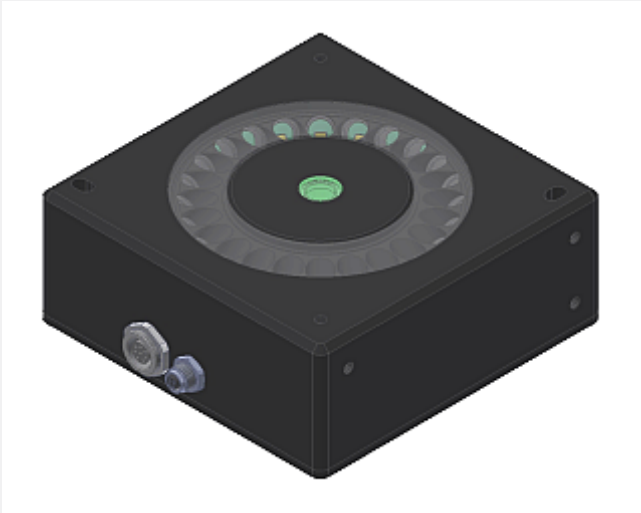
# SPECTRO Series

## SPECTRO-3-28-45°/0°-MSM-DIG-DL

- Object distance (measuring range) 28 mm ± 2 mm
- Color control to 45°/0° method
  (45° transmitter arrangement, 0° receiver arrangement)
- L*a*b* , L*C*h* , L*u*v*, L*u'v' and xyY evaluation (CIE standard)
- Up to 31 colors (max. 48 in group mode) can be stored
- 24x D65 similar LED
  AC-, DC-operation or OFF for luminous objects can be switched
- Color measurement (color, contrast, and gray scale detection)
- Insensitive to outside light (in AC-operation)
- Scan frequency max. 35 kHz (in DC- and OFF-operation)
- Switching frequency typ. 60 kHz
- 5 digital outputs to output taught colors
- TEACH via PC or external input
- Various evaluation algorithms can be activated
- "BEST HIT" mode ("human color assessment")
- Averaging can be activated (from 1 up to over 32000 values)
- Parameterizable via Windows® software, scope function
- RS232 interface (USB or Ethernet adapter is available)
- Temperature compensated
- 3-color filter detector (true color detector: "human color perception")



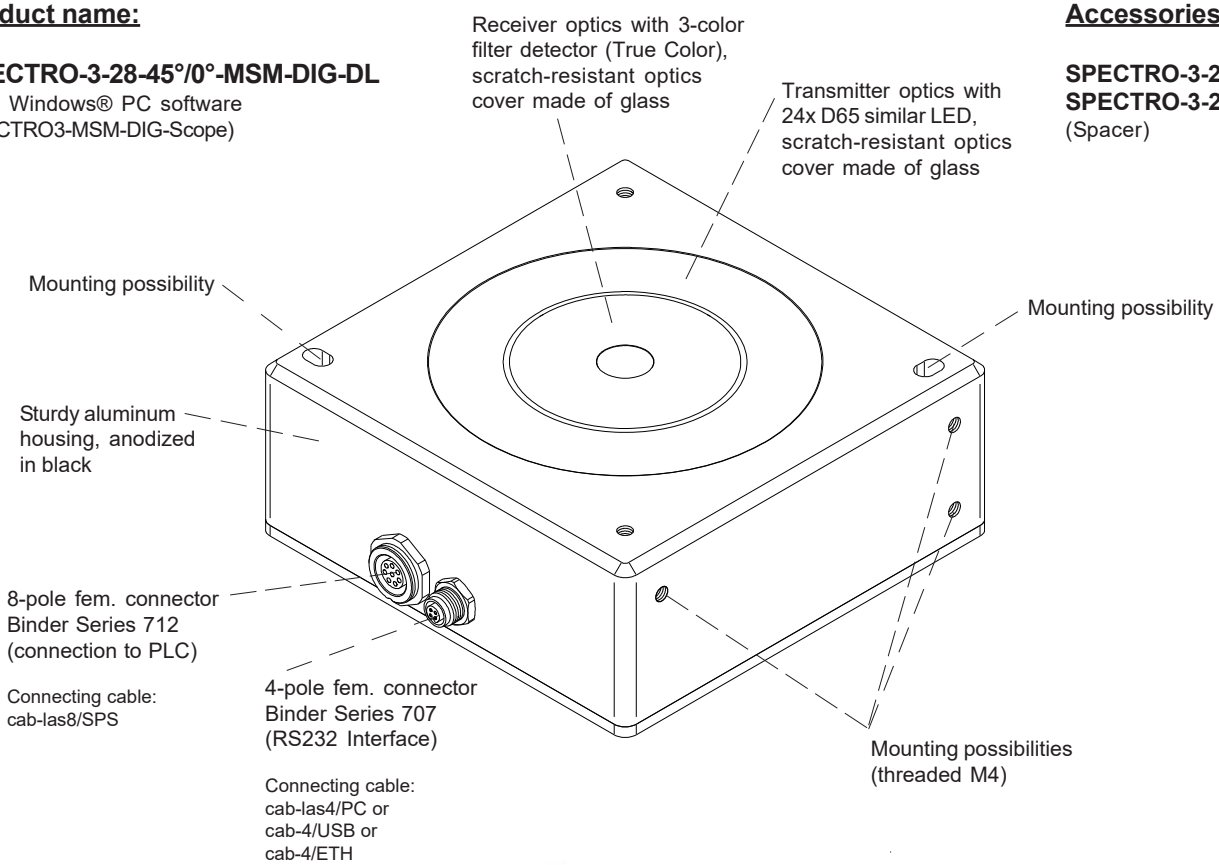
## Design

**Product name:**

**SPECTRO-3-28-45°/0°-MSM-DIG-DL**
(incl. Windows® PC software
SPECTRO3-MSM-DIG-Scope)

**Accessories:** (p. 8-9)

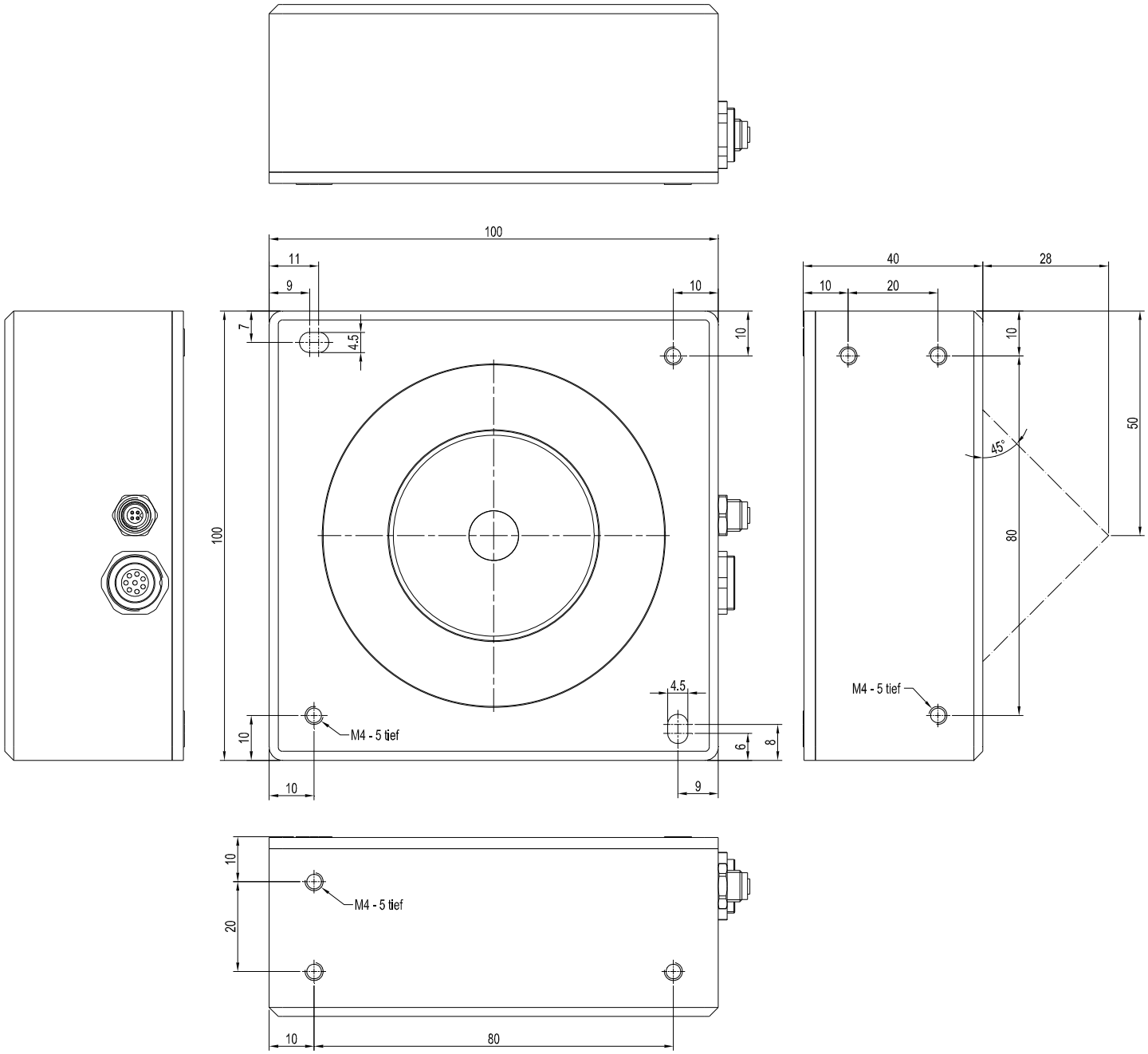
**SPECTRO-3-28-45°/0°-OFL**
**SPECTRO-3-28-45°/0°-OFL-D30**
(Spacer)



## Technical Data

| Type | SPECTRO-3-28-45°/0°-MSM-DIG-DL |
|---|---|
| Voltage supply | +24VDC (± 10%), reverse polarity protected, overcurrent protected |
| Current consumption | < 700 mA |
| Max. switching current | 100 mA, short circuit proof |
| Input digital (1x) | IN0 (Pin 3), digital (0V/+24V) |
| Outputs digital (5x) | OUT0 ... OUT4 (Pin 4 ... 8): digital (0V/+24V), npn-/pnp-able (bright-/dark-switching, can be switched) |
| Interface | RS232 (an external USB and ETHERNET converter is available) |
| Pulse lengthening | 0 ... 100 ms, adjustable via PC software |
| Averaging | max. 32768 values, adjustable via PC software |
| Scan frequency | LED operation, can be switched via PC software:<br>AC operation: max. 20 kHz (depends on parameterization)<br>DC and OFF operation: max. 35 kHz (depends on parameterization) |
| Switching frequency | typ. 60 kHz |
| Transmitter (light source) | 24x D65 similar LED |
| Transmitter control | can be switched via PC software:<br>AC operation (LED MODE-AC), DC operation (LED MODE-DC), OFF operation (LED MODE-OFF) |
| Object distance (measuring range) | typ. 28 mm ± 2 mm |
| Receiver | 3-color filter detector (TRUE COLOR detector, “human color perception“), color filter curves acc. to CIE 1931 |
| Receiver gain setting | 8 steps (AMP1 ... AMP8), adjustable via PC software |
| Ambient light | max. 5000 Lux |
| Detection range (half intensity width) | typ. 10 mm at a distance of 28 mm |
| Reproducibility | in the X, Y color range each 1 digit at 12-bit A/D conversion |
| Temperature drift X,Y | ΔX/ΔT; ΔY/ΔT typ. 0,2 digits/°C (< 0,01% / °C) |
| Measuring accuracy | typ. $\Delta E$ = 0.3 |
| Resolution | $\Delta E$ >= 0.01<br>in case of color space L*u'v': Δu'v' = 0.001 |
| Color space (resolution) | L*a*b* , L*C*h* , L*u*v , L*u'v , and xyY (CIE standard) |
| Color memory capacity | non-volatile EEPROM with parameter sets for max. 31 colors (max. 48 in group mode) |
| Housing dimensions | LxWxH approx. 100 mm x 100 mm x 40 mm (without flange connectors) |
| Housing material | aluminum, anodized in black |
| Enclosure rating | IP64 |
| Connecting cables | to PLC: cab-las8/SPS or cab-las8/SPS-w<br>to PC/RS232 interface: cab-las4/PC or cab-las4/PC-w<br>to PC/USB interface: cab-4/USB or cab-4/USB-w<br>to PC/Ethernet interface: cab-4/ETH |
| Type of connector | connection to PLC: 8-pole fem. connector (Binder 712), connection to PC: 4-pole fem. connector (Binder 707) |
| Operating temp. range | -20°C ... +55°C |
| Storage temperature range | -20°C ... +85°C |
| EMC test acc. to | DIN EN 60947-5-2 CE |

## Dimensions



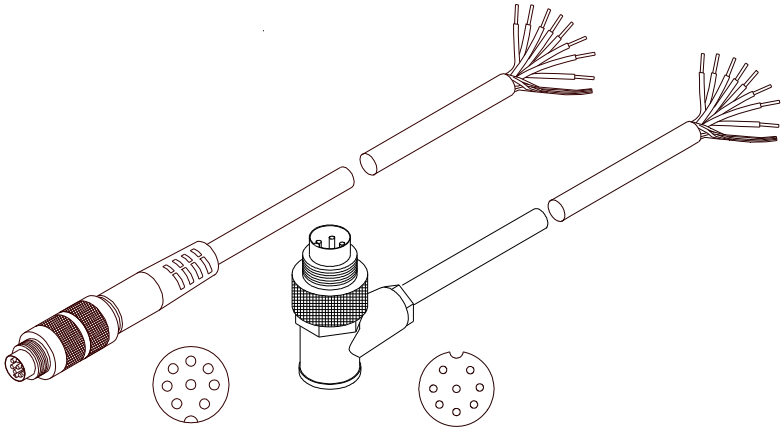

All dimensions in mm

## Connector Assignment

### 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)
cab-las8/SPS-w-(length) (angle type, 90°)
(standard length 2m)



cab-las8/SPS-...
(max. length 25m, outer jacket: PUR)

cab-las8/SPS-w-...
(max. length 25m, outer jacket: PUR)

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

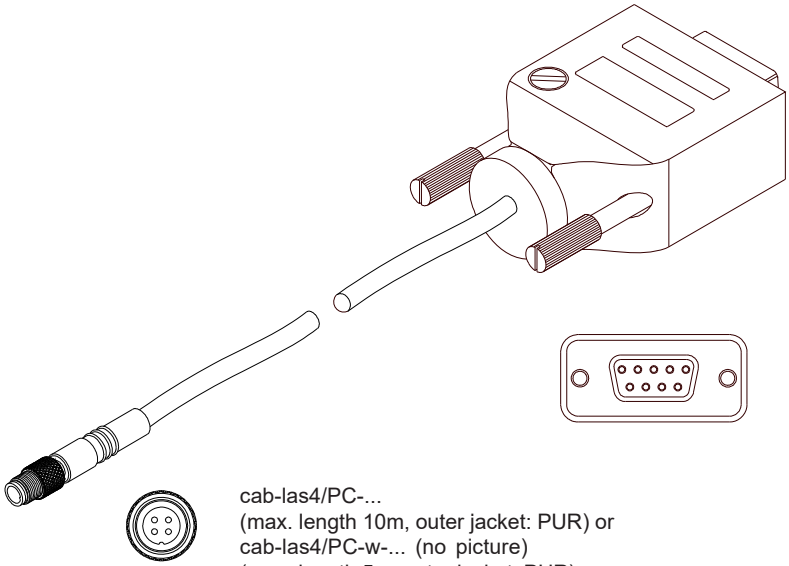
| Pin: | Assignment: |
|---|---|
| 1 | +24VDC (+Ub, OUT) |
| 2 | GND (0V) |
| 3 | RxD |
| 4 | TxD |

***Connection via RS232 interface at the PC:***
Connecting cable:
cab-las4/PC-(length)
cab-las4/PC-w-(length) (angle type 90°)
(standard length 2m)

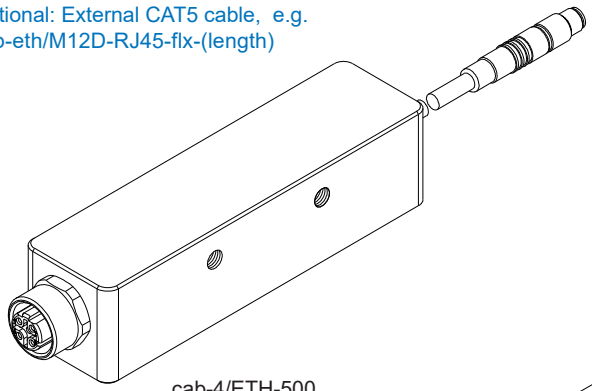
***alternative:***
***Connection via USB interface at the PC:***
Connecting cable (incl. driver software):
cab-4/USB-(length)
cab-4/USB-w-(length) (angle type 90°)
(standard length 2m)

***alternative:***
***Connection to local network via Ethernet bus:***
Adapter (incl. software „SensorFinder“):
cab-4/ETH-500
(standard length 0.5m)

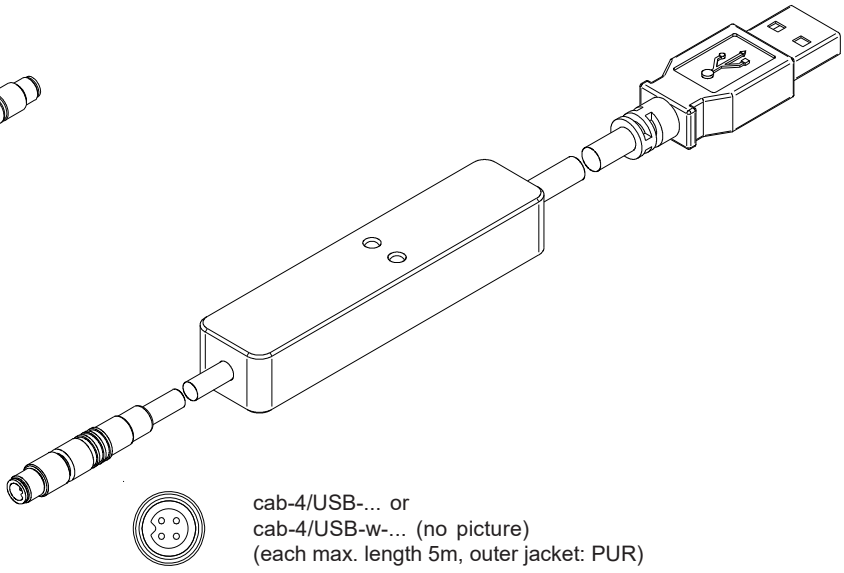
Optional: External CAT5 cable, e.g.
cab-eth/M12D-RJ45-flx-(length)



cab-las4/PC-...
(max. length 10m, outer jacket: PUR) or
cab-las4/PC-w-... (no picture)
(max. length 5m, outer jacket: PUR)



cab-4/ETH-500
(length 0.5m, outer jacket: PUR)
4-pole M12 fem. conn. (D-coded)
for connection of an external
CAT5 cable, e.g.
cab-eth/M12D-RJ45-flx-(length)



cab-4/USB-... or
cab-4/USB-w-... (no picture)
(each max. length 5m, outer jacket: PUR)

## Measuring Principle

**Measuring principle of the color sensors of SPECTRO-3-MSM-DIG series:**

The SPECTRO-3-MSM-DIG provides highly flexible signal acquisition. For example, the sensor can be operated in alternating-light mode (AC mode), which makes the sensor insensitive to extraneous light. It also can be set to constant-light mode (DC mode), which makes the sensor extremely fast. With the stepless adjustment of the integrated light source as well as the selectable gain of the receiver signal and an INTEGRAL function the sensor can be set to almost any surface or any "self-luminous object".

When the integrated light source of the SPECTRO-3-MSM-DIG color sensor is activated, the sensor detects the radiation that is diffusely reflected from the object. As a light source the SPECTRO-3-MSM-DIG color sensor uses LEDs (in case of color sensor type -VISUV additionally UV LEDs) with adjustable transmitter power. An integrated 3-fold receiver for the red, green, and blue content of the light that is reflected from the object, or the light that is emitted by a "self-luminous object", is used as a receiver.

The color sensors of the SPECTRO-3-MSM-DIG series can be taught up to 31 colors that are provided directly at the outputs, and up to 48 colors that are output by means of grouping. For each of these taught colors it is possible to set tolerances. Evaluation of the taught colors is performed either with the "FIRST HIT" or with the "BEST HIT" mode. With "FIRST HIT" the first hit in the teach table is output, and with "BEST HIT" the best hit in the teach table is output. Raw data are represented with 12 bit resolution.

Color detection either operates continuously or is started through an external PLC trigger signal. The respective detected color either is provided as a binary code at the 5 digital outputs or can be sent directly to the outputs, if only up to 5 colors are to be detected. At the same time the detected color code is visualised by means of 5 LEDs at the housing of the SPECTRO-3-MSM-DIG. **[Please note: Visualisation by means of LEDs not available with SPECTRO-3-JR-MSM-DIG and SPECTRO-3-MSM-DIG-VIS, -DL or -VISUV types.]**

With a TEACH button at the sensor housing the color sensor can be taught up to 31 colors (max. 48 colors in group mode). For this purpose the corresponding evaluation mode must be set with the software. The TEACH button is connected in parallel to the input IN0 (green wire at cable cab-las8/SPS). **[Please note: TEACH button not available with SPECTRO-3-JR-MSM-DIG and SPECTRO-3-MSM-DIG-VIS, -DL or -VISUV types.]**

Parameters and measurement values can be exchanged between a PC and the SPECTRO-3-MSM-DIG color sensor through the serial RS232 interface. All the parameters for color detection also can be saved to the non-volatile EEPROM of the SPECTRO-3-MSM-DIG color sensor through this serial RS232 interface. When parameterisation is finished, the color sensor continues to operate with the current parameters in STAND-ALONE mode without a PC.

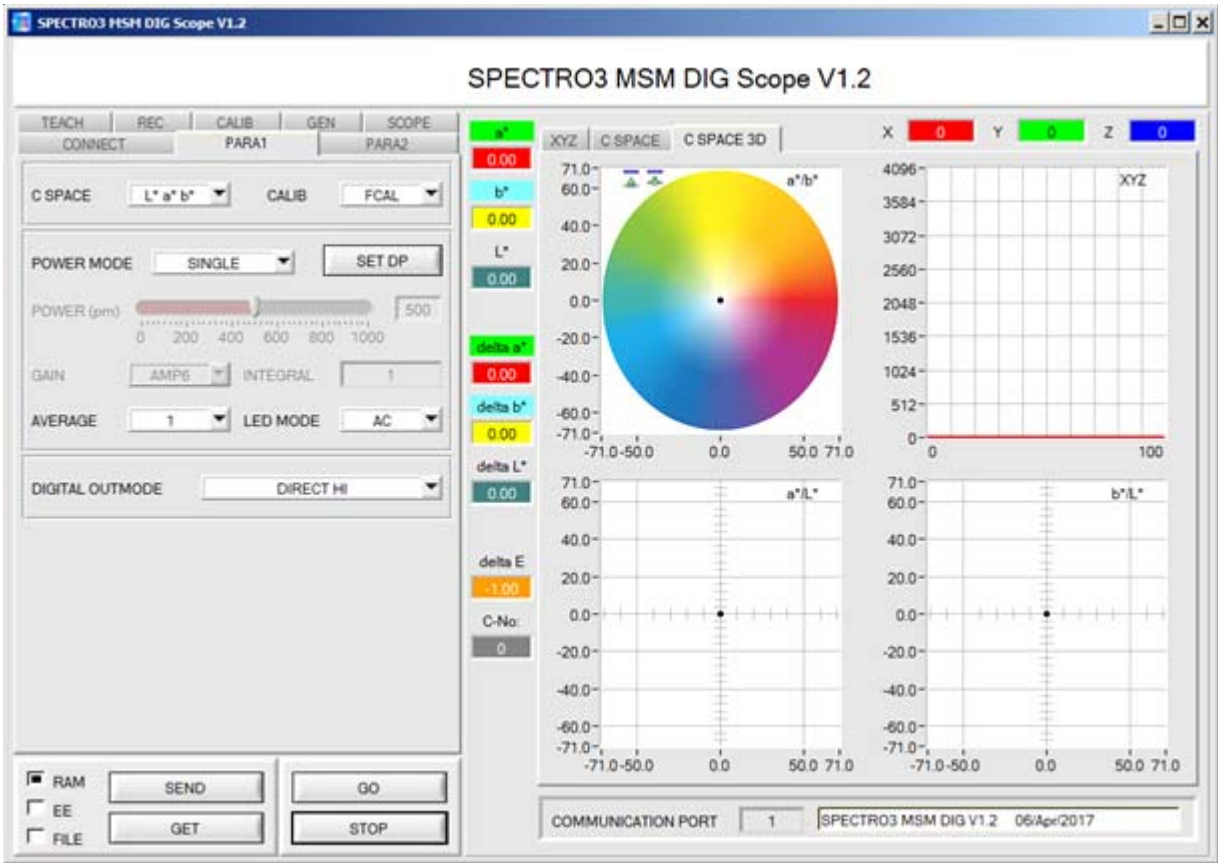
Possible firmware updates can be easily performed through the RS232 interface, even with the sensor system in installed condition (a firmware update is performed via the software „FirmwareLoader").

## Parameterization

**Windows® user interface:**

*(The current software version is available for download on our website.)*

The color sensor is parameterized under Windows® with the SPECTRO3-MSM-DIG-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.



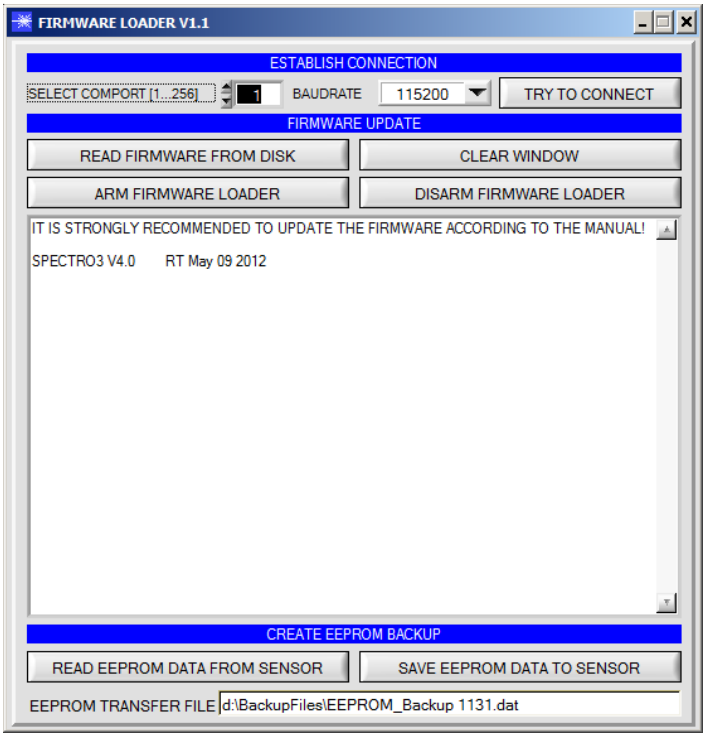

The RS232 interface (tab PARA1 or PARA2) is used for setting parameters such as:

- POWER MODE: Light power of the LED
- SET DP: Set Double Parameter
- LED MODE: Triggering of the internal light source (AC, DC)
- GAIN: Used for setting the gain of the receiver (AMP1 ... AMP8)
- AVERAGE: Number of scanning values (measurement values, 1 ... 32768) over which the raw signal measured at the receiver is averaged. A higher AVERAGE default value reduces noise of the raw signals at the receiver unit and there will be a decrease of the maximal available switching frequency of the sensor.
- INTEGRAL: 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
- C SPACE: Selection of a color space (L*a*b* , L*C*h* , L*u*v*, L*u'v', or xyY) for the calculation of the color stimulus specification
- DIGITAL OUTMODE: Triggering of the five digital outputs (OUT0 ... OUT4)
- EVALUATION MODE: Evaluation mode (FIRST HIT or BEST HIT)
- TRIGGER: Continuous or external or self trigger (CONT, EXT1, EXT2, TRANS)
- 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-MSM-DIG and SPECTRO-3-MSM-DIG-VIS, -DL or -VISUV types.]
- INTLIM: Minimum intensity required for color evaluation
- MAXCOL-No.: Number of colors to be checked

Tab TEACH Opens a window where you can teach colors to the TEACH TABLE
Tab CALIB Selection of calibration mode (FCAL = factory calibration or UCAL = user calibration).
Tab SCOPE Visualises an oscilloscope
Tab GEN Displays the current temperature value TEMP in the sensor housing
Tab REC Data recorder

## Firmware Update

### Firmware update by means of the software „FirmwareLoader“:



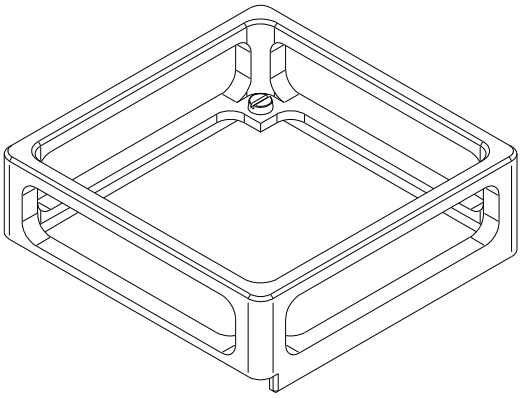

The software „Firmware Loader“ allows the user to perform an automatic firmware update. The update will be carried out through the RS232 interface.

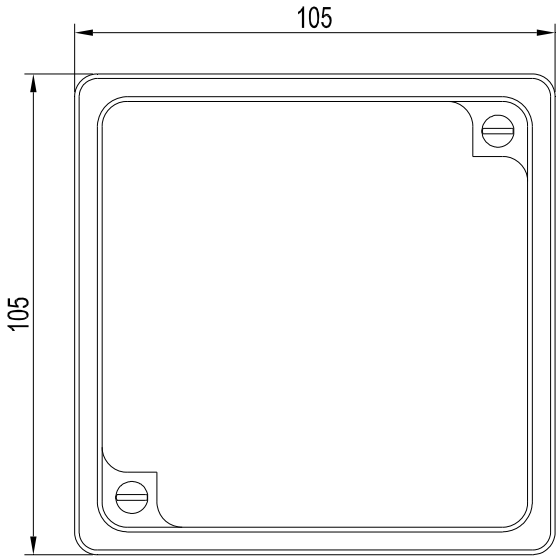
An initialisation file (xxx.ini) and a firmware file (xxx.elf.S) are required for performing a firmware update. These files can be obtained from your supplier. In some cases an additional firmware file for the program memory (xxx.elf.p.S) is also needed, and this file will be automatically provided together with the other two files.

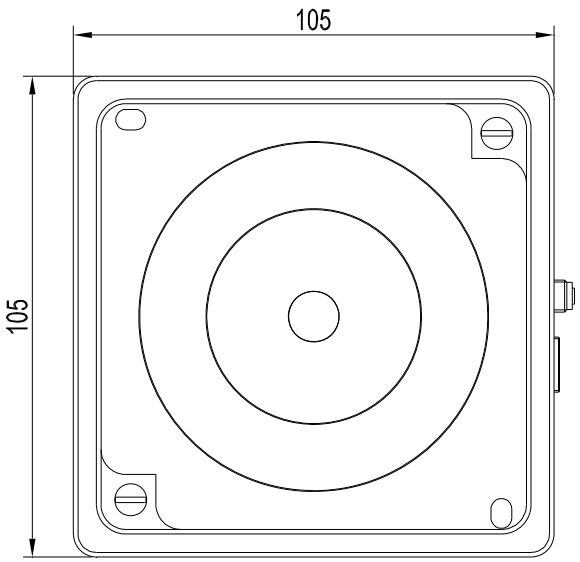
## Spacer

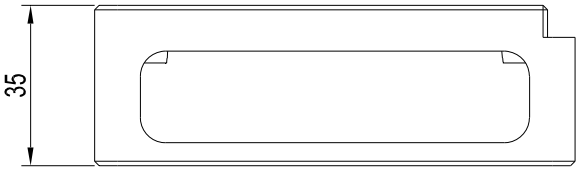
**SPECTRO-3-28-45°/0°-OFL**
**Spacer**
(please order separately)

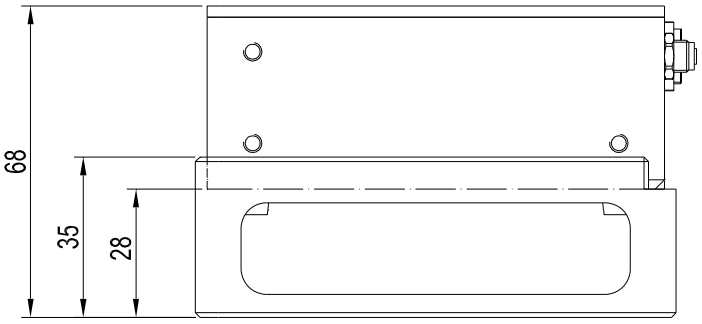
Spacer (offline unit) for
color sensor SPECTRO-3-28-45°/0°-MSM-DIG-VIS





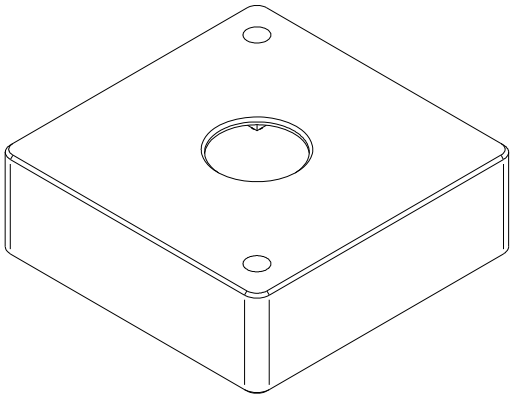



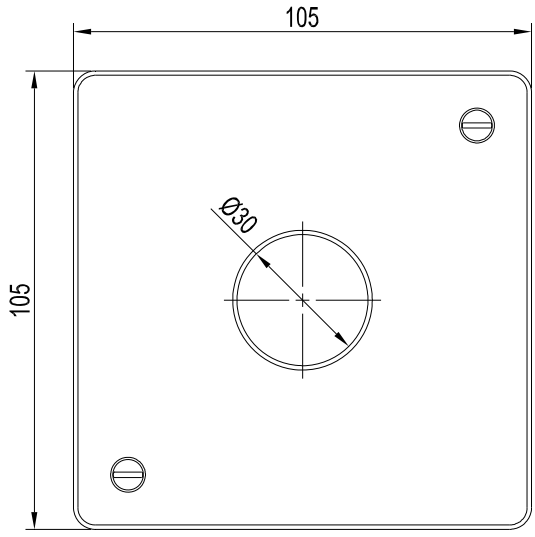

All dimensions in mm

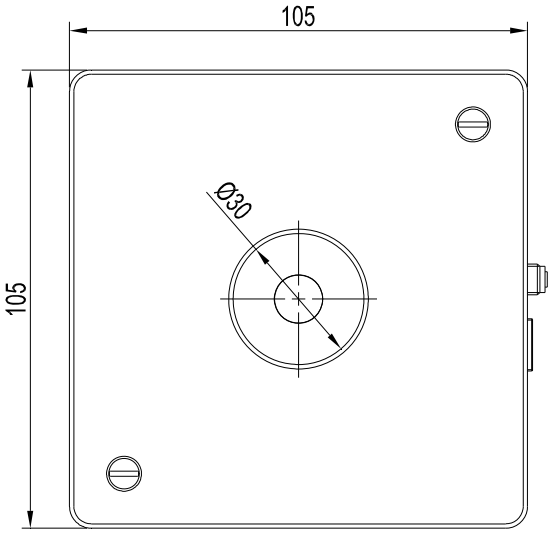
## Spacer

**SPECTRO-3-28-45°/0°-OFL-D30**
**Spacer**
(please order separately)

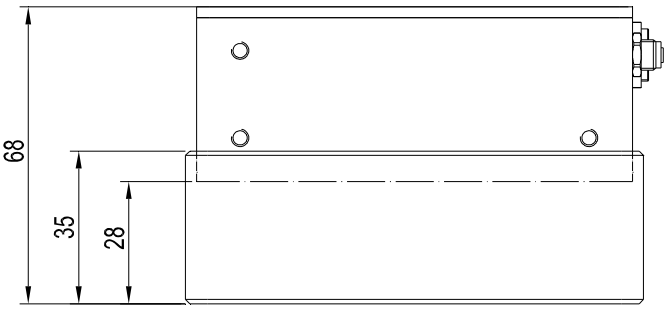
Spacer (offline unit) with an opening of Ø 30 mm for color sensor SPECTRO-3-28-45°/0°-MSM-DIG-VIS










Alle Abmessungen in mm