

# CR200EI and CR210EI

Version 1.0



## Notes

The information contained in this manual has been thoroughly researched and prepared. Nevertheless, we cannot assume liability for omissions or errors of any nature whatsoever. We would, however, be grateful for your comments or suggestions.

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.

We reserve the right to make technical changes, which serve to improve the product, without prior notification. Thus, it cannot be assumed that subsequent versions of a product will have the same features as those described here.

Registered trademarks are the property of their manufacturers.

CR200EI and CR210EI - Manual V1.0

Copyright © ASTECH Angewandte Sensortechnik GmbH, Rostock 2010-2018

## Revision history

Manual version	Date	Changes
1.0	11.04.2018	First release



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.

ASTECH GmbH, Schonenfahrerstr. 5, D-18057 Rostock

Internet [www.astech.de](http://www.astech.de) E-Mail [info@astech.de](mailto:info@astech.de)

Telefon +49 (0)381 / 44073-0 Telefax +49 (0)381 / 44073-20

## I. Contents

1	Technical Data .....	5
2	Specification electrical interfaces .....	7
3	Profinet IO .....	10
3.1	General .....	10
3.2	Connections .....	10
3.3	Data transfer .....	10
3.4	Profinet-IN .....	10
3.5	Profinet-OUT .....	13
4	Drawings .....	14
5	Displays .....	16
6	Button operation .....	17
7	Part numbers .....	18
8	Declaration of Conformity .....	19

## II. List of Figures

Figure 1	: Electrical interfaces .....	7
Figure 2	: Counting order of the round connectors .....	7
Figure 3	: Drawings CR200EI for connecting two separate fiber optical cables .....	14
Figure 4	: Drawings CR210EI with built-in control devices for the drift stabilization CROMLASTAB® .....	15

## III. List of Tables

Table 1	: General technical data .....	5
Table 2	: Operational functionality .....	6
Table 3	: Signal description sensor connector AB1 .....	7
Table 4	: Signal meaning sensor connector AB2 .....	7
Table 5	: Electrical specification sensor connector AB1 .....	7
Table 6	: Electrical specification sensor connector AB2 .....	8
Table 7	: RS-232 .....	9
Table 8	: RS-232 Parameters .....	9
Table 9	: USB .....	9
Table 10	: Pin assignment EtherNet/IP connector .....	10
Table 11	: Data length .....	10
Table 12	: Meaning of the bits in the status byte .....	11
Table 13	: EtherNet/IP-IN data .....	12
Table 14	: Meaning of the control bits in the second EtherNet/IP-Out-Byte .....	13

---

Table 15 : LED meaning ..... 16

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

Table 17: meaning of pulses of Stat. LED (bus status)..... 16

# 1 Technical Data

**Table 1 : General technical data**

Sensing channels	CR200EI: 2 Sensing channels CR210EI: 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 Adjustable (4096 Steps) Can be switched off
Ambient light compensation	Can be switched off
Standard interfaces	12 Switching outputs 2 Control inputs Serial (RS-232) USB
Optional field bus interface	Profibus Fast Ethernet Profinet EtherNet/IP
Displays	22 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	CR200EI:	Difference measurement Channel 1 Channel 1 drift compensated Channel 1+2
	CR210EI:	Channel 1 Channel 1 drift compensated
Color space modes	Non-self-shining objects XYZ, XyY, u'v'L*, L*a*b*, xyl Self-shining objects XYZ, xyY, u'v'L*, xyl	
Color recognition modes	Check spherical tolerance Check cylindrical tolerance Minimal distance	
Operating modes	External triggering Color grouping Color sequence recognition	
Parameterization	Elaborately via PC Software Limited via 3 buttons	

## 2 Specification electrical interfaces

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

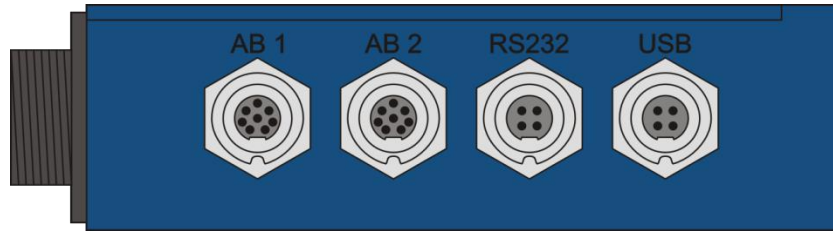


Figure 1 : Electrical interfaces

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." 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 LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA
2 (OUT2)	Push-Pull 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 LOW: 0 V; HIGHT: +U <sub>B</sub> - 1 V; max. 100 mA
6 (OUT4)	Push-Pull 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 (optional 9 ... 28 VDC)

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

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

### 3.1 General

Color sensors that are equipped with the optional EtherNet/IP interface, can be easily integrated into existing networks.

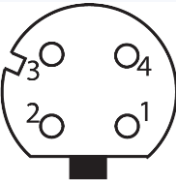
By default, the device is delivered with DHCP so that it is automatically detected and assigned by the network. If no DHCP is available, the device falls back to the IP address 192.168.0.53, the subnet mask 255.255.255.0 and the gateway address 192.168.0.1. Individual IP addresses can be assigned on request.

### 3.2 Connections

The CR210EI and CR200EI 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/IP interface and the RJ45 connector is shown in Table 10.

Table 10 : Pin assignment EtherNet/IP connector

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 EtherNet/IP interface have to be configured as adapters. 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

Length of input data (T→O)	Length of control data(O→T)
28 Byte	2 Byte

### 3.4 EtherNet/IP-IN

For the format of the input data, that are sent to the EI-adapter, the following applies:

The color sensor sends a life-counter, status information and the current state of the switching outputs of the sensor to the bus. Furthermore all relevant color and recognition data of the sensors first measuring channel will be transmitted. 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. The specification to decode values is described in chapter “Converting the numerical format” on page 12

Additionally the color and recognition data of the sensors second measuring channel are transmitted. This is only useful for the CR200EI sensor in two channel mode, since only in this case the measuring channels are evaluated separately.

### 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 EtherNet/IP-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

**Table 13 : EtherNet/IP-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 EtherNet/IP-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 EtherNet/IP-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 0 = as adjusted in the DSP 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

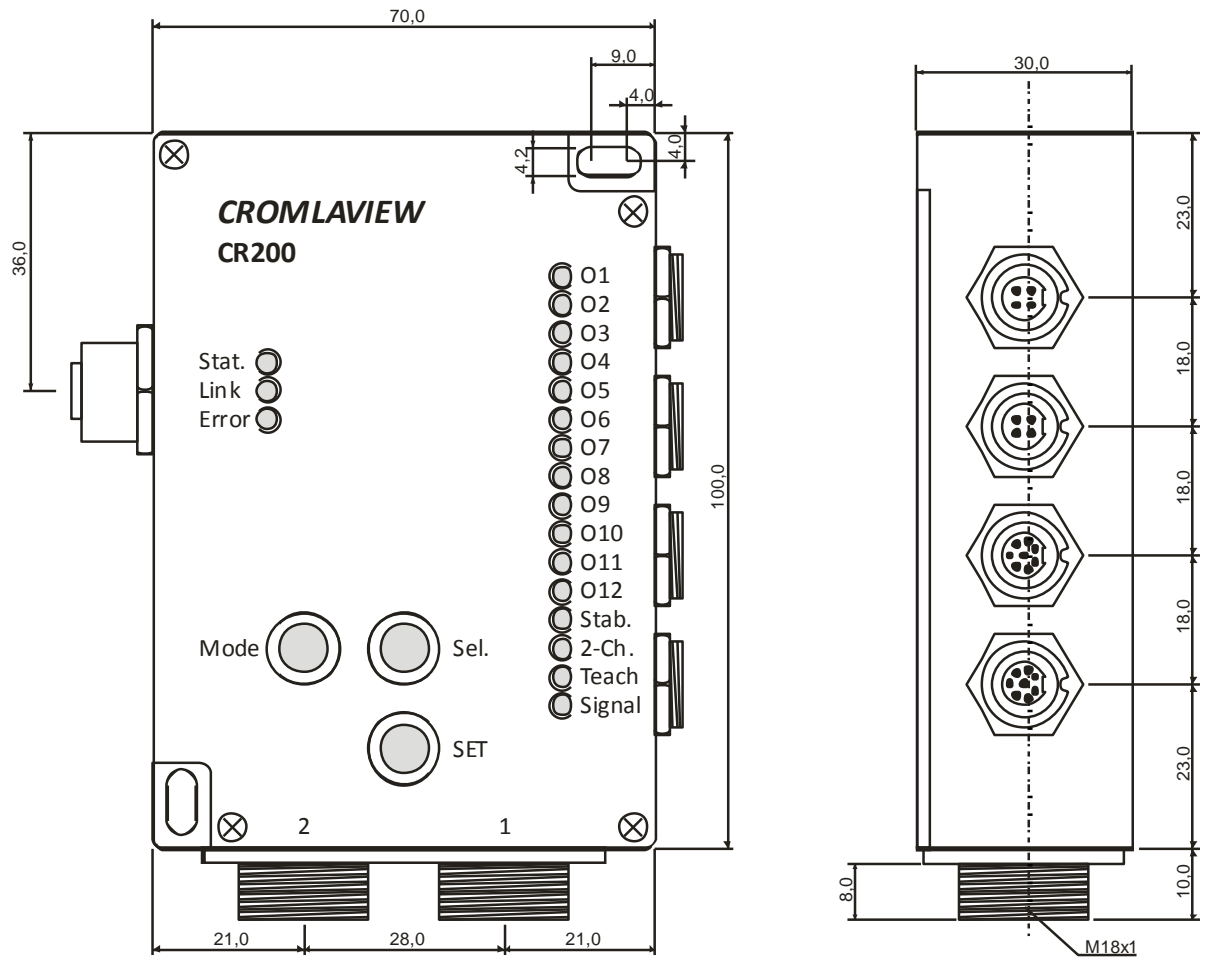


Figure 3 : Drawings CR200EI for connecting two separate fiber optical cables

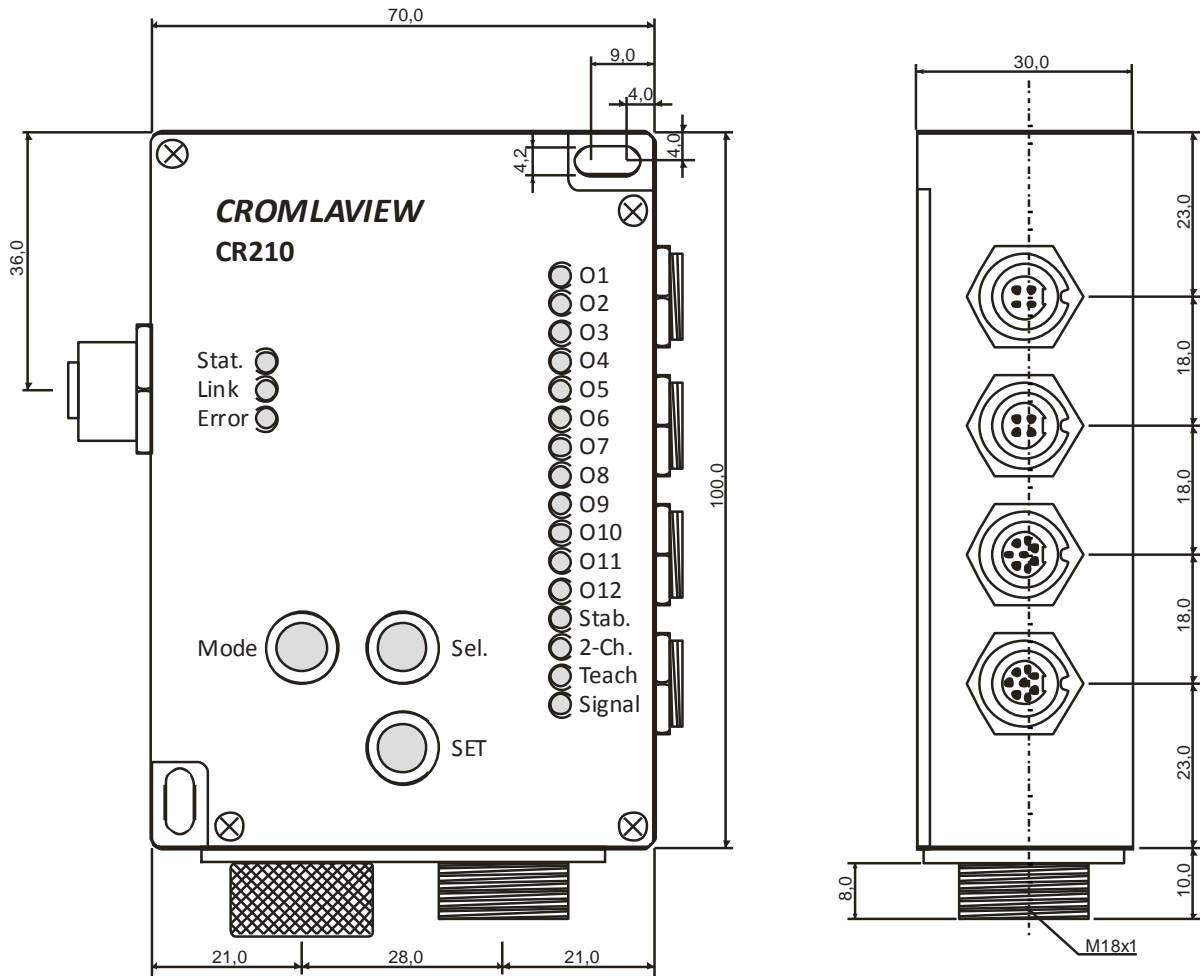


Figure 4 : Drawings CR210EI with built-in control devices for the drift stabilization CROMLASTAB®

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	ETHERNET/IP 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 Schonenfahrerstr. 5 Deutschland
<b>Product name</b>	CR200EI/ CR210EI
<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