OPERATING INSTRUCTIONS

Bulkscan®

FLOW SENSORS

Laser volume flowmeter for the throughput measurement of bulk goods

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Inhalt

1 About this document

Please read this chapter carefully before you begin working with this documentation and the Bulkscan® LMS511 or Bulkscan® LMS111.

1.1 Purpose of this document

These operating instructions guide the technical personnel during the safe mounting, electrical installation, configuration and commissioning as well as during the maintenance of the laser volume flowmeter Bulkscan® LMS511 or Bulkscan® LMS111, referred to for short as the Bulkscan® in the following.

1.2 Target group

These operating instructions are intended for planning engineers, developers and operators of plants and systems in which the Bulkscan® is to be used. They are also intended for people who integrate the Bulkscan® into a machine, initialize its use, or who are in charge of servicing and maintaining the device.

1.3 Information depth

These operating instructions contain information about the Bulkscan® on the following topics:

- Product description.
- Mounting.
- Electrical installation.
- Commissioning and configuration.
- Care and maintenance.
- Fault diagnosis and troubleshooting.
- Conformity and approval.

When planning and using sensors such as the Bulkscan®, specific technical skills are required that are not covered by this documentation.

When operating the Bulkscan®, the national, local and statutory rules and regulations must always be observed.

Note: You can find further information on the Bulkscan® online at www.sick.com.

1.4 Scope

These operating instructions are original operating instructions.

These operating instructions are referring to the following software versions:

Component	Function	Version
LMS511-20190	Firmware	V2.26
LMS111-10190	Firmware	V1.02
SOPAS ET	Configuration software	V3.x

Note: For a table overview of user levels and passwords, see Chapter 7.1.2 Establishing communication with the Bulkscan® LMS511 or Bulkscan® LMS111.

1.5 Abbreviations used

CoLa Communication Language = proprietary SOPAS ET communication language (ASCII = CoLaA or binary = CoLaB)

CS Checksum

LED Light Emitting Diode

SOPAS ET SICK OPEN PORTAL for APPLICATION and SYSTEMS Engineering Tool = configuration software for the configuration of multiple systems in a single project

SOPAS SD SICK OPEN PORTAL for APPLICATION and SYSTEMS Single Device = configuration software for the configuration of a single system

1.6 Symbols used

Recommendations Recommendations are designed to assist you in the decision-making process with respect to the use of a certain function or a technical measure.

Notes inform you about special aspects of the device.

Display symbols show the status of the 7 segment display of a sender or receiver:

 Constant display of characters, e.g., t.

 Successive display of characters, e.g., first 1, then 2.

LED symbols describe the status of a diagnostics LED. Examples:

 The LED is illuminated constantly.

 The LED is flashing.

 The LED is off.

▶ **Take action** Instructions for taking action are indicated by an arrow. Read carefully and follow the instructions for action.

Warning!
A warning indicates a specific or potential hazard. This is intended to protect you against accidents.

Read carefully and follow the warnings!

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

2 On safety

This chapter concerns your own safety and the safety of the equipment operator.

▸ Please read this chapter carefully before you begin working with the Bulkscan®.

2.1 Authorized personnel

The Bulkscan® must only be installed, commissioned, and serviced by adequately qualified personnel.

Risk of damage!
Repair work on Bulkscan® may only be performed by qualified and authorized service personnel from SICK AG.

The following qualifications are necessary for the various tasks:

Activities	Qualification
Mounting and maintenance	Basic practical technical training Knowledge of the current safety regulations in the workplace
Electrical installation and replacement	Practical electrical training Knowledge of current electrical safety regulations Knowledge of the operation and control of the devices in their particular application (e.g., conveyor system)
Commissioning, operation, and configuration	Knowledge of the operation and control of the devices in their particular application (e.g., conveyor system) Knowledge of the software and hardware¬ environment in the related application Basic knowledge of the Windows operating system used Basic knowledge of data transmission

Tab. 1: Qualified safety personnel

2.2 Correct use

The Bulkscan® is a non-contact optical sensor for the measurement of volume, volume flow rate, mass, mass flow rate, determining the center of gravity of bulk on conveyor belts, monitoring of the bulk edges (only for Bulkscan® LMS511) and monitoring of the conveyor belt edges (only for Bulkscan® LMS511).

It must only be used by authorized personnel and only in industrial environments.

Note

In the event of any other usage or modification to the Bulkscan®, e.g., due to opening the housing during mounting and electrical installation, or to the SICK software, any claims against SICK AG under the warranty will be rendered void.

The Bulkscan® must only be operated in the specified ambient temperature range (see "11.1 Bulkscan® LMS511 data sheet“ on page 80) or (see "11.2 Bulkscan® LMS111 data sheet“ on page 82).

2.3 General safety notes and protective measures

Safety notes!
Observe the following to ensure the correct and safe use of the Bulkscan®.

- The notes in these operating instructions (e.g., regarding the use, mounting, installation or integration into the machine controller) must be observed.

- All official and statutory regulations governing operation of the Bulkscan® must be complied with.
- The national and international legal specifications apply to the installation and use of the sensor, to its commissioning and to technical inspections repeated at regular intervals, in particular:
  - The accident prevention regulations and work safety regulations.
  - And any other relevant safety regulations.
- The manufacturer and operator of the system in which the Bulkscan® is installed are responsible for coordinating and complying with all applicable safety specifications and regulations, in cooperation with the relevant authorities.
- The checks must be carried out by qualified safety 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.
- These operating instructions must be made available to the operator of the system in which the Bulkscan® is used. The system operator must be instructed by qualified safety personnel and read the operating instructions.
- The Bulkscan® does not constitute a safety component according to the EC Machinery Directive (2006/42/EC).
- The Bulkscan® is not a device for the protection of people in the context of the related safety standards for machinery.
- The Bulkscan® 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.

2.3.1 Electrical installation work

- Only authorized personnel are allowed to perform the electrical installation work.
- Electrical connections between the Bulkscan® and other devices may only be made when there is no power to the system.
- 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.

2.3.2 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) EN/IEC 60825-1:2014 Identische Laserklasse für Ausgabe EN/IEC 60825-1:2007 Bulkscan® LMS511-20190 Bulkscan® LMS111-10190: Impulsleistung: 29,6 W Impulsbreite: 2,9 ns	Wavelength: 905 nm (invisible infrared light) EN/IEC 60825-1:2014 Identical laser class for issue EN/IEC 60825-1:2007 Bulkscan® LMS511-20190 Bulkscan® LMS111-10190: Pulse power: 29.6 W Pulse width: 2.9 ns	Longueur d'onde: 905 nm (lumière infrarouge invisibles) EN/IEC 60825-1:2014 Même classe laser pour l'édition EN/CEI 60825-1:2007 Bulkscan® LMS511-20190 Bulkscan® LMS111-10190: Puissance d'impulse: 29,6 W Durée d'impulse: 2,9 ns

WARNUNG	WARNING	AVERTISSEMENT
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 Bulkscan® hat kein Laserwarnschild am Gehäuse.	**Laser warning sign** The Bulkscan® has no laser warning sign on the housing.	**Avertissement laser** Le Bulkscan® 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 Laserschutzbestimmungen gemäß EN/IEC 60825-1:2014.	- Do not open the housing (opening the housing will not switch off the laser). - Pay attention to the laser safety regulations as per EN/IEC 60825-1:2014.	- 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 EN/IEC 60825-1:2014.
Laseraustrittsöffnung Die Laseraustrittsöffnung ist die Frontscheibe am Bulkscan®. Siehe Abb. 1 auf Seite 12. Die Laseraustrittsöffnung ist das Sichtfenster der Optikhaube des Bulkscan® LMS111: siehe Abb. 2 auf Seite 12.	**Laser output aperture** The laser output aperture is the front screen on the Bulkscan®. See fig. 1 at page 12. The laser output aperture is the viewing window of the optics hood of the Bulkscan® LMS111: see fig. 2 at page 12.	**Orifice de sortie** L'orifice de sortie du faisceau laser correspond à la vitre dans son ensemble. Voir fig. 1 page 12. L'ouverture de sortie du laser est la fenêtre de visualisation du capot optique du Bulkscan® LMS111: voir fig. 2 à la page 12.

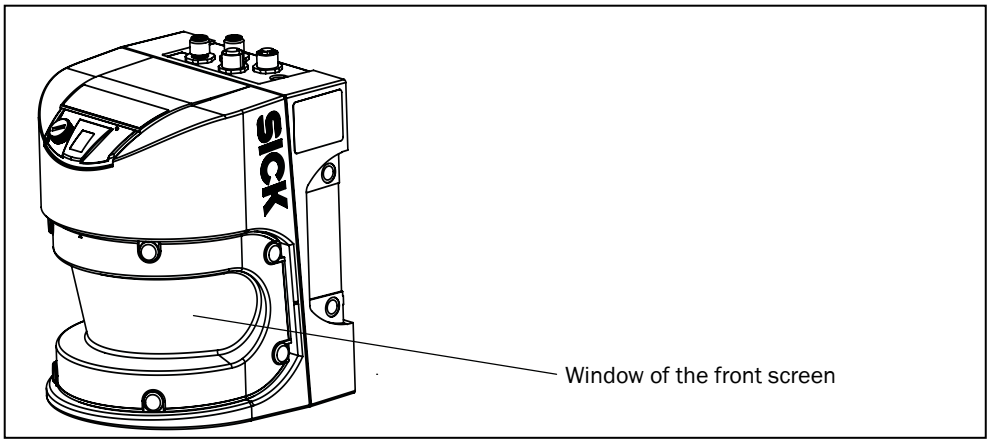


Fig. 1: Laser output aperture of the Bulkscan® LMS511

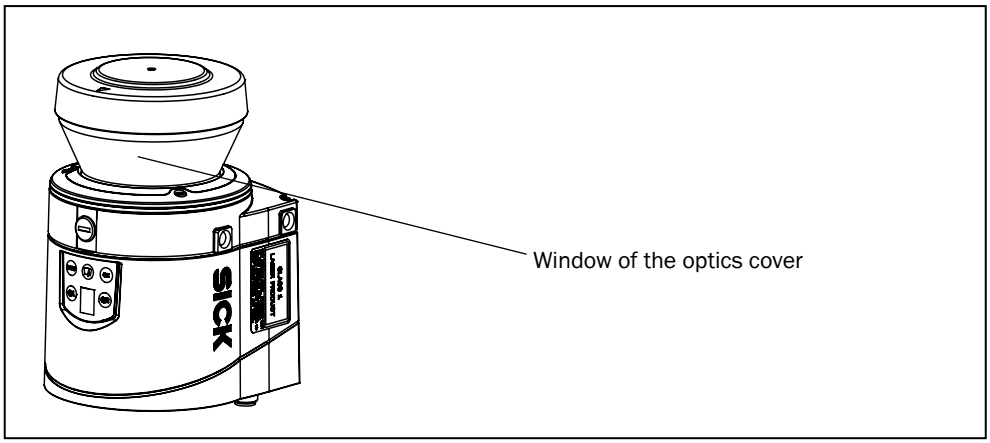


Fig. 2: Laser output aperture of the Bulkscan® LMS111

2.3.3 Damaging potential equalization currents due to different ground potentials

For electrical safety, the Bulkscan® LMS511 has been designed and checked according to IEC 61010-1 and the Bulkscan® LMS111 according to EN 50178.

Risk of injury and damage caused by electrical current!
Potential equalization currents between the Bulkscan® and the peripheral devices can have the following effects:

- Dangerous voltages on the metal housing, e.g., of the Bulkscan®.
- Incorrect function or irreparable damage to the devices.
- Damage/irreparable damage of the cable shield due to heating and cable fires.

▶ Make sure the devices connected together in a system (Bulkscan®, power supply, encoder, PLC/host, etc.) all have the same ground potential.

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 (see "6.1.1 Avoiding potential differences“ on page 44).

2.4 Quick stop and quick restart

To stop the Bulkscan® LMS511 or Bulkscan® LMS111, switch it off.

▶ Switch off the Bulkscan® power supply or disconnect the M12 supply cable.
The Bulkscan® retains parameters stored in the internal non-volatile memory. Parameters that have not been saved as well as the measured values at the interface are lost.

To restart the Bulkscan®, switch it on.

▶ Switch on the power supply to the Bulkscan® or re-connect the M12 supply cable.
The Bulkscan® restarts operation with the last saved parameters.

2.5 Environmental protection

The Bulkscan® LMS511 and Bulkscan® LMS111 have been designed to minimize its impact on the environment. They consume only a minimum of energy.

At work, always act in an environmentally responsible manner. For this reason, please note the following information on disposal.

2.5.1 Power consumption

- The Bulkscan® LMS511 consumes a maximum of 25 W in operation without output loads.
- If the operating temperature of the sensor drops below 5 °C, the Bulkscan® LMS511 switches on the heating. The sensor then consumes a maximum of 90 W.
- The Bulkscan® LMS111 consumes a maximum of 10 W in operation without output loads.
- If the operating temperature of the sensor drops below 10 °C, the Bulkscan® LMS111 switches on the heating. The sensor then consumes a maximum of 55 W.

2.5.2 Disposal after final decommissioning

- ▶ Always dispose of unusable or irreparable devices in accordance with the applicable specific national waste disposal regulations.
- ▶ Dispose of all electronic assemblies as hazardous waste. The electronic assemblies are easy to dismantle.

Note SICK AG does not currently take back devices that are unusable or irreparable.

2.6 IP technology

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.

3 Product description

This chapter provides information on the special features and properties of the Bulkscan® LMS511 and Bulkscan® LMS111. It describes the construction and operating principle of the sensor, in particular the different operating modes.

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

3.1 Special features of the Bulkscan®

- Non-contact, optical measurement of volume, volume flow rate, mass, and mass flow rate of bulk goods.
- Continuous, delay-free measurement.
- High resolution due to short time between the laser pulses and high angular resolution.
- Integrated determination of the center of gravity of the bulk good.
- Calculation of volume flow rate and mass flow rate with summation to form total volume and total mass.
- Determination of bulk height.
- Monitoring of the bulk edges (only for Bulkscan® LMS511).
- Monitoring of the conveyor belt edges (only for Bulkscan® LMS511).
- Scanning range up to 20 with 3% remission (Bulkscan® LMS511).
- Scanning range up to 10 with 3% remission (Bulkscan® LMS111).
- Does not require an official approval.
- Simple installation.
- Low maintenance costs.

User-friendly program SOPAS ET (www.sick.com/SOPAS_ET) for the configuration and visualization of the parameters under Microsoft Windows®.

3.2 Operating principle of the Bulkscan®

3.2.1 Measurement principle

The Bulkscan® scans the surface contour of the measured object using a rotating laser pulse. The Bulkscan® calculates the distance of each point measured, and therefore the surface contour, from the time the laser pulse reflected by the measured object takes to propagate.

During commissioning the Bulkscan® initially learns the reference contour (empty conveyor belt) and uses this information to calculate the reference area A_R (see Fig. 3). In measuring mode the conveyor belt is filled with the bulk. The area A_M calculated from the bulk contour is smaller than the reference area. The cross-sectional area of the bulk A_S is given by the difference between the areas.

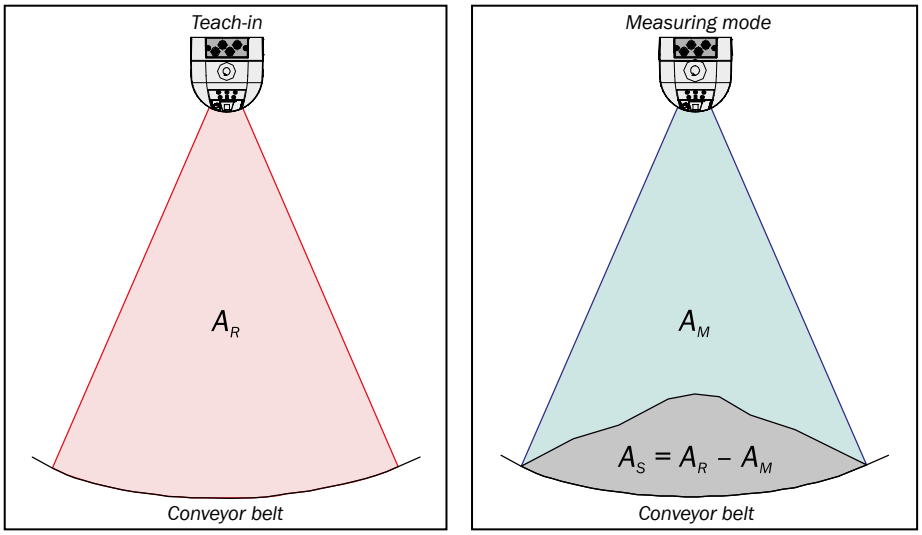


Fig. 3: Measurement principle of Bulkscan® LMS511 and Bulkscan® LMS111

A_R = *Reference area*

A_M = *Area calculated from the bulkcontour*

A_S = *Cross-sectional area of the bulk*

Using the bulk density (fixed value or analog value) and the belt speed (fixed value, encoder or analog value), the Bulkscan® calculates the required output parameters volume flow rate and mass flow rate, as well as the total volume and total mass.

3.3 Application examples

The Bulkscan® is suitable for non-contact continuous detection of the bulk volume on conveyor belts.

It can be used, for example, in the following areas:

- Monitoring transport systems for conveying coal or ore, e.g., in open-cast mines or loading plants for:
  - Minimizing the energy consumption, maximizing the transport performance by means of maximum loading.
  - Preventing tilted belts.
- Measuring the ash produced in power stations.
- Checking the loading of transport such as lorries, ships, railway trucks.
- Measuring volume and mass in gravel plants and other operations in the construction industry.
- Measuring clinker volume flow and mass in Portland cement manufacturing.
- Measuring vegetables volume flow and mass in food industries.

3.4 Status indicators

In measuring mode the sensor operates fully automatically. The diagnostics LEDs and the 7-segment display indicate the operational status of the Bulkscan®.

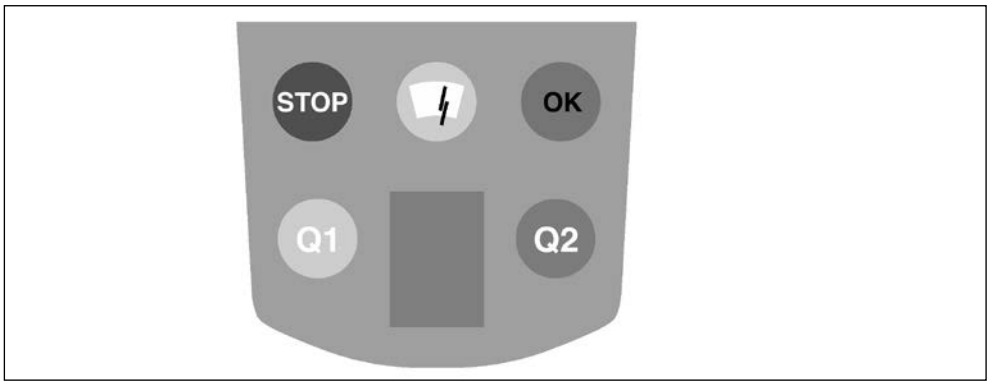


Fig. 4: Status indicator

Display	Meaning
OK	Bulkscan® ready and error-free
STOP	Error. Pay attention to the 7-segment display.
	Slight contamination. Clean the front screen.
	Flashing: Heavy contamination. Clean the front screen.
Q1	Information: Check ambient conditions. Measurements continue. Pay attention to the 7-segment display.
Q2	Warning. Measures must be taken by the operator. Measurement has been interrupted. Pay attention to the 7-segment display.
7-segment display	The 7-segment display shows diagnostics messages on errors or faults that occur (see "10.3 Error and status indicators on the 7 segment display“ on page 77).

Tab. 2: Meaning of the status indicators

4 Configurable functions

This section describes the functions of the Bulkscan® which can be selected via SOPAS ET software.

4.1 Setting the belt speed

In order to measure the flow, it is essential to determine the speed at which the bulk is moving on the conveyor belt.

There are several ways to transmit/transfer the belt speed to the Bulkscan®.

- Set a fixed and known belt speed.
- Connect an encoder to the Bulkscan®.
- Connect a current signal via the analog module BAM100 (see "12.2 Accessories“ on page 96).
- Transmit the belt speed via telegram (see "13.1 Telegram reference“ on page 99).

The Bulkscan® can monitor the belt speed and signal on a digital output if the control range is left.

How to set a fixed value for the belt speed:

- ▶ Switch to the **Measurement** tab.
- ▶ Set **Fixed value** as the source as in the **Belt speed** group.
- ▶ Configure a value for the **Fixed belt speed**.
- ▶ If necessary, you can use a **Status signal** with the required **Logic** for the belt operation (see "4.12 Digital inputs“ on page 25).

How to set an encoder:

- ▶ Switch to the **Measurement** tab.
- ▶ Set **Encoder** as the source in the **Belt speed** group.
- ▶ Configure the Resolution of the encoder. This is calculated from the circumference of the measuring wheel (shaft) and the number of lines.

$$\text{Resolution} = \frac{\text{Measuring wheel circumference in mm}}{\text{Number of lines}}$$

- ▶ If necessary, you can configure **Direction** detection (positive and negative flow) via phase or level. (only for Bulkscan® LMS511)

How to set an analog value for the belt speed:

- ▶ Switch to the **Measurement** tab.
- ▶ Set **Analog value** as the source in the **Belt speed** group.
- ▶ Configure the **4 mA point** as well as the **20 mA point** with the associated belt speeds.

How to configure the belt speed signaling on a digital output:

- ▶ Switch to the **Measurement** tab.
- ▶ Configure the **Belt speed** as **Encoder** or as **Analog value**.
- ▶ Switch to the Interfaces tab
- ▶ Click on **Digital outputs** to open the **Digital outputs** tab (see "4.13 Digital outputs“ on page 26).
- ▶ Select the assignment **Belt speed** for the required output.
- ▶ Select the required **Logic**.
- ▶ Define the **Lower limit**, the **Upper** limit and the associated **Hysteresis**.

4.2 Measurement of the volume

The sensor determines the running total of the volume transported.

The sensor calculates the volume from the measured contour and the conveyor belt speed.

SOPAS indicates this value as a volume sum and the sensor outputs the sum in the measured value telegram. On the other hand, the volume is signaled as a switching point per volume quota reached on a digital output, e.g., one switching point per 100 m³.

You can smooth the measured values with the aid of the averaging filter (see "4.11 Averaging filter“ on page 25).

How to configure the calculation of the volume sum:

- Switch to the **Measurement** tab.
- Configure the **Belt speed** (see "4.1 Setting the belt speed“ on page 17).
- Configure the **Flow averaging filter**, if required.

How to configure the signaling of the volume quota on a digital output:

- Switch to the **Interfaces** tab.
- Click on **Digital outputs** to open the **Digital outputs** tab (see "4.13 Digital outputs“ on page 26).
- Select the assignment **Volume quota** for the required output.
- Select the required **Logic**.
- Configure the **Volume quota** (volume per pulse).
- Configure the **Pulse width**.

Note Ensure that the duration of the pause between pulses is longer than the cycle time resulting from the scan frequency (see "8.4 Monitoring of the contamination degree“ on page 71).

4.3 Measurement of the mass

The sensor determines the running total of the mass transported.

The sensor calculates the mass from the measured contour, the bulk density, and the belt speed.

SOPAS displays this value as a mass sum and the sensor outputs the sum in the measured value telegram. On the other hand, the mass is signaled as a switching point per mass quota reached on a digital output, e.g., one switching point per 10 t.

Note You can smooth the measured value with the aid of the averaging filter (see "4.13 Digital outputs“ on page 26).

How to configure the calculation of the mass sum:

- Switch to the **Measurement** tab.
- Configure the **Belt speed** (see "4.1 Setting the belt speed“ on page 17).
- Configure the mass flow rate as a calculated value.
- Configure the **Bulk density** as **Fixed value** or **Analog value**.
- Configure the **Flow averaging filter**, if required.

How to configure the signaling of the mass quota on a digital output:

- Switch to the **Interfaces** tab.
- Click on **Digital outputs** to open the Digital outputs tab (see "4.13 Digital outputs“ on page 26).
- Select the assignment **Mass quota** for the required output.
- Select the required **Logic.**

- Configure the **Mass quota** (mass per pulse).
- Configure the **Pulse width**.

Note Ensure that the duration of the pause between pulses is longer than the cycle time resulting from the scan frequency (see "8.4 Monitoring of the contamination degree“ on page 71).

4.4 Measurement of volume flow rate

The volume flow rate is the volume transported per unit time.

The sensor calculates the volume flow rate from the measured contour and the belt speed.

Note You can smooth the measured value with the aid of the averaging filter (see "4.13 Digital outputs“ on page 26).

How to configure the calculation of the volume flow rate:

- Switch to the **Measurement** tab.
- Configure the **Belt speed** (see "4.1 Setting the belt speed“ on page 17).
- Configure the **Flow averaging filter**, if required.

How to configure the signaling of the volume flow rate on a digital output:

- Switch to the **Interfaces** tab
- Click on **Digital outputs** to open the **Digital outputs** tab (see "4.13 Digital outputs“ on page 26).
- Select the assignment **Volume flow rate** for the required output.
- Select the required **Logic**.
- Define the **Lower limit**, the **Upper limit** and the associated Hysteresis.

How to configure the signaling of the volume flow rate on an analog output:

- Switch to the **Interfaces** tab.
- Click on **BAM 100** to open the **BAM 100** tab (see "4.14 Analog module BAM100“ on page 28).
- Select the assignment **Volume flow rate** for the required output.
- Define the **4 mA point** and the **20 mA point**.

4.5 Measurement of the mass flow rate

The mass flow rate is the mass transported per unit time.

The sensor calculates the mass flow rate from the measured contour, the bulk density, and the belt speed.

Alternatively you can set the mass flow rate as a fixed value or an analog value. The sensor then uses this value instead of the measured value.

Note You can smooth the measured value with the aid of the averaging filter (see "4.11 Averaging filter“ on page 25).

How to configure the calculation of the mass flow rate:

- Switch to the **Measurement** tab.
- Configure the **Belt speed** (see "4.1 Setting the belt speed“ on page 17).
- Configure the **Bulk density** as a **Fixed value** or **Analog value**.
- Configure the **Mass flow rate** as a **Calculated value**.
- Configure the **Flow averaging filter**, if required.

How to configure the signaling of the mass flow rate on a digital output:

- Switch to the **Interfaces** tab.

- Click on **Digital outputs** to open the **Digital outputs** tab (see "4.13 Digital outputs“ on page 26).
- Select the assignment **Mass flow rate** for the required output.
- Select the required **Logic**.
- Define the **Lower limit**, the **Upper limit**, and the associated **Hysteresis**.

How to configure the signaling of the mass flow rate on an analog output:

- Switch to the **Interfaces** tab.
- Click on **BAM 100** to open the **BAM 100** tab (see "4.14 Analog module BAM100“ on page 28).
- Select the assignment **Mass flow rate** for the required output.
- Define the **4 mA point** and the **20 mA point**.

4.6 Measurement of the bulk density

The bulk density is the mass transported per unit volume.

The sensor calculates the bulk density from the measured contour, the configured mass flow rate, and the measured volume flow rate.

Alternatively you can set the bulk density as a fixed value or an analog value. The sensor then uses this value instead of the measured value.

Note You can smooth the measured value with the aid of the averaging filter (see "4.11 Averaging filter“ on page 25).

How to configure the calculation of the bulk density:

- Switch to the **Measurement** tab.
- Configure the **Belt speed** (see "4.1 Setting the belt speed“ on page 17).
- Configure the **Mass flow rate** as a **Fixed value** or **Analog value**.
- Activate the **Bulk density** as a **Calculated value**.
- Configure the **Flow averaging filter**, if required.

How to configure the signaling of the bulk density on a digital output:

- Switch to the **Interfaces** tab.
- Click on **Digital outputs** to open the **Digital outputs** tab (see "4.13 Digital outputs“ on page 26).
- Select the assignment **Bulk density** for the required output.
- Select the required **Logic**.
- Define the **Lower limit**, the **Upper limit**, and the associated **Hysteresis**.

How to configure the signaling of the bulk density on an analog output:

- Switch to the **Interfaces** tab.
- Click on **BAM 100** to open the **BAM 100** tab (see "4.14 Analog module BAM100“ on page 28).
- Select the assignment **Bulk density** for the required output.
- Define the **4 mA point** and the **20 mA point**.

4.7 Measurement of the bulk height

The sensor determines the height of the bulk on the conveyor belt from the measured contour. This function can be used to protect downstream machines from bulk which is too tall.

Two strategies can be used to calculate the bulk height:

Center point: The point on the bulk contour which is vertical to the Bulkscan® (0° angle) is used.

Highest point: The point on the bulk contour with the smallest distance to the Bulkscan® is used.

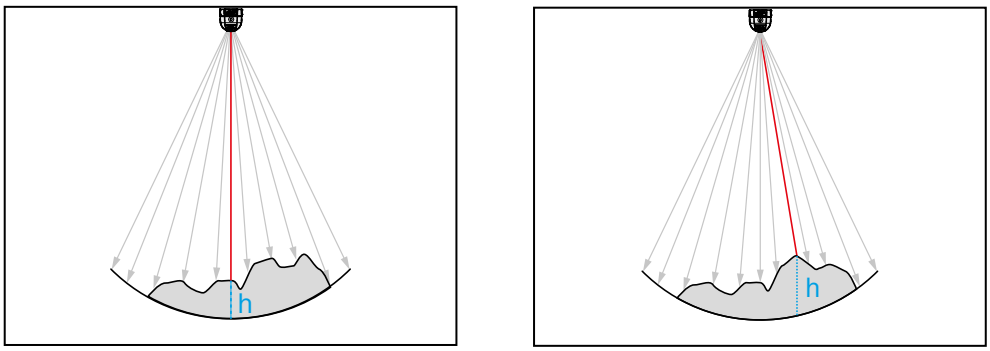


Fig. 5: Bulk height

The bulk height is the distance between this point and the conveyor belt.

The Bulkscan® can monitor the bulk height and signal a violation of the control range on a digital output.

You can smooth the measured value with the aid of the averaging filter (see "4.11 Averaging filter“ on page 25).

How to configure the calculation of the bulk height:

- Switch to the **Measurement** tab.
- Select the required **Strategy**.
- Configure the **Bulk height** avering filter, if required.

How to configure the signaling of the bulk height on a digital output:

- Switch to the **Interfaces** tab.
- Click on **Digital outputs** to open the **Digital outputs** tab (see "4.13 Digital outputs“ on page 26).
- Select the assignment **Bulk height** for the required digital output.
- Select the required **Logic**.
- Define the **Lower limit**, the **Upper limit**, and the associated **Hysteresis**.

How to configure the signaling of the bulk height on an analog output:

- Switch to the **Interfaces** tab.
- Click on **BAM 100** to open the **BAM 100** tab (see "4.14 Analog module BAM100“ on page 28).
- Select the assignment **Bulk density** for the required output.
- Define the **4 mA point** and the **20 mA point**.

4.8 Monitoring the center of gravity

The Bulkscan® determines the position of the center of gravity of the bulk from the bulk contour. This enables tilted belts to be detected and prevents malfunctions in the case of unsymmetrical belt filling or uneven mass distribution.

The value for the position of the center of gravity is calculated in the range from 0.0 to 1.0 within the aperture angle. The aperture angle is defined by the angles on the left and right. A value of 0.5 corresponds to half the aperture angle (see Fig. 6). I.e., if the

angles on the left and right have been configured symmetrically, the value 0.5 corresponds to the sensor's 0° spot.

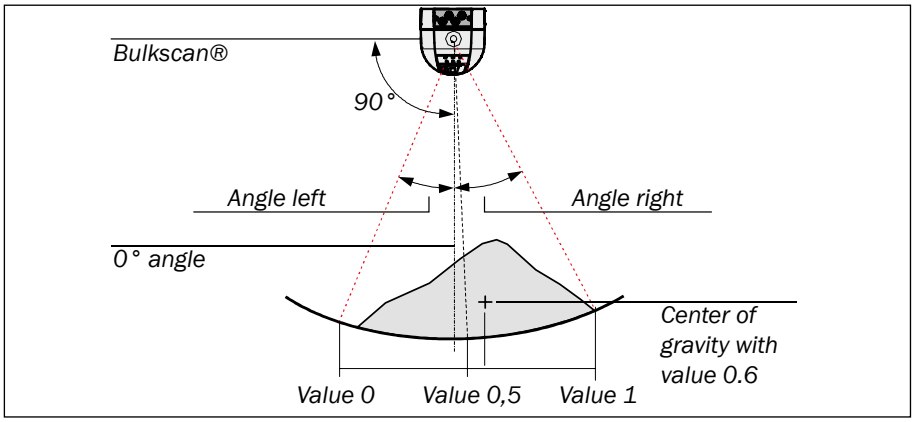


Fig. 6: Determining the center of gravity

The Bulkscan® can monitor the value for the center of gravity within defined limits and signal on a digital output if the value exceeds or drops below the limits.

Note

- Pay attention to the correct angular adjustment of the sensor to obtain meaningful values for the position of the center of gravity (see "8.1 Teaching-in the reference contour" on page 64).
- The sensor only calculates the position of the center of gravity if the bulk contour is outside the tolerance due to vibration (see "8.3.1 Tolerance against vibration" on page 69). Otherwise the sensor outputs the value 0.5.
- You can smooth the measured value with the aid of the averaging filter (see "4.11 Averaging filter" on page 25).

How to configure the calculation of the center of gravity:

- ▶ Switch to the **Measurement** tab.
- ▶ Configure the **Center of gravity averaging filter**, if required.

How to configure the signaling of the center of gravity on a digital output:

- ▶ Switch to the **Interfaces** tab.
- ▶ Click on **Digital outputs** to open the **Digital outputs** tab (see "4.13 Digital outputs" on page 26).
- ▶ Select the assignment **Center of gravity** for the required digital output.
- ▶ Select the required **Logic**.
- ▶ Define the Lower limit, the **Upper limit**, and the associated **Hysteresis**.

How to configure the signaling of the center of gravity on an analog output:

- ▶ Switch to the **Interfaces** tab.
- ▶ Click on **BAM 100** to open the **BAM 100** tab (see "4.14 Analog module BAM100" on page 28).
- ▶ Select the assignment **Center of gravity** for the required output.
- ▶ Define the **4 mA point** and the **20 mA point**.

4.9 Monitoring the bulk edge (only valid for Bulkscan® LMS511)

The Bulkscan® LMS511 monitors the position of the measured bulk material on the conveyor belt by detecting its left and right edges. The distance between the detected bulk edge and end of the measurement field is calulated.

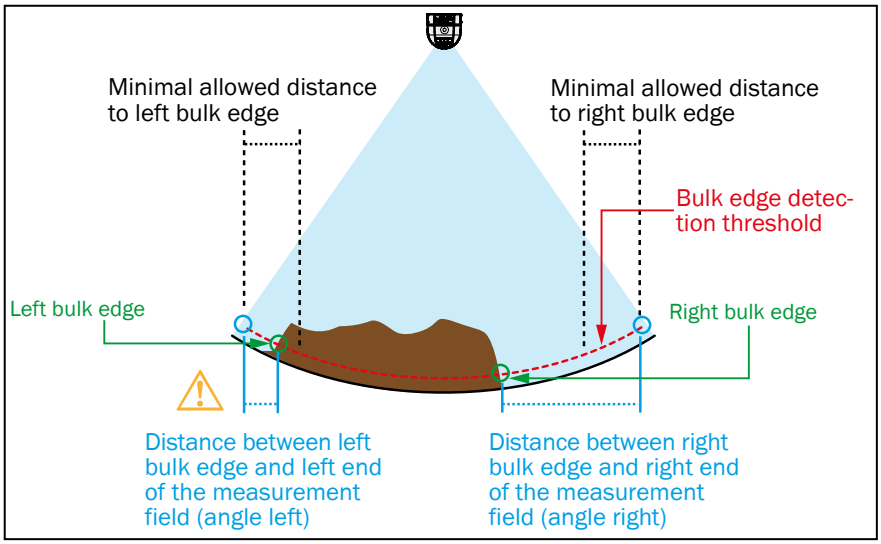


Fig. 7: Bulk materials monitoring (only valid for Bulkscan® LMS511)

The bulk edge is detected at the point where the border of the bulk material lies above a detection threshold. You can configure the value of this detection threshold.

The Bulkscan® LMS511 can monitor the distance to the bulk edge and signal on a digital output if the value drops below a configurable minimal distance.

Note

- If no bulk material is detected, the measured distance to both bulk edges equals the conveyor belt width.
- Pay attention to the correct angular adjustment of the sensor to obtain meaningful values for the distance to the belt edges (see "8.1 Teaching-in the reference contour“ on page 64).
- You can smooth the measured values with the aid of the averaging filter (see "4.11 Averaging filter“ on page 25).

How to configure the calculation of the distance to the bulk edges:

- ▶ Switch to the **Edge monitoring** tab.
- ▶ Configure the **Minimum bulk height for bulk edge detection**.
- ▶ Configure the **Averaging filter Distance to edge**, if required.

How to configure the the signaling of the bulk edges on a digital output:

- ▶ Switch to the **Edge monitoring** tab.
- ▶ Configure the minimum distance to the left and to the right from which a warning is issued (**Warn if closer than**).
- ▶ Switch to the **Interfaces** tab
- ▶ Click on **Digital outputs** to open the **Digital outputs** tab (see "4.13 Digital outputs“ on page 26).
- ▶ Select the assignment **Information/Warnings** for the required output
- ▶ Select the required **Warning** (**All, Bulk edge left or Bulk edge right**)
- ▶ Select the required **Logic**.
- ▶ Configure the **Switching delay**, if required.

4.10 Monitoring the conveyor belt edge (only valid for Bulkscan® LMS511)

The Bulkscan® LMS511 monitors the position of the conveyor belt by detecting its left and right edges. The distance between the conveyor edge and the end of the measurement field is calculated.

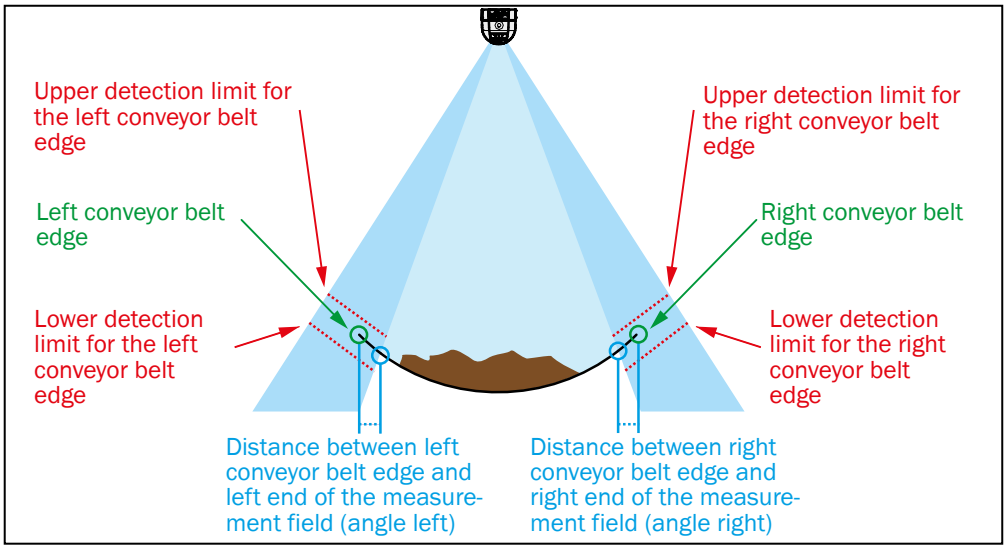
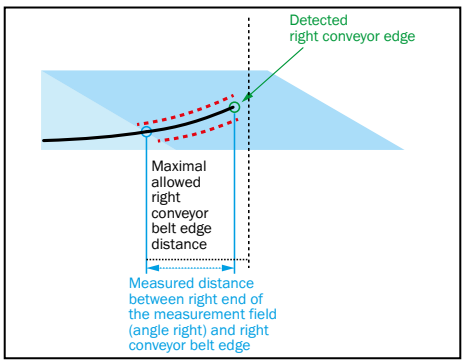


Fig. 8: Belt monitoring (only valid for Bulkscan® LMS511)

The conveyor belt edges are detected using two additional monitoring fields (left and right from the measurement field). These edges are detected, when the conveyor belt lies within the configurable detection limits.

Distance from conveyor belt edge smaller than maximal allowed distance. No warning is issued.



Distance from conveyor belt edge greater than maximal allowed distance. A warning is issued.

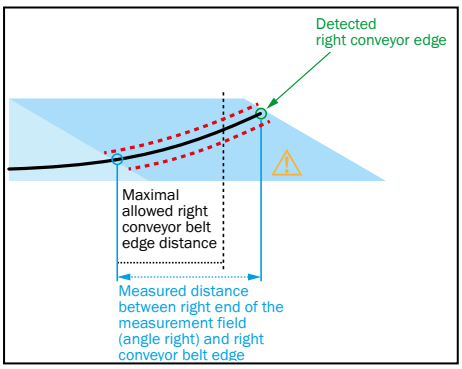


Fig. 9 Signaling of belt edge warnings

The Bulkscan® LMS511 can monitor the distance from the conveyor belt edge and signal on a digital output if the value exceeds a configurable minimal distance.

Note

- Pay attention to the correct angular adjustment of the sensor to obtain meaningful values for the distance to the belt edge (see "8.1 Teaching-in the reference contour“ on page 64).
- You can smooth the measured values with the aid of the averaging filter (see "4.11 Averaging filter“ on page 25).

How to configure the calculation of the distance from the conveyor belt edges:

- On the **Operating mode** configuration bar, click **Maintenance** to switch to maintenance mode.
- Switch to the **Edge monitoring** tab. Set the limits of the monitored area (**left field ends** at and **right field ends** at) so that the entire monitoring area can still be covered.
  Or:
  Switch to the Monitor tab. Click and drag the outside left or right edge beam to the required aperture angle
- Configure the upper and lower monitoring limits for the left and right belt edges (**Upper limit** and **Lower limit**) in the Edge detection tab.
- Configure the **Averaging filter Distance to edge**, if required.

How to configure the signaling of belt edge warnings :

- Switch to the **Edge monitoring** tab.
- Configure the **Distance from the left edge** and the **Distance from the right edge** from which a warning is issued.
- Switch to the **Interfaces** tab.
- Click on **Digital outputs** to open the **Digital outputs** tab (see "4.13 Digital outputs“ on page 26).
- Select the assignment **Information**/**Warnings** for the required output.
- Select the required **Logic**.
- Select the required **Warning** (**All, Conveyor edge left** or **Conveyor edge right**).
- Configure the **Switching delay**, if required.

4.11 Averaging filter

The Bulkscan® smooths the measured values for the calculation of the **Flow, Center of gravity**, **Bulk height**, **Belt speed** and **Distance to edge** (**only valid for** Bulkscan® LMS511) using an averaging filter over the previous *n* seconds.

The **Flow** averaging filter affects both the results for the **Volume flow rate** and the **Mass flow rate**. You can configure the period for the averaging.

Note

- Set the required averaging filter to 0 seconds to disable the filter.
- **Measurement tab**, **Averaging filter group**, **Flow**, **Center of gravity, Bulk height, Belt speed** or **Distance to edge** (**only valid for Bulkscan® LMS511**) option.

4.12 Digital inputs

The Bulkscan® LMS511 and Bulkscan® LMS111 have two digital inputs which are used to signal the belt operation and reset the volume sum and mass sum.

How to configure the signaling of the belt operation:

- Switch to the **Measurement** tab.
- Configure the **Belt speed** as **Fixed value** (see "4.1 Setting the belt speed“ on page 17).
- Check the **Use status signal** checkbox.
- Configure the **Logic** for the digital input signal.

Note Alternatively, you can also make the configuration settings in the **Digital inputs** tab

How to configure the resetting of volume sum and mass sum:

- Switch to the **Interfaces** tab.
- Click on **Digital inputs** to open the **Digital inputs** tab.
- Configure the **Switching condition** of the digital input signal.

4.13 Digital outputs

The Bulkscan® LMS511 has six digital outputs and the Bulkscan® LMS111 has three digital outputs. On the digital outputs the sensors can signal that certain totals have been reached, limits have been exceeded or dropped below, or the occurrence of information/warnings.

The outputs can be used as digital outputs to ground or as floating outputs (see "6.3 Wiring the inputs and outputs to the external components“ on page 51).

Assignment	Switching condition	Behavior
Information/ Warnings	Information (Q1 Yellow): The sensor continues to measure.	The output remains active until the problem is rectified.
	Warnings (Q2 Orange): The sensor no longer measures	
Volume quota **Mass quota**	Reaching the volume quota or mass quota	The output behaves like a pulse output.
Volume flow rate **Mass flow rate** **Center of gravity** **Bulk density** **Bulk height** **Belt speed**	• Dropping below the lower limit • Exceeding the upper limit	The output behaves like a switching output.

Tab. 3: Assignment and switching conditions for the digital outputs

Note

When turning the sensor on, digital outputs are available after the power-up delay. When the sensor is in **Maintenance** mode, only the output selected as **Contamination** output is available.

Digital outputs tab

Logic

You can configure the switching behavior on the occurrence of the switching condition:

- Active low: The digital output changes from HIGH to LOW (= active).
- Active high: The digital output changes from LOW to HIGH (= active).

Behavior as output Information/Warnings

Assignment	Description
All	All information/warnings are displayed
Invalid measuring points	Too many invalid measuring points within one scan
Bulk edge left (only for Bulkscan® LMS511)	Bulk materials too close to the left end of the measurement field
Bulk edge right (only for Bulkscan® LMS511)	Bulk materials too close to the right end of the measurement field
Conveyor edge left (only for Bulkscan® LMS511)	Belt too far from the left end of the measurement field
Conveyor edge right (only for Bulkscan® LMS511)	Belt too far from the right end of the measurement field
Contamination	Front screen contaminated
BAM100 external input (only for Bulkscan® LMS511)	The signal coming from the analog input 4 in BAM100 passed the set limit

Tab. 4: Behavior as output Information/Warnings

It is possible to set a switching delay time. for the digital output.

Warnings that are present for a short time only are not issued via the digital output if the switching delay times are long.

Behavior as pulse output

If the set **Volume quota** or Mass quota is reached, a pulse is transmitted from the digital output. You can set the **Pulse width** to between 20 ms and 10 s.

Note

- Ensure that the set pulse width is as short as possible and as long as necessary for the device connected to the digital output to still detect the pulse.
- Ensure that the duration of the pause between pulses is longer than the cycle time resulting from the scan frequency (see "8.5 Scan frequency“ on page 72).

Behavior as switching output

The digital output is activated when the measured value falls below the set lower limit value or exceeds the set upper limit. The output remains active until the measured value lies within the set limit values again.

If the measured values fluctuate about the upper or lower limit value, the digital output would switch continuously. In practice, this behavior is not desirable. This is prevented by the configurable Hysteresis.

From the upper and lower limits and their respective hysteresis, upper and lower switching limits are calculated as follows:

- Switch on limit high: OnUp= (1 + (**Upper hysteresis** / 100)) × **Upper limit**
- Switch off limit high: OffUp = (1 - (**Upper hysteresis** / 100)) × **Upper limit**
- Switch off limit low: OffLo = (1 + (**Lower hysteresis** / 100)) × **Lower limit**
- Switch on limit low: OnLo = (1 - (**Lower hysteresis** / 100)) × **Lower limit**

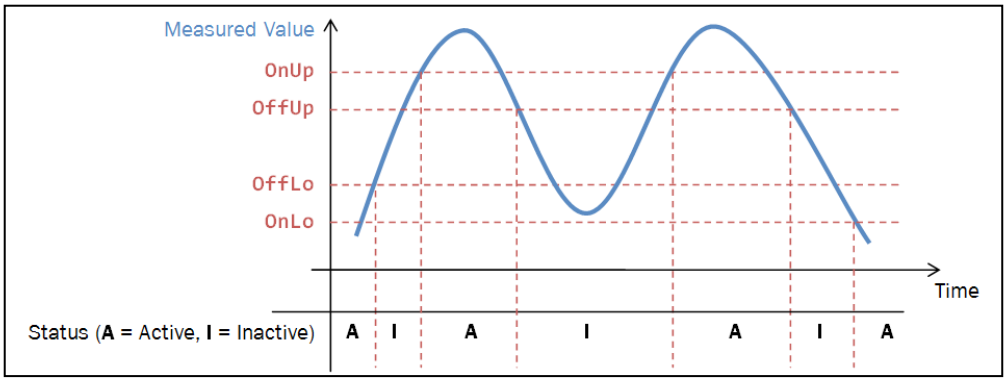


Fig. 10: Switching limits representations with relevant hysteresis

Example: The digital Output1 is selected as *Bulk height* with following settings.

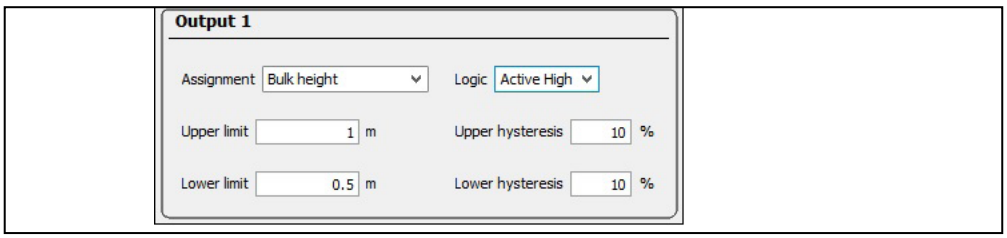


Fig. 11: digital Output1 set as Bulk height rate and settings

Under these conditions the switching limits are defined as follow:

- OnUp = (1 + (**Upper hysteresis** / 100)) × **Upper limit** = (1+10/100) x 1 = 1.1 m
- OffUp = (1 - (**Upper hysteresis** / 100)) × **Upper limit** = (1-10/100) x 1 = 0.9 m
- OffLo = (1 + (**Lower hysteresis** / 100)) × **Lower limit** = (1+10/100) x 0,5 = 0.55 m
- OnLo = (1 - (**Lower hysteresis** / 100)) × **Lower limit** = (1-10/100) x 0,5 = 0.45 m

Note

- A small hysteresis increases the switching frequency at the limit value.
- A large hysteresis reduces the switching frequency at the limit value.

4.14 Analog module BAM100

The Bulkscan® LMS511 and Bulkscan® LMS111 can read in and output analog current values in the range 4 to 20 mA via the analog module BAM100.

Analog input signals are converted to digital format and transmitted to the Bulkscan®.

The analog module BAM100 can also convert measured values from the Bulkscan® into analog output signals and output them.

Four analog inputs are available, which can read in the following input variables:

- **Analog input 1: Belt speed**
- **Analog input 2: Bulk density**
- **Analog input 3: Mass flow rate**
- **Analog input 4: External input (only for Bulkscan® LMS511)**

The analog module has four analog outputs, which can be assigned the following output variables:

- **Volume flow rate**
- **Mass flow rate**
- **Center of gravity**
- **Bulk height**
- **Bulk density**
- **Belt speed**
- **Belt edge left (only for Bulkscan® LMS511)**
- **Belt edge right (only for Bulkscan® LMS511)**
- **Bulk edge left (only for Bulkscan® LMS511)**
- **Bulk edge right (only for Bulkscan® LMS511)**

Note The analog module must be ordered in addition to the basic device.

How to configure the analog inputs:

- ▶ Switch to the **Measurement** tab.
- ▶ Configure the reqired input source as **Analog value**
- ▶ Configure the **4 mA** point and the **20 mA** point according to the represented input variable.

How to configure the analog outputs:

- ▶ Switch to the **Interfaces** tab.
- ▶ Click on **BAM100** to open the **BAM100** tab.
- ▶ Select the assignment under **Analog outputs**.
- ▶ Configure the **4 mA** point and the **20 mA** point according to the represented output variable.

How to establish a connection to the BAM100 analog module:

- ▶ Make sure that you have set and saved all of the application-specific settings.
- ▶ Click to connect **BAM100** module.
- ▶ Close SOPAS ET and connect the Bulkscan® sensor to the BAM100 analog module with the Ethernet connecting cable, see accessories (see "12.2 Accessories“ on page 96). An RJ45 female connector is provided on the BAM100 module for this purpose (see electrical installation).

Note The Bulkscan® and the BAM100 use a point-to-point connection. It is not allowed to connect the BAM100 through a network.

4.15 Data interfaces

The Bulkscan® LMS511 and Bulkscan® LMS111 have different data interfaces for the configuration and the transmission of measured values.

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

4.15.1 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 Bulkscan® as well as the output of measured values.

If your network uses static IP addresses, then you must adapt the configuration of the Ethernet interface so that a connected PC (client) can communicate with the Bulkscan® via Ethernet. If you are unsure about the correct Ethernet configuration, please contact your network administrator.

Network tab, **Interfaces, Ethernet**

Note If you change the parameters for the interface via which you are connected to the sensor, the connection to the sensor will be lost. You must re-establish the connection (see "7.1.2 Establishing communication with the Bulkscan®“ on page 61).

To connect the electrical interface, (see "6.2.2 Ethernet interface connection“ on page 47).

4.15.2 Serial host interface

The Serial host interface is an RS-232/RS-422 interface (RS-422 only Bulkscan® LMS511). The host interface permits the configuration of the Bulkscan® LMS511 and Bulkscan® LMS111 and limited output of measured values.

The interface parameters are freely configurable.

Network tab, **Interfaces, Serial, Serial Host Interface** group.

The factory setting for the host interface is as follows:

- 57,600 baud
- 8 data bits
- 1 stop bit
- No parity bit

The data transmission rate of the RS-232/RS-422 interfaces (RS-422 only Bulkscan® LMS511) is limited to 57,600 baud. Therefore these interfaces are not suitable for transmitting scan data in real time.

If you change the parameters for the interface via which you are connected to the sensor, the connection to the sensor will be lost. You must re-establish the connection (see "7.1.2 Establishing communication with the Bulkscan®“ on page 61).

To connect the electrical interface, (see "6.2.4 Serial interface connection of Bullkscan® LMS511“ on page 48).

4.15.3 Serial auxiliary interface/USB on Bulkscan® LMS511

The Mini-USB Interface permits the direct configuration of the Bulkscan®.

Note

- Configuration via USB is only possible if you have installed the USB driver during the installation of the SOPAS configuration software. This is the case with the default installation.
- Parameters can then also be changed via USB, if the Bulkscan® is connected to a host via another interface. Only the changes last saved in the sensor are retained.

The **Data transmission rate** and **Heartbeat rate** of the USB interface can be configured via software.

Network tab, **Interfaces, Serial, Serial auxiliary interface/USB** group

To connect the electrical interface, (see "6.2.5 Mini-USB connection of Bullkscan® LMS511“ on page 49).

4.15.4 Serial auxiliary interface on Bulkscan® LMS111

The serial auxiliary interface is an RS-232 interface. The auxiliary interface permits the configuration of the direct Bulkscan® LMS111. The factory setting for the auxiliary interface is as follows:

- 57,600 Baud
- 8 data bits
- 1 stop bit
- No parity

5 Mounting

Note Do not open the Bulkscan® LMS511 and Bulkscan® LMS111 housing. If opened, any warranty claims against SICK AG are void.

Overview of the mounting steps

1. Placing mounting materials ready
   (see "5.1 Placing mounting materials ready“ on page 31).
2. Selecting the mounting location
   (see "5.2 Selecting the mounting location“ on page 31).
3. Mounting the sensor (see "5.3 Mounting the sensor“ on page 32).

5.1 Placing mounting materials ready

- Bulkscan® LMS511, weights approx. 3.7 kg.
- Bulkscan® LMS111, weights approx. 1.1 kg.
- Mounting kit(s) with mounting material (not included).

  or

  alternatively, if a mounting bracket is provided by the user:

  - Stable mounting bracket that provides adjustable alignment of the Bulkscan® on the x and y axis.
  - 4 M6 screws for the Bulkscan®, screw length dependent on the thickness of the mounting bracket used.
- 4 M6 screws for mounting the SICK mounting bracket on the support, screw length dependent on the thickness of the support.
- Tool set.

5.2 Selecting the mounting location

Risk of malfunction or damage due to direct sunlight on the sensor!
Direct sunlight on the sensor can cause the sensor to overheat.

▶ Mount the sensor so that it is not exposed to direct sunlight.

Risk of malfunction due to deflection!
If the emitted laser beam is deflected by reflective surfaces, this may result in incorrect measurements.

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

- Mount the sensor so that it is protected from moisture, dirt, damage, and direct sunlight.
- Ensure that the entire field of view of the sensor is not restricted.
- Mount the sensor so that the status indicators can be clearly seen.
- Always mount the sensor so that there is still enough space for mounting and removing the system plug or the connections.
- Avoid excessive shock and vibration loading on the sensor.

The sensor is to be attached in the center over the conveyor belt on mounting ¬brackets to be installed on site. During this process the following conditions must be met to ensure measurement accuracy:

- Optical axis over a transport roller
- Minimum distance to the top edge of the bulk: 500 mm
- Perpendicular alignment to the direction of transport.

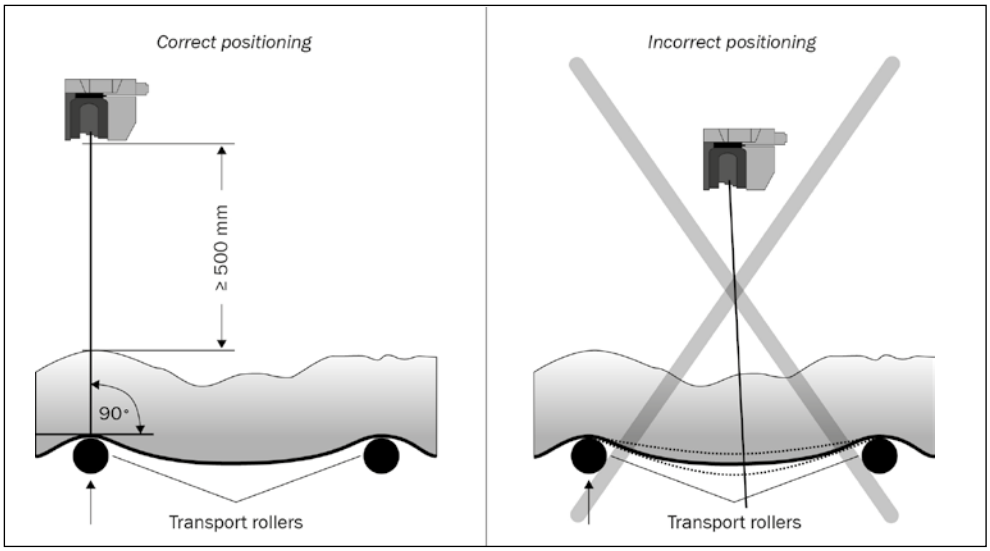


Fig. 12: Positioning of the Bulkscan® LMS511 or Bulkscan® LMS111 above the conveyor belt

Note The field of view of the sensor must be clear.

5.3 Mounting the sensor

- Pay attention to the maximum torque for the Bulkscan® fixing screws:
  - Bulkscan® LMS511: M6 rear = max. 12 Nm
  - Bulkscan® LMS511: M8 side = max. 16 Nm
  - Bulkscan® LMS111: M5 rear = max. 6 Nm
  - Bulkscan® LMS111: M5 side = max. 6 Nm
- Regularly check the tightness of the fixing screws.
- On systems that suffer from heavy vibration, prevent the fixing¬ screws¬ from coming loose using screw locking devices.

Possible ways of mounting the Bulkscan® LMS511:

- Direct mounting of the Bulkscan® LMS511 (see "5.3.1 Direct mounting of the Bulkscan® LMS511“ on page 33).
- Mounting with mounting kit 1 (see "5.3.2 Mounting of Bulkscan® LMS511 with mounting kit 1“ on page 34).
- Mounting with mounting kit 2 (see "5.3.3 Mounting of Bulkscan® LMS511 with mounting kit 2“ on page 35). (Only in conjunction with mounting kit 1).
- Mounting with mounting kit 3 (see "5.3.4 Mounting of Bulkscan® LMS511 with mounting kit 3“ on page 36). (Only in conjunction with mounting kit 1 and 2).
- Mounting Bulkscan® LMS511 with mounting bracket on existing mounting kit LMS2xx (see "5.3.5 Mounting of Bulkscan® LMS511 with mounting bracket on existing mounting kit LMS2xx“ on page 37).
- Mounting Bulkscan® LMS511 with mounting bracket and mast bracket (see "5.3.6 Mounting of Bulkscan® LMS511 with mounting bracket and mast bracket“ on page 38).

Possible ways of mounting the Bulkscan® LMS111:

- Direct mounting (see "5.3.7 Direct mounting of Bulkscan® LMS111“ on page 39).
- Mounting kit 1a: mounting bracket for mounting at the rear on wall or machine (see "5.3.8 Mounting of Bulkscan® LMS111 with mounting kit 1a or 1b“ on page 39).
- Mounting kit 1b: mounting bracket for mounting at the rear on wall or machine, with protection for the optics cover (see "5.3.8 Mounting of Bulkscan® LMS111 with mounting kit 1a or 1b“ on page 39).
- Mounting kit 2: mounting bracket, only in conjunction with mounting bracket 1a or 1b, cross-wise adjustment possible (see "5.3.9 Mounting of Bulkscan® LMS111 with mounting kit 2 or 3“ on page 41).
- Mounting kit 3: mounting plate, only in conjunction with mounting kit 2, lengthwise adjustment possible (see "5.3.9 Mounting of Bulkscan® LMS111 with mounting kit 2 or 3“ on page 41).
- As an alternative you can use a strong stable mounting bracket that provides adjustable alignment of the Bulkscan® LMS111 in the X- and Y axis.

5.3.1 Direct mounting of the Bulkscan® LMS511

The Bulkscan® LMS511 has four M6×8 threaded holes on the rear. They can be used to mount the Bulkscan® LMS511 directly on the intended mounting surface.

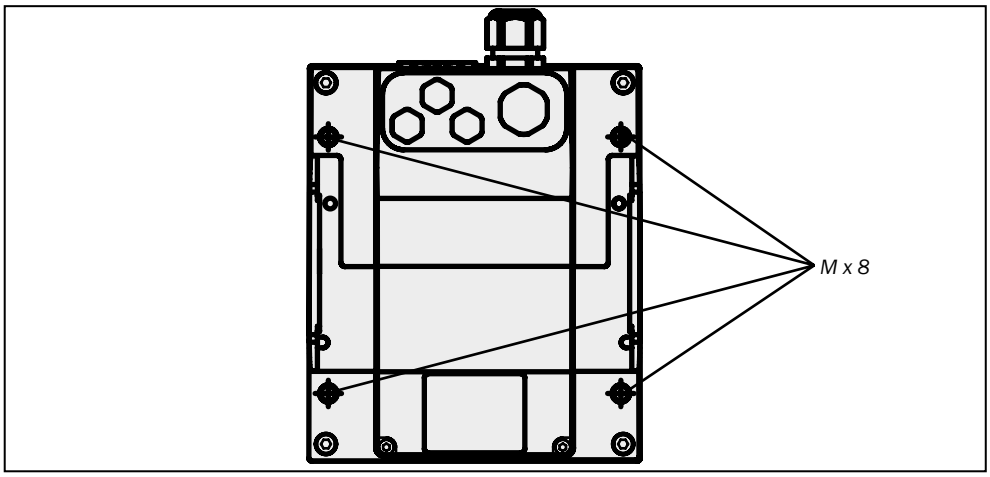


Fig. 13: Direct mounting

Note During mounting, observe the dimensional drawings (see "11.4 Dimensional drawings“ on page 85).

5.3.2 Mounting of Bulkscan® LMS511 with mounting kit 1

You can use mounting kit 1 to mount the Bulkscan® LMS511 on a mounting surface (wall, machine).

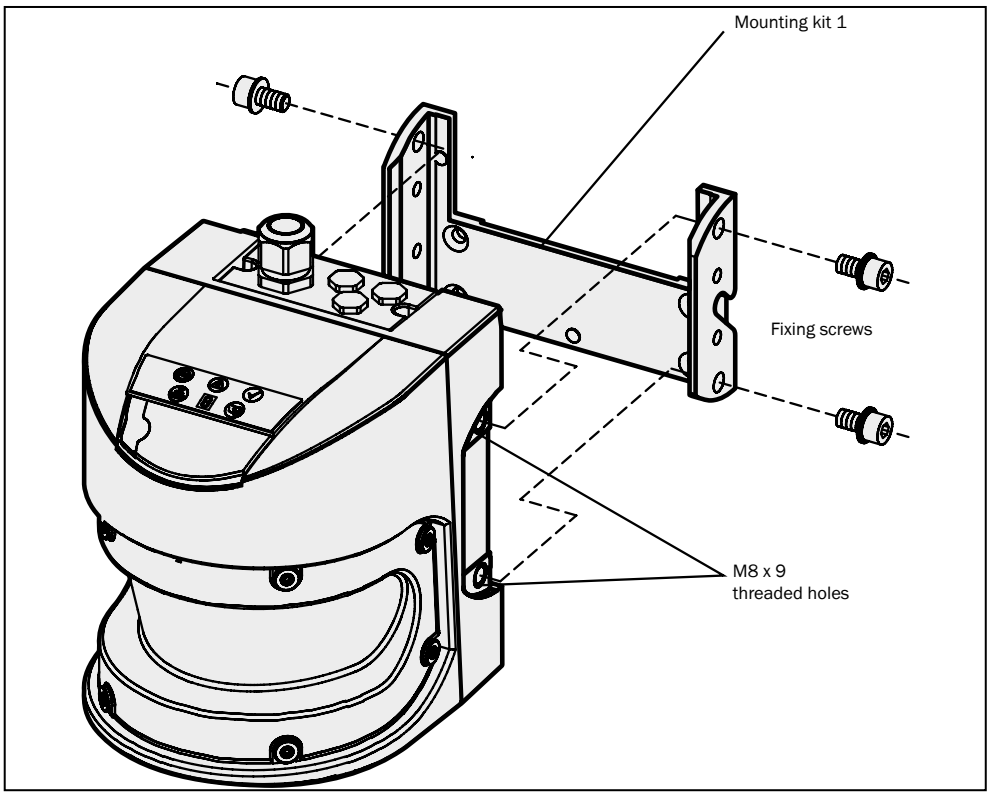


Fig. 14: Mounting with mounting kit 1

- Mount mounting kit 1 on the mounting surface.
- Mount the Bulkscan® LMS511 on mounting kit 1.

Note During mounting, observe the dimensional drawings (see "11.4.2 Dimensional drawings mounting kits“ on page 86).

5.3.3 Mounting of Bulkscan® LMS511 with mounting kit 2

You can use mounting kit 2 (only in conjunction with mounting kit 1) to align the Bulkscan® LMS511 in two planes. The maximum adjustment angle is ±11° in both planes..

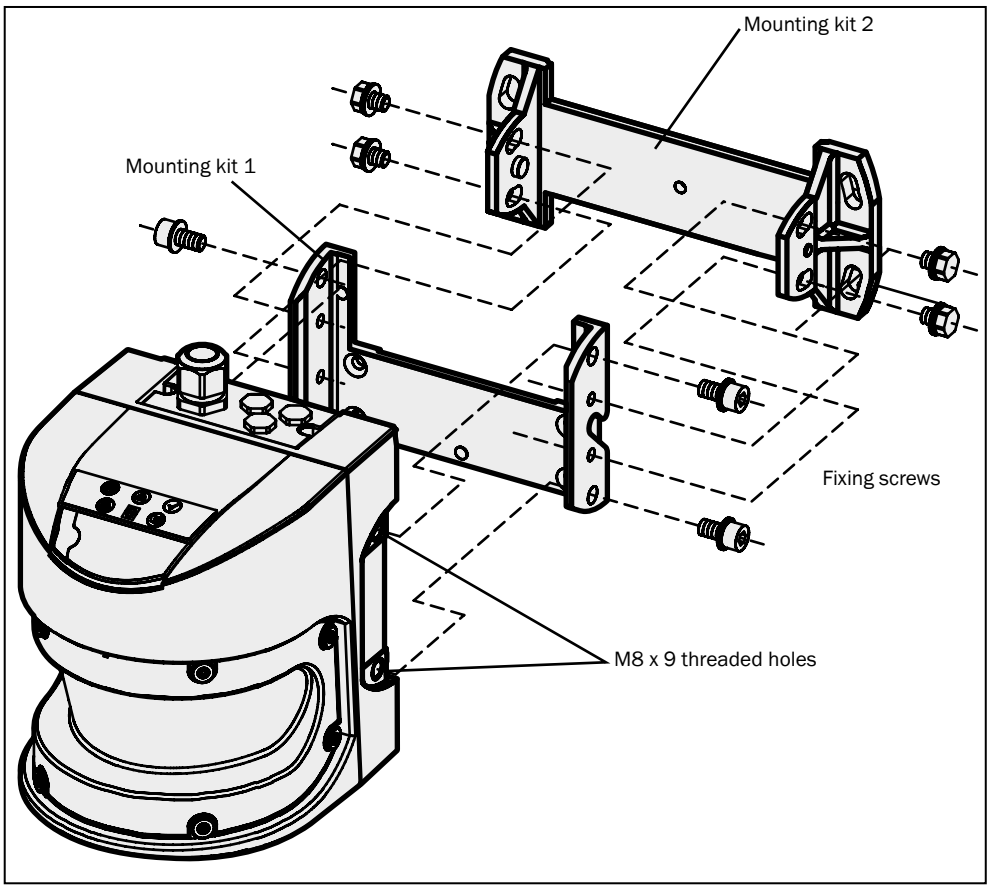


Fig. 15: Mounting with mounting kit 1 and 2

- Mount mounting kit 2 on the mounting surface.
- Then mount mounting kit 1 on mounting kit 2.
- Mount the Bulkscan® LMS511on mounting kit 1.
- Adjust the Bulkscan® LMS511 longitudinally and crosswise.

Note During mounting, observe the dimensional drawings (see "11.4.2 Dimensional drawings mounting kits“ on page 86).

5.3.4 Mounting of Bulkscan® LMS511 with mounting kit 3

You can use mounting kit 3 (only in conjunction with mounting kit 1 and 2) to mount the Bulkscan® LMS511 so that the scan plane is parallel to the mounting surface. This enables stable wall or ceiling mounting or ensures that mounting kit 2 remains precisely adjustable crosswise on uneven surfaces.

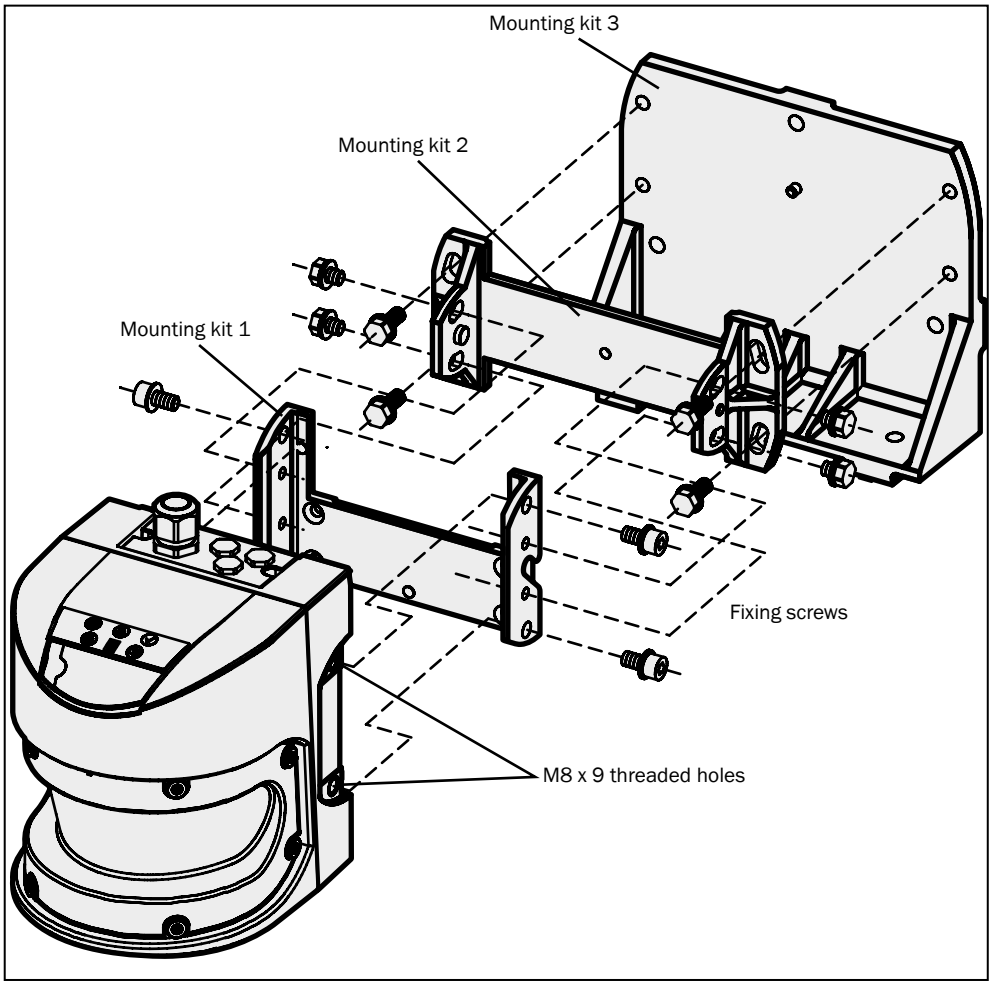


Fig. 16: Mounting with mounting kit 1, 2, and 3

- Mount mounting kit 3 on the mounting surface.
- Then mount mounting kit 2 on mounting kit 3.
- Then mount mounting kit 1 on mounting kit 2.
- Mount the Bulkscan® LMS511 on mounting kit 1.
- Adjust the Bulkscan® LMS511 longitudinally and crosswise

Note During mounting, observe the dimensional drawings ((see "11.4.2 Dimensional drawings mounting kits“ on page 86).

5.3.5 Mounting of Bulkscan® LMS511 with mounting bracket on existing mounting kit LMS2xx

With the aid of the mounting bracket, you can mount the Bulkscan® LMS511 on an existing LMS2xx mounting kit as a replacement sensor for a Bulkscan® LMS211/ LMS221.

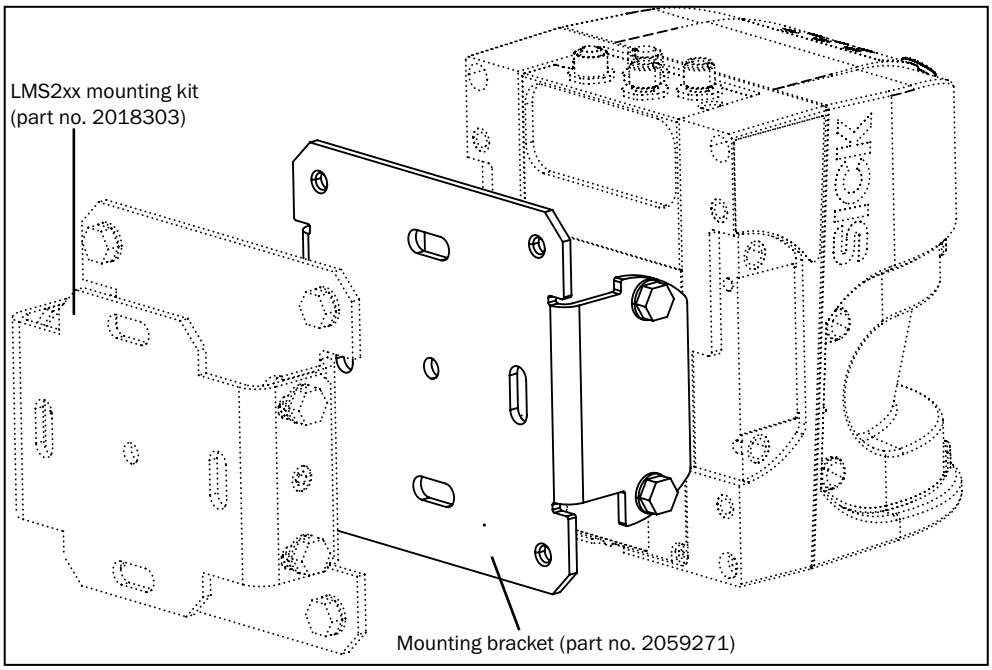


Fig. 17: Mounting Bulkscan® LMS511 with mounting bracket on an existing mounting kit LMS2xx

- Mount the mounting bracket on the existing mounting kit.
- Mount the Bulkscan® LMS511 on the mounting bracket.

Note During mounting, observe the dimensional drawings (see "11.4.3 Dimensional drawing mounting bracket for existing LMS2xx mounting kit“ on page 89).

5.3.6 Mounting of Bulkscan® LMS511 with mounting bracket and mast bracket

With the aid of the mounting bracket in conjunction with the mast bracket, you can mount and radially align the Bulkscan® on round posts.

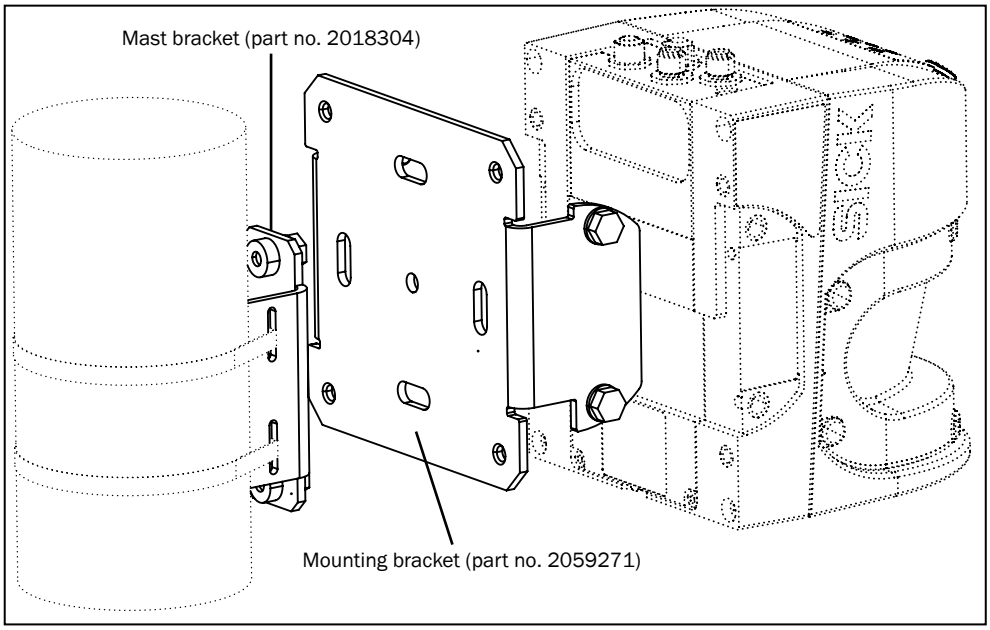


Fig. 18: Mounting with mounting bracket and mast bracket

- Mount the mast bracket hand-tight on the round post.
- Mount the mounting bracket on the mast bracket.
- Mount the Bulkscan® LMS511 on the mounting bracket.
- Align the Bulkscan® LMS511 radially.
- Fix the mast bracket.
- Check the alignment of the Bulkscan® LMS511 and correct, if necessary.

Note During mounting, observe the dimensional drawings (see "11.4.4 Dimensional drawing mounting bracket with mast bracket“ on page 90).

5.3.7 Direct mounting of Bulkscan® LMS111

The Bulkscan® LMS111 has two M5 × 8 threaded holes on the rear. Using them you can mount the Bulkscan® LMS111 directly on the intended mounting surface. To avoid a possible tendency to vibrate, the reference surface on the rear can be used as the third mounting point (1).

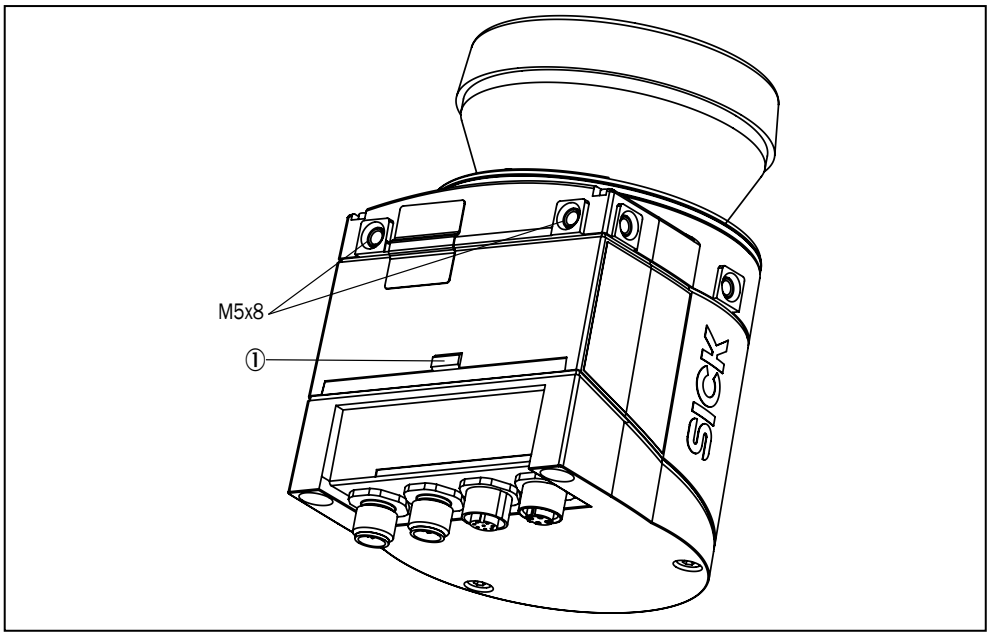


Fig. 19: Direct mounting

Note During mounting, observe the dimensional drawings (see "11.4.5 Dimensional drawing Bulkscan® LMS111“ on page 91).

5.3.8 Mounting of Bulkscan® LMS111 with mounting kit 1a or 1b

Using mounting kit 1 you can mount the Bulkscan® LMS111 on a mounting surface (wall, machine). The mounting kit is available as mounting kit 1a without protection device for the optics cover and as mounting kit 1b with protection device for the optics cover.

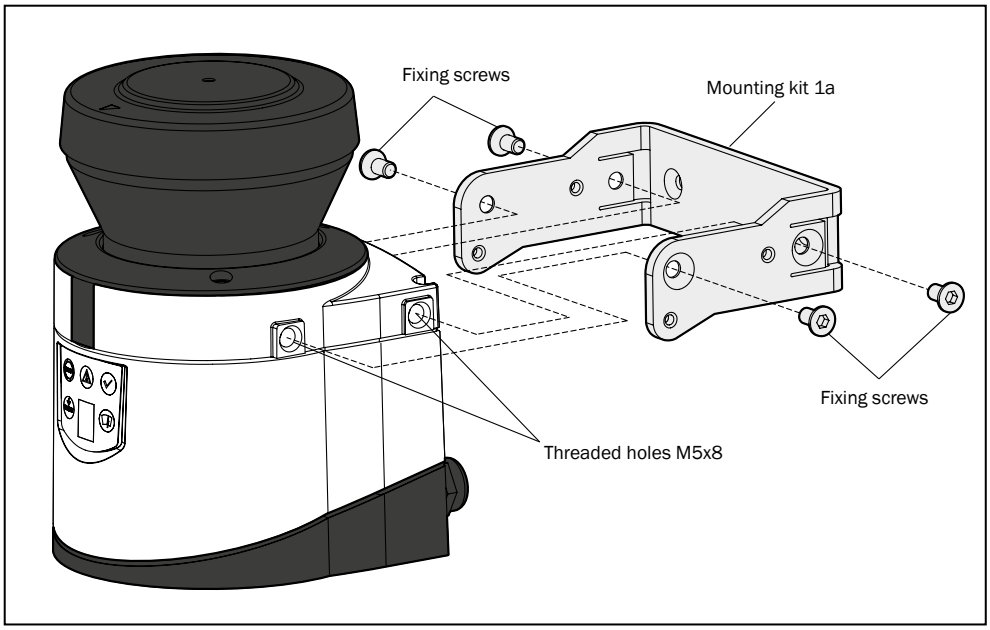


Fig. 20: Mounting with mounting kit 1a (part no. 2034324)

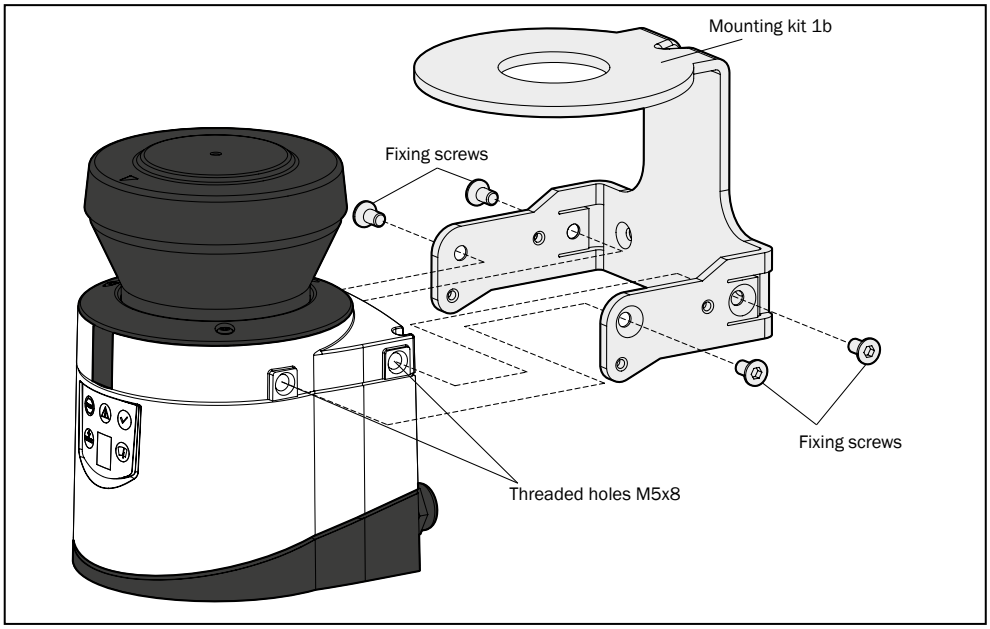


Fig. 21: Mounting with mounting kit 1b (part no. 2034325)

1. Mount mounting kit 1a or 1b on the mounting surface.
2. Then mount the Bulkscan® LMS111 on the mounting kit 1a or 1b.

Note During mounting, please observe the dimensional drawings (see "11.4.6 Dimensional drawing mounting kits (only for Bulkscan® LMS111)“ on page 92).

5.3.9 Mounting of Bulkscan® LMS111 with mounting kit 2 or 3

With the aid of mounting kits 2 and 3 (only in conjunction with mounting kit 1a or 1b) you can align the Bulkscan® LMS111 in two planes. The maximum adjustment angle is ±11° in both planes.

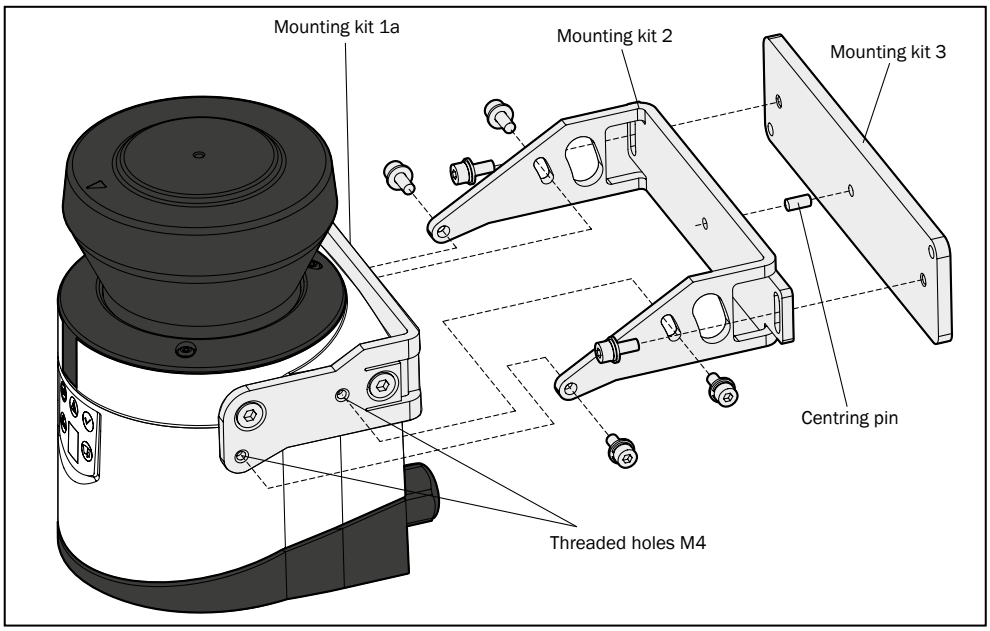


Fig. 22: Mounting with mounting kit 2 (part no. 2039302) and kit 3 (part no. 2039303)

1. Mount mounting kit 1a or 1b to the Bulkscan® LMS111.
2. Mount the mounting kit 3 on the mounting surface.
3. Fit the centring pin (4 mm) in the central hole on mounting bracket 3.
4. Fit mounting kit 2 to mounting kit 3 and mount it using two fixing screws M4 × 10.
5. Then mount the Bulkscan® LMS111 on mounting kit 2 with the aid of the threaded holes in mounting kit 1a.
6. Adjust the Bulkscan® LMS111 longitudinally and transversely and then tighten the six fixing screws on the mounting kits.

Note During mounting, please observe the dimensional drawings (see "11.4.6 Dimensional drawing mounting kits (only for Bulkscan® LMS111)“ on page 92).

5.3.10 Mounting of Bulkscan® LM511 with weather protection hood

To protect the Bulkscan® LMS511 from glare, precipitation and direct sunlight when used outside the weather protection hood (part no. 2063050) is available.

You will find detailed dimensions in section „11.4.7 Dimensional drawing weather protection hood for Bulkscan® LMS511“

Bulkscan® LMS511 with weather protection hood

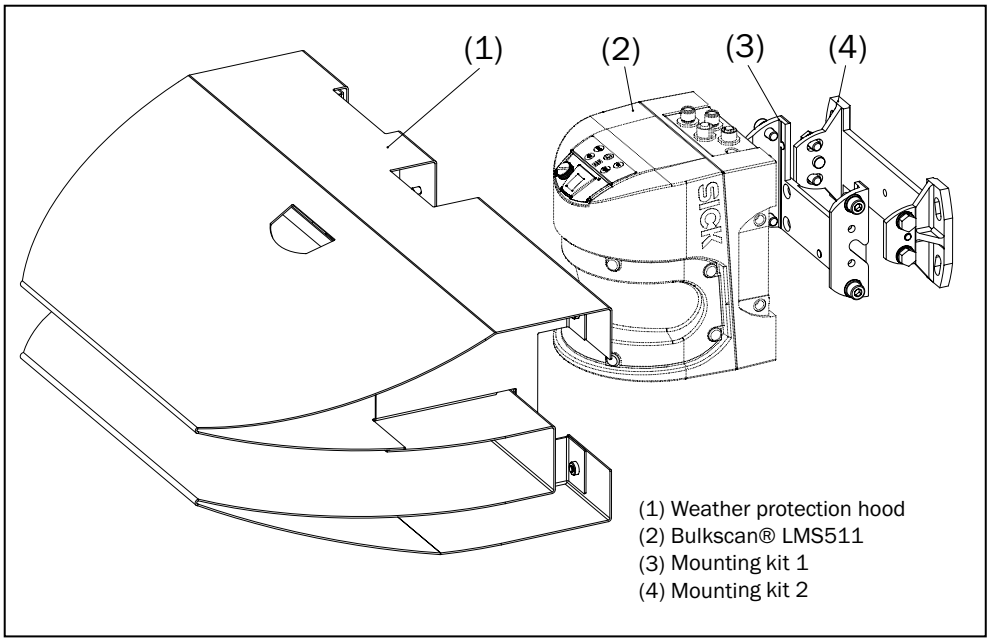


Fig. 23: Weather protection hood (part no. 2063050)

For mounting the Bulkscan® LMS511in combination with the weather protection hood, mounting kit 1 and 2 are required.

5.3.11 Mounting of Bulkscan® LM111 with weather protection hood

To protect the Bulkscan® LMS111 from glare and precipitation when used outside the weather protection hood 190° (part. no 2046459) is available.

You will find detailed dimensions in section „11.4.8 Dimensional drawing weather protection hood for Bulkscan® LMS111“.

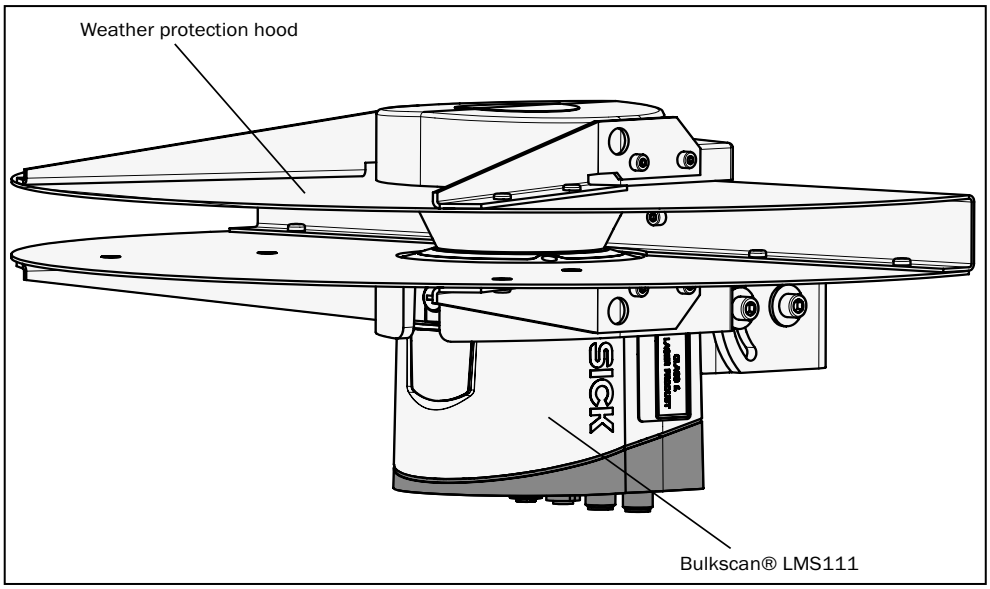


Fig. 24: Weather protection hood 190°(part no. 2046459)

How to mount the weather protection hood on the Bulkscan® LMS111:

1. Put the weather protection hood 190° over the Bulkscan® LMS111.

2. Mount the weather protection hood on the Bulkscan® LMS111 using three M5 × 15 countersunk head screws (included with the delivery of the weather protection hood.

For this purpose you will find on the weather protection hood two holes with 90° countersink on the rear and one hole with 90° countersink on the right.

Mounting kits for the weather protection hood

Using the mounting kits for the weather protection hood you can align the Bulkscan® LMS111 in two planes. The maximum adjustment angle is ±22.5° in both planes.

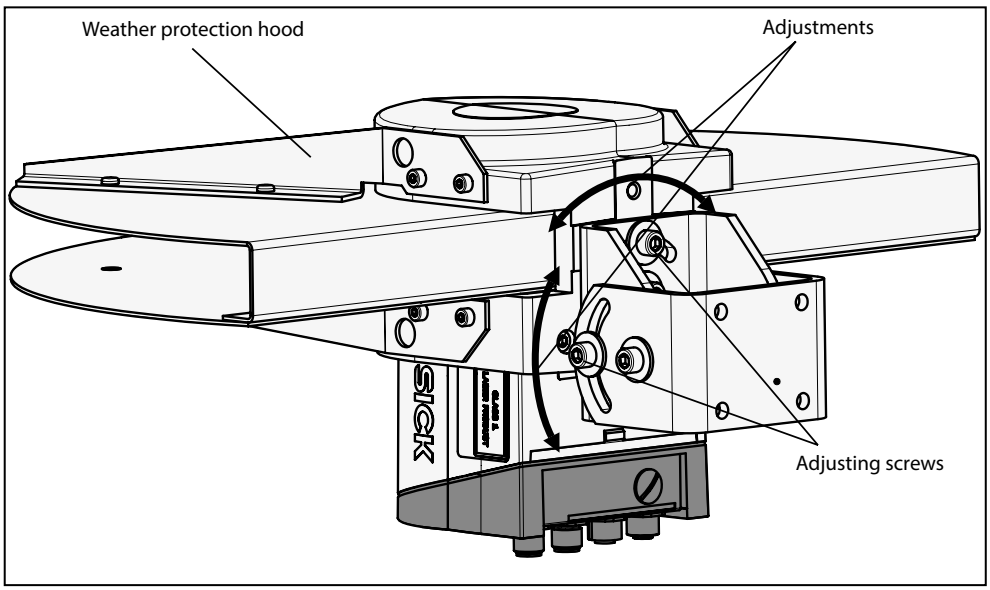


Fig. 25: Standard mounting kit (part no. 2046025) for the weather protection hood
The quick-action mounting kit for the weather protection hood permits the quick replacement of the Bulkscan® LMS111, without the need to adjust the new device.

5.4 Removing the sensor

- Switch the supply voltage off.
- Remove the connection cables.
- Unscrew the mounting screws for the Bulkscan® on the mounting bracket and remove the sensor.

Note On final decommissioning, please observe the requirements for environmentally correct disposal (see "2.5.2 Disposal after final decommissioning“ on page 13).

6 Electrical installation

- Only authorized personnel are allowed to perform the electrical installation work.
- Do not open the sensor housing.
- Observe the current safety regulations when working on electrical systems.

Risk of injury! Risk of damage to the sensor!
The machine/system to which the sensor will be connected could be inadvertently started.

- ▶ Switch the entire machine/system off before connecting the sensor.
- ▶ Make sure that the entire system is disconnected from the power supply during the electrical installation.

Overview of the steps for the electrical installation

- Observe the Requirements for the electrical installation (see "6.1 Requirements for the electrical installation“ on page 44).
- Carrying out the electrical installation on the Bulkscan® (see "6.2 Carrying out the electrical installation on the Bulkscan®“ on page 46).
- Wiring the inputs and outputs to the external components (see "6.3 Wiring the inputs and outputs to the external components“ on page 51).

6.1 Requirements for the electrical installation

6.1.1 Avoiding potential differences

The Bulkscan® is connected to the peripheral devices (power supply, encoder, PLC/host, etc.) via shielded cables (Fig. 26). The shield of each cable is connected to the metal housing of the sensor via the system plug.

The sensor can be grounded via the mounting brackets of the mounting kits or via the shield of the power supply cable, for example.

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

This is achieved by fulfilling the following conditions, for example:

- Mounting the devices on conductive metal surfaces.
- Correctly grounding the devices and metal surfaces in the system.
- If necessary, low-impedance and current carrying equipotential bonding between areas with different ground potentials.

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.

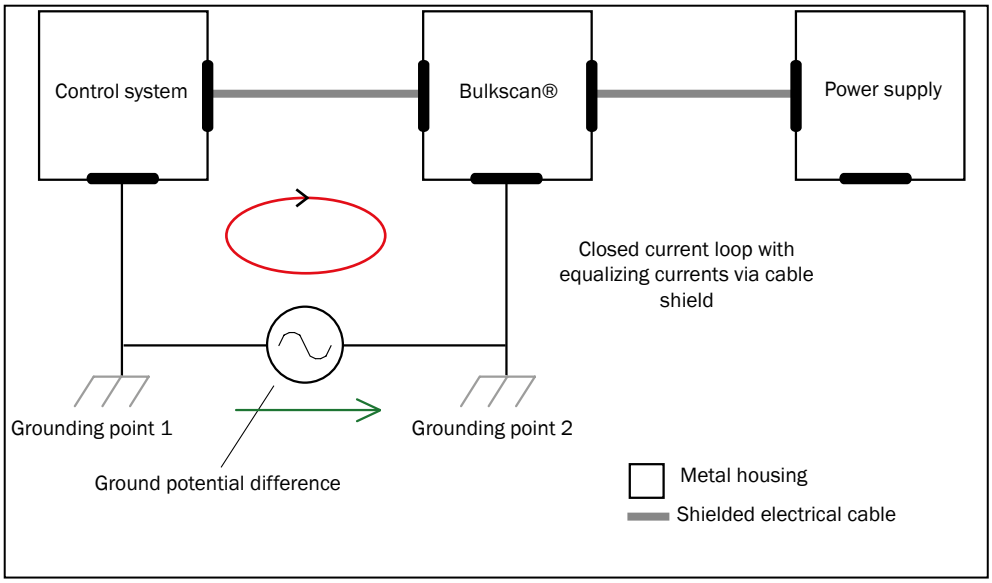


Fig. 26: Currents in the cable shields due to differences in ground potential

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.

Risk of injury and damage caused by electrical current!
Potential equalization currents between the Bulkscan® and the peripheral devices can have the following effects:

- Dangerous voltages on the metal housing, e.g., of the Bulkscan®.
- 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 grounding method (same ground potential at all grounding points), take measures as described below.

Remedial measures
The most common solution for preventing potential equalization currents on cable shields is to ensure low-impedance and current carrying equipotential bonding. If this is not possible, we suggest the following two solutions.

Note

We expressly advise against opening up the cable shields. This would mean that the EMC limit values can no longer be complied with and that the safe operation of the device data interfaces can no longer be guaranteed.

6.1.2 Suitable power supply

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).

- Use a safety transformer to generate the supply voltage.

For information on the supply voltage for the Bulkscan® and the heating (see "11 Technical data“ on page 80).

6.1.3 Cable lengths and wire cross-sections

- Observe the following maximum cable lengths and the related necessary wire cross-sections.

Connection	Maximum cablelength	Minimum wire cross-section	Notes
Supply voltage		0.25 mm²	Power supply unit in immediate vicinity
	20m (with SICK standard cables)	1.0 mm²	
I/O		0.25 mm²	
	50 m	0.5 mm²	
Data (RS-232)	2 m	0.25 mm² (Twisted Pair shielded)	Max. 115,200 baud
	3 m		
	10 m		Max. 57,600 baud
			Max. 19,299 baud
Data (RS-422) (only valid for Bulkscan® LMS511)	500 m	0.25 mm² (Twisted Pair shielded)	Max. 115.200 baud
	1.200 m		Max. 38.400 baud

Tab. 5: Maximum cable lengths and necessary wire cross-sections

Note

- Lay the data cable separately from the power supply and motor cables, e.g., in separate cable channels, to prevent interference.

6.2 Carrying out the electrical installation on the Bulkscan®

Risk of tripping due to cables! Risk of damage to the cables!
Exposed cables on the floor in areas used by people can pose a risk.

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

Risk of reduced enclosure rating!

- Only connect and mount, if necessary, the electrical connections in a dry and clean environment.
- Only use round connectors that are compliant with enclosure rating IP67.

6.2.1 Supply voltage connection

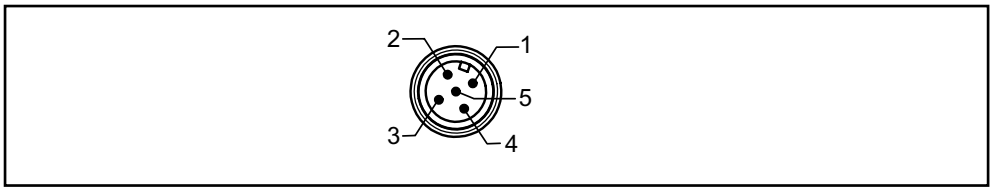


Fig. 27: Pin assignment of the "Power" connection (5-pins M12 male connector, A coded)

Pin	Wire color	Signal	Function
1	Brown	24 V SYS	Power supply sensor
2	White	24 V HEAT	Power supply heating
3	Blue	GND SYS	Ground sensor
4	–	Reserved	Do not use!
5	Black	GND HEAT	Ground heating

Tab. 6: Pin assignment of the "Power" connection

Note Pre-assembled connection cables with flying leads are available as accessories (see "12.2 Accessories“ on page 96).

Other connection cables may have different wire colors.

6.2.2 Ethernet interface connection

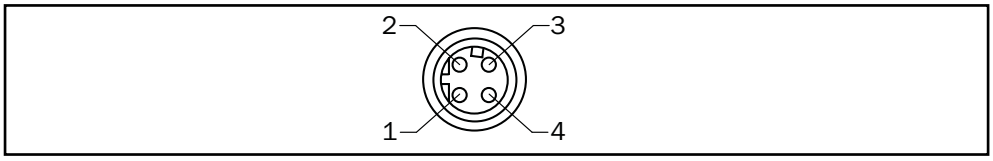


Fig. 28: Pin assignment of the "Ethernet" connection (4-pins M12 female connector, D-coded)

Pin	Signal	Function
1	TX+	Transmit+
2	Rx+	Receive +
3	TX-	Transmit -
4	Rx-	Receive -

Tab. 7: Pin assignment of the "Ethernet" connection

Note Pre-assembled connection cables are available as accessories (see "12.2 Accessories“ on page 96).

Other connection cables may have different wire colors.

6.2.3 Connection of the digital inputs/outputs of Bullkscan® LMS511

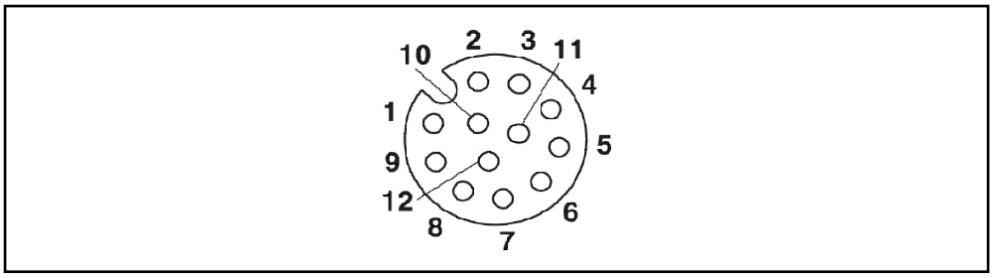


Fig. 29: Pin assignment of the "I/O" connection (12-pins M12 female connector, A-coded).

Pin	Wire color	Signal	Function
1	Brown	24 V EXT	Power supply digital outputs 3 to 6
2	Blue	GND IN	Ground digital inputs 1 + 2
3	White	IN1	Digital input 1
4	Green	GND ENC	Ground encoder inputs
5	Pink	IN2	Digital input 2
6	Yellow	ENC1	Encoder input 1
7	Black	GND EXT	Ground digital outputs 3 to 6
8	Gray	ENC2	Encoder input 2
9	Red	OUT3	Digital output 3
10	Violet	OUT4	Digital output 4
11	Gray/pink	OUT5	Digital output 5
12	Red/blue	OUT6	Digital output 6

Tab. 8: Pin assignment of the "I/O" connection

Pre-assembled connection cables with flying leads are available as accessories (see "12.2 Accessories“ on page 96).

Other connection cables may have different wire colors.

Encoder input 1 is connected to encoder output A (0°).

Encoder input 2 is connected to encoder output B (90°).

6.2.4 Serial interface connection of Bullkscan® LMS511

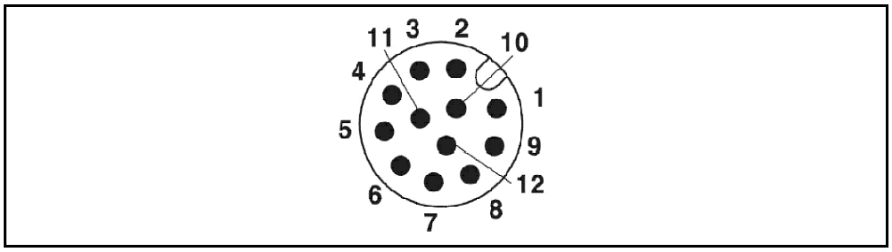


Fig. 30: Pin assignment of the "Data" connection (5-pins M12 male connector, A-coded)

Pin	Wire color	Signal	Function
1	Brown	24 V EXT	Power supply digital outputs 1 + 2
2	Blue	RD–/RxD	RS-422/RS-232

Pin	Wire color	Signal	Function
3	White	OUT1	Digital output 1 [1)]
4	Green	GND RS	GND serial data
5	Pink	OUT2	Digital output 2[1)]
6	Yellow	Reserved	Do not use
7	Black	TD–/TxD	RS-422/RS-232
8	Gray	Reserved	Do not use
9	Red	RD+	RS-422
10	Violet	TD+	RS-422
11	Gray/pink	Reserved	Do not use
12	Red/blue	Reserved	Do not use

Tab. 9: Pin assignment of the "Data" connection

Note

- Observe the maximum cable length (see "6.1.3 Cable lengths and wire cross-sections“ on page 46).
- A shielded cable is required for connecting the RS-232 or the RS-422 interface.
- Pre-assembled connection cables with flying leads are available as accessories (see "12.2 Accessories“ on page 96).
- [1)] Digital outputs 1 and 2: The minimum switching time from low to high is 3 ms.

Other connection cables may have different wire colors.

6.2.5 Mini-USB connection of Bullkscan® LMS511

The Mini-USB Interface permits the direct configuration of the Bulkscan®. The Mini-USB connection is located on the front of the sensor under a dustprotective cap.

Fig. 31: Position of the Mini-USB connection

Note

- The Mini USB connection is only used for configuration of the sensor and must not be connected permanently.
- Configuration via USB is only possible if you have installed the USB driver during the installation of the SOPAS configuration software. This is the case with the default installation.
- Preassembled connection cables are available as accessories (see "12.2 Accessories“ on page 96).
- Always screw the dust protective cap back on when you are not using the connection.

6.2.6 Serial interface connection of Bulkscan® LMS111

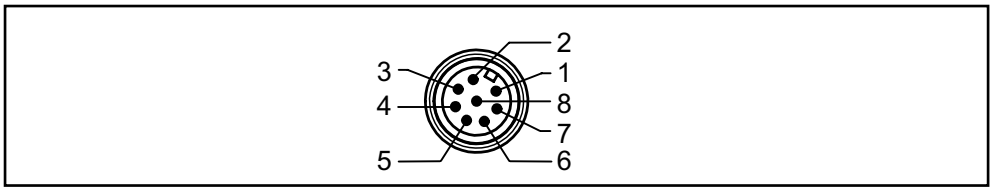


Fig. 32: Pin assignment of the "Data" connection (8-pins M12 male connector, A-coded)

Pin	Signal	Function
1	RxD	Receiver RS232 (Host interface)
2	TxD	Transmitter RS232 (Host interface)
3	Reserved	Do not use!
4	Reserved	Do not use!
5	GND RS	Ground RS232
6	IN1	Switching input 1
7	IN2	Switching input 2
8	GND IN	Ground digital input 1 + 2

Tab. 10: Bulkscan® LMS111 Pin assignment of the “Data” connection (M12x8 male plug, A-coded)

6.2.7 Connection of the digital inputs/outputs on Bulkscan® LMS111

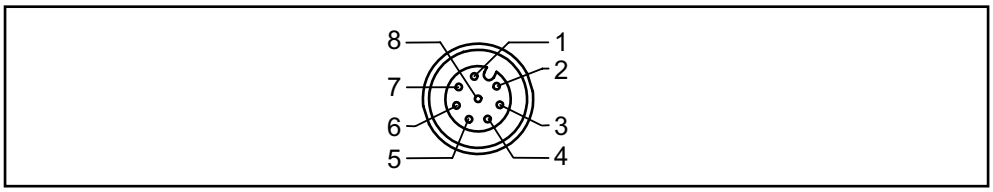


Fig. 33: Pin assignment of the “I/O” connection (8-pins M12 female connector, A-coded)

Pin	Signal	Function
1	ENC1	Encoder input 1
2	ENC2	Encoder input 2
3	GND ENC	Ground encoder inputs
4	OUT1 A	Switching output 1, contact A
5	OUT2 A	Switching output 2, contact A
6	OUT3 A	Switching output 3, contact A
7	OUT1...3 B	Switching output 1...3, contact B
8	OUT1...3 R	Switching output 1...3, resistor monitored

Tab. 11: Bulkscan® LMS111: Pin assignment of the “I/O” connection (8-pins M12 female connector, A-coded)

6.2.8 "AUX" connection of Bulkscan® LMS111

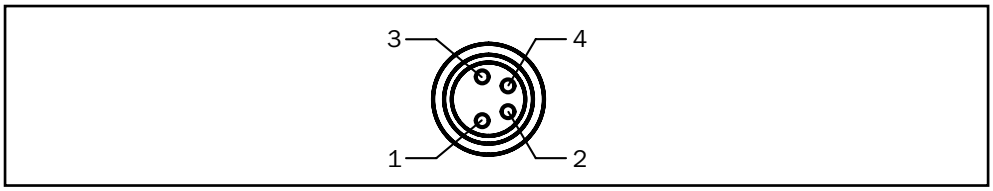


Fig. 34: Pin assignment of the the “AUX” connection (4-pins M8 female connector)

Pin	Signal	Function
1	Reserved	Do not use!
2	RXD AUX	Receiver RS-232 (auxiliary interface)
3	GND RS	Ground RS-232
4	TxD AUX	Transmitter RS-232 (auxiliary interface)

Tab. 12: Bulkscan® LMS111: Pin assignment of the “AUX” connection (4-pins M8 female connector)

6.3 Wiring the inputs and outputs to the external components

6.3.1 Wiring non-floating digital inputs

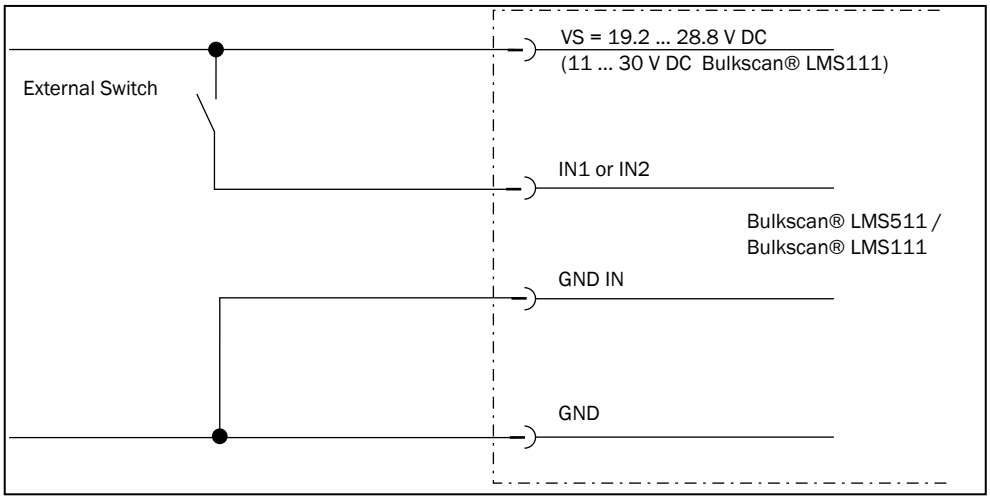


Fig. 35: Wiring non-floating digital inputs

6.3.2 Wiring floating digital inputs

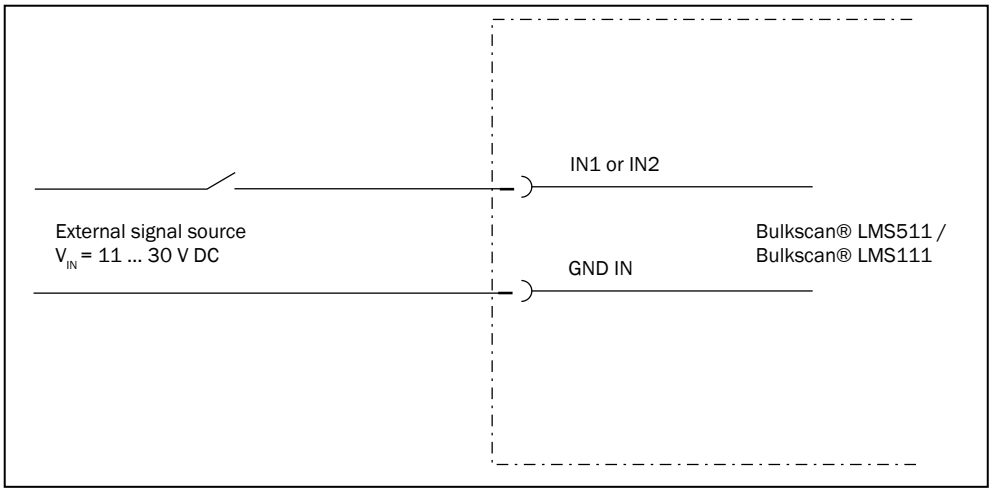


Fig. 36: Wiring floating digital inputs

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

6.3.3 Wiring encoder inputs

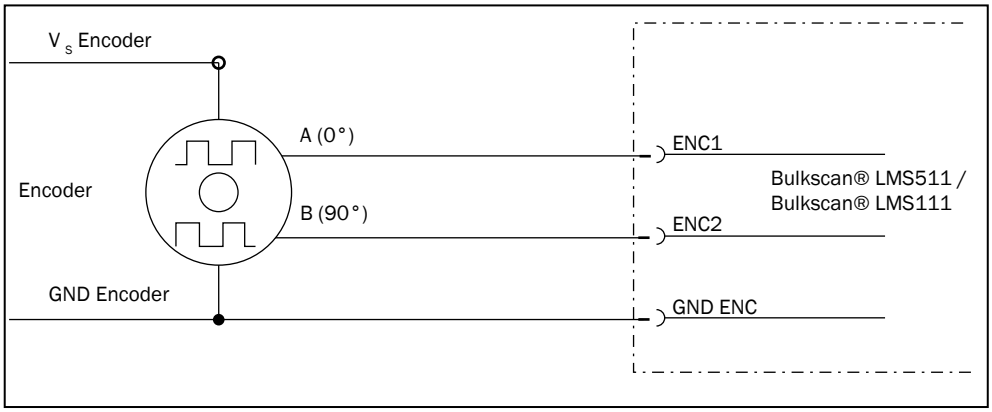


Fig. 37: Wiring encoder inputs

Note The encoder requires its own power supply (V_S encoder and GND encoder).

6.3.4 Input circuits IN1 and IN2 on Bulkscan® LMS511

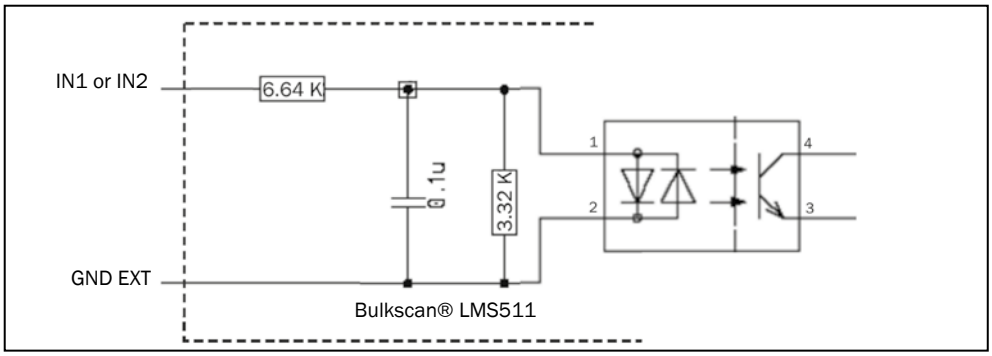


Fig. 38: Input circuits IN1 and IN2

6.3.5 Connecting the outputs to a PLC on Bulkscan® LMS511

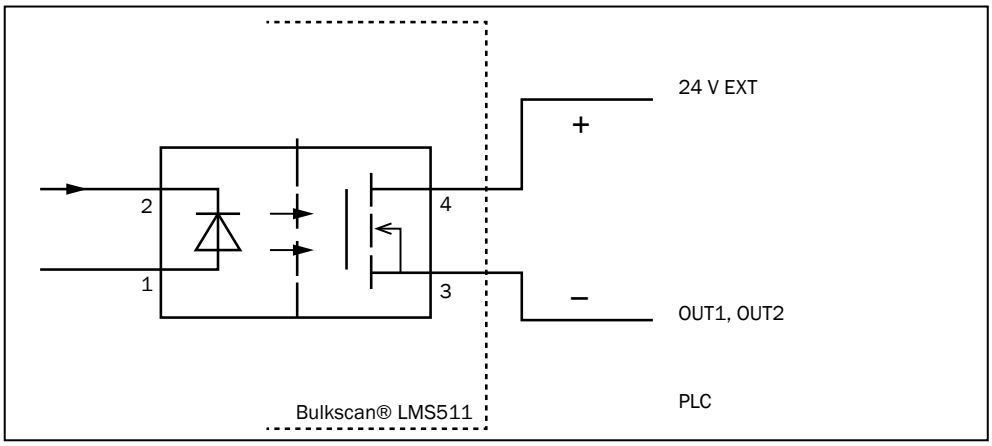


Fig. 39: Connecting the outputs to a PLC (active LOW)

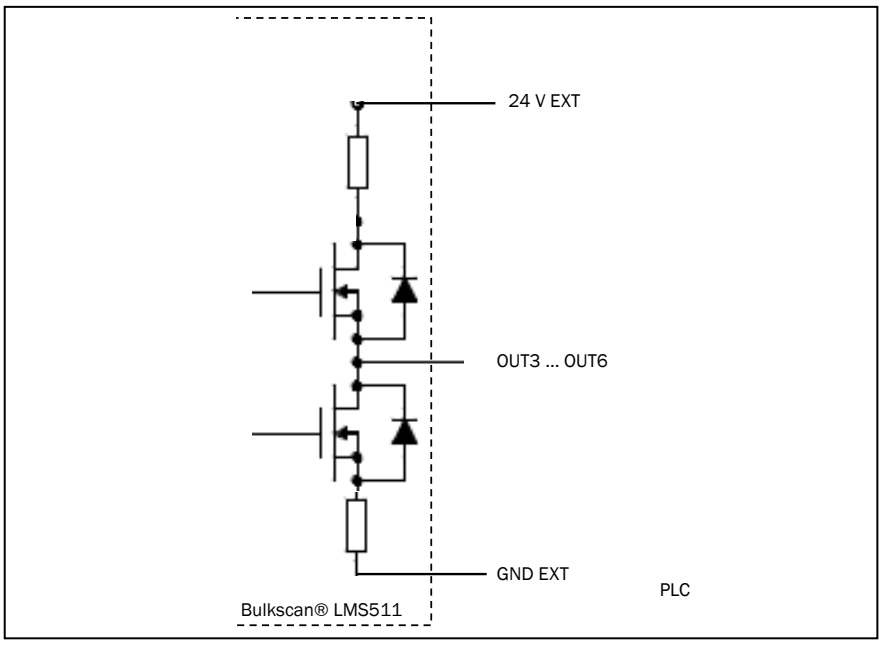


Fig. 40: Connecting the outputs to a PLC (active HIGH)

6.3.6 Connection of the switching outputs on Bulkscan® LMS111 to a PLC, non-floating

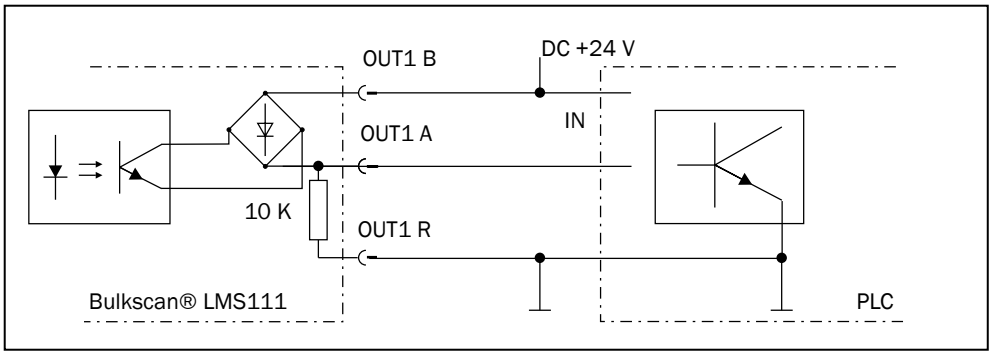


Fig. 41: Connection of the switching outputs, e.g. OUT1, to a PLC, non-floating (active high)

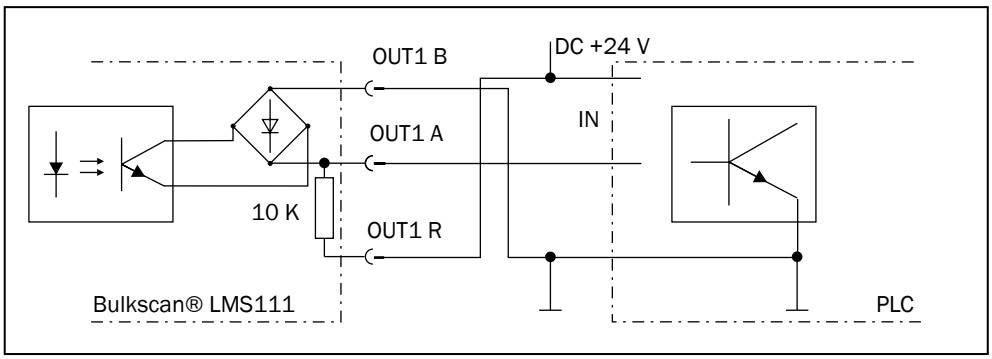


Fig. 42: Connection of the switching outputs, e.g. OUT1, to a PLC, non-floating (active low)

6.3.7 Connection of the switching outputs on Bulkscan® LMS111 to a PLC, floating

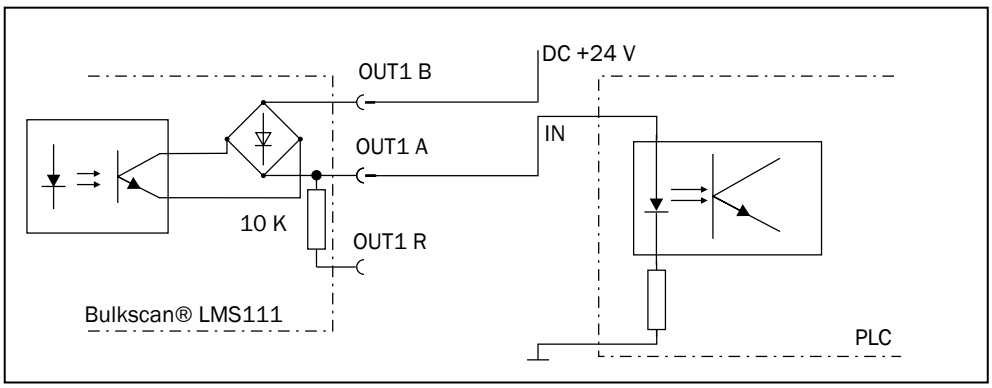


Fig. 43: Connection of the switching outputs, e.g. OUT1, to a PLC, floating (active high)

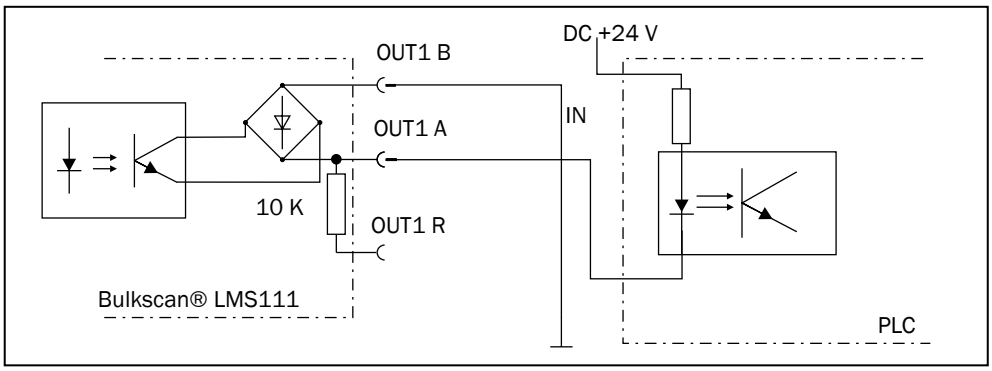


Fig. 44: Connection of the switching outputs, e.g. OUT1, to a PLC, floating (active low)

6.3.8 Analog inputs/outpus with analog module BAM100

6.3.8.1 Module design

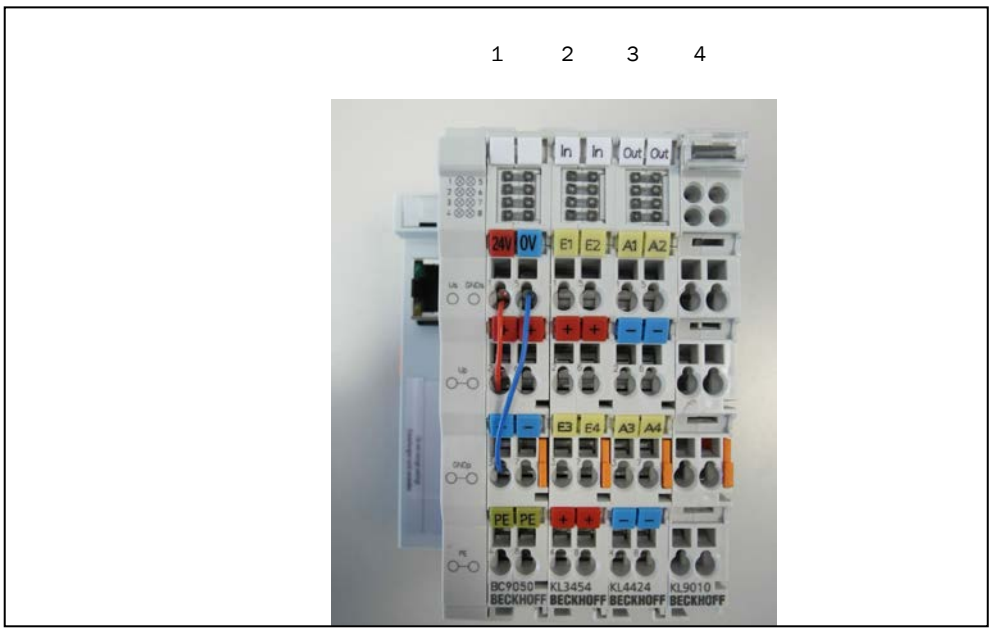


Fig. 45: module design

Note Do not dismount terminals of the module

Order	Marking
1	BC9050 (bus terminal)
2	KL3454 (4 analog inputs)
3	KL4424 (4 analog outputs)
4	KL9010 (end terminal)

6.3.8.2 Installation of Bus Terminals on mounting rails

Bring the bus terminal system into a safe, powered down state
before starting installation, disassembly or wiring of the Bus Terminals!

Assembly
The Bus Coupler and Bus Terminals are attached to commercially available 35 mm mounting rails (DIN rails according to EN 50022) by applying slight pressure:

During the installation of the Bus Terminals, the locking mechanism of the terminals must not come into conflict with the fixing bolts of the mounting rail.

Disassembly
Each terminal is secured by a lock on the mounting rail, which must be released for disassembly:

- Carefully pull the orange-colored lug approximately 1 cm out of the disassembled terminal, until it protrudes loosely. The lock with the mounting rail is now released for this terminal, and the terminal can be pulled from the mounting rail without excessive force.
- Grasp the released terminal with thumb and index finger simultaneous at the upper and lower grooved housing surfaces and pull the terminal away from the mounting rail.

Connections within a bus terminal block
The electric connections between the Bus Coupler and the Bus Terminals are automatically realized by joining the components:

- The six spring contacts of the K-Bus/E-Bus deal with the transfer of the data and the supply of the Bus Terminal electronics.
- The power contacts deal with the supply for the field electronics and thus represent a supply rail within the bus terminal block. The power contacts are supplied via terminals on the Bus Coupler.

PE power contact
The power contact labeled PE can be used as a protective earth. For safety reasons this contact mates first when plugging together, and can ground short-circuit currents of up to 125 A.

Note that, for reasons of electromagnetic compatibility, the PE contacts are capacitatively coupled to the mounting rail. This may lead to incorrect results during insulation testing or to damage on the terminal (e.g. disruptive discharge to the PE line during insulation testing of a consumer with a nominal voltage of 230 V).
For insulation testing, disconnect the PE supply line at the Bus Coupler or the Power Feed Terminal! In order to decouple further feed points for testing, these Power Feed Terminals can be released and pulled at least 10 mm from the group of terminals.

The PE power contact must not be used for other potentials!

Wiring

Up to eight connections enable the connection of solid or finely stranded cables to the Bus Terminals. The terminals are implemented in spring force technology. Connect the cables as follows:

- Open a spring-loaded terminal by slightly pushing with a screwdriver or a rod into the square opening above the terminal.
- The wire can now be inserted into the round terminal opening without any force.
- The terminal closes automatically when the pressure is released, holding the wire securely and permanently.

Note Analog sensors and actors should always be connected with shielded, twisted paired wires.

6.3.8.3 Power supply BC9050

Bus Terminal Controller supply (Us)

The Bus Terminal Controller requires a supply voltage of 24 $V_{DC.}$

The connection is made by means of the upper spring-loaded terminals labelled 24 V and 0 V. This supply voltage is used for the electronic components of the Bus Coupler and Bus Terminal Controllers and (via the K-bus) the electronic components of the Bus Terminals. It is galvanically separated from the field level voltage.

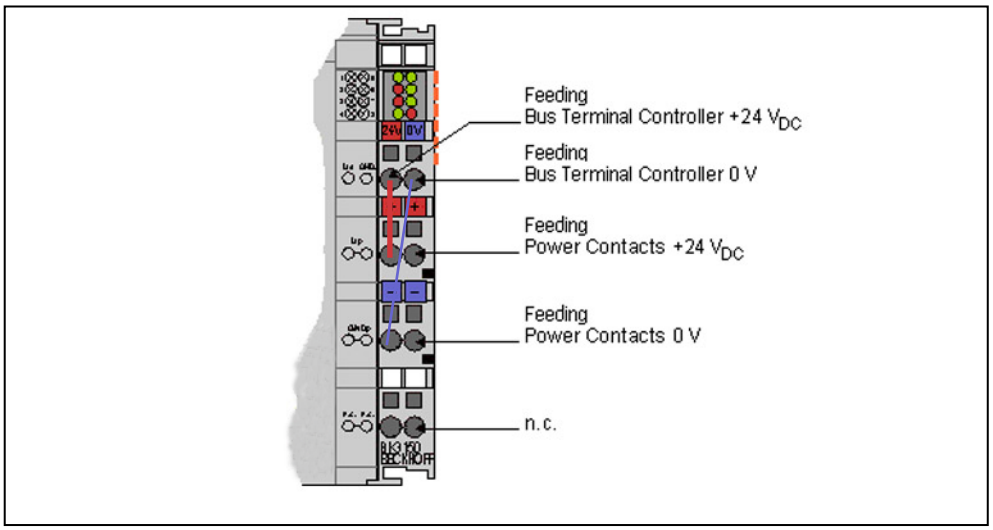


Fig. 46: Power supply BC9050

Power contacts supply (Up)

The bottom six connections with spring-loaded terminals can be used to feed the supply for the peripherals. The spring-loaded terminals are joined in pairs to a power contact. The feed for the power contacts has no connection to the voltage supply for the BC9050 electronics.

The spring-loaded terminals are designed for wires with cross-sections between 0.08 mm^2 and 2.5 mm^2.

The assignment in pairs and the electrical connection between feed terminal contacts allows the connection wires to be looped through to various terminal points. The current load from the power contact must not exceed 10 A for long periods. The current carrying capacity between two spring-loaded terminals is identical to that of the connecting wires.

Power contacts

On the right hand face of the Bus Terminal Controller there are three spring contacts for the power contact connections. The spring contacts are hidden in slots so that they can not be accidentally touched. By attaching a Bus Terminal the blade contacts on the left hand side of the Bus Terminal are connected to the spring contacts. The tongue and groove guides on the top and bottom of the Bus Terminal Controllers and of the Bus Terminals guarantees that the power contacts mate securely.

6.3.8.4 Analog input terminal KL3454

The KL3454 analog input terminal process signals in the range between 4 and 20 mA. The current is digitized to a resolution of 12 bits, and is transmitted, in an electrically isolated form, to the higher-level automation device. In the KL3454 Bus Terminal, the four inputs are 2-wire versions and have a common ground potential. This reference ground for all inputs is connected to the 0 V power contact. The 24 V power contact is connected to the terminals, in order to enable the connection of 2-wire sensors without external supply. The power contacts are connected through. Overload is detected and the terminal status is relayed to the controller via the K-bus. The Run-LEDs indicate the data exchange with the Bus Coupler, the Error-LEDs indicate overload or wire breakage.

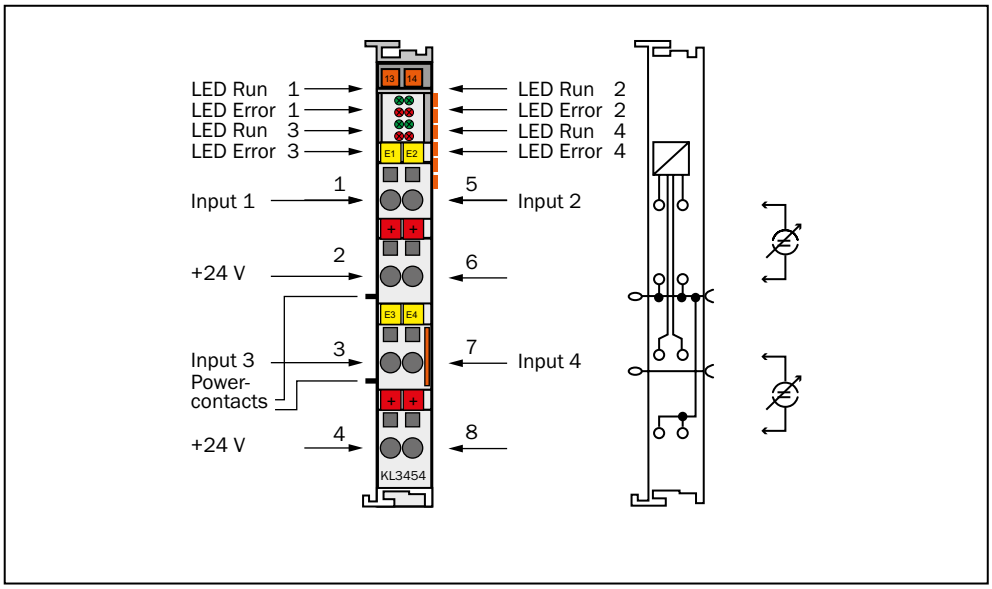


Fig. 47: KL3454 - Connection

Terminal point nr.	Channel	Name	Connection for
1	1	Input 1	Analog input 1, belt speed (4...20 mA)
2		+24 V	Analog input 1, 24 V
3	3	Input 3	Analog input 3, mass flow rate (4...20 mA)
4		+24 V	Analog input 3, 24 V
5	2	Input 2	Analog input 2, bulk density (4...20 mA)
6		+24 V	Analog input 2, 24 V
7	4	Input 4	Analog input 4, external input (4...20 mA)
8		+24 V	Analog input 4, 24 V

6.3.8.5 Analog output KL4424

The KL4424 analog output terminal generates signals in the range 4 ... 20 mA.

The power is supplied to the process level with a resolution of 12 bits, and is electrically isolated. The output stage is powered by the 24 V supply. The terminals four outputs are 2-wire versions and have a common ground potential. The power contacts are connected through. The reference ground of the outputs is the 0 V power contact. The LEDs indicate the data exchange with the Bus Coupler.

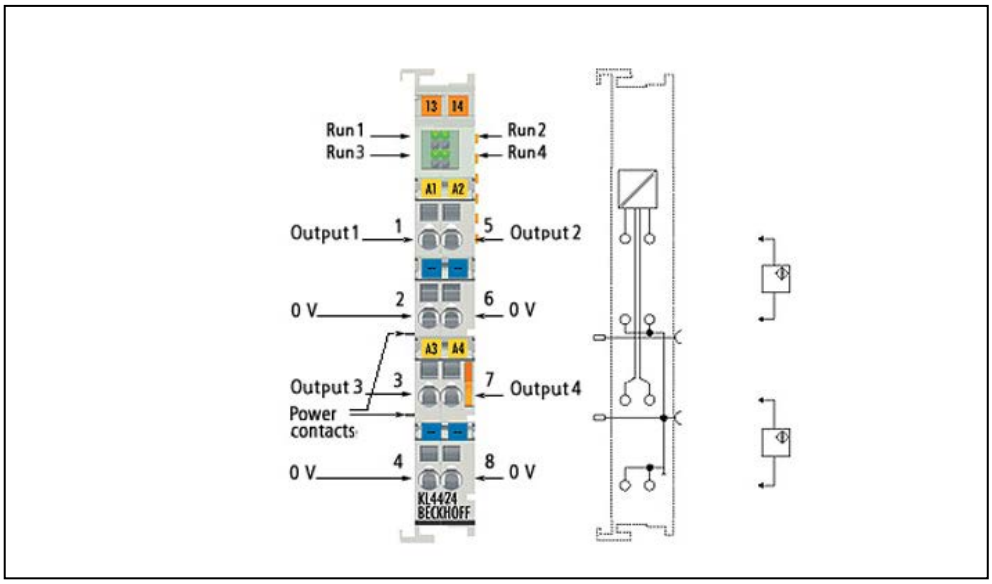


Fig. 48: KL4424

Terminal point nor.	Channel	Name	Connection for
1	1	Output 1	Analog output 1, signal (4 mA ... 20 mA)
2		0 V	Analog output 1, ground
3	3	Output 3	Analog output 3,sSignal (4 mA ... 20 mA)
4		0 V	Analog output 3, ground
5	2	Output 2	Analog output 2, signal (4 mA ... 20 mA)
6		0 V	Analog output 2, ground
7	4	Output 4	Analog output 4, signal (4 mA ... 20 mA)
8		0 V	Analog output 4, ground

7 Configuration

You can configure the Bulkscan® in two ways:

- Configuring the Bulkscan® with SOPAS (see "7.1 Configuring the Bulkscan® with SOPAS“ on page 60).
- Configuration of the Bulkscan® using telegrams (see "7.2 Configuration of the Bulkscan® using telegrams“ on page 62).

Recommendation Use the SOPAS configuration software during initial commissioning at least.

Note If you connect the Bulkscan® via more than one interface, e.g., via Ethernet and USB, then the sensor can also be configured via both interfaces. Only the changes last saved in the sensor are retained.

7.1 Configuring the Bulkscan® with SOPAS

Loss of configuration data in the connected sensor when the power supply is switched off

▶ Do not switch off the power supply while configuring the sensor. Otherwise all parameters not yet saved permanently will be lost.

Saving the configuration in the non-volatile memory

Following successful configuration, you should save the parameters in the non-volatile memory:

- Select **Bulkscan® LMS511 or Bulkscan® LMS111 Parameters, Save permanent**, to save the configuration in non volatile memory in the sensor.
- Select **File, Save device file**, to save the configuration outside the sensor, e.g., to have a backup in case of sensor replacement.

Resetting the configuration

To reset the Bulkscan® to the delivery status, in SOPAS use the **Bulkscan® LMS511 or Bulkscan® LMS111** menu, **Parameters, Load factory defaults in device**.

7.1.1 Installing the SOPAS configuration software

The interactive configuration is carried out using the provided SOPAS configuration software on a PC which must be connected to the Bulkscan®. Using SOPAS you can continuously display and test contour data, measured values, and status signals, and also set parameters as required. You can save and archive the configuration data as a project file on the PC.

How to install the SOPAS configuration software:

▶ Observe the system requirements. These are stated on the download web site www.sick.com/SOPAS.
▶ Run the setup.exe from the download web site.
▶ Follow the instructions in the Setup wizard.

Note To configure the Bulkscan® it is not necessary to select the sensor during installation. SOPAS loads the device description which matches the firmware in the sensor directly from the sensor later.

How to use the SOPAS online help:

Help on using the software as well as for the different options can be found in SOPAS:

- Select **Help** or press [F1]: Detailed online help on the program user interface and the different options as well as on the configuration of several sensors using SOPAS ET.
- **Context help** window: Context sensitive help for the visible dialog.
- **Tool tip**: Move the mouse pointer over an input field. A short text ("tool tip") with information about valid entries appears.
- **Parameter information**: Click a label or input field using the right mouse button. The Parameter information window appears with information on the valid value range and the default setting.

7.1.2 Establishing communication with the Bulkscan®

Note Software access to the Bulkscan® is password protected. The following user levels and passwords are defined as factory defaults:

User level	Password	Rights at this user level
Maintenance	main	• Measuring mode • Upload all parameters from the sensor • Save device files • Change maintenance password
Authorized client	client	In addition to the rights of the maintenance personnel: • Maintenance operation • Teaching-in the reference contour • Configuration of all functions and interfaces • Save parameters in non-volatile memory in the sensor • Reset sensor • Change all passwords
Service	***	Only for SICK service personnel

Tab. 13: Pre-defined user levels and passwords

To configure the Bulkscan® you must ...

- Establish a connection to the sensor using SOPAS,
- Log in to the sensor as Authorized client.

How to establish a connection to the sensor using SOPAS:

- Connect the PC to the same network to which the sensor is connected (see "6.2.2 Ethernet interface connection“ on page 47).
  or:
  Connect the PC to the sensor using a USB cable or via the serial interface (see "6.2.5 Mini-USB connection of Bullkscan® LMS511“ on page 49).
- Switch on the sensor supply voltage.
  The sensor performs a self-test and initializes itself.
- Start SOPAS Single Device on the PC.
  The "Welcome to SOPAS" dialog box appears. The software automatically searches for available sensors and displays them in a list.
- In the **Available devices** list, click the Bulkscan®.
  SOPAS establishes the connection to the sensor and loads the device file.
  If your sensor does not appear in the list, please click **Search connected** devices and follow the instructions in the connection wizard. See the SOPAS online help for additional information.

Note

- The sensor may appear twice in the list. The available connections only differ in relation to the network port used. It is sufficient to carry out the configuration via one of the two connections available. It does not matter which of the two connections you use.
- You can save a Device identification (device ID and location) in the sensor, this code will enable you to identify the sensor more easily in future (see below).
- If you have started SOPAS for the first time, then please check whether the following software settings meet your requirements:
  - **Tools, Language**
  - **Tools, Options, Unit system**

How to log in to the sensor:

- ▶ Select **Tools, Login device**.
  The **Login** dialog box will open.
- ▶ Log in with the user level **Authorized client** and the related password to configure the sensor.

How to change the password for a user level:

- ▶ Log in to the sensor:
- ▶ Select Bulkscan® LMS511 or Bulkscan® LMS111, Password, Change password.

Note

With the user level *Maintenance* you can only change the password for maintenance. As *Authorized client* you can change all passwords.

How to configure the device code:

- ▶ Establish the connection to the sensor.
- ▶ Log in to the sensor as **Authorized client**.
- ▶ On the **Interfaces** tab, enter a **Device ID** and a **Location**

7.2 Configuration of the Bulkscan® using telegrams

The Bulkscan® sends telegrams over its data interfaces to communicate with a connected host. The following functions can be run using telegrams:

- Request measured values via the host and output them once or continuously on the Bulkscan® via the same interface.
- Parameter setting by the host for the configuration of the Bulkscan®.
- Parameters and status log querying by the host.

The telegrams each comprise a frame (see below) and the data.

A detailed description of the different telegrams can be found in the appendix (see "13.1 Telegram reference“ on page 99).

You can configure the transmission protocol (CoLa ASCII or CoLa binary) used in SOPAS.

Interfaces tab, **Data Interfaces** group, **Ethernet, CoLa dialect** option.

Frame and coding for the telegrams

The data frame varies depending on the coding.

	Frame	Telegram	Frame
Designation	STX	Data	ETX
Length (byte)	1	≤ 30,000	1
Description	Start of text character	ASCII coded	End of text character

Tab. 14: Frame for the telegrams with ASCII coding (CoLaA)

	Frame					Telegram	Frame
Designation	STX	STX	STX	STX	Length	Data	CS
Length (byte)	1	1	1	1	4	≤ 2.495	1
Description	Start of text character				Length of the data (without CS)	Binary encoded	Checksum (XOR of all data bytes)

Tab. 15: Frame for the telegrams with binary coding (CoLaB)

8 Commissioning

Overview of the steps for commissioning:

1. Teaching-in the reference contour
(see "8.1 Teaching-in the reference contour“ on page 64).
2. Configuration of measurement parameters
   a. Set the belt speed (see "4.1 Setting the belt speed“ on page 17).
   b. Set the measurement of the mass flow rate or bulk density
(see "4.5 Measurement of the mass flow rate“ on page 19). or (see "4.6 Measurement of the bulk density“ on page 20).
   c. Set the measurement of the bulk height (see "4.7 Measurement of the bulk height“ on page 20).
3. Configuration of inputs and outputs
   a. Digital inputs (see "4.12 Digital inputs“ on page 25).
   b. Digital outputs (see "4.13 Digital outputs“ on page 26).
   c. Analog module BAM100 (see "4.14 Analog module BAM100“ on page 28).
4. Carry out a test measurement to configure system parameters
(see "8.2 Performing a test measurement“ on page 68).
   a. Setting tolerances (see "8.3 Setting tolerances“ on page 68).
   b. Set the Contamination measurement
(see "8.4 Monitoring of the contamination degree“ on page 71).
   c. Set the Scan frequency (see "8.5 Scan frequency“ on page 72).
5. Undertake a reference measurement (compensation function) (see "8.6 Taking a reference measurement (compensation function)“ on page 73).

Saving the configuration in the non-volatile memory
Following successful commissioning, you should save the parameters in the non-volatile memory:

- Select Bulkscan® LMS511 or Bulkscan® LMS111, Parameters, Save permanent, to save the configuration in non-volatile memory in the sensor.
- Select File, Save device file, to save the configuration outside the sensor, e.g., to have a backup in case of sensor replacement.

8.1 Teaching-in the reference contour

The reference contour is the field of view of the sensor when the conveyor belt is empty. It is the basis for the calculation of the measured values. Use the scan view in SOPAS to check the reference contour as an online graphic.

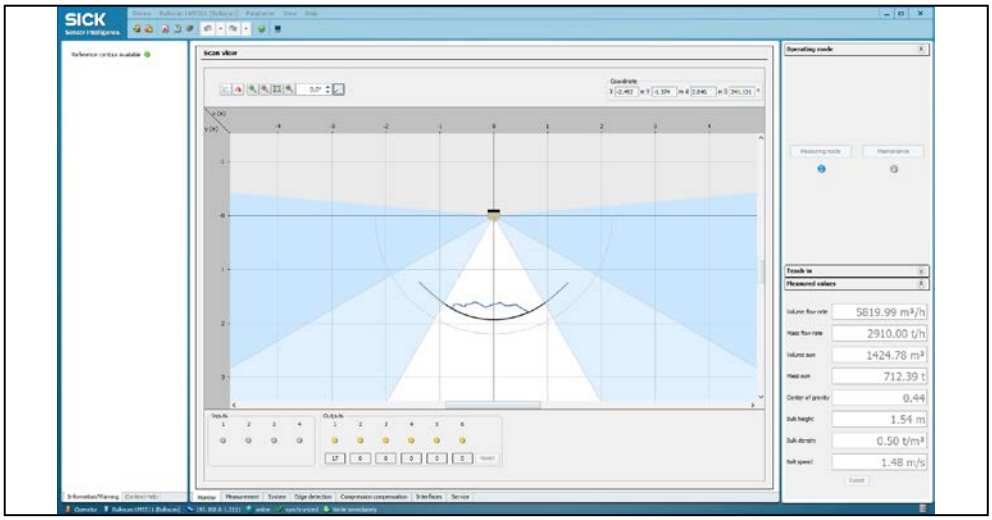


Fig. 49: Scan view on the Monitor tab

How to teach-in the reference contour:

- Start SOPAS and establish a connection to the sensor.
- Log in as Authorized client.
- Click **Maintenance** mode on the **Measurement** configuration bar to set the sensor to maintenance mode.
- On the **Teach-in** configuration bar set the **Angle: left** (negative value) and **right** (positive value) such that the maximum possible conveyor belt width can be detected.
  or: Click and drag the left or right edge beam to the required aperture angle in the monitor.

Recommondation

To reduce the measuring error, we recommend selecting the left and right angle such that only the maximum possible load on the conveyor belt is detected.

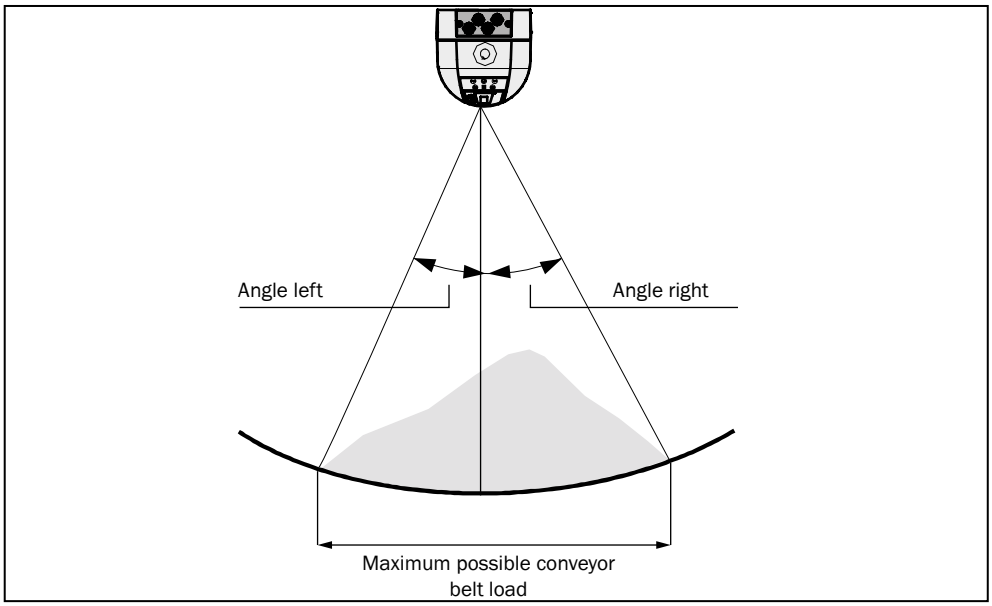


Fig. 50: Limit for the angles at the maximum possible load on the conveyor belt

- Set the **Maximum distance** (scan radius):
  - Enter the distance using the keyboard.
    or:
  - Click and drag the gray distance line to the required radius.
- Enter the number of scan cycles over which the sensor is to determine the reference contour in the **Average reference contour over** field. A large value with a heavily vibrating conveyor belt will result in a better averaged reference contour. The teach-in¬ process takes correspondingly longer.
- If necessary, only for Bulkscan® LMS511, check the Optimization for belts with slits or gaps checkbox (see "8.1.2 Optimization for conveyor belts with slits or gaps“ on page 67).
- If required, move the **Level compensation** slider to compensate for raising or lowering of the conveyor belt (see "8.1.1 Compensation of the conveyor belt level“ on page 66).
- Ensure that hazard-free operation is possible
  and start the empty conveyor belt.
- Click **Teach-in**. The sensor signals the teaching-in:

Process	LED indication:	7-segment display
During teach-in	OK Green	E (Teach-in)
Following successful teach-in	OK Green, O2 Orange	6 (Maintenance)
In the event of an error	OK Green, O2 Orange	5 (Maintenance)

Tab. 16: Indicators during teach-in

- If the teach-in process was not successful: Check the ambient conditions and/or adjust the configuration and repeat the teach-in process.
- If the teach-in process was successful: Start the measuring mode.

Note

- The duration of the teach-in process is dependent on the settings selected:
- During the teach-in the sensor will not respond to terminal commands. Terminal commands sent to the sensor during this time will not be cached.
- If you change the aperture angle during the configuration, then the reference contour should be taught-in again for optimization.

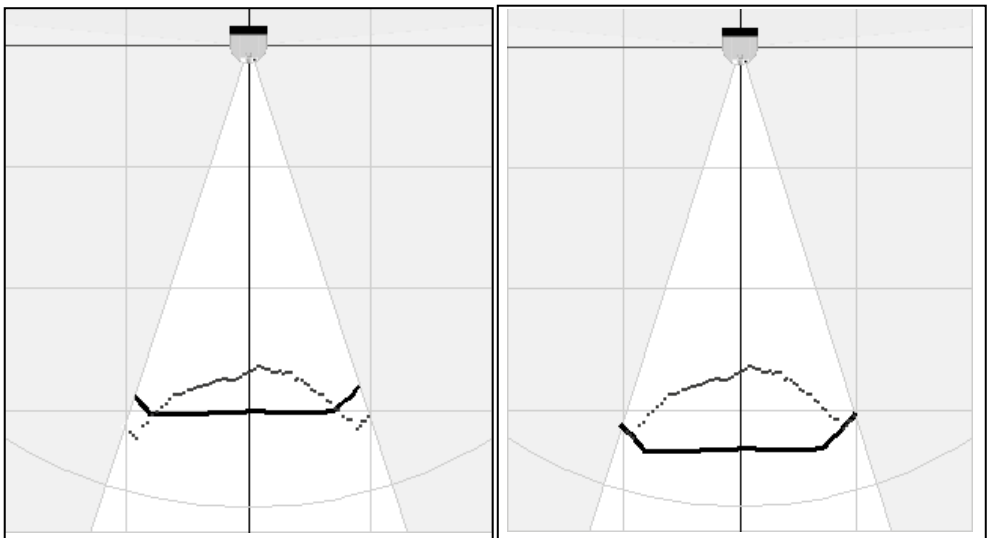
Average reference contour over	Scan frequency	Duration of the teach-in process
100 cycles	75 Hz	100 ÷ 75 Hz = 1,3 s
10,000 cycles	25 Hz	10000 ÷ 25 Hz = 400 s

Tab. 17: Examples of the duration of the teach-in process

8.1.1 Compensation of the conveyor belt level

Due to the weight of the bulk the conveyor belt may drop or may lift:

- **Conveyor belt dropping**: Due to the weight of the bulk, the conveyor belt may drop between transport rollers.
- **Conveyor belt lifting**: Due to the weight of the bulk, the tension on the conveyor belt on the neighboring transport roller sections may be increased and as a result the conveyor belt may lift.



Without level compensation:
The conveyor belt has dropped. The bulk is underneath the reference contour.

With level compensation:
Measured contour (bulk) and reference contour correspond at the edge areas.

Fig. 51: Compensation of the level of the conveyor belt

To compensate for this deviation caused by the weight of the bulk, you can configure **Level compensation**.

Note If the Bulkscan® is correctly mounted over the transport rollers, it should not be be required to adjust the level of the conveyor belt under normal circumstances.

How to compensate the level (–100 mm to +100 mm):

- Check on the Monitor tab, whether the measured contour (blue dots) matches the reference contour in the unloaded edge areas of the conveyor belt.
- On the **Teach-in** configuration bar move the **Level compensation** slider so that the measured contour (blue dots) matches the reference contour at the unloaded edge areas of the conveyor belt.
  - Positive values (0 to +100 mm) lower the reference contour to the level of the conveyor belt.
  - Negative values (–100 to 0 mm) raise the reference contour to the level of the conveyor belt.

Note Note that the conveyor belt must always be within the radius defined by the **Maximum distance** value for correct measurements.

- Click **Apply level compensation**. The scan view and the current measured values are corrected accordingly.
- Test the result and correct the level compensation until the measured contour matches the reference contour in the edge areas.

8.1.2 Optimization for conveyor belts with slits or gaps (only valid for Bulkscan® LMS511)

Some belts may have slits or gaps, which may lead to invalid measurement points while teaching in the reference contour and therefore disturb it. These irregularities can be corrected using the **Optimization for belts with slits or gaps** function.

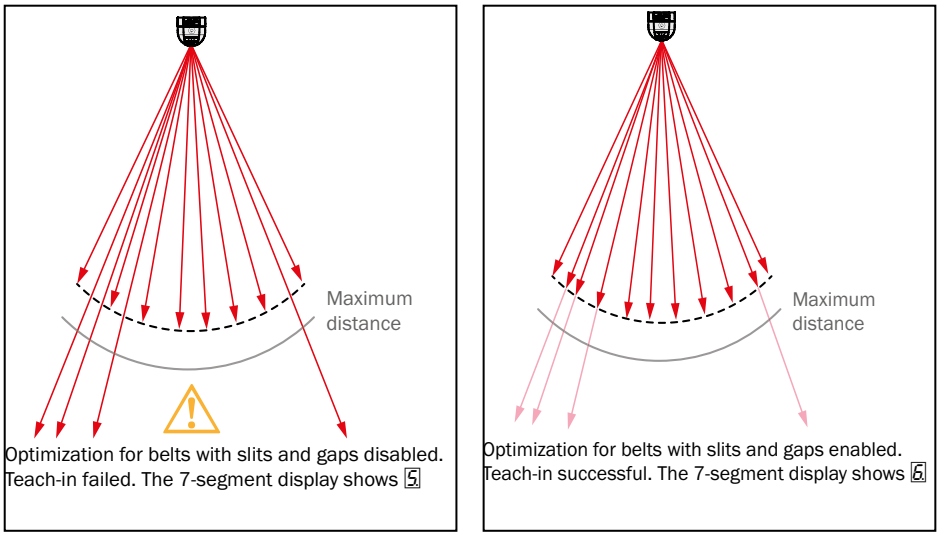


Fig. 52: Optimization for slits or gaps

How to correct conveyor belt irregularities:

- Activate the **Optimization for belts with slits or gaps** checkbox on the **Teach-in** configuration bar
- Set the **Maximum distance** so that all invalid measurement points are outside of the scan radius
- Click **Teach-in**

8.2 Performing a test measurement

Use the scan view in SOPAS to verify the measured contour and the generated measured values online.

Note

The scan view depends on the available bandwidth of the chosen connection and is not output in real-time. For this reason not all measured values are displayed.

How to carry out a test measurement:

- Start SOPAS and establish a connection to the sensor.
- Log in as **Authorized client**.
- Ensure that hazard-free operation is possible and start the full conveyor belt.
- On the **Operating mode** configuration bar, click **Measuring mode** to start the measurement.
- Compare the **Contour** displayed and the **Measured value** with the value expected. Check, in particular, whether the volume sum or mass sum measured by the sensor corresponds to the number of volume quotas or mass quotas signaled on the digital outputs.
- If necessary, correct the configuration of the parameters in the **System** tab
  ▷ (see "8.3 Setting tolerances“ on page 68).
  ▷ (see "8.4 Monitoring of the contamination degree“ on page 71).

8.3 Setting tolerances

You can use the tolerances to reduce the effects of vibration, strong reflection on the bulk, dazzle and other environmental influences on the measured values.

System tab, **Tolerances** group

8.3.1 Tolerance against vibration

The majority of conveyor belts vibrate in operation as a function of the belt speed and the load. If the empty conveyor belt vibrates, the conveyor will rise above or drop below the taught-in reference contour. The Bulkscan® would interpret this movement as a change in the bulk quantity.

For this reason the Bulkscan® has a **Tolerance against vibration** that can be configured. In this case the sensor ignores conveyor belt variations from the bottom edge of the reference contour and outputs the measured value 0. However this situation also means that very low bulk quantities are also ignored

How to configure the tolerance against vibration:

- ▶ Ensure that hazard-free operation is possible and start the empty conveyor belt.
- ▶ On the Operating mode configuration bar, click **Measuring mode.**
- ▶ Switch to the **System** tab.
- ▶ Reduce the **Tolerance against reflection** so that the Volume flow rate measured value remains constant at 0 with the empty conveyor belt.
- ▶ Check on the **Measured value** configuration bar whether small bulk quantities are reliably detected.

8.3.2 Tolerance against reflection

Reflections (total reflection) can result in the Bulkscan® measuring the distance to the reflected object, e.g., a building roof, instead of to the bulk. Examples:

- Fragments of glass as bulk.
- Stagnant water on the conveyor belt.

In this case the distance values measured are way outside the reference area. In relation to the reference area, the Bulkscan® interprets these values as measuring errors:

- The sensor replaces invalid distance values with the last valid distance value.
- The 7-segment display shows 7.
- If you have configured an output as "Information/Warnings", the related output switches.

You can adjust the tolerance against reflection to suit your application. The value defines which part of the measured bulk contour must lie outside the sensor-internal distance threshold for the contour to be interpreted as a measuring error. A high tolerance against reflection increases the availability of the sensor.

Recommandation

If you want to detect stagnant water, the value should be low, because the edges of the conveyor belt that are not covered form part of the contour.

How to configure the tolerance against reflection:

- ▶ Ensure that hazard-free operation is possible and start the empty conveyor belt.
- ▶ On the **Operating mode** configuration bar, click **Measuring mode**.
- ▶ Switch to the **System** tab.
- ▶ Set the **Tolerance against reflection** to a value of 50 %.
- ▶ Reduce or increase the **Tolerance against reflection** so that the availability of the system meets your requirements.

8.3.3 Optimization for outdoor applications

Dust particles, rain drops, snow flakes, etc. can block individual measurement points on the bulk contour. Dazzle from external light sources, such as sunshine or reflections on metal surfaces can reduce the resolution of the bulk contour. This can reduce the measurement accuracy.

You can improve this behavior by activating **Optimization for outdoor applications**. The Bulkscan® rejects invalid measurement points and replaces these with measurement points which have been calculated from valid neighboring areas

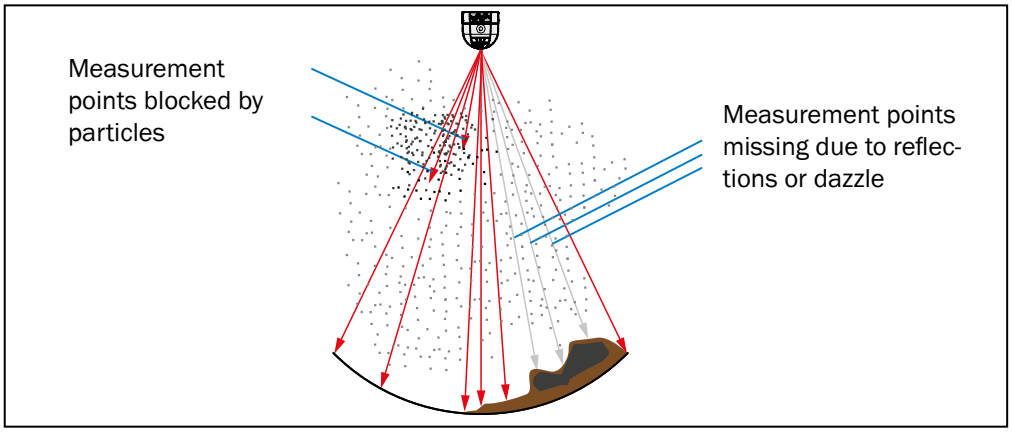


Fig. 53: Optimization for outdoor applications

How to configure Optimization for outdoor applications:

- ▶ Switch to the **System** tab.
- ▶ Activate the **Optimization for outdoor applications** checkbox.

8.3.4 Ignore measurement points below the reference contour (only valid for Bukscan® LMS511)

Some belts may have slits or gaps, which may cause measurement points below the reference contour to be measured, leading to incorrect measurement of the throughput.

The Ignore measurement points below the reference contour function allows you to correct these incorrect measurement points.

It is possible to configure a detection threshold which ensures that values below this threshold are automatically mapped to the reference contour. A value range of between 0 mm and 10 m can be set.

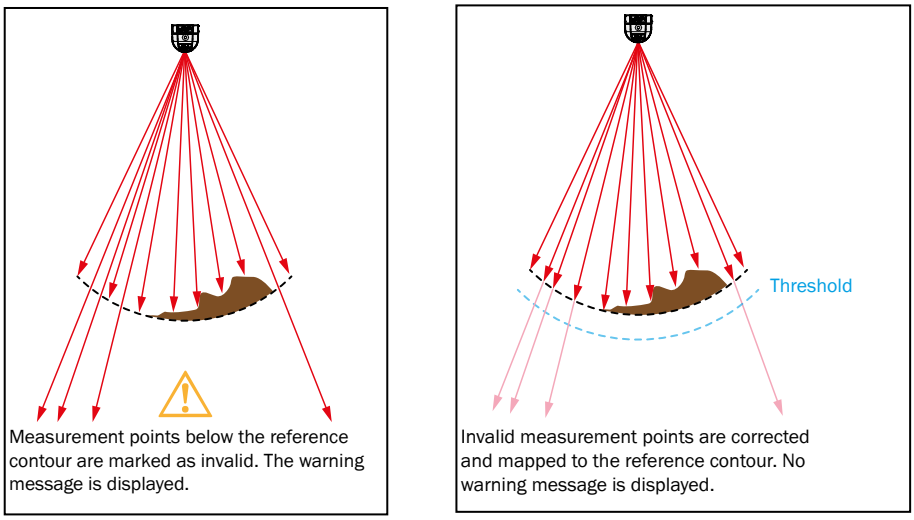


Fig. 54: Ignore measurement points below the reference contour

Note

- Slits or gaps on the conveyor belt have to be covered in order to teach-in the reference contour

- We recommend setting a value of at least 5 mm to avoid incorrect measurement due to conveyor belt vibration.

How to configure the ignoring of measurement points below the reference contour:

- ▶ Switch to the **System** tab.
- ▶ Activate the **Ignore measurement points below the reference contour** checkbox.
- ▶ Configure the **Threshold** value in mm.

8.3.5 Contour smoothing

The contour smoothing function allows to smooth the measured contour in order to avoid short-term fluctuations on the volume measurement. A high level of contour smoothing is recommended for rough measurement contours.

Available values for the **Contour smoothin**g function are **Off, Low, Medium, High, Maximal.**

How to configure the smoothing of the measured contour:

- ▶ Switch to the **System** tab.
- ▶ Configure the optimal **Contour smoothing** level for your application.

8.4 Monitoring of the contamination degree

The front screen of the Bulkscan® may become contaminated due to the environmental conditions. This reduces the emitted and received energy from the laser beam and thereby the measurement accuracy.

The Bulkscan® has six contamination sensors which monitor contamination during operation.

You can choose from different contamination measurement strategies, these determine the number of contamination sensors which are evaluated.

Strategy	Behavior
Inactive	Contamination measurement is not carried out
Highly availabe	Contamination warning and contamination errors are only output when the front screen is uniformly contaminated.
Available	Contamination warning and contamination errors are output when the front screen is partially contaminated.
Sensitive	Contamination warning and contamination errors are output even when there is just a little or local contamination.

Tab. 18: Contamination measurement strategies

A contamination warning is output first for the different degrees of contamination. If the front screen is not cleaned and contamination increases, then a contamination error is output and the Bulkscan® stops the measuring operation.

Note Static charges cause dust particles to be attracted to the front screen. The front screen of the Bulkscan® should be cleaned regularly and in the event of contamination (see "9.1 Cleaning the front screen“ on page 76).

How to configure contamination measurement:

- Switch to the **System** tab.
- Configure the contamination measurement **Strategy**.
- Configure the **Response time**.
- Configure the **Threshold** for the contamination warning and error. Enter the degree of available view as a % for the thresholds.

8.5 Scan frequency

The scan frequency is the frequency with which the Bulkscan® determines and outputs measured values at the interface.

Scan frequency	Cycle time
25 Hz	40.0 ms
50 Hz	20.0 ms

Tab. 19: Configurable scan frequencies for Bulkscan® LMS111

Scan frequency	Cycle time
35 Hz	28.6 ms
50 Hz	20.0 ms
75 Hz	13.3 ms

Tab. 20: Configurable scan frequencies for Bulkscan® LMS511

Note

- If you configure the output of the **Volume quota** or the **Mass quota** on a digital output, then make sure that duration of the pause between pulses is longer than the cycle time resulting from the scan frequency (see "4.13 Digital outputs“ on page 26).
- The selection of the scan frequency affects the energy consumption of the sensor.

System tab, **Scan frequency** group

8.6 Taking a reference measurement (compensation function)

Depending on the application, systematic errors can occur during the determination of the volume. In particular the compression of the lower layers of bulk due the mass of the bulk above will result in reproducible deviations. This systematic error can be calculated from the volume using a compensation function.

The software calculates this compensation function based on one or more reference measurements:

- Perform up to 10 reference measurements when the load on the conveyor belt varies in operation.
- The best results are achieved if the reference measurements cover the entire measuring range, meaning minimum to maximum belt load.

Note If you replace a sensor, you can also enter the compensation function directly instead of the reference measurements.

Requirements for the prevention of measurement errors

- Bulk height of the good transported at least 200 mm.
- Constant belt speed during the calibration.
- Constant bulk properties.
- Suitable mounting location and mounting orientation (see "5.2 Selecting the mounting location“ on page 31).
- Deformations of the conveyor belt under load < 5 mm.

Reference volume

For the reference measurement you need a reference volume. To determine the reference volume, a reference measuring system with an accuracy of ±1% with reference to the end value of the measuring range is required. Examples for suitable reference measuring systems:

- Packing plant for the bulk:
- Vessel with straight contours (e.g., container) into which the bulk is transported with the possibility of subsequently determining the volume.

Note If, instead of a defined volume, a bulk with a defined mass is available, you can convert this into a volume if the bulk density is known and constant.

$$\text{Volume } [m^3] = \frac{\text{Mass } [t]}{\text{Bulk density } [t/m^3]}$$

Compensation function

Two types of compensating functions are available.

Quadratic compensation function

A quadratic compensation function delivers optimal results in the range where the reference measurements were made. However, expected measurements outside of the reference measurement range, could result in a larger deviation.

Linear compensation function

A linear compensation function is recommended if measurements outside of the reference measurement range are expected.

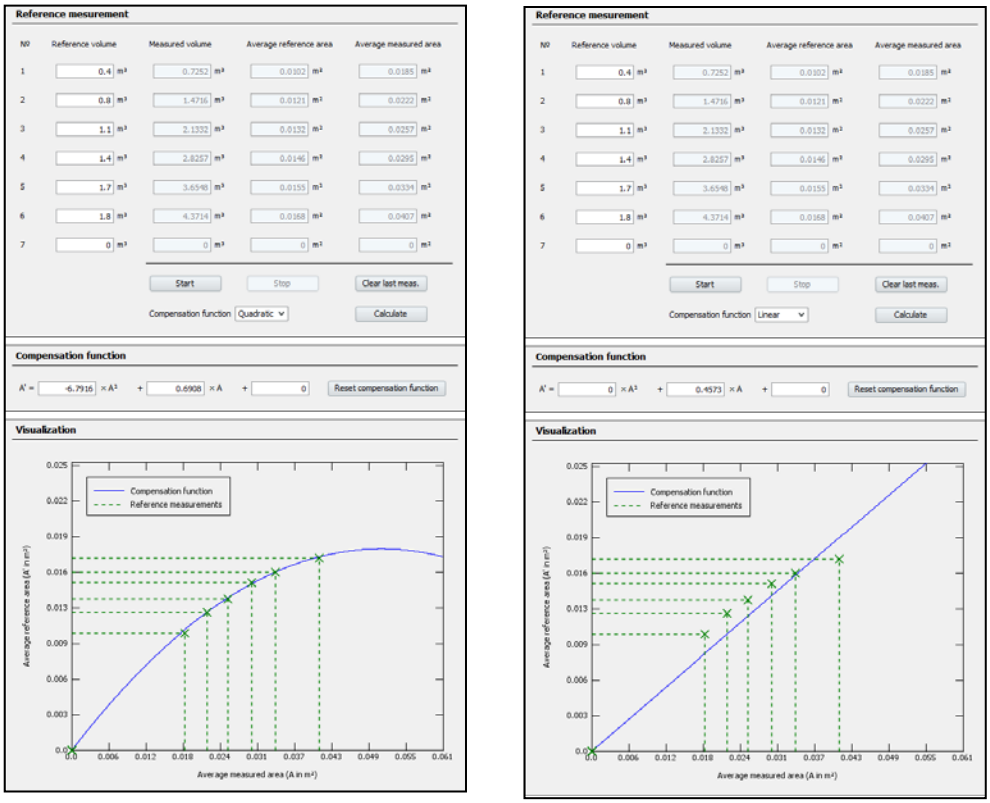


Fig. 55: Compensation function

Note You can make use of the visualization to help you choose the best suited compensation function for your application.

How to carry out a reference measurement:

- Start SOPAS and establish a connection to the sensor.
- Log in as Authorized client.
- On the **Operating mode** configuration bar, click **Measuring mode**.
- Switch to the **Compensation function** tab.
- Click Start to start the reference measurement.

Note

The compensation function is reset to the default values.

The 7-segment display shows c.

- Place a defined reference volume on the conveyor belt.
- Ensure that hazard-free operation is possible
- and start the full conveyor belt.
- Wait until the bulk has moved completely under the sensor.
- Click **Stop** to end the reference measurement.
- If you want to calibrate the sensor to a volume range, then perform up to 9 further measurements now (click **Start**, fill and start conveyor belt, click **Stop**). For calibration to a nominal volume a single reference measurement is sufficient.
- Choose the desired **Compensation function**.
- Click on **Calculate**. The compensation function is calculated and transferred to the sensor immediately.

9 Maintenance and care

Claims under the warranty rendered void!
The housing screws of the Bulkscan® are sealed. Claims under the warranty against SICK AG will be rendered void if the seals are damaged or the sensor opened. The housing must only opened by SICK authorized service personnel.

9.1 Cleaning the front screen

The Bulkscan® is largely maintenance-free. The front screen on the Bulkscan® should however be cleaned regularly and in the event of contamination.

- Do not use aggressive cleaning agents.
- Do not use abrasive cleaning agents.

Note Static charges cause dust particles to be attracted to the front screen. You can reduce this effect by using the anti-static plastic cleaner and the SICK lens cloth (see "12.2 Accessories“ on page 96).

How to clean the front screen:

1. Use a clean, soft brush to remove dust from the front screen.
2. Then wipe the front screen with a clean, damp cloth.

9.2 Replacing a Bulkscan®

All external cable connection terminate in the system plug or the plug connections, therefore there is no need to repeat the electrical installation when the sensor is replaced. The replacement sensor can simply be connected.

How to replace a Bulkscan®:

- Switch off the power supply for the Bulkscan®.
- Disconnect the connection cable from the Bulkscan®.
- Remove the faulty sensor.
- Mount the replacement sensor (see "5 Mounting“ on page 31).
- Connect the cables to the new Bulkscan® or plug in the system plug in the Bulkscan®.
- Configure the replacement sensor by using the parameter set of the former sensor saved on the PC (see "7 Configuration“ on page 60).

10 Fault diagnosis

Claims under the warranty rendered void!
The housing screws of the Bulkscan® are sealed. Claims under the warranty against SICK AG will be rendered void if the seals are damaged or the sensor opened. The housing must only opened by SICK authorized service personnel.

10.1 Response to errors

Danger due to malfunction!
Cease operation if the cause of the malfunction has not been clearly identified

- Immediately put the machine/system out of operation if you cannot clearly identify or allocate the fault and if you cannot safely remedy the fault.

10.2 SICK Suport

If you cannot remedy a fault with the help of the information provided in this chapter, please contact your respective SICK subsidiary.

10.3 Error and status indicators on the 7 segment display

Display	Possible cause	Possible measures
⊡, ⊡, ⊡, ⊡, ⊡, ⊡, ⊡, ⊡, ⊡	Sensor is currently starting (For Bulkscan® LMS111 *P* is shown)	▶ Wait until the sensor is ready for operation.
no display	Sensor in measuring mode	No error
c.	Reference measurement for compensation function is running	▶ Stop the reference measurement when the test volume has passed through. ▶ Determine the coefficients for the compensation function from the values measured and configure the compensation function (see "8.5 Scan frequency“ on page 72).
E.	Device error	▶ Send the sensor to the manufacturer for repair.
t.	Teaching-in reference contour	▶ Wait until the process is complete.
3	Heater not connected or temperature too low	▶ Wait until the sensor has warmed up. ▶ Check the connection of the heater. ▶ Send the sensor to the manufacturer for repair.
4	No reference contour	▶ Teach-in the reference contour (see "8.1 Teaching-in the reference contour“ on page 64).
5	Teach-in failed	▶ Check the angle: Left and right, as well as the maximum distance. ▶ Teach-in the reference contour again.
6	Teach-in successful, reference contour saved. The sensor is in the maintenance mode.	▶ Start the measuring mode.

Display	Possible cause	Possible measures
[?]	Too many invalid measuring points within a scan	▶ Check the ambient conditions (dust, reflective surfaces, contamination on the front screen, bulk properties). ▶ Adjust the tolerance against reflection to the application (see "8.3.2 Tolerance against reflection“ on page 69). ▶ If necessary, activate optimization for outdoor applications (see "8.3.3 Optimization for outdoor applications“ on page 69).

Tab. 21: Error and status indicators on the 7¬segment display

10.4 Status indication BAM100

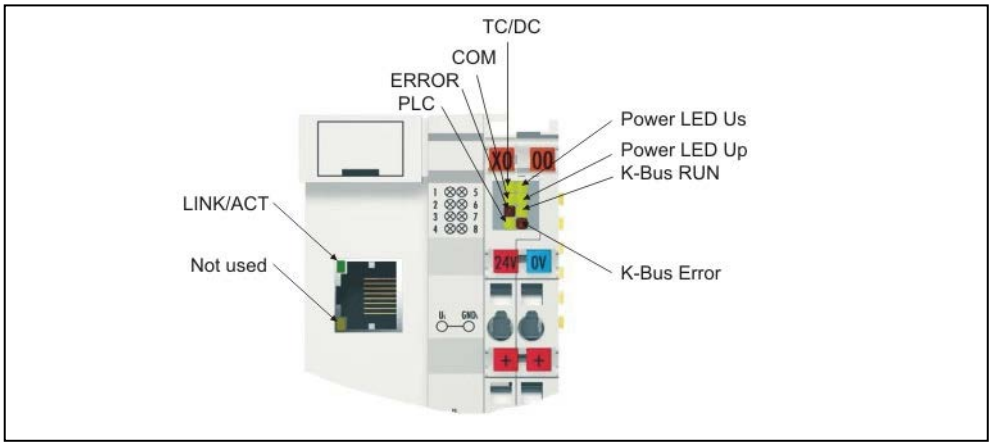


Fig. 56: status indication

LEDs diagnosis of voltage supply

LED (Power LEDs)	Meaning
Power LED Us off	Bus Coupler has no voltage 24 V_{DC}
Power LED Up off	No 24 V_{DC} power supply connected to the power contacts

LEDs diagnosis of K-Bus

LED (K-Bus)	Meaning
K-Bus RUN	on or flashing - K-bus running
K-Bus ERR	flashing (see error code)

LEDs diagnosis of ethernet

LED (Ethernet)	Meaning
LINK/ACT	on - LINK available, flashing - LINK available and communication
ERROR	flashing - DHCP or BootP active. Waiting for an IP address
COM	Communication with controller available

LEDs diagnosis of SPS

LED (Ethernet)	Meaning
PLC	on - PLC running, flashing - cycle time is exceeded, off - cycle time exceeded permanently or PLC stopped
TC/DC	on - TwinCAT configuration active, off - Default configuration active, flashing TwinCAT configuration faulty

11 Technical data

11.1 Bulkscan® LMS511 data sheet

	Minimum	Typical	Maximum
Features			
Infrared laser light source	895 nm	905 nm	915 nm
Laser protection class	1 (safe for eye) according to EN/IEC 60825-1:2014 (complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, June 2007)		
Aperture angle			190°
Angular resolution		0,5°	
Scan frequency	35 Hz	50 Hz	75 Hz
Bandwidth	No limit		
Heating	yes		
Operating range			
Distance sensor - bulk material	0.5 m		20 m
Belt speed	–30 m/s		+30 m/s
Number of echoes evaluated	5		
Performance			
Power-up delay (temperature-dependent)	30 s		60 s
Cycle time	13,3 ms	20,0 ms	28,6 ms
Averaging filter	0 s		3.600 s
Measurement accuracy[1)]			±3 %
Interfaces			
Serial auxiliary interface/USB			
Protocol	USB		
Data transmission rate			57.600 Baud
Serial Host Interface			
Protocol	RS232/RS422		
Data transmission rate			57.600 Baud
Ethernet			
Protocol	TCP/IP		
Data transmission rate	10 Mbit/s		100 Mbit/s
Digital inputs	2		
Encoder inputs	2		
Digital outputs	6		
Analog In-/ output:	5 diagnostic LEDs and one 7-segment display. See accessories analog module BAM100 (see "12.2 Accessories“ on page 96).		
Electrical date			
Electrical connection	5-pins M12 male connector, A-coded		

[1)] Under reference conditions: 2 m distance to conveyor belt, 100 % object remission; reference target area 0.1024 m², 100 % object remission; averaging filter 0 s

Supply voltage			
Sensor	19.2 V	24 V	28.8 V
Heating	19.2 V	24 V	28.8 V
Permissible residual ripple			±5%
Switch on current			2 A
Operating current at 24 V DC			
Sensor			1,3 A
Heating			1,8 A
Power consumption			
Sensor		22 W	25 W
Heating		55 W	65 W
Digital inputs			
Input voltage	11 V		30 V
Input resistance for 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			
Input resistance for 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		50 mA	100 mA
Digital outputs			
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		
Power-down time		0.8 ms	2 ms

Mechanical data

Housing color	RAL 7032 (gray)		
Enclosure rating	IP 67 (as per IEC 60529 Edition 2.2:2013-08)		
Protection class	III		
Weight		3.7 kg	
Dimensions	Width 155 mm × Depth 159 mm × Height 185 mm		

Ambient data

EMC test	As per IEC 61000-6-2:2016-08, IEC 61000-6-3:2006-07		
Vibration resistance			
Frequency range	10 Hz		150 Hz
Amplitude	5 g RMS		
Shock resistance	IEC 60068-2-27		
Single shock	15 g, 11 ms		
Continuous shock	10 g, 16 ms		
Operating temperature range	–40 °C		+60 °C

Storage temperature range	–40 °C		+70 °C (max. 24 h)
Ambient light immunity			70.000 lx

Tab. 22: Bulkscan® LMS511 data sheet

11.2 Bulkscan® LMS111 data sheet

	Minimum	Typical	Maximum
Features			
Infrared laser light source	895 nm	905 nm	915 nm
Laser protection class	1 (eye safe) as perEN/IEC 60825-1: 2014. Identical laser class for issue EN/IEC 60825-1:2007. Complies with 21 CFR 1040.10 with the exception of the deviations as per Laser Notice No. 50, June 2007		
Aperture angle			190°
Angular resolution		0,5°	
Scan frequency	25 Hz	50 Hz	
Bandwidth	No limit		
Heating	yes		
Operating range			
Distance sensor - bulk material	0.5 m		10 m
Belt speed	–30 m/s		+30 m/s
Performance			
Power-up delay (temperature-dependent)			60 s
Cycle time		20 ms	40 ms
Averaging filter	0 s		3.600 s
Measurement accuracy[1)]			±6 %
Interfaces			
Serial Auxiliary/Host Interface			
Protocol	RS232 (proprietary)		
Data transmission rate		57.600 Baud	
Ethernet			
Protocol	TCP/IP		
Data transmission rate	10 Mbit/s		100 Mbit/s
Digital inputs	2		
Encoder inputs	2		
Digital outputs	3		
Analog In-/ output:	5 diagnostic LEDs and one 7-segment display. See accessories analog module BAM100 (see "12.2 Accessories“ on page 96).		
Electrical date			
Electrical connection	5-pins M12 male connector, A-coded		

[1)] Under reference conditions: 2 m distance to conveyor belt, 100 % object remission; reference target area 0.1024 m², 100 % object remission; averaging filter 0 s; contour smoothing setting: High

Supply voltage			
Sensor	10.8 V	24 V	30.0 V
Heating	19.2 V	24 V	28.8 V
Permissible residual ripple			±5%
Switch on current			2 A
Operating current at 24 V DC			
Sensor		0.33 A	0.4 A
Sensor + Heating		1.8 A	2.6 A
Power consumption			
Sensor		8 W	10 W
Heating		35 W	45 W
Digital inputs			
Input resistance for HIGH		2 kΩ	
Voltage for HIGH	11 V	24 V	30 V
Voltage for LOW	-30 V	0 V	5 V
Input capacity		15 nF	
Static input current	6 mA	12 mA	15 mA
Encoder inputs			
Input resistance for HIGH		2 kΩ	
Voltage for HIGH	11 V	24 V	30 V
Voltage for LOW	-30 V	0 V	5 V
Input capacity		1 nF	
Static input current	6 mA	15 mA	20 mA
Duty cycle (Ti/T)		0,5	
Input frequency			100 kHz
Current load		50 mA	100 mA
Digital outputs			
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		
Power-down time		0.8 ms	2 ms

Mechanical data

Housing color	RAL 7032 (gray)		
Enclosure rating	IP67 (as per EN 60529 (1991-10); A1 (2002-02))		
Protection class	III		
Weight		1.1 kg	
Dimensions	Width 102 mm × Depth 106 mm × Height 162 mm		

Ambient data

EMC test	As per EN 61000-6-2 (2005-08), EN 61000-6-3 (2007-01)/A1 (2011-03)		
Vibration resistance			
Frequency range	10 Hz		150 Hz
Amplitude	5 g RMS		
Shock resistance	IEC 60068-2-27		
Single shock	15 g, 11 ms		
Continuous shock	10 g, 16 ms		
Operating temperature range	–30 °C		+50 °C

Storage temperature range	–30 °C		+70 °C (max. 24 h)
Ambient light immunity			40.000 lx

Tab. 23: Bulkscan® LMS111 data sheet

11.3 Analog module BAM100 data sheet

Electric

	Minimum	Typical	Maximum
Power supply	20.4 V DC	24 V DC	28.8 V DC
Current consumption			max. 320 mA
Inrush current	2,5 x current consuption		
Recommended fuse	<= 10 A		
Power contacts			24 VDC max / 10 A max.
Isolation	500 V		
Connection Bulkscan®	1 x RJ45		
Transfer rate	10/100 Mbaud		
Cable length between Bulkscan® and BAM100			100 m max.
Analog input	4 x 4 mA ... 20 mA		
Internal resistance	< 85 Ohm		
Resolution	12 Bit		
Measurement error	<+-0,3% of final value		
Surge voltage resistance	30 V DC		
Total response time Bulkscan® and BAM100	500 ms		
Analog output	4 x 4 mA ... 20 mA		
Load	< 350 Ohm (short-circuit protected)		
Resolution	12 Bit		
Measurement error	<+-0,1% of final value		
EMC	EN 61000-6-2/EN 61000-6-4		

Connection technology

Wiring	Spring force tegnology Cage Clamp
Cross-sectional area	0,08 mm² ... 2,5 mm², wire massive / solid, AWG28-14
Stripping length	8 mm ... 9 mm

Mechanical

Asembly	on 35 mm mounting rail according to EN 50022
Material housing	Polycarbonat
Dimensions (WxHxD)	86 mm x 100 mm x 68 mm
Weight	250 g
Encloser rate	IP20
Installation position	flexible
Vibration/ shock resistance	acc. EN 60068-2-6/EN 60068-2-27

Ambient conditions

Ambient temperature operation	0 °C ... +55 °C
Ambient temperature storage	-25 °C ... +85 °C

Approval

Approval	CE, UL, GL

11.4 Dimensional drawings

11.4.1 Dimensional drawing Bulkscan® LMS511

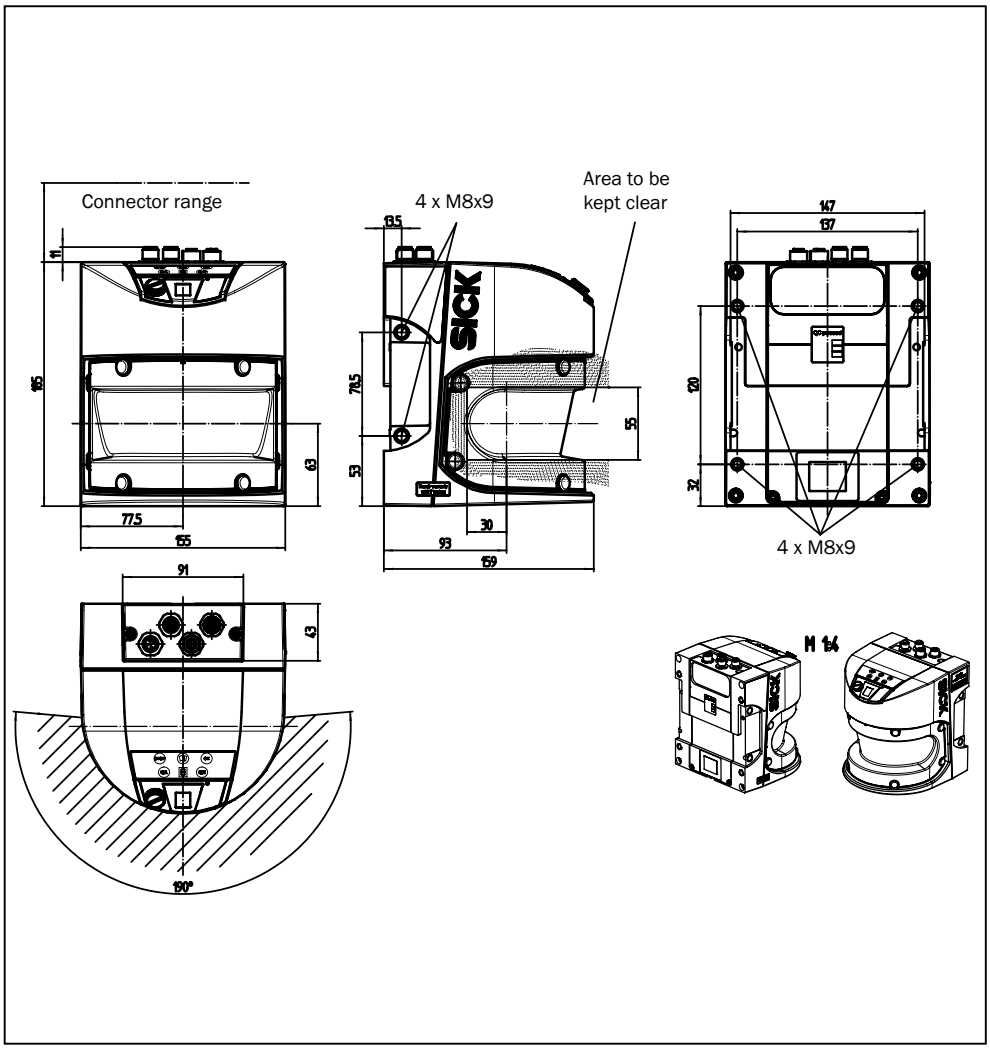


Fig. 57: Dimensional drawing Bulkscan® LMS511 (mm)

11.4.2 Dimensional drawings mounting kits (only for Bulkscan® LMS511)

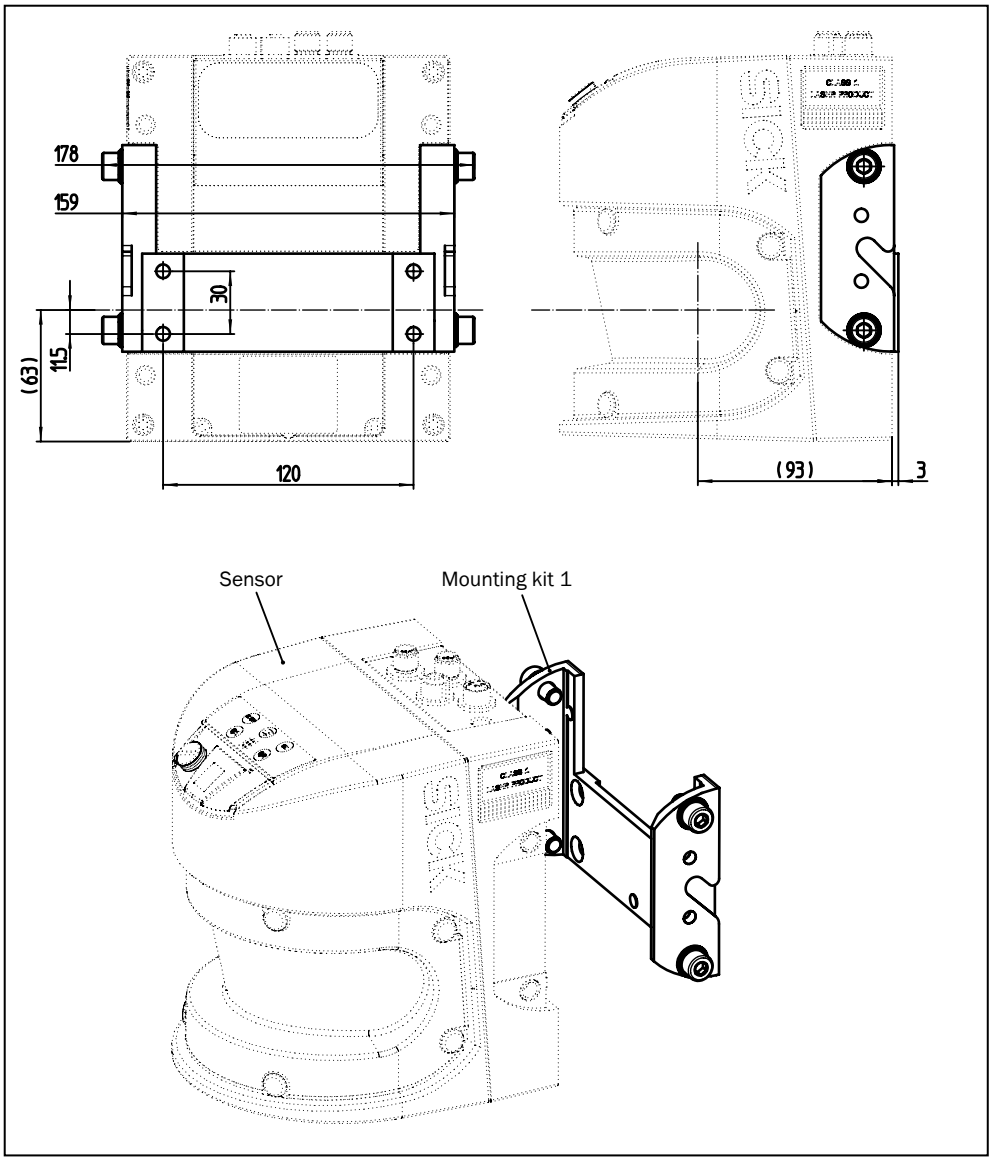


Fig. 58: Dimensional drawing mounting kit 1 (mm)

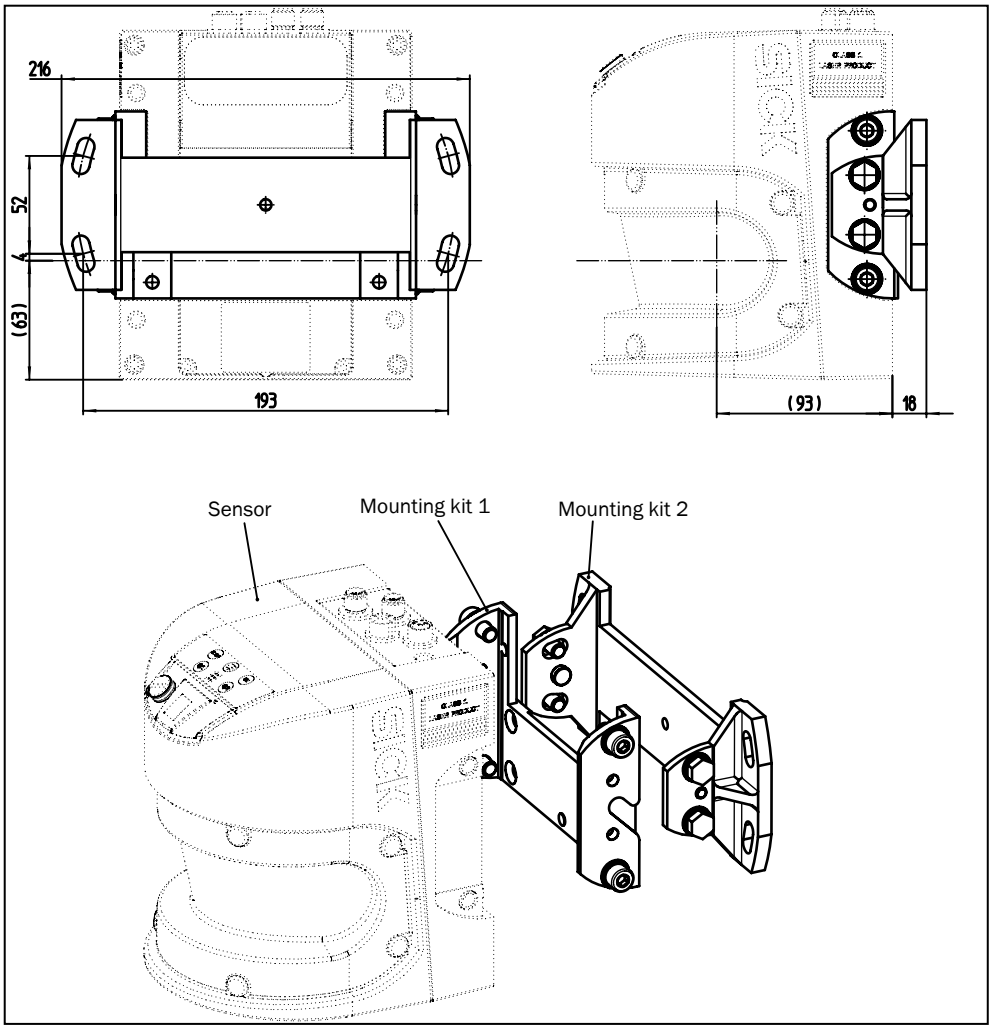


Fig. 59: Dimensional drawing mounting kit 2 (mm)

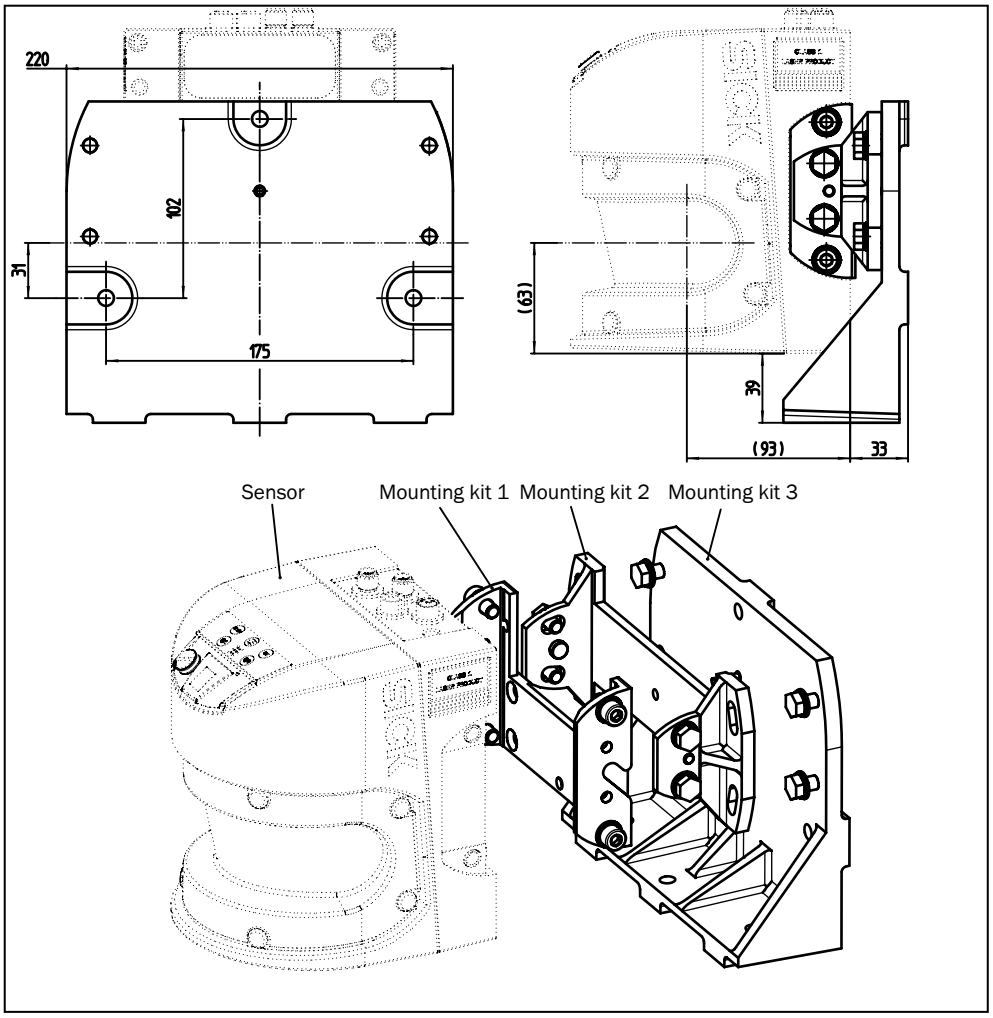


Fig. 60: Dimensional drawing mounting kit 3 (mm)

11.4.3 Dimensional drawing mounting bracket for existing LMS2xx mounting kit (only for Bulkscan® LMS511)

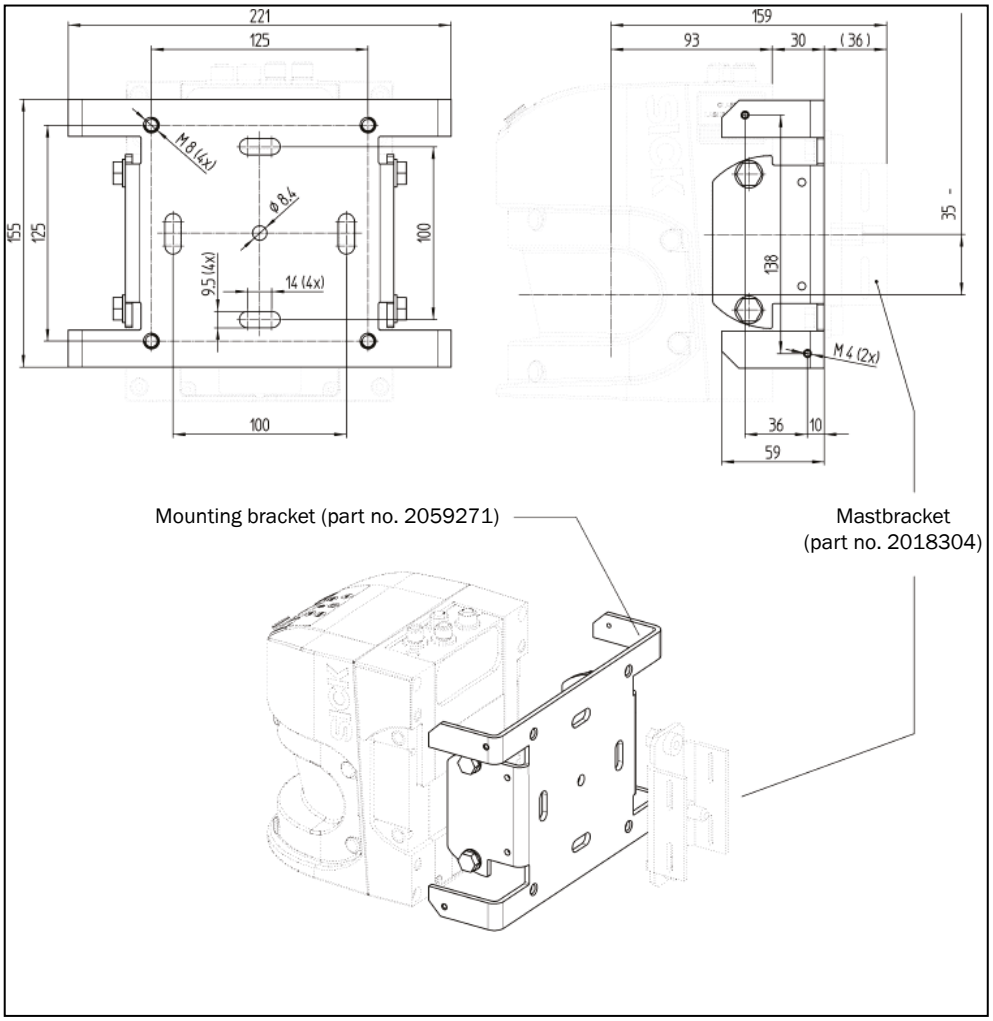


Fig. 61: Dimensional drawing mounting bracket for existing LMS2xx mounting kit (mm)

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OPERATING INSTRUCTIONS | Bulkscan® LMS511
8014829/ZN56/2018-11-28| SICK
Subject to change without notice

11.4.4 Dimensional drawing mounting bracket with mast bracket (only for Bulkscan® LMS511)

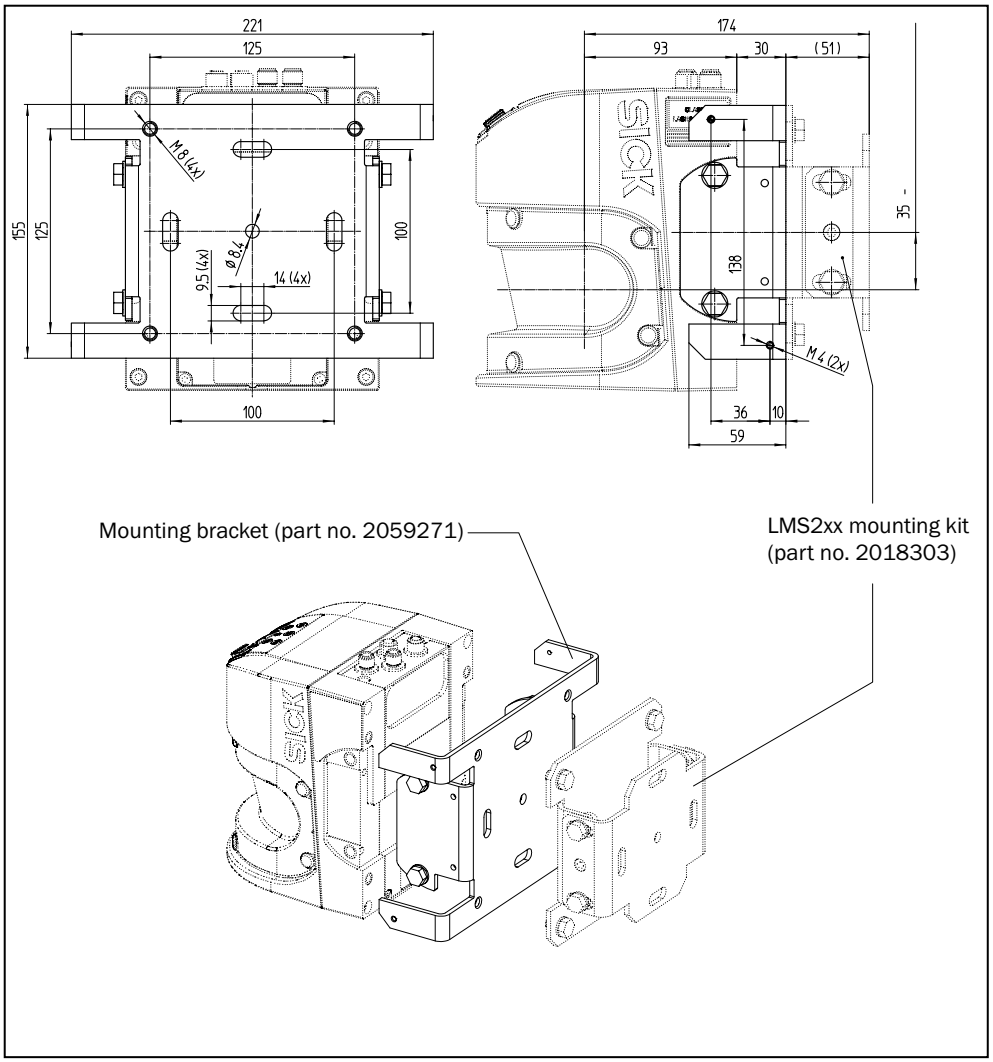


Fig. 62: Dimensional drawing mounting bracket with mast bracket (mm)

11.4.5 Dimensional drawing Bulkscan® LMS111

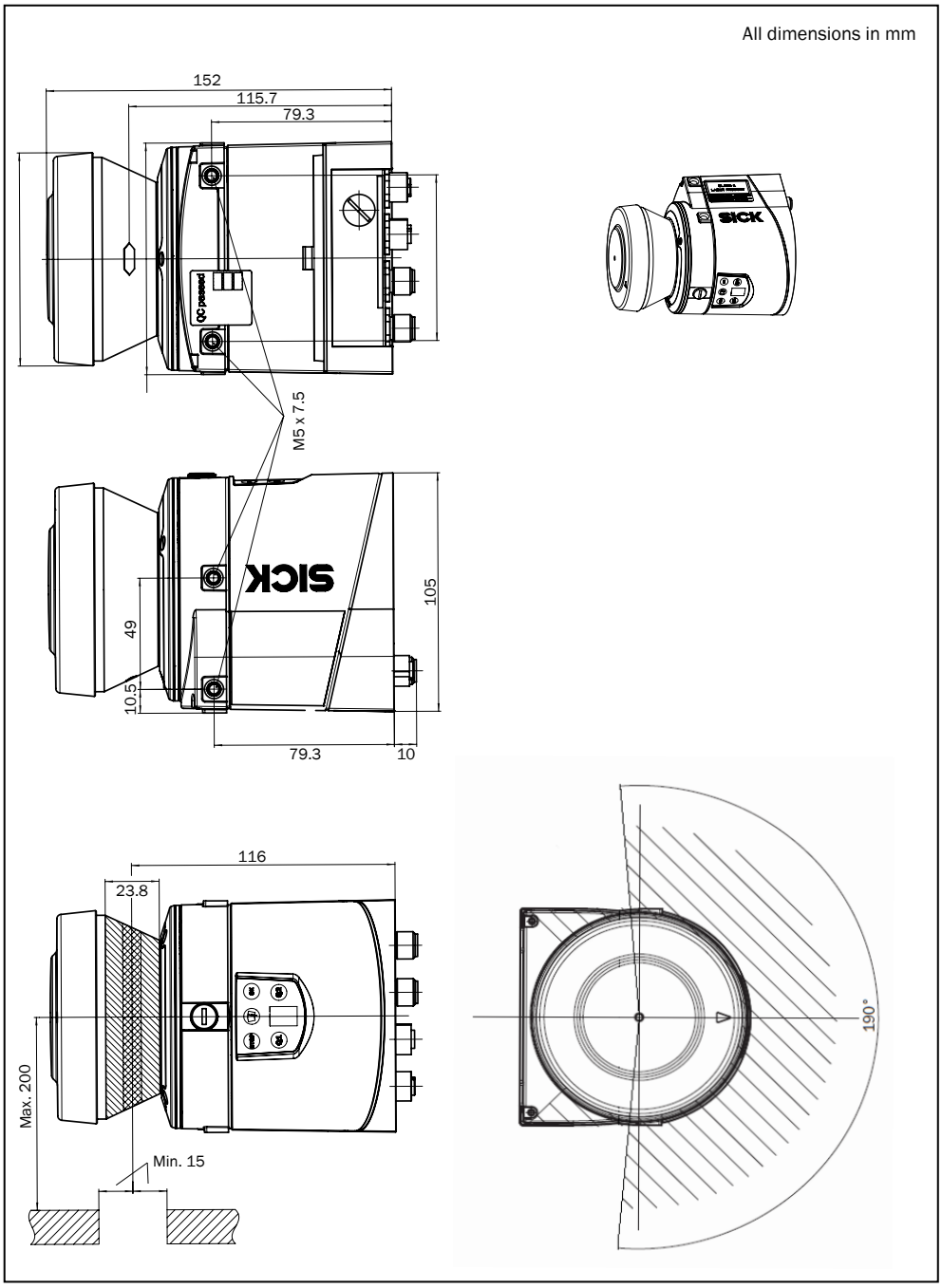


Fig. 63: Dimensional drawing Bulkscan® LMS111

11.4.6 Dimensional drawing mounting kits (only for Bulkscan® LMS111)

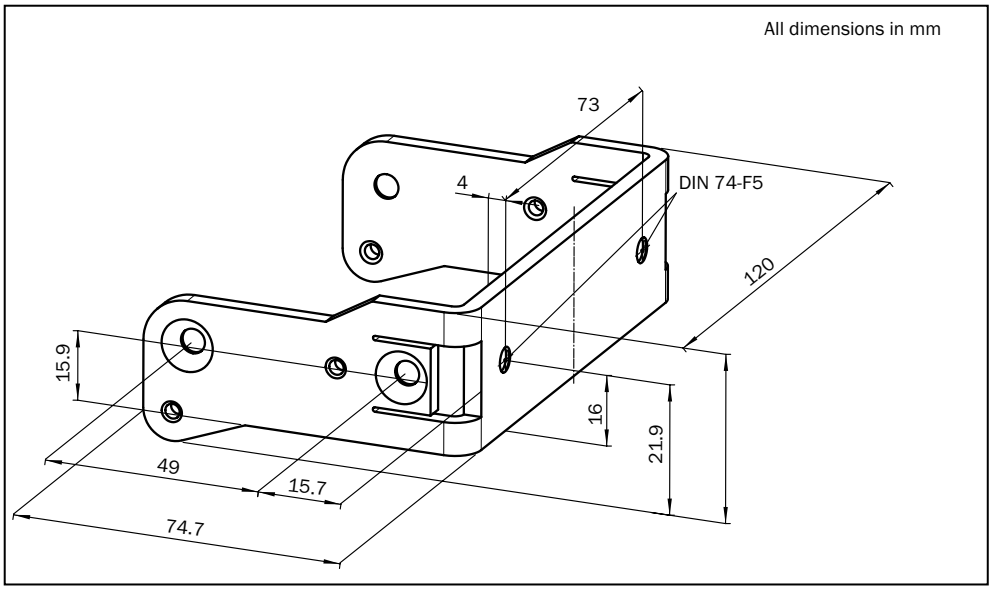


Fig. 64: Dimensional drawing mounting kit 1a (part no. 2034324)

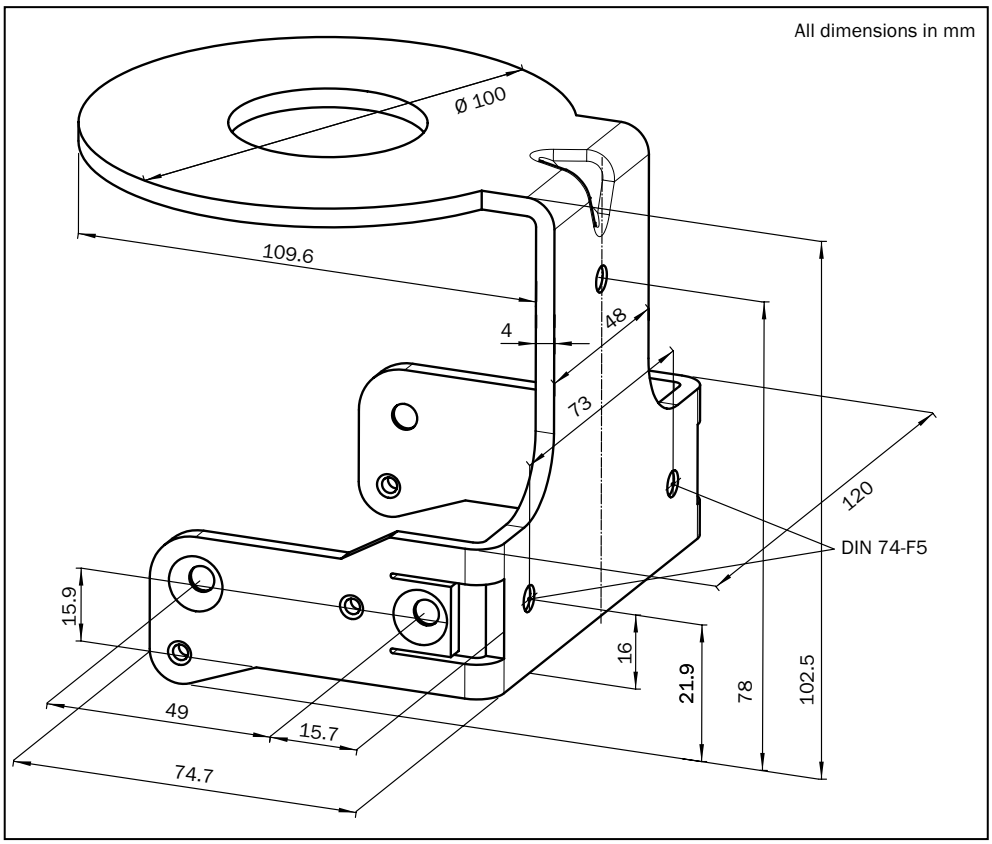


Fig. 65: Dimensional drawing mounting kit 1b (part no. 2034325)

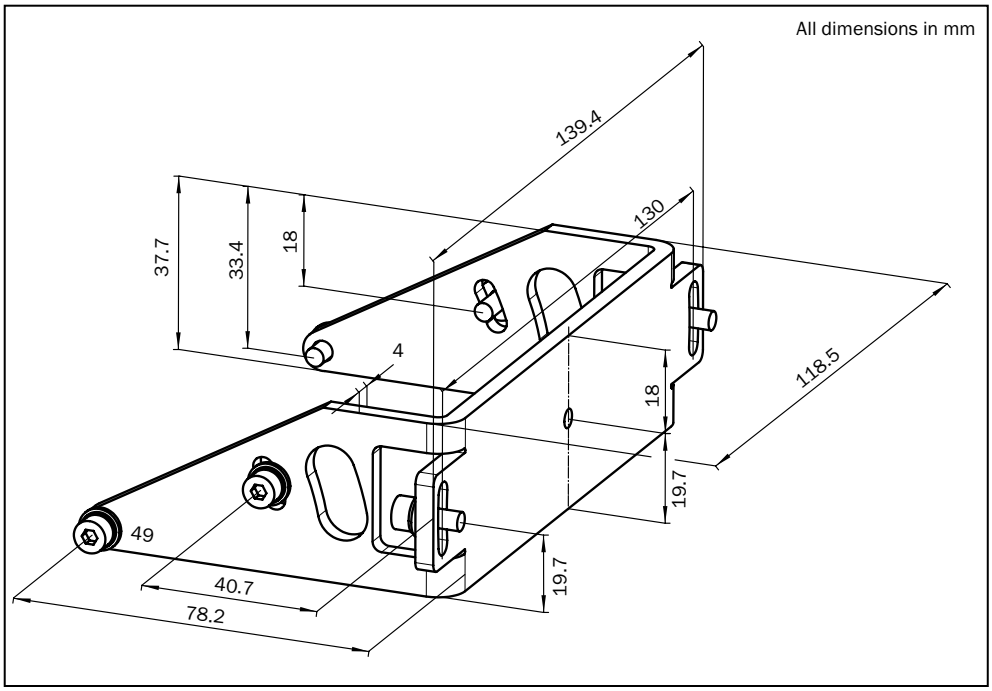


Fig. 66: Dimensional drawing mounting kit 2 (part no. 2039302)

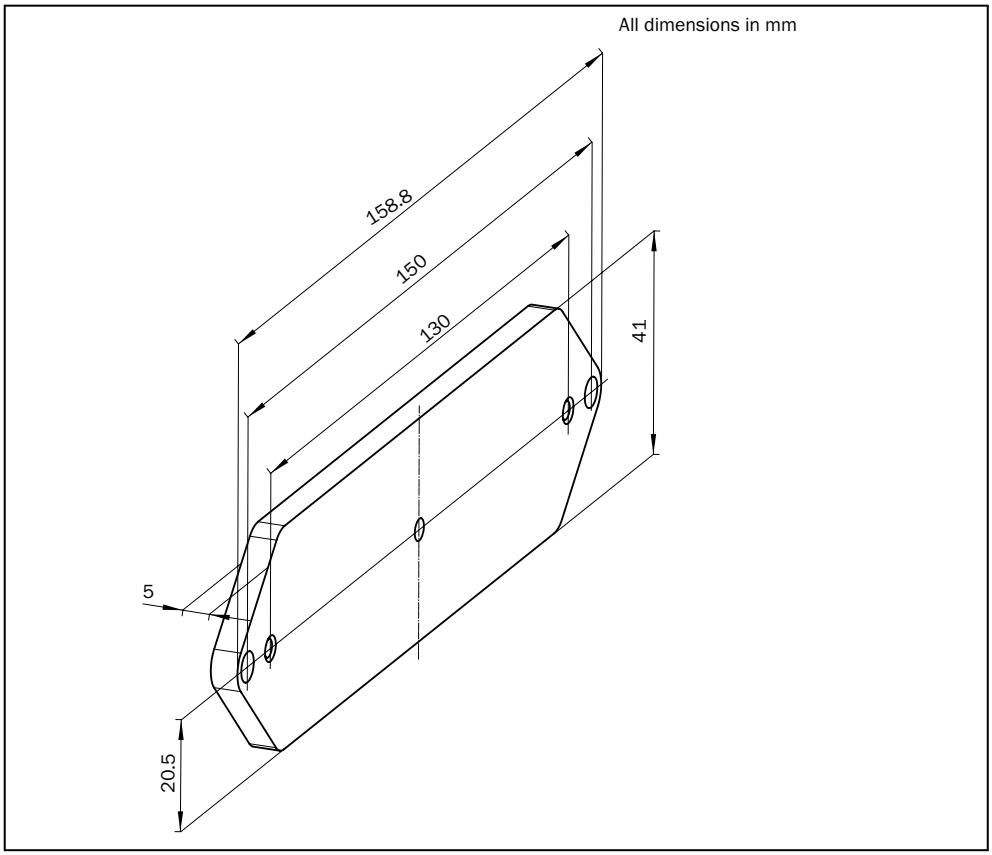


Fig. 67: Dimensional drawing mounting kit 3 (part no. 2039303)

11.4.7 Dimensional drawing weather protection hood for Bulkscan® LMS511 (part. no 2063050)

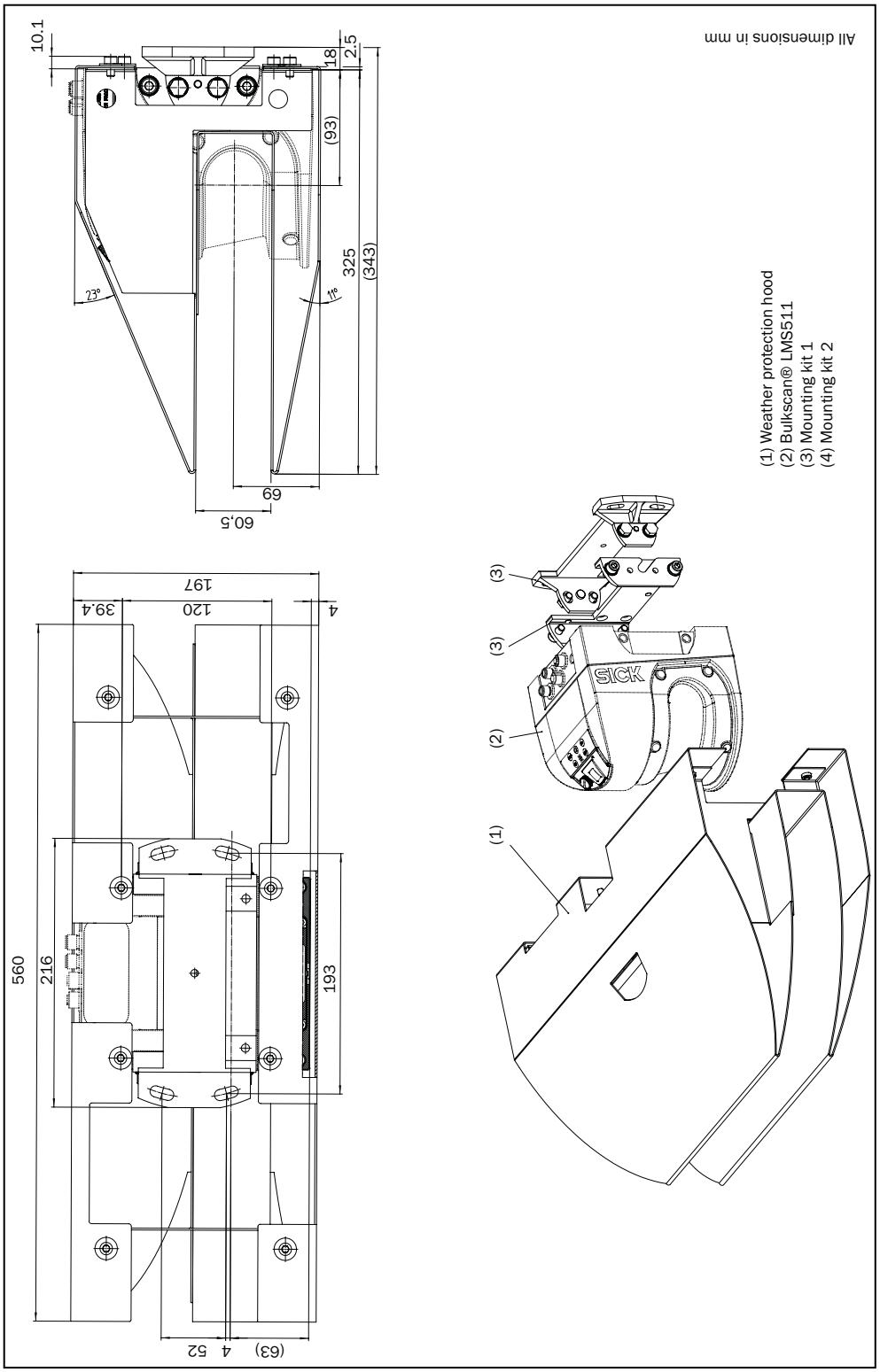


Fig. 68: Dimensional drawing weather protection hood (part. no 2063050)

11.4.8 Dimensional drawing weather protection hood for Bulkscan® LMS111

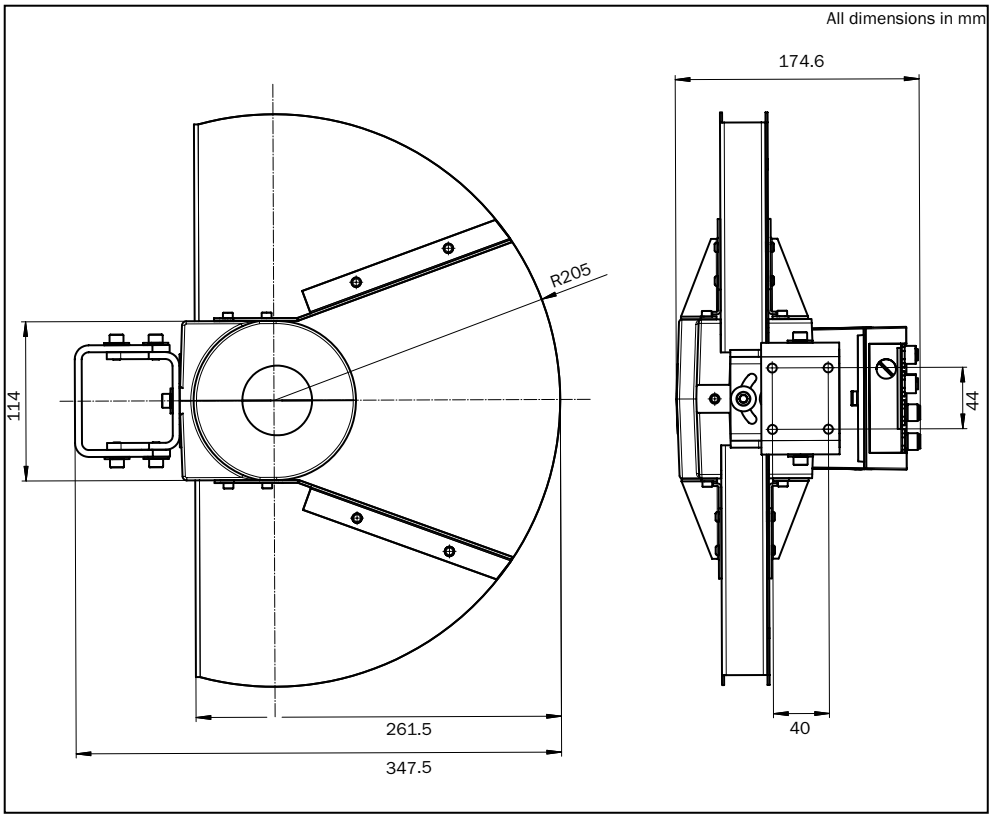


Fig. 69: Dimensional drawing weather protection hood 190° (part no. 2046459)

11.4.9 Dimensional drawing analog module BAM100

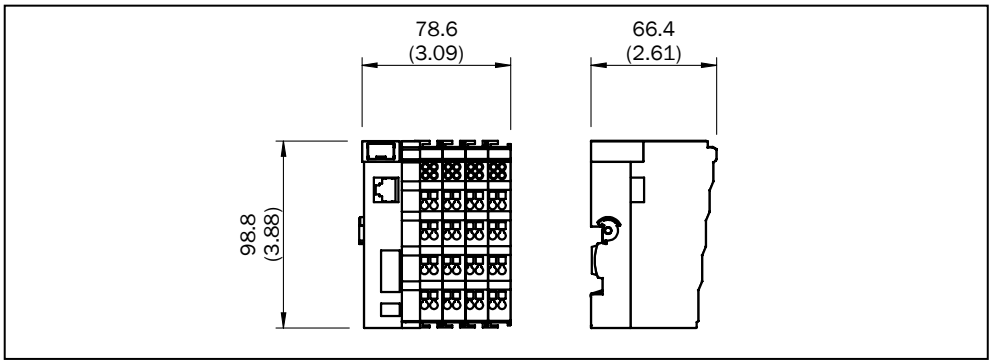


Fig. 70: Dimensional drawing analog module BAM100

12 Ordering information

12.1 Scope of delivery

The Bulkscan® delivery includes the following components:

Piece	Components	Comment
1	Laser volume flowmeter Bulkscan® LMS511-20190 or Bulkscan® LMS111-10190	Consisting of: Sensor head with opto-electronic acquisition system (housing) Application module (only for Bulkscan® LMS511) System plug (already mounted, contains electrical connections)
1	Device instructions with electrical circuit diagram (only for Bulkscan® LMS511)	Included in the Bulkscan® LMS511 packaging
1	Safety Notes (only for Bulkscan® LMS111)	Inlcuded in the Bulkscan® LMS111 packaging

Tab. 24: Scope of delivery

12.2 Accessories

Part	Description	Part number
BAM100	Analogue module, Fa. Beckhoff, Power supply: 24 V DC (-15%/+20%), Din rail module, 35 mm C-rail, acc. EN50022, Encloser rate IP20, Ethernet TCP/IP interface (RJ45), CoLA Communication, Analog signals:3 x IN: 4 ... 20 mA, 4 x OUT: 4 ... 20 mA	2073296
Measuring wheel encoder with open cable	Measuring wheel DFV60E-22EK01024 Cable, 1.5 m, 8-pin Surface: O-ring Measuring wheel circumference: 300 mm Number of lines: 1024 Encoder resolution: 0.293 mm/Inc Temperature range: - 20 ° C ... +100 ° C	1060309
Spring arm for measuring wheel encoder	DFV60 spring arm For connection with measuring wheel encoder of type DFV60 (1060308 and 1060309)	2056155
Incremental encoder with solid shaft	Incremental encoder DFS60E-S4EK01024 Cable, 8-wire universal, 1.5 m Number of lines: 1024 Temperature range: 0 to 85 °C Measuring wheel must be ordered separately	1037534
Measuring wheel for encoder shafts	Measuring wheel for incremental encoders of type DFS60 (1037534) Surface: Hytrel, smooth surface Measuring wheel circumference: 200 mm Encoder resolution: 0.195 mm/Inc	5312988
Measuring wheel for encoder shafts	Measuring wheel for incremental encoders of type DFS60 (1037534) Surface: Hytrel, smooth surface Measuring wheel circumference: 500 mm Encoder resolution: 0.488 mm/Inc	5312989

Part	Description	Part number
Measuring wheel for encoder shafts	Measuring wheel for incremental encoders of type DFS60 (1037534) Surface: Hytrel, grooved surface Measuring wheel circumference: 200 mm Encoder resolution: 0.195 mm/Inc	5318678
Measuring wheel for encoder shafts	Measuring wheel for incremental encoders of type DFS60 (1037534) Surface: O-ring Measuring wheel circumference: 200 mm Encoder resolution: 0.195 mm/Inc	2055224
Measuring wheel for encoder shafts	Measuring wheel for incremental encoders of type DFS60 (1037534) Surface: O-ring Measuring wheel circumference: 300 mm Encoder resolution: 0.293 mm/Inc	2049278
Measuring wheel for encoder shafts	Measuring wheel for incremental encoders of type DFS60 (1037534) Surface: O-ring Measuring wheel circumference: 500 mm Encoder resolution: 0.488 mm/Inc	2055227
Incremental encoder with blind hollow shaft	Incremental encoder DFS60E- BHEK01024 Blind hollow shaft 15 mm Cable, 8-wire universal, 1.5 m Number of lines: 1024 Temperature range: 0 to 85 °C	1055909
Incremental encoder with blind hollow shaft	Incremental encoder DFS60E- BHEC01024 Blind hollow shaft 15 mm Plug, M12, 8-pin, radial Number of lines: 1024 Temperature range: 0 to 85 °C	1036541

Part	Description	Part number
Lens cloth	Special cloth for proper cleaning of the front screen	4003353
Plastic cleaner	Anti-static, mild detergent solution	5600006
Pre-assembled connection cables: Power supply	5 m, stripped	6036159
	10 m, stripped	6042565
	20 m, stripped	6042564
Pre-assembled connection cables: Digital inputs/outputs (only for Bulkscan® LMS511)	5 m, stripped	6042732
	10 m, stripped	6042733
	20 m, stripped	6042734
Pre-assembled connection cables: Data (only for Bulkscan® LMS511)	5 m, stripped	6042735
	10 m, stripped	6042736
	20 m, stripped	6042737
Pre-assembled connection cables: Digital inputs/outputs (only for Bulkscan® LMS111)	5 m, stripped	6036155
	10 m, stripped	6036156
	20 m, stripped	6036157

Part	Description	Part number
Pre-assembled connection cables: Data (only for Bulkscan® LMS111)	5 m, stripped	6036153
	10 m, stripped	6028420
	20 m, stripped	6036154
Pre-assembled connection cables: Ethernet	5 m, RJ45	6034415
	10 m, RJ45	6030928
	20 m, RJ45	6036158
USB connecting cable (only for Bulkscan® LMS511)	3 m, 4pin, USB MiniB to USB Standard	6042517

Model name	Brief description	Part no.
DFV60 spring arm	Spring arm/mounting arm for DFV60	2056155
Mounting bracket Bulkscan® LMS511	Mounting bracket for LMS5xx (for retrofitting, if 2018303 is already in use)	2059271
Mounting kit 1 Bulkscan® LMS511	Mounting bracket for direct mounting, from the rear, on wall or machine, not adjustable	2015623
Mounting kit 2 Bulkscan® LMS511	Mounting bracket for rear mounting on wall or machine, adjustable longitudinal and lateral axes, only in conjunction with mounting kit 1 (2015623)	2015624
Mounting kit 3 Bulkscan® LMS511	Mounting bracket for rear mounting on wall, floor, or machine, adjustable longitudinal and lateral axes, only in conjunction with mounting kit 1 (2015623) and 2 (2015624)	2015625
Mounting kit 1a Bulkscan® LMS111	1 piece, mounting bracket for rear mounting on wall or machine	2034324
Mounting kit 1b Bulkscan® LMS111	1 piece, mounting bracket for rear mounting on wall or machine with protection of optics hood	2034325
Mounting kit 2 Bulkscan® LMS111	1 piece, mounting bracket, adjustable lateral axis, only in conjunction with mounting kit 1a (2034324) or 1b (2034325)	2039302
Mounting kit 3 Bulkscan® LMS111	1 piece, mounting plate, adjustable longitudinal axis, only in conjunction with mounting kit 2 (2039302)	2039303
Wheater hood Bulkscan® LMS511	Wheater hood for Bulkscan® LMS511	2063050
Weather hood 190° Bulkscan® LMS111	Weather hood 190°	2046459
Mounting set for weather hood 190° Bulkscan® LMS111	Standard mounting set for 190° weather hood	2046025
Quick-action lock system Bulkscan® LMS111	Quick-action lock system for weather hood 190°	2046989

Tab. 25: Accessories part numbers

13 Appendix

13.1 Telegram reference

To work with telegrams, please read the following sections:

- Configuration of the Bulkscan® using telegrams (see "7.2 Configuration of the Bulkscan® using telegrams“ on page 62).
- Notation and examples (see below).

The available telegrams are divided as follows based on the structure of the software user interface:

- Logging in to the sensor/Logging out of the sensor (see "13.1.2 Logging in to the sensor/Logging out of the sensor“ on page 101).
- Saving the configuration in the non-volatile memory (see "13.1.3 Saving the configuration in the non-volatile memory“ on page 102).
- Device information (see "13.1.4 Device information“ on page 102).
- Operating mode/Teach-in (see "13.1.5 Operating mode/Teach-in“ on page 102).
- Measured value (see "13.1.6 Measured values“ on page 103).
- Measurement (see "13.1.7 Measurement“ on page 103).
- System (see "13.1.8 System“ on page 104).
- Digital inputs (see "13.1.10 Digital inputs“ on page 106).
- Digital outputs (see "13.1.11 Digital outputs“ on page 106).
- Reference measurement (compensation function) (see "13.1.12 Reference measurement (compensation function)“ on page 108).
- Service data (see "13.1.13 Service data“ on page 109).
- Error codes (sFA) (see "13.1.14 Error codes (sFA)“ on page 110).

13.1.1 Notation and examples

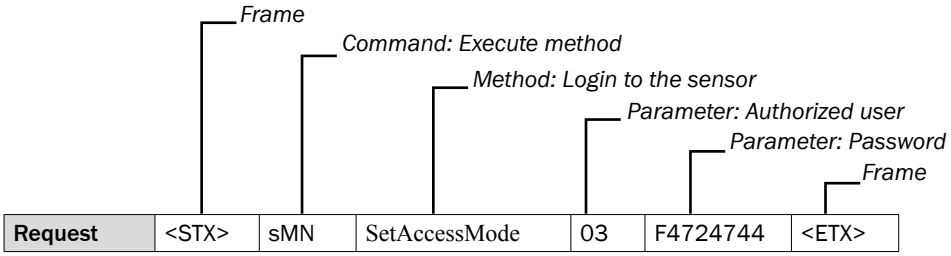
Notation

The individual telegram sections must each be separated by a space (ASCII code 32, 20 h). The Bulkscan® interprets the parameters transferred as follows:

- Parameters with a leading "+" or "–" are interpreted as a decimal value (ASCII notation).
- Parameters without a leading "+" or "–" are interpreted as a hexadecimal value (ASCII notation).
- The Bulkscan® interprets each parameter individually, i.e., the different notations can be mixed within a telegram.
- All examples used in the following telegram lists refer to the CoLaA protocol.

Structure of the data

The data comprises a command, a variable name or a method name, as well as any necessary parameters.



Request	<STX>	sMN	SetAccessMode	03	F4724744	<ETX>

Reply	<STX>	sAN	SetAccessMode	1	<ETX>

Commands

The Bulkscan® replies to each telegram with the reply command to match the request command.

Request commands	Meaning	Reply commands
sRN	Output variable once	sRA
sEN ... 1	Output variable continuously	sEA ... 1, sSN
sEN ... 0	Stop continuous variable output	sEA ... 0
sWN	Write variable	sWA
sMN	Execute method (executed without errors)	sAN sAN ... 1
	Execute method (error, not executed)	sAN ... 0
(Other)	Command or data unknown	sFA

Tab. 26: Request command and the corresponding reply commands

Variable types

The variable types are given in the telegram syntax. Following variable types are possible:

Variable types	Length (Byte)	Value range
bool_1	1	0 oder 1
uint_8	1	0 ... 255
int_8	1	–128 ... +127
uint_16	2	0 ... 65.535
int_16	2	–32.768 ... +32.767
uint_32	4	0 ... 4.294.967.295
int_32	4	–2.147.483.648 ... +2.147.483.647
float_32	4	$1{,}5 \times 10^{-45}$ ... $3{,}5 \times 10^{38}$
string	Fixed	Example: String of length 6: "123ABC" Important: Strings are not null-terminated

Tab. 27: Variable types

Note

- The information in the "Length" column of the table refers to the binary transfer of the numeric parameters.
- The information in the "Value range" column in the table refers to the value range mathematically possible for the variable type. The actual value ranges for the parameters may be different.
- Examples: The variable type "float_32" refers to the IEEE754 single-precision floating-point standard.

Telegram example	Result
Output variable (volume flow rate): Request: <STX>sRN mvVolumeFlow<ETX> Reply: <STX>sRA mvVolumeFlow 43AF6E14<ETX>	The volume flow rate is 350.86 m³/h (43AF6E14h).

Telegram example	Result
Read out variable continuously (mass flow rate): Request: <STX>sEN mvMassFlow 1<ETX> Reply: <STX>sEA mvMassFlow 1<ETX> <STX>sSN mvMassFlow 43006666<ETX> <STX>sSN mvMassFlow 43006E14<ETX> ... <STX>sSN mvMassFlow 430063D7<ETX> Request: <STX>sEN mvMassFlow 0<ETX> Reply: <STX>sEA mvMassFlow 0<ETX>	The mass flow rate is output continuously until the output is stopped using sEN mvMassFlow 0 .
Write variable (tolerance against vibration): Login: <STX>sMN SetAccessMode 03 F4724744<ETX> Reply: <STX>sWA SetAccessMode 1<ETX> Request: <STX>sWN parVibrationTolerance +20<ETX> Reply: <STX>sWA parVibrationTolerance<ETX> Log out: <STX>sMN Run<ETX> Reply: <STX>sAN Run 1<ETX>	Write successful. The new tolerance against vibration is 20%.
Execute method (start maintenance mode): Login: <STX>sMN SetAccessMode 03 F4724744<ETX> Reply: <STX>sWA SetAccessMode 1<ETX> Request: <STX>sMN BsMaintenance<ETX> Reply: <STX>sAN BsMaintenance<ETX> Log out: <STX>sMN Run<ETX> Reply: <STX>sAN Run 1<ETX>	The Bulkscan® switches to the Maintenance operating mode.
Write a read-only variable (total volume): Request: <STX>sWN mvVolumeSum +1000<ETX> Reply: <STX>sFA A<ETX>	Measured values are not input parameters. An error will be output.

Tab. 27: Telegram examples (CoLa-A)

13.1.2 Logging in to the sensor/Logging out of the sensor

To be able to change the configuration of the Bulkscan® (write variables and execute methods), the user must log in to the sensor with a valid user level and password.

Following configuration of the Bulkscan®, the user must log out of the sensor. The new configuration is then transferred to the device.

Permissible commands: **sMN**

Method name	Description	Variable type	Value range
SetAccessMode	Select user level. A valid user level must be included in the transmission. Otherwise the Bulkscan® rejects the command.	string	2: Maintenance personnel 3: Authorized client 4: Service
	Hash value of the password - main: B21ACE26h - client: F4724744h	string	00000000h ... FFFFFFFFh
Run	Logging out of the sensor		

13.1.3 Saving the configuration in the non-volatile memory

Following successful configuration, you should save the parameters in the non-volatile memory.

Permissible commands: **sMN**

Method name	Description
mEEwriteall	Save the configuration in non-volatile memory

13.1.4 Device information

Permissible commands: **sRN, sEN**

Variable name	Description	Variable type	Value range
BsRefAvailable	Reference contour available	bool_1	0: No 1: Yes
BsTeachFailed	Teach-in failed	bool_1	0: No 1: Yes
BsTeachReady	Teach-in successful	bool_1	0: No 1: Yes
BsInvalidPoints	Too many invalid measuring points within a scan	bool_1	0: No 1: Yes
BsContamination	Contamination of the front screen	bool_1	0: No 1: Yes

13.1.5 Operating mode/Teach-in

Permissible commands: **sRN, sEN**

Variable name	Description	Variable type	Value range	Unit
BsState	Operating mode	uint_8	1: Teach-in 2: Measuring mode 3: Maintenance	
contourRef	Reference contour	381 x float_32	500 to 20,000	mm
contourMeas	Surface contour of measured object	381 x float_32	15 to 25,000	mm

Permissible commands: **sRN, sWN**

Variable name	Description	Variable type	Value range	Unit
parAngleLeft	Angle left	float_32	–95 to 0	Degree
parAngleRight	Angle right	float_32	0 to 95	Degree
parTeachDistanceMax	Maximum distance between sensor and conveyor belt	float_32	500 to 20,000	mm
parTeachCycles	Number of cycles for averaging the reference contour	uint_32	100 to 10,000	Cycles
parTeachOutdoor (only for Bulkscan® LMS511)	Optimization for for slits or gaps	bool_1	0: Deactivated 1: Active	

Variable name	Description	Variable type	Value range	Unit
parLevelCompensation	Level for raising or lowering the conveyor belt level	int_8	–100 to 100	mm

Permissible commands: **sMN**

Method name	Description
BsMeasure	Start the Measuring mode
BsMaintenance	Start the Maintenance mode
BsTeach	Start the teach-in process
BsLevelCompensation	Apply level compensation

13.1.6 Measured values

Permissible commands: **sRN, sEN**

Variable name	Description	Variable type	Value range	Unit
mvVolumeFlow	Volume flow rate	float_32		m^3/h
mvMassFlow	Mass flow rate	float_32		t/h
mvVolumeSum	Volume sum	float_32		m^3
mvMassSum	Mass sum	float_32		t
mvGravity	Center of gravity	float_32	0 to 1	
mvHeight	Bulk height	float_32		m
mvDensity	Bulk density	float_32		t/m^3
mvSpeed	Belt speed	float_32		m/s

Permissible commands: **sMN**

Method name	Description
BsClearTotals	Reset measured values (volume sum, mass sum)

13.1.7 Measurement

Permissible commands: **sRN, sWN**

Variable name	Description	Variable type	Value range	Unit
parSpeedSource	Belt speed: Source	uint_8	0: Fixed value 1: Encoder 2: Analog value	
parFixedSpeed[1)]	Belt speed (fixed value)	float_32	–30 to +30	m/s
parUseBeltMoving	Use status signal for the belt operation	bool_1	0: Deactivated 1: Active	
DI1Logic	Logic of the status signal for the belt operation	uint_8	0: Active high 1: Active low	
LICencres	Encoder: Resolution	float_32	0.001 to 2000	mm/Inc

Variable name	Description	Variable type	Value range	Unit
LICencset (only for Bulkscan® LMS511)	Encoder: Direction	uint_8	1: None (ENC1) 2: Over phase (ENC1, ENC2) 3: Over level (ENC1, ENC2)	
aiBeltSpeedMin	Belt speed (4 mA point)	float_32	–30 to +30	m/s
aiBeltSpeedMax	Belt speed (20 mA point)	float_32	–30 to +30	m/s
parDensitySource	Bulk density: Source	uint_8	0: Fixed value 1: Analog value 2: Measured value	
parFixedDensity[1)]	Bulk density (fixed value)	float_32	0 to 50	t/m³
aiDensityMin	Bulk density (4 mA point)	float_32	0 to 50	t/m³
aiDensityMax	Bulk density (20 mA point)	float_32	0 to 50	t/m³
parMassFlowSource	Mass flow rate: Source	uint_8	0: Fixed value 1: Analog value 2: Measured value	
parFixedMassFlow[1)]	Mass flow rate (fixed value)	float_32	0 to 10^6	t/h
aiMassFlowMin	Mass flow rate (4 mA point)	float_32	0 to 10^6	t/h
aiMassFlowMax	Mass flow rate (20 mA point)	float_32	0 to 10^6	t/h
parHeightStrategy	Bulk height: Strategy	uint_8	0: Center point 1: Highest point	
parAveragingFlow	Averaging filter: Flow	float_32	0 to 3,600	s
parAveragingGravity	Averaging filter: Center of gravity	float_32	0 to 3,600	s
parAveragingHeight	Averaging filter: Bulk height	float_32	0 to 3,600	s
parAveragingEdgeDistance (only for Bulkscan® LMS511)	Averaging filter (bulk edge and belt edge)	float_32	0 to 3,600	s

[1)] Also the source must be selected as 0: Fixed value when a fixed value has to be written in this parameter

13.1.8 System

Permissible commands: **sRN, sWN**

Variable name	Description	Variable type	Value range	Unit
parVibrationTolerance	Tolerance against vibration	unit_16	0 to 100	%
parReflectionTolerance	Tolerance against reflection	unit_16	0 to 100	%
parParticleFilter	Optimization for outdoor applications (measuring mode)	bool_1	0: Deactivated 1: Active	

Variable name	Description	Variable type	Value range	Unit
parInvSpotsToZero (only for Bulkscan® LMS511)	Ignore measurement points below the reference contour: Activate	bool_1	0: Deactivated 1: Active	
parThreshold2Zero (only for Bulkscan® LMS511)	Ignore measurement points below the reference contour: Threshold	uint_32	0 to 10,000	
parContourSmoothing	Smoothing filter for measurement contour	unit_8	1: Off 2: Low 4: Medium 8: High 16: Maximal	

13.1.9 Edge monitoring (only for Bulkscan® LMS511)

Variable name	Description	Variable type	Value range	Unit
parBulkEdgeThreshold	Bulk edge detection threshold	float_32	20 ... 10.000	mm
mvBulkEdgeDistanceLeft	Measured distance to left bulk edge	float_32		
mvBulkEdgeDistanceRight	Measured distance to right bulk edge	float_32		
parBulkEdgeDist2WarnLeft	Distance to left bulk edge warning	float_32	0 ... 12.500	mm
parBulkEdgeDist2WarnRight	Distance to right bulk edge warning	float_32	0 ... 12.500	mm
BsBulkEdgeWarningLeft	Left bulk edge warning	bool_1	0: Deactivated 1: Active	
BsBulkEdgeWarningRight	Right bulk edge warning	bool_1	0: Deactivated 1: Active	
parConveyorUpperLimitLeft	Conveyor belt edge left: Upper left	float_32	20 ... 1.000	mm
parConveyorLowerLimitLeft	Conveyor belt edge left: Lower limit	float_32	20 ... 1.000	mm
parConveyorUpperLimitRight	Conveyor belt edge right: Upper limit	float_32	20 ... 1.000	mm
parConveyorLowerLimitRight	Conveyor belt edge right: Lower limit	float_32	20 ... 1.000	mm
mvConveyorDistanceLeft	Measured distance to left conveyor belt edge	float_32		
mvConveyorDistanceRight	Measured distance to right conveyor belt edge	float_32		
parConveyorDist2WarnLeft	Distance to left conveyor belt edge warning	float_32	0 ... 12.500	mm
parConveyorDist2Warn	Measured distance to right conveyor belt edge	float_32	0 ... 12.500	mm
BsConveyorWarningLeft	Left conveyor belt edge warning	bool_1	0: Deactivated 1: Active	

Variable name	Description	Variable type	Value range	Unit
BsConveyorWarningRight	Right conveyor belt edge warning	bool_1	0: Deactivated 1: Active	
parAveragingEdgeDistance (only for Bulkscan® LMS511)	Averaging filter (bulk edge and conveyor belt edge)			

13.1.10 Digital inputs

Permissible commands: **sRN, sWN**

Variable name	Description	Variable type	Value range	Unit
parUseBeltMoving	Use status signal for the belt operation	bool_1	0: Deactivated 1: Active	
DI1Logic	Logic of the status signal for the belt operation	uint_8	0: Active high 1: Active low	
DI2Logic	Switching condition: Reset volume sum and mass sum	uint_8	0: Rising edge 1: Falling edge	

13.1.11 Digital outputs

Permissible commands: **sRN, sWN**

Variable name	Description	Variable type	Value range	Unit
out1Assignment out2Assignment out3Assignment out4Assignment [1] out5Assignment [1] out6Assignment [1]	Assignment of the digital outputs (1 to 6). (Bulkscan® LMS111 only 1 to 3)	uint_8	0: Off 1: Information/ warnings 2: Volume quota 3: Mass quota 4: Volume flow rate 5: Mass flow rate 6: Center of gravity 7: Bulk height 8: Bulk density 9: Belt speed	
DO1Logic DO2Logic DO3Logic DO4Logic [1] DO5Logic [1] DO6Logic [1]	Logic of the digital outputs (1 to 6). (Bulkscan® LMS111 only 1 to 3)	uint_8	0: Active high 1: Active low	
outVolumeQuota	Volume quota per pulse	float_32	0.01 to 10^6	m^3/Inc
outMassQuota	Mass quota per pulse	float_32	0.01 to 10^6	t/Inc

[1] Only Bulkscan® LMS511

Variable name	Description	Variable type	Value range	Unit
outVolumeFlow	Volume flow rate			
	Parameter	Variable type	Value range	Unit
	Lower limit	float_32	-10^6 to 10^6	m^3/h
	Upper limit	float_32	-10^6 to 10^6	m^3/h
	Lower hysteresis	float_32	5 to 95	%
	Upper hysteresis	float_32	5 to 95	%
outMassFlow	Mass flow rate			
	Parameter	Variable type	Value range	Unit
	Lower limit	float_32	-10^6 to 10^6	t/h
	Upper limit	float_32	-10^6 to 10^6	t/h
	Lower hysteresis	float_32	5 to 95	%
	Upper hysteresis	float_32	5 to 95	%
outHeight	Bulk height			
	Parameter	Variable type	Value range	Unit
	Lower limit	float_32	0 ... 20	m
	Upper limit	float_32	0 ... 20	m
	Lower hysteresis	float_32	5 ... 95	%
	Upper hysteresis	float_32	5 ... 95	%
outDensity	Bulk density			
	Parameter	Variable type	Value range	Unit
	Lower limit	float_32	0 to 50	t/m^3
	Upper limit	float_32	0 to 50	t/m^3
	Lower hysteresis	float_32	5 to 95	%
	Upper hysteresis	float_32	5 to 95	%
outSpeed	Belt speed			
	Parameter	Variable type	Value range	Unit
	Lower limit	float_32	0 to 30	m/s
	Upper limit	float_32	0 to 30	m/s
	Lower hysteresis	float_32	5 to 95	%
	Upper hysteresis	float_32	5 to 95	%

13.1.12 Reference measurement (compensation function)

Permissible commands: **sRN, sEN**

Variable name	Description	Variable type	Value range	Unit
ccStatus	Status of the reference measurement	uint_8	0: Deactivated 1: Active	
ccMeasVolume1	Measured volume (reference measurement 1 to 10)	float_32		m^3
ccMeasVolume2				
ccMeasVolume3				
ccMeasVolume4				
ccMeasVolume5				
ccMeasVolume6				
ccMeasVolume7				
ccMeasVolume8				
ccMeasVolume9				
ccMeasVolume10				
ccMeasArea1 ccMeasArea2 ccMeasArea3 ccMeasArea4 ccMeasArea5 ccMeasArea6 ccMeasArea7 ccMeasArea8 ccMeasArea9 ccMeasArea10	Measured area (reference measurement 1 to 10)	float_32		m^2
ccRefArea1 ccRefArea2 ccRefArea3 ccRefArea4 ccRefArea5 ccRefArea6 ccRefArea7 ccRefArea8 ccRefArea9 ccRefArea10	Reference area (reference measurement 1 to 10)	float_32		m^2

Permissible commands: **sRN, sWN**

Variable name	Description	Variable type	Value range	Unit
ccRefVolume1 ccRefVolume2 ccRefVolume3 ccRefVolume4 ccRefVolume5 ccRefVolume6 ccRefVolume7 ccRefVolume8 ccRefVolume9 ccRefVolume10	Reference volume (reference measurement 1 to 10)	float_32	≥ 0	m^3
ccCoeff1	Quadratic coefficient of the compensation function	float_32		
ccCoeff2	Linear coefficient of the compensation function	float_32		

Variable name	Description	Variable type	Value range	Unit
ccCoeff3	Constant coefficient of the compensation function	float_32		
ccPolyDegree	Polynomial degree for calculation of the compensation function	uint_8	0: linear 1: square	

Permissible commands: **sMN**

Method name	Description
ccStart	Start reference measurement
ccStop	Stop reference measurement
ccClearLast	Delete last reference measurement
ccCalculate	Calculate compensation function

13.1.13 Service data

Permissible commands: **sRN, sEN**

Variable name	Description	Variable type	Value range	Unit
ODpwrc	Operating data: Power up counter	uint_32		
OPcurtmpdev	Device status: Current temperature	float_32		°C
SCdevicestate	Device status: Operational status	uint_8	0: Busy 1: Ready 2: Error	
LCMstate	Device status: Contamination	uint_8	0: No contamination 1: Warning 2: Contaminated 3: Fail	
ODoprh	Operating data: Operating hours	uint_32	0 ... 4 x 10^9	1/10 h
ODopdaily	Operating data: Daily operating hours	float_32	0 ... 4 x 10^8	1 h
DIuser	Service information: Last user	string	(max. 18 characters)	
DIpara	Service information: Last configuration	string	DD.MM.YYYY	Date
DIparatm			HH:MM	Time

Permissible commands: **sRN, sWN**

Variable name	Description	Variable type	Value range	Unit
DIlstmt	Service information: Last maintenance	string	DD.MM.YYYY	Date
DInxtmt	Service information: Next maintenance	string	DD.MM.YYYY	Date

13.1.14 Error codes (sFA)

Error code	Description	Example
sFA 1	Method requires higher user level	sWN command without prior log on
sFA 3	Unknown variable	sWN parFxdSpd +10
sFA 4	Variable value range violated	sWN parTeachCycles +10
sFA A	Variable is write-protected	sWN mvVolumeSum +1000
sFA B	Invalid command for this method	sWT parFixedSpeed +10
sFA F	Value range for the variable type violated	sWN parTeachCycles -1
sFA 11	Unknown character in the telegram	sWN parFixedSpeed +1y0
(Other)	Please contact SICK support.	

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