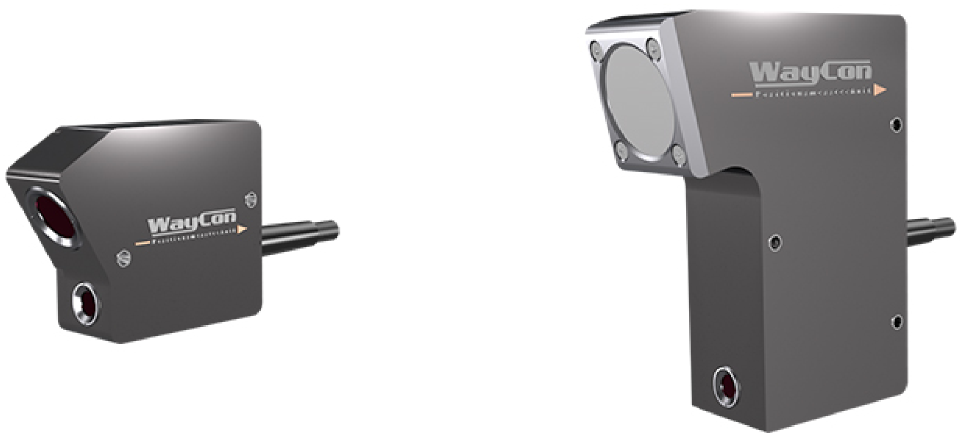
LAM
Laser-Sensors
with integrated Ethernet Interface



Manual

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Hardware and Firmware Versions

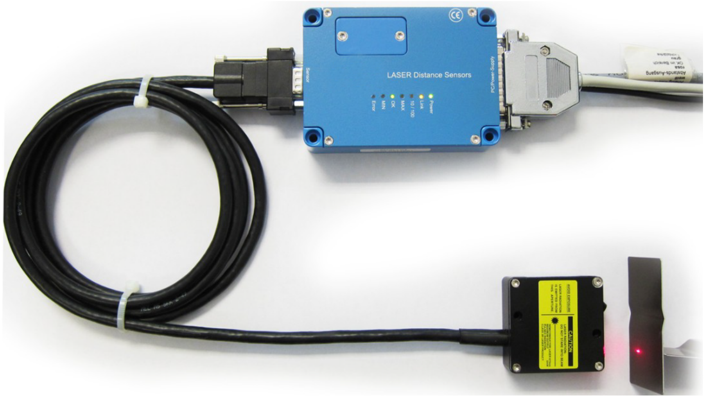
Hardware-Version	1.0	with D-Sub-25 connector
Firmware Electronic System	0.1	

This manual describes installation and integration of sensor hardware and basics of the configuration and demo software. The most important new features:

- Ethernet interface
- Network Link Monitoring (internal)
- 10 Mbit Option for weak network connections
- With each TCP-packet sensor parameters were sent

After a reset the sensor automatically restarts. Settings are not reset.

Factory default parameters could change without notice to the given documentation. Relevant is always the actual interface description.



Optical measuring system consisting of sensor head, sensor head cable and electronic unit

1. Optical Distance Measuring Systems LAM-S and LAM-F

Characteristics:

Range from 0.5 to 200 mm; special models on request
Distance output ± 10V and 4…20 mA
Dip switch adjustable integration time / filter settings
Intensity output 0 ... 10 V
Not sensitive on surface structures and colors
Resolution / accuracy from 0.02 µm
Immune against environment light up to 20.000 LUX
Threshold MIN / MAX adjustable (via software)
Error output
Option thickness measurement (LAM-S only)

Typical applications:

Check dimensions
Position detection of small parts
Position detection on conveyor belt
Detection of tool position in stamping machines
Detecion of sheet duplication
Position / break detection in tooling machines
Robot arm position
Presence detection
Bore hole depth
Fill level detection
Vibration analysis
Crashtest recording
Suspension testing

1.1. Product Identification

Type:	LAM-S-xx or LAM-F-xx	xx = range in millimeter Sensor
Example:	LAM-S-04	LAM-S with 4 mm range

2. System Description

Series LAM are analog laser distance sensors based on PSD sensor elements. The LAM-S sensors have an output rate of 10 kHz and a sampling rate of 54 kHz, series LAM-F works with an output rate of 100 kHz an a sampling rate of 400 kHz.

The hardware consists of a sensor head and an electronic unit for data evaluation. The sensor head is equipped with a laser diode which sends out the measuring beam and a PSD element for receiving the reflected beam. Sensor head and electronic unit are connected via a 9 pin D-Sub connector.
When the power supply is on the sensor sends automatically data in a continuous stream of TCP/IP packages.

2.1. Software

We provide the Demo software „LAM-Software“ to display the measurement values. This software communicates via Ethernet network with the sensor.
This software is easy to use and visualize the data as a number value as well as a grafic.

3. Connections

At the electronic unit there is a 25 pin D-Sub connection for power supply and the analog and digital outputs and a RJ45 socket for the Ethernet TCP/IP connection.
It is possible to transmit several sensors via WLAN. Hubs are not recommended, please use only Ethernet switches.

Note: Gigabit Ethernet cards often cannot identify the polarity of Tx-/Rx- lines. This can be a problem when the sensors are connected directly. In this case please use a crosslink Ehternet cable or a 10/100 Mbit Ethernet switch. The baud rate is adjustable via web browser from 100 Mbit/s (default) to 10 Mbit/s.

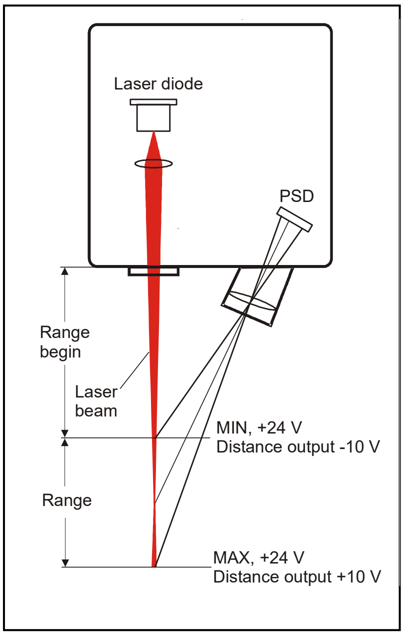
If there are several sensors monitored and evaluated by one PC, the power of PC and grafic card must be sufficient.
Theoretically up to 90 sensors can be managed through one 100 Mbit Ethernet switch. In this case it is recommended to use an additional network card in the PC, a correspondent Ethernet switch, an Ethernet cable for each sensor, an Ethernet cable to connect the switch with the network card and a suitable power supply (10...30 V DC).

4. Function Principle

The sensors work according to the triangulation principle: A laser spot is focused on the object surface. The laser light is reflected on the surface and pictured with an optical system on the PSD position sensor element.

For the measurement the diffuse reflected light is relevant. For a good measurement result, the sensor needs at least 10% of reflected light.
When the intensity of the reflected light is too low and the intensity regulation system cannot set the intensity of the laser beam higher, the error LED lights red.

The sensor system uses light impulses. This reduces the dependency from ambient light.



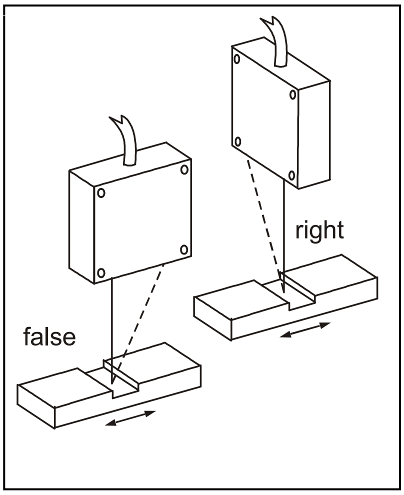
5. Measuring Setup

5.1. Mounting of the Sensor Head

For precise measurement results, the sensor must be mounted in a way that the laser beam is perpendicular to the object surface. Any inclination will cause a deviation from the real distance.

The sensor head must be mounted in a way that a direct look into the beam is not possible. The laser warning sticker must be placed in a position where it is clearly visible for the operator. For adjusting the sensor the MIN / OK / MAX LED’s could be used.
Factory default setting of the MIN / OK / MAX LED’s is at the boundary of the measurement range. When “OK” lights, the object is in range.

Note: The sensor should be mounted with plastic washers.
This helps to avoid electromagnetic interference problems.



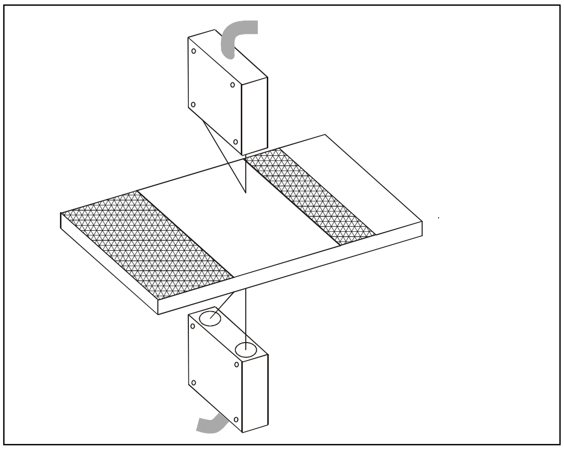
6. Special Applications

6.1. Moving or Striped Objects

If moving or striped objects need to be captured, the sensor head is to be mounted at 90° to the movement axis, as shown in the picture at the right side.

6.2. Thickness Measurement

A thickness measurement system is made of two sensors which are directed to the upper and the lower side of the object. One sensor is the master and one is the slave. The thickness results from the addition of the single measuring signals.
Variations in height do not influence the result as long as they occur within the ranges of the two sensors.
Both sensors and their electronic units are connected and supplied by a special Y-cable. The thickness of the object is output as an analog signal 0...10 V.



7. Measurement Errors

7.1. Surface Material

Objects could be of various materials like metal, plastic, ceramics, rubber and paper. In case of highly reflective materials or liquids it should be tested if the sensor can provide reliable measurement results.
On partially transparent plastic or bleary liquids the laser beam penetrates into the material surface before the diffuse reflected light is sent back from the surface. The real measured distance needs to be corrected by the depth of penetration.

7.2. Scratches within the Laser Spot

A scratch across the lens axis may cause stronger reflections, with a maximum of energy at the side of the spot. This will affect the distance information. For testing on scratches this method may be more helpful than monitoring the pure distance information.

When the object is moving, the average (integrated) value will be constant when moving over the scratch. This means: The positive and the negative edge of the signal will compensate each other.

7.3. Scattered Light

When there are highly reflective objects close to the measurement spot, mirroring the laser light into the receiver optics, then measurement errors may be caused.
Objects with diffuse reflectivity may not cause the same errors. When the mirroring surface is outside of range, the residual error may be up to 2%. Due to the smaller spot size, stray light error is smaller for Laser sensors than for LED sensors.

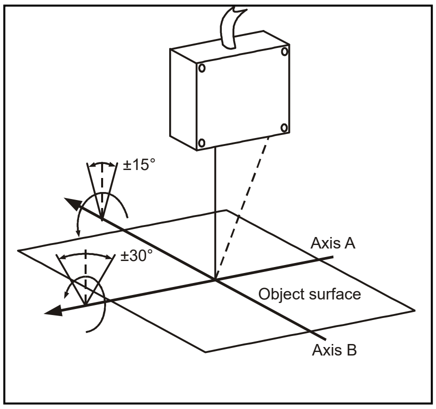
7.4. Transitions from Bright to Dark

When distance measurement is made on objects where the material surface is changing from diffuse reflecting to mirroring material and therefore the reflectivity is changing strongly measurement errors may occur. The maximum of the intensity is not in the center of the spot.
In direction A, the error is minimal; in direction B it is maximal.

7.5. Change of Reflectivity

The sensors are equipped with an automatic intensity regulation for matching to more or less reflecting objects. When the surface is changing during measurement, the intensity is kept constant by the regulation system.

7.6. Angle Dependency



The inclination angle of the object has a little influence to the measurement. A rotation on axis A up to 30° and a rotation on axis B up to 15° do not cause big measurement errors.
Measurements on a surface with good diffuse reflection are less influenced by dumping than a measurement on mirroring surfaces.
When the error is constant, a special calibration could eliminate the error.

7.7. Ambient Light

Ambient light up to 5.000 LUX does not cause errors, up to 20.000 LUX small measurement errors may occur. This corresponds to average sunlight on a white surface.
During the installation of sensors take care that no sunlight could radiate - directly or reflected on a surface - into the sensors receiving optics. This could cancel the function of the sensor.

7.8. Noise

Noise determines the resolution of the sensor. The resolution is indicated for the begin of the measuring range. At the end of the range the noise will be higher and the resolution will be lower.
To get a better resolution the noise can be reduced by filtering the output. This process causes a reduction of the sensor's speed (see chapter 8.3).

8. Measurement Accuracy and Adjustments

8.1. Calibration Protocol

With each sensor, a detailed test report is delivered. The report sheet shows the relative sensor output error to the calculated distance. The relative error is the deviation from the straight line which is made by two points at ± 40% of the range.
For better visualisation, the measurement error is magnified 40 times.
The absolute error is the deviation from the calculated distance.

8.2. Linearization

The sensing element (PSD) does not give results which are in a linear relation to the distance. Therefore the electronic system linearizes the output signal. The linearization compensates different surface reflectivity and creates an output voltage proportional to the distance.

8.3. Reaction Time and Frequency Response

The reaction time at analog outputs is extremely fast with laser sensors. It is specified to be less than 50 µsec for the M7LL or 5 µsec for the M70LL (rise from 0 to 90% of final value).
With DIP-switches in the electronic unit the integration time can be set higher. This reduces noise and improves accuracy.

8.4. Adjustable Thresholds

The electronic unit has two outputs with adjustable thresholds for MIN and MAX. The thresholds can be set with the demo software for LAM-S over the whole range of the sensor. In order to avoid oscillations, the thresholds have a small hysteresis. When the MIN threshold is hit, the MIN output goes high. When MIN or MAX outputs are activated, OK signal goes off (low). When OK is active, neither MIN nor MAX could be active. The thresholds are only active when the object is inside range. For an easy first use, the thresholds are factory default set to the range limits. The thresholds are sampled with the internal CPU processing clock rate of 30 kHz; this is equal to a reaction time of 0.03 msec.

8.5. Repeatability

Other than mechanical systems the optical sensors do not have a hysteresis or problems with repeatability. Accuracy is limited by surface condition and system noise.

9. Network Adjustments

Default IP address	192.168.122.245
MAC address	00-08-DC-00-00-00
Port	3000
Subnet mask	255.255.255.0

Tip: Configure the IP address of your sensor before you add a LAM- sensor to your network. Use a web browser for set up of the IP address, for details see chapter 14.

10. Specifications

10.1. Specifications LAM-S

LAM-S			**0,5**	**2**	**4**	**10**	**20**	**50**	**100**	**200**
Measuring range		[mm]	0,5	2	4	10	20	50	100	200
Range begin		[mm]	23,75	23	22	40	55	115	170	240
Linearity ±		[µm]	1	4	8	20	40	100	200	400
Resolution (f = 10 kHz)		[µm]	0.3	1.3	2.6	6.5	13	32.5	65	200
Resolution (f = 20 Hz)		[µm]	0,02	0,1	0,2	0,5	1	2,5	6	20
Light spot diameter		[mm]	0,1	0,2	0,3	0,6	0,9	1,5	1,5	2
Light source			Laser, wave length 650...670 nm, red visible							
Sampling rate			54 kHz							
Laser protection class			class 2 acc. to DIN EN 60825-1:2001-11, increased laser power optional							
Analog Output	Distance output		±10V (optional 0...10V / 0...5V) ; 4...20mA							
	Output impedance		Approx. 0 Ohm (10 mA max.)							
	Angle error		At 30° inclination (axis A): approx. 0,5% on white object							
	Output rate		10 kHz (-3 dB)							
	Temperature drift		0,02% °C of range							
	Light intensity output		0...10V							
Switching output	MIN		+24V when distance < MIN, LED yellow							
	OK		+24V when distance > MIN and distance < MAX, LED green							
	MAX		+24V when distance > MAX, LED orange							
	Error		+24V / 100mA, LED rot							
Interface			Ethernet TCP/IP							
Baud rate			115.200 Baud							
Switching hysteresis			approx. 0,5% of range							
Ambient light			20.000 LUX							
Operating time			50.000h for Laser diode							
Isolation voltage			200 V DC, 0V against housing							
Max. vibration			5g up to 1kHz							
Operating temperature			0°C...50°C							
Storage temperature			-20°C...70°C							
Humidity			Up to 90% RH, non-condensing							
Protection class			Sensor: IP 64, Elektronik: IP 40							
Supply voltage			+24V DC / 250mA (10...30V)							
Connector			25 pin D-Sub connector							
Sensor cable length (standard)			2m							

All specifications are valid for measurements on matt white object

Note: Dimensional drawings and weights of sensor heads and electronic unit see appendix.

Resolution depending on dip switch settings and object colour (example: LAM-S-10):

On white object		**On black object**	
LAM-S-10	**Resolution**	**LAM-S-10**	**Resolution**
10 kHz	6,5 µm	10 kHz	100 µm
7 kHz	6,0 µm	7 kHz	90 µm
4 kHz	4,0 µm	4 kHz	75 µm
1 kHz	3,0 µm	1 kHz	50 µm
250 Hz	1,5 µm	250 Hz	30 µm
100 Hz	1,0 µm	100 Hz	20 µm
25 Hz	0,7 µm	25 Hz	10 µm
20 Hz	0,5 µm	20 Hz	7,5 µm

Measurement was made with an analog oscilloscope

10.2. Specifications LAM-F

<table>
<tr><th colspan="2">LAM-F</th><th>0,5</th><th>2</th><th>4</th><th>10</th><th>20</th><th>50</th><th>100</th><th>200</th></tr>
<tr><td colspan="2">Measuring range [mm]</td><td>0,5</td><td>2</td><td>4</td><td>10</td><td>20</td><td>50</td><td>100</td><td>200</td></tr>
<tr><td colspan="2">Range begin [mm]</td><td>23,75</td><td>23</td><td>22</td><td>40</td><td>55</td><td>115</td><td>170</td><td>240</td></tr>
<tr><td colspan="2">Linearity ± [µm]</td><td>1,5</td><td>6</td><td>12</td><td>30</td><td>60</td><td>150</td><td>300</td><td>600</td></tr>
<tr><td colspan="2">Resolution (f = 10 kHz) [µm]</td><td>0,8</td><td>3,5</td><td>7</td><td>17,5</td><td>35</td><td>50</td><td>100</td><td>330</td></tr>
<tr><td colspan="2">Resolution (f = 20 Hz) [µm]</td><td>0,05</td><td>0,2</td><td>0,4</td><td>1</td><td>2</td><td>7,5</td><td>15</td><td>50</td></tr>
<tr><td colspan="2">Light spot diameter [mm]</td><td>0,1</td><td>0,2</td><td>0,3</td><td>0,6</td><td>0,9</td><td>1,5</td><td>1,5</td><td>2</td></tr>
<tr><td colspan="2">Light source</td><td colspan="8">Laser, wave length 650…670 nm, red visible</td></tr>
<tr><td colspan="2">Sampling rate</td><td colspan="8">400 kHz</td></tr>
<tr><td colspan="2">Laser protection class</td><td colspan="8">class 2 acc. to DIN EN 60825-1:2001-11, increased laser power optional</td></tr>
<tr><td rowspan="6">Analog Output</td><td>Distance output</td><td colspan="8">±10V (optional 0...10V / 0...5V) ; 4...20mA</td></tr>
<tr><td>Output impedance</td><td colspan="8">Approx. 0 Ohm (10 mA max.)</td></tr>
<tr><td>Angle error</td><td colspan="8">At 30° inclination (axis A): approx. 0,5% on white object</td></tr>
<tr><td>Output rate</td><td colspan="8">100 kHz (-3 dB)</td></tr>
<tr><td>Temperature drift</td><td colspan="8">0,02 % °C of range</td></tr>
<tr><td>Light intensity output</td><td colspan="8">0…10V</td></tr>
<tr><td rowspan="4">Switching output</td><td>MIN</td><td colspan="8">+24V when distance < MIN, LED yellow</td></tr>
<tr><td>OK</td><td colspan="8">+24V when distance > MIN and distance < MAX, LED green</td></tr>
<tr><td>MAX</td><td colspan="8">+24V when distance > MAX, LED orange</td></tr>
<tr><td>Error</td><td colspan="8">+24V / 100mA, LED red</td></tr>
<tr><td colspan="2">Interface</td><td colspan="8">Ethernet TCP/IP</td></tr>
<tr><td colspan="2">Baud rate</td><td colspan="8">115.200 Baud</td></tr>
<tr><td colspan="2">Switching hysteresis</td><td colspan="8">approx. 0,5% of range</td></tr>
<tr><td colspan="2">Ambient light</td><td colspan="8">20.000 LUX</td></tr>
<tr><td colspan="2">Operating time</td><td colspan="8">50.000h for Laser diode</td></tr>
<tr><td colspan="2">Isolation voltage</td><td colspan="8">200 V DC, 0V against housing</td></tr>
<tr><td colspan="2">Max. vibration</td><td colspan="8">5g up to 1kHz</td></tr>
<tr><td colspan="2">Operating temperature</td><td colspan="8">0°C…50°C</td></tr>
<tr><td colspan="2">Storage temperature</td><td colspan="8">-20°C…70°C</td></tr>
<tr><td colspan="2">Humidity</td><td colspan="8">Up to 90% RH, non-condensing</td></tr>
<tr><td colspan="2">Protection class</td><td colspan="8">Sensor: IP 64, Elektronik: IP 40</td></tr>
<tr><td colspan="2">Supply voltage</td><td colspan="8">+24V DC / 250mA (10…30V)</td></tr>
<tr><td colspan="2">Connector</td><td colspan="8">25 pin D-Sub connector</td></tr>
<tr><td colspan="2">Sensor cable length (standard)</td><td colspan="8">2m</td></tr>
</table>

All specifications are valid for measurements on matt white object

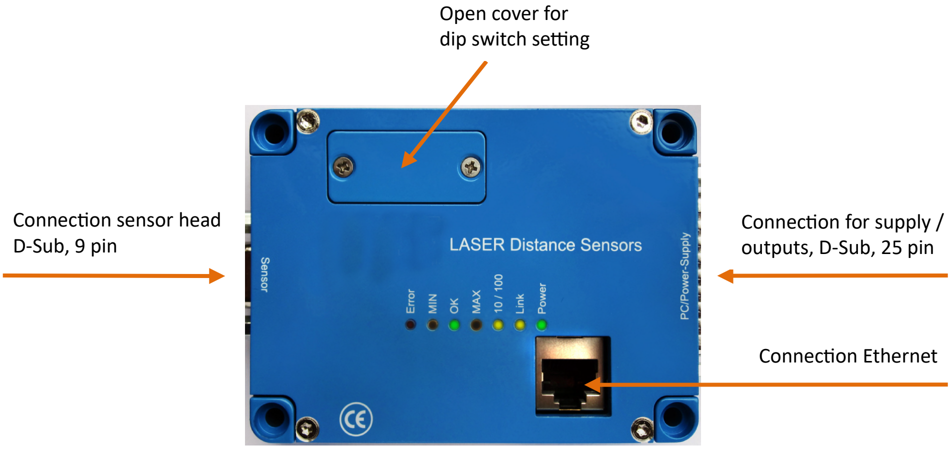
Note: Dimensional drawings and weights of sensor heads and electronic unit see appendix.

Resolution depending on dip switch settings (examples: LAM-F-4 und LAM-F-0,5):

LAM-F-4	Resolution		LAM-F-0,5	Resolution
100 kHz	6,4 µm		100 kHz	0,75µm
70 kHz	6,0 µm		70 kHz	0,68 µm
40 kHz	4,4 µm		40 kHz	0,55 µm
10 kHz	2,4 µm		10 kHz	0,30 µm
2,5 kHz	1,6 µm		2,5 kHz	0,20 µm
1 kHz	1,0 µm		1 kHz	0,13 µm
250 Hz	0,5 µm		250 Hz	0,10 µm
230 Hz	0,4 µm		230 Hz	0,10 µm

Measurement was made with an analog oscilloscope on a white object

11. Electronic Unit



11.1. Pin Assignment Power Supply / Outputs

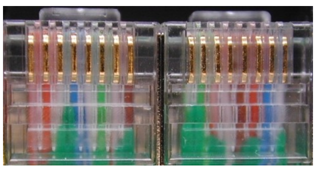
Pin	Signal	Pegel	Pin	Signal	Pegel
1	Distance output	± 10 V	14	Analog GND	0 V
2	Error	0 / 24 V	15	n.c.	
3	n.c.		16	Digital output MAX	0 / 24 V
4	n.c.		17	Distance input	± 10 V
5	Digital output OK	0 / 24 V	18	GND	
6	Distance output	4…20 mA	19	Digital output MIN	0 /24 V
7	n.c.		20	Light intensity output	0…10 V
8	GND	0 V	21	Supply voltage	+ 24 V
9	n.c.		22	n.c.	
10	n.c.		23	n.c.	
11	n.c.		24	n.c.	
12	n.c.		25	n.c.	
13	n.c.		Housing	EMV	

For using the analog output 4…20 mA a resistor of 400 Ω (0,5 W; 0,1% intensity) has to be connected in series between pin 6 and pin 14.

11.2. Pin Assignment Ethernet

Example: Ethernet cable, RJ45, crossed over:

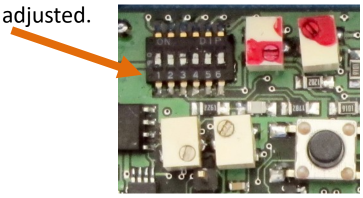
Pin	Signal	Connector A	Pin	Signal	Connector B
1	Transmission data +	green/white	1	Received data +	red/white
2	Transmission data -	green	2	Received data -	red
3	Received data +	red/white	3	Transmission data +	green/white
4	n.c.	blue	4	n. c.	blue
5	n.c.	blue/white	5	n. c.	blue/white
6	Received data -	red	6	Transmission data -	green
7	n. c.	brown/white	7	n. c.	brown/white
8	n. c.	brown	8	n. c.	brown



A direct connection between sensor and network card requires a crossed Ethernet cable. The picture on the left side shows up the position of the blue and red colored wires clearly. When a Ethernet switch is in use, a cross over cable may not be necessary, as the switch may control and correct position of the signals by auto MDI / auto sense function.

11.3. Dip Switch Settings

By setting the dip switches (beyond the small cover on the electronic unit) the output rate can be adjusted.
The settings of the nearby potentiometers may not be changed!
The internal sampling rate of the sensor is not influenced by the dip switch setting.



M7LL (10 kHz)						
Frequency	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**
10 kHz *	-	-	-	-	-	-
7 kHz	x	-	-	-	-	-
4 kHz	-	x	-	-	-	-
1 kHz	-	x	x	-	-	-
250 Hz	-	-	-	x	-	-
100 Hz	-	-	-	-	x	-
25 Hz	-	-	x	x	-	x
20 Hz	x	x	x	x	x	x

M70LL (100 kHz)						
Frequency	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**
100 kHz *	-	-	-	-	-	-
70 kHz	x	-	-	-	-	-
40 kHz	x	x	-	-	-	-
10 kHz	-	x	x	-	-	-
2,5 kHz	-	-	-	x	-	-
1 kHz	-	-	-	-	x	-
250 Hz	-	-	-	-	x	x
230 Hz	x	x	x	x	x	x

x) closed switch
-) open switch
* Default setting

11.4. Status-LED

The LEDs located on the cover of the electronic unit show the following states of the measuring system:

Status LED	**Meaning**	**Colour**	**In function**
Power	Power on	green	lightning
Link	Ethernet link in function	yellow	lightning
10 / 100	Ethernet link activity	yellow	quickly flashing
MAX *	Upper threshold value is reached	orange	lightning
OK *	Object within the measuring range	green	lightning
MIN *	Lower threshold value is reached	yellow	lightning
Error	FPGA self test OK Object out of measuring range	red red	not lit lightning

OK refers to the measuring range of the sensor. As long as the green LED is lightning, the object is within the measuring range. Outside the range the LED is off. MAX/MIN can be adjusted by the user and they must be within the measuring range (Default: MIN at the lower end and MAX at the upper end, both within the measuring range).

12. Communication Components

TCP clients and server are software components in the software development environment. They are represented in the compiled application software as “ports”, using protocols, commands and data. Each sensor has its own IP address matching to the subnet mask. The settings of IP address, port and subnet mask must be set correctly when installing a new sensor. These parameters are responsible for proper function of the unit in the network.
Data is stored in the sensor before sending. The IP address is stored in the sensor electronic unit. For set up a new IP address a web browser can be used. See details in chapter 14.

12.1. IP-Adresse of the Sensor

On delivery the standard setting of the sensor’s IP address is **192.168.122.245.**
The sensor is connected to the network and makes a Peer-to-Peer connection. Once the connection is established to a certain PC, the sensor will not communicate to any other device. The sensor can be connected with a crosslink network cable directly to the PC. Gateways or special hardware is not required.

If a different IP address was set, this will be indicated in the delivery documents or by a sticker.

12.2. Rules for the Setting of IP Addresses

Usually the TCP/IP addresses of gateway, server and router PC are located at the beginning of the address range. These and the network addresses for gateway and router and the addresses with ending 0 and 255 as well must be kept free.

12.3. Solving IP Address Conflicts

DHCP is not supported, the IP addresses for sensor and network card in the PC must be defined and set up manually. The network card of the PC must be in the same subnet, this means that the IP addresses of sensor and PC network card must be differing only in the last 3 digits.

Network clients never must have the same IP address!

Tip: Mark the units and note their respective IP addresses.

Example:
Address sensor 1: 192.168.123.222;
Address sensor 2: 192.168.123.223;
Address sensor 3: 192.168.123.224;
Address sensor 4: 192.168.123.225;
Address sensor 5: 192.168.123.226;
Address sensor 6: 192.168.123.227;
Address sensor 7: 192.168.123.224; // wrong IP address = conflict with sensor 3!
Address sensor 8: 192.168.123.229;
Address sensor 9: 192.168.124.229; // other subnet – no communication!
Address network card: 192.168.123.191
Subnet mask for all sensors and the network card = 255.255.255.0

Explanation: Sensor 7 has been set by error to 192.168.123.224.
This IP address is already given to sensor Nr. 3 and this creates a network conflict. Correct would be 192.168.123.228.
For sensor 9 a different subnet was set. This sensor cannot communicate to the network card in the PC.

Tip: To communicate with sensors in other network segments, a second (third) IP address for the network adapter could be set in Status / Properties / Advanced.

13. Data Format and Interface Description

13.1. Sensor Control

Register HEX	Register DEZ	Byte	Function Register	Remarks
0x1F	31	0	Software Reset	Ethernet module is restartet
0x22	34	0	IP address, port, network settings	M
		1		E
		2		L
		3		S
		4		E
		5		N
		6		S
		7		O
		8		R
		9		IP0(192)
		10		IP1(168)
		11		IP2(123)
		12		IP3(245)
		13		PORT-HI
		14		PORT-LO
		15		SPEED(10/100)
0x26	38	0 1	MAX threshold setting	Max-High Max-Low
0x27	39	0 1	MIN threshold setting	Min-High Min-Low

13.2. Header Data Format

LAM header	Byte no.	Length	Parameter / Value	Data type
Protocol version	0	2	0x2302	unsigned int
Packet size	2	2	Total length = 860 Bytes	unsigned int
Serial number MJ	4	2	4-digit: month, month + year, year (e.g. 0311)	unsigned int
Serial number Cnt	6	2	Production number, 3-digit; 001, 002, 003 …999	unsigned int
On counter	8	4	1…65535	unsigned long
Reserved	12	20		unsigned char
Data packet number	32	2	Consecutive number; natural, 0,1,2,3 ….999	unsigned int
Ethernet transmission rate	34	1	1 10/100-MBit/s	unsigned char
Reserved 1	35	3		unsigned char
AMB	38	2	Begin of range	unsigned int
MB	40	2	Range	unsigned int
MaxValue	42	2	Value set in web browser	unsigned int
MinValue	44	2	Value set in web browser	unsigned int
MaxIntensity	46	1	142	unsigned char
MinIntensity	47	1	14	unsigned char
TriggerStatus	48	2	Bit 0 = Min Status; Bit 1 = Max Status	unsigned int
Reserved 2	50	2		unsigned int
ADZMaxValue	52	2	0xFFFF	unsigned int
ADI MaxValue	54	2	0xFF	unsigned int
AD Frequenz	56	2	30000	unsigned int
AD ValuesMax	58	2	200	unsigned int
AD Values	60	400	2x200 bytes (200 Werte) each 16 bit – distance	unsigned int
ADI Values	460	200	1x200 bytes (200 Werte) each 8 bit – light intensity	unsigned char
ADLValues	660	200	1x200 bytes (200 Werte) each 8 bit – laser control value	unsigned char
Total length		860		

13.3. Status Messages

Conditions:	Terminal software RS232 cabling at the D-Sub-25 connection Power supply PC with RS232 interface
Settings of the RS232:	8 Data bit, no Parity, 1 Stop bit (8N1) Baud rate = 115.200 No hardware handshake (Flow control = none) Switch terminal software to receive

After switching on the supply the sensor sends the following message over RS232:

Data of the RS-232 Prompt:

- Type of device and firmware version
- Serial number
- Ethernet Stack Status
- Ethernet Stack: Baud rate
- Ethernet Stack: Settings
- MAC address
- IP address
- Subnet mask
- Gateway address
- Activity web server
- Settings MAX and MIN
- -
- Ethernet Link Status

14. Integrated Web Server

With the integrated web server the sensor can be accessed through the network, even though the sensor is connected to a PC and is sending distance data. This function is always available when the sensor is connected to a network and to power supply.

Functions of the web server:

Display of:

- IP address, port , subnet mask and MAC address
- Firmware version, serial number
- Optional: Reduce Ethernet transmission rate to 10 Mbit/s

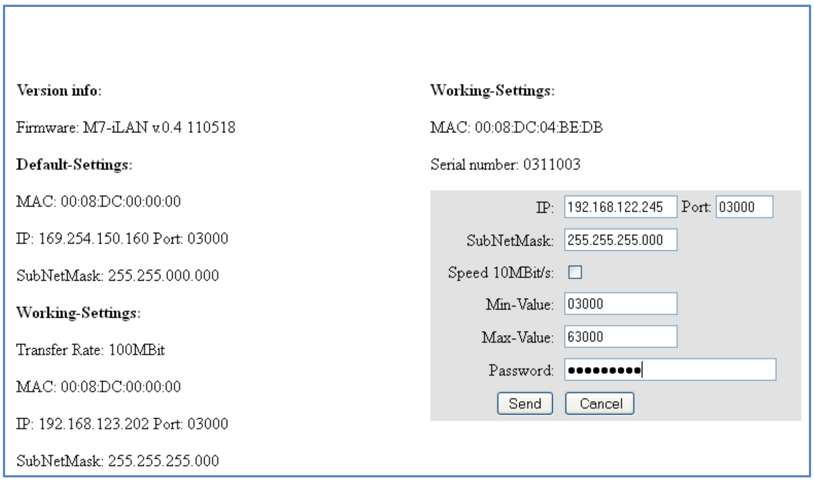
Additionally a direct input of IP and subnet address are possible. A gateway is not necessary, because the sensor builds a peer-to-peer connection.

Requirements for setting the IP address in the web server:

Firmware Rev.	0.1 or higher
Sensor	in normal operation
Remote PC	connected to the sensor via Ethernet
	The PC must be located in the same network segment like the sensor

14.1. Set up of the IP address via web browser

Type the IP address of the sensor into the address field of the web browser (e.g. 192.168.122.245).
The sensor responds with the screen pictured at the right side. In the lower part of the screen the input mask is marked in grey colour.

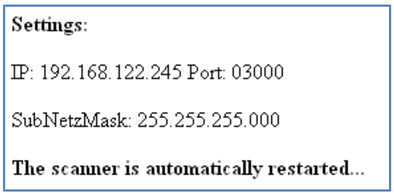


The password is: **SENSOR**

Note: All letters in capitals!

Then click the send button to send the parameters to the sensor or press ENTER.

After a short while the sensor sends a confirmation screen (see picture on the right).
The sensor restarts automatically and uses the new parameters.



Note: If you have programmed a new IP address before, it has to be input now in the web browser and the connection has to be reestablished under this new address.

The IP address of the PC must be similar to the IP address of the sensor, only the last three digits should be different.

Example: Sensor IP = 192.168.122.245 PC IP = 192.168.122.10

15. Trouble Shooting

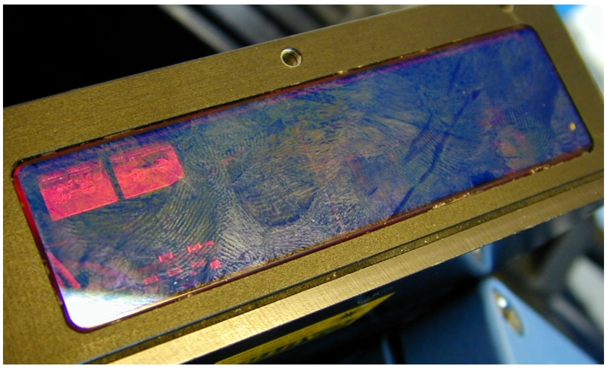
Function	First step	Second step	Remarks
Network connection to PC failed	Check network cables	Exchange cables Use Ethernet switch	Check settings of the PC network card Use a crossed Ethernet cable
	Is a network cable connected to the D-Sub-25 pin connector?	Is the cable tortured too much	reconnect
	The network card in the PC does not recognise zthe polarity of Rx- / Tx automatic	Use an Ethernet switch	The problem arises with cheap Gigabit Ethernet hardware
	Read the RS-232 prompt from the sensor	Cabling according to page Electronic Unit9	Start Terminal software before power up of the sensor
	Check if somebody else is communicating with your sensor	Ping the IP address of the sensor	Cmd: ping xxx.xxx.xxx.xxx When the sensor is not powered on, you must not receive an answer. Whenn you receive an asnwer even when the sensor is not powered then anyone else is using this IP address.
	Check if your routers and switches allow the use of port 3000	Stellen Sie eine direkte make a direct connection	You may need a crossed Ethernet cable! Use unmanaged switches.
	Check the setting of the network card in the PC	Are sensor and PC in the same subnet?	PC and sensor must be in the same network segment (subnet)
Eth.-Link and 100Mbit are lit but no network connection	Turn off firewall	Allow communication for port 3000, TCP protocol	Windows 7 sometimes creates problems, because it deactivates network when it is not active.
	Arp -d	Reset network card cache	
Slow connection	Is the network card a 100 Mbit version?	Use another PC, another Ethernet switch	Do not use hubs.
The connection to the PC is working, but measurement results are received with a delay of a few seconds	The PC is too slow	Use a faster PC	Set graphic display to minimum settings

16. Maintenance

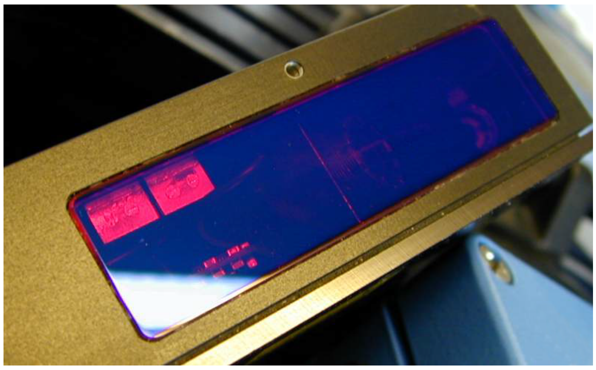
LAM Laser sensors are maintenance free. Because these are optical measurement units, the optical system has to be kept free from dirt and dust. This means: The optical system needs to be cleaned from time to time.

Tip: Cleaning should be done with a soft towel.
You could use alcohol and / or benzine.

Avoid finger prints and remove them carefully and quickly



Dirty sensor



Clean sensor

17. Laser Safety

According to DIN EN 60825-1 (VDE 0837-1), 2001-11 the sensors of series LAM are assigned to laser protection class 2 (optionally 3R).
At laser protection class the optical power sent out from the beam source is less than 1 mW. The laser power quickly disperses through diffuse reflection in the space.

Please note the following warnings:

- Never look directly into the beam
- Never direct the laser onto other people
- Train operators
- Before cleaning switch off laser
- Use a piece of paper to locate the (invisible) beam
- Never use mirrors in the environment
- Shield the workplace
- Use a protective cover / curtain
- Paint machine parts black mat

No bio hazard will occur when the laser beam touches the skin.

Laser Warning Labels:

→Laser protection class 2

→Laser protection class 3R

18. Software Examples

Explanation to the software examples:

To integrate the LAM- sensors in an existing software a DLL is available. More details are available on request.
Our software development engineers use Visual Studio / C++. The source code should be considered as an example. This code could have bugs and we cannot offer guarantees for the accuracy or the completeness of data. We may change the code examples without notice.

Header:

```
#define M27ILANPROTOKOL2302ETHERNETPACKETSIZE 860
#define ADVALUESPROTOKOL2302MAX 200
typedef struct
{
    unsigned int uiVersionProtokol;                  //2 0x2302
    unsigned int uiVersionProtokolSize;              //2 860
    unsigned int uiSerienNummerMJ;                   //2 MMJJ
    unsigned int uiSerienNummerCnt;                  //2 XXX
    unsigned long ulEinschaltzaehler;                //4
    unsigned char ucReserved[20];                    //20
    unsigned int uiPacketNummer;                     //2 consecutive number
    unsigned char ucEthSpeed;                        //1 10/100-MBit/s
    unsigned char Reserved1[3];                      //3
    unsigned int uiAMB;                              //2 Range begin
    unsigned int uiMB;                               //2 Range
    unsigned int uiTriggerMaxValue;                  //2 value adjusted in web browser
    unsigned int uiTriggerMinValue;                  //2 value adjusted in web browser
    unsigned char ucTriggerMaxIntensity;             //1 142
    unsigned char ucTriggerMinIntensity;             //1 14
    unsigned int uiTriggerStatus;                    //2 (uiTriggerMax << 1) | uiTriggerMin
    unsigned int uiReserved2;                        //2
    unsigned int uiADZMaxValue;                      //2 0xFFFF
    unsigned int uiADIMaxValue;                      //2 0xFF
    unsigned int uiADFrequenz;                       //2 30000
    unsigned int uiADValuesMax;                      //2 200
    unsigned int uiADValues[ADVALUESPROTOKOLMAX];        //2x200:400
    unsigned char chADIValues[ADVALUESPROTOKOLMAX];      //1x200:200
    unsigned char chADLValues[ADVALUESPROTOKOLMAX];      //1x200:200
} _structADValues;                                   //860
```

Ethernet Sensor Software Implementation:

For the communication between sensor and Ethernet interface so called “WinSocket” functions are used. These functions are part of all Windows operating systems. Other operating systems may use similar functions. Winsock functions are encapsuled in a „ws2_32.dll“-file. This file is part of the Windows operating system. The communication uses a TCP/IP protocol and the sensor works as a server. This implicates that the PC must be programmed as a client.

At the beginning the „WSAStartup“ function must be called, so that the common functions of WindowsSocket can be used. Next step is to get get a valid TCP-Socket (something like: object) from the system. This is done by calling „socket“.
As soon as a valid socket is available a connection with the sensor can be established. This is made with the function „connect“.
Now the PC is connected to the sensor and both units can exchange data with the commands „send“ and „recv“.
At the end of the communication cycle all memories and sockets should be released using „closesocket“.
Finally the function „WSACleanup“ must be carried out.

Ethernet functions:

– a DLL will be available for these functions -

```
******************************************************************************************************************// size of
input receive buffer: should be modulo 2048, the sensor sends in blocks of 2048
#define TCPBUFSIZE 2048
// Structure for WinSocket
WSADATA wsaData;
// Socket-Variable
SOCKET sTCP;
// make input buffer of specified size
char chBuffer[TCPBUFSIZE];
// number of received Bytes from Sensor
DWORD dwReceived = 0;
// permanently try to get socket, if connect is broken
BOOL bRunSocket = TRUE;
//permanently try to get connect, if receive function returns error
BOOL bRunConnect = TRUE;
// permanently receive data from sensor
BOOL bRunRead = TRUE;
// TimeOut in [ms] for recive function
// after this time receive function return on its own with dwReceived=0
// the communication is locked and initiated immediately
DWORD dwRecvTimeOut = 10000;
//try to start WinSocket v 2.1
if (WSAStartup (MAKEWORD(2, 1), &wsaData) != NULL)
{
  AfxMessageBox("Fehler: WSAStartup", MB_OK | MB_ICONEXCLAMATION, NULL);
  return;
}
//structure of “connect”- order
SOCKADDR_IN serv_addr;
//MUST have value “AF_INET”
serv_addr.sin_family = AF_INET;

//hand over port number of sensor
serv_addr.sin_port = htons(atoi(“3000”));
//hand over IP address of sensor
serv_addr.sin_addr.S_un.S_addr = inet_addr(“192.168.123.224”);
while(bRunSocket)
{
  bRunConnect = TRUE;
  //get socket for TCP=SOCK_STREAM
  sTCP = socket(AF_INET, SOCK_STREAM, 0);
  //Socket error?
  if (sTCP == INVALID_SOCKET)
  {
    sTCP = 0;
    bRunConnect = FALSE;
    TRACE("SocketError\n");
  }
 //set TimeOut for die “recv” function
  setsockopt(sTCP, SOL_SOCKET, SO_RCVTIMEO, (const char*)&dwRecvTimeOut, sizeof(int));
  while(bRunConnect)
  {
 //set up (initiate) connection
    if (connect(sTCP, (SOCKADDR*) &serv_addr, sizeof(SOCKADDR)) == INVALID_SOCKET)
    {
 //if failed keep trying to initiate connection
    }
    else
    {
 //connection established: get data
      bRunRead = TRUE;
      while(bRunRead)
      {
        dwReceived = recv(sTCP, chBuffer, TCPBUFSIZE, NULL);
        if ((dwReceived == 0) || (dwReceived == INVALID_SOCKET))
```

```
        {
          //connection was probably cut, make sure
          //and re-initiate the connection
          bRunRead = FALSE;
          bRunConnect = FALSE;
          closesocket(sTCP);
        }
        else
        {
          //here you find received data
          //number of received data is in dwReceived
        }
      }
    }
  }
  //release socket
  closesocket(sTCP);
  WSACleanup();
}
```

Use the “send” function for sending data to the sensor. As with the „recv“ function it is necessary to set up connection to the sensor before using the “send” function. In the above example you could replace the function „recv“ with “send“.

```
// Data Buffer
// data buffer contains the command
// to set the sensor in single mode
char chBuffer[2] = {0x14, 0x01};
send(sTCP, chBuffer, 2, NULL);
```

****

18.1. Change Log

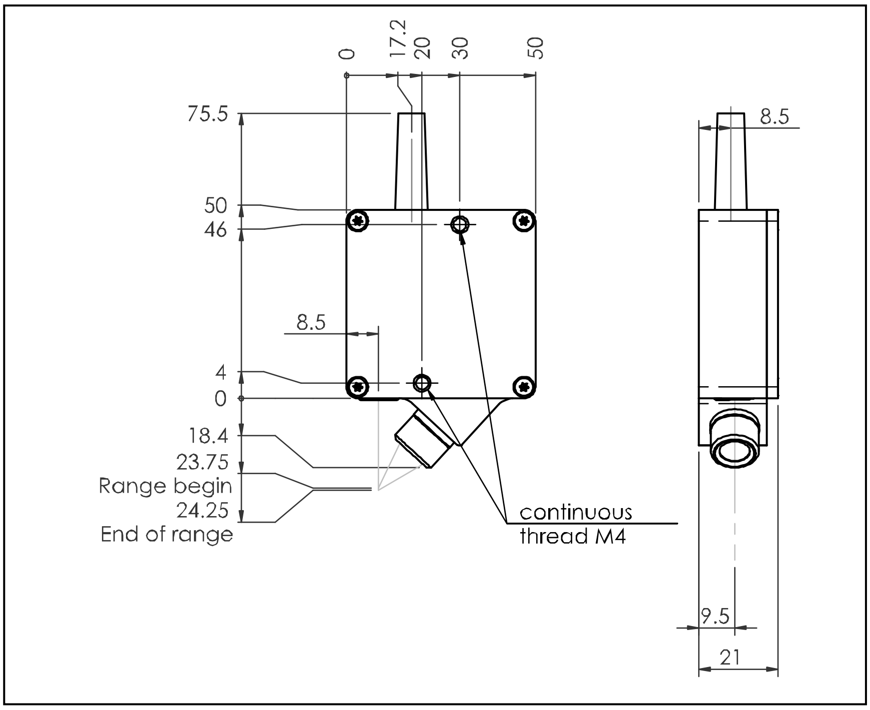
Version	Datum	Änderung
2011-05-13	13.05.2011	Header table
2012-12-10	10.12.2012	Password changed to „SENSOR“
2015-10-19	19.10.2015	Actualization of pin assignment
2016-04-05	05.04.2016	Actualization of software note
2016-06-23	23.06.2016	Correction On counter Correction AD values (numbers of values) Correction ADI values, ADL values (bit size)
2016-08-09	09.08.2016	Restructuring of chapters, introduction of chapter numbers Addition of dimensional drawings for sensor heads and electronic unit

19. Appendix

19.1. Dimensional Drawings Sensor Heads

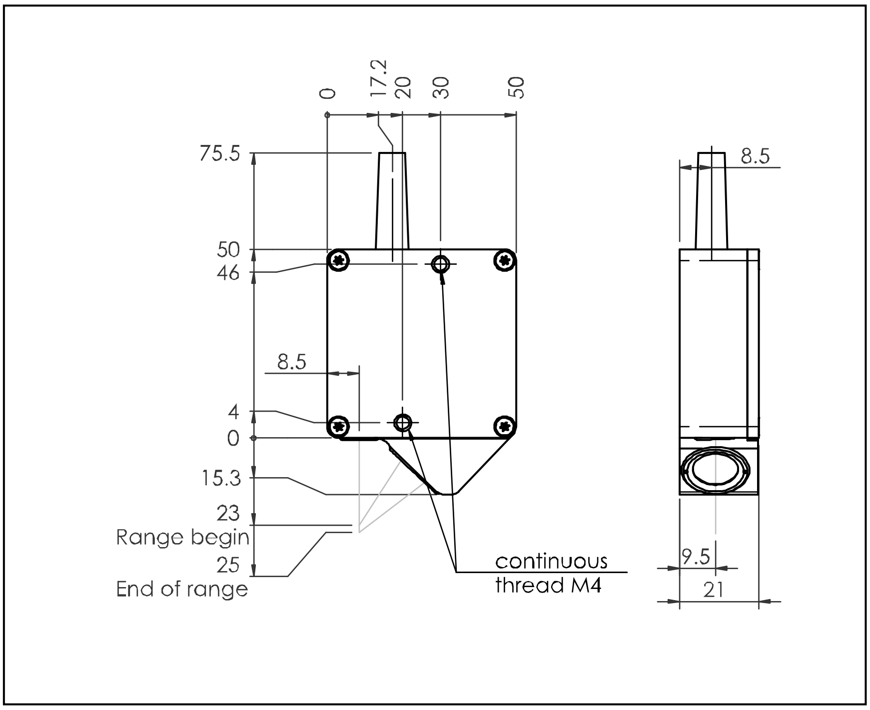
LAM-0,5

Weight: 250 g



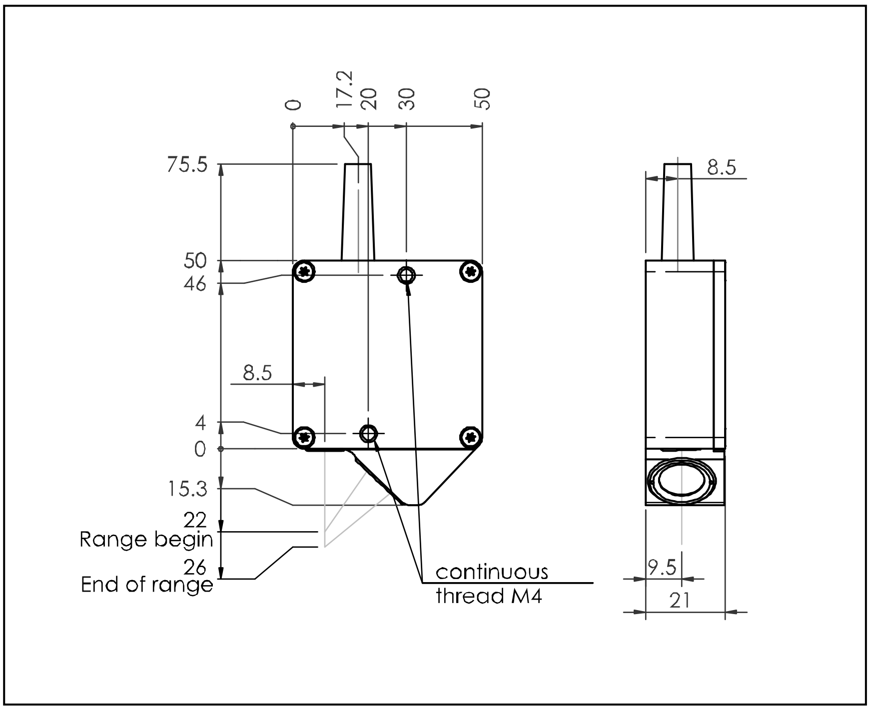
LAM-2

Weight: 250 g



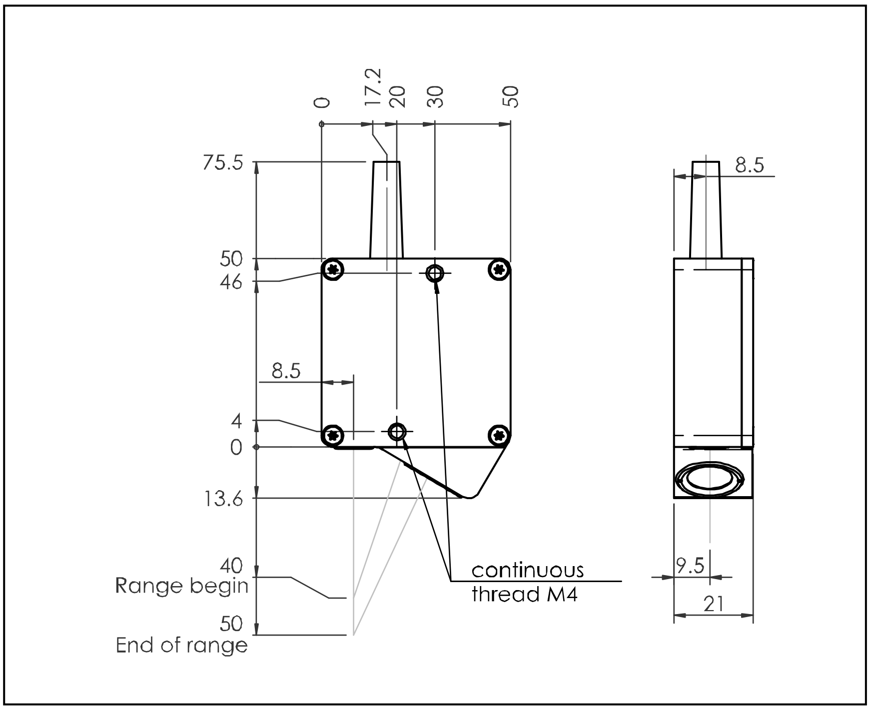
LAM-4

Weight: 250 g



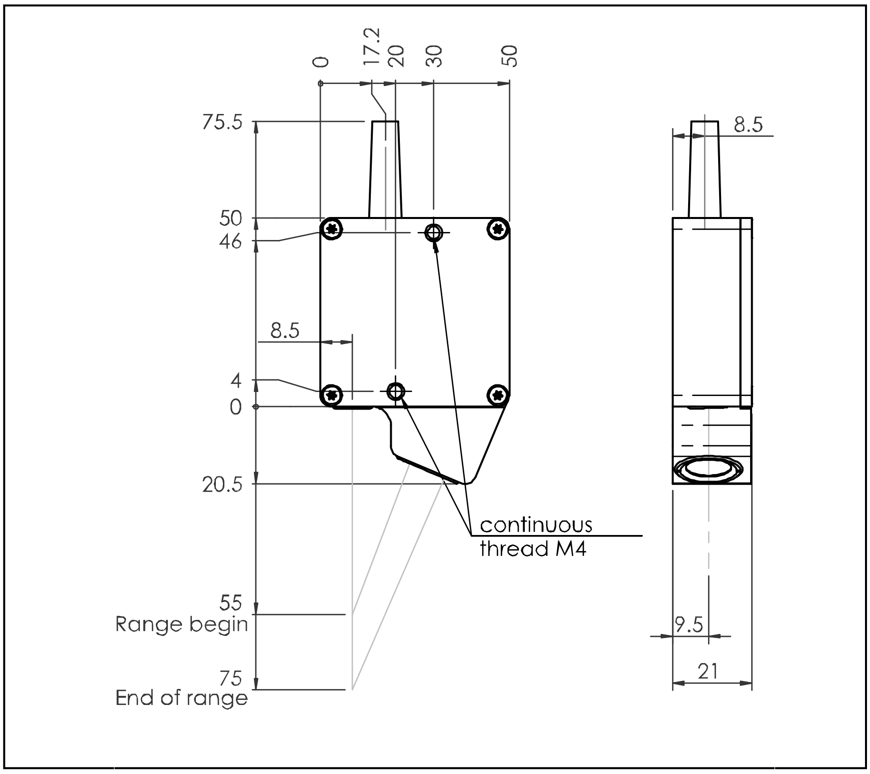
LAM-10

Weight: 250 g



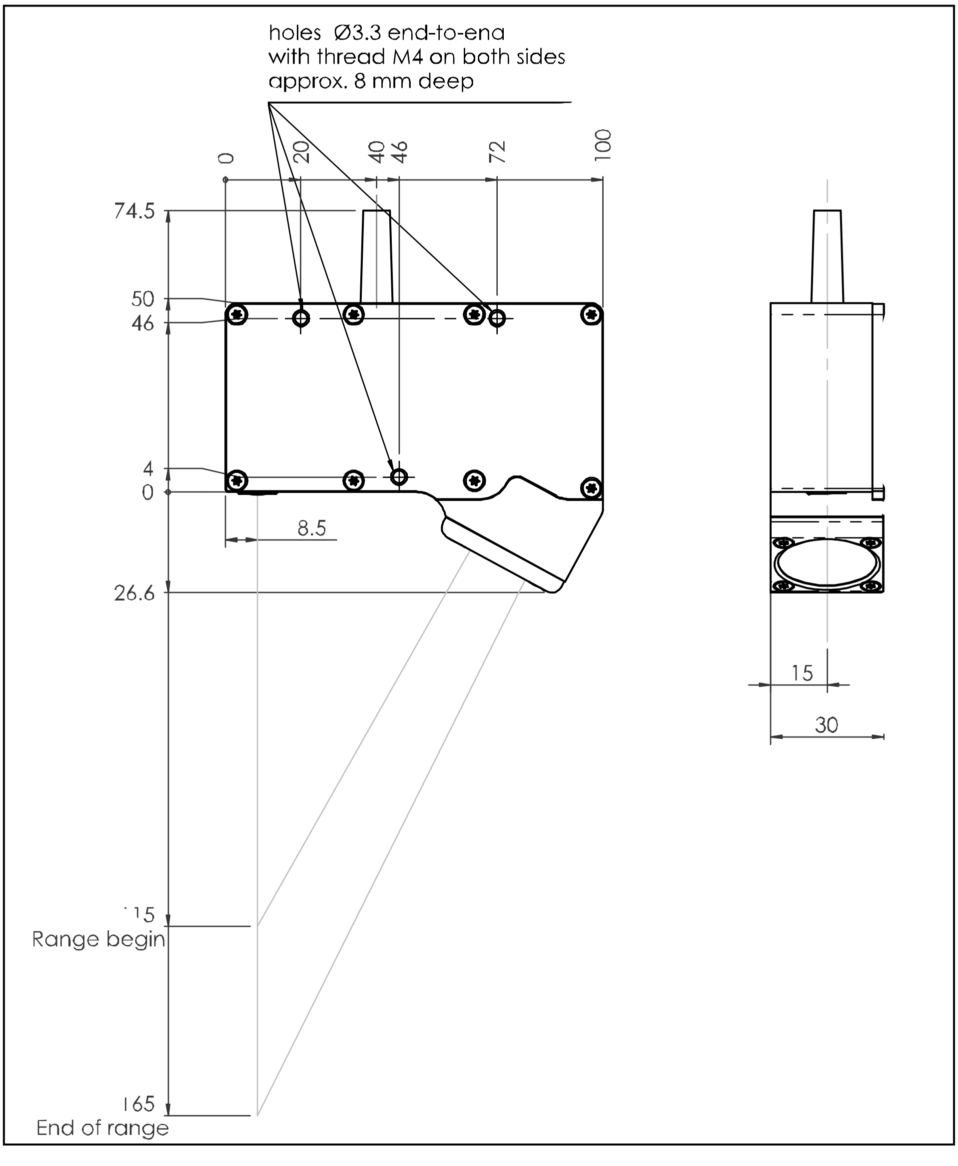
LAM-20

Weight: 250 g



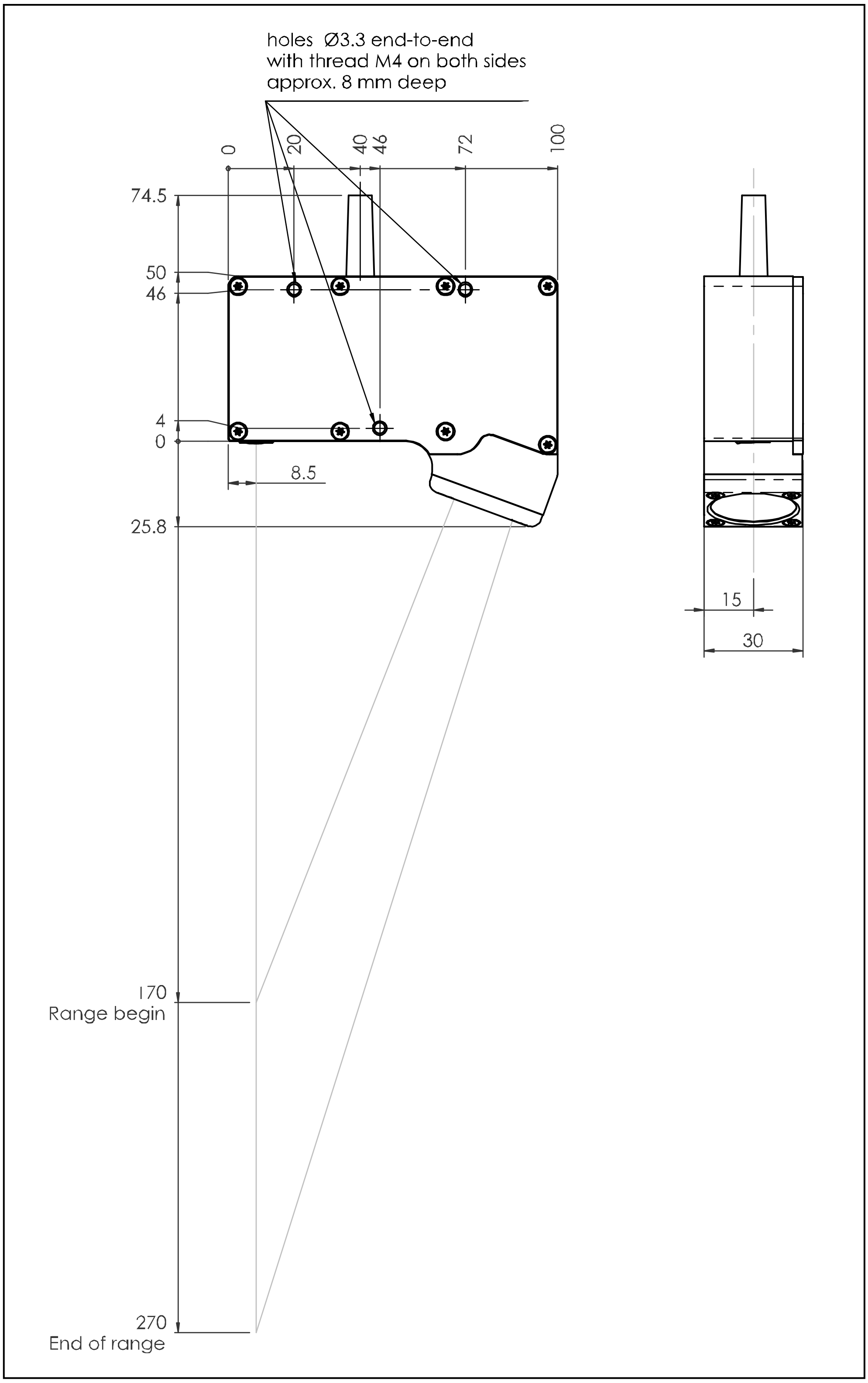
LAM-50

Weight: 480 g



LAM-100

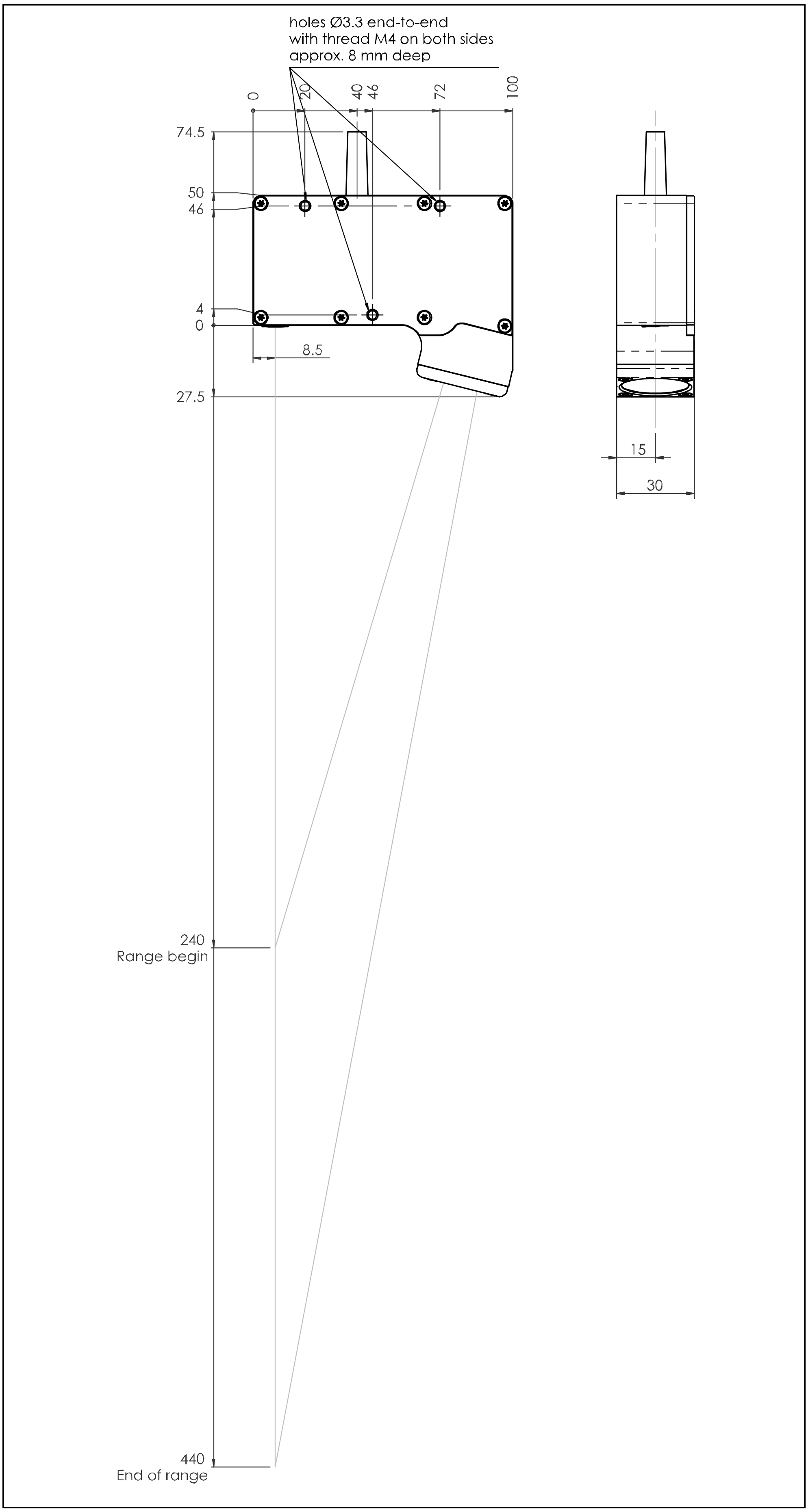
Weight: 480 g



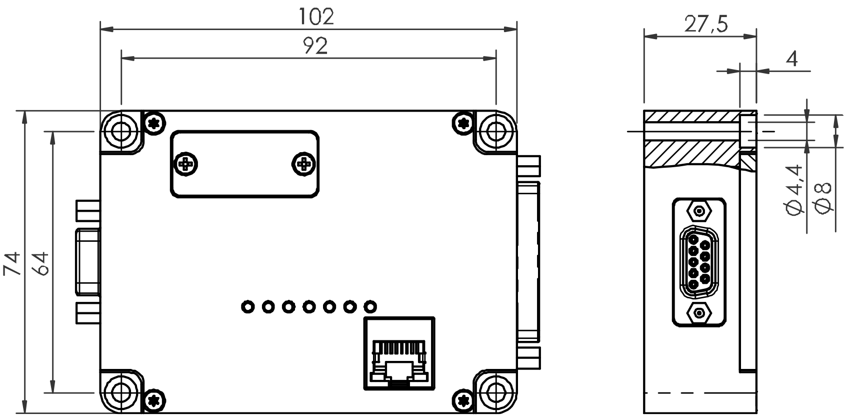
V_2018_08_20

LAM-200

Weight: 480 g



19.2. Dimensional Drawing Electronic Unit



Weight: 300 g

Error and technical modification reserved