

Laser detectors

Planning aids for perimeter and object monitoring



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Contents

1	About this document.....	6
1.1	Purpose 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 information	7
2	Introduction.....	8
2.1	Overview of detection systems.....	8
2.2	2D laser detectors.....	10
2.2.1	Time-of-flight 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.....	13
2.2.6	Beam divergence and object size	14
3	Laser detector applications	15
3.1	Monitoring fences, double fences, and walls.....	15
3.2	Monitoring of open spaces	16
3.3	Camera management and object tracking in open spaces.....	17
3.4	Outer shell protection (facades).....	18
3.5	Roof protection.....	19
3.6	Ceiling monitoring and wall penetration protection.....	20
3.7	Painting protection.....	21
4	Detection ranges	22
5	Devices and accessories	23
5.1	Selecting the right detector	23
5.2	Device overview.....	26
5.2.1	VdS-compliant devices.....	26
5.2.2	Indoor devices (without VdS certification)	27
5.2.3	Outdoor devices	28
5.3	Accessories.....	29
5.3.1	Weather protection covers	29
5.3.2	Mounting kits.....	30
5.3.3	Post brackets.....	32
5.3.4	Mounting sets (LMS531 Lite only).....	33
5.3.5	Connecting cables.....	33
5.3.6	Connection box.....	35
5.3.7	CAN module.....	35
5.3.8	Power supply	36
5.3.9	Scan finder	36
6	Project planning	37
6.1	Analysis of the threat situation.....	37
6.2	Preliminary considerations during installation	38
6.3	Heating	40
6.4	Mounting and connecting cables	41
6.4.1	Voltage supply	41
6.4.2	Connecting cables.....	42

6.4.3	Using a connection box	45
6.5	Detection accuracy and analysis strategy.....	46
6.5.1	Working with filters	46
6.5.2	Defining analysis fields and cases	48
6.5.3	Taking account of object sizes.....	49
6.5.4	Setting the alarm sensitivity.....	50
6.5.5	Using contour as reference for tamper-proofing.....	51
6.5.6	Protecting against shadowing and glare	53
6.5.7	Automatic field adjustment.....	54
6.5.8	Teaching in/updating fields automatically (Easy Teach).....	55
6.5.9	Activating/deactivating analysis cases (day and night mode).....	61
6.6	Configuration of the signaling method	62
6.6.1	Overview of digital inputs	62
6.6.2	Switching laser detectors to armed/disarmed	62
6.6.3	Switching the laser detector to walk-through test mode.....	63
6.6.4	Potential-free semiconductor outputs in relay function (overview).....	63
6.6.5	Circuitry without resistance monitoring.....	65
6.6.6	Circuitry with resistance monitoring	66
6.6.7	Tamper-proofing	67
6.6.8	Working in expert mode	67
6.6.9	Controlling cameras	69
6.7	Pin assignments	71
6.7.1	LMC12x/LMC12x.....	71
6.7.2	TiM320-1031000.....	72
6.7.3	TiM351.....	73
6.7.4	LMC13x/LMS13x.....	74
6.7.5	LMS531 Lite	75
6.7.6	LMS531 Pro.....	76
6.7.7	Connection box	78
6.8	Cleaning	79
7	Scalable solutions with OPC.....	80
7.1	OPC makes integration easier	80
7.2	Easy data handling with the SICK OPC server	81
8	Project planning examples	83
8.1	Selection guide	83
8.1.1	Device selection.....	83
8.1.2	Product characteristics	83
8.2	Fence/double fence protection	84
8.2.1	Monitored area	84
8.2.2	Installation situation.....	85
8.2.3	Accessories	85
8.2.4	Recommended settings	86
8.3	Facade protection.....	87
8.3.1	Monitored area	87
8.3.2	Installation situation.....	88
8.3.3	Accessories	88
8.3.4	Recommended settings	89
8.4	Open space protection	90
8.4.1	Monitored area	90
8.4.2	Mounting.....	91

Building safety and security

8.4.3	Accessories.....	91
8.4.4	Recommended settings.....	91
8.5	Roof protection.....	92
8.5.1	Monitored area.....	92
8.5.2	Installation situation	92
8.5.3	Accessories.....	92
8.5.4	Recommended settings.....	92
8.6	Painting protection.....	93
8.6.1	Monitored area.....	93
8.6.2	Installation situation	93
8.6.3	Accessories.....	94
8.6.4	Recommended settings.....	95
8.7	Parameter assignment for SICK OPC server	96
9	Appendix.....	98
9.1	List of tables.....	98
9.2	List of figures.....	99
9.3	Keywords index	101

1 About this document

1.1 Purpose 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 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 detector
- Laser detector applications
- Detection ranges
- Devices and accessories
- Project planning
- Scalable solutions with OPC
- Project planning examples

Note The laser detectors mentioned in this document are not safety devices for human protection and therefore do not comply with any safety standards.
For safety applications, please contact SICK AG.

1.4 Abbreviations used

LMC SICK AG laser measurement system – certified
LMS SICK AG laser measurement sensor
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 meant to help you make decisions about using a certain function or technical measure.

Note Notes provide information on specific aspects of a device or application.

➤ **Take action** Instructions for taking action are indicated by an arrow. Read and follow them carefully.



WARNING

Warning

A warning indicates a specific or potential hazard. This is to protect you against accidents and protect devices from damage.

Read and follow the warnings carefully.



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

1.6 Legal information

The application graphics and project planning examples contained in this manual, and their recommended settings, are not legally binding. They are not necessarily 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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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 is less expensive but also 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. However, 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 and larger areas are very difficult to monitor reliably.

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 alone serves more for **identification** than detection and can be perceived as an intrusive breach of the privacy rights of individuals. In addition, 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

Laser-based detection methods are extremely **reliable** and **discreet**. The active scanning laser detector 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 detector sends a signal that 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 an audible siren, switching on lighting, or activating a follow-up system for controlling dome cameras.

Laser-guided detection solutions must function **reliably** regardless of weather and lighting conditions and not be affected by the size and properties of detected objects. They must also be tamper-proof and able to trigger alarms via potential-free outputs.

Particularly for outdoor applications, a **high level of availability** 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 an appropriate enhancement to it. Often one mounting point alone is sufficient for observing and monitoring large areas.

Monitoring fields for which the parameters are set 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 sites ranging from small private buildings to large industrial facilities. The OPC interface also allows for 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 detectors

Laser detectors 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. An area of up to 270° can be scanned, depending on the laser detector used.



Fig. 1: 2D laser detector principle of operation

SICK laser detectors have a scanning frequency of up to 100 Hz. A laser pulse and a corresponding measurement are triggered continuously for each angle in increments of as little as 0.167°.

The detection range of the laser detectors 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 Time-of-flight method

The measurement technology of the 2D laser detectors is based on **time-of-flight measurement**. The laser emits beam pulses 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 detector's receiver.

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

Building safety and security

With the **time-of-flight 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 reflected return pulse being received. Radar systems apply this principle in a similar way.

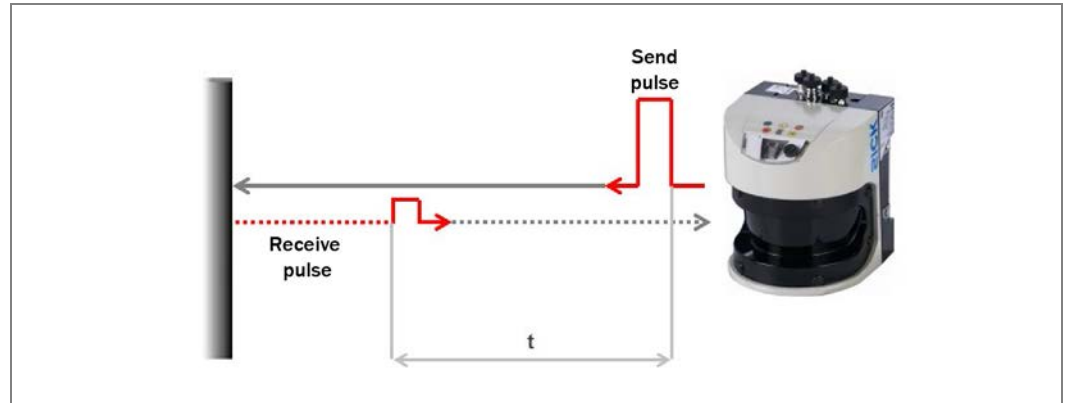
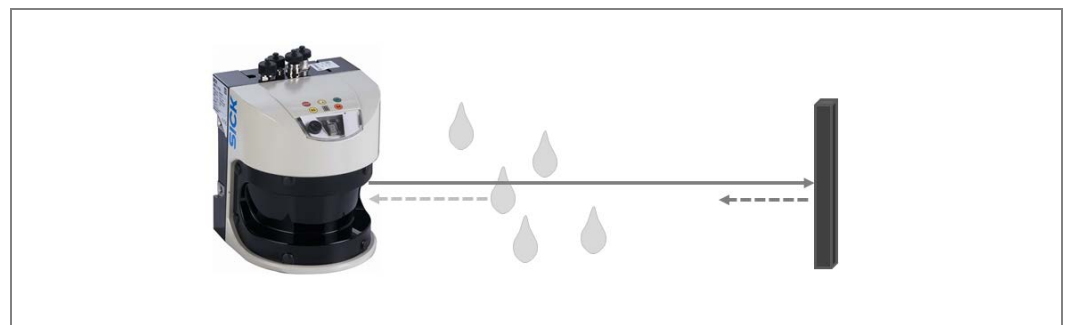


Fig. 2: Time-of-flight principle of operation

2.2.2 Multi-echo method

Interference factors like rain, fog, snow, or dust can influence a laser detector's measurements and reduce the detection range. Additional reflective pulses occur when the laser beam hits smaller particles such as snowflakes or raindrops. Thanks to multi-echo technology, SICK laser detectors can analyze **multiple reflective pulses** to eliminate false alarms caused by environmental factors.



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 **multi-echo time-of-flight 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 can 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%.

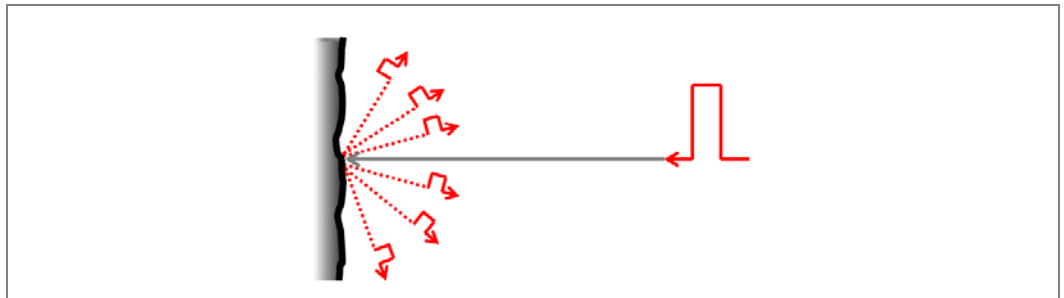


Fig. 3: Reflection of light on the surface of the object

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 detector 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 detector is therefore reduced.

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

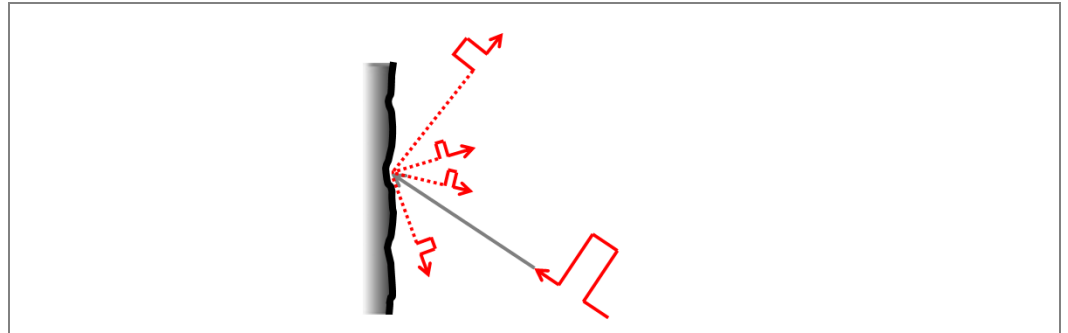


Fig. 4: Angle of reflection

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 detector. Plastic reflectors (cat's eyes), reflective tape, and triple prisms have these properties.

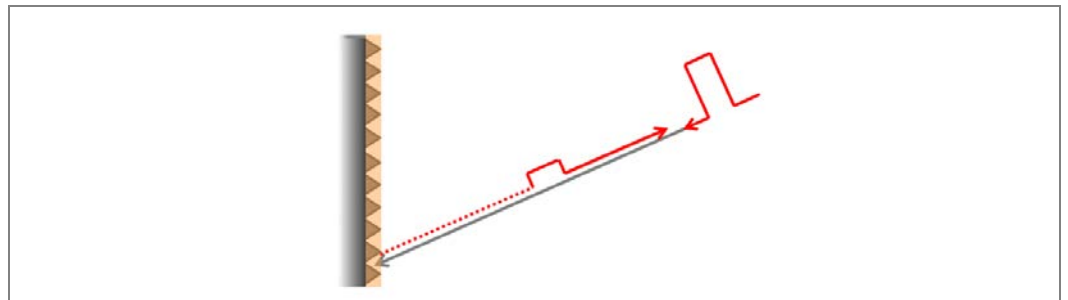


Fig. 5: Reflection from prism-based reflector

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.

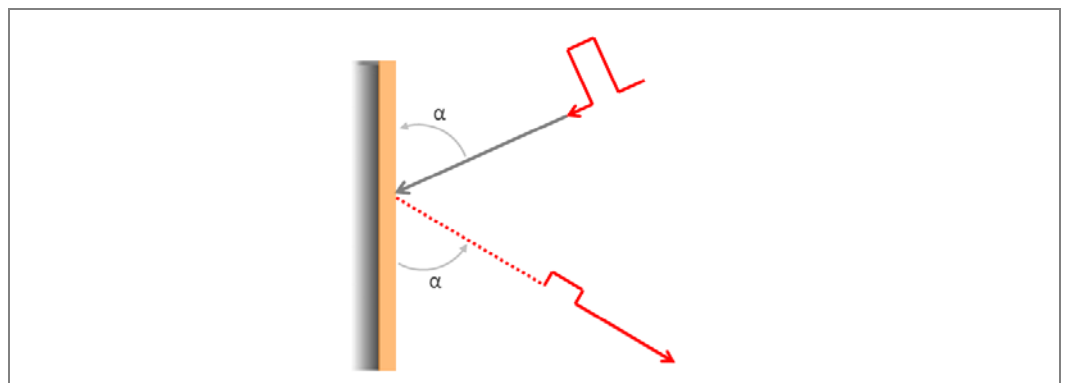


Fig. 6: Reflective surfaces

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 range is less than would theoretically be possible due to the reflective property of the object's surface.

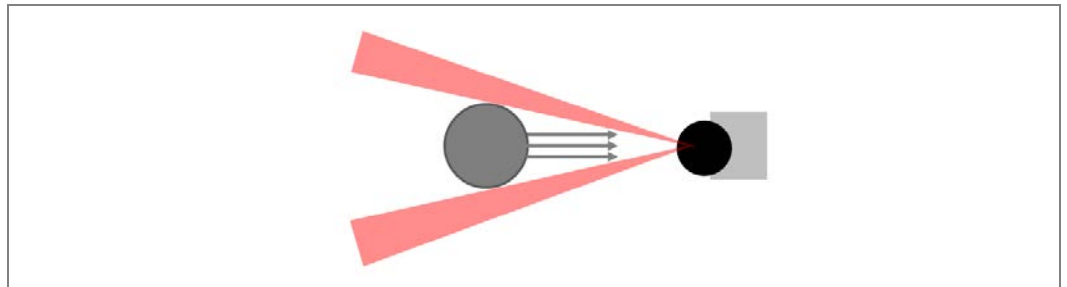


Fig. 7: Beam divergence and object size

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.

3 Laser detector applications

LMS and LMC laser detectors 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 can also be utilized for the monitoring of roofs and ceilings. People or objects entering the detection range of the laser detector 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 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.

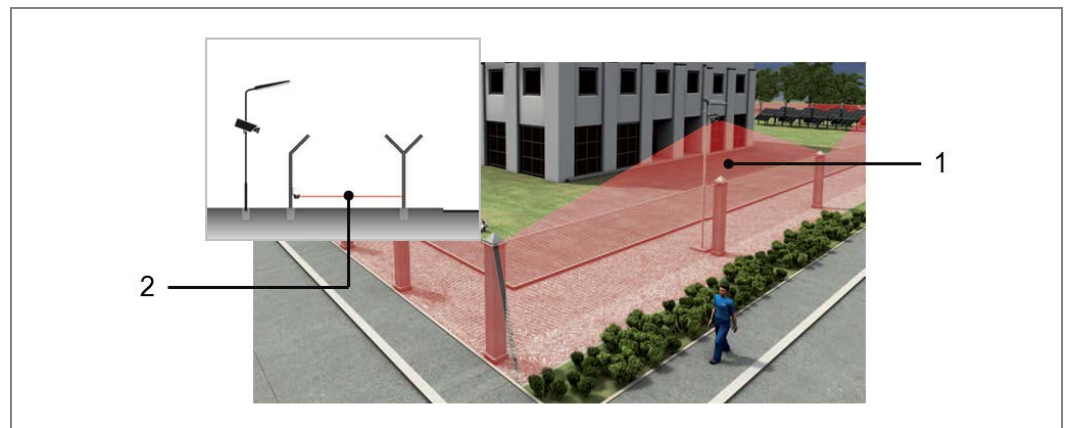


Fig. 8: Monitoring fences, double fences, and walls

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

Overview of features and benefits of laser detectors

- Prevention of undetected intrusion into an area
- Detection of events at the perimeter of an area (fenced areas, , courtyards)
- 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., walls and fences)

3.2 Monitoring of open spaces

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



Fig. 9: Monitoring of open spaces

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

Overview of features and benefits of laser detectors

- Real-time monitoring up to 270°
- Precise demarcation possible
- Insensitive to interference from movements outside of the monitoring area
- Blanking of certain areas possible
- Easy adjustment to changes in monitoring conditions
- Shape of monitoring areas 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 monitoring 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 2D laser system (1) scans the environment over a radius up to 270° using invisible laser beams. As soon as a monitoring area is violated, the coordinates for the area violated (2) are transmitted to a higher-level control and alarm management system.

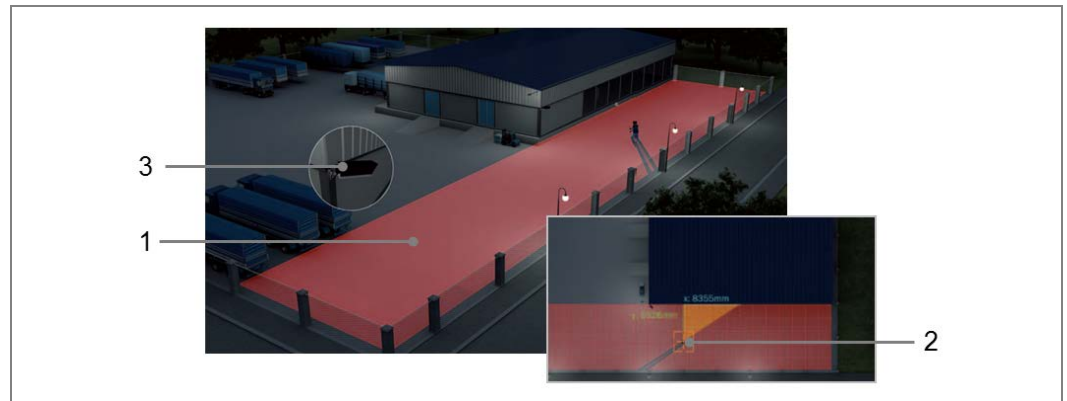


Fig. 10: Camera management and object tracking in open spaces

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

Overview of features and benefits of laser detectors

- Intruders can be detected early using targeted object images
- Event-controlled camera guidance and object tracking
- Automatic tracking of the moving object
- Detection of several objects/persons simultaneously
- Simplifies surveillance task for security guards
- Efficient recording facilitated 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 detectors are usually used vertically for the monitoring of facades. Thanks to the freely definable size of the monitoring fields, just a few systems are required, making safety and security both effective and inexpensive. In day mode, limited monitoring areas can be defined (1). In night mode, the entire facade can be monitored (2).

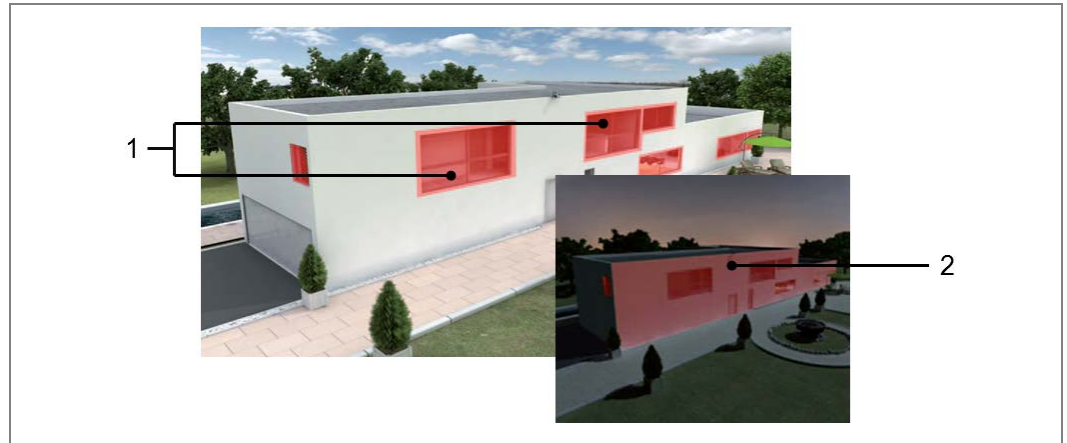


Fig. 11: Outer shell protection (facades)

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

Overview of features and benefits of laser detectors

- Large monitoring area
- As many surrounding contours as desired can be stored as references
- Detects excavation
- No impairments from surrounding lighting
- Blanking of fixed-position obstacles (e.g., walls and fences)
- Detects tampering with the sensor

3.5 Roof protection

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

The monitoring area 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 area can also be placed slightly above the edge of the roof so that ladders, for instance, are detected at once. Roof structures creating shadows are taken into account in the planning of the monitoring fields.

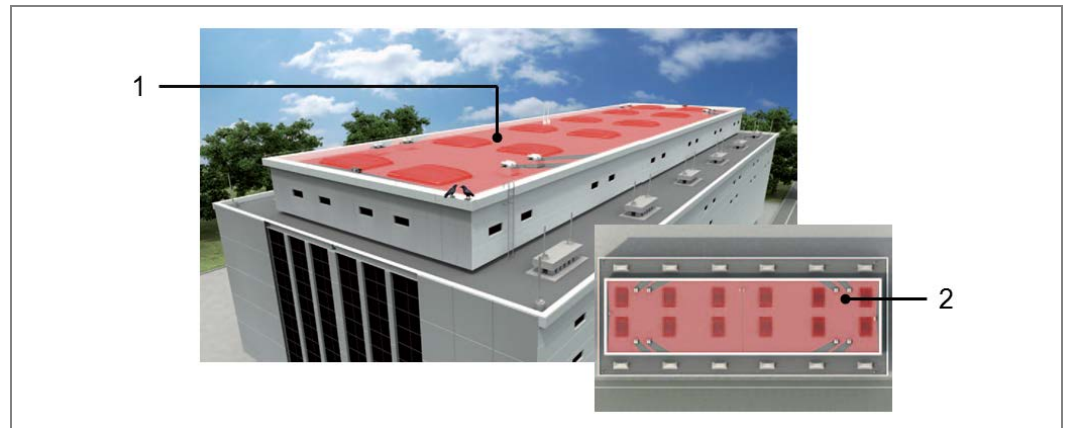


Fig. 12: Roof protection

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

Overview of features and benefits of laser detectors

- High level of protection against intrusion
- Seamless monitoring of skylights
- Early alarm in the event 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 detectors are used for large areas. Often just one laser detector will need to be installed to monitor several skylights simultaneously (1).

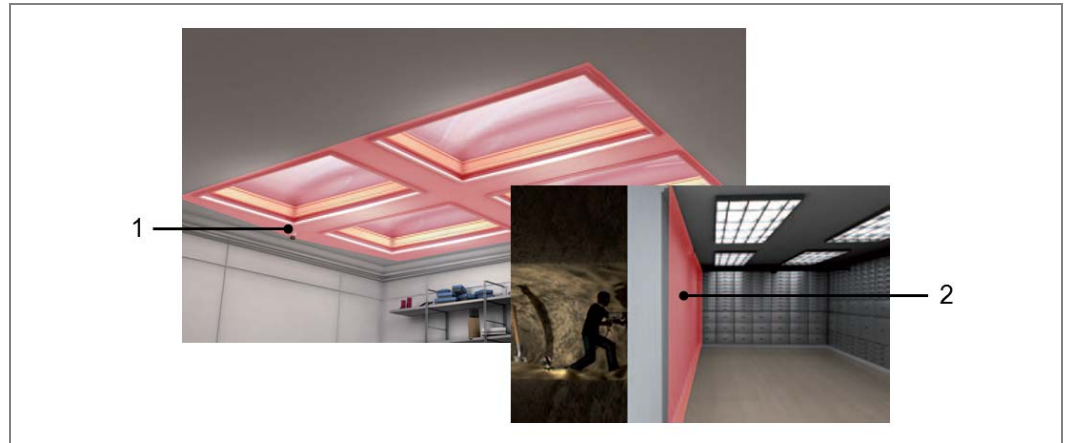


Fig. 13: Ceiling monitoring and wall penetration protection

Interior walls are protected from penetration (2) by a laser detector in the same way as a facade. This method is also useful for warehouse facilities with thin metal walls.

Overview of features and benefits of laser detectors

- Low-cost, easy installation (sender and receiver in single housing)
- Offset areas possible
- Different field geometries (shapes) possible
- Excellent detection of wall penetrations

3.7 Painting protection

Laser detectors 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).

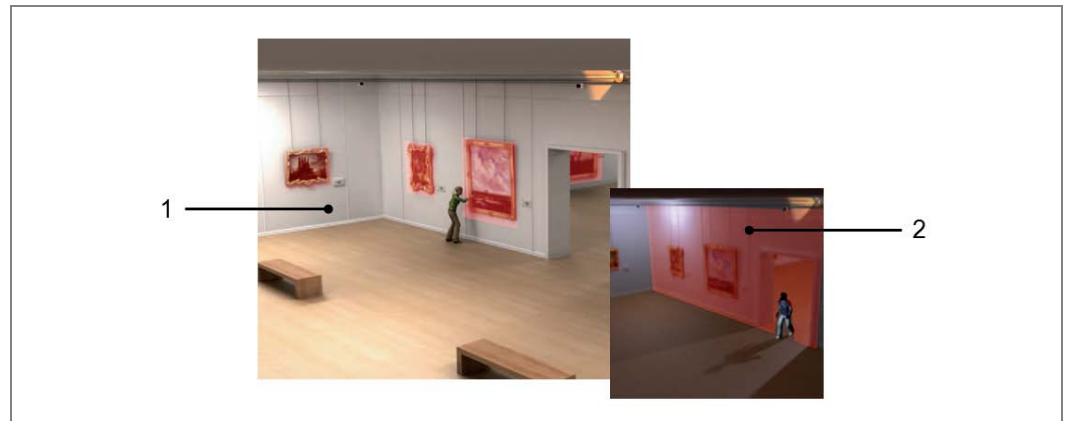


Fig. 14: Painting protection

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

Overview of tasks and benefits of laser detectors

- VdS-certified systems available
- Simple, nearly-invisible installation
- Annunciators (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 detectors.

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
Detection of human body	≥ (300 mm x 300 mm)
Detection of human arm/hand	≥ (40 mm x 40 mm)

Environmental influences

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

Scanning range of the laser detector

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 detector has the required scanning range. An overview of this is provided in the device overview in the following chapter.

Extra laser detector 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 detector is not correct due to environmental conditions, the number of lasers 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 detectors can be used for a wide range of monitoring scenarios. SICK has the right laser detector for any monitoring situation, both indoor and outdoor.

The right device can be selected using the following flowchart.

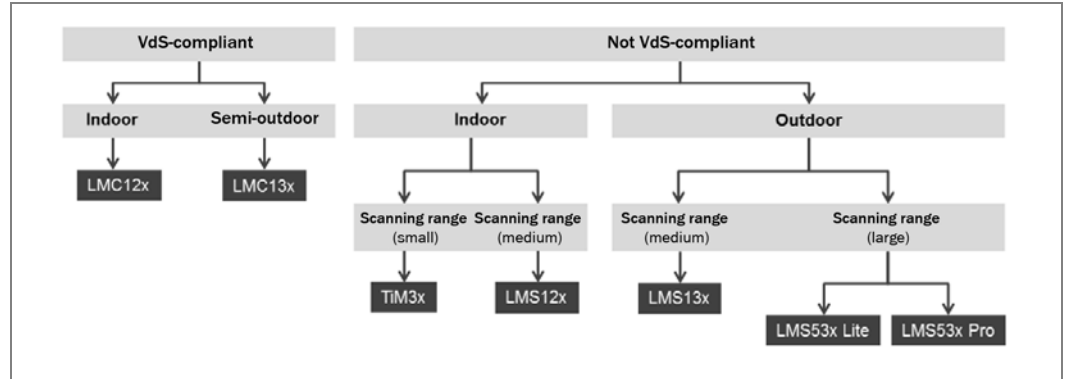


Fig. 15: Flowchart for device selection

Monitoring in accordance with VdS guidelines

LMC1xx laser detectors 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 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 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 detector 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 detector (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 detector (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 its multiple options for analysis, which are 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 detectors 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 detectors 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	Application
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	Indoor
TiM320-1031000	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	Indoor
TiM351	The TiM351 laser detector is designed for outdoor use, but can also be used for indoor monitoring.*	Indoor

Tab. 2: Devices 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**.

Building safety and security

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.

TiM351	Operating ambient 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	Outdoor
LMS13x	Laser detector (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	Outdoor
LMS531 Lite/ LMS531 Pro	Laser detector (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: <ul style="list-style-type: none"> • Scanning frequency: (Pro = higher scanning frequency) • Number of echoes (Lite = 2, Pro = 5) • Switching inputs (Lite = 3, Pro = 4) • Switching outputs (Lite = 2 potential-free semiconductor outputs in relay function, 1 digital output, Pro = 4 potential-free semiconductor outputs in relay function) • Interfaces (pro = additional CAN and RS-422) • Raw data output (Pro = yes) 	Outdoor

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	
					0 - 45 °C	0 - 50 °C	30 - 50 °C	65	67	Class C
1051287	LMC121-11000	x		RAL7032 - gray	x			x		x
1051314	LMC121-11001	x		RAL7032 - gray		x		x		x
1051300	LMC122-11000	x		RAL9005 - black	x			x		x
1051315	LMC122-11001	x		RAL9005 - black		x		x		x
1051301	LMC123-11000	x		RAL9003 - signal white	x			x		x
1051316	LMC123-11001	x		RAL9003 - signal white		x		x		x
1051487	LMC131-11101		x	RAL7032 - gray			x		x	x
1051488	LMC132-11101		x	RAL9005 - black			x		x	x
1051489	LMC133-11101		x	RAL9003 - signal white			x		x	x

Electronics

Model name	Inputs	Outputs	Voltage range
	4 semiconductor inputs, e.g., for <ul style="list-style-type: none"> • Armed / disarmed • Walk-through test • Day/night • Easy teach-in 	2 potential-free semiconductor outputs in relay function <ul style="list-style-type: none"> • Alarm • Error 1 additional tamper output (tamper contact of optical cover)	9 - 30 V
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	RS-232	RS-422	RS-485	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		Visible 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	RAL7032 - gray	x		x	
1044322	LMS122-10000	RAL9005 - black	x		x	
1044321	LMS123-10000	RAL9003 - signal white	x		x	

Electronics

Model name	Inputs	Outputs	Voltage range	
			9 - 30 V	10 - 28 V DC
	4 semiconductor inputs, e.g., for <ul style="list-style-type: none"> Armed / disarmed Walk-through test Day/night Easy teach-in 	2 potential-free semiconductor outputs in relay function <ul style="list-style-type: none"> Alarm Error 1 additional tamper output (tamper contact of optical cover) 	4 semi-conductor outputs	
TiM320-1031000	x		x	x
LMS121-10000	x	x		x
LMS122-10000	x	x		x
LMS123-10000	x	x		x

Interfaces

Model name	RS-232	RS-422	RS-485	Ethernet	OPC	USB	CAN
TiM320-1031000					x	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		Visible 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
			-10 - 50 °C	-30 - 50 °C	
1067299	TIM351-2134001	RAL7032 - gray	x		x
1051379	LMS131-10100	RAL7032 - gray		x	x
1051402	LMS132-10100	RAL9005 - black		x	x
1051485	LMS132-11100	RAL9005 - black		x	x
1051403	LMS133-10100	RAL9003 - signal white		x	x
1055376	LMS531-11100 Lite	RAL7032 - gray		x	x
1067356	LMS531-10100 Pro	RAL7032 - gray		x	x

Electronics

Model name	Inputs		Outputs		Voltage range		
	4 semiconductor inputs, e.g., for • Armed / disarmed • Walk-through test • Day/night • Easy teach-in	3 semiconductor inputs, e.g., for • Armed / disarmed • Walk-through test • Easy teach-in	Potential-free semiconductor outputs in relay function • Alarm • Error	4 semiconductor outputs	9 - 30 V	19.2 - 28.8 V D C	10 - 30 V D C
TIM351-2134001	x			x			x
LMS131-10100	x		2 (+ 1 additional tamper contact of the optical cover)		x		
LMS132-10100	x		2		x		
LMS133-10100	x		2		x		
LMS531-11100 Lite		x	2 + 1 additional tamper contact + 1 additional semiconductor output			x	
LMS531-10100 Pro	x		4 + 1 additional tamper contact + 1 additional disqualification contact			x	

Interfaces

Model name	RS-232	RS-422	RS-485	Ethernet	OPC	USB	CAN
TIM351-2134001				x	x	x	
LMS131-10100	x			x	x		x
LMS132-10100	x			x	x		x
LMS133-10100	x			x	x		x
LMS531-11100 Lite	x			x	x	x	
LMS531-10100 Pro	x	x	x	x	x	x	x

Technical data

Model name	Scanning range		Visible 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			
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		
LMS531-11100 Lite	recommended 35 m (40 m max.)	< 12 m		x		x	x	
LMS531-10100 Pro	recommended 35 m (40 m max.)	< 12 m		x				x

5.3 Accessories



For optimal integration and operation of sensors in the monitoring system, the use of perfectly matched accessories is required.

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



5.3.1 Weather protection covers

To protect the laser detectors outdoors from glare, hail, and direct sunlight, mounting weather protection covers are recommended.

Weather protection covers for LMS13x

	Accessories	Description	Part number
	Weather protection cover outdoor 190°	Sun and rain protection for outdoor applications	2046459
	Weather protection cover outdoor 270°	Sun and rain protection for outdoor applications	2046458

Weather protection cover for LMS531 Lite/Pro

	Accessories	Description	Part number
	Protection cover	Recommended for protection from direct sunlight (heat) and environmental influences Color: RAL7032 gray	2056850
	Weather protection cover	Recommended for protection from direct sunlight (heat) and environmental influences Color: RAL7032 gray	2063050

5.3.2 Mounting kits

VdS-compliant mounting kits

The LMC12x/LMC13x laser detectors with the VdS mounting kits meet the special VdS compliance requirements. A VdS-compliant mounting kit is included with these detectors.

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 prevented.

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. 16: VdS-compliant mounting kits VdS1 long/VdS1 short

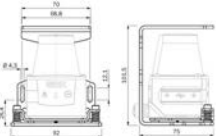
The **VdS1 long** mounting kit (1) completely encloses the LMC12x. The temperature range during VdS-compliant operation runs from 0 °C to +45 °C.

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 semi-outdoor applications.

Mounting kits for TIM320-1031000





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

Mounting kits for TIM351



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

Building safety and security







Mounting kits for LMS12x

	Accessories	Description	Part number
	Mounting kit 1A Indoor	Mounting bracket for rear mounting on the wall (→cannot be used with weather protection cover)	2034324
	Mounting kit 1B Indoor	Mounting bracket for rear mounting on the wall with optical 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




	Accessories	Description	Part number
	Mounting kit for weather protection cover	For 190°/270° weather protection covers	2046025
	Quick release	Mounting kit (2046025) required, makes mounting and removal possible without readjustment (→required when weather protection cover is used, because standard brackets are not suitable)	2046989

Mounting kits for LMS531 Lite/Pro

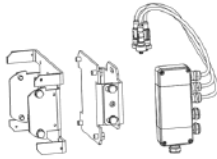
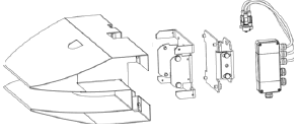
	Accessories	Description	Part number
	Mounting kit 1	Mounting kit 1 for mounting	2015623
	Mounting kit 2	Mounting kit 2 for mounting Mounting kit 1 required	2015624
	Mounting kit 3	Mounting kit 3 for mounting Mounting kits 1 and 2 required	2015625
	Adapter plate	For retrofitting existing LMS2x1 mounting	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 Post brackets

The following mounting kits can be used for mounting LMS531 Lite/Pro outdoor devices on posts.

	Accessories	Description	Part number
	Post bracket	Post bracket requires adapter plate (2059271) or wall bracket (2018303)	2018304
	Adjustable strap for post bracket	Adjustable strap for post bracket (2018304)	5306222
	Adjustable strap lock	Adjustable strap lock for tightening 2 pieces required	5306221

5.3.4 Mounting sets (LMS531 Lite only)


	Accessories	Description	Part number
	Mounting set 1	Mounting set 1 for mounting the LMS531 Lite with connection box Mounting bracket (2059271) Mounting kit (2018303) Connection box (2062346)	1059094
	Mounting set 2	Mounting set 2 for mounting the LMS531 Lite with weather protection cover and connection box Weather protection cover (2056850) Mounting bracket (2059271) Mounting kit (2018303) Connection box (2062346)	1059095

5.3.5 Connecting cables



Both LMC12x and LMS12x indoor devices are wired via the terminal strip of the laser detector. The LMC13x semi-outdoor device and LMS13x, 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 detector and control are bridged, a connection box is available for the LMS13x and LMS531 Lite outdoor devices (see Chapter 5.3.6 **Connection box**).




Ethernet

Devices	Accessories	Description	Part number
	Connecting cable Ethernet to all LMS1xx/LMS5xx	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 LMS5xx	Connecting cable with USB-A/Mini-USB male connectors - 3 m	6042517
	USB cable for configuration of all TiMxxx	Male connector, USB-A, male connector, Micro-B for configuration	6036106

Connecting cables for LMC13x/LMS13x/LMS531 Lite



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

Connecting cables for LMS531 Pro

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

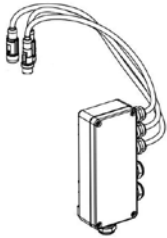
Building safety and security

Extension cable for TiM320-1031000

Devices	Accessories	Description	Part number
	Extension cable	Female connector, D-Sub-HD, 15-pin, 2 m	2043413
	USB cable	Male connector, USB-A, male connector, Micro-B for configuration	6036106

5.3.6 Connection box


A connection box can be used to bridge large distances between the laser detector and the monitoring system. The connection box is available for LMS13x and LMS531 Lite outdoor devices. (See Chapter 6.4.3 Using a connection box.)

Devices	Accessories	Description	Part number
	Connection box	Connection box for power, I/O, and RS-232/RS-422 data (not Ethernet), with three pre-wired M12 cables * The stub cables for the connection box must be laid by the customer. * Not compatible with LMS531 Pro	2062346

5.3.7 CAN module

Eight switching outputs can be added to the existing digital outputs using an I/O module.




Extension module for all laser detectors (except LMS531 Lite)

Devices	Accessories	Description	Part number
	CAN digital I/O module	Extension with 8 extra outputs. Can be replaced by CAN bus in the control center. Available as indoor IP54 or outdoor IP66 - Indoor - Outdoor	6038825 6041328




5.3.8 Power supply

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

Power supply for all LMS1xx laser detectors



Devices	Accessories	Description	Part number
	Power supply unit 24 V DC/2.5 A	For power supply to LMS1xx For power supply to LMS1xx for indoor applications (does not provide power for heating)	6022427
	Power supply unit 24 V DC/3.9 A	For power supply to LMS1xx for electronics and heating	7028790
	Power supply unit 24 V DC/4 A	For power supply to LMS1xx for electronics and heating	6010362

Power supply for all LMS531 Lite/Pro laser detectors

Devices	Accessories	Description	Part number
	Switching power supply 24 V/10 A	For power supply to LMS5xx for electronics and heating	6032863
	Switching power supply 24 V/10 A	For power supply to LMS5xx for electronics and heating	6020875
	Switching power supply 24 V/20 A	For power supply to LMS5xx for electronics and heating	6033968

5.3.9 Scan finder

The scan finder helps locate the laser beam.

Devices	Accessories	Description	Part number
	Rod Eye Plus scan finder	Infrared receiver for locating the laser beam	7019328
	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 safety analysis and use that to create a safety concept that is tailored to the threat 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 the defined safety concepts.

The threat situation and the appropriate protective measures to be taken are determined by the following factors:

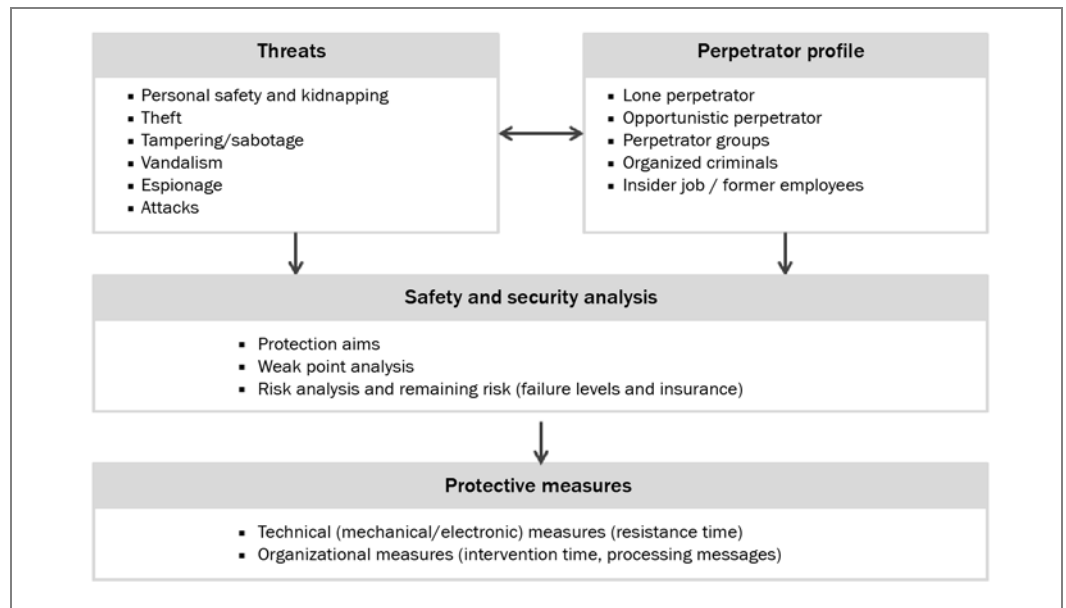


Fig. 17: Analysis of the threat situation

The sensitivity of the laser detector 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 detectors. The sensor should be mounted so that it is protected from tampering.

Facade protection	Obstructions/Issues	What to do
	Grass, bushes, or trees that are growing in the monitored area	<ul style="list-style-type: none"> ➤ Use automatic field adjustment (available for LMS13x 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	<ul style="list-style-type: none"> ➤ 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	<ul style="list-style-type: none"> ➤ "Cut out" (blank) the ventilation outlets ➤ Use a fog filter
	Antennas in the monitored area	<ul style="list-style-type: none"> ➤ "Cut out" (blank) the antennas
	Snowdrifts or snow accumulation in winter	<ul style="list-style-type: none"> ➤ Use automatic field adjustment (available for LMS13x and LMS531 Pro) ➤ Increase the distance between the bottom field edges and the ground
	Highly reflective (wet) windowsills/blinds	<ul style="list-style-type: none"> ➤ Increase the minimum object size
	Falling leaves or accumulation of leaves in autumn	<ul style="list-style-type: none"> ➤ Increase the minimum object size ➤ Use automatic field adjustment (available for LMS13x and LMS531 Pro) ➤ Increase the distance between the bottom field edges and the ground

Tab. 5: Preliminary considerations (facade protection)

Fence protection	Obstructions/Issues	What to do
	Grass, bushes, or trees that are growing in the monitored area	<ul style="list-style-type: none"> ➤ Use automatic field adjustment (available for LMS13x and LMS531 Pro) ➤ Increase the distance between the bottom field edges and the ground
	Snowdrifts, snow accumulation	<ul style="list-style-type: none"> ➤ Use automatic field adjustment (available for LMS13x and LMS531 Pro) ➤ Increase the distance between the bottom field edges and the ground
	If mounted on a post: unsteady or swaying post	<ul style="list-style-type: none"> ➤ Reduce the analysis field ➤ Use suitable posts

Tab. 6: Preliminary considerations (fence protection)

Building safety and security

Open space protection

Obstructions/Issues	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 or near paths)	➤ Increase the distance between the field edges and any walls or similar
Foliage, leaf piles or accumulation of leaves	<ul style="list-style-type: none"> ➤ Increase the minimum object size ➤ Increase the analysis time ➤ Increase the distance between the field edges and any walls or similar
Ventilation outlets	<ul style="list-style-type: none"> ➤ "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

Obstructions/Issues	What to do
Ground fog as it drops	<ul style="list-style-type: none"> ➤ Use a fog filter ➤ Use the contour as reference ➤ Plan in more "functional reserves"
Ventilation outlets/ chimneys and smokestacks	<ul style="list-style-type: none"> ➤ Use a fog filter ➤ Use the contour as reference ➤ "Cut out" (blank) the monitored area accordingly
Antennas	➤ "Cut out" (blank) the monitored area accordingly
Snowdrifts	➤ "Cut out" (blank) the monitored area accordingly
Large birds on the roof	<ul style="list-style-type: none"> ➤ Increase the minimum object size ➤ Implement suitable measures to keep birds away
Reflective roof edges	<ul style="list-style-type: none"> ➤ 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 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.
- 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.

6.3 Heating

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

The laser detectors for LMC13x, LMS13x, and LMS531 Lite/Pro 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 detector too quickly.

The heating strategies vary for the different laser detectors:

LMC13x/LMS13x 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 detector during startup, the device activates.
- If the temperature is below 0 °C in the laser detector during startup, 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 detectors 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 detectors on fixed surfaces.
- Ensure that the entire field of view of the laser detector is not restricted. Mount the laser detectors so that their detection is not affected or distorted by high grass or branches moving in the wind.
- Mount the laser detectors where shocks and vibrations are minimized.
- Ensure that the laser detector 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 protection cover is recommended for outdoor installations (see Chapter 5.3.1 **Weather protection covers**).

6.4.1 Voltage supply

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

If multiple power supplies 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 detectors have heating, a separate power supply is required for this function.

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

Devices	Supply voltage	Power consumption
LMC12x/LMS12x	9 - 30 V DC *	10 W
TiM320-1031000	10 - 28 V DC *	without output load 3 W
TiM351	10 - 30 V DC *	without output load 3 W
LMC13x/LMS13x	10.8 - 30 V DC *	with maximum heating output 60 W
LMS531 Lite/Pro	19.2 - 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 detectors (overview)

6.4.2 Connecting cables

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

Consider the following when determining the number of cores:

- Power supply to the devices
- Connection of the alarm signal (alarm output etc.)
- External control cables (armed/disarmed, 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 ferrules 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 detectors are connected to the terminals of the laser detector via cable glands. The shield 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.

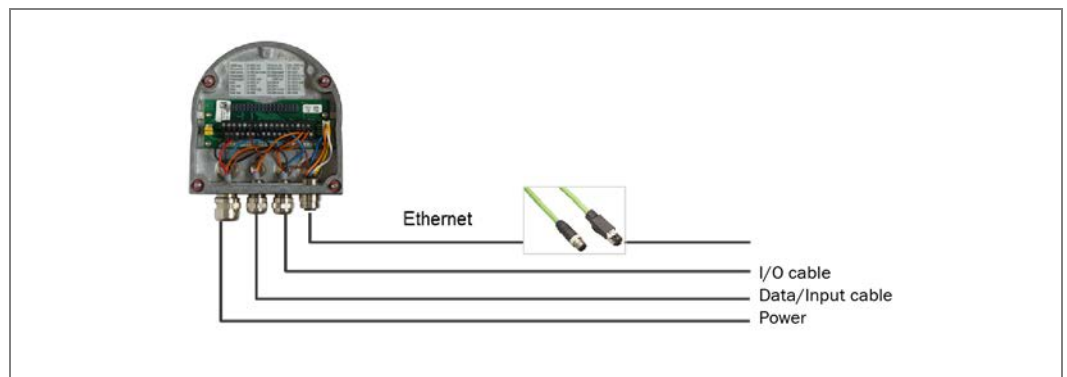


Fig. 18: LMC12x/LMS12x connecting cables

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

Signal type	Length	Cross-section (mm ²)
Supply voltage (12 V)	< 5 m	0.25
	< 10 m	0.5
	< 20 m	1
I/O signal	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**.

Building safety and security

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

TiM320-1031000

The TiM320-1031000 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 to be connected to the distribution unit of the monitoring system on its open end.



Fig. 19: TiM320-1031000 connecting cables

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

TiM351

The connecting cables of the TiM35x laser detector have an M12 plug connector for connecting to the laser detector 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.

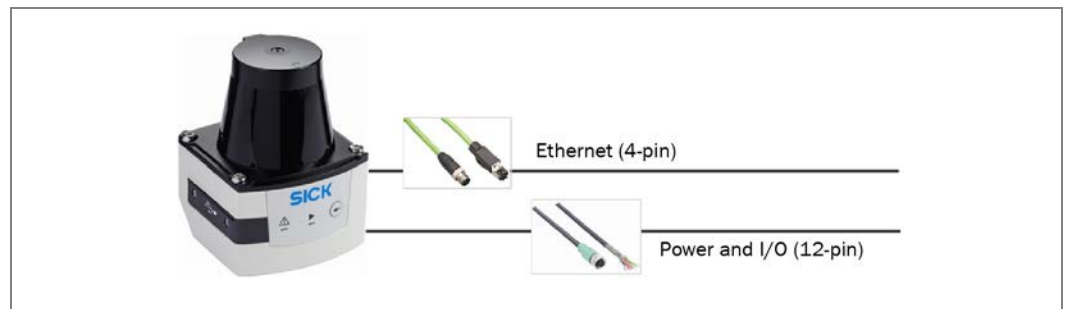


Fig. 20: TiM351 connecting cables

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

LMC13x/LMS13x

The connecting cables of the LMC13x laser detector have an M12 plug connector for the connection of the laser detector and an open end that is to be connected to the distribution unit of the monitoring system. They can be ordered as accessories in lengths up to 20 m.

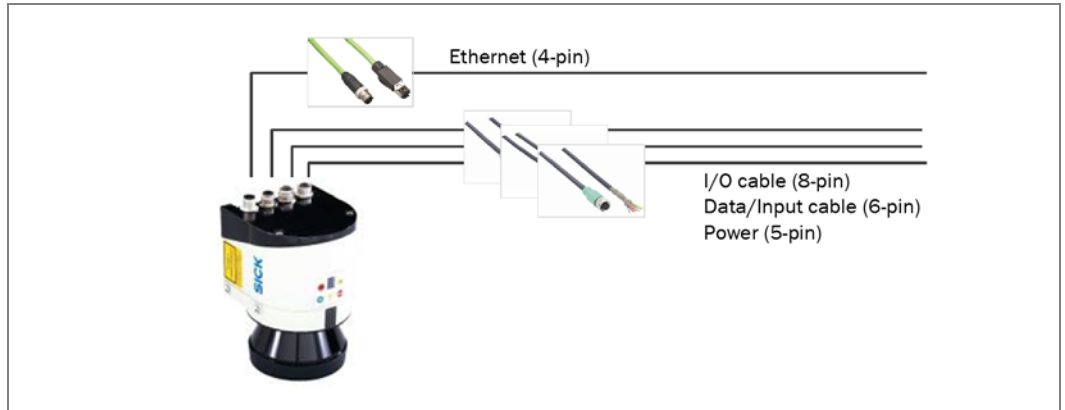


Fig. 21: LMC13x/LMS13x connecting cables

LMS531 Lite/LMS531 Pro

The connecting cables of the LMS531 Lite/Pro laser detector have an M12 plug connector for connecting to the laser detector 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.

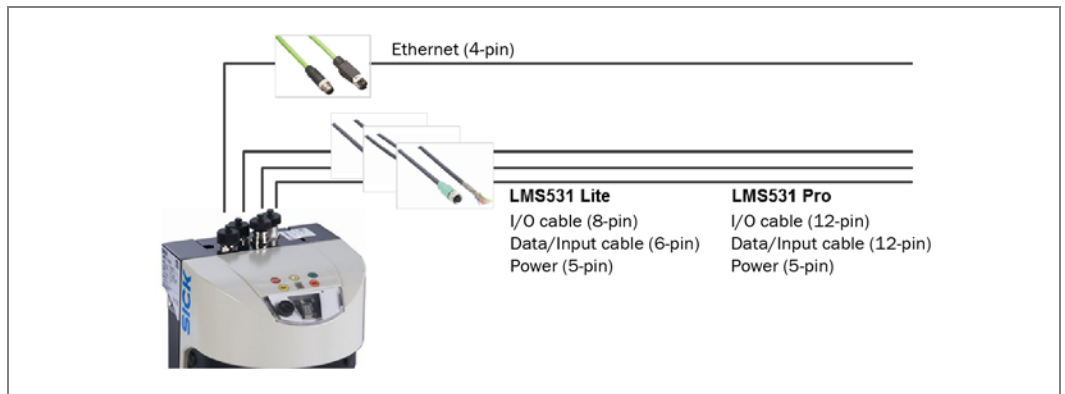


Fig. 22: LMS531 Lite/LMS531 Pro connecting cables

6.4.3 Using a connection box

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

The cable diameter must be between 5 and 12 mm.

The connection box and the laser detector are connected via three pre-assembled cables with M12 plug connectors. The connection has fixed internal wiring. The Ethernet cable is directly connected to the laser detector.

Note The connection box can only be used by LMS13x and LMS531 Lite laser detectors.

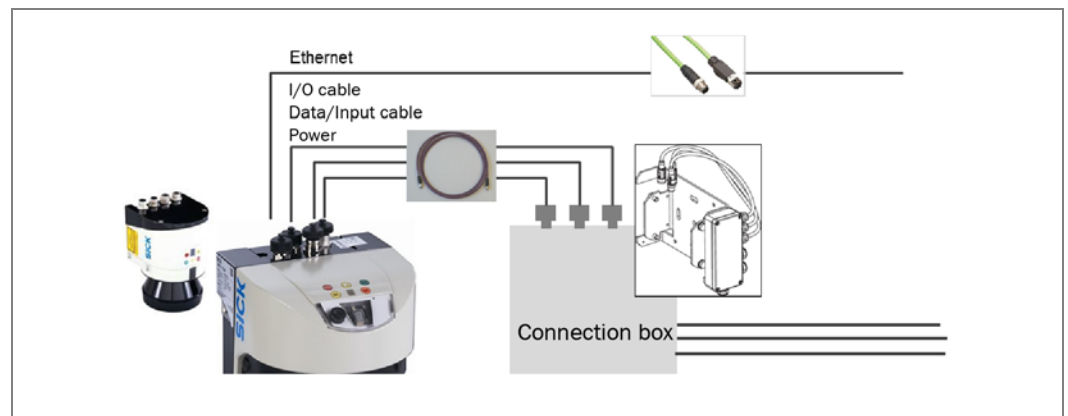


Fig. 23: Connection box connecting cables

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

Signal type	Length	Cross-section (mm ²)
Supply voltage (24 V)	< 50 m	0.25
	< 110 m	0.5
	< 220 m	1
Supply voltage (12 V) →LMS13x only	< 5 m	0.25
	< 10 m	0.5
	< 20 m	1
Heating (24 V)	< 10 m	0.25
	< 20 m	0.5
	< 45 m	1
I/O signal	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 detailed information on assigning terminals, see Chapter 6.7 **Pin assignments**.

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 area monitored by the laser detector 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.

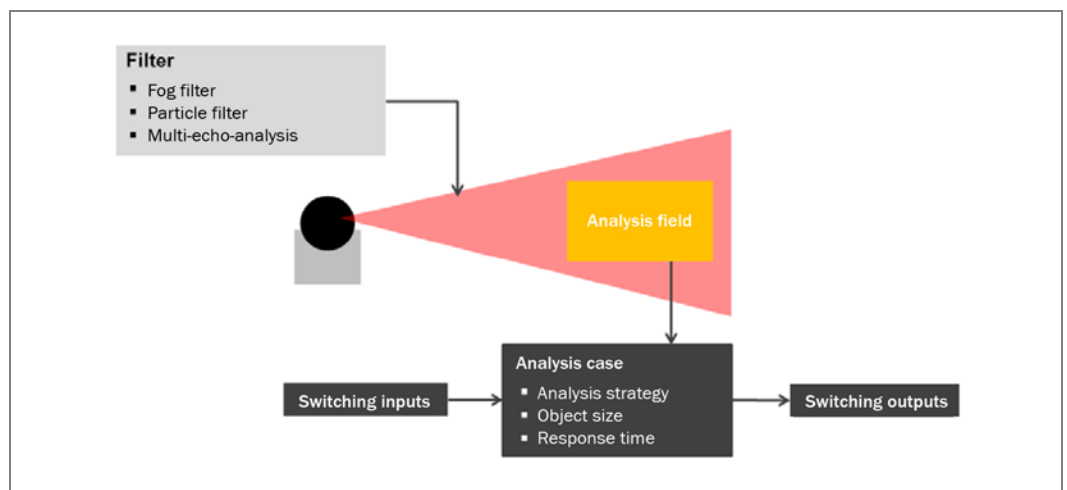


Fig. 24: Filter - analysis fields - analysis cases - switching inputs

6.5.1 Working with filters

The laser detectors 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 glare caused by fog. The laser detector is less sensitive at close range when the fog filter is used.

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

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.

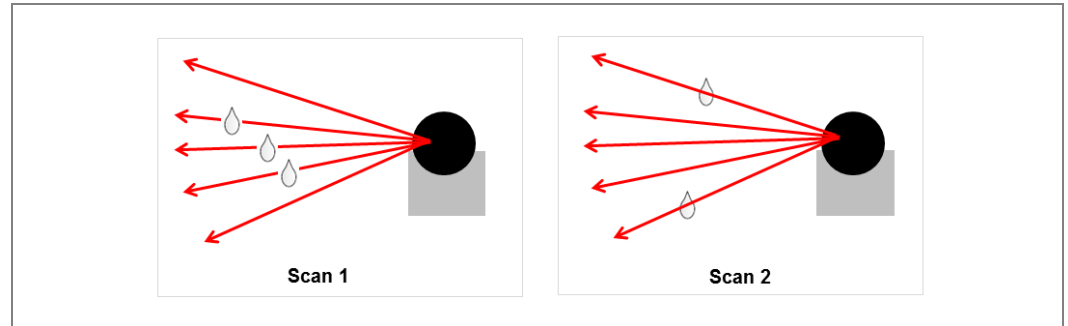


Fig. 25: Particle filter principle of operation

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 detector 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).

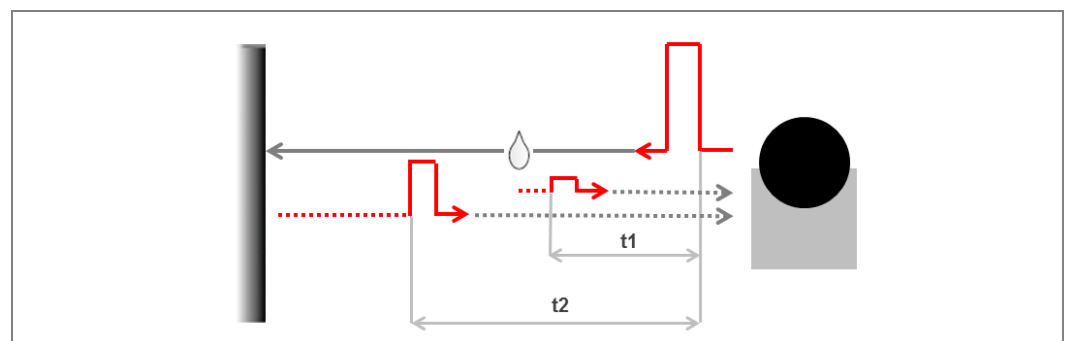


Fig. 26: Multi-echo analysis principle of operation

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 TiM3xx laser detectors.

6.5.2 Defining analysis fields and cases

Analysis fields

The laser detector uses the integrated field application to analyze up to 10 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.

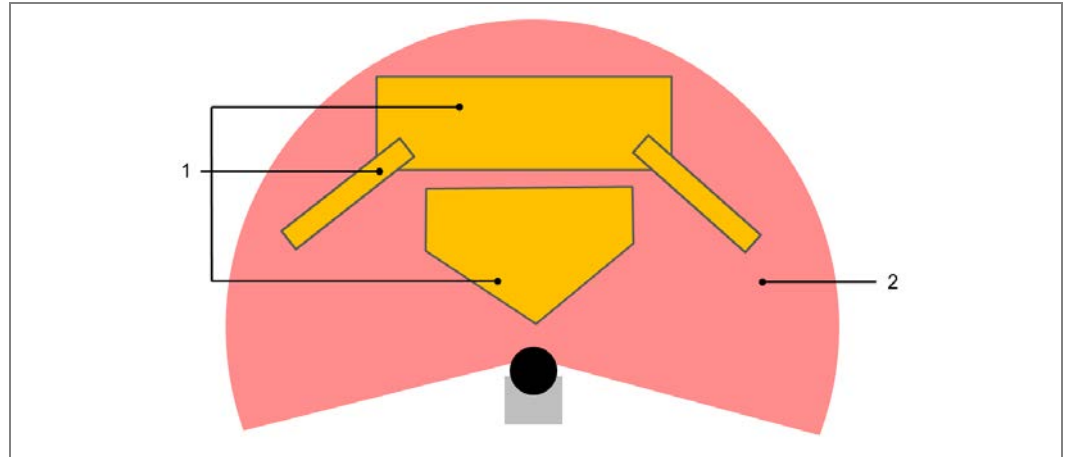


Fig. 27: Scanning range and analysis fields



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.

Analysis cases

Each analysis field is linked to an **analysis case**. An analysis case determines the way the analysis field is evaluated and which switching output is addressed. Up to 10 analysis cases can be created and assigned. Analysis cases adapt the laser detector to the specific analysis situation and determine its detection accuracy.

An analysis 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 workflow results from these parameters:

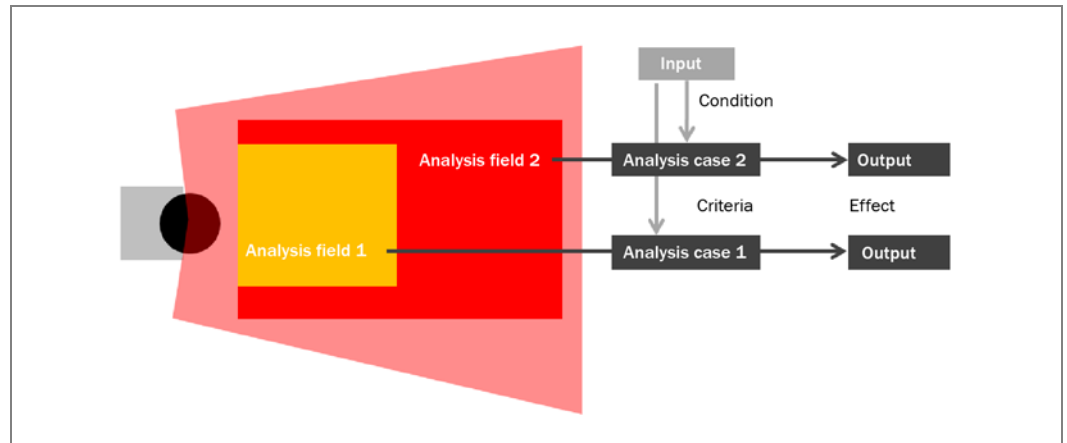


Fig. 28: Analysis cases, principle of operation

- The laser detector 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 analysis 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 analysis 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 analysis 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 **blinking**.

Pixel analysis

The laser detector 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.

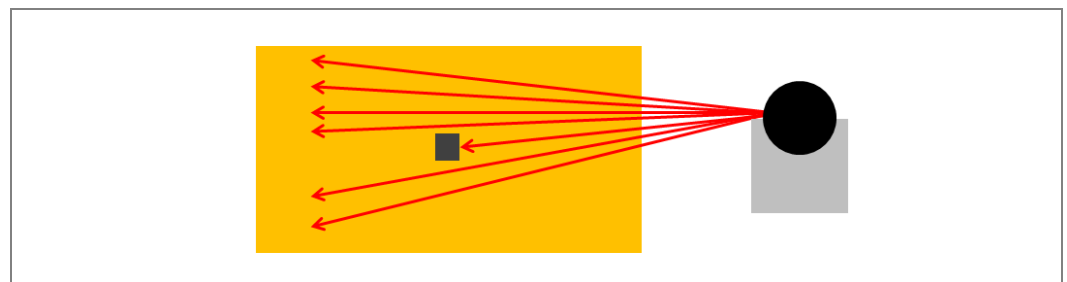


Fig. 29: Pixel analysis principle of operation

Blanking

In this method, the laser detector 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.

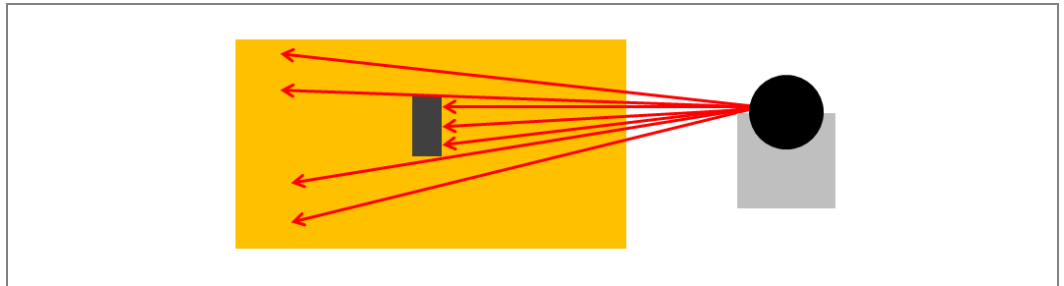


Fig. 30: Blanking principle of operation

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 environmental conditions in question.

The response time is defined for both the **pixel analysis** and **blanking** analysis strategies. For the laser detector 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 detector, the more frequently an object must be detected within the set response time for the analysis strategy used.

Note VdS-compliant laser detectors 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.

Building safety and security

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.

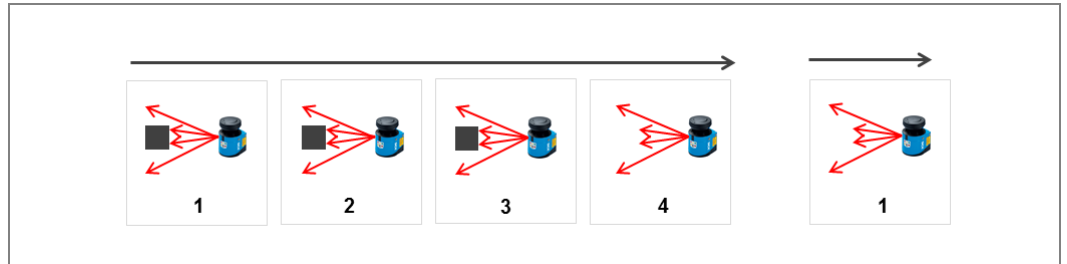


Fig. 31: Example for setting the alarm sensitivity

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.

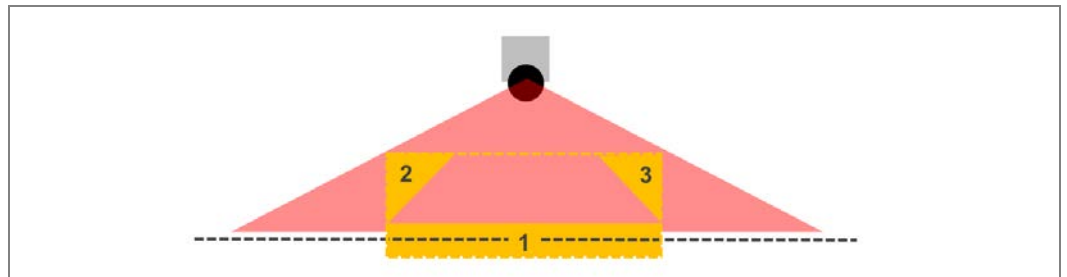


Fig. 32: Analysis strategy using fields

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.

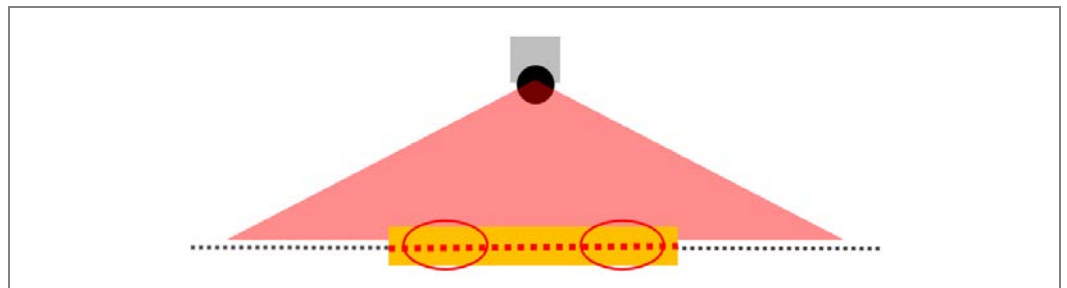


Fig. 33: Contour as reference analysis strategy

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.

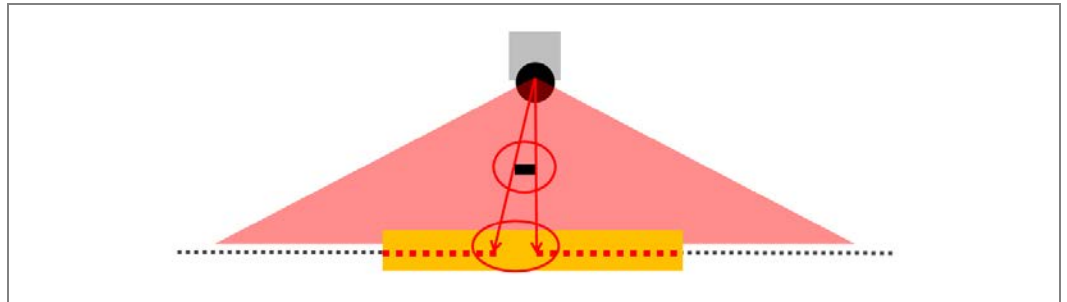


Fig. 34: Contour as reference principle of operation

Fields that 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 reliable protection against tampering and false alarms.

- 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 detector. Because the provided measurement points deviate from the taught-in measurement points of the reference contour, an alarm is triggered.

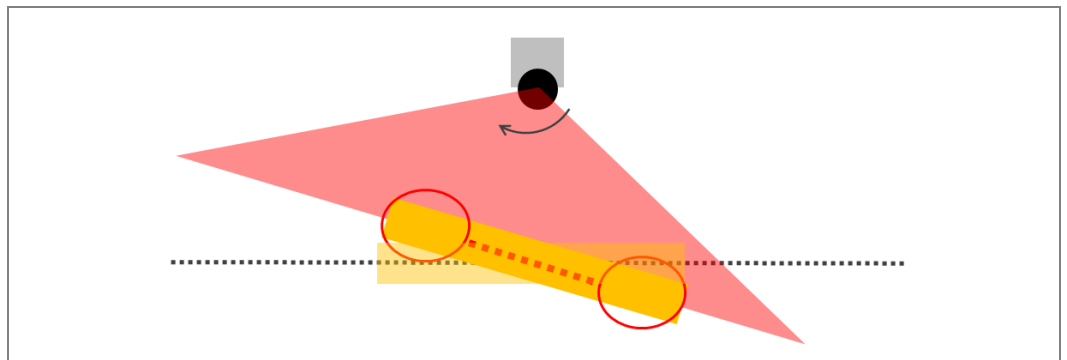


Fig. 35: Protection against tampering thanks to contour as reference

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.

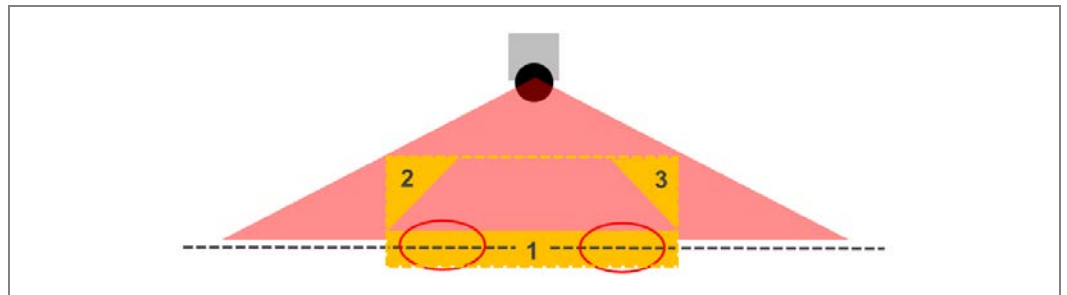


Fig. 36: Combination of analysis strategies: fields and contour as reference

6.5.6 Protecting against shadowing and glare

Shadowing (1) and glare (2) can lead to parts of the analysis field being "invisible" to the laser detector and thus no longer monitored (3).

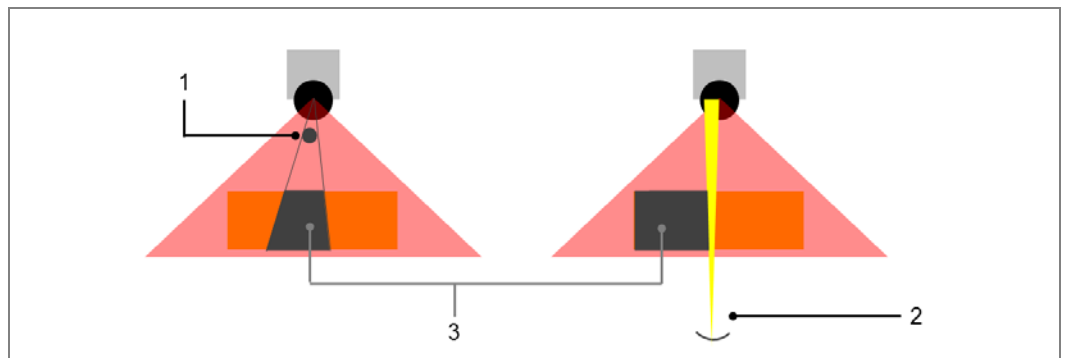


Fig. 37: Tamper-proofing against shadowing and glare

Because the laser detector identifies which area of the field it cannot see at a particular time the risk posed by shadowing and glare 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 detector.

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

Usually the advanced response time should have the same settings 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 environmental conditions will trigger an alarm in the monitored area. Tall grass in the summer or snowdrifts or piles of leaves in the winter are some examples of how monitored areas which have been configured for a specific environmental situation can quickly trigger false alarms when conditions change and no longer suit the configuration.

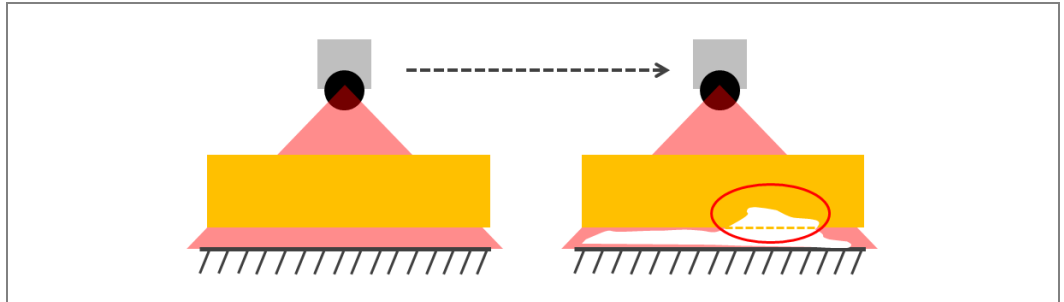


Fig. 38: Field breaches caused by changing environmental conditions

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

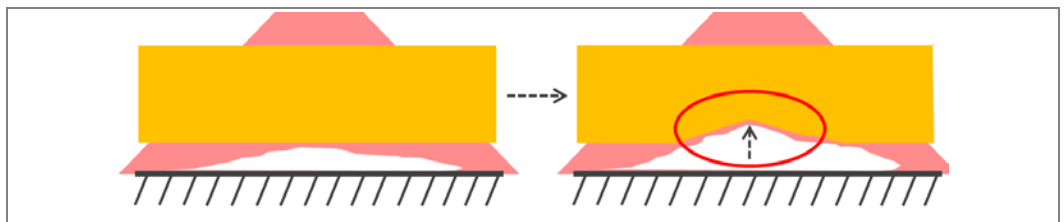


Fig. 39: Automatic field adjustment principle of operation

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 at a faster rate, 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, someone attempting to crawl through the monitored area by raising a board in order to trick the field into adjusting up is prevented. 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 and LMS531 Pro laser detectors.

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 detector 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 detector 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
LMS531 Lite	X	
LMS531 Pro	X	X

Tab. 12: Variants for switching input Teach-In

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

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 detector 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 detector 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.

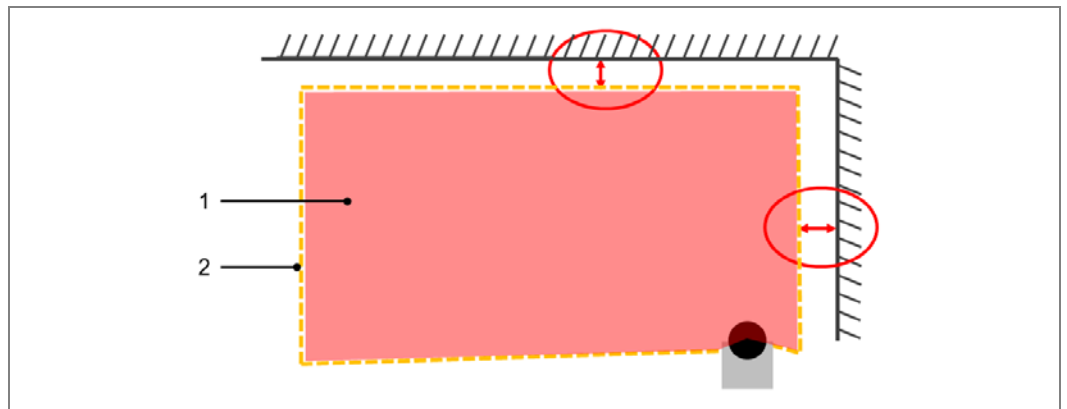


Fig. 40: Easy Teach Lite principle of operation

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.

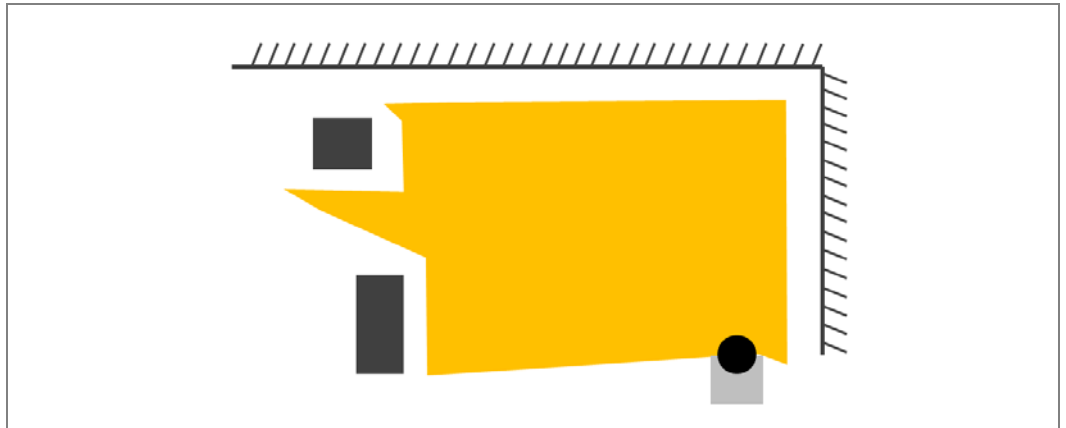


Fig. 41: Easy Teach: blanking objects from the field

Persons using normal access paths in the desired monitoring field can also be taken into account during the teach-in process.

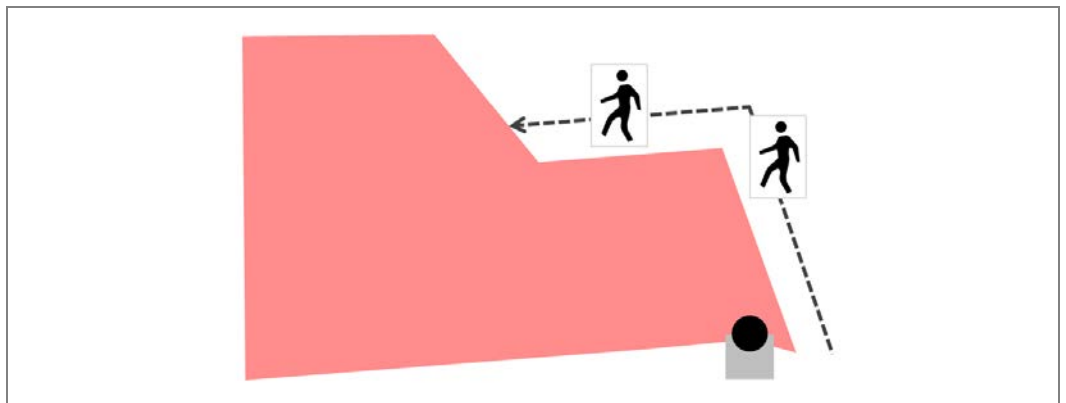


Fig. 42: Easy Teach: entering the monitoring field

Note Since the laser detector 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 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.

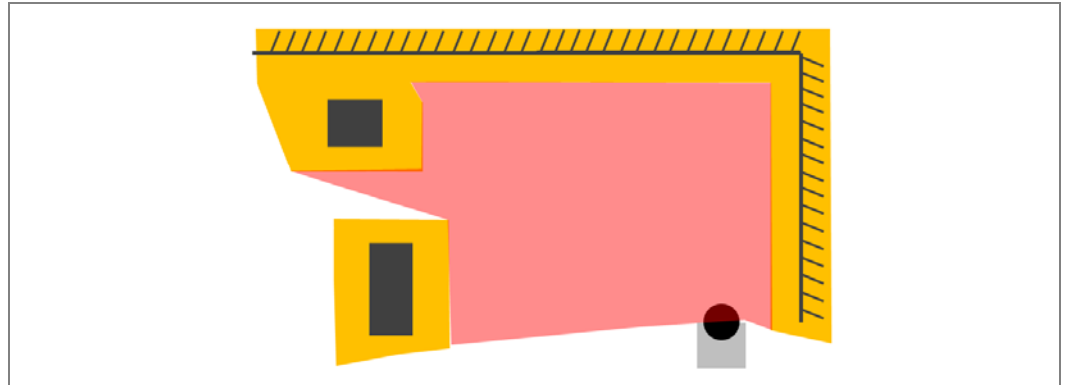


Fig. 43: Easy Teach Lite: further optimizing a field

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**.

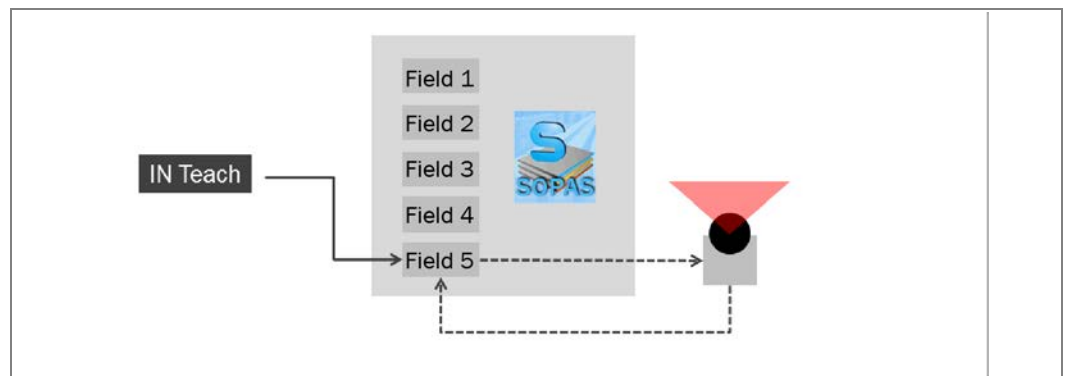


Fig. 44: Easy Teach Pro principle of operation

The figure below shows two analysis fields defined in SOPAS.

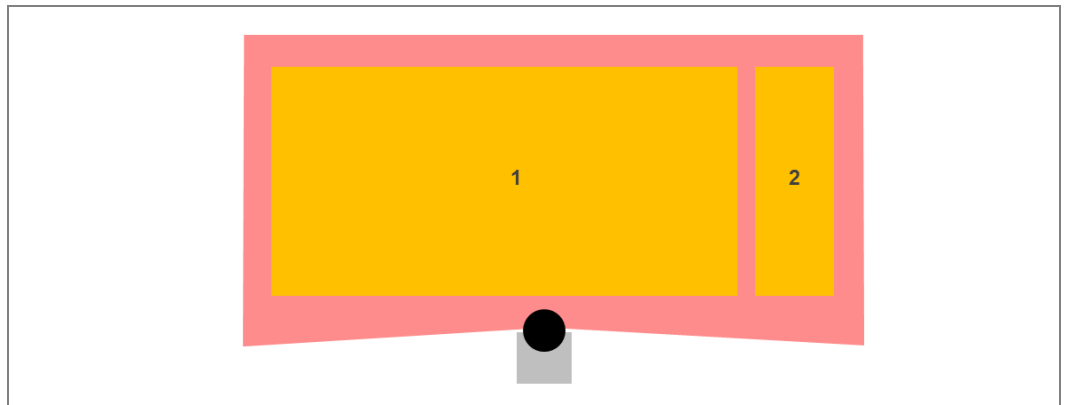


Fig. 45: Easy Teach Pro: monitoring fields before teach-in process

Analysis field 2 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.

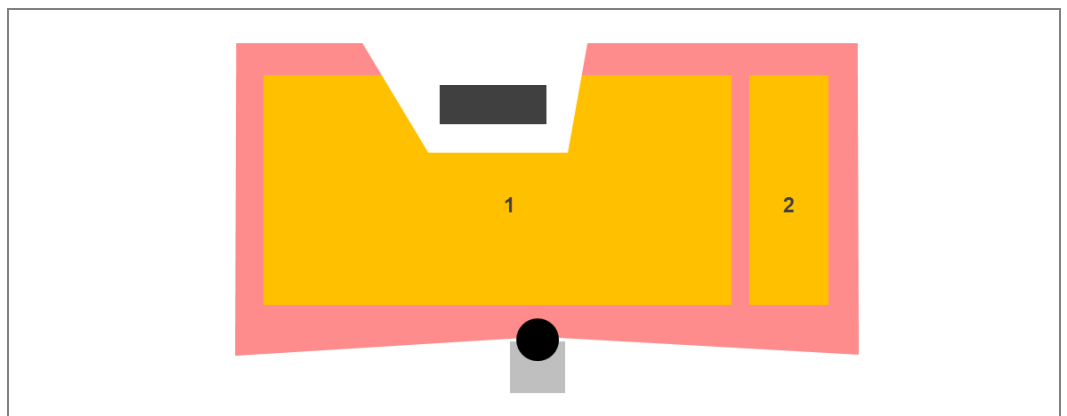


Fig. 46: Easy Teach Pro: monitoring fields after teach-in process

The main benefit of this method is that less configuration of the laser detector 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 the 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**.

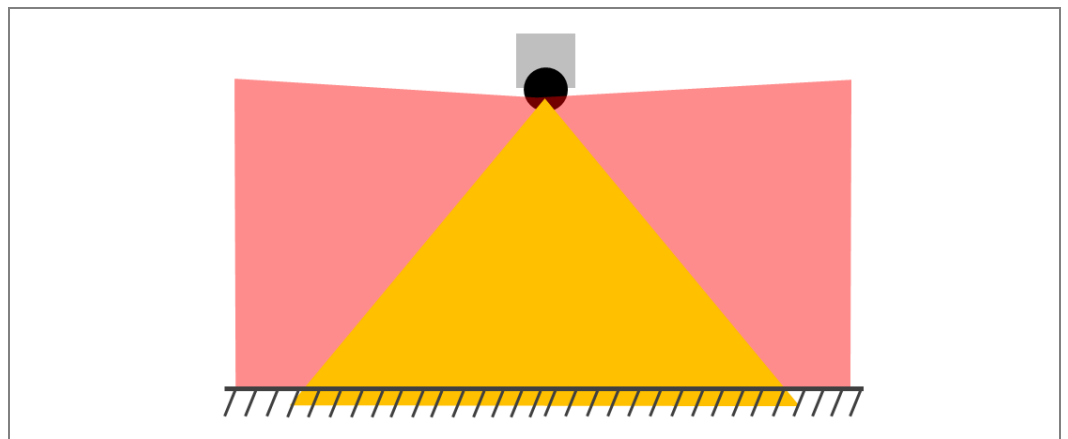


Fig. 47: Easy Teach Pro: master field for contour as reference field

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

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.

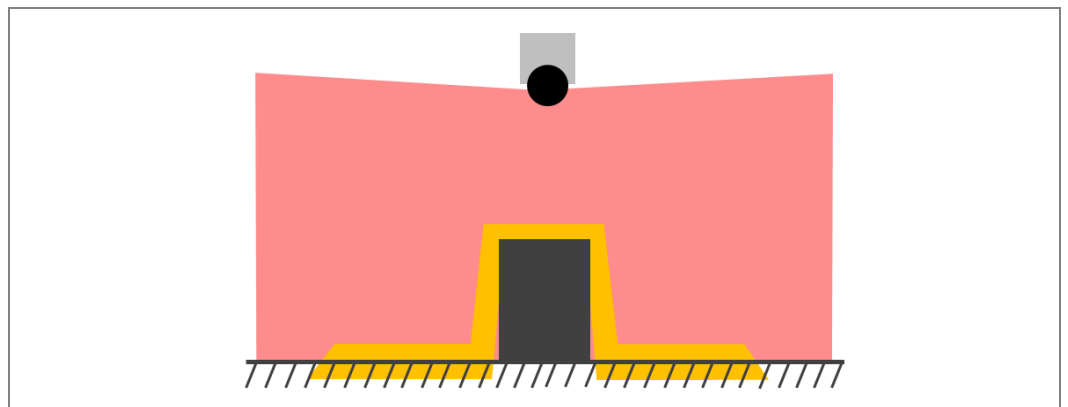


Fig. 48: Easy Teach Pro: contour as reference field after being taught-in with Easy Teach

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 contour as reference teach-in function for the monitoring field 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.

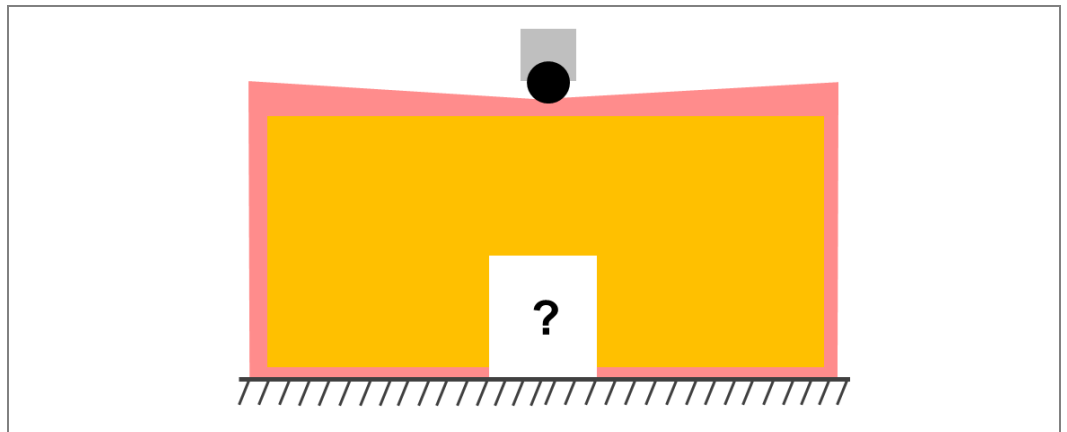


Fig. 49: Easy Teach Pro: problem of using facade monitoring without contour as reference field

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**.

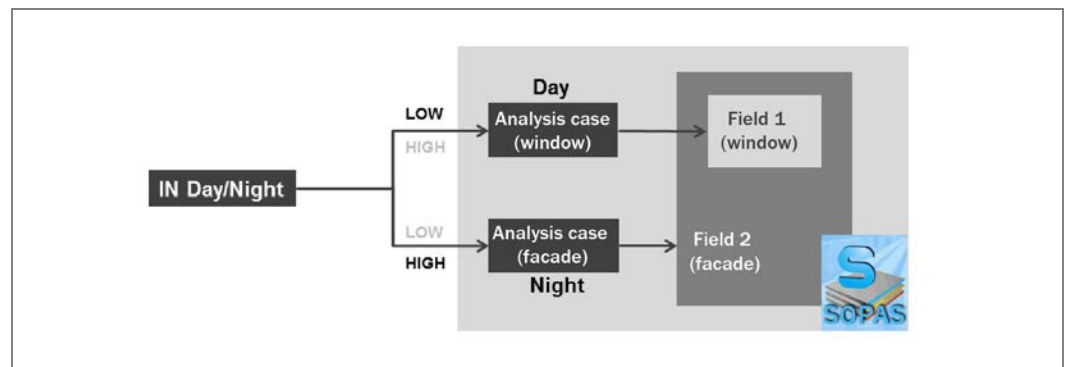


Fig. 50: Activating analysis cases (switching input Day/Night)

Note Day/Night mode is **not** available for TiMxxx and LMS531 Lite laser detectors.

6.6 Configuration of the signaling method

6.6.1 Overview of digital inputs

The laser detector 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 detector 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**.

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 detectors to armed/disarmed

The **Armed/Disarmed** input can be used to switch the laser detector to active for alarm management.

- The laser detector is **switched to armed** when there is **no current** present on the input. In this state, field breaches are registered as alarms via the switching output. The laser detector display cannot be seen. The RS-232 interface is permanently switched off.
- If the **input is switched**, the display can be seen and contamination messages can be viewed. However, a field breach is not displayed and the corresponding LED does not illuminate.
- **Alarm memory:** When the detector is set to "armed," if a monitored area has been breached; this is indicated by LED **Q2** flashing when the detector is switched to "disarmed." The memory is wiped when the detector is switched back to "armed."

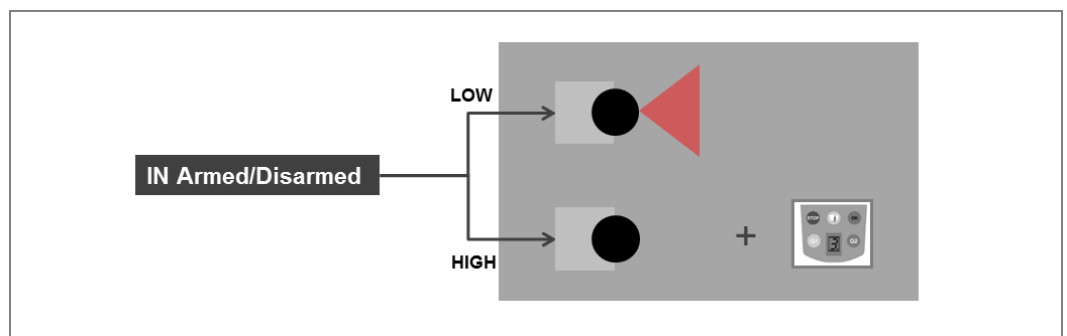


Fig. 51 Switching the laser detector to armed/disarmed (switching input Armed/Disarmed)

Note When set to "disarmed," no field breaches are detected and no conclusions about the monitored area are possible.

6.6.3 Switching the laser detector to walk-through test mode

The **Functional test** input is used to switch the laser detector to walk-through test mode. In this mode, the monitoring functions of the laser detector are checked, by walking through the scanned field.

- 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 detector display cannot be seen. The RS-232 interface is permanently switched off.
- If the **input is switched**, the laser detector 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 detector to be checked by walking through the scanned field.

Faulty switching due to dirty optical covers or tampering with the laser detector by turning it is quickly detected in this manner.

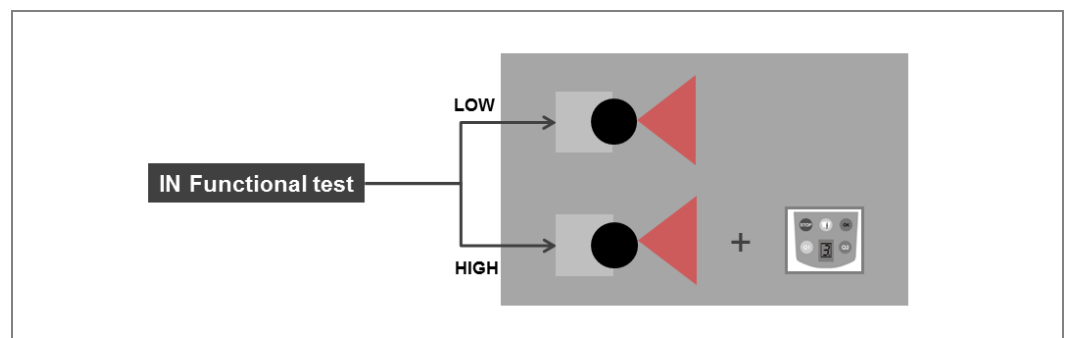


Fig. 52 Walk-through test mode (functional test switching input)

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 Potential-free semiconductor outputs in relay function (overview)

The potential-free semiconductor 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 potential-free 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 potential-free semiconductor outputs in relay function:

LMC12x, LMS12x, LMC13x, LMS13x	Minimum	Typical	Maximum
Number			2
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			220 pF
Electric strength of the inputs/outputs			1500 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/Pro			
Number of LMS531 Lite			2
Number of LMS531 Pro			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	
Electric 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 module**).

6.6.5 Circuitry without resistance monitoring

The potential-free semiconductor outputs in the laser detector's relay function are usually closed in normal operating mode. There is constant voltage between the intrusion alarm central controls and the laser detector. 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 detectors. The cores of the connecting cable should be placed according to the terminal strip of the laser detector.

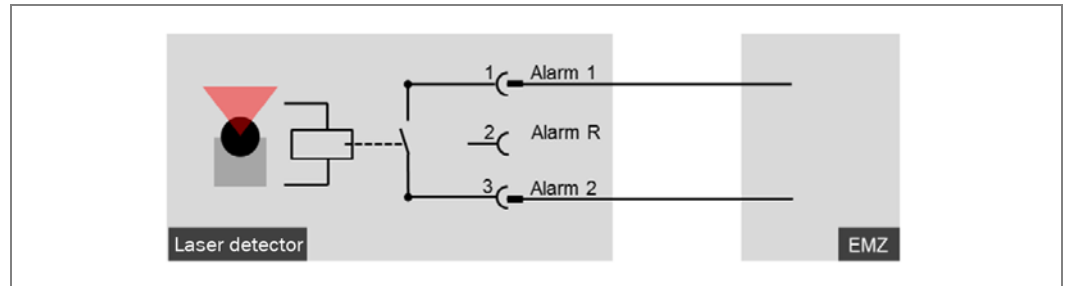


Fig. 53: Circuitry on LMC12x/LMS12x without resistance monitoring

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.

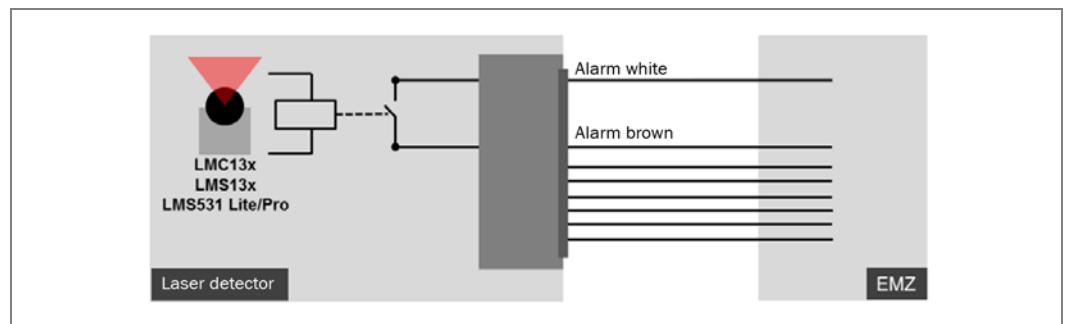


Fig. 54: Circuitry on LMC13x/LMS13x/LMS531 Lite/Pro without resistance monitoring

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.

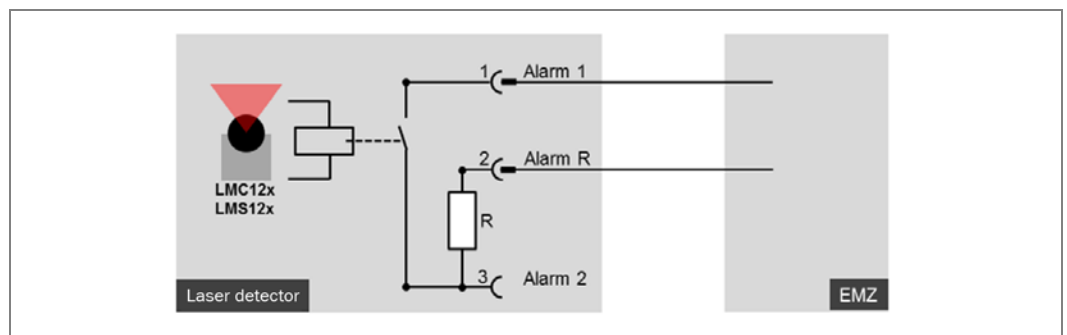


Fig. 55: Circuitry on LMC12x/LMS12x with resistance monitoring

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.

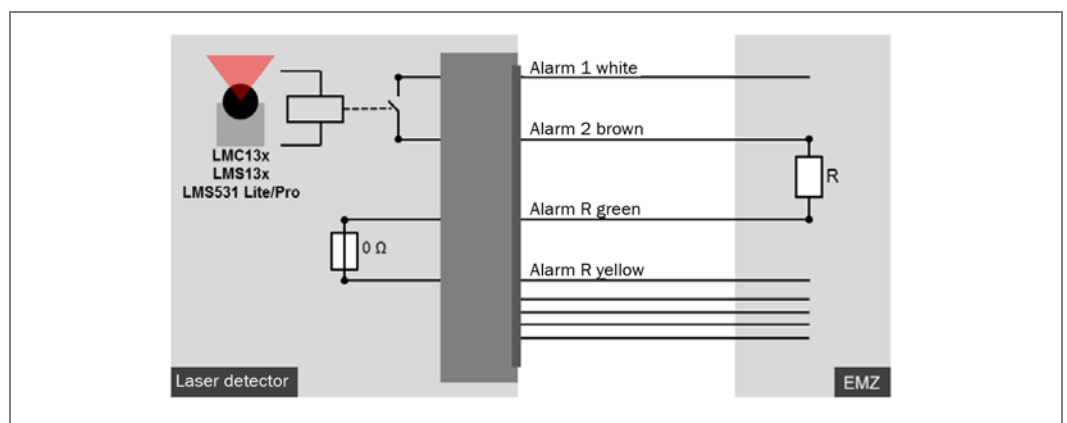


Fig. 56: Circuitry on LMS13x/LMS531 Lite/Pro with resistance monitoring

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 and LMS13x/LMC13x laser detectors are fitted with an internal lift contact for the optical 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. 57: Tamper-proofing of LMS12x/LMC12x and LMS13x/LMC13x

If the screws of the upper part of the housing are loosened and the optical 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**.

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 analysis strategy used, can be defined by a combination of input assignments, for example.

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.

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

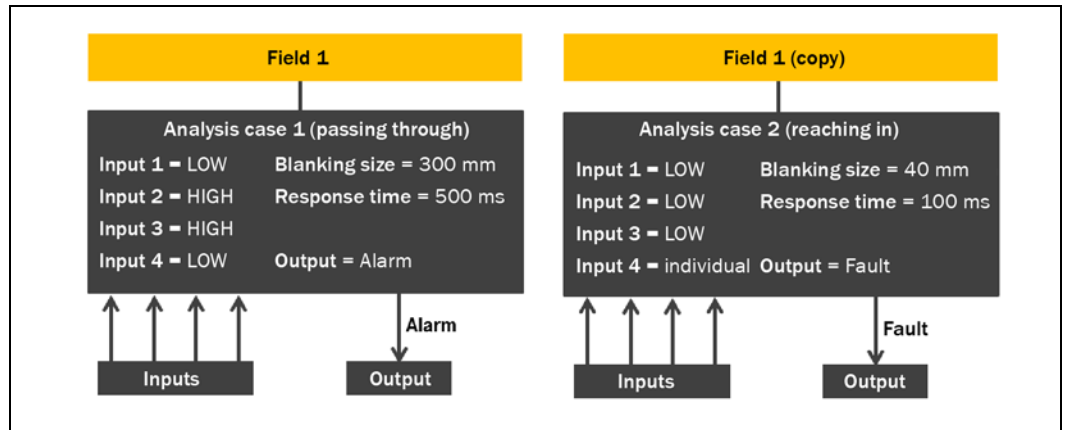


Fig. 58: Analysis cases in expert mode

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 detector used.

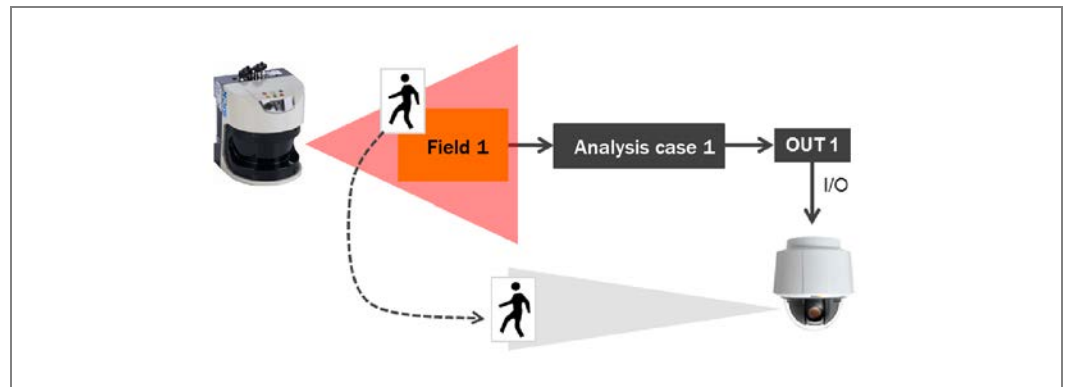


Fig. 59: Field-based switching of cameras (overview)

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 detector directly switches on the camera input.

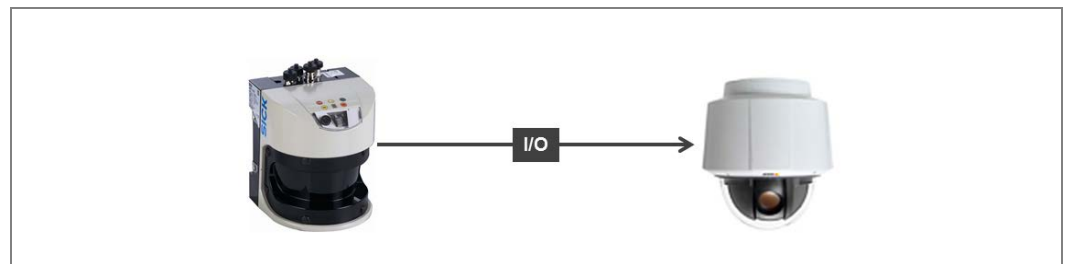


Fig. 60: Field-based camera control (direct)

Field-based camera control via video management system

In the following figure, the digital output signal of the laser detector 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.

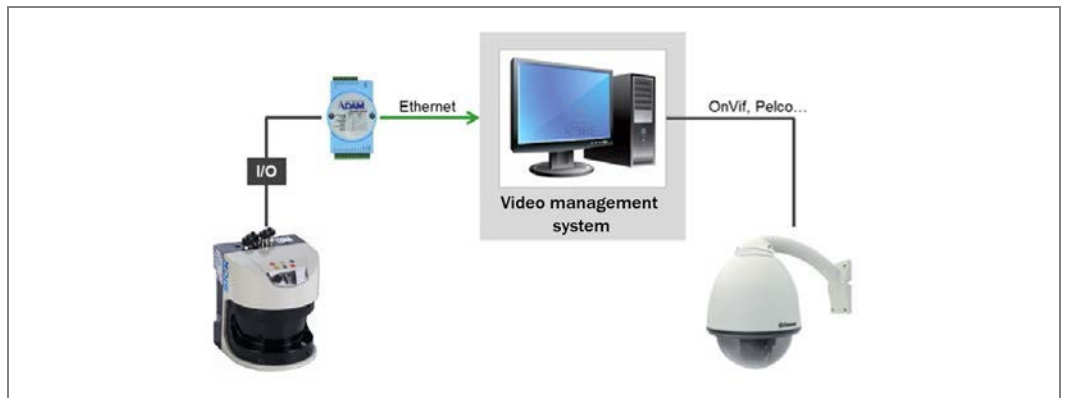


Fig. 61: Field-based camera control (via video management system)

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 detector. SICK provides their own OPC server for integration. The video management accesses the OPC objects as the OPC client.

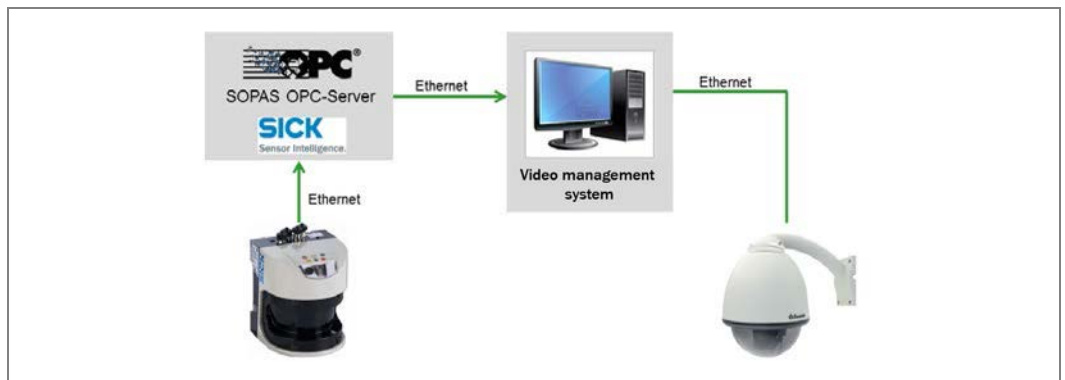


Fig. 62: Field-based camera control (via OPC)

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**.

6.7 Pin assignments

6.7.1 LMC12x/LMC12x

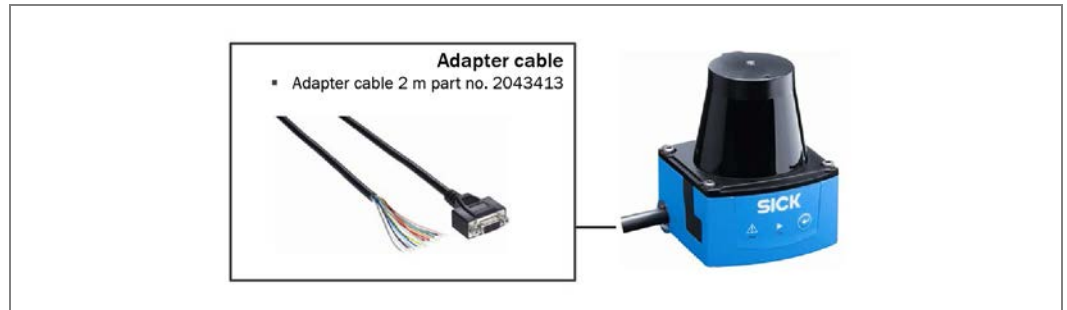
The LMC12x/LMS12x lasers are fitted with a removable system plug, which has a cable entry on the back. The connections are located on the screw terminal in the system plug. These variants also have an M12 round connector to connect to the Ethernet cable. The cable entry and the round connector can be 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 armed/disarmed
7	IN1 GND (S/U GND)	Ground for digital input 1 armed/disarmed
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	IN4 (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. 13: LMC12x/LMS12x pin assignment

6.7.2 TIM320-1031000

The TiM320-1031000 laser 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.



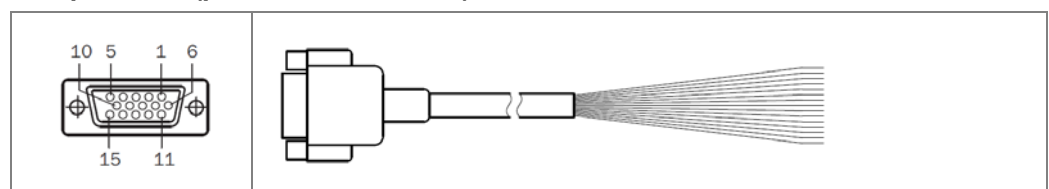
Pin assignment for 15-pin D-Sub-HD male cable connector

	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. 14: TiM320-1031000 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. 15: TiM320-1031000 adapter cable pin assignment

6.7.3 TIM351

The TiM351 laser has two multi-pin M12 round connectors. Pre-assembled cables can be ordered as accessories for connection to the M12 round connectors. The power 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.

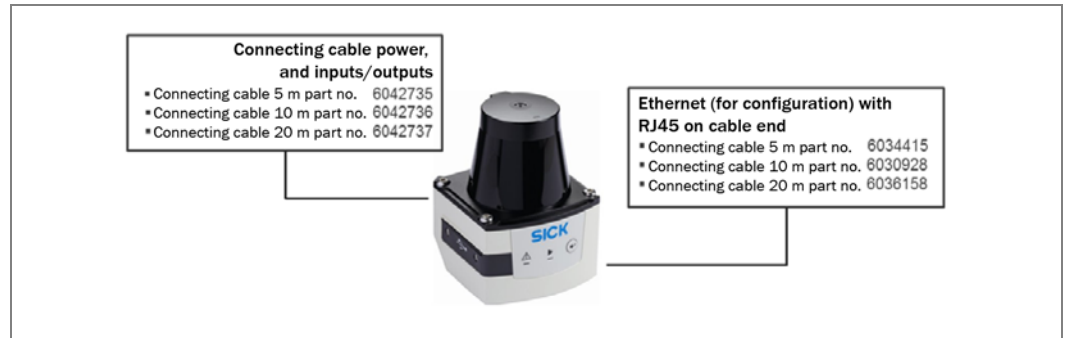


Fig. 63: TiM351 connecting cables (with part number)

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. 16: TiM351 pin assignment (power supply/inputs and outputs)

6.7.4 LMC13x/LMS13x

The LMC13x/LMS13x lasers 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.

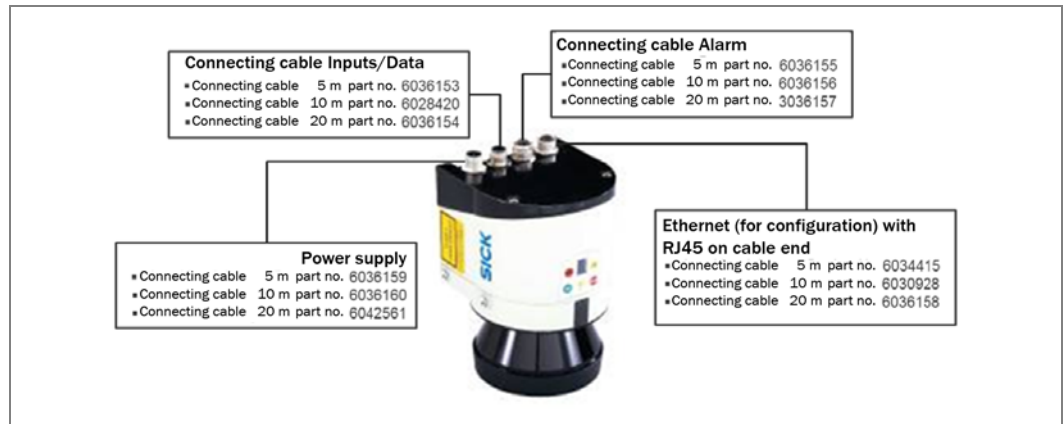


Fig. 64: LMC13x/LMS13x connecting cables (with part number)

Power 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 yet assigned
	5	Black	Ground for heater

Tab. 17: LMC13x/LMS13x pin assignment (power supply)

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

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

Tab. 18: LMC13x/LMS13x pin assignment (alarm)

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

	Pin	Wire color	Description
	1	White	Armed (0 V)/disarmed (+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)
	7	Blue	Operation (0 V)/Easy Teach (+24 V)
	8	Red	Ground for all inputs

Tab. 19: LMC13x/LMS13x pin assignment (inputs)

6.7.5 LMS531 Lite

The LMS531 Lite laser 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.

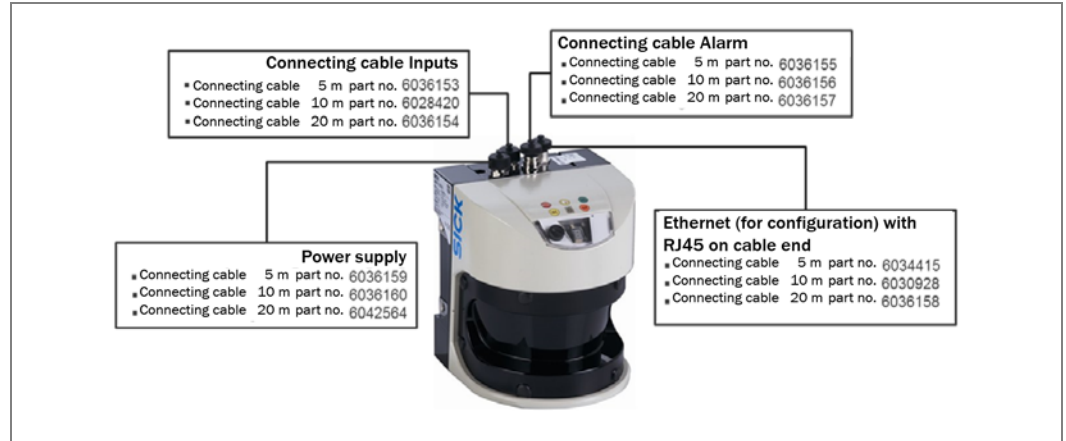


Fig. 65: LMS531 Lite connecting cables (with part number)

Power 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 yet assigned
	5	Black	Ground for heater

Tab. 20: LMS531 Lite pin assignment (power supply)

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

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

Tab. 21: LMS531 Lite pin assignment (alarm)

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

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

Tab. 22: LMS531 Lite pin assignment (inputs)

6.7.6 LMS531 Pro

The LMS531 Lite laser 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.

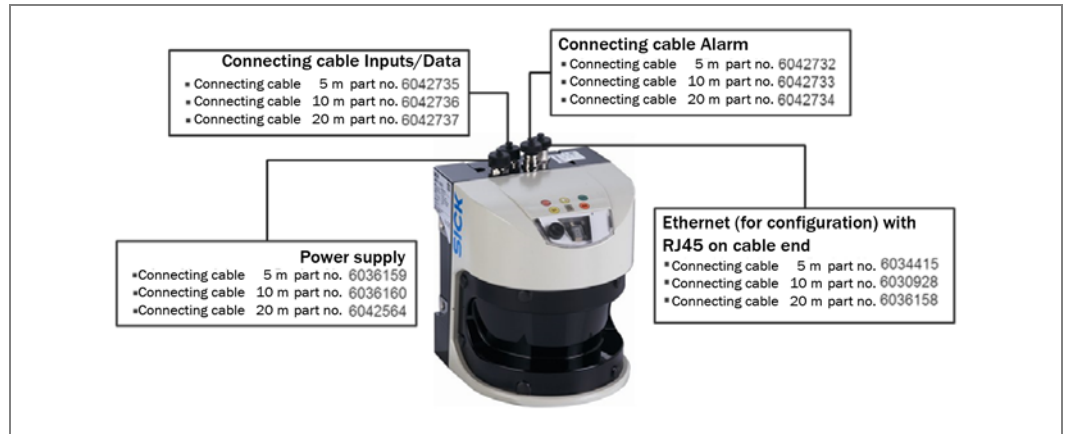


Fig. 66: LMS531 Pro connecting cables (with part number)

Power 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 yet assigned
	5	Black	Ground for heater

Tab. 23: LMS531 Pro pin assignment (power supply)

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

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

Tab. 24: LMS531 Pro pin assignment (alarm)

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

	Pin	Wire color	Description
		1	Brown
	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	Pink	TD+
	11	Gray/pink	CAN_L
	12	Red/blue	CAN_H

Tab. 25: LMS531 Pro pin assignment (inputs/data)

6.7.7 Connection box

The connection box for controlling the monitoring system is wired via 22 terminals.

The terminal assignment of the connection box depends on the connected laser detector.

It can be taken from the accompanying instructions.

The connections for the power supply, the digital inputs and outputs and for the data/input cable are assigned using the appropriate label.

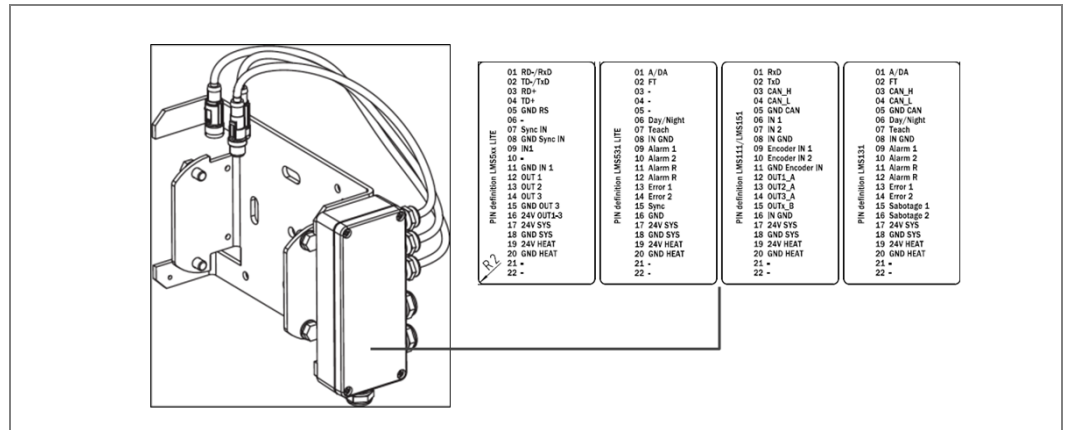


Fig. 67: Connection box terminal assignment

Terminal	LMS13x signal	LMS531 Lite signal
1	A/DA	A/DA
2	FT	FT
3	CAN_H	-
4	CAN_L	-
5	GND CAN	-
6	Day/Night	
7	Teach	Teach
8	IN GND	IN GND
9	Alarm 1	Alarm 1
10	Alarm 2	Alarm 2
11	Alarm R	Alarm R
12	Alarm R	Alarm R
13	Error 1	Error 1
14	Error 2	Error 2
15	Sabotage 1	Sync
16	Sabotage 2	GND
17	24 V SYS	24 V SYS
18	GND SYS	GND SYS
19	24 V HEAT	24 V HEAT
20	GND HEAT	GND HEAT
21	-	-
22	-	-

Tab. 26: Connection box pin assignment

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



6.8 Cleaning

All laser detectors have an optical cover to protect them. This optical cover can get dirty which may reduce the energy emitted and received by the laser beam.

The scanned objects are perceived with less remission than they actually have. When the optical cover becomes too dirty, the laser can no longer make measurements.

For this reason, the dirt levels are constantly checked during running operation and a contamination warning is sent when the dirt levels reach a certain point. If the cover gets too dirty, a **contamination error is sent** and the laser detector stops taking measurements when this occurs. Different strategies for the dirt measurement can be selected depending on the monitoring scenario.

Note The laser detectors are largely maintenance-free. The optical cover of the laser detector 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, 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. The clients access the data provided by the OPC server via the network and convert the data back into the application format.

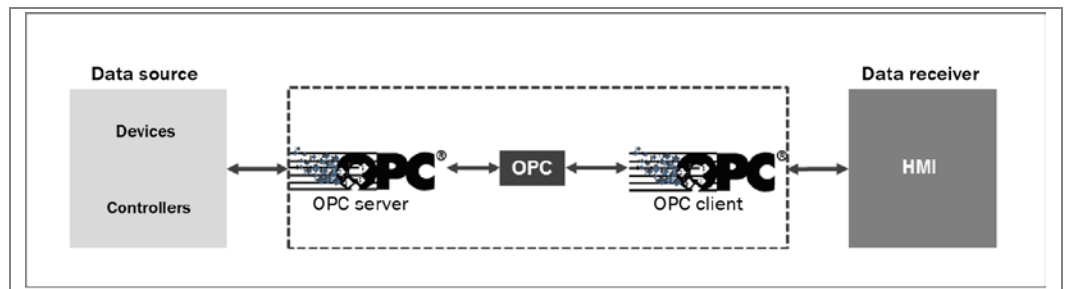


Fig. 68: OPC client/server architecture

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.

Building safety and security

As a result, SICK laser detectors can also be easily integrated into existing OPC high security solutions. The detectors are integrated via SICK's own SOPAS OPC server. On the application side, the OPC server to be accessed has to be specified in the OPC client.

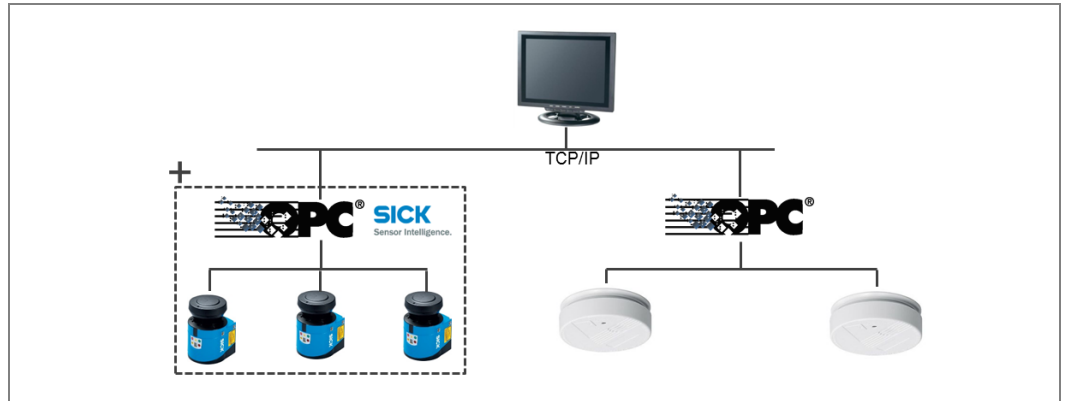


Fig. 69: Integration of laser detectors using SICK OPC server

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 the 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 detectors via OPC is the easiest and most convenient way to view information about the security system in a monitoring control center. The laser detectors 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.

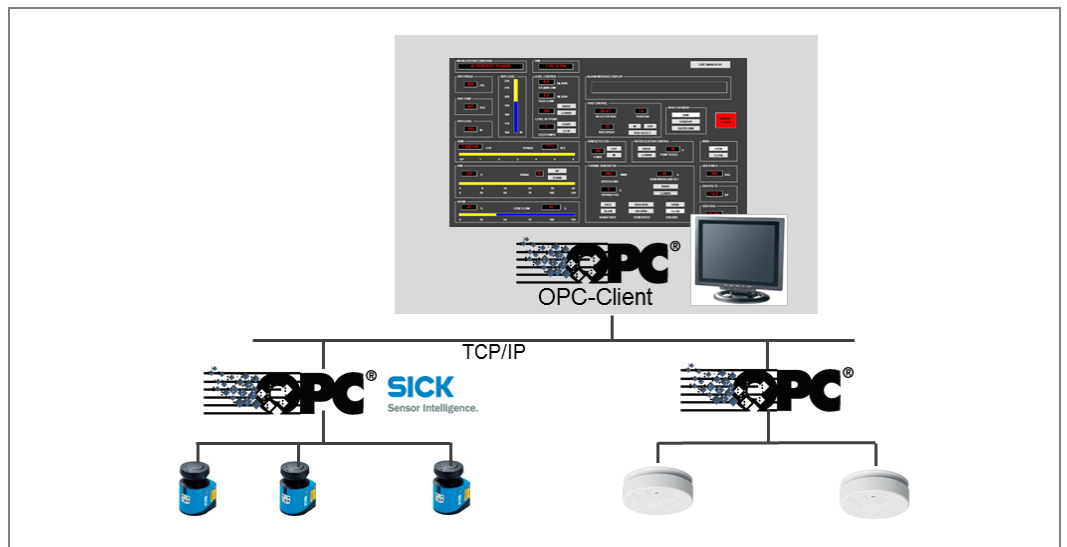


Fig. 70: Viewing information based on OPC

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 detectors
- Information about the contamination levels of the laser detectors

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.

Note Visualization via OPC does not contain a standard mechanism for real-time monitoring.

Advantages at a glance
<ul style="list-style-type: none">• 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	TiM3xx	LMC13x	LMS13x	LMS531 Lite	LMS531 Pro
Fence/double fence/wall	-	-	-	-	+	++	+++
Open spaces	-	-	-	-	++	++	+++
Camera guidance and object tracking in open spaces	-	-	-	-	++	++	+++
Outer shell protection (facades)	-	-	-	-	++	++	+++
Roof protection	-	-	-	-	++	++	+++
Ceiling monitoring and wall penetration protection	+++	+++	+++	+++	++	++	++
Painting protection	++	++	+++	+++	++	++	++

Tab. 27: Selection guide (device selection)

8.1.2 Product characteristics

	LMS12x	LMC12x	TiM320-1031000	LMC13x	TiM351	LMS13x	LMS531 Lite	LMS531 Pro
Indoor/outdoor	Indoor	Indoor	Indoor	Indoor	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
Scanning range								
Passing through zone (300 mm object)	18 m	18 m	2 m	18 m	6 m	18 m	40 m	40 m
People/objects reaching into zone (40 mm object)	9 m	9 m	1.5 m	9 m	2 m	9 m	12 m	12 m
VdS-certified		Class C		Class C				
Detection speed (ms)	max. 20	max. 20	max. 67	max. 20	max. 67	max. 20	max. 14	max. 10
Angular resolution								
Laser class	1	1	1	1	1	1	1	1
Interface								
OPC	YES	YES	YES	YES	YES	YES	YES	YES
IP-Notify								
Ethernet	YES	YES	NO	YES	YES	YES	YES	YES
RS-232								x
RS-422								x
RS-485								x
CAN								x
Switching inputs	4	4	4	4	4	4	3	4
Switching outputs	2+1	2+1	4	2+1	4	2+1	2+1	4 internal + 8 external
Number of analysis fields	10	10	10	10	10	10	4	10

Tab. 28: Selection guide (product characteristics)

8.2 Fence/double fence protection

8.2.1 Monitored area

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

LMS531 Lite/Pro

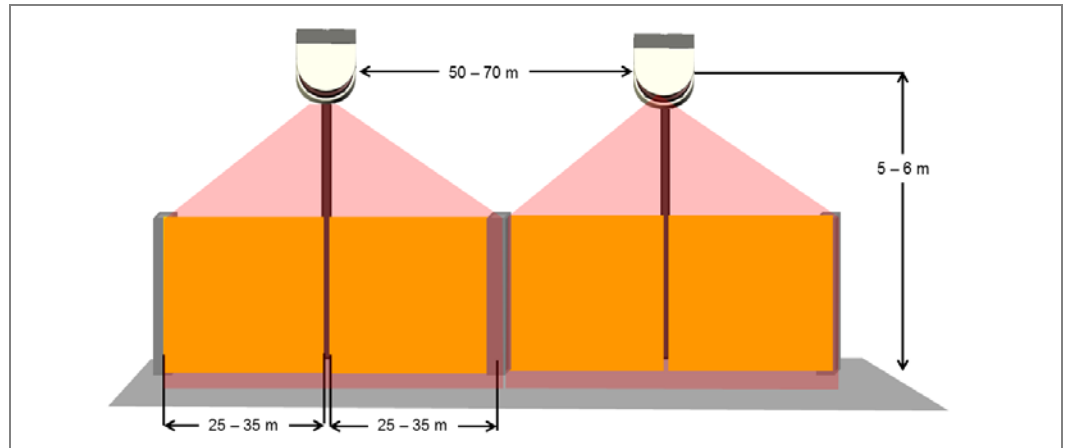


Fig. 71: LMS531 Lite/Pro monitored area (fence protection)

Dimension	Value
Scanning range, laser detector	40 m
Distance to laser detectors	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.

LMS13x

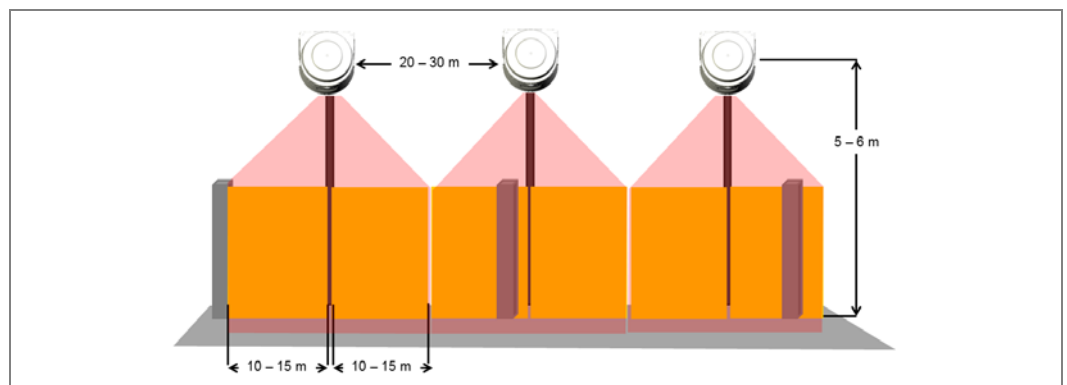


Fig. 72: LMS13x monitored area (fence protection)

Dimension	Recommended value
Scanning range, laser detector	18 m
Distance to laser detectors	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.

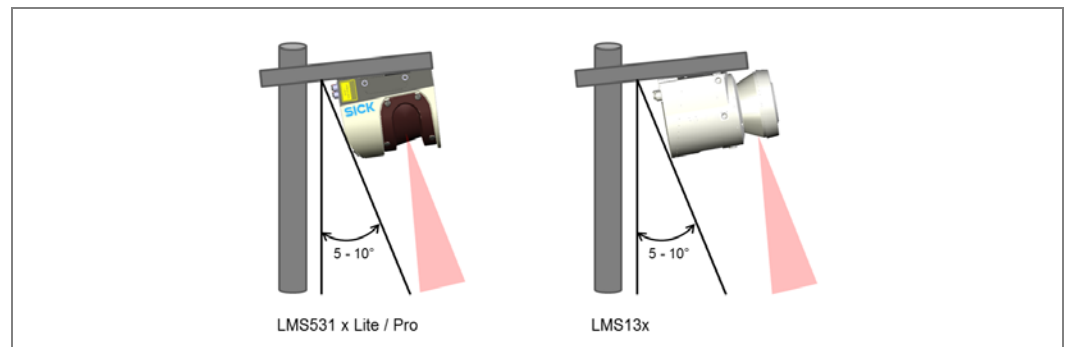



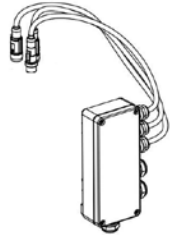


Fig. 73: Installation situation (fence protection)

8.2.3 Accessories

Mounting sets (for LMS531 Lite only)		
	Mounting set 1 with Mounting bracket (2059271) Mounting kit (2018303) Connection box (2062346)	1059094
	Mounting set 2 with Weather protection cover (2056850) Mounting bracket (2059271) Mounting kit (2018303) Connection box (2062346)	1059095
Weather protection covers (LMS531 Lite/Pro)		
	Weather protection cover (large)	2056850
	Weather protection cover (small)	2063050
Weather protection covers (LMS31x)		
	Weather protection cover 190°	2046459
Mounting kits (LMS531 Lite/Pro)		
	Mounting bracket	2059271
	Mounting kit	2018303

Mounting kits (LMS13x)		
	Mounting bracket	2046025
	Quick release	2046989
Connection		
	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
	For LMS13x and LMS531 Lite only Connection box for power, I/O, and RS-232/RS-422 data (not Ethernet), with three pre-wired M12 cables * The stub cables for the connection box must be laid by the customer. * Not compatible with LMS531 Pro	2062346

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	LMS531 Lite	LMS531 Pro
Basic settings			
Scanning frequency/ resolution	50 Hz/0.5°	50 Hz/0.5°	75 Hz/0.5°
Filters			
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-proof		Active	
Depending on distance		Yes (1000 mm)	
Outputs			
Logic		Active Low	
Restart		Time (500 ms)	

Tab. 29: Recommended settings (fence protection)

8.3 Facade protection

8.3.1 Monitored area

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

LMS531 Lite/Pro

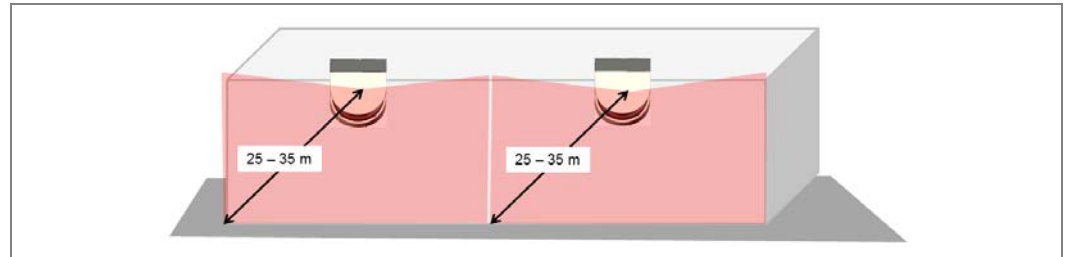


Fig. 74: LMS531 Lite/Pro monitored area (facade protection)

Dimension	Recommended value
Scanning range, laser detector	40 m
Recommended maximum detection distance	25 to 35 m

LMS13x

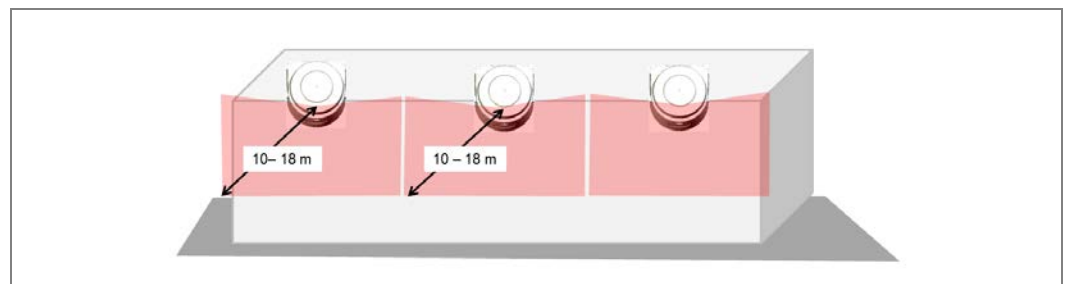


Fig. 75: LMS13x monitored area (facade protection)

Dimension	Recommended value
Scanning range, laser detector	18 m
Recommended detection distance	10 to 18 m

8.3.2 Installation situation

The laser 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.

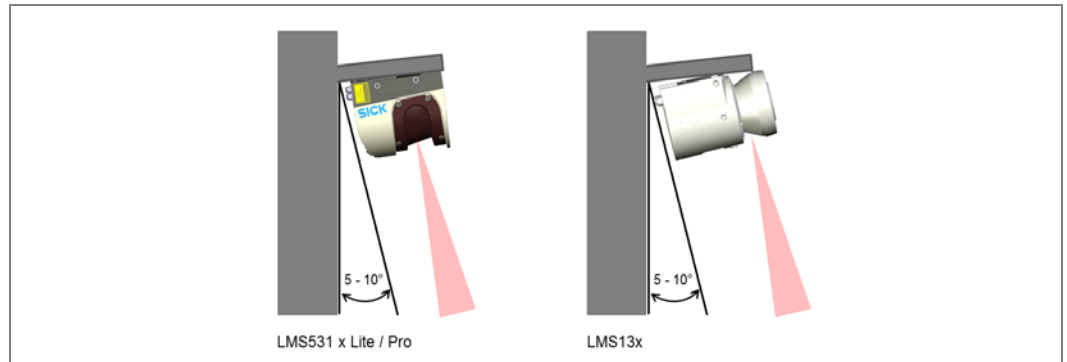





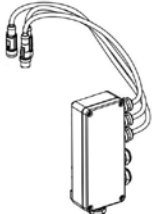
Fig. 76: Installation situation (facade protection)

8.3.3 Accessories

Weather protection covers (LMS531 Lite/Pro)		
	Weather protection cover (small)	2056850
	Weather protection cover (large)	2063050
Weather protection covers (LMS31x)		
	Weather protection cover 190°	2046459
Mounting kits (LMS531 Lite/Pro)		
	Mounting kit 1	2015623
	Mounting kit 2 Mounting kit 1 required	2015624
	Mounting kit 3 Mounting kits 1 and 2 required	2015625

Building safety and security

Mounting kits (LMS13x)		
	Mounting bracket	2046025
	Quick release	2046989

Connection		
	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 Accessories section
	For LMS13x and LMS531 Lite only Connection box for power, I/O, and RS-232/RS-422 data (not Ethernet), with three pre-wired M12 cables * The stub cables for the connection box must be laid by the customer. * Not compatible with LMS531 Pro	2062346

8.3.4 Recommended settings

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

	Facade protection		
	LMS1xx	LMS531 Lite	LMS531 Pro
Basic settings			
Scanning frequency/resolution	50 Hz/0.5°	50 Hz/0.5°	75 Hz/0.5°
Filters			
Particle filter		Active	
Echo filter		Last echo	
Fog filter		Active	
Contamination measurement			
Strategy		Available	
Evaluation case			
Strategy		Blanking	
Response time		500 ms	
Blanking size		250 mm	
Tamper-proof		Active	
Depending on distance		Yes (1000 mm)	
Outputs			
Logic		Active Low	
Restart		Time (500 ms)	

Tab. 30: Recommended settings (facade protection)

8.4 Open space protection

8.4.1 Monitored area

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

LMS531 Lite/Pro

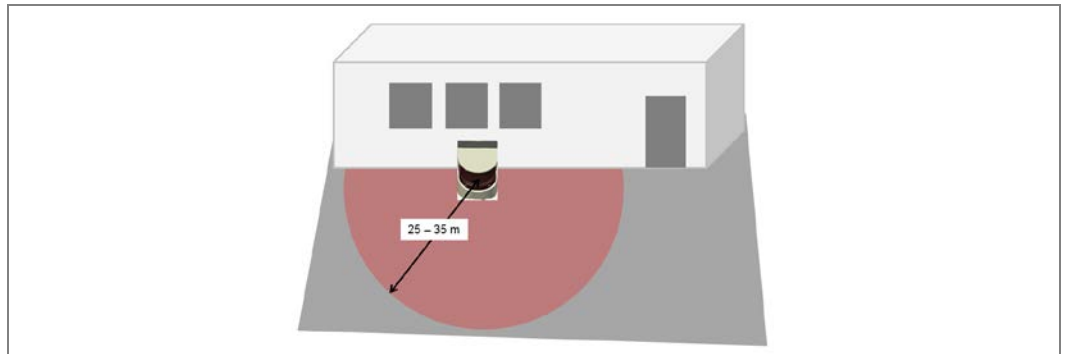


Fig. 77: LMS531 Lite/Pro monitored area (open space protection)

Dimension	Recommended value
Scanning range, laser detector	40 m
Recommended maximum detection distance	25 to 35 m

LMS13x

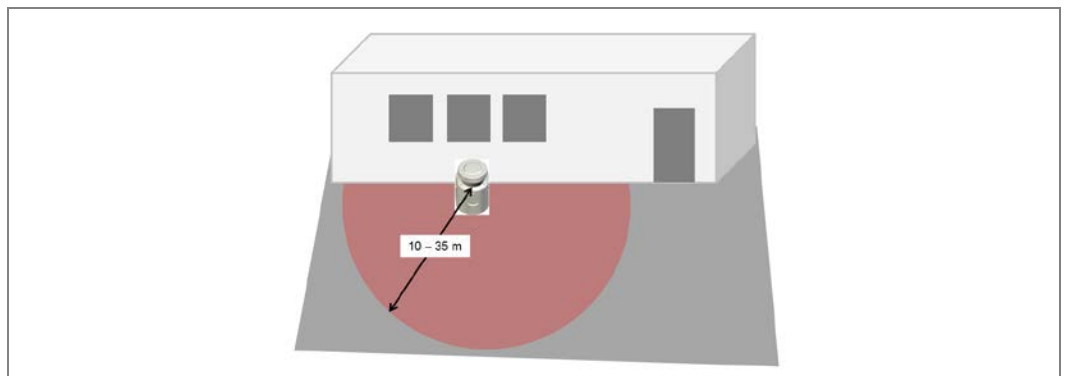


Fig. 78: LMS13x monitored area (open space protection)

Dimension	Recommended value
Scanning range, laser detector	18 m
Recommended detection distance	10 to 18 m

8.4.2 Mounting

SICK laser detectors are usually used horizontally for the monitoring of open spaces. The laser should be mounted at a height of approx. 300 mm to prevent anyone from 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.

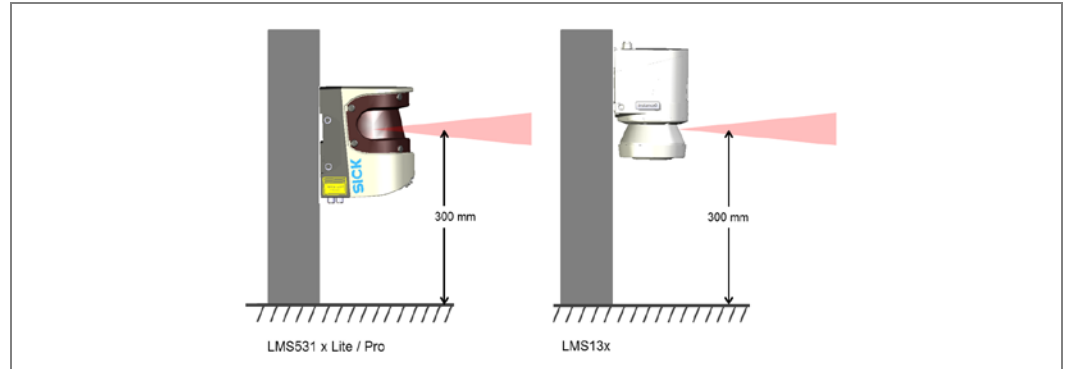


Fig. 79: Installation situation (open space protection)

8.4.3 Accessories

See "Facade protection."

8.4.4 Recommended settings

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

Tab. 31: 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 when determining the monitoring fields.

8.5.2 Installation situation

The laser detectors are generally mounted directly onto the building. The monitoring area 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 area 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
Basic settings			
Scanning frequency/ resolution	50 Hz/0.5°	50 Hz/0.5°	75 Hz/0.5°
Filters			
Particle filter		Active	
Echo filter		Last echo	
Fog filter		Active	
Contamination measurement			
Strategy		Available	
Evaluation case			
Strategy		Blanking	
Response time		1000 ms	
Blanking size		70 mm	
Tamper-proof		Active	
Depending on distance		Yes (1000 mm)	
Outputs			
Logic		Active Low	
Restart		Time (500 ms)	

Tab. 32: Recommended settings (roof protection)

8.6 Painting protection

8.6.1 Monitored area

The number and type of laser detectors depends on how many paintings are being protected per laser detector. 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 prevent persons from entering or reaching into the detection zone.

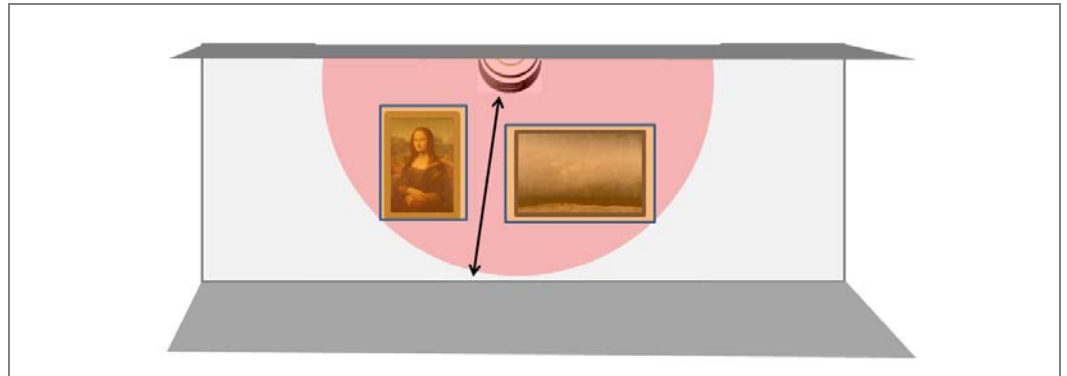


Fig. 80: Monitored area (painting protection)

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

8.6.2 Installation situation

The laser detector is mounted vertically and points downward 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, TiM320-1031000, and TiM351 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 containing the paintings.

LMC12x/LMS12x

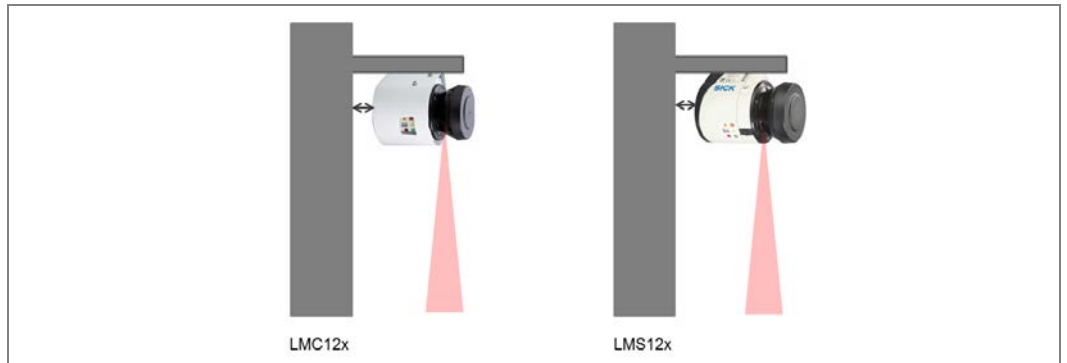


Fig. 81: LMC12x/LMS12x installation situation (painting protection)

TiM320-1031000/
TiM351

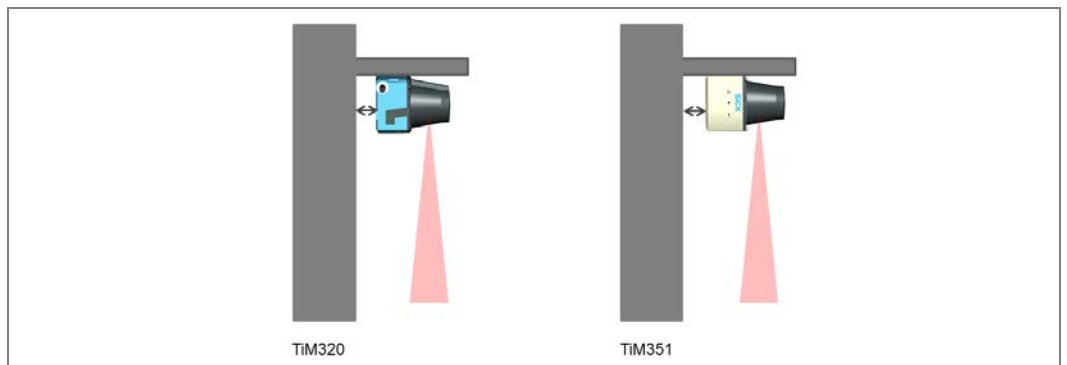




Fig. 82: TiM3xx installation situation (painting protection)

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 optical cover protection	2034325
	Mounting kit 2 Cross-wise adjustment possible only in combination with mounting kit 1A/1B	2039302
	Mounting kit 3 Longitudinal adjustment possible only in combination with mounting kit 2	2039303
Mounting kit (TiM320-1031000)		
	Mounting kit 2, impact protection, and alignment aid	2061776
Mounting kit (TiM351)		
	Mounting kit with sunshade/weather protection	2068398

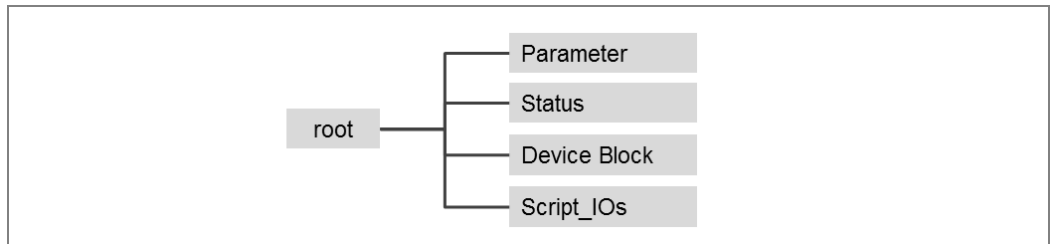
Connection (TiM320-1031000)		
	Extension cable, female connector, D-Sub-HD, 15-pin, straight, 2 m	2043413
Connection (TiM351)		
	Connecting cables (Ethernet, Power) in 5 m, 10 m, and 20 m length	See Accessories

8.6.4 Recommended settings

	Painting protection		
	LMS1xx	LMC1xx	TiMxx
Basic settings			
Scanning frequency/ resolution	50 Hz/0.5°	50 Hz/0.5°	15 Hz/1°
Filters			
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 (DvS 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-proof	Active		-
Depending on distance	Yes (1000 mm)	-	-
Outputs			
Logic	Active Low		
Restart	Time (500 ms)		Time (469 ms)

Tab. 33: Recommended settings (painting protection)

8.7 Parameter assignment for SICK OPC server



Parameter		
Current_Configuration	<ul style="list-style-type: none"> • Frequency • AngleResolution • Output_Data_Range 	<ul style="list-style-type: none"> • StartAngle • StopAngle
Contamination	<ul style="list-style-type: none"> • ContaminationWarn • ContaminationError 	
Display_Settings	<ul style="list-style-type: none"> • FrontPaneEnable 	
Ethernet	<ul style="list-style-type: none"> • IP address • Subnet mask • Gateway 	
Status		
IncrementState		
Encoder	<ul style="list-style-type: none"> • CurrentSpeed • CurrentDirection 	
IO	<ul style="list-style-type: none"> • HWInputNumActive • InputState_{nn} 	<ul style="list-style-type: none"> • With {nn} from '01'...'99' • With {nn} from '01'...'99'
	<ul style="list-style-type: none"> • Output_{nn} 	<ul style="list-style-type: none"> • Counter • State
	<ul style="list-style-type: none"> • External_Output_{nn} 	<ul style="list-style-type: none"> • With {nn} from '01'...'99' • Counter • State
Scan		
Front Panel	<ul style="list-style-type: none"> • LED_Q1_State 	
	<ul style="list-style-type: none"> • LED_Q2_State 	
	<ul style="list-style-type: none"> • LED_Ok_State 	
	<ul style="list-style-type: none"> • LED_Stop_State 	
	<ul style="list-style-type: none"> • LED_CM_State 	
	<ul style="list-style-type: none"> • AlphaNumDisplay 	<ul style="list-style-type: none"> • SectionA • SectionB • SectionC • SectionD • SectionE • SectionF • SectionG • SectionDot

Building safety and security

Sensor	<ul style="list-style-type: none"> • ContaminatorState • PowerOnCount • OperatingHours • DailyOperatingHours • LastUsername • LastParametrizationDate • LastParametrizationTime • LastMaintenance • NextMaintenance • Temperature • MeasurementState • DeviceError • DeviceState 	
FieldEval	<ul style="list-style-type: none"> • EVC[n]_Result 	With[n]-EVC number; <ul style="list-style-type: none"> • State = 1, if EVC condition met; • State = 0, if EVC-condition NOT met
Device_Block		
IncrementState	<ul style="list-style-type: none"> • Manufactor • DeviceType • FirmwareVersion • OrderNumber • SerialNumber • DeviceName 	
Script_IOs		
Inputs	<ul style="list-style-type: none"> • Param.In_0 • ... • Param.,In_3 • Param.In_0_Mem. • ... • Param.In_3_Mem. 	
Outputs	<ul style="list-style-type: none"> • Param.Out_0 • ... • Param.,In_7. 	

Tab. 34: Parameter assignment for SICK OPC server

9 Appendix

9.1 List of tables

Tab. 1: VdS-compliant devices.....	23
Tab. 2: Devices for indoor monitoring	24
Tab. 3: Devices for outdoor monitoring.....	25
Tab. 4: Alarm types: faulty alarm, false alarm	37
Tab. 5: Preliminary considerations (facade protection)	38
Tab. 6: Preliminary considerations (fence protection)	38
Tab. 7: Preliminary considerations (open space protection)	39
Tab. 8: Preliminary considerations (roof protection)	39
Tab. 9: Power consumption of laser detectors (overview)	41
Tab. 10: Length of cable and cable cross-section (LMC12x/LMS12x connection)	42
Tab. 11: Length of cable and cable cross-section (connection box).....	45
Tab. 12: Variants for switching input Teach-In.....	55
Tab. 13: LMC12x/LMS12x pin assignment	71
Tab. 14: TiM320-1031000 pin assignment	72
Tab. 15: TiM320-1031000 adapter cable pin assignment	72
Tab. 16: TiM351 pin assignment (power supply/inputs and outputs)	73
Tab. 17: LMC13x/LMS13x pin assignment (power supply)	74
Tab. 18: LMC13x/LMS13x pin assignment (alarm)	74
Tab. 19: LMC13x/LMS13x pin assignment (inputs).....	74
Tab. 20: LMS531 Lite pin assignment (power supply).....	75
Tab. 21: LMS531 Lite pin assignment (alarm)	75
Tab. 22: LMS531 Lite pin assignment (inputs).....	75
Tab. 23: LMS531 Pro pin assignment (power supply)	76
Tab. 24: LMS531 Pro pin assignment (alarm).....	76
Tab. 25: LMS531 Pro pin assignment (inputs/data).....	77
Tab. 26: Connection box pin assignment.....	78
Tab. 27: Selection guide (device selection)	83
Tab. 28: Selection guide (product characteristics).....	83
Tab. 29: Recommended settings (fence protection)	86
Tab. 30: Recommended settings (facade protection)	89
Tab. 31: Recommended settings (open space protection)	91
Tab. 32: Recommended settings (roof protection).....	92
Tab. 33: Recommended settings (painting protection).....	95
Tab. 34: Parameter assignment for SICK OPC server.....	97

9.2 List of figures

Fig. 1:	2D laser detector principle of operation	10
Fig. 2:	Time-of-flight principle of operation.....	11
Fig. 3:	Reflection of light on the surface of the object.....	12
Fig. 4:	Angle of reflection.....	13
Fig. 5:	Reflection from prism-based reflector.....	13
Fig. 6:	Reflective surfaces	13
Fig. 7:	Beam divergence and object size.....	14
Fig. 8:	Monitoring fences, double fences, and walls	15
Fig. 9:	Monitoring of open spaces	16
Fig. 10:	Camera management and object tracking in open spaces	17
Fig. 11:	Outer shell protection (facades)	18
Fig. 12:	Roof protection	19
Fig. 13:	Ceiling monitoring and wall penetration protection	20
Fig. 14:	Painting protection	21
Fig. 15:	Flowchart for device selection	23
Fig. 16:	VdS-compliant mounting kits VdS1 long/VdS1 short.....	30
Fig. 17:	Analysis of the threat situation	37
Fig. 18:	LMC12x/LMS12x connecting cables	42
Fig. 19:	TiM320-1031000 connecting cables	43
Fig. 20:	TiM351 connecting cables.....	43
Fig. 21:	LMC13x/LMS13x connecting cables	44
Fig. 22:	LMS531 Lite/LMS531 Pro connecting cables	44
Fig. 23:	Connection box connecting cables.....	45
Fig. 24:	Filter - analysis fields - analysis cases - switching inputs.....	46
Fig. 25:	Particle filter principle of operation	47
Fig. 26:	Multi-echo analysis principle of operation	47
Fig. 27:	Scanning range and analysis fields.....	48
Fig. 28:	Analysis cases, principle of operation	49
Fig. 29:	Pixel analysis principle of operation	49
Fig. 30:	Blanking principle of operation.....	50
Fig. 31:	Example for setting the alarm sensitivity	51
Fig. 32:	Analysis strategy using fields.....	51
Fig. 33:	Contour as reference analysis strategy.....	51
Fig. 34:	Contour as reference principle of operation	52
Fig. 35:	Protection against tampering thanks to contour as reference	52
Fig. 36:	Combination of analysis strategies: fields and contour as reference	53
Fig. 37:	Tamper-proofing against shadowing and glare	53
Fig. 38:	Field breaches caused by changing environmental conditions.....	54
Fig. 39:	Automatic field adjustment principle of operation	54
Fig. 40:	Easy Teach Lite principle of operation	55
Fig. 41:	Easy Teach: blanking objects from the field	56
Fig. 42:	Easy Teach: entering the monitoring field.....	56

Fig. 43: Easy Teach Lite: further optimizing a field.....	57
Fig. 44: Easy Teach Pro principle of operation	57
Fig. 45: Easy Teach Pro: monitoring fields before teach-in process.....	58
Fig. 46: Easy Teach Pro: monitoring fields after teach-in process.....	58
Fig. 47: Easy Teach Pro: master field for contour as reference field	59
Fig. 48: Easy Teach Pro: contour as reference field after being taught-in with Easy Teach	59
Fig. 49: Easy Teach Pro: problem of using facade monitoring without contour as reference field	60
Fig. 50: Activating analysis cases (switching input Day/Night)	61
Fig. 51: Switching the laser detector to armed/disarmed (switching input Armed/Disarmed)	62
Fig. 52: Walk-through test mode (functional test switching input).....	63
Fig. 53: Circuitry on LMC12x/LMS12x without resistance monitoring.....	65
Fig. 54: Circuitry on LMC13x/LMS13x/LMS531 Lite/Pro without resistance monitoring	65
Fig. 55: Circuitry on LMC12x/LMS12x with resistance monitoring.....	66
Fig. 56: Circuitry on LMS13x/LMS531 Lite/Pro with resistance monitoring.....	66
Fig. 57: Tamper-proofing of LMS12x/LMC12x and LMS13x/LMC13x.....	67
Fig. 58: Analysis cases in expert mode	68
Fig. 59: Field-based switching of cameras (overview).....	69
Fig. 60: Field-based camera control (direct).....	69
Fig. 61: Field-based camera control (via video management system).....	70
Fig. 62: Field-based camera control (via OPC).....	70
Fig. 63: TIM351 connecting cables (with part number)	73
Fig. 64: LMC13x/LMS13x connecting cables (with part number).....	74
Fig. 65: LMS531 Lite connecting cables (with part number).....	75
Fig. 66: LMS531 Pro connecting cables (with part number)	76
Fig. 67: Connection box terminal assignment	78
Fig. 68: OPC client/server architecture	80
Fig. 69: Integration of laser detectors using SICK OPC server.....	81
Fig. 70: Viewing information based on OPC.....	81
Fig. 71: LMS531 Lite/Pro monitored area (fence protection)	84
Fig. 72: LMS13x monitored area (fence protection)	84
Fig. 73: Installation situation (fence protection).....	85
Fig. 74: LMS531 Lite/Pro monitored area (facade protection)	87
Fig. 75: LMS13x monitored area (facade protection)	87
Fig. 76: Installation situation (facade protection).....	88
Fig. 77: LMS531 Lite/Pro monitored area (open space protection)	90
Fig. 78: LMS13x monitored area (open space protection)	90
Fig. 79: Installation situation (open space protection).....	91
Fig. 80: Monitored area (painting protection).....	93
Fig. 81: LMC12x/LMS12x installation situation (painting protection)	94
Fig. 82: TIM3xx installation situation (painting protection).....	94

9.3 Keywords index

2	
2D laser scanners (overview).....	10
A	
Abbreviations	6
Accessories	29
Alarm sensitivity.....	50
Alarm types	37
Analysis cases	48
activate/deactivate	61
Analysis fields	48
adjust automatically.....	54
teach-in automatically.....	55
Analysis strategy.....	46
Angle of incidence	13
Angle of reflection.....	13
Armed/Disarmed.....	62
B	
Beam divergence.....	14
Blanking	49
C	
Camera circuitry.....	69
CAN module	35
CCTV	8
Ceiling monitoring.....	20
Circuitry	65
resistance-monitored.....	66
Cleaning	79
Connecting cables	33–41
Connection box.....	35–45
Contour as reference.....	51
D	
Day/Night.....	61
Day/night mode.....	61
Dazzle.....	53
Detection accuracy.....	46
Detection range	22
Detection systems.....	8
Device overview.....	26
outdoor	28
VdS-compliant	26
Device selection	23
E	
Environmental influences	22
Expert mode.....	67
F	
Facade protection	18
preliminary considerations	38
False alarm	37
Faulty alarm	37
Fence protection.....	15
preliminary considerations	38
Field adjustment.....	54
Field-based camera control	69
Filters	46
Fog filter	46
H	
Heating.....	40
I	
Indoor monitoring.....	24
devices.....	27
Information depth.....	6
Infrared sensors	8
Inputs	62
Armed/Disarmed	62
Day/Night	61
Teach IN.....	55
walk-through test	63
K	
Keywords index.....	102
L	
Laser detector applications	15
Laser detectors	
applications	15
Laser-guided detection methods.....	9
List of figures	99
List of tables	98
M	
Measuring frequency	11
Mounting.....	41
Mounting kits.....	30
VdS-compliant	30

Mounting sets.....	33	Resistance monitoring.....	66
Multi-echo analysis	11–47	Roof protection	19
O		preliminary considerations.....	39
Object size	14	S	
OPC	80	Safety analysis	37
SICK OPC server	81	Scan finder	36
visualization	81	Shadowing.....	53
OPC integration	80	Sharp/not sharp.....	62
Open space protection.....	16	SOPAS.....	46–67
preliminary considerations.....	39	Symbols	6
with camera guidance	17	T	
Outdoor monitoring.....	25	Taking account of object size.....	49
devices	28	Tamper-proofing.....	67
Outputs	63	contour as reference	51
P		shadowing, dazzle	53
Painting protection.....	21	Target group	6
Particle filter	47	Teach IN.....	55
Pin assignments.....	71	Threat situation	37
Pixel analysis	49	Time-of-flight measurement	10
Planning.....	38	V	
Post brackets	32	VdS guidelines.....	23
Power supply	36	devices	26
Preliminary considerations.....	38	Voltage supply.....	41
Project planning examples	83	Volt-free semiconductor outputs in	
Pulse time method.....	11	relay function	63
R		W	
Radar sensors	8	Walk-through test.....	63
Reflection	12	Weather protection covers	29
Remission.....	12		

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