Software manual

CR-Tool

Version 2.4

For use with CROMLAVIEW® Color Sensor Series

Firmware Version V2.1 and above

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.

CR-Tool - Software manual V2.4

Revision history

Manual Version	Date	Changes
2.4	23.09.20	Introduction demo-mode and pattern-teach, addendum tolerance optimization
2.3	11.06.18	Assignment of color table entry and color diagram by flashing
2.2	04.02.15	New design
2.1	10.01.14	Fig. 2 and Fig. 12 changed; Button "Import table" added Fig "Outputcoding in Deviation Mode" added; Table of Deviation Mode moved; smaller changes; error in scan frequencies corrected
1.9	09.01.13	In chapter Sensor Service description of Color Object Type is extended
1.8	02.03.13	Description of the button "Color object type" changed, Types "Passive – Sync" and "Active – Sync" added
1.7	02.11.11	Fig. 16 replaced, Description of button "Fieldbus" added
1.6	22.06.11	Description of button "COM Port" changed
1.5	06.06.11	Firmware Version added; Fig. 16 replaced; Button "Tolerances for external Teach" added
1.4	21.02.11	Fig. 12 replaced
1.3	13.08.10	Color object type "Passive – HP" added; Fig. 10 replaced; Fig. 11 replaced
1.2	19.07.10	Created

ASTECH GmbH, Schonenfahrerstr. 5, D-18057 Rostock

Internet www.astech.de E-Mail info@astech.de

Telefon +49 (0)381 / 44073-0 Telefax +49 (0)381 / 44073-20

I. Content

II. List of figures

III. List of tables

1 Software "CR-Tool"

Color sensors of the CR-Series can be configured extensively. This allows an easy adjustment for diverse applications. The Software CR-Tool serves as a tool for adjusting and parameterizing the sensors.

If the software is connected to the sensor, the key operation is deactivated. This is signalized by lighting "T-In" and "Sig." simultaneously.

1.1 Software installation

For installing the software please execute the file “SETUP.EXE”. The “SETUP.EXE” file is located on the software CD at the directory [CD DRIVE]:\CR-Tool\English\...

After starting the “SETUP.EXE” several windows will appear. Please follow the corresponding instructions.

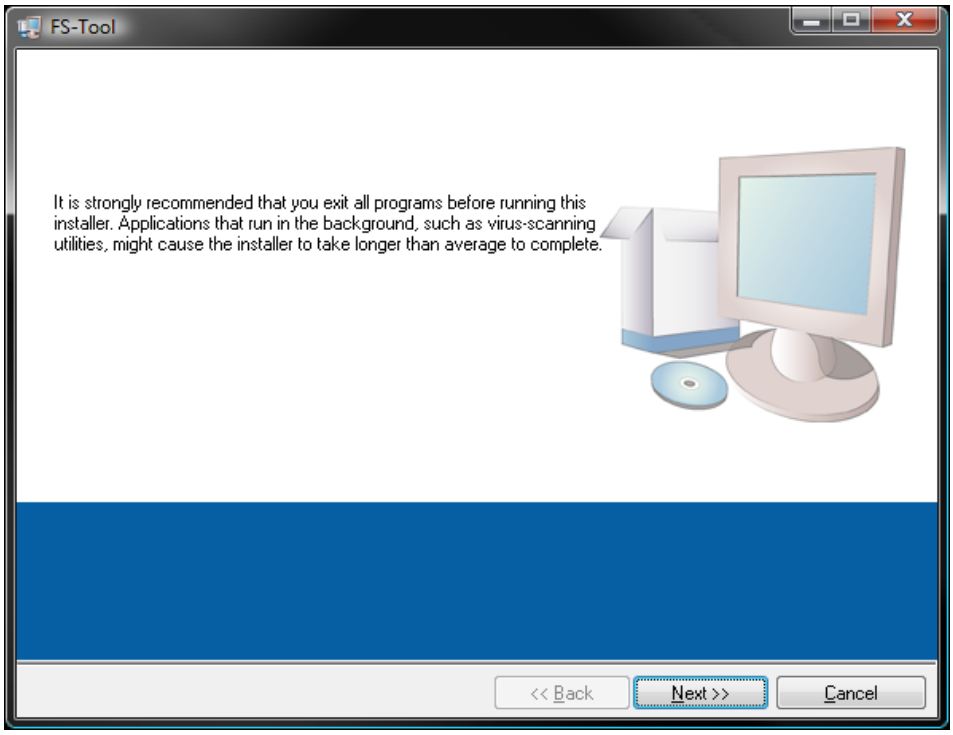


Figure 1 : Installer window

Please make sure that for operating the software the following requirements are fulfilled

- Windows® OS from version 10
- 250 MB free hard disc space
- CD-ROM drive
- VGA graphic with minimum resolution 1024x768
- Mouse for operation

1.2 Program start

The connection of the sensors to the PC depending on the type can be done via the serial interface (RS232) or the USB interface. Right after the program start, the corresponding interface can be chosen (cf.Figure 2).

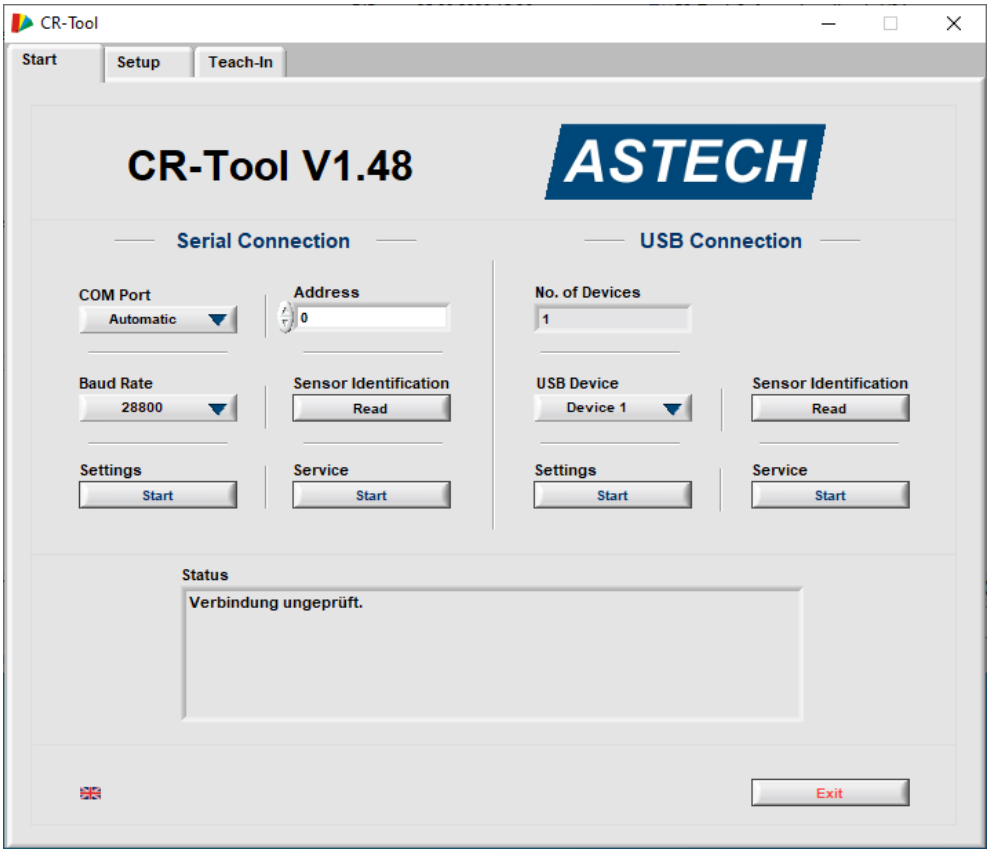
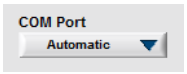
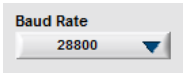


Figure 2 : Start tab window

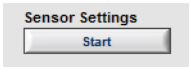
The functions of the buttons and displays are described in the following.



"**Automatic**":
The available COM ports will be scanned for sensors (Baud Rate must be known)
"**COM 1**"... :
Direct selection of available COM port
See also note on page 7



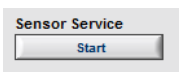
Adjustment of Baud Rate.
Range 9600…115200



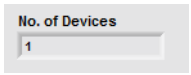
Starts the sensor setup and Teach-In.

A unique address can be adjusted if several sensors are connected to the PC via the serial interface (RS232) (see "Sensor Address" below at section "Sensor Service"-program).

Reads the Identification number of the sensor

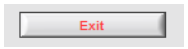


Starts the subprogram "Sensor Service" For details see section 1.5 (p. 26)



Shows the number of sensors connected to the USB port.

Selection of the USB device.



Exit program.

Switch for program language selection. German and English is available. The second selection of languages marked with a "D" (for demo mode) enables the program to be used without connecting a sensor. This means that the setup and teach-in side of the program can also be accessed without a sensor. Parameters can be changed and the effect on recorded dynamic sensor values can be observed. Only the service area can only be viewed.

Note:

The communication port is configured by factory as follows:

- Baud-Rate: 28800
- Data bits: 8
- Parity: no
- Stop bits: 1
- Flow control: none

1.3 Sensor-Setup

After starting the software the "Setup" tab window appears (Figure 3).

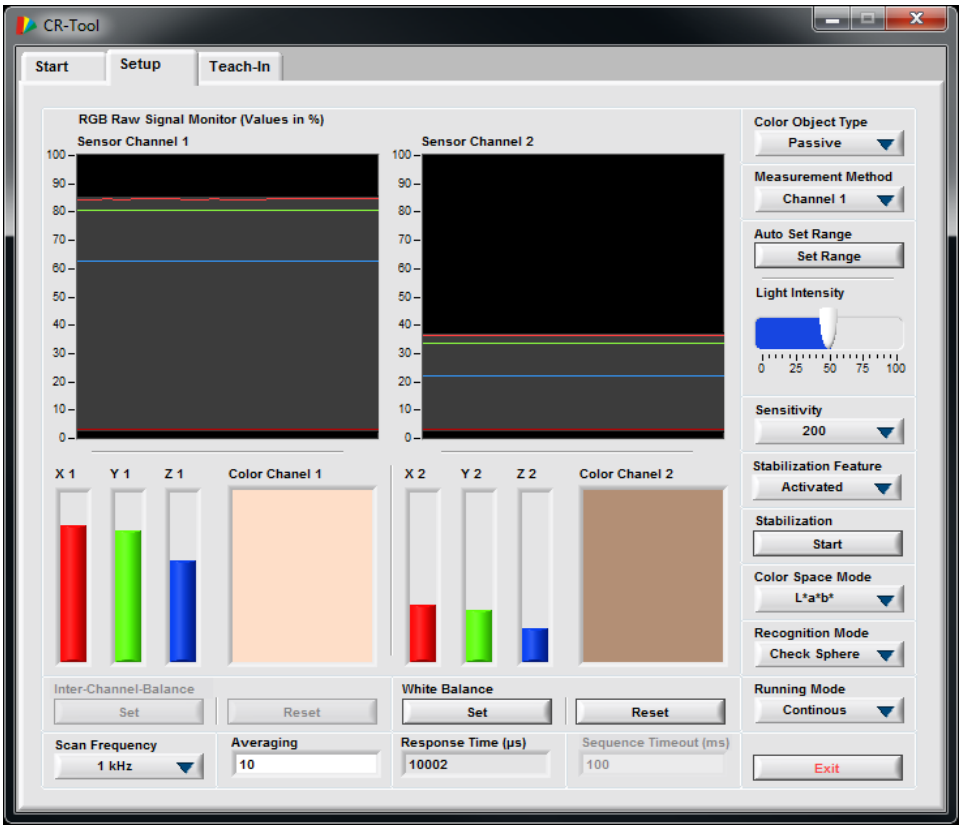
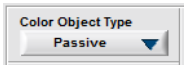


Figure 3 : Parameter setup tab

The displayed parameters are read out of the memory of the color sensor. The function of the buttons and displays are described in the following.

Depending on the connected sensor type not all functions are available.

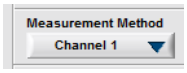


"Active":
Setting for self-shining objects (internal light source off)
"Passive":
Setting for non-self-shining objects (internal light source on)
"Passive-HP":
Setting for non-self-shining objects (internal light source works with higher intensity)
"Passive-Sync":
Setting for non-self-shining objects (internal light source is on, measuring starts with external trigger, positive-going edge)
"Active-Sync":
Setting for self-shining objects (internal light source is off, measuring starts with external trigger, positive-going edge)

Using "Passive- HP" increases the working temperature of the sensor. Pay attention to an adequate heat sink.

In modes "Passive-Sync" and "Active-Sync" button readout depends on the trigger frequency.

Trigger frequency must not exceed the adjusted scan frequency.

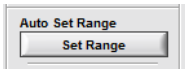


"Difference":
Calculates the difference between Channel 1 and 2 for further processing (DIFFERENCE = CHANNEL 1 – CHANNEL 2)

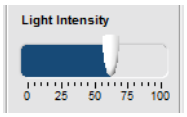
"Channel 1":
Measurement via Channel 1. Using this method all color output channels are available. Furthermore the stabilization feature of the sensor for drift compensation (temperature/aging) can be used.

"Channel 1+2":
Both channels are working independently. Per channel only half of the outputs are available. The stabilization feature of the sensor is not available.

See also note: 1)

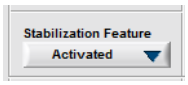


Sensitivity and Illumination intensity are adjusted automatically. Thereby the signals range is set to approx. 70% (default).
See also note: 1), 3)

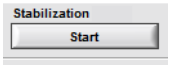


Manual setting of illumination intensity

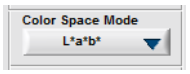
Manual setting of sensitivity
(1, 4, 20, 40, 80, 200, 400, 800)



Activates or deactivates the online stabilization feature for color values against temperature and long-term drift for the "Channel 1" mode.



Starts the stabilization feature of the sensor (only applicable for measurement method "Channel 1" and with activated stabilization feature). For starting the stabilization process the signals of channel 2 (now stabilization channel) must be within a proper range (approx. 30-90%).

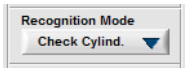


"XYZ":
Color processing by XYZ (red, green, blue). Applicable for self-shining or non-self-shining objects.

"xyY":
Color processing by xyY (red fraction, green fraction, lightness). Applicable for self-shining or non-self-shining objects.

"u'v'L*":
Color processing by u'v'L* (red fraction, green fraction, lightness). Uniform color space processing for self-shining objects.

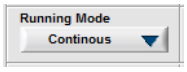
"L*a*b*":
Color processing by L*a*b* (lightness, red-green axis, blue-yellow axis). Uniform color space processing for non-self-shining objects.



"Min. Distance":
The color of the color table with minimum distance to the current measurement value will be detected and outputted.

"Check Sphere"
Color recognition using spherical tolerance settings. Is the current measurement value located within the adjusted tolerance, the corresponding color of the color table will be outputted.

"Check Cylind.":
Color recognition using cylindrical tolerance settings. For lightness and chromaticity separate tolerance adjustments can be done. Is the current measurement value located within the adjusted tolerance, the corresponding color of the color table will be outputted. This Method is not applicable in "XYZ" color space because no separated lightness value is available.
See also note: Figure 4, Figure 5, Figure 6, Table 1, Table 2



"Continuous":
The sensor refreshes its outputs continuously.

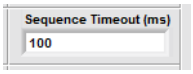
"Extern Trig.":
The sensor refreshes its outputs by an external trigger impulse at TRG 0.

"Trig. Sequ.":
The sensor processes a color sequence according to the color table. Every recognition must be triggered externally (TRG 0).

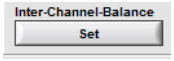
"Ext. Teach":
On every trigger signal at trigger input 0 a color sample is stored into the color table. The behavior (overwrite/append) can be set using the subprogram "Sensor Service".

"Self Trig. Sequ.":
The sensor processes a color sequence according to the color table. The sequence starts with the recognition of the first color entry of the table. Any further recognition requires the recognition of its predecessor. This method is only applicable in the "Check Sphere" or "Check Cylind." recognition modes.
See also note 8)

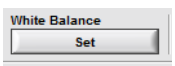
"Ext. Teach & Trig.":
Combines the functions "Extern Trig." and "Ext. Teach".



Sets the time out for the sequence modes.

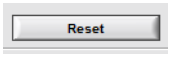


Calls a subprogram for balancing the measurement channels. An inter-channel balance is useful for the “Difference” measurement method to obtain a signal difference of 0 for identical colors.
See section "Inter-channel balance" on page 15
See also note 9)

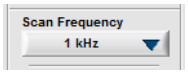


Calls a subprogram for performing a white balance of the measurement channels. This function is optional and has no influence on the recognition quality of the sensor. The function serves for an improved color view on a PC monitor.

See section "White balance" on page 16.
See also note 10)

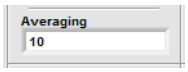


Press the "Reset" button to undo the channel balance.



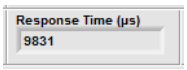
Setting of desired scan frequency (Measurement rate). Range 0.1 kHz ... 10 kHz

See also note 6)



Setting of desired Averaging (Range 1 ...65535)

See also note 7)



Shows the actual resulting response time of the sensor

Notes:

1) At measurement method "Channel 1" the Channel 2 serves for stabilization of the signals of channel 1. This is why channel 2 is not available. To use the stabilization feature the switch "Stabilization Feature" located within the Tab "Setup" must be set to "Activated".
2) To apply the function "Auto Set Range" reasonably, make sure that the sensor system is in its working position. Use a white object for setting the signal range or use the brightest one among the object to recognize. This avoids clipping of the signal at the working phase.
3) At mode "Channel 1" only channel 1 is used for the automatic signal range setting.
4) Due to the limited precision of the sensor hardware and the utilization of a non-standard illumination (white-light LED) the measured color values are not colorimetrically accurate!
5) The ranges of the color values used in this program partly differ from the commonly used color value ranges. Table 1 shows the corresponding ranges in comparison.
6) Due to hardware caused limitations for larger sensitivity settings not all frequencies are available. A smaller frequency reduces the power dissipation. But for a good ambient light suppression a frequency above 1 kHz is recommended.
7) Choose a large averaging if the signal quality is poor. But note that the response time rises for large averaging values (Table 4). By using the value of 0, measuring rate is doubled. Thus, measuring rates of 20 kHz respectively response times of 50 µs can be obtained with a scan frequency of 10 kHz.
8) The encoding of the states in the sequence modes shows Table 3. The result of the color sequence recognition will be processed similar to the result of single color recognition and encoded according to the adjusted result format.
9) The inter-channel balance only affects the processed signals. Therefor no changes will be seen for the raw signals.
10) If the signal settings change the white balance should be performed again (e.g. sensitivity, illumination intensity).

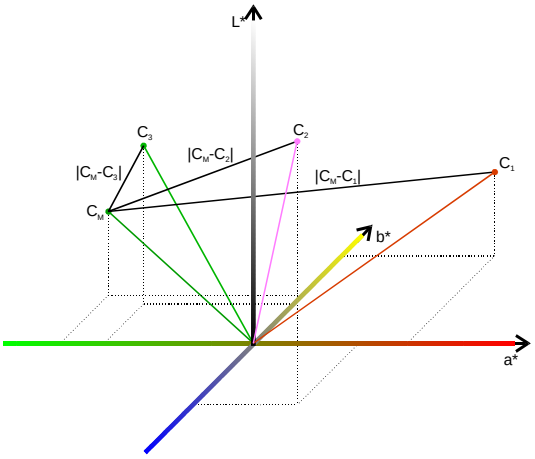


Figure 4 : Diagram for explaining the recognition mode "Min. Distance"

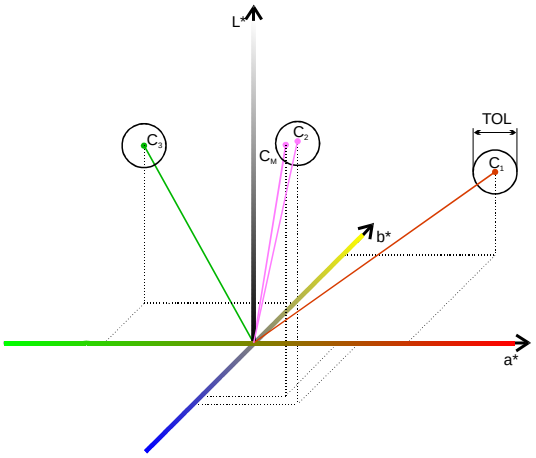


Figure 5 : Diagram for explaining the recognition mode "Check Sphere"

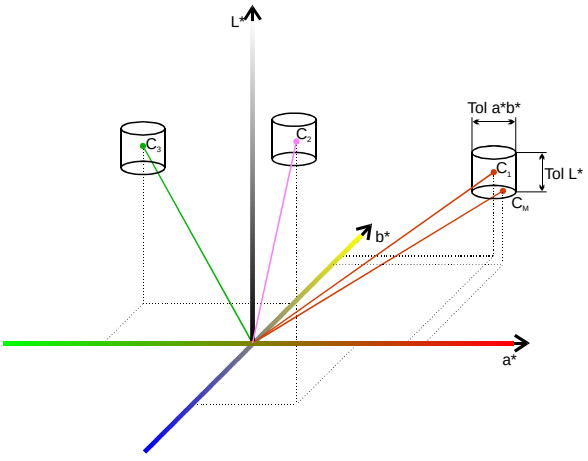


Figure 6 : Diagram for explaining the recognition mode "Check Cylind."

Table 1 : Used ranges in this program

Color space	Common range	Range in this program
XYZ	X: 0…100	X: 0…100
	Y: 0…100	Y: 0…100
	Z: 0…100	Z: 0…100
xyY	x: 0…1	x: 0…100
	y: 0…1	y: 0…100
	Y: 0…100	Y: 0…100
u'v'L*	L*: 0…100	L*: 0…100
	u': 0…1	u': 0…100
	v': 0…1	v': 0…100
L*a*b*	L*: 0…100	L*: 0…100
	a*: -500…+500	a*: -500…+500
	b*: -200…+200	b*: -200…+200
xyl	x: 0…1	x: 0…100
	y: 0…1	y: 0…100
	I: 0…100	I: 0…100

Table 2 : Explanation for the color recognition modes

"Recognition mode"	Explanation
"Min. Distance"	The current measured color value is being assigned to the closest color value of the color table. The assignment is always done independently if the color matches or not. Figure 4 shows the assignment of the current measured color value C_M to the stored color C_3 because the distance $/C_M\text{-}C_3/$ is minimal.
"Check Sphere"	In this mode the sensor checks if the measured color is within a spherical tolerance space. If the measured color is within the tolerance, the check is successful (color recognized), otherwise the check was unsuccessful (color not recognized). Figure 5 shows spherical tolerances and a measured color C_M that is within the tolerance C_3 and hence was recognized as the color C_3.
"Check Cylind."	In this mode the sensor checks if the measured color is within a cylindrical tolerance space. Tolerance parameters can be configured separately for color and brightness. The recognition principle is shown in Figure 6. Two tolerance parameters (color and brightness tolerance) are necessary.

Table 3 : Sequence encoding

State	Description
OFF	Waiting for start
1	Sequence active
2	Sequence finished successfully
3	Wrong color detected
4	Trigger timeout (self-triggered sequence)

Table 4 : Response times for different frequency and averaging settings

Frequency	Averaging	Response time
1 kHz	1	1 ms
10 kHz	10	1 ms
1 kHz	100	100 ms
10 kHz	10000	1000 ms

Signal displays

The life values of the measured color values are displayed at the “RGB Raw Signal Monitor” as raw values (Figure 7).

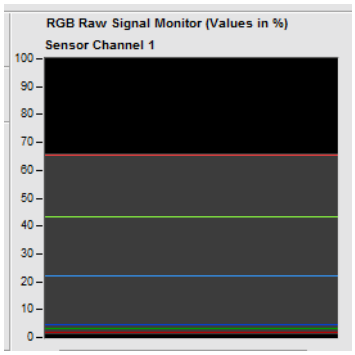


Figure 7 : RGB Raw signal monitor

The lines at the monitor have the following meaning (Table 5).

Table 5 : Signal meaning of the signal monitor diagram

Line color	Meaning
light red (above)	Raw data of the red signal (bright phase)
light green (above)	Raw data of the green signal (bright phase)
light blue (above)	Raw data of the blue signal (bright phase)
dark red (below)	Raw data of the red signal (dark phase)
dark green (below)	Raw data of the green signal (dark phase)
dark blue (below)	Raw data of the blue signal (dark phase)

Out of the light and dark values the difference will be calculated. In this way an ambient light suppression will be performed. The gray region in the monitor depicts the signal deviation.

The color bars red, green and blue, displayed below the sensor signal monitors show ambient light compensated color signals (Figure 8). In the self-shining mode the signals are identical to the signals in the bright phase. On the right-hand side of the bars a color window is displayed that is being continuously calculated from the actual three color signals.

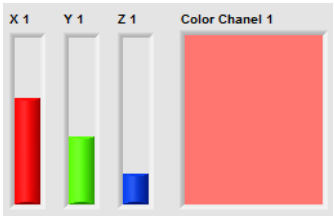


Figure 8 : Beam- and color-display

Notes:

1) The signal data from the dark phase are zero in the self-shining mode and thus not visible. If the signal data from the dark phase of body colors (passive mode) are very small, they are also not visible. Moreover, the signal amplitudes from the bright and dark phase can possibly overlap and hence only one color is able to be seen at the same time.

2) The color windows on the right-hand side of the three color bars display a color which is similar to the measured object after setting a good reference white. However, the color can be incorrect and not 100% identical and shall merely serve as orientation, e.g. during the color sampling process (“Teach-in”) or when displaying tolerance boundaries in color diagrams.

Inter-channel balance

Press the “Set” button at the “Setup” tab window (see above) to balance the signal differences between the two measurement channels. A new subprogram window appears to perform the balance procedure (Figure 9).

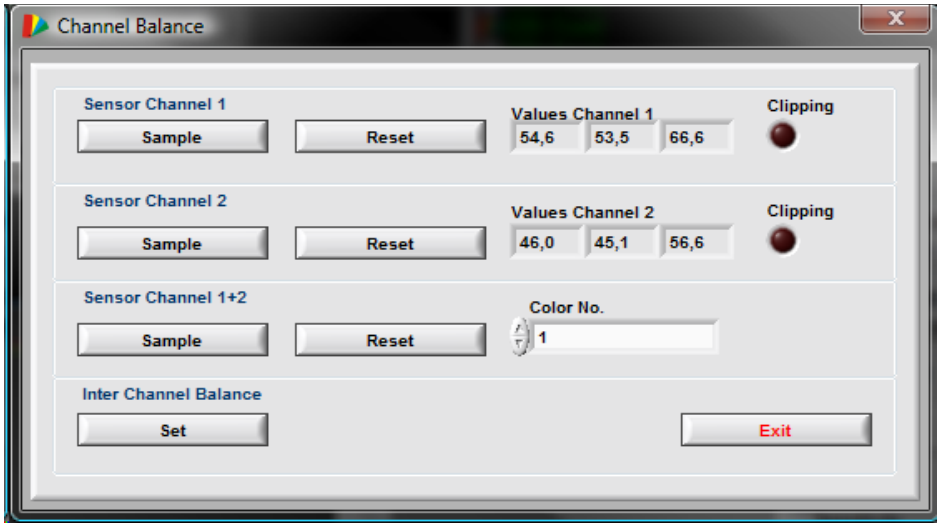
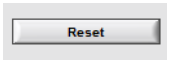


Figure 9 : Inter-channel balance window

The buttons and displays have the following meanings.

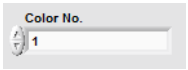
By pressing the corresponding “Sample” button measurement values of the respective channels are captured. By (arbitrary) multiple pressing of the “Sample” button additional values are captured for averaging.

See also note: 1)



The respective "Reset" button delete the current captured color values

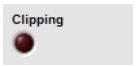
Use this button to capture color values of both channels synchronously



The balance can be performed by multiple colors. The alteration between colors can be done via the "Color No." input field.

By pressing the "Set" button the balance will be performed and the window will be closed.

Displays the captured values.



Indicates a signal clipping.

Note:

1) Before starting the balance procedure make sure that a good signal modulation (70% to 90%)will be reached at the brightest color object.

White balance

By means of the “White Balance” program (Figure 10) the raw values of the sensor can be referenced to desired white values. By the white balance the color display on the PC monitor gets similar to the measured color. For the white balance, a white object should be used and the signal modulation should be large enough (e.g. 90%)

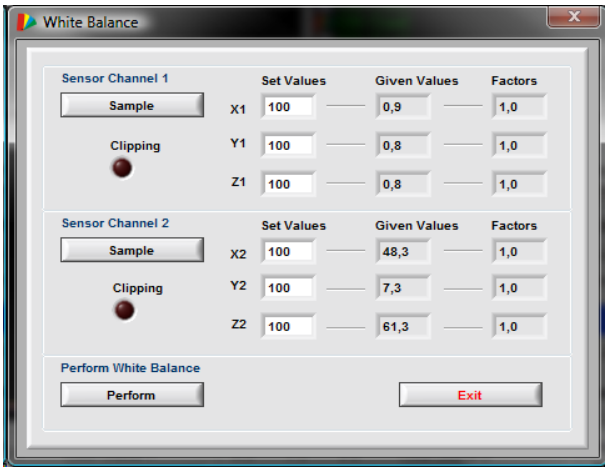
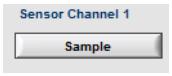


Figure 10 : White balance window

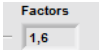
The switches and displays have the following meaning.



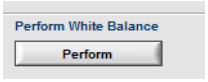
By pressing the button "Sample" measurement values of the corresponding channel are captured. By (arbitrary) multiple pressings, additional values are captured and averaged.

Respective set values (X, Y, Z) for white.

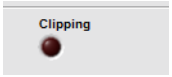
Given values



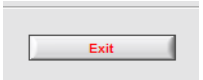
Display of balance factors.



Performs the white balance and closes the window.



Indicates a clipping of the sensor signals.



Exit of program without performing the white balance.

1.4 Teach-In

The teaching of color values and setting of tolerance values can be done at the tab „Teach-In“. Furthermore the recognition results will be displayed. Figure 11 shows the window.

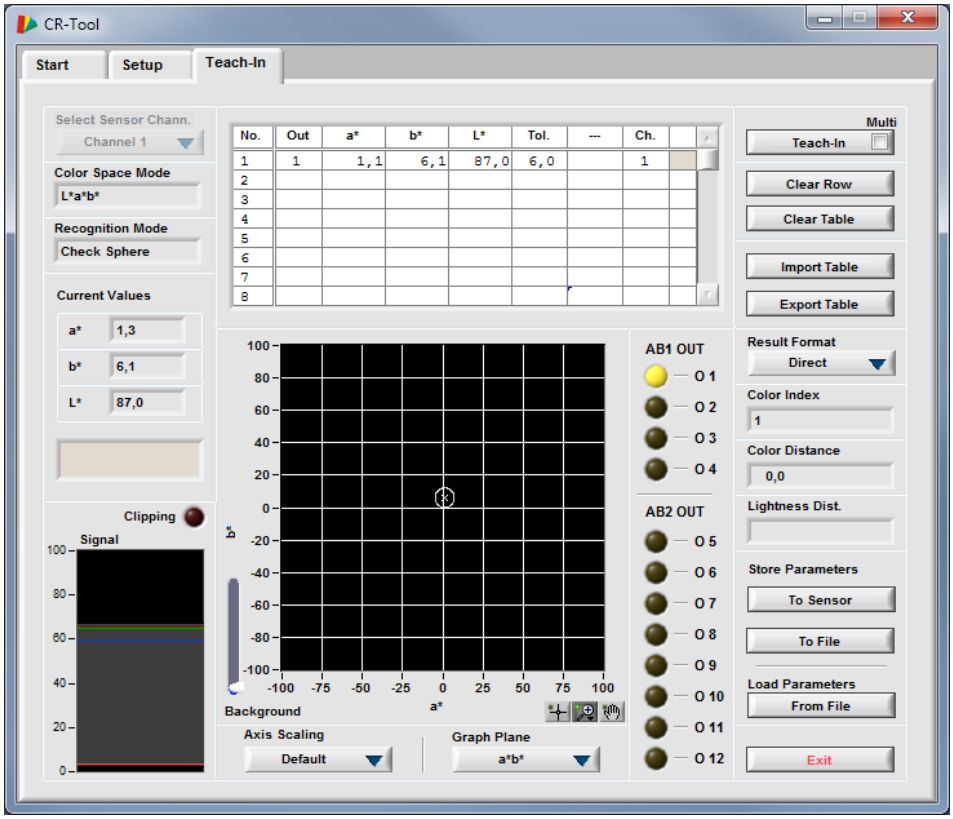
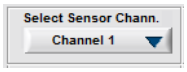
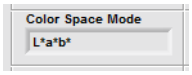


Figure 11 : Teach-In window for teaching colors and displaying recognition results

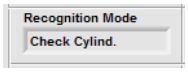
Switches and displays



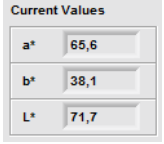
Selection of corresponding sensor measurement channel for teaching. This switch is only available in 2-channel operation.



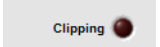
Shows the current color space mode.



Shows the current recognition mode.

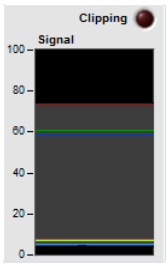


Shows the current measurement values.



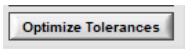
Indicates a signal clipping of the sensor

Display of color value as visible color (a white balance is required for a good display).

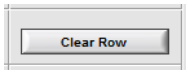


Shows the raw color values in a graph display.

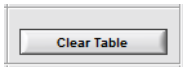
Stores the current color values into the next free row of the color table. For overwriting a row of the color table the PC cursor must be set into the corresponding row. Then press the button "Teach-In" again
For the 2-channel modes the PC cursor must always be set into the corresponding row.
By activation the "Multi" checkbox a new program window appears for a multiple Teach-In (see section Multiple Teach-In on page 21).
By activation the "PT" checkbox a new program window appears for a Pattern-Teach-In (see section Teach-In with good and bad samples on page 21).



Opens a window to start a tolerance optimization process (see section Tolerance optimization on page 23)



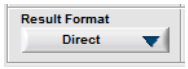
Clears all color values of one row that has been selected by a mouse click. The remaining data rows move up.



Clears all entries in the color table.

Import: Loads color table values from a saved spreadsheet file. The selected color space mode of the sensor has to match the saved color values in the file

Export: Stores the current contents of the color table into a comma separated spreadsheet file (.csv) onto the disk of the PC



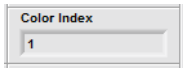
"Direct":
To every entry of the color table a separate output of the sensor can be assigned.

"**Direct inv.**":
Like "Direct", but inverted outputs.

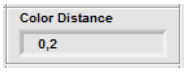
"**Binary**":
The color numbers are outputted binary encoded.

"**Binary inv.**":
Like "Binary", but inverted outputs.

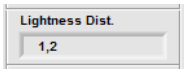
"**Deviation**":
Deviation from a color value is signaled component-by-component at the outputs. Lab color space and cylinder tolerance is used.



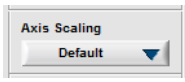
Indicates the color number of the recognized color. The index represents the result of the entire sensor system's signal processing path. This number is the equivalent of the row number in the color table. If in the checking modes the tolerance boundaries are exceeded, the color number becomes 0. In addition the result is also available at the sensor system's communication interface.



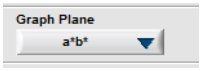
The distance between the current measured color and the recognized color value is displayed. If the cylindrical tolerance mode is selected the distance becomes a 2-dimensional. All other processing modes show a 3-dimensional distance. If in the recognition modes "Check Cylind" or "Check Sphere" the tolerance was exceeded or the color was not recognized (Index 0), the distance to the next closest color is calculated and shown in the field "Color Dist.".



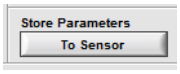
Shows the value of the brightness distance in the "Check Cynlind." recognition mode



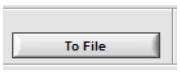
"**Manual**":
Allows manually editing of the diagram axes (by marking and editing the numbers on the axes.
"**Default**":
Resets the axes to default vales
"**Auto**":
Activates an auto scaling of the axes.



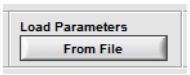
The X and Y axes of the color diagram can be selected in order to display the desired color plane out of all three possible 2-dimensional planes of the 3-dimensional color space. To fit the color diagram scales to the desired range, the axes can be adjusted by editing the numbers on the axes.



Stores all parameters into the built-in nonvolatile Flash-memory of the sensor. The parameters will remain in the Flash-memory after power down.

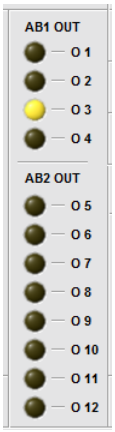


Stores all parameters on a memory drive of a computer that is connected to the sensor system.



Loads a parameter set from a file of the computer into the sensor.

Exit program.



Displays the states of the switching outputs of the sensor

Table 6 : Assignment of switching outputs in Two-Channel mode with CR200

Output	Assignment
OUT1	Channel 1 – Output 1
OUT2	Channel 1 – Output 2
OUT3	Channel 2 – Output 1
OUT4	Channel 2 – Output 2
OUT5	Channel 1 – Output 3
OUT6	Channel 1 – Output 4
OUT7	Channel 1 – Output 5
OUT8	Channel 1 – Output 6
OUT9	Channel 2 – Output 3
OUT10	Channel 2 – Output 4
OUT11	Channel 2 – Output 5
OUT12	Channel 2 – Output 6

Table 7 : Meaning of output signals in "Deviation" mode

Output	Display segment
OUT1	1 = Color recogniced, 0 = Color not recogniced
OUT2	Darker
OUT3	Brighter
OUT4	Deviation to red
OUT5	Deviation to green
OUT6	Deviation to yellow
OUT7	Deviation to blue

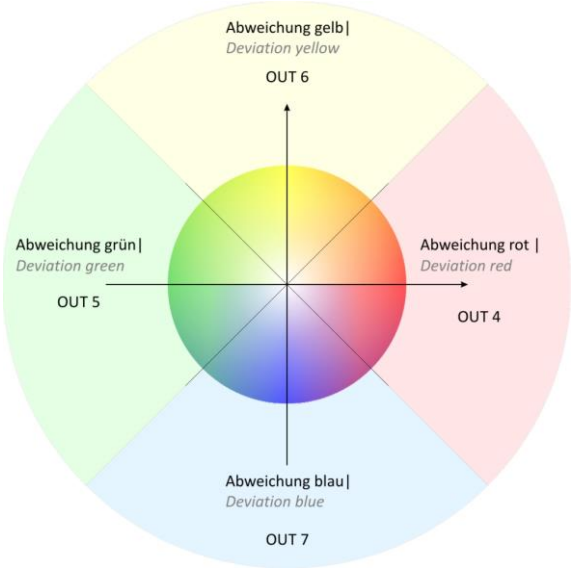


Figure 12 : Output Coding in Deviation Mode for the Tolerance Parameter ab on the outputs OUT4 – OUT7

The evaluation is done in the deviation mode on the color that is stored on table position 1. The deviation from a color value is outputted component-wise at the outputs. The Lab color space and the detection mode cylinder tolerance is used. As long as the color is outputted to OUT1 as recognized, there is no output of the deviation direction. If the tolerance parameter “L” is exceeded outputs OUT2/OUT3 become active. If the tolerance parameter “ab” is exceeded, the result is output to OUT4 - OUT7. If both tolerance parameters are exceeded simultaneously color and brightness deviations are also outputted simultaneously to OUT2 - OUT7.

Multiple Teach-In program window

By means of the "MultiTeach" program, averaged color values and tolerances values can be determined automatically.

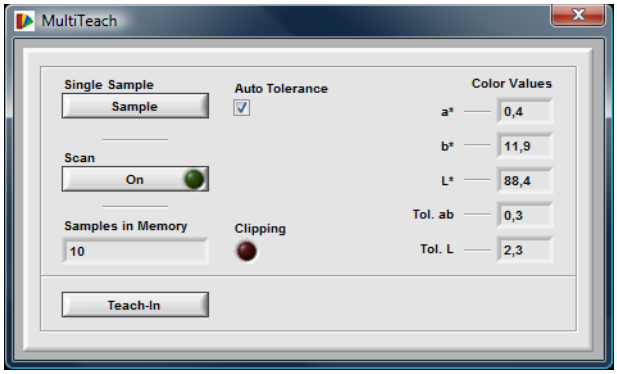
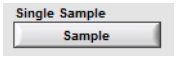
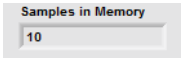


Figure 13 : "MultiTeach" program window



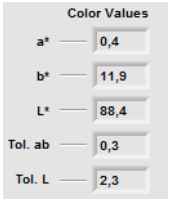
The current color measurement value will be sampled. By multiple pressings additional samples are captured into the memory.

Starts a continuous sampling process. The memory accommodates 10,000 color values in maximum.

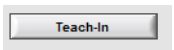


Indicates the number of color values in memory (max. 10,000)

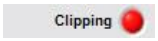
If the checkbox is activated, a tolerance is calculated automatically out of the deviation of the values.



Displays the calculated averaged color values and tolerances (depending on adjusted
color space and recognition mode).



Takes the color and tolerance values over into the color table.



Indicates a clipping of the sensor signals.

Teach-In with good and bad samples

With the help of the **Pattern-Teach** function, the tolerance of the color values can be set using good and bad samples. This makes it easier for the user to choose the correct tolerance parameters. The color values can be edited manually in the table. Since the tolerances are calculated automatically from the distance between the good and bad samples, they cannot be changed in the table. Here only the balance controller can be used globally for all tolerance values.

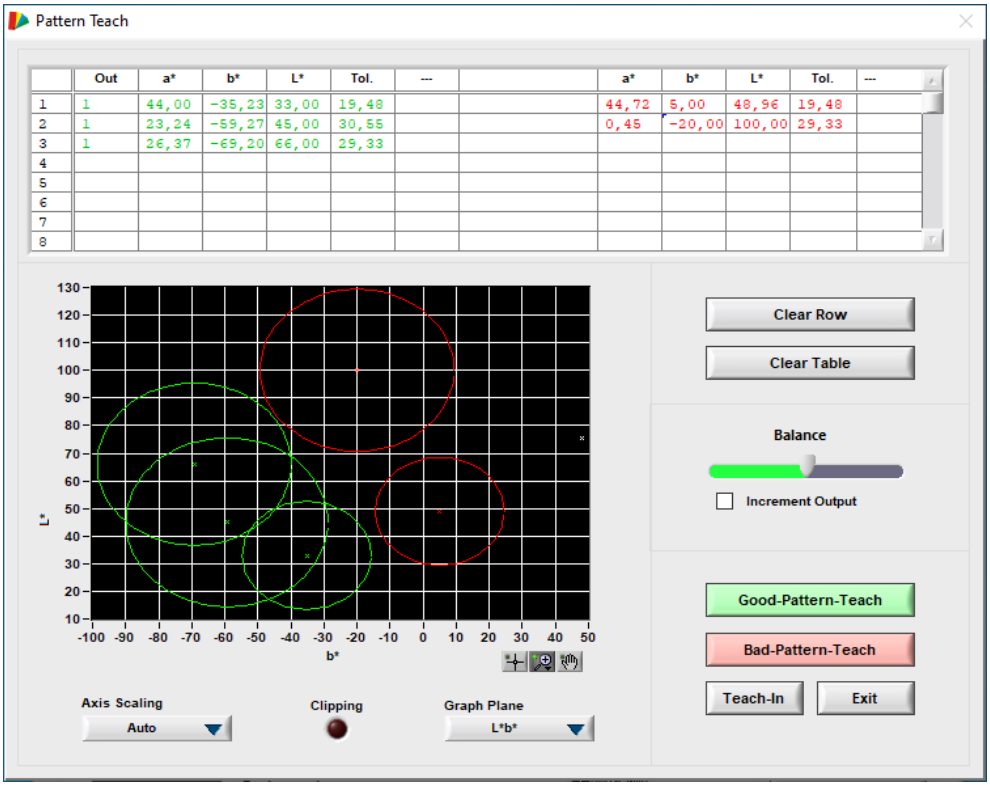
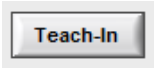


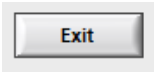
Figure 14: Pattern-Teach-window, good and bad samples are depicted in green and red

The current color measurement value will be stored in to the memory of good samples. By multiple pressings additional samples are captured into the memory.

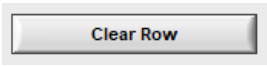
The current color measurement value will be stored in to the memory of bad samples. By multiple pressings additional samples are captured into the memory.



Stores the color- and tolerance values of the good samples in the color table.

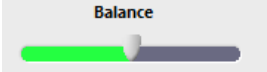


Color values are discarded and it will be returned to the main program.

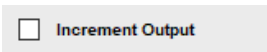


A single line of a good or bad pattern is deleted. The selection is made by clicking in any cell in the diagram that contains a good or bad sample.

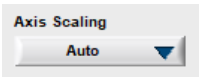
The entire table is deleted.



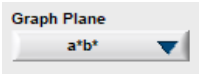
With the balance controller, the tolerance values can be shifted either in favor of the good or bad samples.



Each time a good sample is saved, the associated output is incremented or left constant.



"**Manual**":
Allows manually editing of the diagram axes (by marking and editing the numbers on the axes.
"**Default**":
Resets the axes to default vales
"**Auto**":
Activates an auto scaling of the axes.



Selection switch for switching the coordinate axes of the color diagram. Switching enables the representation of all levels of the 3-dimensional color space. This allows the position of the tolerance spaces and the color values in the color space to be viewed in full.

Displays a clipping of the sensor signal in at least one of the two color sensor channels.

Tolerance optimization

The tolerance optimization eliminates overlapping of tolerance bodies and is designed for both the sphere tolerance and the cylinder tolerance recognition mode. Two different optimization modes have been implemented. Figure 15 shows the mode in which only the existing overlaps are eliminated. The mode from Figure 16, on the other hand, initially enables the tolerance body to be maximized up to a specified maximum. On the one hand, overlaps are avoided, on the other hand, existing overlaps are eliminated. The maximum of the tolerance body size is limited by "*max. Tol. dE*" or the distance between the tolerance bodies.

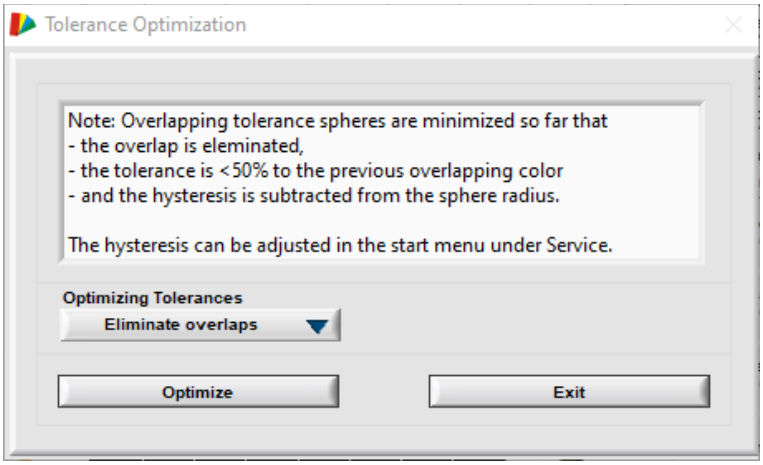


Figure 15: to eliminate overlapping tolerance bodies are minimized

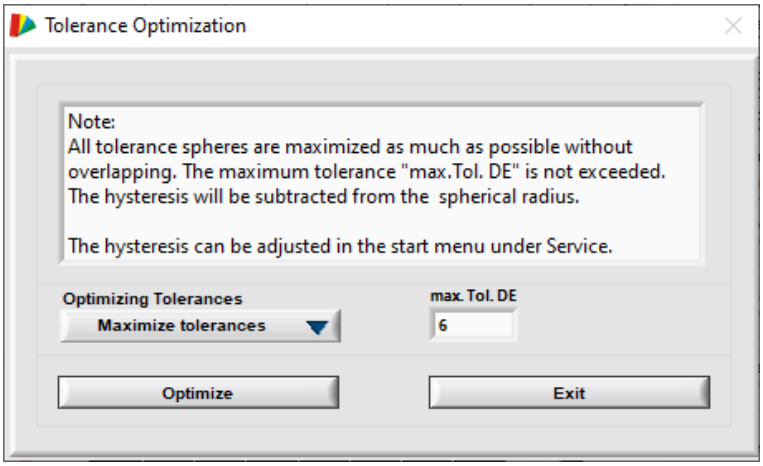
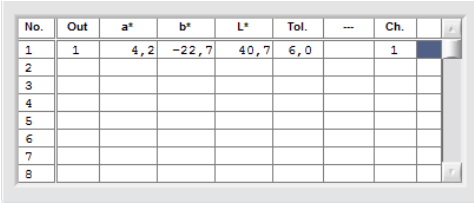


Figure 16: maximization of tolerance

Color table and color diagram

Figure 17 shows the color table



No.	Out	a*	b*	L*	Tol.	---	Ch.	
1	1	4,2	-22,7	40,7	6,0		1	
2								
3								
4								
5								
6								
7								
8								

Figure 17 : Color table

All values stored in the color table (except the row index) can be modified manually. By clicking into a table row the input mode becomes active and numbers can be modified by using the keyboard. By entering the RETURN key or clicking into another area within the program window the modified values will be stored into the color table. There is a scroll bar on the right-hand side at the table for scrolling the table up and down.

Table 8 : Meaning of the color table

Column	Meaning
1	Color index (color number)
2	Sensor output
3	Color component 1 (e.g. a*)
4	Color component 2 (e.g. b*)
5	Color component 3 (e.g. L*)
6	Color tolerance (3D: Tol. / 2D: e.g. Tol. ab) See also note,1) 2), 3)
7	Brightness tolerance e.g. Tol. L See also note 1), 2), 3)
8	Color display

Notes:

1) The tolerance boundaries may overlap. The color recognition is always distinct. The order the colors are stored in the color table does not affect the color recognition in any way.

2) The tolerance parameters are used as ΔE-like units. Table 9 shows how the human color perception commonly recognizes color variations in the L*a*b* color space. Due to the used illumination source (white

LED) and the limited hardware accuracy of the sensor, the table only serves as a clue. Practical tolerance values must be found individually.

3) If the recognition mode "Check Sphere" is selected, the tolerance circles become ellipses in some projection due to different scaling of the diagram axes and are, however, merely a displaying effect.

Table 9 : Common values of human perception of color variations.

Color deviation ΔE	Rating
< 1	Very small color variation that cannot be seed by the human eye
1 ... 2	Small color variation that can be seen by trained human eye
2 ... 3.5	Medium color variation that can be seen by average human eye
3.5 ... 5	Considerable color variation
> 5	High color variation

The used table columns depend on the selected recognition mode and the activated grouping function.

There are no tolerance values needed in the "Min. Distance" The recognition mode "Check Sphere" needs on parameter (radius TOL). The recognition mode "Check Cylind." requires two parameters, color tolerance (column TO ab in Figure 17) and brightness tolerance (column TO L in Figure 17). The latter is favorable in applications where the color brightness variation plays a less important role. If the TO L tolerance is set to a high value the influence of the brightness variation is correspondingly low.

In the right column “GRP” (Figure 17) a group index can be assigned if the grouping feature is activated. The assigned index is encoded according to the adjusted output format (“Result Format”). Equal group index numbers activate the same sensor output. In this way different colors can be assigned to the same output.

The visible colors in the right column of the color table (Figure 17) correspond to the colors of the respective color value. The visible colors in the color table are also used for displaying the tolerance boundaries in the color diagram (Figure 18) and hence support the user at defining the tolerance boundaries in the diagram. Since the colors can be similar and thus difficult to distinguish, there is the possibility to click on the color field in the color table. The corresponding color in the color diagram then flashes for half a second.

The color diagram is located in the lower area of the program window (Figure 18). By moving the slider, the brightness of the background can be infinitely varied to optimally adjust the contrast.

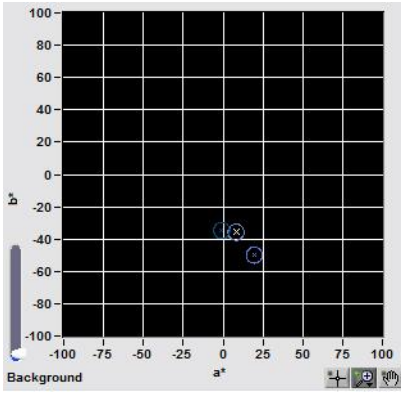


Figure 18 : Color diagram

1.5 Sensor Service

On the “Start” tab a button in the field “Service” is located by which a tool is started, that allows the setting of certain hardware functions. Figure 19 shows the program window.

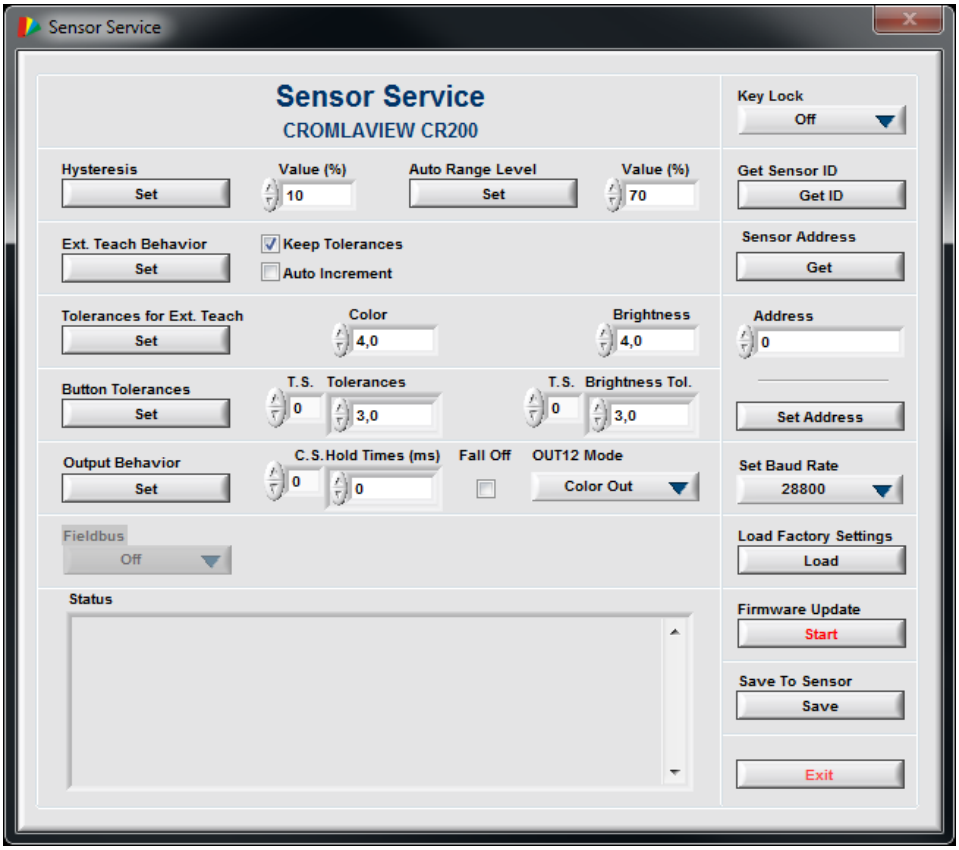
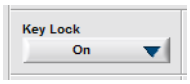


Figure 19 : "Sensor Service" program window

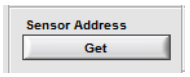
The switches and displays have the following meaning:



"On":
Locking the keys

"Off":
Key lock off.

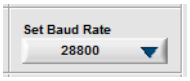
The identification number of the sensor is read from the device and displayed on the textbox.



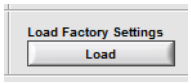
Reads the programmed address of the sensor and displayed on the right textbox. Underneath this switch there is a field to set the particular sensor address (scope: 0…255). With “SET ADDRESS” the sensor is programmed to listen to the chosen address.

Set a separate sensor address (range 0...255).

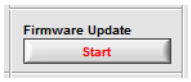
The sensor is set to listen to the chosen address.



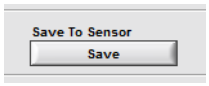
The sensor communication is reconfigured to the chosen baud rate.



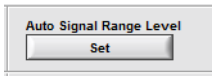
The factory settings are loaded into the RAM of the sensor.



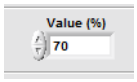
Starts a subroutine for updating the sensor firmware.



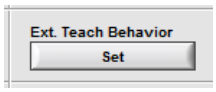
The settings will be stored into the flash memory of the sensor.



Sets the preset value for the "Auto Signal Range level.

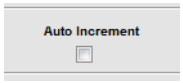


Adjust the preset value for the "Auto Signal Range".

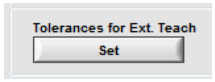


Sets the "Ext. Teach" behavior (see section 1.3).

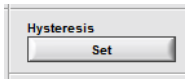
This function is only useful for disabled "Auto Increment". It overwrites the color values and keeps the old tolerance values of the table entry. If this checkbox is disabled, default tolerances are used.



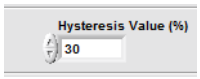
If this checkbox is activated, the new color will be added as new entry of the color table. If disabled, the last row of the color table will be overwritten.



Sets the tolerance values for the external teach as adjusted in the two controls on the right side of this button.

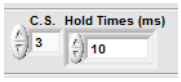


This function guarantees a stable operation of the sensor system. It is recommended to choose a high hysteresis value if the signal quality is poor in order to prevent the signal processing from instability ("flutter").



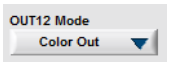
Adjust the value for the desired hysteresis. The values are percentages of the tolerances in the color table

Sets the behavior for the corresponding output.

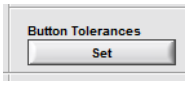


Activates a hold time for the desired sensor output channel. For the running modes "Continuous" und "Ext. teach." the recognition result remains at the outputs for the set hold time. The max. adjustable hold time is 65535 ms. By "C.S." (Channel Selection) the desired sensor output will be selected, for which a hold time has to be set.

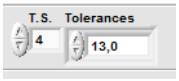
For operation with external trigger the output signals fall back after the expiration of the desired number of milliseconds set by "Hold Times".



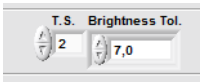
Defines the behavior of the last sensor switching output:
"User Out":
can be set by command 0x73
"CLK Out":
Output of illumination clock
"Color Out":
Output the color output channel



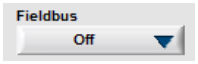
For sensor with adjustable button tolerances the factory presetted tolerance values can be changed. The assignment to the 5 different blinking impulses of the sensor shows Table 10.



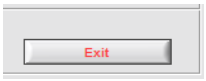
By "T.S." (Tolerance Step) the desired tolerance step can be selected. The tolerance adjustment is done in the right field.



Adjustment for the respective brightness tolerance.



Activates/Deactivates the optional fieldbus-interface.



Exit the program

Table 10 : Assignment of the blinking impulses to the tolerance steps for sensors with buttons

Tolerance Step (T.S.)	Blinking impulses	Factory tolerance value
0	1	3
1	2	6
2	3	9
3	4	15
4	5	20