LMS5xx
LASER MEASUREMENT SENSORS

SICK
Sensor Intelligence.

Described product

LMS5xx

Manufacturer

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Original document

This document is an original document of SICK AG.

The LMS5xx laser measurement sensors are certified according to UL 60950-1:2007. Only vaild when marked on the type plate.

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1   About this document

1.1   Information regarding the operating instructions

These operating instructions provide important information on how to handle laser measurement sensors from SICK AG.

Prerequisites for working safely are:

- Adherence to all the specified safety instructions and guidelines.
- Complying with any local work safety regulations and general safety specifications applicable to the use of the laser measurement sensors

These operating instructions are intended for specialists and electricians.

Important   Read these instructions carefully before starting any work on the device to familiarize yourself with the LMS5xx laser measurement sensor and its functions.

The operating instructions are considered a part of the device and must be kept in an accessible location in the immediate vicinity of the device at all times, optimally in printed format. Should the device be passed on to a third party, these operating instructions should be handed over with it.

These operating instructions do not provide information on operating the machine in which the laser measurement sensor is integrated. For information about this, refer to the operating instructions of the respective machine.

1.2   Scope

These operating instructions are designed to address the technical personnel in regards to safe mounting, electrical installation, commissioning and configuration and maintenance of the following laser measurement sensor variants.
A step-by-setp approach is taken for all tasks.

1.2.1   LMS5xx variants

These operating instructions apply to the following variants:

LMS5xx variant	Resolution
LMS500-20000 PRO Indoor	High Resolution (HR)
LMS500-21000 Lite Indoor	High Resolution (HR)
LMS511-10100 PRO Outdoor	Standard Resolution (SR)
LMS511-11100 Lite Outdoor	Standard Resolution (SR)
LMS511-12100 Heavy Duty Outdoor	Standard Resolution (SR)
LMS511-20100 PRO Outdoor	High Resolution (HR)
LMS511-21100 Lite Outdoor	High Resolution (HR)
LMS511-22100 Heavy Duty Outdoor	High Resolution (HR)
LMS531-10100 PRO Security Outdoor	Standard Resolution (SR)
LMS531-11100 Lite Security Outdoor	Standard Resolution (SR)
LMS581-10100 PRO Outdoor	Standard Resolution (SR)
LMS581-20100 PRO Outdoor	High Resolution (HR)

Tab. 1:   Variants of the LMS5xx laser measurement sensor

Simplified device designation in the document

Below, the LMS5xx laser measurement sensor is referred to in simplified form as "LMS5xx". The exceptions are where distinction between device variants is required because of the technical features or functions are different. In this case either the designation of the variant line (e.g. LMS500 Lite Outdoor) or the complete type designation according to the type code (e.g LMS500-20000) is used.

1.2.2   Software versions

Software/Tool	Function	State
LMS5xx-xxxxx	Firmware	From V 1.50.2
Device description LMS5xx-xxxxx	Device specific software module for SOPAS ET (device description: *.sdd file)	From V 01.00.00
SOPAS ET	Configuration software	From V 02.32

Tab. 2:   Software versions

Access to the LMS5xx via the SOPAS ET configuration software is password protected. For details see *section "Interactive configuration using SOPAS ET" on page 88*.

1.3   Depth of information

These operating instructions contain the following information on the LMS5xx:

- Product description
- Transport and storage
- Mounting
- Electrical installation
- Commissioning and configuration
- Maintenance
- Troubleshooting
- Technical data

In addition, an online help is available in the SOPAS ET configuration software supplied; this help provides information on the usage of the software user interface, as well as on the configuration of the LMS5xx.

You will find a detailed description of the different telegrams for the LMS5xx in the document "Telegram Listing Laser Measurement Sensor", part no.: 8014631, English version.

You will find general information about the laser-guided object monitoring in the "Laser detectors" project planning manual, part no.: 8017354, English version.

You will find further information on the LMS5xx, its accessories as well as documents on the online product page. Please see *section 1.5 "Further information" on page 8*.

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1.4   Explanation of symbols

Warnings in these operating instructions are indicated by symbols. The warnings are introducedby signal words that indicate the extent of the danger.

➢ These warnings must be observed at all times and care must be taken to avoid accidents, personal injury, and material damage.

> ⚠ **DANGER**

… indicates a situation of imminent danger, which will lead to a fatality or serious injuries if not prevented.

> ⚠ **WARNING**

… indicates a potentially dangerous situation, which may lead to a fatality or serious injuries if not prevented.

> ⚠ **CAUTION**

…. indicates a potentially dangerous situation, which may lead to minor/slight injuries if not prevented.

> *NOTICE*

… indicates a potentially harmful situation, which may lead to material damage if not prevented.

Important	… highlights useful tips and recommendations as well as information for efficient and trouble-free operation.
Recommendation	Recommendations are designed to give you assistance in the decision-making process with respect to a certain function or a technical measure.
Important	Sections marked "Important" provide information about special features of the device.
Explanation	Explanations provide background knowledge on technical relationships.
Menu command	This typeface indicates a term in the SOPAS ET user interface.
Terminal output	This typeface indicates messages that the LMS5xx outputs via its interfaces.
➢ Take action …	Here you must do something. This symbol indicates an instruction to perform an action that contains only one action or actions in warnings where a specific sequence does not need to be followed. Instructions to perform actions that contain several steps in sequence are numbered.
📖	This symbol refers to additionally available documentation.

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Software notes show where you can make the appropriate settings and adjustments in the SOPAS ET configuration software.

1.5   Further information

Important   All the documentation available can be found on the online product page at:

➢ **http://www.sick.com/en/lms5xx**

The following information is available for download there:

* Model-specific online data sheets for device variants, containing technical data, dimensional drawings, and working range diagrams

* EU declaration of conformity for LMS5xx product family

* Dimensional drawings and 3D CAD dimension models in various electronic formats

* Working range diagrams

* These "LMS5xx laser measurement sensors" operating instructions, from version 2015-02-05/YFM3. In English (part no. 8013796) and German (part no. 8013795), and other languages (if applicable)

* "Laser Measurement Sensor" telegram listing, from version 2012-05-08, in English (part no. 8014631)

* "LMS5xx Laser Measurement Technology" product information in English (part no. 8013793) and German (part no. 8013792), and other languages (if applicable)

* Publications dealing with accessories

1.6   Customer service

Do not hesitate to contact our customer service should you require any technical information. Please refer to the back page of these operating instructions for your agent's contact details.

Important   Before calling, make a note of all type label data such as type code, serial number, etc. to ensure faster processing.

2   For your safety

This chapter deals with your own safety and the safety of the equipment operators.

➢ Please read this chapter carefully before working with the LMS5xx.

2.1   Correct use

The LMS5xx is a non-contact optical distance measurement sensor for stand-alone or network operation, based on a 2D laser scanner. It is suitable for applications in which precise, electro-sensitive measurements of contours and surroundings are required. It is also possible to create systems, for instance, for collision protection, for building surveillance or for access monitoring

It must be initialized only by qualified personnel and only in industrial environments.

Important   The LMS5xx is only allowed to be operated in the ambient temperature range allowed (see *section 10.1 "Data sheet LMS5xx laser measurement sensor" on page 101*).

2.2   Incorrect use

- The LMS5xx does not constitute a safety component according to the EC Machinery Directive (2006/42/EC).
- The LMS5xx is not a device for the protection of people in the context of the related safety standards for machinery.
- The LMS5xx must not be used in explosion hazard areas.
- Any other use that is not described as correct use is prohibited.
- The use of accessories not specifically approved by SICK is at own risk.

2.3   IP technology

NOTICE

SICK uses standard IP technology in its products. The emphasis is placed on availability of products and services.

SICK always assumes the following prerequisites:

- The customer will ensured the integrity and confidentiality of the data and rights affected by the use of the aforementioned products.
- In all cases, appropriate security measures, such as network separation, firewalls, virus protection, and patch management, is be taken by the customer on the basis of the situation in question.

2.4   Limitation of liability

Applicable standards and regulations, the latest state of technological development and many years of knowledge and experience have all been taken into account when assembling the data and information contained in these operating instructions. The manufacturer accepts no liability for damage caused by:

- Failing to observe the operating instructions
- Incorrect use of the device

- Use by untrained personnel
- Unauthorized conversions
- Technical modifications
- Use of unauthorized spare parts, consumables and accessories

With special variants, where optional extras have been ordered, or owing to the latest technical changes, the actual scope of delivery may vary from the features and illustrations shown here.

2.5 Modifications and conversions

NOTICE

Modifications and conversions to the LMS5xx and/or the installation may result in unforeseeable dangers.

In case of any other usage as well as in case of modifications to the LMS5xx, e.g. due to opening the housing and/or breaking the seals during mounting and electrical installation, or to the SICK software, any claims against SICK AG under the warranty will be rendered void.

Before any technical modifications to and expansions of the LMS5xx, the prior written approval of the manufacturer must be obtained.

2.6 Requirements for skilled persons and operating personnel

⚠ WARNING

Risk of injury due to insufficient training!

Improper handling may result in considerable personal injury and material damage.

- All work must only ever be carried out by the stipulated persons.

These operating instructions list the training requirements for the various fields of activity, as follows:

- **Instructed personnel** have been given a briefing by the operator about the tasks assigned to them and about potential dangers arising from improper action.
- **Skilled personnel** have the specialist training, skills, and experience, as well as knowledge of the relevant regulations, to be able to perform tasks delegated to them and to detect any potential dangers independently.
- **Electricians** have the specialist training, skills, and experience, as well as knowledge of the relevant standards and provisions to be able to carry out work on electrical systems and to detect any potential dangers independently. In Germany, electricians must meet the specifications of the BGV A3 Work Safety Regulations (e. g. Master Electrician). Other relevant regulations applicable in other countries must be observed.

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The following qualifications are necessary for the various tasks:

Activities	Qualification
Mounting and maintenance	• Basic technical training • Knowledge of the current safety regulations in the workplace
Electrical installation and replacement	• Practical electrical training • Knowledge of current electrical safety regulations
Commissioning, operation and configuration	• Basic knowledge of the Windows operating system • Basic knowledge of data transmission
Operation of devices in the related application	• Knowledge on the use and operation of devices in the related application (e.g. crane, assembly system) • Knowledge on the software and hardware environment in the related application (e.g. crane, assembly system)

Tab. 3:   Authorized personnel

2.7   General safety notes and protective measures

Please observe the safety notes and the warnings listed here and in other chapters of these operating instructions to reduce the possibility of risks to health and avoid dangerous situations.

⚠ WARNING

Safety notes

Please observe the following items in order to ensure the correct and safe use of the LMS5xx.

• The notices in these operating instructions (e.g. on use, mounting, installation or integration into the existing machine controller) must be observed.

• When operating the LMS5xx, the national, local and statutory rules and regulations must be observed.

• National/international rules and regulations apply to the installation, commissioning, use and periodic technical inspections of the laser measurement sensor, in particular:

  – the work safety regulations/safety rules

  – other relevant health and safety regulations

• Manufacturers and operators of the machine/system on which the LMS5xx is installed are responsible for obtaining and observing all applicable safety regulations and rules.

• The tests must be carried out by specialist personnel or specially qualified and authorized personnel and must be recorded and documented to ensure that the tests can be reconstructed and retraced at any time.

• The operating instructions must be made available to the operator of the system where the LMS5xx is fitted. The operator of the system is to be instructed in the use of the device by specialist personnel and must be instructed to read the operating instructions.

2.8   Hazard warnings and operational safety

2.8.1   Laser radiation

| ⚠ **WARNUNG**	⚠ **WARNING**	⚠ **AVERTISSEMENT**
Laserstrahlung!	**Laser radiation!**	**Rayonnement laser !**
LASER PRODUKT KLASSE 1	**CLASS 1 LASER PRODUCT**	**APPAREIL À LASER DE CLASSE 1**
Wellenlänge: 905 nm (unsichtbares Infrarotlicht) IEC 60825-1: Ed.2007-03 LMS5xx-1xxxx/LMS25x-1xxxx: Impulsleistung: 55,6 W Impulsdauer: 3,6 ns LMS5xx-2xxxx: Impulsleistung: 29,6 W Impulsdauer: 2,9 ns	Wavelength: 905 nm (invisible infrared light) IEC 60825-1: Ed. 2007-03. LMS5xx-1xxxx/LMS25x-1xxxx: Puls output: 55.6 W Puls duration: 3.6 ns LMS5xx-2xxxx: Puls output 29.6 W Puls output: 2.9 ns	Longueur d'onde: 905 nm (lumière infrarouge invisibles) IEC 60825-1: Ed. 2007-03. LMS5xx-1xxxx/LMS25x-1xxxx: Puissance d'impulse: 55,6 W Durée d'impulse: 3,6 ns LMS5xx-2xxxx: Puissance d'impulse: 29,6 W Durée d'impulse: 2,9 ns
21 CFR 1040.10 und 1040.11 wird erfüllt, mit Ausnahme der Abweichungen nach Laser Notice 50 vom Juni 2007.	Complies with 21 CFR 1040.10 and CFR1040.11 except for deviations pursuant to Laser Notice No. 50, June 2007.	Soit 21 CFR 1040.10 et 1040.11 à l'exception de différences sur les indications du Laser N° 50, juin 2007.
Die im normalen Betrieb austretende Strahlung ist ungefährlich für die Augen und die menschliche Haut.	The radiation emitted in normal operation is not harmful to the eyes and human skin.	Le rayonnement émis en fonctionnement normal n'est pas dangereux pour les yeux et la peau humaine.
VORSICHT – Bestimmungsfremder Einsatz kann zu gefährlichen Strahlungsexpositionen führen.	CAUTION – the use of controls, or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.	PRUDENCE – tout usage de commandes, réglages ou toute application de procédures autres que ceux décrits dans ce document peut entraîner une exposition dangereuse au rayonnement.
Laserwarnschild Der LMS5xx hat kein Laserwarnschild am Gehäuse.	**Laser warning sign** The LMS5xx has no laser warning sign on the housing.	**Avertissement laser** Le LMS5xx n'a pas un avertissement laser au boîtier.
Um die Einhaltung der Laserklasse 1 zu gewährleisten, ist keine Wartung notwendig	No maintenance is necessary to ensure compliance with laser class 1.	Aucune maintenance n'est nécessaire pour assurer la conformité avec la classe laser 1.
➢ Gehäuse nicht öffnen (durch das Öffnen wird der Laser nicht abgeschaltet). ➢ Beachten Sie die Laser-schutzbestimmungen gemäß IEC 60825-1 (neueste Fassung).	➢ Do not open the housing (opening the housing will not switch off the laser). ➢ Pay attention to the laser safety regulations as per IEC 60 825-1 (latest version).	➢ Ne pas ouvrir le boîtier. (La diode laser n'est pas désactivée en cas d'ouverture du boîtier). ➢ Se conformer aux dernières consignes de protection en date contre le rayonnement laser (IEC 60825-1).
Laseraustrittsöffnung Die Laseraustrittsöffnung ist die Frontscheibe am LMS5xx. Siehe *Fig. 1 on page 13*	**Laser output aperture** The laser output aperture is the front screen on the LMS5xx. See *Fig. 1 on page 13*	**Orifice de sortie** L'orifice de sortie du faisceau laser correspond à la vitre dans son ensemble. Voir *Fig. 1 on page 13*
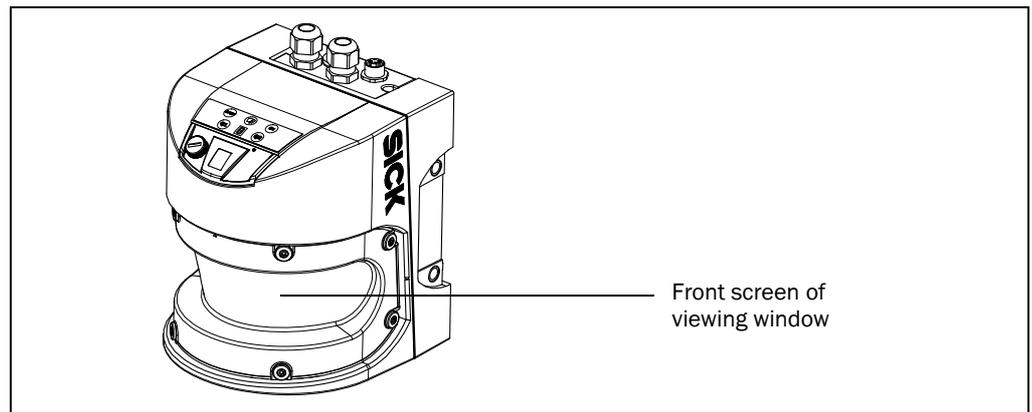
Fig. 1:   Laser output aperture on the LMS5xx, here on LMS500

The LMS5xx operates with a infrared-light laser diode. The laser beam cannot be seen with the human eye.

2.8.2   Electrical installation work

> ## *NOTICE*
>
> - Only authorized, specialist personnel are allowed to perform electrical installation work.
> - The power supply must be disconnected when attaching and detaching electrical connections.
> - Select and implement wire cross-sections and their correct fuse protection in accordance with the applicable standards.
> - ➢ Do not open the housing.
> - ➢ Observe the current safety regulations when working on electrical systems.

2.8.3   Damaging potential equalization currents due to different ground potentials

For electrical safety, the LMS5xx has been designed and checked according to EN 60 950-1 (2006-04) and EN 60 950-1/A11 (2009-03).

The LMS5xx is connected to the peripheral devices (power supply, encoder, PLC/host, if applicable other LMS5xx, etc.) by using shielded cables. The shield of each cable is connected to the metal housing of the LMS5xx via the system connector.

If the peripheral devices have metal housings and if the cable shield also is connected to their housings, it is assumed that all devices involved in the installation have the **same ground potential**.

This is achieved for instance by fulfilling the following conditions:

- mounting the devices on conductive metal surfaces
- correctly grounding the devices/metal surfaces in the system
- a low-impedance and stable current carrying equipotential bonding between areas with different ground potentials, if necessary

If these conditions are not met, e.g. on devices in a widely distributed system over several buildings, potential equalization currents may, due to different ground potentials, flow along the cable shields between the devices and may cause danger.

> ⚠ **DANGER**
>
> **Risk of injury/risk of damage via electrical current!**
>
> Potential equalization currents between the LMS5xx and the peripheral devices can have the following effects:
>
> - Dangerous voltages on the metal housing, e.g. of the LMS5xx
> - Incorrect function or irreparable damage to the devices
> - Damage/irreparable damage of the cable shield due to heating and cable fires
> ➢ Where local conditions are unfavorable and thus do not meet conditions for a safe earthing method (same ground potential at all grounding points), take measures according to *chapter 6.2 "Conditions for safe operation of the LMS5xx in an installation" on page 63*.

2.9 Quick stop and restart

2.9.1 Switching off the LMS5xx

LMS500:

➢ Switch off the voltage supply (power supply).

LMS511/ LMS531/LMS581:

➢ Switch off the voltage supply (power supply) or disconnect the M12 supply cable on the device.

The LMS5xx retains configurations parameters stored in the internal, non-volatile memory. Measured values on the data interface are lost.

2.9.2 Switching back on the LMS5xx

LMS500:

➢ Switch on the voltage supply (power supply).

LMS511/LMS531/LMS581:

➢ Switch on the voltage supply (power supply) or re-connect the M12 supply cable on the device.

The LMS5xx re-commences operation with the parameters last saved.

2.10 Environmental protection

The LMS5xx has been designed to minimize environmental impact. It uses only a minimum of power.

2.10.1 Power consumption

LMS5xx variant	Max. power consumption during operation
LMS500	Sensor: Max. 25 W (without load on the outputs)
LMS511/LMS531/LMS581	Sensor: Max. 25 W (without load on the outputs) Heating: Additionally max. 65 W

Tab. 4:   LMS5xx variants: Maximum of power consumption

While working, always act in an environmentally responsible manner.

2.11   Repair

> ### *NOTICE*
>
> Repairs to the LMS5xx are only allowed to be undertaken by trained and authorized service personnel from SICK AG.
>
> Any manipulation or modification of the LMS5xx by the customer will invalidate the manufacturer warranty.

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3   Product description

This chapter provides information on the special features and properties of the LMS5xx laser measurement sensor. It describes the construction and the operating principle of the device, in particular the different operating modes.

Please read this chapter before mounting, installing and commissioning the device.

3.1   Delivery

The LMS5xx delivery includes the following components:

Quantity	Components	Comment
1	An LMS5xx laser measurement sensor	Model type depends on order. Outdoor variants: M12-round plug-in connectors equipped with protection caps and plugs made of plastic.
1	Type-specific notes on device with electrical circuit diagram for getting started	Included in the LMS5xx packaging

Tab. 5:   Delivery

An overview about the available LMS5xx variants, its accessories and, device documentation is available from the web product page:

➢   **http://www.sick.com/en/lms5xx**

The configuration software SOPAS ET, the current system prerequisites for the PC, and the instructions for downloading the software and the device description file(s) can be found online at:

➢   **http://www.mysick.com/en/SOPAS_ET**

The required USB driver for the PC when using the USB interface of the LMS5xx can be found online at:

➢   **http://www.sick.com/en/lms5xx**

provides an overview of the consumables available for cleaning the front screen.

3.2   Device variants

Type	Purpose of use	Range	Heating	Enclosure rating
LMS500-2x000 Lite/PRO	Indoor	Max. 80 m 26 m at 10% [1]	No	IP 65
LMS511-1x100 Lite/PRO/ Heavy Duty	Outdoor	Max. 80 m 40 m at 10% [1]	Yes	IP 67 [2]
LMS511-2x100 Lite/PRO/ Heavy Duty	Outdoor	Max. 80 m 26 m at 10% [1]	Yes	IP 67 [2]
LMS531-11100 Lite/PRO	Security	Max. 80 m 40 m at 10% [1]	Yes	IP 67 [2]
LMS581-10100 PRO	Outdoor	Max. 80 m 40 m at 10% [1]	Yes	IP 67 [2]
LMS581-20100 PRO	Outdoor	Max. 80 m 26 m at 10% [1]	Yes	IP 67 [2]

Tab. 6:   Device variants

1)   Object remission
2)   Under the following conditions: the SICK cables plugged into the M12 round plug-in connections must be screwed tight. Any electrical connections that are not being used must be fitted with protective caps or plugs that are screwed tight (as in the delivery condition). The M8 connection of the USB interface on the front is screwed tight
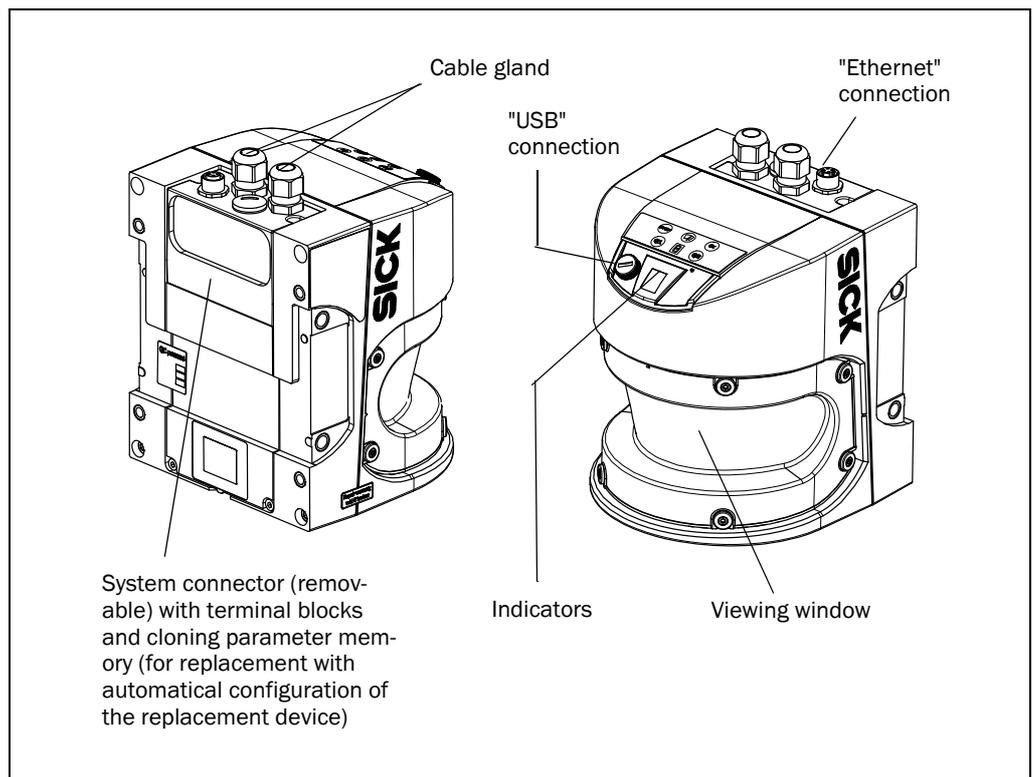

Fig. 2:   View of the LMS500 Indoor

"Power" connection

"Data" [1] connection

"I/O" [2] connection

"USB" connection

"Ethernet" connection

System connector with cloning parameter memory. Removable only from LMS511 Heavy Duty (for replacement with automatical configuration of the replacement device).

Indicators

Viewing window

1) LMS531 Security: "Inputs" connection
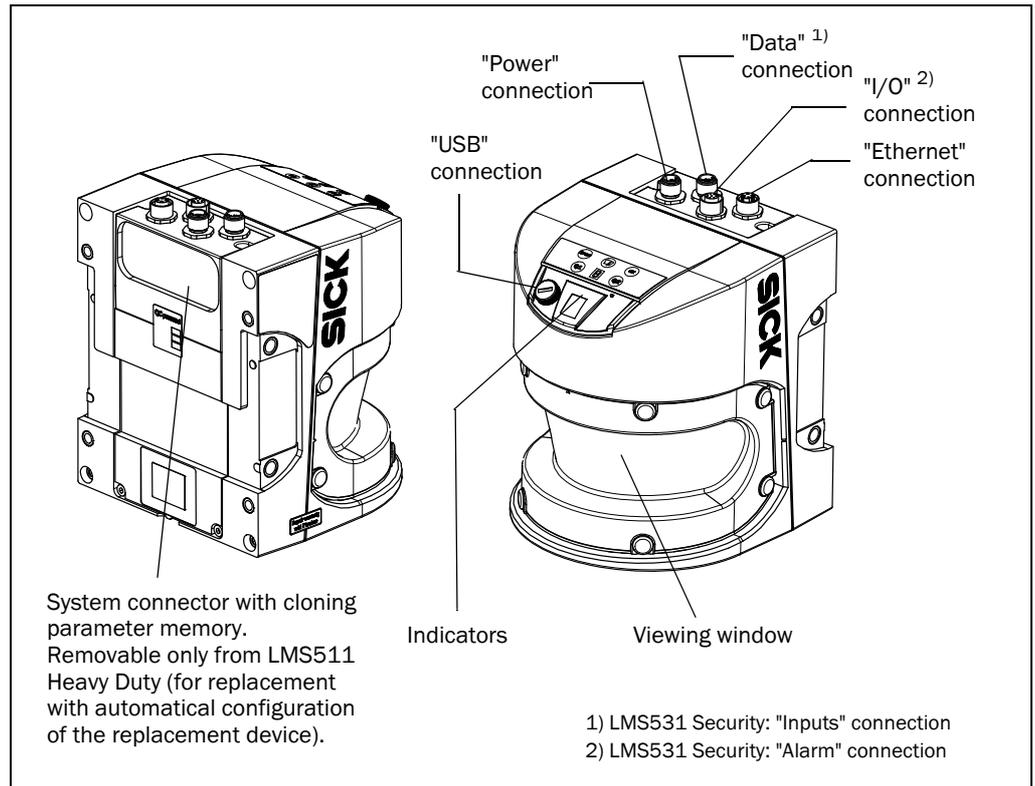2) LMS531 Security: "Alarm" connection

Fig. 3:   View of the LMS511/581/531 Outdoor

The LMS5xx comprises three components:

- Sensor head with the opto-electronic acquisition system (housing)

- Application module, this defines the functionality of the LMS5xx

- System connector with the cloning parameter memory and electrical connections. The system connector is only removable from LMS500 Lite/PRO Indoor and LMS511 Heavy Duty Outdoor. Due to the cloning parameter memory that is included, the existing configuration may be transferred to the relevant replacement device automatically on start-up if, for example, a sensor defect occurs.

3.3 Type code

3.3.1 Marking scheme of standard variants

LMS a b c - d e f gg

Placeholder	Characteristics	Variant
a	Device family	5: LMS5xx
b	Design	0: Indoor housing without heating, IP 65 1: Outdoor housing with heating, IP 67 2: Security indoor housing without heating, IP 65 3: Security outdoor housing with heating, IP 67 7: Indoor housing without heating, IP 65, special 8: Outdoor housing with heating, IP 67, special
c	Color	0: blue 1: gray 2: black 3: white
d	Performance	1: Standard resolution 2: High resolution
e	Variant	0: PRO 1: Lite 2: Heavy Duty
f	Connectivity	0: Cable gland / 1x M12 1: M12 Standard 2: M12 CAN
gg	Application	00: Standard 51: Special 90: Bulkscan software

Tab. 7:   Type code of LMS5xx

Not all possible combinations are available according to the type code.

3.4   Special features of the LMS5xx

Variant	Special features
All	• Field of view maximum 190°
	• Angular resolution Lite: 0.25/0.5/1° PRO/Heavy Duty: 0.1667/0.25/0.3333/0.5/0.6667/1°
	• Scanning frequency Lite: 25/35/50/75 Hz PRO: 25/35/50/75/100 Hz
	• Flexible system configurations
	• Configuration and measured data request using SICK command language (CoLa)
	• Digital switching inputs Lite: 2 inputs PRO/Heavy Duty: 4 inputs
	• Digital switching outputs Lite: 3 outputs PRO/Heavy Duty: 6 outputs
	• Data interfaces Lite: Ethernet, RS-232/-422, USB PRO: Ethernet, RS-232/-422, USB, CAN PRO/Heavy Duty: Ethernet, RS-232/-422, USB, CAN für Erweiterungsmodul
	Measured value output (raw data) • Non-contact, active distance measurement technique • Measurement of objects with almost any shape • Measured value output for all reflection pulses (echoes), e.g. in rain or on measurement through a window
	Integrated field application • Configurable evaluation fields Lite: 4 fields PRO: 10 fields Heavy Duty: 10 fields • Monitoring of the evaluation field contours • Activation of the evaluation fields using digital switching inputs • Encoder inputs (PRO and Heavy Duty version only) • Output of the evaluation field (unoccupied or infringed) via digital switching outputs or telegrams
LMS500-2x000 Lite/PRO	• Scanning range up to 80 m with > 100% object remission (26 m with 10% object remission) • Housing with enclose rating IP 65
LMS511-1x100, LMS581-10100	• Scanning range up to 80 m with > 100% object remission (26 m with 10% object remission) • Outdoor housing with enclose ratingIP 67
LMS511-2x100, LMS581-20100	• Scanning range up to 80 m with > 100% object remission (40 m with 10% object remission) • Outdoor housing with enclose rating IP 67
LMS531-11100 Lite	• Scanning range up to 80 m with > 100% object remission (40 m with 10% object remission) • Outdoor housing with enclose rating IP 67 • 2 potential-free relay outputs • 2 digital switching inputs, 1 switching output
LMS531-10100 PRO	• 4 potential-free relay outputs • 4 digital switching inputs

Tab. 8:   Special features of the LMS5xx variants

3.5 Differences between the LMS5xx Lite, PRO and Heavy Duty versions

The LMS5xx variants are available in the following LMS5xx versions:

Device line	Lite	PRO	Heavy Duty
LMS500	●	●	
LMS511	●	●	●
LMS531	●	●	
LMS581		●	

Tab. 9: Versions of the LMS5xx

The following table shows the main differences:

Funktion	Lite	PRO	Heavy Duty
Scanning frequency/ angular resolution	25 Hz/0,25° 35 Hz/0,5° 50 Hz/0,5° 75 Hz/1°	25 Hz to 100 Hz, angular resolution can be selected freely. See also *Tab. 13 on page 32*	25 Hz to 100 Hz, angular resolution can be selected freely. See also *Tab. 13 on page 32*
Special function	75 Hz/0,5° with an opening angle of 90°, scanning range 65 m (compability with LMS2xxLS14)	–	–
Scanning range	80 m	65 m/80 m, depending on pulse frequency. From a scanning range > 65 m the LMS5xx outputs the data in step size of 2 mm	65 m/80 m, depending on pulse frequency. From a scanning range > 65 m the LMS5xx outputs the data in step size of 2 mm
Echoes	2 LastEcho = 2. Echo	5 LastEcho = 5. Echo	5 LastEcho = 5. Echo
Switching outputs	3	6	6
Switching inputs	2 (no encoder)	2 + 2 = 4 (multiple purposes)	2 + 2 = 4 (multiple purposes)
Evaluation fields	4 parallel	10 parallel	10 parallel
CAN bus	No	Yes	Yes
Connection material	Brass, nickel-plated	Brass, nickel-plated	Stainless steel
Operating ambient temperature	–30 °C ... +50 °C	–30 °C ... +50 °C	–40 °C ... +60 °C
Parameter cloning	Only possible with indoor variant	Only possible with indoor variant	Only possible with outdoor variant

Tab. 10: Differences between LMS5xx Lite-, PRO and Heavy-Duty

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3.6   Controls and status indicators

3.6.1   User interface

In normal operation the laser measurement sensor operates fully automatically without the intervention of an operator.

The interactive configuration is carried out using the provided SOPAS ET configuration software on a PC that must be connected to the LMS5xx.

Use the graphic scan view in SOPAS ET to verify the generated measured values and to verify the measurement area online.

Important   The scan display in SOPAS ET is not performed in real-time but in a limited rate. Therefore not all measured values are displayed.

3.6.2   Status indicators

The LEDs and the 7-segment display indicate the operational status of the LMS5xx.
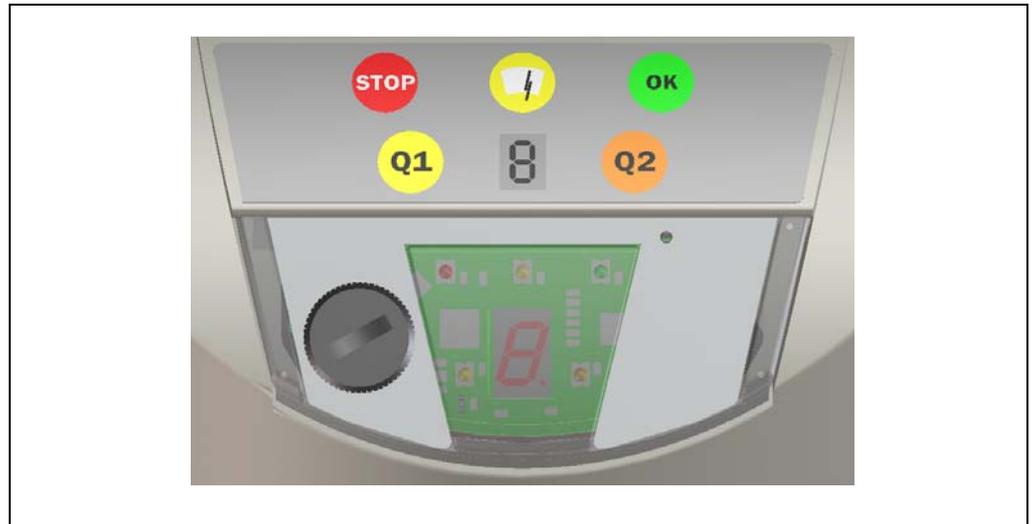
Fig. 4:   Status indicators

Important   On the LMS5xx, along with the standard displays described below, the indication functions of the LEDs and the 7-segment display can be configured in SOPAS ET.

PROJECT TREE, LMS..., PARAMETER, NETWORK/INTERFACES/IOS, DISPLAY.

Indicator lights

Display	Possible cause
(OK)	LMS5xx measuring and no error reported
(STOP)	LMS5xx either not measuring (stopped by user) or measuring with error events
(contamination symbol)	Off: no contamination On: contamination warning Blinking: contamination error
(Q1)	At least one field is infringed (see *section 3.10.3 "Operator for the evaluation cases on the output" on page 43*).
(Q2)	Reserved

Tab. 11:   Meaning of the indicator lights (LEDs)

Further information see *section 9.2 "Error displays of the indicator lights" on page 97*.

7-segment display

Used for diagnostics on occurring errors or malfunctions (see *section 9.3 "Indications of the 7-segment display" on page 98*).

3.7   Operating principle of the LMS5xx

The LMS5xx is a non-contact laser measurement sensor that scans the surrounding perimeter radially on a single plane using pulses of light. The LMS5xx measures in two-dimensional radial coordinates. If a laser beam emitted is reflected from a target object, then the position of the object is given in the form of distance and angle. The LMS5xx cannot see through objects during this process.
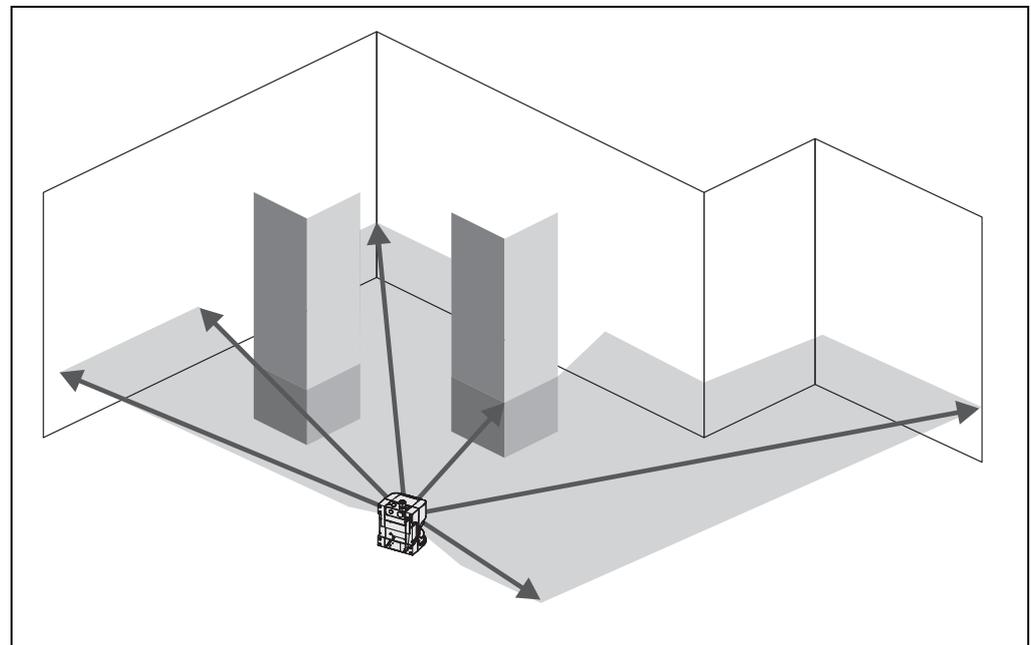

Fig. 5:   Measuring principle of the LMS5xx

Scanning takes place in a sector of 190°. The scanning range of the LMS5xx is maximum 80 m on light, natural surfaces with an object remission > 100 % (e.g. a white house wall). See also *section 10.2 "Operating range diagrams" on page 106*.

Distance measurement

The LMS5xx emits pulsed laser beams using a laser diode. If a laser beam is reflected on a target object the reflected beam is received at the sensor.
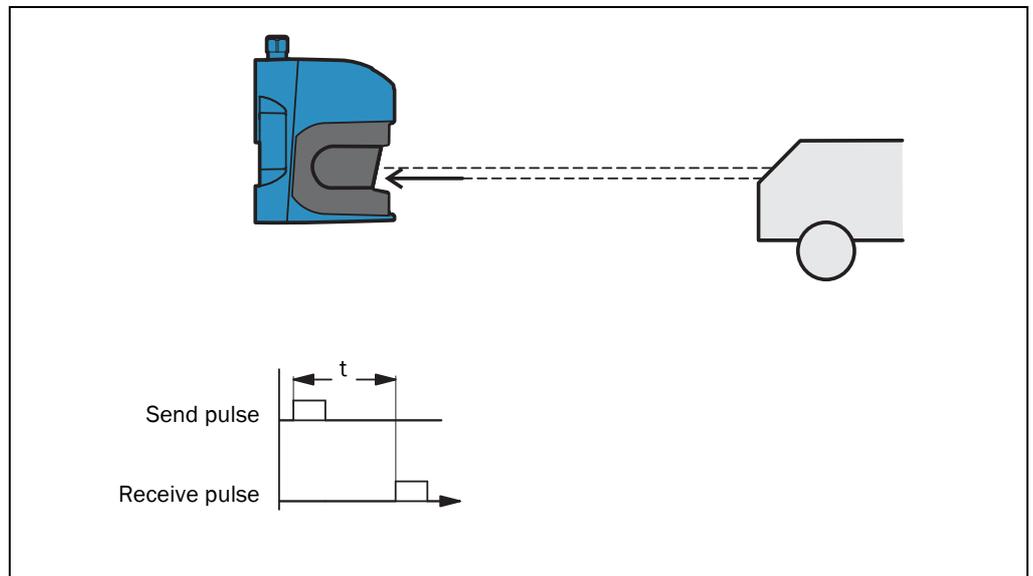

Fig. 6:   Principle of operation for time of flight measurement

The distance to the object is calculated by the time required for the pulsed beam to be reflected and received by the sensor. This principle of "Time of flight" is used by radar systems in a similar manner (see also *section 3.9.4 "Measured value output for a pulse reflected with multiple echoes" on page 36*).

Direction measurement

The emitted laser beams are deflected using an internal rotating mirror and scanning the surroundings in a circular manner. The measurements are triggered at regular steps using an angular encoder.

The LMS5xx PRO/Heavy Duty scans with an adjustable scanning frequency of 25, 35, 50, 75 or 100 Hz. During this process, a laser pulse and therefore a measurement is triggered after an angular step of 0.1667°, 0.25°, 0.33°, 0.5°, 0.6667° or 1°.

The LMS5xx Lite scans with a scanning frequency of 25, 50 or 75 Hz and angular steps of 0.25°, 0.5° or 1°.

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Influences of object surfaces on the measurement

The signal received from a perfectly diffuse reflecting white surface corresponds to the definition of a remission of 100 %. As a result of this definition, the remissions for surfaces that reflect the light bundled (mirrored surfaces, reflectors), are more than 100 %.
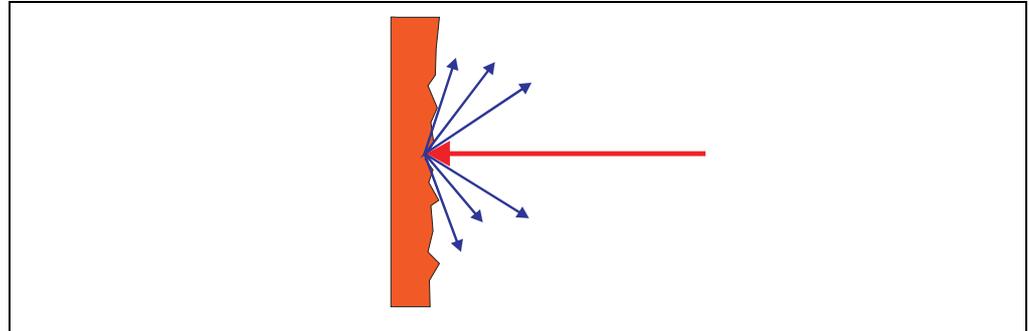

Fig. 7:   Reflection of the laser beam at the surface of an object

The majority of surfaces reflect the laser beam diffusely in all directions (*Fig. 7*).

The reflection of the laser beam will vary as a function of the surface's structure and colour. Light surfaces reflect the laser beam better than dark surfaces and can be detected by the LMS5xx over larger distances. Bright white plaster reflects approx. 100 % of the incident light, black foam rubber approx. 2.4 %. On very rough surfaces, part of the energy is lost due to shading. The scanning range of the LMS5xx will be reduced as a result.
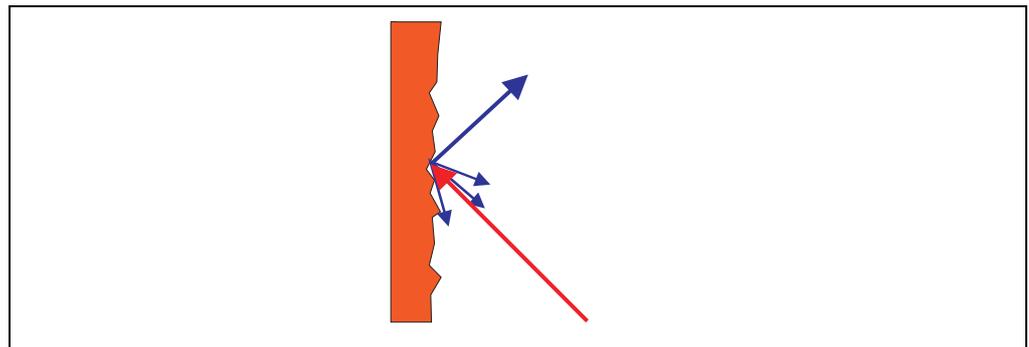

Fig. 8:   Reflection angle

The reflection angle is the same as the angle of incidence. If the laser beam is incident perpendicularly on a surface, the energy is optimally reflected (*Fig. 9*). If the beam is incident at an angle, a corresponding energy and scanning range loss occurs (*Fig. 8*).
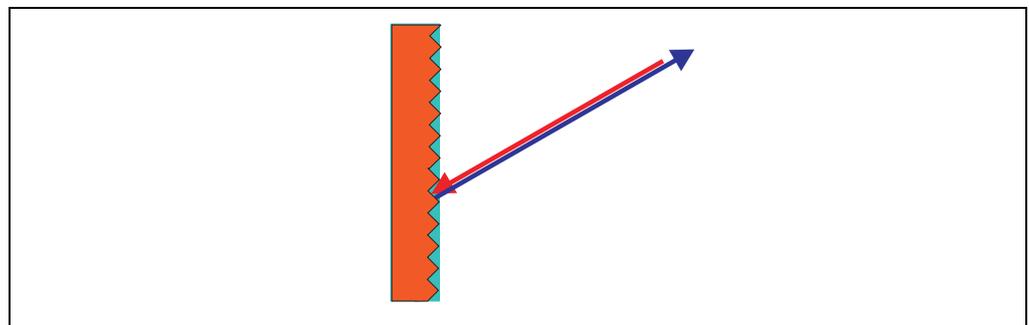

Fig. 9:   Degree of reflection

If the reflected energy returned is over 100% (basis: Kodak standard) the incident beam is not reflected diffusely in all directions, but is reflected in a specific direction (*Fig. 9 on page 26*). As a result a large portion of the energy emitted can be received by the laser distance measurement device. Plastic reflectors ("cats' eyes"), reflective tape and triple prisms have these properties.
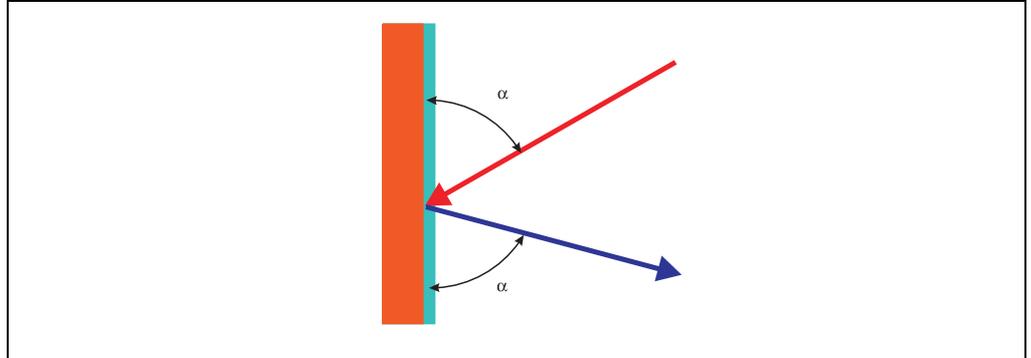

Fig. 10:   Mirror surfaces

At mirror surfaces the laser beam is almost entirely deflected (*Fig. 10*).

Instead of the surface of the mirror, it is possible that the object on which the deflected laser beam is incident may be detected.
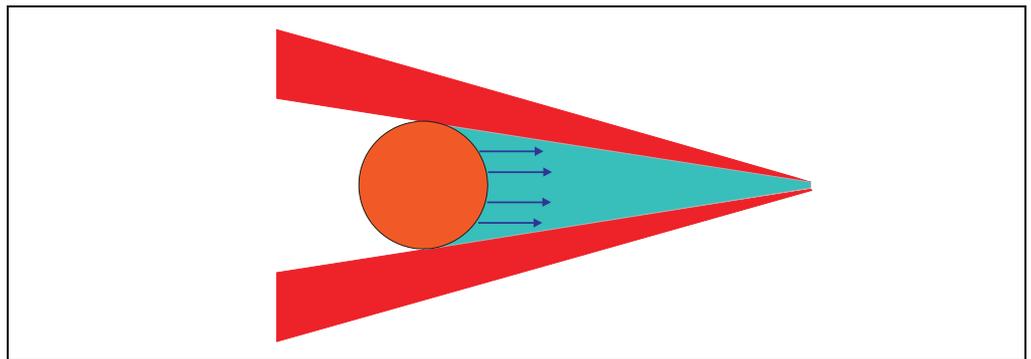

Fig. 11:   Object smaller than diameter of the laser beam

Objects that are smaller than the diameter of the laser beam cannot reflect all the energy of the laser light (*Fig. 11*). Therefore the amount of light not incident on the object is lost. If the total amount of light reflected back to the sensor is not sufficient the object may not be detected. This can reduce the scanning range of the sensor. If the multiple echo option is selected, the amount of light not reflected by the front object may be reflected by a background surface, creating therefore a second echo (see *section 3.9.4 "Measured value output for a pulse reflected with multiple echoes" on page 36*).

3.7.1   Scanning range of the LMS5xx

The scanning range of the LMS5xx is dependent on the remission of the objects to be detected. The better a surface reflects the incident radiation, the greater the scanning range of the LMS5xx. The diagrams in *Fig. 12* indicate the relationship between remission and detectability.

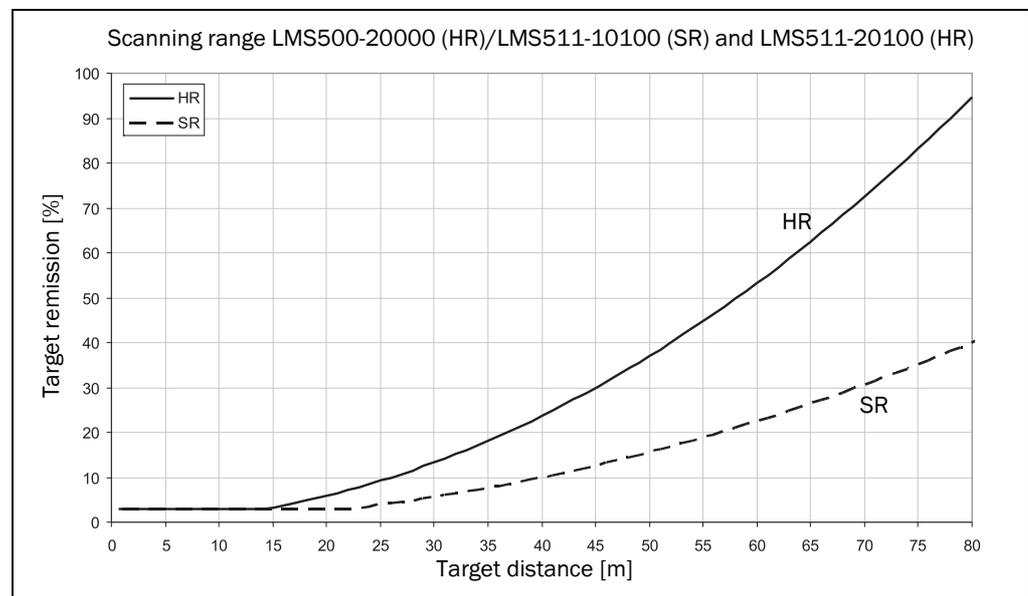Scanning range LMS500-20000 (HR)/LMS511-10100 (SR) and LMS511-20100 (HR)

Fig. 12:   Scanning range of the LMS5xx as a function of the target remission

Example to *Fig. 12*: Up to a distance of 15 m the LMS5xx (HR) can detect objects from 3 % remission. At a distance of 80 m objects are only detected if they have a remission > 95 %.

| Important | • The diagram in *Fig. 12* is only applicable if no filters are configured. |
| | • The scanning range can be significantly reduced depending on the environment (e.g. fog, rain, dust). |

3.7.2   Beam diameter and distance between measured points

With increasing distance from the LMS5xx the laser beam of the LMS5xx increases in size. As a result the diameter of the measured point on the surface of the object increases.

The distance-dependent diameter of the measured point is the distance (mm) × 0.0046 rad (HR) or 0.011 rad (SR) + 13 mm.
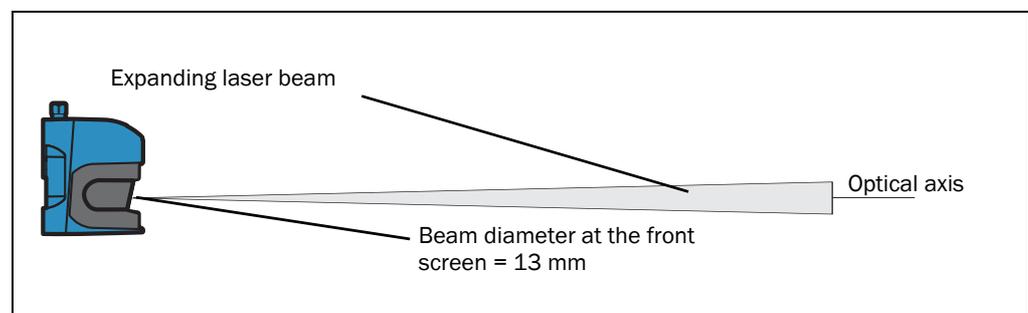

Fig. 13:   Beam expansion

With increasing distance from the LMS5xx, the distance between the individual measured points also increases. The distance between the measured points is also dependent on the angular resolution selected. With a coarser resolution (e.g. 1°), the distance is larger, with a finer resolution (e.g. 0.1667°) the distance is smaller. The distance-dependent spacing between the measured points is the tangent of the angular resolution × distance.
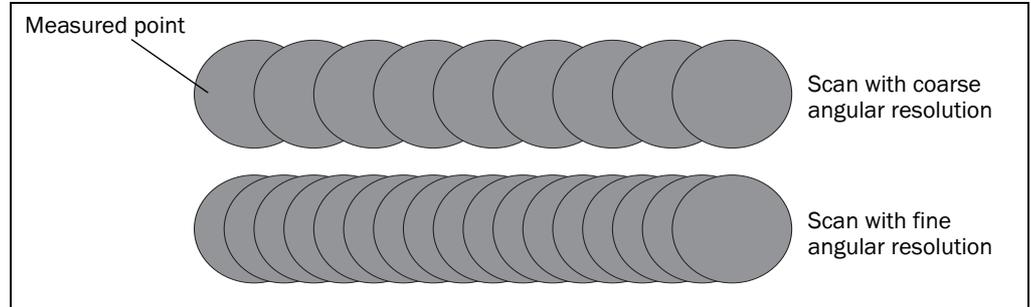

Fig. 14:   Schematic layout of the distance between measured points at different angular resolutions

The diagram in *Fig. 15* shows the beam diameter and the measured point spacing as a function of the distance from the LMS5xx.

Important   Full scanning without gaps depends on the resolution of sensor (SR or HR) and the selected angular resolution.
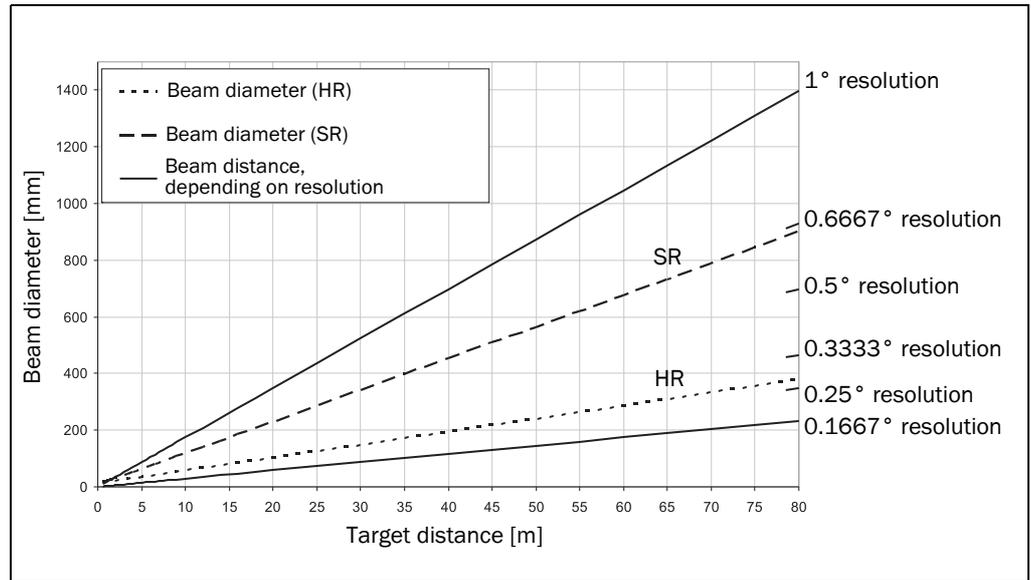

Fig. 15:   Beam diameter and distance between measured points of the LMS500 at 0 to 80 m

Example for angular resolution 0.1667° (HR) in *Fig. 15*

Distance intersection point 30 m gives a distance between the measured points of approx. **87 mm.**

Distance intersection point 30 m with the characteristic curve for beam diameter gives a beam size of approx. **150 mm (HR) or 342 mm (SR).**

3.7.3 Minimum object size

To reliably detect an object, a laser beam must be fully incident on it once. If the beam is partially incident, less energy could be reflected by the object (see *Fig. 11 on page 27*).

An object is only reliably fully seen if it is at least as large as the measured point spacing plus the beam diameter.
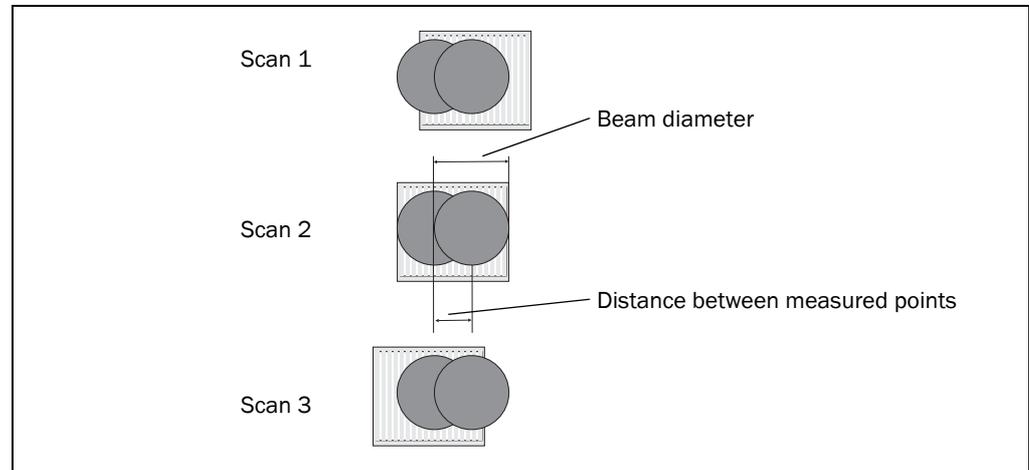

Fig. 16:   Minimum object size for detection

In the example in *Fig. 16*, the beam is fully incident on the object at least once during **each** scan. It will therefore be reliably detected if it has the necessary remission.

How to calculate the minimum object size:

Beam diameter + distance between the measured points = minimum object size

➢   For beam diameter and measured point spacing as a function of the distance from the LMS5xx see the diagram in *Fig. 15 on page 29*.

Important   In particular on the usage of the LMS5xx for measured value output, it is necessary for a reliable measurement that the beam is incident on the object several times. The example shows the minimum size of an object. For a reliable measurement it is important that the beam is incident on the object several times. Therefore an object should be either larger than the minimum object size or the LMS5xx as well as the object should not move.

3.7.4 Contamination measurement

The LMS5xx has a front screen for protection. This front screen can become contaminated. The laser beam radiation emitted and received is reduced by the contamination. As a result scanned objects are perceived with a lower remission than they actually have, or no longer measured at all from a certain level of contamination. The LMS5xx is equipped with 6 dedicated contamination sensors. Depending on the contamination strategy chosen, a selected number of these sensors will be taken into account. The 6 contamination sensors are divided in 2 groups (3 + 3).

For this reason the contamination is monitored continuously by a dedicated system while the device is in operation. For different levels of contamination, first a contamination warning is output; if the screen is not cleaned and the contamination becomes worse, a contamination error is output and the LMS5xx stops taking measurements.

Depending on the application in which the LMS5xx is used, you can choose between various strategies for the contamination measurement.

PROJECT TREE, LMS..., PARAMETER, CONTAMINATION MEASUREMENT.

- Inactive
  No contamination measurement

- Highly available
  Contamination warning and contamination error are only output on even contamination of the front screen. This means that all 6 contamination sensors must have reached the warning level or error level.

- Available
  Contamination warning and contamination error are output on partial contamination of the front screen.

- Semi-sensitive
  Contamination warning and contamination error are output on a smaller partial contamination of the front screen.

- Sensitive
  Contamination warning and contamination error are output on a very small or localized contamination.

Recommendation

The cleaner the application environment, the lower you can set the sensitivity for the contamination measurement. If a high precision of the measured results is crucial, the contamination measurement must be set to the highest possible sensitivity.

Contamination warning and contamination error are indicated on the LEDs on the LMS5xx (see *section 9.2 "Error displays of the indicator lights" on page 97*). You can also read these states using telegrams (see telegram listing "LMS1xx/5xx and more", part no. 8014631, English version).

A contamination error can also be signaled on a digital output if this output is configured for the status "Device Ready" or "Contamination" (see *section 3.11.3 "Digital switching outputs" on page 44*).

Important

If you use the "Contour monitoring with blanking" strategy (see *section "Evaluation strategy" on page 41*) in the field evaluation application, the contamination measurement should be configured as inactive. If the contamination measurement is active, erroneous detections of contour infringements may occur.

3.8 Applications

In principle the LMS5xx can be used for two purposes:

- for the measurement of objects (see *section 3.9 "Measurement of objects" on page 32*)

- for the detection of objects with evaluation fields (see *section 3.10 "Field application" on page 39*)

Therefore, there is a wide range of possible applications. Some of these applications are listed below:

- Container loading/handling/positioning

- Traffic/transport

- Robots/pick and place

- Object/building protection (low false alarm rate)

- Anti-collision

- Navigation

- Mapping

3.9   Measurement of objects

3.9.1   Basic parameters

The LMS5xx PRO/Heavy Duty scans with a scanning frequency of 25 up to 100 Hz or with an angular resolution of 0.1667 ° up to 1 °. The LMS5xx Lite offers a reduced set of possible combinations.

At a higher scanning frequency or a finer angular resolution the LMS5xx supplies more measured values. The following tables give an overview of the possible configurations.

Scanning frequency	Angular resolution	Scaling factor for data output	Max. distance
25 Hz	0.25 °	× 2	80 m
35 Hz	0.5 °	× 2	80 m
50 Hz	0.5 °	× 2	80 m
75 Hz	1 °	× 2	80 m
75 Hz	0.5 °[1]	× 1	65 m

Tab. 12:   Possible configurations LMS5xx Lite

1)   With a fixed opening angle of 90 °.

Scanning frequency	Angular resolution	Scaling factor for data output	Max. distance
25 Hz	0.1667 °	× 1	65 m
25 Hz	0.25 °	× 2	80 m
35 Hz	0.25 °	× 1	65 m
35 Hz	0.5 °	× 2	80 m
50 Hz	0.3333 °	× 1	65 m
50 Hz	0.5 °	× 2	80 m
75 Hz	0.5 °	× 1	65 m
75 Hz	1 °	× 2	80 m
100 Hz	0.6667 °	× 1	65 m
100 Hz	1 °	× 2	80 m

Tab. 13:   Possible configurations LMS5xx PRO

PROJECT TREE, LMS..., PARAMETER, BASIC PARAMETERS, areas CURRENT CONFIGURATION and NEW CONFIGURATION.

Important

- The LMS5xx outputs the data after the start of the measurement using the same interface over which the measured values were requested.

- It is only possible to output all measured values of a scan in real-time using the Ethernet interface.

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3.9.2 Filter

The LMS5xx has digital filters for the pre-processing and optimisation of the measured distance values.

You can configure an echo filter or a particle filter for interference suppression.

PROJECT TREE, LMS..., PARAMETER, FILTER.

Fog filter

The fog filter suppresses possible glare due to fog. The outdoor and security versions become less sensitive in the near range (up to approx. 7 m) with the fog filter. The fog filter is enabled on all outdoor devices. It is not possible to disable this function.

Echo filter

If echo pulses are reflected by several objects during a measurement (incident on drops of rain, glass surfaces, edges etc.) with a maximum of up to five echoes, the echo filter can be selected to give out only the first echo, all echoes or the last echo received (see *section 3.9.4 "Measured value output for a pulse reflected with multiple echoes" on page 36*).

Particle filter

The particle filter can be used in dusty surroundings or in case of rain or snow to filter out interference due to particles of dust, rain drops, snow flakes etc.

Important
- The particle filter is an application filter. It acts on the field application, not on the measured value output.
- Due to the particle filter, the reaction to an object in the evaluation field or an infringement of the contour is delayed by the time for a scan. The response time set for the pixel evaluation, blanking and contour evaluation strategies is not changed as a result.

3.9.3 Measured value output

For the measured value output, the LMS5xx supplies measured values to one of the interfaces. It is prerequisite for this data output that the LMS5xx is in the measurement mode. There are two ways you can start the measurement mode:

- Start via SOPAS ET

  PROJECT TREE, LMS..., PARAMETER, BASIC PARAMETERS, area MEASUREMENT.

- Start via telegram (see telegram listing "LMS1xx/5xx and more", part no. 8014631)

Recommendation
After the measurement mode is started the LMS5xx needs a little time to reach status 7 ("measurement"). You should therefore query the status of the LMS5xx using the sRN STlms telegram.

Then request measured data by using a telegram on the interface from which you want to receive measured data. There are two possible ways of doing this:

- Exactly one measured value telegram can be requested using the **sRN LMDscandata** telegram — the last scan measured is transferred.
- Measured data can be continuously requested using the **sEN LMDscandata** telegram — measured data are then transferred until the measured value output is stopped using

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the **sEN LMDscandata** telegram.

Example of single measured value output
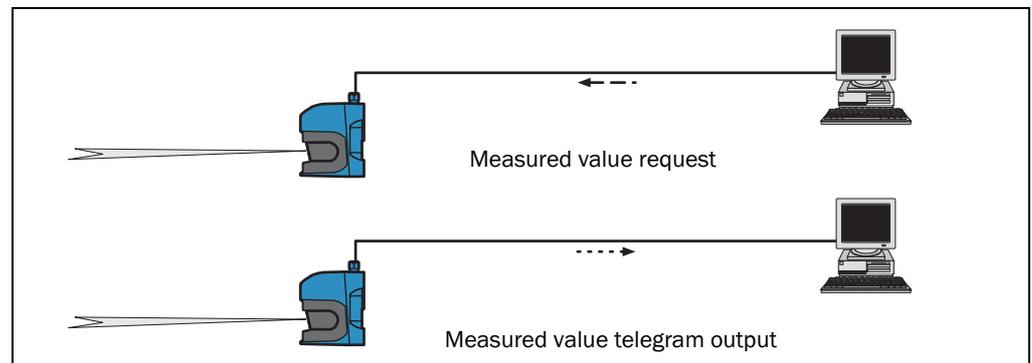

Fig. 17:   Measured value telegram request

1. Log in

    Request

    <STX>sMN SetAccessMode 03 F4724744<ETX>

    LMS5xx answer

    <STX>sAN SetAccessMode <ETX>

2. Start measurement

    Request

    <STX>sMN LMCstartmeas<ETX>

    LMS5xx answer

    <STX>sAN LMCstartmeas 0<ETX>

3. Log out and start the device

    Request

    <STX>sMN Run<ETX>

    LMS5xx answer

    <STX>sAN Run 0<ETX>

4. Query measuring status

    You must query the status until status 7 ("measurement") is given in the reply.

    Request

    <STX>sRN STlms<ETX>

    LMS5xx answer

    <STX>sRA STlms **7** 0 8 00:00:00 8 01.0 1.06 0 0 0<ETX>

Important | If the status is other than 7, you must send the request again.

5. Start the output of measured values for a single scan

    Request

    <STX>sRN LMDscandata<ETX>

    LMS5xx answer

    <STX>sRA LMDscandata<ETX>

    Depending on the type of error, the sensor may or may not stop measuring.

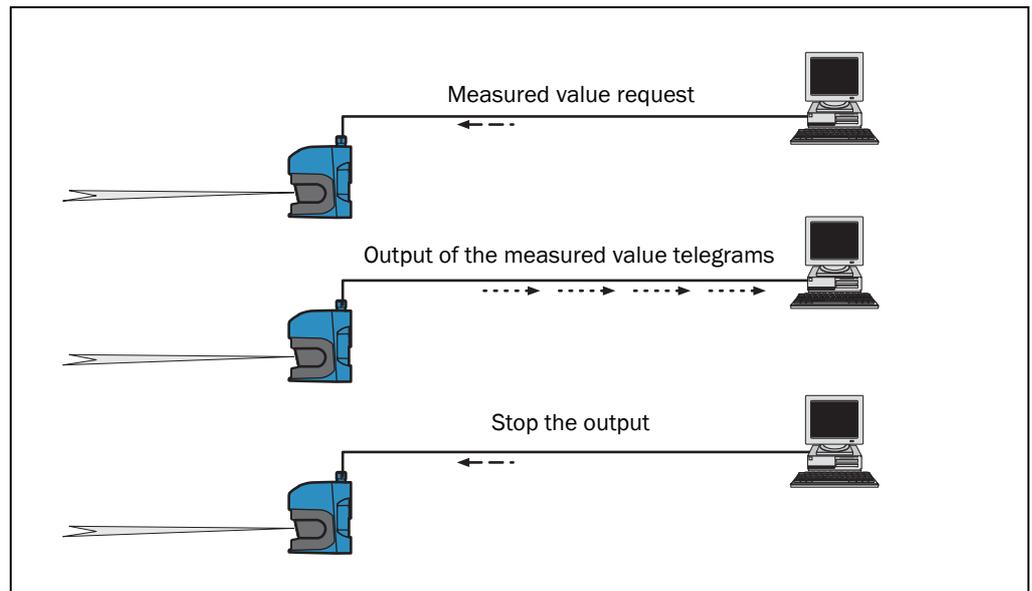**Example of continuous measured value output**

Fig. 18:   Continuous measured value output

Recommendation If you are not certain that the scan data can be processed at the speed at which they are output by the LMS5xx, you should only request the scan data for a single scan. The scan counter in the measured value output can be used as an indication that processing is too slow.

1. Log in

   Request

   <STX>sMN SetAccessMode 03 F4724744<ETX>

   LMS5xx answer

   <STX>sAN SetAccessMode <ETX>

2. Start measurement

   Request

   <STX>sMN LMCstartmeas<ETX>

   LMS5xx answer

   <STX>sAN LMCstartmeas 0<ETX>

3. Log out and start the device

   Request

   <STX>sMN Run<ETX>

   LMS5xx answer

   <STX>sAN Run 0<ETX>

4. Query measuring status

   You must query the status until status 7 ("measurement") is given in the reply.

   Request

   <STX>sRN STlms<ETX>

   LMS5xx answer

   <STX>sRA STlms **7** 0 8 00:00:00 8 01.0 1.06 0 0 0<ETX>

   If the status is other than 7, you must send the request again.

5. Start continuous measured value output

    The scan data are output until measured value output is ended.

    Request

    <STX>sEN LMDscandata 1<ETX>

    LMS5xx confirmation

    <STX>sEA LMDscandata 1<ETX>

    LMS5xx answer continuously

    <STX>sSN LMDscandata<ETX>

6. Stop continuous measured value output

    Request

    <STX>sEN LMDscandata 0<ETX>

    LMS5xx confirmation

    <STX>sEA LMDscandata 0<ETX>

3.9.4   Measured value output for a pulse reflected with multiple echoes

The LMS5xx Lite series can measure up to 2, the LMS5xx PRO/Heavy Duty up to 5 reflected pulses (echoes). The measured values can be output in the measured value telegram or used in the field application according to the echo filter settings (see *section 3.9.2 "Filter" on page 33*). Several echoes can be produced, e.g. if the LMS5xx sender pulse hits several rain drops, fog, glass, etc. These conditions can reflect part of the energy hence creating reflected pulses or echoes. Most of the sending pulse energy will continue to propagate and will eventually reflect against the actual target object. The LMS5xx PRO/Heavy Duty is able to evaluate up to 5 received echoes.
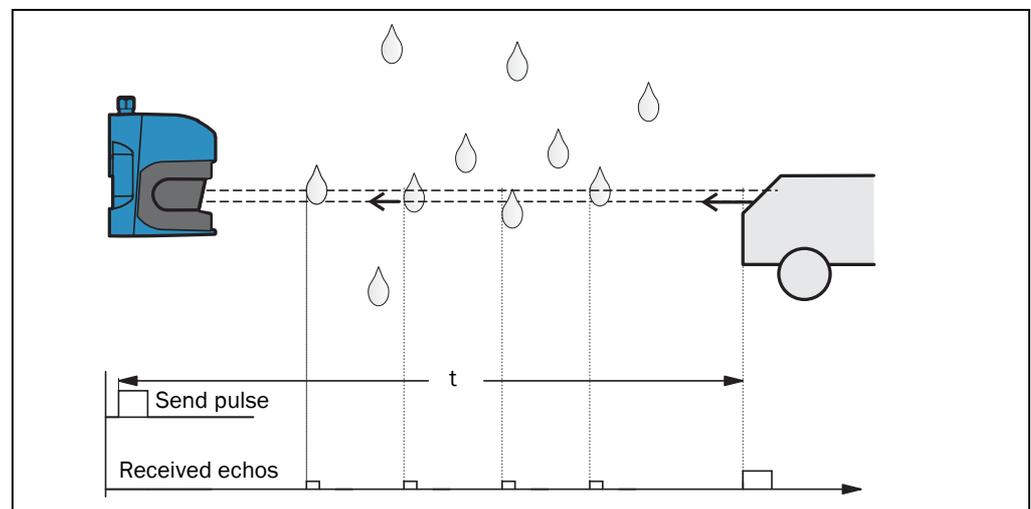

Fig. 19:   Principle of operation of the measurement of the fifth received echo (LMS5xx PRO/Heavy Duty)

If the echo filter is set to First Echo, the LMS5xx will only take the first echo into account and ignore all following echoes.

With All Echoes the sensor will receive up to 2 (Lite) or even 5 (PRO/Heavy Duty) echoes. It will display all of them in the SOPAS monitor function and output all echo values received in the measured value telegram (no values will be displayed as 0).

With the Last Echo setting, the LMS5xx will also receive up to 2 or 5 echoes, however it will only display the last echo received and ignore all previous echoes. In the measured value telegram it will output only one value.

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In bad weather conditions (rain/snow/fog), the LAST ECHO filter can produce better results or actually make special applications possible such as measurement through a window.

Recommendation   If measurement through a window is necessary, then a slight inclination of the window versus the sensor (<> 90°) is recommended to avoid any direct reflections on the sensor (mirror effect).

3.9.5   RSSI values

RSSI (Received Signal Strength Indicator) is the measurement of power received by the sensor. This value is generated for every measurement and has an arbitrary unit with a logarithmic characteristic. The RSSI values have an 8-bit resolution, with integer values from 1 to 255, where 1 is the weakest signal and 254 the strongest signal (e.g. with a reflector). A value of 255 means "dazzled". The value 0 (zero) means that the received power was too low to generate a valid RSSI value. If there is a valid distance measurement it has a minimum RSSI of 1.

Fig. 20 and *Fig. 21* show the different approximate curves for the RSSI ranges of the HR and SR variants depending on the object remission, with 10% being the lowest (black), and 100% the highest (white paper). The value of > 80,000% represents a reflector. This is the reason why the resulting curve remains constantly at 254.

RSSI value	Description
0	No signal
1-254	Valid measurement
255	Dazzled

Tab. 14:   RSSI values

If the RSSI value is 0, then no distance measurement is possible. Two reasons are possible:

- Target object is out of range (> 80 m).
- Target object has an extremely low remission.

Please note that white paper (100%) at close range can give very similar values as a reflector.
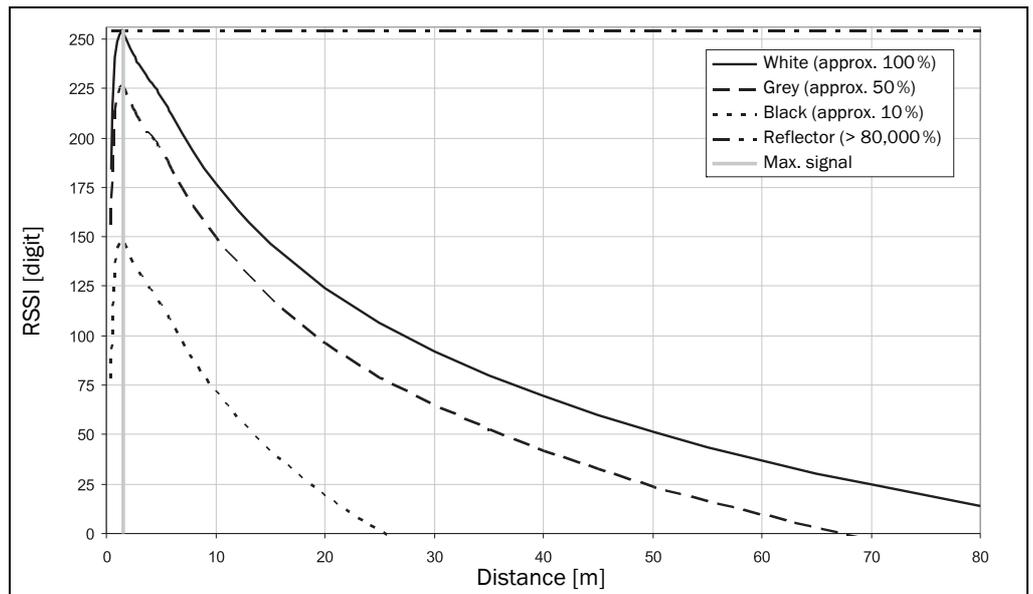

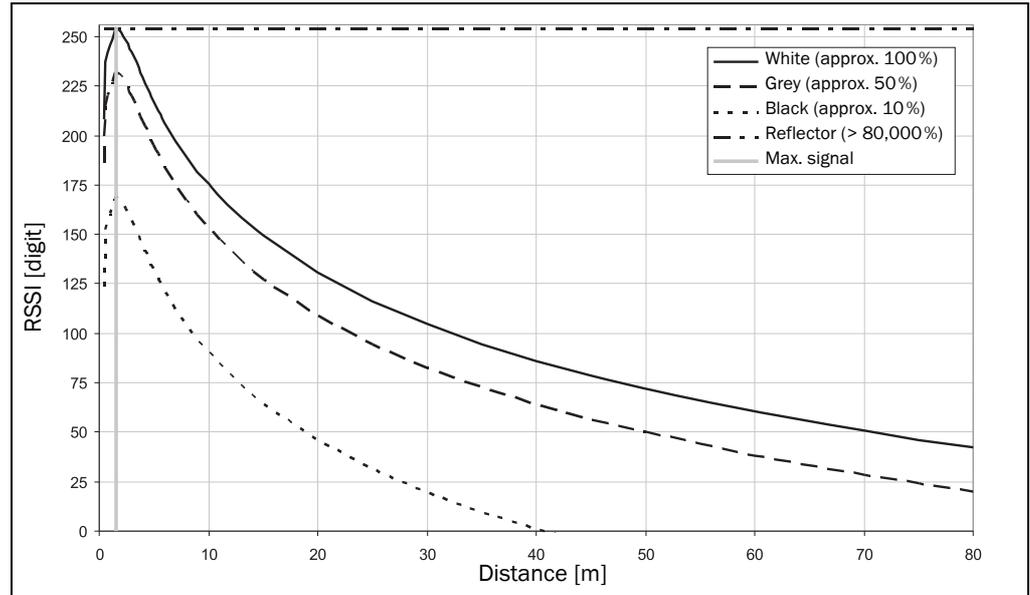Fig. 20:   Typical RSSI values HR

Fig. 21:   Typical RSSI values SR

The RSSI values may vary slightly between different devices and over the life time of the sensor.

PROJECT TREE, LMS..., PARAMETER, DATA PROCESSING/OUTPUT DATA CONFIGURATION.

3.10   Field application

With the aid of the integrated field application, the LMS5xx PRO/Heavy Duty evaluates up to ten, the LMS5xx Lite up to four evaluation fields within its scan area. Using the field application, you can e.g. implement systems for collision protection, for building surveillance or for access monitoring.
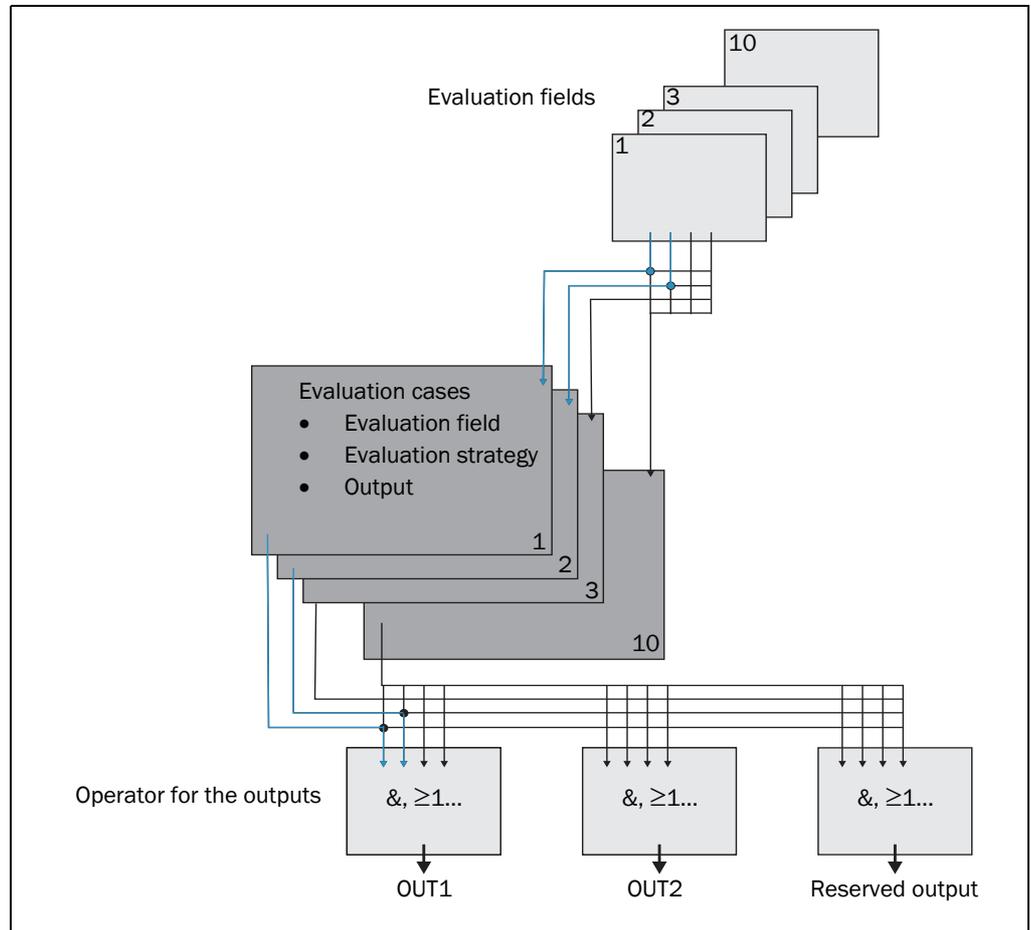
Fig. 22:   Principle of the field application

The LMS5xx PRO/Heavy Duty is adapted to the evaluation situation with the aid of up to ten, the LMS5xx Lite of up to four evaluation cases. In the evaluation case, one of ten (four) configurable evaluation fields, an evaluation strategy, an output and in some circumstances a combination of inputs that activate the evaluation case, are selected. An operator is selected for each output; this operator determines the result on the output if more than one evaluation case acts on the output.

In the example in *Fig. 22*, in evaluation case 1 evaluation field 1 is used, in evaluation case 2 evaluation field 2 is used. Both evaluation cases act on the output OUT1. If an AND operator is used for the results of the evaluation cases, then the output will only switch if both evaluation cases are signalling an event.

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3.10.1　Evaluation cases

An evaluation case defines which output field is evaluated in which way and on which output it acts. With the LMS5xx PRO/Heavy Duty you can configure up to ten evaluation cases, the LMS5xx Lite allows up to four evaluation cases. All configured evaluation cases are active simultaneously.

For each evaluation case you configure in SOPAS ET:

- inputs that activate an evaluation case, if necessary
- the evaluation strategy
- the evaluation field
- the output on which the evaluation case acts
- the response time of the output

PROJECT TREE, LMS..., PARAMETER, EVALUATION CASES.

Inputs

If the evaluation case is not to be permanently active, then you can configure an input combination to activate the evaluation case.

Input 1	Input 2	Input 3	Input 4	Evaluation case
Low	Low	Low	Low	1
Low	Low	Low	High	2
Low	Low	High	Low	3
Low	Low	High	High	4
Low	High	Low	Low	5
Low	High	Low	High	6
Low	High	High	Low	7
Low	High	High	High	8
High	Low	Low	Low	9
High	Low	Low	High	10

Tab. 15:　　Input combination examples LMS5xx PRO[1]

1)　　In SOPAS ET, the output state High is referred to as "Active high". Similarly, the output state Low is referred to as "Active low".

Important　An input combination can also be defined for several evaluation cases, e.g. two evaluation cases will then be active simultaneously.

Although the LMS5xx Lite has two inputs, only IN1 can be used for the field evaluation.

Evaluation strategy

In SOPAS ET choose one of four possible evaluation strategies:

- Pixel evaluation
  The LMS5xx evaluates the entire area of the field. Every single beam is considered in the evaluation. If an object enters the field, this result is sent to the related output.

- Blanking
  The LMS5xx evaluates the entire area of the field. However objects smaller than the specified size will be ignored. An object is only detected if it is larger than the blanking size configured.

- Contour
  The LMS5xx evaluates the presence of a contour that must be permanently and completely in the evaluation field. As a result the LMS5xx can detect, e.g., that a door is opening outwards or that the position of the LMS5xx is being changed. Also crawling beneath a vertical evaluation field or the deflection of the laser beam by a mirror can be detected.

  Using blanking the lack of part of a contour can be blanked up to a certain size.

- I/O operator
  Using the I/O operator evaluation strategy you can link the inputs of the LMS5xx with its outputs (see *section 3.11.6 "Logical operators for inputs and outputs" on page 46*).

Response time

For the Pixel evaluation, Blanking and Contour evaluation strategies you must define a response time. For the LMS5xx to detect an object using the Pixel evaluation or Blanking evaluation strategy, the object must be detected in one place for at least the duration of the response time. For the Contour evaluation strategy the contour infringement must be detected in one place for at least the duration of the response time.

Manipulation prevention

If pixel evaluation is configured, glare may result in it no longer being possible for the LMS5xx to monitor a field. If blanking is configured, small objects in the near range of the LMS5xx can cause large shadows.

If you use evaluation fields at a distance from the LMS5xx, then the object or the object erroneously measured due to glare is outside the evaluation field and will not be detected.

To prevent this situation arising, you can configure the TAMPER PROTECTION option.
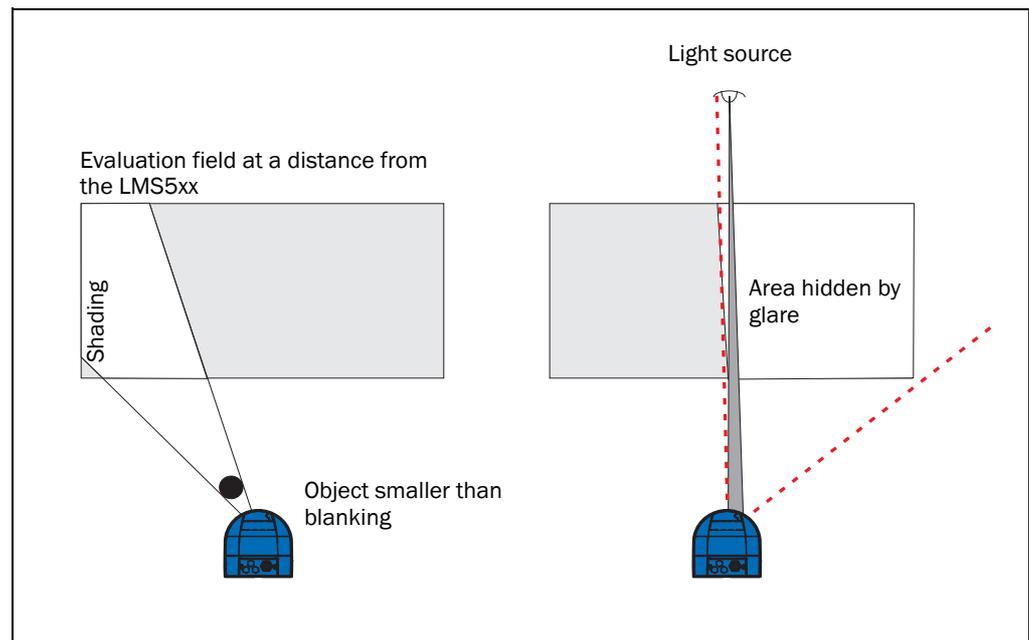

Fig. 23:   Protection against tampering due to shading and glare

The Manipulation prevention option switches the evaluation field if …

- an object that is smaller than or equal to the blanked object size is in front of the laser output aperture on the LMS5xx for the configured response time for Manipulation prevention.
- the LMS5xx is dazzled for longer than the configured response time for Manipulation prevention.

Evaluation field

Choose one of the evaluation fields already configured for the evaluation case. Its shape must match the evaluation strategy (see *section 3.10.2 "Evaluation fields" on page 43*).

Output

Choose one of the outputs for the evaluation case. If several evaluation cases act on an output, you must define how the results of the evaluation cases are linked (see *section 3.10.3 "Operator for the evaluation cases on the output" on page 43*).

Important   The related output must be configured for "Application".

Negating the result

By negating the result the field evaluation output is reversed. The output used is, e.g., then switched if the evaluation field is clear or if the contour is not infringed.

Important   Do not confuse the negation of the result with the setting active high/active low for the outputs (see *section 3.10.3 "Operator for the evaluation cases on the output" on page 43*).

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3.10.2 Evaluation fields

With the aid of the integrated field application, you can configure up to ten evaluation fields in the PRO version and up to four fields in the Lite version. The size and shape of these evaluation fields can be configured almost entirely as required.
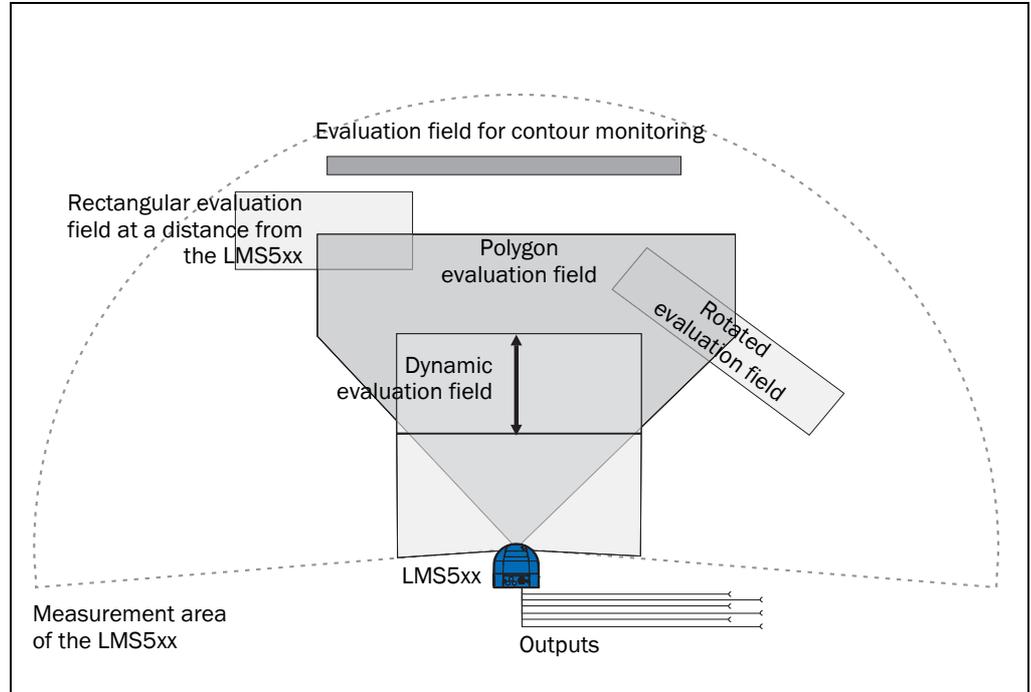

Fig. 24: Examples of 4 different evaluation field shapes

The evaluation fields can be drawn using SOPAS ET to suit the needs of your application. Evaluation fields can have the following properties:

- Polygon
- Rectangular
- Starting from the LMS5xx
- At a distance from the LMS5xx ("island field")
- Dynamic, i.e. the length varies according to the speed measured using the encoder, see *section 3.11.2 "Encoder inputs" on page 44* (LMS5xx PRO/Heavy Duty only)

You can configure the evaluation fields in SOPAS ET:

PROJECT TREE, LMS..., PARAMETER, FIELDS.

If the area to be monitored changes, the field can be easily re-configured using the SOPAS ET software.

3.10.3 Operator for the evaluation cases on the output

If several evaluation cases act on an output, you must define how the results of the evaluation cases are linked. The related results can be linked using an AND or an OR operator.

PROJECT TREE, LMS..., PARAMETER, NETWORK/INTERFACES/IOS, DIGITAL OUTPUTS.

The outputs are configured as active high in the pre-setting. You can configure the outputs also as active low.

Resetting an output

By default the outputs are reset immediately to the inactive state. You can configure a delay of up to 10 s (e.g. to activate a horn or to send the output signal to a PLC).

Alternatively you can also reset the output using an input. The output is reset only when the allocated input has the configured status.

3.11   Inputs and outputs

3.11.1   Digital switching inputs

The LMS5xx Lite has two, the LMS5xx PRO/Heavy Duty has four digital switching inputs. These inputs can activate different evaluation cases (see *section 3.10.1 "Evaluation cases" on page 40*). With the aid of the inputs, the outputs on the LMS5xx can also be reset (see *section "Resetting an output" on page 44*).

On the LMS5xx Lite only IN1 can be used for activating evaluation cases.

3.11.2   Encoder inputs

The LMS5xx PRO/Heavy Duty has two encoder inputs (IN3 and IN4) which can be selected via software.

With the aid of the encoder pulses, the size of so-called dynamic fields can be changed, e.g., for speed-dependent vehicle monitoring. The length of a dynamic field changes with the speed measured, e.g. using an encoder.

PROJECT TREE, LMS..., PARAMETER, NETWORK/INTERFACES/IOS, DIGITAL INPUTS.

PROJECT TREE, LMS..., PARAMETER, INCREMENT CONFIGURATION.

When stationary (V = 0 m/s) the evaluation field is the same size as the basic field configured. The size increases continuously with increasing speed up to the largest physical size for the field at the maximum speed.

3.11.3   Digital switching outputs

The LMS5xx Lite has three, the LMS5xx PRO/Heavy Duty has six digital switching outputs.

The outputs can be used as digital switching outputs to ground or as floating outputs (see *section 6.5.5 "Wiring of inputs and outputs on the LMS5xx" on page 82*).

The sensor will always show Device Ready, no matter whether the outputs are switched by the field evaluation application or by the SOPAS ET telegrams.

PROJECT TREE, LMS..., PARAMETER, NETWORK/INTERFACES/IOS, DIGITAL OUTPUTS.

If an output is switched by the field evaluation application, the LMS5xx can signal evaluation field infringements or contour infringements. For this purpose, configure in SOPAS ET which evaluation case is to act on which output.

3.11.4   Relay outputs

The LMS531 Lite has two, the LMS531 PRO has four relay output. The outputs can be configured to switch either to High or to Low if an object or a person is detected inside the monitored field.

PROJECT TREE, LMS531, PARAMETER, NETWORK/INTERFACES/IOS, RELAY OUTPUTS.

The following configuration possibilities exist:

Output	Configured logic High	Configured logic Low
Alarm output	Relay closed	Relay open
Error output	Relay closed	Relay open
Synchronization output	V_S Sensor present	GND present

Tab. 16:   LMS531 Lite/PRO: output status on field interruption

Alarm output R (PRO: pin 4 and pin 6, Lite: pin 3 and pin 4) can not be configured as it serves as a reference output. PRO: pin 4 and pin 6 respectively Lite: pin 3 and pin 4 are internally connected (0 Ω). See also *section 6.5.5 "Wiring of inputs and outputs on the LMS5xx" on page 82*).

3.11.5   Synchronisation of several LMS5xx

Optical interference between two or more LMS5xx can occur if they have to be installed within the same scanning plane (see *section   "LMS5xx with Weather protection hood (part no. 2063050)" on page 60*).

Several LMS5xx can be synchronized to avoid this type of interference. Through the SOPAS software an LMS5xx can type-dependently be set and sychronized with other LMS5xx via assigned outputs and inputs:

Variant	Output (for master)	Input (for slave)
LMS500 Lite Indoor	Terminal 5: OUT Sync (OUT3)	Terminal 7: IN Sync (IN4)
LMS500 PRO Indoor	Terminal 26: OUT Sync (OUT6)	Terminal 11: IN Sync (IN4)
LMS511 Lite Outdoor	"I/O" connection Pin 7: OUT Sync (OUT3)	"Data" connection Pin 7: IN Sync (IN2)
LMS511 PRO Outdoor	"I/O" connection Pin 12: OUT Sync (OUT6)	"I/O" connection Pin 8: IN Sync (IN4)
LMS511 Heavy Duty	"I/O" connection Pin 12: OUT Sync (OUT6)	"I/O" connection Pin 8: IN Sync (IN4)
LMS581 PRO Outdoor	"I/O" connection Pin 12: OUT Sync (OUT6)	"I/O" connection Pin 8: IN Sync (IN4)

Tab. 17:   Overview: Assigned inutps and outputs for synchronization

Using the Synchronisation Phase value (range: – 180 ... +180°) in the SOPAS software each Master-Slave link can be differentiated.

The synchronisation feature can also be used to increase the scanning frequency of an area by placing several units over the same area and adjusting the phases to alternate scanning.

3.11.6   Logical operators for inputs and outputs

With the help of an evaluation case the inputs and outputs on several LMS5xx can be linked together (see *section 3.10.1 "Evaluation cases" on page 40*).
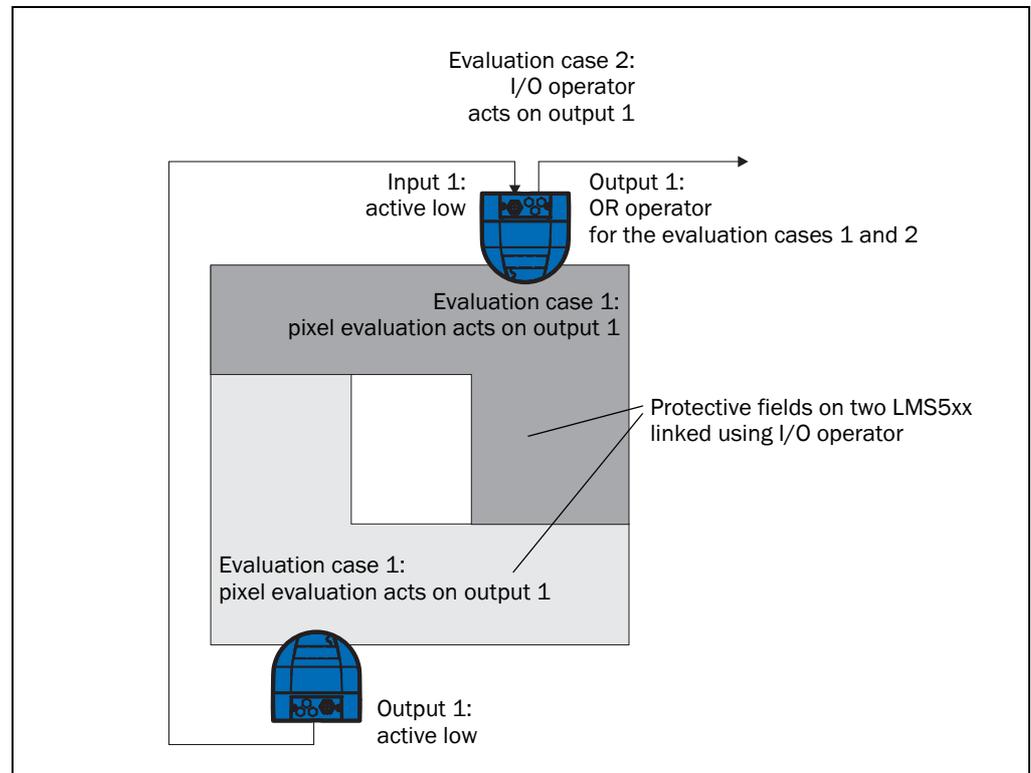

Fig. 25:   Logical operators for inputs and outputs

In the example above output 1 on the LMS5xx at the bottom is connected to input 1 on the LMS5xx at the top. An evaluation field infringement is therefore signalled at the input on the LMS5xx at the top. This LMS5xx links the input to output 1 in its evaluation case 2. At the same time, evaluation case 1 also acts on the LMS5xx at the top and its output 1. Using the OR operator for the two results, evaluation field infringements on both LMS5xx are signalled on output 1 on the LMS5xx at the top.

3.12   Data interfaces

The LMS5xx has different data interfaces for the configuration and the transmission of measured values.

Important	•	It is only possible to output all measured values of a scan in real-time using the Ethernet interface.
	•	The data transmission rate of the RS-232/RS-422 interfaces is limited to 500 kBd. Therefore these interfaces are not suitable for transmitting full scan data in real time.

3.12.1   Ethernet interface

The Ethernet interface has a data transmission rate of 10/100 Mbit/s. The interface is a TCP/IP interface supporting full duplex and half duplex.

The Ethernet interface allows the configuration of the LMS5xx as well as the output of measured values.

The factory setting for the Ethernet interface is as follows:

- IP address: 192.168.0.1
- subnet mask: 255.255.255.0
- TCP port: 2111

If necessary, adjust the TCP/IP configuration for the Ethernet interface to enable a connected PC (client) to communicate with the LMS5xx via Ethernet: PROJECT TREE, LMS..., NETWORK/INTERFACES/IOS, ETHERNET.

Important	If you change the parameters for the Ethernet interface over the Ethernet interface, you must first save the data in non-volatile memory in the LMS5xx and then restart the LMS5xx. For this purpose there is the RESTART button in SOPAS ET.

You will find a description of the electrical interface in *section 6.3 "Connections of the LMS5xx" on page 67*.

3.12.2   Serial host interface

The serial host interface is an RS-232/RS-422 interface. The host interface permits the configuration of the LMS5xx and only limited measured value output.

The interface parameters are freely configurable:

PROJECT TREE, LMS..., NETWORK/INTERFACES/IOS, SERIAL, area SERIAL HOST INTERFACE.

The factory setting for the host interface is as follows:

- 57.6 kBd
- 8 data bits
- 1 stop bit
- no parity

| **Important** | If you change the parameters for the host interface over the host interface, the connection to the device will be lost. In this case you must scan for the LMS5xx again in SOPAS ET (see *section 7.3.5 "Performing scan" on page 87*). |

You will find a description of the electrical interface in *section 6.3 "Connections of the LMS5xx" on page 67*.

3.12.3   USB auxiliary interface

The mini-USB auxiliary interface permits the configuration of the LMS5xx.

| **Important** | For access to the LMS5xx via the USB interface the required USB driver must be installed first on the PC. See *section 3.1 "Delivery" on page 17*. |

Parameters can be changed via USB while the sensor is connected to another interface such as RS or Ethernet to a host. Only the last changes saved in the configuration, either via USB, RS or Ethernet, will be permanent.

3.13   Data communication using telegrams

The LMS5xx sends telegrams over the interfaces described above to communicate with a connected host. The following functions can be run using telegrams:

- request for measured values by the host and subsequent output of the measured values by the LMS5xx
- parameter setting by the host for the configuration of the LMS5xx
- parameters and status log querying by the host

The telegrams each comprise a frame (see *section 3.13.1 "Frame and coding for the telegrams" on page 48*) and the data.

A detailed description of the different telegrams can be found in the telegram listing "LMS1xx/5xx and more", SICK part no. 8014631.

3.13.1   Frame and coding for the telegrams

The data frame varies depending on the coding.

Telegrams with ASCII coding (CoLa-A)

	Frame	**Telegram**	**Frame**
Code	STX	Data	ETX
Length (byte)	1	≤ 60 kB	1
Description	Start of text character	ASCII coded	End of text character

Tab. 18:   Frame for the telegrams with ASCII coding

The frame for the serial host interface can be configured in SOPAS ET: PROJECT TREE, LMS..., INTERFACES, SERIAL, area SERIAL HOST INTERFACE.

3.14   Planning

3.14.1   LMS5xx system requirements

For commissioning and operating the LMS5xx (without load on the switching outputs), the following are required by the customer:

LMS5xx variant	SELV supply voltage[1]	Power output of power unit
LMS500	Sensor: DC 19.2 … 28.8 V	At least 24 W
LMS511/LMS531/LMS581	Sensor: DC 19.2 … 28.8 V	At least 24 W
	Heating: DC 19.2 … 28.8 V	Heating: Additional 57 W (cyclic)
1) per IEC 60364-4-41 (VDE 0100, part 410)		

Tab. 19:   Required supply voltages and output power

- Data interface RS-232/RS-422, Ethernet and CAN (optional, in case several LMS5xx are connected together in a network) (see also *section 6.4.4 "General conditions for the data interfaces" on page 75*)

- PC with operating system Windows 2000™, Windows XP™, Windows Vista™ or Windows 7™ (see also *section 7.2.1 "System requirements for SOPAS ET" on page 85*)

3.14.2   Mounting requirements

The LMS5xx must be mounted as follows:

- robust

- as far as possible without shocks

- as far as possible without vibration

- protected from direct sunlight and heat sources

Mounting kits

The following mounting kits are available:

- Mounting kit 1: mounting bracket for mounting at the rear on wall or machine (see *Fig. 68 on page 109*)

- Mounting kit 2: mounting bracket, only in conjunction with mounting bracket 1, cross-wise adjustment possible (see *Fig. 69 on page 110*)

- Mounting kit 3: mounting plate, only in conjunction with mounting bracket 1 and 2, lengthwise adjustment possible (see *Fig. 70 on page 111*)

- Mounting with the Heavy Duty mounting bracket (see *Fig. 70 on page 111*)

NOTICE

Risk of dysfunction due to overheating or dazzle!

Direct sunlight can increase in the temperature inside the LMS5xx in an inadmissible way.

➢ Mount the LMS5xx such that it is not exposed to direct sunlight (if necessary fit canopy or protection hood), see *section 5.2.10 "Mounting the LMS5xx with protection hood/ weather protection hood" on page 59*).

➢ To avoid dazzling, do not orient the device toward reflective glass or stainless steel surfaces. These may act as a mirror.

3.14.3   Distance between LMS5xx and the object/surface to be monitored

The laser beam diverges with increasing distance from the LMS5xx. In the scan area the floor or a wall may then be continuously detected, as the laser beam is incident on it.
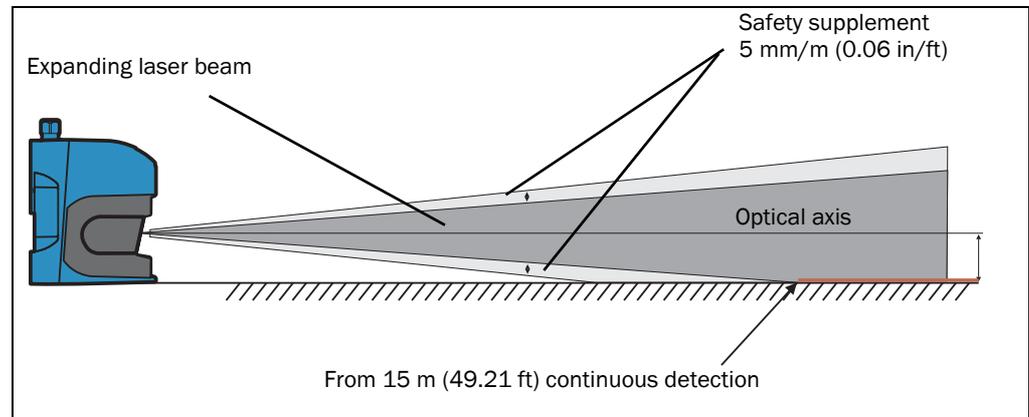

Fig. 26:   Increase in the size of the beam and safety supplement

The optical axis is used as the reference plane for the distance to be maintained from the floor or the wall; on a vertically mounted LMS5xx this axis is approx. 116 mm (4.57 in) above the bottom edge of the housing.

The distance-dependent increase in the size of the beam can be calculated using the formula:

Beam diameter = distance (mm) × divergence + spot size on front screen

For the values please see *Tab. 43: "Data sheet LMS5xx" on page 101*.

The following table shows some example values:

Distance	LMS5xx (HR)	LMS5xx (SR)
5 m	37 mm	73 mm
10 m	61 mm	133 mm
15 m	85 mm	192 mm
20 m	108 mm	252 mm
50 m	250 mm	609 mm

Tab. 20:   Beam diameter on target (diagonal) at different distances from the LMS5xx

For the assessment of whether the laser beam can be incident on an object or the wall, the distance of half the beam diameter from the optical axis is used.

Recommendation   Take into account a safety supplement of approx. 5 mm per meter (0.06 in/ft).

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4   Transport and storage

4.1   Transport

For your own safety, please read and observe the following notes:

NOTICE

Damage to the LMS5xx due to improper transport!

- Package the device so that it is protected against collision and humidity.

- Recommendation: use the original packaging for optimal protection.

- Transport should be performed by trained specialist staff only.

- The utmost care and attention is required at all times during unloading and transportation on company premises.

- Note the symbols on the packaging.

- Do not remove packaging until immediately before you start mounting.

4.2   Transport inspection

Upon receipt, please check the delivery for completeness and for any damage that may have occurred in transit. In the case of transit damage that is visible externally, proceed as follows:

- Do not accept the delivery or only do so conditionally.

- Note the scope of damage on the transport documents or on the transport company's delivery note.

- File a complaint.

Important   Complaints regarding defects should be filed as soon as these are detected. Damage claims are only valid before the applicable complaint deadlines.

4.3   Storage

Store the LMS5xx under the following conditionsLMS5xx:

- Recommendation: use the original packaging.

- Do not store outdoors.

- Store in a dry area that is protected from dust.

- To ensure that any residual moisture present can escape, do not store the device in airtight containers.

- Do not expose to any aggressive substances.

- Protect from sunlight.

- Avoid mechanical shocks.

- Storage ambient temperature range:
  −40 °C to +70 °C (+70 °C max. 24 h)

- Relative humidity: max. 90%, non-condensing.

- For storage periods of longer than 3 months, check the general condition of all components and packaging on a regular basis.

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5   Mounting

NOTICE

Claims under the warranty rendered void!

The housing of the LMS5xx is sealed. Type-dependent, the devices have a diffent quantity of sealing stickers across their components. Claims under the warranty against SICK AG will be rendered void if the screwed housing is opened and/or the seals are damaged.
The housing is only allowed to be opened by SICK authorized service personnel.

The only exception in this case is the process of replacing an LMS500 Lite/Pro Indoor or LMS511 Heavy Duty Outdoor with an appropriate replacement device. Here, the system connector is transferred from the existing device to the replacement device. See *section 8.2 "Exchanging an LMS5xx" on page 91*.

5.1   Overview of the mounting steps

- Selecting a mounting location for the LMS5xx
- Mounting and adjusting the LMS5xx

5.2   Preparations for mounting

5.2.1   Components to be mounted

- An LMS5xx, weight approx. 3.7 kg

5.2.2   Material and accessories necessary

- Optional Mounting kit or mounting kits with mounting material (not in the delivery)

  or

- Optional protection hood or weather protection hood with mounting kit(s) (not in the delivery)

  or

- As an alternative if a fixing bracket is provided by the user
  – Stable mounting bracket that provides adjustable alignment of the LMS5xx in the x and y axis
  – 4 M6 screws for the LMS5xx, screw length dependent on the wall thickness of the mounting bracket used

5.2.3   Necessary tools

- 4 M6 screws for mounting the SICK fixing bracket on the support, screw length as a function of the wall thickness of the support
- tool set

5.2.4   Select mounting location

NOTICE

Risk of dysfunction due to overheating or dazzle!

Direct sunlight on the LMS5xx can cause excessive temperature inside the sensor.

➢ Mount the LMS5xx in a dry and, where necessary, covered location so that it is protected from moisture, dirt, damage, and direct sunlight. If necessary fit canopy or protection hood. See *section 5.2.10 "Mounting the LMS5xx with protection hood/ weather protection hood" on page 59*.

➢ Avoid installing the LMS5xx in view of glass or stainless steel surfaces as they may act as a mirror.

5.2.5   Mounting steps

NOTICE

• Mount the LMS5xx such that it is protected from moisture, dirt, damage and direct sunlight.

• If necessary, use a protection hood when mounting the LMS5xx in indoor areas or use a weather protection hood when mounting the LMS5xx in outdoor areas (optional accessories). See *section 5.2.10 "Mounting the LMS5xx with protection hood/weather protection hood" on page 59*.

• Ensure that the entire field of view of the LMS5xx is not restricted.

• Mount the device such that the indicators are easy to see.

• Always mount the LMS5xx so that there is still enough space for mounting and removing the system connector or the connections.

• Avoid excessive shock and vibration loading on the laser measurement sensor.

• Pay attention to the maximum torque for the fixing screws on the LMS5xx:
  – M6 on rear = max. 12 Nm
  – M8 on side = max. 16 Nm

• Regularly check the tightness of the fixing screws.

• In applications with heavy vibration, prevent the fixing screws from coming loose by using screw locking devices (see *section 10.1 "Data sheet LMS5xx laser measurement sensor" on page 101*).

The LMS5xx can be fastened in the following ways:

• Direct mounting without mounting kit

• Mounting with mounting kit 1 (part no. 2015623)

• Mounting with mounting kit 2 (part no. 2015624), only in conjunction with mounting kit 1

• Mounting with mounting kit 3 (part no. 2015625), only in conjunction with mounting kits 1 and 2

• Mounting with mounting kit 4 (part no. 2020295)

5.2.6 Direct mounting

The LMS5xx has four M6×8 threaded holes on the rear. Using them you can mount the LMS5xx directly on the intended mounting surface.
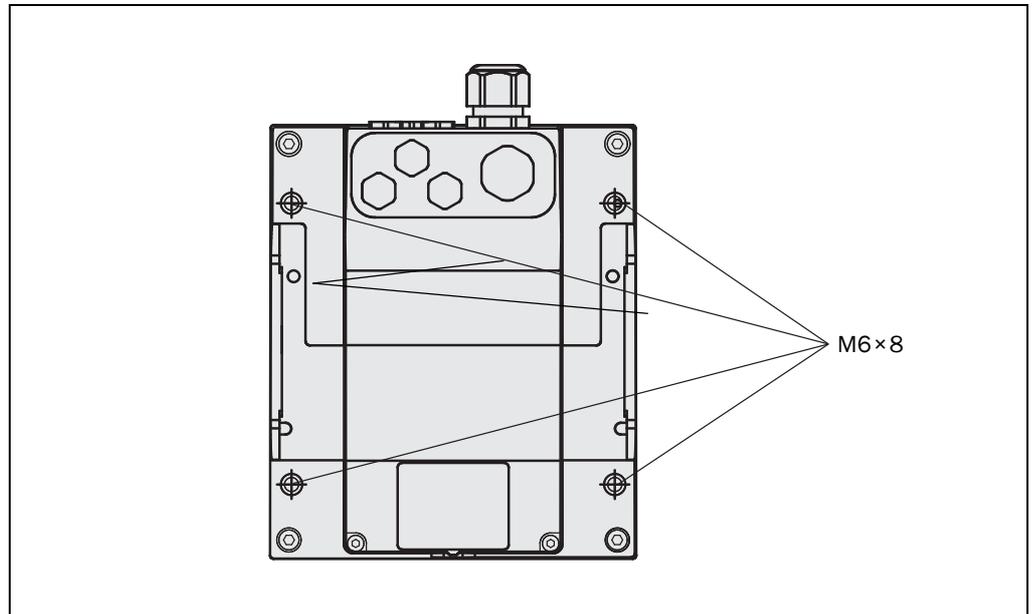
Fig. 27:   Direct mounting

Important   During mounting, please observe the dimensional drawings (see *section 10.3.1 "Dimensional drawing LMS500" on page 107*).

5.2.7   Mounting with mounting kit 1

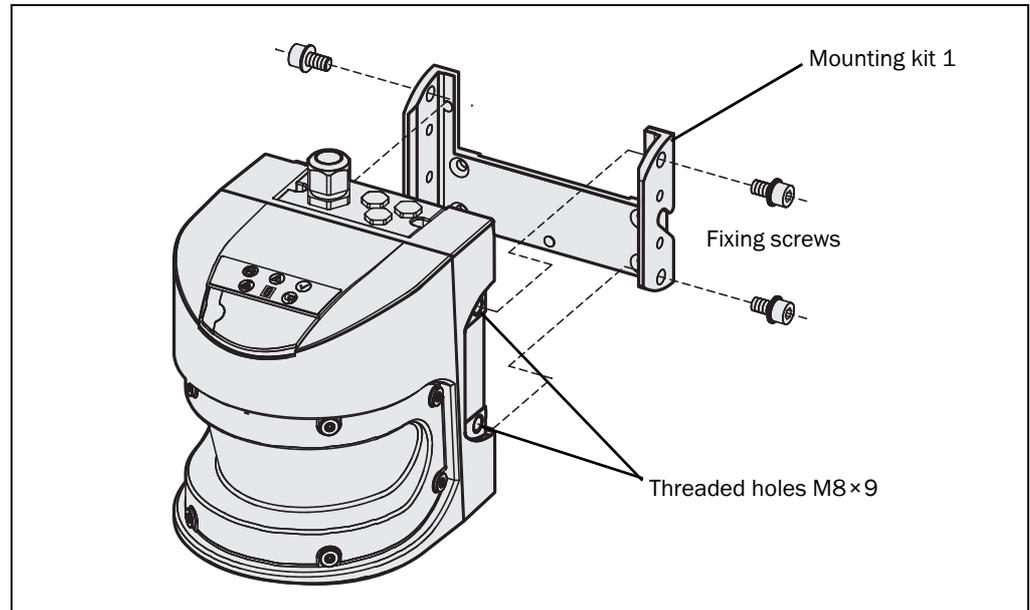Using mounting kit 1 you can mount the LMS5xx on a mounting surface (wall, machine).

Fig. 28:   Mounting with mounting kit 1 (part no. 2015623)

1. Mount mounting kit 1 on the mounting surface.

2. Mount the LMS5xx on mounting kit 1.

Important   During mounting, please observe the dimensional drawings (see *section 10.3.3 "Dimensional drawings, mounting kits" on page 109*).

5.2.8   Mounting with mounting kit 2

Using mounting kit 2 (only in conjunction with mounting kit 1) you can align the LMS5xx in two planes. The maximum adjustment angle is ±11° in both planes.
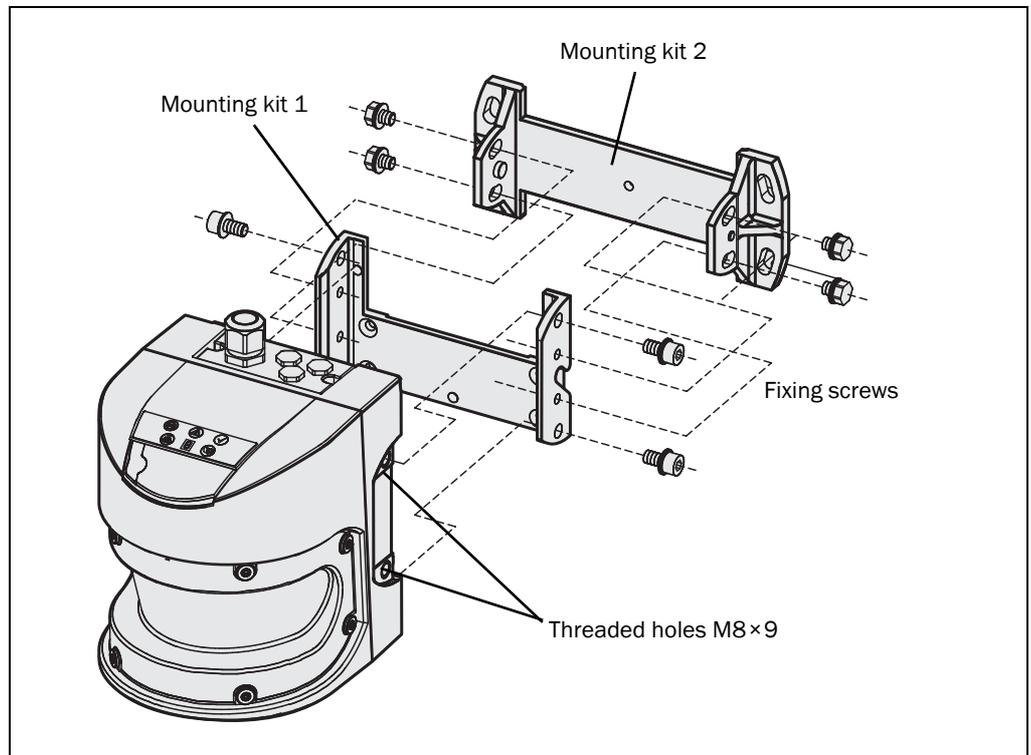
Fig. 29:   Mounting with mounting kits 1 (part no. 2015623) and 2 (part no. 2015624)

1.   Mount mounting kit 2 on the mounting surface.

2.   Mount mounting kit 1 on mounting kit 2.

3.   Mount the LMS5xx on mounting kit 1.

4.   Adjust the LMS5xx longitudinally and crosswise.

Important   During mounting, please observe the dimensional drawings (see *section 10.3.3 "Dimensional drawings, mounting kits" on page 109*).

5.2.9   Mounting with mounting kit 3

Using mounting kit 3 (only in conjunction with mounting kits 1 and 2) you can mount the LMS5xx such that the scan plane is parallel to the mounting surface. This enables stable floor mounting or ensures that mounting kit 2 remains precisely adjustable crosswise on uneven wall surfaces.
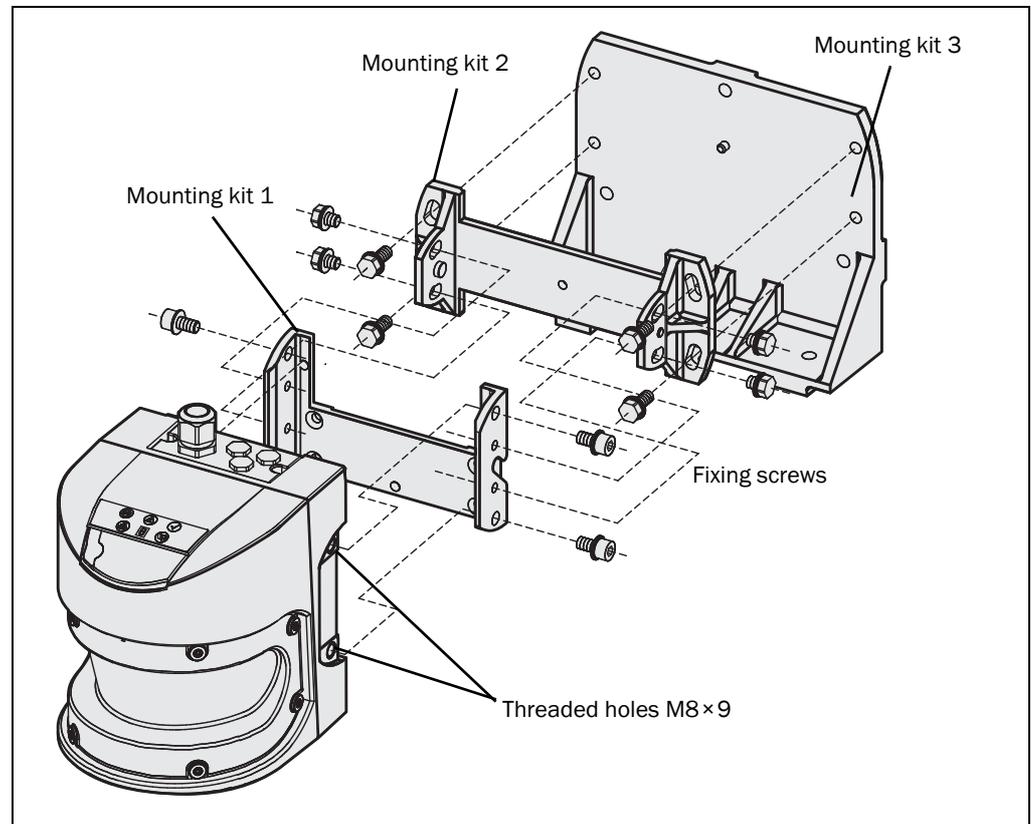
Fig. 30:   Mounting with mounting kits 1 (part no. 2015623), 2 (part no. 2015624) and 3 (part no. 2015625)

1.   Mount mounting kit 3 on the mounting surface.

2.   Mount mounting kit 2 on mounting kit 3.

3.   Mount mounting kit 1 on mounting kit 2.

4.   Mount the LMS5xx on mounting kit 1.

5.   Adjust the LMS5xx longitudinally and crosswise.

Important   During mounting, please observe the dimensional drawings (see *section 10.3.3 "Dimensional drawings, mounting kits" on page 109*).

5.2.10 Mounting the LMS5xx with protection hood/weather protection hood

To protect the LMS5xx from glare, precipitation and direct sunlight when used outside, a small protection hood (part no. 2056850) as well as a greater weather protection hood (part no. 2063050 are available.

The protection hood/weather protection hood can be mounted on the LMS5xx in two different positions depending on the orientation of the LMS5xx.

You will find detailed dimensions in *section 10.3.4 "Dimensional drawings, weather protection hoods" on page 112*.

LMS5xx with protection hood (part no. 2056850)
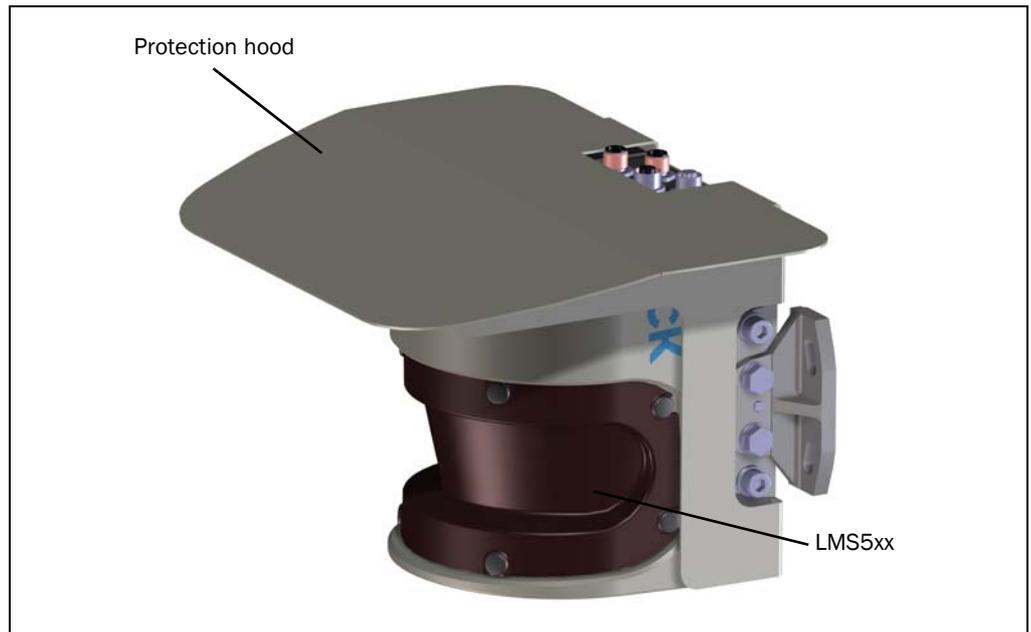
Fig. 31:   Protection hood, upright orientation of the LMS5xx
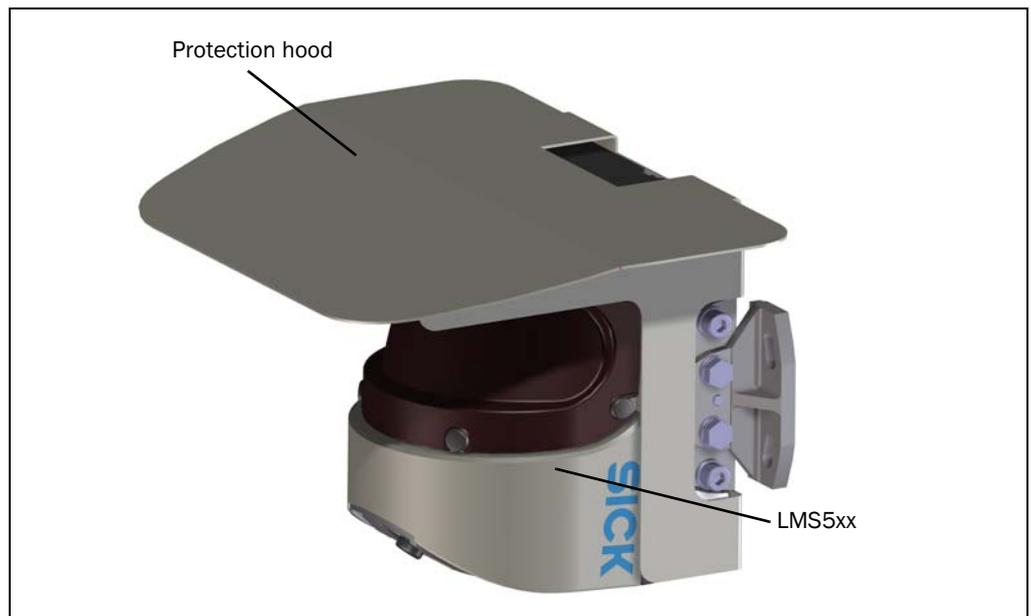
Fig. 32:   Protection hood, upside down orientation of the LMS5xx

LMS5xx with Weather protection hood (part no. 2063050)

(1) Weather protection hood
(2) LMS5xx
(3) Mounting kit 1
(4) Mounting kit 2
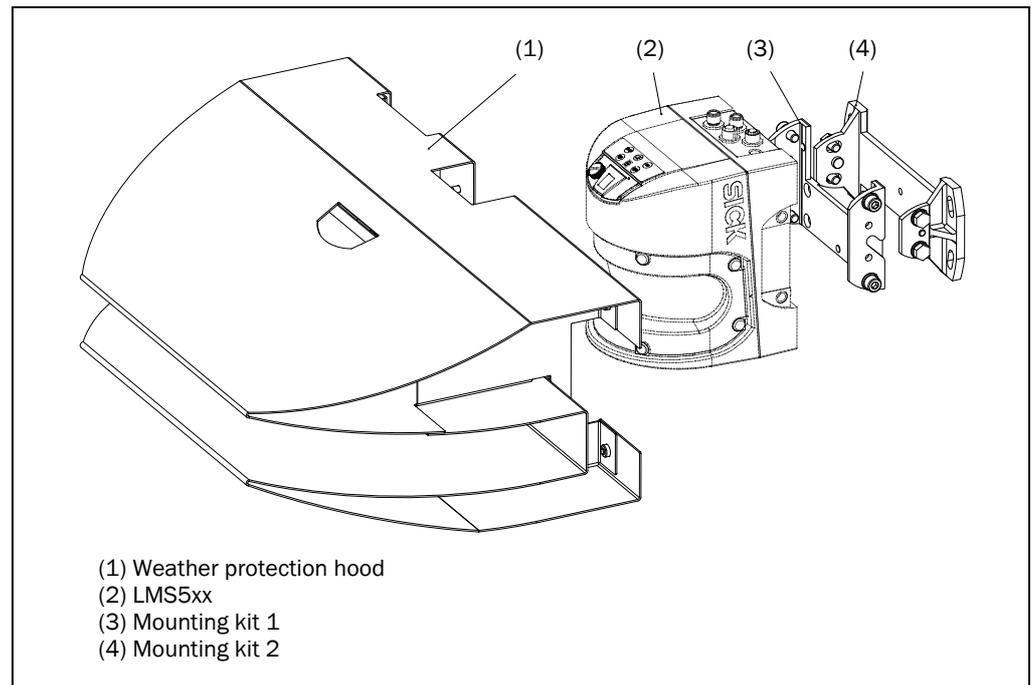
Fig. 33:   Weather protection hood, upright orientation of the LMS5xx

For mounting the LMS5xx in combination with the weather protection hood, mounting kit 1 and 2 are required.

5.2.11 Using multiple LMS5xx laser measurement sensors

> ## *NOTICE*
>
> **Risk of interference on the LMS5xx!**
>
> Sources with a wavelength of 905 nm may cause interference if they act directly on the LMS5xx.

The LMS5xx is designed in such a way that mutual interference between several sensors is unlikely. To completely exclude erroneous switching, we recommend mounting the laser measurement sensors as shown in the following examples.

Use mounting kits 1 to 3 to adjust the laser measurement sensors to different angles.

Correct placement of several LMS5xx

Arrange or shield several LMS5xx such that the laser beam cannot be received by a different LMS5xx.
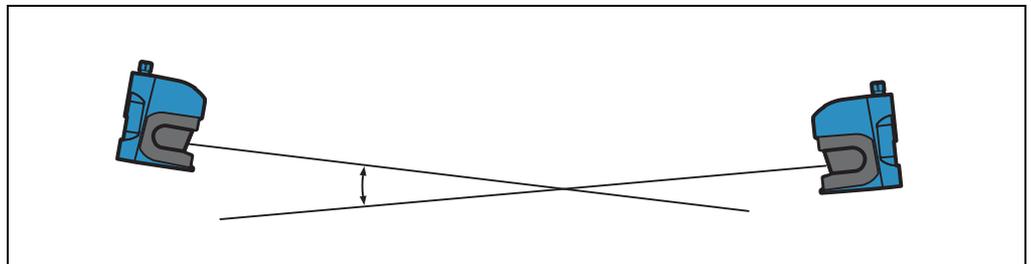
Fig. 34:   Placement of two LMS5xx opposed to each other
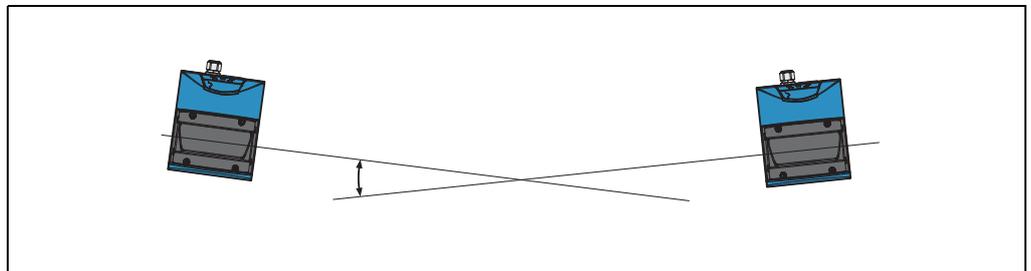
Fig. 35:   Crosswise placement of two LMS5xx
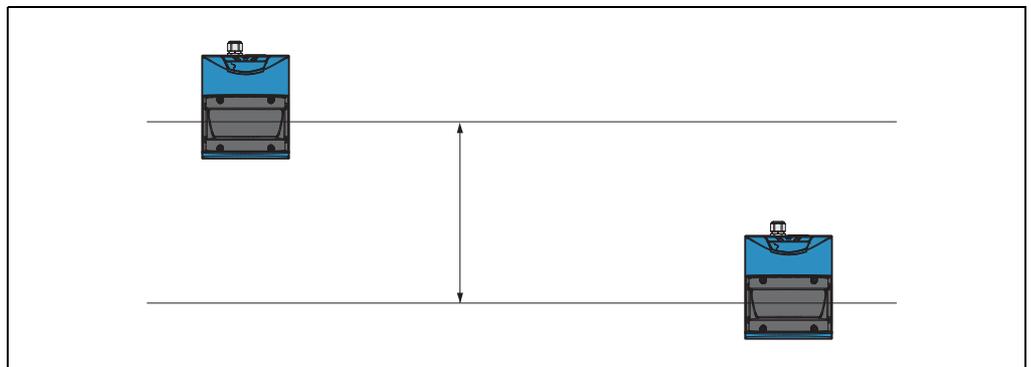
Fig. 36:   Placement of two LMS5xx with parallel offset
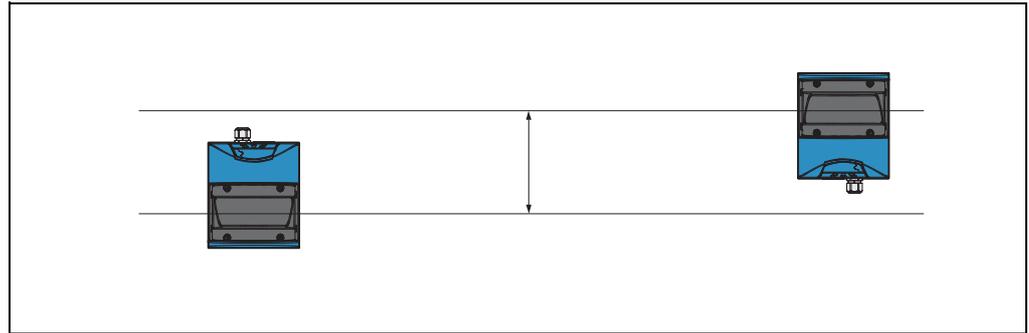
Fig. 37:   Placement of two LMS5xx with parallel offset, one of these upside down
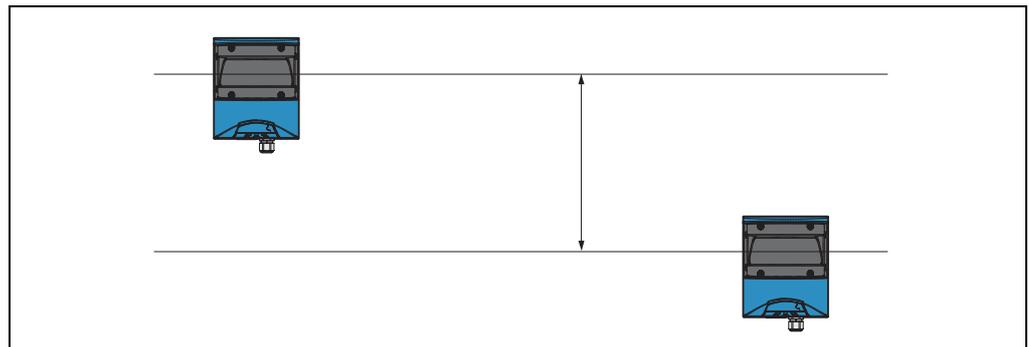
Fig. 38:   Placement of two LMS5xx upside down, parallel offset
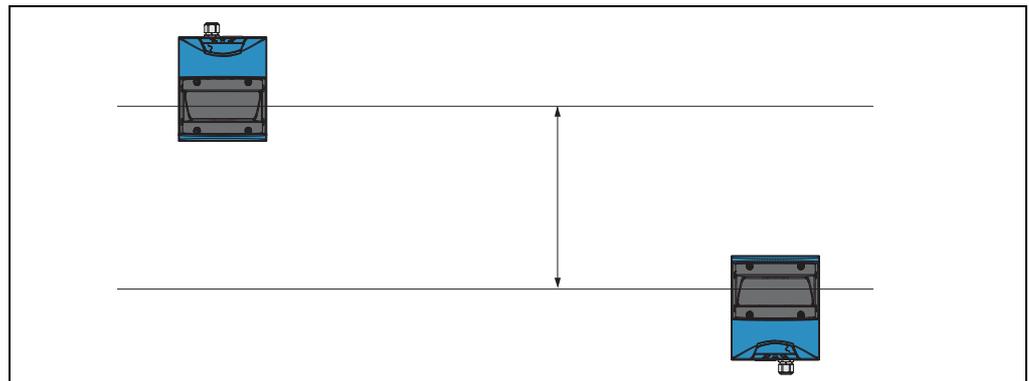
Fig. 39:   Placement of two LMS5xx with parallel offset, one of these upside down

5.3   Dismanteling the system

1. Switch off the supply voltage.

2. **LMS500:**
    Loosen and remove the system connector.
    LMS511/LMS531/LMS581:
    Remove all connection cables.

3. Undo the mounting screws for the LMS5xx to the mounting bracket and remove the device.

Important   On final decommissioning, please observe the disposal requirements in *section 8.3.1 "Disposal" on page 95* for environmentally correct disposal.

6 Electrical installation

NOTICE

Only authorized personnel are allowed to perform the electrical installation work.

➢ Do not open the housing of the device.
Only on LMS500 (indoor variant), remove temporarily the system connector on the back of device for connecting cable leads to the internal terminal blocks.
Exception: When replacing an LMS511 Heavy Duty Outdoor, this is also permitted, see *section 8.2.1 "Replacement of LMS500 Lite/PRO or LMS511 Heavy Duty using the former system connector (parameter cloning)" on page 92*.

➢ Observe the current safety regulations when working on electrical systems.

Switch the entire machine/system offline!

The machine/system could inadvertently start up while you are connecting the device.

➢ Ensure that the entire machine/system is disconnected during the electrical installation.

6.1 Overview of the installation steps

• Wire the switching inputs and outputs (application-dependent).

• Temporarily connect PC (configuration).

• Wire data interface for operation.

• Connect the supply voltage to the LMS5xx.

6.2 Conditions for safe operation of the LMS5xx in an installation

The LMS5xx is connected to the peripheral devices (power supply, encoder, PLC/host, if applicable other LMS5xx, etc.) by using shielded cables (*Fig. 40*). The shield of each cable is connected to the metal housing of the LMS5xx via the system connector.

The device can be grounded via the fixing brackets of the mounting sets or via the shield of e.g. the power supply cable.

If the peripheral devices have metal housings and if the cable shield also is connected to their housings, it is assumed that all devices involved in the installation have the **same ground potential**.

This is achieved for instance by fulfilling the following conditions:

• Mounting the devices on conductive metal surfaces

• Correctly grounding the devices/metal surfaces in the system

• A low-impedance and stable current carrying equipotential bonding between areas with different ground potentials, if necessary

If these conditions are not met, e.g. on devices in a widely distributed system over several buildings, potential equalization currents may, due to different ground potentials, flow along the cable shields between the devices.
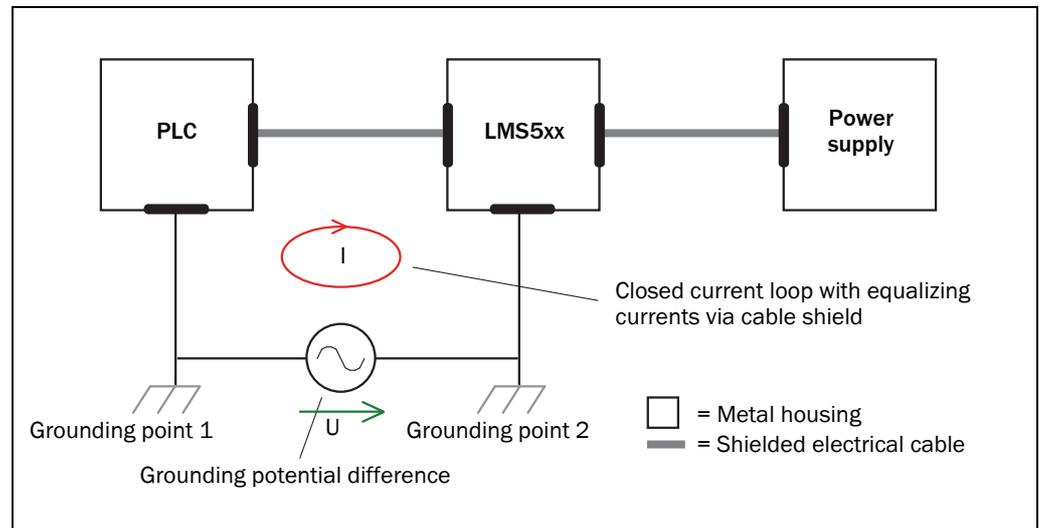

Fig. 40:   Currents in the cable shields due to differences in ground potential

Due to insufficient ground potential equalization, voltage differences arise between the grounding points 1 and 2. The current loop closes via the shielded cables and the housings.

⚠ DANGER

Risk of injury/risk of damage via electrical current!

Potential equalization currents between the LMS5xx and the peripheral devices can have the following effects:

- Dangerous voltages on the metal housing, e.g of the LMS5xx

- Incorrect function or irreparable damage to the devices

- Damage/irreparable damage of the cable shield due to heating and cable fires

➢ Where local conditions are unfavorable and thus do not meet conditions for a safe earthing method (same ground potential at all grounding points), take measures from the following explanations.

Remedial measures

The most common solution to prevent potential equalization currents on cable shields is to ensure low-impedance and stable current carrying equipotential bonding. If this is not possible the following two solution approaches serve as a suggestion.

Important   It is not advisable to open up the cable shields. This would mean that the EMC limit values can no longer be complied with and the safe operation of the device data interfaces can no longer be guaranteed.

a) Measures for widely distributed system installations

On widely distributed system installations with correspondingly large potential differences, we recommend setting up local islands and connecting them using commercially available electro-optical signal converters. This measure achieves a high degree of resistance to electromagnetic interference while at the same time complying with all the requirements of EN 60950-1.
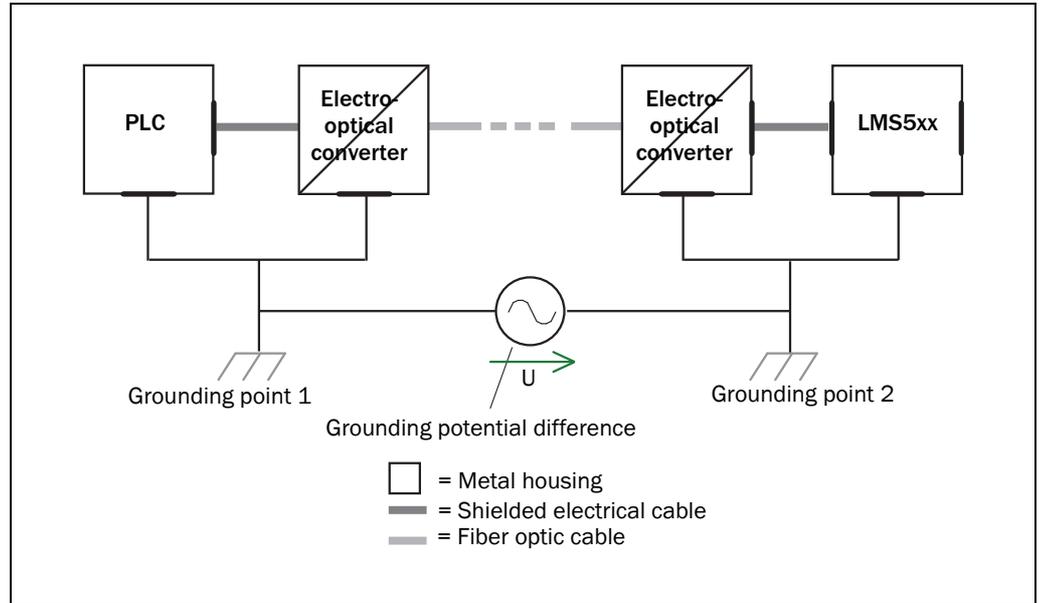
Fig. 41 shows the function of this measure.

Fig. 41:   Use of electro-optical signal converters

The ground loop is opened by using the electro-optical signal converters between the islands. Within the local islands, a stable equipotential bonding prevents equalizing currents from occurring at the cable shields.

b) Measures for small system installations

For smaller installations with small potential differences, the insulated installation of the LMS5xx and the peripheral devices can be a sufficient solution.

Fig. 42 shows the function of this measure.
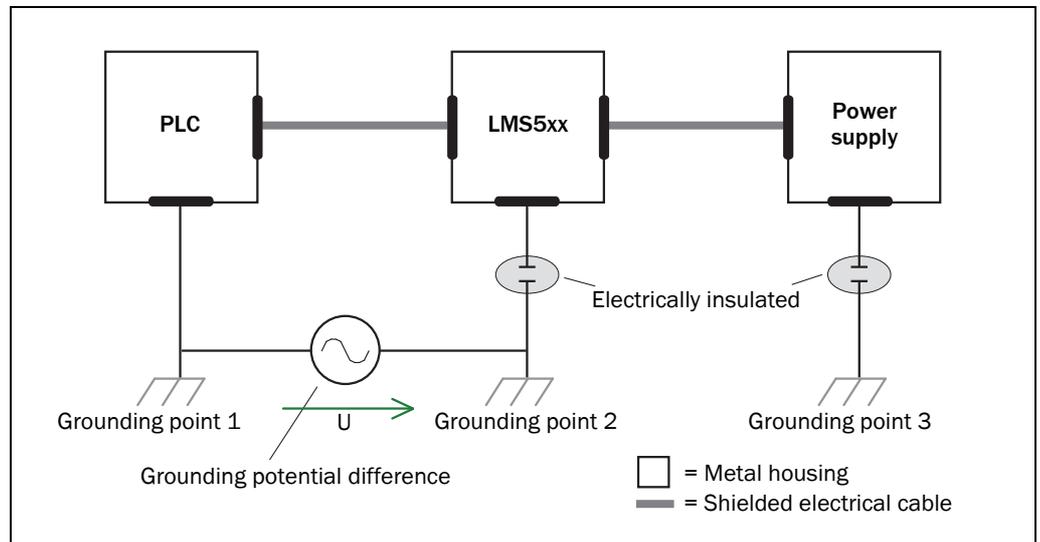
Fig. 42:   Insulated assembly of the LMS5xx and the peripheral devices (sample)

Ground loops are, even in the event of large differences in the ground potential, effectively prevented. This means that equalizing currents cannot occur anymore via the cable shield and the metal housing.

Important   The power supply of the LMS5xx and the connected peripheral devices must also guarantee the required level of insulation.

Under certain circumstances, a tangible potential can develop between the insulated metal housings and the local ground potential.

Swedisch

Varning och åtjärder

Utrustning som är kopplad till skyddsjord via jordat vägguttag och/eller via annan utrustning och samtidigt är kopplad till kabel-TV nät kan i vissa fall medfora risk for brand.

➢ For att undvika detta skall vid anslutning av utrustningen till kabel-TV nät galvanisk isolator finnas mellan utrustningen och kabel-TV nätet.

Norwegian

Advarsel og tiltaker

Utstyr som er koplet til beskyttelsesjord via nettplugg og/eller via annet jordtilkoplet utstyr – og er tilkoplet et kabel-TV nett, kan forårsake brannfare.

➢ For å unngå dette skal det ved tilkopling av utstyret til kabel-TV nettet installeres en galvanisk isolator mellom utstyret og kabel-TV nettet.

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6.3   Connections of the LMS5xx

Depending on the variant, the LMS5xx has different connections:

All variants:

USB:

- Mini USB connector on the front of the unit for connection to the USB interface on a PC. The USB interface is only used for configuration and is not allowed to be permanently connected.

➢ Before connecting the device to the PC install the required USB driver for using the USB interface. The USB driver can be downloaded from the online product page: **http://www.sick.com/en/lms5xx**

Ethernet:

- 4-pole round M12 plug-in connector for the connection to Ethernet.

Indoor variants:

LMS500 Lite/PRO

The LMS500 Lite/PRO Lite Indoor has a removable system connector. This has two M16 screw type cable entries on the top. The wires of the cables have to be connected to the both type-dependent screw type terminals in the system connector.

Outdoor variants:

LMS511 Lite/PRO

- The LMS511 Lite Outdoor has one 5-pole round M12 plug-in connector and two 8-pole round M12 plug-in connectors.

- The LMS511 PRO Outdoor has one 5-pole round M12 plug-in connector and two 12-pole round M12 plug-in connectors.

- The LMS511 Heavy Duty Outdoor has also a removable system connector, but only for the purpose of replacing a device. The connector has one 5-pole round M12 plug-in connector and two 12-pole round M12 plug-in connectors.

The connections are made to the related male connectors or female connectors of the cables.

LMS531 Lite/PRO Security

- The LMS531 Lite Security Outdoor has one 5-pole round M12 plug-in connector and two 8-pole round M12 plug-in connectors.

- The LMS531 PRO Security Outdoor has one 5-pole round M12 plug-in connector and two 12-pole round M12 plug-in connectors.

The connections are made to the related male connectors or female connectors of the cables.

LMS581 PRO

- The LMS581 PRO Outdoor has one 5-pole round M12 plug-in connector and two 12-pole round M12 plug-in connectors.

The connections are made to the related male connectors or female connectors of the cables.

6.3.1   Connections of the LMS500

LMS500 Lite and PRO Indoor: "Ethernet" connection on the system connector

Pin	Signal	Function
1	TX+	Transmitter+
2	Rx+	Receiver+
3	TX−	Transmitter−
4	Rx−	Receiver−

Tab. 21:   LMS500 Lite and PRO Indoor: Pin assignment of the "Ethernet" connection (4-pin M12 female connector, D-coded)

LMS500 Lite Indoor: "Power/Data/I/O" connection in the system connector

Terminal	Signal	Function
1	V_S	Power supply sensor
2	GND	Ground sensor
3	OUT1	Switching output 1
4	OUT2	Switching output 2
5	OUT3 / OUT Sync	Switching output 3 / Output Synchronization
6	IN1	Switching input 1
7	IN Sync	Input Synchronization
8	GND IN /IN Sync	Ground input 1 / Input Synchronization
9	V_S OUT	Power supply switching outputs
10	GND V_S OUT	Ground power supply switching outputs
11	TD+	Transmitter RS-422/RS-232
12	TD−/TxD	Transmitter RS-422/RS-232
13	GND RS	Ground RS-422/RS-232
14	RD−/RxD	Receiver RS-422/RS-232
15	RD+	Receiver RS-422/RS-232
16	Shield RS	Shield RS-422/RS-232

Tab. 22:   LMS500 Lite Indoor: Terminal assignment of the "Power/Data/I/O" connection (2 x terminal blocks, 8-pole)

LMS500 PRO Indoor: "Power/Data/I/O" connection in the system connector

Terminal	Signal	Function
1	V_S	Power supply sensor
2	GND	Ground sensor
3	OUT1	Switching output 1
4	OUT2	Switching output 2
5	OUT3	Switching output 3
6	IN1	Switching input 1
7	IN2	Switching input 2
8	GND IN1/2	Ground inputs 1 and 2
9	GND IN3/4/IN Sync	Ground inputs 3 and 4 / Input Synchronization
10	IN3	Switching input 3
11	IN4/IN Sync	Switching input 4 / Input Synchronization
12	OUT4	Switching output 4
13	OUT5	Switching output 5
14	V_S OUT	Power supply switching outputs
15	GND V_S OUT	Ground power supply switching outputs
16	TD+	Transmitter RS-422
17	TD−/TxD	Transmitter RS-422/RS-232
18	GND RS	Ground RS-422/RS-232
19	RD−/RxD	Receiver RS-422/RS-232
20	RD+	Receiver RS-422
21	Shield RS	Shield RS-422/RS-232
22	Shield CAN	Shield CAN bus
23	CAN H	CAN bus high
24	GND CAN	Ground CAN bus
25	CAN L	CAN bus low
26	OUT6/OUT Sync	Switching output 6 / Output Synchronization

Tab. 23:   LMS500 PRO Indoor: Terminal assignment of the "Power/Data/I/O" connection (2 x terminal blocks, 13-pole)

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6.3.2   Connections of the LMS511, LMS581 and LMS511 Heavy Duty

LMS511 Lite/PRO, LMS581 PRO, LMS511 Heavy Duty Outdoor: Power" connection

Pin	Signal	Function
1	V_S	Power supply sensor
2	V_S heat.	Power supply heating
3	GND	Ground sensor
4	Reserved	Do not use!
5	GND heat.	Ground heating

Tab. 24:   LMS511 Lite/PRO, LMS581 PRO und LMS511 Heavy Duty Outdoor: Pin assignment of the "Power" connection (5-pin M12 male connector, A-coded)

LMS511 Lite/PRO, LMS581 PRO und LMS511 Heavy Duty Outdoor: "Ethernet" connection

Pin	Signal	Function
1	TX+	Transmitter+
2	Rx+	Receiver+
3	TX−	Transmitter−
4	Rx−	Receiver−

Tab. 25:   LMS511 Lite/PRO, LMS581 PRO und LMS511 Heavy Duty Outdoor: Pin assignment of the "Ethernet" connection (4-pin M12 female connector, D-coded)

LMS511 Lite Outdoor: "Data" connection

Pin	Signal	Function
1	RD−/RxD	Receiver RS-422/RS-232
2	TD−/TxD	Transmitter RS-422/RS-232
3	RD+	Receiver RS-422
4	TD+	Transmitter RS-422
5	GND RS	Ground RS-422/RS-232
6	Reserved	Do not use!
7	IN Sync	Input Synchronization
8	GND IN Sync	Ground Synchronization

Tab. 26:   LMS511 Lite Outdoor: Pin assignment of the "Data" connection (8-pin M12 male connector, A-coded)

LMS511 Lite Outdoor: "I/O" connection

Pin	Signal	Function
1	IN1	Switching input 1
2	Reserved	Do not use!
3	GND IN1	Ground Switching input 1
4	OUT1	Switching output 1
5	OUT2	Switching output 2
6	OUT3 /OUT Sync	Switching output 3 / Output Synchronization
7	GND OUT 1 ...3	Ground Switching output 1 ... 3/ Synchronization
8	V_S OUT	Power supply switching outputs

Tab. 27:   LMS511 Lite Outdoor: Pin assignment of the "I/O" connection (8-pin M12 female connector, A-coded)

LMS511 PRO, LMS581 PRO and LMS511 Heavy Duty Outdoor: "Data" connection
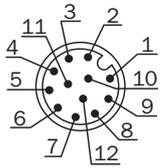
Pin	Signal	Function
1	V_S OUT	Power supply switching outputs 1 and 2
2	RD–/RxD	Receiver RS-422/RS-232
3	OUT1	Switching output 1
4	GND RS, CAN	GND RS-422/RS-232/CAN
5	OUT2	Switching output 2
6	Reserved	Do not use!
7	TD–/TxD	Transmitter RS-422/RS-232
8	Reserved	Do not use!
9	RD+	Receiver RS-422
10	TD+	Transmitter RS-422
11	CAN L	CAN bus low
12	CAN H	CAN bus high

Tab. 28:   LMS511 PRO, LMS581 PRO and LMS511 Heavy Duty Outdoor: Pin assignment of the "Data" connection (12-pin M12 male connector, A-coded)

LMS511 PRO, LMS581 PRO and LMS511 Heavy Duty Outdoor: "I/O" connection
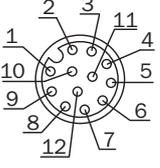
Pin	Signal	Function
1	V_S OUT	Power supply switching outputs 3 to 6
2	GND IN1/2	Ground inputs 1 and 2
3	IN1	Switching input 1
4	GND IN3/4/IN Sync	Ground inputs 3 and 4 / input Synchronization
5	IN2	Switching input 2
6	IN3	Switching input 3
7	GND OUT 3 … 6	Ground outputs 3 to 6
8	IN4/IN Sync	Switching input 4 / Input Synchronization
9	OUT3	Switching output 3
10	OUT4	Switching output 4
11	OUT5	Switching output 5
12	OUT6/OUT Sync	Switching output 6 / Output Synchronization

Tab. 29:   LMS511 PRO, LMS581 PRO and LMS511 Heavy Duty Outdoor: Pin assignment of the "I/O" connection (12-pin M12 female connector, A-coded)

6.3.3   Connections of the LMS531 Security Outdoor

LMS531 Lite und PRO Security Outdoor: "Power" connection

Pin	Signal	Function
1	V_S	Power supply sensor
2	V_S heat.	Power supply heating
3	GND	Ground sensor
4	Reserved	Do not use!
5	GND heat.	Ground heating

Tab. 30:   LMS531 Lite Security Outdoor: Pin assignment of the "Power" connection (5-pin M12 male connector, A-coded)

LMS531 Lite und PRO Security Outdoor: "Ethernet" connection

Pin	Signal	Function
1	TX+	Transmitter+
2	RX+	Receiver+
3	TX–	Transmitter–
4	RX–	Receiver–

Tab. 31:   LMS531 Lite Security Outdoor: Pin assignment of the "Ethernet" connection (4-pin M12 female connector, D-coded)

LMS531 Lite Security Outdoor: "Inputs" connection

Pin	Signal	Function
1	A/DA (IN1)	Armed/Disarmed (Switching input 1)
2	WT (IN2)	Walk Test (Switching input 2)
3	Reserved	Do not use!
4	Reserved	Do not use!
5	Reserved	Do not use!
6	Reserved	Do not use!
7	IN 3	Input 3 (Switching input 3)
8	GND IN	Ground all inputs

Tab. 32:   LMS531 Lite Security Outdoor: Pin assignment of the "Inputs" connection (8-pin M12 male connector, A-coded)

LMS531 Lite Security Outdoor: "Alarm" connection

Pin	Signal	Function
1	Alarm A	Alarm output (relay), contact A
2	Alarm B	Alarm output (relay), contact B
3	Alarm R A	Alarm output, resistor monitored, contact A
4	Alarm R B	Alarm output, resistor monitored, contact B
5	Error A	Error output (relay), contact A
6	Error B	Error output (relay), contact B
7	Sab	Sabotage output
8	GND Sab	Ground Sabotage output

Tab. 33:   LMS531 Lite Security Outdoor: Pin assignment of the "Alarm" connection (8-pin M12 female connector, A-coded)

LMS531 PRO Security Outdoor: Inputs" connection

Pin	Signal	Funktion
1	A/DA (IN1)	Armed/Disarmed (Switching input 1)
2	RD–/RxD	Receiver RS-422/RS-232
3	GND IN	Ground all inputs
4	GND RS/CAN	Ground RS-422/RS-232/CAN
5	D/N (IN3)	Day/Night (Switching input 3)
6	WT (IN2)	Walk Test (Switching input 2)
7	TD–/TxD	Transmitter RS-422/RS-232
8	TEACH (IN4)	EasyTeach (Switching input 4)
9	RD+	Receiver RS-422
10	TD+	Transmitter RS-422
11	CAN L	CAN bus low
12	CAN H	CAN bus high
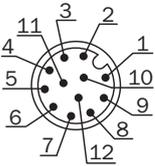
Tab. 34:   LMS531 PRO Security Outdoor: Pin assignment of the "Inputs" connection (12-pin M12 male connector, A-coded)

LMS531 PRO Security Outdoor: "Alarm" connection

Pin	Signal	Funktion
1	Alarm A	Alarm output (relay), contact A
2	Sab A	Sabotage output (relay), contact A
3	Alarm B	Alarm output (relay), contact B
4	Alarm R A	Alarm output, resistor monitored, contact A
5	Error A	Error output (relay), contact A
6	Alarm R B	Alarm output, resistor monitored, contact B
7	Disq. A	Disqualification output (relay), contact A
8	Error B	Error output (relay), contact B
9	Sab B	Sabotage output (relay), contact B
10	Disq. B	Disqualification output (relay), contact B
11	Sab R A	Sabotage output , resistor monitored, contact A
12	Sab R B	Sabotage output , resistor monitored, contact B
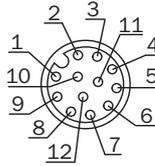
Tab. 35:   LMS531 PRO Security Outdoor: Pin assignment of the "Alarm" connection (12-pin M12 female connector, A-coded)

6.4 Preparing the electrical installation

6.4.1 SELV Supply voltage

For commissioning and operating the LMS5xx, the following are required:

- LMS5xx: SELV Supply voltage 19.2 to 28.8 V DC as per IEC 60364-4-41

The LMS5xx draws the following power:

- LMS5xx: power consumption without output load: typical 22 W, maximum 25 W

- LMS5xx: power consumption with output load: typical 46 W, maximum 50 W

- LMS511/LMS531/LMS581: additional power consumption of heating: typical 55 W, maximum 65 W

Power supply unit

⚠ WARNING

Risk of electrical shock!

The output circuit of the power supply must be safely electrically isolated from the input circuit. This feature is normally provided by a safety transformer in accordance with IEC 742 (VDE 0551).

➢ Only use a safety transformer to generate the power supply voltage.

6.4.2 Wire cross-sections

➢ Wire all connections with copper cables!

➢ Use the following wire cross-sections:

Connection of	Cross-section
Supply voltage	At least 0.25 mm^2 (approx. 24 AWG), if local power supply in the immediate vicinity
	At least 1.0 mm^2 (approx. 18 AWG) at maximum length of 20 m, if the connection is made to an existing 24 V DC supply
Switching outputs	Minimum 0.25 mm^2 (approx. 24 AWG), maximum cable length 50 m with 0.5 mm^2 (approx. 22 AWG)
Data interfaces	Minimum 0.25mm^2 (approx. 24 AWG)

Tab. 36: Required wire cross-sections

- For the LMS500 the outside diameter of the common cable must be a maximum of 9 mm due to the cable entry.

➢ All communication cables must be twisted and shielded.

6.4.3 Length of the spare cable on the system connector

Recommendation Perform a suitable length of the spare cable for the incomming cables on the system connector. The spare cable enables you to change the LMS5xx with ease if necessary.

The length of the spare cable should be such that the system connector cannot inadvertently be plugged into a neighboring LMS5xx! In this way you avoid the inadvertent connection of the system connector to a neighboring LMS5xx and operation of an LMS5xx with an incorrect configuration. From experience 200 to 300 mm spare cable at the LMS5xx have proven to be adequat.

Screw terminal strips of the LMS500 Lite/PRO Indoor

Cable type	Minimum cross section	Maximum cross section
Flexible wires (finely stranded conductor)	0.14 mm² (AWG 26)	1 mm² (AWG 18)
Rigid wires (one conductor)	0.14 mm² (AWG 26)	1.5 mm² (AWG 16)
Flexible wires (finely stranded conductor) with ferrule	0.25 mm² (AWG 24)	0.5 mm² (AWG 22)

Tab. 37:   Cross section specification of the LMS500 terminal strips

Important   If you use flexible connecting cables with stranded wire to connect to the terminals on the LMS5xx you **must not** use any ferrules.

6.4.4   General conditions for the data interfaces

The table below shows the recommended maximum length of cable as a function of the data transmission rate selected.

Interface type	Transmission rate	Maximum cable length
RS-232	115.2 kBd	2 m
	38.4 ... 57.6 kBd	3 m
	Max. 19.2 kBd	10 m
RS-422	Max. 115.2 kBd	500 m
	Max. 38.4 kBd	1,200 m

Tab. 38:   Maximum cable lengths for the data interfaces

Important   • Use screened cable (twisted-pair) with at least 0.25 mm² (approx. 24 AWG).

• To prevent interference, do not lay data cable in parallel with power supply and motor cables over a long run, e.g. in cable ducts.

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6.5   Perform electrical installation on the LMS5xx

⚠ CAUTION

Risk of tripping due to cables! Risk of damage to the cables!

Exposed cables on the floor in areas used by people can cause danger.

➢ Lay all cables such that there is no risk of tripping and all cables are protected against damage.

6.5.1   Equipment

• Ttool set

• Digital multimeter (current/voltage measurement)

6.5.2   Connection on the USB auxiliary interface and the Ethernet interface of the LMS5xx

Pre-assembled cables are available to configure the LMS5xx via the USB auxiliary interface and via the Ethernet interface.
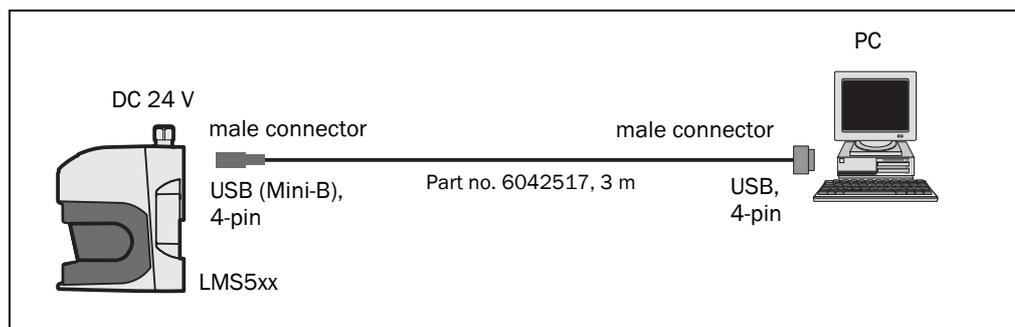
Fig. 43:   LMS5xx: USB connection at the auxiliary interface
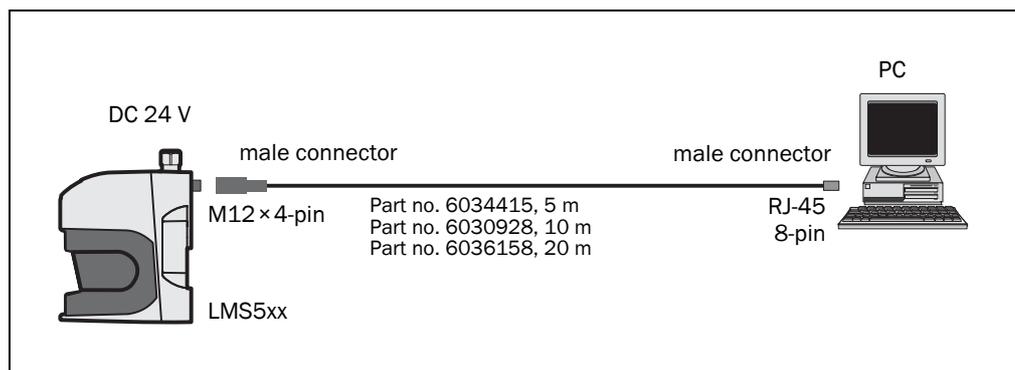
Fig. 44:   LMS5xx: Ethernet connection using the Ethernet cable

6.5.3   LMS500: Wiring the system connector

NOTICE

Reduced enclosure rating IP!

If the system connector is removed, the LMS500 is no longer compliant with the enclosure rating IP 65.

➢ To prevent damage due to the entry of moisture and dirt, only open the system connector in dry, clean surroundings.

➢ If necessary, pre-wire and fit the system connector in suitable surroundings.

Prerequisites on the device for enclosure rating IP 65

- The system connector is plugged on the device, its two screws are tightended.

- The cables in the cable entries have a suitable outside diameter and are fixed by the lock nuts. If a cable entry is not used, it must be fitted with a blind plug that is fixed by the lock nut (as in the delivery condition).

- The cable plugged into the M12 round plug-in connection (Ethernet) is screwed tight. If the conncetion is not used, it must be fitted with a protective plug that is screwed tight (as in the delivery condition).

- The black, round cover of the USB auxiliary interface ("USB" connection) on the front is screwed tight.

1. Ensure the power supply to which the LMS500 is connected is switched off.

2. Remove the system connector on the backside of the device. For this purpose undo the two fixing screws (*Fig. 10.3.1 on page 107*) and pull the system connector carefully off the device upwards.

3. The M16 cable entry (metal) has an earth connection to the device. If a screened connection cable is used, as necessary connect the screen braid on the cable to the cable entry. For this purpose, shorten the screen braid as appropriate before assembling the cable entry and fit over the plastic insert for the cable entry.

4. Undo the fitting for the M16 cable entry.

5. Pull the cable for supply voltage and switching outputs with maximum outside diameter $\varnothing$ 10 mm through the plastic insert for the M16 cable entry.

6. Connect electrically isolated wires to the both terminal blocks.

7. If necessary, connect screen braid on the cable to the cable entry.

8. Fit M16 cable entry fitting and tighten.

9. Carefully re-fit the system connector to the LMS500.

10. Tighten the fixing screws for the system connector.

6.5.4   LMS511/LMS531/LMS581: Connecting the round M12 plug-in connectors

NOTICE

Prerequisites on the device for enclosure rating IP 67

- The system connector is plugged on the device, its two screws are tightended.

- The device is only connected on the M12 plug-in connectors provided for this purpose.

- Only use round plug-in connectors that are compliant with enclosure rating IP 67.

- The cables plugged into the M12 round plug-in connections must be screwed tight. Any electrical connections that are not being used must be fitted with protective caps or plugs that are screwed tight (as in the delivery condition).

- The black, round cover of the USB auxiliary interface ("USB" connection) on the front is screwed tight.

Pre-assembled cables are available as accessories for the connection to the round M12 plug-in connectors. These comprise the round plug-in connector and 5 m, 10 m or 20 m of cable with flying leads.

Connection of the voltage supply on the LMS511/LMS531/LMS581

Pre-assembled cables with flying leads are available for the supply to the LMS511/LMS531/LMS581.
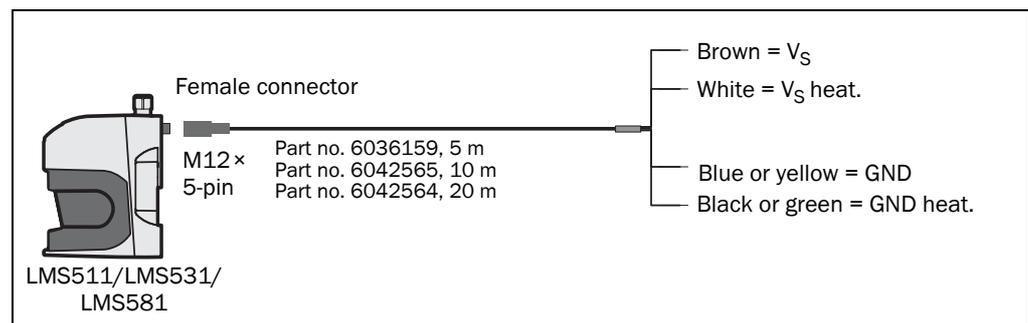
Fig. 45:   LMS511/LMS531/LMS581: connection of the voltage supply

On the connection cables part no. 6036159, part no. 6042565 and part no. 6042564 the wires for GND and GND heating are either blue and black or yellow and green.

The connection cables require the following minimum voltages at the open cable end:

- Part no. 6036159, 5 m: 19.2 V

- Part no. 6042565, 10 m: 19.7 V

- Part no. 6042564, 20 m: 21.4 V

LMS511 Lite: "Data" connection
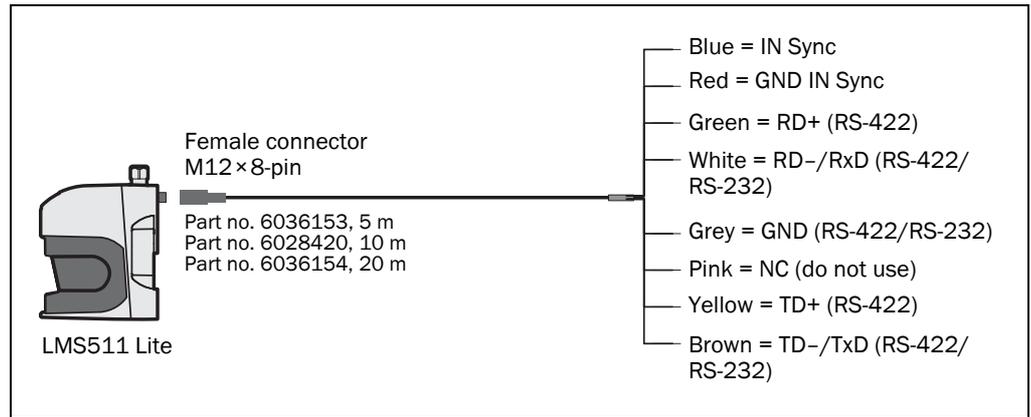
Fig. 46:   LMS511 Lite: "Data" connection

LMS511 Lite: "I/O" connection
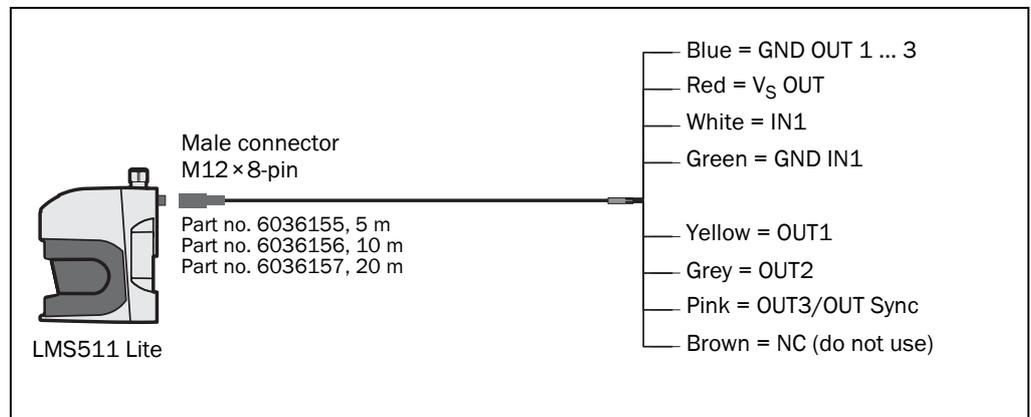
Fig. 47:   LMS511 Lite: "I/O" connection

LMS511 PRO/LMS581 PRO Security/LMS511 Heavy Duty: "Data" connection
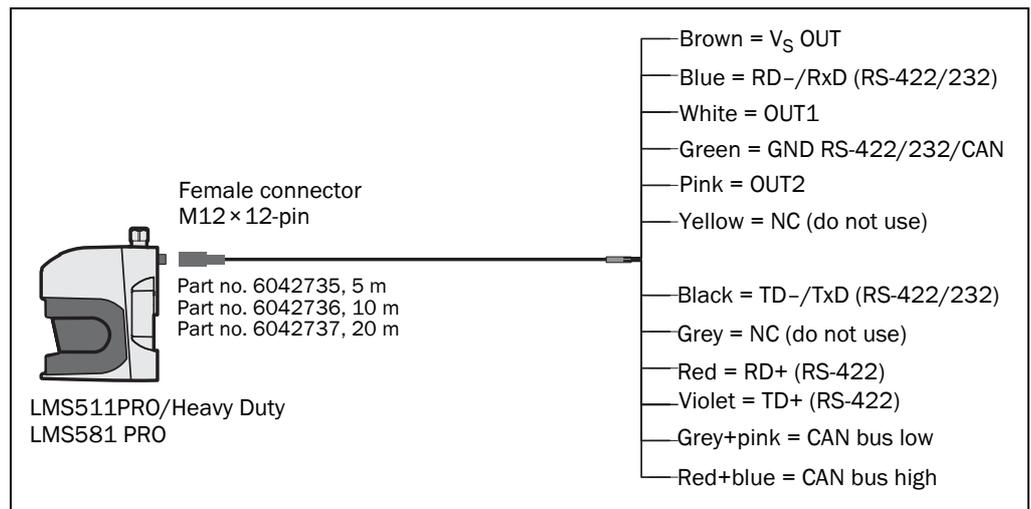
Fig. 48:   LMS511 PRO/LMS581 PRO Security/LMS511 Heavy Duty: "Data" connection

LMS511 PRO/LMS581 PRO Security/LMS511 Heavy Duty: "I/O" connection
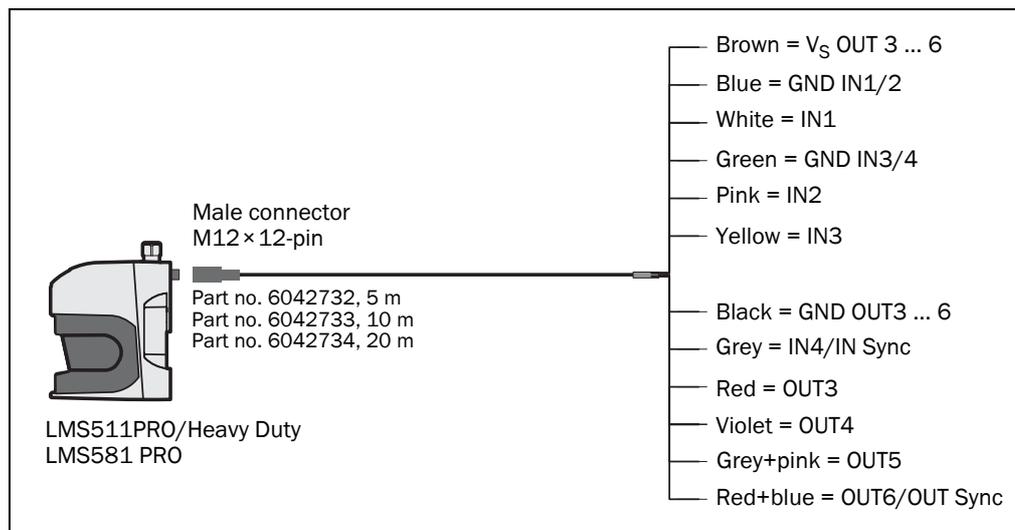
Fig. 49:   LMS511 PRO/LMS581 PRO Security/LMS511 Heavy Duty: "I/O" connection

LMS531 Lite Security: "Inputs" connection
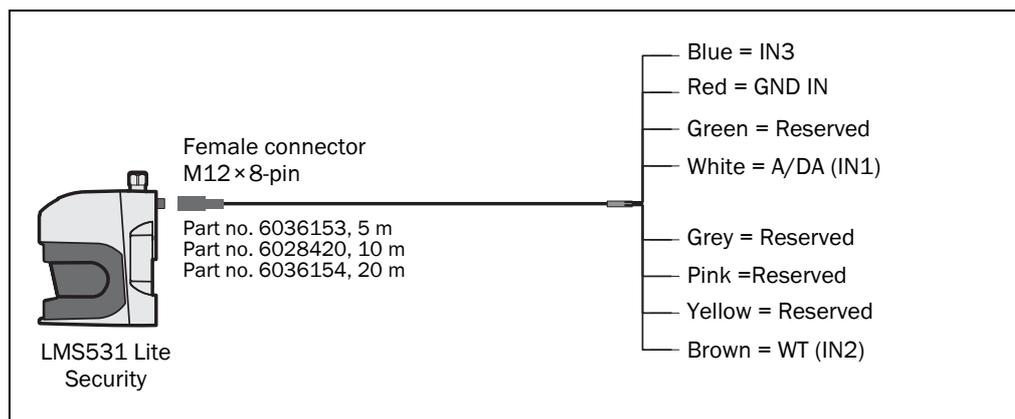
Fig. 50:   LMS531 Lite Security: "Inputs" connection

LMS531 Lite Security: "Alarm" connection
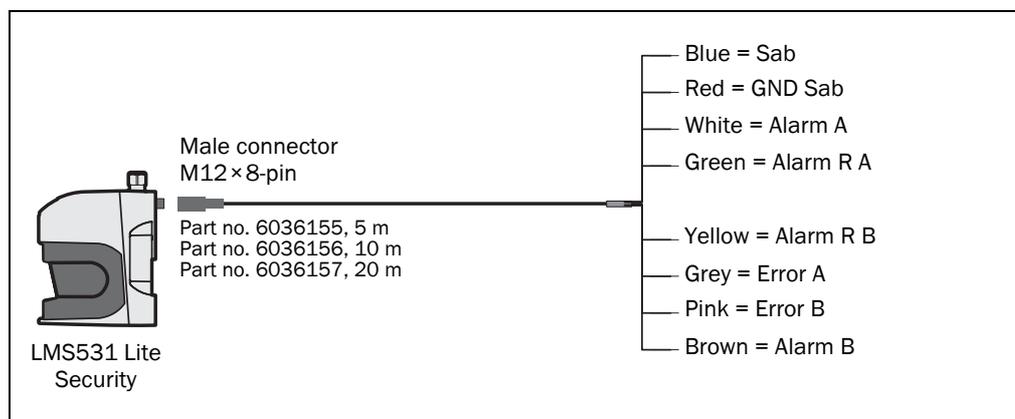
Fig. 51:   LMS531 Lite Security: "Alarm" connection

LMS531 PRO Security: "Inputs" connection

Dose
M12 × 12-polig

Part no. 6042735, 5 m
Part no. 6042736, 10 m
Part no. 6042737, 20 m

LMS531 PRO
Security

Brown = A/DA (IN1)

Blue = RD−/RxD (RS-422/232)

White = GND IN

Green = GND RS-422/232/CAN

Pink = D/N (IN3)

Yellow = WT (IN2)

Black = TD−/TxD (RS-422/232)

Grey = TEACH (IN4)

Red = RD+ (RS-422)

Violet = TD+ (RS-422)

Grey+pink = CAN-Bus low

Red+blue = CAN-Bus high

Fig. 52:   LMS531 PRO Security: "Inputs" connection

LMS531 PRO Security: "Alarm" connection

Stecker
M12 × 12-polig

Part no. 6042732, 5 m
Part no. 6042733, 10 m
Part no. 6042734, 20 m

LMS531 PRO
Security

Brown = Alarm A

Blue = Sab A

White = Alarm B

Green = Alarm R A

Pink = Error A

Yellow = Alarm R B

Black = Disq. A

Grey = Error B

Red = Sab A

Violet = Disq. B

Grey +pink = Sab R A

Red+blue = Sab R B

Fig. 53:   LMS531 PRO Security: "Alarm" connection"

6.5.5   Wiring of inputs and outputs on the LMS5xx

Connecting digital inputs as non-floating
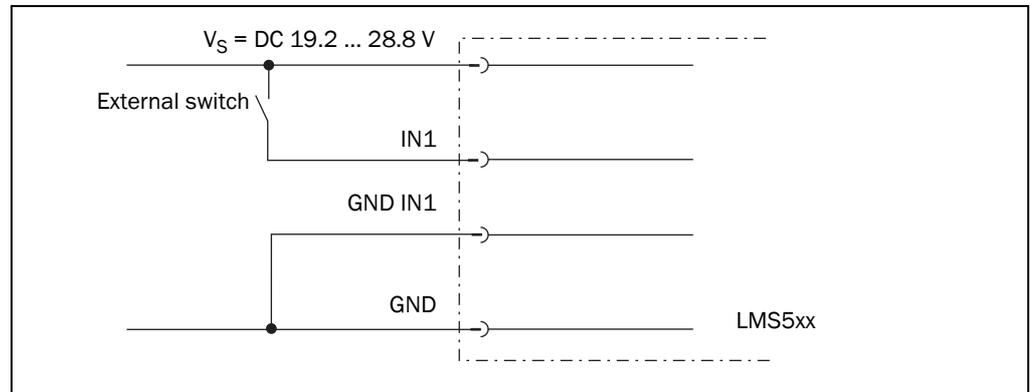
Fig. 54:   Connecting digital inputs as non-floating

Connecting digital inputs as floating
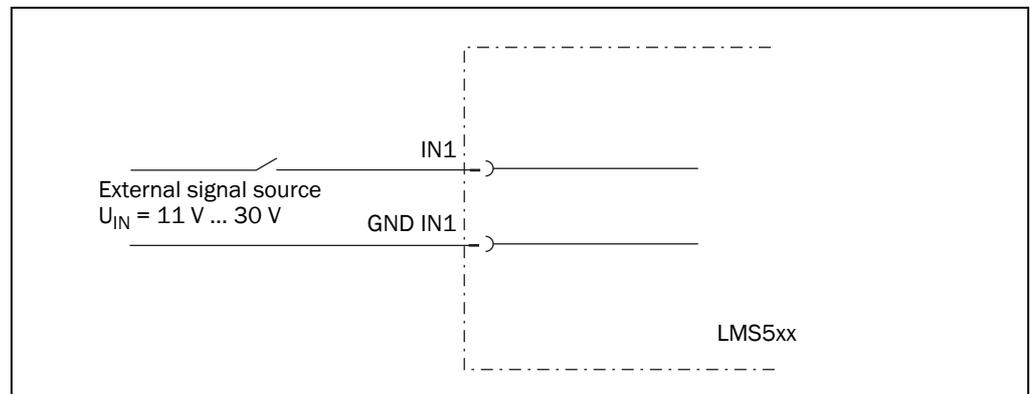
Fig. 55:   Connecting digital inputs as floating

Important   The inputs require a switching voltage of at least 11 V. For this reason the supply voltage must be at least 11 V.

Wiring encoder inputs (LMS5xx PRO/Heavy Duty only)
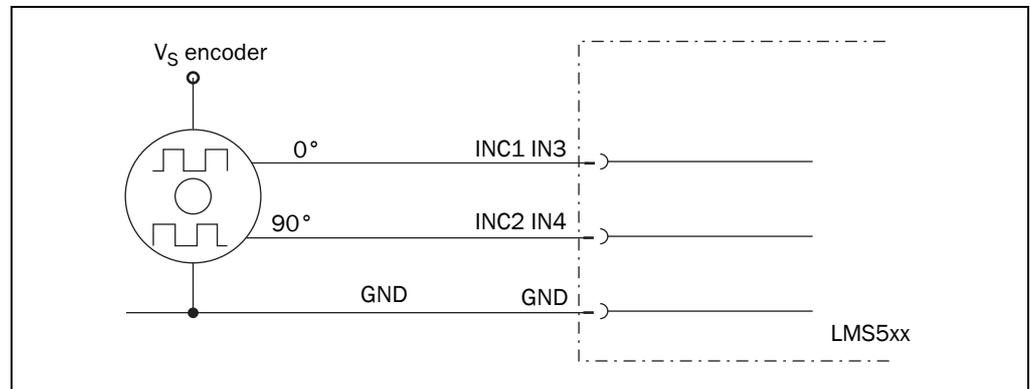
Fig. 56:   Wiring encoder inputs

Input circuit IN1 to IN4
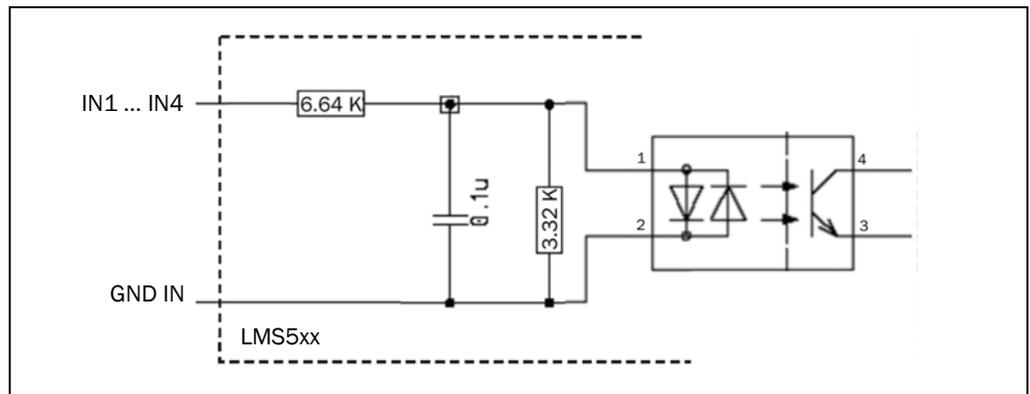
Fig. 57:   Input circuit IN1 to IN4

Connection of the outputs of the LMS5xx to a PLC
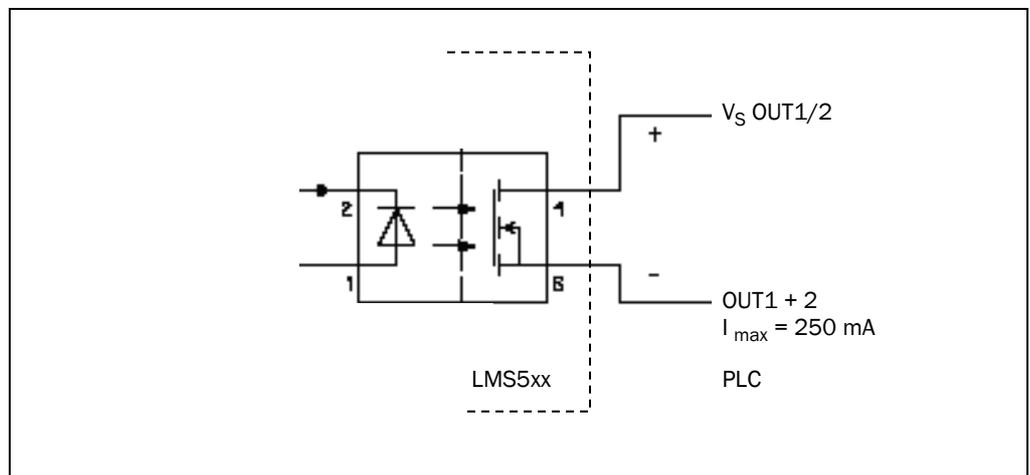
Fig. 58:   Connection of the outputs 1 or 2 to a PLC (active low)
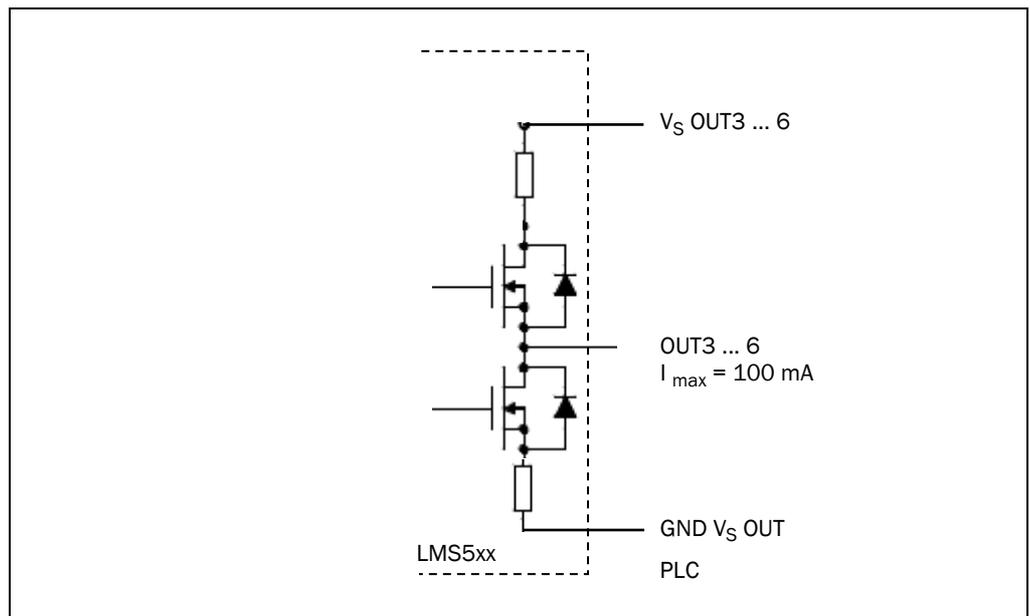
Fig. 59:   Connection of the outputs 3 … 6 to a PLC (active high)

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Connection of the outputs of the LMS531 Security to an alarm system
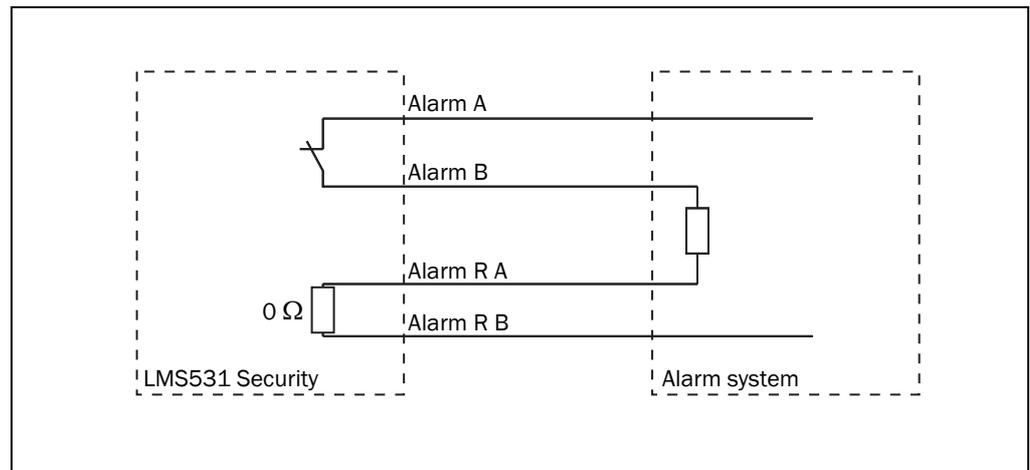
Fig. 60:   Resistance-monitored connection of the outputs of the LMS531 Security to an alarm system

Wiring of the RS-232 or RS-422 interface

A shielded cable is required for the wiring of the RS-232 or the RS-422 interface.

➢ Pay attention to the max. cable length as per *section 6.4.4 "General conditions for the data interfaces" on page 75*.
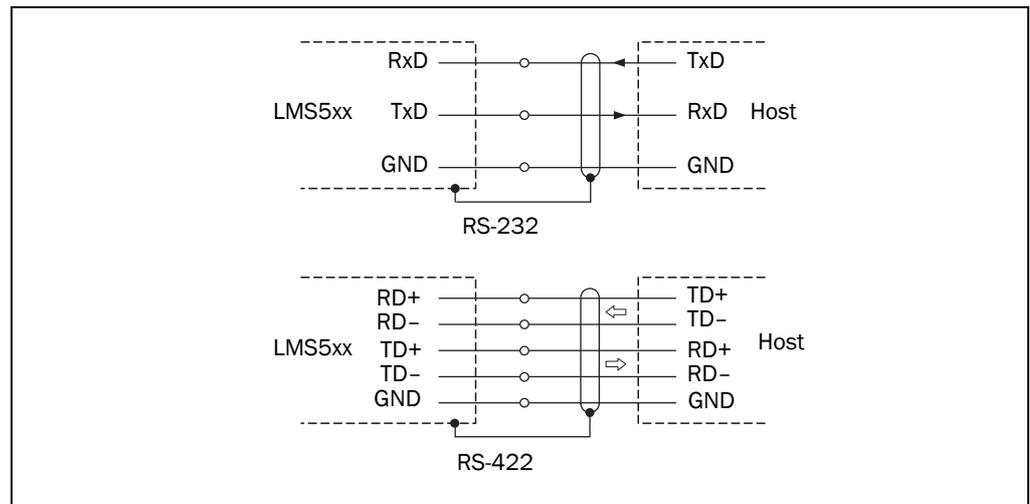
Fig. 61:   Wiring of the RS-232 or RS-422 interface

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7 Commissioning and configuration

⚠️ | **WARNING**
:---:

Danger due to incorrect commissioning and configuration!

Commissioning requires a thorough check by qualified personnel!

Before you operate a system equipped with the LMS5xx for the first time, make sure that the system is first checked and approved by qualified personnel. On this issue, observe the notes in *chapter 2 "For your safety" on page 9*.

Commissioning, configuration and diagnostics are carried out using the SOPAS ET configuration software supplied.

7.1 Overview of the commissioning steps

- Install SOPAS ET configuration software.

- Establish communication with the LMS5xx.

- Create a customer specific parameter set using SOPAS ET, save in non-volatile memory in the LMS5xx and on the PC.

- Test the LMS5xx for correct function.

7.2 SOPAS ET configuration software

The interactive configuration is carried out using SOPAS ET. Using this configuration software, you can configure and test the measurement properties, the analysis behaviour and the output properties of the system as required. The configuration data can be saved as a parameter set (project file) on the PC and archived.

Help for the program user interface as well as for the different options can be found in SOPAS ET:

- menu HELP, HELP F1: comprehensive online help for the program interface and the different options

- HELP window (on the bottom left in the program user interface): context sensitive help for the visible dialog

- tool tips: Move the mouse pointer over an input field. A short text ("tool tip") with information about valid entries appears.

Primary functions are:

- selection of the menu language (German/English)

- establishment of the communication with the LMS5xx

- password-protected configuration with different operating levels

- system diagnostics

7.2.1 System requirements for SOPAS ET

The configuration software SOPAS ET, the current system prerequisites for the PC, and the instructions for downloading the software and the device description file(s) can be found online at:

- **http://www.mysick.com/en/SOPAS_ET**

7.2.2   Download and installation of SOPAS ET

1. Start PC.

2. Download and install the latest version of the SOPAS ET configuration software, as well as current device description file (*.sdd) for the LMS5xx variant, from the online product page for the software by following the instructions provided there.

3. In this case, select the "Complete" option as suggested by the install wizard. Administrator rights may be required on the PC to install the software

4. Start the "SOPAS ET" program option after completing the installation. Path: Start > Programs > SICK > SOPAS ET Engineering Tool > SOPAS.

5. Establish a connection between SOPAS ET and LMS5xx via the wizard which opens automatically. To do so, under the devices available depending on the connected communication interface, e.g. Ethernet, select the LMS5xx. (Default Ethernet address: IP address: 192.168.0.1, Subnet mask: 255.255.255.0).
   SOPAS ET establishes communication with the LMS5xx and loads the associated device description file for the LMS1xx.

7.2.3   SOPAS ET default setting

Parameter	Value
Language for the user interface	English (the software must be re-started after a change)
Units of length	Metric
User group (operating level)	Machine operator
Download of the parameters to the LMS5xx	Immediate on change, temporary in the LMS5xx RAM
Upload of the parameters from the LMS5xx	After switching online, automatic
Window layout	3 (project tree, help, working area)

Tab. 39:   SOPAS ET default setting

7.3   Establish communication with the LMS5xx

Important   For communication via Ethernet TCP-IP, the TCP-IP protocol must be active on the PC.

On the connection of PC/host, following this sequence:

1. Connect the PC to the LMS5xx using a data cable.

2. Switch on the PC.

3. Switch on the supply voltage for the LMS5xx.
   The LMS5xx performs a self-test and initializes itself.

7.3.1   Connect the data interfaces

➢ Connect the LMS5xx to the PC using the following data interface:

- USB (see *Fig. 43 on page 76*) or

- Ethernet (see *Fig. 44 on page 76*) or

- RS-232/RS-422 (see *Fig. 46 on page 79*)

7.3.2   Starting SOPAS ET and opening the scan assistant

1.   Start SOPAS ET.
     By default SOPAS ET opens the program window with the English user interface.

2.   To change the language setting, in the start dialog box click CANCEL and using the menu
     TOOLS, OPTIONS change the language for the user interface to GERMAN/DEUTSCH.

3.   If the language setting has been modified, quit SOPAS ET and re-start.

4.   In the dialog box, choose the option CREATE NEW PROJECT and confirm with OK.

5.   In the main window in SCAN ASSISTANT click the CONFIGURATION button.
     The SCAN ASSISTANT dialog box appears.

7.3.3   Configuring the Ethernet connection

Important   Deactivate all programs on your PC/notebook that access Ethernet or TCP/IP.

1.   In the SCAN ASSISTANT dialog, under INTERNET PROTOCOL, IP COMMUNICATION, select the
     ACTIVATE IP COMMUNICATION checkbox and the USE AUTOIP checkbox.

2.   Confirm the settings in the SCAN ASSISTANT dialog box with OK.
     The SCAN ASSISTANT dialog box is closed.

3.   In addition, the parameter set has to be saved as a project file (*.spr file with configu-
     ration data) on the PC to be used as a base for replacing a faulty LMS5xx if required.

7.3.4   Configuring the serial connection

1.   In the SCAN ASSISTANT dialog box, under SERIAL CONNECTION, STANDARD PROTOCOL, activate
     the ACTIVATE SERIAL COMMUNICATION checkbox.

2.   Click the ADVANCED... button.

3.   Choose following PORT SETTINGS: 8 data bits, no parity, 1 stop bit.

4.   Confirm the settings with OK.
     The ADVANCED SCAN SETTINGS dialog box is closed.

5.   Confirm the settings in the SCAN ASSISTANT dialog box with OK.
     The SCAN ASSISTANT dialog box is closed.

7.3.5   Performing scan

1.   In the SCAN ASSISTANT dialog box, click on the START SCAN button.

2.   Choose devices listed and accept using ADD DEVICE.
     A scan is performed for devices connected via the connection. SOPAS ET adds the
     devices found to the project tree and uploads the actual parameter set from the device.

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7.4 Initial commissioning

The LMS5xx is adapted to the local measurement or detecting situation using SOPAS ET. For this purpose a custom parameter set of the parameter values is created using SOPAS ET. The parameter set can either be loaded initially from the device (upload, initial commissioning: factory settings). Or it can be prepared independently, based on the factory settings or as modification of an existing parameter set of the same device type and firmware version.

The parameter set is then loaded into the LMS5xx (download). This action is performed either immediately (SOPAS ET option IMMEDIATE DOWNLOAD) or manually (SOPAS ET command DOWNLOAD ALL PARAMETERS TO THE DEVICE).

Important   Once the configuration has been completed, the changed parameter set must be saved in the non-volatile memory in the LMS5xx. Due to a saving concept, it is recommeded to save the parameter set also as a project file (*.spr file with configuration data) on the PC.
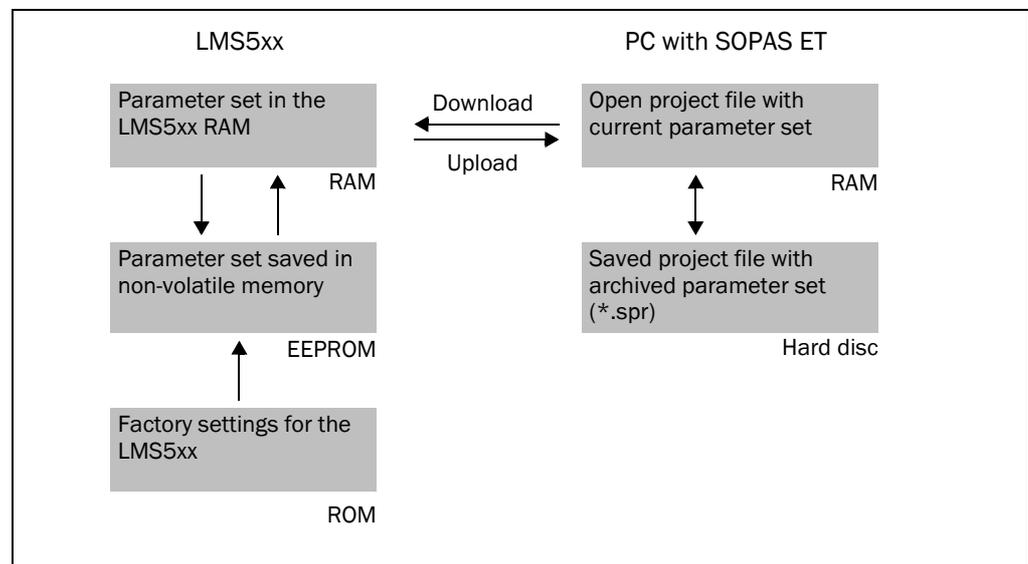
Fig. 62:   Principle of data storage

7.4.1 Configuring the LMS5xx

You can configure the LMS5xx in two ways:

- Interactively using SOPAS ET
  This section describes the interactive configuration.

- Using configuration telegrams
  On this subject please read *section 3.13 "Data communication using telegrams" on page 48*.

Interactive configuration using SOPAS ET

All parameters that can be configured for the LMS5xx are combined into a corresponding device description (sdd file) for SOPAS ET. You can open this file using the device description project tree.

The function of each parameter is explained in a context-sensitive online help ([F1] key). The valid range of values and the default are listed in the PARAMETER INFO window (right mouse button when the pointer is positioned over the parameter).

| Important | Software access to the LMS5xx is password protected. Following completion of the configuration, you should change the password so that it can perform its protective function. |

User level	Password
Maintenance personnel	main
Authorised client	client

Tab. 40:   LMS5xx passwords

A password is not defined for the Operator user level as supplied.

Use the project tree in SOPAS ET to configure the parameters necessary for your application.

NOTICE

Loss of configuration data in the connected LMS5xx

➢   Do not switch off the voltage supply while configuring the LMS5xx. Otherwise all parameters not yet saved permanently will be lost.

---

1.   From the OPTIONS menu select the LOGIN DEVICE command and log in to the system using the password "client" as AUTHORISED CLIENT.

2.   Configure the LMS5xx for the required application with the aid of the parameters in SOPAS ET.

Help for the program user interface as well as for the different options can be found in SOPAS ET.

Resetting the configuration

| Recommendation | To reset the LMS5xx to the default delivery status, please use the "Factory Default" option in the SOPAS software. |

7.5 Connection and test measurement

Use the graphic scan view in SOPAS ET to verify the generated measured values and to verify the measurement area online.

1. In the project tree, choose LMS…, Monitor, Scan View.

2. In order to start the measurement, click on Play.

3. Compare the measurement line with the desired result.

Important
- The Scan View in the Monitor is dependent on the available computing power of the PC and is **not** output in real-time. For this reason not all measured values are displayed. The same limitation also applies when saving measured values displayed in a file.
- The monitor displays the measured values **unfiltered**, i.e. the action of filters can **not** be checked with the aid of the monitor.

4. After completing the test measurement successfully, save the configuration permanently to the LMS5xx: menu LMS…, Parameter, Save permanent.

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8   Maintenance

NOTICE

Claims under the warranty rendered void!

The housing of the LMS5xx is sealed. Type-dependent, the devices have a diffent quantity of sealing stickers across their components (LMS500 Lite/PRO, LMS511 Lite/PRO, LMS531 Lite/PRO, LMS581 PRO: two stickers, LMS511 Heavy Duty: three stickers). Claims under the warranty against SICK AG will be rendered void if the screwed housing is opened and/or the seals are damaged. The housing is only allowed to be opened by SICK authorized service personnel.

The only exception in this case is the process of replacing an LMS500 Lite/Pro Indoor or LMS511 Heavy Duty Outdoor with an appropriate replacement device. Here, the system connector is transferred from the existing device to the replacement device for automatic configuration purposes. See *section 8.2 "Exchanging an LMS5xx" on page 91*.

8.1   Maintenance during operation

8.1.1   Cleaning the front screen

The LMS5xx laser measurement sensor is largely maintenance-free. The front screen on the LMS5xx should however be regularly cleaned and also if contaminated.

➢ Do not use aggressive detergents.

➢ Do not use abrasive cleaning agents.

Important   Static charges cause dust particles to be attracted to the front screen.

You reduce this effect by using the antistatic plastic cleaner (SICK part no. 5600006) and the SICK lens cloth (part no. 4003353). See *section 11.1 "Ordering information" on page 115*.

How to clean the front screen:

1. Use a clean and soft brush to remove dust from the front screen.

2. Wipe the front screen with a clean and damp cloth (antistatic plastic cleaner).

8.2   Exchanging an LMS5xx

Incorrect or damaged LMS5xx have to removed and reclaped with either new or repaired LMS5xx of the **same type.**

Important   Do not make any repairs to the device!
The LMS5xx does not contain any repairable components. For this reason do not open the components of the LMS5xx.

The following parts can be replaced by the user:

- Sensor with all components as complete replacement device unit

- Only possible with LMS500 PRO/Lite (Indoor) and LMS511 Heavy Duty (Outdoor): Sensor as replacement device using the former system connector (with cloning parameter memory).

As all external cable connections end in the system connector or in the round plug-in connectors, it is not necessary to re-install the device electrically on a device replacement. The replacement unit can then be simply connected. If the LMS5xx is to be replaced, proceed type-dependently as follows.

NOTICE

Switch the entire machine/system offline!

The machine/system could inadvertently start up while you are connecting the device.

➢ Ensure that the entire machine/system is disconnected during the exchange procedure.

8.2.1 Replacement of LMS500 Lite/PRO or LMS511 Heavy Duty using the former system connector (parameter cloning)
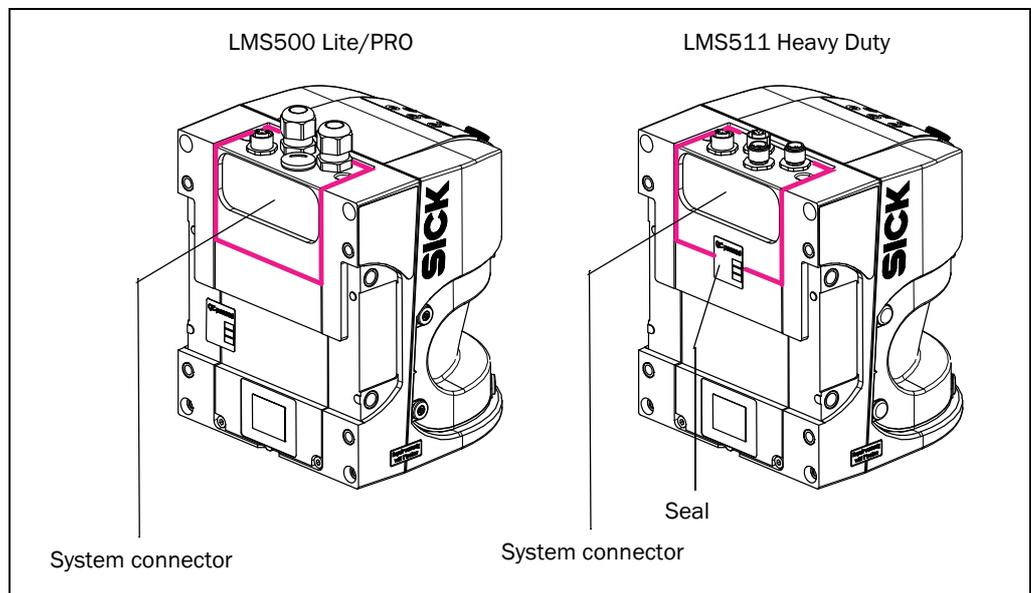
Fig. 63: Disassemble the system connector

NOTICE

Risk of damage due to environmental influences!

If the system connctor is removed from the device, the device and the electrical contacts are unprotected and the enclosure rating no longer corresponds IP 65/67.

➢ Replace sensors with removable system connectors (dismantling and fitting) only in dry, clean and dust-free surroundings. If necessary, place the sensor for this purpose from the outdoor area in a suitable indoor area.

➢ To prevent damage to the sensors, firmly attach the existing system connector to the replacement device immediately after replacement.

➢ Additionally, immediately attach the remaining, non-wired connector for the replacement device firmly to the removed (and potentially defective) sensor.

➢ Make sure that the inlay sealing, the supporting surface opposite, and all the electrical contacts of the system connector are free from dirt and moisture.

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1. Switch off the voltage supply for the LMS5xx.

2. Remove the sensor from the holder.
   If necessary, mark the sensor's situation and alignment on the holder or environment.

3. Optional: If the device is equipped with a protection hood/weather protection hood, remove the hood from the LMS5xx.

4. **LMS511 Heavy Duty:**
   Break the seal named "Remove for cloning" of the system connector on the backside of the device.

5. Loosen the system connector incl. all wired cables/fixed cables on the sensor (two screws) and remove the connector.

6. Remove also the unused system connector from the correspondent replacement device.

7. Immediately plug on and fix the former system connector incl. cables on the backside of the replacement device.

8. Optional: Re-install the protection hood/weather protection hood to the replacement device.

9. Mount the replacement device to the holder (see *chapter 5 "Mounting" on page 53*) and check the correct orientation of the device.

10. Configure automatically the replacement device. See *chapter 8.2.3 "Parameter cloning function of LMS500 PRO/Lite and LMS511 Heavy Duty" on page 94*.

Important   In the case of a complete device replacement, including the system connector (LMS500: rewiring!), the replacement device must be configured manually. This is carried out using the parameter set from the former device, which is saved on your PC due to the saving concept (see *chapter 7 "Commissioning and configuration" on page 85*).

8.2.2 Complete replacement of LMS511 PRO/Lite, LMS531 PRO/Lite Security or LMS581 PRO (without using the former system connector)

1. Switch off the voltage supply for the LMS5xx.

2. Loosen and remove all round plug-in connectors from the device.

3. Remove the sensor from the holder.
   If necessary, mark the sensor's situation and alignment on the holder or environment.

4. Optional: If the device is equipped with a protection hood/weather protection hood, remove the hood from the LMS5xx.

5. Optional: Re-install the protection hood/weather protection hood to the replacement device.

6. Mount the replacement device to the holder (see *chapter 5 "Mounting" on page 53*) and check the correct orientation of the device.

7. Reconnect all connection cables to the replacement device and fix them.

8. Configure the replacement device manually by using the parameter set of the former device saved on the PC due to the saving concept (see *chapter 7 "Commissioning and configuration" on page 85*).

8.2.3 Parameter cloning function of LMS500 PRO/Lite and LMS511 Heavy Duty

Important The parameter cloning function can only be used between devices of the same type (e.g., LMS500 PRO with LMS500 PRO)!

Functionality

When the supply voltage is switched on, the LMS5xx starts up and organizes its current parameter values as follows:

- Initial commissioning of a brand-new LMS5xx:
  The sensor starts with the default setting, set at the factory. The cloning parameter memory of the system connector contains the default setting.

- Each time the functional configuration of the LMS5xx is changed:
  The sensor saves the parameter values permanently in its internal, non-volatile parameter memory. Additionally, it always saves a permanent copy of the parameter set in the cloning parameter memory of the system connector. (This is initiated using SOPAS ET and the "Save permanent" function.)
  The parameter set remains saved in the system connector even if the power supply is interrupted.

- The next time it is started up, the sensor transfers the parameter set from the cloning parameter memory to its RAM.

See also *section 7.4 "Initial commissioning" on page 88*.

If an LMS5xx is replaced, after start-up the replacement device checks whether there is a plausible parameter set in the system connector. If so, the sensor loads this parameter set to its RAM ("cloning connector gains" strategy).
As the existing system connector continues to be in use, the **LMS500 PRO/Lite** and the **LMS511 Heavy Duty** therefore make it possible for the last parameter values used in the system connector to be passed on to a replacement device of the same type automatically (cloning).

Cloning involves the replacement device accepting all the adjustable parameters, including the IP address. Accordingly, the process overwrites all the existing parameter values in the device. The exceptions in this case are the following parameters, which are always device-specific: serial number, MAC address, operating hours counter, and error memory.

Important Testing the device for application suitability by means of acceptance after device replacement
If the replacement device is going on to be used unchanged, with the existing system connector and the parameter values saved in it for the application, acceptance by a qualified person is not required. However, a test based on the regulations for daily testing, or a functional test, must be carried out.

If the replacement device is going on to be used with a system connector that is different from the previous one, the existing configuration must be transferred to the sensor using SOPAS. In this case, acceptance by a qualified person may be required (depending on the system; e.g., Security).

8.2.4   Returns

➢ Only return devices after consultation with the SICK Support.

Important   To enable efficient processing and allow us to determine the cause quickly, please include the following when making a return:

•   Details of a contact person

•   A description of the application

•   Adescription of the fault that occurred

8.3   Decommissioning

8.3.1   Disposal

The design of the LMS5xx allows for its separation as recyclable secondary raw materials and hazardous waste (electronic scrap).

Important   **Danger to the environment due to improper disposal of the LMS5xx:**

Disposing of LMS5xx improperly may cause damage to the environment.

➢ Always observe the valid national regulations on environmental protection.

➢ Following correct disassembly, pass on any commercially viable disassembled components for recycling. Separate materials as far as possible by type.

SICK AG is not currently able to take back devices that can no longer be used.

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9 Troubleshooting

> ## NOTICE
>
> **Claims under the warranty rendered void!**
>
> The housing of the LMS5xx is sealed. Type-dependent, the devices have a diffent quanitity of sealing stickers across their components. Claims under the warranty against SICK AG will be rendered void if the screwed housing is opened and/or the seals are damaged.
> The housing is only allowed to be opened by SICK authorized service personnel.
>
> The only exception in this case is the process of replacing an LMS500 Lite/Pro Indoor or LMS511 Heavy Duty Outdoor with an appropriate replacement device. Here, the system connector is transferred from the existing device to the replacement device. See *section 8.2 "Exchanging an LMS5xx" on page 91*.

This chapter describes how to identify and rectify errors and malfunctions of the LMS5xx.

9.1 In the event of faults or errors

> ## ⚠ WARNING
>
> **Danger due to malfunction!**
>
> Cease operation if the cause of the malfunction has not been clearly identified!
>
> ➢ Stop the machine/system if you cannot clearly identify or allocate the error and if you cannot safely rectify the malfunction.

9.2 Error displays of the indicator lights

Display	Possible cause	Rectification of the error
(OK) and (STOP) off	No operating voltage, or voltage too low	➢ Check the voltage supply and activate, if necessary.
(☐) illuminated	Front screen lightly contaminated (warning)	➢ Clean the front screen.
(☐) flashes with 1 Hz	Front screen heavily contaminated (error)	➢ Clean the front screen.
(☐) illuminated	System error	➢ Pay attention to the error display of the 7-segment display or carry out a diagnostics with the aid of SOPAS ET. ➢ Switch the device off and back on again.

Tab. 41: Error displays of the LEDs

9.3 Indications of the 7-segment display

Display	Possible cause	Rectification of the error
L h r, L h r, ...	No error	Device in measurement mode
⊡	IDLE mode, the outputs are in the OFF state, the laser is switched off.	No error. If the criteria for the IDLE mode are withdrawn, readiness for operation is re-established.
-⊡-	Motor starts	No error.
E.	LMS5xx faulty	➢ Send the LMS5xx to the manufacturer for repair.
0.	Slave sync lost	➢ Reestablish slave connection.
1	Temperature too low (indoor variant only)	➢ The ambient temperature is too low for measurement operation.
3	Heater not connected or temperature too low (outdoor variant only)	➢ Wait for device heating. ➢ Check the connection of the heater. ➢ Send the LMS5xx to the manufacturer for repair.

Tab. 42:   Indications of the 7-segment display

9.4 Detailed error analysis

The LMS5xx outputs occurring errors in various ways. Errors are output in stages and always permit detailed analysis:

- Communication errors can occur on the transfer of telegrams to the LMS5xx. The LMS5xx then returns an error code.

9.4.1 Field evaluation monitor

Using the field evaluation monitor, you can analyse whether and how evaluation fields are infringed and how the outputs on the LMS5xx behave.

PROJECT TREE, LMS..., MONITOR, FIELD EVALUATION MONITOR.

9.4.2 Field evaluation logging

Using the field evaluation logging you can log, save and subsequently play back the operation of LMS5xx. It is used for diagnostics over extended periods and for the analysis of malfunctions or for the optimisation of processes.

PROJECT TREE, LMS..., MONITOR, FIELD EVALUATION LOGGING.

9.5   SICK Support

If an error cannot be eliminated, it is possible that the LMS5xx is defective.

The LMS5xx cannot be repaired by the user, meaning that it is not possible to re-establish functions after a failure. Interrupting or modifying the LMS5xx will invalidate any warranty claims against SICK AG.

However, the LMS5xx can be rapidly replaced by the user, see *section 8.2 "Exchanging an LMS5xx" on page 91*.

➢   If an error occurs which cannot be eliminated, please contact SICK Support. Please refer to the back page of these operating instructions for your agent's contact details.

Important   Before calling, make a note of all type label data such as type code, serial number, etc. to ensure faster processing.

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10   Technical specifications

10.1   Data sheet LMS5xx laser measurement sensor

	Minimum	Typical	Maximum
Functional data			
Scan angle			190°
Scanning frequency			
Lite	25 Hz		75 Hz
PRO/Heavy Duty	25 Hz		100 Hz
Remission	2%		Several 1,000% [1] (reflectors)
Angular resolution			
Lite	0.25°		1°
PRO/Heavy Duty	0.1667°		1°
Measurement accuracy [2]			
Standard Resolution		±24 mm	
High Resolution		±12 mm	
Measurement error 1st reflected pulse [3]			
Systematic error (at 10% object remission[4])			
Standard Resolution 1 to 10 m		±25 mm	
Standard Resolution 10 to 20 m		±35 mm	
Standard Resolution 20 to 30 m		±50 mm	
High Resolution 1 to 10 m		±25 mm	
High Resolution 10 to 20 m		±35 mm	
Statistical error (1σ) (at 10% object remission[4])			
Standard Resolution 1 to 10 m		±6 mm	
Standard Resolution 10 to 20 m		±8 mm	
Standard Resolution 20 to 30 m		±14 mm	
High Resolution 1 to 10 m		±7 mm	
High Resolution 10 to 20 m		±9 mm	
Immunity to external light		70 klx	
Distance from mirror axis of rotation (zero point on the x and y axis) to the rear of the device	93 mm		
Distance between centre of the scan plane and the bottom edge of the housing	63 mm		
Distance measuring range	0.7 m		80 m
Distance measuring range at 10% object remission			
LMS500-2x000 Lite/PRO, LMS511-2x100 Lite/ PRO/Heavy Duty, LMS581-20100 PRO	0.7 m		26 m
LMS511-1x100 Lite/PRO/Heavy Duty, LMS531-11100 Lite/PRO, LMS581-10100 PRO	1 m		40 m
Power-up delay		30 s	60 s

Tab. 43:   Data sheet LMS5xx

	Minimum	Typical	Maximum

General data

Laser class	Laser class 1 according to IEC 60825-1 (2007-3) (complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, June 2007)		
Enclosure rating	As per EN 60529 (1991-10); A1 (2002-02)		
LMS500	IP 65		
LMS511/LMS531/LMS581	IP 67		
EMC test	As per EN 61000-6-2 (2005-08), EN 61000-6-3 (2007-01)		
Electrical safety	As per EN 60950-1 (2006-04) and EN 60950-1/A-11 (2009-03)		
Ambient operating temperature range			
LMS500	0 °C		+50 °C
LMS511/LMS531/LMS581	–30 °C		+50 °C
LMS511 Heavy Duty	–40 °C		+60 °C
Storage temperature range	–40 °C		+70 °C max. 24 h
Humidity (taking into account the ambient operating temperature range)	DIN EN 60068-2-61, method 1		
Vibration resistance	As per EN 60068-2-6 (2008-10)		
Frequency range	10 Hz		150 Hz
Amplitude	5 g RMS		
Shock resistance	As per EN 60068-2-27 (2009-05), EN 60068-2-29 (1995-03)		
Single shock	15 g, 11 ms		
Continuous shock	10 g, 16 ms		
Sender	Pulsed laser diode		
Wave length	895 nm	905 nm	915 nm
Divergence of the collimated beam (solid angle)			
High Resolution		4.7 mrad	
Standard Resolution		11.9 mrad	
Light spot size at the front screen		13.6 mm	
Light spot size at 18 m scanning range			
High Resolution		99 mm	
Standard Resolution		228 mm	
Housing			
Material	GD-ALSI12 3.2582.05		
Color LMS500	RAL 5012 (blue)		
Color LMS511/LMS531/LMS581	RAL 7032 (grey)		
Alloy	Excellent weather resistance as per DIN EN 106:1988, plate 3		
Front screen			
Material	Polycarbonate		
Surface finish	Outside with scratch-resistant coating		

Tab. 43:   Data sheet LMS5xx (cont.)

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	Minimum	Typical	Maximum
System connector			
Material	GD-ALSI12 3.2582.05		
Color	RAL 9005 (black)		
Cable entries (LMS511/LMS531/LMS581)			
Material	Stainless steel/plastic		
Dimensions [5]			
Height			185 mm
Width			155 mm
Depth			160 mm
Total weight (without connection cables)		3.7 kg	

Electrical data

	Minimum	Typical	Maximum
SELV Supply voltage LMS5xx at the sensor accord. to IEC 60364-4-41	19.2 V	24 V	28.8 V
Permissible residual ripple			±5 %
SELV Supply voltage for the LMS511/LMS531/ LMS581 heating accord. to IEC 60364-4-41	19.2 V	24 V	28.8 V
Switch on current			2 A[6]
Operating current at DC 24 V		0.9 A	
Operating current with max. output load at DC 24 V		1.9 A	
Operating current with maximum heating performance at DC 24 V		3.2 A	3.8 A
Power consumption without output load at DC 24 V		22 W	25 W
Power consumption with maximum output load at DC 24 V		46 W	50 W
LMS511/LMS531/LMS581: additional power consumption of heating at DC 24 V		55 W	65 W
Electrical connection LMS511/LMS531/LMS581	4 x round M12 plug-in connectors 1x round M8 plug-in connector		
Electrical connection LMS500	1 x System connector with 2 x screw terminal blocks 1x round M8 plug-in connector		
Technical specifications, screw terminals			
Cross-section of rigid cores (American Wire Gauge — AWG)	0.14 mm² (approx. 26 AWG)		1.5 mm² (approx. 16 AWG)
Cross-section of flexible cores (American Wire Gauge — AWG)	0.14 mm² (approx. 26 AWG)		1.0 mm² (approx. 18 AWG)
Insulation stripping length for the cores		5 mm	
Screw tightening torque	0.22 Nm		0.3 Nm
Cable length for device power supply at DC 24 V			
With 1 mm² wire cross-section (approx. 18 AWG)			220 m
With 0.5 mm² wire cross-section (approx. 22 AWG)			110 m
With 0.25 mm² wire cross-section (approx. 24 AWG)			50 m

Tab. 43:   Data sheet LMS5xx (cont.)

	Minimum	Typical	Maximum
Cable length for heating at DC 24 V			
With 1 mm² wire cross-section (approx. 18 AWG)			45 m
With 0.5 mm² wire cross-section (approx. 22 AWG)			20 m
With 0.25 mm² wire cross-section (approx. 24 AWG)			10 m
Cable length for device power supply at DC 12 V			
With 1 mm² wire cross-section (approx. 18 AWG)			20 m
With 0.5 mm² wire cross-section (approx. 22 AWG)			10 m
With 0.25 mm² wire cross-section (approx. 24 AWG)			5 m
Switching inputs			
Number	LMS500 Lite: 2 LMS500 PRO: 4 LMS511 Lite: 2 LMS511 PRO: 4 LMS511 Heavy Duty: 4 LMS531 Lite: 2 LMS531 PRO: 4 LMS581 PRO: 4		
Input voltage	11 V		30 V
Input resistance on HIGH		2 kΩ	
Voltage for HIGH	11 V	24 V	30 V
Voltage for LOW		0 V	5 V
Input capacity		15 nF	
Static input current	6 mA		15 mA
Encoder inputs (LMS5xx PRO/Heavy Duty only)			
Number	2 (IN3 and IN4)		
Input resistance on HIGH		2 kΩ	
Voltage for HIGH	11 V	24 V	30 V
Voltage for LOW	–3 V	0 V	5 V
Input capacity		1 nF	
Static input current	6 mA		15 mA
Duty cycle (Ti/T)		0.5	
Input frequency			100 kHz
Current load per incremental encoder		50 mA	100 mA
Velocity range that can be sampled			
Forward	From +100 mm/s to +20,000 mm/s		
Backward	From –10 mm/s to –20,000 mm/s		

Tab. 43:   Data sheet LMS5xx (cont.)

	Minimum	Typical	Maximum
Incremental encoders that can be evaluated			
Type	Two-channel rotary encoder with 90° phase offset		
Enclosure rating	IP 54		
Supply voltage	U_V – 3 V		U_V
Outputs required on the incremental encoders	Push/pull		
Pulse frequency			100 kHz
Number of pulses per cm	50		
Cable length (shielded)			10 m
Digital switching outputs			
Number	LMS5xx Lite: 3 LMS5xx PRO: 6 LMS511 Heavy Duty: 6		
Voltage drop load		2 V	
Maximum switching current			140 mA
Current limiting (after 5 ms at 25 °C)	100 mA		200 mA
Power-up delay	Negligible		
Switch off time		0.8 ms	2 ms
Maximum current output 1 + 2 [7]			250 mA
Maximum current output 3 ... 6			100 mA
Auxiliary interface			
Communication protocol	USB 2.0		
Data transmission rate (reduced)			500 kBd
Serial host interface			
Communication protocol	RS-232 (proprietary)/RS-422		
Data transmission rate (selectable)	9.6 kBd	57.6 kBd	500 kBd
Cable length at 38.4 kBd and wire cross-section 0.25 mm² (approx. 24 AWG)			15 m
Galvanic de-coupling	Yes		
Wire cross-section of the connection cable			0.25 mm² (approx. 24 AWG)
Ethernet	10/100 Mbit/s		
CAN (LMS500 PRO/LMS511 Heavy Duty only)	20 kBit/s, 500 kBit/s, 1 MBit/s		

Tab. 43:   Data sheet LMS5xx (cont.)

1)   Corresponds to Diamond Grade 3000X™ (approx. 1,250 cd/lx × m²).
2)   Measured under SICK standard environment (LMS2xx equivalent):
     SR: temperature = 23 °C, object remission = 10% at 20 m distance
     HR: temperature = 23 °C, object remission = 100% at 6 m distance
3)   The time after the first reflected pulse from which measurement can be performed with full accuracy is dependent on the target that reflected the first reflected pulse.
4)   Environmental conditions: good visibility, temperature range = 0 °C to 50 °C, object remission = 10 to 20.000%, ambient light < 70 klux.
5)   Without fixing screws and projection of cable glands with system connector mounted.
6)   6 A for t < 50 µs.
7)   Outputs are short-circuit protected (no overload protection).

10.2   Operating range diagrams
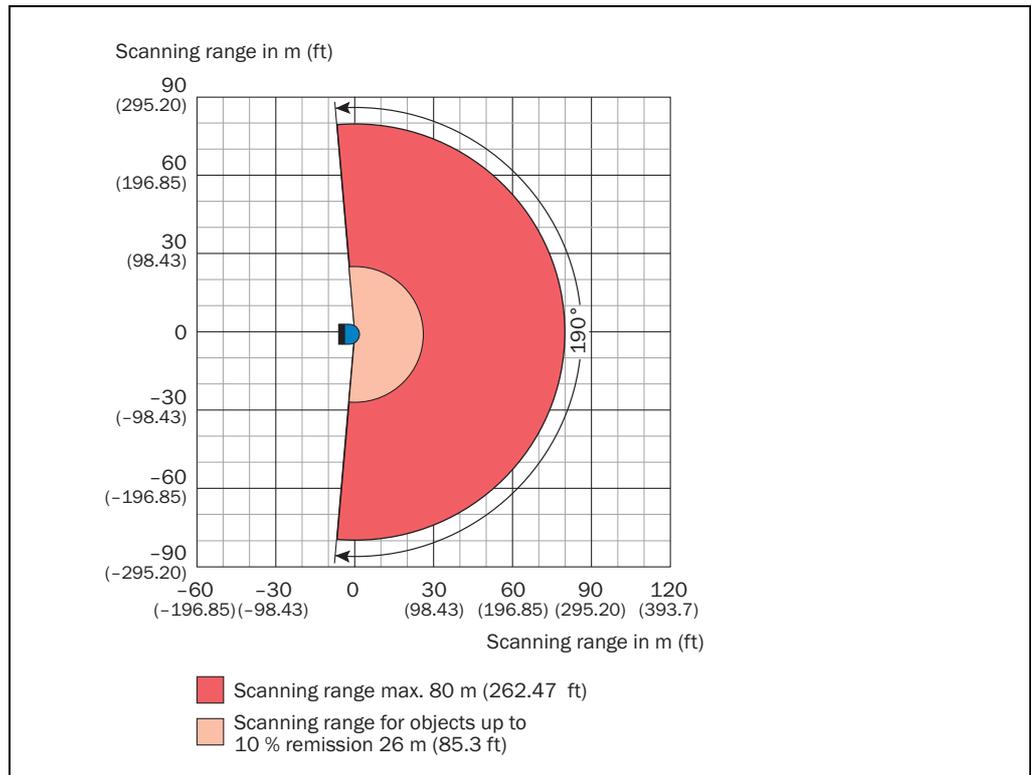
Fig. 64:   Operating range LMS5xx High Resolution
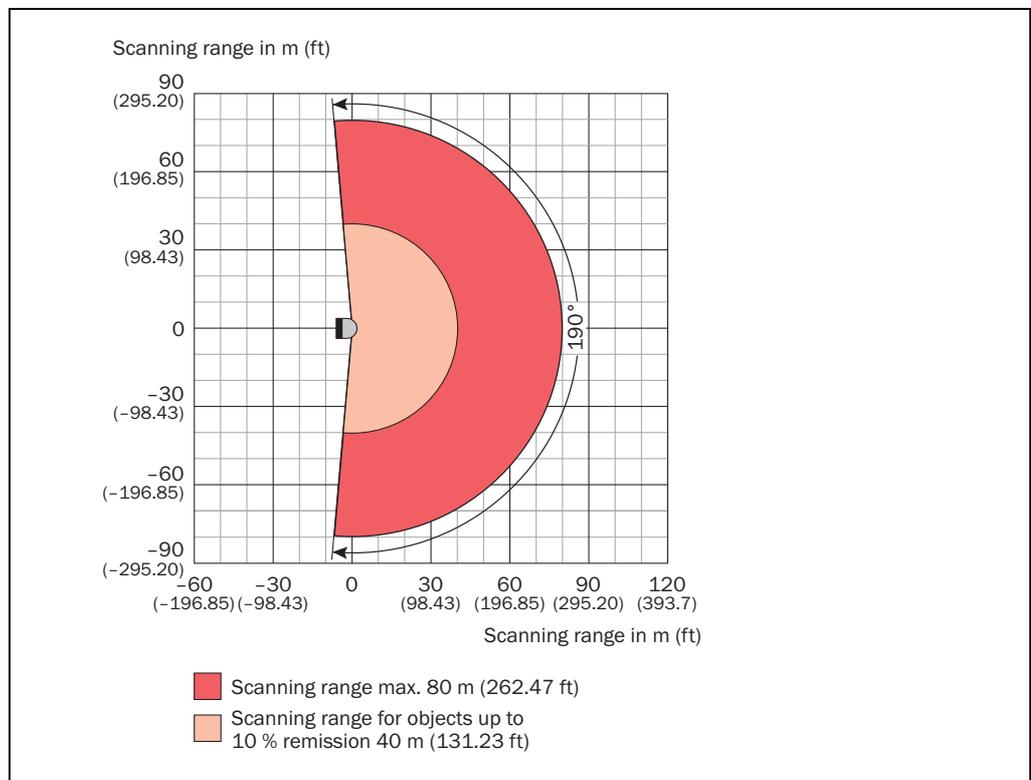
Fig. 65:   Operating range LMS5xx Standard Resolution

10.3 Dimensional drawings

10.3.1 Dimensional drawing LMS500

Connector range ca. 80 mm

185

24

77.5

155

91

43

63

2 × cable gland for cables 5-12 mm

53

78.5

13.5

93

159

30

4 × fastening thread holes M8×9

55

Area to keep clear when mounting the sensor

All dimensions in mm

SICK

32

120

147

137

4 × fastening thread holes M6×8
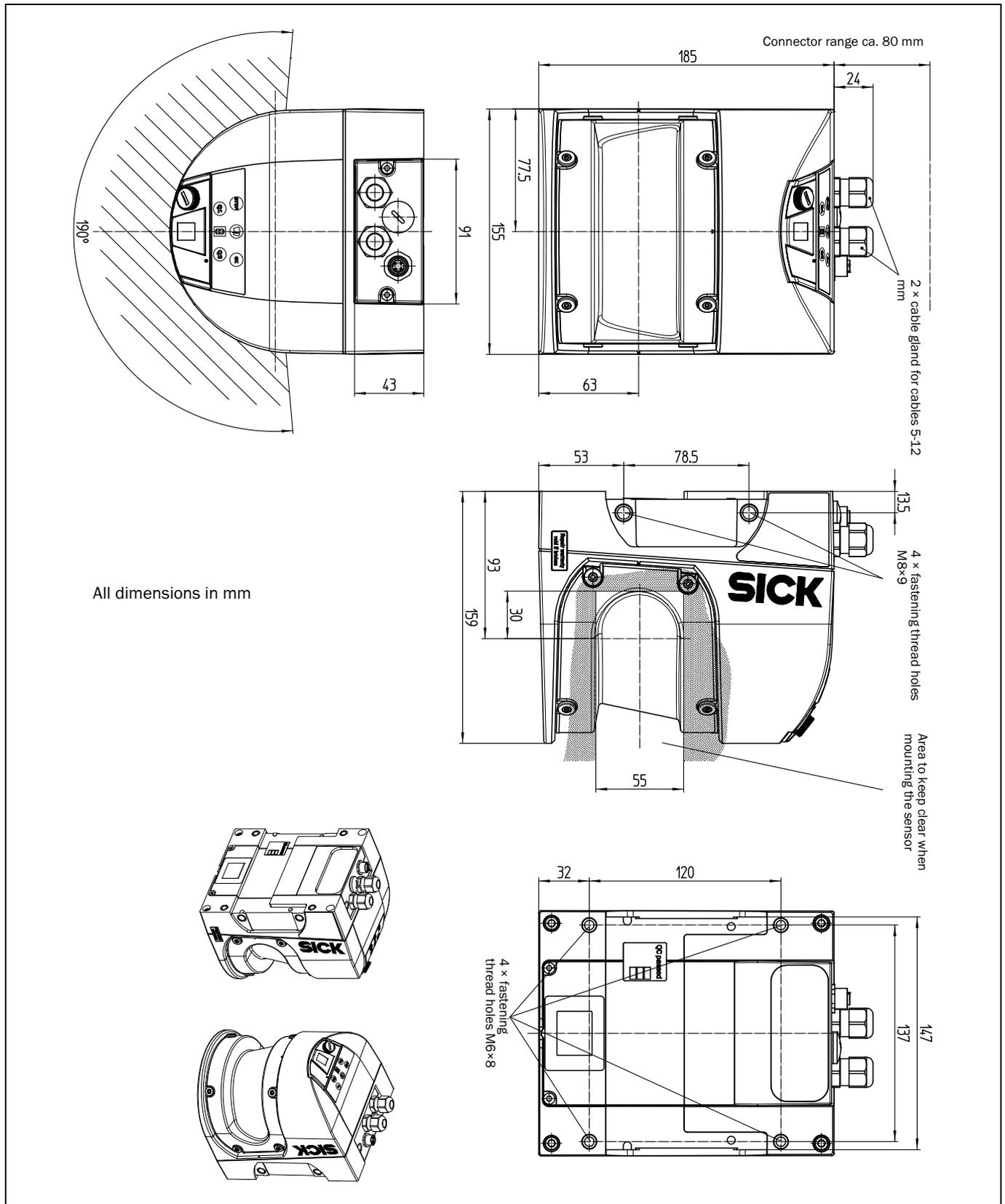
Fig. 66:   Dimensional drawing LMS500

10.3.2   Dimensional drawing LMS511/LMS531/LMS581
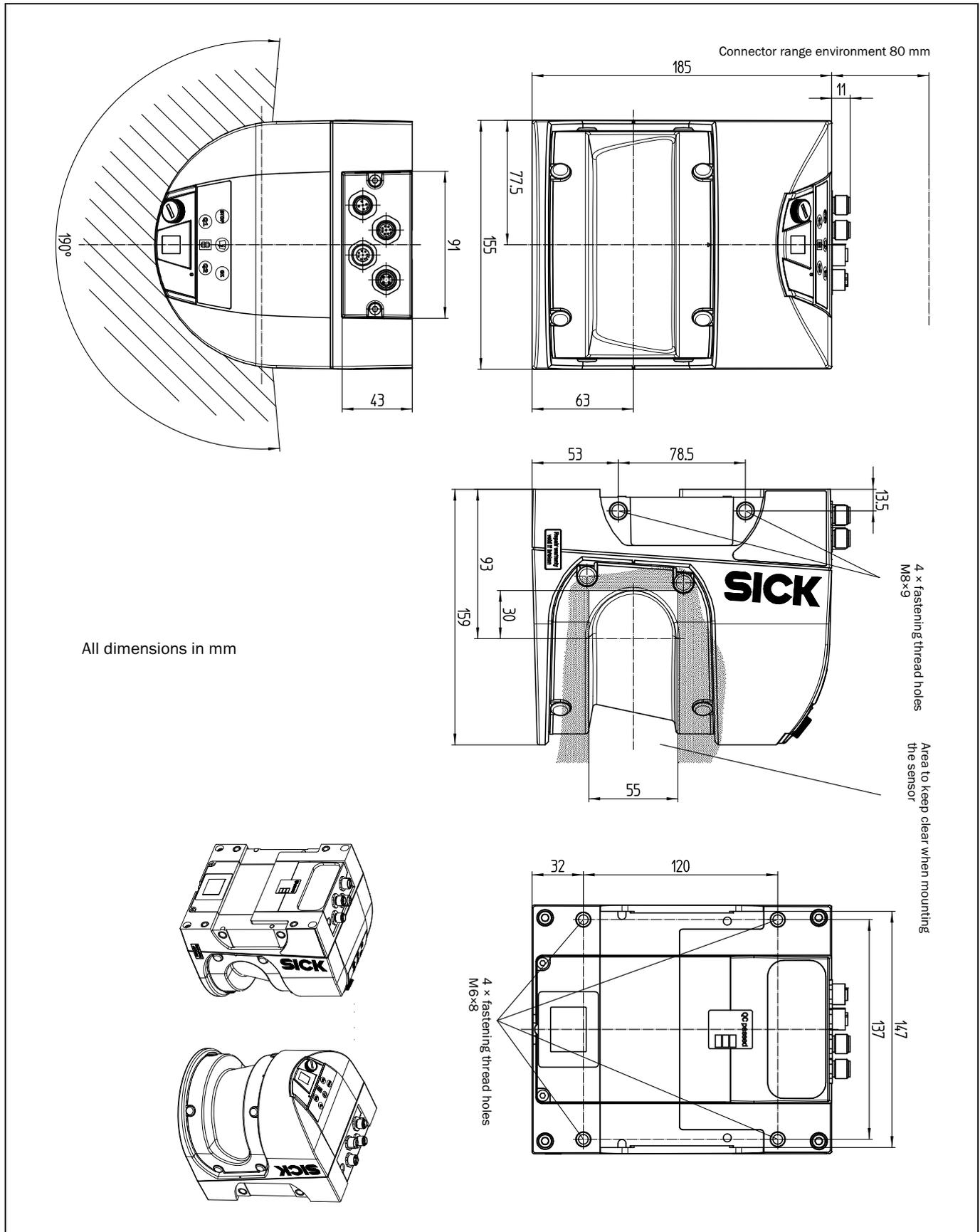
Fig. 67:   Dimensional drawing LMS511/LMS531/LMS581

10.3.3   Dimensional drawings, mounting kits
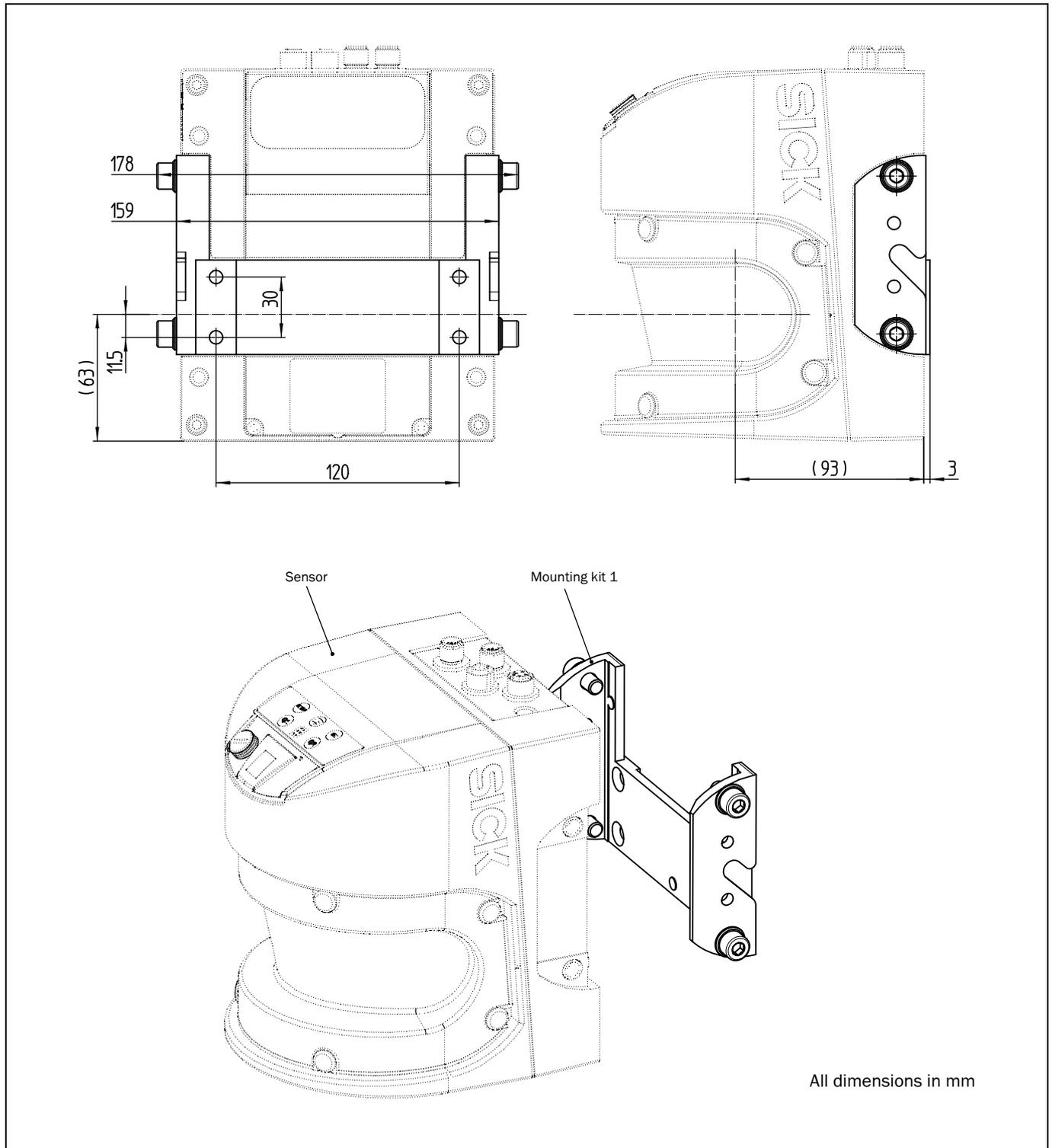
Fig. 68:   Dimensional drawing, mounting kit 1
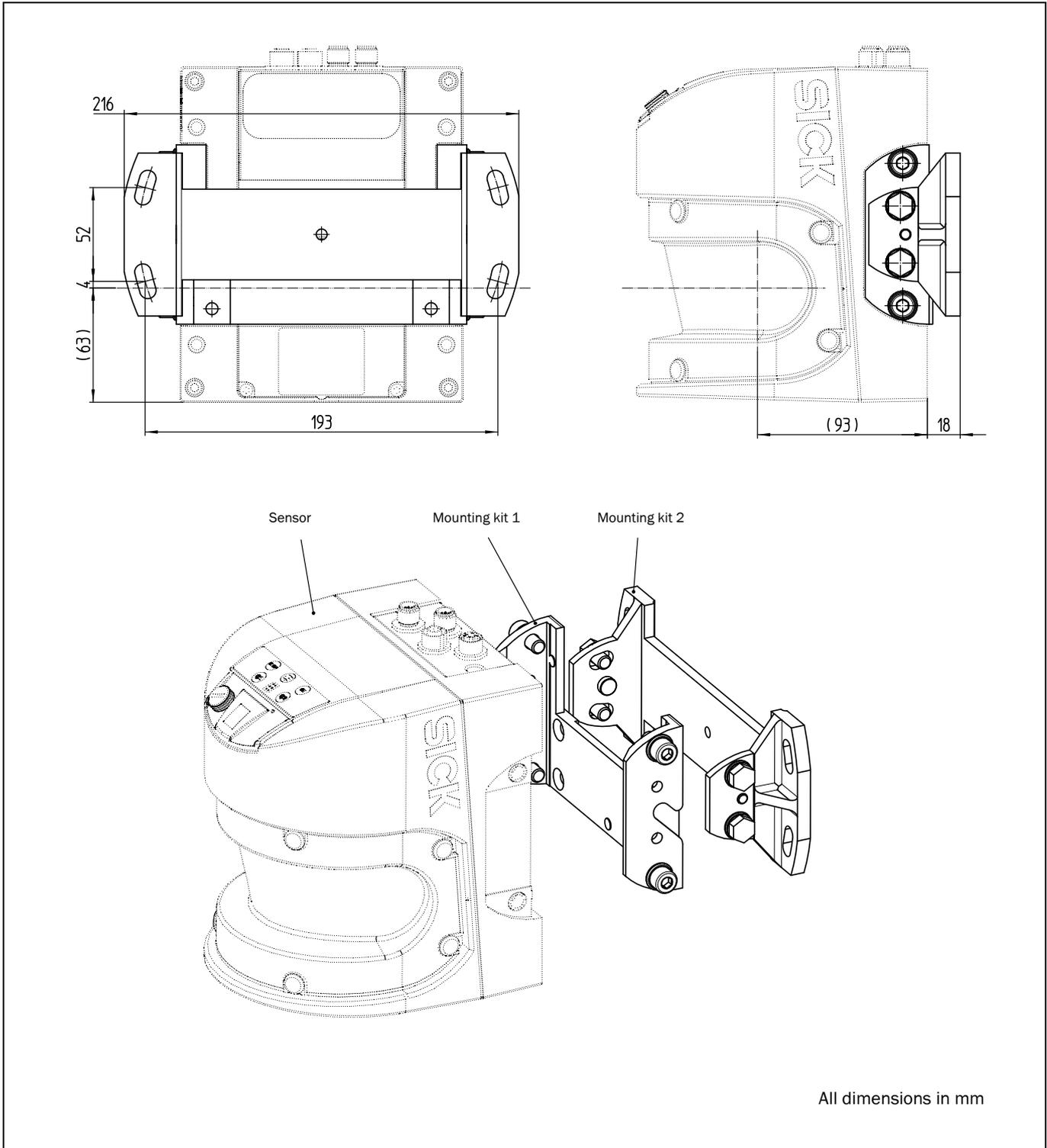
Fig. 69:   Dimensional drawing, mounting kit 2

All dimensions in mm
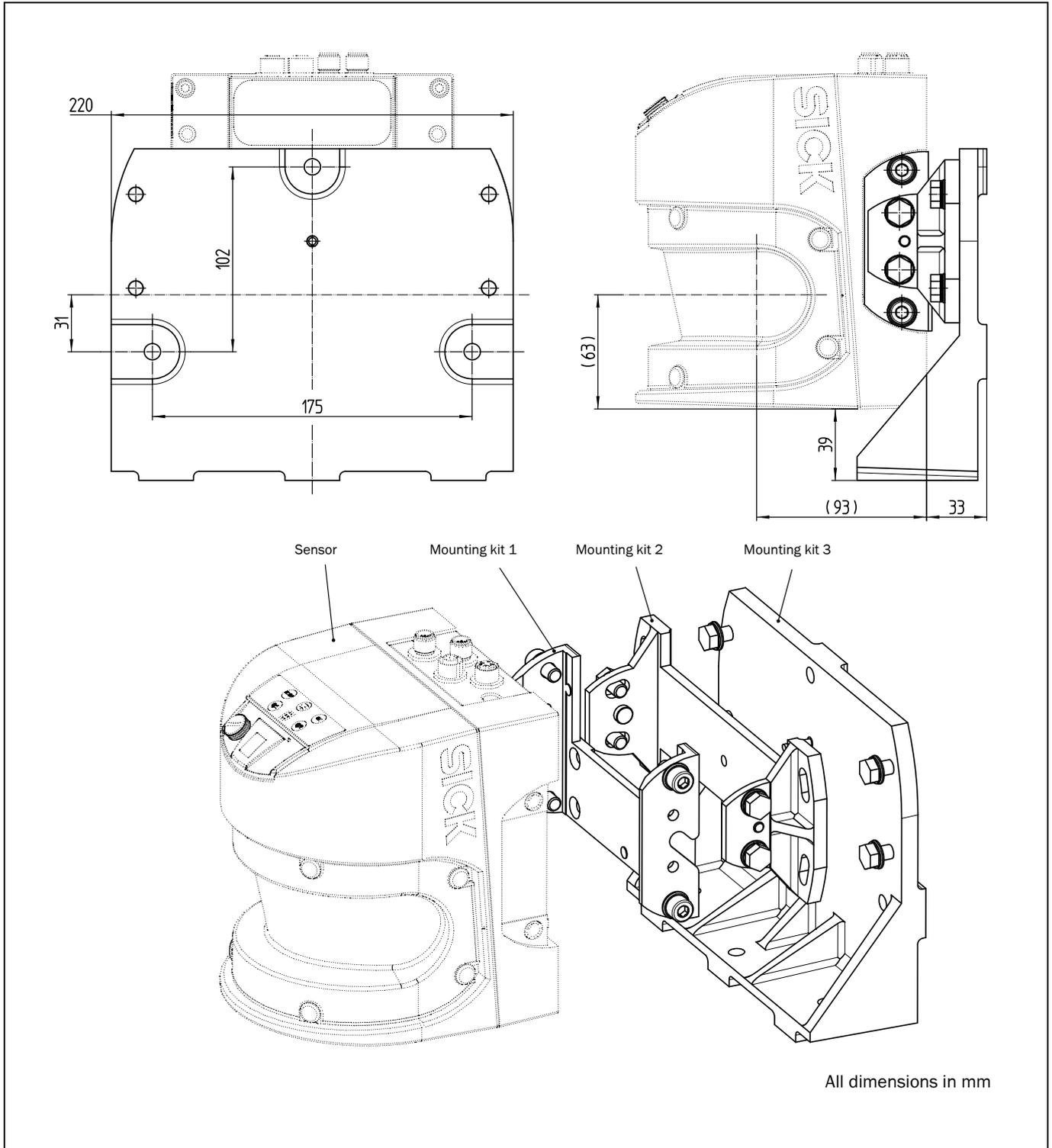
Fig. 70: Dimensional drawing, mounting kit 3 (mm)

10.3.4   Dimensional drawings, weather protection hoods

All dimensions in mm
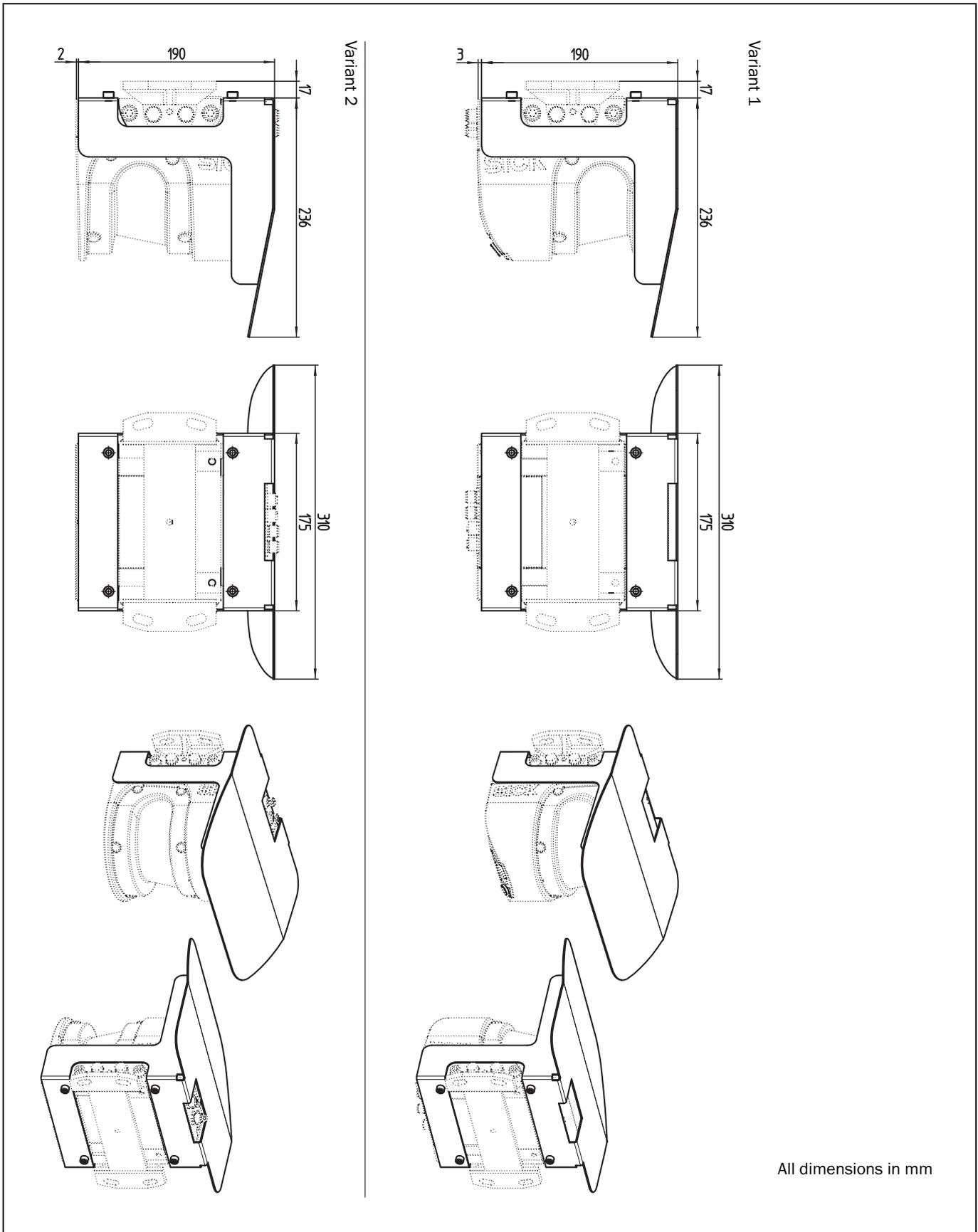
Fig. 71:   Dimensional drawing protection hood

(63) 4 52

193

560

216

4 120 39.4

197

(1)

(2)

(3)

(3)

(1) Weather protection hood
(2) LMS5xx
(3) Mounting kit 1
(4) Mounting kit 2

60,5

69

325
(343)

(93)

1.8
2.5

10.1

All dimensions in mm
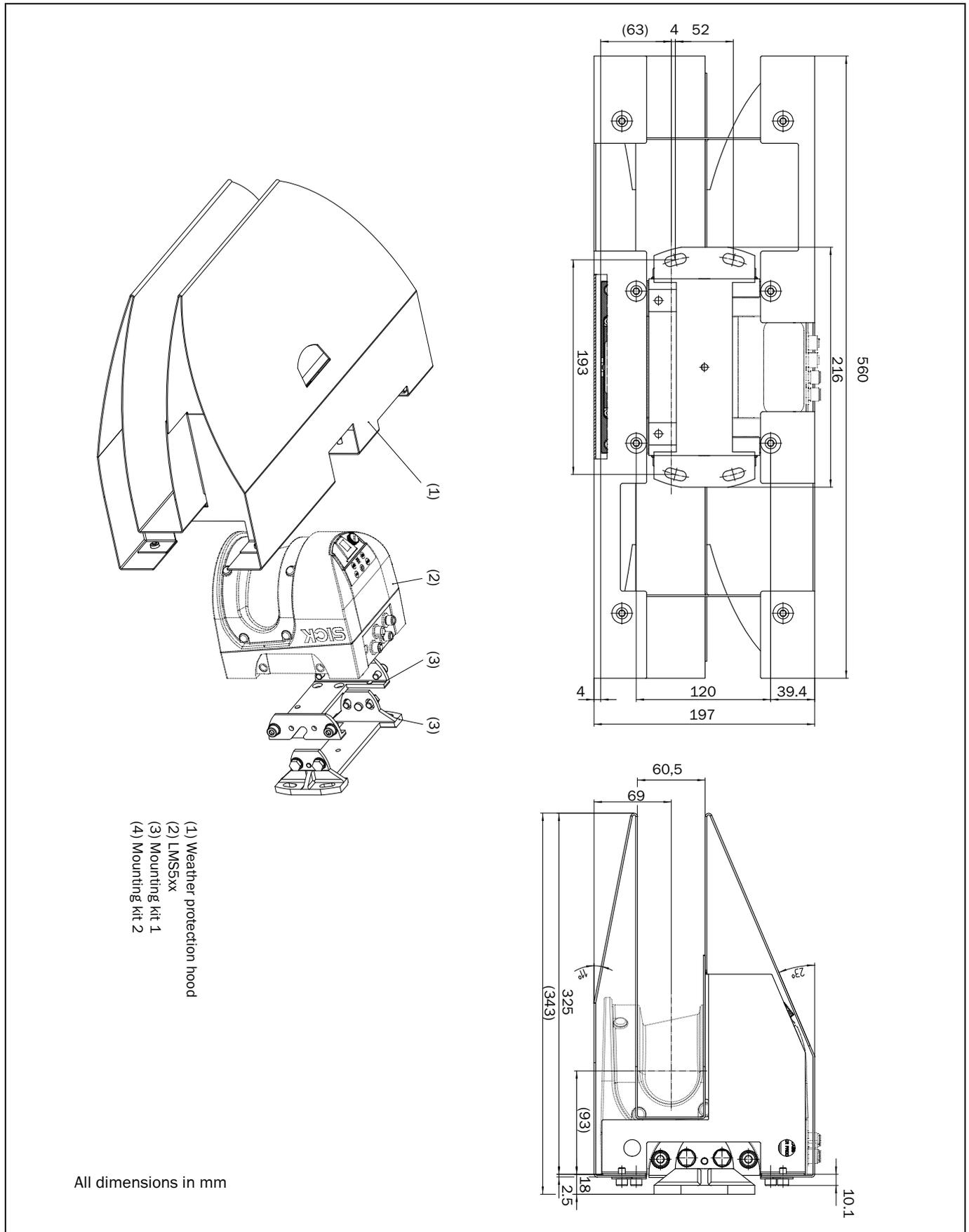
Fig. 72:   Dimensional drawing weather protection hood

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11   Annex

11.1   Ordering information

Ordering information about the LMS5xx and its optional accessories is available from the following web product page:

➤ **http://www.sick.com/en/lms5xx**

11.1.1   Consumables

Part number	Part	Description
4003353	Lens cloth	Special cloth for proper cleaning of the window
5600006	Plastic detergent	Antistatic, mild detergent solution

Tab. 44:   Consumables

11.2   EU declaration of conformity

The EU declaration of conformity of the LMS5xx with the listed available device variants (according to the type code) and the fullfiled standards is availabe in PDF format from the following product web page:

➤ **http://www.mysick.com/en/lms5xx**

11.3   Glossary

Download

Transmission of the parameter set that has been modified offline in the SOPAS ET configuration software from the PC to the LMS5xx. SOPAS ET transmits either always a complete copy to the memory (RAM) of the LMS5xx (menu COMMUNICATION, DOWNLOAD ALL PARAMETERS TO DEVICE) or only the parameter that has just been edited (menu COMMUNICATION, DOWNLOAD MODIFIED PARAMETERS TO DEVICE). With the menu LMS, PARAMETER, SAVE PERMANENT, the parameter set is saved permanently in the EEPROM of the LMS5xx.

Parameter set

Data set that is used to initialize and activate the functions implemented in the LMS5xx. Is transmitted from the LMS5xx to SOPAS ET and in the reverse direction using UPLOAD or DOWNLOAD respectively.

Remission

Remission is the quality of reflection at a surface. The basis is the Kodak standard, known worldwide in, among other areas, photography.

Scan

A scan contains all measured values. These values are in relation with the sensor's parameters such as the scanning angle, start/stop angle etc.

SOPAS ET

Configuration software, used for the offline configuration (adaptation to the read situation on-site) and the online operation of the LMS5xx in dialog mode.

Upload

Transmission of the parameter set from the LMS5xx to the PC into the SOPAS ET configuration software. The values for the parameters are displayed on the file cards of the configuration software. Prerequisite for the modification of the current parameter set.

11.4 Abbreviations

ATEX	Atmosphère explosible = synonym for explosion protection
CAN	Controller area network = standardized fieldbus system with telegram-based protocol for exchanging data
CoLa	Communication Language = proprietary SOPAS ET communication language (ASCII = CoLa-A or binary = CoLa-B)
CS	Checksum
EEPROM	Electrically erasable programmable read-only memory
HTML	Hypertext markup language = page description language on the Internet
LED	Light Emitting Diode
LMS	SICK AG laser measurement sensor
RAM	Random access memory = volatile memory with direct access
ROM	Read-only memory (permanent)
sdd	SOPAS device driver = device description file for SOPAS ET
SOPAS ET	SICK OPEN PORTAL for APPLICATION and SYSTEMS Engineering Tool = configuration software for the configuration of the LMS5xx

11.5   List of Figures

11.6   List of Tables

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