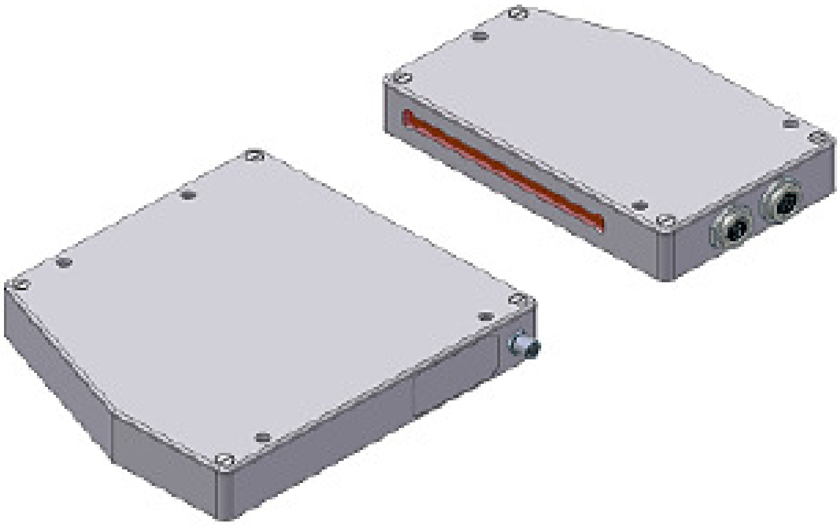
Manual

Software OZLS-Scope V3.24

(PC software for Microsoft® Windows7, Vista, XP, 2000, 98)

for laser line sensor OZLS-75-EM1 (engineering-model 1)



Schönbuch Electronic GmbH   Am Anger 8   D-82237 Wörthsee
Phone: ++49 (0)8153 90 888 0 - Fax: ++49 (0)8153 90 888 49
Email: info@schoenbuch-electronic.de - Internet: www.schoenbuch-electronic.de

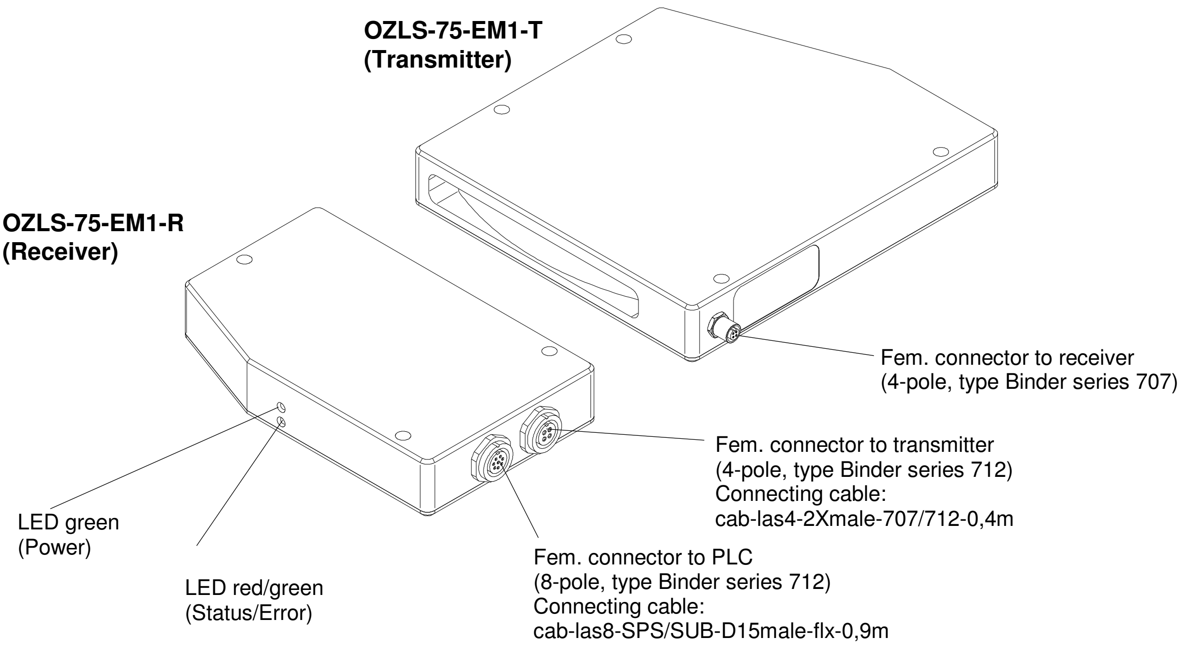
0 Contents

1 Functional principle: *OZLS-75-EM1* sensor system

1.1 Technical description

The *OZLS-75-EM1* sensor system is a transmitted-light laser measurement system comprising a laser transmitter and a CCD line control unit. At the transmitter of the *OZLS-75-EM1* the laser beam of a laser diode (λ=670nm, 1mW output power, laser class 2) through suitable collimators and apertures is emitted from the transmitter optics unit as parallel laser light with homogeneous light distribution in the form of a laser line. In the receiver optics unit this laser line impinges on a CCD line receiver. This CCD line comprises many closely adjacent individual receiver elements (pixels) that are arranged in a line. The light quantity of each of these receiver elements that is collected during the integration time can be separately read out as an analog voltage and, after performing analog-digital conversion, can be stored in a data field as a digital value.

When there is a non-transparent measuring object in the laser line, the parallel laser light only illuminates those receiver elements (pixels) of the line that lie outside the shadow zone of the measuring object. As a result the pixels within the shadow zone give off a considerably lower analog voltage compared to the illuminated pixels. By way of suitable software algorithms the areas of the shadow zones can be determined from the previously stored data field. Since the distance of the pixels on the CCD line is known, the size and position of the measuring object can therefore be determined. The micro-controller of the *OZLS-75-EM1* sensor can be parameterized through the serial RS-232 interface by means of a Windows PC software. The sensor can be set to operate with different evaluation modes. Switching states are visualized by means of 2 two-color LEDs (green/red) that are integrated in the housing of the *OZLS-75-EM1* sensor. The *OZLS-75-EM1* sensor has two digital outputs (OUT0, OUT1), the output polarity of which can be set with the software. One digital input (IN0, IN1) makes it possible to realize an external TRIGGER functionality through a PLC. In addition the control unit features an analog output (0 ... 10V) with 12-bit digital/analog resolution for monitoring purposes.



2 Installation of the *OZLS-Scope* software

Hardware requirements for successful installation of the *OZLS-Scope* software:

- 800 MHz Pentium-compatible processor or better.
- CD-ROM or DVD-ROM drive
- Approx. 10 MByte of free hard disk space
- SVGA graphics card with at least 800x600 pixel resolution and 256 colors or better.
- Windows 98, Windows NT4.0, Windows XP, Windows Vista, or Windows7 operating system
- Free serial RS-232 interface or USB port with USB-RS/232 adaptor at the PC

Please install the *OZLS-Scope* software as described below:

1.


Insert the installation CD-ROM in your CD-ROM drive. In our example we suppose that this is drive "D".

2.

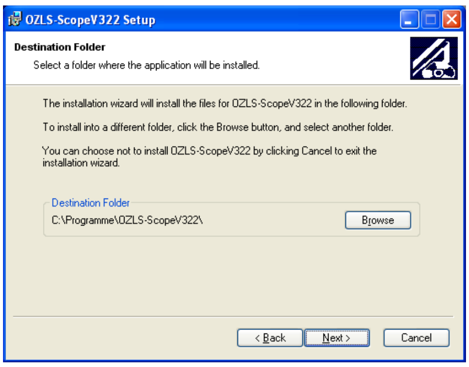

Start the Windows Explorer and in the folder tree of your CD-ROM drive go to the installation folder D:\Install\ .
Then start the installation program by double-clicking on the SETUP.EXE symbol.

As an alternative, software installation can also be started by clicking on **START-Run...** and then entering "D:\Install\setup.exe", which must be confirmed by pressing the **OK** button.

The installation program then displays a dialog box for *OZLS-Scope* installation.
This dialog box shows some general information about installation.

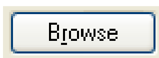
Click on Next> to start the installation

or on Cancel to quit the installation of the OZLS-*Scope* software

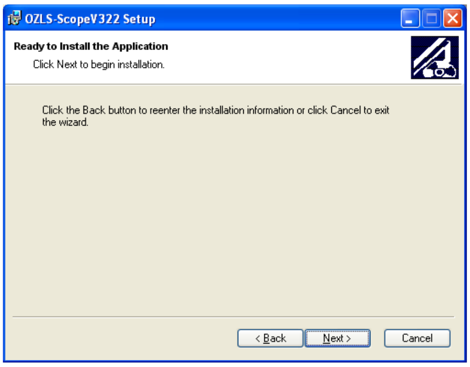
3.


When you click on the Next> button, a new dialog appears for selecting the folder where the application will be installed (destination folder).

You may accept the suggested folder with Next>, or you may change the installation folder as desired by clicking on the Browse button.



4.



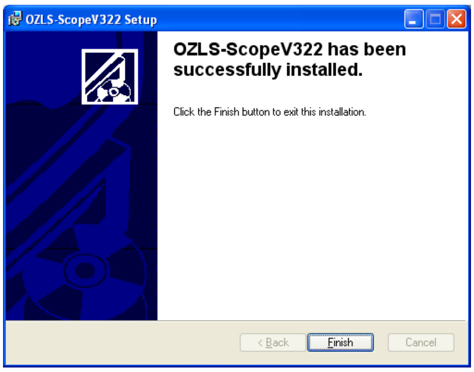
Another *OZLS-Scope* Setup dialog will be displayed.

Click on the Back button if you want to change the installation folder again.

Click on Next>> to start the installation,
or

click on Cancel to quit the installation process.

5.



When installation is completed, a dialog box informs you about successful installation.

A new *OZLS-Scope* program group has been created under Start-All-Programs.

Click on the Finish button to finish the installation.

The *OZLS-Scope* software can now be started by clicking on the respective icon in the newly created program group under:

Start >All Programs > OZLS-ScopeV3.24

Deinstallation of the OZLS-Scope software:

Please use the Windows deinstallation tool to remove the software.

The Windows deinstallation tool can be found under

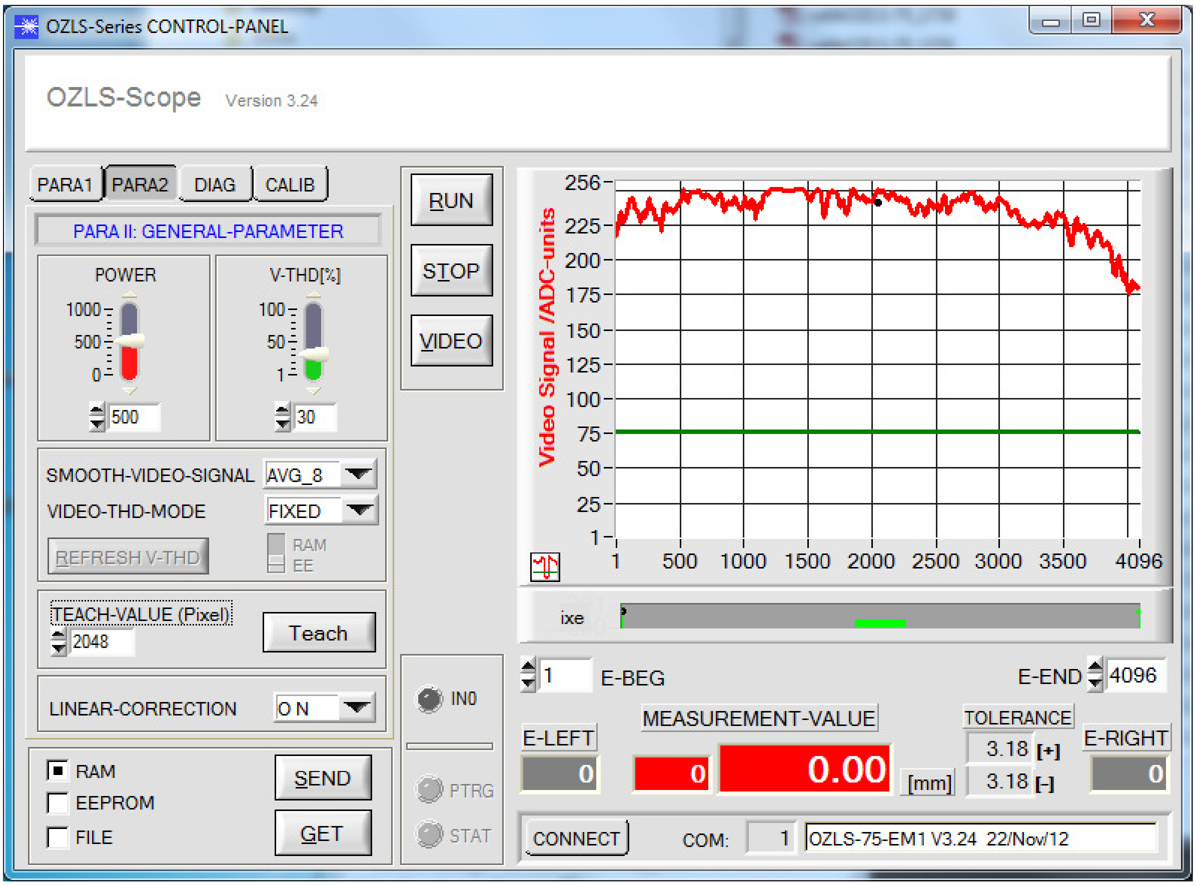
Start / Settings / Control Panel.

3 Operation of the *OZLS-Scope* software

The *OZLS-Scope* software is used for parameterizing the electronic control unit used for controlling the *OZLS-75-EM1* sensor. The measured values provided by the sensor can be visualized with the PC software, which means that the software among others can be used for adjustment purposes and for setting suitable tolerance limits for the inspection of the measuring object.

Data exchange between the PC user interface and the sensor system is effected through a standard RS-232 interface. When parameterization is finished, the setting values can be permanently saved in an EEPROM memory of the *OZLS-75-EM1* sensor. The sensor system then continues to operate in "STAND-ALONE" mode without the PC.

When the *OZLS-Scope* software is started, the following Windows® user interface will be displayed:

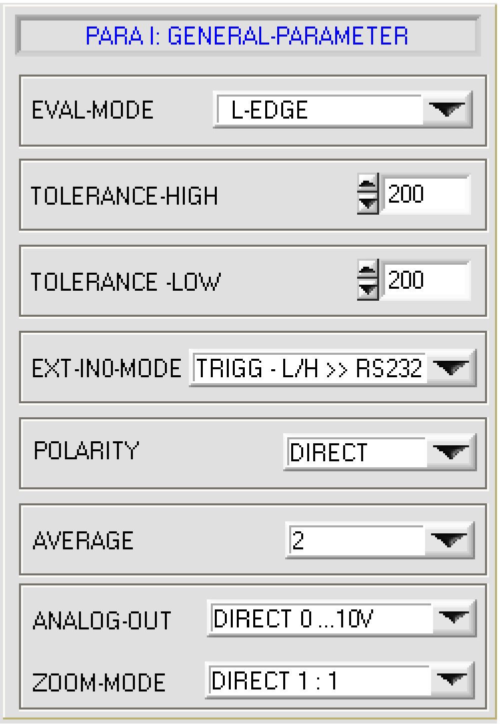


The *OZLS-Scope* CONTROL PANEL provides a great variety of functions:

- Visualization of measurement data in numeric and graphic output fields.
- Setting of the laser power for the laser transmitter.
- Setting of the polarity of the digital switching outputs OUT0 and OUT1.
- Selection of a suitable evaluation mode.
- Presetting of setpoint value and tolerance band.
- Saving of parameters to the RAM, EEPROM memory of the control unit, or to a configuration file on the hard disk of the PC.

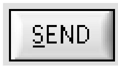
The following chapters provide explanations of the individual control elements of the *OZLS-Scope* software.

3.1 Control elements of the *OZLS-Scope* software:

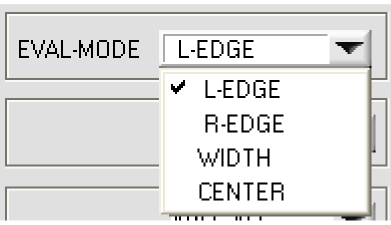


A click on the PARA1 button opens the PARAMETER I (PARA I) window, where various general parameters at the control unit can be set.

Attention !



Changes that are made in the function fields described below only become active at the control unit of the *OZLS-75-EM1* sensor after a click on the SEND button!



EVAL-MODE:

This list selection field serves for setting the evaluation mode at the *OZLS-75-EM1* sensor. Depending on the evaluation mode that is currently set, the edges created from the video signal (intensity profile) of the CCD line will be assessed differently.

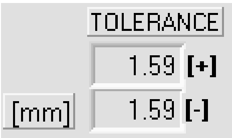
L-EDGE:
The 1st edge (left edge) of the CCD line's intensity profile is used as measurement value (search from the left).
R-EDGE:
The 2nd edge (right edge) of the CCD line's intensity profile is used as measurement value (search from the right).
WIDTH:
The difference between the second and the first edge is used as measurement value: WIDTH = R-EDGE - L-EDGE
CENTER:
The mean value of the first edge and the second edge is used as measurement value: CENTER = (L-EDGE+R-EDGE)/2

E-BEG:

Numeric input field for setting the evaluation beginning. The CCD line will be evaluated starting from the pixel that is entered here (evaluation-begin). (Default value = 1)

E-END:

Numeric input field for setting the evaluation end. The CCD line will be evaluated up to this pixel. Pixels lying further to the right than the pixel value set here will not be evaluated.



TOLERANCE-HIGH, -LOW:

In these input fields an upper and lower tolerance value for the tolerance window can be set by entering a numerical value or by clicking on the arrows. The tolerance window is applied symmetrically around the setpoint value (TEACH-VALUE) and is framed by the upper and lower tolerance threshold.
The tolerance values that are currently set at the sensor are shown in two numeric display fields below the graphic display area in [mm].

Example, in combination with the SLOPE-VALUE (sensitivity):

$$TOL[+]\ [mm] = SLOPE * TOLERANCE\_HIGH$$

*Here: TOL [mm] = 15.875[µm/Pixel]*100 Pixel =1.59 mm*

$$TOL[-]\ [mm] = SLOPE * TOLERANCE\_LOW$$

*Here: TOL [mm] = 15.875[µm/Pixel]*200 Pixel =1.59 mm*

EXT-IN0-MODE:

This list selection field can be used to set the operating mode of the external trigger input (IN0/pin3/green, 8-pol. PLC socket) at the *OZLS-75-EM1* sensor.

TRIGG L/H >> RS-232:
External edge-controlled (LOW/HIGH) triggering of measurement value output through the serial RS-232 interface.

FREE USE:
Setting fields currently not used.

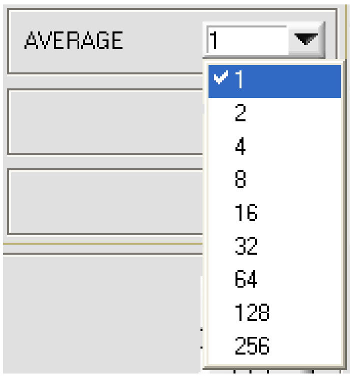
NOT USED:
Deactivates the external trigger function.

POLARITY:

In this function field the output polarity at the *OZLS-75-EM1* sensor can be set with a mouse-click on the selection field or by clicking on the arrow. The *OZLS-75-EM1* sensor has two digital outputs (OUT0, OUT1) through which error states can be sent to the PLC.

DIRECT:
In case of an error, the respective digital output is set to +Ub (+24VDC), [red LED] on.

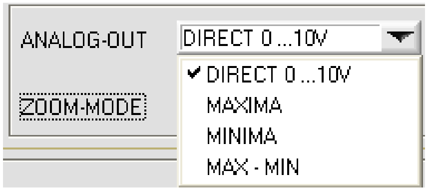
INVERSE:
In case of an error, the respective digital output is set to the reference potential (GND/0V), [red LED] on.



AVERAGE:

In this function field the averaging at the *OZLS-75-EM1* sensor can be selected with a mouse-click on the respective list item. With every cycle of the main program the current measurement value is stored in a ring memory field, and then the average of these values in the ring memory field is calculated.

The average of the ring memory field is used as the MEASUREMENT_VALUE. With the AVERAGE value the size of the ring memory can be set from 1 to 256.



ANALOG-OUT (Analog-Output-Mode):

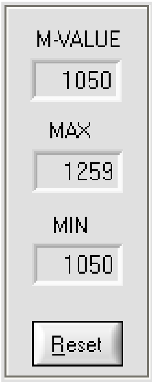
Function element for selecting the output mode of the analog voltage at the *OZLS-75-EM1* sensor (pin8/red 8-pole PLC/POWER female connector). The analog voltage is output in the range from 0 to 10V with a resolution of 12 bit.

DIRECT 0..10V :
A voltage (0 ... 10V) that is proportional to the current measurement value is provided at the analog output pin8/red.

MAXIMA:
The current maximum value is provided at the analog output pin8/red/ (drag pointer principle, resetting by input IN1/pin4/yellow pulse of <750ms length).

MINIMA:
The current minimum value is provided at the analog output pin8/red (drag pointer principle, resetting by input IN1/pin4/yellow pulse of <750ms length).

MAX-MIN:
The current difference between maximum and minimum value is provided at the analog output pin8/red/ (drag pointer principle, resetting by input IN1/pin4/yellow pulse of <750ms length).



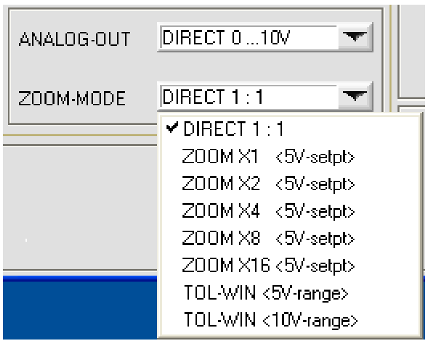
Reset button (Maximum-Minimum values):

These display elements only appear after the selection and activation of one of the three operating modes MAXIMA, MINIMA or MAXMIN in the ANALOG-OUT function field.

A click on the RESET button resets the current maximum and minimum values that are detected by the *OZLS-75-EM1* sensor. The numeric display fields show the respective current maximum and minimum value.

Resetting of the maximum and minimum values also can be triggered by a short pulse (duration t < 750 ms) at digital input IN1/yellow/pin4 from the PLC.

Please note:
This RESET function does not perform a hardware/software reset at the *OZLS-75-EM1* sensor, it only resets the maximum and minimum values!



ZOOM-MODE (Analog-Output):

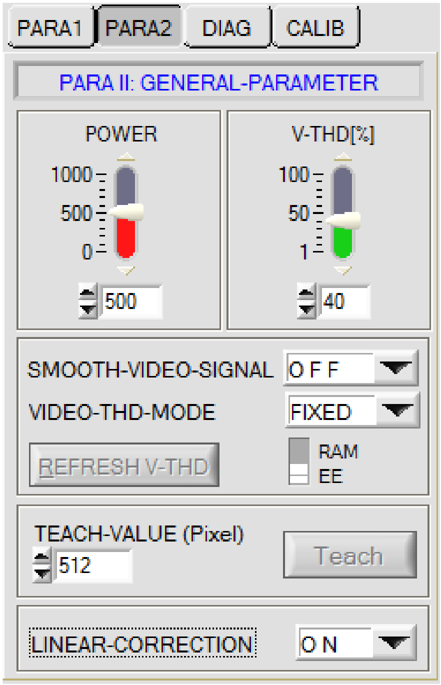
Function element for setting various zoom modes at the analog output of the *OZLS-75-EM1* sensor.

DIRECT 1:1:
The full measuring range of the sensor is provided at the analog output pin8/red/ as a 0 to 10V voltage swing.

ZOOM X1, ZOOM X2 ... ZOOM X16:
The difference between the current measurement value (pixels) and the teach position (teach value in pixels) is provided at the analog output pin8/red/. At the teach position a value of 5V is provided at the analog output. If the current measurement value is lower than the teach position, a value < 5V is output, if the current measurement value is higher than the teach value, a value > 5V is output. The deviation from the 5V teach position can be amplified with a zoom factor of X2 to X16.

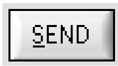
TOL-WIN <5V-range>:
A voltage swing of 5V over the current tolerance window is provided at the analog output pin8/red/. At the lower tolerance limit the voltage value is 2.5V, at the upper tolerance limit 7.5V. A voltage of 5V is provided at the teach position.

TOL-WIN <10V-range>:
A voltage swing of 10V over the current tolerance window is provided at the analog output pin8/red/. A voltage of 5V is provided at the teach position, at the lower tolerance limit the voltage at the analog output is 0V, at the upper tolerance limit 10V.

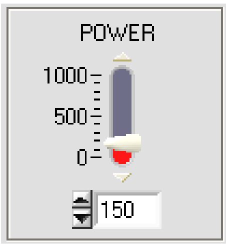


A click on the PARA2 button opens the PARAMETER II (PARA II) window, where additional parameters at the control unit can be set.

Attention !

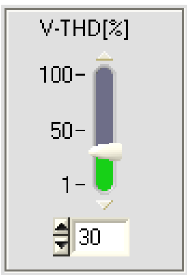


Changes that are made in the function fields described below only become active at the control unit of the *OZLS-75-EM1* sensor after a click on the SEND button!

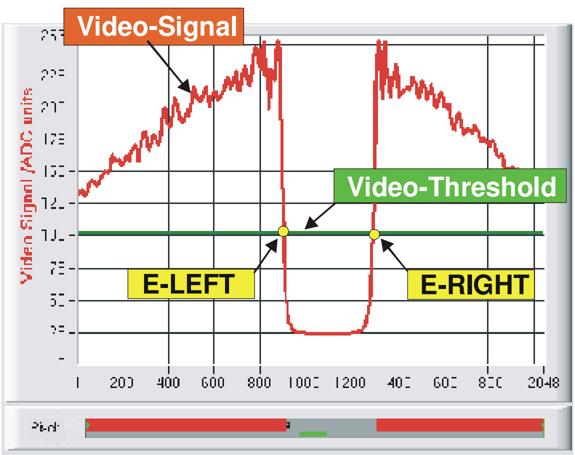


POWER:

In this function field the laser power at the laser transmitter unit of the *OZLS-75-EM1* sensor can be set by using the arrows or the slider, or by entering a numerical value in the respective input field.



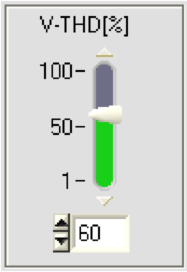
FIXED-Video Threshold



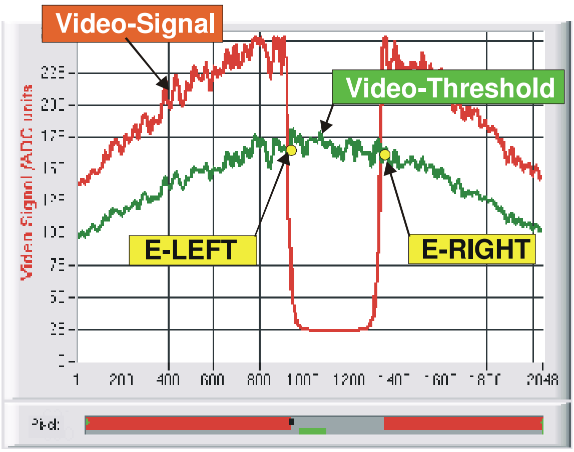
FIXED-VIDEO-THD[%]:

In this function field the video threshold at the *OZLS-75-EM1* sensor can be set by entering a numerical value or by using the slider or the arrows. With the help of this video threshold the measurement values can be derived from the intensity characteristic (video signal) of the CCD line from the bright/dark transitions. For this purpose the intersection points between the intensity profile (red curve) and the adjustable video threshold (green horizontal line) are calculated and stored.

The x-value of the respective intersection point is assigned to a pixel on the CCD line. The measurement value can be calculated from this information and from the known distances of the pixels on the CCD line. The intersection points between intensity profile and video threshold that are provided by this method are hereinafter referred to as edges.



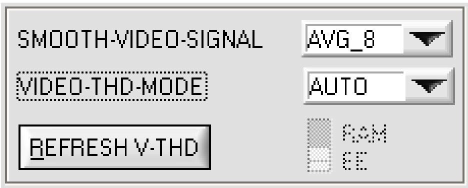
AUTO-Video Threshold



AUTO-VIDEO-THD[%]:

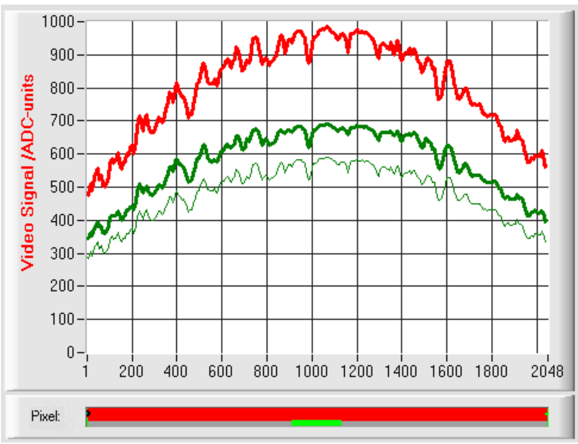
When the toggle switch is in AUTO position, the threshold that is stored in the non-volatile EEPROM of the sensor is used as video threshold.
This threshold (green curve) is not a horizontal line, but is derived from the intensity characteristic of the laser transmitter and thus "tracks" the intensity profile.

As before the measurement values are derived from the intensity characteristic of the CCD line (red curve) and the tracked video threshold (green curve). For this purpose the intersection points between intensity profile and tracked video threshold are calculated again.



VIDEO-THD-MODE AUTO:

The automatic follow-up threshold mode is activated by selecting AUTO from the VIDEO-THD-MODE drop-down list field. A click on the SEND button activates the selected setting at the sensor!



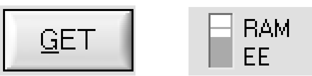
The current threshold can be changed by clicking on the arrow keys in the V-THD[%] slider.
The new video threshold first is shown as a thin green curve. This threshold (green curve) is not a horizontal line but is derived from the intensity characteristic of the laser transmitter (red curve) and thus "follows" the intensity profile. As before, the measurement values are derived from the intensity characteristic of the CCD row (red curve) and the follow-up video threshold (green curve) by calculating the intersection points between intensity profile and follow-up video threshold.

Attention!

Before the new video threshold is saved there must be no measurement object in the beam path between transmitter and receiver.

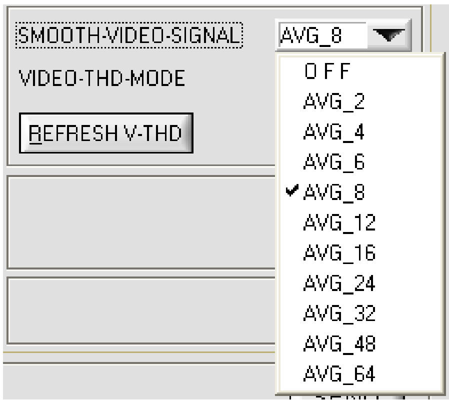
REFRESH V-THD:

Only a click on this software button saves the current intensity profile as a new video threshold to the non-volatile EEPROM of the *OZLS-75-EM1* sensor.



GET:

After a click on this software button the video threshold that is currently saved in the EEPROM will be automatically shown in the graphic display window.



SMOOTH-VIDEO-SIGNAL:

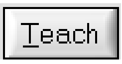
A click on the SMOOTH-VIDEO-FILTER drop-down list field opens the setting options for activating a digital software filter for the video signal characteristic. If the software filter is activated, the corresponding filtering is performed for the video signal after every new scan in the main program run.
If necessary, the video signal characteristic can be smoothed by means of digital software filtering.

OFF:
The video signal is not subjected to filtering.

AVG_2:
The video signal is subjected to a 2nd-order moving average filter. Over the full video profile two adjacent values (pixels) each are used for averaging.
• • •
AVG_64:
The video signal is subjected to a 64th-order moving average filter. For this purpose 64 adjacent values (pixels) each are used for averaging.

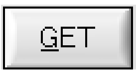
TEACH-VALUE [Pixel]:

Numeric input field for setting the current teach value (setpoint value) in pixels. The teach value that is set here only is activated at the *OZLS-75-EM1* sensor after a click on the SEND button. A tolerance window with parameters TOLERANCE-HIGH and TOLERANCE-LOW is automatically applied around the teach value that is defined here.



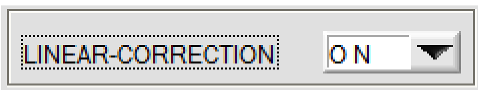
After a click on the TEACH button the current edge information is stored as a teach value to the RAM memory of the *OZLS-75-EM1* sensor. Depending on the evaluation mode that has been set (E-MODE), the left edge, the right edge, the width (WIDTH), or the center position (CENTER) will be stored as a teach value in the RAM memory of the *OZLS-75-EM1* sensor.

When the teach process is completed, the green POWER-LED at the housing of the *OZLS-75-EM1* sensor quickly blinks 3 times.



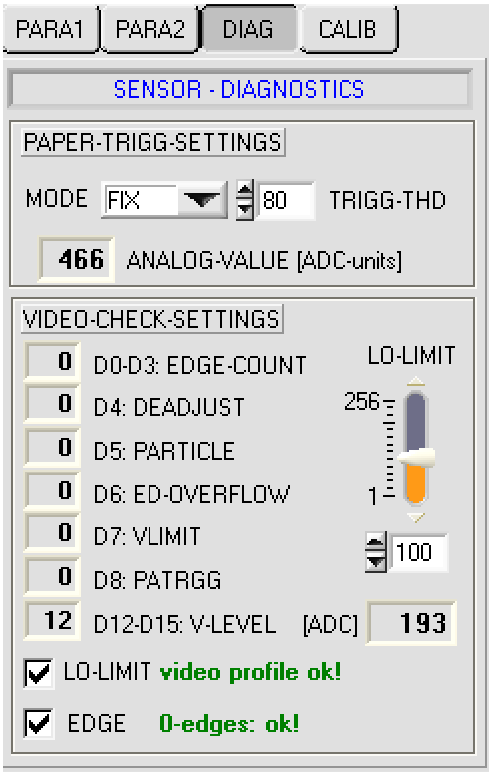
The newly taught setpoint value can be read out through the serial interface by clicking on the GET button.

The new teach value is then shown in the TEACH display field.



LINEAR-CORRECTION:

Activate/deactivate linear correction across the laser beam profile.
ON:
Use look-up table of EEPROM for the correction of the measured value. Linearity full-scale-range error is reduced.
OFF: No look-up-table correction, use 1:1 measurement values.

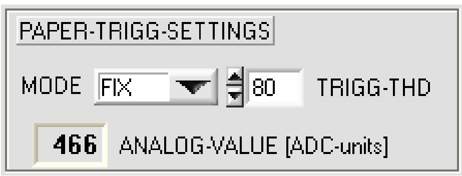


A click on the DIAG button opens the SENSOR-DIAGNOSTICS window on the user interface.
This window informs about different states (dirt-accumulation on optics, misalignment, number of edges) of the video-profile. This option is used when no paper is present! The output fields are updated during active rs-232-data-transfer.

see chap. 5 for more

VIDEO-CHECK-SETTINGS
Several numerical output fields to visualize the bit-state D0 to D15 of the 3-byte-diagnostics-frame.

D0 … D3	= EDGE-COUNT
D4	= DEADJUSTMENT-FLAG
D5	= PARTICLE-FLAG (2 edges detected, no paper)
D6	= EDGE-OVERFLOW (3 or more edges detected)
D7	= VIDEO-LIMIT-FLAG (lower-limit is crossed)
D8	= PAPER-TRIGGER-FLAG
D12-D15	= VIDEO-LEVEL in 16 steps (mean value of video profile height)



PAPER-TRIGG-SETTINGS:

The integrated paper-trigger option can be activated or deactivated at the sensor hardware.

OFF:	deactivation of the paper-trigger unit.
FIX:	fix paper-trigger-threshold-mode
AUTO:	automatic paper-trigger-threshold

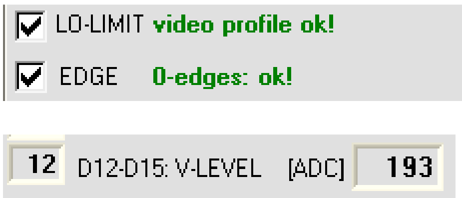
The paper-trigger sensor is integrated in the receiver housing of the *OZLS-75-EM1* sensor system. This sensor is a high-speed photodiode that is illuminated by the laser transmitter unit of the OZLS-75-EM1 transmitter. The light beam is interrupted if there is an object between transmitter and receiver. Photodiode and laser transmitter thus function as a digital transmitted-light sensor that detects the entry of objects in the beam path.
The switching output of the trigger sensor is connected to OUT0/pin6.

A trigger threshold must be preset for the trigger sensor. This trigger threshold can be set to either automatic (AUTO) or to a fixed value (FIX).

FIX: Fixed triggers threshold, the value can be preset in the numeric edit field.

AUTO: Automatic calculation of the trigger threshold = 50% of the current maximum intensity.

Current analog value that is measured at the photodiode. This analog value is digitised with a 10-bit analog/digital converter (value range 0…1023). The analog value is proportional to the impinging light quantity.

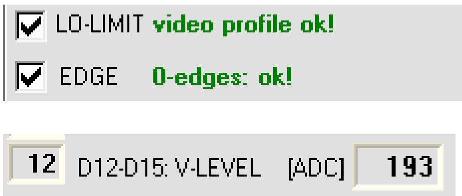


LO-LIMIT check-box:

To activate the monitoring of the check of the average-height of the video-profile. The actual height is indicated by a black cursor on the graphics output window and by the 8-bit [ADC] numerical output field.

EDGE check-box:

To activate/deactivate the monitoring of the number of edges seen by the ccd-line receiver.

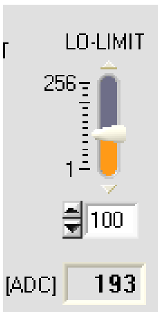


LO-LIMIT check-box:

To activate the monitoring of the check of the average-height of the video-profile. The actual height is indicated by a black cursor on the graphics output window and by the 8-bit [ADC] numerical output field.

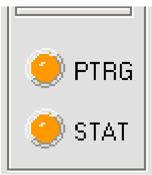
EDGE check-box:

To activate/deactivate the monitoring of the number of edges seen by the ccd-line receiver.



LO-LIMIT-SLIDER:

Slider to preset the lover limit for the video-profile monitoring (range 0 … 256 adc-units).
The actual mean-value of the video profile height is output at the display element [ADC]. Additionally a black round marker is shown in the graphics output window.



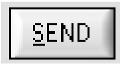
LED DIGITAL-OUTPUT:

Leds to visualize the state of the digital output OUT0 (Paper-Trigger) and OUT1 (status/diagnostics-error)

PTRIG LED indicate state of paper-trigger output OUT0/pin6
STAT: LED indicate state of diagnostics-output OUT1/pin7

PARAMETER TRANSFER:

This group of function buttons is used for transferring parameters between the PC and the *OZLS-75-EM* sensor through the serial RS-232 interface.



SEND:

When the SEND button is clicked, the parameters currently set on the user interface are transferred to the *OZLS-75-EM* sensor.
The target of data transfer is determined by the selected radio-button (RAM, EEPROM, or FILE).

GET:

When the GET button is clicked, the setting parameters are transferred from the *OZLS-75-EM* sensor to the PC and are updated on the user interface. The source of data transfer again is determined by the selected radio-button:

RAM:

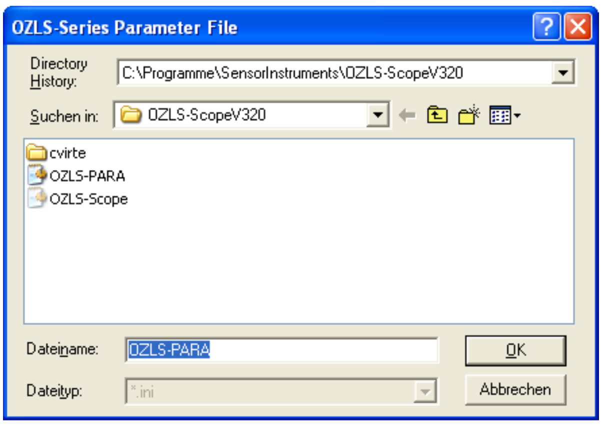
The currently set parameters are written to the volatile RAM memory of the *OZLS-75-EM* sensor, or they are read from the RAM and transferred to the PC.
Please note: The parameters set in the RAM will be lost when the power supply at the *OZLS-75-EM* sensor is turned off.

EEPROM:

The currently set parameters are written to the non-volatile EEPROM memory of the *OZLS-75-EM* sensor, or they are read from the EEPROM and transferred to the PC. Parameters that are saved in the EEPROM will not be lost when the power supply is turned off.
If parameters are read from the EEPROM of the *OZLS-75-EM1* sensor, these must be written to the RAM of the *OZLS-75-EM* sensor by selecting the RAM button and then clicking on SEND. The *OZLS-75-EM* sensor then continues to operate with the set RAM parameters.

FILE:

When the FILE radio-button is selected, a click on the SEND/GET button opens a new file dialog on the user interface. The current parameters can be written to a freely selectable file on the hard disk of the PC, or parameters can be read from such a file.

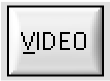


FILE-Dialog window:

The standard output file for the parameter values has the file name „OZLS-PARA.ini“.

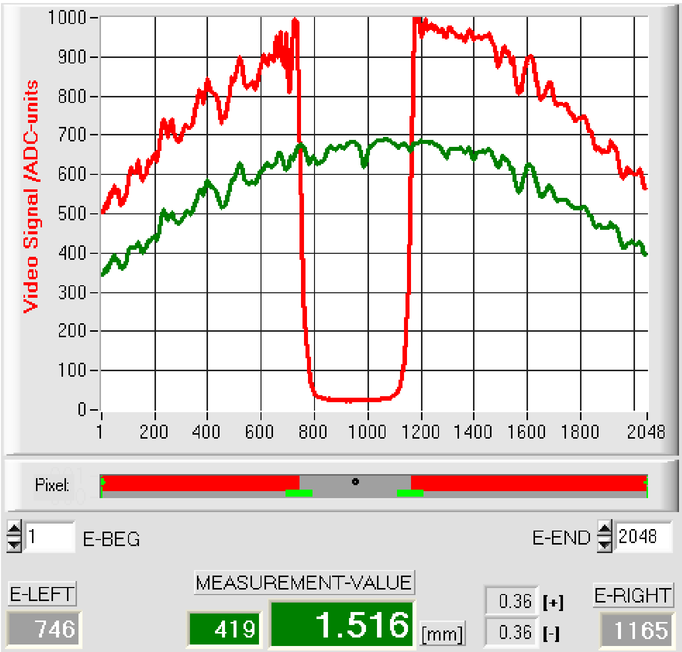
The output file can be opened e.g. with the standard Windows "Editor" program.

3.2 Numeric and graphic display elements:



VIDEO button:

After a click on the VIDEO button, the intensity profile measured at the CCD receiver is transferred to the PC and is shown as a red curve in the graphic display window.



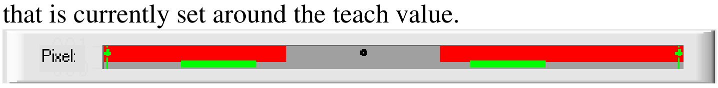
The y-axis shows the analog signals of the individual pixels. The analog values (video signals) of the CCD line are converted by means of an AD converter with 10-bit resolution, which results in a y-axis value range of 0 ... 1023.

The currently set video threshold (V-THD) is shown as a green horizontal line in the graphic display. The edge values (pixels) are derived from the intersection points of the intensity profile (red line) with the video threshold (green line).

The x-axis shows a virtual representation of the individual pixels of the CCD line
(for example: Pixel 1 .. 2048).

Because of the limited data transfer rate of the serial interface (19200 Baud/s) the graphic display window can only be updated every second.

Beneath the graphic display window there is another display element that shows the currently detected shadowed areas and the illuminated areas of the CCD line. Furthermore the currently detected edge position is indicated in this display element by way of a black circular cursor. A green horizontal bar represents the width of the tolerance band that is currently set around the teach value.

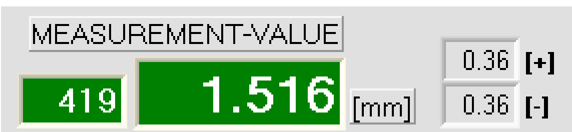


E-LEFT:

Numeric display field that shows the current left edge position.

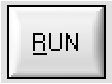
E-RIGHT:

Numeric display field that shows the current right edge position.



M-VALUE:

Numeric display field that shows the current measurement value (depending on the set evaluation mode).
The left numeric display field shows the current measurement value in pixels, whereas the right display field shows the measurement value converted into millimetres.
Besides, the upper and lower tolerance limit are displayed..



RUN button:

After a click on the RUN button, the current measurement data will be transferred from the *OZLS-75-EM1* sensor to the PC via the serial interface.

After a click on the RUN button the current measurement value is shown in the graphic display window in "scroll mode". In the form of a red curve the measurement values pass through the graphic display window from the right to the left.

The division of the y-axis corresponds with the pixels of the CCD line, or with the virtual number of sub-pixels of the line. In the graphic display the current measurement value (M-VALUE=717) is shown at the right end at the x-value of 100.

The current setpoint value (TEACH value) is shown as a broken horizontal line.

In addition, the current tolerance window is represented by two horizontal green lines that are applied symmetrically around the setpoint value.

In "RUN mode" the length of the data frame is limited to 18 words (36 bytes), which allows faster updating of the numeric and graphic display elements.

Compared to "DATA mode", data transfer through the serial RS-232 interface therefore does not take so much time (in DATA mode the intensity information for every pixel must be transferred).

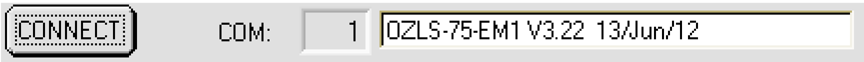
3.3 Serial RS-232 data transfer:

RS-232 COMMUNICATION:

- Standard RS-232 serial interface without hardware-handshake.
- 3-line-connection: GND, TXD, RXD.
- Speed: 19200 baud – 115200 baud, 8 data bits, no parity bit, 1 stop bit in binary mode, MSB first.

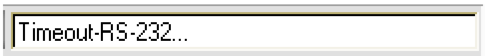
Attention !

The stable function of the RS-232 interface (status message after program start) is a basic prerequisite for data transfer between the PC and the *OZLS-75-EM1* sensor. Due to the low data transfer rate of the serial RS-232 interface (19200 bit/s) only slow changes of the analog values can be observed in the graphic display at the PC. In order to guarantee the maximum switching frequency of the *OZLS-75-EM1* sensor it is therefore necessary to stop the data exchange during the normal monitoring process (click on the STOP button).



CONNECT:

When the software is started, it attempts to establish a connection to the *OZLS-75-EM1* sensor through the standard COM1 interface. If connection could be established successfully, the current firmware version is displayed in the status line.

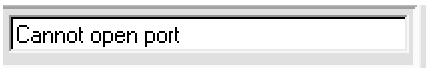


The serial connection between the PC and the *OZLS-75-EM1* sensor could not be established, or the connection is faulty.

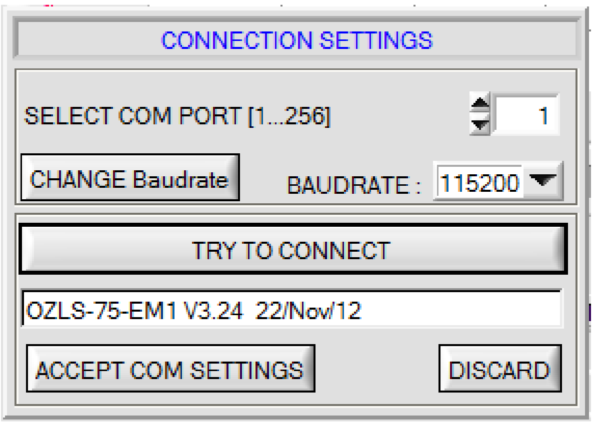
In this case it should first be checked whether the *OZLS-75-EM1* sensor is connected to the power supply, and whether the serial interface cable is correctly connected to PC and control unit.

If the number of the serial interface that is assigned at the PC should not be known, interfaces COM1 to COM9 can be selected by using the CONNECT drop-down list.

If there is an "Invalid port number" status message, the selected interface, e.g. COM2, is not available at your PC.

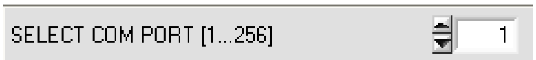


If there is a "Cannot open port" status message, the selected interface, e.g. COM2, may already be used by another device

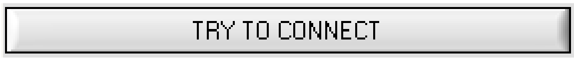


CONNECT button:

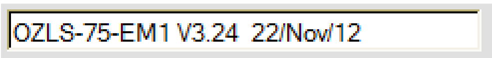
A click on the CONNECT button opens a popup window where various settings for the serial interface can be made.



For setting the current COM port number. Possible value range: 1...256.

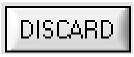


After a click on this button the software tries to establish a connection with the sensor hardware with the currently set baud rate through currently selected COM port.



If connection could be successfully established, a firmware status message is displayed in the status line.

A click on the ACCEPT COM SETTINGS button saves the current settings in the *OZLS-Scope* PC software. The popup window will then be closed.



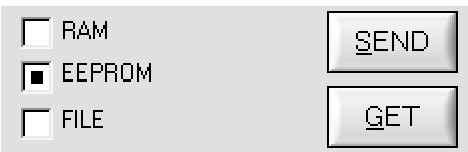
A click on the DISCARD button closes the CONNECT popup window without saving any new values. The settings for baud rate and COM port number are reset to the previous values.

Baud rate setting at the sensor: Possible setting values are 9600Baud, 19200Baud, 38400Baud, 57600Baud or 115200 Baud.

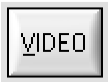
Attention !

The baud rate will only be changed at the sensor hardware when the CHANGE Baudrate button is pressed. When the baud rate change at the sensor was successful, a corresponding status message will be displayed.

The baud rate change is performed in the volatile RAM memory of the sensor. If the baud rate should be permanently stored, it must be written to the sensor's EEPROM memory. To do this, select EE and press the SEND button.

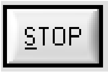


3.4 *OZLS-Scope* as an aid for sensor adjustment:



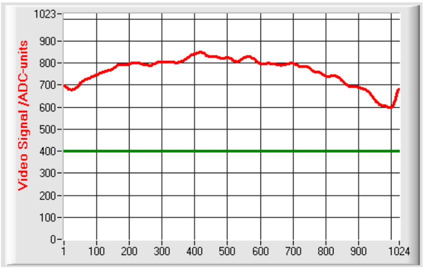
VIDEO:

After a click on the VIDEO button, the fine adjustment between the *OZLS-75*-EM1 transmitter unit and receiver unit can be observed in the graphic display window. Because of the limited data transfer rate of the RS-232 interface the display window can only be updated every second.



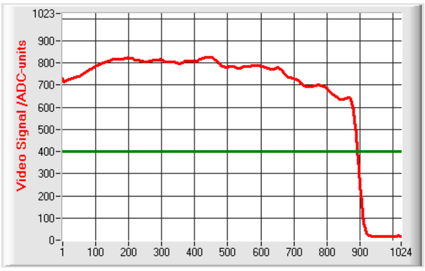
STOP:

A mouse-click on the STOP button stops the data transfer between the *OZLS-75-EM1* sensor and the PC.



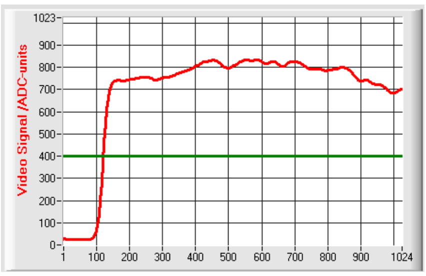
Optimal adjustment:

In the graphic display window the intensity profile is shown as a red curve. The numerical values 1 ... 1024 on the x-axis represent the individual pixels of the CCD line. The analog values of the CCD line are converted by way of an AD converter with 10-bit resolution, which results in a y-axis value range of 0 ... 1023.
As can be seen in the picture on the left, the CCD pixels 1 to 1024 are uniformly illuminated by the transmitter beam.



Wrong adjustment - right:

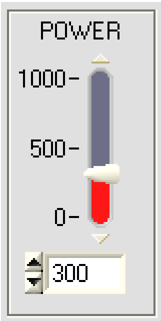
The transmitter beam no longer sufficiently illuminates the pixels at the right end of the CCD line. The red curve (intensity profile) in this part clearly is under the video threshold. The alignment of the laser transmitter unit or the CCD receiver unit must be readjusted in such a way that the pixels at the right end are illuminated again.



Wrong adjustment - left:

The transmitter beam no longer sufficiently illuminates the pixels at the left end of the CCD line. The alignment of the laser transmitter unit or the CCD receiver unit must be readjusted in such a way that the pixels at the left end are illuminated again.

3.5 *OZLS-Scope* as an aid for transmitter power adjustment:

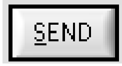


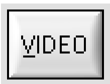
POWER:

In this field the laser power at the laser transmitter unit of the *OZLS-75-EM1* sensor can be set by using the slider or by entering a numerical value in the respective input field.

Attention !

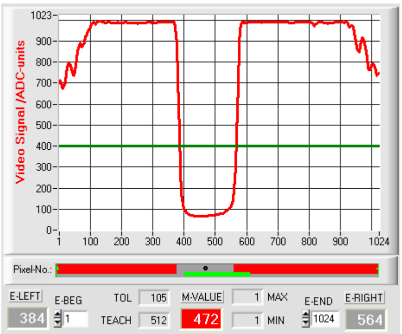
The laser power at the transmitter unit of the *OZLS-75-EM1* sensor is only updated when the SEND button is pressed.





VIDEO:

After a click on the VIDEO button, the current intensity profile is transferred from the *OZLS-75-EM1* sensor to the PC and is shown in the graphic display window. When the VIDEO function is active, the sensor's laser power can be changed (press the SEND button), and the effect of such a change can be observed in the intensity profile.



Optimal adjustment:

In the graphic display window the intensity profile is shown as a red curve. Through the complete CCD line the intensity characteristic lies above the video threshold (green line).

In the shadowed area the intensity characteristic is at low ADC values (offset <120).

In the shadowed areas the intensity characteristic does not show any sporadic "spikes".

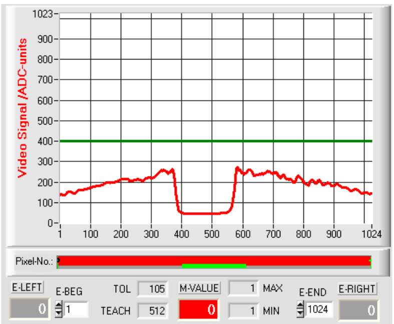
Transmitter power too high:

The transmitter beam overloads individual pixels of the CCD line. There are sporadic short upward "spikes" in the shadowed areas.

If such "spikes" intersect with the green horizontal video threshold, there will be incorrect measurements!

Remedy:

Reduce the laser power in steps, until such "spikes" in the shadowed area do not occur any more.



Transmitter power too low:

The intensity profile of the CCD line completely lies under the video threshold (green horizontal line).

The *OZLS-75-EM1* sensor does not detect any edges (bright/dark transitions, i.e. intersections between red curve and green video threshold) in the image of the beam.

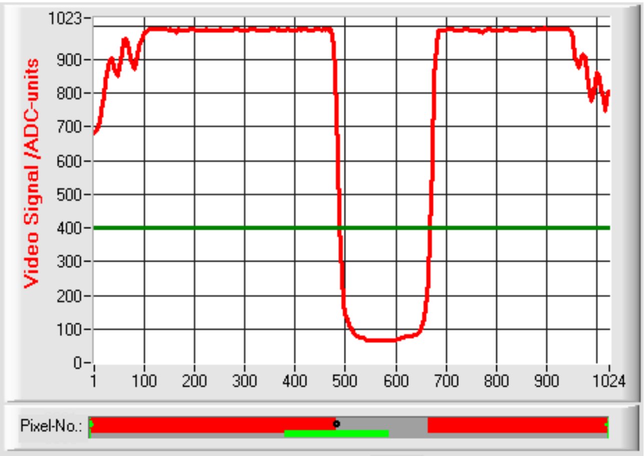
Remedy:

Increase the laser power in steps, at the same time observing the intensity characteristic, until the red curve (intensity profile) from pixel 1 to pixel 1024 lies above the video threshold.

4 Evaluation modes

4.1 LEFT-EDGE

L-EDGE:
The <u>first</u> detected edge in the intensity profile of the CCD line is evaluated.



The criterion for edge detection is the transition between illuminated and shadowed areas in the intensity characteristic of the CCD line.

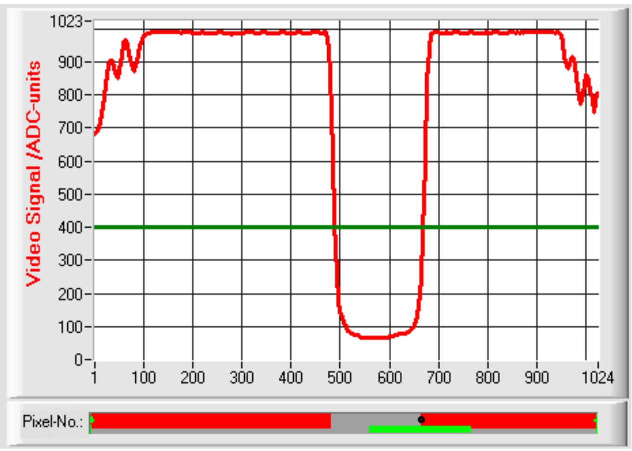
The one pixel of the CCD line at which this bright/dark transition takes place can be determined from the intersection between the video threshold (green horizontal line) and the intensity characteristic (red curve).

In the example picture on the left, the first bright/dark transition is detected at pixel no. 488.

The current measurement value M-VALUE = E-LEFT is shown in the red numeric display element.

4.2 RIGHT-EDGE

R-EDGE:
The first detected edge in the intensity profile of the CCD line is evaluated.
<u>Search direction: Right to left!</u> (high pixel values to low pixel values).



The one pixel of the CCD line at which the second bright/dark transition takes place can be determined from the intersection between the video threshold (green horizontal line) and the intensity characteristic (red curve).

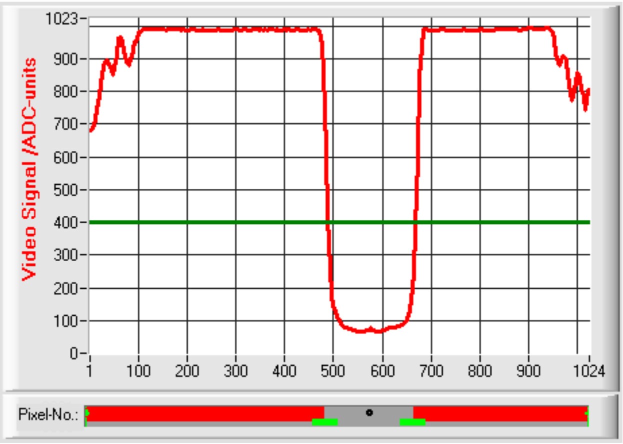
In the example picture on the left, the second bright/dark transition is detected at pixel no. 668.

The black dot-shaped curser beneath the graphic display window represents the current right edge (R-EDGE) of the shadowed area.

The current measurement value M-VALUE = E-RIGHT is shown in the red numeric display element.

4.3 WIDTH

WIDTH:
The difference between the second edge and the first edge in the intensity profile of the CCD line is evaluated.



The two pixels where the bright/dark transition occurs can be determined from the two intersections between the video threshold (green horizontal line) and the intensity characteristic (red curve).

In the example picture on the left, the second bright/dark transition is detected at pixel no. 668, and the first bright/dark transition at pixel no. 488.

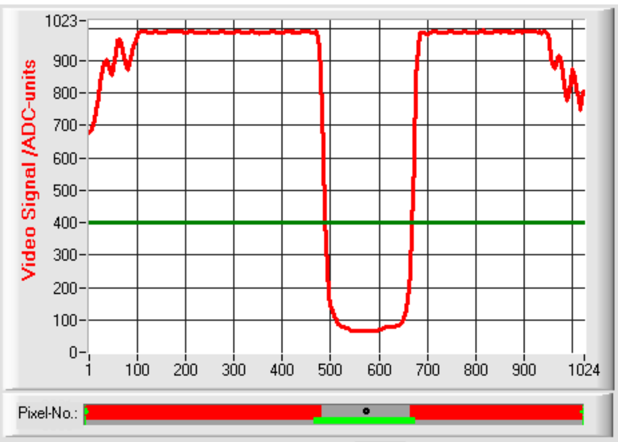
The difference is calculated as follows:

$$WIDTH = E\_RIGHT - E\_LEFT$$

The current measurement value M-VALUE = WIDTH is shown in the red numeric display element.

4.4 CENTER

CENTER:
The mean value of the first and the second edge is used as measurement value:
CENTER = (R-EDGE+L-EDGE)/2



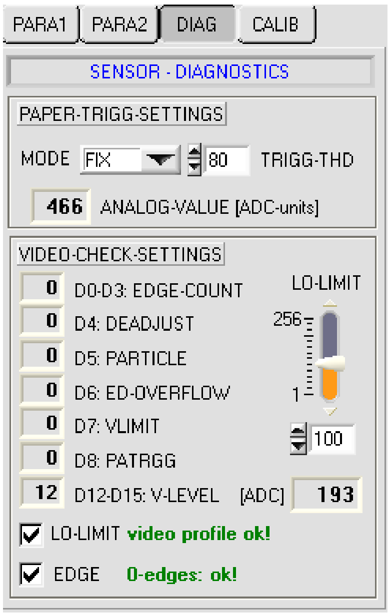
The two pixels where the bright/dark transition occurs can be determined from the two intersections between the video threshold (green horizontal line) and the intensity characteristic (red curve).
In the example picture on the left, the second bright/dark transition is detected at pixel no. 668, and the first bright/dark transition at pixel no. 488.

The mean value is calculated as follows:

$$CENTER = \frac{(E\_RIGHT + E\_LEFT)}{2}$$

The current measurement value M-VALUE = CENTER is shown in the red numeric display element.

5 Description of the sensor-diagnostics option



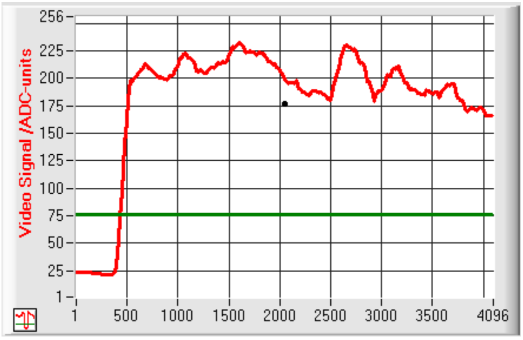
A click on the DIAG button opens the SENSOR-DIAGNOSTICS window on the user interface.

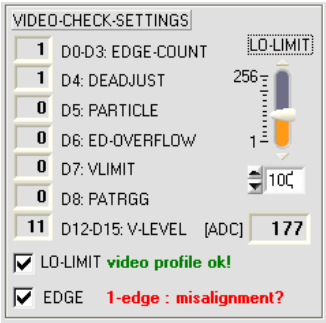
This window informs about different states (dirt-accumulation on optics, misalignment, number of edges) of the video-profile.

This option should be used when no paper is present!
The output fields are updated during active rs-232-data-transfer.

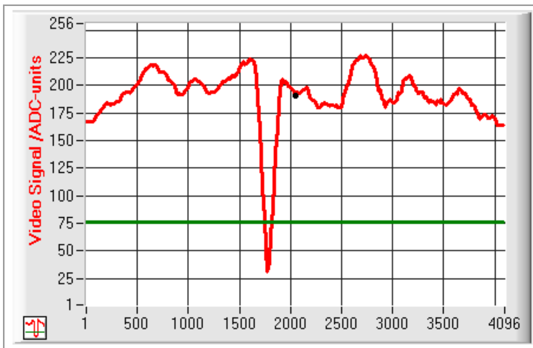
Alternatively to the OZLS-Scope PC-software the diagnostics output state can be read out from the sensor by a 3-byte-diagnostics frame via the serial rs232 interface connection.

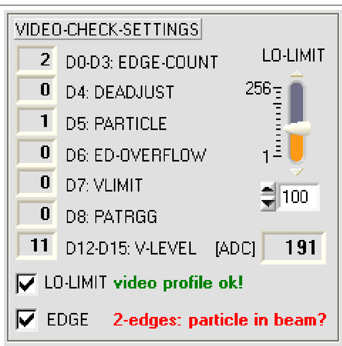
The output of the 3-byte-frame is triggered by a HIGH/LOW transition of the external IN0/pin3 trigger – input at the sensor hardware.
<u>ATTENTION:</u>
The laser-beam must be uncovered during diagnostics data-request !





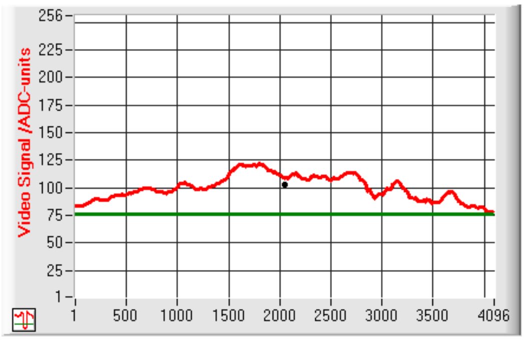
D4: DEADJUSTMENT
Receiver/Transmitter are misaligned. The region of the first pixels 1..500 are not illuminated by the laser transmitter.
One edge is found in the video-profile.
Receiver/Transmitter unit are deadjusted. The D4 bit is set in diagnosis output frame.

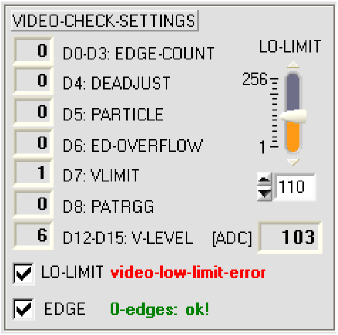




D5: PARTICLE

Two edges are detected.
Reason for this could be a particle in the light measuring section of the sensor.
The D5 bit is set in the diagnosis-output frame.





D7: VIDEL-LEVEL

The video-level-flag D7 is set because the average height of the video-profile (=103 ADC-units) falls below the video-LO-LIMIT (=110 ADC-units).

The bits D12 to D15 represents the average height of the video-profile in 16 steps (0 … 15).
15: max. video-height (=256 adc-units)
The actual average height of the video-profile is represented by a numerical output element and a black dot in the graphics window. If the actual average height of the video profile (=103 adc-units) is below the LO-LIMIT video-threshold (=110) the video-lo-limit-error is activated!

[ADC] 103

5.1 3-byte RS-232 data transfer (measurement-data)

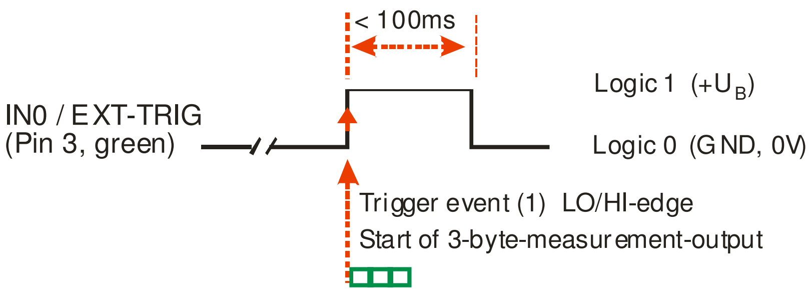
Fast data transfer of digital values (pixel values) from the *OZLS-75-EM1* sensor to the PLC can be realised by way of two RS-232-MODE (3-byte) operating modes. With a baud rate of 19200 kBit/s the transfer of a 3-byte data frame takes approx. 1.0ms, with 115.2 kBit/s data exchanged takes approx. 0.2ms.

Setting of the RS-232 interface:

- Standard RS-232 serial interface, no hardware handshake
- 3-wire-connection: GND, TXD, RXD
- Speed: 9600 baud, 19200 baud, 38400 baud, 57600 baud or 115200 baud
- 8 data-bits, NO parity-bit, 1 stop-bit, binary-mode.

Method: The 3-byte measuring-data-transfer is initiated by the trigger-input IN0=PIN3 (green) at the low/high edge transition of this input.

Short pulse on IN0 <-> 3-byte-measurement-value transfer with each LOW/HIGH-transition:
By applying a short pulse (e.g. t = 10ms … 50ms) only the measurement value is transferred after the L/H transition. (3-byte-measurement-transfer protocol).



Transmission format of 3-byte measurement-data transfer:

START	0	0	6-Bit (D5 ... D0)	STOP	START	0	1	6-Bit (D11 ... D6)	STOP	START	1	0	6-Bit(S1,S0,D15 ... D12)	STOP
L-BYTE					M-BYTE					H-BYTE				

L-BYTE	0	0	D5	D4	D3	D2	D1	D0
M-BYTE	0	1	D11	D10	D9	D8	D7	D6
H-BYTE	1	0	S1	S0	D15	D14	D13	D12

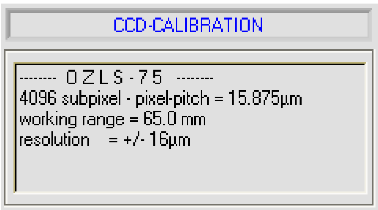
Extraction of the digital value (D0 – D15):

The first two bits are used for recognising the LOW-byte (0|0), Middle-byte (0|1) and High-byte (1|1). The High-byte also transfers two status bits (S1|S0).

Digital value DW = D0 ... D15

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

Conversion of digital value into mm – value:



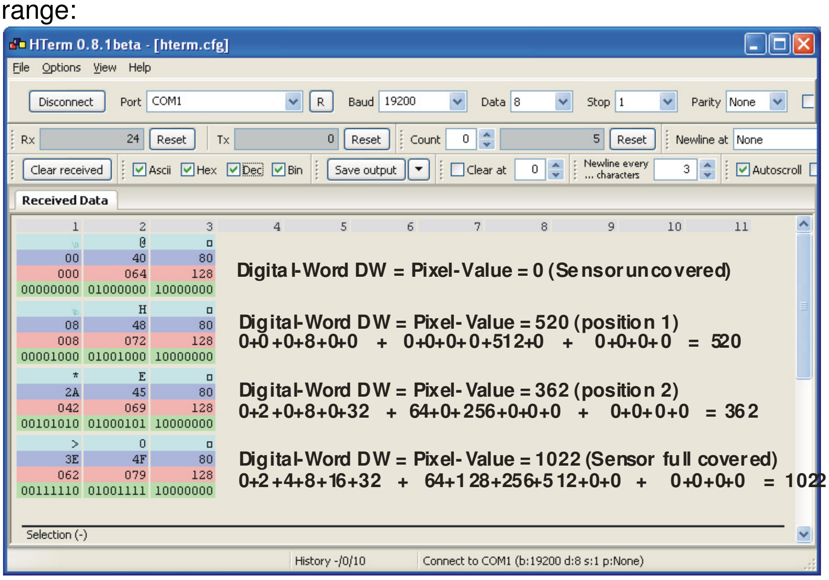
The millimetre value can be determined from the digital value and the pixel pitch. The pixel pitch is sensor-specific.

Example: *OZLS-75-EM1* with 15.875µm pixel pitch:

Measurement value [mm] = DW * 0.015875mm

Examples for the extraction of the digital value:

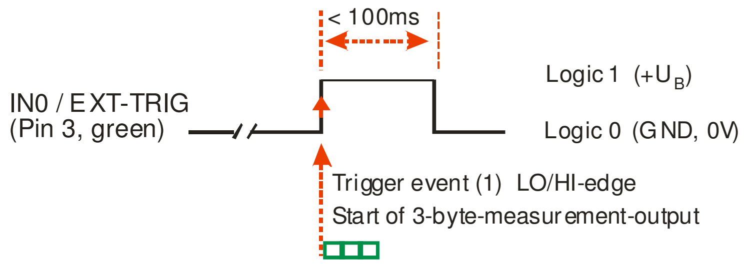
Output of a typical hyperterminal program – The object is placed at two different positions in the operating range:



5.2 3-byte RS-232 data transfer (diagnostics-data)

For the diagnosis option it is a prerequisite that the laser beam is uncovered (=free beam, no paper present). That means that the L/H IN0 transition for the 3-byte-meas-output must be initiated when the paper is present, the H/L transition must be initiated when no paper is in the light measuring section!

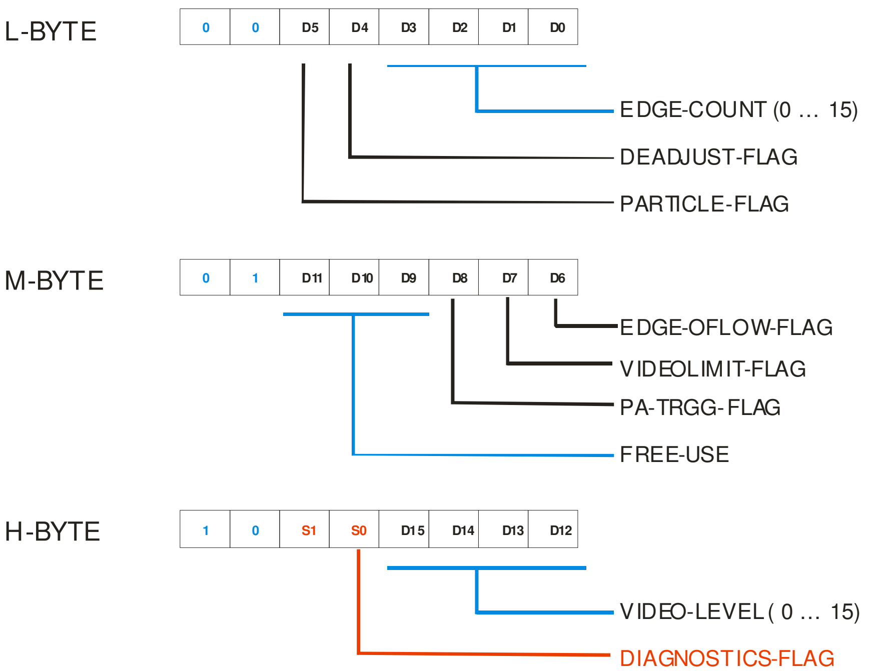
Longer pulse on IN0 <--> additionally 3-byte-diagnosis-output after HIGH/LOW- edge:
By applying a digital pulse of more than 100ms (**t >110ms** ...) duration the measurement transfer is initiated as usually by the L/H edge at IN0, with the HIGH/LOW edge transition additionally the diagnosis-frame is transmitted via the rs232 interface (must be activated in PC-software before).
Attention: When the IN0 H/L diagnosis-transition is initiated no paper should be in the laser beam!



Transmission format of 3-byte diagnostics-data transfer:

The 3-Byte Diagnosis-Data-Transfer is done similar to the 3-Byte-Measuring-Data-Transfer.
The data-frame is split to a LOW-Byte, MEDIUM-Byte and HIGH-Byte aufgeteilt.
The first two bits after the RS-232-START-Bit marking the sequence of the byte (1st byte = 0|0, 2nd byte = 0|1, 3rd byte = 1|0).

START	0	0	6-Bit (D5 ... D0)	STOP	START	0	1	6-Bit (D11 ... D6)	STOP	START	1	0	6-Bit (D15 ... D12)	STOP
		L-BYTE						M-BYTE					H-BYTE	



Short description of diagnostics-frame:

L-BYTE:

D0-D3:=	EDEGE-COUNT: number of edges (0..15), 0 = OK if no paper present.
D4:=	DADJUST-FLAG: (1 edge, if beam is free = no paper present).
D5:=	PARTICLE-FLAG (2 edges if beam is free = particle in beam)

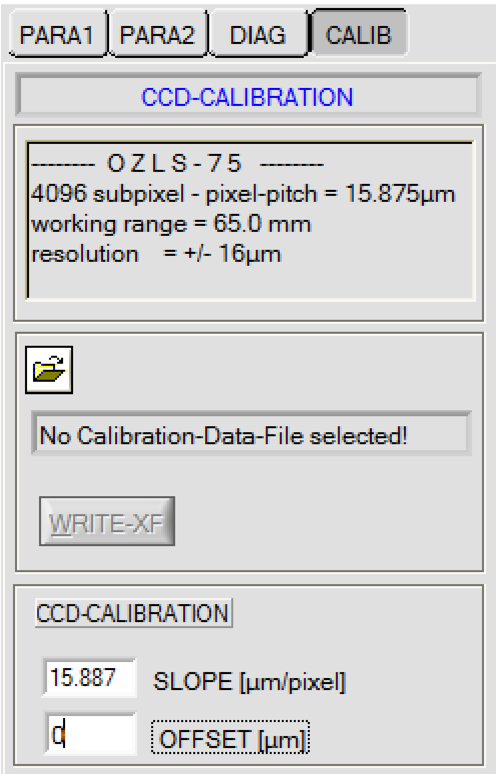
M-BYTE:

D6:=	EDGE-OVERFLOW: (3.. 15 edges if beam is free).
D7:=	VIDEO-LIMIT-FLAG: Lower video-limit is reached.
D8:=	PA-TRGG-FLAG: Paper trigger is set (while no paper present)
D9-D11:=	FREE USE: (currently not used)

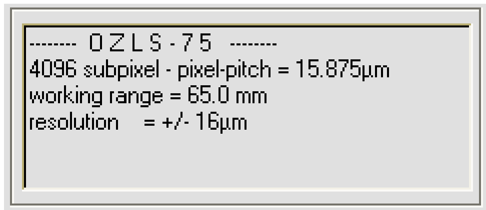
H-BYTE:

D12-D15:=	VIDEO-LEVEL: mean amplitude of video signal in 16 steps (0 .. 15).
SO, S1:=	S0=1 diagnosis-frame – Flag, S0=0 measeuring-data-frame

6 CCD-Calibration



A click on the CALIB button opens the CCD-CALIBRATION window.
The upper section of the CALIBRATION window shows general CCD sensor information:



A double-click with the right mouse-button on the above text display enables a file-dialog button.

The file-dialog-button opens a popup-window. A calibration file can be read in. The calibration file compensates the linearity deviation across the laser beam. With the WRITE-XF button the specified calibration data can be written to the EEPROM of the sensor.

CCD-CALIBRATION:

The problem with stating the measurement value in millimetres [mm] is that depending on the set video threshold and on the set transmitter power the measurement value in pixels will be slightly different.
This is caused by the constantly rising analog characteristic (slope) of the video signal in the transition area between object shading and direct laser light impingement on the pixels of the CCD line
The millimetre value display can be recalibrated with the two numeric input fields in the CCD-CALIBRATION function field.

Measurement value [µm] = OFFSET[µm] + PIXEL* SLOPE [µm/pixel]

Attention!

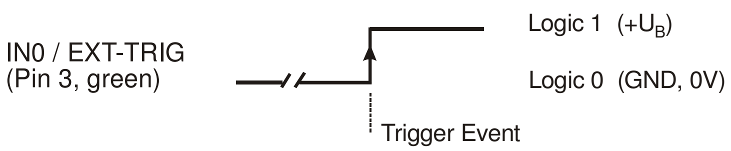
If the new setting values make sense, they can be saved to the RAM/EEPROM memory of the control unit by clicking on the SAVE button.
The last calculated calibration values are only saved to the NON-VOLATILE EEPROM memory of the control unit when EEPROM is selected as the target and the SEND button is then pressed!

7 Annex

7.1 Laser warning

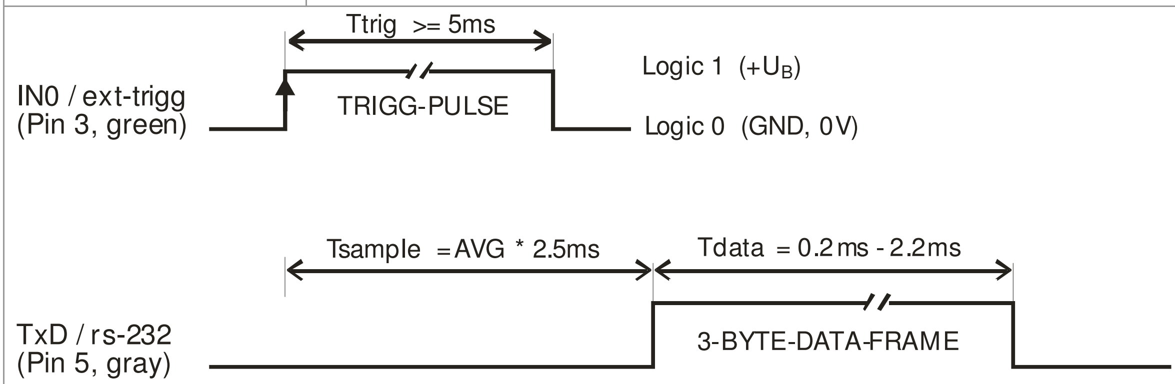
LASER WARNING
Solid-state laser, λ=670 nm, 1mW max. optical power, laser class 2 acc. to EN 60825-1 Therefore no additional protective measures are required for the use of these laser transmitters.

7.2 Function of the digital input IN0/pin3/green



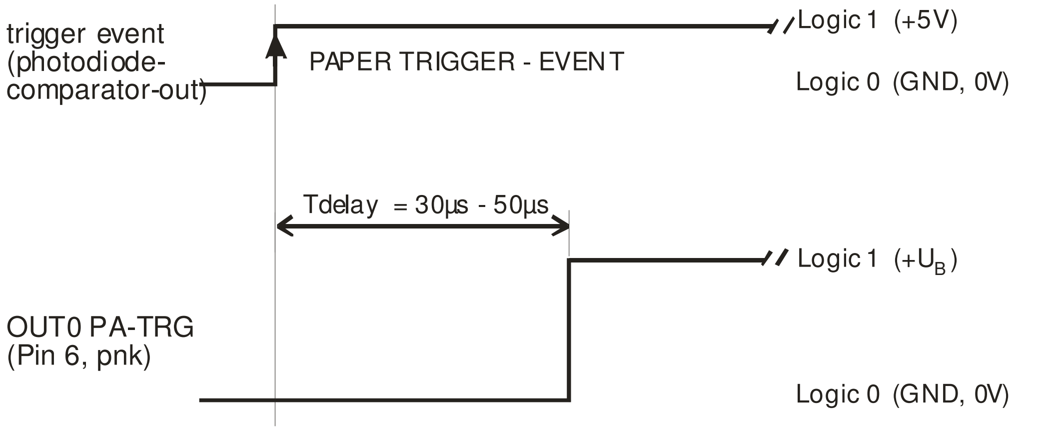
External edge-controlled (LOW/HIGH) triggering of measurement value evaluation through digital input IN0.

Input/Output Timing (3-byte-transfer):	
Ttrig:	Trigger pulse length Ttrig >= 5ms, pos. edge sensitive
Tsample:	Time delay trigger-pulse to 3-byte data output, Tsample = AVG * 2.5ms. AVG=AVERAGE=number of samples to be scanned ->refresh of mean-value calculation after AVG-samples are sampled in ring-buffer. Because of the scan-frequency of 400Hz the interval between two scans = 2.5ms.
Tdata:	Time duration for 3-byte RS-232 data-frame transfer depends on baudrate: 9600Baud: Tdata=2.2ms, 19200Baud: Tdata=1.1ms, 38400Baud: Tdata=0.6ms, 57600Baud: Tdata=0.4ms, 115.2kBaud: Tdata=0.2ms



7.3 Function of the digital output OUT0/Pin6/pink (paper-trigger)

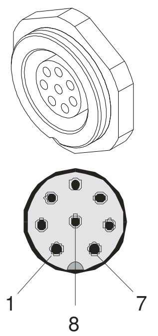
Output Timing (paper trigger):	
Tdelay:	Time span between paper-trigger-event and OU0 digital output change Tdelay (min) = 30µs Tdelay (max) = 50µs



7.4 Connector assignment

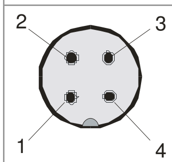
Connector Assignment Receiver:

8-pole fem. connector Binder Series 712, connection to PLC



Pin:	Color:	Assignment	Pin Function:
1	white	0V (GND)	Ground
2	brown	+24VDC +/- 10%	Positive Supply Input Voltage VDC
3	green	IN0 (TRIGGER)	Digital input Input (3-byte-transfer)
4	yellow	RxD (RS-232)	RS-232 receive-data-line
5	grey	TxD (RS-232)	RS-232 transmit-data-line
6	pink	OUT0 (PA-TRG)	Digital output (paper-trigger)
7	blue	OUT1 (STAT/ERR)	Digital output (status/diagnostics error)
8	red	ANA (0 … +10V)	Analog output (0 … +10V)

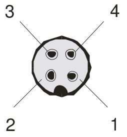
4-pole fem. Connector Binder Series 712, connection to TRANSMITTER



Pin:	Assignment	Pin Function:
1	GND	Ground (0V)
2	+5VDC	Positive supply voltage
3	I-SET	Laser intensity control (0 … +5VDC)
4	N.C.	Not connected

Connector Assignment Transmitter:

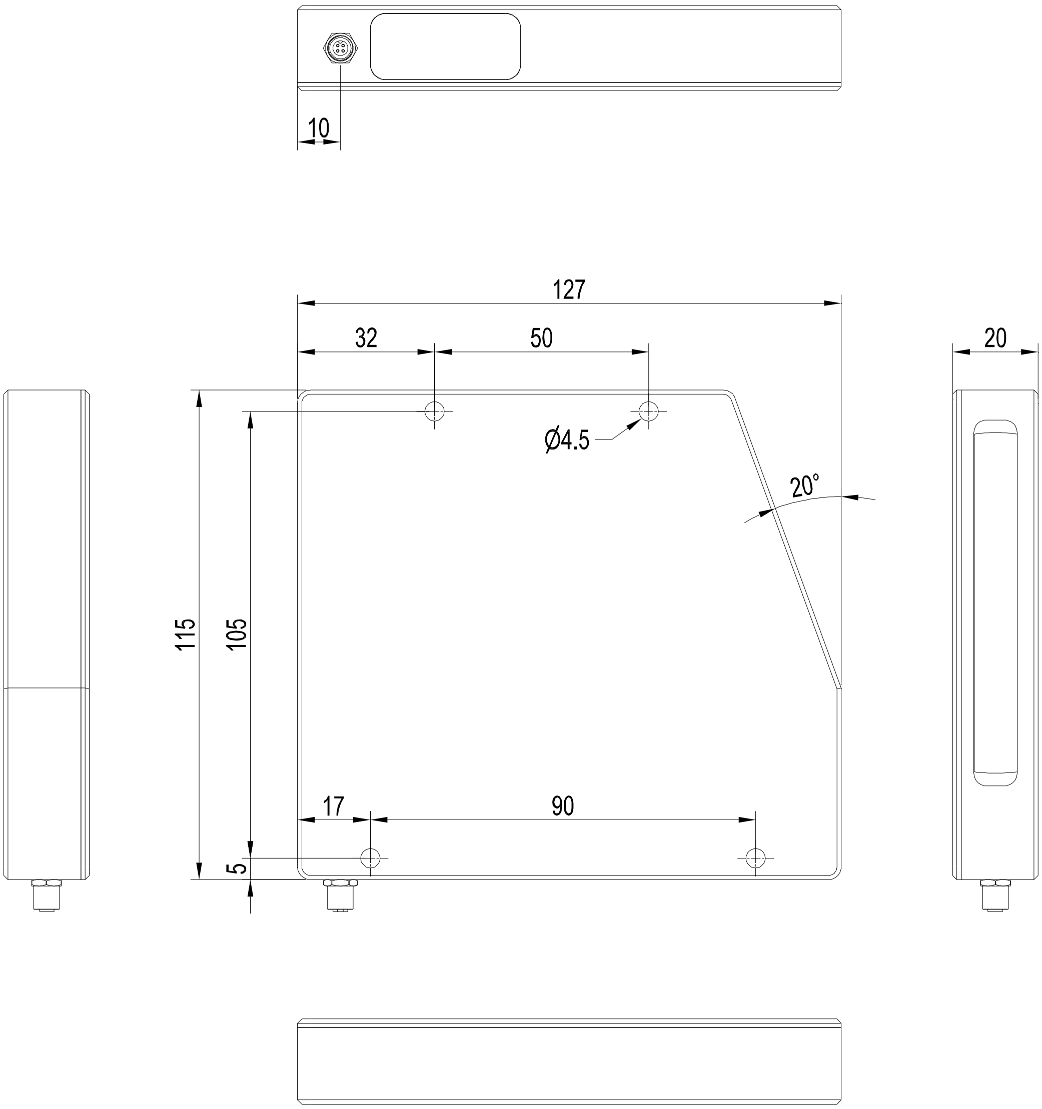
4-pole fem. Connector Binder Series 707, connection to RECEIVER



Pin:	Color	Assignment	Pin Function:
1	brown	+5VDC	Positive supply for transmitter
2	white	GND (0V)	Ground (0V)
3	blue	GND (0V)	Ground (0V)
4	black	I-SET	Laser intensity control (0 …+5VDC)

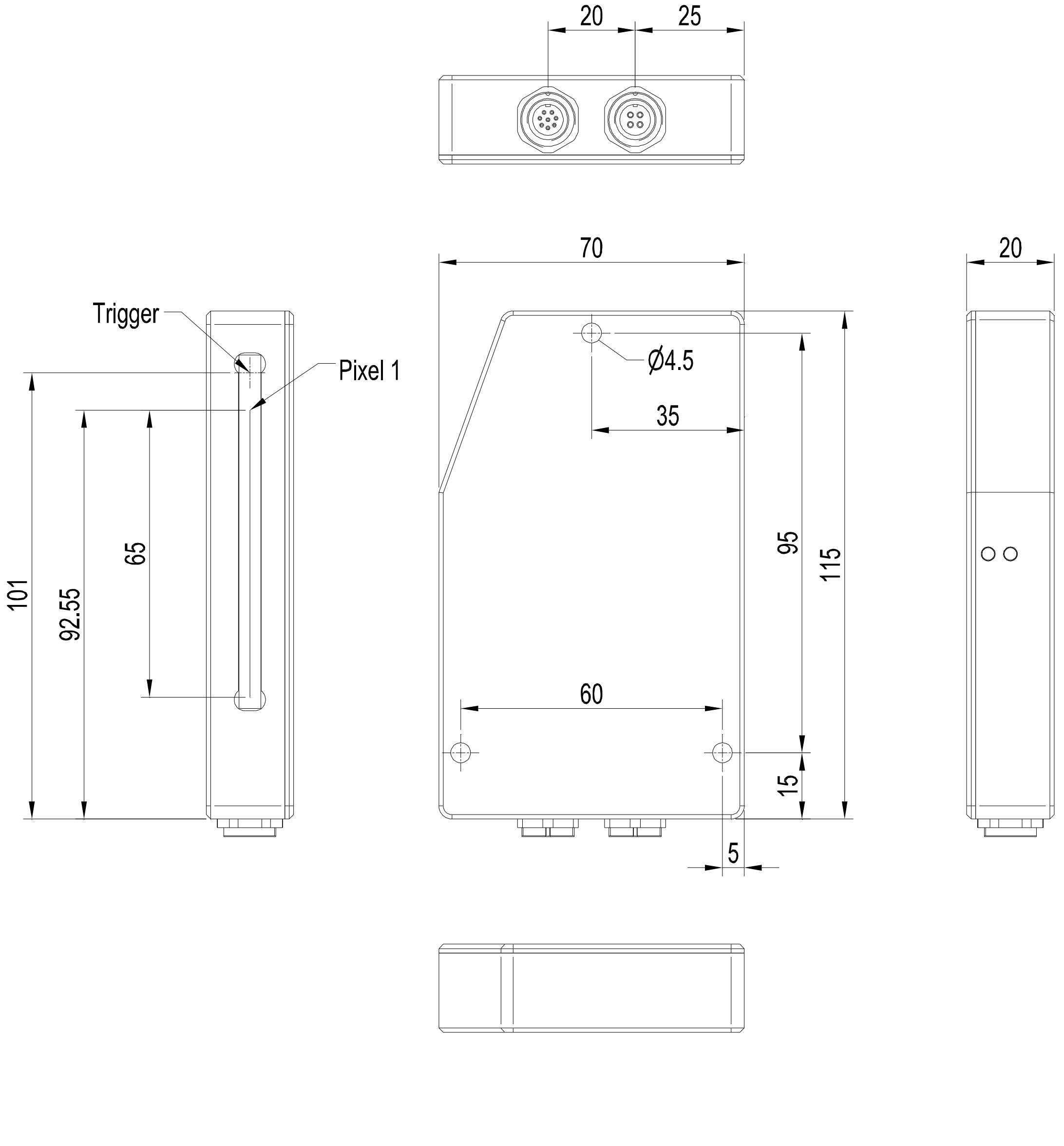
7.5 Housing dimensions

OZLS-75-EM1-T (transmitter)



All dimensions in mm

OZLS-75-EM1-R (receiver)



All dimensions in mm

7.6 RS-232 interface protocol

RS-232 Interface-Protocol PC ⇔ *OZLS-75-EM1* sensor
Firmware version 3.2x

- Standard RS-232 serial interface, no hardware handshake
- 3-wire-connection: GND, TXD, RXD
- Speed: 9600 baud, 19200 baud, 38400 baud, 57600 baud or 115200 baud
- 8 data-bits
- NO parity-bit
- 1 stop-bit
- binary-mode.

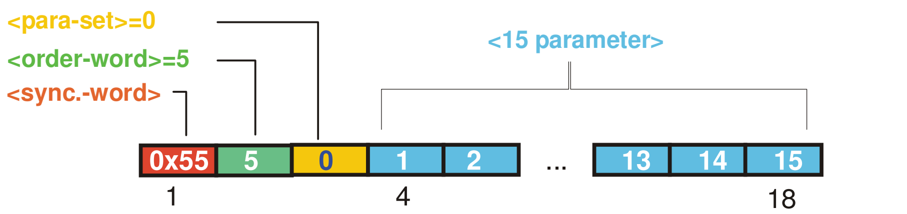
The control device (PC or PLC) have to send a frame of *18-words (1 word = 2 byte = 16 bit)* to the *OZLS-75-EM1* hardware. All words must be transmitted in binary format. The most significant byte must be transmitted first (MSB-first).

METHOD:
The microcontroller of the *OZLS-75-EM1* sensor is permanently reading (polling) the input-buffer of the RS-232 module.
If the incoming word = *0x0055 (0x55 hexadecimal = 85 decimal),* this is interpreted as the synchronisation-event (**<sync-word>**). After this, the 2.nd word with the order number (**<order-word>**) is read in by the microcontroller.

The order word (**<order-word>**), is followed by a further word, which contents parameter-set number 0 or 1 (**<para-set>**). The para-set-word is followed by 15 further words **<parameter-word>,** which contents the actual parameters.

After reading the complete data-frame (18-words = 36 bytes), the *OZLS-75-EM1* sensor-hardware executes the order which is coded at the 2.nd word (**<order-word>**) of the data-frame (c.f. order-table).

DATA FRAME: PC/PLC → SENSOR (18-Words=36Bytes, MSB first)



Format of the data-frame: <para-set = 0>		
Word	**Meaning**	**Comment**
1	<sync-word>	hex-code 0x55, binary=0000 0000 0101 0101, dec.=85
2	<order-word>	Order word (c.f. table below)
3	<parameter-set> = 0	0 = parameter-set number 0
4	POWER	Laser intensity (0 … 1000)
5	POWER-MODE	Transmitter-mode: (0 = STATIC), (1=DYNAMIC), not used
6	POLARITY	Polarity setting for OUT0, OUT1 (0=DIRECT, 1=INVERSE)
7	EVAL-MODE	Evaluation mode (0=L-EDGE, 1=R-EDGE, 2=WIDTH, 3=CENTER)
8	E-BEGIN	Evaluation start -pixel (1 .. E_END-1)
9	E-END	Evaluation end-pixel (E_BEG+1 .. SUBPIXEL)
10	TEACH-VALUE	Teach-value (1 ... SUBPIXEL)
11	TOLERANCE-HIGH VALUE	Upper-tolerance TOL-HIGH: (0 ... SUBPIXEL/2)
12	TOLERANCE-LOW-VALUE	Lower-tolerance TOL-LOW: (0 ... SUBPIXEL/2)
13	AVERAGE	Average-setting (1,2,4,8,16,32,64,128 or 256)
14	TRIGG-MODE	Trigger mode (0=NOT USED, 1=TRIGG-L/H >> RS-232, 2=FREE USE, 3=FREE USE, 4=FREE USE)
15	ANALOG-OUT	Analog-output-mode: (0=DIRECT 0..10V, 1=MAXIMA, 2=MINIMA, 3=MAX-MIN)
16	PA-TRIGG-THD	Paper-Trigger-Threshold FIX (10 … 1000)
17	PA-TRIGG-MODE	Paper-Trigger-Mode (0=FIX, 1=AUTO)
18	VIDEO-THD-MODE	Video-threshold –mode (0=FIX, 1=AUTO)

Format of the data-frame: <para-set = 1>		
Word .	**Meaning**	**Comment**
1	<sync-word> = 0x0055	hex-code 0x55, binary=0000 0000 0101 0101, dec.=85
2	<order-word>	Order-word (c.f. table below)
3	<parameter-set> = 1	1 = parameter-set-number 1
4	VIDEO-THD-FIX	Video-threshold (0 ... 100) percent of full ADC-range
5	VIDEO-THD-AUTO	Video-threshold (0 … 100) percent of full ADC-range
6	RS-232-MODE	Data-recorder-mode: 0 = STAT, 1=EXT-IN0 L/H, 2=EXT-IN0 L/H (3-Byte), 3=CONTINOUS (3-Byte)
7	RS-232-BAUD	Baudrate: 0=9600, 1=19200, 2=38400, 3=57600 , 4=115200 baud
8	SMOOTH-VIDEO-SIGNAL	Smooth video signal over (1,2,4,6,8,12,16,24,32,48 or 64) pixel
9	ANALOG-ZOOM	Zoom-mode for analog-output (0=DIRECT, 1=ZOOMx1, 2=ZOOMx2, 3=ZOOMx4, 4=ZOOMx8, 5=ZOOMx16, 6=WIN-5V, 7=WIN-10V)
10	VIDEO-LO-LIMIT	1..256 , value for video-lo-limit check
11	DIAGNOSTICS-MODE	0:=no-check, 1:=check-video, 2:=check-edge, 3:= check all
12	Parameter 9	0 ,not used
13	Parameter 10	0, not used
14	Parameter 11	0, not used
15	SLOPE VALUE L-WORD	Slope value for calibration (x 1024), low-word
16	SLOPE VALUE H-WORD	Slope value for calibration (x1024), high-word
17	REF-OFFSET L-WORD	Intersection parameter with offset = 32767
18	REF-OFFSET H-WORD	Intersection parameter (not used)

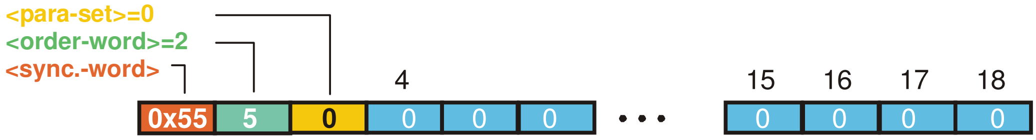
Meaning of the 2.nd word of the data-frame: <order-word> ORDER-TABLE		
value	**Meaning / Action**	
0	NOP	no operation
1	Send parameter from PC to OZLS-RAM	18 words, PC ⇒ OZLS-RAM
2	Get parameter from OZLS-RAM	18 words, OZLS-RAM ⇒ PC
3	Send parameter from PC to EEPROM	18 words, PC ⇒ OZLS-EEPROM
4	Get parameter from EEPROM of OZLS	18 words, OZLS-EEPROM ⇒ PC
5	Echo check: Get echo of OZLS	18 words, first word=0x00AA=170dec
6	Activate teach at OZLS, store in RAM	18 words PC ⇒ OZLS-RAM
7	Get software version info of OZLS	72-bytes, OZLS ⇒ PC
8	**Get measured values out of OZLS-RAM**	**18 words, OZLS-RAM ⇒ PC**
9	Get video-buffer info from OZLS	64 words, OZLS-RAM ⇒ PC
11	Reset maximum/minimum values at analog-output	18 words PC ⇒ OZLS-RAM
13	Refresh auto-video-threshold to RAM or EEPROM	18 words PC ⇒ OZLS-RAM
18	Get measured values from OZLS-RAM (data-recorder)	18 words PC ⇒ OZLS-RAM
190	Change RS-232-baud-rate (OZLS-RAM)	18 words PC ⇒ OZLS RAM

<u>Examples for the data-transfer</u>:

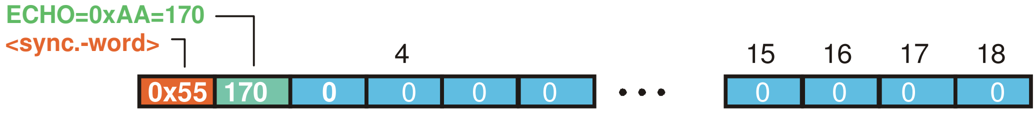
Echo check: <order-word> = 5

<order-word> = 5
Echo check: OZLS sensor sends echo: word=0x00AA=170 to PC

DATA FRAME: PC → SENSOR (18-Words=36Bytes, MSB first)



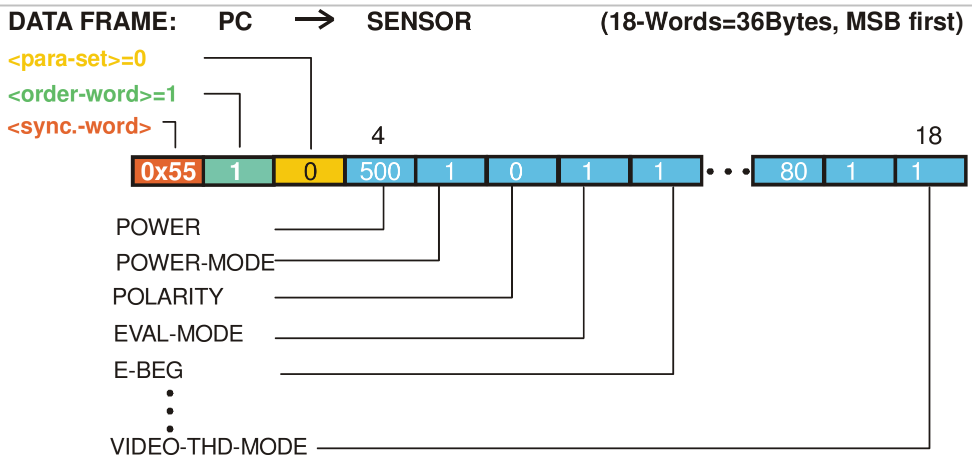
DATA FRAME: SENSOR → PC (18-Words=36Bytes, MSB first)



SEND parameter-set = 0 to OZLS-RAM <order-word> = 1

<order-word> = 1 <para-set> = 0

Send the actual parameter (set=0) into the RAM of the OZLS-sensor

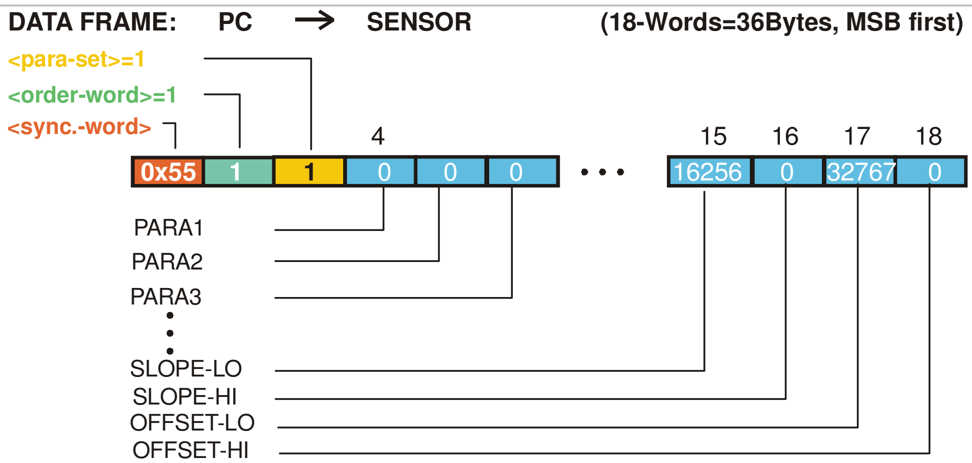


The transmitted data-frame is automatically echoed back by the *OZLS-75-EM1* sensor !

SEND parameter-set = 1 to OZLS-RAM <order-word> = 1

<order-word> = 1 <para-set> = 1

Send the actual parameter (set=0) into the RAM of the OZLS sensors



SLOPE-VALUE is multiplied with x1024 e.g. 15.875[µm/pixel] x 1024 = 16256

OFFSET-VALUE in micrometer [µm] = OFFSET[µm] - MAX_INTEGER
(MAX_INTEGER=32767)

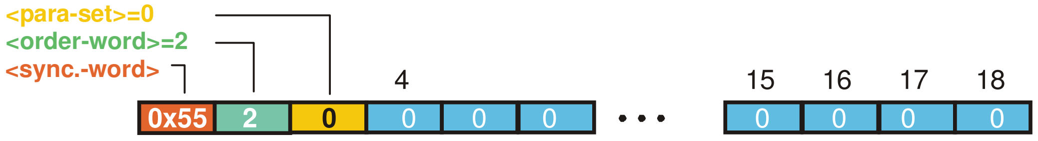
The transmitted data-frame is automatically echoed back by the OZLS sensor !

GET parameter-set = 0 of OZLS-RAM <order-word> = 2

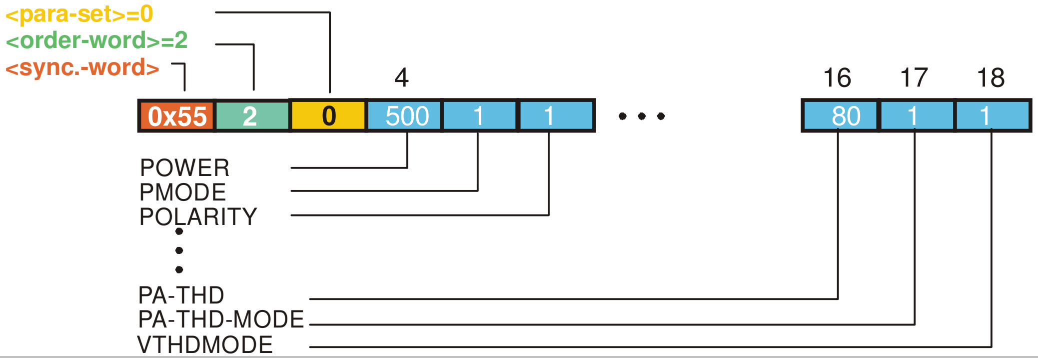
<order-word> = 2 <para-set> = 0

Get the actual RAM-parameters (set=0) of OZLS-RAM

DATA FRAME: PC → SENSOR (18-Words=36Bytes, MSB first)



DATA FRAME: SENSOR → PC (18-Words=36Bytes, MSB first)

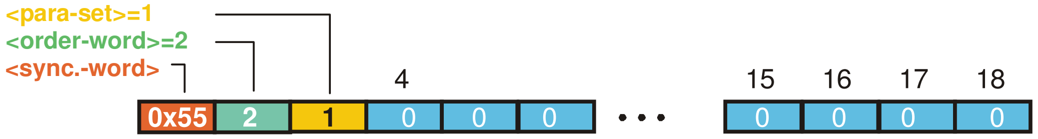


GET parameter-set = 1 of OZLS-RAM <order-word> = 2

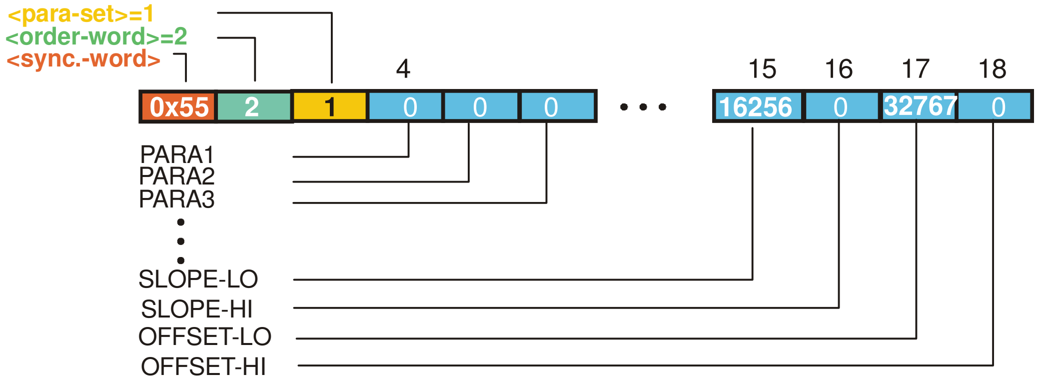
<order-word> = 2 <para-set> = 1

Get the actual RAM-parameters (set=1) of OZLS-RAM

DATA FRAME: PC → SENSOR (18-Words=36Bytes, MSB first)



DATA FRAME: SENSOR → PC (18-Words=36Bytes, MSB first)



SLOPE-VALUE is multiplied with x1024 e.g.15.875µm/pixel] x 1024 = 16256

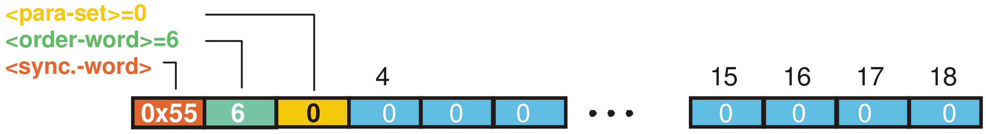
OFFSET-VALUE in micrometer [µm] 32767 = 0 µm (MAX_INTEGER added!)

TEACH-FUNCTION <order-word> = 6

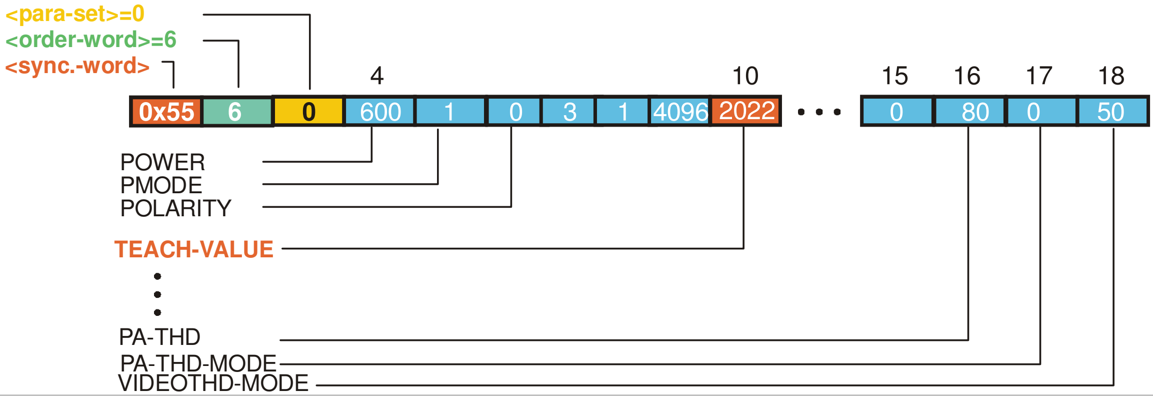
<order-word> = 6 <para-set> = 0

Start teach-procedure at OZLS-sensor. The 10. word of the echo contents the new teach-value.

DATA FRAME: PC → SENSOR (18-Words=36Bytes, MSB first)



DATA FRAME: SENSOR → PC (18-Words=36Bytes, MSB first)

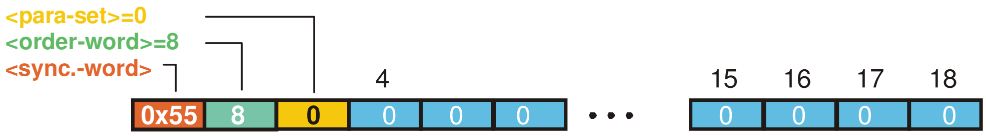


GET measured-values of OZLS-RAM <order-word> = 8

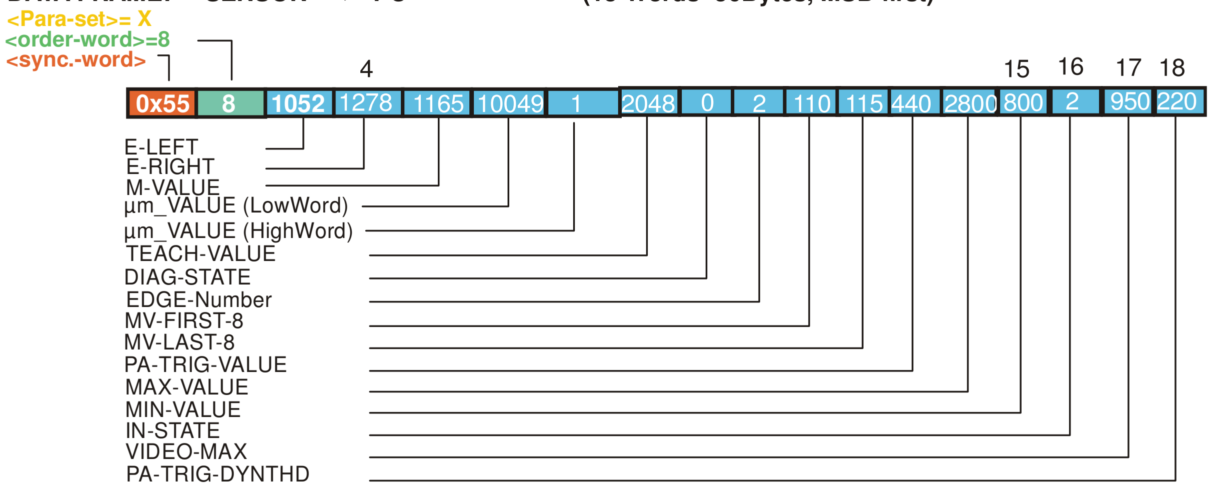
<order-word> = 8 <para-set> = 0

Get the actual measured values of OZLS-RAM

DATA FRAME: PC → SENSOR (18-Words=36Bytes, MSB first)



DATA FRAME: SENSOR → PC (18-Words=36Bytes, MSB first)



Example µm-Value: 75.584mm = 75584µm = LowWord (10049) + HighWord (1x65535)

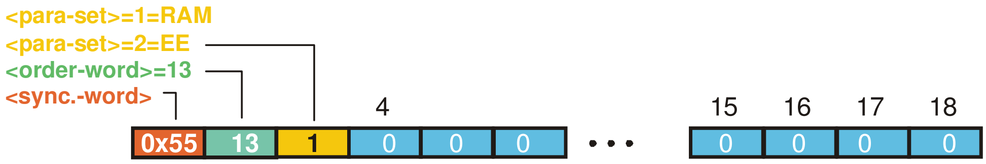
REFRESH-VIDEO-THRESHOLD <order-word> = 13

<order-word> = 13 <para-set> = 0

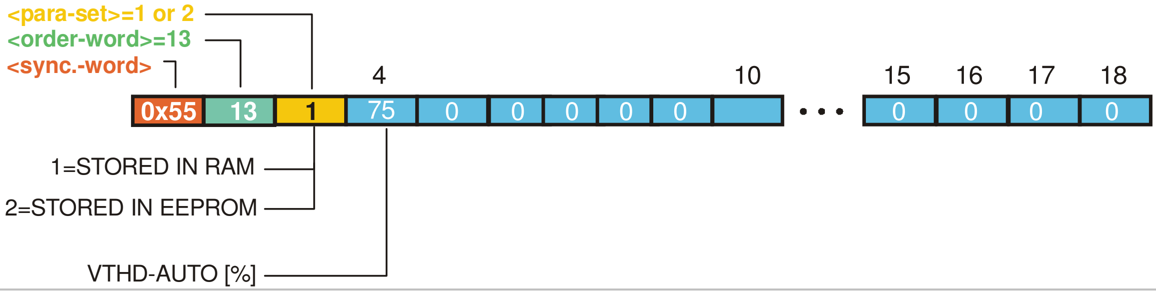
Start the refresh of the auto-video-threshold at OZLS-sensor. The new video threshold is calculated from the actual intensity profile over the CCD-line. The parameter VIDEO-THD-AUTO is used for calculation.

ATTENTION: Make sure that the laser-beam is not covered before you start this action!

DATA FRAME: PC → SENSOR (18-Words=36Bytes, MSB first)



DATA FRAME: SENSOR → PC (18-Words=36Bytes, MSB first)

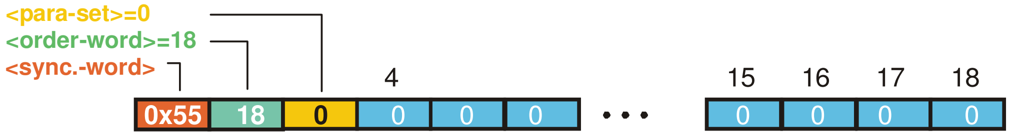


GET measured-values / recorder-of OZLS-RAM <order-word> = 18

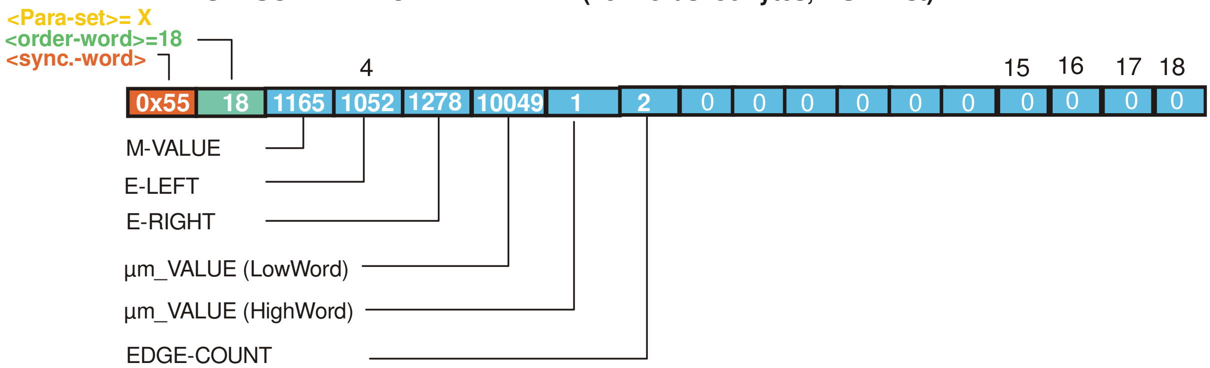
<order-word> = 18 <para-set> = 0

Get the current measurement values of OZLS RAM

DATA FRAME: PC → SENSOR (18-Words=36Bytes, MSB first)



DATA FRAME: SENSOR → PC (18-Words=36Bytes, MSB first)



Example µm-Value: 75.584mm = 75584µm = LowWord (10049) + HighWord (1x65535)

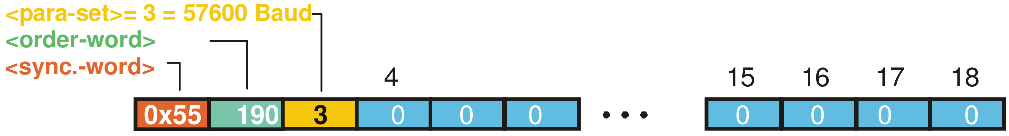
Change baudrate: <order-word> = 190

<order-word> = 190
Change rs-232-baudrate at the OZLS Sensor.
The new baudrate-parameter is transmitted in the 3.rd word <para-set>.
9600 baud = 0, 19200 baud = 1, 38400 baud = 2, 57600 baud = 3, 115200 baud = 4

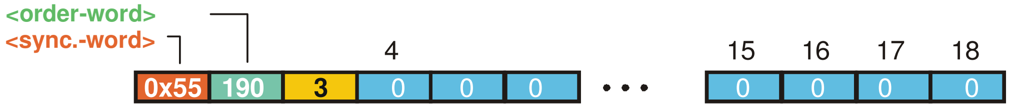
The transmitted data-frame is automatically echoed back from the OZLS Sensor by using the old baudrate!!

The new baudrate is stored in the RAM-memory (volatile). To change the baudrate permanently this must be done by the parameter RS-232-BAUD of the second parameter-set=1 by saving the parameter frame to the EEPROM (c.f. order = 3).

DATA FRAME: PC → SENSOR (18-Words=36Bytes, MSB first)



DATA FRAME: SENSOR → PC (18-Words=36Bytes, MSB first)



GET Video-data of OZLS-RAM <order-word> = 9

<order-word> = 9 **<para-set> = 0,64,128 or 192**

Get the current video-data from the RAM (only 256-pixel of the full video-profile are transmitted)

Step1: DATA FRAME: PC → L-LAS-sensor (18-Words=36Bytes, MSB first)

<order-word>=9

<sync.-word>

<block-index> = 0 (first-64-word-block)

18

0x55	9	0	0	0	•••	0	0	0

DATA FRAME: L-LAS-sensor → PC (64-Words = 128Byte, MSB first)

1 2 3 64

A1	A2	A3	A4	A5	A6	A7	•••	A62	A62	A63	A64

First block of 64 words are the first 64 pixel of the intensity-profile

Attention: Only every 8th pixel is transmitted

Step2: DATA FRAME: PC → L-LAS-sensor (18-Words=36Bytes, MSB first)

<block-index> = 64

1 18

0x55	9	64	0	0	•••	0	0	0

DATA FRAME: L-LAS-sensor → PC (64-Words = 128Byte, MSB first)

1 2 3 64

A65	A66	A67	A68	A69	A70	A71	•••	A127	A128

2nd. block of 64 words: pixel 65 to 128

Attention: Only every 8th pixel is transmitted

Step3: DATA FRAME: PC → L-LAS-sensor (18-Words=36Bytes, MSB first)

<block-index> = 128

1 18

0x55	9	128	0	0	•••	0	0	0

DATA FRAME: L-LAS-sensor → PC (64-Words = 128Byte, MSB first)

1 2 3 64

A129	A130	A131	A132	•••	A192	A192

3rd. block of 64 words: pixel 129 to 192

Attention: Only every 8th pixel is transmitted

Step4: DATA FRAME: PC → L-LAS-sensor (18-Words=36Bytes, MSB first)

<block-index> = 192

18

0x55	9	192	0	0	•••	0	0	0

DATA FRAME: L-LAS-sensor → PC (64-Words = 128Byte, MSB first)

1 2 3 64

A193	A194	A195	A196	•••	A255	A256

3rd. block of 64 words: pixel 193 to 256

Attention: Only every 8th pixel is transmitted