# Manual

# Software RLS-GD-Scope V1.0

(PC software for Microsoft® Windows® XP, 2000, NT® 4.0, Me, 98, 95)

## for RLS-GD-60 gloss detection sensors

This manual describes the installation of the PC software for the RLS-GD-60 gloss detection sensor. As a support for commissioning of the gloss sensor this manual explains the functional elements of the Windows® user interface.

The RLS-GD-60 sensor can be "taught" up to 31 gloss degrees. It provides 3 different gloss detection modes and 4 contrast detection modes. Evaluation always is performed with 12 bits.
With the help of a modulated white-light LED a white light spot (Ø approx. 15 mm) is projected onto the surface to be inspected by way of an optical transmitter unit at an angle of 60° to the vertical plane.

Part of the light directly reflected by the object to be measured is directed onto a photodiode by means of an optical receiver unit (optical receiver unit also arranged at an angle of 60° to the vertical plane). Furthermore, diffuse reflection is determined by way of two additional optical units (at an angle of 20° and 80°).

Gloss detection either operates continuously or is started by an external SPC trigger signal. The respective detected gloss degree is either provided as a binary code at the 5 digital outputs (OUT0 to OUT4) or can be sent directly to the outputs if only up to 5 gloss degrees are to be detected. At the same time the detected gloss degree is visualised by means of 5 LEDs at the housing of the RLS-GD-60.

With the TEACH button at the sensor housing the sensor can be taught up to 31 gloss degrees. 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 of cable cab-las8/SPS).

Through the RS232 interface parameters and measured values can be exchanged between the PC and the RLS-GD-60 gloss sensor. All the parameters for gloss grade detection can be stored in the non-volatile EEPROM of the RLS-GD-60 gloss sensor. When parameterization is finished the gloss sensor continues to operate with the current parameters in "stand alone" mode without a PC.

**Calibration of RLS-GD-60 gloss sensors with software RLS-GD-CALIB-Scope:**

The sensors of RLS-GD-60 Series can be calibrated by means of separate software RLS-GD-CALIB-Scope. The balance can be done on the NEUTRAL field [Neutral 3.5 [1.05)] CC23 of the ColorChecker™ table (→ separate manual for RLS-GD-CALIB-Scope).

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# 0. Contents



**Shortcuts:**

| | |
|---|---|
| SEND | F9 |
| GET | F10 |
| GO | F11 |
| STOP | F12 |

# 1 Installation of the RLS-GD-Scope software

Hardware requirements for successful installation of the RLS-GD-Scope software:

- IBM PC AT or compatible
- VGA graphics
- Microsoft® Windows® XP, Me, 2000, 98, NT® 4.0 or 95
- Serial RS232 interface at the PC
- Microsoft-compatible mouse
- Cable for the RS232 interface
- CD-ROM drive
- Approx. 5 MByte of free hard disk space

The RLS-GD-Scope software can only be installed under Windows. Windows must therefore be started first, if it is not yet running.

Please install the software as described below:

1. The software can be installed directly from the installation CD-ROM. To install the software, start the SETUP program in the INSTALL folder of the CD-ROM.

2. The installation program displays a dialog and suggests to install the software in the C:\FILENAME directory on the hard disk. You may accept this suggestion with **OK** or [**ENTER**], or you may change the path as desired. Installation is then performed automatically.

3. During the installation process a new program group for the software is created in the Windows Program Manager. In the program group an icon for starting the software is created automatically. When installation is successfully completed the installation program displays "Setup OK".

4. After successful installation the software can be started with a left mouse button double-click on the icon.

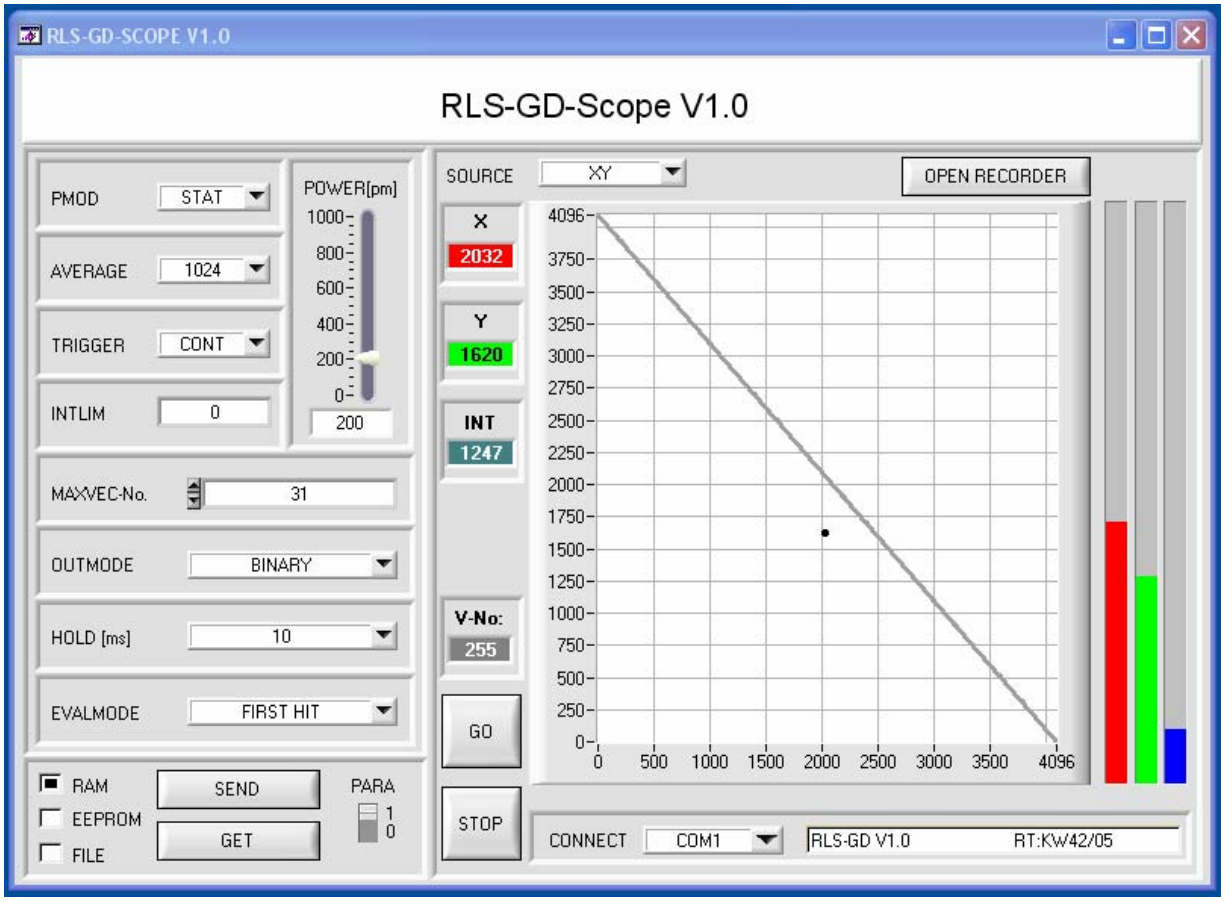
# 2 Installation of the RLS-GD-Scope software

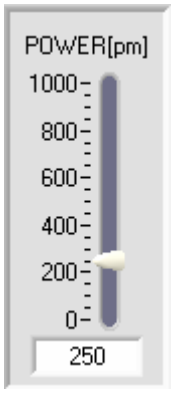
## 2.1 Functions of the individual RLS-GD-Scope control elements

**Please read this chapter first before you start to adjust and parameterise the RLS-GD-60 gloss sensor.**

**Pressing the right mouse button on an individual element will call up a short help text.**
**The function of the OPEN RECORDER button is described in section 2.7.**

When the RLS-GD-Scope software is started, the following window appears on the Windows interface:




POWER:
In this function field the intensity of the transmitter LED can be adjusted by using the slider or by entering a value in the edit box.

A value of 1000‰ [pm] means full intensity at the transmitter LED, a value of 0 stands for the lowest transmitter intensity adjustment!

The POWER slider is only effective in the PMOD STAT.

**ATTENTION!**
**A change of the transmitter power only becomes effective at the RLS-GD-60 gloss sensor after actuation of the SEND button in the MEM function field!**


PMOD:
In this function field the operating mode of automatic power correction at the transmitter unit can be set.

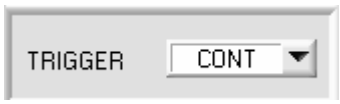
STAT:
The LED transmitter power is constantly kept at the value set with the POWER slider.

DYN:
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 is not exceeded (recommended operating mode).

| **ATTENTION!** | **The setting of the POWER slider has no effect in this operating mode.** |
|---|---|


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 RLS-GD-60 sensor.


TRIGGER:
This function field serves for setting the trigger mode at the RLS-GD-60 sensor.




EXT:
Gloss grade detection is started through the external trigger input (IN0 pin3 green of cable cab-las8/SPS) or through pressing the TEACH button. A trigger event is recognized as long as +24V is present at the IN0 input (HIGH-active).

CONT:
Continuous gloss grade detection (no trigger event required).


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

| **ATTENTION!** | **ERROR STATE if: INT < INTLIM** |
|---|---|


MAXVEC-No.:
This function field determines the number of gloss vectors that are to be inspected. The BINARY mode allows a maximum of 31 gloss vectors to be inspected, the DIRECT HI or DIRECT LO mode a maximum of 5 gloss vectors (0,1,2,3,4). The numerical value set here determines the possible scanning rate of the sensor. The lower the number of gloss degrees to be inspected, the faster the operating rate of the RLS-GD-60 sensor.
The numerical value preset here refers to the number of lines (starting with line 0) in the → TEACH TABLE.


OUTMODE:
This function button group is used for selecting the output mode of the 5 digital outputs.

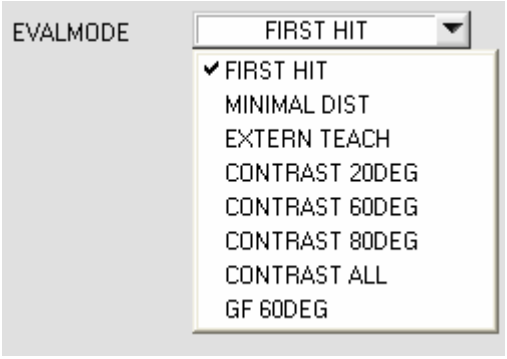
BINARY:
If in a line-by-line comparison the current gloss degrees correspond with the teach-parameters in the TEACH TABLE, this "hit" is indicated in the TEACH TABLE as a vector number (V-No.) and is sent to the digital outputs (OUT0 ... OUT4) as a **bit pattern**.
With this mode a maximum of 31 gloss degrees can be taught.

DIRECT:
This mode allows a maximum of 5 gloss vectors.
If in a line-by-line comparison the current gloss degrees correspond with the teach-parameters in the TEACH TABLE, this "hit" is indicated in the TEACH TABLE as a vector number (V-No.) and is directly output at the digital outputs (OUT0 ... OUT4).

DIRECT HI:
If **DIRECT HI** is activated, the specially digital output is set to HI. If the current gloss vector does not correspond with any of the teach-in gloss vectors, all digital outputs are set to LOW (no LED is lighting).

DIRECT LO:
If **DIRECT LO** is activated, the specially digital output is set to LO, while the other ones are set to HI. If the current gloss vector does not correspond with any of the teach-in gloss vector, all digital outputs are set to HIGH (all LEDs are lighting).


HOLD:
The RLS-GD-60 sensor operates with minimum scanning times in the magnitude of less than 150µs. This is why most of the PLCs that are connected to the digital outputs OUT0 … OUT4 have difficulties with the safe detection of the resulting short switching state changes. For the digital outputs of the RLS-GD-60 gloss sensor pulse lengthening of up to 100 ms can be set by selecting the corresponding HOLD value.




EVALMODE:
This function field serves for setting the evaluation mode at the RLS-GD-60 sensor.
→ See also function group **OUTMODE**.


FIRST HIT:
The currently measured gloss degree is compared with the teach vectors in the TEACH TABLE, starting with teach vector 0. If in a line-by-line comparison the current gloss vector corresponds with the teach vector in the TEACH TABLE, this first "hit" is indicated in the TEACH TABLE as a vector number (V-No.) and output at the digital outputs (OUT0 ... OUT4) according to the setting of the OUTMODE parameter (see OUTMODE).
If the current gloss degree does not correspond with any of the teach vectors, the gloss vector V-No. = 255 will be set ("error status").


MINIMAL DIST:
The individual gloss degrees defined in the **TEACH TABLE** exist as points in the gloss triangle corresponding to their (X,Y) value pairs. When this evaluation mode is set at the RLS-GD-60 sensor, the evaluation algorithm, starting from the currently measured gloss vector (X,Y), calculates the distance to the individual gloss vectors in the gloss triangle. The current gloss vector (X,Y) is assigned to the teach vector that is closest in the gloss triangle. The gloss vector that is detected this way is output at the digital outputs (OUT0 ... OUT4) according to the setting of the OUTMODE parameter (see OUTMODE).
V-No. is only set to 255, if the current intensity is less than the value set under INTLIM (see INTLIM).


EVALMODE „EXTERN TEACH“:
This evaluation mode allows the user to externally enter the currently present gloss vector in the TEACH TABLE by means of the IN0 input or the TEACH button. The currently present gloss vector is entered in as many lines, starting with line 0, as is set in MAXVEC-No..

The advantage for the user is that he does not need to start the parameterisation software for this. Teaching is performed through the external IN0 input. When the input is switched, the currently present gloss vector is stored in the non-volatile EEPROM memory.

Please note that when this evaluation mode is selected, the tolerance for the intensity and the gloss vector itself must once be stored in the EEPROM at the beginning.

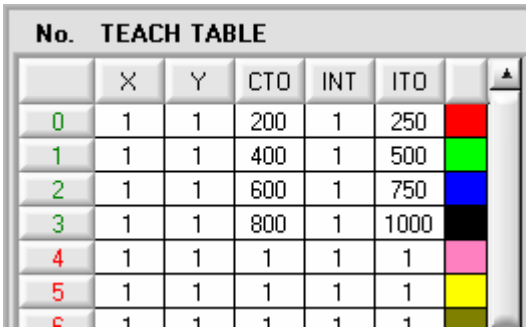
The MAXVEC-No. also must be set first, and must be stored in the EEPROM.

**TEACH PROCEDURE:**


Click on the EVALMODE window to scroll the pull-down menu. Choose the function “EXTERN TEACH”.


Select how many gloss vectors you wish to teach externally.


Click on the field “0” of the PARA switcher to change into the TEACH TABLE.




Now enter the corresponding tolerances for the gloss vectors you wish to teach.

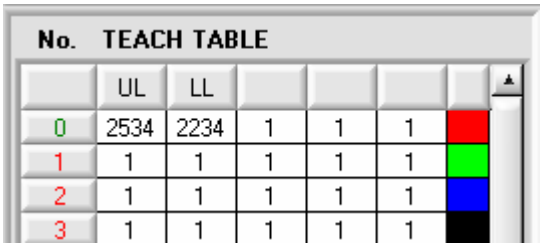
CTO = GLOSS TOLERANCE
ITO = INTENSITY TOLERANCE

In this example, MAXVEC-No. = 4 was selected, i.e. the sensor should detect the gloss vector information that is stored in the first 4 lines of the TEACH TABLE by means of external teaching through IN0. Since the sensor cannot calculate the tolerances for gloss (CTO) and intensity (ITO) itself, these values must be entered once and must be stored in the EEPROM (see MEM) together with the MAXVEC-No. and with EVALMODE = EXTERN TEACH.


Since the same X-,Y-, and INT-values are taught through EXTERN TEACH, the corresponding tolerances CTO and ITO must be set differently. This allows different weighting of the current gloss vector.

Now select the setting EEPROM in the MEM function field, and then click on SEND.
From now on, the PC is no longer necessary, as long as you only wish to teach gloss vectors up to the MAXVEC-No. and do not want to change the tolerances.

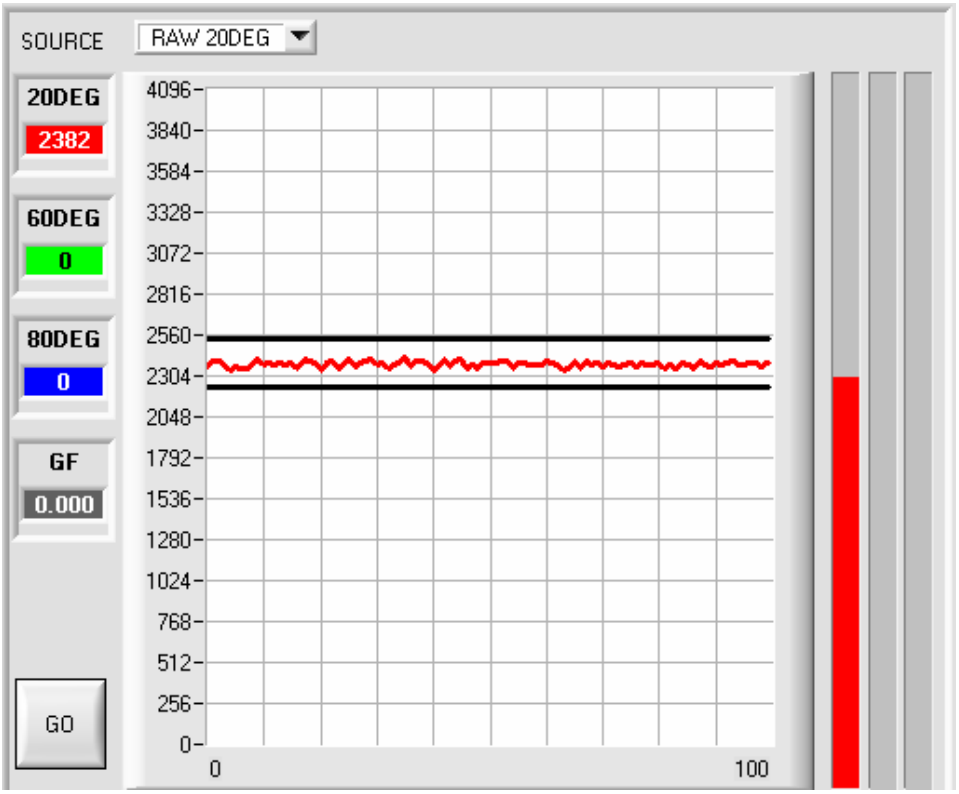
INFO: Of course the taught gloss vectors can be viewed at any time with the PC.


CONTRAST 20DEG:
CONTRAST 60DEG:
CONTRAST 80DEG:

If one of these three function fields is selected, contrast evaluation is activated at the RLS-GD-60 sensor after a click on the SEND button.

In contrast evaluation mode only one selected receiver signal (20DEG, 60DEG, 80DEG) is evaluated for its intensity. Since only one receiver signal is evaluated, a very high switching frequency (depending on AVERAGE) can be maintained.

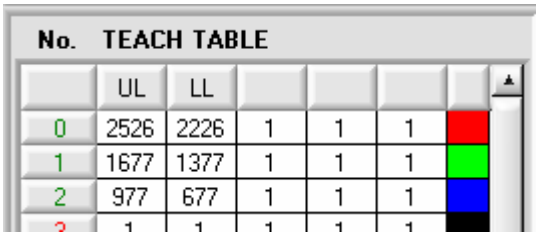



The upper limit (in graph = 2534) and the lower limit (in graph = 2234) constitute an intensity window of the contrast transition to be detected. The two limits (UL, LL) must be entered in line 0 of the TEACH TABLE, or they must be automatically taught with TEACH DATA TO. In case of automatic teaching, a certain upper and lower limit are suggested. These limits can of course be changed by entering different values in the corresponding fields (UL, LL).

If the current intensity of the selected receiver signal lies below the tolerance band set with LL (Lower Limit), digital output OUT0 is set to HIGH level (+24 VDC).

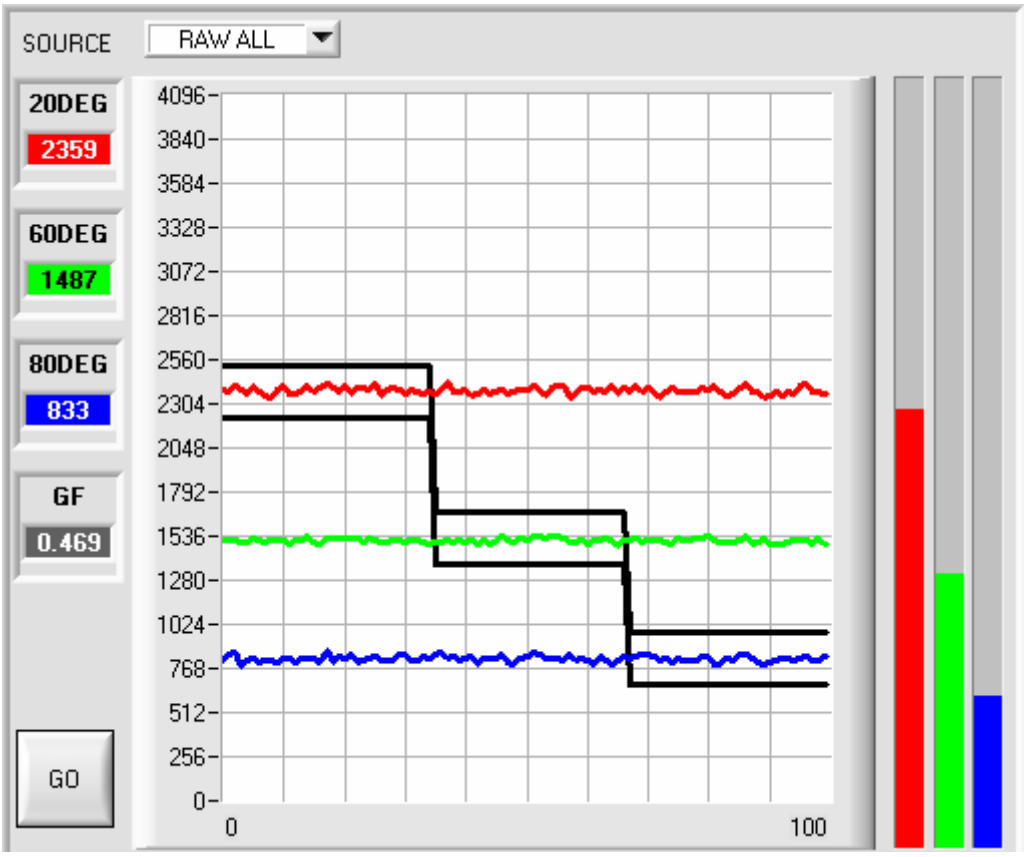
If the current intensity of the selected receiver signal lies within the tolerance window set with UL and LL, digital output OUT1 is set to HIGH level (+24 VDC).

If the current intensity of the selected receiver signal lies above the tolerance band set with UL (Upper Limit), digital output OUT2 is set to HIGH level (+24 VDC).


CONTRAST ALL:
When this function field is selected, contrast evaluation of all the receiver signals at the RLS-GD-60 sensor is active after the SEND button is pressed.

With CONTRAST ALL, all three receiver signals (20DEG, 60DEG, 80DEG) are evaluated with respect to their intensity. Since only the receiver signals are evaluated and since there is no X-,Y-, INT-calculation, this mode allows a very high switching frequency (depending on AVERAGE).



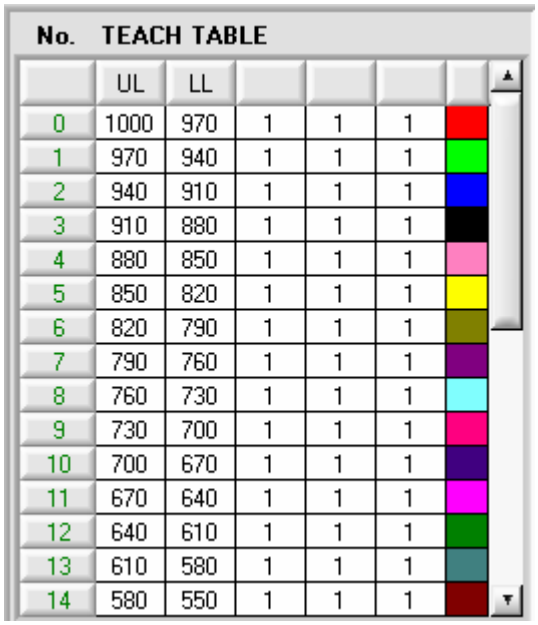

For every channel there is an upper threshold (UL) and a lower threshold (LL). These thresholds form an intensity window for the contrast transition to be detected. For channel 20DEG the thresholds are entered in line 0, for channel 60DEG in line 1, and for channel 80DEG in line 2, or they are automatically taught by means of TEACH DATA TO. In case of automatic teaching a certain upper and lower threshold are suggested. These thresholds of course can be changed by entering different values in the corresponding fields (UL, LL).

Signal evaluation:
OUT0 = 1, if channel 20DEG is in the intensity window set in line 0.
OUT1 = 1, if channel 60DEG is in the intensity window set in line 1.
OUT2 = 1, if channel 80DEG is in the intensity window set in line 2.
OUT3 = 1, if all the channels are in the corresponding intensity windows.
OUT4 = 1, if none of the channels are in the corresponding intensity windows.


GF 60DEG:
When this function field is selected, the evaluation of the gloss factor can be started with a click on the SEND button.

The gloss factor is calculated as a percentage value with respect to a reference surface that is assumed to have a gloss factor of 100%.


Press the CALIB GF 60DEG button to perform calibration to the reference surface. The sensor is factory-preset when it is delivered, and it should be readjusted from time to time (see chapter 2.7 Calibration of the GF 60DEG).




| No. | UL | LL | | | | |
|---|---|---|---|---|---|---|
| 0 | 1000 | 970 | 1 | 1 | 1 | |
| 1 | 970 | 940 | 1 | 1 | 1 | |
| 2 | 940 | 910 | 1 | 1 | 1 | |
| 3 | 910 | 880 | 1 | 1 | 1 | |
| 4 | 880 | 850 | 1 | 1 | 1 | |
| 5 | 850 | 820 | 1 | 1 | 1 | |
| 6 | 820 | 790 | 1 | 1 | 1 | |
| 7 | 790 | 760 | 1 | 1 | 1 | |
| 8 | 760 | 730 | 1 | 1 | 1 | |
| 9 | 730 | 700 | 1 | 1 | 1 | |
| 10 | 700 | 670 | 1 | 1 | 1 | |
| 11 | 670 | 640 | 1 | 1 | 1 | |
| 12 | 640 | 610 | 1 | 1 | 1 | |
| 13 | 610 | 580 | 1 | 1 | 1 | |
| 14 | 580 | 550 | 1 | 1 | 1 | |

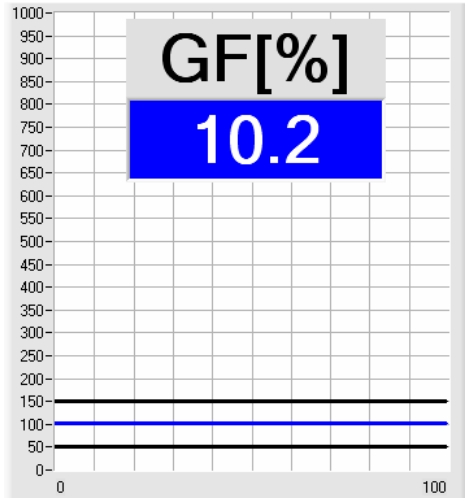
In the GF 60DEG evaluation mode the sensor can be taught 31 different gloss factors. With the TEACH DATA TO button the gloss factors are taught to the respective lines of the TEACH TABLE. It is also possible to enter the values manually. An upper limit UL and a lower limit LL are applied to each gloss factor.

The currently measured gloss factor is compared to the taught values in the TEACH TABLE, starting with line 0. If in this line-by-line comparison the current gloss factor corresponds with the taught factor in the TEACH TABLE, this first "hit" is displayed in the TEACH TABLE as a vector-number (V-No.) and is sent to the digital outputs (OUT0 ... OUT4) according to the OUTMODE parameter setting (see OUTMODE).
If the current gloss factor does not correspond with any of the taught factors, the "error status" V-No. = 255 will be set.



When the GO button is pressed, the intensities of the individual three channels are visualised in the graphic display. One of the three intensity windows is shown in addition. The desired intensity window can be selected with the No. function field.

The gloss factor also is shown in the numerical-value output field GF[%]. A left mouse button double-click on the output field GF[%] shows a larger output field in the graph, which will disappear again by moving the mouse pointer to this field and clicking with the right mouse button.



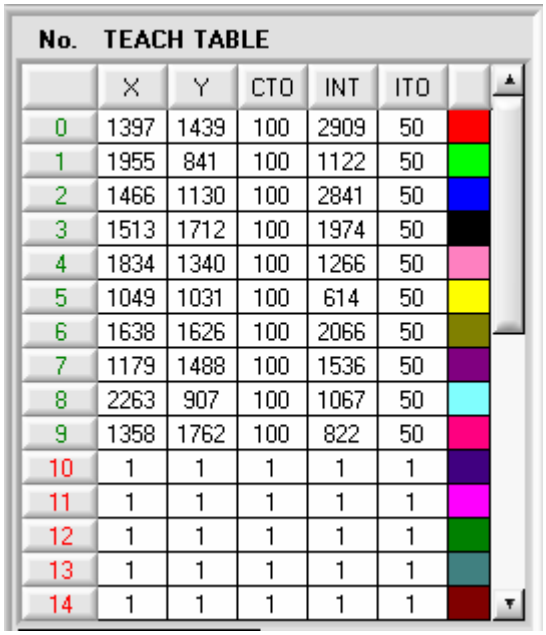

Furthermore, automatic scaling can be started by double-clicking on the y-axis of the graph. A single mouse click cancels automatic scaling again.


RAM, EEPROM, FILE:
This group of buttons controls parameter exchange between PC and RLS-GD-60 sensor through the serial RS232 interface.


PARA:
With this switch the display of the 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 TEACH TABLE for entering the individual parameters for the teach-in gloss vectors.



No. TEACH TABLE

| | X | Y | CTO | INT | ITO | |
|---|---|---|---|---|---|---|
| 0 | 1397 | 1439 | 100 | 2909 | 50 | |
| 1 | 1955 | 841 | 100 | 1122 | 50 | |
| 2 | 1466 | 1130 | 100 | 2841 | 50 | |
| 3 | 1513 | 1712 | 100 | 1974 | 50 | |
| 4 | 1834 | 1340 | 100 | 1266 | 50 | |
| 5 | 1049 | 1031 | 100 | 614 | 50 | |
| 6 | 1638 | 1626 | 100 | 2066 | 50 | |
| 7 | 1179 | 1488 | 100 | 1536 | 50 | |
| 8 | 2263 | 907 | 100 | 1067 | 50 | |
| 9 | 1358 | 1762 | 100 | 822 | 50 | |
| 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 | |

TEACH TABLE:
A click on switch position 0 of the PARA switch (MEM-function field) opens the gloss vector teach table.

The TEACH TABLE shows the currently set parameters.
After a left mouse button double click (or a click on shortcut keybutton F2) on the respective field the default values can be changed by entering numerical values with the PC keyboard.

The TEACH TABLE is organized in lines, i.e. the individual parameters for the teach-in gloss vectors are arranged side by side in the respective line.

The RLS-GD-60 sensor is able to check up to 31 teach-in gloss vectors. The number of the respective teach-in gloss vectors is given in the left column of the table.

X X-value of the teach-in gloss value (in the gloss grade triangle numerical value on the x-axis: 20DEG content)

$$X = \frac{20DEG}{20DEG + 60DEG + 80DEG} \times 4095$$

Y Y-value of the teach-in gloss value (in the gloss grade triangle numerical value on the y-axis: 60DEG content)

$$Y = \frac{60DEG}{20DEG + 60DEG + 80DEG} \times 4095$$

CTO Gloss tolerance: "Tolerance circles" around the teach value in the gloss grade triangle that is defined as an (X,Y) point. The sensor internally calculates a "hysteresis ring". The numerical value of CTO determines the radius of the "tolerance circle" around the teach-in gloss vector. Within the "tolerance circle" defined by this method, the current gloss vector is recognized as the teach gloss vector.

INT Teach-in value for the intensity of the respective gloss vector.

$$INT = \frac{20DEG + 60DEG + 80DEG}{3}$$

**Please note: In mode FIRST HIT both criteria – gloss vector (X,Y) and intensity INT - must be fulfilled for the detection of a teach-in gloss vector, i.e. the currently measured values for gloss vector and intensity must both lie within the respective preset tolerance limits CTO (gloss) and ITO (intensity).**

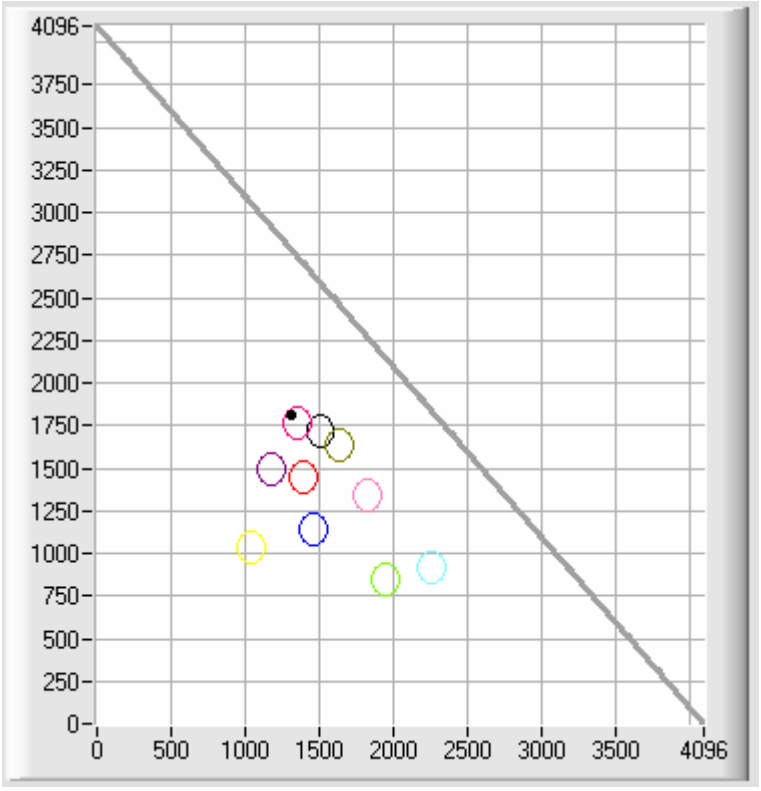
ITO Default value for the permitted tolerance band around the intensity teach-in value (intensity tolerance).


No.:
Selection of the current number of the teach-in gloss vector (0 .. 30) from the TEACH TABLE.

Inc:
If *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 line in the TEACH TABLE is selected.


TEACH DATA TO:
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 gloss vector selected in the No.: function field.


APPLY FROM ALL:
If *X/Y* is selected under SOURCE, a click on this button displays all the teach-in gloss vectors entered in the TEACH TABLE in the gloss grade triangle with the corresponding "tolerance circle" (radius=CTO).
The picture below shows 10 gloss grade tolerance circles with the teach-in values (X,Y) and CTO (tolerance radius) preset in the TEACH TABLE.




AUTO ADJUST

AUTO ADJUST:
A click on this button initiates automatic adjustment of the circle tolerances (CTO).
A circle tolerance of max. 200 DIGITS is allowed in calculation.
Circles may overlap if they are definitely separated by the intensity (please note: ITO must be set first!)

The number of circle tolerances to be calculated is determined by MAXVEC-No. (e.g. MAXVEC-No. = 5 → CTO adjustment up to and including line 4).

When the CTO values have been adjusted, a large graphic window appears, displaying the gloss grade circles. This graph features a zoom function (see ZOOM).

ZOOM

ZOOM:
A click on the ZOOM button opens a large graphic window. This graphic window features an auto-zoom function of all the taught circles and the current X/Y-values. Zooming is stopped with a left mouse click in the graph. It can be started again with a click on the ZOOM button. The graph can be exited either by pressing the right mouse button or by pressing the APPLY FROM ALL button.

RESET TABLE

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


**[F9]**

SEND:
When the SEND button is clicked (or shortcut keybutton F9 is pressed), all the currently set parameters are transferred between PC and RLS-GD-60 sensor. The target of the respective parameter transfer is determined by the selected button (RAM, EEPROM, or FILE).


**[F10]**

GET:
The currently set values can be interrogated from the RLS-GD-60 sensor by clicking on the GET button (or with shortcut keybutton F10). The source of data exchange is determined by the selected button (RAM, EEPROM, or FILE).

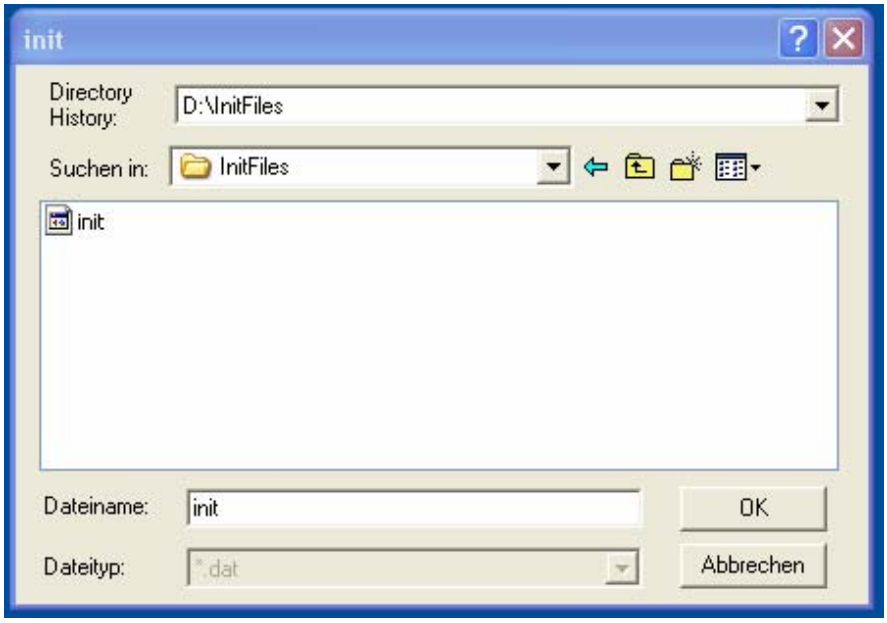
RAM: The current parameters are written into the RAM memory of the RLS-GD-60 gloss sensors, or they are read from the RAM, **i.e. these parameters are lost when the voltage at the RLS-GD-60 sensor is switched off.**

EEPROM: The current parameters are written into the non-volatile memory of the EEPROM in the RLS-GD-60 sensor, or they are read from the EEPROM, **i.e. the parameters in the internal EEPROM are stored when the voltage at the RLS-GD-60 sensor is switched off.**

FILE: A click on this button opens an info field with the file name of the current parameter file.

**PLEASE NOTE:**
**The current parameters are only stored in the current output file, or retrieved from the current output file, when the SEND or GET button is activated with a mouse click.**

If another output file should be accessed, the file button must first be activated with the mouse pointer. Another dialog field then opens, in which an existing output file can be selected, or in which a file name for a new output file can be entered.





**[F11]**

GO:
A click on this button (or pressing shortcut keybutton F11) starts data transfer from the RLS-GD-60 sensor to the PC through the serial RS232 interface.
If *X/Y* is selected under SOURCE, the X/Y coordinates of the current gloss vector are displayed in the graph.
If *RAW INT* is selected under SOURCE, the intensity of the current gloss vector and the intensity window of the gloss vector set under No.: (0…30) are visualised in the graph.


**[F12]**

STOP:
A click on this button (or pressing shortcut keybutton F12) stops data transfer from the RLS-GD-60 sensor to the PC through the serial RS232 interface.


X:
This numerical value output field displays the 20DEG content (x-axis) of the scattered light currently arriving at the receiver.
Formula for calculation:

$$X = \frac{20DEG}{20DEG + 60DEG + 80DEG} \times 4095$$


Y:
This numerical value output field displays the 60DEG content (y-axis) of the scattered light currently arriving at the receiver.
Formula for calculation:

$$Y = \frac{60DEG}{20DEG + 60DEG + 80DEG} \times 4095$$


INT:
This numerical value output field displays the currently measured intensity (proportional to the average of the intensities at the triple receiver).
Formula for calculation:

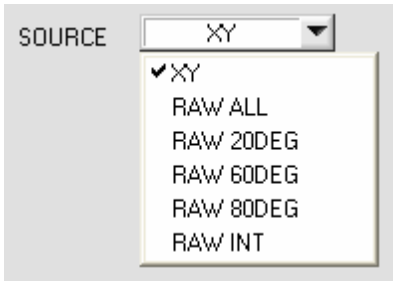
$$INT = \frac{20DEG + 60DEG + 80DEG}{3}$$


GF:
This numerical value output field displays the currently measured gloss vector.
Formula for calculation:

$$GF = \frac{60DEG}{20DEG + 80DEG} \times 4095$$


V-No.:
This numerical value output field displays the currently detected vector number in accordance with the entry in the TEACH TABLE. The currently detected vector number is sent to the digital outputs OUT0 … OUT4 as a corresponding bit pattern.

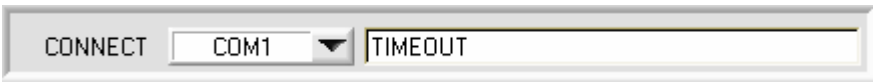
| | |
|---|---|
| **PLEASE NOTE:** | **The above-mentioned 5 output fields are only updated when data transfer between PC and RLS-GD-60 sensor is active (GO button pressed).** |

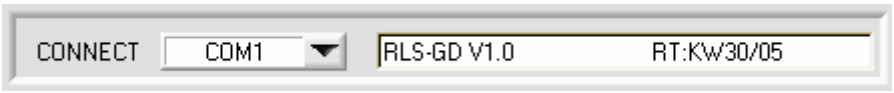



SOURCE:
A click on the arrow button opens a selection field for the selection of a display mode in the graphic display window.

| | |
|---|---|
| XY : | Display of the gloss grade triangle and of the currently determined gloss vector. |
| RAW ALL : | The current raw signals of the 3-fold receiver (20DEG, 60DEG, 80DEG) are displayed. |
| RAW 20DEG : | The current raw signal for 20DEG is displayed |
| RAW 60DEG : | The current raw signal for 60DEG is displayed |
| RAW 80DEG : | The current raw signal for 80DEG is displayed |
| RAW INT : | The currently determined total intensity is displayed. |

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




The software provides the following status messages:

Init COM-PORT: The PC tries to establish a connection with the RLS-GD-60 sensor through the respective selected interface.

RLS-GD-60 V1.0 RT:KW30/05 The connection between PC and RLS-GD-60 sensor could be established successfully.

TIMEOUT: A connection between RLS-GD-60 sensor and PC could not be established, or the connection is faulty.
**In this case it should first be checked whether the RLS-GD-60 sensor is supplied with voltage, and whether the RS232 interface cable is correctly connected.**
If the interface assignment at the PC is not known, a selection can be made from COM1, COM2, … COM9 by clicking on the [↓] selection field in the CONNECT group.

Invalid port number: The selected interface is not available at the PC.

| | |
|---|---|
| **ATTENTION!** | **The stable function of the RS232 interface („RLS-GD-60 V1.0 RT:KW30/05 " status message after program start) is a basic prerequisite for measured value transfer from the PC to the RLS-GD-60 sensor.** |

| | |
|---|---|
|  **ATTENTION !** | **Due to the limited data transfer rate through the serial RS232 interface (19200 bit/s) only slow changes of the raw signals at the sensor front end can be observed in the graphic output window of the PC.**<br><br>**For maintaining maximum switching frequency at the RLS-GD-60 sensor data communication with the PC must be stopped (press the STOP button).** |

## 2.2 RLS-GD-Scope software as an aid for teach-in

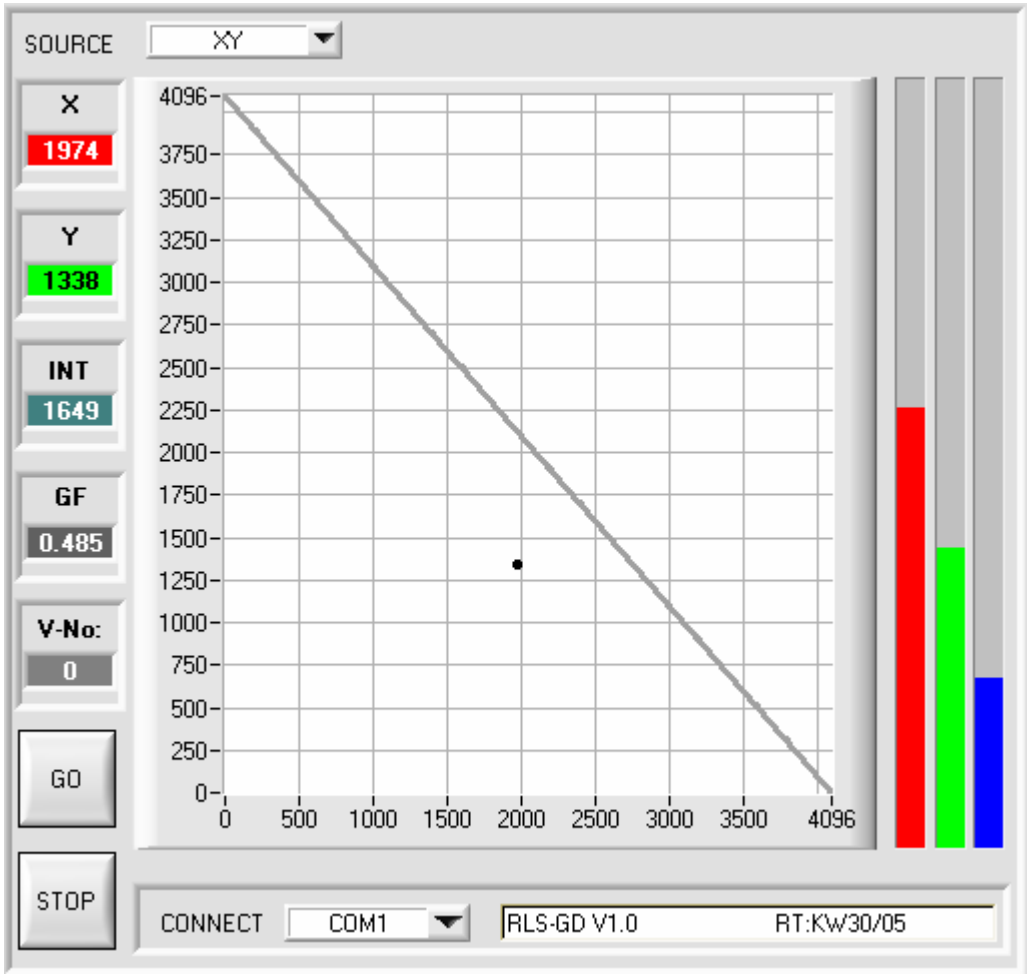
The RLS-GD-60 sensor is able to learn up to 31 different gloss vectors automatically or by way of manual parameter presetting in the TEACH TABLE.

Parameterization can be started when the object to be measured is positioned at the reference distance and the intensity lies in the dynamic range (INT > INTLIM) (if necessary, readjust POWER).


First the trigger mode should be set to CONT, which means that gloss grade detection is continuously active, also without external triggering.

With a click on the SEND button this setting is activated at the gloss sensor.


When this option is selected, the gloss grade triangle is shown in the graphic display window.



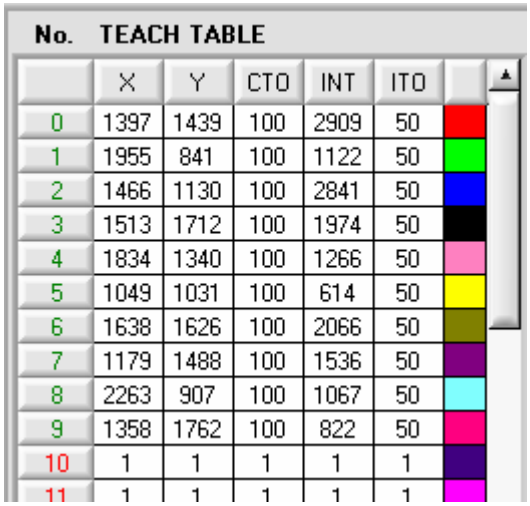

In the gloss grade triangle the currently measured gloss vector is represented by an (X,Y) value pair.

The 20DEG content of the currently measured gloss vector corresponds with the X-coordinate, the 60DEG content corresponds with the Y-coordinate in the gloss grade triangle. The 80DEG content in the gloss grade triangle is proportional to the distance of the (X,Y) value pair from the hypotenuse.


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


Now the number of the current teach-in gloss vector (0 .. 30), in the line 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 line of the TEACH TABLE.
After automatic TEACH-IN the tolerance circle around the teach-in gloss vector 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-in gloss vector in the gloss grade triangle determines the possible choice of the tolerance circles (radius=CTO). They should be chosen so, that they don't overlap each other.



No. TEACH TABLE

| | X | Y | CTO | INT | ITO | |
|---|---|---|---|---|---|---|
| 0 | 1397 | 1439 | 100 | 2909 | 50 | |
| 1 | 1955 | 841 | 100 | 1122 | 50 | |
| 2 | 1466 | 1130 | 100 | 2841 | 50 | |
| 3 | 1513 | 1712 | 100 | 1974 | 50 | |
| 4 | 1834 | 1340 | 100 | 1266 | 50 | |
| 5 | 1049 | 1031 | 100 | 614 | 50 | |
| 6 | 1638 | 1626 | 100 | 2066 | 50 | |
| 7 | 1179 | 1488 | 100 | 1536 | 50 | |
| 8 | 2263 | 907 | 100 | 1067 | 50 | |
| 9 | 1358 | 1762 | 100 | 822 | 50 | |
| 10 | 1 | 1 | 1 | 1 | 1 | |
| 11 | 1 | 1 | 1 | 1 | 1 | |

Tolerance ITO, which lies symmetrically around intensity INT, also should be increased first, because otherwise gloss vector detection might fail due to intensity evaluation.
For the detection of a teach-in gloss vector both criteria, gloss grade (X,Y) and intensity INT must be fulfilled !

**Almost identical gloss grade pairs (X,Y) often can be separated with the intensity criteria INT and ITO (tolerance).**


It must also be observed that in the INTLIM input field the lower limit for gloss vector evaluation may have to be corrected depending on the current intensity INT that is diffusely reflected to the gloss sensor.

**Please note:** **No evaluation if: INT < INTLIM**

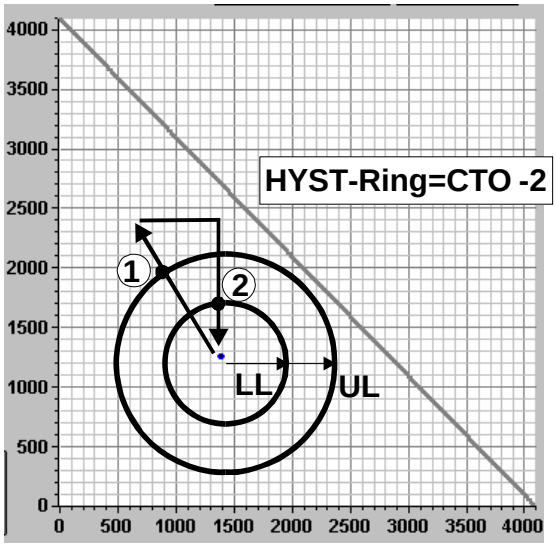

The number of gloss vectors to be checked must be entered in the MAXVEC-No. input field.

**When suitable parameters for the respective gloss vector detection have been established by observing the signal characteristics, the current parameters must be written to the non-volatile EEPROM memory of the RLS-GD-60 sensor by clicking on the SEND button.**

**ATTENTION !** **The selection button in the MEM field must be set to EE !**

When the parameters have been entered and the sensor has been adjusted with the help of the graphical representation provided by the RLS-GD-Scope software, the PC is no longer required for the actual measuring task. The PC and the RS232 interface cable can then be disconnected from the RLS-GD-60 gloss sensor. The RLS-GD-60 sensor then performs the measuring task in STAND-ALONE operation.

## 2.3 Position of the hysteresis ring in the gloss tolerance circle




The tolerance circle (radius = CTO) lies symmetrically around the (X,Y) value pair of the respective teach-in gloss vector in the gloss grade triangle.

For avoiding unstable switching states at the digital outputs OUT0 … OUT4 the sensor defines internally a hysteresis ring around each teach-in gloss vector.
This internal hysteresis ring, which cannot be adjusted by the software user, is calculated by the following formula:
HYST-RING=CTO-2.

A teach-in gloss vector is detected until the tolerance circle (radius=CTO) is exceeded at point (1). When this happens, the switching state at the digital outputs changes.

When the current measured value (X,Y value pair) enters the tolerance circle again, the teach-in gloss vector is only detected again when the value drops below the HYST-RING at point (2).

**The hysteresis range is defined by the ring area between the outer tolerance circle (radius=CTO) and the inner circle (HYST-RING).**

| | |
|---|---|
| **Please note:** | **The inner circle (radius=HYST-RING) for the lower hysteresis threshold is not shown in the graphic output field.** |

## 2.4 Contrast detection with RLS-GD-60 sensor

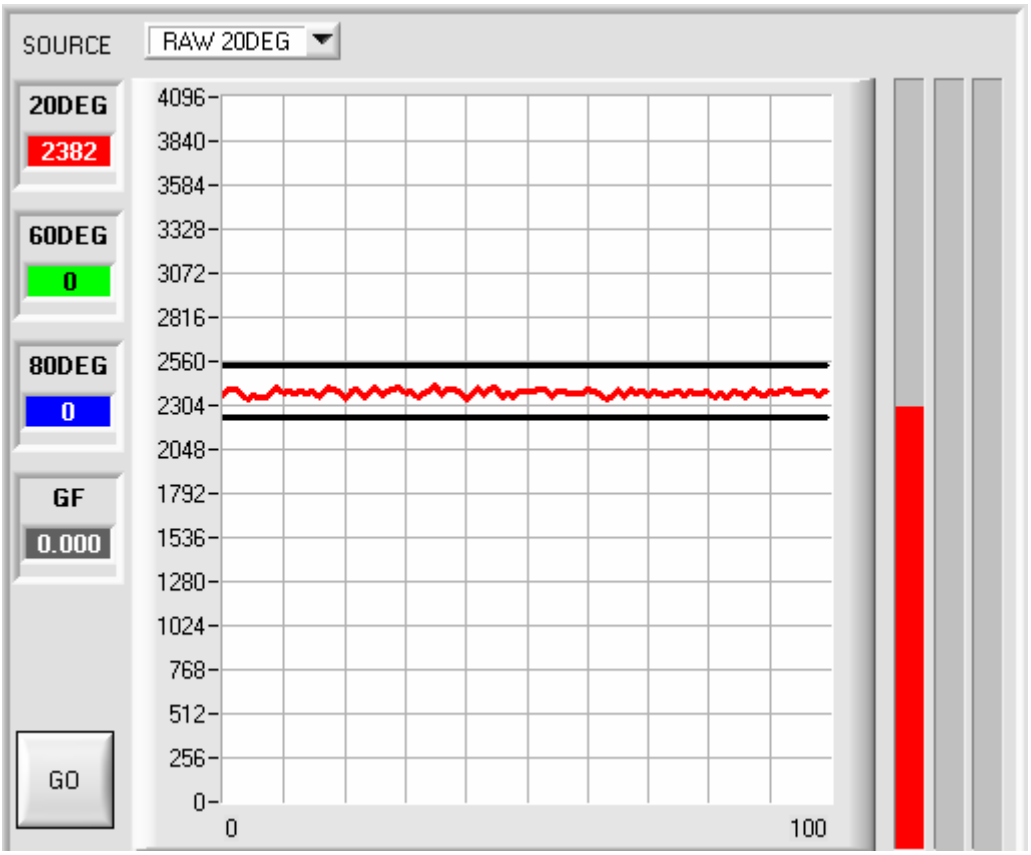
In addition to the gloss degree evaluation modes, the RLS-GD-60 sensor also features a contrast evaluation mode. For contrast evaluation only the intensities of the individual receiver signals (20DEG, 60DEG, 80DEG) are used.

In this mode the sensor operates with a very high switching frequency, depending on the set AVERAGE value (see appendix).


For contrast detection the LED mode must be set to static with PMOD=STAT, i.e. the LED transmission power constantly keeps the value set by the operator with the POWER slide switch.
The LED transmission power should be set such that the light intensity diffusely reflected by the target approximately lies at the center of the dynamic range for the respective receiver content.

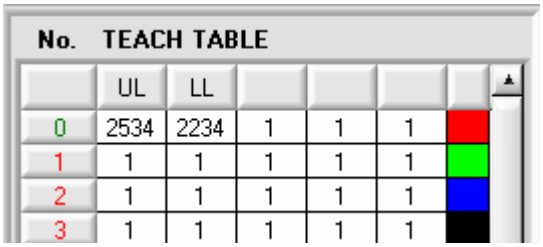

For activating contrast evaluation (e.g. for 20DEG) the corresponding evaluation mode must be selected first. For this purpose the operator should select that receiver signal for contrast detection that offers the most distinct differences between background and alteration.


Then the new evaluation mode must be activated in the RLS-GD-60 sensor by clicking on the SEND button.



After a click on the GO button the raw data of the respective selected receiver content (e.g. 20DEG) can be observed in the graphic display window.

The possible selection of tolerance limits (UL and LL) can be read off in the graphic display window (→ CONTRAST ALL).




Next the setpoint value for the upper tolerance limit (UL=2534) and the lower tolerance limit (LL=2234) must be entered in the corresponding input fields. In contrast evaluation only line 0 of the TEACH TABLE is evaluated.

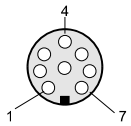
**Any existing entries in the following lines can be kept!**


Finally the new evaluation parameters must be activated in the RLS-GD-60 sensor by clicking on the SEND button.

Evaluation:

| | |
|---|---|
| The current intensity value is lower than LL (Lower Limit): | OUT0 is on HIGH level (+24VDC) |
| The current intensity value lies within the tolerance window (UL,LL): | OUT1 is on HIGH level (+24VDC) |
| The current intensity value is higher than UL (Upper Limit): | OUT2 is on HIGH level (+24VDC) |

## 2.5 External triggering of the RLS-GD-60 sensor



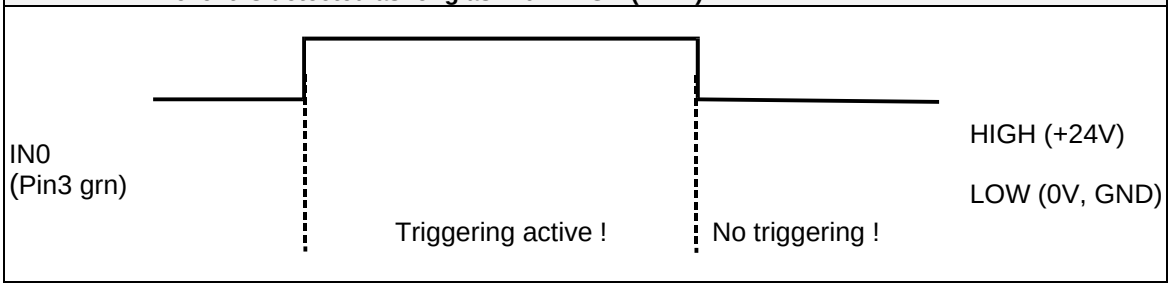

External triggering is performed through pin no. 3 (grn) at the 8-pole socket of the RLS-GD-60/PLC connection.


EXT:
First the external trigger mode must be set at the gloss sensor. For this purpose option EXT must be selected in the TRIGGER selection field.


**PLEASE NOTE:**
**The new setting is only activated at the RLS-GD-60 sensor after a click on the SEND button!**

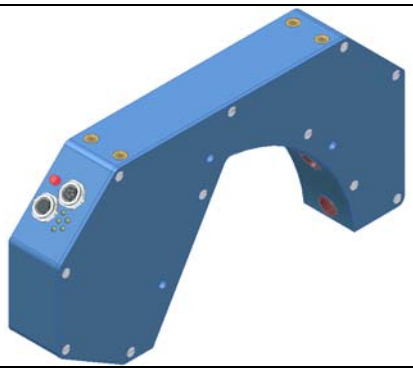
The TRIGGER = EXT mode is only available for the two evaluation cases FIRST HIT and MINIMAL DIST.

| **Please note:** | **The trigger input (IN0 PIN3 green of cable cab-las8/SPS) is HIGH-active, i.e. a trigger event is detected as long as IN0 = HIGH (+24V).** |
|---|---|



## 2.6 Function of the LEDs

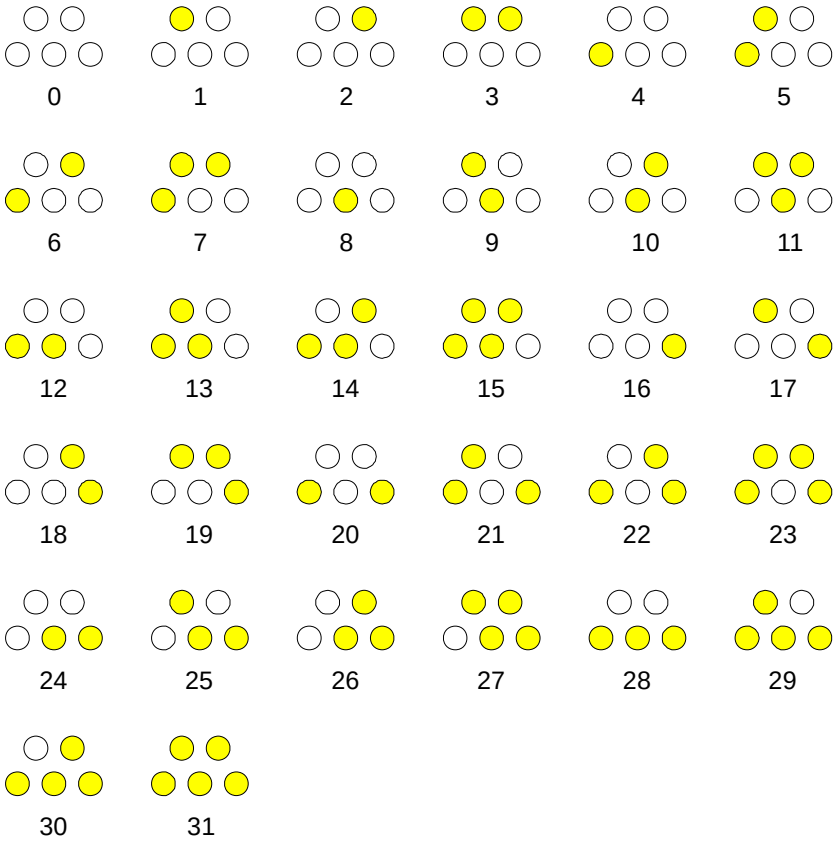
LED display:



**BINARY**

The gloss grade is visualised by way of 5 yellow LEDs at the housing of the RLS-GD-60 sensor. At the same time in the binary modus (OUT BINARY) the gloss grade indicated on the LED display is output as 5-bit binary information at the digital outputs OUT0 to OUT4 of the 8-pin RLS-GD-60/PLC socket.

The RLS-GD-60 sensor is able to process a maximum of 31 gloss vectors (gloss grade 0 ... 30) in accordance with the corresponding lines in the TEACH TABLE. An “error” respectively a “not detected” is displayed by the lighting of all LED (OUT0 ... OUT4) digital outputs are set to HIGH-level).



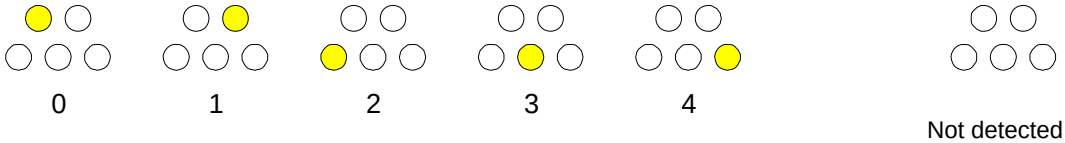

“Error” respectively
“not detected”

**DIRECT**

In the DIRECT mode (OUT DIRECT HI or OUT DIRECT LO) the maximum numbers of gloss vectors to be taught is 5 (no. 0, 1, 2, 3,4).

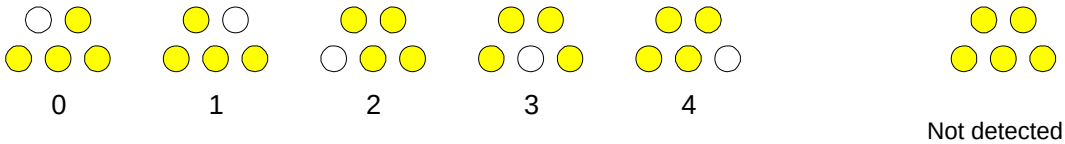
**DIRECT HI:**

If DIRECT HI is activated, the specially digital output is set to HI while the other 4 are set to LO.
If no gloss vector was detected, all digital outputs are set to LOW (no LED is lighting).




**DIRECT LO:**

If DIRECT LO is activated, the specially digital output is set to LO, while the other 4 are set to HI.
If no gloss vector was detected, all digital outputs are set to HIGH (all LED are lighting).



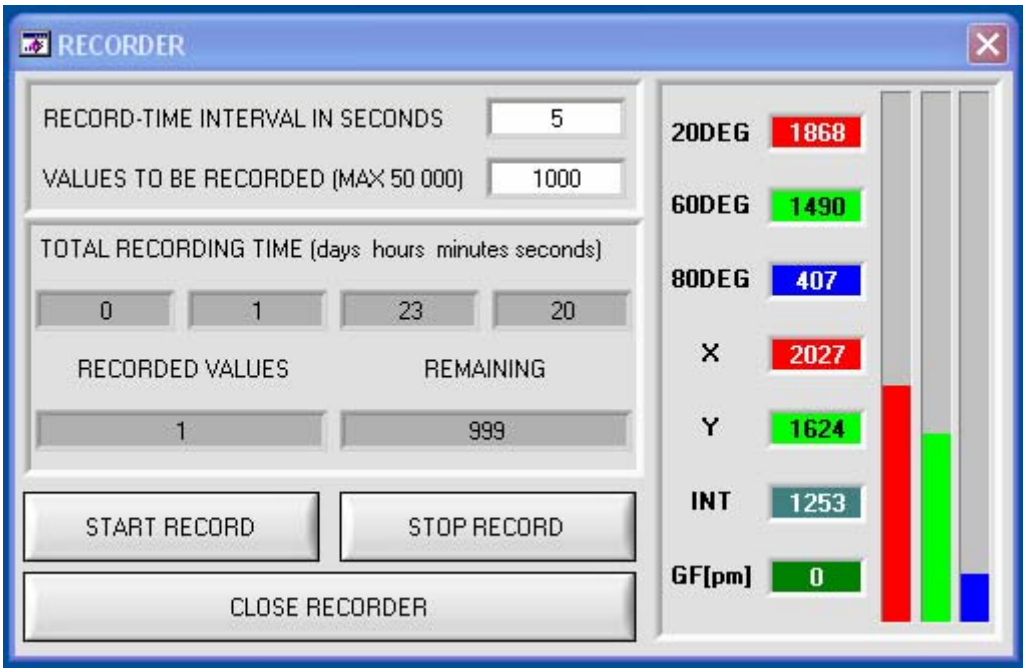
## 2.7 Function of the OPEN RECORDER button

The RLS-GD-Scope software features a data recorder that makes it possible to save a certain number of 20DEG/60DEG/80DEG/X/Y/INT/GF[pm] frames. The recorded file is saved to the hard disk of your PC and can then be evaluated with a spreadsheet program.

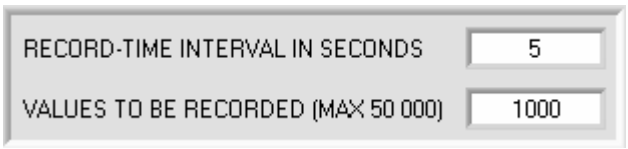
The file that is created has six columns and as many lines as data frames were recorded.
A line is structured as follows: 20DEG, 60DEG, 80DEG, X, Y, INT.

The following steps describe how data frames are recorded with the recorder:

Step 1
Press the OPEN RECORDER button. The following window will be displayed:

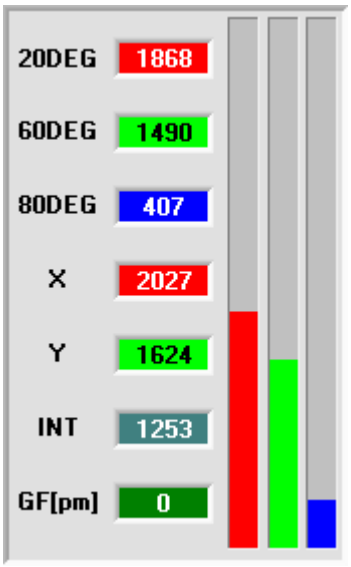

Step 2:
Enter a time interval for recording (in this example: 5, i.e. a new value is called from the sensor every 5 seconds).
Then enter the maximum number of values you wish to record in the second input field.
Please note: Recording can also be stopped earlier, the data recorded so far will not be lost.




These fields indicate how long recording will take (in days, hours, minutes, and seconds) if all data are recorded.

Step 3:
Start data recording by pressing the START RECORD button.
You will be asked to which file the data should be saved when recording is finished. If you select an already existing file name, you will be asked whether you want to overwrite the existing file or not.


If you press YES, the recorder starts to record data. The button will become red to indicate that evaluation is active.
The respective data frames are shown in the display windows.
In the two display fields RECORDED VALUES and REMAINING you can check how many data frames have been recorded, and how many frames remain to be recorded.



Please note:
During recording the two input fields RECORD-TIME INTERVAL and VALUES TO BE RECORDED are inactive.

Step 4:
When all the data frames set under VALUES TO BE RECORDED have been recorded, or when the STOP RECORD button is pressed, a pop-up window will appear and ask you to confirm that you really want to save the recorded values. The pop-up window again displays the path you set for your file.



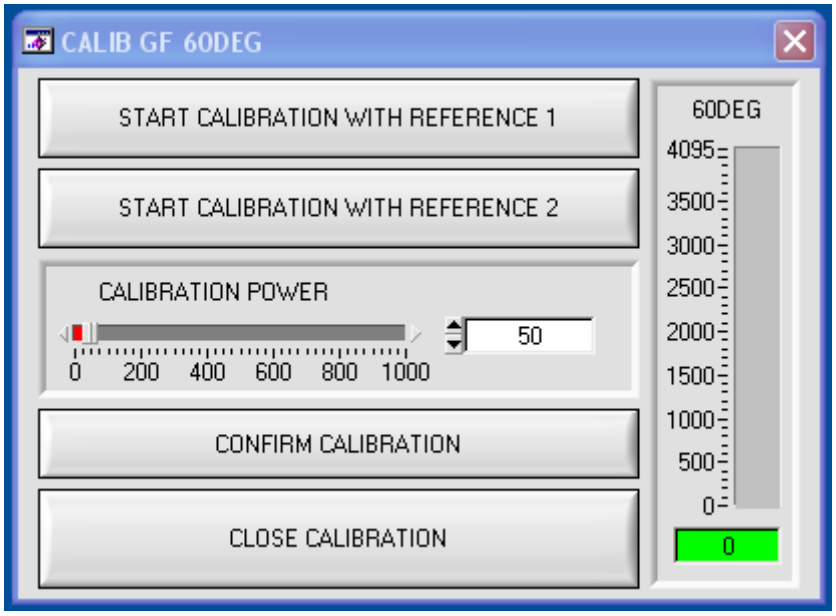
Attention:
If you press NO here, the data will be discarded.

Step 5:
Press the CLOSE RECORDER button to close the recorder and return to the main program.

## 2.8 Calibration of gloss vector GF 60DEG

When you are operating with EVALMODE = GF 60DEG, the sensor should be recalibrated from time to time with the help of a reference surface.

Pressing the CALIB GF 60DEG button calls up the following window:

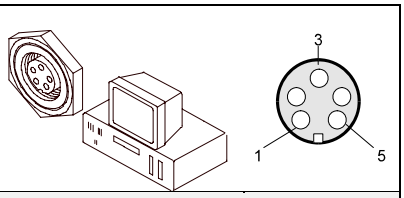



When you press START CALIBRATION WITH REFERENCE 1, you will be asked to place the reference calibration surface with a gloss factor of 100% in front to the sensor.
Click on YES when you have placed the reference surface.
Then a suitable CALIBRATION POWER is set at which the sensor operates in the upper third of its dynamic range of channel GF 60DEG.
When POWER searching is successfully finished, you will be asked to press START CALIBRATION WITH REFERENCE 2.
When you press this button, you will be asked to place a second reference surface with a gloss factor < 10%.
Click on YES when you have done this.
A second CALIBRATION-POWER value is then searched.
If a suitable POWER value is found, the software will inform you that calibration is possible.
Press CONFIRM CALIBRATION to finish the calibration process, then exit the calibration window by pressing CLOSE CALIBRATION.
Two POWER values are searched to fully utilise the dynamic range of the sensor.
For gloss factors > 10% the lower POWER value will be used.
For gloss factors < 10% the higher POWER value will be used.

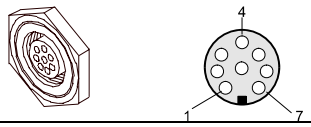
If there should be an error message during calibration, this may have the following causes: The reference surfaces do not have the correct distance to the sensor, or the reference surfaces are dirty. It may also be that the optical unit of the sensor is dirty, or that the PC connection is interrupted.

# 3 Connector assignment of RLS-GD-60 sensor

**Connection of RLS-GD-60 to PC:**

| **5-pole female connector (type Binder 712)**<br>***RLS-GD-60/PC-RS232*** | |  |
|---|---|---|
| **Pin No.:** | | **Assignment:** |
| 1 | | 0V (GND) |
| 2 | | TX0 |
| 3 | | RX0 |
| 4 | | Not connected |
| 5 | | Not connected |

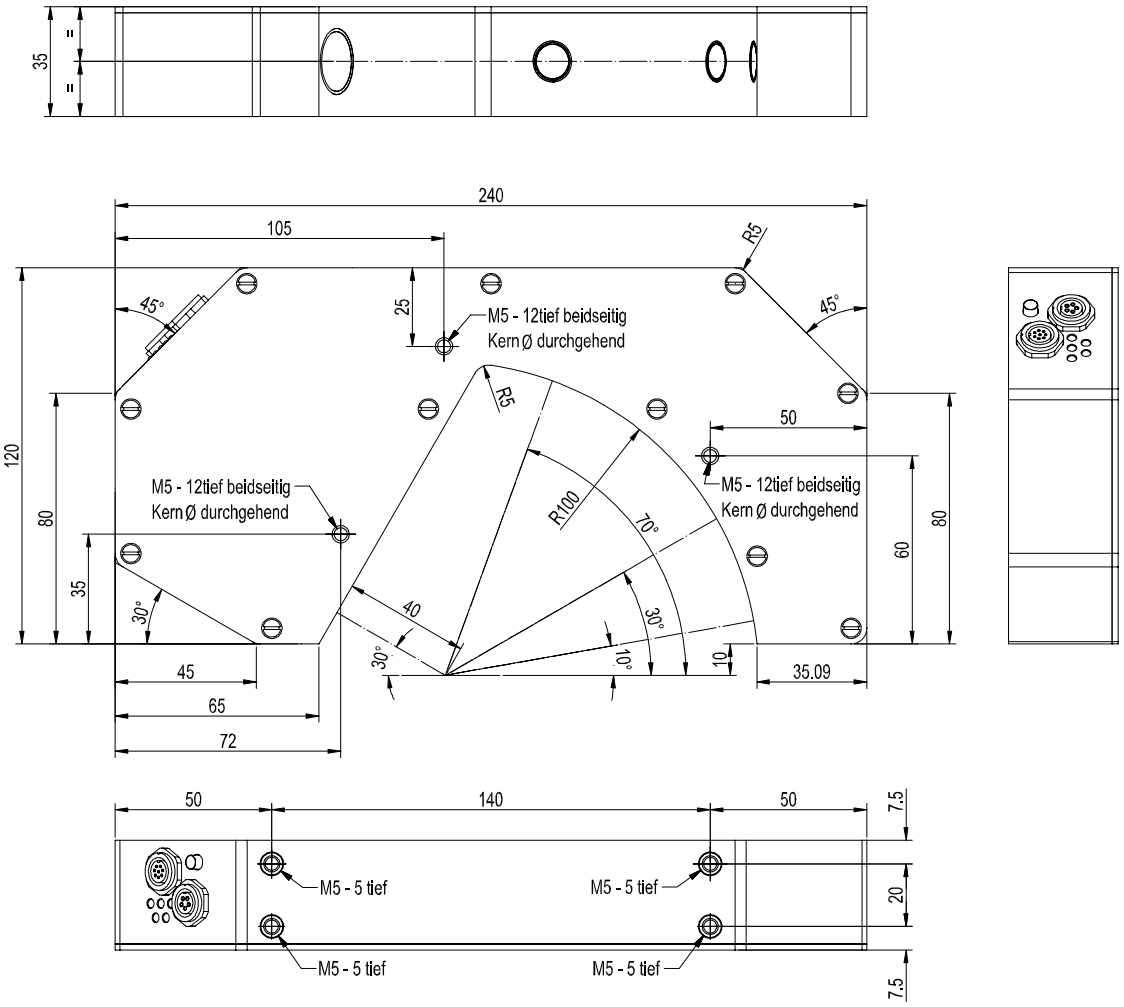
**Connection of RLS-GD-60 to PLC:**

| **8-pole female connector (type Binder 712)**<br>***RLS-GD-60/PLC*** | |  |
|---|---|---|
| **Pin No.:** | **Color:** | **Assignment:** |
| 1 | wht | 0V (GND) |
| 2 | brn | +12VDC .. +30VDC |
| 3 | grn | IN0 |
| 4 | yel | OUT0 (Digital 0: Type 0 … 1V, Digital 1: Type +Ub – 10%) |
| 5 | gry | OUT1 (Digital 0: Type 0 … 1V, Digital 1: Type +Ub – 10%) |
| 6 | pnk | OUT2 (Digital 0: Type 0 … 1V, Digital 1: Type +Ub – 10%) |
| 7 | blu | OUT3 (Digital 0: Type 0 … 1V, Digital 1: Type +Ub – 10%) |
| 8 | red | OUT4 (Digital 0: Type 0 … 1V, Digital 1: Type +Ub – 10%) |

# 4 Technical Data of RLS-GD-60 sensor

| Model | RLS-GD-60 |
|---|---|
| Light source | 1x white light LEDs, AC-operation |
| Light spot size | in 10 mm distance: typ. Ø 15 mm (beam divergency typ. 1°) |
| Optical filter | Daylight filter (clear glass filter KG2) |
| Voltage supply | +12VDC ... +30VDC, reversed polarity protected, overcurrent protected |
| Pulsating light operation | 100 kHz |
| Ambient light | up to 5000 Lux |
| Enclosure rating | IP54 |
| Current consumption | typ. 110 mA |
| Interface | RS232, parameterisable under Windows® |
| EMC test acc. to | IEC - 801... CE |
| Type of connector | Connection to PLC: 8-pole female connector Binder Series 712,<br>connection to PC: 5-pole female connector Binder Series 712 |
| Operating temperature | -20°C ... +55°C |
| Storage temperature | -20°C ... +85°C |
| Housing | Aluminum, anodized in blue |
| Max. switching current | 100 mA, short-circuit-proof |
| Switching frequency | typ. 5 kHz (depends on averaging) |
| Output DIGITAL (5x) | Output OUT0 ... OUT4: Qinv or Q, adjustable via PC:<br>Qinv: npn n.c. / pnp n.o.<br>Q: pnp n.c. / npn n.o. |
| Sensitivity<br>(switching threshold) | parameterisable under Windows® (adjustable: threshold / tolerance window) |
| Pulse lengthening | 0 ms ... 100 ms |
| Working distance | typ. 10 mm ± 10% |
| Luminous power | adjustable under Windows® |
| Averaging | max. 32000 values (adjustable under Windows®) |
| Switching state indication | by means of 5 yellow LED |

# 5 Dimensions of RLS-GD-60 sensor




Dimensions in mm

# 6 RS232 communication protocol

| RS232 communication protocol PC ⇔ RLS-GD-60 Sensor (RLS-GD-Scope V1.0) |
|---|
| - Standard RS232 serial interface without hardware-handshake<br>- 3-wire: GND, TX0, RX0<br>- Speed: 19200 baud, 8 data-bits, no parity-bit, 1 stop-bit in binary mode, us (unsigned), MSB (most significant byte) first.<br>The control device (PC or PLC) has to send a data frame of 18 words to the RLS-GD-60 hardware. All bytes must be transmitted in binary format (us, MSB). The meaning of the parameters is described in the software manual RLS-GD-Scope.<br>Info: 1 word = 2 bytes<br>Method:<br>The RLS-GD-60 hardware is permanently reading (polling) the incoming byte at the RS232 connection. If the incoming word = 0x0055 (synch-word), then the 2. word (order-word) is read in, after this, 16 words (parameters) will be read.<br>After reading in the completely data frame, the RLS-GD-60 hardware executes the order which is coded at the 2. word (order-word). |

| Format of the data frame: | | | |
|---|---|---|---|
| **Word No.** | ***Format*** | **Meaning:** | **Comment:** |
| 1 | Word | sync-word = 0x0055 | hex-code 0x0055, binary: 0000 0000 0101 0101, synchronisation word |
| 2 | Word | **ORDER NUMBER** | order word |
| 3 | Word | parameter POWER | LED intensity (0 ... 1000) Attention intensity in thousendth! |
| 4 | Word | parameter PMOD | LED mode STAT, DYN (0, 1) |
| 5 | Word | parameter AVERAGE | Signal averaging 1,2,4,8,16,32,64,128,256,512,1024,2048,4096,8192,16384 or 32768 |
| 6 | Word | parameter EVAL MODE | Evaluation mode FIRST HIT, MINIMAL DIST, EXT TEACH, CONTRAST 20DEG, CONTRAST 60DEG, CONTRAST 80DEG, CONTRAST ALL, GF 60DEG coded to (0,1,2,3,4,5,6,7) |
| 7 | Word | parameter HOLD[ms] | Hold time 0,1,2,3,5,10,50 or 100ms coded to (0,1,2,3,5,10,50 or 100) |
| 8 | Word | parameter INTLIM | Lower intensity limit (0 ... 4095) |
| 9 | Word | parameter MAXVEC-No. | Number of the vectors (1,2,3,…,31) |
| 10 | Word | parameter OUTMODE | Function of the digital output (0=direct/HI, 1=binary, 2=direct/LO) |
| 11 | Word | parameter TRIGGER | Trigger mode CONT or EXT (0 or 1) |
| 12 … 18 | Word | free | Must be sent as dummy (e.g. 7x value 0) |

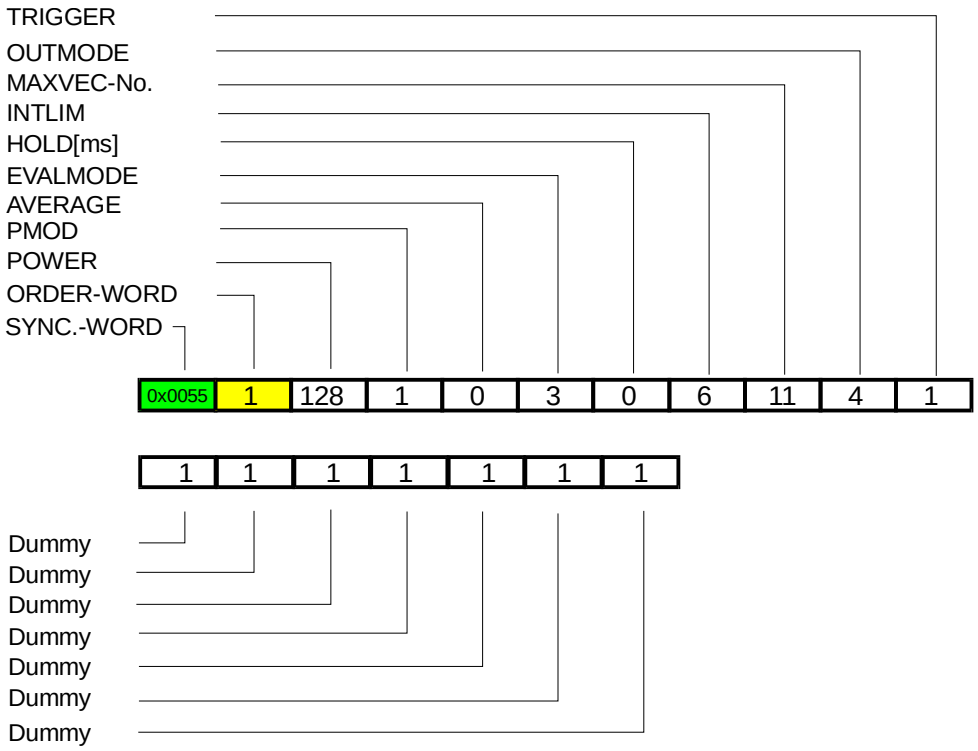
| Value | ORDER NUMBER (parameter byte no. 2) | |
|---|---|---|
| 0 | nop | no operation |
| 1 | Save parameter from PC into RAM | volatile: 18 words PC⇒RLS-GD-60 |
| 2 | Save one selectable line of TEACH TABLE into RAM | volatile: 18 words PC⇒RLS-GD-60 |
| 3 | Send parameter from RAM to PC | 171 words binary RLS-GD-60 ⇒ PC |
| 4 | Send parameter from EEPROM to RAM + to PC | 171 words binary RLS-GD-60 ⇒ PC |
| 5 | Send data from RAM to PC (20DEG,60DEG,80DEG,X,Y,INT,COL,GF, 8 Dummies) | 16 words binary RLS-GD-60 ⇒ PC |
| 6 | Save parameter from RAM to EEPROM | 18 words PC⇒RLS-GD-60 |
| 7 | Send connection OK to PC | 48 words binary RLS-GD-60 ⇒ PC |
| 20 | Send line ok = 0x0055, 0x0014, 0x00AA to PC | 3 words binary RLS-GD-60 ⇒ PC |

**Example 1: DATA FRAME with ORDER NUMBER = 1:**

ORDER NUMBER (second word = **1**): **WRITE parameters from PC into RAM of the RLS-GD-60!**

**The completely data frame = 18 words must be sent to the RLS-GD-60 hardware in binary form (sync-word / order-word / 16 parameter words).**

**Fill unused words of the TEACH VECTOR by value word=1 in binary form.**

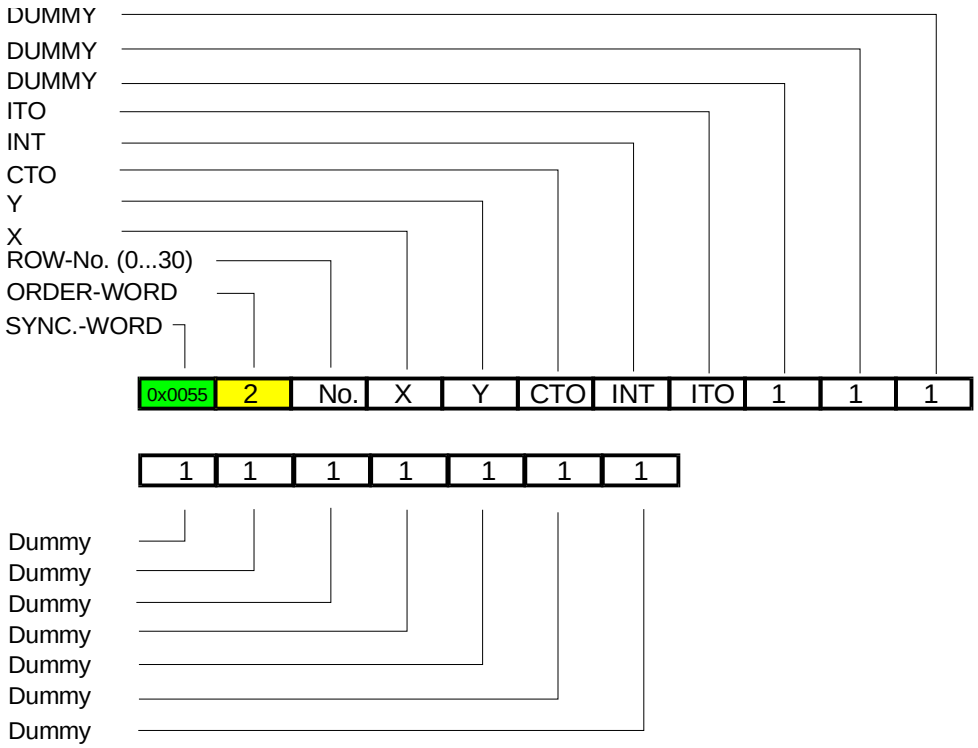


**Example 2: DATA FRAME with ORDER NUMBER = 2:**

ORDER NUMBER (second word = **2**): **WRITE one selectable line (vector) of TEACH TABLE into RAM of the RLS-GD-60!**

**The completely data frame = 18 words must be sent to the RLS-GD-60 hardware in binary form (sync-word / order-word / 6 parameter words = vector, 10 dummies).**

**Fill unused words of the TEACH VECTOR by value word=1 in binary form.**



**Example 3: DATA FRAME with ORDER NUMBER = 3:**

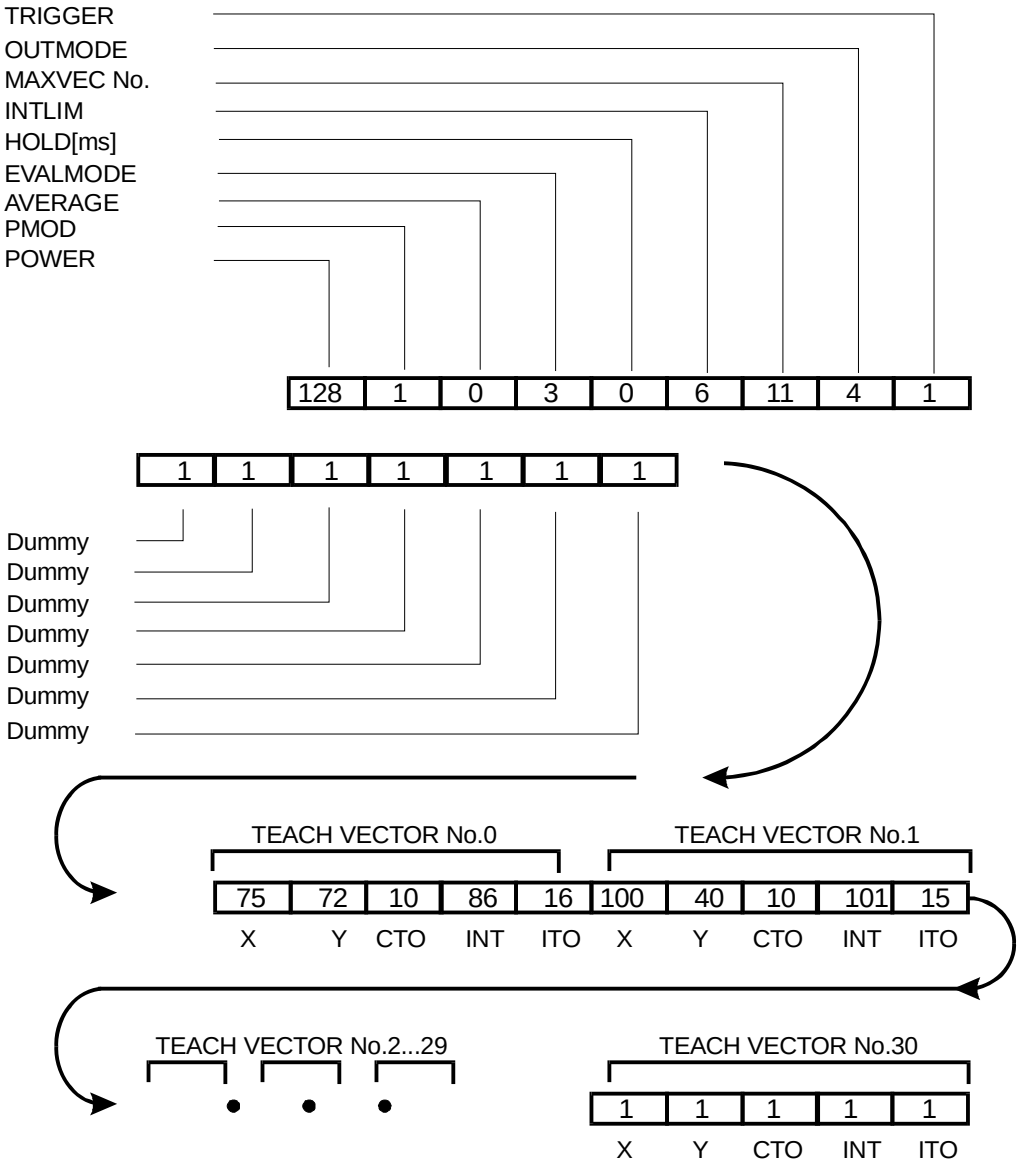
ORDER NUMBER (second word = **3**): **READ parameters out of RLS-GD-60 RAM memory!**

The complete DATA FRAME which is responded by the RLS-GD-60 hardware **is 171 words** long.

**DATA FRAME PC → RLS-GD-60 (18 WORDS)**

**The same frame as example 1 must be sent to the RLS-GD-60 hardware except of the order word that must be 3. The values for the parameters must be sent as Dummies.**

**DATA FRAME RLS-GD-60 → PC (171 WORDS)**



**Example 4: DATA FRAME with ORDER NUMBER = 4:**

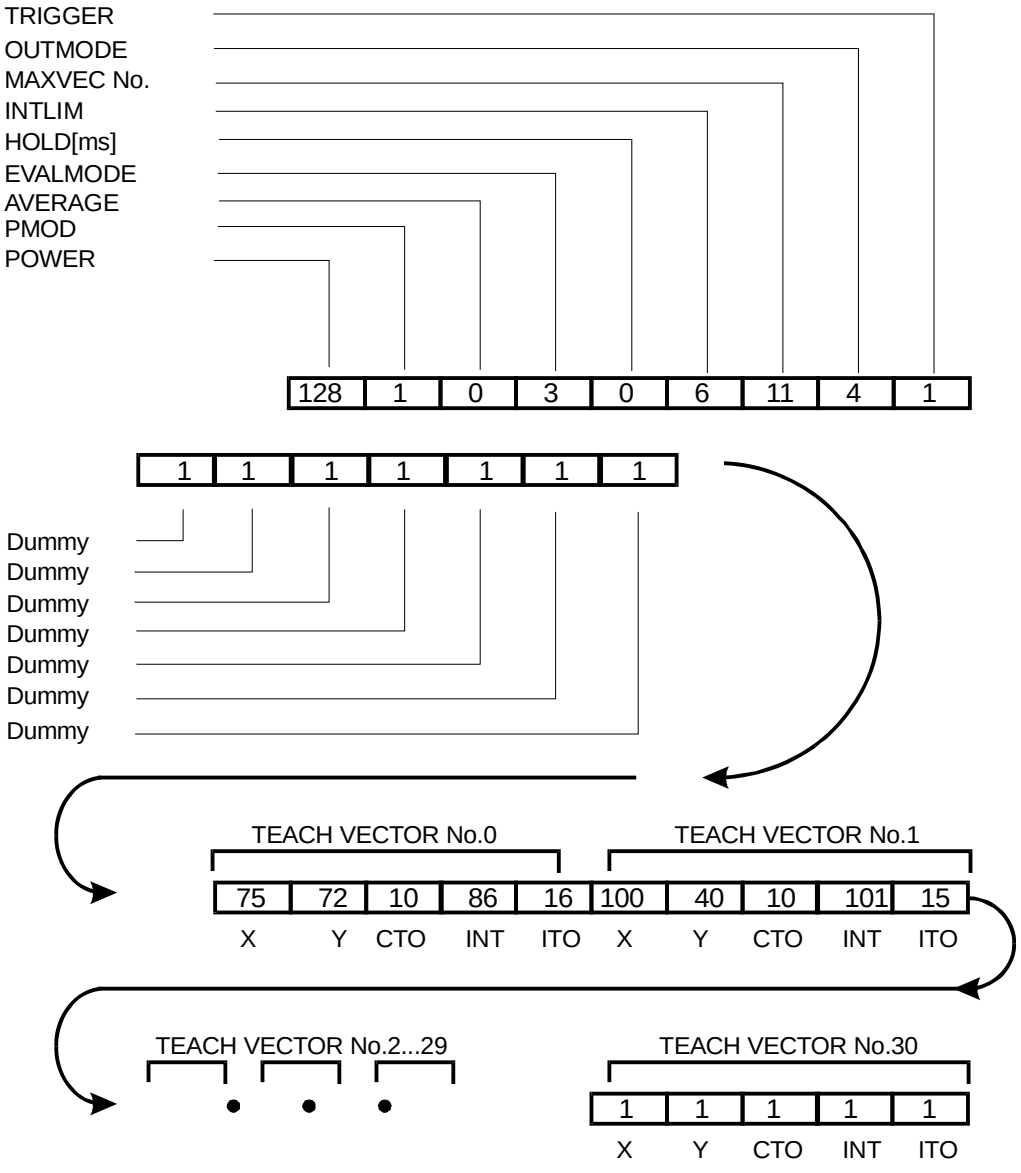
ORDER NUMBER (second word = **4**): **READ parameters out of RLS-GD-60 EEPROM memory!**

The complete DATA FRAME which is responded by the RLS-GD-60 hardware **is 171 words** long.

**DATA FRAME PC → RLS-GD-60 (18 WORDS)**

**The same frame as example 1 must be sent to the RLS-GD-60 hardware except of the order word that must be 4. The values for the parameters must be sent as Dummies.**

**DATA FRAME RLS-GD-60 → PC (171 WORDS)**



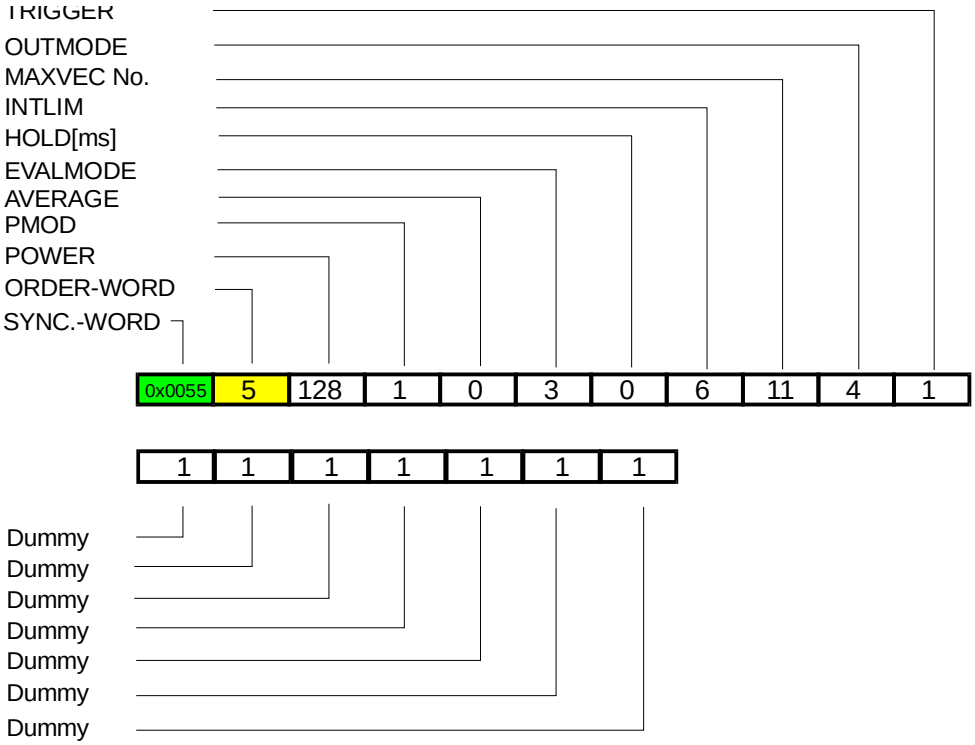
**Example 5: DATA FRAME with ORDER NUMBER = 5:**

ORDER NUMBER (second word = **5**): **READ RLS-GD-60 RAW DATA**

**DATA FRAME PC → RLS-GD-60 (18 WORDS)**

**Parameters must be sent for a constant parameter frame as dummies.**

**At order word 5 they do not affect the RAM or EEPROM.**



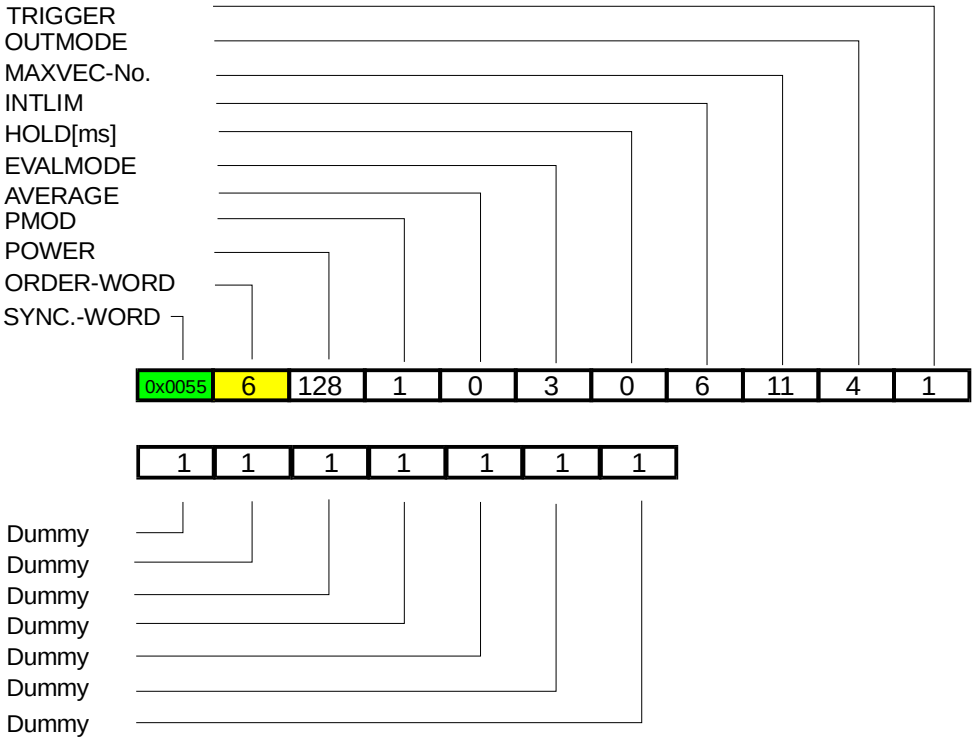

After sending this frame the sensor writes back 16 RAW DATAS.

**Example 6: DATA FRAME with ORDER NUMBER = 6:**

ORDER NUMBER (second word = **6**): **SAVE parameters from RAM to EEPROM of the RLS-GD-60!**

**The completely data frame = 18 words must be sent to the RLS-GD-60 hardware in binary form (sync-word / order-word / 16 parameter words).**

**Fill unused words of the TEACH VECTOR by value word=1 in binary form.**




After sending this data frame the sensor saves all the parameters and teach vectors from its RAM (volatile memory) to its EEPROM (non-volatile memory).

**Attention:**
The right parameters and teach vectors must be in the RAM of the sensor. To save the parameters and teach vectors into the RAM use **example 1** and **example 2**.

| **Example 7: DATA FRAME with ORDER NUMBER = 7:** |
|---|
| ORDER NUMBER (second word = **7**): **SEND CONNECTION OK from the RLS-GD-60 to PC!**<br><br>Cf. **example 1:**<br>Send the same DATA FRAME but with ORDER NUMBER 7 to the sensor.<br>The sensor will reply with 48 words which tell the version of the sensor. |

| **Example 8: DATA FRAME with ORDER NUMBER = 20:** |
|---|
| ORDER NUMBER (second word = **20**): **SEND LINE OK from the RLS-GD-60 to PC!**<br><br>**Cf. example 1:**<br>Send the same DATA FRAME but with ORDER NUMBER 20 to the sensor.<br>The sensor will reply with 3 words which tell that there is a connection. |