

L25

Single-beam photoelectric safety switch

SICK
Sensor Intelligence.



Described product

L25

Manufacturer

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Original document

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1 About this document

1.1 Scope

Product

This document applies to the following products:

- Product code: L25
- “Operating instructions” type label entry: 8024676

Document identification

Document part number:

- This document: 8024678
- Available language versions of this document: 8024676

You can find the current version of all documents at www.sick.com.

1.2 Target groups of these operating instructions

Some sections of these operating instructions are intended for certain target groups. However, the entire operating instructions are relevant for intended use of the product.

Table 1: Target groups and selected sections of these operating instructions

Target group	Sections of these operating instructions
Project developers (planners, developers, designers)	"Project planning", page 11 "Technical data", page 35
Installers	"Mounting", page 25
Electricians	"Electrical installation", page 26
Safety experts (such as CE authorized representatives, compliance officers, people who test and approve the application)	"Project planning", page 11 "Commissioning", page 27 "Technical data", page 35 "Checklist for initial commissioning and commissioning", page 40
Operators	"Operation", page 29 "Troubleshooting", page 32
Maintenance personnel	"Maintenance", page 30 "Troubleshooting", page 32

1.3 Additional information

www.sick.com

The following information is available on the Internet:

- Data sheets and application examples
- CAD data and dimensional drawings
- Certificates (e.g. EU declaration of conformity)
- Guide for Safe Machinery Six steps to a safe machine

1.4 Symbols and document conventions

The following symbols and conventions are used in this document:

Safety notes and other notes



DANGER

Indicates a situation presenting imminent danger, which will lead to death or serious injuries if not prevented.



WARNING

Indicates a situation presenting possible danger, which may lead to death or serious injuries if not prevented.



CAUTION

Indicates a situation presenting possible danger, which may lead to moderate or minor injuries if not prevented.



NOTICE

Indicates a situation presenting possible danger, which may lead to property damage if not prevented.



NOTE

Indicates useful tips and recommendations.

Instructions to action

- ▶ The arrow denotes instructions to action.
- 1. The sequence of instructions for action is numbered.
- 2. Follow the order in which the numbered instructions are given.
- ✓ The check mark denotes the result of an instruction.

LED symbols

These symbols indicate the status of an LED:

- The LED is off.
- ◐ The LED is flashing.
- The LED is illuminated continuously.

Sender and receiver

These symbols indicate the sender and receiver of the device:

- ➡ The symbol indicates the sender.
- ➠ The symbol indicates the receiver.

2 Safety information

2.1 General safety notes

Product integration

**DANGER**

The product can not offer the expected protection if it is integrated incorrectly.

- ▶ Plan the integration of the product in accordance with the machine requirements (project planning).
 - ▶ Implement the integration of the product in accordance with the project planning.
-

Mounting and electrical installation

**DANGER**

Death or severe injury due to electrical voltage and/or an unexpected startup of the machine

- ▶ Make sure that the machine is (and remains) disconnected from the voltage supply during mounting and electrical installation.
 - ▶ Make sure that the dangerous state of the machine is and remains switched off.
-

Repairs and modifications

**DANGER**

Improper work on the product

A modified product may not offer the expected protection if it is integrated incorrectly.

- ▶ Apart from the procedures described in this document, do not repair, open, manipulate or otherwise modify the product.
-

2.2 Intended use

When used in conjunction with a suitable external test device, the L25 single-beam photoelectric safety switch is a Type 2 electro-sensitive protective device (ESPE) in accordance with IEC 61496-1 and IEC 61496-2.

The external test device must satisfy the applicable requirements for a type 2 device in accordance with IEC 61496-1 and IEC 61496-2. The external test device must provide OSSDs (in accordance with IEC 61496-1, chapter 4.2.4), fault detection and a suitable test rate within the target demand rate specified in the data sheet (see "[Data sheet](#)", page 35). The response time and switching level of the sensors must be taken into account.

Suitable test devices include, for example, all SICK safety controllers that allow a single-beam photoelectric safety switch to be connected, e.g., Flexi Soft or Flexi Classic. A single-beam photoelectric safety switch in combination with an external test device can be used in safety applications up to Category 2 according to EN ISO 13849, SILCL1 according to EN 62061 or up to PL c according to EN ISO 13849.

The single-beam photoelectric safety switch is suitable for the following applications:

- Access protection
- Hazardous area protection

The product may be used in safety functions.

The single-beam photoelectric safety switch does not emit any paint wetting impairment substances or volatile silicones and does not expel any fixed parts or materials into its surroundings.

The single-beam photoelectric safety switch must only be used within the limits of the prescribed and specified technical data and operating conditions at all times.

Any instance of improper use, incorrect modification, or manipulation of the L25 single-beam photoelectric safety switch shall void any warranty provided by SICK AG; furthermore, SICK AG shall not accept any responsibility or liability for any resulting damage and consequential damage.

2.3 Improper use

The single-beam photoelectric safety switch works as an indirect protective measure and cannot provide protection from pieces thrown from application nor from emitted radiation. Transparent objects are not detected.

Among others, the single-beam photoelectric safety switch is not suitable for the following applications:

- Outdoors
- Underwater
- In explosion-hazardous areas
- In environments with increased levels of ionizing radiation

2.4 Requirements for the qualification of personnel

The product must be configured, installed, connected, commissioned, and serviced by qualified safety personnel only.

Project planning

You need safety expertise to implement safety functions and select suitable products for that purpose. You need expert knowledge of the applicable standards and regulations.

Mounting, electrical installation and commissioning

You need suitable expertise and experience. You must be able to assess if the machine is operating safely.

Operation and maintenance

You need suitable expertise and experience. You must be instructed in machine operation by the machine operator. For maintenance, you must be able to assess if the machine is operating safely.

3 Product description

3.1 Structure and function

Overview

The L25 single-beam photoelectric safety switch is an electro-sensitive protective device consisting of a sender and receiver.

The hazardous area is protected by means of a light beam between the sender and receiver. As soon as the light beam is interrupted, the protective device reports the interruption in the light path to the secure output signal switching devices.

Sensing range

The scanning range is the maximum dimension of the light path between sender and receiver. This depends on the light source of the sensor.

3.2 Product characteristics

3.2.1 Device overview

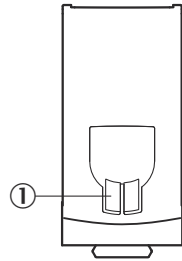


Figure 1: Sender overview

- ① green operating LED: supply voltage active

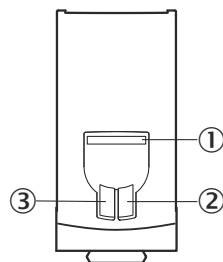


Figure 2: Receiver overview

- ① alignment aid (BluePilot): blue alignment quality LEDs
- ② yellow status LED: light received indicator
- ③ green operating LED: supply voltage active

3.2.2 Alignment aid (BluePilot)

An alignment aid is installed in the receiver of the single-beam photoelectric safety switch. The alignment aid consists of 5 blue alignment quality LEDs.

After switching on the protective device, the alignment aid indicates the alignment quality on the receiver.

3.2.3 Test input

The sender has a test input that can be used to switch off the light beam of the sender and thereby simulate an interruption of the light beam.

The test input is provided for the purposes of checking the functioning of the sender and receiver. When used in combination with an external test device to evaluate the test results, the protective device is suitable for safety applications.

3.2.4 Cascading

Cascading allows up to 4 single-beam photoelectric safety switches to be connected in series.

3.2.5 Application diagnostic output

Overview

An application diagnostic output can be configured on pin 2 of the system connection of the receiver via IO-Link.

The application diagnostic output will signal a specific status of the protective device depending on the configuration.

The status of the protective device is indicated via the yellow status LED.

Output signals

The following signals can be outputted via the application diagnostic output:

- Alarm
When Alarm is configured on the application diagnostic output, the application diagnostic output signals when the protective device is only partially operational, for example if the sender or receiver is contaminated or poorly aligned.

Further topics

- ["Application diagnostic output", page 18](#)

3.2.6 IO-Link

Overview

The protective device is IO-Link capable.

The IO-Link communication between the protective device and a PC can occur via an IO-Link master. To do so, connect the IO-Link master to the system connection of the receiver, and via a USB cable to a PC.

The connected protective device can be configured, or data exchanged or transferred using the SOPAS ET configuration software.

Data exchange and configuration

The following data, for example, can be exchanged or transferred via IO-Link:

- Device information
- Quality of reception

The following functions, for example, can be configured via IO-Link:

- Switching output
- Application diagnostic output

The green operational LED on the receiver flashes during IO-Link communication.

Further topics

- ["IO-Link", page 18](#)

4 Project planning

4.1 Manufacturer of the machine

The manufacturer of the machinery must carry out a risk assessment and apply appropriate protective measures. Further protective measures may be required in addition to the product.

The product must not be tampered with or changed, except for the procedures described in this document.

The product must only be repaired by the manufacturer of the product or by someone authorized by the manufacturer. Improper repair can result in the product not providing the expected protection.

4.2 Operating entity of the machine

Changes to the electrical integration of the product in the machine controller and changes to the mechanical mounting of the product necessitate a new risk assessment. The results of this risk assessment may require the entity operating the machine to meet the obligations of a manufacturer.

The product must not be tampered with or changed, except for the procedures described in this document.

The product must only be repaired by the manufacturer of the product or by someone authorized by the manufacturer. Improper repair can result in the product not providing the expected protection.

4.3 Design

This chapter contains important information about the design.

For information on the individual steps for mounting the device, see: [see "Mounting", page 25](#).



DANGER

Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ▶ Make sure that the following design requirements are met so that the single-beam photoelectric safety switch can fulfill its protective function.
 - Sender and receiver must be arranged such that persons or parts of the body are reliably detected when they enter the hazardous area.
 - Ensure that nobody can pass under the light beam or pass by the side of the protective device.
 - If people can stay between the protective device and the hazardous point without being detected, check if additional protective measures (e.g., restart interlock) are required.
-



DANGER

Hazard due to lack of effectiveness of the protective device

Certain types of light radiation can influence the protective device, e.g., light radiation from fluorescent lamps with electronic ballast installed in the path of the beam, or beams from laser pointers directed at the receiver.

- ▶ If this type of light radiation is present in the environment of the protective device, take additional measures to ensure that the protective device does not become dangerous.
-

4.3.1 Minimum distance from the hazardous point

Overview

A minimum distance must be maintained between the single-beam photoelectric safety switch and the hazardous point. This distance is required to prevent a person or part of their body from reaching the hazardous point before the end of the machine's dangerous state.

Calculating the minimum distance according to ISO 13855

The calculation of the minimum distance is based on international or national standards and statutory requirements applicable at the place of installation of the machine.

If the minimum distance is calculated according to ISO 13855, it depends on the following points:

- Machine stopping time (time interval between triggering the sensor function and the end of the machine's dangerous state)
- Response time of the protective device
- Reach or approach speed of the person
- Number of beams and beam separation of the single-beam photoelectric safety switch
- Type of approach: orthogonal (at right angles) or parallel
- Parameters specified based on the application

For the USA (scope of OSHA and ANSI), different regulations may apply, e.g.:

- a) Laws: Code of Federal Regulations, Title 29 (CFR 29), Part 1910.217
- b) Standards: ANSI B11.19

Complementary information

Additional information is available in the ISO 13855 standard and in the Guide for Safe Machinery.

SICK offers a stopping/run-down time measurement service in many countries.

4.3.1.1 Calculating minimum distance from the hazardous point

Important information



DANGER

Minimum distance from the hazardous point is too small

The dangerous state of the machine may not be stopped or not be stopped in a timely manner due to a minimum distance that is too small.

- ▶ Calculate the minimum distances for the machine in which the single-beam photoelectric safety switch is integrated.
 - ▶ When mounting the single-beam photoelectric safety switch, observe the minimum distance.
-

Approach

The example shows the calculation of the minimum distance for an orthogonal (at right angles) approach to the single-beam photoelectric safety switch. Depending on the application and the ambient conditions, a different calculation may be required (e.g., at a different angle to the direction of approach or an indirect approach).

1. Calculate S using the following formula:

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

where:

- S = minimum distance in millimeters (mm)
- K = approach speed of 1600 mm/s
- T = machine stopping time + response time of the protective device after interruption in the light path in seconds (s)
- C = adjustment factor that depends on the number of beams (1, 2, 3 or 4)

Table 2: Variables for calculating the minimum distance

Number of beams	1	2	3	4
Height of the beams above ground in mm	750	400 900	300 700 1100	300 600 900 1200
Adjustment factor C in mm	1200	850	850	850

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

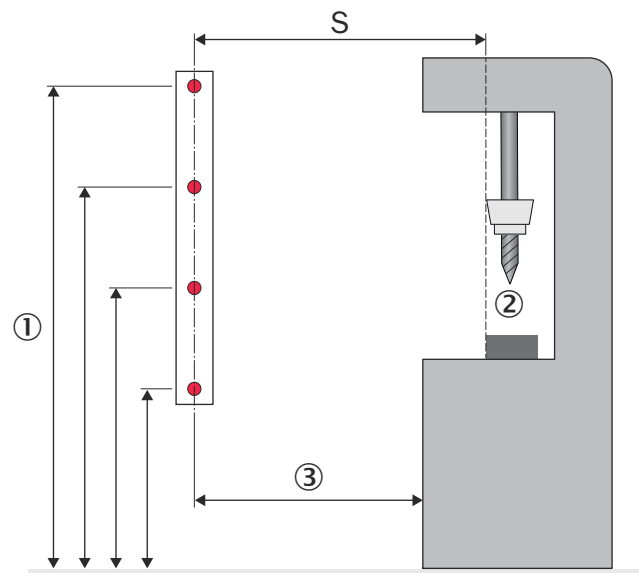


Figure 3: Minimum distance from the hazardous point

- ① Height of the light beams above ground
- ② Hazardous point
- ③ Depending on the application and distance, persons must be prevented from standing behind the protective device.

Example calculation: access protection, no danger from reaching over

Machine stopping time = 290 ms

Response time after interruption of the light path = 20 ms

$T = 290 \text{ ms} + 20 \text{ ms} = 310 \text{ ms} = 0.31 \text{ s}$

$$S = 1600 \text{ mm/s} \times 0.31 \text{ s} + 1200 \text{ mm} = 1696 \text{ mm}$$

4.3.2 Minimum distance from reflective surfaces

Overview

The light beam from the sender may be deflected by reflective surfaces and dispersive media. This can prevent an object from being detected.

Therefore, all reflective surfaces and objects (e.g. material bins, machine table, etc.) must be kept at a minimum distance (a) from the light beam. This minimum distance (a) must be maintained on all sides of the light beam. This applies in horizontal, vertical and diagonal directions as well as at the end of the device. The same area must be free of dispersive media (e.g., dust, fog, or smoke).

The minimum distance (a) depends on the distance (D) between sender and receiver.

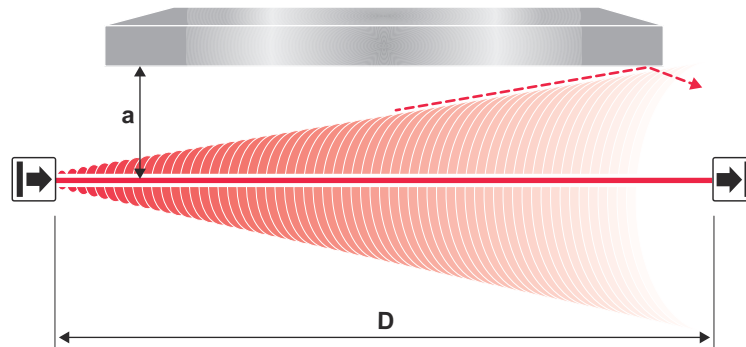


Figure 4: Minimum distance from reflective surfaces

Important information



DANGER

Hazard due to lack of effectiveness of the protective device

Reflective surfaces and dispersive media can prevent persons or parts of the body to be protected from being properly reflected and therefore, they remain undetected.

- ▶ Make sure that all reflective surfaces and objects maintain a minimum distance from the light beam.
- ▶ Make sure that no dispersive media (e.g., dust, fog, or smoke) are within the calculated minimum distance from the light beam.

Determining minimum distance to reflective surfaces

1. Determine the distance between sender and receiver D in meters (m).
2. Read the minimum distance a in millimeters (mm) in the graph or calculate it based on the respective formula from [table 3](#):

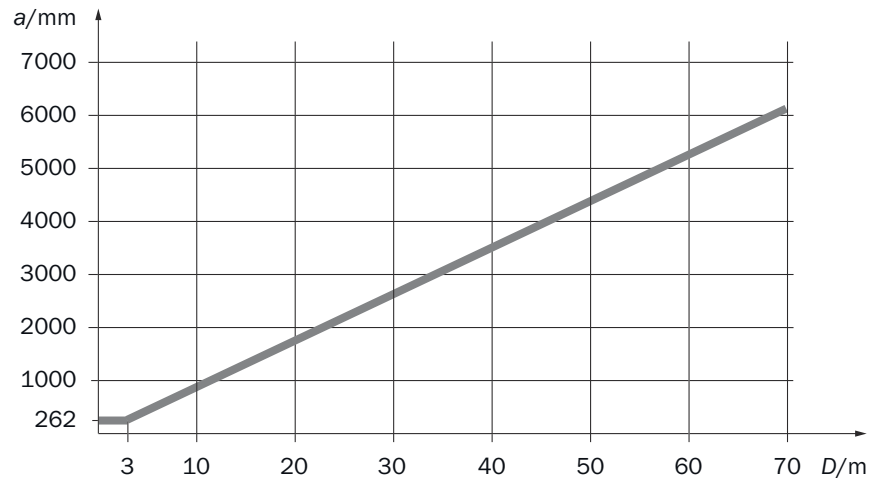


Figure 5: Graph of minimum distance from reflective surfaces

Table 3: Formula for calculating the minimum distance from reflective surfaces

Distance between sender and receiver D in m	Calculating the minimum distance from reflective surfaces a in mm
$D \leq 3 \text{ m}$	$a = 262 \text{ mm}$
$D > 3 \text{ m}$	$a = \tan(5^\circ) \times 1,000 \text{ mm/m} \times D = 87.49 \times 1 \text{ mm/m} \times D$

4.3.3 Protection against interference from systems in close proximity to each other

Overview

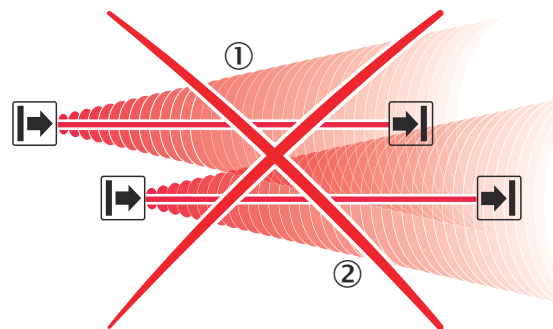


Figure 6: Preventing mutual interference from system ① and system ②

The light beam of the sender of system ① can interfere with the receiver of system ②. This can disrupt the protective function of system ②. This would mean that the operator is at risk.

Avoid such installation situations or take appropriate action, e.g., install optically opaque partitions or reverse the direction of transmission of a system.

Important information



DANGER

Hazard due to lack of effectiveness of the protective device

Systems of single-beam photoelectric safety switches in close proximity to one another can mutually interfere with each other.

- Use suitable measures to prevent interference between systems in close proximity to each other.

4.4 Integration in the electrical control system

This chapter contains important information about integration in the electrical control. Information about the individual steps for electrical installation of the device: [see "Electrical installation", page 26.](#)

Requirements for use

As the single-beam photoelectric safety switch is classified as a Type 2 device in accordance with IEC 61496, it must be monitored by an external test device. The test input of the sender and a semiconductor switching output of the receiver are used for this purpose.

To connect the single-beam photoelectric safety switch, refer to the corresponding operating instructions for the test device or for the higher-order control system.

4.4.1 Switching outputs

Overview

Two switching outputs are provided for evaluation by an external test device:

- Q_{L1}/C
Switching output or IO-Link communication
- MF
Switching output or configurable output

The factory setting for the switching outputs is Q. The switching behavior can be found in [table 4.](#)

Table 4: Push-pull

Q Push-pull (≤ 100 mA)		
\bar{Q} Push-pull (≤ 100 mA)		

Important information**NOTE**

If IO-Link is used on the device, the MF switching output with the factory setting Q must be used.

If no IO-Link is used on the device, any of the switching outputs with the factory setting Q can be used.

The single-beam photoelectric safety switch must not be supplied with voltage via the IO-Link master.

4.4.2 Test input**Overview**

The sender has a test input that can be used to switch off the light beam of the sender and thereby simulate an interruption of the light beam.

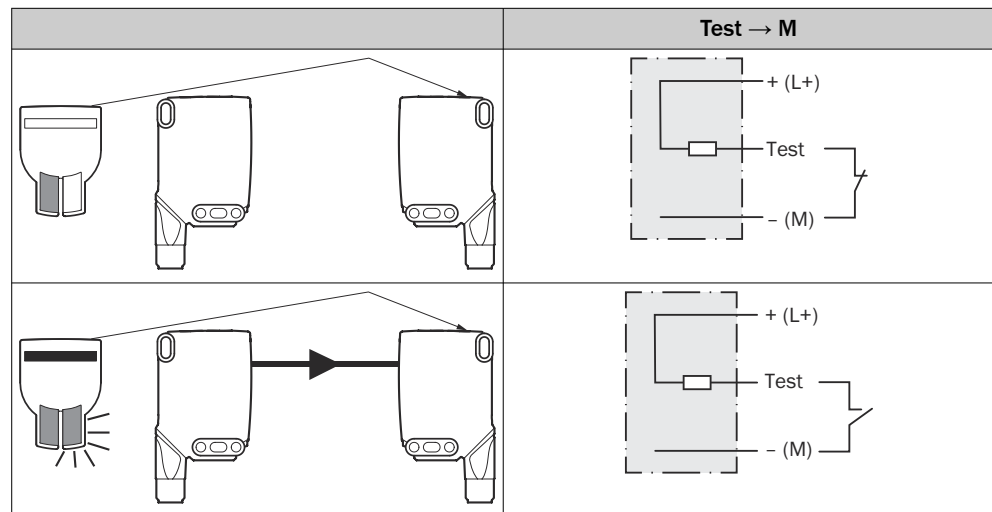
The test input is provided for the purposes of checking the functioning of the sender and receiver. When used in combination with an external test device to evaluate the test results, the protective device is suitable for safety applications.

Functionality

As soon as the test input is activated, the light beam of the sender is switched off to simulate an object having been detected.

- ▶ Refer to [table 5](#) to check the function.
- ▶ If the switching output fails to behave in accordance with [table 5](#), check the application conditions.

Table 5: Test

**Further topics**

- ["Troubleshooting", page 32](#)

4.4.3 Cascading

You can use cascading to connect up to 4 single-beam photoelectric safety switches in series.

Further topics

- ["Connection diagrams", page 20](#)

4.4.4 Application diagnostic output

Overview

An application diagnostic output can be configured on pin 2 of the system connection of the receiver via IO-Link.

The application diagnostic output will signal a specific status of the protective device depending on the configuration.

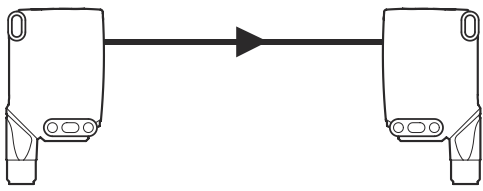
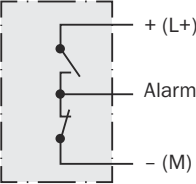
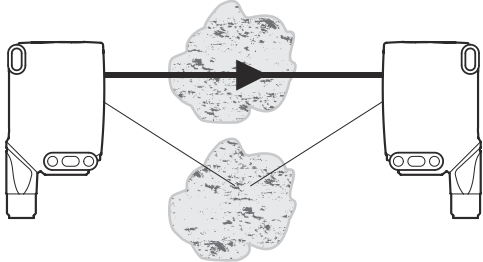
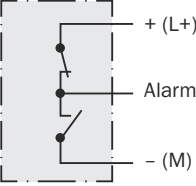
The status of the protective device is indicated via the yellow status LED.

Output signals

The following signals can be outputted via the application diagnostic output:

- Alarm
 When Alarm is configured on the application diagnostic output, the application diagnostic output signals when the protective device is only partially operational, for example if the sender or receiver is contaminated or poorly aligned.
 In the good state: LOW (0), if excessively contaminated HIGH (1), see [table 6, page 18](#)

Table 6: Alarm

	Alarm (≤ 100 mA)
	
	

4.4.5 IO-Link

Overview

The protective device is IO-Link capable.

The IO-Link communication between the protective device and a PC can occur via an IO-Link master. To do so, connect the IO-Link master to the system connection of the receiver, and via a USB cable to a PC.

The connected protective device can be configured, or data exchanged or transferred using the SOPAS ET configuration software.

Important information



DANGER

The output signal of the protective device that is evaluated via the external test device is configured via IO-Link, e.g., using the logic or time delay functions.

This can slow down the response time of the protective device, or make it not possible to evaluate it with the external test device.

- ▶ Use the Q configuration for the switching output when using the protective device in conjunction with an external test device.
 - ▶ Take the use of the logic and time delay functions appropriately into consideration in the risk assessment.
-

Prerequisites

- SOPAS ET configuration software
- SiLink2 Master IO-Link master

Data exchange and configuration

The following data, for example, can be exchanged or transferred via IO-Link:

- Device information
- Quality of reception

The following functions, for example, can be configured via IO-Link:

- Switching output
- Application diagnostic output

The green operational LED on the receiver flashes during IO-Link communication.

Complementary information

For more information on connecting the IO-Link master to a PC and to the protective device, see the IOLA2US-01101 SiLink2 Master operating instructions.

For more information on IO-Link, see the IODD and the SDD for SOPAS ET.

Suitable accessories are available at www.sick.com. Enter the product part number in the search field (part number: see the type label entry in the “Ident. no.” field or in the “P/N” field). All suitable accessories are listed on the Accessories tab of the product page.

4.4.6 Connection diagrams

3 x L25/L26 (cascaded) to Flexi Classic main module and input/output expansion module

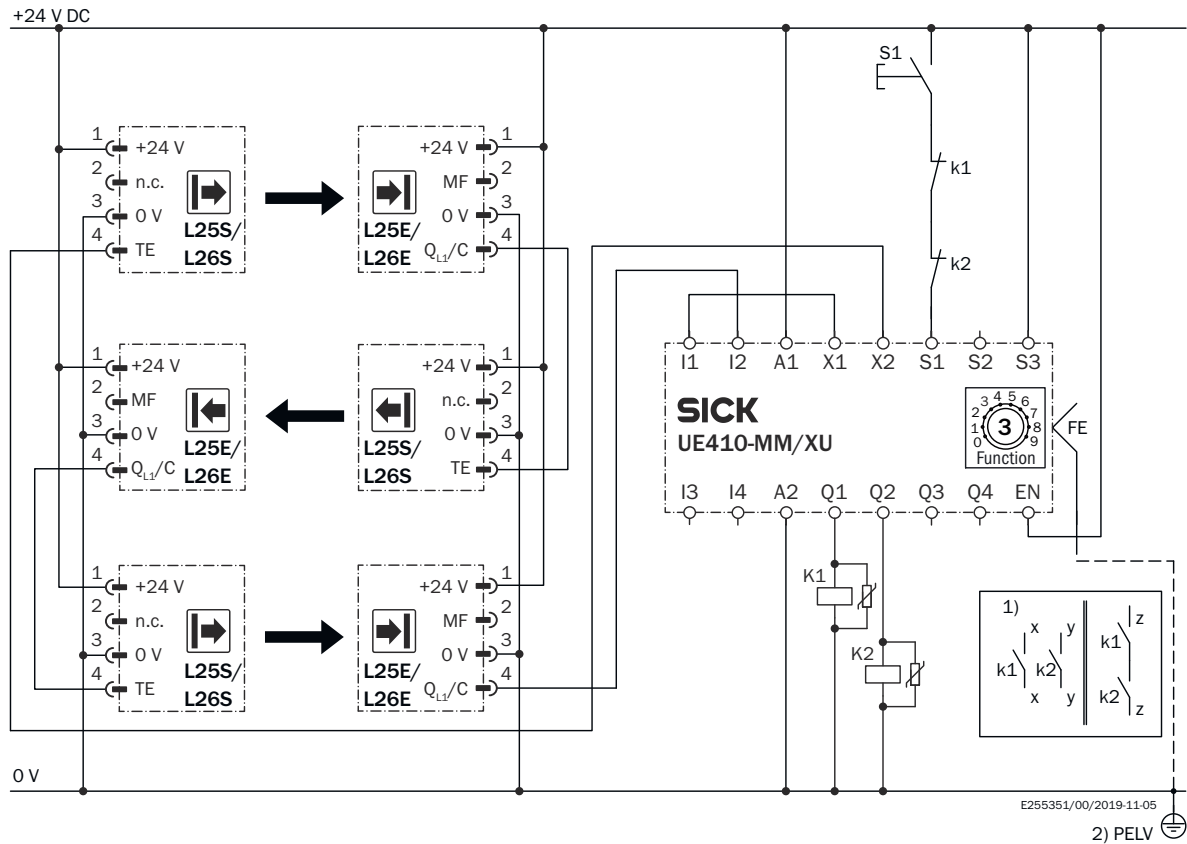


Figure 7: Connection diagram for cascaded L25/L26 to UE410-MM and input/output expansion module

- 1) Output circuits: These contacts must be incorporated into the control such that the dangerous state is brought to an end if the output circuit is open. For categories 4 and 3, they must be incorporated on dual-channels (x, y paths). Single-channel incorporation into the control (z path) is only possible with a single-channel control and taking the risk analysis into account.
 - 2) PELV in accordance with the requirements of EN 60204-1 / 6.4 Optical short-circuits must be avoided. Observe the operating instructions of the integrated devices. The safety-related parameters (safety integrity level and response time) are dependent on the types used.
- **Task**
Connection of three cascaded single-beam photoelectric safety switches from the L25 or L26 family to an UE410-MU/XU safety controller on a relay control/contact control system.
Operating mode: With restart interlock and with external device monitoring.
 - **Mode of operation**
When the input conditions are valid, the system can be switched on and waits for an input signal/switch-on signal. The system can be enabled by pressing and then releasing the S1 pushbutton. The associated output of the UE410-MU/XU carries voltage. When the input conditions are no longer met, the associated outputs of the UE410-MU/XU switch off.
 - **Fault analysis**
A malfunction of the K1, K2 contactors is detected. The shut-down function is retained.

In the event of manipulation (e.g., jamming) of the S1 pushbutton, the system will not re-enable the output current circuits.

3 x L25/L26 (cascaded) with IO-Link to Flexi Classic main module and input/output expansion module

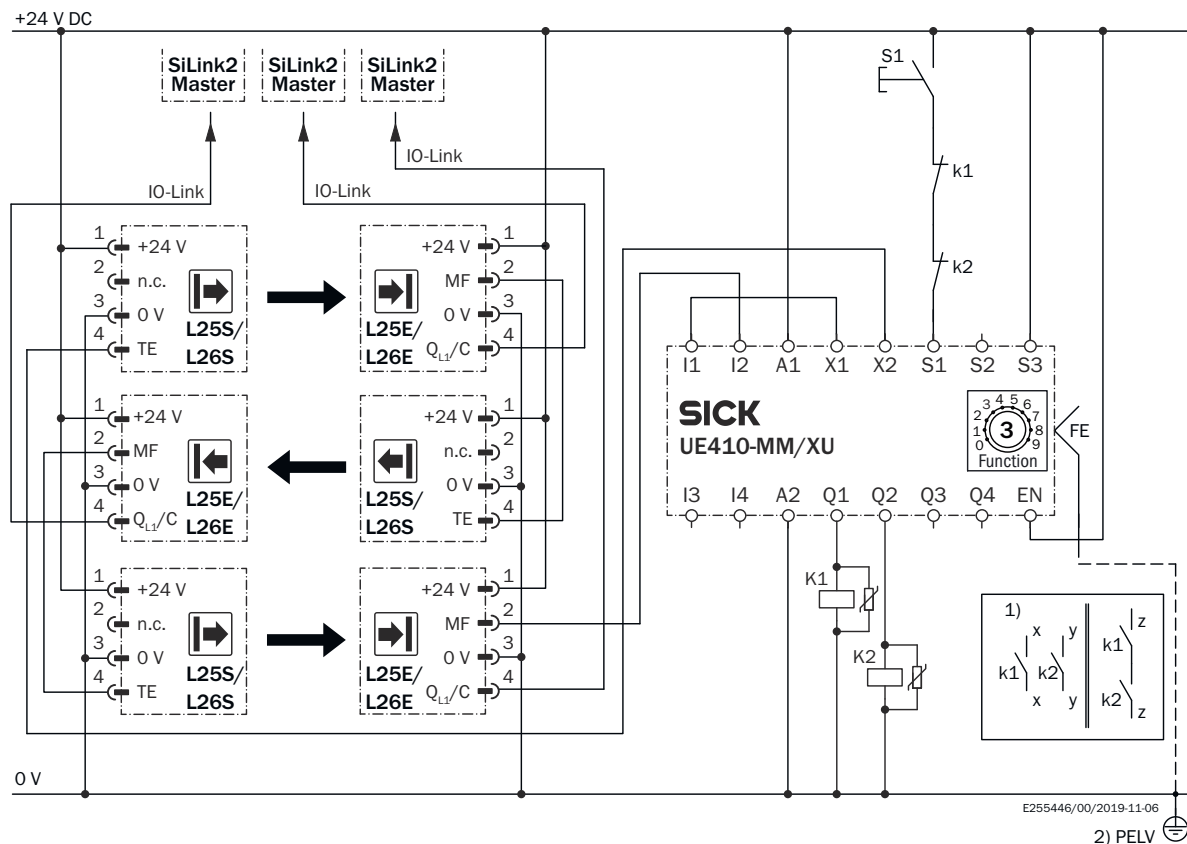


Figure 8: Connection diagram for cascaded L25/L26 with IO-Link to UE410-MM and input/output expansion module

- 1) Output circuits: These contacts must be incorporated into the control such that the dangerous state is brought to an end if the output circuit is open. For categories 4 and 3, they must be incorporated on dual-channels (x, y paths). Single-channel incorporation into the control (z path) is only possible with a single-channel control and taking the risk analysis into account.
- 2) PELV in accordance with the requirements of EN 60204-1 / 6.4 Optical short-circuits must be avoided. Observe the operating instructions of the integrated devices. The safety-related parameters (safety integrity level and response time) are dependent on the types used.
 - **Task**
Connection of three cascaded single-beam photoelectric safety switches from the L25 or L26 family to an UE410-MU/XU safety controller on a relay control/contact control system.
Operating mode: With restart interlock and with external device monitoring.
 - **Mode of operation**
When the input conditions are valid, the system can be switched on and waits for an input signal/switch-on signal. The system can be enabled by pressing and then releasing the S1 pushbutton. The associated output of the UE410-MU/XU carries voltage. When the input conditions are no longer met, the associated outputs of the UE410-MU/XU switch off.
 - **Fault analysis**

A malfunction of the K1, K2 contactors is detected. The shut-down function is retained.

In the event of manipulation (e.g., jamming) of the S1 pushbutton, the system will not re-enable the output current circuits.



NOTE

If IO-Link is used on the device, the MF switching output with the factory setting Q must be used.

If no IO-Link is used on the device, any of the switching outputs with the factory setting Q can be used.

The single-beam photoelectric safety switch must not be supplied with voltage via the IO-Link master.

4.5 Testing plan

The manufacturer of the machine and the operating entity must define all required thorough checks. The definition must be based on the application conditions and the risk assessment and must be documented in a traceable manner.

- ▶ When defining the thorough check, please note the following:
 - Define the type and execution of the thorough check.
 - Define the frequency of the thorough check.
 - Notify the machine operators of the thorough check and instruct them accordingly.

The following thorough checks are often defined in connection with a protective device:

- Thorough check during commissioning and modifications
- Regular thorough check

Thorough check during commissioning and modifications

Before commissioning the machine and after making changes, you must check whether the safety functions are fulfilling their planned purpose and whether persons are being adequately protected.

The following points are often helpful for the definition of the thorough check:

- Does the thorough check have to be completed by qualified safety personnel?
 - Can the thorough check be completed by personnel specially qualified and authorized personnel?
 - Does the thorough check have to be documented in a traceable manner?
 - Can the thorough check be carried out according to a check list (see ["Checklist for initial commissioning and commissioning"](#), page 40)?
 - Do the machine operators know the function of the protective device?
 - Have the machine operators been trained to work on the machine?
 - Have the machine operators been notified about modifications to the machine?
 - Does the hazardous area to be secured have to be checked with a test rod, see ["Test rod check"](#), page 23?
- ▶ Define all guidelines for the thorough check.

Regular thorough check

The thorough check is intended to ensure that the safety functions are fulfilling their planned purpose and whether persons are being adequately protected.

The following points are often helpful for the definition of the thorough check:

- Which thorough check must be carried out and how is it carried out?
 - ["Test rod check"](#), page 23
 - ["Visual check of the machine and the protective device"](#), page 23

- How often does the thorough check have to be carried out?
- Do the machine operators have to be notified of the thorough check and do they need to be instructed accordingly?
- ▶ Define all guidelines for the thorough check.

4.5.1 Test rod check

Overview

The light beam is covered with an opaque test rod (minimum diameter of 30 mm). When the light beam is covered, the higher level test device must switch off. The check is carried out at multiple positions between the sender and the receiver.

Important information



DANGER

Hazard due to unexpected starting of the machine

- ▶ Make sure that the dangerous state of the machine is and remains switched off during the check.
 - ▶ Make sure that the outputs of the single-beam photoelectric safety switch do not affect the machine during the check.
-



DANGER

Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

Do not operate the machine if the higher level test device does not switch off during the test.

- ▶ If the higher level test device does not switch off, even briefly, during the test, work must stop at the machine.
 - ▶ In this case, the mounting and electrical installation of the single-beam photoelectric safety switch must be checked by appropriately qualified safety personnel.
-

Approach

1. Cover the light beam completely.
 - ✓ The higher level test device switches off.
2. Enable the light beam.
 - ✓ The higher level test device switches on.
3. Carry out the check at the following positions:
 - Immediately in front of the sender
 - In the middle, between the sender and the receiver (or the deflector mirrors)
 - Immediately in front of the receiver
 - Where deflector mirrors are used, immediately in front of and behind the mirror

4.5.2 Visual check of the machine and the protective device

The following points are often helpful for the definition of the check:

- Has the machine been retrofitted?
- Have machine parts been removed?
- Have modifications been made to the surroundings of the machine?
- Have the protective device or its parts been dismantled?
- Is it possible to enter the hazardous area without being detected?
- Is the protective device damaged?
- Is the protective device severely contaminated?

- Is the front screen contaminated, scratched or destroyed?
- Are there any damaged cables or open cable ends?

If one of the points applies, the machine should be shut down immediately. In this case, the machine and the protective device must be checked by appropriately qualified safety personnel.

5 Mounting

5.1 Unpacking

Approach

1. Check the components for completeness and the integrity of all parts.
2. In the event of complaints, contact the responsible SICK subsidiary.

Further topics

- ["Scope of delivery", page 38](#)

5.2 Mounting

Overview

The sender and receiver are mounted using suitable mounting brackets that can be obtained as accessories from SICK. The sender and receiver are then aligned with each other.

Important information



DANGER

Hazard due to lack of effectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

- ▶ Take account of the minimum distances calculated for the machine: see ["Minimum distance from the hazardous point", page 12](#), see ["Minimum distance from reflective surfaces", page 14](#).
- ▶ Mount single-beam photoelectric safety switch in such a way that nobody can pass under the light beam or pass by the side of the protective device.

Prerequisites

- Project planning is completed.
- Assembly is carried out according to the project planning.
- Dangerous condition of the machine is and remains switched off during mounting.
- The outputs of the device do not affect the machine during mounting.
- Only use SICK-approved brackets for mounting.
- Take appropriate measures for vibration damping if vibration and shock specifications exceed the values and test conditions specified in the data sheet.

Complementary information

Suitable accessories are available at www.sick.com. Enter the product part number in the search field (part number: see the type label entry in the "Ident. no." field or in the "P/N" field). All suitable accessories are listed on the Accessories tab of the product page.

Further topics

- ["Project planning", page 11](#)

6 Electrical installation

6.1 Connecting

Overview

The device is connected via the M12 plug connector.

Prerequisites

- Mounting is completed.
- Electrical installation is carried out according to the project planning.
- Dangerous condition of the machine is and remains off during the electrical installation.
- Outputs of the device have no effect on the machine during electrical installation.
- The system connection cables of the sender and the receiver are connected to the external test device separately.

Further topics

- ["Project planning", Seite 11](#)
- ["Mounting", Seite 25](#)

6.1.1 System connection (M12, 4-pin)

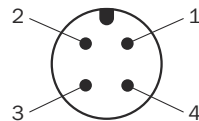


Figure 9: System connection (M12 male connector, 4-pin)

Table 7: System connection pin assignment (male connector, M12, 4-pin)

Pin	Wire color ¹⁾	➡ Sender	➡ Receiver
1	Brown	+24 V DC (voltage supply input)	+24 V DC (voltage supply input)
2	White	Not assigned	MF (digital output/factory setting: Q)
3	Blue	0 V DC (voltage supply input)	0 V DC (voltage supply input)
4	Black	TI (test input)	Q _{L1} /C (digital output/factory setting: Q)

¹⁾ Applies to the connecting cables recommended as accessories.

7 Commissioning

7.1 Switching on

Prerequisites

- Project planning is completed.
- Mounting is completed.
- Dangerous state of the machine is and remains off during commissioning.
- The outputs of the device do not affect the machine during commissioning.
- The machine has been inspected and released by qualified safety personnel.
- Protective device works properly.
- The protection function is checked after each change to the machine or to the integration or the operating and boundary conditions of the device.

Switching on

After switching on the protective device, the green operational LED on the sender lights up.

If the light path is clear, the green operational LED and the yellow status LED on the receiver light up.

In addition, 0 ... 5 of the blue alignment quality LEDs on the receiver light up permanently depending on the alignment quality.

7.2 Alignment of the sender and receiver

Overview

Once mounting and electrical installation are complete, the sender and receiver must be aligned with each other.

Important information



DANGER

Dangerous state of the machine

- ▶ Make sure that the dangerous state of the machine is (and remains) switched off during the alignment process.
- ▶ Make sure that the outputs of the single-beam photoelectric safety switch do not affect the machine during the alignment process.

7.2.1 Aligning the sender and receiver

Important information



NOTE

When aligning the sender and receiver, note the location of the optical axis, [see "Dimensional drawings", page 37](#).



NOTE

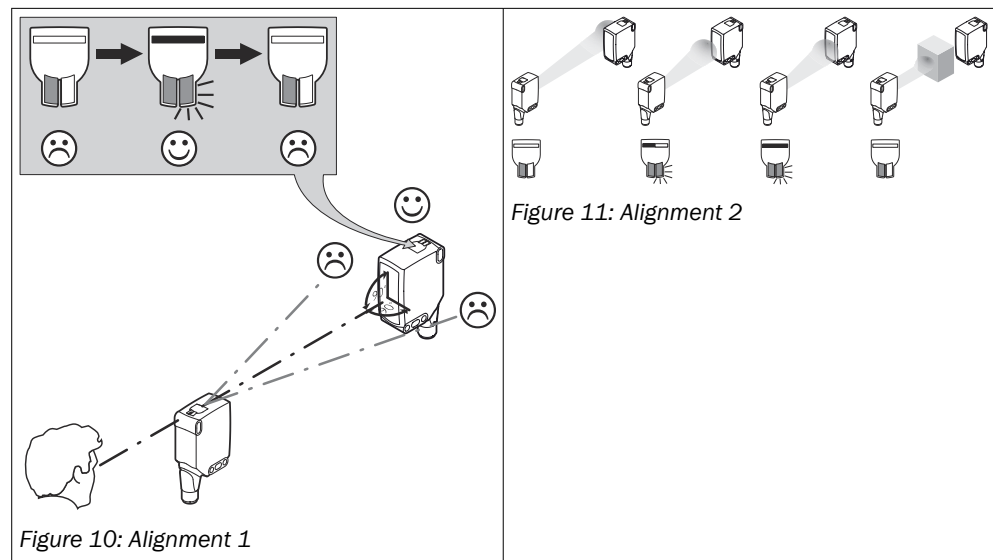
Once the yellow status LED lights up, alignment is good and availability is stable. Ensure no parts of the body or objects are located between the sender and receiver (e.g., hand, tool) as these will negatively affect the alignment quality. Remove all objects from this area to allow the alignment quality to be assessed.

Prerequisites

- Sender and receiver have been mounted at the correct height.
- The light path is completely clear. There is no object between the sender and receiver.

Approach

1. Align the sender with the receiver.
 2. For red light (visible): Select the position so that the red light beam of the sender hits the receiver, [see figure 10](#)
Tip: Use white paper, for example, as an alignment aid.
 3. For infrared light (not visible): Select the position so that the infrared light of the sender hits the receiver.
 4. Observe the status LED and the alignment quality LEDs while performing the alignment, [see figure 10](#), [figure 11](#) and [table 4](#).
- ✓ Once the yellow status LED lights up, alignment is good and availability is stable.
 - ✓ 0 ... 5 of the blue alignment quality LEDs may also light up depending on the separation distance between the sender and receiver and the quality of the alignment.

**7.3 Check during commissioning and modifications**

The thorough check is intended to ensure that the safety functions are fulfilling their planned purpose and whether persons are being adequately protected.

- ▶ Carry out the checks specified in the test plan of the manufacturer of the machine and the operating entity.

8 Operation

8.1 Regular thorough check

The thorough check is intended to ensure that the safety functions are fulfilling their planned purpose and whether persons are being adequately protected.

- ▶ Carry out the checks specified in the test plan of the manufacturer of the machine and the operating entity.

9 Maintenance

9.1 Regular cleaning

Overview

Depending on the ambient conditions of the single-beam photoelectric safety switch, the front screens must be cleaned regularly and in the event of contamination. Static charges can cause dust particles to be attracted to the front screen.

The deflector mirrors also must be cleaned regularly and in the event of contamination.

Important information



DANGER

Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ▶ Regularly check the degree of contamination on all components based on the application conditions.
- ▶ Observe the information on the regular rod test check.



DANGER

Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ▶ Make sure that the optical properties of the front screens of the sender and receiver are not changed, e.g., by:
 - Beading water, mist, frost, or ice formation. If applicable, remove films or other types of contamination, disconnect the voltage supply of the receiver and then switch it back on.
 - Scratches or damage. Replace the device whose front screen is scratched or damaged.
- ▶ Make sure that all reflective surfaces and objects maintain a minimum distance from the light beams.
- ▶ Make sure that no dispersive media (e.g., dust, fog, or smoke) are within the calculated minimum distance from the light beams.



DANGER

Hazard due to unexpected starting of the machine

- ▶ Make sure that the dangerous state of the machine is and remains switched off during the cleaning.
- ▶ Make sure that the outputs of the single-beam photoelectric safety switch do not affect the machine during cleaning.



NOTICE

- ▶ Do not use any aggressive cleaning agents.
- ▶ Do not use any abrasive cleaning agents.
- ▶ We recommend anti-static cleaning agents.
- ▶ We recommend the use of anti-static plastic cleaner (SICK part number 5600006) and the SICK lens cloth (SICK part number 4003353).

Approach

1. Remove dust from the front screen using a soft, clean brush.
2. Then wipe the front screen with a clean, damp cloth.
3. Check the position of the sender and receiver.
4. Check the effectiveness of the protective device.

Further topics

- ["Test rod check", page 23](#)

9.2 Regular thorough check

The thorough check is intended to ensure that the safety functions are fulfilling their planned purpose and whether persons are being adequately protected.

- ▶ Carry out the checks specified in the test plan of the manufacturer of the machine and the operating entity.

10 Troubleshooting

10.1 Safety



DANGER

Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ▶ Immediately shut the machine down if the behavior of the machine cannot be clearly identified.
- ▶ Immediately put the machine out of operation if you cannot clearly identify or allocate the fault and if you cannot safely remedy the fault.
- ▶ Secure the machine so that it cannot switch on unintentionally.



NOTE

Additional information on troubleshooting can be found at the responsible SICK subsidiary.

Fault indicators

Table 8: Fault indicators on the receiver

LED			Possible cause	Troubleshooting
Status LED	Operation LED	Alignment quality LEDs		
○	○	Not all blue alignment quality LEDs light up.	<ul style="list-style-type: none"> • Insufficient alignment • Front screens dirty • Particles in the light beam • Distance between sender and receiver is too large 	<ul style="list-style-type: none"> ▶ Checking the alignment ▶ Clean the front screens ▶ Avoid contamination in the air if possible ▶ Check sensing range
☀ Yellow	○	○	Distance between sender and receiver is too large OR Beam of sender is not hitting the receiver fully, or receiver is not aligned to sender	<ul style="list-style-type: none"> ▶ Check sensing range ▶ Checking the alignment

LED			Possible cause	Troubleshooting
Status LED	Operation LED	Alignment quality LEDs		
<p>● Yellow</p> <p>Status LED lights up yellow even though there is an object in the path of the beam.</p>	○	○	<p>The beam of the single-beam photoelectric safety switch is hitting the receiver of another (neighboring) single-beam photoelectric safety switch.</p>	<ul style="list-style-type: none"> ▶ Swap the sender and receiver arrangement at every second single-beam photoelectric safety switch ▶ Ensure the single-beam photoelectric safety switches are a sufficient distance apart
<p>Switching outputs do not behave in accordance with table 4, table 6</p>			<ul style="list-style-type: none"> ● IO-Link communication ● Change of the configuration ● Short-circuit 	<ul style="list-style-type: none"> ▶ Adjust configuration ▶ Check electrical connections
<p>No object in beam path, no output signal</p>			<p>The test input is not connected properly.</p>	<ul style="list-style-type: none"> ▶ Check connection of the test input

○ LED off. ● LED flashes. ● LED illuminates.

11 Decommissioning

11.1 Disposal

Approach

- ▶ Always dispose of unusable devices in accordance with national waste disposal regulations.



Complementary information

SICK will be glad to help you dispose of these devices on request.

12 Technical data

12.1 Data sheet

General system data

Table 9: General system data

	Minimum	Typical	Maximum
Sensing range			
Near-infrared (NIR), invisible	15 m	20 m	
Visible red light	15 m	20 m	
Protection class	III (IEC 61140)		
Enclosure rating	IP66 (IEC 60529) IP67 (IEC 60529) IP69K (ISO 20653)		
Type ¹⁾	Type 2 (IEC 61496-1)		
Category ¹⁾	Category 2 (ISO 13849-1)		
Performance level ¹⁾	PL c (ISO 13849-1)		
Safety integrity level ¹⁾	SIL1 (IEC 61508)		
SIL claim limit ¹⁾	SILCL1 (IEC 62061)		
PFHd (mean probability of one dangerous failure per hour)	1 x 10 ⁻⁶		
T _M (mission time)	20 years (ISO 13849-1)		
Maximum demand rate ²⁾	60 min ⁻¹		
Test rate			100 s ⁻¹
Supply voltage U _V at the device ^{3) 4)}	24 V DC (19.2 V DC ... 28.8 V DC)		
Residual ripple	≤ 5 V _{SS}		
Response time ⁵⁾			
For one pair of sensors	500 μs		
For two pairs of sensors	2.1 ms		
For three pairs of sensors	3.7 ms		
For four pairs of sensors	5.3 ms		

¹⁾ Only in combination with a suitable test device.

²⁾ Between two requirements on a safety-related response of the device, at least 100 external tests must be carried out.

³⁾ The external voltage supply of the device must be capable of buffering brief power failures of 20 ms as specified in EN 60204. Suitable power supply units can be obtained as accessories from SICK (Siemens Series 6 EP 1).

⁴⁾ A fuse rated maximum 4 A shall be installed in the isolated 24 V DC power supply circuit to the device in order to limit the available current.

⁵⁾ Only in combination with a suitable test device, the response time of which must be taken into consideration.

Technical data for sender

Table 10: Technical data for sender

	Minimum	Typical	Maximum
Wavelength of sender			
Near-infrared (NIR), invisible	850 nm		
Red light, visible	635 nm		
Test input response time ¹⁾			1.1 ms

	Minimum	Typical	Maximum
Test pulse width	1.1 ms		
Current consumption			30 mA
Light spot diameter			
Near-infrared (NIR), invisible	approx. 110 mm at a distance of 8 m		
Red light, visible	approx. 90 mm at a distance of 8 m		
Test input for the sender ^{2) 3)}			
Sender off	≤ 3 V		
Sender on	≥ U _V - 4 V		

- 1) The test input has a pull-up resistor to activate the sender (sender on) even when not connected. A LOW signal is therefore required to activate the cyclic test with test gap (sender off).
- 2) The test input must not be operated when not connected.
- 3) The test input must be operated with a maximum supply voltage of U_V.

Technical data for receiver

Table 11: Technical data for receiver

	Minimum	Typical	Maximum
Current consumption (without load)			30 mA
Switching outputs ¹⁾	Push-pull		
Response time ²⁾			500 μs
Signal voltage HIGH	U _V - 3.2 V	U _V - 2.5 V	U _V
Signal voltage LOW			1 V
Output current I _A			100 mA

- 1) Output signal switching device for controlling the downstream test device, no OSSD according to IEC 61496-1. Output short-circuit protected.
- 2) Signal transit time with resistive load.

Operating data

Table 12: Operating data

System connection	M12, 4-pin
Ambient operating temperature	-40 °C ... +60 °C
Air humidity (non-condensing)	15 % ... 95 %
Storage temperature	-40 °C ... +75 °C
Housing cross-section	20 mm × 42 mm, plus bracket, see " Dimensional drawings ", page 37
Vibration resistance ¹⁾	5 g, 10 Hz ... 55 Hz (IEC 60068-2-6)
Shock resistance ²⁾	10 g, 16 ms (IEC 60068-2-27)

- 1) Test conditions per axis: 1 octave/minute, amplitude: 0.35 mm, 20 sweeps.
- 2) Test conditions per axis: 1000 shocks.

12.2 Dimensional drawings

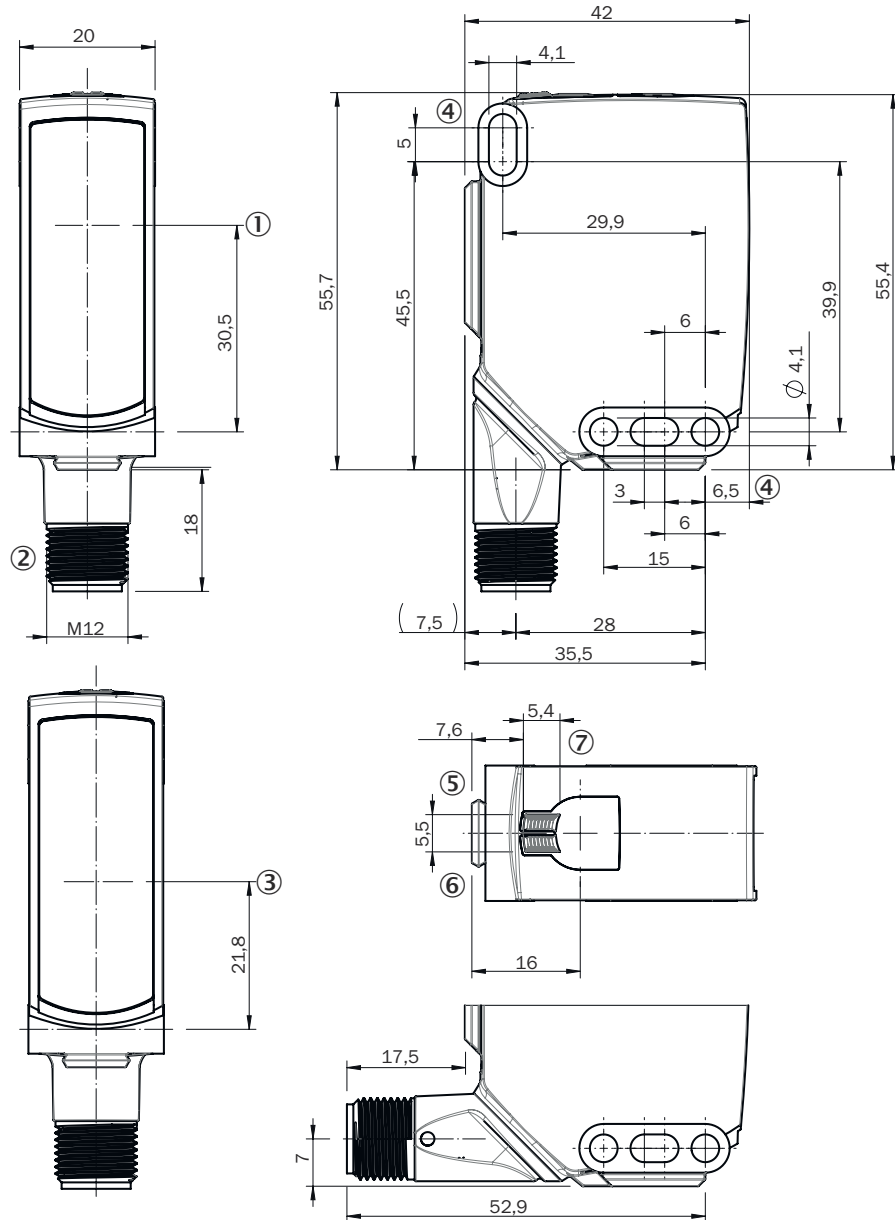


Figure 12: Dimensional drawing L25, male connector

- ① Center of optical axis, sender
- ② Connection
- ③ Center of optical axis, receiver
- ④ Fixing holes
- ⑤ green operating LED: supply voltage active
- ⑥ yellow status LED: light received indicator
- ⑦ alignment aid (BluePilot): blue alignment quality LEDs

13 Ordering information

13.1 Scope of delivery

Scope of delivery, sender

- Sender
- Mounting instructions
- Operating instructions for download: www.sick.com

Items supplied, receiver

- Receiver
- Mounting instructions
- Operating instructions for download: www.sick.com

13.2 Ordering information L25

Table 13: Ordering information L25

Light source	Sender		Receiver	
	Part number	Type code ¹⁾	Part number	Type code ¹⁾
Near-infrared, invisible	2113103	WSO16I- 243ZZ1A0ZZZZLLZZZZZZZ1	2113105	WEO16I- 2416R500A00ZLLZZZZZZZ1
Red light, visible	2113101	WSO16P- 243ZZ1A0ZZZZLLZZZZZZZ1	2113102	WEO16P- 2416R500A00ZLLZZZZZZZ1

¹⁾ Only the first 18 characters of the type code are shown on the device.

14 Accessories

Suitable accessories are available at www.sick.com. Enter the product part number in the search field (part number: see the type label entry in the “Ident. no.” field or in the “P/N” field). All suitable accessories are listed on the Accessories tab of the product page.

15 Annex

15.1 Conformities and certificates

You can obtain declarations of conformity, certificates, and the current operating instructions for the product at www.sick.com. To do so, enter the product part number in the search field (part number: see the entry in the “P/N” or “Ident. no.” field on the type label).

15.1.1 EU declaration of conformity

Excerpt

The undersigned, representing the 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 standards and/or technical specifications stated in the EU declaration of conformity have been used as a basis for this.

- ROHS DIRECTIVE 2011/65/EU
- EMC DIRECTIVE 2014/30/EU
- MACHINERY DIRECTIVE 2006/42/EC

15.1.2 UK declaration of conformity

Excerpt

The undersigned, representing the following manufacturer herewith declares that this declaration of conformity is issued under the sole responsibility of the manufacturer. The product of this declaration is in conformity with the provisions of the following relevant UK Statutory Instruments (including all applicable amendments), and the respective standards and/or technical specifications have been used as a basis.

- Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
- Electromagnetic Compatibility Regulations 2016
- Supply of Machinery (Safety) Regulations 2008

15.2 Checklist for initial commissioning and commissioning

Checklist for manufacturers or installers for installing electro-sensitive protective device (ESPE)

The details relating to the items listed below must be available no later than when the system is commissioned for the first time. However, these depend on the specific application (the requirements of which must be reviewed by the manufacturer or installer).

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

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

Have the safety rules and regulations been observed in compliance with the directives and standards applicable to the machine?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Are the applied directives and standards listed in the declaration of conformity?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Does the protective device correspond to the required PL/SIL and PFHd in accordance with ISO 13849-1 / IEC 62061 and the required type in accordance with IEC 61496-1?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Is access to the hazardous area or hazardous point only possible through the protective field of the ESPE?	Yes <input type="checkbox"/> No <input type="checkbox"/>

Have appropriate measures been taken to protect (mechanical protection) or monitor (protective devices) any persons or objects in the hazardous area when protecting a hazardous area or hazardous point, and have these devices been secured or locked to prevent their removal?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Are additional mechanical protective measures fitted and secured against manipulation which prevent reaching below, above or around the ESPE?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Has the maximum shutdown and/or stopping time of the machine been measured, specified and documented (at the machine and/or in the machine documentation)?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Has the ESPE been mounted such that the required minimum distance from the nearest hazardous point has been achieved?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Are the ESPE devices properly mounted and secured against manipulation after adjustment?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Are the required protective measures against electric shock in effect (protection class)?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Is the control switch for resetting the protective devices (ESPE) or restarting the machine present and correctly installed?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Are the outputs of the ESPE (OSSDs or safety outputs via the network) integrated according to the required PL/SIL in accordance with ISO 13849-1 / IEC 62061 and does the integration correspond to the circuit diagrams?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Has the protective function been checked in compliance with the test notes of this documentation?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Are the specified protective functions effective at every operating mode that can be set?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Are the switching elements activated by the ESPE, e.g. contactors, valves, monitored?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Is the ESPE effective over the entire period of the dangerous state?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Once initiated, will a dangerous state be stopped when switching the ESPE on or off and when changing the operating mode, or when switching to another protective device?	Yes <input type="checkbox"/> No <input type="checkbox"/>

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