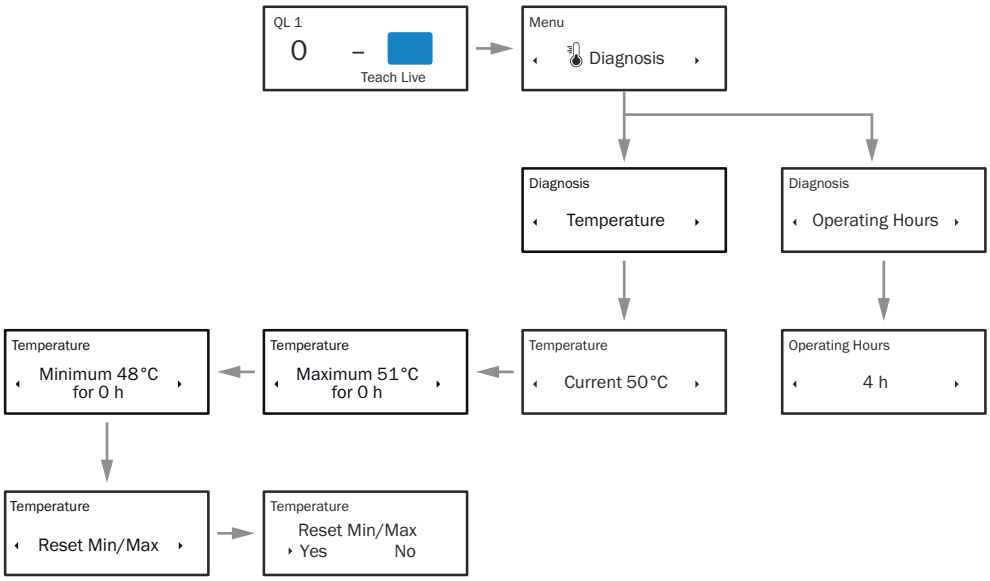


Figure 33: Diagnostics

Coming from the RUN menu:

1. Open the menu with the SET pushbutton
2. Select the **Diagnosis** menu with the +/- pushbutton.
3. Confirm with the SET pushbutton
4. Select the desired diagnostic with the +/- pushbutton
5. Confirm the selection with the SET pushbutton

7.2 Operation via SOPAS

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

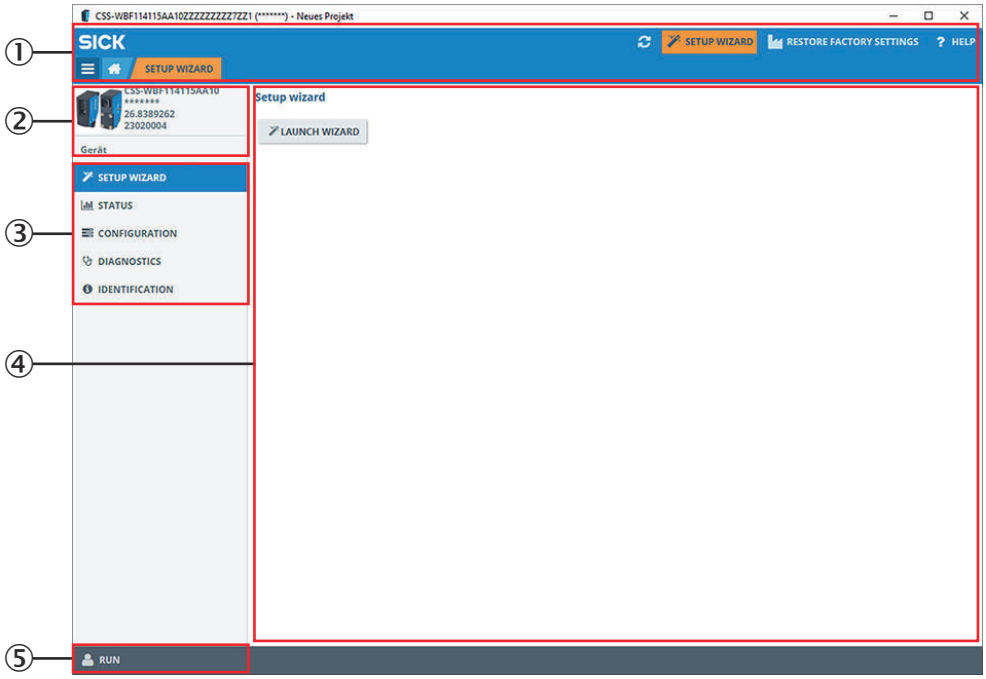


Figure 34: Overview of the SOPAS user interface

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

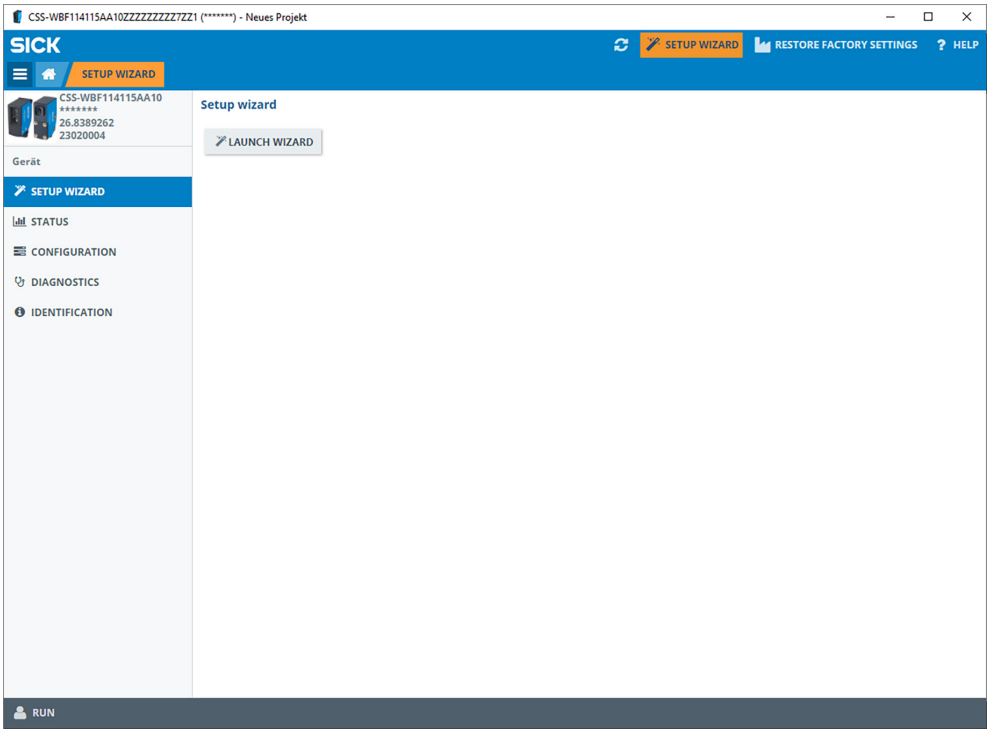


Figure 35: Overview of the Setup Wizard

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

7.2.1.2 Overview of status

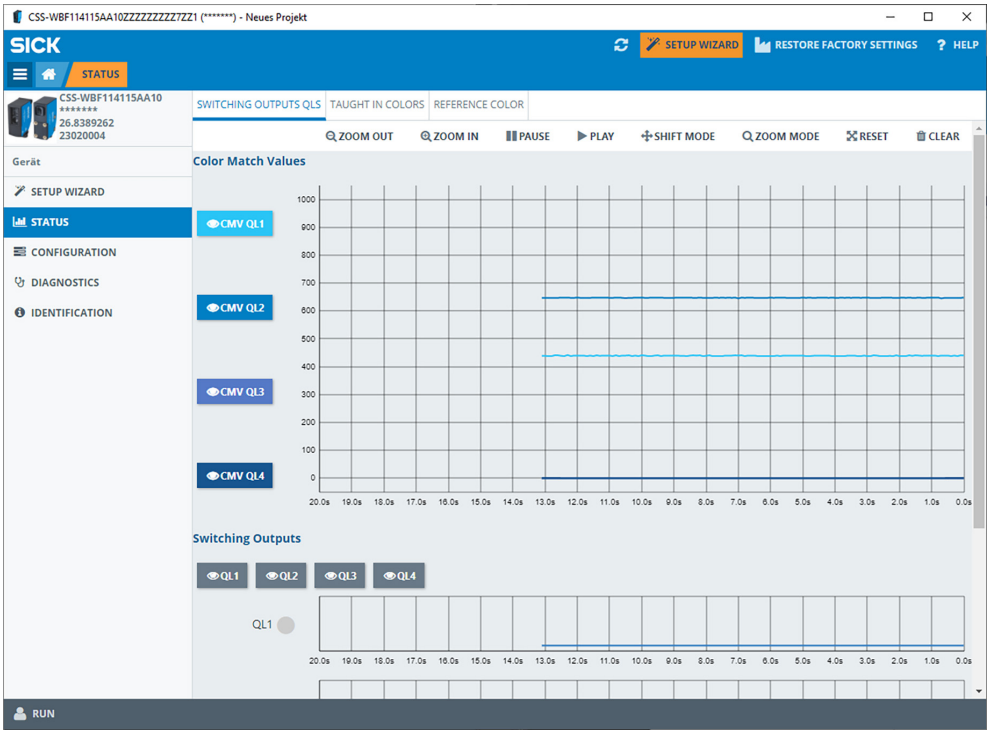


Figure 36: Overview of the Switching Output QLS status

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.

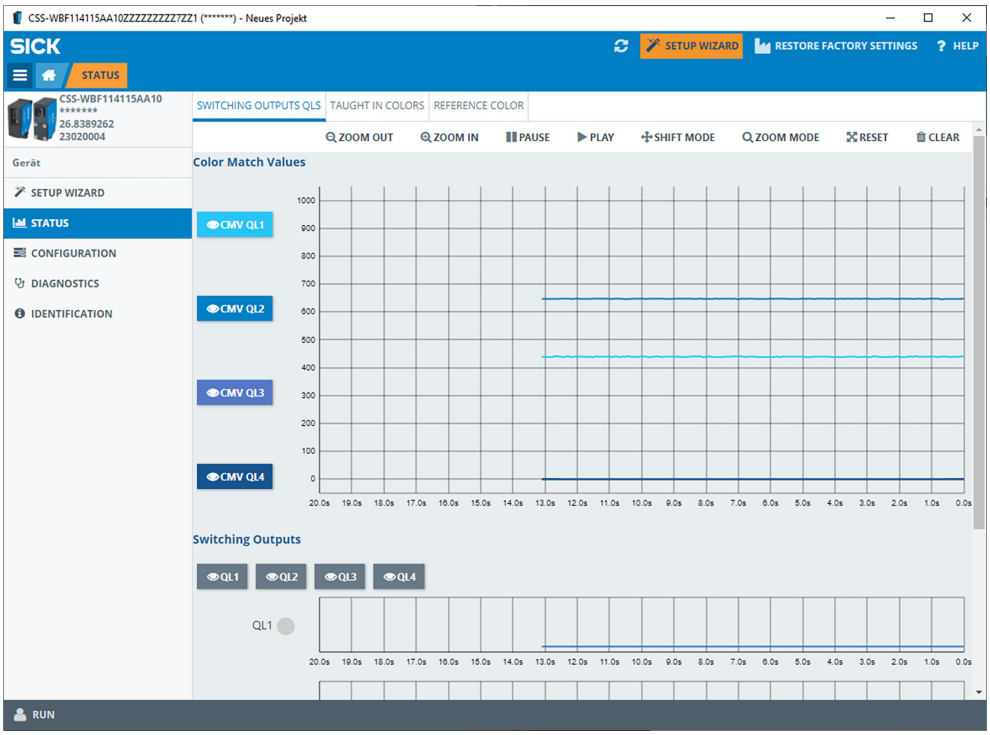


Figure 37: Status Switching Outputs QLS

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

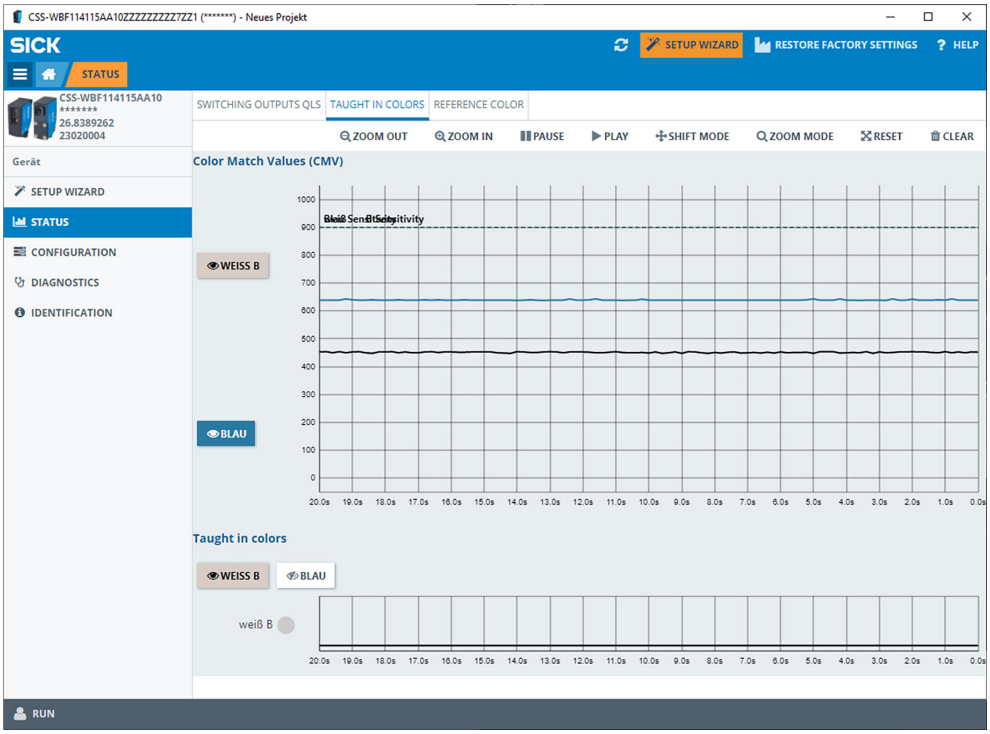


Figure 38: Status Taught-in Colors

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).

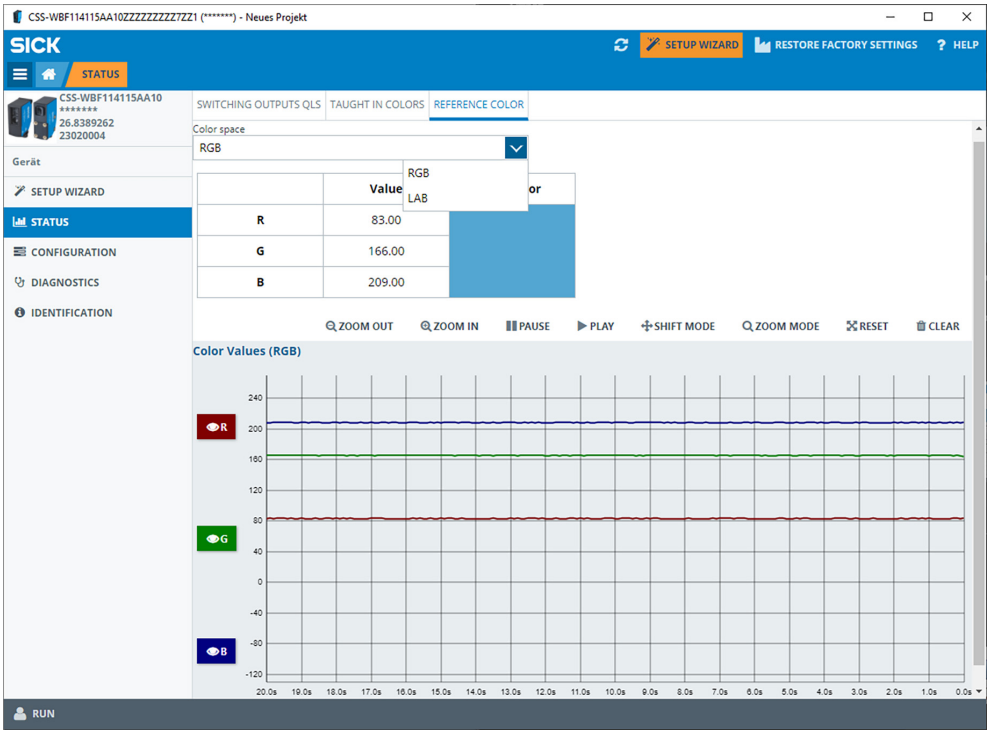


Figure 39: Status Reference Color

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**

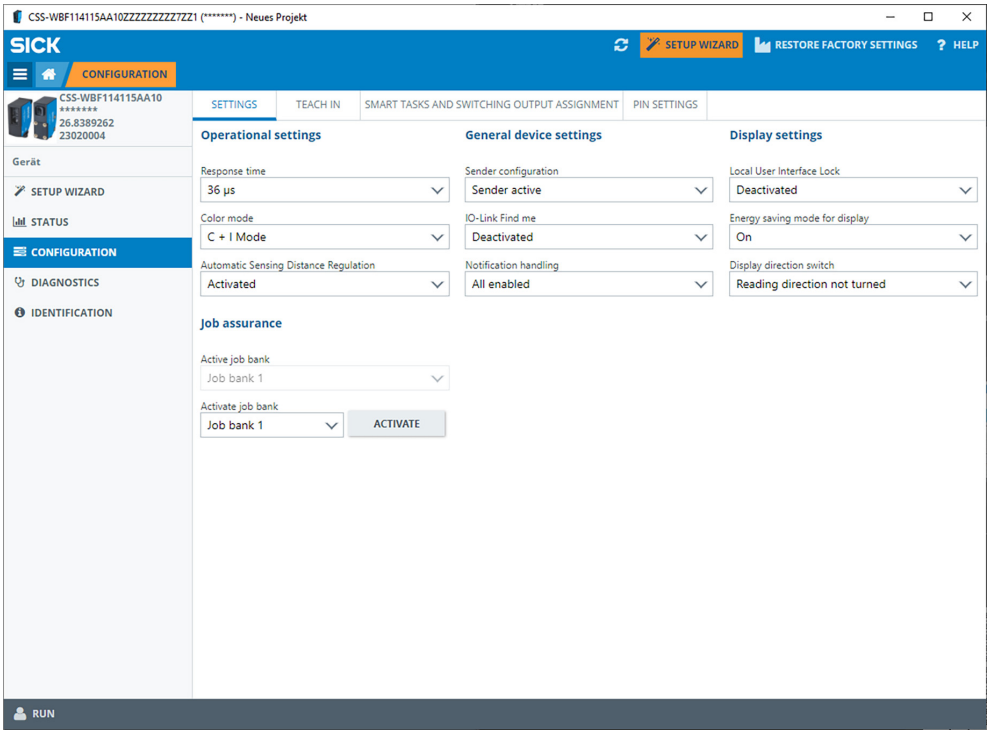


Figure 40: Overview of ***Configuration***

Configuration Settings

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

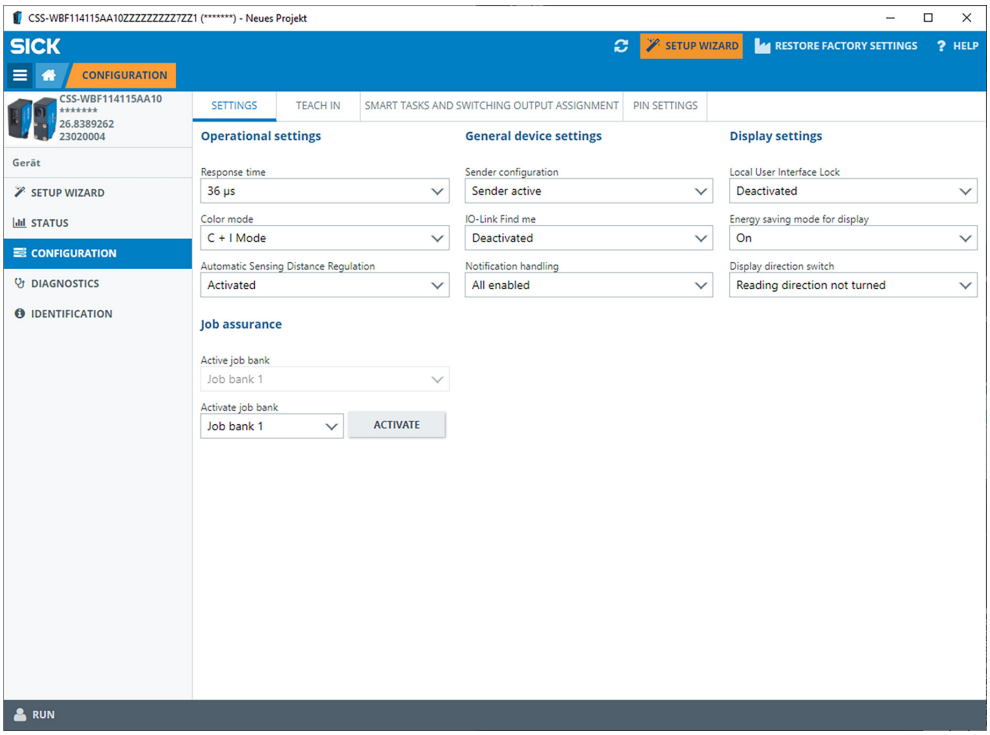


Figure 41: ***Configuration Settings***

Operational settings

- **Response time** (see "Setting the response time", page 36)
- **Color mode** (see "Color Mode (C Mode, C+I Mode)", page 30)
- **Automated Sensing Distance Regulation** (see "Automatic sensing distance regulation", page 37)

General device settings

- **Sender active** (see "Sender configuration", page 63)
- **IO-Link Find me** (see "Setting Find me", page 63)
- **Notification handling** (see "Setting Notification handling", page 63)

Display settings

- **Local User interface Lock** (see "Setting Local User Interface Lock", page 63)
- **Energy saving mode for display** (see "Setting Energy saving mode for display", page 63)
- **Display direction switch** (see "Setting Display direction switch", page 63)

Job assurance

- **Active job bank** (see "Setting Job assurance", page 64)

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.

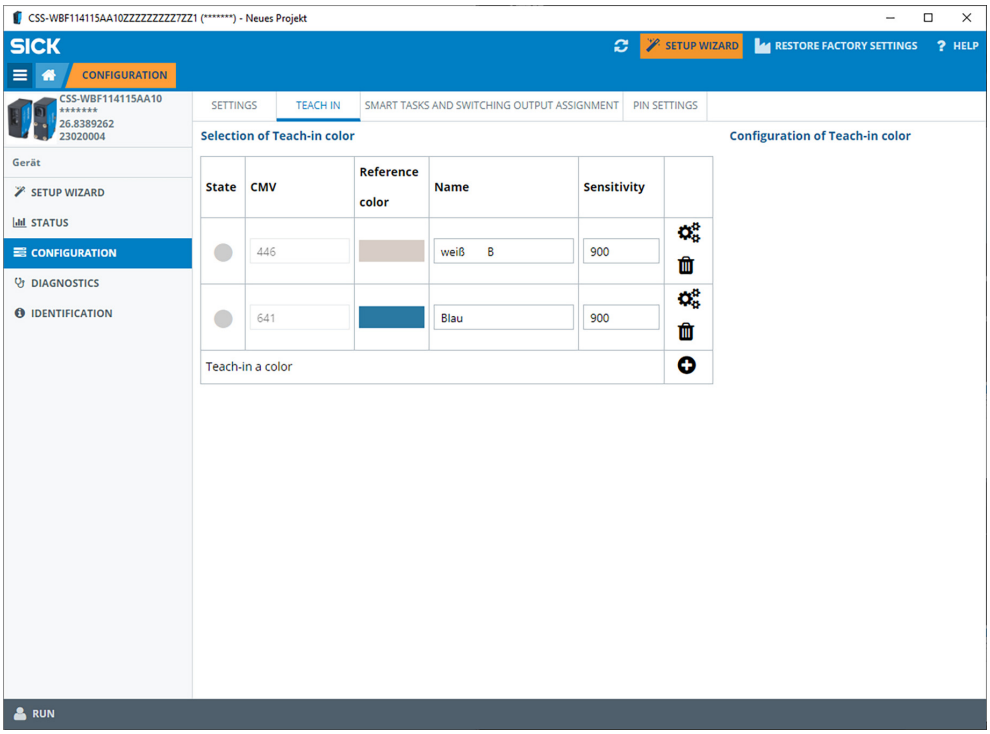


Figure 42: ***Configuration Teach-in***

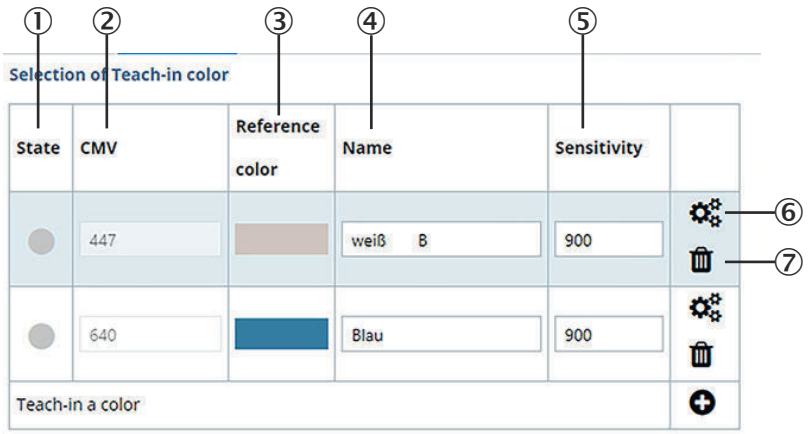


Figure 43: ***Configuration Teach-in legend***

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
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
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
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.

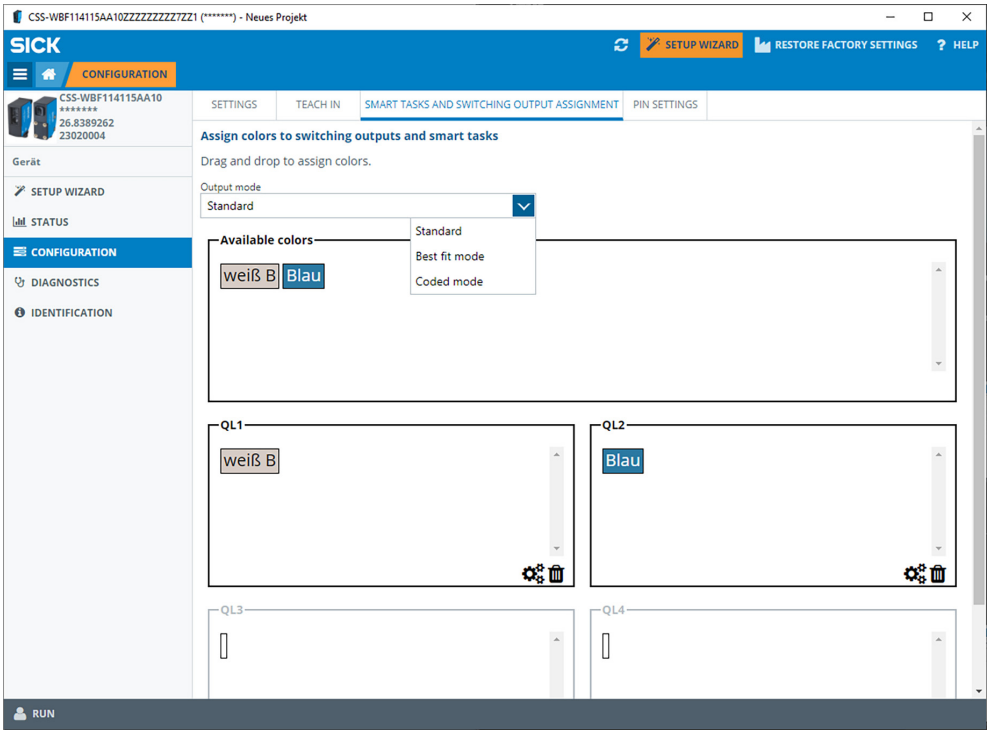


Figure 44: ***Configuration Smart Tasks and switching output assignment***

Configuration Pin settings

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

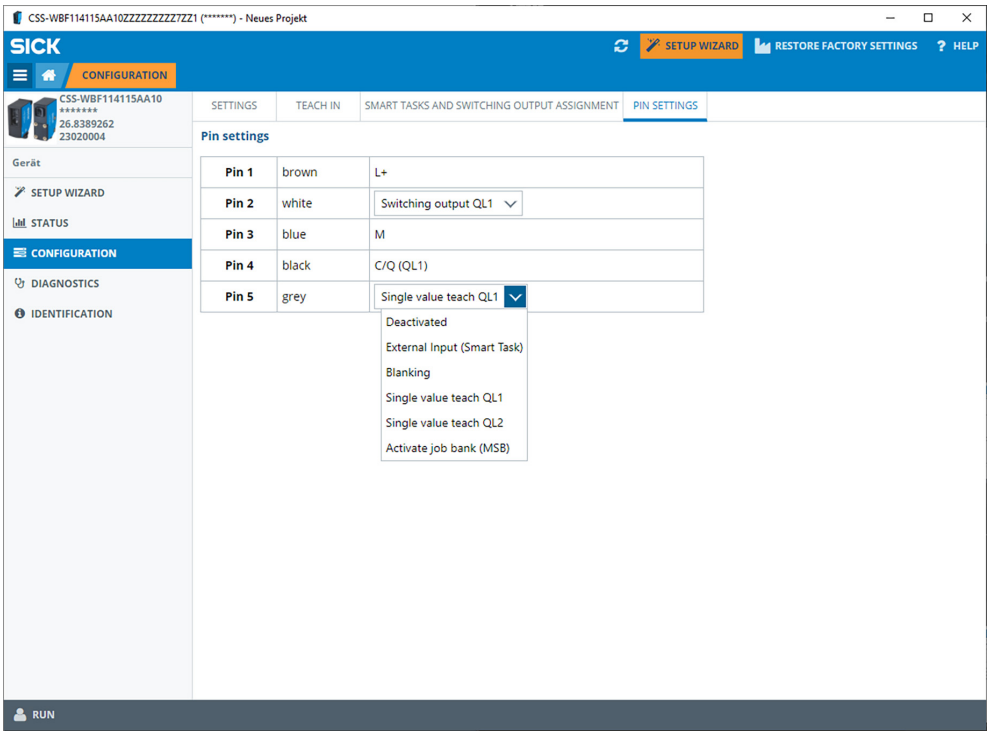


Figure 45: ***Configuration Pin settings***

7.2.1.4 Overview of Diagnostics

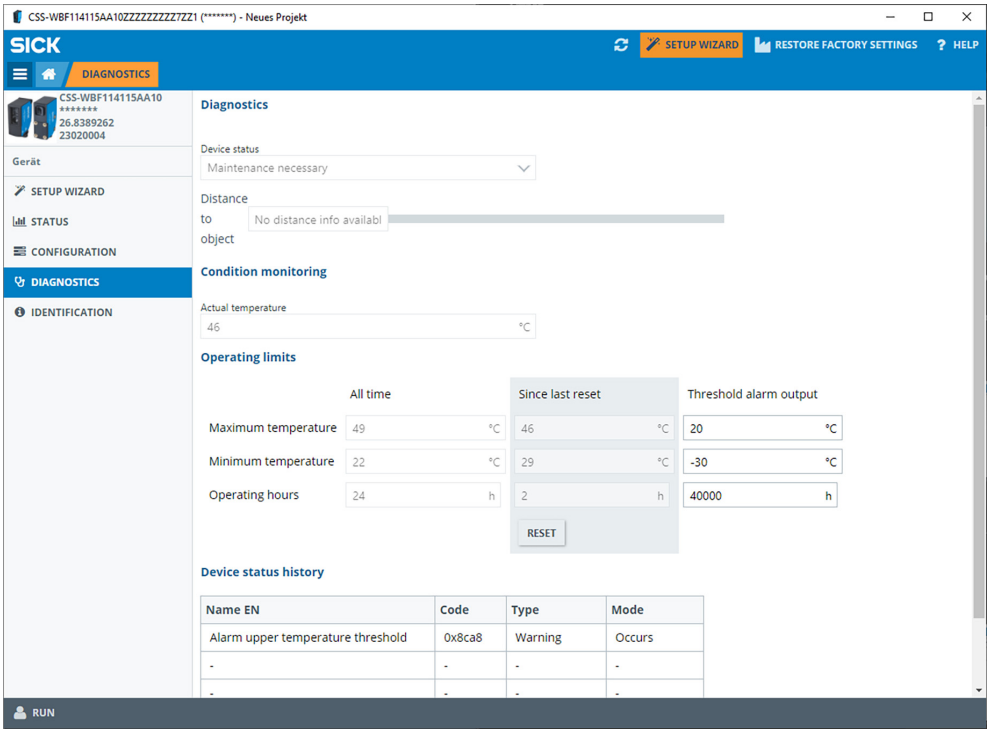


*Figure 46: Overview of **Diagnostics***

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 Provides an indication of the approximate distance to the sensor from the object in the field of view. If **No distance info available** is displayed, the object is outside the nominal sensing distance.

- **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

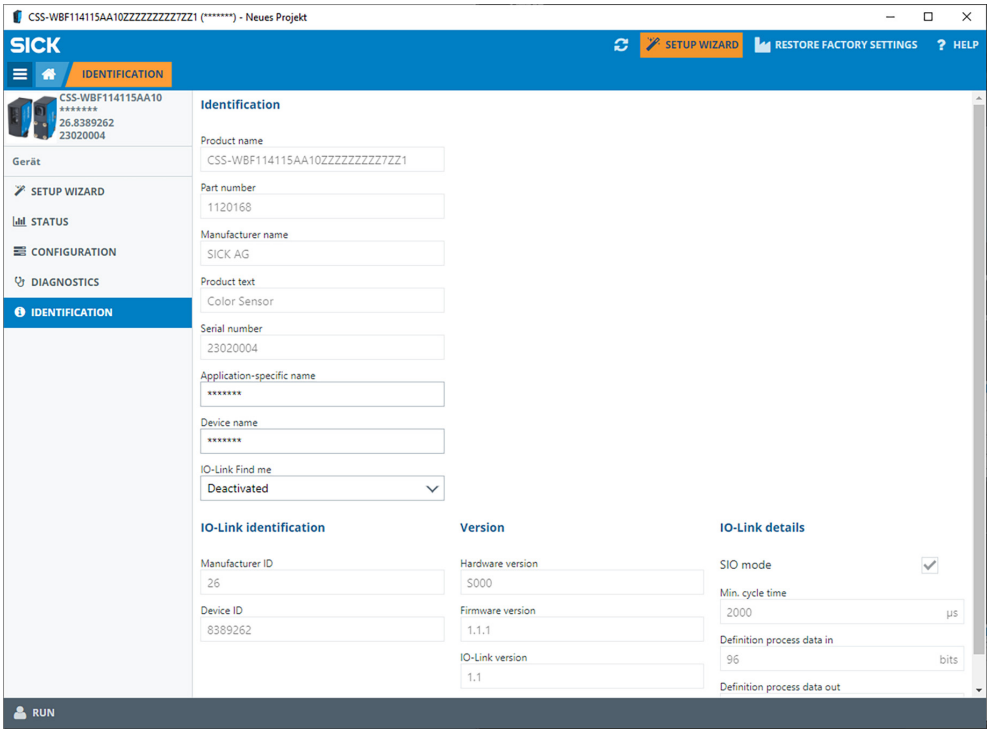


*Figure 47: Overview of **Identification***

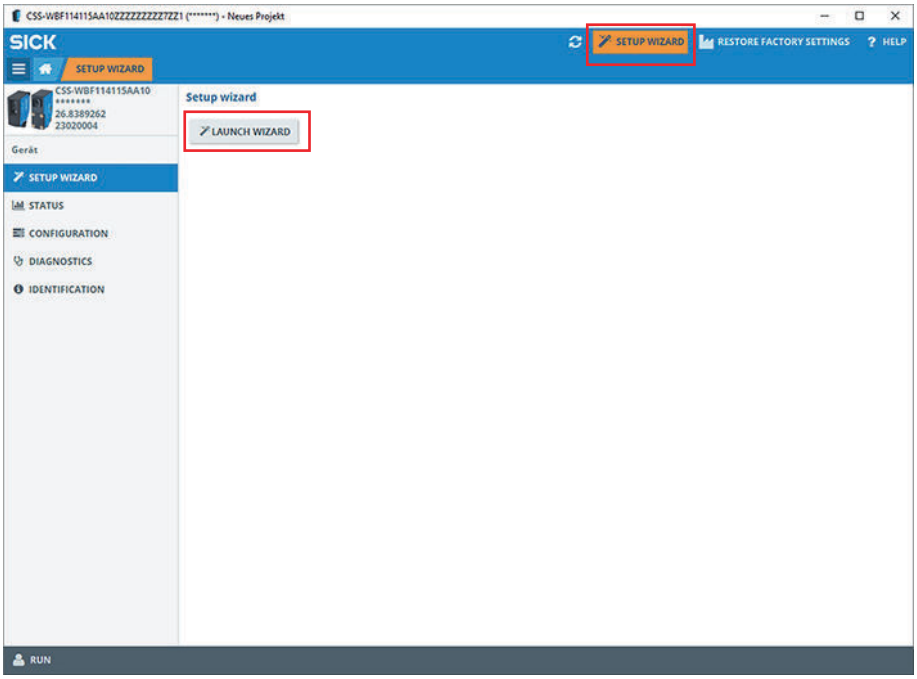
The **Identification** area displays the individual data of the selected sensor. The **IO-Link Find me** function can also be set again here (see "Setting Find me", page 63).

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.

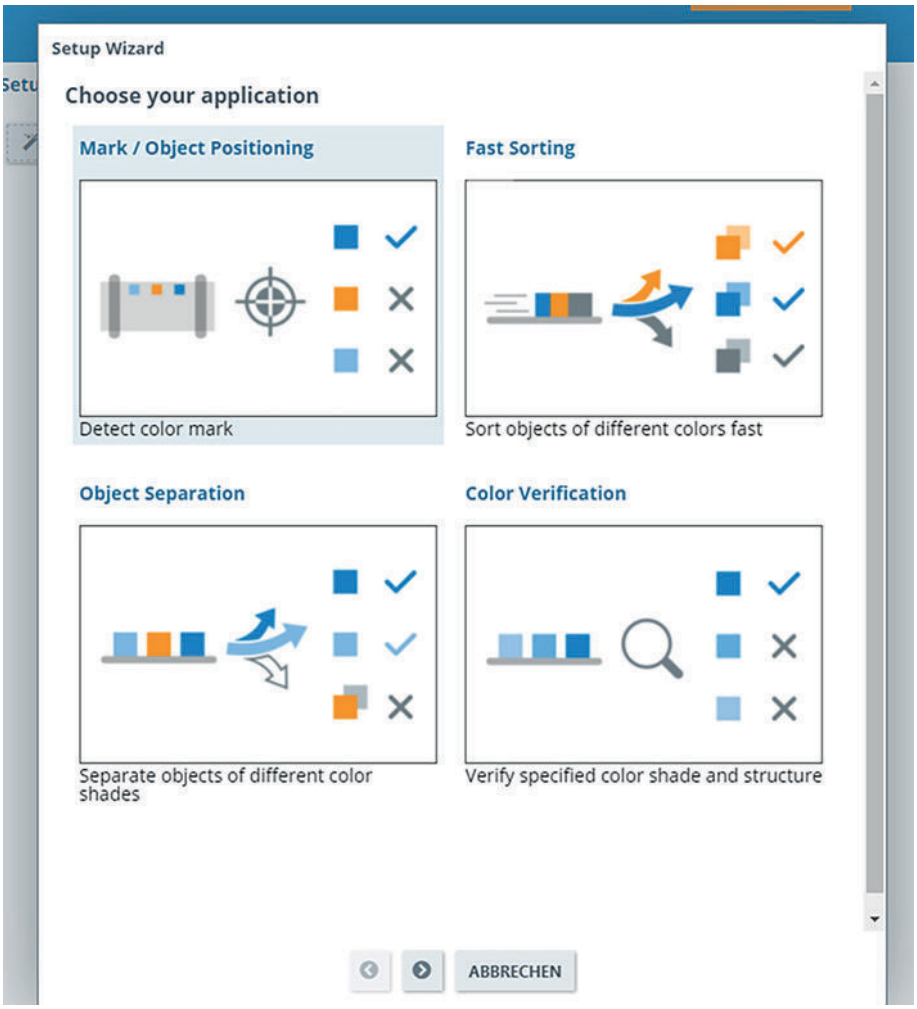
7.2.2.1 Selecting the Setup Wizard

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



7.2.2.2 Selecting the application

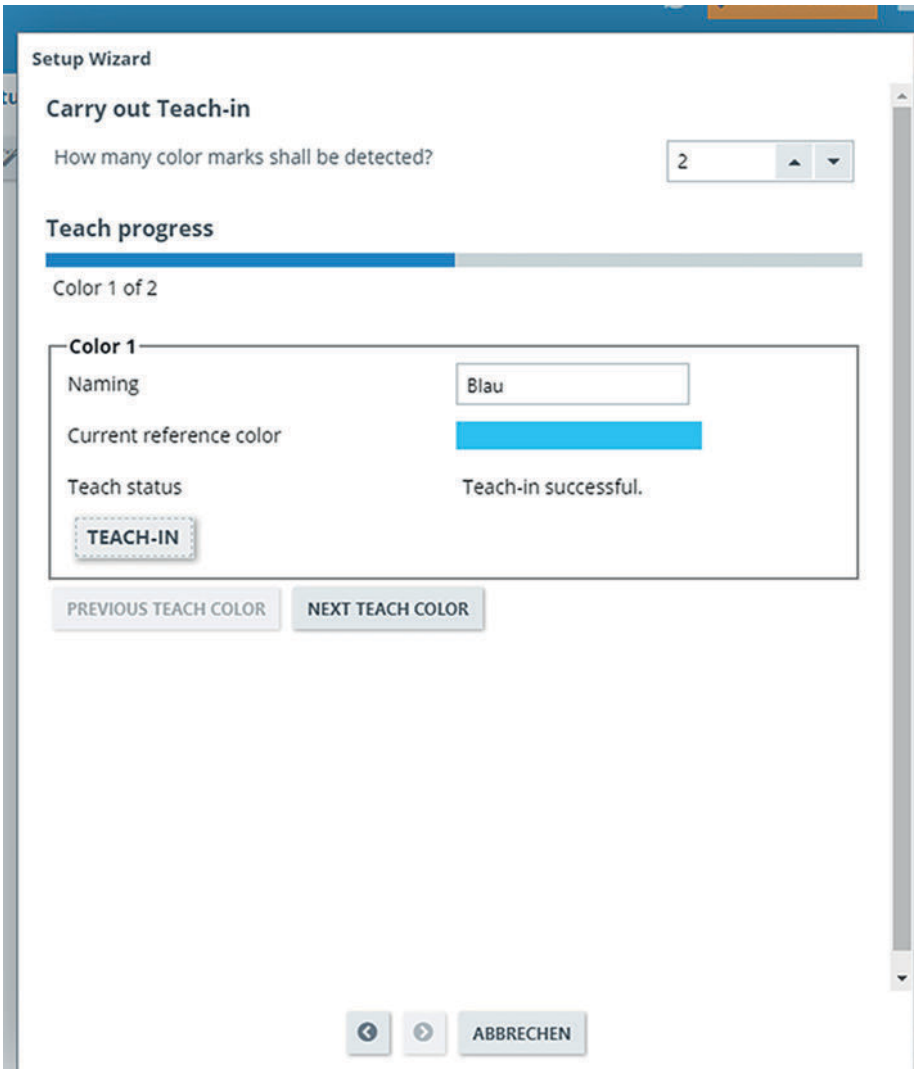
Select the task for which the sensor is to be used (see "Operating Mode", page 30).



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

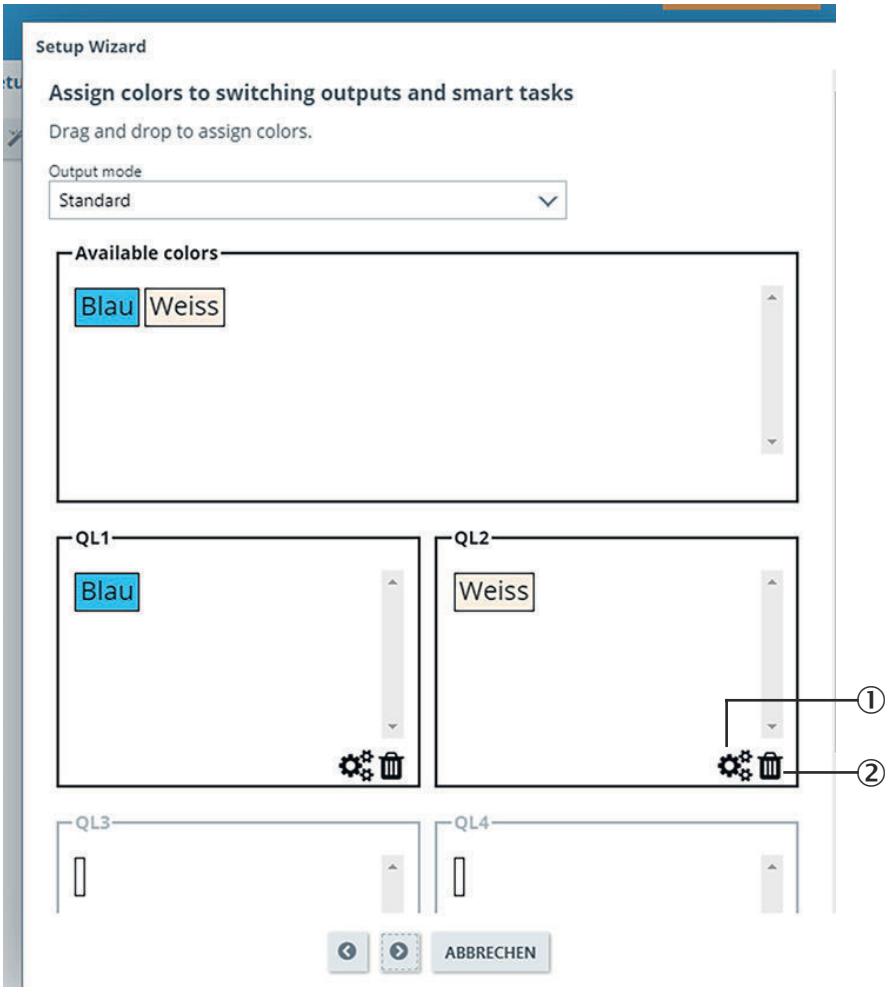
Assignment and configuration of the digital outputs via drag & drop

Option 1

Assignment to 2 and 4 digital outputs (see "Output Mode", page 33)

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

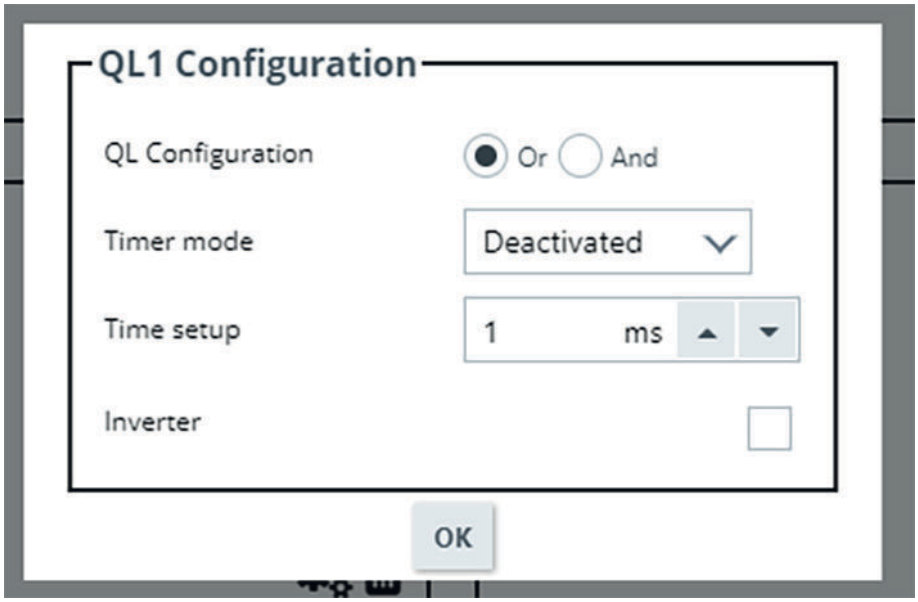
In **Output Mode Standard** and **Output Mode Best Fit**, the taught-in objects can be assigned to the digital outputs (QL) as required.
The CSx-xBxxxxx5A variants only have two physical digital outputs.
The grayed-out QL3 and QL4 are virtual digital outputs that can only be output via IO-Link.



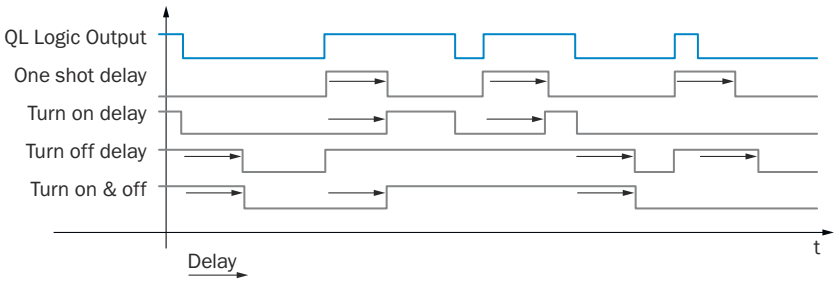
① Open settings
Opens the QL Configuration.

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.



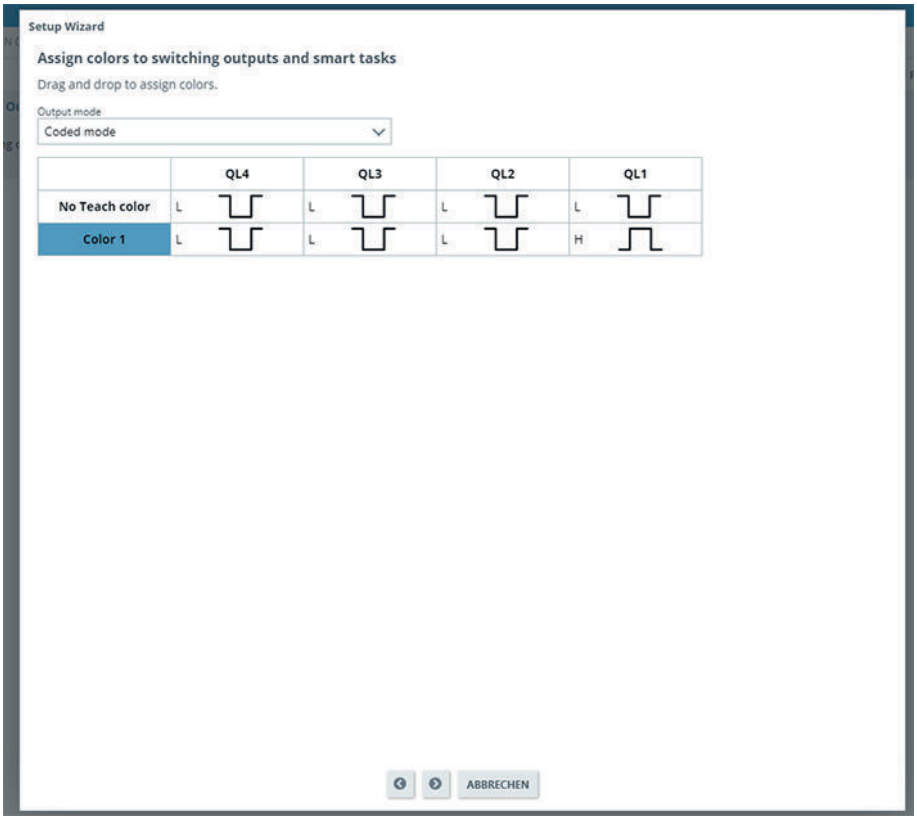
- QL Configuration
  Or At least one of the colors linked to the QL must be detected in order to trigger switching of the QL. This is the default option for the CSS/CSX, and is suitable if any one of the taught-in colors should lead to the QL being switched.
  And
  All of the taught-in colors must be 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).

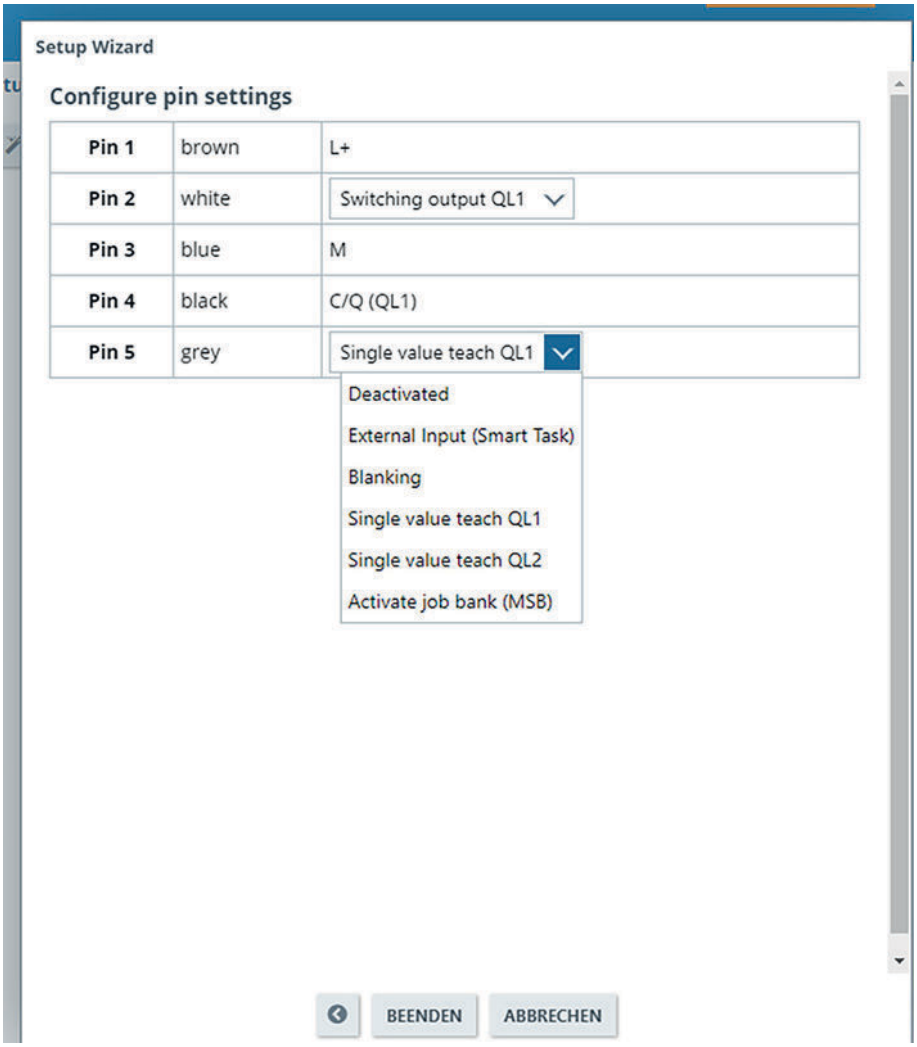
Option 2

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 38).



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**.

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 Setting Automatic sensing distance regulation

The sensor has an automatic sensing distance regulation feature.

This means that the sensor correctly assigns colors regardless of the sensing distance. An object of the same color produces the same color match value (CMV) at the sensor, regardless of whether the object is positioned at a sensing distance of 50 mm or 150 mm.

The minimum remission for determining the distance is shown in the following table.

Table 12: Minimum remission for determining the distance

Variant	CSS-xxxxC	CSS-xxxxD		
Sensing distance	50 ... 150 mm	50 ... 250 mm	250 ... 350 mm	350 ... 500 mm
Minimum remission	10%	5%	10%	25%

This function can be very helpful for different object sizes or fluctuating sensing distances. However, if the CSS is used at a constant distance (e.g. for web material), the automatic sensing distance regulation is not required and can be deactivated. It is not preset in **Operating Modes**.

1. Select the **Configuration** area.
2. Select the **Settings** tab.
3. Click on the arrow next to **Automated sensing distance regulation**.
4. Activate or deactivate the function.

7.2.3.4 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**.

7.2.3.5 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 47, page 55).

7.2.3.6 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.

7.2.3.7 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.

7.2.3.8 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.

7.2.3.9 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.

7.2.3.10 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.

7.2.3.11 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.

7.2.3.12 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.

7.2.3.13 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 “Short circuit”	- 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 cannot differentiate between color differences visible to the eye	Sensor not set to highest color resolution	• Set the highest possible sensitivity (999 at best) • Mount the sensor at a distance of 50 mm from the object • Select the slowest response time (500 ms)
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
! Full	Number of teachable colors exceeded (via the control panel: basic colors QL-QL2 or QL4 plus up to 20 colors via add-teach-ins)	If possible, teach in several colors in a Multi-Value Teach-in instead
Strongly fluctuating Color Matching Value (CMV) when an object moves into view	Deviation from recommended entry direction	Ensure a lateral entry of the object

Display, error situation	Cause	Measure
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)", page 30)
Different Color Matching Values (CMV) for identical object (identical surface & distance)	Operation outside the nominal sensing distance / minimum remission of the automatic sensing distance regulation (see "Automatic sensing distance regulation", page 37)	Check the distance between the sensor and object, if necessary deactivate automatic sensing distance regulation
Transparent objects cannot be distinguished	Signal loss due to opacity	Attach reflective tape in the background to amplify the signal
Incorrect switching when using two CSS or more	Mutual interference of the sensors in the field of view	Attach additional CSS outside the field of view: When used at a sensing distance of < 200 mm, maintain a lateral distance of 50 mm between the sensors, and at a sensing distance of > 200 mm, a lateral distance of 100 mm

Troubleshooting during operation

Table 14: Troubleshooting during operation

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
! Lifetime Reached	Transmit LED service life reached → Stability of color recognition decreases	Replace with new device
x Failed	Appears when an attempt is made to select a job via the control panel when **Activate job** is set in the IN1 / IN2 configuration.	

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.

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

11 Technical data

Features

Table 16: Features

CSS	-xxxxC	-xxxxD
Sensing distance	50 ... 150 mm	50 ... 500 mm
Light sender	LED, RGB	
LED risk group according to IEC 62471:2006	2	
Wavelength	450 nm, 550 nm, 610 nm	
Light emission	Long device side	
Light spot size	Ø 3.5 ... 6.5 mm	Ø 8 ... 32 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 Output Mode Standard / Output Mode Best Fit 3 or 15 colors in output mode Coded (depending on variant)	
Adjustment of the sensitivity	Continuous: 0...999	
Available job banks	4	
Output / channel	2x or 4x hardware switching outputs (depending on variant) / 24x virtual switching outputs (Qint) via IO-Link	

Mechanics/Electronics

Table 17: Mechanics/Electronics

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.	4.1 kHz
Response time min.	120 µs
Jitter min.	60 µs
Switching output	PNP/NPN
Digital output (voltage)	Push-pull: PNP/NPN HIGH = UV - 3 V LOW ≤3 V
Output current $I_{max.}$	100 mA[3]
Input, teach-in (ET)	Teach-in: U = 10 V ... < U_V; deactivated: U ≤ 2 V
Input, blanking input (AT)	Blanked: U = 10 V ... < U_V; deactivated: U ≤ 2 V
Storage time (ET)	3 sec, non-volatile memory
Connection type	M12 male connector, 5-pin or M12 male connector, 8-pin (depending on variant)
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.

Ambient data

Table 18: Ambient data

Ambient temperature, operation	– 20 °C ... + 55 °C
Ambient temperature, storage	– 25 °C ... + 75 °C
Impact load	According to IEC 60068-2-27 (30 g/11 ms)
UL file no.	E181493

11.1 Dimensional drawing

NOTE
All dimensions in mm (inch).

CSS High Resolution TW 50- 150 mm

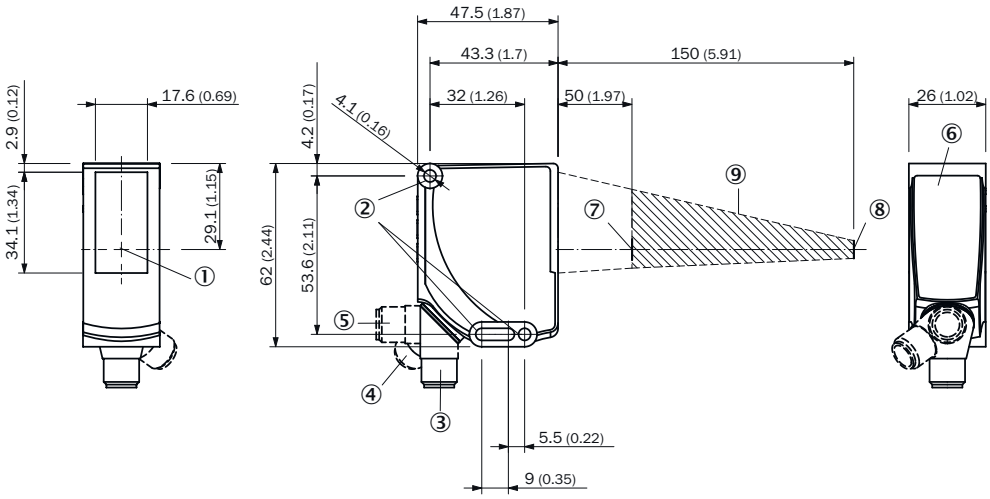


Figure 48: Dimensional drawing for CSS High Resolution TW 50 - 150 mm

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 Display and setting elements
⑦ TW light spot 50, Ø6.5
⑧ TW light spot 150, Ø5.8
⑨ Working range

CSS High Resolution TW 50- 500 mm

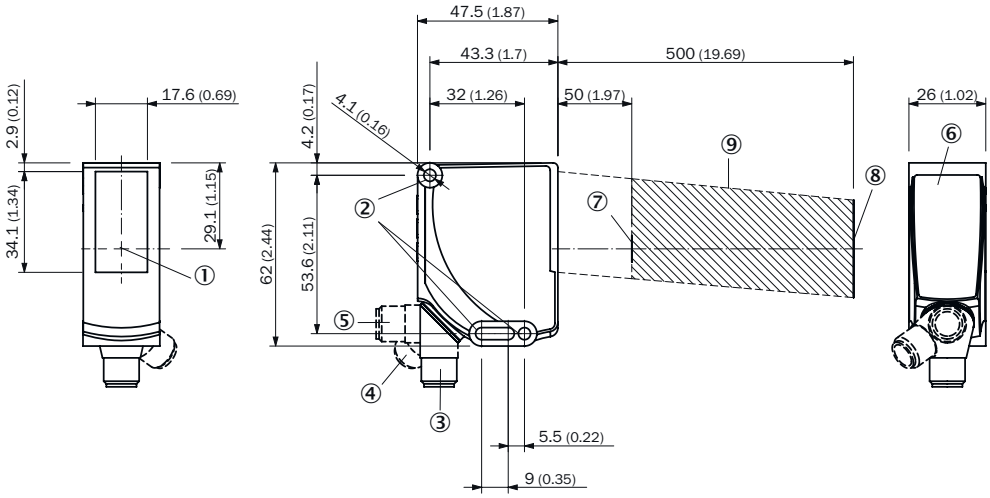


Figure 49: Dimensional drawing for CSS High Resolution TW 50 - 500 mm

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 Display and setting elements
⑦ TW light spot 50, Ø9.0
⑧ TW light spot 500, Ø32.0
⑨ Working range

12 accessories

NOTE

Accessories can be found on the online product page at:

► www.sick.com/CSS_High_Resolution

13 Annex

13.1 Modbus RTU

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", page 44

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 19: 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 20: 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 21: 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 22: "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 23: 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 24: 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 25: Qint byte 0

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

Table 26: 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 27: 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 28: 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

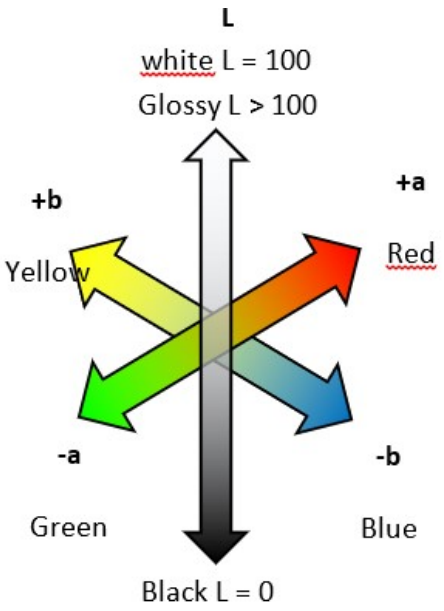


Figure 50: Lab color measurement

Status

Table 29: 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 30: 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 31: 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 32 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 32: 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

The EU declaration of conformity and other certificates can be downloaded from the Internet at:

► www.sick.com/CSS_High_Resolution

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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