# SPECTRO Series

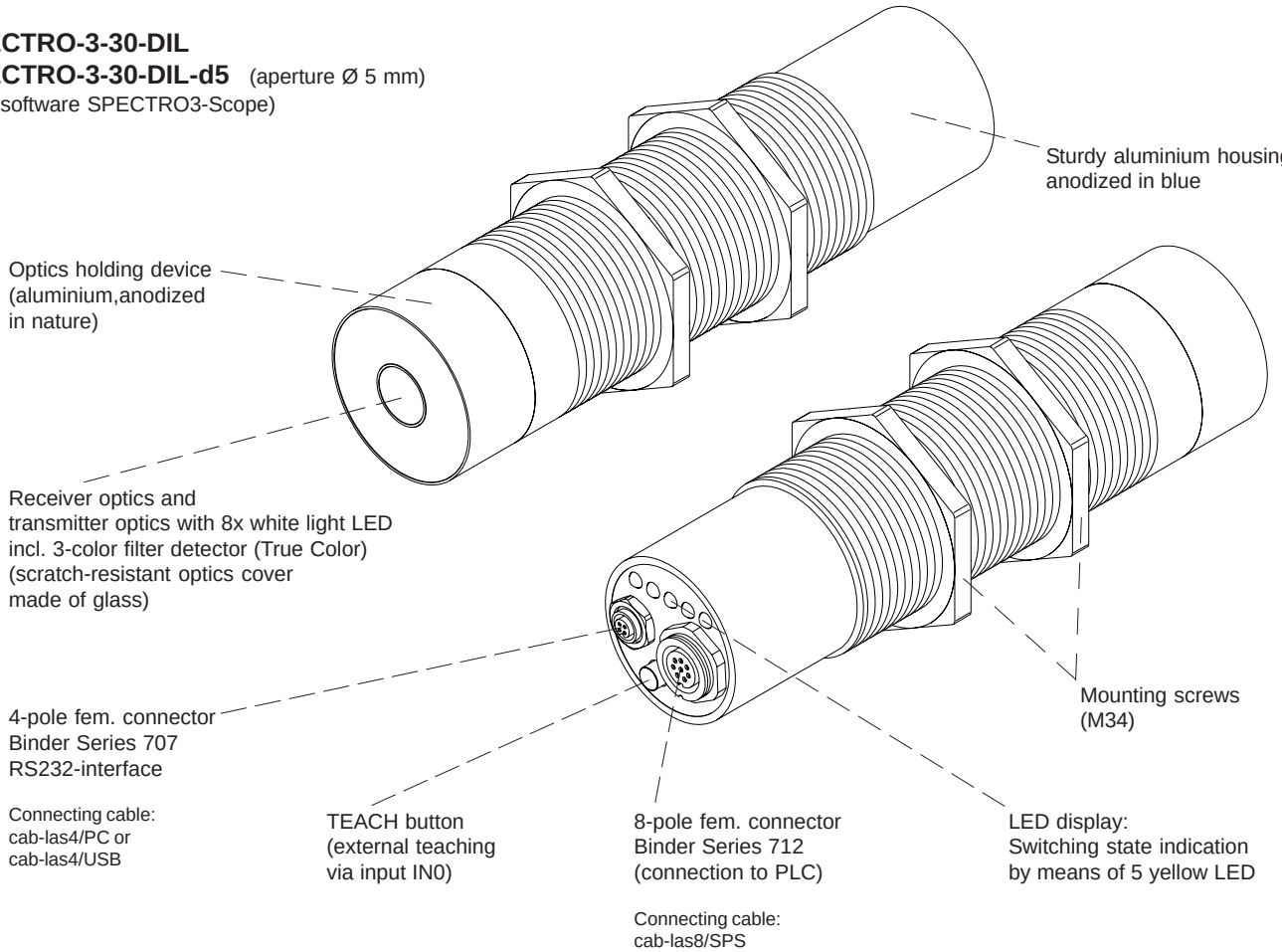
## SPECTRO-3-30-DIL

- Measuring range typ. 10 mm ... 60 mm
- Reduction of gloss effect due to diffuse illumination
- Up to 31 colors can be stored
- RS232 interface (USB adapter is available)
- 8x white-light LED (AC-/DC-operation can be switched)
- Color and gray scale detection
- Insensitive to outside light
- Brightness correction can be activated
- Switching frequency typ. 30 kHz
- Several TEACH functions (via PC, PLC, or push button)
- Extern teach via PLC or teach button
- Various evaluation algorithms can be activated
- Switching state display by means of 5 yellow LEDs
- 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")
- "BEST HIT" mode ("human color assessment")

## Design

**Product name:**

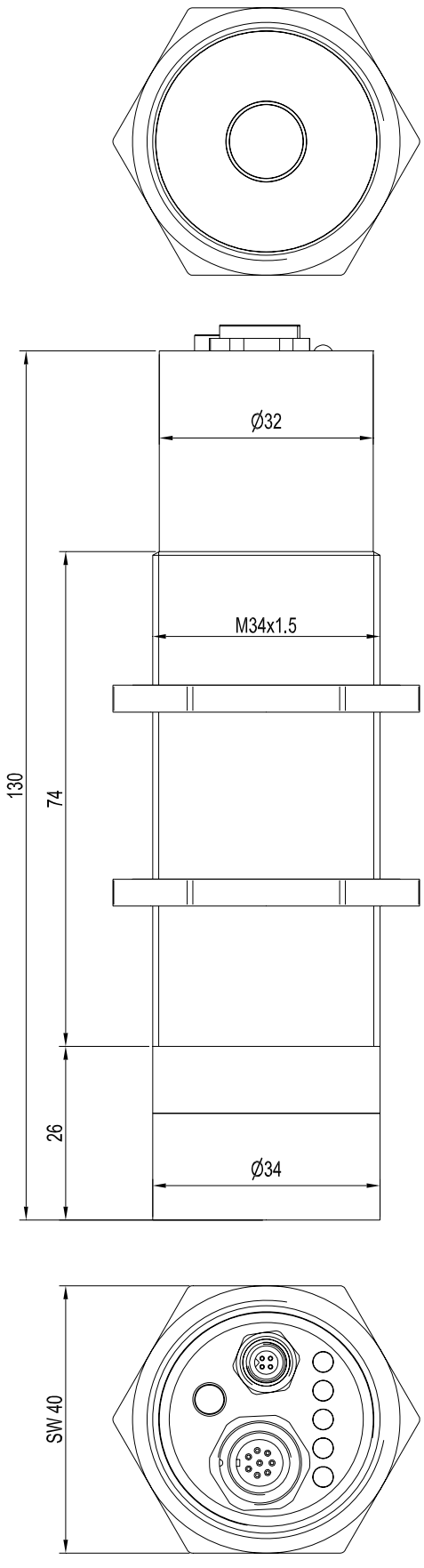
**SPECTRO-3-30-DIL**
**SPECTRO-3-30-DIL-d5** (aperture Ø 5 mm)
(incl. software SPECTRO3-Scope)



## Technical Data

| Model | SPECTRO-3-30-DIL or SPECTRO-3-30-DIL-d5 |
|---|---|
| Light source | 8x white-light LED, diffuse (AC-, DC-operation, can be switched under Windows®) |
| Measuring range | typ. 10 mm ... 60 mm |
| Size of light spot | typ. 12 mm (at a distance of 20 mm) ... typ. 20 mm (at a distance of 40 mm)<br>for type "-d5": typ. 6 mm (at a distance of 20 mm) ... typ. 10 mm (at a distance of 40 mm) |
| Reproducibility | in the X, Y color range each 1 digit at 12-bit A/D conversion |
| Receiver | 3-color filter detector (TRUE COLOR detector, "human color perception"),<br>color filter curves acc. to CIE 1931 |
| AC/DC operation | AC: typ. 10 kHz ... 40 kHz (depends on the gain set: AMP1 ... AMP8)<br>DC: can be switched via PC software SPECTRO3-Scope |
| Ambient light | up to 5000 Lux (in AC-mode) |
| Enclosure rating | IP67 (optics), IP64 (electronics) |
| Current consumption | typ. 320 mA |
| Interface | RS232, parameterisable under Windows® |
| Type of connector | connection to PLC: 8-pole fem. connector (Binder Series 712)<br>connection to PC: 4-pole fem. connector (Binder Series 707) |
| Connecting cables | to PLC: cab-las8/SPS-... (standard length 2m)<br>to PC: cab-las4/PC-... (standard length 2m), alternatively: cab-las4/USB-... (standard length 1m) |
| Housing material | aluminium, anodized in blue (optics holding device: aluminium, anodized in nature) |
| Housing dimensions | length 130 mm x Ø 32 mm (threaded M34x1.5) or Ø 34 mm (optics holding device) |
| 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. 30 kHz (depends on the number of teach-colors and averaging value) |
| Outputs | OUT 0 ... OUT 4, digital (0V/+Ub), short-circuit protected, 100 mA max. switching current<br>npn, pnp-output available (bright-, dark-switching can be switched over) |
| Averaging | over 32768 values max. |
| Voltage supply | +24VDC (± 10%), reversed polarity protected, overcurrent protected |
| Switching state indication | visualization by means of 5 yellow LEDs |
| Color memory capacity | non-volatile EEPROM with parameter sets for 31 colors max. |
| TEACH button | for external teaching of color reference values via input IN0 |
| Temperature drift X,Y | ΔX/ΔT; ΔY/ΔT typ. 0,2 digits/°C (< 0,01% / °C) |
| Adjustment of gain | via step-switch: 8 steps (AMP1 ... AMP8), adjustable under Windows® |
| EMC test acc. to | DIN EN 60947-5-2 CE |

## Dimensions

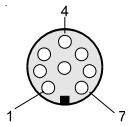



All dimensions in mm

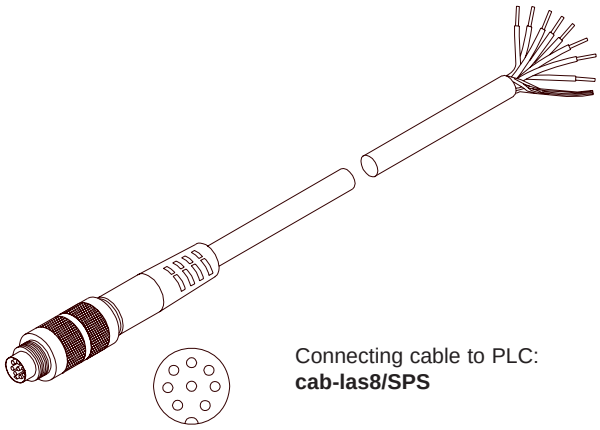
## Connector Assignment

### 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 |
| 5 | grey | OUT1 |
| 6 | pink | OUT2 |
| 7 | blue | OUT3 |
| 8 | red | OUT4 |




Connecting cable:
cab-las8/SPS-*(length)*
(Standard length 2m)



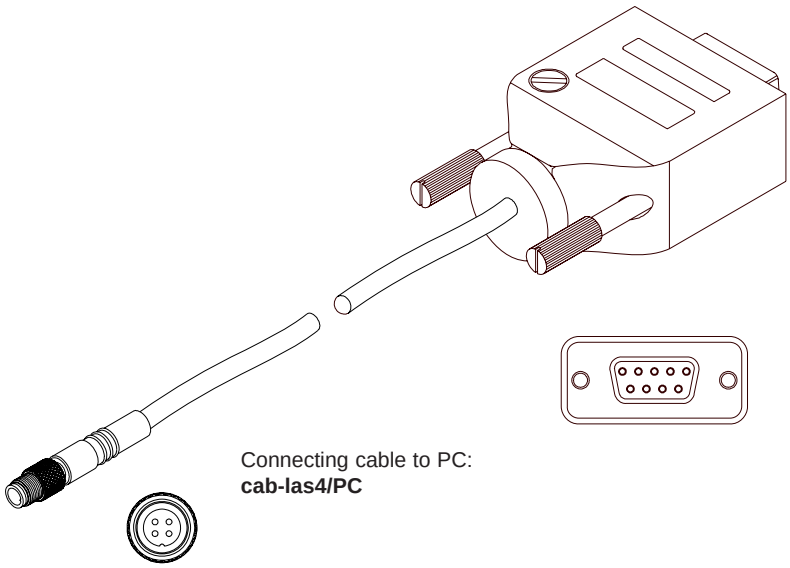
Connecting cable to PLC:
**cab-las8/SPS**

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

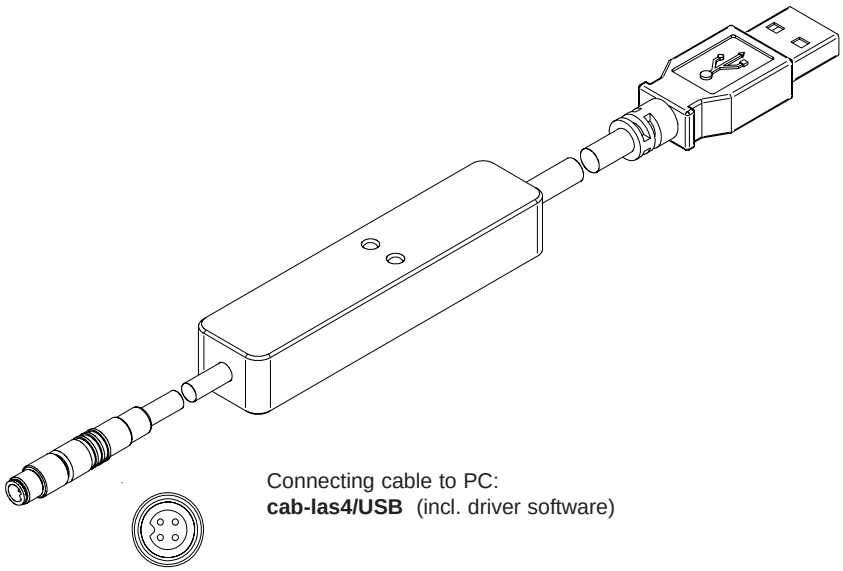
| Pin: | Assignment: |
|---|---|
| 1 | +24V |
| 2 | GND (0V) |
| 3 | RxD |
| 4 | TxD |

Connecting cable:
cab-las4/PC-*(length)*
cab-las4/PC-w-*(length)* (angle type, 90°)
(Standard length 2m)

alternatively:
cab-las4/USB-*(length)*
(Standard length 1m)



Connecting cable to PC:
**cab-las4/PC**



Connecting cable to PC:
**cab-las4/USB** (incl. driver software)

## Measuring Principle

### Measuring principle of color sensors of SPECTRO-3 Series:

The SPECTRO-3 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 and allows a scan-frequency of more than 30KHz. If the integrated light source at the sensor is turned off and the sensor is set to DC mode, the sensor is able to detect so-called "self-luminous objects". With the stepless adjustment of the integrated light source and the selectable gain of the receiver signal the sensor can be set to almost any surface or any "self-luminous object".

When the integrated light source of the SPECTRO-3 color sensor is activated, the sensor detects the radiation that is diffusely reflected from the object. As a light source the SPECTRO-3 color sensor uses a white-light LED 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. As mentioned above, a special feature here is that the gain of the receiver can be set in 8 steps. This makes it possible to optimally adjust the sensor to almost any surface and to different "self-luminous objects".

The SPECTRO-3 color sensor can be "taught" up to 31 colors. For each of these taught colors it is possible to set tolerances. In X/Y INT or s/i M mode these tolerances form a color cylinder in space. In X/Y/INT or s/i/M mode the tolerances form a color sphere in space. Color evaluation according to s/i M is based on the lab calculation method. All modes can be used in combination with several operating modes such as "FIRST HIT" and "BEST HIT". 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.
With a TEACH button at the sensor housing the color sensor can be taught up to 31 colors. 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).

Parameters and measurement values can be exchanged between a PC and the SPECTRO-3 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 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.

The sensors of the SPECTRO-3 series can be calibrated (white-light balancing). Balancing can be performed to any white surface. A ColorCheckerTM table with 24 color fields is available as an alternative.

## Visualization

### 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).

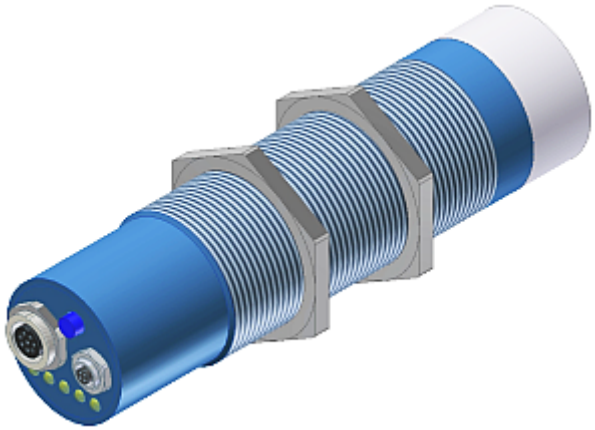
If DIRECT LO is activated, the specially digital output is set to LO, while the other 4 are set to HI. If the current color does not correspond with any of the teach-in colors, all digital outputs are set to HIGH (all LED are lighting).

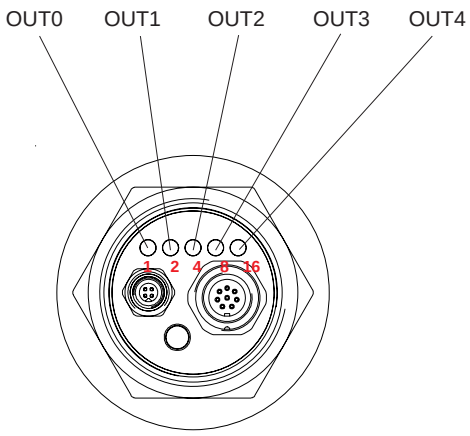
## LED-Display

### 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.



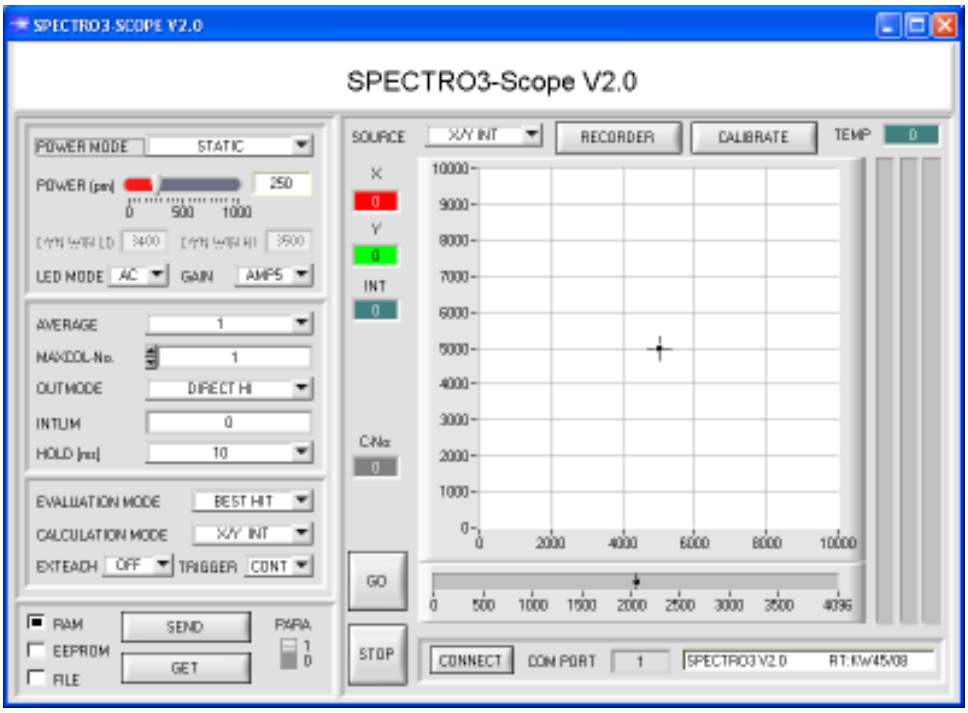



| | | |
|---|---|---|
| 0 | 1 | 2 |
| 3 | 4 | 5 |
| 6 | 7 | 8 |
| 9 | 10 | 11 |
| 12 | 13 | 14 |
| 15 | 16 | 17 |
| 18 | 19 | 20 |
| 21 | 22 | 23 |
| 24 | 25 | 26 |
| 27 | 28 | 29 |
| 30 | Error or „not detected“ | |

## 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.




The color sensor is parameterized under Windows® with the SPECTRO3-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
- Light power of the white-light LED
- Automatic light power control ON/OFF
- Pulse lengthening up to 100ms max.
- External or continuous trigger
- Minimum intensity required for color evaluation

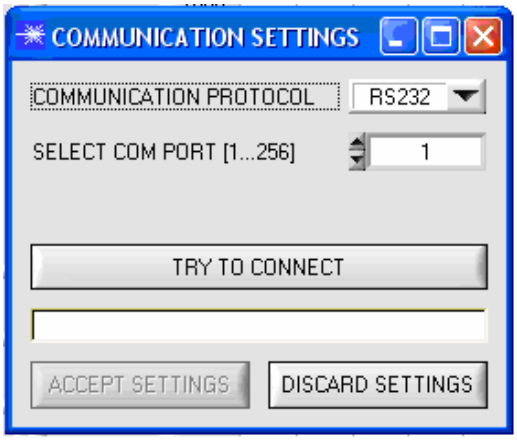
Under Windows® representation of the color value on a PC in numeric form and in a color chart, and representation of RGB values in a time chart.
In addition the current RGB values are displayed as a bar chart.

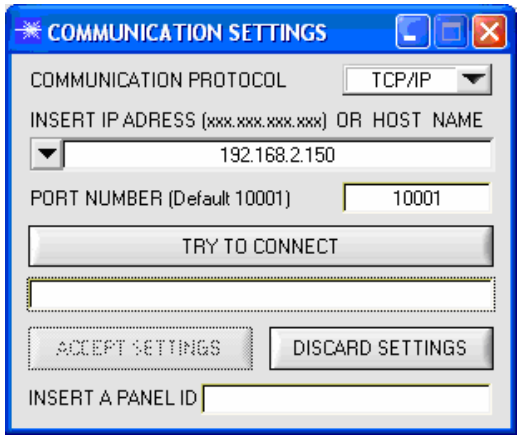

This display shows the temperature prevailing in the sensor housing.

### Explanation of general function groups and display elements:


The SPECTRO3-Scope software starts with the standard configuration COM1 and the respective communication status.

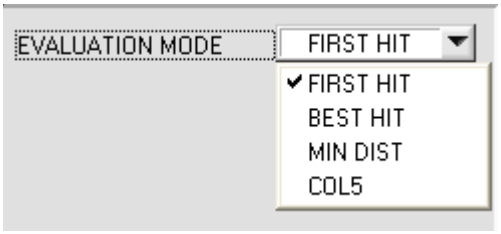

**CONNECT**:
Pressing the CONNECT button opens a window for selecting and configuring the interface. The currently set connection type is displayed beside the CONNECT button.




The COMMUNICATION PROTOCOL function field is used for selecting either an RS232 or a TCP/IP protocol.
If RS232 is selected, a port from 1 to 256 can be selected with SELECT COM PORT, depending on which port the sensor is connected to.
If the sensor should communicate through a local area network, an RS232 to Ethernet adaptor (= SI-RS232/ Ethernet, available as an accessory) will be needed. This adapter makes it possible to establish a connection to the sensor with the TCP/IP protocol.
If a connection has been accepted by pressing ACCEPT SETTINGS, the software starts automatically with these settings when called the next time.

## Parameterization



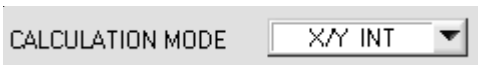

**EVALUATION MODE:**
This function field serves for setting the evaluation mode at the SPECTRO-3 color sensor.

FIRST HIT:
The currently measured color values are compared with the default values in the COLOR TEACH TABLE, starting with teach-color 0. If in the row-by-row comparison the current color values correspond with the teach-parameters entered in the COLOR TEACH TABLE, this first "hit" in the COLOR TEACH TABLE is displayed as a color number (C-No.) and is output at the digital outputs (OUT0 ... OUT4) according to the settings of the OUTMODE parameter (see OUTMODE).
If the current color does not correspond with any of the teach-colors, the color code C-No. = 255 will be set ("error status").

BEST HIT:
The currently measured color values are compared with the default values in the COLOR TEACH TABLE, starting with teach-color 0. If in the row-by-row comparison the current color values correspond with several of the teach parameters entered in the color table, the teach parameter that has the shortest x/y distance from the current color value will be a hit.
This "hit" in the COLOR TEACH TABLE is displayed as a color number (C-No.) and is output at the digital outputs (OUT0 ... OUT4) according to the settings of the OUTMODE parameter (see OUTMODE). If the current color does not correspond with any of the teach-in colors, the color code C-No. = 255 will be set ("error status").

MIN DIST:
The individual teach-in colors defined in the COLOR TEACH TABLE are present as points in the color triangle, defined by their (X,Y) value pairs. When this evaluation mode is set at the SPECTRO-3 color sensor, the evaluation algorithm, starting from the currently measured color value (X,Y), calculates the distance to the individual teach-in colors in the color triangle. The current color value (X,Y) is assigned to the teach-in color that is closest in the color triangle.

COL5:
In this evaluation mode the rows 0 to 4 in the COLOR TEACH TABLE are evaluated.
Every match of current color (row number) and teach vector is directly sent to the corresponding output.

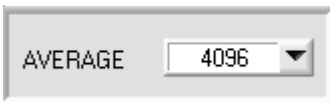



**CALCULATION MODE:**
X/Y INT:
The X/Y pairs of the individual red, green, and blue components, and the intensity are used for evaluation. For X/Y a color tolerance CTO can be set, and for the intensity an INT tolerance ITO can be set. With the individual tolerances the color is represented as a cylinder in space.
CTO defines the diameter of the cylinder, and ITO the height of the cylinder

s/i M:
The s/i pairs of the individual red, green, and blue components, and M are calculated for evaluation. This calculation method follows the Lab calculation method. For s/i a color tolerance siTO can be set, and for the intensity an M tolerance MTO can be set. With the individual tolerances the color is represented as a cylinder in space. siTO defines the diameter of the cylinder, and MTO the height of the cylinder.

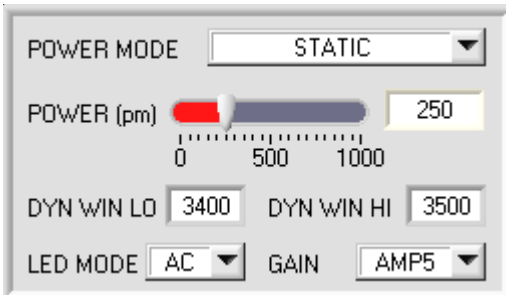
X/Y/INT:
For evaluation, X, Y, and INT are calculated from the individual red, green, and blue components. These three values define a point in three-dimensional space. The tolerance value that is entered defines a sphere in space with radius TOL.

s/i/M:
For evaluation, s, i, and M are calculated from the individual red, green, and blue components following the Lab calculation method. These three values define a point in three-dimensional space. The tolerance value that is entered defines a sphere in space with radius TOL.




**AVERAGE:**
This function field is used for adjusting the number of scanning values (measurement values) 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 SPECTRO-3 color sensor.

## Parameterization



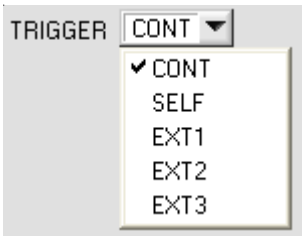

**POWER MODE:**
In this function field the operating mode of automatic power correction at the transmitter unit (transmitter LED) can be set.

STATIC:
The transmitter power is constantly kept at the value set with the POWER [pm] slider (recommended operation mode). The power can be set with the slider or by entering a value in the edit-box. A value of 1000 means full intensity at the transmitter unit, a value of 0 sets the lowest intensity at the transmitter.

DYNAMIC:
The LED transmitter power is dynamically controlled in accordance with the amount of radiation that is diffusely reflected from the object. By using the intensities measured at the receivers the automatic control circuit attempts to adjust the transmitter power in such a way that the dynamic range, which is determined by DYN WIN LO and DYN WIN HI, is not exceeded.

LED MODE:
This item serves for setting the control mode for the integrated light source of the sensor.
In AC mode the sensor is insensitive to extraneous light, which is achieved by "modulating" the integrated light source, i.e. by turning the light on and off. The extraneous content in the signal is determined in off status and is simply subtracted from the on status.
In DC mode the sensor operates extremely fast and reaches a scan frequency of more than 30KHz. Unfortunately the sensor is somewhat sensitive to extraneous light in DC mode, but if the extraneous light source does not directly shine into the sensor's receiver, the signal only is influenced to a very small extent.
If the sensor's internal light source is turned off in DC mode by POWER [pm] = 0, the sensor can be used for so-called "self-luminous objects". Self-luminous objects are light sources that actively emit light (LEDs, lamps, etc.)

GAIN:
This item is used for setting the gain of the receiver in 8 different gain stages (AMP1 to AMP8). GAIN should be set such that with a medium POWER value the sensor operates in its dynamic range (red, green, blue between 2750 and 3750).
In AC mode, GAIN directly influences the scan frequency. The scan-frequency table on the software CD shows the different scan frequencies.




**TRIGGER:**
This function field serves for setting the trigger mode at the SPECTRO-3 color sensor.

CONT:
Continuous color detection (no trigger event required).

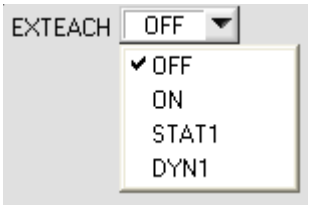
SELF:
By selecting SELF the sensor can be operated in self-trigger mode.
The "free status" must be taught to row 0. With a split optical fibre in transmitted-light operation the free status, for example, is the uncovered status. In reflected-light operation the free status is the status when there is no part.
Color detection is started when row 0 is no longer detected (self-trigger). After the trigger, i.e. when color 0 is detected again, the color from the taught colors will be output that was detected most frequently during triggering.

EXT1:
Color detection is started through the external trigger input (IN0 pin3 green of cable cab-las8/SPS) or by means of a click on the TEACH button. A trigger event is recognized as long as +24V is present at the IN0 input (HIGH-active). After the trigger input goes to LOW again, the state (color no.) that was last detected will be held at the outputs.

EXT2:
Same behaviour as in EXT1 mode, with the difference that an error state (color no. = 255) will be output after the trigger input goes to LOW again.

EXT3:
Color detection is started through the external trigger input (IN0 Pin3 grn at cable cab-las8/SPS) or by pressing the TEACH button. After triggering the color from the taught colors will be output that was detected most frequently during triggering.

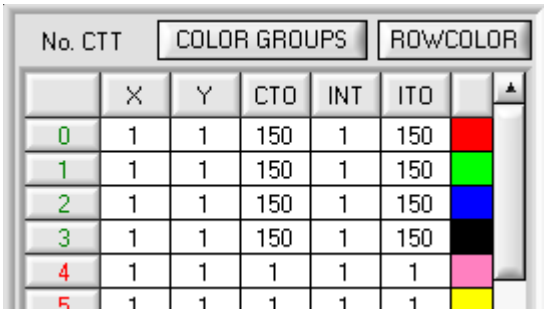
## Parameterization




**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.
OFF: The external TEACH feature is deactivated.
ON : See below

STAT1:
In static power mode, a color is taught to position 0 in the COLOR TEACH TABLE.
The POWER MODE is automatically set to STATIC. A fixed transmitter poser must be set with the POWER slider.
When the button at the sensor housing is pressed, or after a positive signal (+24V) at input IN0, the current color is taught to row 0.

DYN1:
In dynamic power mode, a color is taught to position 0 in the COLOR TEACH TABLE, and evaluation is then performed statically.
The POWER MODE is automatically set to STATIC. When the button at the sensor housing is pressed, or after a positive signal (+24V) at input IN0, the transmitter power is set such that the sensor is in the dynamic range, which is defined by DYN WIN LO and DYN WIN HI. The current color is then taught to position 0 in the COLOR TEACH TABLE. The sensor then continues to operate statically with the established POWER value.




**TEACH PROCESS with EXTEACH=ON:**
Through IN0 or by way of the button at the sensor housing, the sensor can be taught up to 31 colors.

In EVALUATION modes BEST HIT, MIN DIST, and COL5 a single row in the table can be selected with the button or through IN0.
In EVALUATION mode First Hit the currently present color is taught to all active rows depending on MAXCOL-No.

The example shows the external teaching of 4 colors in evaluation mode BEST HIT.

Select the EXTERN TEACH = ON function.
Select how many colors you wish to teach from extern.
Click on the "0" field in the PARA switch to change to the COLOR TEACH TABLE.
Then enter the corresponding tolerances for the colors you want to teach


**PARA:**
With this switch the display of the COLOR TEACH TABLE at the PC screen can be switched on and off.

1: Display of function fields for entering and selecting general monitoring parameters.
0: Display of the COLOR TEACH TABLE for entering the individual parameters for the teach-in colors.

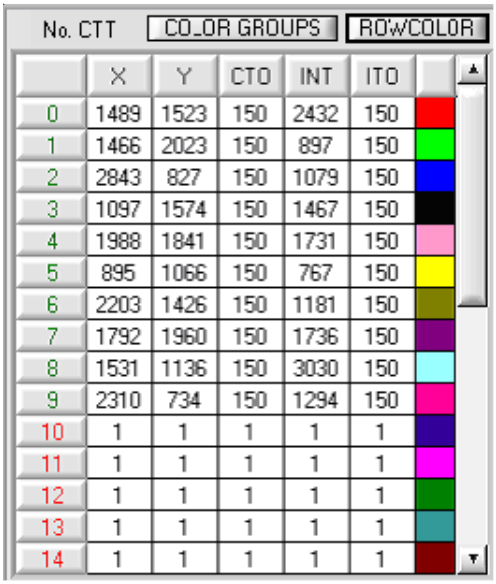

**MAXCOL-No.:**
This function field serves for setting the number of colors to be checked. In the BINARY mode the maximum number of colors to be checked is 31. In the DIRECT HI or DIRECT LO mode the maximum number of colors to be checked is 5 (colors no. 0,1,2,3,4).
The numerical value set here determines the currently possible scanning rate of the color sensor. The less the colors to be checked, the faster the operation of the SI-COLO4 color sensor. The numerical value set here refers to the number of rows (starting with row 0) in the COLOR TEACH TABLE.
In this example, MAXCOL-No. = 4 was selected, i.e. the sensor should detect the color information that is stored in the first 4 rows of the COLOR TEACH TABLE by means of external teaching through IN0. Since the sensor cannot calculate the tolerances for color (CTO) and intensity (ITO) itself, these values must be entered once (in this case 150 at all places) and must be stored in the EEPROM (see MEM) together with the MAXCOL-No. and with EVALMODE = ON.


**INTLIM:**
This edit box is used for setting an intensity limit. Color evaluation is stopped, if the current intensity INT arriving at the receiver unit falls below this limit, and ERROR STATE is output.


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

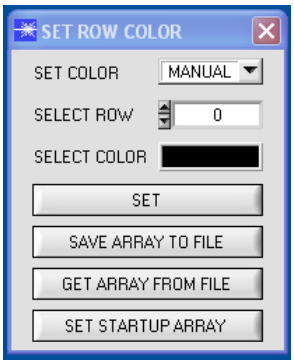
## Parameterization

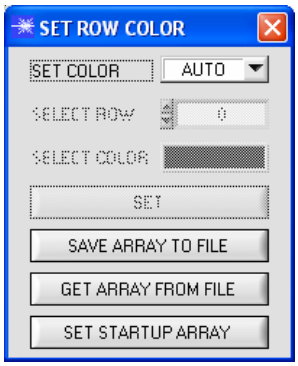

**OUTMODE:**
This group of buttons offers the method of how to control the 5 digital outputs.
BINARY:
If in this row-by-row comparison the current color values correspond with the teach-in parameters entered in the COLOR TEACH TABLE, this color in the COLOR TEACH TABLE is displayed as a color number (C-No.) and is sent to the digital outputs (OUT0 ... OUT4) as a bit pattern. The maximum number of colors to be taught is 31.
DIRECT:
In this mode the maximum number of colors to be taught is 5.
If in this row-by-row comparison the current color values correspond with the teach-in parameters entered in the COLOR TEACH TABLE, this color in the color teach table is displayed as a color number (C-No.) and is sent direct to the digital outputs (OUT0 ... OUT4).

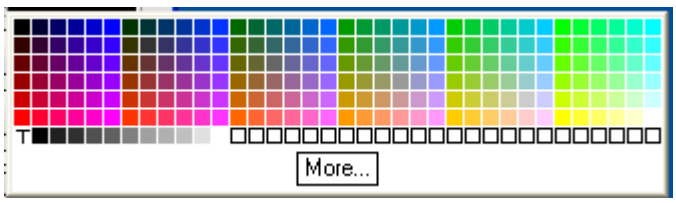



| | X | Y | CTO | INT | ITO |
|---|---|---|---|---|---|
| 0 | 1489 | 1523 | 150 | 2432 | 150 |
| 1 | 1466 | 2023 | 150 | 897 | 150 |
| 2 | 2843 | 827 | 150 | 1079 | 150 |
| 3 | 1097 | 1574 | 150 | 1467 | 150 |
| 4 | 1988 | 1841 | 150 | 1731 | 150 |
| 5 | 895 | 1066 | 150 | 767 | 150 |
| 6 | 2203 | 1426 | 150 | 1181 | 150 |
| 7 | 1792 | 1960 | 150 | 1736 | 150 |
| 8 | 1531 | 1136 | 150 | 3030 | 150 |
| 9 | 2310 | 734 | 150 | 1294 | 150 |
| 10 | 1 | 1 | 1 | 1 | 1 |
| 11 | 1 | 1 | 1 | 1 | 1 |
| 12 | 1 | 1 | 1 | 1 | 1 |
| 13 | 1 | 1 | 1 | 1 | 1 |
| 14 | 1 | 1 | 1 | 1 | 1 |

**COLOR TEACH TABLE:**
A click on switch position 0 of the PARA switch (MEM function field) opens the COLOR TEACH TABLE shown here. The COLOR TEACH TABLE shows the currently set parameters.
After a left mouse button double click (or a click on shortcut key button F2) on the respective field the default values can be changed by entering numerical values with the PC keyboard.
The COLOR TEACH TABLE is organized in rows, i.e. the individual parameters for the teach-in colors are arranged side by side in the respective row.
The SPECTRO-3 color sensor is able to check up to 31 teach-in colors. The number of the respective teach-in color is given in the left column of the table.




**ROW COLOR:**
A click on ROW COLOR opens a panel where the row color in which the individual tolerance circuits are represented can be individually chosen or these can be automatically replaced by the color detected by the system.

If SET COLOR is set to MANUAL, the row color that should be changed must be set under SELECT ROW.
A click on the colored area of SELECT COLOR opens a color palette where the desired color can be selected.
After a click on the SET button, the color will be displayed in the 6th column and the selected row of the COLOR TEACH TABLE.

If SET COLOR is set to AUTO, the system will automatically calculate the corresponding row color, display the color in a color display beside the graph and, after a click on TEACH DATA TO, automatically insert it in the corresponding row.

The SAVE ARRAY TO FILE and GET ARRAY FROM FILE functions allow you to save specified color-arrays on the hard disk, or to load previously saved color-arrays.

SET STARTUP ARRAY is used for setting the selected path of an existing ARRAY. When the software is restarted, the corresponding ARRAY is automatically loaded and displayed in the COLOR TEACH TABLE.


**No.:** When TEACH DATA TO is pressed, the currently displayed data for X, Y, INT or s, i, M are transferred to the row in the COLOR TEACH TABLE that is selected under No.:
**Inc:** When Inc is activated, and the TEACH DATA TO button is pressed, the No.: input field is automatically incremented (increased) by 1, i.e. the next row in the COLOR TEACH TABLE is selected.


A click on this button starts an automatic teach-in process. The current measured values are defined as teach-in values. The teach-in values are assigned to the teach-in color selected in the No.: function field.
The taught colors are only transferred to the sensor and activated when the SEND button is pressed.

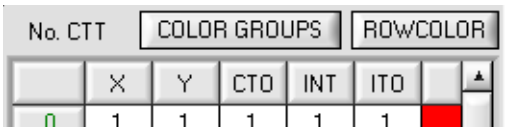
# Parameterization

APPLY FROM ALL

If X/Y is selected under SOURCE, a click on this button displays all the teach-in colors entered in the COLOR TEACH TABLE in the color triangle with the corresponding "tolerance circle" (radius=CTO or siTO).

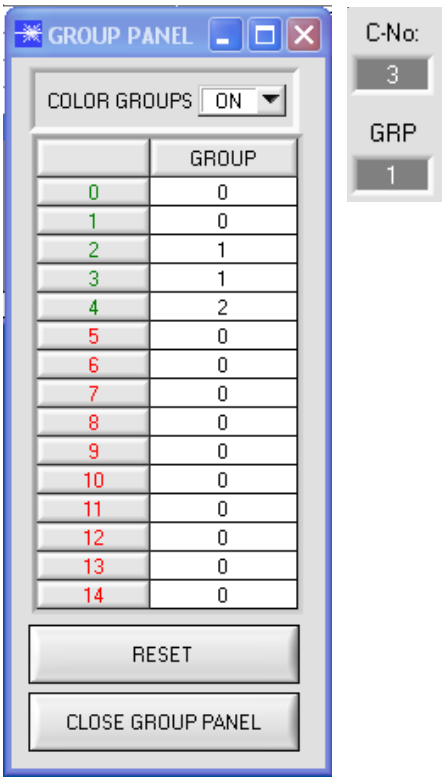
RESET TABLE

A click on this button resets the COLOR TEACH TABLE (RESET value = 1)




**COLOR GROUPS:**
It is possible to form color groups in evaluation modes FIRST HIT, BEST HIT, and MIN DIST. This means that in a special table the individual rows are assigned to a group.

In this example, COLOR GROUPS has been set to ON, i.e. group evaluation is activated.
Rows 0 and 1 have been assigned to group 0.
Rows 2 and 3 have been assigned to group 1, and row 4 to group 2.
A GRP display is shown under the C-No: display.







If, as in this example, row 3 is detected in the evaluation, this row and the corresponding group will be visualised.

The group number will be output through outputs OUT0 to OUT4.

In evaluation mode DIRECT HI and LO 31 different colors can be taught. However, a maximum of only 5 groups can be formed (group 0 to group 4).

A maximum of 31 groups (group 0 to group 30) can be formed in evaluation mode BINARY.

All the cell values can be set to 0 by pressing RESET.
The GROUP PANEL can be closed by clicking on CLOSE GROUP PANEL.

PLEASE NOTE:
Once you have formed groups, they must be reported to the sensor by pressing SEND.

A double-click on the GRP display opens a larger display window.
.


**SOURCE:**
For this purpose the option RAW must be selected in the SOURCE selection field. With this setting the analog channels measured at the receiver unit are represented in the graphic display window.

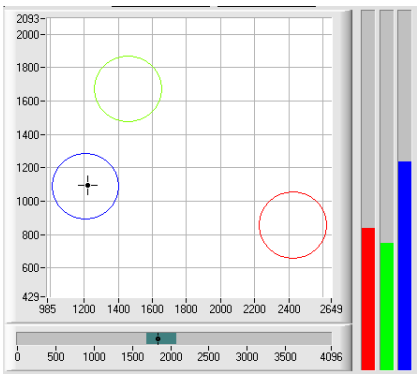
RAW RGB :
The current raw signals of the 3-fold receiver (red, green, blue) are displayed.

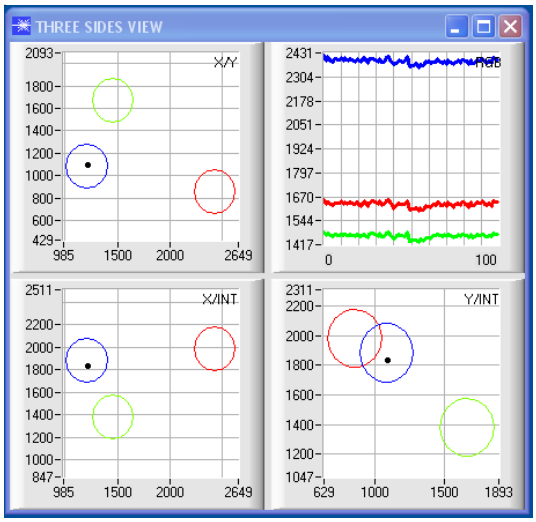
X/Y or s/i :
Display of the color triangle as well as of the X/Y or s/i coordinates of the currently determined color

INT or M:
The currently determined intensity INT or M is displayed

X/Y INT or s/i M:
X/Y or s/i pairs are displayed in a zoomed graph. The intensity INT or M with the tolerance window set under No.: is shown directly below.
Two-side view of the color cylinder in space.

X/Y/INT or s/i/M:
A panel opens that shows the taught color spheres and the current color position. For improved representation a three-side view with the graphs X/Y (s/i), X/INT (s/M) and Y/INT (i/M) was chosen.





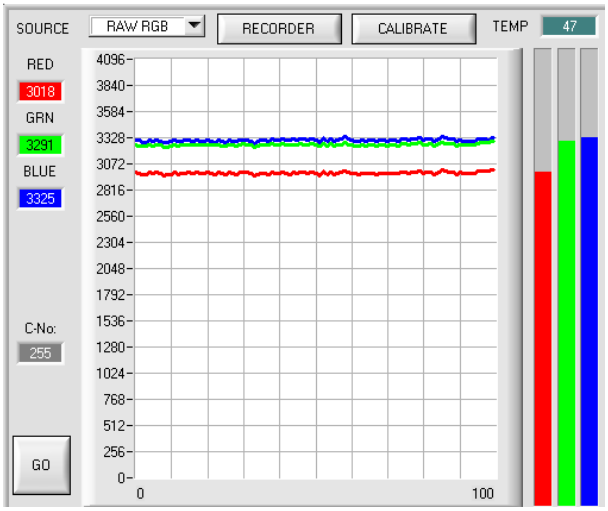
# Parameterization

## SPECTRO3-Scope software as an aid for sensor adjustment:

Prior to the use of the software aids (graphic display of sensor signals) the sensor must be manually adjusted to the respective target or background as accurately as possible. The reference distance of the sensor to the target is defined in the data sheet of the respective sensor.
Fine adjustment of the SPECTRO-3 color sensor is facilitated by the graphic display of the analog. First of all measurement data transfer from the SPECTRO-3 color sensor to the PC must be activated by clicking on the GO button.


**SOURCE RAW:**
For this purpose the option RAW must be selected in the SOURCE selection field. With this setting the analog channels measured at the receiver unit are represented in the graphic display window.


**GO:**
Activation of measurement data transfer between PC and sensor. The current measured values are shown in the graphic display window in "scroll mode".



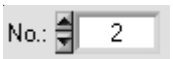

## SPECTRO3-Scope software as an aid for teach-in:

The SPECTRO-3 color sensor is able to learn up to 31 different colors in the COLOR TEACH TABLE, either automatically or by manual parameter input. Actual parameterization can be started when the target has been positioned at the reference distance and the intensity lies in the dynamic range (INT > INTLIM) (if necessary, readjust POWER). In the color triangle the currently measured color is represented by a (X,Y) value pair.
The RED content of the currently measured color corresponds with the X coordinate, the GREEN content corresponds with the Y coordinate in the color triangle. The BLUE content in the color triangle is proportional to the distance of the (X,Y) value pair from the hypotenuse.

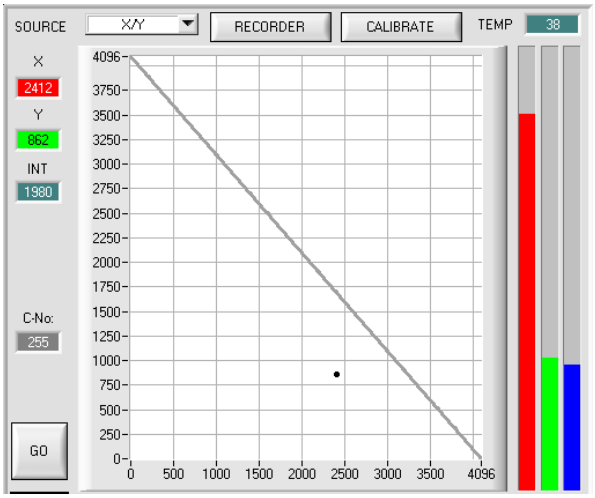

**TRIGGER:**
First the trigger mode should be set to CONT, which means that color detection is continuously active, also without external triggering.
With a click on the SEND button this setting is activated at the color sensor.


**SOURCE:**
When this option is selected, the color triangle is shown in the graphic display window.


**GO:**
After a click on the GO button measured values are transferred from the color sensor to the PC and displayed as (X,Y) value pairs in the color triangle.




**No.:**
Now the number of the current teach-in color (0 ... 30), in the row of which the current teach-in values should be entered, can be selected.





With a click on the TEACH DATA TO button the current measured values are entered as teach-in values in the previously selected row of the COLOR TEACH TABLE.
After automatic TEACH-IN the tolerance circle around the teach-in color should first be slightly corrected, i.e. increased, by entering CTO (depending on the scatter of the measured value).
The position (push button APPLY FROM ALL pressed) of the taught tolerance circles around the respective teach-color in the color triangle determines the possible choice of the tolerance circles (radius=CTO). They should be chosen so, that they don't overlap each other.

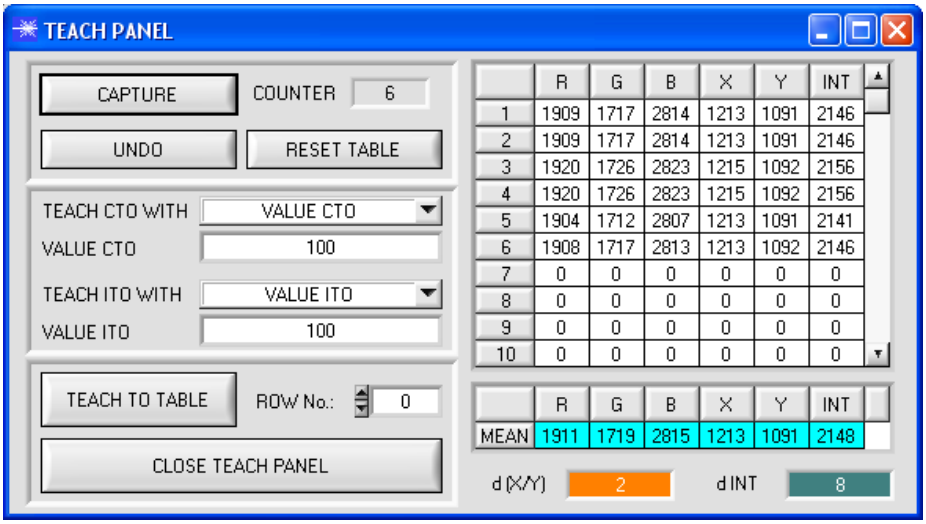
## Parameterization

### Function of the TEACH PANELS (TEACH MEAN VALUES):

TEACH MEAN VALUES

**TEACH MEAN VALUES:**
The Teach Panel can be used in every EVALUATION and CALCULATION MODE.
The explanation herein uses the EVALUATION MODE=BEST HIT and the CALCULATION MODE=X/Y INT.

The following panel will be displayed after a click on TEACH MEAN VALUES:

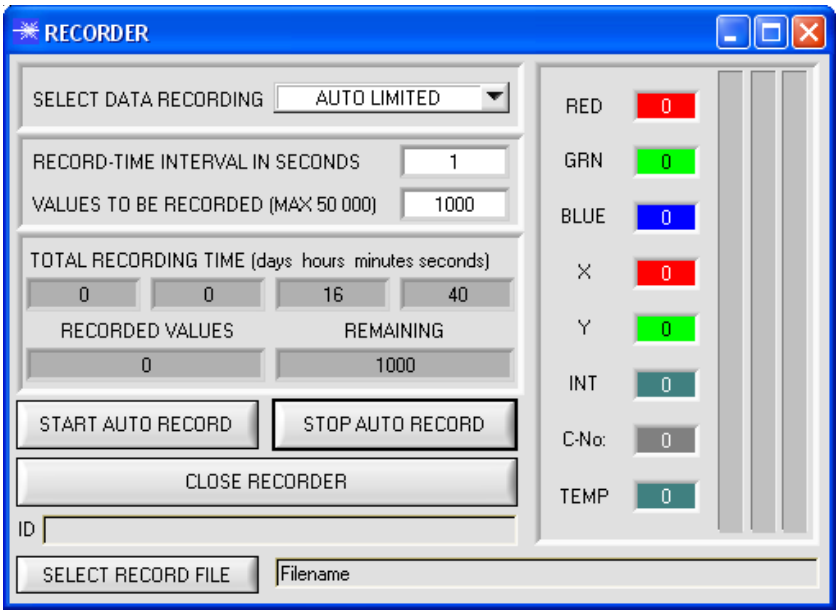



The main panel remains active, and data are automatically picked up from the sensor and are displayed.
A click on the CAPTURE button enters a parameter frame in the table.
The COUNTER display field shown how many frames have already been recorded.
The last frames that were entered in the table can be deleted again by pressing UNDO.
RESET TABLE sets the whole table back to 0.
After every activation of CAPTURE, UNDO, or RESET TABLE, the mean values for the individual parameters are calculated automatically and are displayed in the mean value table.
Furthermore, a maximum color deviation d(X/Y) and a maximum intensity deviation dINT for the average values will be formed.

When the TEACH TO TABLE button is pressed, the respective mean values are taught to the row in the COLOR TEACH TABLE that is selected under ROW No.:.
Teaching of the circular tolerance and of the intensity tolerance can be set by way of TEACH CTO WITH and TEACH ITO WITH, respectively.
- If the setting is VALUE CTO, the value that is set under VALUE CTO will be taught (ditto intensity).
- If the setting is d(X/Y), the value that is determined under d(X/Y) will be taught (ditto intensity).
- If the setting is d(X/Y) + VALUE CTO, the value that is determined under d(X/Y) + VALUE CTO will be taught (ditto intensity).
- With NO CHANGE, the value that is set in the COLOR TEACH TABLE will remain unchanged.

A click on the CLOSE TEACH PANEL button will take you back to the main panel.

### Function of the RECORDER:




The SPECTRO3-Scope software features a data recorder that allows the saving of RED, GREEN, BLUE, X, Y, INT, C-No: and TEMP. The recorded file is saved to the hard disk of the PC and can then be evaluated with a spreadsheet program.

The file that is created has eight columns and as many rows as data frames were recorded.
A row is structured as follows:
Date and time, RED, GREEN, BLUE, X, Y, C-No:, INT, TEMP.