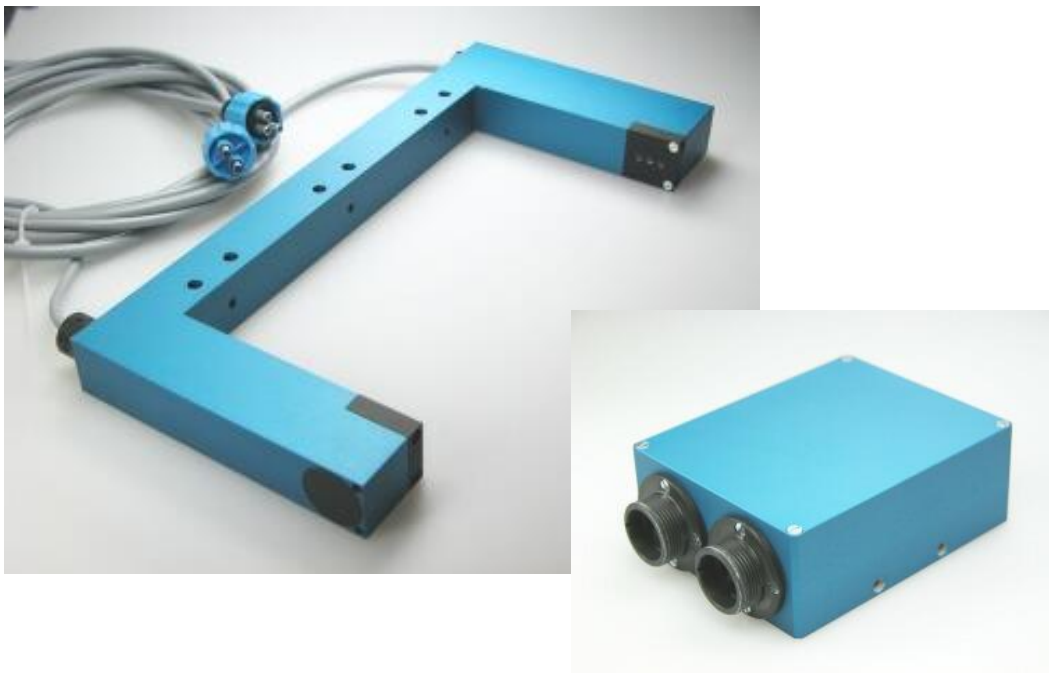


Manual

Software SI-JET-Scope V3.3

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

for the spray jet monitoring sensor SI-JET



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

The **SI-JET** spray jet sensor detects the radiation that is transmitted by the measuring object. It uses a red-light LED with adjustable transmission power as a light source. An integrated 3-fold receiver for the LEFT, CENTRE, and RIGHT component of the light transmitted by the measuring object is employed as a receiver.

The current density and symmetry are taught to the sensor through an external input IN0. As a maximum 31 states can be taught. As an option, this input can be used as a trigger input as well.

Density and symmetry are detected continuously. The respective detected status is provided either as a binary code or directly at the outputs. The detected adjustment is at the same time visualised by way of 5 LEDs at the housing of the **SI-JET** control unit.

Through the RS232 interface parameters and measured values can be exchanged between the PC and the **SI-JET** sensor. All the parameters for density and symmetry detection can be stored in the non-volatile EEPROM of the **SI-JET** sensor. When parameterization is finished the color sensor continues to operate with the current parameters in "stand alone" mode without a PC.

SI-JET spray jet sensors are available as single-channel, dual-channel, or triple-channel systems. In a single-channel system all three receivers for the left, center, and right component that are visualised on the user interface assume the value of the center channel. In a dual-channel system the center component is formed from the mean value of the left and right channel.

The programming software is used to set the number of existing channels.

0. Contents

	Page
1. Measured variables	3
2. Measuring principle	4
2.1 Evaluation modes.....	4
2.2 TEACH process	4
3. Installation of the SI-JET-Scope software	5
4. Operation of the SI-JET-Scope software	6
4.1 Tab CONNECT	7
4.2 Tab PARA, button SEND, GET, GO, STOP (parameterization, data exchange)	9
4.3 Tab TEACH TABLE	13
4.4 Tab RECORDER	15
4.5 EVALUATION MODE ABSOLUT	17
4.6 EVALUATION MODE RELATIVE	19
5. Operation of the TEMPCOMP-Scope Software.....	20
6. Function of the LED display.....	21
7. Connector assignment of the SI-JET system	23
8. RS232 communication protocol.....	24

Shortcuts:

SEND	F9
GET	F10
GO	F11
STOP	F12

1. Measured variables

In this manual, the following measured variables are used for explaining the measurement principle and for representing formulas. The designations also are identical to those on the PC user interface.

CH_L	Current value of channel left
CH_C	Current value of channel centre
CH_R	Current value of channel right
MAX_CHL	Maximum value of channel left
MAX_CHC	Maximum value of channel centre
MAX_CHR	Maximum value of channel right
DENSITY	Current calculated density
SYM1	Current calculated symmetry 1
SYM2	Current calculated symmetry 2
D	Taught value for density in Teach Table
DTO	Tolerance value for density in Teach Table
S1	Taught value for symmetry 1 in Teach Table
S1TO	Tolerance value for symmetry 1 in Teach Table
S2	Taught value for symmetry 2 in Teach Table
S2TO	Tolerance value for symmetry 2 in Teach Table

2. Measuring principle

The following three measurands are picked up and monitored in the production process by the SI-JET spray jet monitoring system:

- Spray jet density (hereinafter referred to as **density**).
- Symmetry 1 (the two outer channels are put into proportion to each other).
- Symmetry 2 (the average of the left channel and the right channel is put into proportion to the centre channel).

Depending on the evaluation mode, density and symmetry are calculated as follows.

2.1 Evaluation modes

EVALUATION MODE ABSOLUTE:

$$DENSITY = \frac{CH_L + CH_C + CH_R}{3} \quad SYM1 = \frac{CH_L}{CH_L + CH_R} * 1000$$

$$SYM2 = \frac{CH_C}{CH_C + \frac{CH_L + CH_R}{2}} * 1000$$

EVALUATION MODE RELATIVE:

$$CHL_N = 4096 - \frac{CH_L}{MAX_CHL} * 4096 \quad CHC_N = 4096 - \frac{CH_C}{MAX_CHC} * 4096 \quad CHR_N = 4096 - \frac{CH_R}{MAX_CHR} * 4096$$

$$DENSITY = CHC_N \quad SYM1 = \frac{CHL_N}{CHL_N + CHR_N} * 1000$$

$$SYM2 = \frac{CHC_N}{CHC_N + \frac{CHL_N + CHR_N}{2}} * 1000$$

2.2 TEACH process

The teach process can be performed either with the parameterisation software, by way of the teach input (INO PIN3 green at the cab-las8/SPS cable), or by means of the switch at the housing.

When teaching is performed through the **INO** input, the tolerance values for **density** and **symmetry** must first be stored once in the **EEPROM** of the control unit with the help of the parameterisation software.

Before input **INO** is activated, the status to be taught must be present at the sensor front-end, i.e. spraying must first be switched on, and then **INO** must be set to +24V.

The current status is taught to as many rows in the **Teach Table** as have been selected under **MAXVEC-No.** classification is performed by way of different set **tolerances**.

3. Installation of the SI-JET-Scope V3.3 software

Hardware requirements for successful installation of the SI-JET-Scope software:

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

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

Please install the software as described below:

1. The software can be installed directly from the installation CD-ROM. To install the software, start the SETUP program in the INSTALL folder of the CD-ROM.
2. The installation program displays a dialog and suggests to install the software in the C:\"FILENAME" directory on the hard disk. You may accept this suggestion with **OK** or **[ENTER]**, or you may change the path as desired. Installation is then performed automatically.
3. During the installation process a new program group for the software is created in the Windows Program Manager. In the program group an icon for starting the software is created automatically. When installation is successfully completed the installation program displays "Setup OK".
4. After successful installation the software can be started with a left mouse button double-click on the icon.

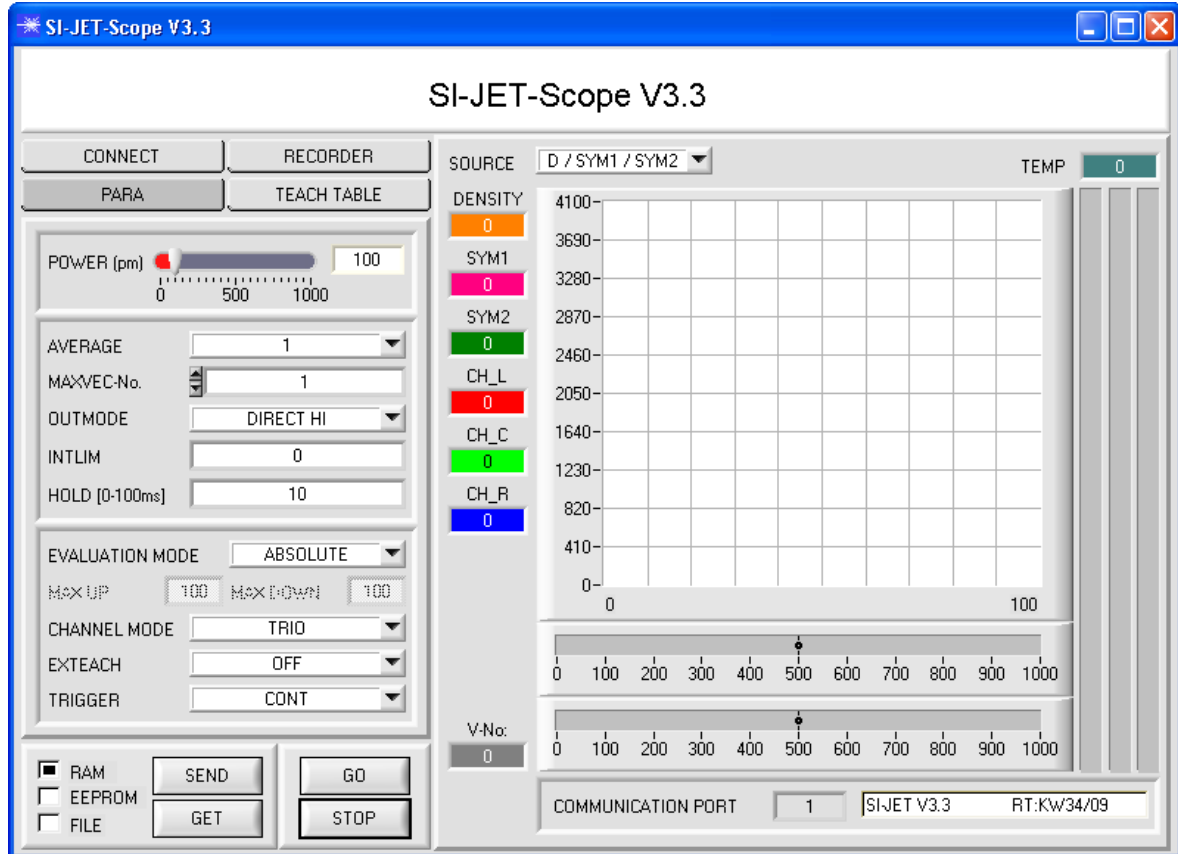
Windows® is a trademark of the Microsoft Corp.
VGA™ is a trademark of the International Business Machines Corp.

4. Operation of the SI-JET-Scope V3.3 software

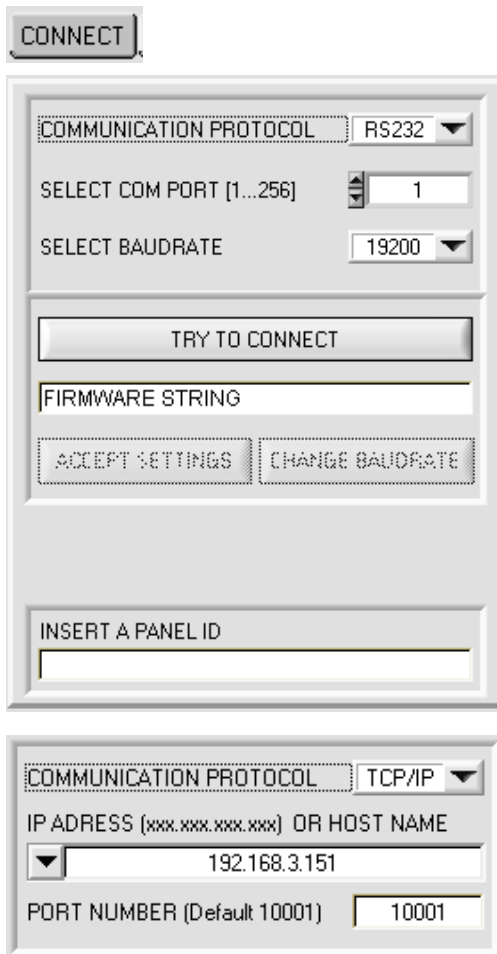
Please read this chapter first before you start to adjust and parameterise the SI-JET sensor.

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

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



4.1 Tab CONNECT



The screenshot shows two panels of the 'CONNECT' tab. The top panel is for RS232 communication, with 'COMMUNICATION PROTOCOL' set to 'RS232', 'SELECT COM PORT' set to '1', and 'SELECT BAUDRATE' set to '19200'. It includes a 'TRY TO CONNECT' button, a 'FIRMWARE STRING' display field, and 'ACCEPT SETTINGS' and 'CHANGE BAUDRATE' buttons. The bottom panel is for TCP/IP communication, with 'COMMUNICATION PROTOCOL' set to 'TCP/IP', 'IP ADDRESS (xxx.xxx.xxx.xxx) OR HOST NAME' set to '192.168.3.151', and 'PORT NUMBER (Default 10001)' set to '10001'.

CONNECT:

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

The **COMMUNICATION PROTOCOL** function field is used for selecting either an **RS232** or a **TCP/IP** protocol.

If **RS232** is selected, a port from 1 to 256 can be selected with **SELECT COM PORT**, depending on which port the sensor is connected to.

The sensor operates with a set baudrate that can be modified with **CHANGE BAUDRATE** (see below). The sensor and the user interface both must operate with the same baudrate. At the user interface the baudrate is set with **SELECT BAUDRATE**. If after starting the software should not automatically establish a connection, the correct baudrate can be found with **SELECT BAUDRATE**.

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

If the sensor should communicate through a local area network, an RS232 to Ethernet adaptor will be needed. This adaptor makes it possible to establish a connection to the sensor with the **TCP/IP** protocol.

The network adaptors that are available from us are based on the Lantronix XPort module. For parameterising these adapters (assigning of an IP address, setting of the Baud rate of 19200) please download the "DeviceInstaller" software that is provided free of charge by Lantronix at <http://www.lantronix.com/>. DeviceInstaller is based on Microsoft's ".NET" framework. Detailed operating instructions for the "DeviceInstaller" software also are available from Lantronix.

In order to establish a connection to the adaptor, its IP address or HOST name must be entered in the field **IP ADDRESS (xxx.xxx.xxx.xxx) OR HOST NAME**. The DROP DOWN menu (down arrow) shows the last 10 IP addresses that were used. An address from this list can be directly selected by clicking on the respective item. The DROP DOWN list is saved and is thus always available when the software is closed.

The **PORT NUMBER** for the XPort-based network adaptors is 10001. This port number must not be changed.

When you press the **TRY TO CONNECT** button, the software tries to establish a connection with the set parameters. The communication status is shown in the display field. If the sensor answers with its FIRMWARE ID, the set connection type can be accepted by pressing **ACCEPT SETTINGS**. You will then be returned to the **PARA** tab. If you get a **TIMEOUT** message, the software could not establish a connection to the sensor. In this case please check if the interface cable is correctly connected, if the sensor is supplied with power, and if the set parameters are correct.

If a connection has been accepted by pressing **ACCEPT SETTINGS**, the software starts automatically with these settings when called the next time.



ATTENTION !

The stable function of the interface is a basic prerequisite for measured value transfer from the PC to the Sensor.

Due to the limited data transfer rate through the serial RS232 interface only slow changes of the raw signals at the sensor front end can be observed in the graphic output window of the PC.

For maintaining maximum switching frequency at the sensor data communication with the PC must be stopped (press the STOP button).

COMMUNICATION PROTOCOL: RS232
 SELECT COM PORT [1...256]: 1
 SELECT BAUDRATE: 19200
 TRY TO CONNECT
 FIRMWARE STRING
 ACCEPT SETTINGS | CHANGE BAUDRATE

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

This is necessary if a high-speed connection is needed for data transfer through the serial interface.

COMMUNICATION PROTOCOL: RS232
 SELECT COM PORT [1...256]: 1
 SELECT BAUDRATE: 19200
 TRY TO CONNECT
 FIRMWARE STRING
 ACCEPT SETTINGS | CHANGE BAUDRATE

If the baudrate should be changed, a connection must first be established by clicking on **TRY TO CONNECT**.

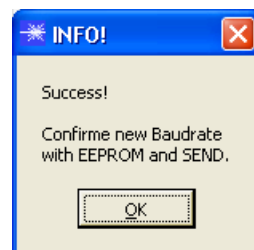
The **CHANGE BAUDRATE** button will then be active.

COMMUNICATION PROTOCOL: RS232
 SELECT COM PORT [1...256]: 1
 SELECT BAUDRATE: 115200
 TRY TO CONNECT
 FIRMWARE STRING
 ACCEPT SETTINGS | CHANGE BAUDRATE

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]: 1
 SELECT BAUDRATE: 115200
 TRY TO CONNECT
 FIRMWARE STRING
 ACCEPT SETTINGS | CHANGE BAUDRATE



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.

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

PARA:

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

ATTENTION!

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

SEND [F9]:

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

GET [F10]:

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

RAM:

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.

EVALUATION MODE

EVALUATION MODE:

The SI-JET can be operated with two different evaluation modes.

MAX UP MAX DOWN

ABSOLUTE:

The absolute status of the three channels **CH_L**, **CH_C**, and **CH_R** is used for evaluation.

RELATIVE:

The current status of the three channels **CH_L**, **CH_C**, and **CH_R** relative to their maximum values within an adjustable time is used for evaluation. Upward and downward tracing of the maximum values can be set with **MAX UP** and **MAX DOWN**. One unit here represents 10 microseconds. This means that a value of 0 results in fastest tracing, and a value of 60000 results in slowest tracing. **See 4.5 and 4.6!**

CHANNEL MODE

CHANNEL MODE:

The SI-JET can be operated with different frontends. A differentiation is made here between a "single-channel", "dual-

channel" and "triple-channel system". The number of channels can be set with **CHANNEL MODE**.

MONO:

Only the center channel **CH_C** is available. **CH_L** and **CH_R** are set to the same value as **CH_C**.

DUO:

Only the channels **CH_L** and **CH_R** are available. **CH_C** is set to $(CH_L+CH_R)/2$.

TRIO:

All three channels **CH_L**, **CH_C** and **CH_R** are available.

EXTEACH

EXTERN TEACH:

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

No. TEACH TABLE							
	D	DTO	S1	S1TO	S2	S2TO	▲
0	1	100	1	20	1	20	
1	1	200	1	40	1	40	
2	1	300	1	60	1	60	
3	1	400	1	80	1	80	
4	1	1	1	1	1	1	
5	1	1	1	1	1	1	

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

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

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

ATTENTION!

When the **EXTERN TEACH** mode is activated, external triggering with **EXT1** and **EXT2** is not possible, because the sensor only has one input.

The **TRIGGER** function field will no longer be active.

TRIGGER



TRIGGER:

This function field serves for setting the trigger mode at the SI-JET sensor.

If **TRIGGER** is not **CONT**, the **TRIG** LED shows a trigger event.

CONT:

Continuous gloss value detection (no trigger event required).

EXT1:

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

EXT2:

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

PLEASE NOTE!

External teaching is not possible when the **TRIGGER** mode is activated, because the sensor only has one input. The **EXTEACH** function field will be inactive.

POWER (pm) 100

POWER:

In this function field the intensity of the transmitter unit can be adjusted by using the slider or by entering a value in the edit box. A value of 1000 means full intensity at the transmitter

unit, a value of 0 stands for the lowest transmitter intensity adjustment!

AVERAGE

AVERAGE:

This function field is used for adjusting the number of scanning values (measurement values) over which the raw signals measured at the receivers are averaged. A higher

AVERAGE default value reduces noise of the raw signals at the receiver unit and there will be a decrease of the maximal available switching frequency of the SI-JET spray jet sensor.

MAXVEC-No.

MAXVEC-No.:

This function field serves for setting the number of spray states to be checked.

In **BINARY** mode the maximum number of spray states to be checked is 31. In **DIRECT HI** or **DIRECT LO** mode the maximum number of spray states to be checked is 5 (No. 0,1,2,3,4). The numerical value set here determines the currently possible scanning rate of the sensor. The less the spray states to be checked, the faster the operation of the SI-JET spray jet sensor.

The numerical value set here refers to the number of rows (starting with row 0) in the → **TEACH TABLE**.

OUTMODE

OUTMODE:

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

BINARY:

If in this row-by-row comparison the current spray state corresponds with the teach-in parameters entered in the **TEACH TABLE**, this "hit" in the **TEACH TABLE** is displayed as a vector number (**V-No.**) and is sent to the digital outputs (OUT0 ... OUT4) as a **bit pattern**.

The maximum number of spray states to be taught is 31.

DIRECT:

In this mode the maximum number of spray states to be taught is 5.

If in this row-by-row comparison the current parameters correspond with the teach-in parameters entered in the **TEACH TABLE**, this "hit" in the **TEACH TABLE** is displayed as a vector number (**V-No.**) and is sent **directly** to the digital outputs (OUT0 ... OUT4).

DIRECT HI:

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

DIRECT LO:

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

INTLIM

INTLIM:

This edit box is used for setting an intensity limit. Evaluation is stopped, if the current intensity $INT=(CH_L+CH_C+CH_R)/3$ arriving at the receiver unit falls below this limit, and **ERROR STATE (V-No.: =255)** is output.

HOLD [0-100ms]

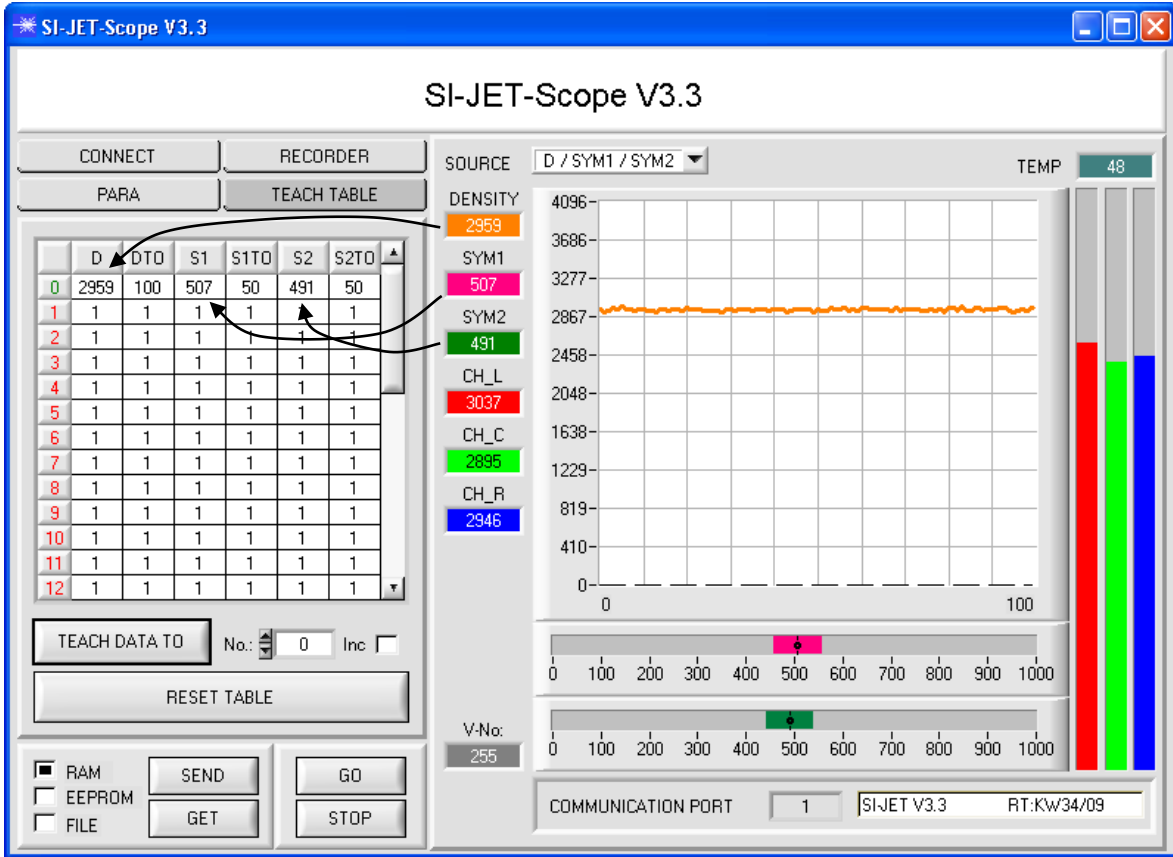
HOLD:

The SI-JET sensor operates with minimum scanning times in the magnitude of less than 150µs. This is why most of the PLCs that are connected to the digital outputs OUT0 ... OUT4

have difficulties with the safe detection of the resulting short switching state changes. For the digital outputs of the SI-JET sensor pulse lengthening of up to 100 ms can be set by selecting the corresponding **HOLD** value.

4.3 Tab TEACH TABLE

Pressing the GO button starts the data transfer from the sensor to the PC. The respective **CH_L**, **CH_C** and **CH_R** components are indicated in the bars beside the graph. The calculated **DENSITY**, **SYM1** and **SYM2** values are visualised in the displays.



DENSITY	0	Current calculated density
SYM1	0	Current calculated symmetry 1
SYM2	0	Current calculated symmetry 2
CH_L	0	Current value of channel left
CH_C	0	Current value of channel centre
CH_R	0	Current value of channel right
MAX_CHL	0	Maximum value of channel left
MAX_CHC	0	Maximum value of channel centre
MAX_CHR	0	Maximum value of channel right

V-No.:
 255
V-No.:
 This numerical value output field displays the currently detected vector number in accordance with the entry in the **TEACH TABLE**. The currently detected vector number is sent to the digital outputs OUT0 ... OUT4 as a corresponding bit pattern.
 A double click on this display opens a larger display of the vector number.

Please note: The above-mentioned 5 output fields are only updated when data transfer between PC and SI-JET sensor is active (GO button pressed).

CONNECT		RECORDER	
PARA		TEACH TABLE	

	D	DTO	S1	S1TO	S2	S2TO
0	3335	100	447	50	464	50
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	1	1	1	1	1	1
4	1	1	1	1	1	1
5	1	1	1	1	1	1
6	1	1	1	1	1	1
7	1	1	1	1	1	1
8	1	1	1	1	1	1
9	1	1	1	1	1	1
10	1	1	1	1	1	1
11	1	1	1	1	1	1
12	1	1	1	1	1	1

RESET TABLE
No.: Inc

TEACH DATA TO

<input checked="" type="checkbox"/> RAM	SEND	GO
<input type="checkbox"/> EEPROM	GET	STOP
<input type="checkbox"/> FILE		

TEACH TABLE:

A click on the **TEACH TABLE** 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-in vectors are arranged side by side in the respective row.

The sensor is able to check up to 31 teach-in vectors. The number of the respective teach-in 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**, and **SYM2** are transferred to the row in the **TEACH TABLE** that is selected under **No.:**

A **DENSITY** tolerance (**DTO**), a **SYM1** tolerance (**S1TO**), and a **SYM2** tolerance (**S2TO**) also are set. If necessary, these tolerances, as well as the teach values, can be changed as described above.

No.: also is used to select which **SYM1** or **SYM2** tolerance window is shown in the respective graphs for the Symmetrie1 or for Symmetrie2.

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

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

4.4 Tab RECORDER

The SI-JET-Scope software features a data recorder that allows the saving of **CH_L**, **CH_C**, **CH_R**, **DENSITY**, **SYM1**, **SYM2**, **V-No**: and **TEMP**. The recorded file is saved to the hard disk of the PC and can then be evaluated with a spreadsheet program.

The file that is created has ten columns and as many rows as data frames were recorded.

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

Please note:

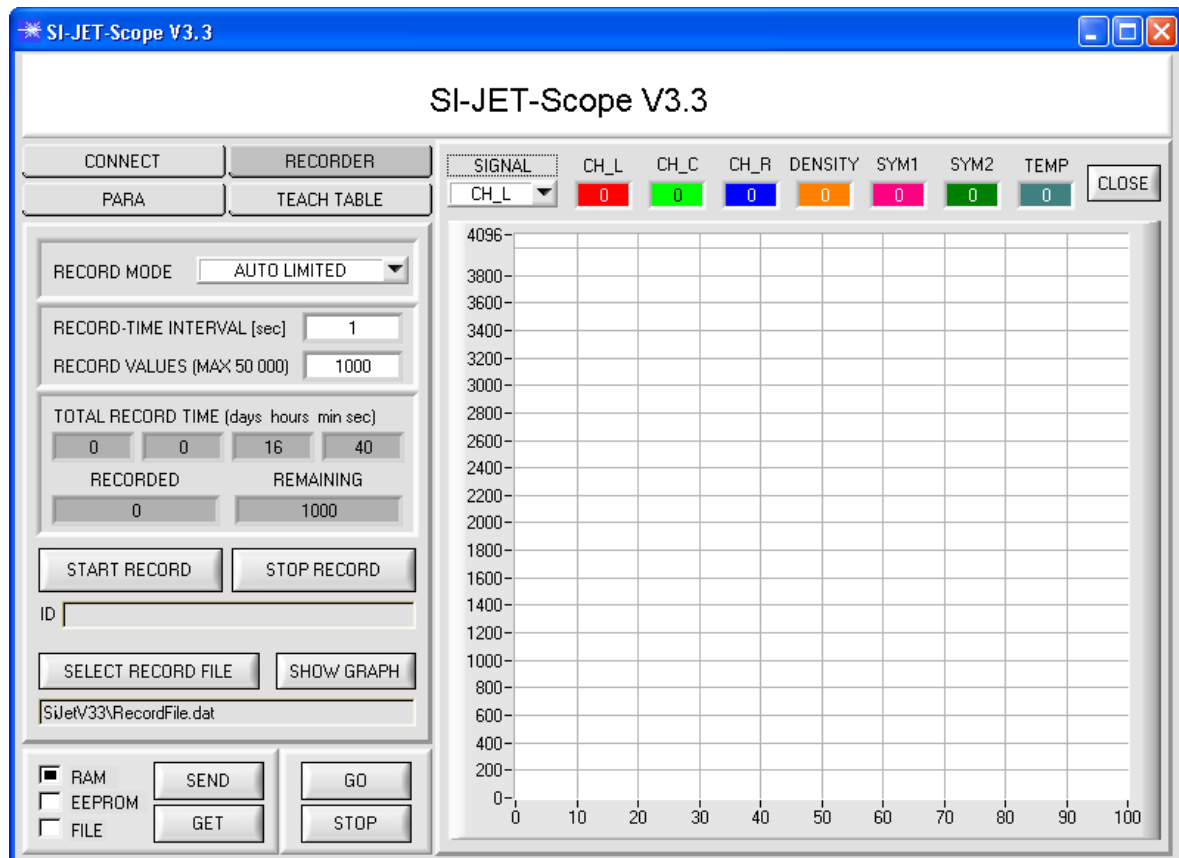
Recording depends on the **EVALUATION MODE** that is chosen. Several **EVALUATION MODES** do not need certain data, therefore these data will be set to 0, i.e. for these data the value 0 will be recorded.

Step 1:

When the **RECORDER** button is pressed, the following window will be displayed:

When the **SHOW GRAPH** button is pressed, a panel will be displayed that allows the user to monitor the different signals.

The individual signals can be activated from the **SIGNAL** drop-down menu.



Step 2:

If you want to automatically record several data frames, please select **AUTO LIMITED** under **RECORD MORE**.

Enter a time interval for recording under **RECORD-TIME INTERVAL [sec]**, in this example: 1, i.e. a new value is called from the sensor every second).

Then enter the maximum number of values you wish to record in the **RECORD VALUES [MAX 50 000]** field.

Please note: Recording can also be stopped earlier by clicking **STOP RECORD**, the data recorded so far will not be lost.

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

Step 3:

By pressing the button **SELECT RECORD FILE** a file can be selected in which the data frame will be stored.

If you select an already existing file name, you will be asked whether you want to overwrite the existing file or not.

Step 4:

Pressing the **START RECORD** button starts automatic data recording.

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

In the two display fields **RECORDED** and **REMAINING** you can check how many data frames have been recorded, and how many frames remain to be recorded.

Please note:

During recording the two input fields **RECORD-TIME INTERVAL** and **RECORD VALUES [MAX 50 000]** are inactive.

Step 5:

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

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

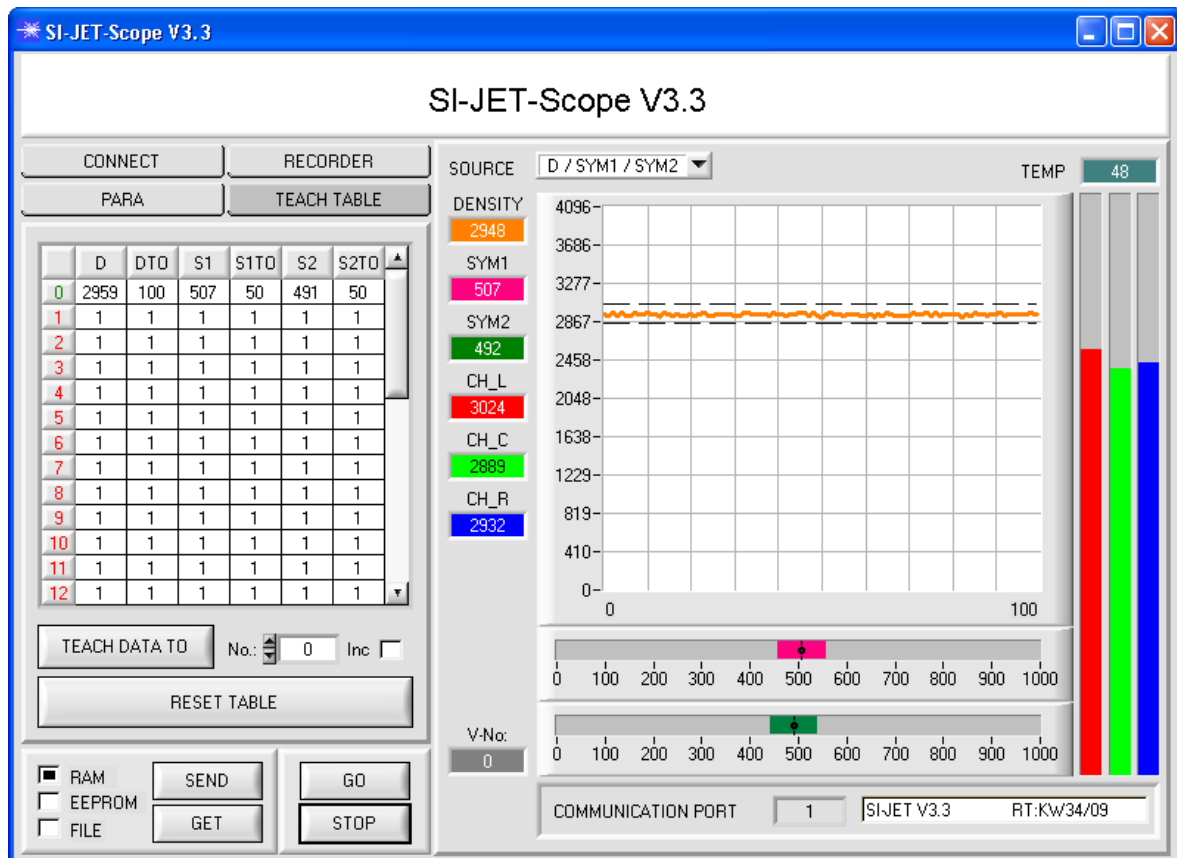
If you want to record data "manually", select the **MANUAL RECORDING** function under **RECORD MORE**. You can start reading data from the sensor by pressing the **GO** button. These data are visualised in the display window. Pressing the **CAPTURE DATA FRAME** button saves a data frame in the file that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

If **AUTO TRIGGERED** is selected under **RECORD MORE**, and **TRIGGER = EXT1** or **EXT2** 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.

4.5 EVALUATION MODE ABSOLUTE



In **EVALUATION MODE ABSOLUTE** all three channels **CH_L**, **CH_C**, and **CH_R** are used for calculating **density**, **symmetry 1**, and **symmetry 2**:

$$DENSITY = \frac{CH_L + CH_C + CH_R}{3} \quad SYM1 = \frac{CH_L}{CH_L + CH_R} * 1000$$

$$SYM2 = \frac{CH_C}{CH_C + \frac{CH_L + CH_R}{2}} * 1000$$

The current values for **DENSITY**, **SYM1**, and **SYM2** are shown in displays on the PC user interface. **CH_L**, **CH_C**, and **CH_R** in addition are visualised in the form of bars at the right side of the graph. **SOURCE** is used to select the signal that should be visualised in the graph.

For teaching, the tab **TEACH TABLE** must be pressed.

When **TEACH TABLE** has been pressed, the setting parameters will disappear and the **TEACH TABLE** will be displayed. The sensor can be taught a total of 31 TEACH vectors.

CONNECT RECORDER
 PARA TEACH TABLE

	D	DTO	S1	S1TO	S2	S2TO
0	2945	100	504	50	492	50
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	1	1	1	1	1	1
4	1	1	1	1	1	1
5	1	1	1	1	1	1
6	1	1	1	1	1	1
7	1	1	1	1	1	1
8	1	1	1	1	1	1
9	1	1	1	1	1	1
10	1	1	1	1	1	1
11	1	1	1	1	1	1
12	1	1	1	1	1	1

TEACH DATA TO No.: 0 Inc

RESET TABLE

RAM SEND GO
 EEPROM GET STOP
 FILE

SOURCE
 DENSITY 2945
 SYM1 504
 SYM2 492
 CH_L 3004
 CH_C 2887
 CH_R 2946

V-No: 0

When the GO button is pressed, the **DENSITY**, **SYM1**, and **SYM2** data that are currently calculated in the sensor are shown on the PC user interface.

When the **TEACH DATA TO** button is pressed, the data are written to the line in the **TEACH TABLE** that is selected under **No.:**.

DTO is used for setting a plus/minus tolerance for the taught density. The value can be changed by the user. For this purpose, the corresponding cell in the **TEACH TABLE** must be selected either with a double-click or with function key F2.

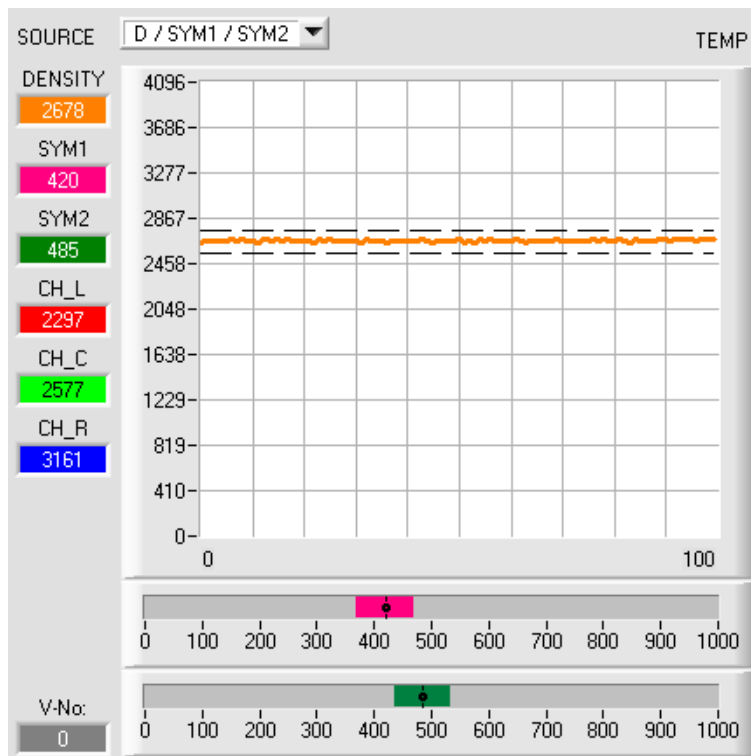
The higher the value of **DTO**, the more insensitive the sensor will be.

S1TO and **S2TO** are used for setting a plus/minus tolerance for the taught **symmetry1** and **symmetry2**.

Once a vector has been taught, the information is transferred to the sensor by pressing the **SEND** button.

In order to check whether the sensor has adopted the teach vector, the **GO** button must be pressed again.

The currently detected line is displayed under **V-No.:**

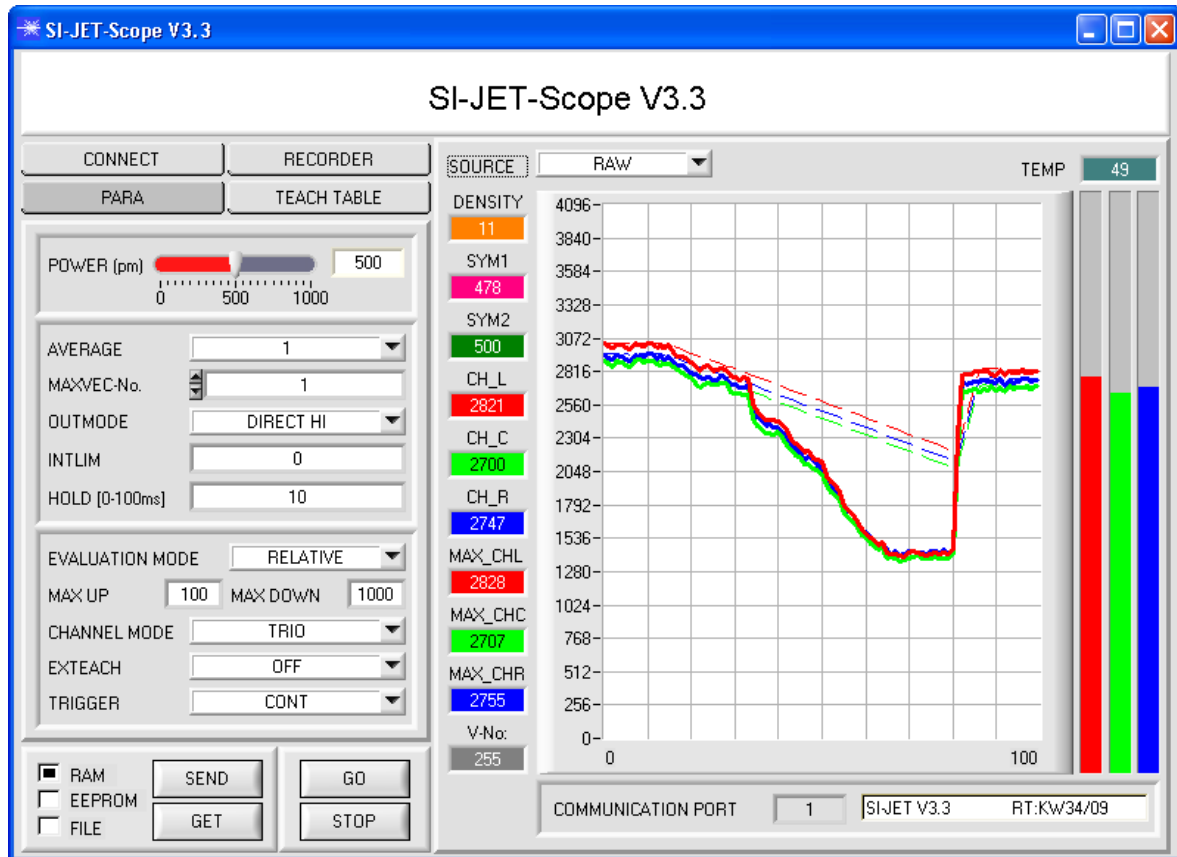


When **D / SYM1 / SYM2** is selected under **SOURCE**, the currently determined values for **density**, **symmetry 1**, and **symmetry 2** as well as the tolerance windows that were selected under **No.:** are displayed.

Please note!

The value range for density is 0 ... 4096.
 The value range for **SYM1** and **SYM2** is 0 ... 1000.

4.6 EVALUATION MODE RELATIVE



In **EVALUATION MODE RELATIVE** all three channels **CH_L**, **CH_C**, and **CH_R** (red, green, and blue line) are normalised to their respective current maximum values (red, green, and blue dashed line).

The speed of maximum value tracing can be set with the two parameters **MAX UP** for upward tracing and **MAX DOWN** for downward tracing. **MAX UP** and **MAX DOWN** have a value range of 0 to 60000, with one unit representing 10 microseconds.

A value of 0 therefore means very fast tracing, whereas a value of 60000 results in very slowly tracing.

The normalised values are used to determine **density**, **symmetry1** and **symmetry2**. The advantage of this evaluation mode is that with normalising to the respective maximum value possible dirtying of the sensor is compensated to a large extent. Fast upward tracing and slow downward tracing should be selected for this purpose.

Tracing is paused when the sensor detects a taught vector (0...31).

Please note that in this evaluation mode the sensor must be allowed a certain time in which it can trace the maximum values. This time depends on the values that are set for **MAX UP** and **MAX DOWN**.

The evaluation of **DENSITY**, **SYM1** and **SYM2** is performed as in evaluation mode **ABSOLUTE**, but calculation is made with the following formulas.

$$CHL_N = 4096 - \frac{CH_L}{MAX_CHL} * 4096 \quad CHC_N = 4096 - \frac{CH_C}{MAX_CHC} * 4096 \quad CHR_N = 4096 - \frac{CH_R}{MAX_CHR} * 4096$$

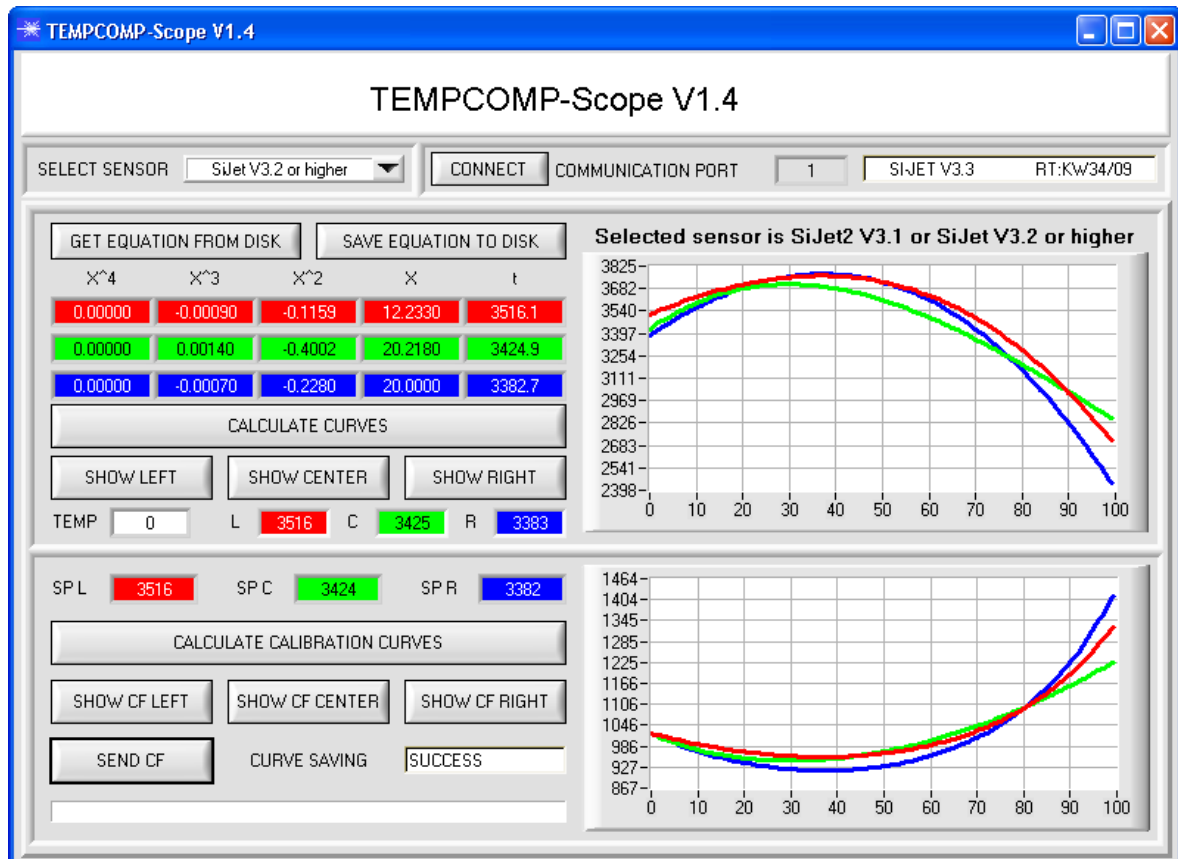
$$DENSITY = CHC_N \quad SYM1 = \frac{CHL_N}{CHL_N + CHR_N} * 1000$$

$$SYM2 = \frac{CHC_N}{CHC_N + \frac{CHL_N + CHR_N}{2}} * 1000$$

5. Operation of the TEMPCOMP-Scope Software

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

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



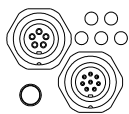
- Step 1: Load the temperature compensation file that you have received from your supplier with **GET EQUATION FROM DISK**.
- Step 2: Press **CALCULATE CURVES** to display the data in the graph. The buttons **SHOW LEFT**, **SHOW CENTER**, and **SHOW RIGHT** show the individual curves.
- Step 3: Select the sensor-internal operating temperature (not in °C) that the sensor has at an ambient temperature of 20°. The value should be included in the file designation.
- Step 4: Press **CALCULATE CALIBRATION CURVES** to calculate the mean straight line. The buttons **SHOW CF LEFT**, **SHOW CF CENTER**, **SHOW CF RIGHT** again show the individual curves.
- Step 5: Pressing the **SEND CF** button saves the mean straight lines in the EEPROM of the sensor.
- Step 6: Temperature compensation is successfully finished if the **SUCCESS** status message is then displayed.

Comment!

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

6. Function of the LED display

LED display:



BINARY

The line vector is visualised by way of 5 yellow LEDs at the housing of the SI-JET sensor. At the same time in the binary mode (OUTMODE BINARY) the line vector indicated on the LED display is output as 5-bit binary information at the digital outputs OUT0 to OUT4 of the 8-pole SI-JET/PLC female connector.

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

○ ○	● ○	○ ●	● ●	○ ○	● ○
○ ○ ○	○ ○ ○	○ ○ ○	○ ○ ○	● ○ ○	● ○ ○
0	1	2	3	4	5
○ ●	● ●	○ ○	● ○	○ ●	● ●
● ○ ○	● ○ ○	○ ● ○	○ ● ○	○ ● ○	○ ● ○
6	7	8	9	10	11
○ ○	● ○	○ ●	● ●	○ ○	● ○
● ● ○	● ● ○	● ● ○	● ● ○	○ ○ ●	○ ○ ●
12	13	14	15	16	17
○ ●	● ●	○ ○	● ○	○ ●	● ●
○ ○ ●	○ ○ ●	● ○ ●	● ○ ●	● ○ ●	● ○ ●
18	19	20	21	22	23
○ ○	● ○	○ ●	● ●	○ ○	● ○
○ ● ●	○ ● ●	○ ● ●	○ ● ●	● ● ●	● ● ●
24	25	26	27	28	29
○ ●	● ●				
● ● ●	● ● ●				
30	31				

Error or not detected

SI-JET-Scope V3.3 (KW 34/2009)
20.08.2009

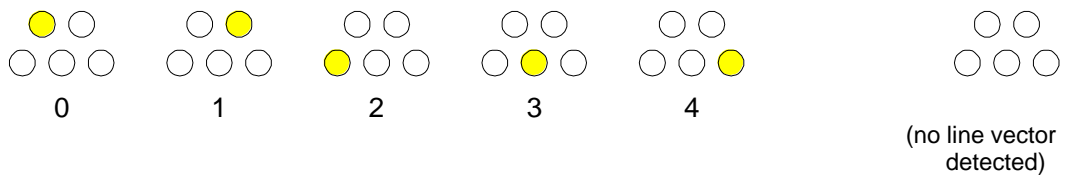
21

DIRECT

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

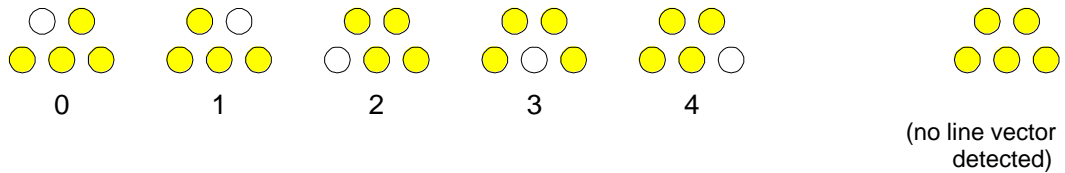
DIRECT HI:

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



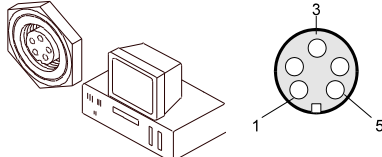
DIRECT LO:

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

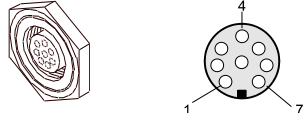


7. Connector assignment of the SI-JET system

Connection of SI-JET to PC:

5-pole fem. connector (type Binder 712) SI-JET/PC-RS232		
Pin No.:		Assignment:
1		0V (GND)
2		TxD
3		RxD
4		Not connected
5		Not connected

Connection of SI-JET to PLC:

8-pole fem. connector (type Binder 712) SI-JET/SPS		
Pin No.:	Color:	Assignment:
1	white	0V (GND)
2	brown	+12VDC .. +30VDC
3	green	IN0
4	yellow	OUT0 (Digital 0: Type 0 ... 1V, Digital 1: Type +Ub – 10%)
5	grey	OUT1 (Digital 0: Type 0 ... 1V, Digital 1: Type +Ub – 10%)
6	pink	OUT2 (Digital 0: Type 0 ... 1V, Digital 1: Type +Ub – 10%)
7	blue	OUT3 (Digital 0: Type 0 ... 1V, Digital 1: Type +Ub – 10%)
8	red	OUT4 (Digital 0: Type 0 ... 1V, Digital 1: Type +Ub – 10%)

8. RS232 communication protocol

RS232 communication protocol PC ↔ SI-JET Sensor (SI-JET-Scope V3.3)
<ul style="list-style-type: none"> - Standard RS232 serial interface without hardware-handshake - 3-wire: GND, TX0, RX0 - Speed: 19200 baud factory setting, can be changed (example 190) to 9600, 19200, 38400, 57600, 115200 <p>8 data-bits, no parity-bit, 1 stop-bit in binary mode, us (unsigned), MSB (most significant byte) first.</p> <p>The control device (PC or PLC) has to send a data frame of 18 words to the Sensor. All bytes must be transmitted in binary format (us, MSB). The meaning of the parameters is described in the software manual. Info: 1 word = 2 bytes</p> <p><u>Method:</u> The hardware is permanently reading (polling) the incoming byte at the RS232 connection. If the incoming word is 0x0055 (synch-word), then the 2. word (order-word) is read in, after this, 16 words (parameters) will be read. After reading in the completely data frame, the Sensor executes the order which is coded at the 2. word (order-word).</p>

Format of the data frame:			
Word No.	Format	Meaning	Comment:
1	Word	sync-word = 0x0055	hex-code 0x0055, binary: 0000 0000 0101 0101, synchronisation word
2	Word	ORDER NUMBER	order word
3	Word	POWER	LED intensity (0 ... 1000) Attention intensity in thousandth!
4	Word	CHANNEL MODE	Channel mode MONO, DUO or TRIO coded to (0,1,2)
5	Word	AVERAGE	Signal averaging 1,2,4,8,16,32,64,128,256,512,1024,2048,4096,8192,16384 or 32768
6	Word	EVALUATION MODE	Evaluation mode ABSOLUTE or RELATIVE coded to (0,1)
7	Word	HOLD[ms]	Hold time 0,1,2,3,5,10,50 or 100ms coded to (0,1,2,3,5,10,50 or 100)
8	Word	INTLIM	Lower intensity limit (0 ... 4095)
9	Word	MAXVEC-No.	Number of the vectors (1,2,3,...,31)
10	Word	OUTMODE	Function of the digital output (0=direct/HI, 1=binary, 2=direct/LO)
11	Word	TRIGGER	Trigger mode CONT, EXT1, EXT2 (0,1,2)
12	Word	EXTERN TEACH	Extern Teach OFF or ON coded to (0,1)
13	Word	MAX UP	For maximum value tracing up (0 ... 60000)
14	Word	MAX DOWN	For maximum value tracing down (0 ... 60000)
15-18	Word	Free	Must be sent as dummy (e.g. 6 value 0)

Value	ORDER NUMBER	(parameter byte no. 2)
0	nop	no operation
1	Save parameter from PC into RAM	Cf. Example 1
2	Save one selectable row of TEACH TABLE into RAM	Cf. Example 2
3	Send parameter from RAM to PC	Cf. Example 3
4	Send one selectable Row of TEACH TABLE from RAM to PC	Cf. Example 4
5	Send data from RAM to PC	Cf. Example 5
6	Save parameter from RAM to EEPROM	Cf. Example 6
7	Send connection OK to PC	Cf. Example 7
8	Load Parameter from EEPROM to RAM	Cf. Example 8
20	Send line ok = 0x0055, 0x0014, 0x00AA, 11 Dummies to PC	Cf. Example 20
190	Change baud rate	CF.Example190

Example 1: DATA FRAME with ORDER NUMBER = 1:

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

DATA FRAME PC → SI JET (18 WORDS)

0x0055	SYNC.-WORD
1	ORDER-WORD
200	POWER
2	CHANNEL MODE
1024	AVERAGE
0	EVALUATION MODE
10	HOLD[ms]
10	INTLIM
5	MAXVEC-No.
0	OUTMODE
0	TRIGGER
0	EXTER TEACH
100	MAX UP
10000	MAX DOWN
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY

DATA FRAME SI JET → PC (18 WORDS)

0x00AA	SYNC.-WORD
1	ORDER-WORD
200	POWER
2	CHANNEL MODE
1024	AVERAGE
0	EVALUATION MODE
10	HOLD[ms]
10	INTLIM
5	MAXVEC-No.
0	OUTMODE
0	TRIGGER
0	EXTER TEACH
100	MAX UP
10000	MAX DOWN
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY

Example 2: DATA FRAME with ORDER NUMBER = 2:

ORDER NUMBER (second word = 2): **WRITE one selectable row (vector) of TEACH TABLE into RAM of the SI JET!**

The completely data frame = 18 words must be sent to the SI JET hardware in binary form (sync-word / order-word / ROW-NO / 4 parameter words = vector, 11 dummies).

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

DATA FRAME PC → SI JET (18 WORDS)

0x0055	SYNC-WORD
2	ORDER-WORD
0	ROW-No. (0...30)
2000	D
100	DTO
500	S1
30	S1TO
400	S2
25	S2TO
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY

DATA FRAME SI JET → PC (18 WORDS)

0x00AA	SYNC-WORD
2	ORDER-WORD
0	ROW-No. (0...30)
2000	D
100	DTO
500	S1
30	S1TO
400	S2
25	S2TO
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY

Example 3: DATA FRAME with ORDER NUMBER = 3:

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

DATA FRAME PC → SI JET (18 WORDS)
DATA FRAME SI JET → PC (18 WORDS)

0x00AA	SYNC-WORD
3	ORDER-WORD
200	POWER
2	CHANNEL MODE
1024	AVERAGE
0	EVALUATION MODE
10	HOLD[ms]
10	INTLIM
5	MAXVEC-No.
0	OUTMODE
0	TRIGGER
0	EXTER TEACH
100	MAX UP
10000	MAX DOWN
0	DUMMY
0	DUMMY
0	DUMMY
0	DUMMY

Example 4: DATA FRAME with ORDER NUMBER = 4:

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

DATA FRAME PC → SI JET (18 WORDS)
DATA FRAME SI JET → PC (18 WORDS)

0x00AA	SYNC-WORD
4	ORDER-WORD
0	ROW-No. (0...30)
2000	D
100	DTO
500	S1
30	S1TO
400	S2
25	S2TO
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY
1	DUMMY

Example 5: DATA FRAME with ORDER NUMBER = 5:

ORDER NUMBER (second word = 5): READ SI JET RAW DATA

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

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

ORDER NUMBER = 19 is similar. but if TRIGGER = 1 or 2 only triggered values are transmitted.

DATA FRAME PC → SI JET (18 WORDS)

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

DATA FRAME SI JET → PC (18 WORDS)

0x00AA
5
CH_L
CH_C
CH_R
DENSITY
SYM1
SYM2
V-No:
TEMP
MAX_CHL
MAX_CHC
MAX_CHR
DUMMY
DUMMY
DUMMY
DUMMY
DUMMY

Example 6: DATA FRAME with ORDER NUMBER = 6:

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

DATA FRAME PC → SI JET (18 WORDS)

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

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

ATTENTION: The right parameters and teach vectors must be in the RAM of the sensor. To save the parameters and teach vectors into RAM see **Example1** and **Example2**.

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

DATA FRAME SI JET → PC (18 WORDS)

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

Example 8: DATA FRAME with ORDER NUMBER = 8:

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

DATA FRAME PC → SI JET (18 WORDS)

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

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

ATTENTION: The EEPROM parameters must be load first to the RAM to read it from the sensor. To get the parameters and teach vectors from RAM see **Example3** and **Example4**.

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

DATA FRAME SI JET → PC (18 WORDS)

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

Example 7: DATA FRAME with ORDER NUMBER = 7:

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

Example 20: DATA FRAME with ORDER NUMBER = 20:

ORDER NUMBER (second word = 20): SEND LINE OK from the SI JET to PC!
Cf. example 1:
Send the same DATA FRAME but with ORDER NUMBER 20 to the sensor.
The sensor will reply with the same 18 words but with SYNC-WORD=0x00AA which tell that there is a connection.

Example 190: DATA FRAME with ORDER NUMBER = 190:

ORDER NUMBER (second word = 190): Write new baud rate to sensor.

Attention! New baud rate is only in the RAM. To store the new baud rate to EEPROM refer to example 6.

baud rate is coded to:

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

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

DATA FRAME PC → Sensor (18 WORDS)

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

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

0x00AA	SYNC.-WORD
190	ORDER-WORD
3	new baud rate 57600 Bit/s
0	DUMMY
0	DUMMY
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FROM now the sensor works with the new baud rate