

Manual

Software GLOSS-Scope V1.0

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

for sensors of GLOSS Series

This manual describes the installation of the PC software for the sensors of the GLOSS series. As a support for commissioning of the color sensor this manual explains the functional elements of the Windows® user interface.

A white-light LED projects a white light spot onto the surface to be inspected.

A part of the light that is directly reflected from the measuring object is directed onto a receiver by the receiver optics (the receiver optics is arranged at the same angle from the vertical as the transmitter optics). Furthermore, diffuse reflection is determined by means of an additional optics.

Signal acquisition is performed with 12 bit.

The GLOSS sensor optionally can be "taught" up to 7 gloss levels or norm vectors.

The gloss level or the detected norm vector is provided at the digital outputs.

In addition, the gloss level also is provided in analog form from 0 to 10V or from 4mA to 20mA.

A digital input allows external "teaching" of the sensor.

As an alternative the sensor also can be triggered with the same input.

An additional input allows the "freezing" of the analog output signal upon a positive input edge.

The GLOSS sensor allows highly flexible signal acquisition. The sensor, for example, can be operated in alternating-light mode (AC mode), which means the sensor is not influenced by external light, or in constant-light mode (DC mode), which provides outstanding high-speed sensor operation. An OFF function deactivates the sensor's integrated light source. With the stepless adjustment of the integrated light source, the selectable gain of the receiver signal, and an INTEGRAL function the sensor can be adjusted to almost any surface.

The sensor must be calibrated for gloss level detection. For this purpose, a reference surface is required which by definition has a gloss level of 100GU (Gloss Units). Calibration then is performed with the PC software. The sensor also can be calibrated to foreign systems, which can be optionally activated in the PC software.

The GLOSS series sensors are factory calibrated. When establishing the connection, the date of the next calibration is displayed in the status window in the CONNECT tab. For continuously accurate measurement results, we recommend having the calibration renewed every 12 months and sending in the sensors for calibration.

Parameters and measurement values can be exchanged between PC and sensor either through RS232 or Ethernet (using an Ethernet converter). Through the interface all the parameters can be stored in the non-volatile EEPROM of the sensor.

The PC software facilitates the parameterisation, diagnostics, and adjustment of the sensor system (oscilloscope function). The software furthermore provides a data recorder function that automatically records data and stores them on the hard disk of the PC.

GLOSS sensors are temperature-compensated over a range of 0°C to 80°C.

Possible firmware updates can be easily performed through the RS232 interface, even with the sensor system in installed condition.

When parameterisation is finished, the color sensor continues to operate with the current parameters in STAND-ALONE mode without a PC.

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Shortcuts:

SEND	F9
GET	F10
GO	F11
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1 Installation of the GLOSS-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-las4/PC** for the RS232 interface or **cab-4/USB** USB converter or **cab-4/ETH** Ethernet converter

Please install the software as described below:

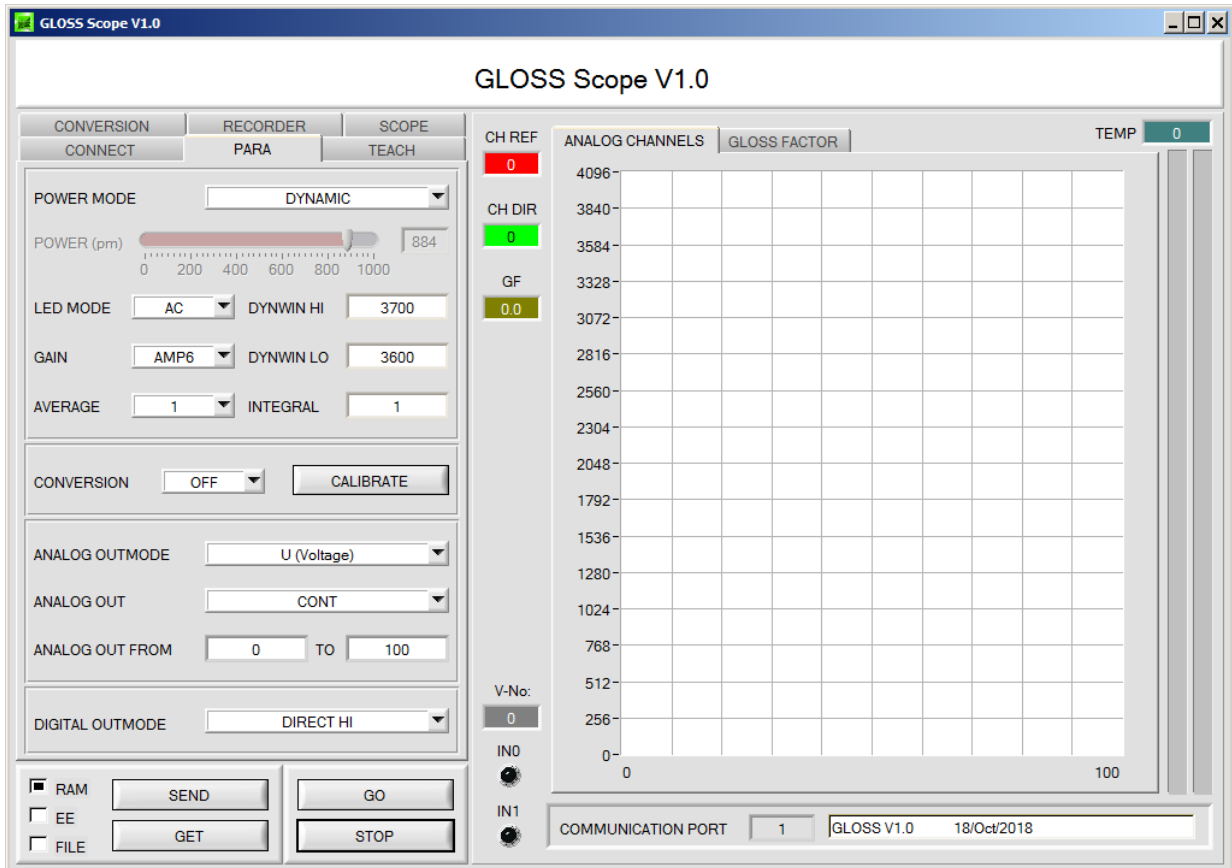
1. The software can be installed directly from the installation DVD. To install the software, start the SETUP program in the SOFTWARE folder of the DVD.
2. The installation program displays a dialog and suggests to install the software in the C:\"FILENAME" directory on the hard disk. You may accept this 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 GLOSS-Scope software

Please read this chapter first before you start to adjust and parameterise the GLOSS sensor.

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



The window size and position will be the same as when the software was last closed. A double-click with the right mouse button e.g. under the minimise symbol places the window centrally in its original size.

If a connection is not established automatically, e.g. if no sensor is connected, the software can be run in OFFLINE mode. In offline mode it is only possible to exchange parameters with a file on a storage medium, which often is helpful for the purpose of analysing parameter files.

If a sensor is connected and a connection still cannot be established, either the SCOPE version (program at the PC) and the firmware version (program in the sensor) do not match, or the interface to the sensor must be correctly configured.

If different Scope and firmware versions should be the problem, please get the Scope version that matches the firmware from your supplier.

The interface configuration is described in the CONNECT tab chapter.

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

Due to a better overview, parameters that are not required, displays, graphs, etc., are greyed out or invisible depending on the parameterization.

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 converter is used, the **COM PORT** number can be determined by way of the hardware manager in the system control panel.

Click on the magnifier icon to show a list of all possible COM ports in the display.

An RS232 to Ethernet converter (**cab-4/ETH**) is needed if the sensor should communicate through a local network. With this converter a connection to the sensor can be established using the **TCP/IP** protocol.

Parameterisation of the **cab-4/ETH** converter (assigning of IP address, baudrate setting, ...) can be done with the **SensorFinder** software that is available free of charge on the internet.

In order to establish a connection to the converter, 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 network converter is 5000. This port number must not be changed.

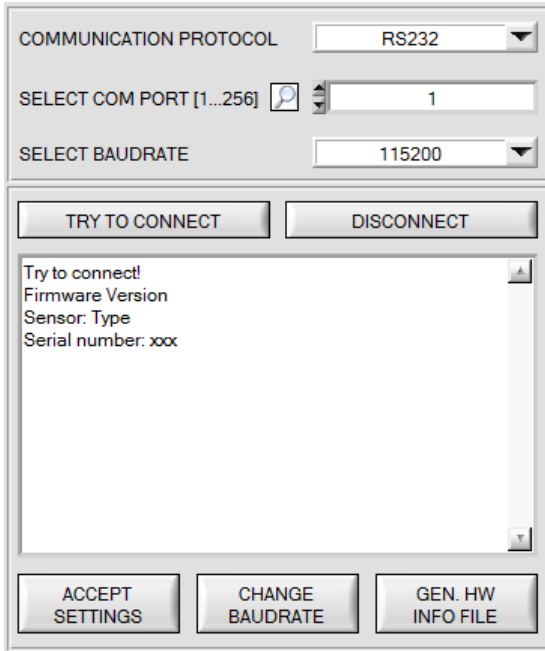
When you press the **TRY TO CONNECT** button, the software tries to establish a connection with the set parameters. The communication status is shown in the display field. If the sensor answers with its FIRMWARE ID, the set connection type can be accepted by pressing **ACCEPT SETTINGS**. You will then 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.

DISCONNECT disconnects the connection between sensor and PC. The software then switches to OFFLINE mode, where it is only possible to exchange parameters with a file on a storage medium.

Under **PANEL ID** a name can be entered that will be displayed at different points in the program window, and that will be recorded in different files (e.g. Record File) as well.

With the input field **LANGUAGE** a language can be set with which the individual controls are displayed on the surface. This also applies to the help function that is actuated with the right mouse button.

<p>Please note:</p>  <p>ATTENTION !</p>	<p>The stable function of the interface is a basic prerequisite for measured value transfer from the PC to the sensor.</p> <p>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.</p> <p>For maintaining maximum switching frequency at the sensor data communication with the PC must be stopped (press the STOP button).</p>
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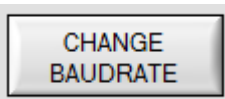


The baudrate for data transfer through the RS232 interface can be set by means of the **SELECT BAUDRATE** drop down menu and **CHANGE BAUDRATE** function field.

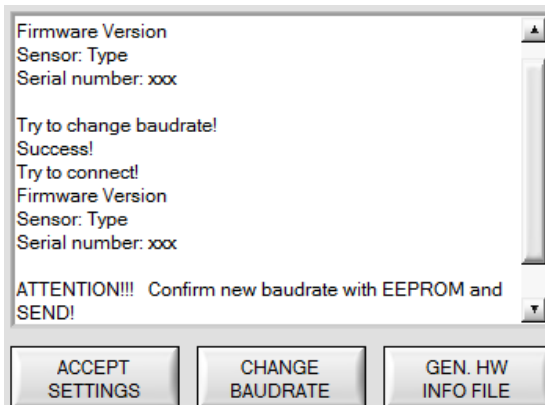
If the baudrate should be changed, a connection must first be established by clicking on **TRY TO CONNECT**. The **CHANGE BAUDRATE** button will then be active.



Now a new baudrate can be selected under **SELECT BAUDRATE**.

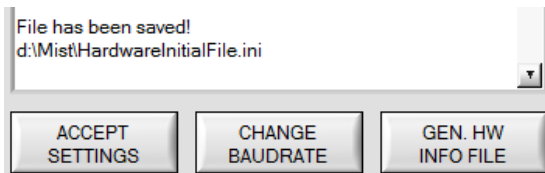


A click on **CHANGE BAUDRATE** sends the new baudrate information to the sensor.



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.



A click on the **GEN. HW INFO FILE** generates a file in which all the important sensor data are stored in encrypted form. This file can be sent to the manufacturer for diagnostic purposes.

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 shortcut key button F9 is pressed), 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 button F10). The source of data exchange is determined by the selected button (**RAM**, **EEPROM**, or **FILE**).

RAM:

The **RAM** is a **volatile** memory in the sensor's micro-controller, i.e. when the power at the sensor is turned off, these parameters will be lost again.

The sensor always operates with the parameters in its RAM.

If the **RAM** option is selected, a click on **SEND** writes the current parameters to the sensor's **RAM** memory, and a click on **GET** reads the parameters from the sensor's **RAM** memory.

EEPROM:

The **EEPROM** is a **non-volatile** memory in the sensor's micro-controller. When the power at the sensor is turned off the parameters in the **EEPROM** will not be lost. When power is turned on again, the parameters are loaded from the **EEPROM** to the **RAM** memory. Figuratively speaking the **EEPROM** thus is a level lower than the **RAM**. Data exchange between **PC** and **EEPROM** automatically is performed through the **RAM** memory, which means that parameters that are written to the **EEPROM** automatically are also written to the **RAM**, and data that are read from the **EEPROM** automatically are also read to the **RAM**.

If the **EEPROM** option is selected, a click on **SEND** writes the current parameters to the sensor's non-volatile **EEPROM** memory, and a click on **GET** reads the parameters from the sensor's **EEPROM**.

The **RAM** memory should always be used for parameterising the sensor. When suitable parameters have been found for the respective application, these parameters must be written to the sensor's **EEPROM** so that after restarting the sensor these parameters can be loaded from the **EEPROM** into the **RAM** memory.

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.

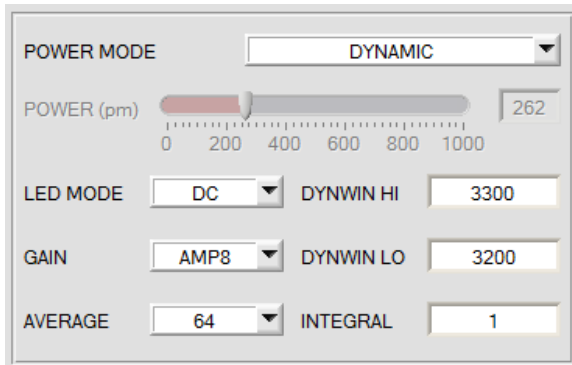
TIP! Once suitable parameters have been found for a certain application, these should always be saved in a file on the PC.

GO [F11]:

A click on this button starts data transfer from the sensor to the PC through the serial RS232 interface.

STOP [F12]:

A click on this button stops data transfer from the sensor to the PC through the serial RS232 interface.



The screenshot shows a control panel with the following settings:

- POWER MODE:** DYNAMIC (selected in a dropdown menu)
- POWER [pm]:** A slider set to 262, with a scale from 0 to 1000.
- LED MODE:** DC (selected in a dropdown menu)
- DYNWIN HI:** 3300 (text input field)
- GAIN:** AMP8 (selected in a dropdown menu)
- DYNWIN LO:** 3200 (text input field)
- AVERAGE:** 64 (selected in a dropdown menu)
- INTEGRAL:** 1 (text input field)

POWER MODE:

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

STATIC:

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

DYNAMIC: (recommended operation mode)

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

LED MODE:

This item serves for setting the control mode for the integrated light source of the sensor.

DC: In this mode the sensor operates extremely fast. Unfortunately the sensor is somewhat sensitive to extraneous light in DC mode, but if the extraneous light source does not directly shine into the sensor's receiver, the signal only is influenced to a very small extent.

AC: In this mode the sensor is insensitive to extraneous light, which is achieved by "modulating" the integrated light source, i.e. by turning the light on and off. The extraneous content in the signal is determined in off status and is simply subtracted from the on status.

GAIN:

This item is used for setting the gain of the receiver directly in 8 different gain stages (AMP1 to AMP8).

GAIN should be set such that with a medium **POWER** value the sensor operates in its dynamic range.

In **AC** mode, **GAIN** directly influences the scan frequency. The current scan frequency is displayed in the **SCOPE** tab.

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 sensor

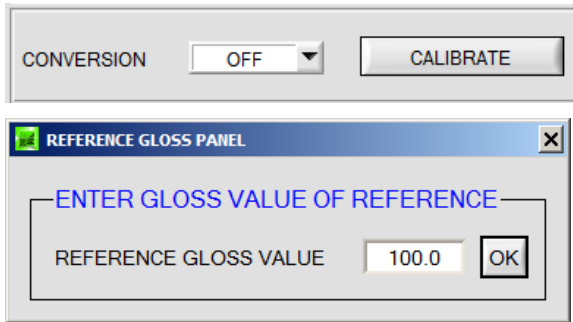
INTEGRAL:

This function field is used to set the number of scan values (measurement values) over which the raw signal measured at the receiver is summed up. This integral function allows the reliable detection even of extremely weak signals. A higher **INTEGRAL** value increases the noise of the raw signals of the receiver unit, and simultaneously decreases the maximum achievable switching frequency of the sensor.

INFO:

The **POWER** slider is only effective in the **POWER MODE = STATIC**.

DYN WIN LO and **DYN WIN HI** are only effective in **POWER MODE = DYNAMIC**.



Like any other measuring instrument the sensors of the GLOSS series must be calibrated from time to time. This calibration can be performed by means of a reference surface that can be obtained from the supplier.

When you click on **CALIBRATE** you will be prompted to place the calibration disk with the reference surface in front of the sensor.

Click on **YES** to confirm that you have placed the reference surface.

Then enter the gloss value of the reference surface and confirm it with **OK**. The gloss value is written on the calibration disk.

The channels **CH DIR** or **CH REF** are then saved in the sensor's EEPROM as references for the reference surface. This means that it is **NOT** necessary to perform calibration every time the sensor is started anew.

After successful calibration the sensor can be calibrated to another system. This is necessary, for example, if several systems of the same type must be exactly matched to each other, or if the sensor should be matched to a foreign system. **Conversion** can be activated with the **CONVERSION=ON** parameter.

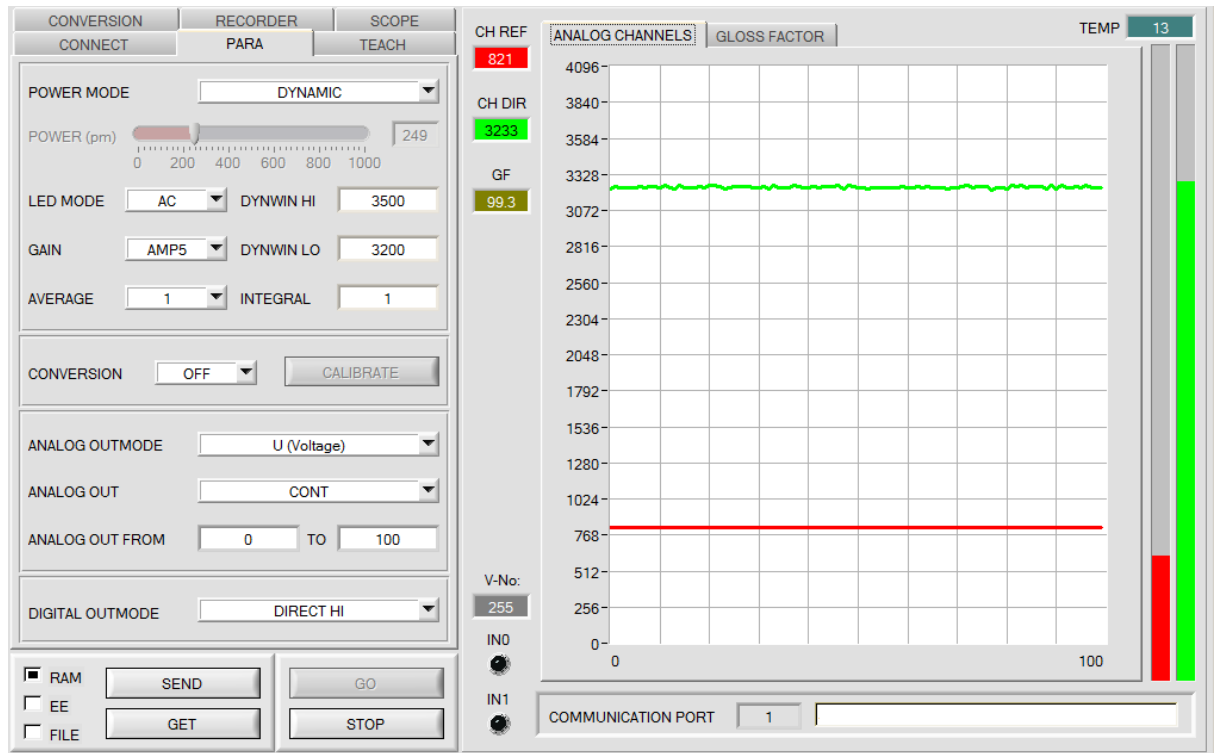
TIP:

Measurements of gloss factors between 0 and 100 GU

To fully utilise the sensor's dynamic range, **GAIN** should be set such that the reference channel **CH REF** assumes a value of about 1000, and **POWER** should be higher than 200 and lower than 400. **POWER** can be checked by clicking on **GET** in **GO** mode.

In this example calibration is performed to a reference surface with 99.3 GU. If the gloss factor should decrease, the red bar (**CH REF**) will move upwards. When it reaches the level of the green bar (**CH DIR**) this green bar will move downwards. This means that the dynamic range of both channels is fully utilised to measure gloss factors between 0 and 100 GU with highest resolution. It also means, however, that gloss factors of more than 100 GU can no longer be accurately measured.

However, this only works if **POWER MODE = DYNAMIC** is set. In this mode the sensor automatically adjusts its **POWER** value in such a way that the strongest channel always lies in the window that is defined with **DYNWIN LO** and **DYNWIN HI**.

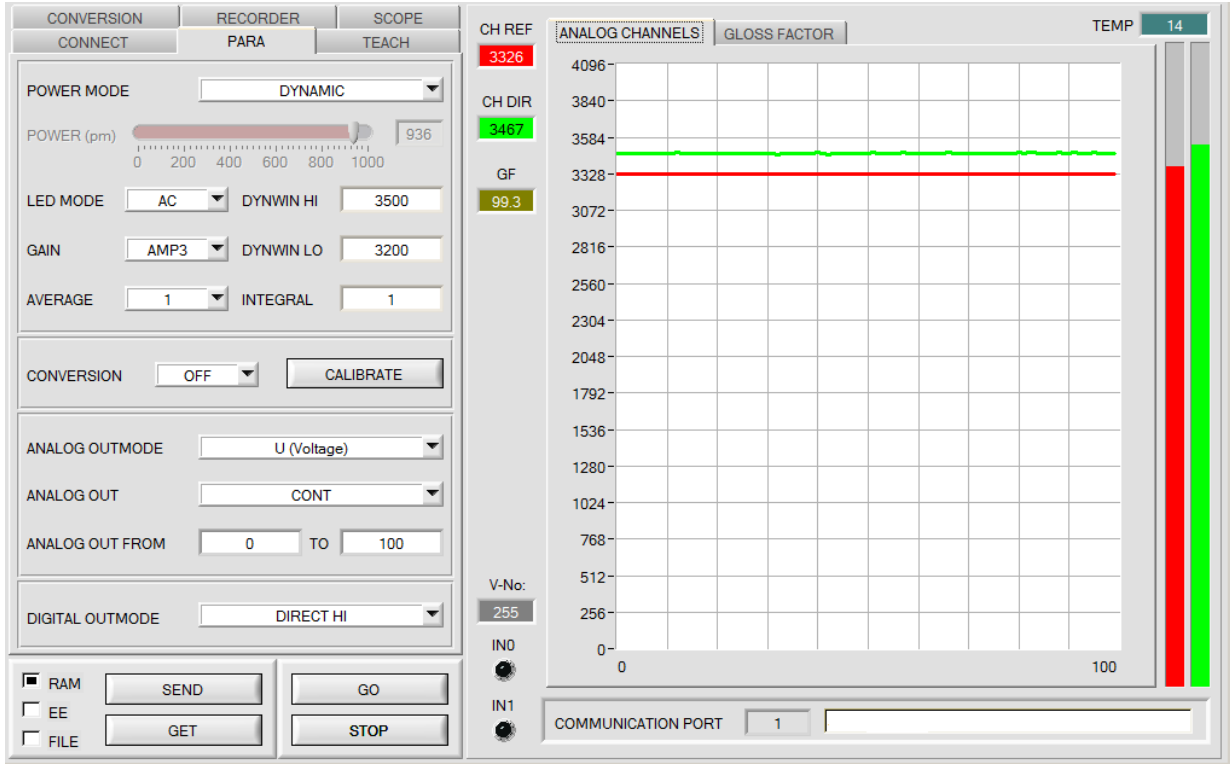


TIP:

Measurements of gloss factors between 0 and 1000 GU

To also fully utilise the sensor's dynamic range here, **GAIN** should be set such that the reference channel **CH REF** approximately is as high as **CH DIR**. **POWER** should assume a value of about 1000. **POWER** can be checked by clicking on **GET** in **GO** mode.

In this example calibration again is performed to a reference surface with 99.3 GU. If the gloss factor should increase now, the red bar (**CH REF**) will move down, and the gloss factor will increase. If, however, the gloss factor drops below 100 GU, the green bar (**CH DIR**) will move down. This means that the dynamic range of both channels is fully utilised to measure gloss factors between 0 and 1000 GU with highest resolution.



TIP:

Measurements of gloss factors between 0 and 10 GU

A calibration disk with a reference surface of approx. 10 GU is required for measuring gloss factors between 0 and 10 GU with highest resolution. This calibration disk is available as an accessory.

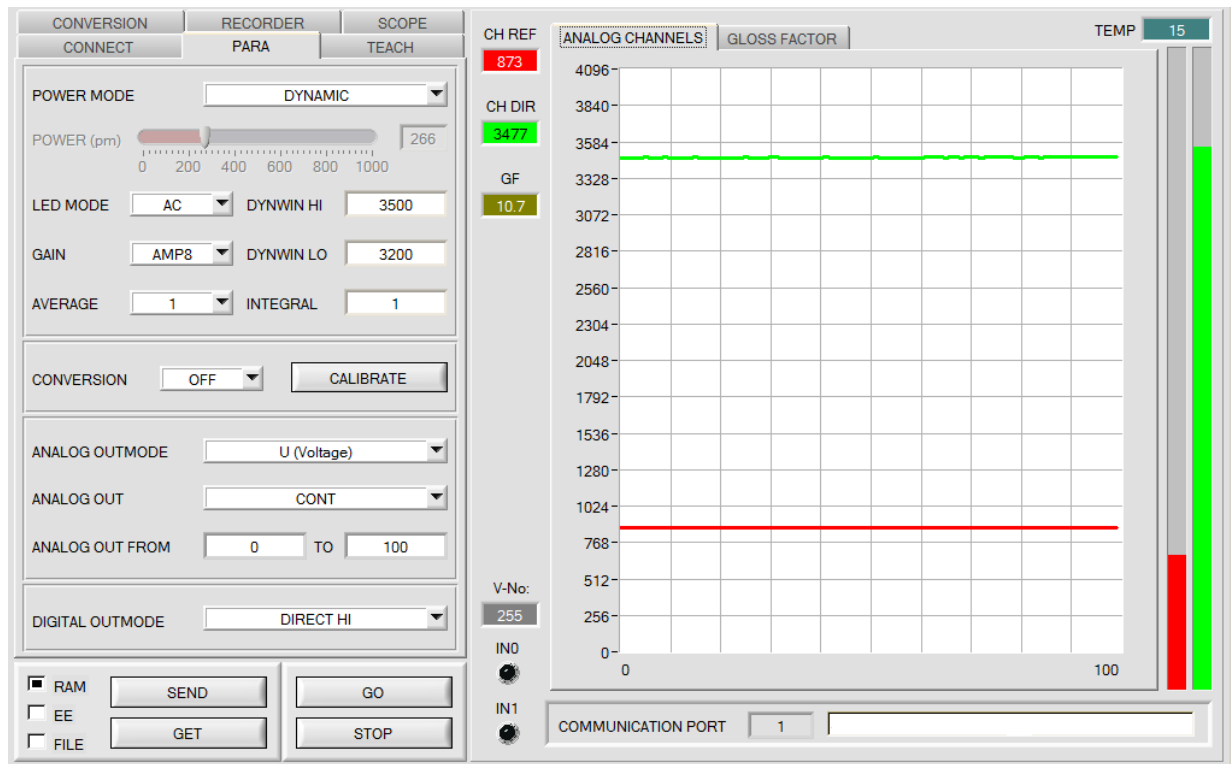
The procedure is exactly the same as for measuring gloss factors between 0 and 100 GU.

To fully utilise the sensor's dynamic range, **GAIN** here, too, should be set such that the reference channel **CH REF** assumes a value of about 1000, and **POWER** should be higher than 200 and lower than 400. **POWER** can be checked by clicking on **GET** in **GO** mode.

In this example calibration is performed to a reference surface with 10.7 GU. If the gloss factor should decrease, the red bar (**CH REF**) will move upwards. When it reaches the level of the green bar (**CH DIR**) this green bar will move downwards. This means that the dynamic range of both channels is fully utilised to measure gloss factors between 0 and 10 GU with highest resolution. It also means, however, that gloss factors of more than 10 GU can no longer be accurately measured.

However, this only works if **POWER MODE = DYNAMIC** is set. In this mode the sensor automatically adjusts its **POWER** value in such a way that the strongest channel always lies in the window that is defined with **DYNWIN LO** and **DYNWIN HI**.

INFO! During calibration it also would be possible to enter a value of 107 instead of 10.7. This would result in values between 0 and 107. This means that with this method a gloss factor of e.g. 6 GU would become a gloss factor of 60 GU. This often is desired if in the teach table tolerances should be set with decimal places. It must not be forgotten, however, that the true gloss factor then is smaller than the displayed gloss factor by a factor of 10.



ANALOG OUTMODE	U (Voltage) ▼
ANALOG OUT	CONT ▼
ANALOG OUT FROM	0 TO 100

The gloss factor **GF** is used to output an analog signal. **GF** is acquired with a resolution of 12 bit and therefore may have values between 0 and 4095

ANALOG OUTMODE:

This function field is used to define how the sensor uses the analog output.

OFF:

No analog signal is output.

U (Voltage): **GF** is provided as a voltage of 0 - 10V.

I (Current): **GF** is provided as a current of 4 - 20mA.

ANALOG OUT FROM ...TO ...:

This function field is used to set the range in which the sensor outputs the gloss factor **GF** at the analog output.

Example: **FROM 10 TO 30**

0-10V or 4-20mA are represented in a range from GF=10 to GF=30.

With GF=20 5V or 12mA are output.

ANALOG OUT:

This function field is used to specify when the sensor outputs the analog signal.

CONT: The analog signal is output continuously.

RISING EDGE of IN1: The analog signal only is output when there is a positive edge at IN1.

DIGITAL OUTMODE	DIRECT HI ▼
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DIGITAL OUTMODE:

This function field is used to determine the operating mode of the digital outputs.

OFF:

No digital signal is output. All the corresponding function fields are hidden.

DIRECT:

In this mode a maximum of 3 gloss factors is allowed.

If in the line-by-line comparison the current gloss factor matches the teach gloss factor that was entered in the TEACH TABLE, this "hit" is displayed as a vector number (V-No.) and is **directly** output at the digital outputs (OUT0 ... OUT2).

DIRECT HI:

If **DIRECT HI** is activated, the respective digital output is set to HIGH. If no gloss vector was detected, the digital outputs are in LOW state.

DIRECT LO:

If **DIRECT LO** is activated, the respective digital output is set to LOW and the others to HIGH. If no gloss vector was detected, the digital outputs are in HIGH state.

BINARY HI:

If in the line-by-line comparison the current gloss factor matches the teach gloss factor that was entered in the TEACH TABLE, this "hit" is displayed as a vector number (V-No.) and is provided as a **bit pattern** at the digital outputs (OUT0 ... OUT2).

A maximum of 7 gloss factors can be taught.

BINARY LO:

Same function as **BINARY HI**, but the **bit pattern** is output inversely.

MAXVEC-No.	<input type="text" value="1"/>
INTLIM	<input type="text" value="0"/>
HOLD [0-100ms]	<input type="text" value="10.0"/>
EXTERN TEACH	<input type="text" value="OFF"/>
TRIGGER	<input type="text" value="CONT"/> <input type="text" value="ST TRSH"/> <input type="text" value="200"/>
PROFILE FROM [%]	<input type="text" value="0"/> TO <input type="text" value="100"/>

MAXVEC-No.:

This function field is used to define the number of gloss factors in the **TEACH TABLE** that should be checked. In **BINARY** mode a maximum of 7 gloss factors can be checked, in **DIRECT HI** or **DIRECT LO** mode a maximum of 3 gloss factors (0, 1, 2) can be checked.

MAXVEC-No. has an influence on the current possible scan rate of the sensor. With a lower number of vectors that must be checked the sensor operates faster.

INTLIM:

An intensity limit can be set in this edit box. If the current

intensity (**CH DIR + CH REF**) arriving at the receiver unit falls below this limit, evaluation will no longer be performed, and an error state will be output (V-No.: =255).

HOLD:

With corresponding settings the sensor operates with minimum scan times in the magnitude of less than 25.

This is why most of the PLCs that are connected to the digital outputs have difficulties with the safe detection of the resulting short switching state changes.

HOLD can be used to set a pulse lengthening at the digital outputs of the sensor system of up to 100 ms.

EXTERN TEACH:

	GF	GF TOL
0	0.0	3.0
1	0.0	6.0
2	0.0	9.0
3	0 0	0 0

When **EXTERN TEACH** is activated, the currently present gloss factor can be written to the **TEACH TABLE** by way of the external IN0 input. The currently present gloss vector is automatically taken over in as many rows as is set in **MAXVEC-No.**, starting with row 0.

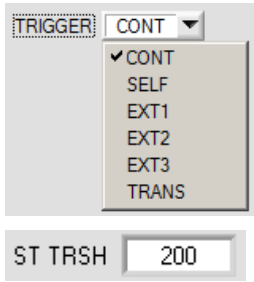
The advantage is that the user does not have to start the parameterisation software for this purpose.

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

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

ATTENTION!

When **EXTERN TEACH = ON**, external triggering with EXT1, EXT2, EXT3 and TRANS is not possible.



TRIGGER:

This function field is used to set the trigger mode at the sensor.

CONT: Continuous evaluation (no trigger event required).

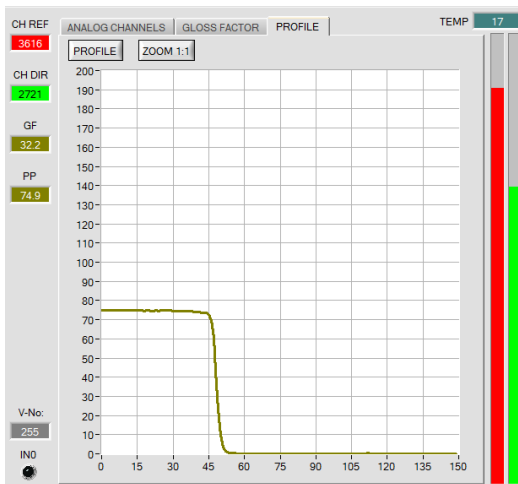
SELF: As long as the **CH_DIR** channel is higher than **ST TRSH** (Self Trigger Threshold), measurement values are recorded in an internal buffer. When **CH_DIR** is lower than **ST TRSH** again, an average is determined from the number of recorded measurement values, and this average is then output.

As long as the sensor is internally "triggered" the outputs are held at binary 6. 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 6 must not be assigned, because otherwise there will be no change of the outputs when the vector is detected.

Otherwise this mode exactly corresponds with the functionality of **EXT1**, the only difference is the type of triggering. **SELF** means self-triggering, and **EXT1** means external triggering through the physical IN0 input.

EXT1: As long as input IN0 is high (+24V), measurement values are recorded in an internal buffer. When the input has dropped again, an average is formed from the number of recorded measurement values and is then output.



Click on the **PROFILE** button to show the internally recorded buffer that is used for evaluation on the graphic display. The display furthermore shows the peak-to-peak value **PP**.

Hold the CTRL key and use the mouse to draw a window in the graph in order to zoom into the graph.

Click on **ZOOM 1:1** to deactivate the zoom function again.

	GF	GF TOL	PP TOL
0	94.4	2.0	5.0
1	0.0	0.0	0.0

PP is used for evaluation. An error 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 [%] TO

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

EXT2: Evaluation is started through the external trigger input IN0. 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) also are output.

When the trigger input goes to LOW again, the state (V-No. :) that was last detected will be held at the outputs.

EXT3: Same behaviour as in **EXT1** mode, with the difference that an error state (V-No. : = 255) will be output when the trigger input goes to LOW again.

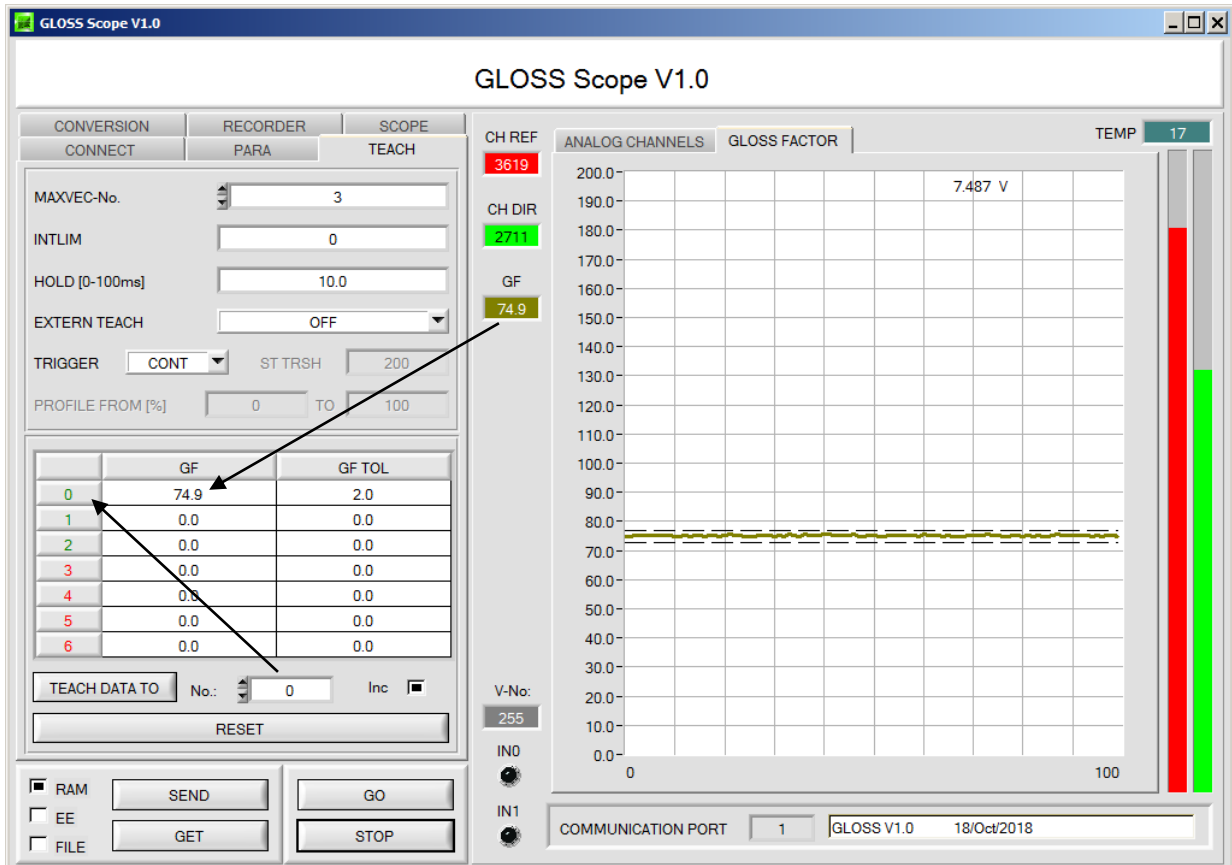
TRANS: The transmitter LED is active and evaluation is performed as long as input IN0 is high (+24V) or the button at the housing is pressed. When IN0 drops again or the button is released, the state that was last detected is held and the transmitter LED switches off.

This trigger mode was introduced to preserve the transmitter LED. The TRANS mode is recommended if the transmitter LED is a UV LED.

2.3 Tab TEACH

Click on the **TEACH** tab to open a tab where you can teach vectors to the **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.



With a click on **TEACH DATA TO** the currently displayed gloss factor **GF** is written to the row in the **TEACH TABLE** that is selected under **No.:**. A tolerance (**GF TOL**) also is defined. Tolerance and teach value can be changed, if necessary.

No.: is used to select which tolerance window is displayed 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** button resets the **TEACH TABLE** (**RESET** value = 0).

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.

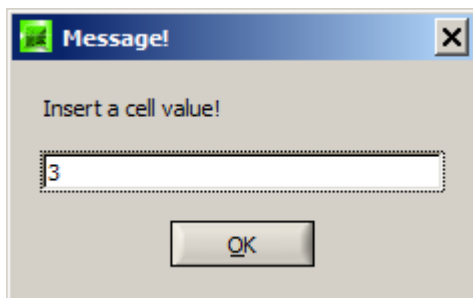
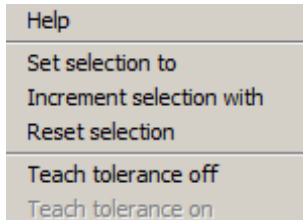
The **TEACH TABLE** is organized in rows, i.e. the individual parameters for the teach-in vectors are arranged side by side in the respective row.

The sensor is able to check up to 7 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.**

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

	GF	GF TOL
0	94.4	3.0
1	80.0	3.0
2	45.0	3.0
3	0.0	0.0



With **Set selection to** several cells in the **TEACH TABLE** can be filled with a value.

For this purpose the cells that should be changed must first be selected.

A right mouse click then opens a popup menu.

If you click on **Set selection to** there, a popup window will open where you can enter the value to which the cells should be changed.

Incrementing tolerance values can be entered by using **Increment selection with**.

The start value is the value of the topmost left cell. Starting from this cell the following cells are increased each by the value that is entered in the popup window.

A click on **Reset selection** resets the selected cells to a value of 0.

When you use **TEACH DATA TO** the software suggests tolerance values and writes these values to the respective cells. This function can be turned off and on with **Teach tolerance off** and **Teach tolerance on**.

A click on **Help** opens a popup window that provides explanations for the respective functions.

2.4 Graphic display elements

The software provides various display elements and a graphic window for the visualisation of all the data that are important for parameterisation. The individual display elements and the graph are explained in the chapter below.



These displays indicate the data that are currently measured at the sensor.

CH REF = Reference channel

CH DIR = Direct reflection

On the right side of the graph the data are additionally visualised in the form of bars.

In the graph under the **ANALOG CHANNELS** tab the data also are displayed as continuous lines.

GF:

This display shows the calculated gloss factor.

The value is displayed in Gloss Units (GU).

A double-click on this display calls up a large display.

In the graph under the **GLOSS FACTOR** tab the gloss factor **GF** also is displayed as a continuous line. The tolerance window that is set under **No.:** also is displayed here.

PP:

Is the peak-to-peak value is of the profile buffer.



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 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.

IN0 and IN1:

The LEDs visualise the physical state of inputs IN0 and IN1.

When the LED is black, the input is at 0V.

When the LED is green, the input is at +24V

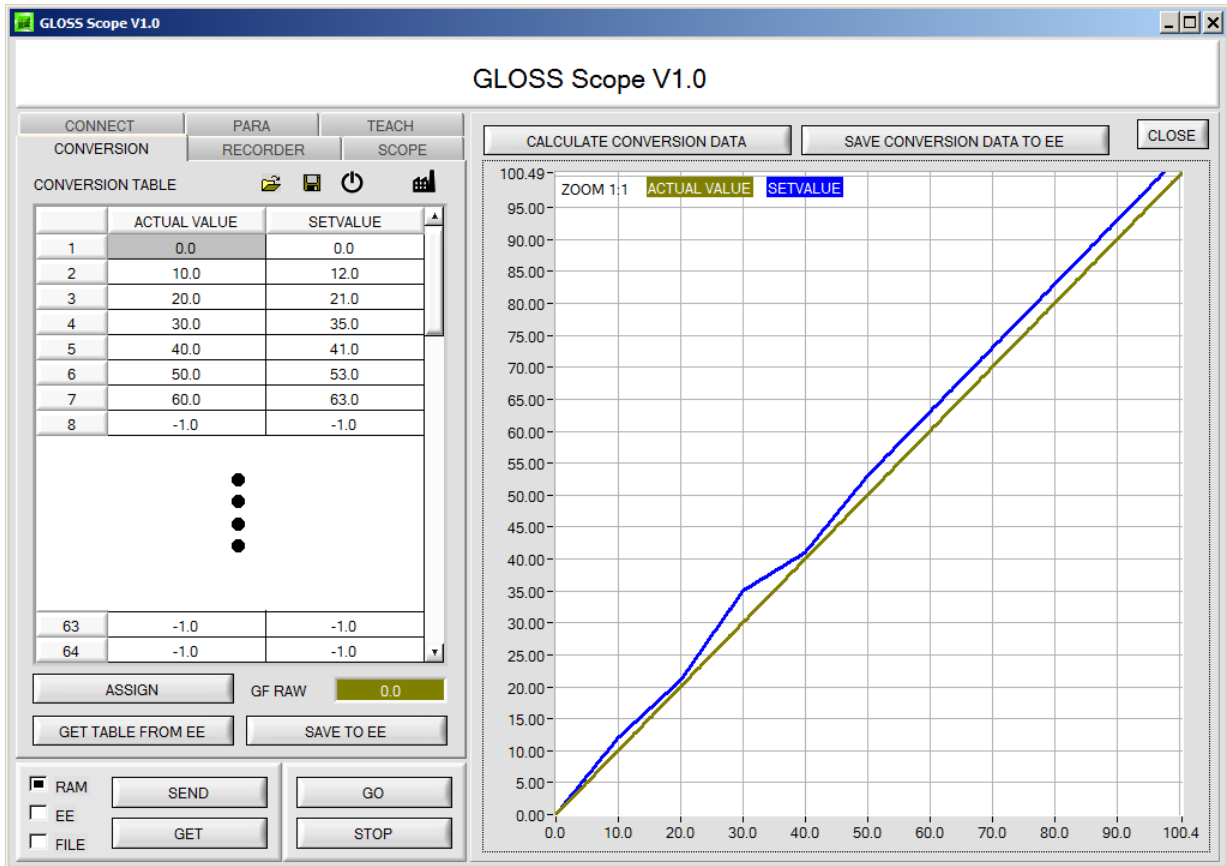


TEMP:

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

2.5 Tab CONVERSION

In the **CONVERSION** tab a certain conversion value can be assigned to the gloss factor **GF** signal.
If **CONVERSION = ON** is set the corresponding conversion value is output instead of **GF**.



When the **GO** button is pressed the current **GF** value is shown in the **GF RAW** display.
Use the mouse to select a cell in the **ACTUAL VALUE** column and press **ASSIGN**. This value is then written to the cell in the table. Then enter the value that should be output in analog form in the **SETVALUE** column.
A total of 64 conversion values can be entered this way.
The first and the last row must be filled in (see **CONVERSION TABLE** row 1 and 64).
Rows that are not used must be disabled with -1 (see **CONVERSION TABLE** row 63).
The **ACTUAL VALUE** and **SETVALUE** columns have a value range of 0 to 2000.

Click on **CALCULATE CONVERSION DATA** to display a graph of the conversion table. The blue line represents the actual value, the green line shows the setvalue.
The graph can be zoomed by holding down the control key and drawing a window with the left mouse button. Click on **ZOOM 1:1** to display the graph in normal size again.

With **SAVE CONVERSION DATA TO EE** the conversion data can be sent to the EEPROM of the sensor.

With the   symbols the conversion table can be saved in a file or read from a file.

With **GET TABLE FROM EE** and **SAVE TO EE** the conversion table can be loaded from the sensor's EEPROM or saved to the sensor's EEPROM.

A click on the  symbol resets the table.

A click on the  symbol loads the factory-set conversion table from the EEPROM.
Click on **SAVE CONVERSION DATA TO EE** to activate these factory settings.

2.6 Tab RECORDER

The GLOSS-Scope software features a data recorder that allows the saving of **CH REF**, **CH DIR**, **GF** 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 four columns and as many rows as data frames were recorded. A row is structured as follows: **CH DIR**, **CH REF**, **TEMP**, **GF**.

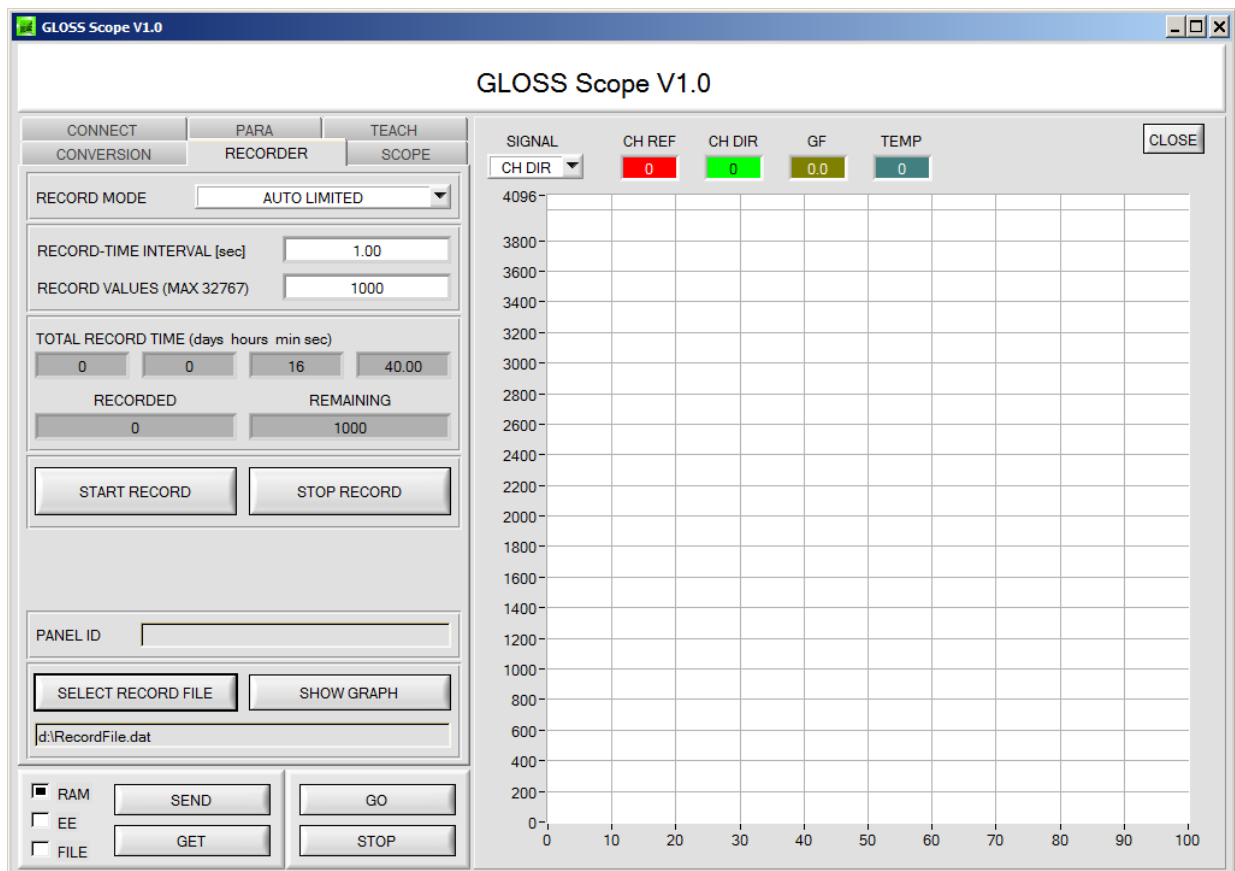
The following steps describe how data frames are recorded with the recorder:

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]		1.00	
RECORD VALUES (MAX 32767)		1000	
TOTAL RECORD TIME (days hours min sec)			
0	0	16	40.00
RECORDED		REMAINING	
0		1000	
START RECORD		STOP RECORD	
PANEL ID			
SELECT RECORD FILE		SHOW GRAPH	
d:\Mist\RecordFile.dat			

Step 2:

If you want to automatically record several data frames, please select **AUTO LIMITED** under **RECORD MODE**. 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 32767]** 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 32767]** 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 MODE**. Then select the desired recording interval and press **START RECORD**.

If you want to record data "manually", select the **MANUAL RECORDING** function under **RECORD MODE**. 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 MODE**, and **TRIGGER = SELF, EXT1, EXT2, EXT3 or TRANS** 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 select a file with SELECT RECORD FILE this file is created as a new file. Then a file header with the meaning of the individual columns is written to the file.

When data are then recorded, these data are appended to the selected file, even when data recording is stopped and then resumed again.

2.7 Tab SCOPE

The SCOPE tab visualises an oscilloscope.

A click on **GET CYCLE TIME** displays the current sensor scan frequency in [Hz] and [ms]. The current scan frequency must be determined for the correct calculation of **deltaX[ms]**. Please give the sensor 8 seconds to determine the correct scan frequency before you click on **GET CYCLE TIME**.

In **TRIGGER MODE = SINGLE SHOT** a click on **SCAN** records a data frame and displays it in the graph.

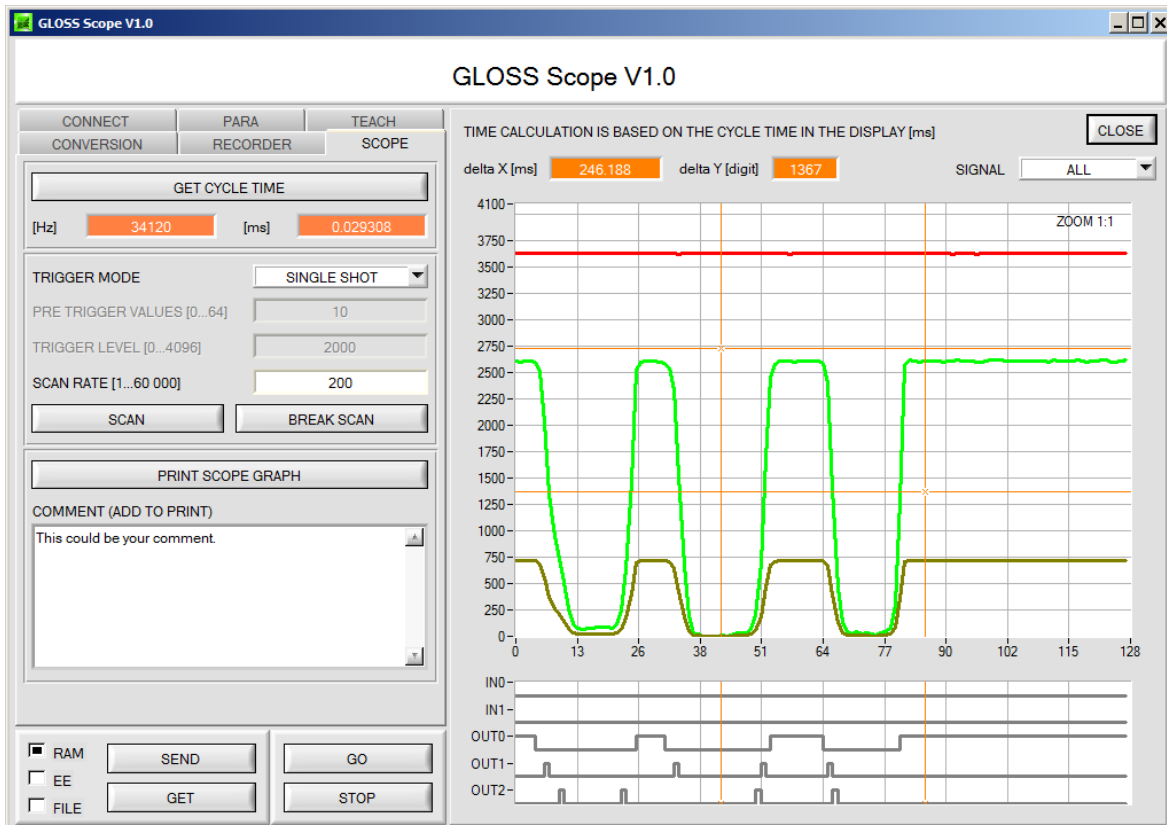
In **TRIGGER MODE = FALLING EDGE** and **TRIGGER MODE = RISING EDGE** a click on **SCAN** starts triggered recording. A trigger start can be defined with **TRIGGER LEVEL**.

In **TRIGGER MODE= INTERN V-Nr.0** recording starts stand-alone once vector 0 is detected.

In **TRIGGER MODE= EXTERN IN0** recording can be started external via input IN0.

This only works if **IN0** is not used for anything else.

SCAN-RATE can be used to delay or accelerate recording. This corresponds with the TIMEBASE function known in oscilloscopes. **PRE TRIGGER VALUES** can be used to define how many values should still be displayed before the actual trigger start.



The zoom function in the graph can be activated by holding the control key (CTRL) and drawing a window with the mouse. A click on **ZOOM 1:1** cancels the zoom function again.

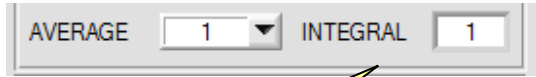
The two orange cursors can be moved with the mouse. The displays **deltaX[ms]**, and **deltaY[digit]** will be updated. **deltaX[ms]** shows the time between the cursors in X direction. **deltaY[digit]** shows the difference between the two cursors in Y direction in digits.

PRINT SCOPE GRAPH prints the current screen together with the text in the **COMMENT** text field.

The two bottom graphs (picture above) represent the states of the two outputs **OUT0** and **OUT1**.

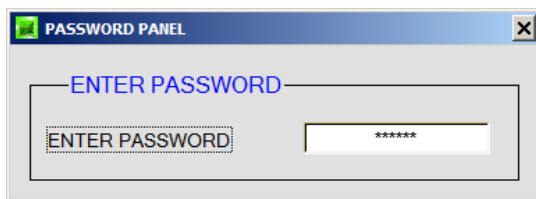
2.8 Offset calibration

To avoid an increase of the electronic offset when using the integral function (**INTEGRAL** parameter), this offset can be eliminated by way of offset calibration or zero-point calibration. The corresponding tab is password-protected to prevent inadvertent incorrect settings.



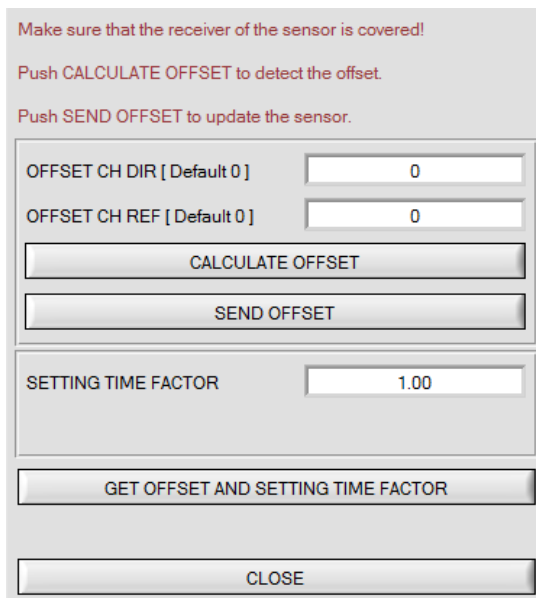
e.g. here:
 Double-click with the right mouse button.

Offset calibration can be accessed by double-clicking with the right mouse button exactly at the frame below **INTEGRAL** in the **PARA** tab.



You will then be prompted to enter a password. The password is: mellon

Then follow the instructions provided in the tab.



ATTENTION!

With offset calibration it is of utmost importance that the receiver does not see any extraneous light. Therefore cover the receiver of the sensor, e.g. with a black cloth that is impermeable to light.

This is absolutely necessary for proper and perfect offset calibration.

Now press **CALCULATE OFFSET**. The offset value always should be clearly less than 100. The value automatically is written to the EEPROM of the sensor.

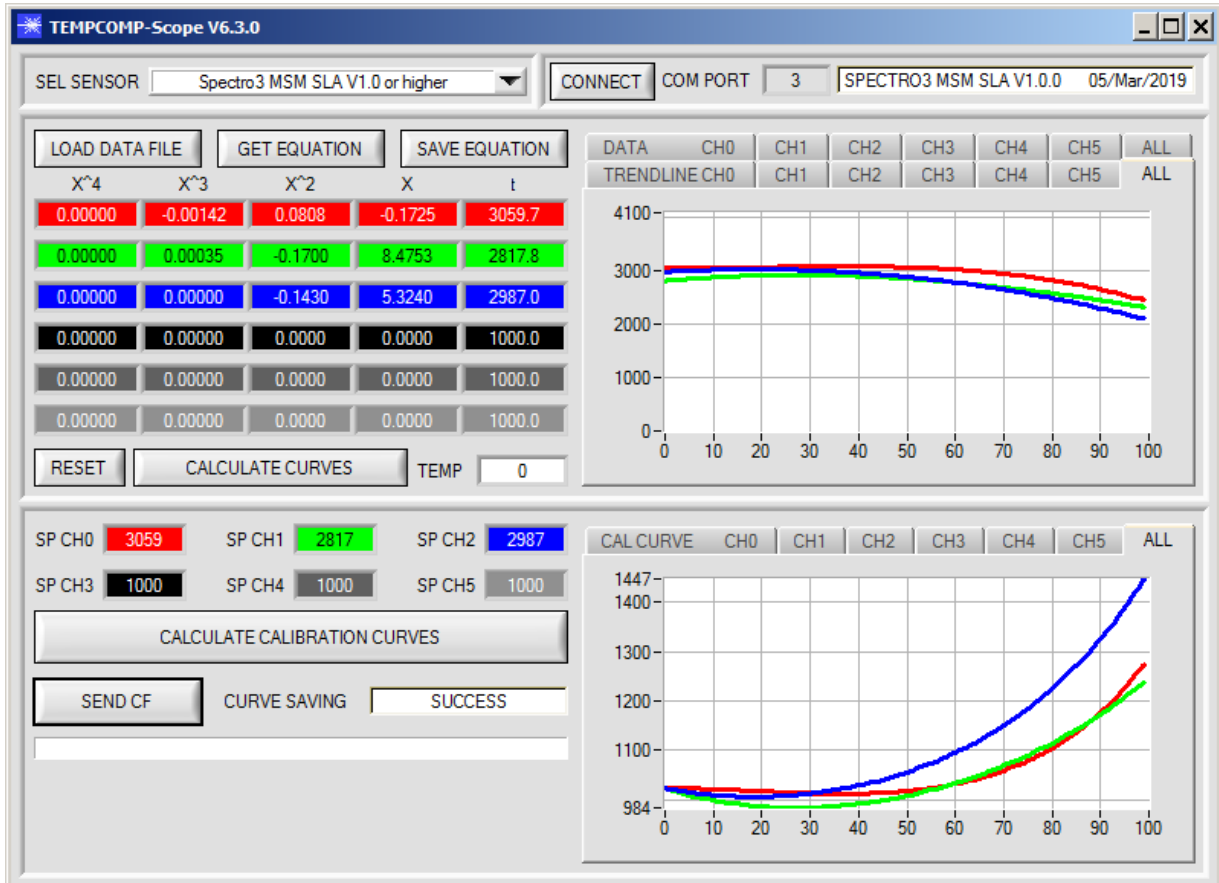
GET OFFSET AND SETTING TIME FACTOR can be used to check the value that is saved as the offset value. If necessary, **SEND OFFSET** can be used to save an offset value manually. (! not recommended !).

SETTING TIME FACTOR is a value that is defined when the sensor is manufactured. For sensors with infrared light source this value is 2.5. For all other sensors this value should be 1.0. It is possible to change this value, but for safety reasons the procedure to change this value is not described in this manual. If it should be necessary to change this value, please contact your supplier.

3 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.


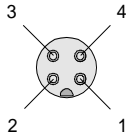


- Step 1: Load the temperature compensation file that you have received from your supplier with **GET EQUATION** or **LOAD DATA FILE**.
- Step 2: Press **CALCULATE CURVES** to display the data in the graph.
- Step 3: Select the sensor-internal operating temperature (not in °C) that the sensor has at an ambient temperature of 20°, if this has not already been done automatically. The value should be included in the file designation.
- Step 4: Press **CALCULATE CALIBRATION CURVES** to calculate the mean straight line.
- 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.

4 Connector assignment of the GLOSS sensors


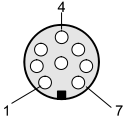
Connection of GLOSS to PC:

4-pole M5 fem. connector (type Binder 707) GLOSS/PC-RS232		 
Pin No.:		Assignment:
1		+24VDC (+Ub)
2		0V (GND)
3		Rx0
4		Tx0

Available connecting cables:

cab-las4/PC-...
cab-4/USB-...
cab-4/ETH-...

Connection of GLOSS to PLC:

8-pole fem. connector (type Binder 712) GLOSS/PLC		 
Pin No.:	Color of wire: (cab-las8/SPS)	Assignment:
1	white	0V (GND)
2	brown	+24V ($\pm 10\%$)
3	green	IN0 (Digital 0: 0 ... 1V, Digital 1: +Ub – 10%)
4	yellow	IN1 (Digital 0: 0 ... 1V, Digital 1: +Ub – 10%)
5	grey	OUT0 (Digital 0: 0 ... 1V, Digital 1: +Ub – 10%)
6	pink	OUT1 (Digital 0: 0 ... 1V, Digital 1: +Ub – 10%)
7	blue	OUT2 (Digital 0: 0 ... 1V, Digital 1: +Ub – 10%)
8	red	ANALOG 0...10V or 4...20mA

Connecting cable:

cab-las8/SPS-...

5 RS232 communication protocol

The sensors of the GLOSS series operate with the following **parameters** that are sent to the sensor or read from the sensor in the stated sequence.

Info! 2 bytes (8bit) are one word (16bit).

TABLE PARAMETER			
Parameter	Type	Meaning	
Para1: POWER	Word	Transmitter intensity (0 ... 1000) Attention intensity in thousandth!	
Para2: POWER MODE	Word	Transmitter mode: STATIC, DYNAMIC coded to (0, 1)	
Para3: DYNWIN LO	Word	Low limit for dynamic window when POWER MODE=dynamic (0...4095)	
Para4: DYNWIN HI	Word	High limit for dynamic window when POWER MODE=dynamic (0...4095)	
Para5: LED MODE	Word	Control for the internal light source DC, AC coded to (0,1)	
Para6: GAIN	Word	Amplification of the integrated receiver AMP1, AMP2, AMP3, AMP4, AMP5, AMP6, AMP7, AMP8 coded to (1, 2, 3, 4, 5, 6, 7, 8)	
Para7: AVERAGE	Word	Signal averaging 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384 or 32768	
Para8: INTEGRAL	Word	Signal integration (1...250)	
Para9: CONVERSION	Word	Conversion table OFF or ON coded to (0,1)	
Para10: ANALOG OUTMODE	Word	Function of the analog output: OFF, U, I coded to (0,1,2)	
Para11: ANALOG OUT	Word	Function of the analog out: CONT, RISING EDGE of IN1 coded to (0,1)	
Para12: ANALOG OUT FROM	Word	Begin of analog output range (0...4095)	
Para13: ANALOG OUT TO	Word	End of analog output range (0...4095)	
Para14: DIGITAL OUTMODE	Word	Function of the digital output: OFF, DIRECT HI, DIRECT LO, BINARY HI, BINARY LO coded to (0,1,2,3,4)	
Para15: MAXVEC-No.	Word	Number of the vectors (0,1,2, ...6)	
Para16: INTLIM	Word	Lower intensity limit (0...4095)	
Para17: HOLD	Word	Hold time for minimum pulse length coded to (0...100 [ms]) send value*10	
Para18: EXTERN TEACH	Word	External teach mode: OFF, ON coded to (0,1)	
Para19: TRIGGER	Word	Trigger mode CONT, SELF, EXT1, EXT2, EXT3, TRANS coded to (0,1,2,3,4,5)	
Para20: ST TRSH	Word	Self Trigger Threshold (200...4095)	
Para21: PROFILE FROM [%]	Word	Profile Range begin (0...100)	
Para22: TO	Word	Profile Range end (0...100)	

One row in the Teach Table determines a **TEACH VECTOR**.

The sensors of the GLOSS series operate with **7 TEACH VECTORS** that are sent to the sensor or read from the sensor in the stated sequence.

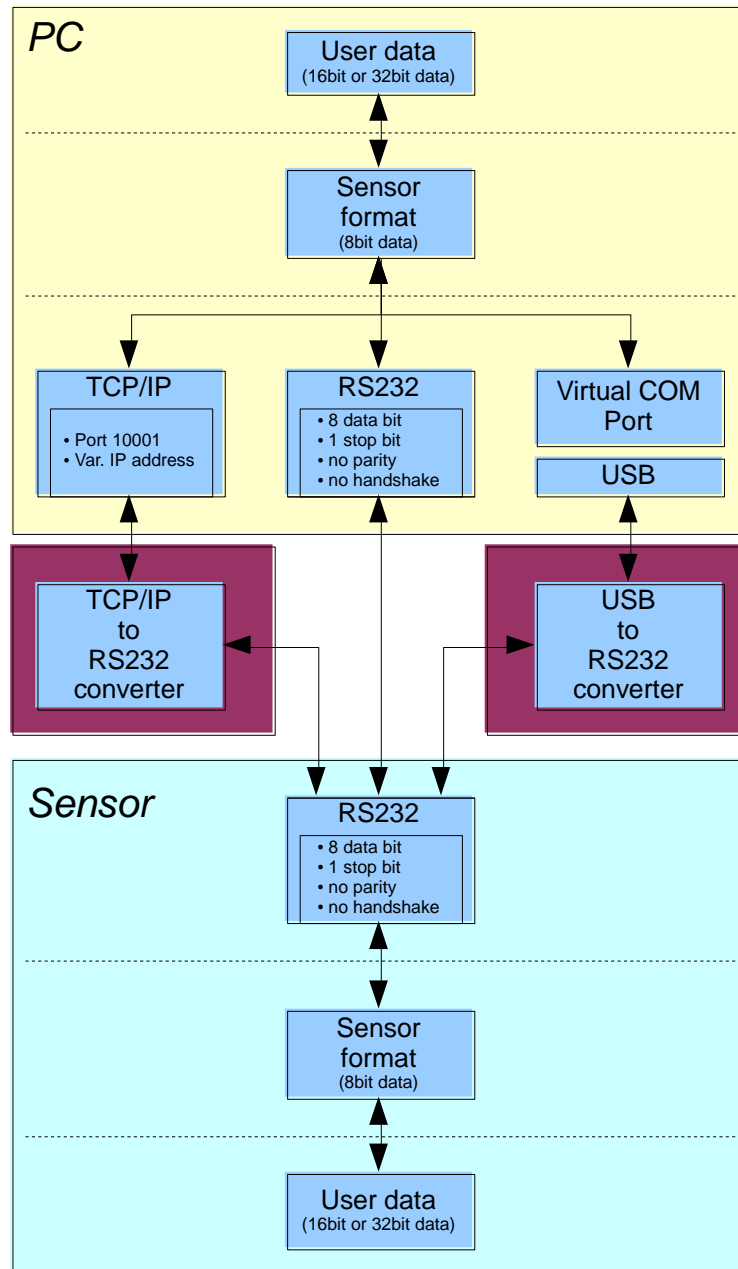
TABLE TEACH VECTORS			
TEACH VECTOR	Type	Meaning	
TeachVal1: Teach Table Row 0 Column 0	Word	Gloss factor of row 0	
TeachVal2: Teach Table Row 0 Column 1	Word	Gloss factor tolerance of row 0	
TeachVal3: Teach Table Row 0 Column 2	Word	Peak to peak tolerance of profile of row0	
TeachVal4: Teach Table Row 1 Column 0	Word	Gloss factor of row 1	
TeachVal5: Teach Table Row 1 Column 1	Word	Gloss factor tolerance of row 1	
TeachVal6: Teach Table Row 1 Column 2	Word	Peak to peak tolerance of profile of row1	
...	
TeachVal19: Teach Table Row 6 Column 0	Word	Gloss factor of row 6	
TeachVal20: Teach Table Row 6 Column 1	Word	Gloss factor tolerance of row 6	
TeachVal21: Teach Table Row 6 Column 2	Word	Peak to peak tolerance of profile of row6	

Upon request, the data acquired and processed by the sensor are sent by the sensor in the following sequence.

TABLE DATA VALUE			
DATA VALUE	Type	Meaning	
DatVal1: CH DIR	Word	Analogue raw signal of the channel direct	
DatVal2: CH REF	Word	Analogue raw signal of the channel reference	
DatVal3: TEMP	Word	Sensor internal temperature (not in °C or F)	
DatVal4: GF	Word	Gloss value	
DatVal5: GF RAW	Word	Gloss raw value (before conversion table)	
DatVal6: V-No:	Word	Detected vector number from the teach table	
DatVal6: DIGITAL IN	Word	Bit 0 is 0 when IN0 is LO Bit 0 is 1 when IN0 is HI Bit 1 is 0 when IN1 is LO Bit 1 is 1 when IN1 is HI	
DatVal7: ANA OUT	Word	Analogue output value in digit (0=0V, 4095=10V)	
DatVal8: PP	Word	Peak to peak value of actual profile	

Digital serial communication is used for the exchange of data between the software running on the PC and the sensor. For this purpose the control unit features an EIA-232 compatible interface that operates with the (fixed) parameters **"8 data bits, 1 stop bit, no parity bit, no handshake"**.

Five values are available for the baudrate: 9600baud, 19200baud, 38400baud, 57600baud and 115200baud. As an option the PC software also can communicate through TCP/IP or USB. In these cases transparent interface converters must be used that allow a connection to the RS232 interface.



A proprietary protocol format that organises and bundles the desired data is used for all physical connection variants between PC software and control unit. Depending on their type and function the actual data are 16- or 32-bit variables and represent integer or floating-point values. The protocol format consists of 8-bit wide unsigned words ("bytes"). The actual data therefore sometimes must be distributed to several bytes.

The control unit always behaves passively (except if another behaviour has been specifically activated). Data exchange therefore always is initiated by the PC software. The PC sends a data package ("frame") corresponding to the protocol format, either with or without appended data, to which the control unit responds with a frame that matches the request.

The protocol format consists of two components:

A "header" and an optional appendant ("data").

The header always has the same structure.

The first byte is a synchronisation byte and always is 85_{dez} (55_{hex}).

The second byte is the so-called order byte. This byte determines the action that should be performed (send data, save data, etc.).

A 16-bit value (argument) follows as the third and fourth byte. Depending on the order, the argument is assigned a corresponding value.

The fifth and sixth byte again form a 16-bit value. This value states the number of appended data bytes. Without appended data both these bytes are 0_{dez} or 00_{hex}, the maximum number of bytes is 512.

The seventh byte contains the CRC8 checksum of all data bytes (data byte 0 up to and incl. data byte n).

The eight byte is the CRC8 checksum for the header and is formed from bytes 0 up to and incl. 6.

The header always has a total length of 8 bytes. The complete frame may contain between 8 and 520 bytes.

Byte0 Header	Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Data	Byte9 Data	...	Byte n+6 Data	Byte n+7 Data
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	Data1 (lo byte)	Data1 (hi byte)	...	Data n/2 (lo byte)	Data n/2 (hi byte)

The following **orders** can be sent to the sensor.

Number	ORDER (header byte no. 2)	Example
0	Sensor answers with order=0 if a communication error occurs. ARG=1: Invalid order number was sent to the sensor ARG=2: General communication error (wrong baudrate, overflow, ...)	
1	Write parameter to the RAM of the sensor	order=1
2	Read parameter from the RAM of the sensor	order=2
3	Load parameter and actual Baudrate from RAM to EEPROM of the sensor	order=3
4	Load parameter from EEPROM to RAM of the sensor	order=4
5	Read CONNECTION OK and serial number from sensor	order=5
6	Free	
7	Read Firmware String and serial number from sensor	order=7
8	Read data values from sensor	order=8
30	Start and Stop triggered sending of data frames	order=30
105	Get cycle time from sensor	order=105
190	Write new baud rate to the sensor	order=190

CRC8 Checksum

The so-called "Cyclic Redundancy Check" or CRC is used to verify data integrity. This algorithm makes it possible to detect individual bit errors, missing bytes, and faulty frames. For this purpose a value - the so-called checksum - is calculated over the data (bytes) to be checked and is transmitted together with the data package. Calculation is performed according to an exactly specified method based on a generator polynomial. The length of the checksum is 8 bit (= 1 byte). The generator polynomial is:

$$X^8+X^5+X^4+X^0$$

To verify the data after they have been received, CRC calculation is performed once again. If the sent and the newly calculated CRC values are identical, the data are without error.

The following pseudo code can be used for checksum calculation:

```

calcCRC8 (data[ ], table[ ])
Input:  data[ ], n data of unsigned 8bit
          table[ ], 256 table entries of unsigned 8bit
Output: crc8, unsigned 8bit

crc8 := AAhex
for I := 1 to n do
    idx := crc8 EXOR data[ i ]
    crc8 := table[ idx ]
endfor
return  crc8
    
```

table[]

0	94	188	226	97	63	221	131	194	156	126	32	163	253	31	65
157	195	33	127	252	162	64	30	95	1	227	189	62	96	130	220
35	125	159	193	66	28	254	160	225	191	93	3	128	222	60	98
190	224	2	92	223	129	99	61	124	34	192	158	29	67	161	255
70	24	250	164	39	121	155	197	132	218	56	102	229	187	89	7
219	133	103	57	186	228	6	88	25	71	165	251	120	38	196	154
101	59	217	135	4	90	184	230	167	249	27	69	198	152	122	36
248	166	68	26	153	199	37	123	58	100	134	216	91	5	231	185
140	210	48	110	237	179	81	15	78	16	242	172	47	113	147	205
17	79	173	243	112	46	204	146	211	141	111	49	178	236	14	80
175	241	19	77	206	144	114	44	109	51	209	143	12	82	176	238
50	108	142	208	83	13	239	177	240	174	76	18	145	207	45	115
202	148	118	40	171	245	23	73	8	86	180	234	105	55	213	139
87	9	235	181	54	104	138	212	149	203	41	119	244	170	72	22
233	183	85	11	136	214	52	106	43	117	151	201	74	20	246	168
116	42	200	150	21	75	169	247	182	232	10	84	215	137	107	53

Example order=1: Write parameter to the RAM of the sensor.

SET ARG=2 if you want to send the Teach Values.

Example is with 5 parameter (Para1=500, Para2=0; Para3=3200, Para4=3300, Para5=1)
Have a look at the **TABLE PARAMETER** to check out how much parameter you have to send.

DATA FRAME PC → Sensor

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header	
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	
85 (dec)	1	0	0	10	0	130	107	
ARG=0			LEN=10					

Byte9 Data	Byte10 Data	Byte11 Data	Byte12 Data	Byte13 Data	Byte14 Data	Byte15 Data	Byte16 Data	Byte17 Data	Byte18 Data
Para1 (lo byte)	Para1 (hi byte)	Para2 (lo byte)	Para2 (hi byte)	Para3 (lo byte)	Para3 (hi byte)	Para4 (lo byte)	Para4 (hi byte)	Para5 (lo byte)	Para5 (hi byte)
244	1	0	0	128	12	228	12	1	0
Para1=500		Para2=0		Para3=3200		Para4=3300		Para5=1	

DATA FRAME Sensor → PC

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header	
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	
85 (dec)	1	0	0	0	0	170	224	
ARG=0			LEN=0					

If you receive an argument greater 0, ARG parameter where out of range and have been set to a default value.

Example order=2: Read parameter from the RAM of the sensor.

SET ARG=2 if you want to read the Teach Values.

Example is with 5 parameter (Para1=500, Para2=0; Para3=3200, Para4=3300, Para5=1)
Have a look at the **TABLE PARAMETER** to check out how much parameter you will receive.

DATA FRAME PC → Sensor

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	2	0	0	0	0	170	185
ARG=0				LEN=0			

DATA FRAME Sensor → PC

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	2	0	0	10	0	130	50
ARG=0				LEN=10			

Byte9 Data	Byte10 Data	Byte11 Data	Byte12 Data	Byte13 Data	Byte14 Data	Byte15 Data	Byte16 Data	Byte17 Data	Byte18 Data
Para1 (lo byte)	Para1 (hi byte)	Para2 (lo byte)	Para2 (hi byte)	Para3 (lo byte)	Para3 (hi byte)	Para4 (lo byte)	Para4 (hi byte)	Para5 (lo byte)	Para5 (hi byte)
244	1	0	0	128	12	228	12	1	0
Para1=500		Para2=0		Para3=3200		Para4=3300		Para5=1	

Example order=3: Load parameter and actual Baudrate from RAM to EEPROM of the sensor.

DATA FRAME PC → Sensor

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	3	0	0	0	0	170	142
ARG=0				LEN=0			

DATA FRAME Sensor → PC

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	3	0	0	0	0	170	142
ARG=0				LEN=0			

Example order=4: Load parameter from EEPROM to RAM of the sensor.

DATA FRAME PC → Sensor

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	4	0	0	0	0	170	11
ARG=0				LEN=0			

DATA FRAME Sensor → PC

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	4	0	0	0	0	170	11
ARG=0				LEN=0			

Example order=5: Read CONNECTION OK from sensor.

DATA FRAME PC → Sensor

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	5	0	0	0	0	170	60
ARG=0				LEN=0			

DATA FRAME Sensor → PC

ARG determines the serial number of the sensor

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	5	170	0	0	0	170	178
ARG=170				LEN=0			

Example order=7: Read Firmware String from sensor

DATA FRAME PC → Sensor

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	7	0	0	0	0	170	82
ARG=0				LEN=0			

DATA FRAME Sensor → PC

ARG determines the serial number of the sensor

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header	Byte9 Data	Byte10 Data	Byte11 Data	Byte12 Data
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	ASCII	ASCII	ASCII	ASCII
85 (dec)	7	0	0	72	0	183	38	F	I	R	M
ARG=0				LEN=72							

Byte13 Data	Byte14 Data	Byte15 Data	Byte16 Data	Byte17 Data	Byte18 Data	Byte19 Data	Byte20 Data	Byte21 Data	Byte22 Data	Byte23 Data	Byte24 Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII
W	A	R	E		S	T	R	I	N	G	

Byte25 Data	Byte26 Data	Byte27 Data	Byte28 Data	Byte29 Data	Byte30 Data	Byte31 Data	Byte32 Data	Byte33 Data	Byte34 Data	Byte35 Data	Byte36 Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII
											R

Byte37 Data	Byte38 Data	Byte39 Data	Byte40 Data	Byte41 Data	Byte42 Data	Byte43 Data	Byte44 Data	Byte45 Data	Byte46 Data	Byte47 Data	Byte48 Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII
T	:	K	W	x	x	/	x	x			

Byte49 Data	Byte50 Data	Byte51 Data	Byte52 Data	Byte53 Data	Byte54 Data	Byte55 Data	Byte56 Data	Byte57 Data	Byte58 Data	Byte59 Data	Byte60 Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII

Byte61 Data	Byte62 Data	Byte63 Data	Byte64 Data	Byte65 Data	Byte66 Data	Byte67 Data	Byte68 Data	Byte69 Data	Byte70 Data	Byte71 Data	Byte72 Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII

Byte73 Data	Byte74 Data	Byte75 Data	Byte76 Data	Byte77 Data	Byte78 Data	Byte79 Data	Byte80 Data	Byte81 Data	Byte82 Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII

Example order=8: Read data values from sensor.

Example is with 5 data values (DataVal1=2000, DataVal2=4; DataVal3=3000, DataVal4=3500, DataVal5=18)
Have a look at the **TABLE DATA VALUE** to check out how much data values you will receive.

DATA FRAME PC → Sensor

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	8	0	0	0	0	170	118
ARG=0				LEN=0			

DATA FRAME Sensor → PC

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	8	0	0	10	0	28	243
ARG=0				LEN=10			

Byte9 Data	Byte10 Data	Byte11 Data	Byte12 Data	Byte13 Data	Byte14 Data	Byte15 Data	Byte16 Data	Byte17 Data	Byte18 Data
DataVal1 (lo byte)	DataVal1 (hi byte)	DataVal2 (lo byte)	DataVal2 (hi byte)	DataVal3 (lo byte)	DataVal3 (hi byte)	DataVal4 (lo byte)	DataVal4 (hi byte)	DataVal5 (lo byte)	DataVal5 (hi byte)
208	7	4	0	184	11	172	13	18	0
DatVal1 = 2000		DatVal2 = 4		DatVal3 = 3000		DatVal4 = 3500		DatVal5 = 18	

Example order=30: Start and Stop triggered sending of data frames

Start triggered sending of data frames

DATA FRAME PC → Sensor

ARG = 1 --> starts triggered sending

Byte0 Header	Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	30	1	0	0	0	170	82
ARG=1				LEN=0			

DATA FRAME Sensor → PC

Byte0 Header	Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	30	1	0	0	0	170	82
ARG=1				LEN=0			

Stop triggered sending of data frames

DATA FRAME PC → Sensor

ARG = 0 --> stops triggered sending.

Byte0 Header	Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	30	0	0	0	0	170	159
ARG=0				LEN=0			

DATA FRAME Sensor → PC

Byte0 Header	Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	30	0	0	0	0	170	159
ARG=0				LEN=0			

Example order=105: Get cycle time from sensor

DATA FRAME PC → Sensor

Byte0 Header	Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	105	0	0	0	0	170	130
ARG=0				LEN=0			

DATA FRAME Sensor → PC

Byte0 Header	Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Data	Byte9 Data	Byte10 Data	Byte11 Data
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	lo word lo byte	lo word hi byte	hi word lo byte	hi word hi byte
85 (dec)	105	0	0	8	0	82	17	23	140	8	0
ARG=0				LEN=8				CYCLE COUNT = 560151			

Byte12 Data	Byte13 Data	Byte14 Data	Byte15 Data
lo word lo byte	lo word hi byte	hi word lo byte	hi word hi byte
64	156	0	0
COUNTER TIME = 40000			

$$\text{Cycle Time [Hz]} = \text{CYCLE COUNT} / (\text{COUNTER TIME} * 0,0001)$$

$$\text{Cycle Time [ms]} = (\text{COUNTER TIME} * 0,01) / \text{CYCLE COUNT}$$

Example order=190: Write new baud rate to the sensor.

DATA FRAME PC → Sensor

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	190	1	0	0	0	170	14
ARG=1				LEN=0			

New baud rate is determined by argument.

ARG=0: baud rate = 9600

ARG=1: baud rate = 19200

ARG=2: baud rate = 38400

ARG=3: baud rate = 57600

ARG=4: baud rate = 115200

ARG=5: baud rate = 230400

ARG=6: baud rate = 460800

DATA FRAME Sensor → PC

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	190	0	0	0	0	170	195
ARG=0				LEN=0			

A. Firmware update via software Firmware Loader

A.1 Manual software Firmware Loader V1.1

This manual describes the installation of the Firmware Loader PC software and as a support for starting up the Firmware Loader software explains the individual functional elements of the graphic Windows® user interface.

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

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

Important! For a firmware update the two or three files must always be located in the same folder.

A plausibility check is performed after the initialisation file has been loaded with the Firmware Loader. If the initialisation file was changed or damaged, it will not be possible to perform a firmware update.

When the plausibility check is successfully completed, the instructions contained in the initialisation file will be carried out step by step.

The complete memory contents of the micro-controller in the sensor will be deleted in a firmware update. This means that both the program in the program memory and the data in the data memory will be lost.

The new firmware automatically writes the correct data to the program memory again.

However, the parameter settings, temperature curves, linearization curves, etc. that are stored in the data memory (EEPROM) will be deleted.

With the Firmware Loader V1.1 the data will be saved in the EEPROM, and can be written back again after successful firmware update.

For this purpose the software creates an EEPROM backup file.

A.2 Installation of the software Firmware Loader V1.1

Hardware requirements for successful installation of the Firmware Loader 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-las4/PC (cab-las5/PC)*** for the RS232 interface or ***cab-4/USB (cab-5/USB)*** USB converter or ***cab-4/ETH (cab-5/ETH)*** Ethernet converter

Please install the software as described below:

1. The software can be installed directly from the installation DVD. To install the software, start the SETUP program in the SOFTWARE folder of the DVD.
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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VGA™ is a trademark of the International Business Machines Corp.

Please read this chapter before you start!
In this example a software update is performed from SPECTRO3 V4.0 to SPECTRO3 V4.1.

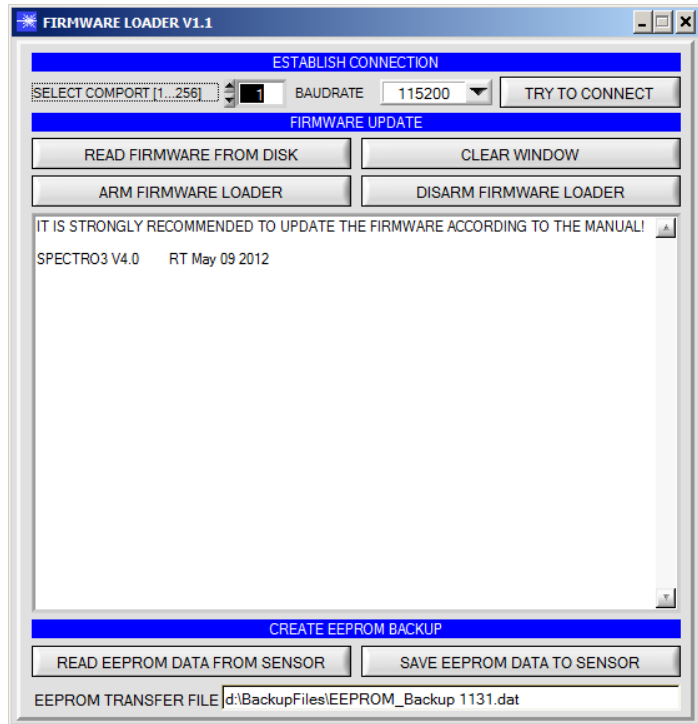
Step 1:

When the Firmware Loader software is started, this window opens on the Windows® user interface.

Immediately after starting, the software attempts to establish a connection to the connected sensor. If the sensor should not be connected at **COM PORT 1**, please select the corresponding **COM PORT**.

Please make sure that the correct **BAUDRATE** is selected.

Now try to establish a connection by clicking on **TRY TO CONNECT**. When the connection has been established, the sensor sends back information about the current firmware.



Step 2:

Press the **READ FIRMWARE FROM DISK** button and load the **xxx.ini** file.

The uploaded initialization file will be displayed in the status window.

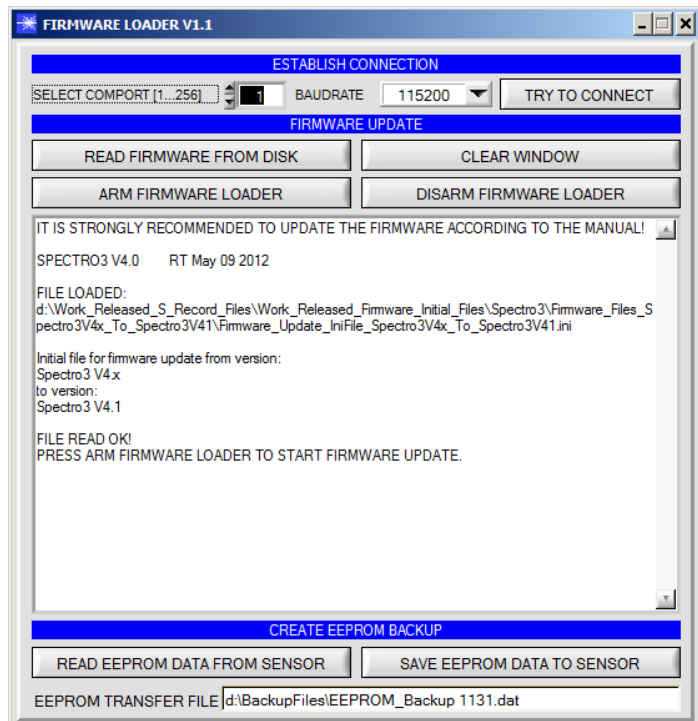
As described above, a plausibility check of the initialisation file will be performed first.

If the file is OK, the following message will be displayed:

File read OK!

Press ARM FIRMWARE LOADER to start the firmware update.

Please read the comments that are shown in the display window. These comments allow you to make sure that you have loaded the correct initialisation file.



Step 3:

Now click on the **ARM FIRMWARE LOADER** button. The program now attempts to send a software command that interrupts the normal program run and jumps to the start address of the boot sector.

If this is successful, the sensor displays a prompt for loading the S-Record file to the sensor.

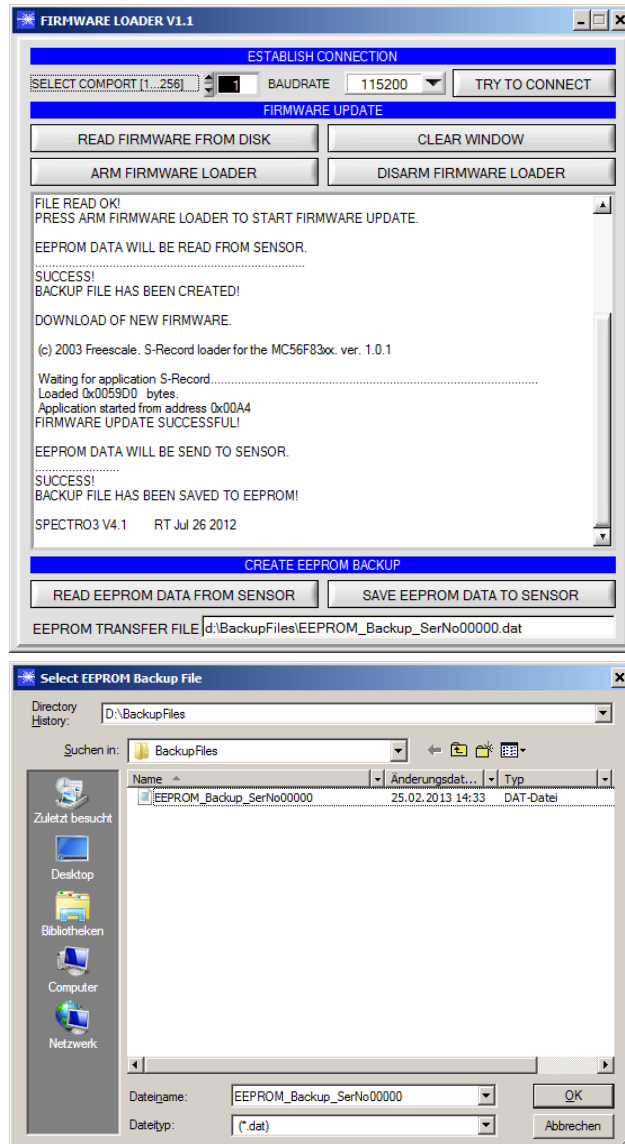
When you press the **ARM FIRMWARE LOADER** button the firmware update will be performed automatically.

In the course of the update process you will only be prompted to enter a name for the EEPROM backup file. If the firmware update should run perfectly until the EEPROM data are read out, but should then go wrong for any reason whatsoever, the EEPROM backup file can always be written back with **SAVE EEPROM DATA TO SENSOR**.

The file name for your **EEPROM backup file** should be chosen such that the names for several sensors cannot be mixed up. Using a file name that contains the sensor serial number might be advisable. Saving this file for future updates also might be a good idea.

After a successful update the sensor displays the status line of the new firmware.

The complete update process may take up to 1 minute.



If, contrary to expectations, there should be any trouble with the update of the program memory, it will still be possible to perform an update, even though it may look like the sensor was "killed".

Please make sure that you have selected the correct **COM PORT** and the correct **BAUDRATE**.

You will not get any connection when you click on **TRY TO CONNECT**.

Load the corresponding **xxx.ini** file from the hard disk.

Then click on the **ARM FIRMWARE LOADER** button.

The program will try to send the software command for the update. This will not work, however, and you will get a **CONNECTION FAILURE** message.

However, the Firmware Loader software now is "armed" for 30 seconds.

If you perform a hardware reset within these 30 seconds, the firmware update will be performed.

After a successful update the sensor displays the status line of the new firmware.

The complete update process may take up to 1 minute.

INFO! In case that the sensor was "killed", the sensor will work with a **BAUDRATE** of 115200.

You may at any time create an EEPROM backup file for archiving it on your hard disk.

To do this, click on **READ EEPROM DATA FROM SENSOR**. You will be prompted to choose an initialization file in case that there has not yet been loaded any. Afterwards you will be asked to enter a file name. The selected name will be shown in the **EEPROM TRANSFER FILE** display.

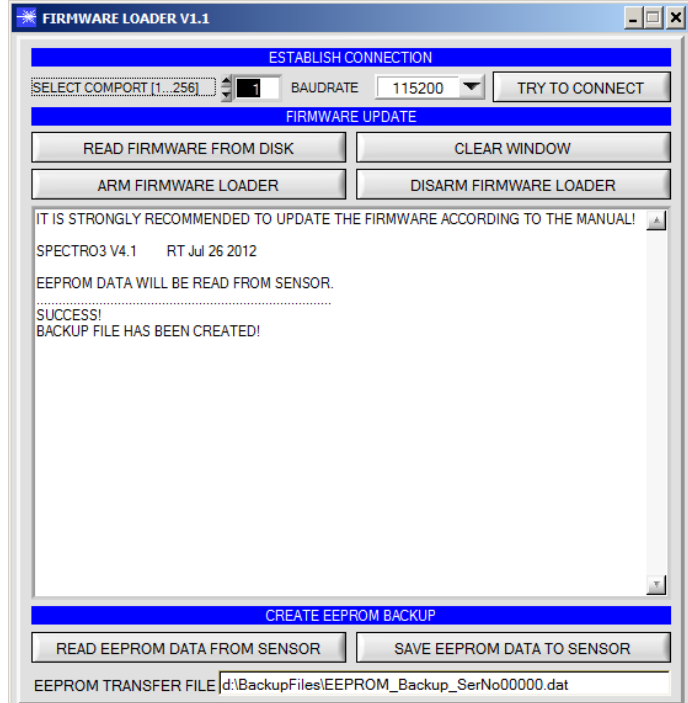
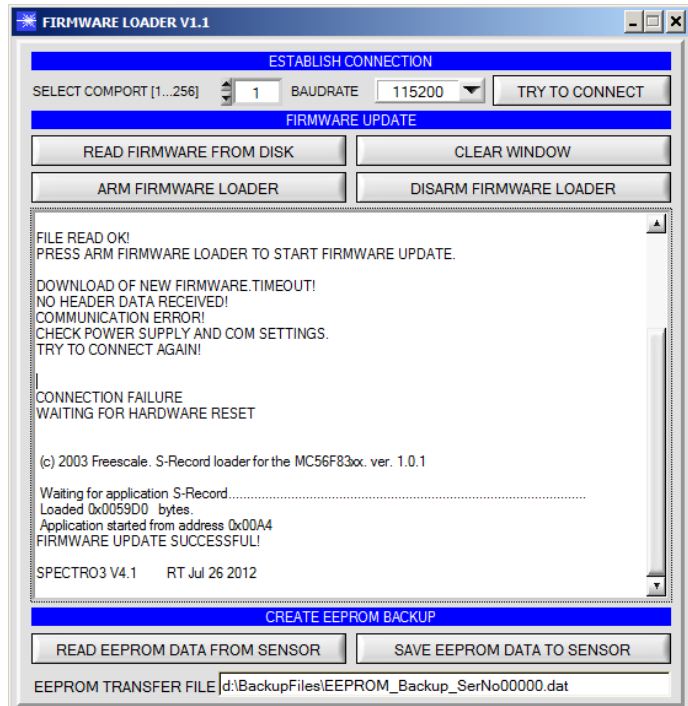
The file name for your **EEPROM backup file** should be chosen such that the names for several sensors cannot be mixed up. Using a file name that contains the sensor serial number might be advisable.

The Firmware Loader then reads all the EEPROM data from the data memory and saves these data in the selected file.

Upon successful completion the following message will be displayed:

Success!
Backup File has been created!

If something should go wrong in a firmware update, any you have created the **backup file**, the saved **EEPROM backup file** can at any time be uploaded to the sensor again with **SAVE EEPROM DATA TO SENSOR**.



CLEAR WINDOW resets the display window.

If you should not get any response for a longer time, or if messages should be displayed in the status line, **DISARM FIRMWARE LOADER** can be used to cancel the firmware update process.

However, you should always wait for approx. 1 minute before you press this button.

