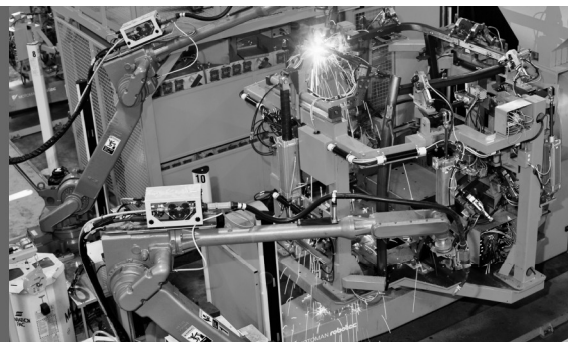


OPERATING INSTRUCTIONS

M4000 Advanced, M4000 Advanced A/P and M4000 Area 60/80



Multiple Light Beam Safety Device



en

SICK
Sensor Intelligence.

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1 About this document

Please read this chapter carefully before working with this documentation and the M4000 multiple light beam safety device.

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 M4000 multiple light beam safety device.

These operating instructions do *not* provide instructions for operating machines on which the multiple light beam safety device 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 M4000 multiple light beam safety devices. It also addresses people who integrate the M4000 multiple light beam safety device into a machine, initialise its use, or who are in charge of servicing and maintaining the device.

1.3 Depth of information

These operating instructions contain the following information on the M4000 multiple light beam safety device:

- 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 M4000 multiple light beam safety device also require specific technical skills which are not detailed in this documentation.

When operating the M4000 multiple light beam safety device, 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 SICK brochure "Safe Machines with opto-electronic protective devices".

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

Here you will find information on:

- sample applications
- a list of frequently asked questions regarding the M4000
- these operating instructions in different languages for viewing and printing
- EU declaration of conformity

1.4 Scope

These operating instructions are original operating instructions.

Note These operating instructions apply to the M4000 Advanced, M4000 Advanced A/P and M4000 Area 60/80 multiple light beam safety devices with one of the following entries on the type label in the field *Operating Instructions*:

- 8010794_WP70
- 8010794_YT72
- 8010794_13LY

This document is part of SICK part number 8010794 (operating instructions “M4000 Advanced, M4000 Advanced A/P and M4000 Area 60/80 – Multiple light beam safety device” in all available languages).

For the configuration and diagnostics of these devices you require CDS (Configuration & Diagnostic Software) version 3.6.4 or higher. To determine the version of your software version, select the **Module-Info...** option in the **?** menu.

Note The general requirements for muting are defined in CLC/TS 62 046.

1.5 Abbreviations and terms

ADO	Application diagnostic output = configurable signal output that indicates a specific status of the protective device
Beam separation	Distance between two neighbouring beams, measured from the middle of one beam to the middle of the other.
CDS	SICK Configuration & Diagnostic Software = software for the configuration and diagnostics of your M4000 multiple light beam safety device
EDM	External device monitoring
EFI	Enhanced function interface = safe SICK device communication
ESPE	Electro-sensitive protective equipment (e.g. M4000)
Muting	A temporary automatic suppression of one or more safety function/s by safety-related parts of the control system.
OSSD	Output signal switching device
OWS	Output weak signal = contamination signal
PLC	Programmable logic controller
Resolution	Minimum size of a test rod that is reliably detected by the protective device The resolution is measured from the outside edge of a beam to the opposite outside edge of the neighbouring beam.
SDL	Safety Data Link = SICK safety interface (connection for OSSD and EFI of an ESPE)
sens:Control	The SICK products in the sens:Control series include safety relays, safety controllers and network solutions. If reference is made in this document to sens:Control devices, safety controllers and network solutions are meant.
UE403	The UE403 safety relay is an accessory for the SICK M4000 Advanced multiple light beam safety device. It extends the technical application possibilities of the M4000 Advanced.

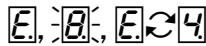
1.6 Symbols used

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 display of the letter E



Flashing display of the digit 8



Alternating display of E and 4

The depiction of digits on the 7-segment display of the M4000 can be rotated by 180° with the aid of the CDS. In this document the depiction of the 7-segment display is however always in the normal, non-rotated position.



LED symbols describe the status of an LED:



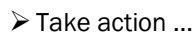
The LED is constantly illuminated.



The LED is flashing.



The LED is off.



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 M4000 multiple light beam safety device or with the machine protected by the M4000 multiple light beam safety device.

2.1 Qualified safety personnel

The M4000 multiple light beam safety device must only be installed, commissioned and serviced by qualified safety personnel. Qualified safety personnel are defined as persons who

- have undergone the appropriate technical training

and

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

and

- who have access to these operating instructions.

2.2 Applications of the device

The M4000 system is a type 4 electro-sensitive protective equipment (ESPE) as defined by IEC 61496-1 and IEC 61496-2 and is therefore allowed for use with controls in category 4 according to EN ISO 13849-1. The preconfiguration of the M4000 multiple light beam safety device is suitable for:

- hazardous area protection
- access protection

The multiple light beam safety devices must be installed such that the hazardous area can only be reached by interrupting the light path between sender and receiver. It must not be possible to start the plant/system as long as personnel are within the hazardous area.

The M4000 system is intended only for use in industrial environments. When used in residential areas it can cause interference.

Refer to page 16 for an illustration of the protection modes and an example application.



WARNING

Only use the multiple light beam safety device 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 protective devices may be required in addition to the M4000 system.

2.3 Correct use

The M4000 system must be used only as defined in chapter 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.

All warranty claims against SICK AG are forfeited in the case of any other use, or alterations being made to the system, even as part of their mounting or installation.

2.4 General safety notes and protective measures

**WARNING**

Safety notes

Please observe the following items in order to ensure the correct and safe use of the M4000 multiple light beam safety device.

- The national/international rules and regulations apply to the installation, commissioning, use and periodic technical inspections of the multiple light beam safety device, 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 multiple light beam safety device 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 100) of these operating instructions (e.g. on use, mounting, installation or integration into the existing machine controller) must be observed.
- 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 M4000 multiple light beam safety device 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.
- The external voltage supply of the devices must be capable of buffering brief mains voltage failures of 20 ms as specified in EN 60204-1. Suitable power supplies are available as accessories from SICK (Siemens type series 6 EP 1).

2.5 Environmental protection

The M4000 multiple light beam safety device is constructed in such a way that it adversely affects the environment as little as possible. It uses only a minimum of power and natural resources.

➤ At work, always act in an environmentally responsible manner.

2.5.1 Disposal

Unusable or irreparable devices should always be disposed as per the applicable national regulations on waste disposal (e.g. European waste code 16 02 14).

Notes

- We would be pleased to be of assistance on the disposal of this device. Contact your local SICK representative.
- Information on the individual materials in the M4000 is given in chapter 13 “Technical specifications” on page 113.

2.5.2 Separation of materials



WARNING

Only appropriately trained personnel are allowed to separate materials!

Caution is required when dismantling devices. There is a risk of injuries.

Before you send the devices for appropriate recycling, it is necessary to separate the different materials in the M4000.

- Separate the housing from the rest of the parts (in particular the circuit board).
- Send the separated parts for recycling as appropriate (see Tab. 1).

Tab. 1: Overview on disposal by components

Components	Disposal
Product	
Housing	Metal recycling (aluminium)
Circuit boards, cable, connector and electrical connecting pieces	Electronic recycling
Packaging	
Cardboard, paper	Paper/cardboard recycling
Polyethylene packaging	Plastic recycling

3 Product description

This chapter provides information on the special features and properties of the M4000 multiple light beam safety device. It describes the construction and the operating principle of the device.

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

3.1 Special features

Properties of all devices described in these operating instructions

- protective operation with either internal or external (realised on the machine) restart interlock
- external device monitoring (EDM)
- beam coding
- configurable application diagnostic output (ADO)
- status display with 7-segment display
- SDL interface

M4000 Advanced

- muting configurable (only with UE403 or sens:Control)
- 2, 3 or 4 beams
- scanning range up to 70 m
- integrated laser alignment aid (optional)
- end cap with integrated LED (optional)

M4000 Advanced A/P

- less wiring costs: Only one device needs to be connected electrically.
- quick and straightforward alignment in conjunction with the M4000 Passive (deflector unit)
- 2 beams, scanning range to 7.5 m (M4000 Passive with mirror deflection)
- 2 or 4 beams, scanning range to 4.5 m (M4000 Passive with fibre-optic deflection)
- muting configurable (only with UE403 or sens:Control)
- end cap with integrated LED (optional)

M4000 Area 60/80

- horizontal area protection
- M4000 Area 60:
 - 60 mm resolution
 - length of the monitored area 300-1800 mm
 - scanning range 19 m
- M4000 Area 80:
 - corresponds: 80 mm resolution
 - length of the monitored area 600-1800 mm
 - scanning range 70 m

3.2 Operating principle of the device

3.2.1 The principle of the multiple light beam safety device

The M4000 multiple light beam safety device secures the access to a hazardous area and signals the entry of objects as soon as a light beam is interrupted. The machine or plant controller that evaluates this message must then bring the dangerous movement to a halt. You can secure two sides of a hazardous area by using a deflector mirror, with two deflector mirrors you can secure three sides (see chapter 3.3.2 “Access protection on several sides with the aid of deflector mirrors” on page 17ff).

3.2.2 Device components

Fig. 1: Device components of the M4000 Advanced

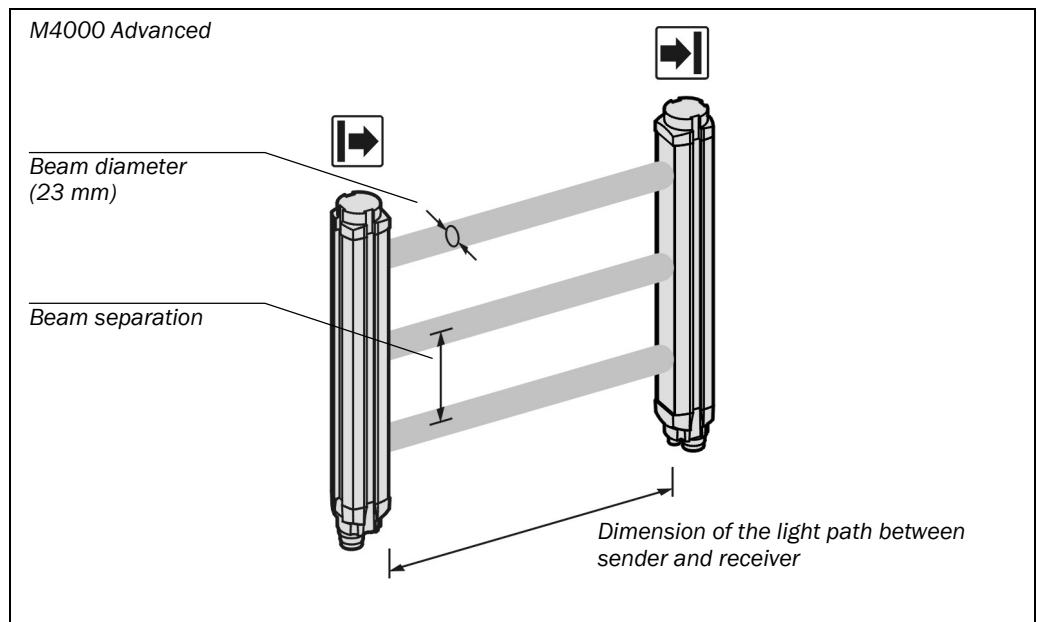
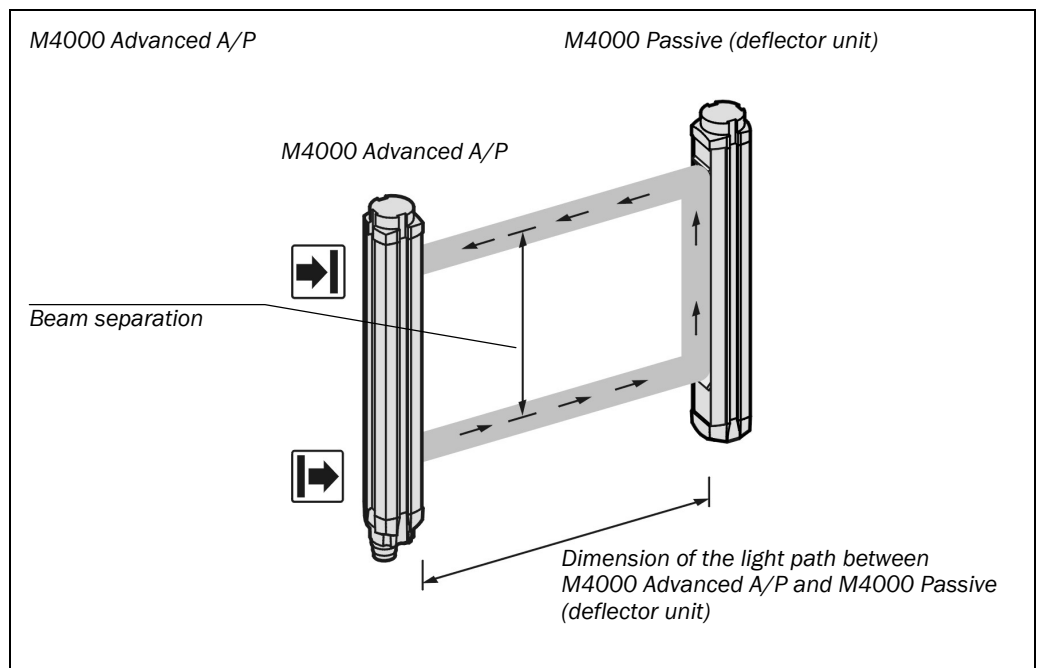
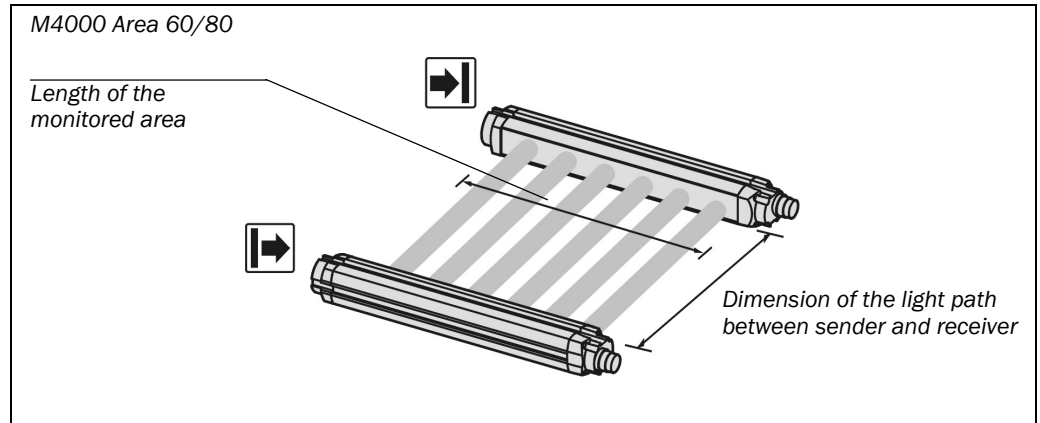


Fig. 2: Device components of the M4000 Advanced A/P



M4000 Adv., Adv. A/P, Area

Fig. 3: Components of the M4000 Area 60/80

**Principles of operation**

The M4000 multiple light beam safety device consists of a sender unit and a receiver unit. A distinction should be made between active/active systems and active/passive systems:

- On the active/active system, sender unit and receiver unit are in separate housings, the *sender* and the *receiver*. The light beam is emitted from the sender and is incident to the receiver.
- On the active/passive system, sender unit and receiver unit are in a common housing (M4000 Advanced A/P). The light beam is emitted from the sender unit and is deflected by the deflector unit M4000 Passive (mirror deflection or fibre-optic deflection) by 180° back to the receiver unit (see Fig. 2). As a passive element, the deflector unit does not require any electrical connections.

For the exact number and distance of beams, please see chapter 13.3 “Dimensional drawings” on page 120ff.

The dimension of the light path between sender and receiver (or between the M4000 Advanced A/P and M4000 Passive) must not exceed the maximum permissible scanning range (see “Technical specifications” on page 113ff.).

On active/active systems, sender unit and receiver unit synchronise automatically by optical means. An electrical connection between both components is not required.

The M4000 is modular in structure. All optical and electronic components and assemblies are housed in a slim and torsionally rigid housing.

M4000 Advanced

The M4000 Advanced multiple light beam safety device is available with 2, 3 or 4 beams. Other configurations with up to 12 beams are possible on request. The maximum scanning range (dimension of the light path between sender and receiver) is 70 m.

M4000 Advanced A/P

The M4000 Advanced A/P is available with 2 or 4 beams. The maximum scanning range (dimension of the light path between the M4000 Advanced A/P and the M4000 Passive) is dependent of the number of beams as well as the utilized M4000 Passive and is 7.5 m max.

M4000 Area 60/80

The M4000 Area 60/80 multiple light beam safety device is available with a monitored area length from 300/600 mm to 1800 mm. The beam separation is 50 or 57 mm (resolution of 60 or 80 mm). The maximum scanning range is 19 m (M4000 Area 60) or 70 m (M4000 Area 80).

3.3 Application examples

3.3.1 Access protection

Fig. 4: Access protection with an M4000 Advanced multiple light beam safety device

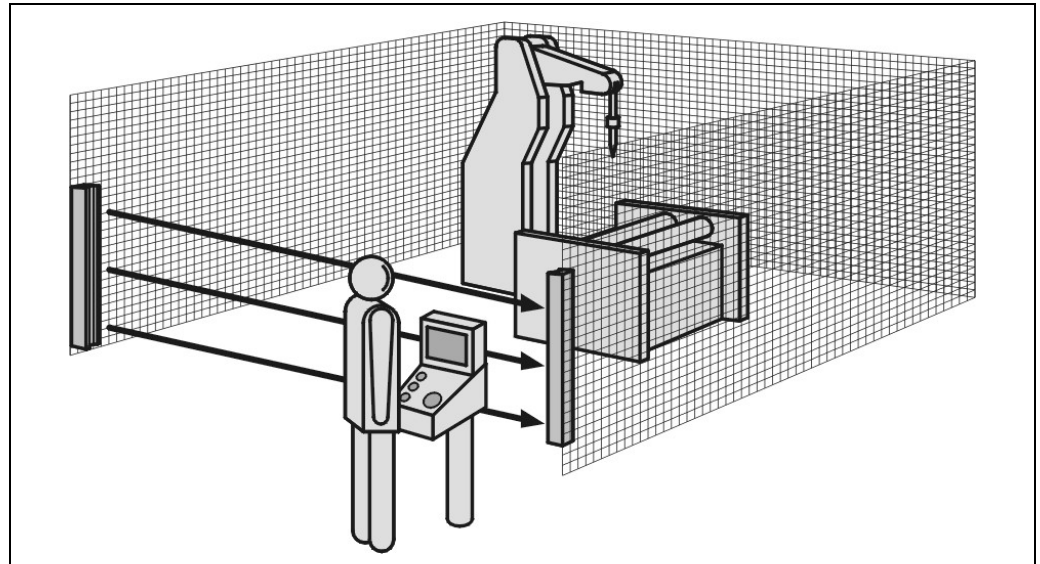
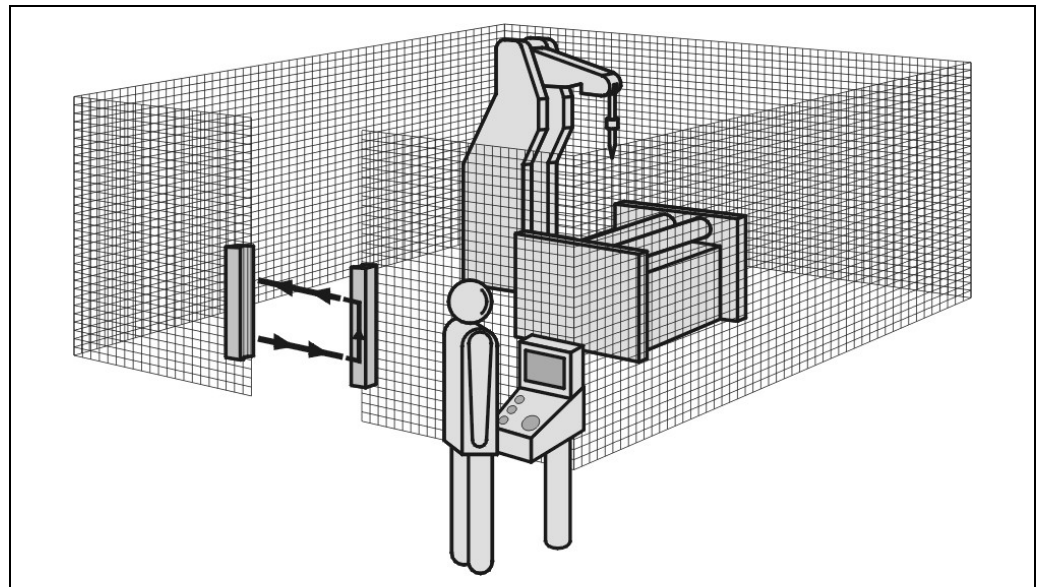
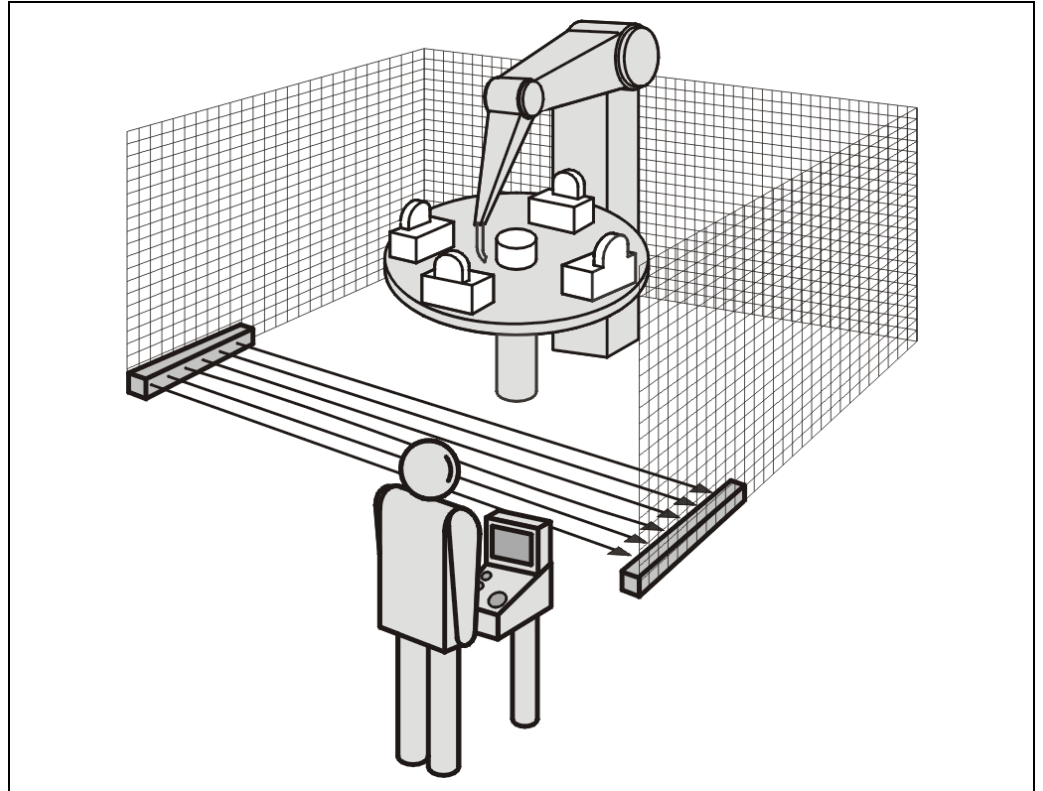


Fig. 5: Access protection with an M4000 Advanced A/P multiple light beam safety device



M4000 Adv., Adv. A/P, Area

Fig. 6: Access protection with an M4000 Area 60/80 multiple light beam safety device



The M4000 multiple light beam safety device 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 must be mounted in a way that objects penetrating the hazardous area are safely identified by the M4000.
- 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.

3.3.2 Access protection on several sides with the aid of deflector mirrors

You can secure two sides of a hazardous area by using one deflector mirror (see Fig. 7), with two deflector mirrors you can secure three sides (see Fig. 8).

Fig. 7: Access protection with an M4000 Advanced multiple light beam safety device and one deflector mirror

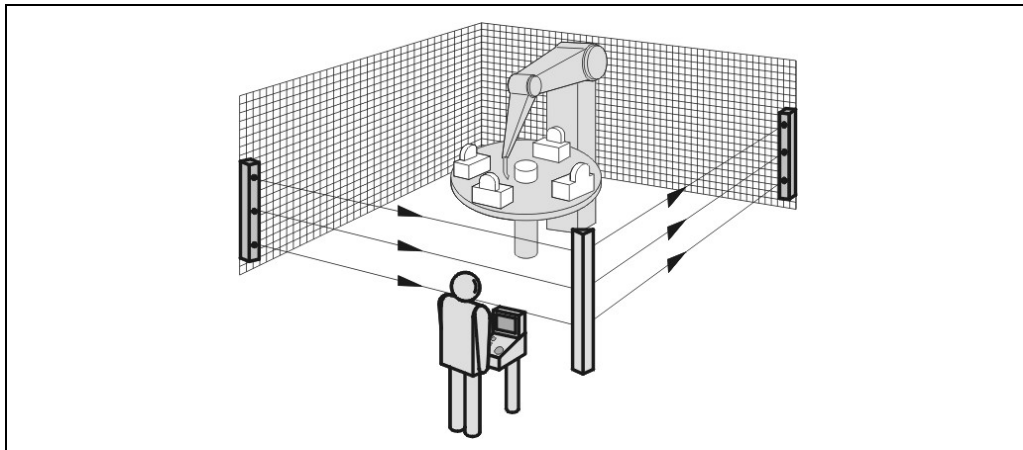


Fig. 8: Access protection with an M4000 Advanced multiple light beam safety device and two deflector mirrors

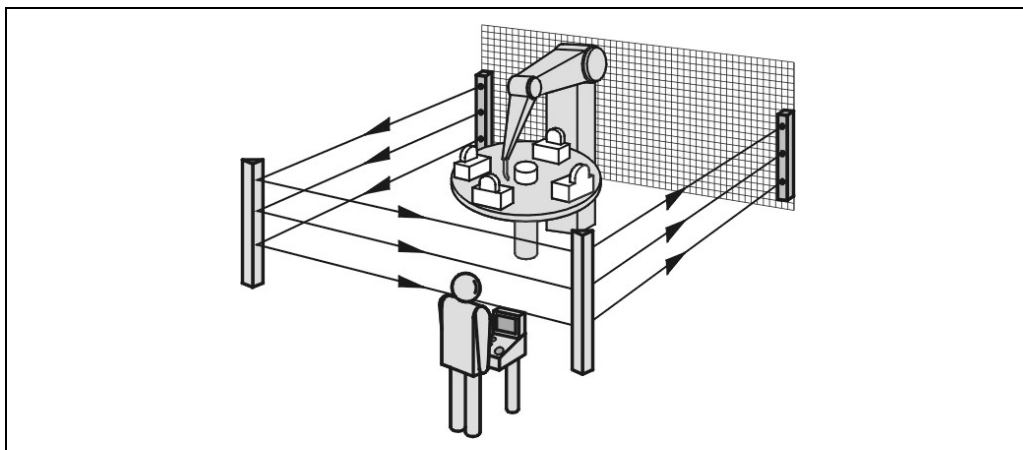
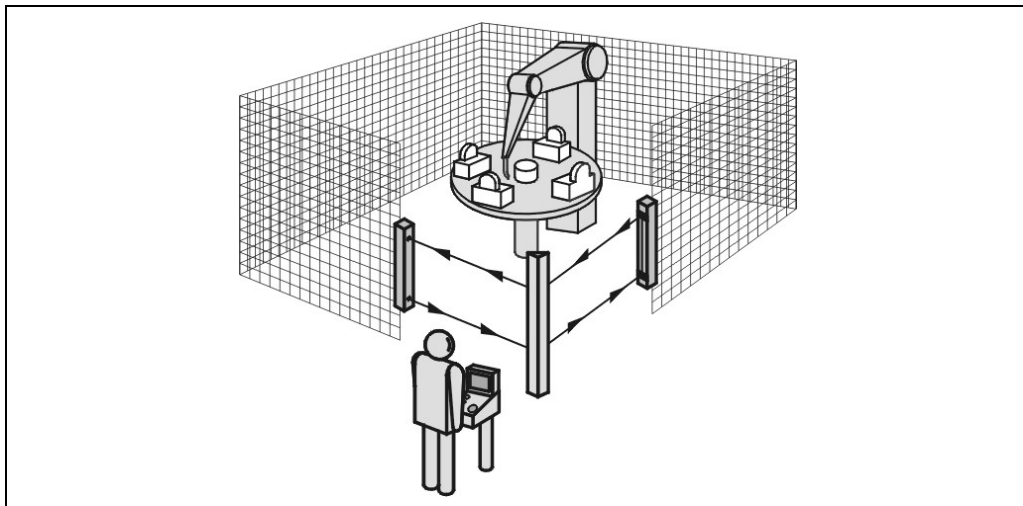


Fig. 9: Access protection with an M4000 Advanced A/P multiple light beam safety device and one deflector mirror



Notes

- The formation of droplets of heavy contamination can be detrimental to the reflection behaviour. Take the necessary organisational measures to avoid the formation of droplets on the deflector mirrors. The deflector mirrors are available as accessories (see page 128f.).
- Deflector mirrors reduce the effective scanning range. The effective scanning range depends on the number of deflector mirrors in the light path (see chapter 5.4 “Scanning range” on page 42ff).
- You can extend the M4000 Advanced A/P multiple light beam safety device with a maximum of one deflector mirror.

3.4 Controls and status indicators

The LEDs and the 7-segment display of sender and receiver signal the operating status of the M4000.

Note The depiction of numbers on the 7-segment display can be rotated by 180° with the aid of the CDS (Configuration & Diagnostic Software). If you rotate the numbers of the 7-segment display, the point in the 7-segment display goes out:

- 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.

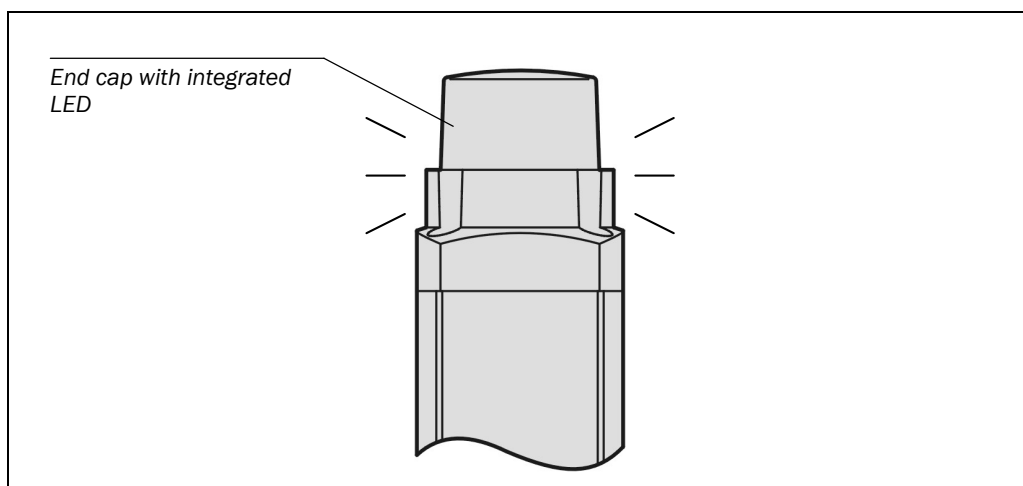


Device symbol **M4000 Advanced (sender or receiver)**, **M4000 Advanced (A/P)** or **M4000 Area (sender or receiver)**, context menu **Open device window**, parameter node **General**.

3.4.1 End cap with integrated LED (optional, only on receiver)

- Notes**
- The end cap with integrated LED is available only for the receiver of the M4000 Advanced and the M4000 Advanced A/P.
 - The integrated LED is not monitored. This means that a failure of the integrated LED has no effect on the function of the M4000.

Fig. 10: End cap with integrated LED

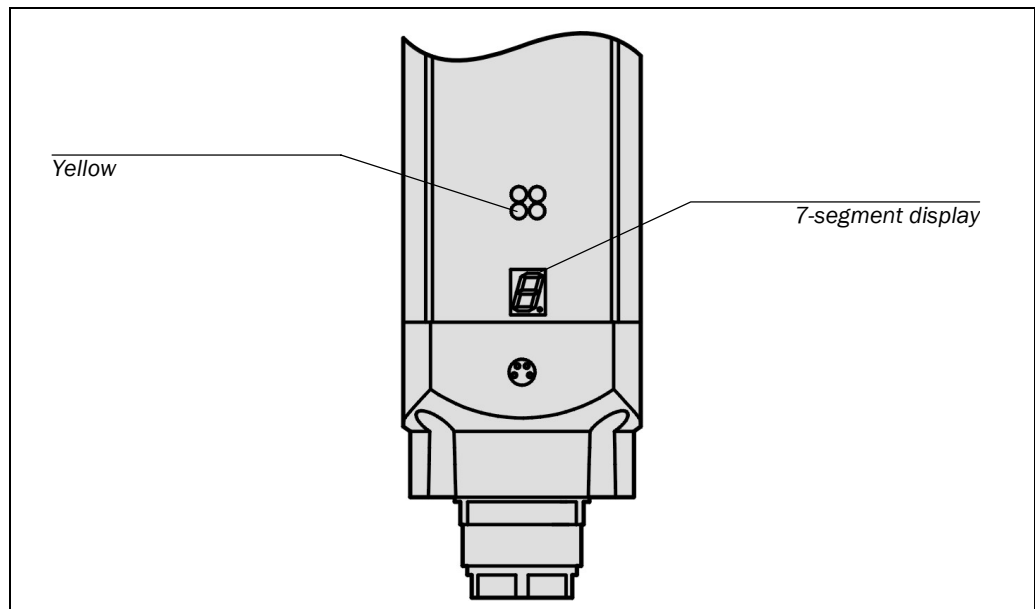


Tab. 2: Significance of the indications on the integrated LED

Display	Meaning	Output signal switching devices
● Red	System providing signals for shutting down the machine	Off
● Green	System clear	On
● Yellow	Muting (only with UE403 or sens:Control)	On
☼ Yellow/red (1 Hz)	Reset required	Off
☼ Yellow/red (2 Hz)	Override required (only with UE403 or sens:Control)	Off

3.4.2 Status indicators of the sender

Fig. 11: Status indicators of the sender

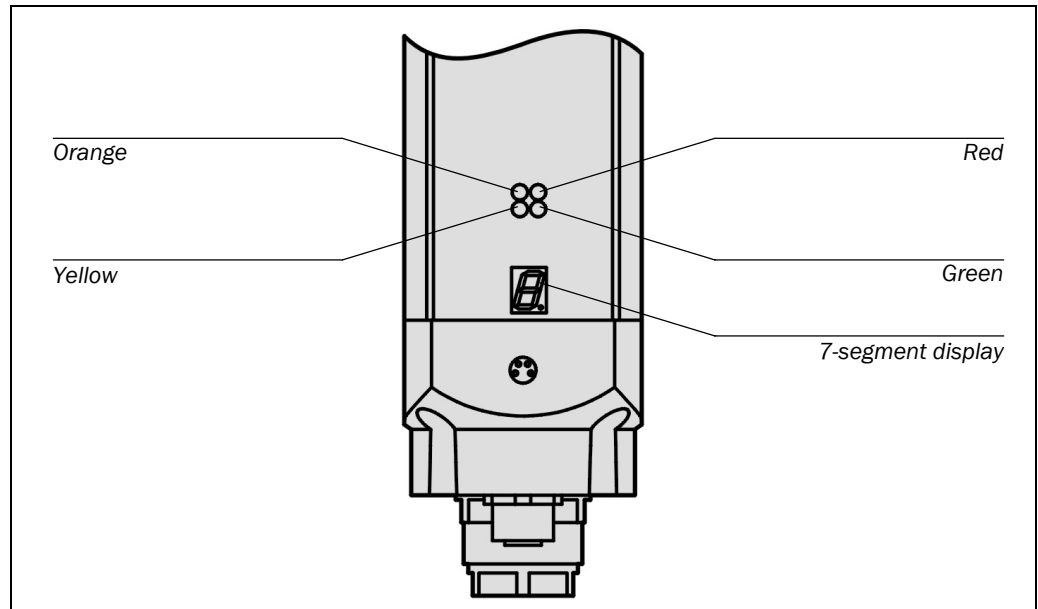


Tab. 3: Meaning of the status indicators of the sender

Display	Meaning
● Yellow	Supply voltage o.k.
	System error. Disconnect the supply voltage to the M4000 for at least 3 seconds. If the problem persists, replace the unit.
	The device is in the test mode.
	Non-coded operation (only after switching on)
	Operation with code 1 (only after switching on)
	Operation with code 2 (only after switching on)
Other displays	All other displays are error messages. Please refer to chapter 12 "Fault diagnosis" on page 105.

3.4.3 Status indicators of the receiver or of the M4000 Advanced A/P

Fig. 12: Status indicators of the receiver or of the M4000 Advanced A/P



Tab. 4: Meaning of the status indicators of the receiver or the M4000 Advanced A/P

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 clear: output signal switching devices on
	System error. Disconnect the supply voltage to the M4000 for at least 3 seconds. If the problem persists, replace the unit.
	Poor alignment to sender.
	Please refer to chapter 9.2 "Alignment of the M4000" on page 90.
	Note: In normal operation, the display  indicates the state "The light path is interrupted".
	Muting (only with UE403 or sens:Control)
	Override (only with UE403 or sens:Control)
	Operation with blanking (only with UE403 or sens:Control)
	Operation with large scanning range (only after switching on)
	Non-coded operation (only after switching on)
	Operation with code 1 (only after switching on)
	Operation with code 2 (only after switching on)
Other displays	All other displays are error messages. Please refer to chapter 12 "Fault diagnosis" on page 105.

4 Muting

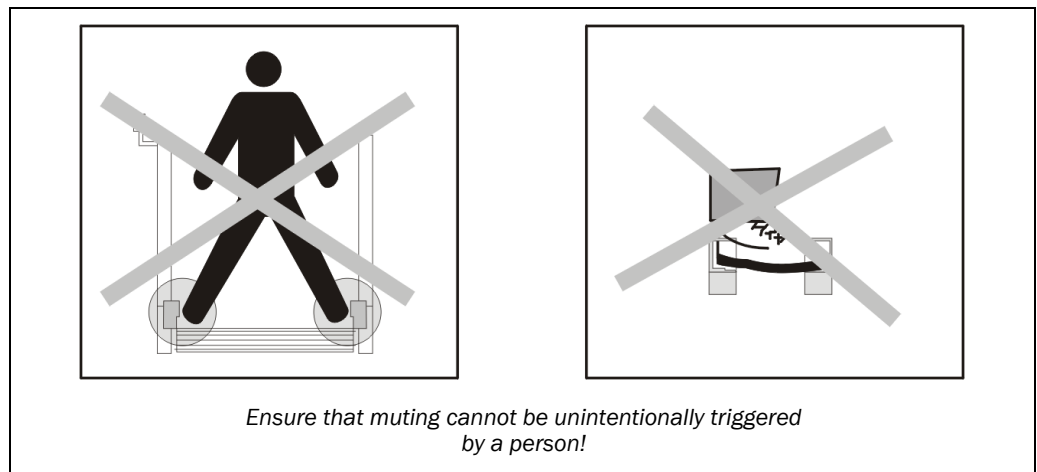
- Note** ➤ When using the muting functions of the M4000 Advanced please observe the operating instructions of the corresponding UE403 or sens:Control device.



Pay attention to the following safety notes!

- Muting is only allowed to be activated during the period when the material to be transported (e.g. on a pallet) blocks the access to the hazardous area.
- Muting must be performed automatically, but must not depend on a single electrical signal.
- Muting must be triggered by at least two independently wired signals (e.g. from muting sensors) and must not depend entirely on software signals (for instance from a PLC).
- Muting must be removed immediately as soon as the material to be transported no longer blocks the access to the dangerous movement so that the protective device is once more effective.
- The material to be transported must be detected over its entire length, i.e. there must be no interruption in the output signals.
- Mount the control switch for reset or override outside the hazardous area such that it cannot be operated by a person in the hazardous area. When operating the control switch, the operator must have full visual command of the hazardous area.
- Always mount the sensors so that the minimum distance to the protective device is maintained.
- Prevent the unintentional triggering of muting by a person by mounting the sensors appropriately (see Fig. 13)!

Fig. 13: Safety on mounting the muting sensors

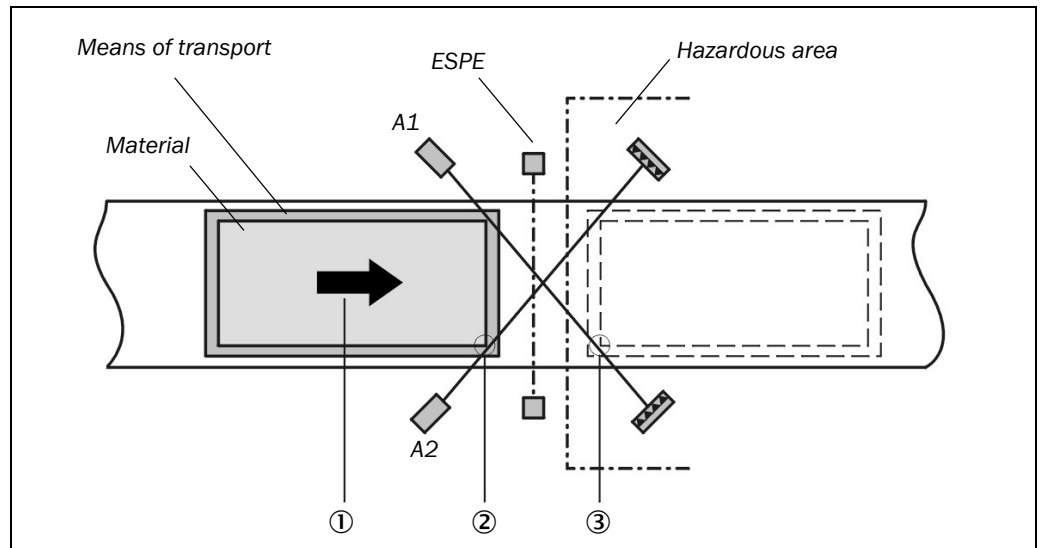


4.1 Muting principle

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.

Fig. 14: Schematic illustration of muting



In the example, the material moves from left to right on a conveyor belt ①. As soon as the muting sensors A1 and A2 are activated ②, the protection provided by the ESPE protective device is muted and the material can move into the hazardous area. As soon as the muting sensors are clear again ③, the protection provided by the protective device is re-activated.

4.1.1 Muting cycle

The muting cycle is the defined sequence of all processes that take place during muting. The cycle starts when the first muting sensor is activated. The cycle ends when the last muting sensor returns to its initial state (e.g. clear light path for optical sensors). Only then is it possible to activate muting again.

Material can be transported several times during a muting cycle, if the muting condition is maintained continuously, i.e. at least one pair of sensors remains activated continuously. Exception: With the *Exit monitoring* function activated (see sections 4.2.3 and 4.2.4 from page 30), multiple material transport within a muting cycle is not possible.

4.1.2 Muting sensors

Muting sensors detect material and supply the signals which an evaluation unit requires for the logic operation.

Sensor signals can be generated by the following external sensors:

- optical sensors
- inductive sensors
- mechanical switches
- controller signals

SICK muting sensors

Recommendation

A selection of optical muting sensors is given in the following. Depending on the type (light-switching or dark-switching), you can use these as testable or non-testable sensors.

Note

You can use testable muting sensors in conjunction with the UE403 safety relay or a sens:Control device. For this purpose, the sensor test function of the M4000 multiple light beam safety device must be configured (see section 6.2 “Sensor test” on page 50ff.).

Tab. 5: Selection and settings for the SICK optical muting sensors in muting applications

Sensor	Type	Testable	Non-testable
Photoelectric proximity switch	WT24	Dark switching	Light switching
	WT27		
	WT280	Not possible	Light switching
Photoelectric reflex switch	WL24	Dark switching, reflector moving on the object	Dark switching
	WL27		
	WL280	Not possible	Dark switching
	WL12	Not possible	Dark switching
	WL14	Not possible	Dark switching
	WL18	Dark switching, reflector moving on the object	Dark switching
Through-beam photoelectric switch	WS24/WE24	Not possible	Dark switching
	WS27/WE27		
	WS280/WE280		

Note

For the selection and settings for the SICK optical muting sensors in muting applications, the following applies:

- Outputs must be PNP switching.
- Other series are possible.
- Pay attention to the output signals in chapter 6.2.

4.1.3 Muting lamp

To signal muting, the use of a muting lamp or a muting status signal is stipulated. The muting lamp signals the temporary muting. You can use an external lamp (monitored/not monitored) or the integrated LED on the M4000 Advanced multiple light beam safety device (not monitored).

Note Depending on the national legal situation, the *monitoring of the external muting lamp* may be deactivated with the aid of the CDS.



WARNING

Always mount the muting lamp where it can be clearly seen!

The muting lamp must be clearly visible from all sides of the hazardous area and for the system operator.

4.2 Placement of muting sensors

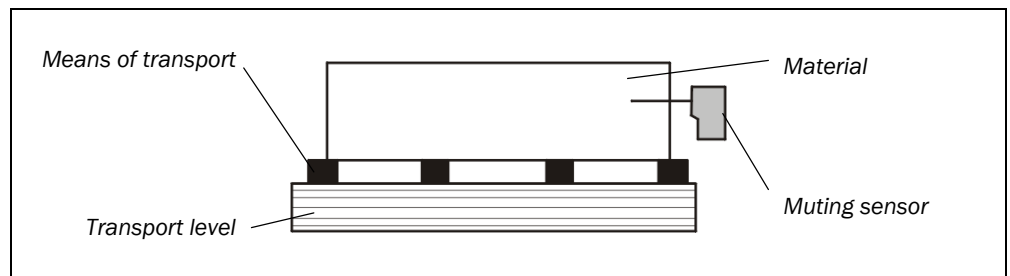


WARNING

Pay attention to the following notes on the placement of the muting sensors!

- Always position the muting sensors such that only the material is detected and not the means of transport (pallet or vehicle).
- Always position the muting sensors such that material can pass unhindered, but people are reliably detected.

Fig. 15: Detection of material during muting

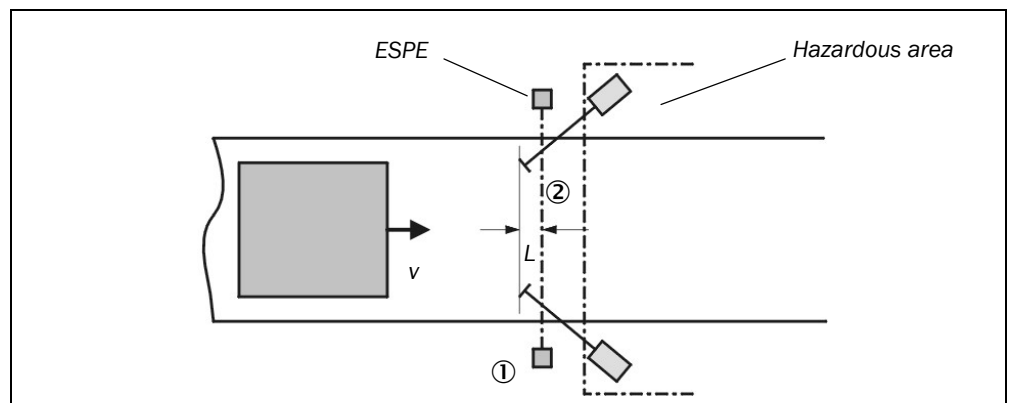


- Always position the muting sensors such that, on the detection of the material ①, a minimum distance to the light beams on the ESPE ② is maintained.

Note

The minimum distance provides the processing time necessary until muting is activated.

Fig. 16: Minimum distance, material detection to the ESPE on muting



How to calculate the minimum distance:

$$L \geq v \times \left(t_d + \frac{t_{res}}{2} + 0.004 \right)$$

Where ...

L = Minimum distance [m]

v = Velocity of the material (e.g. of the conveyor belt) [m/s]

t_d = Input delay of the UE403 or the sens:Control device [s]
(see the operating instructions of the UE403 or sens:Control device)

t_{res} = Response time M4000 [s]
(see section 13.1 "Data sheet" on page 115)

- Use optical sensors with background suppression. These detect material only up to a specific distance. Objects that are further away than the material to be detected are not detected.

Fig. 17: Principle of operation of sensors with background suppression

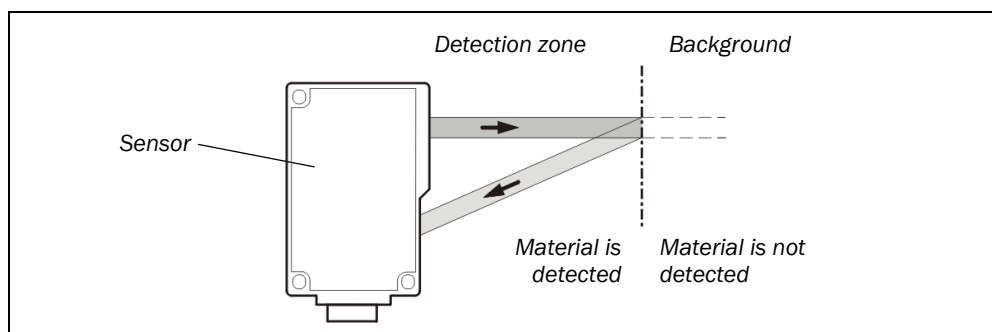
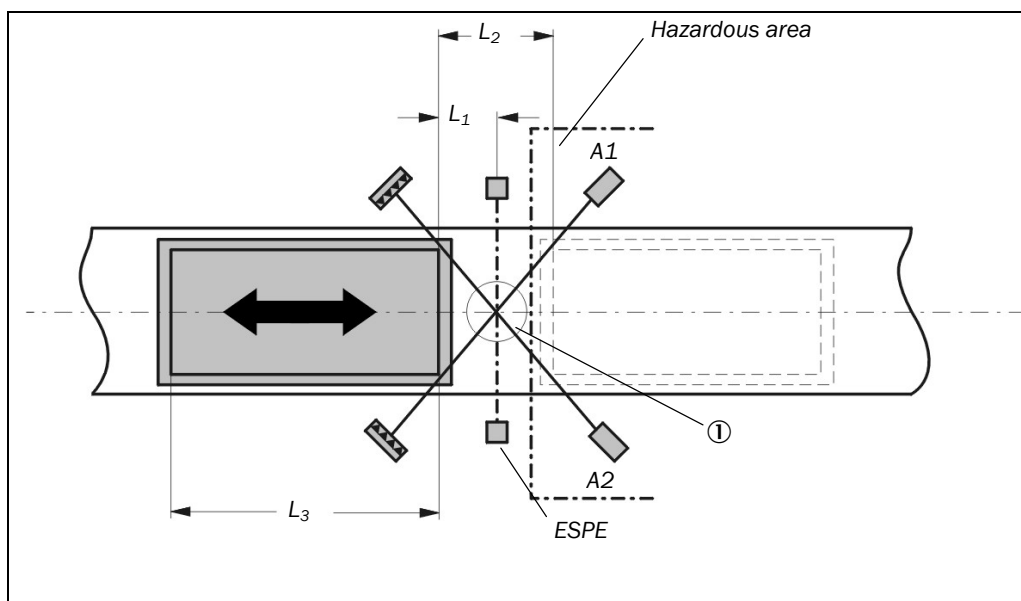
**4.2.1 Muting with two sensors (one sensor pair), crossed placement**

Fig. 18: Muting with two sensors, crossed placement



In the example, the material moves from left to right or, alternatively, from right to left. As soon as the muting sensors A1 and A2 are activated, the protection provided by the protective device (ESPE) is muted.

The following requirements must be met:

Tab. 6: Conditions for muting with two sensors, crossed placement

Condition	Description
A1 & A2	Muting applies as long as this condition is met.

How to calculate the distance:

$$L_1 \geq v \times \left(t_d + \frac{t_{res}}{2} + 0.004 \right)$$

$$v \times t > L_2 + L_3$$

Where ...

L_1 = Minimum distance between the light beams on the ESPE and the detection by the muting sensors [m]

v = Velocity of the material (e.g. of the conveyor belt) [m/s]

t_d = Input delay of the UE403 or the sens:Control device [s]
(see the operating instructions of the UE403 or sens:Control device)

t_{res} = Response time M4000 [s]
(see section 13.1 "Data sheet" on page 115)

t = Total muting time set [s]
(see section 6.3.2 "Monitoring of the total muting time" on page 51)

L_2 = Distance between the two sensor detection lines (sensors activated/sensors clear) [m]

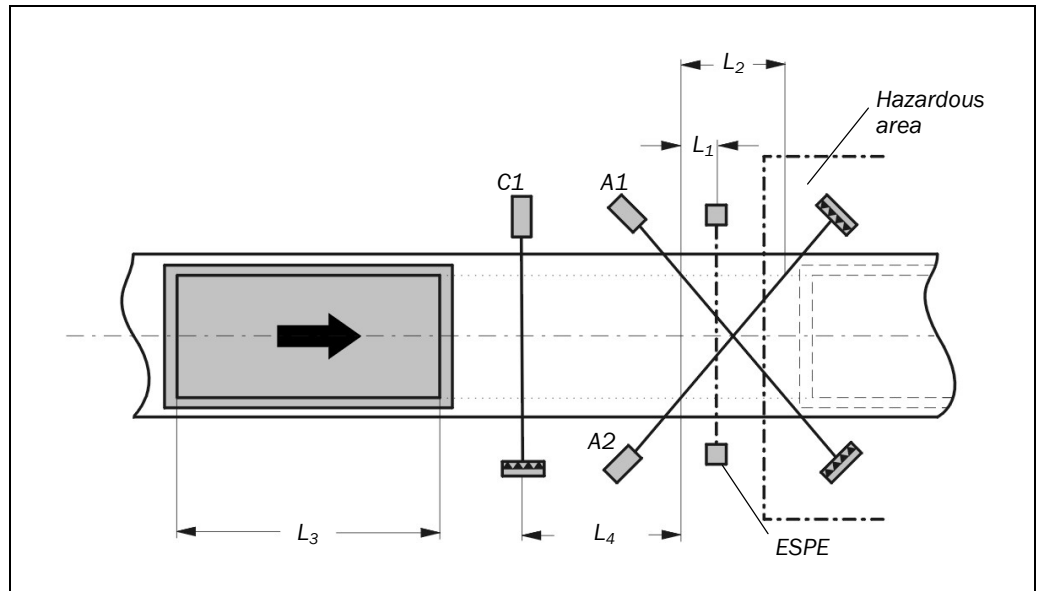
L_3 = Length of the material on the conveyor [m]

Notes

- The material can flow in both directions.
- Place the cross-over point for the muting sensors ① exactly in the path of the ESPE's light beams. If this is not possible, place the cross-over point in the direction of the hazardous area (see Fig. 14).
- This placement is suitable for through-beam photoelectric switches and photoelectric reflex switches.
- You can usefully increase the protection against manipulation and safety using the following configurable functions:
 - Sensor test, see page 50 ff.
 - Concurrence monitoring, see page 51 ff.
 - Monitoring of the total muting time, see page 51 ff.
 - End of muting by ESPE, see page 53 ff.

4.2.2 Muting with two sensors (one sensor pair), crossed placement, and an additional signal C1

Fig. 19: Muting with two sensors, crossed placement, and an additional signal



The protection provided by the protective device is muted when the muting sensors are activated in a defined sequence. The muting sensor (signal C1) must always be activated, before **both** muting sensors in the first sensor pair (e.g. A1 and A2) are active (see section “Additional signal C1” on page 49).

The following requirements must be met:

Tab. 7: Conditions for muting with two sensors and an additional signal

Condition	Description
C1 & A1 & A2	Brief, to the start of the muting. C1 must always be activated, before both muting sensors in the first sensor pair (e.g. A1 and A2) are active.
A1 & A2	Muting applies as long as this condition is met.

How to calculate the distance:

$$L_1 \geq v \times \left(t_d + \frac{t_{res}}{2} + 0.004 \right)$$

$$v \times t > L_2 + L_3$$

$$L_4 < L_3$$

Where ...

L_1 = Minimum distance between the light beams on the ESPE and the detection by the muting sensors [m]

v = Velocity of the material (e.g. of the conveyor belt) [m/s]

t_d = Input delay of the UE403 or the sens:Control device [s]
(see the operating instructions of the UE403 or sens:Control device)

t_{res} = Response time M4000 [s]
(see section 13.1 "Data sheet" on page 115)

t = Total muting time set [s]
(see section 6.3.2 "Monitoring of the total muting time" on page 51)

L_2 = Distance between the two sensor detection lines (sensors activated/sensors clear) [m]

L_3 = Length of the material on the conveyor [m]

L_4 = Maximum distance between C1 and the detection line for A1, A2 [m]

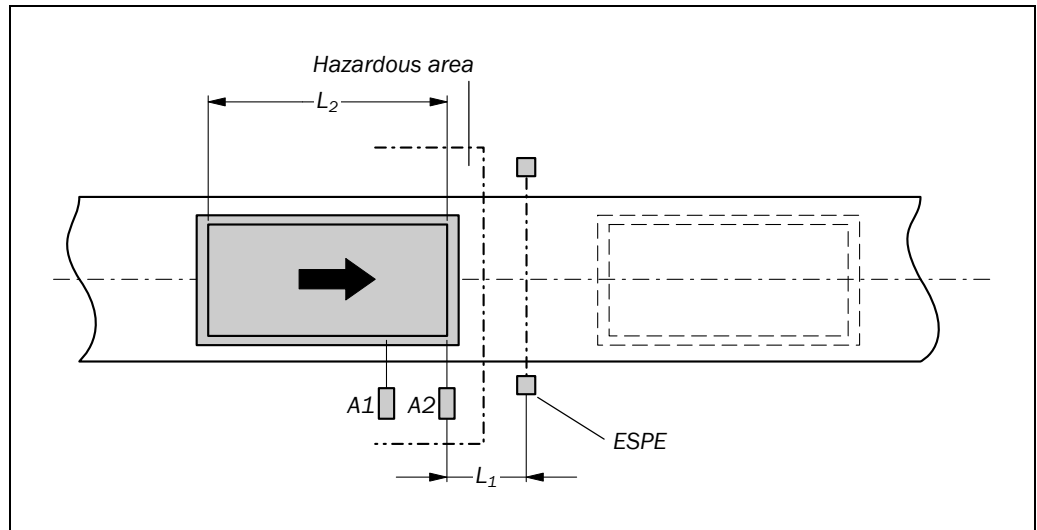
Notes

- The material can only flow in one direction.
- This placement is suitable for through-beam photoelectric switches and photoelectric reflex switches.
- Avoid mutual interference between the sensors.
- You can usefully increase the protection against manipulation and safety using the following configurable functions:
 - Sensor test, see page 50 ff.
 - Concurrence monitoring, see page 51 ff.
 - Monitoring of the total muting time, see page 51 ff.
 - End of muting by ESPE, see page 53 ff.

4.2.3 Muting using two sensors, serial placement (one sensor pair in the hazardous area), exit monitoring with End of muting by ESPE

Note The *Exit monitoring* function is supported by M4000 systems with **firmware $\geq$ V1.50**.

Fig. 20: Muting with two sensors, serial placement



In the case of the *Exit monitoring* function the muting sensors are at the side of the hazardous area. The material moves out of the hazardous area. As soon as all muting sensors (A1 and A2) are actuated, the protection provided by the protective device (ESPE) is bypassed and this situation remains in force until the configured muting hold time (0.5 s ... 4 s) has elapsed or the protective device becomes clear. The muting hold time starts as soon as one of the muting sensors becomes clear.

The following requirements must be met:

Tab. 8: Conditions for muting with two sensors, serial placement

Condition	Description
A1 & A2	Muting starts as soon as this condition is met.
A1 & ESPE or A2 & ESPE or ESPE	Muting applies as long as this condition is met. The muting hold time counts down.

How to calculate the distance:

$$L_1 \geq v \times \left(t_d + \frac{t_{res}}{2} + 0.004 \right)$$

$$v \times t > L_1 + L_2$$

Where ...

L_1 < 200 mm; Minimum distance between the light beams on the ESPE and the detection by the muting sensors [m]

v = Velocity of the material (e.g. of the conveyor) [m/s]

t_d = Input delay of the UE403 or the sens:Control device [s]
(see the operating instructions of the UE403 or sens:Control device)

t_{res} = Response time M4000 [s]
(see section 13.1 "Data sheet" on page 115)

t = Muting hold time set[s] (with *End of muting by ESPE* function activated) or total muting time set [s]
(see section 6.3.2 "Monitoring of the total muting time" on page 51)

L_2 = Length of the material on the conveyor [m]

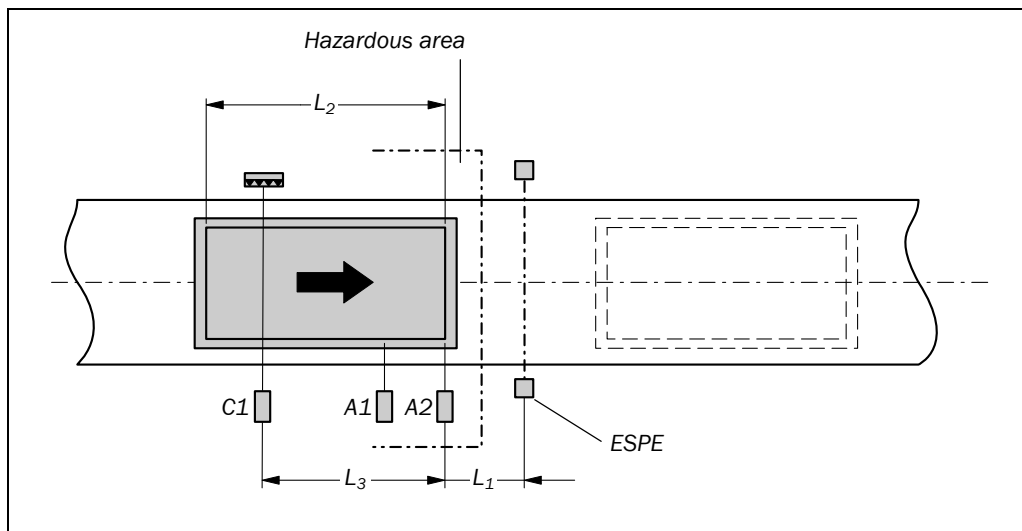
Notes

- Only material flow out of the hazardous area is possible.
- Position the two muting sensors at the side of the hazardous area.
- This placement is suitable for through-beam photoelectric switches and photoelectric reflex switches.
- Avoid mutual interference between the sensors.
- If you activate the *Exit monitoring* function, you must either activate the *End of muting by ESPE* function or configure the *Total muting time*.
- The functions *Direction detection* and *Sequence monitoring* can not be configured.
- You can usefully increase the protection against manipulation and safety using the following configurable functions:
 - Sensor test, see page 50ff.
 - Concurrence monitoring, see page 51ff.
 - Monitoring of the total muting time, see page 51ff.

4.2.4 Muting using two sensors, serial placement (one sensor pair in the hazardous area), with additional signal C1, exit monitoring with End of muting by ESPE

Note The *Exit monitoring* function is supported by M4000 systems with **firmware ≥ V1.50**.

Fig. 21: Muting with two sensors, serial placement, with additional signal C1



In the case of the *Exit monitoring* function the muting sensors are at the side of the hazardous area. The material moves out of the hazardous area. As soon as all muting sensors (A1 and A2 and C1) are actuated, the protection provided by the protective device (ESPE) is bypassed and this situation remains in force until the muting hold time configured (0.5 s ... 4 s) has elapsed or the protective device becomes clear. The muting hold time starts as soon as one of the muting sensors becomes clear. The muting sensor (additional signal C1) must always be activated before the muting sensors A1 and A2 (see section “Additional signal C1” on page 49).

The following requirements must be met:

Tab. 9: Conditions for muting with two sensors, serial placement, with additional signal C1

Condition	Description
C1 & A1 & A2	Muting starts as soon as this condition is met. C1 must always be activated before A1 and A2.
A1 & ESPE or A2 & ESPE	Muting applies as long as this condition is met. The muting hold time counts down.

How to calculate the distance:

$$L_1 \geq v \times \left(t_d + \frac{t_{res}}{2} + 0.004 \right)$$

$$v \times t > L_1 + L_2$$

$$L_3 < L_2$$

Where ...

L_1 < 200 mm; Minimum distance between the light beams on the ESPE and the detection by the muting sensors [m]

v = Velocity of the material (e.g. of the conveyor) [m/s]

t_d = Input delay of the UE403 or the sens:Control device [s]
(see the operating instructions of the UE403 or sens:Control device)

t_{res} = Response time M4000 [s]
(see section 13.1 "Data sheet" on page 115)

t = Muting hold time set [s] (with *End of muting by ESPE* function activated) or total muting time set [s]
(see section 6.3.2 "Monitoring of the total muting time" on page 51)

L_2 = Length of the material on the conveyor [m]

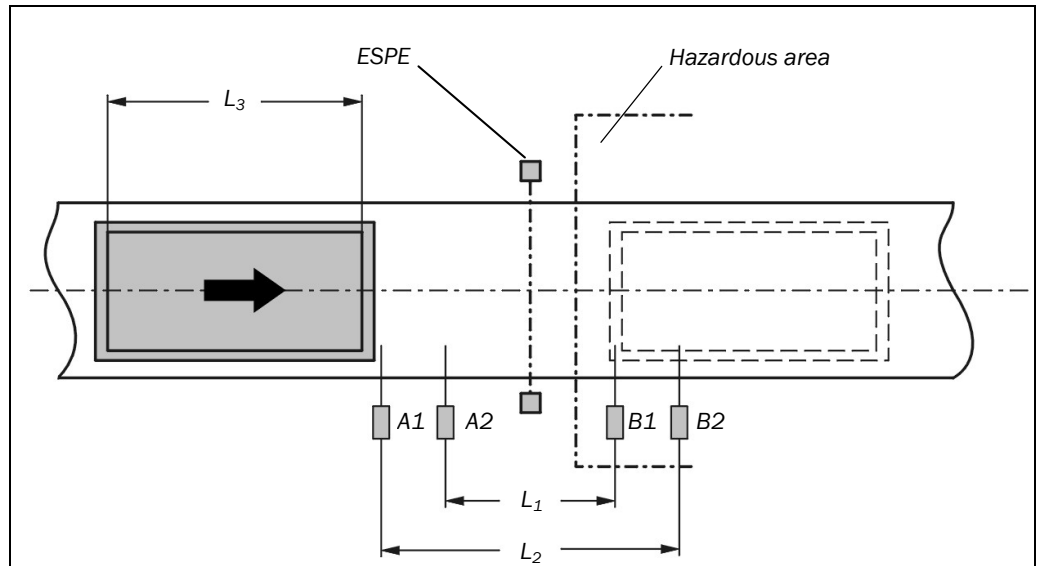
L_3 = Maximum distance between C1 and the detection line of the sensor which is closest to the ESPE [m]

Notes

- Only material flow out of the hazardous area is possible.
- Position the two muting sensors at the side of the hazardous area.
- This placement is suitable for through-beam photoelectric switches and photoelectric reflex switches.
- Avoid mutual interference between the sensors.
- If you activate the *Exit monitoring* function, you must either activate the *End of muting by ESPE* function or configure the *Total muting time*.
- The functions *Direction detection* and *Sequence monitoring* can not be configured.
- You can usefully increase the protection against manipulation and safety using the following configurable functions:
 - Sensor test, see page 50ff.
 - Concurrence monitoring, see page 51ff.
 - Monitoring of the total muting time, see page 51ff.

4.2.5 Muting with four sensors (two sensor pairs), serial placement

Fig. 22: Muting with two serial sensor pairs



In the example, the material moves from left to right. As soon as the muting sensors A1 & A2 are activated, the protection provided by the protective device (ESPE) is muted. The protection remains muted until one of the sensors in the muting sensor pair B1 & B2 is clear again.

The following requirements must be met:

Tab. 10: Conditions for muting with four sensors, serial placement

Condition	Description
A1 & A2 (or B1 & B2)	Brief, to the start of the muting. The first sensor pair is activated as a function of the direction of transport of the material.
A1 & A2 & B1 & B2	Brief, for accepting the muting condition.
B1 & B2 (or A1 & A2)	Muting applies as long as this condition is met. The second sensor pair is activated as a function of the direction of transport of the material.

How to calculate the distance:

$$L_1 \geq v \times 2 \times \left(t_d + \frac{t_{res}}{2} + 0.004 \right)$$

$$v \times t > L_1 + L_3$$

$$L_2 < L_3$$

Where ...

L_1 = Distance between the inner sensors (placement symmetrical in relation the ESPE's light beams) [m]

v = Velocity of the material (e.g. of the conveyor belt) [m/s]

t_d = Input delay of the UE403 or the sens:Control device [s]
(see the operating instructions of the UE403 or sens:Control device)

t_{res} = Response time M4000 [s]
(see section 13.1 "Data sheet" on page 115)

t = Total muting time set [s]
(see section 6.3.2 "Monitoring of the total muting time" on page 51)

L_2 = Distance between the outer sensors (placement symmetrical in relation the ESPE's light beams) [m]

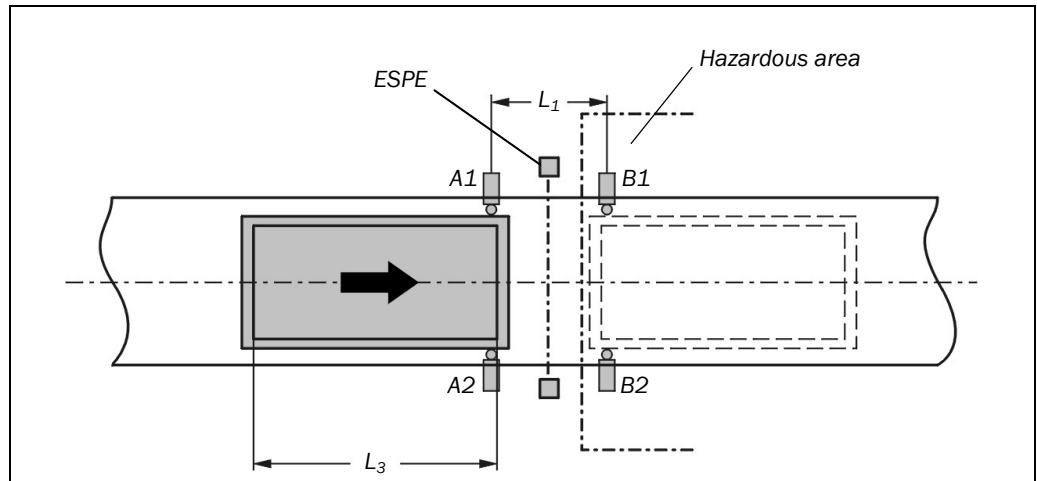
L_3 = Length of the material on the conveyor [m]

Notes

- The material can flow in both directions.
- The direction can also be defined as fixed:
 - Using the additional signal C1: The signal C1 must always be activated, before **both** muting sensors in the first sensor pair (e.g. A1 and A2) are active (see section "Additional signal C1" on page 49).
 - Using the Direction detection function that can be configured in software (page 55ff.).
- All types of sensor can be used in this placement.
- You can usefully increase the protection against manipulation and safety using the following configurable functions:
 - Sensor test, see page 50 ff.
 - Concurrence monitoring, see page 51 ff.
 - Monitoring of the total muting time, see page 51 ff.
 - End of muting by ESPE, see page 53 ff.
 - Sequence monitoring, see page 55 ff.

4.2.6 Muting with four sensors (two sensor pairs), parallel placement

Fig. 23: Muting with two parallel sensor pairs



In the example, the material moves from left to right. As soon as the first muting sensor pair A1 & A2 is activated, the protection provided by the protective device (ESPE) is muted. The protection remains muted until the muting sensor pair B1 & B2 is clear again.

The following requirements must be met:

Tab. 11: Conditions for muting with four sensors, parallel placement

Condition	Description
A1 & A2 (or B1 & B2)	Brief, to the start of the muting. The first sensor pair is activated as a function of the direction of transport of the material.
A1 & A2 & B1 & B2	Brief, for accepting the muting condition.
B1 & B2 (or A1 & A2)	Muting applies as long as this condition is met. The second sensor pair is activated as a function of the direction of transport of the material.

How to calculate the distance:

$$L_1 \geq v \times 2 \times \left(t_d + \frac{t_{res}}{2} + 0.004 \right)$$

$$v \times t > L_1 + L_3$$

$$L_1 < L_3$$

Where ...

L_1 = Distance between the inner sensors (Placement symmetrical to the light path between sender and receiver) [m]

v = Velocity of the material (e.g. of the conveyor belt) [m/s]

t_d = Input delay of the UE403 or the sens:Control device [s]
(see the operating instructions of the UE403 or sens:Control device)

t_{res} = Response time of the M4000 [s]
(see section 13.1 "Data sheet" on page 115)

t = Total muting time set [s]
(see section 6.3.2 "Monitoring of the total muting time" on page 51)

L_3 = Length of the material on the conveyor [m]

Notes

- The material can flow in both directions.
- With the parallel placement, the width of the object allowed is also checked due to the position of the muting sensors. The objects must always fit in an identical width to suit the muting sensors.
- The direction can also be defined as fixed:
 - Using the additional signal C1: The signal C1 must always be activated, before **both** muting sensors in the first sensor pair (e.g. A1 and A2) are active (see section "Additional signal C1" on page 49).
 - Using the Direction detection function that can be configured in software (page 55ff.).
- In this placement, optical proximity sensors and all types on non-optical sensors can be used. Use sensors and proximity sensors with background suppression.
- Avoid mutual interference between the sensors.
- You can usefully increase the protection against manipulation and safety using the following configurable functions:
 - Sensor test, see page 50 ff.
 - Concurrence monitoring, see page 51 ff.
 - Monitoring of the total muting time, see page 51 ff.
 - End of muting by ESPE, see page 53 ff.

5 Configurable functions

This chapter describes the functions on the M4000 multiple light beam safety device that can be set via software. Some of the functions can be combined.



WARNING

Test the protective device after any changes!

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 (see section 9.3 on page 100).

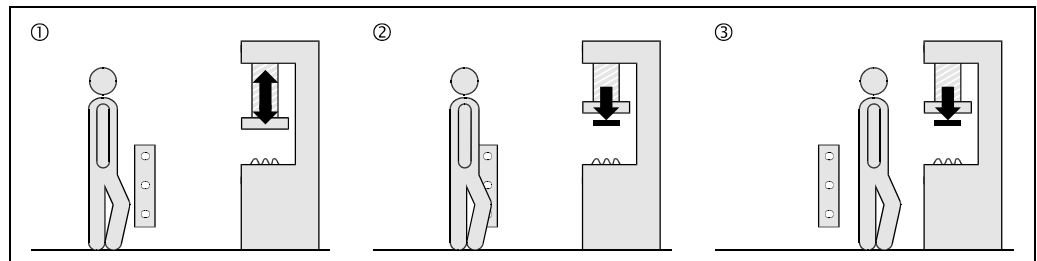
The person who makes the change is also responsible for the correct protective function of the device. When making configuration changes, please always use the password hierarchy provided by SICK to ensure that only authorised persons make changes to the configuration. The SICK service team is available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



When starting to configure the device, you may save an application name with a maximum of 22 characters. Use this function as a “memory jog”, e.g. to describe the application of the current device configuration. Device symbol **M4000 Advanced (sender or receiver)**, **M4000 Advanced (A/P)** or **M4000 Area (sender or receiver)**, context menu **Open device window**, parameter node **General**.

5.1 Restart interlock

Fig. 24: Schematic illustration of the protective operation



The dangerous state of the machine ① is interrupted if the light path is broken ②, and is not re-enabled ③ until the operator presses the reset button situated outside the hazardous area.

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

You can prevent the machine restarting in two ways:

- With the internal restart interlock of the M4000:
The M4000 controls the restart.
- With the restart interlock of the machine (external):
The M4000 has no control over the restart.

Tab. 12: Permissible configuration of the restart interlock

The possible combinations are shown in the following table:

Restart interlock of the M4000	Restart interlock of the machine	Permissible application
Deactivated	Deactivated	Only when it is not possible to stand behind the multiple light beam safety device. Observe EN 60 204-1!
Deactivated	Activated	All
Activated	Deactivated	Only when it is not possible to stand behind the multiple light beam safety device. Observe EN 60 204-1!
Activated	Activated	All. The restart interlock of the M4000 handles the Reset function (see "Reset" further below).



WARNING

Always configure the application with restart interlock!

Ensure that there is always a restart interlock. The M4000 is unable to verify if the restart interlock of the machine is operable. If you deactivate both the internal and the external restart interlock, the users and operators of the machine will be at acute risk of injury.

The electrical connection of the reset button is described in chapter 8.5 "Reset button" on page 87.



Recommendation

Device symbol **M4000 Advanced (receiver)**, **M4000 Advanced (A/P)** or **M4000 Area (receiver)**, context menu **Open device window**, parameter node **General**.

You can indicate the status "Reset required" using a signal lamp. The M4000 has a dedicated output for this purpose. The electrical connection of the signal lamp is described in chapter "Connection of a Reset required signal lamp" on page 87.

Reset

If you want to activate the restart interlock on the M4000 (internal) and also a restart interlock on the machine (external), then each restart interlock has its own button.

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

- the M4000 activates the output signal switching devices.
- the multiple light beam safety device changes to green.

Only the external restart interlock prevents the machine from restarting. After pressing the reset button for the M4000, 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.

5.2 Beam coding

If several multiple light beam safety devices 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: non-coded, code 1 and code 2.

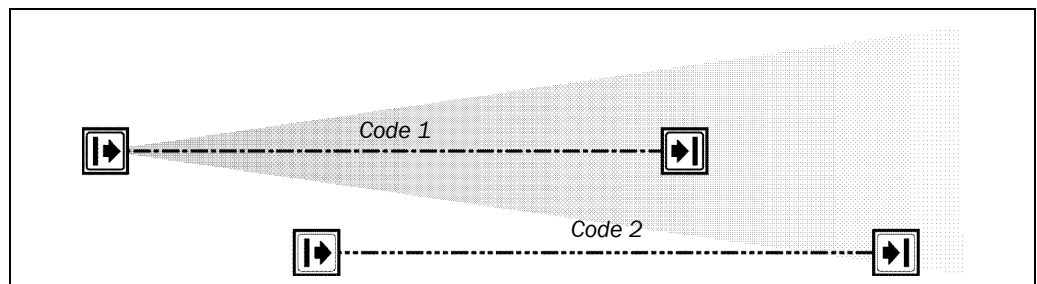


WARNING

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. 25: Schematic illustration 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.
- Within a system you must configure the beam coding for every device (sender **and** receiver) separately.
- After switching on, the 7-segment display of sender and receiver will briefly display the coding.



Device symbol **M4000 Advanced (sender or receiver)**, **M4000 Advanced (A/P)** or **M4000 Area (sender or receiver)**, context menu **Open device window**, parameter node **General**.

5.3 Application diagnostic output (ADO)

The M4000 has an application diagnostic output (ADO) that can be configured. With the aid of the application diagnostic output, the multiple light beam safety device can signal specific states. You can use this output for a relay or a PLC.



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.

Tab. 13: Possible configuration for the application diagnostic output

The connection can signal one of the following states:

Assignment	Possible uses
Contamination (OWS)	Eases diagnostics in case of contaminated front screen
OSSD status	Signals the status of the output signal switching devices when the multiple light beam safety device switches to red or green ¹⁾
Reset required	Signals the status "Reset required"
Muting status	Signals the status "Muting" (only M4000 Advanced and M4000 Advanced A/P in conjunction with UE403 or sens:Control device)
Override status	Signals the status "Override" (only M4000 Advanced and M4000 Advanced A/P in conjunction with UE403 or sens:Control device)

The electrical connection of a PLC to the application diagnostic output is described in chapter 8.6 "Application diagnostic output (ADO)" on page 88.

Notes

- When you connect the application diagnostic output as an alarm signal for contamination (OWS) or for the OSSD status, then during the configuration you can choose how the application diagnostic output is to signal the alarm.
 - HIGH active: If there is contamination or if the OSSDs are switched on, 24 V are present. Otherwise the output is high resistance.
 - LOW active: If there is contamination or if the OSSDs are switched on, the output is high resistance. Otherwise 24 V are present¹⁾.
- If you use the application diagnostic output as an alarm signal for "Reset required", it has a frequency of 1 Hz.
- If you connect the application diagnostic output as an alarm signal for muting or override status, then the application diagnostic output will always signal the alarm with an active HIGH. With muting or override 24 V are present. Otherwise the output is high resistance.



Device symbol **M4000 Advanced (receiver)**, **M4000 Advanced (A/P)** or **M4000 Area (receiver)**, context menu **Open device window**, parameter node **General**.

¹⁾ With external device monitoring activated, the OSSD status function cannot be configured as **active LOW**.

5.4 Scanning range



WARNING

Configure the scanning range to suit the dimension of the light path between sender and receiver!

You must adjust the scanning range of every system to the dimension of the light path between sender and receiver.

- If the scanning range is set too low, the multiple light beam safety device may not switch to green.
- If the scanning range is set too large, the multiple light beam safety device may malfunction due to reflections. This would mean that the operator is at risk.

Notes

- Additional front screens (SICK accessories see page 136) reduce the effective scanning range.
- Deflector mirrors (see page 128f.) reduce the effective scanning range. It is dependent on the number of deflector mirrors in the light path.
- A further reduction in the scanning range is possible due to soiling, e.g. of the additional front screens or deflector mirrors used.
- The scanning ranges with deflector mirrors given apply for beam deflections between 80° and 110°.

5.4.1 Scanning range of the M4000 Advanced

You can set the M4000 Advanced multiple light beam safety device to two different scanning ranges. The effective scanning range is dependent here upon the dimension of the light path between sender and receiver and the number of deflector mirrors and additional front screens used. You will find the necessary scanning ranges and the resulting setting in Tab. 14.

The following scanning ranges are available:

- low scanning range (0.5-20 m)
- high scanning range (9-70 m)



Device symbol **M4000 Advanced (receiver)**, context menu **Open device window**, parameter node **General**.

Tab. 14: Scanning range of the M4000 Advanced as a function of the number of deflections per beam and the additional front screens

Number of deflections per beam	Number of additional front screens	M4000 Advanced with short scanning range	M4000 Advanced with long scanning range
None	Without	0.5-20.0 m	9.0-70.0 m
	1	0.5-18.4 m	9.0-64.4 m
	2	0.5-16.9 m	9.0-59.2 m
1	Without	0.5-18.0 m	9.0-63.0 m
	1	0.5-16.5 m	9.0-57.9 m
	2	0.5-15.1 m	9.0-53.2 m
2	Without	0.5-16.0 m	9.0-56.0 m
	1	0.5-14.7 m	9.0-51.5 m
	2	0.5-13.5 m	9.0-47.3 m
3	Without	0.5-14.3 m	9.0-50.0 m
	1	0.5-13.1 m	9.0-46.0 m
	2	0.5-12.0 m	9.0-42.3 m
4	Without	0.5-12.8 m	9.0-45.0 m
	1	0.5-11.7 m	9.0-41.4 m
	2	0.5-10.7 m	9.0-38.0 m

5.4.2 Scanning range of the M4000 Advanced Curtain system

Information on the scanning range of the M4000 Advanced Curtain-system can be found in the corresponding Addendum Operating Instructions "M4000 Standard Curtain and M4000 Advanced Curtain" in the "Scanning Range" section.

5.4.3 Scanning range of the M4000 Advanced A/P

With the M4000 Advanced A/P multiple light beam safety device you must differentiate between the **scanning range to be configured** and the **maximum effective scanning range**.

You must configure the scanning range to be configured to suit the deflector unit used (mirror deflection or fibre-optic deflection) (see Tab. 15).

Tab. 15: Scanning range of the M4000 Advanced A/P to be configured dependent of the deflector unit used

Deflector unit used	Scanning range to be configured
Mirror deflection - M4000 Passive with mirror deflection or - two deflector mirrors PSK45 (see section 13.3.10 "Deflector mirror PSK45" on page 129) or - one mirror column (part number: 1041917, see section 14.5 "Deflector mirrors and mirror columns" on page 138)	Low scanning range
Fibre-optic deflection M4000 Passive with fibre-optic deflection	High scanning range



Device symbol **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **General**.

The maximum effective scanning range is dependent here on the number of deflections between the M4000 Advanced A/P and the M4000 Passive and the number of additional front screens used (see Tab. 16).

Tab. 16: Maximum effective scanning range of the M4000 Advanced A/P as a function of the number of deflections and the number of additional front screens

Number of deflections ²⁾	Number of additional front screens	Maximum effective scanning range	
		Mirror deflection	Fibre-optic deflection
None	Without	7.5 m	4.5 m
	1	6.3 m	3.8 m
	2	5.1 m	3.5 m
1	Without	6.0 m	Not recommended
	1	5.1 m	Not recommended
	2	4.3 m	Not recommended

²⁾ Between M4000 Advanced A/P and M4000 Passive.

5.4.4 Scanning range of the M4000 Area 60/80

The scanning range of the M4000 Area 60/80 multiple light beam safety device is dependent on the related resolution and the beam separation.

Note Additional front screens reduce the scanning range. Pay attention to the related maximum scanning range dependent of the number of additional front screens in Tab. 17 and Tab. 18.

M4000 Area 60

You can set the M4000 Area 60 multiple light beam safety device to two different scanning ranges. The effective scanning range is dependent here upon the dimension of the light path between sender and receiver and the number of additional front screens used. You will find the necessary scanning ranges and the resulting setting in Tab. 17.

The following scanning ranges are available:

- low scanning range (0.5-6 m)
- high scanning range (5-19 m)



Device symbol **M4000 Area (receiver)**, context menu **Open device window**, parameter node **General**.

Tab. 17: Scanning range of the M4000 Area 60 as a function of the number of additional front screens

Number of additional front screens	M4000 Area 60 with short scanning range	M4000 Area 60 with long scanning range
Without	0.5-6.0 m	5.0-19.0 m
1	0.5-5.5 m	5.0-17.4 m
2	0.5-5.0 m	5.0-15.9 m

M4000 Area 80

You can set the M4000 Area 80 multiple light beam safety device to two different scanning ranges. The effective scanning range is dependent here upon the dimension of the light path between sender and receiver and the number of additional front screens used. You will find the necessary scanning ranges and the resulting setting in Tab. 18.

The following scanning ranges are available:

- low scanning range (0.5-20 m)
- high scanning range (9-70 m)³⁾



Device symbol **M4000 Area (receiver)**, context menu **Open device window**, parameter node **General**.

Tab. 18: Scanning range of the M4000 Area 80 as a function of the number of additional front screens

Number of additional front screens	M4000 Area 80 with short scanning range	M4000 Area 80 with long scanning range
Without	0.5-20.0 m	9.0-70.0 m
1	0.5-18.4 m	9.0-64.4 m
2	0.5-16.9 m	9.0-59.2 m

³⁾ 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 %.

5.5 External device monitoring (EDM)

The external device monitoring (EDM) checks if the contactors actually de-energize when the protective device responds. If you activate external device monitoring, then the M4000 checks the contactors after each interruption to the light path and prior to machine restart. The EDM can so identify if one of the contacts has fused, for instance. In this case the external device monitoring places the system in the safe operational status. The OSSDs are not re-activated in this case.

Note The indicators and the operational status after the external device monitoring has triggered are dependent on the type of error present and the configuration of the internal restart interlock in the M4000 (see Tab. 19).

Tab. 19: Device status after the external device monitoring has triggered

Internal restart interlock of the M4000	Signal on the EDM input	Device status after the external device monitoring has triggered		
		Display of the 7-segment display	Display of the diagnostics LED	Operational status
Activated	Permanently 0 V		● Red	Output signal switching devices off
	Permanently 24 V		● Red ● Yellow	Output signal switching devices off and "Reset required"
Deactivated	Permanently 0 V		● Red	Output signal switching devices off
	Permanently 24 V		● Red	Lock-out

The electrical connection for the external device monitoring is described in chapter 8.4 "External device monitoring (EDM)" on page 86.



Device symbol **M4000 Advanced (receiver)**, **M4000 Advanced (A/P)** or **M4000 Area (receiver)**, context menu **Open device window**, parameter node **General**.

5.6 Sender test

Note The function Sender test is not available with the M4000 Advanced A/P.
The M4000 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.

- During the test the sender indicates .
- The test is successful, if the M4000 receiver switches to red, i.e. the output signal switching devices (OSSDs) are deactivated.

Note M4000 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.
- a means of controlling the test input must be available.



Device symbol **M4000 Advanced (sender)** or **M4000 Area (sender)**, context menu **Open device window**, parameter node **General**.

The electrical connection at the test input is described in chapter 8.7 “Test input (sender test)” on page 89.

The pin assignment of the system connection is described in chapter 8.1 “System connection M26 × 11 + FE” on page 82.

6 Configurable muting functions

This section describes the muting functions of the M4000 Advanced multiple light beam safety device which can be adjusted with the software and can only be used *in conjunction with an UE403 safety relay or a sens:Control device*. The functions can be partially combined with the other configurable functions of the multiple light beam safety device.



Test the protective device after any changes!

The entire protective device must be tested for correct operation after each change of the configuration (see Operating Instructions for the M4000 Advanced multiple light beam safety device, section 9.3 “Test notes” from page 100 as well as the operating instructions of the corresponding UE403 or sens:Control 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.

6.1 Number of muting sensors

To realise muting, two to four sensors can be connected. The number of sensors is defined by the geometry of the object to be detected.

You can use the following sensor combinations:

- two sensors (one sensor pair)
- two sensors (one sensor pair) and an additional signal C1
- for the *Exit monitoring* function:
 - two sensors (one sensor pair) at the side of the hazardous area
 - two sensors (one sensor pairs) and one additional signal C1 at the side of the hazardous area
- four sensors (two sensor pairs)
- four sensors (two sensor pairs) and an additional signal C1

Electrical connection of muting sensors is described in the chapter “Electrical Installation” of the operating instructions of the corresponding UE403 or sens:Control device.



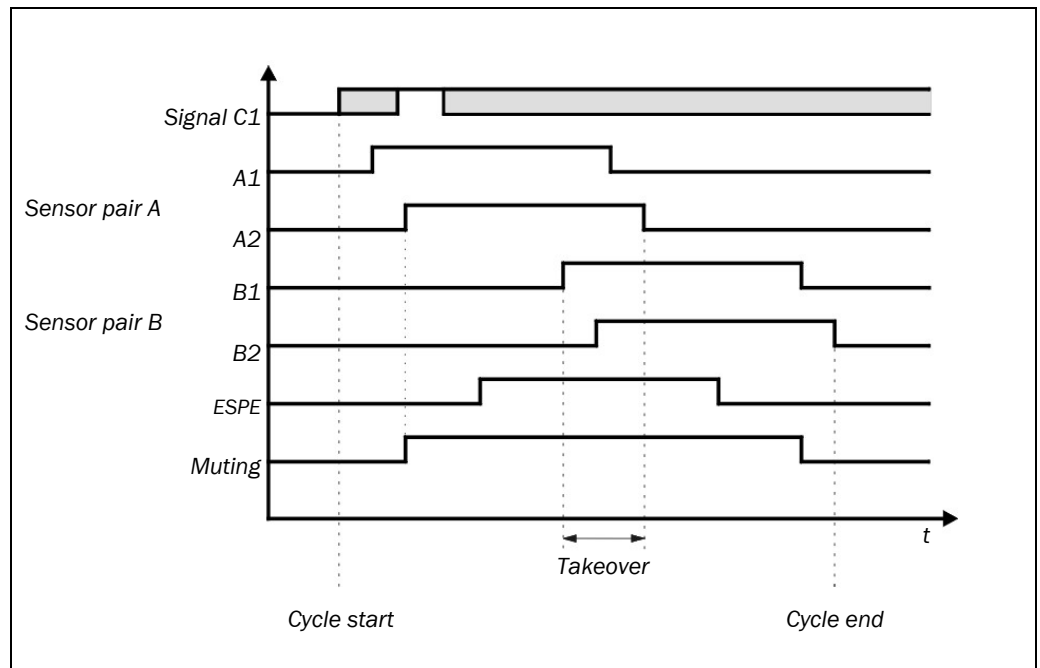
You define the number of muting sensors by allocating the muting sensors to the related connection using drag and drop. Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **I/O configuration**.

Additional signal C1

You can also connect an additional signal C1 to the muting sensors. The signal can be a control signal from a PLC or a further sensor. The additional signal C1 is not allowed to be a static signal. It is checked for dynamic behaviour during the muting cycle. If dynamic signal behaviour is not detected, no further muting can be initiated.

The following dynamic sequence must be present at the input:

Fig. 26: Signal sequence with integrated C1 input during the muting cycle



- Notes**
- To activate muting, a LOW/HIGH signal change must occur on input C1, before **both** muting sensors in the first sensor pair (e.g. A1 and A2) are active. If this is not the case, then muting is not initiated.
 - If muting has been initiated, then a HIGH/LOW signal change must then occur on input C1. If this is not the case, muting cannot be initiated again.
 - If you activate the additional signal C1, the direction detection function is activated automatically and cannot be deactivated.
 - Information on the possible combinations of additional signal C1 and on connection can be found in section 6.10 "Combinable muting functions and facilities for connecting" from page 63.

6.2 Sensor test

Notes

- Sensor test is only possible with testable optical proximity switches and only in conjunction with the UE403 and is only performed when the *sensor test* function has been configured.
- You can usefully increase safety with testable and non-testable sensors by using the configurable functions (e.g. time monitors, direction detection, sequence monitoring).

To ensure that a sensor is connected and functioning, the system sends a short test signal (LOW signal) to the sensor when the muting sensor is activated and waits for its reply (HIGH signal on the output). The test pulse lasts 30 ms and does not affect the muting function.



Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **Sensor configuration**.

6.2.1 Testable sensors

Testable sensors provide a continuous check on their correct function.

Testable sensors must meet the following technical requirements:

- Tests must be possible in the activated state (when material activates the sensor).
- In the activated state the LOW output signal must be output.

Tab. 20: Output signals of testable sensors

Testable sensors output	Status
LOW	Activated, material detected
HIGH	Deactivated, no material detected

6.2.2 Non-testable sensors

All sensors that do not comply with the technical requirements for testable sensors are considered non-testable sensors. On non-testable sensors, the HIGH output signal is always output in the activated state.

Tab. 21: Output signals of non-testable sensors

Non-testable sensors output	Status
HIGH	Activated, material detected
LOW	Deactivated, no material detected

6.3 Time monitoring

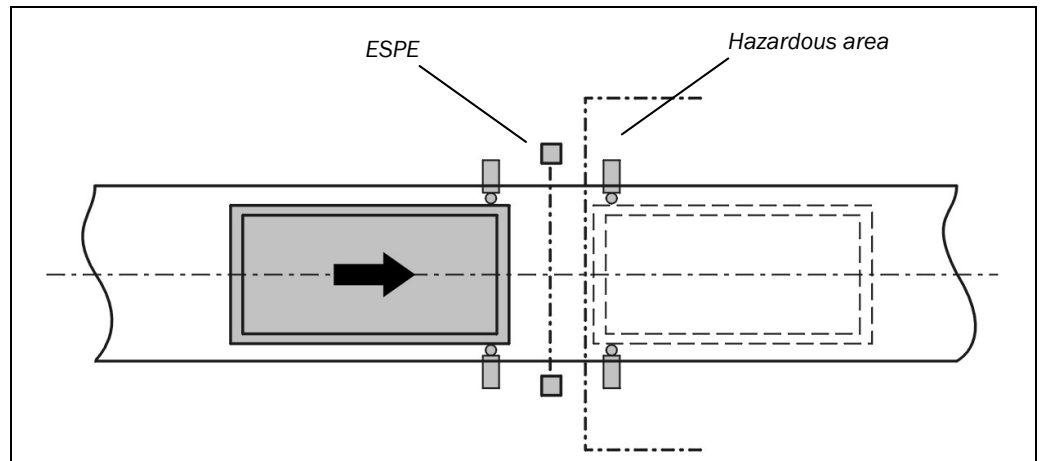
6.3.1 Concurrence monitoring

For protection against manipulation (e.g. covering an optical sensor) of the safety application, you can configure what is known as *Concurrence monitoring*.

The concurrence monitoring monitors whether both muting sensors in a sensor pair are actuated within a configurable time (100 ms to 3000 ms).

Note The configurable time for the concurrence monitoring applies to both sensor pairs.

Fig. 27: Concurrence monitoring



Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **Sensor configuration**.

6.3.2 Monitoring of the total muting time

With active *Monitoring of the total muting time*, the maximum duration of the muting is limited:

- Exit monitoring function deactivated: Total muting time 10 to 300 seconds
- Exit monitoring function activated: Total muting time 10 seconds to 8 hours

The muting is brought to an end at the latest at the end of the total muting time.

Note Monitoring of the total muting time is also active during partial blanking (see section 6.6 on page 56).



WARNING

Configure the shortest possible muting hold time!

In combination with the *Exit monitoring* function the muting hold time remaining after leaving the monitored area must be ≤ 1 second. Otherwise people could enter undetected the hazardous area which has become clear.

- Configure the shortest possible muting hold time or adjust the transport velocity to the requirements.
- In combination with the *Exit monitoring* function use the *End of muting by ESPE* function.



Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **Muting configuration**.

6.3.3 Sensor gap monitoring

If a valid muting condition is present for a sensor pair, then a sensor can become clear (inactive) again for a defined time without lifting the valid muting condition. The defined time (10 ms to 1000 ms) can be adjusted by CDS.

Notes

- Only one sensor pair is allowed to be clear (inactive) for a short time.
- A valid muting condition must be met at the sensor pair affected.



Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **Sensor configuration**.

6.3.4 Belt stop

To ensure a valid muting condition is not reset by time monitoring elapsing during a belt stop, the following time monitoring functions can be stopped using the *Belt stop* function and a belt stop signal:

- Monitoring of the total muting time
- Concurrence monitoring
- Muting hold time

3 seconds after the belt stop the system starts to monitor the active muting sensors.

When the conveyor belt is restarted, muting ...

- is continued if the muting condition is still valid.
- stopped if the muting condition was invalid.

Note

If the belt stop function is configured in the CDS, the conveyor belt signal must be applied to the belt stop input (see section 6.10 "Combinable muting functions and facilities for connecting" on page 63).

Tab. 22: Input signals from belt stop

Belt stop input	Status
HIGH	Conveyor belt is running, muting time monitoring active
LOW	Conveyor belt is stationary: • The muting time monitoring is stopped. and • The last state of the active muting sensors and the ESPE is monitored.

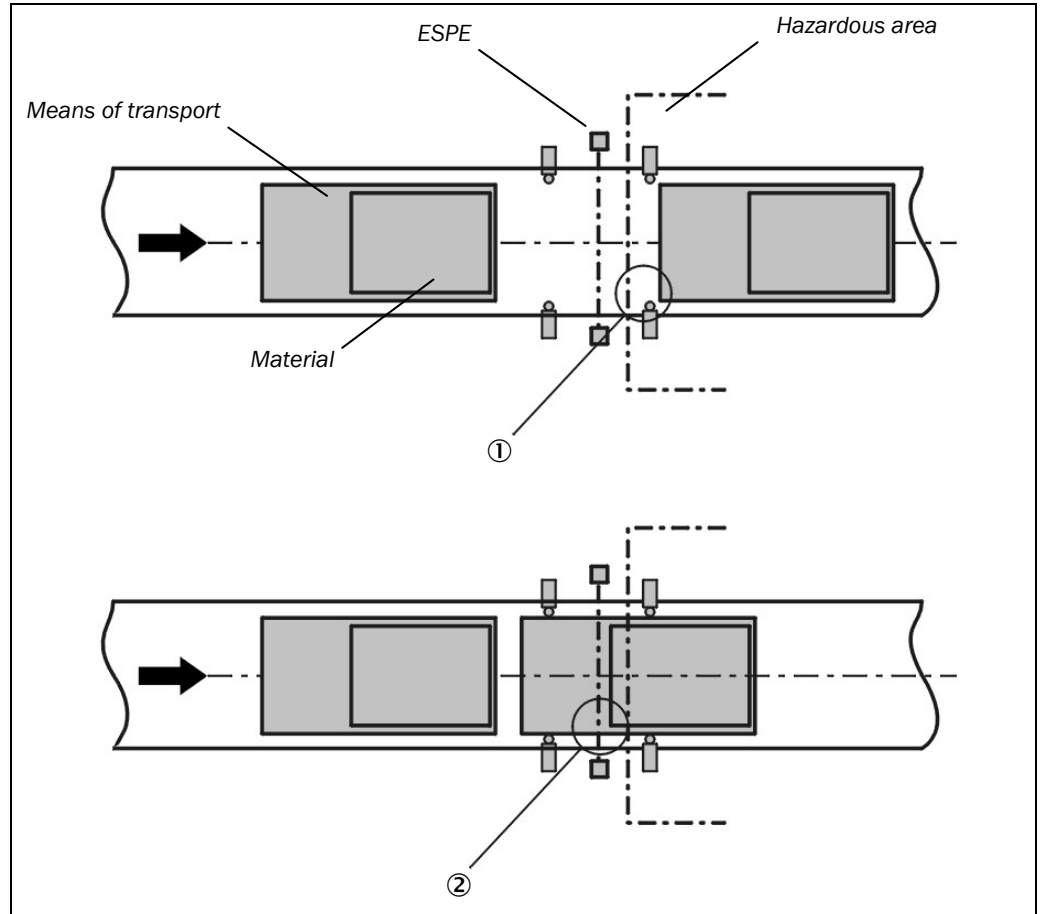


Configure belt stop by allocating the signal for belt stop to the related connection using drag and drop. Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **I/O configuration**.

6.3.5 End of muting by ESPE

Muting ends if a sensor in the last sensor pair becomes inactive and as a result a valid muting condition is not met. The *End of muting by ESPE* function shortens the duration of muting to the time at which the ESPE light path becomes clear again. In this way you will achieve a shorter muting time and at the same time, a high level of safety.

Fig. 28: End of muting by ESPE



Without the *End of muting by ESPE* function, muting is only brought to an end when a sensor in the last sensor pair becomes clear again (see ① in Fig. 28).

With the *End of muting by ESPE* function, muting is brought to an end when the ESPE becomes clear again (see ② in Fig. 28).

- Notes**
- Material and means of transport must be detected by the muting sensors or the ESPE over their entire length. There must not be any detectable gaps as otherwise muting will be brought to an end prematurely.



If the ESPE does not always accurately detect the end of muting due to irregularities of the material or means of transport, plant availability can be increased by configuring a **muting end delay** of up to 1000 ms in the EDS.

- If the ESPE's light path does not become clear again, muting will be brought to an end at the latest when the muting condition is no longer met.



Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **Muting configuration**.

6.3.6 Exit monitoring

- Note** The *Exit monitoring* function is supported by M4000 systems with **firmware ≥ V1.50**. You can use the *Exit monitoring* function if material is allowed to move out of the hazardous area while a person is however not allowed enter.

- The muting hold time configured starts as soon as the muting condition is no longer met.
- Muting ends as soon as the muting hold time configured has elapsed or – if *End of muting by ESPE* is configured – if the ESPE becomes clear.

Fig. 29: Exit monitoring:
Signal sequence of the
configured muting hold time

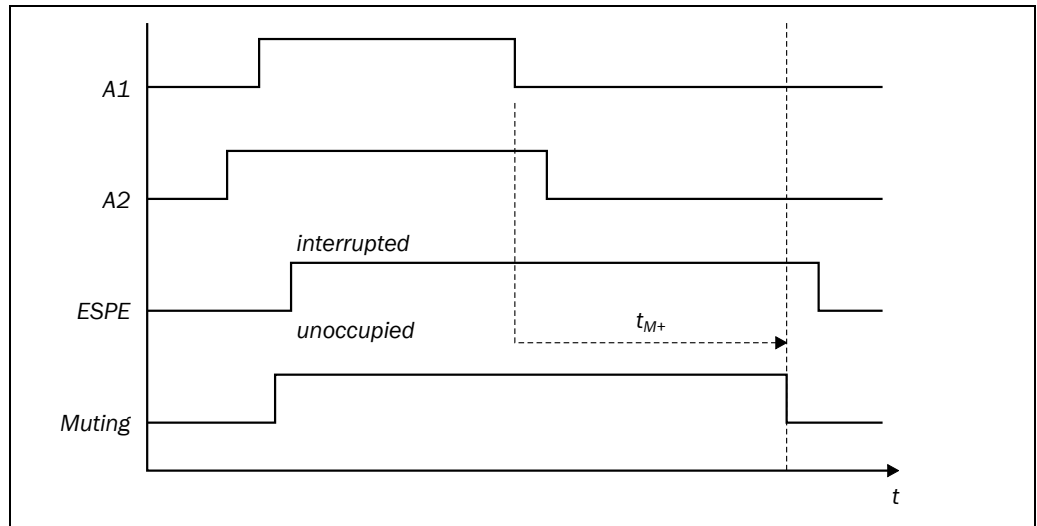
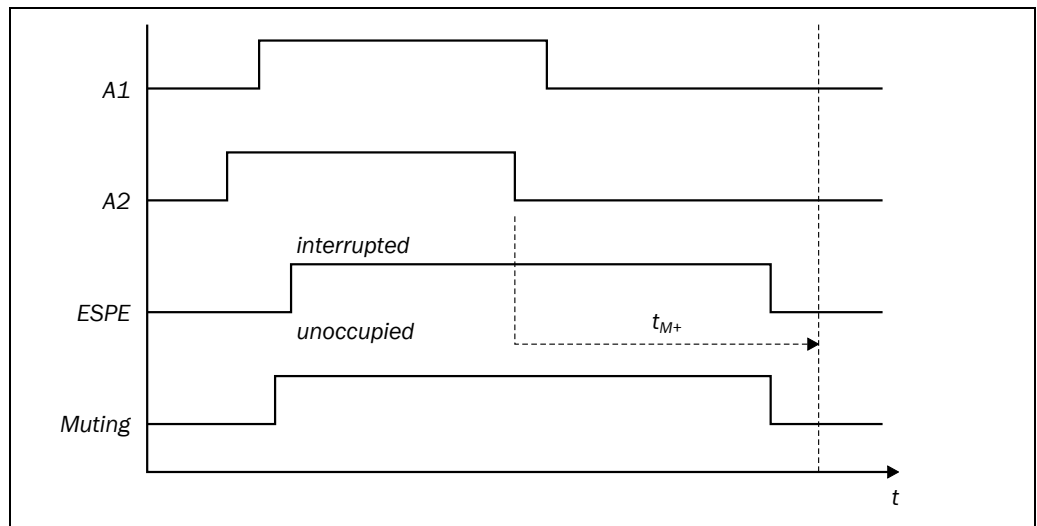


Fig. 30: Exit monitoring:
Signal sequence on End of
muting by ESPE



Note You must place the muting sensors such that the entire length of both the material and the means of transport is detected by sensors or the ESPE. There must not be any detectable gaps as otherwise muting will be brought to an end prematurely (reduced system availability).

- Recommendations**
- The *End of muting by ESPE* function shortens the duration of muting to the time at which the ESPE light path becomes clear again. In this way you will achieve a shorter muting time and at the same time, a higher level of safety.
 - If the ESPE does not always accurately detect the end of muting due to irregularities of the material or means of transport, plant availability can be increased by configuring a **muting end delay** of up to 1000 ms in the EDS.
 - If you activate the *Exit monitoring* function, you must either activate the *End of muting by ESPE* function or configure the *Total muting time*.



Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **Muting configuration**.

6.4 Direction detection

If *Direction detection* is activated, a sensor pair must be triggered and cleared again in a specific sequence. The material can only pass the protective device in one direction. The order of the sensors within a sensor pair is not relevant here. The following table shows the exact conditions as a function of the number of sensors.

Tab. 23: Conditions for direction detection

Number of muting sensors	Conditions to be met
2 (1 sensor pair)	Direction detection is not possible
4 (2 sensor pairs)	The sensor pairs must be triggered in the following order as a function of the direction set: • sensor pair A before sensor pair B or • sensor pair B before sensor pair A

For the muting conditions to be met, the object is only allowed to move through the muting sensors in the direction and order described.



Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **Muting configuration**.

6.5 Sequence monitoring

If *Sequence monitoring* is activated, the sensors must be triggered and cleared again in a specific sequence. The material must completely pass the protective device to ensure that a muting error does not occur. The direction can be additionally defined by the configuration of the *Direction detection*. The table shows the exact conditions as a function of the number of sensors.

Tab. 24: Conditions for sequence monitoring

Number of muting sensors	Conditions to be met
2 (1 sensor pair)	Sequence monitoring not possible
4 (2 sensor pairs)	• A₁ before A₂ before B₁ before B₂ (defined direction, defined sequence) or • B₂ before B₁ before A₂ before A₁ (defined direction, defined sequence) or • A₁ before A₂ before B₁ before B₂ or B₂ before B₁ before A₂ before A₁ (changing direction, defined sequence)

For the muting conditions to be met, the object is only allowed to move through the muting sensors in the direction and order described.

Note If you activate the additional signal C1, the *Direction detection* function is activated automatically and cannot be deactivated.

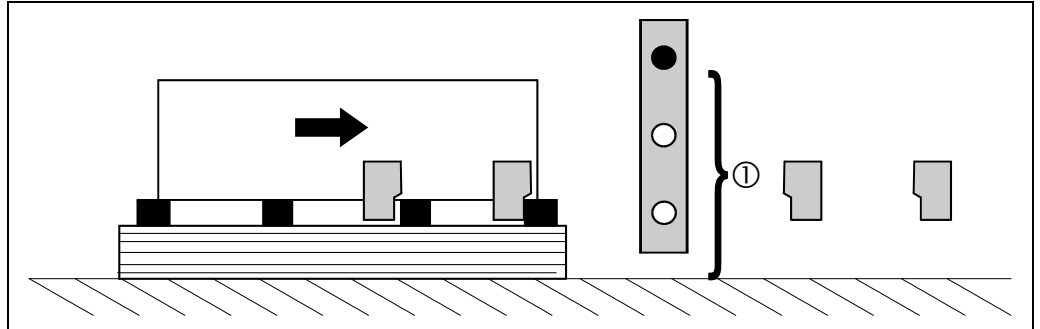


Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **Muting configuration**.

6.6 Partial blanking

Muting mutes the ESPE on the presence of a valid muting condition. With the *Partial blanking* function, safety can be increased by only blanking part of the ESPE on the presence of a valid muting condition. One or more light beams remain permanently active.

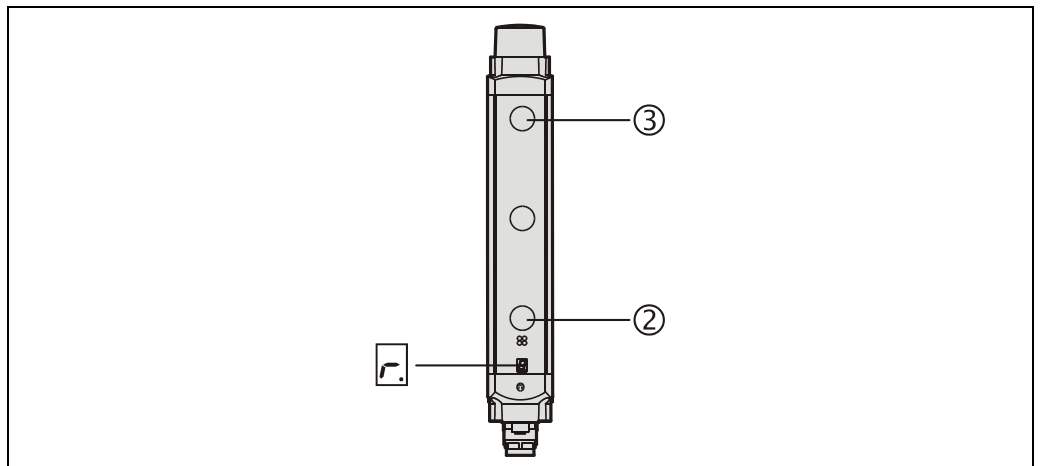
Fig. 31: Principle of operation of the partial blanking function



The part of the ESPE configured by the partial blanking function is blanked on the presence of a valid muting condition ① (e.g. for a specific object height). The rest of the light beams remain active; an interruption to the light beams in the active area always results in the shutdown of the OSSDs.

The area to be blanked is configured by entering the start of the blanking (see Fig. 32: first beam adjacent to display ② or first beam remote from display ③) and the number of blanked beams.

Fig. 32: Start of the blanking



- Notes**
- Even if partial blanking is configured, the active light beams can be muted by an override.
 - Monitoring of total muting time is also active during partial blanking (see section 6.3.2 on page 51).
 - The partial blanking is **not** signalled by the muting lamp.



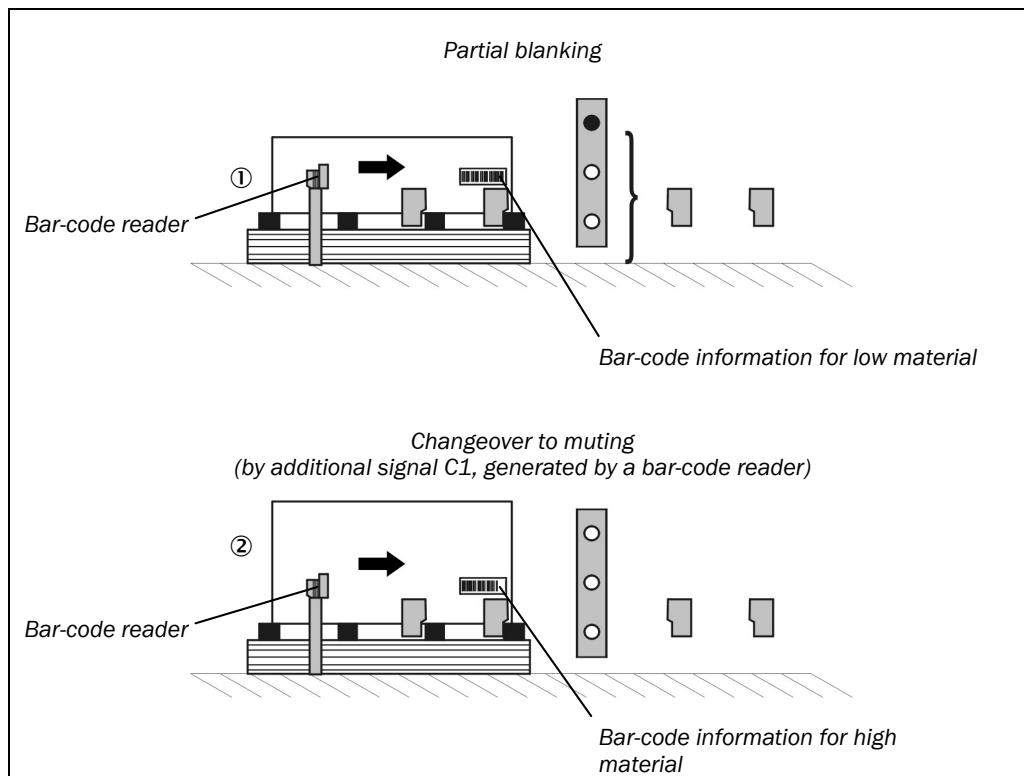
Device symbol **M4000 Advanced (receiver)**, context menu **Open device window**, parameter node **Muting configuration** and parameter node **Partial blanking**.

6.7 Partial blanking/muting changeover

If partial blanking is configured, this function makes it possible to switch between partial blanking and muting. To ensure that an incorrect signal does not trigger invalid changeover from the partial blanking function to the muting function, it is checked whether a valid condition for changeover is present with the aid of the additional signal C1 (dynamic sequence) (see section “Additional signal C1” on page 49).

A changeover is only sensible if, e.g., different material heights are transported at irregular intervals and some beams cannot remain permanently active without interrupting the material flow. The material can be classified, e.g., using a bar-code reader that generates the signal C1 necessary for the changeover.

Fig. 33: Principle of operation of the changeover between the partial blanking and muting functions using a bar-code reader



In the example, the changeover between the partial blanking and muting functions is performed using a bar-code reader. The different material heights are classified and saved using bar-codes. The bar-code reader classifies the material and generates the changeover signal C1 over a separate output as required.

If the bar-code reader detects low material ①, the partial blanking configured remains active.

If the bar-code reader detects high material ②, it generates the additional signal C1 and the configured changeover between partial blanking and muting is performed.

Tab. 25: Selection of the type of muting as a function of the input signal

Input C1	Type of muting
Partial blanking/muting	
LOW	Partial blanking
HIGH	Muting

- Notes**
- To activate muting, a LOW/HIGH signal change must occur on input C1, before **both** muting sensors in the first sensor pair (e.g. A1 and A2) are active. If this is not the case, the partial blanking function is initiated on the activation of the sensors in the first sensor pair.
 - If muting has been initiated, then a HIGH/LOW signal change must then occur on input C1. If this is not the case, muting cannot be initiated again.
 - You will find information on the connection and on the possible combinations for the additional signal C1 in section 6.10 “Combinable muting functions and facilities for connecting” from page 63.



Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **Muting configuration**.

6.8 Override

Override is a manual triggering of muting after an error in the muting conditions. By means of the brief simulation of a valid muting condition, you can mute the protective device (muting) and then move the system clear and establish an error-free state.

Override can be realised using an external circuit or using the integrated override function.

6.8.1 Override realised using an external circuit

An additional key-operated switch connects the relay K1/K2 directly to 24 V. In this way you overwrite the outputs OSSD1 and OSSD2.

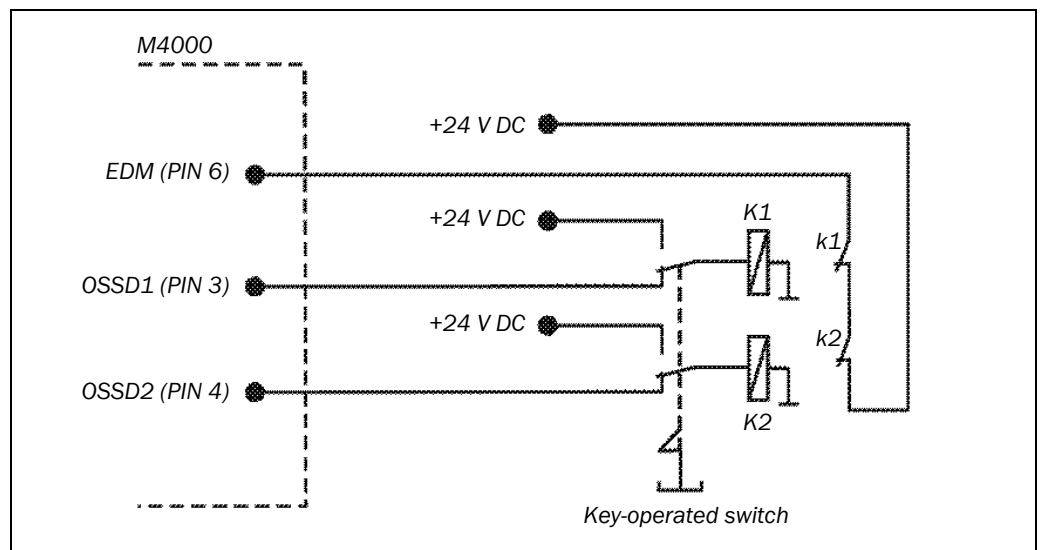


WARNING

Please pay attention to the following notes on integration!

- The key-operated switch must have a positive-action resetting device and two switching contacts for K1 and K2.
- Override is only to be effective using a key-operated switch in the manual mode of the machine or plant controller.
- The control switch for override (key-operated switch) and the control switch for the restart interlock must not be identical.
- Always fit the key-operated switch so that the entire hazardous area can be seen.
- The key-operated switch and its integration must comply with EN ISO 12 100 and EN 60 204-1.

Fig. 34: Connection diagram for Override



6.8.2 Override realised with the integrated override function

The override function is activated with the aid of the CDS and differentiates between two states *Override required* and *Override*.

Override required

The Override required state means that the output signal switching devices (OSSD) are in the OFF state and the system is waiting for the activation of the override control switch. The system signals this state with a flashing muting lamp (2 Hz) and at the same time indicates the cause of the error message on the 7-segment display.

The Override required state is only triggered by the system if, during the presence of a valid muting condition ...

- an error occurs, i.e. if at least one muting sensor is active and at least one is inactive
- and**
- muting is brought to an end
- and**
- the ESPE is interrupted by an object.

Errors can be triggered by the triggering of the concurrence monitoring, the monitoring of the total muting time, the direction detection, the sequence monitoring or the sensor gap monitoring, by the muting sensors or the muting lamp or by a re-start after an emergency stop/mains voltage failure.

Override



WARNING

Please pay attention to the following safety notes for the Override state!

- Install the control switch for override so that the entire hazardous area can be seen when the switch is operated.
- After clearing the system and **before actuating the override** make sure the plant is in the correct state. Check in particular whether the following muting indicators are off:
 - end cap with integrated LED
 - external muting lamp
 - display Override required (● Yellow/red 2 Hz)
- If it is necessary to press the override button twice in two muting cycles one after the other, the muting arrangement and the sensors must be checked.

Override (indication ) can only started in the override required state (● Yellow/red 2 Hz) by actuating the control switch for the override. The system continues the muting at the point at which it was interrupted. The output signal switching devices (OSSD) switch to the ON state and the system only monitors the override status.

Override can be triggered in two different ways:

- with a separate control switch
- with a common control switch for reset and override

Electrical connection of the control switch is described in the chapter “Electrical Installation” of the operating instructions of the corresponding UE403 or sens:Control device.



Configure override by allocating a control switch for reset/override to the related connection using drag and drop. Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **I/O configuration**.

Monitoring the override time

Note For safety reasons the override duration is limited and is monitored using 2 time monitors. The first time monitor lasts 30 minutes, the second time monitor lasts 60 minutes.

Both time monitors are started the first time the override control switch is actuated. The following two conditions must be met:

1. The muting cycle initiated must have been brought to an end within 30 minutes, i.e. all muting sensors and the ESPE must be clear again (objects/material has been moved out of or removed from the area of the muting sensors/the ESPE).
2. A **completely error-free muting cycle** must have been completed within 60 minutes without triggering of the override.

Effects of the conditions:

- If both conditions are met, the system continues to operate normally (muting is triggered on the presence of valid muting condition) and both time monitors are reset.
- If the first condition is not met (30 minutes have elapsed), the system goes back into the Override required state. The first time monitor re-starts and a further 30 minutes are available to meet **both conditions**.
- If the second condition is not met completely (a completely error-free muting cycle has not been completed within 60 minutes), the system changes to the lock-out status.

Monitoring the number of override statuses

For safety reasons the number of override statuses is limited.

The system automatically calculates the permissible number of override statuses. The permissible number is dependent on the configuration of the *monitoring of the total muting time* function.

Tab. 26: Permissible number of override statuses

Configuration of the function <i>Monitoring of the total muting time</i>	Permissible number of override statuses
Deactivated	5×
Activated, total muting time ≤ 300 s	Calculation using the formula: $\frac{3600}{\text{Total muting time [s]}}$ The result is always rounded. Example values: • 10 s ⇒ 360× • 30 s ⇒ 120× • 120 s ⇒ 30× • 250 s ⇒ 14× (rounded)
Activated, total muting time > 300 s	5×

- Notes**
- The system automatically resets the counter each time the system is powered up as well as after every error-free muting cycle without override.
 - If the permissible number of override statuses has been exceeded, the system changes to the *lock-out* status and the 7-segment display indicates the error message .

6.9 Monitoring the muting lamp

The *monitoring the muting lamp* function is a minimum current monitor. It is checked whether a minimum current flows at the muting lamp output when muting is activated.

Tab. 27: Significance of the muting lamp

Muting lamp	Meaning
Off	No muting
Illuminated	Muting
Flashing	Entry from a control switch is expected: • Override required

Notes

- The *Monitoring of the muting mamp* function is only available in conjunction with UE403 or with a sens:Control device.
- Depending on the national legal situation, the *monitoring of the external muting lamp* may be deactivated with the aid of the CDS.
- The integrated LED on the M4000 multiple light beam safety device can not be checked using the *monitoring the muting lamp* function.



Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **Muting configuration**.

6.10 Combinable muting functions and facilities for connecting

Up to three different muting functions can be combined for any application. Tab. 28 shows the possible combinations (A to Q).

Tab. 28: Combinable muting functions

Function that can be configured	Possible combinations																
	A	B ⁴⁾	C ⁴⁾	D	E ⁴⁾	F	G	H	I ⁴⁾	J	K	L	M ⁴⁾	N ⁴⁾	O	P ⁴⁾	Q
Reset	■	■	■	■	■	■	■										
Reset/override (combined)								■	■	■	■						
Override	■	■	■									■	■	■			
Additional signal C1		■		■	■			■	■				■		■	■	
Belt stop			■		■	■			■	■				■		■	■

There are different connection options for the signals:

- The signals for *Reset*, *Reset/Override (combined)*⁵⁾, *Additional signal C1* and *Belt stop* can be optionally connected to M4000 multiple light beam safety device or to the UE403 or sens:Control device.
- The *Override* signal can only be connected to the UE403 or sens:Control device.
- Each signal must only be connected once.



The used connections and functions are configured with the help of the CDS. Device symbol **M4000 Advanced (receiver)** or **M4000 Advanced (A/P)**, context menu **Open device window**, parameter node **I/O configuration**. Invalid combinations are prevented by the software.

⁴⁾ This combination option is not available if an IP 67 Remote-I/O-controller, e.g. UE4455 is used since pins 5 and 11 of M4000 cannot be used in an IP 67 environment.

⁵⁾ It is only possible to connect *Reset/Override (combined)* on the M4000 in conjunction with an UE403 or sens:Control device.

7 Mounting

This chapter describes the preparation and completion of the installation of the M4000 multiple light beam safety device. The mounting requires two steps:

- determining the necessary minimum distance
- mounting with swivel mount or side bracket, rigid or pivoting mounting bracket

The following steps are necessary after mounting and installation:

- completing the electrical connections (chapter 8)
- aligning sender and receiver (chapter 9.2)
- testing the installation (chapter 9.3)

7.1 Determining the minimum distance

The M4000 multiple light beam safety device must be mounted with an adequate minimum distance:

- to the hazardous area
- from reflective surfaces



WARNING

No protective function without sufficient minimum distance!

- You must mount the multiple light beam safety device/s with the correct minimum distance to the hazardous area. Otherwise the safe protection of the M4000 system is not provided.

Risk of failure to detect!

- Persons who are in the hazardous area but not in the light path between sender and receiver are not detected by the M4000 system. It is therefore to be ensured that the hazardous area is fully visible and any dangerous state can only be initiated if there are no personnel in the hazardous area.
- The M4000 system is not allowed to be used for hand and finger protection.

Read and follow the relevant safety standards!

The procedure described in the following sections for the calculation of the minimum distance is no substitute for knowledge of the related safety standards.

➤ Therefore read and follow in particular the standards stated in the following sections.

You will find further information on the application of the standards during the calculation of the minimum distance in the SICK reference brochure "Guidelines Safe Machinery" (part no. 8007988).

Note The applicable legal and official regulations apply to the use and mounting of the protective device. These regulations vary depending on the application.

7.1.1 Minimum distance to the hazardous area

A minimum distance must be maintained between the multiple light beam safety device and the hazardous area. This ensures that the hazardous area can only be reached when the dangerous state of the machine is completely at an end.

The minimum distance as defined in EN ISO 13 855 and EN ISO 13 857 depends on:

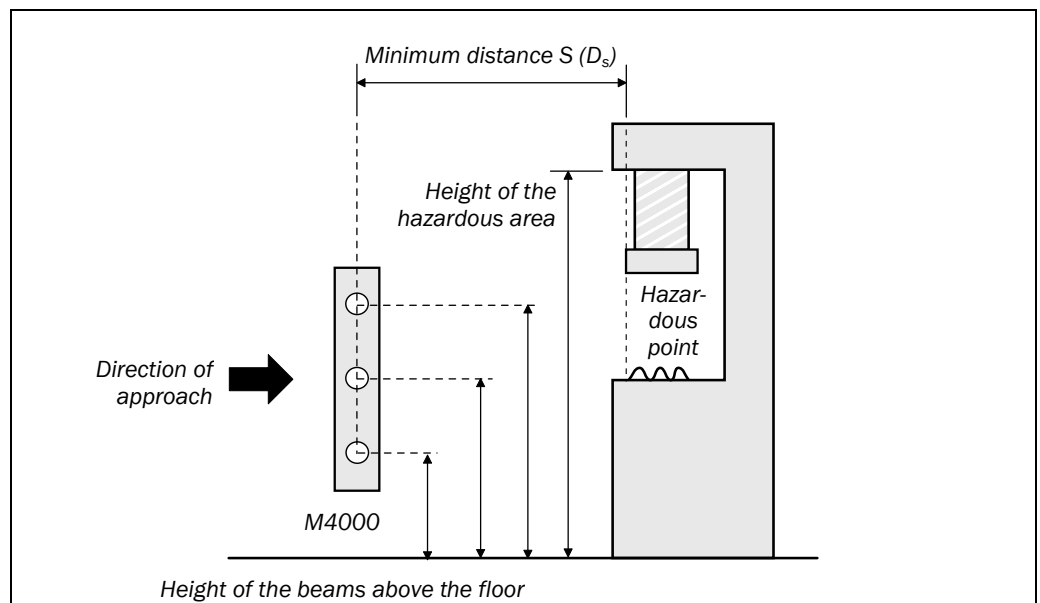
- stopping/run-down time of the machine or system
(The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- response time of the protective device (response times see chapter 13.1 “Data sheet” on page 113)
- reach or approach speed
- resolution of the multiple light beam safety device or beam separation
- other parameters that are stipulated by the standard depending on the application

Under the authority of OSHA and ANSI the minimum 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 protective device (response times see chapter 13.1 “Data sheet” on page 113)
- reach or approach speed
- other parameters that are stipulated by the standard depending on the application

Calculation of the minimum distance for perpendicular approach

Fig. 35: Minimum distance to the hazardous point for perpendicular approach



How to calculate the minimum distance S according to EN ISO 13855 and EN ISO 13857:

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

➤ First, calculate S using the following formula:

$$S = 1600 \times T + C \text{ [mm]}$$

Where ...

T = Stopping/run-down time of the machine
+ Response time of the M4000 system after light path interruption [s]

S = Minimum distance [mm]

C = Supplement [mm], depending on the number of beams (1, 2, 3 or 4)
If it is possible to reach over the vertical protective field of an ESPE, the supplement C must be determined as per the tables in EN ISO 13855. Here the following always applies: C_{RO} (reaching over) $\geq C_{RT}$ (reaching through)

Example 1: Access protection with two beams for a hazardous point, where there is no risk of reaching over:

$$C = 850 \text{ mm}$$

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

Response time of the light path interruption = 30 ms

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

$$S = 1600 \times 0.32 + 850 = 1362 \text{ mm}$$

Example 2: Access protection with three beams for a hazardous point, where there is a risk of reaching over:

- Three-beam standard ESPE (300/400/1100 mm)
- Height of the top edge of the protective field: 1100 mm
- Height of the hazardous area: 1400 mm

As per EN ISO 13855 a resolution-dependent supplement C of 1100 mm applies (instead of the previously usual 850 mm).

$$C = 1100 \text{ mm}$$

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

Response time of the light path interruption = 30 ms

$$T = 290 \text{ ms} + 30 \text{ ms} = 320 \text{ ms} = 0,32 \text{ s}$$

$$S = 1600 \times 0,32 + 1100 = 1612 \text{ mm}$$

How to calculate the minimum 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 minimum distance. Depending on the application and the ambient conditions, a different calculation may be necessary.

➤ First, 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 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

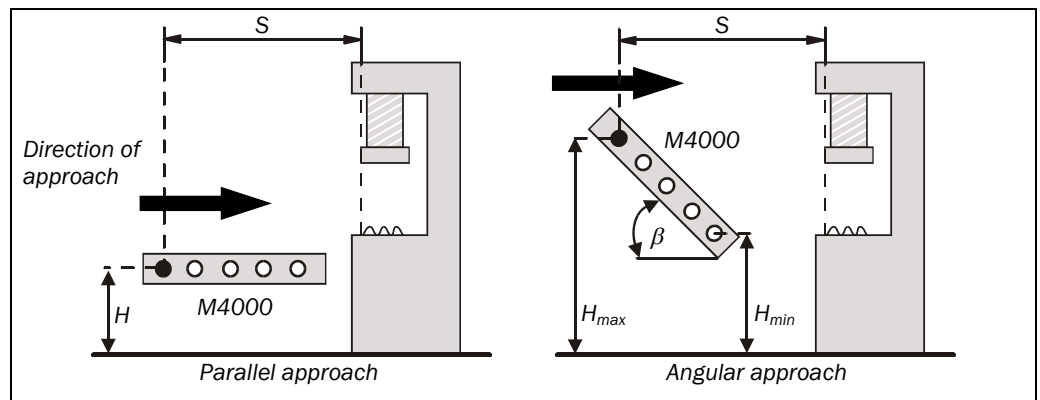
Note Any additional response times must be accounted for in this calculation.

D_{pf} = An additional distance added to the overall minimum distance required. This value is based on a possible intrusion toward the hazardous point prior to actuation of the electro-sensitive protective equipment (ESPE). For applications that can be reached over, the value $D_{pf} = 1.2$ m. For beam arrangements that permit reaching in with the arms or the detectable object size is greater than 63 mm, the value $D_{pf} = 0.9$ m.

The applicable legal and official regulations apply to the use and mounting of the protective device. These regulations vary depending on the application.

Calculation of the minimum distance S for non-perpendicular approach

Fig. 36: Minimum distance to the hazardous point for non-perpendicular approach



Tab. 29: Equations for calculating the minimum distance S

Approach	Calculation	Conditions
Parallel	$S = 1600 \times T + (1200 - 0.4 \times H)$ [mm]	$1200 - 0.4 \times H > 850 \text{ mm}$ $15 \times (d - 50) \leq H \leq 1000 \text{ mm}$
Angular	$\beta > 30^\circ$ calculation as for perpendicular approach $\beta < 30^\circ$ calculation as for parallel approach S is applied to the beam that is the farthest away from the hazardous point.	$d \leq H_{\min}/15 + 50$ $H_{\max} \leq 1000 \text{ mm}$

Where ...

S = Minimum distance [mm]

H = Height of the beams above the floor [mm]

For approach at an angle:

$H_{\max}$ = Height of the uppermost beam [mm]

$H_{\min}$ = Height of the bottom beam [mm]

d = Resolution of the multiple light beam safety device [mm]

β = Angle between detection plane and the direction of entry

T = Time

7.1.2 Minimum distance to reflective surfaces



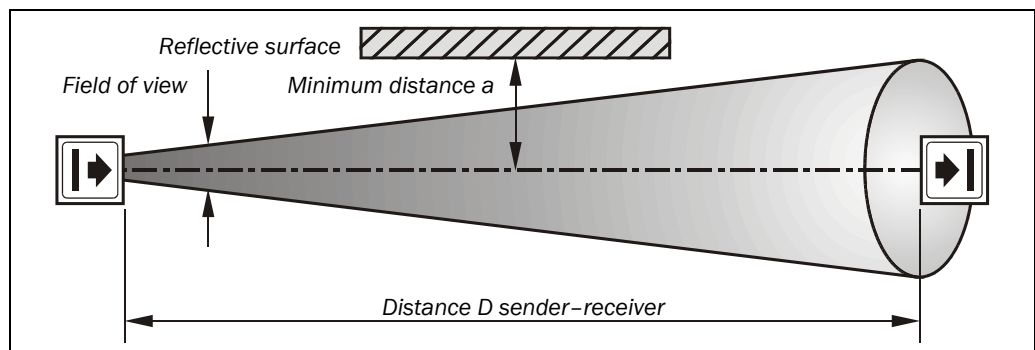
WARNING

Maintain the minimum distance from reflective surfaces!

The light beams from the sender may be deflected by reflective surfaces. This can result in failure to identify an object. This would mean that the operator is at risk.

All reflective surfaces and objects (e.g. material bins) must be a minimum distance a from the light path between sender and receiver. The minimum distance a depends on the distance D between sender and receiver.

Fig. 37: Minimum distance to reflective surfaces

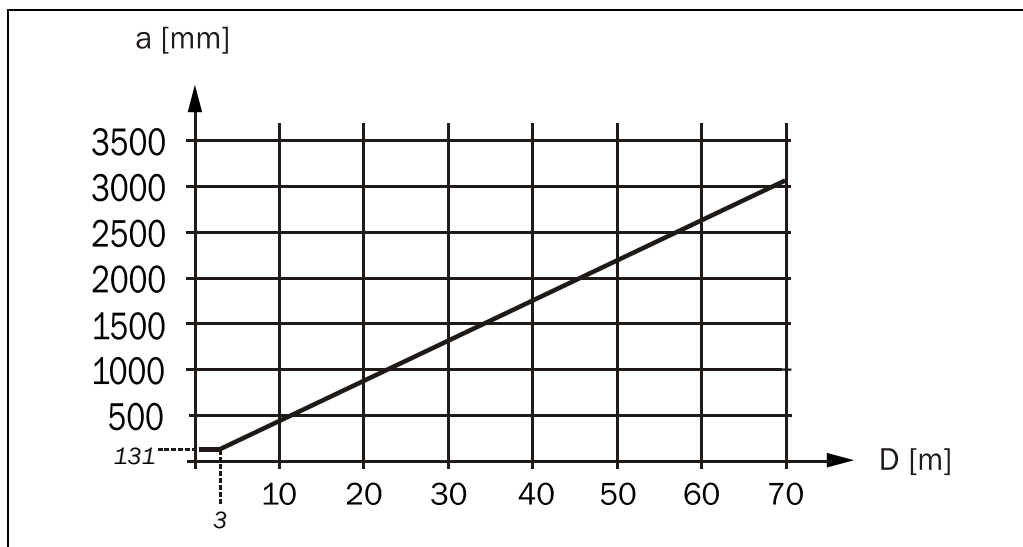


Note The field of view of the sender and receiver optics is identical.

How to determine the minimum distance from reflective surfaces:

- Determine the distance D [m] sender–receiver.
- Read the minimum distance a [mm] in the diagram or calculate it using the related formula in Tab. 30.

Fig. 38: Graph, minimum distance from reflective surfaces



Tab. 30: Formula for the calculation of the minimum distance to reflective surfaces

Distance D [m] sender–receiver	Calculation of the minimum distance a from reflective surfaces
$D \leq 3$ m	a [mm] = 131
$D > 3$ m	a [mm] = $\tan(2.5^\circ) \times 1000 \times D$ [m] = $43.66 \times D$ [m]

7.2 Steps for mounting the device

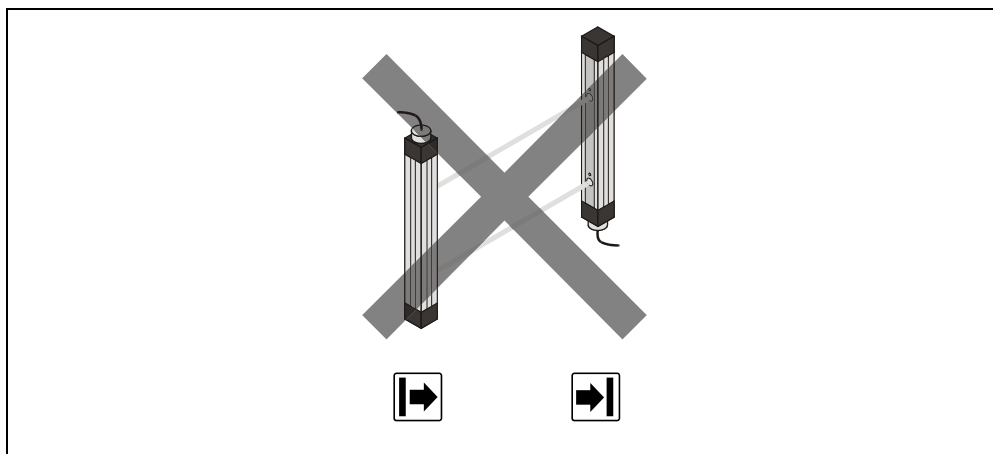


WARNING

Special features to note during mounting:

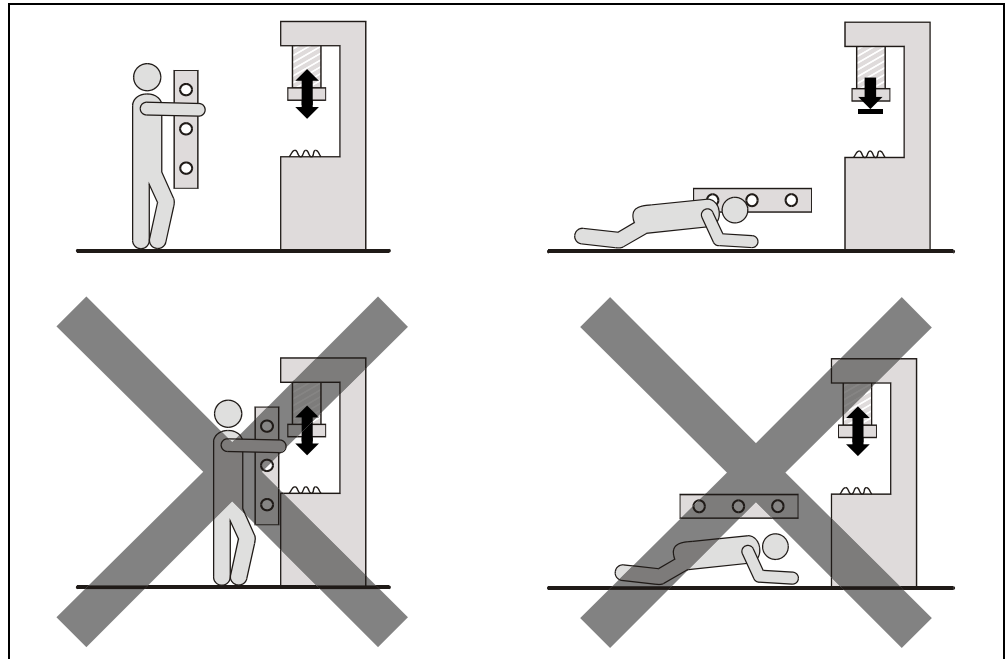
- Always mount the sender and receiver parallel to one another.
- During mounting, ensure that sender and receiver are aligned correctly. The optical lens systems of sender and receiver must be located in exact opposition to each other; the status indicators must be mounted at the same height. The system plugs of both devices must point in the same direction.

Fig. 39: Sender and receiver must not be rotated 180° with respect to each other



- Observe the minimum distance of the system during mounting. On this subject read chapter 7.1 “Determining the minimum distance” on page 64.
- Mount the multiple light beam safety device such that the risk of failure to detect is excluded. Ensure that the protective device cannot be bypassed by crawling underneath, reaching over, climbing between 2 beams, jumping over or moving the multiple light beam safety device.

Fig. 40: The correct installation (above) must eliminate the errors (below) of reaching through and crawling beneath



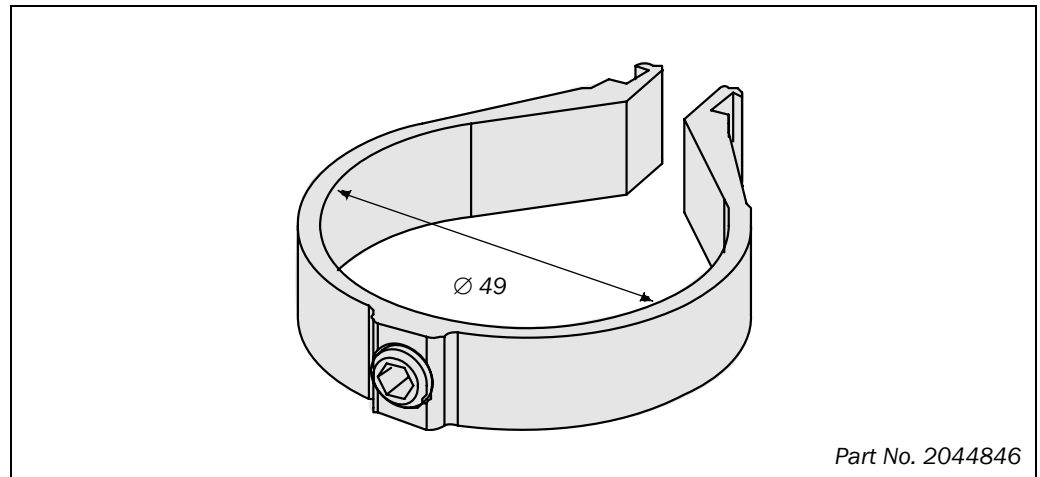
- Once the system is mounted, one or several of the enclosed self-adhesive information labels must be affixed:
 - Use only information labels in the language which the users and operators of the machine understand.
 - Affix the information labels such that they are easily visible by the users and operators during operation. After attaching additional objects and equipment, the information labels must not be concealed from view.
 - Affix the information label “Important Notices” to the system in close proximity to sender and receiver.
- When mounting a M4000 with integrated laser alignment aid, ensure that the laser warning labels on the device remain visible. If the laser warning labels are covered, e.g. on installation of the M4000 in a device column (accessory), you must apply the laser warning labels supplied with the receiver in the appropriate place on the cover.

Sender and receiver can be mounted in five different ways:

- Mounting with Omega bracket
- Mounting with swivel mount bracket
- Mounting with side bracket
- Mounting with rigid mounting bracket
- Mounting with pivoting mounting bracket

7.2.1 Mounting with Omega bracket

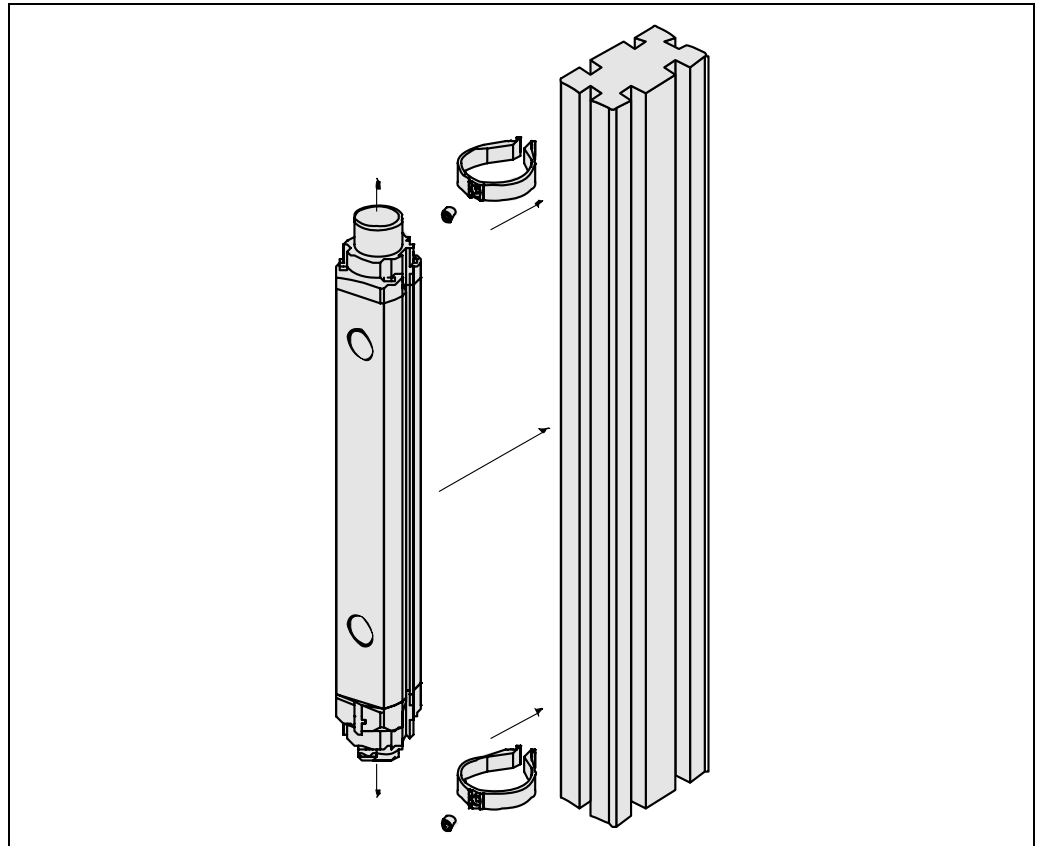
Fig. 41: Omega bracket (mm)



The Omega bracket is made of aluminium. The bracket is designed such that sender and receiver can also be exactly aligned after the installation and mounting of the bracket.

Note Attach the screws of the Omega bracket with a torque of between 2 and 2.5 Nm. Higher torques can damage the bracket; lower torques provide inadequate protection against vibration.

Fig. 42: Mounting with Omega bracket



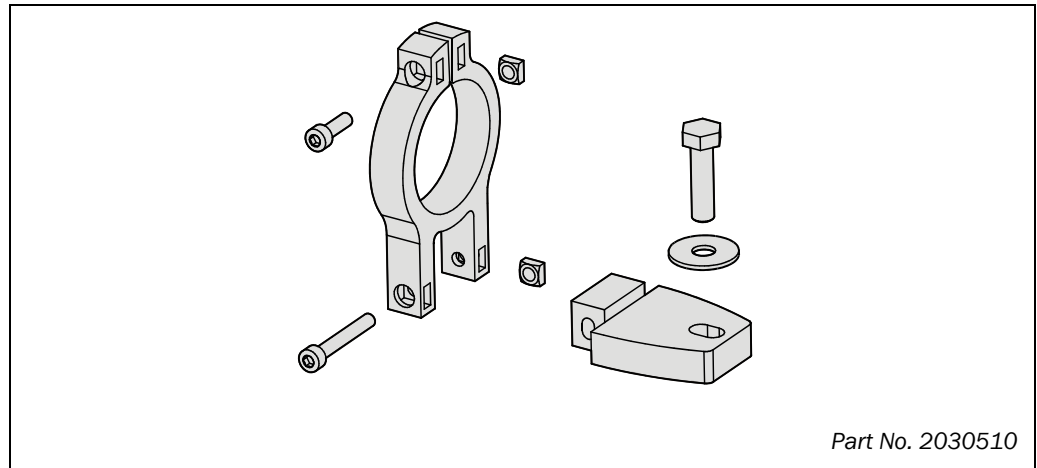
Note ➤ Engage the Omega fixing bracket in its profile rails. Additional spacers are used to correctly adjust the bracket in the slot. The safety light curtain can be mounted and also subsequently adjusted using just one screw.

7.2.2 Mounting with swivel mount bracket

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

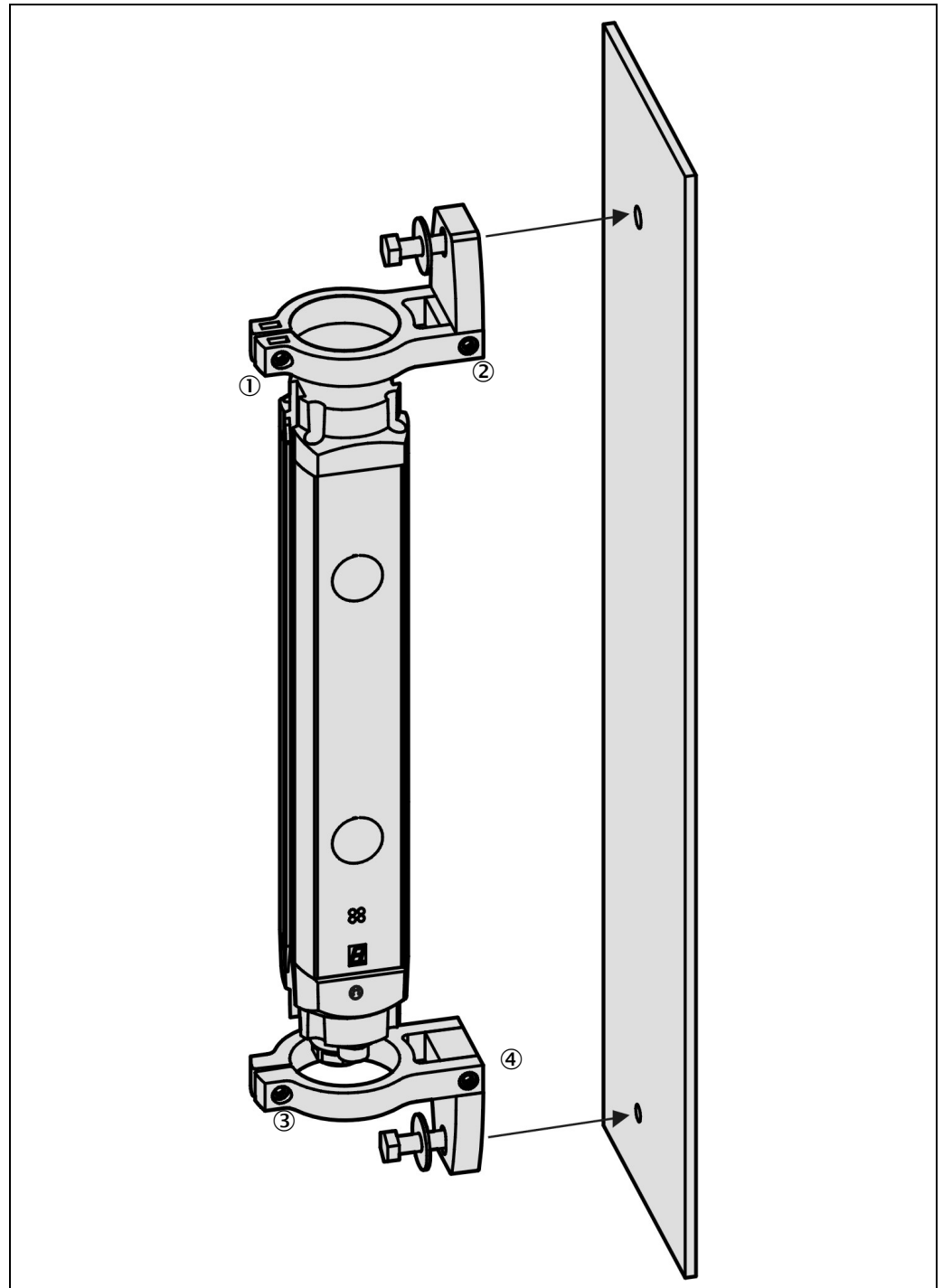
Note Attach the screws of the swivel mount bracket with a torque of between 2.5 and 3 Nm. Higher torques can damage the bracket; lower torques provide inadequate protection against vibration.

Fig. 43: Composition of the swivel mount bracket



M4000 Adv., Adv. A/P, Area

Fig. 44: Mounting the M4000 with swivel mount bracket

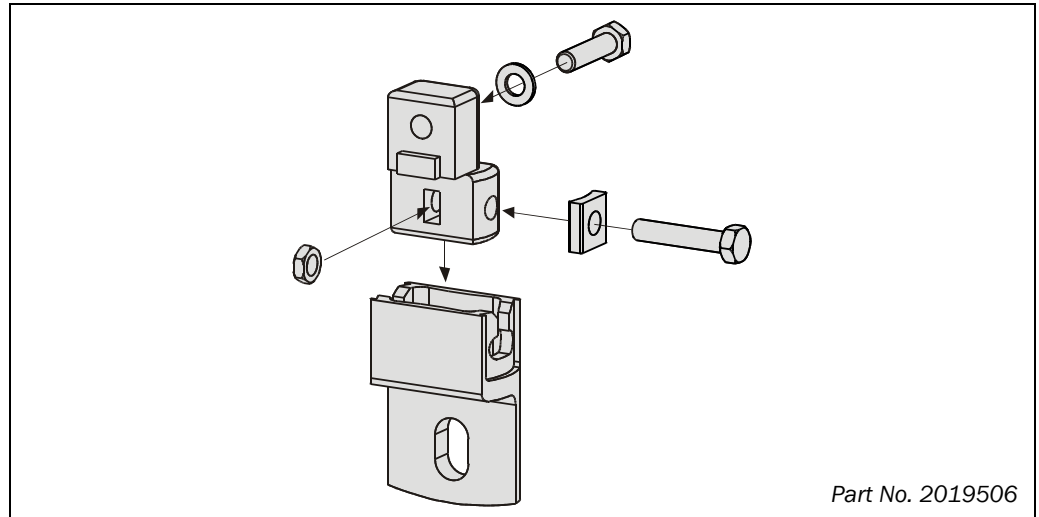


- Notes**
- Mount the bolts marked with ① to ④ on the operator side of the system to ensure that they remain accessible after mounting. The multiple light beam safety device can then also be adjusted later.
 - The mounting screw is not included in the delivery.

7.2.3 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. It provides adjustment so that the vertical alignment of sender and receiver can be corrected by $\pm 2.5^\circ$ after mounting.

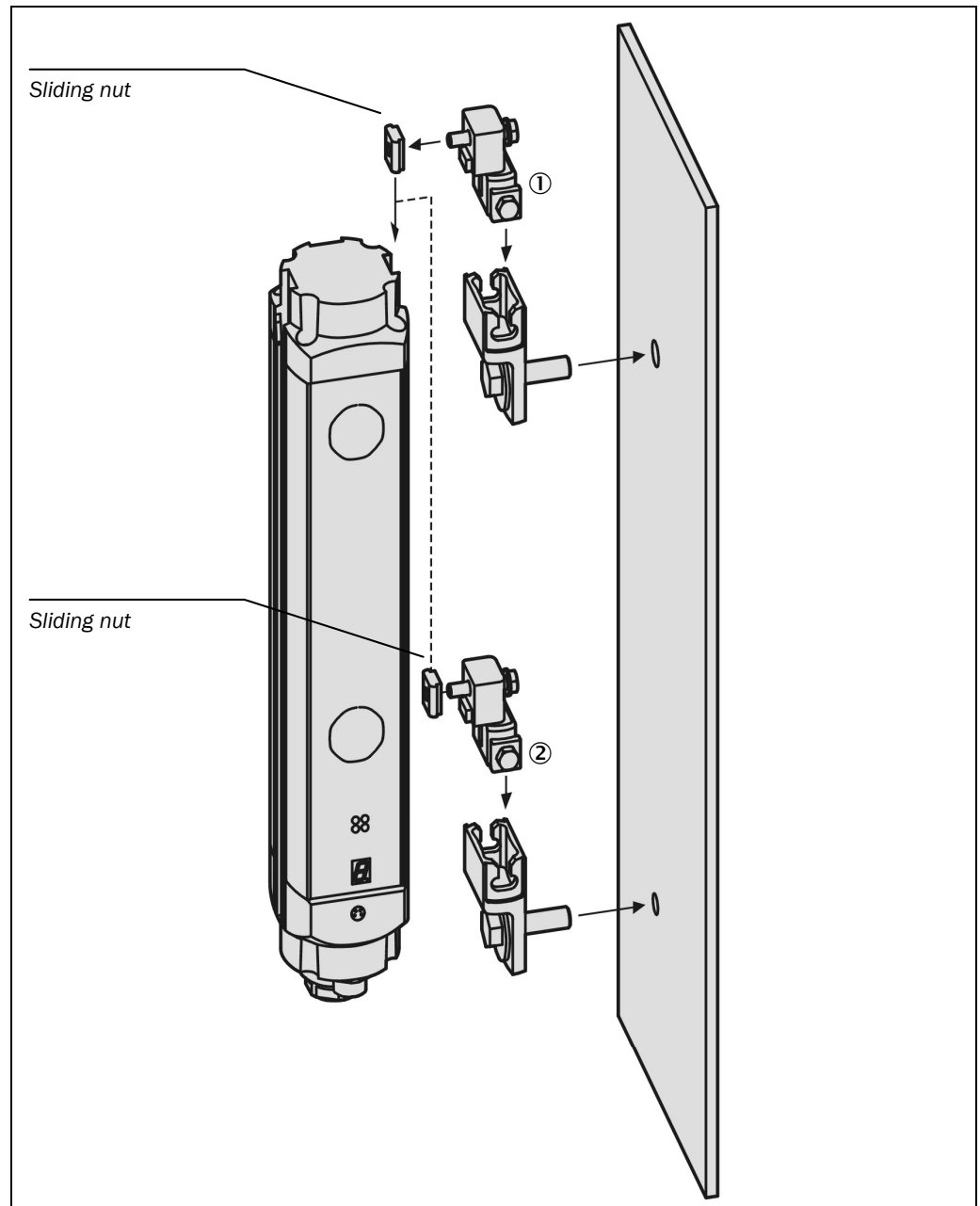
Fig. 45: Composition of the side bracket



- 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.

M4000 Adv., Adv. A/P, Area

Fig. 46: Mounting the M4000 with side bracket

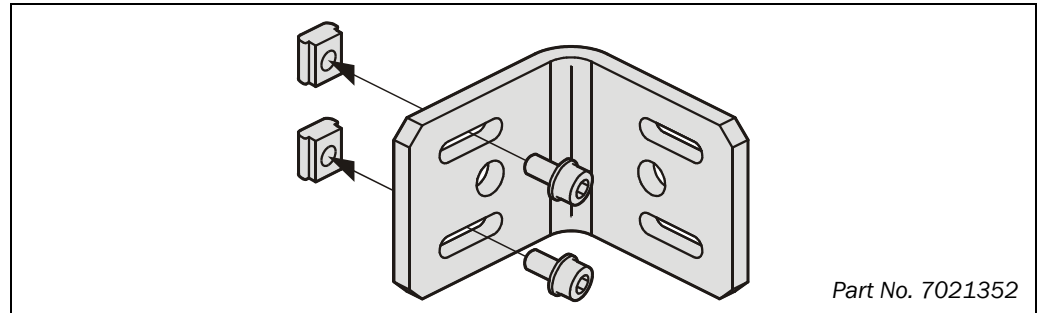


- Notes**
- When mounting the side bracket ensure that the bolts marked ① and ② remain accessible, allowing you later to adjust and lock the multiple light beam safety device in position.
 - When mounting the bracket, note the distance and the position of the sliding nuts as described in chapter 13.3 “Dimensional drawings” on page 120f.
 - The mounting screw is not included in the delivery.

7.2.4 Mounting with rigid mounting bracket

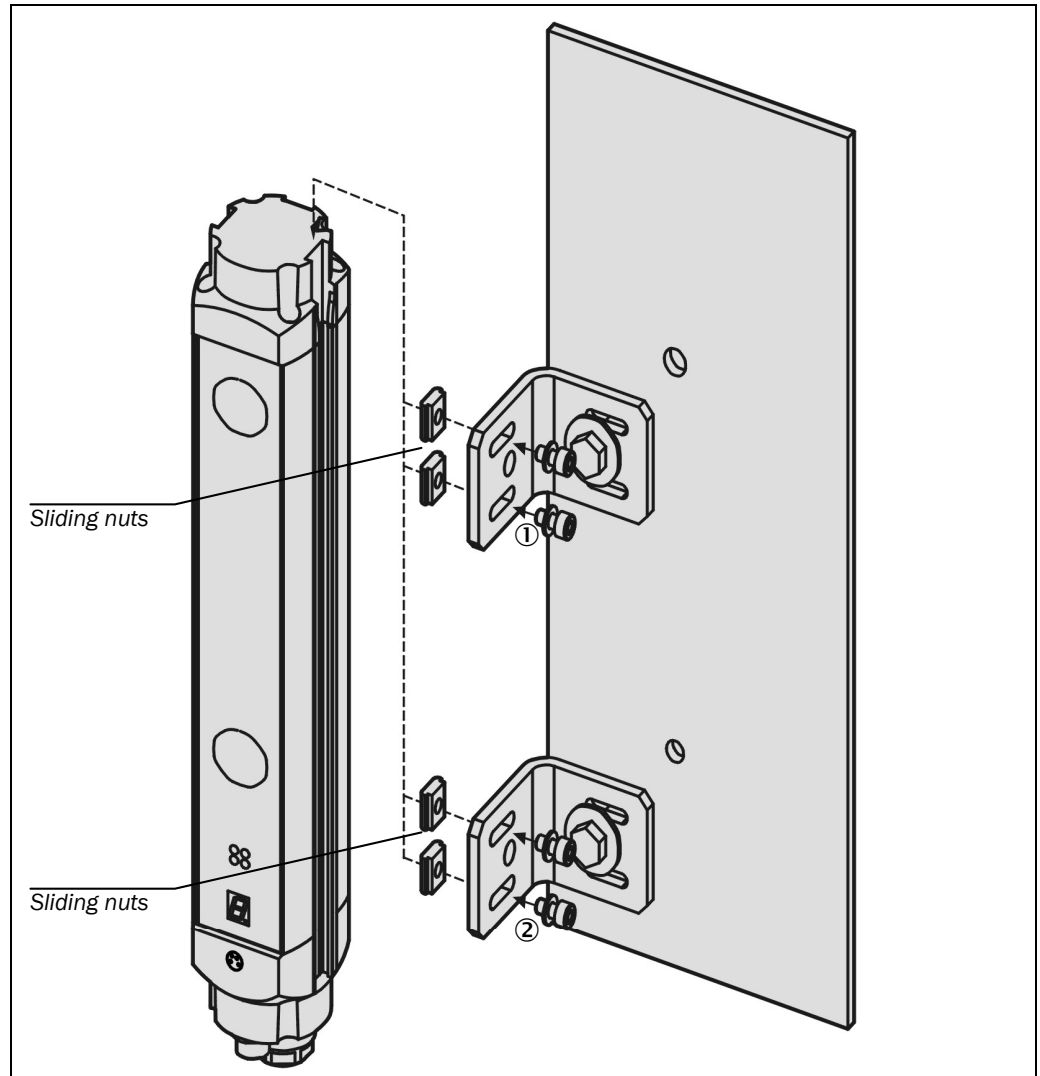
The rigid mounting bracket is a black, powder-coated bracket without adjustment. It is only suitable for mounting surfaces on which it is not necessary to compensate for large mechanical tolerances. The alignment of the sender and receiver can be corrected after mounting using only the slots.

Fig. 47: Rigid mounting bracket



M4000 Adv., Adv. A/P, Area

Fig. 48: Mounting the M4000 with rigid mounting bracket

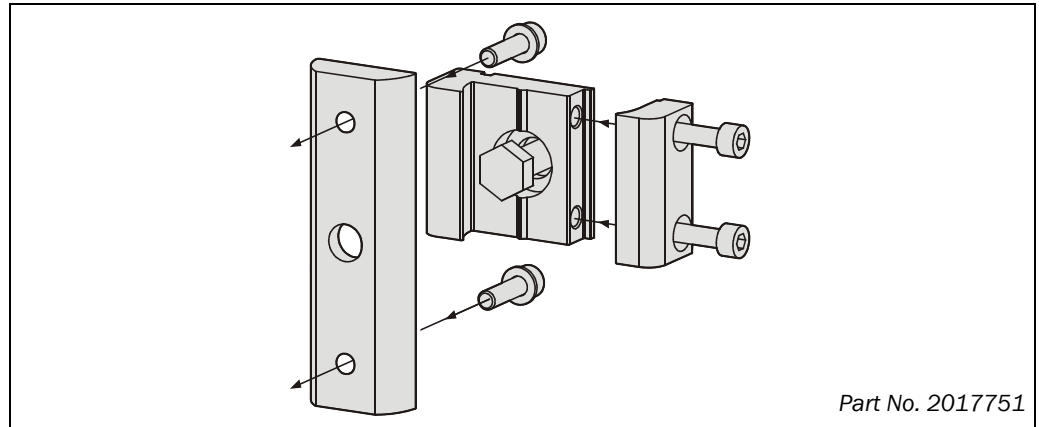


- Notes**
- When mounting the rigid mounting bracket ensure that the four bolts marked ① and ② remain accessible, allowing you later to adjust and lock the multiple light beam safety device in position.
 - When mounting the bracket, note the distance and the position of the sliding nuts as described in chapter 13.3 “Dimensional drawings” on page 120f.
 - The mounting screw is not included in the delivery.

7.2.5 Mounting with pivoting mounting bracket

The pivoting mounting bracket is made of black anodised aluminium. It will be covered by the device after mounting. The pivoting mounting bracket provides adjustment for correcting the horizontal alignment of sender and receiver by $\pm 2.0^\circ$ after mounting.

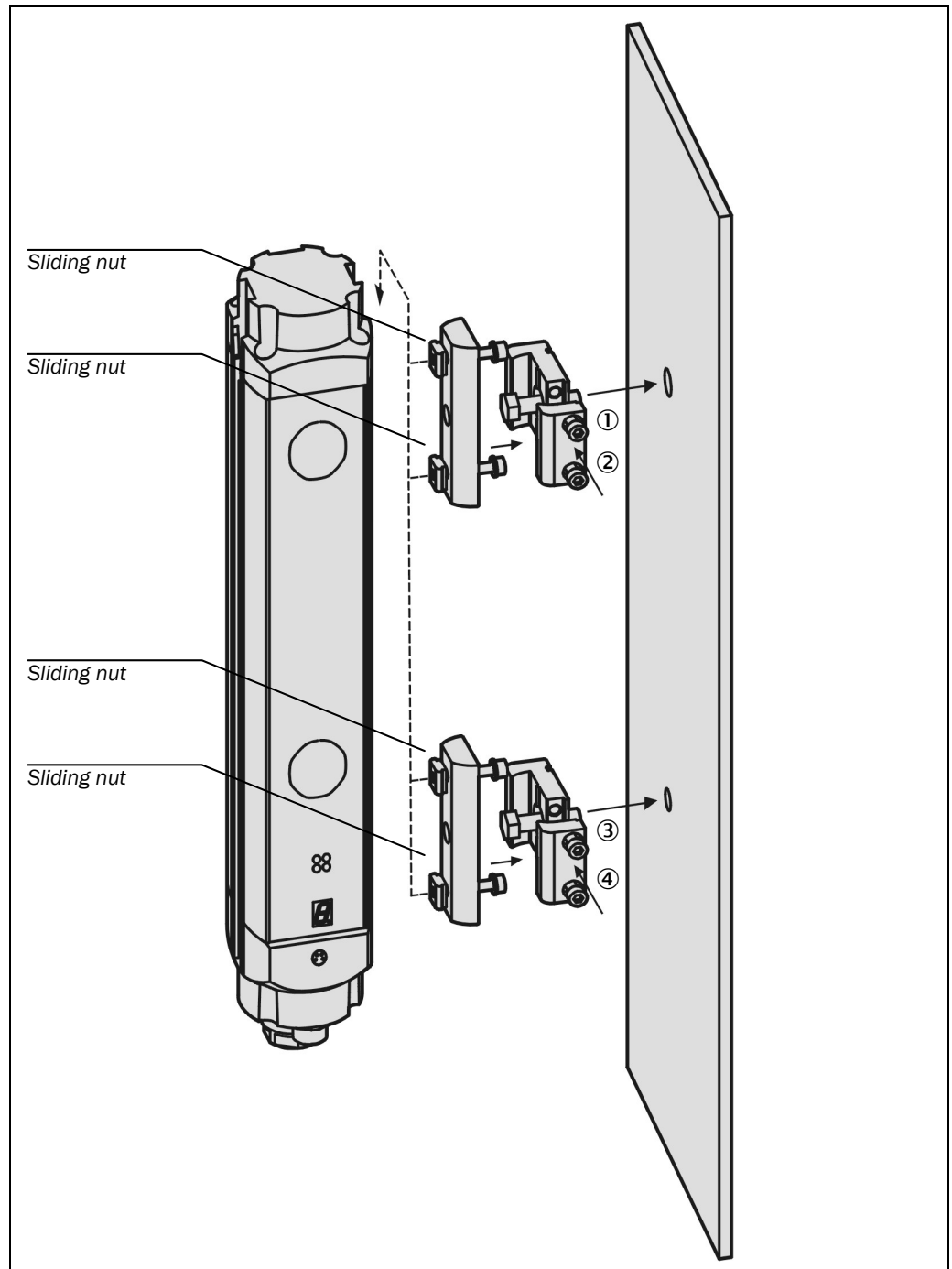
Fig. 49: Assembly of the pivoting mounting bracket



- Note** ➤ Tighten the bolts on the pivoting mounting bracket to a torque of between 5 and 6 Nm. Higher torques can damage the bracket; lower torques provide inadequate protection against vibration.

M4000 Adv., Adv. A/P, Area

Fig. 50: Mounting the M4000 with pivoting mounting bracket



- Notes**
- When mounting the pivoting mounting bracket ensure that the bolts marked ①, ②, ③ and ④ remain accessible, allowing you later to adjust and lock the multiple light beam safety device in position.
 - When mounting the bracket, note the distance and the position of the sliding nuts as described in chapter 13.3 “Dimensional drawings” on page 120f.
 - The mounting screw is not included in the delivery.

8 Electrical installation



WARNING

Switch the power supply off!

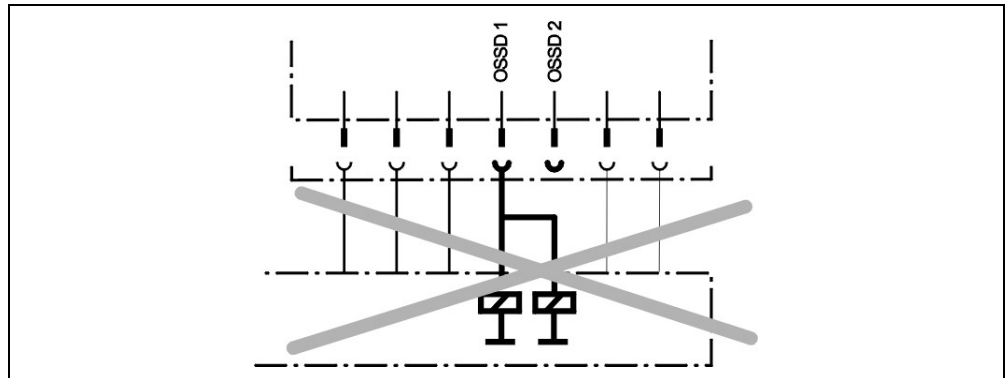
The machine/system could inadvertently start up while you are connecting the devices.

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

Connect OSSD1 and OSSD2 separately!

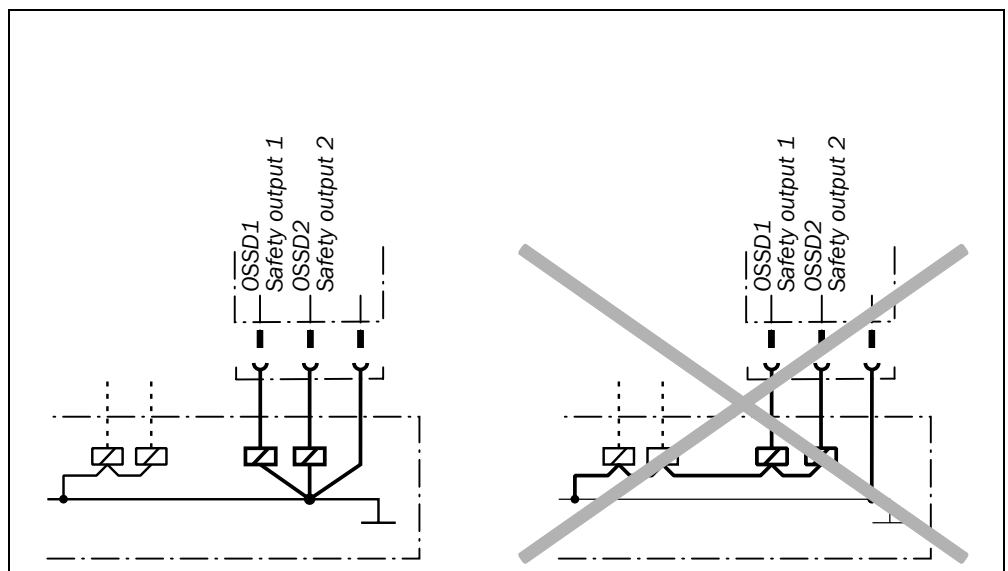
You are not allowed to connect OSSD1 and OSSD2 together, otherwise signal safety will not be ensured.

- Connect OSSD1 and OSSD2 separately to the machine controller.
- Ensure that the machine controller processes the two signals separately.



Prevent the formation of a potential difference between the load and the protective device!

- If you connect loads that are not reverse-polarity protected to the OSSDs or the safety outputs, you must connect the 0 V connections of these loads and those of the corresponding protective device individually and directly to the same 0 V terminal strip. This is the only way to ensure that, in the event of a defect, there can be no potential difference between the 0 V connections of the loads and those of the corresponding protective device.



M4000 Adv., Adv. A/P, Area

- Notes**
- The two outputs are protected against short-circuits to 24 V DC and 0 V. When the light path is clear, the signal level on the outputs is HIGH DC (at potential), when the light beams are interrupted or there is a device fault the outputs are LOW DC.
 - The M4000 multiple light beam safety device 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.
 - The external voltage supply of the devices must be capable of buffering brief mains voltage failures of 20 ms as specified in EN 60204-1. Suitable power supplies are available as accessories from SICK (Siemens type series 6 EP 1).
 - The plug alignment (direction of turn) 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.

Connections of the M4000

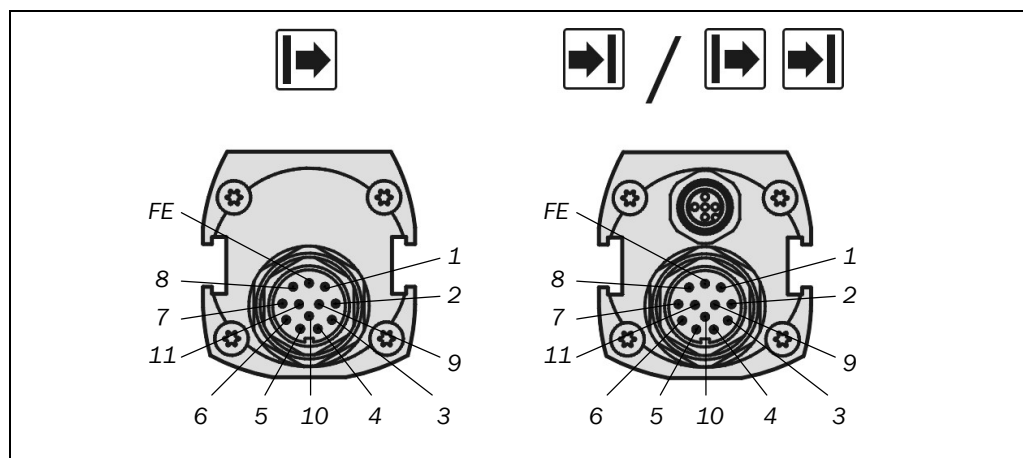
Tab. 31: Connections of the M4000

Connections	M4000 Advanced	M4000 Advanced A/P	M4000 Area 60/80
System connection	■ (see page 82)	■ (see page 82)	■ (see page 83)
Extension connection	■ (see page 84)	■ (see page 84)	–
Configuration connection	■ (see page 85)	■ (see page 85)	■ (see page 85)

8.1 System connection M26 × 11 + FE

8.1.1 M4000 Advanced or M4000 Advanced A/P

Fig. 51: Pin assignment
system connection M4000
Advanced or M4000
Advanced A/P M26 × 11 + FE



Tab. 32: Pin assignment
system connection
M4000 Advanced or
M4000 Advanced A/P
M26 × 11 + FE

Pin	Wire colour	☐ Sender	☑ Receiver or ☑ ☑ M4000 Advanced A/P
1	Brown	Input 24 V DC (voltage supply)	Input 24 V DC (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 or Reset/override (combined) ⁶⁾
6	Yellow	Reserved	External device monitoring (EDM)
7	White	Reserved	Application diagnostic output (ADO)
8	Red/blue	Reserved	Reset required
9	Black	Device communication (EFI _A)	Device communication (EFI _A)
10	Purple	Device communication (EFI _B)	Device communication (EFI _B)
11	Grey/pink	Reserved	Belt stop/C1 (only in conjunction with UE403 or sens:Control device)
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 14.7 “Accessories” on page 139).
- If the UE403 safety relay is used on the extension connection of the M4000, then only SICK sens:Control devices may be connected to pin 9 and pin 10 (EFI device communication) of the system connection.
- If you do not use either a UE403 or a sens:Control device on the system connection pin 9 and 10 (EFI device communication), to improve the EMC behaviour we recom-

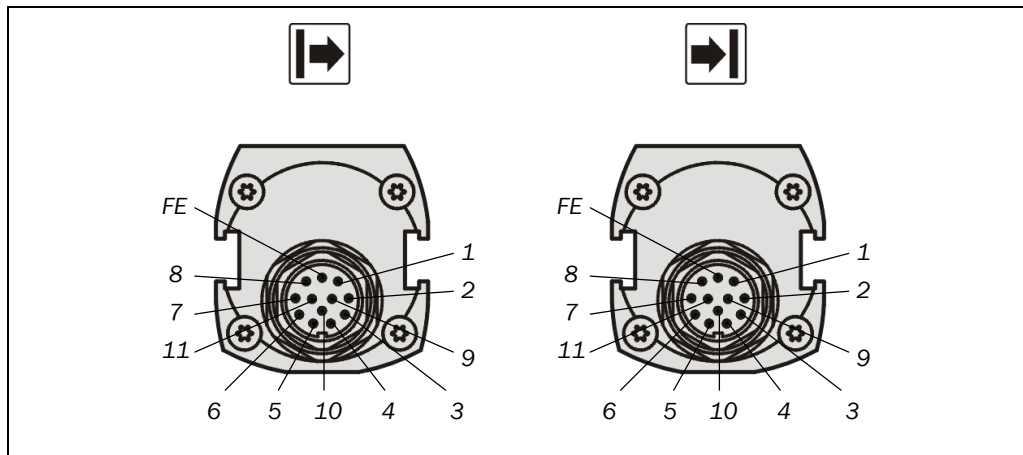
⁶⁾ It is only possible to connect Reset/Override (combined) on the M4000 in conjunction with an UE403 or sens:Control device.

M4000 Adv., Adv. A/P, Area

ment — especially when using the combination M4000 Advanced or M4000 Advanced A/P with the UE403 safety relay at the extension connection — the termination of the connections pin 9 and 10 (EFI device communication) on the system connection in the control cabinet using a resistor of 182 Ω (SICK part number 2027227). Alternatively we recommend the use of a connecting cable on which pin 9 and 10 are not used (see section 14.7 “Accessories” on page 139).

8.1.2 M4000 Area 60/80

Fig. 52: Pin assignment
system connection M4000
Area 60/80 M26 × 11 + FE



Tab. 33: Pin assignment
system connection M4000
Area 60/80 M26 × 11 + FE

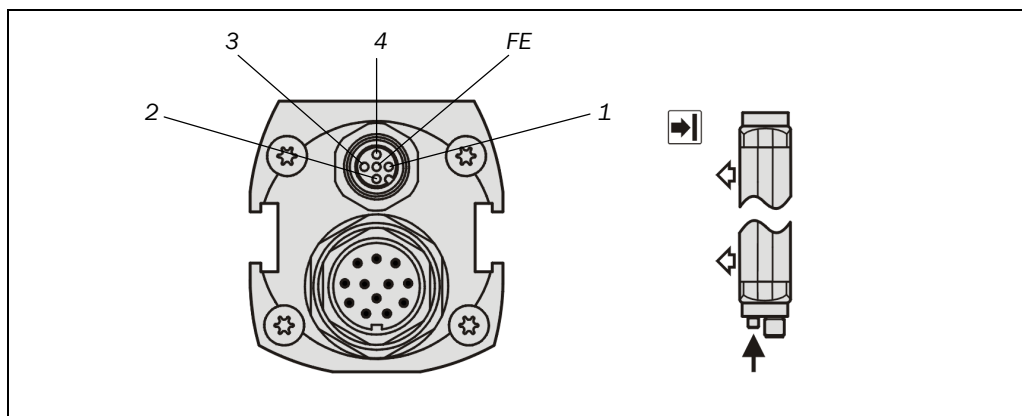
Pin	Wire colour	☑ Sender	☑ Receiver
1	Brown	Input 24 V DC (voltage supply)	Input 24 V DC (voltage supply)
2	Blue	0 V DC (voltage supply)	0 V DC (voltage supply)
3	Grey	Test input: 0 V: external test active 24 V: external test inactive	OSSD1 (output signal switching device 1)
4	Pink	Reserved	OSSD2 (output 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	Reset required
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 14.7 “Accessories” on page 139).
- If you do not use either a UE403 or a sens:Control device on the system connection pin 9 and 10 (EFI device communication), to improve the EMC behaviour we recommend the termination of the connections pin 9 and 10 (EFI device communication) on the system connection in the control cabinet using a resistor of 182 Ω (SICK part number 2027227). Alternatively we recommend the use of a connecting cable on which pin 9 and 10 are not used (see section 14.7 “Accessories” on page 139).

8.2 Extension connection M12 × 4 + FE for UE403

Fig. 53: Pin assignment
extension connection
M12 × 4 + FE



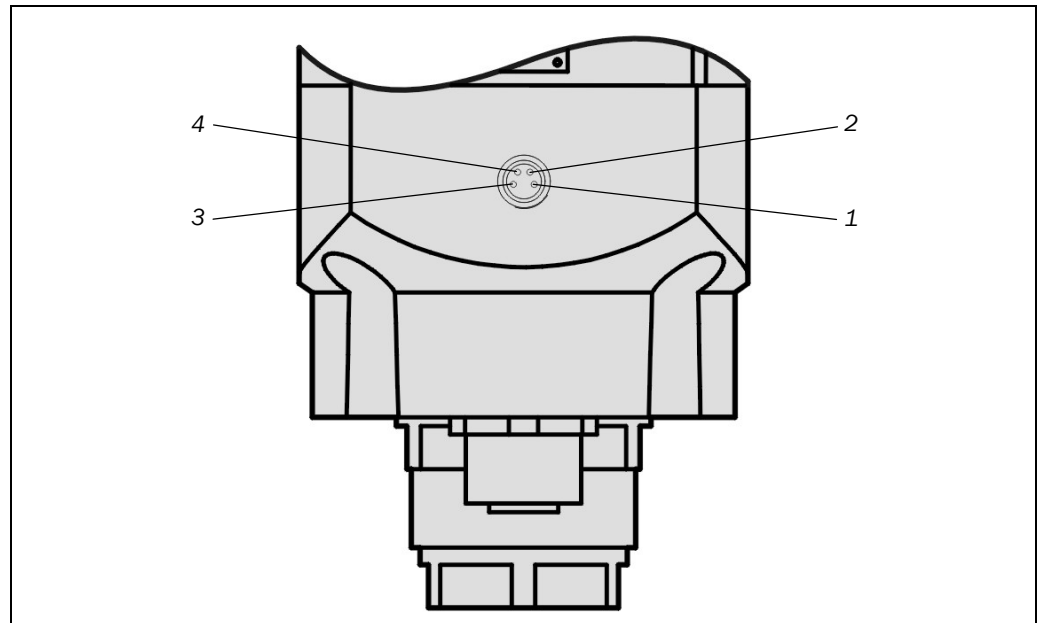
Tab. 34: Pin assignment
extension connection
M12 × 4 + FE

Pin	M4000 Advanced (receiver) or M4000 Advanced A/P
1	24 V DC output (voltage supply UE403)
2	Device communication (EFI _A)
3	0 V DC (voltage supply UE403)
4	Device communication (EFI _B)
FE	Functional earth

Note If the UE403 safety relay is used on the extension connection of the M4000, then only SICK sens:Control devices may be connected to pin 9 and pin 10 (EFI device communication) of the system connection.

8.3 Configuration connection M8 × 4 (serial interface)

Fig. 54: Pin assignment
configuration connection
M8 × 4



Tab. 35: Pin assignment
configuration connection
M8 × 4

Pin	M4000	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

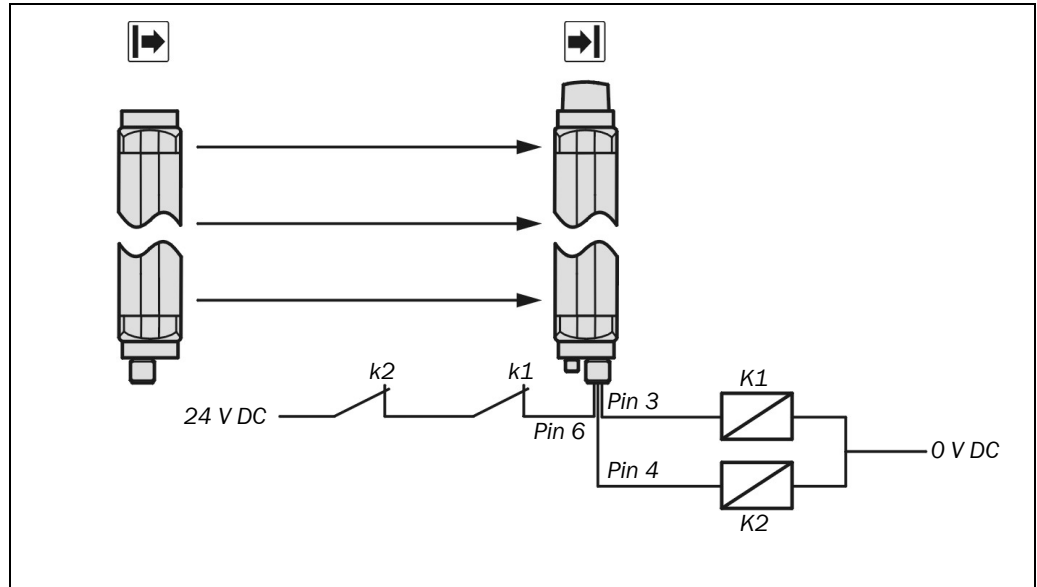
Note The pin assignment of sender, receiver and M4000 Advanced A/P is identical.

- 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.

8.4 External device monitoring (EDM)

The external device monitoring (EDM) checks if the contactors actually de-energize when the protective device responds. If, after an attempted reset, the EDM does not detect a response from the switched devices within 300 ms, the EDM will deactivate the output signal switching devices again.

Fig. 55: 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.

8.5 Reset button

In the protective operation mode with internal restart interlock (see page 38) the operator must first press the reset button before restarting.

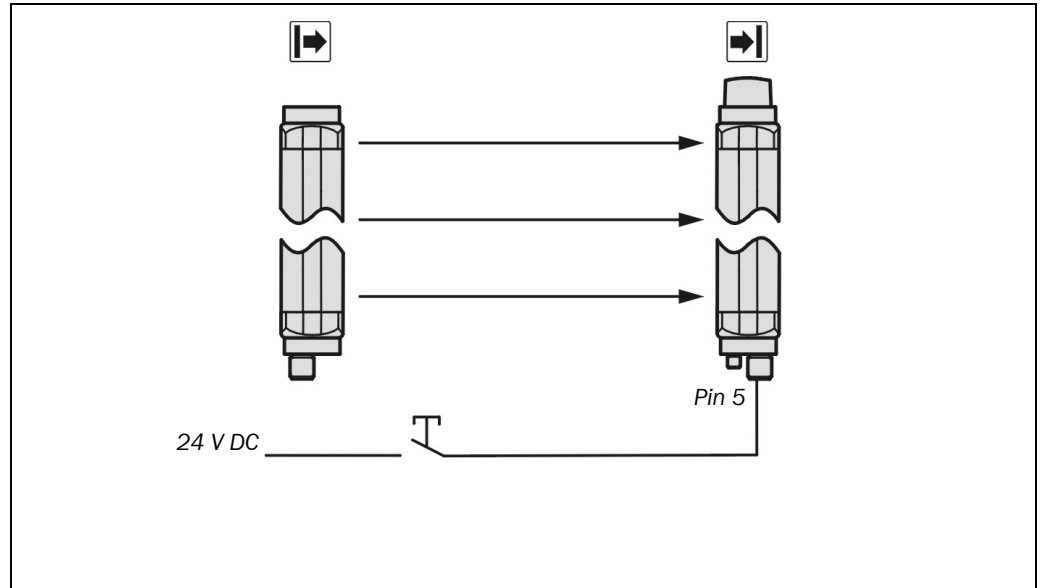


WARNING

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. 56: Connection of the reset button



WARNING

Device configuration after replacement!

If you replace a multiple light beam safety device with activated *Reset* function with a replacement device, you must activate the *Reset* function again via the CDS. It is not enough to only make the electrical connections.

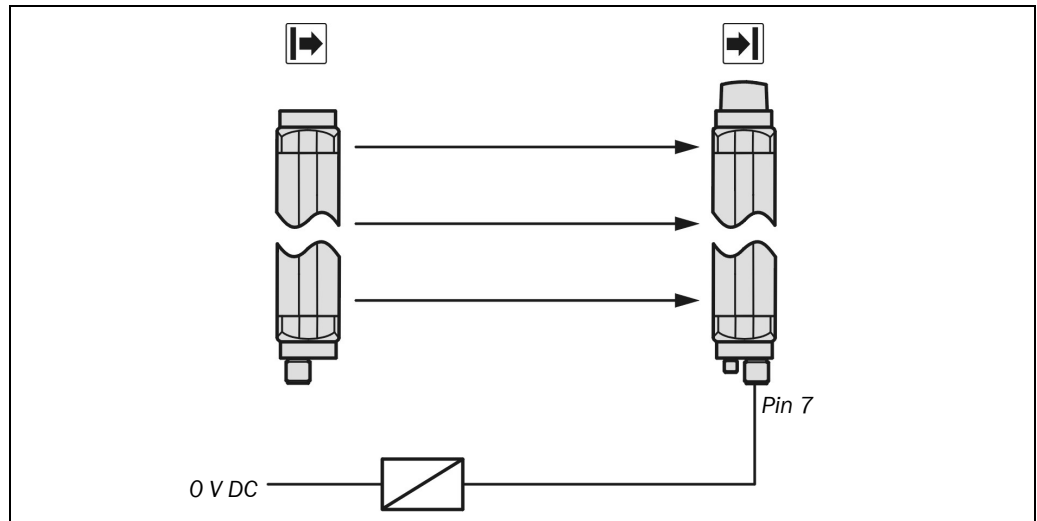
Connection of a *Reset required* signal lamp

Pin 8 of the system connection can be used as *Reset required* output (24 V). The output has a frequency of 1 Hz.

8.6 Application diagnostic output (ADO)

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

Fig. 57: Connection to the application diagnostic output



Notes

- When you connect the application diagnostic output as an alarm signal for contamination (OWS) or for the OSSD status, then during the configuration you can choose how the application diagnostic output is to signal the alarm.
 - HIGH active: If there is contamination or if the OSSDs are switched on, 24 V are present. Otherwise the output is high resistance.
 - LOW active: If there is contamination or if the OSSDs are switched on, the output is high resistance. Otherwise 24 V are present.
- If you use the application diagnostic output as an alarm signal for “Reset required”, it has a frequency of 1 Hz.
- Only M4000 Advanced and M4000 Advanced A/P in conjunction with a UE403 or sens:Control device:

If you connect the application diagnostic output as an alarm signal for muting or override status, then the application diagnostic output will always signal the alarm with an active HIGH. With muting or override 24 V are present. Otherwise the output is high resistance.



If you connect the signal output, then you must configure it with the aid of the CDS prior to commissioning. Details can be found in chapter 5.3 “Application diagnostic output (ADO)” on page 41.



WARNING

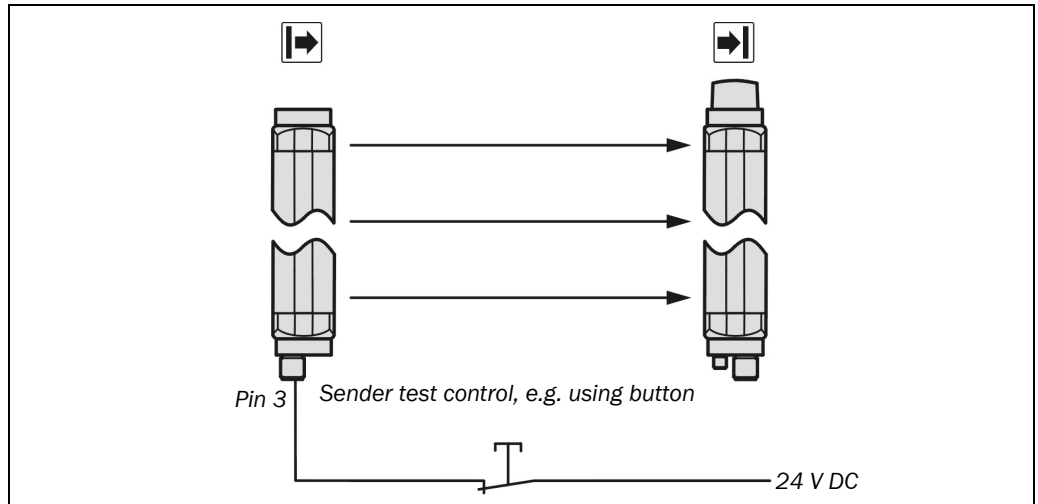
Device configuration after replacement!

If you replace a multiple light beam safety device on which the application diagnostic output (ADO) is connected and configured, then you must activate the application diagnostic output (ADO) again via the CDS. It is not enough to only make the electrical connections.

8.7 Test input (sender test)

Note The function Sender test is not available with the M4000 Advanced A/P.

Fig. 58: Connection of the sender test button



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



To be able to use the sender test button, you must also configure the **Sender test** function with the aid of the CDS: device symbol **M4000 Advanced (sender)**, context menu **Open device window**, parameter node **General**.

8.8 sens:Control applications

Using sens:Control, the intelligent interface technology for safety systems, SICK provides you with an entire range of interface products that were specially developed for interfacing safety products and machines.

For complex applications the M4000 can be integrated into UE100 sens:Control family safety systems. In this way the functions of the multiple light beam safety device can be enhanced and corresponding applications realised.

All variants of the M4000 Advanced, M4000 Advanced A/P and M4000 Area 60/80 are equipped with EFI (safe SICK device communication). All safety-relevant signals are transmitted using this interface. A bus interface to a safe fieldbus is possible using the series UE1000 sens:Control device family.

Note You will find connection diagrams in the operating instructions for the series UE100 and UE1000.

9 Commissioning



WARNING

Commissioning requires a thorough check by qualified safety personnel!

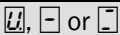
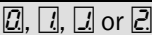
Before you operate a system protected by the M4000 multiple light beam safety device for the first time, make sure that the system is first checked and released by qualified safety personnel. Please read the notes in chapter 2 “On safety” on page 10.

9.1 Display sequence during start-up

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 indications have the following meaning:

Tab. 36: Displays shown during the power-up cycle

Display	Meaning
	Testing the 7-segment display. All segments are activated sequentially.
	Ca. 0.5 s. Is displayed only at the receiver and only in operation with large scanning range.
	Ca. 0.5 s. Non-coded operation or operation with code 1 or 2
	Receiver only: Sender–receiver alignment is not optimal (see chapter 9.2.1 “Meaning of the 7-segment display during alignment” on page 90ff).
Other display	Device error. See chapter 12 “Fault diagnosis” on page 105.

9.2 Alignment of the M4000

After the multiple light beam safety device has been mounted and connected, you must align the sender and receiver precisely in relation to each other.

Alignment is performed by mechanically adjusting the M4000 components. During this process the M4000 is in the alignment mode. You can then see when the optimal alignment is achieved on the 7-segment display on the receiver.

The alignment mode is automatically activated when the multiple light beam safety device is switched on if the light beams are not yet aligned or the light path is interrupted.

Alignment aids

You can conveniently and accurately align the devices using a laser alignment aid. An alignment aid is recommended particularly when a M4000 system is used with deflector mirrors (each mirror on the mirror columns must be adjusted).

The following alignment aids are available:

- integrated laser alignment aid per beam (optional, only for M4000 Advanced)
On this subject read the description in chapter 9.2.4 “Alignment of the M4000 Advanced with integrated laser alignment aid (optional)” on page 95.
- alignment aid AR60 + adapter for M4000 (see section 14.7 “Accessories” on page 139)
On this topic read the description in the operating instructions for the “Alignment aid AR60”.

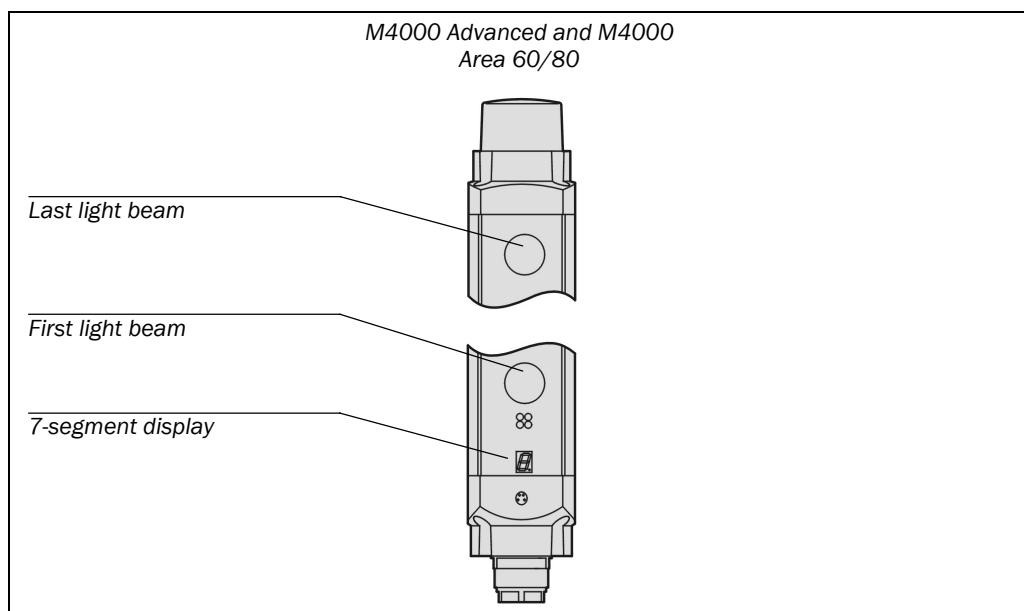
9.2.1 Meaning of the 7-segment display during alignment

During alignment, the 7-segment display on the receiver shows you when the optimal alignment is achieved (see Tab. 37).

- Notes**
- The beam that is closest to the 7-segment display is termed the first light beam (see Fig. 59 and Fig. 60).
 - Only the first and last light beam are evaluated during alignment.
 - If the optimum alignment (= no display) persists for longer than 2 minutes without the multiple light beam safety device being interrupted, the system automatically deactivates the alignment mode.

M4000 Advanced and M4000 Area 60/80

Fig. 59: Illustration of the beam order of the M4000 Advanced and the M4000 Area 60/80

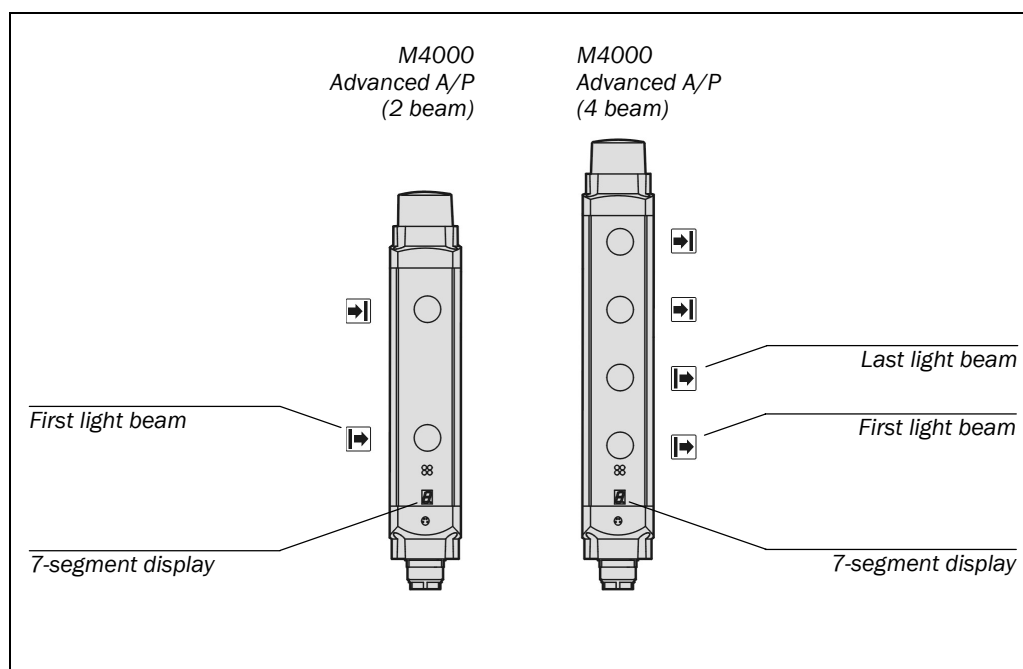


Tab. 37: Indications on the 7-segment display during alignment of the M4000 Advanced and the M4000 Area 60/80

Display	Significance during alignment
	First and last light beam not aligned.
	Only the first light beam is aligned.
	Only the last light beam is aligned.
	All the light beams hit the receiver, but the alignment is still slightly off.
No indication and green LED illuminated on the receiver	The alignment is now true; the devices must be locked in this position.

M4000 Advanced A/P

Fig. 60: Illustration of the beam order of the M4000 Advanced A/P



Tab. 38: Indications on the 7-segment display during alignment of the M4000 Advanced A/P

Display	Meaning during alignment of the M4000 Advanced A/P	
	2 beam	4 beam
	The first light beam is not aligned.	None of the light beams is aligned.
	–	Only the first light beam is aligned.
	–	Only the last light beam is aligned.
	The first light beam is aligned, but the alignment is still slightly off.	All the light beams hit the receiver, but the alignment is still slightly off.
No indication and green LED illuminated.	The alignment is now true; the devices must be locked in this position.	



WARNING

9.2.2 Aligning sender and receiver

Secure the plant/system. No dangerous state possible!

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

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

- Check with a spirit level whether the devices and the deflector mirrors, if used, are mounted vertically.
- Check whether the following points are the same distance from the floor:

M4000 Advanced or M4000 Area 60/80

- first beam of the sender
- first beam of the receiver
- when using deflector mirrors: centre of the first mirror surface

M4000 Advanced A/P

- first beam of the M4000 Advanced A/P
- centre of the first mirror surface for the M4000 Passive (with mirror deflection) or centre of the first beam for the M4000 Passive (with fibre-optic deflection)
- Loosen the clamping bolts which hold the multiple light beam safety device in place.
- Switch the power supply to the multiple light beam safety device on.
- Watch the alignment information on the 7-segment display of the receiver. Correct the alignment of the sender and receiver (or of the M4000 Advanced A/P and the M4000 Passive), until the 7-segment display goes off.
- Fix the multiple light beam safety device using the clamping screws.
- 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 (see Tab. 37 or Tab. 38).

9.2.3 Special aspects of alignment with deflector mirrors

If you use the M4000 multiple light beam safety device with deflector mirrors (mirror columns), then you must note the following points when aligning the mirrors:

1. On the deflection of several beams using a mirror column, each individual mirror must be adjusted separately.
2. For deflection using mirrors, the angle of incidence equals the angle of reflection. This means: A slight rotation of the mirror results in a change that is twice as large (see Fig. 61).

If the light beam is guided to the receiver using a deflector mirror, only part of the original diverging beam is passed on.

The alignment tolerance will become smaller with each further deflection (see Fig. 62).

Recommendation

Always use an alignment aid when aligning the M4000 Advanced with deflector mirrors (see section "Alignment aids" on page 90).

Fig. 61: Schematic illustration of the change on slight rotation of the deflector mirror

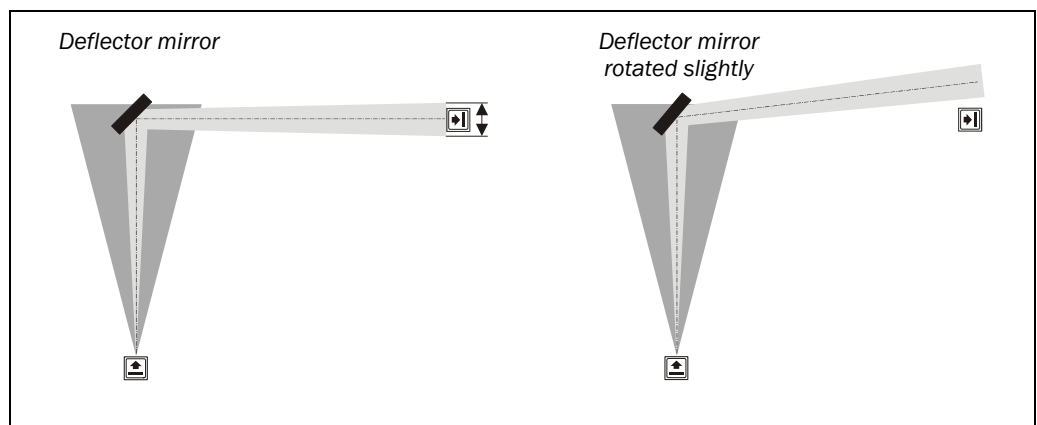
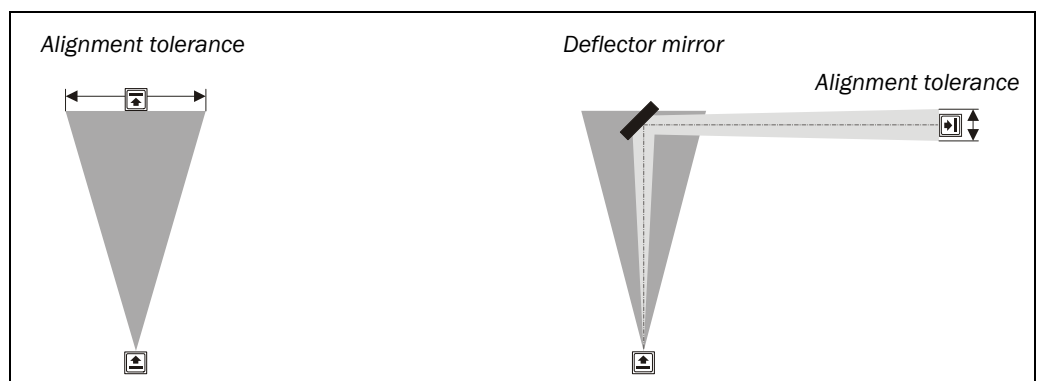


Fig. 62: Schematic illustration of the alignment tolerance without and with deflector mirror



9.2.4 Alignment of the M4000 Advanced with integrated laser alignment aid (optional)

The multiple light beam safety device is equipped with an integrated laser alignment aid of laser class 2.



WARNING

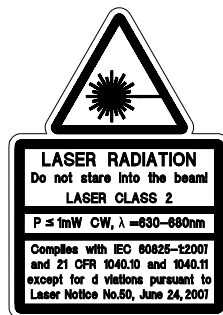
Never look directly into the laser beam!

Do not point the laser at a person's eye at close range!

The laser beam is not dangerous for the eye in case of accidental, brief exposure (< 0.25 s). There is only a hazard for the eye if the normal blinking reaction to bright light is suppressed. If the laser beam falls on your eye, you must consciously close your eyes or turn away immediately.

Do not use any other controls or adjustments!

Caution! Use of controls, adjustments or performance of procedures other than those herein specified may result in hazardous radiation exposure.



LASER RADIATION
Do not stare into the beam!
LASER CLASS 2

$P \leq 1 \text{ mW}$ CW, $\lambda = 630-680 \text{ nm}$

Complies with IEC 60825-1:2007
and 21 CFR 1040.10 and 1040.11
except for deviations pursuant to
Laser Notice No. 50, June 24, 2007

The M4000 Advanced multiple light beam safety device is available with an integrated laser alignment aid as an extra.

The laser alignment aid in conjunction with the indications on the 7-segment display enables you to precisely adjust and align the multiple light beam safety device. The aid comprises a laser per light beam (in the receiver) as well as a laser deflector mirror and a transparent display screen (in the sender).

The laser alignment aid is activated automatically when the M4000 Advanced is switched on if the light beams are not yet aligned or if the light path is interrupted.

Notes

- Always align the beams individually and in the following order: first beam, second beam ..., last beam (starting at the 7 segment display). When aligning the second and all further beams, it may occur that the laser beams for beams already aligned (e.g. the first beam) are no longer incident to the target on the alignment template (when this is fitted again). This situation has no effect on the accuracy of the overall alignment. I.e. beams already correctly aligned (e.g. first beam) do not need to be re-aligned after the alignment of the next beam (e.g. second beam), even if the laser beam for the beam previously aligned deviates from the target on the alignment template.
- If the multiple light beam safety device is in the lock-out status when switched on (see section "The lock-out status" on page 105), the laser alignment aid is not activated.
- The laser alignment aid switches off automatically, ...
 - if the LED ● **Green** on the receiver (light path unoccupied and optimal alignment) is on without interruption for more than 2 minutes.
 - independent of the state after 60 minutes.

- In the delivery with the receiver for the M4000 Advanced with integrated laser alignment aid you will find two self-adhesive alignment templates (one template for the deflector mirror and one for the sender). Keep both alignment templates at hand. You will find further information on the alignment templates as well as a master for copying in the annex 15.3.



WARNING

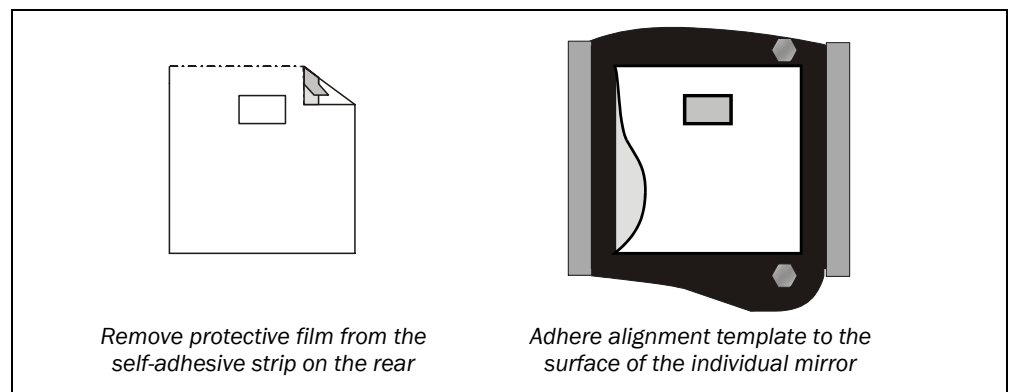
Secure the plant/system. No dangerous state possible!

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

How to align the M4000 Advanced with the aid of the integrated alignment aid:

- Check with a spirit level whether the devices and the deflector mirrors, if used, are mounted vertically.
- Check whether the following points are the same distance from the floor:
 - first beam of the sender
 - first beam of the receiver
 - when using deflector mirrors: centre of the first mirror surface
- Loosen the clamping bolts which hold the multiple light beam safety device in place.
- Adhere the alignment template for mirrors to the individual mirror on the mirror pillar that is used to deflect the beam to be aligned. If you start the alignment with the first beam as per these instructions, this is the bottom mirror on the mirror pillar (see Fig. 64).

Fig. 63: Attaching the alignment template for mirrors



- Activate the laser alignment aid by switching on the power supply to the multiple light beam safety device.

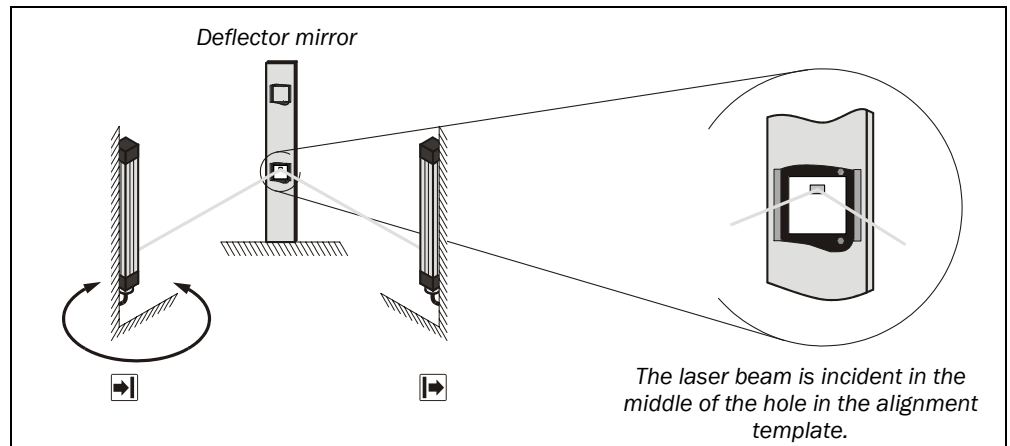
Note You can also activate and deactivate the laser alignment aid via the CDS.

- Rotate the receiver until the alignment beam is incident in the centre of the hole in the alignment template (see Fig. 64). If further mirror columns are used, use the alignment template for all further mirrors on the mirror columns.

Note If you do not use an alignment template, the alignment beam must be incident approx. 23.5 mm above the centre of the mirror.

Fig. 64: Alignment of the receiver to the deflector mirror using the laser alignment aid

- Remove the alignment template from the individual mirror.



- Adhere the alignment template for the sender to the beam on the sender that is closest to the 7-segment display.

Note

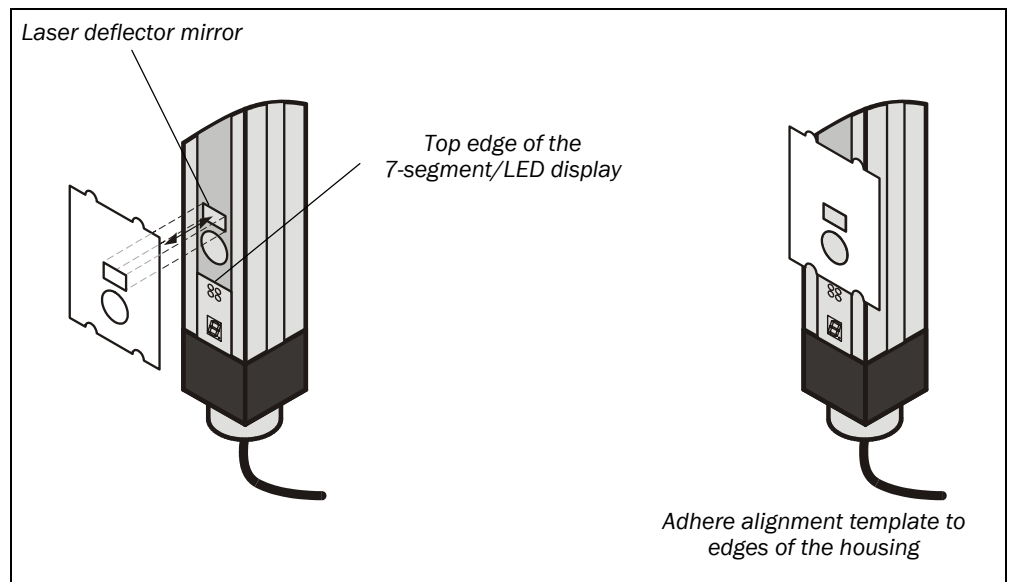
The alignment template for the sender is correctly positioned on the sender (see Fig. 65), when ...

- the circular opening is exactly over the beam optics

and

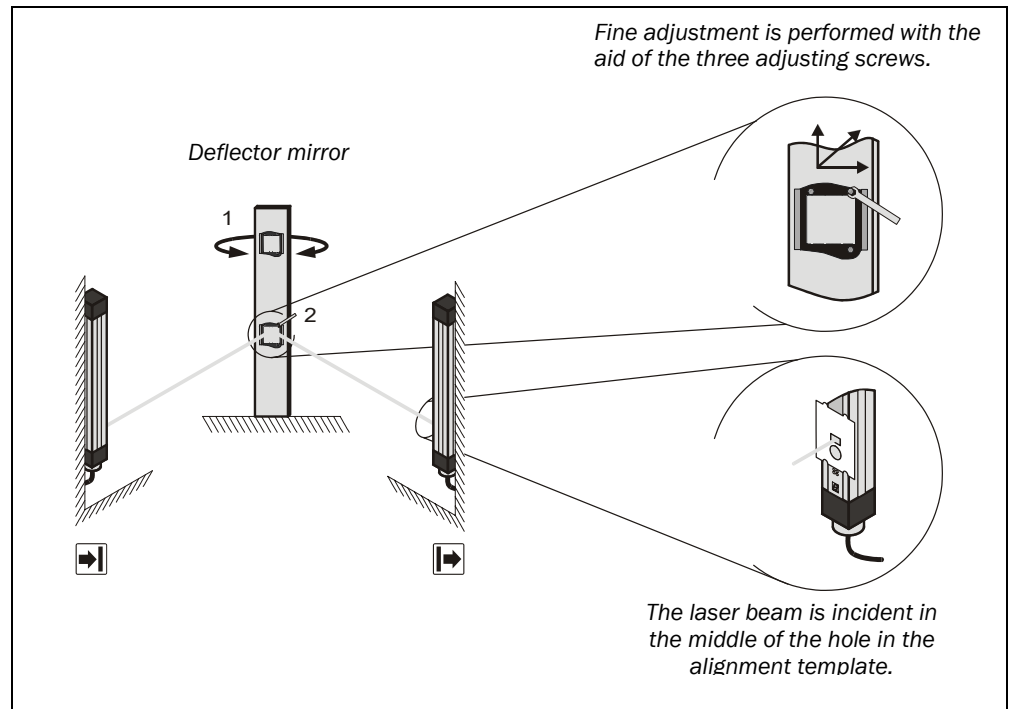
- the tabs on the template are exactly positioned on the edges of the sender housing and point upward from the 7-segment/LED display.

Fig. 65: Attach the alignment template to the sender



- Align the deflector mirror (depending on the mirror columns, you may need to remove the cover plate first). With the aid of three adjusting screws, you can finely adjust the individual mirror (see Fig. 66). The optimal alignment is achieved when the alignment beam is incident in the middle of the rectangular hole in the alignment template.

Fig. 66: Alignment of the deflector mirror to the sender using the laser alignment aid



Note

For the alignment of the sender, the laser beam is deflected within the sender onto a transparent display screen with the aid of the laser deflector mirror. As soon as correct alignment is achieved, the display screen, which can be seen from the exterior, illuminates (see Fig. 67).

Fig. 67: Principle of laser deflection in the sender

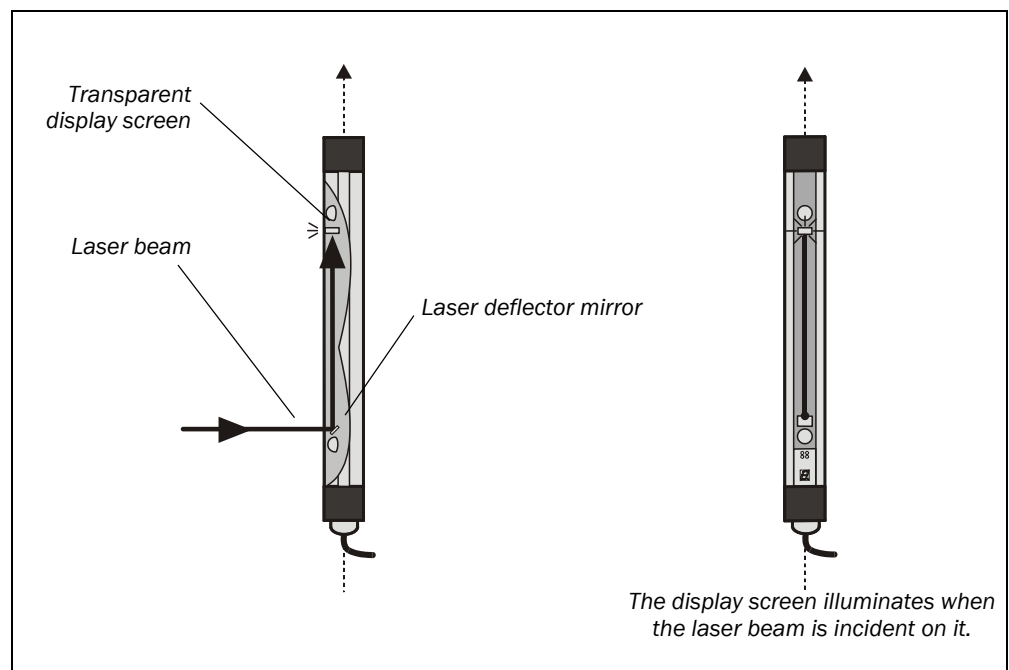
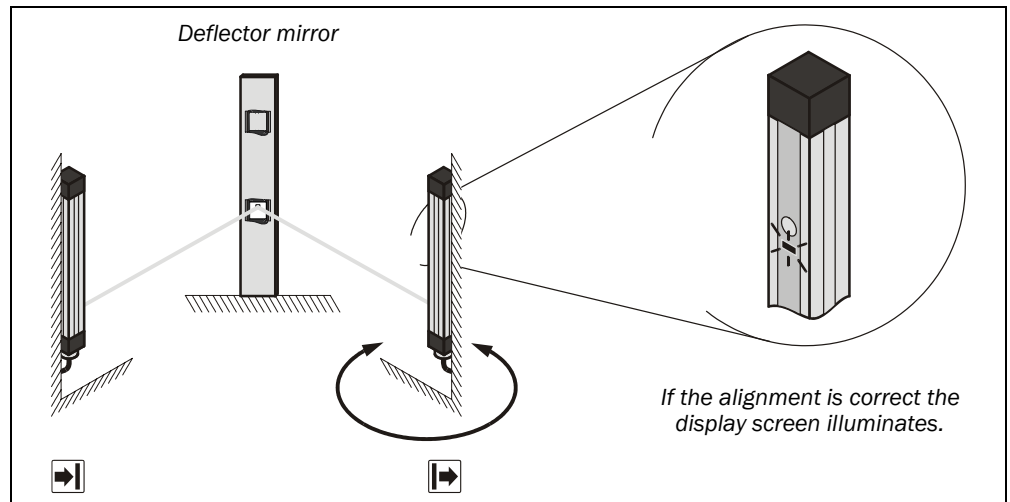


Fig. 68: Alignment of the sender using the laser alignment aid

- Rotate the sender until the display screen illuminates.



- Remove the alignment template. Watch the alignment information on the 7-segment display of the receiver (see Tab. 37). The optimal alignment of the beam near the 7-segment display is achieved when a  appears on the 7-segment display.

- Notes**
- When the alignment information on the 7-segment display goes out (no indication), then all other beams are already aligned.
 - The sender is only aligned once. This step is not necessary when aligning other beams.
 - Fix the sender in place.
 - Align the other beams using the steps described.

Note When aligning the second and all further beams, it may occur that the laser beams for beams already aligned (e.g. the first beam) are no longer incident to the target on the alignment template (when this is fitted again). This situation has no effect on the accuracy of the overall alignment.

- Using the clamping bolts, fix the receiver 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 (see Tab. 37).

Note All alignment templates used must be removed after the alignment procedure!

9.3 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.

9.3.1 Pre-commissioning test notes



WARNING

Ensure that you do not place anybody at risk during initial commissioning of the machine!

Always expect that the machine, plant or the protective device does not yet behave as you have planned.

- Ensure that there are no persons in the hazardous area during 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 15.2 on page 142).
- Ensure that the operating personnel of the machine protected by the multiple light beam safety device 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 15.2 of this document shows a checklist for review by the manufacturer and OEM. Use this checklist as a reference before commissioning the system for the first time.

9.3.2 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 first commissioning are detected.
- If major changes have been made to the machine or the protective device, or if the multiple light beam safety device has been modified or repaired, check the plant again as per the checklist in the annex.

9.3.3 Daily functional checks of the protective device

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



WARNING

Do not operate the machine if the green or yellow LED is lit during the test!

If the green or yellow LED lights up during the test even for a short period, work must stop at the machine. In this case the mounting and the configuration of the multiple light beam safety device must be checked by qualified safety personnel (see chapter 7 and chapter 10).

Testing the light path between sender and receiver

- **Prior** to covering each light beam with a test rod, check whether ...
 - the green LED lights up on the M4000 with de-activated internal restart interlock.
 - the yellow LED lights up on the M4000 with activated internal restart interlock (“Reset required”).

Note If this is not the case, ensure that this condition is reached. The test is otherwise meaningless.

Only M4000 Advanced:

- Completely cover each light beam with a test rod that is not transparent to light (at least 30 mm diameter) at the following positions:
 - immediately in front of the sender
 - in the middle between sender and receiver (or between the deflector mirrors)
 - immediately in front of the receiver
 - when using deflector mirrors: immediately before and after the deflector

Only M4000 Advanced A/P:

- Completely cover each light beam with a test rod that is not transparent to light (at least 30 mm diameter). Hold the test rod in the following positions with your arm outstretched:
 - immediately in front of the M4000 Advanced A/P
 - in the middle between M4000 Advanced A/P and M4000 Passive or another mirror deflection (e.g. deflector mirror PSK45)
 - immediately in front of the M4000 Passive or another mirror deflection (e.g. deflector mirror PSK45)
 - when using deflector mirrors between M4000 Advanced A/P and M4000 Passive: immediately before and after the deflector

Only M4000 Area 60/80:

- Use a test rod that is not transparent to light and that has the following diameters:
 - 60 mm for the M4000 Area 60
 - 80 mm for the M4000 Area 80
- Guide the test rod along the entire length of the area monitored:
 - immediately in front of the sender
 - in the middle between sender and receiver
 - immediately in front of the receiver

This must produce the following result:

- On the receiver for the related multiple light beam safety device only the red LED is allowed to illuminate and **not** the green or yellow LED
and
- as long as the light beam is interrupted, it must not be possible to initiate the dangerous state.

Further tests

- Check the protective device for damage or wear, particularly the mounting, the electrical connection and the connection cable, the housing and the front screen.
- Check whether the access to the hazardous area is only possible by interrupting the light path between sender and receiver for the M4000 system (e.g. correct mounting of mechanical protective devices).
- Check whether the protective device is effective for the set operating mode.

10 Configuration

10.1 Default delivery status

As delivered the M4000 is configured ready for protective operation. In the following table you will find all functions that can be configured as well as information on which device the functions need to be configured.

- Notes**
- The preconfiguration of the M4000 multiple light beam safety device depends on the type (see Ordering information on page 130ff).
 - You can open the existing configuration of the M4000 at any time with the aid of the CDS.

Tab. 39: Overview of the configurable functions

Function	M4000 Advanced, M4000 Area 60/80		M4000 Advanced A/P
	➡ Sender	➡ Receiver	➡ ➡ Sender and receiver unit
Beam coding	■	■	■
External device monitoring	–	■	■
Reset/restart interlock	–	■	■
Scanning range	–	■	■
Application diagnostic output (ADO)	–	■	■
Sender test	■	–	–

You will find more detailed information on the individual functions in chapter 5 “Configurable functions” on page 38ff.

10.2 Preparation of the configuration

How to prepare the configuration:

- Make sure that the multiple light beam safety device has been correctly mounted and that the electrical connections are correct and in place.
- Plan all necessary settings (beam coding, scanning range, external device monitoring, etc.) and document them.

For the configuration of the multiple light beam safety device you will need:

- CDS (Configuration & Diagnostic Software) on CD-ROM
- user manual for CDS on CD-ROM
- PC/Notebook with Microsoft Windows® and a serial interface (RS-232). PC/Notebook not included
- connecting cable between PC and M4000 (SICK-Part No. 6021195)

To configure the device, please read the user manual for the CDS (Configuration & Diagnostic Software) and use the online help function of the programme.

11 Care and maintenance

The M4000 multiple light beam safety device is maintenance-free. The front screen of the M4000 multiple light beam safety device should be regularly cleaned and also if contaminated.

- Do not use aggressive detergents.
- 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 No. 5600006) and the SICK lens cloth (SICK Part No. 4003353).

How to clean the front screen:

- 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, under or standing behind).

➤ Verify the effectiveness of the protective device as described in chapter 9.3 “Test notes” on page 100.

12 Fault diagnosis

This chapter describes how to identify and remedy errors and malfunctions during the operation of the M4000 multiple light beam safety device.

12.1 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 remedy the malfunction.

Complete function test after rectification of fault!

After rectifying a fault, perform a complete function test as per section 9.3 “Test notes”.

The lock-out status

In case of certain faults or an erroneous configuration, the system can go into the lock-out status. The 7-segment display on the multiple light beam safety device then indicates  or a defined error message (see Tab. 41).

- First check whether the lock-out status is still present after switching off and on the M4000 (e.g. by disconnecting the system plug and re-connecting).

To place the device back in operation:

- Rectify the cause of the fault as per Tab. 41.
- Switch the power supply for the M4000 off and on again (e.g. by unplugging the system plug and reinserting it).

Note The lock-out status has the highest priority above all other indications on the 7-segment display.

12.2 SICK support

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

12.3 Error displays of the 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 3.4 "Controls and status indicators" on page 19.

Tab. 40: Error displays of the LEDs

Display		Possible cause	Remedying the error
 Sender			
 Yellow	LED fails to light up	No operating voltage, or voltage too low	➤ Check the voltage supply and activate, if necessary.
 Receiver or M4000 Advanced A/P			
 Orange	LED illuminated	Received signal is weak	➤ Check the alignment of sender and receiver or of the M4000 Advanced A/P and the M4000 Passive. ➤ Check the front screen (dirt) and clean, if necessary.
 Yellow	LED flashing	Reset required	➤ Press the reset button.
 Red and  Green	Neither the red nor the green LED lights up	No operating voltage, or voltage too low	➤ Check the voltage supply and activate, if necessary.

12.4 Error displays of the 7-segment display

This section explains the meaning of the error displays on the 7-segment display and how to respond to the messages. Please refer to chapter 3.4 "Controls and status indicators" on page 19 for a description of the 7-segment display.

Tab. 41: Error displays of the 7-segment display

Display	Possible cause	Remedying the error
 or 	Inadequate alignment (in alignment mode)	➤ Re-align sender and receiver (see page 90). The display goes off after 2 minutes.
	The light path is interrupted (in normal operation)	➤ Rectify the cause of the interruption in the light path.
	Configuration incomplete	➤ The display goes off automatically once the configuration has been successfully transferred. If the display  does not go off: ➤ Check the configuration of the system using the CDS (Configuration & Diagnostic Software). ➤ Re-transfer the corrected configuration to the system.
 or 	EDM error (see also page 46)	➤ Check the contactors and their wiring, eliminate any wiring errors, if necessary. ➤ If  is displayed, switch the device off and back on again.
	Reset button fault	➤ Check the reset button for correct function. The button may be defective or stuck. ➤ Check the wiring of the reset button for any short-circuit to 24 V.
 ⁷⁾	Override time exceeded by 60 minutes Or: No completely error-free muting cycle within 60 minutes after first operation of the control switch for override Permissible number of override statuses exceeded (see Tab. 26 on page 61)	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Ensure the muting sensors are correctly positioned and are working correctly and that the muting lamp is in correct working order.

⁷⁾ This error display only occurs in conjunction with a UE403 or a sens:Control device.

Display	Possible cause	Remedying the error
	Communication error during ongoing operation	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check pin 9 and pin 10 (EFI device communication) of the system connection(see the notes in section 8.1) ➤ Check the connection between the M4000 and the UE403 or sens:Control device. If necessary, replace defective cables. ➤ Have the UE403 or sens:Control device replaced.
	Invalid configuration of muting sensor B1 or B2	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check whether muting sensor B1 or B2 is connected correctly but is not configured.
	Invalid configuration of the signals Override/C1/belt stop	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check whether the signals Override/C1/belt stop on the UE403 or sens:Control device or C1/belt stop on the ESPE are connected correctly, but not configured.
	Invalid configuration of Reset or Reset/Override signal (combined)	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check whether the Reset or Reset/Override signal (combined) on the UE403 or sens:Control device or ESPE has been connected correctly and configured.
	System error	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Replace the unit (receiver or sender).
	Error in external device	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check the connection between the M4000 and the UE403 or sens:Control device. If necessary, replace defective cables. ➤ Have the UE403 or sens:Control device replaced.
	Overcurrent at output signal switching device 1	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check the contactor. Replace, if necessary. ➤ Check the wiring for short-circuit to 0 V.

Display	Possible cause	Remedying the error
	Short-circuit at output signal switching device 1	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check the wiring for short-circuit to 24 V.
	Short-circuit at output signal switching device 1	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check the wiring for short-circuit to 0 V.
	Overcurrent at output signal switching device 2	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check the contactor. Replace, if necessary. ➤ Check the wiring for short-circuit to 0 V.
	Short-circuit at output signal switching device 2	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check the wiring for short-circuit to 24 V.
	Short-circuit at output signal switching device 2	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check the wiring for short-circuit to 0 V.
	Short-circuit between output signal switching device 1 and 2	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check the wiring and rectify the error.
	Short-circuit on the belt stop/C1 input	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check the wiring for short-circuits on the inputs/outputs: Reset, External device monitoring, Reset required and Application diagnostic output (ADO).
	Invalid configuration of the EDM	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check whether the machine-side EDM is connected but not activated in the configuration.

Display	Possible cause	Remedying the error
	Unknown sender detected	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check the distance from reflective surfaces (see page 68) or from other multiple light beam safety devices. ➤ If necessary, re-configure the device with another beam coding (see page 40) or install non-reflective partitions.
	Supply voltage error	➤ Switch the device off and back on again for at least 3 seconds. If the error continues to occur: ➤ Check whether the power supply complies with the specification (see page 113). ➤ Check whether the cable lengths comply with the specification (see page 113, the cable lengths must not be exceeded).
	Fault of a device connected via EFI.	➤ Wait a few seconds. Invalid input signals could still be present on the external UE403 or sens:Control device. If the error continues to occur: ➤ Check the sensors/signals connected to the external device. ➤ Check whether the sensor test is configured correctly. ➤ Check the connections to the external devices. If necessary, replace defective cables. ➤ Carry out a fault diagnosis of the device connected with the M4000 (see 12.5 on page 112).
	Override time exceeded by 30 minutes Override required is signaled	➤ Ensure the muting sensors are correctly positioned and are working correctly and that the muting lamp is in correct working order.
	Total muting time exceeded	If override is configured, <i>Override required</i> is displayed. ➤ Check the muting sensors. If necessary, replace them. ➤ Check whether the total muting time is correctly configured and whether the system is working correctly.

⁸⁾ This error display only occurs in conjunction with a UE403 or a sens:Control device.

Display	Possible cause	Remedying the error
 ⁸⁾	Concurrence monitoring error	If override is configured, <i>Override required</i> is displayed. ➤ Check the muting sensors. If necessary, replace them. ➤ Check whether the concurrence monitoring is correctly configured and whether the system is working correctly.
 ⁸⁾	Sequence monitoring error	If override is configured, <i>Override required</i> is displayed. ➤ Check the muting sensors. If necessary, replace them. ➤ Check whether the muting sensors are activated and deactivated in the correct sequence.
 ⁸⁾	Direction detection error	If override is configured, <i>Override required</i> is displayed. ➤ Check the muting sensors. If necessary, replace them. ➤ Check whether the system is working correctly, whether the transport device is functioning correctly and whether the muting sensors are correctly positioned.
 ⁸⁾	Sensor gap monitoring error	If override is configured, <i>Override required</i> is displayed. ➤ Check whether the sensor gap monitoring is configured correctly and whether the gaps in the goods transported are not too large. ➤ Check the muting sensors. If necessary, replace them.
 ⁸⁾	Error after belt stop	If override is configured, <i>Override required</i> is displayed. ➤ Check whether the belt stop input signal is working correctly. ➤ Ensure that there are no further state changes at the muting sensors and the ESPE once the belt stop signal is present. ➤ Check the muting sensors. If necessary, replace them.
 ⁸⁾	Error of the muting lamp	If override is configured, <i>Override required</i> is displayed. ➤ Check the muting lamp. If necessary, replace them. ➤ Verify that the muting lamp is connected correctly.

12.5 Extended diagnostics



The CDS software (Configuration & Diagnostic Software) supplied with the M4000 Advanced multiple light beam safety device contains extensive diagnostic facilities. 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 function of the CDS (Configuration & Diagnostic Software).
- in the user manual for the CDS.

Note M4000 systems with **firmware ≥ V1.50** support the following diagnostics features:

- You can read the event history for the last four muting signal events from the system using the CDS. The event history depicts the signal trace prior to the triggering of the protective device. In this way you can trace errors in the muting process if the system was no longer connected to the PC when the errors occurred. The event history for the M4000 can be retrieved until it is switched off.
- With the aid of the CDS data recorder you can record, display and save the signal traces if there is a connection between the PC and M4000.

How to conduct an extended diagnostics of the M4000:

- Connect the PC/Notebook on which the CDS has been installed to the M4000 Advanced multiple light beam safety device.
- Carry out a diagnostics on the M4000 Advanced receiver.



Device symbol **M4000 Advanced (sender or receiver)**, **M4000 Advanced (A/P)** or **M4000 Area (sender or receiver)**, context menu **Diagnostics**, **Display**.

13 Technical specifications

13.1 Data sheet

M4000 Advanced, M4000 Advanced A/P and M4000 Area 60/80

Tab. 42: Data sheet M4000 Advanced, M4000 Advanced A/P and M4000 Area 60/80

	Minimum	Typical	Maximum
General system data			
Type	Type 4 (IEC 61496-1)		
Safety Integrity Level ⁹⁾	SIL3 (IEC 61508)		
SIL claim limit ⁹⁾	SILCL3 (EN 62061)		
Category	Category 4 (EN ISO 13849-1)		
Performance Level ⁹⁾	PL e (EN ISO 13849-1)		
PFHd (mean probability of a dangerous failure per hour)			
M4000 Advanced	6.6×10^{-9}		
M4000 Advanced A/P	6.6×10^{-9}		
M4000 Area 60/80	14×10^{-9}		
T _M (mission time)	20 years (EN ISO 13849)		
Safe state in case of an error	At least one OSSD is in the LOW state		
Number of beams, type-dependent			
M4000 Advanced	2		12
M4000 Advanced A/P	2		4
Length of the monitored area, depending on type			
M4000 Area 60	300 mm		1800 mm
M4000 Area 80	600 mm		1800 mm
Beam separation, type-dependent			
M4000 Advanced	120 mm		600 mm
M4000 Advanced A/P		500 mm and 300 mm	
M4000 Area 60/80	50 mm		57 mm
Resolution, depending on type			
M4000 Area 60/80	60 mm		80 mm

⁹⁾ For detailed information on the safety design of your machine/system, please contact your local SICK representative.

	Minimum	Typical	Maximum
Scanning range, configurable			
M4000 Advanced,			
M4000 Area 80			
Low scanning range	0.5 ... 20 m		
High scanning range	9 ... 70 m	9 ... 90 m ¹⁰⁾	
M4000 Area 60			
Low scanning range	0 ... 6 m		
High scanning range	5 ... 19 m	5 ... 21 m	
Scanning range ¹¹⁾			
M4000 Advanced A/P			
With mirror deflection	0.5 m		7.5 m
With fibre-optic deflection	0.5 m		4.5 m
Beam diameter			
M4000 Advanced,		23 mm	
M4000 Advanced A/P and			
M4000 Area 80			
M4000 Area 60		13 mm	
Protection class ¹²⁾	III (EN 50 178)		
Enclosure rating	IP 65 (EN 60 529)		
Supply voltage V_S at device ¹³⁾	19.2 V	24 V	28.8 V
Residual ripple ¹⁴⁾			±10 %
Synchronisation ¹⁵⁾	Optical, without separate synchronisation		
Power-up delay of sender and receiver before ready			10 s

Sender

Test input			
Input voltage ¹⁶⁾ 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 ¹⁶⁾	-3.5 mA	0 mA	0.5 mA
Response time to test	Depending on the number of beams, maximum 150 ms		
Wavelength of sender ¹⁷⁾	Near infrared (NIR), invisible ¹⁷⁾		

¹⁰⁾ 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 %.

¹¹⁾ The scanning range of the M4000 Advanced A/P device must be configured to suit the deflection used (see section 5.4.3 "Scanning range of the M4000 Advanced A/P" on page 44).

¹²⁾ Safety extra-low voltage SELV/PELV.

¹³⁾ The external voltage supply must be capable of buffering brief mains voltage failures of 20 ms as specified in EN 60 204-1. Suitable power supplies are available as accessories from SICK (Siemens type series 6 EP 1).

¹⁴⁾ Within the limits of V_S .

¹⁵⁾ Only with Active/Active systems.

¹⁶⁾ As per IEC 61 131-2.

¹⁷⁾ For the exact value see www.sick.com.

	Minimum	Typical	Maximum
Power consumption M4000 Advanced, M4000 Area 60/80			0.2 A
Weight, type-dependent	See section 13.2 "Table of weights" on page 119ff.		

➤ **Receiver or ➤ ➤ M4000 Advanced A/P**

Output signal switching devices (OSSDs)	2 PNP semiconductors, short-circuit protected ¹⁸⁾ , cross-circuit monitored		
Response time M4000 Advanced, M4000 Advanced A/P			
2 to 6 beams	10 ms		
7 to 11 beams	11 ms		
12 beams	12 ms		
M4000 Area 60/80			
Non-coded	11 ms		
Coded	17 ms		
Additional response time when using the safe SICK-device communication (EFI)	+ 4 ms		
Switch off time	100 ms		
Power-up delay			6.5 × resp. time
Switching voltage ^{19) 20)} HIGH (active, U_{eff})	$V_S - 2.25\text{ V}$	24 V	V_S
Switching voltage LOW (inactive)	0 V	0 V	2 V
Switching current	0 mA		500 mA
Leakage current ²¹⁾			0.25 mA
Load capacity			2.2 μF
Switching sequence	Depending on load inductance		
Load inductance ²²⁾			2.2 H

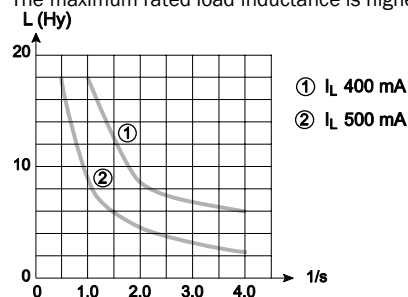
¹⁸⁾ Applies to the voltage range between -30 V and +30 V.

¹⁹⁾ As per IEC 61131-2.

²⁰⁾ On the device plug.

²¹⁾ 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.

²²⁾ The maximum rated load inductance is higher with lower switching sequence.



	Minimum	Typical	Maximum
Test pulse data ²³⁾			
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 ²⁴⁾			2.5 Ω
Supply lead			1 Ω
Power consumption			
M4000 Advanced			0.6 A ²⁵⁾
M4000 Advanced A/P			0.6 A ²⁵⁾
M4000 Area 60/80			0.6 A ²⁵⁾
External device monitoring (EDM) input			
Input voltage ²⁶⁾ HIGH (inactive)	11 V	24 V	30 V
Input current HIGH	6 mA	10 mA	20 mA
Input voltage ²⁶⁾ LOW (active)	–30 V	0 V	5 V
Input current LOW	–2.5 mA	0 mA	0.5 mA
Contactors			
Permissible dropout time			300 ms
Permissible pick-up time			300 ms
Control switch input (reset button)			
Input voltage ²⁶⁾ HIGH (active)	11 V	24 V	30 V
Input current HIGH	6 mA	10 mA	20 mA
Input voltage ²⁶⁾ LOW (inactive)	–30 V	0 V	5 V
Input current LOW	–2.5 mA	0 mA	0.5 mA
Operation time control switch input	200 ms		
Output <i>Reset required</i>	PNP semiconductors, short-circuit protected ²⁷⁾		
(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	

²³⁾ 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.

²⁴⁾ 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 60 204-1 Electrical Machine Equipment, Part 1: General Requirements.)

²⁵⁾ Without OSSDs, without ADO, without *Reset required* and without UE403.

²⁶⁾ As per IEC 61 131-2.

²⁷⁾ Applies to the voltage range between –30 V and +30 V.

	Minimum	Typical	Maximum
Application diagnostic output (ADO)	PNP semiconductors, short-circuit protected ²⁷⁾		
Switching voltage HIGH (active)	$V_S - 4.2 \text{ V}$	24 V	V_S
Switching voltage LOW (inactive)		High resistance	
Switching current	0 mA		100 mA
Belt stop input/C1			
Input voltage ²⁶⁾ HIGH (inactive ²⁸⁾ , active ²⁹⁾)	11 V	24 V	30 V
Input current HIGH	6 mA	10 mA	20 mA
Input voltage ²⁶⁾ LOW (active ²⁸⁾ , inactive ²⁹⁾)	-30 V	0 V	5 V
Input current LOW	-2.5 mA	0 mA	0.5 mA
Operation time input	100 ms		
Wavelength			
M4000 Adv. A/P (sender unit)	Near infrared (NIR), invisible ³⁰⁾		
Alignment laser (optional) ³¹⁾	Laser class 2. Complies with IEC 60825-1:2007 and 21 CFR 1040.10 and 1040.11 with the exception of the deviations as per Laser Notice No. 50, June 24, 2007 Optical power output $\leq 1 \text{ mW}$ Wavelength 630 nm–680 nm (visible red light)		
Weight, type-dependent	See section 13.2 "Table of weights" on page 119ff.		

Operating data

Connection	Hirschmann plug M26 × 11 + FE		
Cable length ³²⁾			50 m
Wire cross-section	0.75 mm ²		
Ambient operating temperature	-30 °C		+55 °C
Air humidity (non-dewing)	15 %		95 %
Storage temperature	-30 °C		+70 °C
Housing cross-section	52 mm × 55.5 mm		
Vibration resistance	5 g, 10-55 Hz (EN 60068-2-6)		
Shock resistance	10 g, 16 ms (EN 60068-2-27)		

²⁸⁾ Belt stop.²⁹⁾ C1.³⁰⁾ For the exact value see www.sick.com.³¹⁾ Below -10 °C the availability of the alignment laser is limited.³²⁾ Depending on load, power supply and wire cross-section. The technical specifications must be observed.

Minimum	Typical	Maximum
---------	---------	---------

Environmental data, materials

Housing	Aluminium alloy ALMGSI 0.5 (powder coated)
Front screen	Polycarbonate, scratch-resistant coating
End caps	Polyamide 6.6 CF30
Packaging	Corrugated cardboard with polyethylene inlays
Circuit boards	Glass-fibre reinforced epoxy resin with flame retarding agent TBBPA

M4000 Passive

Housing cross-section	52 mm × 55.5 mm
Weight, type-dependent	See section 13.2 "Table of weights" on page 119ff.

13.2 Table of weights

13.2.1 M4000 Advanced and M4000 Advanced A/P

Tab. 43: Table of weights
M4000 Advanced and
M4000 Advanced A/P

Number of beams	Beam separation [mm]	Type code	Weight [g]
2	500	M40Z-0250##### ³³⁾	1860
		M40#-0250#####	1925
	600	M40#-0260#####	2200
3	220	M40#-0322#####	1760
	400	M40#-0340#####	2750
	450	M40#-0345#####	3025
4	220	M40#-0422#####	2370
	300	M40Z-0430##### ³³⁾	3040
		M40#-0430#####	3030
5	220	M40#-0522#####	2975
6		M40#-0622#####	3580
7		M40#-0722#####	4185
8		M40#-0822#####	4795

13.2.2 M4000 Passive

Tab. 44: Table of weights
M4000 Passive

For number of beams	Deflector unit	Part number	Type code	Weight [g]
2	Mirror deflection	1027906	PSD01-1501	1500
	Fibre-optic deflection	1027907	PSD01-2501	1760
4	Fibre-optic deflection	1027908	PSD02-2301	2920

13.2.3 M4000 Area 60/80

Tab. 45: Table of weights
M4000 Area 60/80

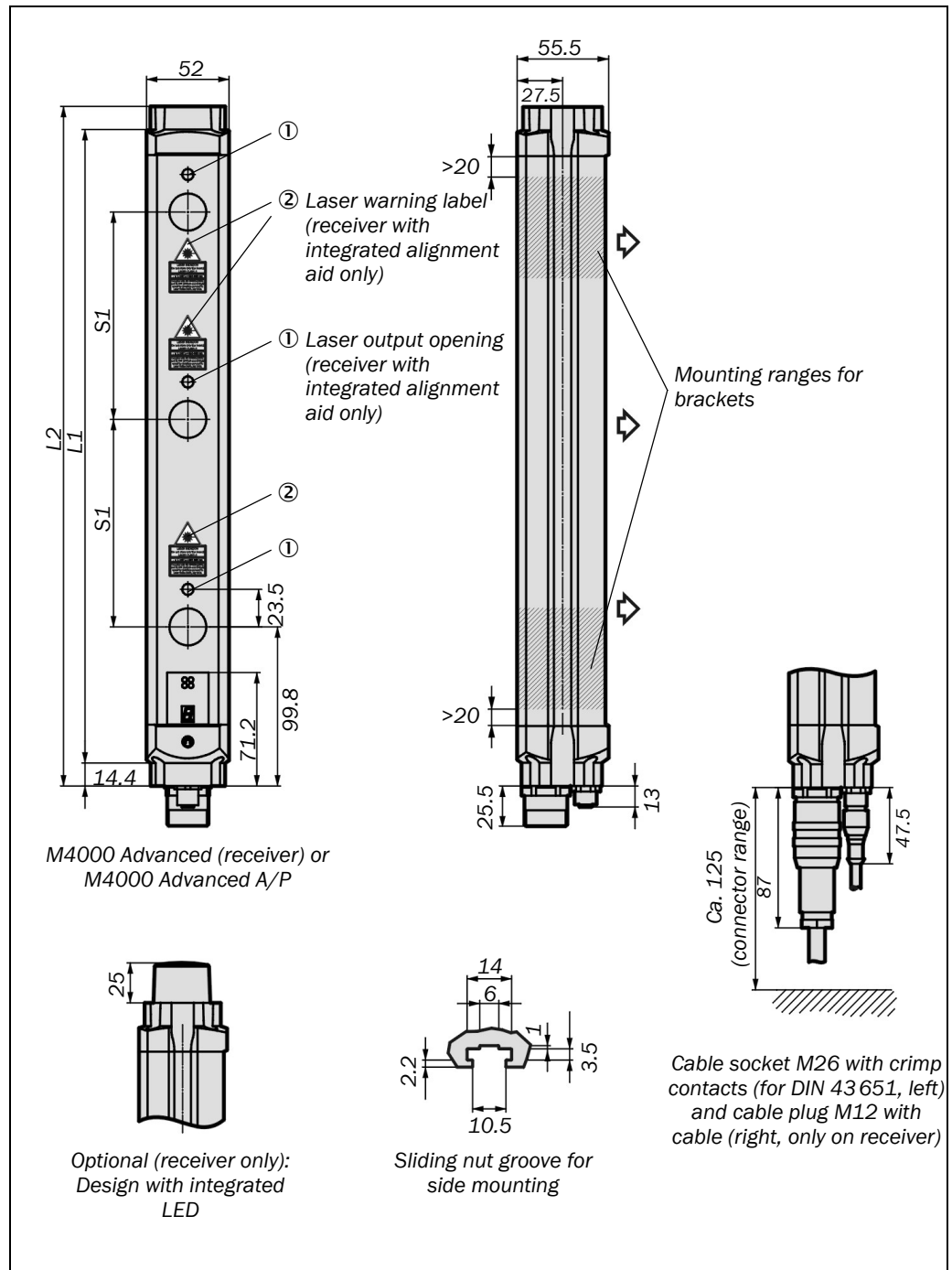
Length of the monitored area [mm]	Type code	Weight [g]	
		M4000 Area 60	M4000 Area 80
300	M40#-60A#####	1290	n. u.
450	M40#-61A#####	1740	n. u.
600	M40#-62A#####	2195	2090
750	M40#-63A#####	2650	2510
900	M40#-64A#####	3100	2950
1050	M40#-65A#####	3555	3375
1200	M40#-66A#####	4010	3795
1350	M40#-67A#####	4465	4230
1500	M40#-68A#####	4915	4660
1650	M40#-69A#####	5370	5095
1800	M40#-70A#####	5825	5515

³³⁾ M4000 Advanced A/P.

13.3 Dimensional drawings

13.3.1 M4000 Advanced, M4000 Advanced A/P

Fig. 69: Dimensional drawing
M4000 Advanced receiver
(sender mirror image) or
M4000 Advanced A/P (mm)



M4000 Adv., Adv. A/P, Area

Tab. 46: Dimensions of the M4000 Advanced or the M4000 Advanced A/P dependent on the number of beams

M4000 Advanced

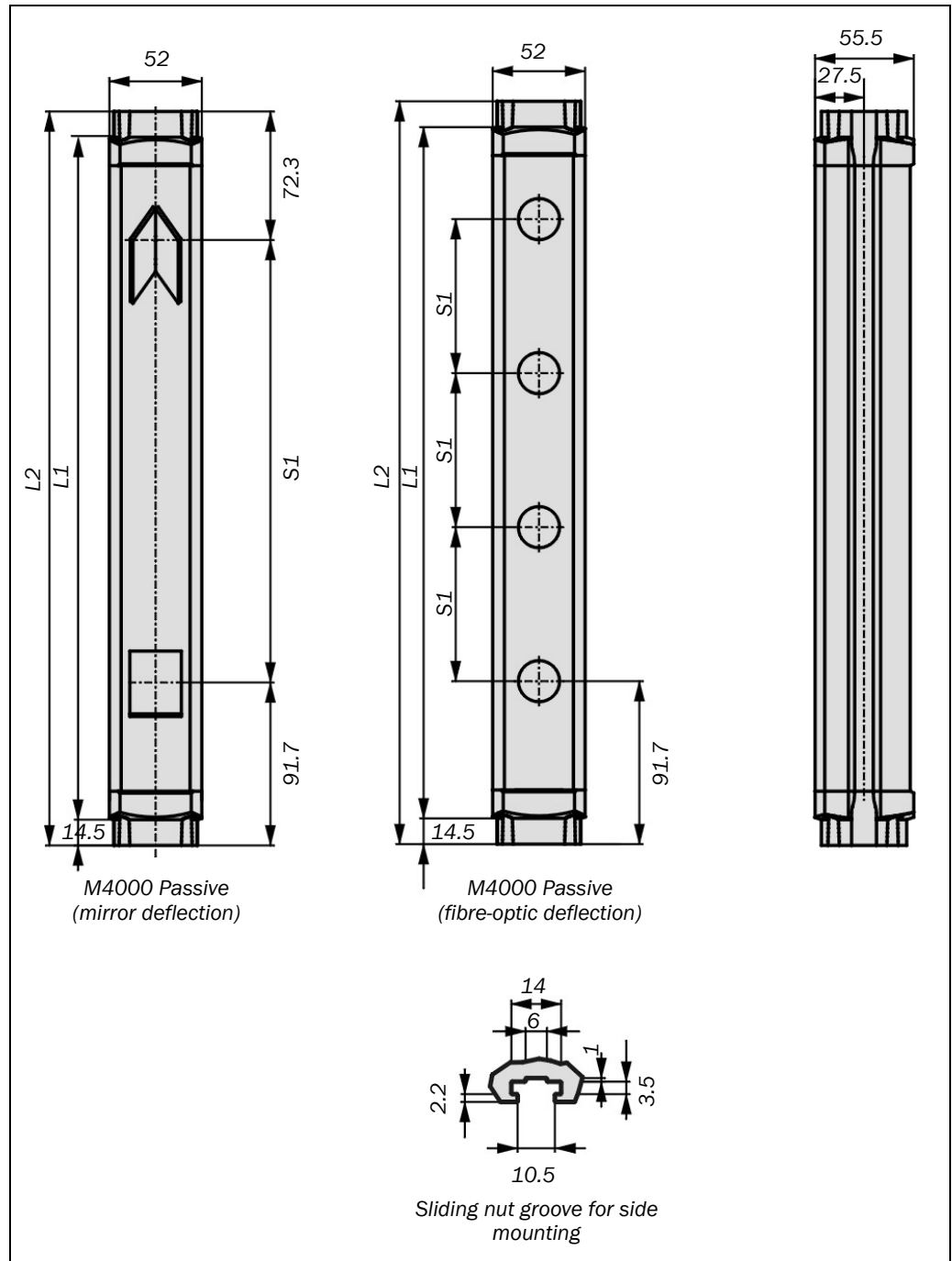
Number of beams	Beam separation S1 [mm]	Dimension L1 [mm]	Dimension L2 [mm]
2	500	643	672
	600	743	772
3	220	583	612
	400	943	972
	450	1043	1072
4	220	803	832
	300	1043	1072
5	220	1023	1052
6		1243	1272
7		1462	1491
8		1682	1711

M4000 Advanced A/P

Number of beams	Beam separation S1 [mm]	Dimension L1 [mm]	Dimension L2 [mm]
2	500	643	672
4	300	1043	1072

Note If you use the M4000 Advanced (or the M4000 Advanced A/P) with optional end cap with integrated LED, the dimension L2 of the receiver increases by 25 mm.

13.3.2 M4000 Passive

Fig. 70: Dimensional drawing
M4000 Passive (mm)

M4000 Adv., Adv. A/P, Area

Tab. 47: Dimensions of the M4000 Passive dependent on the number of beams

M4000 Passive (mirror deflection)

For number of beams	Beam separation S1 [mm]	Dimension L1 [mm]	Dimension L2 [mm]
2	500	635	664

M4000 Passive (fibre-optic deflection)

For number of beams	Beam separation S1 [mm]	Dimension L1 [mm]	Dimension L2 [mm]
2	500	635	664
4	300	1035	1064

Note If you use a two-beam M4000 Advanced A/P, then instead of the M4000 Passive you can use one of the following alternatives:

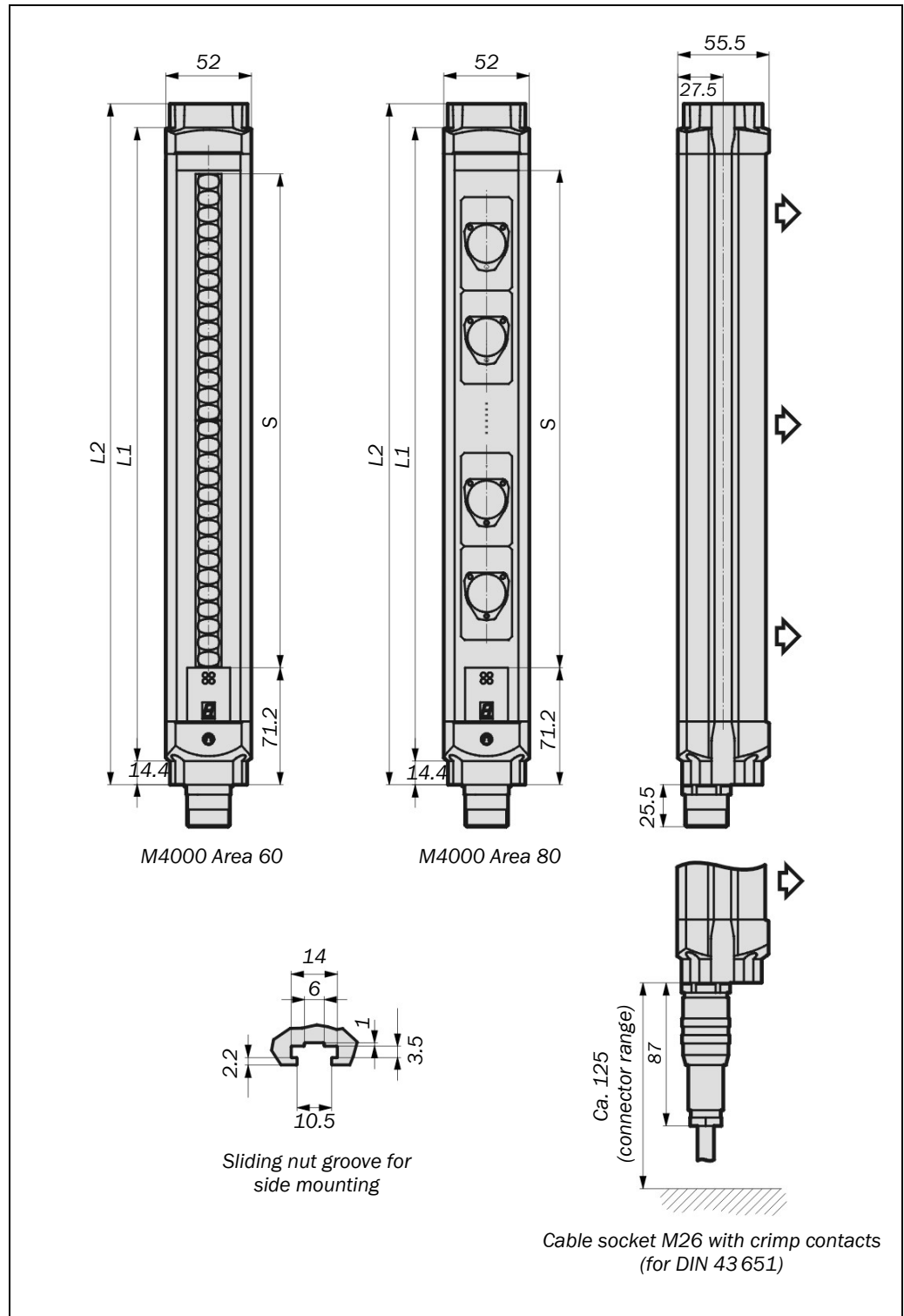
- two deflector mirrors PSK45 (see section 13.3.10 “Deflector mirror PSK45” on page 129)

or

- one mirror column (part number: 1041917, see section 14.5 “Deflector mirrors and mirror columns” on page 138)

13.3.3 M4000 Area 60/80

Fig. 71: Dimensional drawing
M4000 Area 60/80 receiver,
sender mirror image (mm)



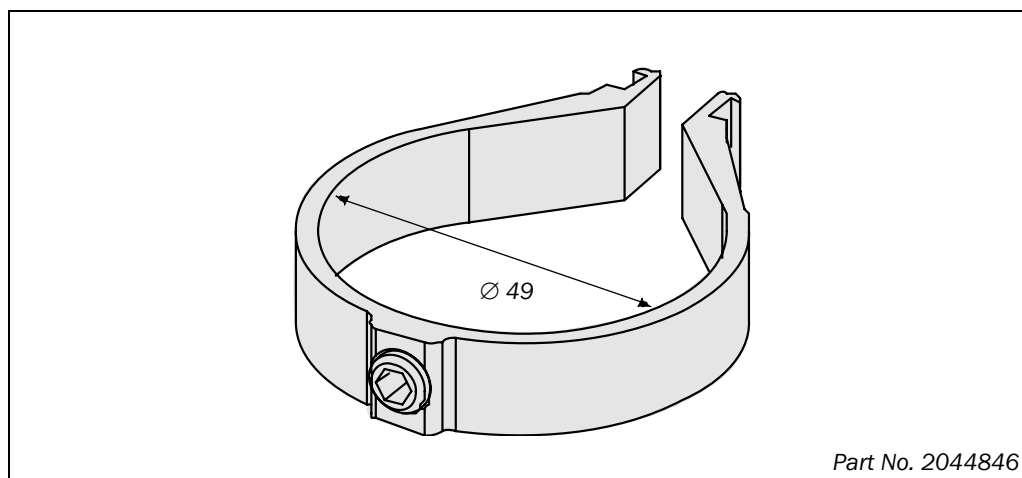
M4000 Adv., Adv. A/P, Area

Tab. 48: Dimensions of the M4000 Area 60/80, dependent of the length of the monitored area

Length of the monitored area S [mm]	Dimension L1 [mm]	Dimension L2 [mm]
300	387	416
450	537	566
600	687	716
750	837	866
900	987	1016
1050	1137	1166
1200	1287	1316
1350	1437	1466
1500	1587	1616
1650	1737	1766
1800	1887	1916

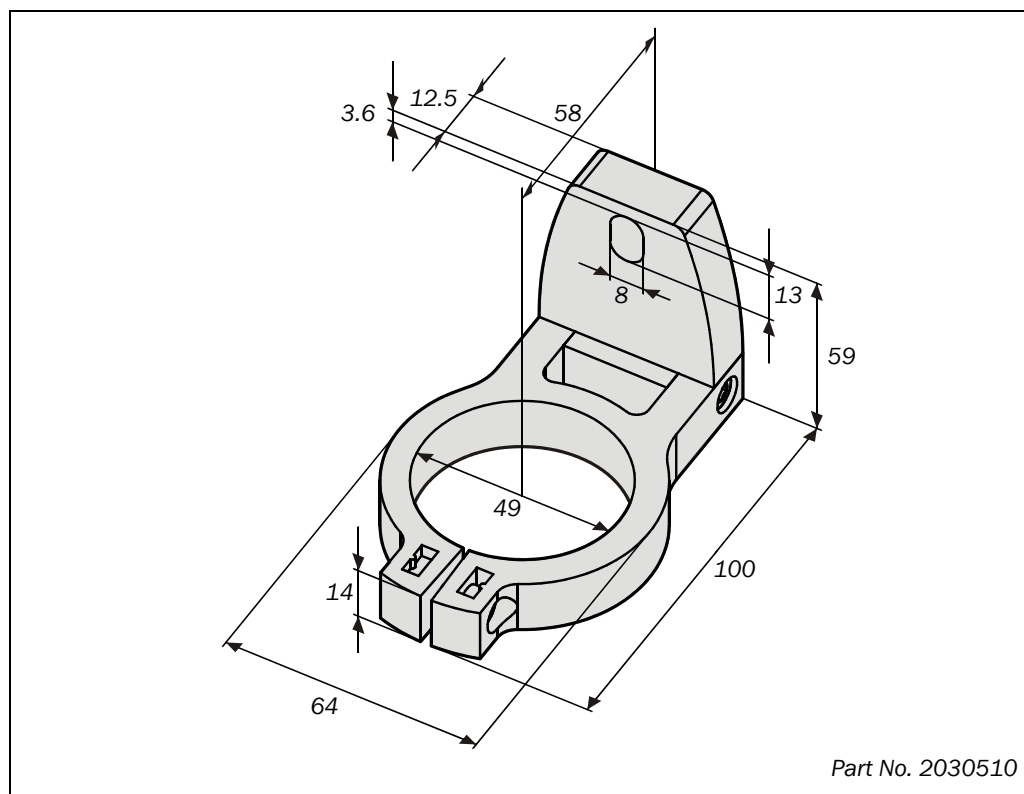
13.3.4 Omega bracket

Fig. 72: Omega bracket (mm)



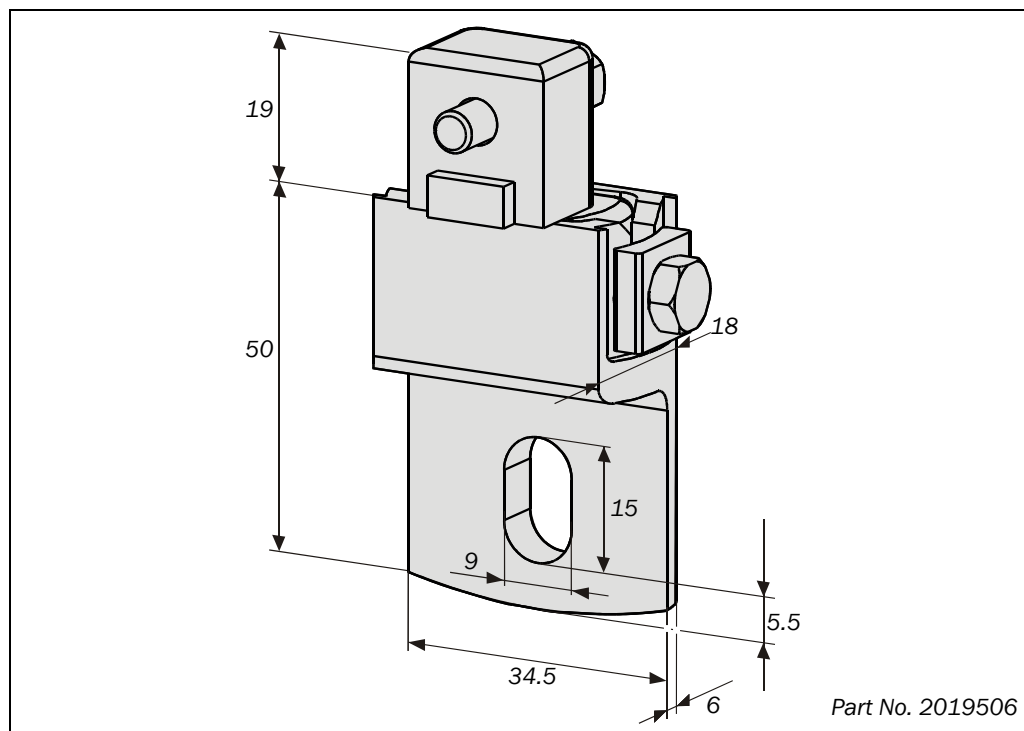
13.3.5 Swivel mount bracket

Fig. 73: Dimensional drawing swivel mount bracket (mm)



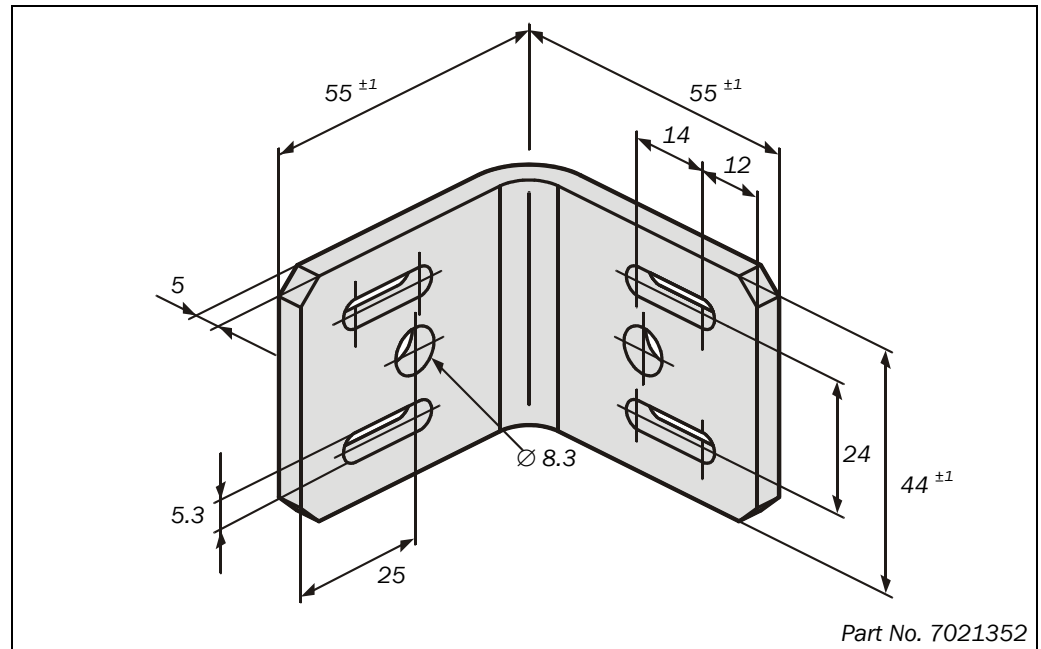
13.3.6 Side bracket

Fig. 74: Dimensional drawing side bracket (mm)



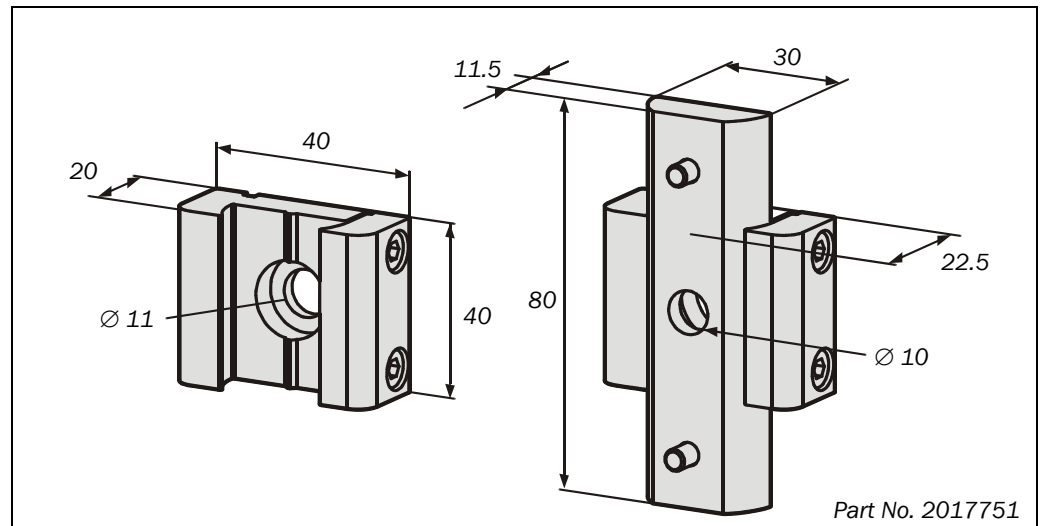
13.3.7 Rigid mounting bracket

Fig. 75: Dimensional drawing rigid mounting bracket (mm)



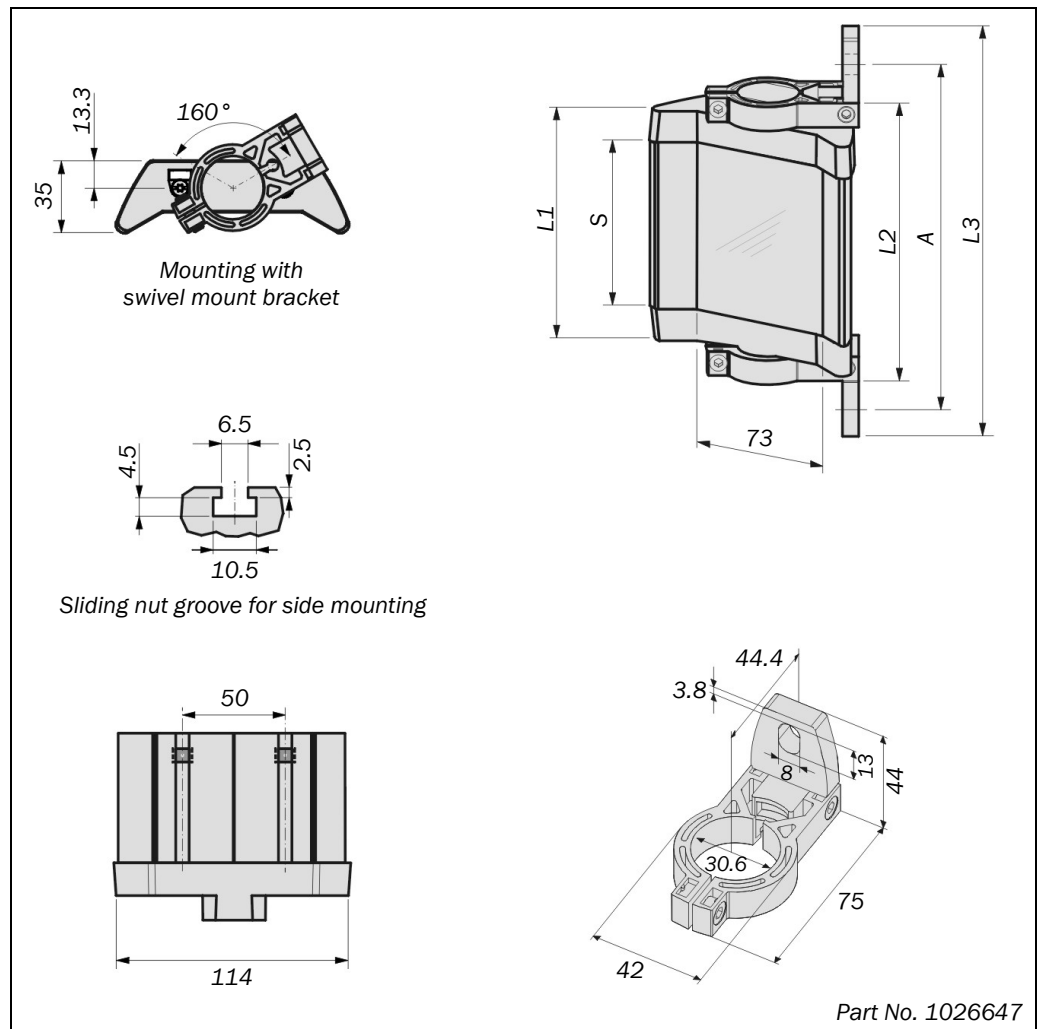
13.3.8 Pivoting mounting bracket

Fig. 76: Dimensional drawing pivoting mounting bracket (mm)



13.3.9 Deflector mirror PNS75-008

Fig. 77: Dimensional drawing deflector mirror PNS75-008 (mm)



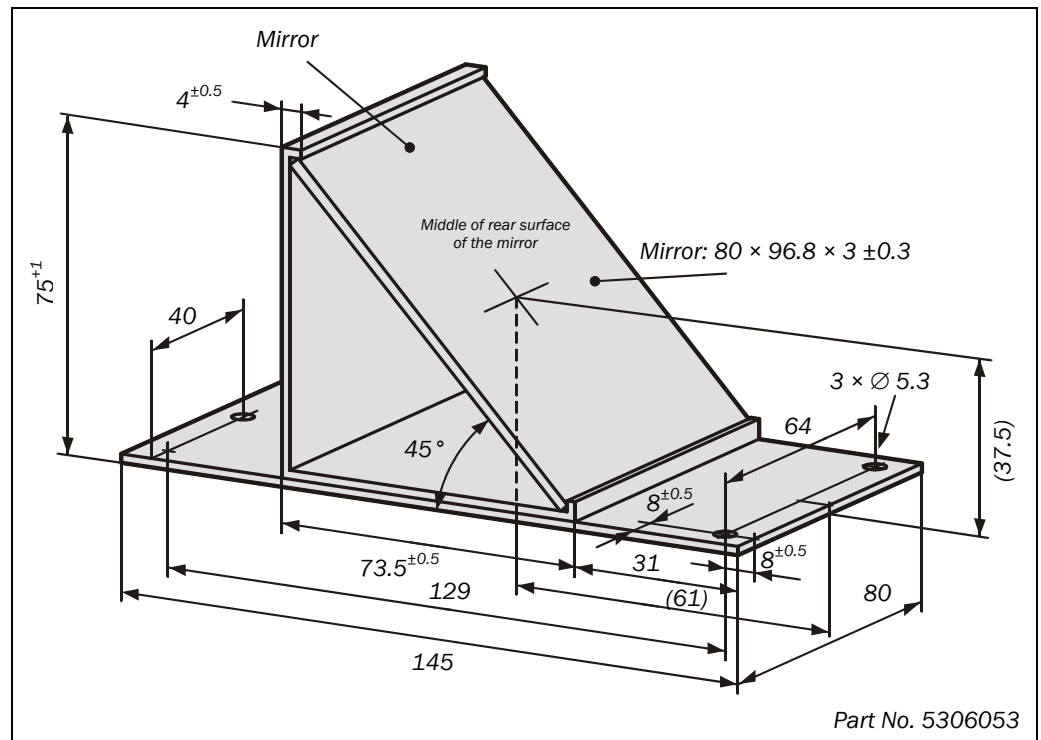
Tab. 49: Dimensions of the deflector mirror PNS75-008

Mirror height S [mm]	Dimension L1 [mm]	Dimension L2 [mm]	Dimension L3 [mm]	Dimension A [mm]
80	112	136	200	180

- Note**
- When using deflector mirrors, the effective scanning range is reduced (see Tab. 14 on page 43).
 - The formation of droplets of heavy contamination can be detrimental to the reflection behaviour. Take the necessary organisational measures to avoid the formation of droplets on the deflector mirrors.
 - The mounting kit is included in the delivery of the deflector mirror PNS75-008.

13.3.10 Deflector mirror PSK45

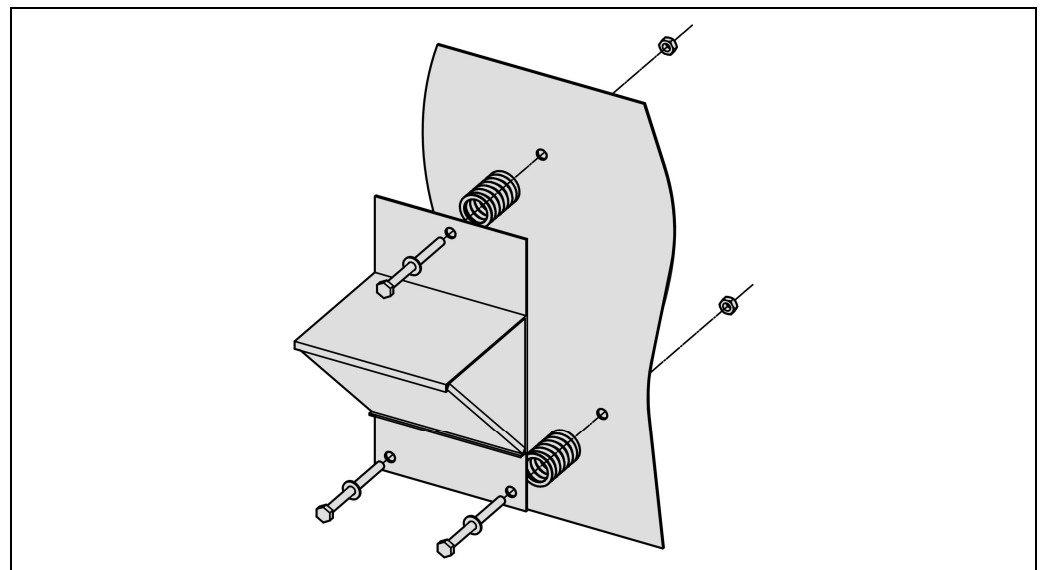
Fig. 78: Dimensional drawing deflector mirror PSK45 (mm)



Notes

- If you use a two-beam M4000 Advanced A/P, then you can use two PSK45 deflector mirrors instead of the M4000 Passive.
- The deflector mirror PSK45 is not suitable for column mounting.
- When using deflector mirrors, the effective scanning range is reduced (see Tab. 16 on page 44).
- The formation of droplets of heavy contamination can be detrimental to the reflection behaviour. Take the necessary organisational measures to avoid the formation of droplets on the deflector mirrors.

Fig. 79: Mounting of the deflector mirror PSK45



14 Ordering information

14.1 M4000 Advanced

14.1.1 Delivery

Tab. 50: Delivery
M4000 Advanced

 Sender	 Receiver
• sender unit • 4 sliding nuts for side bracket	• receiver unit • 4 sliding nuts for side bracket • label "Important Information" • operating instructions on CD-ROM • CDS (Configuration & Diagnostic Software) on CD-ROM

14.1.2 Type code

M4000 Advanced
with M26 Hirschmann plug and
M12 × 5 socket³⁴⁾

Tab. 51: Type codes
M4000 Advanced with
M26 plug

Number of beams	Beam separation [mm]	Type code	Type code
		 Sender	 Receiver
2	500	M40S-025003AA0	M40E-025003RB0
	600	M40S-026003AA0	M40E-026003RB0
3	220	M40S-032203AA0	M40E-032203RB0
	400	M40S-034003AA0	M40E-034003RB0
	450	M40S-034503AA0	M40E-034503RB0
4	220	M40S-042203AA0	M40E-042203RB0
	300	M40S-043003AA0	M40E-043003RB0
5	220	M40S-052203AA0	M40E-052203RB0
6		M40S-062203AA0	M40E-062203RB0
7		M40S-072203AA0	M40E-072203RB0
8		M40S-082203AA0	M40E-082203RB0

³⁴⁾ Receiver only: extension connection for UE403.

M4000 Adv., Adv. A/P, Area

Tab. 52: Type codes M4000 Advanced with M26 plug and integrated alignment aid

M4000 Advanced
with M26 Hirschmann plug,
M12 × 5 socket³⁵⁾ and
integrated alignment aid

Number of beams	Beam separation [mm]	Type code	Type code
		☒ Sender	☒ Receiver
2	500	M40S-025013AA0	M40E-025013RB0
	600	M40S-026013AA0	M40E-026013RB0
3	400	M40S-034013AA0	M40E-034013RB0
	450	M40S-034513AA0	M40E-034513RB0
4	300	M40S-043013AA0	M40E-043013RB0

Tab. 53: Type codes M4000 Advanced with M26 plug and end cap with integrated LED

M4000 Advanced
with M26 Hirschmann plug,
M12 × 5 socket³⁵⁾ and
end cap with integrated LED³⁶⁾

Number of beams	Beam separation [mm]	Type code	Type code
		☒ Sender	☒ Receiver
2	500	M40S-025003AA0	M40E-025023RB0
	600	M40S-026003AA0	M40E-026023RB0
3	400	M40S-034003AA0	M40E-034023RB0
	450	M40S-034503AA0	M40E-034523RB0
4	300	M40S-043003AA0	M40E-043023RB0

Tab. 54: Type codes M4000 Advanced with M26 plug, integrated alignment aid and end cap with integrated LED

M4000 Advanced
with M26 Hirschmann plug,
M12 × 5 socket³⁵⁾,
integrated alignment aid and
end cap with integrated LED³⁶⁾

Number of beams	Beam separation [mm]	Type code	Type code
		☒ Sender	☒ Receiver
2	500	M40S-025013AA0	M40E-025033RB0
	600	M40S-026013AA0	M40E-026033RB0
3	400	M40S-034013AA0	M40E-034033RB0
	450	M40S-034513AA0	M40E-034533RB0
4	300	M40S-043013AA0	M40E-043033RB0

³⁵⁾ Receiver only: extension connection for UE403.

³⁶⁾ Receiver only.

14.1.3 Default delivery status

Notes

- The pre-setting for the device configuration is termed the default delivery status. You can accept or change these pre-settings (see chapter 10 "Configuration" on page 103).
- The default delivery status is only applicable for the device types listed in chapter 14.1.2 "Type code" on page 130ff.

Tab. 55: Default delivery status M4000 Advanced

Function	Configuration	
	 Sender	 Receiver
Beam coding	Non-coded	Non-coded
Sender test	Deactivated	–
Restart interlock	–	Internal
External device monitoring (EDM)	–	Activated
Scanning range	–	0.5-20 m
Application diagnostic output (ADO)	–	Contamination

14.2 M4000 Advanced A/P

14.2.1 Delivery

Tab. 56: Delivery M4000 Advanced A/P

  M4000 Advanced A/P	M4000 Passive
• sender/receiver unit • 4 sliding nuts for side bracket • label "Important Information" • operating instructions on CD-ROM • CDS (Configuration & Diagnostic Software) on CD-ROM	• deflector unit • 4 sliding nuts for side bracket

14.2.2 Type code

M4000 Advanced A/P
with M26 Hirschmann plug and
M12 × 5 socket

Tab. 57: Type codes M4000 Advanced A/P with M26 plug

Number of beams	Beam separation [mm]	Type code	Part number	Type code
		  M4000 Advanced A/P	M4000 Passive	
2	500	M40Z-025003RB0	1027906	PSD01-1501 ³⁷⁾
		M40Z-025003TB0	1027907	PSD01-2501 ³⁸⁾
4	300	M40Z-043003TB0	1027908	PSD02-2301 ³⁸⁾

³⁷⁾ With mirror deflection (max. effective scanning range 7.5 m).

³⁸⁾ With fibre-optic deflection (max. effective scanning range 4.5 m).

M4000 Adv., Adv. A/P, Area

**M4000 Advanced A/P
with M26 Hirschmann plug,
M12 × 5 socket and
end cap with integrated LED**

Tab. 58: Type codes M4000 Advanced A/P with M26 plug and end cap with integrated LED

Number of beams	Beam separation [mm]	Type code	Part number	Type code
		 M4000 Advanced A/P		M4000 Passive
2	500	M40Z-025023RB0	1027906	PSD01-1501 ³⁹⁾
		M40Z-025023TB0	1027907	PSD01-2501 ⁴⁰⁾
4	300	M40Z-043023TB0	1027908	PSD02-2301 ⁴⁰⁾

14.2.3 Default delivery status

- Notes**
- The pre-setting for the device configuration is termed the default delivery status. You can accept or change these pre-settings (see chapter 10 “Configuration” on page 103).
 - The default delivery status is only applicable for the device types listed in chapter 14.2.2 “Type code” on page 132ff.

Tab. 59: Default delivery status M4000 Advanced A/P

Function	Configuration
	 M4000 Advanced A/P
Beam coding	Non-coded
Restart interlock	Internal
External device monitoring (EDM)	Activated
Scanning range	Preconfigured depending on type
Application diagnostic output (ADO)	Contamination

³⁹⁾ With mirror deflection (max. effective scanning range 7.5 m).

⁴⁰⁾ With fibre-optic deflection (max. effective scanning range 4.5 m).

14.3 M4000 Area 60/80

14.3.1 Delivery

Tab. 60: Delivery
M4000 Area 60/80

 Sender	 Receiver
• sender unit • 4 sliding nuts for side bracket	• receiver unit • 4 sliding nuts for side bracket • label "Important Information" • operating instructions on CD-ROM • CDS (Configuration & Diagnostic Software) on CD-ROM

14.3.2 Type code

M4000 Area 60 with M26 Hirschmann plug

Tab. 61: Type codes
M4000 Area 60 with
M26 plug

Length of the monitored area [mm]	Type code	Type code
	 Sender	 Receiver
300	M40S-60A005AA0	M40E-60A005RA0
450	M40S-61A005AA0	M40E-61A005RA0
600	M40S-62A005AA0	M40E-62A005RA0
750	M40S-63A005AA0	M40E-63A005RA0
900	M40S-64A005AA0	M40E-64A005RA0
1050	M40S-65A005AA0	M40E-65A005RA0
1200	M40S-66A005AA0	M40E-66A005RA0
1350	M40S-67A005AA0	M40E-67A005RA0
1500	M40S-68A005AA0	M40E-68A005RA0
1650	M40S-69A005AA0	M40E-69A005RA0
1800	M40S-70A005AA0	M40E-70A005RA0

M4000 Adv., Adv. A/P, Area

Tab. 62: Type codes
M4000 Area 80 with
M26 plug

**M4000 Area 80
with M26 Hirschmann plug**

Length of the monitored area [mm]	Type code	Type code
	☑ Sender	☑ Receiver
600	M40S-62A105AA0	M40E-62A105RA0
750	M40S-63A105AA0	M40E-63A105RA0
900	M40S-64A105AA0	M40E-64A105RA0
1050	M40S-65A105AA0	M40E-65A105RA0
1200	M40S-66A105AA0	M40E-66A105RA0
1350	M40S-67A105AA0	M40E-67A105RA0
1500	M40S-68A105AA0	M40E-68A105RA0
1650	M40S-69A105AA0	M40E-69A105RA0
1800	M40S-70A105AA0	M40E-70A105RA0

14.3.3 Default delivery status

- Notes**
- The pre-setting for the device configuration is termed the default delivery status. You can accept or change these pre-settings (see chapter 10 “Configuration” on page 103).
 - The default delivery status is only applicable for the device types listed in chapter 14.3.2 “Type code” on page 134ff.

Tab. 63: Default delivery
status M4000 Area 60/80

Function	Configuration	
	☑ Sender	☑ Receiver
Beam coding	Non-coded	Non-coded
Sender test	Deactivated	–
Restart interlock	–	Internal
External device monitoring (EDM)	–	Activated
Scanning range		
M4000 Area 60	–	0.5-6 m
M4000 Area 80	–	0.5-20 m
Application diagnostic output (ADO)	–	Contamination

14.4 Additional front screen (weld spark guard)

Tab. 64: Part numbers
additional front screens for
M4000

Description	Part number
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-0250#####	2033225
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-0260#####	2033226
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-0322#####	2033227
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-0340#####	2033228
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-0345#####, M40#-0430#####	2033229
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-0422#####	2033230
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-0522#####	2033231
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-0622#####	2033232
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-0722#####	2033233
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-0822#####	2033234
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-60#####	2033235
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-61#####	2033236
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-62#####	2033237
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-63#####	2033238

M4000 Adv., Adv. A/P, Area

Description	Part number
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-64#####	2033239
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-65#####	2033240
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-66#####	2033241
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-67#####	2033242
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-68#####	2033243
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-69#####	2033244
Additional front screen for M4000, including sliding nuts and fixing screws, 2 pieces, suitable for: M40#-70#####	2033245

- Notes**
- The additional front screens are bolted directly to the mounting groove on the M4000 using the sliding nuts and fixing screws.
 - Each additional front screen fits both on the sender and on the receiver.
 - 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. 65: Part numbers
deflector mirrors and mirror
columns

14.5 Deflector mirrors and mirror columns

Description	Part number
Deflector mirror PNS75-008, including mounting kit	1026647
Deflector mirror PSK45, including mounting kit, not suitable for column mounting	5306053
Mirror column, fully assembled with mirrors Suitable for M40#-0250#####, 2-beam, 500 mm beam separation	1040619
Mirror column, fully assembled with mirrors Suitable for M40#-0260#####, 2-beam, 600 mm beam separation	1040620
Mirror column, fully assembled with mirrors Suitable for M40#-0340#####, 3-beam, 400 mm beam separation	1040625
Mirror column, fully assembled with mirrors Suitable for M40#-0345#####, 3-beam, 450 mm beam separation	1040624
Mirror column, fully assembled with mirrors Suitable for M40#-0430#####, 4-beam, 300 mm beam separation	1040626
Mirror column, fully assembled with mirrors (45°) Suitable for M40Z-02500#### and M40Z-02501####, 2-beam, 500 mm beam separation	1041917
Adjusting plate Suitable for mirror and device columns	4031053

Note Mirror columns affect the scanning range of the system. On this subject see section 5.4 “Scanning range” on page 42ff.

14.6 Device columns

Tab. 66: Part numbers
device columns

Description	Part number
Stable device columns with 2 exterior mounting grooves for safety light curtains and multiple light beam safety devices	
Column height 985 mm	2045490
Column height 1165 mm	2045641
Column height 1265 mm	2045642
Column height 1720 mm	2045643
Column height 2020 mm	2045644
Column height 2250 mm	2045645
Column height 2400 mm	2045646
Adjusting plate Suitable for mirror and device columns	4031053
Omega bracket for device columns, long, 2 pieces	2045736
Steel plug for floor fastening	5308961

14.7 Accessories

Tab. 67: Part numbers accessories

Part	Part number
Mounting kits	
Mounting kit 1: mounting bracket rigid, 4 pcs.	7021352
Mounting kit 2: mounting bracket pivoting, 4 pcs.	2017751
Mounting kit 6: side bracket pivoting, 4 pcs.	2019506
Mounting kit 12: swivel-mount bracket, pivoting, 4 pcs	2030510
Omega bracket for M4000, 4 pieces	2044846
M4000 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 83)	2027227
Connecting cable for M4000 with Hirschmann cable socket M26 × 11 + FE:	
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
Connecting cable for M4000 with Hirschmann cable socket M26 × 11 + FE (without EFI: pin 9 and 10 not connected):	
Socket straight, stripped, 5 m	2046888
Socket straight, stripped, 10 m	2046889
Socket straight, stripped, 20 m	2046890
M4000 extension connection	
Connection cable for M4000 Advanced with 5-pin M12 plug and UE403	
Wire cross-section 0.34 mm ² , 5-pin M12 plug, 5-pin M12 socket, PUR halogen-free	
Plug straight/socket straight, 0.6 m	6025930
Plug straight/socket straight, 1.0 m	6029280
Plug straight/socket straight, 1.5 m	6029281
Plug straight/socket straight, 2.0 m	6025931
Plug straight/socket straight, 5.0 m	6029282
Safety relay	
UE403 (UE403-A0930)	1026287

Part	Part number
Muting lamps for connection to UE403 Version with incandescent lamp, incl. 2 m connecting cable with M12 plug, mounting bracket and mounting kit Version with incandescent lamp, incl. 10 m connecting cable with M12 plug, mounting bracket Version with LED, incl. 2 m connecting cable with M12 plug, mounting bracket and mounting kit Version with LED, incl. 10 m connecting cable with M12 plug, mounting bracket	2033116 2033117 2033118 2033119
Muting mechanism components 1 × round steel arm 400 mm For PU3H column profile and M4000 device profile incl. 1 × universal bracket incl. 2 × universal brackets incl. 1 × universal bracket with reflector P250 fitted incl. 2 × universal brackets with reflectors P250 fitted incl. 1 × universal bracket with sensor WL280P132 fitted and 2 m connecting cable with M12 plug incl. 2 × universal brackets with sensors WL280P132 fitted and 2 m connecting cable with M12 plug 2 × round steel arm 400 mm For PU3H column profile and M4000 device profile incl. 4 × universal brackets (for exit monitoring) incl. 2 × universal brackets with sensors WL280P132 mounted and 2 m connection cable with M12 plug and 2 × universal brackets with reflectors P250 mounted (for exit monitoring)	2045506 2045507 2045513 2045512 2045729 2045730 2045508 2060157
Connection cable for PC For the connection between PC and M4000 or UE403 (2.0 m)	6021195
External laser alignment aid AR60 Adapter for M4000 housing	1015741 4040006
Accessories included in a standard delivery CDS (Configuration & Diagnostic Software) on CD-ROM incl. Online documentation and operating instructions in all available languages Sliding nuts for mounting bracket/side bracket, 4 pcs Alignment template for integrated laser alignment aid ⁴¹⁾	2032314 2017550 4040263

⁴¹⁾ Only with devices with integrated laser alignment aid.

15 Annex

15.1 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

15.2 Checklist for the manufacturer

SICK

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

Details about the points listed below must be present at least during initial commissioning — they are, however, dependent on the respective application, the specifications of which are to be controlled 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 ☐ | No ☐ |
| 2. Are the applied directives and standards listed in the declaration of conformity? | Yes ☐ | No ☐ |
| 3. Does the protective device comply with the required PL/SIL claim limit and PFHd in accordance with EN ISO 13849-1/EN 62061 and the required type in accordance with IEC 61496-1? | Yes ☐ | No ☐ |
| 4. Is access to the hazardous area/hazardous point only possible through the light path/the protective field of the ESPE? | Yes ☐ | No ☐ |
| 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 ☐ | No ☐ |
| 6. Are additional mechanical protective measures fitted and secured against manipulation which prevent reaching under, over or around the ESPE? | Yes ☐ | No ☐ |
| 7. Has the maximum stopping and/or stopping/run-down time of the machine been measured, specified and documented (at the machine and/or in the machine documentation)? | Yes ☐ | No ☐ |
| 8. Has the ESPE been mounted such that the required minimum distance from the nearest hazardous point has been achieved? | Yes ☐ | No ☐ |
| 9. Are the ESPE devices correctly mounted and secured against manipulation after adjustment? | Yes ☐ | No ☐ |
| 10. Are the required protective measures against electric shock in effect (protection class)? | Yes ☐ | No ☐ |
| 11. Is the control switch for resetting the protective equipment (ESPE) or restarting the machine present and correctly installed? | Yes ☐ | No ☐ |
| 12. Are the outputs of the ESPE (OSSD) integrated according to required PL/SILCL compliant with EN ISO 13849-1/EN 62061 and does the integration correspond to the comply with the circuit diagrams? | Yes ☐ | No ☐ |
| 13. Has the protective function been checked in compliance with the test notes of this documentation? | Yes ☐ | No ☐ |
| 14. Are the specified protective functions effective at every operating mode that can be set? | Yes ☐ | No ☐ |
| 15. Are the switching elements activated by the ESPE, e.g. contactors, valves, monitored? | Yes ☐ | No ☐ |
| 16. Is the ESPE effective over the entire period of the dangerous state? | Yes ☐ | No ☐ |
| 17. Is a dangerous state halted when the ESPE is switched on or off, the operating modes are changed over, or when switching over to another protective device? | Yes ☐ | No ☐ |
| 18. Has the information label for the daily check been attached so that it is easily visible for the operator? | Yes ☐ | No ☐ |

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

15.3 Alignment templates

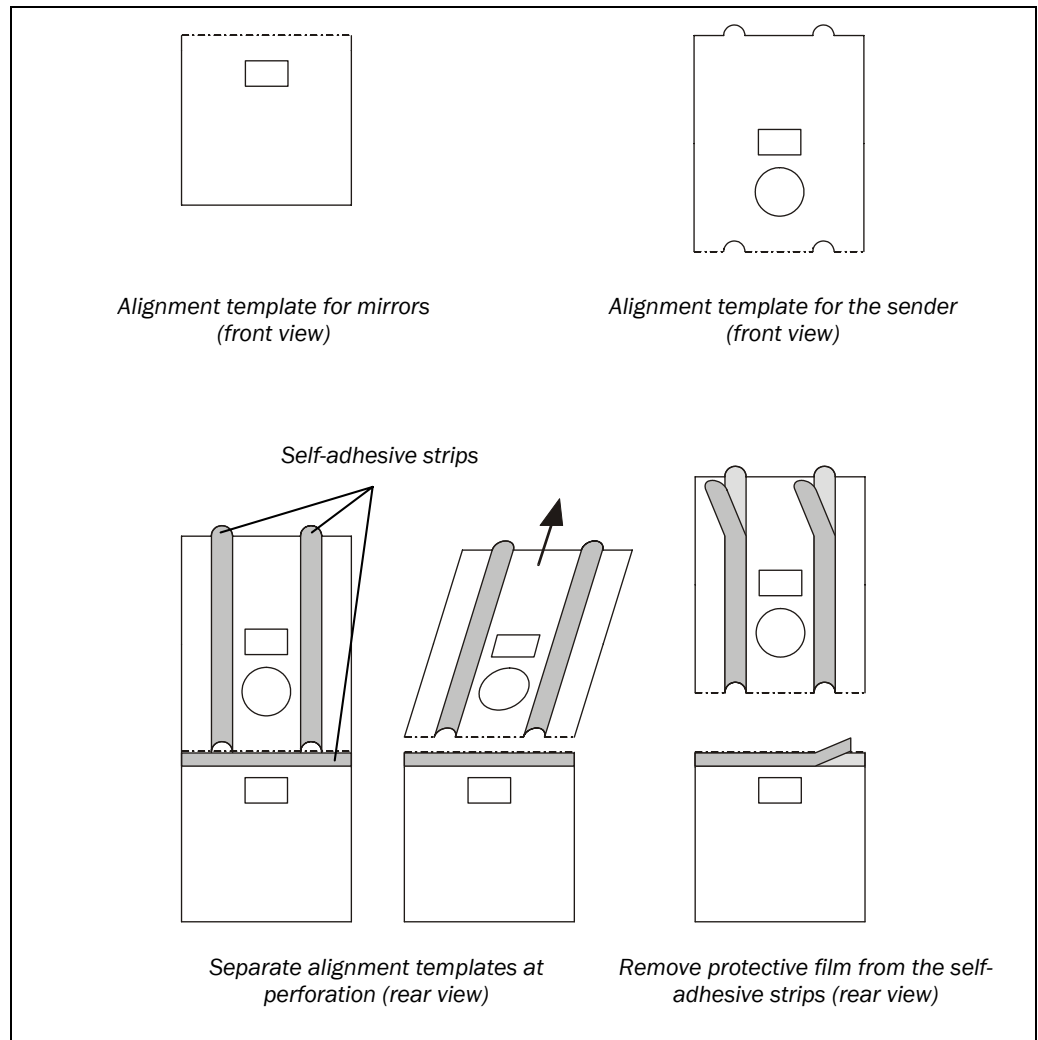
For the alignment of the M4000 Advanced with integrated laser alignment aid you need two alignment templates:

- alignment template for mirrors
- alignment template for the sender

Note The alignment templates are in the delivery of the M4000 receiver⁴²⁾. If you no longer have the alignment templates supplied, you can make new templates using the master for copying on the next page.

- Separate the alignment templates along the perforated line.
- Pull the protective film off the self-adhesive strips on the rear of the alignment templates.

Fig. 80: Illustration of the alignment templates

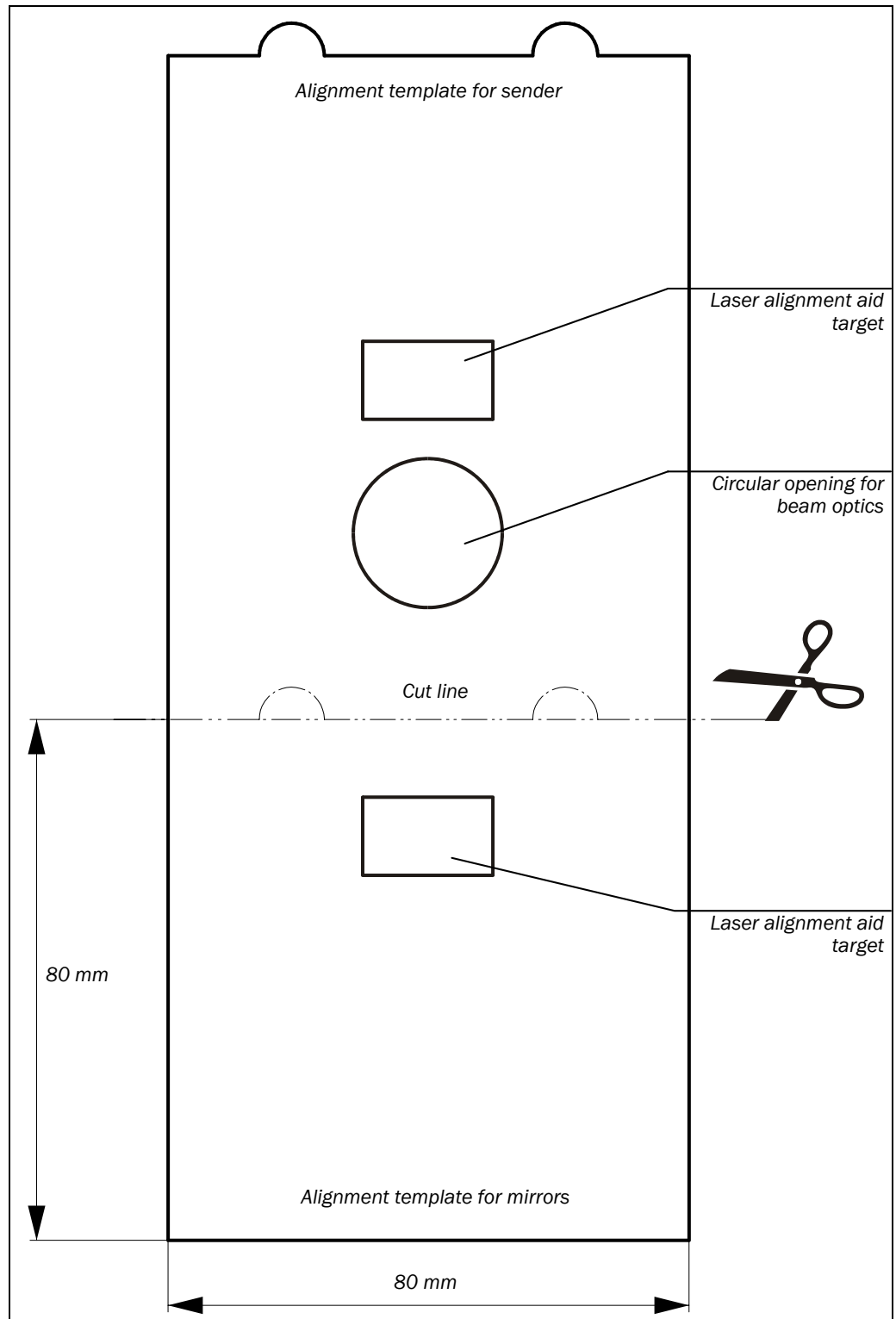


⁴²⁾ Only with devices with integrated laser alignment aid.

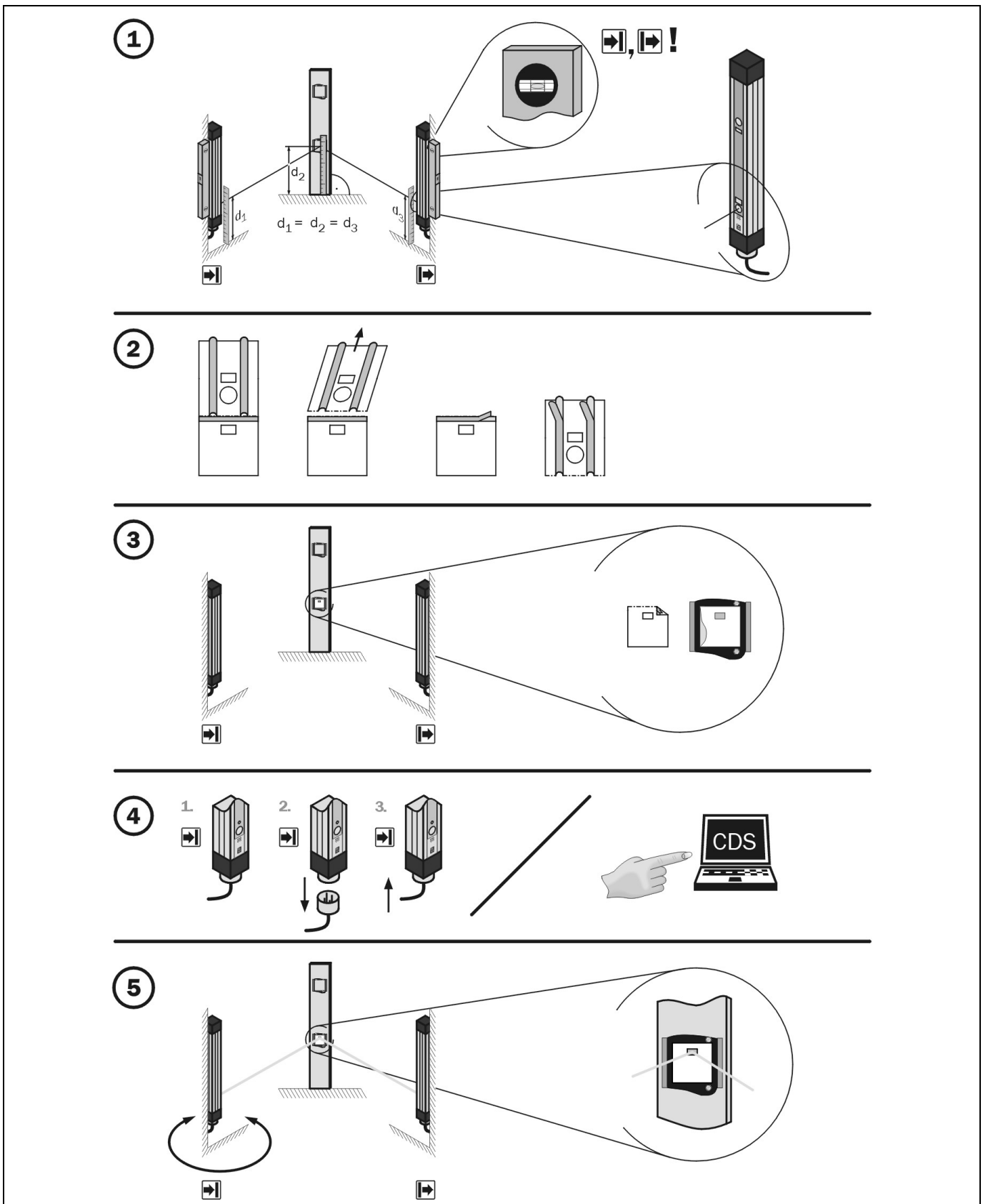
How to make the alignment templates:

- Copy this page.
- Cut the copied template along the edge and at the line marked.
- Cut out the two targets on the laser alignment aid and the circular opening for the beam optics.

Fig. 81: Alignment templates
copying master



15.4 Alignment instructions



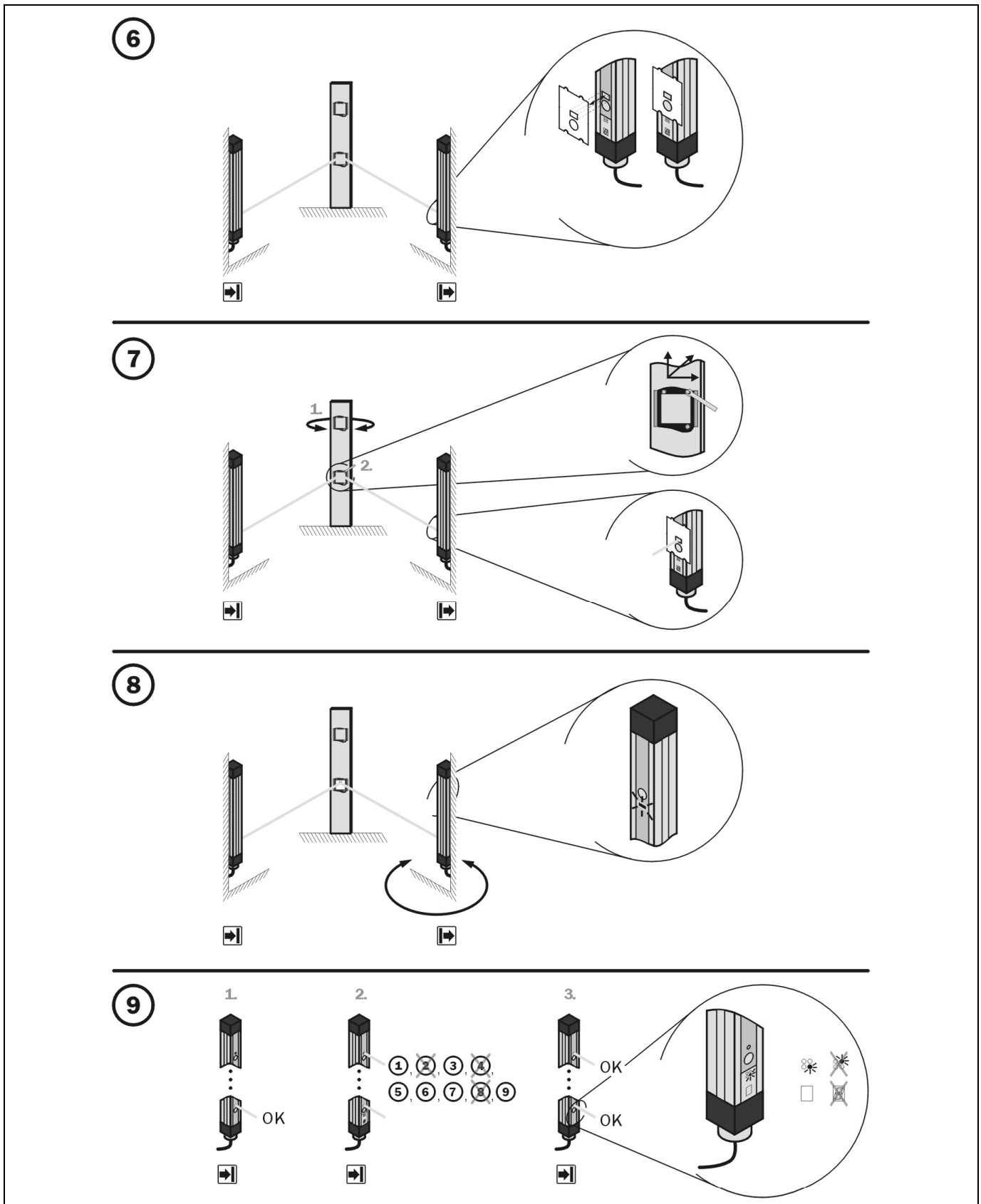


Fig. 82: Alignment instructions copying master

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