

# CR200PN and CR210PN

Version 1.3



## Notes

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We shall not accept any claims for damages, except for those resulting from intent or gross negligence.

As this product is available in several designs, there might be deviations between the descriptions and instructions in hand and the product supplied.

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CR200PN and CR210PN - Manual V1.3

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## Revision history

| Manual version | Date       | Changes  |
|----------------|------------|--|
| 1.0            | 14.04.2015 | First release  |
| 1.1            | 11.06.2015 | Converting the numerical format has changed                    |
| 1.2            | 23.06.2015 | Meaning of field bus leds added                                |
| 1.3            | 16.05.2018 | Color value memory cells, drawing, EtherNet/IP, CE declaration |



The instruments are not to be used for safety applications, in particular applications in which safety of persons depends on proper operation of the instruments.  
These instruments shall exclusively be used by qualified personnel.  
Repair only by ASTECH.

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# 1 Technical Data

**Table 1 : General technical data**

|                                |   |
|--------------------------------|---|
| Sensing channels               | CR200: 2 Sensing channels<br>CR210: 1 Sensing channel, 1 Internal stab. channel |
| Drift stabilization            | CROMLASTAB®, Can be switched off  |
| Receiving detector             | Three range photo diode   |
| Sensitivity                    | Adjustable by user  |
| Sensitivity steps              | 8 (1x, 4x, 20x, 40x, 80x, 200x, 400x, 800x)                                     |
| Receiving signal resolution    | 3 x 4096 steps  |
| Object illumination            | Power white light LED<br>Adjustable (4096 Steps)<br>Can be switched off         |
| Ambient light compensation     | Can be switched off   |
| Standard interfaces            | 12 Switching outputs<br>2 Control inputs<br>Serial (RS-232)<br>USB              |
| Field bus interface            | Profinet  |
| Displays                       | 19 LEDs for outputs and status  |
| Buttons                        | 3 Buttons for Teach-In  |
| Color resolution (L*a*b*)      | $\Delta E_{Lab} \leq 1$   |
| Response time                  | $\geq 50 \mu s$ (limited functionality)   |
| Off-Delay (channel specific)   | 0 ms ... 65535 ms   |
| On-Delay                       | 0 ms ... 65535 ms   |
| Hysteresis                     | 0 % ... 255 %   |
| Color value memory cells       | 100   |
| Color output channels          | 12 (up to 100 at binary encoding)   |
| Protection standard            | IP54  |
| Power supply                   | 18 ... 28 VDC, max. 500 mA  |
| Case temperature for operation | -10 °C ... 55 °C  |
| Coupling in signal path        | Via optical fiber   |
| Optical fiber adaption         | M18x1   |
| Housing material               | Aluminum, anodized  |
| Housing size                   | 100 mm × 70 mm × 30 mm  |
| Weight                         | Ca. 260 g   |

**Table 2 : Operational functionality**

|                             |   |
|-----------------------------|---|
| Channel measurement methods | CR200PN:<br>Difference measurement<br>Channel 1<br>Channel 1 drift compensated<br>Channel 1+2<br>CR210PN:<br>Channel 1<br>Channel 1 drift compensated |
| Color space modes           | Non-self-shining objects<br>XYZ, XyY, u'v'L*, L*a*b*, xyl<br>Self-shining objects<br>XYZ, xyY, u'v'L*, xyl  |
| Color recognition modes     | Check spherical tolerance<br>Check cylindrical tolerance<br>Minimal distance  |
| Operating modes             | External triggering<br>Color grouping<br>Color sequence recognition   |
| Parameterization            | Elaborately via PC Software<br>Limited via 3 buttons  |

## 2 Specification electrical interfaces

Figure 1 shows the electrical connectors (type M9) of the sensor.

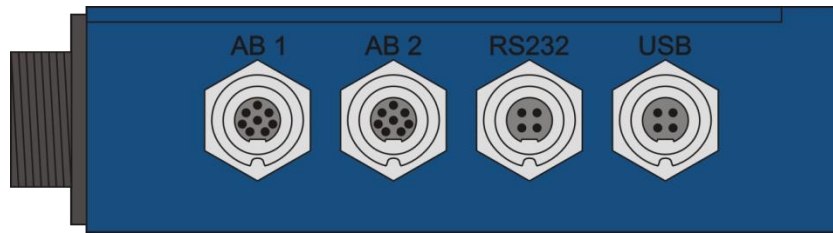


Figure 1 : Electrical interfaces

The counting order of round connectors is shown in Figure 2.



Figure 2 : Counting order of the round connectors

Table 3 : Signal description sensor connector AB1

| Pin (color) | Name            | Description   |
|-------------|-----------------|---|
| 1 (white)   | OUT1            | Sensor output 1   |
| 2 (brown)   | OUT2            | Sensor output 2   |
| 3 (green)   | TRG1            | Input for external triggered Teach-In in mode "Ext. Teach"  |
| 4 (yellow)  | TRG0            | Input for updating the sensor outputs in mode "Extern Trig."<br>Input for trigger controlled color sequence in mode "Trig. Sequ." |
| 5 (grey)    | OUT3            | Sensor output 3   |
| 6 (pink)    | OUT4            | Sensor output 4   |
| 7 (blue)    | GND             | Ground  |
| 8 (red)     | +U <sub>B</sub> | Power supply  |
| Shield      | SH              | Device shield (earth)   |

Table 4 : Signal meaning sensor connector AB2

| Pin (color) | Name  | Description           |
|-------------|-------|-----------------------|
| 1 (white)   | OUT5  | Sensor output 5       |
| 2 (brown)   | OUT6  | Sensor output 6       |
| 3 (green)   | OUT7  | Sensor output 7       |
| 4 (yellow)  | OUT8  | Sensor output 8       |
| 5 (grey)    | OUT9  | Sensor output 9       |
| 6 (pink)    | OUT10 | Sensor output 10      |
| 7 (blue)    | OUT11 | Sensor output 11      |
| 8 (red)     | OUT12 | Sensor output 12      |
| Shield      | SH    | Device shield (earth) |

Table 5 : Electrical specification sensor connector AB1

| Pin | Specification |
|-----|---------------|
|-----|---------------|

|                      |  |
|----------------------|--|
| 1 (OUT1)             | Push-Pull<br>LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA |
| 2 (OUT2)             | Push-Pull<br>LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA |
| 3 (TRG1)             | LOW: 0 V ... 3 V; HIGH: 18 V ... 28 V                            |
| 4 (TRG0)             | LOW: 0 V ... 3 V; HIGH: 18 V ... 28 V                            |
| 5 (OUT3)             | Push-Pull<br>LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA |
| 6 (OUT4)             | Push-Pull<br>LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA |
| 7 (GND)              | 0 V  |
| 8 (+U <sub>B</sub> ) | 18 ... 28 VDC, max. 500 mA<br>(optional 9 ... 28 VDC)            |

**Table 6 : Electrical specification sensor connector AB2**

| Pin       | Specification  |
|-----------|--|
| 1 (OUT5)  | Push-Pull<br>LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA |
| 2 (OUT6)  | Push-Pull<br>LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA |
| 3 (OUT7)  | Push-Pull<br>LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA |
| 4 (OUT8)  | Push-Pull<br>LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA |
| 5 (OUT9)  | Push-Pull<br>LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA |
| 6 (OUT10) | Push-Pull<br>LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA |
| 7 (OUT11) | Push-Pull<br>LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA |
| 8 (OUT12) | Push-Pull<br>LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA |



**Table 7 : RS-232**

| Pin                  | Description             | Specification |
|----------------------|-------------------------|---------------|
| 1 (GND)              | GND                     | 0 V           |
| 2 (TXD)              | Send                    | -5 V ... +5 V |
| 3 (RXD)              | Receive                 | -5 V ... +5 V |
| 4 (+U <sub>B</sub> ) | Optional voltage output | 18 ... 28 VDC |
| Shield               | Device shield (earth)   | Earth         |

**Table 8 : RS-232 Parameters**

| Parameter    | Value             |
|--------------|-------------------|
| Baud rate    | 9.600 ... 115.200 |
| Data bits    | 8                 |
| Parity       | no                |
| Stop bits    | 1                 |
| Flow control | No                |

**The baud rate of the RS-232 interface is pre-set to 28800.**

**Table 9 : USB**

| Pin      | Description           | Specification |
|----------|-----------------------|---------------|
| 1 (GND)  | GND (black)           | 0 V           |
| 2 (VBUS) | VBUS (red)            | +5 V          |
| 3 (D-)   | D- (white)            | -400 mV       |
| 4 (D+)   | D+ (green)            | +400 mV       |
| Shield   | Device shield (earth) | Earth         |

**Make sure that the respective shield wires of the used sensor cables are properly connected to earth!**

## 3 Profinet IO

### 3.1 General

Color sensors that are equipped with the optional Profinet interface, can be easily integrated into existing bus systems. They work as Profinet slaves.

**The Profinets address of the device is set via the bus.** The default factory set ip address is 192.168.0.53. The device ID is **cr2xx-pn**.

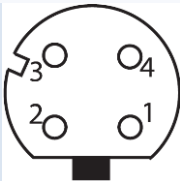
The user can choose the data, which is transferred to the Profinet master, via different modes. The possibilities range from status-information and the current state of the switching outputs to the transfer of all color values, including the color detection result and the color distance.

### 3.2 Connections

The CR210PN and CR200PN can be easily connected to a network by using the M12-connector (Binder-series 715, 4-pin, D-coded)

The pin assignment of the Ethernet interface and the RJ45 connector is shown in Table 10.

Table 10 : Profinet pin assignment

| Description | Ethernet-IN  | RJ45-Connector     |
|-------------|--|--------------------|
| Scheme      |  |                    |
| TD+         | 1  | 1 = white / orange |
| RD+         | 2  | 3 = white / green  |
| TD-         | 3  | 2 = orange         |
| RD-         | 4  | 6 = green          |

### 3.3 Data transfer

The CROMLAVIEW® CR200 CR210 color sensors with Profinet interface have to be configured as standard Profinet IO slave. By the first parameter setting after power on, the sensor recognize the chosen mode by the Profinet input bytes. The data format of the different modes is explained in the following section.

The data length of the several modes is shown in Table 11.

Table 11 : Data length

| Mode | Length of input data (Profinet-IN) | Length of control data(Profinet-Out) |
|------|------------------------------------|--------------------------------------|
| 1    | 4 Byte                             | 2 Byte                               |
| 2    | 16 Byte                            | 2 Byte                               |
| 3    | 28 Byte                            | 2 Byte                               |

### 3.4 Profinet-IN

For the format of the input data there are three different modes available. The data is sent to the Profinet-master.

#### Mode 1

In mode 1 the color sensor sends a life-counter, status information and the current state of the switching outputs of the sensor to the bus.

##### Life-counter (byte 1)

- Counts cyclic from 0 to 255 (1 byte)
- Is incremented with every measured value of the sensor
- Ensures the validity of the measured value
- Importance if the sampling rate of the sensor is faster than the bus cyclic time

##### Status (byte 2)

- Shows information about the state of the sensor
- Is updated with each bus request
- Trigger-Ack confirms the correct reception of a rising edge of one of the two trigger bits from the Profinet in bytes

Table 12 shows the meaning of the bits in the status byte.

**Table 12 : Meaning of the bits in the status byte**

| Bit | Name         | Function   |
|-----|--------------|--|
| 0   | Trigger-Ack  | Toggle Bit für Trigger-Mode  |
| 1   | Stab-Error   | 1 = Stabilization channel under- respectively over steered         |
| 2   | Math-Error   | 1 = mathematical over steering of the transformation function      |
| 3   | Software-Acc | 1 = Access of the parameter setting software CR-Tool on the sensor |
| 4   | Reserved     | Not used   |
| 5   | Reserved     | Not used   |
| 6   | Reserved     | Not used   |
| 7   | Reserved     | Not used   |

##### Switching outputs (byte 3 and 4)

- Show the latest state of the 12 color sensor switching outputs
- Byte 3: 0 ... 3: switching outputs 9 to 12
- Byte 4: 0 ... 7: switching outputs 1 to 8

#### Mode 2

In mode 2 the sensor outputs all data of mode 1 and all relevant color and recognition data of the sensors first measuring channel. These include the three color values (e.g. a\*, b\*, L\* or X, Y, Z) and the result of the recognition including the two color distances.

The individual values are 16 byte long and the higher byte is transferred first.

## Mode 3

Mode 3 outputs the data of mode 1, mode 2 and the color and recognition data of the sensors second measuring channel. This mode is only useful for the CR200PN sensor. Only in this case the measuring channels are evaluated separately.

Overview of all modes

**Table 13 : Profinet-IN data**

| Byte | Mode  | Data   |
|------|-------|--|
| 1    | 1+2+3 | Life-Counter                                   |
| 2    | 1+2+3 | State  |
| 3    | 1+2+3 | Switch outputs 9 ... 12                        |
| 4    | 1+2+3 | Switch outputs 1 ... 8                         |
| 5    | 2+3   | Color value 1 channel 1 High                   |
| 6    | 2+3   | Color value 1 channel 1 Low                    |
| 7    | 2+3   | Color value 2 channel 1 High                   |
| 8    | 2+3   | Color value 2 channel 1 Low                    |
| 9    | 2+3   | Color value 3 channel 1 High                   |
| 10   | 2+3   | Color value 3 channel 1 Low                    |
| 11   | 2+3   | Color index channel 1 High                     |
| 12   | 2+3   | Color index channel 1 Low                      |
| 13   | 2+3   | Color distance Channel 1 High                  |
| 14   | 2+3   | Color distance Channel 1 Low                   |
| 15   | 2+3   | Lightness distance Channel 1 High <sup>1</sup> |
| 16   | 2+3   | Lightness distance Channel 1 Low <sup>1</sup>  |
| 17   | 3     | Color value 1 Channel 2 High                   |
| 18   | 3     | Color value 1 Channel 2 Low                    |
| 19   | 3     | Color value 2 Channel 2 High                   |
| 20   | 3     | Color value 2 Channel 2 Low                    |
| 21   | 3     | Color value 3 Channel 2 High                   |
| 22   | 3     | Color value 3 Channel 2 Low                    |
| 23   | 3     | Color index Channel 2 High                     |
| 24   | 3     | Color index Channel 2 Low                      |
| 25   | 3     | Color distance Channel 2 High                  |
| 26   | 3     | Color distance Channel 2 Low                   |
| 27   | 3     | Lightness distance Channel 2 High <sup>1</sup> |
| 28   | 3     | Lightness distance Channel 2 Low <sup>1</sup>  |

## Converting the numerical format

The color values and the recognition result in mode 2 and mode 3 are transmitted in 16Bit-signed-integer format. To present color values in a correct way they have to be divided by 100. The range of value in the sensor is between +32768 and -32667 and has consequently to be converted in a range of +327.68 and -326.67.

Due to the internal data processing, the value of the color distance is squared. For further processing it has to be calculated with the square root function. In case of usage of the cylinder mode also lightness distance parameter will be transmitted. This value has to be divided by 100, like color values.

<sup>1</sup> If spherical tolerance is chosen, the lightness distance is set to the maximum(0xFFFF)

### 3.5 Profinet-OUT

Within all modes, two data bytes are transferred to the sensor with every bus-cycle. The first byte specifies the table index for the controlled teach-in of a color. The individual bits of the second byte are used to control the sensor. Table 14 provides an overview of the functions.

**Table 14 : Meaning of the control bits in the second Profinet-Out-Byte**

| Bit  | Name     | Function  |
|------|----------|---|
| 0    | TRG 0    | Control line to update the outputs                          |
| 1    | TRG 1    | Control line for Teach-In                                   |
| 2    | Teach    | Teach-In Mode<br>0 = as adjusted in the DSP<br>1 = TabIndex |
| 3    |          | Reserved  |
| 4    |          | Reserved  |
| 5    |          | Reserved  |
| 6    |          | Reserved  |
| 7    |          | Reserved  |
| 8-15 | TabIndex | Table index for Teach-In (if bit 2 = '1')                   |

The Teach-Bit determines how the teach in takes place.

Teach = low      triggered teach-in, as adjusted in the sensor

Teach = high     the new reference color is stored in the table space, as indicated in byte 2

The reserved control bits are not evaluated. They should be kept to 'low'.

## 4 Drawings

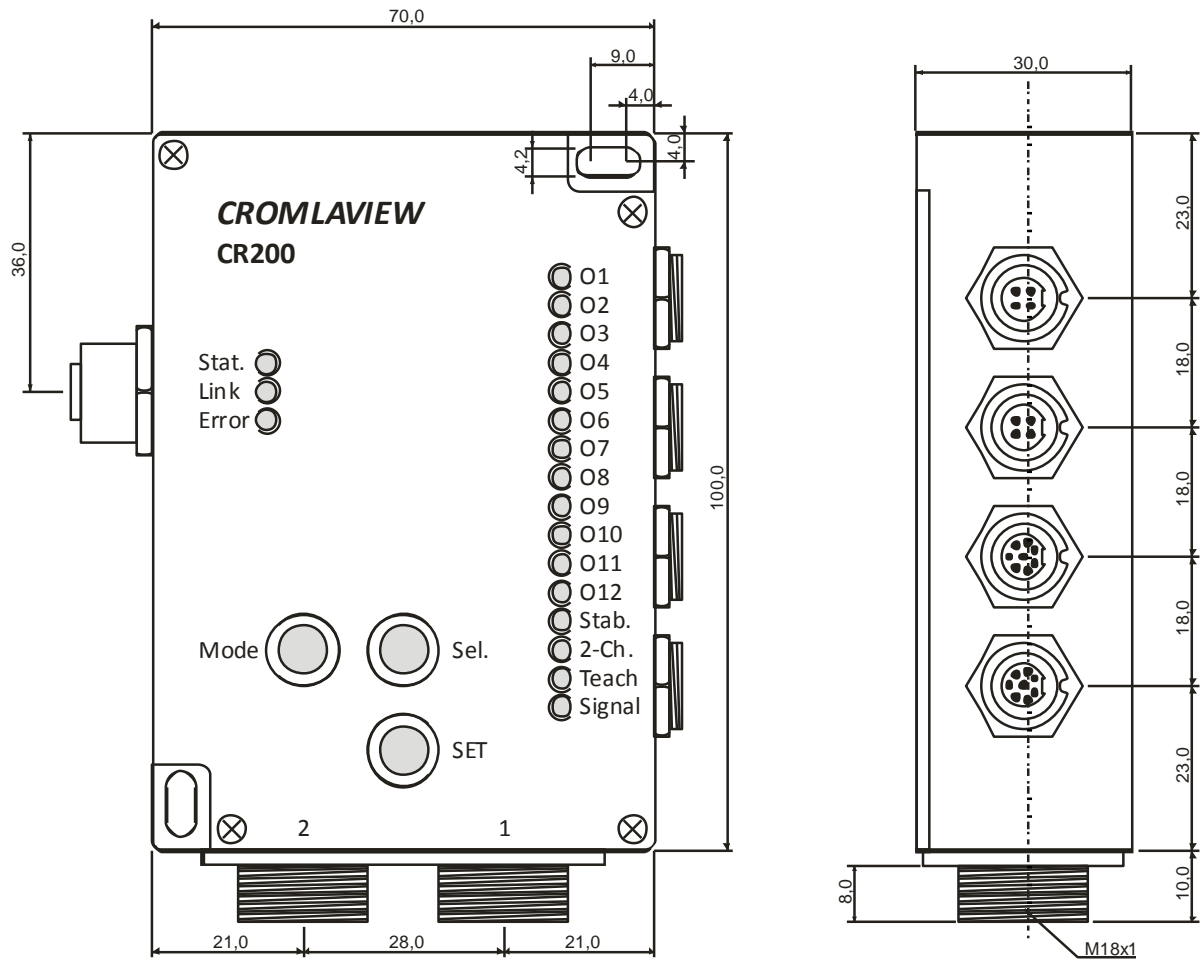
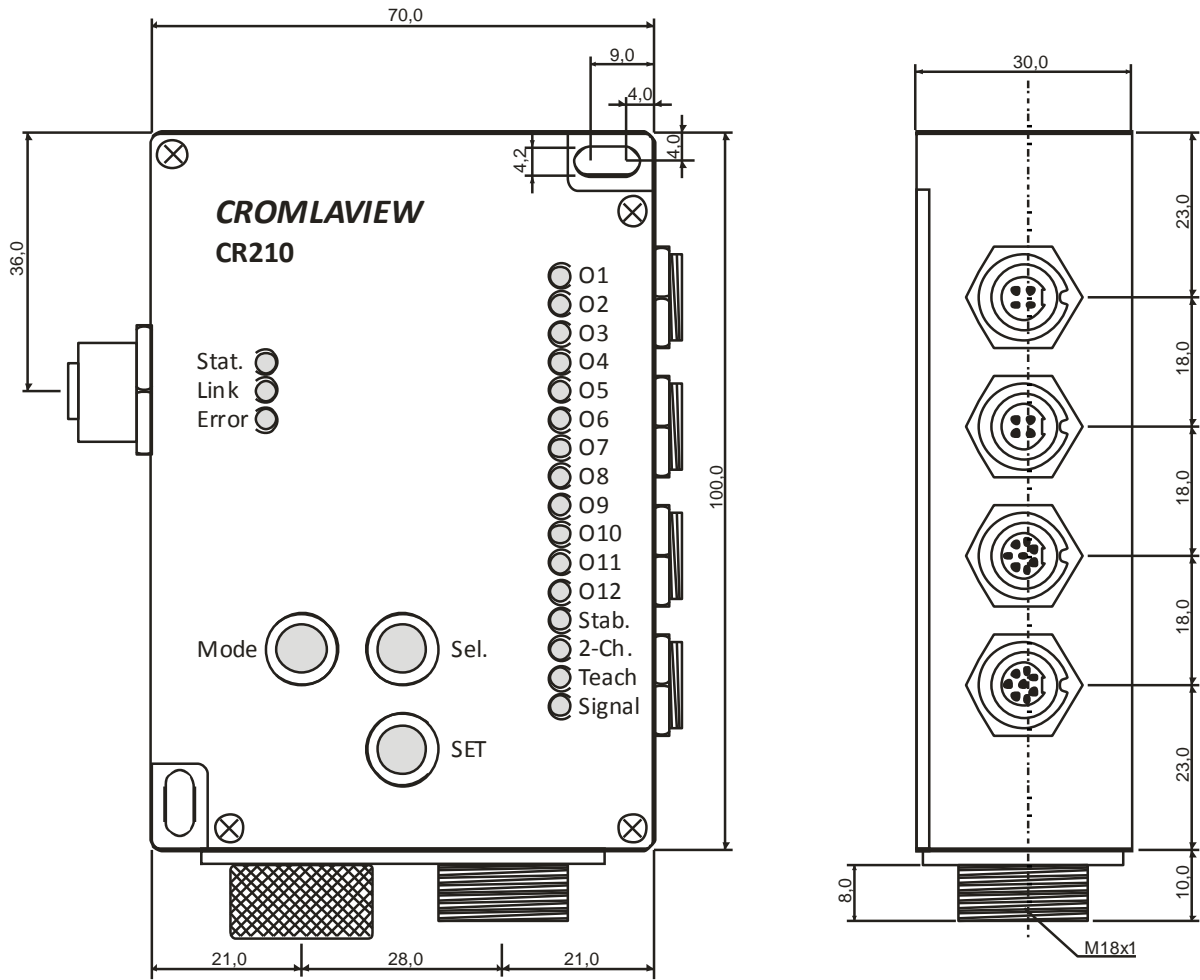


Figure 3 : Drawings CR200PN for connecting two separate fiber optical cables



**Figure 4 : Drawings CR210PN with built-in control devices for the drift stabilization CROMLASTAB®**

To control the stabilization channel, the cap on the left side is removed and the underlying slotted screw adjusted. The leveling can be controlled either in the software CR-Tool or in the control display O1 - O12 when setting with the buttons.

## 5 Displays

**Table 15 : LED meaning**

| LED    | Meaning  |
|--------|--|
| O1-O12 | State output 1-12  |
| Stab.  | Error stabilization  |
| 2-Ch.  | Two channel operation  |
| Teach  | Teach-in mode active   |
| Signal | Signal mode active   |
| Sel.   | Sensing channel 2 active   |
| SET    | Tolerance  |
| Stat.  | LED green, displays bus status according to Table 17   |
| Link   | LED green, lights up if gateway is connected to an able to work network (link pulses will be received) and flickers during network traffic |
| Error  | LED red, lights up in error case   |

**Table 16 : Assignment of flash impulses to tolerance values**

| Flash impulses | Tolerance  | Tolerance value |
|----------------|------------|-----------------|
| 1              | Very small | 3               |
| 2              | Small      | 6               |
| 3              | Medium     | 9               |
| 4              | Large      | 15              |
| 5              | Very large | 20              |

**If the sensor signal is clipping the LEDs are flashing alternately.**

**Table 17: meaning of pulses of Stat. LED (bus status)**

| Blink pulses | Meaning  |
|--------------|--|
| Off          | Bus not started  |
| Flash 10 Hz  | Error  |
| Flash 2 Hz   | Bus started, waiting for connection / configuration mode |
| Flash 1 Hz   | PROFINET participant blinking test                       |
| On           | Connection established                                   |



## 6 Button operation

### Automatic signal adjustment

- Position sensor to object
- Press "Mode" button shortly until "Sig." mode is active
- Press "SET" button for at least 2 seconds
- To store parameters press "Mode" button for at least 2 seconds

### Sample stabilization reference value

- Press "Mode" button shortly until "Sig." mode active
- Press "Sel." Button shortly to select stabilization channel
- Adjust signal level for stabilization channel mechanically (adjusting screw)
- Press "SET" button for at least 2 seconds
- To store parameters press "Mode" button for at least 2 seconds

### Teaching in colors

- Position sensor to object
- Press "Mode" button shortly until "Teach-In" mode active
- Press "Sel." button to select table entry
- Press "SET" button for at least 2 seconds
- To store parameters press "Mode" button for at least 2 seconds

### Adjust tolerance

- Press "Mode" button shortly until "Teach-In" mode active
- Press "SET" button shortly to select tolerance
- Press "SET" button for at least 2 seconds
- To store parameters press "Mode" button for at least 2 seconds

### Clear color table

- Press "Mode" button shortly until "Teach-In" mode active
- Press "Sel." button for at least 2 seconds
- To store parameters press "Mode" button for at least 2 seconds

## 7 Part numbers

| Part                                    | Part number                |
|---|----------------------------|
| CR200 color sensor                      | 10-3001-00                 |
| CR200P (Profibus interface)             | 10-3001-01                 |
| CR200E (Fast Ethernet interface)        | 10-3001-03                 |
| CR200PN (Profinet interface)            | 10-3001-04                 |
| CR200EI (EtherNet/IP interface)         | 10-3001-05                 |
| CR210 color sensor                      | 10-3002-00                 |
| CR210P (Profibus interface)             | 10-3002-01                 |
| CR210E (Fast Ethernet interface)        | 10-3002-03                 |
| CR210PN (Profinet interface)            | 10-3002-04                 |
| CR210EI (EtherNet/IP)                   | 10-3002-05                 |
| Fiber optical cables                    | See catalogue (18-0003-00) |
| STR-C2.0-M18                            | 14-3001-00                 |
| External stabilization target CR200     |                            |
| Connection cable, 8-pin, M9 / open, 2 m | 15-3000-00                 |
| RS232 cable, 4-pin, M9 / D-SUB9, 2 m    | 15-3001-00                 |
| USB cable, 4-pin, M9 / USB-A, 2 m       | 15-3003-00                 |
| M9 protection cap for sensor connector  | 15-3010-00                 |
| Ethernet cable M12M4D-RJ45, 3 m         | 15-0040-00                 |
| Ethernet cable M12M4D-RJ45, 5 m         | 15-0040-01                 |
| Ethernet cable M12M4D-RJ45, 10 m        | 15-0040-02                 |

### Surge protection

To use the sensor in systems where the supply voltage line > 3 meters, it is recommended to use a filter module to protect against surges. A suitable 24 V DC filter module (surge) is available from the company WAGO under order number 750-626.

## 8 Declaration of Conformity

|                           |   |
|---------------------------|---|
| <b>Manufacturer</b>       | <b>ASTECH Angewandte Sensortechnik GmbH</b>         |
| <b>Address</b>            | 18057 Rostock<br>Schonenfahrerstr. 5<br>Deutschland |
| <b>Product name</b>       | CR200PN/ CR210PN                                    |
| <b>Device description</b> | Color sensor  |



### EG Declaration of Conformity

In accordance with the directive 2011/65/EU and  
2014/30/EU

#### Conforming to the following standards

Radio disturbance characteristics: EN 61000-6-3:2007 +A1:2011

EMC immunity EN 61000-6-2:2005

In addition the following standard is passed:

EN 61326-1:2013; Electrical equipment for measurement, control and laboratory use –  
EMC requirements;  
Classification: Class B (emission);  
Industrial equipment (immunity)

**Place** Rostock

**Date** April 2018

ASTECH Angewandte Sensortechnik GmbH

A handwritten signature in blue ink, appearing to read 'J. Mirow', is written over a faint, light blue circular stamp or watermark.

Jens Mirow

Managing director