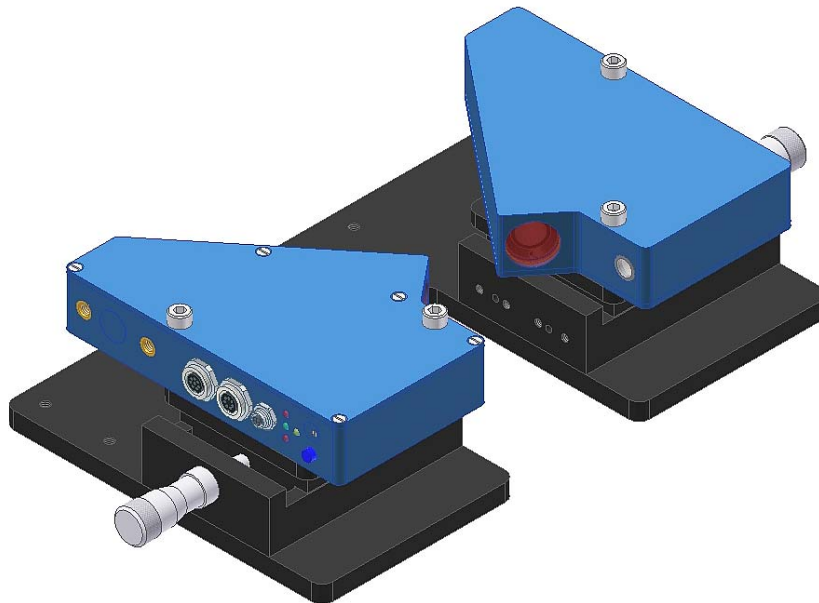


Manual

L-LAS-LT-MS-Scope V3.04

(PC software for Microsoft® Windows® XP, 2000, Me)

for laser line sensors of the *L-LAS-LT-...-MS (Master-Slave) series*



L-LAS-LT-37-MS
L-LAS-LT-55-MS
L-LAS-LT-80-MS
L-LAS-LT-110-MS
L-LAS-LT-135-MS
L-LAS-LT-160-MS
L-LAS-LT-200-MS
L-LAS-LT-275-MS
L-LAS-LT-450-MS

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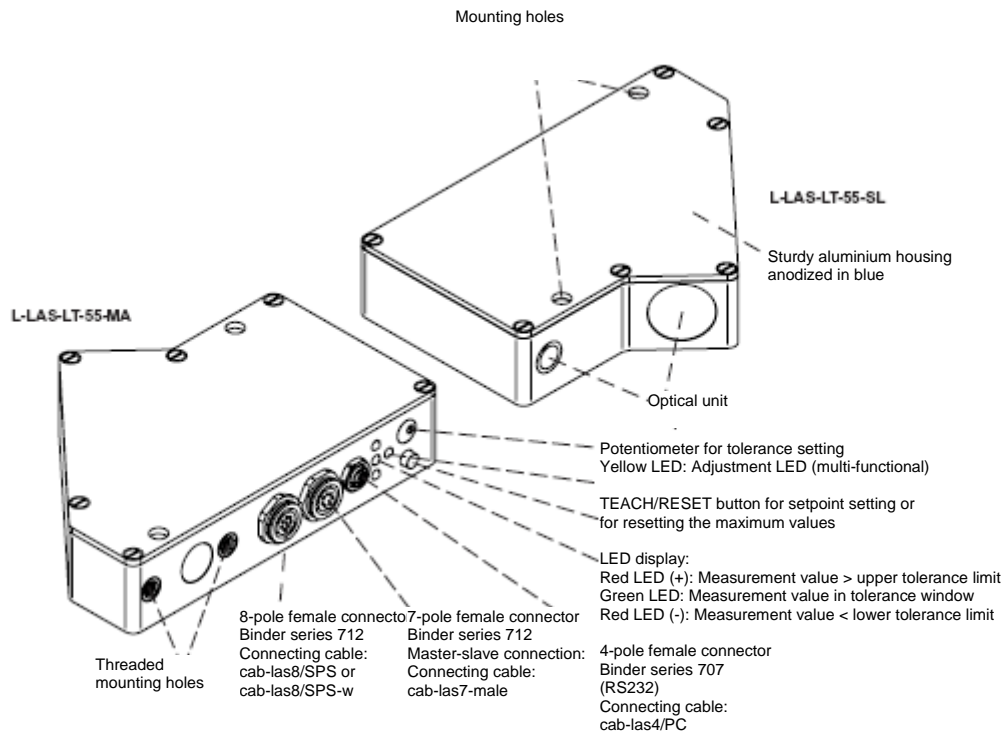
1 Functional principle: *L-LAS-LT-...-MS* Master-Slave control system

1.1 Technical description

In the laser line sensors of the *L-LAS-LT-MS* series the laser beam of a laser diode ($\lambda=670\text{nm}$, 1mW power, laser class 2) through suitable collimators and apertures is emitted from the optical transmitter unit as a parallel laser beam with homogeneous light distribution. After being reflected from the object surface, the laser light impinges on the CCD line receiver of the optical receiver unit. 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.

Depending on the object distance the laser light that is scattered back from the measuring object (triangulation principle) will only illuminate certain receiver elements (pixels) on the line. Compared to the non-illuminated pixels these pixels will output a considerably higher analog voltage (intensity maxima). By way of suitable software algorithms the areas of the illuminated zones can be determined from the previously stored data field. Since the distance of the pixels on the CCD line is known, the position and distance of the measuring object can therefore be determined.

The micro-controller of the *L-LAS-LT-...MA* sensor can be parameterized through the serial RS232 interface by means of a Windows PC software. This allows the setting of various evaluation and operating modes. The housing of the control unit features a TEACH/RESET button and a potentiometer for tolerance setting. Switching states are visualized by means of 4 LEDs (1x green, 1x yellow, and 2x red) that are integrated in the housing of the *L-LAS-LT-...-MA* sensor. The control unit that is integrated in the sensor 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.






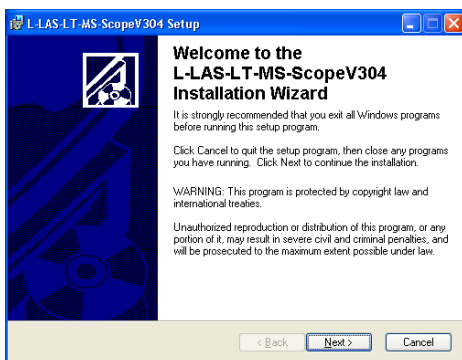
2 Installation of the *L-LAS-LT-MS-Scope* software

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

- 500 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 higher.
- Windows 98, Windows NT4.0, Windows 2000, Windows XP, or Windows Vista operating system
- Free serial RS232 interface or USB port with USB-RS/232 adaptor at the PC

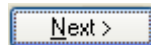
Please install the *L-LAS-LT-MS-Scope* software as described below:

-  1. CD-Laufwerk (D:) 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.
 setup.exe
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.

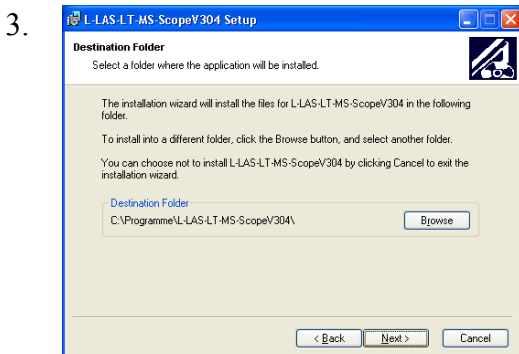
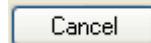


The installation program then displays a dialog box for *L-LAS-LT-MS-Scope* installation. This dialog box shows some general information about installation.

Click on Next> to start the installation

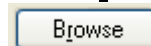


or on Cancel to quit the installation of the *L-LAS-LT-MS-Scope* software.

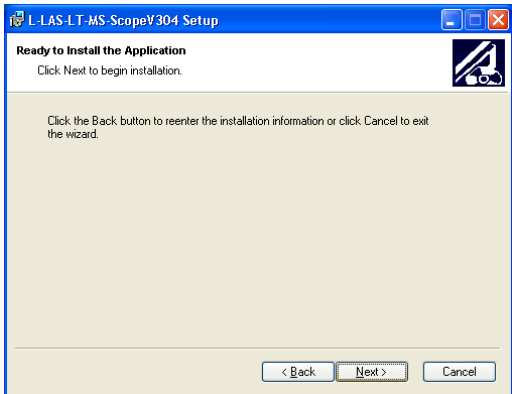


When you click on the Next> button, a new dialog appears for selecting the folder where the application will be installed (destination folder).

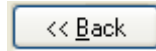
You may accept the suggested folder with Next>, or you may change the installation folder as desired by clicking on the Browse button.



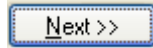
4.



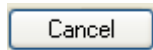
Another *L-LAS-LT-MS-Scope* Setup dialog will be displayed.



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

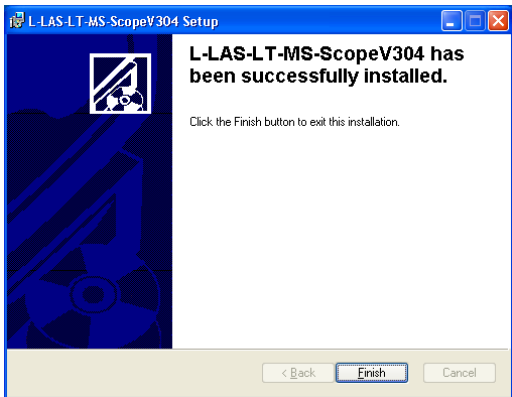


Click on Next>> to start the installation, or



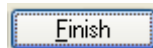
click on Cancel to quit the installation process.

5.



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

A new *L-LAS-LT-MS-Scope* program group has been created under Start-All Programs.



Click on the Finish button to finish the installation.



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

Start >All Programs > L-LAS-LT-MS-ScopeV3.0x

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



Please use the Windows® deinstallation tool to remove the software.

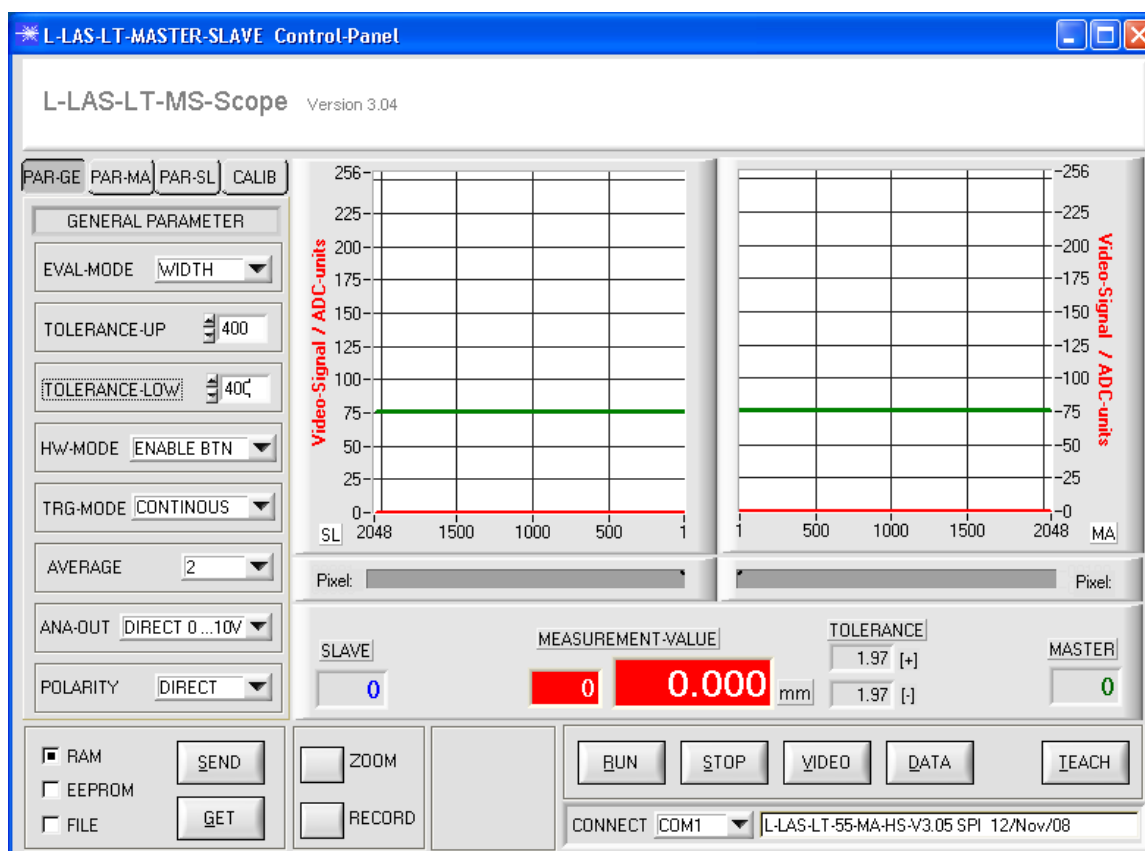
The Windows deinstallation tool can be found under Start / Settings / Control Panel / Software

3 Operation of the *L-LAS-LT-MS-Scope* software

The *L-LAS-LT-MS-Scope* software is used for parameterizing the control unit of the *L-LAS-LT-...MA* line sensors through the serial interface. The measured values provided by the master and slave of 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 RS232 interface with the master sensor. For this purpose the master sensor is connected to the PC with the serial interface cable cab-las-4/PC. When parameterization is finished, the setting values can be permanently saved in an EEPROM memory of the *L-LAS-LT-...-MA control unit*. The sensor system then continues to operate in "STAND-ALONE" mode without PC.

When the *L-LAS-LT-MS-Scope* software is started, the following Windows® user interface will be displayed:

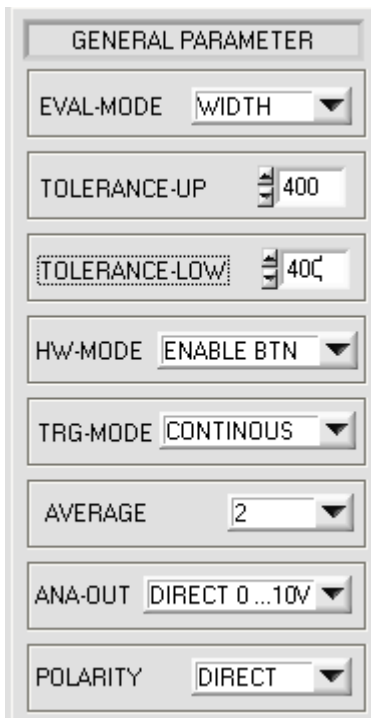


The *L-LAS-LT-MS-Scope* CONTROL PANEL provides a great variety of functions:

- Visualization of the measurement data of master and slave on a graphic user interface.
- Setting of the laser power for the respective laser transmitter.
- Setting of the polarity of the digital switching outputs OUT0, OUT1, and 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.

The following chapters provide explanations of the individual control elements of the *L-LAS-LT-MS-Scope* software.

3.1 Control elements of the L-LAS-LT-MS-Scope software:



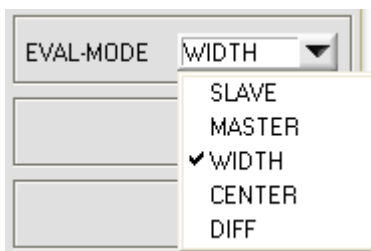
A click on the PARA-GE button opens the GENERAL PARAMETERS window on the user interface. This window is used for setting various general parameters at the master control unit.



Attention !



Changes that are made in the function fields described below only become active at the control unit of the L-LAS-LT-...-MA sensor after a click on the SEND button!



EVAL-MODE:

Selection field for setting the evaluation mode at the L-LAS-LT-...-MA sensor. Depending on the currently set evaluation mode the edges determined from the video signals of master or slave will be evaluated differently.

SLAVE:

The "Peak" that is detected at the SLAVE sensor is used as the measurement value. The center of the "intensity peak" of the CCD line is calculated from the intersection points between the video threshold (green horizontal line) and the intensity profile of the CCD line (red curve).

MASTER:

The "intensity peak" that is detected from the intensity profile of the CCD line at the MASTER sensor is used as the measurement value.

WIDTH:

The distance between the two "intensity peaks" of MASTER and SLAVE is used as the measurement value:

$$\text{WIDTH} = (\text{MAXPIXEL-MASTER_Peak}) + (\text{MAXPIXEL-SLAVE_Peak})$$

CENTER:

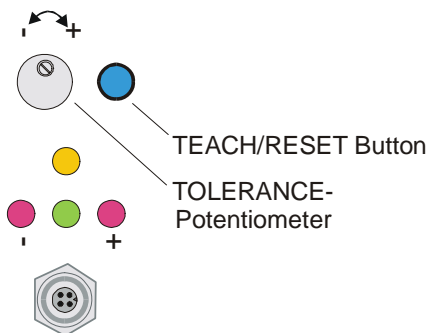
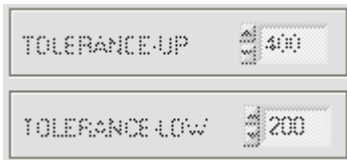
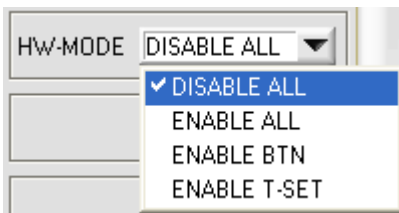
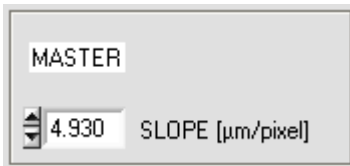
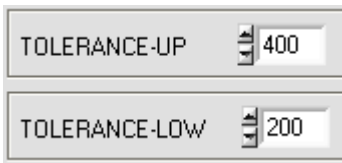
The difference of the "intensity peaks" of MASTER and SLAVE is used as the measurement value.

$$\text{CENTER} = 2048 + [\text{MASTER_Peak} - \text{SLAVE_Peak}]$$

DIFF:

The difference of the deviations of the current measurement value and the teach value of MASTER and SLAVE is used as the measurement value.

$$\text{DIFF} = 2048 + [(\text{MASTER-Teach_MA}) - (\text{SLAVE-Teach_SL})]$$



TOLERANCE -UP, TOLERANCE-LOW:

In these two numeric input fields tolerance default values in pixels for the upper (UP) and lower (LOW) tolerance limits can be set by entering numerical values or by way of mouse-clicks on the arrows.

The two tolerance limits form a tolerance band around the setpoint value (TEACH-VALUE). The two tolerances currently set at the sensor are shown in the unit of [mm] in two numeric display fields below the graphic display window.

Example, combined with the SLOPE value (sensitivity) of the master sensor:

$$TOL[+] [mm] = SLOPE * TOLERANCE_HIGH$$

Here: $TOL [mm] = 4.93[\mu m/pixel] * 400 pixel = 1.97 mm$

$$TOL[-] [mm] = SLOPE * TOLERANCE_LOW$$

Here: $TOL [mm] = 4.93[\mu m/pixel] * 200 pixel = 0.99 mm$

HARDWARE (Hardware-Mode):

The TOLERANCE potentiometer and/or the TEACH/RESET button at the housing of the L-LAS-LT-...-MA sensor can be activated (ENABLE) or deactivated (DISABLE) by clicking on the respective item in the list selection field.

The TOLERANCE potentiometer allows the presetting of a tolerance window around the setpoint value. If the function field is set to ENABLE ALL or ENABLE T-SET, it is not possible to enter numerical values in the TOLERANCE-UP/LOW input field of the PC software. The respective function fields will be grayed.

DISABLE ALL

Both the TEACH/RESET button and the TOLERANCE potentiometer at the housing are deactivated.

ENABLE ALL:

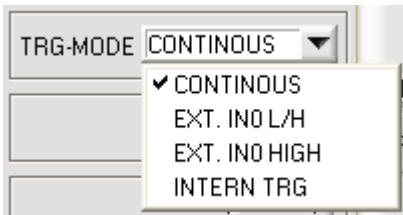
The TOLERANCE potentiometer at the housing is activated. (clockwise turning increases the tolerance bandwidth)
 The TEACH/RESET button at the housing is activated.
 Button pressed for a short time ($t < 0.7s$) : RESET function.
 Button pressed for a long time ($t > 1.5s$) : TEACH function.

ENABLE BTN:

Only the TEACH/RESET button at the housing is activated.

ENABLE T-SET:

Only the TOLERANCE potentiometer at the housing is activated.



TRIGGER-MODE:

CONTINUOUS:

Continuous evaluation of the current measurement values.

EXT. IN0 L/H:

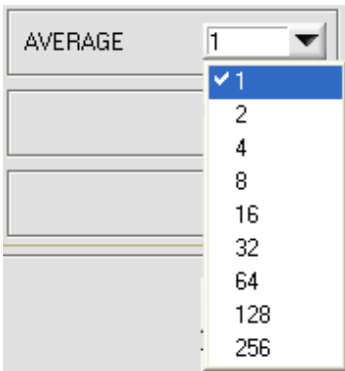
External edge-controlled (LOW/HIGH) triggering of measurement value evaluation through digital input IN0/pin3/green at the 8-pol. PLC female connector of the MASTER sensor.

EXT. IN0 HIGH:

External triggering of measurement value evaluation by a high-level (+Ub) at digital input IN0/pin3/green of the MASTER sensor.

INTERN TRG:

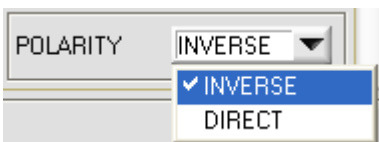
Internal triggering of measurement value evaluation, started when the trigger threshold is exceeded. A maximum of 256 scans will then be recorded and evaluated.



AVERAGE:

In this function field the averaging at the *L-LAS-LT-...-MA 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.



POLARITY:

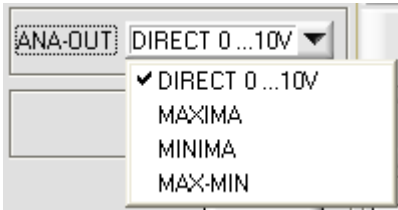
In this function field the output polarity at the *L-LAS-LT-...-MA sensor* can be set with a mouse-click. The *L-LAS-LT-...-MA sensor* has 3 digital outputs (OUT0, OUT1, OUT2) through which error states can be sent to the PLC.

DIRECT:

In case of an error, the respective digital output is set to +Ub (+15DC ... +30VDC), (red LED on).

INVERSE:

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



ANALOG-OUT (Analog-Output-Mode):

Function element for selecting the output mode of the analog voltage at the *L-LAS-LT-...-MA* sensor (pin8/red 8-pol. 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:

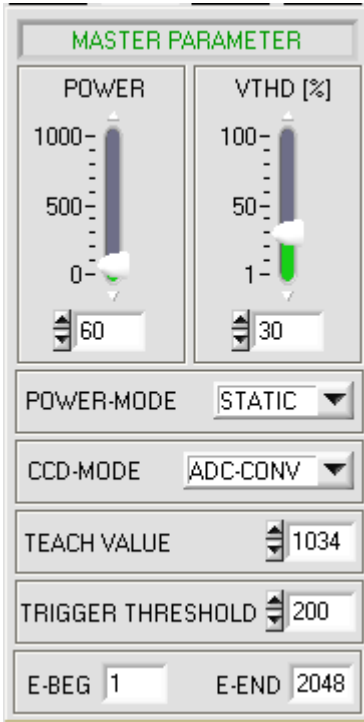
The current maximum value is provided at the analog output pin8/red/ (drag pointer principle, resetting by input IN1/pin4/yellow pulse of <750ms length, or by pressing the TEACH/RESET button).

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:

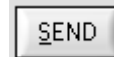
The current difference between maximum and minimum value is provided at the analog output pin8/red/ (drag pointer principle, resetting by input IN1/pin4/yellow pulse of <750ms length, or by pressing the TEACH/RESET button).



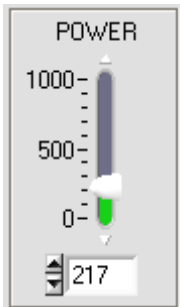
A click on the PARA-MA button opens the MASTER PARAMETERS window on the user interface. This window is used for setting additional parameters at the control unit of the master sensor.



Attention !



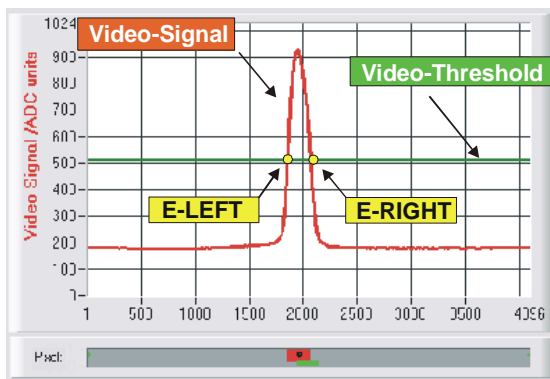
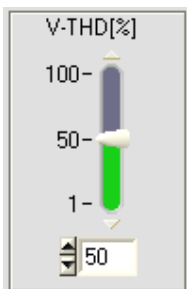
Changes that are made in the function fields described below only become active at the control unit of the *L-LAS-LT-...-MA* sensor after a click on the SEND button!



POWER:

(only relevant with POWER-MODE = STATIC)

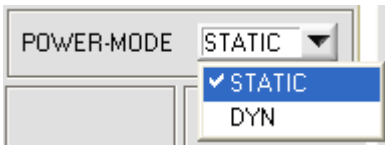
In this function field the laser power at the laser transmitter unit of the *L-LAS-LT-...-MA* sensor can be set by using the arrows, the slider, or by entering a numerical value in the corresponding input field.



VTHD[%]:

In this function field the video threshold at the *L-LAS-LT-...-MA* 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.



POWER-MODE:

This function field is used for setting the laser mode at the *L-LAS-LT-...-MA* sensor.

STATIC:

The laser power at the sensor is not automatically controlled. The value that is set at the POWER slider is used as the setting value for the laser power.

DYNAMIC:

When the operating mode is set to dynamic, the laser power at the *L-LAS-LT-...-MA* sensor is automatically controlled.

The laser power here is controlled in such a way that the maximum value of the "intensity peaks" approx. is at 80-90% of the analog dynamic range.

CCD-MODE:

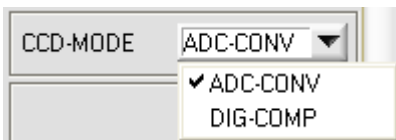
This function field is used for setting the operating mode at the *L-LAS-LT-...-MA* master sensor.

Depending on the respective CCD line receiver that is used, the gain stage (HIGH-GAIN, LOW-GAIN) or the read mode (ADC-CONV, DIG-CMP) can be set here.

HIGH-GAIN/LOW-GAIN (gain-stage):

Binary switch for setting the gain at the CCD line.

Please note: This function is not available with all *L-LAS-LT-...-MA* sensor types.

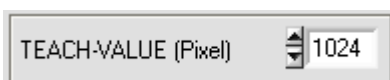


ADC-CONV/DIG-COMP (read-mode):

This selection field serves for setting the read mode,

ADC-CONV:= the CCD line is read via **red Analog to Digital Converter**.

DIG-COMP:= the CCD line is read via **red Digital-Comparator Outputs of the pre-amplifier board**.



TEACH-VALUE (Pixel):

In this function field a teach value can be preset at the *L-LAS-LT-...-MA* sensor by entering a numerical value or by using the arrows.

Please note:

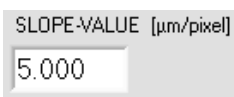
A change of the teach value will only be updated at the control unit when the SEND button is pressed.

The TEACH-VALUE is set in pixels. As with the tolerance, conversion into μm can be done by way of the SLOPE-VALUE (sensitivity – $\mu\text{m}/\text{pixel}$).

For example, the result for the *L-LAS-LT-...-MA-80* is:

$$TEACH_VALUE [mm] = SLOPE * TEACH [Pixel]$$

$$TEACH_VALUE [mm] = 5.000[\mu\text{m}/\text{Pixel}] * 1024[\text{Pixel}] = 5.120 \text{ mm}$$



TRIGGER THRESHOLD

TRIGGER THRESHOLD:

This function field is used for setting the trigger threshold for trigger mode TRG-MODE = INTERN TRG at the *L-LAS-LT-...-MA sensor*.

A trigger threshold of 200 means that internal triggering is initiated when the measurement value in pixels is > 200.

E-BEG E-END

E-BEG, E-END:

These two numeric input fields are used for setting the evaluation beginning and the evaluation end at the *L-LAS-LT-...-MA sensor*.

E-BEG:

The CCD line is evaluated starting from the pixel that is set here. The analog information of the pixels lying on the left side of E-BEG is not used for evaluation.

E-END:

The intensity information of the CCD line is evaluated up to this pixel. Pixels lying on the right side of the pixel value that is set here are not evaluated.

SLAVE PARAMETER

<p>POWER <input type="text" value="200"/></p>	<p>VTHD [%] <input type="text" value="30"/></p>
<p>POWER-MODE <input type="text" value="STATIC"/></p>	
<p>CCD-MODE <input type="text" value="ADC-CONV"/></p>	
<p>TEACH VALUE <input type="text" value="1024"/></p>	
<p>TRIGGER THRESHOLD <input type="text" value="200"/></p>	
<p>E-BEG <input type="text" value="1"/> E-END <input type="text" value="2048"/></p>	

A click on the PARA-SL button opens the SLAVE PARAMETERS window on the user interface. This window is used for setting additional parameters at the control unit of the SLAVE sensor.



Attention !

Changes that are made in the function fields described below only become active at the control unit of the *L-LAS-LT-...-MA sensor* after a click on the SEND button!

Since the functions of the individual control elements in the SLAVE PARAMETERS window are identical to those in the MASTER PARAMETERS window, no detailed explanation on these parameter settings is required here (see the corresponding items on the previous pages).

CCD-CALIBRATION

512-pixel; 12.5µm pixel-pitch
 2048-subpixel
 resolution = +/-5µm
 working-range = 55mm +/-5.0mm

SETPOINT-VALUE
 [µm]

MASTER
 SLOPE [µm/pixel]

SLAVE
 SLOPE [µm/pixel]

PAR-GE
PAR-MA
PAR-SL
CALIB

A click on the CALIB button opens the CCD-CALIBRATION window on the user interface.



Attention !

SEND

Changes that are made in the function fields described below only become active at the control unit of the L-LAS-LT-...-MS master/slave system after a click on the SEND button!

512-pixel; 12.5µm pixel-pitch
 2048-subpixel
 resolution = +/-5µm
 working-range = 55mm +/-5.0mm

CCD-INFO:

After a click on the CONNECT function field, information about the currently detected sensor hardware is automatically provided through the serial RS-232 interface. This hardware information is displayed in the CCD-INFO text field.

SETPOINT-VALUE
 [µm]

SETPOINT-VALUE:

Numeric input field for presetting an **setpoint-value**. **The setpoint value that is set here is used after a new teach procedure to evaluate the CCD line information.**

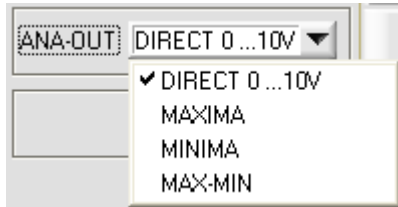
MASTER
 SLOPE [µm/pixel]

SLOPE-VALUE [µm/pixel]:

Numeric input field for presetting the sensitivity of the L-LAS-LT-...-MA sensor. The numerical value that is set here determines how many micrometers of distance change correspond with each pixel change.

SLAVE
 SLOPE [µm/pixel]

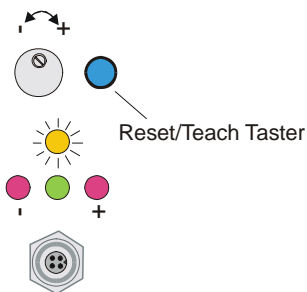
These sensitivity values result from the sensor linearisation. For every sensor the operating range in [mm] is determined. This operating range is divided over the maximum pixel number of 2048 pixels.



RESET button:

The current drag pointer values of maximum and minimum value determination can be reset with the RESET button.

The current maximum value MAX and the current minimum value MIN since the last RESET each are displayed in a numeric display field. The numerical values that are shown here are pixel values. The current measurement value in pixels is displayed in the M-VALUE output field. These numeric display elements only are shown in analog output mode ANA-OUT: MAX, MIN or MAX-MIN.

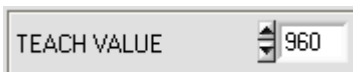


TEACH button:

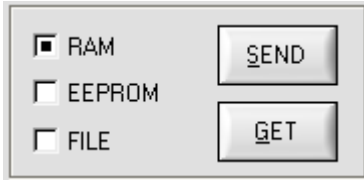
A click on the TEACH button starts the teach process at the *L-LAS-LT-...-MA sensor*. The current pixel measurement values at the *L-LAS-LT-...-MA* master/slave sensor system are evaluated and, depending on the evaluation mode, the calculated value is written to the volatile RAM memory of the control unit as a teach value.

When the teach process is completed the yellow LED at the housing of the *L-LAS-LT-...-MA sensor* shortly blinks 3 times.

The teach process also can be started by means of the TEACH/RESET button at the housing (pressing the button for $t > 1.5s$) or by way of a HIGH pulse at digital input IN1/yellow/pin4 of at least 1.5s length.



As an alternative the current teach value in pixels (setpoint value) also can be set by entering a numerical value in the numeric input field. The teach value that is set by this method will only be activated at the *L-LAS-LT-...-MA sensor* after a click on the SEND button.



PARAMETER TRANSFER:

This group of function buttons is used for transferring parameters between the PC and the *L-LAS-LT-...-MA 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-LT-...-MA control unit*.

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 *L-LAS-LT-...-MA control unit* 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 *L-LAS-LT-..._MA control unit*, 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 *L-LAS-LT-..._MA control unit* is turned off.

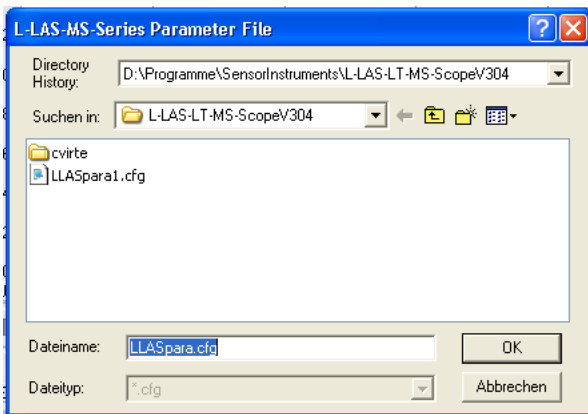
EEPROM:

The currently set parameters are written to the non-volatile EEPROM memory of the *L-LAS-LT-..._MA 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.

If parameters are read from the EEPROM of the *L-LAS-LT-..._MA control unit*, these must be written to the RAM of the *L-LAS-LT-..._MA control unit* by selecting the RAM button and then clicking on SEND. The *L-LAS-LT-...-MA control unit* 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 "LLASpara.dat".

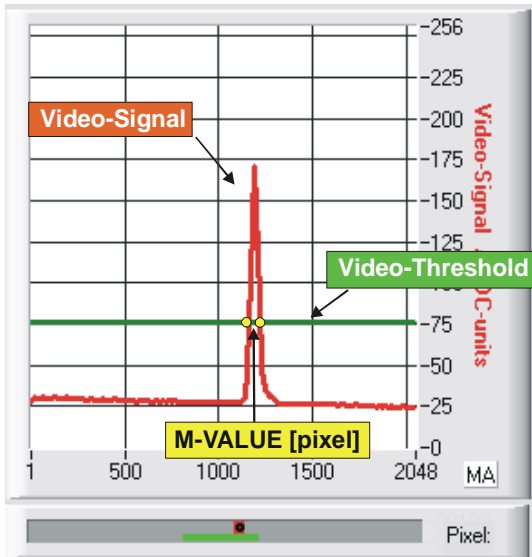
The output file can be opened e.g. with the standard Windows "Editor" program.

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 8-bit resolution, which results in a y-axis value range of 0 .. 256. The currently set video threshold (V-THD) is shown as a green horizontal line in the graphic window. The intensity maximum on the CCD line results from the optical representation of the laser light that is scattered back from the measuring object. The video information for the master and the slave sensor each is shown in an own graphic window.

- Master graphic window
- Slave graphic window

The edge values (pixels) are derived from the intersection points of the intensity profile (red curve) with the video threshold (green line). The x-axis shows the pixels of the CCD line (e.g.: 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 (gray) and the illuminated areas (red) of the CCD line. Furthermore the currently detected edge position is indicated by way of a black circle.



SLAVE:

Numeric display field showing the current pixel position of the SLAVE sensor. The pixel position is calculated from the intersection points of the bright/dark transitions between the intensity profile (red curve) and the video threshold (green line).



MASTER:

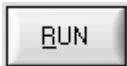
Numeric display field showing the current pixel position of the MASTER sensor. The pixel position is calculated from the intersection points of the bright/dark transitions between the intensity profile (red curve) and the video threshold (green line).



MEASUREMENT-VALUE:

Numeric display field showing 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 millimeters.

If the current measurement value lies within the tolerance band around the teach value, the display fields are shown with a green background. If the measurement value is outside the tolerance band, the display fields will have a red background.



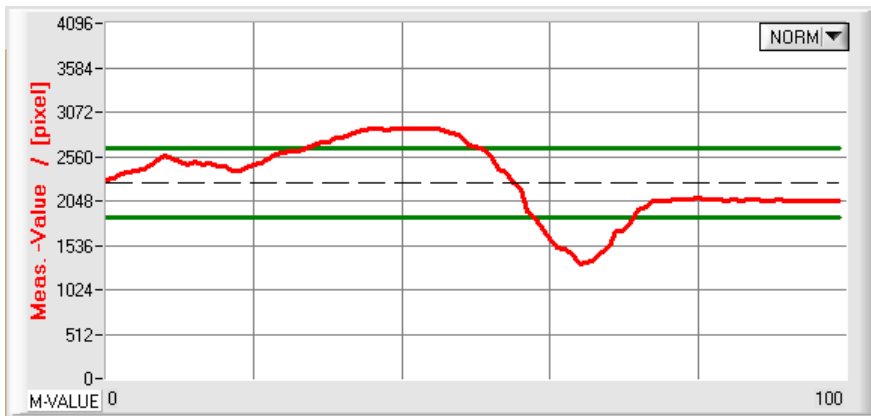
RUN button:

After a click on the RUN button, the current measurement data will be transferred from the L-LAS-LT-...-MA sensor to the PC via the serial interface. A click on the STOP button terminates the data transfer.



STOP button:

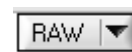
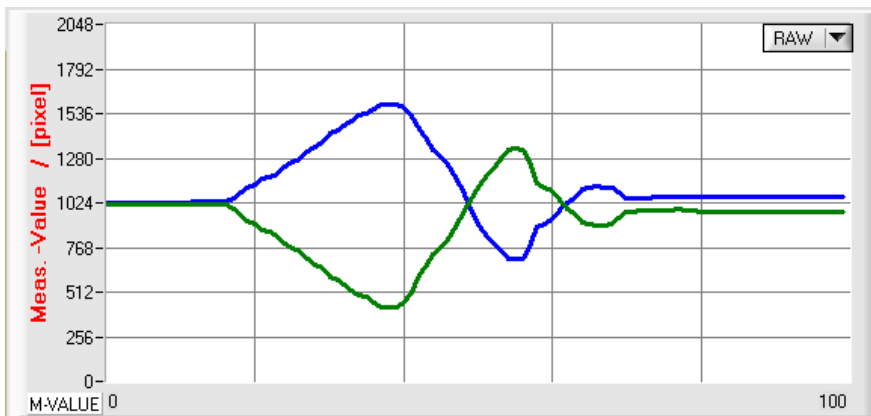
A mouse-click on the STOP button terminates the data transfer between the L-LAS-LT-...-MA sensor and the PC.



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 right to left.

The y-axis graduation corresponds with the pixels on the CCD line and with the respective set evaluation mode. The most recent measurement value is shown at the right end of the graphic display at x-value = 100. The currently set setpoint value (TEACH value) is shown as a black, broken horizontal line. In addition, the currently set tolerance window is represented by two horizontal green lines that are applied around the setpoint value.

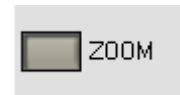
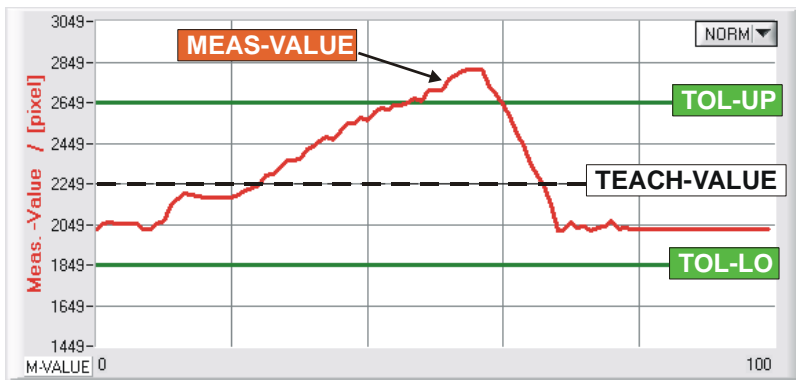


After a click on the RUN button the current positions of the video spots of the respective CCD line are shown in the graphic display window in "scroll mode".

The y-axis graduation corresponds with the pixels or sub-pixels on the CCD line. The current position of the video spot is shown as a green (MASTER) or blue (SLAVE) curve.

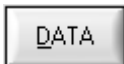
The length of the data frame that is transferred via the serial interface in "RUN mode" is limited to 18 words (36 bytes), which allows faster updating of the numeric and graphic display elements.

Compared to the "VIDEO mode", data transfer through the serial RS232 interface therefore does not take so much time (in VIDEO mode the intensity information for every pixel of the CCD line must be transferred).



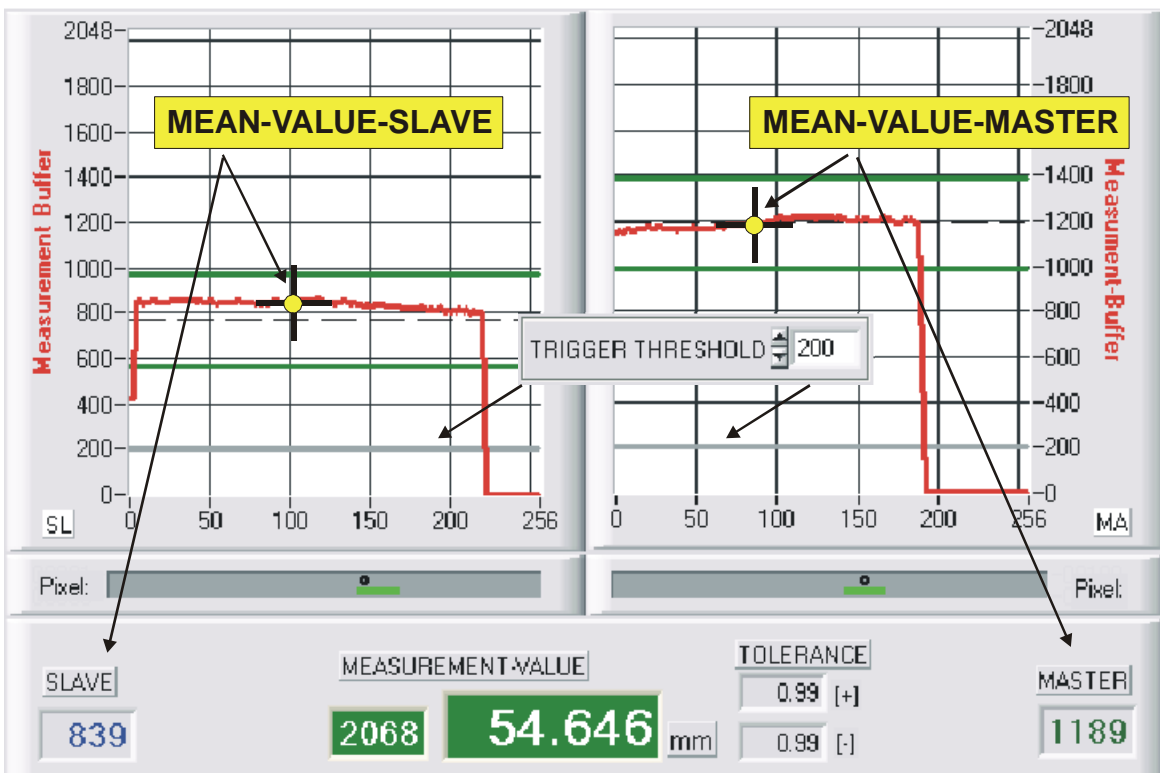
A click on the ZOOM button automatically rescales the y-axis in the graphic display window, which means that the changes of the measurement value can be displayed more clearly.

The picture above shows the time characteristic of the measurement value change as a red curve, and the tolerance band as two green lines. The teach value is shown as a broken horizontal black line.



DATA button:

After a click on the DATA button the measurement value ring memory comprising 256 elements is read from L-LAS-LT-...-MS master/slave sensor and is shown in the graphic display windows. With internal triggering this measurement value memory is updated after a trigger event..



The ring memory in the master and the ring memory in the slave are evaluated separately. After the trigger event the current measurement value is calculated as a mean value from the respective ring memory. Evaluation begins 4 pixels after the value exceeds the trigger threshold, and ends 4 pixels before the value falls below the trigger threshold.

3.3 Serial RS232 data transfer:

RS232 COMMUNICATION:

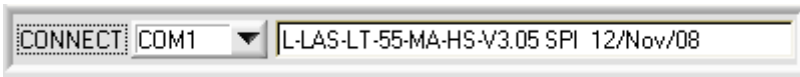
- Standard RS232 serial interface without hardware-handshake.
- 3-line-connection: GND, TXD, RXD.
- Speed: 19200 baud, 8 data bits, no parity bit, 1 stop bit in binary mode, MSB first.



Attention !

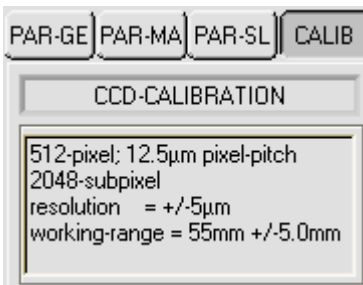
The stable function of the RS232 interface (status message after program start) is a basic prerequisite for successful data transfer between the PC and the L-LAS-LT-...-MA control unit. Due to the low data transfer rate of the serial RS232 interface (19200 bit/s) only slow changes of the analog values can be observed in the graphic display at the PC. In order to guarantee the maximum switching frequency of the L-LAS-LT-...-MA control unit it is therefore necessary to stop the data transfer during the normal monitoring process (click on the STOP button).

In the master/slave system the serial RS-232 interface must be established between the PC and the MASTER control unit!



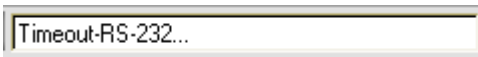
CONNECT:

When the software is started, it attempts to establish a connection to the L-LAS-LT-...-MA control unit through the standard COM1 interface. If connection could be established successfully, the current firmware version is displayed in the status line.



Furthermore, the CCD-INFO field shows the sensor type that is detected by the software as well as other information.

If another sensor type is connected at the RS-232 interface, the CONNECT function field must always be activated again to ensure that the current sensor type is properly detected by the PC software.

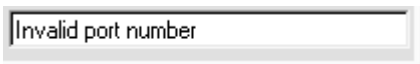


The serial connection between the PC and the L-LAS-LT-...-MA control unit could not be established, or the connection is faulty.



In this case it should first be checked whether the L-LAS-LT-...-MA control unit 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, interface 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.



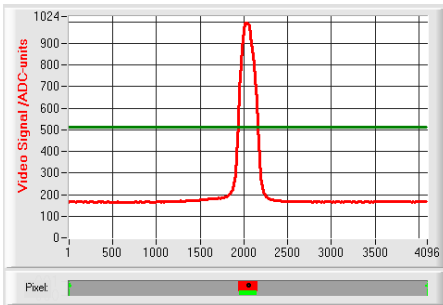
If there is a “Cannot open port” status message, the selected interface (e.g. COM2) may already be used by another device.

3.4 L-LAS-LT-MS-Scope as an aid for sensor adjustment:



VIDEO:

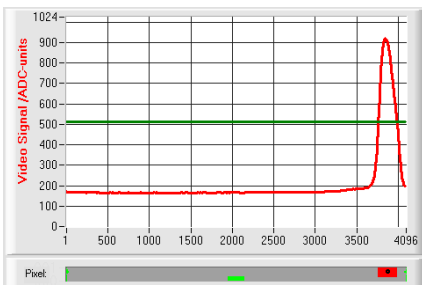
After a click on the VIDEO button, fine adjustment of the sensors relative to the measuring object can be done with the help of the graphic display window. Because of the limited data transfer rate of the RS232 interface the display window can only be updated every second.



Adjustment OK - centered

In the graphic display window the intensity profile is shown as a red curve. The numerical values 1 ... 4096 on the x-axis represent the individual pixels of the CCD line.

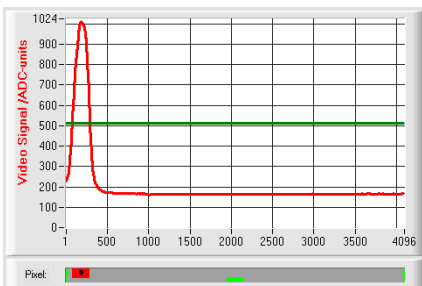
The intensity maximum approx. lies at pixel 2048. The *L-LAS-LT-...-MA sensor* thus is optimally adjusted at the centre of the measuring range.



Upper measuring range limit reached:

The distance of the *L-LAS-LT-...-MA sensor* from the measuring object almost is too large. The intensity maximum lies at pixel values close to 4000 (**max. number of pixels = MAXPIXEL**).

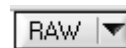
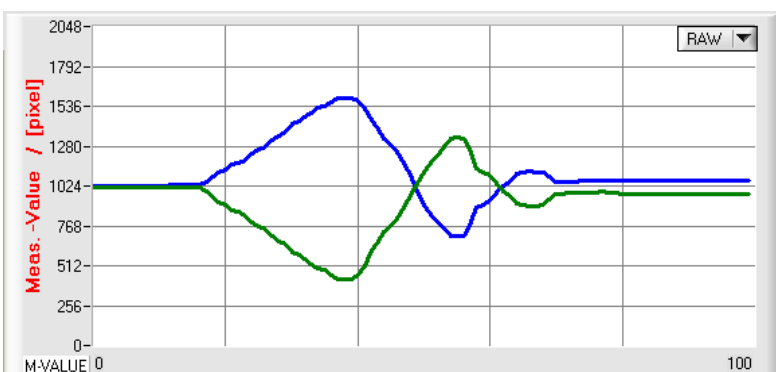
The distance between the *L-LAS-LT-...-MA sensor* and the measuring object should be reduced.



Lower measuring range limit reached

The distance of the *L-LAS-LT-...-MA sensor* from the measuring object almost is too small. The intensity maximum lies at pixel values close to 1.

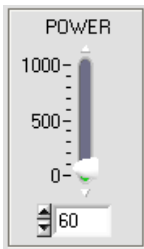
The distance between the *L-LAS-LT-...-MA sensor* and the measuring object should be increased.



As an alternative the sensor adjustment of MASTER and SLAVE can be simultaneously observed in "scroll mode" in the graphic display window after a click on the RUN button. The sensors are optimally adjusted when the measurement values lie at the center of the measuring range.

The current position of the video spot (= distance from the measuring object) is shown as a green (MASTER) and as a blue (SLAVE) curve.

3.5 L-LAS-LT-MS-Scope as an aid for transmitter power adjustment:

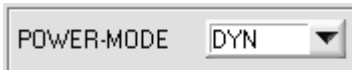


POWER:

The laser power at the laser transmitter unit of the *L-LAS-LT-...-MA sensor* can be set by using the POWER slider or by entering a numerical value in the respective input field.



The laser power at the transmitter unit of the *L-LAS-LT-...-MA sensor* is only updated when the SEND button is pressed.



DYNAMIC:

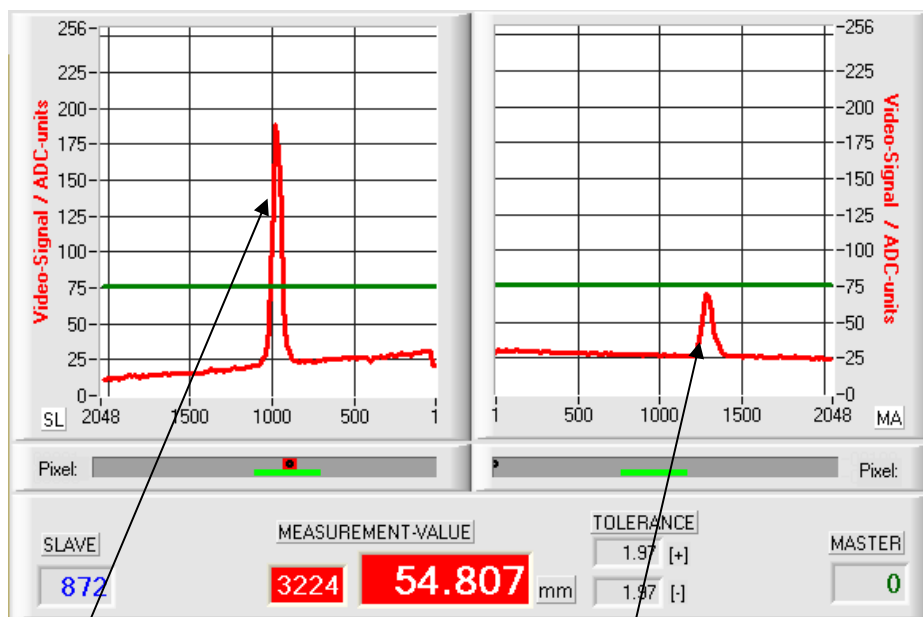
When the power mode is set to DYNAMIC, the laser power at the *L-LAS-LT-...-MA sensor* is automatically regulated. This means that the laser power is regulated in such a way that the maximum values of the "intensity peaks" approx. lie at 80-90% of the analog dynamic range.

In this mode the POWER slider is without function! --- It is recommended to use this DYNAMIC mode as the standard mode!



VIDEO:

After a click on the VIDEO button, the current intensity profile is transferred from the *L-LAS-LT-...-MA sensor* to the PC and is shown as a red curve in the graphic display window.



Transmitter power OK!:

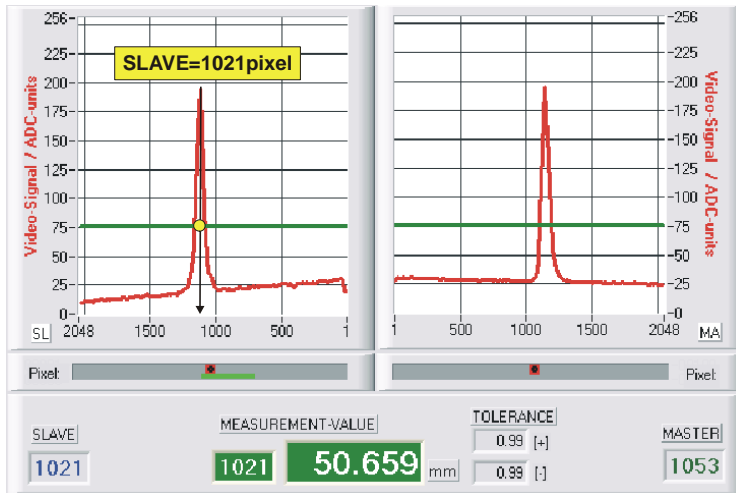
In the whole measuring range (pixel 1 ... 2048) the maximum of the intensity profile should be clearly above the video threshold (green line). The measurement value at the slave can be calculated from the intersection points of the intensity profile with the video threshold at pixel SLAVE=872.

Transmitter power too low!

The intensity profile (red curve) at the CCD receiver is too low. The maximum values lie below the video threshold (green horizontal line). No bright/dark transitions (intersection points between red and green curve) can be detected. The calculated measurement value therefore is MASTER = 0!

4 Evaluation modes

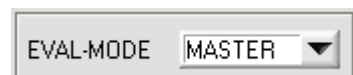
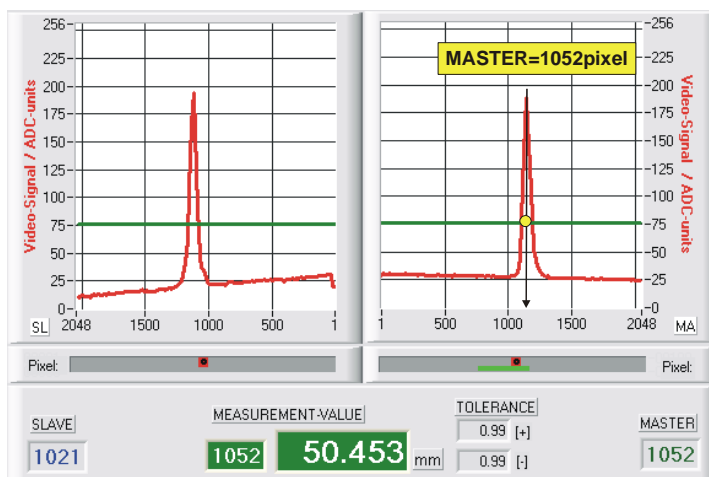
4.1 SLAVE:



The measurement value is calculated from the intersection points (bright/dark transitions) of the video signals at the SLAVE sensor (left graphic window).

$MVAL[pixel] = SLAVE$
here: 1021

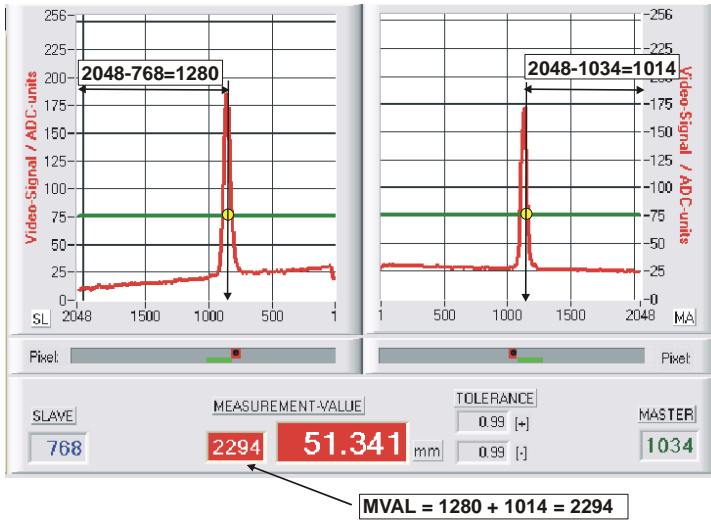
4.2 MASTER:



The measurement value is calculated from the intersection points (bright/dark transitions) of the video signals at the MASTER sensor (right graphic window).

$MVAL[pixel] = MASTER$
here: 1052

4.3 WIDTH:



In the WIDTH evaluation mode the width of the measuring object is calculated by adding the measurement values of MASTER and SLAVE.

The MASTER sensor is positioned on one side of the measuring object, the SLAVE sensor is positioned on the opposite side.

If the width of the measuring object increases, the distance from the sensor decreases, i.e. the video spots change to lower pixel values.

$$MVAL[\text{pixel}] = MASTER\# + SLAVE\#$$

with:

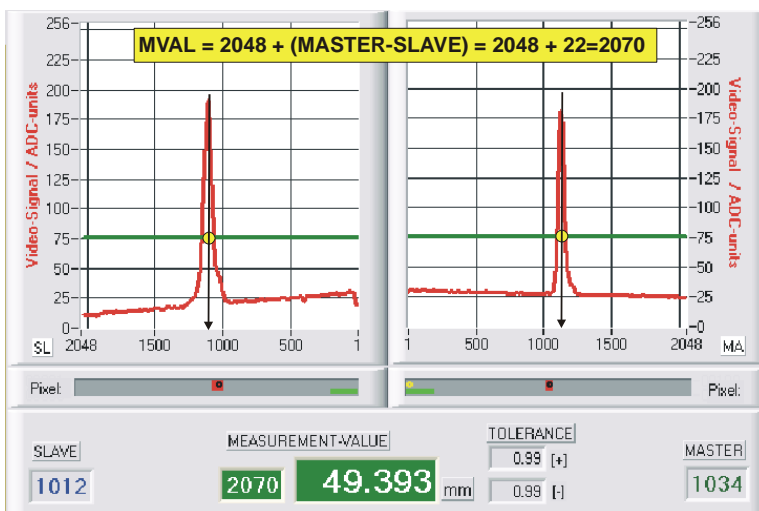
$$MASTER\#[\text{pixel}] = MAXPIXEL - MASTER$$

$$SLAVE\#[\text{pixel}] = MAXPIXEL - SLAVE$$

here: $MVAL = 2294 = (2048 - 1034) + (2048 - 768)$

In WIDTH mode, the measurement value thus must be calculated indirectly from the known maximum pixel number (e.g. 2048) of the CCD line and the measured pixel values of MASTER and SLAVE. For this purpose the two interim values MASTER# and SLAVE# are first calculated by way of subtraction. The width of the measuring object in pixels is then calculated by adding these two values.

4.4 CENTER:



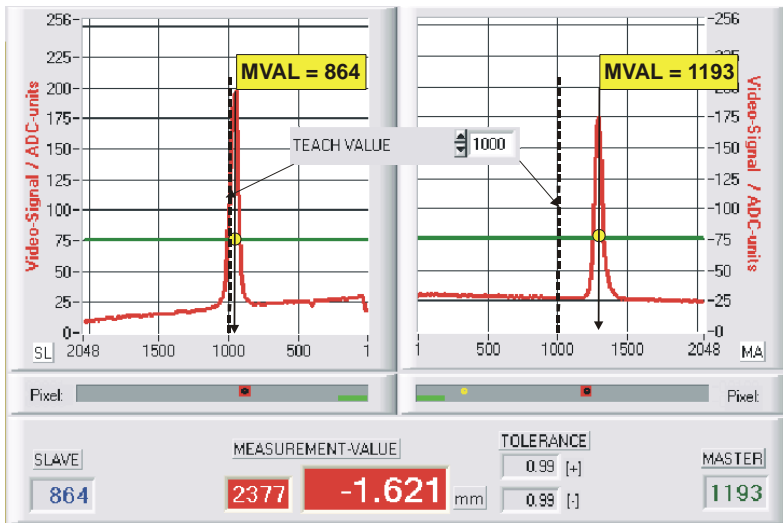
In this evaluation mode the center position is calculated on the basis of the two measurement values of MASTER and SLAVE.

The difference between MASTER and SLAVE measurement value that is determined this way is assigned an offset of 2048 (maximum pixel number of the CCD line).

$$MVAL[\text{pixel}] = MAXPIXEL + (MASTER - SLAVE)$$

here: $MVAL = 2070 = 2048 + (1034 - 1012) = 2048 + 22$

4.5 DIFF:



EVAL-MODE

In this evaluation mode the differences between the current measurement value MVAL and the respective TEACH-VALUE are calculated both at the MASTER and at the SLAVE.

The difference between the measurement values and the teach values that is determined by this method is assigned an offset of 2048 (maximum pixel number of the CCD line).

$$MVAL[\text{pixel}] = \text{MAXPIXEL} + (\text{DELTA_MA} - \text{DELTA_SL})$$

with:

$$\text{DELTA_MA}[\text{pixel}] = \text{MASTER} - \text{TEACH_MA}$$

$$\text{DELTA_SL}[\text{pixel}] = \text{SLAVE} - \text{TEACH_SL}$$

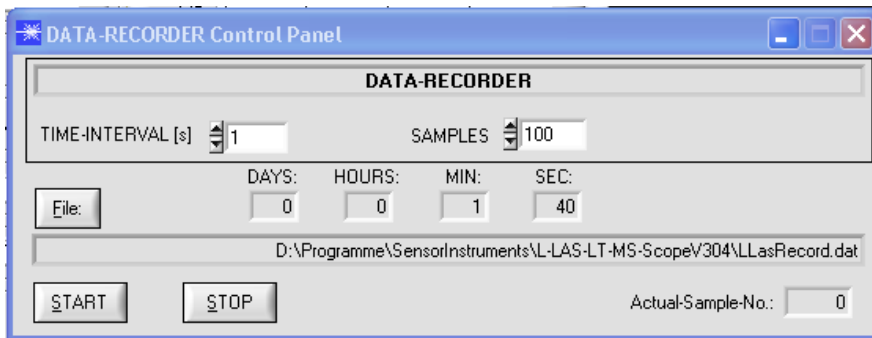
here:

$$\text{DELTA_A} = 1193 - 1000 = 193$$

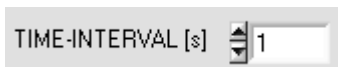
$$\text{DELTA_B} = 864 - 1000 = -136$$

$$MVAL = 2048 + (193 - (-136)) = 2377$$

5 Data recorder function



A click on the RECORD button opens a new window for setting the data recorder.



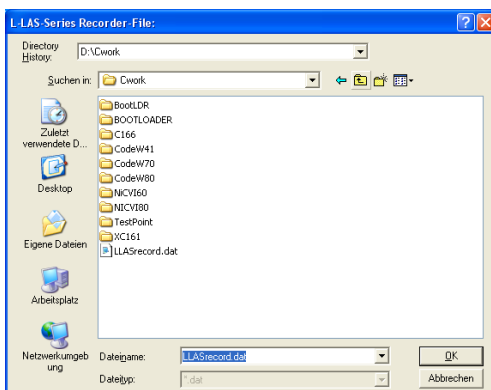
A time interval in seconds can be set in this numeric input field. After this time interval the PC software automatically transfers measurement data from the sensor to the PC and stores these data in an output file on the hard disk.



Numeric input field for setting the maximum number of measurement values that should be stored. The value range is from 10 to 30000.

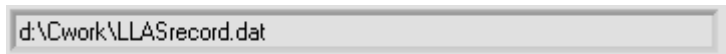


These numeric display elements show the time the recorder has been active since it was started.

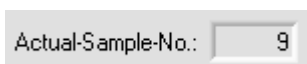


A click on the File button opens a dialog for entering the file name and the target directory of the output file.

The currently selected target directory and file name of the output file are shown in the text display below.



Automatic recording can be started by pressing the START button. With a click on the STOP button recording can be stopped before the maximum number set in SAMPLES is reached.

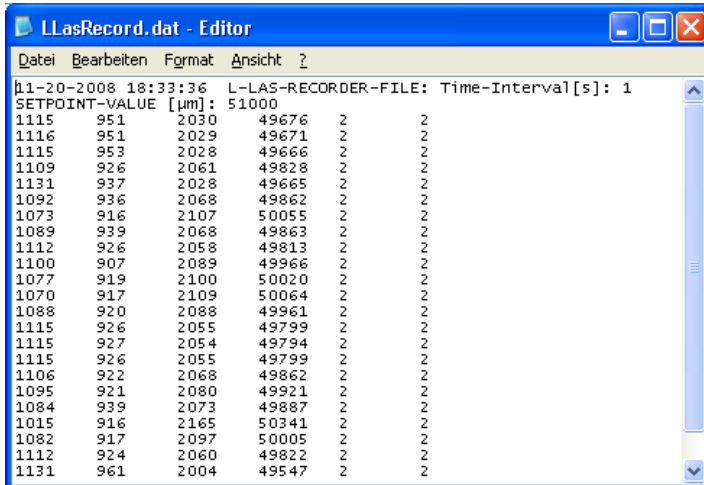


This numeric display field shows the current number of already stored measurement values.

5.1 Data format of the output file

The output file of the data recorder consists of 2 header lines, followed by the actual measurement data. The measurement data are written to the output file line-by-line. Each line comprises 6 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).



```

11-20-2008 18:33:36 L-LAS-RECORDER-FILE: Time-Interval[s]: 1
SETPOINT-VALUE [µm]: 51000
1115 951 2030 49676 2 2
1116 951 2029 49671 2 2
1115 953 2028 49666 2 2
1109 926 2061 49828 2 2
1131 937 2028 49665 2 2
1092 936 2068 49862 2 2
1073 916 2107 50055 2 2
1089 939 2068 49863 2 2
1112 926 2058 49813 2 2
1100 907 2089 49966 2 2
1077 919 2100 50020 2 2
1070 917 2109 50064 2 2
1088 920 2088 49961 2 2
1115 926 2055 49799 2 2
1115 927 2054 49794 2 2
1115 926 2055 49799 2 2
1106 922 2068 49862 2 2
1095 921 2080 49921 2 2
1084 939 2073 49887 2 2
1015 916 2165 50341 2 2
1082 917 2097 50005 2 2
1112 924 2060 49822 2 2
1131 961 2004 49547 2 2
    
```

- 1st column = Measurement value (pixel) MASTER
- 2nd column = Measurement value (pixel) SLAVE
- 3rd column = Measurement value (pixel) MVALUE
- 4th column = Measurement value MVALUE in micrometers
- 5th column = Number of edges MASTER
- 6th column = Number of edges SLAVE


6 Annex

6.1 Laser warning

LASER WARNING

Solid-state laser, $\lambda=670$ nm, 1mW max. optical power,
laser class 2 acc. to EN 60825-1

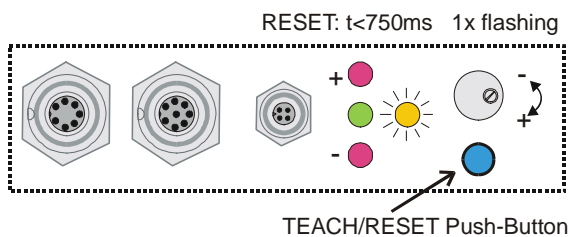
Therefore no additional protective measures are required for the use of these laser transmitters.



**Do not look
into the laser
beam.
Laser class 2**

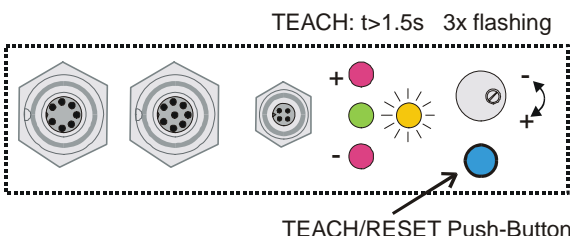
6.2 Function of the TEACH/RESET button:

The housing of the *L-LAS-LT-...-MA* sensor features a pushbutton with two functions:



RESET function:

When the button is pressed for a short time ($t < 750\text{ms}$) the current maximum and minimum values (drag pointer values) are reset. This does not perform a hardware/software RESET!

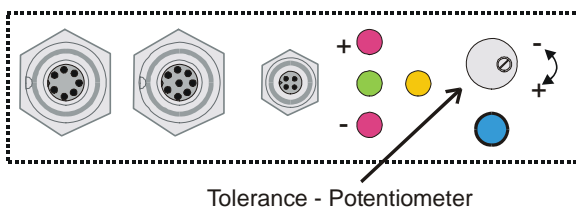


TEACH function:

When the button is pressed for a longer time ($t > 1.5\text{s}$), the current edge coverings are stored as teach value in the RAM memory. When the teach process has been performed successfully, the green LED flashes three times.

6.3 Function of the tolerance potentiometer:

The housing of the *L-LAS-LT-...-MA* sensor features a potentiometer for setting the tolerance band width.



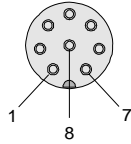
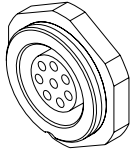
TOLERANCE potentiometer:

Turning the potentiometer clockwise increases the tolerance band width.

Turning it counter-clockwise decreases the tolerance band width. The potentiometer must be activated in order to use it for setting the tolerance band width at the *L-LAS-LT-...-MA* sensor (switch HW-MODE in position ENABLE ALL or ENABLE TOL SET).

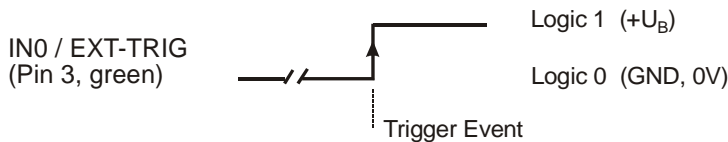
6.4 Function of digital inputs IN0 and IN1

The *L-LAS-LT-...-MA* sensor has two digital inputs IN0 and IN1 that can be contacted through the 8-pole female connector (type Binder 712).

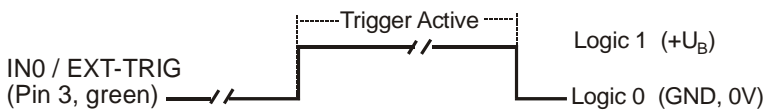


Pin:	Color:	Assignment:
1	white	0V (GND)
2	brown	+12VDC ... +32VDC
3	green	IN0 (EXT TRIGGER)
4	yellow	IN1 (TEACH/RESET)
5	gray	OUT0
6	pink	OUT1
7	blue	OUT2
8	red	ANALOG (0 ... +10V)

DIGITAL INPUT IN0 (pin3/green) EXT-TRIGGER:



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

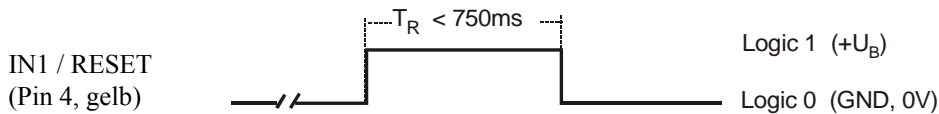


External triggering of measurement value evaluation through a HIGH level (+U_B) at digital input IN0.

DIGITAL INPUT IN1 (pin4/yellow) TEACH/RESET:

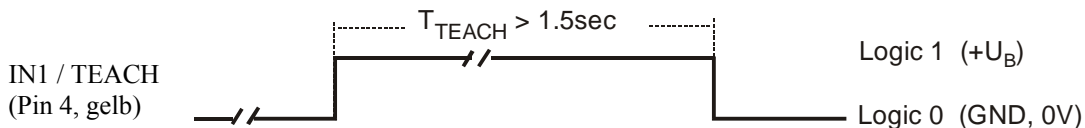
RESET function:

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

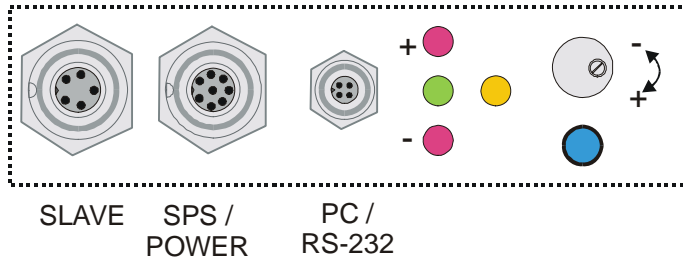


TEACH function:

When a HIGH pulse of more than **1.5s** duration is applied, the TEACH function is performed at the *L-LAS-LT-...-MA* sensor. When a TEACH pulse has been detected, the green LED at the housing flashes shortly three times.



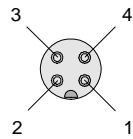
6.5 Connector assignment



At the housing of the *L-LAS-LT-...-MA* sensor there is a female connector for power supply connection (8-pole type Binder 712), a 7-pole female connector (type Binder 712) for connection of the SLAVE sensor, and a third female connector for connecting a serial RS232 connecting cable (4-pole type Binder 707).

RS232 connection to a PC:

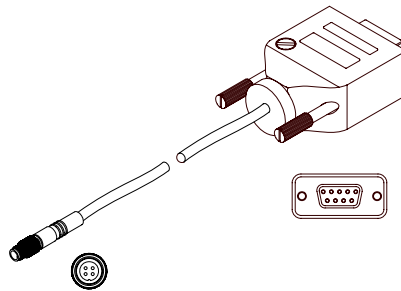
4-pole M5 female connector type Binder 707



Pin:	Assignment:
1	+24VDC (+Ub)
2	0V (GND)
3	TxD
4	RxD

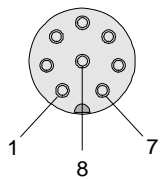
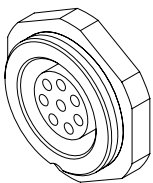
Connecting cable:

cab-las4/PC (length 2m, cable jacket: PUR)



Interface to PLC / power supply MASTER:

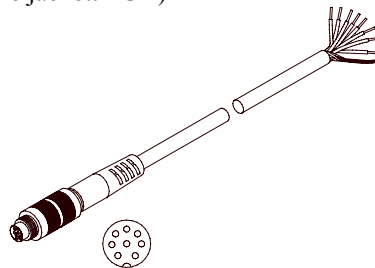
8-pole female connector type Binder 712



Pin:	Color:	Assignment:
1	white	0V (GND)
2	brown	+15VDC ... +30VDC
3	green	IN0 (EXT TRIGGER)
4	yellow	IN1 (TEACH/RESET)
5	gray	OUT0 (-)
6	pink	OUT1 (+)
7	blue	OUT2 (OK)
8	red	ANALOG (0 ... +10V)

Connecting cable:

cab-las8/SPS-... (standard length 2m, cable jacket: PUR)



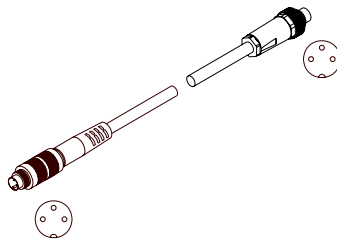
Connector Assignment SLAVE:

2x 3-pole female connector type Binder 712

Pin:	Assignment:
1	+5VDC
2	GND (0V)
3	I-CONTROL (0V...+5V)

Connecting cable:

cab-las3-male-... (length 1m or 2m, cable jacket: PUR)



6.6 RS-232 interface protocol

RS232 interface protocol PC ↔ L-LAS-LT-...-MA sensor - Firmware version 3.03

- Standard RS232 serial interface, no hardware handshake
- 3-line connection: GND, TX0, RX0
- Speed: 19200 baud, 8 data-bits, no parity-bit, 1 stop-bit, binary-mode

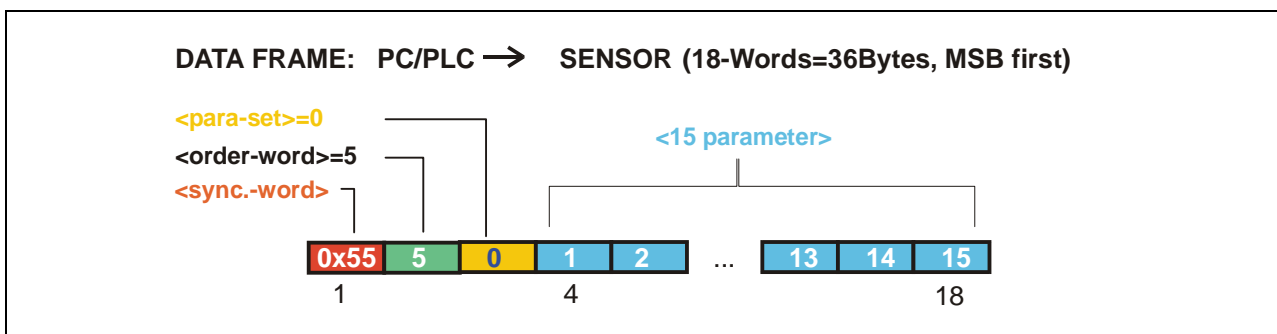
The control device (PC or PLC) must send a data frame consisting of 18-words (1 word = 2 byte = 16 bit) to the L-LAS-LT-...-MA control unit. All words in the data frame must be transferred in binary format. The higher-order byte must be transferred first (MSB-first).

METHOD:

The microcontroller in the L-LAS-LT-...-MA sensor permanently reads the input buffer of its RS-232 module (polling). If the arriving word is 0x0055 (0x55 hexadecimal = 85 decimal), this is interpreted as a synchronisation event: (<sync-word>). The microcontroller then reads the order number (<order-word>) that is transferred with the 2nd word.

After the order word (<order-word>) another word is transferred that informs about the number of the parameter set (<para-set>). This is followed by additional 15 words <parameter-word> that contain the actual parameters.

When the complete data frame (18 words = 36 bytes) has been read in, the L-LAS-LT-...-MA control unit starts to execute the order contained in the 2nd word (<order-word>).



Format of the data frame: <para-set = 0> GENERAL-PARAMETERS

Word no.	Meaning	Comment
1	<sync-word>	hex-code 0x55, binary=0000 0000 0101 0101, dec.=85
2	<order-word>	Order word (see table below)
3	<para-set> = 0	0 = Parameter set GENERAL
4	EVALMODE	Evaluation mode (0=SLAVE, 1=MASTER, 2=WIDTH, 3=CENTER, 4=DIFF)
5	TRIGGERMODE	Trigger mode (0=CONTINUOUS, 1=EXT-IN0-L/H, 2=EXT-IN0-HIGH, 3=INTERN)
6	ANAMODE	Analog output mode: (0=DIRECT 0..10V, 1=MAXIMA, 2=MINIMA, 3=MAX-MIN)
7	HWMODE	Operating mode of hardware button and potentiometer: (0=DISABLE ALL, 1=ENABLE-ALL, 2=EN.-BTN, 3=EN.-POTI)
8	AVERAGE	Setting for averaging: (1,2,4,8,16,32,64,128 or 256)
9	POLARITY	Output polarity of the digital outputs: (0=DIRECT, 1=INVERS)
10	TOLLO	Lower tolerance value (1 ... MAXPIXEL)
11	TOLUP	Upper tolerance value: (1 ... MAXPIXEL)
12	PARA9	0, currently not used
13	PARA10	0, currently not used
14	PARA11	0, currently not used

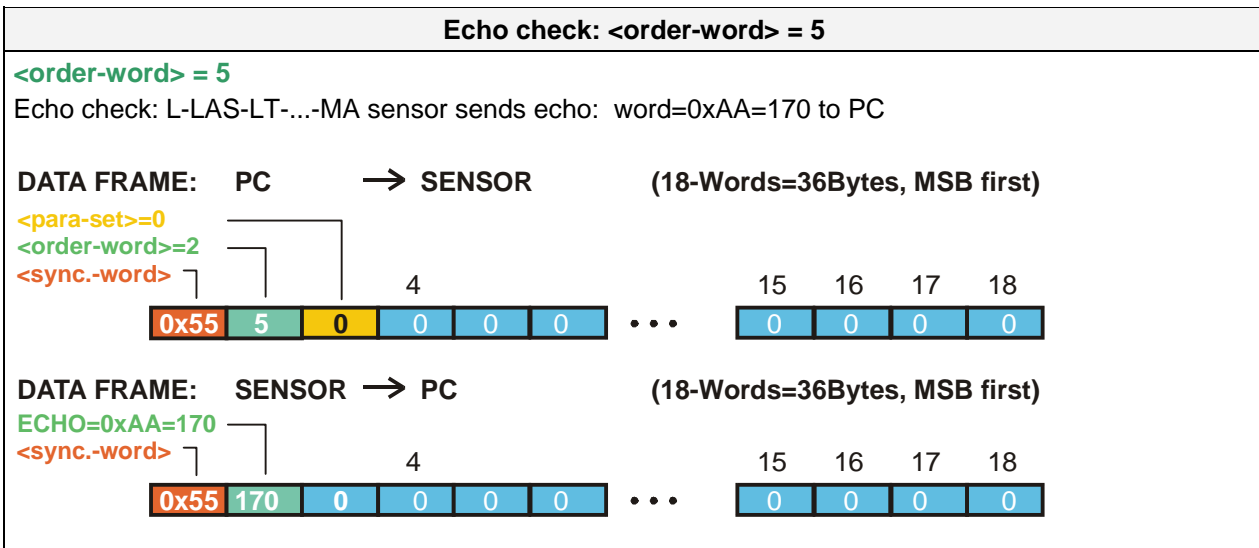
Format of the data frame: <para-set = 0> GENERAL-PARAMETERS		
Word no.	Meaning	Comment
15	PARA12	0, currently not used
16	PARA13	0, currently not used
17	umSETPOINT LO-WORD	Reference value in micrometers, low-order 16-bit-word
18	UmSETPOINT HI-WORD	Reference value in micrometers, high-order 16-bit-word

Format of the data frame: <para-set = 1> MASTER-PARAMETERS		
Word no.	Meaning	Comment
1	<sync-word> = 0x0055	hex-code 0x55, binary=0000 0000 0101 0101, dec.=85
2	<order-word>	Order word (see table below)
3	<para-set> = 1	1 = Parameter set MASTER
4	POWER-MASTER	Power of the laser transmitter (0 ... 1000)
5	POWER-MODE-MASTER	Power mode of the laser transmitter: 0=STATIC, 1=DYNAMIC
6	VIDEO-THRESHOLD-MA	Video threshold (0 ... 100) in percent
7	TEACH-VALUE-MASTER	Teach value (pixel) (0 .. max. pixel number of the CCD line)
8	EVAL-BEGIN-MASTER	Evaluation beginning: Pixel (1 ... E_END-1)
9	EVAL-END-MASTER	Evaluation end: Pixel (E_BEGIN+1 ... MAXPIXEL of the CCD line)
10	CCD OP-MODE-MASTER	Operating mode of the CCD line: 0=LOW-GAIN, 1=HIGH-GAIN
11	TRIGGER-THRESH.-MA	Trigger threshold for INT-TRIGG.: (1 ... MAXPIXEL of the CCD line)
12	Parameter 9	0 , currently not used
13	Parameter 10	0 , currently not used
14	Parameter 11	0 , currently not used
15	SLOPE VALUE L-WORD MA	Sensitivity of the master (x 1024), low-order 16-bit-word
16	SLOPE VALUE H-WORD MA	Sensitivity of the master (x1024), high-order 16-bit-word
17	REF-OFFSET L-WORD MA	0, currently not used
18	REF-OFFSET H-WORD MA	0, currently not used

Format of the data frame: <para-set = 2> SLAVE-PARAMETERS		
Word no.	Meaning	Comment
1	<sync-word> = 0x0055	hex-code 0x55, binary=0000 0000 0101 0101, dec.=85
2	<order-word>	Order word (see table below)
3	<order-word> = 2	2 = Parameter set SLAVE
4	POWER-SLAVE	Power of the laser transmitter (0 ... 1000)
5	POWER-MODE-SLAVE	Power mode of the laser transmitter: 0=STATIC, 1=DYNAMIC
6	VIDEO-THRESHOLD-SL	Video threshold (0 ... 100) in percent
7	TEACH-VALUE-SLAVE	Teach value (pixel) (0 .. max. pixel number of the CCD line)
8	EVAL-BEGIN-SLAVE	Evaluation beginning: Pixel (1 ... E_END-1)
9	EVAL-END-SLAVE	Evaluation end: Pixel (E_BEGIN+1 ... MAXPIXEL of the CCD line)
10	CCD OP-MODE-SLAVE	Operating mode of the CCD line: 0=LOW-GAIN, 1=HIGH-GAIN
11	TRIGGER-THRESH.-SL	Trigger threshold for INT-TRIGG.: (1 ... MAXPIXEL of the CCD line)
12	Parameter 9	0 , currently not used
13	Parameter 10	0 , currently not used
14	Parameter 11	0 , currently not used
15	SLOPE VALUE L-WORD SL	Sensitivity of the slave (x 1024), low-order 16-bit-word
16	SLOPE VALUE H-WORD SL	Sensitivity of the slave (x1024), high-order 16-bit-word
17	REF-OFFSET L-WORD SL	0, currently not used
18	REF-OFFSET H-WORD SL	0, currently not used

Meaning of the 2nd word in the data frame: <order-word>		
Value	Meaning / Action	
0	Nop	no operation
1	Send parameters from PC to L-LAS RAM	18 words, PC ⇒ L-LAS-RAM
2	Get parameters from L-LAS RAM	18 words, L-LAS-RAM ⇒ PC
3	Send parameters from PC to L-LAS EEPROM	18 words, PC ⇒ L-LAS-EEPROM
4	Get parameters from L-LAS EEPROM	18 words, L-LAS-EEPROM ⇒ PC
5	Echo check: Get echo character from L-LAS hardware, Line Ok = 0xAA	18 words, first word=0x00AA (Echo=170)
6	Activate teach process, store in RAM	18 words PC ⇒ L-LAS-RAM
7	Get firmware version message from L-LAS	72-bytes, L-LAS ⇒ PC
8	Get measurement data from L-LAS-RAM	18 words, L-LAS-RAM ⇒ PC
9	Get video buffer information from L-LAS	64 words, L-LAS-RAM ⇒ PC
10	Get hardware information from L-LAS	18 words L-LAS-RAM ⇒ PC
11	Reset maximum/minimum values	18 words PC ⇒ L-LAS-RAM

Examples for data exchange:

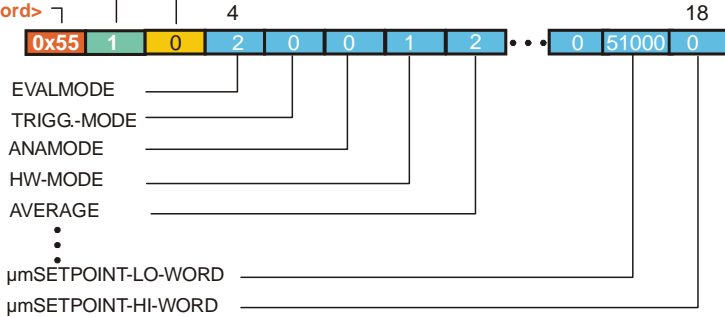


SEND parameter set = 0 to L-LAS-RAM <order-word> = 1

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

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

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



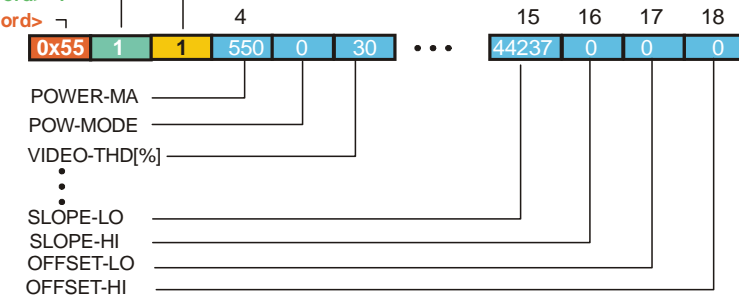
The transferred data frame automatically is sent back as an echo from the L-LAS-LT-...-MA sensor!!

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

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

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

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



SLOPE-VALUE is multiplied with x1024 e.g. 43.2[μm/pixel] x 1024 = 44237
 OFFSET-VALUE in micrometer [μm] , not used

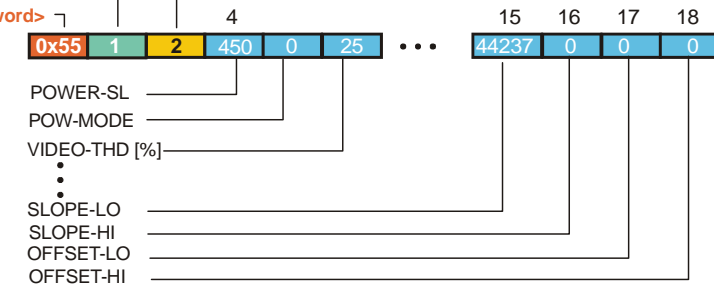
The transferred data frame automatically is sent back as an echo from the L-LAS-LT-...-MA sensor!!

SEND parameter set = 2 to L-LAS-RAM <order-word> = 1

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

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

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

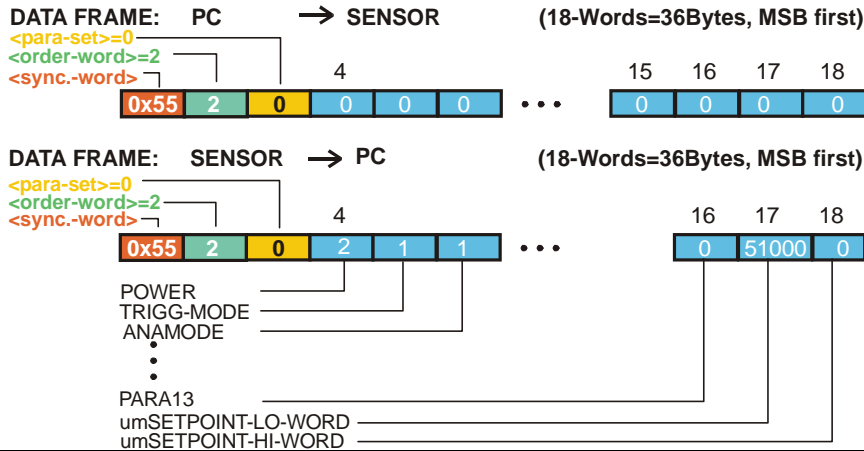


SLOPE-VALUE is multiplied with x1024 e.g. 43.2[μm/pixel] x 1024 = 44237
 OFFSET-VALUE in micrometer [μm] , not used

The transferred data frame automatically is sent back as an echo from the L-LAS-LT-...-MA sensor!!

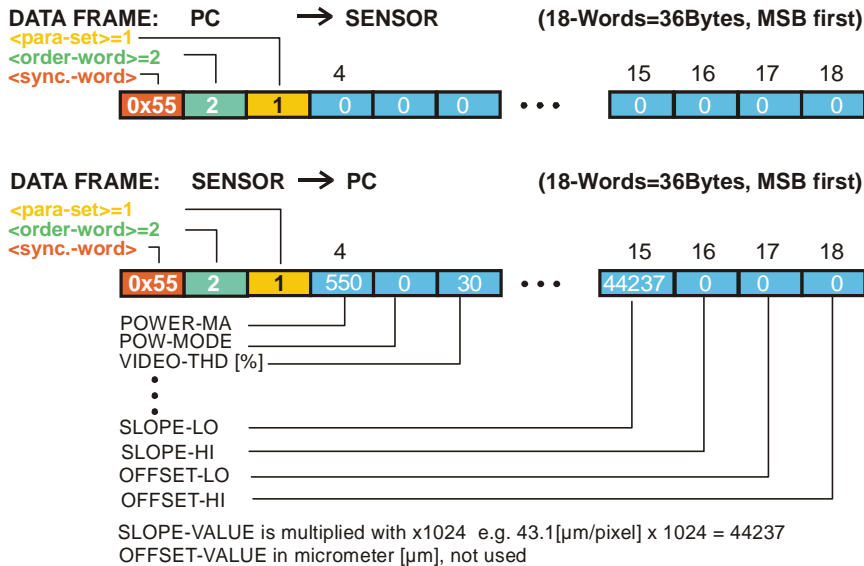
GET parameter set = 0 from L-LAS-RAM <order-word> = 2

<order-word> = 2 <para-set> = 0 = **GENERAL** parameters



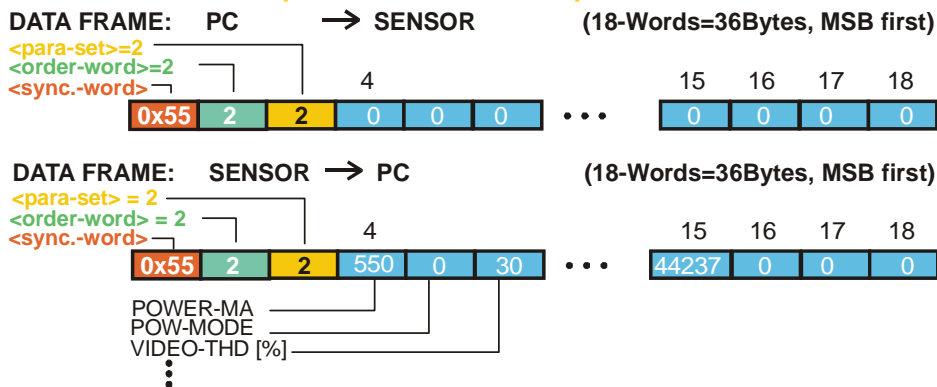
GET parameter set = 1 from L-LAS-RAM <order-word> = 2

<order-word> = 2 <para-set> = 1 = **MASTER** parameters



GET parameter set = 2 from L-LAS-RAM <order-word> = 2

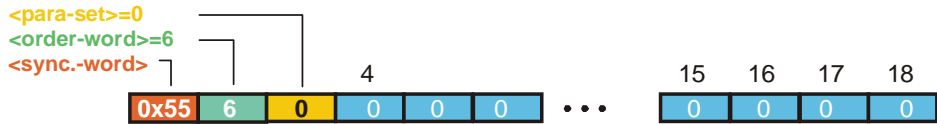
<order-word> = 2 <para-set> = 2 = **SLAVE** parameters



Activate the TEACH FUNCTION at the L-LAS <order-word> = 6

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

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



The current data frame is sent back as an echo!

RESET the maximum/minimum values at the L-LAS <order-word> = 11

<order-word> = 11 <para-set> = 0

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

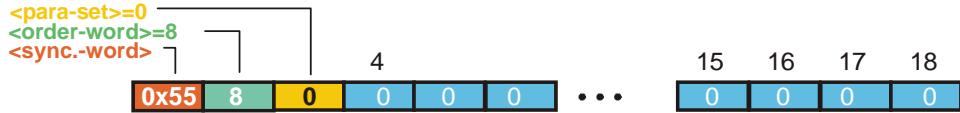


The current data frame is sent back as an echo!

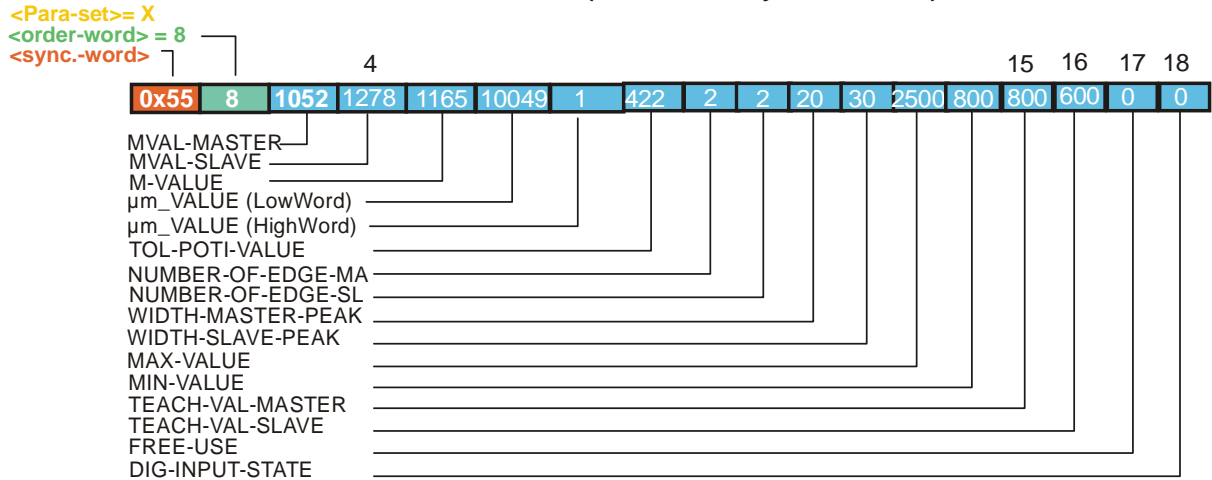
GET measurement data from L-LAS-RAM <order-word> = 8

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

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)

