PROJECT PLANNING MANUAL

Laser scanner
Planning aids for perimeter and object monitoring

EN

SICK
Sensor Intelligence.

Contents

1 About this document ... **6**
1.1 Function of this document ... 6
1.2 Target group ... 6
1.3 Information depth ... 6
1.4 Abbreviations used ... 6
1.5 Symbols used ... 6
1.6 Legal notices ... 7

2 Introduction ... **8**
2.1 Overview of detection systems ... 8
2.2 2D laser scanner ... 10
2.2.1 Pulse time method ... 10
2.2.2 Multi-echo method ... 11
2.2.3 Measuring frequency ... 11
2.2.4 Remission (effect of the object surface) ... 12
2.2.5 Angle of incidence and reflection ... 12
2.2.6 Beam divergence and object size ... 13
2.2.7 Beam expansion ... 14

3 Laser scanner applications ... **16**
3.1 Monitoring fences, double fences, and walls ... 16
3.2 Monitoring of open spaces ... 17
3.3 Camera management and object tracking in open spaces ... 18
3.4 Outer shell protection (facades) ... 19
3.5 Roof protection ... 20
3.6 Ceiling monitoring and wall penetration protection ... 21
3.7 Painting protection ... 22

4 Detection ranges ... **23**

5 Devices and accessories ... **24**
5.1 Selecting the right detector ... 24
5.2 Device overview ... 27
5.2.1 VdS-compliant devices ... 27
5.2.2 Indoor devices (without VdS certification) ... 28
5.2.3 Outdoor devices ... 29
5.3 Accessories ... 31
5.3.1 Weather hoods ... 31
5.3.2 Mounting kits ... 32
5.3.3 Fine-adjustment unit ... 34
5.3.4 Post and wall brackets ... 35
5.3.5 Connecting cables ... 36
5.3.6 Connection boxes ... 38
5.3.7 CAN modules ... 39
5.3.8 Power supply unit ... 39
5.3.9 Scan finder ... 40

6 Project planning ... **41**
6.1 Analysis of the threat situation ... 41
6.2 Preliminary considerations during installation ... 42
6.3 Heating ... 45

6.4 Mounting and connecting cables ... 46
6.4.1 Voltage supply ... 46
6.4.2 Connecting cables ... 47
6.4.3 Using a connection box ... 50
6.5 Detection accuracy and analysis strategy ... 53
6.5.1 Working with filters ... 53
6.5.2 Defining analysis fields and cases ... 55
6.5.3 Taking account of object sizes ... 56
6.5.4 Setting the alarm sensitivity ... 57
6.5.5 Using contour as reference for tamper-proofing ... 58
6.5.6 Tamper-proofing against shadowing and dazzle ... 59
6.5.7 Automatic field adjustment ... 60
6.5.8 Teaching in/updating fields automatically (Easy Teach) ... 61
6.5.9 Activating/deactivating analysis cases (day and night mode) ... 66
6.6 Configuration of the signaling method ... 67
6.6.1 Overview of digital inputs ... 67
6.6.2 Switching laser scanners to sharp/not sharp ... 67
6.6.3 Switching the laser scanner to walk-through test mode ... 68
6.6.4 Volt-free semiconductor outputs in relay function (overview) ... 69
6.6.5 Circuitry without resistance monitoring ... 71
6.6.6 Circuitry with resistance monitoring ... 72
6.6.7 Tamper-proofing ... 73
6.6.8 Working in expert mode ... 73
6.6.9 Controlling cameras ... 74
6.7 Pin assignments ... 77
6.7.1 LMC12x/LMC12x ... 77
6.7.2 TiM320 ... 78
6.7.3 TiM351/TiM361 ... 79
6.7.4 LMC13x/LMS13x, LMS141 core/LMS14x prime ... 80
6.7.5 LMS531 Lite ... 81
6.7.6 LMS531 PRO ... 82
6.7.7 Connection boxes ... 83
6.8 Cleaning ... 87

7 Scalable solutions with OPC ... 88
7.1 OPC makes integration easier ... 88
7.2 Easy data handling with the SICK OPC server ... 89

8 Project planning examples ... 91
8.1 Selection guide ... 91
8.1.1 Device selection ... 91
8.1.2 Product characteristics ... 91
8.2 Fence/double fence protection ... 92
8.2.1 Monitored area ... 92
8.2.2 Installation situation ... 93
8.2.3 Accessories ... 94
8.2.4 Recommended settings ... 95
8.3 Facade protection ... 96
8.3.1 Monitored area ... 96
8.3.2 Installation situation ... 97
8.3.3 Accessories ... 98
8.3.4 Recommended settings ... 100

Contents

8.4 Open space protection ... 101
8.4.1 Monitored area ... 101
8.4.2 Mounting ... 102
8.4.3 Accessories ... 102
8.4.4 Recommended settings ... 103
8.5 Roof protection ... 104
8.5.1 Monitored area ... 104
8.5.2 Installation situation ... 104
8.5.3 Accessories ... 104
8.5.4 Recommended settings ... 104
8.6 Painting protection ... 105
8.6.1 Monitored area ... 105
8.6.2 Installation situation ... 105
8.6.3 Accessories ... 106
8.6.4 Recommended settings ... 107
8.7 Parameter assignment for SICK OPC server ... 108

9 Annex ... 110
9.1 List of tables ... 110
9.2 List of figures ... 111
9.3 Keywords index ... 114

1 About this document

1.1 Function of this document

This document provides an introduction to laser-guided object monitoring and explains the technology behind non-contact detection systems.

It provides all the information required for planning and installing laser-guided detection systems from SICK.

1.2 Target group

This project planning manual is intended for those planning and setting up safety and security systems, who wish to take advantage of the benefits that laser technology provides in terms of protection and require detailed information about the technology and its practical implementation.

1.3 Information depth

This project planning manual contains information on the following topics:

- 2D laser scanner
- Laser scanner applications
- Detection ranges
- Devices and accessories
- Project planning
- Scalable solutions with OPC
- Project planning examples

Note The laser scanners mentioned in this document are not safety devices for human protection and it therefore do not comply with any safety standards.

For safety applications, please contact SICK AG.

1.4 Abbreviations used

LMC Laser measurement system certified = VdS-certified laser scanner from SICK AG

LMS Laser measurement sensor = laser scanner from SICK AG

OPC The most widely accepted industrial communication standard

VdS Formerly the “Verband der Sachversicherer e.V.” [Association of Property Insurers]. The technical departments of the former insurers' association were taken over in 1997 by VdS Schadenverhütung GmbH, which is a subsidiary of the Gesamtverband der Deutschen Versicherungswirtschaft e.V. (GDV).

1.5 Symbols used

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

Note Notes provide information about the features of a device or application.

➢ Take action Instructions for taking action are indicated by an arrow. Carefully read and follow the instructions for action.

Software notes indicate where to make the appropriate settings in the SOPAS configuration software.

1.6 Legal notices

The application graphics and project planning examples contained in this manual, and their recommended settings, are not legally binding. They make no claim to be accurate or complete. They serve only as product demonstrations and do not represent customer-specific solutions in any way.

The application graphics and project planning examples and their recommended settings are not a suitable replacement for necessary technical advice provided by a specialist. The specifications given in the product data sheets for the products described in this manual take precedence.

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Furthermore, essential contractual obligations are duties that must be performed in order for the contract to be properly fulfilled and which a contractual party expects and can expect to be met.

Further claims to compensation are excluded.

2 Introduction

2.1 Overview of detection systems

Conventional detection methods are presented here in order to better demonstrate the advantages of laser-guided detection methods.

Infrared sensors

Infrared sensors respond to **temperature changes**. They continuously receive infrared radiation (heat) from the environment and save it as a reference. If a person enters the area monitored by the infrared sensor, the change in infrared radiation is detected and an alarm is triggered.

Infrared technology may be less expensive, however it is prone to false alarms triggered by other heat sources or sudden light incursion.

Radar sensors

Radar sensors do not detect temperature changes in the environment. **Electromagnetic waves** are used for detection, where motion triggers the alarm (in addition to people this can include animals, vehicles, machine parts, or even trees and bushes in the wind).

The monitored area cannot be strictly defined at its edges. Areas are very difficult to monitor.

Infrared sensors are relatively insensitive to radial movement. Radar sensors, in contrast, have maximum sensitivity to this type of movement. However, infrared sensors are sensitive to orthogonal and tangential movement, whereas radar sensors are not.

CCTV

CCTV monitoring with analog or digital cameras serves more for **identification** than detection, which is frequently perceived to be an intrusive breach of the rights of the individual and therefore negatively influences the feeling of safety.

The quality of the monitoring greatly depends on the lighting at the time. Furthermore, complete monitoring of areas or facades requires many cameras and the necessary infrastructure to support these conditions.

Laser monitoring

Detection systems utilizing laser scanners are extremely **reliable** and **discreet**. The active scanning laser scanner is a **non-contact** two-dimensional detection system that scans a freely programmable area. It emits an invisible infrared laser beam, so that **detection is independent** of **ambient light**, i.e., it can even function in absolute darkness.

As soon as a person enters the monitored area, the laser scanner sends a signal which can be used to **trigger various actions**, such as alerting the main office of the security services or the police, setting off a silent alarm or audible siren, switching on lighting, or activating a follow-up system for controlling dome cameras.

Detection systems utilizing laser scanners function **reliably** regardless of weather, lighting conditions or the size and properties of detected objects. They are also tamperproof and able to trigger alarms via volt-free outputs.

Particularly for outdoor applications, a **high level of reliability** due to a low rate of false alarms is a key assessment factor. In the case of outer shell and open terrain protection, laser technology has frequently proven to be both an economically viable alternative technology to CCTV as well as a sensible enhancement to this. Often one mounting point alone is sufficient for observing and monitoring large areas.

Monitoring fields with easily definable parameters enable the detection zone to be defined exactly, preventing false alarms. The light curtain can be precisely positioned and tailored to the monitoring situation in question. This also circumvents the need for additional investment in mechanical barriers.

The **detection accuracy** can also be configured in terms of the size and speed of detected objects in each monitored area.

The solution is scalable and can be used for the protection of private buildings all the way to large industrial facilities. The OPC interface also allows integration into existing high-security systems.

Advantages at a glance
• Various configuration options • Panoramic monitoring (horizontal security up to 270°) • Detection independent of illumination or time of day • Definition of clearly definable monitored areas • Definition of the size and speed of detected objects in each monitored area • Can be combined with CCTV via digital switching outputs • Blanking of environmental factors (fog, rain, etc.) • Analysis of monitoring fields using intelligent algorithms • Integration via OPC interface

2.2 2D laser scanner

Laser scanners are electro-optical sensors that use non-contact laser beams to scan the outline of their surroundings on a plane. They measure their surroundings in two-dimensional polar coordinates.

A rotating mirror is used to deflect the pulsed light in a horizontal area. Due to the rotation of the mirror, a multitude of single measurements are merged to form an entire scan of an area. The scanning sector is up to 270° depending on the laser scanner used.

Fig. 1: 2D laser scanner principle of operation

SICK laser scanners have a scanning frequency of up to 100 Hz. A laser pulse and thus a measurement is triggered continuously after each angle increment up to 0.167°.

The detection range of the laser scanners depends on the performance of the device used, the environment, the size of the detected object, and the remission, i.e., the nature of the surface of the detected object, which reflects the laser beam.

2.2.1 Pulse time method

The measurement technology of the 2D laser scanners is based on **time-of-flight measurement**. The laser emits a pulsed beam using a laser diode. If a laser pulse hits an object or person, it is reflected on the surface of the object or person in question. The reflection is registered by a photo-diode in the laser scanner's receiver.

The sender and receiver are thus housed together in the laser scanners, making these compact measurement systems that require less space and installation time in comparison to other solutions.

With the **pulse time method**, the distance between the sensor and the object is calculated by measuring the time interval between the emission of the laser pulse and the pulse being received again. Radar systems apply this "pulse time-of-flight measurement" principle in a similar way.

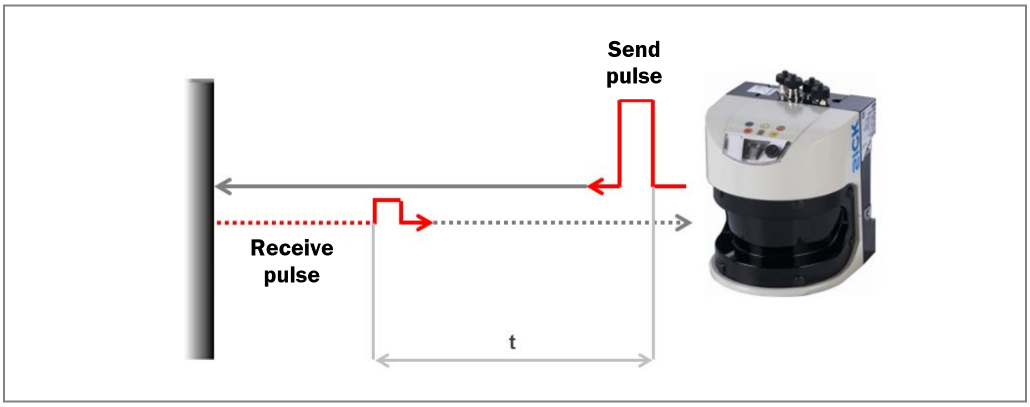
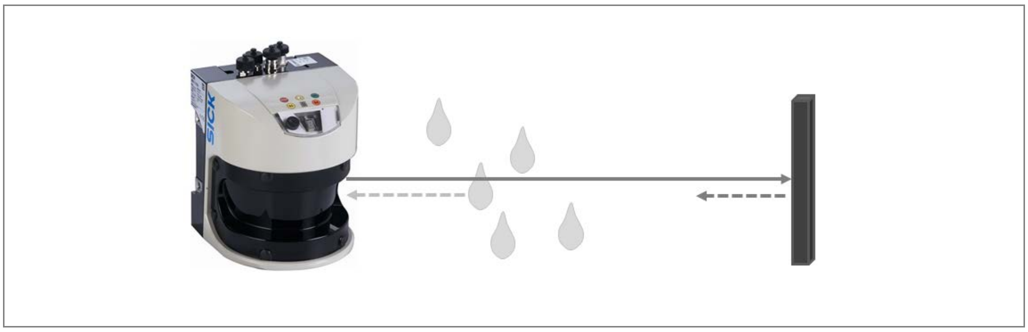


Fig. 2: Pulse time-of-flight measurement principle of operation

2.2.2 Multi-echo method

Interference factors like rain, fog, snow, or dust can typically influence a laser scanner's measurements and reduce the detection range. However, thanks to multi-echo technology, SICK laser scanners can analyze **multiple reflective pulses**. Additional reflective pulses occur when the laser beam hits smaller particles such as snowflakes or raindrops.



Through the reception of several echoes for each emitted laser pulse, object detection can be optimized and refined significantly.

This technology is also known as the **multiple pulse time method**.

2.2.3 Measuring frequency

The measuring frequency is the number of measurements per second in hertz. With each revolution of the mirror, a scan is made. A measurement may consist of one or more scans and thus be **analyzed multiple times**.

2.2.4 Remission (effect of the object surface)

The received signal also provides information about remission of the detected object. Remission describes the part of the laser pulse that is reflected. Depending on the surface composition (structure, color), each material has its own specific remission. When a laser pulse hits a surface, energy is partly absorbed by the material.

The received signal from a perfectly diffuse reflection from a white surface corresponds to a remission of 100%. By this definition, surfaces that reflect the light in bundles (reflecting surfaces, reflectors) have remissions of over 100%.

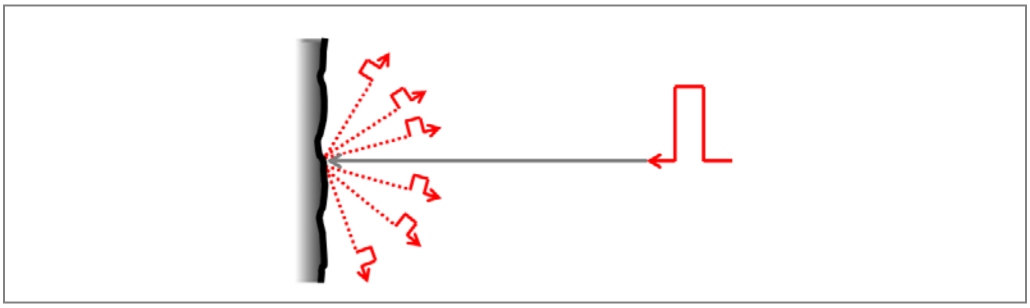


Fig. 3: Reflection of light on the surface of the object

Most surfaces produce a diffuse reflection of the laser beam in all directions. The structure and color of the surface determine how well the laser beam is reflected. Bright surfaces reflect the laser beam better than dark surfaces and can be detected by the laser scanner over greater distances.

Brilliant white plaster reflects approx. 100% of the light, while black foam rubber reflects approx. 2.4%. On very rough surfaces, part of the energy is lost due to shadowing.
The scanning range of the laser scanner is therefore reduced.

Conclusion The maximum detection range of the laser scanner greatly depends on the remission of the object. The higher the remission, the greater the possible measuring scanning range.

The scanning range data for detection solutions refers to a remission of 10%.

2.2.5 Angle of incidence and reflection

The angle of reflection corresponds to the angle of incidence. If the laser beam hits a surface at right angles, the energy is optimally reflected. If the laser beam hits a surface at an oblique angle, energy and range are lost accordingly.

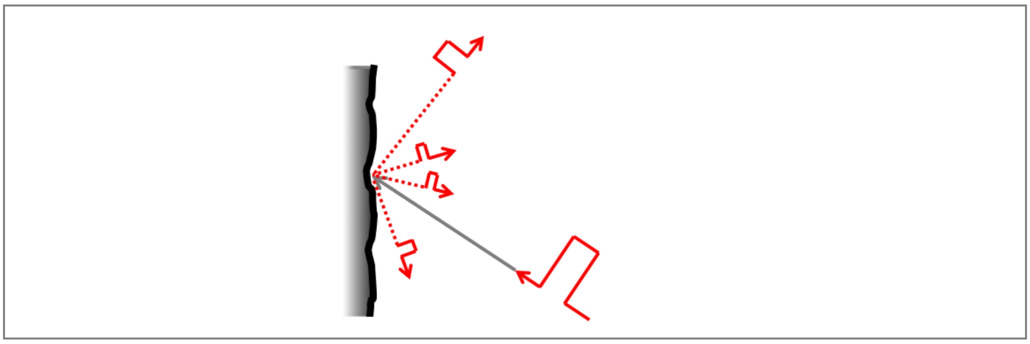


Fig. 4: Angle of reflection

If the reflective energy is greater than 100% (basis: Kodak Standard), the beam is not reflected diffusely in all directions; instead it is reflected in a targeted way. Thus a large part of the emitted energy can be received by the laser distance measurer. Plastic reflectors (cat's eyes), reflective tape, and triple prisms have these properties.

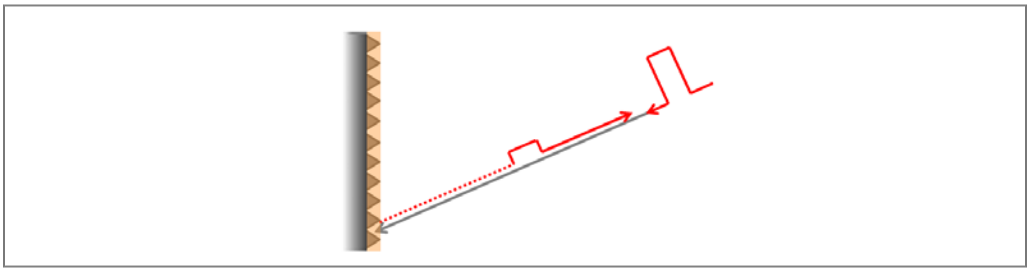


Fig. 5: *Reflectance*

The laser beam is almost completely deflected on reflective surfaces. This means that an object hit by the deflected beam may be detected instead of the reflective surface.

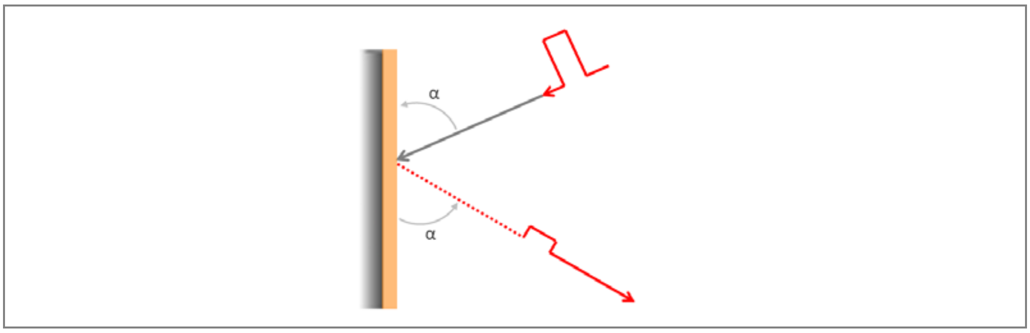


Fig. 6: *Reflective surfaces*

2.2.6 Beam divergence and object size

For an object to be detected reliably, it must be completely hit by the laser beam once. If it is only partially hit, less energy will be reflected from the object. To be sure that an object is completely hit, it must be at least as large as the diameter of the laser beam.

Objects that are smaller than the diameter of the laser beam cannot reflect the laser light's full energy. The energy of the non-reflected part of the laser light is lost. This means the scanning range is less than would theoretically be possible due to the reflective property of the object's surface.

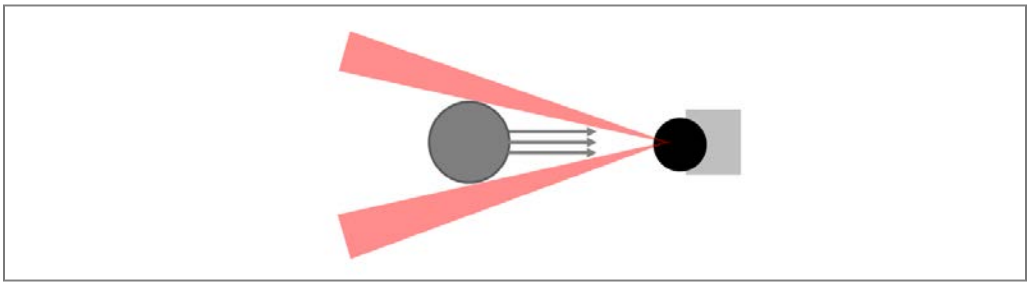


Fig. 7: *Beam divergence and object size*

Conclusion

For reliable measurement, an object needs to be hit several times. Furthermore, the object to be detected should be larger than the minimum object size.

2.2.7 Beam expansion

As the distance increases, the laser beam expands. As a result, the diameter of the measuring point increases on the surface of the object.

To avoid false alarms, it is important to prevent the laser beam (or part of it) from hitting the floor or the facade.

If the ground or the facade is detected, this may not be noticed when mounting. However, if the surface composition changes subsequently due to frost, moisture, snow, or rain, it can result in measuring points which then lead to false alarms.

LMS1xx beam expansion

The range-dependent diameter of the measuring point corresponds to the *distance (mm) * 0.015 rad + 8 mm.*

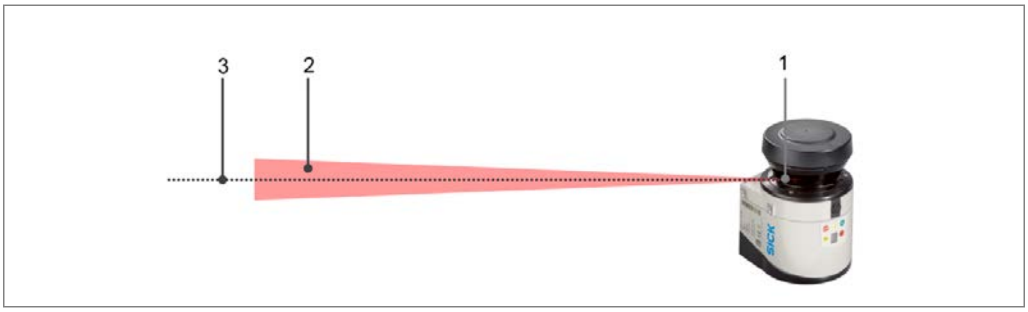


Fig. 8: LMS1xx beam expansion

No.	Meaning
1	Beam diameter on the optics cover = 8 mm
2	Expanded laser beam
3	Optical axis

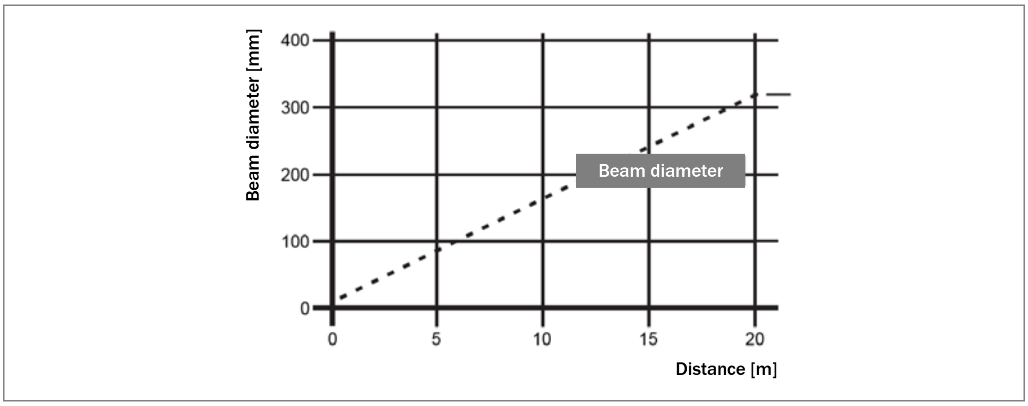


Fig. 9: LMS1xx beam diameter

LMS5xx beam expansion

The range-dependent diameter of the measuring point corresponds to the *distance (mm) * 0.011 rad + 13 mm.*

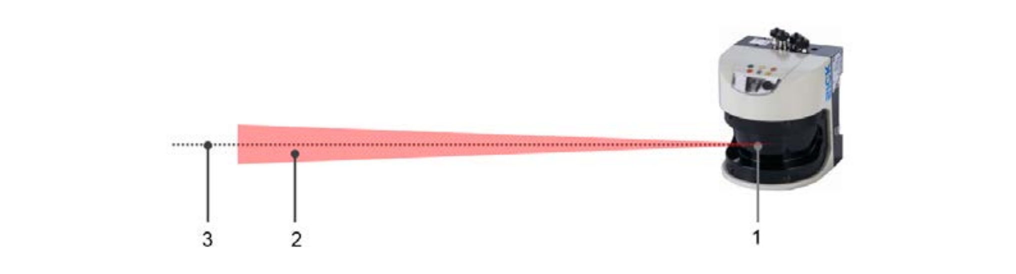


Fig. 10: LMS5xx beam expansion

No.	Meaning
1	Beam diameter on the front screen = 13 mm
2	Expanded laser beam
3	Optical axis

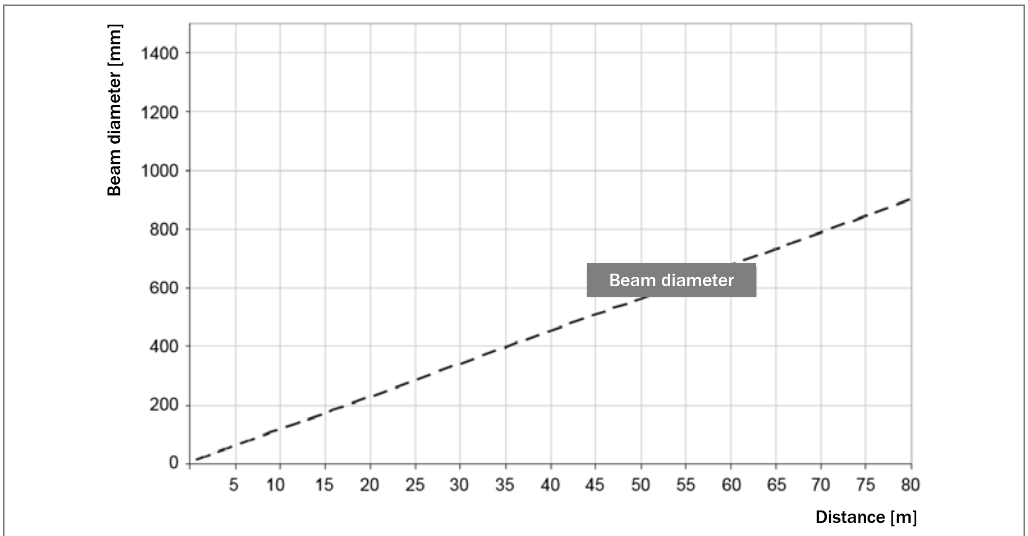


Fig. 11: LMS5xx beam diameter

TiM3xx beam expansion

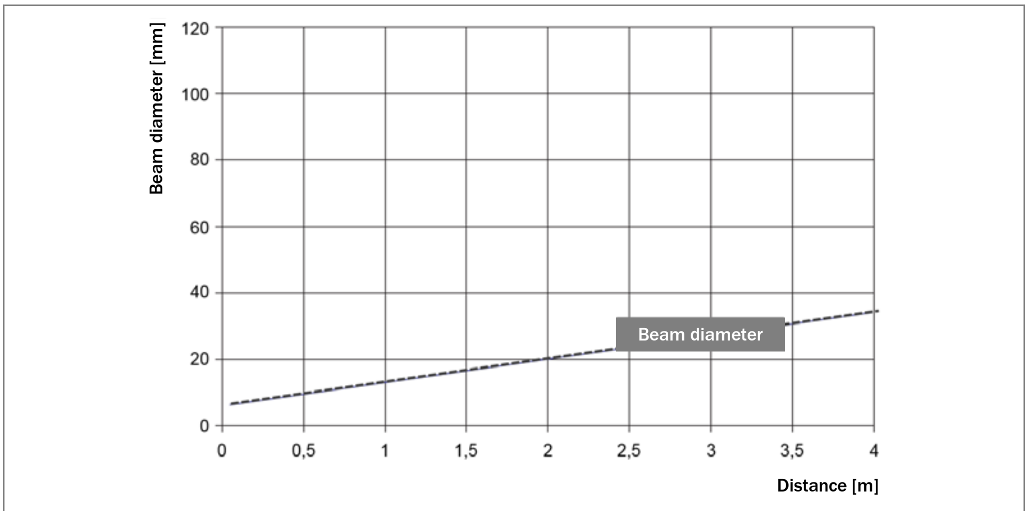


Fig. 12: TiM3xx beam diameter

3 Laser scanner applications

LMS and LMC laser scanners are suitable for the vertical monitoring of facades, perimeter walls, building walls, or windows, and the horizontal monitoring of open spaces such as lawns and fields, outdoor spaces, pedestrian paths, and roads. They are also suitable for the monitoring of roofs and ceilings. People or objects entering the detection range of the laser scanner are reliably detected. People reaching into and penetrating the detection range with or without tools are also detected depending on distance, as are objects or people passing over or through the range.

The sensor also provides good detection of people and vehicles moving across an area (walking, running, crawling, or driving).

3.1 Monitoring fences, double fences, and walls

Fences and walls are monitored diagonally and vertically (1). If a monitoring field is breached, an alarm is triggered. The sensor uses the measuring data with which it has been provided to determine the location.

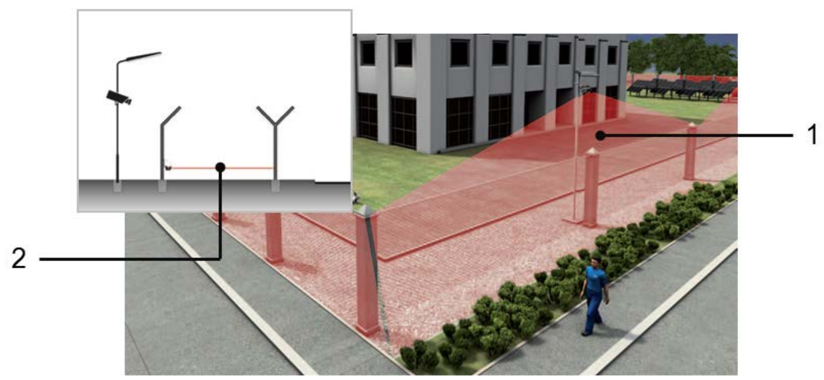


Fig. 13: Monitoring fences, double fences, and walls

Unlike single fences, which use vertical or diagonal area monitoring, with a double fence horizontal monitoring can also be used (2).

Overview of tasks and benefits of laser scanners
• Prevention of undetected intrusion into an area • Detection of events at the perimeter of an area (fence protection, forecourt protection) • Protection and/or monitoring of entrances • Excavation protection (with horizontal and diagonal setup) • Large monitoring area • As many surrounding contours as desired can be stored as references • No impairments from surrounding lighting • Blanking of fixed-position obstacles (e.g., wall constructions)

3.2 Monitoring of open spaces

SICK laser scanners are usually used horizontally for the monitoring of open spaces.
If necessary, several monitoring areas can be defined for each laser scanner (1).

Fig. 14: Monitoring of open spaces

Approach roads and access paths can be blanked (2). At night, the system can switch to full monitoring.

Overview of tasks and benefits of laser scanners
• Real-time monitoring up to 270° • Precise demarcation possible • Insensitive to interference from movements outside of the monitoring field • Blanking of certain areas possible • Easy adjustment to changes in monitoring conditions • Shape of monitoring fields can be defined by user as required • Coverage of large areas • Separate alarm signals and camera control • Can also be installed on buildings with adjacent monitored areas

3.3 Camera management and object tracking in open spaces

Large open spaces cannot be monitored at all times with just a camera. Intelligent video monitoring combined with a laser sensor system will bridge any security gaps.

The laser scanner (1) scans the environment over a radius up to 270° using invisible laser beams. As soon as a monitoring field is violated, the coordinates for the area violated (2) are transmitted to a higher-level control and alarm management system.

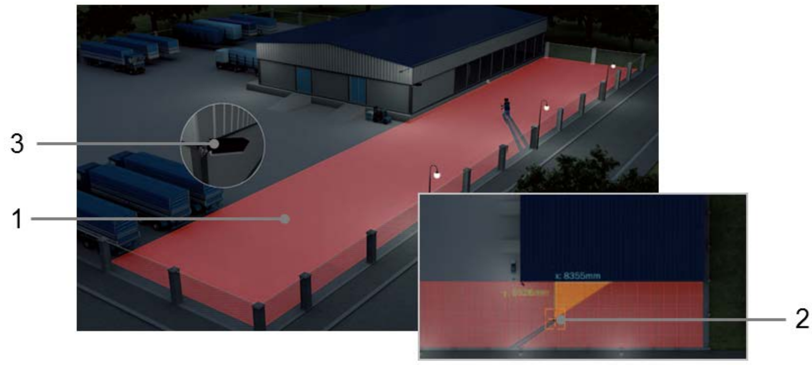


Fig. 15: Camera management and object tracking in open spaces

This processes the data and guides the camera (3) immediately to the place where the event occurred. Cameras are fitted with a tilting/turning mechanism enabling them to be guided to any coordinates as required.

Overview of tasks and benefits of laser scanners
• Intruders can be detected early using targeted, pin-sharp object images • Event-controlled camera guidance and object tracking • Automatic tracking of the moving object • Detection of several objects or persons simultaneously • Simplifies surveillance task for security guards • Efficient recording including by moving cameras • Easy integration into existing camera systems • Retrofitting and networking of multiple sensors possible • Privacy can be taken into account by using laser sensors only

3.4 Outer shell protection (facades)

Laser scanners are usually used vertically for the monitoring of facades. Thanks to the freely definable shape and size of the monitoring fields, just a few systems are required, making safety and security both effective and inexpensive. In night mode (2), unlike day mode (1), the whole of the facade can be monitored.

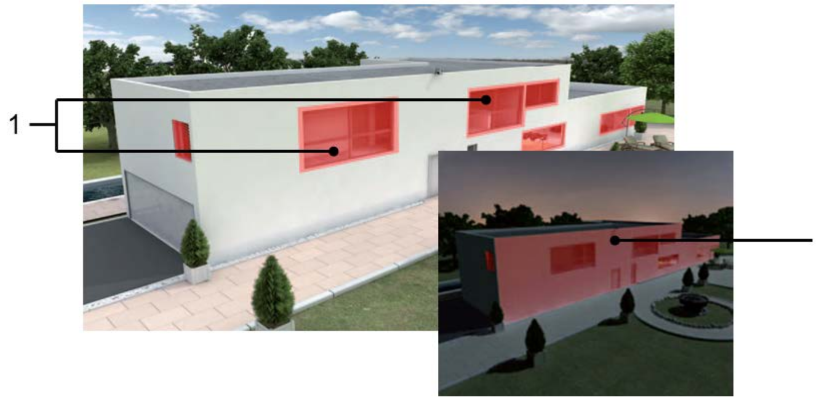


Fig. 16: Outer shell protection (facades)

The building's floor outline or fence serves as the **reference contour**. This can be constantly inspected by the system to see it remains intact (distance measurement). Deviations in this contour, e.g., due to movements of earth (excavation) in the monitoring area or manipulation of the laser scanner (dismantling) trigger an alarm.

Overview of tasks and benefits of laser scanners
• Large monitoring area • As many surrounding contours as desired can be stored as references • Prevents undetected excavation • No impairments from surrounding lighting • Blanking of fixed-position obstacles (e.g., wall constructions)

3.5 Roof protection

With flat roof protection, SICK laser scanners are generally installed directly on the building. This removes the need for expensive installations or attachments on the roof.

The monitoring field for the system is set up approx. 30 cm above the ground so that any persons crawling beneath the alarm zone are detected and registered (1). The edge of the monitoring area can also be placed slightly above the edge of the roof so that ladders, for instance, are detected at once. Roof structures casting shadows are taken into account in the planning of the monitoring fields (2).

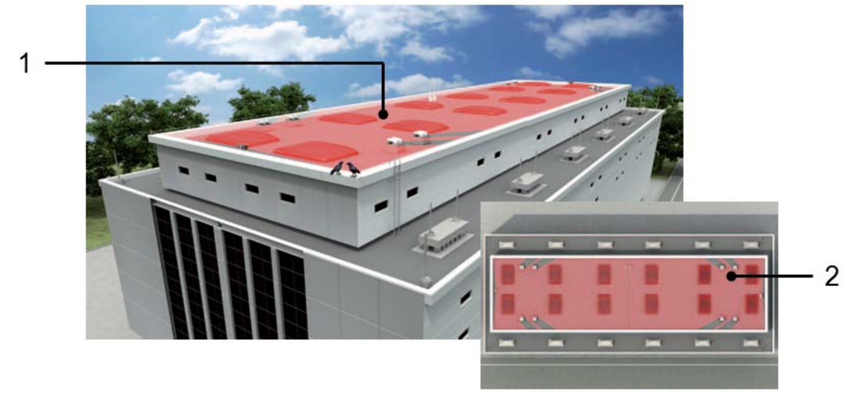


Fig. 17: Roof protection

The arrangement of the monitored areas, the choice of object size to be detected, and flexibly adjustable response times mean any movement of animals, birds, or leaves through the monitored field will not trigger an alarm (filter function).

Overview of tasks and benefits of laser scanners
• High level of protection against intrusion • Seamless monitoring of light domes and bands of light • Early alarm in the case of intrusion attempts • Monitoring of large areas using just a few sensors • Simple, low cost retrofitting • Low installation and wiring costs • Prevention of destruction to property with associated low follow-up costs

3.6 Ceiling monitoring and wall penetration protection

Indoor protection has the advantage that ambient conditions are stable for the most part. Laser scanners are used for large areas. Often just one laser scanner will need to be installed to monitor several skylights simultaneously (1).

Fig. 18: Ceiling monitoring and wall penetration protection

Interior walls are protected from penetration (2) similarly to a facade using a laser scanner. This method is also useful for warehouse facilities with thin metal walls.

Overview of tasks and benefits of laser scanners
• Low-cost easy installation (sender and receiver in single housing) • Offset areas possible • Different field geometries (shapes) possible

3.7 Painting protection

Laser scanners provide precise and discreet protection of paintings and sculptures. Thanks to flexible day and night modes, individual areas can be secured throughout the day (1), while the entire wall, including the entrance, can be monitored at night (2).

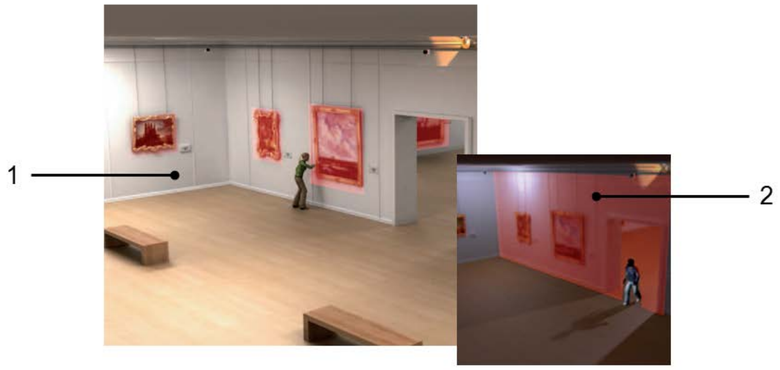


Fig. 19: Painting protection

If a painting is touched without permission, an alarm will be triggered.

Overview of tasks and benefits of laser scanners
• Certified systems • Simple, almost invisible installation • Actuators (e.g., a signal system) can be connected directly to outputs

4 Detection ranges

The detection range of laser monitoring depends on several factors.

Remission

The remission is the measure of reflective energy. This energy depends on the surface of the objects to be detected. The better a surface reflects the beam (i.e., the brighter the object), the greater the scanning range of the laser scanners.

In the security field, the detection range assumes a remission of at least 10%.

Object size

The size of the object also affects the scanning range. The smaller the object, the harder it is to detect. If the beam only partially hits the object, less energy is reflected.

VdS certification guidelines differentiate between monitoring of persons or objects entering the detection zone, reaching into the detection zone, and using tools to penetrate the detection zone.

Monitoring for	Object size
People/objects passing through zone	≥ (300 mm x 300 mm)
People/objects reaching into zone	≥ (40 mm x 40 mm)

Environmental influences

In outdoor monitoring, fog, rain, or snow may physically affect the detection range. The extent to which the scanning range might be affected in this case can only be quantified in a specific verification test on site.

Scanning range of the laser scanner

SICK laser detectors cover various detection ranges indoors and outdoors. Depending on the monitoring situation on site, it may be necessary to check the current conditions and determine which laser scanner has the required scanning range. An overview of this is provided in the device overview in the following chapter.

Extra laser scanner recommended

Data on the scanning range should always be viewed as a point of reference rather than a guarantee. If the specified scanning range for the laser scanner is not correct due to ambient conditions, the number of laser scanners should be increased in order to be sure that an area or facade is protected.

See the project planning examples at the end of this manual.

5 Devices and accessories

5.1 Selecting the right detector

The 2D laser scanners can be used for a wide range of monitoring scenarios. SICK has the right laser scanner for any monitoring situation, both indoor and outdoor.

The right device can be selected using the following flowchart.

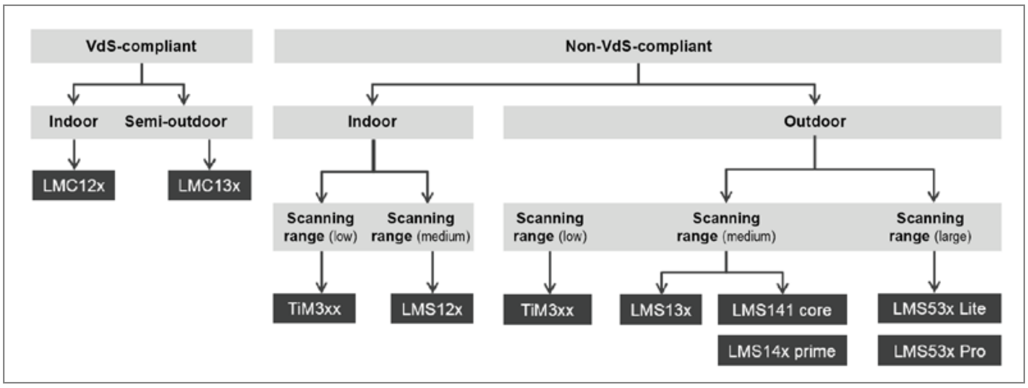


Fig. 20: Flowchart for device selection

Monitoring in accordance with VdS guidelines

LMC1xx laser scanners are used to monitor VdS object protection systems. These devices are designed for use in intrusion detection systems as per EN 50131-1. Under the VdS guideline, these devices are suitable for monitoring for intrusions caused by someone or something passing through the detection zone up to a maximum distance of 18 meters (penetration of an area of at least 300 mm in diameter) and for monitoring for intrusions caused by someone reaching into the detection zone up to a maximum distance of 9 meters (penetration of an area of at least 40 mm in diameter).

The VdS mounting kit, which is available as an accessory, must be used in order for the laser scanner setup to be VdS-compliant (see Chapter **5.3.2 Mounting kits**). Due to the two mounting kits used for the LMC1xx, there are two temperature ranges. The relevant VdS guidelines for planning and installation, for example, must likewise be taken into consideration.

	Devices	Notes	Application
	LMC12x	VdS-certified laser scanner (without heating) Mounting kit VdS1 short Ambient temperature: 0 °C to +45 °C Mounting kit VdS2 long Ambient temperature: 0 °C to +50 °C Colors: pebble gray, deep black, signal white	Indoor
	LMC13x	VdS-certified laser scanner (with heating) Ambient temperature: –30 °C to +50 °C Fog filter is set at the factory, but not the particle filter. Colors: pebble gray, deep black, signal white * Semi-outdoor refers to the analysis time and with it the multiple options for analysis, which is restricted by VdS class C to 25 ms and by VdS class B to 40 ms.	Semi-outdoor*

Tab. 1: VdS-compliant devices

The LMC1xx laser scanners are the only devices on the market with a VdS certificate (German safety certificate). VdS certification guarantees that the system is reliable and is recognized by insurance companies. The devices have a firmware version that has been accepted and documented by the VdS.

VdS guidelines

Both laser scanners are subject to the following VdS guidelines:

- 2117 requirement (photoelectric sensors = LS) according to test method VdS 2485
- 2312 requirement (motion detectors = BM) according to test method VdS 2326

Testing was carried out:

- For LMC12x under photoelectric sensors class C environmental class II (indoor)
- For LMC13x under photoelectric sensors class C environmental class IVa (outdoor)
- The LMC12x version has VdS certificate number G110045.
- The LMC13x version has VdS certificate number G111032.
- The corresponding VSÖ number is GZ01150000211101-10.

Indoor monitoring

	Devices	Notes
	LMS12x	Ambient temperature: 0 °C to +50 °C Scanning range for passing through zone: < 18 m Scanning range for reaching into zone: < 9 m Colors: pebble gray, deep black, signal white
	TiM320	Ambient temperature: –10 °C to +50 °C Scanning range for passing through zone: 2 m Scanning range for reaching into zone: < 1.5 m Color: light blue
	TiM351 TiM361	The TiM351 and TiM361 laser scanners are designed for outdoor use, but can also be used for indoor monitoring.* * In general, if the scanning range of the indoor devices is not sufficient for the monitoring scenario, outdoor devices can also be used for indoor monitoring. See the following chapter, Outdoor monitoring.

Tab. 2: Devices for indoor monitoring

Outdoor monitoring

Scanning range

The scanning range is the main criterion for device selection, especially outdoors. The device type and number of devices must be chosen depending on the size of the sectors to be monitored.

	Devices	Notes
	TiM351	Ambient operating temperature: –25 °C to +50 °C Switch-on ambient temperature: –10 °C to +50 °C Scanning range for passing through zone: 6 m Scanning range for reaching into zone: 2 m Color: pebble gray
	TiM361	Ambient operating temperature: –25 °C to +50 °C Switch-on ambient temperature: –10 °C to +50 °C Scanning range for passing through zone: 8 m Scanning range for reaching into zone: 6 m Color: pebble gray
	LMS13x	Laser scanner (with heating) Ambient temperature: –30 °C to +50 °C Fog and particle filter are set at the factory Scanning range for passing through zone: < 18 m Scanning range for reaching into zone: < 9 m Colors: pebble gray, deep black, signal white
	LMS141 core / LMS14x prime	Laser scanner (with heating) Ambient temperature: –40 °C to +60 °C Fog and particle filter are set at the factory Scanning range for passing through zone: < 30 m Scanning range for reaching into zone: < 12 m Colors (LMS141 core): pebble gray only Colors (LMS141 prime): pebble gray, deep black, signal white
	LMS531 Lite/ LMS531 PRO	Laser scanner (with heating) Ambient temperature: –30 °C to +50 °C Fog and particle filter are set at the factory Scanning range for passing through zone: < 40 m Scanning range for reaching into zone: < 12 m Color: pebble gray * Differences regarding technical equipment: • Scanning frequency: (PRO = higher scanning frequency) • Number of echoes (Lite = 2, PRO = 5) • Switching inputs (Lite = 3, PRO = 4) • Switching outputs (Lite = 2 volt-free semiconductor outputs in relay function, 1 digital output, PRO = 4 volt-free semiconductor outputs in relay function) • Interfaces (PRO = additional CAN and RS422) • Raw data output (PRO = yes)

Tab. 3: Devices for outdoor monitoring

5.2 Device overview

5.2.1 VdS-compliant devices

General

Part no.	Model name	Indoor	Semi-outdoor	Color	Temperature range			IP		VDS
					0 … 45 °C	0 … 50 °C	–30 … 50 °C	65	67	Class C
1051287	**LMC121-11000**	x		RAL 7032 – pebble gray	x			x		x
1051314	**LMC121-11001**	x		RAL 7032 – pebble gray		x		x		x
1051300	**LMC122-11000**	x		RAL 9005 – deep black	x			x		x
1051315	**LMC122-11001**	x		RAL 9005 – deep black		x		x		x
1051301	**LMC123-11000**	x		RAL 9003 – signal white	x			x		x
1051316	**LMC123-11001**	x		RAL 9003 – signal white		x		x		x
1051487	**LMC131-11101**		x	RAL 7032 – pebble gray			x		x	x
1051488	**LMC132-11101**		x	RAL 9005 – deep black			x		x	x
1051489	**LMC133-11101**		x	RAL 9003 – signal white			x		x	x

Electrical

Model name	Inputs	Outputs	Voltage range
	4 semiconductor inputs, e.g., for • Sharp/not sharp • Walk-through test • Day/night • Easy Teach	2 volt-free semiconductor outputs in relay function • Alarm • Fault 1 additional tamper output (tamper contact of optics cover)	9 V DC … 30 V DC
LMC121-11000	x	x	x
LMC121-11001	x	x	x
LMC122-11000	x	x	x
LMC122-11001	x	x	x
LMC123-11000	x	x	x
LMC123-11001	x	x	x
LMC131-11101	x	x	x
LMC132-11101	x	x	x
LMC133-11101	x	x	x

Interfaces

Model name	RS232	RS422	RS485	Ethernet	OPC	USB	CAN
LMC121-11000	x			x	x		x
LMC121-11001	x			x	x		x
LMC122-11000	x			x	x		x
LMC122-11001	x			x	x		x
LMC123-11000	x			x	x		x
LMC123-11001	x			x	x		x
LMC131-11101	x			x	x		x
LMC132-11101	x			x	x		x
LMC133-11101	x			x	x		x

Technical data

Model name	Scanning range		Scanning range		Max. detection speed			
	Passing through zone (300 mm)	Reaching into zone (40 mm)	270°	190°	67 ms	20 ms	14 ms	10 ms
LMC121-11000	< 18 m	< 9 m	x					
LMC121-11001	< 18 m	< 9 m	x			x		
LMC122-11000	< 18 m	< 9 m	x			x		
LMC122-11001	< 18 m	< 9 m	x			x		
LMC123-11000	< 18 m	< 9 m	x			x		
LMC123-11001	< 18 m	< 9 m	x			x		
LMC131-11101	< 18 m	< 9 m	x			x		
LMC132-11101	< 18 m	< 9 m	x			x		
LMC133-11101	< 18 m	< 9 m	x			x		

5.2.2 Indoor devices (without VdS certification)

General

Part no.	Model name	Color	Temperature range		IP	
			0 … 50 °C	−10 … 50 °C	65	67
1063467	**TiM320-1031000**	RAL 5012 – light blue		x	x	
1051384	**LMS121-10000**	RAL 7032 – pebble gray	x		x	
1044322	**LMS122-10000**	RAL 9005 – deep black	x		x	
1044321	**LMS123-10000**	RAL 9003 – signal white	x		x	

Electrical

Model name	Inputs	Outputs		Voltage range	
	4 semiconductor inputs, e.g., for • Sharp/not sharp • Walk-through test • Day/night • Easy Teach	2 volt-free semiconductor outputs in relay function • Alarm • Fault 1 additional tamper output (tamper contact of optics cover)	4 semiconduc-tor outputs	9 V DC … 30 V DC	9 V DC … 28 V DC
TiM320-1031000			x		x
LMS121-10000	x	x		x	
LMS122-10000	x	x		x	
LMS123-10000	x	x		x	

Interfaces

Model name	RS232	RS422	RS485	Ethernet	OPC	USB	CAN
TiM320-1031000						x	
LMS121-10000	x			x	x		x
LMS122-10000	x			x	x		x
LMS123-10000	x			x	x		x

Technical data

Model name	Scanning range		Scanning range		Max. detection speed			
	Passing through zone (300 mm)	Reaching into zone (40 mm)	270°	190°	67 ms	20 ms	14 ms	10 ms
TiM320-1031000	2 m	1.5 m	x		x			
LMS121-10000	< 18 m	< 9 m	x			x		
LMS122-10000	< 18 m	< 9 m	x			x		
LMS123-10000	< 18 m	< 9 m	x			x		

5.2.3 Outdoor devices

General

Part no.	Model name	Color	Temperature range			IP
			−25 … 50 °C	−30 … 50 °C	−40 … 60 °C	67
1067299	**TIM351-2134001**	RAL 7032 – pebble gray	x			x
1071399	**TIM361-2134101**	RAL 7032 – pebble gray	x			x
1051379	**LMS131-10100**	RAL 7032 – pebble gray		x		x
1051402	**LMS132-10100**	RAL 9005 – deep black		x		x
1051485	**LMS132-11100**	RAL 9005 – deep black		x		x
1051403	**LMS133-10100**	RAL 9003 – signal white		x		x
1070209	**LMS141-05100 core**	RAL 7032 – pebble gray			x	x
1070409	**LMS141-15100 prime**	RAL 7032 – pebble gray			x	x
1070410	**LMS142-15100 prime**	RAL 9005 – deep black			x	x
1070411	**LMS143-15100 prime**	RAL 9003 – signal white			x	x
1055376	**LMS531-11100 Lite**	RAL 7032 – pebble gray		x		x
1067356	**LMS531-10100 PRO**	RAL 7032 – pebble gray		x		x

Electrical

Model name	Inputs		Outputs		Voltage range		
	4 semiconductor inputs, e.g., for • Sharp/not sharp • Walk-through test • Day/night • Easy Teach	3 semiconductor inputs, e.g., for • Sharp/not sharp • Walk-through test • Easy Teach	Volt-free semiconductor outputs in relay function	4 semiconductor outputs	10.8 … 30 V DC	19.2 … 28.8 V DC	9 … 28 V DC
TIM351-2134001	Only one input can be used for Easy Teach			x			x
TIM361-2134101	Only one input can be used for Easy Teach			x			x
LMS131-10100	x		2 + 1 additional tamper contact of the optics cover		x		
LMS132-10100	x		2 + 1 additional tamper contact of the optics cover		x		
LMS133-10100	x		2 + 1 additional tamper contact of the optics cover		x		
LMS141-05100 core		x	2 + 1 additional tamper contact of the optics cover		x		
LMS141-15100 prime	x		2 + 1 additional tamper contact of the optics cover		x		
LMS142-15100 prime	x		2 + 1 additional tamper contact of the optics cover		x		
LMS143-15100 prime	x		2 + 1 additional tamper contact of the optics cover		x		
LMS531-11100 Lite		x	2 + 1 additional semiconductor output			x	
LMS531-10100 PRO	x		4			x	

Interfaces

Model name	RS232	RS422	RS485	Ethernet	OPC	USB	CAN*
TIM351-2134001				x	x	x	
TIM361-2134101				x	x	x	
LMS131-10100	x			x	x		x
LMS132-10100	x			x	x		x
LMS133-10100	x			x	x		x
LMS141-05100 core	x			x (1 Hz)	x		
LMS141-15100 prime	x			x	x		x
LMS142-15100 prime	x			x	x		x
LMS143-15100 prime	x			x	x		x
LMS531-11100 Lite				x (1 Hz)	x	x	
LMS531-10100 PRO	x	x	x	x	x	x	x

* With the help of the CAN digital I/O module, it is also possible to expand the number of outputs by up to 8 outputs via the CAN interface (see also Chapter **5.3.7 CAN modules**).

Technical data

Model name	Scanning range		Scanning range		Max. detection speed			
	Passing through zone (300 mm)	Reaching into zone (40 mm)	270°	190°	67 ms	20 ms	14 ms	10 ms
TIM351-2134001	6 m	2 m	x		x			
TIM361-2134101	8 m	6 m	x		x			
LMS131-10100	Recommended 15 m (18 m max.)	< 9 m	x			x		
LMS132-10100	Recommended 15 m (18 m max.)	< 9 m	x			x		
LMS133-10100	Recommended 15 m (18 m max.)	< 9 m	x			x		
LMS141-05100 core	Recommended 25 m (30 m max.)	< 12 m	x			x		
LMS141-15100 prime	Recommended 25 m (30 m max.)	< 12 m	x			x		
LMS142-15100 prime	Recommended 25 m (30 m max.)	< 12 m	x			x		
LMS143-15100 prime	Recommended 25 m (30 m max.)	< 12 m	x			x		
LMS531-11100 Lite	Recommended 35 m (40 m max.)	< 12 m		x			x	
LMS531-10100 PRO	Recommended 35 m (40 m max.)	< 12 m		x				x

5.3 Accessories

For optimal integration and operation of the scanners in the monitoring system, the use of SICK and SICK approved accessories is essential.”

This not only includes connection and mounting systems, but also weather hoods, scan finders, and lens cloths.

5.3.1 Weather hoods

To protect laser scanners mounted outdoors from dazzle, hail and direct sunlight, the use of a weather hood is recommended.

Weather hood for TiM351/TiM361

	Accessories	Description	Part number
	Weatherproof housing	Included in the mounting kit for the TiM351/TiM361 (see under **5.3.2 Mounting** kits)	2068398

Weather hoods for LMS13x/LMS14x

	Accessories	Description	Part number
	Weather hood, 190°	Sun and rain protection for outdoor applications Color: pebble gray	2046459
	Weather hood, 270°	Sun and rain protection for outdoor applications Color: pebble gray	2046458
	Weather hood, 190°, compact	Compact weather hood, 190°, for LMS1xx Color: deep black* * Other colors on request	2082563
	Weather hood, 270°, compact	Compact weather hood, 190°, for LMS1xx Color: deep black* * Other colors on request	2082560

Weather hood for LMS531 Lite/PRO

	Accessories	Description	Part number
	Protection hood	Recommended for protection from direct sunlight (heat) and environmental influences Color: RAL 7032 gray	2056850
	Weather hood	Recommended for protection from direct sunlight (heat) and environmental influences Color: RAL 7032 gray	2063050

5.3.2 Mounting kits

VdS-compliant mounting kits

The LMC12x/LMC13x laser scanners with the VdS mounting kits meet the special VdS compliance requirements. A VdS-compliant mounting kit is included in the scope of delivery.

According to VdS guideline 2312, the fixing screws must not be freely accessible. The VdS-compliant mounting kits meet this requirement; mechanical tampering is therefore excluded.

The mounting kit consists of two parts: the lower part (for wall and ceiling mounting) and a flexible upper part (placed over the device).

Fig. 21: VdS-compliant mounting kits VdS1 long/VdS1 short

The **VdS1 long** mounting kit (1) completely encloses the LMC12x. The temperature range during VdS-compliant operation runs from 0 °C to +45 °C.

The **VdS1 short** mounting kit (2) only partially covers the upper part of the LMC12x/13x. The temperature range during VdS-compliant operation runs from 0 °C to +50 °C for the LMC12x and from –30 °C to +50 °C for the LMC13x. The LMC13x is therefore suitable for outdoor applications protected from the weather.

Mounting kits for TiM320

	Accessories	Description	Part number
	Mounting kit 2	Mounting kit, impact protection, and alignment aid	2061776

Mounting kits for TiM351/TiM361

	Accessories	Description	Part number
	Mounting kit	Mounting kit with sunshade/weather protection	2068398

Mounting kits for LMS12x

The following mounting kits cannot be used with a weather hood.

	Accessories	**Description**	**Part number**
	Mounting kit 1A Indoor	Mounting bracket for rear mounting on the wall	2034324
	Mounting kit 1B Indoor	Mounting bracket for rear mounting on the wall with optics cover protection	2034325
	Mounting kit 2 Indoor	Cross-wise adjustment possible only in combination with mounting kit 1a or 1b	2039302
	Mounting kit 3 Indoor	Longitudinal adjustment possible only in combination with mounting kit 2	2039303

Mounting kits for LMS13x/LMS14x

	Accessories	**Description**	**Part number**
	Mounting kit for weather hood	For 190°/270° weather hoods	2046025
	Quick release	Mounting kit 2046025 required Makes mounting and removal possible without readjustment	2046989
	Corner mounting bracket	Basis for both mounting kits 2046025 and 2046989	2082910

Mounting kits for LMS531 Lite/PRO

	Accessories	**Description**	**Part number**
	Mounting kit 1	Mounting kit 1 for mounting	2015623
	Mounting kit 2	Mounting kit 2 for mounting Mounting kit 1 required	2015624
	Mounting kit 3	Mounting kit 3 for mounting Mounting kits 1 and 2 required	2015625

	Mounting bracket	For retrofitting existing LMS2x1 mounting	2059271
	Mounting kit	Mounting kit for wall mounting (adjustment bracket)	2018303
	Mounting bracket	Mounting bracket, heavy-duty version, with protection cover, for floor mounting, height adjustment possible	7087514

5.3.3 Fine-adjustment unit

The fine-adjustment unit makes it possible to precisely align the LMS1xx and LMS5xx scanners. It can be combined with the following mounting kits:

	Accessories	**Description**	**Part number**
	Fine-adjustment unit	Can be combined with the following mounting kits: LMS5xx  Mounting bracket (2059271)  Mounting kit (2018303) LMS1xx  Mounting kit for weather hood (2046025)  Quick release (2046989)  Mounting kit 1A (2034324)  Mounting kit 1B (2034325)  Mounting kit 2 (2039302)	2076764

5.3.4 Post and wall brackets

Brackets with corresponding adapter plates for holding the respective devices are available for mounting the LMS13x, LMS14x core/prime, and LMS531 Lite/PRO outdoor devices on poles and walls. The post and wall brackets for the LMS531 Lite/PRO laser scanners also hold the relevant connection box.

The devices can be mounted with or without sun protection on the post and wall brackets.

	Accessories	Description	Part number
	Post/wall bracket for LMS1xx	Post/wall bracket with adapter plate for mounting the LMS13x and LMS14x core/prime laser scanners	1081413
	Connection box mounting bracket	Mounting bracket for mounting the connection box on the post/wall bracket for LMS1xx	2081636
	Post/wall bracket for LMS531 Lite/PRO	Post/wall bracket with adapter plate for mounting the LMS531 Lite/PRO laser scanners	1081412

Accessories for post mounting

	Accessories	Description	Part number
	Adjustable strap for post bracket	Adjustable strap for post/wall bracket (2018304)	5306222
	Adjustable strap lock	Adjustable strap lock for tightening, 2 pieces required	5306221

5.3.5 Connecting cables

Both LMC12x and LMS12x indoor devices are wired via the terminal strip of the laser scanner. The LMC13x semi-outdoor device and LMS13x, LMS141 core, LMS14x prime, LMS531 Lite, and LMS531 PRO outdoor devices are connected directly via pre-assembled cables with an M12 plug connector and open end (see Chapter **5.3.5 Connecting cables**).

If large distances between the laser scanner and control are bridged, suitable connection boxes are available for the TiM3xx, LMS13x, LMS141 core, LMS14x prime, LMS531 Lite, and LMS 531 PRO outdoor devices (see Chapter **5.3.6 Connection boxes**).

Ethernet

Devices	Accessories	Description	Part number
	Connecting cable Ethernet to all LMS1xx/LMS5xx as well as to TiM351/TiM361	Connecting cable with M12 male connector, 4-pin/RJ45 - 05 m - 10 m - 20 m	 6034415 6030928 6036158

USB

Devices	Accessories	Description	Part number
	USB cable for configuration of all LMS5xx	Connecting cable with USB-A/Mini USB male connectors - 3 m	 6042517
	USB cable for configuration of all TiMxxx	Connecting cable with male connector, USB-A, male connector, Micro-B for configuration	6036106

TiM320 extension cable

Devices	Accessories	Description	Part number
	Extension cable	Female connector, D-Sub-HD, 15-pin, 2 m	2043413

TiM351/361 connecting cable

Devices	Accessories	Description	Part number
	Power and data connecting cable	Connecting cable with M12 female connector (12-pin), open cable end, shielded - 05 m - 10 m - 20 m	 6042735 6042736 6042737

Connecting cables for LMC13x/LMS141 core/LMS14x prime/LMS13x/LMS531 Lite

Devices	Accessories	Description	Part number
	Power connecting cable	Voltage supply with M12 coupling (5-pin) and open cable end (electronics and heating) - 05 m - 10 m - 20 m	6036159 6042565 6042564
	Output connecting cable	Connecting cable with M12 male connector (8-pin), open cable end, shielded - 05 m - 10 m - 20 m	6036155 6036156 6036157
	Inputs/data connecting cable	Connecting cable with M12 female connector (8-pin), open cable end, shielded - 05 m - 10 m - 20 m	6036153 6028420 6036154

Connecting cables for LMS531 PRO

Devices	Accessories	Description	Part number
	Power connecting cable	Voltage supply with M12 coupling (5-pin) and open cable end (electronics and heating) - 05 m - 10 m - 20 m	6036159 6042565 6042564
	Output connecting cable	Connecting cable with M12 male connector (12-pin), open cable end, shielded - 05 m - 10 m - 20 m	6042732 6042733 6042734
	Data connecting cable	Connecting cable with M12 female connector (12-pin), open cable end, shielded - 05 m - 10 m - 20 m	6042735 6042736 6042737

5.3.6 Connection boxes

A connection box can be used to bridge large distances between the laser scanner and the monitoring system.

Connection boxes are available for the TiM351/TiM361, LMS13x, LMS141 core, LMS14x prime, LMS531 Lite, and LMS531 PRO devices. (See Chapter **6.4.3 Using a connection box**).

Note The connection box for the TiM351/361 can be used together with the CAN expansion modules (see below) in order to make further outputs available as volt-free relay contacts.

Connection box for TiM351/TiM361

Devices	Accessories	Description	Part number
	Connection box relay	Connection box for power, I/O, tamper contact, and 4 relays * The stub cables for the connection box must be laid by the customer.	2082916

Connection box for LMS13x/LMS141 core/LMS14x prime/LMS531 Lite

Devices	Accessories	Description	Part number
	Connection box	Connection box for power and I/O (not Ethernet), with three pre-wired M12 cables (length of cable approx. 40 cm) * The stub cables for the connection box must be laid by the customer.	2062346

Connection box for LMS531 PRO

Devices	Accessories	Description	Part number
	Connection box	Connection box for power and I/O (not Ethernet), with three pre-wired M12 cables (length of cable approx. 40 cm) and tamper contact on housing cover * The stub cables for the connection box must be laid by the customer.	2063034

5.3.7 CAN modules

Eight switching outputs can be added to the existing digital outputs if the compatible laser scanners using an I/O module. Together with the connection box for the TiM351/361 (see above), the outputs can be provided as volt-free relay contacts.

Expansion modules for LMS13x/LMS141 core/LMS14x prime/LMS531 Lite

Devices	Accessories	Description	Part number
	CAN digital I/O module (Indoor)	External CAN expansion module for up to 8 additional switching outputs (IP 20)	6038825
	CAN digital I/O module (Outdoor)	External CAN expansion module for up to 8 additional switching outputs (IP 66) Can be triggered by CAN bus in the central controls	6041328
	PG connector kit	Cable gland kit for CAN module (6041328)	6043917

5.3.8 Power supply unit

If the laser scanners cannot be connected to the existing voltage supply, appropriate power supply units are available.

Power supply unit for all TiM3xx/LMS1xx laser scanners

Devices	Accessories	Description	Part number
	Power supply unit, 24 V DC / 2.5 A	For voltage supply to TiM3xx and LMS1xx Only suitable for indoor applications, because it is not strong enough to provide power for heating	6022427
	Power supply unit, 24 V DC / 3.9 A	For voltage supply to TiM3xx and LMS1xx for electronics and heating	7028790
	Power supply unit, 24 V DC / 4 A	For voltage supply to TiM3xx and LMS1xx for electronics and heating	6010362

Power supply unit for all LMS531 Lite/PRO laser scanners

Devices	Accessories	Description	Part number
	Switching power supply unit, 24 V / 10 A	For voltage supply to LMS5xx for electronics and heating Relay for DC OK	6032863
	Switching power supply unit, 24 V / 10 A	For voltage supply to LMS5xx for electronics and heating	6020875
	Switching power supply unit, 24 V / 20 A	For voltage supply to LMS5xx for electronics and heating	6033968
	Power supply unit, 24 V DC / 40 A	DC OK relay contact, shutdown input	6052600

5.3.9 Scan finder

The scan finder helps locate the laser beam during installation.

Devices	Accessories	Description	Part number
	LS80b scan finder	Infrared receiver for locating the laser beam	6020756

6 Project planning

6.1 Analysis of the threat situation

The basis of project planning is to carry out a project-specific security analysis and use that to create a security concept that is tailored to the threat situation in question. Good analysis and customized planning based on the needs of the users, planners, and installation and security personnel ensure that the various systems are optimized within closed security concepts.

The threat situation and any according measures to be taken are determined by the following factors:

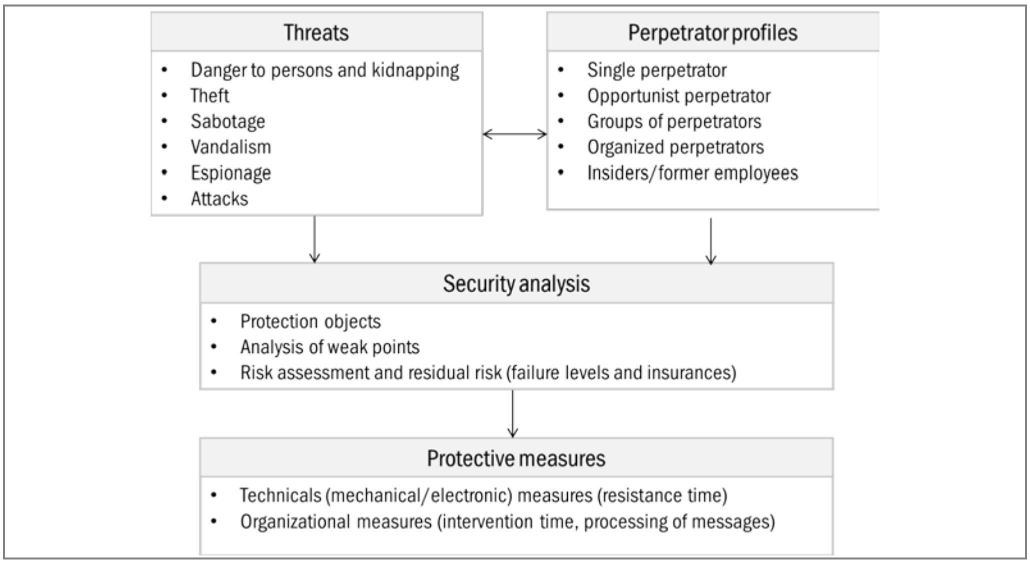


Fig. 22: Analysis of the threat situation

The sharpness of the laser scanner should be set based on the threat situation, so that only relevant alarms are triggered. The objective should be:

As few false alarms as possible and no faulty alarms!

Alarm type	Meaning
Faulty alarm	Alarm not triggered. The system does not report a threat even though one exists.
False alarm	Alarm triggered without cause. Alarm is triggered even though no threat exists. The cause of the trigger is either undetermined or is not considered a threat.

Tab. 4: Alarm types: faulty alarm, false alarm

The rate of undesired messages (RuM), caused by technical faults or animals, plants, weather, etc., should be kept as low as possible. Suitable alarm verifications should be used to minimize undesired messages and optimize detection (by connecting to another detection system, perhaps, such as to CCTV).

The configuration of the detection accuracy using the SOPAS configuration software is described in detail in Chapter **6.5 Detection accuracy and analysis strategy**.

6.2 Preliminary considerations during installation

It is important to ensure in advance that the monitored area can be “seen” as easily as possible by the laser scanners. The sensor should be mounted so that it is protected from tampering.

Facade protection

What to look for	What to do
Grass, bushes, or trees that are growing in the monitored area	➢ Use automatic field adjustment (available for LMS13x, LMS14x prime, and LMS531 PRO) ➢ Increase the distance between the bottom field edges and the ground
Water surfaces (after rain) that cover the area's contour as reference and may produce reflections	➢ Use the field analysis instead of the contour as reference ➢ Increase the minimum object size if necessary
Ventilation outlets, steam outlets in the monitored area	➢ “Cut out” (blank) the ventilation outlets ➢ Use a fog filter
Antennas in the monitored area	➢ “Cut out” (blank) the antennas
Snowdrifts or snow accumulation in winter	➢ Use automatic field adjustment (available for LMS13x, LMS14x prime, and LMS531 PRO) ➢ Increase the distance between the bottom field edges and the ground
Highly reflective (wet) windowsills/blinds	➢ Increase the minimum object size
Falling leaves or accumulation of leaves in autumn	➢ Increase the minimum object size ➢ Use automatic field adjustment (available for LMS13x, LMS14x prime, and LMS531 PRO) ➢ Increase the distance between the bottom field edges and the ground

Tab. 5: Preliminary considerations (facade protection)

Fence protection

What to look for	What to do
Grass, bushes, or trees that are growing in the monitored area	➢ Use automatic field adjustment (available for LMS13x, LMS14x prime, and LMS531 PRO) ➢ Increase the distance between the bottom field edges and the ground
Snowdrifts, snow accumulation	➢ Use automatic field adjustment (available for LMS13x, LMS14x prime, and LMS531 PRO) ➢ Increase the distance between the bottom field edges and the ground
If mounted on a post: unsteady or swaying post	➢ Reduce the analysis field ➢ Use suitable posts

Tab. 6: Preliminary considerations (fence protection)

Open space protection

What to look for	What to do
Grass, bushes, or trees that are growing in the monitored area	➢ "Cut out" (blank) bushes and trees
Snow piles	➢ Should be avoided
Snowdrifts, snow accumulation, e.g., at the field edges (such as on paths)	➢ Increase the distance between the field edges and any walls or similar
Foliage, leaf piles, or accumulation of leaves	➢ Increase the minimum object size ➢ Increase the analysis time ➢ Increase the distance between the field edges and any walls or similar
Ventilation outlets	➢ "Cut out" (blank) the ventilation outlets ➢ Use a fog filter ➢ Use the contour as reference and analyze the "last echo"
Molehills	➢ Adjust the mounted height of the sensor (warning: risk of allowing people to crawl beneath the detection zone)
Animals (cats, rabbits, etc.)	➢ Increase the minimum object size (warning: risk of blanking people's legs)
Sprinkler systems for watering and irrigation	➢ Use the contour as reference

Tab. 7: Preliminary considerations (open space protection)

Roof protection

What to look for	What to do
Ground fog as it drops	➢ Use a fog filter ➢ Use the contour as reference ➢ Plan in more "functional reserves"
Ventilation outlets/ stacks	➢ Use a fog filter ➢ Use the contour as reference ➢ "Cut out" (blank) the monitoring field accordingly
Antennas	➢ "Cut out" (blank) the monitoring field accordingly
Snowdrifts	➢ "Cut out" (blank) the monitoring field accordingly
Large birds on the roof	➢ Increase the minimum object size ➢ Implement suitable measures to keep birds away
Reflective roof edges	➢ Increase the minimum object size ➢ Cover the edges with appropriate materials

Tab. 8: Preliminary considerations (roof protection)

Important general considerations

➢ Check the capability of the power supply unit if using long lengths of cables or large cable cross-sections. Take the voltage drop that occurs when the heating is switched on into account here, too.

➢ If using the contour as reference analysis strategy, ensure that the contour target does not blow in the wind. Use analysis fields with sufficient distance to the ground.

No reflective surfaces behind the reference target

All TiM3xx and LMS1xx devices have an external reference target to perform a self-check of the laser performance. The reference target must return a defined reflection value when it is scanned by the laser beam.

When mounting the laser scanner, make sure there are no reflective surfaces behind the reference target which could distort the returned reflection value.

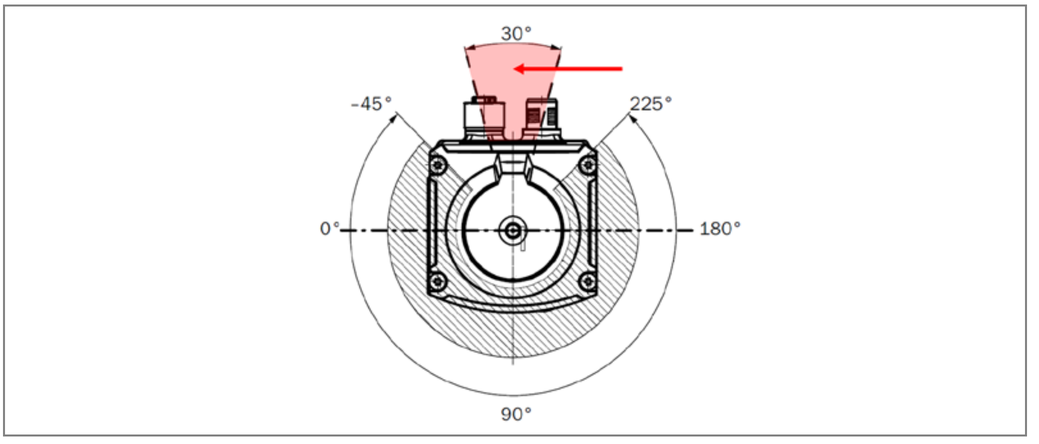


Fig. 23: Area behind the reference target in which no reflective surfaces are allowed

6.3 Heating

For outdoor applications or applications subject to strong environmental changes, the optics cover of the laser scanner may ice over or thaw due to radical fluctuations in temperature. The negative affects of this on laser performance can lead to false alarms.

The LMC13x, LMS13x, LMS14x and LMS531 Lite/PRO laser scanners for semi-outdoor and outdoor applications are fitted with a heating function for this reason.

A separate power source is required for heating.

The minimum operating temperature of –30 °C (outdoor temperature) is guaranteed for a wind speed of 0 m/s. Experience has shown that operation is possible at wind speeds up to 0.5 m/s. At higher wind speeds the heat is transferred from the scanner too quickly.

The heating strategies vary for the different laser scanners:

LMC13x/LMS13x/LMS14x heating strategies

Heating begins when the internal temperature drops below 10 °C. It then continues for at least three hours. If the temperature continues to fluctuate around the 10 °C mark, the heating often runs for a shorter time.

Important

- If the temperature is over 0 °C in the laser scanner during commissioning, the device activates.
- If the temperature is below 0 °C in the laser scanner during commissioning, the device must first be heated before it activates.
- If the temperature in the device drops below 0 °C during operation, the device continues to run, but sends a telegram indicating that the minimum operating temperature has been breached.

LMS531 Lite/PRO heating strategy

Heating begins when the internal temperature drops below 5 °C. It then continues for at least three hours. Heating also starts when the sensor has been started.

The heating is automatically switched off after these three hours if all internal temperature sensors register a temperature over 10 °C.

The heating is always switched off if the measured internal temperature exceeds 50 °C.

6.4 Mounting and connecting cables

Both VdS-certified LMC12x and LMC13x laser scanners must be mounted using the mounting kit included with delivery.

For mounting non-certified devices, the appropriate mounting kit can be ordered from the accessories list.

In general the following information should be considered when selecting the mounting location:

- Only mount the laser scanners on fixed surfaces.
- Ensure that the entire field of view of the laser scanner is not restricted. Mount the laser scanners so that their detection is not affected or distorted by high grass or branches moving in the wind.
- Mount the laser scanners where shocks and vibrations are minimized.
- Ensure that the laser scanner is not placed in direct sunlight or in the path of other heat sources, in order to prevent the sensor interior from becoming overheated.
- Avoid installation where the laser would be directed at glass or stainless steel surfaces.

Note Use of a weather hood is recommended for outdoor installations (see Chapter **5.3.1 Weather hoods**).

6.4.1 Voltage supply

The laser scanners are supplied with a DC voltage between 12 V and 30 V, depending on the device type. If multiple devices are connected to a power supply unit, the current consumption of all devices must be added together.

If multiple power supply units are used, the negative potentials must be connected to each other.

To prevent an excessive voltage drop on the cables, the individual devices should be wired radially with a distribution unit at the center.

If the laser scanners have heating, a separate power supply is required for this function.

The customer will require the following to commission and operate the laser scanners:

Devices	Supply voltage	Power consumption
LMC12x/LMS12x	9 V DC … 30 V DC*	10 W
TiM320	9 V DC … 28 V DC*	without output load 3 W
TiM351/TiM361	9 V DC … 28 V DC*	without output load 3.5 W
LMC13x/LMS13x	10.8 V DC … 30 V DC*	with maximum heating output 60 W
LMS141 core LMS14x prime	10.8 V DC … 30 V DC*	with maximum heating output 60 W
LMS531 Lite LMS531 PRO	19.2 V DC … 28.8 V DC*	Power consumption at 24 V: 25 W Extra power consumption of heating at 24 V: 55–65 W
* generated as per IEC 60364-4-41 (VDE 0100 Part 410)		

Tab. 9: Power consumption of laser scanner (overview)

6.4.2 Connecting cables

In general, all connections must be wired with copper cables. The connecting cable cross-section depends on the length of the cable, the connected device type, and the signal type. Laser scanners with integrated heating must be supplied with voltage via a separate cable. All communication cables must be stranded and shielded.

Consider the following when determining the number of cores:

- Voltage supply to the devices
- Connection of the alarm signal (alarm output, etc.)
- External control cables (sharp/not sharp, walk-through test, day/night, teach-in)

It is a good idea to plan for additional reserve cores for possible extensions.

Note

- ➢ When using connecting cables with flexible wires to connect to the terminals, ensure that no wire end sleeves are used and that core ends are not soldered.
- ➢ The length of cable must be calculated with the voltage drop in mind.

LMC12x/LMS12x

The connecting cables for the LMC12x/LMS12x laser scanners are connected to the terminals of the laser scanner via cable glands. The shielding must be attached as described in the operating instructions. The I/O cable and data/input cable should have at least 8 cores. The Ethernet connection is established via the Ethernet cable with a plug connector.

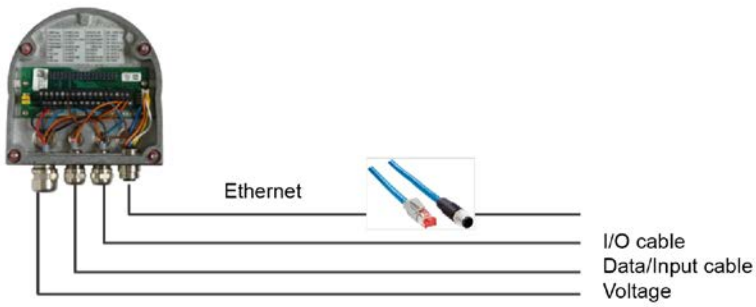


Fig. 24: LMC12x/LMS12x connecting cables

The following cross-sections apply for each signal type, depending on the length of cable:

Signal type	Length of cable for 12 V	Length of cable for 24 V	Cross-section
Supply voltage	< 10 m	< 125 m	0.25 mm^2
	< 20 m	< 250 m	0.50 mm^2
	< 40 m	< 500 m	1.00 mm^2
I/O signals	Similar to supply voltage The appropriate input GND must be used for the input signals; do not use the supply GND. Otherwise ground loops may cause undesired switching processes to occur.		

Tab. 10: Length of cable and cable cross-section (LMC12x/LMS12x connection)

For more information on assigning individual connections, see Chapter **6.7 Pin assignments**.

Note Due to the PNG cable entry, the external diameter of the joint cable must not exceed 9 mm.

TiM320

The TiM320 has a pre-fitted cable with a 15-pin D-sub HD male connector. This cable is connected to a 15-pin extension cable (2 m) that is directed to the distribution unit of the monitoring system on its open end.

Fig. 25: TiM320 connecting cables

For detailed information on assigning individual connections, see Chapter **6.7 Pin assignments**.

TiM351/TiM361

The connecting cables of the TiM351/TiM361 laser scanners have an M12 plug connector for connecting to the laser scanner and an open end that is directed to the distribution unit of the monitoring system. They can be ordered as accessories in lengths up to 20 m.

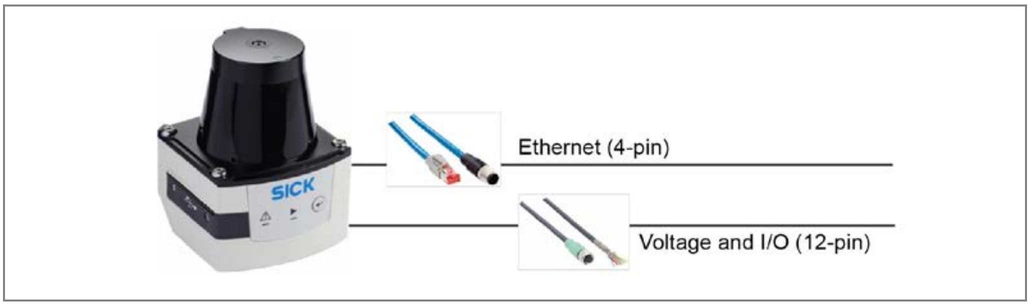


Fig. 26: TiM351/TiM361 connecting cables

For detailed information on assigning individual connections, see Chapter **6.7 Pin assignments**.

LMC13x/LMS13x/LMS141 core/LMS14x prime

The connecting cables of the LMC13x/LMS13x/LMS141 core/LMS14x prime laser scanners have an M12 plug connector for the connection of the laser scanner and an open end that is directed to the distribution unit of the monitoring system. They can be ordered as accessories in lengths up to 20 m.

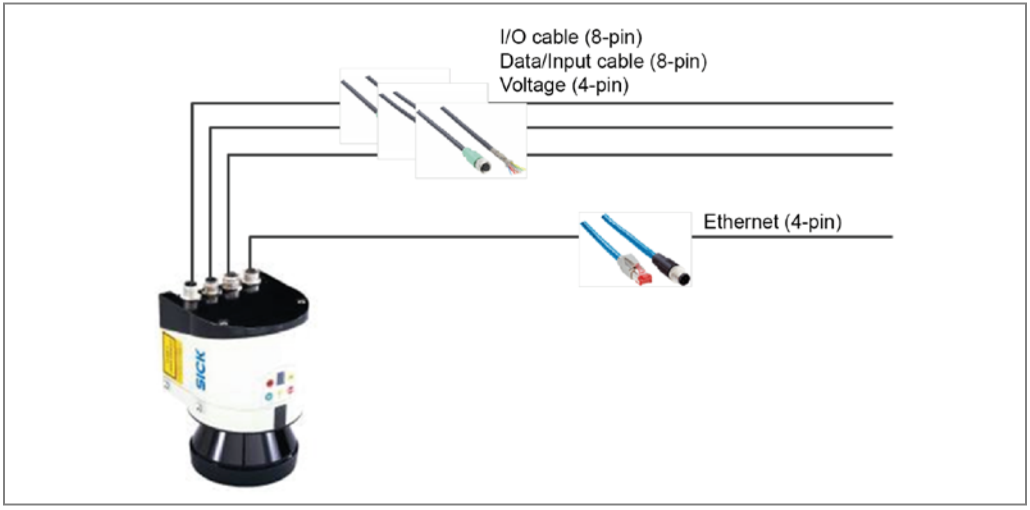


Fig. 27: LMC13x/LMS13x/LMS141 core/LMS14x prime connecting cables

LMS531 Lite/LMS531 PRO

The connecting cables of the LMS531 Lite/PRO laser scanner have an M12 plug connector for connecting to the laser scanner and an open end that is directed to the distribution unit of the monitoring system. They can be ordered as accessories in lengths up to 20 m.

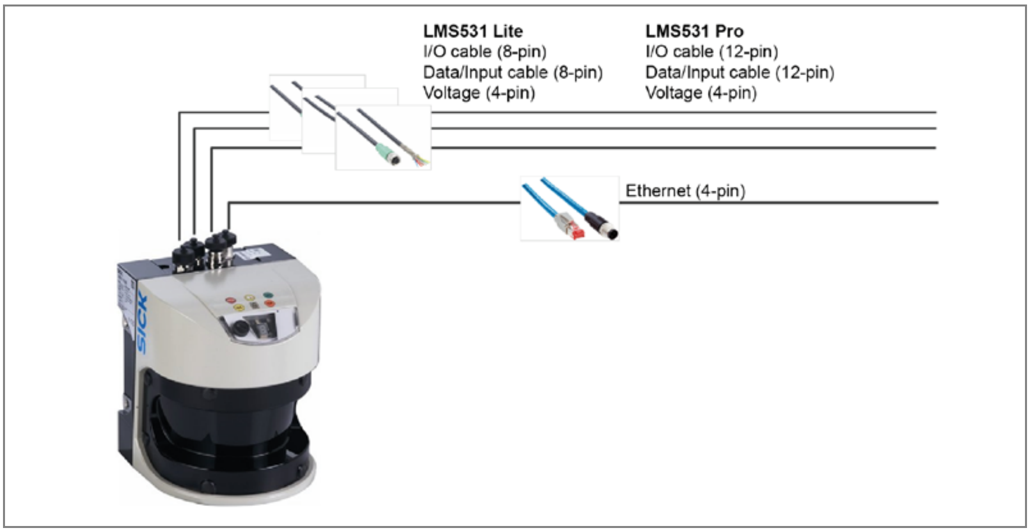


Fig. 28: LMS531 Lite/LMS531 PRO connecting cables

6.4.3 Using a connection box

If the length of the connecting cables is not sufficient, use a suitable connection box. **Separate installation cables** are routed from the central control to the connection box on-site to produce the connection.

Suitable connection boxes are available for the different device types.

For detailed information on assigning terminals, see **Pin assignment** in Chapter **6.7.7Connection** boxes.

Connection box for TiM3xx

The TiM3xx laser scanners use the connection box with the part number 2082916. In addition to its connectivity, the connection box also features volt-free semiconductor outputs in relay function. It therefore provides an electronic component which the laser scanners do not have themselves.

The connection between the connection box and the laser scanner depends on the device type.

TiM320 The TiM320 laser scanner is connected to the connection box via the adapter cable. The plug connector for the adapter cable is inserted into the cable harness of the laser scanner. The open end of the adapter cable is directed through the PG connector into the inside of the connection box housing and connected to the terminal strip accordingly.

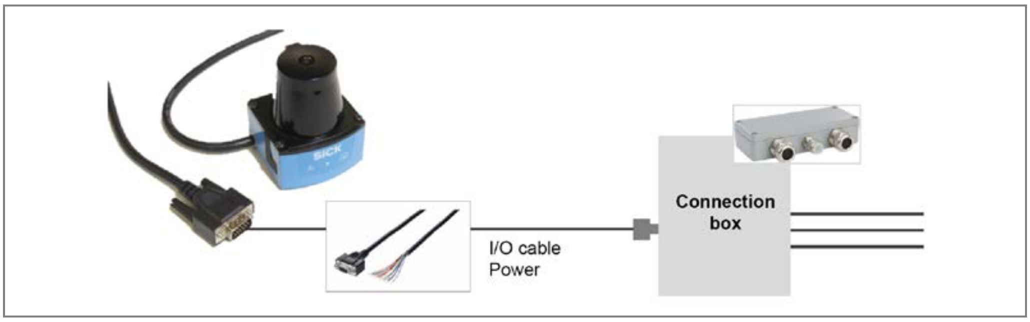


Fig. 29: Connection box for TiM320

TiM351/TiM361 TiM351 and TiM361 laser scanners are connected via a pre-assembled connecting cable. This cable has an M12 connector for connection to the laser scanner on one end. The open end of the cable is directed through the PG connector into the inside of the connection box housing and connected to the terminal strip accordingly.

The Ethernet cable is directly connected to the laser scanner.

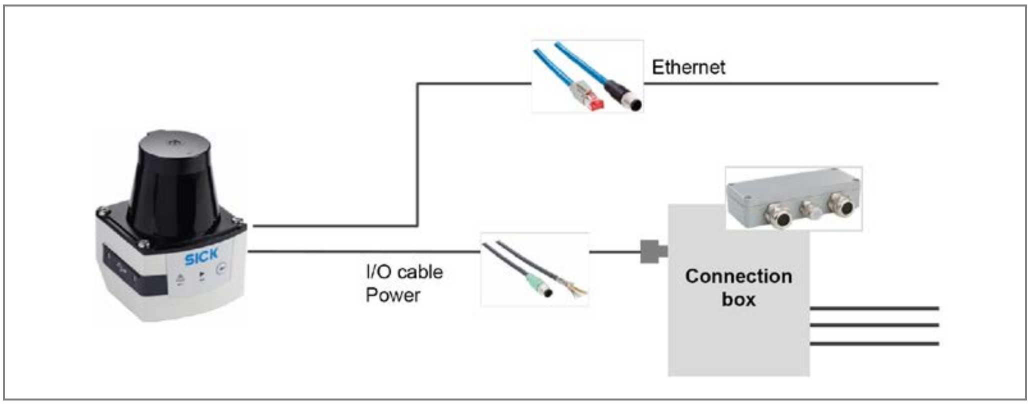


Fig. 30: Connection box for TiM351/TiM361

The following cable cross-sections apply for each signal type, depending on the length of installation cables:

Signal type	**Length of cable for 12 V**	**Length of cable for 24 V**	**Cross-section**
Supply voltage power consumption **max. 15 W** (all outputs fully loaded)	< 12 m	< 60 m	0.25 mm²
	< 25 m	< 125 m	0.50 mm²
	< 50 m	< 250 m	1.00 mm²
Supply voltage power consumption **typically 3 W**	< 60 m	< 300 m	0.25 mm²
	< 125 m	< 600 m	0.50 mm²
	< 250 m	< 1,200 m	1.00 mm²
I/O signals	Similar to supply voltage The appropriate input GND must be used for the input signals; do not use the supply GND. Otherwise ground loops may cause undesired switching processes to occur.		

Tab. 11: Length of cable and cable cross-section (connection box for TiM351/TiM361)

LMS13x/LMS141 core/LMS14x Lite/LMS531 Lite connection box

The LMS13x/LMS141 core/LMS14x Lite/LMS531 Lite laser scanners use the connection box with the part number 2062346. The connection box and the laser scanner are connected via three pre-assembled cables with M12 plug connectors. The connection has fixed wiring in the connection box. The Ethernet cable is directly connected to the laser scanner.

The diameter of the stub cables must be between 5 and 12 mm.

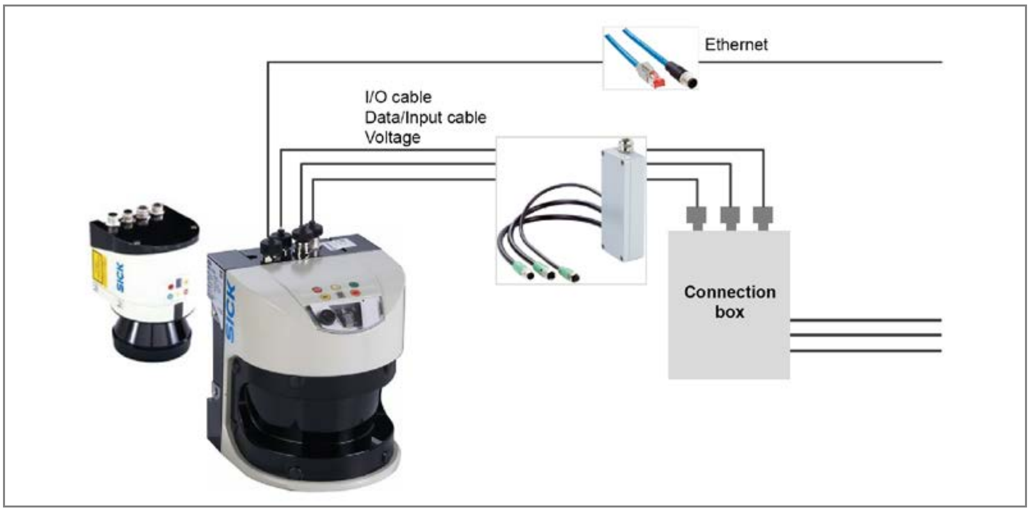


Fig. 31: Connection box for LMS13x/LMS141 core/LMS14x prime/LMS531 Lite

The following cable cross-sections apply for each signal type, depending on the length of installation cable:

LMS1xx connection

Signal type	Length of cable for 12 V	Length of cable for 24 V	Cross-section
Supply voltage	< 10 m	< 125 m	0.25 mm^2
	< 20 m	< 250 m	0.50 mm^2
	< 40 m	< 500 m	1.00 mm^2
Heating (LMS13x)	–	< 15 m	0.25 mm^2
	–	< 30 m	0.50 mm^2
	–	< 60 m	1.00 mm^2
Heating (LMS14x)	–	< 9 m	0.25 mm^2
	–	< 17 m	0.50 mm^2
	–	< 35 m	1.00 mm^2
I/O signals	Similar to supply voltage The appropriate input GND must be used for the input signals; do not use the supply GND. Otherwise ground loops may cause undesired switching processes to occur.		

Tab. 12: Length of cable and cable cross-section (connection box for LMS1xx)

LMS531 Lite connection

Signal type	Length of cable for 12 V	Length of cable for 24 V	Cross-section
Supply voltage	–	< 29 m	0.25 mm^2
	–	< 60 m	0.50 mm^2
	–	< 120 m	1.00 mm^2
Heating	–	< 12 m	0.25 mm^2
	–	< 24 m	0.50 mm^2
	–	< 48 m	1.00 mm^2
I/O signals	Similar to supply voltage The appropriate input GND must be used for the input signals; do not use the supply GND. Otherwise ground loops may cause undesired switching processes to occur.		

Tab. 13: Length of cable and cable cross-section (connection box for LMS531 Lite)

LMS531 PRO connection box

The LMS531 PRO laser scanners uses the connection box with the part number 2063034. The connection box and the laser scanner are connected in the same way as for the LMS531 Lite (see above).

The connection box has **tamper contacts** in the housing cover.

The diameter of the stub cables must be between 5 and 12 mm.

The following cable cross-sections apply for each signal type, depending on the length of installation cable:

Signal type	Length of cable for 12 V	Length of cable for 24 V	Cross-section
Supply voltage	–	< 29 m	0.25 mm^2
	–	< 60 m	0.50 mm^2
	–	< 120 m	1.00 mm^2
Heating	–	< 12 m	0.25 mm^2
	–	< 24 m	0.50 mm^2
	–	< 48 m	1.00 mm^2
I/O signals	Similar to supply voltage The appropriate input GND must be used for the input signals; do not use the supply GND. Otherwise ground loops may cause undesired switching processes to occur.		

Tab. 14: Length of cable and cable cross-section (connection box for LMS531 PRO)

6.5 Detection accuracy and analysis strategy

The SOPAS configuration software is used to define all settings for determining the accuracy and sharpness (resolution) of detection and to specify the analysis strategy.

- **Filters** generally affect the detection of objects in this case. They influence the measured distance values.
- **Analysis fields** divide the reading field monitored by the laser scanner into individual zones, which can then be analyzed separately.
- **Analysis cases** determine how a breached analysis field is analyzed. The analysis case defines the analysis strategy and also takes into account the set filters. The digital outputs to be switched are defined for each analysis case. Analysis cases can be activated and deactivated via the digital inputs.

The analysis case is therefore central to the monitoring process.

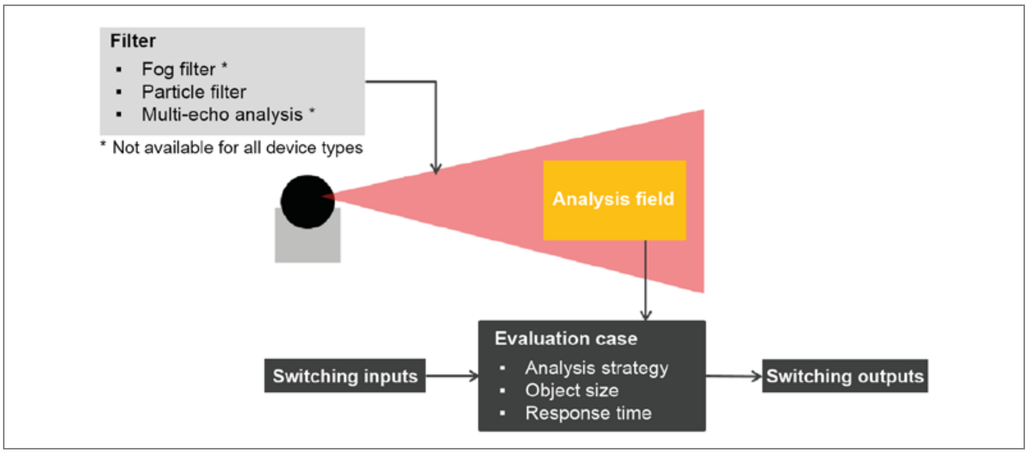


Fig. 32: Filter - analysis fields - analysis cases - switching inputs

6.5.1 Working with filters

The laser scanners have digital filters for pre-processing and optimizing the measured distance values.

Depending on the LMS type, a fog filter and particle filter can be configured. The multi-echo analysis of the reflective pulses makes it possible to prevent faults from occurring in a way that is tailored to the monitoring situation.

Note The described filters are not active for VdS-compliant LMC12x and LMC13x devices. They cannot be activated for these devices.

Fog filter

The fog filter prevents possible dazzle caused by fog. The laser scanner is less sensitive at close range when the fog filter is used.

Note The fog filter is not available for TiM3xx laser scanners.

Particle filter

The particle filter can filter out faults caused by dust particles, raindrops, or snowflakes, and other similar particles in dusty environments, when it is raining or snowing, etc.

The particle filter causes the response to an object in the analysis field or to a breach of the contour to be delayed by the time it takes to complete one scan. This approach eliminates typical "noise" thanks to multiple measurements.

Raindrops are detected in both scans in the following example. Because the measuring points in the repeated measurement are not provided by the same beams, however, a random process is assumed that remains unconsidered.

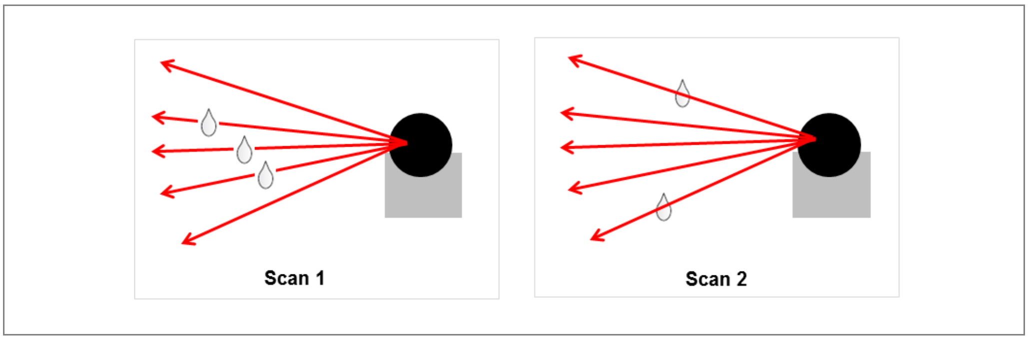


Fig. 33: Particle filter principle of operation

The set response time of the analysis strategies, **pixel analysis**, **blanking**, and **contour as reference**, remain unchanged by this (for response time, see Chapter **6.5.4 Setting the alarm sensitivity**).

Multi-echo analysis

Multi-echo technology makes it possible to detect object and weather-related breaches and multiple reflections. In this approach, both the rate of false and faulty alarms and the rate of undesired messages (RuM) are significantly reduced.

The laser scanner measures a potential second reflective pulse and sends this measured value in a measured value telegram. A second reflective pulse occurs, for example, when the laser beam next hits a raindrop. This reflects part of the energy (first reflective pulse). The other part of the beam continues and is then reflected by an actual object (second reflective pulse).

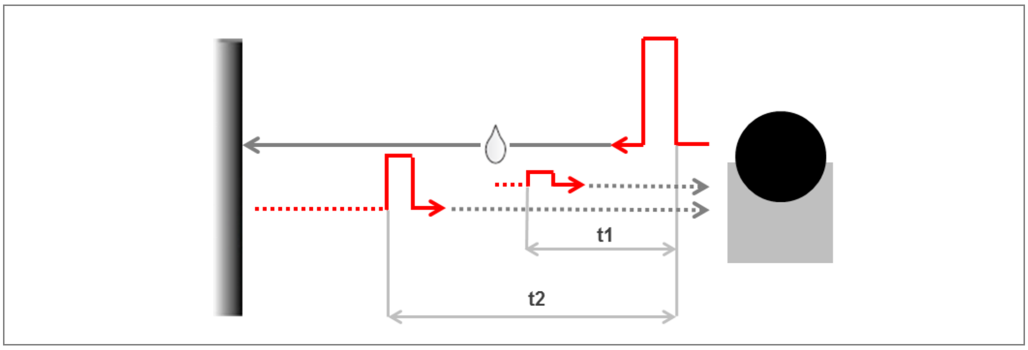


Fig. 34: Multi-echo analysis principle of operation

The described method is especially suitable for use with the contour as reference analysis strategy (see Chapter **6.5.5 Using contour as reference for** tamper-proofing).

Note Multi-echo analysis is not available for TiMxxx laser scanners.

6.5.2 Defining analysis fields and cases

Analysis fields

The laser scanner uses the integrated field application to analyze up to ten analysis fields (1) within its scanning range (2). Using this method it is possible to divide up different monitored areas exactly and analyze these, making it significantly easier to monitor areas.

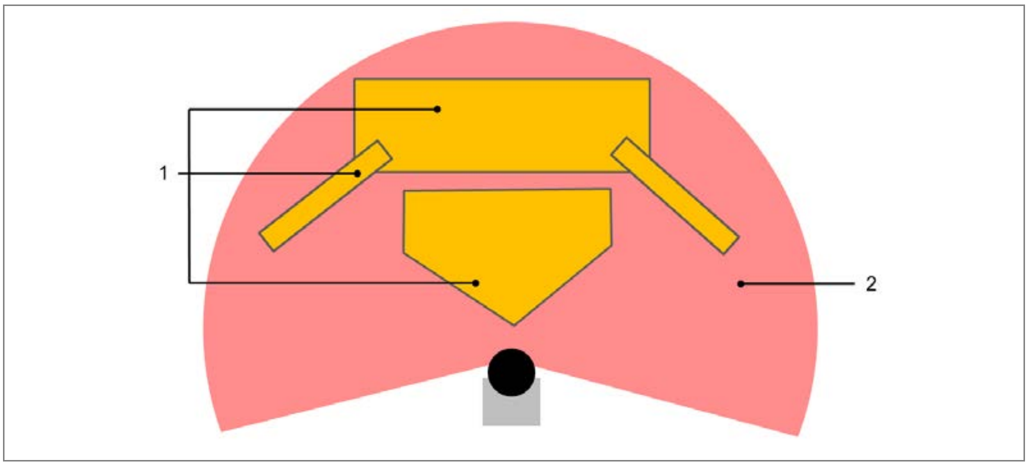


Fig. 35: Scanning range and analysis fields

Analysis fields are created in the SOPAS configuration software. Their size and shape can be defined in virtually any way and thus tailored to suit the individual monitoring situation.

Evaluation cases

Each analysis field is linked to an **evaluation case**. An evaluation case determines the way the analysis field is evaluated and which switching output is addressed. Up to ten evaluation cases can be created and assigned. Evaluation cases adapt the laser scanner to the specific analysis situation and determine its detection accuracy.

An evaluation case is configured via the following parameters:

- The **inputs**, which switch a case between active and inactive.
- The **analysis strategy** (pixel analysis, blanking).
- The **alarm sensitivity** (response time and object size).
- The **output** affected by the analysis case.

The following work flow results from these parameters:

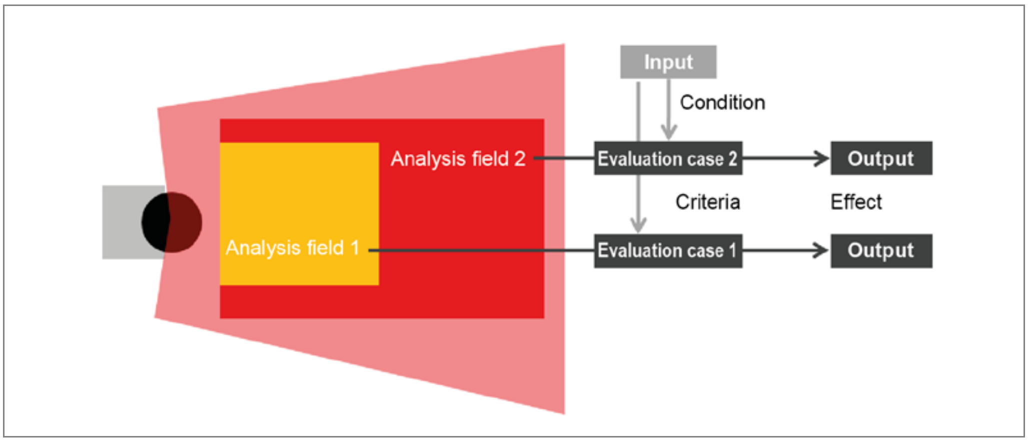


Fig. 36: Evaluation cases, principle of operation

- The laser scanner calculates whether there is an object in the analysis field or whether an analysis field is not being completely visible due to tampering, taking the filter settings into account.
- The evaluation case linked to the analysis field determines based on the defined parameters (object size, response time, etc.) whether the analysis field has been breached and how to respond. The evaluation case thus defines the sharpness (resolution) of the detection.
- The switching output is used to define which event must be signaled (alarm, fault, tampering, etc.).
- The evaluation case is set as active or inactive via a digital switching input if necessary.

6.5.3 Taking account of object sizes

The SOPAS control software can be used to define the minimum size an object must be in order to be detected. This setting differentiates between the two analysis strategies, **pixel analysis** and **blanking**.

Pixel analysis

The laser scanner analyzes the entire area of the monitoring field, during which **every single beam** is included in the analysis. An object is considered “detected” when a laser beam in the analysis field has been breached.

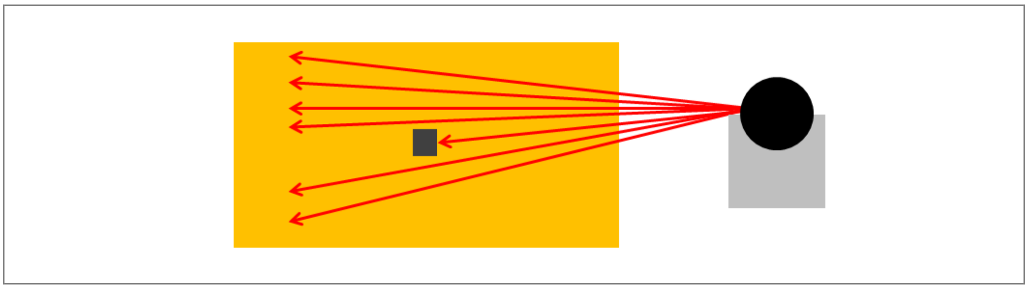


Fig. 37: Pixel analysis principle of operation

Blanking

In this method, the laser scanner also analyzes the entire area of the monitoring field. However, objects up to a specific size are not considered due to blanking.

In the following example, an object is only detected if three adjacent laser beams are breached in the analysis field. Objects that are smaller than the blanking are ignored.

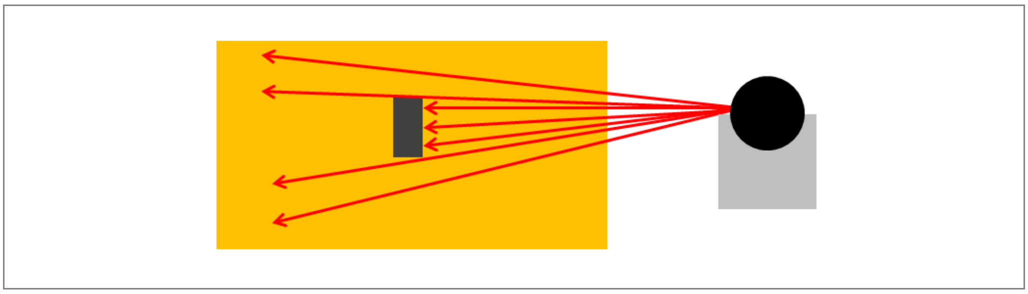


Fig. 38: Blanking principle of operation

6.5.4 Setting the alarm sensitivity

The response time is used to define how **long** an object must be detected in order for a breach to be identified. A longer response time makes multiple sampling possible, where the alarm sensitivity can be better tailored to the ambient conditions in question.

The response time is defined for both the **pixel analysis** and **blanking analysis** strategies. For the laser scanner to detect an object, the object must be detected for at least the duration of the response time.

The response time depends on the scanning frequency. The higher the frequency of the laser scanner, the more frequently an object must be detected within the set response time for the analysis strategy used.

Note VdS-compliant laser scanners are limited to a short response time. VdS class C detectors have a response time of 25 ms, and VdS class B detectors have a response time of 40 ms.

Example

The following example assumes a scanning frequency of 10 Hz and a response time of 1 s. Therefore, the criterion for a breach must be met 10 times per second.

With the **pixel analysis** strategy, a breach of the same measuring beam must occur 10 times one after the other in order for an object to be detected. Otherwise no breach is reported.

With the **blanking** analysis strategy, a breach of three adjacent measuring beams must occur 10 times in order for an object to be detected. It does not have to be the same measuring beam. The criterion for a breach only specifies that the three measuring beams must be adjacent to each other.

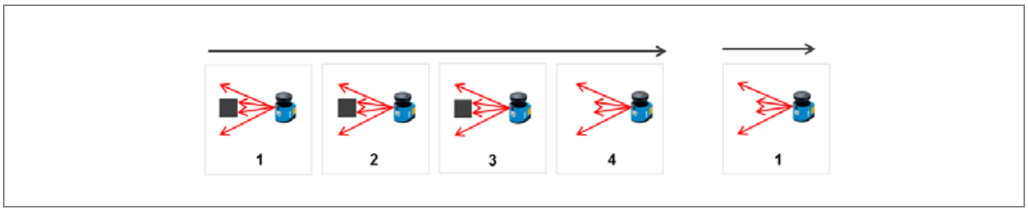


Fig. 39: Example for setting the alarm sensitivity

If the criterion is not met in a scan, the process starts again from scratch.

Note Because in the **blanking** analysis strategy it does not have to be the same adjacent measuring beams, this strategy is better suited to the security field than pixel analysis.

6.5.5 Using contour as reference for tamper-proofing

In the analysis strategy using **fields** as described above, the analysis field must not touch the ground during vertical scanning, because this would result in a permanent breach of the detection zone. An alarm should only be triggered if an object has penetrated the field and thus generated a measurement point in the analysis field.

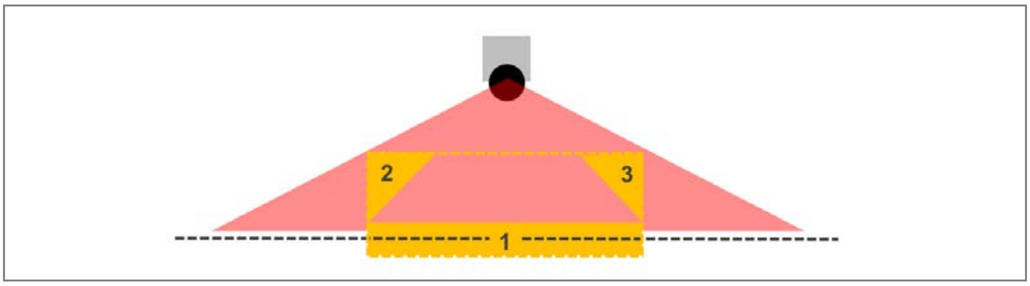


Fig. 40: Analysis strategy using fields

The approach used in the **contour as reference** analysis strategy is the opposite. The field is positioned so that the contour of an object (the ground in this case) is constantly located in the detection zone. The scanned contour of the ground is used as a reference by the monitoring system. It must remain in the detection zone at all times, otherwise an alarm will be triggered.

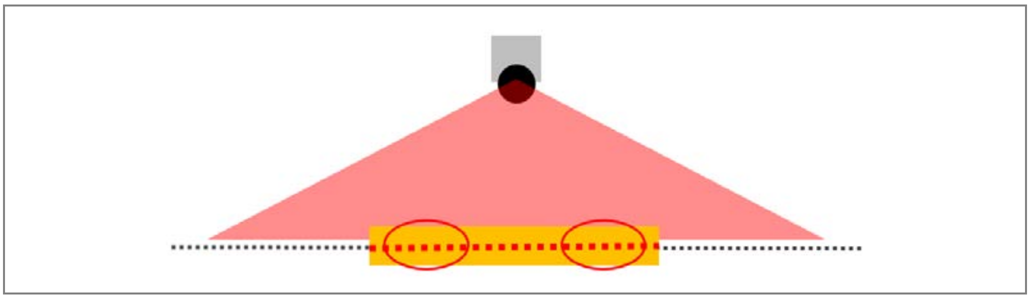


Fig. 41: Contour as reference analysis strategy

The analysis case linked to the field is created so that an alarm is only triggered when the reference contour is no longer fully detected.

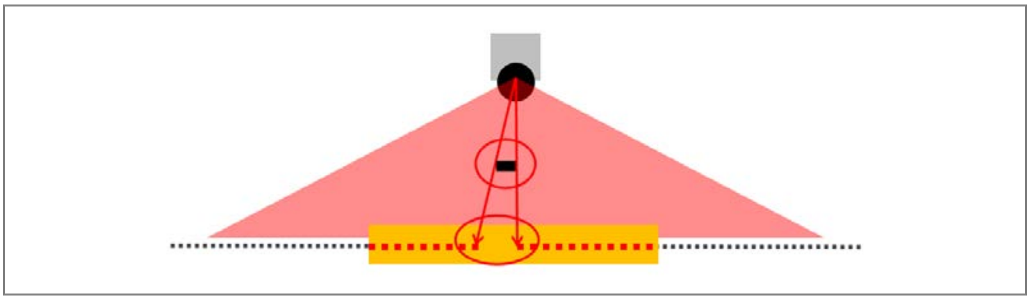


Fig. 42: Contour as reference principle of operation

Fields which analyze the reference contour are only possible if the **blanking** analysis strategy is also used at the same time. This strategy can be used to set the size of the shadowing.

The **contour as reference** configuration provides good protection against tampering in many ways.

- The **multi-echo analysis** is especially suitable for this purpose. Because the system knows which measurement points need to be seen, the measurement points generated by snow or rain can be blanked in a targeted way.
- The **remission** of these points is insignificant for detection, because only the shadowing from the known measurement points is counted.
- Finally, the contour as reference strategy provides effective **protection against tampering**, such as repositioning the laser scanner. Because the provided measurement points deviate from the taught-in measurement points of the reference contour, an alarm is triggered.

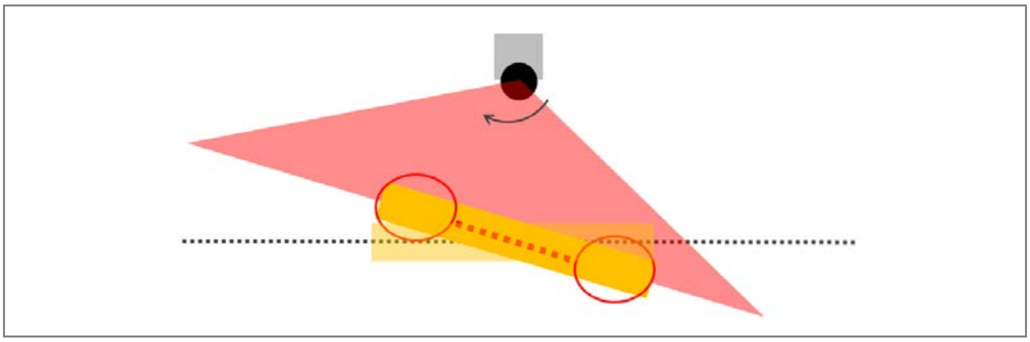


Fig. 43: Protection against tampering thanks to contour as reference

The **contour as reference** monitoring scenario can be supplemented by analysis fields. In the following example, scanned analysis fields 2 and 3 prevent someone or something from jumping over the reference contour from the side undetected. The monitored area takes on the shape of a rectangle again.

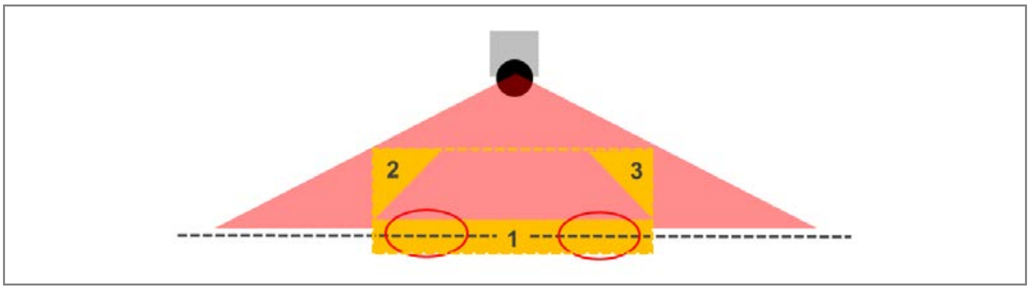


Fig. 44: Combination of analysis strategies: fields and contour as reference

6.5.6 Tamper-proofing against shadowing and dazzle

Shadowing (1) and dazzle (2) can lead to parts of the analysis field being “invisible” to the laser scanner and thus no longer monitored (3).

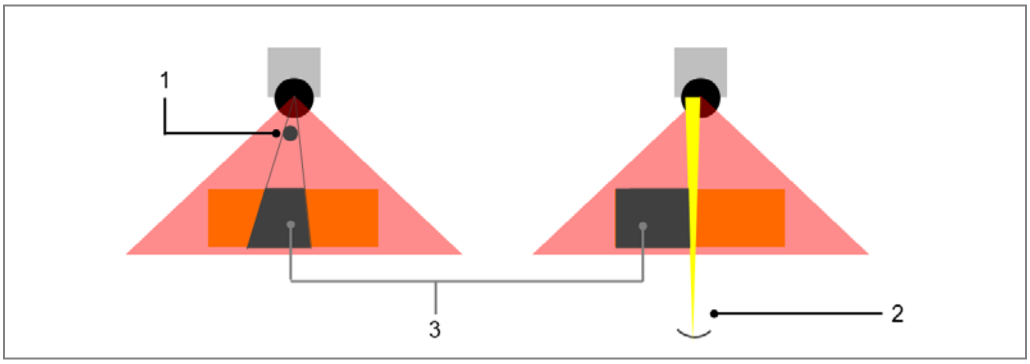


Fig. 45: Tamper-proofing against shadowing and dazzle

Because the laser scanner identifies which area of the field it cannot see in which time, the risk posed by shadowing and dazzle can be eliminated by the software. It can prevent shadowing of a field from going unnoticed.

In this case an **advanced response time** is defined in addition to the response time of the analysis case. This advanced response time defines how long an area of the analysis field can be "invisible" to the laser scanner.

If the advanced response time is exceeded, an alarm is triggered similarly to a "normal" field breach.

Usually the advanced response time should be set to be the same as the "normal" response time.

Note The advanced response time is not available for the contour as reference strategy.

6.5.7 Automatic field adjustment

When open spaces or fences are protected, there is a risk that changing ambient conditions will trigger an alarm in the monitoring fields. Tall grass in the summer or snowdrifts or piles of leaves in the winter are some examples of how monitoring fields which have been configured for a specific environmental situation can quickly trigger false alarms when conditions change and no longer suit the configuration.

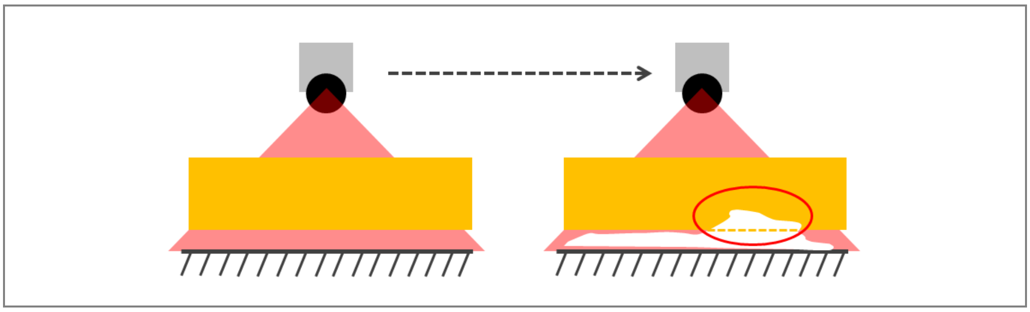


Fig. 46: Field breaches caused by changing ambient conditions

Automatic field adjustment can be used to adapt the monitoring fields dynamically to suit changing conditions. In the example of falling snow, then, the field slowly adapts to the accumulating snow. It moves slowly up as the snow levels increase.

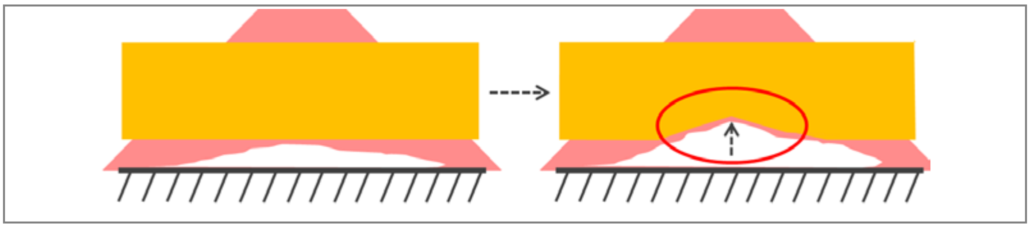


Fig. 47: Automatic field adjustment principle of operation

Because the automatic field adjustment should only react to environmental changes slowly, the speed of the change is specified in cm per minute when the analysis field is configured. If the change occurs more quickly, the field will not adapt quickly enough and an alarm will be triggered.

This prevents the analysis field from being manipulated or tampered with, for example by raising a board in order to trick the field into adjusting by moving up. Crawling through the monitored area is ruled out.

The automatic field adjustment can be assigned to a digital switching output (e.g., Error 1) and reported to the monitoring system. If reported, a camera is switched on and directed at the place where the event is occurring.

Note Automatic field adjustment is only available for LMS13x, LMS14x, and LMS531 PRO laser scanners.

6.5.8 Teaching in/updating fields automatically (Easy Teach)

The **Teach** digital input can be used to activate the Easy Teach function. This function allows information to be taught-in to the laser scanner without a PC. The monitoring field is automatically generated during the teach-in process. Already existing monitoring fields can be quickly adapted to new locations.

The monitoring system is notified via error output **Error 1** that the laser scanner is not switched to sharp resolution during the teach-in process. The display is activated, and the 7-segment display can be viewed.

The teach-in process ends when the digital switching input **Teach** is switched back to inactive.

Lite and PRO variants

The Easy Teach function is available as a Lite and PRO version. Easy Teach Lite can only be used to automatically teach-in **one monitored area**. Easy Teach PRO can be used to adapt up to five **already existing monitored areas** by initiating a new scan process in the current environmental situation.

Easy Teach is available in the device variants as follows:

Device	Easy Teach Lite	Easy Teach PRO
LMS12x	X	X
LMS13x	X	X
LMS141 core	X	
LMS14x prime	X	X
LMS531 Lite	X	
LMS531 PRO	X	X

Tab. 15: Variants for switching input Teach In

Easy Teach cannot be used with VdS-compliant LMC12x and LMC13x devices and TiM3xx laser scanners.

Setting up a field for permanent monitoring (Easy Teach Lite)

The **Easy Teach Lite** variant can be used to teach-in the maximum scanning range of the laser scanner via digital switching input **Teach**. Just put the laser into operation and switch on the input signal. Working with the SOPAS configuration software is not necessary.

In the standard configuration, the laser scanner moves from its start and stop angles (from –5° to 185° or from –5° to 270°, depending on the device type). The field is taken at a distance of 250 mm to the recognized contour. The scanning range (1) and monitoring field (2) are congruent.

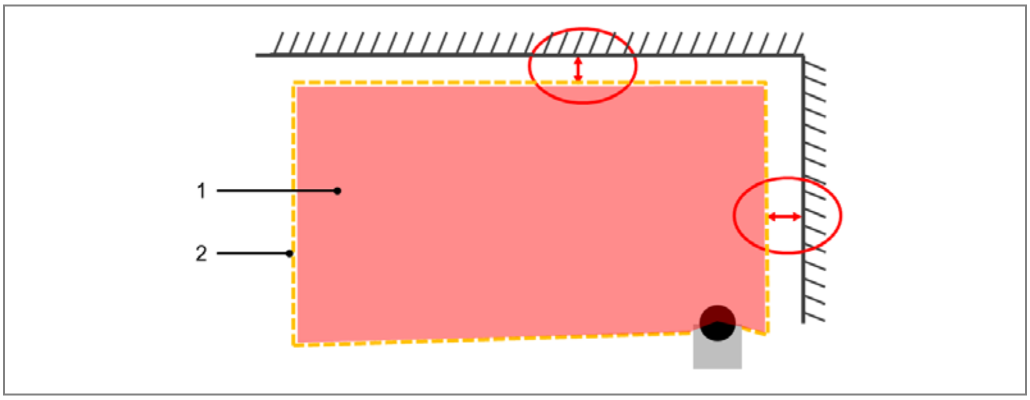


Fig. 48: Easy Teach Lite principle of operation

The monitoring field is scanned, taking into account the objects found in the scanning range. All objects found in the scanning range are blanked from the field.

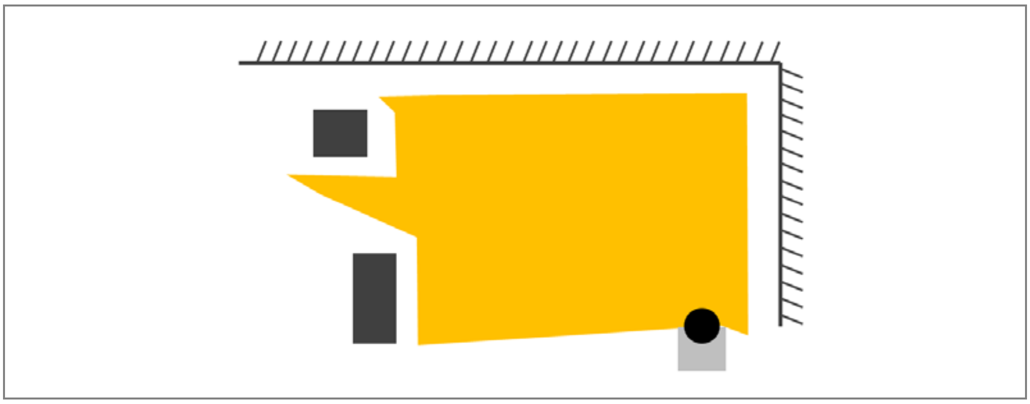


Fig. 49: Easy Teach: blanking objects from the field

Persons may also enter the desired monitoring field can also be entered by during the teach-in process.

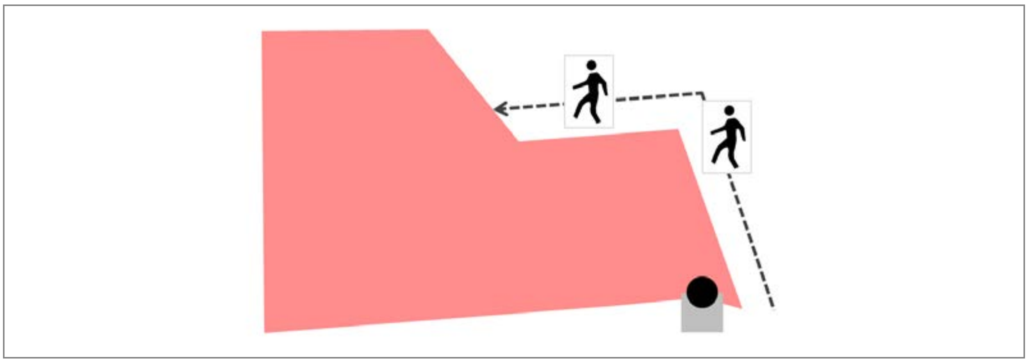


Fig. 50: Easy Teach: entering the monitoring field

Note Since the laser scanner always measures the shortest distance during the teach-in phase, it must be ensured that no one inadvertently enters the intended detection zone.

Further optimizing a field (Easy Teach Lite)

The SOPAS configuration software can be used to make further adjustments to automatically generated reading fields so that they are tailored to individual requirements. The start and stop angle or the minimum distance to the recognized contour can be changed.

Easy Teach can also be converted into **contour as reference**. In this case the field is set up so that the scanned contour(s) is/are located inside it.

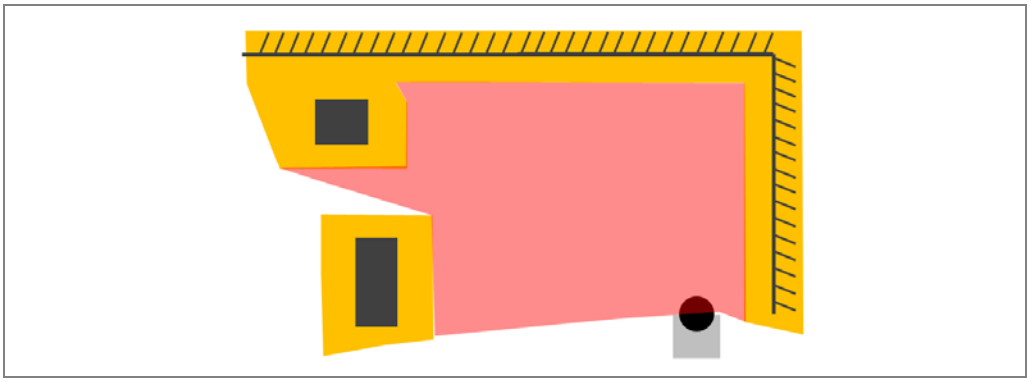


Fig. 51: Easy Teach Lite: further optimizing a field

Updating existing monitoring fields (Easy Teach PRO)

Easy Teach PRO can be used to update fields that have already been set up in SOPAS, using digital switching input **Teach**.

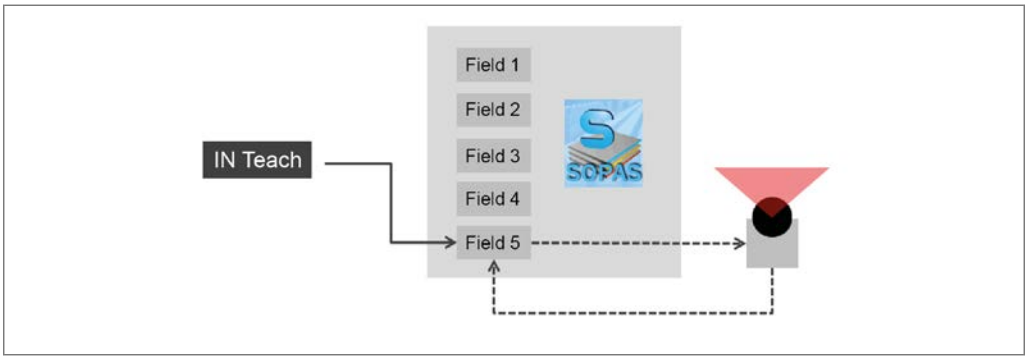


Fig. 52: Easy Teach PRO principle of operation

The figure below shows two analysis fields defined in SOPAS.

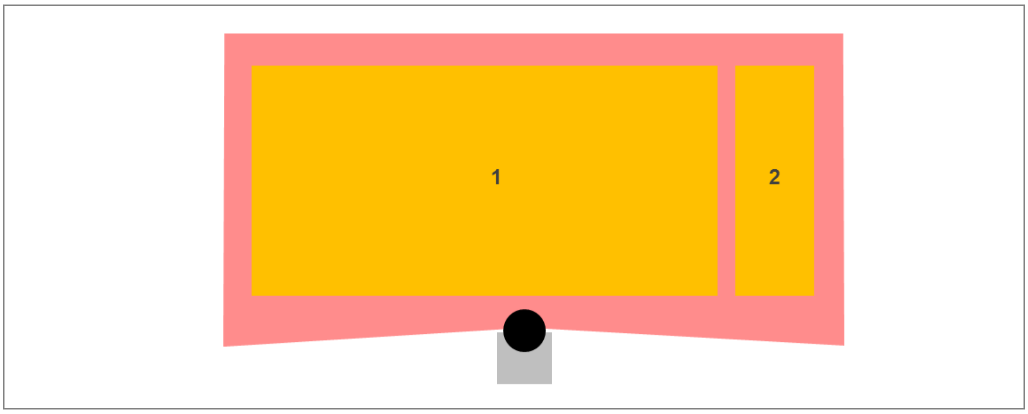


Fig. 53: Easy Teach PRO: monitoring fields before teach-in process

Analysis field 1 is updated via input **Teach**. This means that **field 1** defined in its limits is **taught-in again**, where all objects located in the scanning range are blanked from the field.

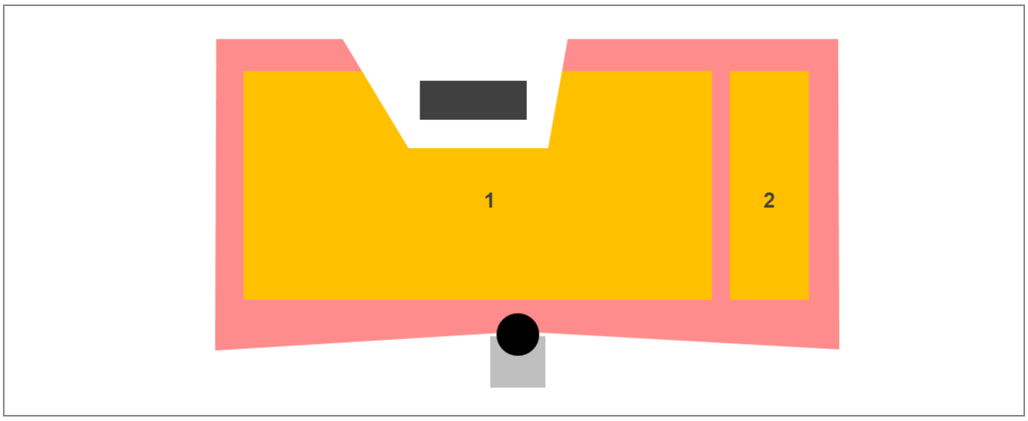


Fig. 54: Easy Teach PRO: monitoring fields after teach-in process

The main benefit of this method is that less configuration of the laser scanner is required for permanent monitoring; instead the individual response to specific environmental situations is emphasized before the monitoring resolution is set.

Example A parking lot is monitored during the night. Since the spaces are never always empty or always occupied, the cars currently parked in the lot are scanned and then blanked from the field before the monitoring resolution is set.

The objects in the analysis field therefore do not constitute a breach and will not trigger an alarm.

Teaching in existing fields with contour as reference (Easy Teach PRO)

The Easy Teach function can also be used to teach-in fields that have already been defined in SOPAS regardless of the specific monitoring situation as fields with tamper-proofing. These fields are taught-in as **contour as reference fields**. This means that the contours of all objects in the monitoring field at the time of the teach-in process are included in the scan.

The figure below shows a field defined in SOPAS for facade protection. The field was created using the **Teach-in tamper-proofing** function. A radial, triangular field emitting from the sensor is automatically generated, which extends into the current contour (in this case the contour of the ground).

Background: Because all fields taught-in via the Easy Teach function must be located within the existing master field, the master field must be larger or equal to the contour as reference field being taught-in. In the **Teach-in tamper-proofing** function, the extent to which the master field extends into the contour can be specified via **Distance to contour**.

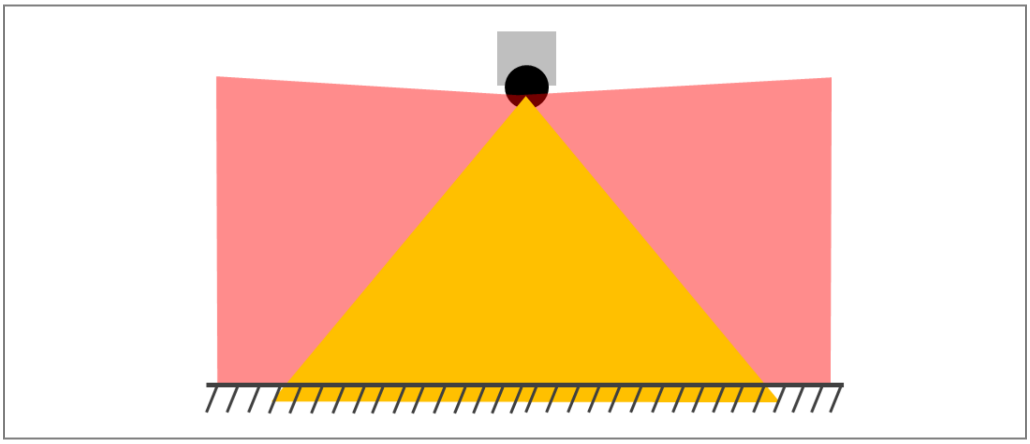


Fig. 55: Easy Teach PRO: master field for contour as reference field

Note When the master field is defined, there should be no objects in the scanning range of the laser scanner.

The master field is taught-in via the Easy Teach function using the **Contour as reference** option before the system resolution is set. The contours scanned here (ground and contour of the object) are used later as a reference for monitoring. The scanned contours must remain in the detection zone at all times, otherwise an alarm will be triggered.

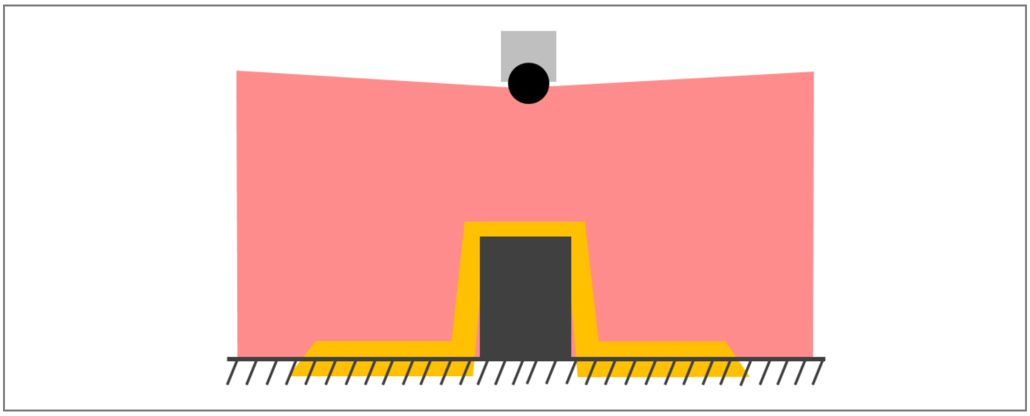


Fig. 56: Easy Teach PRO: contour as reference field after being taught-in with Easy Teach

Example The monitoring situation on a truck loading bridge is adapted via the **Teach** switching input to the current loading situation before the system resolution is set. The teach-in function for the monitoring field as contour as reference is used to ensure that an alarm is triggered is the truck drives forward.

If the situation had been adapted using **facade monitoring without contour as reference**, the Easy Teach function would have blanked the area with the object from the analysis field. Should the object have moved forward, the missing contour would not have triggered an alarm, because the area would have been blanked from monitoring.

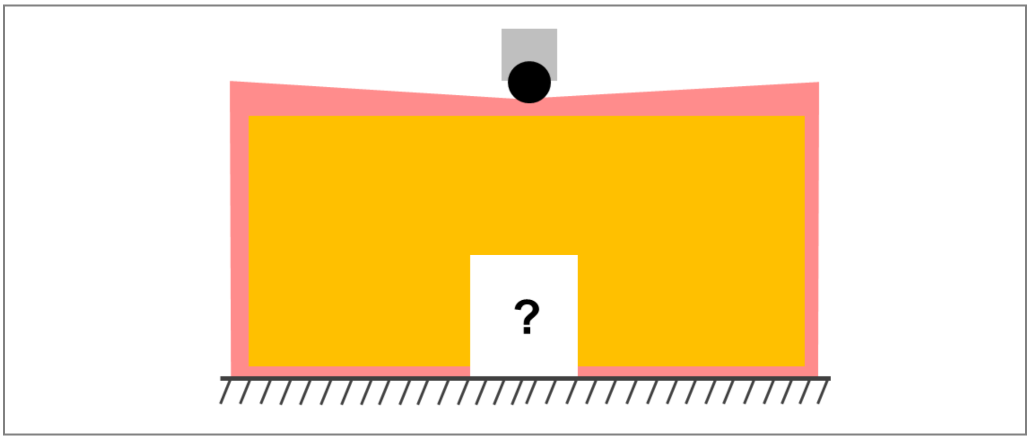


Fig. 57: Easy Teach PRO: problem of using facade monitoring without contour as reference field

6.5.9 Activating/deactivating analysis cases (day and night mode)

The **Day/Night** digital switching input can be used to set one or more analysis cases to active or inactive. Switching the analysis cases causes the linked monitoring fields to be analyzed or not analyzed, respectively.

There are two possible configurations for a monitoring field using the input. Day and night are just the names of the input modes. The monitoring field can be considered by the analysis case during the "Day" only, during the "Night" only, or in both cases (i.e., "always").

In the example, the two analysis cases, **Window** and **Facade**, are switched as follows:

- During the day, the **Window analysis case** is set to **LOW**, and the **Facade analysis case** to **HIGH**: Only the **Window field** is monitored. A breach of the **Facade field** is ignored by the **Facade analysis case**.
- At night the **Window analysis case** is set to **HIGH** and the **Facade analysis case** to **LOW**. The facade is monitored as a result. A breach of the **Window field** is now ignored by the **Window analysis case**.

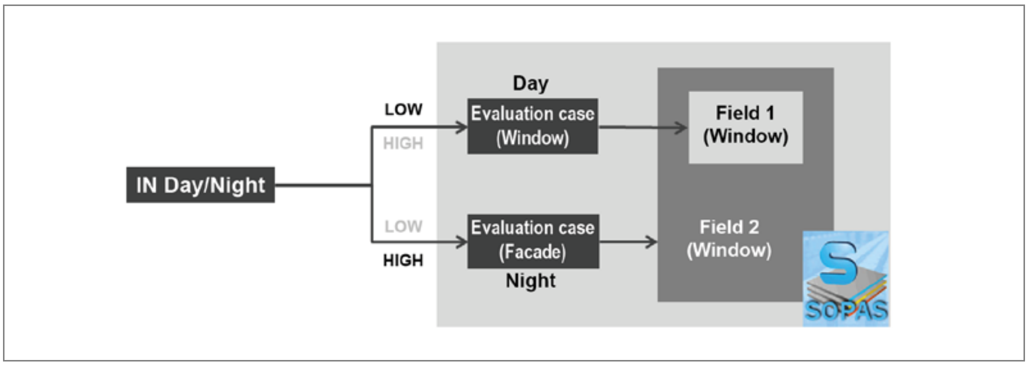


Fig. 58: Activating analysis cases (switching input Day/Night)

Note Day/Night mode is **not** available for TiM3xx, LMS141 core, and LMS531 Lite laser scanners.

6.6 Configuration of the signaling method

6.6.1 Overview of digital inputs

The laser scanner has up to four digital switching inputs, depending on the device. These inputs affect analysis cases (see Chapters **6.5.8 Teaching in/updating fields automatically (Easy Teach)** and **6.5.9 Activating/deactivating analysis cases (day and night mode)**) or the operating status of the laser scanner directly.

In the standard configuration, input assignments are preset for the cases: **Armed/Disarmed** (sharp/not sharp), **Functional test** (walk-through test), **Day/Night** (day/night mode), and **Teach-In** (Easy Teach function).

Note This pre-assignment can be adjusted in expert mode in the SOPAS configuration software (see Chapter **6.6.8 Working in expert mode**).

6.6.2 Switching laser scanners to sharp/not sharp

The **Armed/Disarmed** input can be used to switch the laser scanner to active for alarm management (does not apply to TiM3xx).

- The laser scanner is **switched to sharp** when there is **no current** present on the input. In this state, field breaches are registered as alarms via the switching output. The laser scanner display cannot be seen. The RS232 interface is permanently switched off.
- If the **input is switched**, the display can be seen. In this status, contamination messages can be viewed, for example. A field breach is not displayed. The corresponding LED does not illuminate.
- **Alarm memory**: If when the detector is set to “sharp” a monitored area has been breached, this is indicated by LED **Q2** flashing when the detector is switched to “not sharp”. The memory is wiped when the detector is switched back to “sharp”.

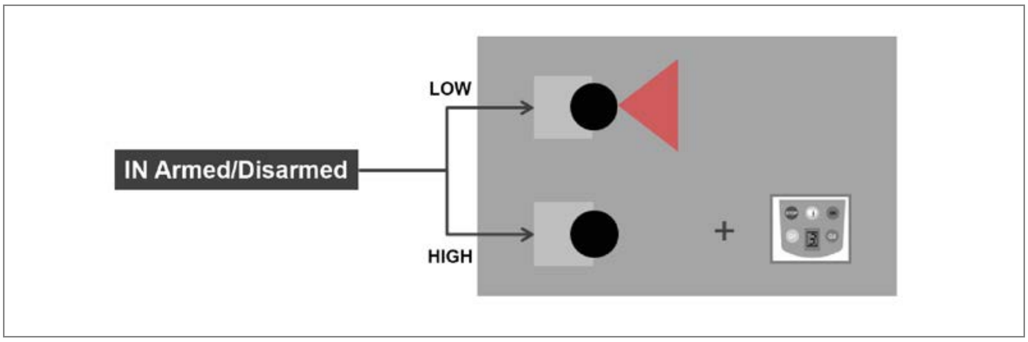


Fig. 59 Switching the laser scanner to sharp/not sharp (switching input Armed/Disarmed)

Note This ensures that even when set to “not sharp” no field breaches are detected and thus no conclusions about the monitored area are possible.

6.6.3 Switching the laser scanner to walk-through test mode

The **Functional test** input is used to switch the laser scanner to walk-through test mode. In this mode, the monitoring functions of the laser scanner are checked, by walking through the scanned reading field (does not apply to TiM3xx).

- Walk-through test mode is **switched off** when there is no current present on the input. In this state, field breaches are registered as alarms via the switching output. The laser scanner display cannot be seen. The RSE232 interface is permanently switched off.
- If the **input is switched**, the laser scanner goes into walk-through test mode. The display can be seen. Field breaches are indicated by the yellow LED but do not trigger an alarm on the monitoring system. This allows the correct switching behavior of the laser scanner to be checked by walking through the reading field.

Faulty switching due to dirty optics covers or tampering with the laser scanner by turning it is quickly detected.

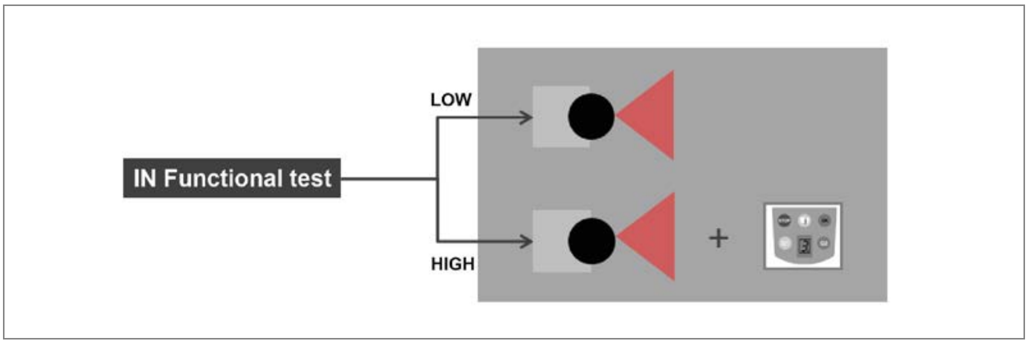


Fig. 60 Walk-through test mode (functional test switching input)

Note Note that in walk-through test mode field breaches are detected and indicated, and thus conclusions about the monitored area are possible.

6.6.4 Dry contact solid state outputs in relay function (overview)

The dry contact solid state outputs in the laser detector's relay function are configured as an alarm output and fault output. The analysis cases are all linked to the alarm output.

The outputs can be used as potential-free relay contacts **(Alarm 1, Alarm 2)** or as resistance-monitored outputs **(Alarm R)**.

One advantage of dry contact solid state contacts is that they are independent of the internal power supply. The contacts can be switched without loss because the output voltage can be clearly defined by creating an external voltage. Switching through the applied voltage creates a clearly defined alarm status without internal voltage drops or power loss.

Note the following information about the dry contact solid state outputs in relay function:

LMC12x, LMS12x, LMC13x, LMS13x LMS141 core, LMS14x prime	**Minimum**	**Typical**	**Maximum**
Quantity			2
Switching voltage			40 V DC/AC
Continuous load current (25 °C)			0.5 A
Peak load (25 °C, 100 ms, one time)			3 A
Specific insulation resistance		0.34 Ω	0.7 Ω
Output capacity			220 pF
Dielectric strength of the inputs/outputs			1,500 V AC
Power-up delay		1.3 ms	0.1 ms
Power-down time		0.1 ms	0.5 ms
Switching frequency	5 Hz		
LMS531 Lite/LMS531 PRO			
Number of LMS531 Lite Number of LMS531 PRO			2 4
Switching voltage			28 V AC 40 V DC
Continuous load current (25 °C)			1 A
Peak load (25 °C, 100 ms, one time)			3 A
Specific insulation resistance		0.34 Ω	0.7 Ω
Output capacity		450 pF	
Dielectric strength of the inputs/outputs			60 V
Power-up delay		1.5 ms	5 ms
Power-down time		0.1 ms	0.5 ms
Switching frequency	5 Hz		
Data output via Ethernet (LMS531 Lite)			1 Hz

Note A CAN module can be supplied to add to the digital switching outputs (see Chapter **5.3.7 CAN modules**).

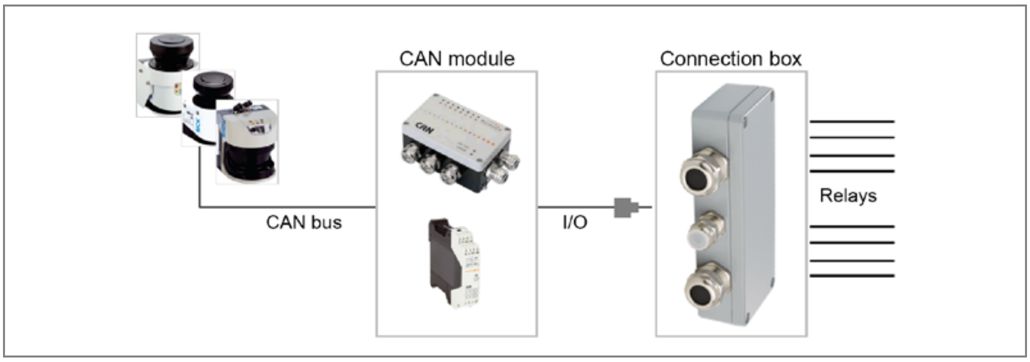
Dry contact relay output in the connection box for TiM3xx

In addition to its connectivity, the connection box with the part number 2082916 also features 4 volt-free semiconductor outputs in relay function. These outputs can be used accordingly by the TiM3xx laser scanners.

Note the following information about the volt-free semiconductor outputs on the connection box:

TiM3xx	Minimum	Typical	Maximum
Number (of semiconductor relays)			4
Cover contact			1
Semiconductor relay switching voltage			20 V AC 30 V DC
Cover contact switching voltage			30 V
Semiconductor relay switching current			0.5 A
Cover contact switching current			0.5 A
Specific insulation resistance		0.34 Ω	0.7 Ω
Output capacity			220 pF
Dielectric strength of the inputs/outputs			1,500 V AC
Power-up delay		1.3 ms	0.1 ms
Power-down time		0.1 ms	0.5 ms
Switching frequency	5 Hz		

Laser scanners which feature dry contact relay outputs can expand the existing relay outputs using the CAN module and the connection box.



Further information on the CAN module can be found in Chapter **5.3.7 CAN** modules. The terminal assignment of the connection box is described in under **Pin assignment** in Chapter **6.7.7 Connection boxes**.

6.6.5 Circuitry without resistance monitoring

The dry contact relay outputs in the laser scanner's relay function are usually closed in normal operating mode. There is constant voltage between the intrusion alarm central controls and the laser scanner. The relay contact opens when an alarm is triggered. An alarm message is issued when the output voltage drops. The described behavior can be customized.

In the following figure, terminals **1** (**Alarm 1**) and **3** (**Alarm 2**) are defined as alarm outputs for the LMS12x/LMC12x laser scanners. The cores of the connecting cable should be placed according to the terminal strip of the laser scanner.

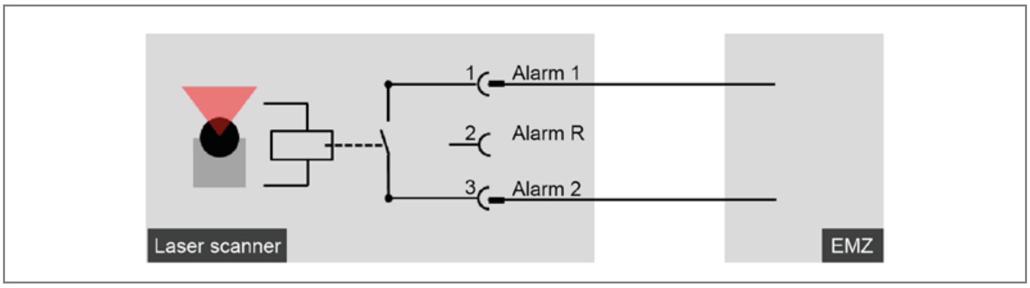


Fig. 61: Circuitry without resistance monitoring (LMC12x/LMS12x)

In semi-outdoor and outdoor devices, the alarm is triggered via the open ends of the white and brown cores of the I/O connecting cable. The open ends of the cable must be placed in the intrusion alarm central controls accordingly.

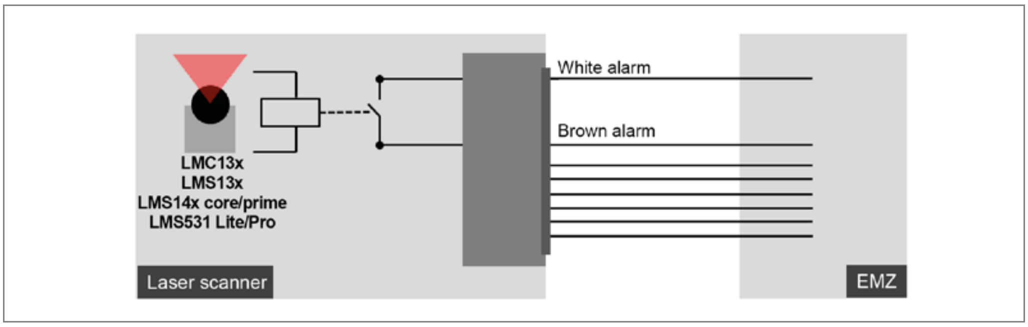


Fig. 62: Circuitry without resistance monitoring (LMC13x/LMS13x/LMS141 core/LMS14x prime/LMS531 Lite/LMS531 PRO)

6.6.6 Circuitry with resistance monitoring

The circuits also function with resistance monitoring for increased protection against tampering with the cable connections (against disconnection or bridging). The resistance is located between the outputs. If bridged, for example by an alarm sensor that had been previously tampered with or using a normal wire, the measured resistance value changes, which is detected by the central controls and identified as a sabotage alarm.

The resistance R must be adapted to the alarm central controls in question and to the number of sensors connected to an input.

The resistor must be directly inserted into the terminal strip on **LMS12x/LMC12x** indoor devices. Outputs **3** (**Alarm 2**) and **2** (**Alarm R**) are bridged by a resistor. The voltage on the resistance-monitored output **2** (**Alarm R**) is regulated at the defined resistance value.

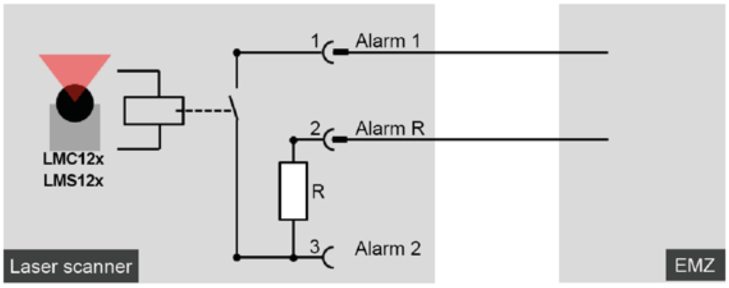


Fig. 63: Circuitry with resistance monitoring (LMC12x/LMS12x)

For the LMC13x, LMS13x, LMS531 Lite, and LMS531 PRO semi-outdoor and outdoor devices, the resistance must be monitored via the open ends of the connecting cable in the intrusion alarm central controls. The voltage on the alarm outputs **1** (**white** core) and **2** (**brown** core) is regulated in the intrusion alarm central controls by a resistor. The resistance-monitored connection layout of the alarm system is implemented using the resistance-monitored output **Alarm R**. The green and yellow cores of the connecting cable are internally linked in the LMS.

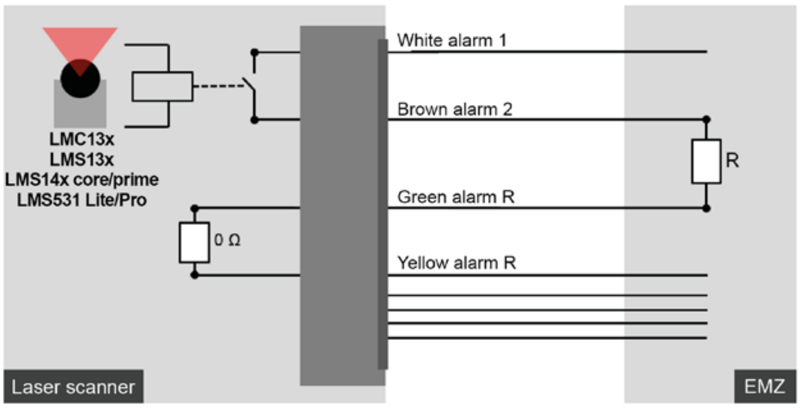


Fig. 64: Circuitry with resistance monitoring (LMC13x/LMS13x/LMS141 core/LMS14x prime/LMS531 Lite/LMS531 PRO)

Note The figures show the resistance monitoring for the alarm output. The other outputs can also be resistance-monitored in the same way.

6.6.7 Tamper-proofing

The LMS12x/LMC12x, LMC13x/LMS13x, LMS141 core, and LMS14x prime laser scanners are fitted with an internal lift contact for the optics cover to prevent tampering. This contact is located between the upper part of the housing and the basic housing and monitors the screw connection.

Fig. 65: LMS12x/LMC12x/LMC13x/LMS13x/LMS141 core/LMS14x prime tamper-proofing

If the screws of the upper part of the housing are loosened and the optics cover is lifted, a sabotage alarm is triggered. The sabotage output is switched without power and an alarm is triggered.

For more information on the sabotage outputs, see Chapter **6.7 Pin assignments**.

The connection boxes for the TiM3xx and LMS531 PRO laser scanners also feature an internal lift contact to prevent tampering. The contact is located between the housing cover and the basic housing for the connection box.

6.6.8 Working in expert mode

The standard switching input assignments given here can be customized in the SOPAS expert mode. In contrast to the standard settings, the following can be configured:

- The input to which the analysis case responds and the switching output affected by the result.
- Whether the input assignment in question is permitted to have status LOW or HIGH or both.
- Whether combinations of input assignments affect an analysis case.

The monitoring scenarios can be adapted in expert mode to be more flexible to the specific threat situation. The conditions under which an analysis case takes effect, and the evaluation strategy used, can be defined by a combination of input assignments, for example.

While during standard operation, an analysis case can only be set to active or inactive, in expert mode an analysis case can be activated in significantly more detail.

Note Expert mode is **not** available for TiM3xx and LMS141 core laser scanners.

Example The following example assumes that the same analysis field has been copied and linked with a different analysis case in each case.

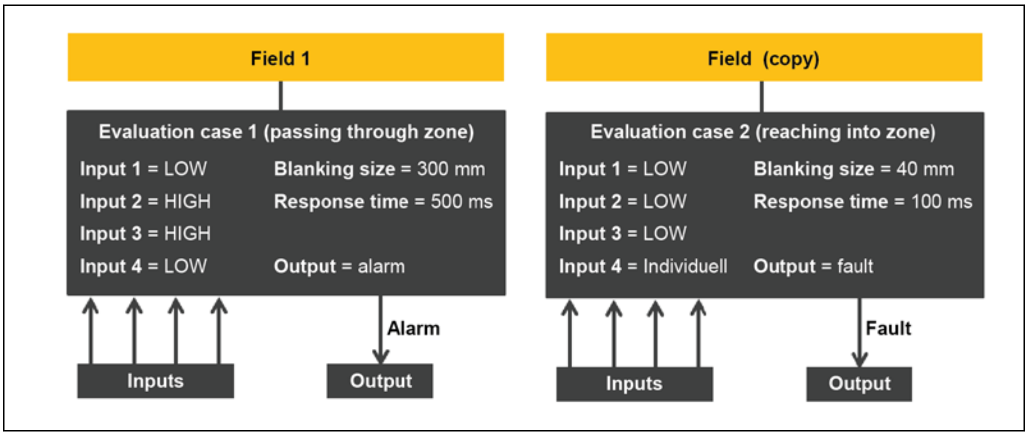


Fig. 66: Analysis cases in expert mode

Analysis case 1 protects the monitored area against **people/objects passing through the detection zone** due to a corresponding input assignment. A response time of 500 ms and a blanking size of 300 mm are defined. The output is connected to the alarm.

Analysis case 2 checks the monitoring scenario for **people reaching into the detection zone**. The response time is set to 100 ms and the blanking size is 40 mm. The output is connected to the fault.

6.6.9 Controlling cameras

CCTV is frequently used as a sensible addition to laser technology in fence, facade, or open space monitoring.

If the field is breached, the analysis case switches the corresponding digital output. The switching signal is used for the camera as the input, to trigger a pre-setting or direct a camera with a tilting/turning mechanism to the place where the event occurred. Up to 10 fields and outputs for camera control can be used depending on the laser scanner used.

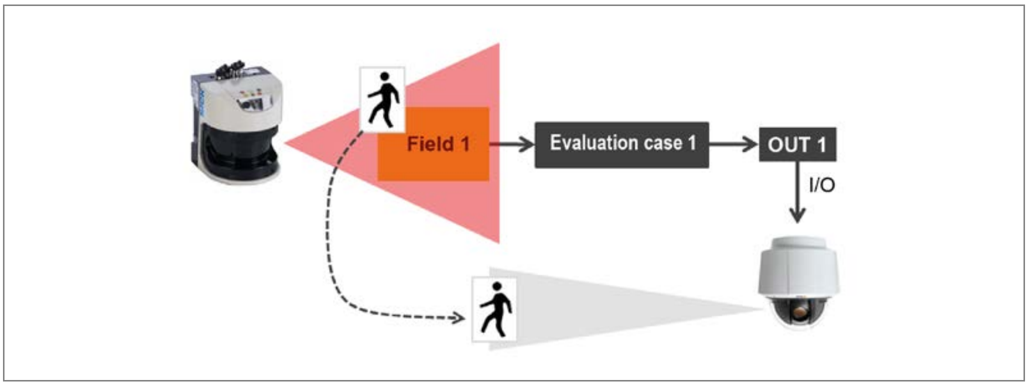


Fig. 67: Field-based switching of cameras (overview)

The cameras can be addressed in three ways:

- Directly via the corresponding I/O switching signal.
- Via a video management system.
- Via the SICK OPC server.

Direct field-based camera control

In the following figure, the digital output signal of the laser scanner directly switches on the camera input.

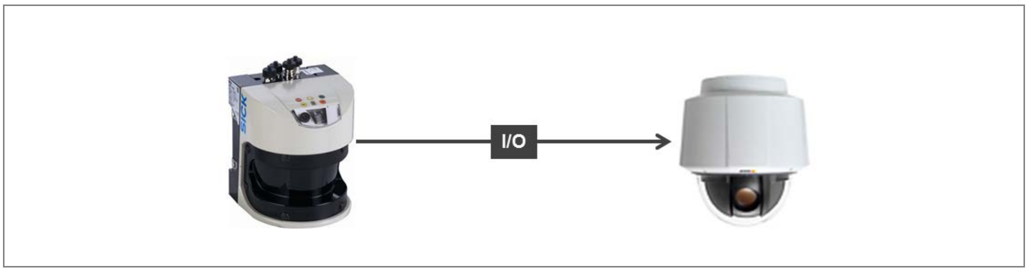


Fig. 68: Field-based camera control (direct)

Field-based camera control via video management system

In the following figure, the digital output signal of the laser scanner is converted to the TCP/IP protocol via an Ethernet I/O module and transmitted via Ethernet to the video management system for camera control.

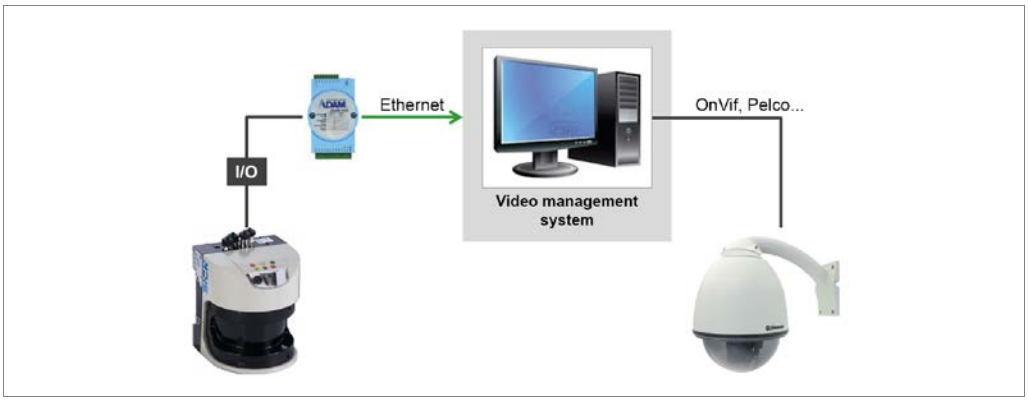


Fig. 69: Field-based camera control (via video management system)

Note I/O to Ethernet transducers are supported by all video management systems currently on the market.

Field-based camera control via OPC

In the following figure, the digital output signals are integrated into an existing OPC solution via the TCP/IP interface of the laser scanner. SICK provides its own OPC server for integration. The video management accesses the OPC objects as the OPC client.

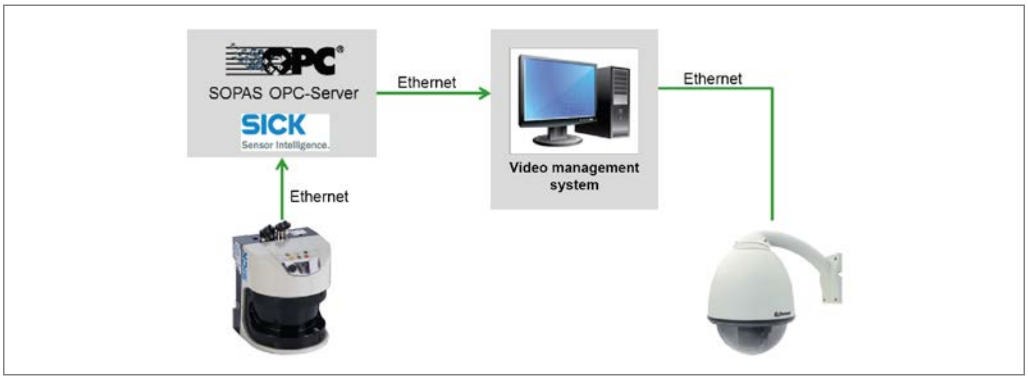


Fig. 70: Field-based camera control (via OPC)

The statuses of the monitoring field can easily be polled and used to program camera control.

For detailed information on OPC technology, see Chapter **7 Scalable solutions with OPC**.

How to integrate a laser scanner into Milestone XProtect

The **LaserGuardian** plug-in makes it possible to integrate laser-based object monitoring directly into the Milestone XProtect video management system.

In this case, objects are tracked on an overview of the facility and the PTZ cameras are guided to follow the objects on the on the basis of measuring data which has been supplied by the laser scanners.

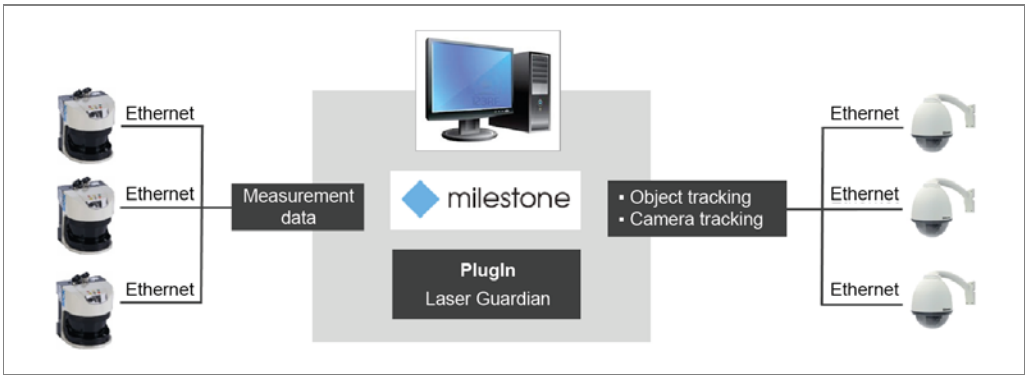


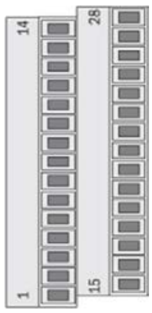
Fig. 71: How to integrate a laser scanner into Milestone XProtect

6.7 Pin assignments

6.7.1 LMC12x/LMC12x

The LMC12x/LMS12x laser scanners are fitted with a removable system plug, which has a cable entry on the back. The connections are located on the screw terminal in the system plug.

These variants also have an M12 round connector to connect to the Ethernet. The cable entry and the round connector can be remounted from the back to the bottom of the system plug.



Terminal	Signal	Function
1	Alarm 1	Relay contact 1 of alarm output
2	Alarm R	Resistance monitor for relay contact of alarm output
3	Alarm 2	Relay contact 2 of alarm output
4	Sabotage 2	Digital sabotage output 2
5	Sabotage 1	Digital sabotage output 1
6	IN1 (S/U)	Digital input 1 sharp/not sharp
7	IN1 GND (S/U GND)	Ground for digital input 1 sharp/not sharp
8	IN2 (GT)	Digital input 2 walk-through test
9	IN2 GND (S/U GND)	Ground for digital input 2 walk-through test
10	IN4 Teach	Digital input 4 teach-in
11	IN3 (T/N)	Digital input 3 Day/ Night mode
12	IN3/IN4 GND (Teach T/N GND)	Ground for digital inputs 3 and 4
13	Error R	Resistance monitor for relay contact 1 of fault output
14	Error 2	Relay contact 2 of the fault output
15	GND	Ground LMS/LMC
16	V_S	Supply voltage LMS/LMC
17	No function	Do not use
18	Sabotage R	Resistance monitor for digital sabotage output
19	GND CAN	Ground CAN-BUS
20	CAN_H	CAN-BUS High
21	CAN_L	CAN-BUS Low
22	CAN V_S 24 V	Supply voltage CAN
23	GND CAN	Ground CAN-BUS
24	CAN_H	CAN-BUS High
25	CAN_L	CAN-BUS Low
26	CAN V_S 24 V	Supply voltage CAN
27	Error 1	Relay contact 1 of the fault output
28	Case	Housing

Tab. 16: LMC12x/LMS12x pin assignment

6.7.2 TiM320

The TiM320 laser scanner has a 0.9 m long cable harness with 15-pin D-Sub-HD male connector. A 2 m long adapter cable with a 15-pin D-Sub-HD female connector and open end can be ordered as an accessory for an extension cable.

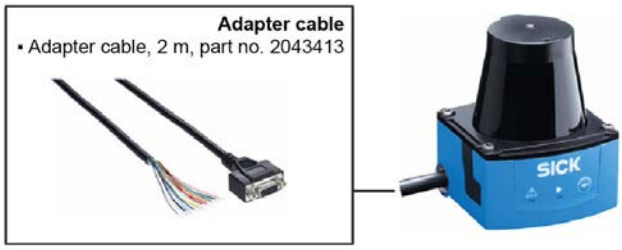
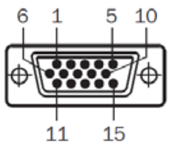


Fig. 72: TiM320 adapter cable (with part number)

Pin assignment for 15-pin D-Sub-HD male cable connector

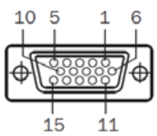


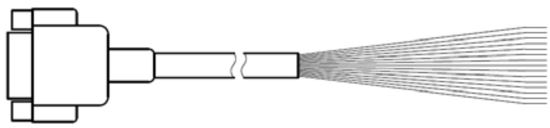
Pin	Wire color	Description
1	Red	Supply voltage
2	Violet	-
3	Yellow	-
4	Red + black	Switching output 4 (index/error)
5	Black	Ground
6	Light blue	-
7	Dark blue	-
8	Turquoise or light gray	Switching input 1 (field set selection)
9	Green	Switching input 2 (field set selection)
10	Gray	Switching input 3 (field set selection)
11	Pink	Switching input 4 (field set selection)
12	Brown	Switching output 1 (field breach)
13	Orange	Switching output 2 (field breach)
14	White	Switching output 3 (field breach)
15	White + black	Common ground for all inputs

Tab. 17: TiM320 pin assignment

The core colors of the 2 m long adapter cable are identical to the core colors of the cable harness.

Adapter cable (part number: 2043413)





Tab. 18: TiM320 adapter cable pin assignment

6.7.3 TiM351/TiM361

The TiM351 and TiM361 laser scanners have two multi-pin M12 round connectors. Pre-assembled cables can be ordered as accessories for connection to the M12 round connectors. The voltage supply cable consists of the round connector and a 5, 10, or 20 m long cable with an open end. The Ethernet cable has an RJ45 male connector on the other end.

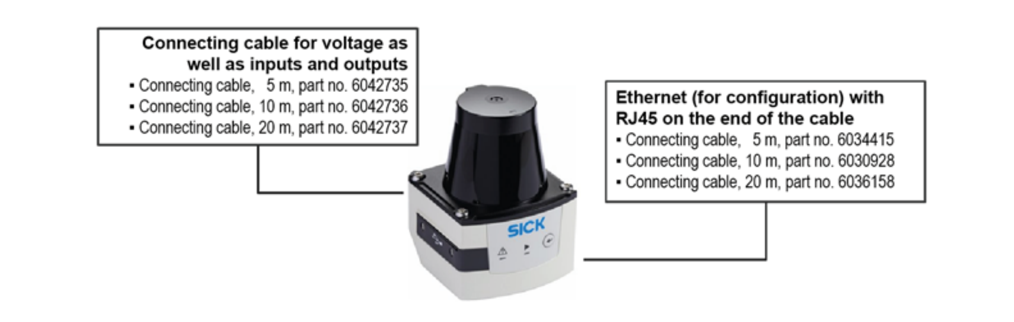
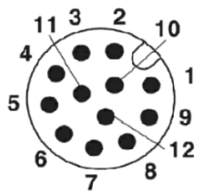


Fig. 73: TiM351/TiM361 connecting cables (with part number)

Connecting cable for voltage, inputs, and outputs (part number: 6042735, 6042736, 6042737)



Pin	Wire color	Description
1	Brown	System ground
2	Blue	Supply voltage (10 ... 28 V DC)
3	White	Switching input 1 (field set selection)
4	Green	Switching input 2 (field set selection)
5	Pink	Switching output 1 (field breach)
6	Yellow	Switching output 2 (field breach)
7	Black	Switching output 3 (field breach)
8	Gray	Switching output 4 (field breach)
9	Red	Common ground for inputs
10	Pink	Switching input 3 (field set selection)
11	Gray/pink	Switching input 4 (field set selection)
12	Red/blue	-

Tab. 19: TiM351/TiM361 pin assignment (voltage supply/inputs and outputs)

6.7.4 LMC13x/LMS13x, LMS141 core/LMS14x prime

The LMC13x/LMS13x/LMS141 core, and LMS14x prime laser scanners have four multi-pin M12 round connectors. The connections are located on the corresponding male or female connectors. Pre-assembled cables can be ordered as accessories for connection to the M12 round connectors. These cables consist of the round connector and a 5, 10, or 20 m long cable with an open end. The Ethernet cable has an RJ45 male connector on the other end.

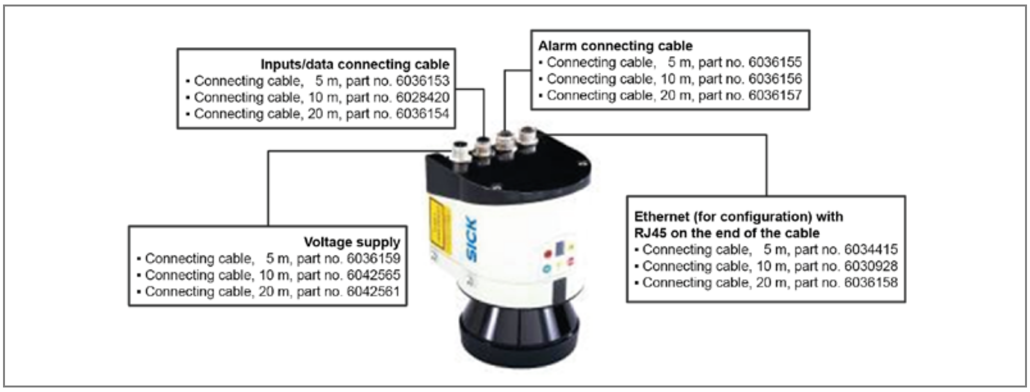
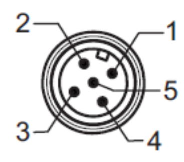


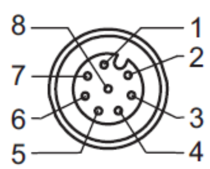
Fig. 74: LMC13x/LMS13x/LMS141 core/LMS14x prime connecting cables (with part number)

Voltage supply (part number: 6036159, 6036160, 6042561)

	Pin	Wire color	Description
	1	Brown	24 V system
	2	White	24 V heating
	3	Blue	System ground
	4	-	Not assigned
	5	Black	Ground for heating

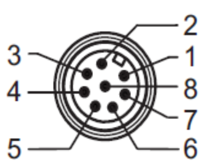
Tab. 20: LMC13x/LMS13x/LMS141 core/LMS14x prime pin assignment (voltage supply)

Alarm connecting cable (part number: 6036155, 6036156, 6036157)

	Pin	Wire color	Description
	1	White	Volt-free contact **Alarm**
	2	Brown	
	3	Green	Internal bridge (0 ohm) for setting up the resistance-monitored output
	4	Yellow	
	5	Gray	Volt-free output **Fault**
	6	Pink	
	7	Blue	Cover switch for monitoring the optics cover for removal
	8	Red	

Tab. 21: LMC13x/LMS13x/LMS141 core/LMS14x prime pin assignment (alarm)

Input connecting cable (part number: 6036153, 6028420, 6036154)

	Pin	Wire color	Description
	1	White	Sharp (0 V)/not sharp (+24 V)
	2	Brown	Operation (0 V)/walk-through test (+24 V)
	3	Green	CAN-BUS High
	4	Yellow	CAN-BUS Low
	5	Gray	CAN-BUS GND
	6	Pink	Day (0 V)/Night (24 V) LMC13x/LMS13x/LMS14x prime only
	7	Blue	Operation (0 V)/Easy Teach (+24 V)
	8	Red	Ground for all inputs

Tab. 22: LMC13x/LMS13x/LMS141 core/LMS14x prime pin assignment (inputs)

6.7.5 LMS531 Lite

The LMS531 Lite laser scanner has four multi-pin M12 round connectors. The connections are located on the corresponding male or female connectors. Pre-assembled cables can be ordered as accessories for connection to the M12 round connectors. These cables consist of the round connector and a 5, 10, or 20 m long cable with an open end. The Ethernet cable has an RJ45 male connector on the other end.

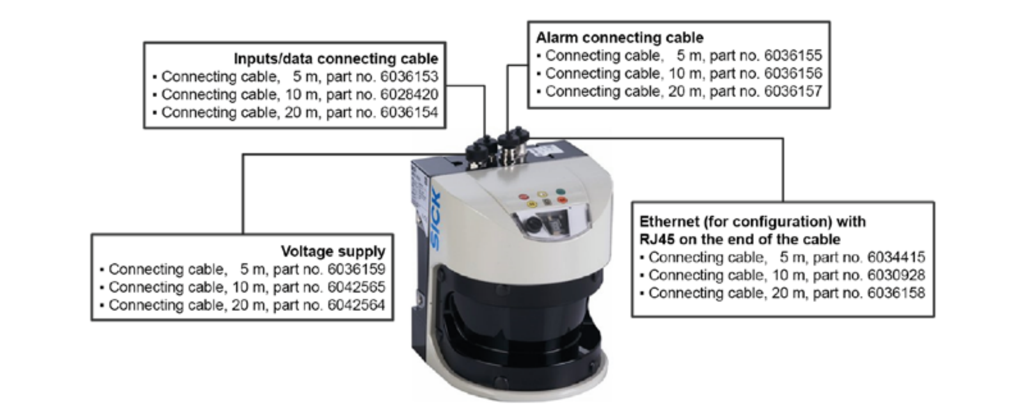
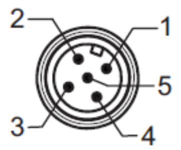


Fig. 75: LMS531 Lite connecting cables (with part number)

Voltage supply (part number: 6036159, 6036160, 6042564)



Pin	Wire color	Description
1	Brown	24 V system
2	White	24 V heating
3	Blue	System ground
4	-	Not assigned
5	Black	Ground for heating

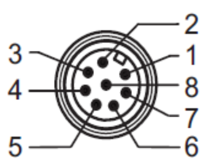
Tab. 23: LMS531 Lite pin assignment (voltage supply)

Alarm connecting cable (part number: 6036155, 6036156, 6036157)

Pin	Wire color	Description
1	White	Volt-free contact **Alarm**
2	Brown	
3	Green	Internal bridge (0 ohm) for setting up the resistance-monitored output
4	Yellow	
5	Gray	Volt-free output **Fault**
6	Pink	
7	Blue	Volt-free output **Sabotage** (24 V)
8	Red	Volt-free output **Sabotage** (GND)

Tab. 24: LMS531 Lite pin assignment (alarm)

Input connecting cable (part number: 6036153, 6028420, 6036154)



Pin	Wire color	Description
1	White	Sharp (0 V)/not sharp (+24 V)
2	Brown	Operation (0 V)/walk-through test (+24 V)
3	Green	Not assigned
4	Yellow	Not assigned
5	Gray	Not assigned
6	Pink	Not assigned
7	Blue	Operation (0 V)/Easy Teach (+24 V)
8	Red	Ground for all inputs

Tab. 25: LMS531 Lite pin assignment (inputs)

6.7.6 LMS531 PRO

The LMS531 PRO laser scanner has four multi-pin M12 round connectors. The connections are located on the corresponding male or female connectors. Pre-assembled cables can be ordered as accessories for connection to the M12 round connectors. These cables consist of the round connector and a 5, 10, or 20 m long cable with an open end. The Ethernet cable has an RJ45 male connector on the other end.

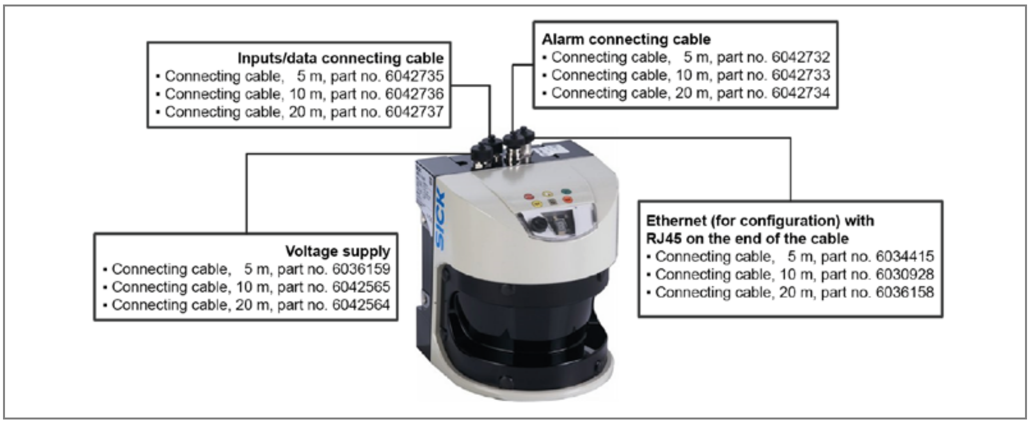
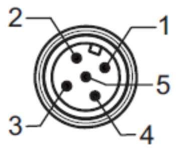


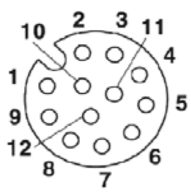
Fig. 76: LMS531 PRO connecting cables (with part number)

Voltage supply (part number: 6036159, 6036160, 6042564)

	Pin	Wire color	Description
	1	Brown	24 V system
	2	White	24 V heating
	3	Blue	System ground
	4	-	Not assigned
	5	Black	Ground for heating

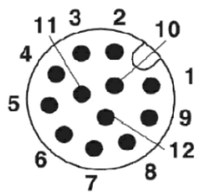
Tab. 26: LMS531 PRO pin assignment (voltage supply)

Alarm connecting cable (part number: 6042732, 6042733, 6042734)

	Pin	Wire color	Description
	1	Brown	Out1_a - volt-free contact **Alarm**
	2	Blue	Out4_a - volt-free contact **Sabotage**
	3	White	Out1_b - volt-free contact **Alarm**
	4	Green	Out1R_a - volt-free contact for setting up a **resistance-monitored** alarm
	5	Pink	Out2_a - volt-free contact **Fault**
	6	Yellow	Out1R_b - volt-free contact for setting up a **resistance-monitored** alarm
	7	Black	Out3_a - volt-free contact **Disqualification**
	8	Gray	Out2_b - volt-free contact **Fault**
	9	Red	Out4_b - volt-free contact **Sabotage**
	10	Violet	Out3_b - volt-free contact **Disqualification**
	11	Gray/pink	Out4R_a/Out4R_b - internal bridge (0 ohm) for setting up the **resistance-monitored** output **Sabotage**
	12	Red/blue	

Tab. 27: LMS531 PRO pin assignment (alarm)

Connecting cable for inputs/data (part number: 6042735, 6042736, 6042737)



Pin	Wire color	Description
1	Brown	IN1 - sharp (0 V)/not sharp (+24 V)
2	Blue	RD-/RxD
3	White	Ground for all inputs
4	Green	Ground RS
5	Pink	IN3 - Day (0 V)/Night (+24 V)
6	Yellow	IN2 - operation (0 V)/walk-through test (+24 V)
7	Black	TD-/TxD
8	Gray	Operation (0 V)/Easy Teach (+24 V)
9	Red	RD+
10	Violet	TD+
11	Gray/pink	CAN_L
12	Red/blue	CAN_H

Tab. 28: LMS531 PRO pin assignment (inputs/data)

6.7.7 Connection boxes

The connection box for controlling the monitoring system is wired via corresponding terminals inside the housing. The terminal assignments are indicated on the pinout included with the box.

The connections for the voltage supply, the digital inputs and outputs and for the data/input cable are assigned using the enclosed pinout.

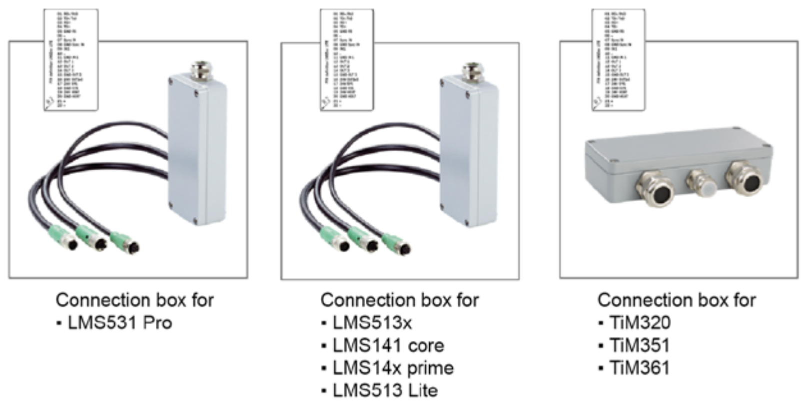


Fig. 77: Connection box terminal assignment

Note

The terminal assignment should not be affixed to the box for security reasons; it should be kept separately in a safe location.

Terminal assignment of the connection box for TiM3xx laser scanners

Terminal	Description		Terminal	Description
Supply voltage/inputs			Outputs	
1	GND		21	OUT 1A
2	10 V DC … 28 V DC		22	OUT 1B
3	IN 1		23	OUT_R1A
4	IN 2		24	OUT_R1B
5	IN 3		25	OUT 2A
6	IN 4		26	OUT 2B
7	INGND_ext		27	OUT_R2A

8	n.c.		28	OUT_R2B
Sensor connections (TiM3xx)			20	OUT 3A
9	GND		30	OUT 3B
10	10 V DC … 28 V DC		31	OUT_R3A
11	IN 1		32	OUT_R3B
12	IN 2		Outputs/cover contact	
13	IN 3		33	OUT 4A
14	IN 4		34	OUT 4B
15	INGND		35	OUT_R4A
16	OUT 1		36	OUT_R4B
17	OUT 2		37	Tamper A
18	OUT 3		38	Tamper B
19	OUT 4		39	Tamper A (wired)
20	n.c.		40	Tamper B (wired)

Tab. 29: Pin assignment of the connection box for TiM3xx laser scanners

The following color assignment applies when the laser scanners are connected using adapter cables with an M12 plug connector and open ends, which are available as accessories:

Terminal	**Description**	**Cable (part number)** 60427735 60427736 60427737 6050688
9	GND	Brown
10	10 V DC … 28 V DC	Blue
11	IN 1	White
12	IN 2	Green
13	IN 3	Violet
14	IN 4	Gray-pink
15	INGND	Red
16	OUT 1	Pink
17	OUT 2	Yellow
18	OUT 3	Black
19	OUT 4	Gray
20	n.c.	Red-blue

Terminal assignment of the connection box for LMS13x/LMS141 core/ LMS14x prime/LMS151 Lite

The terminal assignment of the connection box for the LMS13x/LMS141 core/LMS14x prime/LMS151 Lite laser scanners depends on the device type.

Terminal	**LMS13x/LMS14x prime signal**	**LMS141 core/LMS531 Lite signal**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

15		
16		
17		
18		
19		
20		
21		
22		

Tab. 30: Pin assignment of the connection box for LMS13x, LMS14x prime, LMS141 core, LMS531 Lite

Terminal assignment of the connection box for LMS531 PRO laser scanners

Terminal	Description
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	-

Tab. 31: Pin assignment of the connection box for LMS531 PRO

6.8 Cleaning

All laser scanners have an optics cover to protect them. This optics cover can get dirty. Contamination reduces the energy emitted and received by the laser beam.

The scanned objects are perceived with less remission than they actually have. If the scanner lens becomes too contaminated, the laser's performance may be affected.

For this reason the contamination level is constantly checked during running operation and a contamination warning is sent when the dirt levels reach a certain point. If the cover gets dirtier, a **contamination error is sent**. The laser scanner switches off measurements in this case. Different strategies for the contamination measurement can be selected depending on the monitoring scenario.

Note The laser scanners are largely maintenance-free. The optics cover of the laser scanner should however be cleaned regularly and in the event of contamination. Do not use aggressive or coarse cleaning agents.

	Accessories	Description	Part number
	Plastic cleaner	Plastic cleaner and polish, anti-static	5600006
	Lens cloth	Lens cloth	4003353

7 Scalable solutions with OPC

OPC technology plays an important role in large integrative solutions. OPC is the most widely accepted industrial communication standard. It allows communication between devices, controllers, and applications without the usual driver-related connection problems.

7.1 OPC makes integration easier

While conventional proprietary communication protocols allow products of a specific product range to communicate with one another, communication with third-party products requires special drivers.

OPC solves this driver problem by running an OPC server via a TCP/IP connection as a mediator between data sources and data receivers. The OPC server converts the proprietary protocols of the data sources and provides these as OPC objects. OPC object users are called OPC clients. These access the data provided by the OPC server via the network and convert the data back into the application format.

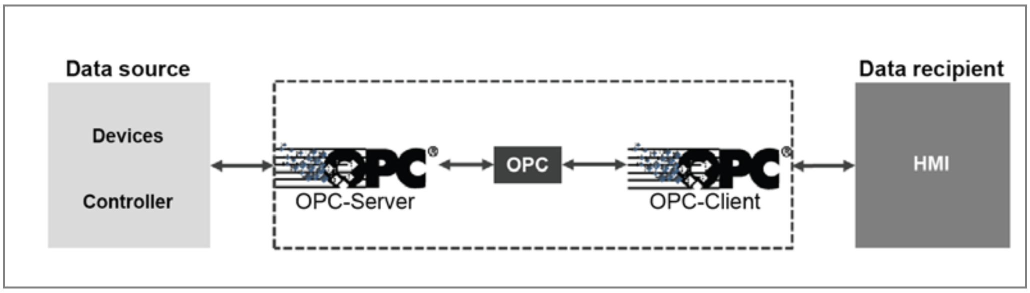


Fig. 78: OPC client/server architecture

OPC thus provides a universal way of communicating, simplifying the integration via industrial bus systems and protocols. As soon as an OPC connection is configured for a specific data source, all OPC-compatible applications can exchange data with this source. No new drivers are required.

The OPC technology allows quick integration of new devices into existing systems. With just a little cabling work, the new data sources of a provider and of the OPC server belonging to the data source can be integrated thanks to TCP/IP communication.

In this way, SICK laser scanners can also be easily integrated into existing OPC high security solutions. The scanners are integrated via SICK's own SOPAS OPC server. On the application side, the OPC server to be accessed just has to be specified in the OPC client.

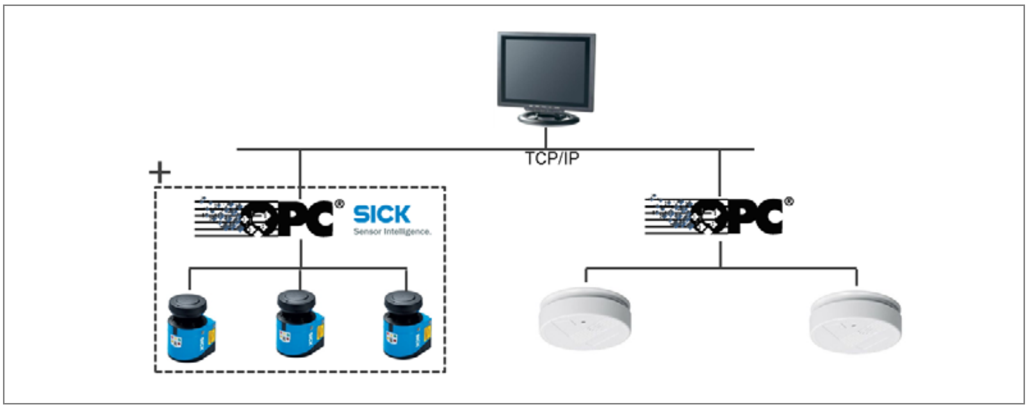


Fig. 79: Integration of laser scanners using SICK OPC server

7.2 Easy data handling with the SICK OPC server

The SICK OPC server follows the OPC-DA specification and can therefore be used on Windows operating systems.

Thanks to the SOPAS OPC server, SICK provides the option of integrating process data, status messages, and diagnostic information from SICK sensors into a visualization system. The server allows straightforward and fast integration into any HMI solution, irrespective of the technology used, thanks to OPC.

Interpreting output signals from the laser scanners via OPC is the easiest and most convenient way to view information about the security system in a monitoring control center. The laser scanners provide specific information based on OPC rather than data records, which can be moved to the graphical user interface using the drag and drop function and easily tracked there.

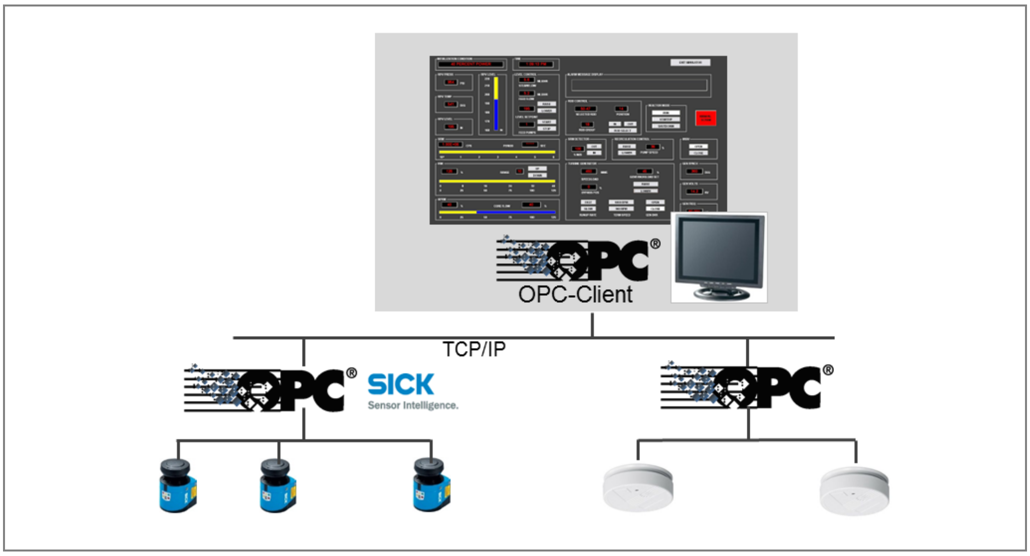


Fig. 80: Viewing information based on OPC

Via OPC, the following information can be transmitted and displayed on the screen:

- Alarm messages and physical visualization of the alarm
- Display of controlled dome cameras or tilting/turning heads
- Information about tampering or attempts to manipulate the system through unauthorized changes to parameters
- Device status for monitoring the laser scanners
- Information on the contamination levels of the laser scanners

Flexibility

While conventional control panels only provide lamps and segment displays to indicate status and diagnostic messages, graphical user interfaces are much more intuitive and informative.

Furthermore, changes on control panels often require a lot of work. On graphical user interfaces, new parameters can be quickly and easily represented on the screen.

Notes

- Visualization via OPC does not contain a standard mechanism for real-time monitoring.
- The SICK OPC server corresponds to the OPC standard 2.05.

Advantages at a glance
• Standardized data format • Significant reduction of drivers and protocols • Easy implementation and low costs of commissioning • User-friendly data handling (device data) • No special knowledge about interfaces and data protocols required

8 Project planning examples

8.1 Selection guide

8.1.1 Device selection

	LMS12x	LMC12x	TiM320 TiM531	TiM361	LMC13x	LMS13x	LMS141 core	LMS14x prime	LMS531 Lite	LMS531 PRO
Fence/double fence/ wall	-	-	-	-	-	+	+	+	++	+++
Open spaces	-	-	-	-	-	++	++	++	++	+++
Camera management and object tracking in open spaces	-	-	-	-	-	++	++	++	++	+++
Outer shell protection (facades)	-	-	-	+	-	++	++	++	++	+++
Roof protection	-	-	-	-	-	++	++	++	++	+++
Ceiling monitoring and wall penetration protection	+++	+++	+++	+++	+++	++	++	++	++	++
Painting protection	++	++	+++	+++	+++	++	++	++	++	++

Tab. 32: Selection guide (device selection)

8.1.2 Product characteristics

	LMS12x	LMC12x	TiM320	LMC13x	TiM351	TiM361	LMS13x	LMS141 core	LMS14x prime	LMS531 Lite	LMS531 PRO
Indoor/outdoor	Indoor	Indoor	Indoor	Indoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor
Operating temperature range											
Enclosure rating	IP 65	IP 65	IP 65	IP 67	IP 67	IP 67	IP 67	IP 67	IP 67	IP 67	IP 67
Scanning range											
Passing through zone (300 mm object)	18 m	18 m	2 m	18 m	6 m	8 m	40 m	30 m	30 m	40 m	40 m
People/objects reaching into zone (40 mm object)	9 m	9 m	1.5 m	9 m	2 m	6 m	12 m	12 m	12 m	12 m	12 m
VdS-certified		Class C		Class C							
Angular resolution											
Laser class	1	1	1	1	1	1	1	1	1	1	1
Interface											
OPC	x	x	x	x	x	x	x	x	x	x	x
IP-Notify											
Ethernet	x	x	–	x	x	x	x	x (1 Hz)	x	x (1 Hz)	x
RS232	x	x		x			x	x	x		x
RS422											x
RS485											x
CAN	x	x	–	x	–	–	x	–	x	–	x
Switching inputs	4	4	4	4	4	4	4	3	4	3	4
Switching outputs	2+1	2+1	4	2+1	4	4	2+1	2+1	2+1	2+1	4 internal
Number of analysis fields	10	10	10	10	10	10	10	4	10	4	10

Tab. 33: Selection guide (product characteristics)

8.2 Fence/double fence protection

8.2.1 Monitored area

The number of laser scanners depends on the device type and on the size of the monitored area.

LMS531 Lite/PRO

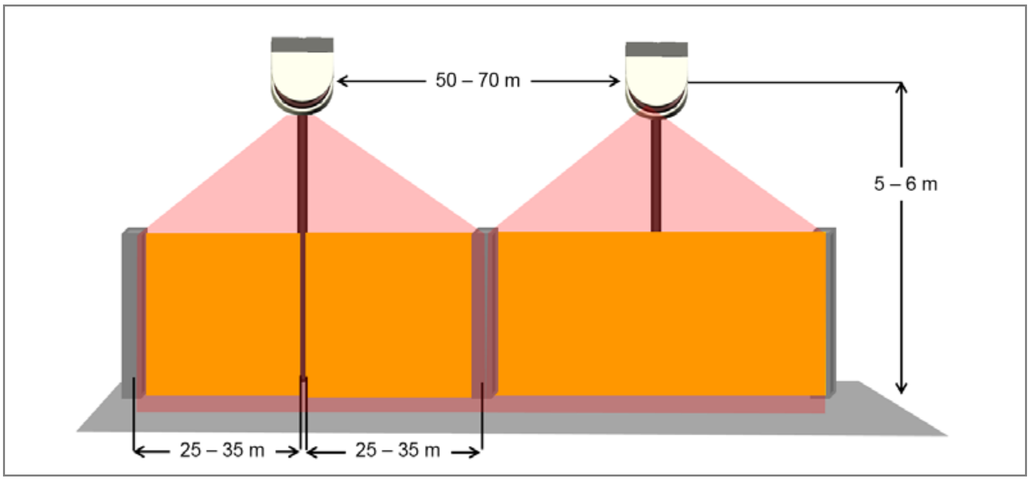


Fig. 81: LMS531 Lite/PRO monitored area (fence protection)

Dimension	Value
Scanning range of the laser scanner	40 m
Distance to laser scanners	50* to 70 m
Width of analysis field (left and right of LMS)	25* to 30 m
Total width of analysis field	approx. 50* m
Mounting height	5 to 6 m

* Recommended value to keep as reserve for poor weather conditions.

LMS141 core/ LMS14x prime

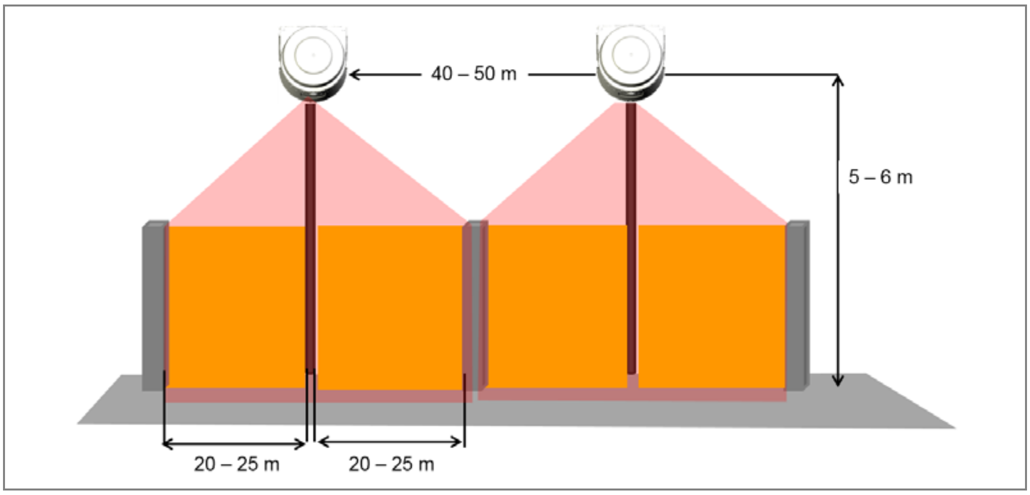


Fig. 82: LMS141 core/LMS14x prime monitored area (fence protection)

Dimension	Value
Scanning range of the laser scanner	30 m
Distance to laser scanners	40* to 50 m
Width of analysis field (left and right of LMS)	20* to 25 m
Total width of analysis field	approx. 40* m
Mounting height	5 to 6 m

* Recommended value to keep as reserve for poor weather conditions.

LMS13x

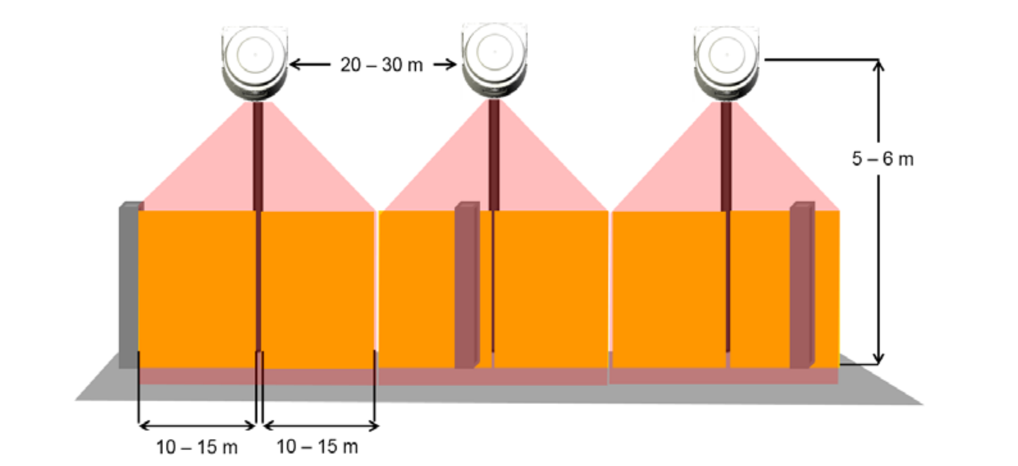


Fig. 83: LMS13x monitored area (fence protection)

Dimension	Recommended value
Scanning range of the laser scanner	18 m
Distance to laser scanners	20* to 30 m
Width of analysis field (left and right of LMS)	10* to 15 m
Total width of analysis field	approx. 20* m
Mounting height	5 to 6 m

* Recommended value to keep as reserve for poor weather conditions.

8.2.2 Installation situation

The detector is usually mounted on a post with a tilting angle of approx. 5 to 10° to the post.

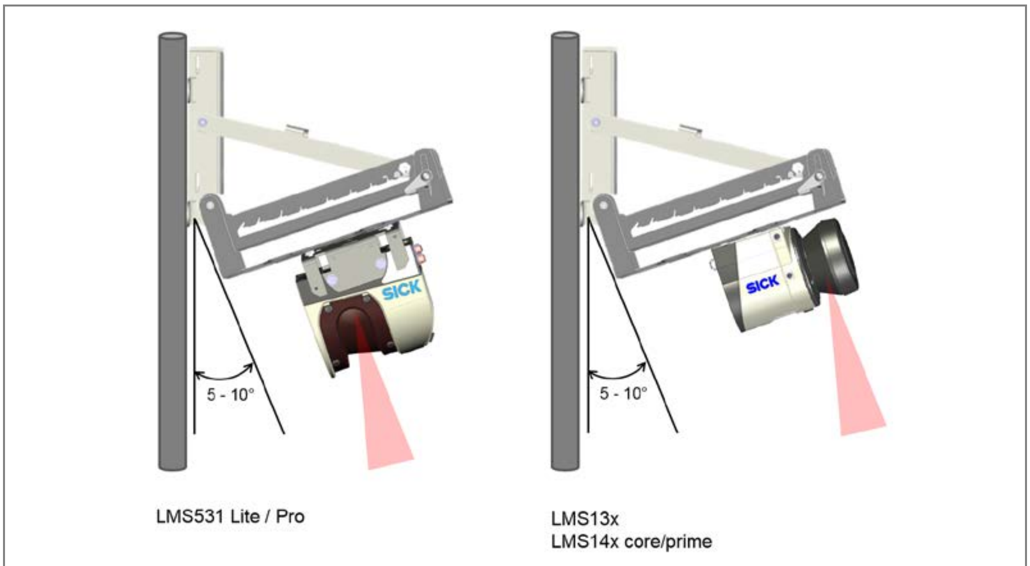


*Fig. 84: Installation situation (fence protection)**

* The figure above shows the laser scanners without the recommended weather hoods to provide a better illustration.

8.2.3 Accessories

Post/wall brackets		
	Post/wall bracket with adapter plate for mounting the LMS13x and LMS14x core/prime laser scanners	1081413
	Mounting bracket for mounting the connection box on the post/wall bracket for LMS1xx	2081636
	Post/wall bracket with adapter plate for mounting the LMS531 Lite/PRO laser scanners	1081412
Accessories for post mounting		
	Adjustable strap for post/wall bracket (2018304)	5306222
	Adjustable strap lock for tightening, 2 pieces required	5306221
Weather hoods (LMS13x)		
	Weather hood, 190°	2046459
	Compact weather hood, 190°, for LMS1xx Color: deep black* * Other colors on request	2082563
Weather hoods (LMS531 Lite/PRO)		
	Weather hood (large)	2063050
	Weather hood (small)	2056850

LMS13x, LMS14x core/prime, LMS531 Lite connection box		
	Connection box for power and I/O (not Ethernet), with three pre-wired M12 cables (length of cable approx. 40 cm) * The stub cables for the connection box must be laid by the customer.	2062346
LMS531 PRO connection box		
	Connection box for power and I/O (not Ethernet), with three pre-wired M12 cables (length of cable approx. 40 cm) and tamper contact on housing cover * The stub cables for the connection box must be laid by the customer.	2063034
Connecting cables		
	Connecting cables (Ethernet, Power, I/O, and Data Input) in 5 m, 10 m, and 20 m length * For direct connection of devices without connection box	* See under Accessories

8.2.4 Recommended settings

If it is possible for someone to run through the monitored area (large distance between the monitored area and the fence), the analysis time should be reduced.

	Fence protection		
	LMS1xx LMS14x core/prime	LMS531 Lite	LMS531 PRO
Default settings			
Scanning frequency/ resolution	50 Hz/0.5°	50 Hz/0.5°	75 Hz/0.5°
Filter			
Particle filter	Active		
Echo filter	Last echo		
Fog filter	Active		
Contamination measurement			
Strategy	Available		
Evaluation case			
Strategy	Blanking		
Response time	150 ms		
Blanking size	200 mm		
Tamper protection	Active		
Depending on distance	Yes (1,000 mm)		
Outputs			
Logic	Active Low		
Restart	Time (500 ms)		

Tab. 34: Recommended settings (fence protection)

8.3 Facade protection

8.3.1 Monitored area

The number of laser scanners depends on the device type and on the maximum required detection distance. Switch between day and night mode for facade protection using the **Day/Night** switching input.

LMS531 Lite/PRO

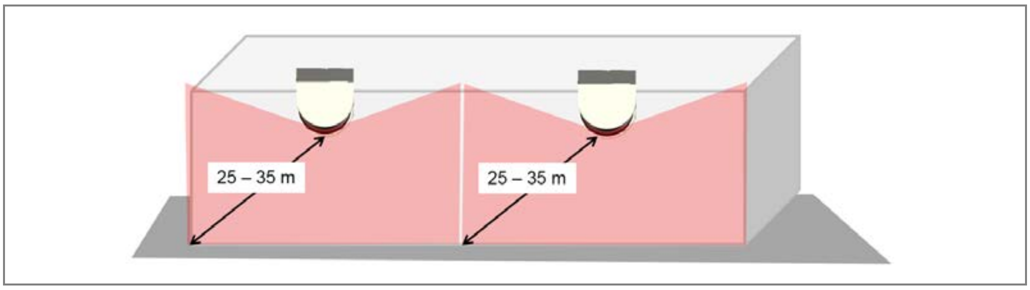


Fig. 85: LMS531 Lite/PRO monitored area (facade protection)

Dimension	Recommended value
Scanning range of the laser scanner	40 m
Recommended maximum detection distance	25 to 35 m

LMS14x core/prime

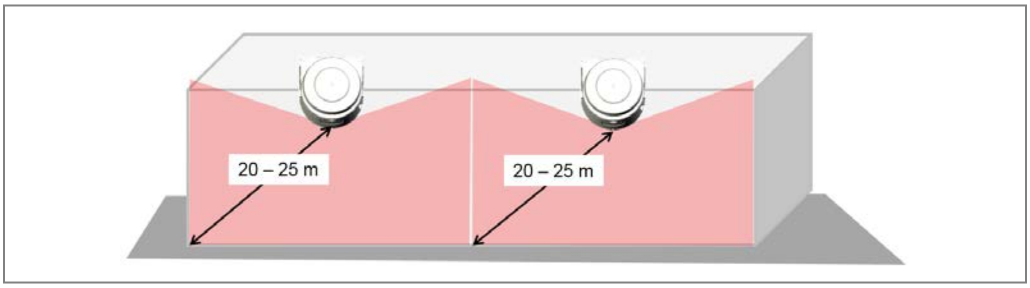


Fig. 86: LMS14x core/prime monitored area (facade protection)

Dimension	Recommended value
Scanning range of the laser scanner	30 m
Recommended maximum detection distance	20 to 25 m

LMS13x

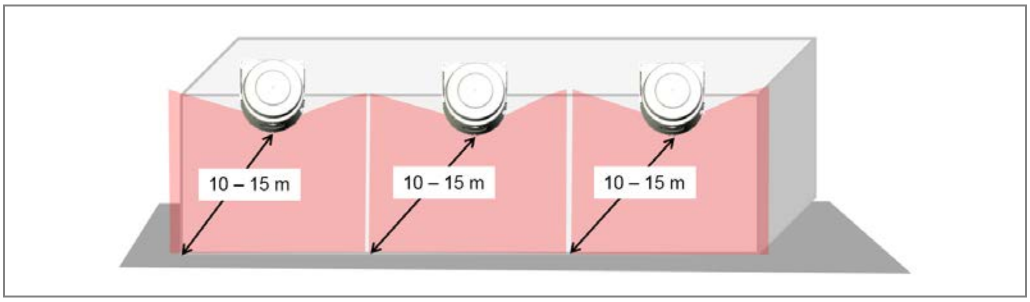


Fig. 87: LMS13x monitored area (facade protection)

Dimension	Recommended value
Scanning range of the laser scanner	18 m
Recommended detection distance	10 to 15 m

TiM351/361

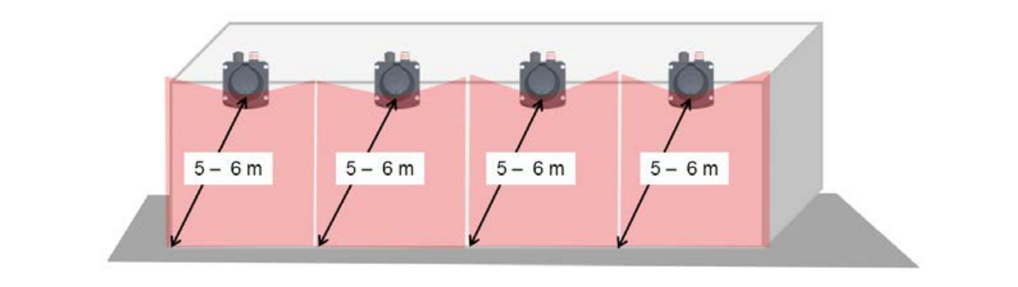


Fig. 88: TiM351/361 monitored area (facade protection)

Dimension	Recommended value
Scanning range of the laser scanner	8 m
Recommended detection distance	5 to 6 m

8.3.2 Installation situation

Detector is mounted on the facade as far out of reach as possible (tamper-proofing) with a tilt angle of 5 to 10° to the wall. A beam finder must be used to ensure that the laser beam hits the ground and not the facade.

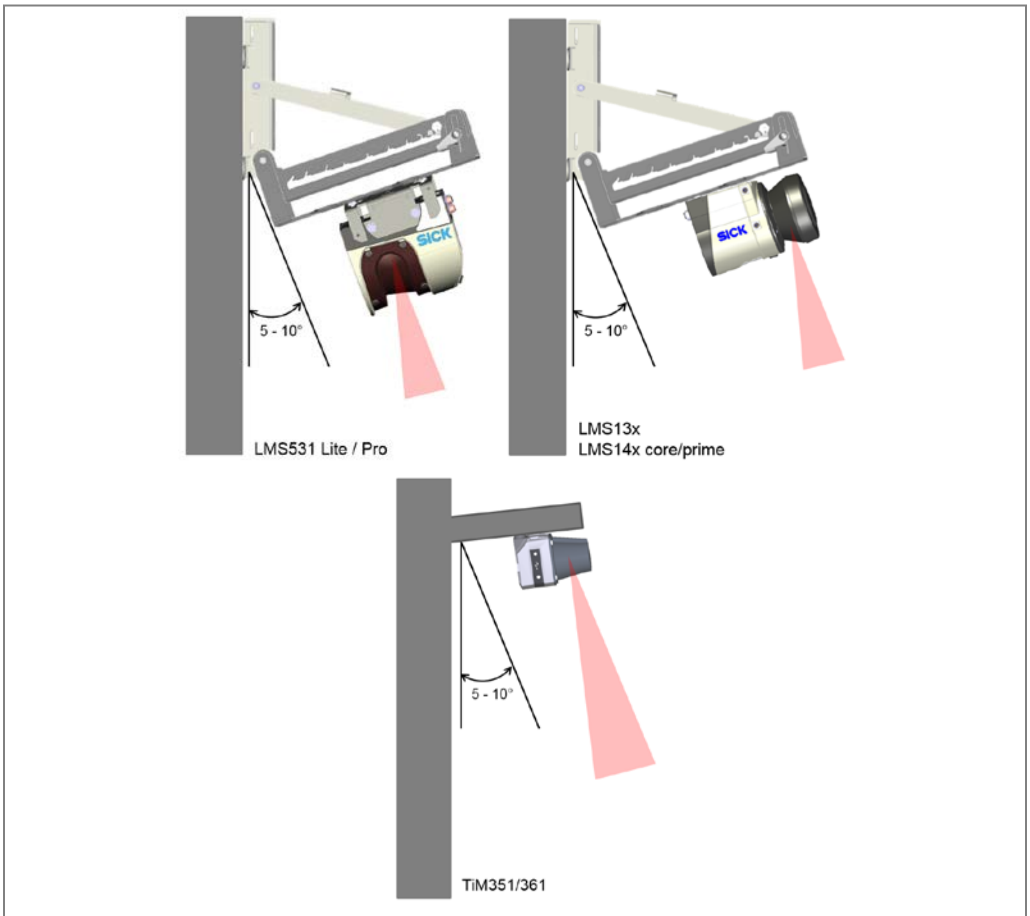


*Fig. 89: Installation situation (facade protection)**

* The figure above shows the laser scanners without the recommended weather hoods to provide a better illustration.

8.3.3 Accessories

Post/wall brackets		
	Post/wall bracket with adapter plate for mounting the LMS13x and LMS14x core/prime laser scanners	1081413
	Mounting bracket for mounting the connection box on the post/wall bracket for LMS1xx	2081636
	Post/wall bracket with adapter plate for mounting the LMS531 Lite/PRO laser scanners	1081412
Mounting bracket (TiM351/361)		
	Mounting kit with sunshade/weather protection	2068398
Weather hoods (LMS13x)		
	Weather hood, 190°	2046459
	Compact weather hood, 190°, for LMS1xx Color: deep black* * Other colors on request	2082563
Weather hoods (LMS531 Lite/PRO)		
	Weather hood (large)	2063050
	Weather hood (small)	2056850

LMS13x, LMS14x core/prime, LMS531 Lite connection box		
	Connection box for power and I/O (not Ethernet), with three pre-wired M12 cables (length of cable approx. 40 cm) * The stub cables for the connection box must be laid by the customer.	2062346
LMS531 PRO connection box		
	Connection box for power and I/O (not Ethernet), with three pre-wired M12 cables (length of cable approx. 40 cm) and tamper contact on housing cover * The stub cables for the connection box must be laid by the customer.	2063034
TiM351/361 connection box		
	Relay connection box for power, I/O, tamper contact, and 4 relays * The stub cables for the connection box must be laid by the customer.	2082916
Connecting cables (LMS13x, LMS14x core/prime, LMS531 Lite)		
	Connecting cables (Ethernet, Power, I/O, and Data Input) in 5 m, 10 m, and 20 m length * For direct connection of devices without connection box	* See under Accessories
Connecting cables (TiM351/361)		
	Power and data connecting cable in 5 m, 10 m, and 20 m length * For direct connection of devices without connection box	* See under Accessories

8.3.4 Recommended settings

If someone can run through the monitored area (large distance between the monitored area and the facade), the analysis time should be reduced.

	Facade protection				
	TiM351	TiM361	LMS1xx LMS141 core/ LMS14x prime	LMS531 Lite	LMS531 PRO
Default settings					
Scanning frequency	15 Hz		50 Hz	50 Hz	75 Hz
Resolution	1°	0.33°	0.5°	0.5°	0.5°
Filter					
Particle filter	–		Active		
Echo filter	–		Last echo		
Fog filter	–		Active		
Contamination measurement					
Strategy	–		Available		
Evaluation case					
Strategy	Blanking		Blanking		
Response time	540 ms		500 ms		
Blanking size	250 mm		250 mm		
Tamper protection	–		Active		
Depending on distance	–		Yes (1000 mm)		
Outputs					
Logic	Active Low		Active Low		
Restart	Time (469 ms)		Time (500 ms)		

Tab. 35: Recommended settings (facade protection)

8.4 Open space protection

8.4.1 Monitored area

The number and type of laser scanners depend on which areas of the open space are being protected. If necessary, several monitoring areas can be defined for each laser scanner. Approach roads and access paths can be blanked. At night, the system can switch to full monitoring via switching input **Day/Night**.

LMS531 Lite/PRO

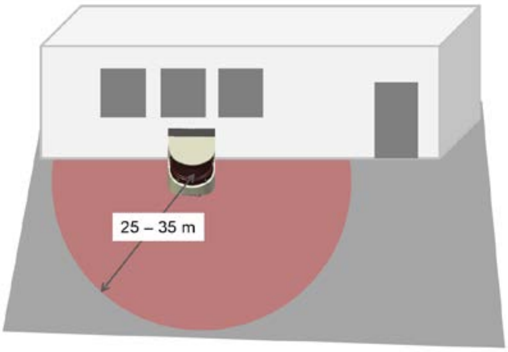


Fig. 90: LMS531 Lite/PRO monitored area (open space protection)

Dimension	Recommended value
Scanning range of the laser scanner	40 m
Recommended maximum detection distance	25 to 35 m

LMS14x core/prime

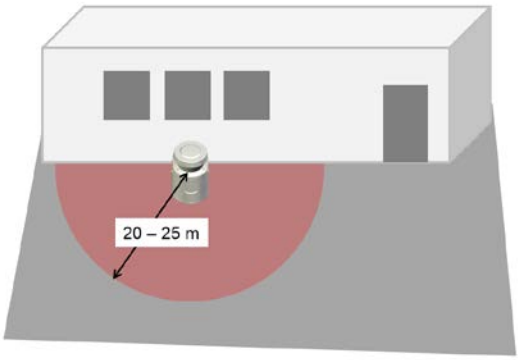


Fig. 91: LMS1341x core/prime monitored area (open space protection)

Dimension	Recommended value
Scanning range of the laser scanner	30 m
Recommended detection distance	20 to 25 m

LMS13x

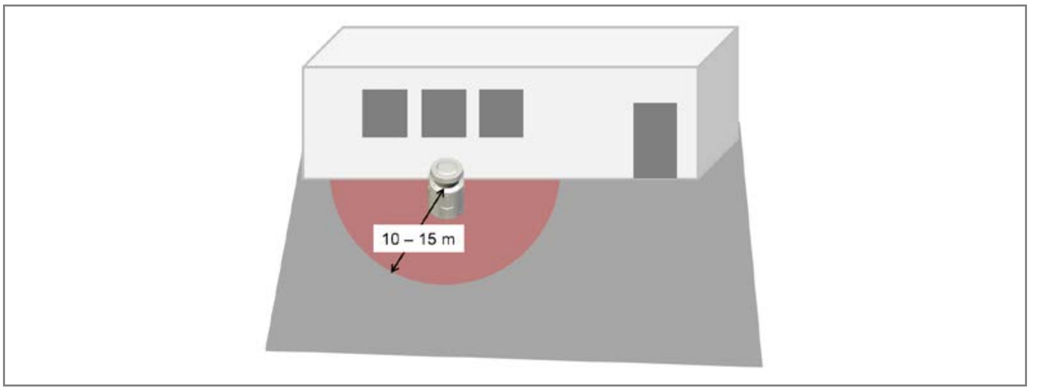


Fig. 92: LMS13x monitored area (open space protection)

Dimension	Recommended value
Scanning range of the laser scanner	18 m
Recommended detection distance	10 to 15 m

8.4.2 Mounting

SICK laser scanners are usually used horizontally for the monitoring of open spaces. The scanner should be mounted at a height of approx. 300 mm to protect again crawling through the detection zone, with a tilt angle of 5 to 10°. A beam finder must be used to ensure that the laser beam does not hit the ground within the monitored area and trigger an alarm.

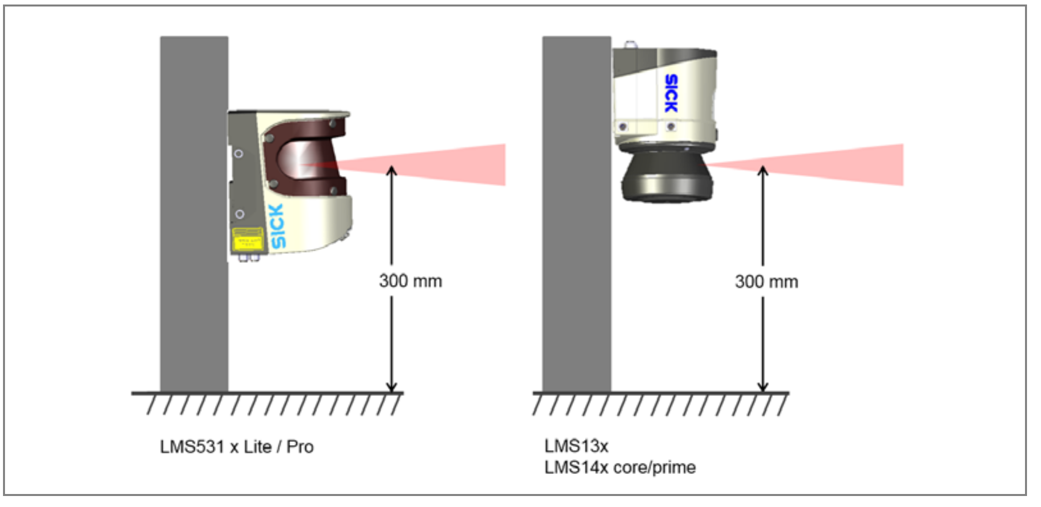


*Fig. 93: Installation situation (open space protection)**

* The figure above shows the laser scanners without the recommended weather hoods to provide a better illustration.

When using the compact weather hood for the LMS1xx, overhead mounting is not possible.

8.4.3 Accessories

See “Facade protection”.

8.4.4 Recommended settings

	Open space protection		
	LMS1xx	LMS531 Lite	LMS531 PRO
Default settings			
Scanning frequency/ resolution	50 Hz/0.5°	50 Hz/0.5°	75 Hz/0.5°
Filter			
Particle filter	Active		
Echo filter	Last echo		
Fog filter	Active		
Contamination measurement			
Strategy	Available		
Evaluation case			
Strategy	Blanking		
Response time	1,000 ms		
Blanking size	150 mm (at mounting height < 1.2 m)/ 250 mm (at mounting height 1.2–1.6 m)		
Tamper protection	Active		
Depending on distance	Yes (1000 mm)		
Outputs			
Logic	Active Low		
Restart	Time (500 ms)		

Tab. 36: Recommended settings (open space protection)

8.5 Roof protection

8.5.1 Monitored area

Flat roof protection is the same as open space protection. Roof structures casting shadows are taken into account in the planning of the monitoring fields.

8.5.2 Installation situation

The laser scanners are generally mounted directly onto the building. The monitoring field for the system is set up approx. 30 cm above the ground so that any persons crawling beneath the alarm zone are detected and registered. The edge of the monitoring field can also be placed slightly above the edge of the roof so that ladders, for instance, are detected at once.

8.5.3 Accessories

See "Facade protection".

8.5.4 Recommended settings

	Roof protection		
	LMS1xx	LMS531 Lite	LMS531 PRO
Default settings			
Scanning frequency/ resolution	50 Hz/0.5°	50 Hz/0.5°	75 Hz/0.5°
Filter			
Particle filter	Active		
Echo filter	Last echo		
Fog filter	Active		
Contamination measurement			
Strategy	Available		
Evaluation case			
Strategy	Blanking		
Response time	1,000 ms		
Blanking size	70 mm		
Tamper protection	Active		
Depending on distance	Yes (1,000 mm)		
Outputs			
Logic	Active Low		
Restart	Time (500 ms)		

Tab. 37: Recommended settings (roof protection)

8.6 Painting protection

8.6.1 Monitored area

The number and type of laser scanners depends on how many paintings are being protected per laser scanner. Thanks to flexible day and night modes, individual areas can be secured throughout the day, while the entire wall, including the entrance, can be monitored at night.

The detection sharpness (resolution) can be set in the analysis case via the object size in order to protect again persons entering or reaching into the detection zone.

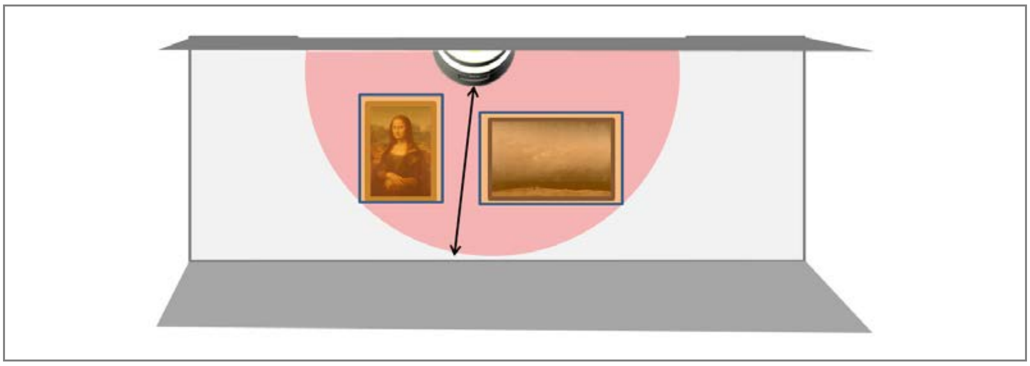


Fig. 94: Monitored area (painting protection)

Dimension	Recommended value			
	LMS12x/LMC12x	TiM320	TiM351	TiM361
Scanning range of the laser scanner	18 m	2 m	8 m	8 m
Scanning range when monitoring for passing through the detection zone	15 m	2 m	6 m	8 m
Scanning range when monitoring for reaching into the detection zone	9 m	1.5 m	2 m	6 m

8.6.2 Installation situation

The scanner is mounted vertically pointed downwards out of reach (tamper-proofing) with a small space between the bottom of the device and the wall.

VdS-compliant LMC12x devices can only be mounted with the supplied mounting kit. The LMS12x, TiM320, and TiM351 laser scanners can be mounted with mounting kits which can be ordered as accessories.

A beam finder must be used to ensure that the laser beam hits the floor and not the wall with the paintings.

LMC12x/LMS12x

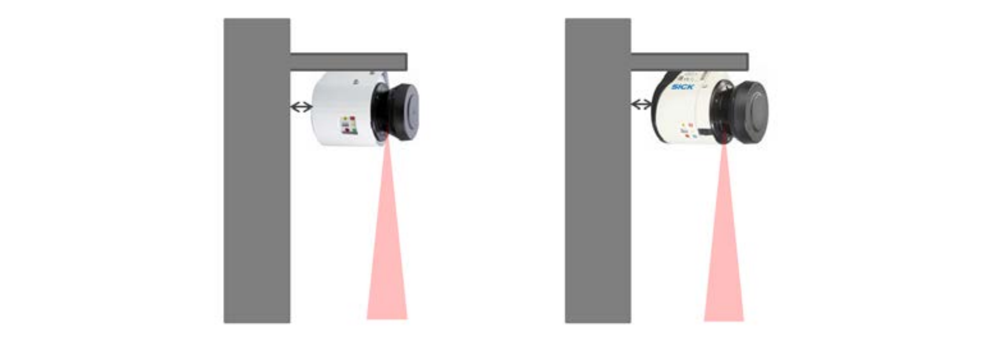


Fig. 95: LMC12x/LMS12x installation situation (painting protection)

TiM320/ TiM351 TiM361

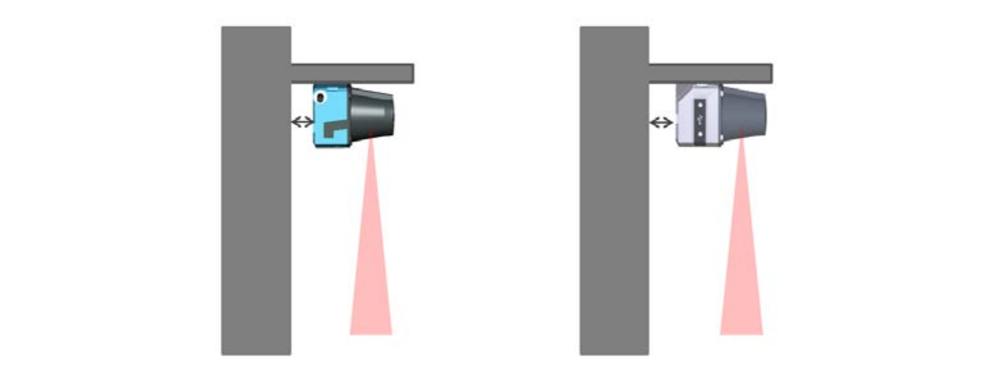


Fig. 96: TiM3xx installation situation (painting protection)

8.6.3 Accessories

Mounting kits (LMS12x)		
	Mounting kit 1A Mounting bracket for rear mounting on the wall	2034324
	Mounting kit 1B Mounting bracket for rear mounting on the wall with optics cover protection	2034325
	Mounting kit 2 Cross-wise adjustment possible only in combination with mounting kit 1a or 1b	2039302
	Mounting kit 3 Longitudinal adjustment possible only in combination with mounting kit 2	2039303
Mounting kit (TiM320)		
	Mounting kit 2, impact protection and alignment aid	2061776

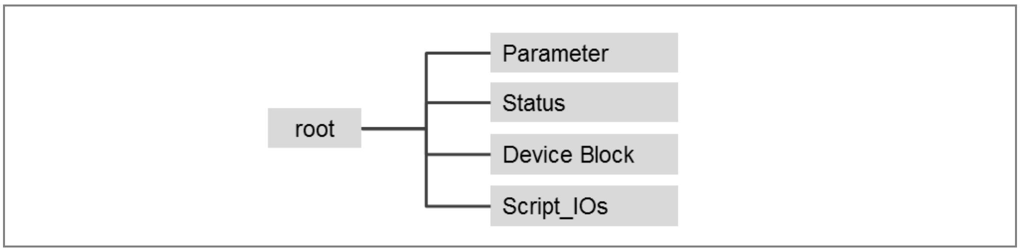
Mounting kit (TiM351/TiM361)		
	Mounting kit (with sun protection)	2068398
Connection box (TiM351/361)		
	Relay connection box for power, I/O, tamper contact, and 4 relays * The stub cables for the connection box must be laid by the customer.	2082916
Connection (TiM320)		
	Extension cable, female connector, D-Sub-HD, 15-pin, straight, 2 m	2043413
Connection (TiM351/TiM361)		
	Connecting cables (Ethernet, Power) in 5 m, 10 m, and 20 m length	See Accessories

8.6.4 Recommended settings

	Painting protection			
	LMS12x	LMC1xx	TiM320 TiM351	TiM361
Default settings				
Scanning frequency	50 Hz	50 Hz	15 Hz	
Resolution	0.5°	0.5°	1°	0.33°
Filter				
Particle filter	Not active		-	
Echo filter	Last echo		-	
Fog filter	Not active		-	
Contamination measurement				
Strategy	Available		-	
Evaluation case				
Strategy	Blanking			
Response time	25 ms to 100 ms	25 ms (VdS class C) 40 ms (VdS class B)	134 ms	
Blanking size	40 mm (monitoring for reaching into the detection zone) 300 mm (monitoring for passing through the detection zone)			
Tamper protection	Active		-	
Depending on distance	Yes (1000 mm)	-	-	
Outputs				
Logic	Active Low			
Restart	Time (500 ms)		Time (469 ms)	

Tab. 38: Recommended settings (painting protection)

8.7 Parameter assignment for SICK OPC server



Parameter		
Current_Configuration	• Frequency • AngleResolution	
	• Output_Data_Range	• StartAngle • StopAngle
Contamination	• ContaminationWarn • ContaminationError	
Display_Settings	• FrontPaneEnable	
Ethernet	• IP address • Subnet mask • Gateway	
Status		
IncrementState		
Encoder	• CurrentSpeed • CurrentDirection	
IO	• HWInputNumActive	
	• InputState_{nn}	• With {nn} from “01”…“99”
	• Output_{nn}	• With {nn} from “01”…“99” • Counter • State
	• External_Output_{nn}	• With {nn} from “01”…“99” • Counter • State
Scan		
Front Panel	• LED_Q1_State	
	• LED_Q2_State	
	• LED_Ok_State	
	• LED_Stop_State	
	• LED_CM_State	
	• AlphaNumDisplay	• SectionA • SectionB • SectionC • SectionD • SectionE • SectionF • SectionG • SectionDot

Sensor	• ContaminatorState • PowerOnCount • OperatingHours • DailyOperatingHours • LastUsername • LastParametrizationDate • LastParametrizationTime • LastMaintenance • NextMaintenance • Temperature • MeasurementState • DeviceError • DeviceState	
FieldEval	• EVC[n]_Result	• With[n]-EVC number; • State = 1, if EVC condition met; • State = 0, if EVC condition NOT met
Device_Block		
IncrementState	• Manufactor • DeviceType • FirmwareVersion • OrderNumber • SerialNumber • DeviceName	
Script_IOs		
Inputs	• Param.In_0 • … • Param.In_3 • Param.In_0_Mem. • … • Param.In_3_Mem.	
Outputs	• Param.Out_0 • … • Param.In_7.	

Tab. 39: Parameter assignment for SICK OPC server

Notes The parameters depend on the device type used.

The SICK OPC server corresponds to the OPC standard 2.05.

9 Annex

9.1 List of tables

Tab. 1: VdS-compliant devices 24
Tab. 2: Devices for indoor monitoring 25
Tab. 3: Devices for outdoor monitoring 26
Tab. 4: Alarm types: faulty alarm, false alarm 41
Tab. 5: Preliminary considerations (facade protection) 42
Tab. 6: Preliminary considerations (fence protection) 42
Tab. 7: Preliminary considerations (open space protection) 43
Tab. 8: Preliminary considerations (roof protection) 43
Tab. 9: Power consumption of laser scanner (overview) 46
Tab. 10: Length of cable and cable cross-section (LMC12x/LMS12x connection) 47
Tab. 11: Length of cable and cable cross-section (connection box for TiM351/TiM361) 51
Tab. 12: Length of cable and cable cross-section (connection box for LMS1xx) 52
Tab. 13: Length of cable and cable cross-section (connection box for LMS531 Lite) 52
Tab. 14: Length of cable and cable cross-section (connection box for LMS531 PRO) 52
Tab. 15: Variants for switching input Teach In 61
Tab. 16: LMC12x/LMS12x pin assignment 77
Tab. 17: TiM320 pin assignment 78
Tab. 18: TiM320 adapter cable pin assignment 78
Tab. 19: TiM351/TiM361 pin assignment (voltage supply/inputs and outputs) 79
Tab. 20: LMC13x/LMS13x/LMS141 core/LMS14x prime pin assignment (voltage supply) 80
Tab. 21: LMC13x/LMS13x/LMS141 core/LMS14x prime pin assignment (alarm) 80
Tab. 22: LMC13x/LMS13x/LMS141 core/LMS14x prime pin assignment (inputs) 80
Tab. 23: LMS531 Lite pin assignment (voltage supply) 81
Tab. 24: LMS531 Lite pin assignment (alarm) 81
Tab. 25: LMS531 Lite pin assignment (inputs) 81
Tab. 26: LMS531 PRO pin assignment (voltage supply) 82
Tab. 27: LMS531 PRO pin assignment (alarm) 82
Tab. 28: LMS531 PRO pin assignment (inputs/data) 83
Tab. 29: Pin assignment of the connection box for TiM3xx laser scanners 84
Tab. 30: Pin assignment of the connection box for LMS13x, LMS14x prime, LMS141 core, LMS531 Lite 85
Tab. 31: Pin assignment of the connection box for LMS531 PRO 86
Tab. 32: Selection guide (device selection) 91
Tab. 33: Selection guide (product characteristics) 91
Tab. 34: Recommended settings (fence protection) 95
Tab. 35: Recommended settings (facade protection) 100

Tab. 36: Recommended settings (open space protection) ... 103
Tab. 37: Recommended settings (roof protection) ... 104
Tab. 38: Recommended settings (painting protection) ... 107
Tab. 39: Parameter assignment for SICK OPC server ... 109

9.2 List of figures

Fig. 1: 2D laser scanner principle of operation ... 10
Fig. 2: Pulse time-of-flight measurement principle of operation ... 11
Fig. 3: Reflection of light on the surface of the object ... 12
Fig. 4: Angle of reflection ... 12
Fig. 5: Reflectance ... 13
Fig. 6: Reflective surfaces ... 13
Fig. 7: Beam divergence and object size ... 13
Fig. 8: LMS1xx beam expansion ... 14
Fig. 9: LMS1xx beam diameter ... 14
Fig. 10: LMS5xx beam expansion ... 15
Fig. 11: LMS5xx beam diameter ... 15
Fig. 12: TiM3xx beam diameter ... 15
Fig. 13: Monitoring fences, double fences, and walls ... 16
Fig. 14: Monitoring of open spaces ... 17
Fig. 15: Camera management and object tracking in open spaces ... 18
Fig. 16: Outer shell protection (facades) ... 19
Fig. 17: Roof protection ... 20
Fig. 18: Ceiling monitoring and wall penetration protection ... 21
Fig. 19: Painting protection ... 22
Fig. 20: Flowchart for device selection ... 24
Fig. 21: VdS-compliant mounting kits VdS1 long/VdS1 short ... 32
Fig. 22: Analysis of the threat situation ... 41
Fig. 23: Area behind the reference target in which no reflective surfaces are allowed ... 44
Fig. 24: LMC12x/LMS12x connecting cables ... 47
Fig. 25: TiM320 connecting cables ... 48
Fig. 26: TiM351/TiM361 connecting cables ... 48
Fig. 27: LMC13x/LMS13x/LMS141 core/LMS14x prime connecting cables ... 49
Fig. 28: LMS531 Lite/LMS531 PRO connecting cables ... 49
Fig. 29: Connection box for TiM320 ... 50
Fig. 30: Connection box for TiM351/TiM361 ... 50
Fig. 31: Connection box for LMS13x/LMS141 core/LMS14x prime/LMS531 Lite ... 51
Fig. 32: Filter - analysis fields - analysis cases - switching inputs ... 53
Fig. 33: Particle filter principle of operation ... 54
Fig. 34: Multi-echo analysis principle of operation ... 54
Fig. 35: Scanning range and analysis fields ... 55

Fig. 36: Analysis cases, principle of operation ... 56
Fig. 37: Pixel analysis principle of operation ... 56
Fig. 38: Blanking principle of operation ... 57
Fig. 39: Example for setting the alarm sensitivity ... 57
Fig. 40: Analysis strategy using fields ... 58
Fig. 41: Contour as reference analysis strategy ... 58
Fig. 42: Contour as reference principle of operation ... 58
Fig. 43: Protection against tampering thanks to contour as reference ... 59
Fig. 44: Combination of analysis strategies: fields and contour as reference ... 59
Fig. 45: Tamper-proofing against shadowing and dazzle ... 59
Fig. 46: Field breaches caused by changing ambient conditions ... 60
Fig. 47: Automatic field adjustment principle of operation ... 61
Fig. 48: Easy Teach Lite principle of operation ... 62
Fig. 49: Easy Teach: blanking objects from the field ... 62
Fig. 50: Easy Teach: entering the monitoring field ... 63
Fig. 51: Easy Teach Lite: further optimizing a field ... 63
Fig. 52: Easy Teach PRO principle of operation ... 63
Fig. 53: Easy Teach PRO: monitoring fields before teach-in process ... 64
Fig. 54: Easy Teach PRO: monitoring fields after teach-in process ... 64
Fig. 55: Easy Teach PRO: master field for contour as reference field ... 65
Fig. 56: Easy Teach PRO: contour as reference field after being taught-in with Easy Teach ... 65
Fig. 57: Easy Teach PRO: problem of using facade monitoring without contour as reference field ... 66
Fig. 58: Activating analysis cases (switching input Day/Night) ... 66
Fig. 59 Switching the laser scanner to sharp/not sharp (switching input Armed/Disarmed) ... 67
Fig. 60 Walk-through test mode (functional test switching input) ... 68
Fig. 61: Circuitry without resistance monitoring (LMC12x/LMS12x) ... 71
Fig. 62: Circuitry without resistance monitoring (LMC13x/LMS13x/LMS141 core/LMS14x prime/LMS531 Lite/LMS531 PRO) ... 71
Fig. 63: Circuitry with resistance monitoring (LMC12x/LMS12x) ... 72
Fig. 64: Circuitry with resistance monitoring (LMC13x/LMS13x/LMS141 core/LMS14x prime/LMS531 Lite/LMS531 PRO) ... 72
Fig. 65: LMS12x/LMC12x/LMC13x/LMS13x/LMS141 core/LMS14x prime tamper-proofing ... 73
Fig. 66: Analysis cases in expert mode ... 74
Fig. 67: Field-based switching of cameras (overview) ... 74
Fig. 68: Field-based camera control (direct) ... 75
Fig. 69: Field-based camera control (via video management system) ... 75
Fig. 70: Field-based camera control (via OPC) ... 75
Fig. 71: How to integrate a laser scanner into Milestone XProtect ... 76
Fig. 72: TiM320 adapter cable (with part number) ... 78
Fig. 73: TiM351/TiM361 connecting cables (with part number) ... 79

Fig. 74: LMC13x/LMS13x/LMS141 core/LMS14x prime connecting cables (with part number) 80
Fig. 75: LMS531 Lite connecting cables (with part number) 81
Fig. 76: LMS531 PRO connecting cables (with part number) 82
Fig. 77: Connection box terminal assignment 83
Fig. 78: OPC client/server architecture 88
Fig. 79: Integration of laser scanners using SICK OPC server 89
Fig. 80: Viewing information based on OPC 89
Fig. 81: LMS531 Lite/PRO monitored area (fence protection) 92
Fig. 82: LMS141 core/LMS14x prime monitored area (fence protection) 92
Fig. 83: LMS13x monitored area (fence protection) 93
Fig. 84: Installation situation (fence protection)* 93
Fig. 85: LMS531 Lite/PRO monitored area (facade protection) 96
Fig. 86: LMS14x core/prime monitored area (facade protection) 96
Fig. 87: LMS13x monitored area (facade protection) 96
Fig. 88: TiM351/361 monitored area (facade protection) 97
Fig. 89: Installation situation (facade protection)* 97
Fig. 90: LMS531 Lite/PRO monitored area (open space protection) 101
Fig. 91: LMS1341x core/prime monitored area (open space protection) 101
Fig. 92: LMS13x monitored area (open space protection) 102
Fig. 93: Installation situation (open space protection)* 102
Fig. 94: Monitored area (painting protection) 105
Fig. 95: LMC12x/LMS12x installation situation (painting protection) 106
Fig. 96: TiM3xx installation situation (painting protection) 106

9.3 Keywords index

A
Abbreviations 6
Alarm sensitivity 57
Alarm types 41
Analysis cases
  Activating/deactivating 66
Analysis fields 55
  Adjusting automatically 60
  Teach-in automatically 61
Analysis strategy 53
Angle of incidence 12
Angle of reflection 12
Armed/Disarmed 67

B
Beam divergence 13
Blanking 57

C
Camera circuitry 74
CAN modules 39
CCTV 8
Ceiling monitoring 21
Circuitry 71
  resistance-monitored 72
Cleaning 87
Connecting cables 36–46
Connection box 38–50
Contour as reference 58

D
Day/Night 66
Day/night mode 66
Dazzle 59
Detection accuracy 53
Detection range 23
Detection systems 8
Device overview 27
  Outdoor 29
  VdS-compliant 27
Device selection 24
Dry contact solid state outputs 69

E
Environmental influences 23
Evaluation cases 55
Expert mode 73

F
Facade protection 19
  Preliminary considerations 42
False alarm 41
Faulty alarm 41
Fence protection 16
  Preliminary considerations 42
Field adjustment 60
Field-based camera control 74
Filter 53
Fine-adjustment unit 34
Fog filter 53

H
Heating 45

I
Indoor monitoring 25
  Devices 28
Information depth 6
Infrared sensors 8
Inputs 67
  Armed/Disarmed 67
  Day/Night 66
  Teach IN 61
  Walk-through test 68

K
Keywords index 114

L
Laser measurement technology
  (overview) 10
Laser scanner
  Applications 16
Laser scanner applications 16
Laser-guided detection methods 8
List of figures 111
List of tables 110

M
Measuring frequency 11
Milestone XProtect 76
Mounting 46
Mounting kits 32
  VdS-compliant 32
Multi-echo analysis 11–54

O
Object size 13
OPC 88
  SICK OPC server 89
  Visualization 89
OPC integration 88
Open space protection 17
  preliminary considerations 43
  With camera guidance 18
Outdoor monitoring 26
  Devices 29

P
Painting protection 22
Particle filter 54
Pin assignments 77
Pixel analysis 56
Planning 42
Post brackets 35
Power supply unit 39
Preliminary considerations 42
Project planning examples 91
Pulse delay method 11

R
Radar sensors 8
Reflection 12
Remission 12
Resistance monitoring 72
Roof protection 20
  Preliminary considerations 43

S
Scan finder 40
Security analysis 41
Shadowing 59
Sharp/not sharp 67
SOPAS 53–73
Symbols 6

T
Taking account of object size 56
Tamper-proofing 73
  Contour as reference 58
  Shadowing, dazzle 59
Target group 6
Teach IN 61
Threat situation 41
Time-of-flight measurement 10

V
VdS guidelines 24
  Devices 27
Voltage supply 46

W
Walk-through test 68
Wall brackets 35
Weather hoods 31

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