Leuze

Translation of original operating instructions

RSL230
RSL235
Safety Laser Scanner

The Sensor People

We reserve the right to make technical changes
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1 About this document

1.1 Other applicable documents

The information on the safety sensor is distributed over several documents to make working with the documents easier. You will find the documents and software for the safety sensor in the following table:

Tab. 1.1: Other applicable documents

Purpose and target group of the document	Document/software title	Source
Software for machine users [a] for diagnosing the safety sensor in the event of a fault and for machine designers for configuring the safety sensor	Sensor Studio DTM RSL 200 (collection of safety devices)	Leuze website, on the product page of the device under the Downloads tab
Notes for the machine design engineer [a]	Operating instructions RSL 200 (this document)	
Notes for the machine design engineer [a] for configuring the safety sensor (software instructions)	Online help for software	
Notes for the design engineer on the use of UDP data telegrams	RSL 400 / RSL 200 UDP specification	
Notices regarding mounting, alignment and connection of the safety sensor	User instructions RSL 200	Print document, supplied with the safety sensor

[a] Machine identifies the product that the safety sensor is installed in.

1.2 Download configuration and diagnostic software from the Internet

- Call up the Leuze website: **www.leuze.com**.
- Enter the type designation or part number of the device as the search term.
- The configuration software can be found on the product page for the device under the Downloads tab.

1.3 Used symbols and signal words

Tab. 1.2: Warning symbols and signal words

	Symbol indicating dangers to persons
	Symbol indicating dangers from harmful laser radiation
	Symbol indicating possible property damage
NOTE	Signal word for property damage Indicates dangers that may result in property damage if the measures for danger avoidance are not followed.
CAUTION	Signal word for minor injuries Indicates dangers that may result in minor injury if the measures for danger avoidance are not followed.
WARNING	Signal word for serious injury Indicates dangers that may result in severe or fatal injury if the measures for danger avoidance are not followed.
DANGER	Signal word for life-threatening danger Indicates dangers with which serious or fatal injury is imminent if the measures for danger avoidance are not followed.

Tab. 1.3: Other symbols

	Symbol for tips Text passages with this symbol provide you with further information.
	Symbol for action steps Text passages with this symbol instruct you to perform actions.
	Symbol for action results Text passages with this symbol describe the result of the preceding action.

Tab. 1.4: Terms and abbreviations

CS	Switching signal from a control (**C**ontroller **S**ignal)
DTM	Software device manager of the safety sensor (**D**evice **T**ype **M**anager)
EDM	Contactor monitoring (**E**xternal **D**evice **M**onitoring)
FDT	Software frame for management of device managers (DTM) (**F**ield **D**evice **T**ool)
Field triple	One protective field with two associated warning fields
AGV	**A**utomated **G**uided **V**ehicle
LED	LED, display element in the safety sensor (**L**ight **E**mitting **D**iode)
OSSD	Safety-related switching output (**O**utput **S**ignal **S**witching **D**evice)
PELV	Protective extra-low voltage (**P**rotective **E**xtra **L**ow **V**oltage)
PFH_d	Probability of a dangerous failure per hour (**P**robability of dangerous **F**ailure per **H**our)
PL	**P**erformance **L**evel
RES	Start/restart interlock (Start/**RES**tart interlock)
SIL	**S**afety **I**ntegrity **L**evel
State	ON: ON: device intact, OSSDs switched on OFF OFF: device intact, OSSDs switched off Lock Locking: device, connection or actuation/operation faulty, OSSDs switched off (lock-out)

1.4 Checklists

The checklists are used as a reference for the machine manufacturer or equipment supplier (see chapter 10 "Testing"). They do not replace the inspection of the entire machine or system before the first start-up, nor their regular inspections by a qualified person (see chapter 2.3 "Competent persons"). The checklists contain minimum testing requirements. Depending on the application, other tests may be necessary.

2 Safety

Before using the safety sensor, a risk assessment must be performed according to valid standards (e.g. EN ISO 12100, EN ISO 13849-1, IEC/EN 61508, EN IEC 62061). The result of the risk assessment determines the required safety level of the safety sensor (see chapter 14.1 "Safety-relevant technical data"). For mounting, operating and testing, this document as well as all applicable national and international standards, regulations, rules and directives must be observed. Relevant and supplied documents must be observed, printed out and handed to affected persons.

↳ Before working with the safety sensor, completely read and observe the documents applicable to your task.

In particular, the current version of the following national and international legal regulations apply for commissioning, technical tests and handling of safety sensors:

- Machinery directive
- Low voltage directive
- Electromagnetic Compatibility Directive
- Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment
- OSHA
- Safety regulations
- Accident-prevention regulations and safety rules
- Ordinance on Industrial Safety and Health and employment protection act
- Product Safety Law (ProdSG)

	NOTICE
	For safety-related information you may also contact local authorities (e.g., industrial inspectorate, employer's liability insurance association, labor inspectorate, occupational safety and health authority).

2.1 Intended use

The safety sensor protects persons or body parts at points of operation, danger zones or access points of machines and systems.

	WARNING
	**A running machine may result in serious injury!** ↳ Make certain that the safety sensor is correctly connected and that the protective function of the protective device is ensured. ↳ Make certain that, during all conversions, maintenance work and inspections, the system is securely shut down and protected against being restarted.

- The safety sensor must only be used after it has been selected in accordance with the respective valid instructions and relevant rules, standards and regulations on occupational safety and safety at work, and installed, connected, commissioned and tested by a competent person on the machine (see chapter 2.3 "Competent persons").
- When selecting the safety sensor, it must be ensured that its safety-related performance capability is greater than or equal to the required performance level PL_r determined in the risk assessment (see chapter 14.1 "Safety-relevant technical data").
- The safety sensor may only be used in North America in applications that satisfy the requirements specified by NFPA 79.
- The construction of the safety sensor must not be altered. When manipulating the safety sensor, the protective function is no longer guaranteed. Manipulating the safety sensor also voids all warranty claims against the manufacturer of the safety sensor.
- The safety sensor must be inspected regularly by a competent person to ensure proper integration and mounting (see chapter 14.1 "Safety-relevant technical data").

CAUTION

Observe intended use!

The protection of personnel and the device cannot be guaranteed if the device is operated in a manner not complying with its intended use.

- Only operate the device in accordance with its intended use.
- Leuze electronic GmbH + Co. KG is not liable for damages caused by improper use.
- Read these operating instructions before commissioning the device. Knowledge of the operating instructions is an element of proper use.

NOTICE

Comply with conditions and regulations!

- Observe the locally applicable legal regulations and the rules of the employer's liability insurance association.

2.1.1 Airborne particles

Vapors, smoke, dust and all particles visible in the air can cause the machine to switch off unintentionally. This can mislead the user into bypassing the safety devices.

- Do not use the safety sensor in environments in which heavy vapors, smoke, dust or other visible particles occur at the beam level.

2.1.2 Stray light

Light sources can impair the safety sensor's availability. Interfering light sources are:

- Infrared light
- Fluorescent light
- Strobe light

- Ensure that there are no interfering light sources at beam level.
- Prevent reflective surfaces at beam level.
- Where applicable, take protective field addition distances into account.
- Implement all additional measures to ensure that any special application of any effected beam types does not impair the safety sensor's operation.

2.1.3 Obstructions in the protective field

- Do not bring any additional window materials into the area monitored by the safety sensor.

NOTICE

No screen between optics cover and monitoring area!

- Between the optics cover of the safety sensor and the monitored area, no further screen may be mounted to protect the safety sensor.

2.2 Foreseeable misuse

Any use other than that defined under "Intended use" or which goes beyond that use is considered improper use.

In principle, the safety sensor is **not** suitable as a protective device for use in the following cases:

- Danger posed by ejected objects or the spraying of hot or hazardous liquids from within the danger zone.
- Applications in explosive or easily flammable atmospheres.
- Use for outdoor applications or under extreme temperature fluctuations.

  Humidity, condensation and other weather influences can impair the protective function.
- Use on vehicles with combustion engines.

  Alternators and ignition systems can cause EMC interferences.

	NOTICE
	**Do not modify or otherwise interfere with the safety sensor!** ↳ Do not carry out modifications or otherwise interfere with the safety sensor. The safety sensor must not be tampered with and must not be changed in any way. ↳ The safety sensor must not be opened. There are no user-serviceable parts inside. ↳ The construction of the safety sensor must not be altered. When manipulating the safety sensor, the protective function is no longer guaranteed. ↳ Manipulating the safety sensor voids all warranty claims against the manufacturer of the safety sensor. ↳ Repairs must only be performed by Leuze electronic GmbH + Co. KG.

2.3 Competent persons

Connecting, mounting, commissioning and adjustment of the safety sensor must only be carried out by competent persons.

Prerequisites for competent persons:

- They have a suitable technical education.
- They know the rules and regulations for labor protection, safety at work and safety technology and can assess the safety of the machine.
- They know the operating instructions for the safety sensor and the machine.
- They have been instructed by the responsible person on the mounting and operation of the machine and of the safety sensor.
- You are currently employed in a role related to the subject of the audit.

Task-specific minimum requirements for suitably qualified persons:

Configuration

Specialist knowledge and experience in the selection and use of protective devices on machines as well as the application of technical rules and the locally valid regulations on labor protection, safety at work and safety technology.

Mounting

Specialist knowledge and experience needed for the safe and correct installation and alignment of the safety sensor with regard to the respective machine.

Electrical installation

Specialist knowledge and experience needed for the safe and correct electrical connection as well as safe integration of the safety sensor in the safety-related control system.

Electrical work must be carried out by a certified electrician. Due to their technical training, knowledge and experience as well as their familiarity with relevant standards and regulations, certified electricians are able to perform work on electrical systems and independently detect possible dangers. In Germany, certified electricians must fulfill the requirements of accident-prevention regulations DGUV (German Social Accident Insurance) provision 3 (e.g. electrician foreman). In other countries, there are respective regulations that must be observed.

Operation and maintenance

Specialist knowledge and experience needed for the regular inspection and cleaning of the safety sensor – following instruction by the person responsible.

Servicing

Specialist knowledge and experience in the mounting, electrical installation and the operation and maintenance of the safety sensor in accordance with the requirements listed above.

Commissioning and testing

- Commissioning and testing: experience and specialist knowledge in the rules and regulations of labor protection, safety at work and safety technology that are necessary for being able to assess the safety of the machine and the use of the safety sensor, including experience with and knowledge of the measuring equipment necessary for performing this work.

- In addition, an activity in the environment of the object of the inspection is carried out in a timely manner and the person's level of knowledge is kept up to date through continuous training in the latest technology – a “qualified person” as defined by the German Industrial Safety Regulation and other national legal requirements.

2.4 Disclaimer

Leuze electronic GmbH + Co. KG is not liable in the following cases:

- The safety sensor is not used as intended.
- Safety notices are not adhered to.
- Reasonably foreseeable misuse is not taken into account.
- Mounting and electrical connection are not properly performed.
- Proper function is not tested (see chapter 10 "Testing").
- Changes (e.g., constructional) are made to the safety sensor.

2.5 Laser safety notices

Laser class 1 for wavelength range outside 400 - 700 nm

NOTICE
Additional measures for shielding the laser radiation are not necessary (safe for eyes).

ATTENTION
LASER RADIATION – CLASS 1 LASER PRODUCT The device satisfies the requirements of IEC 60825-1:2014 / EN 60825-1:2014+A11:2021 safety regulations for a product of **laser class 1** and complies with 21 CFR 1040.10 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019. ↳ Observe the applicable statutory and local laser protection regulations. ↳ The device must not be tampered with and must not be changed in any way. There are no user-serviceable parts inside the device. **CAUTION!** Opening the device may result in hazardous radiation exposure! Repairs must only be performed by Leuze electronic GmbH + Co. KG.

2.6 Responsibility for safety

Manufacturer and operator must ensure that the machine and implemented safety sensor function properly and that all affected persons are adequately informed and trained.

The type and content of all imparted information must not lead to unsafe actions by users.

The manufacturer of the machine is responsible for:

- Safe machine construction and information on any residual risks
- Safe implementation of the safety sensor, verified by the initial test performed by a competent person (see chapter 2.3 "Competent persons")
- Imparting all relevant information to the operating company
- Adhering to all regulations and directives for the safe commissioning of the machine

The operator of the machine is responsible for:

- Instructing the operator
- Maintaining the safe operation of the machine
- Adhering to all regulations and directives for labor protection and safety at work
- Regular inspection by authorized persons (see chapter 2.3 "Competent persons")

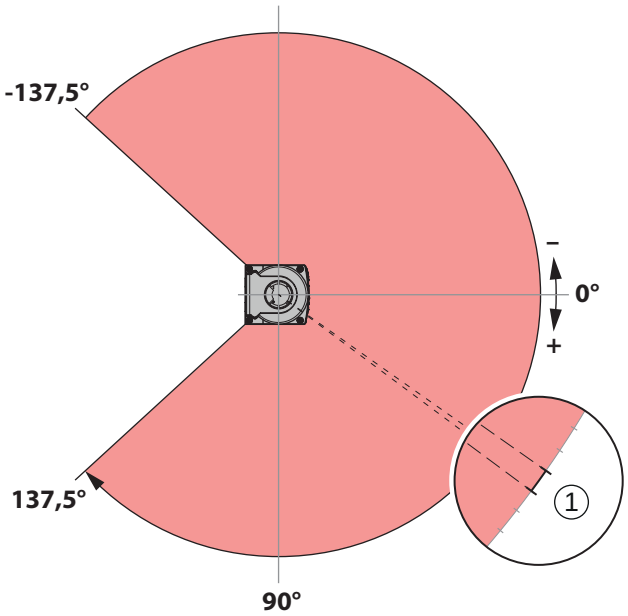
3 Device description

3.1 Protective function

The RSL 200 safety laser scanner is an active optoelectronic protective device (AOPD) that is used to protect people or body parts at points of operation, in hazardous areas or at access points to machines and systems.

The safety laser scanner contains a rotating mirror that deflects periodically transmitted light pulses, thereby scanning the surrounding area in two dimensions. The light pulses are scattered in all directions by obstacles, e.g. persons. A part of the light pulses is received again by the safety sensor and evaluated. The safety sensor calculates the precise position of the object from the propagation time of the radiated light and the current angle of the deflection unit at that time. If the object is within a predefined area, the protective field, the safety sensor performs a safety-related switching function. It switches the safety-related switching outputs off. Only when the protective field is free again does the safety sensor reset the safety-related switching function, either automatically or following acknowledgment, depending on the operating mode. The safety sensor can even detect people wearing very dark clothing with a very low reflectivity (>1.8%).

The angular resolution, i.e. the angular distance between two distance measurement values, is 0.2° for the RSL 200 series safety laser scanners and objects in the scanning range of up to 275° are detected, depending on which monitoring area is configured.



1 Angular resolution 0,2°

Fig. 3.1: Light pulses scan an area

The following parameters for switching off the safety-related switching outputs of the safety sensor are taken into consideration for the protective function:

- Configurable protective fields
- Configurable field triple switchover
- Selectable resolution for leg detection
- Safety sensor response time
- Selectable start-up behavior

The following non-safety-oriented functions and signals also belong to the protective function:

- Configurable warning fields
- Configurable indication signals

Additional functions of the protective function

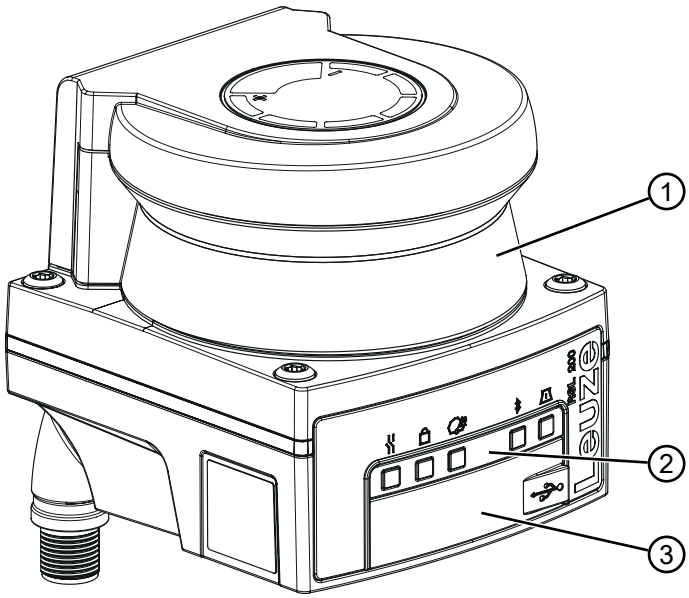
- Warning field evaluation
- Selectable dynamic contactor monitoring (EDM)

3.2 Device overview

The safety sensors from the RSL 200 series are optoelectronic, two-dimensional measuring safety laser scanners. They satisfy the following standards:

Tab. 3.1: Safety features

Standardization	RSL 200
Type in accordance with EN IEC 61496	3
Category in accordance with EN ISO 13849-1	3
Safety Integrity Level (SIL) in accordance with IEC/EN 61508	2
Maximum SIL in accordance with EN IEC 62061	2
Performance Level (PL) in accordance with EN ISO 13849-1	d



1 Optics cover
2 LED indicator
3 USB connection type C (behind protection cap)

Fig. 3.2: Device overview of RSL 200 safety laser scanners

All safety sensors in the RSL 200 series are equipped with the following features:

- Switchable protective/warning field triple consisting of one configurable protective field and two configurable warning fields. The number of switchable protective/warning field triples is variant-dependent.
- Number of OSSD pairs: 1
- Laser scanner with the range class S (3,00 m)
- LED indicator
- Bluetooth interface
- USB interface
- Configuration memory
- Electrical connection to the machine via connection cable

NOTICE

- Use the USB connection only temporarily for configuration or diagnosis of the safety sensor.
- For permanent connection, connect the safety sensor to the Ethernet connection of the connection unit. (RSL 230, RSL 235)
- Unused USB lines must not be permanently connected to the safety sensor.

The following table provides an overview of the variant-dependent features and functions of the RSL 200 safety sensors.

Tab. 3.2: Features and functions

Feature/function	RSL 210	RSL 220	RSL 230	RSL 235
Ethernet connection	-	-	X	X
Configurable signal outputs	Up to 4	Up to 4	Up to 8	Up to 8
Number of switchable protective/warning field pairs	1	8	32	32
Measurement data output optimized for vehicle navigation	-	-	-	X

3.3 Device connections

The safety laser scanners of the RSL 200 series are each equipped with a rotatable M12 connector for the power supply, OSSDs and universal I/Os (can be used as a universal input or universal output), which differs in the number of pins depending on the device model.

The RSL 230 and RSL 235 device variants have an additional Ethernet TCP/IP communication and configuration interface.

Tab. 3.3: Device connections

Device model	Connection
RSL 230	• M12 connector, 12-pin, A-coded • M12 socket, 4-pin, D-coded (Ethernet TCP/IP communication and configuration interface)
RSL 235	• M12 connector, 12-pin, A-coded • M12 socket, 4-pin, D-coded (Ethernet TCP/IP communication and configuration interface)

NOTICE

To ensure the IP protection and leak tightness of the devices, the supplied protection caps must always be placed on unused connections.

3.3.1 USB connection

The safety sensor has a USB port as a service interface for configuration and diagnostics. The USB port complies with the 2.0 Type C standard.

NOTICE

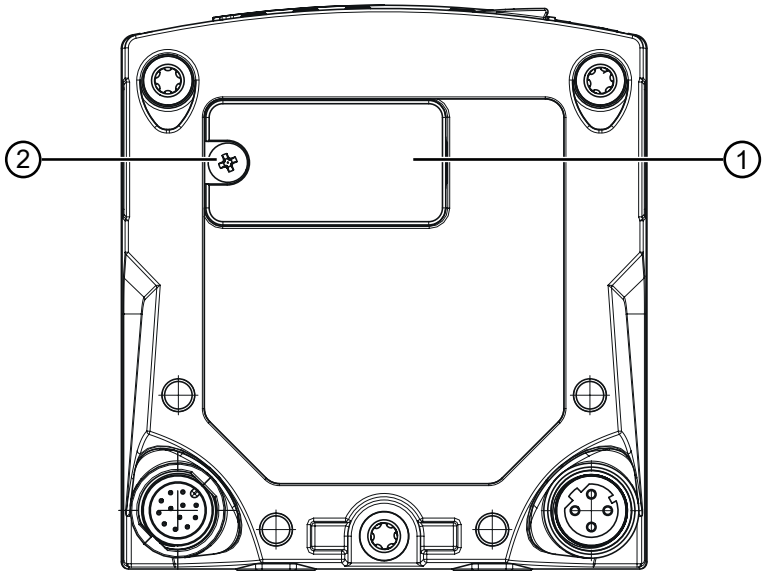
- Use the USB connection only temporarily for configuration or diagnosis of the safety sensor.
- For permanent connection, connect the safety sensor to the Ethernet connection of the connection unit. (RSL 230, RSL 235)
- Unused USB lines must not be permanently connected to the safety sensor.

NOTICE

- After use, seal the USB connection using a protection cap. Make sure that the protection cap is felt to engage when sealing. The IP degree of protection specified in the technical data is only achieved when the protection cap is closed.

3.3.2 Configuration memory

The safety sensor has a replaceable configuration memory on the underside of the device. This is used to store the configuration files and automatically transfers the stored parameters when devices are replaced (see chapter 12.1 "Replacing the device").



1 Configuration memory
2 Cross-head screw M3
Tightening torque 0.35 - 0.5 Nm

Fig. 3.3: Position of the configuration memory

3.4 Bluetooth

The safety sensor has an integrated Bluetooth interface for transmitting diagnostic data to a PC or mobile device.

The RSL 200 app provided by Leuze is required for reading out the diagnostic data and status and error information on a mobile device (see chapter 11.2 "Diagnostic displays RSL 200 app").

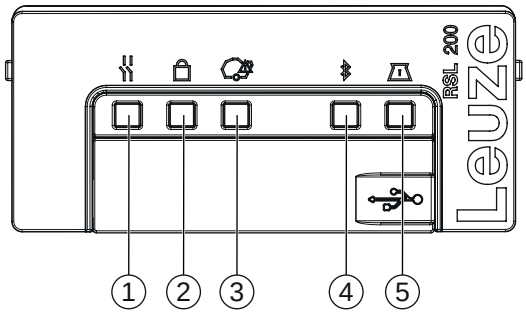
The integrated Bluetooth interface is intended for temporary use.

3.5 Display elements

The display elements of the safety sensors simplify start-up and fault analysis.

LED indicator

Five status LEDs are located below the optical hood.



1 LED 1, red/green
2 LED 2, yellow
3 LED 3, blue
4 LED 4, blue/green
5 LED 5, yellow/green

Fig. 3.4: LED indicator

Tab. 3.4: LED indicator

LED	Color	State	Description
1	Red/green	OFF	Device switched off
		Red	OSSD off
		Red, flashing	• Error • Device starting up
		Green	OSSD on
2	Yellow	OFF	• RES deactivated • RES activated and enabled
		Yellow flashing	Protective field occupied
		ON	RES activated and blocked but ready to be unlocked
3	Blue	OFF	All warning fields are empty
		Blue, flashing	Two warning fields are interrupted
		ON	A warning field is interrupted
4	Blue/ green	OFF	Bluetooth deactivated
		Blue, flashing	Bluetooth activated, active connection to external device
		Blue	Bluetooth activated
		Green, flashing (30 s)	Ping received via Sensor Studio
5	Yellow/ green	OFF	No contamination warning / no contamination error
		Yellow flashing	Contamination warning (OSSD ON)
		Yellow	Contamination error (OSSD OFF)
		Green, flashing (30 s)	Ping received via Sensor Studio
All	1: Red 2: Yellow 3: Blue 4: Green 5: Green	ON (4 s)	Supply voltage applied. Device starting up

3.6 Field types

The safety laser scanner continuously checks whether persons or objects are located in one or several fields. The following field types are distinguished:

Protective field

The protective field secures the danger zone of a machine or vehicle. If an object is within the protective field, the safety sensor carries out a safety-related switching function and switches off the safety-related switching outputs (OSSDs). Downstream control elements can use this signal to end the dangerous state. Only when the protective field is free again does the safety sensor reset the safety-related switching function, either automatically or following acknowledgment, depending on the operating mode.

Warning field

The warning field must not be used in safety-related applications. It is used to generate simple switching functions such as visual or audible warning signals before the protective field is violated.

Tab. 3.5: Features protective field and warning field

Feature	Protective field (degree of reflectance: 1.8 %	Warning field (degree of reflectance: 20.0
Safe shutdown (according to EN ISO 13849-1)	Yes (PL d)	No
Max. Address of the safety laser scanner.	3.0 m	15,0 m
Intended use	Recognition and protection of persons	• Application-specific use (e.g. visual or audible warning signal) • Not a safety-related use

4 Functions

The functions of the safety sensor must be matched to the respective application and its safety requirements. You can activate/deactivate the functions and adapt them using parameters. You configure the functions using the configuration and diagnostics software (see chapter 8.2 "Configuring the safety sensor").

- You configure the functions of the safety sensor in the software as configuration projects.
- In each configuration project you determine the protective function and the configurable field pairs via the selected function mode.
- You determine the resolution, the start-up behavior, the response time and, where applicable, the vehicle speed together for all protective/warning field pairs of a configuration bank.

4.1 Authorization concept of safety sensor

User management allows target-group-oriented communication between the software and the safety sensor. Which functions are available depends on the selected **access level** of the user. For information on the software and user administration (see chapter 8.1 "Configuration and diagnostics software - Sensor Studio").

- Changing the safety configuration as well as the communication and diagnostics settings of the sensor is only permitted for certain access levels.
- Installation and operation of the software do not depend on the access level of the user.

The following access levels are available:

Tab. 4.1: Access levels and functions available

Access level	Functions
Observer	• Display the measurement contour • Upload and display configuration data from the safety sensor • Display status information from the safety sensor • Display diagnostics list • Customize display • Display and evaluate the measurement contour • Load configuration data from the safety sensor • Load status information from the safety sensor • Create service file • Reset password
Expert	In addition to the functions of the *Observer* • Load the signed safety configuration from a file and transfer/download to the safety sensor • Transfer changed communication and diagnostics settings from the PC to the safety sensor • Print configuration data incl. protective/warning fields • Calibrate optics cover

Access level	Functions
Engineer	In addition to the functions of the *Expert*, full access to all user-relevant functions and parameters: Create and change a safety configuration: • Save configuration data to file • Change all parameters of configuration • Reset safety sensor to default values • Define and change protective/warning fields • Print and delete protective/warning fields • Load protective/warning field data from file • Save protective/warning field data • Transfer protective/warning field data from the PC to the safety sensor • Change passwords

NOTICE
The software saves individual passwords in the connected safety sensor, thereby ensuring that only authorized users can change the existing configuration.

Determining access level

When creating a user in the user management via **Tools > User management** in the FDT frame menu, select the access level for the user. In the user management you can also create and change passwords for the users.

Using the device manager (DTM) you can change the access level of the user, if necessary (see chapter 8.1.6 "Selecting access level").

Click in the DTM menu bar on the [Change authorization level].

4.2 Function modes of safety sensor

You configure the functions of the safety sensor in configuration projects with the help of the configuration and diagnostics software. In each configuration project you determine the protective function and the configurable field pairs via the selected function mode.

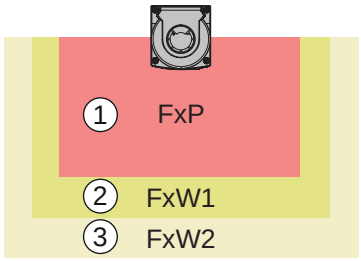
Select the function mode of the safety sensor in the software device manager (DTM) with **CONFIGURATION > FIELD CONFIGURATIONS** (see chapter 8.2 "Configuring the safety sensor").

You use the protective function to define the criteria for switching off the safety-related switching outputs.

Tab. 4.2: Function mode

Device model	field triple/protective fields warning fields	Field triple activation
RSL 230 RSL 235	32 field triples 32 protective fields + 64 warning fields	• Fixed selection of a field triple • Selection by signal inputs (2, 3, 4, 5 or 6) • Fixed changeover time (changeover time selectable)

The safety sensor monitors a protective field and up to two warning fields simultaneously. Depending on the model, a fixed triple field or up to 32 switchable triple fields are monitored.



1 Protective field
2 Warning field 1
3 Warning field 2

Fig. 4.1: One protective field with two warning fields

If the protective field is violated, the safety-related switching outputs (OSSDs) switch to OFF.

The assignment of the signals that are generated when a warning field is violated to the switching outputs is done via the configuration and diagnostics software (**CONFIGURATION > Signal parameter**; see chapter 8.2 "Configuring the safety sensor").

4.3 Selectable resolution for leg detection

The application-specific resolution of the safety sensor is defined in the configuration project together for all protective/warning field pairs of a configuration bank.

Tab. 4.3: Resolution of the safety sensor depending on the function

Safety sensor resolution (mm)	Function	Application
50 mm	Leg detection with the safety sensor mounted close to floor level	Stationary protection of hazardous areas
70 mm	Leg detection with the safety sensor mounted at a height of 300 mm	• Stationary protection of hazardous areas • Danger zone safeguarding

Mounting height = Height of the scan level above floor level

4.4 Speed-dependent protective function for vehicles

For object detection in the case of mobile applications, the safety sensor evaluates the relative speed of the object. If the safety sensor is mounted on vehicles or on moving parts of machines, the maximum speed of the vehicle must be entered during configuration of the protective function.

The maximum vehicle speed (*Max. AGV speed*) is selected in the configuration project together for all protective/warning field pairs of a configuration bank.

4.5 Response time

The response time is the maximum time from a protective field violation to switch-off of the safety-related switching outputs.

The response time is selected in the configuration project for all protective/warning fields together.

4.6 Configurable start-up behavior

The start-up behavior is selected in the configuration project for all protective/warning fields together.

4.6.1 Automatic start/restart

The safety sensor switches the OSSDs to the ON state as soon as the machine is turned on or the power supply is restored and when the protective field is cleared again.

Using automatic start/restart

You can use the *automatic start/restart* function under the following prerequisites:

- The *start/restart interlock* function is taken over by a downstream safety-related component of the machine control system.

  or:

- It is not possible to walk behind or go around the effective protective field.

↳ Allow for an optical and/or acoustic start warning.

Automatic start-up

The *automatic start-up* function starts the machine automatically as soon as the supply voltage is present.

Automatic restart

The *automatic restart* function starts the machine automatically as soon as the protective field is free again.

4.6.2 Start interlock/automatic restart

With start interlock/automatic restart, the safety sensor remains in the OFF state when, following a power supply interruption, the voltage supply is restored. After violation of the protective field, the system restarts when the protective field is free again.

The *start/restart interlock* has two functions:

- Start interlock
- Automatic restart

Using start interlock/automatic restart

↳ In addition to the safety sensor you must also install the reset button. The machine operator starts the machine with this reset button.

↳ Position the reset button outside the danger zone so that it cannot be activated from the protective fields and danger zones. The operator must be able to see all danger zones from this position.

↳ Identify the area to be released on the reset button so that its meaning is clear and easy to understand.

↳ Ensure that nobody is in the danger zone **before** pressing the reset button.

↳ Hold down the reset button for between 0.12 s and 4 s to enable the safety-related switching outputs.

	DANGER
	Risk of death if start-up is operated unintentionally! ↳ Ensure that the reset button for unlocking the start interlock cannot be reached from the danger zone. ↳ Before unlocking the start interlock, make certain that no people are in the danger zone.

Start interlock

The *start interlock* function prevents the machine from starting automatically after switching on or after the supply voltage returns.

The machine only starts when you press the reset button.

Automatic restart

The *automatic restart* function starts the machine automatically as soon as the protective field is free again.

4.6.3 Start/restart interlock (RES)

When accessing the protective field, the start/restart interlock ensures that the safety sensor remains in the OFF state after the protective field has been cleared. It prevents automatic release of the safety circuits and automatic start-up of the system, e.g. if the protective field is again clear or if an interruption in the voltage supply is restored.

The *start/restart interlock* has two functions:

- Start interlock
- Restart interlock

NOTICE

For access guarding, the start/restart interlock function is mandatory. The protective device may only be operated without start/restart interlock in certain exceptional cases and under certain conditions acc. to EN ISO 12100.

Using start/restart interlock

- In addition to the safety sensor you must also install the reset button. The machine operator starts the machine with this reset button.
- Position the reset button outside the danger zone so that it cannot be activated from the protective fields and danger zones. The operator must be able to see all danger zones from this position.
- Identify the area to be released on the reset button so that its meaning is clear and easy to understand.
- Ensure that nobody is in the danger zone **before** pressing the reset button.
- Hold down the reset button for between 0.12 s and 4 s to enable the safety-related switching outputs.

DANGER

Risk of death if start/restart is operated unintentionally!

- Ensure that the reset button for unlocking the start/restart interlock cannot be reached from the danger zone.
- Before unlocking the start/restart interlock, make certain that no people are in the danger zone.

Start interlock

The *start interlock* function prevents the machine from starting automatically after switching on or after the supply voltage returns.

The machine only starts when you press the reset button.

Restart interlock

The *restart interlock* function prevents the machine from starting automatically, as soon as the protective field is free again. The *restart interlock* function always includes the *start interlock* function.

The machine only starts again when you press the reset button.

4.7 Field triple changeover

Depending on the model, the safety sensor has 1 (RSL 210), 8 (RSL 220) or 32 (RSL 230, RSL 235) switchable field triples. With the models with 8 or 32 switchable field triples, it is possible to switch between the field triples at any time, as far as the operating situation allows.

Use the field pair changeover when the danger zones vary depending on the activity of the machine or the operating state, e.g. automated guided vehicles (AGVs), to control the field pair changeover for straight and curved stretches.

If the rules for field pair changeover are not complied with, the safety sensor signals a fault and the safety-related switching outputs are switched off.

The safety sensor has the following modes for field pair activation and field pair changeover:

- Fixed selection of a field triple
- Selection by signal inputs with fixed switchover time

The field triple switchover can be monitored by configurable measures (see chapter 4.8 "Monitoring the field triple switchover").

During the switchover process the safety sensor monitors the field triple activated before the field triple switchover according to the configured switchover time.

Using field triple switchover

You can configure and switch the field triples according to the different requirements. Switching is via the correspondingly configured control inputs.

The rules of the field triple switchover depend on the switchover time. The activated field pair must correspond with the respective operating mode. The time of the field pair changeover must correspond with the machine's risk assessment. You must take the lead time, braking distances, response times and machine stopping times, e.g. influenced by overlapping protective fields, into account.

If the requirements on the time behavior of the field pair changeover are not maintained, the safety-related switching outputs switch off and a message is displayed (see chapter 11 "Diagnosis and troubleshooting").

The following rules apply to the field triple switchover:

- The field pair changeover performed by the control system must agree with the safety sensor's configuration. This configuration is set using the configuration and diagnostics software (see chapter 8.2.4 "Configuring protective function").
- In the case of field pair changeover with fixed changeover time to an occupied protective field, the safety sensor switches off the safety-related switching outputs only after the sum of the synchronization time of 25 ms, the set changeover time and the set response time.

Example of protective field switchover – Point of operation G1 and G2 with immediate switchover or time overlap:

The machine has 2 points of operation (G1 and G2). Each point of operation is safeguarded by a protective field (SFa and SFb). Initially, point of operation G1 is active and protective field SFa is selected. If the machine now switches directly from G1 to G2, a further protective field SFc must be interposed, covering the areas SFa and SFb in a suitable manner.

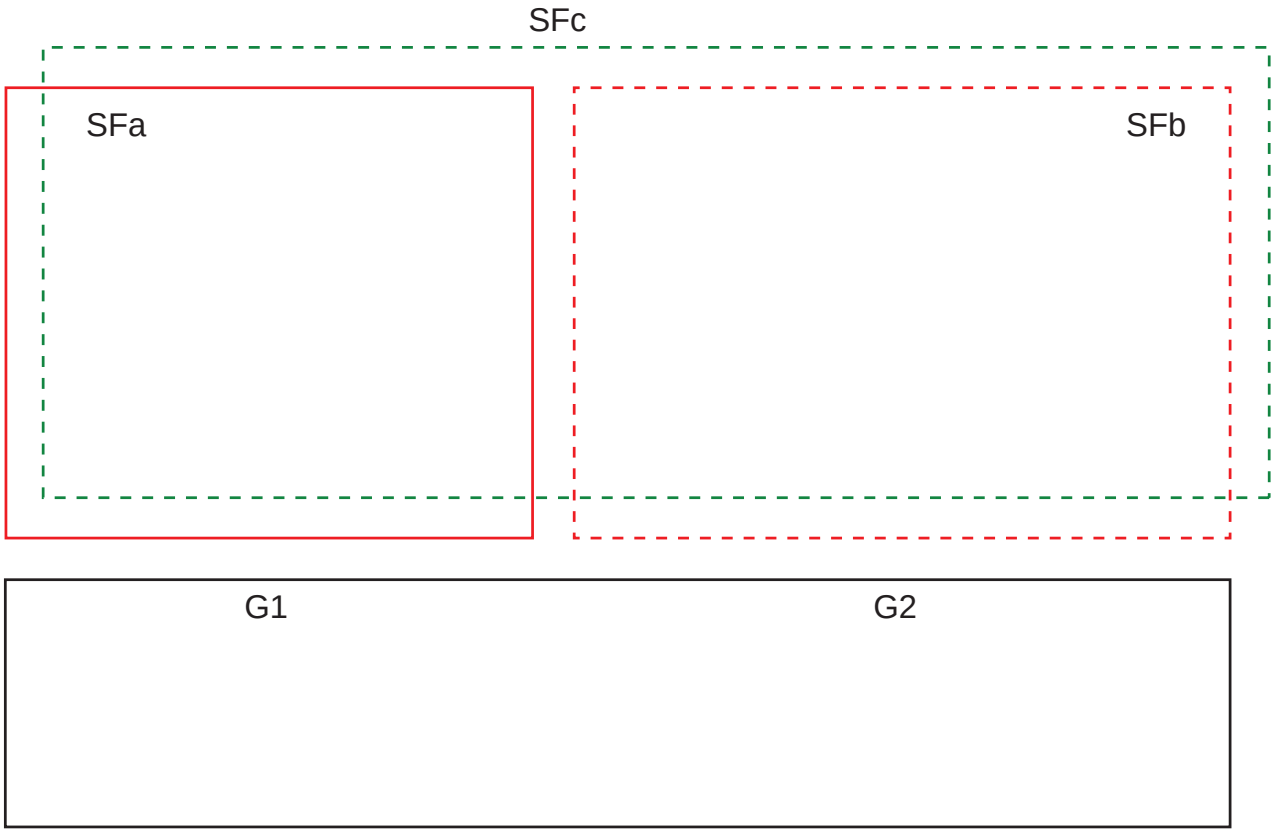


Fig. 4.6: Arrangement of points of operation and protective fields

The field pair changeover from SFa to SFc takes place at time T0, whereby T0 must be Tv before activation of point of operation G2 (danger G2 begins as of Tx). The time Tv is derived from the risk assessment for the machine and from the rules governing field pair changeover and must be selected such that point of operation G2 can be shut down in good time.

The field pair changeover from SFc to SFb may take place at time T01 = Tz minus the set changeover time at the earliest (danger G1 persists until Tz).

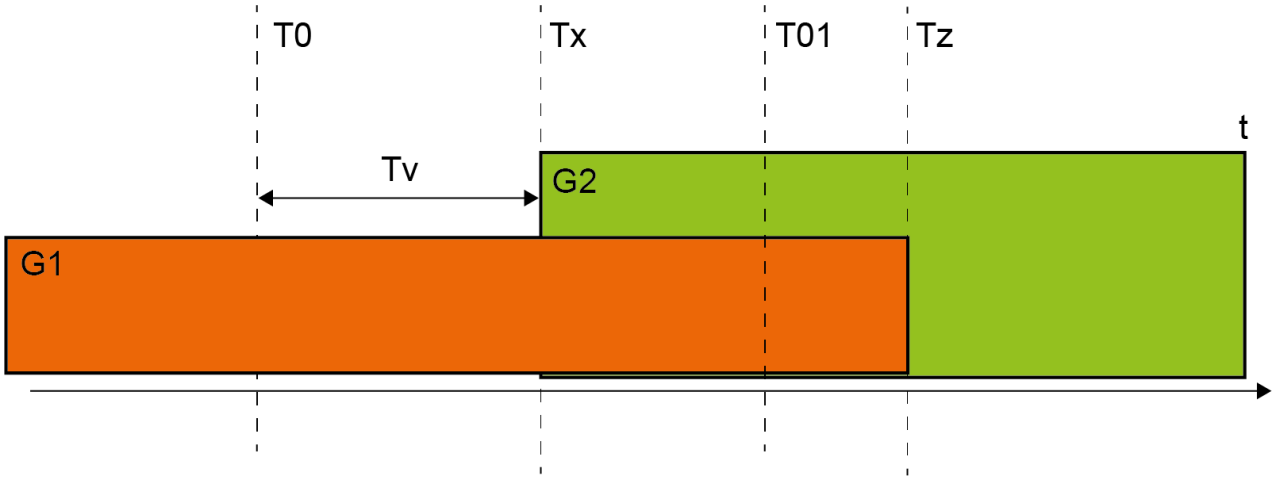


Fig. 4.7: Protective field switchover at 2 points of operation

4.7.1 Fixed selection of a field triple

If **Fixed selection of one field pair** is set as the mode for field pair activation, field pair F1.1 is monitored irrespective of how the control inputs are connected.

4.7.2 Switching between multiple field triplets with a fixed switchover time

The field triple switchover must take place within the configurable switchover time, i.e. a valid and stable input configuration must be present after the switchover time has elapsed.

- The previously active field pair is monitored during the changeover time.
- The switchover time starts when the safety sensor registers a change at the control inputs E1 to E4 (RSL 220) or E1 to E6 (RSL 230, RSL 235). When the changeover time has expired, only one field pair should still be active.
- Monitoring of the newly activated field pair starts when the changeover time has expired.
- The changeover time is specified with the configuration and diagnostics software.

The activation of a field triple occurs depending on the device variant and the number of selected signal inputs and thus the number of switchable field triples according to the tables below.

Tab. 4.4: Wiring of the control inputs E1 to E6 for activating the field triples F1 to F32 (RSL 230, RSL 235)

Field triple	Control input					
	E1	E2	E3	E4	E5	E6
F1	1	0	0	0	0	0
F2	0	1	0	0	0	0
F3	0	0	1	0	0	0
F4	0	0	0	1	0	0
F5	0	0	0	0	1	0
F6	0	0	0	0	0	1
F7	1	1	1	1	1	0
F8	1	1	1	1	0	1
F9	1	1	1	0	1	1
F10	1	1	0	1	1	1
F11	1	0	1	1	1	1
F12	0	1	1	1	1	1
F13	0	0	0	1	1	1
F14	0	0	1	1	1	0
F15	0	1	1	1	0	0
F16	1	1	1	0	0	0
F17	1	0	0	0	1	1
F18	0	1	0	0	1	1
F19	0	0	1	0	1	1
F20	1	0	0	1	1	0
F21	0	1	0	1	1	0
F22	1	0	1	1	0	0
F23	0	0	1	1	0	1
F24	0	1	1	0	0	1
F25	0	1	1	0	1	0
F26	1	1	0	0	0	1
F27	1	1	0	0	1	0
F28	1	1	0	1	0	0
F29	1	0	1	0	0	1
F30	1	0	0	1	0	1
F31	1	0	1	0	1	0
F32	0	1	0	1	0	1

Tab. 4.5: Wiring of the control inputs E1 to E5 for activating the field triples F1 to F10 (RSL 230, RSL 235)

Field triple	Control input				
	E1	E2	E3	E4	E5
F1	1	0	0	0	0
F2	0	1	0	0	0
F3	0	0	1	0	0
F4	0	0	0	1	0
F5	0	0	0	0	1
F6	1	1	1	1	0
F7	1	1	1	0	1
F8	1	1	0	1	1
F9	1	0	1	1	1
F10	0	1	1	1	1

Tab. 4.6: Wiring of the control inputs E1 to E4 for activating the field triple F1 to F8 (RSL 220, RSL 230, RSL 235)

Field triple	Control input			
	E1	E2	E3	E4
F1	1	0	0	0
F2	0	1	0	0
F3	0	0	1	0
F4	0	0	0	1
F5	1	1	1	0
F6	1	1	0	1
F7	1	0	1	1
F8	0	1	1	1

Tab. 4.7: Wiring of the control inputs E1 to E3 for activating the field triple F1 to F4 (RSL 220, RSL 230, RSL 235)

Field triple	Control input		
	E1	E2	E3
F1	0	0	1
F2	0	1	0
F3	1	0	0
F4	1	1	1

Tab. 4.8: Wiring of the control inputs E1 to E2 for activating the field transformers F1 to F2 (RSL 220, RSL 230, RSL 235)

Field triple	Control input	
	E1	E2
F1	1	0
F2	0	1

4.8 Monitoring the field triple switchover

The *Switchover Order* function specifies the permissible field triple switchovers, e.g. if it is mandatory to switch from field triple F2 to field triple F5. If the *Monitoring the Field Triple Switchover* function is activated, the safety-related switching outputs (OSSDs) switch off in the following cases:

- The control initiates an unauthorized field triple switchover.
- The field triple to which the switchover is made has been deactivated.

Activating the function

↳ Define the *switchover sequence* with the configuration and diagnostics software (see chapter 8.2.5 "Defining permissible field pair changeovers").

4.9 Field triple monitoring

With the *Field triple monitoring* function, you can define the monitoring mode for the selected field triple.

With the *Standby request* monitoring mode, you can switch off the field triple monitoring and the safety-related switching outputs (OSSDs). This is advisable when parking vehicles, for example.

Activation of the function

↳ Activate the field triple monitoring in the configuration and diagnostics software (see chapter 8.2.4 "Configuring protective function").

4.10 EDM contactor monitoring

The *EDM contactor monitoring* function dynamically monitors the contactors, relays or valves connected downstream of the safety sensor. Prerequisite for this are switching elements with positive-guided feedback contacts (normally closed contacts).

Activation of the function

↳ Activate the contactor monitoring function using the configuration and diagnostics software (see chapter 8.2.4 "Configuring protective function").

If contactor monitoring is activated, it operates dynamically, i.e., in addition to monitoring the closed feedback circuit every time before the OSSDs are switched on, it also checks whether the feedback circuit has opened within 500 ms after release and whether it has closed again within 500 ms after the OSSDs switched off. If this is not the case, the OSSDs return to the OFF state after being switched on briefly.

The safety sensor goes into the fault lock state:

- With the OSSDs switched off, +24 V must be present at the EDM input.
- With the OSSDs switched on, the EDM circuit must be open (high impedance).

4.11 Signaling functions

The device and monitoring functions of the safety sensor deliver indication signals for the following function groups:

- Protective functions, e. g,
  - Protective field violated
  - Warning field violated
- Device functions
- Error messages
- Warnings
- Diagnosis

The assignment of the individual functions within the function groups to the indication signals is defined using the configuration and diagnostics software (see chapter see chapter 8.2.6 "Configuring signal outputs").

5 Applications

The following chapters essentially describe the safety sensor's usage possibilities.

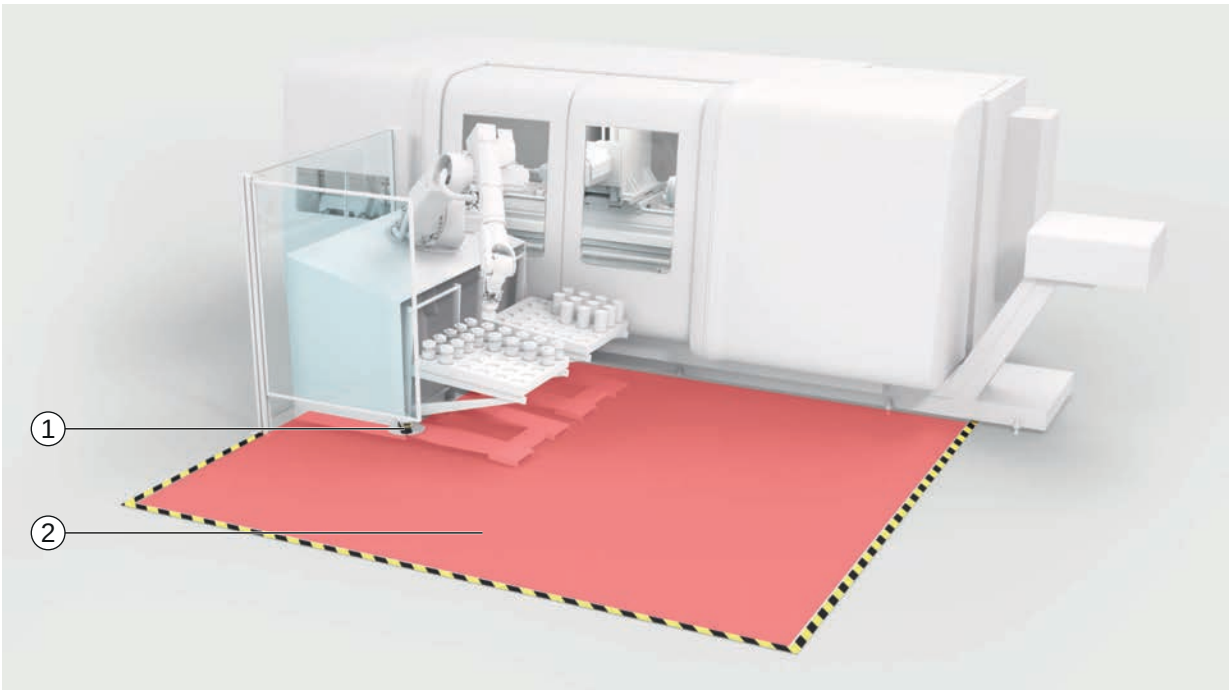
- To safely mount the safety sensor for the respective application, see chapter 6 "Mounting".
- For the electrical connection of the safety sensor, see chapter 7 "Electrical connection".
- To safely configure the safety sensor for the respective application, see chapter 8.2 "Configuring the safety sensor".

5.1 Stationary danger zone guarding

Stationary danger zone guarding enables a very spacious protection of people on machines that are to remain as accessible as much as possible. The safety sensor is applied as a stop-activating and presence-detecting protective device. The safety sensor's protective field is set up horizontally in front of the machine or system's point of operation.

You can also use the stationary danger zone guarding if you do have to guard areas under the machine or at the rear that are not visible.

If the danger zone changes during operation, the respective danger zone is guarded by means of a field pair changeover while the working area is accessible.

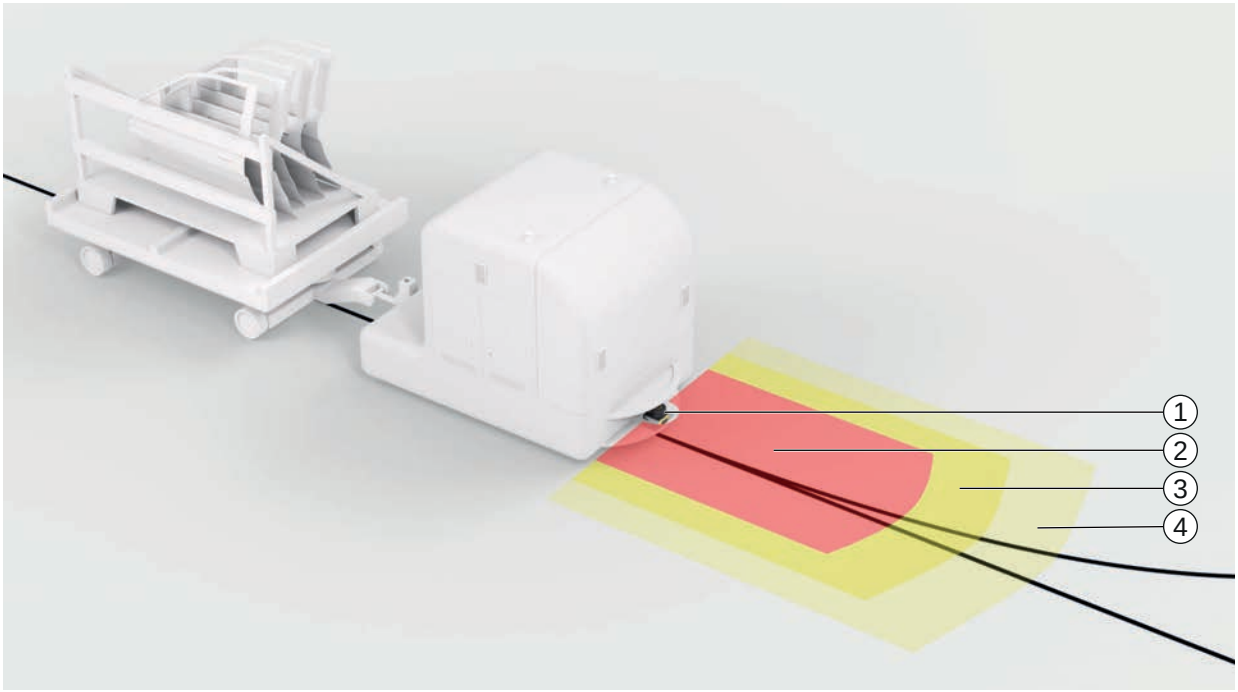


1 Safety sensor
2 Danger zone, protective function activated

Fig. 5.1: Stationary danger zone guarding

5.2 Mobile danger zone guarding

The mobile hazard zone guarding protects people who are in the path of an automated guided vehicle system (AGVS), cranes, forklifts or transfer cars. The distance between the protective field front edge and the vehicle front must be greater than the stopping distance of the vehicle with selected speed and maximum load. A safe control system selects speed-dependent protective fields and can activate side horizontal protective fields for curved stretches.



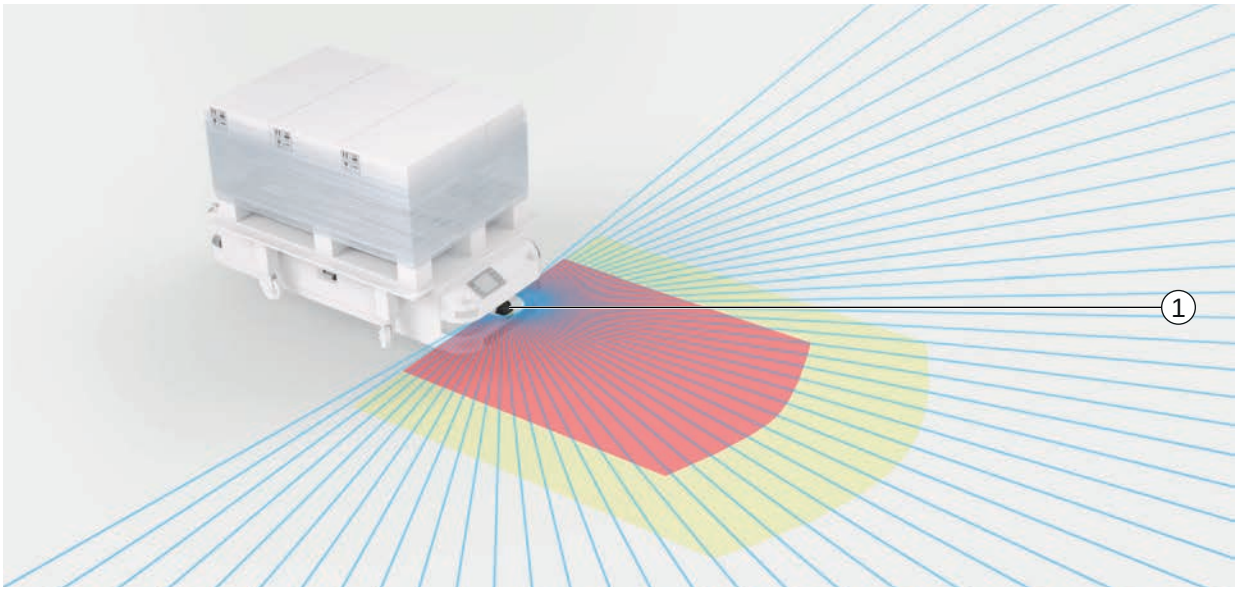
1 Safety sensor
2 Protective field
3 Warning field 1
4 Warning field 2

Fig. 5.2: Mobile danger zone guarding

5.3 Vehicle navigation (RSL 235)

The measurement data cyclically transmitted by the safety sensor can be used for navigation by automated guided vehicles.

For each measurement point of the scan level, values for distance and signal strength are part of the measurement data. A navigation system evaluates the measurement data and calculates the position of the vehicle. With the help of the transmitted signal strength, highly reflective landmarks can be detected.



1 Safety sensor

Fig. 5.3: Vehicle navigation

In addition to the measurement data, a status profile of the safety sensor is also transmitted. The status profile contains information about the status of the inputs and outputs as well as other status information. The status profile thereby offers a possibility for performing diagnostics on the safety sensor.

You can find additional information in document *RSL 200 / RSL 400 UDP*, which is available for download on the Leuze website: **www.leuze.com**.

	NOTICE
	The measurement data transmitted via UDP is not part of the safety function of the safety sensor and therefore may only be used for diagnostic purposes or to support navigation on automated guided vehicles. The safety function of the safety sensor is only provided by switching off the OSSDs.

Signal strength and reflector detection

The signal strength transmitted via UDP is a measure of the optical power received by the safety sensor, which is largely dependent on the following values:

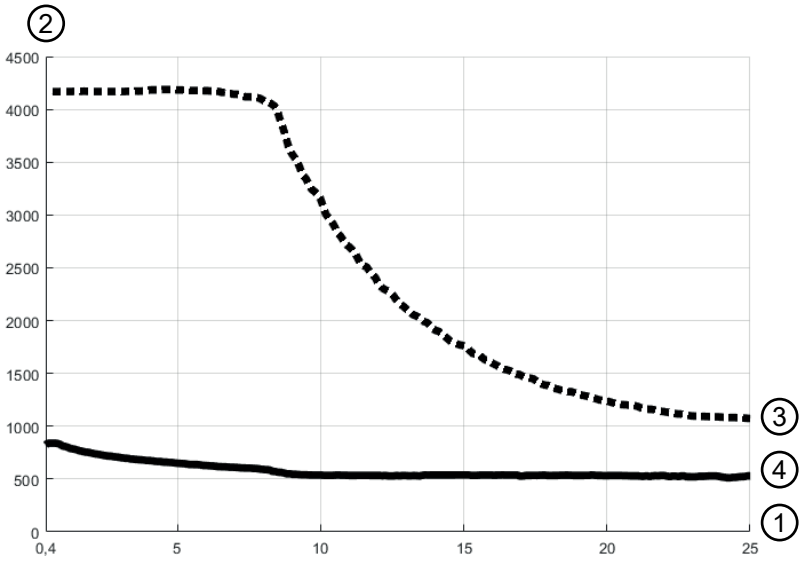
- Distance
- Brightness of the object or structure of the object surface
- Angle of incidence of the laser beam on the object surface
  0°: vertically incident light
- Share of area of the light spot on the object
  100%: the light spot lies completely on the measured object

The signal strength transmitted by the safety sensor can be used to navigate automated guided vehicles. The transmitted signal strength value is a unitless, non-calibrated measurement value that is output unprocessed by the safety sensor.

To navigate automated guided vehicles, highly reflective landmarks are distinguished from the less-reflective surroundings. These landmarks usually consist of retro-reflector films. Retro-reflectors can be identified by analyzing the signal strength values. If the signal strength exceeds a limit value, a retro-reflector can be mapped at this angle. Reliable detection of retro-reflectors is usually given from the following signal strength limit:

- Distance range 0.4 - 12 m: 2000
- Distance range 12 - 16 m: 1200
- Distance range > 16 m: 900

The safety sensor normally measures a signal strength value of max. 4000 for reflective surfaces.



1 Object distance [m]
2 Signal strength
3 Retro-reflector film
4 White surface

Fig. 5.4: Signal strength curves depending on the distance

The figure shows a typical curve of the signal strength transmitted by the safety sensor as a function of the measured object distance and object diffuse reflection for the following boundary conditions:

- Angle of incidence of the laser beam: 0°
- Share of area of the light spot on the object: 100%

The upper curve (3) represents the typical, distance-dependent change of the signal strength for a typical retro-reflector film, e.g. 3M™ Diamond Grade 983-10™.

The lower curve (4) shows the typical, distance-dependent change of the signal strength for a white, naturally scattering surface with 90% diffuse reflection, e.g., a white wall.

6 Mounting

The safety sensor's protective function is only guaranteed when the device arrangement, configuration, protective field dimensioning and mounting are coordinated with the respective application.

The installation work must only be performed by a competent person in compliance with the applicable standards and these instructions. The mounting must be thoroughly inspected on completion.

- Observe the relevant machine-specific standards and regulations (see chapter 16 "Standards and legal regulations").
- Observe the basic instructions for assembly (see chapter 6.1 "Basic infos").

WARNING

Improper mounting may result in serious injury!

The protective function of the safety sensor is only ensured if appropriately and professionally mounted for the respective, intended area of application.

- Only allow competent persons to install the safety sensor.
- Observe the necessary safety distances (see chapter 6.1.1 "Calculation of safety distance S").
- Make sure that stepping behind, crawling under or stepping over the protective device is reliably ruled out and reaching under, over or around is taken into account in the safety distance, if applicable with additional distance C_{RO} corresponding to EN ISO 13855.
- Mount the safety sensor in such a way that it is protected from being damaged.
- If the vibration and shock requirements are above the values specified in this document, vibration damping measures must be implemented.
- Take measures to prevent that the safety sensor can be used to gain access to the danger zone, e.g. by stepping or climbing into it.
- Observe the relevant standards, regulations and these instructions.
- After mounting, check the safety sensor for proper function.
- Clean the safety sensor at regular intervals.
  Environmental conditions: see chapter 14 "Technical data"
  Care: see chapter 12 "Care, maintenance and disposal"

6.1 Basic infos

6.1.1 Calculation of safety distance S

Optical protective devices can only perform their protective function if they are mounted with adequate safety distance. When mounting, all delay times must be taken into account, e.g. the response times of the safety sensor and the control elements as well as the stopping time of the machine.

The following standards specify calculation formulas:

- ISO 13855 – Safety of machinery – The positioning of protective equipment in respect to approach speeds of parts of the human body Cultivation situation and safety distances.

General formula for calculating the safety distance S of an Optoelectronic Protective Device acc. to EN ISO 13855

$$S = K \cdot T + C$$

S	[mm]	Safety distance
K	[mm/s]	Approach speed
T	[s]	Total time of the delay, sum from (t_a + t_i + t_m)
t_a	[s]	Response time of the protective device
t_i	[s]	Response time of the safety relay
t_m	[s]	Stopping time of the machine
C	[mm]	Additional distance to the safety distance

NOTICE
If longer stopping times are determined during regular inspections, an appropriate additional time must be added to t_m.

6.1.2 Suitable mounting locations

Area of application Mounting

Inspector: Technician who mounts the safety sensor

Tab. 6.1: Checklist for mounting preparations

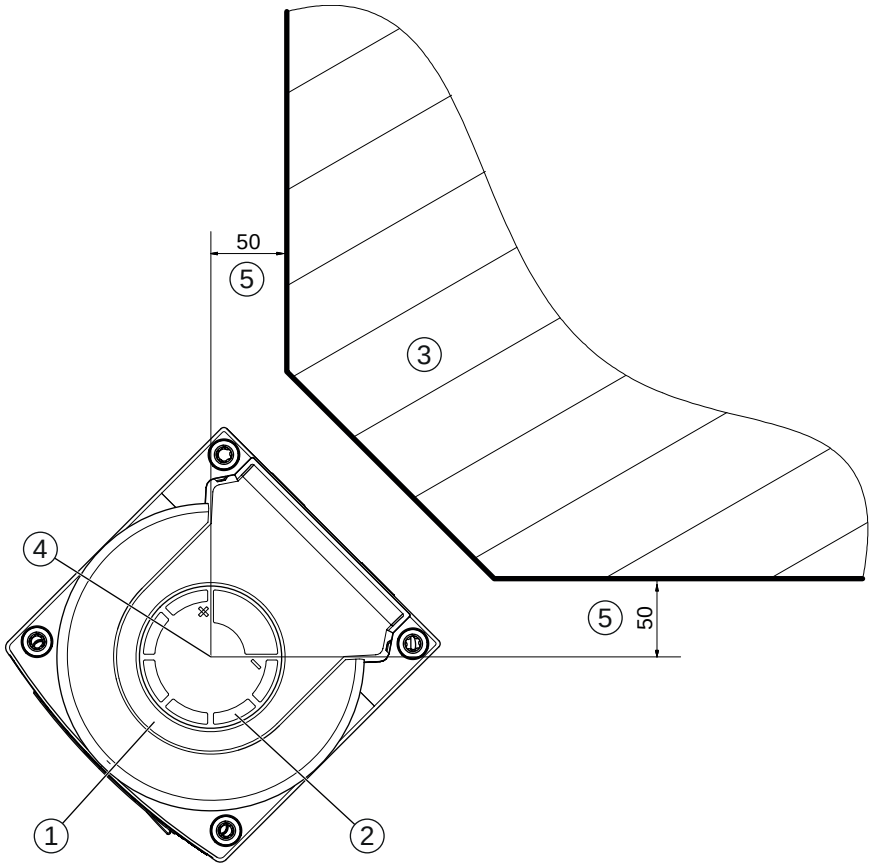
Check:	Yes	No
Is the safety distance to the hazard location maintained?		
Has the scanning angle of the safety sensor as given on the marking/template on the top of the sensor been taken into consideration?		
Can the point of operation or the danger zone only be accessed through the protective field?		
Have measures been taken to prevent the protective field from being bypassed by crawling under?		
Is stepping behind the protective device prevented or is mechanical protection available?		
Can the safety sensors be fastened in such a way that they cannot be moved and turned?		
Is the safety sensor accessible for testing and replacing?		
Is it impossible to actuate the reset button from within the danger zone?		
Can the entire danger zone be seen from the installation site of the reset button?		

NOTICE
If you answer one of the items on the checklist with *no*, the mounting location must be changed.

6.1.3 Mounting the safety sensor

Proceed as follows:

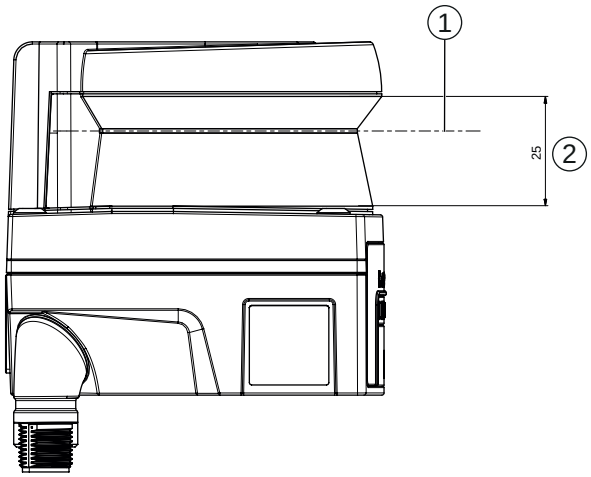
- ✓ Calculate the necessary safety margin and determine the surcharges required for your application; see chapter 6.1.1 "Calculation of safety distance S".
- ✓ Determine the mounting location.
- ↳ Please note the information on installation locations; see chapter 6.1.2 "Suitable mounting locations".
- ↳ Ensure that machine parts, safety guards or covers do not impair the safety sensor's field of vision.
- ↳ Make sure that the scanning range of the safety sensor is not limited. To mount the safety sensor taking the scanning range into consideration, a template must be attached to the top cover of the safety sensor.
- ↳ Make sure that no small objects are in the safety sensor's scanning range, even if these do not trigger an object detection and the safety-related switching outputs do not switch to the OFF state.
- ↳ Make sure that the safety sensor is mounted so that good air circulation and thus heat dissipation is ensured.



all dimensions in mm

1 Safety sensor
2 Template (markings on safety sensor)
3 Mounting location
4 Reference point for distance measurement and protective field radius
5 Area with unobstructed view; must remain free

Fig. 6.1: Mounting taking the 275° scanning range into account

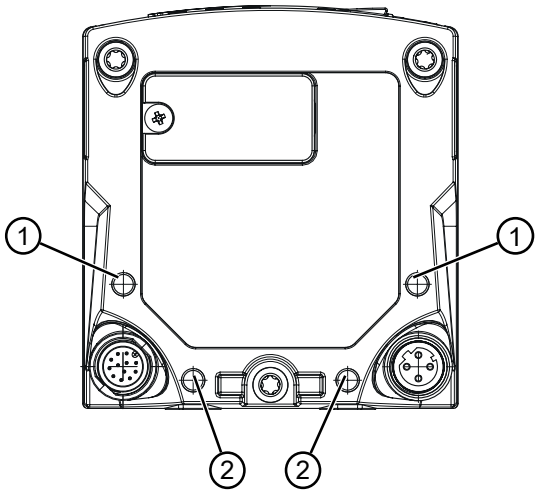


all dimensions in mm

1 Scanning plane
2 Area with unobstructed view; must remain free (25 mm)

Fig. 6.2: Mounting Mounting: area with unobstructed view

- Determine whether you are going to install the safety sensor with or without the mounting system.
- For direct mounting, use all four M5 threaded holes on the bottom of the device or the two M5 threaded holes on the rear side of the device.
- When using the two M5 threaded holes on the back of the safety sensor, ensure a screw-in depth of 6 mm and take into account the maximum screw-in depth of 6.5 mm.
  When using the four M5 threaded holes on the underside of the device, a maximum screw-in depth of 5.5 mm (1) or 9.5 mm (2) must be taken into account.
  Make sure that the mounting elements or construction can carry at least four times the weight of the device with mounting system.



1 M5 threaded hole, 5.5 mm deep
2 M5 threaded hole, 9.5 mm deep

Fig. 6.3: Maximum screw-in depth

- Tighten the M5 screws with a tightening torque of 2.3 Nm on the safety sensor.
- Use a screw locking adhesive for strong vibrations to secure the fastening screws.
- Have the appropriate tools at the ready and mount the safety sensor.
- Install protective enclosures or safety bars if the safety sensor is in an exposed position.
- If there is a risk that the safety sensor will be used as a climbing aid, install a suitable physical cover over the safety sensor.
- Align the mounted safety sensor horizontally and vertically.
- Attach safety notice stickers to the mounted safety sensor (the stickers are included in the delivery contents).
- Configure the safety sensor with the configuration and diagnostics software; see chapter 8.2 "Configuring the safety sensor".
  Note the information on response times, machine stopping time and protective field dimensioning for your application.
  Determine the protective field size based on the mounting location, the calculated safety distances and additional distances.

	NOTICE
	If the protective field boundaries < 190 mm, object detection can be limited due to the measurement error. - When defining the protective field, take the additional distance Z_{sm} to the protective field contour into account (see chapter 6.2 "Stationary danger zone guarding").

- Configure the protective field so that the safety-related switching outputs switch off from every accessible point with sufficient minimum distance D.
- Determine the start-up/restart operating mode required for the application.
- If you are using start and/or restart interlock, determine the position for the reset button.
- Many safety-relevant parameters are preset for each application in the configuration and diagnostics software. Use these preset values where possible.

- Determine the conditions for the field triple switchover and the sequence of the field triple switchover.
- Create a verification document for the device configuration and protective field dimensioning.
  The document must be signed by the person responsible for the configuration.
  Attach this document to the machine documentation.
- Mark the protective field boundaries on the floor.
  You can easily test the safety sensor along this marking.

After mounting, you can electrically connect (see chapter 7 "Electrical connection"), start up and align (see chapter 9 "Starting up the device") as well as test (see chapter 10 "Testing") the safety sensor.

6.1.4 Information on protective field dimensioning

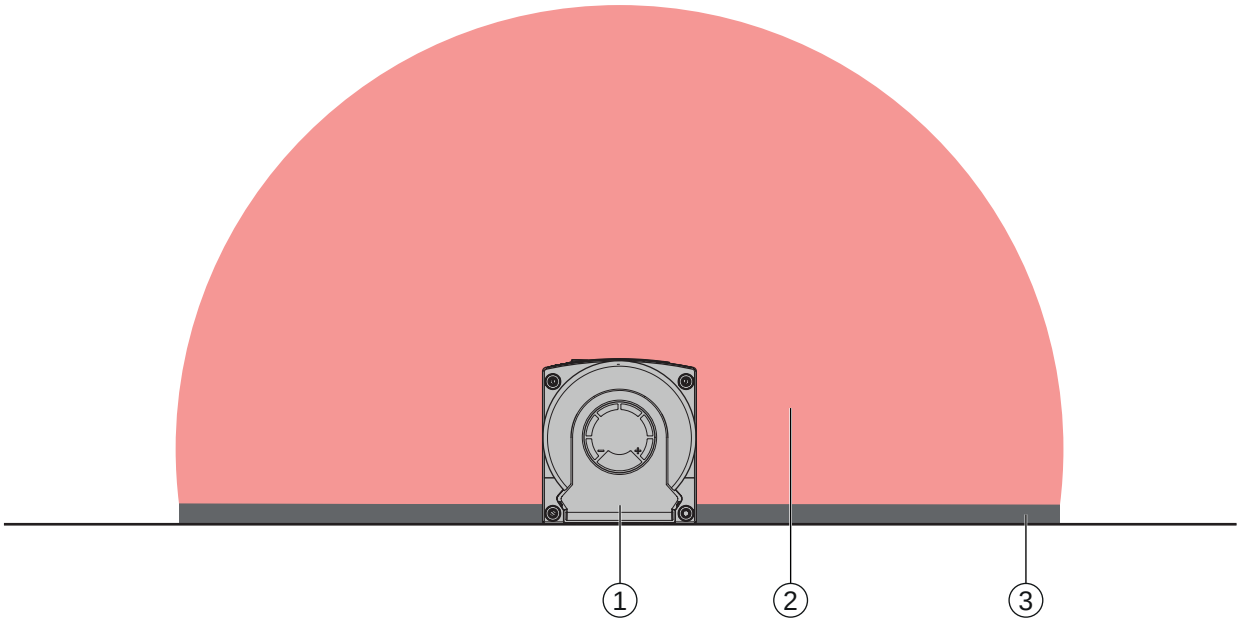
	NOTICE
	**If the protective field boundaries < 190 mm, object detection can be limited due to the measurement error.** - When defining the protective field, take the additional distance Z_{sm} to the protective field contour into account (see chapter 6.2 "Stationary danger zone guarding").

- Dimension the protective field big enough that the safety sensor's switching signal can stop the dangerous movement in good time.
- If several protective fields are selected with field pair changeover, this condition applies for all protective fields.
- If you cannot sufficiently dimension a protective field, use additional protective measures, e.g. safety guards.
- Ensure that the protective field cannot be walked behind in the direction of the danger zone.
- Observe all delay times, e.g. safety sensor response times, control element response times, braking times or machine or automated guided vehicle stopping times (AGV).
- Take changed delay times, which, for example, can be caused by reducing the braking force, into account.
- Observe shadowing effects, e.g. surfaces and areas behind static objects. People in the shadows of these objects will not be detected by the safety sensor.
- Observe the lateral tolerance when dimensioning the protective fields (see chapter 14 "Technical data").
- Do not use cone-shaped protective field contours, as these do not guarantee any protective function.
- Take the additional distances required for the application into account.

Handling unmonitored areas

There is an area behind the safety sensor that the safety sensor does not monitor. Unmonitored areas can also materialize, e.g. if you install a safety sensor on a rounded off vehicle front.

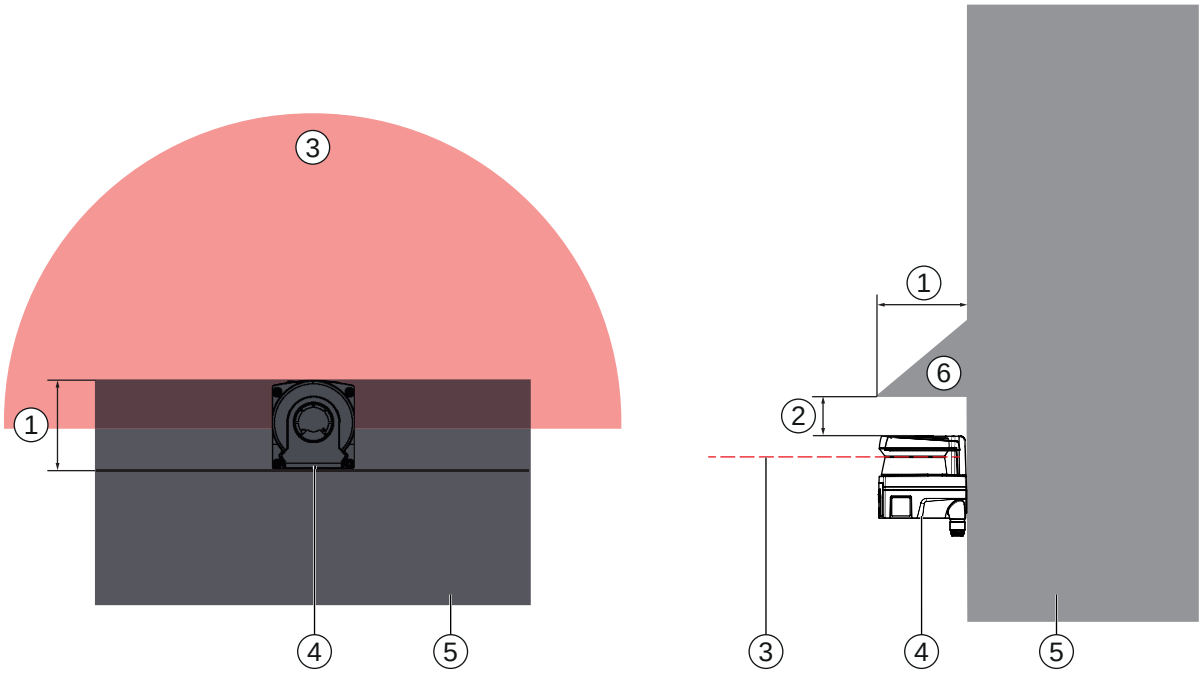
It must not be possible to walk behind unmonitored areas.



1 Safety sensor
2 Protective field
3 Unmonitored area;
Optimum availability at a distance of 50 mm to fixed contours

Fig. 6.4: Unmonitored area

- Prevent access to an unmonitored area with screens.
- Prevent walking behind by countersinking the safety sensor into the machine contour.



1 Countersinking into the machine contour, min. 95 mm
2 Minimum distance above the scanner unit, min. 10 mm
3 Protective field
4 Safety sensor
5 Machine
6 Angled physical cover

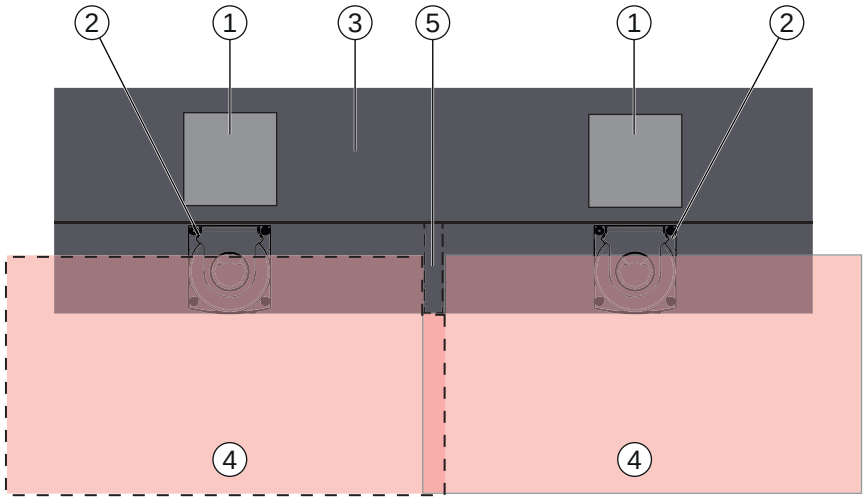
Fig. 6.5: Stepping behind protection by countersinking into the machine contour

- Use a physical cover set at an angle over the safety sensor if you expect that the safety sensor will be used as a climbing aid or standing surface.

Protective field setup with adjacent safety sensors

The safety sensor has been developed in a way that prevents several safety sensors from interfering with one another as much as possible. Nevertheless, if several safety sensors are positioned adjacent to each other, this may result in a reduction in the availability of the safety sensors.

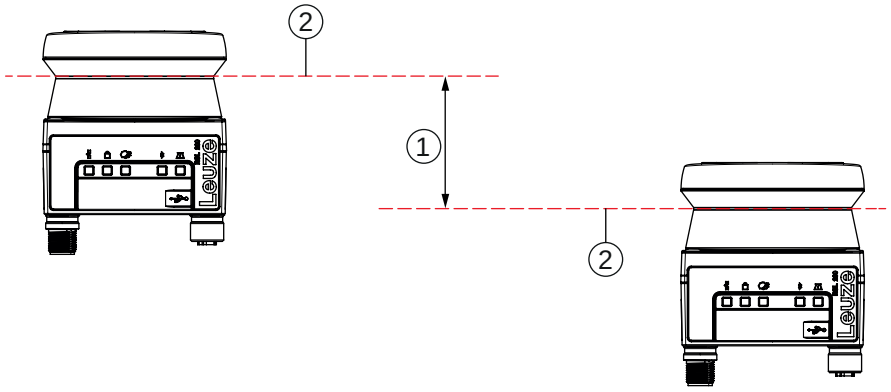
- When mounting the safety sensor, avoid glossy surfaces directly behind the optics cover.
- Plan for shielding with stationary applications. The shielding must be at least as high as the safety sensor's optical hood and flush with the front housing edge.
  If you provide the shielding within the indentation in the machine contour, the resolution of the protective fields is not compromised at any accessible point.
  You need the reciprocal shielding for both horizontal and vertical alignment of the protective fields.



1 Point of operation
2 Safety sensor
3 Machine with countersinking for sensor installation
4 Protective fields
5 Shielding

Fig. 6.6: Shielding against the influence of neighboring protective fields

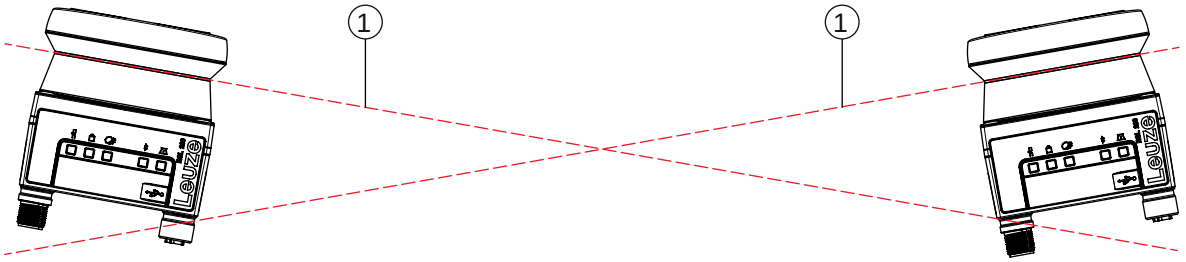
- Install the safety sensors off-set on the height.



1 Minimum distance, 140 mm (for distance between neighboring scanners <9 m)
2 Scanning plane

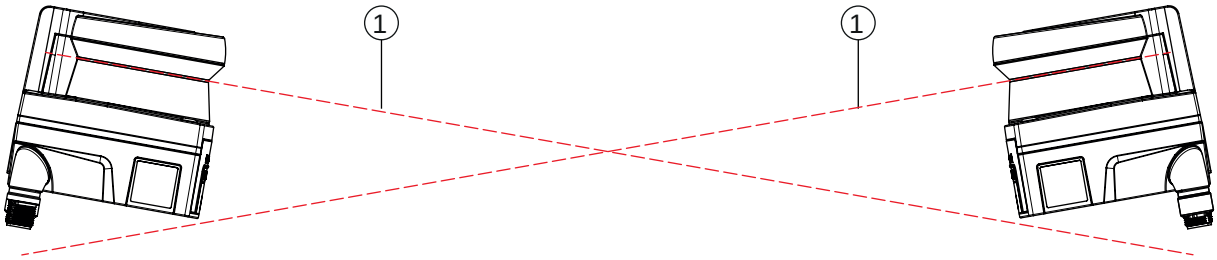
Fig. 6.7: Height offset mounting, parallel alignment

↳ Install the safety sensors with crossed alignment.



1 Scanning plane

Fig. 6.8: Mounting beside one another, without height offset, crossed alignment



1 Scanning plane

Fig. 6.9: Mutually opposing mounting, without height offset, crossed alignment

6.2 Stationary danger zone guarding

The safety sensor takes over the stop-activating and presence-detecting function.

Calculation of safety distance S for parallel approach to the protective field

$$S = K \cdot T + C$$

S_{RO}	[mm]	Safety distance
K	[mm/s]	Approach speed for danger zone guarding with approach direction parallel to the protective field (resolution up to 90 mm): 1600 mm/s
T	[s]	Total time of the delay, sum from (t_a + t_i + t_m)
t_a	[s]	Response time of the protective device
t_i	[s]	Response time of the safety relay
t_m	[s]	Stopping time of the machine
C	[mm]	Surcharge for securing the danger area with approach reaction, see below

Response times, stopping time of the machine

The cycle time of the safety sensor is 25 ms, which corresponds to one scan. At least two consecutive scans must be interrupted so that the safety-related switching outputs switch off. The safety sensor's minimum response time is therefore 75 ms.

If you want to increase the safety sensor's availability in an environment with fine particles, increase the number of interrupted scans after which the safety-related switching outputs switch off. With each additional scan the response time t_a increases by 25 ms. With K = 1600 mm/s the safety distance increases by 40 mm per additional scan.

↳ Select a response time t_a of at least 125 ms or higher.

↳ Determine the machine/system's stopping time t_m.
If data is not available, you can commission Leuze to perform measurements (see chapter 13 "Service and support".).

↳ If an increase in the stopping time within the regular test periods is to be expected, take an additional time into account for the machine's stopping time t_m.

Surcharge C for securing the danger area with approach reaction

You prevent reaching the point of operation by reaching over with the additional distance C:

$$C = 1200 - 0,4 \cdot H$$

C	[mm]	Additional distance for safeguarding the danger zone
H	[mm]	= Height of protective field above floor (installation height)
C_{MIN}	[mm]	850 mm
H_{MAX}	[mm]	1000 mm
H_{min}	[mm]	Minimum permissible mounting height, but never less than 0 $H_{min} = 15 \times (d - 50)$
d	[mm]	Arrangement of the protective device

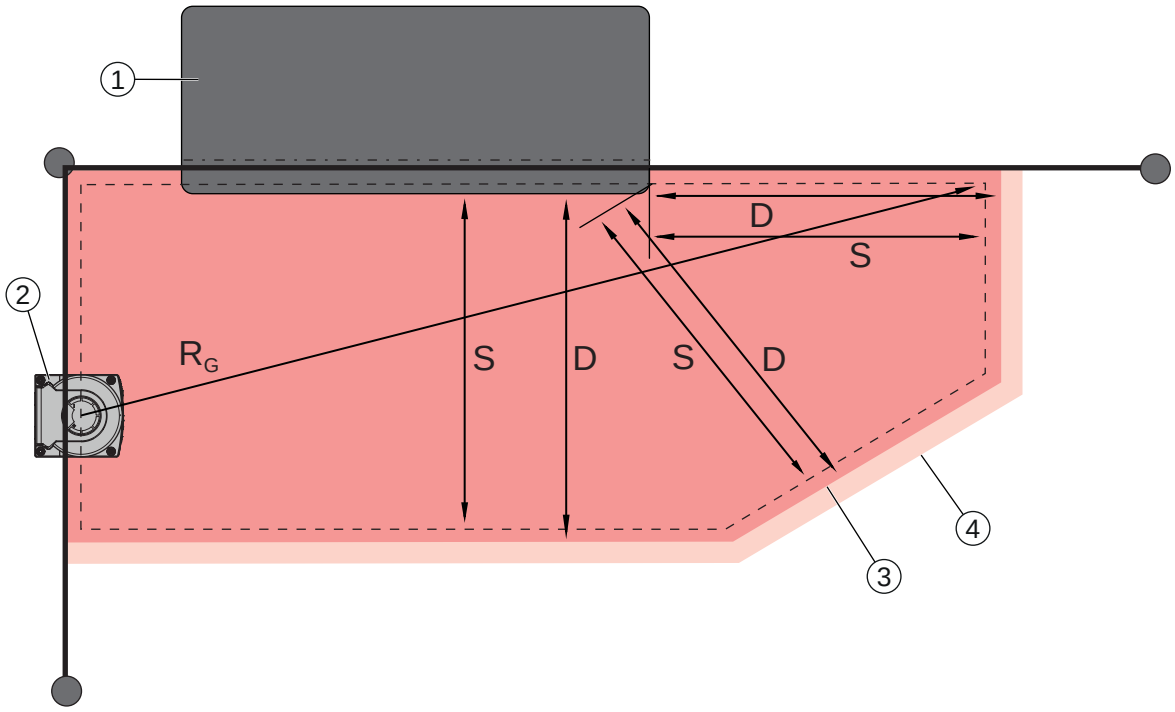
The minimum permissible installation height depends on the resolution of the safety sensor:

Tab. 6.2: Additional distance C depending on the resolution of the safety sensor

Safety sensor resolution	Minimum permissible installation height	Additional distance C
50 mm	0 mm	1200 mm
70 mm	300 mm	1080 mm

Application-related additional distances for safety distance S

The protective field boundaries must be defined so that the calculated safety distance S to the point of operation, extended by the additional distances, is complied with everywhere. Where this is not possible or does not make sense, you can use hard guards as supplementary measures.



1 Routing machine with free space for sensor protective field in the area under the machine table
2 Safety sensor
3 Protective field contour
4 Warning field contour
S Calculated safety distance S
D Minimum distance D (= safety distance S + additional distance Z_{SM} + Z_{REFL}, where required)
R_G Largest protective field radius without additional distances, measured from the rotation axis of the rotary mirror

Fig. 6.10: Defining the protective field contour for a stationary, horizontal protective field

- Define the limits of the protective field using the safety distance S without an additional distance.
- Determine the biggest protective field radius R_G for this protective field.
- The biggest protective field radius determines the additional distance Z_{SM} for the system-related measurement error, by which the protective field contour must be enlarged. The position of the rotary mirror's center point with regard to the housing is provided by the dimensioned drawings.

Tab. 6.3: Additional distance Z_{SM} for the protective field contour because of measurement error

Biggest protective field radius R_G without additional distances	Additional distance Z_{SM}
≤ 3,00 m	100 mm

- Avoid retro-reflectors at the beam level beyond the protective field boundaries. If this is not possible, add another additional distance Z_{REFL} of **100 mm**.

Minimum distance D to the protective field contour

The minimum distance D is the distance between point of operation and protective field contour.

$$D = S + Z_{SM} + Z_{REFL}$$

D	[mm]	= Minimum distance between the point of operation and the protective field contour
S	[mm]	Safety distance
Z_{SM}	[mm]	= Additional distance for system-related measurement error
Z_{REFL}	[mm]	= Additional distance for retro-reflectors

- If the protective field runs up against fixed boundaries, such as walls or machine frames, take a countersinking into the machine contour of at least the size of the necessary additional distance Z_{SM}, and Z_{REFL} where required, into account. With the protective field contour under these conditions, stay about 50 mm away from the machine surface.
- If the protective field runs up against hard guards, ensure that the protective field ends under instead of in front of the hard guards. The width of the lower post must correspond with the size of the required additional distances.
- If all hazards in the fenced off area are covered by the safety sensor and the height of the beam level is 300 mm, you can raise the bottom edge of the hard guards from 200 mm to 350 mm in the protective field range. The protective field reaching to under the hard guards takes over the protective function of preventing an adult from crawling under in this case.
- Prevent obstructions within the calculated protective field boundaries. If this is not possible, implement protective measures so that the point of operation cannot be reached from out of the shadow of the obstruction.

6.3 Mobile danger zone guarding on AGVs

Danger zone guarding protects people and objects that are in rooms in which vehicles move in, e.g. automated guided vehicle systems (AGVs).

A horizontally arranged protective field protects people and objects that are in the vehicle's path and are detected by the front edge of the protective field.

WARNING

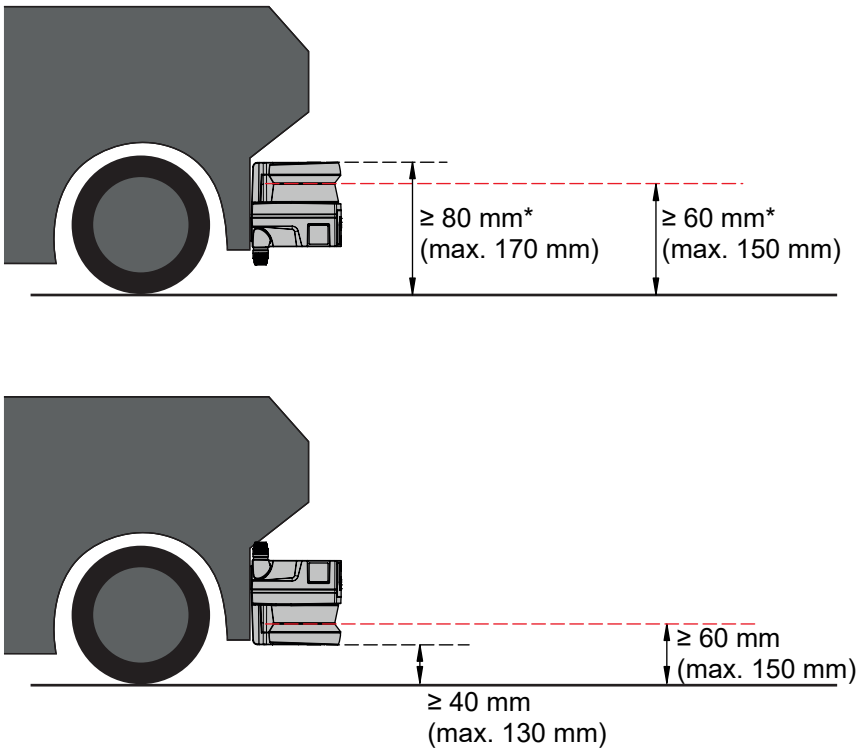
Danger of injury because of insufficient vehicle stopping distance

- The operator of the machine must use organizing measures to prevent people from entering the protective field of the vehicle from the sides or being able to move towards an approaching vehicle.

- Only use the safety sensor on vehicles with electrical drive and electrically influenced drive and braking devices.
- Only install the safety sensor on the front of the vehicle.
  If you must also guard the reverse travel, you must also install a safety sensor on the rear of the vehicle.
- Mount the safety sensor on the vehicle so that there are no unmonitored areas ≥ 70 mm between the protective field and vehicle front.
- Set the mounting height such that the beam level is not more than 150 mm above the floor. A person lying on the floor can therefore be safely detected.
- The scanning level is located in the upper area of the optics hood (see chapter 3.2 "Device overview"

WARNING
Danger of invalidation of the protective device! To be able to reliably detect a person lying on the floor, the scanning level must be mounted at a maximum height of 150 mm.

In most cases, a mounting height (height of the scanning level above the floor) of at least 60 mm (consider sufficient ground clearance depending on the installation situation of the safety sensor) when only using the safety function and at least 120 mm when also using the safety sensor for navigation support is suitable, depending on the floor conditions. When determining the mounting height, it must also be ensured that the safety sensor does not come into contact with the floor as a result of vertical movements of the vehicle, for example when driving over a speed bump, as this can cause damage to the device and render the protective device ineffective.



* Ensure sufficient ground clearance

Fig. 6.11: Recommended mounting height for RSL 210, RSL 220 and RSL 230 on AGVs (use of the safety function)

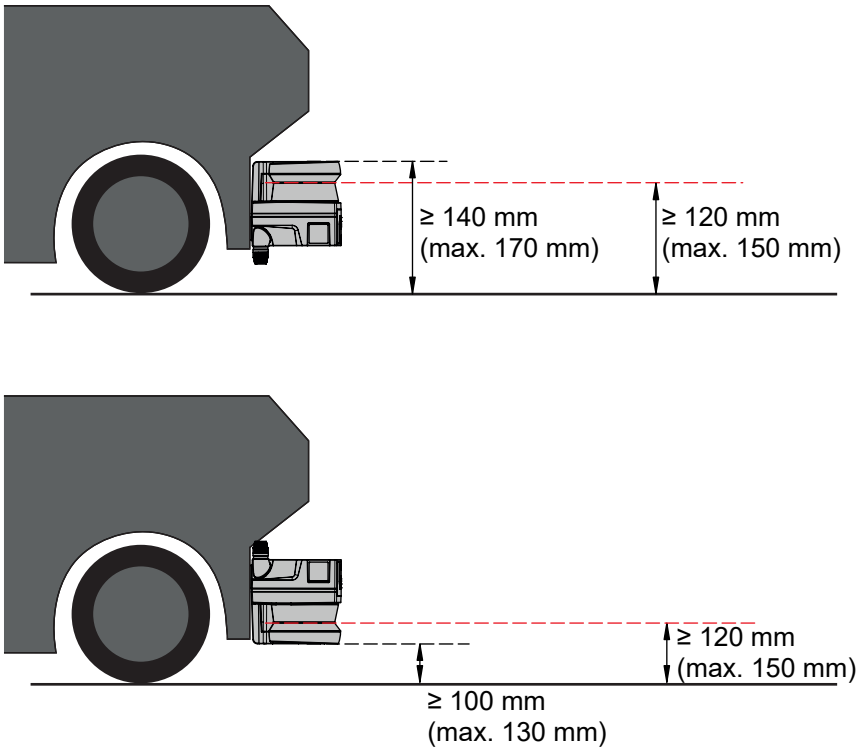


Fig. 6.12: Recommended mounting height for RSL 235 on AGVs (use of the safety function and measurement data output for navigation support)

6.3.1 Minimum distance D

$$D = D_A + Z_{Ges}$$

D	[mm]	Minimum distance, vehicle front (danger) to protective field front edge
D_A	[mm]	Stopping distance
Z_{TOT}	[mm]	= Sum of required additional distances

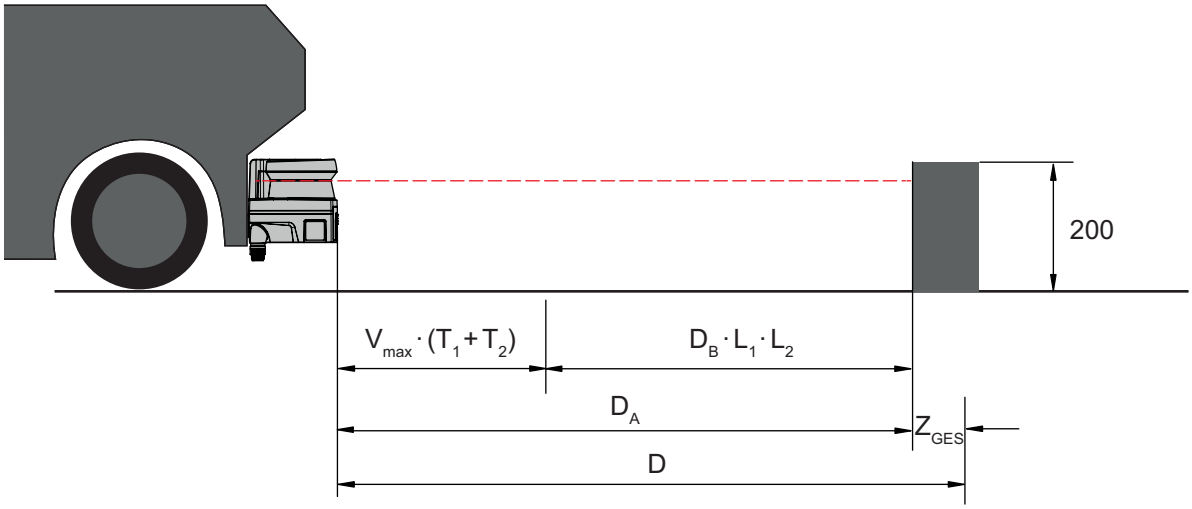


Fig. 6.13: Mobile danger zone guarding, calculation of required minimum distance D

Stopping distance D_A

$$D_A = v_{max} \cdot (T_1 + T_2) + D_B \cdot L_1 \cdot L_2$$

D_A	[mm]	Stopping distance
v_{max}	[mm/s]	Maximum vehicle speed
T_1	[s]	Safety sensor response time
T_2	[s]	= Response time of the AGV
D_B	[mm]	= Braking distance with v_{max} and maximum vehicle load
L_1	[---]	= Factor for brake wear
L_2	[---]	= -Factor for problematic floor conditions, e.g. dirt, wet conditions

Additional distances Z

$$Z_{Ges} = Z_{SM} + Z_F + Z_{REFL}$$

Z_{tot}	[mm]	= Total of the required additional distances
Z_{SM}	[mm]	Surcharge for system-related measurement error, see chapter 6.2 "Stationary danger zone guarding"
Z_F	[mm]	= Additional distance required with lack of floor space H_F
Z_{REFL}	[mm]	= Additional distance required with retro-reflectors beyond the protective field boundaries; Z_{REFL} = 100 mm

The **additional distance Z_{SM}** is always required. Its size depends on the biggest radius R_G from the safety sensor mirror's rotary axis to the protective field boundary without Z_{Tot}. The position of the rotary mirror axis depends on the installation situation.

If the distance between the vehicle and the ground (**ground clearance H_F**) is less than 120 mm, there is a risk of parts of the foot becoming trapped underneath the vehicle before the vehicle comes to a standstill when the person above the foot is detected. An additional **distance Z_F** to the protective field, which is determined according to the following diagram, is required:

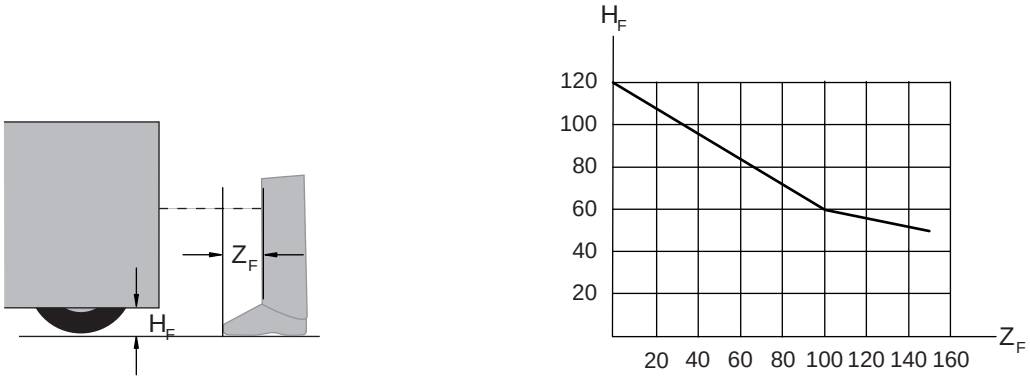
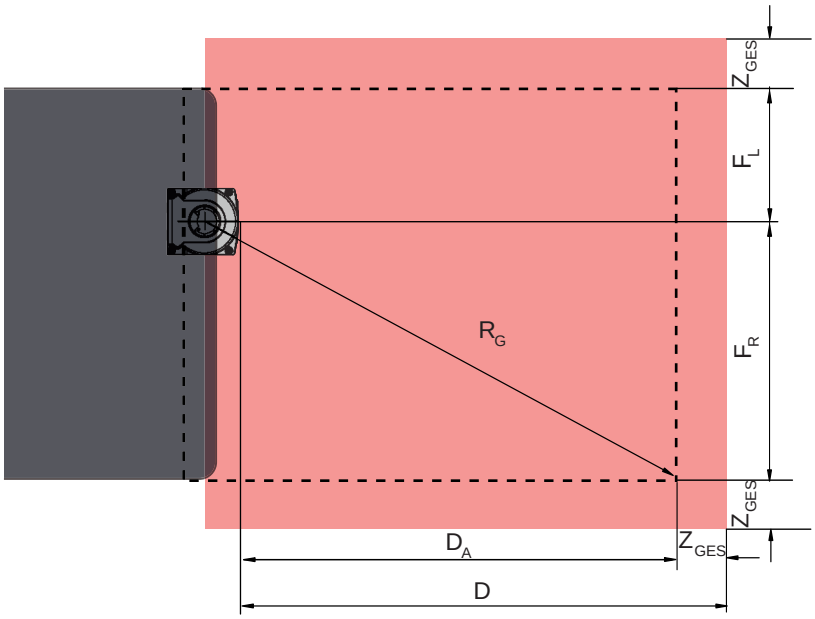


Fig. 6.14: Diagram for determining the additional distance Z_F with lack of floor space H_F

With a vehicle height of less than 50 mm, an additional distance Z_F of 150 mm is always required.

If wheels are mounted near the side wall, always add an additional distance Z_F > 150 mm.

6.3.2 Protective field dimensions



D	Minimum distance, vehicle front (danger) to protective field front edge
D_A	Stopping distance
Z_{TOT}	Total required additional distances to the front and for both sides
F_L	Distance from safety sensor center to left vehicle edge
F_R	Distance from safety sensor center to right vehicle edge
R_G	Biggest radius in the protective field without Z_{TOT} for determining the additional distance Z_{SM}

Fig. 6.15: Mobile danger zone guarding, dimensions for horizontal protective field

- Select 70 mm resolution.
- Set the protective field length so that the response time until braking and the braking distance, including factors for wear and tear and floor conditions, and any necessary additional distances are taken into account.
- Arrange the protective field symmetrically with reference to the vehicle width, even if the safety sensor is not arranged centered.
- Configure an upstream warning field that reduces the vehicle's speed. A full brake with a subsequent interruption of the protective field is then executed moderately and is less demanding on the vehicle's drives.
- Dimension the minimum distance D for the maximum speed as if the speed reduction initiated by the warning field had not happened.
- Take the required free space for lateral protrude protective fields under the roller conveyors along the transportation path into account.
- If you have to expect angular deviations of the vehicle during the travel, plan an additional tolerance area to guarantee undisturbed travel operation.

6.4 Mounting accessories

6.4.1 Mounting system

Using the mounting system you can adjust the safety sensor horizontally and vertically by ±5 degrees when mounting.

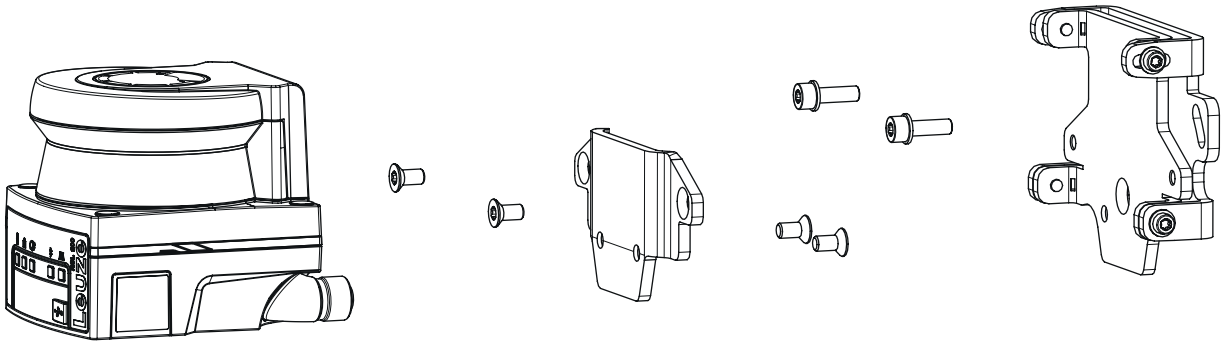


Fig. 6.16: Mounting with wall bracket

- Mount the wall bracket on the system side. Two cylinder head screws M5x16 with washers are included for this purpose.
- Mount the safety sensor with the included countersunk head screws M5x10 on the BT 500M mounting adapter (tightening torque = 2.3 Nm).
- Mount the safety sensor (with the fastening adapter) on the BTU 500M assembly system. In doing so, tighten the countersunk screw to 4.5 Nm.
- Align the safety sensor vertically and horizontally on the BTU 500M mounting system:
  – using the slotted holes in the wall section with the M5 cylinder head screws and
  – the inclination using the slotted holes of the M4 cylinder head screws.
- After alignment, fix the safety sensor by tightening the four cylinder head screws M4 with 3.0 Nm and the on-site cylinder head screws M5.

	NOTICE
	The scanner can also be mounted directly on the mounting system without the BT 500M mounting adapter. In this case, it must be taken into account that the scanning range is limited to -135°... +135°.

6.4.2 Loop guard

The loop guard for the optics cover prevents damage to the safety sensor caused by light contact with foreign objects.

The BTP 500M protective bracket can be used individually for direct mounting or in combination with the BTU 500M mounting system if vertical or horizontal adjustment of the safety sensor is necessary.

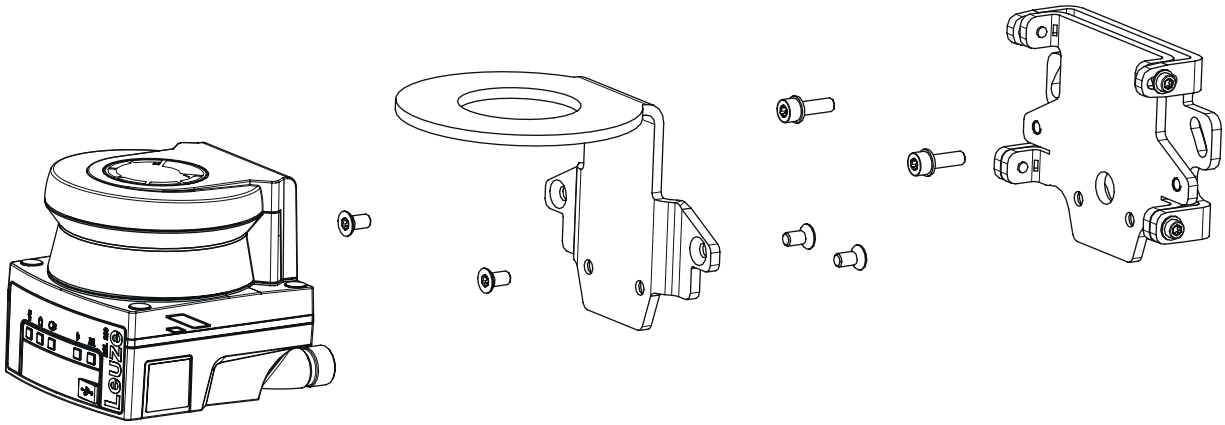


Fig. 6.17: Mounting with wall bracket and protective bracket

The protective bracket is mounted with the mounting system as described above, see chapter 6.4.1 "Mounting system". Only the BT 500M fastening adapter is replaced by the BTP 500M protective bracket.

7 Electrical connection

WARNING

Faulty electrical connection or improper function selection may result in serious injury!

- Only allow competent persons to perform the electrical connection.
- For access guarding, activate the start/restart interlock and make certain that it cannot be unlocked from within the danger zone.
- Select the functions so that the safety sensor can be used as intended (see chapter 2.1 "Intended use").
- Select the safety-relevant functions for the safety sensor (see chapter 4.2 "Function modes of safety sensor").
- Always loop both safety-related switching outputs OSSD1 and OSSD2 into the work circuit of the machine.
- Signal outputs must not be used for switching safety-relevant signals.

Laying of cables

- Lay all connection cables and signal lines within the electrical installation space or permanently in cable ducts.
- Lay the cables and lines so that they are protected against external damages.

For further information: see EN ISO 13849-2, Table D.4.

NOTICE

Observe the maximum cable length!

Observe the maximum cable lengths as a function of operating voltage and load current.

Observe when wiring with terminals and connectors

In the case of wiring that continues beyond the device or during repairs to connectors, the user must ensure that cables or conductors that have defectively disconnected cannot result in contact with other signals.

- Use suitable terminals.
- Use heat-shrink tubing, wire-end sleeves or similar.

NOTICE

Protective Extra Low Voltage (PELV)!

The device is designed in accordance with protection class III for supply with PELV (Protective Extra-Low Voltage).

- Acc. to IEC/EN 60204-1, the external power supply must demonstrate the ability to bridge short-term mains failures of up to 20 ms. The power supply unit must ensure safe mains separation (SELV/PELV) and a current reserve of at least 2 A.

7.1 Electrical supply

see chapter 14.1 "General specifications"

Functional earth

NOTICE

Always connect the housing of the safety sensor to functional earth or ground!

- The housing of the safety sensor must always be connected to earth (functional earth) or machine/vehicle ground.
- If the safety sensor is attached to a non-conductive material (e.g. a concrete wall), the housing of the safety sensor must be earthed.

- Factory recommendation: Functional grounding via ground strap/wire (low-resistance for HF). The corresponding screw-on points on the underside of the device are provided for grounding.
- Functional grounding via the shield of the connection cable.
  For grounding, the shield of the connection cable in the switch cabinet must be connected to earth or machine/vehicle ground.

↳ If the housing of the safety sensor or the mounting bracket – despite being mounted on a non-conductive material – is connected to metallic parts (even temporarily), you must ensure that the appropriate potential equalization is provided between the switch cabinet and housing potential; e.g. by grounding the Ethernet connection.

7.2 Cable lengths depending on the supply voltage

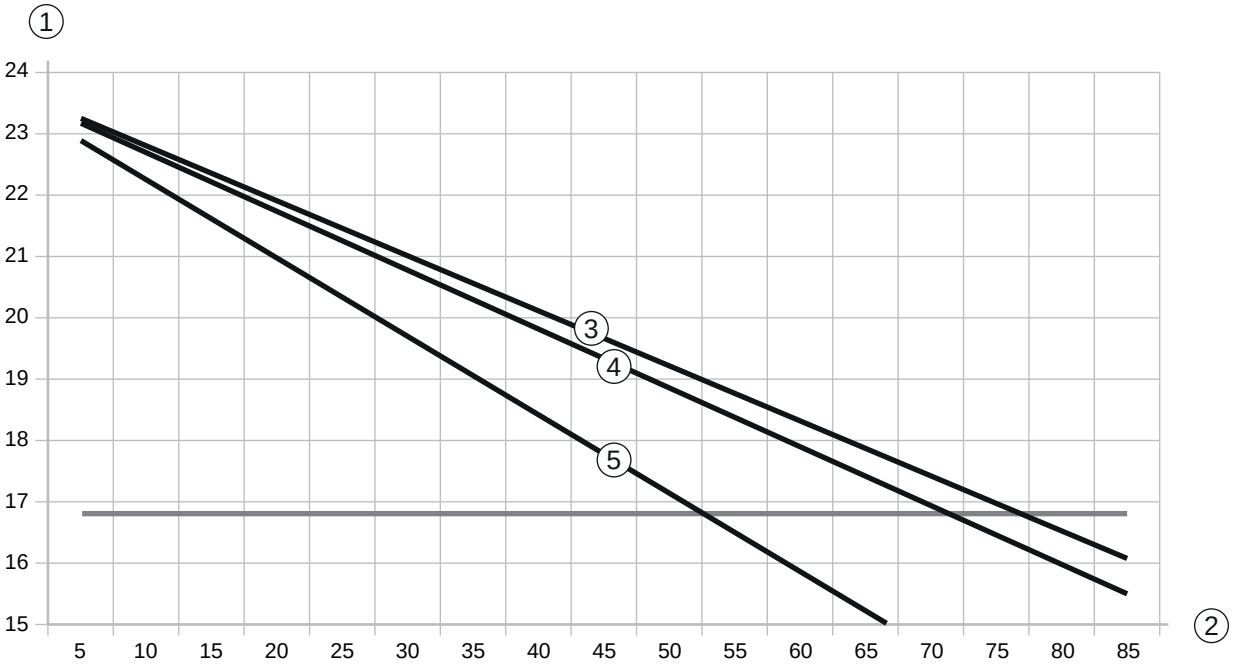
The maximum cable length is determined by voltage drops on the supply and signal lines.

The following conditions apply to the necessary supply voltage U_B at the safety sensor's input terminals:

- U_B must be greater than the permissible nominal voltage limit of 16.8 V.

	NOTICE
	The recommended supply voltage is at least 16.8 V! Leuze recommends a supply voltage U_B of at least 16.8 V at the input terminals of the safety sensor. ↳ The operating voltage should not be allowed to drop below the recommended value if possible.

- The necessary operating voltage U_B must also ensure the function of the downstream devices in the case of a linear configuration.
  - Once the operating voltage U_B has been determined, check whether the resulting signal voltages are sufficient for the downstream devices.
  - Take into account the voltage drops in the safety sensor – up to 1.8 V – and on the signal wiring.



1 Supply voltage [V]
2 Cable length [m]
3 RSL 230/235 Two of the universal I/Os are configured as outputs.
4 RSL 230/235 Three of the universal I/Os are configured as outputs.
5 RSL 230/235 Four of the universal I/Os are configured as outputs.

Fig. 7.1: Diagram for estimating the voltage drop on the supply line (line cross-section = 0.14 mm^2 (12-pole line))

7.3 Interfaces

The safety sensor has the following interfaces, depending on the version:

- Interface for connection with the control system
- Ethernet interface for communication with PC or laptop
- USB interface for communication with PC or laptop
- Bluetooth interface for communication with PC, notebook or mobile device

Tab. 7.1: RSL 230 and RSL 235 interfaces

Interface	Type	Function
Control	M12 connector, 12-pin, A-coded	• Power supply • Switching and signal lines
Communication	M12 socket, 4-pin, D-coded	Configuration, data and diagnostic interface: • Parameter configuration • Protective field definition and warning field definition • Display of the measurement contour • Diagnosis • Measurement value transmission via UDP (signal strength, distance and process image) (RSL 235)
Communication	USB 2.0 type C socket	Configuration and diagnostic interface: • Parameter configuration • Protective field definition and warning field definition • Display of the measurement contour • Diagnosis
Communication	Bluetooth	Configuration and diagnostic interface: • Parameter configuration • Protective field definition and warning field definition • Display of the measurement contour • Diagnosis

A protective cap on the M12 socket protects the communication interface when no Ethernet cable is connected.

7.3.1 Bluetooth interface

The safety sensor has an integrated Bluetooth interface that is intended for temporary use to transfer diagnostic data to a PC or mobile device.

The Bluetooth interface can be activated/deactivated using the configuration and diagnostic software Sensor Studio and is activated when the device is delivered (see chapter 8.2.2 "Connecting safety sensor to PC").

	NOTICE
	This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules (Contains FCC ID: A8TBM78ABCDEFGH). These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: - Reorient or relocate the receiving antenna. - Increase the separation between the equipment and receiver. - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected. - Consult the Leuze Service Hotline or an experienced radio technician for help. This device complies with Industry Canada's license- exempt RSS standard(s). Operation is subject to the following two conditions: (1) This device may not cause interference; and (2) This device must accept any interference, including interference that may cause undesired operation of the device. This device complies with Industry Canada's RSS for license-exempt radio equipment. Operation is authorized subject to the following two conditions: (1) this device may not cause interference to radio communications; (2) the user of this equipment must accept any interference received, even if such interference is likely to cause undesired operation. Guidelines on Transmitter Antenna for License Exempt Radio Apparatus: Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. In accordance with Industry Canada regulations, this radio transmitter may be operated with an antenna of the type and maximum gain (or less) approved for the transmitter by Industry Canada. To reduce the risk of radio interference to other users, the antenna type and gain must be chosen so that the equivalent isotropically radiated power (e.i.r.p.) does not exceed the intensity required to establish satisfactory communication.

7.3.2 Pin assignment for control

The safety sensor is equipped with an M12 connector.

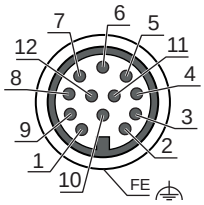


Fig. 7.2: Pin assignment for M12 connector, 12-pin, A-coded

Tab. 7.2: Pin assignment

Pin	Signal	Function
1	EA1	• Function input for field triple changeover • Alternatively: State signaling (configurable)
2	+24 VDC	Supply voltage
3	EA2	• Function input for field triple changeover • Alternatively: State signaling (configurable)
4	EA3	• Function input for field triple changeover • Alternatively: State signaling (configurable)
5	OSSD 1	Safety-related switching output
6	OSSD 2	Safety-related switching output
7	0 VDC	Supply voltage ground
8	EA4	• Function input for field triple changeover • Alternatively: State signaling (configurable)
9	EA5	• Function input for field triple changeover • Alternatively: State signaling (configurable)
10	EA6	• Function input for field triple changeover • Alternatively: State signaling (configurable)
11	A7	Contactor monitoring State signaling (configurable)
12	A8 / RES	• Start/restart input • Acknowledgment • Alternatively: State signaling (configurable)
Thread	FE	Functional earth/shield

7.3.3 Ethernet interface connection assignment (communication)

NOTICE

The safety sensor must not be connected to Ethernet cables or Ethernet networks that are routed outside.

The safety sensor is equipped with a 4-pin M12 socket (D-coded).

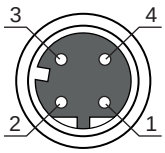


Fig. 7.3: Pin assignment of the Ethernet interface

Tab. 7.3: Pin assignment

PIN	Signal	Description
1	TD+	Data communication, transmission
2	RD+	Data communication, transmission
3	TD-	Data communication, reception
4	RD-	Data communication, reception
FE	GND/shield	Functional earth, communication cable shield. The shield of the interconnection cable is on the thread of the M12 connector. The thread is part of the metallic housing. The housing is at the same potential as functional earth.

7.4 Circuit diagram example

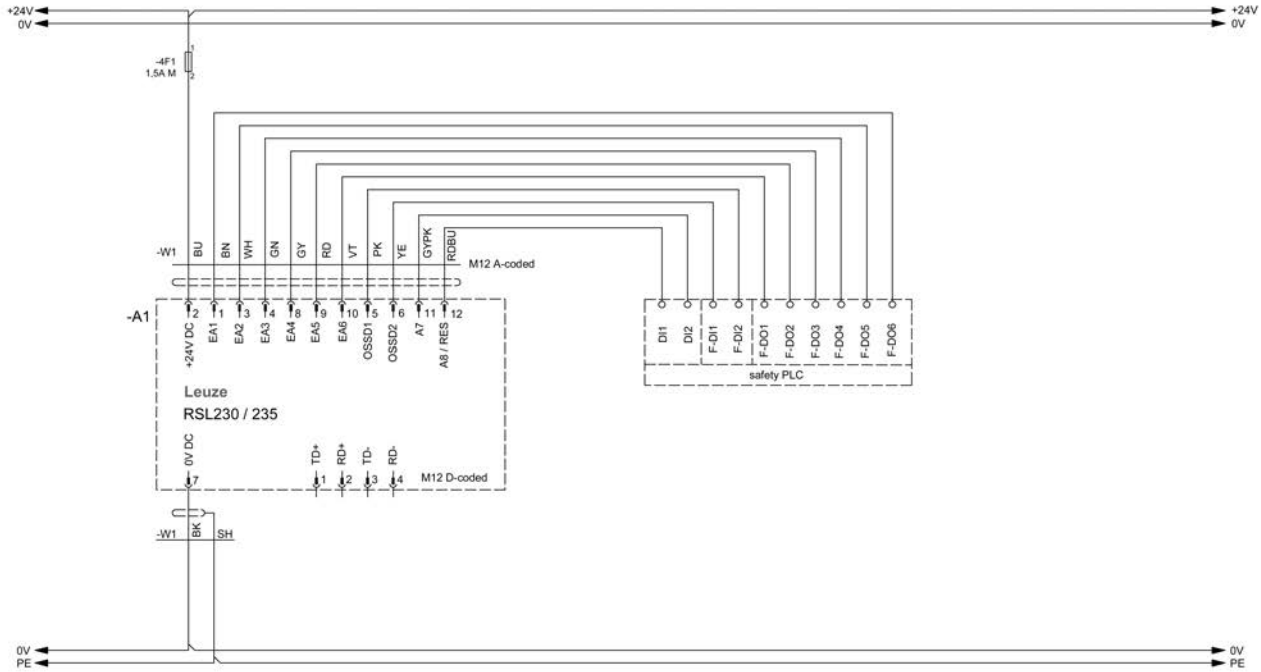


Fig. 7.4: RSL 230/235 with safety control

8 Configuration

8.1 Configuration and diagnostics software - Sensor Studio

To start up a safety sensor in your application, the safety sensor must be set up according to its specific use using the configuration and diagnostic software. The software is used to set up the safety configuration of the safety sensor, to change the communication and diagnostics settings and to perform diagnostic routines. Communication takes place via the PC.

The software is designed according to the FDT/DTM concept:

- You make the individual configurations for the safety sensor in the Device Type Manager (DTM).
- The individual DTM configurations of a project can be called up via the frame application of the Field Device Tool (FDT).
- Each device DTM has a communication DTM that sets up and monitors the communication connections to the sensor.

8.1.1 System requirements

To use the software, you need a PC or laptop with the following specifications:

Hard disk space	At least 400 MB free memory If you want to save the protective field or configuration values, you will need more memory.
Input device	Keyboard and mouse or touchpad
Output device	Printer (black-white or color)
Interfaces	RJ45 Ethernet network Bluetooth (optional) - If the PC does not have integrated Bluetooth technology, use an appropriate USB or PCMCIA adapter if necessary.
Operating system	Microsoft® Windows 11 or higher

Only the term "PC" is used below.

8.1.2 Installing software

Prerequisites:

- You do **not** need the safety sensor to install the software on the PC.
- All Windows applications are closed.

The software is installed in two steps:

- Installing the *Sensor Studio* FDT frame.
- Device Manager (DTM) *Installing a security device package*

Installing the Sensor Studio software

↳ Call up the Leuze website: **www.leuze.com**.

↳ Enter the type designation or part number of the device as the search term.

↳ The configuration software can be found on the product page for the *device* under the Downloads tab.

↳ Download the configuration and diagnostic software.

↳ Double-click the *SensorStudioSetup.exe* file.

↳ Select a language for the interface text in the installation wizard and software and confirm with [OK].

⇨ The installation wizard starts.

↳ Click [Next].

⇨ The installation wizard opens the software license agreement.

↳ If you want to accept the license agreement, select the appropriate option field and click [Next].

↳ If the suggested installation path is OK, click [Next].
If you want to specify a different path, click the [Browse] button. Select a different path, confirm with [OK] and click [Next].

↳ Click the [Install] button to start installation.

⇨ The wizard installs the software and places a shortcut on the desktop (insert symbol).

↳ Click the [Finish] button to complete installation.

Device Manager (DTM) ***Installing a security device package***

Prerequisites:

- The *Sensor Studio* software is installed on the PC.

↳ Double-click the file *LeSafetyCollectionSetup.exe*.

↳ Select a language for the interface text in the installation wizard and software and confirm with [OK].

⇨ The installation wizard starts.

↳ Click [Next].

⇨ The installation wizard opens the software license agreement.

↳ If you want to accept the license agreement, select the appropriate option field and click [Next].

↳ If the suggested installation path is OK, click [Next].
If you want to specify a different path, click the [Browse] button. Select a different path, confirm with [OK] and click [Next].

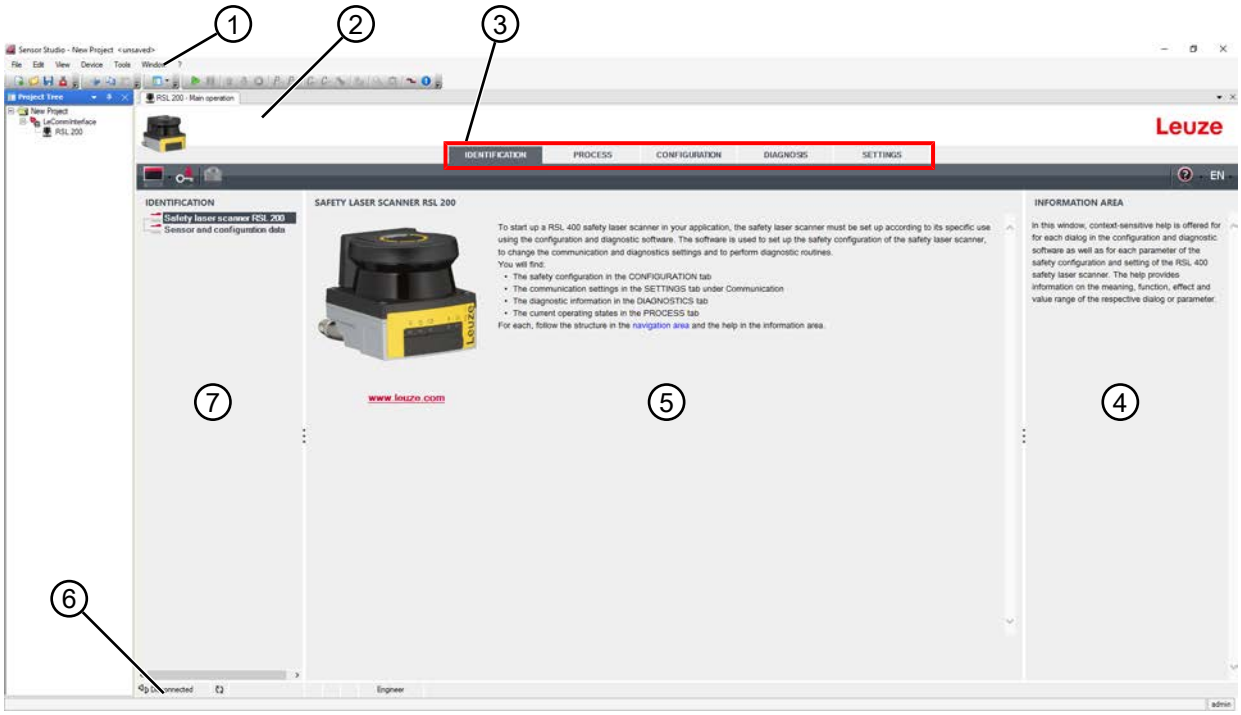
↳ Click the [Install] button to start installation.

⇨ The wizard installs the software.

↳ Click the [Finish] button to complete installation.

	NOTICE
	During installation of the software, a user *admin* (without password query) is created so that you can start the software without user identification. If other users are registered (**Tools > User management** in the FDT frame menu), you must log in at the software with a user name and password. This setting allows you to connect to the safety sensor and to read out, upload, enter or change the safety configuration and all settings using the RSL 200 device DTM. The password for the safety sensor only needs to be entered (i.e. the access level only needs to be changed) when the changes are downloaded to the safety sensor (see chapter 8.1.6 "Selecting access level").

8.1.3 User interface



1 FDT frame menu with toolbar
2 RSL 200 device manager (DTM)
3 Navigation tabs
4 Information area
5 Dialog box
6 Status line
7 Navigation area

Fig. 8.1: User interface of the software

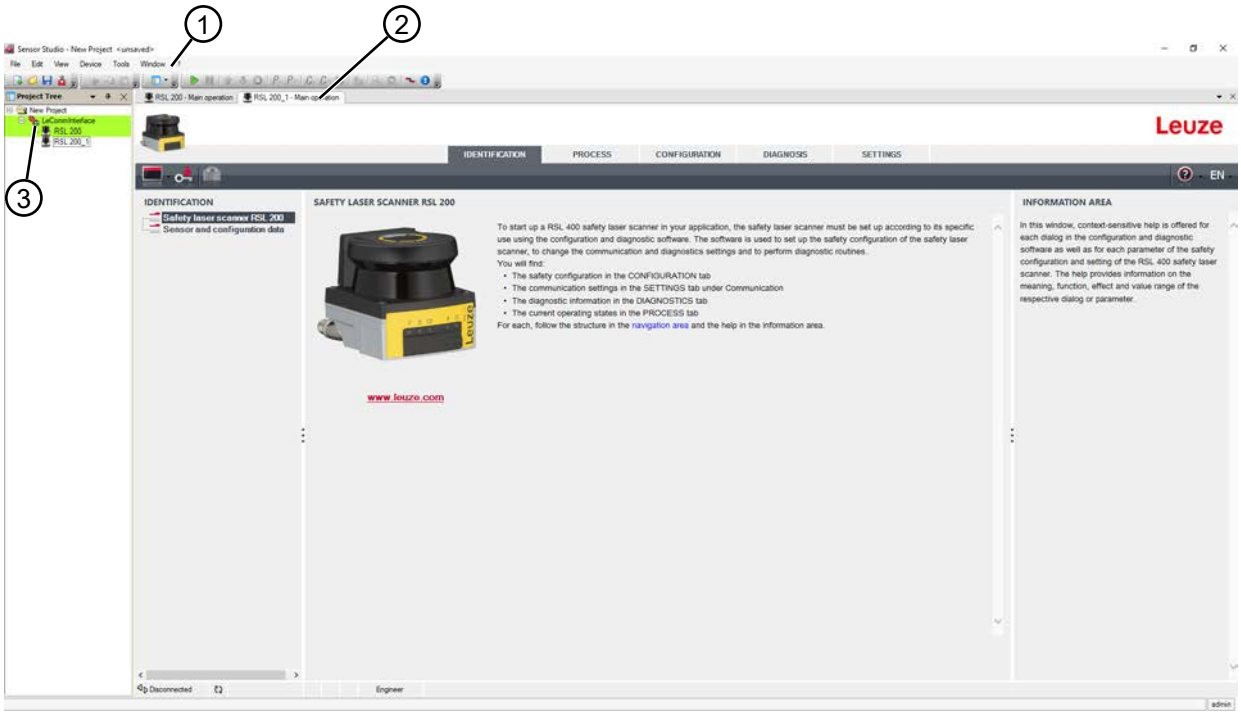
FDT frame menu

The device managers (DTM) of the safety sensors are created and managed in the FDT frame menu.

Device manager DTM

Configuration projects for setting up the selected safety sensor are created and managed in the device managers (DTM) of the safety sensors.

Project tree view



1 FDT frame menu
2 Device manager (DTM) tabs
3 Project tree view

Fig. 8.2: User interface with project tree view

The project tree view shows the structure of the currently installed device managers (DTM). In the project tree view you can, for example, add copies of an already configured device manager (DTM) quickly and easily to the DTM structure if you want to operate multiple safety sensors with the same configuration settings.

Example: Example: AGV with safety sensors on front and rear side

8.1.4 FDT frame menu

NOTICE
You can find complete information on the FDT frame menu in the online help system. Select the **Help** menu item in the menu [?].

Project wizard

Using the Project Wizard you can create and change configuration projects for setting up the safety sensor (see chapter 8.1.5 "Using configuration projects").

↳ Start the Project Wizard in the FDT frame menu by clicking the button.

NOTICE
Information on the Project Wizard can be found in the online help for the FDT frame menu under **Sensor Studio Options**.

DTM change

The *DTM Change* function makes it easier for you to call up the communication DTM of a device or change from device DTM to communication DTM.

↳ Start the *DTM change* function in the FDT frame menu by clicking the button.

NOTICE
Information on *DTM change* can be found in the online help for the FDT frame menu under **Sensor Studio Options**.

User management

Using the user management in the FDT frame menu, you can create users, log users in/out and manage passwords.

Creating users

When creating a user in the user management via **Tools > User management** in the software frame menu, select the access level for the user. For information on access rights and authorization levels (see chapter 4.1 "Authorization concept of safety sensor").

↳ In the FDT frame menu, click on Tools > User Administration > Create User.

Logging users in/out

To be able to register and deregister users, the corresponding user must have been created beforehand.

In the FDT frame menu, click **Tools > Log in/log out**.

Managing passwords

To be able to register and deregister users, the corresponding user must have been created beforehand.

↳ In the FDT frame menu, click on PROJECT > Options > User accounts / Passwords.

NOTICE
Password management via the FDT frame menu applies to all installed device managers (DTM) of the project. Whenever write access occurs, the safety sensors of the RSL 200 series always check the access level (*Engineer*, *Expert*) and the password defined via the device manager (DTM) (**SETTINGS > Passwords**) independently of the password management via the FDT frame menu.

Exiting Sensor Studio

When you have finished making the configuration settings, close the configuration and diagnostics software.

↳ Exit the program via **File > Exit**.

↳ Save the configuration settings as a configuration project on the PC.

You can open the configuration project again at later time via **File > Open** or with the *Sensor Studio* Project Wizard ( ).

8.1.5 Using configuration projects

Configuration projects are created and managed in the device manager (DTM) of the selected safety sensor.

NOTICE
During installation of the software, a user *admin* (without password query) is created so that you can start the software without user identification. If other users are registered (**Tools > User management** in the FDT frame menu), you must log in at the software with a user name and password. This setting allows you to connect to the sensor and to read out, upload, enter or change the safety configuration and all settings using the RSL 200 device DTM. The password for the sensor only needs to be entered (i.e. the access level only needs to be changed) when the changes are downloaded to the safety sensor (see chapter 8.1.6 "Selecting access level").

↳ Start the configuration and diagnostics software on the PC by double-clicking the button.

⇨ The **mode selection** of the Project Wizard is displayed.

⇨ If the **mode selection** is not shown, start the project wizard in the FDT frame menu by clicking the [Project Wizard] button.

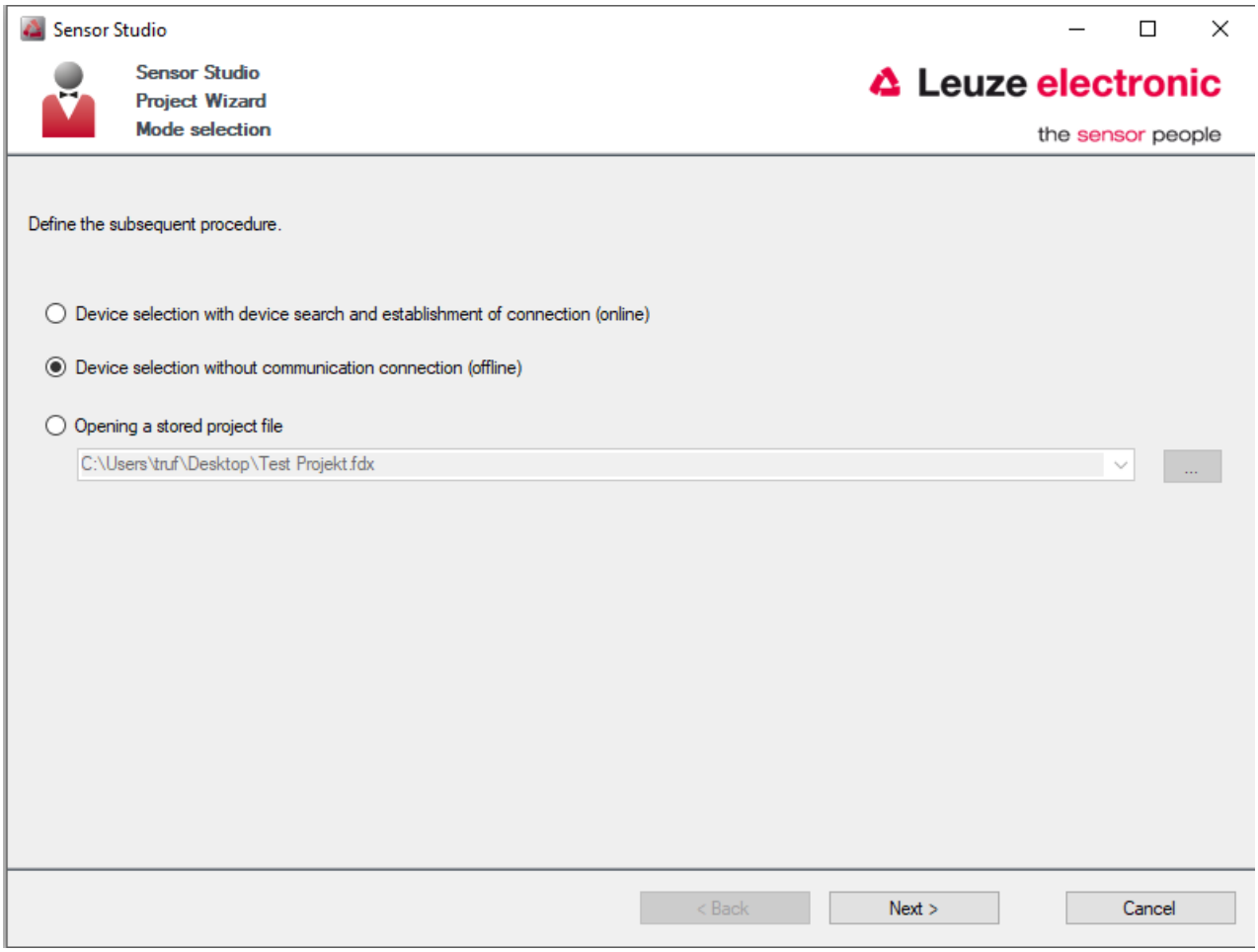


Fig. 8.35: Start project assistant

↳ Select the configuration mode and click [Next].

- Automatic connection to a connected safety sensor (**Online**)
- Device selection without communication connection (**offline**)
- Load a saved project again

When selecting the configuration mode Online:

The project wizard displays the **SEARCH DEVICES** dialog box.

↳ Select the interface and click the [Start] button.

↳ Select the safety sensor for your configuration project that you want to connect to and click the [Next] button.

⇨ The project wizard displays the device list of configurable safety sensors in the **SEARCH DEVICES** dialog box.

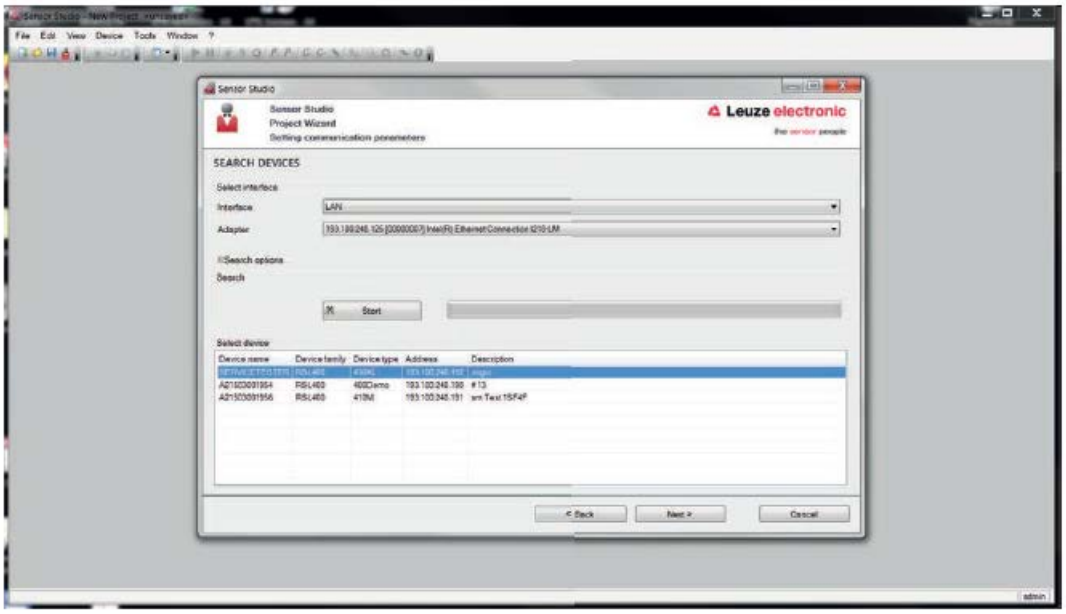
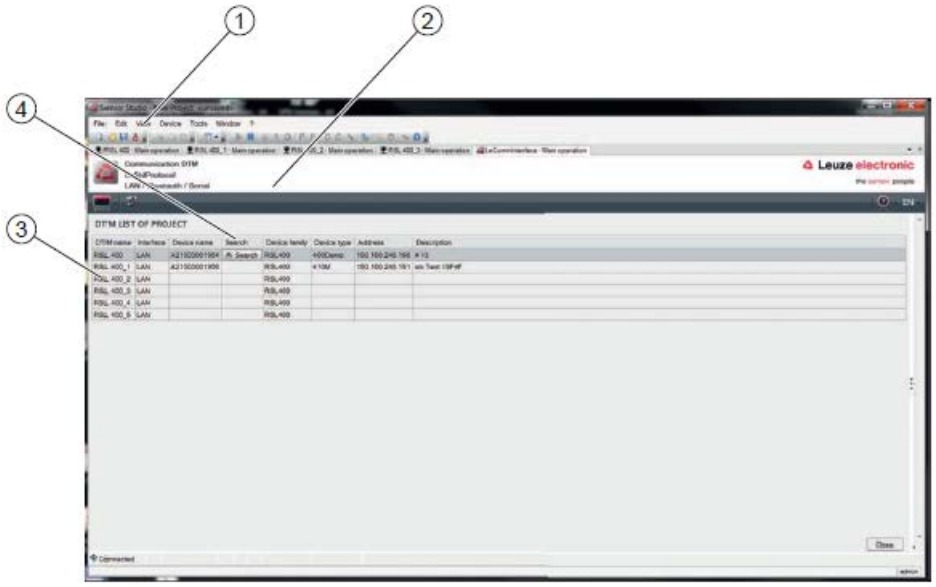


Fig. 8.3: Device selection in project wizard

When selecting the configuration mode Offline:

↳ To establish a connection with the safety sensor after selecting offline operation, search for the safety sensor for your configuration project using the search function of the communication DTM.



1 FDT-Rahmenmenü
2 Kommunikations-DTM
3 Geräteliste
4 Suchfunktion

Bild 4.4: Kommunikations-DTM mit Suchfunktion

1 FDT frame menu
2 Communication DTM
3 Device list
4 Search function

Fig. 8.4: Communication DTM with search function

The project wizard displays the device list of configurable safety sensors in the **SEARCH DEVICES** dialog box.

↳ Select the safety sensor from the device selection list and click [Next].

⇨ The device manager (DTM) of the safety sensor shows the initial screen for the configuration project.

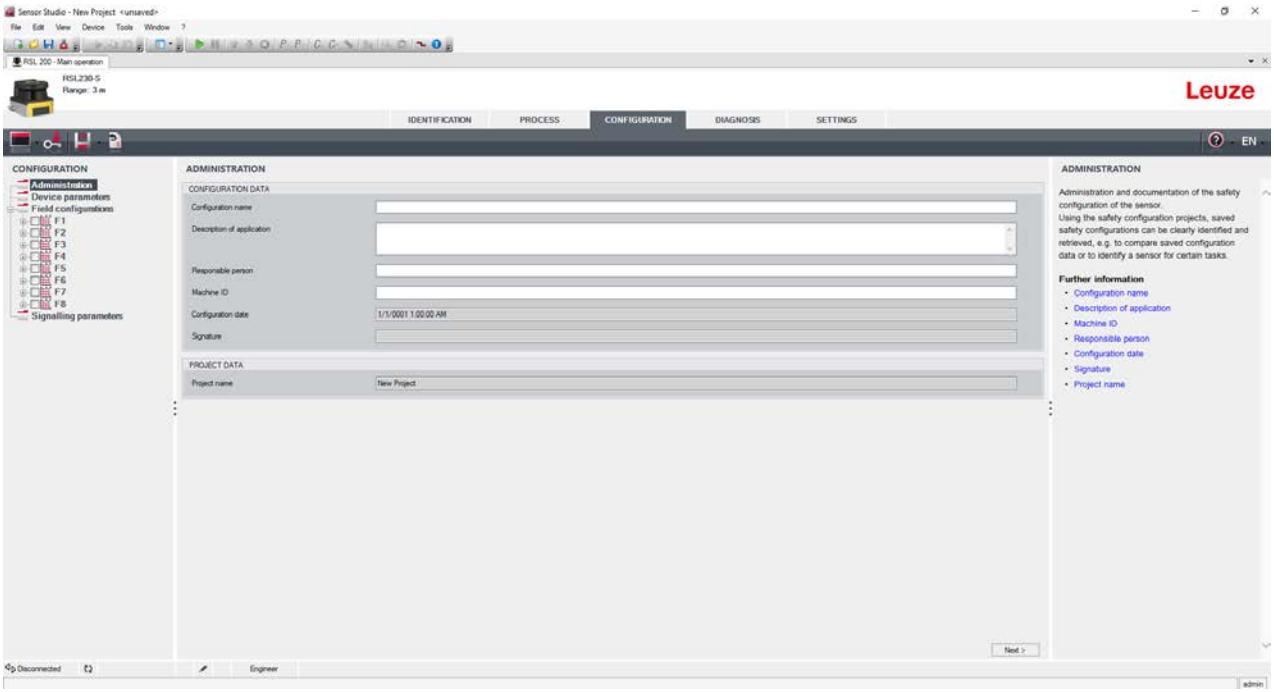


Fig. 8.38: Start screen for the configuration project

NOTICE	
	The device manager (DTM) starts without querying the access level of the user. During communication with the safety sensor, the safety sensor does however query the access level of the user. To change the authorization levels (see chapter 8.1.6 "Selecting access level").

Use device manager

Using the menus of the device manager (DTM) you can set the parameters of the safety configuration. The online help system provides information on the menu items and adjustment parameters. Select the **Help** menu item in the menu [?].

8.1.6 Selecting access level

With the device manager, you can change the authorization level of the user if necessary.
For the authorization concept of the software, see chapter 4.1 "Authorization concept of safety sensor".

↳ Click in the DTM menu bar on the [Change access level] button ().

⇨ The **Change access level** dialog box opens.

↳ In the *Access level* list, select the item *Expert*, *Engineer* or *Observer* and enter the default password or the password defined for the individual user.

The following access levels are available:

- *Observer* can read everything (no password)
- *Expert* can change communication and diagnostics settings (default password = **comdiag**)
- *Engineer* can additionally change the safety configuration (default password = **safety**)

The password is case-sensitive (i.e. a distinction is made between upper-case and lower-case letters).

↳ Confirm with [OK].

8.1.7 IDENTIFICATION

Detailed information on the menu items and setting parameters can be found in the information area and in the online help. Select the **Help** menu item in the menu [?].

- RSL 200 safety laser scanner
- Sensor and configuration data

8.1.8 PROCESS

Detailed information on the menu items and setting parameters can be found in the information area and in the online help. Select the **Help** menu item in the menu [?].

- Sensor display Device display in the DTM menu
  - Sensor display
  - State of the active protective and warning fields
  - Measurement contour
- Optics cover status (yellow):
- Inputs / outputs
  - Sensor display
  - Connections and signals
- UDP measurement data
  - Settings and information
  - Distance
  - Signal strength

8.1.9 CONFIGURATION

see chapter 8.2 "Configuring the safety sensor"

	NOTICE
	You can only transfer changes made in the **CONFIGURATION** menu to the safety sensor if you are logged in with the access level *Engineer*.

8.1.10 DIAGNOSIS

Visually identify device

If you have installed multiple safety sensors, identify the safety sensor that is connected to the currently open device manager (DTM).

Prerequisites: The software and safety sensor are connected.

- ↳ In the **DIAGNOSIS** menu, click the [Visually identify sensor].
- ⇨ On the display of the safety sensor connected to the device manager (DTM), LEDs 4 and 5 flash green for 30 seconds.

Resetting the sensor (only possible with authorization level *Engineer*)

- ↳ Acknowledge messages and faults
- ↳ Set safety sensor to safety mode

Create and save service file

The service file contains all available information on the safety sensor as well as configuration and settings.

- ↳ When requesting support, send the service file to the Leuze customer service (see chapter 13 "Service and support").

Diagnostics list

Access list

EventLog signals

8.1.11 SETTINGS

NOTICE
You can only transfer changes made in the **SETTINGS** menu to the safety sensor if you are logged in with the access level *Engineer*.

Communication

- LAN
  - DHCP
  - CONNECTION SETTINGS
  - MAC address
- USB
  - DHCP
  - CONNECTION SETTINGS
  - Sensor data
- Bluetooth
  - Activate Bluetooth module
  - Activate device scan
  - Bluetooth address

EventLog

Trigger signals output when certain events occur, are recorded and shown in the event list of the safety sensor.

The state of the monitored signals is displayed in the configuration and diagnostics software *Sensor Studio* in a detailed table view, in a signal flow diagram and in a graphical display (protective field violations).

Information on the monitored signals can be found in the *Sensor Studio* configuration software in the information area and in the online help. Select the **Help** menu item in the menu [?].

Passwords

NOTICE
If a user has forgotten his password for login at the safety sensor or has repeatedly entered the password incorrectly, he cannot log in at the safety sensor. The **CHANGE PASSWORD** function is therefore not available. To reset the password, a user must generate a reset password and have it confirmed by the manufacturer.

Change password

↳ Define individual passwords for the access levels *Engineer* and *Expert*. These passwords replace the default passwords set by the manufacturer.
The password is case-sensitive (i.e. a distinction is made between upper-case and lower-case letters).

Reset password

Prerequisites:

- The software is connected to the safety sensor.

↳ Generate a one-time password. Note down the generated reset password.

↳ Send the reset password to the Leuze customer service for confirmation(see chapter 13 "Service and support").
The device can now be switched off and the connection can be terminated.

↳ Enter the confirmed reset password and create a new password.

Optics cover

- Monitoring of optics cover
- Dialog box for calibrating a replacement optics cover

8.2 Configuring the safety sensor

To start up the safety sensor in your application, the safety sensor must be individually adapted using the software. All configuration data is defined using the configuration and diagnostics software.

General procedure for configuring safety sensor

↳ Assessing the risk

- The system has been determined and its boundaries defined.
- The safety sensor has been selected as the safety component.
- The type of guarding has been determined (danger zone guarding, point of operation guarding, access guarding).

↳ Calculating safety distance
Shape and size of the protective and warning fields

↳ Configuring the safety sensor

- Configuration and diagnostics software (see chapter 8.1 "Configuration and diagnostics software - Sensor Studio")
- Determine configuration project (see chapter 8.2.3 "Determine the configuration project")
- Configure protective function (see chapter 8.2.4 "Configuring protective function")

↳ Check function (see chapter 10 "Testing")

8.2.1 Defining safety configuration

⚠ WARNING

Serious accidents caused by incorrect safety configuration!

The protective function of the safety sensor is only ensured if the safety sensor is correctly configured for the intended application.

↳ Allow only competent persons to perform safety configuration.

↳ Select the safety configuration so that the safety sensor can be used as intended (see chapter 2.1 "Intended use").

↳ Select the protective field dimensions and contours according to the safety distance calculated for the application (see chapter 6.1.1 "Calculation of safety distance S").

↳ Select the parameters of the safety configuration according to your risk analysis.

↳ After start-up, check the function of the safety sensor (see chapter 10.1 "Before the initial start-up and following modifications").

⚠ WARNING

Additional protection against manipulation when the monitoring time is increased!

If the monitoring time is increased to above 5 s or if manipulation protection is deactivated, the system operator must introduce other measures to prevent manipulation.

↳ For example, make sure that the distance range in which manipulation is possible cannot be accessed by personnel under normal operating conditions.

NOTICE

An error in the display (protective field contour does not match expectations or contour points jump back and forth) or a changing display of parameter values, for example, indicate that the configuration has been incorrectly transferred to the device. A configuration of this kind must not be used.

	NOTICE
	**OSSDs will switch off if no reflection signals are being measured!** If the safety sensor is unable to measure any reflection signals in a continuous scanning angle of ≥ 90° for a long period of time, the safety-related switching outputs switch off. In certain application types (e.g. in buildings with extremely large distances), the safety sensor may not be able to measure any reflection signals. For such application types, it is possible to set or deactivate the monitoring times. ↳ In the **CONFIGURATION** menu, click the *Device function* option. ⇨ The **DEVICE FUNCTION** dialog box opens. ↳ In the **PROTECTION AGAINST MANIPULATION** dialog box, define the monitoring time according to your specific conditions. ⇨ If the parking position is active, there will be no manipulation monitoring.

Prerequisites:

- The safety sensor is correctly mounted (see chapter 6 "Mounting") and connected (see chapter 7 "Electrical connection").
- Dangerous process is switched off, outputs of the safety sensor are disconnected, and the system is protected against being switched back on
- The size of the protective field is determined on the basis of the mounting location, the calculated safety distances and additional distances.
- The start/restart operating mode required by the application has been determined.
- The conditions for field pair changeover, if required, have been determined.
- Configuration and diagnostics software for the safety sensor is installed on the PC (see chapter 8.1.2 "Installing software").

	NOTICE
	Many safety-relevant parameters are preset for each application in the configuration and diagnostics software. Use these preset values where possible.

Procedure

All configuration data is defined using the configuration and diagnostics software.

To configure the safety sensor, proceed as follows:

↳ Connect the PC to the safety sensor

↳ Start the software

- Set up communication
- Determine the configuration project

↳ Configure the protective function using the project wizard

- Protective/warning field configuration
- Resolution and response time
- Start-up behavior
- Contactor monitoring
- Field triple changeover
- Configuration of the signal outputs

↳ Save configuration project

↳ Transferring a configuration to the safety sensor

↳ Create a record document for the device configuration and protective field dimensioning. The document must be signed by the person responsible for the configuration.
To document the configuration, you can create a PDF file of the safety configuration or save the configuration and settings in an *.xml file.

NOTICE
The configuration data are stored in the configuration memory of the safety sensor and are therefore also available after replacement or repair of the safety laser scanner. The configuration data only needs to be transferred again if changes are made to the configuration.

8.2.2 Connecting safety sensor to PC

Connection via Ethernet cable

The TCP/IP protocol is used for communication via Ethernet.

- Connect the Ethernet cable to the PC or to the network.

NOTICE
In addition to configuration, you can use the Ethernet interface to forward measurement data in real time (process data) to another computer, e.g. for vehicle navigation (RSL 235). This process data cannot be used for safety-relevant purposes.

Connection via Bluetooth

NOTICE
No process data is transferred in the case of connection via Bluetooth.

Prerequisites: Bluetooth communication of the safety sensor activated (see chapter 8.2.2 "Connecting safety sensor to PC")

- Activate the Bluetooth interface on the PC.
- Select the safety sensor as the device for the Bluetooth connection.

NOTICE
Distance between safety sensor and PC The possible distance between safety sensor and PC depends on the quality of the Bluetooth adapter that is used. USB Bluetooth adapters with external rod antenna enable a larger operating range.

Connection via USB interface

NOTICE
Distance between safety sensor and PC with USB connection! The USB interface of the safety sensor is connected to the USB interface on the PC with a standard USB cable (plug combination - Mini-B type / Type A). The distance between safety sensor and PC is limited to 5 m if a standard USB cable is used. Use active USB cables if longer cable lengths are required.

- Connect the USB cable to the safety sensor and the PC.
- Select the *LAN / USB (RNDIS)* interface for the device search.
- Start the device search by clicking the [Start] button.
- Select the safety sensor from the list of found devices.

NOTICE
↳ After use, seal the USB connection using a protection cap. Make sure that the protection cap is felt to engage when sealing. The IP degree of protection specified in the technical data is only achieved when the protection cap is closed.

Communication between safety sensor and PC

The following communication settings are active when the safety sensor is delivered:

- LAN
  - DHCP DHCP: Obtain IP address automatically
- USB
- Bluetooth
  - Bluetooth module activated
  - Device scan activated

You can change the communication settings on the PC using the configuration and diagnostics software in order to, for example, assign a permanent IP address to the safety sensor in your network.

↳ Start the configuration and diagnostics software on your PC.

⇨ The **mode selection** of the Project Wizard is displayed.

If the mode selection is not displayed, start the project wizard in the FDT frame menu by clicking the button **Project > New > Project Wizard** (see chapter 8.1.5 "Using configuration projects").

↳ Select the configuration mode **Online** and click [Next].

⇨ The **Project Wizard** displays the **device selection** list containing the configurable safety sensors.

↳ Select the safety sensor from the device selection list and click [Next].

⇨ The initial screen for the configuration project is displayed together with information for identification of the selected safety sensor.

↳ On the home screen, click the *SETTINGS* tab.

⇨ The **SETTINGS** menu opens.

Assign permanent IP address

↳ Select the menu command **Communication > LAN**.

↳ In the **DHCP** dialog box, deactivate the *Obtain IP address automatically* checkbox.

↳ In the **CONNECTION SETTINGS** dialog box, enter the IP address information.

Activating/deactivating the Bluetooth interface

↳ Select the menu command **Communication > Bluetooth**.

↳ Activate/deactivate communication with the safety sensor via the Bluetooth interface using the *Activate Bluetooth module* checkbox. If the Bluetooth module is deactivated, communication with the safety sensor via the Bluetooth interface is not possible.

↳ Activate/deactivate the Bluetooth device scan using the *Activate device scan* checkbox. If the device scan is deactivated, the safety sensor will not be found during the Bluetooth device scan. To allow communication via the Bluetooth interface, you must enter the device identification of the safety sensor manually.

8.2.3 Determine the configuration project

↳ Start the configuration and diagnostics software on your PC.

⇨ The **mode selection** of the Project Wizard is displayed.

⇨ If the mode selection is not displayed, start the project wizard in the FDT frame menu by clicking the button **Project > New > Project Wizard** (see chapter 8.1.5 "Using configuration projects").

	NOTICE
	During installation of the software, a user *admin* (without password query) is created so that you can start the software without user identification. If other users are registered (**Tools > User management** in the FDT frame menu), you must log in at the software with a user name and password. This setting allows you to connect to the safety sensor and to read out, upload, enter or change the safety configuration and all settings using the RSL 200 device DTM. The password for the safety sensor only needs to be entered (i.e. the access level only needs to be changed) when the changes are downloaded to the safety sensor (see chapter 8.1.6 "Selecting access level").

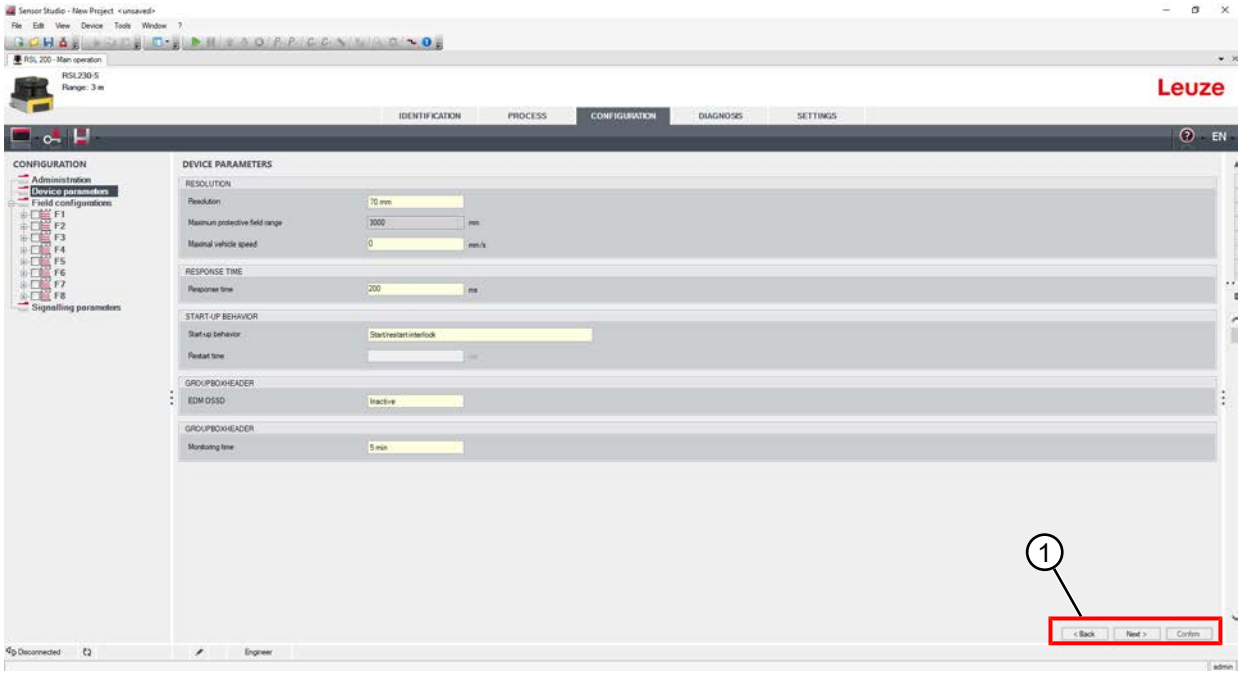
↳ Select the configuration mode and click [Next].

⇨ The **Project Wizard** shows the list of configurable safety sensors.

NOTICE
You can use a prepared configuration project as a template and make changes to it. To do so, select the configuration mode *Open a stored project file*. If you want to load the configuration project currently stored in the safety sensor to the PC, select the configuration mode *Device selection with device scan and establishment of connection (online)*.

↳ Select the safety sensor in the **Sensor** list and click OK.
Alternatively, you can select the safety sensor by entering the part number or by specifying the sensor range and the sensor type.

⇨ The device manager (DTM) of the safety sensor shows the initial screen for the configuration project.



1 Configuration assistant

Fig. 8.5: Safety configuration using Configuration Wizard

NOTICE
The device manager (DTM) starts without querying the access level of the user. During communication with the safety sensor, the safety sensor does however query the access level of the user. To change the authorization levels, choose see chapter 8.2.9 "Selecting access level".

8.2.4 Configuring protective function

Prerequisites: Prerequisites: The safety distance, additional distances and protective field dimensions and contours have been determined according to the mounting position (see chapter 6.1.1 "Calculation of safety distance S").

↳ In the initial screen, click the *CONFIGURATION* tab.

⇨ The CONFIGURATION menu opens with the options:

- *Administration*
- *Device function*
- *Field configurations*
- *Signal parameters*

Creating simple safety configuration

To create a safety configuration for simple commissioning, you must first perform five configuration steps to access the editor used for defining the contours of the protective and warning fields.

By clicking [Next], you can proceed to the next configuration step without selecting the corresponding option in the **CONFIGURATION** menu.

If you make changes to the default settings in a configuration step, first click the [Confirm] button and then [Next].

Entering administration parameters

- In the **CONFIGURATION** menu, click the *Administration* option.
  - ⇨ The **ADMINISTRATION** dialog box opens.
- In the input fields, enter the device data and the project data for the configuration project.

Configuring protective function

- In the **CONFIGURATION** menu, click the *Device function* option.
  - ⇨ The **DEVICE FUNCTION** dialog box opens.
- Determine the device functions such as resolution, maximum vehicle speed (for AGV applications), response time, start-up behavior, external device monitoring and manipulation protection of the safety sensor.

	NOTICE
	For resolution, response time and AGV speed, select the values that you used for calculating the safety distances and additional distances for the application assigned to the configuration bank.

	NOTICE
	Configuration of the start-up behavior is only implemented if the corresponding electrical signal connections exist; see chapter 7 "Electrical connection".

	NOTICE
	When the safety sensor is configured, the set restart time should correspond to at least the selected response time.

Field configurations

- Select the field triple activation mode.
  - Fixed selection of a field triple
  - Selection by signal inputs with fixed switchover time
- Select the changeover time.

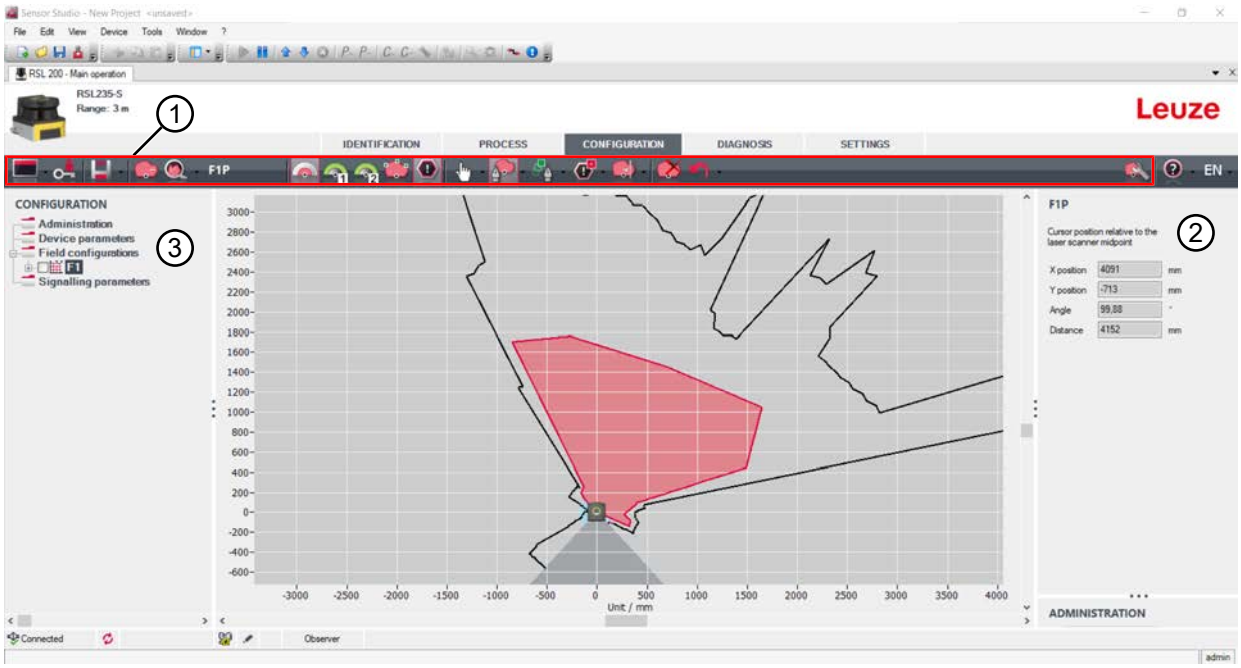
Create protective and warning fields

A field triple consists of one protective field and two warning fields.

- In menu **CONFIGURATION**, right-click on option *Field Configurations*.
- Select *Add Field Triple*.
  - ⇨ The **Add Field Triple** dialog opens.
- Select the number of the field triple from the **Field Triple** list and click on the [Add] button. When you have added all field triples, click on [Close].
- The added field triples are displayed in the **CONFIGURATION** menu as an option under *Field configurations*. The option *Field triple Fx* is displayed for each field triple.

Configure protective and warning fields

Defining contours and boundaries for protective field and warning field



1 Toolbar of field editor
2 Display of field coordinates
3 Structure of safety configuration

Fig. 8.6: Field editor with toolbar for field definition

↳ In the **CONFIGURATION** menu, click the field pair the protective and warning fields of which you want to define.

↳ Click the  button and define the contours and boundaries of the protective field.

	NOTICE
	Determine protective field size! The protective field size is determined by the calculated safety distances and additional distances that you determined for the application assigned to the configuration bank.

	NOTICE
	If the protective field boundaries < 190 mm, object detection can be limited due to the measurement error. ↳ When defining the protective field, take the additional distance Z_{sm} to the protective field contour into account (see chapter 6.2 "Stationary danger zone guarding").

↳ Click on the  or  button and define the contours and boundaries of the warning fields.

	NOTICE
	Right-click on the triple field in menu **CONFIGURATION** to calculate an auto-contour of the protective or warning field. You can define the display options for the field editor in menu **SETTINGS > Display options field editor** (see chapter 8.1.11 "SETTINGS").

Set the Triple Field Monitoring

↳ In the **CONFIGURATION** menu, click on the *Field Triple Fx* option whose protective and warning fields you have set.

↳ Select the monitoring mode for the triple field in the **Field Triple Monitoring** list.

Configure the signal parameters

- Click on *Signal Parameters* in the **Configuration** menu.
- Define the field quadruple switchover (see chapter 8.2.5 "Defining permissible field pair changeovers")
- Configure the signal outputs (see chapter 8.2.6 "Configuring signal outputs").

8.2.5 Defining permissible field pair changeovers

If monitoring of field pair changeover is activated, you can define the permissible sequence of field pair changeovers.

Determining changeover mode

- In the **Configuration** menu, select *Field Configurations*.
- In the **Field Triple Activation and Switchover Mode** dialog, select field triple activation and the switchover time.

Tab. 8.1: Field triple activation

Field triple activation	Description
Fixed selection of a field triple	Fixed selection of F1
Selection by signal inputs Fixed changeover moment	Switching between 32 field triplets: Selection by 2, 3, 4, 5 or 6 signal inputs When the changeover time has expired, the system changes over to the field pair which at this time has a permanent and valid assignment. Field pair changeover signals issued during the changeover time are ignored.

- Click the [Confirm] button.

Determining changeover order

- In the **CONFIGURATION** menu, select *SIGNAL PARAMETERS*.
- In the **MONITORING OF FIELD TRIPLE SWITCHING** dialog ox, activate the option *Monitoring* for the previously selected field triple.
- In the **MONITORING OF FIELD TRIPLE SWITCHING** dialog box, define the sequence of the field triple changeover for all fields created in the configuration project.
- Click the [Confirm] button.

8.2.6 Configuring signal outputs

You can define which indication signals are transmitted to the individual indication signal connections.

- In the **CONFIGURATION** menu, select *SIGNAL PARAMETERS.*
- Assign the corresponding status signals to the free pins.
- Click the [Confirm] button.

	NOTICE
	All signal outputs are *high active*, i.e. logical 1 or +24 V DC with an active signal.

8.2.7 Saving configuration

To save the changed configuration loaded in the software, you can transfer the configuration and settings to the safety sensor or save them in a file on the PC.

Saving safety configuration as PDF file

- In the **CONFIGURATION** menu, click the [Create PDF file of safety configuration] button.
- Determine the storage location and the file name for the safety configuration.
- Click [Save].
- ⇨ The safety configuration is saved as a PDF file.

Saving configuration and settings as file

- In the **CONFIGURATION** menu or in the **SETTINGS** menu, click the [Save configuration and settings to file] button.
- Determine the storage location and the name of the configuration file.
- Click [Save].
- ⇨ The configuration and settings are saved in the file format *.xml.

Saving configuration project as file

Click on [PROJECT] > [Save] in the FDT frame menu.

- Determine the storage location and the name of the configuration project file.
- Click [Save].

8.2.8 Transferring configuration project to safety sensor

The changes that you have made to the configuration only become effective when the changed configuration project file is transferred to the safety sensor.

Prerequisites:

- The software and safety sensor are connected.
- The changed configuration project has been loaded in the software.
- The individual password for the access level *Engineer* is available.
  - Only users with the access level *Engineer* can transfer configuration data to the safety sensor. To change the authorization level, press see chapter 8.2.9 "Selecting access level".
  - If no individual password has been defined for the access level *Engineer*, use the preset default password (**safety**).

	NOTICE
	Alternatively, you can transfer a configuration project saved as a file on the PC directly to the safety sensor.

- In the menu bar of the FDT frame menu, click the [download arrow] button. Alternatively: In the FDT menu bar, select **Device > Download parameters**.
- ⇨ The software asks for the access level and the password.
- Select the access level *Engineer* and enter the preset default password (**safety**) or the defined individual password.
  Confirm with [OK].
- Before downloading the safety configuration, check whether you are connected to the correct safety sensor.
  Confirm the displayed safety notice with [Yes].

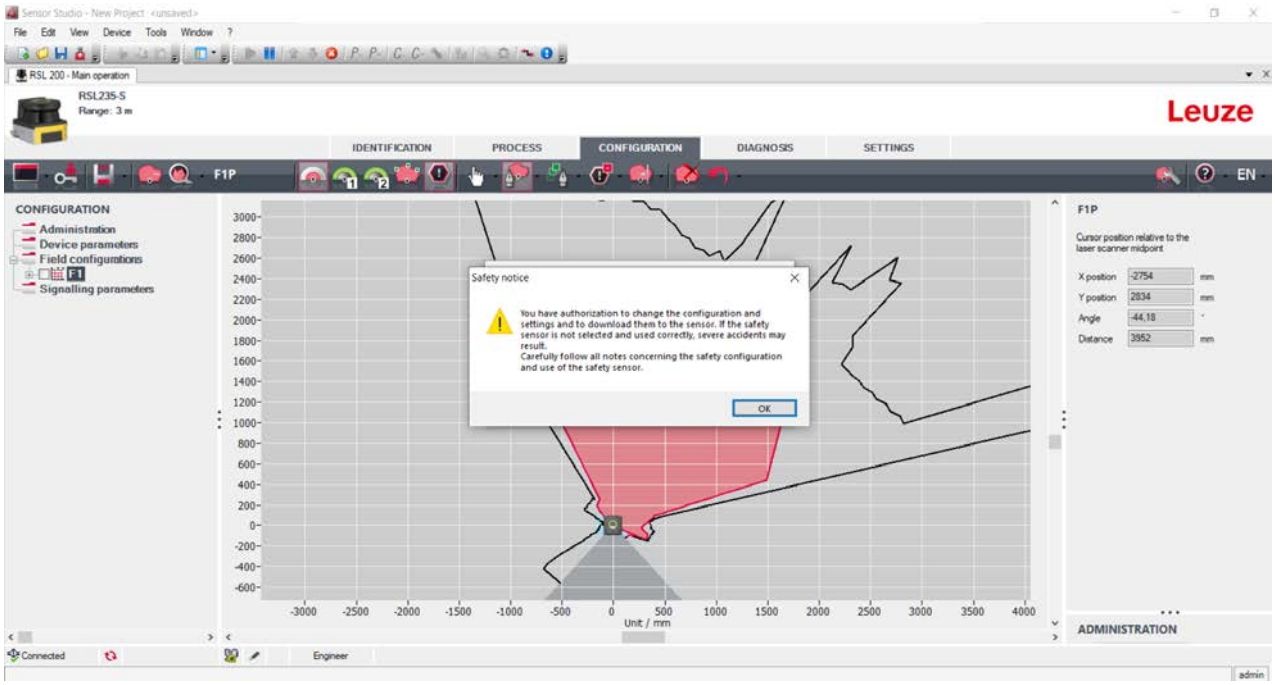


Fig. 8.41: Check before safety configuration is downloaded

The software transfers the data of the configuration project to the safety sensor.

After successful transfer, the safety sensor immediately enters safety mode, i.e. the safety-related switching outputs switch on if all conditions are fulfilled.

- The configuration data is stored in the safety sensor.
- A copy of the safety configuration is stored in the configuration memory of the safety sensor.

	NOTICE
	The safety sensor can only be operated with a built-in configuration memory. If there is no configuration memory built into the safety sensor, the OSSDs remain in the OFF state and the safety sensor is prevented from starting up.

↳ Check the displayed signature.

↳ Confirm successful transfer of the safety configuration to the safety sensor with [OK].
The safety configuration has only been successfully transferred to the safety sensor when the confirmation dialog is displayed during the download.

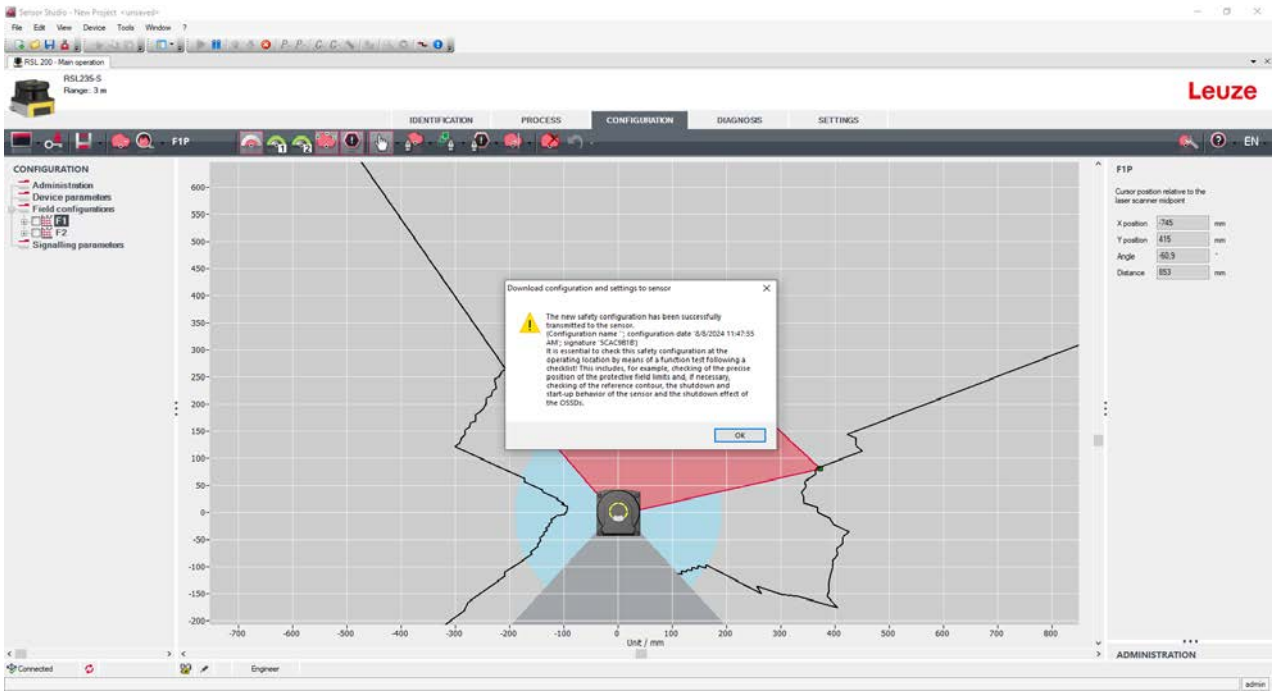


Fig. 8.42: Confirmation Confirmation: safety configuration downloaded

NOTICE	
	The safety-related switching outputs will already have switched on if all conditions are fulfilled.

⇨ The software has saved the configuration project in the safety sensor.

8.2.9 Selecting access level

With the device manager (DTM), you can change the authorization level of the user if necessary (see chapter 4.1 "Authorization concept of safety sensor").

↳ Click in the DTM menu bar on the [Change authorization level].

⇨ The **Change access level** dialog box opens.

↳ Select the entry *Engineer, Expert* or *Observer* from the **Authorization** list and enter the specified individual password or the preset standard password (see chapter 8.1.11 "SETTINGS").
- Default password *Engineer*: **safety**
- Default password *Expert*: **comdiag**

↳ Confirm with [OK].

8.2.10 Reset safety configuration

The device manager (DTM) can be used to reset the safety configuration to the default configuration (one protective function, no restart).

↳ In the DTM menu bar, click the [Reset safety configuration] button.

⇨ Users with authorization level *Engineer* can also transfer the changed safety configuration to the safety sensor (see chapter 8.2.8 "Transferring configuration project to safety sensor").

9 Starting up the device

9.1 Switching on

Requirements for the supply voltage (power supply unit):

- Safe mains separation is ensured.
- Current reserve of at least 1 A is available.

↳ Switch on the safety sensor.

9.2 Aligning the safety sensor

NOTICE
Faulty or incorrect alignment may result in an operating fault! ↳ The alignment performed during start-up should only be performed by qualified personnel. ↳ Observe the data sheets and mounting instructions of the individual components.

↳ Align the safety sensor using an external spirit level.

9.3 Unlocking start/restart interlock

WARNING
Premature unlocking of the start/restart interlock may result in serious injury! If the start/restart interlock is unlocked, the system can start up automatically. ↳ Before unlocking the start/restart interlock, make certain that no people are in the danger zone.

The responsible person can restore the ON state of the safety sensor following process interruptions (due to triggering of protective function, failure of the voltage supply).

↳ Unlock the start/restart interlock using the reset button.
The safety-related switching outputs are only enabled if you hold down the reset button for between 0.5 s and 4 s.

9.4 Shutting down

Temporarily shutting down the machine with the safety sensor

When you shut down the machine with the safety sensor temporarily, you do not have to observe any more steps. The safety sensor saves the configuration and starts again with the switch-on with this configuration.

Shutting down safety sensor and removing from machine

When you shut down the safety sensor and store it away for a later use, you must reset the safety sensor to the factory settings.

Reset the safety sensor to the factory settings using the software:

↳ In the device manager (DTM) of the safety sensor, select the *CONFIGURATION* tab.

↳ Click the [Reset safety configuration] button.

9.5 Restarting

Restarting the machine with the safety sensor

If you have only shut down the system with the safety sensor temporarily and are restarting the system without any changes, you can restart the safety sensor with the configuration that applied with the shut-down. The configuration remains saved in the safety sensor.

↳ Perform a function check (see chapter 10.3 "Periodically by the operator").

Starting up machine with safety sensor after modification or reconfiguration

If you have performed significant changes on the machine or have reconfigured the safety sensor, the safety sensor must be checked as with the initial start-up.

↳ Check the safety sensor (see chapter 10.1 "Before the initial start-up and following modifications").

9.6 Set up replacement safety sensor in operation

Mount and align replacement safety sensor

↳ Mount the replacement safety sensor instead of the previous safety sensor and install the configuration memory mounted in the previous safety sensor in the new safety sensor (see chapter 12.1 "Replacing the device").

Transferring the configuration to the replacement safety sensor

The configuration stored in the configuration memory is automatically transferred to the replacement safety sensor.

10 Testing

NOTICE

- Always replace the safety sensors completely (including the configuration memory).
- For the tests, observe, if necessary, nationally applicable regulations.
- Document all tests in a comprehensible manner and include the configuration of the safety sensor along with the data for the safety- and minimum distances in the documentation.

10.1 Before the initial start-up and following modifications

WARNING

Unpredictable machine behavior during initial start-up may result in serious injury!

- Make certain that there are no people in the danger zone.

- Before they begin work, train the operators on their respective tasks. The training is the responsibility of the operating company.
- Attach notes regarding daily testing in the respective national language of the operator on the machine in a highly visible location, e.g. by printing out the corresponding chapter (see chapter 10.3 "Periodically by the operator").
- Test the electrical function and installation according to this document.

Acc. to EN IEC 62046 and national regulations (e.g. EU directive 2009/104/EC), tests are to be performed by competent persons in the following situations:

- Prior to initial commissioning
- Following modifications to the machine
- After longer machine downtime
- Following retrofitting or new configuration of the machine

- To prepare, check the most important criteria for the safety sensor using the following checklist (see chapter 10.1.1 "Checklist for integrator – to be performed prior to the initial start-up and following modifications"). Completing the checklist does not replace testing by a competent person!

Not until proper function of the safety sensor is ascertained may it be integrated in the control circuit of the system.

10.1.1 Checklist for integrator – to be performed prior to the initial start-up and following modifications

NOTICE

Completing the checklist does not replace testing by a competent person!

- If you answer one of the items on the check list with *no*, the machine must no longer be operated (see table below).
- EN IEC 62046 contains additional recommendations on testing protective devices.

Tab. 10.1: Checklist for integrator – to be performed prior to the initial start-up and following modifications

Check:	Yes	No	n. a. not applicable
Is the safety sensor operated acc. to the specific environmental conditions that are to be maintained (see chapter 14 "Technical data")?			
Is the safety sensor correctly aligned and are all fastening screws and connectors secure?			
Are safety sensor, connection cables, connectors, protection caps and command devices undamaged and without any sign of manipulation?			
Does the safety sensor satisfy the required safety level (PL, SIL, category)?			
Are the safety-related switching outputs (OSSDs) integrated in the downstream machine control acc. to the required safety category?			
Are switching elements that are controlled by the safety sensor monitored according to the required safety level (PL, SIL, category) (e.g., contactors through EDM)?			
Are all points of operation near the safety sensor accessible only through the protective field of the safety sensor?			
Are the necessary additional protective devices in the immediate surroundings (e.g., safety guard) properly mounted and secured against tampering?			
If an undetected stay between the safety sensor and the danger point is possible: Is an assigned start/restart interlock functional?			
Is the command device for unlocking the start/restart interlock mounted in such a way that it cannot be reached from within the danger zone and so that the complete danger zone can be seen from the installation location?			
Has the maximum stopping time of the machine been measured and documented?			
Is the required safety distance maintained?			
Does interruption with a test object intended for this purpose cause the dangerous movement(s) to stop?			
Is the safety sensor effective during the entire dangerous movement(s)?			
Is the safety sensor effective in all relevant operating modes of the machine?			
Is start-up of dangerous movements reliably prevented if the protective field is interrupted with a test object intended for this purpose?			
Was the sensor detection capability (see chapter 10.3.1 "Checklist – periodically by the operator") successfully checked?			
Were distances to reflective surfaces taken into account during configuration and no reflection bypasses subsequently detected?			
Are notices for regular testing of the safety sensor legible to the operator and are they located in a highly visible location?			
Are changes to the safety function (e.g. protective field changeover) not easy to achieve through tampering?			
Are settings that could result in an unsafe state possible only by means of key, password or tool?			
Are there incentives that pose stimulus for tampering?			
Were the operators instructed prior to starting work?			

10.2 To be performed periodically by competent persons

The reliable interaction of safety sensor and machine must be periodically tested by competent persons in order to detect changes to the machine or impermissible tampering with the safety sensor.

Acc. to EN IEC 62046 and national regulations (e.g., EU directive 2009/104/EC), tests of elements which are subject to wear must be performed by competent persons at regular intervals. Testing intervals may be regulated by nationally applicable regulations (recommendation acc. to EN IEC 62046 months). 6 months

- Have all tests performed by competent persons.
- Observe the nationally applicable regulations and the time periods specified therein.
- Please refer to the checklist (see chapter 10.1 "Before the initial start-up and following modifications") for preparation.

10.3 Periodically by the operator

The function of the safety sensor must be checked regularly (e.g., daily, on shift change, monthly or in an even longer cycle) according to the following checklist. The frequency of the checks is determined by means of the risk analysis performed by the operating company.

Due to complex machines and processes, it may be necessary under certain circumstances to check some points at longer time intervals. Observe the classification in "Test at least" and "Test when possible".

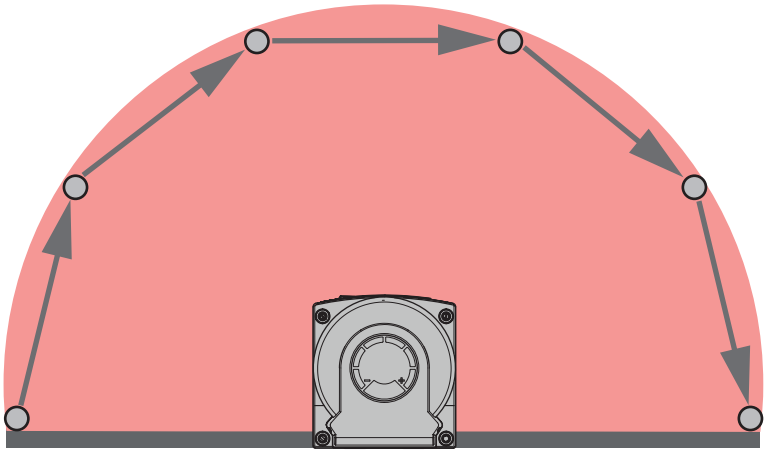
	WARNING
	**Unpredictable machine behavior during the test may result in serious injury!** - Make certain that there are no people in the danger zone. - Before they begin work, train the operators on their respective tasks and provide suitable test objects and an appropriate test instruction.

10.3.1 Checklist – periodically by the operator

NOTICE

↳ If you answer no to any of the points on the checklist, the machine must no longer be operated (see chapter 10.1.1 "Checklist for integrator – to be performed prior to the initial start-up and following modifications").

Tab. 10.2: Checklist – regular function test by trained operators/persons

Test at least:	Yes	No
Are safety sensor and connectors securely mounted and free of obvious signs of damage, changes or tampering?		
Were obvious changes made to access or entry possibilities?		
Test the effectiveness of the safety sensor: 1. The LED 1 on the safety sensor must illuminate green (Display elements) 2. Interrupt the protective field using a suitable opaque test object (Leuze RSL400 test rod or similar test object with 1.8 % diffuse reflectance at wavelength = 905 nm).  Testing the protective field function with test body. Use a test body with the set resolution. The test object should have a matt surface structure. Does the LED 1 on the safety sensor illuminate constantly red while the protective field is interrupted?		

Tab. 10.3: Checklist – regular function test by trained operators/persons

When possible, test during running operation:	Yes	No
Protective device with proximity function: Protective device with approach function: during machine operation, the protective field is interrupted with the test object – are the obviously dangerous machine parts stopped without noticeable delay?		
Protective device with presence detection: Protective device with presence detection: the protective field is interrupted with the test object – does this prevent operation of the obviously dangerous machine parts?		

11 Diagnosis and troubleshooting

11.1 What to do in case of failure?

Information on the device status and on diagnostics and troubleshooting for the safety sensor can be displayed as listed below:

LED indicator

Indicator elements make it easier to check for proper function and to find errors after the safety sensor is turned on (see chapter 3.5 "Display elements").

App

Diagnostic data such as status and error information can be read out on a Bluetooth-capable end device via the Bluetooth interface integrated in the safety sensor.

In the event of a fault, you can recognize the fault on the displays of the LEDs or via the displays in the app and read a message. With the error message you can determine the cause of the error and initiate measures to rectify it.

Sensor Studio

The Sensor Studio configuration and diagnostics software can be used to display device status and diagnostic information.

NOTICE	
	**If the safety sensor responds with an error display, you will often be able to eliminate the cause yourself!** ↳ Switch off the machine and leave it switched off. ↳ Analyze the cause of the fault using the diagnostics displays and rectify the fault. ↳ If you are unable to rectify the fault, contact the Leuze branch responsible for you or call the Leuze customer service (see chapter 13 "Service and support").

11.2 Diagnostic displays RSL 200 app

To call up the diagnostic data, you need a Bluetooth-capable device and the RSL 200 app provided by Leuze. The app can be used to display diagnostic data and change the communication settings.

The RSL 200 app is available for the iOS and Android operating systems and can be downloaded from the Playstore (Android) or App Store (iOS).

Diagnostic data

The following diagnostic data can be displayed in the RSL 200 app:

- Device information
  - Device type
  - Device name
  - Serial_No.
  - Firmware version
- Device status
  - OSSD state
  - State of start/restart interlock
  - Warning field status
  - Bluetooth status
  - Window soiling status
- Monitoring
  - Window dirtiness rating
  - Pin assignment
  - Display active field triple

- Technical data
  - Device type
  - Device name
  - Serial_No.
  - Part no.
  - Number of available field triples
- Diagnosis
  - Diagnostics list
  - EventLog
  - Access list
  - Service file
- Communication settings
  - TCP/IP settings
  - UDP telegram settings
  - EventLog settings

11.3 Diagnostics messages

The diagnostics displays consist of one letter plus four numbers, divided into classes consisting of letters and the first number.

Tab. 11.1: Diagnostics classes:

Code letter	Diagnostics classes:	Description
I	Information	• No OSSD switch-off • Unhindered operation possible
U	Usage	Application error
E	External	External error
F	Failure	Internal device error. • OSSD switch-off • Self test unsuccessful • Hardware error
P	Parameter	Discrepancy in configuration

Tab. 11.2: Diagnostic messages

Diagnose ID	Diagnostic message	Measure
U370	Input level at the electrical inputs is unclear	Check the wiring of the safety sensor.
U573	EDM fault at system start	Check the wiring of the downstream relays and that they are functioning correctly.
U574/U576	Switching fault, EDM at OSSD: external relay does not switch off	Check the wiring of the downstream relays and that they are functioning correctly.
U575/U577	Switching fault, EDM at OSSD: external relay does not switch on	Check the wiring of the downstream relays and that they are functioning correctly.
U581	Protection against manipulation triggered	Check if the optics cover is covered or if the scanning range of the sensor is outside the maximum operating range.

Diagnose ID	Diagnostic message	Measure
U583	Field triple changeover is not performed in accordance with the specifications configured in the safety sensor: field triad not defined Signal for field triple activation is missing	Check the wiring and the changeover times of control inputs for the field triple changeover (E1…E6)
U584	Field triple changeover is not performed in accordance with the specifications configured in the safety sensor: field triad not defined Switchover time exceeded	Check the changeover times of control inputs for the field triple changeover (E1…E6) or that the parameter settings in the configuration are correct
U585	Field triple changeover is not performed in accordance with the specifications configured in the safety sensor: field triad not defined Switching sequence not followed in the correct order	Check the wiring of control inputs for the field triple changeover (E1…E6) or that the parameter settings in the configuration are correct
U587	Motor speed outside tolerance	Check the voltage supply.
U661	Safety-related switching outputs (OSSDs) cannot be switched: Short circuit with 0 V, +24 V DC or between OSSDs	Check the wiring of the OSSDs.
U791	Protection against manipulation triggered at system start	Check if the optics cover is covered or if the scanning range of the sensor is outside the maximum operating range.
U882	IO output monitoring indicates an error	Check the wiring of the safety sensor.
P296	Higher access level required for the assignment of a machine ID	Log on with a higher access level
P414	Safety configuration is not compatible: unknown EDM inputs	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software
P415	Safety configuration is not compatible: unknown monitoring mode of the field triple changeover	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software
P416	Safety configuration is not compatible: unknown field triple monitoring parameters	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software
P417	Safety configuration is not compatible: unknown monitoring mode of the field triple changeover	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software
P419	Safety configuration is not compatible: unknown monitoring parameter for the changeover order	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software
P422	Safety configuration is not compatible: unknown field triple selection mode	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software

Diagnose ID	Diagnostic message	Measure
P424	Safety configuration is not compatible: unknown parameter for manipulation monitoring	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software
P425	Safety configuration is not compatible: unknown configuration of the output signals	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software
P426	Safety configuration is not compatible: unknown resolution	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software
P427	Safety configuration is not compatible: unknown parameter	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software
P429	Safety configuration is not compatible: unknown start/restart mode	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software
P430	Safety configuration is not compatible: unknown start mode	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software
P431	Safety configuration is not compatible: unknown restart mode	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software
P607	Unable to unpack configuration file	Re-transmit the safety configuration to the sensor or re-create the safety configuration.
P608	Unable to unpack configuration file	Re-transmit the safety configuration to the sensor or re-create the safety configuration.
P609	Wrong CRC of the configuration file	Re-transmit the safety configuration to the sensor or re-create the safety configuration.
P610	Wrong signature of the configuration file	Re-transmit the safety configuration to the sensor or re-create the safety configuration.
P611	The configuration could not be read	Re-transmit the safety configuration to the sensor or re-create the safety configuration.
P612/P613/P614	Safety test configuration incorrect	Re-transmit the safety configuration to the sensor or re-create the safety configuration.

Diagnose ID	Diagnostic message	Measure
P615-P620	Security check configuration: CRC error	Re-transmit the safety configuration to the sensor or re-create the safety configuration.
P621-P626 P629-P631 P633-P649	Parameter description test faulty	Create the safety configuration again
P627	Security check configuration: CRC error	Re-transmit the safety configuration to the sensor or re-create the safety configuration.
P628	Security check configuration: Contour size incorrect	Re-transmit the safety configuration to the sensor or re-create the safety configuration.
P650	Machine ID not stated or wrong	Enter the correct machine ID.
P651	Safety test configuration incorrect	Re-transmit the safety configuration to the sensor or re-create the safety configuration.
P652	Unknown operating mode	Restart the sensor.
P653	The safety configuration is not compatible: The protective/warning field radius is too large.	Swap out the safety sensor or change the configuration. The safety sensor type must match the type stored in the configuration memory or in the configuration software
P654	Field triple changeover is not performed in accordance with the specifications configured in the safety sensor: field triad not defined Field triple not defined	Check the wiring of control inputs for the field triple changeover (E1…E6) or that the parameter settings in the configuration are correct
P676	Safety test configuration in the sensor incorrect	Re-transmit the safety configuration to the sensor or re-create the safety configuration.
P678	Safety test configuration in configuration memory failed	Re-transmit the safety configuration to the sensor or re-create the safety configuration.
P747	The safety configuration is not compatible: Protective/warning field radius too small	Change the dimensions and contour of the protective field in the configuration. The minimum range of the protective field must be observed.
P810	Safety test configuration incorrect	Re-transmit the safety configuration to the sensor or re-create the safety configuration.
P926	Parameter description: Value of a constant is missing	Create the safety configuration again
P927	Parameter description: Enum parameter not defined	Create the safety configuration again
P928	Parameter description: Enum parameter name not unique	Create the safety configuration again
P929	Parameter description: Enum parameter is not permitted here	Create the safety configuration again
I660	Field triad changeover is not performed in accordance with the specifications configured in the safety sensor: no field triple activated at system start	Check the wiring of control inputs for the field triple changeover (E1…E6) or that the parameter settings in the configuration are correct

Diagnose ID	Diagnostic message	Measure
I719	Timeout of RES signal (acknowledgment button, start/restart)	Check the wiring of the RES input. The time specifications for start/restart must be observed
I825	Simulation mode has been activated	The safety-related switching outputs (OSSDs) have been switched off.
I826	Simulation mode has been deactivated	Sensor is again in safety mode. CAUTION! Be aware of potential hazards which can occur when the machine is started up!
I935	Life expectancy will soon be reached	Replace the safety sensor with a new device.
I936	All errors deleted	The safety sensor is in normal operation.
I1004	Field violation due to glare	Mount the safety sensor in such a way that it is not exposed to any external light sources in the scan level
I1008	An error may have to be acknowledged	Press the reset button.
I1009	Field triple selection is valid again	Error during field triple selection has been rectified; the signals are valid
I1010	The signal at the restart input is valid again	Error at the restart input has been rectified; the signal is valid again.
I1207	Optics cover is soiled	Clean the optics cover as soon as possible. Sensor is still in safety mode.
I1218	The temperature measured in the device is in the permissible range again	The temperature of the safety sensor is in the normal range again
E1206	Optics cover is soiled	Clean the optics cover.
F…	The monitoring functions have detected an internal error.	Create the service file and contact Leuze Customer Service.

12 Care, maintenance and disposal

12.1 Replacing the device

If the test of the safety laser scanner or an error message indicates a defective safety sensor, replace the device.

Only an instructed and competent person may replace the safety sensor.

The safety sensor is replaced in the following steps:

- Disconnect the defective device from the connection cables.
- Remove the configuration memory from the defective safety sensor.
- Install the configuration memory in the new safety sensor.

	NOTICE
	↳ Only configuration memories of the same variants (same item number of the safety sensor) can be exchanged. If a configuration memory is installed in a device variant other than the one in which it was installed in the delivery state or with which it was initially configured, the configuration is not transferred and the OSSDs remain in the OFF state. ↳ If a pre-configured configuration memory is built into a brand-new, unconfigured safety sensor, the safety configuration stored on the configuration memory is transferred to the safety sensor and you can use the safety sensor after the restart without reconfiguration. ↳ If a brand-new, non-configured configuration memory is built into a pre-configured safety laser scanner, the safety configuration stored in the safety sensor is transferred to the configuration memory and you can use the safety sensor after a restart without reconfiguration. ↳ The safety laser scanner must only be operated when a valid configuration memory is built into it. ↳ The configuration memory's cover must always be closed and the M3 screw tightened with a tightening torque of 0.35 - 0.5 Nm to achieve the stated IP type of protection.

↳ Connect the new safety sensor.

↳ Check the safety sensor's configuration (see chapter 8.2 "Configuring the safety sensor").

↳ Check the safety sensor in accordance with the initial operation (see chapter 10.1.1 "Checklist for integrator – to be performed prior to the initial start-up and following modifications").

↳ Set up the new safety sensor.

	NOTICE
	**Safety sensor malfunction due to contamination and damage!** ↳ Carry out all work in an environment that is as free of dust and dirt as possible. ↳ Do not touch any parts inside the device. ↳ The configuration memory must be replaced in a clean environment with little dust. ↳ Visually inspect the configuration memory including the installed seal. If damage is detected, the configuration memory must not be reused and must be replaced.

12.2 Cleaning the optics cover

Clean the optics cover as required by the application-related load rating.

Use the RS4-cleantex cleaning cloths and an isopropanol-based cleaner to clean the optical dome.

The procedure for cleaning depends on the kind of contamination:

Soiling	Cleaning
Particles, loose, scouring	Vacuum without touching or blow away softly, oil-free Wipe free in one swipe with cleaning cloth
Particles, loose, non-scouring	Vacuum without touching or blow away softly, oil-free or Wipe free in one swipe with cleaning cloth

Soiling	Cleaning
Particles, sticking	Wet with cloth soaked in cleaning agent Wipe free in one swipe with cleaning cloth
Particles, statically charged	Vacuum without touching Wipe free in one swipe with cleaning cloth soaked with cleaning agent
Particles/drops, smearing	Wet with cloth soaked in cleaning agent Wipe free in one swipe with cleaning cloth
Water drops	Wipe free in one swipe with cleaning cloth
Oil drops	Wet with cloth soaked in cleaning agent Wipe free in one swipe with cleaning cloth
Fingerprints	Wet with cloth soaked in cleaning agent Wipe free in one swipe with cleaning cloth
Scratches	Change optics cover

NOTICE

The wrong cleaning agents or cloths will damage the optics cover!

- Do not use any scouring cleaning agents or scratching cloths.

NOTICE

If cleaning takes longer than four seconds, e.g. with fingerprints, the safety sensor displays a fault of optics cover monitoring. After cleaning is complete, the safety sensor resets itself automatically.

- Clean the entire optical dome.
- Soak cloth with cleaning agent.
- Wipe optics cover free in one swipe.

NOTICE

Internal monitoring of optics cover!

- The monitored area is dependent on the configuration and can be smaller than the entire scanning range of 275°.
- On account of device safety, the internal monitoring of the optics cover monitors a range that is larger than specified by the configured protective field.

WARNING

Improper calibration of the optics cover may result in serious accidents!

The optics cover may be calibrated only if it is as new, clean and scratch-free.

Calibration of a not as new, scratched or soiled window can impair the protective function of the safety sensor.

12.3 Servicing

The device does not normally require any maintenance by the operator.

Repairs to the device must only be performed by the manufacturer.

- For repairs, contact your responsible Leuze subsidiary or Leuze customer service (see chapter 13 "Service and support").

12.4 Disposing

- For disposal observe the applicable national regulations regarding electronic components.

13 Service and support

Service hotline

You can find the contact information for the hotline in your country on our website **www.leuze.com** under **Contact & Support**.

Repair service and returns

Defective devices are repaired in our service centers competently and quickly. We offer you an extensive service packet to keep any system downtimes to a minimum. Our service center requires the following information:

- Your customer number
- Product description or part description
- Serial number or batch number
- Reason for requesting support together with a description

Please register the merchandise concerned. Simply register return of the merchandise on our website **www.leuze.com** under **Contact & Support > Repair Service & Returns**.

To ensure quick and easy processing of your request, we will send you a returns order with the returns address in digital form.

14 Technical data

14.1 General specifications

Tab. 14.1: Safety-relevant technical data

Type in accordance with EN IEC 61496	Type 3
SIL in accordance with IEC/EN 61508	SIL 2
Maximum SIL in accordance with EN IEC 62061	SIL 2
Performance level (PL) in accordance with EN ISO 13849-1	PL d
Category in acc. with EN ISO 13849-1	Cat. 3
Average probability of a failure to danger per hour (PFH_d)	$2x10^{-8}$ 1/h
Mission time (T_M)	20 years (ISO 13849-1) Repairs or the exchange of wear parts do not extend the mission time.

Tab. 14.2: Optical data

Laser class according to IEC 60825-1:2014 / EN 60825-1:2024 + A11:2021	Class 1
Wavelength	905 nm (infrared)
Impulse duration	6 ns
Maximum output power (peak)	25 W
Pulse frequency of laser transmitter	96 kHz
Scan rate	40 scans/s, equal to 25 ms/scan
Scanning angle	Max. 275°
Angular resolution	0.2°

Tab. 14.3: Protective field data

Safety sensor	RSL 210	RSL 220	RSL 230 RSL 235
Number of field triples	1	8	32
Minimum adjustable range	50 mm		
Detection range of the test object from the housing edge	The detection capability is limited in the 0 mm to 50 mm range to increase availability.		
Diffuse reflectance PF minimum	1.8 %		

Tab. 14.4: Protective field range

Resolution [mm]	Protective field range [m]
70	3.00
50	3.00

Tab. 14.5: Warning field data

Safety sensor	RSL 210	RSL 220	RSL 230 RSL 235
Number of field triples	1	8	32
Warning field range	0 … 15 m		
Object size	150 mm x 150 mm		
Diffuse reflectance WF minimum	Min.: 20		

Tab. 14.6: RSL 235 measurement field data

		Min.	Typical	Max.
Detection range	Diffuse reflection > 90%		0 … 25 m	
Distance resolution, radial			2 mm	
Distance resolution, lateral			0.2°	
Systematic measurement error D_{meas} - D_{real}	Diffuse reflection: 1.8% … retro-reflector Measurement range: 0.4 m … 11,5 m 11.5 m … 20 m	 20 mm 0 mm		 20 mm 40 mm
Measurement value noise	1 σ Diffuse reflection 1.8%... retroreflec-tor measuring range: 0 m … 25 m		10 mm	
Laser spot height	5 m 10 m 15 m 20 m 25 m		63 mm 125 mm 188 mm 250 mm 313 mm	
Laser spot width	5 m 10 m 15 m 20 m 25 m		8 mm 15 mm 23 mm 30 mm 38 mm	

Tab. 14.7: Electrical supply

Voltage supply	24 V DC (+20% / -30%)
Power supply unit/battery	Supply acc. to EN IEC 61558 with safe mains separation and equalization for power outages of up to 20 ms acc. to EN IEC 61496-1.
Current consumption	< 300mA (use power supply unit with 1 A)
Power consumption	7 W with 24 V plus output capability
Switch-on current	Max. 1 A
Overvoltage protection	overvoltage protection with protected limit stop
Protective conductor	Connection required
Device connection	8-pin M12 connector (RSL 210, RSL 220) 12-pin M12 connector (RSL 230, RSL 235)
Connection socket for Ethernet/communication	4-pin M12 connector, D-coded (RSL 235)

Tab. 14.8: Inputs

Reset	+24 V, dynamically monitored (0.12 s to 4 s)
Field triple changeover	RSL 220 Selection of 8 field triplets via 4 control inputs +24 V, dynamically monitored RSL 230, RSL 235: Selection of 32 field triplets via 6 control inputs +24 V, dynamically monitored

Tab. 14.9: Safety-related switching outputs

OSSD transistor safety-related switching outputs	2 safe PNP semiconductor outputs Short-circuit proof, cross circuit monitored		
Class (source) acc. to CB24I Edition 2.0.1	C2		
	Minimum	Typical	Maximum
Response time	75 ms (3 scans)		1000 ms (40 scans)
Switching voltage high active	U_B – 1.8 V		
Switching voltage low			< 3 V
Switching current			85 mA
Cut-off frequency f_g			1 kHz
Load capacity C_{load}			10 nF
Cable length between safety sensor and load	see chapter 7.2 "Cable lengths depending on the supply voltage"		
Test pulse width	200 µs		200 µs
Test pulse distance	24,6 ms	25 ms	76,9 ms

NOTICE

The safety-related transistor outputs perform the spark extinction. With transistor outputs, it is therefore neither necessary nor permitted to use the spark extinction circuits recommended by contactor or valve manufacturers (RC elements, varistors or recovery diodes), since these considerably extend the decay times of inductive switching elements.

Tab. 14.10: Inputs and outputs

Input, min. input current I_{Emin}	3 mA (at U_{min})
Output, max. output current I_{Amax}	50 mA
Signal definition:	
High / logical “1”	U - 1.8 V (U is the supply voltage of the device)
Low / logical “0”	< 3 V

Tab. 14.11: USB connection

Type of interface	USB 2.0
Connection type	Type C
Transmission rate	≤ 12 Mbit/s
Cable length	≤ 5 m Longer cable lengths are possible using active cables.

Tab. 14.12: Bluetooth

Frequency band	2400 ... 2483,5 MHz
Radiated transmitting power	Max. 4.5 dBm (2.82 mW), Class 2

Tab. 14.13: Software

Configuration and diagnostics software	Sensor Studio for Windows 11 or higher

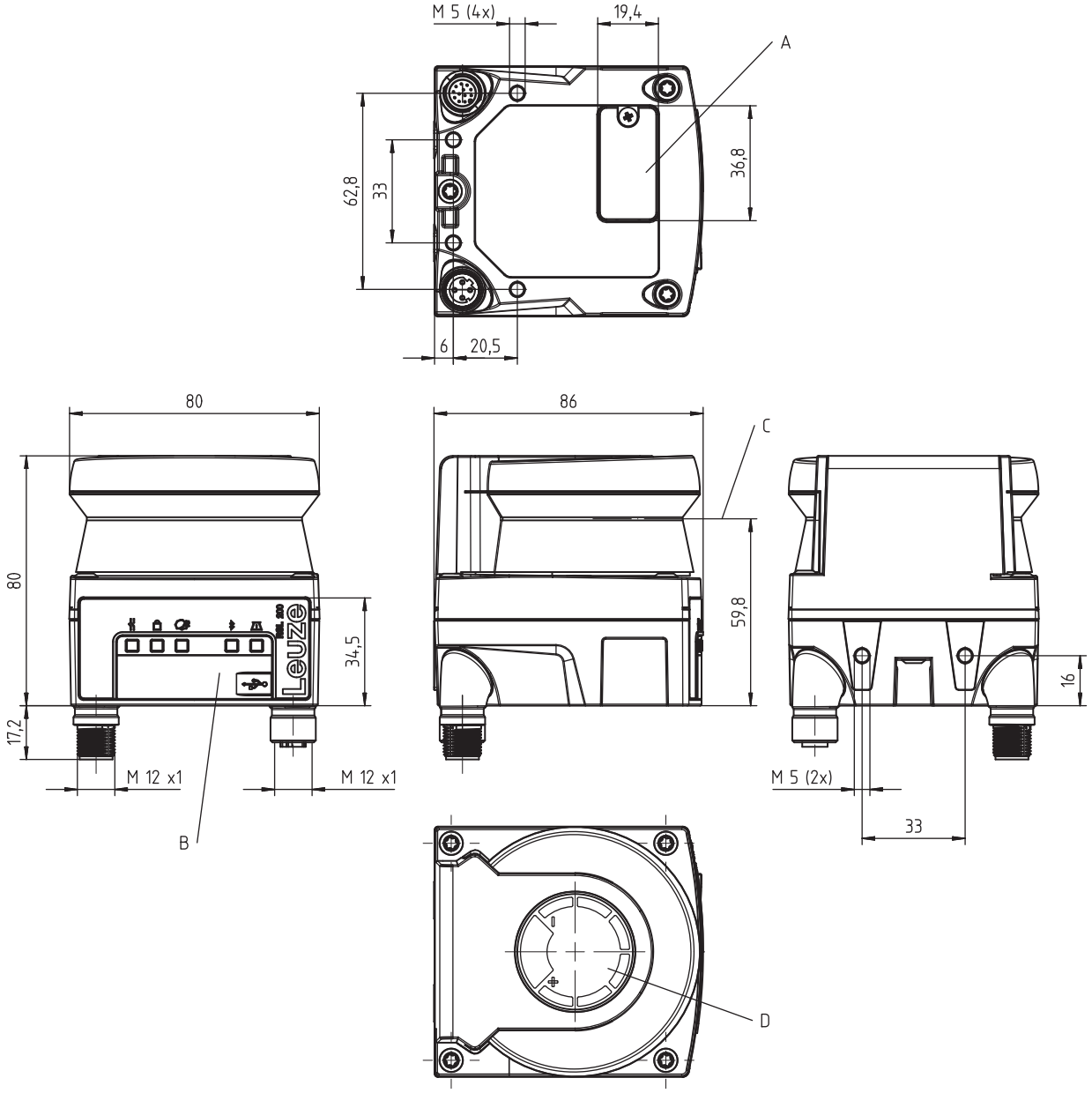
Tab. 14.14: General system data

Degree of protection	IP 65 in accordance with IEC/EN 60529
Protection class	III in accordance with IEC/EN 61140
Ambient temperature, operation	0 … +50 °C
Ambient temperature, storage	-20 … +60 °C
Humidity	DIN 40040, table 10, code letter E (moderately dry)
Height above standard elevation zero (operation)	≤ 3000 m
Interference rejection	In acc. with EN IEC 61496-1 (type 4)
Vibration stress over 3 axes	In acc. with IEC/EN 60068 Part 2 – 6, 10 – 55 Hz, max 5 G, additionally acc. to IEC TR 60721 Part 4 – 5, class 5M1, 5 – 200 Hz, max 5 G
Continuous shocks over 3 axes (6 directions)	In acc. with IEC/EN 60068 Part 2 – 29, 100 m/s^2, 16 ms, additionally acc. to IEC TR 60721 Parts 4 – 5, class 5M1, 50 m/s^2, 11 ms
Disposal	Specialist disposal required
Housing	Diecast zinc, plastic
Standard version dimensions (ensure free space for connector with fixing and connection cable)	80 x 80 x 86 (W x H x D) in mm
Weight of standard version	Approx. 0.6 kg
Distance, beam level center to bottom housing edge	60 mm

Tab. 14.15: Patents

US patents	-

14.2 Dimensions



All dimensions in mm

A Configuration memory

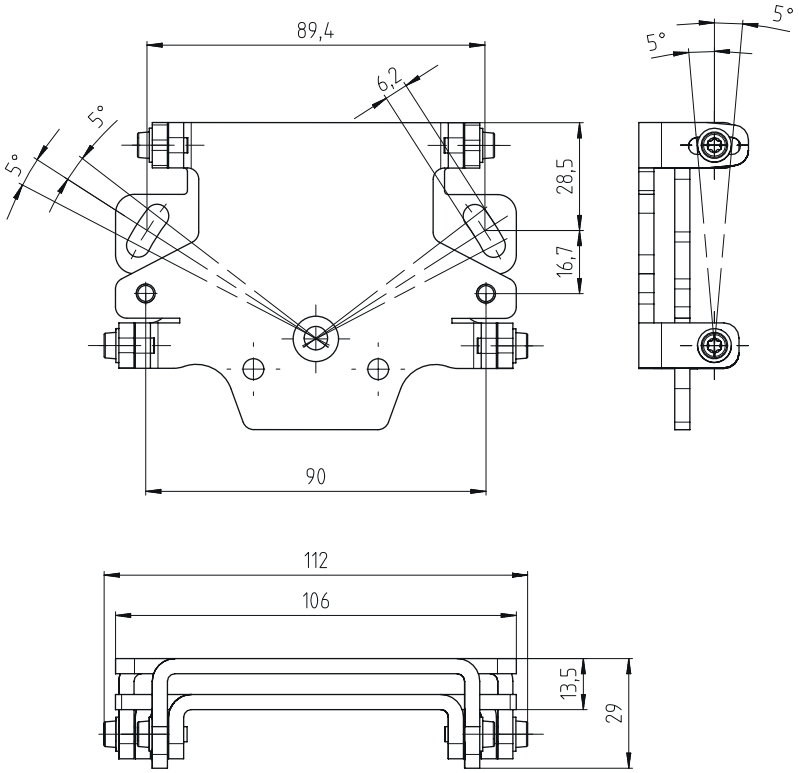
B USB connection

C Scanning plane

D Template

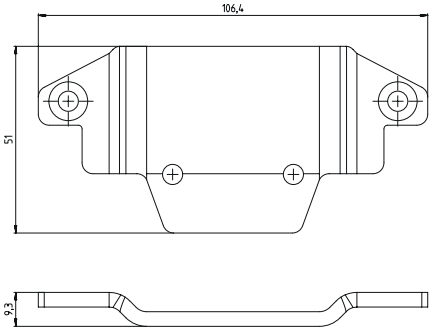
Fig. 14.1: RSL 230/235 dimensions

14.3 Dimensioned drawings: Accessories



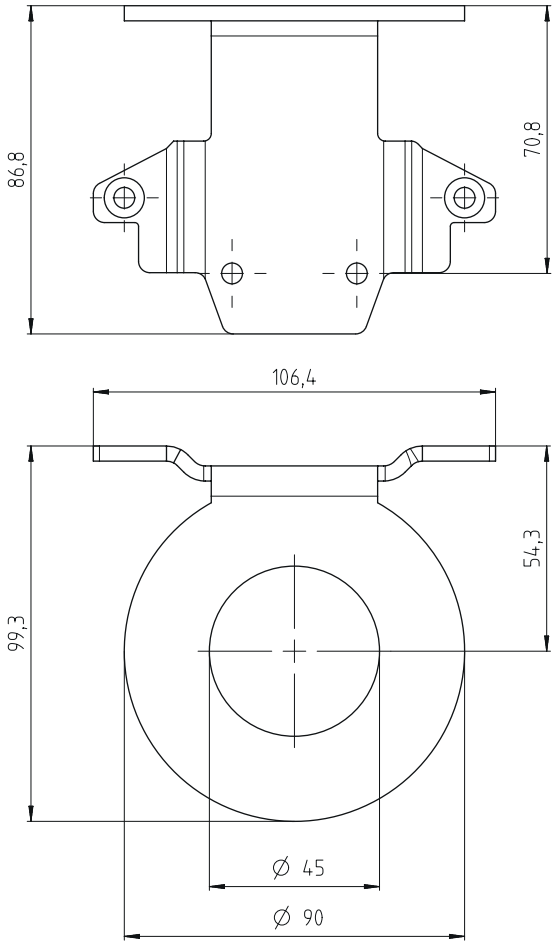
All dimensions in mm

Fig. 14.2: Mounting system BTU 500M



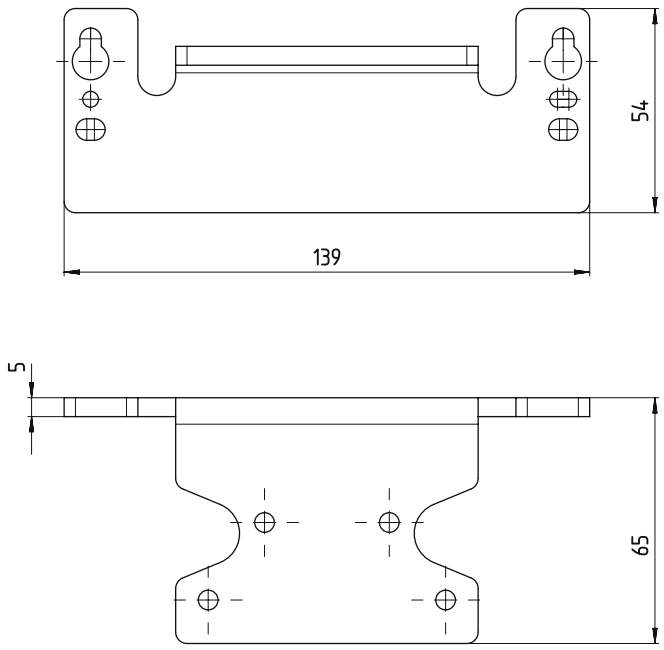
All dimensions in mm

Fig. 14.3: BT 500M mounting adapter



All dimensions in mm

Fig. 14.4: BTP 500M protective bracket



All dimensions in mm

Fig. 14.5: BTX 500M-BTU800M adapter plate

15 Order guide and accessories

Scope of delivery

- RSL 2xx safety laser scanner
- Document: RSL 200 user information
- Self-adhesive safety

15.1 Type overview

Tab. 15.1: Safety laser scanner

Part no.	Article	Description
53802107	RSL230-S/12-M12	1 OSSD pair, 32 field triples, 8 outputs, protective field range max. 3 m Control connection: M12, 12-pin Ethernet connection: M12, 4-pin
53802110	RSL235-S/12-M12	1 OSSD pair, 32 field triples, 8 outputs, protective field range max. 3 m Measurement data output for navigation Control connection: M12, 12-pin Ethernet connection: M12, 4-pin

Tab. 15.2: Spare parts

Part no.	Article	Description
50152639	RSL200-WIN	Optics cover
50152640	RSL200-CONFIG	Configuration memory

15.2 Accessories – connection technology

Tab. 15.3: Connection cables

Part no.	Article	Description
50130281	KD S-M12-CA-P1-020	M12 connection cable, axial, 12-pin, A-coded, 2 m
50130282	KD S-M12-CA-P1-050	M12 connection cable, axial, 12-pin, A-coded, 5 m
50130283	KD S-M12-CA-P1-100	M12 connection cable, axial, 12-pin, A-coded, 10 m
50149620	KD S-M12-CA-P1-150	M12 connection cable, axial, 12-pin, A-coded, 15 m
50149621	KD S-M12-CA-P1-250	M12 connection cable, axial, 12-pin, A-coded, 25 m

Tab. 15.4: Interconnection cables

Part no.	Article	Description
50130632	KSS ET-M12-4A-RJ45-A-P7-010	Interconnection cable RJ45, 1 m
50135080	KSS ET-M12-4A-RJ45-A-P7-020	Interconnection cable RJ45, 2 m
50135081	KSS ET-M12-4A-RJ45-A-P7-050	Interconnection cable RJ45, 5 m
50135082	KSS ET-M12-4A-RJ45-A-P7-100	Interconnection cable RJ45, 10 m
50135083	KSS ET-M12-4A-RJ45-A-P7-150	Interconnection cable RJ45, 15 m
50135084	KSS ET-M12-4A-RJ45-A-P7-300	Interconnection cable RJ45, 30 m
50151103	KSS US-USB2-A-USB2-C-V1-020	USB 2.0 A - USB 2.0 C connection cable, 2 m

15.3 Accessories - mounting technology

Tab. 15.5: Mounting technology

Part no.	Article	Description
50152257	BTU 500M set	Mounting system Laser scanner for vertical and horizontal alignment incl. mounting adapter
50152258	BT 500M	Mounting adapter
50152259	BTP 500M	Loop guard
50152260	BTX 500M-BTU800M	Adapter plate to BTU800M
50152261	BTU 500M	Laser scanner mounting system for vertical and horizontal alignment

15.4 Other accessories

Tab. 15.6: Specimen

Part no.	Article	Description
50145020	RSL400 test rod 50	Specimen Ø50 mm
50145022	RSL400 test rod 70	Specimen Ø70 mm

16 Standards and legal regulations

In particular, the current version of the following national and international legal regulations apply for commissioning, technical tests and handling of safety sensors:

- Machinery directive 2006/42/EC
- Low voltage directive 2014/35/EU
- EMC directive 2014/30/EU
- Use of work equipment directive
- Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment
- OSHA 1910 Subpart O
- Vibration IEC/EN 60068-2-6
- Eye safety (measurement laser) IEC/EN 60825-1
- Safety regulations
- Accident-prevention regulations and safety rules
- Ordinance on Industrial Safety and Health and employment protection act
- Product Safety Law (ProdSG)
- Standards for risk assessment, e.g. g,
  - EN ISO 12100
  - EN ISO 13849-1, -2
  - IEC/EN 61508-1 to -7
  - EN IEC 62061
  - IEC/EN 60204-1
- EN ISO 13849-1
- EN ISO 13855
- EN IEC 61496-3
- EN ISO 3691-4
- EN IEC 62046

16.1 Radio approvals

- Contains FCC ID: A8TBM78ABCDEFGH
  This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
  - This device may not cause harmful interference.
  - This device must accept any interference received, including interference that may cause undesired operation.

Responsible Party – U.S. Contact Information

Leuze electronic, Inc.

2510 Northmont Parkway, Suite N

Duluth, GA 30096

Phone: +1 470 508-3600

E-mail: info.us@leuze.com

16.2 IT security

This chapter provides information on the safe operation of a safety laser scanner of the RSL 200 series with regard to IT security. It covers various aspects, including recommendations for system configuration, as well as instructions and support for avoiding system vulnerabilities.

Changing the default passwords

- Change the safety laser scanner's default passwords for the authorization levels *Expert* and *Engineer* when the safety sensor is first put into operation.

Further information on changing passwords can be found in see chapter 8.1.11 "SETTINGS".

Deactivate Bluetooth

- Deactivate the safety sensor's Bluetooth interface if it is not used regularly (e.g. to connect the safety sensor to the Sensor Studio configuration and diagnostics software or the RSL 200 app).

Physical access control

The operator must ensure that physical access to the safety sensor is restricted to authorized persons.

Network segmentation

The operator's network should be segmented into different zones. Each environment has its own subnet and internal communication is only allowed based on a predefined allow list based network policy.

Zones according to IEC 62443

Systems are segmented into homogeneous zones by grouping the assets (logical or physical) with common security requirements. The security requirements are defined by Security Level (SL). The level required for a zone is determined by the risk analysis.

Zones have boundaries that separate the elements within the zone from the elements of other zones. Information moves within and between zones. Zones can be divided into subzones, which define different security levels (security levels) and thus enable defense in depth.

Conduits group the elements that enable communication between two zones. They provide security functions that enable secure communication and allow zones with different security levels to coexist.

Mobile device management

An update strategy for mobile devices, e.g. smartphones and tablets (iOS and Android) that are connected to the safety sensor via Bluetooth, is required. Always keep mobile devices up to date with the latest software version.

The Leuze RSL 200 app must not be installed on a rooted device. A rooted device (Android or iOS smartphone/tablet) has been unlocked to adjust settings or install unapproved apps. Like jailbreaking an iPhone, rooting a device can pose a security risk if pirated apps containing malware are uploaded.

Employees must report lost or stolen devices to management immediately. IT staff can remotely lock or wipe missing devices to ensure system security.

Public USB ports are known to be a method of distributing malware and must not be used either. Since data can easily be stored online or in the cloud, you should consider banning USB use altogether for maximum security.

Computer and software management

- Only install Leuze software on PCs managed by IT.

Avoid public Wi-Fi and USB ports!

Public Wi-Fi carries security risks and should be avoided for business purposes. Unsecured networks are frequent gateways for malware that can endanger devices and access company data.

Public USB ports are known to be used to distribute malware and should also be prohibited. Since data can easily be stored online or in the cloud, you should consider banning USB use altogether for maximum security.

Use passwords

Using lock screen passwords and strong passwords is an easy first step to increasing the security of devices.

Use antivirus software

Antivirus software is an indispensable tool in the fight against cybercrime.

- Use antivirus software to scan data and drives for viruses.
- Protect removable devices from infection with antivirus software.

Force updates

- Keep all software up to date with effective patch management. If software updates are not implemented, you endanger the stability of your software environment. Experienced hackers are familiar with system vulnerabilities and unpatched software makes it easy for them to penetrate your network.

17 Declaration of Conformity

The RSL 200 series safety laser scanners have been developed and manufactured in accordance with applicable European standards and directives.

	NOTICE
	You can download the EC Declaration of Conformity from the Leuze website. ↳ Call up the Leuze website: *www.leuze.com*. ↳ Enter the type designation or part number of the device as the search term. The article number can be found on the name plate of the device under the entry “Part. No.”. ↳ The documents can be found on the product page for the device under the *Downloads* tab.