

SI-COLO Series

▶ SI-COLO3-LWL-ACL (12 bit A/D conversion)

This sensor is mainly used to check luminous objects as for instance LEDs in view of color and luminosity

- Checking of LEDs as to intensity differences
- Checking of LEDs as to color differences
- Checking of bicolor and tricolor LEDs
- Up to 15 colors can be stored
- RS232 - interface (USB adapter available)
- External teaching through PLC, RS232, or push button
- 'Averaging' can be activated (from 1 up to over 32000 values)
- Neutral glass filter attachments available for fiber optics



Design

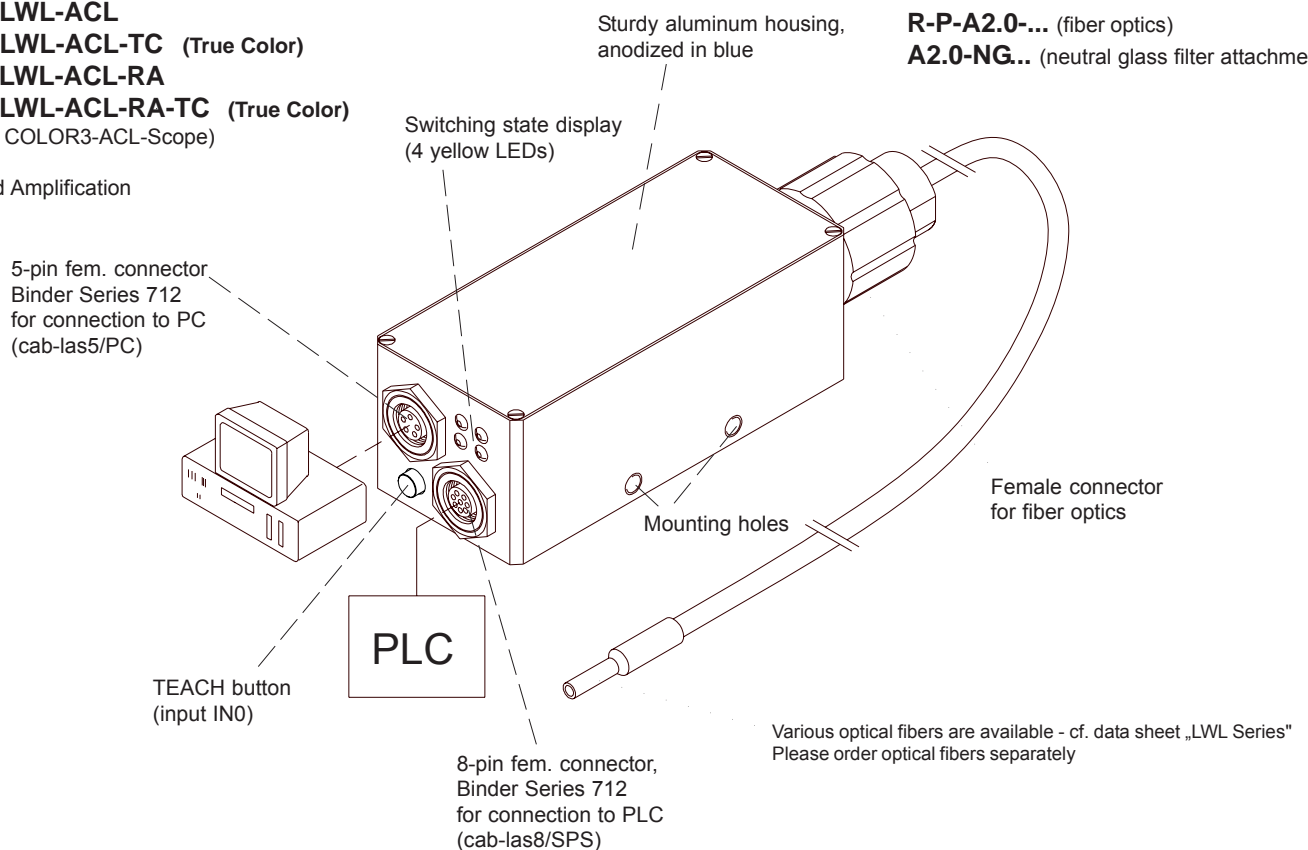
Product name:

SI-COLO3-LWL-ACL
SI-COLO3-LWL-ACL-TC (True Color)
SI-COLO3-LWL-ACL-RA
SI-COLO3-LWL-ACL-RA-TC (True Color)
 (incl. software COLOR3-ACL-Scope)

RA = Reduced Amplification

Available accessories: (cf. page 7)

R-P-A2.0-... (fiber optics)
A2.0-NG.. (neutral glass filter attachment)



Parameterization under Windows® with software COLOR3-ACL-Scope:

The reflex color sensor SI-COLO3-LWL-ACL can be parameterized via serial interface (RS232) under Windows® (please cf. pages 4-6). Up to 15 colors can be taught, and stored in the sensor. If the sensor detects one of the taught colors, a change of switching state is performed through 4 encoded digital outputs (visual display by means of 4 yellow LEDs at the housing).

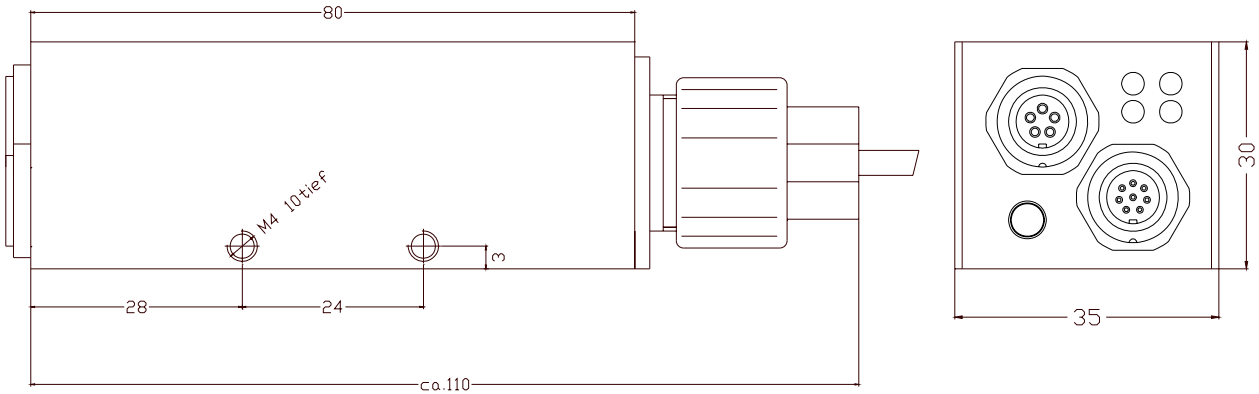


Technical Data

| | |
|------------------------------|---|
| Model | SI-COLO3-LWL-ACL or SI-COLO3-LWL-ACL-RA |
| Light source | The measuring object itself serves as a light source |
| Reproducibility | In the x,y color range 1 digit each with 12 bit A/D conversion |
| Object distance | SI-COLO3-LWL-ACL with optical fiber: typ. 2 mm ... 10 mm (depends on the light source to be measured) SI-COLO3-LWL-ACL-RA with optical fiber: typ. 2 mm ... 1000 mm (depends on the light source to be measured) |
| Receiver | 3-color filter detector (in case of model "-TC": TRUE COLOR) |
| Type of protection | IP54 |
| Current consumption | typ. 180 mA |
| Interface | RS232, parameterizable under Windows® |
| Connector type | Connection to the PLC: 8-pin female connector (Binder Series 712) Connection to the PC: 5-pin female connector (Binder Series 712) |
| EMC test acc. to | IEC - 801... |
| Housing | Aluminum, anodized in blue |
| Operating temperature range | -20°C ... +55°C |
| Storage temperature range | -20°C ... +85°C |
| Pulse lengthening | Adjustable under Windows® 0 ms ... 100 ms |
| Max. switching current | 100 mA, short-circuit-proof |
| Switching frequency | Max. 1,6 kHz with 15 teach-in colors, max. 11,5 kHz with 1 teach-in color, max. 95 kHz with contrast detection |
| Outputs | OUT 0 to OUT 3 |
| Averaging | Over 32768 values max. |
| Voltage supply | +12VDC ... +30VDC, protected against polarity reversal, overload-protected |
| Switching state display | Visualization by means of 4 yellow LEDs |
| Color memory capacity | non-volatile EEPROM with parameter sets for 15 colors max. |
| Optical fibers | various optical fibers are available (please cf. catalog "LWL Series") |
| Attachment of optical fibers | Various neutral glass filter tops for use with R-P-A2.0-...: A2.0-NG4, A2.0-NG5, A2.0-NG9, A2.0-NG11 |
| TEACH button | for external teaching of color references via input IN0 |
| Temperature drift X,Y | $\Delta X/\Delta T$; $\Delta Y/\Delta T$ typ. 0,3 digits/°C (< 0,01% / °C) |

Dimensions

All dimensions in mm

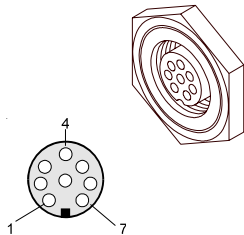


Connector Assignment

Connection of SI-COLO3-LWL-ACL to PLC:

8-pole female connector Binder Series 712

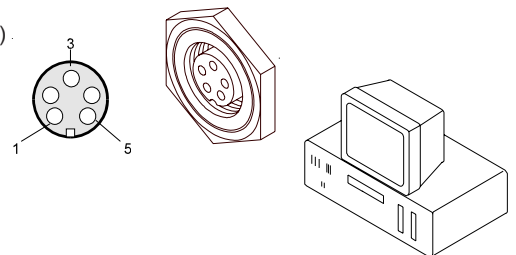
| Pin: | Color: | Assignment: |
|------|--------|----------------|
| 1 | wht | GND (0V) |
| 2 | brn | +12 ... +30VDC |
| 3 | grn | INO |
| 4 | yel | OUT0 |
| 5 | gry | OUT1 |
| 6 | pnk | OUT2 |
| 7 | blu | OUT3 |
| 8 | red | n.c. |



Connection of SI-COLO3-LWL-ACL to PC:

5-pole female connector Binder Series 712

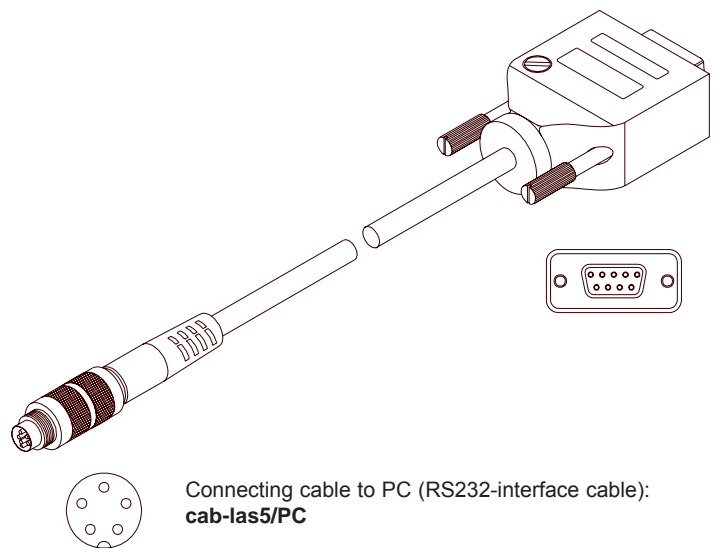
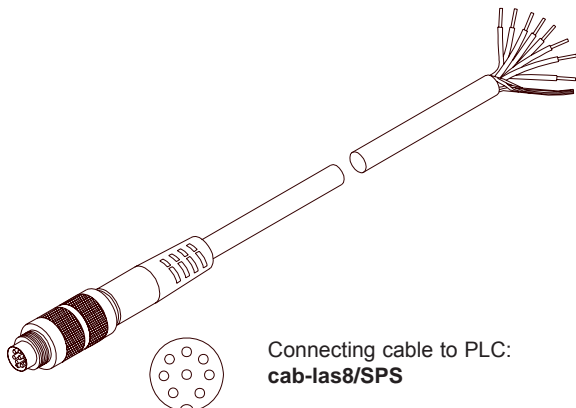
| Pin: | Assignment: |
|------|-------------|
| 1 | GND (0V) |
| 2 | TX0 |
| 3 | RX0 |
| 4 | n.c. |
| 5 | n.c. |




Connecting Cables

Connecting cables for SI-COLO3-LWL-ACL:

- cab-las8/SPS** Length: 2m Outer jacket: PUR
- cab-las5/PC** Length: 2m Outer jacket: PUR




Measuring Principle
Measuring principle:

With the help of the light source to be examined part of the emitted light is coupled into a fiberoptic bundle and directed onto a color-sensitive detector element. The received light is separated according to the 3-color-range process (red, green, blue).

The SI-COLO3-LWL-ACL operates with an internal integrator that collects the quantity of light of the light source over a certain time (exposure time). This exposure time can be set with the PC software. The sensor therefore also works with extremely strong or weak light sources.


Parameterization
Parameterization under Windows® with software COLOR3-ACL-Scope:

The color sensor is parameterized under Windows® with the COLOR3-ACL-Scope software. The RS232 interface is used for setting parameters such as:

- Averaging over a maximum of 32768 values
- Number of colors to be checked
- Pulse lengthening up to 100ms max.
- External or continuous trigger
- Minimum intensity required for color evaluation

Visualization:

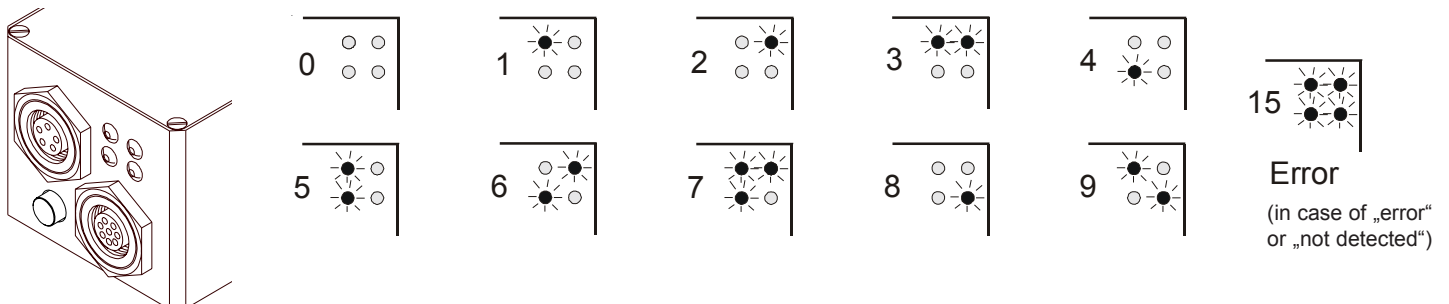
Under Windows® representation of the color value on a PC in numeric form and in a color chart, and representation of RGB values in a time chart. In addition the current RGB values are displayed as a bar chart.

The following evaluation algorithms can also be selected:

- Target lies within the color tolerance circle of a taught color and within an intensity window (FIRST HIT)
- Determination of the taught color that is most similar to the target (minimum distance between target color and reference color in the color chart) (MINIMAL DIST)
- Contrast check of the target. In this case only one primary color (freely selectable) is used for evaluation (CONTRAST)
Advantage: Possibility of using a very high scanning rate.
- EXTERN TEACH: With this function field the color sensor can be taught by means of a LOW-signal at pin 3 (for instance via push button, or PLC). During this procedure the object to be taught has to be in the visibility range of the color sensor. The yellow LEDs indicate a successful teaching procedure.

LED-Display:

The color code is visualized by means of 4 yellow LEDs at the housing of the SI-COLO3-LWL-ACL color sensor. At the same time the color code indicated at the LED display is output as 4-bit binary information at the digital outputs OUT0 to OUT3 of the 8-pin SI-COLO/PLC connector.



In the DIRECT mode the maximum numbers of colors to be taught is 4 (color no. 0,1,2,3). These 4 colors can be directly output at the 4 digital outputs. The respective detected color is displayed by means of the 4 yellow LEDs at the color sensor housing.

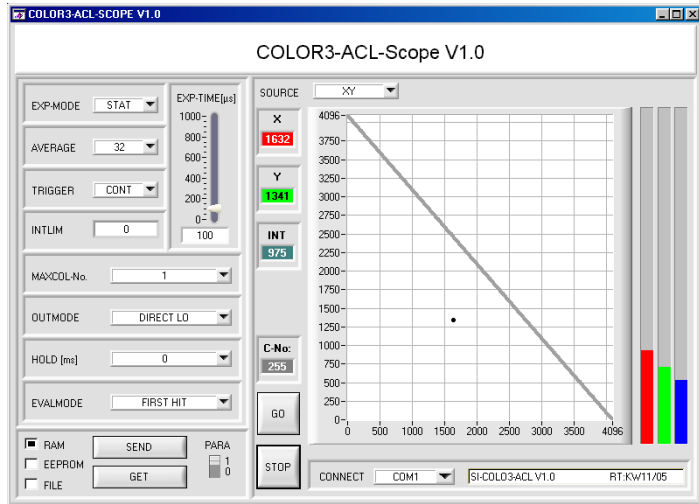


Parameterization

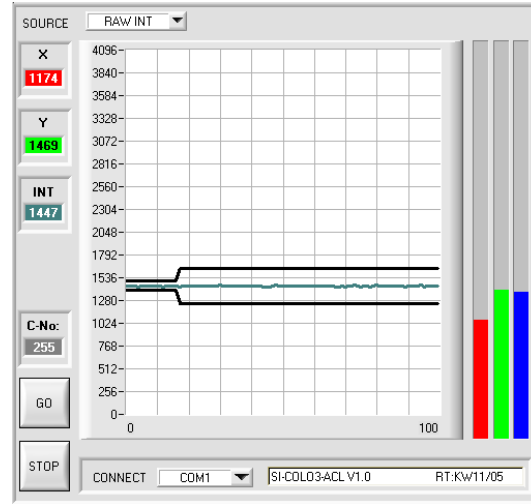
Windows® user interface:

The Windows® user interface facilitates the teach-in process at the color sensor and supports the operator in the task of adjustment and commissioning of the color sensor.

X,Y-chart:



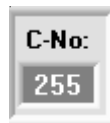
RGB-t-chart:



The color value is displayed graphically by way of the X,Y-color triangle and also in the numerical output fields.

The current raw data (red, green, blue) from the color detector are visualized in a bar chart.

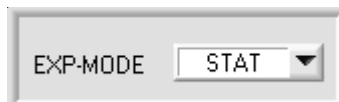
If a color is detected during measuring operation, the currently detected color is displayed in a numeric output field:



Display of the current raw data (red, green, blue) from the color sensor in „scroll mode“ (oscilloscope function).

In addition the current raw data are visualized as a bar display. This facilitates the adjustment of the color sensor.

Parameter setting: Among others the following parameters can be set:



EXP-MODE:
In this function field the operating mode of the exposure time can be set.
STAT: Exposure time is constantly kept at the EXP-TIME[μs] value.
DYN: Exposure time is automatically and dynamically controlled by way of the quantity of light given off by the object.



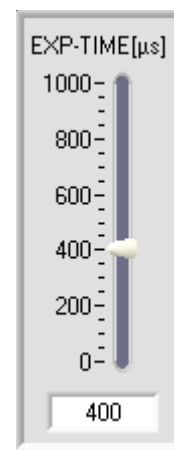
AVERAGE:
Averaging (over 32768 scanning values max.). Here the number of scanning values over which the raw signal measured at the receiver is averaged can be set.



TRIGGER:
In this function field the trigger mode at the color sensor can be set.
EXT: Color detection is activated through the external trigger input (IN0).
CONT: Continuous color detection (no trigger event required).



INTLIM:
This edit box is used for setting a lower intensity limit. Color evaluation is stopped if the total intensity of the three primary colors (red, green, blue) that is measured at the receiver unit falls below this limit.



EXP-TIME:
With this slider, the exposure time for the internal integrator can be adjusted. The higher the chosen exposure time, the longer the integrator is exposed to the external illumination, i.e. INT increases.
The EXPOSURE TIME should be selected in a way that the three bars RED, GREEN, BLUE are lying in the dynamic range.

Parameterization

MAXCOL-No.

HOLD [ms]

EVALMODE

MAXCOL-No.:

In this function field the number of colors to be checked can be set. With the color sensor a maximum of 15 colors can be checked.

HOLD:

In this edit box a pulse lengthening (100 ms max.) at the digital outputs of the color sensor can be set.

EVALMODE:

In this function field the evaluation mode at the color sensor can be set:

FIRST HIT: The current color value (X,Y) lies within the tolerance circle of a taught color.

MINIMAL DIST: The current color value (X,Y) is assigned to the teach-in color that lies next to this color value (X,Y) in the color triangle.

CONTRAST: Intensity check of a selected primary color (red, green, blue) with a maximum switching frequency of 95 kHz.

EXTERN TEACH: Teaching procedure is started by setting the input to 0V for instance via PLC, or push button). The integrated yellow LED indicates the successful teaching procedure.

| No. | X | Y | CTO | INT | ITO | |
|-----|-----|-----|-----|-----|-----|----------------|
| 0 | 63 | 99 | 10 | 177 | 10 | Blue |
| 1 | 60 | 118 | 10 | 47 | 10 | Red |
| 2 | 101 | 69 | 10 | 50 | 10 | Black |
| 3 | 56 | 97 | 10 | 99 | 10 | Pink |
| 4 | 71 | 119 | 10 | 116 | 10 | Green |
| 5 | 56 | 60 | 10 | 40 | 10 | Yellow |
| 6 | 81 | 99 | 10 | 66 | 10 | Olive |
| 7 | 65 | 122 | 10 | 119 | 10 | Purple |
| 8 | 66 | 79 | 10 | 139 | 10 | Cyan |
| 9 | 88 | 62 | 10 | 65 | 10 | Magenta |
| 10 | 1 | 1 | 1 | 1 | 1 | Dark Purple |
| 11 | 1 | 1 | 1 | 1 | 1 | Bright Magenta |
| 12 | 1 | 1 | 1 | 1 | 1 | Bright Green |
| 13 | 1 | 1 | 1 | 1 | 1 | Dark Teal |
| 14 | 59 | 64 | 10 | 67 | 10 | Dark Red |

TEACH DATA TO No.: Inc

APPLY FROM ALL ZOOM

AUTO ADJUST RESET TABLE

COLOR TEACH TABLE:

Input of parameters X, Y, CTO, INT, and ITO in the corresponding input fields, or automatically by clicking the **TEACH DATA TO** button.



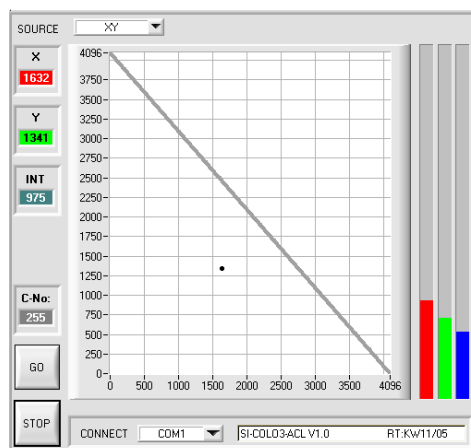
- X: X-value of the teach-in color, normalized red color content
- Y: Y-value of the teach-in color, normalized green color content
- CTO: Tolerance circle around the teach color that is defined as (X,Y) point
- INT: Teach-in value for the total intensity
- ITO: Intensity tolerance around the INT teach-in value

Each of the color ranges defined in the color teach table is represented as a tolerance circle around the teach-in color (X,Y) after a click on the **APPLY FROM ALL** button.



"COLOR TRIANGLE":

In the color triangle the currently detected color is represented by an X,Y value pair, with the X-value representing the normalized red content, and the Y-value representing the normalized green content of the teach-in color. The blue content on the color triangle is proportional to the distance of the X,Y value pair from the hypotenuse.



$$X = \frac{R}{R+G+B} * 4095$$

$$Y = \frac{G}{R+G+B} * 4095$$



Fiber Optics

Fiber optics of type R-P-A2.0-... for use with SI-COLO3-LWL-ACL and SI-COLO3-LWL-ACL-RA:

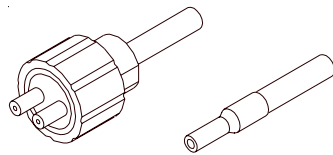
Various models available:

R-P-A2.0-(2.5)-600-67°

R-P-A2.0-(2.5)-600-22°

R-P-A2.0-(2.5)-1200-67°

R-P-A2.0-(2.5)-1200-22°



Information on fiber optics order code:

Reflected light operation (R)

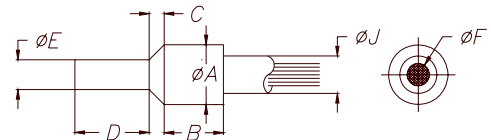
PVC special sheath (P)

Sensor type A2.0 (fiber bundle Ø 2.5 mm)

Total length 600 mm or 1200 mm

Beam angle 67° or 22°

Sensor type A (end sleeve: special steel)



| Type | A | B | C | D | E | F | ØJ | | |
|------|-----|----|---|----|-----|-----|----|---|-----|
| | Ø | | | | Ø | Ø | P | M | S |
| A2.0 | 6.6 | 10 | 2 | 12 | 4.5 | 2.5 | 6 | 6 | 5.8 |



Neutral Glass Filter

Neutral glass filter attachment for use with fiber optics of type R-P-A2.0-(2.5)-....:

Attachment available with various neutral glass sorts:

A2.0-NG4

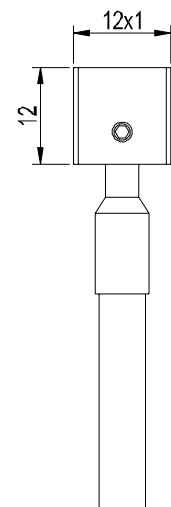
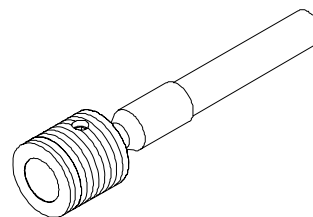
A2.0-NG5

A2.0-NG9

A2.0-NG11



A2.0-NG9 neutral glass filter attachment
(fixed onto fiber optics R-P-A2.0-...)



(Dimensions in mm)

**Application Example****100% check of signal lamps**

In the production of signal lamps, both the intensity and the color of the signal lamp are checked. Its high dynamic range makes the SI-COLO3-LWL-ACL color sensor especially suitable for this application. The true color detector performs color checking that comes very close to human vision. In case of incorrect intensity or color, an error message is provided at the digital output.

