SPECTRO Series

**SPECTRO-3-30-POL**

- Measuring range typ. 15 mm ... 80 mm
- Polarization filter (very intense reduction of gloss effect)
- Up to 31 colors can be stored
- RS232 interface (USB or Ethernet adapter is available)
- 9x super-bright white-light LED, focused (AC-/DC-/PULSE-operation or OFF for luminous objects can be switched)
- Color detection, contrast detection, and gray scale detection
- Insensitive to outside light (in AC- or PULSE-operation)
- Brightness correction can be activated (STAT/DYN)
- Scan frequency max. 35 kHz (in DC- or OFF-operation)
- Switching frequency typ. 60 kHz
- Several TEACH functions (via PC, PLC, or push button)
- Various evaluation algorithms can be activated
- "BEST HIT" mode ("human color assessment")
- Switching state display by means of 5 yellow LEDs
- Parameterizable via Windows® software, scope function
- Temperature compensated
- Averaging can be activated (from 1 up to over 32000 values)
- Color control of luminous objects (LEDs, halogen lamps, displays, ...)
- 3-color filter detector (true color detector: "human color perception")

**Product name:**

SPECTRO-3-30-POL

SPECTRO-3-30-POL-d5

(incl. Windows® PC software SPECTRO3-Scope)

**d5** = By use of an aperture Ø 5 mm the detection range at the working distance of 30 mm will be reduced to typ. 5,5 mm

**Accessories:** (p. 10-11)

- FL-34 (flange)
- WFL-34 (flange, angle type)
- SPECTRO-3-30-OFL (offline top part/spacer)

**Optics holding device**

(aluminum, anodized)

Receiver optics with
3-color filter detector (True Color)
transmitter optics with 9x white light LED
and polarization filter
(scratch-resistant optics cover made of glass)

4-pole fem. connector
Binder Series 707
(RS232 interface)

Connecting cable:
cab-las4/PC or
cab-las4/USB or
SI-RS232/Ethernet-4

**TEACH button**

(external teaching via input IN0)

8-pole fem. connector
Binder Series 712
(connection to PLC)

Connecting cable:
cab-las8/SPS

**Sturdy aluminum housing, anodized in blue**

**Mounting screws**

(M34)

**LED display:**

Switching state indication by means of 5 yellow LED
# Technical Data

<table>
<thead>
<tr>
<th>Model</th>
<th>SPECTRO-3-30-POL</th>
<th>SPECTRO-3-30-POL-d5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage supply</td>
<td>+24VDC (± 10%), reverse polarity protected, overcurrent protected</td>
<td></td>
</tr>
<tr>
<td>Current consumption</td>
<td>&lt; 220 mA</td>
<td></td>
</tr>
<tr>
<td>Max. switching current</td>
<td>100 mA, short circuit proof</td>
<td></td>
</tr>
<tr>
<td>Switching state indication</td>
<td>5 yellow LED visualize the physical state of the outputs OUT0 ... OUT4</td>
<td></td>
</tr>
<tr>
<td>Input digital (1x)</td>
<td>IN0 (Pin 3), digital (0V/+24V) or teach button at the housing</td>
<td></td>
</tr>
<tr>
<td>Outputs digital (5x)</td>
<td>OUT0 ... OUT4 (Pin 4 ... 8): digital (0V/+24V), npn/pnp-able (bright/dark-switching, can be switched)</td>
<td></td>
</tr>
<tr>
<td>Interface</td>
<td>RS232</td>
<td></td>
</tr>
<tr>
<td>Pulse lengthening</td>
<td>0 ... 100 ms, adjustable via PC software</td>
<td></td>
</tr>
<tr>
<td>Averaging</td>
<td>max. 32768 values, adjustable via PC software</td>
<td></td>
</tr>
<tr>
<td>LED operation, can be switched via PC software:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC operation: max. 20 kHz (depends on parameterization)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC and OFF operation: max. 35 kHz (depends on parameterization)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PULSE operation: max. 5 kHz (depends on parameterization)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmitter (light source)</td>
<td>9x super-bright white-light LED, focused, polarization filter</td>
<td></td>
</tr>
<tr>
<td>Transmitter control</td>
<td>can be switched via PC software:</td>
<td></td>
</tr>
<tr>
<td>AC operation (LED MODE-AC), DC operation (LED MODE-DC), OFF operation (LED MODE-OFF)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring range</td>
<td>typ. 15 mm ... 80 mm</td>
<td></td>
</tr>
<tr>
<td>Receiver</td>
<td>3-color filter detector (TRUE COLOR detector, &quot;human color perception&quot;), color filter curves acc. to CIE 1931</td>
<td></td>
</tr>
<tr>
<td>Receiver gain setting</td>
<td>8 steps (AMP1 ... AMP8), adjustable via PC software</td>
<td></td>
</tr>
<tr>
<td>Ambient light</td>
<td>max. 5000 Lux</td>
<td></td>
</tr>
<tr>
<td>Detection range (half intensity width)</td>
<td>typ. 11 mm at a distance of 30 mm typ. 14 mm at a distance of 50 mm typ. 23 mm at a distance of 70 mm</td>
<td>typ. 5.5 mm at a distance of 30 mm typ. 7 mm at a distance of 50 mm typ. 11.5 mm at a distance of 70 mm</td>
</tr>
<tr>
<td>Reproducibility</td>
<td>in the X, Y color range each 1 digit at 12-bit A/D conversion</td>
<td></td>
</tr>
<tr>
<td>Temperature drift X,Y</td>
<td>ΔX/ΔT, ΔY/ΔT typ. 0.2 digits/°C (&lt; 0.01% / °C)</td>
<td></td>
</tr>
<tr>
<td>Color difference</td>
<td>ΔE &gt;= 0.5</td>
<td></td>
</tr>
<tr>
<td>Color space</td>
<td>X Y INT, sIM (Lab)</td>
<td></td>
</tr>
<tr>
<td>Color memory capacity</td>
<td>non-volatile EEPROM with parameter sets for max. 31 colors</td>
<td></td>
</tr>
<tr>
<td>Housing dimensions</td>
<td>length approx. 130 mm x Ø 32 mm (threaded M34x1.5) or Ø 34 mm (optics holding device), without connectors</td>
<td></td>
</tr>
<tr>
<td>Housing material</td>
<td>aluminum, anodized in blue (optics holding device: aluminum, anodized)</td>
<td></td>
</tr>
<tr>
<td>Enclosure rating</td>
<td>IP67 (optics), IP64 (electronics)</td>
<td></td>
</tr>
<tr>
<td>Connecting cables</td>
<td>to PLC: cab-las8/SPS or cab-las8/SPS-w to PC/RS232 interface: cab-las4/PC or cab-las4/PC-w to PC/USB interface: cab-las4/USB or cab-las4/USB-w to PC/Ethernet interface: SI-RS232/Ethernet-4</td>
<td></td>
</tr>
<tr>
<td>Type of connector</td>
<td>connection to PLC: 8-pole fem. connector (Binder 712), connection to PC: 4-pole fem. connector (Binder 707)</td>
<td></td>
</tr>
<tr>
<td>Operating temp. range</td>
<td>-20°C ... +55°C</td>
<td></td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>-20°C ... +85°C</td>
<td></td>
</tr>
<tr>
<td>EMC test acc. to</td>
<td>DIN EN 60947-5-2</td>
<td></td>
</tr>
</tbody>
</table>
All dimensions in mm
Connection to PLC:
8-pole fem. connector Binder Series 712

Pin: Color: Assignment:
1 white GND (0V)
2 brown +24VDC (+10%)
3 green IN0
4 yellow OUT0 (Digital 0: typ. 0...1V, Digital 1: typ. +Ub - 10%)
5 grey OUT1 (Digital 0: typ. 0...1V, Digital 1: typ. +Ub - 10%)
6 pink OUT2 (Digital 0: typ. 0...1V, Digital 1: typ. +Ub - 10%)
7 blue OUT3 (Digital 0: typ. 0...1V, Digital 1: typ. +Ub - 10%)
8 red OUT4 (Digital 0: typ. 0...1V, Digital 1: typ. +Ub - 10%)

Connecting cable:
cab-las8/SPS-(length) (standard length 2m)
cab-las8/SPS-w-(length) (angle type, 90°) (max. length 25m, outer jacket: PUR)

Connection to PC:
4-pole fem. connector Binder Series 707

Pin: Color: Assignment:
1 +24VDC (+Ub, OUT)
2 GND (0V)
3 RxD
4 TxD

Connection via RS232 interface at the PC:
Connecting cable:
cab-las4/PC-(length) (standard length 2m)
cab-las4/PC-w-(length) (angle type, 90°) (max. length 10m, outer jacket: PUR)

alternative:
Connection via USB interface at the PC:
Connecting cable (incl. driver software):
cab-las4/USB-(length) (standard length 2m)
cab-las4/USB-w-(length) (angle type, 90°) (max. length 5m, outer jacket: PUR)

alternative:
Connection to local network via Ethernet bus:
Adapter (based on Lantronix XPortModul):
SI-RS232/Ethernet-4-(length) (standard length 2m)
Visualization of the color code:

The color code is visualised by way of 5 yellow LEDs at the housing of the SPECTRO-3 color sensor. At the same time in the binary mode (OUT BINARY) the color code indicated on the LED display is output as 5-bit binary information at the digital outputs OUT0 to OUT4 of the 8-pin SPECTRO-3/PLC socket.

The SPECTRO-3 color sensor is able to process a maximum of 31 colors (color code 0 ... 30) in accordance with the corresponding rows in the COLOR TEACH TABLE. An "error" respectively a "not detected color" is displayed by the lighting of all LED (OUT0 ... OUT4 digital outputs are set to HIGH-level).

In the DIRECT mode (OUT DIRECT HI or OUT DIRECT LO) the maximum numbers of colors to be taught is 5 (color no. 0, 1, 2, 3, 4). If DIRECT HI is activated, the specially digital output is set to HI, while the other 4 are set to LO. If the current color does not correspond with any of the teach-in colors, all digital outputs are set to LOW (no LED is lighting).

If DIRECT LO is activated, the specially digital output is set to LO, while the other 4 are set to HI. If the current color does not correspond with any of the teach-in colors, all digital outputs are set to HIGH (all LED are lighting).
LED display:

The color code is visualized by means of 5 yellow LEDs at the housing of the color sensor. At the same time the color code indicated at the LED display is output as 5-bit binary information at the digital outputs OUT0 ... OUT4 of the 8-pole PLC connector.

In the DIRECT mode the maximum number of color codes to be taught is 5. These 5 color codes can be directly output at the 5 digital outputs. The respective detected color code is displayed by means of the 5 yellow LEDs at the color sensor housing.

Error or "not detected"

OUT0 OUT1 OUT2 OUT3 OUT4

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
**Windows® user interface:**

The color sensor is parameterized under Windows® with the SPECTRO3-Scope software. 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.

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 RS232 interface (tab PARA1 or PARA2) is used for setting parameters such as:

- **POWER MODE:** Light power of the LED
- **LED MODE:** Triggering of the internal light source
- **GAIN:** Used for setting the gain of the receiver
- **AVERAGE:** Averaging over a maximum of 32768 values
- **INTEGRAL:** This function field is used to set the number of scan values (measurement values) over which the raw signal measured at the receiver is summed up. This integral function allows the reliable detection even of extremely weak signals
- **MAXCOL-No.:** Number of colors to be checked
- **OUTMODE:** Triggering of the digital outputs
- **INTLIM:** Minimum intensity required for color evaluation
- **EVALUATION MODE:** Various evaluation modes to choose from (FIRST HIT, BEST HIT, MIN DIST, COL5, THD RGB)
- **CALCULATION MODE:** There are 2 methods of teaching a color, which are selectable via CALCULATION MODE. The CALCULATION MODE „X Y INT - 3D“ (or „s i M - 3D“) uses a color sphere in space with radius TOL. Contrary to this, the CALCULATION MODE „X Y INT - 2D“ (or „s i M - 2D“) uses a color cylinder in space with radius CTO or siTO and with height ITO or M. The teach process is the same for both methods. Color evaluation according to „s i M - 2D“ uses the Lab calculation method
- **EXTEACH:** In all the evaluation modes teaching of a color can be performed externally through IN0 or by means of the button at the sensor housing [Please note: TEACH button not available with SPECTRO-3-...-JR types.]
- **TRIGGER:** Continuous or external or self trigger
Firmware update by means of software „ProgramLoader“ or „FirmwareLoader“:

The software „ProgramLoader“ or „FirmwareLoader“ allows the user to perform an automatic firmware update. The update will be carried out through the RS232 interface.

An initialisation file (xxx.ini) and a firmware file (xxx.elf.S) are required for performing a firmware update. These files can be obtained from your supplier.

In some cases an additional firmware file for the program memory (xxx.elf.p.S) is also needed, and this file will be automatically provided together with the other two files.
Diagrams: DETECTION RANGE (HALF INTENSITY WIDTH) and RELATIVE INTENSITY SPECTRO-3-30-POL

Detection range (half intensity width d)
SPECTRO-3-30-POL:
11 mm (typ.) at a working distance of 30 mm

Relative intensity
SPECTRO-3-30-POL:
100% at a working distance of 15 mm (INTENSITY 3703)
Mounting Accessories

**FL-34** (flange)

Example: FL-34 with SPECTRO-3-30-DIL mounted

**WFL-34** (flange, angle type 90°)

Example: WFL-34 with SPECTRO-3-30-DIL mounted

(All dimensions in mm)
SPECTRO-3-30-OFL
offline top part/spacer
(please order separately)

The spacer is mounted onto the optics of the SPECTRO-3-30-POL, thus the color sensor can be used as a hand-held unit.

For the purpose of color control the SPECTRO-3-30-POL with the spacer is put directly on the surface to be checked.

By means of the spacer directly put on the surface, the color sensor SPECTRO-3-30-POL works at a reference distance of 30 mm to the measuring object.
Application Example

Surface inspection of cast pipes

Centrifugally cast pipes must be inspected for their surface quality. Bad surface quality is characterized by the occurrence of frequent, larger depressions which as a whole make the surfaces appear brighter and more diffuse. Good surface quality, on the other hand, only shows slight depressions, and the surface appears more homogeneous and blank, and therefore also darker. With the SPECTRO-3-30-POL color sensor high-quality surfaces can be reliably differentiated from low-quality surfaces. Direct reflection is suppressed by polarised white light, a good surface therefore appears considerably darker than a bad surface. The inspection was performed at a sensor distance of approx. 30 mm.