Manual
Software RLS-GD-2REF-Scope V4.8

(PC software for Microsoft® Windows® 7, 8, 10)

for gloss detection sensors of the RLS-GD series

This manual describes the installation of the PC software for the RLS-GD 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 sensor can be "taught" up to 31 gloss factors or normalized vectors. Evaluation always is performed with 12 bits. With the help of a modulated white-light LED a white light spot is projected onto the surface to be inspected.

Part of the light directly reflected by the object to be measured is directed onto a photodiode by means of an optical receiver unit (the optical receiver unit is arranged to the vertical plane at the same angle as the optical transmitter unit). Furthermore, diffuse reflection is determined by way of an additional optical unit.

Gloss detection either operates continuously or is started by an external PLC trigger signal. The gloss factor or the detected normalized vector is output at the 5 digital outputs OUT0 to OUT4, or it can be sent analog either to the voltage output 0…+10V or to the current output 4…20mA. At the same time the detected gloss factor is visualised by means of 5 LEDs at the housing of the RLS-GD.

With the TEACH button at the sensor housing the sensor can be taught the currently detected gloss factor or the normalized vector. 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 sensor. All the parameters for gloss grade detection and normalized vector detection can be stored in the non-volatile EEPROM of the RLS-GD sensor. When parameterization is finished the gloss sensor continues to operate with the current parameters in "stand alone" mode without a PC.

In order to perform gloss factor detection the sensor must be calibrated. For this purpose, a black glass inlay is required which by definition has a gloss factor of 100. Calibration is then performed with the help of the PC software. The sensor also can be calibrated to a second reference surface. The calibration values that should be used can then be selected through the input. It is also possible to perform calibration to other systems. This calibration can be activated or deactivated with the PC software.

The sensor is factory-temperature-compensated. It is stable over a temperature range from 10 degrees to 60 degrees centigrade.

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1 Installation of the RLS-GD-2REF-Scope software

The following requirements must be fulfilled for successful installation of the software:

- Microsoft® Windows® 7, 8, 10
- IBM PC AT or compatible
- VGA graphics
- Microsoft-compatible mouse
- Serial RS232 interface at the PC or USB slot or RJ45 connector
- Cable *cab-las5/PC* for the RS232 interface or *cab-5/USB* USB converter or *cab-5/ETH* Ethernet converter

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.

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2 Operation of the RLS-GD-2REF-Scope software

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

Pressing the right mouse button on an individual element will call up a short help text.

When the RLS-GD-2REF-Scope software is started, the following window appears on the Windows interface:

TIP! To avoid problems with the handling of the file path, it is advisable to run the software as administrator. You can either set this in the **Properties** under **Compatibility** or you start the software with a right click and choose **"Run as administrator"**.
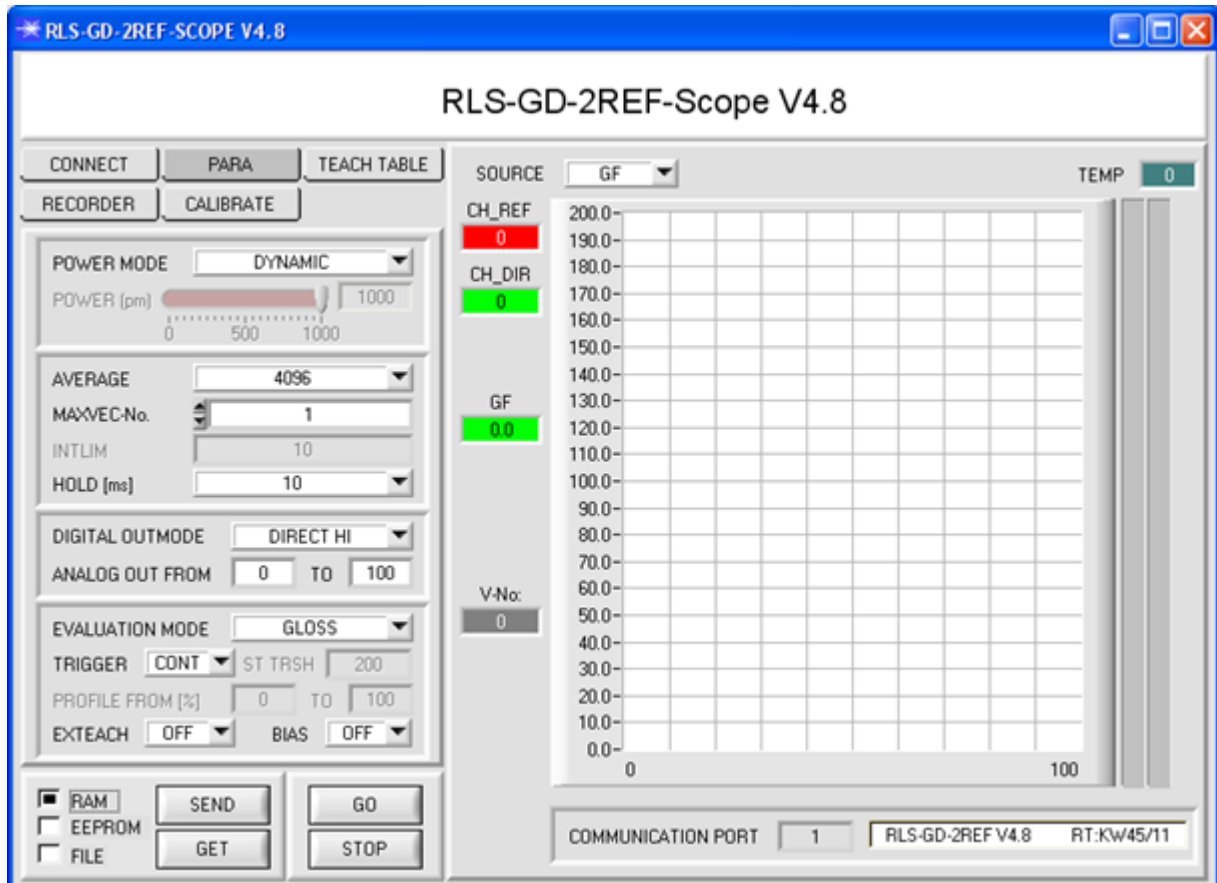
2.1 Tab CONNECT

CONNECT:
Pressing the **CONNECT** tab opens a window for selecting and configuring the interface.

The **COMMUNICATION PROTOCOL** function field is used for selecting either an **RS232** or a **TCP/IP** protocol.
If **RS232** is selected, a port from 1 to 256 can be selected with **SELECT COM PORT**, depending on which port the sensor is connected to.
The sensor operates with a set baudrate that can be modified with **CHANGE BAUDRATE** (see below). The sensor and the user interface both must operate with the same baudrate. At the user interface the baudrate is set with **SELECT BAUDRATE**. If after starting the software should not automatically establish a connection, the correct baudrate can be found with **SELECT BAUDRATE**.
If an adaptor is used, the **COM PORT** number can be determined by way of the hardware manager in the system control panel.
If the sensor should communicate through a local area network, an RS232 to Ethernet adaptor will be needed. This adapter makes it possible to establish a connection to the sensor with the **TCP/IP** protocol.
The network adaptors that are available from us are based on the Lantronix XPort module. For parameterising these adapters (assigning of an IP address, setting of the Baud rate of 19200) please download the "DeviceInstaller" software that is provided free of charge by Lantronix at http://www.lantronix.com/. DeviceInstaller is based on Microsoft's ".NET" framework. Detailed operating instructions for the "DeviceInstaller" software also are available from Lantronix.

In order to establish a connection to the adaptor, its IP address or HOST name must be entered in the field **IP ADDRESS (xxx.xxx.xxx.xxx) OR HOST NAME**. The DROP DOWN menu (down arrow) shows the last 10 IP addresses that were used. An address from this list can be directly selected by clicking on the respective item. The DROP DOWN list is saved and is thus always available when the software is closed.
The **PORT NUMBER** for the XPort-based network adaptors is 10001. This port number must not be changed.
When you press the **TRY TO CONNECT** button, the software tries to establish a connection with the set parameters. The communication status is shown in the display field. If the sensor answers with its FIRMWARE ID, the set connection type can be accepted by pressing **ACCEPT SETTINGS**. You will then be returned to the **PARA** tab. If you get a **TIMEOUT** message, the software could not establish a connection to the sensor. In this case please check if the interface cable is correctly connected, if the sensor is supplied with power, and if the set parameters are correct.
If a connection has been accepted by pressing **ACCEPT SETTINGS**, the software starts automatically with these settings when called the next time.

⚠ ATTENTION !	**The stable function of the interface is a basic prerequisite for measured value transfer from the PC to the Sensor.** **Due to the limited data transfer rate through the serial RS232 interface only slow changes of the raw signals at the sensor front end can be observed in the graphic output window of the PC.** **For maintaining maximum switching frequency at the sensor data communication with the PC must be stopped (press the STOP button).**

The baudrate for data transfer through the RS232 interface can be set by means of the **SELECT BAUDRATE** drop down menu and **CHANGE BAUDRATE** function field.
This is necessary if a high-speed connection is needed for data transfer through the serial interface.

If the baudrate should be changed, a connection must first be established by clicking on **TRY TO CONNECT**.
The **CHANGE BAUDRATE** button will then be active.

Now a new baudrate can be selected under **SELECT BAUDRATE**.
A click on **CHANGE BAUDRATE** sends the new baudrate information to the sensor.

When the new baudrate information has been successfully sent, the sensor operates with the new baudrate. A window will pop up, prompting you to select **EEPROM** and then to press **SEND**. After a hardware reset the new baudrate only will be used when **EEPROM** and **SEND** have been pressed.

A click on **ACCEPT SETTINGS** saves the current interface settings, which will then be automatically set when the software is restarted.

2.2 Tab PARA, button SEND, GET, GO, STOP

PARA:
Pressing the PARA tab opens a window for setting the sensor parameters.

ATTENTION!
A change of the parameter function groups only becomes effective at the sensor after actuation of the SEND button in the MEM function field!

SEND [F9]:
When the SEND button is clicked (or with shortcut key F9), all the currently set parameters are transferred between PC and sensor. The target of the respective parameter transfer is determined by the selected button (RAM, EEPROM, or FILE).

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

RAM:
After a click on the SEND button the current parameters are written into the RAM memory of the sensor, or they are read from the RAM by clicking on the GET button, i.e. these parameters are lost when the voltage at the sensor is switched off.

EEPROM:
After a click on the SEND button the current parameters are written into the non-volatile memory of the EEPROM in the sensor, or they are read from the EEPROM by clicking on the GET button, i.e. the parameters in the internal EEPROM are stored when the voltage at the sensor is switched off.

FILE:
After pressing SEND, the current parameters can be written to a selectable file on the hard disk. With GET parameters can be read from such a file. When the SEND or GET button is pressed, a dialog box opens for selecting the desired file.
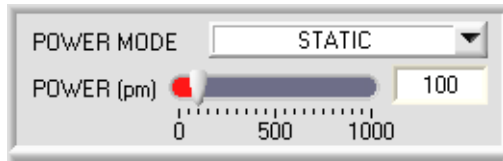
GO [F11]:
A click on this button (or pressing shortcut key F11) starts data transfer from the sensor to the PC through the serial RS232 interface.
SOURCE is used to select which signals should be shown in the displays and graphs.

STOP [F12]:
A click on this button (or pressing shortcut key F12) stops data transfer from the sensor to the PC through the serial RS232 interface.

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

STATIC:
The LED transmitter power is constantly kept at the value set with the POWER slider. This operation mode is the recommended if EVALUATION MODE = NORM_INT is selected.

DYNAMIC:
The LED transmitter power is dynamically controlled in accordance with the amount of radiation that is diffusely reflected from the object. By using the intensities measured at the receivers the automatic control circuit attempts to adjust the transmitter power in such a way that the dynamic range is not exceeded. This operation mode is the recommended if EVALUATION MODE = GLOSS is selected.

POWER [pm]:
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‰ means full intensity at the transmitter LED, a value of 0 stands for the lowest transmitter intensity adjustment! With dynamic transmitter power the POWER slider is not active, because the sensor automatically regulates the LED power.
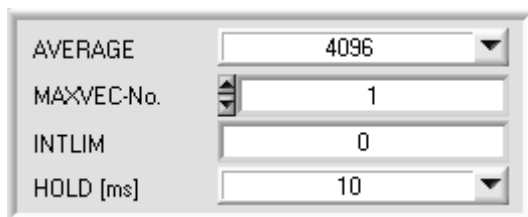
AVERAGE:
This function field is used for adjusting the number of scanning values (measurement values) over which the raw signals measured at the receivers are averaged. A higher AVERAGE default value reduces noise of the raw signals at the receiver unit and there will be a decrease of the maximal available switching frequency of the RLS-GD sensor.

MAXVEC-No.:
This function field serves for setting the number of gloss degrees or normalized vectors to be checked.
In the BINARY modus the maximum number of gloss degrees to be checked is 31. In the DIRECT HI or DIRECT LO modus the maximum number of gloss degrees to be checked is 5 (No. 0,1,2,3,4). The numerical value set here determines the currently possible scanning rate of the sensor. The less the vectors to be checked, the faster the operation of the RLS-GD sensor.
The numerical value set here refers to the number of rows (starting with row 0) in the → TEACH TABLE.

INTLIM:
This edit box is used for setting an intensity limit. Gloss evaluation is stopped, if the current intensity INT=(CH_L+CH_C_+CH_R)/3 arriving at the receiver unit falls below this limit, and ERROR STATE (V-No.: =255) is output.
INFO:
The INTLIM functionality only is available in EVALUATION MODE NORM_INT.
This function field has no effect when the EVALUATION MODE GLOSS is used.

HOLD:
The RLS-GD sensor operates with minimum scanning times in the magnitude of less than 150µs. This is why most of the PLC 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 sensor pulse lengthening of up to 100 ms can be set by selecting the corresponding HOLD value.

DIGITAL OUTMODE:
This group of buttons offers the method of how to control the 5 digital outputs.

BINARY:
If in this row-by-row comparison the current gloss grades or normalized vectors correspond with the teach-in parameters entered in the TEACH TABLE, this gloss factor or normalized vector in the TEACH TABLE is displayed as a vector number (V-No.) and is sent to the digital outputs (OUT0 ... OUT4) as a **bit pattern**.
The maximum number of gloss factors or normalized vectors to be taught is 31.

DIRECT:
In this mode the maximum number of gloss factors or normalized vectors to be taught is 5.
If in this row-by-row comparison the current parameters correspond with the teach-in parameters entered in the TEACH TABLE, this gloss factor or normalized vector in the TEACH TABLE Is displayed as a vector number (V-No.) and is sent **direct** to the digital outputs (OUT0 ... OUT04).I

DIRECT HI:
If **DIRECT HI** is activated and if a line vector (V-no.: 0…4) is detected in the TEACH TABLE, the special digital output (OUT0 … OUT4) is set to HI. If no line vector was detected, the digital outputs are in LO status (no LED is lighting).

DIRECT LO:
If **DIRECT LO** is activated and if a line vector (V-no.: 0…4) is detected in the TEACH TABLE, the special digital output (OUT0 … OUT4) is set to LO, while the other ones are set to HI. If no line vector was detected, the digital outputs are in HI status (all LEDs are lighting).
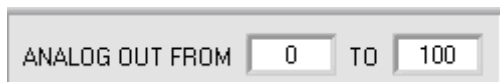
ANALOG OUT FROM:
These function groups are used for selecting the output mode of the analog outputs.

The gloss sensor features a 4 to 20mA current output and a 0 to 10V voltage output.
Depending on the model the gloss sensor can measure a gloss factor of up to 2000 GU (Gloss Units).
The calculated NORM can have values between 0 and 1000.
Depending on the EVALUATION MODE, either the gloss factor or the norm value will be output in analog form.
The above function field is used to inform the sensor about the sector of the total measuring range that should be output (zoom function).

Example 1: ANALOG OUT FROM 0 TO 100 :

Gloss factor in GU (Gloss Unit)	Voltage output	Current output
25	2,5 V	8mA
75	7,5V	16mA

Example 2: ANALOG OUT FROM 0 TO 50 :

Gloss factor in GU (Gloss Unit)	Voltage output	Current output
25	5 V	12mA
75	10V (out)	20mA (out)

Example 3: ANALOG OUT FROM 50 TO 100 :

Gloss factor in GU (Gloss Unit)	Voltage output	Current output
25	0 V (out)	4mA (out)
75	5V	12mA

Example 4: ANALOG OUT FROM 0 TO 2000 :

Gloss factor in GU (Gloss Unit)	Voltage output	Current output
250	1,25 V	6mA
750	3,75V	10mA

EVALUATION MODE:
The gloss sensor can be operated with two different evaluation modes.

NORM_INT:
Only the channels CH_DIR (direct reflection) and CH_DIF (diffuse reflection) are used for evaluation.
From the two values of CH_DIR and CH_DIF a NORM signal and an INTENSITY are calculated and evaluated.

GLOSS:
The channels CH_REF (reference channel) and CH_DIR (direct channel) are used for evaluation. Before this evaluation mode can be used, however, the sensor must be calibrated (see below).
After successful calibration the sensor determines the gloss factor of the respective surface and outputs this in digital and analog form.

EXTERN TEACH:
When EXTERN TEACH is activated, the currently present gloss factor or normalized vector (depending on EVALMODE) can be written to the TEACH TABLE by way of the external IN0 input or the TEACH button. The currently present line vector is automatically taken over, starting with line 0, in as many lines as is set in MAXVEC-No..

The advantage is that the user does not have to start the parameterisation software for this purpose.

Please note that when this evaluation mode is selected, the tolerances must at the beginning be stored once to the EEPROM.

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

EVALUATION MODE = NORM_INT

	NORM	N TOL	INT	I TOL
0	1	25	1	20
1	1	50	1	40
2	1	100	1	80
3	1	200	1	100
4	1	1	1	1

EVALUATION MODE = GLOSS

	GF	GF TOL		
0	0.0	2.5	0.0	0.0
1	0.0	5.0	0.0	0.0
2	0.0	7.5	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0

ATTENTION!
When the EXTERN TEACH mode is activated, external triggering with EXT1, EXT2, EXT3, EXT4, and 2 REF is not possible, because the sensor only has one input.

The TRIGGER function field will no longer be active.
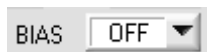
BIAS:
In evaluation mode **GLOSS**, the gloss factor value can be influenced by means of **BIAS**.
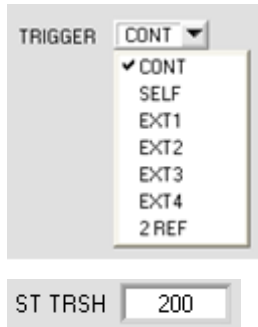
If **BIAS = FCAL** (Factory Calibration) is chosen, the gloss sensor works with the values calibrated by the manufacturer (factory produced).

The sensors can be calibrated to other systems. This function is activated with **BIAS = OCAL** (Other Calibration).
For details see below under BUTTON CALIBRATE.

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

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

SELF: As long as the **CH_DIR** channel is higher than **ST TRSH** (Self Trigger Threshold), measurement values are recorded in an internal buffer. Once **CH_DIR** is lower than **ST TRSH** again, a mean value is determined from the number of recorded measurement values, and this mean value is then output.
As long as the sensor is internally "triggered" the outputs are held at binary 30. When the internal trigger has dropped, the vector that is detected again or the error status is output. This is necessary for detecting a trigger event through the outputs.

PLEASE NOTE! With **TRIGGER=SELF** and **OUTMODE=BINARY** row 30 must not be assigned, because otherwise there will not be a change of the outputs when vector 30 is detected. The same applies to **OUTMODE=DIRECT LO** and vector 0.
Otherwise this mode exactly corresponds with the functionality of **EXT3**, the only difference is the type of triggering. **SELF** means self-triggering, and **EXT3** means external triggering through the physical IN0 input.

EXT1: Evaluation is started through the external trigger input (IN0 pin3 green of cable cab-las8/SPS) or through clicking the TEACH button at the sensor housing. A trigger event is recognized as long as +24V is present at the IN0 input (HIGH active).
While IN0 is high (+24V), the detected states (vectors) are output, too.
After the trigger input goes to LOW again, the state (V-No.:) that was last detected will be held at the outputs.

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

EXT3: As long as input IN0 is high (+24V), measured values are recorded in an internal buffer. When the input has dropped again, an average is formed from the number of the recorded measured values and is then output. Please note here that the first 10 percent and the last 10 percent of the recorded values are discarded.
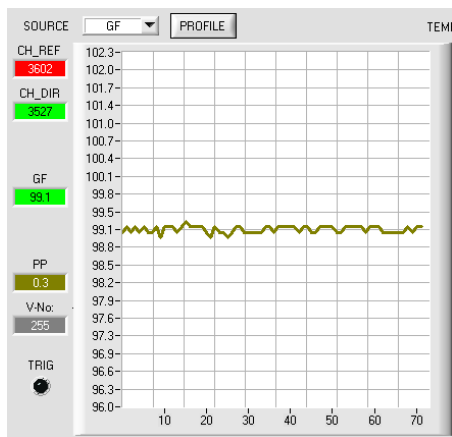
Pressing the **PROFILE** button shows the internally recorded buffer that is used for evaluation on the graphic display. The display furthermore shows **PP**, the peak-to-peak value.
A double-click with the left mouse button performs automatic scaling of the X and Y axes. A single click with the left mouse button cancels this scaling again.

In **NORM_INT** evaluation mode the peak-to-peak value is only visualised.
In **GLOSS** evaluation mode **PP** is used for evaluation. An error signal will be output if the current **PP** value is higher than **PP TOL**. Reason: A high variation in a profile might be averaged in such a way that the gloss factor fits, although the product varies too much.

PROFILE FROM [%] defines the range in which the recorded buffer is evaluated.

EXT4:
The transmission LED is active and evaluation is running as long as input IN0 is high (+24V) or as long as the button at the housing is pressed. When IN0 drops again or the button is released, the last recognised state remains present and the transmission LED goes off.
This trigger mode was introduced to reduce the strain on the transmission LED. If the transmission LED is a UV LED it is recommended to operate with this mode.

2 REF: The sensor can be calibrated to two different surfaces **REF1** and **REF2**.
If **IN0=LO** the sensor operates with the calibration values of **REF1**.
If **IN0=HI** the sensor operates with the calibration values of **REF2**.

2.3 Tab TEACH TABLE

Pressing the GO button starts data transfer from the sensor to the PC. The respective CH-REF, CH_DIR components are indicated by the bars beside the graph. The calculated gloss factor GF is visualised in the display.
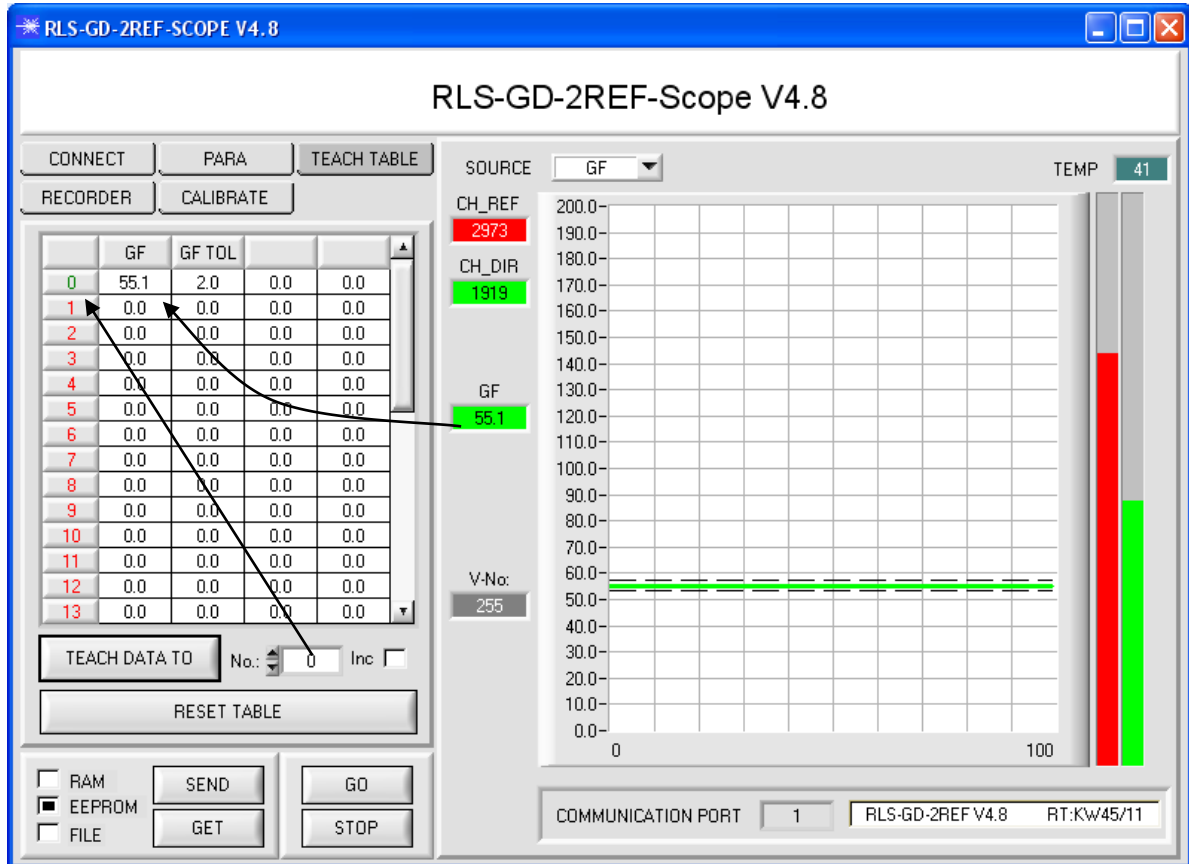
CH_REF, CH_DIR, CH_DIF:
These displays indicate the data that are currently measured at the receiver.
CH_REF = Reference channel
CH_DIR = Direct reflection
CH_DIF = Diffuse reflection
On the right side of the graph the data are additionally visualised in the form of bars.

NORM, INT:
The NORM and INT displays show the norm and intensity values that are calculated from the measurement data.

GF:
This display shows the calculated gloss factor.
The gloss factor is shown in percent.
A double-click on this display calls up a large display.

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. If value 255 is displayed, no value has been detected that corresponds to the values taught to the Teach Table.
A double-click on this display calls up a large display.

TEMP:
This display shows the current temperature that is measured in the sensor housing.
(!!! not in °C)

Please note:	**The above-mentioned output fields are only updated when data transfer between PC and sensor is active (GO button pressed).**

TEACH TABLE:
TEACH TABLE opens a view where vectors can be taught to the **TEACH TABLE**.

Please note: The sensor must be informed about the teach vectors by pressing SEND.

After a left mouse button double click (or with shortcut key 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 rows, i.e. the individual parameters for the teach-in vectors are arranged side by side in the respective row.
The sensor is able to check up to 31 teach-in vectors. The number of the respective teach-in vectors is given in the left column of the table.
Only the green rows are used for evaluation in the sensor. The number of rows to be inspected is set with **MAXVEC-No.** .

When **TEACH DATA TO** is pressed, the currently displayed gloss factor **GF** is transferred to the row in the **TEACH TABLE** that is selected under **No.:** . In addition, a tolerance **(GF TO)** is set. If necessary, the tolerances, as well as the teach value, can be changed as described above.
No.: also is used to select which tolerance window is shown in the graph.

When **Inc:** is activated, and the **TEACH DATA TO** button is pressed, the **No.:** input field is automatically incremented (increased) by 1, i.e. the next row in the TEACH TABLE is selected

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

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

NORM	The current NORM is displayed in the graph (range of values 0 … 1000).
INT	The current intensity is displayed in the graph (range of values 0 … 4096).
GF	The current gloss factor is displayed (range of values 0 … 2000).
RAW	The current raw signals are displayed.

2.4 Tab RECORDER

The RLS-GD-2REF-Scope software features a data recorder that allows the saving of CH_REF, CHD_DIR, CH_DIF, NORM, INT, GF, PP, V-No. and TEMP. The recorded file is saved to the hard disk of the PC and can then be evaluated with a spreadsheet program.

The file that is created has eleven columns and as many rows as data frames were recorded.
A row is structured as follows: Date and time, CH_REF, CHD_DIR, CH_DIF, NORM, INT, GF, PP, V-No., TEMP.

The following steps describe how data frames are recorded with the recorder:
Please note:
Recording depends on the EVALUATION MODE that is chosen. Several EVALUATION MODES do not need certain data, therefore these data will be set to 0, i.e. for these data the value 0 will be recorded.

Step 1:
When the RECORDER button is pressed, the following window will be displayed:
When the SHOW GRAPH button is pressed, a panel will be displayed that allows the user to monitor the different signals.
The individual signals can be activated from the SIGNAL drop-down menu.

RECORD MODE   AUTO LIMITED ▼

RECORD-TIME INTERVAL [sec]   1

RECORD VALUES (MAX 50 000)   1000

TOTAL RECORD TIME (days hours min sec)

| 0 | 0 | 16 | 40 |

RECORDED   REMAINING

| 0 | 1000 |

START RECORD   STOP RECORD

ID

SELECT RECORD FILE   SHOW GRAPH

Filename
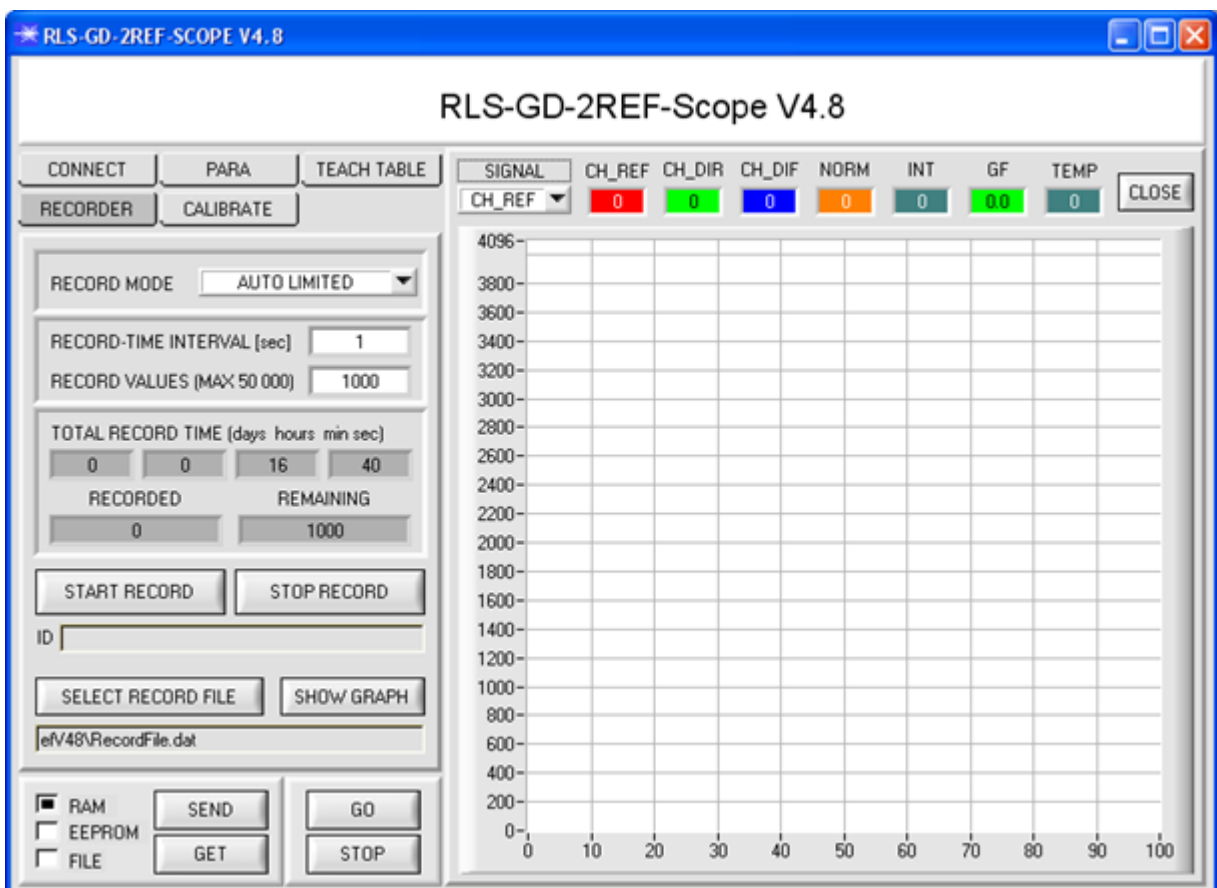
Step 2:
If you want to automatically record several data frames, please select **AUTO LIMITED** under **RECORD MORE**. Enter a time interval for recording under **RECORD-TIME INTERVAL [sec]**, in this example: 1, i.e. a new value is called from the sensor every second).
Then enter the maximum number of values you wish to record in the **RECORD VALUES [MAX 50 000]** field.
Please note: Recording can also be stopped earlier by clicking **STOP RECORD**, the data recorded so far will not be lost.

The **TOTAL RECORD TIME** field indicates how long recording will take (in days, hours, minutes, and seconds) if all data are recorded.

Step 3:
By pressing the button **SELECT RECORD FILE** a file can be selected in which the data frame will be stored.
If you select an already existing file name, you will be asked whether you want to overwrite the existing file or not.

Step 4:
Pressing the START RECORD button starts automatic data recording.

The recorder starts to record data, and the button **START RECORD** is red to indicate that recording is active. The respective data frames are shown in the display windows.

In the two display fields **RECORDED** 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 5:
When as many data frames as set under **RECORD VALUES [MAX 50 000]** have been recorded, or when the **STOP AUTO RECORD** button is pressed, a pop-up window will appear which confirms that the file is stored.

If you want to record an unlimited number of data, select the **AUTO UNLIMITED** function under **RECORD MORE**. Then select the desired recording interval and press **START RECORD**.

If you want to record data "manually", select the **MANUAL RECORDING** function under **RECORD MORE**. You can start reading data from the sensor by pressing the **GO** button. These data are visualised in the display window. Pressing the **CAPTURE DATA FRAME** button saves a data frame in the file that was selected under **SELECT RECORD FILE**. The **RECORDED** field shows the sum of the frames already recorded.

If **AUTO TRIGGERED** is selected under **RECORD MORE**, and **TRIGGER** = **SELF**, **EXT1**, **EXT2**, **EXT3**, **EXT4 or 2 REF** is selected, the sensor will automatically send a data frame after each drop of the trigger when **START RECORD** is pressed. This data frame is captured and recorded by the recorder.
Pressing the **STOP RECORD** button terminates the automatic sending function of the sensor again.

Please note:
When you press START RECORD, the file that is selected under SELECT RECORD FILE will be deleted. With RECORD FRAME MANUALLY, the file will be created if it does not already exist. If the file already exists, the data are added to the existing file.

2.5 Tab CALIBRATE

As any other measuring equipment the sensors of the RLS-GD series must be calibrated from time to time. With the RLS-GD-CAL unit and the software you can perform calibration yourself.
With the **RLS-GD-2REF V4.8** software it is possible to calibrate the sensor to two different surfaces. For this purpose **TRIGGER=2 REF** must be selected.

The following panel will be displayed after a click on CALIBRATE:
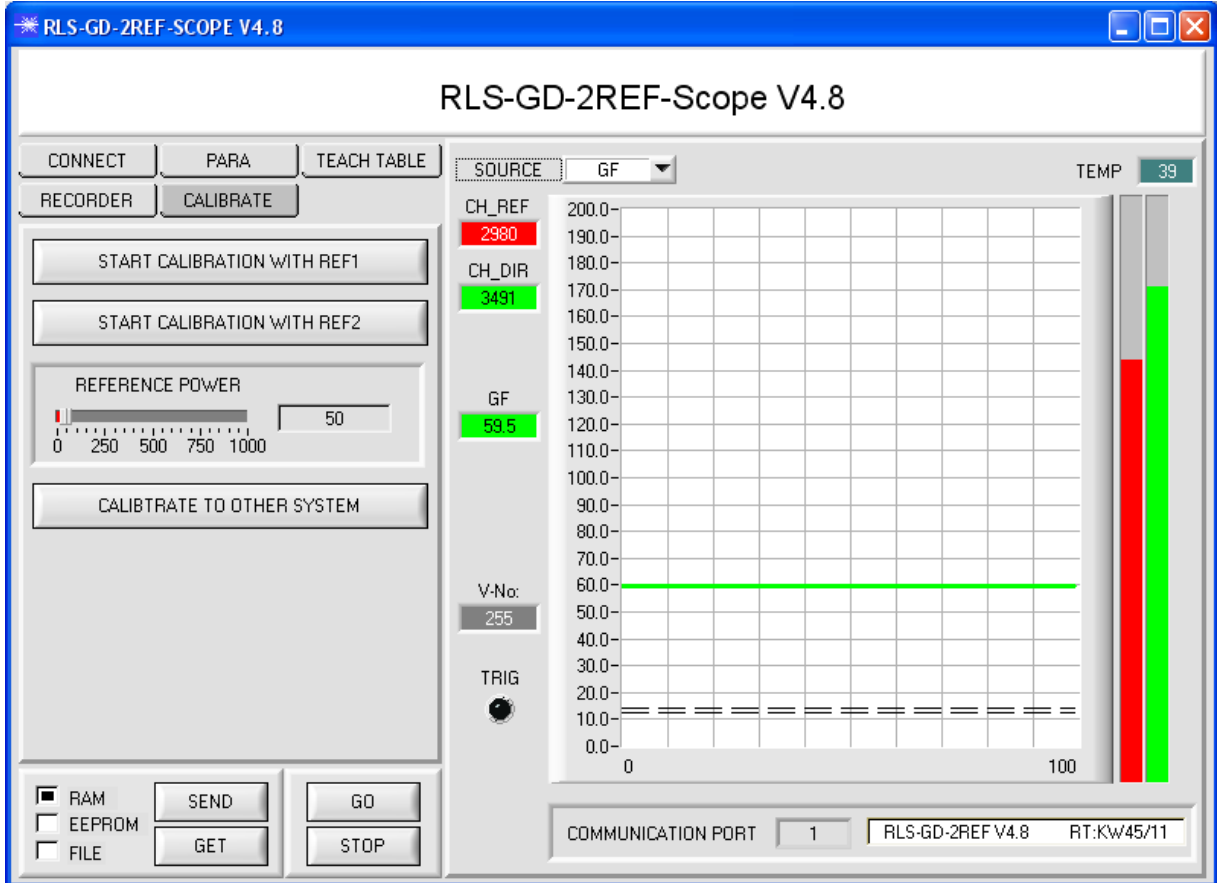
After a click on **START CALIBRATION WITH REF1** the software will ask you to place a reference calibration surface before the sensor. After confirmation with **YES** a suitable POWER value will be set such that channel CH_DIR or CH_REF lies in the upper third of its dynamic range.
If a suitable POWER value could be found the software informs you that calibration is possible and that the corresponding calibration factors have been saved in the EEPROM of the sensor. This means that calibration does not have to be performed every time the sensor is restarted.

When **TRIGGER=2 REF** is selected, an additional button labelled **START CALIBRATION WITH REF2** appears in the **CALIBRATE** tab.
If you then place a second surface before the sensor and click on the **START CALIBRATION WITH REF2** button, the sensor is calibrated to this second surface with 100GU.
The calibration set that the sensor should operate with is selected through input **IN0** or with the **button** at the sensor housing.
If **IN0=LO** the sensor operates with the calibration values of **REF1**.
If **IN0=HI** the sensor operates with the calibration values of **REF2**.

Please note!
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.

CALIBTRATE TO OTHER SYSTEM

CALIBRATE TO OTHER SYSTEM:
After successful calibration, the sensor can be calibrated to another system.
This is necessary, for example, if several systems of the same type should be exactly matched to each other, or the RLS-GD should be matched to another system. Calibration is activated with the parameter **BIAS = ON**. For performing calibration to another system, press the **CALIBRATE TO OTHER SYSTEM** button. The following panel will be displayed:
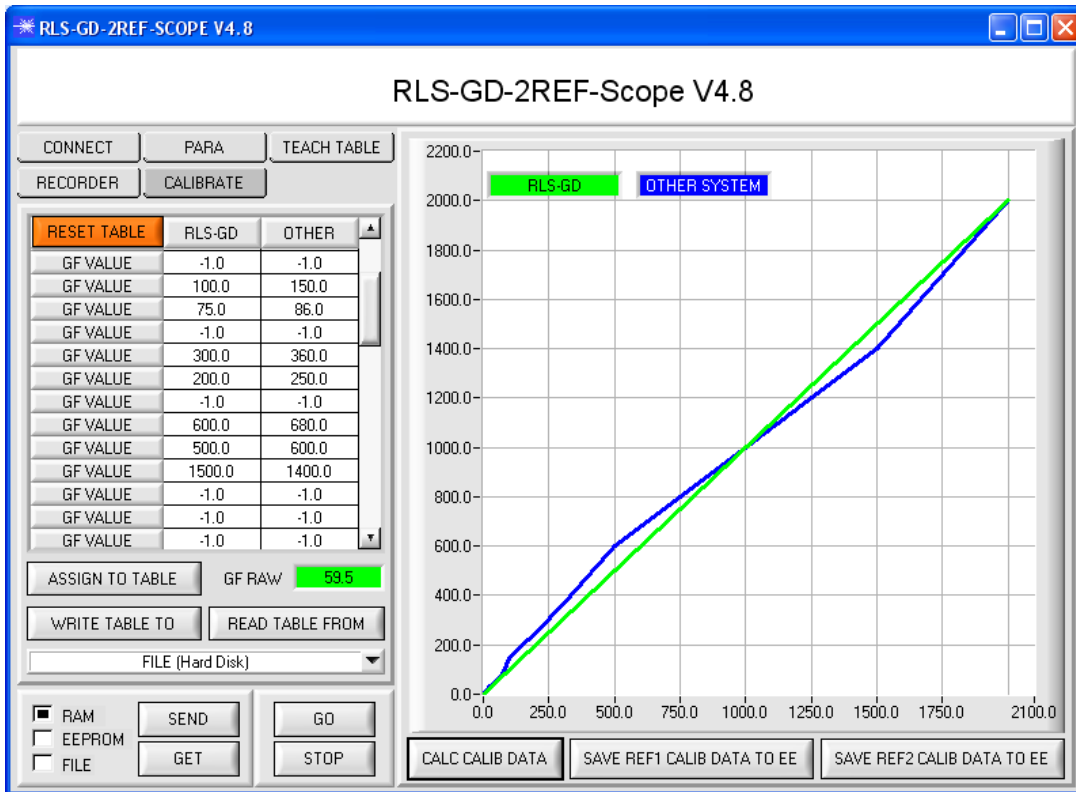
Plug the RLS-GD sensor into the offline holder.
Start the gloss factor display for the RLS-GD with **GO** and **STOP**.
For calibration to another system you need various reference surfaces with various gloss factors. The rows for 0 and 2000 must contain values. As a rule the value 0 is entered in row 0 for both systems, and the value 2000 in row 2000 for both systems. Rows that are not used must be deactivated with -1.
Click on **GO** to start the gloss factor display for the reference surface that is currently placed before the sensor. The value that is displayed under **GF RAW** can be directly transferred to any cell in the **RLS-GD column**. To do this, select a cell with the left mouse button and then click on **ASSIGN**. The value may of course also be entered manually by double-clicking on the respective cell.
Then perform the measurement at the same place with the other system, and enter the value in the same row, but this time under the **OTHER column**. When you have entered several data points, click on the **CALC CALIB DATA** button. The characteristic lines of both systems are then visualised in the graph (green = RLS-GD, blue = other system).

A click on **SAVE REF1 CALIB DATA TO EE** saves a table for calibration with **REF1** in the EEPROM. A click on **SAVE REF2 CALIB DATA TO EE** saves a table for calibration with **REF2** in the EEPROM.

The current calibration table on the user interface can be saved as a file on the hard disk or in the EEPROM of the sensor. Date exchange can be started with **WRITE TABLE TO** and **READ TABLE FROM**. The target for data exchange can be selected in the drop-down list.

RESET TABLE sets all the cells except cell 0 and 2000 to -1 (deactivated)

INFO: Press STOP first, before you transfer the data to the EEPROM.
The rows in the table may be filled as desired, i.e. no special order has to be observed. The program sorts automatically. You only have to make sure that the same reference surfaces are entered in the same rows. A double-click on the graph opens a panel for scaling of the axes.
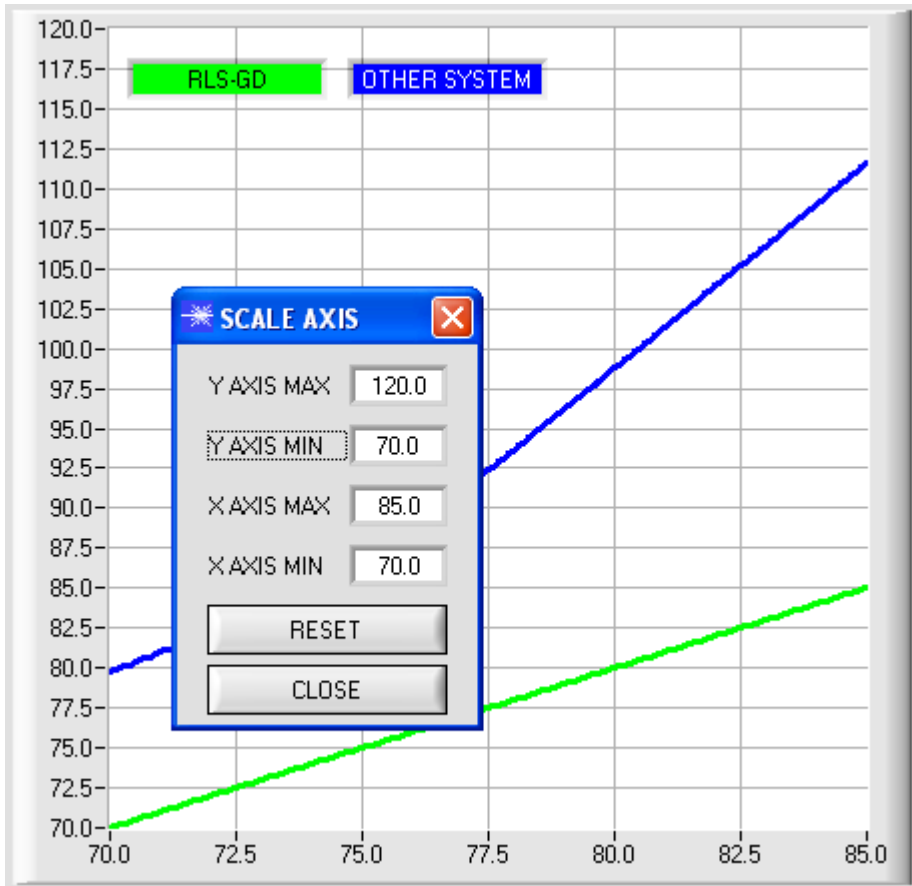
BIAS [OFF ▼]

BIAS:
With the software parameter **BIAS** calibration to another system can be activated or deactivated.
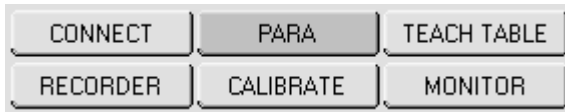
BIAS = OFF
If the sensor detects a RAW GF of 80 this factor will be output directly.
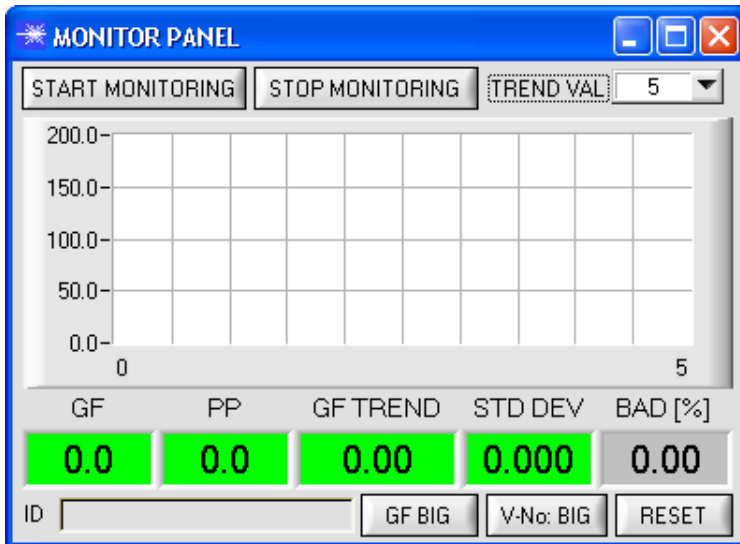
BIAS = ON
If the sensor detects a RAW GF of 80 this factor will not be output but the value 98,5 instead.

2.6 Tab MONITOR

The monitoring function is only available if EVALUATION MODE = GLOSS is selected and if TRIGGER = SELF, EXT1, EXT2, EXT3, or EXT4. By clicking the **MONITOR** button the following panel is opened:

START MONITORING starts gloss factor monitoring. After every trigger event the sensor automatically sends the current gloss factor to the PC. This gloss factor is visualised in the GF display and in the graph. Under **TREND VAL** you can set how many of the last data frames are shown in the graphic display. The **GF TREND** display shows the gloss factor mean value that is calculated from the values that are displayed in the graph.

When **TRIGGER = SELF** or **EXT3** is selected, the **PP value** of the current profile is also transferred and shown in the **PP display window**. The displayed value **STD DEV** visualizes the standard deviation from average **GF TREND**.

The background of the **GF, PP, GF TREND** display windows may either be red or green.
GF is green, if **GF ± GF TL** of vector 0 was recognized in the **TEACH TABLE**.
PP is green, if PP is smaller than the value taught in row 0 of the **TEACH TABLE** (only if TRIGGER=SELF or EXT3).
GF TREND is green, if the gloss factor mean value corresponds with vector 0 in the **TEACH TABLE**.
The **BAD[%]** display shows the percentage of values recorded in the graph that do not correspond with the teach vector in row 0.

A left double-click on the display **GF** or a click on the button **GF BIG** opens a large window that displays the gloss factor.
A click on the button **V-No: BIG** opens a large window that displays the recognized vector.
A click on the button **RESET** sets all values to 0.
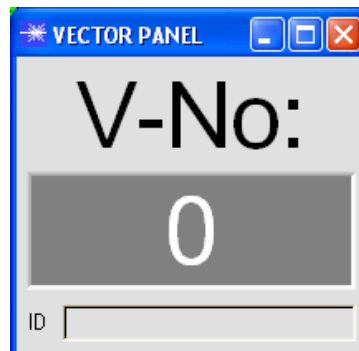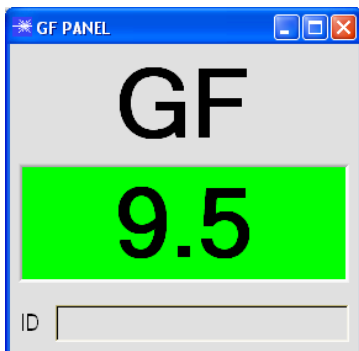
3.   Short instructions for the operation of RLS-GD gloss sensors through software RLS-GD-2REF-Scope V4.8

These instructions describe how to perform quick teaching of the gloss sensors of RLS-G_D series with the **RLS-GD-2REF-Scope V4.8** software interface.

The sensor is equipped with an internal light source and with 3 receivers. Depending on the type, the receivers are arranged at different angles, and they provide the signals CH_REF (reference channel), CH_DIR (direct reflection), and CH_DIF (diffuse reflection).

Basically, the sensor can be operated with two evaluation modes that can be set by way of **EVALUATION MODE**.

In **EVALUATION MODE GLOSS** the sensor operates as a **measuring device** that **measures** the gloss factor of a certain surface and displays this gloss factor. For this purpose it uses the **CH_REF** and **CH_DIR** channels, from which the gloss factor of a surface is determined. Up to 31 gloss factors can be taught to a **TEACH TABLE**. A tolerance **GF TOL** can be set for every gloss factor. The gloss factor and its respective tolerance are referred to as a **VECTOR** below. Each vector corresponds with a row. When a taught vector (gloss factor) is recognised again, the row number of the vector is sent to 5 digital outputs (OUT0 … OUT4). In addition the value of the gloss factor in analog form is sent to a 0 - 10V voltage output and to a 4 - 20mA current output.

In evaluation mode GLOSS the sensor, just like any other measuring device, must be calibrated from time to time. An RLS-GD-CAL calibration unit is available for this purpose. For calibrating the sensor, please follow the instructions under **Tab CALIBRATE**.

In **EVALUATION MODE NORM_INT** the sensor operates as a **control system**. A **NORM** and an **INT** (intensity) are calculated from the **CH_DIR** and **CH-DIF** channels. These two values are characteristic for a certain surface. For both the **NORM** and **INT** value a respective **N TOL** and **I TOL** tolerance can be set. The information comprising **NORM, N TOL, INT and ITOL** again is referred to as a **VECTOR** below. A total of 31 vectors can be taught in the **TEACH TABLE**. When in a row-by-row comparison a vector is recognised again, this vector is sent to the digital outputs. In addition the value of **NORM** in analog form is sent to the voltage and current output.

The following pages describe a teach process with both evaluation modes.
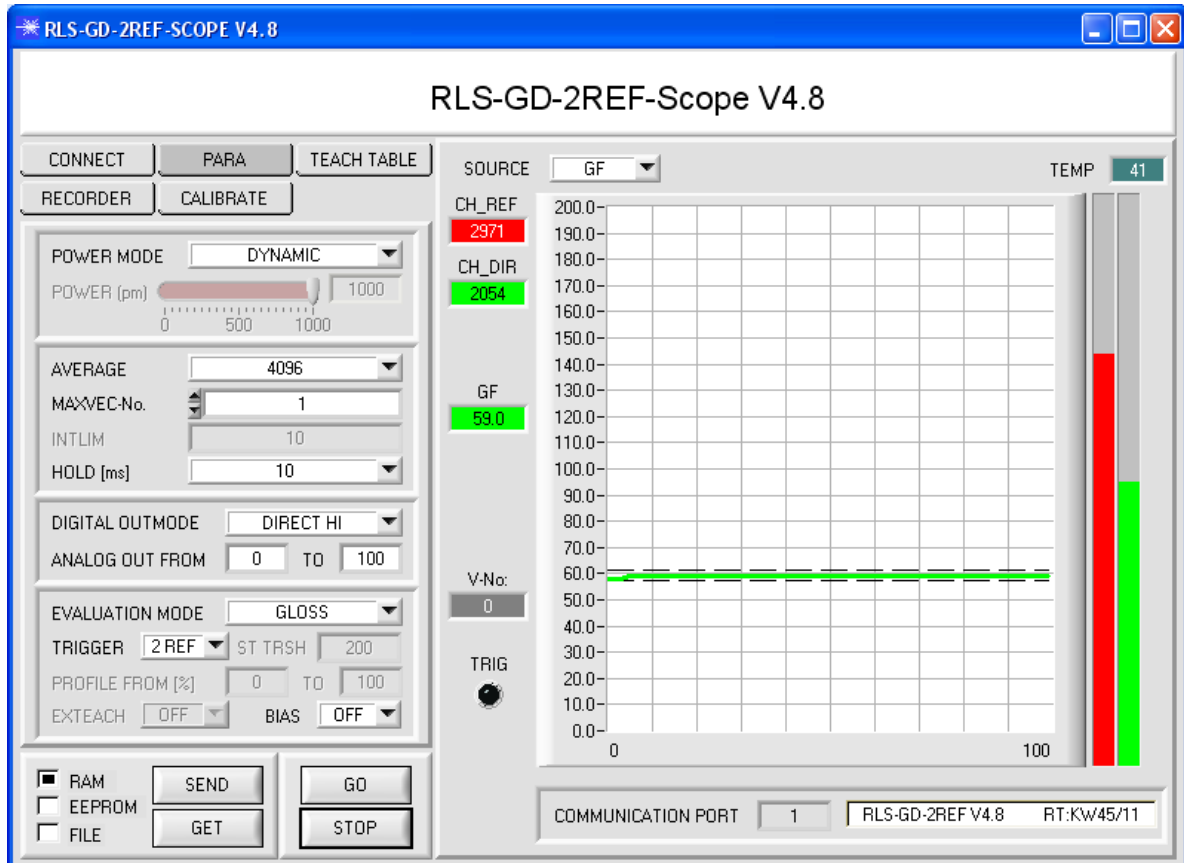
3.1 EVALUATION MODE GLOSS

Step 1:
Prior to the use of the software aids (graphic display of sensor signals) the sensor must be manually adjusted to the respective target or background as accurately as possible. The reference distance of the sensor to the target is defined in the data sheet of the respective sensor.
Please make sure that the sensor is properly connected and supplied with power.

Step 2:
Start the RLS-GD-2REF-Scope V4.8 software. Please check whether the status line at the right bottom displays the „RLS-GD-2REF V4.8   RT:KW*xx/xx* " message.
Info: Moving the mouse cursor to a control element and clicking with the right mouse button displays a short info on the respective individual control element.

Step 3:
Please make sure that for the time being **RAM** and not **EEPROM** is selected for the data exchange with the sensor (RAM is a volatile memory in the sensor, i.e. the data will be lost when power is turned off. EEPROM is a non-volatile memory in the sensor, i.e. the data will not be lost when power is turned off.)
All the other parameters should be set as shown in the picture above. Press the tab **PARA** to show the parameters. (See the FILE function in the manual.)
Now press the **GO** button. Data exchange between sensor and PC will then start. The contents for **CH_REF** and **CH_DIR** that are diffusely reflected from the surface are represented as bars on the software interface. The gloss factor **GF** is shown in a display and in the graph.

Please note: The sensor must be informed when you have changed the parameter values. Press the **SEND** button to send this information to the sensor.
The gloss factor **GF** has a value range of 0 to 2000. A double-click with the left mouse button on the graph starts automatic scaling. A single-click with the left mouse button turns auto-scaling off again.
The signal that should be displayed can be selected under Source.

Step 4:
The gloss factor **GF** is calculated from the **CH_REF** and **CH_DIR** data.

Press the **GO** button once again to read out the current data.
Press **STOP** to stop the data exchange.
Now use the tab **TEACH TABLE** to switch to the TEACH TABLE.
Select a row under **No.:** to which the currently present gloss factor should be taught.
(ATTENTION: Only the rows marked with green numbers are evaluated by the sensor. If you want to teach more vectors, use the **MAXVEC-No.** parameter to select how many vectors you want to teach.)
Now press the **TEACH DATA TO** button. The calculated gloss factor is transferred to the **TEACH TABLE** in the row that was selected under **No.:**. If necessary, adapt the **GF TOL** tolerance by selecting the respective cell in the **TEACH TABLE** and pressing F2, or by double-clicking on the respective cell.
The graphic display shows the current gloss factor with the tolerance window set under **No.:**.
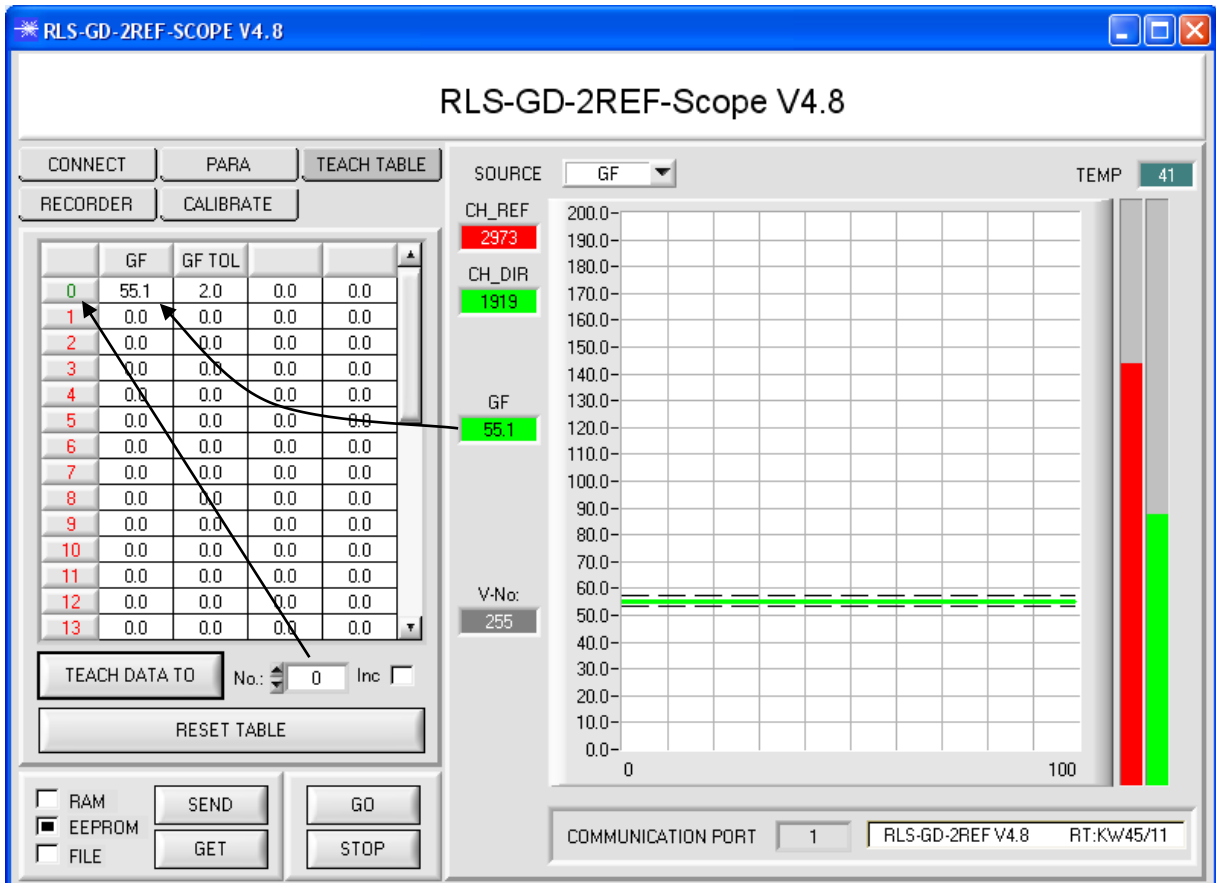
Now press the **SEND** button to inform the sensor about the taught vector. Then activate the **GO** mode again. When the sensor recognises a row vector, the corresponding row number is visualised on the software interface under **V-No:**. A value of 255 means that none of the taught vectors were recognised.

A gloss factor only is recognised if it lies within the tolerance window.

Step 5:
For teaching additional vectors please make sure that the sensor head is directed onto the respective vector.
Then repeat the procedure starting from step 4.

Step 6:
When you have taught all the vectors, please select **EEPROM** and press **SEND** to save the data to the non-volatile memory of the sensor.
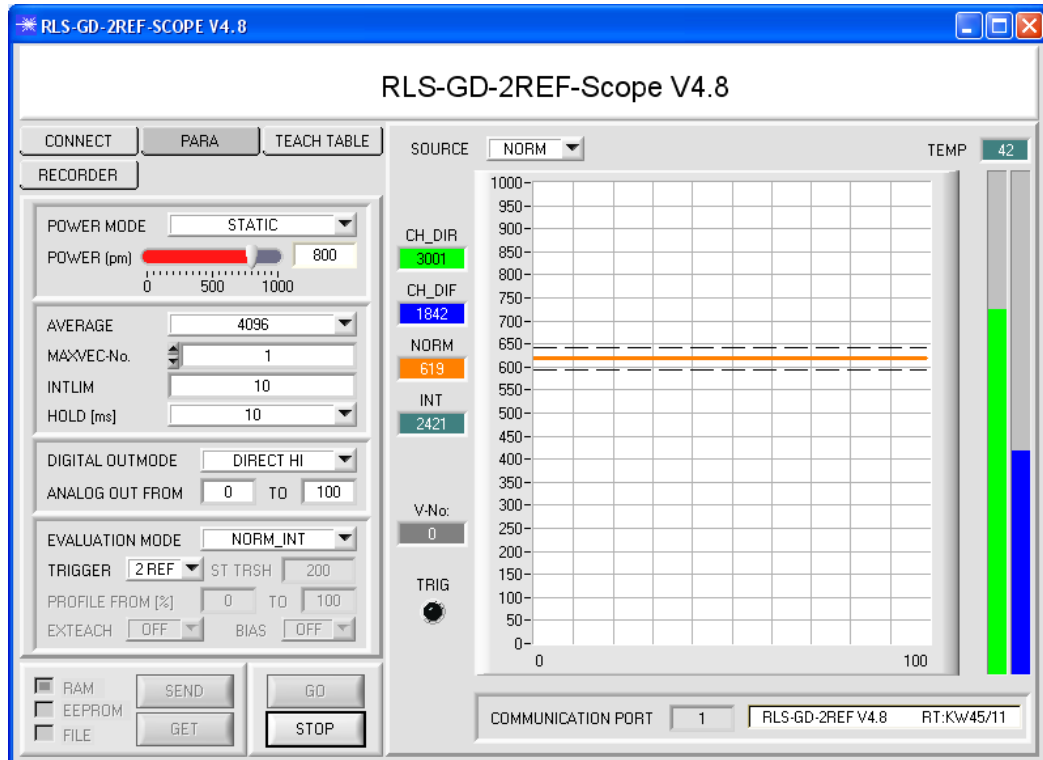
3.2 EVALUATION MODE NORM_INT

Step 1:
Prior to the use of the software aids (graphic display of sensor signals) the sensor must be manually adjusted to the respective target or background as accurately as possible. The reference distance of the sensor to the target is defined in the data sheet of the respective sensor.
Please make sure that the sensor is properly connected and supplied with power.

Step 2:
Start the RLS-GD-2REF-Scope V4.8 software. Please check whether the status line at the right bottom displays the „RLS-GD-2REF V4.8   RT:KW*xx/xx* " message.
Info: Moving the mouse cursor to a control element and clicking with the right mouse button displays a short info on the respective individual control element.

Step 3:
Please make sure that for the time being **RAM** and not **EEPROM** is selected for the data exchange with the sensor (RAM is a volatile memory in the sensor, i.e. the data will be lost when power is turned off. EEPROM is a non-volatile memory in the sensor, i.e. the data will not be lost when power is turned off.)
All the other parameters should be set as shown in the picture above. Press the tab **PARA** to show the parameters. (See the FILE function in the manual.)
Now press the **GO** button. Data exchange between sensor and PC will then start. The contents for **CH_DIR** and **CH_DIF** that is diffusely reflected from the surface are represented as bars on the software interface. **NORM** and **INT** are shown in a display and in the graph.
Set the POWER value such that at least one of the two bars lies in the upper third of its dynamic range, but that none of them is saturated.

ATTENTION: The sensor must be informed when you have changed the **POWER** value. Press the **SEND** button to send this information to the sensor. Check the bars by pressing **GO** again. Repeat this process until you have a suitable **POWER** value.

Tip! There is a trick for finding a suitable **POWER** value in no time at all. Set **POWER MODE = DYNAMIC**. The sensor then tries to find a suitable power value. Check this by pressing **GO**. Press **STOP** when the bars have "levelled out". Then press **GET**. The power value that was found now is shown in the **POWER** function field. Now set **POWER MODE = STATIC**, and press **SEND**.

Step 4:
From the data of **CH_DIR** and **CH_DIF, NORM** and **INT** are calculated acc. to the following formulas:

$$NORM = \frac{CH\_DIR}{CH\_DIR + CH\_DIF} * 1000 \qquad\qquad INT = \frac{CH\_DIR + CH\_DIF}{2}$$

Press the **GO** button once again to read out the current data.
Press **STOP** to stop the data exchange.
Now use the tab **TEACH TABLE** to switch to the TEACH TABLE.
Select a row under **No.:** to which the currently present gloss factor should be taught.
(ATTENTION: Only the rows marked with green numbers are evaluated by the sensor. If you want to teach more vectors, use the **MAXVEC-No.** parameter to select how many vectors you want to teach.)
Now press the **TEACH DATA TO** button. The calculated **NORM** and **INT** are transferred to the **TEACH TABLE** in the row that was selected under **No.:**. If necessary, adapt the **N TOL** and **I TOL** tolerances by selecting the respective cell in the TEACH TABLE and pressing F2, or by double-clicking on the respective cell.
The graphic display shows the current **NORM** with the tolerance window set under No.:.
Select **INT** under **SOURCE** to visualise the intensity with its tolerance window.
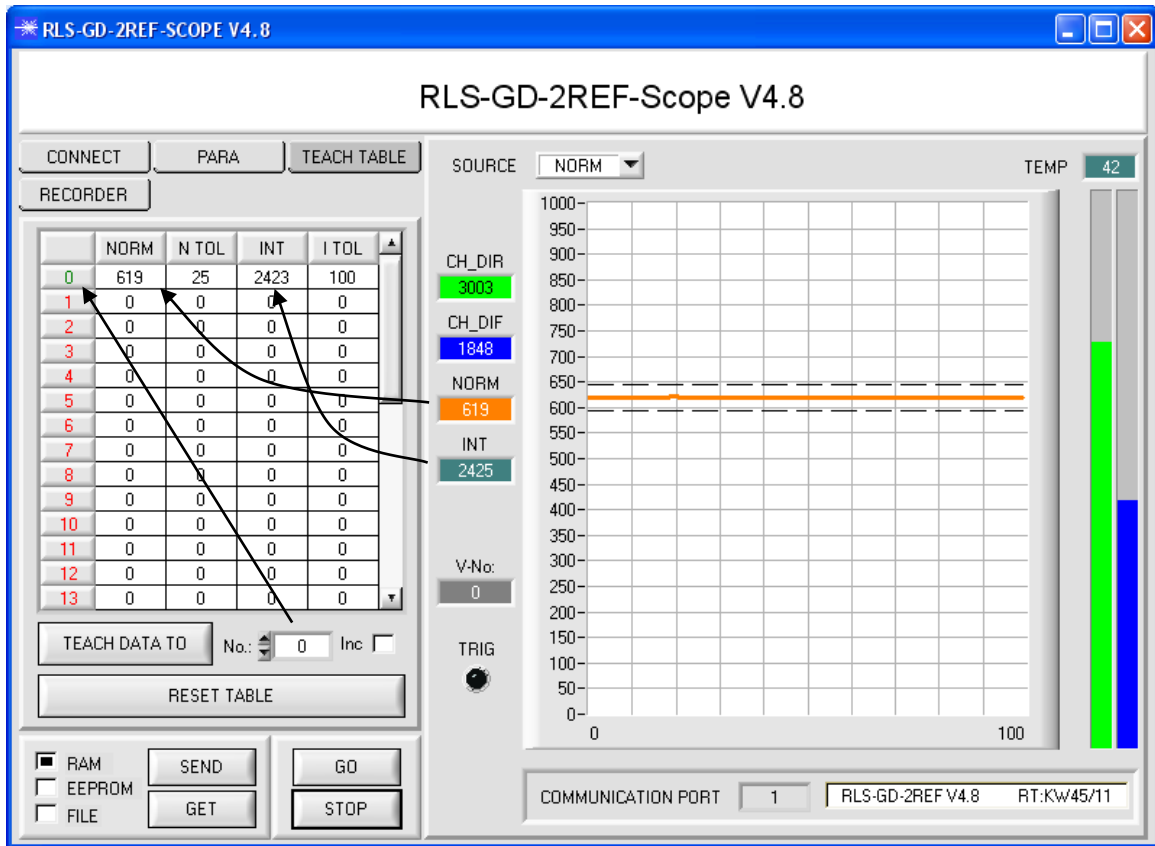
Now press the **SEND** button to inform the sensor about the taught vector. Then activate the **GO** mode again. When the sensor recognises a row vector, the corresponding row number is visualised on the software interface under **V-No:**. A value of 255 means that none of the taught vectors were recognised.

A teach vector only is recognised if it lies within the tolerance window for **NORM** and **INT**.

Step 5:
For teaching additional vectors please make sure that the sensor head is directed onto the respective vector.
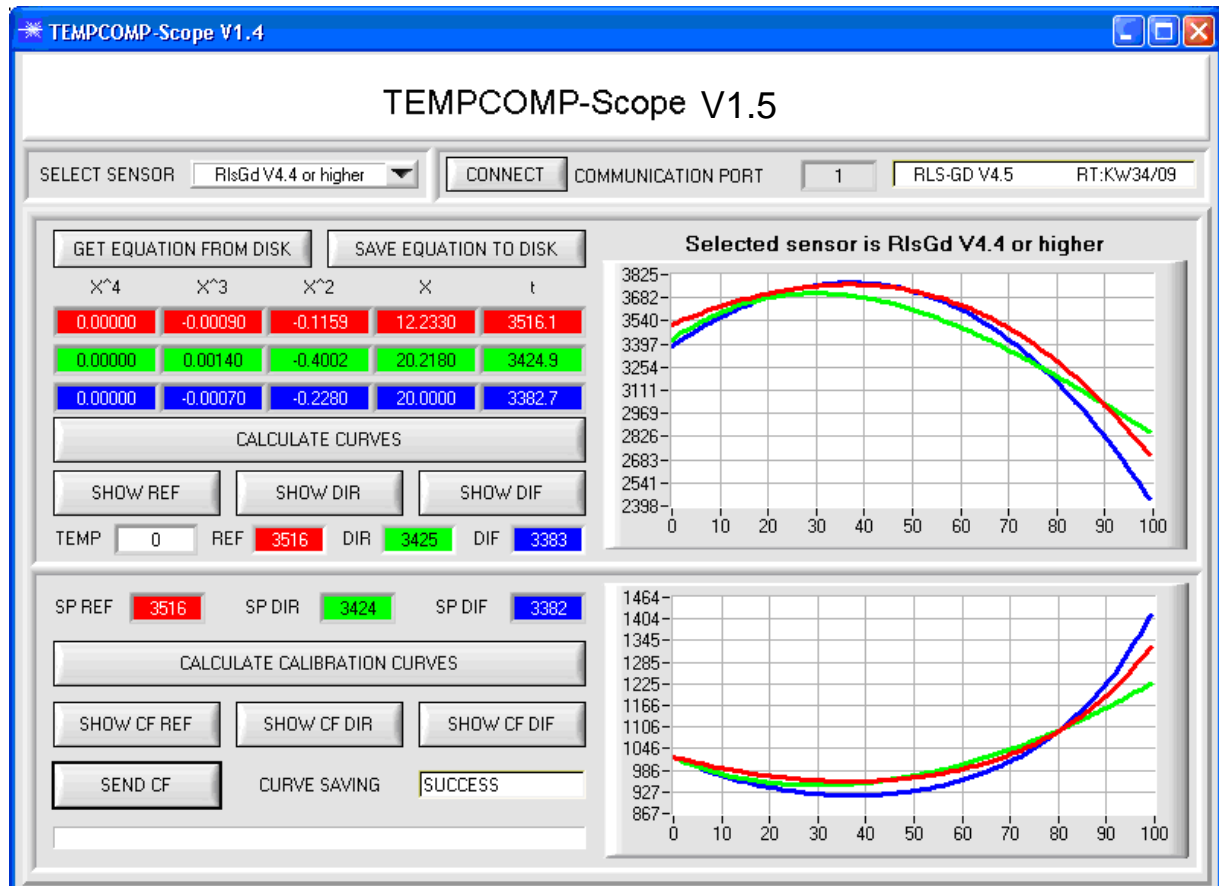Then repeat the procedure starting from step 4.

Step 6:
When you have taught all the vectors, please select **EEPROM** and press **SEND** to save the data to the non-volatile memory of the sensor.

4. Operation of the TEMPCOMP-Scope software

If a firmware update should go wrong and the temperature characteristics that are stored in the EEPROM should be lost, these characteristics must be created anew. For this purpose you will need a file with the corresponding data. This file can be obtained from your supplier.

To perform temperature compensation please start the corresponding **TEMPCOMP-Scope software** that is included on the supplied CD. Please make sure that you have a functioning sensor connection. It may be necessary to select the connection with **CONNECT**. Set the correct sensor under **SELECT SENSOR**, if this is not done automatically.

Step 1: Load the temperature compensation file that you have received from your supplier with **GET EQUATION FROM DISK**.

Step 2: Press **CALCULATE CURVES** to display the data in the graph.
The buttons **SHOW REF**, **SHOW DIR**, and **SHOW DIF** show the individual curves.

Step 3: Select the sensor-internal operating temperature (not in °C) that the sensor has at an ambient temperature of 20°. The value should be included in the file designation.

Step 4: Press **CALCULATE CALIBRATION CURVES** to calculate the mean straight line.
The buttons **SHOW CF REF**, … again show the individual curves.

Step 5: Pressing the **SEND CF** button saves the mean straight lines in the EEPROM of the sensor.

Step 6: Temperature compensation is successfully finished if the **SUCCESS** status message is then displayed.

Comment!

If you do not immediately have the temperature compensation file at hand, simply start the **TempComp-Scope software**. Establish a connection, if it is not already established, and simply press **SEND-CF**. The sensor then functions as before, but it is not temperature-compensated.

5. External triggering of the RLS-GD sensors
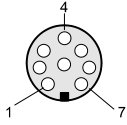
External triggering is performed through pin no. 3 (grn) at the 8-pole socket of the RLS-GD/PLC connection.
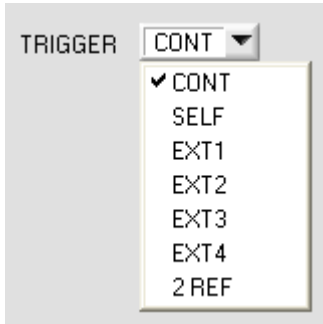
EXTERN:
First the external TRIGGER mode must be set at the sensor. For this purpose option EXT1, EXT2, EXT3, EXT4, or 2 REF must be selected in the TRIGGER selection field.

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

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).

IN0
(Pin3 grn respectively
TEACH button)

Triggering active !   No triggering !

HIGH (+24V)

LOW (0V, GND)
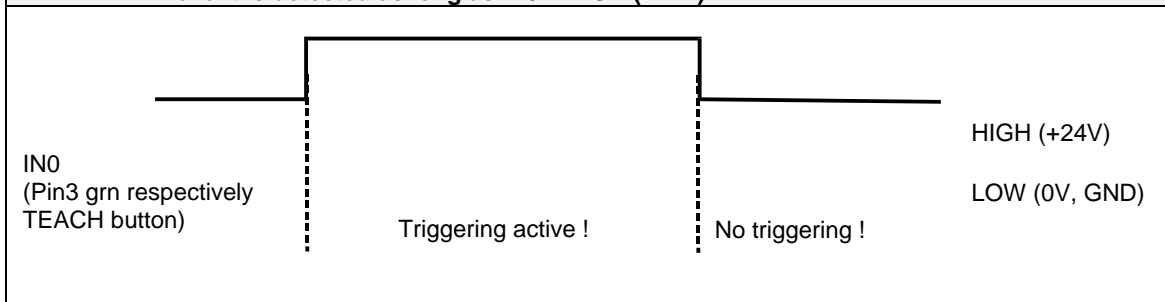
6. Function of the LED display

LED display:

BINARY

The line vector is visualised by way of 5 yellow LEDs at the housing of the RLS-GD sensor. At the same time in the binary modes (OUT BINARY) the line vector 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/PLC socket.

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

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

DIRECT

In the DIRECT mode (OUT DIRECT HI or OUT DIRECT LO) the maximum numbers of line 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 line vector was detected, all digital outputs are set to LOW (no LED is lighting).

```
●○○○○    ○●○○○    ○○●○○    ○○○●○    ○○○○●
  0         1         2         3         4

                                         ○○○○○

                                      (no line vector
                                         detected)
```
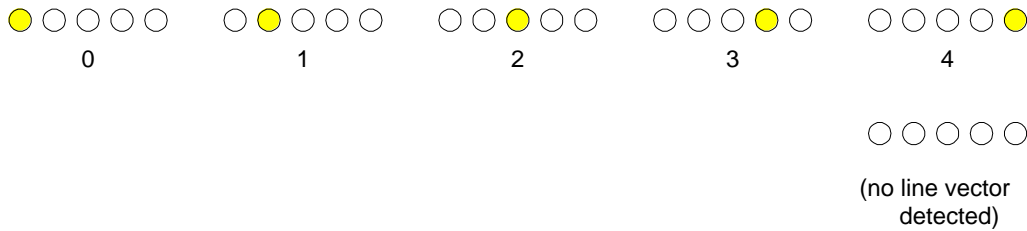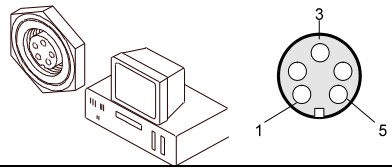
DIRECT LO:

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

```
○●●●●    ●○●●●    ●●○●●    ●●●○●    ●●●●○
  0         1         2         3         4

                                         ●●●●●

                                      (no line vector
                                         detected)
```
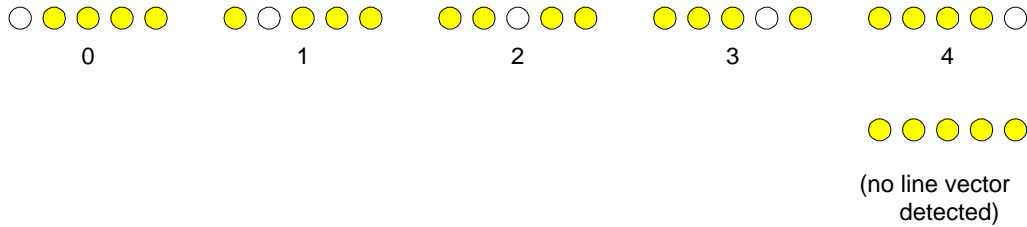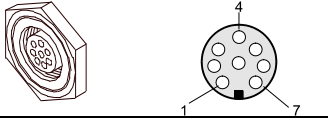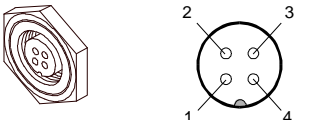
7. Connector assignment of the RLS-GD sensors

Connection of RLS-GD to PC:

Pin No.:		Assignment:
5-pole female connector (type Binder 712) *RLS-GD/PC-RS232*
1		0V (GND)
2		TxD
3		RxD
4		+24VDC
5		Not connected

Connection of RLS-GD to PLC:

Pin No.:	Color:	Assignment:
8-pole female connector (type Binder 712) *RLS-GD/PLC*
1	white	0V (GND)
2	brown	+24VDC (± 10%)
3	green	IN0
4	yellow	OUT0 (Digital 0: Type 0 … 1V, Digital 1: Type +Ub – 10%)
5	grey	OUT1 (Digital 0: Type 0 … 1V, Digital 1: Type +Ub – 10%)
6	pink	OUT2 (Digital 0: Type 0 … 1V, Digital 1: Type +Ub – 10%)
7	blue	OUT3 (Digital 0: Type 0 … 1V, Digital 1: Type +Ub – 10%)
8	red	OUT4 (Digital 0: Type 0 … 1V, Digital 1: Type +Ub – 10%)

Pin No.:	Color:	Assignment:
4-pole female connector (type Binder 712) *RLS-GD/PLC*
1	white	0V (GND)
2	brown	Not connected
3	black	Analog voltage output (0 ... +10V)
4	blue	Analog current output (4 ... 20mA)

8. RS232 communication protocol

RS232 communication protocol PC ⇔ RLS GD Sensor (RLS-GD-2REF-Scope V4.8)
- Standard RS232 serial interface without hardware-handshake - 3-wire: GND, TX0, RX0 - Speed: 19200 baud factory setting, can be changed (example 190) to 9600, 19200, 38400, 57600, 115200 8 data-bits, no parity-bit, 1 stop-bit in binary mode, us (unsigned), MSB (most significant byte) first. The control device (PC or PLC) has to send a data frame of 18 words to the Sensor. All bytes must be transmitted in binary format (us, MSB). The meaning of the parameters is described in the software manual. Info: 1 word = 2 bytes <u>Method:</u> The hardware is permanently reading (polling) the incoming byte at the RS232 connection. If the incoming word is 0x0055 (synch-word), then the 2. word (order-word) is read in, after this, 16 words (parameters) will be read. After reading in the completely data frame, the Sensor 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	POWER	LED intensity (0 ... 1000) Attention intensity in thousandth!
4	Word	PMOD	LED mode STAT, DYN (0,1)
5	Word	AVERAGE	Signal averaging 1,2,4,8,16,32,64,128,256,512,1024,2048,4096,8192,16384 or 32768
6	Word	EVALUATION MODE	Evaluation mode NORM_INT or GLOSS coded to (0,1)
7	Word	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	INTLIM	Lower intensity limit (0 ... 4095)
9	Word	MAXVEC-No.	Number of the vectors (1,2,3,…,31)
10	Word	DIGITAL OUTMODE	Function of the digital output (0=direct/HI, 1=binary, 2=direct/LO)
11	Word	TRIGGER	Trigger mode CONT,SELF,EXT1,EXT2,EXT3,EXT4, 2 REF coded to (0,1,2,3,4,5,6)
12	Word	EXTERN TEACH	Extern Teach OFF or ON coded to (0,1)
13	Word	ANAOUT BEGIN	Analog Output Range begin
14	Word	ANAOUT END	Analog Output Range end
15	Word	BIAS	BIAS OFF, OCAL or FCAL coded to (0,1,23)
16	Word	ST TRSH	Self Trigger Threshold
17-18	Word	Free	Must be sent as dummy (e.g. 2x value 0)

Value	ORDER NUMBER (parameter byte no. 2)	
0	nop	no operation
1	Save parameter from PC into RAM	Cf. Example 1
2	Save one selectable row of TEACH TABLE into RAM	Cf. Example 2
3	Send parameter from RAM to PC	Cf. Example 3
4	Send one selectable Row of TEACH TABLE from RAM to PC	Cf. Example 4
5	Send data from RAM to PC	Cf. Example 5
6	Save parameter from RAM to EEPROM	Cf. Example 6
7	Send connection OK to PC	Cf. Example 7
8	Load Parameter from EEPROM to RAM	Cf. Example 8
9	Send Profile to PC	Cf. Example 9
20	Send line ok = 0x0055, 0x0014, 0x00AA, 15 Dummies to PC	Cf. Example 20
50	Start or Stop an automatic send of a data frame after trigger	Cf. Example 50
190	Change baud rate	Cf. Example190

Example 1: DATA FRAME with ORDER NUMBER = 1:

ORDER NUMBER (second word = 1): WRITE parameters from PC into RAM of the RLS-GD!
The completely data frame = 18 words must be sent to the RLS-GD hardware in binary form
(sync-word / order-word / 16 parameter words).

DATA FRAME PC → RLS GD (18 WORDS)

0x0055	SYNC.-WORD
1	ORDER-WORD
200	POWER
0	PMOD
1024	AVERAGE
0	EVALUATION MODE
10	HOLD[ms]
10	INTLIM
5	MAXVEC-No.
0	DIGITAL OUTMODE
0	TRIGGER
0	EXTER TEACH
0	ANAOUT BEGIN
100	ANAOUT END
0	BIAS
200	ST TRSH
0	DUMMY
0	DUMMY

DATA FRAME RLS GD → PC (18 WORDS)

0x00AA	SYNC.-WORD
1	ORDER-WORD
200	POWER
0	PMOD
1024	AVERAGE
0	EVALUATION MODE
10	HOLD[ms]
10	INTLIM
5	MAXVEC-No.
0	DIGITAL OUTMODE
0	TRIGGER
0	EXTER TEACH
0	ANAOUT BEGIN
100	ANAOUT END
0	BIAS
200	ST TRSH
0	DUMMY
0	DUMMY

Example 2: DATA FRAME with ORDER NUMBER = 2:

ORDER NUMBER (second word = 2): WRITE one selectable row (vector) of TEACH TABLE
into RAM of the RLS-GD!
The completely data frame = 18 words must be sent to the RLS-GD hardware in binary form
(sync-word / order-word / ROW-NO / 4 parameter words = vector, 11 dummies).
Fill unused words of the TEACH VECTOR by value word=1 in binary form.

DATA FRAME PC → RLS-GD (18 WORDS)

0x0055	SYNC-WORD
2	ORDER-WORD
0	ROW-No. (0…30)
500	NORM respectively GF
20	N TOL respectively GF TOL
500	INT respectively PP respectively DUMMY
30	I TOL respectively DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY

DATA FRAME RLS-GD → PC (18 WORDS)

0x00AA	SYNC-WORD
2	ORDER-WORD
0	ROW-No. (0…30)
500	NORM respectively GF
20	N TOL respectively GF TOL
500	INT respectively PP respectively DUMMY
30	I TOL respectively DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY

Example 3: DATA FRAME with ORDER NUMBER = 3:

ORDER NUMBER (second word = 3): READ parameters out of RLS-GD-RAM memory!
The same frame as example 1 must be sent to the RLS-GD hardware except of the order word that must be **3**.
The values for the parameters must be sent as Dummies.
The complete DATA FRAME which is responded by the RLS-GD hardware is 18 words.

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

0x00AA	SYNC-WORD
3	ORDER-WORD
200	POWER
0	PMOD
1024	AVERAGE
0	EVALUATION MODE
10	HOLD[ms]
10	INTLIM
5	MAXVEC-No.
0	DIGITAL OUTMODE
0	TRIGGER
0	EXTER TEACH
0	ANAOUT BEGIN
100	ANAOUT END
0	BIAS
200	ST TRSH
0	DUMMY
0	DUMMY

Example 4: DATA FRAME with ORDER NUMBER = 4:

ORDER NUMBER (second word = 4): READ one selectable row (vector) from RAM of the RLS-GD!
The same frame as example 2 must be sent to the RLS-GD hardware except of the order word that must be **4**.
The values for the parameters must be sent as Dummies.
The complete DATA FRAME which is responded by the RLS-GD hardware is 18 words.

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

0x00AA	SYNC-WORD
4	ORDER-WORD
0	ROW-No. (0…30)
500	NORM respectively GF
20	N TOL respectively GF TOL
500	INT respectively PP respectively DUMMY
30	I TOL respectively DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY

Example 5: DATA FRAME with ORDER NUMBER = 5:

ORDER NUMBER (second word = 5): READ RLS-GD RAW DATA.
Parameters must be sent for a constant parameter frame as dummies.
At order word **5** they do not affect the RAM or EEPROM.
ORDER NUMBER = 19 is similar. but if TRIGGER = 1 or 2 only triggered values are transmitted.

DATA FRAME PC → RLS-GD (18 WORDS)

0x0055	SYNC-WORD
5	ORDER-WORD
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY

DATA FRAME RLS-GD → PC (18 WORDS)

0x00AA
5
CH_REF
CH_DIR
CH_DIF
NORM
INT
GF
V-No:
TEMP
GF RAW
DUMMY
DUMMY
DUMMY
DUMMY
DUMMY
DUMMY
DUMMY

Example 6: DATA FRAME with ORDER NUMBER = 6:

ORDER NUMBER (second word = 6): SAVE parameters from RAM to EEPROM of the RLS-GD!
The complete data frame = 18 words must be sent to the RLS-GD hardware in binary form
(sync-word / order-word / 16 parameter words).

DATA FRAME PC → RLS-GD (18 WORDS)

0x0055	SYNC-WORD
6	ORDER-WORD
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY

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 RAM see **Example1** and **Example2.**

After completing the sensor writes back an echo of the same frame.
DATA FRAME RLS-GD → PC (18 WORDS)

0x00AA	SYNC-WORD
6	ORDER-WORD
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY

Example 7: DATA FRAME with ORDER NUMBER = 7:

ORDER NUMBER (second word = 7): SEND CONNECTION OK from the RLS-GD to PC!
Cf. example 1:
Send the same DATA FRAME but with ORDER NUMBER 7 to the sensor.
The sensor will reply with 18 words which tell the version of the sensor.

Example 8: DATA FRAME with ORDER NUMBER = 8:

ORDER NUMBER (second word = 8): Load parameters from EEPROM to RAM of the RLS-GD!
The complete data frame = 18 words must be sent to the RLS-GD hardware in binary form
(sync-word / order-word / 16 parameter words).

DATA FRAME PC → RLS-GD (18 WORDS)

0x0055	SYNC-WORD
8	ORDER-WORD
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY

After sending this data frame, the sensor loads all the parameters and teach vectors from its EEPROM
(non volatile memory) to its RAM (volatile memory).
ATTENTION: The EEPROM parameters must be load first to the RAM to read it from the sensor.
To get the parameters and teach vectors from RAM see **Example3** and **Example4.**

After completing the sensor writes back an echo of the same frame.

DATA FRAME RLS-GD → PC (18 WORDS)

0x00AA	SYNC-WORD
8	ORDER-WORD
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY

Example 9: DATA FRAME with ORDER NUMBER = 9:

ORDER NUMBER (second word = 9): Send profile buffer to PC. The profile buffer contains 120 values.
Only 16 values can be send in one block. → 8 blocks must be send.
The complete data frame = 18 words must be sent to the RLS-GD hardware in binary form
(sync-word / order-word / 16 parameter words).

DATA FRAME PC → RLS-GD (18 WORDS)

0x0055	SYNC-WORD
9	ORDER-WORD
0	block number (0….7)
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY

DATA FRAME RLS-GD → PC (18 WORDS)

0x00AA	SYNC-WORD
9	ORDER-WORD
Value in profile Buffer	Value (block*16)+0 in the profile Buffer
Value in profile Buffer	Value (block*16)+1 in the profile Buffer
Value in profile Buffer	Value (block*16)+2 in the profile Buffer
Value in profile Buffer	Value (block*16)+3 in the profile Buffer
Value in profile Buffer	Value (block*16)+4 in the profile Buffer
Value in profile Buffer	Value (block*16)+5 in the profile Buffer
Value in profile Buffer	Value (block*16)+6 in the profile Buffer
Value in profile Buffer	Value (block*16)+7 in the profile Buffer
Value in profile Buffer	Value (block*16)+8 in the profile Buffer
Value in profile Buffer	Value (block*16)+9 in the profile Buffer
Value in profile Buffer	Value (block*16)+10 in the profile Buffer
Value in profile Buffer	Value (block*16)+11 in the profile Buffer
Value in profile Buffer	Value (block*16)+12 in the profile Buffer
Value in profile Buffer	Value (block*16)+13 in the profile Buffer
Value in profile Buffer	Value (block*16)+14 in the profile Buffer
Value in profile Buffer	Value (block*16)+15 in the profile Buffer

If block number = 7
DATA FRAME RLS-GD → PC (18 WORDS)

0x00AA	SYNC-WORD
9	ORDER-WORD
Value in profile Buffer	Value (block*16)+0 in the profile Buffer
Value in profile Buffer	Value (block*16)+1 in the profile Buffer
Value in profile Buffer	Value (block*16)+2 in the profile Buffer
Value in profile Buffer	Value (block*16)+3 in the profile Buffer
Value in profile Buffer	Value (block*16)+4 in the profile Buffer
Value in profile Buffer	Value (block*16)+5 in the profile Buffer
Value in profile Buffer	Value (block*16)+6 in the profile Buffer
Value in profile Buffer	Value (block*16)+7 in the profile Buffer
Maximum	Maximum Value of profile buffer
Minimum	Minimum Value of profile buffer
Amount	Amount of captured values during trigger
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY

Example 20: DATA FRAME with ORDER NUMBER = 20:

ORDER NUMBER (second word = 20): SEND LINE OK from the RLS-GD to PC!
Cf. example 1:
Send the same DATA FRAME but with ORDER NUMBER 20 to the sensor.
The sensor will reply with the same18 words but with SYNC-WORD=0x00AA which tell that there is a connection.

Example 50: DATA FRAME with ORDER NUMBER = 50:

ORDER NUMBER (second word = 50): Start or Stop an automatic send of a data frame after a trigger.
The complete data frame = 18 words must be sent to the RLS-GD hardware in binary form
(sync-word / order-word / 16 parameter words).

DATA FRAME PC → RLS-GD (18 WORDS)

0x0055	SYNC-WORD
50	ORDER-WORD
0	0=autosend off, 1=autosend on
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY

After activation of automatic send (autosend=1) the sensor writes a dataframe after each trigger.
Cf. DATA FRAME RLS-GD → PC (18 WORDS) in Example 5.

Example 190: DATA FRAME with ORDER NUMBER = 190:

ORDER NUMBER (second word = 190): Write new baud rate to sensor.
Attention! New baud rate is only in the RAM. To store the new baud rate to EEPROM refer to example 6.

baud rate is coded to:

0	9600 Bit/s
1	19200 Bit/s
2	38400 Bit/s
3	57600 Bit/s
4	115200 Bit/s

The completely data frame = 18 words must be sent to the sensor hardware in binary form **with old baud rate** (sync-word / order-word / 16 parameter words).

DATA FRAME PC → Sensor (18 WORDS)

0x0055	SYNC.-WORD
190	ORDER-WORD
3	new baud rate 57600 Bit/s
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY

DATA FRAME Sensor → PC (18 WORDS) comes also with old baud rate

0x00AA	SYNC.-WORD
190	ORDER-WORD
3	new baud rate 57600 Bit/s
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY

From now the sensor works with the new baud rate.