OPERATING INSTRUCTIONS

MLP1

Safety switches

SICK
Sensor Intelligence.

Described product

MLP1

Manufacturer

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Legal information

Original document

This document is an original document of SICK AG.

Contents

1 About this document

1.1 Function of this document

These operating instructions contain the information needed during the life cycle of the safety switch.

They must be made available to all people who work with the safety switch.

1.2 Scope

Product

This document applies to the following products:

- Product code: MLP1

Document identification

Document part number:

- This document: 8020169
- Available language versions of this document: 8019902

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

1.3 Target groups of these operating instructions

Some chapters 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 chapters of these operating instructions

Target group	Chapters of these operating instructions
Project developers (planners, developers, designers)	"Project planning", page 12 "Technical data", page 39
Installers	"Mounting", page 20
Electricians	"Electrical installation", page 25
Safety experts (such as CE authorized representatives, compliance officers, people who test and approve the application)	"Project planning", page 12 "Commissioning", page 33 "Technical data", page 39
Operators	"Troubleshooting", page 36
Maintenance personnel	"Maintenance", page 37 "Troubleshooting", page 36

1.4 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

1.5 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.

2 Safety information

2.1 General safety notes

This chapter contains general safety information about the safety switch.

Further information about specific product use situations can be found in the relevant chapters.

DANGER
Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

- ▶ Please read this document carefully and make sure that you understand the content fully before working with the device.
- ▶ Follow all safety notes in this document.

2.2 Intended use

The MLP1 safety switch is a transponder safety switch with a locking function, which is controlled without contact by actuators and is suitable for the following applications:

- Monitoring of movable physical guards
- Locking device for process protection

The product may be used in safety functions.

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

Incorrect use, improper modification or manipulation of the safety switch will invalidate any warranty from SICK; in addition, any responsibility and liability of SICK for damage and secondary damage caused by this is excluded.

The following may impair the function of the safety switch:

- Metal subsurface or metal in direct proximity
- Passing metal chips

2.3 Inappropriate use

Important information

WARNING
Improper use of the safety switch

In the event of a voltage drop, the locking device unlocks regardless of whether the dangerous state of the machine has ended

This safety switch has a simple electromagnetic locking device. There is no locking device monitoring.

- ▶ Do not use the safety switch as a safety locking device according to EN 14119.
- ▶ Do not use the safety switch in applications in which the dangerous state cannot be ended immediately (stopping/run-down time).

Unsuitable ambient conditions

- Applications in which the dangerous state cannot be ended immediately (stopping/run-down time)
- Radioactivity (exception: natural radioactivity)

- Vacuum or high pressure
- High UV load
- In the vicinity of low-frequency RFID devices
- In the vicinity of magnetic fields

Ambient conditions which could impair the function

- Passing metal chips

2.4 Requirements for the qualification of personnel

The safety switch must be planned in, mounted, connected, commissioned, and serviced by qualified safety personnel only.

Project planning

For project planning, a person is considered competent when he/she has expertise and experience in the selection and use of protective devices on machines and is familiar with the relevant technical rules and national work safety regulations.

Mechanical mounting, electrical installation, and commissioning

For the task, a person is considered qualified when he/she has the expertise and experience in the relevant field and is sufficiently familiar with the application of the protective device on the machine to be able to assess whether it is in an operationally safe state.

Operation and maintenance

For operation and maintenance, a person is considered competent when he/she has the expertise and experience in the relevant field and is sufficiently familiar with the application of the protective device on the machine and has been instructed by the machine operator in its operation.

3 Product description

3.1 Device overview

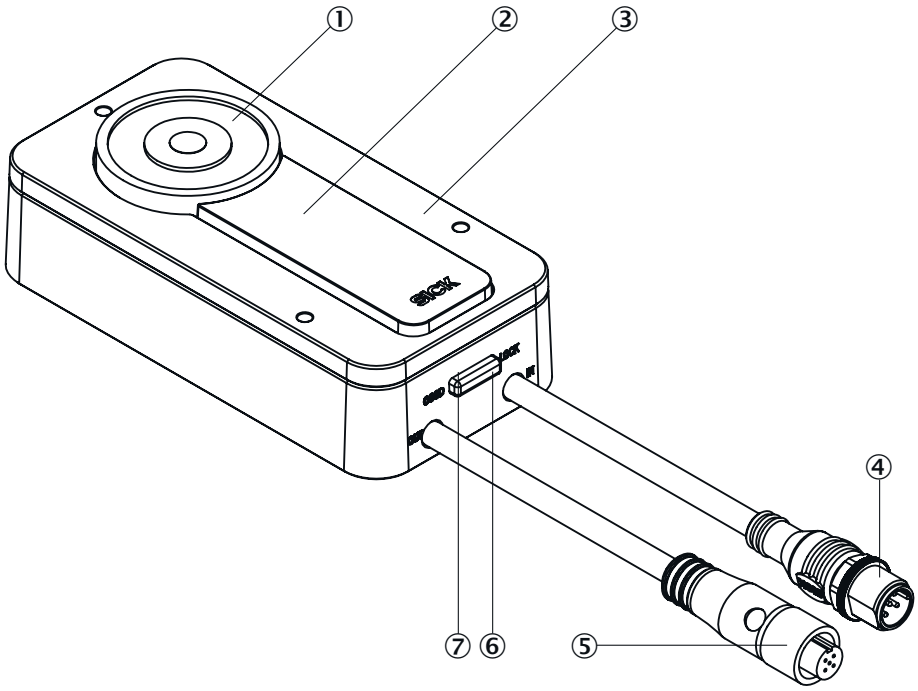


Figure 1: Sensor

① Locking solenoid
② Sensor surface
③ Cover plate
④ Plug connector IN
⑤ Plug connector OUT
⑥ LOCK light emitting diode
⑦ OSSD light emitting diode

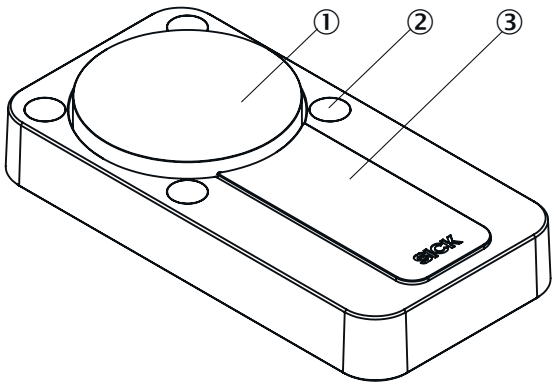


Figure 2: Actuator

① Anchor plate
② Protective cap
③ Actuator surface

3.2 Structure and function

The safety switch is an interlocking device with a locking device consisting of a non-contact sensor with locking solenoid and a coded actuator. The actuator has a low coding level.

If the protective device is closed, the actuator is led to the sensor. If the actuation field is reached, the actuator code is read out and evaluated by RFID. If the code is valid, the safe output signal switching device (OSSD) switches.

If the locking solenoid is supplied with power, the locking device is active.

3.3 Product characteristics

3.3.1 Product variants

Overview

The safety switch is delivered in different variants. You will find an overview of important distinguishing features of the variants in the following.

Connection type

- 2 cables with M12 plug connectors (5-pin)
- 1 cable with M12 plug connector (5-pin)
- 1 cable with M12 plug connector (8-pin)

Coding

The safety switch is available with the following codings:

- **Universally coded**
  All actuators are accepted. Teach-in is not necessary.
- **Uniquely coded**
  For variants with unique coding, the actuator is already taught in when delivered. It is possible to teach in up to 7 actuators in succession. Only the most recently taught-in actuator is valid. Previously taught-in actuators can no longer be used.

3.3.2 Open-circuit current principle

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

In the event of a voltage drop, the locking device unlocks regardless of whether the dangerous state of the machine has ended

▶ Do not use the safety switch in applications in which the dangerous state cannot be ended immediately (stopping/run-down time).

Power to lock principle

- Lock locking device: voltage at locking device input
- Unlock locking function: no voltage at locking device input

If voltage is interrupted, the locking device is unlocked and the protective device can be opened immediately.

Complementary information

- The locking device is not monitored, which means that the safety switch does not check whether the anchor plate is applied to the solenoid.
- The locking force is not monitored.
- Locking force is not a safety-related function.

3.3.3 Protective functions

The safety switch has the following internal protective functions:

- Short-circuit protection at all outputs
- Cross-circuit monitoring at OSSDs
- Overload protection on OSSDs
- Supply voltage reverse polarity protection

3.3.4 Status indicators

The safety switch outputs important status information using a number of LEDs.

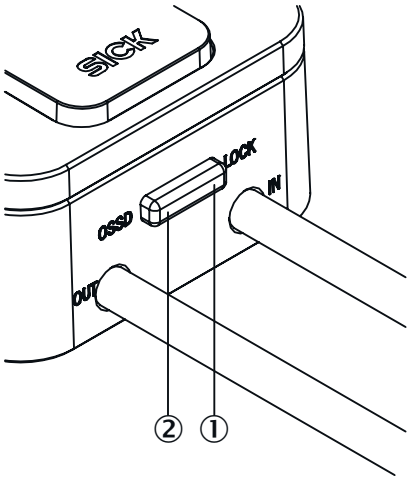


Figure 3: Status LEDs

Table 2: Status LEDs

No.	Name	Color	Meaning
①	LOCK	Yellow	Lights up when the magnet is supplied with voltage.
②	OSSD	Red/green	Lights up green when the OSSD pair is in the ON state. Lights up red when the OSSD pair is in the OFF state.[1)]

1) When a too high load is applied to the application diagnostic output, the red OSSD LED remains continuously lit. This will not have any effect on the actual switching behavior of the safety switch.

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 safety switch.

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

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

If several devices are connected in series (safe series connection) and the simplified process according to EN ISO 13849 is used to determine the performance level (PL), the PL may be reduced.

4.2 Operating entity of the machine

DANGER
Failure to comply with operating entity's obligations
Hazard due to lack of effectiveness of the protective device

- Modifications to the machine and modifications to the mechanical mounting of the safety switch necessitate a new risk assessment. The results of this risk assessment may require the operating entity of the machine to fulfill the manufacturer's obligations.
- Apart from during the procedures described in this document, the components of the safety switch must not be opened or modified.
- Do not perform repair work on the components. Improper repair of the safety switch can lead to a loss of the protective function.
- Ensure that there is no bypassing by replacement actuators. Restrict access to actuators.

4.3 Assembly

Important information

DANGER
Bypassing the protective device
Hazard due to lack of effectiveness of the protective device

- Avoid incentives to manipulate the safety switch by taking at least one of the following measures:
  - Cover the sensor and the actuator with additional equipment or protect them against access.
  - If possible use permanent mounting methods for actuators (e.g., glue, safety screws, or rivets).

CAUTION
Hot housing
Risk of burns

- At ambient temperatures > 40 °C, protect the safety switch from unintentional touching by people.

Mounting location

- Select the mounting location so that the sensor and actuator are accessible for maintenance work and are protected against damage.
- Mount the sensor and actuator on a non-ferrous surface and at a distance from metal parts if possible in order to avoid influencing the sensing range. If this is not possible, the influence on the assured switch-on distance S_{ao} and the assured switch-off distance S_{ar} must be checked.
- Select a mounting location that ensures the sensor is as far away from the door hinge as possible.
- If necessary, fit an additional stop for the moving protective device.

Distance

When several safety switches are mounted to the machine, they must be mounted at a minimum distance to one another see "Mounting several safety switches", page 20.

Alignment

The safety switch can be mounted in any alignment. When mounted horizontally, manipulation protection is increased by the anchor plate with rotating bearings. When mounted horizontally, if the actuator is triggered by the movable physical guard, the actuator is held by the magnet. As the anchor plate has rotating bearings, the gravitational force rotates the actuator surface away from the sensor surface and the OSSDs go into the OFF state.

2 possible mounting methods

The sensor can be mounted in 2 ways:

- **Surface mounting**. The sensor is mounted on the fixed part of the protective device (e.g., door frame).
- **Flush mounting**. The sensor is mounted in the fixed part of the protective device (e.g., door frame). There must be a suitable recess in the mounting surface. The thickness of the mounting surface must be between 1.5 mm and 3 mm.

Complementary information

Dimensional drawing of the recess for flush mounting see figure 20.

4.4 Integration in the electrical control system

You need to take the following into consideration when integrating the safety switch into the electrical control system.

Requirement for use

- The safety locking device must not be bypassed by electrical means, e.g. by bridging the contacts. You may need to take measures to prevent this.
- The connected controller and all devices responsible for safety must comply with the required performance level and the required category (for example according to ISO 13849-1).
- The overall concept of the control system in which the device is integrated must be validated in accordance with ISO 13849-2.
- The inputs of a connected evaluation unit must be positive-switching (PNP) inputs because the two outputs of the safety switch supply a level of the supply voltage in the switched-ON state.

4.4.1 OSSDs

Safety switches with local inputs and outputs can be directly integrated into the machine controller.

DANGER

Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

▶ Make sure that the following control and electrical requirements are met so the protective function can be fulfilled.

- The output signals from an OSSD pair must not be connected to each other.
- In the machine controller, both signals from an OSSD pair must be processed separately.

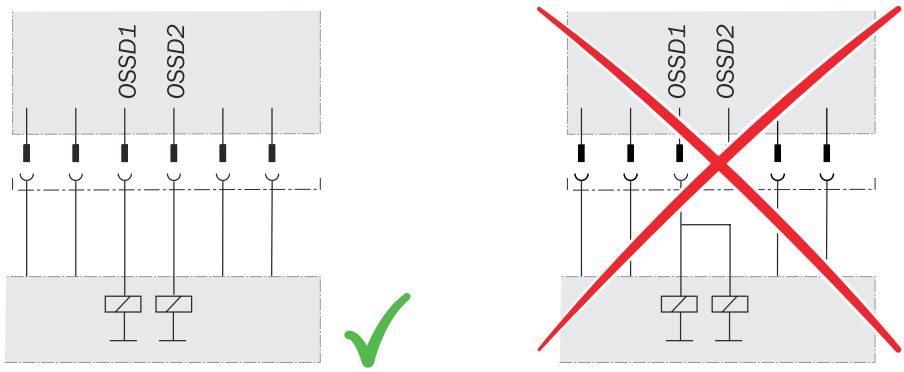


Figure 4: Dual-channel and isolated connection of OSSD 1 and OSSD 2

- The machine must switch to the safe state at any time if at least one OSSD in an OSSD pair switches to the OFF state.
- Prevent the formation of a potential difference between the load and the protective device. If you connect loads to the OSSDs (safety outputs) that then also switch if controlled with negative voltage (e.g., electro-mechanical contactor without reverse polarity protection diode), 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. In the event of a fault, this is the only way to ensure that there can be no potential difference between the 0 V connections of the loads and those of the corresponding protective device.

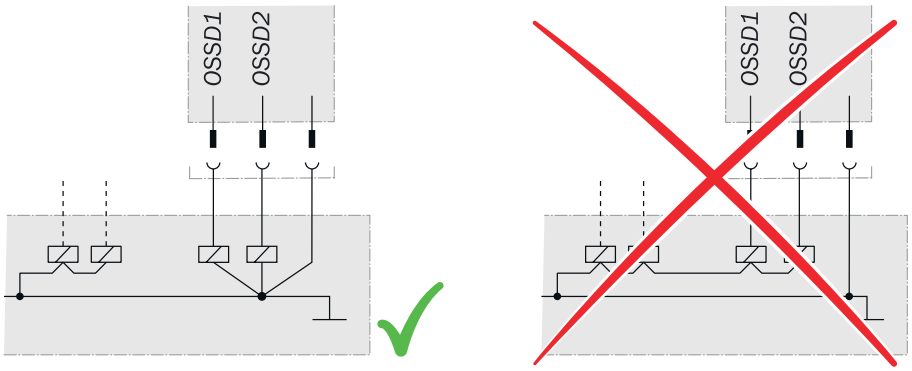


Figure 5: No potential difference between load and protective device

DANGER
Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

Downstream contactors must be positively guided and monitored depending on applicable national regulations or required reliability of the safety function.

▶ Make sure that downstream contactors are monitored (external device monitoring, EDM).

Requirements for the electrical control of the machine

- Use the control without test pulses. The safety switch is self-testing.
- The safety switch tests the OSSDs at regular intervals. To do this, it switches each OSSD briefly (for max. 1 ms) to the OFF state and checks whether this channel is voltage-free during this time.
  Make sure that the machine's control does not react to these test pulses and the machine does not switch off.
- The inputs of a connected evaluation unit must be positive-switching (PNP), as the two outputs of the safety switch send a level of the supply voltage in the switched-on state.

The OSSDs are short-circuit protected to 24 V DC and 0 V. When the actuator is in the sensor's response range, the OSSDs signal the ON state with the HIGH signal level (non-isolated). If the actuator is removed from the sensor's response range or there is a device fault, the OSSDs signal the OFF state with the LOW signal level.

DANGER
Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

▶ Make sure that the following control and electrical requirements are met so the safety switch can fulfill its protective function.

- The external voltage supply of the safety switch must be capable of jumpering brief power failures of 20 ms as specified in IEC 60204-1.
- The power supply unit must provide safe isolation according to IEC 61140 (SELV/PELV). Suitable power supply units are available as accessories from SICK.

4.4.2 Course of the OSSD test over time

The device tests the OSSDs for self-diagnosis at regular intervals. To do this, the device switches each OSSD briefly to the OFF state and checks whether this channel is voltage-free during this time.

Make sure that the machine's control does not react to these test pulses and the machine does not switch off.

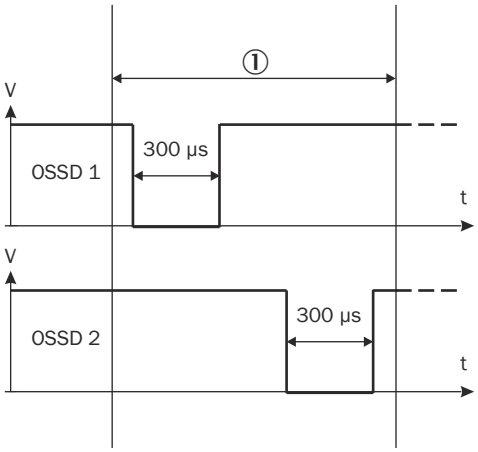


Figure 6: Course of the OSSD test over time

① Usually every 40 ms.

The interval is dynamic and can be smaller than 40 ms.

4.4.3 Controlling the locking solenoid

The locking solenoid is activated through the upstream control. There is no internal activation or deactivation of the locking solenoid through the safety switch. The locking device and locking force are not monitored. When the machine starts, the following sequence must be followed:

1 Check whether safety switch OSSDs are in the ON state.
2 Supply the locking solenoid with power.
3 Start the machine.

4.4.4 Application diagnostic output

Switching behavior of the application diagnostic output

The application diagnostic output switches equivalently to the safety outputs. This is not a safety output.

Table 3: Switching behavior of the application diagnostic output

OSSDs	Application diagnostic output
OFF	OFF
ON	ON

Further topics

- "Data sheet", page 39

4.4.5 Safe series connection

Overview

Several safety switches can be connected in a safe series connection. The connected devices act like one device.

Construction of a safe series connection

There are 2 connection methods for a safe series connection.

- Connecting the safety switches with M12 plug connectors, terminating the safe series connection with an end connector (only for variant with 2 M12 plug connectors)
- Connecting the safety switches with special T-connectors, terminating the safe series connection with an end connector (only for variant with 8-pin M12 plug connector)

DANGER

Bypassing the protective device

The dangerous state may not be stopped in the event of non-compliance.

- ▶ If a safe series connection is created with directly connected safety switches, the connecting cable must be mounted so that a safety switch cannot be easily jumpered; e.g., cover plug connector or protect against access with additional means (e.g., protective plate with disposable screws).
- ▶ If a safe series connection is created with T-connectors, the connecting cable must be mounted so that individual T-connectors (and therefore a safety switch) cannot be easily jumpered.

Both connection methods can be combined as desired.

Using other safety switches

NOTE

In a safe series connection, other safety switches within the safe series connection can also be used via special T-connectors as long as the connections are structured as follows:

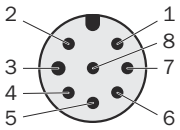


Table 4: Device connection pin assignment (male connector, M12, 8-pin, A-coded)

Pin	Wire color [1]	Designation	Description
1	White	–	– [2]
2	Brown	+24 V DC	Safety switch voltage supply
3	Green	N. c. or +24 V DC	Not connected or Voltage supply for locking device [3]
4	Yellow	In 2	OSSD 2 input
5	Gray	OSSD 1	OSSD 1 output
6	Pink	OSSD 2	OSSD 2 output
7	Blue	0 V	0 V DC voltage supply
8	Red	In 1	OSSD 1 input

1) Applies to the extension cables recommended as accessories.
2) Pin 1 is not assigned on T-connector. Safety switch signals to pin 1 are not relevant for the safe series connection (see figure 21).
3) The locking device must function in accordance with the power to lock principle.

Additional voltage supply

The voltage drop in the safe series connection must be checked so that the defined minimum voltage is still applied to each safety switch. If the defined minimum voltage is no longer applied to a safety switch, a node for voltage supply must be integrated. The node for voltage supply must be integrated in the safe series connection in the direction of the safe evaluation unit, as close as possible to the relevant switch.

Number of safety switches

The maximum number of safety switches depends on the following factors:

- Applied supply voltage
- Length of cables used
- Cable cross-section of cables used
- Load current
- Nodes for voltage supply
- Required performance level (see "Data sheet", page 39)

The number of safety switches in a safe series connection influences the response time of the system (see "Data sheet", page 39).

The maximum number of safety switches in a safe series connection changes depending on the total length of cable as follows:

Table 5: Maximum number of safety switches in a safe series connection depends on the total length

Maximum number of safety switches	Total length of the safe series connection [1]
1	140 m
2	70 m
3	46 m
4	35 m
5	28 m
6	22 m
7	20 m

[1] At a cable cross-section of 0.34 mm^2

If a safe series connection has more safety switches or gets longer, additional voltage must be fed in via a node for voltage supply.

4.5 Thorough check concept

The safety switch must be tested by appropriately qualified safety personnel during commissioning, after modifications, and at regular intervals; see "Requirements for the thorough check during commissioning and in certain situations", page 33.

Regular thorough checks serve to investigate the effectiveness of the safety switch and discover defects resulting from modifications or external influences (such as damage or manipulation).

The manufacturer and operating entity must define the type and frequency of the thorough checks on the machine on the basis of the application conditions and the risk assessment. The process of defining the thorough checks must be documented in a traceable manner.

4.5.1 Minimum requirements for the regular thorough check

The following thorough checks must be carried out at least once a year:

- Thorough check of the protective function of the safety switch
- Thorough check of the switch housing for damage
- Thorough check of the switch cables for damage
- Thorough check of the safety switch for signs of misuse or manipulation
- Thorough check of the locking solenoid for correct function

5 Mounting

5.1 Safety

DANGER
Bypassing the protective device
Hazard due to lack of effectiveness of the protective device

- Prevent incentives to manipulate the safety switch by taking at least one of the following measures:
  - Universally coded variant only: Attach safety switches with a cover or with shielding, or ensure they are out of reach.
  - If possible, use non-detachable mounting methods for actuators (such as welding, gluing, non-removable screws, or rivets).

5.2 Mounting several safety switches

If several safety switches are mounted, they must be mounted at a minimum distance to one another.

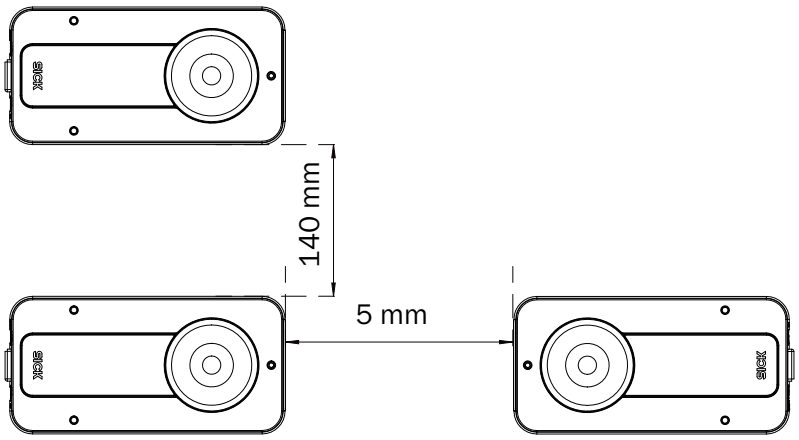


Figure 7: Minimum distance of safety switches

5.3 Mounting the sensor

Overview

The sensor can be mounted in 2 ways:

- **Surface mounting**. The sensor is mounted on the fixed part of the protective device (e.g., door frame).
- **Flush mounting**. The sensor is mounted in the fixed part of the protective device (e.g., door frame). There must be a suitable recess in the mounting surface. The thickness of the mounting surface must be between 1.5 mm and 3 mm.

Important information

CAUTION
Hot housing
Risk of burns

- At ambient temperatures > 40 °C, protect the safety switch from unintentional touching by people.

NOTE
Installing the safety switch horizontally increases protection against manipulation.

Approach

1. Unscrew the fixing screw (hexagon socket, 2 mm) and remove the cover plate:

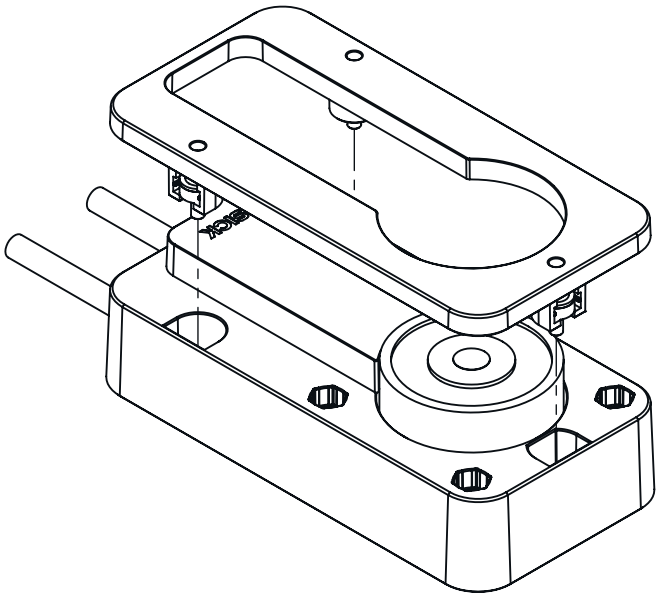


Figure 8: Removing the cover plate

2. Mount the sensor on the fixed part of the protective device with 4 x M4 screws and secure it with 4 nuts.
   - With surface mounting: mount the sensor on the fixed part of the protective device. The screws can be set in the front or the back:

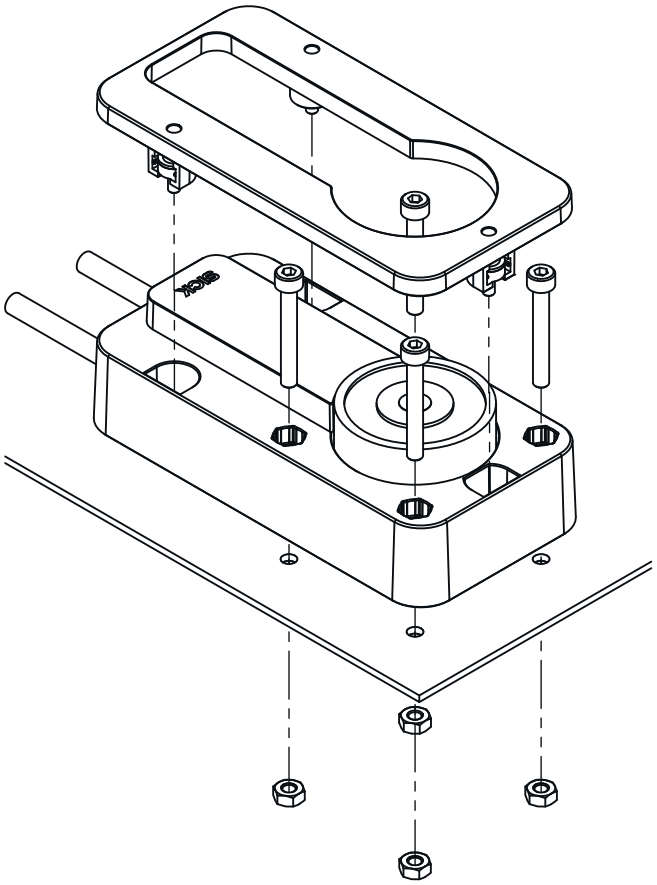


Figure 9: Surface mounting

- With surface mounting: mount the sensor in the fixed part of the protective device:

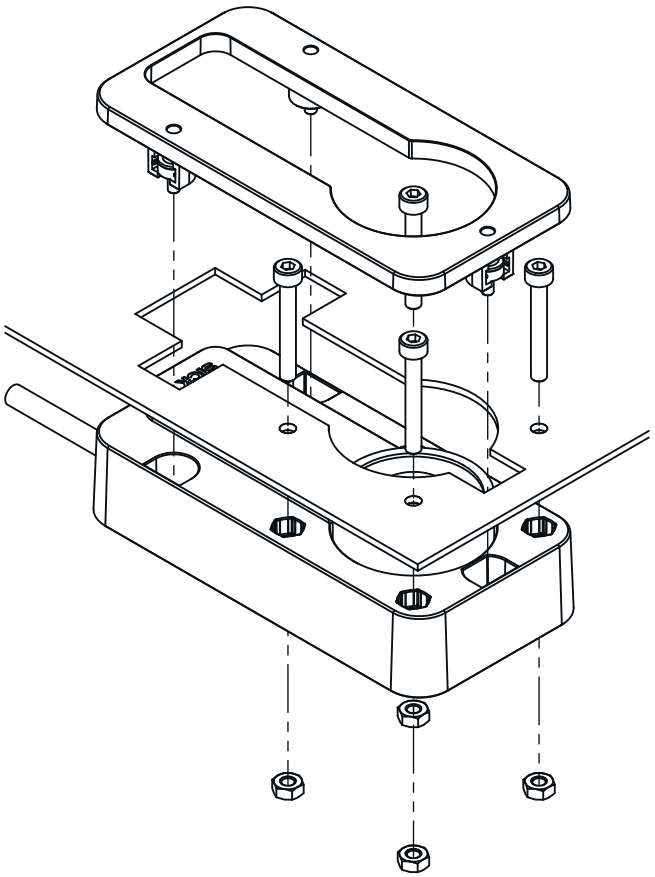


Figure 10: Flush mounting

Tightening torque: 1 Nm.

3. Set cover plate on the sensor.
4. Tighten the fixing screws. Tightening torque: 0.8 Nm.

Further topics

- see "Dimensional drawings", page 42

5.4 Mounting the actuator

Approach

1. Align the actuator to the mounted sensor.
2. Mount the actuator on the moving part of the protective device (e.g., door) with 4 x M4 screws. Tightening torque: 1 Nm Use disposable screws if possible.

- Maximum deviation between sensor and actuator: 5 mm.
- Maximum angle between sensor and actuator when protective device is closed: 3 °

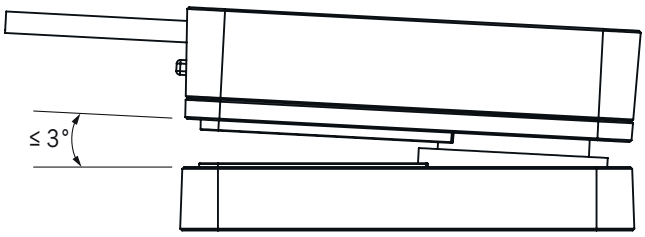


Figure 11: Maximum angle between sensor and actuator

3. Cover drill holes of the actuator with protective caps.

6 Electrical installation

6.1 Safety

Overview

You can directly integrate the safety switch into the machine controller via the safety outputs (OSSDs). The OSSDs indicate the ON state with the HIGH signal level (non-isolated). The OFF state is indicated with the LOW signal level.

Downstream control elements must evaluate the output signals of the protective device in such a way that the dangerous state of the machine is safely ended. Depending on the safety concept, the signal is analyzed by, e.g., safety relays or a safety controller.

Important information

DANGER
Hazard due to electrical voltage
Hazard due to unexpected starting of the machine

- Make sure that the machine is and remains disconnected from the power supply during the electrical installation.
- Make sure that the dangerous state of the machine is and remains switched off during electrical installation.
- Make sure that the outputs of the safety switch have no effect on the machine during electrical installation.

DANGER
Hazard due to lack of effectiveness of the protective device
The dangerous state may not be stopped in the event of non-compliance.

- Always connect the two OSSDs separately. The two OSSDs must not be connected to each other.
- Connect the OSSDs such that the machine controller processes both signals separately.

Isolated connection of OSSD1 and OSSD2

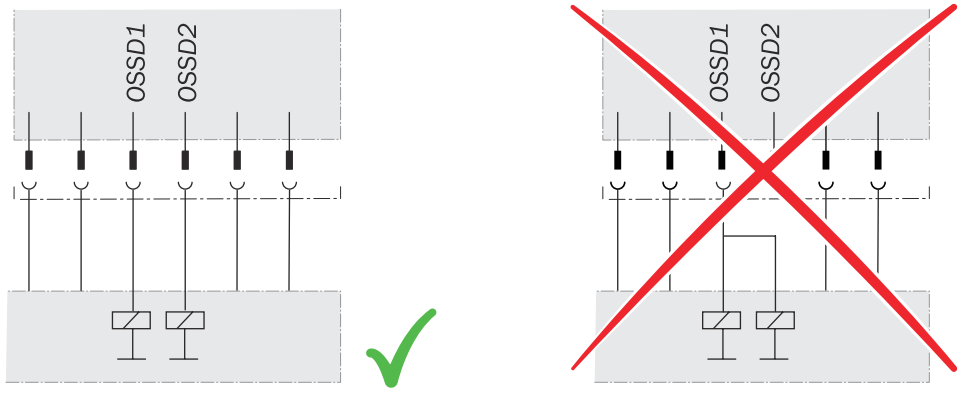


Figure 12: Dual-channel and isolated connection of OSSD1 and OSSD2

Avoiding any potential difference between load and protective device

If you connect loads to the output signal switching devices (switching outputs) that then also switch if controlled with negative voltage (e.g., electro-mechanical contactor without reverse polarity protection diode), you must connect the 0 V connections of these loads and those of the corresponding protective device separately and also directly to the same 0 V terminal strip. In the event of a fault, this is the only way to ensure that there can be no potential difference between the 0 V connections of the loads and those of the corresponding protective device.

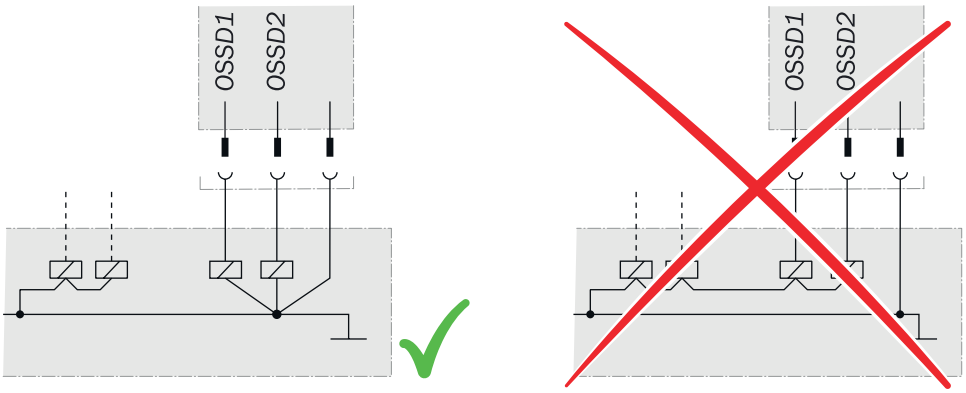


Figure 13: No potential difference between load and protective device

6.2 Notes on cULus

For use according to the requirements of UL 508, the following conditions must also be met:

- Voltage supply U_V sensor secured with 2 A fuse
- Voltage supply U_V magnet secured with 2 A fuse

6.3 Device connection (M12, 5-pin)

Device connection (male connector, M12, 5-pin, A-coded)

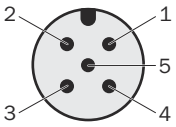


Table 6: Device connection pin assignment (male connector, M12, 5-pin, A-coded)

Pin	Wire color [1)]	Designation	Description
1	Brown	+24 V DC	Safety switch voltage supply
2	White	OSSD 1	OSSD 1 output
3	Blue	0 V	Voltage supply 0 V DC
4	Black	OSSD 2	Output OSSD 2
5	Gray	Magnet	Magnet activation 24 V DC

1) Applies to the extension cables recommended as accessories.

6.4 Device connection (2 x M12, 5-pin)

IN device connection (male connector, M12, 5-pin, A-coded)

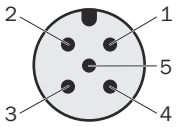


Table 7: IN device connection pin assignment (male connector, M12, 5-pin, A-coded)

Pin	Wire color [1]	Designation	Description
1	Brown	In +24 V DC	Safety switch voltage supply
2	White	OSSD 1	OSSD 1 output
3	Blue	0 V	Voltage supply 0 V DC
4	Black	OSSD 2	Output OSSD 2
5	Gray	Magnet	Input for magnet activation 24 V DC

[1] Applies to the extension cables recommended as accessories.

OUT device connection (female connector, M12, 5-pin, A-coded)

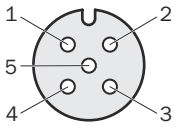


Table 8: OUT device connection pin assignment (female connector, M12, 5-pin, A-coded)

Pin	Wire color [1]	Designation	Description
1	Brown	Out +24 V DC	Safety switch voltage supply
2	White	In 1	OSSD 1 input
3	Blue	0 V	Voltage supply 0 V DC
4	Black	In 2	OSSD 2 input
5	Gray	Magnet	Output for magnet activation 24 V DC

[1] Applies to the extension cables recommended as accessories.

6.5 Device connection (M12, 8-pin)

Device connection (male connector, M12, 8-pin, A-coded)

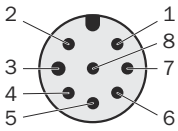


Table 9: Device connection pin assignment (male connector, M12, 8-pin, A-coded)

Pin	Wire color [1]	Designation	Description
1	White	Aux	Application diagnostic output (not safe)
2	Brown	24 V DC	Safety switch voltage supply
3	Green	Magnet	Magnet activation 24 V DC
4	Yellow	In 2	OSSD 2 input [2]

Pin	Wire color [1]	Designation	Description
5	Gray	OSSD 1	OSSD 1 output
6	Pink	OSSD 2	Output OSSD 2
7	Blue	0 V	Voltage supply 0 V DC
8	Red	In 1	OSSD 1 input [2]

1) Applies to the extension cables recommended as accessories.
2) When used as an individual safety switch or as the first safety switch in a safe series connection: Apply 24 V DC.

6.6 Connection of a safe series connection

A safe series connection can be created in different ways. Depending on the construction, end connectors, T-connectors, and nodes are required for voltage supply (see "Accessories", page 46).

Connecting directly connected safety switches

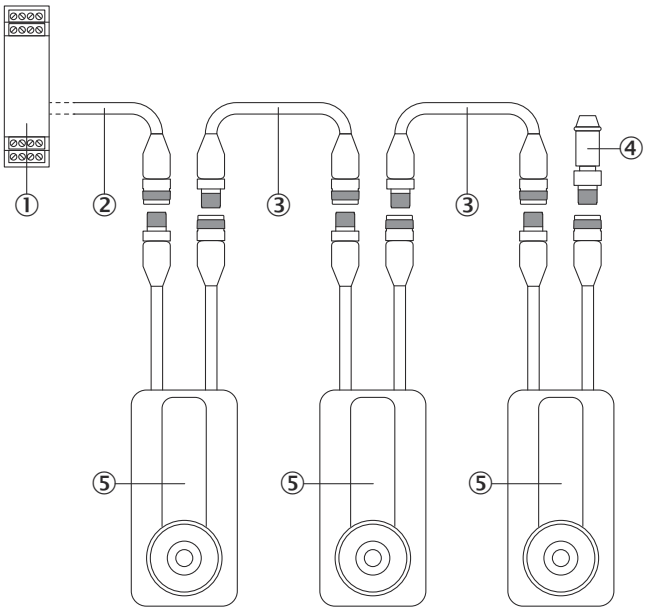


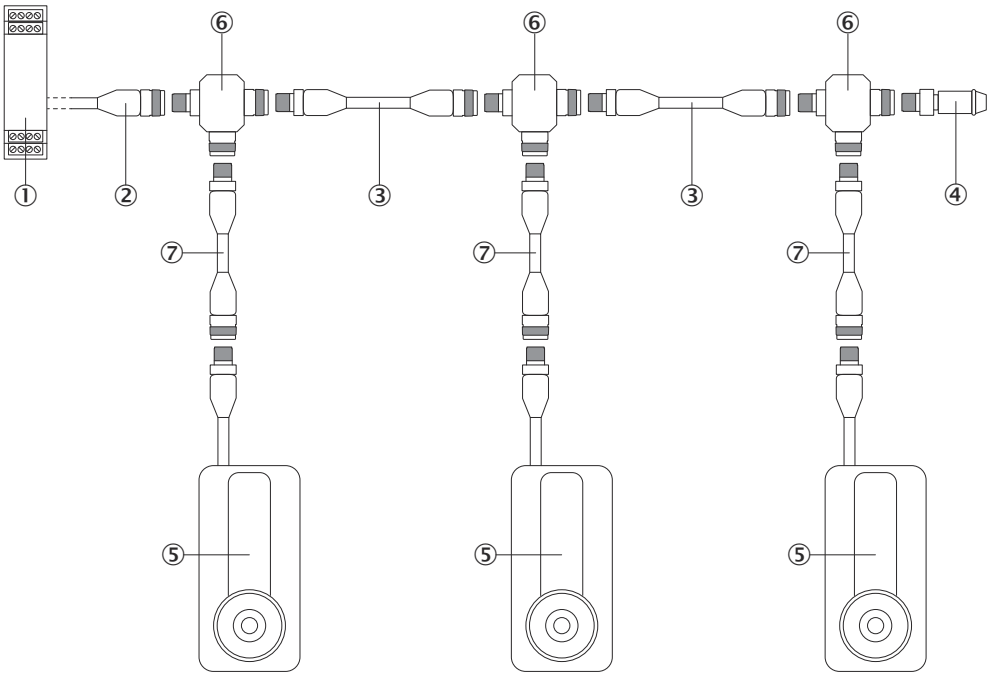
Figure 14: Safe series connection of several safety switches

① Safe evaluation unit
② Connecting cable, M12, 5-pin
③ Connection cable, M12, 5-pin
④ End connector
⑤ MLP1 safety switch (2 × M12, 5-pin)

DANGER
Bypassing the protective device
The dangerous state may not be stopped in the event of non-compliance.

- If the safe series connection is created with directly connected safety switches, the connecting cable must be mounted so that a safety switch cannot be easily jumpered; e.g., cover plug connectors or protect against access with additional means (e.g., protective plate with disposable screws)

Connecting safety switches connected with T-connectors



① Safe evaluation unit
② Connecting cable, M12, 5-pin
③ Connection cable, M12, 5-pin
④ End connector
⑤ MLP1 safety switch (M12, 8-pin)
⑥ T-connector
⑦ Connection cable, M12, 8-pin

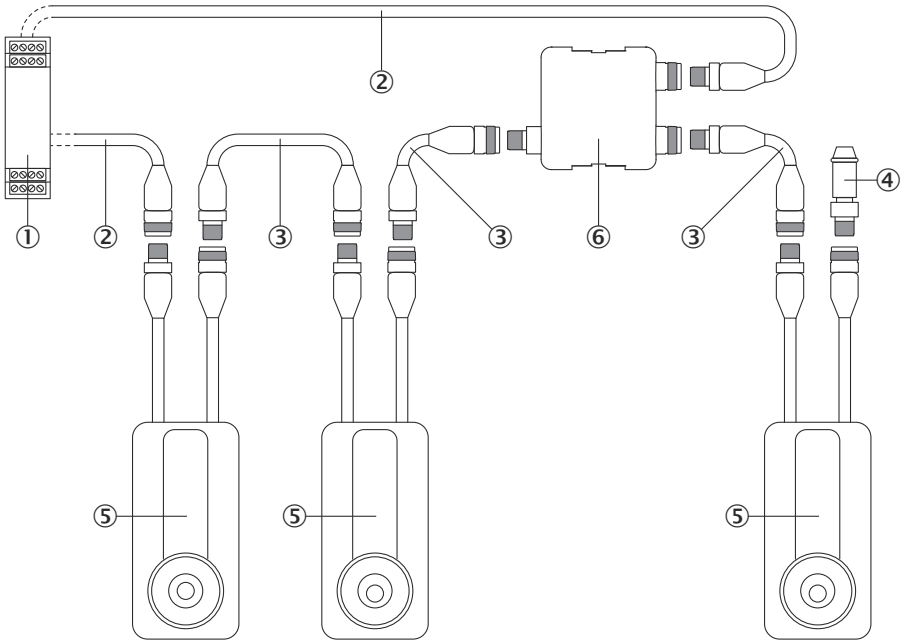
DANGER

Bypassing the protective device

The dangerous state may not be stopped in the event of non-compliance.

If a safe series connection is created with T-connectors, the connecting cable must be mounted so that individual T-connectors (and therefore a safety switch) cannot be easily jumpered.

Connecting an additional voltage supply



① Safe evaluation unit
② Connecting cable, M12, 5-pin
③ Connection cable, M12, 5-pin
④ End connector
⑤ MLP1 safety switch (2 × M12, 5-pin)
⑥ Nodes for voltage supply

Connecting other safety switches

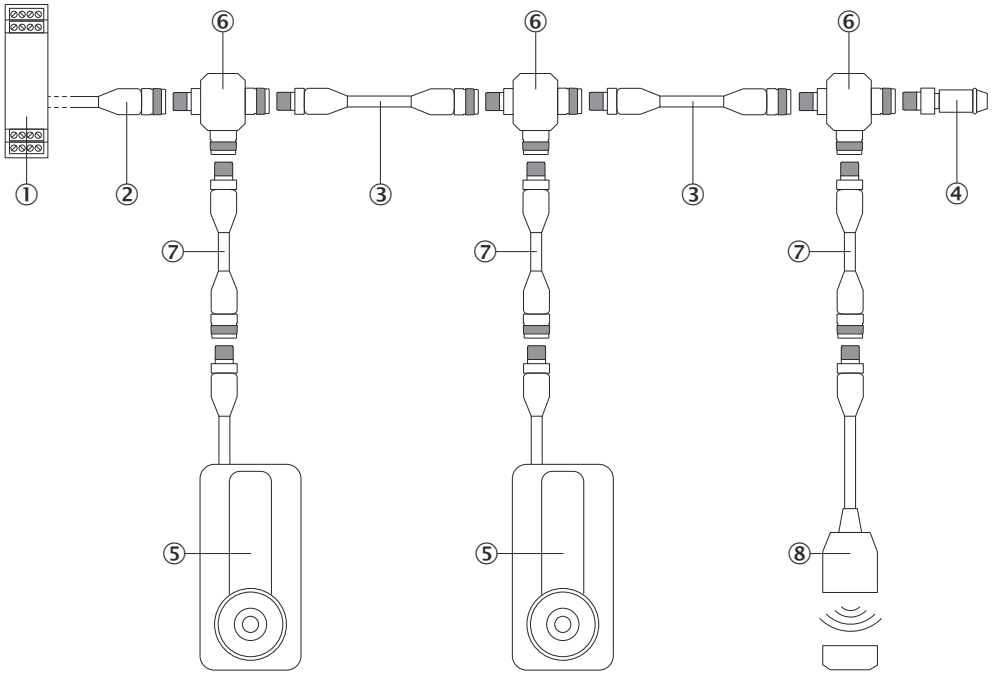


Figure 15: Safe series connection of several safety switches

① Safe evaluation unit
② Connecting cable, M12, 5-pin
③ Connection cable, M12, 5-pin

④ End connector
⑤ MLP1 safety switch (M12, 8-pin)
⑥ T-connector
⑦ Connection cable, M12, 8-pin
⑧ Other safety switch, M12, 8-pin

NOTE

In a safe series connection, other safety switches within the safe series connection can also be used via special T-connectors as long as the connections are structured as follows:

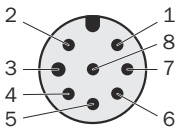


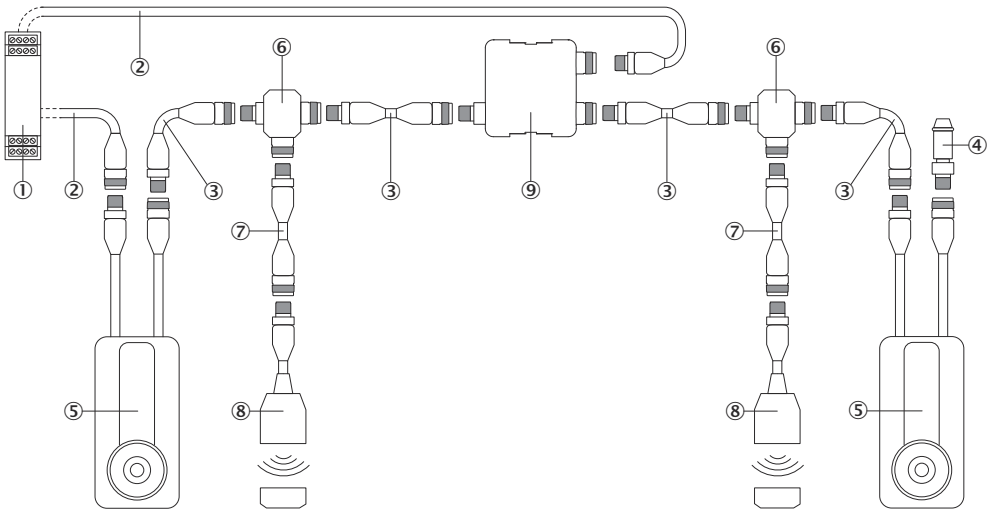
Table 10: Device connection pin assignment (male connector, M12, 8-pin, A-coded)

Pin	Wire color [1]	Designation	Description
1	White	–	– [2]
2	Brown	+24 V DC	Safety switch voltage supply
3	Green	N. c. or +24 V DC	Not connected or Voltage supply for locking device [3]
4	Yellow	In 2	OSSD 2 input
5	Gray	OSSD 1	OSSD 1 output
6	Pink	OSSD 2	OSSD 2 output
7	Blue	0 V	0 V DC voltage supply
8	Red	In 1	OSSD 1 input

1) Applies to the extension cables recommended as accessories.
2) Pin 1 is not assigned on T-connector. Safety switch signals to pin 1 are not relevant for the safe series connection (see figure 21).
3) The locking device must function in accordance with the power to lock principle.

Combining connection methods as desired

The various connection methods can be combined within a safe series connection as desired.



① Safe evaluation unit
② Connecting cable, M12, 5-pin
③ Connection cable, M12, 5-pin
④ End connector
⑤ MLP1 safety switch
⑥ T-connector
⑦ Connection cable, M12, 8-pin
⑧ Other safety switch, M12, 8-pin
⑨ Nodes for voltage supply

Connection to safe evaluation unit (M12, 5-pin)

The 5-pin male connector of the last safety switch or T-connector upstream of the safe evaluation unit is the interface between the safe series connection and the safe evaluation unit.

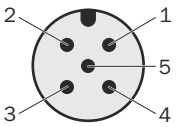


Figure 16: Connection of the safe evaluation unit (M12, 5-pin, A-coded, male connector)

Table 11: Device connection pin assignment (male connector, M12, 5-pin, A-coded)

Pin	Wire color [1)]	Designation	Description
1	Brown	In +24 V DC	Safety switch voltage supply
2	White	OSSD 1	OSSD 1 output
3	Blue	0 V	0 V DC voltage supply
4	Black	OSSD 2	OSSD 2 output
5	Gray	In +24 V DC	Locking solenoid voltage supply

1) Applies to the extension cables recommended as accessories.

7 Commissioning

7.1 Safety

DANGER
Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

1. Before commissioning the machine, have it checked and released by qualified safety personnel.
2. Make sure that the time for the safety requirement (closing the protective device again) is longer than the response time.

7.2 Switching on

The device initializes after it is switched on. OSSDs are switched off in the meantime. The OSSD light emitting diode lights up after initialization.

7.3 No actuator teach-in necessary

Overview

Actuators do not have to be taught in on the sensor.

Variants with universal coding

The sensor accepts all MLP1 actuators.

Variants with unique coding

Actuators are already taught in when delivered. You can identify sensors and actuators that belong together using the label on the side.

Replacement actuators are available in the event of damage.

Further topics

- "Teaching in replacement actuators", page 37

7.4 Requirements for the thorough check during commissioning and in certain situations

The protective device and its application must be thoroughly checked in the following situations:

- Before commissioning
- After changes to the safety function
- After changes to the mounting, the alignment, or the electrical connection
- After exceptional events, such as after a manipulation has been detected, after modification of the machine, or after replacing components

The thorough check ensures the following:

- All relevant regulations are complied with and the protective device is active for all of the machine's operating modes.
- The documentation corresponds to the state of the machine, including the protective device

The thorough checks must be carried out by qualified safety personnel or specially qualified and authorized personnel and must be documented in a traceable manner.

- Check whether the protective device of the machine is effective in all operating modes in which the machine can be set.
- Make sure that operating personnel have been instructed in the function of the protective device before starting work on the machine. The machine operator has overall responsibility for the instruction, which must be carried out by qualified personnel.

8 Operation

8.1 Security

The safety switch detects an actuator mounted on the door without making contact. On principle, the safety switch detects the actuator even with a few centimeters of space. It may therefore be possible for the safety switch to detect the actuator even though the door is not yet fully closed. There is therefore the risk that the machine could start up even though the door is not yet fully closed and not locked.

- ▶ Always close the door completely.

9 Troubleshooting

9.1 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.

DANGER
Hazard due to unexpected starting of the machine

- When any work is taking place, use the protective device to secure the machine or to ensure that the machine is not switched on unintentionally.

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 do repair work on device components.
- Do not make changes to or manipulate device components.
- Apart from the procedures described in this document, the device components must not be opened.

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

9.2 Determining the cause of error

Approach

- Check voltage supply.
- Check cables.
- Check alignment of safety switch and actuator.
- Check ambient conditions (e.g., interfering RFID frequencies or magnetic fields, distances to other safety switches).

Complementary information

If a safety switch has a fault in a safe series connection with an end connector, the OSSDs of all safety switches between the safe evaluation unit and the safety switch concerned switch into the OFF state.

10 Maintenance

10.1 Cleaning

NOTICE

- Do not use aggressive cleaning agents (such as isopropanol or spirit).
- Do not use any substances that hinder the wetting properties of lacquers.
- We recommend anti-static cleaning agents.

10.2 Teaching in replacement actuators

Overview

For variants with unique coding, the actuator is already taught in when delivered. In the event of damage, a replacement actuator can be taught in.

It is possible to teach in up to 7 actuators in succession. Only the most recently taught-in actuator is valid. Actuators that have already been taught in cannot be taught in again.

Important information

DANGER
Bypassing the protective device
The dangerous state may not be stopped in the event of non-compliance.

- Document teaching-in of an actuator.
- During regular thorough checks, make sure that the taught-in actuator is still being used.

Teaching in an actuator

1. Open physical guard.
2. Connect safety switch to voltage supply (see "Electrical installation", page 25).
✓ When the start sequence is complete, the OSSD LED lights up red.
3. Close physical guard.
✓ When the protective device is closed and the actuator has reached the required position, the safety switch automatically starts the teach-in sequence.
4. Wait approx. 20 seconds.
5. Within the next 5 minutes, disconnect and restore the voltage supply to the safety switch.
✓ When the taught-in actuator is in the response range, both OSSDs switch to the ON state and the OSSD LED lights up green.

10.3 Regular thorough check

The safety switch must be checked regularly. The type and frequency of thorough checks is defined by the manufacturer and the operating entity of the machine, see "Thorough check concept", page 18

The regular thorough checks serve to investigate the effectiveness of the safety switch and detect any ineffectiveness due to modifications or external influences (e.g., damage or manipulation).

1. Carry out the thorough checks according to the instructions from the manufacturer and the machine user.

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

Table 12: Features

Features	
Safe switch on distance S_{ao}	4 mm
Typical switch on distance S_o	15 mm
Safe switch off distance S_{ar}	
MLP1-SMM**** MLP1-SMU****	45 mm 35 mm
Max. actuation frequency	0.5 Hz
Locking force	500 N
Magnetic retaining force when not supplied with power	25 N
Alignment tolerance for locking device	
Vertical	5 mm
Horizontal	5 mm
Aperture angle	3°

Table 13: Safety-related parameters

Safety-related parameters	
Performance level	PL e (ISO 13849-1) [1]
Category	4 (ISO 13849)
Safety integrity level	SIL 3 (EN 61508)
PFH_D (mittlere Wahrscheinlichkeit eines Gefahr bringenden Ausfalls pro Stunde)	1.5×10^{-8} at 40 °C and 1,000 m above seal level
T_M (mission time)	20 years (ISO 13849-1)
Type	Type 4 (ISO 14119)
Coding level	Universally coded: Low coding level (ISO 14119) Uniquely coded: High coding level (ISO 14119)
Safe state when a fault occurs	At least one safety-related semiconductor output (OSSD) is in the OFF state.

[1] In a safe series connection, the performance level for the switching as a whole depends on the number and type of devices. PL e is only possible in safe series connections with a maximum of 6 devices.

Table 14: Interfaces of variant with 1 × M12 plug connector, 5-pin

Interfaces of variant with 1 × M12 plug connector, 5-pin	
System connection	
Voltage supply Local inputs and outputs	Male connector, M12, 5-pin, A-coded (common plug connector for voltage supply and outputs)
Length of connecting cable	150 mm

Table 15: Interfaces of variant with 2 × M12 plug connector, 5-pin

Interfaces of variant with 2 × M12 plug connector, 5-pin
System connection

Interfaces of variant with 2 × M12 plug connector, 5-pin	
Voltage supply Local inputs and outputs	Male connector, M12, 5-pin, A-coded (common plug connector for voltage supply and outputs) Female connector, M12, 5-pin, A-coded (common plug connector for voltage supply and inputs)
Length of connecting cable	150 mm

Table 16: Interfaces of variant with 1 × M12 plug connector, 8-pin

Interfaces of variant with 1 × M12 plug connector, 8-pin	
System connection	
Voltage supply Local inputs and outputs	Male connector, M12, 8-pin, A-coded (common plug connector for voltage supply as well as inputs and outputs)
Length of connecting cable	150 mm

Table 17: Electrical data

Electrical data	
OSSD pairs	1
Rated impulse withstand voltage U_{imp}	1,500 V
Pollution degree	3 (external, according to EN 60947-1)
Power-up delay (after supply voltage applied) [1]	2.5 s
Supply voltage when an individual safety switch is connected	
Supply voltage V_v sensor	24 V DC (19.2 V ... 28.8 V)
Supply voltage V_v magnet	24 V DC (19.2 V ... 28.8 V)
Supply voltage when a safe series connection switch is connected	
Supply voltage V_v sensor	24 V DC (22.8 V ... 28.8 V)
Supply voltage V_v magnet	24 V DC (21.6 V ... 28.8 V)
Muting time when supply voltage is interrupted	4 ms
Rated insulation voltage Ui	32 V DC
Cable capacitance	400 nF (for Out A and Out B)
Device fuse	0.6 ... 1 A
Current consumption at 24 V	
Sensor	≤ 50 mA
Magnet	≤ 300 mA
Protection class	III (EN 61140/IEC 61140)
Response time [2]	≤ 50 ms [3]
Release time [4]	≤ 100 ms [3]
Risk time [5]	≤ 100 ms [3]

1) Once the supply voltage has been switched on, the OSSDs are in the OFF state during the time delay before availability. The time specified applies to one sensor; in a safe series connection, 0.1 s must be added per sensor.
2) Response time for moving the OSSDs into the OFF state when the actuator is removed from the response area or when the OSSD input signals go into the OFF state.
3) In a safe series connection, the value is multiplied by the number of safety switches in the safe series connection.
4) Response time for moving the OSSDs into the ON state when the actuator is detected by the sensor and the OSSD input signals are in the ON state.
5) The risk time is the time needed to detect internal and external faults. External errors affect the OSSDs (short-circuit to an OSSD and cross-circuit between the two OSSDs). At least one of the two OSSDs is safely switched off during the risk time.

Table 18: Mechanical data

Dimensions (W x H x D)	
Safety switch	120 mm x 60 mm x 38.5 mm
Actuator	120 mm x 60 mm x 20.5 mm
Material	
Sensor housing	Anodized aluminum
Actuator housing	Fiber-glass-reinforced PVC
Anchor plate	Nickle-plated steel
Weight	
Safety switch	510 g
Actuator	210 g

Table 19: Inputs

Inputs	
Rated voltage	24 V DC
Switching current	
ON state	≤ 5 mA
OFF state	0 mA
Switching voltage	
ON state	19.2 V DC ... 28.8 V DC
OFF state	0 V DC ... 2 V DC

Table 20: Outputs

Outputs	
2 OSSDs (Out 1 and Out 2)	2 x PNP, max. 100 mA, short-circuit protected and overload-proof
1 Application diagnostic output (Aux)	25 mA max,[1)] short-circuit protected (resistive load)
Switching voltage (all outputs)	
ON state	19.2 V DC ... 28.8 V DC
OFF state	0 V DC ... 2 V DC
Switching current (OSSDs)	
ON state	≤ 100 mA
OFF state	≤ 500 µA
Test pulse duration (OSSDs)	300 µs

1) A higher load affects the behavior of the status indicators, see "Status indicators", page 11.

Table 21: Ambient data

Ambient data	
Enclosure rating	IP 67 (IEC 60529)
Ambient operating temperature	–20 °C ... +55 °C
Storage temperature	-25 °C ... +70 °C
Relative humidity	50% at 70 °C (IEC 60947-5-2)
Vibration resistance	1 mm / 10 Hz ... 55 Hz (IEC 60068-2-6)
Shock resistance	30 g, 11 ms (IEC 60068-2-27)

Ambient data	
EMC	In accordance with IEC 61326-3-1, IEC 60947-5-2, IEC 60947-5-3, and EN 300330 V2.1.1
Minimum distance between 2 safety switches	Depending on alignment, see "Mounting several safety switches", page 20

12.2 Dimensional drawings

Sensor

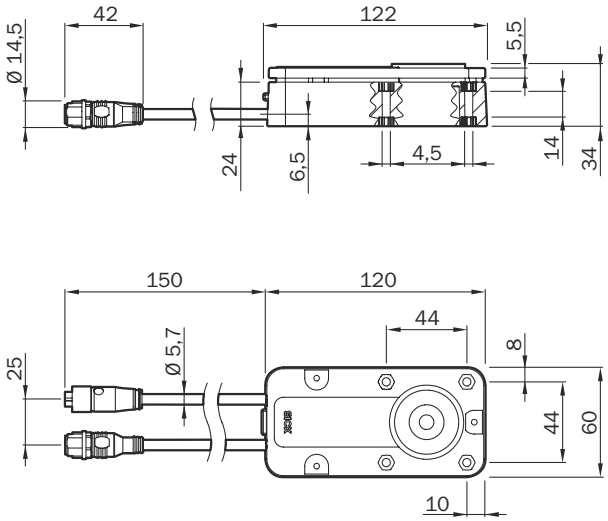


Figure 17: Dimensional drawing of MLP1 sensor with 2 × M12 male connector

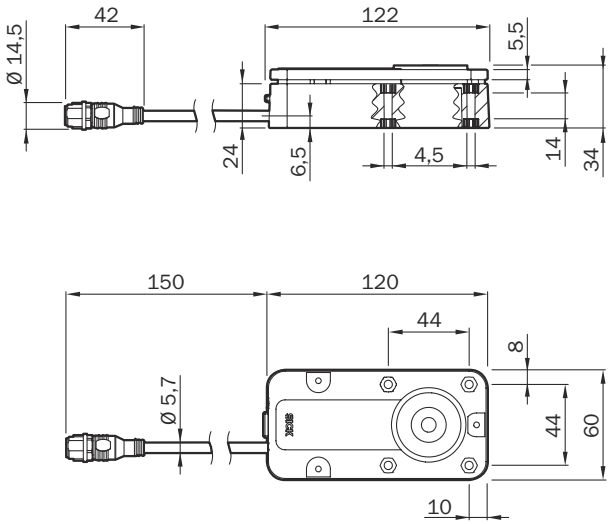


Figure 18: Dimensional drawing of MLP1 sensor with 1 × M12 male connector

Actuator

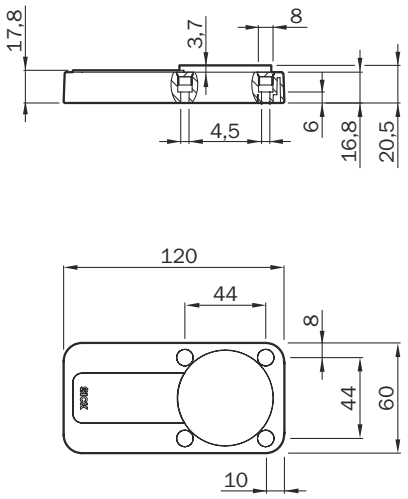


Figure 19: Dimensional drawing of MLP1 actuator

Dimensional drawing for flush mounting

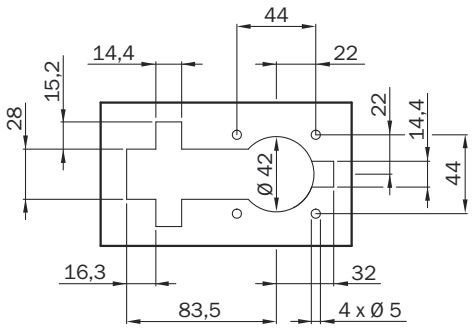


Figure 20: Dimensional drawing for flush mounting

13 Ordering information

13.1 Scope of delivery

- Safety switch
- Actuator
- 4 protective caps
- Safety note
- Mounting instructions
- Downloadable operating instructions: www.sick.com

13.2 MLP1 ordering information

Table 22: MLP1 ordering information

Coding	Sensor connection type	Type code	Part number
Universally coded	Cable with male connector, M12, 5-pin Cable with female connector, M12, 5-pin	MLP1-SMMC0AC	1077942
Universally coded	Cable with male connector, M12, 5-pin	MLP1-SMMA0AC	1077943
Universally coded	Cable with male connector, M12, 8-pin	MLP1-SMMF0AC	1080321
Uniquely coded	Cable with male connector, M12, 5-pin Cable with female connector, M12, 5-pin	MLP1-SMUC0AC	1117390
Uniquely coded	Cable with male connector, M12, 5-pin	MLP1-SMUA0AC	1117627
Uniquely coded	Cable with male connector, M12, 8-pin	MLP1-SMUF0AC	1117626

14 Spare parts

14.1 Actuator

Table 23: Actuator ordering information

Part	Type code	Part number
MLP1 actuator	MLP1-XA	2092167

15 Accessories

15.1 Connectivity

Connecting cable, M12, 5-pin (0.34 mm²)

Table 24: Ordering information for M12 connecting cable, 5-pin (0.34 mm²) [1)]

Part	Type code	Part number
Female connector, straight, 2 m cable, open end	YF2A15-020VB5XLEAX	2096239
Female connector, straight, 5 m cable, open end	YF2A15-050VB5XLEAX	2096240
Female connector, straight, 10 m cable, open end	YF2A15-100VB5XLEAX	2096241
Female connector, straight, 15 m cable, open end	YF2A15-150VB5XLEAX	2096242

Connecting cable, M12, 8-pin (0.25 mm²)

Table 25: Ordering information for M12 connecting cable, 8-pin (0.25 mm²) [1)]

Part	Type code	Part number
Female connector, straight, 2 m cable, open end	YF2A18-020UA5XLEAX	2095652
Female connector, straight, 5 m cable, open end	YF2A18-050UA5XLEAX	2095653
Female connector, straight, 10 m cable, open end	YF2A18-100UA5XLEAX	2095654
Female connector, straight, 15 m cable, open end	YF2A18-150UA5XLEAX	2095679
Female connector, straight, 20 m cable, open end	YF2A18-200UA5XLEAX	2095680
Female connector, straight, 30 m cable, open end	YF2A18-300UA5XLEAX	2095681

Connection cable, M12, 5-pin (0,34 mm²)

Table 26: Ordering information for M12 connection cable, 5-pin (0.34 mm²) [1)]

Part	Type code	Part number
Female connector, straight, 0.6 m cable, male connector, straight	YF2A15-C60UB5M2A15	2096006
Female connector, straight, 1 m cable, male connector, straight	YF2A15-010UB5M2A15	2096007
Female connector, straight, 1.5 m cable, male connector, straight	YF2A15-015UB5M2A15	2096008
Female connector, straight, 2 m cable, male connector, straight	YF2A15-020UB5M2A15	2096009
Female connector, straight, 5 m cable, male connector, straight	YF2A15-050UB5M2A15	2096010
Female connector, straight, 10 m cable, male connector, straight	YF2A15-100UB5M2A15	2096011
Female connector, straight, 15 m cable, male connector, straight	YF2A15-100UB5M2A15	2096171
Female connector, straight, 20 m cable, male connector, straight	YF2A15-200UB5M2A15	2095844

1) Ambient operating temperature: Down to –30° C with fixed installation.

Part	Type code	Part number
Female connector, straight, 30 m cable, male connector, straight	YF2A15-300UB5M2A15	2095845

Connection cable, M12, 8-pin (0.25 mm²)

Table 27: Ordering information for M12 connection cable, 8-pin (0.25 mm²) [2)]

Part	Type code	Part number
Female connector, straight, 0.6 m cable, male connector, straight	YF2A18-C60UA5M2A18	2096031
Female connector, straight, 1 m cable, male connector, straight	YF2A18-010UA5M2A18	2096032
Female connector, straight, 1.5 m cable, male connector, straight	YF2A18-015UA5M2A18	2096012
Female connector, straight, 2 m cable, male connector, straight	YF2A18-020UA5M2A18	2096033
Female connector, straight, 5 m cable, male connector, straight	YF2A18-050UA5M2A18	2096034
Female connector, straight, 10 m cable, male connector, straight	YF2A18-100UA5M2A18	2096035

Distributor

Table 28: Distributor ordering information

Part	Type code	Part number
T-connector	STR1-XXA	5339609

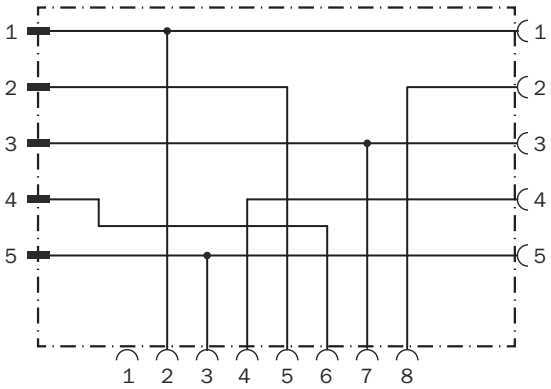


Figure 21: Internal circuitry: T-connector for series connection

End connector

Table 29: End connector ordering information

Part	Type code	Part number
End connector for series connection	MLP1-XXT	1078201

2) Ambient operating temperature: Down to −30° C with fixed installation.

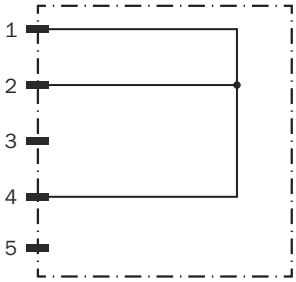


Figure 22: Internal circuitry: end connector for series connection

Nodes for voltage supply

Table 30: Nodes for voltage supply ordering information

Part	Type code	Part number
Nodes for voltage supply	MLP1-XXN	1078202

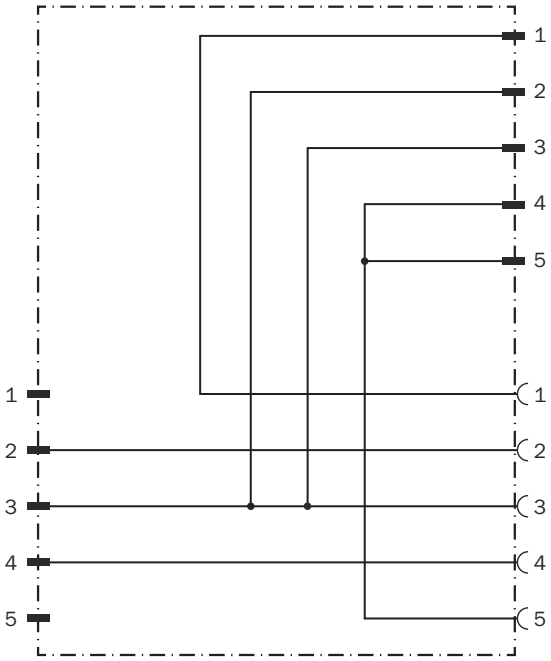


Figure 23: Internal circuitry: nodes for voltage supply ordering information

16 Annex

16.1 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).

16.1.1 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
- MACHINERY DIRECTIVE 2006/42/EC
- RE DIRECTIVE 2014/53/EU

16.1.2 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
- Supply of Machinery (Safety) Regulations 2008
- Radio Equipment Regulations 2017

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