User Manual

µSPEED smartsensor

Optical Device for Speed and Length Measurement
***µSPEED-smart*-Sx and –*smart-ECO*-Sx**

Version 1.0

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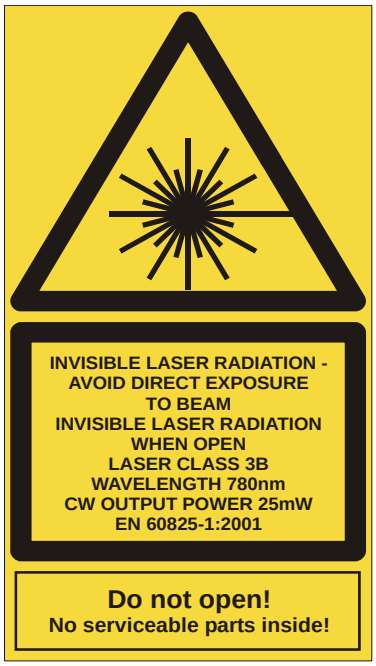
DEAR CUSTOMER

Thank you for giving us and our products your trust. Kindly read the operating instructions carefully. This is a prerequisite to achieve faultless initial operation and functioning of the unit. Before unpacking the equipment, please also read the following paragraphs.

This unit is a class IIIB laser product and complies with EN60825-1:2001. Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.



The following safety features required to comply with the Bureau of Radiological Health Class IIIB laser requirements are included:

- **Laser indicator light on controller and laser**
- **Delayed laser startup- laser indicator light on prior to laser radiation**
- **Laser beam blocking device**
- **Interlock capability for remote shut-off**

Specifications are subject to change without notice.

CAUTION! Every operation, adjustment or servicing that does not exactly conform to the indications given in this instruction manual can result in dangerous irradiation from the laser. Servicing of laser appliances should be performed by suitably qualified personal only.

The lasers used do not emit X-rays or other harmful radiations. You should however use proper caution when handling them.

Remarks about Laser Classes

Equipment with laser light sources is classed according to its AEL (Accessible Emission Limit). A laser belongs to one of the classes 1, 2, 3A, 3B or 4. It is important to know that the accessible radiation is the radiation emitted by the equipment when it is operating.
The overall laser power in both partial beams of the µSPEED measuring unit does not exceed 25 mW. The laser gauge thus belongs to the low end of laser class 3B. Eye damage could occur in the laser area and under unfavourable conditions. The laser area is shown in chapter 4.3. It is possible to avoid the danger by taking suitable precautions such as those in chapter 3. A danger only exists when looking directly into the beam or when the reflected beam falls into the eye.
Any surface that does not cause a sharp reflection of the beam can be looked at without any risk. This also applies to bright reflecting surfaces not made of metal, e.g. cable insulation or foil. A laser reflection from a metal surface that diffuses light and with a curvature radius < 5 mm, e.g. wire, is also harmless. Exposure, even a direct one, of the skin to the radiations is also harmless. The complete characteristics of the µSPEED measuring unit are given in chapter 3.1.1.

Laser Type Used

Maximum power	25 mW
Wavelength	780 nm
Laser class	3B

Table 1: Laser Data

Other properties of the laser gauge, how to set up correctly the measuring unit, as well as references and source of the regulations and guidelines for laser protection are to be found in chapter 3: Description of Laser Protection.

PRECAUTION MEASURES DURING OPERATION

Never use a measuring unit when it is not mounted! Please consider the information about the laser area in chapter 3.2. A detailed description on how to mount correctly a measuring unit is to be found in chapter 3 (Laser Protection).
- Kindly pay attention to the following regulations when using laser equipment:
- Prevention of accidents "Laser Radiation" BGV B2
- Guidelines for BGV B2
- DIN VDE 0837: Radiation Safety of Laser Equipment, Classification of Systems, Requirements, User Guidelines
- DIN VDE 0836: VDE regulations on Electrical Safety of Laser Equipment and Installations

Always switch off the laser when work is performed on the measuring unit!
☞ Further, specific safety aspects are listed in the corresponding chapters.

ELOVIS GMBH is not responsible for accidents due to the inappropriate use of the equipment and to ignoring laser protection regulations!

PROHIBITED USE

The user, owner, to be called here "the customer" must be aware of the following use restrictions:

1. The customer may use the "products" only for their intended use and must not divert them from their initial purpose. This concerns in particular possible harm to persons caused by disregarding laser safety guidelines.
2. The customer must not open the "products".
3. The customer must not modify, extend, transform, copy or decompile the hardware and software contained in the "products".
4. The customer agrees not to duplicate the product in any way whatsoever.

The list does not pretend to be complete!

In case of infringement, the ELOVIS GMBH rejects all claims for damages but it shall itself make such claims.

WARRANTY

The equipment has been carefully tested both mechanically and electrically prior to shipment. It has also been verified, as far as possible, that the equipment is in good working order.

- We guarantee good working of the equipment for a period of 12 months beginning on the day the equipment is ready to be shipped at our plant. We promise to repair or replace at will, as quickly and reasonably as possible, any parts which are proven to be faulty in design, material or workmanship.
- Warranty begins from the moment, the equipment is ready to be shipped at our plant.
- In cases where we undertake assembly and/or initial operation, the warranty begins from the day of initial operation.
- Our liability is limited to direct damages only.
- Our warranty shall not cover replacements or repairs which are due to normal wear and tear.
- Faulty construction of buildings
- Likewise excepted from the warranty are:

– faulty or negligent maintenance
– disregard of operating instructions
– overloading
– use of unsuitable materials
– incorrect assembly works
– faulty electrical connections
– acts of God, and any other cause beyond our control

► ***Our "General Terms and Conditions of Sale" (ELOVIS.AGB), of which the above text is an excerpt, are binding for all warranty cases.***

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1 INTRODUCTION

- *µSPEED-smartsensor*
- Technical Data
- Scope of Delivery
- Installation and Commissioning

1.1 µSPEED-SMARTSENSOR

General description

The measuring devices type *µSPEED-smartsensor* are laser sensors based on the Doppler effect and are used for non-contact measurement of length and velocity of surfaces with diffuse reflection. They provide extremely accurate measurement without markings or rods. This measuring equipment is thus particularly suitable for its use in process control and quality assurance. It allows the optimization of cutting operations, positioning and dosing in the case of flat or rope-like material such as paper, metal, wood, textile, plates, sheets, wires and cables.

Function

The measurement is non-contact and therefore completely free of wear and tear. It is performed by scanning the product from a laser-based measuring unit that projects a striated pattern on the object. The measured object backscatters the laser beam into the measuring unit. The frequency of the backscattered light is directly proportional to the measured object's velocity.

1.2 TECHNICAL DATA

Technical data of the *µSPEED-smartsensor* are listed in the following Table 1.

Speed measuring range (dependend on type of sensor)	2 m/min – 2400 m/min
Accuracy	< 0,05 % for length more than 20m
Stand-off distance (depth of field)	120 mm (+/- 5mm [+/- 10mm]) 240mm (+/- 10mm [+/- 20mm])
Interfaces	1x RS232 oder RS485 & 1x Multifunktion
Voltage	24 V / 3 Watt
Degree of protection	IP 67
Laser classification	3B (780nm)

Table 1: Technical data *µSPEED-smartsensor*

1.3 SCOPE OF DELIVERY

The standard scope of delivery of the *µSPEED-smartsensor* is:

- Sensor head (in the following *µSPEED-smartsensor)*
- Sensor cable
- Plastic screws and plastic plate for insulated installation
- User manual

1.4 INSTALLATION AND COMMISSIONING

Check.

1. Please check whether you received all components listed in the scope of delivery.
2. Please check every single delivery component. If you see damages or in case of missing components, please do not set the unit into operation, but contact:
   ELOVIS GmbH, Karl-Friedrich Str. 14-18, D-76133 Karlsruhe, Germany
   Tel.: +49 (0) 721 / 933 823-0; Fax: +49 (0) 721 / 933 823-23

Mounting *µSPEED-smartsensor*.

Danger of eye damage from class 3B laser!
Never use the measuring unit when it is not mounted!

1. The alignment of the measuring unit has to be perpendicular to the measured object. It should be mounted at an angle of 90 degree and at a distance of 120mm (+/- 3mm to +/-5mm) or 240 mm (+/- 10mm) from the measured object (see Figure 1). The rules and regulations of laser protection must be followed (see chapter 3).

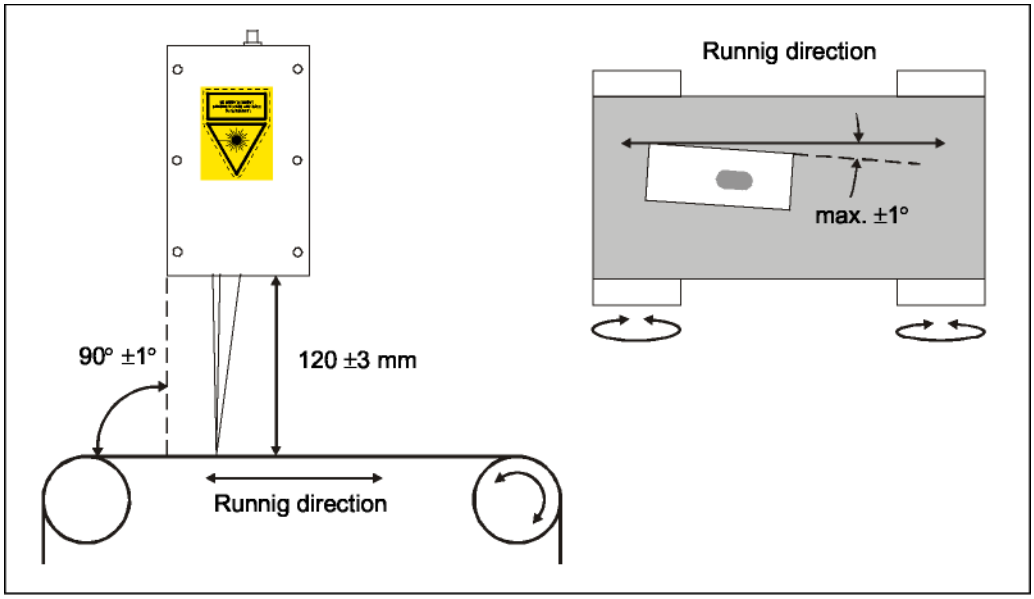


Figure 1: Mounting tolerances and alignment of *µSPEED-smartsensor*

2. *µSPEED-smartsensor* must be mounted electrically isolated (no contact with machinery ground). The PVC plate and plastic screws which are included in the scope of delivery, should be used for this purpose.

Electrical connection of *µSPEED-smartsensor*.

1. Connect the delivered sensor cable with the *µSPEED-smartsensor*.
2. Interconnect/wire the other end of the sensor cable according to the designated functions.
3. Interconnect/wire the emergency shut-off input **Fehler! Verweisquelle konnte nicht gefunden werden.**according to the laser protection directions (see detailed information in chapter 3.1.2). The shut-off input has to be connected to a key switch (which is not

part of the scope of delivery), whose key can only be pulled out during laser off status, and has to be connected additionally to one or more emergency shut-off devices.

4. Instead of 2. and 3.: Connect the other end of the sensor cable with the optional ELOVIS *Speed-Box*. The possibilities of wiring of the *Speed-Box* can be found in the in the associated *Speed-Box* manual.

2 INTERFACES

The *µSPEED-smartsensor* is delivered with a connector plug, which provides all signals and which is used for power supply in addition.

- ❒ Mechanical Interface
- ❒ Electrical Interface

2.1 MECHANICAL INTERFACE

The sensor head of *µSPEED-smartsensor* is equipped with a flange connector of the company Binder (Germany).

- series: 423
- number of poles: 12
- type: 09-0131-68-12
- degree of protection: IP67

The following types of sockets (female) can be used for the above mentioned flange connector:

- straight: type: 99-5630-15-12
- bent: type: 99-5630-75-12

The sensor cable, which is part of the scope of delivery, has on its end to the *µSPEED-smartsensor a fitting socket and on the other end a connector* 15-pole standard Sub-D.

2.2 ELECTRICAL INTERFACE

2.2.1 VOLTAGE

- supply voltage: 18-30V (nominal 24V) controlled
- wattage: max. 3W
- pin assignment see 2.2.5.

2.2.2 EMERGENCY SHUT-OFF / LASER INTERLOCK

- type of signal: one-sided (against signal ground)
- min. signal voltage: 0V
- max. signal voltage: 30V
- switching voltage:
- upward: approx. 19V
- downward: approx. 7V
- hysteresis: approx. 12V
- pin assingment see 2.2.5.

status possibilities:

- input voltage < switching voltage: emergency shut-off / laser protection
- input voltage > switching voltage: standard operation

2.2.3 COMMUNICATION INTERFACES

There are two separate, equitable interfaces for communication. One always existent communication interface and one flee configurable multifunction interface.

2.2.3.1 CONFIGURATION INTERFACE (RS-485 / RS-232)

Always existent interface. The mode (RS-485 or RS-232) is configurable.

- interface to RS-485 or RS-232
- min. baud rate: 1200 baud
- Max. baud rate: 460800 baud
- data bit: 7 or 8
- parity: none, even, odd
- pin assignment see 2.2.5.

2.2.3.2 MULTIFUNCTION INTERFACE

The multifunction interface consists of three differential pairs of five Volt.
These pairs according to the configuration (see 2.2.4) form a RS-485- ,RS-422- or SSI-interface, I/O ports or a combination thereof.
Interfaces which can be implemented are described in the following.

RS-485

Possible in configuration K3, K4 and K7 (see 2.2.4).

- Interface to RS-485
- min. baud rate: 1200 baud
- max. baud rate: 460800 baud
- data bits: 7 or 8
- parity: none, even, odd
- pin assignment see 2.2.5.

RS-422

Possible in configuration K5 and K8 (see 2.2.4).

- Interface to RS-485
- min. baud rate: 1200 baud
- max. baud rate: 460800 baud
- data bits: 7 or 8
- parity: none, even, odd
- pin assignment see 2.2.5.

SSI

Possible in configuration K6 and K9 (see 2.2.4).

- standard SSI-interface
- SSI-Clock input to RS-422 input specification
- SSI-Data outnput to RS-422 output specification
- max. output frequency: 1MHz
- pin assignment see 2.2.5.

Quadrature / Pulse output

Possible in configuration K1 (quadrature output with dead center position), K2 and K3 (quadrature output without dead center position), K4, K5 and K6 (pulse output) (see 2.2.4).

- ouput to RS-422 output specification
- max. output frequency: 1MHz
- max. output frequency for one permille frequency accuracy: 20kHz
- max. output frequency for one percent frequency accuracy: 200kHz
- pin assignment see 2.2.5.

I/O

Possible in configuration K2, K4, K8 and K9 (one I/O-Port), K7 (two I/O-Ports), K10 (three I/O-Ports) (see 2.2.4).

- input to RS-422 input specification
- ouput to RS-422 output specification
- pin assingment see 2.2.5.

2.2.4 CONFIGURATION ALTERNATIVES

Configuration	Description
K1	Quadrature output with Dead Center Position (A/B/N)
K2	Quadrature output wirhout Dead Center Position (A/B) & 1x I/O
K3	Quadrature output without Dead Center Position (A/B) & RS-485
K4	Pulse output (A) & RS-485 & 1x I/O
K5	Pulse output (A) & RS-422
K6	Pulse output (A) & SSI
K7	RS-485 & 2x I/O
K8	RS-422 & 1x I/O
K9	SSI & 1x I/O
K10	3x I/O

Table 2: Configuration Alternatives

2.2.5 PIN ASSIGNMENT

Pin assignment up to output configuration:

Pin	Signal	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10
M	VCC	X	X	X	X	X	X	X	X	X	X
G	PGND	X	X	X	X	X	X	X	X	X	X
J	SGND	X	X	X	X	X	X	X	X	X	X
H	EmS-Off	X	X	X	X	X	X	X	X	X	X
F	Config A	X	X	X	X	X	X	X	X	X	X
E	Config B	X	X	X	X	X	X	X	X	X	X
A	I/O1+	A	A	A	A	A	A	I/O	I/O	I/O	I/O
K	I/O1-	A/	A/	A/	A/	A/	A/	I/O	I/O	I/O	I/O
L	I/O2+	B	B	B	I/O	422-R+	SSI-C+	I/O	422-R+	SSI-C+	I/O
B	I/O2-	B/	B/	B/	I/O	422-R-	SSI-C-	I/O	422-R-	SSI-C-	I/O
D	I/O3+	N	I/O	485+	485+	422-T+	SSI-D+	485+	422-T+	SSI-D+	I/O
C	I/O3-	N/	I/O	485-	485-	422-T-	SSI-D-	485-	422-T-	SSI-D-	I/O

Table 3: Binder Flange Connector

Pin	Signal	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10
14	VCC	X	X	X	X	X	X	X	X	X	X
15	PGND	X	X	X	X	X	X	X	X	X	X
12	SGND	X	X	X	X	X	X	X	X	X	X
13	EmS-off	X	X	X	X	X	X	X	X	X	X
8	Config A	X	X	X	X	X	X	X	X	X	X
7	Config B	X	X	X	X	X	X	X	X	X	X
2	I/O1+	A	A	A	A	A	A	I/O	I/O	I/O	I/O
1	I/O1-	A/	A/	A/	A/	A/	A/	I/O	I/O	I/O	I/O
4	I/O2+	B	B	B	I/O	422-R+	SSI-C+	I/O	422-R+	SSI-C+	I/O
3	I/O2-	B/	B/	B/	I/O	422-R-	SSI-C-	I/O	422-R-	SSI-C-	I/O
6	I/O3+	N	I/O	485+	485+	422-T+	SSI-D+	485+	422-T+	SSI-D+	I/O
5	I/O3-	N/	I/O	485-	485-	422-T-	SSI-D-	485-	422-T-	SSI-D-	I/O

Table 4: Pin assignment Sub-D Connector

- Yellow: Power supply
- Green: Red-off/Laser protection – emergency shut-off
- Orange: Configuration interface
- Blue: Multifunction interface

Pair I/O1, I/O2 and I/O3, as well as the configuration interface in RS-485 Mode can in each case be configurated with a terminating impedance (load resistance) of 120 Ohm effectively. Depending on the kind of mode, the configuration interface is assigned as follows:

Pin	Signal	RS-232 Mode	RS-485 Mode
F	Config A	RS-232-TXD	RS-485+
E	Config B	RS-232-RXD	RS-485-

Table 5: Pin assignment Binder Flange Connector

Pin	Signal	RS-232 Mode	RS-485 Mode
8	Config A	RS-232-TXD	RS-485+
7	Config B	RS-232-RXD	RS-485-

Table 6: Pin assignment Sub-D Connector

3 LASER PROTECTION

The µSPEED sensor system is a laser-based measuring system. When using a µSPEED, it is necessary to comply with the following regulations and guidelines:

- Prevention of accidents "Laser Radiation" BGV B2
- Guidelines for BGV B2
- DIN VDE 0837: Radiation Safety of Laser Equipment, Classification of Systems, Requirements, User Guidelines
- DIN VDE 0836: VDE regulations on Electrical Safety of Laser Equipment and Installations

This chapter provides an overview of the characteristics of the µSPEED laser sensors and of the protection measures needed. It does not replace reading the rules and regulations mentioned above.

❒ *µSPEED-smartsensor Laser Device*

❒ Safety Measures

❒ Laser Safety Information Sources

3.1 *µSPEED-SMARTSENSOR LASER DEVICE*

3.1.1 CHARACTERISTICS

The overall laser power in both partial beams of the µSPEED measuring unit does not exceed 25 mW. The laser gauge thus belongs to the low end of laser class 3B. Eye damage could occur in the laser area and under unfavourable conditions. The laser area is shown in chapter 4.3. It is possible to avoid the danger by taking suitable precautions such as those in chapter 3. A danger only exists when looking directly into the beam or when the reflected beam falls into the eye.

Any surface that does not cause a sharp reflection of the beam can be looked at without any risk. This also applies to bright reflecting surfaces not made of metal, e.g. cable insulation or foil. A laser reflection from a metal surface that diffuses light and with a curvature radius < 5 mm, e.g. wire, is also harmless. Exposure, even a direct one, of the skin to the radiations is also harmless.

The *µSPEED-smartsensor* Laser Data are listed in the following Table 7.

Laser class	3B
Visible laser radiation	780 nm (red)
Output power at the intersecting point of the beams	< 25 mW
Power of a partial beam	< 12,5 mW
Spot diameter	> 0.5 mm
Max. irradiation up to 360 mm behind the output aperture (both beams)	< 400 W/m^2
Max. irradiation at 360 mm or more behind the output aperture (one beam)	< 200 W/m^2
Max. irradiation at 20 m or more behind the output aperture	< 25 W/m^2
Divergence angle	horizontal 1.6 mrad vertical 0.8 mrad

Table 7: *µSPEED-smartsensor* Laser Data

3.1.2 SAFTEY FEATURE

µSPEED-smartsensor has a special safety feature:

- Without wiring the emergency shut-off input (see 2.2.2) the laser is always shut-off.
- This shut-off input has to be connected with a key switch (which is not part of the scope of delivery), whose key can only be pulled out during laser off status, and has to be connected additionally to one or more emergency shut-off devices.

3.2 SAFETY MEASURES

The following protection measures for avoiding eye damage should apply when the µSPEED measuring unit is operating:

1. The measuring unit should be solidly fastened before operating it. It is necessary to ensure that the laser beam does not freely propagate through the area by the use of the laser tube and in addition by placing a laser blocking device (as shown in chapter 4.3) e.g. an opaque plate with diffuse reflection.
2. If the measuring unit is not fastened, the unit has to be switched off. If this is not possible the mechanical shutter has to be closed as shown in chapter 4.5.
3. The 10 cm area around the beam axis is to be signalled as a laser area. In the laser area, the threshold for direct eye irradiation is exceeded. It is therefore necessary to prevent anybody from manipulating plane reflecting surfaces or optical instruments in the laser area. The laser area ends either where the beam is blocked by a target with diffuse reflection or – when there is no such target – at a distance of 20 m.
4. A person responsible for laser protection should be charged in writing to supervise the operation of the laser equipment.
5. The employer's liability insurance association or the equivalent organization should be informed prior to commissioning of the µSPEED that equipment including a laser of class 3B will be operated.
6. The exact regulations can be found in BGV B2.

3.3 LASER SAFETY INFORMATION SOURCES IN GERMANY

The referred to regulations, guidlines and instructions at the beginning of this document as well as in this chapter can be purchased at a bookselling trade or under the following addresses in Germany:

- Carl Heymanns Verlag KG, Luxemburgerstr. 449, 50939 Köln
- Berufsgenossenschaft für Feinmechanik und Elektrotechnik, Gustav-Heinemann-Ufer 130, 50968 Köln

3.4 LASER SAFETY INFORMATION SOURCES OUTSIDE GERMANY

Users who operate the µSPEED-smartsensor outside Germany:

Please be aware that you have to inform yourself about the legal and official restrictions of your individual country, which can be different from the things mentioned in this manual. ELOVIS GmbH is not responsible for inappropriate use of the equipment and to ignoring laser protection regulations of the particular country! You may ask also for the assistance of our country sales agent.

4 DIAGRAMS AND DRAWINGS

- ❒ Pin Identification of the Binder Flange Connector
- ❒ Dimensional drawing of *µSPEED-smartsensor*

4.1 PIN IDENTIFICATION OF THE BINDER FLANGE CONNECTOR

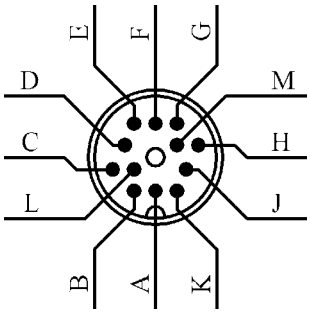


Figure 2: Pin Identification of the Binder Flange Connector

4.2 DIMENSIONAL DRAWING OF *µSPEED-SMARTSENSOR*

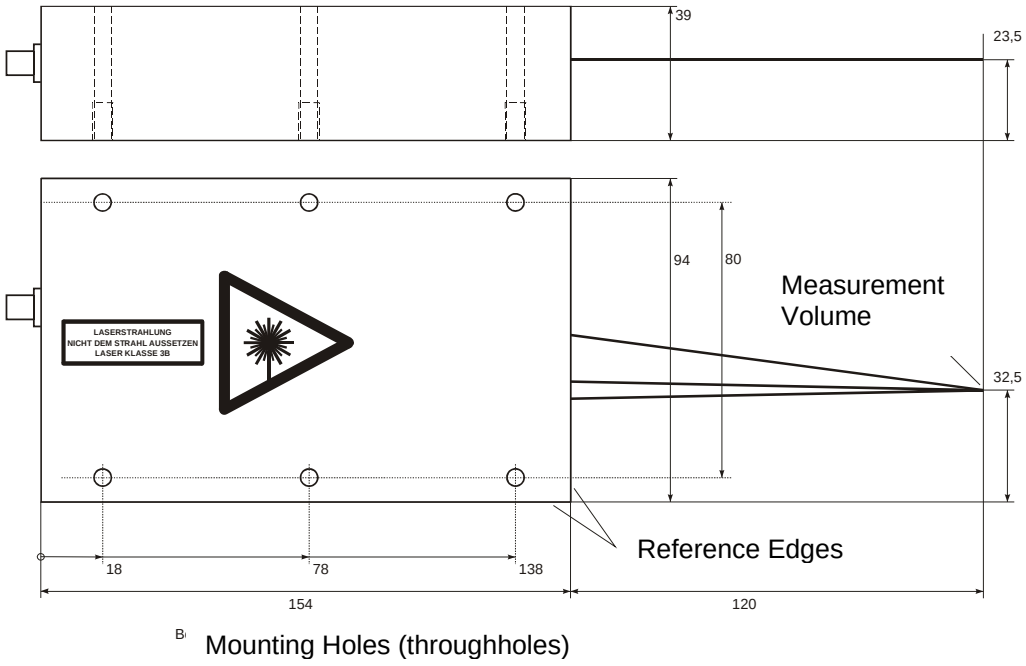
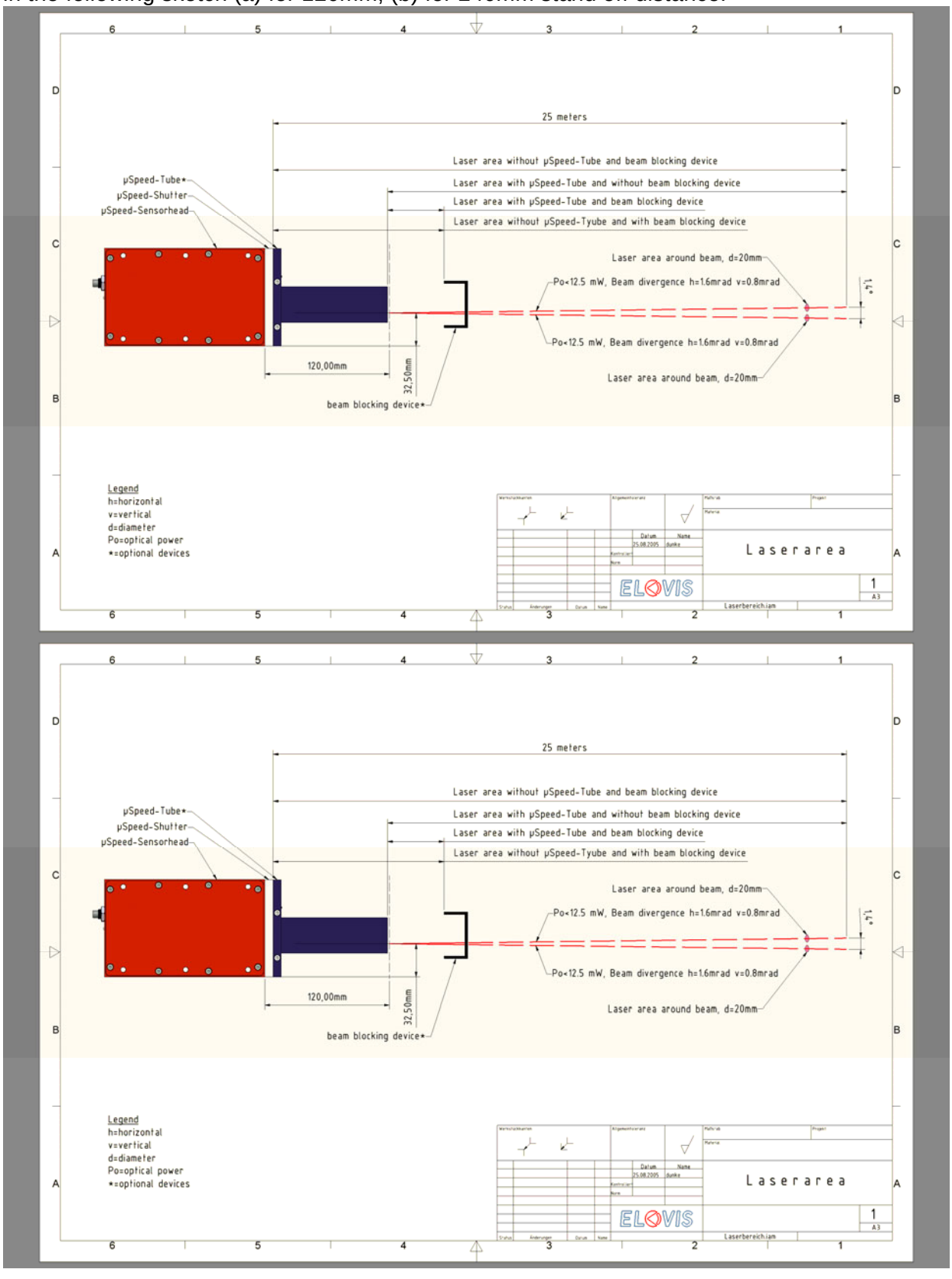


Figure 3: Dimensional drawing of *µSPEED-smartsensor (all measures in mm)*

Drawing shows µSPEED device with 120mm stand-off distance; Devices with 240mm stand-off distance see chapter 4.3 below.

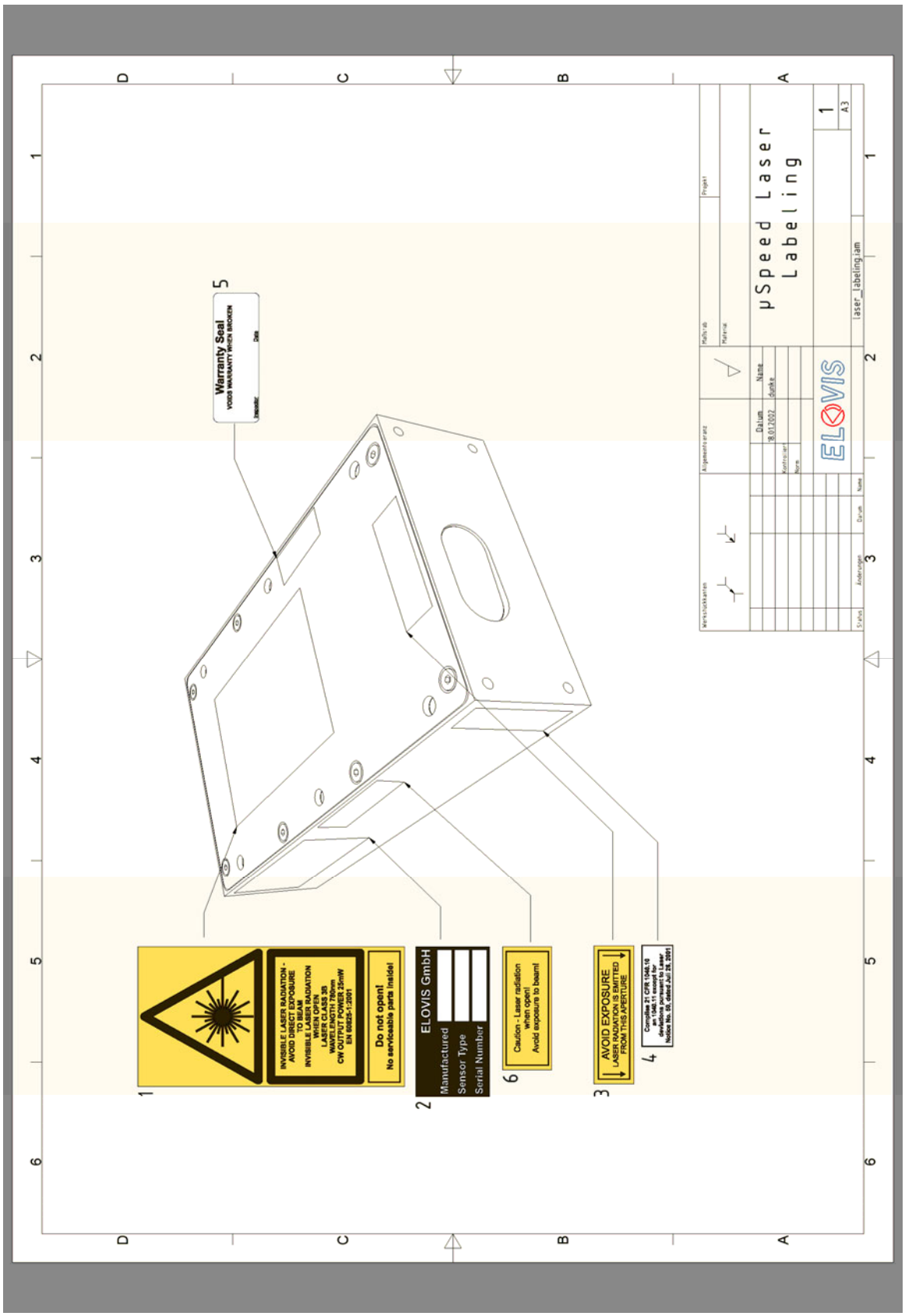
4.3 LASER AREA

The laser area is the zone which is dangerous if looking directly into the laser beam. It does not show the danger by reflected beam. The danger for looking directly into the laser beam can be reduced by the use of the optional laser tube and by installing a beam blocker device as shown in the following sketch (a) for 120mm; (b) for 240mm stand off distance.



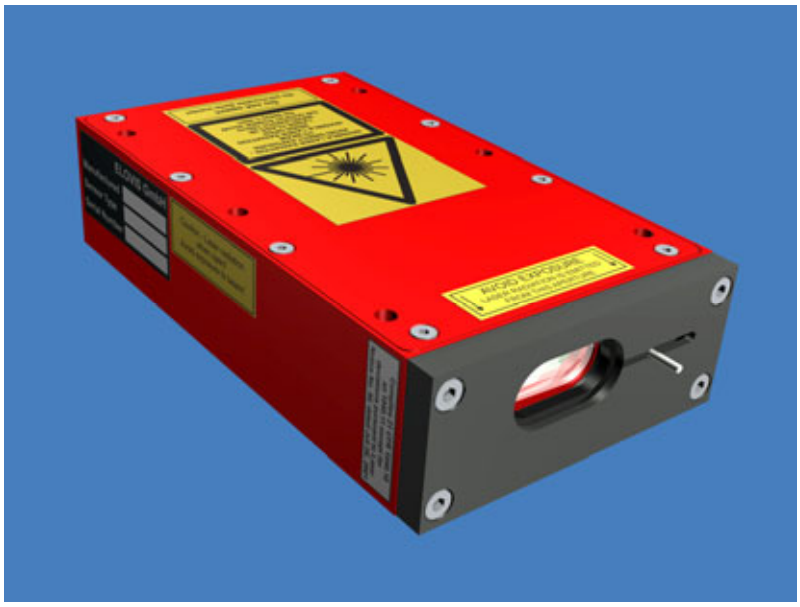
4.4 WARNING LABELS

The warning labels prescribed by EN60825 are affixed to the µSPEED measuring unit.



4.5 MECHANICAL SHUTTER (OPTIONAL)

→ Measuring Unit including mechanical shutter



→ Use of mechanical shutter