Manual

CR10

Version 1.5

ASTECH
Angewandte Sensortechnik

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.

CR10 - Handbuch V1.5

Revisions overview

Manual version	Date	Changes
1.0	20.12.2017	New design
1.1	17.01.2018	Link to Instructions, Cover photo, several text corrections
1.2	19.01.2018	Comments output behavior Declaration of conformity
1.3	24.04.2018	Start tolerance for multiteach
1.4	25.07.2018	Working distance added
1.5	14.09.2018	Reference, p.8; revision multiteach

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	1 Sensing channel 1 internal stabilization channel
Drift stabilization	CROMLASTAB®
Receiving detector	Three range photo diode
Sensitivity steps	7 × automatic
Receiving signal resolution	3 × 4096 steps
Object illumination	Power white light LED 420 - 750 nm
Color Space	L*a*b*
Interface	**8 pin** 1 Switching output: • 200mA, push-pull • Short circuit-proof, short circuit detection • Capacitive load < 100 nF 5 control inputs: • Trigger • Teach-In • Keylock • Multiteach • Off Delay 50ms
Display	1 LED in button, Blinking (2 Hz): Tolerance level indication or multiteach Blinking (5 Hz): Understeering in teach-mode Blinking (10 Hz): Indication of output short circuit LED on: Color recognized 1 x blinking at start: continuous recognition mode 2 x blinking at Start: triggered recognition mode
Input	1 button for Teach-In
Teach-Modes	Tolerance-mode Multiteach-mode
Tolerance level/-modes	5 levels (3, 6, 9, 15, 30 ΔE_{Lab}) automatic tolerance in multiteach-mode
Color resolution	$\Delta E_{Lab} < 1$
Response time	500 µs
Off-Delay	0 ms / 50 ms
Hysteresis	10 %
Protection standard	IP 67
Power supply	10 … 28 VDC, maximal 500 mA
Temperature range	-15 °C … 55 °C
Coupling in signal path	Via optical fiber
Housing material	Aluminum, anodized
Housing size	41 mm × 46 mm × 22 mm
Weight	55 g
Reverse polarity protection	Yes
Ambient light immunity	Up to 15 kLux
min. bending radius of standard fiber cable	60 mm
Working distance with standard fiber cable	Up to 25 mm

2 Specification of electrical connections

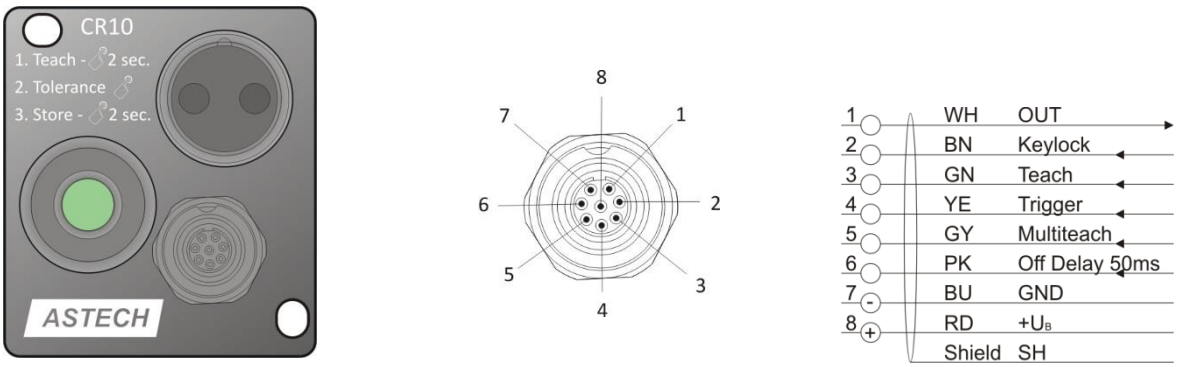

Figure 1 Scheme of connection and counting order of connector

Table 2: Signal description of sensor connector

Pin (Color)	Name	Description
1 (white)	OUT	Sensor output
2 (brown)	Keylock	Keylock (High – button locked, Low – button not locked)
3 (green)	Teach	Input for external Teach-In[1]
4 (yellow)	Trigger	Input for updating the sensor output
5 (grey)	Multiteach	Mode for tolerance setting by presenting different samples[2]
6 (pink)	Off_Delay_50ms	Hold time of output 50 ms
7 (blue)	GND	Ground
8 (red)	$+U_B$	Power supply
Shield	SH	Device shielding (earth)

Table 3: Electrical specification of signal lines

Pin	Specification
1 (OUT1)	Push-pull LOW: 0 V … 0.7 V; HIGH: ($+U_B$ – 0.7 V) … $+U_B$; max. 200 mA, capacitive load < 100 nF • Short circuit protection • Short circuit detection (indication: 10 Hz Blinking of LED)
2 (Keylock)	LOW: 0 V ... 3 V; HIGH: 10 V ... 28 V
3 (Teach)	LOW: 0 V ... 3 V; HIGH: 10 V ... 28 V
4 (Trigger)	LOW: 0 V ... 3 V; HIGH: 10 V ... 28 V
5 (Multiteach)	LOW: 0 V ... 3 V; HIGH: 10 V ... 28 V
6 (Off_Delay_50ms)	LOW: 0 V ... 3 V; HIGH: 10 V ... 28 V
7 (GND)	0 V
8 ($+U_B$)	10 ... 28 VDC, maximum 500 mA

[1] To enable a very fast Teach-In there is no leveling of the sensor. The leveling has to be done beforehand by button. Moreover the result is not stored permanently.
[2] see chapter 0

3 Drawings

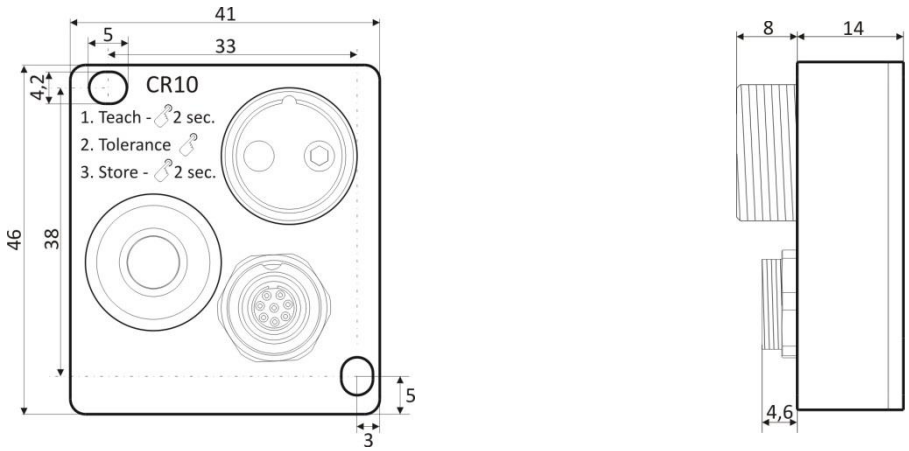

Figure 2: Drawing CROMLAVIEW® CR10

4 Thermal specification

The sensor is stabilized against thermal drift. However, an increase of temperature and thus drift phenomena may occur when setting a very high LED light output. To ensure safe color recognition, the sensor should be screwed to a heat sink with a heat resistance small than 0.5 K / W. For example this can be a standard aluminum heat sink with the size of 200 mm x 200mm with a gill height of 50mm. Large parts of machines also can be used.

⚠	The sensor can be very hot without using a heat sink. The use of a heat sink is strongly recommended to avoid injury.

5 Fields of applications and sensor properties

5.1 Fields of application

The CROMLAVIEW® CR10 contains a pulsed light source and is thus suitable for color recognition of body colors with compensation of ambient light influences. The sensor cannot be used to detect the color of self-shining objects, e.g. LEDs.
The field of application of body colors includes all objects that can be detected in reflex- and through beam mode. In reflex mode, opaque objects with rough, smooth, but also reflecting surfaces are measured. The more reflective a surface is, the more important is the inclination of the fiber cable to the surface. 4° - 10° are sufficient here in most cases. For transparent objects, it is advisable to use a through beam fiber (with separate transmitting and receiving fiber). The transparent objects also include liquids which, like transparent solids, are also detected by the through beam principle.

5.2 Colorimetric properties of the sensor

The CROMLAVIEW® CR10 works perceptually and thus resembles the human eye in its colorimetric properties. The perceptivity allows the assessment of color differences, as is possible for humans and shown in DIN 5033. The basis is the transformation of the color signals into the *L*a*b** color space. This largely corresponds to the human color perception and is described by a three-dimensional coordinate system with the axes ***L, a*** and ***b***.

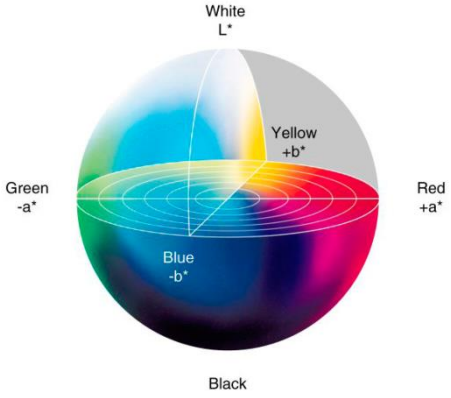

Figure 3: Representation of the L*a*b* color space

The ***a*** - axis describes the green or red portion of a color, with negative values for green and positive values for red. The ***b*** - axis describes the blue or yellow part of a color, with negative values for blue and positive values for yellow. The ***L*** - axis describes the brightness of the color with values from 0 - 100. Color differences between two colors are represented as follows:

$$\Delta E = \sqrt{(L_1 - L_2)^2 + (a_1 - a_2)^2 + (b_1 - b_2)^2}$$

A deviation of ΔE = 1 is generally considered to be the resolving power of the human eye, with brighter colors (pastel colors and whites) smaller color distances (e.g. 0.5) can be perceived and for darker, more saturated colors larger distances (e.g. 3 - 4) some not yet noticed. Color deviations from 5 are considered to be clearly noticeable.
The recognition of a color in the CROMLAVIEW® CR10 is based on the calculation of the color difference ΔE. The stored color value is surrounded by a tolerance sphere with the radius ΔE. As soon as the current color value enters this sphere, the sensor output switches. The tolerance can be set in **tolerance-mode** by fixed setting of ΔE values or in multiteach-mode by sampling several color patterns that define the tolerance sphere. Further information can be found in section 6.3.

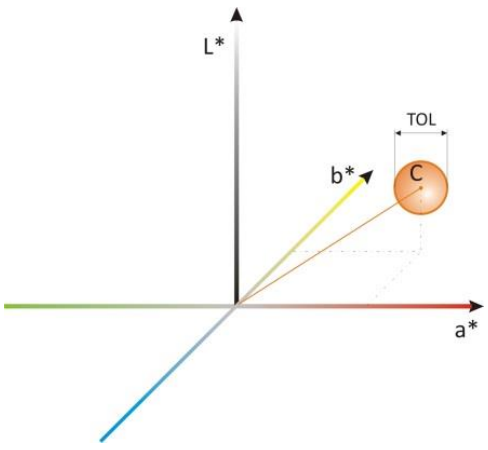

Figure 4: Diagram explaining the detection mode "Checking with sphere tolerance"

6 Parameterization

The sensor settings can be made via a button and five input lines. The LED integrated in the button serves as a display of relevant parameters (see section 6.5.). Table 4 gives an overview of the various configuration options.

Table 4: Sensor parameter

Recognition mode	• continuous recognition mode • triggered recognition mode
Output behavior	• 0 ms output hold time • 50 ms output hold time
Teach-In	• Teach-In in tolerance-mode • Teach-In in multiteach-mode • Via button with leveling and permanent storing • Via Teach-In line without leveling and without permanent storing
Operability	• Keylock On/Off

6.1 Detection mode – continuous or triggered

Each time the sensor is started, the detection mode is indicated by the LED as shown in Table 5. Changing the detection mode is done by pressing and holding the button before turning on the power supply. The change is displayed immediately and stored permanently. Since the display is largely obscured when the key is pressed, the sensor should again be disconnected from the supply voltage and reconnected to check the successful change.

Table 5: Indication of recognition mode

Blinking pulses when the sensor is switch on	**meaning**
1	Sensor works in *continuous* recognition mode
2	Sensor works in *triggered* recognition mode

Continuous recognition mode

The default setting is *continuous recognition*. In this mode, the detection result is outputted at the switching output with a response time of 500 µs.

Triggered recognition mode

In the case of *triggered recognition*, the switching output is only updated according to the recognition result if an L / H edge is present at the *trigger* input. The state does not change until a further L / H edge is detected at the *trigger* input. The triggered recognition mode allows signals to be synchronized on the one hand. For example, a light barrier can trigger the color sensor when it reaches an object at a certain position to ensure that only a specific color mark is evaluated on an object. On the other hand, by using the *triggered recognition mode*, the output hold time can be extended to any period of time. This can be useful for very slow inputs or for delayed evaluation.

6.2 Output behavior

A holding time of 50 ms at the switching output is activated if the input *Off_Delay_50ms* (pin 6, cable color pink) is set to H. In the *continuous recognition mode*, the detection result thus remains at the switching output for 50 ms longer, as the stored color is detected by the sensor.

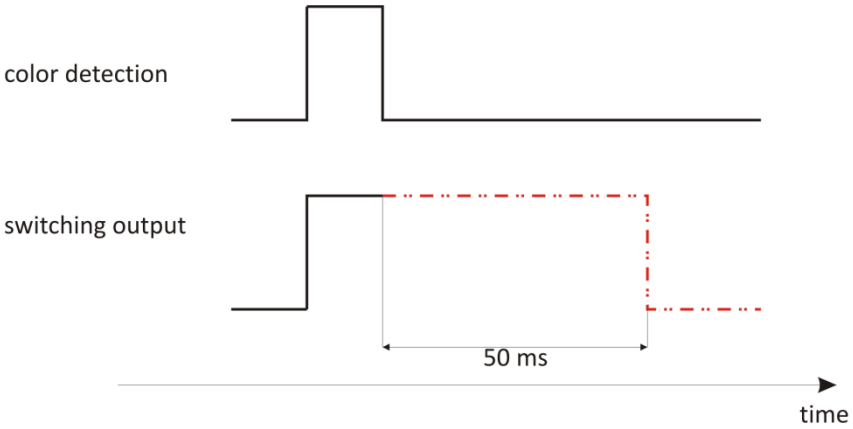

Figure 5: Output behavior for continuous recognition mode

In *triggered recognition mode*, each recognition result is internally extended by 50 ms if *Off_Delay_50ms = H*. Thus, the trigger even with quite short color detections has the chance to trigger the output, even if it does not arrive time-synchronized. A detection result is output at the switching output as long as the trigger pulse arrives in the period from the start of color detection until 50 ms thereafter (see Figure 6). The reset of the output can only be done by a new trigger pulse after this period.

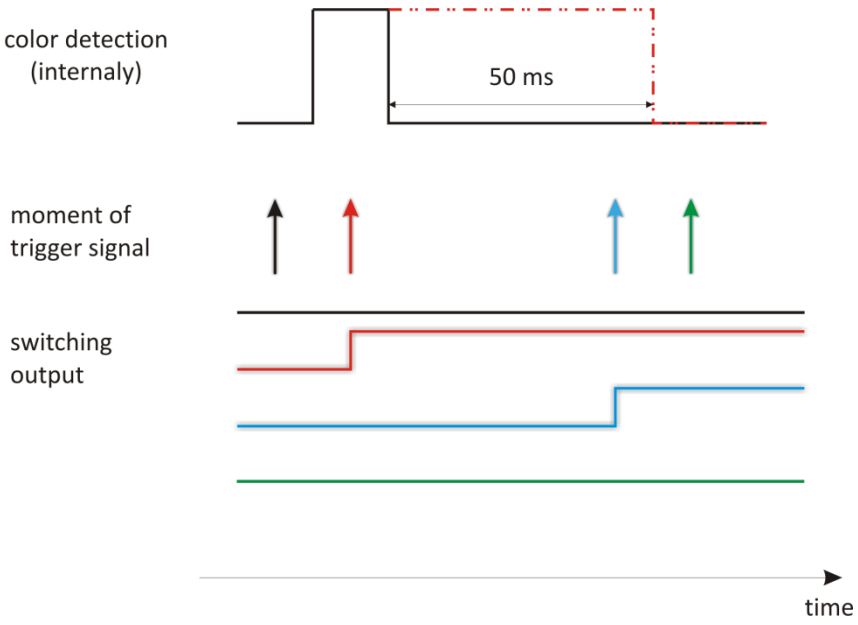

Figure 6: Output behavior or triggered recognition mode

6.3 Teach-In

To store a color in the sensor by hand or automatically, there are various possibilities. There are different modes for setting the tolerances. An illustrated manual for key operation can be found at www.astech.de (CR10 Instructions.pdf) .

Button or teach line?

Basically, the CROMLAVIEW® CR10 needs the right level of the illumination LED and amplifier for optimal operation. This is done with each teach-in, which is carried out **with the button**. Likewise, after setting the tolerance, the color value, the tolerance value and the level parameter values are permanently stored.

The stored color value - and only this - can also be overwritten with a current color value by **switching the teach input line** (pin 3, green cable) with an L / H edge. This happens without previous leveling and is therefore very fast.

The color value taught in via the *teach input line* must not be significantly brighter than the current leveling allows. Prior to teach-in via *teach input line*, a leveling with button must be carried out in advance if signal conditions has changed.

Very fast storage via the teach input line is achieved by not permanently saving the color value.

The color value taught via the *teach input line* is not stored permanently and is lost when the supply voltage is switched off. If a color value should also be available after switching on again, the button must be used to save the color value.

When teaching via *teach input line*, the tolerance is always maintained - regardless of whether *tolerance mode* or *multiteach-mode* is used.

Tolerance-mode

In tolerance mode (Multiteach = Low, Pin5, grey cable), the color is taught in as follows:

- Align the fiber cable to the object
- Press button for 2 seconds (sensor is leveled and color value saved)
- Press the button briefly several times until the desired tolerance is set (see Table 6)
- Press button for 2 seconds (color value, tolerance and level values are stored permanently).

Table 6: Assignment of the blinking pulses (2 Hz) to tolerance values in tolerance mode

Blinking pulses	Tolerance	Tolerance value ΔE
1	Very small	3
2	Small	6
3	Medium	9
4	Big	15
5	Very big	30

The color tolerance levels correspond to the color deviations in ΔE of the *L*a*b** color space (see Section 5).

Multiteach-mode

In *multiteach-mode* (Multiteach = High, Pin5, grey cable) the color tolerance is set by presenting several color samples. The center of the tolerance sphere is defined by the first color. Without further tolerance adjustment, the previously set tolerance is retained. If a second color is added, the tolerance sphere gets the radius of the distance between these two colors. Any additional color presented to the sensor will increase the tolerance radius, if it is farther from the center, than the previously determined tolerance maximum. A tolerance of ΔE = 1 is added to the maximum tolerance (see Figure 7) during the storing procedure. In the example shown below, the switching output of the sensor accordingly switches on at a color difference of ΔE = 4. However, considering a 10 percent hysteresis, this output does not switch off again until ΔE = 4.4. Thus, the flutter of the output is prevented when a color value is on the switching threshold. The function of hysteresis applies equally in tolerance mode.

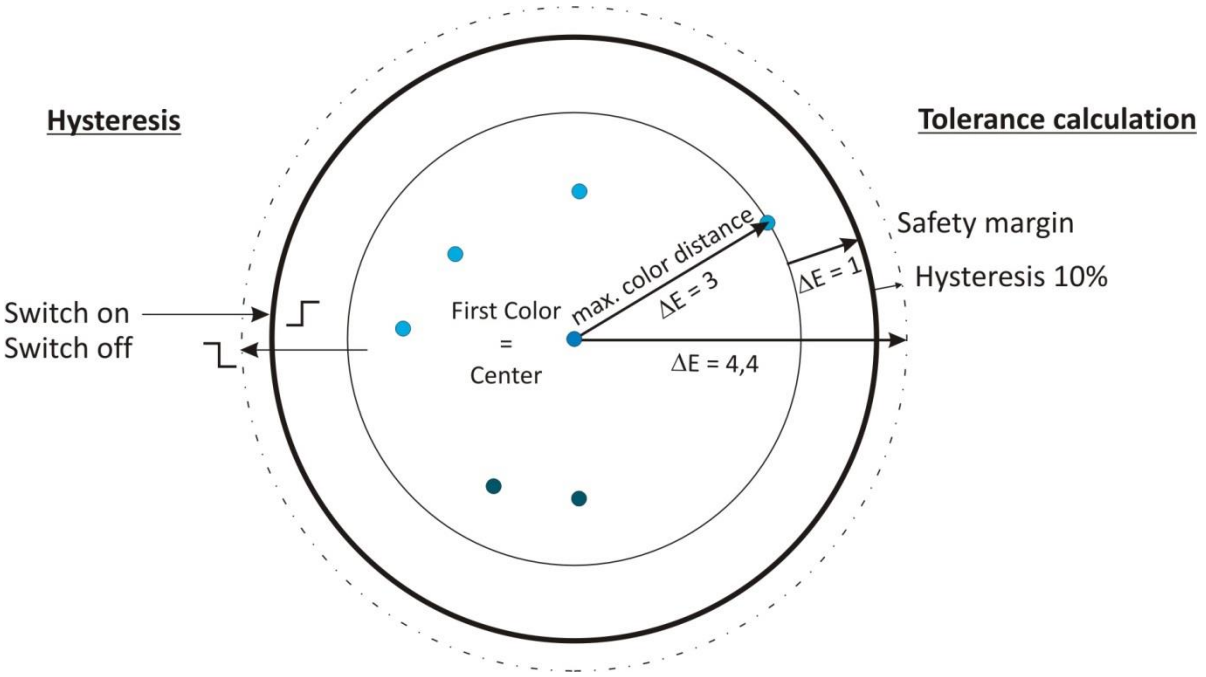

Figure 7: Example of tolerance calculation in multiteach mode and how the hysteresis works

> If the colors for the tolerance setting have clear brightness differences, the first color should be the brightest or one of the lighter colors to avoid oversteering.

The teach-in procedure in *multiteach-mode* is to be carried out as follows:

- Align the fiber cable to the object (the brightest color first for a large brightness spectrum)
- Press button for 2 seconds (sensor is leveled and center color value saved)
- Align the fiber cable to other objects and briefly press the button (tolerance is adjusted)
- Press button for 2 seconds (color value, tolerance and level values are stored permanently)

The differentiation of the *tolerance mode* from the *multiteach-mode* happens after teaching in the color in the *tolerance mode* or the **first** color in the *multiteach-mode*. The LED will then blink with a 2 Hz frequency. In *tolerance mode* 1 to 5 blinking pulses appear depending on the tolerance. Then there is a break. In contrast, the LED in the *multiteach-mode* blinks constantly.

6.4 Keylock

The sensor button can be locked against unauthorized or accidental parameterization. To do this, set the *Keylock input* (pin 2, brown cable) to High. A teach-in via *teach input line* remains possible.

6.5 Further meanings of the LED display

The main meaning of the button LED is the indication of the switching state of the switching output. Further meanings are coded by a blink frequency and are to be interpreted in the respective context. Table 7 gives an overview.

Table 7 : Meaning of the blink frequency

Blink frequency	Meaning
2 Hz	Display of the currently set color tolerance (see Table 6) or of the *multiteach-mode* each after teach in of the (first) color
5 Hz	In teach-mode: understeering
10 Hz	Output short circuit or output current >200 mA or cap. load > 100 nF

Display of understeering

Oversteering is practically impossible in **teach-in mode**. Understeering (<20% leveling), e.g. caused by a too large working distance, however, is indicated (5 Hz blinking).

7 Part numbers

Table 8: Accessory parts for CROMLAVIEW® CR10

Part	Part number
CROMLAVIEW® CR10 color sensor	10-3006-00
Connection cable, 8-pin, M9 / open, 2 m	15-3000-00
Filter module	11-3005-00
Fiber cable R-P-A2.0-2.5-700-68°	25-0202-07
Fiber cable R-P-C2.0-2.5-700-68°	25-2102-07
Further fiber cable	See catalogue (18-0003-00)
Focus optics: FOR-A2.0-10 FOR-C2.0-35 FOR-C2.0-50 further focus optics	 13-3002-00 13-3021-00 13-3021-01 See catalogue (18-0003-00)

Overvoltage protection

To use the sensor in systems where the supply voltage line is > 3 meters, it is recommended to use a filter module to protect against overvoltage (see Table 8).

8 Declaration of Conformity

Manufacturer	**ASTECH Angewandte Sensortechnik GmbH**
Address	18057 Rostock
	Schonenfahrerstr. 5
	Deutschland
Product name	CROMLAVIEW® CR10
Device description	Color sensor

EU 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 A (emission); Industrial equipment (immunity)
Place	Rostock
Date	April 2018

ASTECH Angewandte Sensortechnik GmbH

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Managing director