Manual
Software SI-JET-Scope V4.0

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

for sensors of SI-JET series
with internal temperature compensation and channel calibration

This manual describes the installation of the PC software for the **SI-JET** spray jet sensor. As a support for commissioning of the spray jet sensor this manual explains the functional elements of the Windows® user interface.

The spray jet 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. With stepless adjustment of the integrated light source, selectable gain of the receiver signal, and an INTEGRAL function the sensor can be adjusted to almost any surface.

The SI-JET spray jet sensor detects the radiation that is transmitted from the measurement object. Depending on the system a red-light LED or a laser diode with adjustable transmission power is used as a light source for the SI-JET sensor. An integrated 3-fold receiver is used for the left, center, and right component of the light transmitted from the measurement object.

Raw data are detected and displayed with 12 bit resolution.

A density and two symmetry values are formed from the detected values for the left, center, and right channel. These values and their individually adjustable tolerances represent a status, and this status is referred to as a vector.

The sensors of the SI-JET series can be "taught" up to 31 vectors that can be directly provided at the outputs, and up 64 vectors that can be output by way of grouping.

As a special feature the sensor can be taught two completely independent parameter sets. Input IN0 can then be used to tell the sensor which parameter set it should work with. Vector detection either operates continuously or is started through an external PLC trigger signal. The respective detected vector either is provided as a binary code at the 5 digital outputs or can be sent directly to the outputs, if only up to 5 vectors are to be detected.

Through input IN0 the sensor can be taught up to 31 vectors (max. 64 vectors in group mode). For this purpose the corresponding evaluation mode must be set with the software.

In another evaluation mode a switching threshold can be set for each of the 3 channels left, center, and right. The respective output switches when the value falls below this threshold.

Parameters and measurement values can be exchanged between PC and sensor through the RS232 interface. Through this RS232 interface all the parameters for vector detection can be stored in the non-volatile EEPROM of the sensor. When parameterisation is finished, the sensor continues to operate with the current parameters in STAND-ALONE mode without a PC.

Necessary firmware updates can be easily performed through RS232, also with the sensor installed (→ see annex "Firmware update via software Firmware Loader").

The sensors of the SI-JET series can be calibrated (channel calibration). Such calibration is performed in transmitted-light mode, when there is no object between transmitter and receiver.

0 Contents

Shortcuts:

SEND	F9
GET	F10
GO	F11
STOP	F12

1. Installation of the SI-JET-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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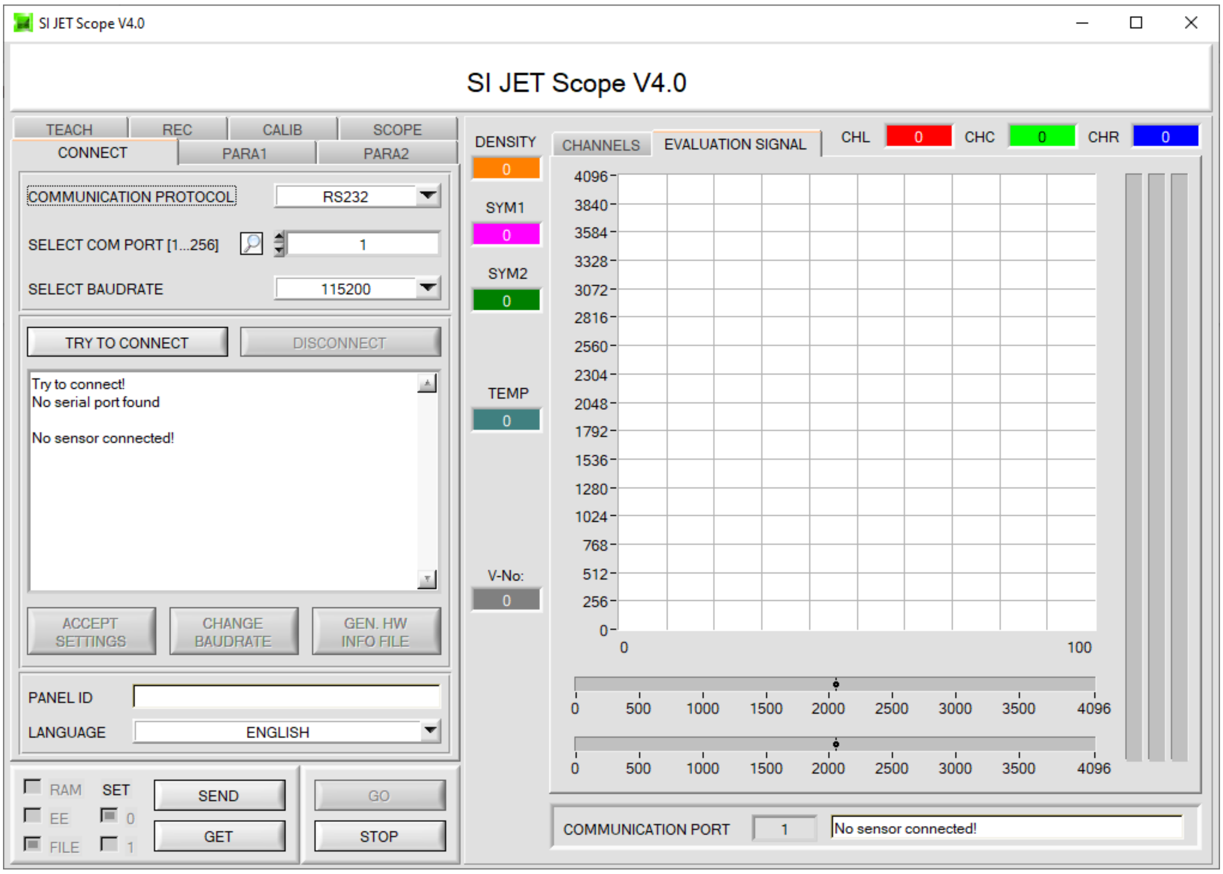
VGA^{TM} is a trademark of International Business Machines Corp.

2. Operation of the SI-JET-Scope software

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

When the SI-JET-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"**.



SI JET Scope V4.0

COMMUNICATION PROTOCOL: RS232

SELECT COM PORT [1...256]: 1

SELECT BAUDRATE: 115200

Try to connect!
No serial port found

No sensor connected!

PANEL ID:

LANGUAGE: ENGLISH

COMMUNICATION PORT: 1 No sensor connected!

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.

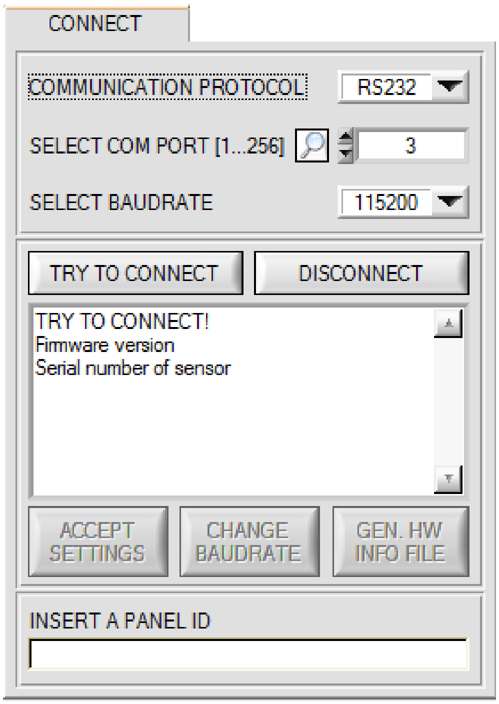
If a connection is not established automatically, e.g. if no sensor is connected, the software can be run in OFFLINE mode. In offline mode it only is possible to exchange parameters with a file on a storage medium, which often is helpful for the purpose of analysing parameter files.

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.

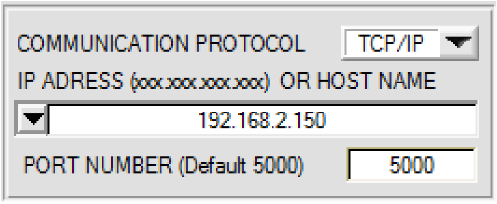
Due to a better overview, parameters that are not required, displays, graphs, etc., are greyed out or invisible depending on the parameterization.

2.1 Tab CONNECT



COMMUNICATION PROTOCOL RS232
SELECT COM PORT [1...256] 3
SELECT BAUDRATE 115200

TRY TO CONNECT!
Firmware version
Serial number of sensor



COMMUNICATION PROTOCOL TCP/IP
IP ADRESS (xxx.xxx.xxx.xxx) OR HOST NAME
192.168.2.150
PORT NUMBER (Default 5000) 5000

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.

A click on the magnifier symbol opens a list with all the 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.

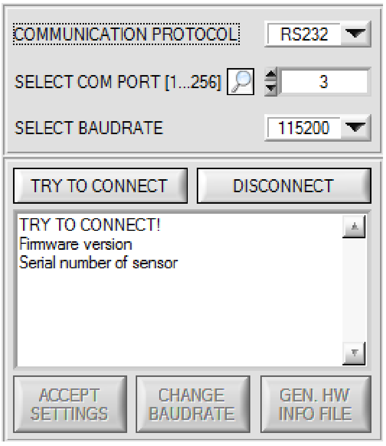
In order to establish a connection to the converter, its IP address or HOST name must be entered in the field **IP ADDRESS (xxx.xxx.xxx.xxx) OR HOST NAME**. The DROP DOWN menu (down arrow) shows the last 10 IP addresses that were used. An address from this list can be directly selected by clicking on 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.

Please note: **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).

ATTENTION !



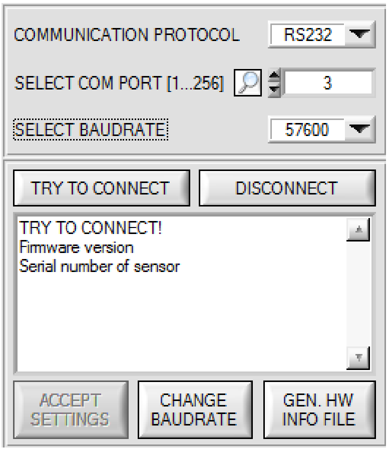
COMMUNICATION PROTOCOL RS232
SELECT COM PORT [1...256] 3
SELECT BAUDRATE 115200

TRY TO CONNECT!
Firmware version
Serial number of sensor

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.

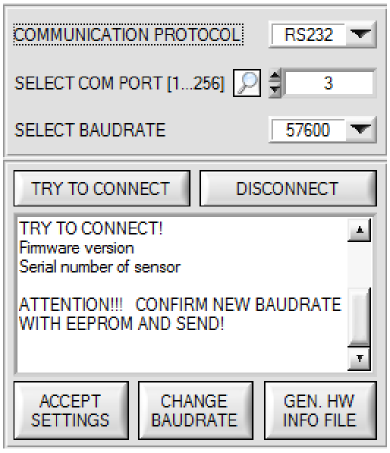


COMMUNICATION PROTOCOL RS232
SELECT COM PORT [1...256] 3
SELECT BAUDRATE 57600

TRY TO CONNECT!
Firmware version
Serial number of sensor

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

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



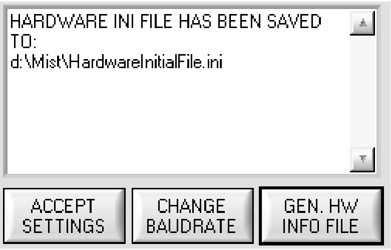
COMMUNICATION PROTOCOL RS232
SELECT COM PORT [1...256] 3
SELECT BAUDRATE 57600

TRY TO CONNECT!
Firmware version
Serial number of sensor

ATTENTION!!! CONFIRM NEW BAUDRATE WITH EEPROM AND SEND!

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.

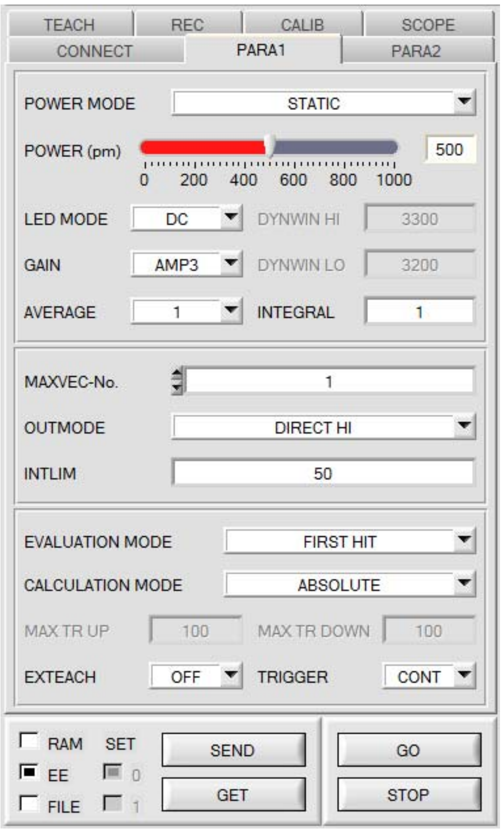


HARDWARE INI FILE HAS BEEN SAVED TO:
d:\Mist\HardwareInitialFile.ini

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 PARA1, button SEND, GET, GO, STOP



POWER MODE STATIC

POWER (pm) 500

LED MODE DC DYNWIN HI 3300

GAIN AMP3 DYNWIN LO 3200

AVERAGE 1 INTEGRAL 1

MAXVEC-No. 1

OUTMODE DIRECT HI

INTLIM 50

EVALUATION MODE FIRST HIT

CALCULATION MODE ABSOLUTE

MAX TR UP 100 MAX TR DOWN 100

EXTEACH OFF TRIGGER CONT

□ RAM SET
☒ EE ☒ 0
□ FILE □ 1

PARA1:
Pressing the **PARA1** 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:
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.

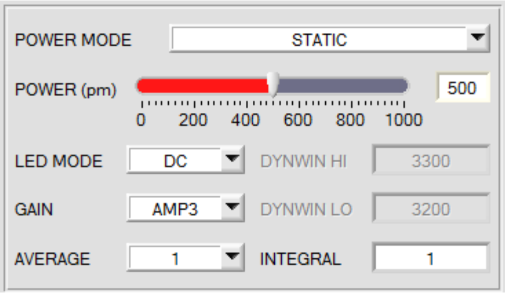
EEPROM:
After a click on the **SEND** button the current parameters are written into the non-volatile memory of the **EEPROM** in the sensor, or they are read from the **EEPROM** by clicking on the **GET** button, i.e. the parameters in the internal **EEPROM** are stored when the voltage at the sensor 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 with shortcut key button 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 with shortcut key button F12) stops data transfer from the sensor to the PC through the serial RS232 interface.

SET:
If you work with **TRIGGER=PARA**, two parameter sets can be saved for the sensor.
SET can then be used to select whether the current parameters on the user interface should be saved as parameter set 0 or parameter set 1 in the sensor.
Input IN0 (push button at the sensor housing) is used to tell the sensor which parameter set it should work with.
SET only is active with **TRIGGER=PARA**.



POWER MODE STATIC
POWER (pm) 500
LED MODE DC
DYNWIN HI 3300
GAIN AMP3
DYNWIN LO 3200
AVERAGE 1
INTEGRAL 1

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

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

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

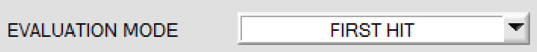
LED MODE:
This item serves for setting the control mode for the integrated light source of the sensor.
DC: In this mode the sensor operates extremely fast. Unfortunately the sensor is somewhat sensitive to extraneous light in DC mode, but if the extraneous light source does not directly shine into the 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 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 (CHL, CHC, CHR between 2750 and 3750).
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.**



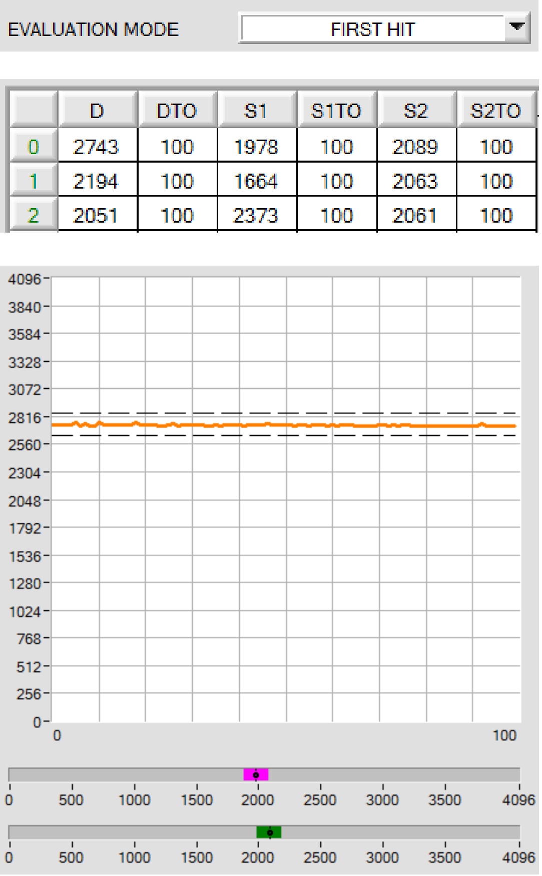
EVALUATION MODE: FIRST HIT

EVALUATION MODE:
This function field serves for setting the evaluation mode at the SI-JET sensor.

In evaluation modes **FIRST HIT and VEC5** the function field **CALCULATION MODE** is active. From the raw data **CHL**, **CHC** and **CHR** a density value **DENSITY** and two symmetry values **SYM1** and **SYM2** are calculated and are then correspondingly evaluated.

With evaluation mode **THD CHA** only switching thresholds are defined for the respective channels.
For evaluation the raw data **CHL**, **CHC** and **CHR** are considered individually here.
If the current signal is higher than the set switching threshold, the respective output is HI.
If the signal is lower, the output changes to LO.

The **TEACH TABLE** is correspondingly adapted depending on **EVALUATION MODE** and **CALCULATION MODE**.
In the text below the **CALCULATION MODE = ABSOLUTE** is used to explain the evaluation modes **FIRST HIT and VEC5**.

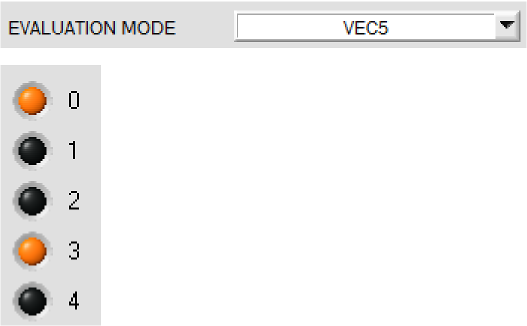


EVALUATION MODE: FIRST HIT

	D	DTO	S1	S1TO	S2	S2TO
0	2743	100	1978	100	2089	100
1	2194	100	1664	100	2063	100
2	2051	100	2373	100	2061	100

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

Tip! If, for example, only the DENSITY should be checked, and symmetry SYM1 and SYM2 are of no importance, a tolerance of 4096 can be selected for **S1TO or S2TO**. This inspection criterion is thus always fulfilled.
Tip! Values can be entered in a cell of the table either by double-clicking on the respective cell, or by highlighting the respective cell and then pressing F2 .
Tip! The teach vectors are only activated when the **SEND** button is pressed!



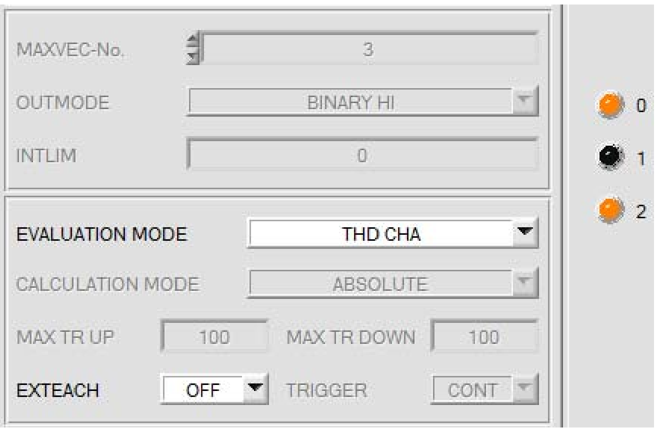
EVALUATION MODE VEC5

VEC5:
In this evaluation mode the rows 0 to 4 in the **TEACH TABLE** are evaluated.
Every match of current vector (row number) and teach vector is directly sent to the corresponding output.

Example.
If the result of evaluation is that both row 0 and row 3 is a hit, outputs OUT0 and OUT3 will be set to high (+24V).

Tip! Values can be entered in a cell of the table either by double-clicking on the respective cell, or by highlighting the respective cell and then pressing F2.
Tip! The teach vectors are only activated when the **SEND** button is pressed!

Attention! In **VEC5** evaluation mode it is not possible to form vector groups!



MAXVEC-No. 3

OUTMODE BINARY HI

INTLIM 0

EVALUATION MODE THD CHA

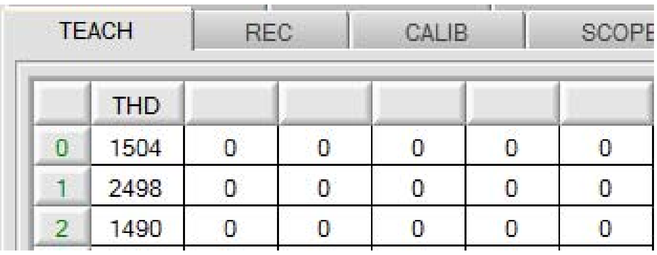
CALCULATION MODE ABSOLUTE

MAX TR UP 100 MAX TR DOWN 100

EXTEACH OFF TRIGGER CONT

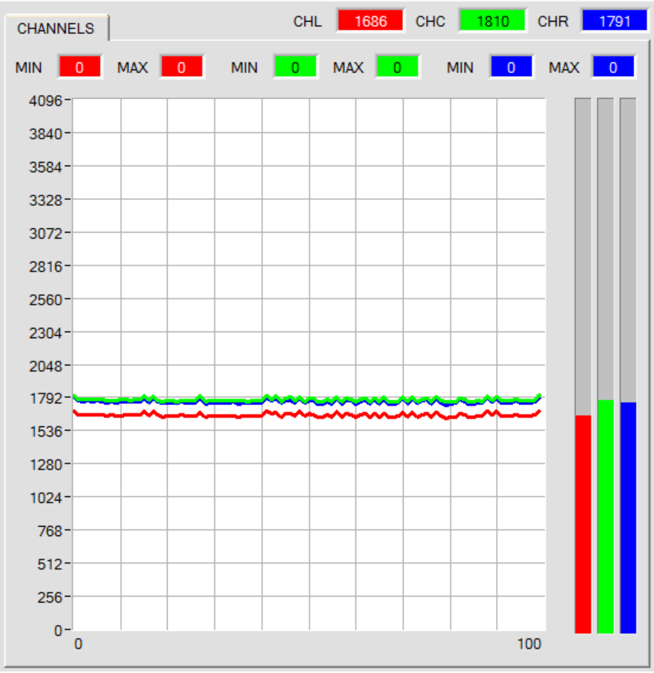
THD CHA:
In this evaluation mode a specific switching threshold can be set for CHL, CHC and CHR.
If the respective channel is higher than this threshold, **OUT** = HI, otherwise it is LO.
HOLD is used as output pulse lengthening for error state 255.
If one of the three outputs changes its state, the **HOLD** time is started.

On the screen this is visualised by LEDs **0, 1** and **2**.



	THD					
0	1504	0	0	0	0	0
1	2498	0	0	0	0	0
2	1490	0	0	0	0	0

In the teach table the switching threshold for **CHL** is set in row 0 under the **THD** column. **CHC** is set in row 1, and **CHR** in row 2.
If you click on **TEACH DATA TO**, the current **CHL, CHC and CHR** values are automatically written to the table.

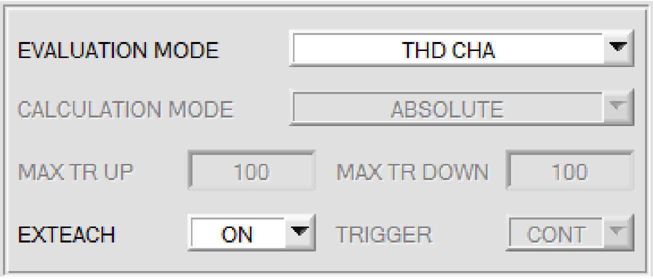


CHL 1686 CHC 1810 CHR 1791

MIN 0 MAX 0 MIN 0 MAX 0 MIN 0 MAX 0

If a teach mode is selected under **EXTEACH**, the switching thresholds for **CHL, CHC and CHR** can be learned through IN0.
While IN0=HI, a maximum and a minimum is determined for every channel.
The determined **MIN-MAX** values for the **CHL, CHC, CHR** channels are displayed in the **CHANNELS** tab.
The respective switching threshold is calculated from **THD=(Max+Min)/2** and thus lies exactly in the middle of the determined Max-Min values.
If you click on GET, the determined thresholds are displayed in the teach table.

With **EXTEACH=ON** the switching thresholds are stored in the sensor's EEPROM.
With **EXTEACH=STAT1** the switching thresholds are stored in the sensor's RAM.
With **EXTEACH=DYN1** the sensor first automatically adjusts itself, then starts the **MIN-MAX** search, and finally stores the switching thresholds in the RAM.



EVALUATION MODE THD CHA

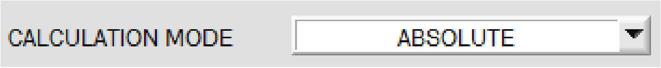
CALCULATION MODE ABSOLUTE

MAX TR UP 100 MAX TR DOWN 100

EXTEACH ON TRIGGER CONT

Furthermore, during external teaching that channel is determined that has the largest delta between **MIN** and **MAX**. This channel then is output not only at its respective output (**OUT0**, **OUT1** or **OUT2**) but in addition at **OUT3 as well as inverse at OUT4**

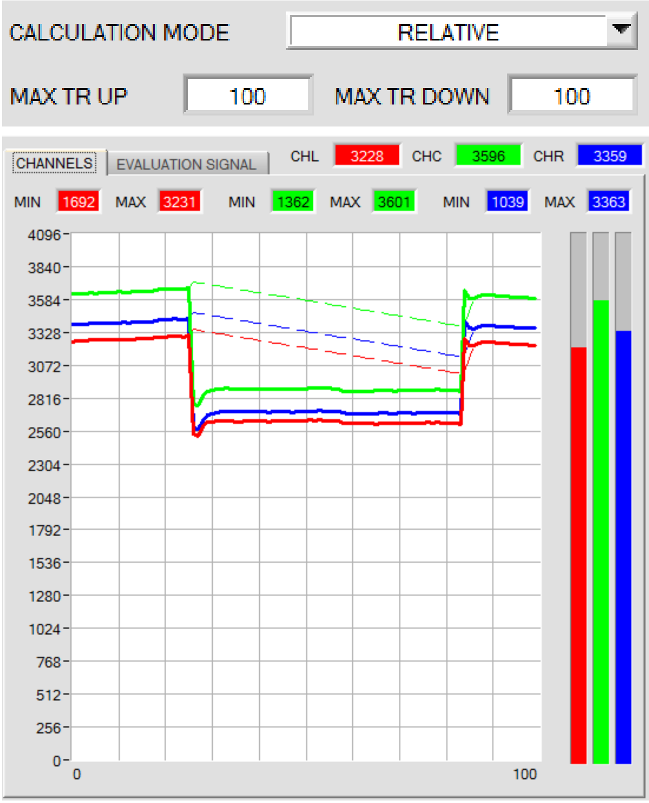
Since the **THD CHA** mode is no vector evaluation in the proper sense, certain input elements and display elements are masked out or grayed out.



CALCULATION MODE: ABSOLUTE

CALCULATION MODE = ABSOLUTE:
This field defines how the values for **DENSITY, SYM1** and **SYM2** are calculated from the raw signals **CHL, CHC** and **CHR**

$$DENSITY = \frac{CH\_L + CH\_C + CH\_R}{3} \qquad SYM1 = \frac{CH\_L}{CH\_L + CH\_R} * 4096 \qquad SYM2 = \frac{CH\_C}{CH\_C + \frac{CH\_L + CH\_R}{2}} * 4096$$



CALCULATION MODE: RELATIVE

MAX TR UP: 100

MAX TR DOWN: 100

CHL: 3228 CHC: 3596 CHR: 3359

MIN: 1692 MAX: 3231 MIN: 1362 MAX: 3601 MIN: 1039 MAX: 3363

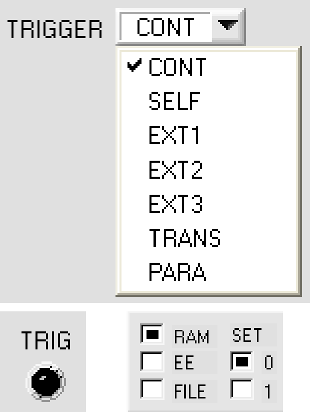
CALCULATION MODE = RELATIVE:
In **CALCULATION MODE RELATIVE** all three channels **CH_L, CH_C** and **CH_R** (red, green and blue line) are normalised to their respective current maximum (red, green and blue dashed line).
The speed of maximum tracking is set with the two parameters **MAX TR UP** (for tracking upwards) and **MAX TR DOWN** (for tracking downwards). **MAX TR UP** and **MAX TR DOWN** have a value range of 0 to 60000, with one unit representing 100 microseconds.
A value of 0 thus means high-speed tracking, and a value of 60000 means very slow tracking.

The normalised values are used to calculate **density**, **symmetry1** and **symmetry2**. The advantage of this evaluation is that due to normalisation to the respective maximum, possible dirtying of the sensor is compensated to a large extent. For this purpose high-speed upward tracking and slow downward tracking should be chosen.
Tracking is paused when the sensor detects a taught vector (0…31).
Please note that in this evaluation mode the sensor must be given a certain time in which it can track the maximum values. This time depends on the values that are set for **MAX TR UP** and **MAX TR DOWN**.
Further evaluation of **DENSITY**, **SYM1** and **SYM2** is then performed as with evaluation mode **ABSOLUTE**, calculation, however, is done with the following formulas.

$$CHL\_N = 4096 - \frac{CH\_L}{MAX\_CHL} * 4096 \qquad CHC\_N = 4096 - \frac{CH\_C}{MAX\_CHC} * 4096 \qquad CHR\_N = 4096 - \frac{CH\_R}{MAX\_CHR} * 4096$$

$$DENSITY = CHC\_N$$

$$SYM1 = \frac{CHL\_N}{CHL\_N + CHR\_N} * 4096 \qquad SYM2 = \frac{CHC\_N}{CHC\_N + \frac{CHL\_N + CHR\_N}{2}} * 4096$$



TRIGGER:
This function field serves for setting the trigger mode at the sensor. If **TRIGGER** is not **CONT**, the **TRIG** LED shows a trigger event.

CONT: Continuous evaluation (no trigger event required).

SELF: By selecting **SELF** the sensor can be operated in self-trigger mode.
The "free status" must be taught to row 0. This free status, for example, is the uncovered status.
Evaluation is started when row 0 is no longer detected (self-trigger). After the trigger, i.e. when vector 0 is detected again, the vector from the taught vectors will be output that was detected most frequently during triggering.
When the sensor leaves row 0, row 0 will be output in accordance with the output mode.
When it returns to row 0, an error will be output, or the vector that was present for the longest time.
This means that after a self-trigger there always is a change of output states.
The same applies to **VECTOR GROUP = ON.** When the sensor leaves group 0, group 0 will be output in accordance with the output mode. When it returns to group 0, an error will be output, or the group that was present for the longest time. This means that even if an individual vector was present for the longest time it will not be output if, for example, two vectors that belong to the same group together were present for a longer time. Furthermore, several vectors can be combined in group 0 for the trigger condition, because the leaving of group 0 determines the trigger condition.
After dropping of the trigger an average over **DENSITY, SYM1** and **SYM2** is output once. The average is determined from all the color hits, but not from row 0, and can be acquired with **RECORD MODE = AUTO TRIGGERED**.

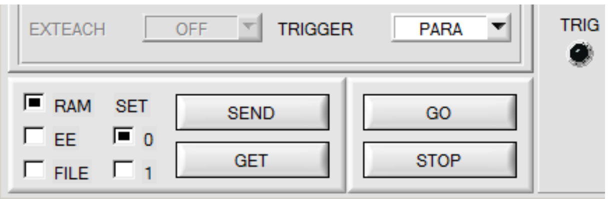
EXT1: Evaluation is started through the external trigger input IN0. After triggering the color from the taught vectors or groups in case of **VECTOR GROUP = ON** will be output that was detected most frequently during triggering. Furthermore, an average over **DENSITY, SYM1 a**nd **SYM2** is output once. The average is determined from all the hits and can be acquired with **RECORD MODE = AUTO TRIGGERED**.

EXT2: Evaluation is started through the external trigger input IN0. A trigger event is recognized as long as HI is present at IN0 (HIGH-active).
After the trigger input goes to LOW again, the state (V-No.) that was last detected will be held at the outputs.

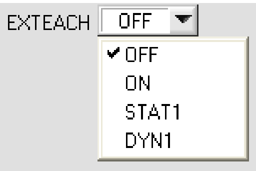
EXT3: Same behaviour as in EXT2 mode, with the difference that an error state (V-No. = 255) will be output after the trigger input goes to LOW again.

TRANS:
Same behaviour as in **CONT.** However, in contrast to **CONT** in this mode the transmitter source will be switched off if no trigger event (IN0) is given.

PARA:
If you work with **TRIGGER=PARA**, two parameter sets can be saved for the sensor.
SET can then be used to select whether the current parameters on the user interface should be saved as parameter set 0 or parameter set 1 in the sensor.
The external trigger input IN0 is used to tell the sensor which parameter set it should work with.



On the software interface the status of IN0 is displayed by the TRIG LED. If this LED is black, IN0=LO=0V, and the sensor operates with parameter set 0.
If this LED is green, IN0=HI=+24V, and the sensor operates with parameter set 1.
To watch the signal on the software interface, select 0 or 1 depending on **TRIG SET**, and then click on the **GET** button.
SET only is active with **TRIGGER=PARA**.



EXTEACH:
In all the evaluation modes teaching of a vector can be performed externally through IN0 (push button at the sensor housing).

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

STAT1: In static power mode, a vector is taught to position 0 in the **TEACH TABLE**.
The **POWER MODE** is automatically set to **STATIC**. A fixed transmitter poser must be set with the **POWER** slider.
Click once IN0 to teach the current state to row 0.
The taught vector is stored only in the **RAM** and not in the **EEPROM** of the sensor.

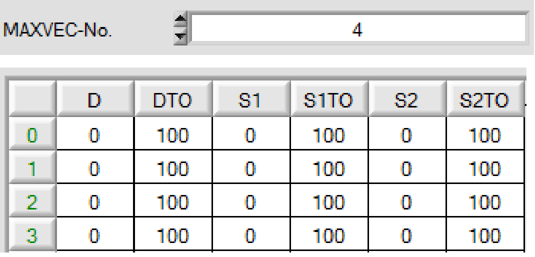
DYN1: In dynamic power mode, a state is taught to position 0 in the **TEACH TABLE**, and evaluation is then performed statically.
The **POWER MODE** is automatically set to **STATIC**. After a click on IN0, the transmitter power is set such that the sensor is in the dynamic range, which is defined by **DYN WIN LO** and **DYN WIN HI**. The current state is then taught to position 0 in the **TEACH TABLE**.
The sensor then continues to operate statically with the established **POWER** value.
The taught vector is stored only in the **RAM** and not in the **EEPROM** of the sensor.

TEACH PROCESS WITH EXTEACH=ON:

Through IN0 the sensor can be taught up to 64 vectors.

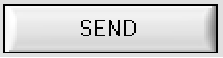
The example shows the external teaching of 4 vectors, in evaluation mode **FIRST HIT**.

Select the **EXTERN TEACH = ON** function.
Adjust the power value such that the sensor is neither overloaded nor that a too low signal arrives at the sensor.
Select how many vectors you wish to teach from extern.
Click on the **TEACH TABLE** tab to switch to the **TEACH TABLE**.
Then enter the corresponding tolerances for the colors you want to teach.


MAXVEC-No. 4

	D	DTO	S1	S1TO	S2	S2TO
0	0	100	0	100	0	100
1	0	100	0	100	0	100
2	0	100	0	100	0	100
3	0	100	0	100	0	100

In this example, **MAXVEC-No. = 4** was selected, i.e. the sensor should detect the vectors that are stored in the first 4 rows of the **TEACH TABLE** by means of external teaching through IN0. Since the sensor cannot calculate the tolerances itself, these values must be entered once only (in this case 100 at all places) and must be stored in the **EEPROM** together with the **MAXVEC-No.** and with **EXTEACH = ON**.



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

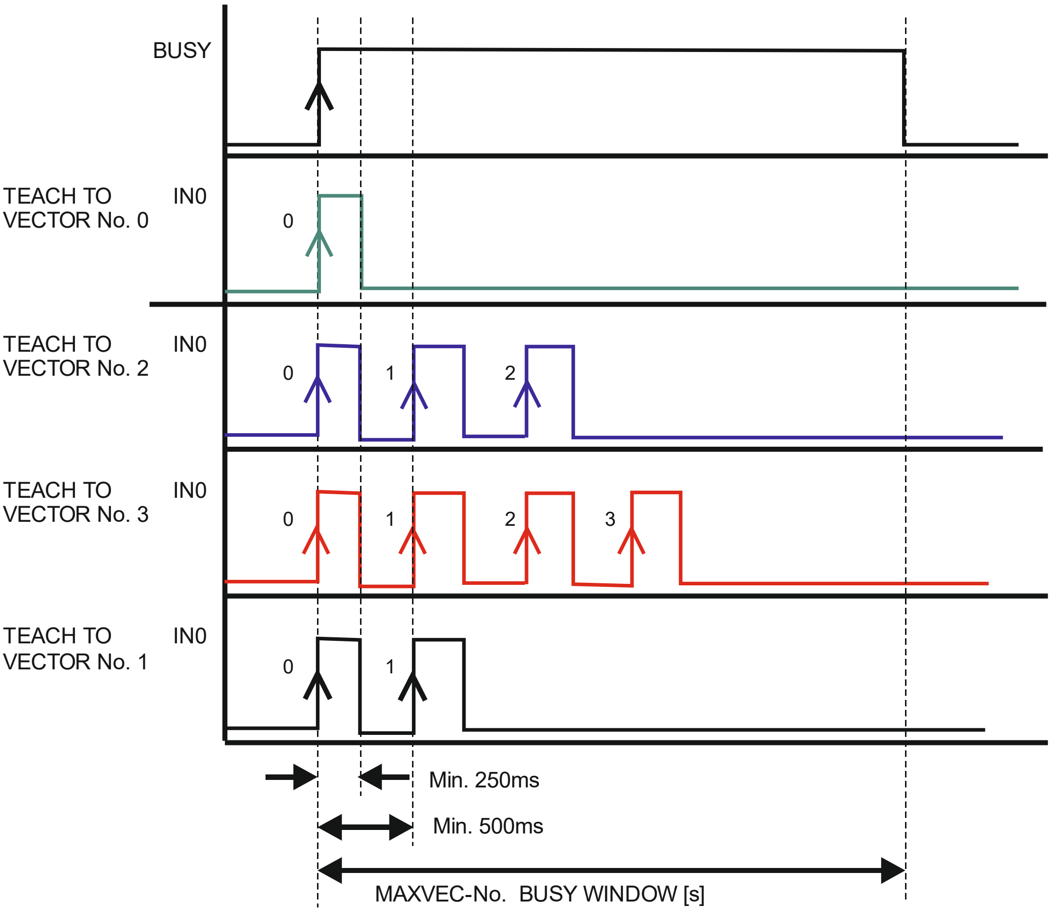
INFO:
Of course the taught vectors can be viewed at any time with the PC.
Vectors that are taught by way of **EXTEACH = ON** are stored in the **EEPROM** of the sensor, i.e. the information will not be lost when the system is turned off.
This function rather is intended for "after-teaching", because the sensor does not automatically adjust its **POWER** value.

EXTEACH=ON:

Before the external teach-process can be started, the state to be taught must be presented to the sensor.
The external teach process is started with a click on IN0. The outputs OUT0 … OUT4 alternately change their state between 0V and 24V. From now on, the user has a certain number of seconds time to inform the sensor about the position at which the vector (DENSITY, SYM1, SYM2) should be placed in the **TEACH TABLE**. The BUSY window is the time that the user has for informing the sensor about the teach rows. It depends on the value that is set in **MAXVEC-No.** (e.g. approx. 5 seconds when **MAXVEC-No.** = 5).
The first positive edge (start edge 0) selects position 0 in the **TEACH TABLE**.
Every additional positive edge selects one position higher (see table below).

Example:
If you wish to save the current state (vector) to position 3 in the **TEACH TABLE**, the following steps have to be performed:

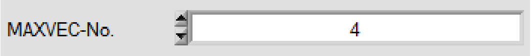
1. Start the external TEACH process with a positive edge (0) at IN0 → Position 0 is selected.
2. Another positive edge (1) selects position 1 in the TEACH TABLE.
3. Another positive edge (2) selects position 2 in the TEACH TABLE.
4. Another positive edge (3) selects position 3 in the TEACH TABLE.
5. The desired position is now selected.
6. When the BUSY window is over, the sensor starts the evaluation.
7. To teach another vector → go to pos. 1



INTLIM 0

INTLIM:
This edit box is used for setting an intensity limit. Evaluation is stopped, if the current intensity **(CHL+CHC+CHR)/3** arriving at the receiver unit falls below this limit, and ERROR STATE is output.

Attention: ERROR STATE if: (CHL+CHC+CHR)/3



MAXVEC-No. 4

MAXVEC-No.:
This function field serves for setting the number of vectors to be checked.

With **OUTMODE = BINARY HI or BINARY LO** a maximum of 31 vectors or 31 groups can be taught.
With **OUTMODE = DIRECT HI** or **DIRECT LO** a maximum of 5 vectors or 5 groups can be taught.
If **VECTOR GROUPS = ON**, the sensor can be taught up to 64 vectors.
However, only 31 groups can be formed with **OUTMODE = BINARY,** and 5 groups with **DIRECT HI** or **LO**. In the **TEACH TABLE** the rows 31-63 are therefore represented with a gray background.
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 sensor.
The numerical value set here refers to the number of rows (starting with row 0) in the **TEACH TABLE** (→ 2.4 Tab TEACH TABLE).

OUTMODE DIRECT HI

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

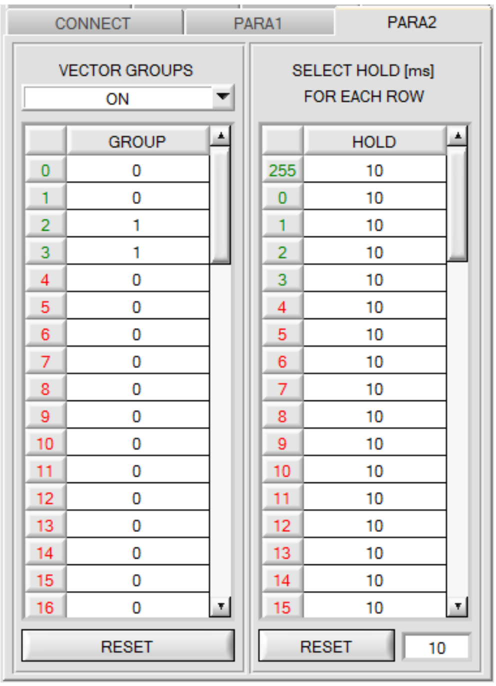
DIRECT HI:
In this mode a maximum of 5 teach vectors or 5 groups is permitted.
If in the row-by-row comparison the current measured values correspond with the teach parameters entered in the table, the respective digital output (OUT0 to OUT4) is switched to HIGH.
If no vector is detected the digital outputs are in LOW state.

DIRECT LO:
In this mode a maximum of 5 teach vectors or 5 groups is permitted.
If in the row-by-row comparison the current measured values correspond with the teach parameters entered in the table, the respective digital output (OUT0 to OUT4) is switched to LOW.
If no vector is detected the digital outputs are in HIGH state.

BINARY HI:
In this mode a maximum of 31 teach vectors or 31 groups is permitted.
If in the row-by-row comparison the current measured values correspond with the teach parameters entered in the table, this "hit" in the table is provided as a **bit pattern** at the digital outputs (OUT0 to OUT4).

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

2.3 Tab PARA2



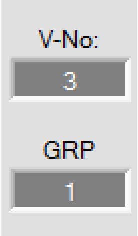
VECTOR GROUPS: ON

	GROUP
0	0
1	0
2	1
3	1
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	0
13	0
14	0
15	0
16	0

SELECT HOLD [ms] FOR EACH ROW

	HOLD
255	10
0	10
1	10
2	10
3	10
4	10
5	10
6	10
7	10
8	10
9	10
10	10
11	10
12	10
13	10
14	10
15	10

RESET: 10


V-No: 3

GRP: 1

PARA2:
A click on **PARA2** opens a view where vectors in the **TEACH TABLE** can be assigned to certain groups, and for each color and the error status an explicit **HOLD** time can be set.

Please note:
The sensor must be informed about the vector groups and HOLD settings by pressing SEND.

VECTOR GROUPS:
It is possible to form vector groups in the evaluation mode **FIRST HIT**. This means that in a special table the individual rows are assigned to a group.

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

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

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

A total of 64 different vectors can be taught.
In evaluation mode **DIRECT HI** and **DIRECT LO** a maximum of 5 groups can be formed (group 0 to 4).
In evaluation mode **BINARY HI** and **BINARY LO** 31 groups can be formed.

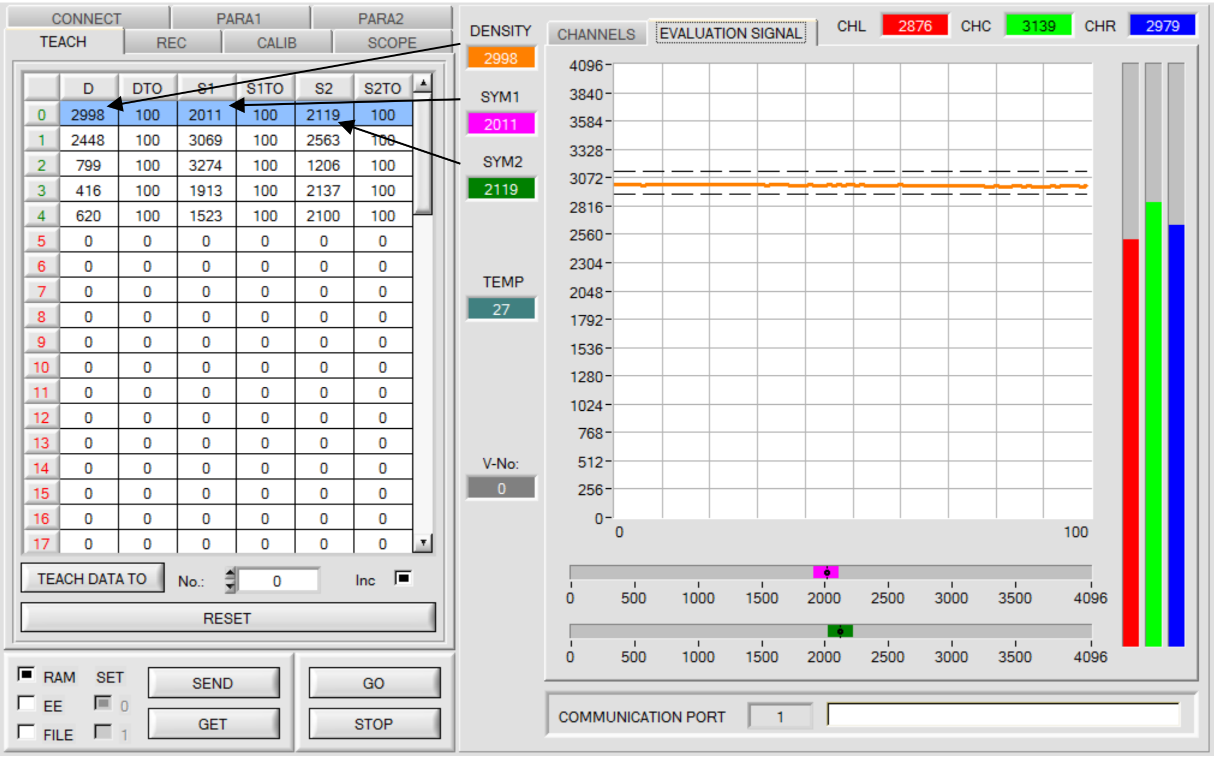
All the cell values can be set to 0 by pressing **RESET**.
A double-click on the **GRP** display opens a larger display window.

HOLD in milliseconds [ms]:
The sensor operates with minimum scanning times in the magnitude of less than 100µs. 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. Entering values in the table provides pulse lengthening at the digital outputs of the sensor system up to 100 ms. Each individual row can be assigned its own HOLD time.
When the **RESET** button is pressed, the complete table is set to the reset value indicated beside the **RESET** button.

Example from the printing industry with a color sensor:
Print marks are transported at a very high speed. The print marks are positioned in the sensor's range only for a very short time (milliseconds or even shorter). A minimum pulse of 10 ms is required for the reliable detection of a mark.
The background is taught to row 0, and the print mark to row 1.
If row 0 and row 1 overlap seamlessly, the sensor operates perfectly. The output is immediately activated and remains active at least for the time specified in the corresponding row.
If row 0 and row 1 do not overlap, the sensor detects an error at the transition from row 0 to row 1 (print mark), which immediately is sent to the output and remains active there at least for the **HOLD** time. An error inevitably would occur here if **HOLD** for the error state (255) was chosen too high, because the sensor only outputs a status change again after **HOLD** has elapsed (this may be the print mark, but it does not have to be).
It is absolutely necessary here to select a **HOLD** time of 0 for error state 255.

2.4 Tab TEACH

When the **GO** button is pressed, data transfer from the sensor to the PC is started. The respective RED, GREEN, and BLUE contents are shown by way of the bars beside the graph. The calculated **X, Y, INT or s,i,M** values are visualised in the displays.



	D	DTO	S1	S1TO	S2	S2TO
0	2998	100	2011	100	2119	100
1	2448	100	3069	100	2563	100
2	799	100	3274	100	1206	100
3	416	100	1913	100	2137	100
4	620	100	1523	100	2100	100
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0

No.: 0

DENSITY 2998
SYM1 2011
SYM2 2119
TEMP 27
V-No: 0

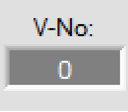
CHL 2876 CHC 3139 CHR 2979

COMMUNICATION PORT 1

DENSITY
2998
SYM1
2011
SYM2
2119

DENSITY:
This numerical value output field displays the density value.

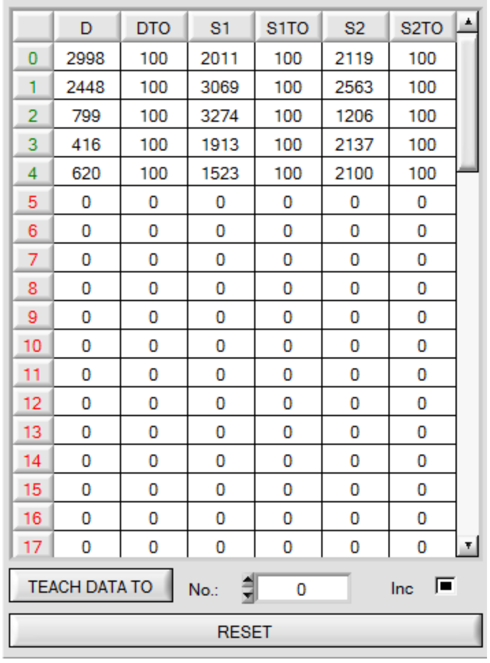
SYM1 and **SYM2:**
These numerical value output fields display the two symmetry values.



V-No:
0

V-No.:
This numerical value output field displays the currently detected vector in accordance with the entry in the **TEACH TABLE**. The currently detected vector is sent to the digital outputs OUT0 … OUT4 as a corresponding bit pattern.
The value 255 means that none of the taught vectors is recognised.
A double-click on the display opens a larger display window.

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



	D	DTO	S1	S1TO	S2	S2TO
0	2998	100	2011	100	2119	100
1	2448	100	3069	100	2563	100
2	799	100	3274	100	1206	100
3	416	100	1913	100	2137	100
4	620	100	1523	100	2100	100
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0

TEACH:
A click on the **TEACH** tab 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 a click on shortcut key button F2) on the respective field the default values can be changed by entering numerical values with the PC keyboard.

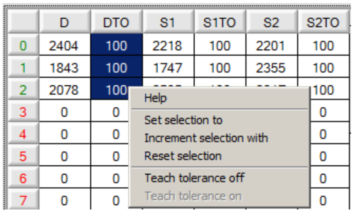
The **TEACH TABLE** is organized in rows, i.e. the individual parameters for the teach vectors are arranged side by side in the respective row.
The sensor is able to check up to 64 teach vectors. The number of the respective teach vector is given in the left column of the table.
Only the green rows are 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 data for **DENSITY, SYM1** und **SYM2** are transferred to the row in the **TEACH TABLE** that is selected under **No.:**
In addition a specific tolerance is set for each value. If necessary, these tolerances, as well as the teach values, can be changed as described above.

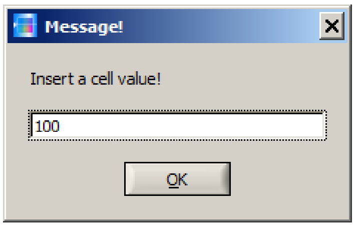
No.: also is used to select which tolerance windows are displayed in the respective graphs.

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 = 0).



	D	DTO	S1	S1TO	S2	S2TO
0	2404	100	2218	100	2201	100
1	1843	100	1747	100	2355	100
2	2078	100				100
3	0	0				0
4	0	0				0
5	0	0				0
6	0	0				0
7	0	0				0



Message!

Insert a cell value!

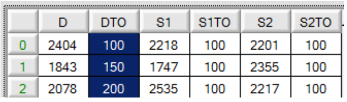
100

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

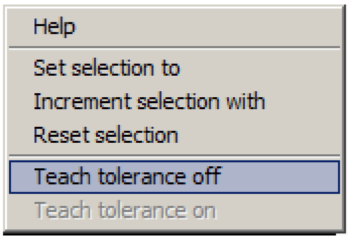
For this purpose the cells that should be changed must first be selected.

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.



	D	DTO	S1	S1TO	S2	S2TO
0	2404	100	2218	100	2201	100
1	1843	150	1747	100	2355	100
2	2078	200	2535	100	2217	100



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 1.

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**.

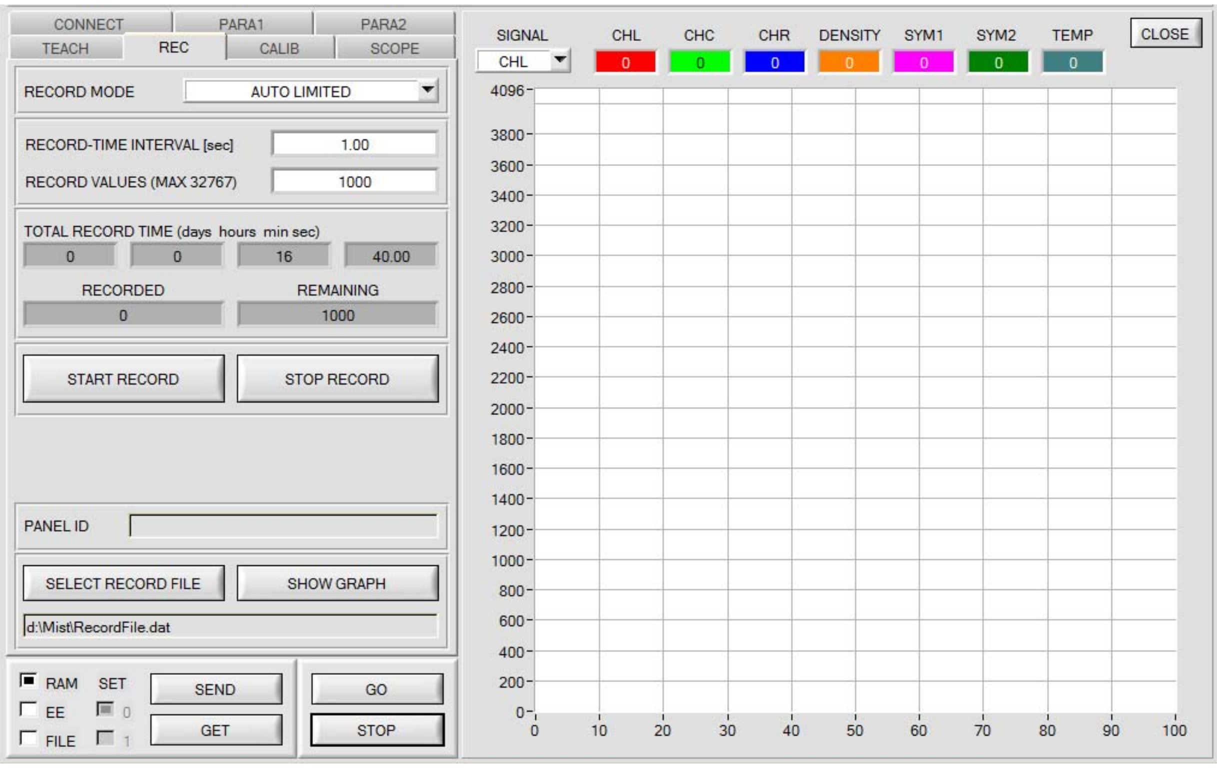
A click on **Help** opens a popup window that provides explanations for the respective functions.

2.5 Tab REC

The SI-JET-Scope software features a data recorder that makes it possible to save the data that are acquired and calculated by the sensor. The recorded file is saved to the hard disk of the PC and can then be evaluated with a spreadsheet program.

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 **REC** 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

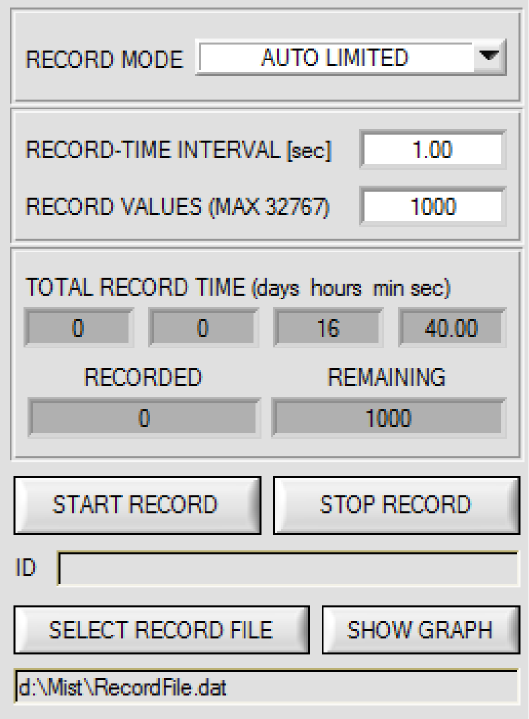
RECORDED: 0 | REMAINING: 1000

PANEL ID:

d:\Mist\RecordFile.dat

☒ RAM ☐ EE ☐ FILE | SET ☒ 0 ☐ 1

SIGNAL	CHL	CHC	CHR	DENSITY	SYM1	SYM2	TEMP
CHL	0	0	0	0	0	0	0



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: 0

REMAINING: 1000

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, TRANS** or **PARA** 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.

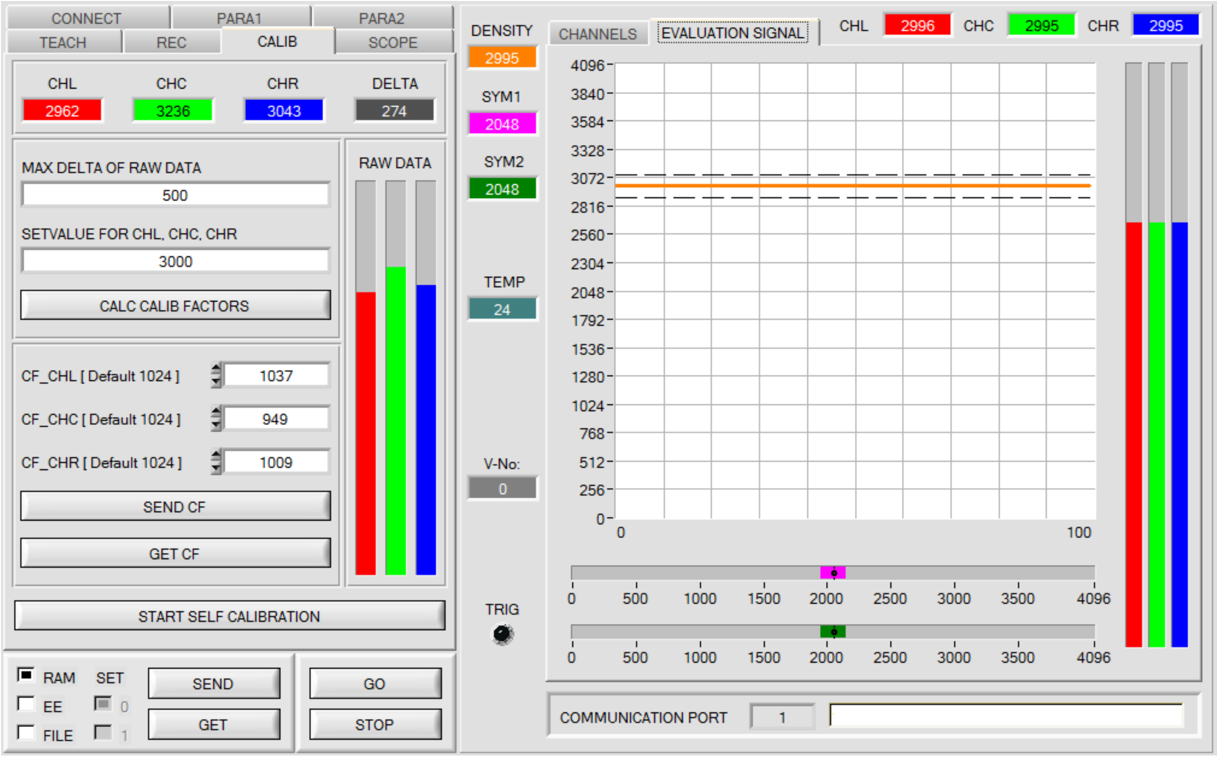
Please note:
When you press START RECORD, the file that is selected under SELECT RECORD FILE will be deleted. With RECORD FRAME MANUALLY, the file will be created if it does not already exist. If the file already exists, the data are added to the existing file.

2.6 Tab CALIB

2.6.1 Channel calibration

Channel calibration can be performed with the sensors of the SI-JET series. Such calibration is performed in transmitted-light mode, when there is no object between transmitter and receiver.

The following panel will be displayed after a click on **CALIB**:



CHL 2962
CHC 3236
CHR 3043
DELTA 274

MAX DELTA OF RAW DATA 500

SETVALUE FOR CHL, CHC, CHR 3000

CF_CHL [Default 1024] 1037

CF_CHC [Default 1024] 949

CF_CHR [Default 1024] 1009

■ RAM
□ EE
□ FILE

SET
▣ 0
□ 1

DENSITY 2995

SYM1 2048

SYM2 2048

TEMP 24

V-No: 0

CHL 2996 CHC 2995 CHR 2995

COMMUNICATION PORT 1

<u>Calculation example for determining the calibration factors</u>

In the example, a POWER value at which the three bars of the raw signals **RAW DATA** are in the dynamic range has been set. Each of the three bars is at approx. 3000 digits. It is thus appropriate to set a setpoint value of 3000 (see **SETVALUE FOR CHL, CHC, CHR**) for the three bars. When calibration is now started by pressing **CALC CALIB FACTORS**, the software automatically calculates the calibration factors for the **CHL, CHC** and **CHR** channels The calibration factors are normalized as integers to the value 1024.

Formula:

CF_CHL = (SETVALUE / RAW DATA CHL) * 1024 = (3000 / 2962) * 1024 = 1037
CF_CHC = (SETVALUE / RAW DATA CHC) * 1024 = (3000 / 3236) * 1024 = 949
CF_CHR = (SETVALUE / RAW DATA CHR) * 1024 = (3000 / 3043) * 1024 = 1009

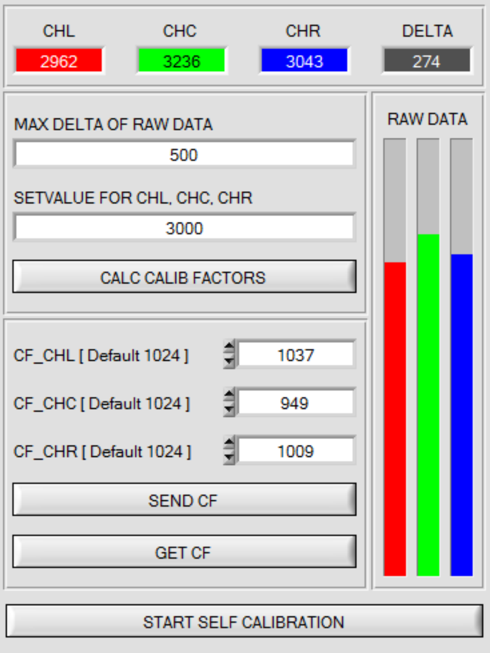
When the calibration factors have been calculated by the software on the user interface, they are automatically saved to the non-volatile **EEPROM** memory of the sensor. Calibration is then finished, work can then be continued in the main panel.

When the sensor detects a raw signal, it applies the calibration factor saved in the **EEPROM** to this raw signal, i.e. in the main panel only the calibrated data for the **CHL, CHC** and **CHR** channels are displayed. Evaluation by the micro-controller also is exclusively done with the calibrated data.

In the following the individual steps for calibrating the sensors are described:

INFO: The individual pop-up windows are intended as a help to guide you through the calibration process.

ATTENTION: It is a prerequisite for successful calibration that the sensor front-end is calibrated to a white surface.



CHL 2962
CHC 3236
CHR 3043
DELTA 274
MAX DELTA OF RAW DATA 500
SETVALUE FOR CHL, CHC, CHR 3000
CF_CHL [Default 1024] 1037
CF_CHC [Default 1024] 949
CF_CHR [Default 1024] 1009

Step 1:
First of all a suitable **POWER** value must be found such that the **RAW DATA** for **CHL, CHC, and CHR** lie in the dynamic range (upper third of the bar display).

Step 2:
When you have set a suitable POWER value, determine a **SETVALUE FOR CHL, CHC, CHR.** The software now calculates the calibration factors in such a way that this SETVALUE is reached for the raw data (see calculation example above).

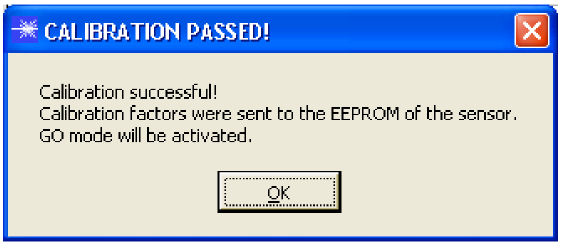
Step 3:
Determine a **MAX DELTA OF RAW DATA** (the software suggests 500).
Calibration is only permitted, if the current **DELTA** of the **RAW DATA** is smaller than the **MAX DELTA OF RAW DATA**.
DELTA is the maximum of **CHL, CHC, and CHR**, minus the minimum of **CHL, CHC, and CHR**. This is necessary in order to ensure that the sensor functions properly and that the space between transmitter and receiver is free.

Step 4:
Start calibration by pressing **CALC CALIB FACTORS**.
The button starts to flash in red, and at the same time 100 raw data are recorded through the interface, of which the respective mean value of **CHL, CHC, and CHR** is formed.
The individual calibration factors are formed from these mean values and from the **SETVALUES,** and they are then entered in the corresponding edit-boxes.
The calibration software automatically saves the calculated calibration factors to the EEPROM of the sensor.
Then the software changes to the GO mode and displays the **RAW DATA** and the calibrated data in the main panel.
Please note that the values for **CHL, CHC, and CHR** in the main panel approximately are equal to the value of SETVALUE.

You may also change the calibration factors **CF_CHL, CF_CHC, CF_CHR** manually by entering new values in the corresponding input fields. Please note that these factors are saved to the EEPROM by pressing **SEND CF**. **GET CF** reads the calibration factors that are currently saved in the EEPROM.

If pressing **CALC CALIB FACTORS** should not be successful, please follow the information provided in the pop-up windows.

Calibration only is completed successfully, if the following pop-up window is displayed:



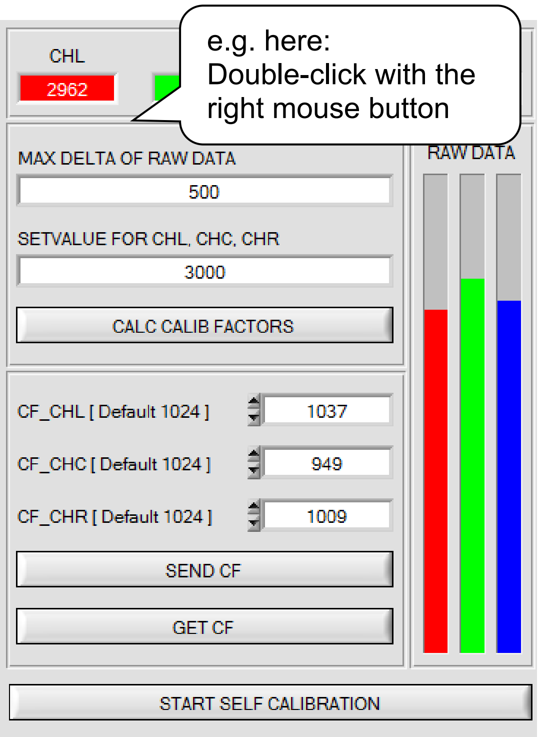
CALIBRATION PASSED!

Calibration successful!
Calibration factors were sent to the EEPROM of the sensor.
GO mode will be activated.

A click on **START SELF CALIBRATION** causes the sensor to calculate the calibration factors itself. It is not possible to specify a **SETVALUE** and a **MAX DELTA** here.
When the sensor has calculated the calibration factors, it displays them on the software interface. In the corresponding input fields it also displays the **SETVALUE** that it used for calculation and the **MAX DELTA** value that resulted from calculation. The **SEND CF** button must be pressed to confirm the calculated calibration factors.

2.6.2 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

CHL 2962

MAX DELTA OF RAW DATA: 500

SETVALUE FOR CHL, CHC, CHR: 3000

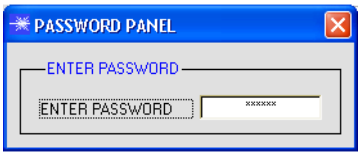
CF_CHL [Default 1024]: 1037

CF_CHC [Default 1024]: 949

CF_CHR [Default 1024]: 1009

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

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

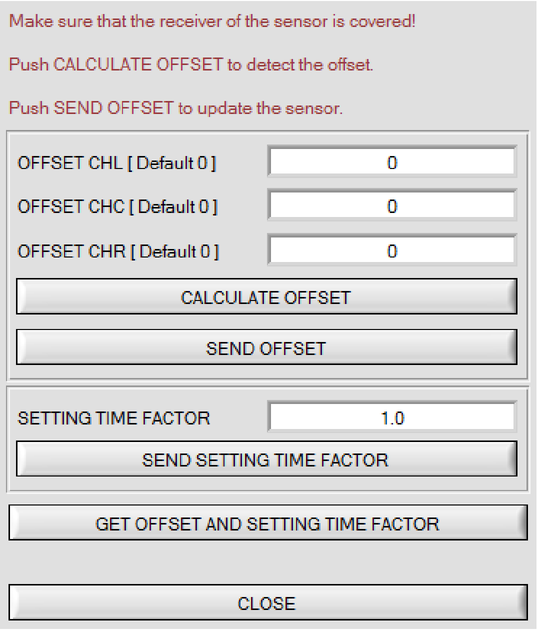


PASSWORD PANEL

ENTER PASSWORD

ENTER PASSWORD: ******

Now please follow the instructions provided in the tab.



Make sure that the receiver of the sensor is covered!

Push CALCULATE OFFSET to detect the offset.

Push SEND OFFSET to update the sensor.

OFFSET CHL [Default 0]: 0

OFFSET CHC [Default 0]: 0

OFFSET CHR [Default 0]: 0

SETTING TIME FACTOR: 1.0

ATTENTION!
It is extremely important for offset calibration that the receiver is not exposed to any extraneous light.
Please make sure that you cover the receiver of the sensor e.g. witch a black cloth that is impervious to light.

This is absolutely necessary for proper offset calculation.

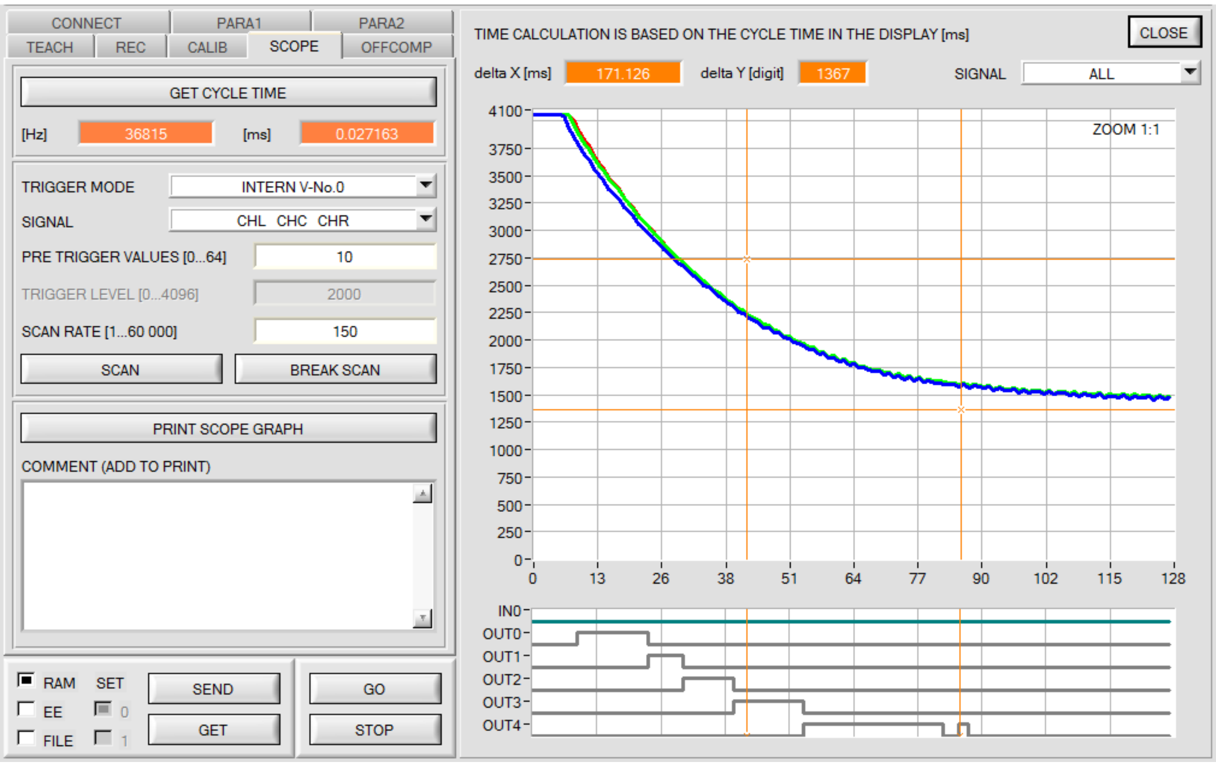
Now click on **CALCULATE OFFSET**. The offset values for **CHL**, **CHC** and **CHR** should be clearly lower than 100.
Click on **SEND OFFSET** to save the values to the sensor's EEPROM.

GET OFFSET AND SETTING TIME FACTOR can be used to check the saved offset value.
If necessary, **SEND OFFSET** can be used to save your own offset value (! not recommended).

SETTING TIME FACTOR is a value that is factory-preset during sensor production.
For sensors with infrared light source this value is 2.5.
For all other sensors this value should be 1.0.
Although it is possible to change this value, this is not described in this manual for safety reasons.
If it should be absolutely necessary to change this value, please contact your sensor supplier.

2.7 Tab SCOPE

The SCOPE tab visualises an oscilloscope.
TRIG MODE now optionally displays the signals **CHL, CHC, CHR** or **DENSITY, SYM1, SYM2** as well as the status of the digital inputs and outputs.
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]**. For determining the correct scan frequency please give the sensor a time of 8 seconds before you click on **GET CYCLE TIME**.
In **TRIG MODE = SINGLE SHOT** a data frame is recorded and displayed in the graph when you click on **SCAN**.
In **TRIG MODE = FALLING EDGE** and **RISING EDGE** triggered recording can be started by clicking on **SCAN**. A trigger start can be defined with **TRIGGER LEVEL**.
Triggering is performed either to **CHL** or **DENSITY**, depending on the signal that should be recorded. In the graph this is the red or orange line.
In **TRIG MODE = INTERN V-No.0** recording starts automatically when V-No. 0 is detected. **TRIG MODE= EXTERN IN0** can be used to start recording externally through input IN0.
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.



[Hz] 36815 [ms] 0.027163

TRIGGER MODE: INTERN V-No.0
SIGNAL: CHL CHC CHR
PRE TRIGGER VALUES [0...64]: 10
TRIGGER LEVEL [0...4096]: 2000
SCAN RATE [1...60 000]: 150

TIME CALCULATION IS BASED ON THE CYCLE TIME IN THE DISPLAY [ms]

delta X [ms] 171.126 delta Y [digit] 1367 SIGNAL ALL

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.

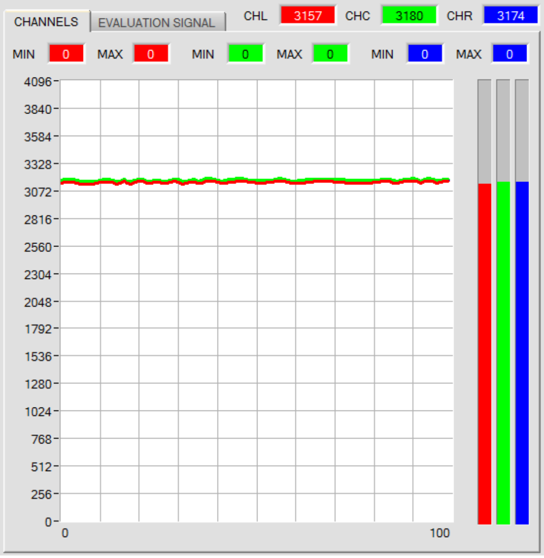
The two orange cursors can be moved with the mouse.
The two displays **deltaX[ms]** and **deltaY[digit]** will be updated.
deltaX[ms] shows the time between the cursors in X direction.
deltaY[digit] shows the difference between the two cursors in digits or in Volt in Y direction.

SIGNAL can be used to display individual curves.

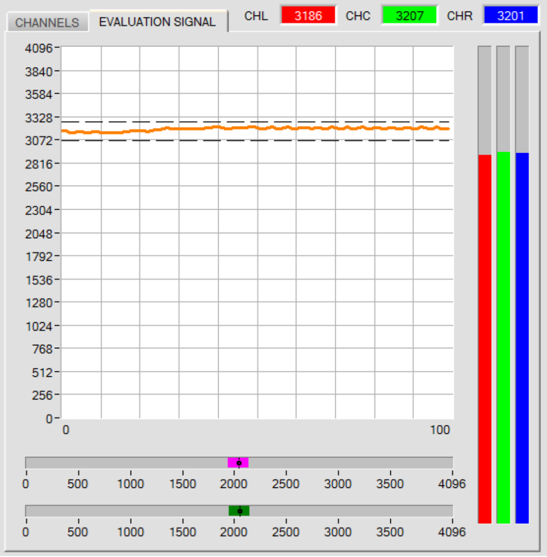
PRINT SCOPE GRAPH prints the current screen together with the text in the **COMMENT** text field.

2.8 Graphic display elements

CHANNELS tab:
Display of the current raw signals of the receivers (**CHL**, **CHC**, **CHR**).



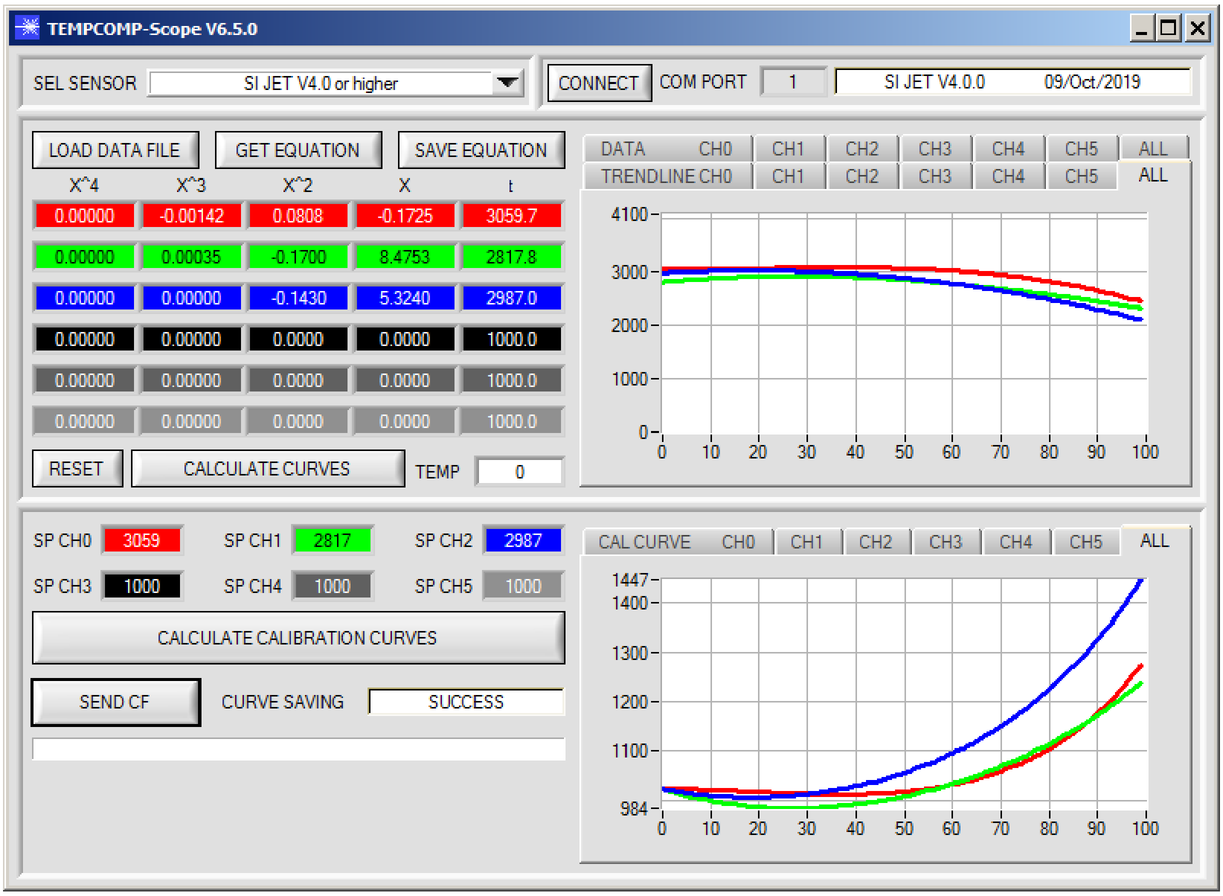
EVALUATION SIGNAL tab:
Display of the current values of **DENSITY**, **SYM1** and **SYM2** and of the tolerance windows set under No.:



TEMP:
This display shows the temperature prevailing in the sensor housing.
The display **DOES NOT** show degrees Centigrade or Fahrenheit.

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.



TEMPCOMP-Scope V6.5.0

SEL SENSOR: SI JET V4.0 or higher

COM PORT: 1 — SI JET V4.0.0 09/Oct/2019

X^4	X^3	X^2	X	t
0.00000	-0.00142	0.0808	-0.1725	3059.7
0.00000	0.00035	-0.1700	8.4753	2817.8
0.00000	0.00000	-0.1430	5.3240	2987.0
0.00000	0.00000	0.0000	0.0000	1000.0
0.00000	0.00000	0.0000	0.0000	1000.0
0.00000	0.00000	0.0000	0.0000	1000.0

TEMP: 0

SP CH0	3059	SP CH1	2817	SP CH2	2987
SP CH3	1000	SP CH4	1000	SP CH5	1000

CURVE SAVING: SUCCESS

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.

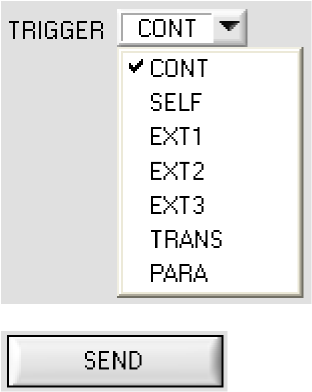
Step 5: Pressing the **SEND CF** button saves the mean straight lines in the **EEPROM** of the sensor.

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. External triggering of the SI-JET sensor

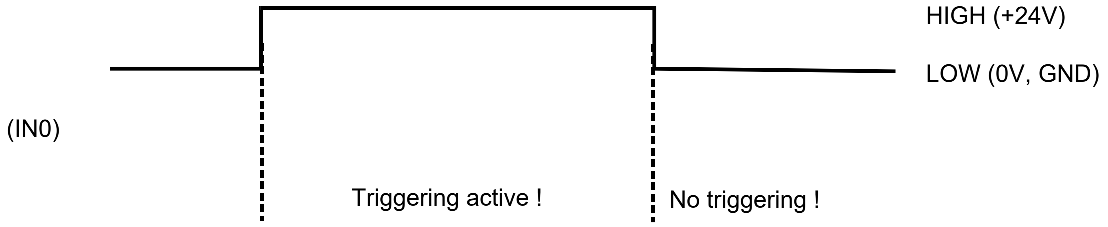
External triggering is performed through pin 3 of the 8-pole M12 connector at the SI-JET control electronics.



TRIGGER:
First the external trigger mode must be set at the sensor. For this purpose option **EXT1, EXT2, EXT3, TRANS,** or **PARA** must be selected in the **TRIGGER** selection field.

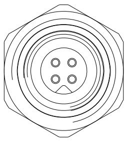
PLEASE NOTE:
The new setting is only activated at the sensor after a click on the SEND button!

Please note: The trigger input IN0 is HIGH-active, i.e. a trigger event is detected as long as IN0 = HIGH (+24V).



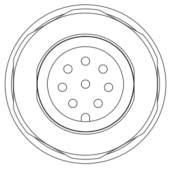
5. Connector assignment of the SI-JET sensor

Connection of SI-JET to PC:

4-pole fem. M5 connector (type Binder 707) ***SI-JET/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 SI-JET to PLC:

8-pole M12 connector (type Binder 763/713) ***SI-JET/PLC***		
Pin-No.:	**Color:**	**Assignment:**
1	White	0V (GND)
2	Brown	+24VDC (± 10%)
3	Green	IN0
4	Yellow	OUT0 (Digital 0: typ. 0 … 1V, Digital 1: typ. +Ub – 10%)
5	Gray	OUT1 (Digital 0: typ. 0 … 1V, Digital 1: typ. +Ub – 10%)
6	Pink	OUT2 (Digital 0: typ. 0 … 1V, Digital 1: typ. +Ub – 10%)
7	Blue	OUT3 (Digital 0: typ. 0 … 1V, Digital 1: typ. +Ub – 10%)
8	Red	OUT4 (Digital 0: typ. 0 … 1V, Digital 1: typ. +Ub – 10%)

Connecting cable:
cab-M12/8-…-shd (shielded)

6. RS232 communication protocol

The sensors of the SI-JET 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).
A second parameter SET can be sent to the sensor. See **TRIGGER=PARA**.

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:	AVERAGE	Word	Signal averaging 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384 or 32768
Para4:	EVALUATION MODE	Word	Evaluation mode: FIRST HIT, VOL5, THD CHA coded to (0,1,2)
Para5:	HOLD for V-No: 255	Word	Hold time for failure condition (V-No: 255) coded to (0…100) [ms]
Para6:	INTLIM	Word	Intensity limit (0 ... 4095)
Para7:	MAXVEC-No.	Word	Number of the colours (1,2,3,…,64)
Para8:	OUTMODE	Word	Function of the digital output: DIRECT HI, DIRECT LO, BINARY HI, BINARY LO coded to (0,1,2,3)
Para9:	TRIGGER	Word	Trigger mode: CONT, SELF, EXT1, EXT2, EXT3, TRANS, PARA coded to (0, 1, 2, 3, 4, 5, 6)
Para10:	EXTEACH	Word	External teach mode: OFF, ON, STAT1, DYN1 coded to (0,1,2,3)
Para11:	CALCULATION MODE	Word	Calculation mode: ABSOLUTE, RELATIVE coded to (0,1)
Para12:	DYN WIN LO	Word	Low limit for dynamic window when POWER MODE=dynamic (0…4095)
Para13:	DYN WIN HI	Word	High limit for dynamic window when POWER MODE=dynamic (0…4095)
Para14:	VECTOR GROUPS	Word	Vector groups enable: OFF, ON coded to (0,1)
Para15:	LED MODE	Word	Control for the internal light source DC, AC coded to (0,1)
Para16:	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)
Para17:	INTEGRAL	Word	Signal integration (1…250)
Para18:	MAX TR UP	word	Maximal value tracing up (0 … 60000)
Para19:	MAX TR DOWN	word	Maximal value tracing down (0 … 60000)

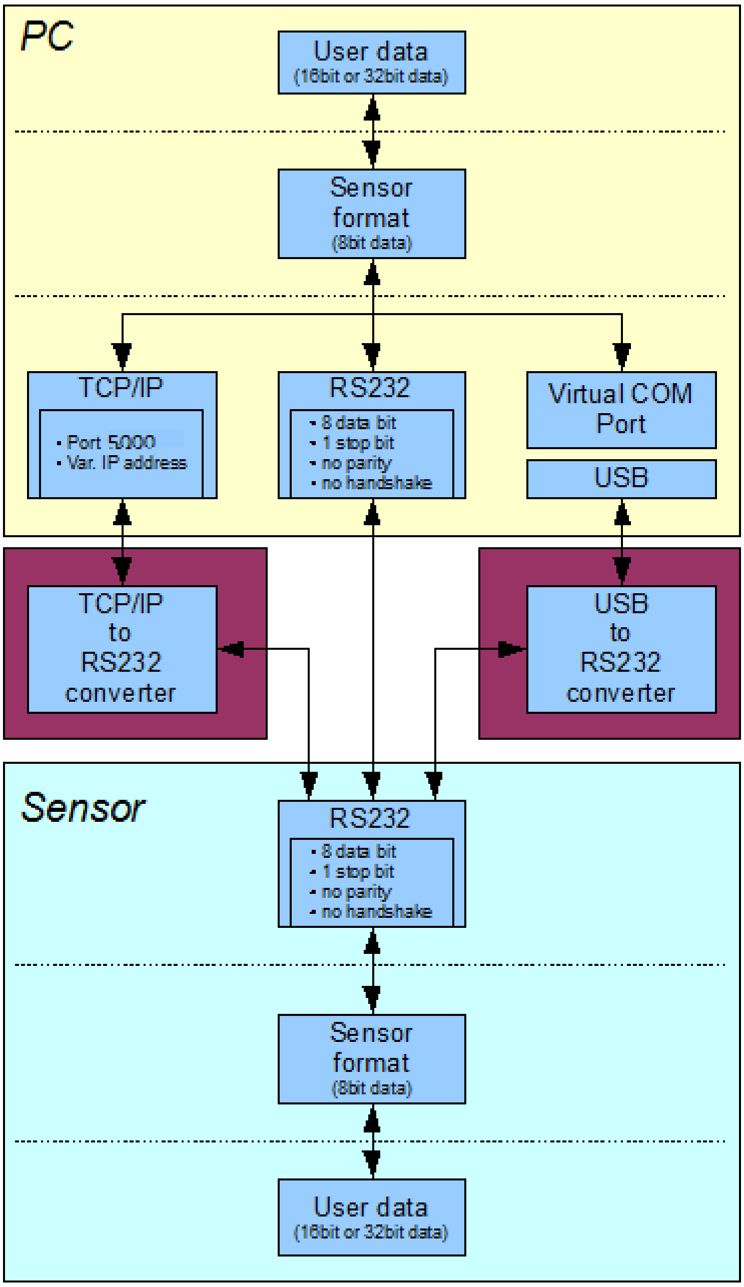
One row in the Teach Table, Group Table and Hold Table determines a **TEACH VECTOR**.
The sensors of the SI-JET series operate with 64 **TEACH VECTORS** that are sent to the sensor or read from the sensor in two blocks in the stated sequence.
Additional 64 **TEACH VECTORS** can be sent as a second SET. See **TRIGGER=PARA.**
Info! 1 **bytes** = 8bit 1 **word** = 2 **byte**

TEACH VECTOR		Type	Meaning
TeachVal1:	Teach Table Row 0 Column 0	Word	DENSITY of row 0
TeachVal2:	Teach Table Row 0 Column 1	Word	DENSITY tolerance of row 0
TeachVal3:	Teach Table Row 0 Column 2	Word	SYM1 of row 0
TeachVal4:	Teach Table Row 0 Column 3	Word	SYM1 tolerance of row 0
TeachVal5:	Teach Table Row 0 Column 4	Word	SYM2 of row 0
TeachVal6:	Teach Table Row 0 Column 5	Word	SYM2 tolerance of row 0
TeachVal7:	Group Table Row 0	Word	Group for row 0
TeachVal8:	Hold Table Row 0	Word	Hold time for row 0
TeachVal9:	Teach Table Row 1 Column 0	Word	DENSITY of row 1
TeachVal10:	Teach Table Row 1 Column 1	Word	DENSITY tolerance of row 1
TeachVal11:	Teach Table Row 1 Column 2	Word	SYM1 of row 1
…	…	…	…
TeachVal512	Hold Table Row 63	Word	Hold time for row 63

Upon request, the data acquired and processed by the sensor are sent by the sensor in the following sequence.
Info! 1 **bytes** = 8bit 1 **word** = 2 **byte**

DATA VALUE		Type	Meaning
DatVal1:	CHL	Word	Calibrated and temperature compensated signal from channel CHL
DatVal2:	CHC	Word	Calibrated and temperature compensated signal from channel CHC
DatVal3:	CHR	Word	Calibrated and temperature compensated signal from channel CHR
DatVal4:	DENSITY	Word	Calculated DENSITY value
DatVal5:	SYM1	Word	Calculated SYM1 value
DatVal6:	SYM2	Word	Calculated SYM2 value
DatVal7:	V-No:	Word	Detected vector
DatVal8:	GRP	Word	Detected group
DatVal9:	TRIG	Word	TRIG is 1 when a trigger condition is given
DatVal10:	TEMP	Word	Temperature in the sensor (**not** in °C or °F)
DatVal11:	RAW CHL	Word	None Calibrated and none temperature compensated signal from channel CHL
DatVal12:	RAW CHC	Word	None Calibrated and none temperature compensated signal from channel CHC
DatVal13:	RAW CHR	Word	None Calibrated and none temperature compensated signal from channel CHR
DatVal14:	MIN CHL	Word	Calibrated and temperature compensated minimum signal from channel CHL
DatVal15:	MIN CHC	Word	Calibrated and temperature compensated minimum signal from channel CHC
DatVal16:	MIN CHR	Word	Calibrated and temperature compensated minimum signal from channel CHR
DatVal17:	MAX CHL	Word	Calibrated and temperature compensated maximum signal from channel CHL
DatVal18:	MAX CHC	Word	Calibrated and temperature compensated maximum signal from channel CHC
DatVal19:	MAX CHR	Word	Calibrated and temperature compensated maximum signal from channel CHR

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 firmware number from sensor	order=7
8	Read data values from sensor	order=8
108	Read 3 data values from sensor	order=108
30	Start and Stop triggered sending of data frames	order=30
103	Start channel correction and get calibration factors, setvalue and max delta of raw data.	order=103
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.
<ARG> determines whether you want to save parameter or teach vectors:
ARG = 0 --> Parameter Set 0
ARG = 1 --> Parameter Set 1
ARG = 2 --> Teach vector Set 0 Row 0…31
ARG = 3 --> Teach vector Set 0 Row 32..63
ARG = 4 --> Teach vector Set 1 Row 0…31
ARG = 5 --> Teach vector Set 2 Row 32..63

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 for Parameter Set 0

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.
<ARG> determines whether you want to read parameter or teach vectors:
ARG = 0 --> Parameter Set 0
ARG = 1 --> Parameter Set 1
ARG = 2 --> Teach vector Set 0 Row 0…31
ARG = 3 --> Teach vector Set 0 Row 32..63
ARG = 4 --> Teach vector Set 1 Row 0…31
ARG = 5 --> Teach vector Set 2 Row 32..63

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

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Header	Header	Header	Header	Header	Header	Header	Header
0x55	<order>	<ARG>	<ARG>	<LEN>	<LEN>	CRC8	CRC8
		(lo byte)	(hi byte)	(lo byte)	(hi byte)	(Data)	(Header)
85 (dec)	3	0	0	0	0	170	142
		ARG=0		LEN=0			

DATA FRAME Sensor → PC

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Header	Header	Header	Header	Header	Header	Header	Header
0x55	<order>	<ARG>	<ARG>	<LEN>	<LEN>	CRC8	CRC8
		(lo byte)	(hi byte)	(lo byte)	(hi byte)	(Data)	(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

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Header	Header	Header	Header	Header	Header	Header	Header
0x55	<order>	<ARG>	<ARG>	<LEN>	<LEN>	CRC8	CRC8
		(lo byte)	(hi byte)	(lo byte)	(hi byte)	(Data)	(Header)
85 (dec)	4	0	0	0	0	170	11
		ARG=0		LEN=0			

DATA FRAME Sensor → PC

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Header	Header	Header	Header	Header	Header	Header	Header
0x55	<order>	<ARG>	<ARG>	<LEN>	<LEN>	CRC8	CRC8
		(lo byte)	(hi byte)	(lo byte)	(hi byte)	(Data)	(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

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Header	Header	Header	Header	Header	Header	Header	Header
0x55	<order>	<ARG>	<ARG>	<LEN>	<LEN>	CRC8	CRC8
		(lo byte)	(hi byte)	(lo byte)	(hi byte)	(Data)	(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

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Header	Header	Header	Header	Header	Header	Header	Header
0x55	<order>	<ARG>	<ARG>	<LEN>	<LEN>	CRC8	CRC8
		(lo byte)	(hi byte)	(lo byte)	(hi byte)	(Data)	(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

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Header	Header	Header	Header	Header	Header	Header	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 firmware number of the sensor

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9	Byte10	Byte11
Header	Header	Header	Header	Header	Header	Header	Header	Data	Data	Data	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							

Byte12	Byte13	Byte14	Byte15	Byte16	Byte17	Byte18	Byte19	Byte20	Byte21	Byte22	Byte23
Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII
W	A	R	E		S	T	R	I	N	G	

Byte24	Byte25	Byte26	Byte27	Byte28	Byte29	Byte30	Byte31	Byte32	Byte33	Byte34	Byte35
Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII
											R

Byte36	Byte37	Byte38	Byte39	Byte40	Byte41	Byte42	Byte43	Byte44	Byte45	Byte46	Byte47
Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII
T	:	K	W	x	x	/	x	x			

Byte48	Byte49	Byte50	Byte51	Byte52	Byte53	Byte54	Byte55	Byte56	Byte57	Byte58	Byte59
Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII

Byte60	Byte61	Byte62	Byte63	Byte64	Byte65	Byte66	Byte67	Byte68	Byte69	Byte70	Byte71
Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII

Byte72	Byte73	Byte74	Byte75	Byte76	Byte77	Byte78	Byte79	Byte80	Byte81
Data	Data	Data	Data	Data	Data	Data	Data	Data	Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII

Example order=8: Read data values from sensor.

DATA FRAME PC → Sensor

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Header	Header	Header	Header	Header	Header	Header	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

8 Header Bytes and all **DATA VALUES** (See Table DATA VALUE)

Example order=108: Read 3 data values from sensor.

DATA FRAME PC → Sensor

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Header	Header	Header	Header	Header	Header	Header	Header
0x55	<order>	<ARG>	<ARG>	<LEN>	<LEN>	CRC8	CRC8
		(lo byte)	(hi byte)	(lo byte)	(hi byte)	(Data)	(Header)
85 (dec)	108	0	0	0	0	170	105
		ARG=0		LEN=0			

DATA FRAME Sensor → PC

8 Header Bytes and 3 **DATA VALUES** (DatVal1, DatVal2, DatVal3. See Table DATA VALUE)

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

DATA FRAME Sensor → PC

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

DATA FRAME Sensor → PC

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

Example order=103: Start white light correction and get calibration factors, setvalue and max delta of raw data.

DATA FRAME PC → Sensor

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Header	Header	Header	Header	Header	Header	Header	Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	103	0	0	0	0	170	145
		ARG=0		LEN=0			

DATA FRAME Sensor → PC

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9	Byte10	Byte11
Header	Header	Header	Header	Header	Header	Header	Header	Data	Data	Data	Data
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	CF RED (lo byte)	CF RED (hi byte)	CF GREEN (lo byte)	CF GREEN (hi byte)
85 (dec)	103	0	0	10	0	212	28	228	3	223	3
		ARG=0		LEN=10				CF_RED = 996		CF_GREEN = 991	

Byte12	Byte13	Byte14	Byte15	Byte16	Byte17
Data	Data	Data	Data	Data	Data
CF BLUE (lo byte)	CF BLUE (hi byte)	SET VALUE (lo byte)	SET VALUE (hi byte)	MAX DELTA (lo byte)	MAX DELTA (hi byte)
65	4	134	12	43	1
CF_BLUE = 1089		SETVALUE = 3206		MAX DELTA = 299	

Example order=105: Get cycle time from sensor

DATA FRAME PC → Sensor

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Header	Header	Header	Header	Header	Header	Header	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	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9	Byte10	Byte11
Header	Header	Header	Header	Header	Header	Header	Header	Data	Data	Data	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	206	163	40	28	2	0
		ARG=0		LEN=8				CYCLE COUNT = 138280			

Byte12	Byte13	Byte14	Byte15
Data	Data	Data	Data
lo word lo byte	lo word hi byte	hi word lo byte	hi word hi byte
144	1	0	0
COUNTER TIME = 400			

Cycle Time [Hz] = CYCLE COUNT / (COUNTER TIME * 0,1)

Cycle Time [ms] = (COUNTER TIME * 0,1) / CYCLE COUNT

Example order=190: Write new baud rate to the 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)	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

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)	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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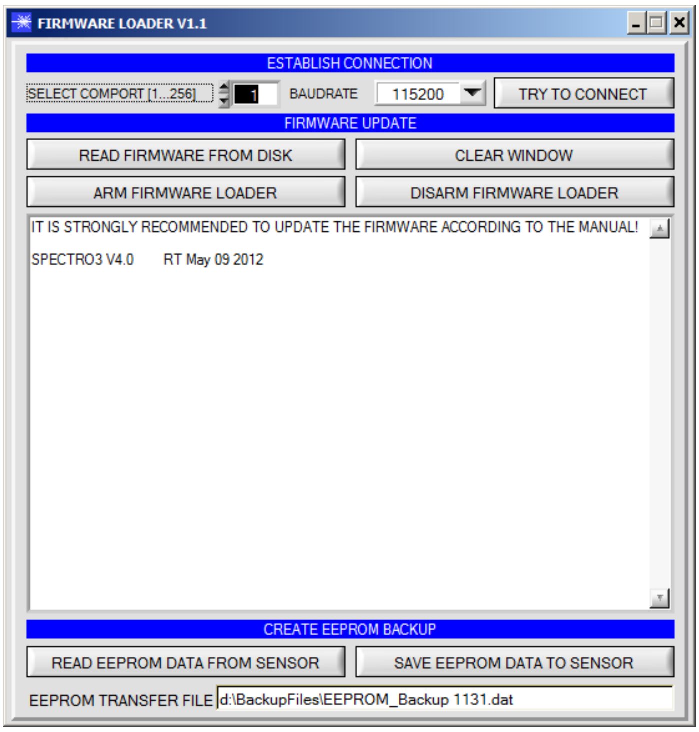
Please read this chapter before you start!

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.



SELECT COMPORT [1...256] 1
BAUDRATE 115200

```
IT IS STRONGLY RECOMMENDED TO UPDATE THE FIRMWARE ACCORDING TO THE MANUAL!

SPECTRO3 V4.0      RT May 09 2012
```

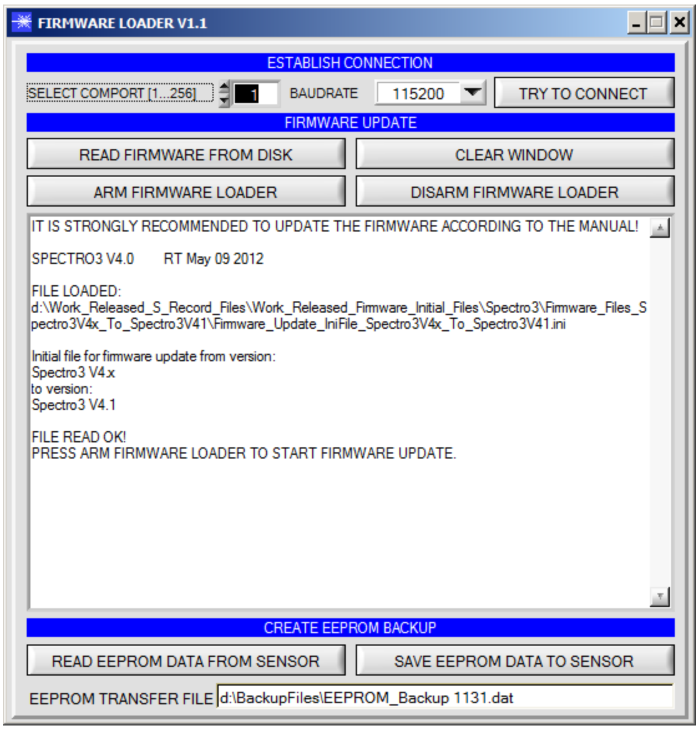
EEPROM TRANSFER FILE d:\BackupFiles\EEPROM_Backup 1131.dat

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.



SELECT COMPORT [1...256] 1
BAUDRATE 115200

```
IT IS STRONGLY RECOMMENDED TO UPDATE THE FIRMWARE ACCORDING TO THE MANUAL!

SPECTRO3 V4.0      RT May 09 2012

FILE LOADED:
d:\Work_Released_S_Record_Files\Work_Released_Firmware_Initial_Files\Spectro3\Firmware_Files_S
pectro3V4x_To_Spectro3V41\Firmware_Update_IniFile_Spectro3V4x_To_Spectro3V41.ini

Initial file for firmware update from version:
Spectro3 V4.x
to version:
Spectro3 V4.1

FILE READ OK!
PRESS ARM FIRMWARE LOADER TO START FIRMWARE UPDATE.
```

EEPROM TRANSFER FILE d:\BackupFiles\EEPROM_Backup 1131.dat

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.

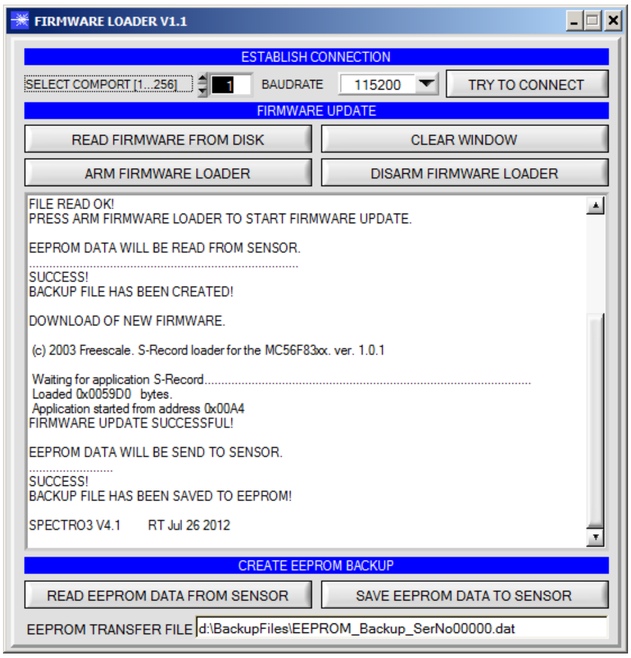
When you press the **ARM FIRMWARE LOADER** button the firmware update will be performed automatically.

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.

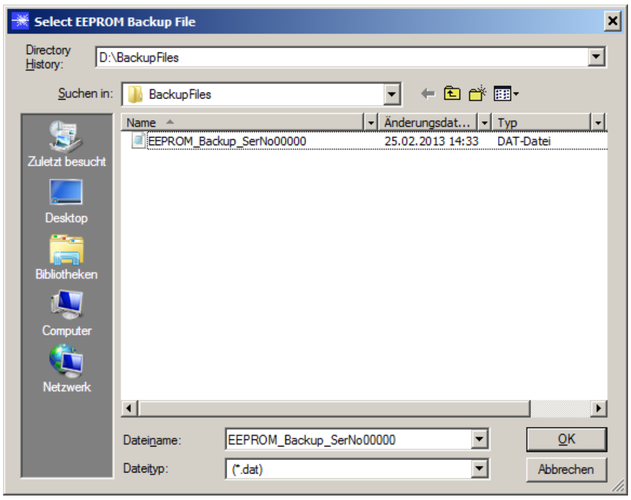
The complete update process may take up to 1 minute.



SELECT COMPORT [1...256]: 1
BAUDRATE: 115200

```
FILE READ OK!
PRESS ARM FIRMWARE LOADER TO START FIRMWARE UPDATE.

EEPROM DATA WILL BE READ FROM SENSOR.
........................................................................
SUCCESS!
BACKUP FILE HAS BEEN CREATED!

DOWNLOAD OF NEW FIRMWARE.

 (c) 2003 Freescale. S-Record loader for the MC56F83xx. ver. 1.0.1

 Waiting for application S-Record.............................................................................................
 Loaded 0x0059D0  bytes.
 Application started from address 0x00A4
FIRMWARE UPDATE SUCCESSFUL!

EEPROM DATA WILL BE SEND TO SENSOR.
......................
SUCCESS!
BACKUP FILE HAS BEEN SAVED TO EEPROM!

SPECTRO3 V4.1     RT Jul 26 2012
```

EEPROM TRANSFER FILE: d:\BackupFiles\EEPROM_Backup_SerNo00000.dat



Directory History: D:\BackupFiles
Suchen in: BackupFiles

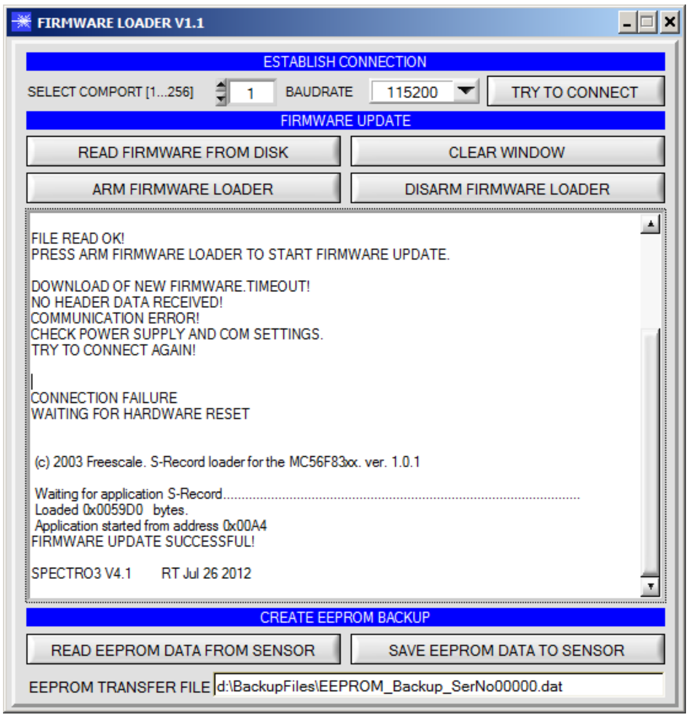
Name	Änderungsdat...	Typ
EEPROM_Backup_SerNo00000	25.02.2013 14:33	DAT-Datei

Dateiname: EEPROM_Backup_SerNo00000
Dateityp: (*.dat)

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.



SELECT COMPORT [1...256] 1 BAUDRATE 115200

```
FILE READ OK!
PRESS ARM FIRMWARE LOADER TO START FIRMWARE UPDATE.

DOWNLOAD OF NEW FIRMWARE.TIMEOUT!
NO HEADER DATA RECEIVED!
COMMUNICATION ERROR!
CHECK POWER SUPPLY AND COM SETTINGS.
TRY TO CONNECT AGAIN!

|
CONNECTION FAILURE
WAITING FOR HARDWARE RESET


 (c) 2003 Freescale. S-Record loader for the MC56F83xx. ver. 1.0.1

 Waiting for application S-Record...............................................................................................
 Loaded 0x0059D0  bytes.
 Application started from address 0x00A4
FIRMWARE UPDATE SUCCESSFUL!

SPECTRO3 V4.1      RT Jul 26 2012
```

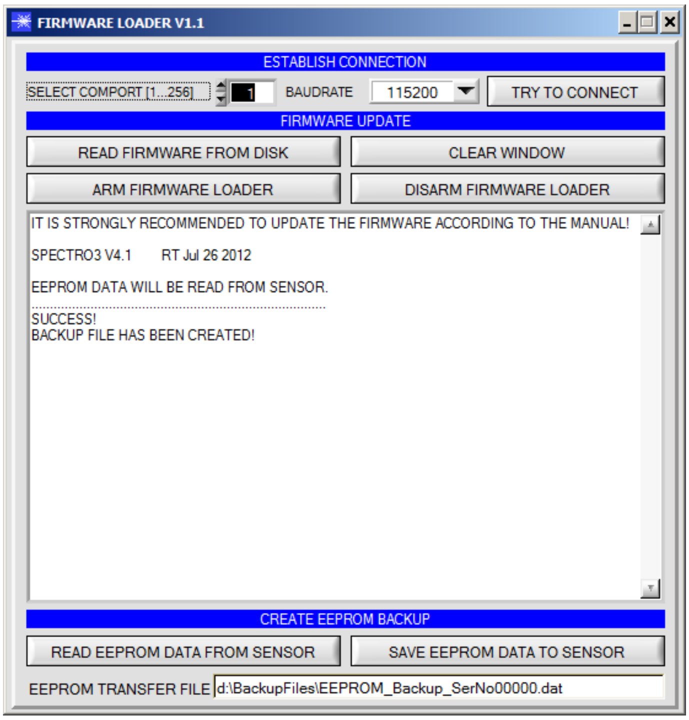
EEPROM TRANSFER FILE d:\BackupFiles\EEPROM_Backup_SerNo00000.dat

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 if none has yet been loaded. 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.**



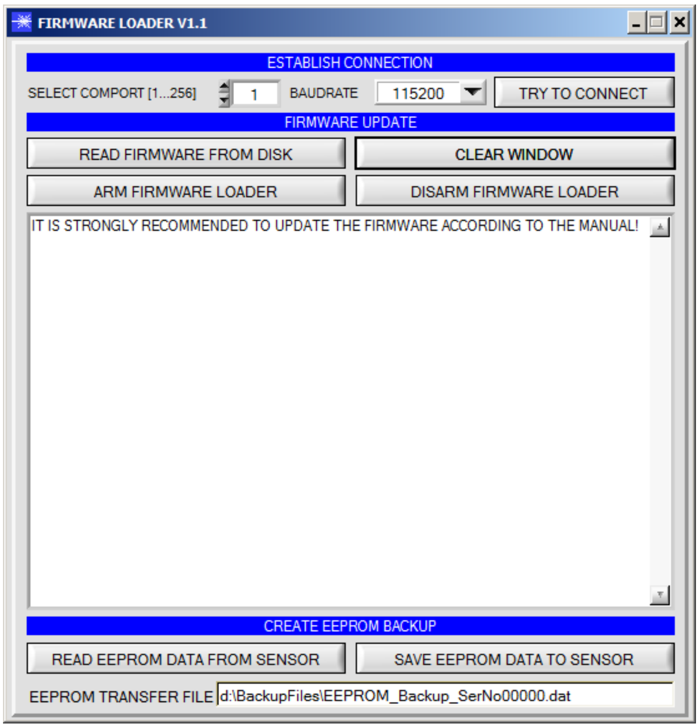
SELECT COMPORT [1...256] 1 BAUDRATE 115200

```
IT IS STRONGLY RECOMMENDED TO UPDATE THE FIRMWARE ACCORDING TO THE MANUAL!

SPECTRO3 V4.1      RT Jul 26 2012

EEPROM DATA WILL BE READ FROM SENSOR.
..............................................................
SUCCESS!
BACKUP FILE HAS BEEN CREATED!
```

EEPROM TRANSFER FILE d:\BackupFiles\EEPROM_Backup_SerNo00000.dat

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.



IT IS STRONGLY RECOMMENDED TO UPDATE THE FIRMWARE ACCORDING TO THE MANUAL!

EEPROM TRANSFER FILE d:\BackupFiles\EEPROM_Backup_SerNo00000.dat