Manual
Software L-LAS-TB-Scope V5.1

(PC software for Microsoft® Windows XP, Vista, 7, 10)

for laser line sensors of the *L-LAS-TB-…-AL series*

Split version:

L-LAS-TB-6-AL

L-LAS-TB-16-AL

L-LAS-TB-28-AL

L-LAS-TB-50-AL

L-LAS-TB-75-AL

L-LAS-TB-100-AL

Fork type version:

L-LAS-TB-F-(6)-20/40-AL

L-LAS-TB-F-(6)-40/40-AL

L-LAS-TB-F-(16)-40/40-AL

L-LAS-TB-F-(16)-100/100-AL

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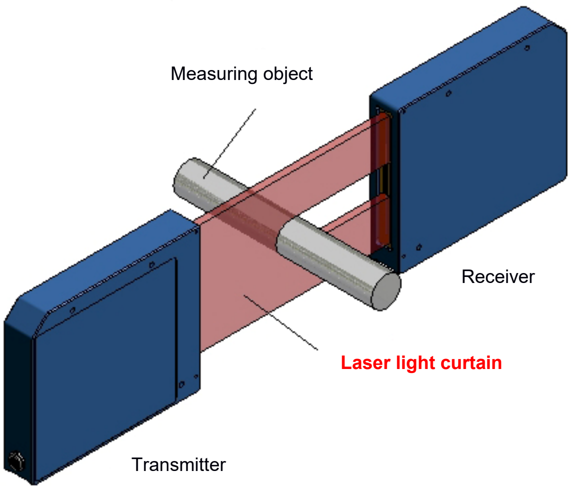
0 Contents

1 Functional principle: *L-LAS-TB-…-AL* line sensor

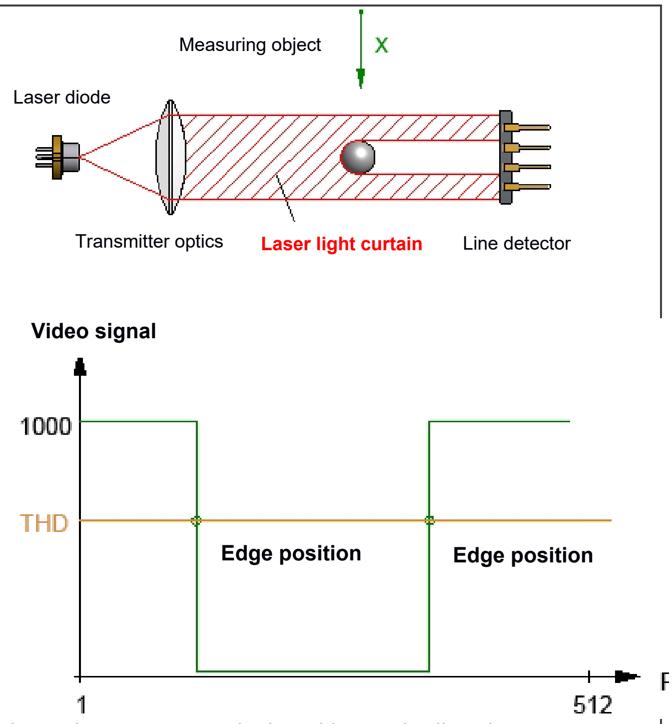
1.1 Technical description

In the laser line sensors of the L-LAS-TB-...-AL series the laser beam of a laser diode (λ=670nm, 0,4mW max. opt. power, laser class 1) through suitable collimators and apertures is emitted from the optical transmitter unit as a laser line, i.e. as parallel laser light with homogeneous light distribution. In the optical receiver unit the laser line impinges on a CMOS line receiver. This CMOS 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 (video signal) 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 (cf. pict. 1). 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 line detector is known, the size and position of the measuring object can therefore be determined. The micro-controller of the *L-LAS-TB-…-AL sensor* can be parameterized through the serial RS232 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 four LEDs (1x green, 1x yellow, and 2x red) that are integrated in the housing of the *L-LAS-TB-…-AL sensor*. The *L-LAS-TB-…-AL control unit* has three digital outputs (OUT0, OUT1, OUT2), the output polarity of which can be set with the software. Two digital inputs (IN0, IN1) make it possible to realize an external TEACH/RESET functionality and an external TRIGGER functionality through a PLC. In addition the control unit features a high-speed analog output (0 ... 10V) with 12-bit digital/analog resolution.



Pict.1:
Functional principle laser through-beam sensor



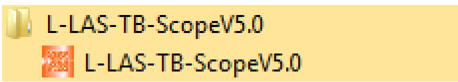
Intensity curve over pixel position at the line detector

2 Installation of the *L-LAS-TB-Scope* software

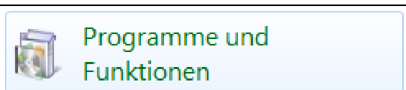
Hardware requirements for successful installation of the *L-LAS-TB-Scope* software:

- 1GHz Pentium-compatible processor or better.
- CD-ROM or DVD-ROM drive
- Approx. 200 MByte of free hard disk space
- SVGA graphics card with at least 1024x768 pixel resolution and 256 colors or better.
- Windows® 7, Windows® 8 or Windows® 10 operating system
- Free serial RS232 interface or USB port with USB-RS/232 adaptor at the PC

Please install the *L-LAS-TB-Scope* software as described below:

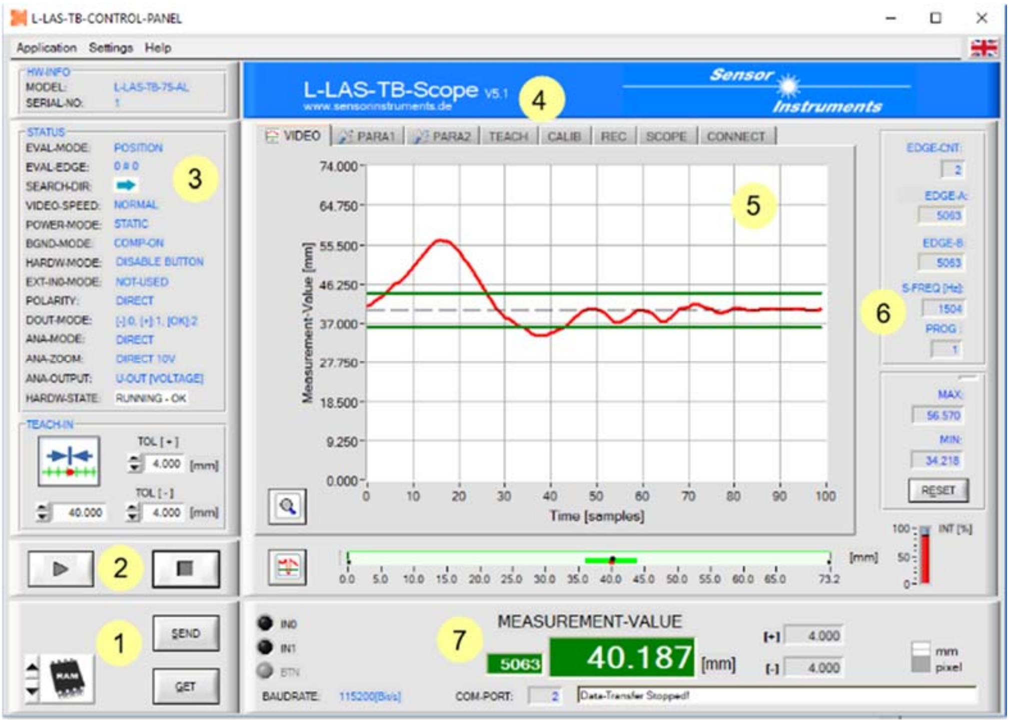
1. 	Insert the installation CD-ROM in your CD-ROM drive. In our example we suppose that this is drive "D".
2. 	Start the Windows Explorer and in the folder tree of your CD-ROM drive go to the installation folder D:\Install\ . Then start the installation program by double-clicking on the SETUP.EXE symbol. 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.
3.	During the installation process a new program group for the software is created in the Windows Program Manager. In this program group an icon for starting the software is created automatically. When installation is successfully completed the installation program displays a "Setup OK" message.
4.	The *L-LAS-TB-Scope* software can now be started by clicking on the respective icon in the newly created program group under: Start >All Programs > *L-LAS-TB-ScopeV5.0* 

Deinstallation of the *L-LAS-TB-Scope* software:

	Please use the Windows® uninstall tool to remove the software. The Windows® uninstall tool can be found under Start / Settings / Control Panel.

3 Control elements of the *L-LAS-TB-Scope* software

3.1 Short description of the *L-LAS-TB-Scope* user interface



The *L-LAS-TB-Scope* user interface provides a great variety of functions:

- Visualization of measurement data in numeric and graphic output fields.
- Setting of the lighting source.
- Setting of the polarity of the digital switching outputs OUT0, OUT1, OUT2
- 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.

1 Function fields for sending / reading the setting parameters (parameter transfer).

2 START / STOP Functional field for the RS232 data exchange to the sensor.

3 Displays the current operating status of the sensor (evaluation mode, output polarity, ...).

4 Tab row to switch between different tab graphic windows.

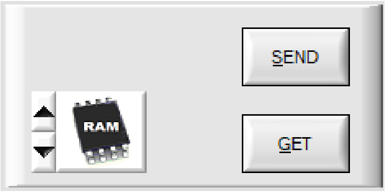
5 Graphic output (display of the measured value over time with teach value and tolerance band).

6 Numerical display elements (measuring frequency, number of edges, program number, ...).

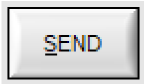
7 Measured value display in [mm] and graphical representation of the measuring range.

The following chapters provide explanations of the individual control elements of the L-LAS-TB-Scope software.
Pressing the right mouse button on an individual element will call up a short help text.

3.2 Control elements of the *L-LAS-TB-Scope* Software

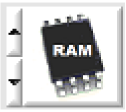


PARAMETER TRANSFER:
This group of function buttons is used for transferring parameters between the PC and the *L-LAS-TB-…-AL control unit* through the serial RS232 interface.



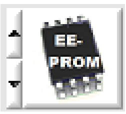
SEND:
When the SEND button is clicked, the parameters currently set on the user interface are transferred to the *L-LAS-TB-…-AL control unit*.

GET:
When the GET button is clicked, the setting parameters are transferred from the *L-LAS-TB-…-AL control unit* to the PC and are updated on the user interface.

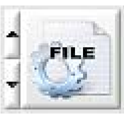


The source or the destination of the data transfer is defined by means of this selection function field:

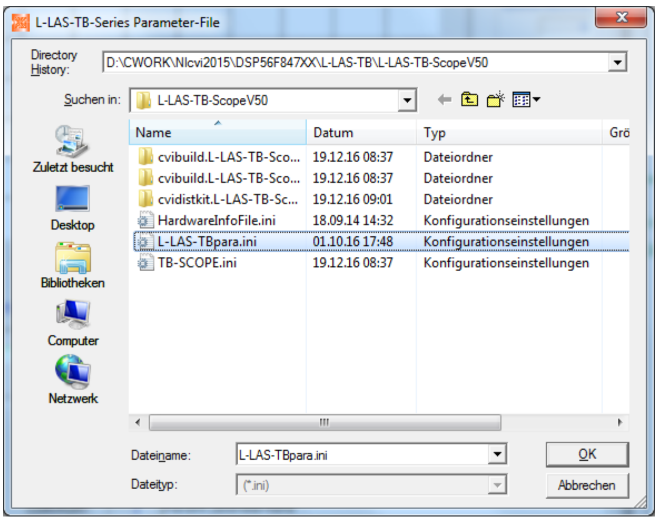
RAM:
The currently set parameters are written to the volatile RAM memory of the *L-LAS-TB-…-AL control unit*, or they are read from the RAM and transferred to the PC.



EEPROM:
The currently set parameters are written to the non-volatile EEPROM memory of the *L-LAS-TB-...-AL control unit*, 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.

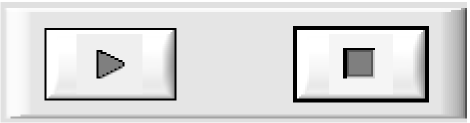


FILE:
When the FILE radio-button is selected, a click on the SEND/GET button opens a new file dialog on the user interface. The current parameters can be written to a freely selectable file on the hard disk of the PC, or parameters can be read from such a file.



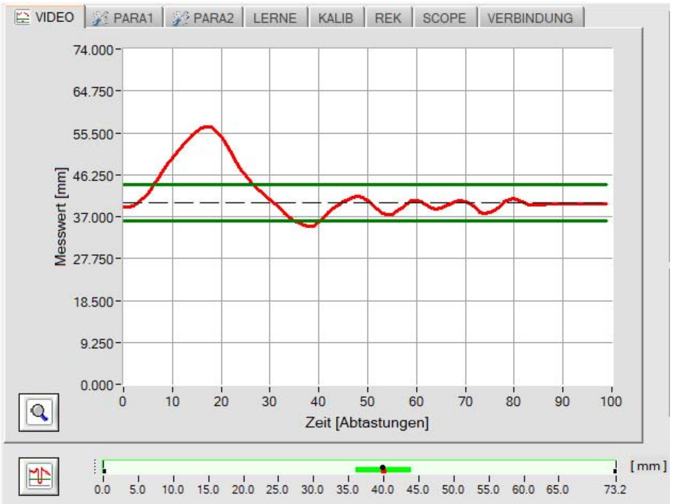
FILE dialog window:
The standard output file for the parameter values has the file name „L-LAS-TBpara.ini“.

The output file with the file extension *.ini can be opened with the standard *Windows®* text editor program "EDITOR".



START – STOP button:

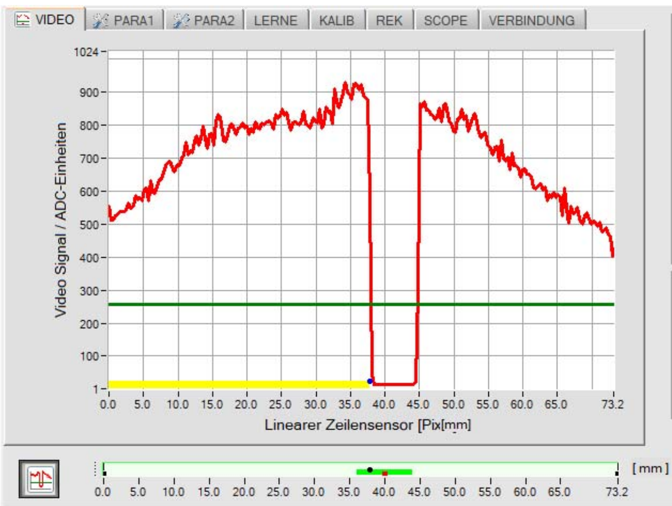
Data transfer through the serial RS232 interface is controlled by clicking on these two buttons.

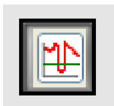


When the **[VIDEO]** tab is selected, the current time characteristic of measurement values or the video signal of the line sensor will be transferred.

Time characteristic of measurement values:
Y-axis: Current distance value [mm]
X-axis: Frequency

The frequency spectrum is calculated from the video image (intensity characteristic) by way of a FFT algorithm. The frequency spectrum shows the frequency distribution of the frequency components contained in the video image.



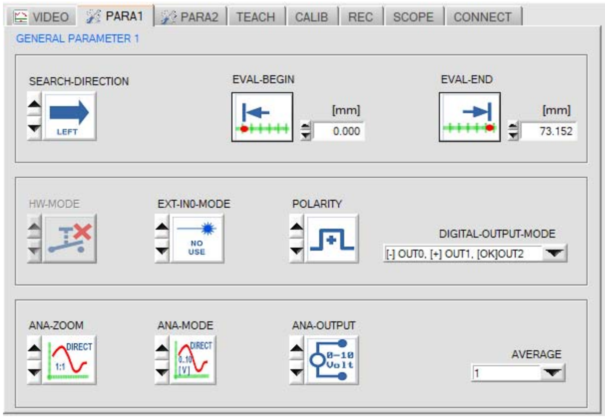


When you click on the Video button, the video image of the line sensor will be transferred.

Intensity characteristic at line sensor:
Y-axis: Amplitude at the respective pixel
X-axis: Pixel of the line sensor

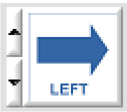
The picture on the left side shows a typical video response of the line sensor. If there is an object between transmitter and receiver, this can be recognised as a shadow area (lower intensity). For the determination of the measurement value the intensity characteristic is evaluated together with the comparator threshold.

3.3 PARAMETER1 tab



PARA1 tab:

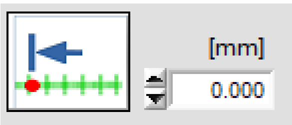
A click on PARA1 opens the GENERAL PARAMETERS 1 window, where various general parameters at the *L-LAS-TB-...-AL control unit* can be set.



SEARCH DIRECTION:

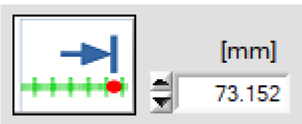
This function element can be used to set the direction for edge searching. A change of the search direction may be helpful if there is interference in the video image.

LEFT: Search from pixel1 to the last pixel (from left to right)
RIGHT: Search from last pixel to pixel1 (from right to left)



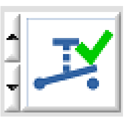
EVAL-BEGIN:

Enter a numerical value in the input field or click on the EVAL-BEGIN button to set the start of the evaluation range in [mm] or [pixel].



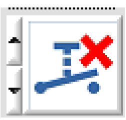
EVAL-END:

Enter a numerical value in the input field or click on the EVAL-END button to set the end of the evaluation range in [mm] or [pixel].



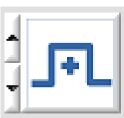
HW-MODE:

The hardware button at the sensor housing is enabled. The button can then be used for teaching (TEACH-IN) and for resetting the analog maximum values [1].



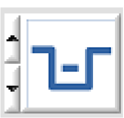
The hardware button at the sensor housing is locked (inactive).

[1] not available in all series



POLARITY:

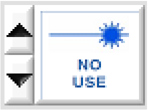
This function element is used to set the polarity at digital outputs OUT0 and OUT1.
[+] DIRECT: In case of an error the respective digital output is set to +Ub (+24VDC), the LED that visualises the state of the digital output lights up in red.



[-] INVERSE: In case of an error the respective digital output is set to GND (0V), the LED that visualises the state of the digital output lights up in red.

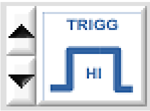
EXT-IN0 MODE:

This list element is used to set the trigger mode at digital input IN0/pin3/green.

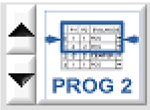


NO-USE: No triggering, the control unit operates continuously.

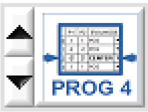
TRIGG-IN0 L/H:
External edge-controlled triggering of measurement value evaluation through digital input IN0/pin3/green. A new measurement value is generated with every new low/high edge.



TRIGG-IN0 HIGH:
External triggering of measurement value evaluation through a high-level (+Ub) at digital input IN0/pin3/green.
New measurement values are generated as long as digital input IN0=HIGH.

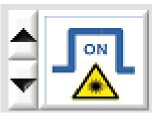


PROG2:
The external digital input IN0 is used to select the measurement program.
IN0=LOW: Program 0 active, IN0=HIGH: Program1 active

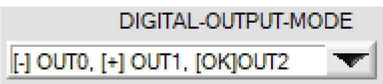


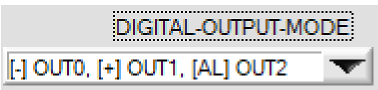
PROG4:
Both external digital inputs IN0 and IN1 are used to select the measurement program.

IN0=LOW,	IN1=LOW :	Programm0,
IN0=HIGH,	IN1=LOW :	Programm1
IN0=LOW,	IN1=HIGH:	Programm2
IN0=HIGH,	IN1=HIGH:	Programm3



LASER ON – IN0 HI
Activation of the laser transmitter unit by a HIGH level at IN0/pin3/green.



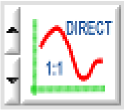


DIGITAL OUTPUT MODE:

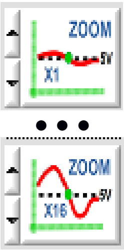
This list element is used to set the operating mode of the digital outputs. For the *L-LAS-TB-…-AL sensor* it can here be specified which state "LOW HIGH / GO" is output at the respective digital output.

With this setting the output OUT0 is used to indicate that the measurement-value is less than the lower tolerance limit, OUT1 is used to indicate that the measurement value is greater than the upper tolerance limit. Additionally OUT2 is used as an alert-output to indicate dirt accumulation on the sensor system or to indicate an error state concerning the number of edges.

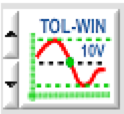
ANA-ZOOM-MODE: This list element is used to set the zoom mode at analog output AOUT/pin8/red.



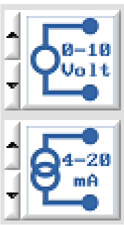
DIRECT 1:1:
At the analog output pin8/red/ the full measuring range of the sensor is provided as a 0 to 10V voltage swing.



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



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.

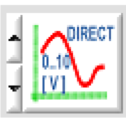


ANA OUTPUT:

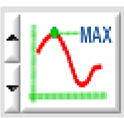
0-10Volt: Analog voltage output 0…+10V / pin8 / M12 PLC connector

4-20mA: Current output 4…20mA / pin7 / M12 PLC connector

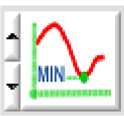
ANA-MODE: Function element for selecting the output mode of the analog voltage at the *L-LAS-TB-…-AL Sensor* (pin7/pin8 8-pole PLC/POWER female connector). The analog voltage is output in the range from 0 to +10V with a resolution of 12 bit, the current output provides 4...20mA.



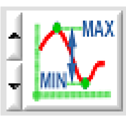
DIRECT:
At the analog output pin8/red/ the full measuring range of the sensor is provided as a 0…+10V voltage swing.



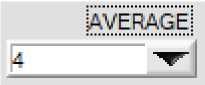
MAXIMA:
The current maximum value is provided at the analog output pin8/red/ (drag pointer principle, resetting by input IN1/pin4/yellow pulse of <750ms length, or by pressing the TEACH/RESET button).



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, or by pressing the TEACH/RESET button).



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, or by pressing the TEACH/RESET button).



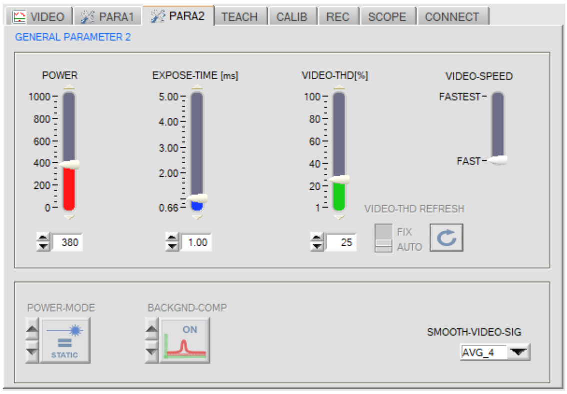
AVERAGE:

In this function field the averaging at the *L-LAS-TB-…-AL 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 1024. The measurement value determined after averaging is output at the analog output pin8/red/.

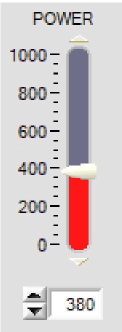
Averaging reduces the switching frequency at the *L-LAS-TB-…-AL sensor* by a factor of 1/AVERAGE.
The current switching frequency is shown in a numeric display element.

3.4 PARAMETER 2 tab



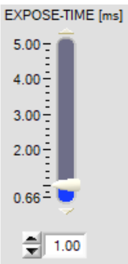
PARA2 tab:

A click on PARA2 opens the GENERAL PARAMETERS 2 window.
In this window various parameters such as laser power, exposure time, and laser operating mode can be set. If necessary, these settings must be adapted to the respective color/brightness of the surface.



POWER:

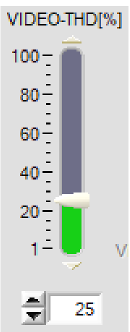
In this function field the transmitter power at the laser transmitter unit of the *L-LAS-TB-…-AL sensor* can be set by using the arrows or the slider, or by entering a numerical value in the respective input field.

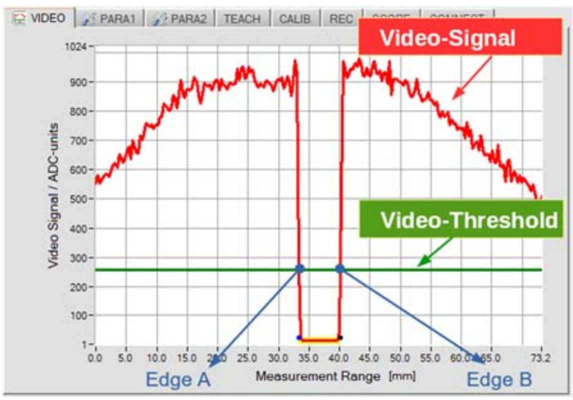


EXPOSURE TIME[ms]:

In this function field the exposure time at the *L-LAS-TB-…-AL sensor* can be set by using the arrows or the slider, or by entering a numerical value in the respective input field.

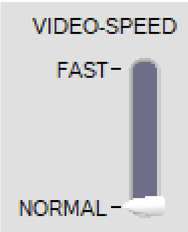
In case of particularly dark or matt surfaces an increase of the exposure time may help to ensure that enough intensity arrives at the receiver line.
An increase of the exposure time reduces the scan frequency of the sensor (e.g. 1ms=1000Hz, 5ms=200Hz).





VIDEO THRESHOLD[%]:

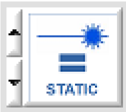
With the help of the video threshold (green) the edges (= bright/dark transitions) can be derived from the intensity characteristic of the video signal (red).
For this purpose the intersection points between the video threshold and the video signal are calculated. The x-value of the respective intersection point is assigned to a pixel on the line receiver. The measurement value can be calculated from this information and from the known distances of the pixels.



VIDEO SPEED:

This toggle switch is used to set the read speed at the line sensor receiver. A higher read speed will reduce the resolution at the sensor:

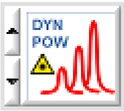
NORMAL:	Normal read frequency	►	Full resolution
FAST:	Fast read frequency	►	Half resolution



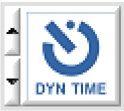
POWER MODE:

In this function field the power control mode for the laser transmitter unit at the *L-LAS-TB-...-AL* sensor can be set.

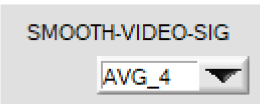
STATIC:
Static (constant) power at the laser transmitter unit.



DYN-POWER: *)
The laser power is set dynamically during operation. Dynamic power control attempts to keep the maximum value of the video signal in the control range between 700 and 900 ADC units.



DYN-TIME: *)
In this mode it is not the laser power at the transmitter unit that is controlled. Here the exposure time at the CMOS line sensor is dynamically adapted. Dynamic exposure time control attempts to keep the maximum value of the video signal in the control range between 700 and 900 ADC units.

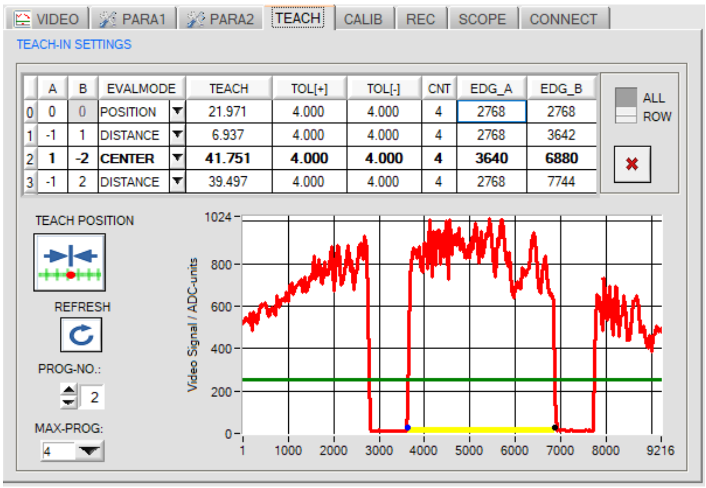


AVERAGING VIDEO SIGNAL:

This list function field can be used to set an averaging value for the video signal. The intensity characteristic of the video signal undergoes "floating averaging" prior to edge searching. This may be helpful for the suppression of interference in the video signal. The size of the ring memory can be set between AVG=1 and AVG=16.

*) currently not used

3.5 TEACH-IN SETTINGS tab:



TEACH-IN SETTINGS tab:

A click on the [TEACH] tab opens a window where you can display and set the teach values at the sensor.

In this tab the teach-in settings at the *L-LAS Control Unit* can be set by using the teach table and other function elements.

TEACH TABLE:

The teach table is used to visualise and set the teach values and tolerances of up to four different programs (0-3). Each individual program corresponds with a row in the teach table. Depending on the respective switch setting the teach values and tolerances are displayed in [mm] or [Pixel].

	A	B	EVALMODE	TEACH	TOL[+]	TOL[-]	CNT	EDG_A	EDG_B
0	0	0	POSITION	21.971	4.000	4.000	4	2768	2768
1	-1	1	DISTANCE	6.937	4.000	4.000	4	2768	3642
2	**1**	**-2**	**CENTER**	**41.751**	**4.000**	**4.000**	**4**	**3640**	**6880**
3	-1	2	DISTANCE	39.497	4.000	4.000	4	2768	7744

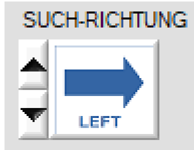
Meaning of columns:

Column1: PROG (program number 0,1,2 or 3)
Column2: EDGE A (first edge that should be used for evaluation).
Column3: EDGE B (second edge that should be used for evaluation).
Column4: EVALMODE (evaluation mode between edges A and B - position, distance, or center).
Column5: TEACH (teach value in [mm] or [Pixel]).
Column6: TOL[+] (upper tolerance in [mm] or [Pixel]).
Column7: TOL[-] (lower tolerance in [mm] or [Pixel]).
Column8: CNT (edge count).
Column9: EDG_A (edge position - first edge to be evaluated in [Pixel]).
Column10: EDG_B (edge position - second edge to be evaluated in [Pixel]).

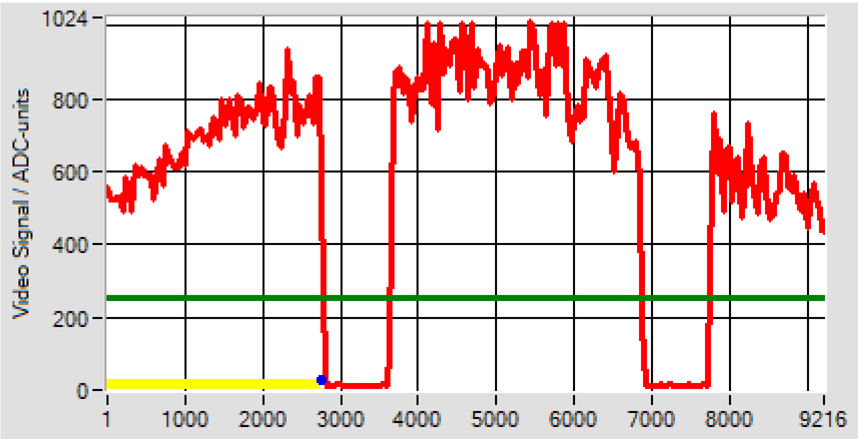
With multi-edge evaluation a maximum of 16 positive (rising) edges and 16 negative (falling) edges can be differentiated for every program. For actual evaluation two edges (A, B) must always be selected.

EXAMPLES FOR MULTI-EDGE EVALUATION:

	A	B	EVALMODE	TEACH	TOL[+]	TOL[-]	CNT	EDG_A	EDG_B
0	0	0	POSITION	2768	503	503	4	2768	2768
1	-1	1	DISTANCE	874	503	503	4	2768	3642
2	1	-2	CENTER	5259	503	503	4	3640	6880
3	-1	2	DISTANCE	4976	503	503	4	2768	7744



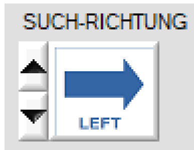
PROG=0: POSITION of the first outer edge



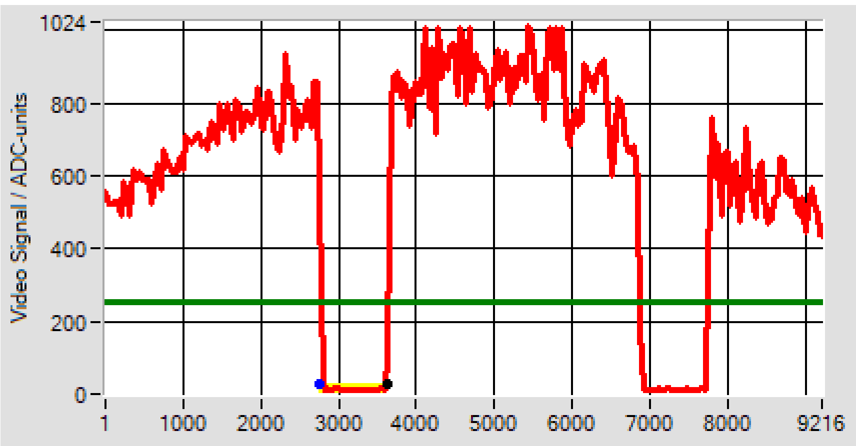
The position of the outermost edge (A=0) starting with search direction left at pixel 1 is taught and evaluated.
If you enter A=0 or B=0 no difference will be made between rising (+) or falling (-) edge.

The last taught pixel position of edge EDG_A = 2768. In evaluation mode POSITION, EDG_A = EDG_B will be set.

	A	B	EVALMODE	TEACH	TOL[+]	TOL[-]	CNT	EDG_A	EDG_B
0	0	0	POSITION	2768	503	503	4	2768	2768
1	-1	1	DISTANCE	874	503	503	4	2768	3642
2	1	-2	CENTER	5259	503	503	4	3640	6880
3	-1	2	DISTANCE	4976	503	503	4	2768	7744



PROG=1: DISTANCE between first negative and first positive edge:

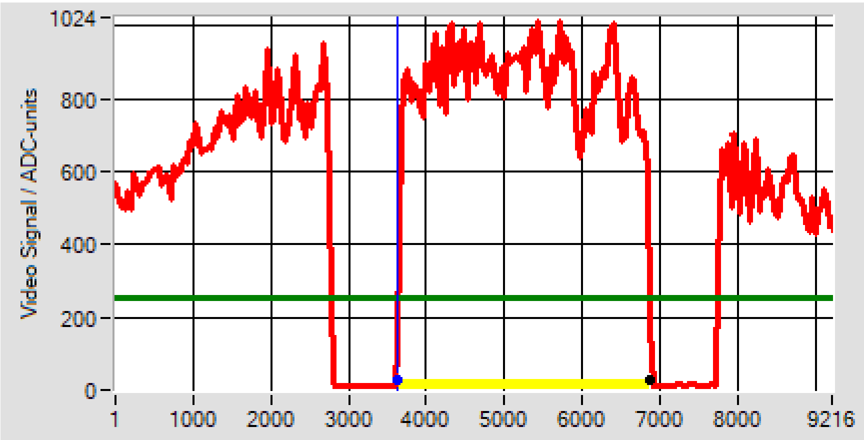


The DISTANCE between the first falling edge (A = -1) and the first rising edge (B = +1) starting with search direction left at pixel 1 is taught and evaluated.
The last taught pixel position of edge EDG_A = 2768, the pixel position of the second edge EDG_B = 3641.
The distance between the two edges A and B is 7.0 [mm] or 881 [Pixel].

	A	B	EVALMODE	TEACH	TOL[+]	TOL[-]	CNT	EDG_A	EDG_B
0	0	0	POSITION	2768	503	503	4	2768	2768
1	-1	1	DISTANCE	864	503	503	4	2768	3632
2	1	-2	CENTER	5259	503	503	4	3640	6880
3	-1	2	DISTANCE	4976	503	503	4	2768	7744

SUCH-RICHTUNG
LEFT

PROG=2: CENTER between first positive and second negative edge:

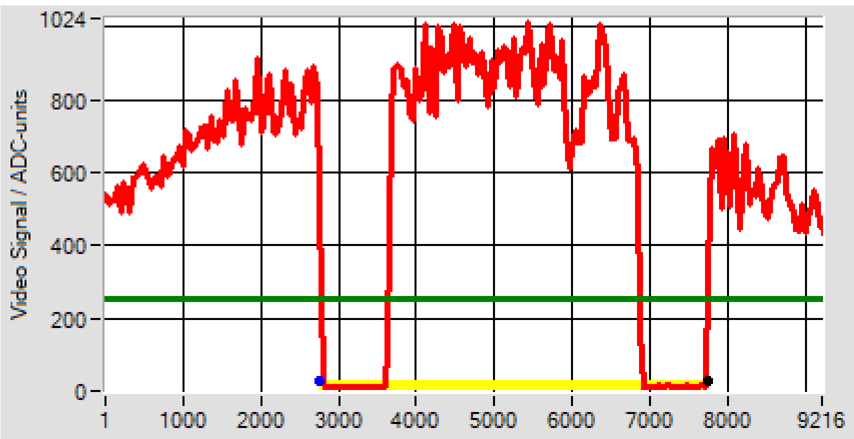


The CENTER (center distance) between the first rising edge (A = +1) and the second falling edge (B = -2) starting with search direction left at pixel 1 is taught and evaluated.
The last taught pixel position of edge EDG_A = 3641, the pixel position of the second edge EDG_B = 6880.
The CENTER between the two edges A and B is at (A+B)/2 = 5260 [Pixel].

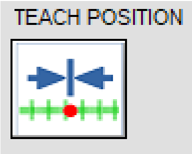
	A	B	EVALMODE	TEACH	TOL[+]	TOL[-]	CNT	EDG_A	EDG_B
0	0	0	POSITION	2768	503	503	4	2768	2768
1	-1	1	DISTANCE	864	503	503	4	2768	3632
2	1	-2	CENTER	5259	503	503	4	3640	6880
3	-1	2	DISTANCE	4976	503	503	4	2768	7744

SUCH-RICHTUNG
LEFT

PROG=3: DISTANCE between first negative and second positive edge:



The DISTANCE between the first falling edge (A = -1) and the second rising edge (B = +2) starting with search direction left at pixel 1 is taught and evaluated.
The last taught pixel position of edge EDG_A = 2768, the pixel position of the second edge EDG_B = 7744.
The DISTANCE between the two edges A and B is (B-A) = 4976 [Pixel].



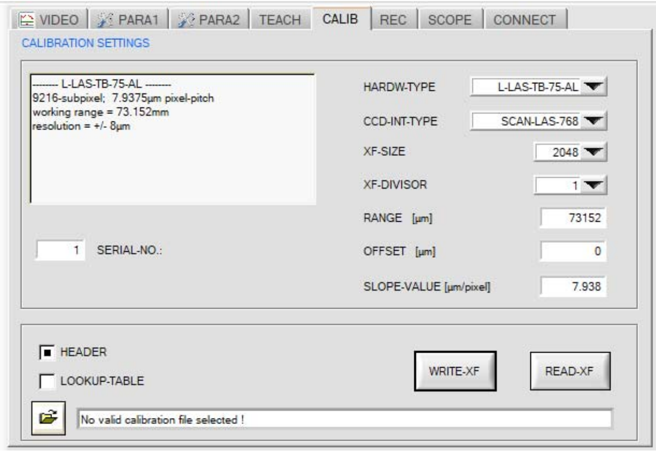
TEACH POSITION:
Start the TEACH-IN procedure at the sensor hardware. The specified type of edges A and B from the selected row in the teach-table are used to determine the corresponding pixel positions. The actual pixel position represents the new teach-in value. The values are refreshed in the teach-table row.

REFRESH:
Button to load the actual teach-vector from the sensor. The teach-vector is updated in the corresponding teach-table row. Additionally the video signal in the graphics window is refreshed.

PROG-NR:
Select a teach-row in the teach table (program number).

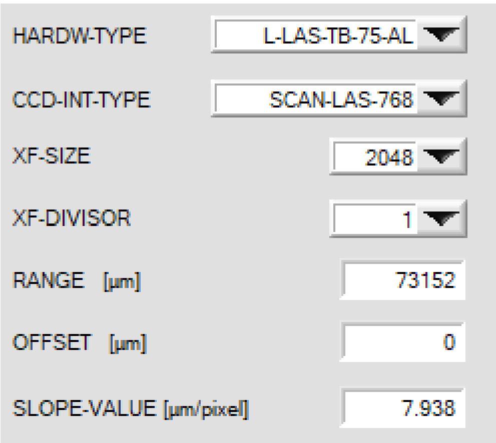
MAX-PROG:
Set number of program rows which are used for evaluation.

3.6 CALIBRATION SETTINGS tab



CALIB tab:

A click on the [CALIB] tab opens a window that displays calibration data.
When connection is successfully established, these calibration data are automatically transferred from the *L-LAS-TB-…-AL* sensor to the PC.
Information about the detected hardware, the working range, and sensor resolution is displayed in a text field.



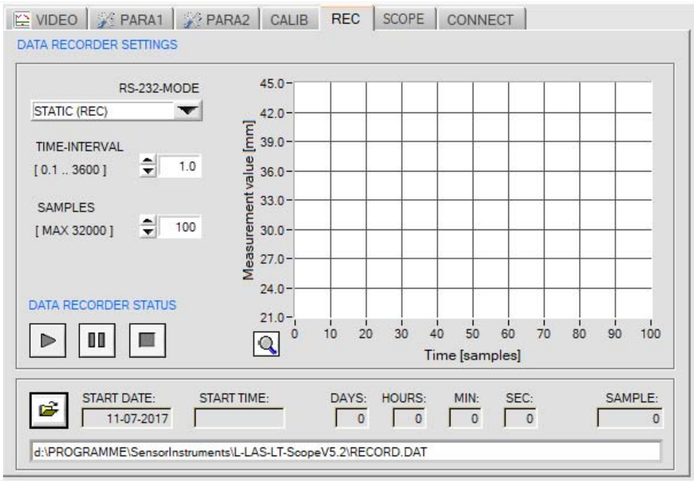
Sensor calibration data:

The sensor-specific factory settings are displayed in several function fields.

These factory-settings only can be changed by the manufacturer!

SERIAL-NO:	4-digit serial number
HARDW-TYPE:	Hardware designation of the sensor
XF-SIZE:	Size of the look-up table
XF-DIVISOR:	Divisor for conversion of the look-up values.
RANGE [µm]:	Measurement range
OFFSET [µm]:	Measurement range start
SLOPE-VALUE [µm/pixel]:	Sensitivity

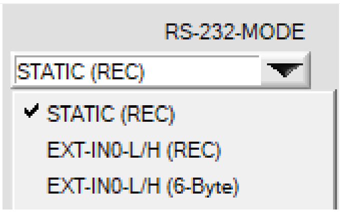
3.7 DATA RECORDER SETTINGS tab:



REC tab:

Click on the [REC] tab to open a window that contains settings for the data recorder.

In this window you can make several settings for the data recorder. The data recorder is used to automatically record measurement data in an output file.



RS232 MODE:

This function field is used to set the operating mode of RS232 data exchange between the PC (PLC) and the *L-LAS-LT Control Unit*.

STATIC (REC):

The sensor does not automatically send measurement data through the RS-232 interface. Every individual data transfer is started by the PC (PLC) with command no. 18. Upon this request the sensor sends a single data frame (36 bytes) to the PC (PLC).

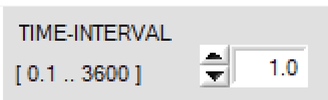
EXT-IN0 L/H (REC):

A single data frame (36 bytes) is automatically sent to the PC (PLC) at every LOW/HIGH edge at digital input IN0/pin3/green.

EXTI-IN0 L/H (6-BYTE):

Cannot be used with the data recorder!

The current measurement value in micrometres is sent with a 6-byte data frame to the RS232 female connector at every LOW/HIGH edge at digital input IN0/pin3/green.



TIME-INTERVAL [s]:

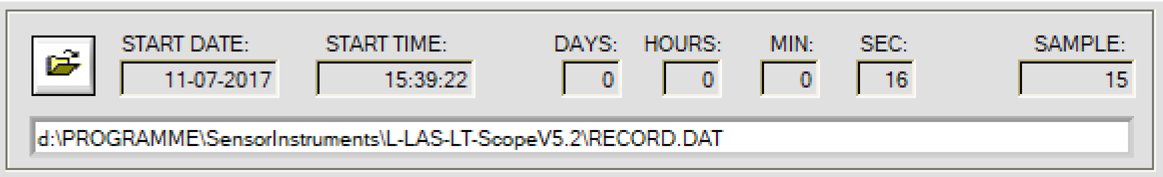
This numeric input field can be used to set a time interval in seconds. When this time interval is over, the PC software automatically requests measurement data from the sensor (command 18). The PC (PLC) waits until the complete data frame (36 bytes) from the sensor has arrived in the input buffer of the serial interface of the PC (PLC). Then the PC (PLC) saves the new measurement data in an output file on the hard disk.

Minimum value: 0.1 [s], maximum value 3600[s] =1 hour.

SAMPLES:

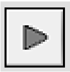
Numeric input field for presetting the maximum number of measurement values that should be saved. The value range is 10 to 32000.

NUMERIC DISPLAY of the data recorder:

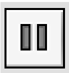


Numeric display fields providing information about the start date and start time of the data recorder. These displays only are updated when the START button is pressed!

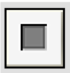
DATA RECORDER STATUS:



START:
Click on the START button to automatically start data recording.

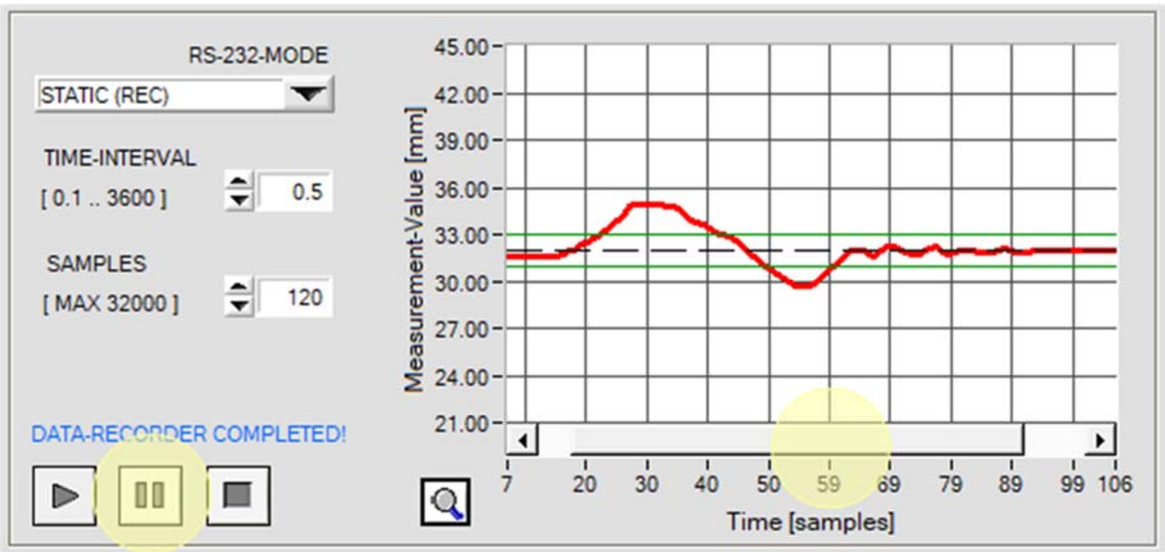


PAUSE:
Click on the PAUSE button to interrupt the ongoing graphic output. In the graphic window you can then look at the already recorded data.
The PAUSE button does not interrupt ongoing data recording!



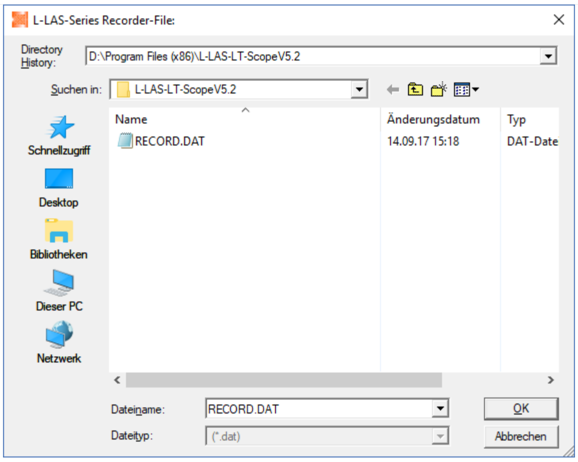
STOP:
Click on the STOP button to stop the ongoing data exchange between PC (PLC) and sensor. The STOP button can be used to stop the process of recording before the maximum number that is preset in the SAMPLES field has been reached.

GRAPHIC DISPLAY of the data recorder:



After the START of data recording the temporal measurement value profile is shown as a red curve. The setpoint value is displayed as a black dashed line. The tolerance band around the setpoint value is represented by green lines. The graphic display shows the last 100 measurement values. If you wish to see previously recorded values, click on the PAUSE button. A scroll bar will appear in the graphic display and can be used to scroll to previously recorded values. During this PAUSE time data transfer and saving in the output file are not interrupted but continue to run in the background.

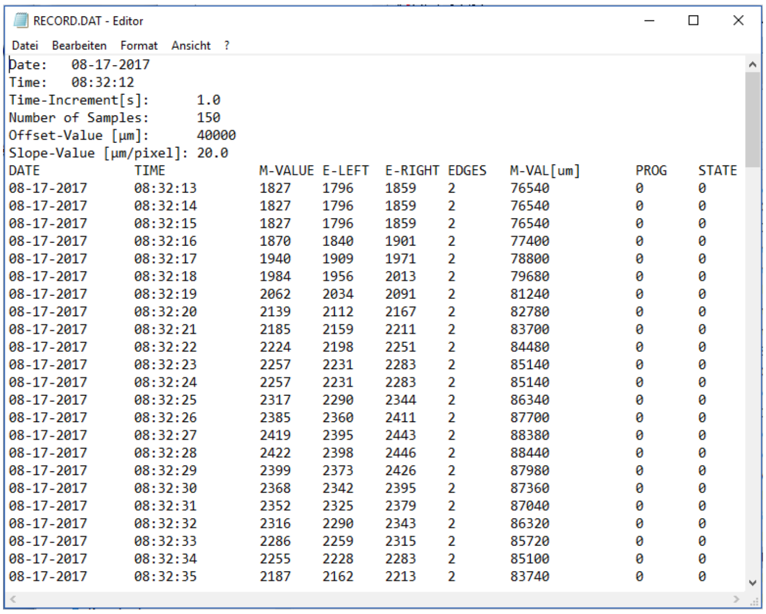
3.7.1 Data format of the output file



FILE button

Click on the FILE button to open a new dialog window where you can enter the file name and set the directory for the output file.

The currently selected directory and the file name of the output file are shown in a text display under the FILE button.



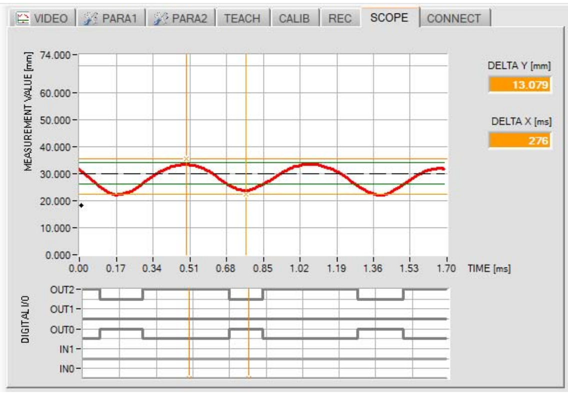
Date: 08-17-2017
Time: 08:32:12
Time-Increment[s]: 1.0
Number of Samples: 150
Offset-Value [µm]: 40000
Slope-Value [µm/pixel]: 20.0

DATE	TIME	M-VALUE	E-LEFT	E-RIGHT	EDGES	M-VAL[um]	PROG	STATE
08-17-2017	08:32:13	1827	1796	1859	2	76540	0	0
08-17-2017	08:32:14	1827	1796	1859	2	76540	0	0
08-17-2017	08:32:15	1827	1796	1859	2	76540	0	0
08-17-2017	08:32:16	1870	1840	1901	2	77400	0	0
08-17-2017	08:32:17	1940	1909	1971	2	78800	0	0
08-17-2017	08:32:18	1984	1956	2013	2	79680	0	0
08-17-2017	08:32:19	2062	2034	2091	2	81240	0	0
08-17-2017	08:32:20	2139	2112	2167	2	82780	0	0
08-17-2017	08:32:21	2185	2159	2211	2	83700	0	0
08-17-2017	08:32:22	2224	2198	2251	2	84480	0	0
08-17-2017	08:32:23	2257	2231	2283	2	85140	0	0
08-17-2017	08:32:24	2257	2231	2283	2	85140	0	0
08-17-2017	08:32:25	2317	2290	2344	2	86340	0	0
08-17-2017	08:32:26	2385	2360	2411	2	87700	0	0
08-17-2017	08:32:27	2419	2395	2443	2	88380	0	0
08-17-2017	08:32:28	2422	2398	2446	2	88440	0	0
08-17-2017	08:32:29	2399	2373	2426	2	87980	0	0
08-17-2017	08:32:30	2368	2342	2395	2	87360	0	0
08-17-2017	08:32:31	2352	2325	2379	2	87040	0	0
08-17-2017	08:32:32	2316	2290	2343	2	86320	0	0
08-17-2017	08:32:33	2286	2259	2315	2	85720	0	0
08-17-2017	08:32:34	2255	2228	2283	2	85100	0	0
08-17-2017	08:32:35	2187	2162	2213	2	83740	0	0

The output file of the data recorder consists of 7 header lines, followed by the actual measurement data.
The measurement data are written to the output file line-by-line. Each line comprises 9 columns that are separated from each other by a TAB control character.
The output file can be opened with a simple text editor or a spreadsheet program (e.g. Microsoft EXCEL).

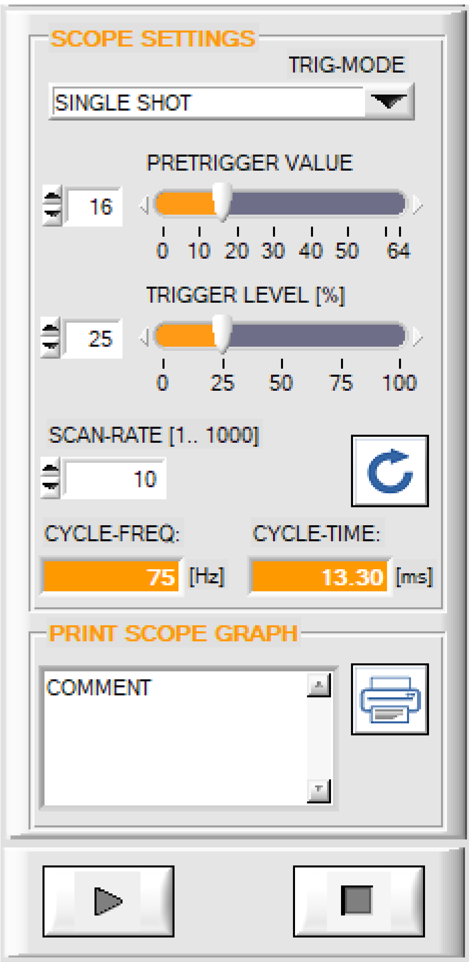
1. Column : = DATE: Date of measurement value acquisition
2. Column : = TIME: Time of measurement value acquisition
3. Column : = M-VALUE: Measurement value (pixel)
4. Column : = E-LEFT: Pixel position of left edge at video peak
5. Column : = E-RIGHT: Pixel position of right edge at video peak
6. Column : = EDGES: Number of detected edges
7. Column : = M-VAL[µm]: Measurement value in micrometres
8. Column : = PROG: Program number
9. Column : = STATE: System state (0 = OK)

3.8 SCOPE tab :



SCOPE tab:
Click on the [SCOPE] tab to open a window that contains an oscilloscope function of the L-LAS-TB control-unit.

t sich auf der Bedienoberfläche das VERBINDUNGS



SCOPE SETTINGS:
In this window you can make several settings for oscilloscope function. After a trigger event 128 measurement values are stored in principal in the trigger-buffer of the L-LAS control unit. After this the trigger-buffer is transferred via the RS-232 interface to the PC. The following basic settings can be made:

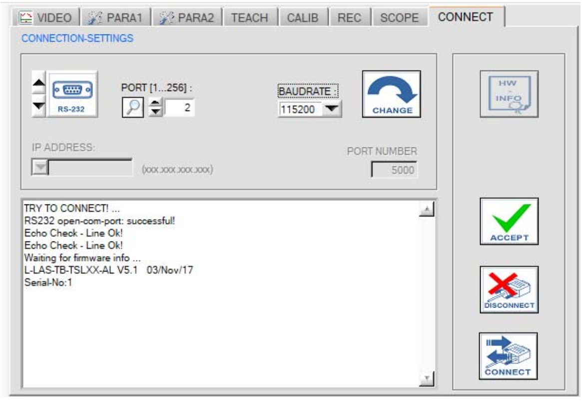
● TRIGGER-MODE
The trigger mode can be set to SINGLE shot or to RISING- or FALLING progress of the measurement values. In EXT-IN mode the trigger can be started external via the digital input IN0.

● PERTRIGGER VALUE
A pretrigger value can be used to define how many values should still be sampled before the actual trigger event occurs.

● TRIGGER-LEVEL[%]
The trigger-level setting only is used in the modes RISING or FALLING progress of measurement values. If the actual measurement value is crossing this threshold, the data recording is started.

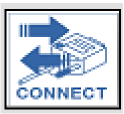
● SCAN-RATE[1-1000]
With the help of the SCAN-RATE the duration of the trigger recording can be set. .

3.9 CONNECTION tab



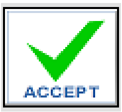
CONNECTION tab:
A click on this tab opens the CONNECTION window, where you can set various parameters for data exchange through the serial RS232 interface.
Basically the following default values are used for communication:

- Standard RS232 serial interface, no hardware handshake
- 3-wire-connection: GND, TXD, RXD
- Baudrates from 9600Baud to 115200Baud
- 8 DATA bits, 0 PARITY bit, 1 STOP bit
- Highest-order byte first (MSB first).



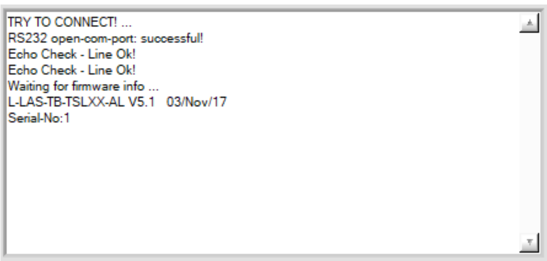
CONNECT:
When you click on this button, the system attempts to establish a connection to the sensor with the set communication parameters. Feedback about the progress of connection establishment is shown in the status display field.

DISCONNECT:
Click on this button to disconnect the connection with the sensor. The opened communication port becomes free again.



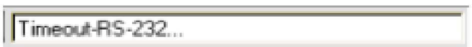
ACCEPT:
When you click on the ACCEPT button, the current communication settings are saved in the *TB-Scope.ini* file. When the *L-LAS-TB-Scope* software is started again, communication is established with the parameters saved in the *TB-Scope.ini* file.

STATUS MESSAGES – CONNECTION PROBLEMS:



When the software is started it attempts to establish a connection to the *L-LAS-TB-…-AL sensor* through the COM interface that was last used.

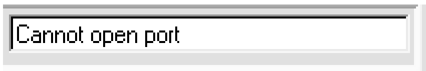
If connection could be established successfully, the current firmware version and the serial number of the sensor are displayed in the status line.



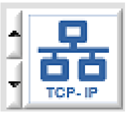
The serial connection between the PC and the *L-LAS-TB-…AL control unit* could not be established, or the connection is faulty.

In this case it should first be checked whether the *L-LAS-TB-…-AL control unit* is connected to the power supply, and whether the serial interface cable is correctly connected to PC and control unit.

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.

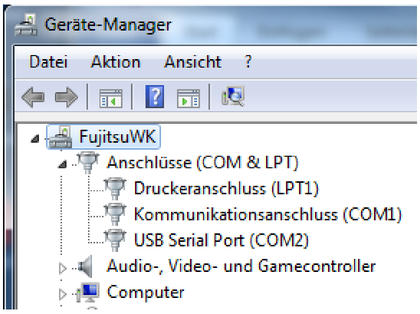


COMMUNICATION TYPE:

The type of data communication can be set in this function field:

RS232:
Data communication through the standard RS232 interface.

TCP/IP:
Data communication through a RS232-TCP/IP Ethernet converter module.

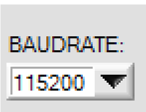


PORT [1…256]:

The number of the communication port can be set in this function field. Possible values are COM 1 to 255.
The communication port number can be found in the Windows® operating system under START/Control Panel/Device Manager.

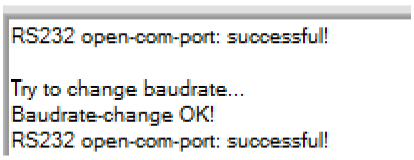
As an alternative the communication port numbers that are available on the PC can be searched by clicking on the magnifier symbol.

The available COM ports are displayed in the status text field.



BAUDRATE:

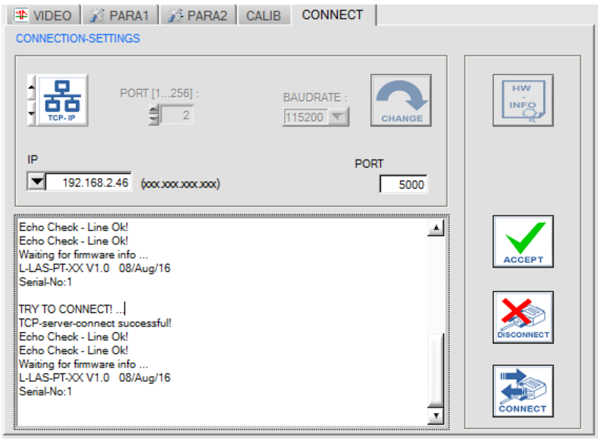
The baud rate of the serial interface can be set in this function field:
Possible values: 9600Baud, 19200Baud, 38400Baud, 57600Baud or 115200Baud.
(Setting when delivered = 115200 Baud).



CHANGE BAUDRATE:

With a click on this button the baud rate of the serial interface at the sensor hardware is changed to the value selected in the SELECT-BAUDRATE list field. A corresponding status message will be displayed when the change of baud rate at the sensor was successful.
The baud rate change is performed in the volatile RAM memory of the *L-LAS-TB-…-AL sensor*. If the baud rate should be changed permanently, the new baud rate value must be saved to the EEPROM by clicking on the [SEND] + [EEPROM] button!

3.9.1 Data transfer through the external RS232 to Ethernet adapter (cab-4/ETH-500)

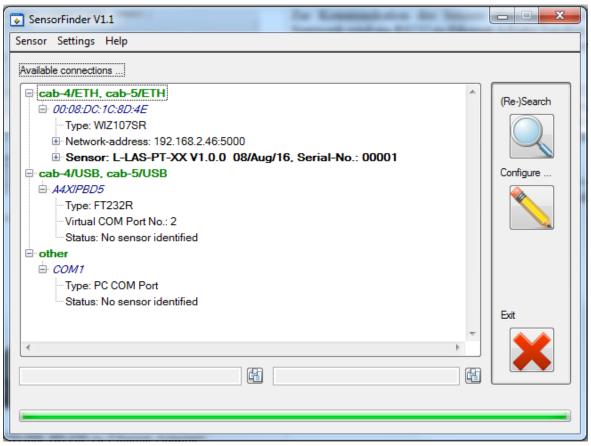


An RS232 to Ethernet adapter (***cab-4/ETH-500***) is needed if the sensor should communicate through a local network. With this adapter a connection to the sensor can be established using the **TCP/IP** protocol.

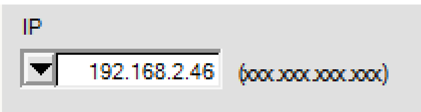
The network adapter converts the standard RS232 signals of the sensor and provides an interface for a LAN network. The RS232 interface can be operated with a Baudrate of 11200Baud.

A software (*SensorFinder*) that is supplied with the adapter can be used to find the adapter in the network – and to then configure it:

cab-4/ETH-500 RS232 to Ethernet adapter

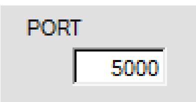


Software: *SensorFinder V1.1*



IP ADDRESS:

Input mask for entering the IP address.



PORT NUMBER:

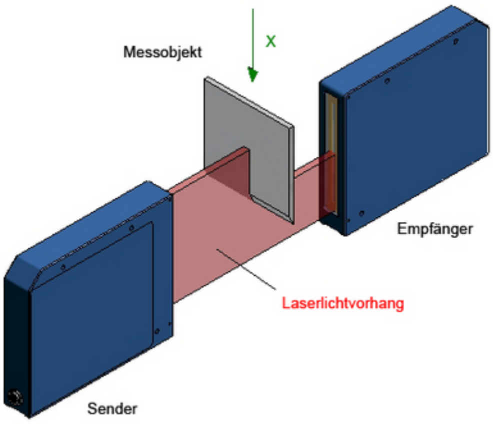
The **PORT NUMBER** for the network adapter ***(cab-4/ETH-500)*** is set to PORT:5000. This value must not be changed.

ACCEPT SETTINGS:

With a click on the ACCEPT SETTINGS button the current setting values of the *L-LAS-TB-Scope* PC software are saved in the TB-Scope.ini file. The popup window will then be closed. When the *L-LAS-TB-Scope* software is restarted, the parameters saved in the INI file will be loaded.

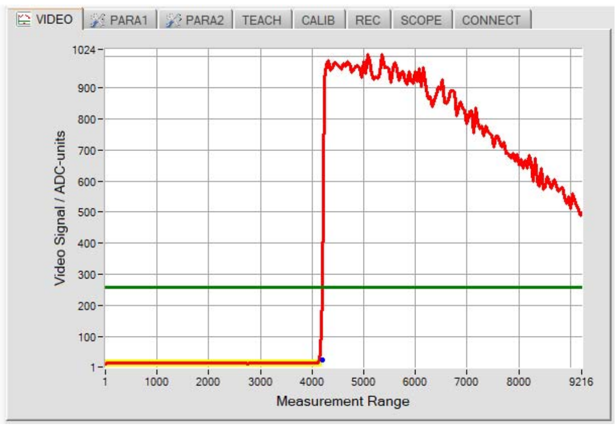
4 Working with the *L-LAS-TB-Scope* software

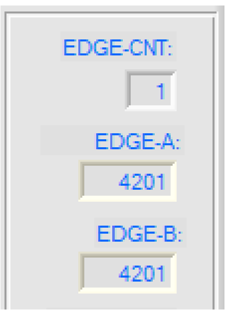
4.1 Aid for sensor adjustment, numeric and graphic display elements



The picture on the left side shows the principle function of the *L-LAS-TB-…-AL sensor* in through-beam mode.

On its path between transmitter and receiver the laser beam is partially covered. The object position can be determined from the resulting typical intensity characteristic at the line sensor (VIDEO image).





VIDEO IMAGE:
X-axis: Position of pixels of the receiver line.
Y-axis: Intensity height at the individual pixel.

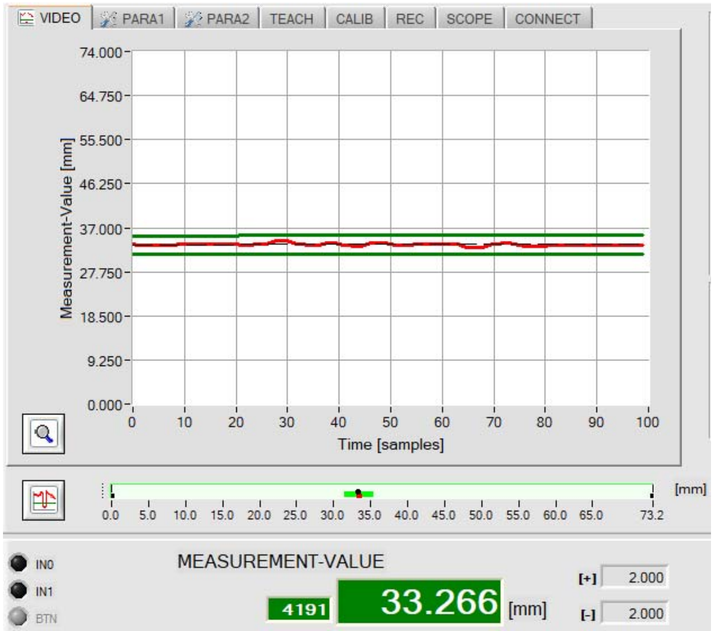
The position of the lower end of the measuring object can be calculated from the VIDEO image (red curve) that results when the measuring object partly covers the laser beam. For this purpose the covered pixels of the line sensor are determined (low intensity).

The "edge values" are calculated by means of an adjustable comparator threshold (=video-threshold, green horizontal line). The calculated edge position (pixel) is indicated by a black marker.

The pixel position and the number of edges is also shown in numeric display fields.
In the area below the measuring object the laser beam from the transmitter reaches the receiver pixel line without any obstacles. This results in a higher intensity at the individual pixels.

If the surface of the polishing head is not smooth and homogeneous, the position of the "edge" in the VIDEO image will move to the right or left. This change also affects the measurement value and must be monitored by means of tolerance thresholds.

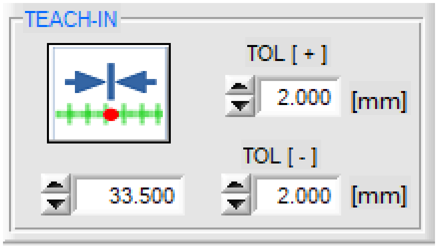
4.2 Teaching the reference position



In measurement value display mode the change of measurement values (= position of the measuring object) can be watched when the object moves slowly.

The current measurement values (pixel values) move through the display window from right to left.

The measurement value fluctuations that can be observed here provide information about the minimum tolerance band that should be set around the reference value.



TEACH-IN:

Click on the software button or enter a numerical value in the TEACH-IN input field to preset a reference value at the sensor.
When you click on the TEACH-IN button, the teach procedure will be started at the sensor. The currently selected edge is used as the teach position. The size of the tolerance band can be preset in the corresponding input fields.

TEACH function with the PLC:

As an alternative the teach function also can be started with the PLC through digital input IN1.

When a HIGH pulse of more than **1.5s** duration is applied, the TEACH function will be started at the *L-LAS-TB-…-AL sensor*. When the TEACH pulse is detected, the orange POWER LED at the housing shortly blinks 3 times.

The currently detected edge position is used as the teach value. The tolerance band automatically is calculated anew around the reference value that is determined this way. The switching thresholds for the digital outputs thus are calculated anew.

4.3 Working with the teach table

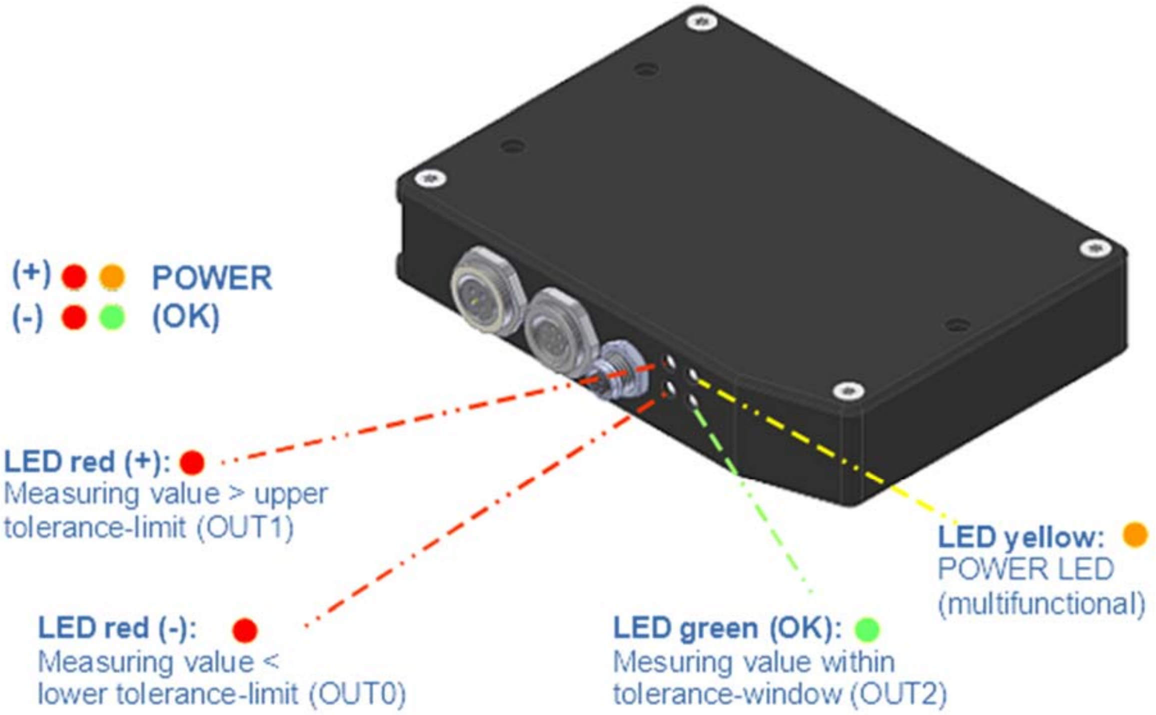
(to be done ...)

5 Annex

5.1 Display elements

At the housing of the *L-LAS-TB-…-AL control unit* there are 4 bicolor LEDs that visualise system states.

L-LAS-TB- … - R-AL (receiver)



5.2 Laser warning

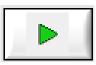
LASER WARNING

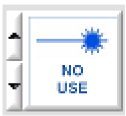
Solid state laser, λ=670 nm, 0.4mW max. optical power,
Laser class 1 acc. to EN 60825-1
The use of these laser transmitters therefore requires no additional protective measures.

5.3 Function of digital input IN0

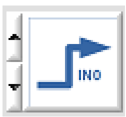
The function of digital input IN0/pin3/green depends on the operating mode that is set in the EXT-IN0-MODE function field (PARAMETERS-1 tab):

The state of IN0 is displayed on the user interface by way of the IN0 LED.
When there is a HIGH level (+24VDC) the LED lights up in green.
A change of state only is refreshed if data transfer is active !

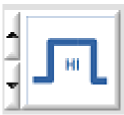

GO



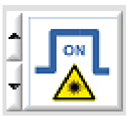
NO USE = CONTINUOUS OPERATION:
The control unit continuously evaluates the video images. The evaluation result continuously is provided at the digital outputs (OUT0, OUT1, OUT2) and at the analog output.



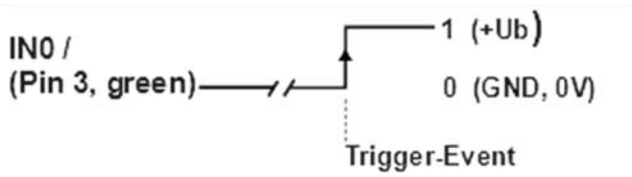
TRIGG-IN0 L/H:
The current video image immediately after the LOW/HIGH edge is used for evaluation and is output.



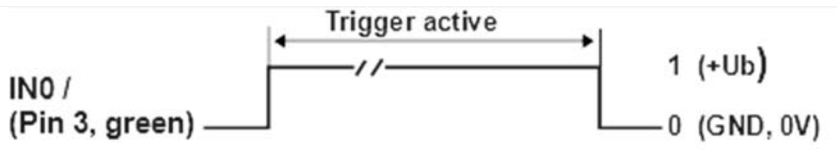
TRIGG IN0 HIGH:
Video images only are evaluated when there is a HIGH level (+24VDC) at pin3/IN0.



LASER ON/OFF:
The laser transmitter can be turned on or off through the external trigger input IN0/pin3.
IN0 = 0V: LASER OFF
IN0 = +24VDC: LASER ON



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



TRIGG-IN0 HIGH:
External triggering of measurement value evaluation through a HIGH level (+Ub) at digital input IN0.

5.4 Function of the digital input IN1

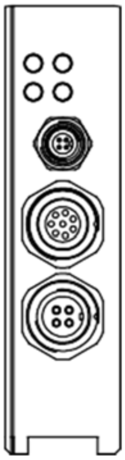
RESET function:

When a HIGH pulse of **less than 750 ms** duration is applied, the RESET function is performed at the *L-LAS-TB-…-AL sensor*. This resets the current maximum and minimum values (drag pointer).
A hardware/software RESET is not performed!
When a RESET pulse is detected, the yellow POWER LED flashes shortly one time.

TEACH function:

When a HIGH pulse of **more than 1.5s** duration is applied, the TEACH function is performed at the *L-LAS-TB-…-AL sensor*. When a TEACH pulse is detected, the yellow LED at the housing flashes shortly three times.

5.5 Connector assignment



There are three connecting sockets at the housing of the *L-LAS-TB-…-AL sensor*.

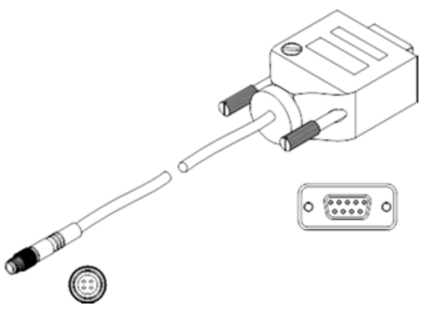
A 4-pole M5 socket type Binder 707 is used to connect the serial RS232 interface.

An 8-pole M9 socket type Binder 712 is used to connect the sensor with the PLC / power supply.

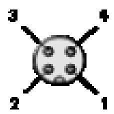
A 4-pole M9 socket type Binder 712 is used to connect the L-LAS transmitter unit.

RS232 connection to the PC:

4-pole female M5 connector type Binder 707
Connecting cable: cab-las4/PC (standard length 2m, cable jacket: PUR), also available: cab-4/USB, cab-4/ETH-500

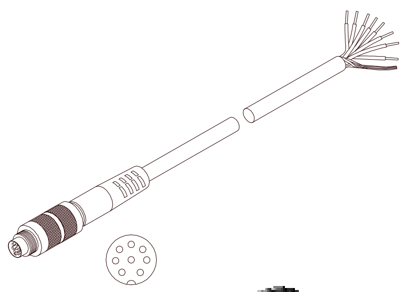


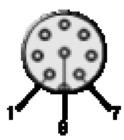
Pin	Assignment
1	+Ub
2	0V (GND)
3	RxD
4	TxD



Interface to PLC/voltage supply:

8-pole female connector type Binder 712
Connecting cable: cab-las8/SPS (standard length 2m, cable sheath: PUR)





Pin	Color	Assignment L-LAS-TB-…-AL
1	White	0V (GND)
2	Brown	+24 VDC ± 10%
3	Green	IN0 (EXT TRIGGER)
4	Yellow	IN1 (TEACH/RESET)
5	Grey	OUT0 (-)
6	Pink	OUT1 (+)
7	Blue	OUT2 (OK)
8	Red	Analog (voltage 0…+10V or current 4…20mA)

5.6 RS232 interface protocol

- Standard RS232 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 sensor control unit always behaves passively. Data exchange therefore is initiated by the PC (or PLC). The PC sends a data package ("frame") either with or without appended data, to which the sensor control unit responds with a frame that matches the request. The data package comprises a **HEADER** and the optional **DATA**.

HEADER

1. Byte : Synchronisation byte <SYNC> (85dez = 0x55hex)
2. Byte: Order byte <ORDER>
3. Byte : Argument <ARG LO>
4. Byte : Argument <ARG HI>
5. Byte : Data length <LEN LO>
6. Byte : Data length <LEN HI>
7. Byte : Checksum Header <CRC8 HEAD>
8. Byte : Checksum Data <CRC8 DATA>

The first byte is a synchronisation byte and always is 85_{dez} (55_{hex}). The second byte is the so-called order byte <ORDER>, it determines the action that should be performed (send data, save data, etc.).
A 16-bit value <ARG> follows as the third and fourth byte. Depending on the order the argument is assigned a corresponding value. The fifth and sixth byte again form a 16-bit value <LEN>. This value states the number of appended data bytes. Without appended data <LEN=0>, the maximum data length is 512 bytes <LEN=512>. The seventh byte is formed with the CRC8 checksum over all data bytes.
The eight byte is the CRC8 checksum for the header and is formed from bytes 0 up to and incl. 7.
The header always has a total length of 8 bytes. The complete frame may contain between 8 and 520 bytes.

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header	Byte9 Data	Byte10 Data	...	Byte n+7 Data	Byte n+8 Data
0x55	<ORDER>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	Data1 (lo byte)	Data1 (hi byte)	...	Data n/2 (lo byte)	Data n/2 (hi byte)

<ORDER>	Meaning of the 2.nd byte <order>:	ORDER-TABLE
0	NOP	no operation
1	Send parameter from PC to L-LAS-RAM	PC ⇒ L-LAS-RAM
2	Get parameter from L-LAS-RAM	L-LAS-RAM ⇒ PC
3	Send parameter from PC to EEPROM	PC ⇒ L-LAS-EEPROM
4	Get parameter from EEPROM of L-LAS	L-LAS-EEPROM ⇒ PC
5	Echo check: Get echo of L-LAS	first word=0x00AA=170dec
6	Activate teach at L-LAS, store in RAM	PC ⇒ L-LAS-RAM
7	Get software version info of L-LAS	L-LAS ⇒ PC
8	**Get measured values from L-LAS-RAM**	**L-LAS-RAM ⇒ PC**
9	Get video-buffer info from L-LAS	L-LAS-RAM ⇒ PC
11	Reset maximum/minimum values at analog-output	PC ⇒ L-LAS-RAM
18	Get data recorder values from L-LAS	L-LAS-RAM ⇒ PC
22	Set laser power at L-LAS	PC ⇒ L-LAS-RAM
190	Change RS232-baud-rate (L-LAS-RAM)	PC ⇒ L-LAS-RAM

CRC8 checksum

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

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

To verify the data after they have been received, CRC calculation is performed once again. If the sent and the newly calculated CRC values are identical, the data are without error.
The following pseudo code can be used for checksum calculation:

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

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

table[ ]

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

5.6.1 Parameter set format

The sensors of the *L-LAS-TB-…-AL series* operate with the following parameters that are sent to the sensor or read from the sensor as appended data in the stated sequence:

DATA-FRAME: <parameter-set>		
Para	**Meaning**	**Comment**
0	POWER	Laser intensity (0 … 1000)
1	INTEGRATION-TIME	Integration time 0.3ms … 10ms (= 300 … 10000)
2	POWER-MODE	Laser power mode: (0 = STATIC), (1=DYNAMIC), (2=DYN-EXPOSE)
3	SEARCH-DIRECTION	Edge search: (0:= LEFT_TO_RIGHT, 1:=RIGHT_TO_LEFT)
4	EVAL-MODE	Evaluation mode (0=L-EDGE, 1=R-EDGE, 2=WIDTH, 3=CENTER)
5	BACKGROUND-MODE	Background compensation (0:=OFF, 1:=ON)
6	EVALUATE-PROGRAM	Program number to evaluate (0,1,2 or 3)
7	E-BEG	Evaluation start-pixel (1 … E_END - 1)
8	E-END	Evaluation end -pixel (E_BEG+1 … SUBPIXEL)
9	TEACH-VALUE	Teach-value (1 … SUBPIXEL)
10	TOLERANCE-HI-VALUE	Upper-tolerance (0 ... SUBPIXEL/2)
11	TOLERANCE-LO-VALUE	Lower-tolerance (0 … SUBPIXEL/2)
12/13	UM-BEGIN	Range begin in [microns] Attention long-variable 32 bit
14/15	*UM-END*	*Range end in [microns] Attention long variable 32 bit*
16/17	*UM-TEACH*	*Teach-value in [microns] Attention long variable 32 bit*
18/19	*UM-TOLUP*	*Upper tolerance in [microns] Attention long variable 32 bit*
20/21	*UM-TOLLO*	*Lower tolerance in [microns] Attention long variable 32 bit*
22	AVERAGE	Average-setting (1,2,4,5,16,32,64,128,256, 512 or 1024)
23	POLARITY	Polarity for OUT0, OUT1 und OUT2 (0=DIRECT, 1=INVERT)
24	DOUT-MODE	Mode for digital outputs (0, or 1)
25	OP-MODE	CCD-operation-mode (0=FULL_RES, 1=HALF_RES/DOUBLE-SPEED)
26	HW-MODE	Enable/disable button at housing (DISABLE=0, ENABLE=1)
27	AOUT-MODE	Mode for analog output (0:=UOUT, 1:=I-OUT 4..20mA)
28	ANA-MODE	Analog-mode (0=DIRECT,1=MAXIMA,2=MINIMA,3=MAX_MIN)
29	ANA-ZOOM	Analog-output-zoom-mode: output (0=DIRECT, 1=ZOOMx1, 2=ZOOMx2, 3=ZOOMx4, 4=ZOOMx8, 5=ZOOMx16, 6=WIN_10V)
30	VIDEO-THRESHD MODE	Video-threshold FIX (0 … 100
31	VIDEO-THRESHD FIX	Video-threshold FIX (0 … 100
32	VIDEO-THRESHD AUTO	Video-threshold AUTO 0 … 100
33	RS232-MODE	RS232 mode: (0=STAT,1=IN0-L/H,2=IN0-HI[6-byte],3=CONT[6-byte]
34	RS232-BAUDRATE	Baudrate: (0=9600,1=19200,2=38400,3=57600,4=115200) baud
35	VIDEO-SMOOTH	Smooth video signal over (1,2,4,6,8,12,14,16,32,or 64) pixel
36	EXT-TRIGG-MODE	External-trigger-mode:(0=CONTINOUS, 1=IN0 L/H, 2=IN0 HI, 3=PROG2, 4=PROG4, 5=LASER-ON)
37	INT-TRIGG-MODE	Internal-trigger-mode (0=DISABLE, 1=ENABLE-DARK, 2=ENABLE-LIGHT)
38	INT-TRIGG-THD	Internal-trigger-threshold pixel (1 … SUBPIXEL)
39	MAX-PROG-NO	Max. possible programs (0,1,2 or 3)
40	FREE-USE	Free-use
41	FREE-USE	Free-use

5.6.2 RS232 data transfer examples

< ORDER = 5 > : ECHO-CHECK, READ LINE OK from sensor.

DATA FRAME PC → Sensor (8 Bytes)

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

DATA FRAME Sensor → PC (8 Bytes)

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

Serial – number of sensor = <ARG> value

< ORDER = 7 > : Read FIRMWARE-VERSION STRING from sensor.

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

DATA FRAME Sensor → PC (8 + 72) Bytes

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header	Byte9 Data	Byte10 Data	Byte11 Data	Byte12 Data
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	ASCII	ASCII	ASCII	ASCII
85 (dec)	7	1	2	72	0	252	82	L	-	L	A
		ARG=513 (Ser.-No)		LEN=72							

Byte13 Data	Byte14 Data	Byte15 Data	Byte16 Data	Byte17 Data	Byte18 Data	Byte19 Data	Byte20 Data	Byte21 Data	Byte22 Data	Byte23 Data	Byte24 Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII
S	-	T	B	-	T	S	L	X	X	-	A

Byte25 Data	Byte26 Data	Byte27 Data	Byte28 Data	Byte29 Data	Byte30 Data	Byte31 Data	Byte32 Data	Byte33 Data	Byte34 Data	Byte35 Data	Byte36 Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII
L		V	5	.	1	.	0			10	/

Byte37 Data	Byte38 Data	Byte39 Data	Byte40 Data	Byte41 Data	Byte42 Data	Byte43 Data	Byte44 Data	Byte45 Data	Byte46 Data	Byte47 Data	Byte48 Data
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII
N	o	v	/	1	7						

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

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

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

< ORDER = 1 > : SEND PARAMETER-SET TO RAM of the sensor

DATA FRAME PC → Sensor (8 + 84) Bytes

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header	Byte9 Data	Byte10 Data	Byte11 Data	Byte12 Data
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	Para1 (lo byte)	Para1 (hi byte)	Para2 (lo byte)	Para2 (hi byte)
85 (dec)	1	0	0	42	0	xxx	81	144	1	244	1
		ARG=0		LEN=42				POWER=400		INT-TIME=500	

Byte13 Data	Byte14 Data	Byte15 Data	Byte16 Data	Byte17 Data	Byte18 Data	Byte19 Data	Byte20 Data	Byte21 Data	Byte22 Data	Byte23 Data	Byte24 Data
Para3	Para3	Para4	Para4	Para5	Para5	Para6	Para6	Para7	Para7	Para8	Para8
0	0	0	0	0	0	0	0	0	0	1	0
P-MODE=0		SDIR=0		E-MODE=0		BG-MODE=0		E-PROG=0		E-BEG=1	

Byte25 Data	Byte26 Data	Byte27 Data	Byte28 Data	Byte29 Data	Byte30 Data	Byte31 Data	Byte32 Data	Byte33 Data	Byte34 Data	Byte35 Data	Byte36 Data
Para9	Para9	Para10	Para10	Para11	Para11	Para12	Para12	Para13	Para13	Para14	Para14
0	0	0	8	100	0	100	0	0	0	0	0
E-END=9216		TEACH=2048		TOLUP=100		TOLLO=100		UM-BEG=0			

Byte37 Data	Byte38 Data	Byte39 Data	Byte40 Data	Byte41 Data	Byte42 Data	Byte43 Data	Byte44 Data	Byte45 Data	Byte46 Data	Byte47 Data	Byte48 Data
Para15	Para15	Para16	Para16	Para17	Para17	Para18	Para18	Para19	Para19	Para20	Para20
112	17	1	0	0	0	0	0	0	0	0	0
UM-END=73125				UM-TEACH=240000				UM-TOLUP=0			

Byte49 Data	Byte50 Data	Byte51 Data	Byte52 Data	Byte53 Data	Byte54 Data	Byte55 Data	Byte56 Data	Byte57 Data	Byte58 Data	Byte59 Data	Byte60 Data
Para21	Para21	Para22	Para22	Para23	Para23	Para24	Para24	Para25	Para25	Para26	Para26
0	0	0	0	2	0	0	0	2	0	0	0
UM-TOLLO=10000				AVERAGE=2		POLARITY=0		DOUT-MODE=2		OP-MODE=0	

Byte61 Data	Byte62 Data	Byte63 Data	Byte64 Data	Byte65 Data	Byte66 Data	Byte67 Data	Byte68 Data	Byte69 Data	Byte70 Data	Byte71 Data	Byte72 Data
Para27	Para27	Para28	Para28	Para29	Para29	Para30	Para30	Para31	Para31	Para32	Para32
1	0	0	0	0	0	0	0	0	0	25	0
HW-MODE=1		AOUT-MODE=0		ANA-MODE=0		ANA-ZOOM=0		VTHD-MODE=0		VTHDFIX=25	

Byte73 Data	Byte74 Data	Byte75 Data	Byte76 Data	Byte77 Data	Byte78 Data	Byte79 Data	Byte80 Data	Byte81 Data	Byte82 Data	Byte83 Data	Byte84 Data
Para33	Para33	Para34	Para34	Para35	Para35	Para36	Para36	Para37	Para37	Para38	Para38
75	0	0	0	4	0	2	0	0	0	0	0
VTHDAUTO=75		RS232-MODE=0		RS232-BAUD=4		VIDEO-SMOOTH=2		TRIG-MODE=0		INTTRGMODE=0	

Byte85 Data	Byte86 Data	Byte87 Data	Byte88 Data	Byte89 Data	Byte90 Data	Byte91 Data	Byte92 Data
Para39	Para39	Para40	Para40	Para41	Para41	Para42	Para42
10	0	4	0	0	0	0	0
TRIGPIX=10		MAXPROG=4		FREE-USE=0		FREE-USE=0	

DATA FRAME Sensor → PC (8 Byte)

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	1	0	0	0	0	170	81
		ARG=0		LEN=0			

< ORDER = 2 > : READ PARAMETER-FROM RAM of the sensor

DATA FRAME PC → Sensor (8 Bytes)

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

DATA FRAME Sensor → PC (8+84) Bytes

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header	Byte9 Data	Byte10 Data	Byte11 Data	Byte12 Data
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	Para1 (lo byte)	Para1 (hi byte)	Para2 (lo byte)	Para2 (hi byte)
85 (dec)	2	0	0	42	0	xxx	185	144	1	244	1
		ARG=0		LEN=42				POWER=400		INT-TIME=500	

The data-block is similar to < ORDER = 1 >:

●
●
●
●

Byte85 Data	Byte86 Data	Byte87 Data	Byte88 Data	Byte89 Data	Byte90 Data	Byte91 Data	Byte92 Data
Para39	Para39	Para40	Para40	Para41	Para41	Para42	Para42
10	0	4	0	0	0	0	0
TRIGPIX=10		MAXPROG=4		FREE-USE=0		FREE-USE=0	

< ORDER = 6 > : INITIATE TEACH-PROCEDURE at sensor (RAM)

The actual measurement value is set as new TEACH-IN value

DATA FRAME PC → Sensor (8-Bytes + 32)Bytes

A and B values are used for detecting the valid edge. (+1 = first positive edge, -1=first negative edge, 0=outer edge)

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header	Byte9 Data	Byte10 Data	Byte11 Data	Byte12 Data
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	Word1 (lo byte)	Word1 (hi byte)	Word2 (lo byte)	Word2 (hi byte)
85 (dec)	6	0	0	32	0	XXX	247	1	0	1	0
		ARG =0		LEN=32				A=1		B=1	

Byte13 Data	Byte14 Data	Byte15 Data	Byte16 Data	Byte17 Data	Byte18 Data	Byte19 Data	Byte20 Data	Byte21 Data	Byte22 Data	Byte23 Data	Byte24 Data
Word3	Word3	Word4	Word4	Word5	Word5	Word6	Word6	Word7	Word7	Word8	Word8
0	0	0	8	247	1	247	1	1	0	0	8
E-MODE=0		TVAL=2048		TOLUP=503		TOLLO=503		EDCNT=1		EDG-A=2048	

Byte25 Data	Byte26 Data	Byte27 Data	Byte28 Data	Byte29 Data	Byte30 Data	Byte31 Data	Byte32 Data	Byte33 Data	Byte34 Data	Byte35 Data	Byte36 Data
Word9	Word9	Word10	Word10	Word11	Word11	Word12	Word12	Word13	Word13	Word14	Word14
0	8	2	0	32	191	2	0	39	16	0	0
EDG-B=2048		FREE-USE=0		UM-TEACH=25000				UM-TOLUP=4000			

Byte37 Data	Byte38 Data	Byte39 Data	Byte40 Data
Word 15	Word15	Word16	Word16
16	39	0	0
UM-TOLLO=4000			

DATA FRAME Sensor → PC (8 + 32) Bytes

New TEACH-VECTOR is sent back in refreshed-BYTES

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header	Byte9 Data	Byte10 Data	Byte11 Data	Byte12 Data
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	Word1 (lo byte)	Word1 (hi byte)	Word2 (lo byte)	Word2 (hi byte)
85 (dec)	6	1	0	32	0	XXX	236	1	0	1	0
		ARG =1 = OK		LEN=32				A=1		B=1	

Byte13 Data	Byte14 Data	Byte15 Data	Byte16 Data	Byte17 Data	Byte18 Data	Byte19 Data	Byte20 Data	Byte21 Data	Byte22 Data	Byte23 Data	Byte24 Data
Word3	Word3	Word4	Word4	Word5	Word5	Word6	Word6	Word7	Word7	Word8	Word8
0	0	0	0	247	1	247	1	1	0	136	12
E-MODE=0		TVAL=2432		TOLUP=503		TOLLO=503		EDCNT=1		EDGE-A=3208	

Byte25 Data	Byte26 Data	Byte27 Data	Byte28 Data	Byte29 Data	Byte30 Data	Byte31 Data	Byte32 Data	Byte33 Data	Byte34 Data	Byte35 Data	Byte36 Data
Word9	Word9	Word10	Word10	Word11	Word11	Word12	Word12	Word13	Word13	Word14	Word14
136	12	0	0	7	192	2	0	160	15	0	0
EDGE-B=3208		FREE-USE=0		UM-TEACH=25463				UM-TOLUP=4000			

Byte37 Data	Byte38 Data	Byte39 Data	Byte40 Data
Word 15	Word15	Word16	Word16
160	15	0	0
UM-TOLLO=4000			

< ORDER = 8 > : READ MEASUREMENT DATA from sensor

DATA FRAME PC → Sensor (8 Bytes)

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

DATA FRAME Sensor → PC (8 + 60) Bytes

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header	Byte9 Data	Byte10 Data	Byte11 Data	Byte12 Data
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	Raw1 (lo byte)	Raw1 (hi byte)	Raw2 (lo byte)	Raw2 (hi byte)
85 (dec)	8	0	0	60	0	250	118	68	13	141	13
		ARG=0		LEN=60				EDGE_A = 3151		EDGE_B = 3151	

Byte13 Data	Byte14 Data	Byte15 Data	Byte16 Data	Byte17 Data	Byte18 Data	Byte19 Data	Byte20 Data	Byte21 Data	Byte22 Data	Byte23 Data	Byte24 Data
Raw3	Raw3	Raw4	Raw4	Raw5	Raw5	Raw6	Raw6	Raw7	Raw7	Raw8	Raw8
78	8	2	0	7	192	2	0	0	8	11	0
M_VAL = 3151		EDGE_CNT = 1		UM_VALUE = 25026				UM_MAX = 25026			

Byte25 Data	Byte26 Data	Byte27 Data	Byte28 Data	Byte29 Data	Byte30 Data	Byte31 Data	Byte32 Data	Byte33 Data	Byte34 Data	Byte35 Data	Byte36 Data
Raw9	Raw9	Raw10	Raw10	Raw11	Raw11	Raw12	Raw12	Raw13	Raw13	Raw14	Raw14
0	0	0	0	7	192	2	0	0	0	0	0
UM_MIN = 25019				UM_TEACH = 25463				UM_EVAL_BEG = 0			

Byte37 Data	Byte38 Data	Byte39 Data	Byte40 Data	Byte41 Data	Byte42 Data	Byte43 Data	Byte44 Data	Byte45 Data	Byte46 Data	Byte47 Data	Byte48 Data
Raw15	Raw15	Raw16	Raw16	Raw17	Raw17	Raw18	Raw18	Raw19	Raw19	Raw20	Raw20
192	69	4	0	104	13	0	0	250	3	0	0
UM_EVAL_END = 48768				ANAMAX=3152		ANAMIN = 3152		TVAL = 3207		INSTATE=0	

Byte49 Data	Byte50 Data	Byte51 Data	Byte52 Data	Byte53 Data	Byte54 Data	Byte55 Data	Byte56 Data	Byte57 Data	Byte58 Data	Byte59 Data	Byte60 Data
Raw21	Raw22	Raw23	Raw24	Raw25	Raw26	Raw27	Raw27	Raw28	Raw28	Raw29	Raw29
235	1	0	0	214	3	0	0	0	0	0	0
VIDEOMAX=1010		DYNPOW=0		DYNTIME=1004		DARKPIX=3207		STATE=0		EPROG=1	

Byte61 Data	Byte62 Data	Byte63 Data	Byte64 Data	Byte65 Data	Byte66 Data	Byte67 Data	Byte68 Data
Raw21	Raw22	Raw23	Raw24	Raw25	Raw26	Raw27	Raw27
235	1	0	0	214	3	0	0
MV_BEG=0		MV_END=0		SCANTIME=4016			

Name	Value	Type
raw	0x007046B4	raw_struct
raw.Lval	3153	unsigned short
raw.Rval	3153	unsigned short
raw.Mval	3153	unsigned short
raw.edcnt	1	unsigned short
raw.umVAL	25026	long int
raw.umMAX	25026	long int
raw.umMIN	25019	long int
raw.umTEACH	25463	long int
raw.umRBEG	0	long int
raw.umREND	48768	long int
raw.anamax	3152	unsigned short
raw.anamin	3152	unsigned short
raw.teach	3207	unsigned short
raw.instate	0	unsigned short
raw.videomax	1010	unsigned short
raw.dynpow	0	unsigned short
raw.dyntime	1004	unsigned short
raw.darkpix	3207	unsigned short
raw.state	0	short
raw.eprog	1	unsigned short
raw.mvstart	0	unsigned short
raw.mvend	0	unsigned short
raw.scntime	4016	long int

< ORDER = 11 > : RESET MAX/MIN VALUE OF ANALOG-OUTPUT at sensor

DATA FRAME PC → Sensor (8 Bytes)

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	11	0	0	0	0	170	47
		ARG=0		LEN=0			

DATA FRAME Sensor → PC (8 Bytes)

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	11	0	0	0	0	170	47
		ARG=0		LEN=0			

< ORDER = 18 > : READ DATA-RECORDER VALUE from sensor

DATA FRAME PC → Sensor (8 Bytes)

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	**18**	0	0	0	0	170	226
		ARG=0		LEN=0			

DATA FRAME Sensor → PC (8 + 16) Bytes

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header	Byte9 Data	Byte10 Data	Byte11 Data	Byte12 Data
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	Raw1 (lo byte)	Raw1 (hi byte)	Raw2 (lo byte)	Raw2 (hi byte)
85 (dec)	**18**	0	0	16	0	177	226	68	13	141	13
		ARG=0		LEN=60				EDGE_A = 3352		EDGE_B = 3352	

Byte13 Data	Byte14 Data	Byte15 Data	Byte16 Data	Byte17 Data	Byte18 Data	Byte19 Data	Byte20 Data	Byte21 Data	Byte22 Data	Byte23 Data	Byte24 Data
Raw3	Raw3	Raw4	Raw4	Raw5	Raw5	Raw6	Raw6	Raw7	Raw7	Raw8	Raw8
78	8	2	0	7	192	2	0	0	1	0	0
M_VAL = 3352		EDGE_CNT = 1		UM_VALUE = 26606				EPROG=0		STATE = 0	

Name	Value	Type
rec	0x007046F8	rec_struct
rec.lval	3352	unsigned short
rec.rval	3352	unsigned short
rec.mval	3352	unsigned short
rec.edcnt	1	unsigned short
rec.umval	26606	long int
rec.eprog	0	unsigned short
rec.state	0	short

< ORDER = 190 > : CHANGE BAUDRATE at sensor (RAM)

DATA FRAME PC → Sensor

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

New baud rate is set by <ARG> value:
ARG=0: baud rate = 9600
ARG=1: baud rate = 19200
ARG=2: baud rate = 38400
ARG=3: baud rate = 57600
ARG=4: baud rate = 115200

DATA FRAME Sensor → PC

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

< ORDER = 9 > : GET VIDEO-DATA INFORMATION of sensor

ATTENTION: Only 256 pixel of the CMOS line-sensor are transferred!
The <ARG> value determines the source of the VIDEO-DATA-INFORMATION
ARG = 0 : CMOS-VIDEO-RAM-DATA

DATA FRAME PC → Sensor

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)
85 (dec)	**9**	0	0	0	0	170	185
		ARG=0		LEN=0			

DATA FRAME Sensor → PC

Byte1 Header	Byte2 Header	Byte3 Header	Byte4 Header	Byte5 Header	Byte6 Header	Byte7 Header	Byte8 Header	Byte9 Data	Byte10 Data	Byte11 Data	Byte12 Data
0x55	<order>	<ARG> (lo byte)	<ARG> (hi byte)	<LEN> (lo byte)	<LEN> (hi byte)	CRC8 (Data)	CRC8 (Header)	Para1 (lo byte)	Para1 (hi byte)	Para2 (lo byte)	Para2 (hi byte)
85 (dec)	**9**	0	0	0	1	XXX	185	200	0	220	0
		ARG=0		LEN=256				PIX1=200		PIX2=220	

Byte13 Data	Byte14 Data	Byte15 Data	Byte16 Data	Byte17 Data	Byte18 Data	Byte19 Data	Byte20 Data	Byte21 Data	Byte22 Data	Byte23 Data	Byte24 Data
Para3	Para3	Para4	Para4	Para5	Para5	Para6	Para6	Para7	Para7	Para8	Para8
240	0	0	1	44	1	124	1	0	2	88	2
PIX3=240		PIX4=256		PIX5=300		PIX6=380		PIX7=512		PIX8=600	

Byte25 Data	Byte26 Data	Byte27 Data	Byte28 Data	Byte29 Data	Byte30 Data	Byte31 Data	Byte32 Data	Byte33 Data	Byte34 Data	Byte35 Data	Byte36 Data
Para9	Para9	Para10	Para10	Para11	Para11	Para12	Para12	Para13	Para13	Para14	Para14
168	2	170	2	188	2	188	2	198	2	208	2
PIX9=680		PIX10=682		PIX11=700		PIX12=700		PIX13=710		PIX14=720	

Byte37 Data	Byte38 Data	Byte39 Data	Byte40 Data	Byte41 Data	Byte42 Data	Byte43 Data	Byte44 Data	Byte45 Data	Byte46 Data	Byte47 Data	Byte48 Data
Para15	Para15	Para16	Para16	Para17	Para17	Para18	Para18	Para19	Para19	Para20	Para20
34	3	32	3	32	3	22	3	19	3	20	3
PIX15=802		PIX16=800		PIX17=800		PIX18=790		PIX19=787		PIX20=788	

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Byte49 Data	Byte50 Data	Byte51 Data	Byte52 Data	Byte53 Data	Byte54 Data	Byte55 Data	Byte56 Data	Byte57 Data	Byte58 Data	Byte59 Data	Byte60 Data
Para251	Para251	Para252	Para252	Para253	Para253	Para254	Para254	Para255	Para255	Para256	Para256
124	1	44	1	0	1	240	0	220	0	200	0
PIX251=380		PIX252=300		PIX253=256		PIX254=240		PIX255=220		PIX256=200	