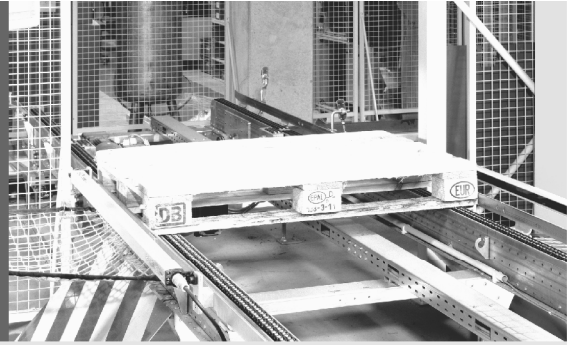


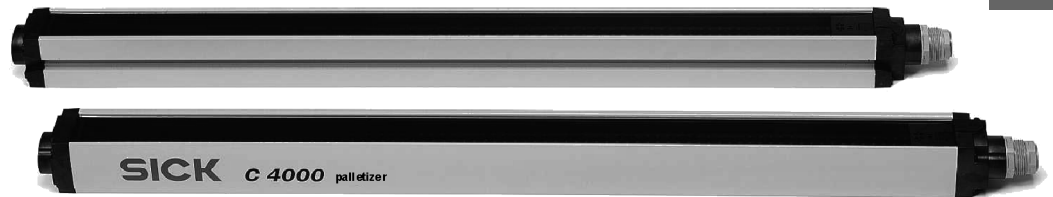
OPERATING INSTRUCTIONS

C4000 Palletizer Standard/Advanced C4000 Fusion



Safety light curtain

en



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1 About this document

Please read this chapter carefully before working with the documentation and the C4000 Palletizer or the C4000 Fusion, also referred to in the following as C4000 for short.

1.1 Function of this document

These operating instructions are designed to address *the technical personnel of the machine manufacturer* or the *machine operator* in regards to safe mounting, installation, configuration, electrical installation, commissioning, operation and maintenance of the C4000 safety light curtain.

These operating instructions do *not* provide instructions for operating machines on which the safety light curtain is, or will be, integrated. Information on this is to be found in the appropriate operating instructions for the machine.

1.2 Target group

These operating instructions are addressed to *planning engineers, machine designers* and *operators* of plants and systems which are to be protected by one or several C4000 safety light curtains. It also addresses people who integrate the C4000 into a machine, initialise its use, or who are in charge of servicing and maintaining the device.

1.3 Scope

Note These operating instructions apply to the C4000 Palletizer or C4000 Fusion safety light curtain with the following entry on the type label in the field *Operating Instructions*:

- 8012246
- 8012246/TE44
- 8012246/TG79
- 8012246/YT69

This document is part of SICK part number 8012246 (operating instructions “Safety Light Curtain C4000 Palletizer Standard/Advanced/C4000 Fusion” in all available languages).

These operating instructions are original operating instructions.

For the configuration and diagnostics of these devices you require CDS (Configuration & Diagnostic Software) version 3.6.1 or higher. To check the version of the software, on the **?** menu select **Info...**

1.4 Information depth

These operating instructions contain the following information on the C4000 safety light curtain:

- mounting
- electrical installation
- commissioning and configuration
- care and maintenance
- fault diagnosis and troubleshooting
- part numbers
- conformity and approval

Planning and using protective devices such as the C4000 also require specific technical skills which are not detailed in this documentation.

When operating the C4000, the national, local and statutory rules and regulations must be observed.

General information on accident prevention using opto-electronic protective devices can be found in the brochure "Safe Machines with opto-electronic protective devices".

Note Please refer also to the SICK homepage on the Internet at www.sick.com.

Here you will find information on:

- sample applications
- connection diagrams
- CAD drawings
- CAD dimensional model
- these operating instructions in different languages for viewing and printing
- certificates on the prototype test, the EU declaration of conformity and other documents

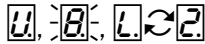
1.5 Abbreviations

ADO	Application diagnostic output = configurable signal output that indicates a specific status of the protective device
CDS	SICK Configuration & Diagnostic Software = software for the configuration and diagnostics of the C4000 safety light curtain
EDM	External device monitoring
EFI	Enhanced function interface = safe SICK device communication
ESPE	Electro-sensitive protective equipment (e.g. C4000)
OSSD	Output signal switching device

1.6 Symbols used

Recommendation Recommendations are designed to give you some assistance in your decision-making process with respect to a certain function or a technical measure.

Note Refer to notes for special features of the device.



Display indications show the status of the 7-segment display on sender or receiver:

- Constant indication of characters, e.g. U
- Flashing indication of characters, e.g. 8
- Alternating indication of characters, e.g. L and 2

The depiction of numbers on the 7-segment display can be rotated by 180° with the aid of the CDS. In this document the depiction of the numbers on the 7-segment display is however always in the normal, non-rotated position.

- **Red**, ● **Yellow**, ○ **Green** LED symbols describe the state of a diagnostics LED. Examples:
 - **Red** The red LED is illuminated constantly.
 - **Yellow** The yellow LED is flashing.
 - **Green** The green LED is off.

➤ Take action ... Instructions for taking action are shown by an arrow. Read carefully and follow the instructions for action.



WARNING

Warning!

A warning indicates an actual or potential risk or health hazard. They are designed to help you to prevent accidents.

Read carefully and follow the warning notices!



Software notes show the location in the CDS (Configuration & Diagnostic Software) where you can make the appropriate settings and adjustments.



Sender and receiver

In drawings and diagrams, the symbol denotes the sender and the symbol denotes the receiver.

The term “dangerous state”

The dangerous state (standard term) of the machine is always shown in the drawings and diagrams of this document as a movement of a machine part. In practical operation, there may be a number of different dangerous states:

- machine movements
- electrical conductors
- visible or invisible radiation
- a combination of several risks and hazards

2 On safety

This chapter deals with your own safety and the safety of the equipment operators.

- Please read this chapter carefully before working with the C4000 or with the machine protected by the C4000.

2.1 Qualified safety personnel

The C4000 safety light curtain must be installed, connected, commissioned and serviced only by qualified safety personnel. Qualified safety personnel are defined as persons who ...

- due to their specialist training and experience have adequate knowledge of the power-driven equipment to be checked

and

- have been instructed by the responsible machine owner in the operation of the machine and the current valid safety guidelines

and

- are sufficiently familiar with the applicable official health and safety regulations, directives and generally recognized engineering practice (e.g. DIN standards, VDE stipulations, engineering regulations from other EU member states) that they can assess the work safety aspects of the power-driven equipment

and

- have access to these operating instructions and who have read them.

As a rule these are qualified safety personnel from the ESPE manufacturer or also those persons who have been appropriately trained at the ESPE manufacturer, are primarily involved in checking ESPE and are allocated the task by the organisation operating the ESPE.

2.2 Applications of the device

The C4000 safety light curtain is an item of electro-sensitive protective equipment (ESPE). The C4000 consists of a sender and a receiver (Fig. 1 and Fig. 2). Between the two is the protective field.

The size of the C4000 defines the *protective field length* in horizontal applications, the *protective field height* in vertical applications. The effective protective field length or protective field height is between 300 and 1800 mm.

The *protective field width* is given by the dimension of the light path between sender and receiver (see “Technical specifications” on page 95).

The physical resolution is 20, 30 or 40 mm.

The device is a *Type 4 ESPE* as defined by IEC 61496-1 and IEC 61496-2 and is therefore allowed for use with controls in category 4 PL e according to EN ISO 13849-1 and SIL3 according to IEC 61508.

The emergency stop monitoring in the device corresponds to stop category 0 in accordance with EN ISO 13850. The C4000 Palletizer Standard/Advanced and the C4000 Fusion are suitable for:

- hazardous area protection
- access protection

In addition, the C4000 Fusion is suitable for:

- hazardous point protection

For hazardous area protection or access protection, the C4000 is used for the protection of hazardous areas that can be entered on foot. Access can be directly via corridors (e.g. the building floor) or via conveyors (e.g. roller conveyors or chain conveyors).

Access to the hazardous point must be allowed only through the protective field. The plant/system must not start as long as personnel are within the hazardous area. Refer to chapter 3 “Product description” on page 13 for an illustration of the protection modes.

You will find a description of the default delivery status in section 9.1 “Default delivery status” on page 88.



WARNING

Only use the safety light curtain as an indirect protective measure!

An opto-electronic protective device provides indirect protection, e.g. by switching off the power at the source of the hazard. It cannot provide protection from parts thrown out, nor from emitted radiation. Transparent objects are not detected.

Depending on the application, mechanical guards may be required in addition to the safety light curtain.

Requirements for the protective function

The C4000 safety light curtain operates correctly as a protective device only if the following conditions are met:

- The control of the machine must be electrical.
- It must be possible to achieve a safe state on the machine at any time.
- Sender and receiver unit must be mounted in a way that objects penetrating the hazardous area are safely identified by the C4000.
- The reset button must be fitted outside the hazardous area such that it cannot be operated by a person working inside the hazardous area. When operating the reset button, the operator must have full visual command of the hazardous area.
- The statutory and local rules and regulations must be observed when installing and using the device.

Notes

- Configuration files for devices with software version V05.x cannot be used for devices from software version V06.x or V07.x.
- Configuration files for devices with software version V06.x cannot be used for devices from software version V07.x.

2.3 Correct use

The C4000 safety light curtain must be used only as defined in section 2.2 “Applications of the device”. It must be used only by qualified personnel and only on the machine where it has been installed and initialised by qualified safety personnel in accordance with these operating instructions.

If the device is used for any other purposes or modified in any way – also during mounting and installation – any warranty claim against SICK AG shall become void.

2.4 General safety notes and protective measures**WARNING****Safety notes**

Please observe the following procedures in order to ensure the correct and safe use of the C4000 safety light curtain.

- The usage of the safety light curtain requires a risk analysis. Check whether the safety light curtain can be used as the protective device or whether additional protective measures are necessary.
- The national/international rules and regulations apply to the installation, use and periodic technical inspections of the safety light curtain, in particular:
 - Machinery Directive
 - Work Equipment Directive
 - the work safety regulations/safety rules
 - other relevant safety regulations

Manufacturers and operators of the machine on which the safety light curtain is used are responsible for obtaining and observing all applicable safety regulations and rules.

- The notices, in particular the test regulations (see “Test notes” on page 85) of these operating instructions (e.g. on use, mounting, installation or integration into the existing machine controller) must be observed.

- The organisation operating the machine on which the safety light curtain is used must prevent bypassing of the protective field using suitable additional measures (see “Additional measures to prevent bypassing of the protection” on page 58).
- Changing the configuration requires a separate risk analysis. Check in detail whether and where a configuration change is actually required.

Changes to the configuration of the devices can degrade the protective function. After every change to the configuration you must therefore check the effectiveness of the protective device.

The person who makes the change is also responsible for the correct protective function of the device. When making configuration changes, please always use the password hierarchy provided by SICK to ensure that only authorised persons make changes to the configuration. The SICK service team is available to provide assistance if required.

- The tests must be carried out by qualified safety personnel or specially qualified and authorised personnel and must be recorded and documented to ensure that the tests can be reconstructed and retraced at any time.
- The operating instructions must be made available to the operator of the machine where the C4000 safety light curtain is fitted. The machine operator is to be instructed in the use of the device by qualified safety personnel and must be instructed to read the operating instructions.
- To meet the requirements of the relevant product standards (e.g. IEC 61496-1), the external voltage supply for the devices (SELV) must be able to withstand a brief mains failure of 20 ms as required by EN 60204-1. The power supply must provide safe mains isolation (SELV/PELV) and have a current limit of max. 8 A. Suitable power supplies are available as accessories from SICK (see section 13.5 “Accessories” on page 116).

2.5 Environmental protection

The C4000 safety light curtain has been designed to minimise environmental impact. It uses only a minimum of power and natural resources.

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

Disposal

- Always dispose of unserviceable or irreparable devices in compliance with local/national rules and regulations with respect to waste disposal.

Note We would be pleased to be of assistance on the disposal of these devices. Contact us.

3 Product description

This chapter provides information on the special features and properties of the C4000 safety light curtain. It describes the construction and the operating principle of the device, in particular the different operating modes.

➤ Please read this chapter before mounting, installing and commissioning the device.

3.1 Special features

3.1.1 C4000 Palletizer

The C4000 Palletizer safety light curtain has the following characteristics:

Advanced

- self-teach dynamic blanking for pallet detection, as a result differentiation between **several** moving objects with static distance in the protective field plane (e.g. feet on pallets or mesh crates or wheels on a trolley) and other objects, in particular people
- Object entry monitoring: At the unidirectional output on a machine, the C4000 Palletizer permits discharge independent of the size of the objects, as long as the direction in which the objects are transported is correct.

Standard

- self-teach dynamic blanking for goods detection, differentiation between **a single** object in the protective field plane (e.g. packages or goods on a pallet) and other objects, in particular people

Standard and Advanced

- Object entry monitoring (Exit Only): This universal function permits the discharge of objects at the unidirectional output on a machine independent of the size of the objects with a tolerance in relation to the distance between the objects if the direction in which the objects are transported is out of the hazardous area.
- automatic teach-in of object sizes
- object size monitoring
- gap suppression
- reduced resolution
- multiple sampling
- external device monitoring (EDM)
- connection of a reset button in the control cabinet or directly to the device (in many cases connection to the device results in shorter cable lengths and improved visibility of the hazardous point)
- bypass for safe operating states or emergency stop (facility on the device for connecting a key-operated pushbutton for bypass or an emergency stop button)
- 2 beam codings for protection against mutual interference between two systems physically close together

- Sender and receiver automatically synchronise themselves optically during switching on. During this process the first and last beam are used as synchronisation beams. For this reason one of the two beams must be clear on switch on. During operation, these two beams are then allowed to also be covered at the same time (not during goods detection).
- configurable signal output (ADO) for improved availability
- status display with 7-segment display
- two virtual photoelectric switches in the protective field for determining the position of the pallet/the skid (saves additional photoelectric switches). Output via the EFI protocol, in the case of devices with extension connection the output signals can also be sampled there.
- operating mode switching (only in conjunction with SICK switching amplifier, e.g. UE402)
- range of functions can be expanded using switching amplifiers in the SICK sens:Control product family

3.1.2 C4000 Fusion

The C4000 Fusion has the following additional properties:

- laser in the sender that can be switched on electro-sensitively, to make alignment easier with large protective field widths

With horizontal operation

- customer-specific blanking for object pattern recognition, as a result differentiation between complex objects in the protective field plane (e.g. transport skids) and other objects, in particular people

With vertical operation

- high availability in protective operation in soiled environments due to reduced resolution and multiple sampling
- access protection with detection of geometrically even objects
- hazardous point protection with up to five blanked areas
- teaching-in the number, size and position of the blanked areas with the aid of a key-operated pushbutton for teach-in

**C4000 Palletizer Std./Adv.
C4000 Fusion**

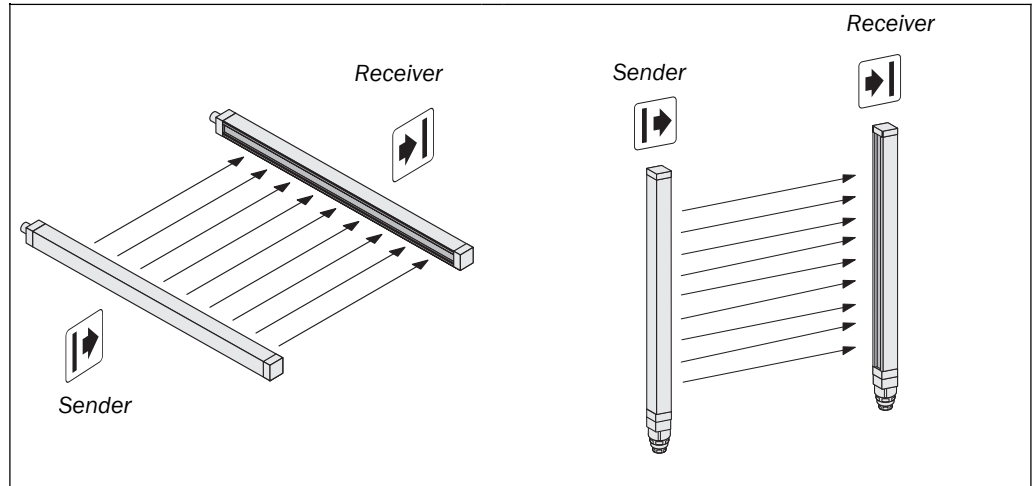
3.2 Operating principle of the device

The C4000 Palletizer and the C4000 Fusion safety light curtains provide access protection if, e.g., packages or goods on a pallet have access to a system or machine.

The C4000 Fusion also provides access protection when geometrically even objects without undercutting have access to a system or machine. It also provides hazardous point protection with up to five blanked areas.

Fig. 1: C4000 Palletizer Standard/Advanced and C4000 Fusion used horizontally for hazardous area protection or access protection

Fig. 2: C4000 Fusion used vertically for hazardous area protection, access protection or hazardous point protection



3.2.1 Horizontal applications

The pattern-detecting operating modes for goods detection, for pallet detection or for object pattern recognition represent an alternative muting.

Muting temporarily mutes the protection provided by a safety device. In this way it is possible to move material to or from a machine without the need to interrupt the work process.

During muting a differentiation is made between people and material with the aid of additional sensor signals. In the event of a valid muting condition the protective device is overridden on the basis of a logical evaluation of these external sensor signals so that the material to be transported can pass through the protective device. As soon as anything other than material enters the hazardous area, the work process is interrupted.

Self-teach dynamic blanking for goods detection, for pallet detection or for object pattern recognition uses this principle in that an object (good, pallet, mesh crate etc.) is briefly frozen based on the static pattern and movement through the field/conveying allowed. Conversely, a person will dynamically interrupt the beams.



WARNING

Safety considerations are therefore comparable to muting.

In comparison to muting, there are the following differences: C4000 is always active, never “muted”, i.e. a part of the protective field is always monitored for whether a person is entering the hazardous point.

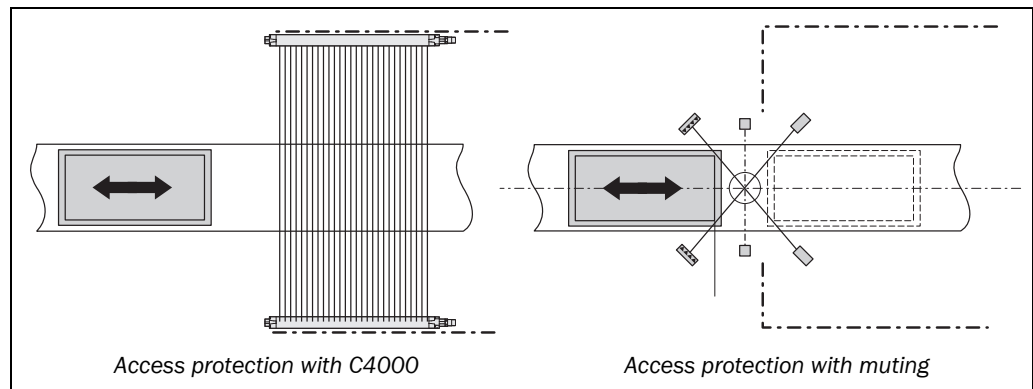
Compared to commercially available muting solutions, there is also a whole series of advantages:

- No muting sensors are required, as a result it is therefore not necessary to re-align the sensors after changing the item transported.
- less wiring, installation and maintenance effort
- Valid objects can remain in the protective field for an unlimited amount of time (even after restarting the machine). These aspects save valuable space in your system.
- Fewer sensors are required, as a result availability is higher.
- Significantly simpler circuit concept, it is only necessary to integrate the outputs on the C4000 in the cut-off path.

Recommendation

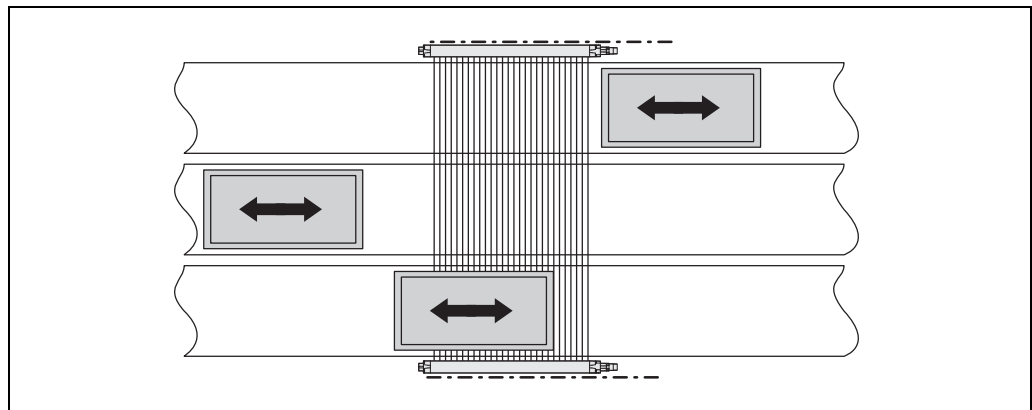
For detailed information on the exact design of your machine/system, please contact your local SICK representative.

Fig. 3: Access protection with C4000



Note Due to the principle of operation of the C4000, a person can partially enter the protective field under certain conditions without the OSSDs shutting down. This aspect is taken into account in the formula for the calculation of the safety distance using an additional factor, at variance with the standard (see section 6.2 “Determining the safety distance in a horizontal application” on page 59).

Fig. 4: Access protection for several accesses



Note If it can be ensured that there will always only be one object in the protective field, several accesses can be monitored at once! In this case concealment in the shadow of the goods must be prevented.

3.2.2 Vertical applications

The C4000 is mounted **vertically** in the direction of transport of the objects or vertically as access protection or hazardous point protection.

**C4000 Palletizer Std./Adv.
C4000 Fusion****3.2.3 Applications**

Tab. 1 shows the applications for the C4000 variants:

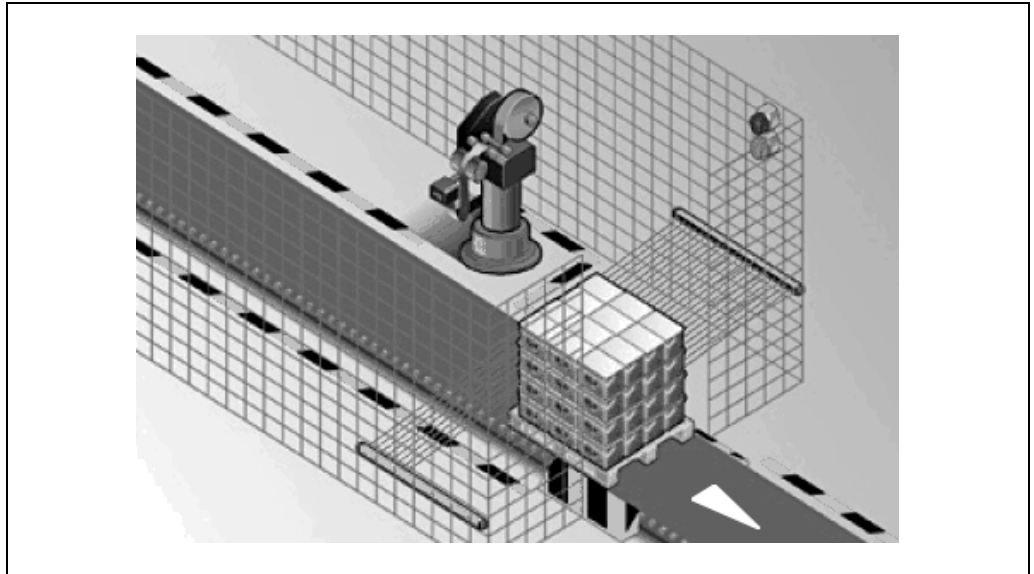
Tab. 1: Applications for the C4000 variants

Application	C4000 Palletizer Standard	C4000 Palletizer Advanced	C4000 Fusion
Horizontal applications			
Object entry monitoring (see 3.2.4 on page 18)		■	■
Goods detection (see 3.2.4 on page 18)	■	■	■
Pallet detection (see 3.2.6 on page 20)		■	■
Object pattern recognition (see 3.2.7 on page 21)			■
Hazardous area protection (see 3.2.9 on page 24)	■	■	■
Vertical applications			
Detection of geometrically even objects (see 3.2.8 on page 23)			■
Hazardous point protection (see 3.2.9 on page 24)	■	■	■
Manual teach-in of blanked areas			■

3.2.4 Object entry monitoring

The object entry monitoring function monitors the direction of transport of objects. People are prevented from entering the system by the object entry monitoring.

Fig. 5: Object entry monitoring



This function can be used, for example, if pallets are to be monitored that cannot meet the parameters for pallet detection or goods detection. These could be, e.g. partially wrapped pallets or pallets on which only one foot is continuously visible in the protective field (e.g. the Duesseldorfer or the CHEP pallet on which the wooden blocks have been replaced with steel plates).

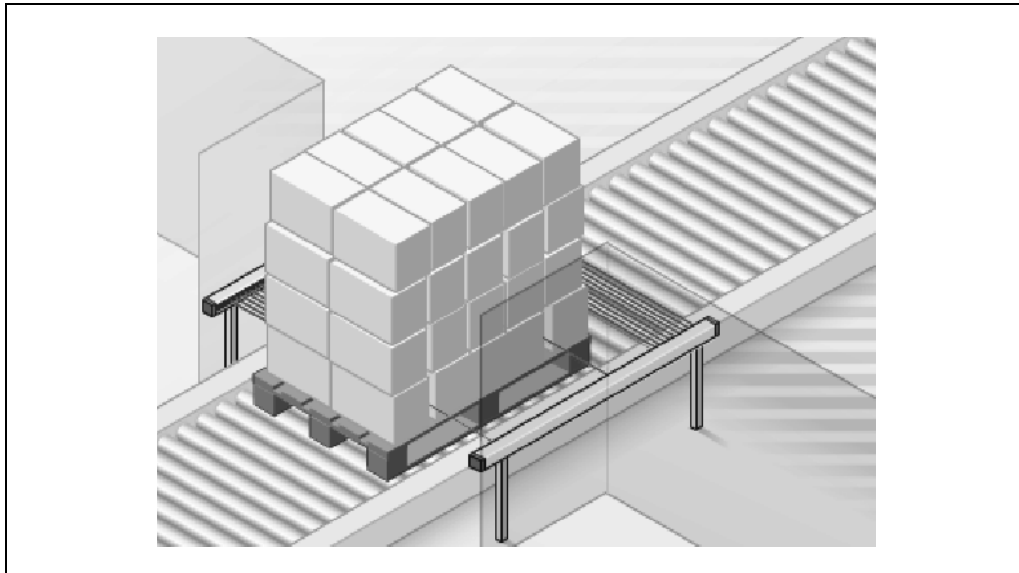
If there are several objects in the protective field, the object entry monitoring also allows pallets to move apart or move together. However, objects once detected are not allowed to “merge” with others.

If it is to be expected that pallets are fully wrapped, then it is to be ensured the protective field length is approx. 150 mm longer than the longest object, as otherwise complete shading could occur.

**C4000 Palletizer Std./Adv.
C4000 Fusion**
3.2.5 Goods detection

Goods detection provides access protection during which e.g. packages, or goods on a pallet that are at least 150 mm smaller than the protective field length have access to a system or machine. If other objects, in particular people, enter the protective field then the C4000 shuts down its output signal switching devices.

Fig. 6: Goods detection

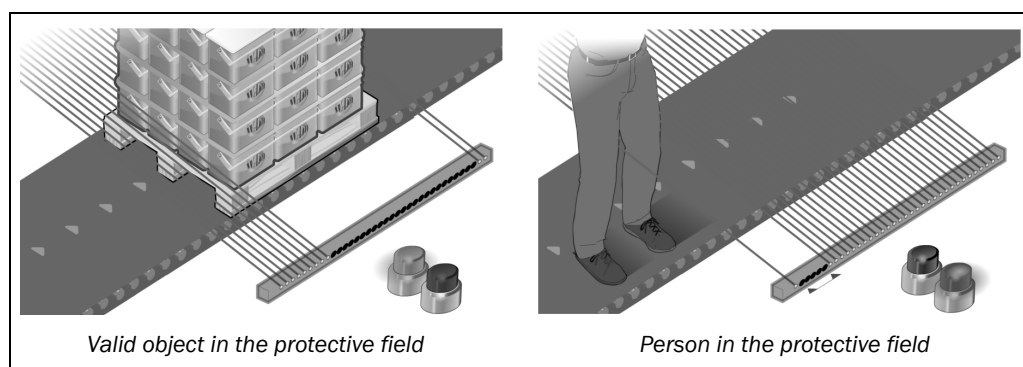


The C4000 is mounted **horizontally** in the direction of transport of the objects. The beams of the safety light curtain are aligned on the packages on the pallet.

The size of the object allowed (min. 500 mm) is configured or taught-in (see section 5.2 “Self-teach dynamic blanking for goods detection” on page 43).

A single object (e.g. a stack of pallets) must enter the protective field and in the process interrupt the first, second, third beam etc. one after the other. The object must then leave the protective field and in the process clear the safety light curtain beam by beam. It is allowed to stop and restart a valid object; this action will not result in the shutdown of the OSSDs. In bidirectional operation, the object can enter and then move back again.

Fig. 7: Principle of operation, goods detection

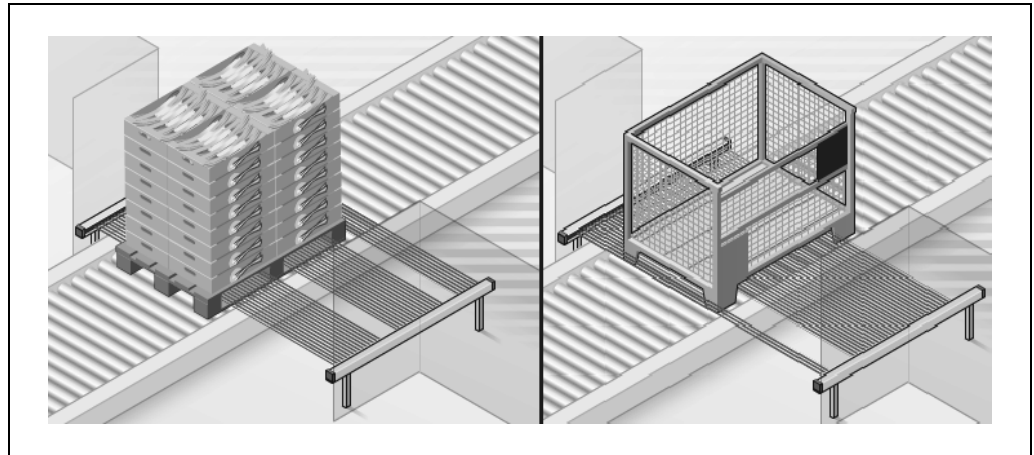


3.2.6 Pallet detection

Pallet detection provides access protection in which e.g. pallets, mesh crates or trolleys can have access to a system or machine. If other objects, in particular people, enter the protective field then the C4000 shuts down its output signal switching devices.

Note With this type of access protection, very different pallets can be used without prior teaching-in. No muting sensors are required, as a result it is therefore not necessary to re-align the sensors after changing the item transported.

Fig. 8: Pallet detection



The C4000 is mounted **horizontally** in the direction of transport of the objects. The beams on the safety light curtain are aligned with the feet on a pallet or mesh crate. Then several objects enter the protective field per pallet.

The maximum number of these floating objects depends on the protective field length (see Tab. 2). Their maximum size of 240 mm is fixed.

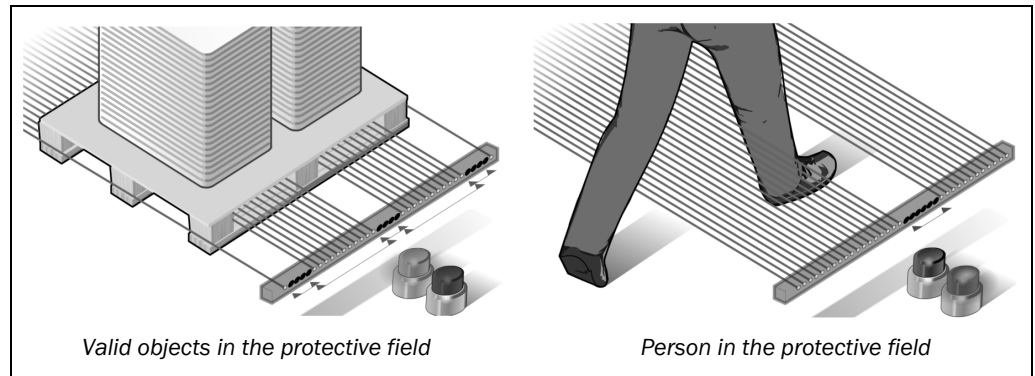
Tab. 2: Number of moving objects during pallet detection

Protective field length [mm]		Number of floating objects
C4000 Palletizer Advanced	C4000 Fusion	
-	300	1
-	450	2
-	600	2
750	750	3
900	900	4
1050	1050	4
1200	1200	4
1350	1350	5
1500	1500	5
1650	1650	5
1800	1800	5

As for goods detection, the first object must interrupt the first, second, third beam etc. in succession. As soon as a further object enters the protective field, the object distance is determined. This distance is not allowed to change as the object passes through the protective field.

**C4000 Palletizer Std./Adv.
C4000 Fusion**

Fig. 9: Principle of operation,
pallet detection



3.2.7 Object pattern recognition

The object pattern recognition provides access protection in which complex objects, e.g. transport skids, have access to a system or machine. If other objects, in particular people, enter the protective field then the C4000 shuts down its output signal switching devices.

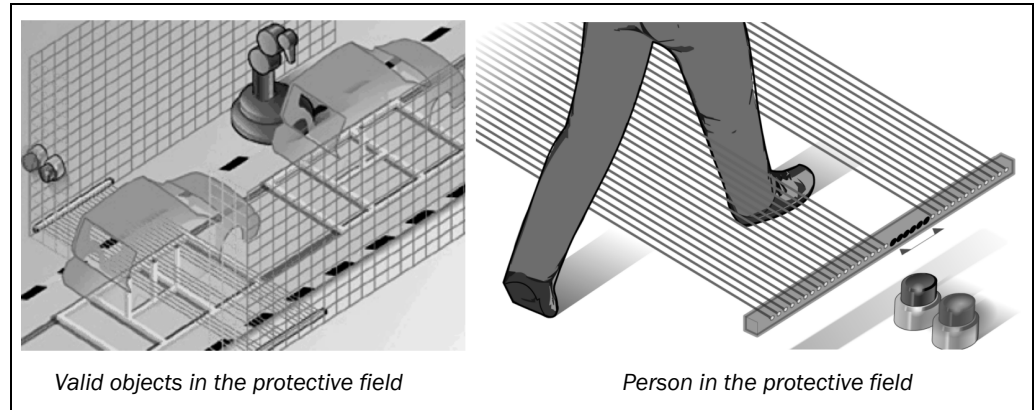
Fig. 10: Object pattern
recognition



The C4000 is mounted **horizontally** in the direction of transport of the objects. The beams on the safety light curtain are e.g. aligned on the rails on a transport skid. Then several objects per transport skid enter the protective field.

The maximum number of these floating objects depends on the protective field length (see Tab. 3 on page 22), their size is configurable. In addition, it is also possible to configure the distance between the objects. As a result, it is possible to accurately configure an object pattern, the blanking can be adapted to the related application for the specific customer.

Fig. 11: Principle of operation, object pattern recognition



Tab. 3: Number of moving objects with object pattern recognition

Protective field length [mm] C4000 Fusion	Number of floating objects
300	1
450	2
600	2
750	3
900	4
1050	4
1200	4
1350	5
1500	5
1650	5
1800	5

3.2.8 Detection of geometrically even objects

The detection of geometrically even objects (objects that throw a shadow with a straight edge at the front and back) makes possible access protection while objects, e.g. rolls of paper or cardboard boxes have access to a system or machine. If other objects, in particular people, enter the protective field then the C4000 shuts down its output signal switching devices.

Fig. 12: Examples of geometrically even objects

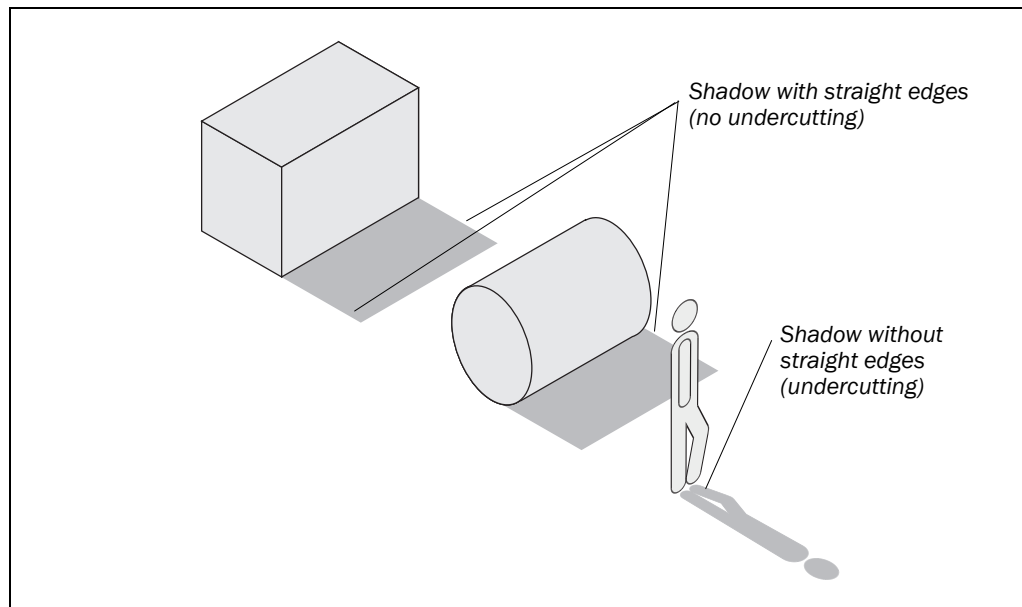
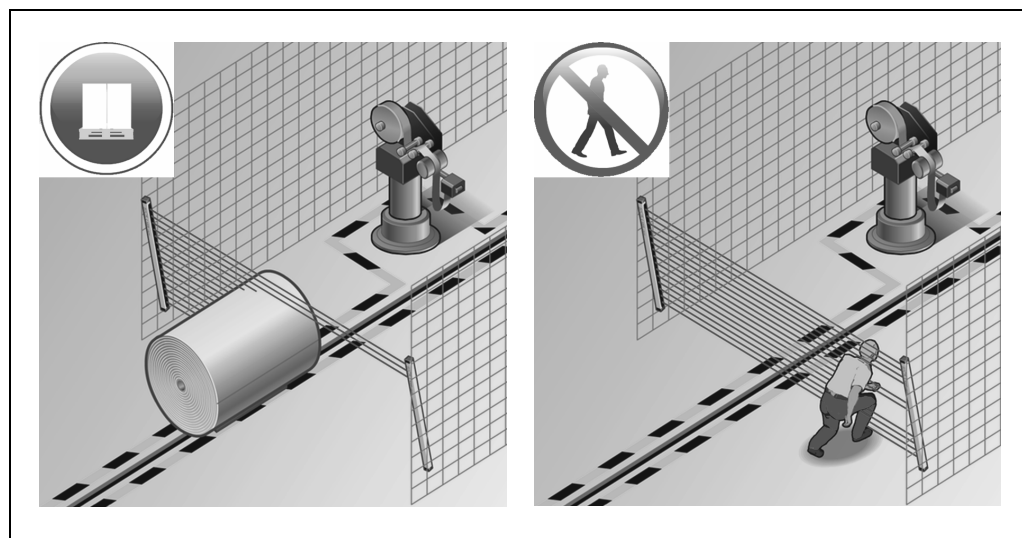


Fig. 13: Detection of geometrically even objects



The protective field is blanked for defined individual objects up to the maximum height expected for the objects. Objects allowed must have a contiguous profile without undercutting.

3.2.9 Protective operation for hazardous point protection or hazardous area protection

In protective operation, even in dirty environments a high level of availability is ensured by the configurable multiple sampling and/or the configurable reduced resolution and by the two synchronisation beams.

Fig. 14: Hazardous point protection



3.2.10 Protective operation with blanking

In addition, up to five fixed areas can be blanked. You can configure the maximum number of areas in the CDS. The actual number, size and position of the areas can be taught-in using the key-operated pushbutton for teach-in.

Teach-in enables the operator to re-define the number, size and position of blanked areas in a simple manner by introducing objects of appropriate sizes into the protective field at the required positions. This is, e.g., useful during a tool change.

The blanked areas are subject to continuous object monitoring. During this process, the safety light curtain interrupts the dangerous movement if the object or the objects are removed from the beam path after teaching-in.

3.3 Status indicators

The LEDs and the 7-segment display of sender and receiver signal the operating status of the C4000.



The depiction of numbers on the 7-segment display can be rotated by 180° with the aid of the CDS (Configuration & Diagnostic Software). If the numbers are displayed rotated, the point on the 7-segment display goes off:

- Point visible: The bottom edge of the numbers on the 7-segment display is pointing towards the configuration connection.
- Point not visible: The bottom edge of the numbers on the 7-segment display is pointing towards the LED display.

**C4000 Palletizer Std./Adv.
C4000 Fusion**

3.3.1 Status indicators of the sender

Fig. 15: Status indicators of the sender of the C4000 Palletizer

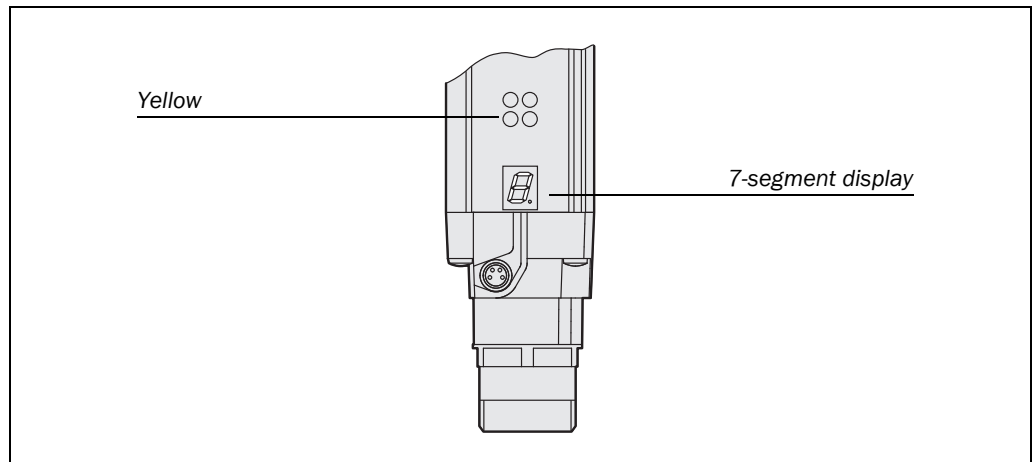
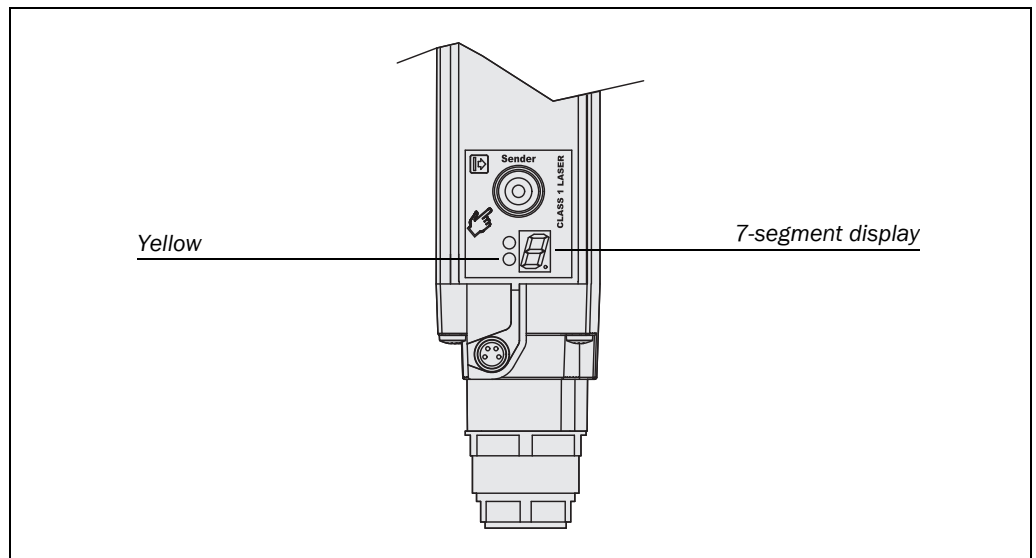


Fig. 16: Status indicators of the sender of the C4000 Fusion

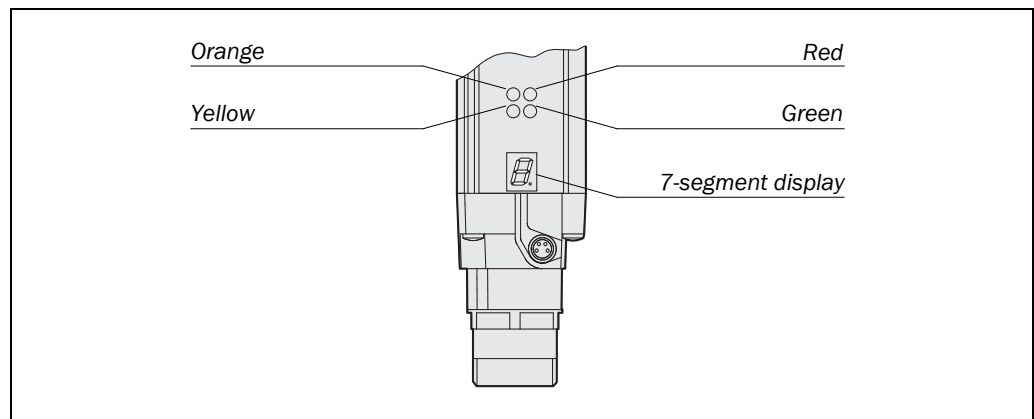


Tab. 4: Status indicators of the sender

Display	Meaning
● Yellow	Power supply OK
	System error. The device is defective. Replace the sender.
	The device is in the test mode.
	Operation with beam coding 1 (only after switching on)
	Operation with beam coding 2 (only after switching on)
Other displays	All other displays are error messages. Please refer to chapter 11 "Fault diagnosis" on page 91.

3.3.2 Status indicators of the receiver

Fig. 17: Status indicators of the receiver



Tab. 5: Status indicators of the receiver

Display	Meaning
● Orange	Cleaning or realignment required
● Yellow	Reset required
● Red	System providing signals for shutting down the machine (output signal switching devices off)
● Green	System enabled (output signal switching devices on)
	Bypass active
	System error. The device is defective. Replace the receiver.
	Poor alignment to sender.
	Please refer to chapter 8.2 "Aligning sender and receiver" on page 83.
	Operation with large protective field width (only after switching on)
	Blanking or reduced resolution active
	Object in the protective field with activated reduced resolution or blanking
	Operation with beam coding 1 (only after switching on)
	Operation with beam coding 2 (only after switching on)
	Emergency stop active
Other displays	All other displays are error messages. Please refer to chapter 11 "Fault diagnosis" on page 91.

4 Configurable functions



WARNING

Test the protective device after any changes!

The entire protective device must be tested for correct operation after each change of the configuration (see section 8.3 “Test notes” on page 85).

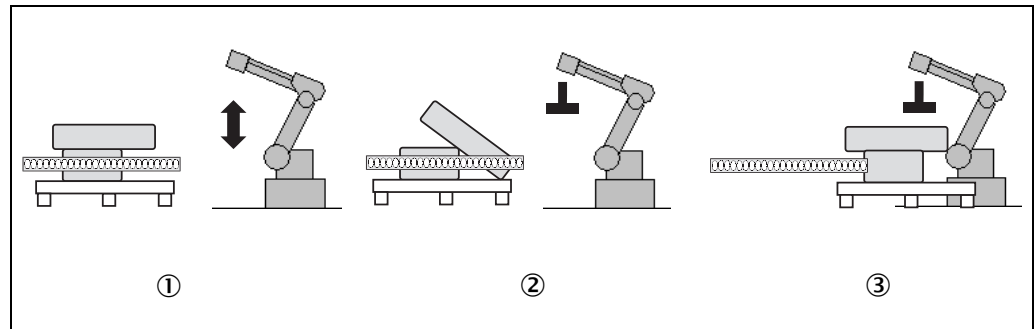
Tab. 6: Overview of the configurable functions

	C4000 Palletizer				C4000 Fusion	
	Standard		Advanced			
Extension connection on the receiver	Without	With	Without	With	Without	With
Basic functions (see chapter 4)						
Protective operation	■	■	■	■	■	■
Restart interlock	■	■	■	■	■	■
EDM	■	■	■	■	■	■
Emergency stop		■		■		■
Bypass on the device		■		■		■
Bypass in conjunction with a SICK switching amplifier, e.g. UE402	■	■	■	■	■	■
Application diagnostic output (ADO)	■	■	■	■	■	■
Virtual photoelectric switches	■ ¹⁾	■	■ ¹⁾	■	■ ¹⁾	■
Beam coding	■	■	■	■	■	■
Scanning range [m]	0.5-6	0.5-6	0.5-6	0.5-6	1.5-19	1.5-19
Multiple sampling	■	■	■	■	■	■
Reduced resolution	■	■	■	■	■	■
Operating modes in conjunction with a SICK switching amplifier, e.g. UE402	■	■	■	■	■	■
Blanking (see chapter 5)						
Object entry monitoring²⁾			■	■	■	■
Goods detection						
≥500 ... PF-150 mm	■	■	■	■	■	■
Object size monitoring	■	■	■ ³⁾	■ ³⁾	■ ³⁾	■ ³⁾
Teach-in of individual objects	■	■	■	■	■	■
Object gap suppression	■	■	■ ³⁾	■ ³⁾	■ ³⁾	■ ³⁾
Pallet detection						
0 ⁴⁾ ... 240 mm/2 ... 5 Objects, depending on length			■	■	■	■
Object pattern recognition						
0 ⁴⁾ ... PF-150 mm/ 1 ... 5 Objects, depending on length					■	■
Teach-in of object patterns					■	■
Object size and distance monitoring					■	■
Sequence monitoring					■	■
Direction detection	■	■	■	■	■	■
Detection of geometrically even objects (e.g. coil)					■	■
Fixed blanking					■	■
0 ... 5 objects can be taught-in					■	■

1) In conjunction with a sens:Control device via EFI.
2) Software version V07.20 and higher.
3) Only with blanking of a single object configured.
4) 0 mm only without reduced resolution.

4.1 Restart interlock

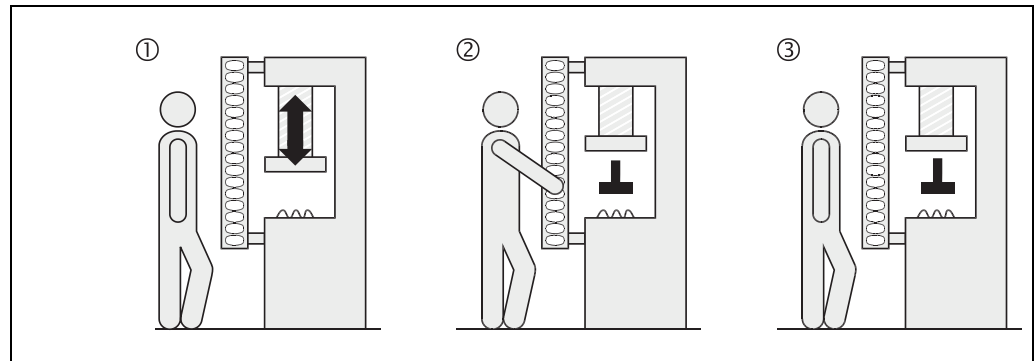
Fig. 18: Restart interlock with access protection



The machine's dangerous state (①) is locked in the event of an invalid object in the protective field (② in Fig. 18) or in the event of an interruption in the light path (② in Fig. 19) and is not re-enabled (③) until the operator actuates the reset button.

Note The reset button is often also called the “local enable button”. In these operating instructions the term **reset button** is used.

Fig. 19: Restart interlock with hazardous point protection



The restart interlock can be implemented in two different ways:

- With the internal restart interlock of the C4000:
The outputs of the C4000 are enabled after the connected control switch is operated.
- With the restart interlock of the machine controller:
The C4000 has no effect on the restart.

The possible combinations are shown in the following table:

Tab. 7: Permissible configuration of the restart interlock

Restart interlock of the C 4000	Restart interlock of the machine	Permissible application
Deactivated	Deactivated	With access protection: Not permitted! With hazardous point protection: Only if the safety light curtain cannot be stood behind. Observe EN 60 204-1!
Deactivated	Activated	All
Activated	Deactivated	Only if the safety light curtain cannot be stood behind. Observe EN 60 204-1!
Activated	Activated	All. The restart interlock of the C4000 handles the reset function (see “Reset” on page 29).



WARNING

It is imperative you configure the C4000 with restart interlock if the protective field can be left to approach the hazardous point!

Restart interlock is imperative if the protective field can be left to approach the hazardous point. If this is the case and you deactivate both the restart interlock on the C4000 and the restart interlock on the machine, you will place the equipment operators at serious risk. Check, if necessary, whether it is possible to prevent the protective field from being left to approach the hazard point by design measures.

Select the correct installation site for the reset button!

Install the reset button outside the hazardous area such that it cannot be operated from inside the hazardous area. When operating the reset button, the operator must have full visual command of the hazardous area.

Note

Do not confuse the restart interlock with the starting interlock on the machine. The starting interlock prevents the machine starting after switching on. The restart interlock prevents the machine starting again after an error or an interruption of the light path.



You can configure the restart interlock and the connection for the reset button (on the system plug or on the extension connection) in the CDS on the C4000 (receiver).

The electrical connection of the reset button is described in chapter 7.5 “Reset button” on page 78.

Recommendation

You can indicate the status *Reset required* using a signal lamp. The C4000 has a dedicated output for this purpose. The electrical connection of the signal lamp is described in chapter “Connection of a signal lamp to the *Reset required* output” on page 78.

Reset

If you activate the restart interlock on the C4000 (internal) and also realise a restart interlock on the machine (external), then each restart interlock gets its own button.

When actuating the reset button (for the internal restart interlock) ...

- the C4000 activates the output signal switching devices.
- the safety light curtain switches to green.



Only the external restart interlock prevents the machine from restarting. After pressing the reset button for the C4000, the operator must also press the restart button for the machine. If the reset button and the restart button are not pressed in the specified sequence, the dangerous state remains disrupted.


Recommendation

The reset button prevents the accidental and inadvertent operation of the external restart button. The operator must first acknowledge the safe state with the reset button.

4.2 External device monitoring (EDM)

The EDM checks if the contactors actually de-energize when the protective device is tripped. If you activate external device monitoring, then the C4000 checks the contactors after each interruption to the light path and prior to the machine restart. The EDM can so identify if one of the contacts has welded, for instance. In this case ...

- the error message  appears (in the 7-segment display).
- the safety light curtain remains red.
- with the internal restart interlock activated, the safety light curtain uses the flashing LED  **Yellow** to signal “Reset required”.

Note If the system is unable to change to a safe operational state (e.g. after contactor failure), the system locks and shuts down completely (lock-out). The 7-segment display will then show the error message .

The electrical connection for the external device monitoring is described in chapter 7.4 “External device monitoring (EDM)” on page 77.



You can configure the external device monitoring (EDM) function in the CDS on the C4000 (receiver).

4.3 Emergency stop

The C4000 has an input for a dual-channel emergency stop button. The emergency stop monitoring in the device corresponds to stop category 0 in accordance with EN ISO 13850. You can connect e.g. a door contact or an emergency stop button to the emergency stop input. The operation of the emergency stop button has the following effect:

- The safety light curtain deactivates the OSSDs.
- The C4000 switches to red.
- The 7-segment display on the C4000 indicates

Notes The emergency stop function deactivates the OSSDs even if the bypass function is activated.

Take into account the response time of the emergency stop function! The response time of the safety light curtain on interruption via the emergency stop input is up to 200 ms.



WARNING

Pay attention to the way in which the emergency stop function works!

The emergency stop button connected to the extension connection on C4000 affects only the output signal switching devices (OSSDs) on the C4000.

- Notes**
- The C4000 checks after switching on whether an emergency stop function has been configured and whether a door switch or similar switch is connected. If the configuration and the electrical connection do not match, the system locks completely (lock-out). The 7-segment display will then show the error message
 - The safety light curtain has an application diagnostic output (ADO) at which the status of the emergency stop input can be signalled. Details can be found in chapter 4.5 “Application diagnostic output (ADO)” on page 33.



WARNING

Regularly check the connected emergency stop button or door contact!

- By means of organisational measures ensure that the emergency stop button or door contact is operated once at a specified interval.

This is necessary so that the C4000 can detect any fault that has occurred on the emergency stop button or door switch. The interval is to be defined to suit the specific case dependant on the application.

- Always check whether the output signal switching devices on the light curtain are deactivated on the operation of the emergency stop button or door switch.

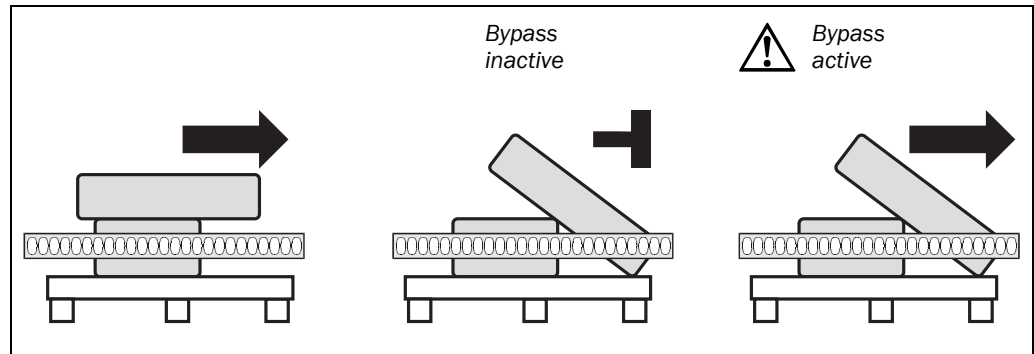


You can configure the emergency stop and whether the input is connected equivalent or complementary in the CDS on the C4000 (receiver).

The electrical connection of the emergency stop is described in chapter 7.6 “Emergency stop” on page 79.

4.4 Bypass

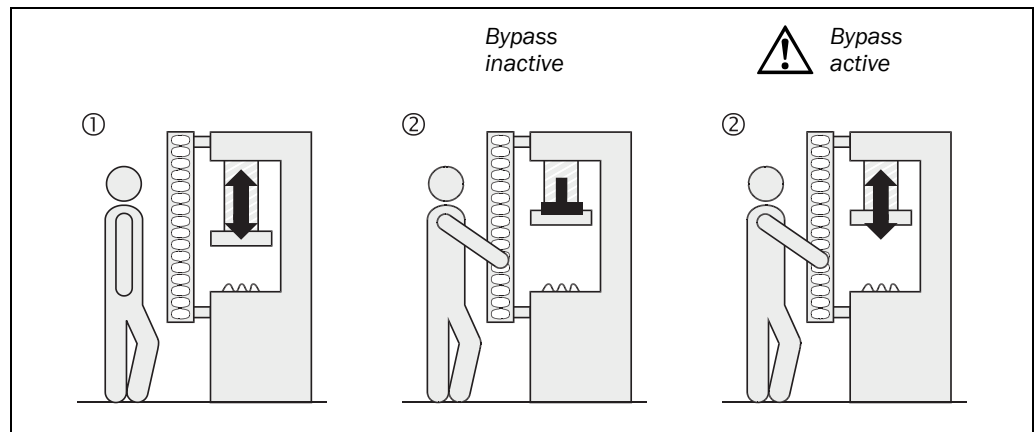
Fig. 20: Schematic layout of the bypass function for horizontal applications



In some applications it is at times necessary to mute the protective field evaluation of the safety light curtain.

- for access protection (Fig. 20), e. g. for the further transport of a pallet with a load that has slipped
- for hazardous point protection (Fig. 21), e.g. in a safe setup operating mode on the machine in which it is only possible to make movements in jog mode

Fig. 21: Schematic layout of the bypass function for vertical applications



When the bypass is active, the safety light curtain displays ● **Green** and the 7-segment display of the receiver displays



WARNING

Switch the system to a safe condition, when using the bypass function!

As long as the bypass function is active, the safety light curtain does **not** detect any interruption in the protective field. You must ensure that other protective measures are forcibly activated during the bypass, e.g. the safe machine setup mode, so that the system cannot endanger persons or parts of the system during the bypass function.

The bypass function is only allowed to be activated as follows:

- using a key-operated pushbutton with automatic return and two positions
 - using two independent input signals, e.g. two position switches or two safe PLC signals
- Notes**
- You must prevent continuous activation of the bypass by organisational means.
 - It must be possible to view the entire hazardous area when pressing the key-operated pushbutton.
 - It is not possible to combine the bypass and PSDI mode functions.
 - 200 ms after switching off the bypass, the system is again in a safe status (latency time).

**C4000 Palletizer Std./Adv.
C4000 Fusion**



You can configure the bypass function and whether the input is connected equivalent or complementary in the CDS on the C4000 (receiver).

The connection of the key-operated pushbutton for bypass is described in chapter 7.7 “Key-operated pushbutton for bypass” on page 80.

4.5 Application diagnostic output (ADO)

The C4000 has a signal output (ADO) that can be configured). With the aid of the application diagnostic output, the safety light curtain can signal specific states. You can use this output for a relay or a FPLC.



WARNING

You must not use the application diagnostic output for safety-relevant functions!

You are only allowed to use the application diagnostic output for signalling. You must never use the application diagnostic output for controlling the application or with safety-relevant functions.

The connection can signal one of the following states:

Tab. 8: Possible configuration for the application diagnostic output

Assignment	Application possibilities
Contamination	Eases diagnostics in case of contaminated front screen
OSSD status with delay of [s]	Signals the status of the output signal switching devices. If the safety light curtain switches to red, then it signals the status immediately. If it switches to green, then it signals the status only after an adjustable delay in the range from 0.1 to 3.1 seconds.
Status of the emergency stop	Signal is present if the button connected to the emergency stop input on the C4000 has been pressed.
Valid object in the protective field	Signal is present, if there is at least one valid object in the protective field (OSSDs activated).



You can configure the application diagnostic output (ADO) in the CDS on the C4000 (receiver).

The electrical connection of a PLC/controller to the application diagnostic output is described in chapter 7.9 “Application diagnostic output (ADO)” on page 81.

4.6 Virtual photoelectric switch



WARNING

You are not allowed to use the virtual photoelectric switches for safety-relevant functions!

You are only allowed to use the virtual photoelectric switches for signaling. You must never use the signals on the outputs for controlling the application or for safety-relevant functions.

Two of the beams on the C4000 can be used as so-called virtual photoelectric switches. With the aid of the two photoelectric switches, the safety light curtain can, e.g., signal the positions of objects in the protective field.



You can configure which beams represent the virtual photoelectric switches and their layout in the CDS on the C4000 (receiver).

The electrical connection of the photoelectric switches is described in chapter 7.8 “Outputs for the virtual photoelectric switches” on page 80.

Note If virtual photoelectric switches are configured, it is not possible to connect an emergency stop, a Reset button, a key-operated pushbutton for bypass or for teach-in or a signal lamp for “Reset required” to the extension plug.

The results from the photoelectric switches can also be output via EFI and forwarded via a control device in the sens:Control family to an (F)PLC.

4.7 Beam coding

If several safety light curtains operate in close proximity to each other, the sender beams of one system may interfere with the receiver of another system. With code 1 or 2 activated, the receiver can distinguish the beams designated for it from other beams. The following settings are available: code 1 and code 2.

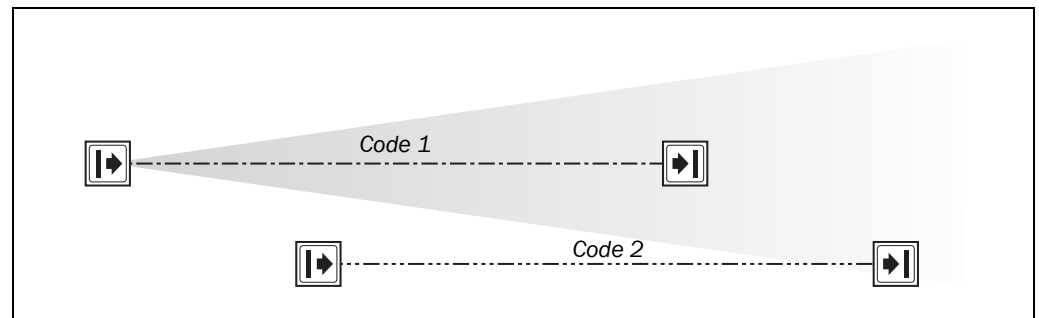


WARNING

Use different beam codings if the systems are mounted in close proximity!

Systems mounted in close proximity to each other must be operated with different beam codings (code 1 or code 2). If this precaution is neglected, the system may be impaired in its protective function by the beams from the neighbouring system and so change to the unsafe state. This would mean that the operator is at risk.

Fig. 22: Schematic layout of the beam coding



- Notes**
- Beam coding increases the availability of the protected machine. Beam coding also enhances the resistance to optical interference such as weld sparks or similar.
 - Beam coding will increase the response time of the system. This may also change the required safety distance. Instructions can be found in chapter 12.2 “Response time” on page 99.
 - After activating the system, sender and receiver will briefly display the coding.



You can configure the beam coding in the CDS on the C4000 (receiver) and C4000 (sender).

4.8 Scanning range



WARNING

Match the scanning range with the protective field width!

The scanning range of the system must be adapted to the protective field width.

- If the scanning range is set too low, the light curtain may not switch to green.
- If the scanning range is too great, the light curtain may malfunction. This would mean that the operator of the machine or system is at risk.

The available settings depend on the variant of the C4000:

Tab. 9: Guaranteed scanning ranges

Variant	Selectable scanning ranges	Scanning range with 1 additional front screen	Scanning range with 2 additional front screens
C4000 Palletizer	0.5-2 m	0.5-1.5 m	0.5-1.5 m
	0.5-6 m	0.5-5.5 m	0.5-5 m
C4000 Fusion	1.5-6 m	1.5-5.5 m	1.5-5 m
	5-19 m	4.6-17.4 m	4.2-16 m



Note

You can configure the scanning range in the CDS on the C4000 (receiver).

- If you are using the additional front screen (see page 115) available as an accessory, the effective scanning range will be reduced by 8% for each additional front screen.
- The C4000 Fusion can be operated with a deflector mirror. The deflector mirrors (see page 107f.) reduce the effective scanning range as a function of the number of deflector mirrors in the light path (see Tab. 10). When using deflector mirrors, you **must** configure the safety light curtain for a long scanning range.



WARNING

Do not use deflector mirrors if the formation of droplets or heavy contamination of the deflector mirrors is to be expected!

The formation of droplets or heavy contamination can be detrimental to the reflection behaviour. The protective function of the system will be affected and the system will thus become unsafe. This would mean that the operator is at risk.

Tab. 10: Scanning range when using 1 or 2 deflector mirrors

Deflector mirror	20, 30 or 40 mm	
	Minimum	Typical
1 × PNS75	8 m	13 m
2 × PNS75	8 m	12 m
1 × PNS125	17 m	18.5 m
2 × PNS125	15.2 m	16.8 m

The information in the table relates to 90° beam deflection per mirror and a protective field height of 900 mm. If you need more advice on mirror applications, please get in touch with your contact at SICK.

4.9 Multiple sampling

When multiple sampling is set, the C4000 must detect an object several times, before it deactivates its OSSDs. In this way you can reduce the probability that objects falling through the protective field, for example wooden shavings, welding sparks or other particles, result in the shutdown of the system.

With a multiple sampling configuration of, e.g., 2, the C4000 must detect an object two times in succession before it switches off the OSSDs.

As a maximum in the case of goods detection, pallet detection and object pattern recognition, a multiple sampling of 2 can be configured, in protective operation a multiple sampling of 4.



WARNING

Check the total response time!

The total response time is increased by the multiple sampling! If you change the multiple sampling, then you must recalculate the response time (see 12.2 on page 99).



You can configure the multiple sampling in the CDS on the C4000 (receiver)

4.10 Reduced resolution

Under reduced resolution, the safety light curtain ignores the interruption of multiple adjacent beams. Objects which are not larger may be moved through the safety light curtain without the light curtain changing to red.


You can use the reduced resolution function for suppressing interfering objects such as straps or wood splinters, or for instance, if cables and hoses are to be laid through the protective field. For object sizes that do not result in shutdown see Tab. 11.

In the case of devices with 20 mm resolution, you can reduce the resolution by up to 30 beams, in the case of devices with 30 mm resolution by 3 beams and in the case of devices with 40 mm resolution by up to 2 beams.



Note

You can configure a reduced resolution in the CDS on the C4000 (receiver).

With reduced resolution, the 7-segment display indicates  as soon as sender and receiver are aligned.

With reduced resolution the effective resolution of a safety light curtain changes. Tab. 11 shows the effective resolution as a function of the reduced resolution for different physical resolutions.

Tab. 11: Effective resolution as a function of the reduced resolution

Physical resolution	Reduced resolution	Effective resolution	Object sizes that do not result in shutdown
20 mm	1 beam	30 mm	10 mm
	2 beams	40 mm	20 mm
	3 beams	50 mm	30 mm
	4 beams	60 mm	40 mm
	5 beams	70 mm	50 mm
	6 beams	80 mm	60 mm
	7 beams	90 mm	70 mm
	8 beams	100 mm	80 mm
	9 beams	110 mm	90 mm
	10 beams	120 mm	100 mm
	11 beams	130 mm	110 mm
	12 beams	140 mm	120 mm
	13 beams	150 mm	130 mm
	14 beams	160 mm	140 mm
	15 beams	170 mm	150 mm
	16 beams	180 mm	160 mm
	17 beams	190 mm	170 mm
	18 beams	200 mm	180 mm
	19 beams	210 mm	190 mm
	20 beams	220 mm	200 mm
	21 beams	230 mm	210 mm
	22 beams	240 mm	220 mm
	23 beams	250 mm	230 mm
	24 beams	260 mm	240 mm
	25 beams	270 mm	250 mm
	26 beams	280 mm	260 mm
	27 beams	290 mm	270 mm
	28 beams	300 mm	280 mm
	29 beams	310 mm	290 mm
	30 beams	320 mm	300 mm
30 mm	1 beam	50 mm	20 mm
	2 beams	70 mm	40 mm
	3 beams	90 mm	60 mm
40 mm	1 beam	70 mm	30 mm
	2 beams	100 mm	60 mm



WARNING

In horizontal applications you are allowed to reduce the effective resolution to 70 mm as a maximum!

If the C4000 is operated with reduced resolution in horizontal applications, in certain circumstances the device may then no longer detect a human leg from a resolution of 70 mm.

Check the safety distance if the protective field is mounted vertically!

On vertical mounting of the protective field and reduced resolution, the safety distance required depends on the *effective* resolution.

➤ If required, recalculate the safety distance and readjust it on the machine.

- Example:
- physical resolution 20 mm
 - resolution reduced by 1 beam
 - effective resolution 30 mm

Calculate the safety distance with a resolution of 30 mm (see page 62).

➤ Mark the effective resolution on the information label “Operation with ‘reduced resolution’ or ‘blanking’ ...” on the related sender and receiver.

Fig. 23: Marking the effective resolution on the device label

Warning: During operation with “Reduced resolution” or “Blanking” the safety distance that corresponds to the modified resolution is to be observed.					
Resolution modified to: (please mark)	14 mm	20 mm	30 mm	40 mm	
		Physical resolution			
Reduction		Effective resolution/Minimum object size			
1 beam	22 mm	30 mm	50 mm	70 mm	
2 beams	30 mm	40 mm	70 mm	100 mm	
3 beams	37 mm	50 mm	90 mm	130 mm	
n beams		mm	mm	mm	mm

Note With reduced resolution the size and position tolerances for blanking objects change (see section 12.3 “Tolerances” on page 101).

4.11 Sender test

The C4000 sender has a test input on pin 3 for checking the sender and the related receiver. During the test, the sender no longer emits light beams. Thus, it simulates - for the receiver - an interruption of the protective field.

- During the test the sender indicates .
- The test is successful, if the C4000 receiver switches to red, i.e. the output signal switching devices (OSSDs) are deactivated.

Note C4000 sender and receiver are self-testing. You only need to configure the function of the sender test if this is necessary for an older existing application.

To be able to perform a sender test ...

- the option **Enable sender test** must be active. (Is deactivated as delivered).
- a means of controlling the test input must be available.



You can configure the sender test in the CDS on the C4000 (sender).

The electrical connection at the test input is described in chapter 7.10 “Test input (sender test)” on page 81.

5 Configuration of blanking

The C4000 offers various ways of blanking areas of the protective field. In this way in many applications a higher level of safety and availability can be assured than would be possible without the usage of the blanking function. This requires the careful analysis of the usage of blanking as part of a risk analysis for these applications. Only if the analysis produces advantages in reliability and thus advantages in safety when the blanking function is used the usage of the function is recommended.

The person responsible for the machine has the responsibility to decide whether or not to use the blanking function and to undertake the installation, mounting and configuration of the safety light curtain such that

- the necessary safety is achieved on the machine
- and**
- access to the hazardous area through the safety light curtain in conjunction with the blanking function is prevented by other protective measures.

Tab. 12: Possible methods of blanking of the different C4000 variants

Type of blanking	Application	
	Horizontal	Vertical
Object entry monitoring	C4000 Palletizer Advanced C4000 Fusion	Not permitted!
Self-teach dynamic blanking for goods detection	C4000 Palletizer Standard/Advanced C4000 Fusion	Not permitted!
Self-teach dynamic blanking for pallet detection	C4000 Palletizer Advanced C4000 Fusion	Not permitted!
Dynamic blanking for object pattern recognition	C4000 Fusion	Not permitted!
Blanking of fixed areas	C4000 Fusion	C4000 Fusion
Fixed blanking for the detection of geometrically even objects	Not permitted!	C4000 Fusion

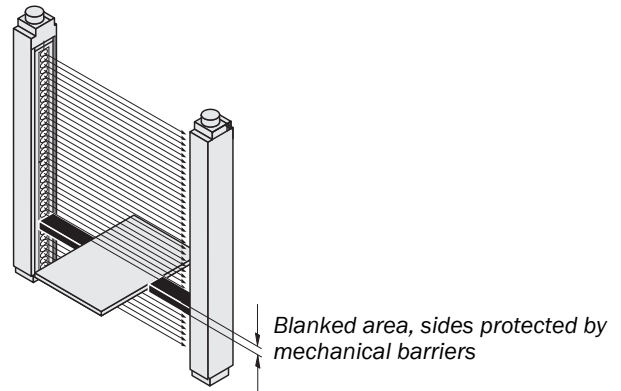


WARNING

Fig. 24: Example of the mechanical protection of a fixed blanking

Blanked areas require a separate risk analysis!

A blanked area is in principle a hole in the protective field. Check in detail whether and where blanking is actually required. You must protect the blanked area in another way, e.g. mechanically. Otherwise you must take the blanked area into consideration in the calculation of the safety distance and mount the safety light curtain appropriately.



- In vertical applications, check the protective field with the test rod after each modification of the blanking. Instructions can be found in chapter 8.3.3 “Daily functional checks of the protective device” on page 86.
- Check the protective field in horizontal applications by inserting an invalid object into the protective field. The C4000 must shut down its OSSDs.
- In horizontal applications, make sure to limit the velocity of the objects in the protective field to maximally 2 m/s.
- Also pay attention to the warnings in the related chapter.

5.1 Object entry monitoring

The beams on the C4000 are aligned with the pallet feet or the freight on the pallet for object entry monitoring. Using this function all goods and pallets that leave a system can be blanked.

If other objects, in particular people, enter the protective field in the direction opposite to that allowed, the C4000 shuts down its output signal switching devices.

This object entry monitoring can be used for example if pallets are to be monitored that do not meet the precise parameters for pallet detection or goods detection. These could be, e.g. partially wrapped pallets or pallets on which only one foot is continuously visible in the protective field (e.g. the Duesseldorfer or the CHEP pallet on which the wooden blocks have been replaced with steel plates).



You can configure the **object entry monitoring** function in the CDS on the C4000 (receiver).

For object entry monitoring you configure:

- the direction of entry into the beam path:
 - object entry only adjacent to display
 - object entry only remote from display
- if necessary, the maximum size allowed for the objects



WARNING

Ensure the C4000 is mounted in the correct direction and configuration is correct!

A C4000 with object entry monitoring configured is only allowed to be used at the output from a machine or system. In the configuration pay attention to the direction in which the C4000 is mounted and then configure the object entry as only adjacent to display or only remote from display as appropriate.

The object entry monitoring is subject to a direction tolerance of 150 mm. In this way it is ensured that a vibrating object or an object that slips back slightly does not result in the shutdown of the C4000.

The C4000 switches to red, if ...

- an object enters the protective field in the wrong direction.
- an object enters the protective field other than at the start.
- an object leaves the protective field other than at the end.
- the distance between the objects is less than the minimum.
- there are more than the maximum number of objects allowed in the protective field.
- the protective field of the safety light curtain is interrupted completely.
- the first and last beam of the protective field are interrupted on switching on.

Minimum distance between two objects with object entry monitoring

For it to be possible to detect individual objects, these must maintain a minimum distance of 20, 30 or 40 mm depending on the resolution of the safety light curtain.

Object size that will result in safe shutdown

The object size that results in safe shutdown is dependent on the maximum size configured and the resolution of the C4000.

How to calculate the object size that will result in safe shutdown:

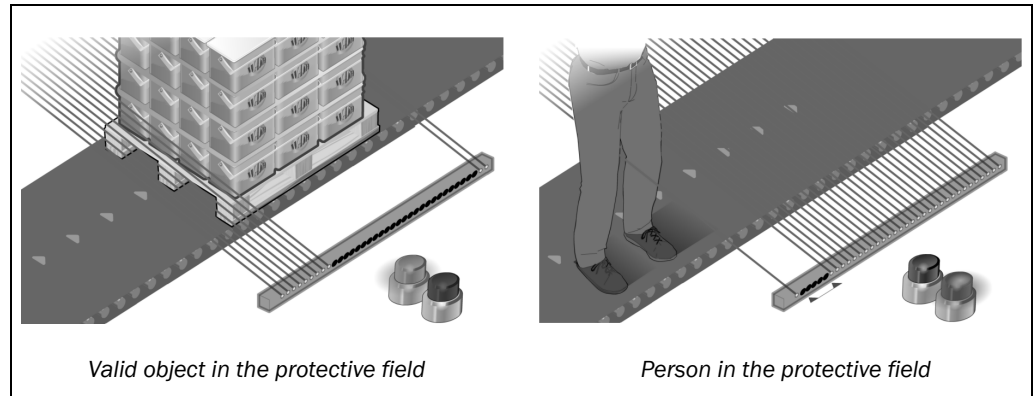
Physical resolution of the devices	
30 mm	20 mm
Configured maximum object size	
+ 38 mm	+ 28 mm
= Object size for safe shutdown	

Tab. 13: Calculating the object size that will result in safe shutdown

5.2 Self-teach dynamic blanking for goods detection

The beams on the C4000 are aligned with the freight on the pallet for goods detection. Using this function, e.g., pallets with packages can be blanked that as a result then have access to a system or machine.

Fig. 25: Principle of operation, goods detection



If other objects, in particular people, enter the protective field then the C4000 shuts down its output signal switching devices.

Note If you use a C4000 with a protective field length <750 mm, you must take suitable measures to prevent stepping over the protective field (see section 6.1 “Additional measures to prevent bypassing of the protection” on page 58).



WARNING



Prevent people entering the hazardous area beside the object!

During entry, the item transported must block the access to the hazardous area.

You can configure the **goods detection** function in the CDS on the C4000 (receiver).

For goods detection you have to configure:

- a minimum object size. This is approx. 500 mm⁵⁾.
- a maximum object size. This is approx. 150 mm less than the protective field⁵⁾.

Note The object size can also be taught-in (see section 5.2.2 “Teach-in of individual objects” on page 45).

The C4000 switches to red, if ...

- more than one object enters the protective field.
- the object is below the minimum object size or above the maximum object size.
- an object enters the protective field other than at the start.
- an object leaves the protective field other than at the end.
- the object enters the protective field in the wrong direction with direction detection configured.
- the object has gaps or these gaps are larger than the object gap suppression configured.
- the protective field of the safety light curtain is interrupted completely.
- the first and last beam of the protective field are interrupted on switching on.

Object size that will result in safe shutdown

The object size that results in safe shutdown is dependent on the size configured, the reduced resolution if configured, and the resolution of the C4000.

⁵⁾ Depending on the resolution of the C4000.

How to calculate the object size that will result in safe shutdown:

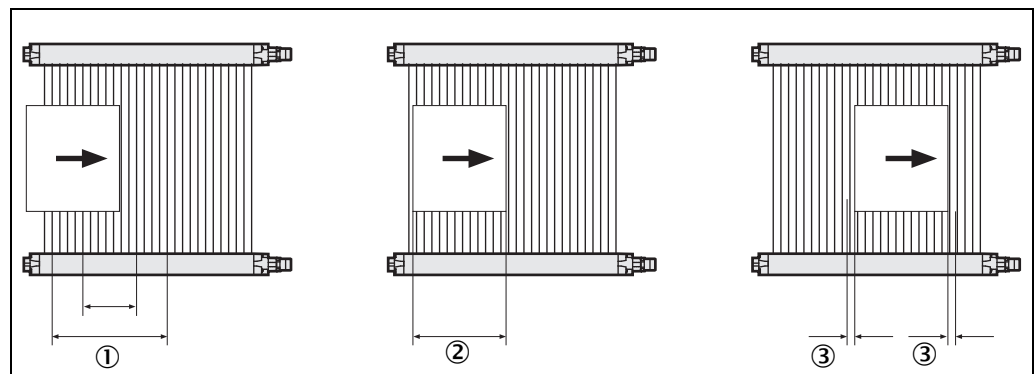
Tab. 14: Calculating the object size that will result in safe shutdown

Physical resolution of the devices		
40 mm	30 mm	20 mm
Configured maximum object size		
± 48 mm	± 38 mm	± 28 mm
= Object size for safe shutdown		

5.2.1 Object size monitoring

Using object size monitoring, the size of the object is monitored more strictly using the minimum and maximum object size configured.

Fig. 26: Object size monitoring



On the entry of objects into the protective field, first the validity of the object is checked based in the minimum and maximum object size configured (①).

After the object has fully entered the protective field, the C4000 can determine the exact object size and save the object for the time it is passing through the field (②). The C4000 then switches to red if the object size currently saved changes by more than the size tolerance (③).

Once the object has left the protective field again, the saved object size is reset. On the entry of the next object, first the validity of the object is checked based on the configured values and then the precise value saved and monitored.

Note

The C4000 does not switch to red when saving the object size.

You can configure the object size monitoring function in the CDS on the C4000 (receiver).

Size tolerance

If you have configured the object size monitoring, a size tolerance for the object is set automatically (see Fig. 26, ③). This size tolerance depends on the resolution of the C4000 and the configured reduced resolution (see section 12.3.1 “Size and distance tolerances” on page 101).

5.2.2 Teach-in of individual objects




WARNING

It is imperative you configure a restart interlock if you use the teach-in function (see section 4.1 “Restart interlock” on page 28)!

If you do not configure a restart interlock, the safety light curtain will switch to green 1 s after the object has been taught in.

Teach-in makes it possible to re-define the size of the blanked area in a simple manner. To use the teach-in function, you must activate the option in the CDS.

An object with a size that is different to that of the previous object enters the protective field on the conveyor system. Once the object is completely in the protective field and the entry area is clear again, the safety light curtain switches to red.

The C4000 automatically saves the interrupted part of the protective field as the new object size after 1 s. The 7-segment display on the receiver indicates  if the object is a valid object.

Once the operator has actuated the reset button, the safety light curtain switches to green. The object moves out of the protective field. Further objects of the same size (within the tolerance limits) can pass the protective field.

Size tolerance

If you have configured the teach-in of individual objects, a size tolerance for the object is set automatically (see Fig. 26, ③). This size tolerance depends on the resolution of the C4000 and the configured reduced resolution (see section 12.3.1 “Size and distance tolerances” on page 101).



You can configure the teach-in of individual objects function in the CDS on the C4000 (receiver).

5.2.3 Object gap suppression

During goods detection, gaps in the objects, as for instance are produced by inaccurately stacked objects on a pallet, will result in the shutdown of the OSSDs.

For this reason, it is possible to permit a gap of approx. 21 mm (for the C4000 Palletizer Standard) and 11 mm (for the C4000 Palletizer Advanced and C4000 Fusion).



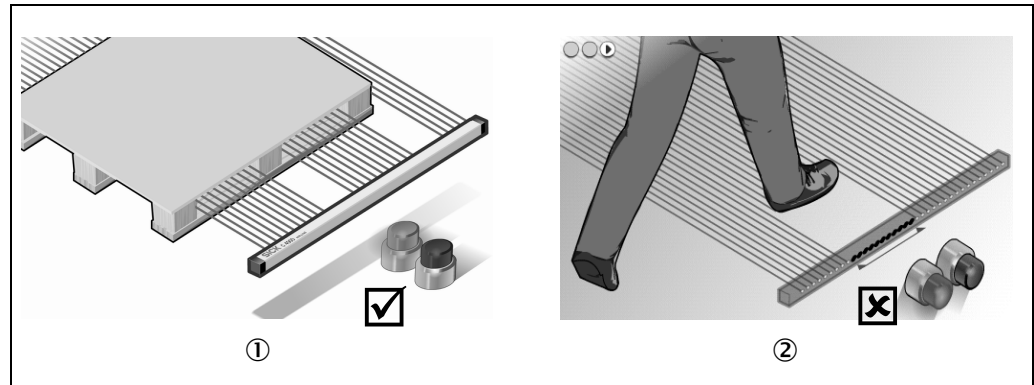
You can configure the **object gap suppression** function in the CDS on the C4000 (receiver).

5.3 Self-teach dynamic blanking for pallet detection

The beams on the safety light curtain are, for instance, aligned with the feet on a pallet or mesh crate or the wheels on a trolley. Several objects move into the protective field on the freight carrier.

The C4000 allows objects up to a size of 240 mm. It learns the distances between the objects and as a result makes it possible, e.g., for different pallet types to enter a system (see Fig. 27, ①).

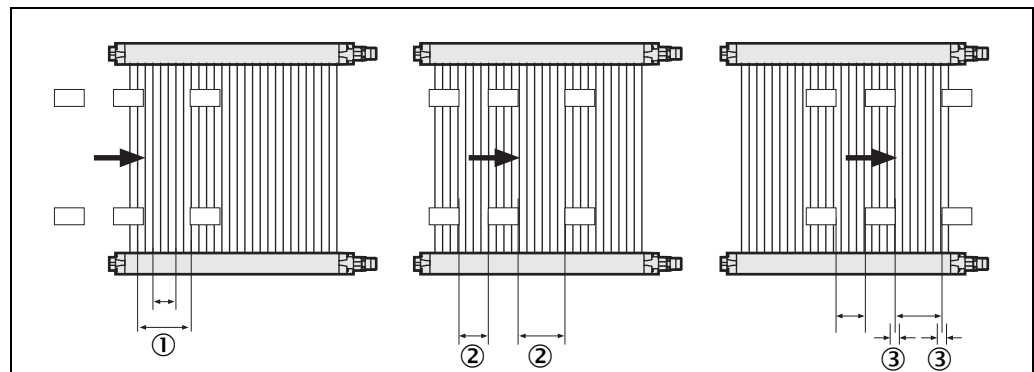
Fig. 27: Principle of operation, pallet detection



If other objects, in particular people, enter the protective field, then the C4000 shuts down its output signal switching devices (see Fig. 27, ②).

When objects enter the protective field, first the validity of the object is checked based on the maximum object size (①).

Fig. 28: Monitoring object distances



Once the objects have fully entered the protective field, the C4000 saves the object distances for the length of time the pallet passes through the field (②). The distances are allowed to change by twice the reduced resolution plus two additional beams during movement through the protective field (③) (see also section 12.3.1 “Size and distance tolerances” on page 101).

Once the objects have left the protective field again, the values saved are reset. When the next object enters the field, first its validity is checked based on the object size, then the distances are saved and monitored.



You can configure the **pallet detection** function in the CDS on the C4000 (receiver).

You do not need to configure object sizes or distances for pallet detection. The maximum object size allowed is fixed at 240 mm.

The C4000 switches to red, if ...

- only one object passes through the entire protective field.
- more than the permitted number of objects (dependent on the protective field length, see Tab. 2 on page 20) enter the protective field.
- the distances between the objects change by more than the tolerances (see section 12.3.1 on page 101).
- the object size allowed is exceeded.
- an object enters the protective field other than at the start.
- an object leaves the protective field other than at the end.
- the object enters the protective field in the wrong direction with direction detection configured.
- the protective field of the safety light curtain is interrupted completely.
- the first and last beam of the protective field are interrupted on switching on.

Object size for safe shutdown with pallet detection

For safe shutdown in the case of devices with 20 mm resolution an object size of at least 260 mm is necessary, in the case of devices with 30 mm resolution an object size of at least 270 mm is necessary.

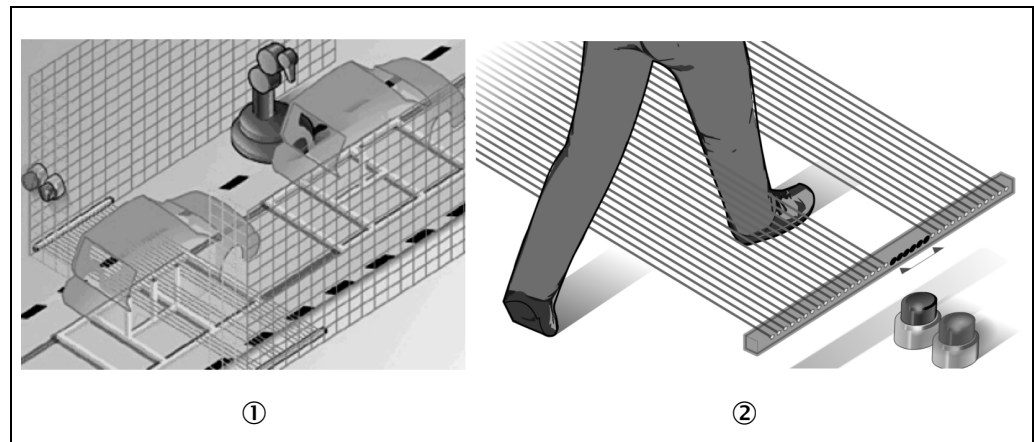
Minimum distance between two objects with pallet detection

For it to be possible to detect individual objects, these must maintain a minimum distance of 20, 30 or 40 mm depending on the resolution of the safety light curtain.

5.4 Dynamic blanking for object pattern recognition

This blanking makes possible access protection without muting while fixed objects have access to a system or machine (e.g. skids for car bodyshells)①.

Fig. 29: Principle of operation, object pattern recognition



If moving objects, in particular the legs of people, enter the protective field then the C4000 shuts down its output signal switching devices ②.

Depending on the protective field length, several objects in the protective field can be blanked dynamically at the same time (see Tab. 3 on page 22). During this process the size is monitored to check whether it is below the minimum size or above the maximum size.

Once the objects have fully entered the protective field, the C4000 saves the object distances for the length of time the skid passes through the field. The distances are allowed to change by the distance tolerance configured while passing through the field (see section 12.3.1 on page 101).

In the case of dynamic blanking for object pattern recognition, different types of skid can pass through the field. The protective field can also be used a permanent parking place.

- Notes**
- If you use a C4000 with less than 750 mm protective field length, you must take suitable protective measures against stepping over the protective field (see section 6.1 on page 58).
 - To ensure objects larger than 240 mm do not pass unintentionally through the protective field, the following additional measures must be taken:
 - Configure the number of objects that must be in the protective field at the same time to at least 2.
 - Or:
 - Choose a protective field length of at least twice the step length = 1500 mm.
 - Or:
 - Take additional measures, e.g. an appropriate mounting height to prevent unintentional passage through the field.

**C4000 Palletizer Std./Adv.
C4000 Fusion**



You can configure the **object pattern recognition** function in the CDS on the C4000 (receiver).

For blanking object patterns you configure:

- the maximum number of objects (1 to 5, depending on the protective field length, see Tab. 2 on page 20)
- the minimum number of objects that must be in the protective field at the same time (1 to 5), before the protective field becomes clear again
- the minimum and maximum object size

The C4000 switches to red, if ...

- more or less objects than configured pass the protective field.
- an object is smaller than the minimum size or larger than the maximum size.
- the distances between the objects change by more than the tolerances (see section 12.3.1 on page 101).
- an object enters the protective field other than at the start.
- an object leaves the protective field other than at the end.
- the object has gaps or the gaps are larger than the gap suppression configured.
- the protective field of the safety light curtain is interrupted completely.
- the first and last beam of the protective field are interrupted on switching on.

Object size that will result in safe shutdown

The object size that results in safe shutdown is dependent on the size configured.

How to calculate the object size that will result in safe shutdown:

Physical resolution of the devices
20 mm
Configured maximum object size
± 28 mm
= Object size for safe shutdown

Tab. 15: Calculating the object size that will result in safe shutdown

Teach-in of object patterns

As an alternative to the manual entry of object sizes and object distances, you can measure the existing skids using the “Teach-in of object patterns” function. This function makes it possible to measure the sizes and distances between the blanked areas (e.g. pillars, wheel arches, shock absorbers) in a simple manner. To use the teach-in function, you must activate the option in the CDS.



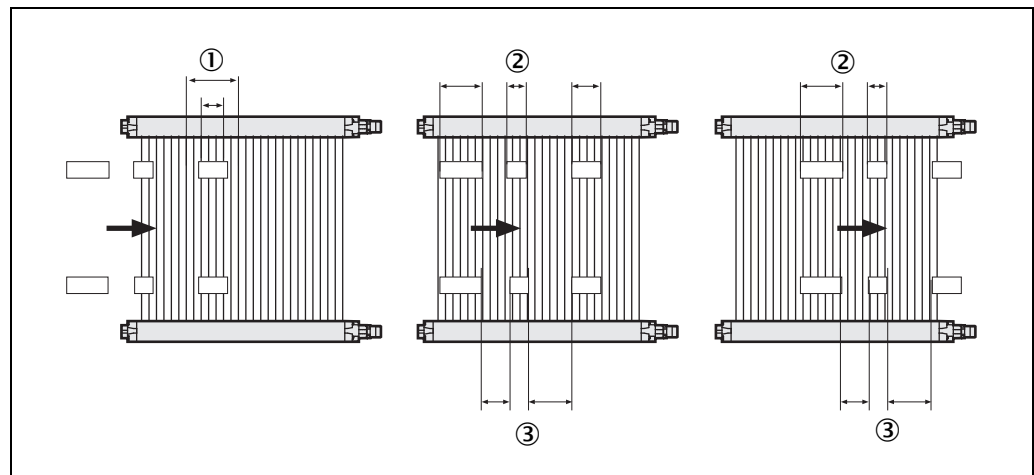
You can configure the teach-in of object patterns function in the CDS on the C4000 (receiver). For teaching-in, the PC with the CDS must remain connected to the C4000.

Teach-in is performed by moving several skids through the protective field. The CDS develops a suggestion from the object patterns seen; you can modify this suggestion and use it.

5.4.1 Object size monitoring

In addition you can configure object size monitoring. On the entry of objects into the protective field, first the validity of the object is checked based in the minimum and maximum object size configured ①. The actual size is then “frozen” and monitored during the entire time it passes through the field ②. It is also monitored that the distances between the objects do not change ③.

Fig. 30: Monitor object sizes



The C4000 switches to red, if ...

- more or less objects than configured pass the protective field.
- the object is below the minimum object size or above the maximum object size.
- the frozen size changes by more than the tolerance allowed (see section 12.3.1 on page 101).
- the distances between the objects change by more than the tolerances (see section 12.3.1 on page 101).
- an object enters the protective field other than at the start.
- an object leaves the protective field other than at the end.
- the object has gaps or the gaps are larger than the gap suppression configured.
- the protective field of the safety light curtain is interrupted completely.
- the first and last beam of the protective field are interrupted on switching on.

Minimum distance between two objects with object pattern recognition

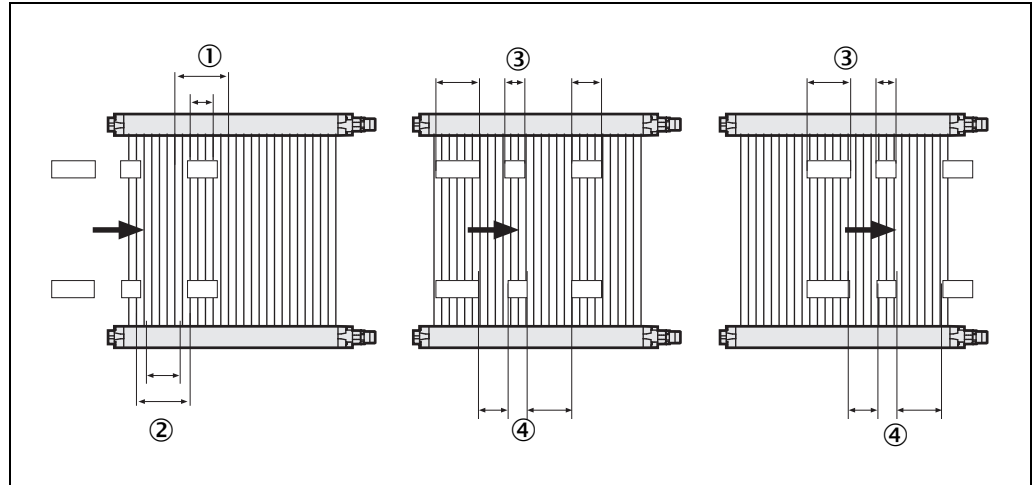
For it to be possible to detect individual objects, these must maintain a minimum distance of 20 mm.

**C4000 Palletizer Std./Adv.
C4000 Fusion**
5.4.2 Sequence monitoring

As an alternative to object size monitoring, sequence monitoring can be activated. In this case, in addition to the minimum and maximum object sizes configured (①), the minimum and maximum distances between objects (②) can also be configured.

The automatic freezing of the sizes and distances is deactivated.

Fig. 31: Monitoring object sizes and object distances



During the entire time the objects pass through the field, the object size and object distance are continuously monitored (③ and ④).

The C4000 switches to red, if ...

- more or less objects than configured pass the protective field.
- the object is below the minimum object size or above the maximum object size.
- the distance between the objects is below the minimum distance or exceeds the maximum distance.
- the object sequence is not maintained with sequence monitoring configured.
- an object enters the protective field other than at the start.
- an object leaves the protective field other than at the end.
- the object has gaps or the gaps are larger than the gap suppression configured.
- the protective field of the safety light curtain is interrupted completely.
- the first and last beam of the protective field are interrupted on switching on.

5.4.3 Object gap suppression

If you only configure one object as an object pattern, you can configure object gap suppression similar to goods detection (see 5.2.3 on page 45). It is possible to allow a gap of approx. 10 mm on the C4000 Fusion.



You can configure the **object gap suppression** function in the CDS on the C4000 (receiver).

5.5 Additional functions for horizontal applications

Direction detection

The C4000 can also monitor the direction of object movement.



You can configure the direction detection function in the CDS on the C4000 (receiver).

For this purpose, the direction of entry into the beam path can be configured:

- object entry only adjacent to display
- object entry only remote from display
- from both directions

In addition to the shutdown criteria in 5.1, 5.3 and 5.4 the following applies:

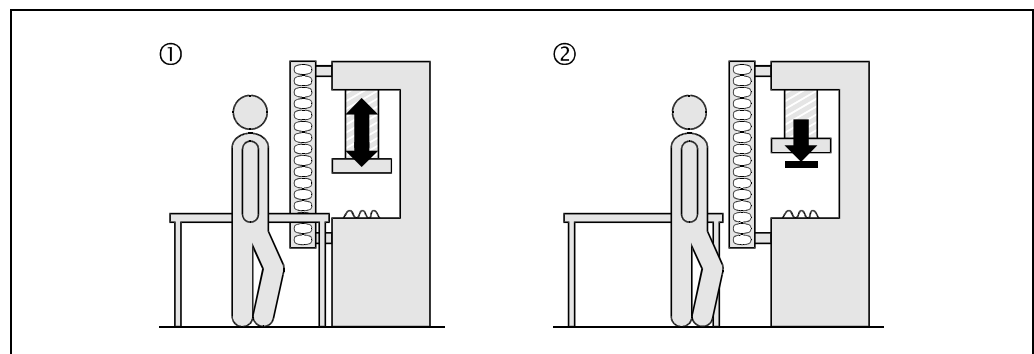
If one of the “object entry only adjacent to display” or “object entry only remote from display” options is selected, the C4000 switches to red if an object moves in the wrong direction.

Note The tolerance of the direction detection is 150 mm. As a result the object can also move unevenly through the protective field. If an object enters in the wrong direction, the C4000 only switches to red once the object has entered 150 mm into the protective field.

5.6 Fixed blanking

The C4000 Fusion safety light curtain is capable of fixed-blanking up to five areas in the protective field, e.g. to allow continued operation in spite of an obstruction such as a support arm placed permanently in the light path.

Fig. 32: Schematic layout of the fixed blanking



The blanked area will no longer be part of the protective field. Objects to be blanked out must therefore be permanently located inside the blanked area (①). As soon as the object is removed from the beam path, the safety light curtain will interrupt the dangerous movement (②). Protection is otherwise no longer guaranteed.

The size and the position of blanked areas are defined simply by the operator by placing objects of appropriate size in the required positions in the protective field and then teaching-in these areas with the aid of a key-operated pushbutton for teach-in. This is, e.g., useful during a tool change.

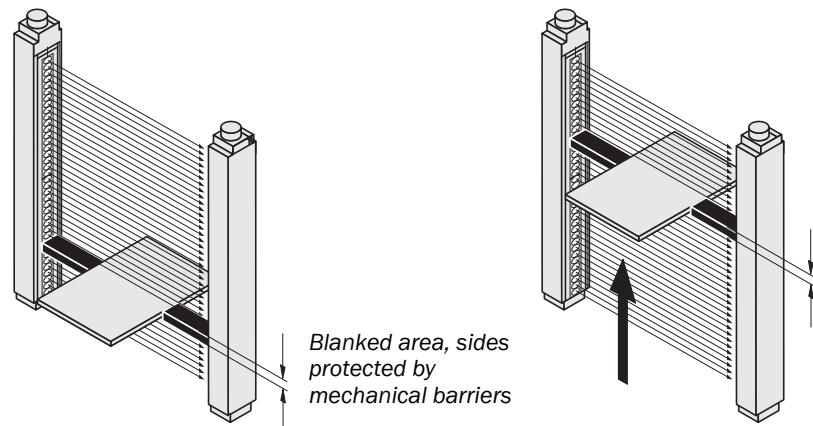


WARNING

Blanked areas require a separate risk analysis!

A blanked area is in principle a hole in the protective field. Check in detail whether and where blanking is actually required. You must protect the blanked area in another way, e.g. mechanically. Otherwise you must take the blanked area into consideration in the calculation of the safety distance and mount the safety light curtain appropriately.

Fig. 33: Example of the mechanical protection of a fixed blanking



- After modifying the blanking, check the protective field with the test rod. Instructions can be found in chapter 8.3.3 on page 86.
- Also pay attention to the warnings in the related chapter.



You can configure **blanking of fixed areas** in the CDS on the C4000 (receiver).

For blanking fixed areas, you configure:

- the maximum number of objects (1 to 5)
- a key-operated pushbutton for teach-in (see section 7.11 “Key-operated pushbutton for teach-in” on page 82).

The C4000 switches to red, if ...

- more objects or fewer objects than taught-in enter the protective field.
- the taught-in object size changes by more than the tolerance allowed.
- the object leaves the taught-in position by more than the tolerance allowed.

Limits for teach-in operation

- Objects are only reliably taught-in if the objects to be taught-in have a size of at least 20 mm. With objects <20 mm, no blanking may be taught-in in certain circumstances. This situation can result in shutdowns in the event of vibration of the object. In this case, slight re-adjustment and/or teaching-in the areas again may rectify the problem.
- At least one beam must remain without interruption between the objects.
- The first or the last beam of the protective field must remain free.

Note At variance with the operating instructions for the SICK UE402 switching amplifier, you do not need a reset button for the teach-in function and will need a key-operated pushbutton for teach-in instead of a key-operated switch for teach-in.

How to teach-in a blanked area:

WARNING

Prevent teach-in in areas or operating modes where it is not intended to be used!

A successfully completed teach-in process changes the size and, for fixed blanking, also the position of the blanked areas. Areas of unsuitable size or in an unsuitable position can reduce the availability of the system. For this reason:

- Ensure by means of organisational measures that the operator only teaches in those areas and only in those operating modes that are also suitable in relation to the application.
- Ensure that only authorised persons have access to the teach-in key.


- Guide the object or objects into the protective field.

The safety light curtain changes to red.

Note

You must guide an object of suitable size into the protective field for all blanked areas. There must be no other objects in the protective field.

- Press the key-operated pushbutton for teach-in.

After the button is released, the C4000 saves the interrupted part of the protective field as a blanked area. The 7-segment display on the receiver indicates  if the valid areas to be blanked were taught.

If the properties of the objects vary from the parameters configured during teaching-in, then no blanked area will be taught-in. The protective field of the C4000 has the same shape as before teaching-in.

The areas taught-in will be deleted if the supply voltage for the C4000 is shut down. The safety light curtain is in protective operation after power up.



WARNING

Test the protective device after teach-in!

- Test the entire protective device for effectiveness (see 8.3 on page 85).
- If you use blanked areas, then the protective field is divided into several sections. In this case check all sections of the protective field.
- Check whether the safety light curtain behaves as expected when you introduce the object into the protective field, remove it again, or operate the system without the object.
- If required, recalculate the safety distance and readjust it on the machine.

How to reset blanked areas:

- Remove all objects or the objects that are no longer required from the protective field.
- Press the key-operated pushbutton for teach-in. The safety light curtain changes to red. After the key-operated pushbutton for teach-in is released, the C4000 deletes all blanked areas and monitors the newly defined protective field. The safety light curtain switches to green if the protective field is clear and the 7-segment display on the receiver goes off.
- Or:
- Switch off the supply voltage for the C4000. As a result the blanked areas are deleted. After switching back on, the safety light curtain is in protective operation.



WARNING

Test the protective device after resetting the blanked areas!

- Test the entire protective device for effectiveness (see section 8.3 “Test notes” on page 85).

Effective resolution with areas taught-in

The effective resolution of an optical system depends on both its optical components and on its configuration. The effective resolution cannot be higher than the highest possible physical resolution of the system. However, it can be reduced by the configuration, e.g. by blanking beams.

In conjunction with size tolerance, the effective resolution is reduced at the edges of the blanked areas. The effective resolution in the case of blanking with fixed size tolerance on the C4000 Fusion is 30 mm.



WARNING

Check the safety distance!

When using blanking with fixed size tolerance, the required safety distance will depend on the effective resolution of 30 mm.

- Re-calculate the safety distance with a resolution of 30 mm (see page 62) and correct it on the machine.
- Mark the effective resolution on the information label “Operation with ‘reduced resolution’ or ‘blanking’ ...” on the related sender and receiver.

Fig. 34: Marking the effective resolution on the device label

	Warning: During operation with “Reduced resolution” or “Blanking” the safety distance that corresponds to the modified resolution is to be observed.				
	Resolution modified to: (please mark)	14 mm	20 mm	30 mm	40 mm
Reduction		Physical resolution			
1 beam	22 mm	30 mm	✓ 50 mm	70 mm	
2 beams	30 mm	40 mm	70 mm	100 mm	
3 beams	37 mm	50 mm	90 mm	130 mm	
n beams		mm	mm	mm	mm
		Effective resolution/minimum object size			

Object gap suppression

You can also configure object gap suppression to permit gaps between the objects in the blanked areas. It is possible to allow gaps of approx. 10 mm.

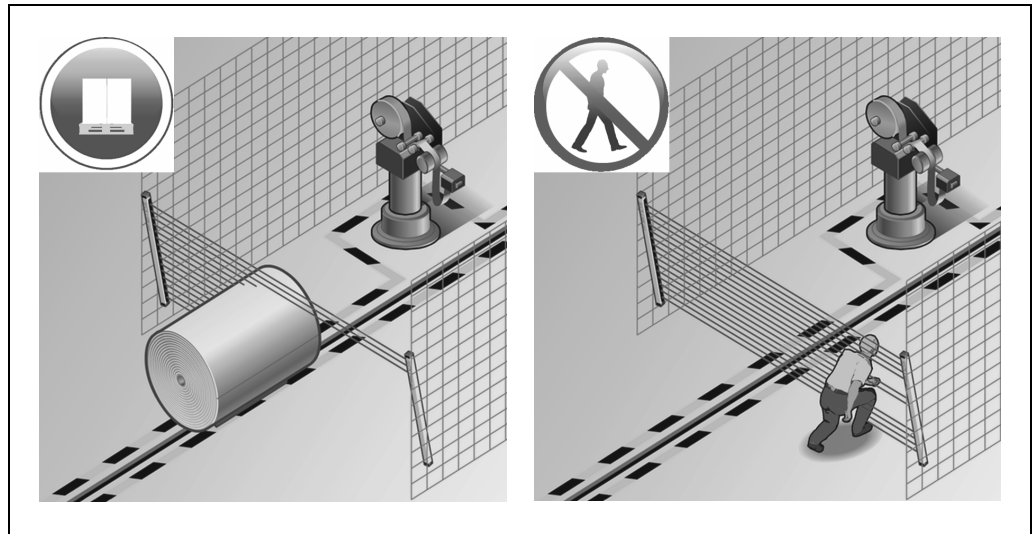


You can configure the **object gap suppression** function in the CDS on the C4000 (receiver).

5.7 Blanking of geometrically even objects

Using this function, e.g., rolls of paper or cardboard boxes on conveyors can be blanked that as a result then have access to a system or machine.

Fig. 35: Blanking of geometrically even objects



If other objects, in particular people, enter the protective field then the C4000 shuts down its output signal switching devices.



WARNING

Prevent people entering the hazardous area beside the object!

During entry, the item transported must block the access to the hazardous area.

The blanked area requires a separate risk analysis!

It is the responsibility of the person responsible for the machine to check whether this type of access protection produces safe shutdown in the related application. As a rule, application-specific acceptance is required. Please consult the related authorities or your insurer.

The resolution of the safety light curtain is defined by the blanked area. You must take this aspect into account when calculating the safety distance (see section 6.3 “Calculating the safety distance for a vertical application” on page 62).

Notes

- The area of the protective field that is permanently active must start at the latest at 1500 mm above the access plane so that a person is safely detected.
- The C4000 Fusion is mounted **slightly at an angle** in the direction in which the objects are transported. The slightly inclined position is necessary to suppress interference due to front faces on the objects that are not completely smooth.
- The safety light curtain must be near to the ground to prevent crawling beneath.



Configure the **blanking of geometrically even objects** function in the CDS on C4000 (receiver).

For blanking geometrically even objects, you configure:

- 1 object to be blanked
- the height of the blanked area

**C4000 Palletizer Std./Adv.
C4000 Fusion****The C4000 switches to red, if ...**

- an object with an undercutting enters the protective field.
- more than one object enters the protective field.
- if an object enters the protective field in the area above the blanked area.
- if an object exceeds the blanked area.

Effective resolution for the blanked area configured**How to calculate the effective resolution:**

Tab. 16: Calculating the effective resolution

	Configured maximum object size
-	Configured minimum object size
+	29 mm
<hr/>	
=	Effective resolution
<hr/>	

Example:

Physical resolution of the device = 20 mm

Configured maximum object size = 1500 mm

Configured minimum object size = 0 mm

Effective resolution = 1500 mm - 0 mm + 29 mm = 1529 mm

6 Mounting

This chapter describes the preparation and completion of the mounting of the C4000 safety light curtain. The mounting requires two steps:

- determining the necessary safety distance
- installation with swivel mount or side brackets
- additional measures to prevent bypassing of the protection

The following steps are necessary after mounting:

- completing the electrical connections (chapter 7)
- aligning sender and receiver unit (section 8.2)
- testing the installation (section 8.3)

6.1 Additional measures to prevent bypassing of the protection

Note The measures described relate to the horizontal mounting of the C4000.

To ensure the protective field is not intentionally or unintentionally bypassed, the following additional measures may be necessary:

Tab. 17: Additional measures to prevent bypassing of the protection

Method of attempting to bypass	Possible measures
<ul style="list-style-type: none"> • jumping over/stepping over the protective field 	<ul style="list-style-type: none"> ➤ select adequate length for the safety light curtain ➤ mount safety light curtain higher ➤ mount fixed barriers ➤ limit height of the material entry/exit
<ul style="list-style-type: none"> • crawling beneath the protective field 	<ul style="list-style-type: none"> ➤ comply with mounting height of maximum 300 mm or take additional measures
<ul style="list-style-type: none"> • balancing over the protective field • walking in the shadow of an object • teach-in people with fixed object (box, briefcase) 	<ul style="list-style-type: none"> ➤ fit additional safety light curtains ➤ mount fixed barriers ➤ mount device for preventing steps or barriers ➤ minimise the distance between ESPE and pallet so that a foot does not fit between ➤ reduce headroom
<ul style="list-style-type: none"> • unintentional riding with the objects, e.g. on belt conveyors 	<ul style="list-style-type: none"> ➤ fit additional photoelectric safety switches ➤ limit clearance height to the dangerous movement ➤ take organisational measures (e.g. training courses and information labels that forbid this action)

6.2 Determining the safety distance in a horizontal application

The safety light curtain must be mounted with sufficient safety distance:

- from the hazardous point
- from reflective surfaces



WARNING

No protective function without sufficient safety distance!

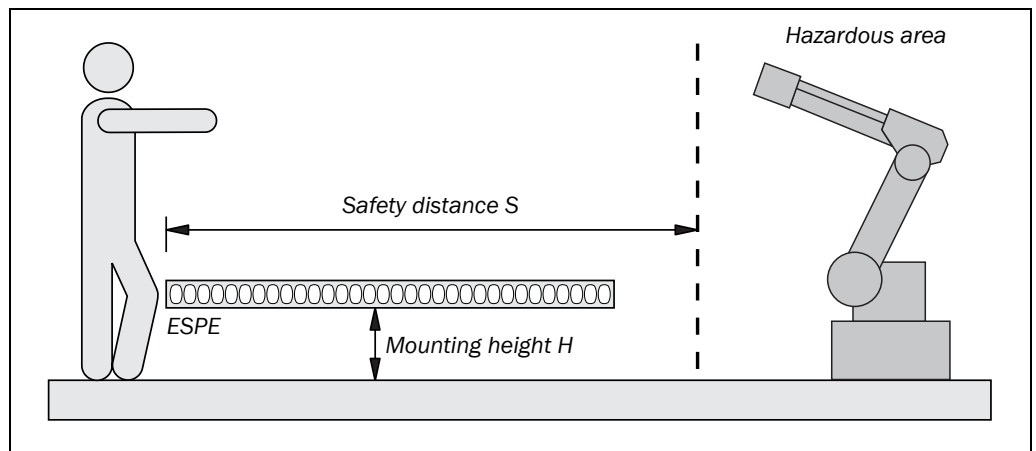
The reliable protective effect of the safety light curtain depends on the system being mounted with the correct safety distance from the hazardous point.

A safety distance must be maintained between the safety light curtain and the hazardous point. This safety distance ensures that the hazardous point can only be reached after the dangerous state of the machine has been completely stopped.

The safety distance as per EN ISO 13855 and EN ISO 13857 depends on:

- stopping/run-down time of the machine or system
(The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- response time of the protective device
(response times see section 12.2 “Response time” on page 99)
- approach speed
- other parameters that are stipulated by the standard depending on the application

Fig. 36: Safety distance from the hazardous point



Note The safety distance relates to the first beam in the protective field, as seen from the direction of approach toward the hazardous point (see Fig. 36).

The following calculations show example calculations of the safety distance. Depending on the application and the ambient conditions, a different calculation may be necessary.

How to calculate the safety distance according to EN ISO 13 855 and EN ISO 13 857:

➤ Calculate the safety distance using the following formula:

$$S = k \times T + 1200 \text{ mm} - (0.4 \times H) + Z_{\text{App}}$$

Where ...

S = Safety distance [mm]

k = Approach speed [1600 mm/s]

T = Stopping/run-down time of the machine
+ Response time of the protective device after light path interruption [s]

1200 = Arm length (850 mm) + half step length (350 mm) according to EN ISO 13 855
[mm]

H = Mounting height of the C4000

Z_{App} = Application dependent supplement

Z_{App} comprises: ET + K_{App}

Where ...

ET = Entry depth
(a step length of 700 mm as per EN ISO 13 855)

K_{App} = Application dependent constant of 150 mm
(area of entry into the safety light curtain)

Example:

Stopping/run-down time of the machine = 290 ms

Response time after light path interruption = 30 ms

$T = 290 \text{ ms} + 30 \text{ ms} = 320 \text{ ms} = 0.32 \text{ s}$

Mounting height of the C4000 = 500 mm

$Z_{\text{App}} = 850 \text{ mm}$

$S = 1600 \times 0.32 + 1200 - (0.4 \times 500) + 850 = \underline{\underline{2362 \text{ mm}}}$

You can reduce the safety distance using the following factors:

- You configure exactly defined object patterns.

The supplement Z_{App} is reduced by the distance between the objects. Example: With Euro pallets a second object enters the protective field at the latest after 380 mm. For this reason the entry depth ET is = $700 - 380 \text{ mm} = 320 \text{ mm}$.

- You configure direction detection such that objects are not allowed to move towards the dangerous state.

Z_{App} is then only 150 mm.

- You configure an object pattern in which the first object is smaller than 60 mm (from a mounting height of at least 300 mm, EN ISO 13 855 assumes an ankle width of 70 mm, less 10 mm tolerance).

If a person then enters the protective field, then shutdown does not take place only after a step length, but after 150 mm.

Z_{App} is then only 150 mm.

6.2.1 Safety distance calculation as per Berufsgenossenschaft Nahrungsmittel und Gaststaetten (BGN)

For protective fields of 1350 mm length, as per the decision by the Pruef- und Zertifizierungsstelle in the Fachausschuss Nahrungs- und Genussmittel in the Berufsgenossenschaft Nahrungsmittel und Gaststaetten, it is also possible to use the following calculation:

In the case of goods detection with the aid of the C4000 Palletizer Standard a maximum entry depth until shutdown occurs of 450 mm is assumed. In the case of pallet detection with the aid of the C4000 Palletizer Advanced, a maximum entry depth until shutdown occurs of 900 mm is assumed.

How to calculate the safety distance C4000 Palletizer Standard with 1350 mm protective field length:

➤ Calculate the safety distance using the following formula:

$$S = k \times T + E$$

Where ...

S = Safety distance [mm] (minimum protective field length)

k = Approach speed [1600 mm/s]

T = Stopping/run-down time of the machine
+ response time of the protective device after light path interruption [s]

E = Entry depth into the protective field until shutdown occurs [450 mm]

Example:

Stopping/run-down time of the machine = 290 ms

Response time after light path interruption = 30 ms

$T = 290 \text{ ms} + 30 \text{ ms} = 320 \text{ ms} = 0.32 \text{ s}$

$S = 1600 \times 0.32 + 450 = \underline{962 \text{ mm}}$ **due to minimum condition however S = 1350 mm**

How to calculate the safety distance C4000 Palletizer Advanced with 1350 mm protective field length:

➤ Calculate the safety distance using the following formula:

$$S = k \times T + E$$

Where ...

S = Safety distance [mm] (minimum protective field length + 850 mm)

k = Approach speed [1600 mm/s]

T = Stopping/run-down time of the machine
+ Response time of the protective device after light path interruption [s]

E = Entry depth into the protective field until shutdown occurs [900 mm]

Example:

Stopping/run-down time of the machine = 290 ms

Response time after light path interruption = 30 ms

$T = 290 \text{ ms} + 30 \text{ ms} = 320 \text{ ms} = 0.32 \text{ s}$

$S = 1600 \times 0.32 + 900 = \underline{1412 \text{ mm}}$ **due to minimum condition however S = 2200 mm**

Note In the case of pallet detection with the aid of the C4000 Palletizer Advanced, if a person places one leg in the first beam of the protective field and then steps over the protective field with the second leg, the OSSDs may only be shutdown on the removal of the 1st leg from the protective field. To exclude this residual risk, you must maintain a safety distance of 2200 mm (protective field length + 850 mm).

6.3 Calculating the safety distance for a vertical application

The safety light curtain must be mounted with sufficient safety distance:

- from the hazardous point
- from reflective surfaces



WARNING

No protective function without sufficient safety distance!

The reliable protective effect of the safety light curtain depends on the system being mounted with the correct safety distance from the hazardous point.

A safety distance must be maintained between the safety light curtain and the hazardous point. This safety distance ensures that the hazardous point can only be reached after the dangerous state of the machine has been completely stopped.

The safety distance as per EN ISO 13855 and EN ISO 13857 depends on:

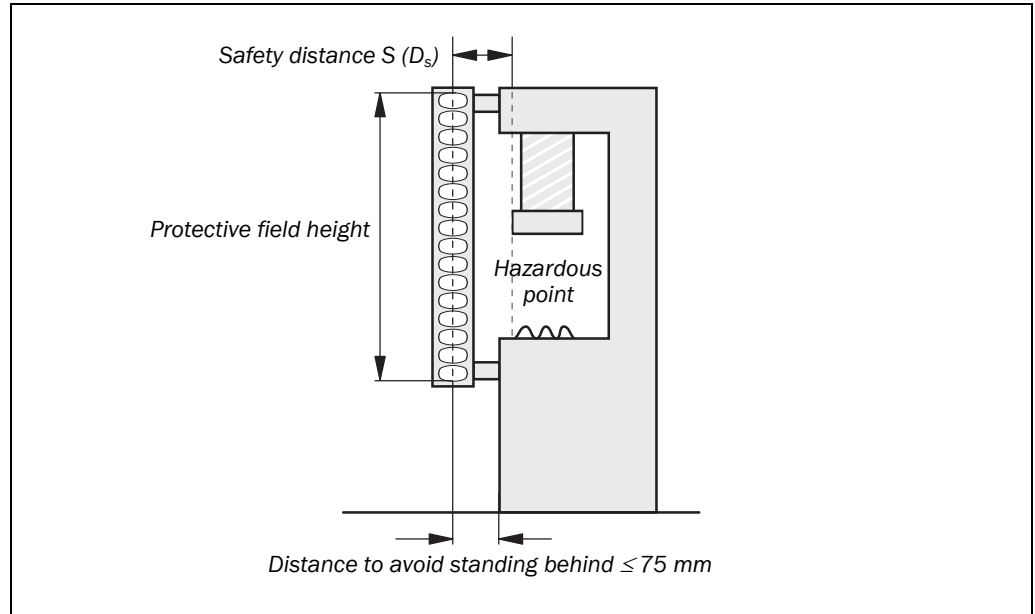
- stopping/run-down time of the machine or system
(The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- response time of the protective device (see section 12.2 “Response time” on page 99)
- reach or approach speed
- resolution of the safety light curtain and/or beam separation
- other parameters that are stipulated by the standard depending on the application

Under the authority of OSHA and ANSI the safety distance as specified by ANSI B11.19:2003-04, Annex D and Code of Federal Regulations, Volume 29, Part 1910.217 ... (h) (9) (v) depends on:

- stopping/run-down time of the machine or system
(The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- response time of the entire protective device
(response times see chapter 12.2 “Response time” on page 99)
- reach or approach speed
- other parameters that are stipulated by the standard depending on the application

**C4000 Palletizer Std./Adv.
C4000 Fusion**

Fig. 37: Safety distance to the hazardous point for vertical mounting


How to calculate the safety distance S according to EN ISO 13 855 and EN ISO 13 857:

Note The following calculation shows an example calculation of the safety distance. Depending on the application and the ambient conditions, a different calculation may be necessary.

➤ First, calculate S using the following formula:

$$S = 2000 \times T + 8 \times (d - 14) \text{ [mm]}$$

➤ Where ...

T = Stopping/run-down time of the machine
+ Response time of the protective device after light path interruption [s]

d = Resolution of the safety light curtain [mm]

S = Safety distance [mm]

The reach/approach speed is already included in the formula.

➤ If the result S is ≤ 500 mm, then use the determined value as the safety distance.

If the result S is > 500 mm, then recalculate S as follows:

$$S = 1600 \times T + 8 \times (d - 14) \text{ [mm]}$$

➤ If the new value S is > 500 mm, then use the newly determined value as the minimum safety distance.

➤ If the new value S is ≤ 500 mm, then use 500 mm as the minimum safety distance.

Example:

Stopping/run-down time of the machine = 290 ms

Response time after light path interruption = 30 ms

Resolution of the safety light curtain = 14 mm

$$T = 290 \text{ ms} + 30 \text{ ms} = 320 \text{ ms} = 0.32 \text{ s}$$

$$S = 2000 \times 0.32 + 8 \times (14 - 14) = 640 \text{ mm}$$

$S > 500$ mm, for this reason:

$$S = 1600 \times 0.32 + 8 \times (14 - 14) = \underline{\underline{512 \text{ mm}}}$$

How to calculate the safety distance D_s according to ANSI B11.19:2003-04, Annex D and Code of Federal Regulations, Volume 29, Part 1910.217 ... (h) (9) (v):

Note The following calculation shows an example calculation of the safety distance. Depending on the application and the ambient conditions, a different calculation may be necessary.

➤ Calculate D_s using the following formula:

$$D_s = H_s \times (T_s + T_c + T_r + T_{bm}) + D_{pf}$$

Where ...

D_s = The minimum distance in inches (or millimetres) from the hazardous point to the protective device

H_s = A parameter in inches/second or millimetres/second, derived from data on approach speeds of the body or parts of the body. Often 63 inches/second (1600 mm/second) is used for H_s .

T_s = Stopping/run down time of the machine tool measured at the final control element

T_c = Stopping/run-down time of the control system

T_r = Response time of the entire protective device after light path interruption

T_{bm} = Additional response time allowed for brake monitor to compensate for wear

Note Any additional response times must be accounted for in this calculation.

D_{pf} = An additional distance added to the overall safety distance required. This value is based on intrusion toward the hazardous point prior to actuation of the electro-sensitive protective equipment (ESPE). Values range from 0.25 inches to 48 inches (6 to 1220 millimetres) or more depending on application.

Example:

For perpendicular protection using an opto-electronic protective device with an object sensitivity (effective resolution) less than 2.5 inches (64 millimetres), D_{pf} can be approximated based on the following formula:

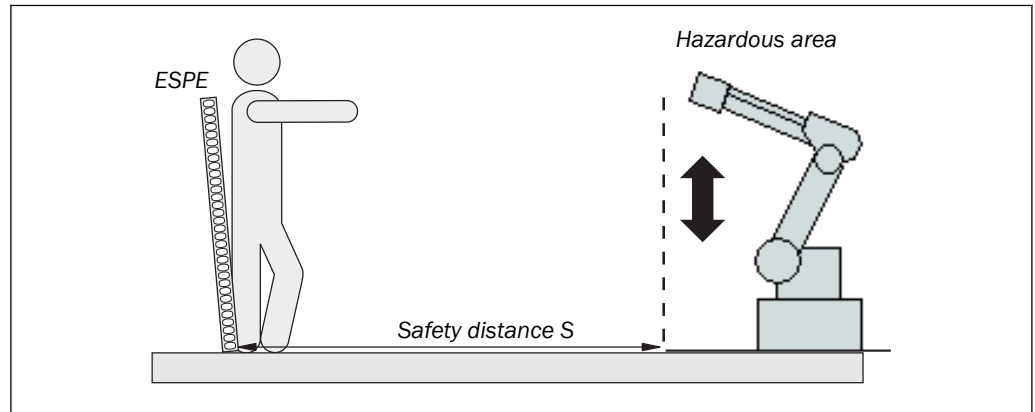
$$D_{pf} \text{ (inches)} = 3.4 \times (\text{effective resolution} - 0.276), \text{ but not less than } 0.$$

6.3.1 Calculating the safety distance for access protection with the aid of the blanking of geometrically even objects

The safety distance as per EN ISO 13855 and EN ISO 13857 depends on:

- stopping/run-down time of the machine or system
(The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- response time of the protective device (see section “Response time” on page 99)
- approach speed
- other parameters that are stipulated by the standard depending on the application

Fig. 38: Safety distance from the hazardous point



- Notes**
- It is imperative crawling beneath is prevented. For this reason mounting near the floor is imperative.
 - As, in certain circumstances, it is only possible to assess whether the object is valid or, for instance, is a person, when the object leaves the protective field, a safety supplement must be added to the safety distance. As per EN ISO 13855 this must be the length of an arm (850 mm) + half the length of a step (350 mm).

How to calculate the safety distance according to EN ISO 13855:

- Calculate the safety distance using the following formula:

$$S = k \times T + 1200 \text{ mm}$$

Where ...

S = Safety distance [mm]

k = Approach speed [1600 mm/s]

T = Stopping/run-down time of the machine
+ Response time of the protective device after light path interruption [s]

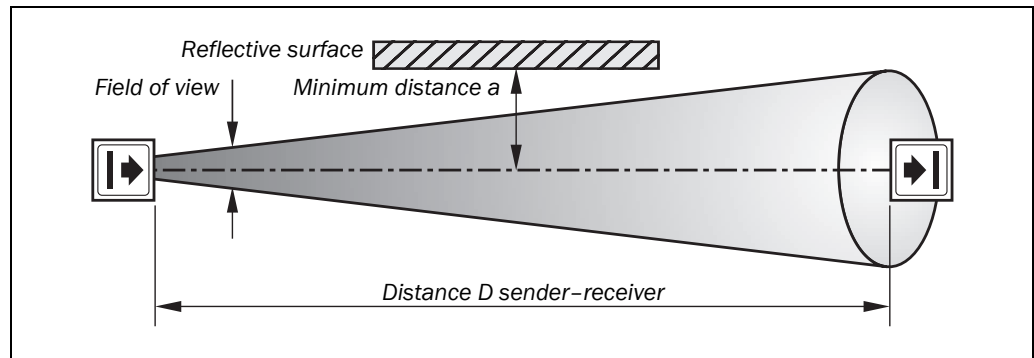
1200 = Arm length (850 mm) + half step length (350 mm) according to EN ISO 13855 [mm]

6.3.2 Minimum distance to reflective surfaces

The light beams from the sender may be deflected by reflective surfaces. This can result in failure to identify an object.

All reflective surfaces and objects (e.g. material bins) must therefore be located at a minimum distance a from the protective field of the system. The minimum distance a depends on the distance D between sender and receiver.

Fig. 39: Minimum distance to reflective surfaces

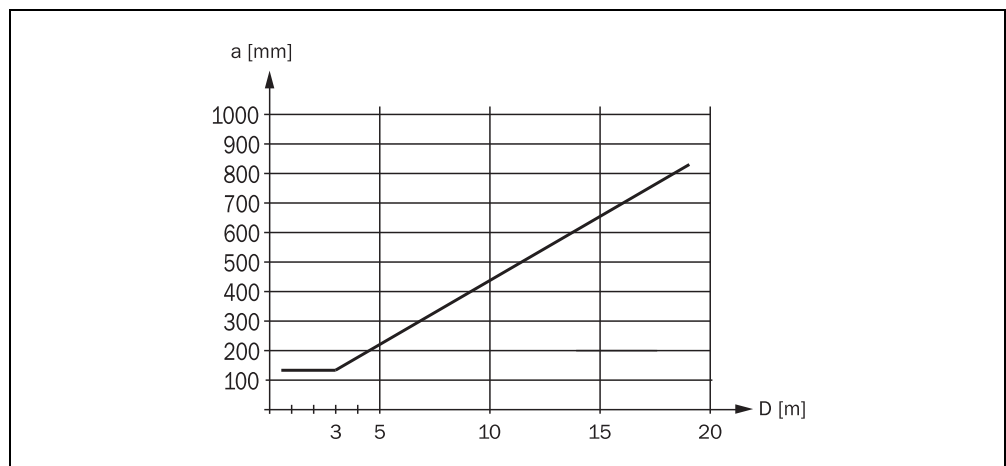


Note The field of view of the sender and receiver optics is identical.

How to determine the minimum distance from reflective surfaces:

- Determine the distance D [m] sender-receiver.
- Read the minimum distance a [mm] from the graph:

Fig. 40: Graph, minimum distance from reflective surfaces



Note If it is not possible to maintain the minimum distance from reflective surfaces, there are ways of reducing the risk of reflections and the resulting resolution. To check whether these measures are sufficient to adequately reduce the residual risk, you must perform a risk analysis. For further information, please contact your local SICK representative.

6.4 Steps for mounting the device



WARNING

Special features to note during mounting:

- Always mount the sender and receiver parallel to one another.
- During mounting, ensure that sender and receiver are aligned correctly. The optical lens systems of sender and receiver must be located in exact opposition to each other. The system plugs of both devices must point in the same direction.
- The minimum distance between sender and receiver is 500 mm on the C4000 Palletizer and Advanced and 1500 mm on the C4000 Fusion.
- Take suitable measures to attenuate vibration if the shock requirements are above the values given in section 12.1 “Data sheet” on page 99.
- Observe the safety distance of the system during mounting. On this subject read chapter 6.2 on page 59 and 6.3 on page 62.
- Access to the hazardous area is only to be via the protective field.
- Once the system is mounted, one or several of the enclosed self-adhesive safety information labels must be affixed:
 - Use only information labels in the language which the operators of the machine understand.
 - Affix the information labels such that they are easily visible by the operators during operation. After attaching additional objects and equipment, the information labels must not be concealed from view.
 - Affix the information label “Important Information” to the system in close proximity to sender and receiver.

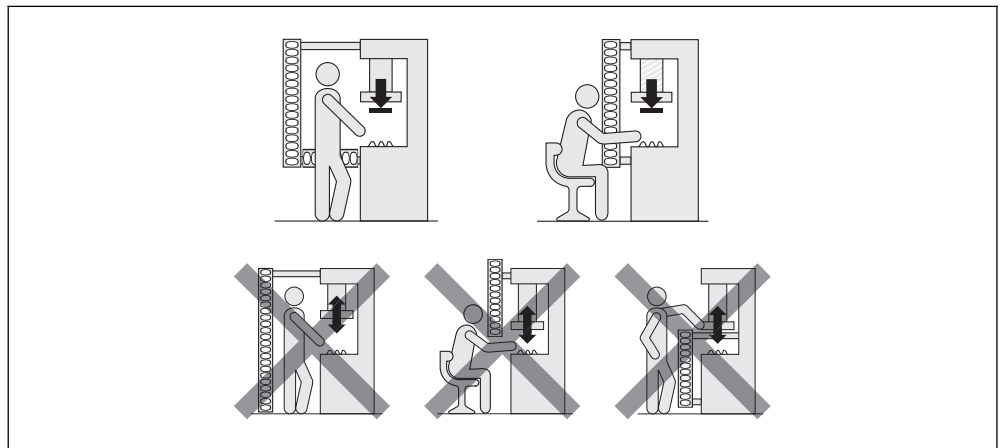
In the case of horizontal mounting also note:

- Mount the safety light curtain such that it is not possible to climb over, crawl beneath or stand behind the safety light curtain and such that the safety light curtain cannot be repositioned. An uncritical value against crawling beneath is a mounting height of 300 mm.

In the case of vertical mounting also note:

- Mount the safety light curtain such that reaching under, reaching over or standing behind the safety light curtain is not possible and that the safety light curtain cannot be displaced. An uncritical value against crawling beneath is a mounting height of 300 mm.

Fig. 41: The correct mounting (above) must eliminate the errors (below) standing behind, reaching under and reaching over



Sender and receiver can be mounted in three different ways:

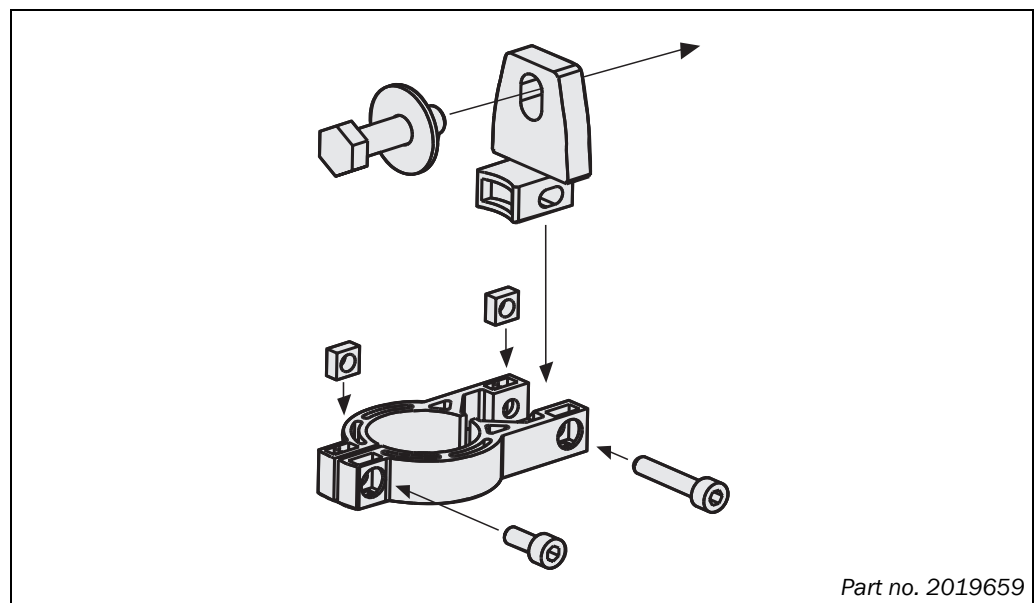
- mounting with swivel mount bracket (see 6.4.1)
- mounting with side bracket (see 6.4.2)
- fastening to floor stands (see 12.5.5)

6.4.1 Mounting with swivel mount bracket

The swivel mount bracket is made of black polyamide PA6. The bracket is designed such that sender and receiver can still be accurately aligned even after the bracket has been mounted.

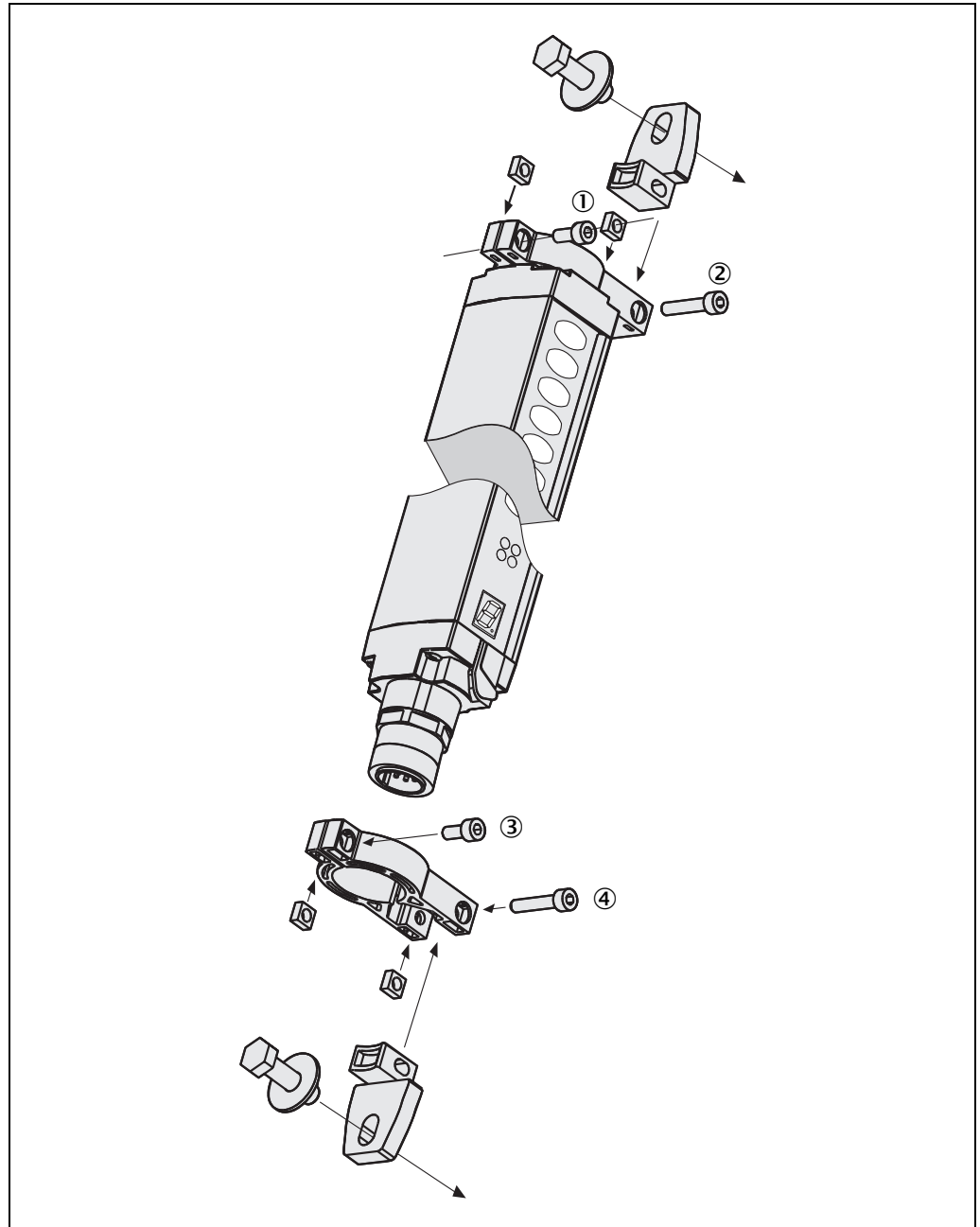
- Note** ➤ Attach the screws of the swivel mount bracket with a torque of between 2.5 and 3 Nm. Higher torques can damage the bracket; lower torques provide inadequate protection against vibration.

Fig. 42: Composition of the swivel mount bracket



**C4000 Palletizer Std./Adv.
C4000 Fusion**

Fig. 43: Mounting sender and receiver using swivel mount brackets

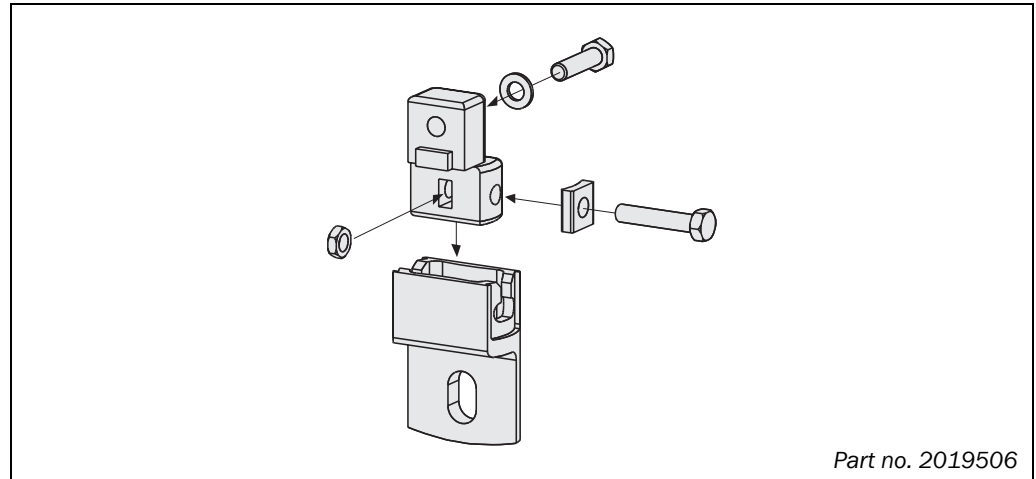


- Notes**
- Mount the bolts marked with ① to ④ on the operator side of the system to ensure that they remain accessible after mounting and to allow you to readjust the safety light curtain later, if necessary.
 - If you wish to use the additional front screen (see “Additional front screen (weld spark guard)” on page 115), make sure that the curved side of the device remains accessible after mounting.

6.4.2 Mounting with side bracket

The side bracket is made of die cast zinc ZP 0400. It is enamelled in black. The side bracket will be covered by the device after mounting. But it is only suitable for mounting surfaces lying parallel to the desired protective field because the alignment of sender and receiver can only be adjusted by a maximum of 2.5° after mounting.±

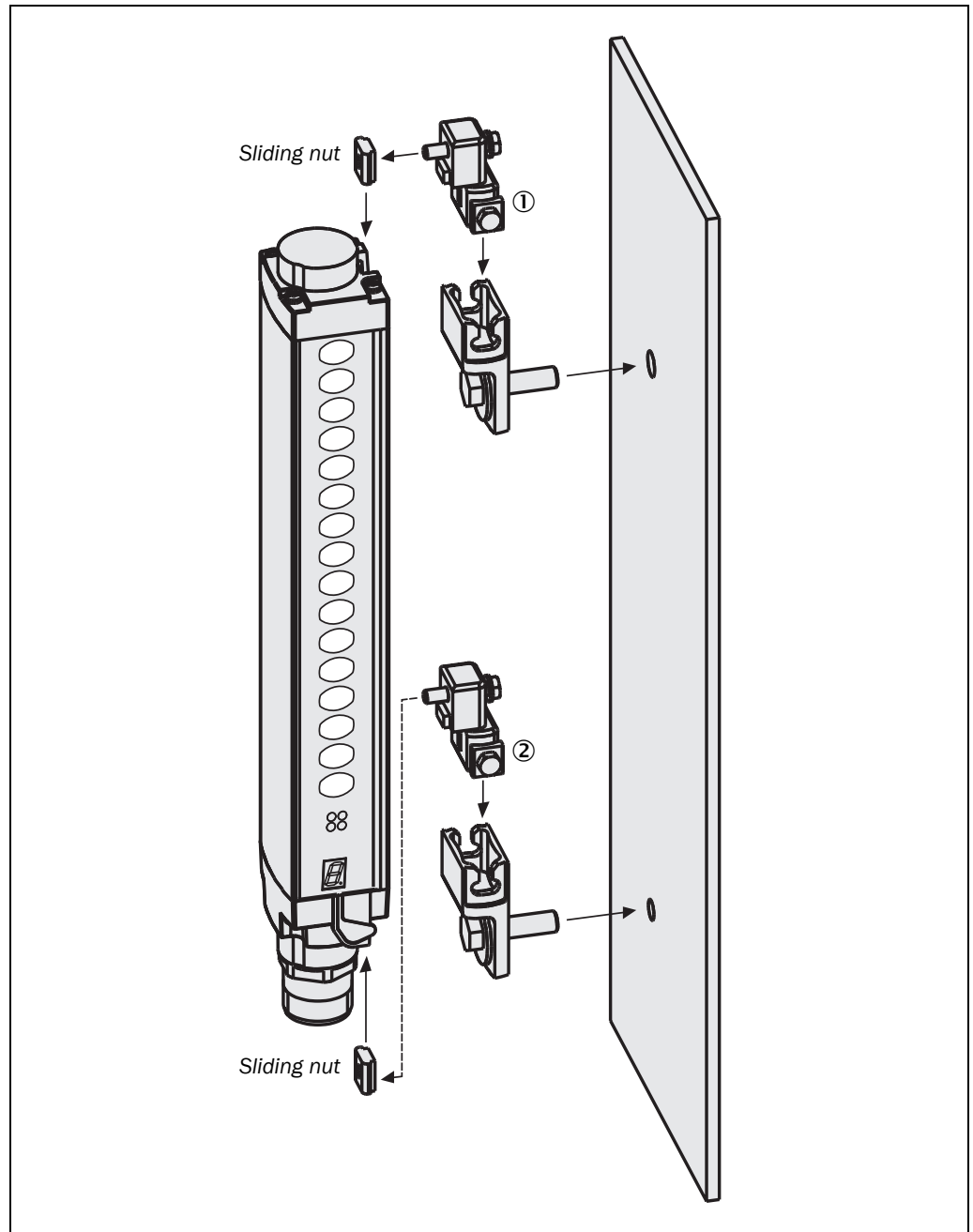
Fig. 44: Composition of the side bracket



- Notes**
- Attach the bolts of the side bracket with a torque of between 5 and 6 Nm. Higher torques can damage the bracket; lower torques provide inadequate protection against vibration.
 - Pay attention to the position and distance between the sliding nuts during mounting as described in section 12.5 “Dimensional drawings” on page 103.

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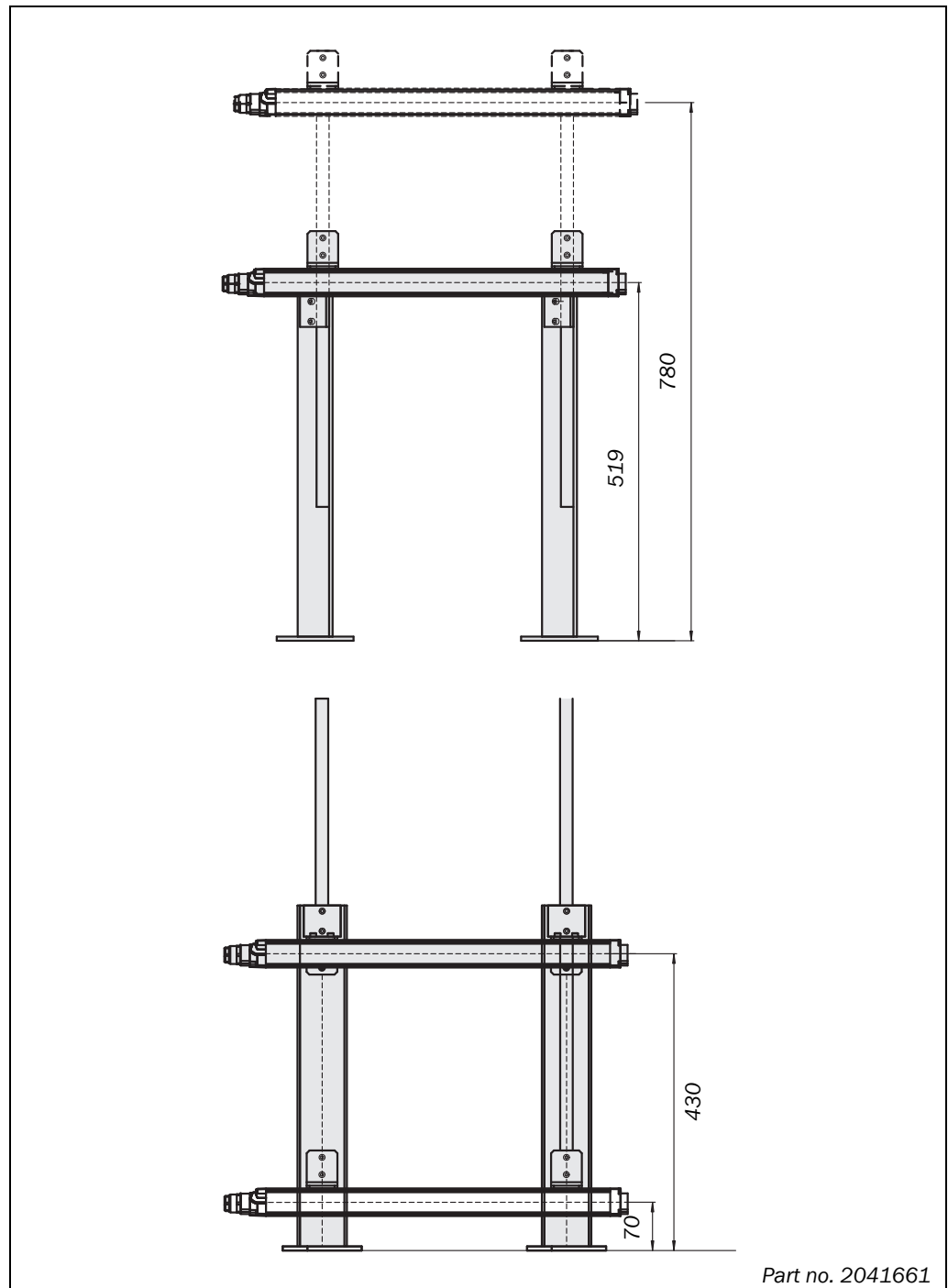
Fig. 45: Mounting the C4000
with side bracket



- Notes**
- When mounting the side bracket ensure that the bolts marked ① and ② remain accessible, allowing you later to adjust and lock the safety light curtain in position.
 - If you wish to use the additional front screen (see “Additional front screen (weld spark guard)” on page 115), make sure that the curved side of the device remains accessible after mounting.

6.4.3 Fastening with floor stands

Fig. 46: Mounting with floor stands



Floor stands are suitable for mounting the C4000 horizontally. Depending on the mounting method, in this way you can realise mounting heights from 70 to 430 or 519 to 780 mm.

7 Electrical installation



WARNING

Switch the entire machine/system off line!

The machine/system could unintentionally start up while you are connecting the devices.

- Ensure that the entire machine/system is disconnected during the electrical installation.

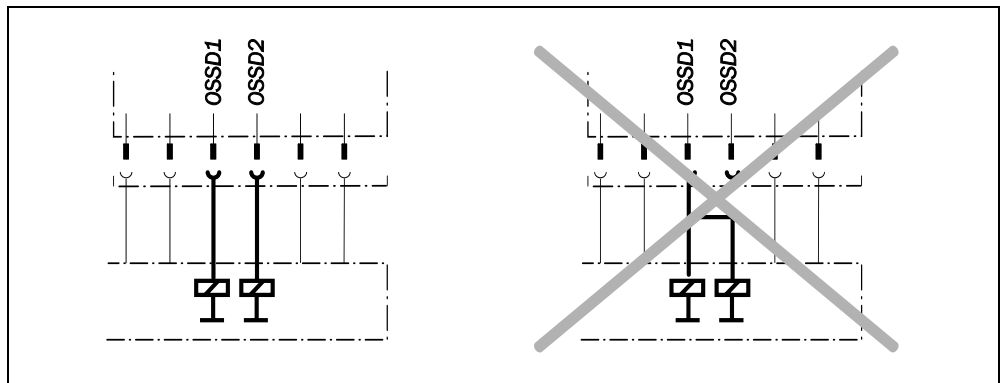
Ensure that downstream contactors are monitored!

Downstream contactors must be positively guided and monitored (see section 7.4 “External device monitoring (EDM)” on page 77)!

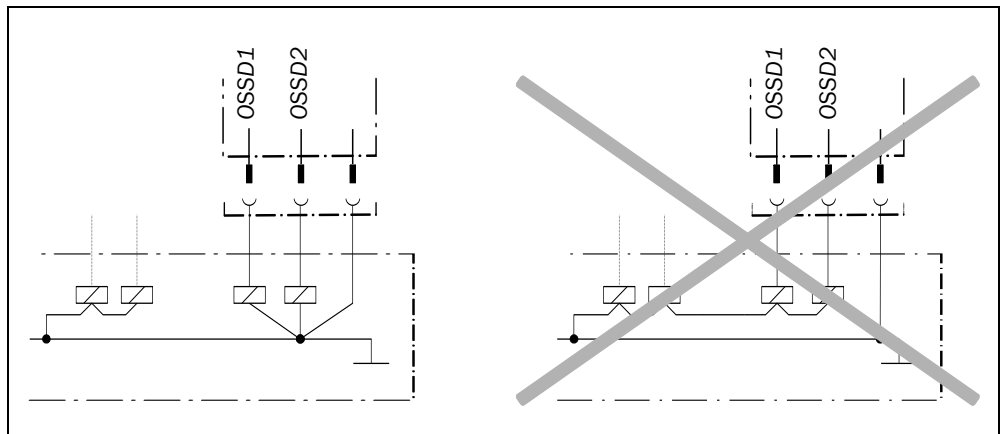
Connect OSSD1 and OSSD2 separately!

You are not allowed to connect OSSD1 and OSSD2 together, otherwise signal safety will not be ensured.

- Ensure that the machine controller processes the two signals separately.



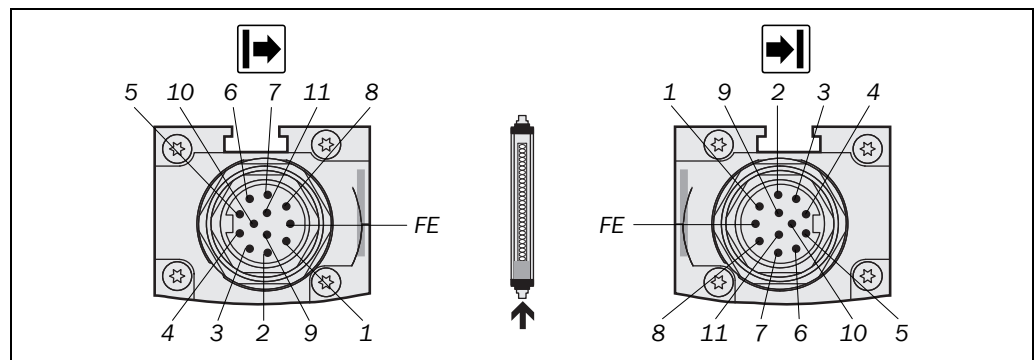
- If you connect loads that are not protected against reverse polarity to the OSSDs or to the safety outputs, then you must connect the 0 V connections of these loads as well as the 0 V connections of the related protective device separately and directly to the same 0 V terminal strip. Only in this way will it be ensured that in case of a fault there is no potential difference between the 0 V connections of the loads and the 0 V connections of the related protective device.



- Notes**
- The C4000 safety light curtain meets the interference suppression requirements (EMC) for industrial use (interference suppression class A). When used in residential areas it can cause interference.
 - To ensure full electromagnetic compatibility (EMC), functional earth (FE) must be connected.
 - To meet the requirements of the relevant product standards (e.g. IEC 61496-1), the external voltage supply for the devices (SELV) must be able to withstand a brief mains failure of 20 ms as required by EN 60204-1. The power supply must provide safe mains isolation (SELV/PELV) and have a current limit of max. 8 A. Suitable power supplies are available as accessories from SICK (see section 13.5 “Accessories” on page 116).

7.1 System connection M26 × 11 + FE

Fig. 47: Pin assignment
system connection
M26 × 11 + FE



Tab. 18: Pin assignment
system connection
M26 × 11 + FE

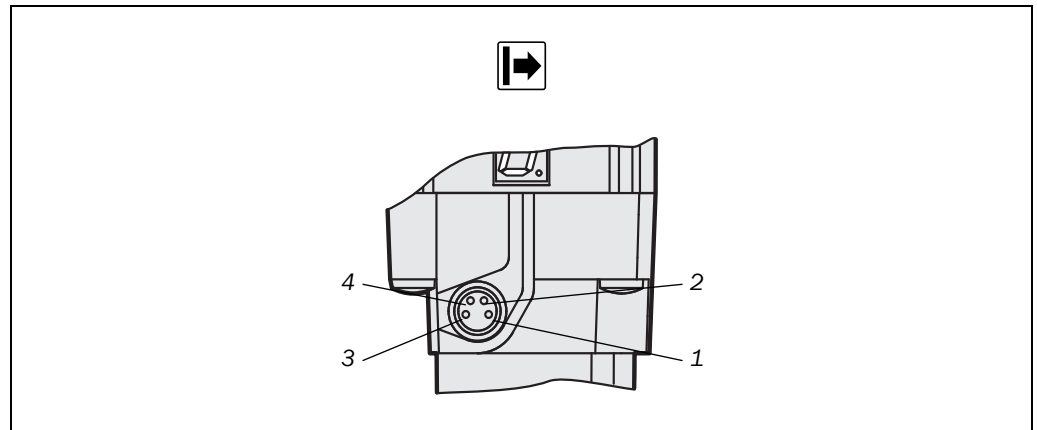
Pin	Wire colour	Sender	Receiver
1	Brown	24 V DC input (voltage supply)	24 V DC input (voltage supply)
2	Blue	0 V DC (voltage supply)	0 V DC (voltage supply)
3	Grey	Test input: 0 V: external test active 24 V: external test inactive	OSSD1 (output signal switching device 1)
4	Pink	Reserved	OSSD2 (output signal switching device 2)
5	Red	Reserved	Reset/restart
6	Yellow	Reserved	External device monitoring (EDM)
7	White	Reserved	Application diagnostic output (ADO)
8	Red/blue	Reserved	Output <i>Reset required</i>
9	Black	Device communication (EFI _A)	Device communication (EFI _A)
10	Purple	Device communication (EFI _B)	Device communication (EFI _B)
11	Grey/pink	Reserved	Reserved
FE	Green	Functional earth	Functional earth

- Notes**
- For the connection of pin 9 and 10 only use cable with twisted cores, e.g. the SICK connection cables available as accessories (see section 13.5 “Accessories” on page 116).
 - If you do not use either a SICK switching amplifier or a SICK bus node, to improve the EMC behaviour we recommend the termination of the connections pin 9 and 10 (device communication EFI) on the system connection in the control cabinet using a resistor of 182 Ω (SICK part number 2027227).

**C4000 Palletizer Std./Adv.
C4000 Fusion**

Fig. 48: Pin assignment of the configuration connection M8 × 4

7.2 Configuration connection M8 × 4 (serial interface)



Tab. 19: Pin assignment of the configuration connection M8 × 4

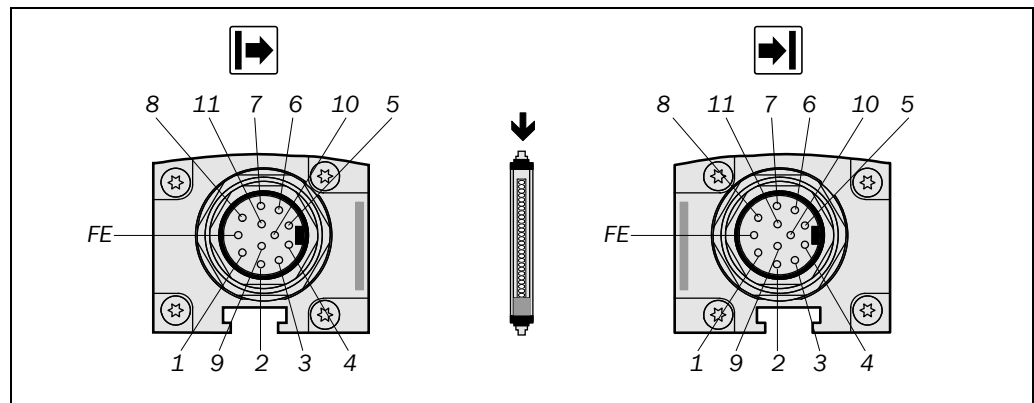
Pin	☒ Sender/☒ Receiver	PC-side RS-232-D-Sub
1	Not assigned	
2	RxD	Pin 3
3	0 V DC (voltage supply)	Pin 5
4	TxD	Pin 2

Notes The pin assignment of sender and receiver is identical.

- After configuration always remove the connecting cable from the configuration connection!
- After the configuration of the device has been completed, locate the attached protection cap to cover the configuration connection.

7.3 Extension connection M26 × 11 + FE

Fig. 49: Pin assignments for extension connection M26 × 11 + FE



Tab. 20: Pin assignments for extension connection M26 × 11 + FE

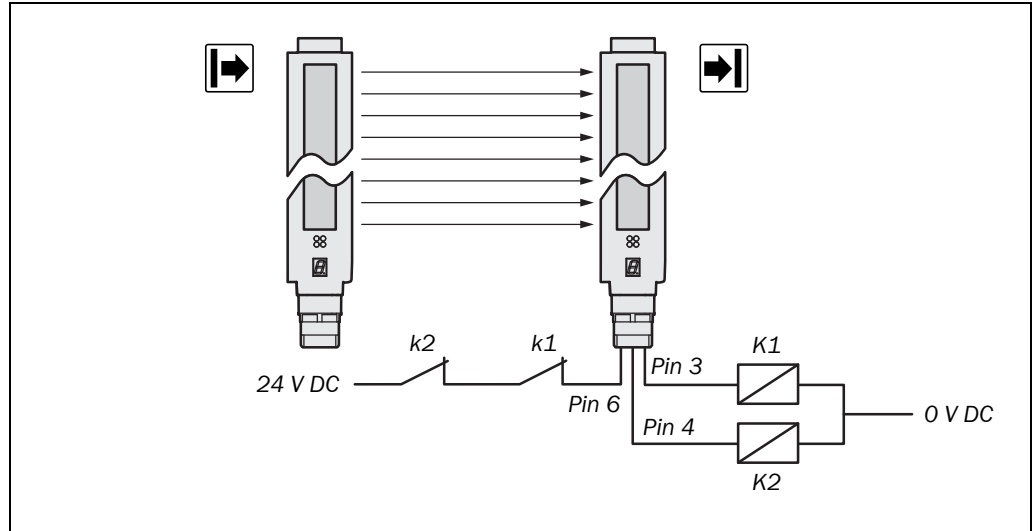
Pin	Wire colour	☑ Sender	☑ Receiver
1	Brown	24 V DC output (voltage supply)	24 V DC output (voltage supply)
2	Blue	0 V DC (voltage supply)	0 V DC (voltage supply)
3	Grey	Reserved	Input emergency stop 1/bypass
4	Pink	Reserved	Input emergency stop 2/bypass/teach-in
5	Red	Reserved	Reset/restart
6	Yellow	Reserved	Test output emergency stop 2/bypass/output photoelectric switch 2/teach-in
7	White	Reserved	Test output emergency stop 1/bypass/output photoelectric switch 1
8	Red/blue	Reserved	Output <i>Reset required</i>
9	Black	Device communication (EFI _A)	Device communication (EFI _A)
10	Purple	Device communication (EFI _B)	Device communication (EFI _B)
11	Grey/pink	Reserved	Reserved
FE	Green	Functional earth	Functional earth

- Notes**
- The plug alignment (rotational position) in the housing may vary from device to device. You can identify the correct pin assignment by the position of the pins in relation to each other as shown in the drawings.
 - If you do not connect any further safety light curtain to an extension connection, then you must also not connect any cable to pins 9 and 10.
 - If the extension connection is no longer required, always screw the attached protective cap over the extension connection.

7.4 External device monitoring (EDM)

The EDM checks if the contactors actually de-energize when the protective device is tripped. If, after an attempted reset, the EDM does not detect a response from the switched device within 300 ms, the EDM will deactivate the OSSDs again.

Fig. 50: Connecting the contact elements to the EDM



You must implement the external device monitoring electrically by the positively guided closing action of both N/C contacts (k1, k2) when the contact elements (K1, K2) reach their de-energized position after the protective device has responded. 24 V is then applied at the input of the EDM. If 24 V is not present after the response of the protective device, then one of the contact elements is faulty and the external device monitoring prevents the machine starting up again.

Notes



- If you connect the contact elements to be monitored to the EDM input, then you must activate the option **EDM** in the CDS (Configuration & Diagnostic Software). If not, the device will show the error .
- If you later deselect the **EDM** option, pin 6 of the system plug must not remain connected to 24 V.

7.5 Reset button

In the protective operation with internal restart interlock (see page 28) the operator must first press the reset button before restarting.

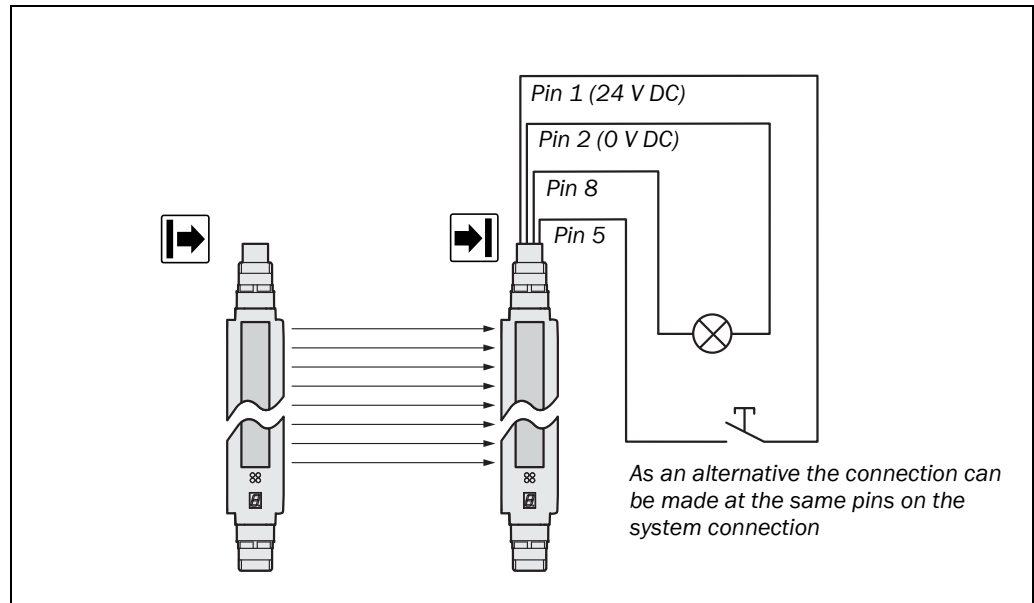


WARNING

Select the correct installation site for the reset button!

Install the reset button outside the hazardous area such that it cannot be operated from inside the hazardous area. When operating the reset button, the operator must have full visual command of the hazardous area.

Fig. 51: Connection of the reset button and the "Reset required" signal lamp to the extension connection



WARNING

Device configuration after replacement!

If you replace a safety light curtain with deactivated reset function with a replacement device, the reset function must again be deactivated via the software. It is not sufficient to make the electrical connections, because new devices are supplied ex factory always with activated reset function.

Connection of a signal lamp to the Reset required output

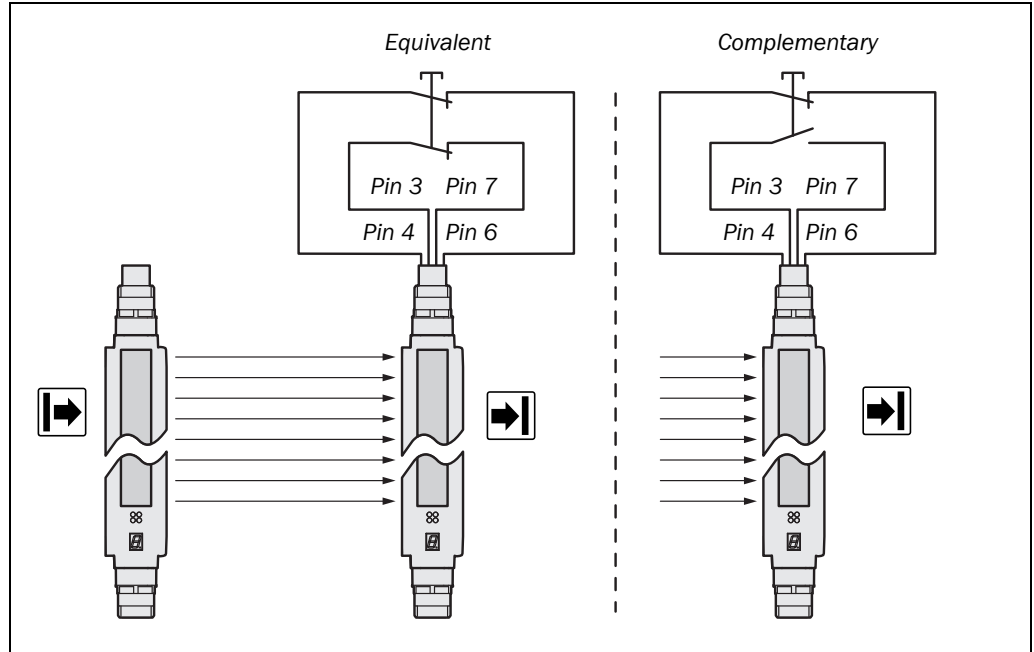
Pin 8 of the system plug is the *Reset required* output (24 V). You can connect a signal lamp here to indicate this status. The output has a frequency of 1 Hz.

7.6 Emergency stop

The emergency stop input has two channels. The emergency stop monitoring in the device corresponds to stop category 0 in accordance with EN ISO 13850. Switching off at the emergency stop input has the same effect as reaching into the protective field (see page 31). You can connect the emergency stop input e.g. to a door switch.

The emergency stop can be connected instead of the key-operated pushbutton for bypass and to the same connections as the key-operated pushbutton for bypass.

Fig. 52: Possible connection methods for a door switch or similar to the emergency stop input



You can design the dual-channel button as equivalent (N/C / N/C) or complementary (N/O / N/C). You must configure the C4000 as appropriate with the aid of the CDS. If the configuration and the electrical connection do not match, the system locks completely (lock-out). The 7-segment display will then show the error message

Note If you connect an emergency stop to the C4000, it is not possible to connect a bypass, as it needs the same connections.



You must configure the connection layout for the emergency stop (equivalent/complementary) with the aid of the CDS.



WARNING

Device configuration after replacement!

If you replace a safety light curtain with the emergency stop function activated, then you must transfer the configuration again to the new device. It is not sufficient to make the electrical connections, because new devices are supplied ex factory with deactivated emergency stop function.

7.7 Key-operated pushbutton for bypass

The bypass function is only allowed to be activated as follows:

- using a key-operated pushbutton with automatic return and two positions
- using two independent input signals, e.g. two position switches or two safe PLC signals

The key-operated pushbutton for bypass is connected to the same connections as the emergency stop instead of the emergency stop. You can design it also as equivalent (N/C / N/C) or complementary (N/O / N/C). See section 7.6 “Emergency stop” on page 79.

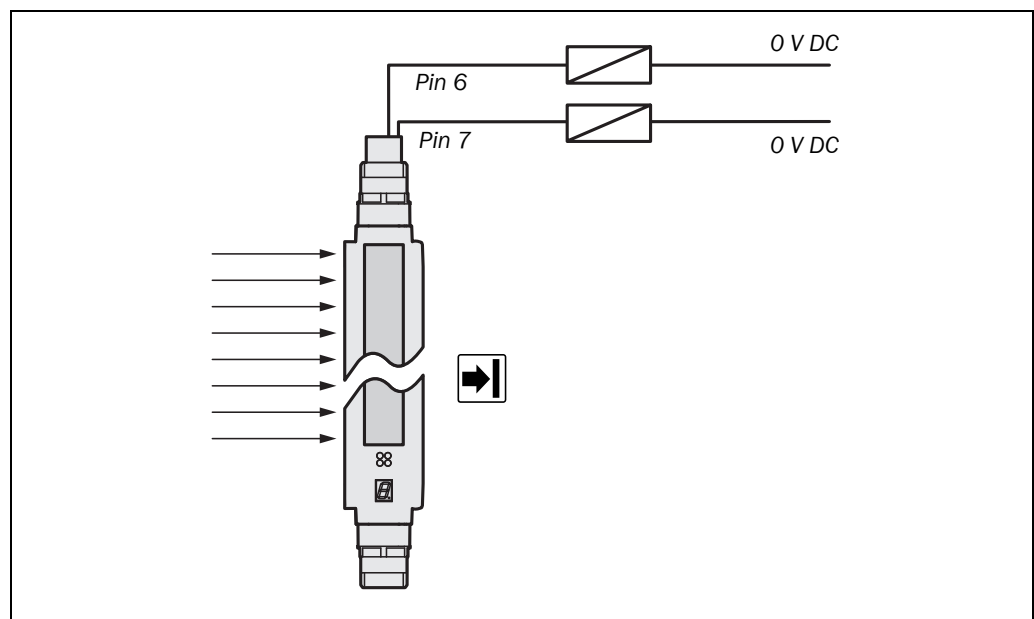
- Notes**
- Mount the key-operated pushbutton for bypass in such a way that the hazardous point is completely visible when the key-operated pushbutton is used.
 - The key-operated pushbutton for bypass must have volt-free contacts.
 - If you connect the key-operated pushbutton for bypass to the C4000, then it is not possible to connect an emergency stop, as it needs the same connections.
 - You must configure the switching mode of the key-operated pushbutton for bypass to comply with the selected switch type (N/C / N/O or N/O / N/O) with the aid of the CDS.



7.8 Outputs for the virtual photoelectric switches

Pin 6 and 7 on the extension connection on the receiver are the outputs for the virtual photoelectric switches. You can use these outputs for a PLC.

Fig. 53: Connection of the virtual photoelectric switches

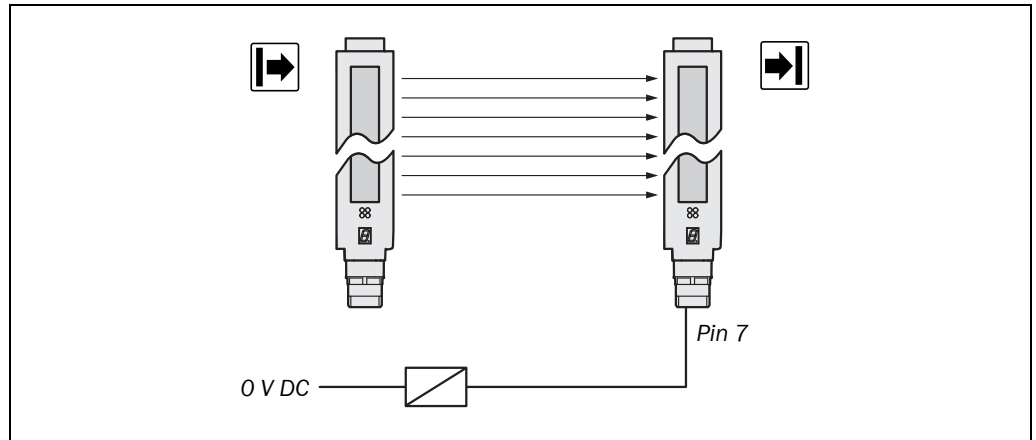


If you connect the outputs of the virtual photoelectric switches, then you must configure them with the aid of the CDS prior to commissioning.

7.9 Application diagnostic output (ADO)

Pin 7 on the system plug is a signal output (ADO). You can use this output for a relay or a PLC.

Fig. 54: Connection to the application diagnostic output



If you connect the signal output, then you must configure it with the aid of the CDS prior to commissioning.



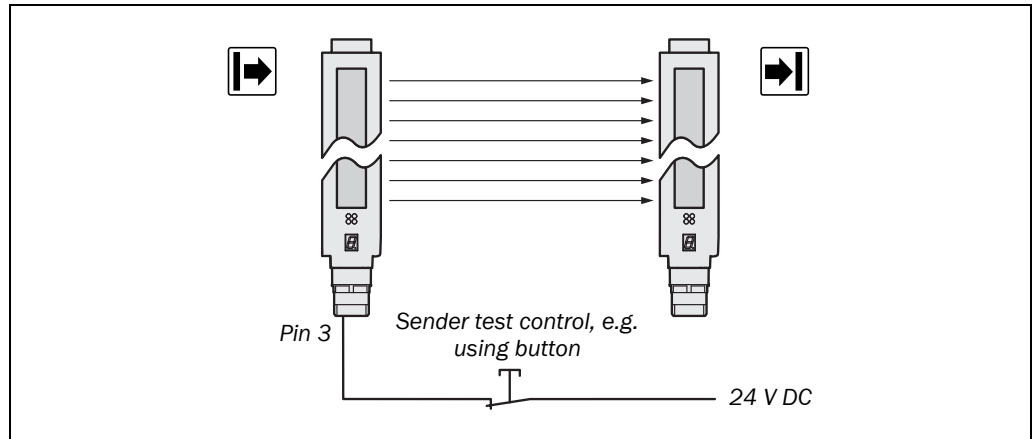
WARNING

Device configuration after replacement!

If you replace a safety light curtain on which the signal output (ADO) is connected, then you must transfer the configuration to the device again. It is not sufficient to make the electrical connections, because new devices are supplied ex factory with the signal output deactivated.

7.10 Test input (sender test)

Fig. 55: Connection of the sender test button



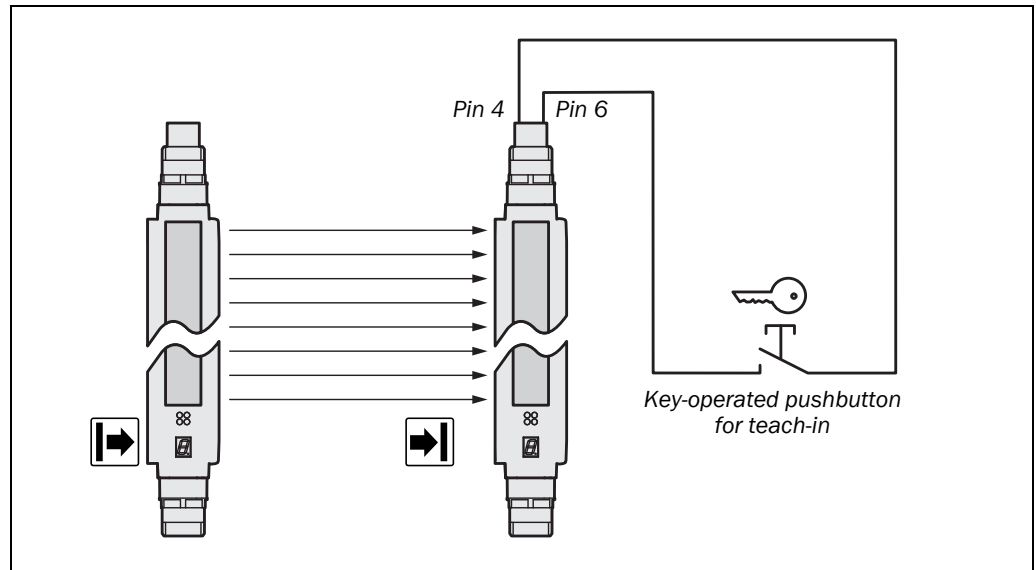
The sender test is performed when 0 V is present at the test input (pin 3).



To be able to use the sender test button, you must also configure the sender test function with the aid of the CDS.

7.11 Key-operated pushbutton for teach-in

Fig. 56: Connection of a key-operated pushbutton for teach-in



- Notes**
- Instead of the key-operated pushbutton for teach-in a comparable tamper-proof device, e.g. an MMI (Man-Machine-Interface) with password protection can be connected.
 - If you connect a key-operated pushbutton for teach-in to the C4000, then you can no longer use the emergency stop function or the bypass function in the C4000.
 - Ensure that only authorised persons have access to the teach-in key.

8 Commissioning



WARNING

Commissioning requires a thorough check by qualified safety personnel!

Before you operate a system protected by the C4000 safety light curtain for the first time, make sure that the system is first checked and released by qualified safety personnel. Please read the notes in chapter 2 “On safety” on page 9.

8.1 Display sequence during switching on

After the system is activated, sender and receiver go through a power-up cycle. The 7-segment display indicates the device status during the power-up cycle.

The display values have the following meaning:

Tab. 21: Displays shown during the power-up cycle

Display	Meaning
	Testing the 7-segment display. All segments are activated sequentially.
	Approx. 0.5 s. Is displayed only at the receiver and only in operation with large scanning range.
	approx. 0.5 s. Non-coded operation or operation with code 1 or 2.
	The device is operational. The indication appears if the device has detected an object in the protective field on switch on.
	Receiver only: Receiver-sender alignment is not optimal (see “Aligning sender and receiver” further below).
Other display	Device error. See “Fault diagnosis” on page 91.

8.2 Aligning sender and receiver

After the safety light curtain has been mounted and connected, sender and receiver must be aligned in relation to each other. The light beams emitted by the sender must hit the receiver accurately.

How to align sender and receiver in relation to each other:



WARNING

Secure the plant/system. No dangerous movement possible!

Ensure that the dangerous state of the machine is (and remains) switched off! During the alignment process, the outputs of the safety light curtain are not allowed to have any effect on the machine.

- Loosen the clamping bolts which hold the safety light curtain in place.
- Switch on the power supply to the safety light curtain.
- Important for problem-free operation is the alignment of all axes:
Place the AR60 at the start and end of the device in succession. The laser point is incident on the “Receiver/Sender” text on the opposite device or in the hole on the second mounting bracket that is also to be fitted to the device.
- Watch the alignment information on the 7-segment display of the receiver (see Tab. 22). Correct the alignment of the sender and receiver, until the 7-segment display goes off.

- Using the clamping bolts, fix the safety light curtain in place.
- Switch the power supply off and then back on again and check via the 7-segment display whether the alignment is correct after tightening the clamping bolts (Tab. 22).

The display values have the following meaning:

Tab. 22: Display values during the alignment of sender and receiver

Display	Meaning
	The receiver cannot synchronise with the sender; the alignment is very poor.
	Some light beams do not hit the receiver.
	All the light beams hit the receiver, but the alignment is still slightly off.
	The alignment is now true; the devices must be locked in this position. The indication appears when the device has detected an object in the protective field, otherwise is indicated.

- Notes**
- If the optimum alignment (= no display) persists for longer than 2 minutes without the protective field being interrupted, the system deactivates the alignment mode.
 - If you wish to readjust the alignment later, switch the power supply of the C4000 off and back on again.

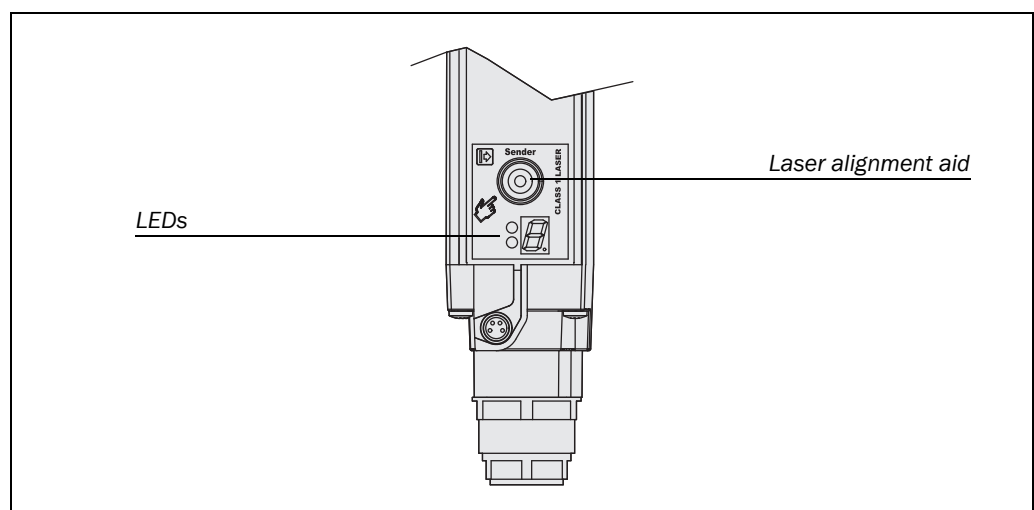
Recommendation For aligning the sender and receiver of the C4000 Palletizer use the AR60 laser alignment aid. For aligning the sender and receiver of the C4000 Fusion use the integrated AR60 laser alignment aid.

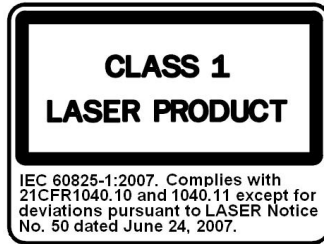
8.2.1 Alignment of the C4000 Fusion with integrated laser alignment aid

The C4000 Fusion contains an internal, collimated, visible class 1 laser to help you during the alignment of the sender and receiver units. The laser for the alignment of the sender in relation to the receiver is in the sender unit. Further adjustments should be made on the receiver unit until the system is correctly aligned.

You will find a sensor button for activating the laser near the LEDs in the sender unit for C4000 Fusion. Touch the sensor for longer than 0.25 seconds. Then the laser illuminates for seven (7) minutes. If the sensor is touched again the laser is switched off.

Fig. 57: Laser alignment aid of the C4000 Fusion



**C4000 Palletizer Std./Adv.
C4000 Fusion**


The laser alignment aid for the C4000 is classified as a class 1 laser. Additional measures for screening the laser radiation are not necessary. The laser warning label is part of the information on the type label on the rear of the C4000 Fusion sender immediately above the system end cap.

This device complies with the standard CDRH 21 CFR 1040.10 as well as EN 60825-1. There the following note is required: "Caution – use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure!"

Note



The laser is used to align the optics for a single sender and receiver pair.


WARNING
Do not look into the laser outlet opening!

The laser alignment aid on the C4000 Fusion sender unit is classified as class 1 (safe for the eyes) in accordance with the applicable standards. Nevertheless, as for any source that radiates energy (e.g. light), extended direct action by the laser light may damage your sight.

The laser alignment aid in conjunction with the indications on the 7-segment display enables you to precisely adjust and align the C4000 Fusion. The laser alignment aid must be activated manually.

How to align the C4000 Fusion with the aid of the integrated alignment aid:

- Check with a spirit level whether the devices are mounted vertically or horizontally.
- Check whether the following points are the same distance from the floor:
 - first beam of the sender
 - first beam of the receiver
- Loosen the clamping bolts which hold sender and receiver in place.
- Activate the laser alignment aid by placing a finger on the laser in the sender.
- Rotate the sender until the alignment beam is incident in the centre of the receiver.
- Watch the alignment information on the 7-segment display of the receiver. The optimal alignment of the beam near the 7-segment display is achieved when  or  appears on the 7-segment display.
- Then fix sender and receiver.

8.3 Test notes

Check the protective device as described below and in accordance with the applicable standards and regulations.

These tests are also used to identify if the protection is affected by external light sources or other unusual ambient effects.

These tests must therefore always be performed.

8.3.1 Tests before the initial commissioning

- Check the effectiveness of the protective device mounted to the machine, using all selectable operating modes as specified in the checklist in the annex (see 14.2 on page 119).
- Ensure that the operating personnel of the machine protected by the safety light curtain are correctly instructed by qualified safety personnel before being allowed to operate the machine. Instructing the operating personnel is the responsibility of the machine owner.
- Annex 14.2 to this document includes a checklist for review by the manufacturer and OEM. Use this checklist as a reference before commissioning the system for the first time.

8.3.2 Regular inspection of the protective device by qualified safety personnel

- Check the system following the inspection intervals specified in the national rules and regulations. This procedure ensures that any changes on the machine or manipulations of the protective device after the initial commissioning are detected.
- If any modifications have been made to the machine or the protective device, or if the safety light curtain has been changed or repaired, the system must be checked again as specified in the checklist in the annex.

8.3.3 Daily functional checks of the protective device

The effectiveness of the protective device must be checked daily by a specialist or by authorised personnel, using the correct test rod.

Note Always test along the complete hazardous area to be protected, never solely at the mounting position of the safety light curtain.



WARNING

Do not operate the machine if the red LED does not light up during the test!

If the red LED does not light up *during the test*, work must stop at the machine. In this case the mounting and the configuration of the safety light curtain must be checked by qualified safety personnel (see chapter 6).

- *Before* interrupting the protective field or *before* inserting the test rod, check that the green LED is lit if the internal restart interlock is deactivated and that the yellow LED is flashing if the internal restart interlock is activated (“Reset required”). If this is not the case, ensure that this condition is reached. The test is otherwise meaningless.

How to check the effectiveness and correct function of the safety light curtain in horizontal applications:

- The output signal switching devices on the safety light curtain must shut off once every 24 hours, i.e. the LEDs must illuminate red. For this purpose interrupt the protective field from the top, in the middle, not in the entry or exit area. In this case the brief illumination of the red LEDs indicates the shut down of the OSSDs.
- It is not necessary to test individual beams.

**C4000 Palletizer Std./Adv.
C4000 Fusion**
How to check the effectiveness and correct function of the safety light curtain in vertical applications:

- Select the correct test rod depending on device resolution. By means of the configuration, the entire system or individual areas can have an *effective resolution* that is different to the *physical resolution*, e.g. in case of blanking or reduced resolution. In this case you must select the test rod to suit the effective resolution. The effective resolution is described with the related function in chapter 4.

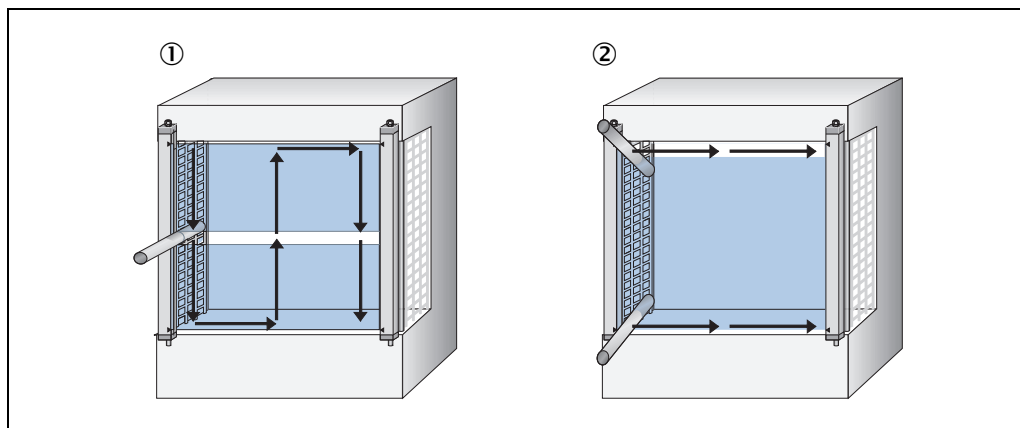
Example: – physical resolution 20 mm
 – operation with resolution reduced by 1 beam
 – effective resolution 30 mm

Use the test rod for a resolution of 30 mm.

- Move the test rod slowly through the area to be protected, as shown under ① in Fig. 58.
- Then, guide the test rod along the edges of the area to be protected as shown under ② in Fig. 58. This procedure allows you to test if the reaching behind protection/presence detection is functioning correctly (see 6.4 “Steps for mounting the device” on page 67).
- If you use one or more deflector mirrors (e.g. PNS), then also guide the test rod slowly through the area to be protected directly in front of the mirrors.
- If you are using the blanking function, then this will divide the protective field into multiple sub-areas (see section 5.6 “Fixed blanking” on page 52). In such cases, check **all sub-areas to be protected**.

Note During all tests, only the red LED is allowed to illuminate on the C4000 receiver.

Fig. 58: Daily checks of the protective device



9 Configuration

9.1 Default delivery status

As delivered the C4000 is configured as follows:

- restart interlock: Internal
- external device monitoring (EDM): Deactivated
- multiple sampling: 2 times

C4000 Palletizer Standard

- goods detection
 - object size: 500 mm to protective field length – 150 mm
- object size monitoring
- scanning range: 0.5-6 m
- reduced resolution: 2 beams
- beam coding: Code 1

C4000 Palletizer Advanced

- pallet detection
 - 2-5 objects
 - maximum object size 240 mm
- reduced resolution: 3 beams
- scanning range: 0.5-6 m
- beam coding: Code 1

C4000 Fusion

- protective operation
- reduced resolution: none
- scanning range: 1.5-6 m
- beam coding: Code 1



WARNING

Check the functions configured prior to commissioning!

Check whether the functions configured as delivered match the requirements for your application. Change the functions with the aid of the CDS if necessary.

9.2 Preparing the configuration

How to prepare the configuration:

- Ensure that the safety light curtain has been correctly mounted and that the electrical connections are correct and in place.
- Plan all the necessary adjustments (operating modes, beam coding, resolution, etc.).

To configure the safety light curtain, you need:

- CDS (Configuration & Diagnostic Software) on CD-ROM
- user manual for CDS on CD-ROM
- PC/Notebook with Windows 9x/NT 4/2000 Professional/XP/Vista and a serial interface (RS-232). PC/Notebook not included
- connecting cable between PC and C4000 (SICK part no. 6021195)
You may need a USB to RS-232 adapter for your notebook. This adapter is available as an accessory from SICK: UC-232 A (SICK part no. 6035396).
- To configure the device, please read the user manual for the CDS (Configuration & Diagnostic Software) and use the online help function of the programme.

10 Care and maintenance

The C4000 safety light curtain is maintenance-free. The front screen of the C4000 safety light curtain and any additional front screen(s) (see “Additional front screen (weld spark guard)” on page 115) should be cleaned at regular intervals and when dirty.

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

Note Static charges cause dust particles to be attracted to the front screen. You can prevent this effect by using the antistatic plastic cleaner (SICK part number 5600006) and the SICK lens cloth (part number 4003353).

How to clean the front screen and/or the additional front screen (accessories):

- Use a clean and soft brush to remove dust from the front screen.
- Now wipe the front screen with a clean and damp cloth.

Note ➤ After cleaning, check the position of sender and receiver to ensure that the protective device cannot be bypassed (reaching over, reaching under or standing behind).

➤ Check the effectiveness of the protective device as described in section 8.3 “Test notes” on page 85.

11 Fault diagnosis

This chapter describes how to identify and rectify errors and malfunctions during the operation of the safety light curtain.

Recommendation You can speed up the fault diagnosis of some frequent faults by checking the status of the signal output on the safety light curtain on the occurrence of the fault. Instructions can be found in chapter 4.5 “Application diagnostic output (ADO)” on page 33.

11.1 In the event of faults or errors



WARNING

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

Stop the machine if you cannot clearly identify or allocate the error and if you cannot safely rectify the malfunction.

The system status lock-out

In case of certain faults or an erroneous configuration, the system can go into the lock-out system status. The 7-segment display on the safety light curtain then indicates , , , or . To place the device back in operation:

- Rectify the cause of the fault as per Tab. 24.
- Switch the power supply for the C4000 off and back on again (e.g. by unplugging the system plug and reinserting it).

11.2 SICK support

If you cannot rectify an error with the help of the information provided in this chapter, please contact your local SICK representative.

11.3 Error displays of the diagnostics LEDs

This chapter explains the meaning of the error displays of the LEDs and how to respond. You will find a description of the LEDs in chapter 3.3 “Status indicators” on page 24.




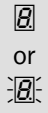






Tab. 23: Error displays of the LEDs

Display	Possible cause	Rectification of the error
● Orange LED of receiver lights up	Weak signal	<ul style="list-style-type: none"> ➤ Check the alignment of sender and receiver. ➤ Check the front screen for contamination and clean, if necessary.
● Yellow LED of receiver flashes	Reset required	<ul style="list-style-type: none"> ➤ Press the reset button.
○ Yellow LED of sender fails to light up ○ Red and ○ Green Neither the red nor the green receiver LED lights up	No operating voltage, or voltage too low	<ul style="list-style-type: none"> ➤ Check the voltage supply and activate, if necessary.













11.4 Error displays of the 7-segment display





This section explains the meaning of the error displays of the 7-segment display and how to respond to the messages. Please refer to chapter 3.3 "Status indicators" on page 24 for a description of the 7-segment display.

Tab. 24: Error displays of the 7-segment display

Display	Possible cause	Rectification of the error
	Inadequate alignment	<ul style="list-style-type: none"> ➤ Re-align sender and receiver (see page 83). The display goes off after 2 minutes.
	Configuration incomplete	<ul style="list-style-type: none"> ➤ The display goes off automatically once the configuration has been successfully transferred. If the display  does not go off: <ul style="list-style-type: none"> ➤ Check the configuration of the system using the CDS (Configuration & Diagnostic Software). ➤ Re-transfer the corrected configuration to the system.
	EDM error	<ul style="list-style-type: none"> ➤ Check the contactors and their wiring, eliminate any wiring errors, if necessary. ➤ If  is displayed, switch the device off and back on again.
	Fault in the reset button or in its operation	<ul style="list-style-type: none"> ➤ Check the reset button for correct function. The button may be defective or stuck. ➤ Check whether the reset button has been pressed, before reset was required. ➤ Check the wiring of the reset button for any short-circuit to 24 V.
	The configuration of the connected switching amplifier (e.g. UE402) is incorrect	<ul style="list-style-type: none"> ➤ Configure the switching amplifier connected with the aid of the CDS. ➤ Check the connection from the C4000 to the switching amplifier.
	Several operating modes configured, but none selected	<ul style="list-style-type: none"> ➤ Check the connection and the function of the operating mode selector switch. ➤ Check the connection for the operating mode selector switch on the switching amplifier.
	Several operating modes selected simultaneously	<ul style="list-style-type: none"> ➤ Check the connection and the function of the operating mode selector switch. ➤ Check the connection for the operating mode selector switch on the switching amplifier for a short-circuit.
	Un-configured operating mode selected	<ul style="list-style-type: none"> ➤ Configure the operating mode set on the operating mode selector switch, or ensure that this operating mode cannot be selected.

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Display	Possible cause	Rectification of the error
	Key-operated pushbutton for bypass malfunctioning or invalid configuration	<ul style="list-style-type: none"> ➤ Check whether the configuration of the key-operated pushbutton for bypass in the CDS matches the electrical connection. ➤ Check the function of the key-operated pushbutton for bypass and replace it if necessary. ➤ Ensure that both contacts on the key-operated pushbutton for bypass are pressed within 2 seconds.
	Short-circuit at the operating mode selector switch	<ul style="list-style-type: none"> ➤ Check the operating mode inputs on the switching amplifier connected for short-circuit to 24 V.
	System error	<ul style="list-style-type: none"> ➤ Replace the unit (receiver or sender).
	The connected switching amplifier (e.g. UE402) is faulty	<ul style="list-style-type: none"> ➤ Interrupt the supply of power to the C4000 and to the switching amplifier for at least 3 seconds. ➤ If the problem is still present, then replace the switching amplifier.
	Overcurrent at output signal switching device 1	<ul style="list-style-type: none"> ➤ Check the contactor. Replace, if necessary. ➤ Check the wiring for short-circuits.
	Short-circuit at output signal switching device 1	
	Short-circuit at output signal switching device 1	
	Overcurrent at output signal switching device 2	
	Short-circuit at output signal switching device 2	
	Short-circuit at output signal switching device 2	
	Short-circuit between output signal switching device 1 and 2	
	Fault on the emergency stop button or the key-operated pushbutton for bypass	<ul style="list-style-type: none"> ➤ Check whether the configuration of the emergency stop button or the key-operated pushbutton for bypass in the CDS matches the electrical connection. ➤ Check whether the emergency stop button or the key-operated pushbutton for bypass is functional.

Display	Possible cause	Rectification of the error
	Invalid configuration of the EDM	➤ Verify that the machine-side EDM is connected correctly.
	External sender detected	<ul style="list-style-type: none"> ➤ Check the distance from reflective surfaces (see page 66) or from other safety light curtains. ➤ If necessary, re-configure the device with another beam coding (see page 35) or install non-reflective partitions.
	Supply voltage too low	➤ Check the supply voltage and the power supply. If necessary, replace defective components.
	Fault of a device connected via EFI	➤ Carry out a fault diagnosis of the device connected with the C4000.

11.5 Extended diagnostics

The CDS software supplied with the device (Configuration & Diagnostic Software) includes extended diagnostic options. It allows you to narrow down the problem if the error is non-specific or if you experience usage downtime problems. Detailed information to be found ...

- in the online help for the CDS.
- in the user manual for the CDS.

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12 Technical specifications

12.1 Data sheet

Tab. 25: Data sheet C4000

	Minimum	Typical	Maximum
General system data			
Protective field length, depending on type	300 mm to 1800 mm		
Resolution, depending on type	20 mm, 30 mm or 40 mm		
Protective field width			
C4000 Fusion	1.5-19 m	1.5-21 m ⁶⁾	
C4000 Palletizer	0.5 -6 m	0.5-7 m ⁶⁾	
Protection class (EN 50 178) ⁷⁾	III		
Enclosure rating	IP 65 (EN 60 529)		
Supply voltage V_s on the device ⁸⁾	19.2 V	24 V	28.8 V
Residual ripple ⁹⁾			±10 %
Synchronisation	Optical, without separate synchronisation ¹⁰⁾		
Type	Type 4 (IEC 61 496-1)		
Category	Category 4 (EN ISO 13 849-1)		
Performance Level ¹¹⁾	PL e (EN ISO 13 849-1)		
Safety integrity level ¹¹⁾	SIL3 (IEC 61 508) SILCL3 (EN 62 061)		
PFHd (mean probability of a dangerous failure per hour)	1.50×10^{-8}		
T_M (mission time)	20 years (EN ISO 13 849)		
Power-up delay of sender and receiver before ready			8 s

⁶⁾ On the utilisation of this protective field width, it must be expected the orange LED will illuminate (cleaning or realignment required). The system then only has a reserve of 30%.

⁷⁾ Safety extra-low voltage SELV/PELV.

⁸⁾ To meet the requirements of the relevant product standards (e.g. IEC 61 496-1), the external voltage supply for the devices (SELV) must be able to withstand a brief mains failure of 20 ms as required by EN 60 204-1.

⁹⁾ Within the limits of V_s .

¹⁰⁾ During switching on with the aid of the first or last beam, after that with any beam.

¹¹⁾ For detailed information on the exact design of your machine/system, please contact your local SICK representative.

Minimum	Typical	Maximum
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Sender unit

Test input			
Input voltage ¹²⁾ HIGH (active)	11 V	24 V	30 V
Input current HIGH	7 mA	10 mA	20 mA
Switching voltage LOW (inactive)	-30 V	0 V	5 V
Input current LOW ¹²⁾	-3.5 mA	0 mA	0.5 mA
Response time to test	Depending on number of beams, maximum 150 ms		
Wavelength of sender		950 nm	
Power consumption			1 A
Laser of the alignment aid	Class 1 according to EN 60825-1 and 21 CFR 1040.10 und 1040.11 with the exception of deviations as per Laser Notice No. 50, June 24, 2007, optical output power $\leq 390 \mu\text{W CW}$ $\lambda_{\text{typically}} = 650 \text{ nm}$		
Weight	Depending on the protective field length (see page 102)		

¹²⁾ As per IEC 61131-2.

Minimum	Typical	Maximum
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Receiver

Output signal switching devices (OSSDs)	2 PNP semiconductors, short-circuit protected ¹³⁾ , cross-circuit monitored		
Response time	See section 12.2 on page 99		
Switch off time	100 ms		
Switch off time if self-teach dynamic blanking is configured	1000 ms		
Power-up delay		1.5 × response time	
Switching voltage ^{14) 15)} HIGH (active, U_{rms})	$V_S - 2.25 V$	24 V	V_S
Switching voltage ¹⁴⁾ LOW (inactive)	0 V	0 V	2 V
Switching current	0 mA		500 mA
Leakage current ¹⁶⁾			0.25 mA
Load capacity			2.2 μF
Switching sequence	Depending on load inductance		
Load inductance ¹⁷⁾			2.2 H
Test pulse data ¹⁸⁾			
Test pulse width	120 μs	150 μs	300 μs
Test pulse rate	3 $1/s$	5 $1/s$	10 $1/s$
Permissible cable resistance			
Between device and load ¹⁹⁾			2.5 Ω
Supply cable			1 Ω
Power consumption		0.6 A	1.8 A (<50 ms)
Contactors			
Permissible dropout time			300 ms
Permissible pick-up time			300 ms

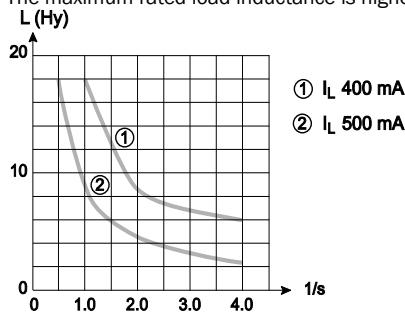
¹³⁾ Applies to the voltage range between -30 V and +30 V.

¹⁴⁾ As per IEC 61131-2.

¹⁵⁾ On the device plug.

¹⁶⁾ In the case of a fault (0 V cable open circuit) maximally the leakage current flows in the OSSD cable. The downstream controller must detect this status as LOW. A FPLC (fail-safe programmable logic controller) must be able to identify this status.

¹⁷⁾ The maximum rated load inductance is higher with lower switching sequence.



¹⁸⁾ When active, the outputs are tested cyclically (brief LOW). When selecting the downstream controllers, make sure that the test pulses do not result in deactivation when using the above parameters.

¹⁹⁾ Make sure to limit the individual cable resistance to the downstream controller to this value to ensure that a cross-circuit between the outputs is safely detected. (Also note EN 60204, Electrical Machine Equipment, Part 1: General Requirements).

	Minimum	Typical	Maximum
External device monitoring (EDM) input			
Input voltage ²⁰⁾ HIGH (inactive)	11 V	24 V	30 V
Input current HIGH	6 mA	10 mA	20 mA
Input voltage ²⁰⁾ LOW (active)	-30 V	0 V	5 V
Input current LOW	-2.5 mA	0 mA	0.5 mA
Control switch input (reset button)			
Input voltage ²⁰⁾ HIGH (active)	11 V	24 V	30 V
Input current HIGH	6 mA	10 mA	20 mA
Input voltage ²⁰⁾ LOW (inactive)	-30 V	0 V	5 V
Input current LOW	-2.5 mA	0 mA	0.5 mA
Actuating time control switch input	50 ms		
Output <i>Reset required</i> (24 V lamp output)			4 W/0.2 A
Switching voltage HIGH (active)	15 V	24 V	28.8 V
Switching voltage LOW (inactive)		high resistance	
Application diagnostic output (ADO)			
Switching voltage HIGH (active)	15 V	24 V	28.8 V
Switching voltage LOW (inactive)		high resistance	
Switching current	0 mA		100 mA
Outputs for the virtual photoelectric switches			
Switching voltage HIGH (active)	15 V	24 V	28.8 V
Switching voltage LOW (inactive)		high resistance	
Switching current	0 mA		100 mA
Emergency stop/bypass			
Changeover time			2 s
Latency time			200 ms
Cable resistance			30 Ω
Cable capacitance			10 nF
Input teach-in			
Input voltage HIGH (active)	13.5 V	24 V	30 V
Input current HIGH	1.5 mA	2 mA	2.5 mA
Input voltage LOW	-0.5 V	0 V	5 V
Input current LOW	0 mA	0 mA	0.4 mA
Actuating time of the key-operated pushbutton for teach-in	100 ms		
Weight	Depending on the protective field length (see page 102)		

²⁰⁾ As per IEC 61131-2.

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Minimum	Typical	Maximum
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Operating data

Connection	Hirschmann plug M26 × 11 + FE		
Cable length ²¹⁾			50 m
Wire cross-section		0.75 mm ²	
Ambient operating temperature	0 °C		+55 °C
Air humidity (non-condensing)	15 %		95 %
Storage temperature	-25 °C		+70 °C
Housing cross section	40 mm × 48 mm		
Vibration resistance	5 g, 10-55 Hz (EN 60 068-2-6)		
Shock resistance	10 g, 16 ms (EN 60 068-2-29)		

12.2 Response time

The response time depends on the following parameters:

- number of beams
- beam coding
- multiple sampling

How to determine the response time of the system:

- Read the response times of the C4000 (shown on type label). Note whether the system is operated with or without beam coding.

Note If you are planning the application without actually having any devices available, you may also determine the response time using Tab. 26 and Tab. 27.

- For information on the number of beams see Tab. 26.
- Then see Tab. 27 for information on the response time.

Tab. 26: Number of beams depending on the protective field length and the physical resolution

Protective field height [mm]	Number of beams		
	20 mm	30 mm	40 mm
300	30	15	10
450	45	23	15
600	60	30	20
750	75	38	25
900	90	45	30
1050	105	53	35
1200	120	60	40
1350	135	68	45
1500	150	75	50
1650	165	83	55
1800	180	90	60

- For information on the response time see Tab. 27 on page 100.

²¹⁾ Depending on load, power supply and cable cross-section. The technical specifications must be observed.

Tab. 27: Response time depending on the number of beams, the application and the selected multiple sampling

Number of beams	Multiple sampling					
	1 time		2 times		3 times	4 times
	Application					
	Vertical	Horizontal	Vertical	Horizontal	Vertical	Vertical
10	10 ms	12 ms	16 ms	18 ms	21 ms	26 ms
15	11 ms	14 ms	17 ms	20 ms	23 ms	29 ms
20	12 ms	15 ms	19 ms	22 ms	25 ms	31 ms
23	13 ms	16 ms	20 ms	23 ms	26 ms	33 ms
25	13 ms	17 ms	20 ms	23 ms	27 ms	34 ms
30	14 ms	18 ms	22 ms	25 ms	29 ms	36 ms
35	15 ms	20 ms	23 ms	27 ms	31 ms	38 ms
38	16 ms	21 ms	24 ms	29 ms	32 ms	40 ms
40	16 ms	21 ms	25 ms	29 ms	33 ms	41 ms
45	17 ms	23 ms	26 ms	31 ms	35 ms	43 ms
50	18 ms	24 ms	27 ms	33 ms	37 ms	46 ms
53	19 ms	25 ms	28 ms	34 ms	38 ms	47 ms
55	19 ms	26 ms	29 ms	35 ms	39 ms	48 ms
60	20 ms	27 ms	30 ms	37 ms	41 ms	51 ms
68	22 ms	29 ms	33 ms	40 ms	44 ms	55 ms
75	23 ms	31 ms	35 ms	43 ms	46 ms	58 ms
80	24 ms	33 ms	36 ms	45 ms	48 ms	61 ms
83	25 ms	34 ms	37 ms	46 ms	50 ms	62 ms
90	26 ms	36 ms	39 ms	49 ms	52 ms	65 ms
100	28 ms	39 ms	42 ms	53 ms	56 ms	70 ms
105	29 ms	40 ms	44 ms	55 ms	58 ms	73 ms
120	32 ms	45 ms	48 ms	61 ms	64 ms	80 ms
135	35 ms	49 ms	52 ms	67 ms	70 ms	87 ms
140	36 ms	51 ms	54 ms	69 ms	72 ms	90 ms
150	38 ms	54 ms	57 ms	72 ms	76 ms	95 ms
160	40 ms	56 ms	60 ms	76 ms	80 ms	100 ms
165	41 ms	58 ms	61 ms	78 ms	82 ms	102 ms
180	44 ms	62 ms	66 ms	84 ms	88 ms	110 ms ²²⁾

²²⁾ Only allowed for horizontal usage. Other usage not allowed as per IEC 61496.

12.3 Tolerances

12.3.1 Size and distance tolerances

The table shows the change in the size of an object or the change in the distance between two objects at which the C4000 safely switches to red.

The table also shows up to which change in the size of an object or up to which change in the distance between two objects, the C4000 remains safely switched to green.

Tab. 28: Size and distance tolerances

Reduced resolution [beams]	Size and distance tolerances [mm]					
	Fusion 20 mm resolution		Palletizer Advanced 30 mm resolution		Palletizer Standard 40 mm resolution	
	Green	Red	Green	Red	Green	Red
0	20	39	40	69	60	99
1	40	59	80	109	120	159
2	60	79	120	149	180	219
3	80	99	160	189	-	-
4	100	119	-	-	-	-
5	120	139	-	-	-	-

Note The tolerances are a tolerance band by which the size or the distance is allowed to/can change. The size or the distance is allowed to change both negatively and positively, but never by more than the total tolerance.

Example:

If the tolerance is 20 mm (C4000 Fusion with 20 mm resolution, no reduced resolution), the following changes are possible:

- If the size changes by +10 mm, then it is also allowed to change by -10 mm.
- If the size changes by +20 mm, then the size is no longer allowed to change negatively.
- If the size changes by -20 mm, then the size is no longer allowed to change positively.

12.4 Table of weights

12.4.1 C4000

Tab. 29: Weight of sender and receiver

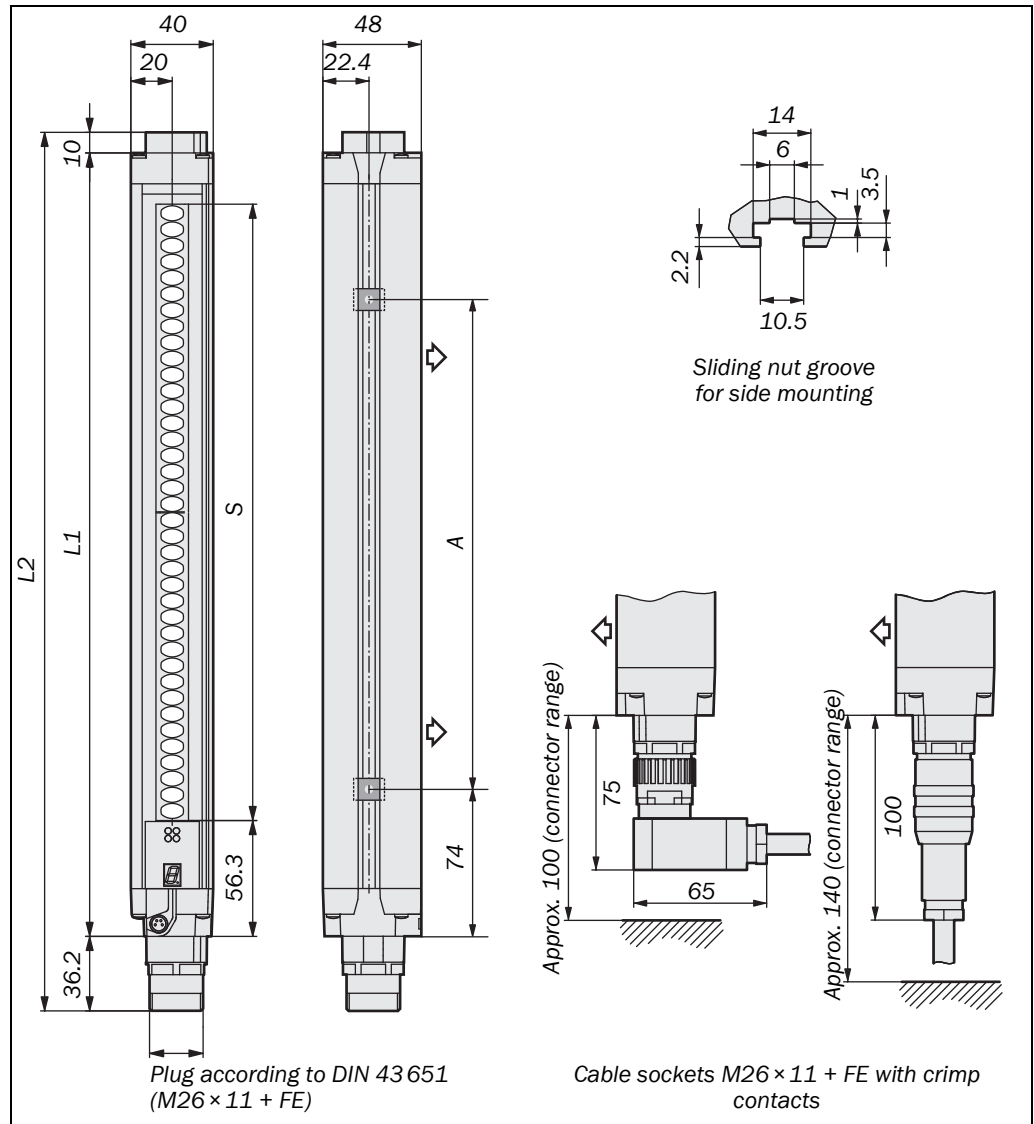
Protective field length [mm]	Weight [g]	
	☒ Sender	☒ Receiver
300	820	850
450	1100	1130
600	1390	1420
750	1670	1700
900	1960	1990
1050	2250	2280
1200	2530	2560
1350	2820	2850
1500	3110	3140
1650	3390	3420
1800	3680	3710

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12.5 Dimensional drawings

12.5.1 C4000 without extension connection

Fig. 59: Dimensional drawing C4000 without extension connection, sender (mm) Receiver, mirror image

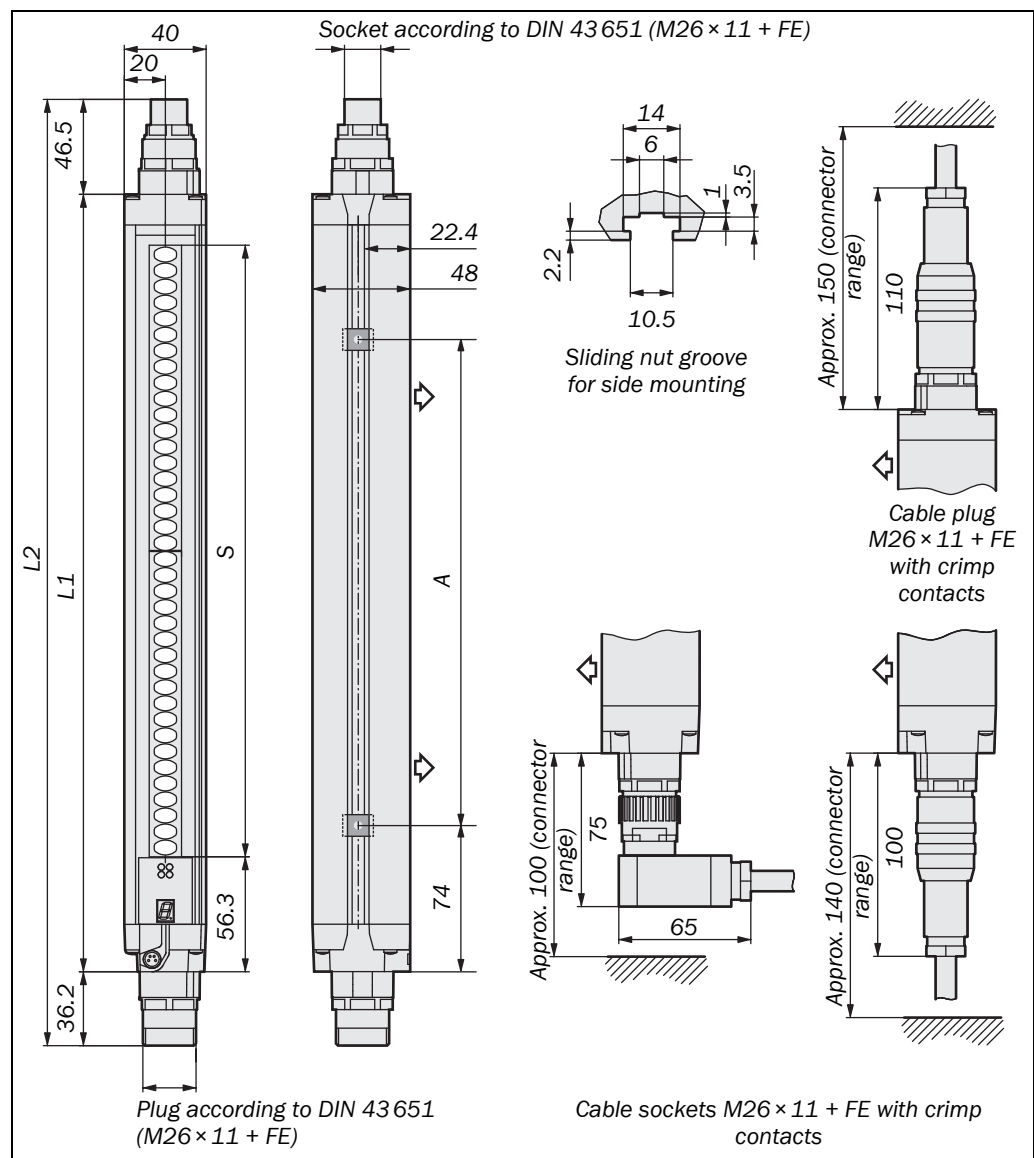


Tab. 30: Dimensions dependent on the protective field length or protective field height, C4000 without extension connection

Protective field length S [mm]	Dimension L1 [mm]	Dimension L2 [mm]	Dimension A [mm]
300	381	427	224
450	532	578	374
600	682	728	524
750	833	879	674
900	984	1030	824
1050	1134	1180	974
1200	1283	1329	1124
1350	1435	1481	1274
1500	1586	1632	1424
1650	1736	1782	1574
1800	1887	1933	1724

12.5.2 C4000 with extension connection

Fig. 60: Dimensional drawing C4000 with extension connection, sender (mm) Receiver, mirror image



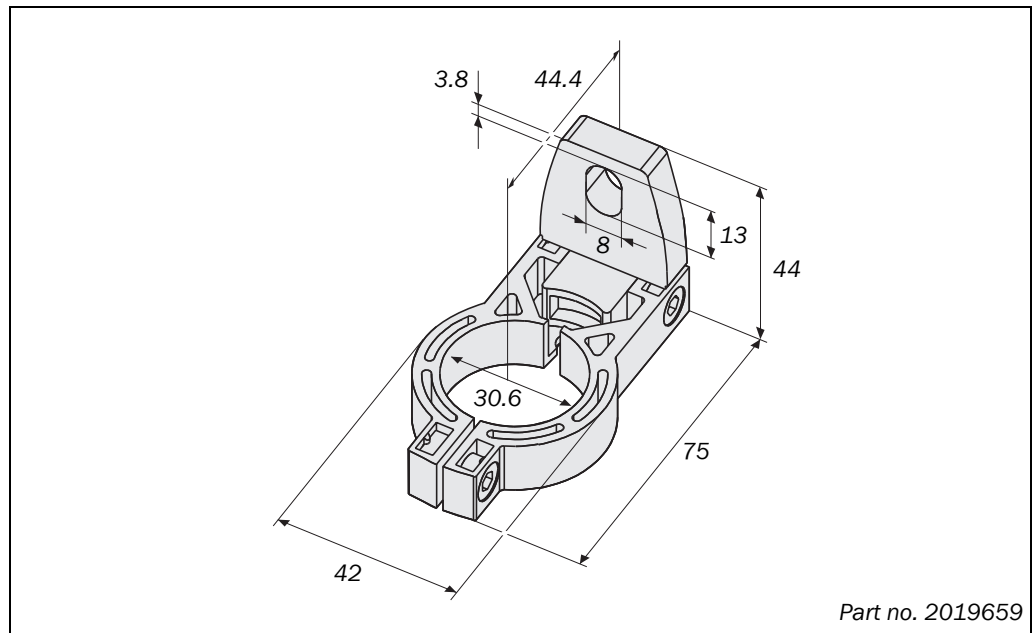
Tab. 31: Dimensions dependent on the protective field length or protective field height, C4000 with extension connection

Protective field length or protective field height S [mm]	Dimension L1 [mm]	Dimension L2 [mm]	Dimension A [mm]
300	381	464	224
450	532	614	374
600	682	765	524
750	833	915	674
900	984	1066	824
1050	1134	1216	974
1200	1283	1366	1124
1350	1435	1517	1274
1500	1586	1669	1424
1650	1736	1818	1574
1800	1887	1969	1724

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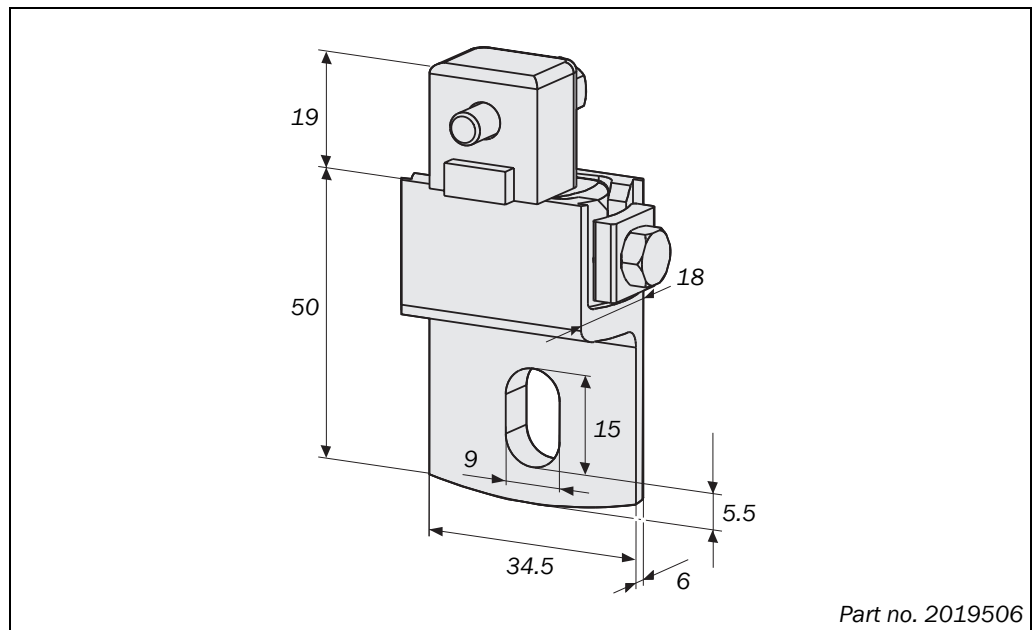
12.5.3 Swivel mount bracket

Fig. 61: Dimensional drawing swivel mount bracket (mm)



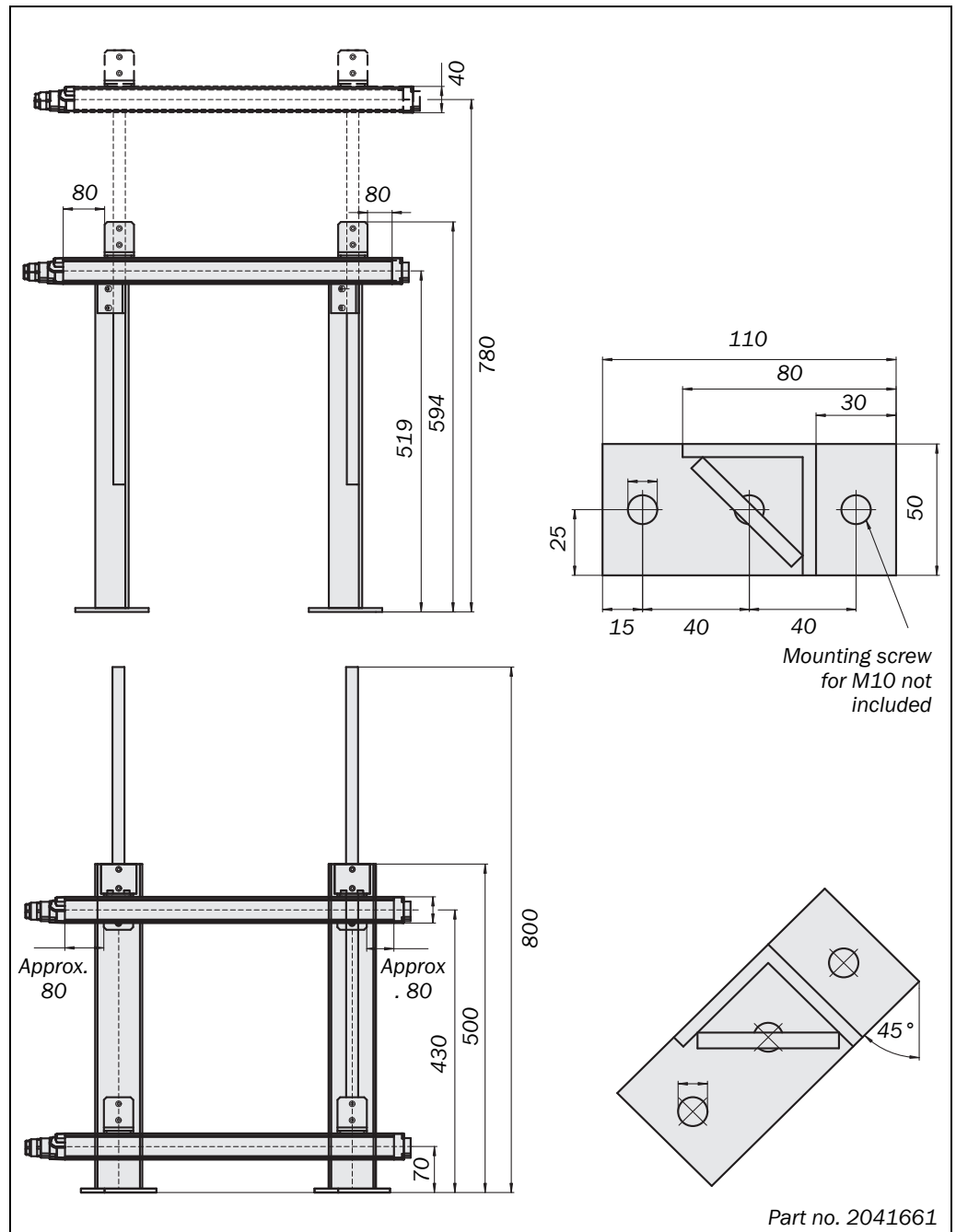
12.5.4 Side bracket

Fig. 62: Dimensional drawing, side bracket (mm)



12.5.5 Floor stands

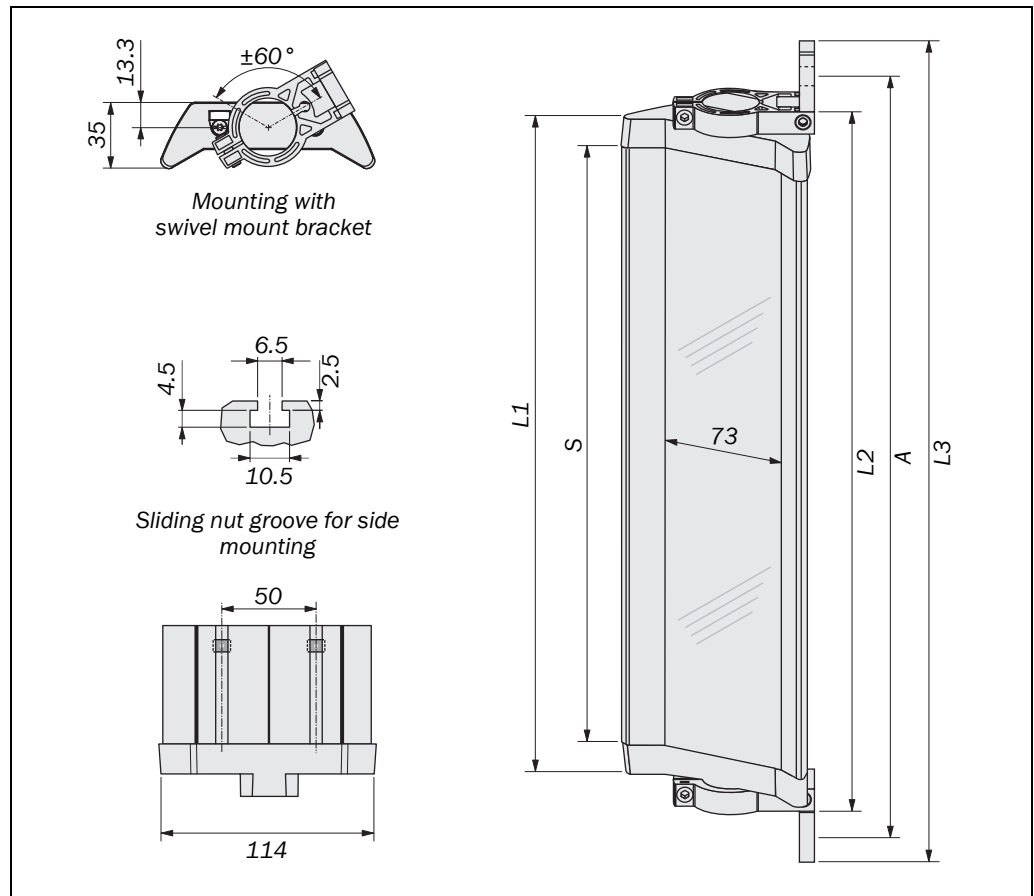
Fig. 63: Dimensional drawing floor stands (mm)



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C4000 Fusion**

12.5.6 Deflector mirror PNS75

Fig. 64: Dimensional drawing deflector mirror PNS75 (mm)



Tab. 32: Dimensions for the deflector mirror PNS75 depending on the mirror height

Mirror height S [mm]	Dimension L1 [mm]	Dimension L2 [mm]	Dimension L3 [mm]	Dimension A [mm]
340	372	396	460	440
490	522	546	610	590
640	672	696	760	740
790	822	846	910	890
940	972	996	1060	1040
1090	1122	1146	1210	1190
1240	1272	1296	1360	1340
1390	1422	1446	1510	1490
1540	1572	1596	1660	1640
1690	1722	1746	1810	1790
1840	1872	1896	1960	1940

Note When using deflector mirrors, the effective scanning range is reduced (see Tab. 10 on page 36).

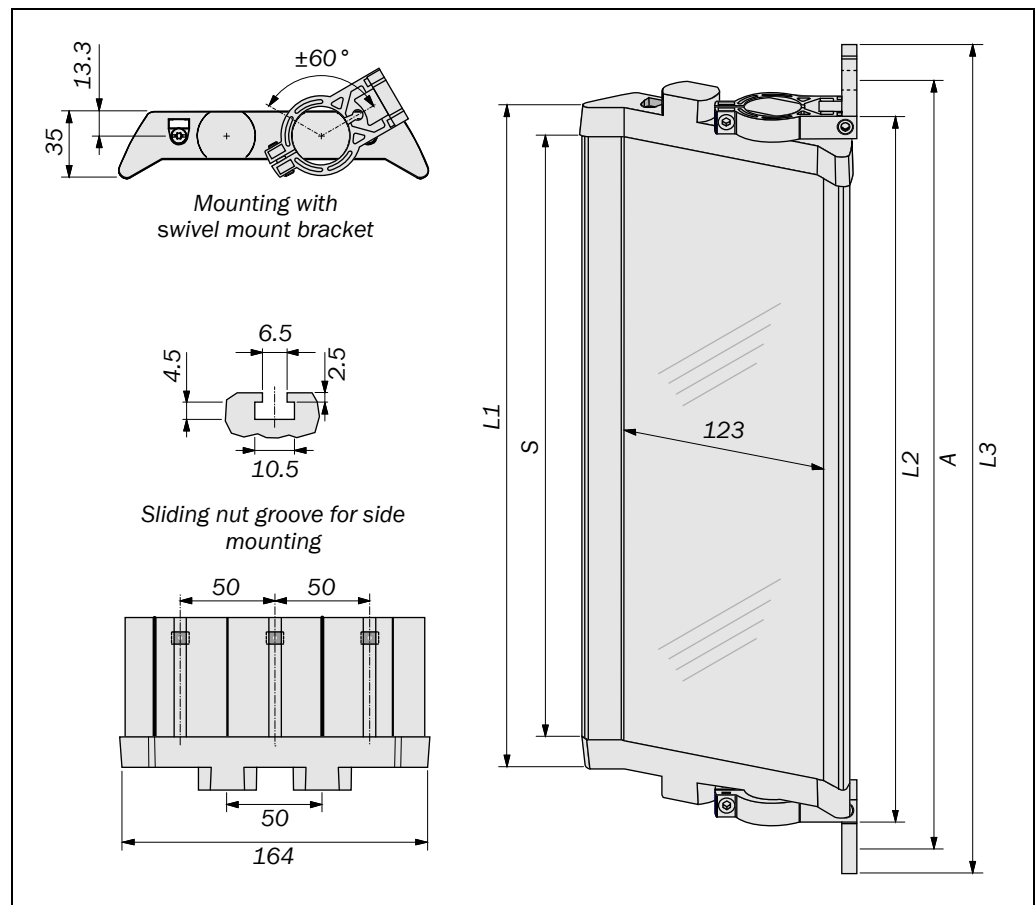


WARNING

Do not use deflector mirrors if the formation of droplets or heavy contamination of the deflector mirrors is to be expected!

The formation of droplets or heavy contamination can be detrimental to the reflection behaviour. The protective function of the system will be affected and the system will thus become unsafe. This would mean that the operator is at risk.

12.5.7 Deflector mirror PNS125

Fig. 65: Dimensional drawing
deflector mirror PNS125
(mm)Tab. 33: Dimensions for the
deflector mirror PNS125
depending on the mirror
height

Mirror height S [mm]	Dimension L1 [mm]	Dimension L2 [mm]	Dimension L3 [mm]	Dimension A [mm]
340	372	396	460	440
490	522	546	610	590
640	672	696	760	740
790	822	846	910	890
940	972	996	1060	1040
1090	1122	1146	1210	1190
1240	1272	1296	1360	1340
1390	1422	1446	1510	1490
1540	1572	1596	1660	1640
1690	1722	1746	1810	1790
1840	1872	1896	1960	1940

Note When using deflector mirrors, the effective scanning range is reduced (see Tab. 10 on page 36).



WARNING

Do not use deflector mirrors if the formation of droplets or heavy contamination of the deflector mirrors is to be expected!

The formation of droplets or heavy contamination can be detrimental to the reflection behaviour. The protective function of the system will be affected and the system will thus become unsafe. This would mean that the operator is at risk.

13 Ordering information

13.1 Items supplied

Items supplied, sender

- sender unit

Items supplied, receiver

- receiver
- 8 sliding nuts for side bracket
- test rod with diameter corresponding to the physical resolution of the safety light curtain
- label "Important Information"
- operating instructions on CD-ROM
- CDS (Configuration & Diagnostic Software) on CD-ROM

13.2 C4000 systems

13.2.1 C4000 Palletizer Standard without extension connection

Tab. 34: Part numbers
C4000 Palletizer Standard
without extension connection

Protective field length [mm]	Part numbers for resolution
	40 mm
750	1043445 (C40S-0704CD010) 1043171 (C40E-0704FP010)
900	1043446 (C40S-0904CD010) 1043172 (C40E-0904FP010)
1050	1043447 (C40S-1004CD010) 1043173 (C40E-1004FP010)
1200	1043448 (C40S-1204CD010) 1043174 (C40E-1204FP010)
1350	1043449 (C40S-1304CD010) 1043175 (C40E-1304FP010)
1500	1043450 (C40S-1504CD010) 1043176 (C40E-1504FP010)
1650	1043451 (C40S-1604CD010) 1043177 (C40E-1604FP010)
1800	1043452 (C40S-1804CD010) 1043178 (C40E-1804FP010)

Other systems on request.

**C4000 Palletizer Std./Adv.
C4000 Fusion**

Tab. 35: Part numbers
C4000 Palletizer Advanced
without extension connection

13.2.2 C4000 Palletizer Advanced without extension connection

Protective field length [mm]	Part numbers for resolution
	30 mm
750	<p>➤ 1041900 (C40S-0703CD010)</p> <p>➤ 1043155 (C40E-0703FK010)</p>
900	<p>➤ 1041901 (C40S-0903CD010)</p> <p>➤ 1043156 (C40E-0903FK010)</p>
1050	<p>➤ 1041902 (C40S-1003CD010)</p> <p>➤ 1043157 (C40E-1003FK010)</p>
1200	<p>➤ 1041903 (C40S-1203CD010)</p> <p>➤ 1043158 (C40E-1203FK010)</p>
1350	<p>➤ 1041904 (C40S-1303CD010)</p> <p>➤ 1043159 (C40E-1303FK010)</p>
1500	<p>➤ 1041905 (C40S-1503CD010)</p> <p>➤ 1043160 (C40E-1503FK010)</p>
1650	<p>➤ 1041907 (C40S-1603CD010)</p> <p>➤ 1043161 (C40E-1603FK010)</p>
1800	<p>➤ 1041908 (C40S-1803CD010)</p> <p>➤ 1043162 (C40E-1803FK010)</p>

Other systems on request.

Tab. 36: Part numbers
C4000 Palletizer Advanced
with extension connection on
the receiver

13.2.3 C4000 Palletizer Advanced with extension connection on the receiver

Protective field length [mm]	Part numbers for resolution
	30 mm
750	<p>▣ 1041900 (C40S-0703CD010)</p> <p>▣ 1043220 (C40E-0703GK010)</p>
900	<p>▣ 1041901 (C40S-0903CD010)</p> <p>▣ 1043179 (C40E-0903GK010)</p>
1050	<p>▣ 1041902 (C40S-1003CD010)</p> <p>▣ 1043180 (C40E-1003GK010)</p>
1200	<p>▣ 1041903 (C40S-1203CD010)</p> <p>▣ 1043221 (C40E-1203GK010)</p>
1350	<p>▣ 1041904 (C40S-1303CD010)</p> <p>▣ 1043181 (C40E-1303GK010)</p>
1500	<p>▣ 1041905 (C40S-1503CD010)</p> <p>▣ 1043222 (C40E-1503GK010)</p>
1650	<p>▣ 1041907 (C40S-1603CD010)</p> <p>▣ 1043223 (C40E-1603GK010)</p>
1800	<p>▣ 1041908 (C40S-1803CD010)</p> <p>▣ 1043182 (C40E-1803GK010)</p>

Other systems on request.

**C4000 Palletizer Std./Adv.
C4000 Fusion**Tab. 37: Part numbers
C4000 Fusion without
extension connection**13.2.4 C4000 Fusion without extension connection**

Protective field length [mm]	Part numbers for resolution
	20 mm
300	☞ 1043224 (C40S-0302FY010)
	☞ 1043225 (C40E-0302FY010)
450	☞ 1043226 (C40S-0402FY010)
	☞ 1043227 (C40E-0402FY010)
600	☞ 1043228 (C40S-0602FY010)
	☞ 1043229 (C40E-0602FY010)
750	☞ 1043183 (C40S-0702FY010)
	☞ 1043184 (C40E-0702FY010)
900	☞ 1043185 (C40S-0902FY010)
	☞ 1043186 (C40E-0902FY010)
1050	☞ 1043187 (C40S-1002FY010)
	☞ 1043189 (C40E-1002FY010)
1200	☞ 1043190 (C40S-1202FY010)
	☞ 1043191 (C40E-1202FY010)
1350	☞ 1043192 (C40S-1302FY010)
	☞ 1043193 (C40E-1302FY010)
1500	☞ 1043194 (C40S-1502FY010)
	☞ 1043195 (C40E-1502FY010)
1650	☞ 1043196 (C40S-1602FY010)
	☞ 1043197 (C40E-1602FY010)
1800	☞ 1043198 (C40S-1802FY010)
	☞ 1043199 (C40E-1802FY010)

Other systems on request.

13.2.5 C4000 Fusion with extension connection on the receiver

Tab. 38: Part numbers
C4000 Fusion with extension
connection on the receiver

Protective field length [mm]	Part numbers for resolution
	20 mm
300	☐ 1043224 (C40S-0302FY010)
	☐ 1043239 (C40E-0302GY010)
450	☐ 1043226 (C40S-0402FY010)
	☐ 1043240 (C40E-0402GY010)
600	☐ 1043228 (C40S-0602FY010)
	☐ 1043241 (C40E-0602GY010)
750	☐ 1043183 (C40S-0702FY010)
	☐ 1043242 (C40E-0702GY010)
900	☐ 1043185 (C40S-0902FY010)
	☐ 1043243 (C40E-0902GY010)
1050	☐ 1043187 (C40S-1002FY010)
	☐ 1043244 (C40E-1002GY010)
1200	☐ 1043190 (C40S-1202FY010)
	☐ 1043245 (C40E-1202GY010)
1350	☐ 1043192 (C40S-1302FY010)
	☐ 1043246 (C40E-1302GY010)
1500	☐ 1043194 (C40S-1502FY010)
	☐ 1043247 (C40E-1502GY010)
1650	☐ 1043196 (C40S-1602FY010)
	☐ 1043248 (C40E-1602GY010)
1800	☐ 1043198 (C40S-1802FY010)
	☐ 1043249 (C40E-1802GY010)

Other systems on request.

13.3 Additional front screen (weld spark guard)

- Notes**
- Two additional front screens (weld spark guards) supplied for each part number.
 - The additional front screen fits both on the sender and on the receiver.
 - The additional front screen can be used only if the curved side of the housing is accessible.
 - An additional front screen reduces the scanning range of the system by 8%. If sender and receiver each use an additional front screen, the scanning range will be reduced by 16%.

Tab. 39: Part numbers additional front screen (weld spark guard)

Protective field height [mm]	Part number	Protective field height [mm]	Part number
300	2022412	1200	2022418
450	2022413	1350	2022419
600	2022414	1500	2022420
750	2022415	1650	2022421
900	2022416	1800	2022422
1050	2022417		

13.4 Deflector mirror

13.4.1 Deflector mirror PNS75 for protective field width 0 ... 12 m (total)

Tab. 40: Part numbers deflector mirror PNS75

For protective field height [mm]	Type number	Part number
300	PNS75-034	1019414
450	PNS75-049	1019415
600	PNS75-064	1019416
750	PNS75-079	1019417
900	PNS75-094	1019418
1050	PNS75-109	1019419
1200	PNS75-124	1019420
1350	PNS75-139	1019421
1500	PNS75-154	1019422
1650	PNS75-169	1019423
1800	PNS75-184	1019424

Dimensional drawing see Fig. 64 on page 107. Effect on the scanning range see Tab. 10 on page 36.

Tab. 41: Part numbers
deflector mirror PNS125**13.4.2 Deflector mirror PNS125 for protective field width 4 ... 18.5 m (total)**

For protective field height [mm]	Type number	Part number
300	PNS125-034	1019425
450	PNS125-049	1019426
600	PNS125-064	1019427
750	PNS125-079	1019428
900	PNS125-094	1019429
1050	PNS125-109	1019430
1200	PNS125-124	1019431
1350	PNS125-139	1019432
1500	PNS125-154	1019433
1650	PNS125-169	1019434
1800	PNS125-184	1019435

Dimensional drawing see Fig. 65 on page 108. Effect on the scanning range see Tab. 10 on page 36.

13.5 AccessoriesTab. 42: Part numbers
accessories

Part	Part number
C4000 system connection	
Hirschmann cable socket M26 × 11 + FE, crimp contacts, straight	6020757
Hirschmann cable socket M26 × 11 + FE, crimp contacts, angled	6020758
Terminal with 182 Ω resistance for pin 9 and 10 on the system connection (see page 74)	2027227
Connecting cable	
Socket straight/stripped, 2.5 m	2022544
Socket straight/stripped, 5 m	2022545
Socket straight/stripped, 7.5 m	2022546
Socket straight/stripped, 10 m	2022547
Socket straight/stripped, 15 m	2022548
Socket straight/stripped, 20 m	2022549
Socket straight/stripped, 30 m	2022550

**C4000 Palletizer Std./Adv.
C4000 Fusion**

Part	Part number
Other accessories	
Mounting kit 2: pivoting (swivel mount), 4 pcs. for any protective field length	2019659
Mounting kit 6: pivoting (side bracket), 4 pcs. for any protective field length. For higher vibration and shock exposure	2019506
Reinforced stainless steel bracket, pivoting (swivel mount) 4 pieces for all protective field lengths (vibration load 5 g/10-55 Hz, impact load 10 g/16 ms)	2026850
Floor stands (quantity 2, height adjustable, for sender or receiver)	2041661
AR60 – laser alignment aid (does not require connection to power supply)	1015741
AR60 adapter for C4000 (2 pieces recommended for the alignment of all axes)	4032461
UE402 switching amplifier: expands the C4000 with the functions bypass and operating mode switching	1023577
Connection cable M8 × 4/D-Sub 9-pin (DIN 41642); for connecting the configuration connection to the serial interface on the PC If you need an RS-232/USB converter for your PC, then we recommend an adapter cable manufactured by Spectra Computersysteme GmbH (see www.spectra.de).	
2 m	6021195
8 m	2027649
Power supply 24 V, 2.1 A, 100/240 V AC, 50 W	7028789
Power supply 24 V, 3.9 A, 120/240 V AC, 95 W	7028790
Accessories already included	
Sliding nuts for side bracket, 4 pcs.	2017550
CDS (Configuration & Diagnostic Software) on CD-ROM including online documentation and operating instructions in all available languages	2032314

14 Annex

14.1 Compliance with EU directives

EU declaration of conformity (excerpt)

The undersigned, representing the following manufacturer herewith declares that the product is in conformity with the provisions of the following EU directive(s) (including all applicable amendments), and that the respective standards and/or technical specifications are taken as the basis.

Complete EU declaration of conformity for download: www.sick.com

14.2 Checklist for the manufacturer

SICK**Checklist for the manufacturer/installer for the installation of electro-sensitive protective equipment (ESPE)**

The details on the items listed below must be available at least during initial commissioning, depending, however, on the respective application, the requirements of which must be reviewed by the manufacturer/installer.

This checklist should be retained and kept with the machine documentation to serve as reference during recurring tests.

- | | | |
|--|------------------------------|-----------------------------|
| 1. Have the safety rules and regulations been observed in compliance with the directives/standards applicable to the machine? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 2. Are the applied directives and standards listed in the declaration of conformity? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 3. Does the protective device comply with the required PL/SIL claim limit and PFHd in accordance with EN ISO 13 849-1/EN 62061 and the required type in accordance with IEC 61496-1? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 4. Is the access to the hazardous area/hazardous point only possible through the protective field of the ESPE? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 5. Have appropriate measures been taken to protect (mechanical protection) or monitor (protective devices) any persons or objects in the hazardous area when protecting a hazardous area or hazardous point, and have these devices been secured or locked to prevent their removal? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 6. Are additional mechanical protective measures fitted and secured against manipulation which prevent climbing over or crawling beneath the ESPE? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 7. Has the maximum stopping and/or stopping/run-down time of the machine been measured and has it been entered and documented (at the machine and/or in the machine documentation)? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 8. Has the ESPE been mounted such that the required minimum distance from the nearest hazardous point has been achieved? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 9. Are the ESPE devices correctly mounted and secured against manipulation after adjustment? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 10. Are the required protective measures against electric shock in effect (protection class)? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 11. Is the control switch for resetting the protective device (ESPE) or restarting the machine present and correctly installed? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 12. Are the outputs of the ESPE (OSSD) integrated according to required PL/SILCL compliant with EN ISO 13 849-1/EN 62061 and does the integration correspond to the comply with the circuit diagrams? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 13. Has the protective function been checked in compliance with the test notes of this documentation? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 14. Are the specified protective functions effective at every operating mode that can be set? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 15. Are the switching elements activated by the ESPE, e.g. contactors, valves, monitored? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 16. Is the ESPE effective over the entire period of the dangerous state? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 17. Once initiated, will a dangerous state be stopped when switching the ESPE on or off and when changing the operating mode, or when switching to another protective device? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 18. Has the information label for the daily check been attached so that it is easily visible for the operator? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |

This checklist does not replace the initial commissioning, nor the regular inspection by qualified safety personnel.

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