Leuze

Original operating instructions

RSL 420P

Safety Laser Scanner with PROFIsafe Interface



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:

Purpose and target group of the document	Document/software title	Source
Software for users of the machine [a] for safety sensor diagnostics if a fault occurs and for machine design engineers for configuring the safety sensor	Sensor Studio DTM RSL 400	Supplied with the safety sensor on data carrier
Notes for the machine design engineer [a]	"Safe implementation and operation" (this document)	PDF, supplied with the safety sensor on data carrier
Notes for the machine design engineer [a] for configuring the safety sensor (software instructions)	Online help for software	Supplied with the safety sensor on data carrier
Notices regarding mounting, alignment and connection of the safety sensor	"Quick Start Guide RSL 400"	Print document, supplied with the safety sensor

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

1.2 Downloading configuration software from the Internet

- Call up the Leuze home page: **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. 1.1: 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. 1.2: 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. 1.3: Terms and abbreviations

CS	Switching signal from a control (**C**ontroller **S**ignal)
DAP	**D**evice **A**ccess **P**oint
DTM	Software device manager of the safety sensor (**D**evice **T**ype **M**anager)
FDT	Software frame for management of device managers (DTM) (**F**ield **D**evice **T**ool)
Field pair	A protective field with an associated warning field
AGV	**A**utomated **G**uided **V**ehicle
GSDML	Description file of the RSL400 PROFIsafe for integration in the control **G**eneric **S**tation **D**escription **M**arkup **L**anguage
LED	LED, display element in the safety sensor (**L**ight **E**mitting **D**iode)
OSSD	Safety switching signal or safety-related switching output (**O**utput **S**ignal **S**witching **D**evice)
PFH_d	Probability of a dangerous failure per hour (**P**robability of dangerous **F**ailure per **H**our)
PL	**P**erformance **L**evel
Quad	Two field pairs (four fields) that are monitored simultaneously in four field mode
TSS	**T**ransverse **S**ide-tracking **S**kate
RES	Start/restart interlock (Start/**RES**tart interlock)
SIL	**S**afety **I**ntegrity **L**evel
State	ON: device intact, safety-related switching signals switched on OFF: device intact, safety-related switching signals switched off Locking: device, connection or actuation/operation faulty, safety-related switching signals switched off (lock-out)

1.4 Checklists

The checklists serve as a reference for the machine manufacturer or supplier (see chapter 12 "Testing"). They replace neither testing of the complete machine or system prior to the initial start-up nor their periodic testing by a competent person. 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 61508, EN IEC 62061). The result of the risk assessment determines the required safety level of the safety sensor (see chapter 16.1 "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
- Use of Work Equipment 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 may only be used after it has been selected in accordance with the respectively applicable instructions and relevant standards, rules and regulations regarding labor protection and safety at work, and after it has been installed on the machine, connected, commissioned, and checked by a competent person (see chapter 2.3 "Competent persons").
- When selecting the safety sensor it must be ensured that its safety-related capability meets or exceeds the required Performance Level PL_r ascertained in the risk assessment (see chapter 16.1 "Safety-relevant technical data").
- The safety sensor may only be used in North America in applications that satisfy the requirements specified by NFPA 79.
- With the “access guarding” function, the safety sensor detects persons only when they enter the danger zone but cannot tell whether there are any persons inside the danger zone. For this reason, a start/restart interlock in the safety chain is essential in this case.
- 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 16.1 "Safety-relevant technical data").
- The safety sensor must be exchanged after a maximum of 20 years. Repairs or the exchange of wear parts do not extend the mission time.

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 Vapors, smoke, dust, 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.
- They perform a task related to the subject matter shortly thereafter and keep their knowledge up to date through continuous further training.

Certified electricians

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.

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 12 "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/EN 60825-1:2014 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.
  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
- Imparting all relevant information to the operating company
- Adhering to all regulations and directives for the safe commissioning of the machine

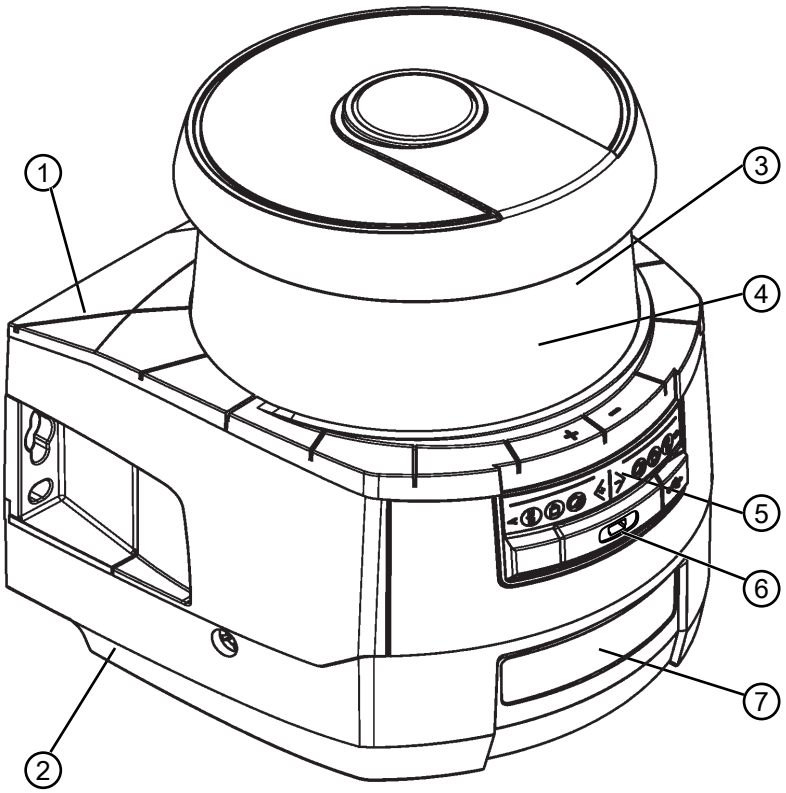
The operator of the machine is responsible for:

- Instructing the operator
- Maintaining the safe operation of the machine
- Adhering to all regulations and directives for labor protection and safety at work
- Regular testing by competent persons

3 Device description

The safety sensors from the RSL 400 series are optoelectronic, two-dimensional measuring safety laser scanners. They satisfy the following standards:

	RSL 400
Type in accordance with IEC 61496	3
Category in accordance with ISO 13849	3
Safety Integrity Level (SIL) in accordance with IEC 61508	2
SILCL in accordance with IEC 62061	2
Performance Level (PL) in accordance with ISO 13849-1	d



1 Scanner unit
2 Connection unit PROFINET (CU400P-3M12)
3 Optics cover
4 Alphanumerical display (displayed)
5 RSL 400 LED indicators
6 Mini-B USB connection (behind protective cap)
7 RSL 400 PROFINET LED indicators

Fig. 3.1: Device overview of RSL 400 safety laser scanners with PROFIsafe interface

All safety sensors of the RSL 420P series are equipped as follows:

- Laser scanner with the range class **S**, **M**, **L** or **XL**:

Operating range class	Operating range [m]
S	3.00
M	4.5
L	6.25
XL	8.25

  - 24-digit alphanumerical display
  - Integrated electronic spirit level for aligning the safety sensor
  - LED indicator
  - USB interface

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.

- Connection unit:
  - Configuration memory
  - Ethernet connection for communication and configuration with the PC/laptop

3.1 Device overview

The following table provides an overview of the possible uses, features and functions of the RSL 400 safety sensors with PROFIsafe interface.

Tab. 3.1: Device overview

	RSL 420P	RSL 450P RSL 455P
Stationary danger zone guarding	x	x
Mobile danger zone guarding	x	x
Point of operation guarding	x	x
Safe output signals	1 bit	4 bit
Additional output signals	See description of the process data	
Number of changeover-capable protective/warning field pairs	10	100
Four field mode (quads)	-	x
Measurement data output optimized for vehicle navigation	-	Only RSL 455P
USB interface	x	x

3.1.1 Protective function of RSL 400 safety sensors

The safety sensor transmits periodic light pulses via a rotating deflection unit. 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 when they are wearing very dark clothes, which have a very weak diffuse reflectance.

3.1.2 Device and monitoring functions

- Monitoring and release of field pair changeover

3.2 USB connection

The safety sensor features a Mini-B type USB socket as a service interface for configuration and diagnosis. This interface can be used with a device firmware version V4.5 and higher.

	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.

	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 Connection units

The safety sensor is mounted, connected and aligned using the connection unit.

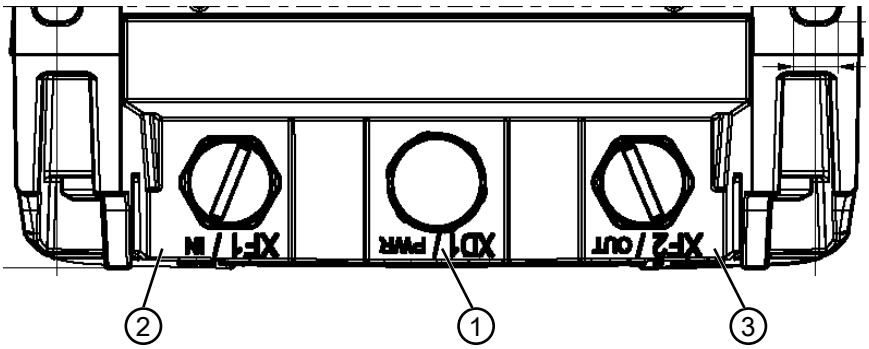
Functions of connection unit:

- Attachment point for mounting, either directly or using an optional mounting system.
  When devices are swapped out, the connection unit remains mounted and aligned.
- EMC wiring for signal inputs/outputs and supply using connection cable
- Connector bushing and EMC for the Ethernet TCP/IP communication and configuration interface to the PC/laptop
- Memory for the configuration files and automatic parameter transfer in the event of device swap-out
- Quick-release connection to the scanner unit for easy device swap-out (see "Quick Start Guide RSL 400").

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

Connection unit CU400P-3M12

- Three connections with M12 connectors / sockets

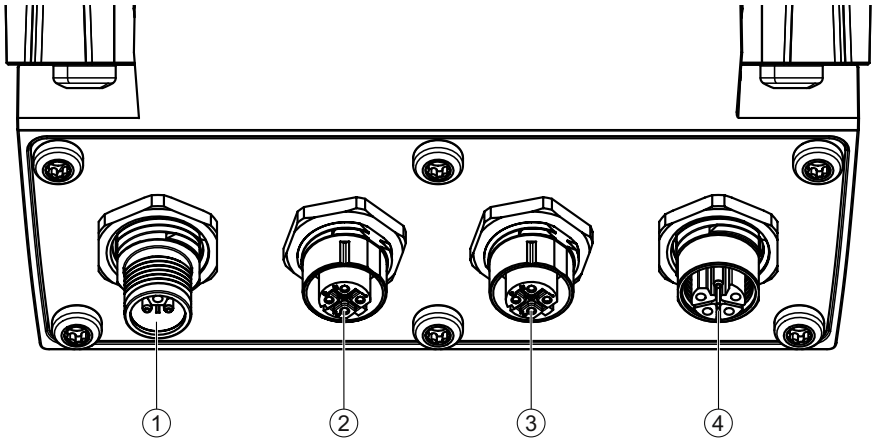


1 M12 connector, A-coded, voltage supply, I/O signal RSL
2 M12 socket, D-coded, PROFINET/PROFIsafe communication, input
3 M12 socket, D-coded, PROFINET/PROFIsafe communication, output

Fig. 3.2: Device with connection unit CU400P-3M12

Connection unit CU400P-4M12

- Four connections with M12 connectors / sockets for power and communication

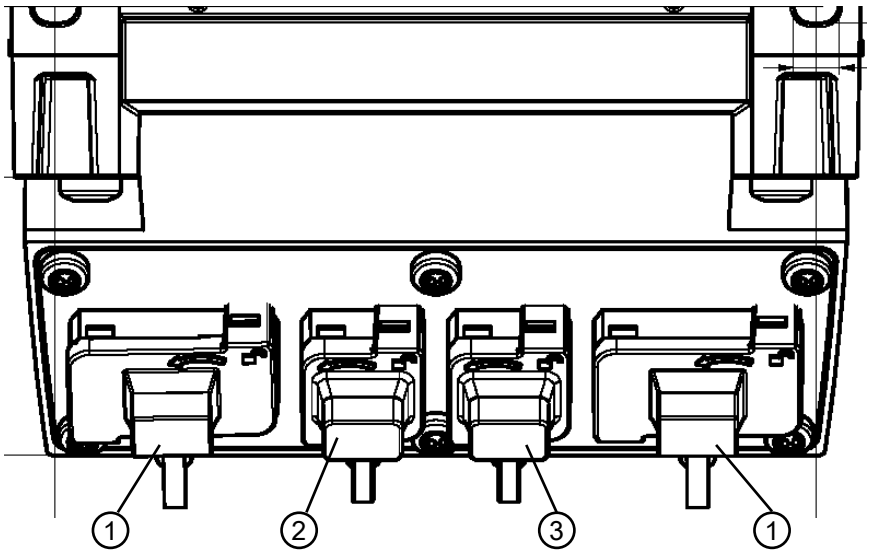


1 M12 connector, L-coded, voltage supply
2 M12 socket, D-coded, PROFINET/PROFIsafe communication, input
3 M12 socket, D-coded, PROFINET/PROFIsafe communication, output
4 M12 socket, L-coded, voltage supply

Fig. 3.3: Device with connection unit CU400P-4M12

Connection unit CU400P-AIDA

- Four push/pull connectors for power and communication
- PROFINET/PROFIsafe connection via copper cable

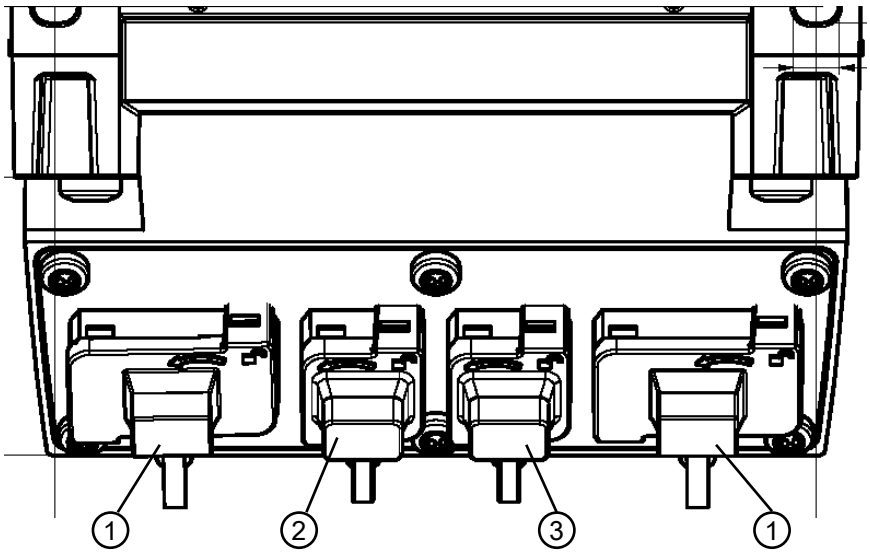


1 AIDA sockets, PROFINET, push-pull, 5-pin, voltage supply
2 AIDA socket, PROFINET, RJ45 push-pull, 8-pin, Ethernet, input
3 AIDA socket, PROFINET, RJ45 push-pull, 8-pin, Ethernet, output

Fig. 3.4: Device with connection unit CU400P-AIDA

Connection unit CU400P-AIDA-OF

- Four push/pull connectors for power and communication
- PROFINET/PROFIsafe connection via fiber optics



1 AIDA sockets, PROFINET, push-pull, 5-pin, voltage supply via copper cable
2 AIDA socket, PROFINET, SCRJ push-pull, 2-pin, PROFINET/PROFIsafe communication via fiber-optic cable, input
3 AIDA socket, PROFINET, SCRJ push-pull, 2-pin, PROFINET/PROFIsafe communication via fiber-optic cable, output

Fig. 3.5: Device with connection unit CU400P-AIDA-OF

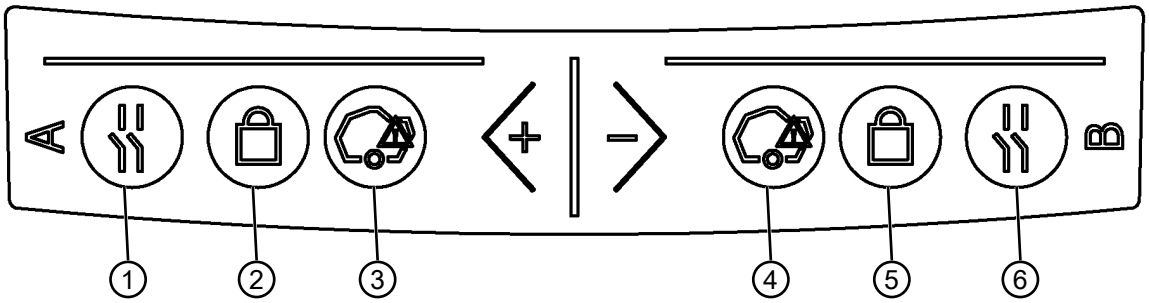
3.4 Display elements

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

3.4.1 RSL 400 LED indicator

Located on the connection unit are the LEDs for displaying the operating state.

- Protective function A: LEDs 1, 2, 3



1 LED 1, red/green
2 LED 2, yellow
3 LED 3, blue
4 LED 4, blue
5 LED 5, yellow
6 No function

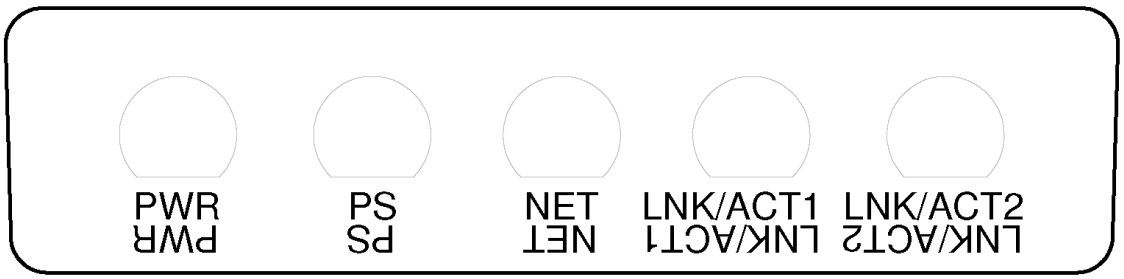
Fig. 3.6: LED indicators

Tab. 3.2: Meaning of the LEDs

LED	Color	State	Description
1	Red/green	OFF	Device switched off
		Red	Safety signal off
		Red, flashing	Error
		Green	Safety signal on
2	Yellow	OFF	RES deactivated RES activated and enabled
		Flashing	Protective field occupied
		ON	RES activated and blocked but ready to be unlocked Protective field free and linked sensor enabled (if applicable)
3	Blue	OFF	Free warning field
		ON	Warning field interrupted
4	Blue	OFF	Four field mode: warning field 3 free
		ON	Four field mode: warning field 3 interrupted
5	Yellow	Flashing	Four field mode: warning field 2 interrupted

3.4.2 LED indicator of PROFINET connection unit

The PROFINET connection units are equipped with an additional LED indicator for displaying the PROFINET/PROFIsafe communication status.



PWR	Power LED, green/red
PS	PROFIsafe LED, green/red
NET	NET LED, green/red/orange
LNK/ACT1 LNK/ACT2	Link LEDs, green/orange

Fig. 3.7: LED indicators of PROFINET connection units

Tab. 3.3: Meaning of the LEDs

LED	Color	State	Description
PWR	Green/red		Supply voltage of the PROFINET connection unit
		OFF	Device not supplied with power or switched off
		Red	Error during self test or internal communication problems
		Green, flashing	PROFINET wave function active
		Green, continuous light	Device switched on, supply voltage applied, no internal error
PS	Green/red		PROFIsafe LED
		OFF	PROFIsafe communication not initialized or switched off
		Green, flashing	Device in passive state or PROFINET wave function active
		Green, continuous light	Device on PROFIsafe active
		Red, flashing	PROFIsafe configuration failed
		Red, continuous light	PROFIsafe communication error

LED	Color	State	Description
NET	Red/green/ orange		Ethernet communication
		OFF	PROFINET communication not initialized or inactive
		Green, flashing	PROFINET bus initialization or PROFINET wave function active
		Green, continuous light	PROFINET active, data exchange with IO controller active
		Orange, flashing	Ethernet topology error
		Red, flashing	Ethernet configuration failed, no data exchange or exchange of invalid data
		Red, continuous light	Bus error, no communication
LNK/ACT1 LNK/ACT2	Green/orange		Ethernet link
		OFF	No Ethernet link present
		Green, continuous light	Ethernet link active, no current data transmission
		Green / orange, flashing	Ethernet link active, current data transmission

3.4.3 Alphanumerical display

In normal operation, the 24-digit alphanumerical display of the safety sensor shows the monitored protective and warning field pairs. It also provides assistance during detailed error diagnostics (see chapter 13 "Diagnosis and troubleshooting").

Tab. 3.4: Alphanumerical displays

Display	Description	Example
Upon startup without configuration/upon initial commissioning		
Sensor type	Sensor type	420P-M
Software version	Software version of the device	V5.1
Sensor serial number	Sensor serial number	SN: 21513123456
Sensor name / Network name	Name of the sensor / network	A123456789
IP: DHCP/FIX	DHCP or permanent IP address	IP: DHCP IP: 10.25.45.2
Bluetooth on/off	Bluetooth detection ON/OFF	Bluetooth ON

Display	Description	Example
Configuration necessary	Configuration required	CONFIG REQUESTED
Repeated until end of booting phase / start phase, then		
Spirit level permanent	Horizontal alignment in degrees: H Vertical alignment in degrees: V	H -3° V +9°
Upon startup with configuration		
Sensor type	Sensor type	450P-XL
Software version	Software version of the device	V5.1
Sensor serial number	Sensor serial number	SN: 21513123456
Sensor name / Network name	Name of the sensor / network	A123456789
IP: DHCP/FIX	DHCP or permanent IP address	IP: DHCP IP: 10.25.45.2
Bluetooth on/off	Bluetooth detection ON/OFF	Bluetooth ON
Date of configuration	Date of configuration	11/13/2014 08:15
Signature	Signature of configuration	DG45L8ZU
Level	Horizontal alignment in degrees: H Vertical alignment in degrees: V	H-3° V+9°
Repeated until end of booting phase / start phase, then		
Display following configuration of normal operation e.g. display of active field pair		A1.1
Transfer of the configuration data		
AWAITING CONFIG	Until downloading of configuration data is confirmed	
DOWNLOAD CONFIG	During transfer of configuration data	
Level		
H +/- ..° V +/- .. °	Horizontal alignment in degrees: H Vertical alignment in degrees: V	H -3° V +9°
Sensor detection		
PING received	Display for identification by device name	PING received *Device name*
Message		
	Message via a signal output or diagnosis ID	ProtF A: E123 Device: P007 - wrong Config
Error diagnostics		
F…	**F**ailure, internal device error	
E…	**E**rror, external error	
U…	**U**sage info, application error	
I…	**I**nformation	
P…	**P**arameter, inconsistency in the configuration	

For error diagnostics, the error's respective letter is displayed first followed by the number code. An AutoReset is carried out after 10 seconds for errors that do not cause locking, with an unauthorized restart being impossible. In the case of blocking errors, the voltage supply must be separated and the cause of the error must be eliminated. Before switching on again, the steps taken before initial commissioning must be repeated (see chapter 10 "Starting up the device").

When the protective field has been free for about 5 seconds, the device switches back to the display in normal operation.

Displays in normal operation

The display in normal operation depends on the operating state of the safety sensor. The display can be switched off or rotated by 180° by means of the software.

Output of texts on the alphanumerical display

The control can display any text on the alphanumerical display of the safety sensor.

The text can contain up to 32 ASCII characters and is displayed as scrolling text for approx. 40 s.
Listed in the character set table are the characters that can be displayed.

Text is output on the alphanumerical display with an acyclic write command of the control on slot 0 or slot 1, subslot 1, index 70DD.

Tab. 3.5: Character set for alphanumerical display

!	“	#	$	%	&	‘	(	)	*	+	,	-	.	/	
0	1	2	3	4	5	6	7	8	9	:	°	<	=	>	?
@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
´	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	

3.4.4 Field-of-view display

The upper and lower limit of the safety sensor's field of view can be displayed by means of horizontal lines on the optics cover.

↳ Make sure that the safety sensor's field of view is always completely unobstructed.

	NOTICE
	**Always check the protective field configuration!** ↳ Check all defined protective fields each time the configuration is changed. The field-of-view display is a comfort function and is not intended as a substitute for checking the protective field configuration. ↳ The safety sensor's field of view must be completely unobstructed on the application side.

3.5 Mounting system (optional)

Mounting systems and mounting brackets simplify mounting and alignment of the safety sensor. Mounting systems and mounting brackets are available as accessories (see chapter 18 "Order guide and accessories").

3.6 Loop guard (optional)

The loop guard for the optics cover prevents damage to the safety sensor caused by light contact with foreign objects. The loop guard is available as an accessory (see chapter 18 "Order guide and accessories").

4 Configuration and diagnostic 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.

	NOTICE
	Only use the software for safety sensors manufactured by **Leuze.**

4.1 System requirements

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

Hard disk space	At least 250 MB free memory If you want to save the protective field or configuration values, you will need more memory.
Screen display	Color
External drive	DVD drive
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 7 or higher

	NOTICE
	Only the term "PC" is used below.

4.2 Installing software

Prerequisites:

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

	NOTICE
	The software is installed in two steps: ↳ Installing the *Sensor Studio* FDT frame. ↳ Installing *LeSafetyCollection* device manager (DTM).

Installing the Sensor Studio software

NOTICE
If FDT frame software is already installed on your PC, you do not need the *Sensor Studio* installation. You can install the device manager (DTM) in the existing FDT frame.

- Insert the data carrier.
- ⇨ The installation will start automatically.
- If installation does not start automatically, double-click the file *SensorStudioSetup.exe*.
- If you want to call up the menu of the CD, double-click the file *start.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 and places a shortcut on the desktop ( ).
- Click the [Finish] button to complete installation.

Installing *LeSafetyCollection* device manager (DTM)

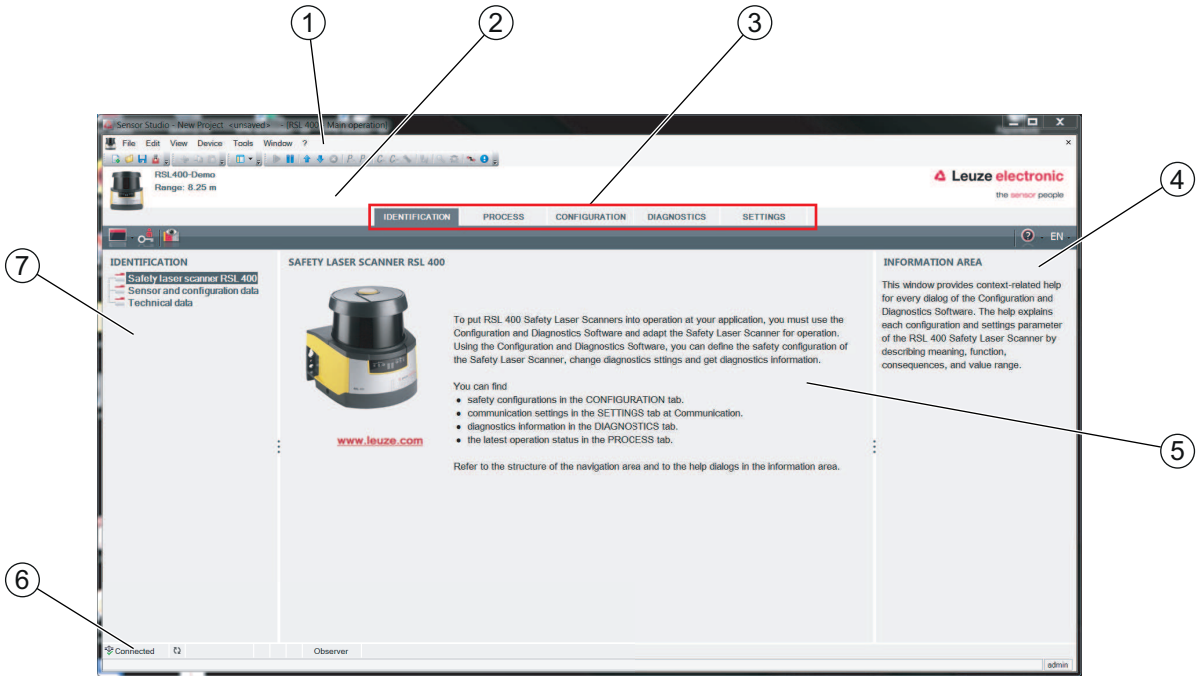
Prerequisites:

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

- 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 400 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 4.5.1 "Selecting access level").

4.3 User interface



1 FDT frame menu with toolbar
2 RSL 400 device manager (DTM)
3 Navigation tabs
4 Information area
5 Dialog box
6 Status line
7 Navigation area

Fig. 4.1: User interface of the software

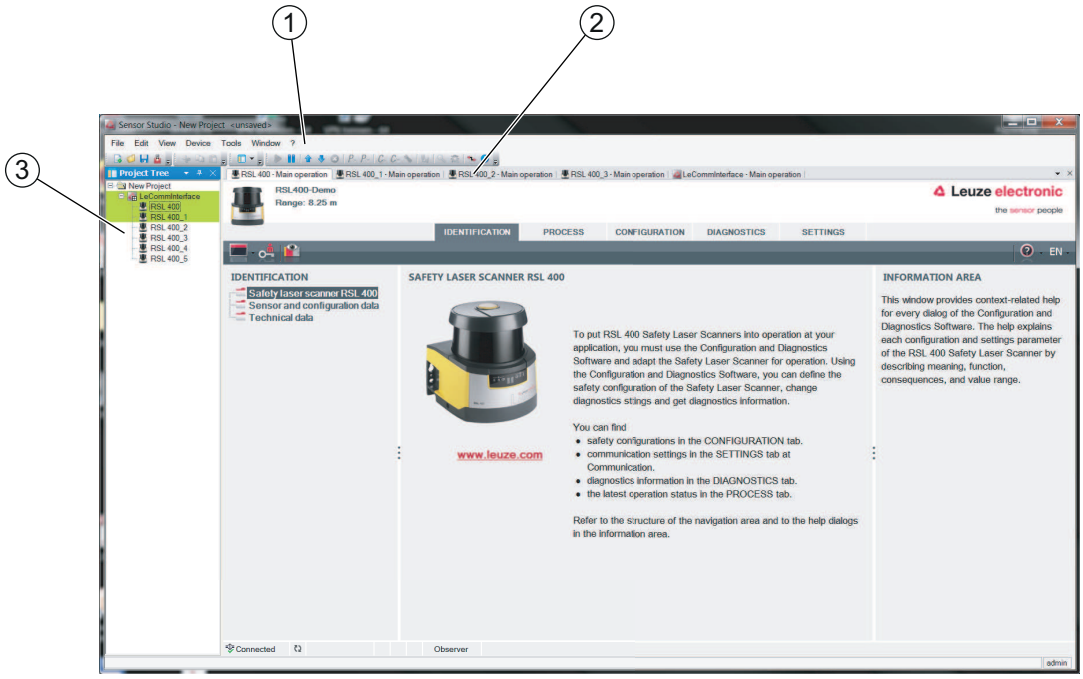
FDT frame menu

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. 4.2: 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: AGV with safety sensors on front and rear side

4.4 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 [?].

4.4.1 Project wizard

Using the Project Wizard you can create and change configuration projects for setting up the safety sensor (see chapter 4.5 "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**.

4.4.2 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**.

4.4.3 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 permissions and access levels (see chapter 5.1 "Authorization concept of safety sensor").

↳ In the FDT frame menu, click **Tools > User management > Create user**.

Logging users in/out

Prerequisites:

- Users have been created

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

Managing passwords

Prerequisites:

- Users have been created

↳ In the FDT frame menu, click **Tools > Change password**.

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 400 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.

4.4.4 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 ( ).

4.5 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 400 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 4.5.1 "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 ( ).

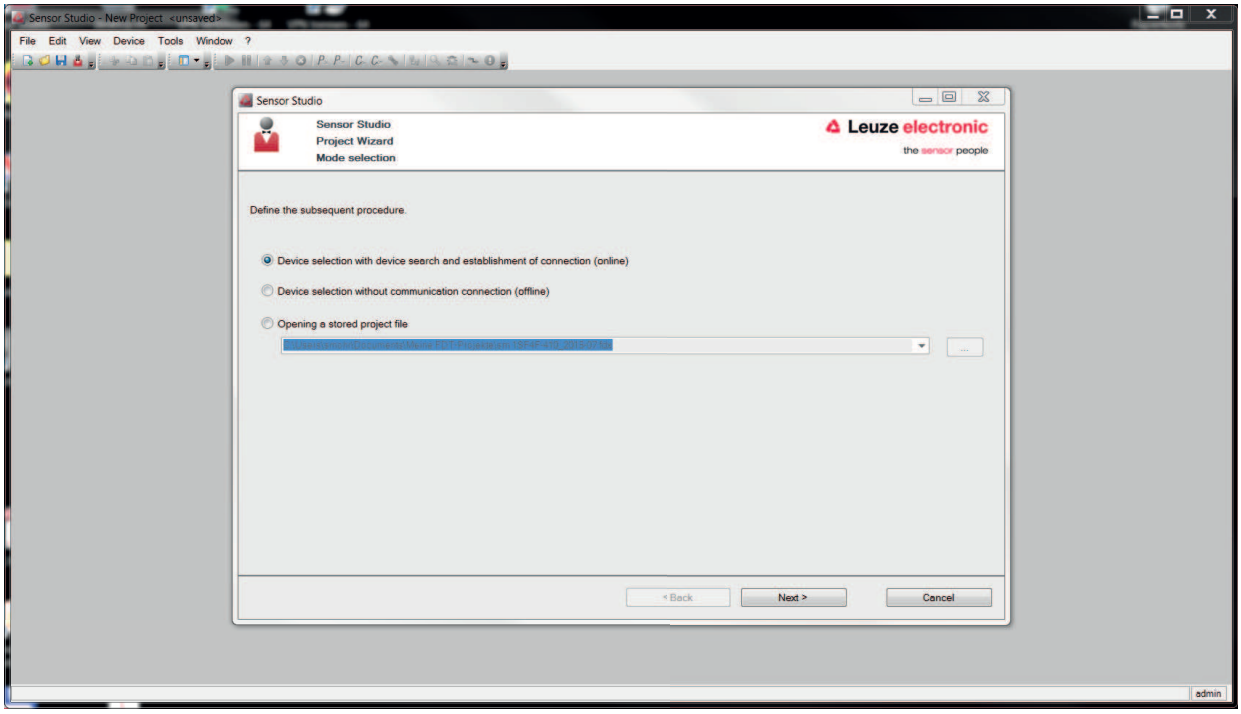


Fig. 4.3: Project wizard

↳ 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

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

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

NOTICE
RSL 400 PROFIsafe devices cannot be integrated in a configuration project using the integrated search function of the communication DTM.

↳ Define the IP address of the PROFIsafe device using a different tool (e.g. *PRONETA* from Siemens).

↳ Enter the IP address directly in the device manager (DTM) of the RSL 400P (1).

↳ Click on the [Establish connection with device] button (2).

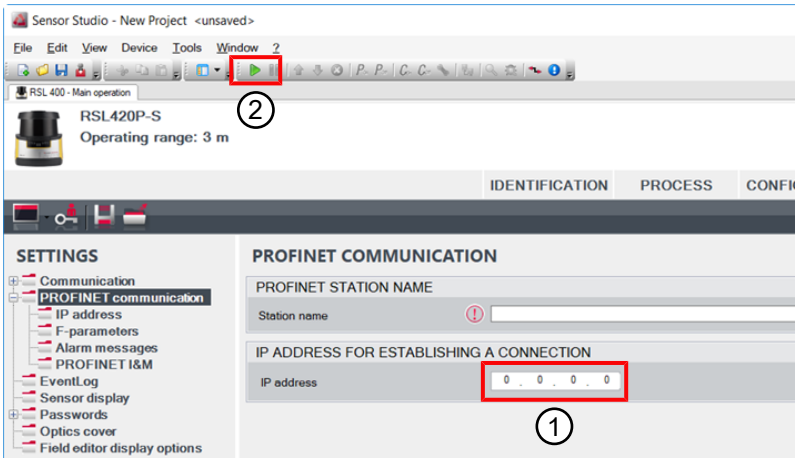


Fig. 4.4: Device manager (DTM) – IP address

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

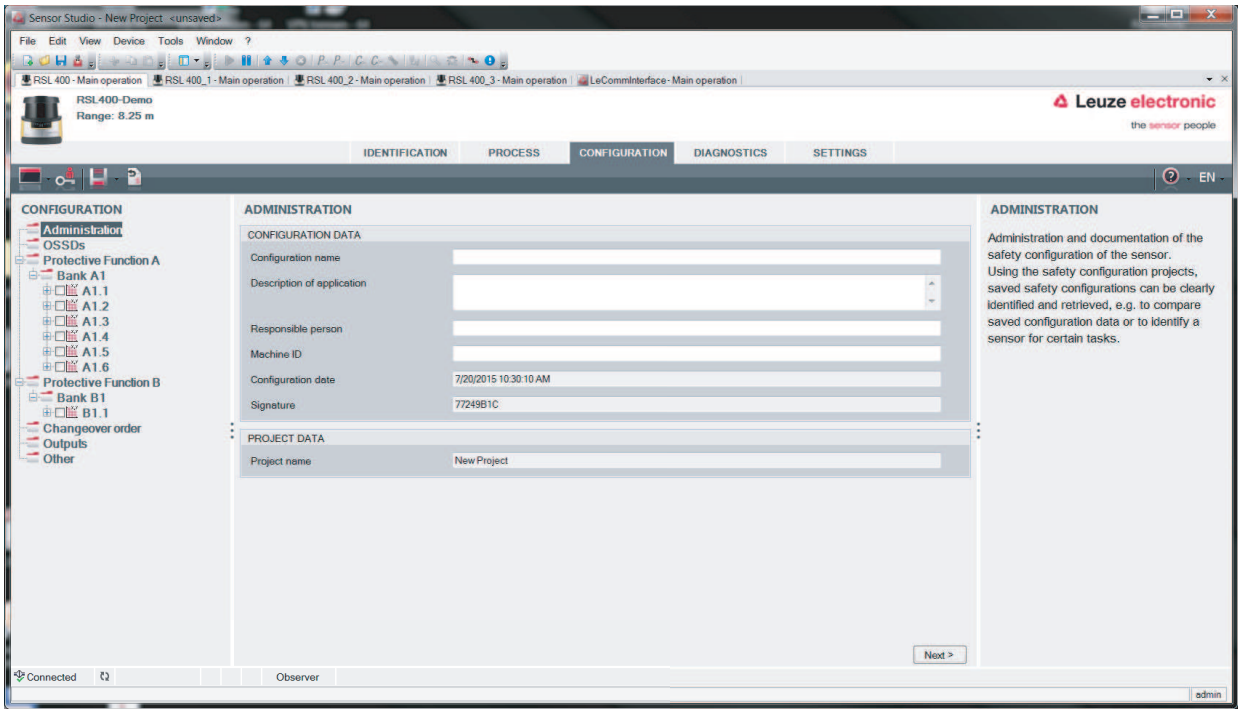


Fig. 4.5: Initial screen for safety configuration

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 access levels (see chapter 4.5.1 "Selecting access level").

Setting 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 [?].

4.5.1 Selecting access level

Using the device manager you can change the access level of the user if necessary.
For the authorization concept of the software, see chapter see chapter 5.1 "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].

4.5.2 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 400 safety laser scanner
- Sensor and configuration data
- Technical data

4.5.3 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
  - SENSOR DATA
- PROFINET connection unit
  - LED INDICATOR
  - DIAGNOSIS
- Measurement contour
- Inputs / outputs
  - SENSOR DISPLAY
  - CONNECTIONS AND SIGNALS
- Simulation – only with access level *Engineer*
  - Measurement contour
  - Inputs / outputs

4.5.4 CONFIGURATION

see chapter 9 "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*.

4.5.5 DIAGNOSIS

Adjustment / Alignment

Display of safety sensor alignment using the integrated electronic spirit level

Prerequisites: The software and safety sensor are connected.

↳ In the **DIAGNOSIS** menu, click the [Align sensor mechanically] button ( ).

⇨ The safety sensor display shows the horizontal and vertical alignment in degrees.

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] button ( ).

⇨ In the display of the safety sensor connected to the device manager (DTM), the message "PING received" flashes for ten seconds.

Reset sensor

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 15 "Service and support").

Sensor display

Device display in the DTM menu

- SENSOR DISPLAY
- STATE OF THE ACTIVE PROTECTIVE AND WARNING FIELDS
- SENSOR DATA

Diagnostics list

Access list

EventLog

4.5.6 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

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

PROFINET communication

Set parameters for PROFINET/PROFIsafe communication.

- IP address

  Display of the IP connection settings
- F-parameters

  Define PROFIsafe address
- Alarm messages

  The safety sensor can make alarms available for diagnostic purposes.
  - Alarms are output acyclically.
  - If the safety sensor detects an error, it passes this on to the PROFIsafe controller as an alarm.
  - The signaling of an alarm takes place as acyclic communication.

  Both PROFINET-specific as well as device-specific alarms are realized in the safety sensor. Each alarm can be selected and deselected individually.

  Alarm-specific help texts support the user in rectifying the causes of alarms.
  - The alarm-specific help texts are stored in the GSDML file of the device.
  - The alarm-specific help text can be displayed on or read out by the PROFIsafe controller.

NOTICE	
	For safety sensors with PROFIsafe interface, the alarm messages, with the exception of the PROFIsafe-specific alarms, are activated by default. ↳ If necessary, you can activate the alarms individually via the *Sensor Studio* configuration software.

- PROFINET I&M

  PROFINET function for the unique identification of the safety sensor.

EventLog

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

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 [?].

The EventLog data recorder is activated in a different manner with PROFIsafe devices, depending on the selected PROFINET module structure (see chapter 11.5 "PROFINET project modules"):

- Project modules [M1] … [M8]:
  starting/stopping of the data recorder is set via the PROFIsafe configuration (see chapter 11.5.3 "Module [M1] - SAFE_SIGNAL") or via an acyclic command.
- Project modules [M11] … [M17]:
  starting/stopping of the data recorder is set via an acyclic command.

Acyclic command for activating/deactivating the event log:

- Slot: 1
- SubSlot: 0
- Index 70DE
- Data:
  1 byte
  1: activate event log
  0: deactivate event log

Sensor display

Activation of the safety sensor alphanumerical display.

Information on the display options 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 15 "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

Field editor display options

Display settings for the field editor when defining protective/warning fields.

- CONTOUR ALIGNMENT
- INSTALLATION POSITION
- COORDINATE DISPLAY
- EDITOR BEHAVIOR

Information on the display options 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 [?].

5 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 with the help of the configuration and diagnostics software (see chapter 9 "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.
- The changeover-capable protective/warning field pairs for the selected function mode are defined in configuration banks.
- 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.

5.1 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 on user management (see chapter 4 "Configuration and diagnostic 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. 5.1: 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 • Display diagnostics list • 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 • Set reference contour in protective field • 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 (see chapter 4.5.1 "Selecting access level").

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

5.2 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.

You select the function mode of the safety sensor in the software device manager (DTM) with **CONFIGURATION > Device function** (see chapter 9 "Configuring the safety sensor").

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

The changeover-capable protective and warning field pairs for the selected function mode are defined in the configuration banks, e.g. **CONFIGURATION > Protective function A > Bank A1**.

Overview of the function modes

Tab. 5.2: Function modes

Function mode	Field pairs (FP) Protective fields (PF) Warning fields (WF)	Field pair activation
One protective function	1 FP / 1 PF + 1 WF	Fixed selection of one field pair
	5 FP / 5 PF + 5 WF	Selection by signal input: • Overlapped monitoring
	10 FP / 10 PF + 10 WF	Selection by signal input: • Fixed changeover moment

5.2.1 One protective function

Ten changeover-capable field pairs for safety-related switching signals A_SAFE_xx_CLEAR. For the field pair changeover, see chapter 5.7 "Field pair changeover".

5.3 Selectable resolution for hand, leg and body 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. 5.3: Resolution of the safety sensor depending on the function

Safety sensor resolution [mm]	Function	Application(s)
30	Hand detection	Point of operation guarding
40	Arm detection	Point of operation guarding
50	Leg detection with the safety sensor mounted close to floor level	Danger zone safeguarding
60	• Leg detection with the safety sensor mounted at a height of 150 mm • Leg detection and detection of lying persons in the case of mounting on vehicles, mounting height approx. 200 mm	Stationary danger zone safeguarding Mobile danger zone safeguarding
70	• Leg detection with the safety sensor mounted at a height of 300 mm	Stationary danger zone safeguarding Mobile danger zone safeguarding
150	Body detection	Access guarding Mobile side guarding
Mounting height = Height of the scan level above floor level		

5.4 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.

5.5 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 together for all protective/warning field pairs of a configuration bank.

5.6 Configurable start-up behavior

The start-up behavior is selected in the configuration project together for all protective/warning field pairs of a configuration bank.

5.6.1 Automatic start/restart

The machine starts automatically as soon as the machine is switched on or the supply voltage returns and when the protective field is free 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.

5.6.2 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.

5.6.3 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 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 signals.

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.

5.7 Field pair changeover

The safety sensor has ten field pairs. Switchover between the field pairs is possible at all times, provided the operating situation allows this.

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 signals are switched off.

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

- **Fixed selection of one field pair**
- **Selection by signal inputs** with the changeover mode **Overlapped monitoring**
- **Selection by signal inputs** with the changeover mode **Fixed changeover moment**

Field pair activation and field pair changeover are configured via the protective function, e.g. **CONFIGURATION > Protective function A > MODE FOR FIELD PAIR ACTIVATION AND CHANGEOVER.**

The field pair changeover can be monitored by means of configurable measures (see chapter 5.8 "Monitoring of field pair changeover").

During the changeover process, the safety sensor monitors the field pair active before the field pair changeover, according to the configured changeover mode and changeover time.

Using field pair changeover

You can configure and switch over the field pairs according to the different requirements. The field pairs are changed over via the corresponding control inputs.

The rules for field pair changeover depend on the changeover mode and changeover 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 rules are not observed, the safety-related switching signals switch off and a message is displayed (see chapter 13 "Diagnosis and troubleshooting").

The following rules apply for the field pair changeover:

- The field pair changeover performed by the control system must agree with the safety sensor's configuration. This configuration is specified with the configuration and diagnostics software (see chapter 9.4 "Configuring protective function").
- With field pair changeover to an occupied protective field, the safety sensor only switches off the safety-related switching signals after the set response time plus a synchronization time of 40 ms.

NOTICE	
	**Take the lead time into consideration!** ↳ Take the lead time of the changeover time and response time into consideration before operating the machine in its new operating situation.

5.7.1 Fixed selection of one field pair

If **Fixed selection of one field pair** is set as the mode for field pair activation, field pair A1.1 is monitored irrespective of how the control inputs are connected.

5.7.2 Changeover of five field pairs in changeover mode Overlapped monitoring

Changeover mode **Overlapped monitoring**: This changeover mode is only permitted for up to five field pairs.

The field pair changeover must take place within a configurable time period of the changeover time. Two field pairs can be monitored simultaneously during the changeover time.

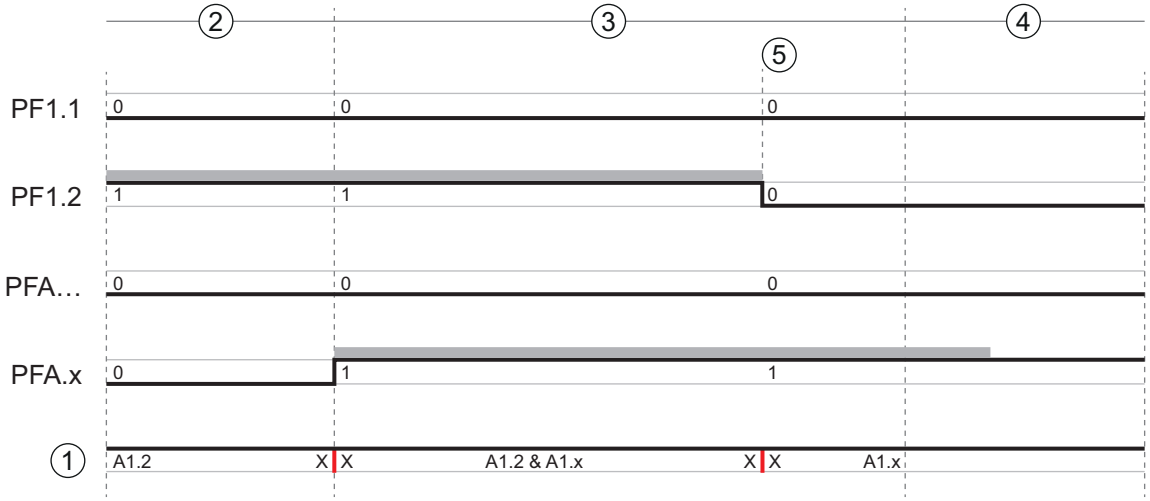
- First the control unit must switch to a new field pair before it switches off the previously active one.
- A maximum of two field pairs are active.

  Each field pair is then only active if it is selected by the control unit.
- The changeover time starts when the second field pair is connected. When the changeover time has expired, only one field pair should still be active.
- The changeover time is specified with the configuration and diagnostics software (see chapter 9.4.4 "Creating and configuring protective/warning field pairs").

Tab. 5.4: Connection of control inputs F1 to F5 with activation of field pairs A1.1 to A1.5 for protective function A

Field pair	Control input					Description
	F1	F2	F3	F4	F5	
A1.1	1	0	0	0	0	Field pair A1.1 is active
A1.2	0	1	0	0	0	Field pair A1.2 is active
A1.3	0	0	1	0	0	Field pair A1.3 is active
A1.4	0	0	0	1	0	Field pair A1.4 is active
A1.5	0	0	0	0	1	Field pair A1.5 is active

In the case of two protective functions, connection of control inputs F6 to F10 applies analogously for activation of field pairs B1.1 to B1.5 for protective function B.



1 Active protective field
2 An old protective field is active
3 Set changeover time
4 A new protective field is active
5 Changeover complete
PF Field pair or quad
X X Field pair changeover

Fig. 5.1: Signal/time diagram: Overlapped monitoring

5.7.3 Changeover of ten field pairs in changeover mode Fixed changeover moment

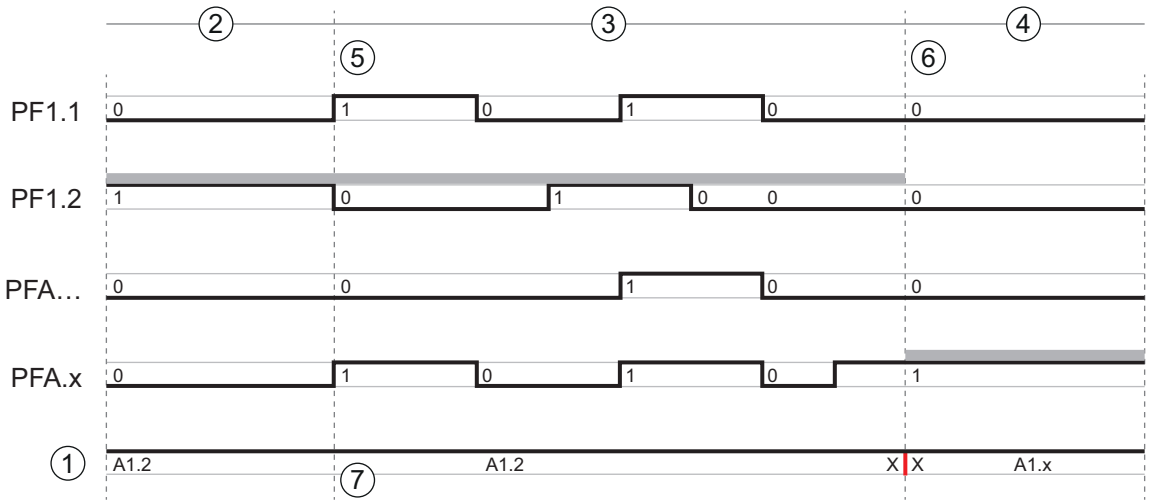
Changeover mode **Fixed changeover moment**: The field pair changeover must take place within the configurable changeover time, i.e. after the changeover time has expired, a valid and stable input connection must be present. The old field pair is monitored during the changeover time.

- The previously active field pair is monitored during the changeover time.
- The changeover time starts when the safety sensor registers a change at control inputs F1 to F5. 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 (see chapter 9.4.4 "Creating and configuring protective/warning field pairs").

Tab. 5.5: Connection of control inputs F1 to F5 with activation of field pairs A1.1 to A1.10 for protective function A

Field pair	Control input					Description
	F1	F2	F3	F4	F5	
A1.1	1	0	0	0	0	Field pair A1.1 is active
A1.2	0	1	0	0	0	Field pair A1.2 is active
A1.3	0	0	1	0	0	Field pair A1.3 is active
A1.4	0	0	0	1	0	Field pair A1.4 is active
A1.5	0	0	0	0	1	Field pair A1.5 is active
A1.6	1	1	1	1	0	Field pair A1.6 is active
A1.7	1	1	1	0	1	Field pair A1.7 is active
A1.8	1	1	0	1	1	Field pair A1.8 is active
A1.9	1	0	1	1	1	Field pair A1.9 is active
A1.10	0	1	1	1	1	Field pair A1.10 is active

In the case of two protective functions, connection of control inputs F6 to F10 applies analogously for activation of field pairs B1.1 to B1.10 for protective function B.



1 Active protective field
2 An old protective field is active
3 Set changeover time
4 A new protective field is active
5 Initiation of the field pair changeover caused by a change in the signal – the old protective field is monitored until the end of the changeover time
6 Fixed end – field pair changeover complete
7 … Only one field pair change
PF Field pair or quad
X X Field pair changeover

Fig. 5.2: Signal/time diagram: Overlapped monitoring

5.8 Monitoring of field pair changeover

The *Changeover order* function determines the permissible field pair changeovers, e.g. if field pair A1.3 must be changed over to field pair A2.5. If the *Changeover order* function is active, the safety-related switching signals (OSSDs) switch off in the following cases:

- the control initiates an impermissible field pair changeover.
- the field pair to which the system is changed over has been deactivated.

Activating the function

↳ The *Changeover order* is defined using the configuration and diagnostics software (see chapter 9.5 "Defining permissible field pair changeovers").

5.9 Reference contour monitoring

The *reference contour monitoring* function prevents unintentional misalignment and deliberate manipulation of the safety sensor. If a protective field contains an area with reference contour, the safety sensor not only monitors interruptions of the protective field, it also monitors the concurrence of the measured area contour with the set reference contour. If the measurement values of the area contour deviate from the defined reference contour by more than the tolerance zone of 200 mm, i.e., if no object is detected in the area with reference contour, the safety sensor switches off and the safety-related switching signals switch to *off*.

Activation of the function

↳ Activate the *Reference contour monitoring* function together with the definition of the protective field boundaries using the configuration and diagnostics software (see chapter 9.4.4 "Creating and configuring protective/warning field pairs").

5.10 Field pair monitoring

The *Field pair monitoring* function is used to set the monitoring mode for the selected field pair.

The *Standby request* monitoring mode is used to switch off field pair monitoring and the safety-related switching signals. This is advisable when parking vehicles, for example.

Activation of the function

↳ Activate field pair monitoring in the configuration and diagnostics software (see chapter 9.4.5 "Configuring field pair monitoring").

5.11 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
  - Field pair changeover active
- Device functions
- Error messages
- Warnings
- Diagnosis

For an overview of all logic and electrical signals of the safety sensor, see chapter 16.4 "PROFIsafe status profile".

6 Applications

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

- To safely mount the safety sensor for the respective application, see chapter 7 "Mounting".
- For the electrical connection of the safety sensor, see chapter 8 "Electrical connection".
- To safely configure the safety sensor for the respective application, see chapter 9 "Configuring the safety sensor".

6.1 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

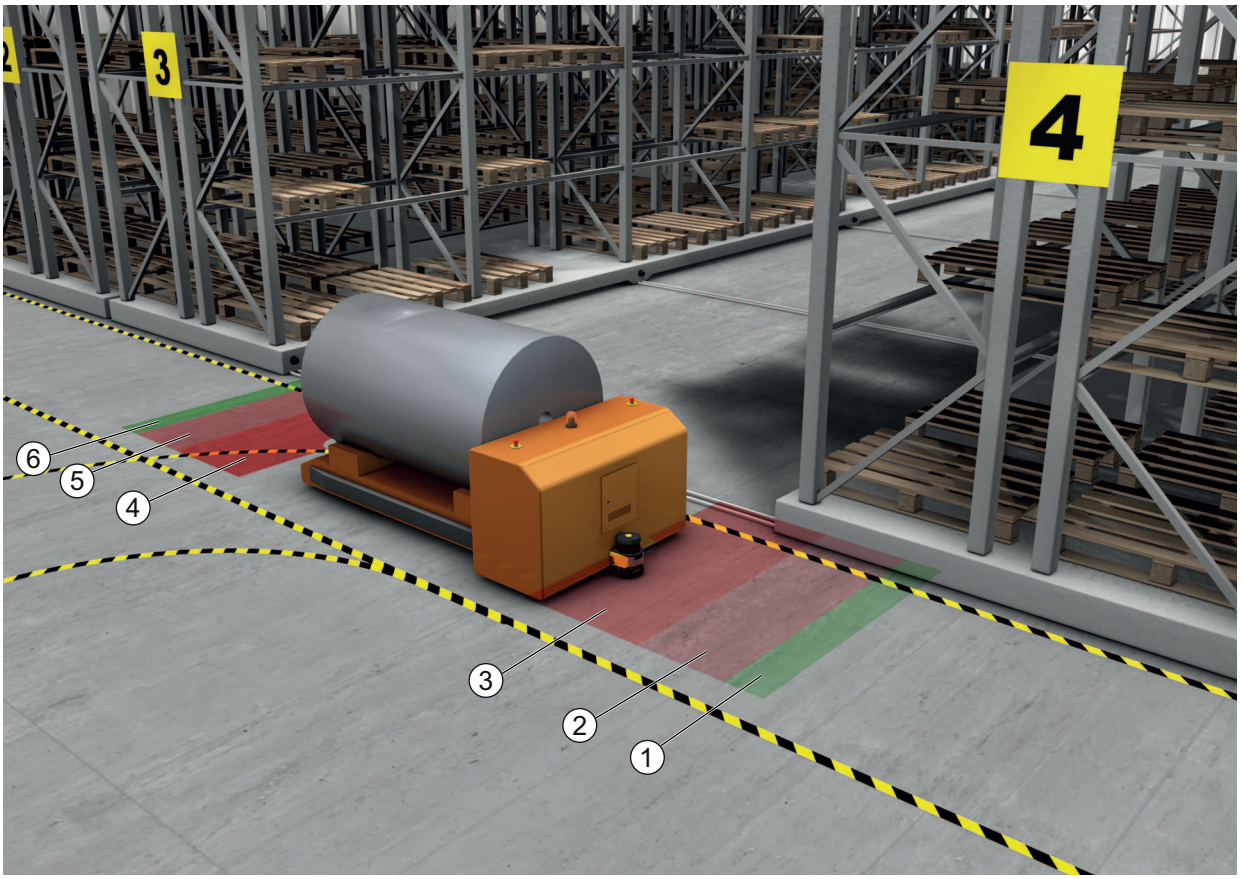
Fig. 6.1: Stationary danger zone guarding

6.2 Stationary point of operation guarding

Hand and arm protection are always required when people must work at the point of operation. The safety sensor is applied as a stop-activating and presence-detecting protective device. The safety sensor's protective field is set up vertically in front of the machine or system's point of operation. In accordance with EN ISO 13855, resolutions from 14 to 40 mm make sense here. This yields the necessary safety distance for finger protection, among others (see chapter 7.3 "Stationary point of operation guarding").

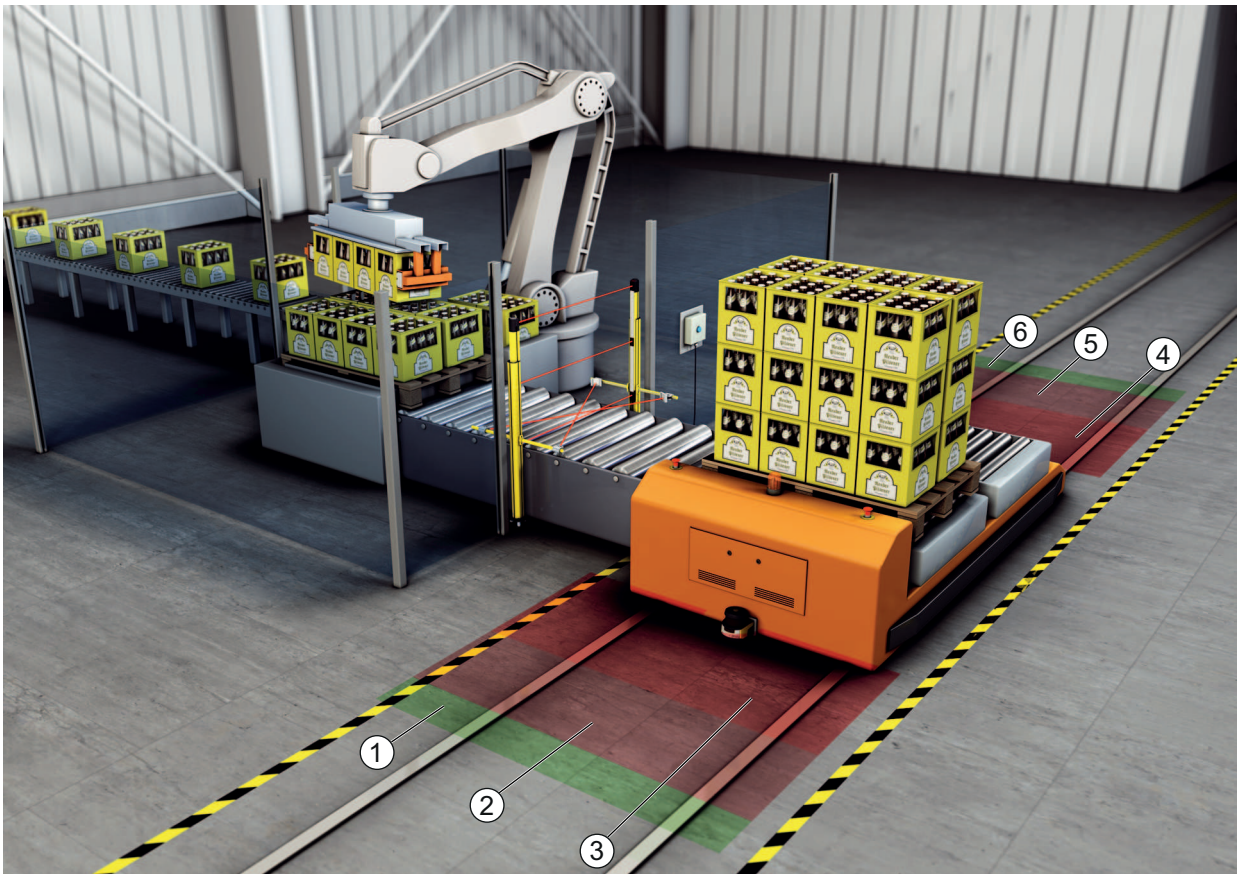
6.3 Mobile danger zone guarding

Mobile danger zone guarding protects people that are located in the transportation path of an automated guided vehicle (AGV). 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 Warning field for forward travel
2 Protective field 1 for forward travel, deactivated
3 Protective field 2 for forward travel, activated
4 Protective field 1 for reverse travel, activated
5 Protective field 2 for reverse travel, deactivated
6 Warning field for reverse travel

Fig. 6.2: Mobile danger zone guarding



1 Warning field for forward travel
2 Protective field 1 for forward travel, deactivated
3 Protective field 2 for forward travel, activated
4 Protective field 1 for reverse travel, activated
5 Protective field 2 for reverse travel, deactivated
6 Warning field for reverse travel

Fig. 6.3: Mobile danger zone guarding

6.4 Danger zone safeguarding on side-tracking skates

Side-tracking skate guarding

Side-tracking skate guarding protects personnel who are located in the transportation path of a transverse side-tracking skate (TSS). One safety sensor is mounted in each direction of travel. The safety sensor that is mounted opposite the current direction of travel is deactivated. Evaluation of the warning field allows the transverse side-tracking skate to be braked gently. To ensure optimum material transport, the control changes over the protective/warning field pair depending on the state and speed.

Mobile side guarding

Mobile side guarding protects people and objects that are located on the vehicles path. This application is used when very low arranged roller conveyors do not permit an unobstructed passage of horizontal, lateral protrude protective fields. The safety sensors are positioned laterally and the protective fields are arranged vertically, at a slight tilt. The position of the front edges of the side protective fields is oriented here on the position of the front edge of the horizontal protective field.



1 Protective and warning field pair for forward travel, activated
2 Protective and warning field pair for side guarding, left, activated
3 Protective and warning field pair for side guarding, right, activated
4 Protective and warning field pair for reverse travel, deactivated

Fig. 6.4: Mobile side guarding on side-tracking skates

7 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.

- You must observe and comply with the respective relevant machine-specific standards and regulations (see chapter 17 "Standards and legal regulations").
- Observe the basic information on mounting (see chapter 7.1 "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.
- Maintain the necessary safety distances (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.
- 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 16 "Technical data"
  Care: see chapter 14 "Care, maintenance and disposal"

7.1 Basic infos

7.1.1 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, such as the response times of the safety sensor and control elements, the stopping time of the machine as well as the PROFIsafe watchdog time, among others.

The following standards specify calculation formulas:

- EN ISO 13855, "Safety of machines - The positioning of protective device in respect of approach speeds of parts of the human body": mounting 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 ($t_a + t_i + t_m + t_{PS}$)
t_a	[s]	= Response time of the protective device
t_i	[s]	= Response time of the safety control
t_m	[s]	= Stopping time of the machine
t_{PS}	[s]	= PROFIsafe watchdog time
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.

7.1.2 Suitable mounting locations

Area of application: Mounting

Tester: Technician who mounts the safety sensor

Tab. 7.1: 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.

7.1.3 Mounting the safety sensor

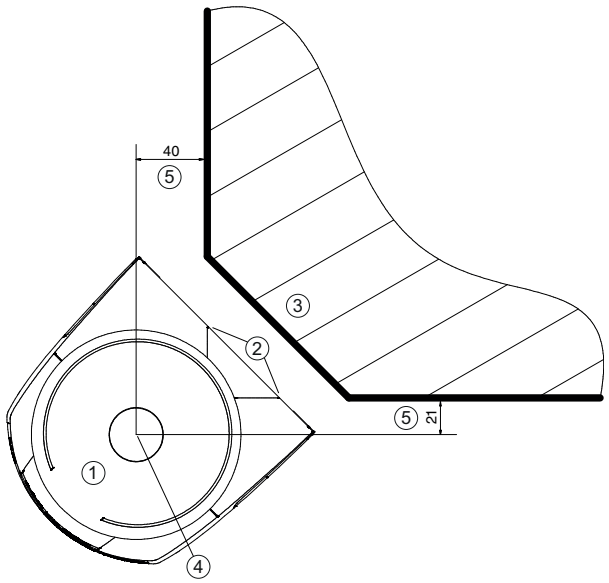
NOTICE
Detailed information on mounting the safety sensor can be found in the document "Quick Start Guide RSL 400".

Proceed as follows:

↳ Calculate the necessary safety distance and determine the required additional distances for your application.

↳ Determine the mounting location.

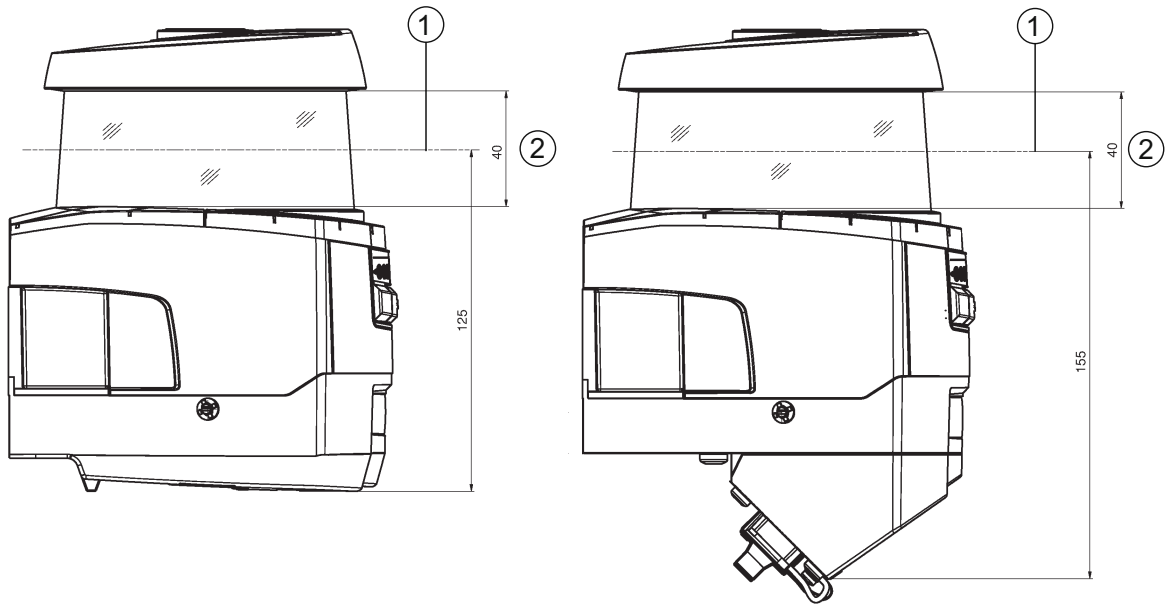
- Observe the information regarding the mounting locations; see chapter 7.1.2 "Suitable mounting locations"
- Ensure that machine parts, safety guards or covers do not impair the safety sensor's field of vision.
- Make sure that the scanning range of the safety sensor is not limited. To mount the safety sensor taking the scanning range into consideration, a template must be attached to the top cover of the safety sensor.



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. 7.1: Mounting taking the scanning range of 270° into consideration

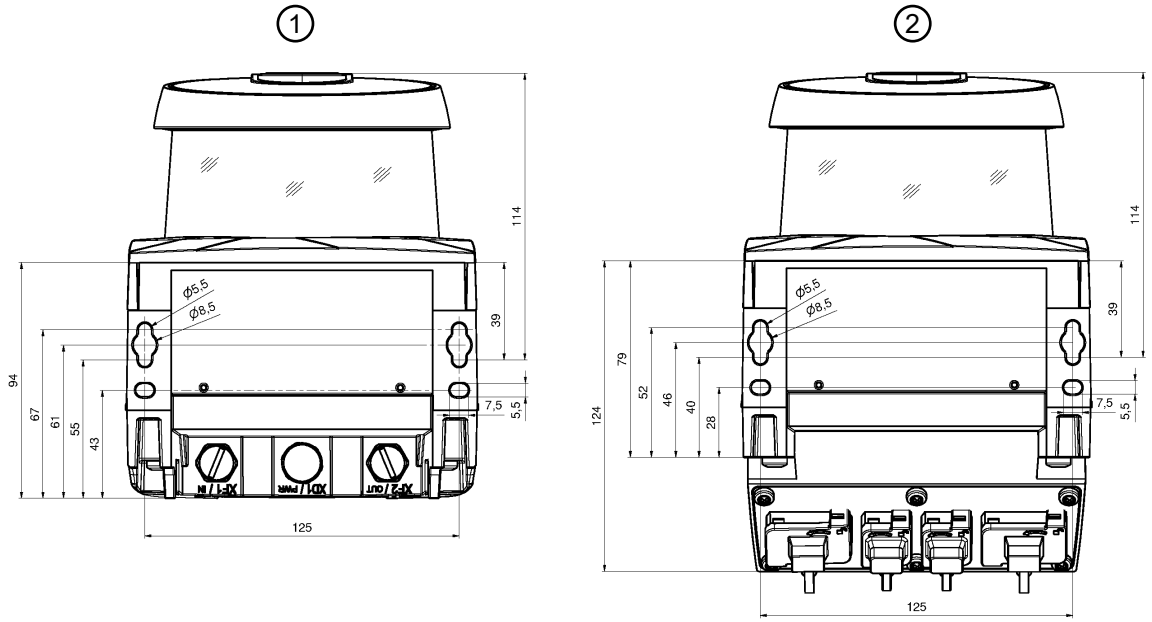


all dimensions in mm

1 Scan level
2 Area with unobstructed view; must remain free (40 mm)

Fig. 7.2: Mounting: area with unobstructed view

- Determine whether you are going to install the safety sensor with or without the mounting system. During mounting, use the four supplied M5 screws or four similar screws with a diameter of 5 mm, and make certain that the mounting elements or mounting construction supports at least four times the weight of the device with or without mounting system.
- Have the appropriate tools at the ready and mount the safety sensor.



All dimensions in mm

1 Screw connection of safety sensor with connection unit CU400P-3M12

2 Screw connection of safety sensor with connection unit CU400P-AIDA or CU400P-AIDA-OF

Fig. 7.3: Mounting

- 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 using the integrated electronic spirit level.

- For the electronic spirit level to work, the supply voltage of 24 V must be present at the safety sensor.
- The electronic spirit level indicates the vertical (V) and horizontal (H) alignment of the safety sensor. The spirit level is displayed
  - permanently after the end of the booting phase/start phase when starting without configuration
  - repeatedly until the end of the booting phase/start phase when starting with configuration
  - using the configuration and diagnostic software:
    Diagnosis > [Align sensor mechanically] button (▬)
- When mounting without a mounting system, the safety sensor can be aligned only slightly along the horizontal axis.

- 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 9 "Configuring the safety sensor":

- Observe the information on the response times, the stopping time of the machine and the protective field dimensioning for your application.
- Determine the size of the protective field on the basis of the mounting location, the calculated safety distances and additional distances.

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NOTICE

With protective field boundaries <200 mm, object detection may be restricted owing to the measurement error.

↳ When defining the protective field, take into account the additional distance Z_{sm} to the protective field contour (see chapter 7.2 "Stationary danger zone guarding").

- Configure the protective field so that the safety-related switching outputs are switched 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 pair changeover and the sequence of the field pair changeover.

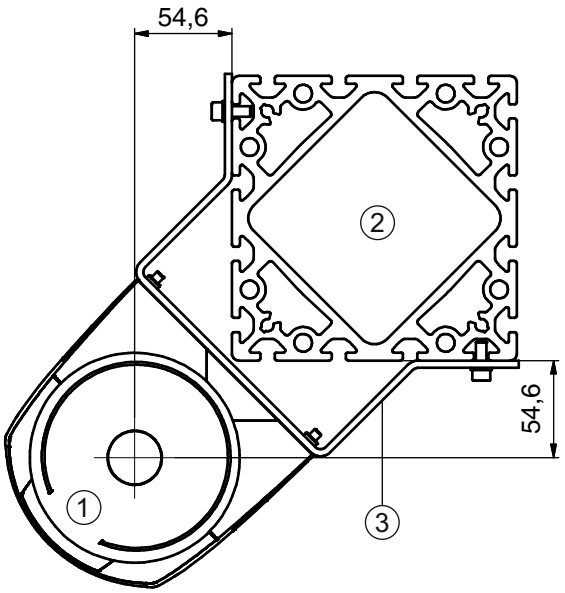
↳ Create a record document for the device configuration and protective field dimensioning.

- The document must be signed by the person responsible for the configuration.
- Include this document with 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 8 "Electrical connection"), start up, align (see chapter 10 "Starting up the device"), and test (see chapter 12 "Testing") the safety sensor.

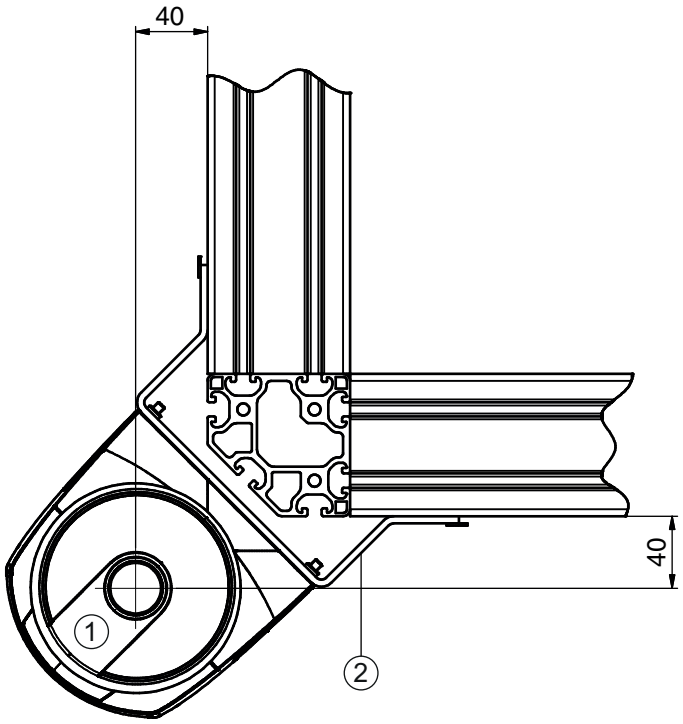
7.1.4 Mounting examples



all dimensions in mm

1 Safety sensor
2 Column
3 BT856M mounting bracket

Fig. 7.4: Example: mounting on a post

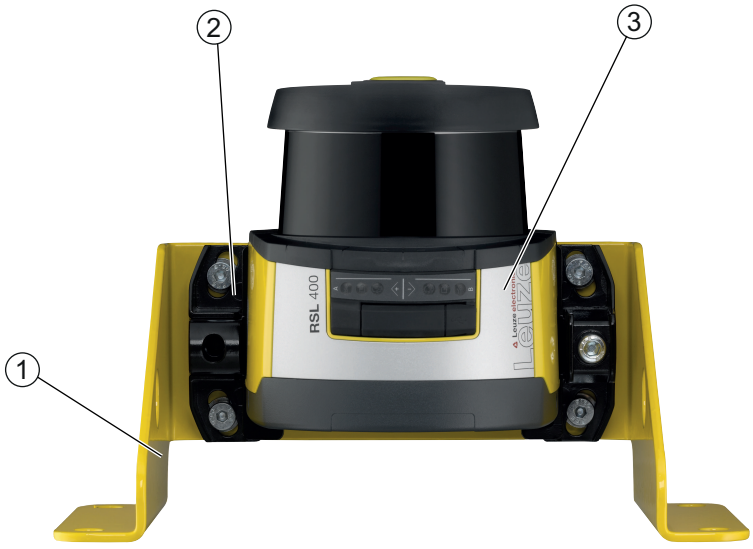


all dimensions in mm

1 Safety sensor

2 BT840M mounting bracket

Fig. 7.5: Example: mounting on a chamfered corner



1 BTF815M mounting bracket (only in combination with the BTU800M mounting system)

2 BTU800M mounting system

3 Safety sensor

Fig. 7.6: Example: mounting on floor

7.1.5 Information on protective field dimensioning

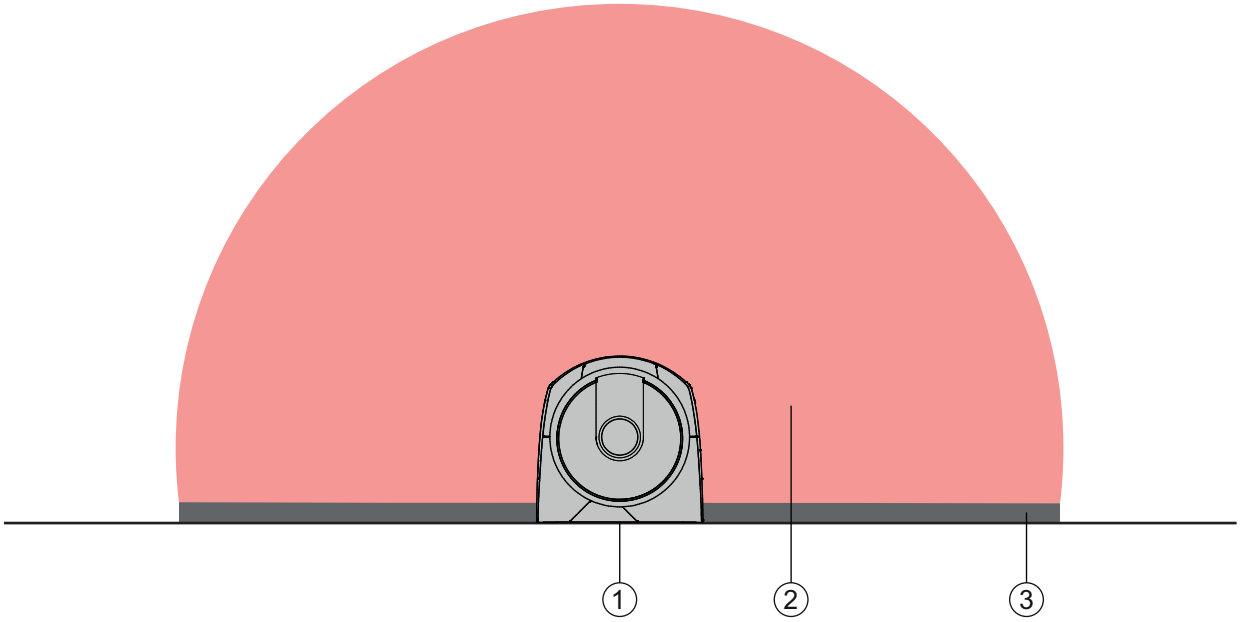
NOTICE
With protective field boundaries <200 mm, object detection may be restricted owing to the measurement error. ↳ When defining the protective field, take into account the additional distance Z_{sm} to the protective field contour (see chapter 7.2 "Stationary danger zone guarding").

- ↳ 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, PROFIsafe watchdog time, braking times or stopping times of the machine or automated guided vehicle (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 16 "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.

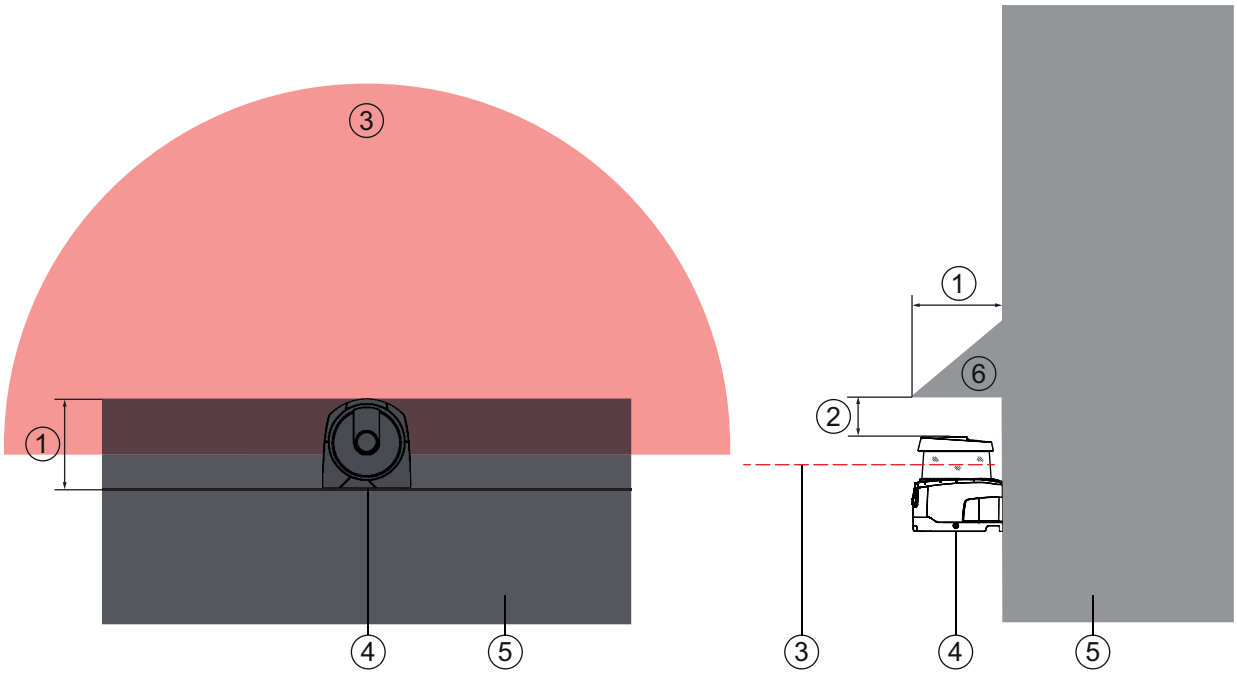


1 Safety sensor
2 Protective field
3 Unmonitored area;
Optimum availability at a distance of 50 mm to fixed contours

Fig. 7.7: 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. 100 mm
2 Minimum distance above the scanner unit, min. 34 mm
3 Protective field
4 Safety sensor
5 Machine
6 Angled physical cover

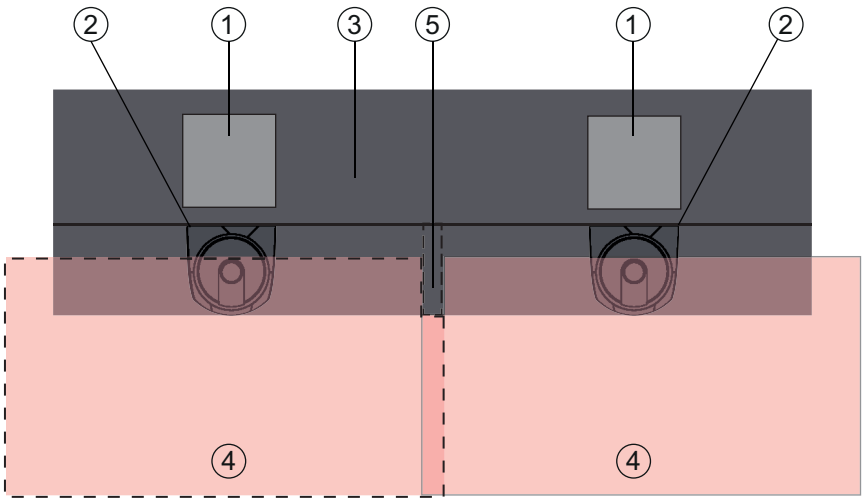
Fig. 7.8: Stepping behind protection by countersinking into the machine contour

↳ 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.

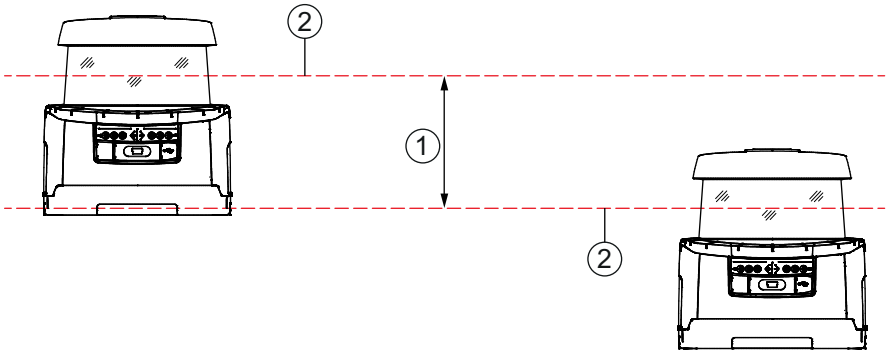
- When mounting the safety sensor, avoid glossy surfaces directly behind the optics cover.
- Plan for shielding with stationary applications.
  The shielding must be at least as high as the safety sensor's optics cover and embedded with the front housing edge.
  If you plan for a shielding that is still within the countersinking in the machine contour, the resolution of the protective fields must not be impaired at any accessible points.
  You require the reciprocal shielding with 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. 7.9: Shielding prevents reciprocal influencing of safety sensors set up beside one another

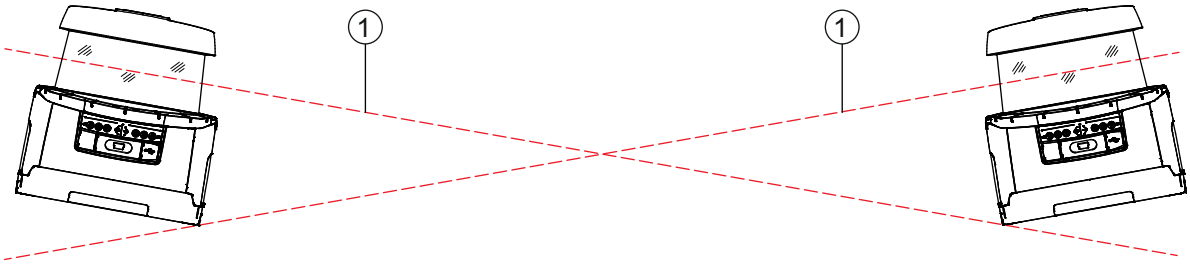
- Install the safety sensors off-set on the height.



1 Minimum distance, min. 100 mm
2 Scan level

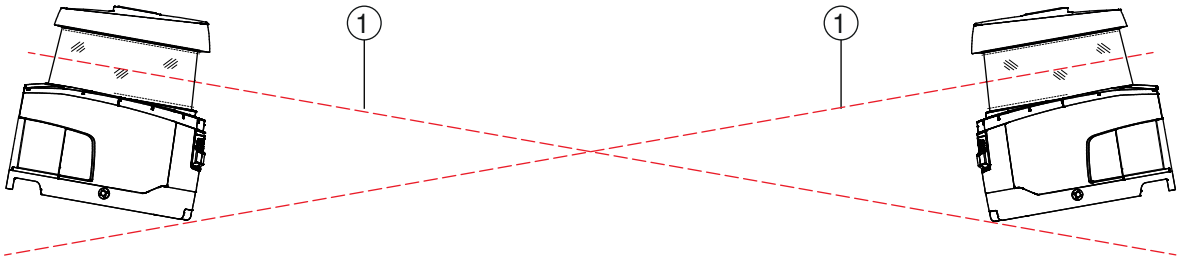
Fig. 7.10: Height offset mounting, parallel alignment

↳ Install the safety sensors with crossed alignment.



1 Scan level

Fig. 7.11: Mounting beside one another, without height offset, crossed alignment



1 Scan level

Fig. 7.12: Mutually opposing mounting, without height offset, crossed alignment

7.2 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 ($t_a + t_i + t_m + t_{PS}$)
t_a	[s]	= Response time of the protective device
t_i	[s]	= Response time of the safety control
t_m	[s]	= Stopping time of the machine
t_{PS}	[s]	= PROFIsafe watchdog time
C	[mm]	Additional distance for danger zone guarding with approach reaction H = height of the protective field, H_{min} = minimum installation height permitted, but no smaller than 0, d = resolution of the protective device C = 1200 mm - 0.4 × H; H_{min} = 15 × (d - 50)

Response times, stopping time of the machine

The safety sensor's rotary mirror rotates on its own axis every 40 ms. One revolution is a 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 80 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 40 ms. With K = 1600 mm/s the safety distance increases by 64 mm per additional scan.

↳ Select a response time t_a of at least 120 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 15 "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.

Additional distance C for danger zone guarding with approach reaction

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

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

H	[mm]	= Height of protective field above floor (installation height)
C_{MIN}	[mm]	= 850 mm
H_{MAX}	[mm]	= 1000 mm

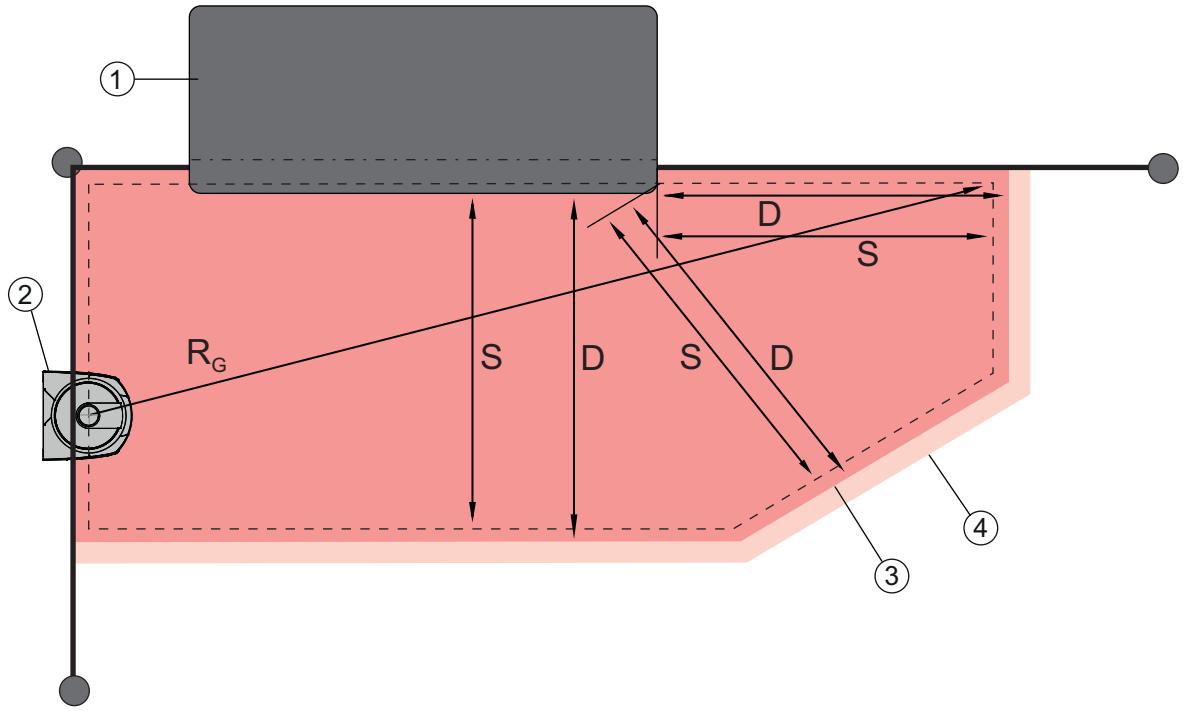
The minimum permissible installation height depends on the resolution of the safety sensor:

Tab. 7.2: Additional distance C depending on the resolution of the safety sensor

Safety sensor resolution (mm)	Minimum permissible installation height (mm)	Additional distance C (mm)
50	0	1200
60	150	1140
70	300	1080

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. 7.13: 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. 7.3: 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}
< 6.25 m	100 mm
> 6.25 m	120 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
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.

NOTICE

The beam level of the safety sensor is level with the alphanumerical display.

↳ 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.

7.3 Stationary point of operation guarding

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

Calculation of safety distance S_{RO} for access over the vertical protective field

$$S_{RO} = K \cdot T + C_{RO}$$

S_{RO}	[mm]	= Safety distance
K	[mm/s]	= Approach speed for point of operation guarding with approach reaction and normal approach direction to the protective field (resolution 14 to 40 mm): 2000 mm/s or 1600 mm/s, when S_{RO} > 500 mm
T	[s]	= Total time of the delay, sum from (t_a + t_i + t_m + t_{PS})
t_a	[s]	= Response time of the protective device
t_i	[s]	= Response time of the safety control
t_m	[s]	= Stopping time of the machine
t_{PS}	[s]	= PROFIsafe watchdog time
C_{RO}	[mm]	= Additional distance in which a body part can move towards the protective device before the protective device triggers

Response times, stopping time of the machine

The safety sensor's rotary mirror rotates on its own axis every 40 ms. One revolution is a scan. With each additional scan the response time t_a increases by 40 ms. With K = 2000 mm/s approach speed this corresponds with an increase in the safety distance of 80 mm per additional scan. With K = 1600 mm/s it is 64 mm.

- Select a response time t_a of at least 80 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 15 "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.

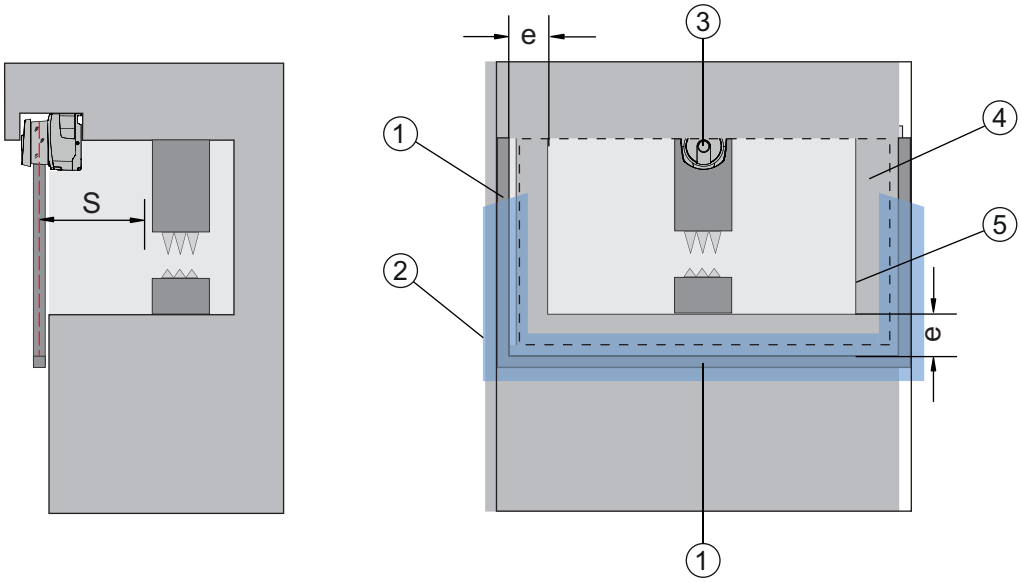
Additional distance C_{R0} for finger protection

The required finger protection is ensured here by an additional distance C, which depends on the safety sensor resolution, in addition to the safety distance.

- Detection of an adult's hand:
  - Resolution: 30 mm
  - Additional distance C_{RO}: 128 mm
- Arm detection:
  - Resolution: 40 mm
  - Additional distance C_{RO}: 208 mm

Protective field contour and reference contour

With a vertical protective field, you must define at least two sides of the protective field contour as reference contour. The objective is to monitor the position of the protective field with regard to its marginal area. If the arrangement misaligns and the distance of the safety sensor to the reference surface changes as a result, switch the safety-related switching outputs off.



1	Physical frame for reference contour
2	Reference contour, must cover at least two sides of the protective field
3	Safety sensor
4	Distance e between the reference contour frame and machine opening, recommended: e = 150 mm
5	Machine opening contour

Fig. 7.14: Defining the protective field contour and reference contour, stationary point of operation guarding, vertical protective field

7.4 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 200 mm above the floor.
  A person lying on the floor can therefore be safely detected. This is required by the C standard, EN 1525 "Safety of industrial trucks – Driverless corridor supply vehicles and their systems".

NOTICE

The beam level of the safety sensor is level with the alphanumerical display.

7.4.1 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

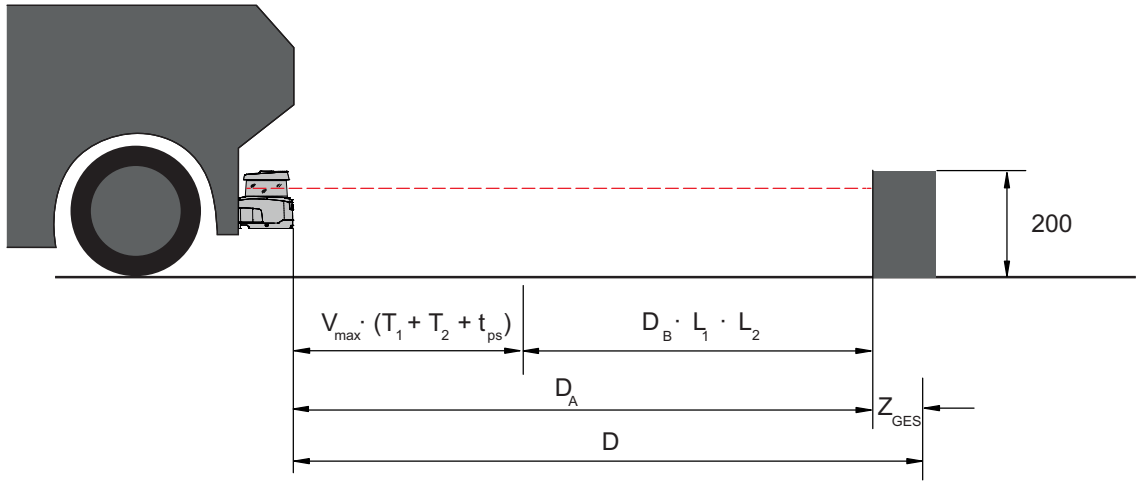


Fig. 7.15: Mobile danger zone guarding, calculation of required minimum distance D

Stopping distance D_A

$D_A = v_{max} * (T_1 + T_2 + t_{PS}) + D_B * L_1 * L_2$

D_A	[mm]	= Stopping distance
v_{max}	[mm/s]	= Maximum vehicle speed
T_1	[s]	= Response time of the safety sensor
T_2	[s]	= Response time of the AGV
t_{PS}	[s]	= PROFIsafe watchdog time
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]	= Additional distance for system-related measurement error, see chapter 7.2 "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.

The **additional distance Z_F** is required if the vehicle does not have enough free floor space H_F and there is therefore no space under the vehicle or the safety sensor for the tips of the feet. You determine the additional distance Z_F according to the following diagram:

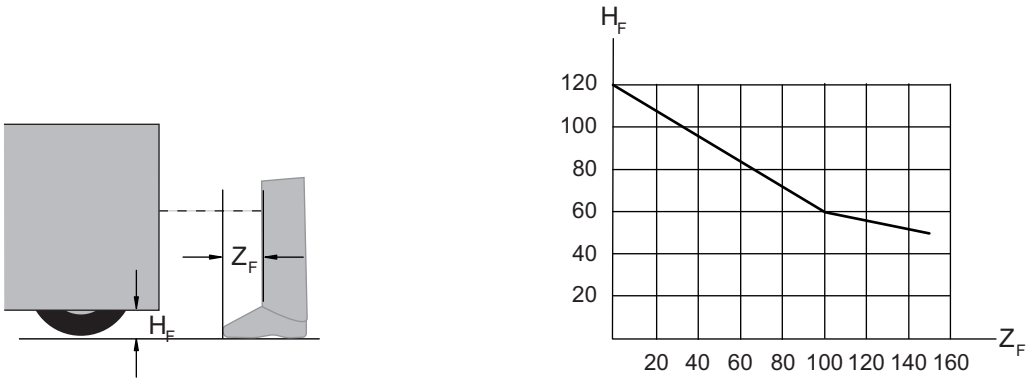
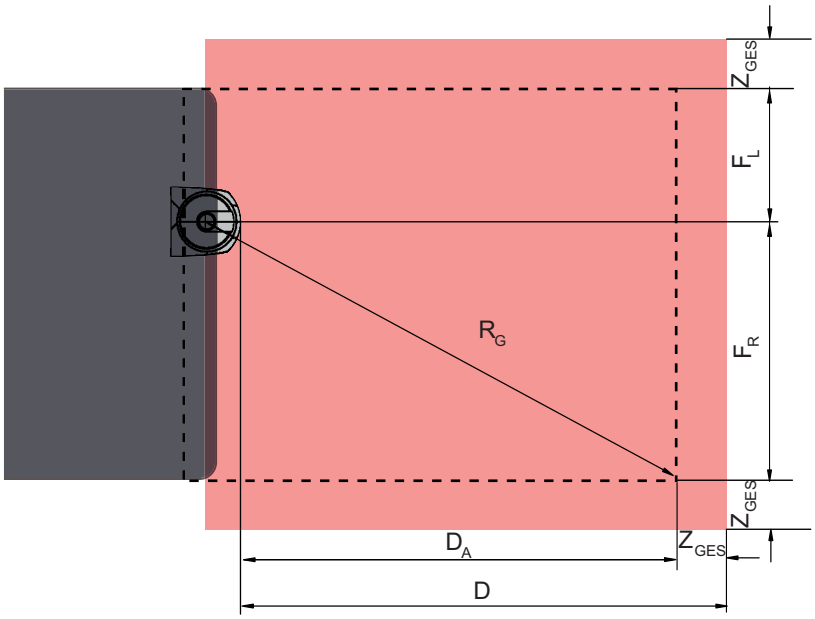


Fig. 7.16: Diagram for determining the additional distance Z_F with lack of floor space H_F

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

7.4.2 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. 7.17: 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.

7.5 Mobile side guarding on AGVs

WARNING

Danger of injury because of insufficient vehicle stopping distance

- The operator of the machine must use organizing measures to ensure that people cannot enter the vehicle's protective field from the side.

- For mobile vertical protective fields use a resolution of at least 150 mm.
- Position the protective field edges in the travel direction in accordance with the front protective field edge of the horizontal protective field.
- Ensure that the response times of all components of the switch-off circuit are the same or balance the response times with different protective field dimensioning.
- Set the vertical protective fields at a slight angle so that the lower protective field edges protrude over the vehicle width by the amount of the additional distances, Z_{SM}, Z_F and Z_{REFL} where required; see chapter 7.4.2 "Protective field dimensions".

7.6 Mounting accessories

7.6.1 Mounting system

Using the mounting system you can adjust the safety sensor horizontally and vertically by ±10 degrees when mounting.

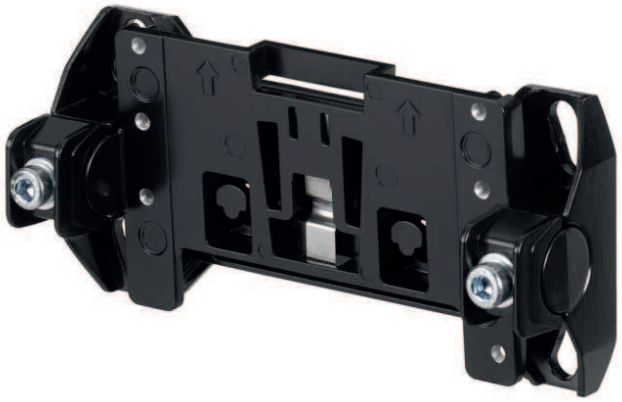


Fig. 7.18: BTU800M mounting system

NOTICE

Floor mounting only with mounting system BTU800M

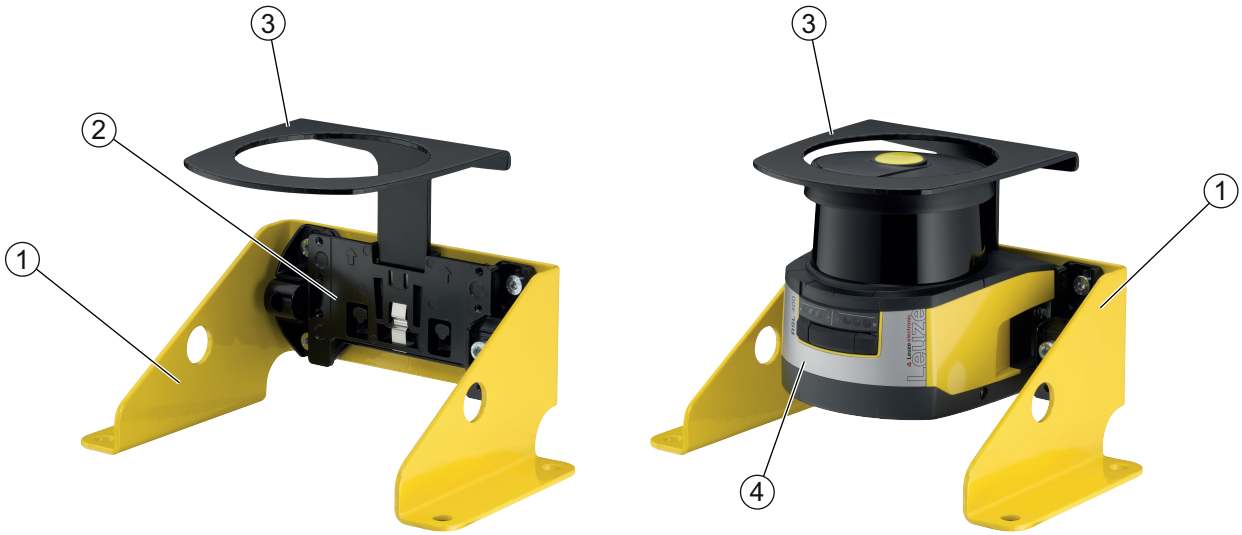
- The mounting system BTU800M must be used in the case of installation using the mounting bracket for floor mounting.

- Install the wall mount or mounting bracket for floor mounting on the system side.
- Mount the mounting system on the wall mount or on the mounting bracket for floor mounting.
- Attach the safety sensor to the mounting system.
  Tightening the screws fixes the safety sensor in position.
- Align the safety sensor using the integrated electronic spirit level.

7.6.2 Loop guard

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

	NOTICE
	The loop guard can only be used together with the mounting system BTU800M.



1 BTF815M mounting bracket for floor mounting (only with BTU800M mounting system)
2 BTU800M mounting system
3 Loop guard
4 Safety sensor

Fig. 7.19: Loop guard

- Attach the safety sensor to the mounting system.
- Engage the loop guard for the optics cover from above into the mounting system.

8 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 5.2 "Function modes of safety sensor").
- Always loop both safety-related switching signals – A_SAFE_xx_CLEAR and B_SAFE_xx_CLEAR – into the work circuit of the machine.
- Signal outputs must not be used for switching safety-relevant signals.

NOTICE

Laying 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 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.

8.1 Electrical supply

see chapter 16.1 "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 earth via a ground strap/braid (low impedance for RF). Connection points for self-tapping screws used for the ground connection are provided and labeled on the bottom of the connection unit.
- 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.

NOTICE
Make sure that potential equalization is provided! ↳ 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.

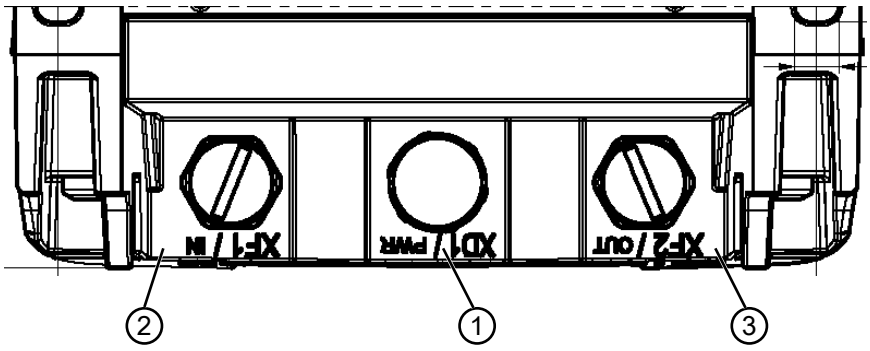
8.2 Interfaces

The safety sensor has the following interfaces:

- Interface for voltage supply
- Interface for PROFINET/PROFIsafe communication
- USB interface for communication with PC or laptop

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.

8.3 Connection unit CU400P-3M12



1 M12 connector, A-coded, voltage supply, I/O signal RSL
2 M12 socket, D-coded, PROFINET/PROFIsafe communication, input
3 M12 socket, D-coded, PROFINET/PROFIsafe communication, output

Fig. 8.1: Device with connection unit CU400P-3M12

Voltage supply

Voltage is supplied to the safety sensor via a 4-pin M12 connector

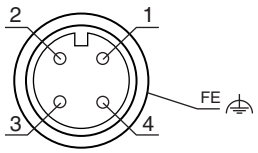


Fig. 8.2: Pin assignment for M12 connector, 4-pin, A-coded

Tab. 8.1: Pin assignment for voltage supply

PIN	Signal	Comment
1	VIN	Positive supply voltage +24 V DC
2	EA1	I/O signal RSL
3	GND	Negative supply voltage 0 V DC
4	EA2	I/O signal RSL
FE	GND/shield	Functional earth, interconnection 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. It is also possible to operate the device with unshielded interconnection cables. The use of shielded interconnection cables is, however, recommended.

- The maximum current load of the connections is limited to 4 A/pin.
- The I/O signals are guided from the safety sensor through the PROFINET box to the connector plug.
- The supply voltage is not intended for linear topology and is not looped through.

PROFINET/PROFIsafe communication

The PROFINET/PROFIsafe communication takes place via two 4-pin M12 sockets.

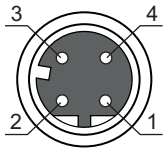
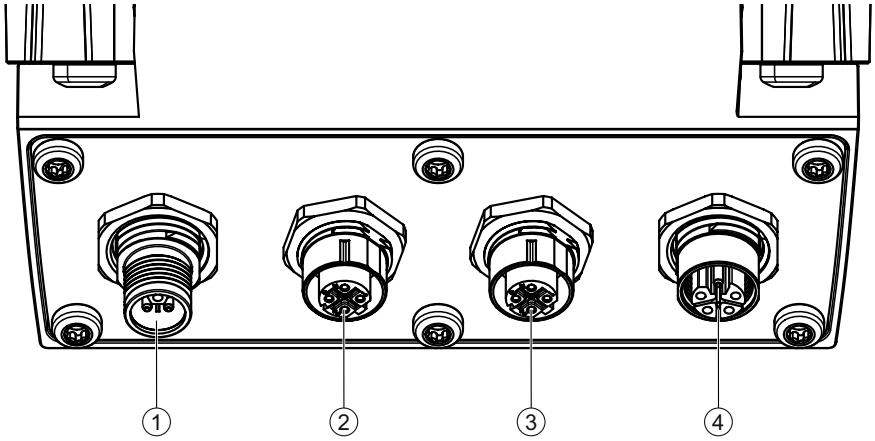


Fig. 8.3: Pin assignment for M12 socket, 4-pin, D-coded

Tab. 8.2: Pin assignment for PROFINET/PROFIsafe communication interfaces

PIN	Signal	Direction	Comment
1	TD+	OUT	Transmitter data +
2	RD+	IN	Receiver data +
3	TD-	OUT	Transmitter data -
4	RD-	IN	Receiver data -
FE	GND/shield		Functional earth, communication cable shield. The shield of the interconnection cable is on the thread of the M12 socket. The thread is part of the metallic housing. The housing is at the same potential as functional earth.

8.4 Connection unit CU400P-4M12

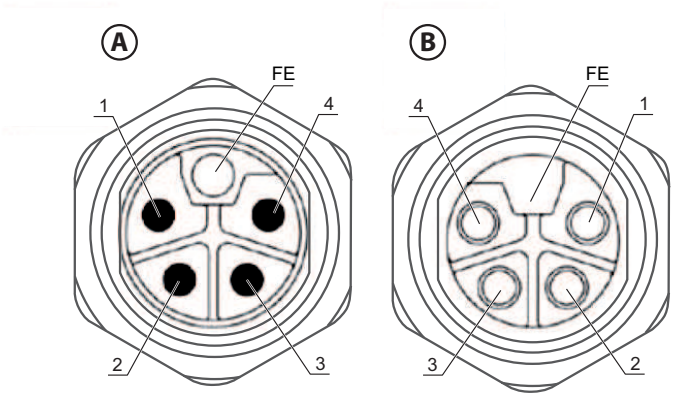


1 M12 connector, L-coded, voltage supply
2 M12 socket, D-coded, PROFINET/PROFIsafe communication, input
3 M12 socket, D-coded, PROFINET/PROFIsafe communication, output
4 M12 socket, L-coded, voltage supply

Fig. 8.4: Device with connection unit CU400P-4M12

Voltage supply

The safety sensor is supplied with voltage via two 5-pin L-coded M12 connections. The scanner is supplied from mains L1/N1.



A M12 connector, 5-pin, L-coded
B M12 socket, 5-pin, L-coded

Fig. 8.5: Pin assignment M12 connector/socket, 5-pin, L-coded

Tab. 8.3: Pin assignment for voltage supply

PIN	Signal	Comment
1	L1	24 V DC (US1+)
2	N2	0 V DC (US2-)
3	N1	0 V DC (US1-)
4	L2	24 V DC (US2+)

PIN	Signal	Comment
FE	GND/shield	It is also possible to operate the device with unshielded interconnection cables. The use of shielded interconnection cables is, however, recommended.

The current load of the connections must not exceed 16 A/pin.

PROFINET/PROFIsafe communication

The PROFINET/PROFIsafe communication takes place via two 4-pin M12 sockets.

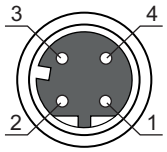
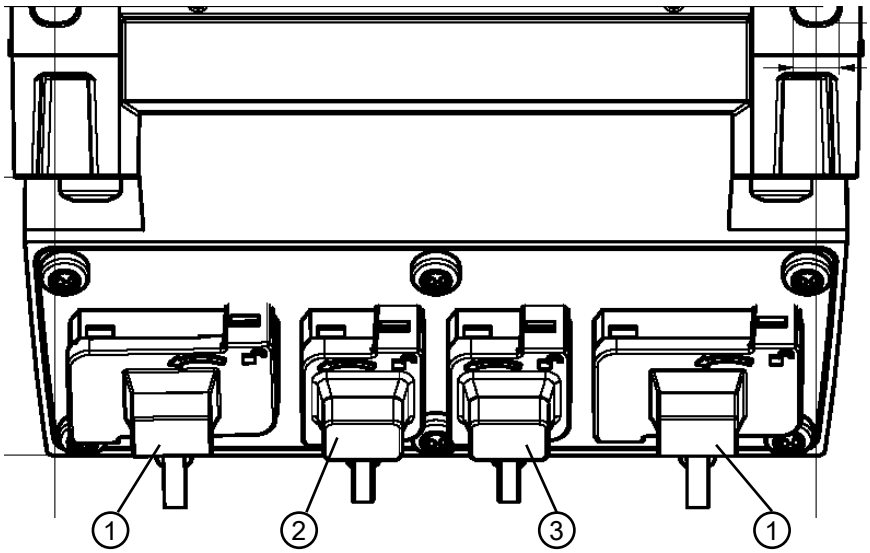


Fig. 8.6: Pin assignment for M12 socket, 4-pin, D-coded

Tab. 8.4: Pin assignment for PROFINET/PROFIsafe communication interfaces

PIN	Signal	Direction	Comment
1	TD+	OUT	Transmitter data +
2	RD+	IN	Receiver data +
3	TD-	OUT	Transmitter data -
4	RD-	IN	Receiver data -
FE	GND/shield		Functional earth, communication cable shield. The shield of the interconnection cable is on the thread of the M12 socket. The thread is part of the metallic housing. The housing is at the same potential as functional earth.

8.5 Connection unit CU400P-AIDA



All dimensions in mm

1 AIDA sockets, PROFINET, push-pull, 5-pin, voltage supply

2 AIDA socket, PROFINET, RJ45 push-pull, 8-pin, Ethernet, input

3 AIDA socket, PROFINET, RJ45 push-pull, 8-pin, Ethernet, output

Fig. 8.7: Device with connection unit CU400P-AIDA

Voltage supply

The safety sensor is supplied with voltage via two 5-pin PROFINET AIDA push/pull connections for copper cables. The scanner is supplied from mains L1/N1.

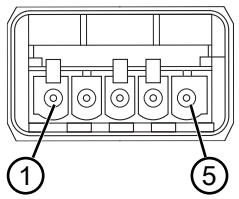


Fig. 8.8: Pin assignment PROFINET AIDA push-pull, 5-pin

Tab. 8.5: Pin assignment for voltage supply

PIN	Signal	Comment
1	L1	24 V DC (US1+)
2	N1	0 V DC (US1-)
3	L2	24 V DC (US2+)
4	N2	0 V DC (US2-)
5	GND/shield	It is also possible to operate the device with unshielded interconnection cables. The use of shielded interconnection cables is, however, recommended.

- The current load of the connections must not exceed 16 A/pin.

NOTICE

↳ Lay the cables for the linear topology and the tap in the PROFINET controller in such a way that short circuits are prevented.

PROFINET/PROFIsafe communication

The PROFINET/PROFIsafe communication takes place via two 8-pin PROFINET RJ45 AIDA push/pull connections for copper cables.

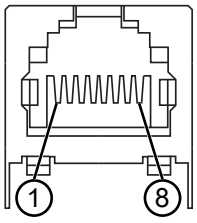


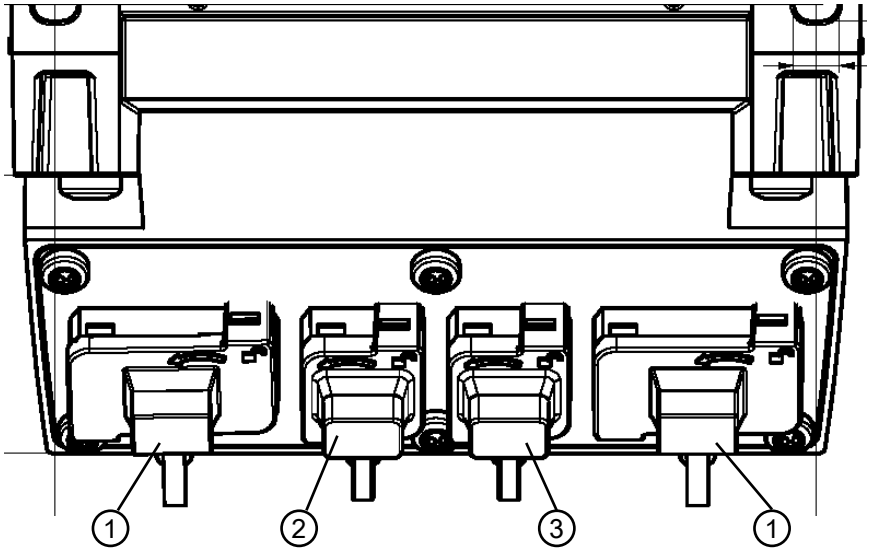
Fig. 8.9: Pin assignment PROFINET RJ45 AIDA push/pull

Tab. 8.6: Pin assignment for PROFINET/PROFIsafe communication interfaces

PIN	Core color	Signal	Direction	Comment
1	Yellow	TD+	OUT	Transmitter data +
2	Orange	TD-	OUT	Transmitter data -
3	White	RD+	IN	Receiver data +
4	---	---	---	n.c.
5	---	---		n.c.
6	Blue	RD-	IN	Receiver data -
7	---	---	---	n.c.

PIN	Core color	Signal	Direction	Comment
8	---	---	---	n.c.
FE		GND/shield		Functional earth, communication cable shield. The shield of the communication cable is in contact with the housing of the AIDA socket. The housing is at the same potential as functional earth.

8.6 Connection unit CU400P-AIDA-OF



1 AIDA sockets, PROFINET, push-pull, 5-pin, voltage supply via copper cable
2 AIDA socket, PROFINET, SCRJ push-pull, 2-pin, PROFINET/PROFIsafe communication via fiber-optic cable, input
3 AIDA socket, PROFINET, SCRJ push-pull, 2-pin, PROFINET/PROFIsafe communication via fiber-optic cable, output

Fig. 8.10: Device with connection unit CU400P-AIDA-OF

Voltage supply

The safety sensor is supplied with voltage via two 5-pin PROFINET AIDA push/pull connections for copper cables. The scanner is supplied from mains L1/N1.

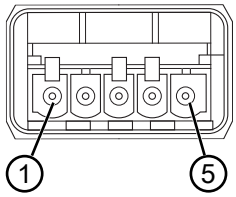


Fig. 8.11: Pin assignment PROFINET AIDA push-pull, 5-pin

Tab. 8.7: Pin assignment for voltage supply

PIN	Signal	Comment
1	L1	24 V DC (US1+)
2	N1	0 V DC (US1-)
3	L2	24 V DC (US2+)
4	N2	0 V DC (US2-)

PIN	Signal	Comment
5	GND/shield	It is also possible to operate the device with unshielded interconnection cables. The use of shielded interconnection cables is, however, recommended.

- The current load of the connections must not exceed 16 A/pin.

NOTICE

↳ Lay the cables for the linear topology and the tap in the PROFINET controller in such a way that short circuits are prevented.

PROFINET/PROFIsafe communication

PROFINET/PROFIsafe communication takes place via two fiber-optic cables (FOC) to a PROFINET controller AIDA FOC.

The PROFINET controller AIDA FOC must provide two external Ethernet interfaces:

- Bit rate: 100 Mbit/s
- Medium: glass fiber
- Protocols: PROFINET, TCP/IP

The optical Ethernet connection of the PROFINET controller AIDA FOC must be designed for the use of PROFINET SCRJ push/pull AIDA connectors (acc. to ISO/IEC 61754-24-2).

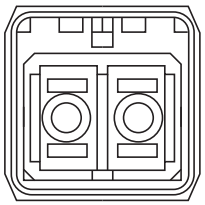


Fig. 8.12: PROFINET SCRJ push/pull AIDA connection

Tab. 8.8: Details on the fiber-optic cables

Parameter	Minimum	Typical	Maximum
Transceiver wavelength	635 nm	650 nm	660 nm
Diameter of fiber-optic cable with polymer optical fiber (POF)	980 µm	---	1000 µm
Cable length	1 m	---	50 m
Line attenuation	---	---	12 dB

NOTICE

↳ Observe the mounting and installation guidelines of the manufacturer of the connectors and cables, especially with regard to the number of bending cycles (bend cable – extend cable). The bending radius for the cables must be > 80 mm.

↳ Use as few connectors as possible in the connection cable.
Ideally, the connection cable consists of a single piece and is connected with one connector on the connection unit and one on the control.
The connection cable should not consist of multiple pieces that are connected by means of connectors.

↳ Use low-loss cables and connectors to achieve a signal reserve of > 4 dB.

8.7 Cable lengths according to the operating voltage

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

The following conditions apply for the necessary operating voltage U_B at the input terminals of the connection unit:

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

	NOTICE
	**The recommended operating voltage is at least 19 V!** Leuze recommends an operating voltage U_B of at least 19 V at the input terminals of the connection unit. ↳ 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.

9 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 4 "Configuration and diagnostic software Sensor Studio")
- Determine the configuration project (see chapter 9.3 "Determine the configuration project")
- Configure the protective function (see chapter 9.4 "Configuring protective function")

↳ Checking function (see chapter 12 "Testing")

9.1 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 (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 12.1 "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
Safety-related switching signals 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 signals 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 *Other* option. ⇨ The **OTHER** 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 mounted (see chapter 7 "Mounting") and connected (see chapter 8 "Electrical connection") correctly.
- 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.
- The configuration and diagnostics software for the safety sensor is installed on the PC (see chapter 4.2 "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
- Field pair changeover
- PROFINET configuration

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

9.2 Connecting safety sensor to PC

9.2.1 Connection via Ethernet cable

- Connect the Ethernet cable to the PC or to the network; see the document "Quick Start Guide RSL 400".
- Define the IP address of the device using an external tool (e.g. *PRONETA* from Siemens).
- Enter the IP address of the device directly in the *Sensor Studio* communication DTM and start communication.

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

9.2.2 Connection via Bluetooth

Prerequisites: Bluetooth communication of the safety sensor has been activated (see chapter 9.2.4 "Communication between safety sensor and 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.

9.2.3 Connection via USB

The USB interface is behind a protection cap on the front of the safety sensor.

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.

NOTICE
- If possible, use the ready-made cables from Leuze (see chapter 18 "Order guide and accessories").

- 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.

9.2.4 Communication between safety sensor and PC

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

Bluetooth

- Bluetooth module deactivated
- Device scan deactivated

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 shown, click the [Project Wizard] button () in the menu bar of the software to start the project wizard.
- Select the configuration mode 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.
- In the initial 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.

9.3 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 shown, click the [Project Wizard] button ( ) in the menu bar of the software to start the project wizard.

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 400 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 4.5.1 "Selecting access level").

↳ Select the configuration mode and click [Next].

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

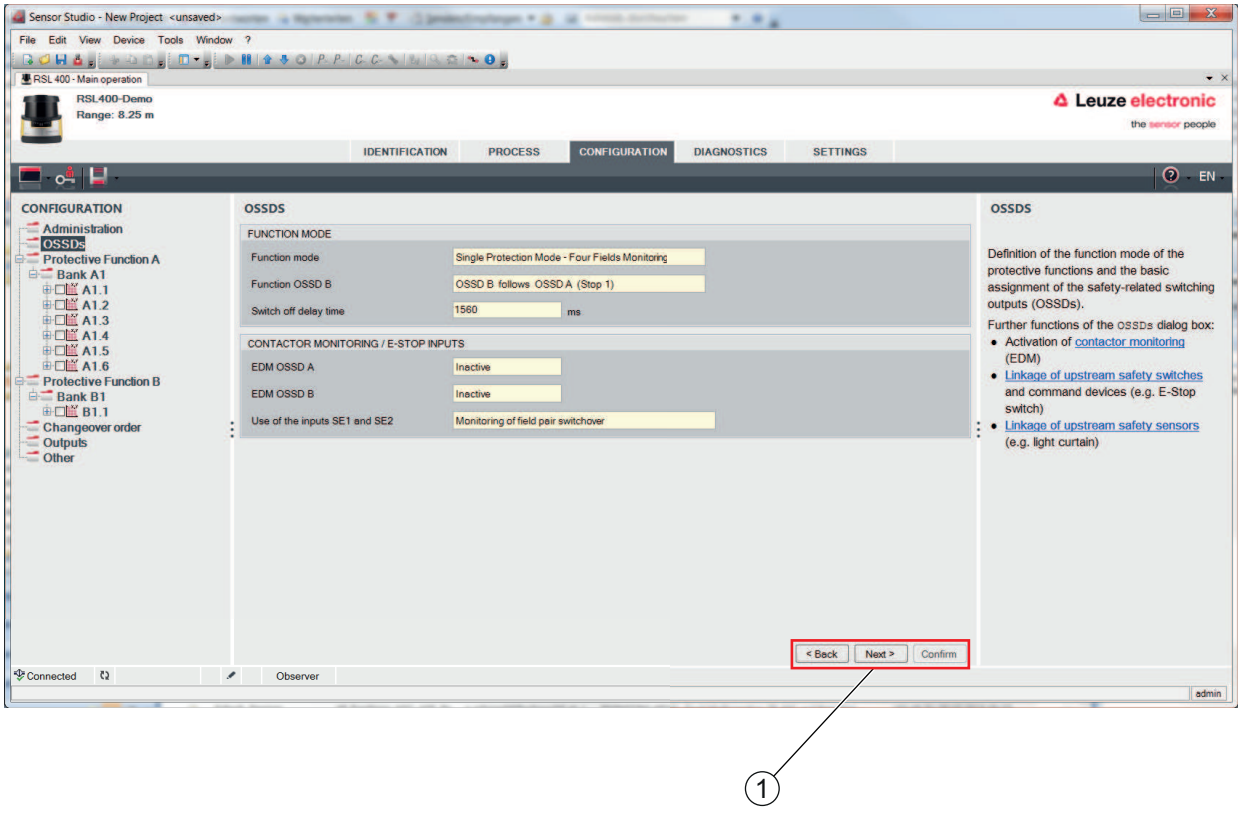
NOTICE

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 Wizard

Fig. 9.1: 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 access levels, see chapter 9.8 "Selecting access level".

9.4 Configuring protective function

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

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

⇨ The CONFIGURATION menu opens with the options:

- Administration
- *Device function*
  If the *Device function* option is selected in the **CONFIGURATION** menu, the *Protective function A* option is displayed.
- *Other*

9.4.1 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].

↳ *Administration*

↳ *Device function*

↳ *Protective function A*

↳ *Bank A1*

↳ *Outputs*

9.4.2 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.

9.4.3 Activate protective function

↳ In the **CONFIGURATION** menu, click the *Device function* option.

⇨ The **DEVICE FUNCTION** dialog box opens.

↳ In the **Protective function operating mode** list, select the protective function of the safety sensor.

⇨ The *Protective function A* option is shown in the **CONFIGURATION** menu.

NOTICE

The changeover-capable protective/warning field pairs for the selected protective function are defined in configuration banks.

↳ Click the [Confirm] button.

9.4.4 Creating and configuring protective/warning field pairs

The changeover-capable protective/warning field pairs for the selected protective function are defined in configuration banks. The configuration banks are shown in the navigation tree of the configuration menu as "Bank", e.g. *Bank A1*.

Creating banks

- In the **CONFIGURATION** menu, click the *Protective function A* option.
- ⇨ The **PROTECTIVE FUNCTION A** dialog box opens.
- Enter the description of the protective function in the input field.
- In the **CONFIGURATION** menu, right-click the *Protective function A* option. Select *Add configuration bank*.
- ⇨ The **Add bank** dialog box opens.
- In the **Bank** list, select the number of the bank and click the [Add] button. When you have added all banks for the protective function, click [Close].

Configuring banks

The resolution for hand, leg or body detection, the response time and start-up behavior of the safety sensor and the field pair changeover for the protective/warning field pairs are configured via the banks.

	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.

- In the **CONFIGURATION** menu, select the bank the configuration of which you want to define.
- In the **RESOLUTION** dialog box, enter the resolution and, if applicable, the maximum speed of an automated guided vehicle (AGV) in the input fields.

	NOTICE
	If in the *Resolution* and *Max. AGV speed* input fields you select values > 0, the application usually used for the bank is displayed in the *Application* field, e.g. *Point of operation guarding*. For access guarding, point of operation guarding and danger zone guarding, you must select *Max. AGV speed* = 0!

- In the **RESPONSE TIME** dialog box, select the response time of the safety sensor.
- In the **START-UP BEHAVIOR** dialog box, select the start-up behavior and the restart time of the safety sensor.

	NOTICE
	Configuration of the start-up behavior is only implemented if the corresponding electrical signal connections exist; see chapter 8 "Electrical connection".

- Click the [Confirm] button.
- Configure all other banks of the protective function following the described procedure.

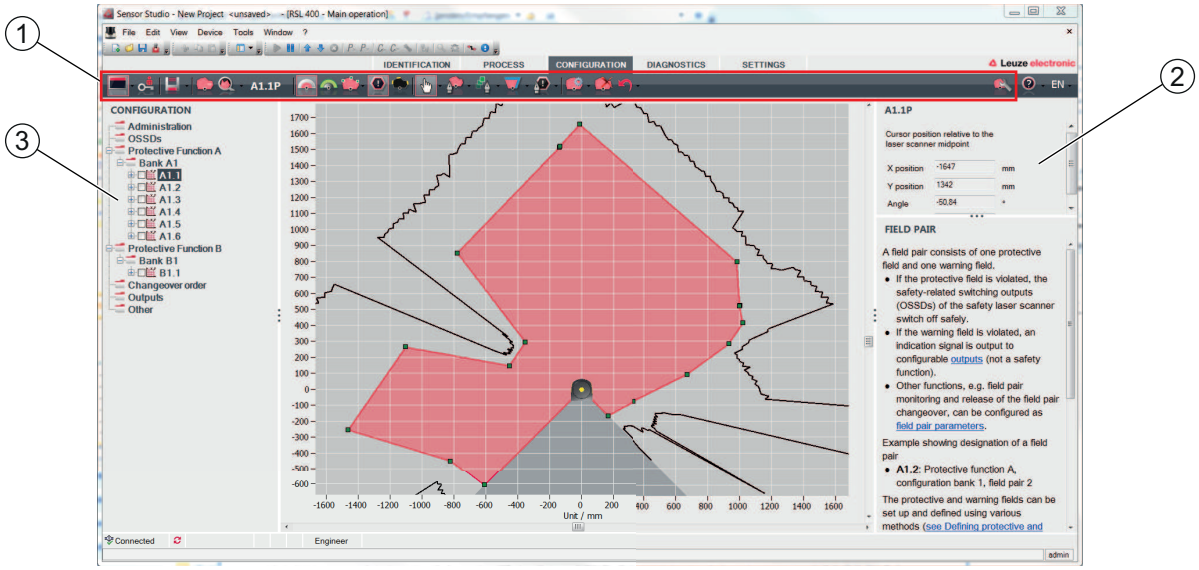
Create protective and warning fields

A field pair consists of one protective field and one warning field.

- In the **CONFIGURATION** menu, right-click the *Bank 1* option under *Protective function_A* Select *Add field pair*.
- ⇨ The **Add field pair** dialog box opens.
- In the **Field pair** list, select the number of the field pair and click the [Add] button. When you have added all field pairs for the bank, click [Close].
- ⇨ The added field pairs are shown in the **CONFIGURATION** menu as an option under *Bank 1* under *Protective function_A*. The *Parameters* option is displayed for each field pair.

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. 9.2: 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
	With protective field boundaries <200 mm, object detection may be restricted owing to the measurement error. ↳ When defining the protective field, take into account the additional distance Z_{sm} to the protective field contour (see chapter 7.2 "Stationary danger zone guarding").

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

	NOTICE
	By right-clicking the field pair in the **CONFIGURATION** menu, you can calculate an autocontour for the protective or warning field. You can determine the display options for the field editor in the menu **SETTINGS > Field editor display options** (see chapter 4.5.6 "SETTINGS").

↳ Configure all other field pairs of the configuration bank following the described procedure.

	NOTICE
	It is also possible to read in an RS4 configuration file as well as to convert the protective fields on the RSL400. Note here, that the converted field pairs are only contour suggestions. Therefore, check that the fields are appropriate for the requirements of your safety application.

9.4.5 Configuring field pair monitoring

- In the **CONFIGURATION** menu, click the *Parameters* option of the field pair the protective and warning fields of which you have defined.
- Select the monitoring mode for the field pair in the **Field pair monitoring** list.

9.5 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 the *protective function A* option.
- In the dialog box **MODE FOR FIELD PAIR ACTIVATION AND CHANGEOVER**, select the field pair activation, the mode for field pair changeover and, if required, the changeover time.

Field pair activation Changeover mode	Description
Fixed selection of one field pair	Changeover of two field pairs
Selection by signal inputs Fixed changeover moment	Changeover of 10 field pairs (see chapter 5.7.3 "Changeover of ten field pairs in changeover mode Fixed changeover moment") 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. The inputs F1 - F5 are active.
Selection by signal inputs Overlapped monitoring	Changeover of 5 field pairs () Both field pairs are monitored during the changeover time. The inputs F1 - F5 are active.

- Click the [Confirm] button.

Determining changeover order

- In the **CONFIGURATION** menu, select the *Changeover order* option.
- ⇨ The **CHANGEOVER ORDER** dialog box opens.
- In the **MONITORING OF FIELD PAIR CHANGEOVER** dialog box, activate the *Monitoring* option.
- In the **MONITORING OF FIELD PAIR CHANGEOVER** dialog box, define the sequence of field pair changeovers according to your conditions.
- Click the [Confirm] button.

9.6 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

- In the menu bar of the FDT frame menu, click the button.
  Alternatively, select the menu command **File > Save**.
- Determine the storage location and the name of the configuration project file.
- Click [Save].

9.7 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 access level, see chapter 9.8 "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].

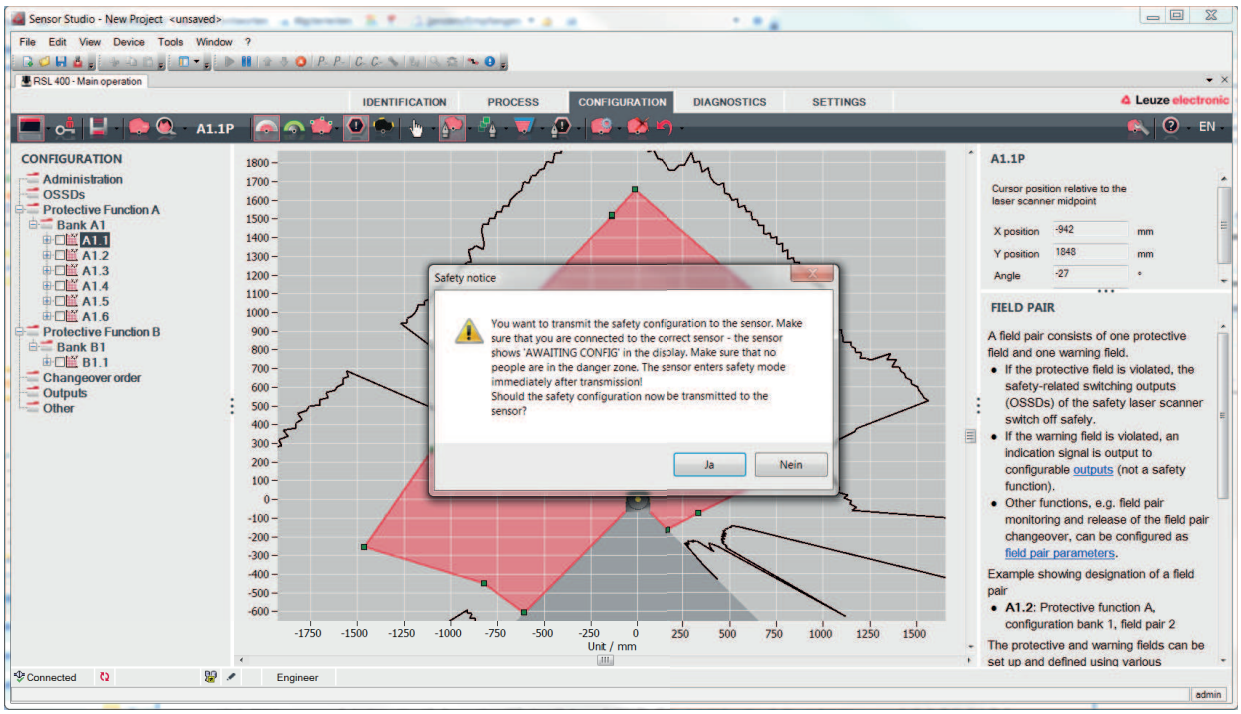


Fig. 9.3: Check before safety configuration is downloaded

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 saved in the connection unit of the safety sensor.
- A copy of the safety configuration is saved in the scanner unit of the safety sensor.
  If, due to a device swap-out, the scanner unit is attached to a brand new, unconfigured connection unit, the safety configuration is transferred from the scanner unit to the connection unit.

NOTICE

Observe the safety notices regarding changes to the configuration!

Transferring the safety configuration from the scanner unit to the connection unit corresponds to reconfiguration of the system consisting of scanner unit and connection unit.

↳ Observe the relevant safety notices regarding changes to the configuration (see chapter 9.1 "Defining safety configuration").

↳ 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.

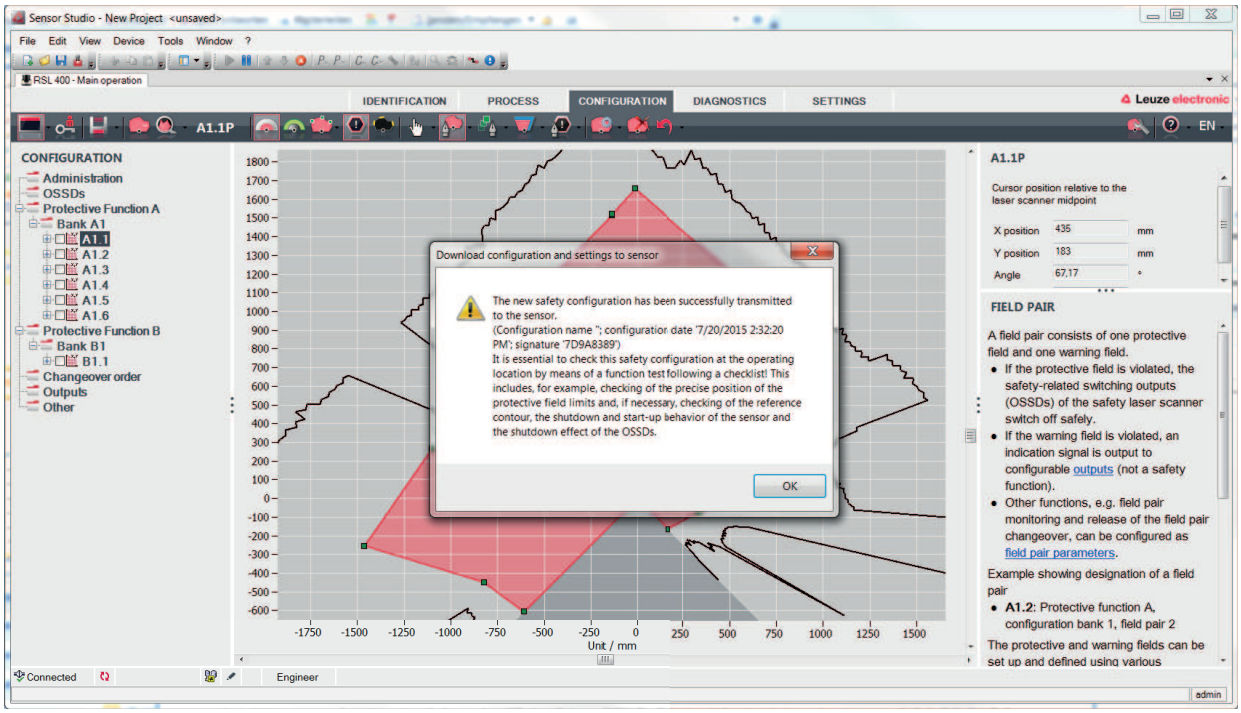


Fig. 9.4: Confirmation: safety configuration downloaded

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.

9.8 Selecting access level

Using the device manager (DTM) you can change the access level of the user, if necessary (see chapter 5.1 "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 **Authorization** list, select the item *Engineer, Expert* or *Observer* and enter the default password or the password defined for the individual user (see chapter 4.5.6 "SETTINGS").

- Default password for *Engineer*: **safety**
- Default password for *Expert*: **comdiag**

↳ Confirm with [OK].

9.9 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 the access level *Engineer* can additionally transfer the changed safety configuration to the safety sensor (see chapter 9.7 "Transferring configuration project to safety sensor").

10 Starting up the device

WARNING

Improper use of the safety sensor may result in serious injury!

- Make certain that the entire device and the integration of the optoelectronic protective device was inspected by competent and instructed persons.
- Make certain that a dangerous process can only be started while the safety sensor is switched on

Prerequisites:

- Safety sensor mounted (see chapter 7 "Mounting") and connected (see chapter 8 "Electrical connection") correctly
- Operating personnel were instructed in proper use
- Dangerous process is switched off, outputs of the safety sensor are disconnected, and the system is protected against being switched back on

- After start-up, check the function of the safety sensor (see chapter 12.1 "Before the initial start-up and following modifications").

10.1 Switching on

Requirements for the supply voltage (power supply unit):

- Safe mains separation is ensured.
- Current reserve of at least 3 A is available.

- Switch on the safety sensor.

10.2 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.

To simplify alignment during start-up, the safety sensors of the RSL 400 series have an integrated electronic spirit level.

- Align the safety sensor using the integrated electronic spirit level.

10.3 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 signals are only enabled if you hold down the reset button for between 0.12 s and 4 s.

10.4 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.

10.5 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 test (see chapter 12.3 "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.

↳ Test the safety sensor (see chapter 12.1 "Before the initial start-up and following modifications").

10.6 Starting up replacement scanner unit

The replacement scanner unit and the original scanner unit must be the same with regard to the following points:

- Scanner unit type in accordance with name plate or downward compatible with previous scanner unit with greater range and greater function range
- Mounting on the existing connection unit

Mounting and aligning replacement scanner unit

↳ Mount the replacement scanner unit on the connection unit instead of the original scanner unit (see chapter 14.1 "Changing scanner unit").

NOTICE

Realignment of safety sensor not necessary!

Realignment of the safety sensor is not necessary since the replacement scanner unit is mounted on the existing, aligned connection unit.

Transferring configuration to replacement scanner unit

The configuration stored in the connection unit is automatically transferred to the replacement scanner unit.

WARNING

Malfunctioning of safety sensor due to incorrect configuration!

↳ The safety sensor configuration stored in the connection unit can only be adopted without changes if the replacement scanner unit and the original scanner unit are downward compatible with respect to range and performance class.
The replacement scanner unit will reject an invalid configuration.

↳ Change the configuration parameters of the safety sensor using the configuration and diagnostic software according to the performance class of the replacement scanner unit.

↳ Change the configuration parameters of the safety sensor using the configuration and diagnostic software according to the operating range of the replacement scanner unit.

Transferring configuration with the PC

If the range and/or performance class of the replacement scanner unit is not compatible with the original scanner unit, you must adapt the configuration of the safety sensor to the replacement scanner unit.

- Connect the safety sensor's Ethernet communication interface with the PC.
- Configure the safety sensor according to the range and performance class of the replacement scanner unit (see chapter 9 "Configuring the safety sensor").
- Transfer the configuration to the safety sensor with the replacement scanner unit.
- ⇨ The alphanumerical display confirms successful transfer of the configuration.
  The replacement scanner unit is not compatible with the connection unit if the safety sensor displays a fault.

	NOTICE
	**Extension of boot time!** After installing large configurations, the boot time of the safety sensor can increase significantly.

Checking replacement scanner unit

The check performed on the replacement device depends on whether you automatically adopted the configuration from the connection unit or whether you transferred the changed configuration to the safety sensor.

- If you adopted the configuration from the connection unit, check the safety sensor using the checklist for the daily test.
- If you transferred a new configuration to the safety sensor, check the safety sensor according to the routine for initial start-up (see chapter 12.1.1 "Checklist for integrator – to be performed prior to the initial start-up and following modifications").

11 PROFIsafe and PROFINET

11.1 Overview

The safety laser scanner is designed as a modular field device and is a PROFIsafe device that communicates cyclically with the assigned PROFIsafe control.

The device can be operated as a single device (standalone) with individual device name in a PROFINET-IO star or tree topology. The control must communicate this device name to the participant during the device naming (see chapter 11.4 "Configuring for the Siemens TIA Portal").

By means of the integrated 2-port IRT switch, operation in a linear or ring topology is also possible.

Performance characteristics

The device has the following performance characteristics:

- A GSDML file is available for the device description
- The device family is certified as a PROFINET-IO device according to V2.34
- PROFINET-IO with real-time (RT) communication
- The device family is certified as a PROFIsafe device:
- Integrated 2-port IRT switch
- Standard Fast Ethernet (100 Mbit/s) connection (M12 or push-pull technology)
- Auto-crossover and auto-negotiation
- Cyclical data exchange
- Detection of topology errors
- Identification & maintenance functions (I&M) IM0 – IM4
- The IP address, the PROFIsafe address or the name assignment is set using, e.g., the Siemens STEP7 or TIA development environment or comparable tools
- Cycle time: min. 1 ms (*MinDeviceInterval*=32)
- Function range acc. to Conformance Class C
- Network class III, security level 1

Communication

Basic communication and integration takes place via the GSDML file (see chapter 11.2 "GSDML file"). The modules of the GSDML file do not support any configuration of the device functionality. Configuration is performed using the *Sensor Studio* configuration software (see chapter 4 "Configuration and diagnostic software Sensor Studio").

Each device has a unique MAC address (Media Access Control) that is specified on the name plate. The MAC address (MAC-ID) is linked to an IP address during the course of configuration. The MAC address can be found on the name plate.

On delivery, the device is assigned the following network address:

- IP address: 0.0.0.0
- Subnet mask: 255.255.255.0

Electrical connection

For the electrical connection of the supply voltage and the interface, M12 connectors/sockets or AIDA push/pull connectors/sockets are mounted on the device (see chapter 8 "Electrical connection").

11.2 GSDML file

The functionality of the safety laser scanner via the PROFINET interface is defined with input/output data that is defined in the modules of the GSDML file (see chapter 11.5 "PROFINET project modules").

A user-specific configuration tool is used during PLC program creation to integrate the required modules and configure them appropriately for their respective use.

When operating the device on the PROFINET, all input/output data is occupied with default values. If this input/output data is not changed by the user, the device operates with the default settings set by Leuze on delivery. The default settings of the device can be found in the module descriptions.

NOTICE

Observe when configuring PROFINET devices!

- **Always** perform the basic configuration using the GSDML file (GSDML=Generic Station Description Markup Language).
- Download the appropriate GSDML file from the Internet: **www.leuze.com**.
- In process operation, the input/output data of the respective, activated GSDML modules are exchanged with the control.
- Settings configured with the *Sensor Studio* configuration software are overwritten by the PROFINET master with the settings made via the GSDML file upon connection to PROFINET.

General information on the GSDML file

The term GSD (Generic Station Description) stands for the textual description of a PROFINET device model. For the description of the complex PROFINET device model, the XML-based GSDML (Generic Station Description Markup Language) was introduced.

- In the GSDML file, all data necessary for operating the device is described in modules:
  - Input and output data
  - Definition of control bits or status bits.
- During configuration, different module structures and their properties can be selected via Device Access Points (DAPs) that are created in the GSDML file.
- The GSDML file can support an arbitrary number of languages in one file. Every GSDML file contains a version of the RSL 400 PROFIsafe device model. This is also reflected in the file name.
- The GSDML file is a certified and integral part of the device and must not be changed. The file is not changed by the system either. If parameters are changed in the project tool, for example, these changes are stored by the control in the project, not in the GSDML file.

NOTICE

GSDML file name structure

The file name of the GSDML file is constructed according to the following rule:

GSDML-[GSDML schema version]-Leuze-RSL400P [connection unit]-[date].xml

[GSDML schema version] = Version identifier of the GSDML schema version used, e.g., V2.34

[Date] = Release date of the GSDML file in the format yyyymmdd

This date also stands for the release date of the file.

Example: **GSDML-V2.34-LEUZE-RSL400P CU M12-20190608.xml**
for RSL400 PROFIsafe devices with M12 connection unit

The following connection units are defined for the GSDML files:

- CU M12: connection unit with M12 connectors/sockets
- CU 4M12: connection unit with L-coded M12 connectors/sockets for the voltage supply
- CU AIDA: connection unit with push-pull connectors/sockets for copper cables
- CU AIDA OF: connection unit with push-pull connectors/sockets for fiber-optic cables

PROFINET module structures

There are two PROFINET module structures available for configuring the functionality of the safety laser scanner (see chapter 11.5 "PROFINET project modules").

The desired PROFINET module structure is selected during configuration via Device Access Points (DAPs) in the GSDML file.

- DAP 1: project modules [M1] … [M8] (see chapter 11.5.1 "Project modules for DAP 1")
- DAP 2: project modules [M11] … [M17] (see chapter 11.5.2 "Project modules for DAP 2")

NOTICE

- DAP 1 project modules are only available for PROFIsafe version 2.4.
- DAP 2 project modules are available for PROFIsafe versions 2.4 and 2.6.

NOTICE

- The DAP 2 project modules can only be used in combination with a device firmware version of 5.4 or higher and a connection unit firmware version of 2.0 or higher.

GSDML files

The following GSDML files are available:

- For devices with M12 connection unit (CU M12):
  - DeviceID: 0x0011
  - Textual designation for configuration:
    RSL400P M12: modules [M1] … [M8] (DAP 1)
    RSL400P M12 V2: modules [M11] … [M17] (DAP 2)
- For devices with AIDA connection unit for copper cables (CU AIDA):
  - DeviceID: 0x0012
  - Textual designation for configuration:
    RSL400P AIDA: modules [M1] … [M8] (DAP 1)
    RSL400P AIDA V2: modules [M11] … [M17] (DAP 2)
- For devices with AIDA connection unit for fiber-optic cables (CU AIDA-OF):
  - DeviceID: 0x0013
  - Textual designation for configuration:
    RSL400P AIDA-OF: modules [M1] … [M8] (DAP 1)
    RSL400P AIDA-OF V2: modules [M11] … [M17] (DAP 2)
- For devices with connection unit with L-coded M12 connectors/sockets for the voltage supply (CU 4M12):
  - DeviceID: 0x0016
  - Textual designation for configuration:
    RSL400P 4M12: modules [M1] … [M8] (DAP 1)
    RSL400P 4M12 V2: modules [M11] … [M17] (DAP 2)

You can find the GSDML files for the device on the Internet at www.leuze.com. Download the appropriate GSDML file from the Internet:

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

11.3 Integrating in a PROFIsafe network

11.3.1 Network topology

RSL 400 PROFIsafe devices can be integrated in the following network topologies:

- Star
- Line
- Ring

11.3.2 Addressing

The following information is needed for the RSL 400 PROFIsafe to exchange data with other devices in the network:

- PROFINET name
- Unique IP address
- Subnet mask
- If applicable, the IP address of the router.

You can assign the data to the RSL 400 PROFIsafe in the following ways:

- *Sensor Studio* configuration software
- Configuration software for a PROFINET network
- PROFINET control

	NOTICE
	Storing IP address permanently in the device ↳ If you store the IP address permanently in the RSL 400 PROFIsafe, it is retained even after the device is switched off. ↳ The IP address can, however, be changed by the PROFINET control.

11.3.3 Configuring the PROFINET control

	NOTICE
	For further information on configuring the PROFINET control, see see chapter 11.4 "Configuring for the Siemens TIA Portal".

Proceed as follows to configure the PROFINET control:

↳ Load the GSDML file in the configuration software of the control.

↳ Select the desired device in the hardware catalog, e.g., use the search function and enter *RSL400* or *Leuze*.

↳ Add the device to the project and connect the device to the control.

↳ Select the PROFINET project modules according to the process image (see chapter 11.5 "PROFINET project modules").

↳ Assign a unique PROFINET device name.

↳ Set the PROFIsafe parameters.

Tab. 11.1: PROFIsafe parameters

Parameter	Meaning	Setting
F_SIL	Safety integration level of the safety laser scanner	SIL2 (not changeable)
F_Block_ID		’0’ (not changeable)
F_Par_Version	PROFIsafe operating mode	’0’ (not changeable)

Parameter	Meaning	Setting
F_Source_Add	Address of the safe control. Must be unique in combination with F_Dest_Add.	1 … 65534
F_Dest_Add	Address of the safety laser scanner. Address F_Dest_Add must be unique. F_Dest_Add must be the same address as is assigned in the configuration of the RSL 400 PROFIsafe device.	1 … 65534
F_WD_Time	Watchdog time for the cyclical service. The watchdog time should be long enough that small delays in the communication are tolerated. The watchdog time affects the response time of the total system and is therefore relevant to safety.	80 ms … 10000 ms Depending on the application

- Configure the RSL 400 PROFIsafe device (if not yet performed; see chapter 9 "Configuring the safety sensor").
- If necessary, perform further configurations in the *Sensor Studio* configuration software.

11.4 Configuring for the Siemens TIA Portal

The functionality of the device is defined via input/output data, which is organized in modules (see chapter 11.5 "PROFINET project modules"). The modules are part of the device description file (GSDML file, see chapter 11.2 "GSDML file").

By using a user-specific configuration tool, such as SIMATIC Manager or TIA Portal, the required modules are integrated in a project during programming via the control. These modules are provided by the GSDML file.

Integrating RSL 400 PROFIsafe in an existing project

The following steps are necessary for commissioning:

To integrate in an existing project – control (PLC) is already configured – the following steps are necessary:

- Start RSL 400 PROFIsafe
- Prepare the control
- Install the device description file (GSDML file)
- Start TIA Portal
- Load the device description file
- Integrate the RSL 400P in the project
- Connect the RSL 400P to the control
- Add safety module
- Configure RSL400P header module
- Configure the safety module
- Conclude configuration

11.4.1 Start RSL 400 PROFIsafe

- Connect the supply voltage (typ. +24 V DC).
  - ⇨ The RSL 400 PROFIsafe starts up.

11.4.2 Prepare the control

- Assign the IO controller of the control an IP address.
- Prepare the control for consistent data transmission.

11.4.3 Install the GSDML file

The following GSDML files are available:

- For devices with M12 connection unit (CU M12):
  - DeviceID: 0x0011
  - Textual designation for configuration:
    RSL400P M12: modules [M1] … [M8] (DAP 1)
    RSL400P M12 V2: modules [M11] … [M17] (DAP 2)
- For devices with AIDA connection unit for copper cables (CU AIDA):
  - DeviceID: 0x0012
  - Textual designation for configuration:
    RSL400P AIDA: modules [M1] … [M8] (DAP 1)
    RSL400P AIDA V2: modules [M11] … [M17] (DAP 2)
- For devices with AIDA connection unit for fiber-optic cables (CU AIDA-OF):
  - DeviceID: 0x0013
  - Textual designation for configuration:
    RSL400P AIDA-OF: modules [M1] … [M8] (DAP 1)
    RSL400P AIDA-OF V2: modules [M11] … [M17] (DAP 2)
- For devices with connection unit with L-coded M12 connectors/sockets for the voltage supply (CU 4M12):
  - DeviceID: 0x0016
  - Textual designation for configuration:
    RSL400P 4M12: modules [M1] … [M8] (DAP 1)
    RSL400P 4M12 V2: modules [M11] … [M17] (DAP 2)

NOTICE

- DAP 1 project modules are only available for PROFIsafe version 2.4.
- DAP 2 project modules are available for PROFIsafe versions 2.4 and 2.6.

NOTICE

- The DAP 2 project modules can only be used in combination with a device firmware version of 5.4 or higher and a connection unit firmware version of 2.0 or higher.

Download the corresponding GSDML file from the Leuze homepage:

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

NOTICE

Do not change the GSDML file!

The GSDML file is a certified and integral part of the device and must not be changed. The file is not changed by the system either.

If parameters are changed in the project tool, for example, these changes are stored by the control in the project, not in the GSDML file.

- Load the GSDML file for the configuration of the safety laser scanner (see chapter 11.4.5 "Load the device description file (GSDML file)").

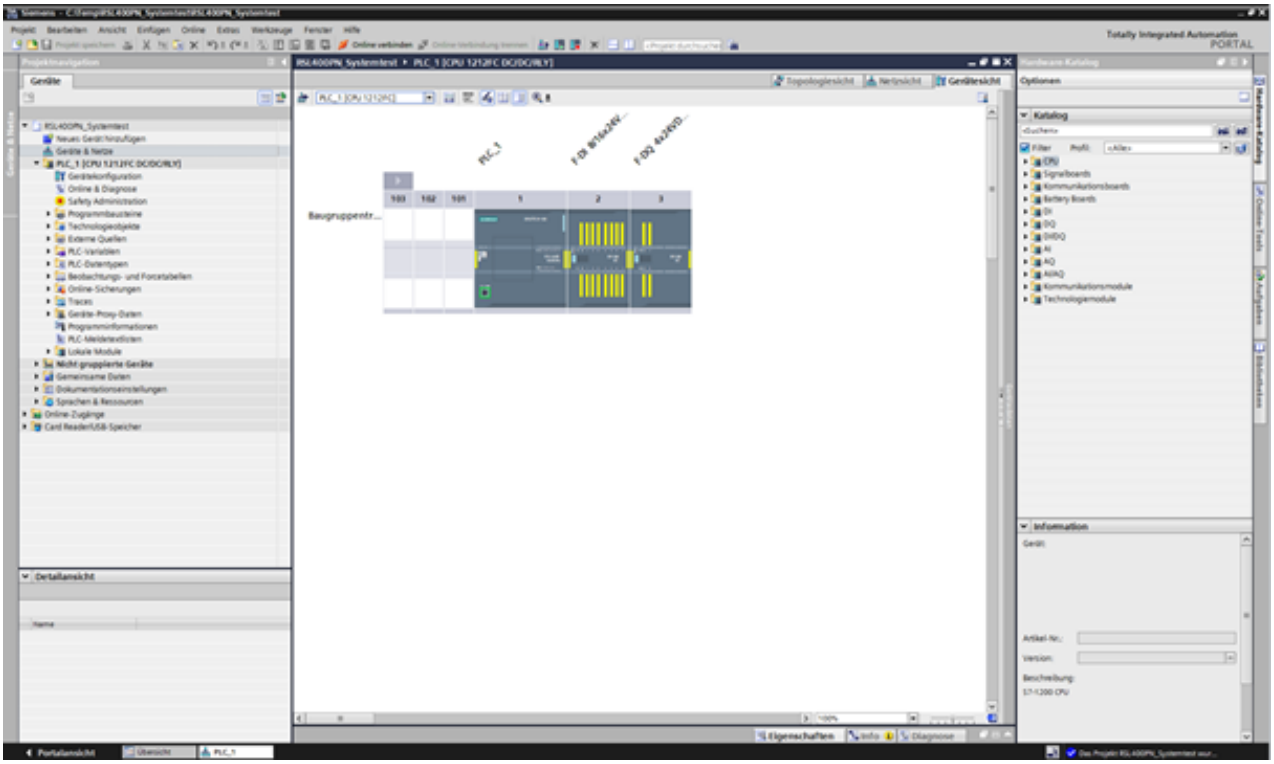
11.4.4 Start TIA Portal

↳ Start the TIA portal and open an existing project with the configured control (PLC).

↳ Select the *Devices & Networks* option.

↳ Select the configured PLC with a double-click.

⇨ The device view dialog is displayed



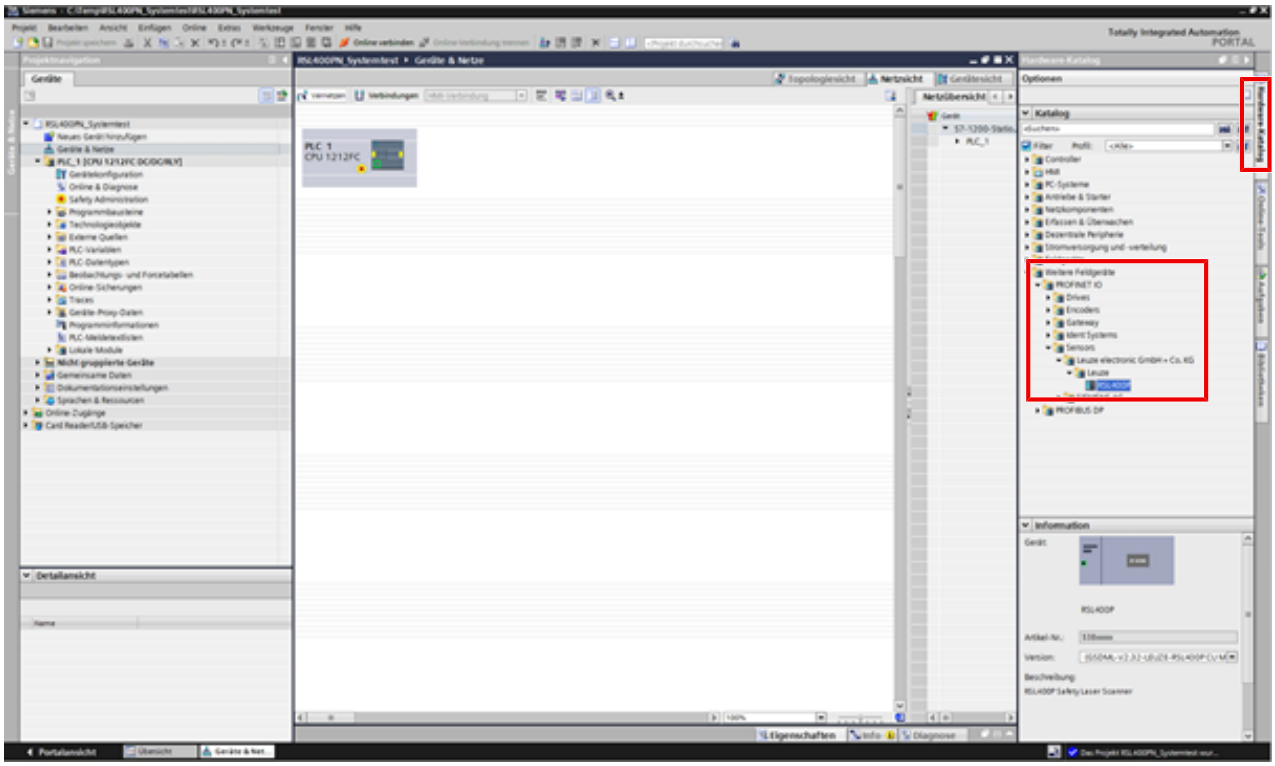
11.4.5 Load the device description file (GSDML file)

- Open the dialog via **Tools > Manage device description file (GSD)**.
- Select the RSL 400 device description file (GSDML file) and click the [Install] button.
- Close the *Manage device description file* dialog.
  - ⇨ The hardware catalog is updated.

11.4.6 Integrate the RSL 400P in the project

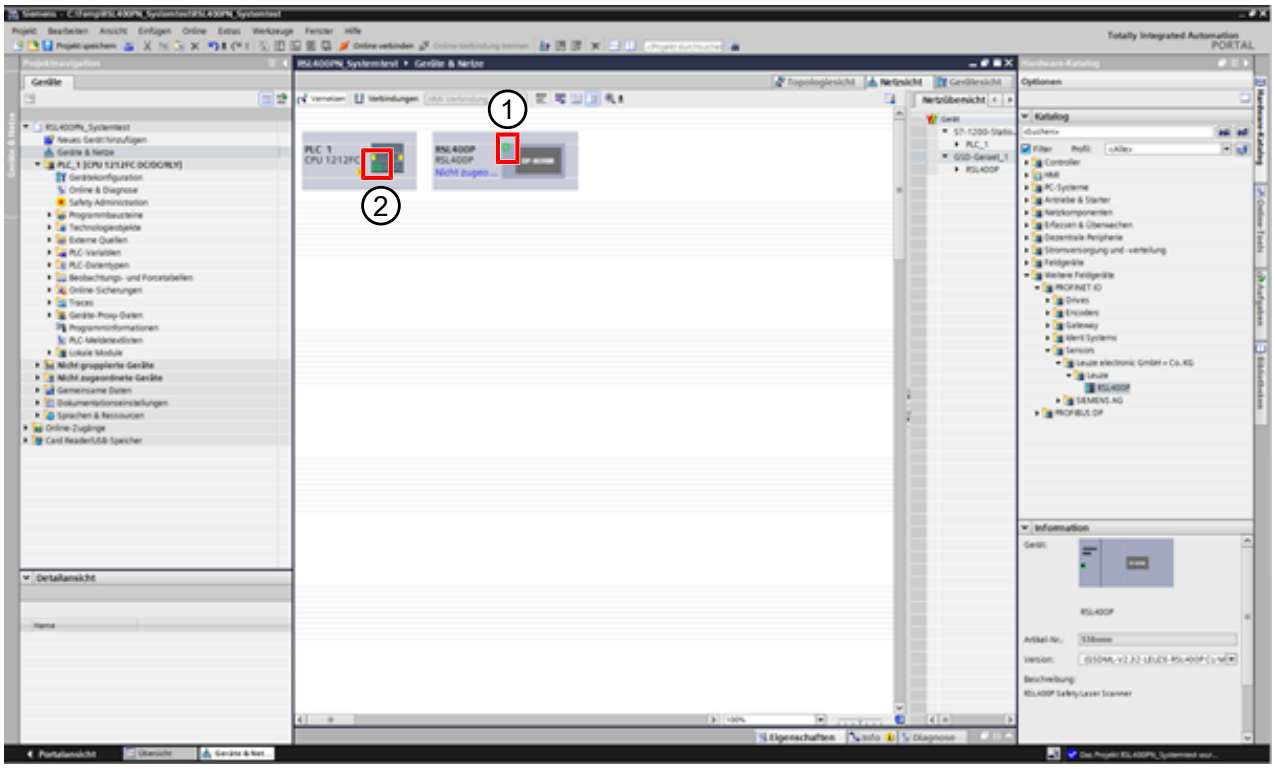
In the project navigation, select **Devices & Networks** and select the *Network view* tab.

- Open the hardware catalog.
  Double-click to select
  Other field devices > Profinet IO > Sensors > Leuze electronic GmbH+Co.KG > Leuze > RSL400P.



11.4.7 Connect the RSL 400P to the control

↳ With the left mouse button pressed down, connect the PROFINET port of the RSL 400P(1) to the port of the PLC (2).

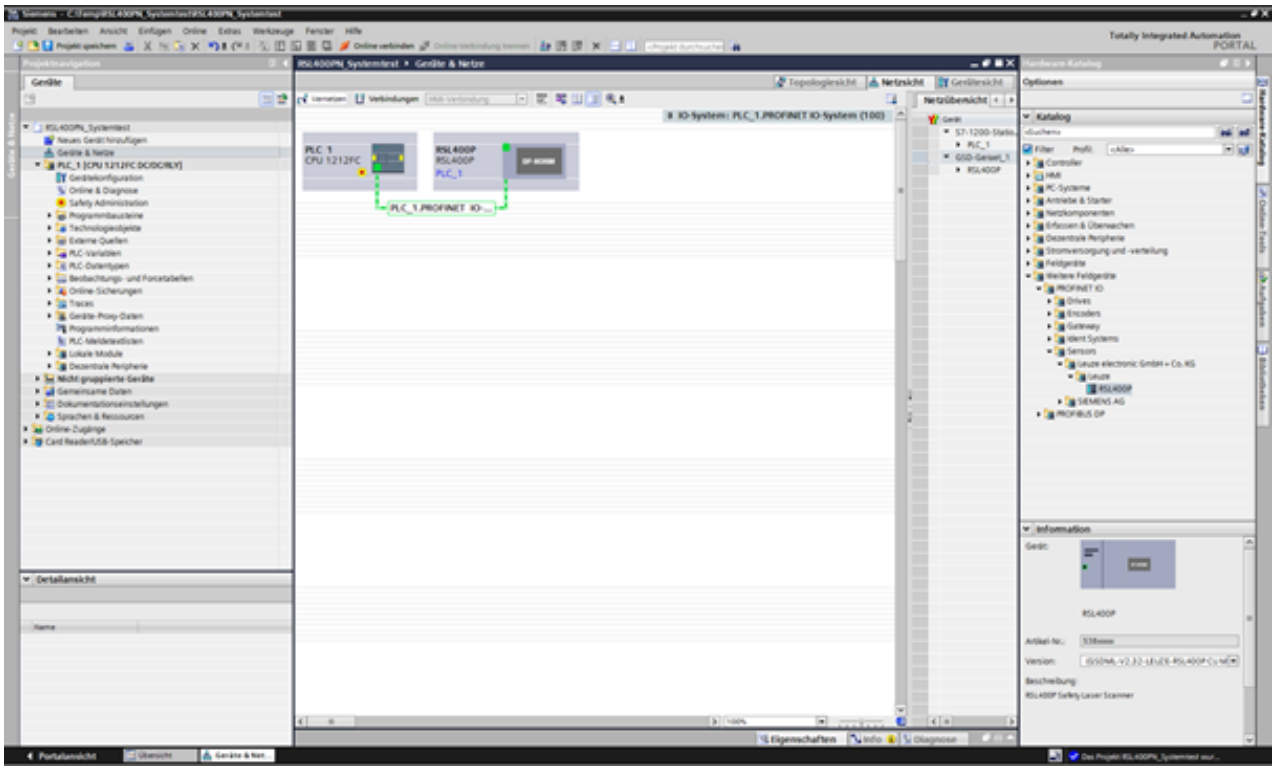


1 PROFINET port of the RSL 400P
2 Port of the PLC

NOTICE

↳ Make certain that the correct PLC port is selected if multiple ports are configured in the PLC.

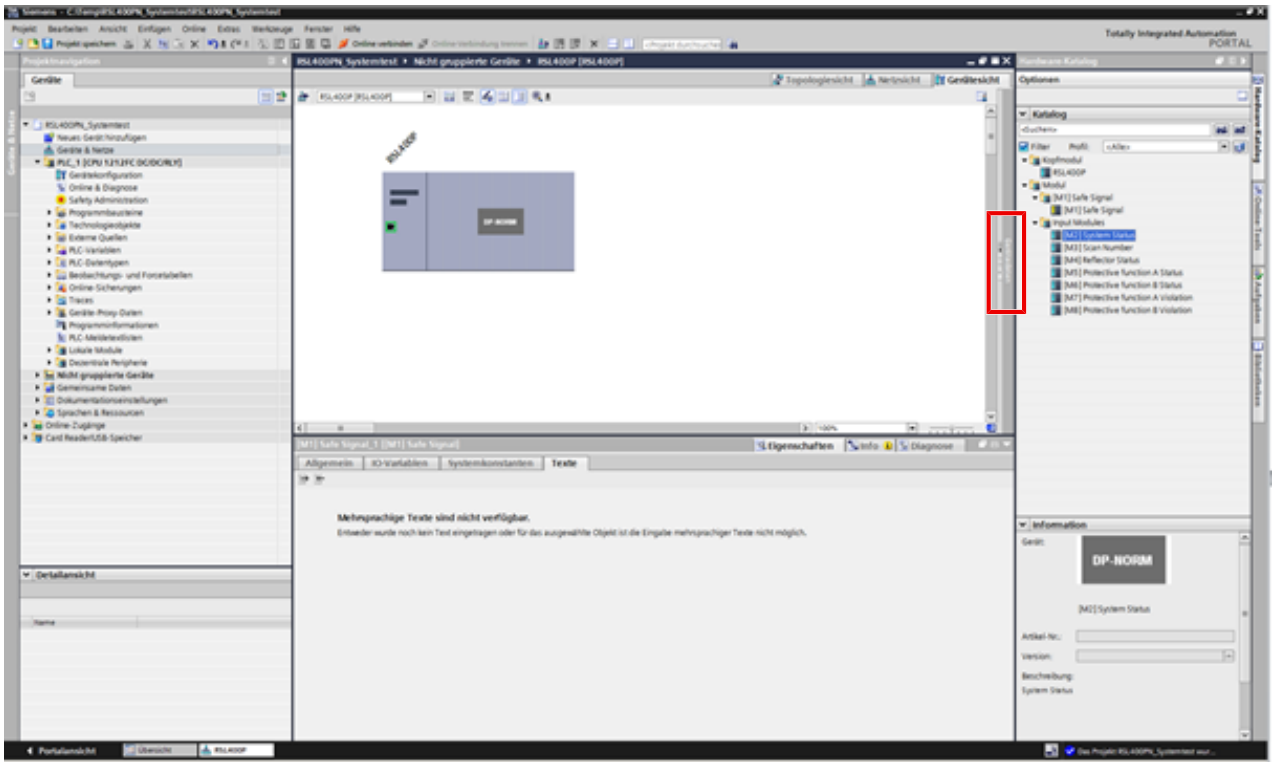
⇨ The RSL 400P is connected to the PLC via PROFINET-IO.



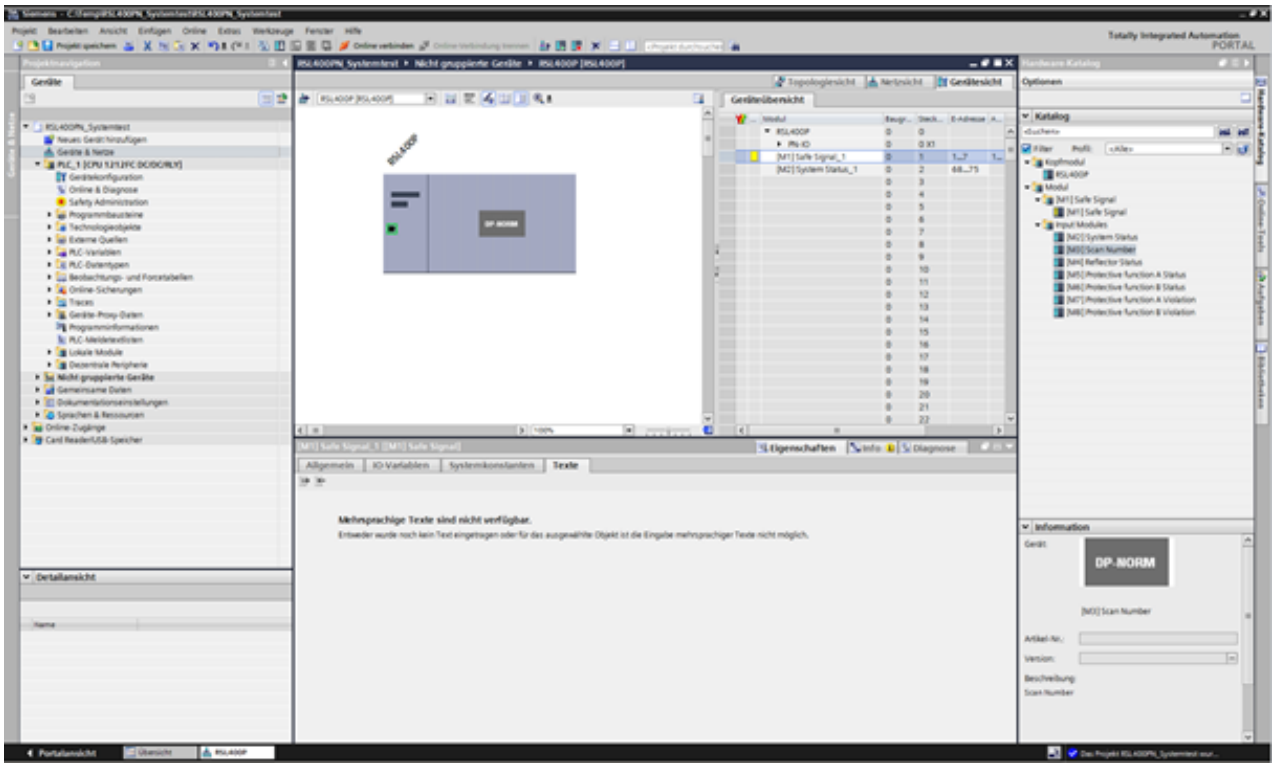
11.4.8 Add safety module

↳ Open the device view of the RSL400P by double-clicking on the *RSL400P* list entry.

↳ Insert the PROFINET safety module:
Hardware catalog > Catalog > Module > [M1] Safe Signal
; double-click on *[M1] Safe Signal*.



↳ If necessary, insert other non-safety-oriented PROFINET modules.
Expand the **Device data** dialog box in the device view.
You can only insert PROFINET modules that are listed under the *Device overview* tab.



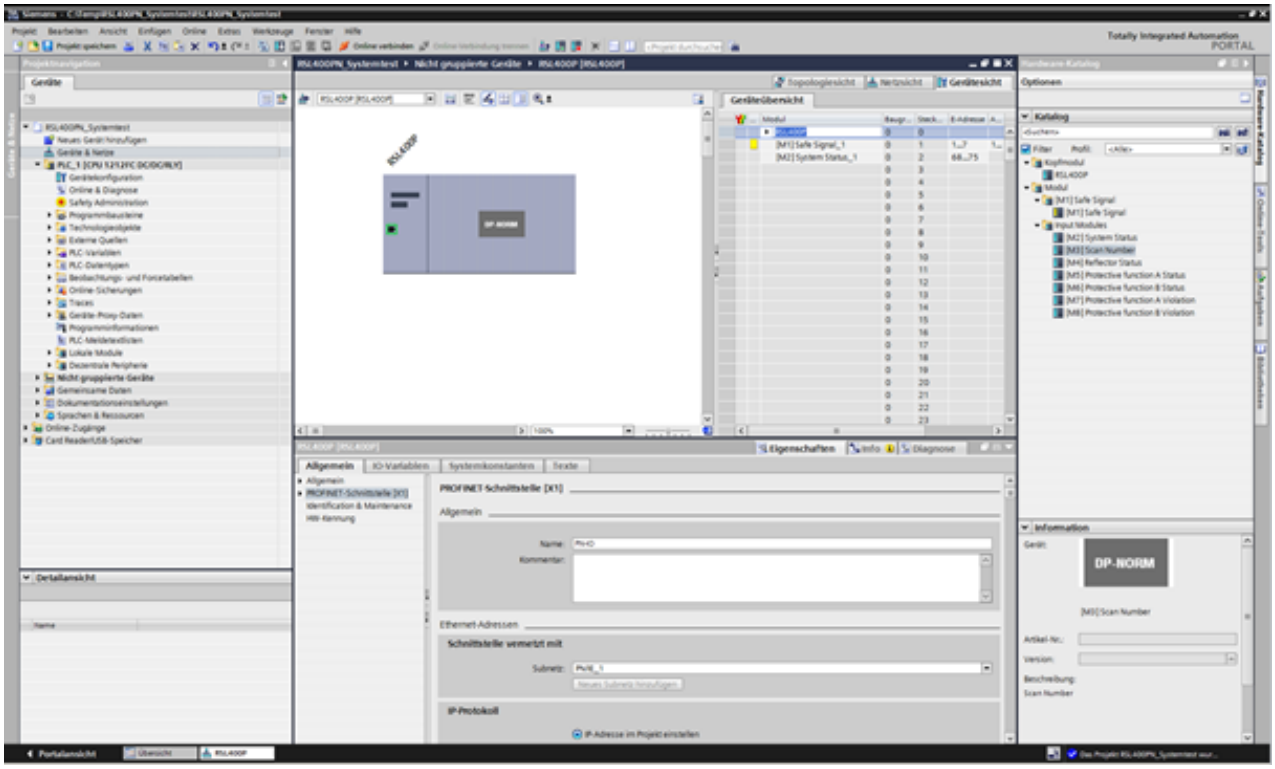
11.4.9 Configure RSL400P header module

↳ Expand the **Device data** dialog box in the device view.

↳ On the *Device overview* tab, select the RSL400P module. Perform the configuration via **Properties > General**.

↳ Set the Ethernet addresses and the PROFINET device names.

- Assign each IP address a unique PROFINET device name.



NOTICE

Assign unique device names!

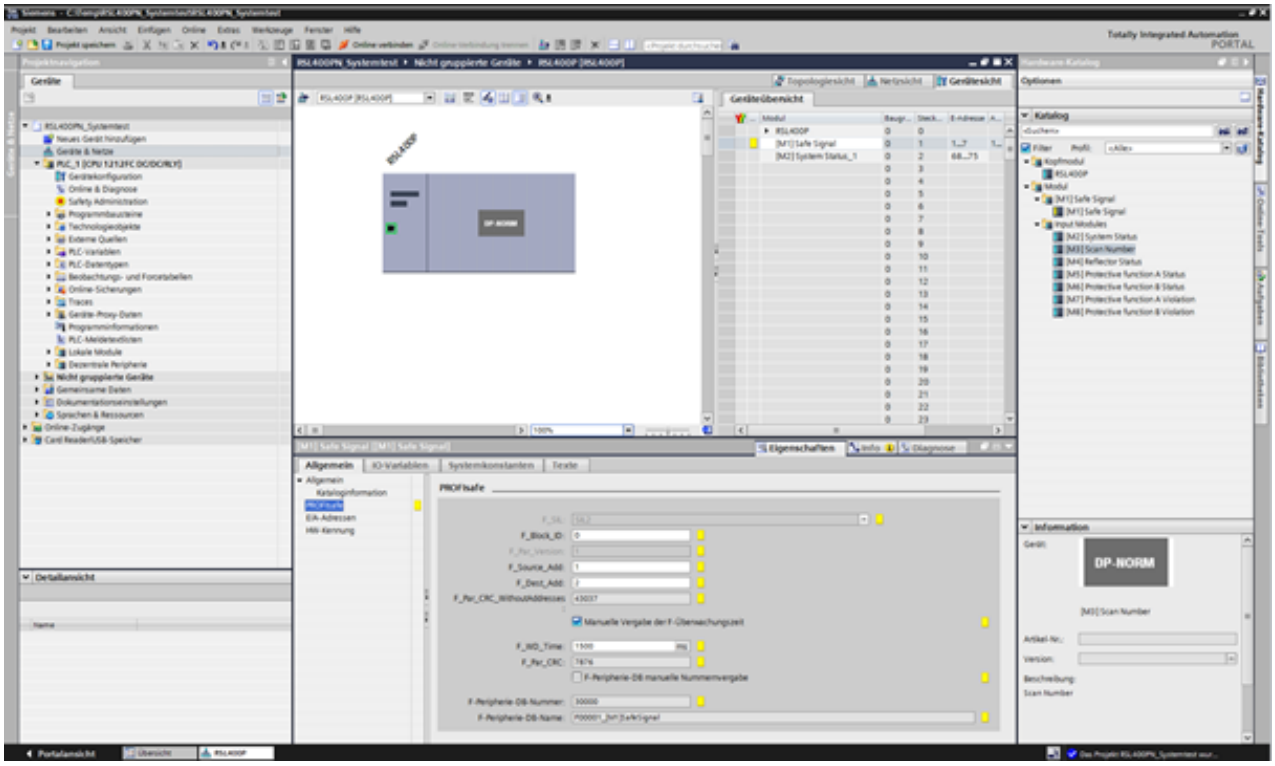
↳ Ensure that the device names are unique and that all participants are located in the same subnet.

↳ Perform other configuration settings as necessary.

11.4.10 Configure the safety module

On the *Device overview* tab, select module [M1] Safe Signal.

↳ Set the PROFIsafe parameters via **Properties > General > PROFIsafe**.



PROFIsafe parameters are marked in yellow

Set the safe device address via the PROFIsafe parameters; (PROFIsafe address; see chapter 11.3.3 "Configuring the PROFINET control").

The PROFIsafe address must be unique.

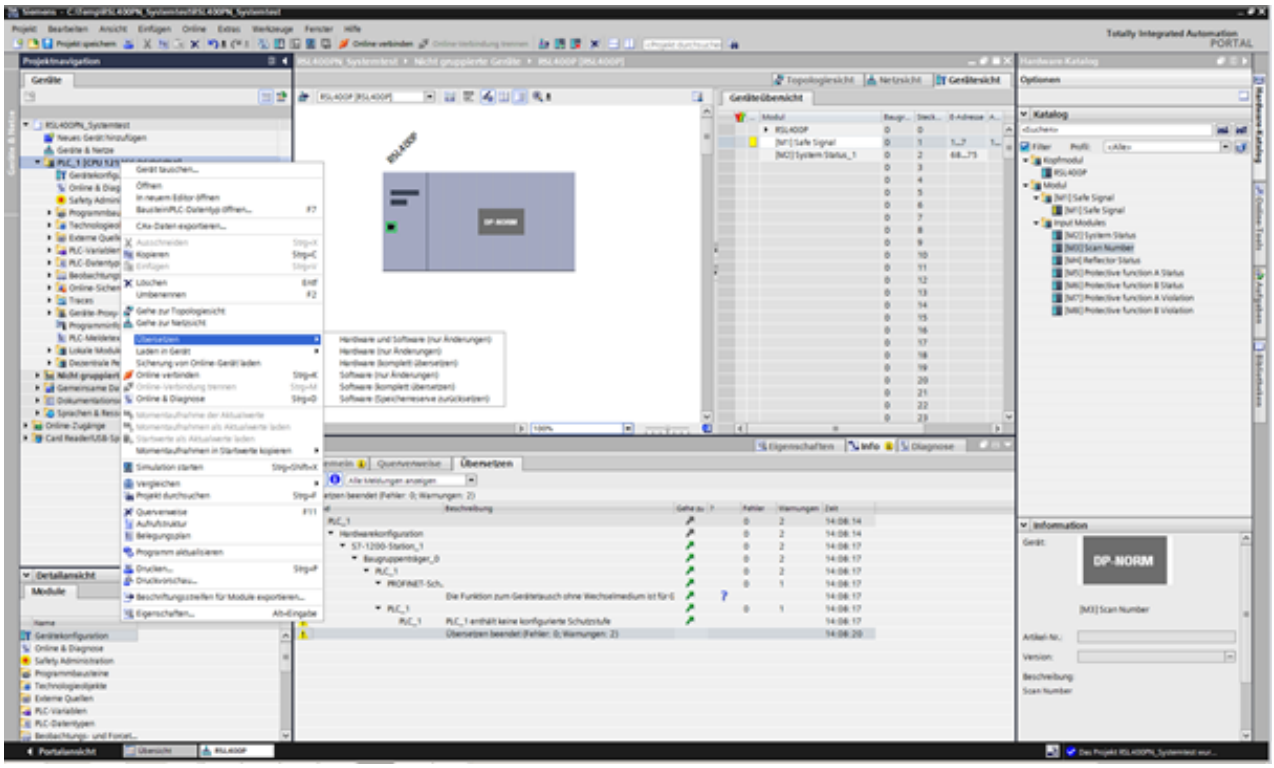
NOTICE

Default PROFIsafe parameters in the GSDML file

The GSDML file defines the default values for the PROFIsafe parameters. The default values are used if the PROFIsafe parameters were not modified when configuring.

11.4.11 Conclude configuration

↳ On the *Devices* tab, select
PLC > Compile > Hardware.



11.5 PROFINET project modules

During configuration, different module structures and their properties can be selected via Device Access Points (DAPs) that are created in the GSDML file:

- DAP 1: project modules [M1] … [M8] (see chapter 11.5.1 "Project modules for DAP 1")
- DAP 2: project modules [M11] … [M17] (see chapter 11.5.2 "Project modules for DAP 2")

NOTICE

↳ DAP 1 project modules are only available for PROFIsafe version 2.4.

↳ DAP 2 project modules are available for PROFIsafe versions 2.4 and 2.6.

NOTICE

↳ The DAP 2 project modules can only be used in combination with a device firmware version of 5.4 or higher and a connection unit firmware version of 2.0 or higher.

NOTICE

If the scanner is separated from the PROFINET communication unit, the connection is automatically terminated and the communication channel is blocked. In this state, the configured modules no longer update any data. The switch functionality of the PROFINET connection continues to exist.

11.5.1 Project modules for DAP 1

Modules [M1] … [M8]

- For devices with M12 connection unit (CU M12):
  - DeviceID: 0x0011

  - Textual designation for configuration:
    RSL400P M12
- For devices with AIDA connection unit for copper cables (CU AIDA):
  - DeviceID: 0x0012
  - Textual designation for configuration:
    RSL400P AIDA
- For devices with AIDA connection unit for fiber-optic cables (CU AIDA-OF):
  - DeviceID: 0x0013
  - Textual designation for configuration:
    RSL400P AIDA-OF
- For devices with connection unit with L-coded M12 connectors/sockets for the voltage supply (CU 4M12):
  - DeviceID: 0x0016
  - Textual designation for configuration:
    RSL400P 4M12

Module	Description	Input data [Byte]	Output data [Byte]
[M1] SAFE_SIGNAL see chapter 11.5.3 "Module [M1] - SAFE_SIGNAL"	Safe module with the safe signals and the most important status signals for simple system diagnostics.	3	3
[M2] SYSTEM_STATUS see chapter 11.5.4 "Module [M2] - SYSTEM_STATUS"	General information on error diagnostics and system alignment.	8	0
[M3] SCAN_NUMBER see chapter 11.5.5 "Module [M3] – SCAN_NUMBER"	Sequential scan number	4	0
[M4] REFLECTOR_STATUS see chapter 11.5.6 "Module [M4] – REFLECTOR_STATUS"	Information on reflectors in the field of view of the safety laser scanner	2	0
[M5] PROTECTIVE_FUNC-TION_A_STATUS see chapter 11.5.7 "Module [M5] – PROTECTIVE_FUNC-TION_A_STATUS"	Detailed status of protective function A	3	0
[M6] PROTECTIVE_FUNC-TION_B_STATUS see chapter 11.5.8 "Module [M6] – PROTECTIVE_FUNC-TION_B_STATUS"	Detailed status of protective function B	3	0

Module	Description	Input data [Byte]	Output data [Byte]
[M7] PROTECTIVE_FUNC-TION_A_VIOLATION see chapter 11.5.9 "Module [M7] – PROTECTIVE_FUNC-TION_A_VIOLATION"	Information on protective field interruption or warning field interruption of protective function A	8	0
[M8] PROTECTIVE_FUNC-TION_B_VIOLATION see chapter 11.5.10 "Module [M8] – PROTECTIVE_FUNC-TION_B_VIOLATION"	Information on protective field interruption or warning field interruption of protective function B	8	0

11.5.2 Project modules for DAP 2

Modules [M11] … [M17]

- For devices with M12 connection unit (CU M12):
  - DeviceID: 0x0011
  - Textual designation for configuration:
    RSL400P M12 V2
- For devices with AIDA connection unit for copper cables (CU AIDA):
  - DeviceID: 0x0012
  - Textual designation for configuration:
    RSL400P AIDA V2
- For devices with AIDA connection unit for fiber-optic cables (CU AIDA-OF):
  - DeviceID: 0x0013
  - Textual designation for configuration:
    RSL400P AIDA-OF V2
- For devices with connection unit with L-coded M12 connectors/sockets for the voltage supply (CU 4M12):
  - DeviceID: 0x0016
  - Textual designation for configuration:
    RSL400P 4M12 V2

Module	Description	Input data [Byte]	Output data [Byte]
[M11] SAFE_SIGNAL_PS2V4 see chapter 11.5.11 "Module [M11] - SAFE_SIGNAL_PS2V4"	For PROFIsafe version 2.4: Safe module containing the safe input and output signals.	3	7
[M11] SAFE_SIGNAL_PS2V6 see chapter 11.5.12 "Module [M11] - SAFE_SIGNAL_PS2V6"	For PROFIsafe version 2.6: Safe module containing the safe input and output signals.	2	6
[M12] SYSTEM_STATUS see chapter 11.5.13 "Module [M12] - SYSTEM_STATUS"	General information on the status of the de-vice and safety functions. Simple system diagnostics is possible.	6	0

Module	Description	Input data [Byte]	Output data [Byte]
[M13] SYSTEM_DATA see chapter 11.5.14 "Module [M13] – SYSTEM_DATA"	Current data: Alignment of the safety laser scanner Voltage supply Inside temperature	8	0
[M14] PROTECTIVE_FUNC-TION_A_STATUS see chapter 11.5.15 "Module [M14] – PROTECTIVE_FUNC-TION_A_STATUS"	Detailed status of protective function A	8	0
[M15] PROTECTIVE_FUNC-TION_B_STATUS see chapter 11.5.16 "Module [M15] – PROTECTIVE_FUNC-TION_B_STATUS"	Detailed status of protective function B	8	0
[M16] PROTECTIVE_FUNC-TION_A_VIOLATION see chapter 11.5.17 "Module [M16] – PROTECTIVE_FUNC-TION_A_VIOLATION"	Information on protective field interruption or warning field interruption of protective function A	8	0
[M17] PROTECTIVE_FUNC-TION_B_VIOLATION see chapter 11.5.18 "Module [M17] – PROTECTIVE_FUNC-TION_B_VIOLATION"	Information on protective field interruption or warning field interruption of protective function B	8	0

11.5.3 Module [M1] - SAFE_SIGNAL

- Module ID: 0x00000002
- Submodule ID: 0x00000001

Description

The module defines the safe input and output data of the RSL 400 PROFIsafe:

- The protective fields and configuration banks are changed over via the output data.
- The output data contains the start signals for releasing a manual (re-)start as well as possibilities for controlling the data recorder.
- The input data contains the safe switching signals for the protective fields and warning fields of the RSL 400 PROFIsafe.
- The input data contains the most important diagnostic information for the protective functions, the RSL 400 and PROFIsafe. Simple device diagnostics is made possible by integrating this module.

	NOTICE
	The layout of the output data varies depending on the function mode of the RSL 400 PROFIsafe. For this reason, the layout of the output data is listed separately for each function mode.

Input data structure module SAFE_SIGNAL

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value '0'	Value '1'	Safe	Description
0	0	0	Bit	A-SAFE-WF-CLEAR			Y	Safe switching signal of warning field free - protective function A
		1	Bit	A-SAFE-PF-CLEAR	ASSIGNED	FREE	Y	Safe switching signal of protective field free - protective function A
		2	Bit	B-SAFE-WF-CLEAR			Y	Safe switching signal of warning field free - protective function B
		3	Bit	B-SAFE-PF-CLEAR	ASSIGNED	FREE	Y	Safe switching signal of protective field free - protective function B
		4	Bit	A-WF-VIO	ASSIGNED	FREE	N	Status of active warning field - protective function A
		5	Bit	A-PF-VIO	ASSIGNED	FREE	N	Status of active protective field - protective function A
		6	Bit	B-WF-VIO	ASSIGNED	FREE	N	Status of active warning field - protective function B
		7	Bit	B-PF-VIO	ASSIGNED	FREE	N	Status of active protective field - protective function B

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
1	1	0	Bit	A-RES-WF			N	Start/restart interlock active (start request A for warning field) **Note:** The signal is only necessary if the warning field is evaluated as safe.
		1	Bit	A-RES	OFF	ACTIVE	N	Start/restart interlock active (start request A)
		2	Bit	B-RES-WF			N	Start/restart interlock active (start request B for warning field) **Note:** The signal is only necessary if the warning field is evaluated as safe.
		3	Bit	B-RES	OFF	ACTIVE	N	Start/restart interlock active (start request B)
		4	Bit	Reserve0				
		5	Bit	Reserve1				
		6	Bit	Reserve2				
		7	Bit	Reserve3				
2	2	0	Bit	ERROR	OFF	Message	N	Collective message: error with switch-off
		1	Bit	SCREEN	OFF	Message	N	Optics cover contamination indicator (warning and switch-off)
		2	Bit	FIELD PAIR	OFF	Message	N	Collective message: fault detected by field pair selection monitoring
		3	Bit	MODE-PARK	NOT PARKED	PARKED	N	Park request fulfilled
		4	Bit	EA1			N	Status of local output 1
		5	Bit	EA2			N	Status of local output 2
		6	Bit	Reserve4				
		7	Bit	Reserve5				

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
3	3	0 … 7	Byte	Profisafe status				PROFIsafe status
4	4	0 … 7	Byte	CrcHL				Crc PROFIsafe
5	5	0 … 7	Byte	CrcLH				Crc PROFIsafe
6	6	0 … 7	Byte	CrcLL				Crc PROFIsafe

Output data structure module SAFE_SIGNAL

NOTICE

The layout of the output data varies depending on the function mode of the RSL 400 PROFIsafe. For this reason, the layout of the output data is listed separately for each function mode.

Tab. 11.2: Function mode: one protective function, 5/10 field pairs

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Safe	Description
0	0	0 … 4	Bit		Y	Field pair selection
		5 … 7	Bit	Reserve	Y	
1	1	0 … 7	Bit	Reserve	Y	
2	2	0 … 1	Bit		Y	Start signals
		2 … 6	Bit	Reserve	Y	
		7	Bit		N	Start/stop data recorder

Tab. 11.3: Function mode: one protective function, 100 field pairs

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Safe	Description
0	0	0 … 4	Bit		Y	Field pair selection group 1
		5 … 7	Bit	Reserve	Y	
1	1	0 … 4	Bit		Y	Field pair selection group 2
		5 … 7	Bit	Reserve	Y	
2	2	0 … 1	Bit		Y	Start signals
		2 … 6	Bit	Reserve	Y	
		7	Bit		N	Start/stop data recorder

Tab. 11.4: Function mode: one protective function, multi configuration

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Safe	Description
0	0	0 … 4	Bit		Y	Bank selection
		5 … 7	Bit	Reserve	Y	
1	1	0 … 4	Bit		Y	Field pair selection
		5 … 7	Bit	Reserve	Y	
2	2	0 … 1	Bit		Y	Start signals
		2 … 6	Bit	Reserve	Y	
		7	Bit		N	Start/stop data recorder

Tab. 11.5: Function mode: two protective functions

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Safe	Description
0	0	0 … 4	Bit		Y	Field pair selection A
		5 … 7	Bit	Reserve	Y	
1	1	0 … 4	Bit		Y	Field pair selection B
		5 … 7	Bit	Reserve	Y	
2	2	0 … 1	Bit		Y	Start signals A
		2 … 3	Bit	Reserve	Y	
		4 … 5	Bit		Y	Start signals B
		6	Bit	Reserve	Y	
		7	Bit		N	Start/stop data recorder

Tab. 11.6: Function mode: two protective functions, four field mode

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Safe	Description
0	0	0 … 4	Bit		Y	Field pair selection group 1 AB
		5 … 7	Bit	Reserve	Y	
1	1	0 … 4	Bit		Y	Field pair selection group 2 AB
		5 … 7	Bit	Reserve	Y	
2	2	0 … 1	Bit		Y	Start signals A
		2 … 3	Bit	Reserve	Y	
		4 … 5	Bit		Y	Start signals B
		6	Bit	Reserve	Y	
		7	Bit		N	Start/stop data recorder

Tab. 11.7: Function mode: two protective functions, multi configuration

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Safe	Description
0	0	0 … 4	Bit		Y	Field pair selection group 1 AB
		5 … 7	Bit	Reserve	Y	
1	1	0 … 4	Bit		Y	Field pair selection group 2 AB
		5 … 7	Bit	Reserve	Y	
2	2	0 … 1	Bit		Y	Start signals A
		2 … 3	Bit	Reserve	Y	
		4 … 5	Bit		Y	Start signals B
		6	Bit	Reserve	Y	
		7	Bit		N	Start/stop data recorder

11.5.4 Module [M2] - SYSTEM_STATUS

- Module ID: 0x00000002
- Submodule ID: 0x00000002

Description

The module supplies information on the current operating mode of the RSL 400 PROFIsafe and on possible error causes. The module also contains the pitch of the internal spirit level and the internal system temperature.

Input data structure module SYSTEM_STATUS

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value '0'	Value '1'	Safe	Description
0	0	0 … 7	Byte	OP-MODE			N	Current operating mode of the RSL 400 PROFIsafe
1	1	0	Bit	ERROR	OFF	Message	N	Collective message: error with switch-off
		1	Bit	ALARM	OFF	Message	N	Collective message: warnings without shutdown (including optics cover contamination warning)
		2	Bit	SCREEN	OFF	Message	N	Optics cover contamination indicator (warning and switch-off)
		3	Bit	FIELD PAIR	OFF	Message	N	Collective message: fault detected by field pair selection monitoring
		4	Bit	MODE-PARK	NOT PARKED	PARKED	N	Park request fulfilled
		5	Bit	Reserve1				
		6	Bit	Reserve2				
		7	Bit	Reserve3				
2	2	0 … 15	Int16	ALIGNMENT-H			N	Horizontal alignment of the spirit level
4	4	0 … 15	Int16	ALIGNMENT-V			N	Vertical alignment of the spirit level
6	6	0 … 15	Int16	SYS-TEMP			N	System temperature

11.5.5 Module [M3] – SCAN_NUMBER

- Module ID: 0x00000002
- Submodule ID: 0x00000003

Description

The module contains the sequential scan number of the measurement system. The scan number is a 32-bit value that is incremented with each revolution of the system. In the event of an overflow and after power-on, the counter begins with value **0**.

Input data structure module SCAN_NUMBER

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
8	0	0 … 31	uint32	SCAN			Y	Sequential counting of the scans; reset to 0 by switching off

11.5.6 Module [M4] – REFLECTOR_STATUS

- Module ID: 0x00000002
- Submodule ID: 0x00000004

Description

This module supplies information on reflectors that are found in the current scan.

	NOTICE
	This function has not yet been implemented and only outputs values of '0'.

11.5.7 Module [M5] – PROTECTIVE_FUNCTION_A_STATUS

- Module ID: 0x00000002
- Submodule ID: 0x00000005

The module returns detailed information on the status of protective function A.

- The module indicates whether the protective field or warning field is free or occupied at a certain angle.
- In addition, the module indicates which field pair is selected for protective function A and whether the active field pair corresponds to a predefined field pair.

Input data structure module – PROTECTIVE_FUNCTION_A_STATUS

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
14	0	0	Bit	A-ACTIVE	OFF	ACTIVE	N	Protective function A is active / configured
		1	Bit	A-WF-VIO	ASSIGNED	FREE	N	Status of active warning field - protective function A
		2	Bit	A-PF-VIO	ASSIGNED	FREE	N	Status of active protective field - protective function A
		3	Bit	A-WF-VIO-SEG-1	ASSIGNED	FRE	N	Status of active warning field segment – Protective function A
		4	Bit	A-WF-VIO-SEG-2	ASSIGNED	FREE	N	Status of active warning field segment – Protective function A
		5	Bit	A-PF-VIO-SEG-1	ASSIGNED	FREE	N	Status of active protective field segment - protective function A
		6	Bit	A-PF-VIO-SEG-2	ASSIGNED	FREE	N	Status of active protective field segment - protective function A
		7		Reserve0				
15	1	0 … 3	Bit	A-PAIR-SEL 1			N	First selected field pair A (numbers 1 - 10)
		4 … 7	Bit	A-PAIR-SEL 2			N	Second selected field pair A (numbers 1 - 10); superimposed field
16	2	0 … 3	Bit	A-PAIR-SEL 3			N	Third selected field pair A (numbers 1 - 10); superimposed field
		4		Reserve1				
		5		Reserve2				
		6	Bit	A-FP-SEL-1	OFF	SELECTED	N	Defined field pair selected – Protective function A
		7	Bit	A-FP-SEL-2	OFF	SELECTED	N	Defined field pair selected – Protective function A

11.5.8 Module [M6] – PROTECTIVE_FUNCTION_B_STATUS

- Module ID: 0x00000002
- Submodule ID: 0x00000006

The module returns detailed information on the status of protective function B.

- The module indicates whether the protective field or warning field is free or occupied at a certain angle.
- In addition, the module indicates which field pair is selected for protective function B and whether the active field pair corresponds to a predefined field pair.

Input data structure module – PROTECTIVE_FUNCTION_B_STATUS

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
17	0	0	Bit	B-ACTIVE	OFF	ACTIVE	N	Protective function B is active / configured
		1	Bit	B-WF-VIO	AS-SIGNED	FREE	N	Status of active warning field - protective function B
		2	Bit	B-PF-VIO	AS-SIGNED	FREE	N	Status of active protective field - protective function B
		3	Bit	B-WF-VIO-SEG-1	AS-SIGNED	FRE	N	Status of active warning field segment - protective function B
		4	Bit	B-WF-VIO-SEG-2	AS-SIGNED	FREE	N	Status of active warning field segment - protective function B
		5	Bit	B-PF-VIO-SEG-1	AS-SIGNED	FREE	N	Status of active protective field segment - protective function B
		6	Bit	B-PF-VIO-SEG-2	AS-SIGNED	FREE	N	Status of active protective field segment - protective function B
		7		Reserve0				
18	1	0 … 3	Bit	B-PAIR-SEL 1			N	First selected field pair B (numbers 1 - 10)
		4 … 7	Bit	B-PAIR-SEL 2			N	Second selected field pair B (numbers 1 - 10); superimposed field

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
19	2	0 … 3	Bit	B-PAIR-SEL 3			N	Third selected field pair B (numbers 1 - 10); superimposed field
		4		Reserve1				
		5		Reserve2				
		6	Bit	B-FP-SEL-1	OFF	SELECTED	N	Defined field pair selected - protective function B
		7	Bit	B-FP-SEL-2	OFF	SELECTED	N	Defined field pair selected - protective function B

11.5.9 Module [M7] – PROTECTIVE_FUNCTION_A_VIOLATION

- Module ID: 0x00000002
- Submodule ID: 0x00000007

If the protective field or warning field is interrupted for protective function A, the module indicates the angle and distance of the first interruption. The first interruption corresponds to the first interruption in the direction of rotation.

Input data structure module – PROTECTIVE_FUNCTION_A_VIOLATION

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
20	0	0 … 15	Int16	A-PF-VIO-ANGLE			N	Angle of the first beam with protective field violation in the direction of rotation for protective field -135 ° … +135 °
22	2	0 … 15	uInt16	A-PF-VIO-RADIUS			N	Distance of the first beam with protective field violation in the direction of rotation for protective field 0 mm … 8250 mm
24	4	0 … 15	Int16	A-WF-VIO-ANGLE			N	Angle of the first beam with warning field violation in the direction of rotation for warning field -135 ° … +135 °
26	6	0 … 15	uInt16	A-WF-VIO-RADIUS			N	Distance of the first beam with warning field violation in the direction of rotation for warning field 0 mm … 20000 mm

11.5.10 Module [M8] – PROTECTIVE_FUNCTION_B_VIOLATION

- Module ID: 0x00000002
- Submodule ID: 0x00000008

If the protective field or warning field is interrupted for protective function B, the module indicates the angle and distance of the first interruption. The first interruption corresponds to the first interruption in the direction of rotation.

Input data structure module – PROTECTIVE_FUNCTION_B_VIOLATION

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
20	0	0 … 15	Int16	B-PF-VIO-ANGLE			N	Angle of the first beam with protective field violation in the direction of rotation for protective field -135 ° … +135 °
22	2	0 … 15	uInt16	B-PF-VIO-RADIUS			N	Distance of the first beam with protective field violation in the direction of rotation for protective field 0 mm … 8250 mm
24	4	0 … 15	Int16	B-WF-VIO-ANGLE			N	Angle of the first beam with warning field violation in the direction of rotation for warning field -135 ° … +135 °
26	6	0 … 15	uInt16	B-WF-VIO-RADIUS			N	Distance of the first beam with warning field violation in the direction of rotation for warning field 0 mm … 20000 mm

11.5.11 Module [M11] - SAFE_SIGNAL_PS2V4

NOTICE
SAFE_SIGNAL module for PROFIsafe version 2.4

- Module ID: 0x00000004
- Submodule ID: 0x0000000B

Description

The module defines the safe input and output signals of the RSL 400 PROFIsafe:

- The protective fields and configuration banks are changed over via the output signals.
- The output signals contain the start signals for releasing a manual (re-)start.

- The input data contains the safe switching signals for the protective fields and warning fields of the RSL 400 PROFIsafe.

NOTICE

The layout of the output data varies depending on the function mode of the RSL 400 PROFIsafe. For this reason, the layout of the output data is listed separately for each function mode.

Input data structure module SAFE_SIGNAL_PS2V4

Byte in safe tele-gram	Byte in mod-ule	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0	Bit	A-SAFE-WF-CLEAR	AS-SIGNED	FREE	Y	Safe switching signal of warning field free - protective function A
		1	Bit	A-SAFE-PF-CLEAR	AS-SIGNED	FREE	Y	Safe switching signal of protective field free - protective function A
		2 … 7	Bit	Reserve				
1	1	0	Bit	B-SAFE-WF-CLEAR	AS-SIGNED	FREE	Y	Safe switching signal of warning field free - protective function B.
		1	Bit	A-SAFE-PF-CLEAR	AS-SIGNED	FREE	Y	Safe switching signal of protective field free - protective function B
		2 … 7	Bit	Reserve				
2	2	0 … 7	Byte	Reserve				
3	3	0 … 7	Byte	Profisafe status				PROFIsafe status
4	4	0 … 7	Byte	CrcHL				Crc PROFIsafe
5	5	0 … 7	Byte	CrcLH				Crc PROFIsafe
6	6	0 … 7	Byte	CrcLL				Crc PROFIsafe

Output data structure module SAFE_SIGNAL_PS2V4

NOTICE

The layout of the output data varies depending on the function mode of the RSL 400 PROFIsafe. For this reason, the layout of the output data is listed separately for each function mode.

Tab. 11.8: General layout of the output data

Byte in safe tele-gram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0 … 5	0 … 5	0 … 7	Byte					Output data according to the function mode
6	6	0 … 7	Byte	Reserve				

Byte in safe tele-gram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
7	7	0 … 7	Byte	Profisafe sta-tus				PROFIsafe status
8	8	0 … 7	Byte	CrcHL				Crc PROFIsafe
9	9	0 … 7	Byte	CrcLH				Crc PROFIsafe
10	10	0 … 7	Byte	CrcLL				Crc PROFIsafe

Tab. 11.9: Function mode: one protective function, 5/10 field pairs

Byte in safe tele-gram	Byte in mod-ule	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0 … 4	Bit				Y	Selection of pro-tective field switchover (F1 … F5) - pro-tective function A
		5 … 7	Bit	Reserve				
1	1	0 … 7	Bit	Reserve				
2	2	0 … 7	Byte	Reserve				
3	3	0 … 7	Byte	Reserve				
4	4	0	Bit		OFF	AC-TIVE	Y	Start/restart signal for warning field - protective func-tion A
		1			OFF	AC-TIVE	Y	Start/restart signal for protective field - protective func-tion A
		2 … 7	Bit	Reserve				
5	5	0 … 7	Byte	Reserve				

Tab. 11.10: Function mode: one protective function, 100 field pairs

Byte in safe tele-gram	Byte in mod-ule	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0 … 4	Bit				Y	Selection of pro-tective field switchover group 1 (F1 … F5)
		5 … 7	Bit	Reserve				
1	1	0 … 7	Byte	Reserve				
2	2	0 … 4	Bit				Y	Selection of pro-tective field switchover group 2 (F6 … F10)
		5 … 7	Bit	Reserve				
3	3	0 … 7	Byte	Reserve				

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
4	4	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function A
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function A
		2 … 7	Bit	Reserve				
5	5	0 … 7	Byte	Reserve				

Tab. 11.11: Function mode: one protective function, multi configuration

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0 … 4	Bit				Y	Selection of configuration bank (F1 … F5) - protective function A
		5 … 7	Bit	Reserve				
1	1	0 … 7	Byte	Reserve				
2	2	0 … 4	Bit				Y	Selection of protective field switchover (F6 … F10) - protective function A
		5 … 7	Bit	Reserve				
3	3	0 … 7	Byte	Reserve				
4	4	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function A
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function A
		2 … 7	Bit	Reserve				
5	5	0 … 7	Byte	Reserve				

Tab. 11.12: Function mode: two protective functions

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0 … 4	Bit				Y	Selection of protective field switchover (F1 … F5) - protective function A
		5 … 7	Bit	Reserve				

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
1	1	0 … 7	Byte	Reserve				
2	2	0 … 4	Bit				Y	Selection of protective field switchover (F6 … F10) - protective function B
		5 … 7	Bit	Reserve				
3	3	0 … 7	Byte	Reserve				
4	4	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function A
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function A
		2 … 7	Bit	Reserve				
5	5	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function B
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function B
		2 … 7	Bit	Reserve				

Tab. 11.13: Function mode: two protective functions, four field mode

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0 … 4	Bit				Y	Selection of protective field switchover group 1 (F1 … F5) - protective function A, B
		5 … 7	Bit	Reserve				
1	1	0 … 7	Byte	Reserve				
2	2	0 … 4	Bit				Y	Selection of protective field switchover group 2 (F6 … F10) - protective function A, B
		5 … 7	Bit	Reserve				
3	3	0 … 7	Byte	Reserve				

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
4	4	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function A
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function A
		2 … 7	Bit	Reserve				
5	5	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function B
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function B
		2 … 7	Bit	Reserve				

Tab. 11.14: Function mode: two protective functions, multi configuration

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0 … 4	Bit				Y	Selection of configuration bank (F1 … F5) - protective function A, B
		5 … 7	Bit	Reserve				
1	1	0 … 7	Byte	Reserve				
2	2	0 … 4	Bit				Y	Selection of protective field switchover (F6 … F10) - protective function A, B
		5 … 7	Bit	Reserve				
3	3	0 … 7	Byte	Reserve				
4	4	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function A
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function A
		2 … 7	Bit	Reserve				

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
5	5	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function B
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function B
		2 … 7	Bit	Reserve				

11.5.12 Module [M11] - SAFE_SIGNAL_PS2V6

NOTICE
SAFE_SIGNAL module for PROFIsafe version 2.6

- Module ID: 0x00000004
- Submodule ID: 0x0000001B

Description

The module defines the safe input and output signals of the RSL 400 PROFIsafe:

- The protective fields and configuration banks are changed over via the output signals.
- The output signals contain the start signals for releasing a manual (re-)start.
- The input data contains the safe switching signals for the protective fields and warning fields of the RSL 400 PROFIsafe.

NOTICE
The layout of the output data varies depending on the function mode of the RSL 400 PROFIsafe. For this reason, the layout of the output data is listed separately for each function mode.

Input data structure module SAFE_SIGNAL_PS2V6

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0	Bit	A-SAFE-WF-CLEAR	ASSIGNED	FREE	Y	Safe switching signal of warning field free - protective function A
		1	Bit	A-SAFE-PF-CLEAR	ASSIGNED	FREE	Y	Safe switching signal of protective field free - protective function A
		2 … 7	Bit	Reserve				

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
1	1	0	Bit	B-SAFE-WF-CLEAR	ASSIGNED	FREE	Y	Safe switching signal of warning field free - protective function B.
		1	Bit	A-SAFE-PF-CLEAR	ASSIGNED	FREE	Y	Safe switching signal of protective field free - protective function B
		2 … 7	Bit	Reserve				
2	2	0 … 7	Byte	Profisafe status				PROFIsafe status
3	3	0 … 7	Byte	CrcHH				PROFIsafe Crc
4	4	0 … 7	Byte	CrcHL				Crc PROFIsafe
5	5	0 … 7	Byte	CrcLH				Crc PROFIsafe
6	6	0 … 7	Byte	CrcLL				Crc PROFIsafe

Output data structure module SAFE_SIGNAL_PS2V6

NOTICE

The layout of the output data varies depending on the function mode of the RSL 400 PROFIsafe. For this reason, the layout of the output data is listed separately for each function mode.

Tab. 11.15: General layout of the output data

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0 … 5	0 … 5	0 … 7	Byte					Output data according to the function mode
6	6	0 … 7	Byte	Profisafe status				PROFIsafe status
7	7	0 … 7	Byte	CrcHH				PROFIsafe Crc
8	8	0 … 7	Byte	CrcHL				Crc PROFIsafe
9	9	0 … 7	Byte	CrcLH				Crc PROFIsafe
10	10	0 … 7	Byte	CrcLL				Crc PROFIsafe

Tab. 11.16: Function mode: one protective function, 5/10 field pairs

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0 … 4	Bit				Y	Selection of protective field switchover (F1 … F5) - protective function A
		5 … 7	Bit	Reserve				

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
1	1	0 … 7	Bit	Reserve				
2	2	0 … 7	Byte	Reserve				
3	3	0 … 7	Byte	Reserve				
4	4	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function A
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function A
		2 … 7	Bit	Reserve				
5	5	0 … 7	Byte	Reserve				

Tab. 11.17: Function mode: one protective function, 100 field pairs

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0 … 4	Bit				Y	Selection of protective field switchover group 1 (F1 … F5)
		5 … 7	Bit	Reserve				
1	1	0 … 7	Byte	Reserve				
2	2	0 … 4	Bit				Y	Selection of protective field switchover group 2 (F6 … F10)
		5 … 7	Bit	Reserve				
3	3	0 … 7	Byte	Reserve				
4	4	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function A
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function A
		2 … 7	Bit	Reserve				
5	5	0 … 7	Byte	Reserve				

Tab. 11.18: Function mode: one protective function, multi configuration

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0 … 4	Bit				Y	Selection of configuration bank (F1 … F5) - protective function A
		5 … 7	Bit	Reserve				
1	1	0 … 7	Byte	Reserve				
2	2	0 … 4	Bit				Y	Selection of protective field switchover (F6 … F10) - protective function A
		5 … 7	Bit	Reserve				
3	3	0 … 7	Byte	Reserve				
4	4	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function A
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function A
		2 … 7	Bit	Reserve				
5	5	0 … 7	Byte	Reserve				

Tab. 11.19: Function mode: two protective functions

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0 … 4	Bit				Y	Selection of protective field switchover (F1 … F5) - protective function A
		5 … 7	Bit	Reserve				
1	1	0 … 7	Byte	Reserve				
2	2	0 … 4	Bit				Y	Selection of protective field switchover (F6 … F10) - protective function B
		5 … 7	Bit	Reserve				
3	3	0 … 7	Byte	Reserve				

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
4	4	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function A
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function A
		2 … 7	Bit	Reserve				
5	5	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function B
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function B
		2 … 7	Bit	Reserve				

Tab. 11.20: Function mode: two protective functions, four field mode

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0 … 4	Bit				Y	Selection of protective field switchover group 1 (F1 … F5) - protective function A, B
		5 … 7	Bit	Reserve				
1	1	0 … 7	Byte	Reserve				
2	2	0 … 4	Bit				Y	Selection of protective field switchover group 2 (F6 … F10) - protective function A, B
		5 … 7	Bit	Reserve				
3	3	0 … 7	Byte	Reserve				
4	4	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function A
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function A
		2 … 7	Bit	Reserve				

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
5	5	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function B
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function B
		2 … 7	Bit	Reserve				

Tab. 11.21: Function mode: two protective functions, multi configuration

Byte in safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
0	0	0 … 4	Bit				Y	Selection of configuration bank (F1 … F5) - protective function A, B
		5 … 7	Bit	Reserve				
1	1	0 … 7	Byte	Reserve				
2	2	0 … 4	Bit				Y	Selection of protective field switchover (F6 … F10) - protective function A, B
		5 … 7	Bit	Reserve				
3	3	0 … 7	Byte	Reserve				
4	4	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function A
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function A
		2 … 7	Bit	Reserve				
5	5	0	Bit		OFF	ACTIVE	Y	Start/restart signal for warning field - protective function B
		1			OFF	ACTIVE	Y	Start/restart signal for protective field - protective function B
		2 … 7	Bit	Reserve				

11.5.13 Module [M12] - SYSTEM_STATUS

- Module ID: 0x00000004
- Submodule ID: 0x0000000C

Description

The module supplies information on the current operating mode of the RSL400 and on possible error causes. It contains the most important diagnostic information for the total system and the individual protective functions. Simple device diagnostics is made possible by integrating this module.

Input data structure module SYSTEM_STATUS

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value '0'	Value '1'	Safe	Description
0	0	0 … 7	Byte	OP-MODE			N	Current operating mode of the RSL 400 PROFIsafe 0: No configuration defined 1: Safety monitoring mode 2: Simulation mode
1	1	0	Bit	A-ACTIVE	N	Y	N	Protective function A active / configured
		1 … 3	Bit	Reserve				
		4	Bit	B-ACTIVE	N	Y	N	Protective function B active / configured
		5 … 7	Bit	Reserve				
2	2	0	Bit	ERROR	OFF	Message	N	Collective message: error (safety bit 0)
		1	Bit	ALARM	OFF	Message	N	Collective message: warning (safety bit 1)
		2	Bit	SCREEN	OFF	Message	N	Contamination display for optics cover (Warning and switch-off)
		3	Bit	FIELD PAIR	OFF	Message	N	Collective message for field pair changeover error
		4	Bit	MODE-PARK	NOT PARKED	PARKED	N	Park mode confirmed
		5 … 7	Bit	Reserve				

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
3	3	0	Bit	EA1			N	Status of local output 1 (currently not implemented)
		1	Bit	EA2			N	Status of local output 2 (currently not implemented)
		2 … 7	Bit	Reserve				
4	4	0	Bit	A-WF-VIO	ASSIGNED	FREE	N	Status of active warning field - protective function A
		1	Bit	A-PF-VIO	ASSIGNED	FREE	N	Status of active protective field - protective function A
		2 … 3	Bit	Reserve				
		4	Bit	B-WF-VIO	ASSIGNED	FREE	N	Status of active warning field - protective function B
		5	Bit	B-PF-VIO	ASSIGNED	FREE	N	Status of active protective field - protective function B
		6 … 7	Bit	Reserve				
5	5	0	Bit	A-RES-WF	OFF	ACTIVE	N	Start/restart active (warning field A)
		1	Bit	A-RES	OFF	ACTIVE	N	Start/restart active (protective field A)
		2 … 3	Bit	Reserve				
		4	Bit	B-RES-WF	OFF	ACTIVE	N	Start/restart active (warning field B)
		5	Bit	B-RES	OFF	ACTIVE	N	Start/restart active (protective field B)
		6 … 7	Bit	Reserve				

11.5.14 Module [M13] – SYSTEM_DATA

- Module ID: 0x00000004
- Submodule ID: 0x0000000D

Description

The module contains the current data of the internal spirit level for aligning the device.

The module also contains the data of the inside temperature and the applied supply voltage.

Input data structure module SYSTEM_DATA

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value '0'	Value '1'	Safe	Description
6	0	0 … 15	int16	ALIGNMENT-H			N	Horizontal alignment of the spirit level -90 ° … +90 ° 0.01 ° display
8	2	0 … 15	int16	ALIGNMENT-V			N	Vertical alignment of the spirit level -90 ° … +90 ° 0.01 ° display
10	4	0 … 15	int16	SYS-TEMP			N	Internal system temperature 0.1 °C display
12	6	0 … 15	int16	VOLTAGE			N	Applied supply voltage 0.1 V display

11.5.15 Module [M14] – PROTECTIVE_FUNCTION_A_STATUS

- Module ID: 0x00000004
- Submodule ID: 0x0000000E

The module returns detailed information on the status of protective function A.

- The module indicates whether the protective field or warning field is free or occupied at a certain angle.
- In addition, the module indicates which field pair is selected for protective function A and whether the active field pair corresponds to a predefined field pair.

Input data structure module – PROTECTIVE_FUNCTION_A_STATUS

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value '0'	Value '1'	Safe	Description
14	0	0	Bit	A-WF-VIO	ASSIGNED	FREE	N	Status of active warning field - protective function A
		1	Bit	A-PF-VIO	ASSIGNED	FREE	N	Status of active protective field - protective function A
		2 … 3	Bit	Reserve				
		4	Bit	A-ACTIVE	OFF	ACTIVE	N	Protective function A active / configured
		5 … 7	Bit	Reserve				

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
15	1	0	Bit	A-RES-WF	OFF	ACTIVE	N	Start/restart active (warning field A)
		1	Bit	A-RES	OFF	ACTIVE	N	Start/restart active (protective field A)
		2 … 7	Bit	Reserve				
16	2	0	Bit	A-WF-VIO-SEG-1	ASSIGNED	FREE	N	Status of active warning field segment 1 - protective function A
		1	Bit	A-WF-VIO-SEG-2	ASSIGNED	FREE	N	Status of active warning field segment 2 - protective function A
		2 … 7	Bit	Reserve				
17	3	0	Bit	A-PF-VIO-SEG-1	ASSIGNED	FREE	N	Status of active protective field segment 1 - protective function A
		1	Bit	A-PF-VIO-SEG-2	ASSIGNED	FREE	N	Status of active protective field segment 2 - protective function A
		2 … 7	Bit	Reserve				
18	4	0 … 3	Bit	A-PAIR-SEL 1			N	First selected field pair A (numbers 1 … 10)
		4 … 7	Bit	A-PAIR-SEL 2			N	Second selected field pair A (numbers 1 … 10); superimposed field
19	5	0 … 3	Bit	A-PAIR-SEL 3			N	Third selected field pair A (numbers 1 … 10); superimposed field (currently not implemented)
		4 … 7		Reserve				
20	6	0	Bit	A-FP-SEL-1	OFF	SELECTED	N	Defined field pair selected 1 - protective function A
		1	Bit	A-FP-SEL-2	OFF	SELECTED	N	Defined field pair selected 2 - protective function A
		2 … 7	Bit	Reserve				
21	7	0 … 7	Byte	Reserve				

11.5.16 Module [M15] – PROTECTIVE_FUNCTION_B_STATUS

- Module ID: 0x00000004
- Submodule ID: 0x0000000F

The module returns detailed information on the status of protective function B.

- The module indicates whether the protective field or warning field is free or occupied at a certain angle.
- In addition, the module indicates which field pair is selected for protective function B and whether the active field pair corresponds to a predefined field pair.

Tab. 11.22: Input data structure module – PROTECTIVE_FUNCTION_B_STATUS

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value '0'	Value '1'	Safe	Description
22	0	0	Bit	B-WF-VIO	ASSIGNED	FREE	N	Status of active warning field - protective function B
		1	Bit	B-PF-VIO	ASSIGNED	FREE	N	Status of active protective field - protective function B
		2 … 3	Bit	Reserve				
		4	Bit	B-ACTIVE	N	Y	N	Protective function B active / configured
		5 … 7	Bit	Reserve				
23	1	0	Bit	B-RES-WF	OFF	ACTIVE	N	Start/restart active (warning field B)
		1	Bit	B-RES	OFF	ACTIVE	N	Start/restart active (protective field B)
		2 … 7	Bit	Reserve				
24	2	0	Bit	B-WF-VIO-SEG-1	ASSIGNED	FREE	N	Status of active warning field segment 1 - protective function B
		1	Bit	B-WF-VIO-SEG-2	ASSIGNED	FREE	N	Status of active warning field segment 2 - protective function B
		2 … 7	Bit	Reserve				
25	3	0	Bit	B-PF-VIO-SEG-1	ASSIGNED	FREE	N	Status of active protective field segment 1 - protective function B
		1	Bit	B-PF-VIO-SEG-2	ASSIGNED	FREE	N	Status of active protective field segment 2 - protective function B
		2 … 7	Bit	Reserve				

26	4	0 … 3	Bit	B-PAIR-SEL 1			N	First selected field pair B (numbers 1 … 10)
		4 … 7	Bit	B-PAIR-SEL 2			N	Second selected field pair B (numbers 1 … 10); superimposed field
27	5	0 … 3	Bit	B-PAIR-SEL 3			N	Third selected field pair B (numbers 1 … 10); superimposed field (currently not implemented)
		4 … 7		Reserve				
28	6	0	Bit	B-FP-SEL-1	OFF	SELECTED	N	Defined field pair selected 1 - protective function B
		1	Bit	B-FP-SEL-2	OFF	SELECTED	N	Defined field pair selected 2 - protective function B
		2 … 7	Bit	Reserve				
29	7	0 … 7	Byte	Reserve				

11.5.17 Module [M16] – PROTECTIVE_FUNCTION_A_VIOLATION

- Module ID: 0x00000004
- Submodule ID: 0x00000010

If the protective field or warning field is interrupted for protective function A, the module indicates the angle and distance of the first interruption. The first interruption corresponds to the first interruption in the direction of rotation.

Input data structure module – PROTECTIVE_FUNCTION_A_VIOLATION

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
30	0	0 … 15	int16	A-WF-VIO-ANGLE			N	Angle of the first beam with warning field violation in the direction of rotation for warning field -135 ° … +135 °
32	2	0 … 15	uint16	A-WF-VIO-RADIUS			N	Distance of the first beam with warning field violation in the direction of rotation for warning field 0 mm … 20000 mm

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
34	4	0 … 15	int16	A-PF-VIO-ANGLE			N	Angle of the first beam with protective field violation in the direction of rotation for protective field -135 ° … +135 °
36	6	0 … 15	uint16	A-PF-VIO-RADIUS			N	Distance of the first beam with protective field violation in the direction of rotation for protective field 0 mm … 8250 mm

11.5.18 Module [M17] – PROTECTIVE_FUNCTION_B_VIOLATION

- Module ID: 0x00000004
- Submodule ID: 0x00000011

If the protective field or warning field is interrupted for protective function B, the module indicates the angle and distance of the first interruption. The first interruption corresponds to the first interruption in the direction of rotation.

Input data structure module – PROTECTIVE_FUNCTION_B_VIOLATION

Byte in non-safe telegram	Byte in module	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
38	0	0 … 15	int16	B-WF-VIO-ANGLE			N	Angle of the first beam with warning field violation in the direction of rotation for warning field -135 ° … +135 °
40	2	0 … 15	uint16	B-WF-VIO-RADIUS			N	Distance of the first beam with warning field violation in the direction of rotation for warning field 0 mm … 20000 mm

Byte in non-safe telegram	Byte in mod-ule	Bit	Data type	Signal name	Value ‘0‘	Value ‘1‘	Safe	Description
42	4	0 … 15	int16	B-PF-VIO-ANGLE			N	Angle of the first beam with protective field violation in the direction of rotation for protective field -135 ° … +135 °
44	6	0 … 15	uint16	B-PF-VIO-RADIUS			N	Distance of the first beam with protective field violation in the direction of rotation for protective field 0 mm … 8250 mm

11.6 Status messages of the PROFINET stack

In certain situations, the safety laser scanner may send device-specific PROFINET status messages to the control that are not described in the PROFINET standard.

These PROFINET status messages indicate a special situation in which the device is located.

The following device-specific PROFINET status messages are defined for RSL 400 PROFIsafe devices:

Value	Text	Description
0x8181FF00	Resource available again	A scanner unit was plugged into the connection unit during operation. The total system is now ready for operation.
0x8181FF01	Resource unavailable	The scanner unit was unplugged from the connection unit during operation. As a result, valid data is no longer available.
0x8181FF03	Configuration changed	A valid configuration was loaded in the device for the first time. The system switches to monitoring mode.

NOTICE

You can find further information on PROFINET status message in the description of the PROFINET device protocol.

12 Testing

NOTICE
↳ Safety sensors must be replaced at the end of their mission time (see chapter 16 "Technical data"). ↳ Always exchange entire safety sensors. ↳ 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.

12.1 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 12.3 "Periodically by the operator").

↳ Test the electrical function and installation according to this document.

Acc. to 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

↳ As preparation, check the most important criteria for the safety sensor according to the following checklist (see chapter 12.1.1 "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.

12.1.1 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). ↳ IEC 62046 contains additional recommendations on testing protective devices.

Tab. 12.1: 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 16 "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 signals 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 it is possible to be present undetected between the safety sensor and point of operation: 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 capacity successfully tested (see chapter 12.3.1 "Checklist – periodically by the operator")?			
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?			

12.2 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 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 IEC 62046: 6 months).

- Have all tests performed by competent persons.
- Observe the nationally applicable regulations and the time periods specified therein.
- As preparation, observe the checklist (see chapter 12.1 "Before the initial start-up and following modifications").

12.3 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!

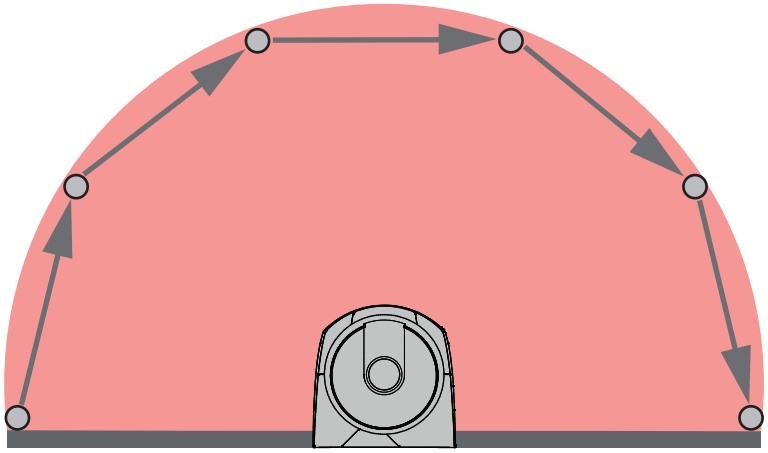
- Make certain that there are no people in the danger zone.
- Before they begin work, train the operators on their respective tasks and provide suitable test objects and an appropriate test instruction.

12.3.1 Checklist – periodically by the operator

NOTICE

↳ If you answer one of the items on the check list with *no*, the machine must no longer be operated (see chapter 12.1.1 "Checklist for integrator – to be performed prior to the initial start-up and following modifications").

Tab. 12.2: 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 (see chapter 3.4 "Display elements"). 2. Interrupt the protective field using a suitable opaque test object (see figure).  Checking the protective field function with test rod. Use a sample item with the set resolution as the test rod. The sample item should have a matt surface structure. Does the LED 1 on the safety sensor illuminate constantly red while the protective field is interrupted?		

Tab. 12.3: Checklist – regular function test by trained operators/persons

When possible, test during running operation:	Yes	No
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: the protective field is interrupted with the test object – does this prevent operation of the obviously dangerous machine parts?		

13 Diagnosis and troubleshooting

13.1 What to do in case of failure?

After switching the safety sensor on, the display elements assist in checking the correct functionality and in faultfinding (see chapter 3.4 "Display elements").

In case of failure, you can determine the fault from the LED displays and read a message from the display. With the error message you can determine the cause of the error and initiate measures to rectify it.

PROFIsafe alarm messages

The safety sensor can make alarms available for diagnostic purposes.

- If the safety sensor detects an error, it passes this on to the PROFIsafe control as an alarm.
- Both PROFINET-specific as well as device-specific alarms are realized in the safety sensor. Each alarm can be selected and deselected individually.
- Alarm-specific help texts can be displayed on the PROFIsafe control or read out by the PROFIsafe control.

	NOTICE
	For safety sensors with PROFIsafe interface, the alarm messages, with the exception of the PROFIsafe-specific alarms, are activated by default. ↳ If necessary, you can activate the alarms individually via the *Sensor Studio* configuration software.

	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 15 "Service and support").

13.2 Diagnostics displays

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

Diagnostics classes:

- I (Information)
  - No switch-off of the safety-related switching signals
  - Unhindered operation possible
- U (Usage)
  Application error
- E (External)
  External fault
- F (Failure)
  internal device error
  - Switch-off of the safety-related switching signals
  - Self test unsuccessful
  - Hardware error
- P (Parameter)
  Inconsistency in configuration

Tab. 13.1: Diagnostics displays in order of ascending ID number

Diagnostic ID	Diagnostic message	Measure
U0370	Input level at the electrical inputs is unclear.	Check the wiring of the safety sensor.
P0409	Safety configuration is not compatible: unknown bank switchover.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0410	Safety configuration is not compatible: unknown output signals.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0413	Safety configuration is not compatible: unknown inputs SE1 and SE2.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0414	Safety configuration is not compatible: unknown EDM inputs.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0415	Safety configuration is not compatible: unknown field pair monitoring mode.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0416	Safety configuration is not compatible: unknown field pair monitoring parameters.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0417	Safety configuration is not compatible: unknown field pair monitoring mode.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0419	Safety configuration is not compatible: unknown monitoring parameter for the changeover order.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0420	Safety configuration is not compatible: unknown monitoring mode of the field pair changeover.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0421	Safety configuration is not compatible: unknown parameter for field pair changeover monitoring.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0422	Safety configuration is not compatible: unknown field pair selection mode.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0423	Safety configuration is not compatible: unknown field pair selection parameter.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.

Diagnostic ID	Diagnostic message	Measure
P0424	Safety configuration is not compatible: unknown parameter for manipulation monitoring.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0425	Safety configuration is not compatible: unknown configuration of the output signals.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0426	Safety configuration is not compatible: unknown resolution.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0427	Safety configuration is not compatible: unknown parameter.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0429	Safety configuration is not compatible: unknown start/restart mode.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0430	Safety configuration is not compatible: unknown start mode.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0431	Safety configuration is not compatible: unknown restart mode.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0432	Safety configuration is not compatible: unknown safety-signal stop mode.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
U0582	Field pair changeover is not performed in accordance with the specifications configured in the safety sensor: overlap time too long.	Check the changeover times of function inputs F1 to F10 or the parameter settings in the configuration.
U0583	Field pair changeover is not performed in accordance with the specifications configured in the safety sensor: no signal for field pair activation.	Check the wiring and the changeover times of function inputs F1 to F10.
U0584	Field pair changeover is not performed in accordance with the specifications configured in the safety sensor: changeover time exceeded.	Check the changeover times of function inputs F1 to F10 or the parameter settings in the configuration.
U0585	Field pair changeover is not performed in accordance with the specifications configured in the safety sensor: changeover order not observed.	Check the wiring of function inputs F1 to F10 and that the parameter settings in the configuration are correct.
U0792	Field pair changeover without release.	Check the release signal for field pair changeover or change the safety configuration.
U0793	Field pair changeover without request.	Check the request signal for field pair changeover or change the safety configuration.

Diagnostic ID	Diagnostic message	Measure
U0849	Field pair changeover not permitted.	Check the wiring of the field pair inputs.
E0588	Optics cover is soiled.	Clean the optics cover.
I0604	Optics cover is soiled.	Clean the optics cover as soon as possible. Sensor is still in safety mode.
P0653	Safety configuration is not compatible: protective/warning field radius too large.	Swap out the safety sensor or change the configuration. The type of safety sensor must be the same as the type stored in the connection unit or in the *Sensor Studio* software.
P0654	Field pair changeover is not performed in accordance with the specifications configured in the safety sensor: field pair not defined.	Check the wiring of function inputs F1 to F10 and that the parameter settings in the configuration are correct.
I0660	Field pair changeover is not performed in accordance with the specifications configured in the safety sensor: no field pair activated at system start.	Check the wiring of function inputs F1 to F10 and that the parameter settings in the configuration are correct.
I0719	Timeout of signals RES1 or RES2 (acknowledgment button, start/restart).	Check the wiring of inputs RES1 and RES2. The time specifications for start/restart must be observed.
P0747	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.
I0825	Simulation mode has been activated.	The safety-related switching signals have been switched off.
I0826	Simulation mode has been deactivated.	Safety sensor is again in safety mode. **CAUTION!** Be aware of potential hazards which can occur when the machine is started up!
I0859	Configuration was reset.	+24 V detected at RES input after switch-on. The communication parameters were reset to default values.
I0914	Internal temperature is normal again.	The safety sensor is in the specified temperature range and in normal operation.
I0915	Internal temperature above 82°C.	Switch off the safety sensor and wait until it has cooled down.
I0935	Life expectancy will soon be reached.	Replace the safety sensor with a new device.
I0936	All PROFINET errors deleted.	The safety sensor is in normal operation.
I0992	CU incompatible.	Use a connection unit that is suitable for the safety sensor.
I1004	Field violation due to glare. (With switch-off of the safety-related switching signals)	Mount the safety sensor so that the light source does not hit the outlet disc directly.
I1005	Dazzled RSL. (Without switch-off of the safety-related switching signals)	Mount the safety sensor so that the light source does not hit the outlet disc directly.
I1018	Internal temperature is normal again.	The safety sensor is in the specified temperature range and in normal operation.

Diagnostic ID	Diagnostic message	Measure
I1019	Internal temperature below 3°C.	Temperature outside of the specified temperature range. Move the safety sensor to a warmer environment.
I1025	Internal temperature above 85°C.	Switch off the safety sensor and wait until it has cooled down.
I1027	Internal temperature below -0.5°C.	Temperature outside of the specified temperature range. Move the safety sensor to a warmer environment.
I1028	Internal temperature above 82°C.	Switch off the safety sensor and wait until it has cooled down.
I1030	Internal temperature below 3°C.	Temperature outside of the specified temperature range. Move the safety sensor to a warmer environment.
F....	The monitoring functions have detected an internal error.	Create the service file (see chapter 4.5.5 "DIAGNOSIS") and contact the Leuze customer service (see chapter 15 "Service and support").

14 Care, maintenance and disposal

14.1 Changing scanner unit

If the safety sensor check or an error message indicates a defective scanner unit, change the scanner unit.

Only a trained and competent person is permitted to change the scanner unit.

The scanner unit is changed as follows:

- Detach the scanner unit from the connection unit.
- Attach the replacement scanner unit to the connection unit.

NOTICE

Safety sensor malfunction caused by dirt!

- Perform all work in an environment which is as dust-free and dirt-free as possible.
- Do not touch any of the parts inside the device.

WARNING

Malfunctioning of safety sensor due to incompatibility of connection unit and scanner unit! Malfunctioning of safety sensor due to incorrect configuration!

- Wherever possible, replace the scanner unit with a scanner unit with the same range and performance class (e.g. RSL 420P-M with RSL 420P-M). The safety sensor configuration stored in the connection unit is only adopted without changes if the new scanner unit supports all configured functions.
- Change the configuration parameters of the safety sensor using the configuration and diagnostic software according to the performance class of the scanner unit or of the connection unit.
  If a scanner unit is attached to a connection unit with a lower performance class (e.g. scanner unit RSL 430 to connection unit CU416), the integrated cable management of the connection unit means that only the functions of the lower performance class (of the connection unit) are available.
  If a scanner unit is attached to a connection unit with a higher performance class (e.g. RSL 420 scanner unit to CU429 connection unit), the performance of the scanner unit restricts the functions to those of the lower performance class (of the scanner unit).
- If a PROFIsafe scanner unit is attached to a connection unit without PROFINET, no function is possible (e.g., scanner unit RSL 420P on connection unit CU416).
  If a scanner unit without PROFIsafe is attached to a PROFINET connection unit, no function is possible (e.g., scanner unit RSL 420 on connection unit CU400P-3M12).
- Change the configuration parameters of the safety sensor using the configuration and diagnostic software according to the operating range of the replaced scanner unit. If the scanner unit is replaced with a scanner unit with a different range (e.g. RSL 420P-L with RSL 420P-M), you must check and, if necessary, adapt the configuration of the safety sensor.

NOTICE

Detailed information on attaching the scanner unit can be found in the document "Quick Start Guide RSL 400".

- Undo the quick-release fasteners on both sides of the scanner unit.
- Pull the scanner unit off the connection unit.
- Place the new scanner unit on the connection unit.
- Connect and lock the new scanner unit using the quick-release fasteners on both sides.
- Check the configuration of the safety sensor (see chapter 9 "Configuring the safety sensor").

NOTICE

If a preconfigured scanner unit is attached to a brand new, unconfigured connection unit, the safety configuration stored in the scanner unit is transferred to the connection unit and you can use the safety sensor without reconfiguration after a restart.

↳ Check the safety sensor according to the routine for initial start-up (see chapter 12.1.1 "Checklist for integrator – to be performed prior to the initial start-up and following modifications").

14.2 Cleaning the optics cover

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

Use the cleaning set consisting of special cleaning agent and cleaning cloths for cleaning (see chapter 18 "Order guide and accessories").

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
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 optics cover over the entire 360° range.

↳ Soak cloth with cleaning agent.

↳ Wipe optics cover free in one swipe.

↳ Clean not only the optics cover, but also the reflector ring under the cap.



1 Reflector ring

Fig. 14.1: Reflector ring

	NOTICE
	Internal monitoring of optics cover! ↳ The monitored area is dependent on the configuration and can be smaller than the entire scanning range of 270°. ↳ 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.

14.3 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 15 "Service and support").

14.4 Disposing

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

15 Service and support

24-hour on-call service at:
+49 7021 573-0

Service hotline:
+49 7021 573-123

E-mail:
service.protect@leuze.de

Return address for repairs:
Servicecenter
Leuze electronic GmbH + Co. KG
In der Braike 1
D-73277 Owen/Germany

16 Technical data

16.1 General specifications

Tab. 16.1: Safety-relevant technical data

Type in accordance with IEC 61496	Type 3
SIL in accordance with IEC 61508	SIL 2
SILCL in accordance with IEC 62061	SILCL 2
Performance Level (PL) in accordance with ISO 13849-1	PL d
Category in accordance with ISO 13849-1	Cat. 3
Average probability of a failure to danger per hour (PFH_d)	$9x10^{-8}$ 1/h
Mission time (T_M)	20 years

Tab. 16.2: Optics

Laser protection class in accordance with EN 60825-1	Class 1
Wavelength	905 nm (infrared)
Impulse duration	2.5 ns
Maximum output power (peak)	35 W
Pulse frequency of laser transmitter	90 kHz
Scanning rate	25 scans/s, equal to 40 ms/scan
Scanning angle	Max. 270 °
Angular resolution	0.1 °
Tolerance field of reference contour	+ 200 mm

Tab. 16.3: Protective field data

Safety sensor	RSL 420P	RSL 450P RSL 455P
Number of field pairs	10	100
Reference contour selectable	x	x
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. 16.4: Protective field range

Device range	**S**	**M**	**L**	**XL**
Resolution [mm]	**Protective field range [m]**			
150	3.00	4.50	6.25	8.25
70	3.00	4.50	6.25	8.25
60	3.00	4.50	6.25	8.25
50	3.00	4.50	6.25	6.25
40	3.00	4.50	4.50	4.50
30	3.00	3.50	3.50	3.50

Tab. 16.5: Warning field data

Safety sensor	RSL 420P	RSL 450P RSL 455P
Number of field pairs	10	100
Warning field range	0 … 20 m	
Object size	150 mm x 150 mm	
Diffuse reflectance WF minimum	Min. 10%	

Tab. 16.6: Measurement field data

Detection range	0 … 50 m
Diffuse reflection	90 %
Radial resolution	1 mm
Lateral resolution	0.1 °

Tab. 16.7: Electrical supply

RSL 4xxP voltage supply	24 V DC (+20% / -30%)
Power supply unit/battery	Supply acc. to IEC 742 with safe mains separation and equalization for power outages of up to 20 ms acc. to IEC 61496-1.
Current consumption	RSL 4xxP with CU400P-3M12, CU400P-4M12 or CU400P-AIDA: 0.9 A
	RSL 4xxP with CU400P-AIDA-OF: 1.0 A
Power consumption	RSL 4xxP with CU400P-3M12, CU400P-4M12 or CU400P-AIDA: 22 W
	RSL 4xxP with CU400P-AIDA-OF: 24 W
Switch-on current	Max. 2 A
Overvoltage protection	overvoltage protection with protected limit stop
Protective conductor	Connection required

Tab. 16.8: Device connection and PROFIsafe/communication connection

CU400P-3M12	• Device connection: M12 connector, 4-pin, standard, A-coded • Connection socket PROFIsafe/communication: M12 socket, 4-pin, D-coded
CU400P-4M12	• Device connection: M12 connector/socket, 5-pin, L-coded • Connection socket PROFIsafe/communication: M12 socket, 4-pin, D-coded
CU400P-AIDA	• Device connection: PROFINET push-pull 24 V • Connection socket PROFIsafe/communication: PROFINET RJ45 push-pull IEC 61076-3-117 var. 14

CU400P-AIDA-OF	• Device connection: PROFINET push-pull 24 V • Connection socket PROFIsafe/communication: PROFINET SCRJ push-pull ISO/IEC 61754-24-2

Tab. 16.9: Inputs and outputs

Properties	Max. output current I_a	Min. input current I_e	Typical connection components
EA1, EA2	20 mA	---	
Signal definition:			
High/logical 1	16 - 30 V		
Low/logical 0	< 3 V		

Tab. 16.10: Reaction time

	Minimum	Typical	Maximum
Response time (T_{SC})	80 ms (2 scans)		1000 ms (25 scans)
PROFIsafe processing and output (DAT_{output})		47 ms	
PROFIsafe watchdog time (T_{WD})	$DAT_{output} + T_{PS-MASTER} + 4*T_{PN}$		

Tab. 16.11: PROFINET

PROFINET device	Device acc. to Spec V2.3.4
GSDML	GSDML acc. to Spec V2.3.4
Profile	PROFINET/PROFIsafe
Conformance class	Class C
Network load class	Class III
Security level	Security level 1
Switch	IRT-ready 2-port switch acc. to IEEE 802; integrated in connection unit
Port properties	Auto-Negotiation Auto-Polarity Auto-Crossover
I&M	I&M 0 - 4
Supported topologies	SNMP MRP client
Safety-related switching signals	1

Tab. 16.12: USB

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

Tab. 16.13: Bluetooth

Frequency band	2400 ... 2483.5 MHz
Radiated transmitting power	Max. 4.5 dBm (2.82 mW), class 2

Tab. 16.14: Software

Configuration and diagnostics software	Sensor Studio for Windows 7 or higher

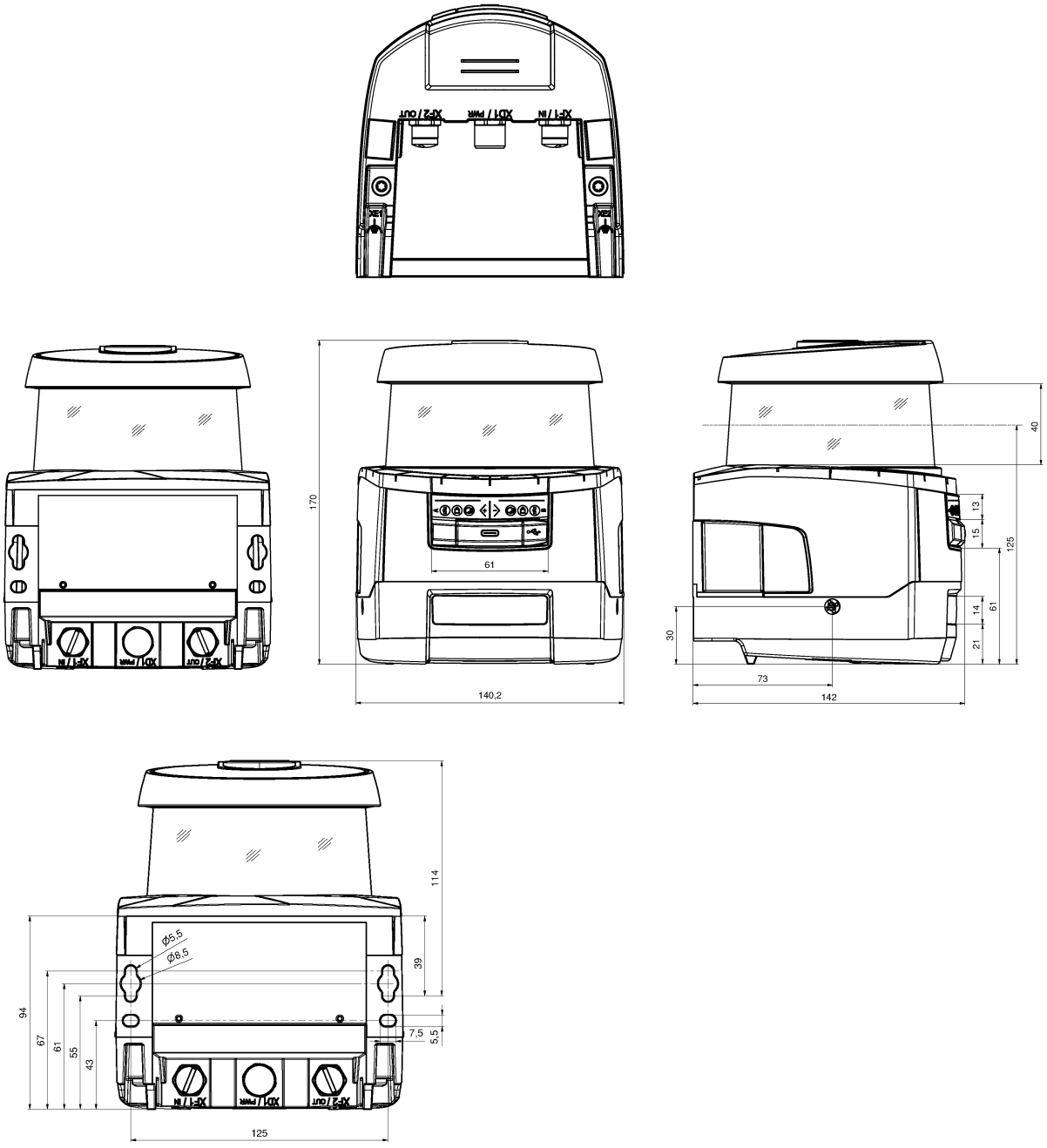
Tab. 16.15: General system data

Degree of protection	IP 65 in acc. with IEC 60529
Protection class	III in accordance with EN 61140
Ambient temperature, operation	0 … +50 °C
Ambient temperature, storage	-20 … +60 °C
Humidity	DIN 40040, table 10, code letter E (reasonably dry)
Interference rejection	In acc. with IEC 61496-1 (type 4), also in acc. with DIN 40839-1/3 test pulses 1, 2, 3a, 3b and 5
Vibration stress over 3 axes	In acc. with IEC 60068 part 2 - 6, 10 - 55 Hz max 5 G
Continuous shock over 3 axes	In acc. with IEC 60068 part 2 - 29, 10 G, 16 ms
Disposal	Specialist disposal required
Housing	Diecast zinc, plastic
Standard version dimensions (ensure free space for connector with fixing and connection cable)	see chapter 16.2 "Dimensions"
Weight of standard version incl. connection unit	Approx. 3 kg
Distance, beam level center to bottom housing edge	104 mm

Tab. 16.16: Patents

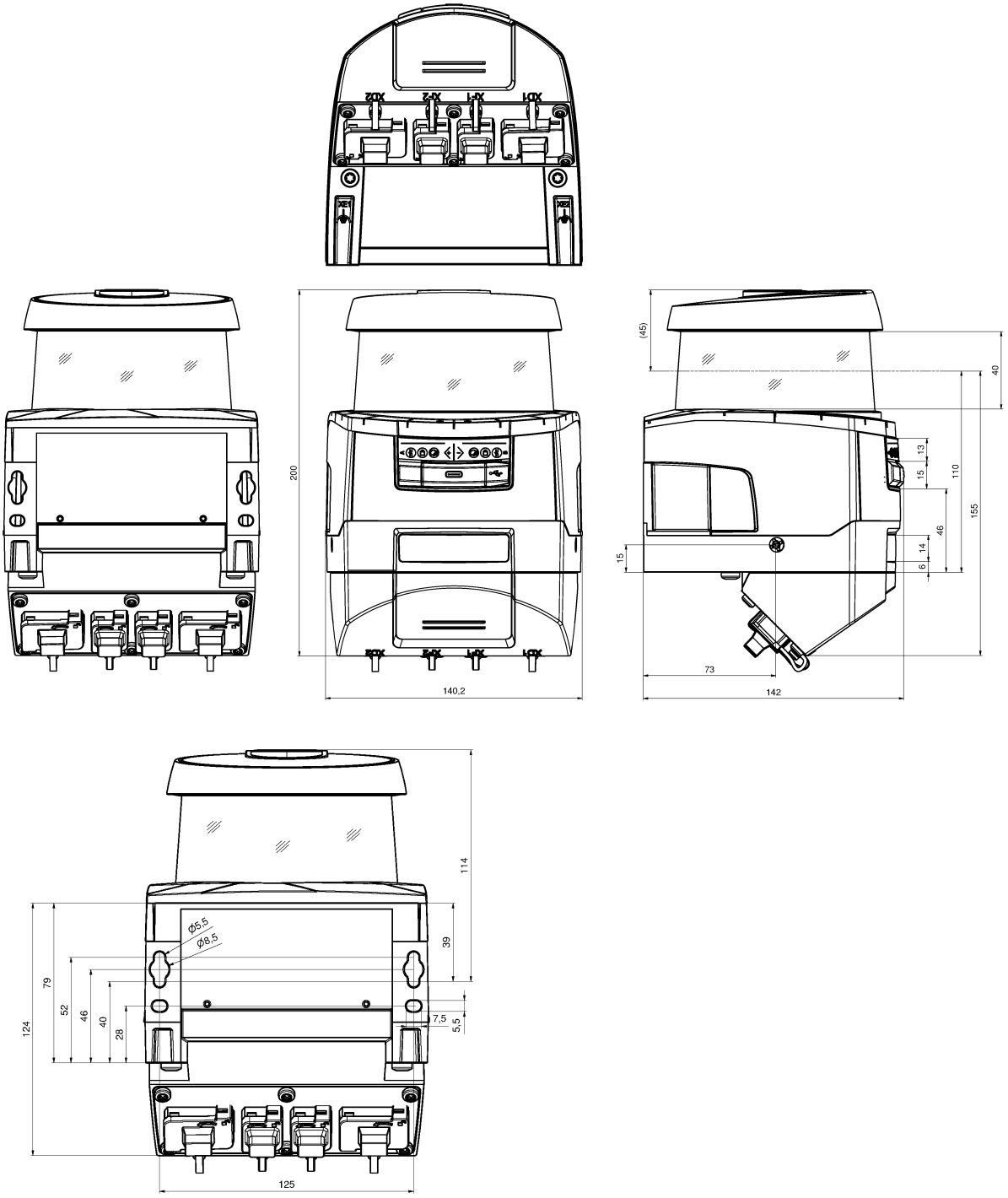
US patents	US 7,656,917 B US 7,696,468 B US 8,520,221 B US 2016/0086469 A

16.2 Dimensions



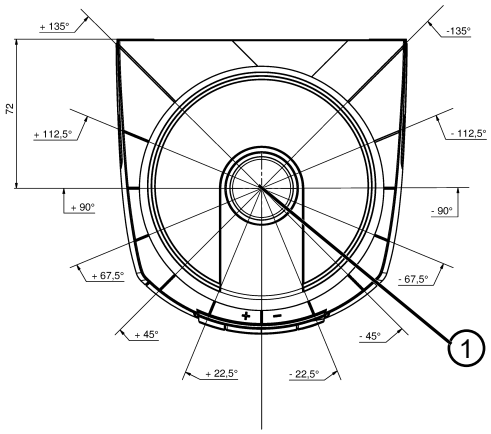
all dimensions in mm

Fig. 16.1: Dimensions of safety laser scanner with CU400P-3M12 connection unit



all dimensions in mm

Fig. 16.2: Dimensions safety laser scanner with connection unit CU400P-4M12, CU400P-AIDA or CU400P-AIDA-OF

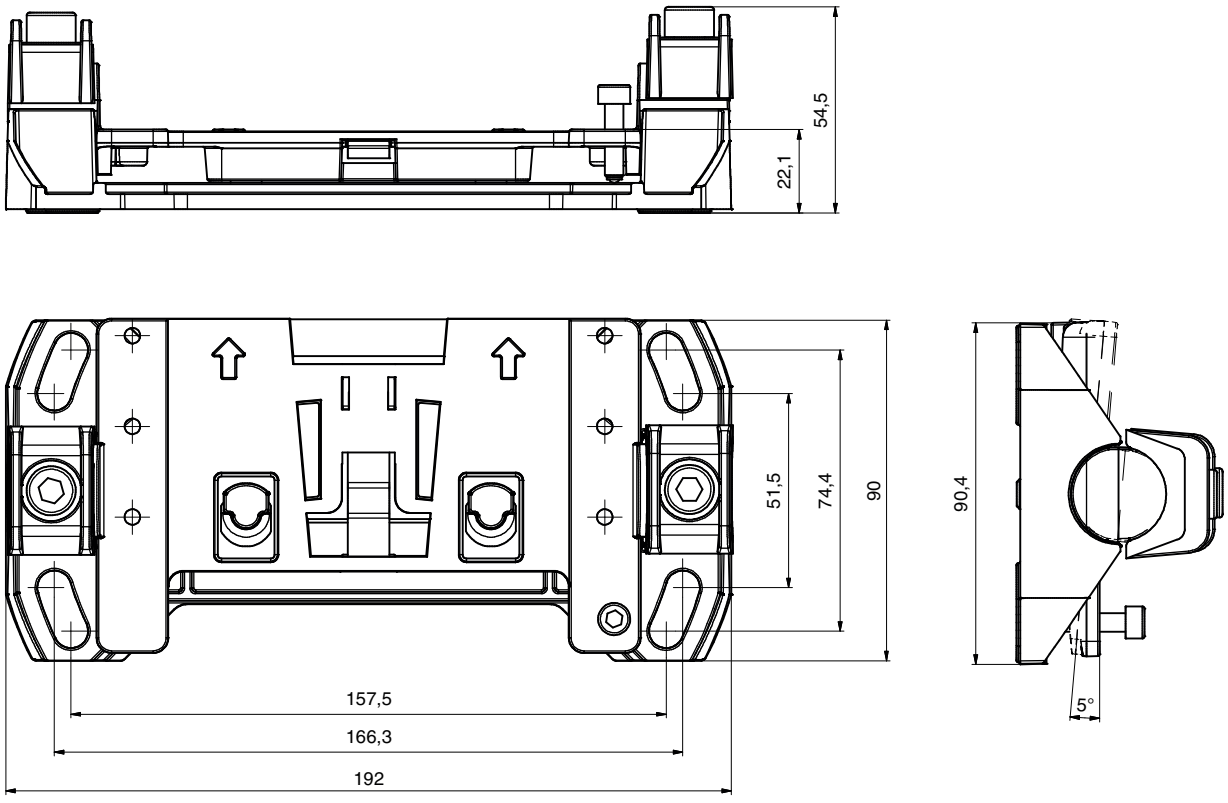


all dimensions in mm

1 Reference point for distance measurement and protective field radius

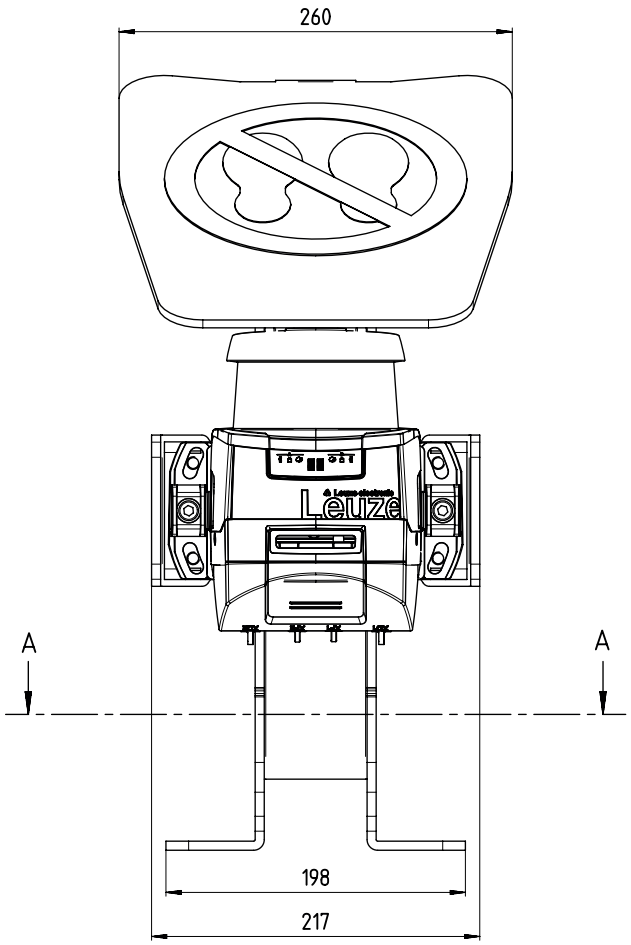
Fig. 16.3: Dimensions of scanning range

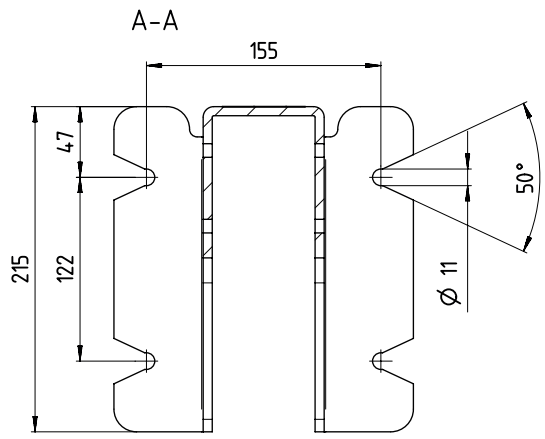
16.3 Dimensioned drawings: Accessories

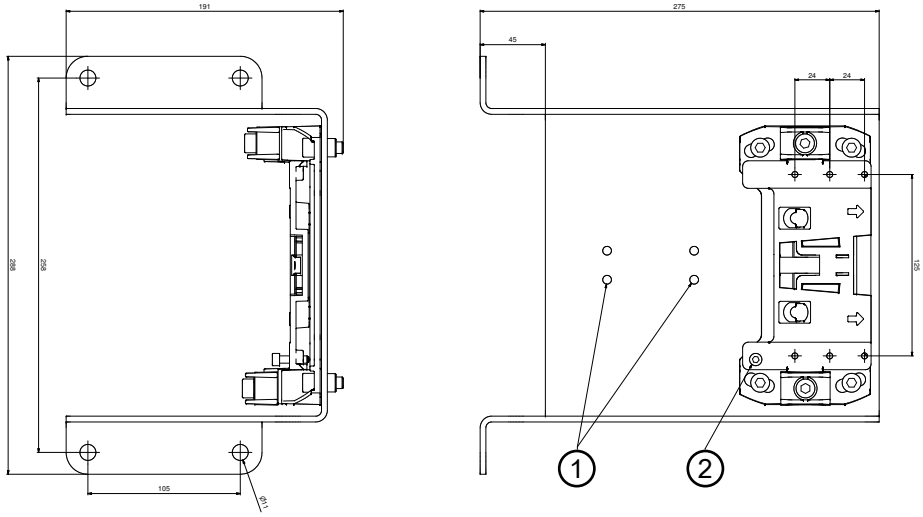


all dimensions in mm

Fig. 16.4: BTU800M mounting system


260
Leuze
A
A
198
217


A-A
155
47
122
215
50°
Ø 11

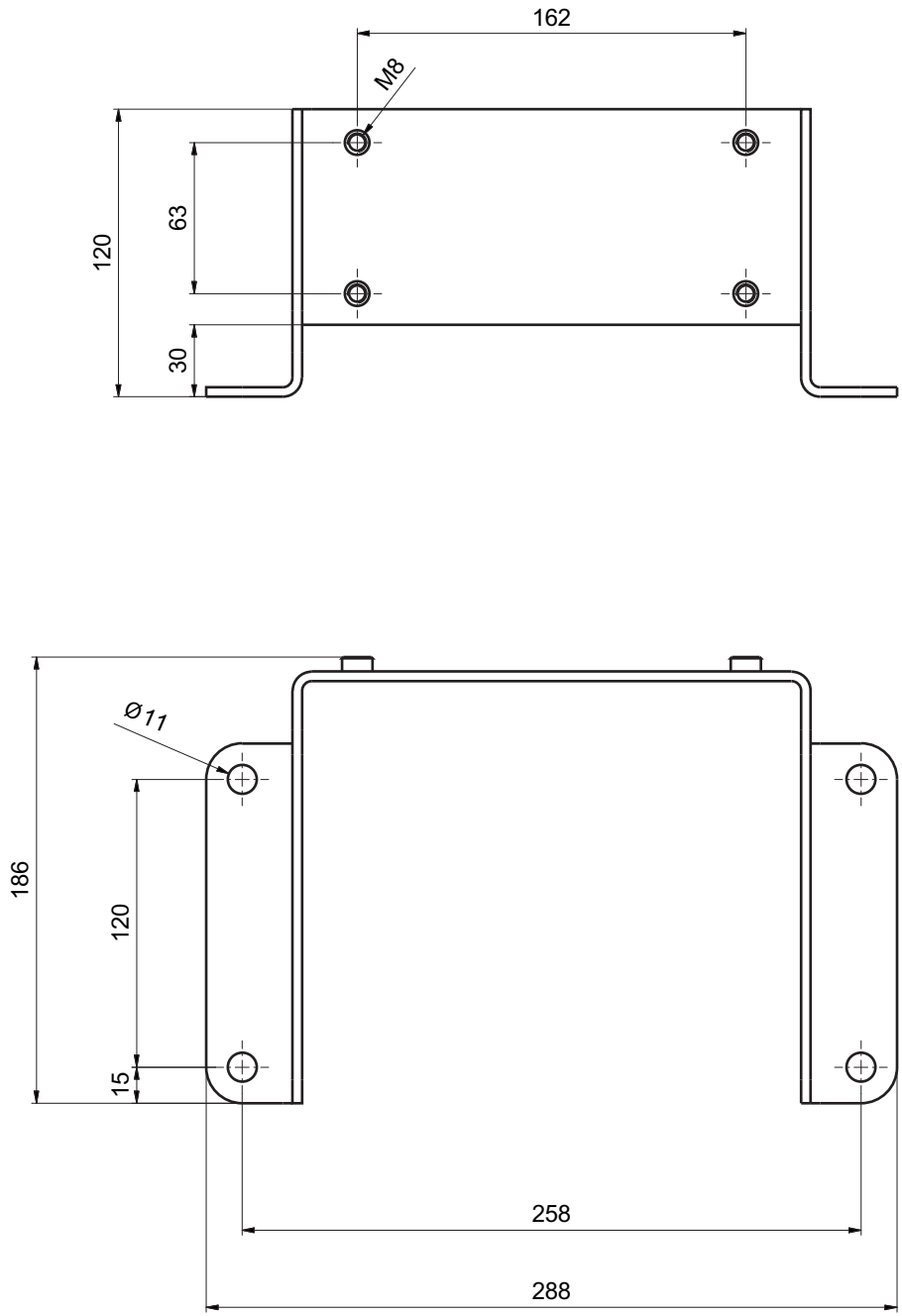


all dimensions in mm

1 Cable fastening

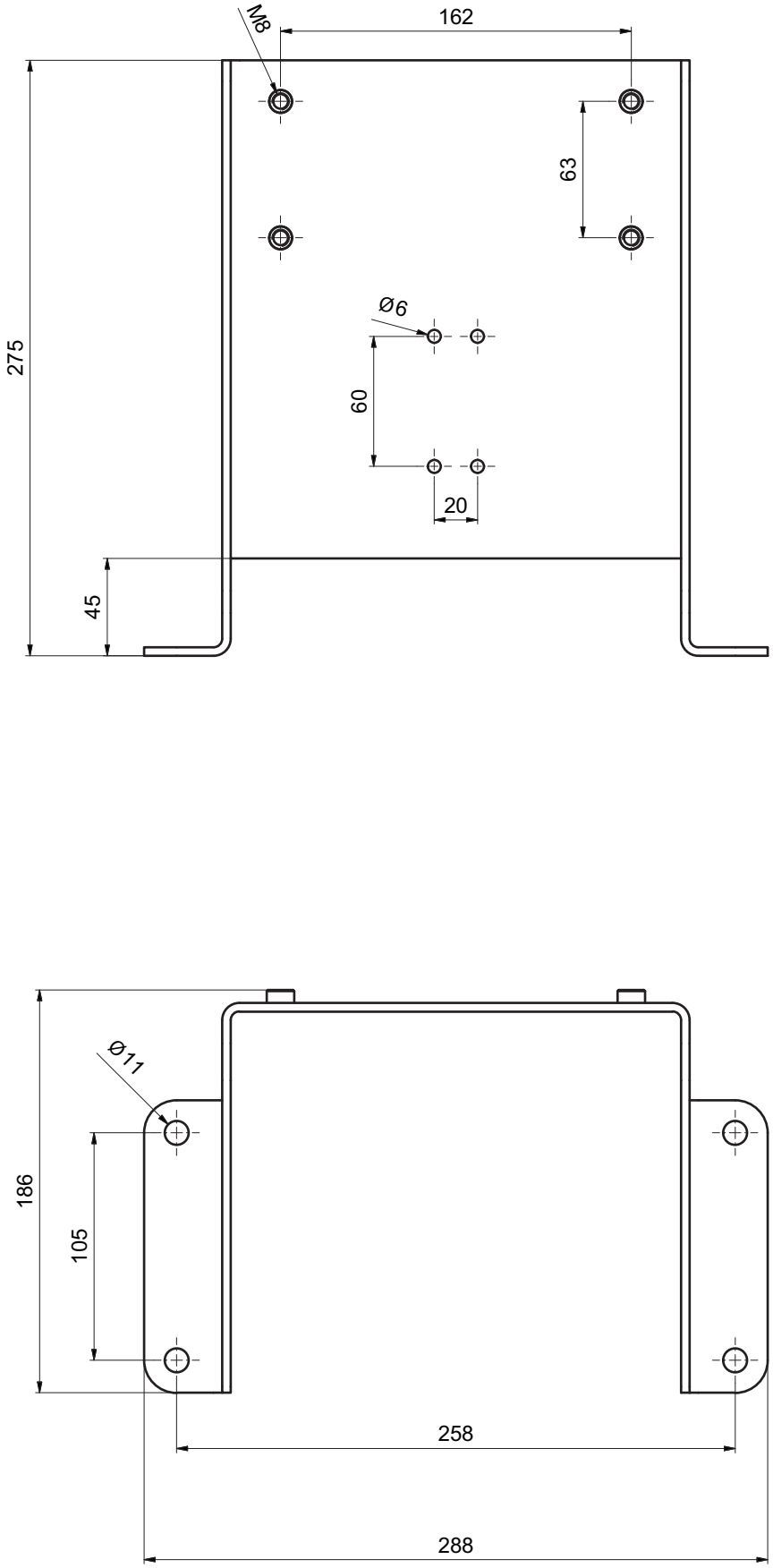
2 Adjustable scanning height: 75 mm – 375 mm

Fig. 16.5: Bracket for floor assembly BTF815-30M



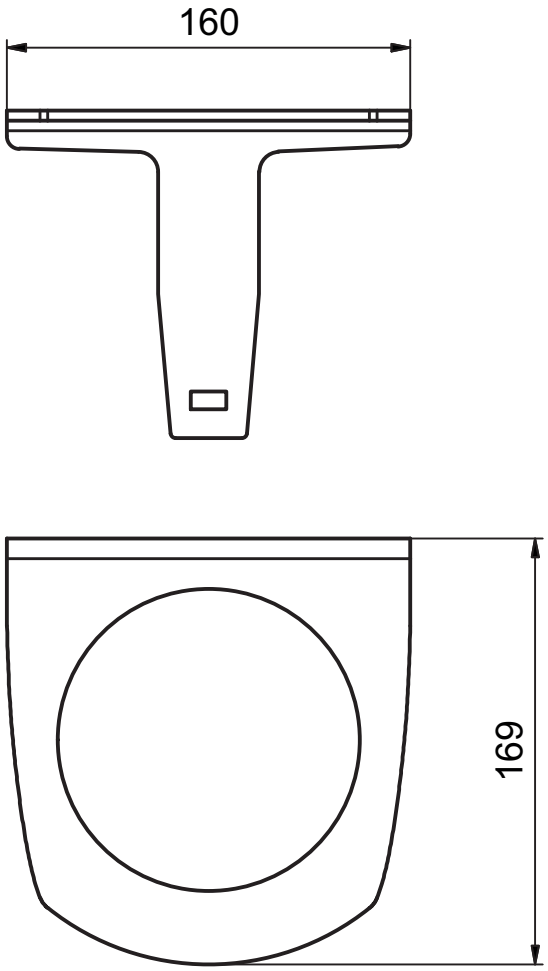
all dimensions in mm

Fig. 16.6: BTF815M mounting bracket



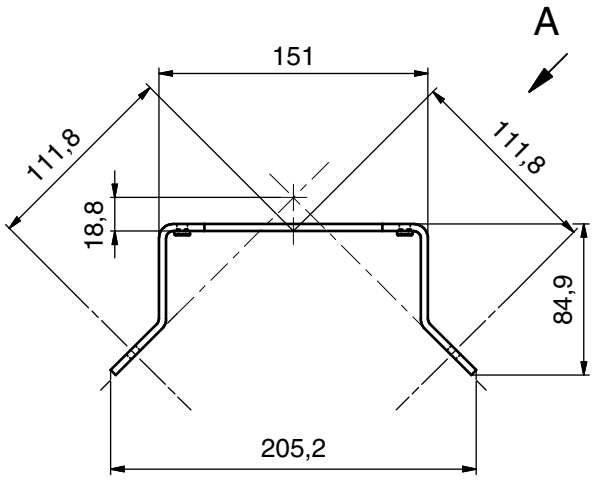
all dimensions in mm

Fig. 16.7: BTF830M mounting bracket



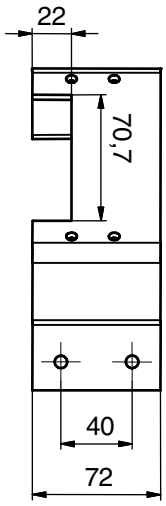
all dimensions in mm

Fig. 16.8: Loop guard BTP800M



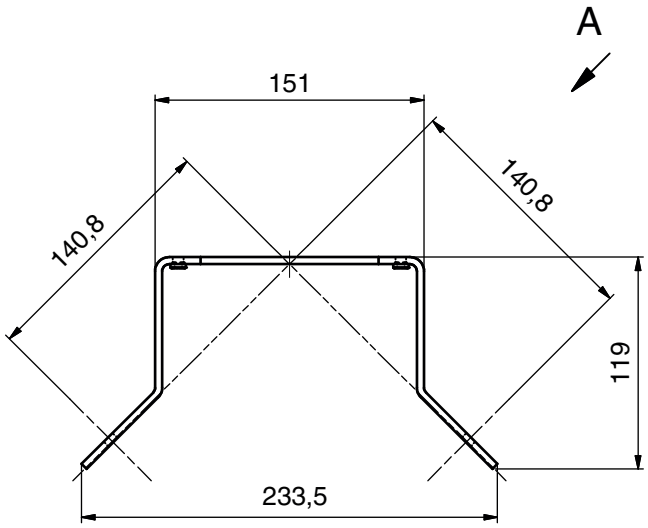
all dimensions in mm

Fig. 16.9: BT840M mounting bracket



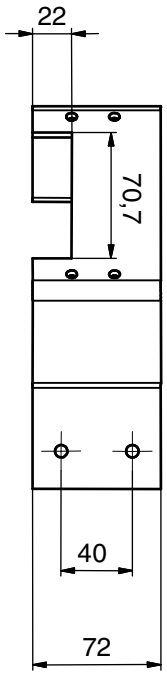
all dimensions in mm

Fig. 16.10: Mounting bracket BT840M, view A



all dimensions in mm

Fig. 16.11: BT856M mounting bracket



all dimensions in mm

Fig. 16.12: Mounting bracket BT856M, view A

16.4 PROFIsafe status profile

The PROFIsafe configuration modules contain all logical and electrical signals that are present in the safety sensor. The signal names are used consistently throughout the configuration and diagnostics software (device DTM), in the event log and in the data telegram.

PROFIsafe project modules

During configuration, different module structures and their properties can be selected via Device Access Points (DAPs) that are created in the GSDML file:

- DAP 1: project modules 1 … 8

16.4.1 Project modules for DAP 1

Modules [M1] … [M8]

- For devices with M12 connection unit (CU M12):
  - DeviceID: 0x0011
  - Textual designation for configuration:
    RSL400P M12
- For devices with AIDA connection unit for copper cables (CU AIDA):
  - DeviceID: 0x0012
  - Textual designation for configuration:
    RSL400P AIDA
- For devices with AIDA connection unit for fiber-optic cables (CU AIDA-OF):
  - DeviceID: 0x0013
  - Textual designation for configuration:
    RSL400P AIDA-OF
- For devices with connection unit with L-coded M12 connectors/sockets for the voltage supply (CU 4M12):
  - DeviceID: 0x0016
  - Textual designation for configuration:
    RSL400P 4M12

Module	Description	Input data [Byte]	Output data [Byte]
[M1] SAFE_SIGNAL see chapter 11.5.3 "Module [M1] - SAFE_SIGNAL"	Safe module with the safe signals and the most important status signals for simple system diagnostics.	3	3
[M2] SYSTEM_STATUS see chapter 11.5.4 "Module [M2] - SYSTEM_STATUS"	General information on error diagnostics and system alignment.	8	0
[M3] SCAN_NUMBER see chapter 11.5.5 "Module [M3] – SCAN_NUMBER"	Sequential scan number	4	0
[M4] REFLECTOR_STATUS see chapter 11.5.6 "Module [M4] – REFLECTOR_STATUS"	Information on reflectors in the field of view of the safety laser scanner	2	0
[M5] PROTECTIVE_FUNC-TION_A_STATUS see chapter 11.5.7 "Module [M5] – PROTECTIVE_FUNC-TION_A_STATUS"	Detailed status of protective function A	3	0
[M6] PROTECTIVE_FUNC-TION_B_STATUS see chapter 11.5.8 "Module [M6] – PROTECTIVE_FUNC-TION_B_STATUS"	Detailed status of protective function B	3	0
[M7] PROTECTIVE_FUNC-TION_A_VIOLATION see chapter 11.5.9 "Module [M7] – PROTECTIVE_FUNC-TION_A_VIOLATION"	Information on protective field interruption or warning field interruption of protective function A	8	0
[M8] PROTECTIVE_FUNC-TION_B_VIOLATION see chapter 11.5.10 "Module [M8] – PROTECTIVE_FUNC-TION_B_VIOLATION"	Information on protective field interruption or warning field interruption of protective function B	8	0

16.4.2 Project modules for DAP 2

Modules [M11] … [M17]

- For devices with M12 connection unit (CU M12):
  - DeviceID: 0x0011
  - Textual designation for configuration:
    RSL400P M12 V2
- For devices with AIDA connection unit for copper cables (CU AIDA):
  - DeviceID: 0x0012
  - Textual designation for configuration:
    RSL400P AIDA V2
- For devices with AIDA connection unit for fiber-optic cables (CU AIDA-OF):
  - DeviceID: 0x0013
  - Textual designation for configuration:
    RSL400P AIDA-OF V2
- For devices with connection unit with L-coded M12 connectors/sockets for the voltage supply (CU 4M12):
  - DeviceID: 0x0016
  - Textual designation for configuration:
    RSL400P 4M12 V2

Module	Description	Input data [Byte]	Output data [Byte]
[M11] SAFE_SIGNAL_PS2V4 see chapter 11.5.11 "Module [M11] - SAFE_SIGNAL_PS2V4"	For PROFIsafe version 2.4: Safe module containing the safe input and output signals.	3	7
[M11] SAFE_SIGNAL_PS2V6 see chapter 11.5.12 "Module [M11] - SAFE_SIGNAL_PS2V6"	For PROFIsafe version 2.6: Safe module containing the safe input and output signals.	2	6
[M12] SYSTEM_STATUS see chapter 11.5.13 "Module [M12] - SYSTEM_STATUS"	General information on the status of the device and safety functions. Simple system diagnostics is possible.	6	0
[M13] SYSTEM_DATA see chapter 11.5.14 "Module [M13] – SYSTEM_DATA"	Current data: Alignment of the safety laser scanner Voltage supply Inside temperature	8	0
[M14] PROTECTIVE_FUNCTION_A_STATUS see chapter 11.5.15 "Module [M14] – PROTECTIVE_FUNCTION_A_STATUS"	Detailed status of protective function A	8	0
[M15] PROTECTIVE_FUNCTION_B_STATUS see chapter 11.5.16 "Module [M15] – PROTECTIVE_FUNCTION_B_STATUS"	Detailed status of protective function B	8	0

Module	Description	Input data [Byte]	Output data [Byte]
[M16] PROTECTIVE_FUNC-TION_A_VIOLATION see chapter 11.5.17 "Module [M16] – PROTECTIVE_FUNC-TION_A_VIOLATION"	Information on protective field interruption or warning field interruption of protective function A	8	0
[M17] PROTECTIVE_FUNC-TION_B_VIOLATION see chapter 11.5.18 "Module [M17] – PROTECTIVE_FUNC-TION_B_VIOLATION"	Information on protective field interruption or warning field interruption of protective function B	8	0

17 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
- Low Voltage Directive
- Electromagnetic compatibility
- Use of Work Equipment Directive
- Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment
- OSHA
- Vibration IEC 60068-2-6
- Eye safety (measurement laser) IEC 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.
  - ISO 12100
  - ISO 13849-1, -2
  - IEC 61508-1 to -7
  - IEC 62061
  - IEC 60204-1
- ISO 13849-1
- ISO 13855
- IEC 61496-3
- EN 1525
- IEC 62046
- IEC 61158
- IEC 61784
- IEC 61784-3-3
- IEC 61076-3-117
- ISO/IEC 61754-24-2

18 Order guide and accessories

Scope of delivery

- 1 self-adhesive notice sign "Important notes and notes for the machine operator"
- 1 Original operating instructions "Safe implementation and operation" (PDF file on data carrier)
- 1 print document "Quick Start Guide RSL 400"

Tab. 18.1: Part numbers

Part no.	Article	Description
53800300	RSL420P-S/ CU400P-3M12	1 safety-related switching signal; 10 field pairs; protective field range max. 3.0 m, PROFIsafe PROFINET: 2x M12 connector
53800301	RSL420P-M/ CU400P-3M12	1 safety-related switching signal; 10 field pairs; protective field range max. 4.5 m, PROFIsafe PROFINET: 2x M12 connector
53800302	RSL420P-L/ CU400P-3M12	1 safety-related switching signal; 10 field pairs; protective field range max. 6.25 m, PROFIsafe PROFINET: 2x M12 connector
53800303	RSL420P-XL/ CU400P-3M12	1 safety-related switching signal; 10 field pairs; protective field range max. 8.25 m, PROFIsafe PROFINET: 2x M12 connector
53800329	RSL420P-S/ CU400P-4M12	1 safety-related switching signal; 10 field pairs; protective field range max. 3.0 m, PROFIsafe PROFINET: 2x M12 connector
53800330	RSL420P-M/ CU400P-4M12	1 safety-related switching signal; 10 field pairs; protective field range max. 4.5 m, PROFIsafe PROFINET: 2x M12 connector
53800331	RSL420P-L/ CU400P-4M12	1 safety-related switching signal; 10 field pairs; protective field range max. 6.25 m, PROFIsafe PROFINET: 2x M12 connector
53800332	RSL420P-XL/ CU400P-4M12	1 safety-related switching signal; 10 field pairs; protective field range max. 8.25 m, PROFIsafe PROFINET: 2x M12 connector
53800304	RSL420P-S/CU400P-AIDA	1 safety-related switching signal; 10 field pairs; protective field range max. 3.0 m, PROFIsafe PROFINET: 2x push-pull connector for copper cables
53800305	RSL420P-M/CU400P-AIDA	1 safety-related switching signal; 10 field pairs; protective field range max. 4.5 m, PROFIsafe PROFINET: 2x push-pull connector for copper cables
53800306	RSL420P-L/CU400P-AIDA	1 safety-related switching signal; 10 field pairs; protective field range max. 6.25 m, PROFIsafe PROFINET: 2x push-pull connector for copper cables
53800307	RSL420P-XL/CU400P-AIDA	1 safety-related switching signal; 10 field pairs; protective field range max. 8.25 m, PROFIsafe PROFINET: 2x push-pull connector for copper cables
53800308	RSL420P-S/CU400P-AIDA-OF	1 safety-related switching signal; 10 field pairs; protective field range max. 3.0 m, PROFIsafe PROFINET: 2x push-pull connector for fiber-optic cables

Part no.	Article	Description
53800309	RSL420P-M/CU400P-AIDA-OF	1 safety-related switching signal; 10 field pairs; protective field range max. 4.5 m, PROFIsafe PROFINET: 2x push-pull connector for fiber-optic cables
53800310	RSL420P-L/CU400P-AIDA-OF	1 safety-related switching signal; 10 field pairs; protective field range max. 6.25 m, PROFIsafe PROFINET: 2x push-pull connector for fiber-optic cables
53800311	RSL420P-XL/CU400P-AIDA-OF	1 safety-related switching signal; 10 field pairs; protective field range max. 8.25 m, PROFIsafe PROFINET: 2x push-pull connector for fiber-optic cables

Tab. 18.2: Scanner units as spare parts

Part no.	Article	Description
53800154	RSL420P-S	1 safety-related switching signal; 10 field pairs; protective field range max. 3.0 m, PROFIsafe
53800157	RSL420P-M	1 safety-related switching signal; 10 field pairs; protective field range max. 4.5 m, PROFIsafe
53800160	RSL420P-L	1 safety-related switching signal; 10 field pairs; protective field range max. 6.25 m, PROFIsafe
53800163	RSL420P-XL	1 safety-related switching signal; 10 field pairs; protective field range max. 8.25 m, PROFIsafe

Tab. 18.3: Connection units as spare parts

Part no.	Article	Description
53800150	CU400P-3M12	PROFINET, 1x M12 connector for supply, 2x M12 connector for communication
53800169	CU400P-4M12	PROFINET, 1x M12 connector and 1x M12 socket for supply, 2x M12 connector for communication
53800151	CU400P-AIDA	PROFINET, 2x push-pull connector for supply, 2x push-pull connector for communication via copper cable
53800152	CU400P-AIDA-OF	PROFINET, 2x push-pull connector for supply, 2x push-pull connector for communication via fiber-optic cable

Tab. 18.4: Accessories

Part no.	Article	Description
Connection technology – Connection cables		
678055	CB-M12-5000E-5GF	Connection cable, 5-pin, 5 m
678056	CB-M12-10000E-5GF	Connection cable, 5-pin, 10 m
678057	CB-M12-15000E-5GF	Connection cable, 5-pin, 15 m
678058	CB-M12-25000E-5GF	Connection cable, 5-pin, 25 m
50129553	CB-M12-30000E-5GF	Connection cable, 5-pin, 30 m
Connection technology – RJ45 interconnection cables		
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

Part no.	Article	Description
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
Connection technology – USB interconnection cables		
547822	AC-MSI-USB	USB-Mini-B interconnection cable, USB-A, 3 m
Connection technology – Adapters		
50134656	RSL400 M12 adapter	Adapter for the simple connection of an Ethernet cable to the front side of the device.
Mounting technology		
53800130	BTU800M	Laser scanner mounting system for vertical and horizontal alignment
53800132	BTF815M	Mounting bracket for floor mounting; scanning height 150 mm Mounting of safety sensor only in combination with BTU800M
53800133	BTF830M	Mounting bracket for floor mounting; scanning height 300 mm Mounting of safety sensor only in combination with BTU800M
53800134	BT840M	Mounting bracket for corner mounting on posts (chamfered corner) Direct mounting of the safety sensor
53800135	BT856M	Mounting bracket for corner mounting on posts Direct mounting of the safety sensor
53800131	BTP800M	Loop guard for optics cover Only in combination with BTU800M
53800138	BTF815-30M	Bracket for floor mounting Adjustable scanning height: 75 mm – 375 mm Mounting of safety sensor only in combination with BTU800M
Cleaning fluids		
430400	Cleaning set 1	Cleaning fluid for plastic, 150 ml, cleaning cloths, 25x, soft, fuzz-free
430410	Cleaning set 2	Cleaning fluid for plastic, 1,000 ml, cleaning cloths, 100x, soft, fuzz-free

19 EC Declaration of Conformity

SMART
SENSOR
BUSINESS

Leuze electronic
the sensor people

EU-/EG-KONFORMITÄTS-ERKLÄRUNG

Hersteller:

Produktbeschreibung:
Sicherheits-Laserscanner für Personenschutz, Berührungslos wirkende Schutzeinrichtung, Sicherheitsbauteil nach 2006/42/EG Anhang IV
RSL 400/RSL 400P
Seriennummer siehe Typschild

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.

Der oben beschriebene Gegenstand der Erklärung erfüllt die einschlägigen Harmonisierungsrechts-vorschriften der Union:

Angewandte EU-/EG-Richtlinie(n):
2006/42/EG (*1)
2014/30/EU
2014/53/EU (*2)

EU/EC DECLARATION OF CONFORMITY

Manufacturer:
Leuze electronic GmbH + Co. KG
In der Braike 1, PO Box 1111
73277 Owen, Germany

Description of product:
Safety Laser Scanner for personnel protection, Active opto-electronic protective device, safety component in acc. with 2006/42/EC annex IV
RSL 400/RSL 400P
Serial no. see name plates

This declaration of conformity is issued under the sole responsibility of the manufacturer.

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

Applied EU/EC Directive(s):
2006/42/EC (*1)
2014/30/EU
2014/53/EU (*2)

DECLARATION UE/CE DE CONFORMITE

Constructeur:

Description de produit:
Scanner laser de sécurité pour la protection des personnes, Equipement de protection électrosensible, Elément de sécurité selon 2006/42/CE annexe IV
RSL 400/RSL 400P
N° série voir plaques signalétiques

La présente déclaration de conformité est établie sous la seule responsabilité du fabricant.

L'objet de la déclaration décrit ci-dessus est conforme à la législation d'harmonisation de l'Union applicable:

Directive(s) UE/CE appliquées:
2006/42/CE (*1)
2014/30/UE
2014/53/UE (*2)

Angewandte harmonisierte Normen / Applied harmonized standards / Normes harmonisées appliquées:

EN ISO 13849-1:2015
EN 55022:2010+AC:2011
EN 62061:2005+A1:2013 (SILCL 2)
EN 61000-6-4:2007+A1:2011
EN 61496-1:2013

Angewandte technische Spezifikationen / Applied technical specifications / Spécifications techniques appliquées:

EN 61508-1/-2/-3/-4:2010 (SIL 2)
IEC 61496-3 (ed.2)

Notified Body
(*1) TÜV-SÜD PRODUCT SERVICE GmbH, Zertifizierungsstelle, Ridlerstraße 65, D-80339 München, NB 0123, Z10 15 06 68636 004
Dokumentationsbevollmächtigter ist der genannte Hersteller, Kontakt: quality@leuze.de.
Authorized for documentation is the stated manufacturer, contact: quality@leuze.de.
Autorisé pour documentation est le constructeur déclaré, contact: quality@leuze.de

2014/30/EU veröffentlicht: 29.03.2014, EU-Amtsblatt Nr. L 96/79-106; 2014/30/EU published: 29.03.2014, EU-Journal No. L 96/79-106; 2014/30/UE publié: Journal EU n° L 96/79-106

(*2) Nur für Geräte mit Funkmodul; Only for devices with radio module; Seulement pour les appareils avec module radio.

14.06.2018
Datum / Date / Date

Ulrich Balbach,
Geschäftsführer / Managing Director / Gérant

i.A. Fabien Zelenda
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Persönlich haftende Gesellschafterin Leuze electronic Geschäftsführungs-GmbH,
Sitz Owen, Registergericht Stuttgart, HRB 230550
Geschäftsführer: Ulrich Balbach
USt.-IdNr. DE 145912521 | Zollnummer 2554232
Es gelten ausschließlich unsere aktuellen Verkaufs- und Lieferbedingungen
Only our current Terms and Conditions of Sale and Delivery shall apply

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