Flexi Loop

Safe sensor cascade hardware

SC-FLN-OSSD5, SC-FLN-OSSD8, SC-FLN-EMSS5, SC-FLN-EMSS8

SICK
Sensor Intelligence.

Described product

Flexi Loop safe sensor cascade

SC-FLN-OSSD5, SC-FLN-OSSD8, SC-FLN-EMSS5, SC-FLN-EMSS8

Manufacturer

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Legal information

Original document

This document is an original document of SICK AG.

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Contents

1 Ordering information

1.1 Scope of delivery

The following is included with delivery of the Flexi Loop node and the Flexi Loop accessories:

- Flexi Loop node or Flexi Loop accessory depending on order
- general safety notes

1.2 Flexi Loop node

Table 1: Part numbers Flexi Loop nodes

Part	Description	Part number
SC-FLN-OSSD5	Flexi Loop node for a safety sensor with monitored semiconductor output (OSSD) with one non-safe input	1096455
SC-FLN-OSSD8	Flexi Loop node for a safety sensor with monitored semiconductor output (OSSD) with one non-safe input with one non-safe output	1096456
SC-FLN-EMSS5	Flexi Loop node for a dual-channel, equivalent switching, electro-mechanical safety switch	1096457
SC-FLN-EMSS8	Flexi Loop node for a dual-channel, equivalent switching, electro-mechanical safety switch with one non-safe input with one non-safe output	1096458

1.3 Flexi Loop accessories

Table 2: Part numbers Flexi Loop accessories

Part	Description	Part number
SC-FLA-PWRI	Flexi Loop accessories for supply of power for electrical isolation for overcurrent shutdown	1096459
SC-FLT-TERM	Flexi Loop termination element	1096460

2 About this document

2.1 Function of this document

These operating instructions contain the information that is required during the life cycle of the safe sensor cascade.

These operating instructions are to be made accessible to all persons who work with the safe sensor cascade.

Read these operating instructions carefully and make sure you have completely understood the contents before you work with the safe sensor cascade.

2.2 Scope

These operating instructions only apply to the Flexi Loop safe series connection with one of the following part numbers:

- 1096455
- 1096456
- 1096457
- 1096458

These operating instructions are included with SICK part number 8023204 (all available languages of this document).

In addition, the following documents contain information on the safe sensor cascade:

Table 3: Available documents

Document	Title	Part number
Operating instructions	Flexi Loop in the Flexi Soft Designer Software	8023208
Operating instructions	Flexi Soft Modular safety controller Hardware	8022462
Operating instructions	Flexi Soft in the Flexi Soft Designer Configuration Software	8022491
Competence brochure	Guide for Safe Machinery	8008007

2.3 Target groups and structure of these operating instructions

These operating instructions are aimed at the following target groups: project engineers (planners, developers, designers), fitters, electricians, operators and maintenance personnel.

The structure of these operating instructions is orientated on the phases of life of the safe sensor cascade: design, mounting, electrical installation, commissioning, operation and maintenance.

In many applications the target groups are assigned as follows to the manufacturer and organization operating the machine in which the safe sensor cascade is integrated:

Table 4: Assignment of target groups

Area of responsibility	Target group	Specific chapter in these operating instructions [1]
Manufacturer	Project engineers (planners, developers, designers)	"Total current and power failure", page 23 "Technical data", page 47 "Accessories", page 54
	Fitters	"Mounting", page 32 "Commissioning", page 41 "Checklist for the manufacturer", page 56
	Electricians	"Electrical installation", page 34
Operators	Operator	"Troubleshooting", page 42
	Maintenance personnel	"Troubleshooting", page 42 "Ordering information", page 6

[1] Chapters listed here are aimed at all target groups. All target groups must follow the safety notes and warnings in the entire operating instructions!

In other applications the operating organization is at the same time the manufacturer of the machine — with the corresponding assignment of the target groups.

2.4 Additional information

www.sick.com

The following information is available on the Internet:

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

2.5 Symbols and document conventions

The following symbols are used in these operating instructions:

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.

(i) **NOTE**
Indicates useful tips and recommendations.

Instructions to action

▶   The arrow denotes instructions to action. Read carefully and follow the instructions for action.

LED symbols

These symbols indicate the status of an LED:

○   The LED is off.
●   The LED is illuminated continuously.
☼   The LED is flashing.
☼☼   Two LEDs are flashing alternately.
☼☼   Two LEDs are flashing in synchronism.

3 Safety information

3.1 General safety notes

This chapter contains general safety information about the safe sensor cascade.

More safety information about specific usage situations of the safe sensor cascade is available in the respective 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.

▶ Read this document carefully and ensure that you have fully understood the contents before you work with the device.
▶ Pay particular attention to all safety notes in this document.

3.2 Correct use

The Flexi Loop safe sensor cascade is an expansion for the Flexi Soft and Flexi Classic safety controllers. It can be used …

- To IEC 61508 up to SIL3
- To EN 62061 up to SIL claim limit 3
- To EN ISO 13849-1 up to category 4 and performance level e

The degree of safety actually attained depends on the external circuit, the design of the wiring, the parameter configuration, the selection of the safety sensors and their placement on the machine.

The safe sensor cascade 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 tampering with the safe sensor cascade will invalidate any warranty offered by SICK AG; in addition, any responsibility and liability on the part of SICK AG for damage and secondary damage caused by such use, modification, or tampering shall be excluded.

Foreseeable misuse

The Flexi Loop safe sensor cascade is **not** suitable for the following usage, among others:

- outdoors
- under water
- in explosive environments

3.3 Requirements for the qualification of personnel

Only qualified safety personnel are permitted to configure, install, connect, commission, and maintain the safe sensor cascade.

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

For mechanical mounting, 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 that he/she can assess its operational safety status.

Electrical installation

For electrical installation, 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 that he/she can assess its operational safety status.

Configuration

For configuration, 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 that he/she can assess its work safety aspects.

Commissioning

For commissioning, 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 that he/she can assess its operational safety status.

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.

4 Product description

4.1 Structure and function

The Flexi Loop safe sensor cascade is an expansion for the Flexi Soft or Flexi Classic system. A safe sensor cascade comprises individual Flexi Loop nodes that are connected to the safety controller. The Flexi Loop nodes make it possible to collect information from physically distributed safety sensors and safety switches.
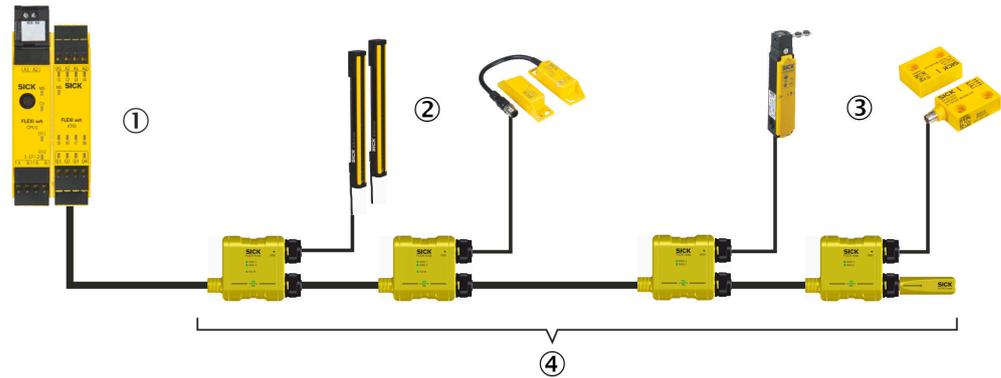
Figure 1: Flexi Loop safe sensor cascade

①　　Flexi Soft

②　　Safety sensors with monitored semiconductor output (OSSD)

③　　Electro-mechanical safety switches

④　　Flexi Loop

Dual-channel, equivalent switching, electro-mechanical safety switches (e.g. reed switches) or safety sensors with monitored semiconductor output (OSSD) (e.g. safety light curtains or safety laser scanners) can be connected to the Flexi Loop nodes.

The main function of the Flexi Loop nodes is the safe and quick monitoring of the switches and sensors connected so as to provide a common shutdown criterion to the safety controller.

Diagnostic functions make it possible to locate which safety sensor or safety switch has shut down for which reason. Discrepancy or sequence errors are detected by means of testing, as are cross-circuits or short-circuits on the sensors or switches.

Unsafe inputs and outputs also make it possible to evaluate certain situations (e.g. contamination) on the monitored system or to trigger functions (e.g. illumination of lamps and activation of door locking devices).

Special features

- up to 32 Flexi Loop nodes per safe sensor cascade
- up to 100 m between Flexi Loop nodes and up to 3,200 m total length of the safe sensor cascade
- up to 10 m cable length between the Flexi Loop nodes and the devices connected
- Optional voltage supply with PWRI power supply accessory
- enclosure rating IP 65 and IP 67 to EN 60529

Connection to safety controllers:
- Flexi Soft safety controller
- up to 8 safe sensor cascades on one Flexi Soft safety controller

4.1.1 System requirements

Flexi Soft safety controller

The safe sensor cascade is connected directly to a Flexi Soft safety controller extension module. The following prerequisites apply:

- one main module
    - SC-FS-CPUx
- one or more expansion modules
    - SC-FS-XTIO
    - SC-FS-XTDI
    - SC-FS-XTDS

4.1.2 Safety by means of Flexi Loop

- Performance level up to PL e
    - dependent on the performance level of the overall application
    - independent of the number of Flexi Loop nodes and thus the number of sensors / switches
    - independent of whether the sensors / switches are directly connected to the safety controller or to the safe sensor cascade
- one cut-off path; the status of this path is represented in the Flexi Soft logic by means of a single safe bit. This feature permits quick, safe shutdown.
- no error masking

The problem of error masking

If tested dual-channel equivalent safety switches are connected in series, errors cannot be detected reliably. The following example shows such a situation.
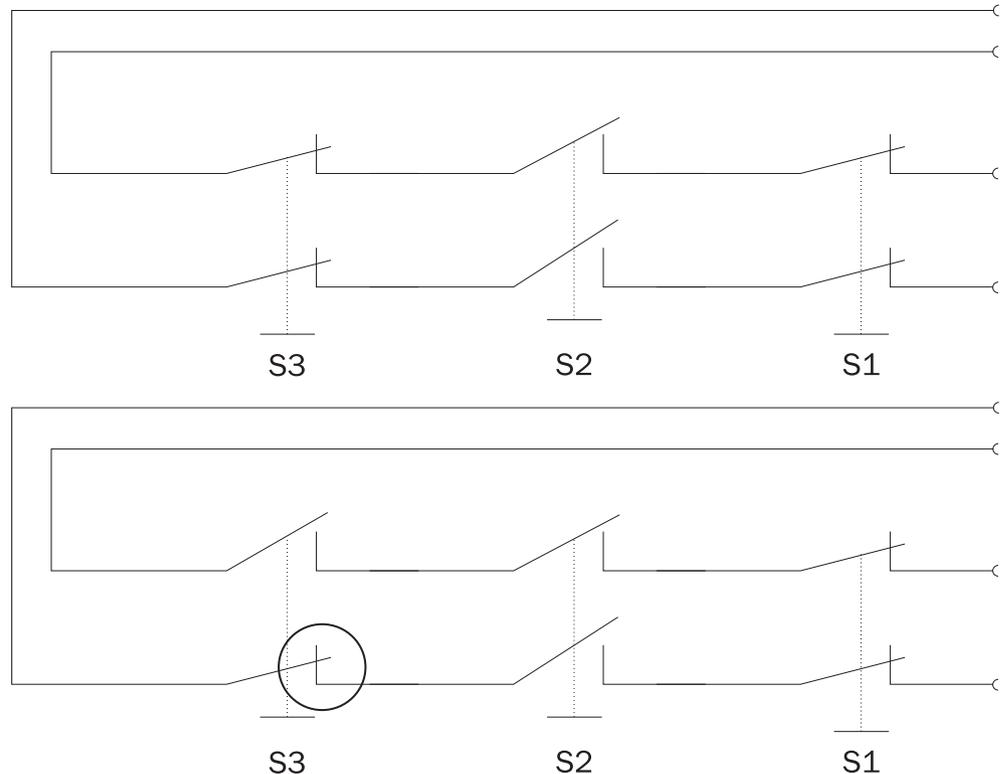
Figure 2: Error masking

If the switch S2 is opened correctly, e.g. the system is shut down. If the switch S3 is now also opened, the error on S3 cannot be detected (error masking). If the switch S3 is closed before S2, the error remains undetected.

4.1.3 Subdivision of the safe sensor cascade

The safe sensor cascade is divided into segment, section and string:

- Segment
  A segment starts at the safety controller or the FL_OUT female connector of the upstream Flexi Loop node; it includes the connection cable as far as the FL_OUT female connector of the Flexi Loop node (see "Connections of the Flexi Loop nodes", page 36) and the supply lines to the devices connected to the Flexi Loop node.

- section
  A section extends from a supply of power to the next accessory for the supply of power or to the terminator.

- string
  A string covers the complete safe sensor cascade from the connection on the safety controller to the terminator.
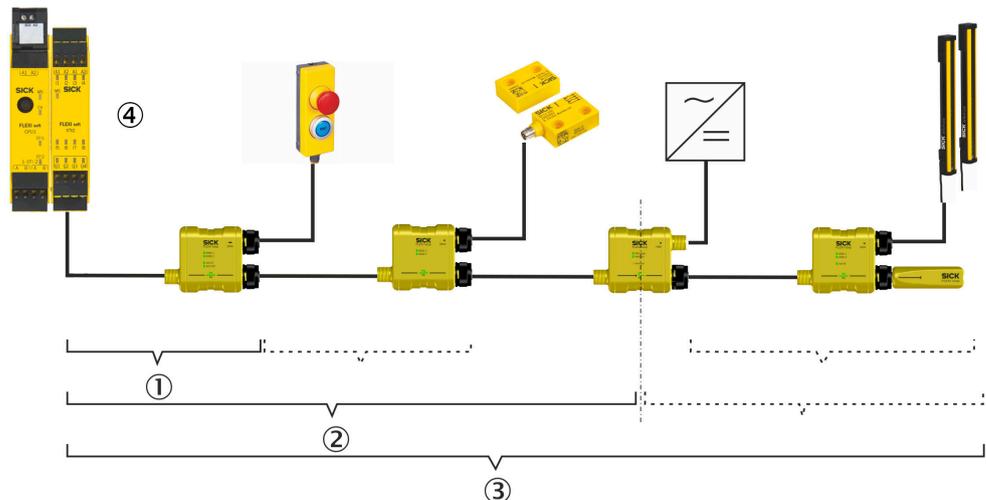
Figure 3: Subdivision of the safe sensor cascade

①   Segment
②   Section
③   Line
④   Safety controller

The Flexi Loop safe series connection is structured as a line topology. The series connection must always be terminated with an SC-FLT-TERM terminator after the last Flexi Loop node.

NOTE
The terminator must be connected directly to the Flexi Loop node, it is not allowed to be connected via a cable.

Power supply accessories can be installed between the Flexi Loop nodes (see "Supply of power", page 15).

Within Flexi Loop, the connection is made with standard 5-pin unshielded cables with A-coded M12 male connectors and M12 female connectors. Cables up to 100 m in length can be laid between the individual Flexi Loop nodes.

Sensors or switches are connected using 5-pin or 8-pin unshielded cables with M12 male connectors. A series of SICK sensors or switches can be connected with 1:1 cables (male/female connector).

- The cables for the sensors or switches must not exceed a length of 10 m .
- You must consider the pin assignment of the individual Flexi Loop nodes and the accessories when making the connection (see "Connections", page 35).

4.1.4 Supply of power

⚠️ **DANGER**
Danger due to overcurrent

Non-compliance can lead to cable fires.

If multiple power supply units in a Flexi Loop section are connected in parallel, the loss of the GND connection can lead to overcurrent and cable fires.

▶ Always supply connected OSSD devices with power via the OSSD female connector of Flexi Loop node SC-FLN-OSSD5 or SC-FLN-OSSD8.
▶ OSSD devices must always be connected to the same voltage supply as the Flexi Loop node to which they are connected.
▶ Always use the power supply accessory to connect additional power supply units.
▶ **Never** use a separate power supply unit to supply power directly to a connected OSSD device.

The power supply accessory is characterized by:

- Voltage supply to the safe series connection and connection of additional voltage supply units (see "Connection facilities", page 24)
- electrical isolation in individual sections
- shutdown of the safe sensor cascade or the section in case of overload

Depending on the number of Flexi Loop nodes, the length of the cables, and the power consumption of the connected sensors or actuators, a voltage supply from a single power supply unit might not be sufficient. Should this be the case, additional power supply units can be connected with the power supply accessory.
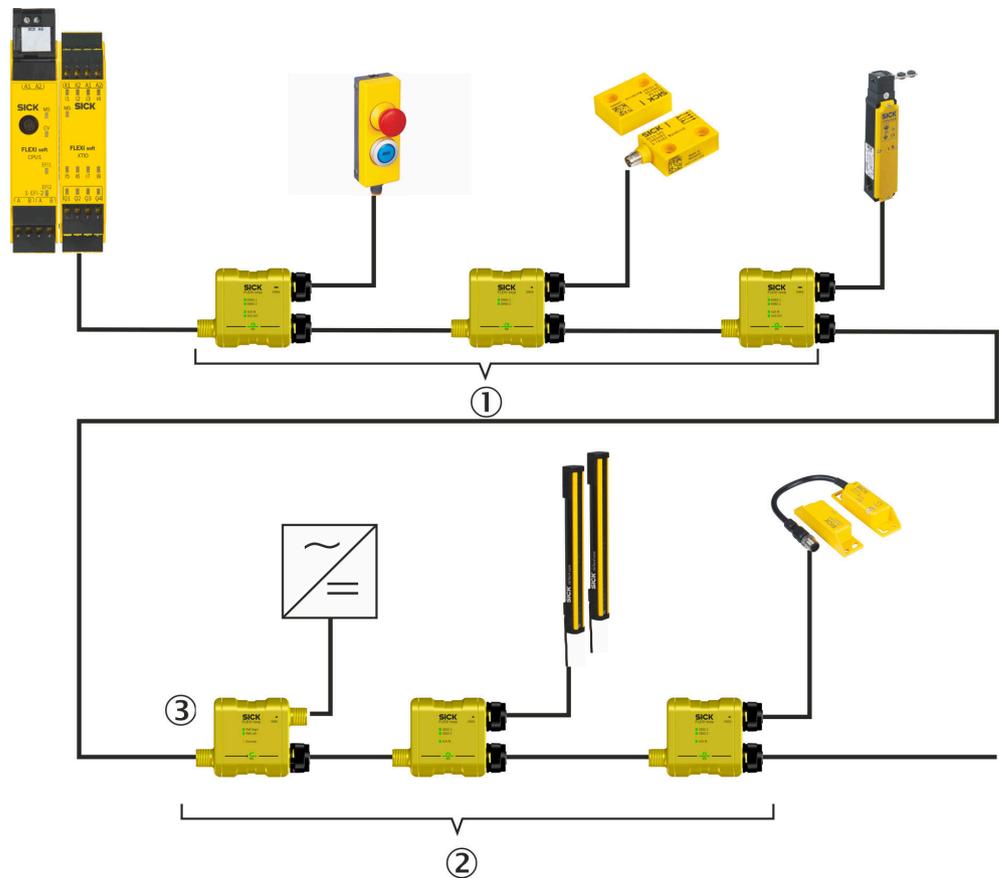
Figure 4: Supply of power

①   Section 1
②   Section 2
③   Supply of power for section 2

4.2 Principle of operation

4.2.1 Operating principle of Flexi Soft

The Flexi Soft I/O modules provide the interface to the Flexi Soft safety controller.

Safe cut-off path

The safety information on the switches and sensors connected is combined and transmitted quickly and safely to the Flexi Soft.
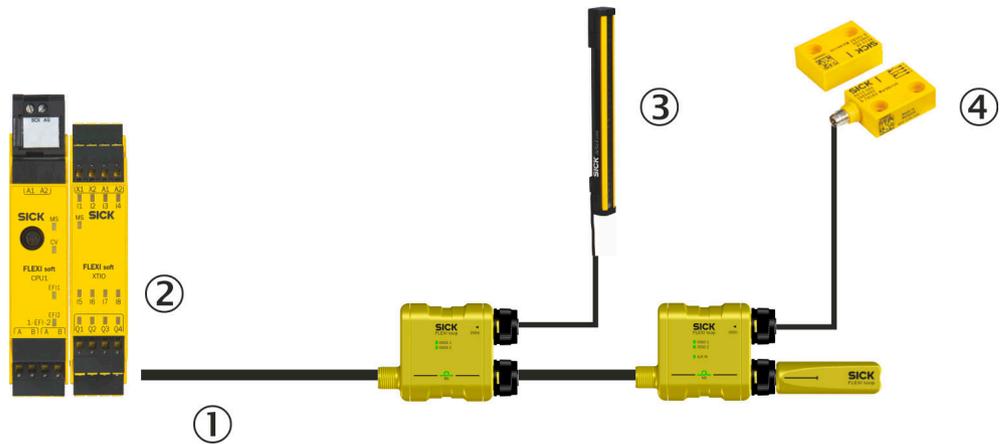
Figure 5: Safe cut-off path

①   Safe cut-off path

②   I/O module for the Flexi Soft safety controller

③   Safety sensors with monitored semiconductor output (OSSD)

④   Electro-mechanical safety switches

Diagnostic information

Non-safe diagnostic information about the statuses inside the safe sensor cascade and about the Flexi Loop nodes is also sent to the Flexi Soft safety controller.

Further processing of information in the logic editor

The safety information and the non-safe diagnostic information can undergo further processing in the logic of the Flexi Soft safety controller (see the "Flexi Loop in the Flexi Soft Designer" operating instructions, part no. 8023208) or it can be forwarded to a PLC, for example, via a gateway.
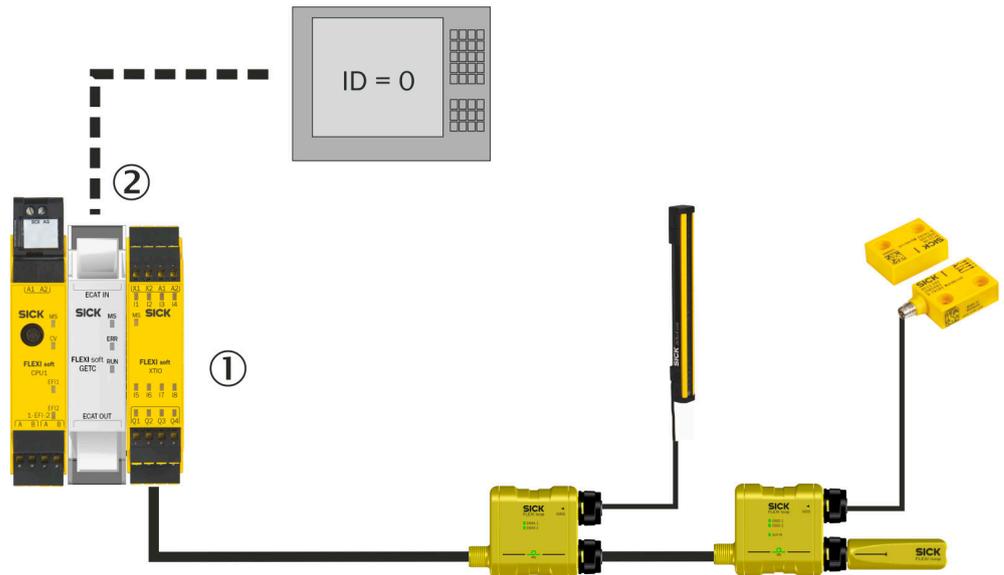
Figure 6: Further processing of information

①   Gateway

②   Diagnostic information

4.2.2 Protection against tampering

⚠️ **DANGER**
Hazard due to lack of effectiveness of the protective device

If the manipulation protection is switched off, a Flexi Loop node can be removed or bridged. In this case, the safe sensor cascade switches back on despite the change.

▶ Only deactivate manipulation protection when it is absolutely necessary to realize the application.
▶ In this case, take other steps (e.g. protected cable laying) to prevent possible manipulation.

Flexi Soft safety controller

The Flexi Soft safety controller saves the node type and the number of nodes in a safe sensor cascade.

This prevents Flexi Loop nodes from being replaced with other types of nodes as well as preventing them from being removed, added, or jumpered. In specific cases, this protection against manipulation can be disabled (see the "Flexi Loop in the Flexi Soft Designer" operating instructions, part no. 8023208).

4.3 Device components

4.3.1 Flexi Loop node

SC-FLN-EMSS5 – 5-pin

Figure 7: SC-FLN-EMSS5 Flexi Loop node – 5-pin

The 5-pin EMSS Flexi Loop node is suitable for connecting **dual-channel, equivalent switching electro-mechanical safety switches**, e.g. magnetic safety switches or emergency stop pushbuttons. The safety switches connected are tested for cross-circuit and short-circuit as well as discrepancy and sequence errors.

SC-FLN-EMSS8 – 8-pin

Figure 8: SC-FLN-EMSS8 Flexi Loop node – 8-pin

The 8-pin Flexi Loop EMSS node **has one more non-safe input and one more non-safe output** than the 5-pin Flexi Loop EMSS node. Control switches (e.g., pushbuttons) or actuators (e.g., lamps or locks) can be connected here.

SC-FLN-OSSD5 – 5-pin

Figure 9: SC-FLN-OSSD5 Flexi Loop node – 5-pin

The 5-pin OSSD Flexi Loop node is suitable for connecting **safety sensors with monitored semiconductor output (OSSD)** (e.g. safety light curtains or transponder safety switches). **In addition it has a non-safe input**. Signal outputs from the sensors (e.g. for signaling contamination) can be connected to this input. The safety sensors connected are tested for discrepancy and sequence errors.

SC-FLN-OSSD8 – 8-pin

Figure 10: SC-FLN-OSSD8 Flexi Loop node – 8-pin

The 8-pin Flexi Loop OSSD node **has one more non-safe output** than the 5-pin Flexi Loop OSSD node. Sensor signal outputs (e.g., for weak signals) or LEDs (e.g., for reset required) can be connected here.

4.3.2   Flexi Loop terminator

SC-FLT-TERM

Figure 11: SC-FLT-TERM terminator

The terminator is used to terminate the safe series connection at the last Flexi Loop node. The terminator must be connected directly to the FL_OUT connection of the last Flexi Loop node ().

4.3.3 Flexi Loop accessories

SC-FLA-PWRI

Figure 12: SC-FLA-PWRI power supply accessories

The power supply accessory is used to connect a power supply with +24 V, for the electrical isolation of individual Flexi Loop sections and for overcurrent shutdown.

4.3.4 Status indicators

The LEDs indicate the operating states of the Flexi Loop nodes.

For a detailed overview of the error messages .

MS LED

Figure 13: MS LED

The Flexi Loop nodes and the Flexi Loop accessories have an LED which displays the communication status and the status of the Flexi Loop node. The designation MS (= module status) comes from the Flexi Soft safety controller.

EMSS LEDs, AUX_IN-LED, AUX_OUT-LED
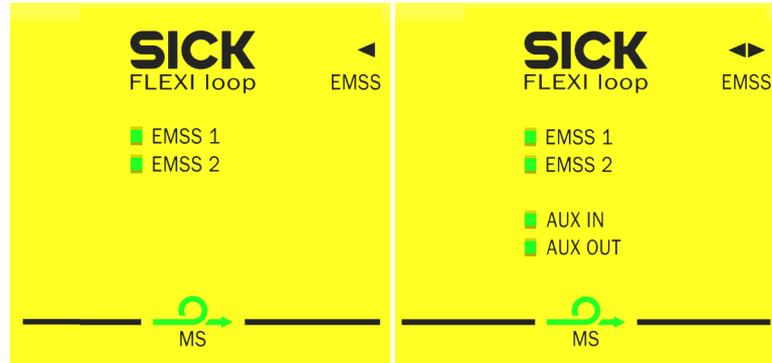
Figure 14: LEDs of the EMSS Flexi Loop nodes

The EMSS LEDs indicate the status of switching contact 1 or 2 on the safety switch connected.

The AUX_IN and AUX_OUT LEDs indicate the status of the non-safe input and the non-safe output respectively.

OSSD LEDs, AUX_IN-LED, AUX_OUT-LED

Figure 15: LEDs of the OSSD Flexi Loop nodes

The OSSD LEDs indicate the status of the OSSDs connected.

The AUX_IN and AUX_OUT LEDs indicate the status of the non-safe input and the non-safe output respectively.

PWR LEDs, Overload LED
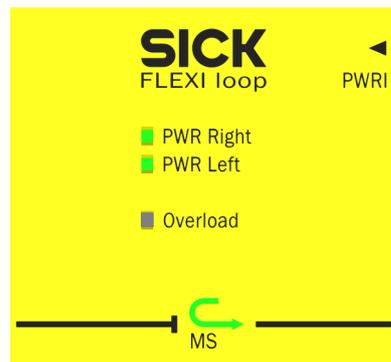
Figure 16: LEDs of the PWRI power supply accessory

The PWR LEDs indicate the status of the input voltage on the right and left side of the PWRI power supply accessory.

The Overload LED indicates an output overload.

5 Project planning

5.1 Total current and power failure

The safe sensor cascade makes it possible to cover a large distance. On the other hand a large number of switches, sensors, actuators and LEDs can be connected.

Due to the cable lengths and the power consumption, it is imperative you pay attention to two things:

- The total current in the safe sensor cascade must not exceed 4 A at any point! [1]
- The voltage VDC must be present at each input on a Flexi Loop node in the range from 16.8 … 30 V DC!

5.2 Total current

> ⚠️ **DANGER**
> Danger due to overcurrent
>
> Non-compliance can lead to cable fires.
>
> The safe sensor cascade permits a maximum total current of 4 A.
>
> ▶ The total current within a section of the safe sensor cascade must be limited to 4 A.
> ▶ Use suitable fuse protection or current limiting devices to ensure that the input current does not exceed 4 A.

The magnitude of the total current is dependent on the following factors:

- number of nodes
- current consumption of the sensors and actuators connected

5.2.1 Permissible total current of a section

The permissible total current within a section is dependent upon the ambient temperature (see "Division into sections", page 25).

Table 5: Permissible total current within a section

Ambient temperature	Permissible total current [1]
40 °C	4.0 A
55 °C	3.19 A

[1] At UL/CSA applications only 3.2 A.

5.2.2 Permissible inrush current

Limit the inrush current flowing through the PWRI connection of the PWRI power supply accessory to less than 40 A. Failure to do this may cause the short-circuit limiter associated with the power supply accessory to trip.

Possible solutions:

- Use a suitable current-limited power supply unit.
- Increase the electrical resistance between the power supply unit and the first Flexi Loop node downstream of the PWRI power supply accessory to 0.75 Ω (e.g., by reducing the wire cross-section or increasing the length of the cable).
  Tip: Minimum length of the cable between power supply unit and Flexi Loop node = wire cross-section × 25 m/mm² (e.g., 8.5 m for 0.34 mm²).

[1] At an ambient temperature of 40 °C.

5.2.3 Other limits

Sensors with a maximum current consumption of 3.9 A can be connected to the OSSD device connection of the SC-FLN-OSSD5 Flexi Loop node.

A maximum current of 2 A is allowed to flow through the 8-pin M12 female connectors on the Flexi Loop nodes (AUX_OUT + VDC). [2]

Consumers with a maximum current consumption of 0.5 A can be connected to the non-safe outputs (AUX_OUT) of the SC-FLN-OSSD8 and SC-FLN-EMSS8 Flexi Loop nodes, with connection to ground.

5.2.4 Connection facilities

⚠️ **DANGER**
Danger due to overcurrent

Non-compliance can lead to cable fires.

If the cables of the safe sensor cascade are disconnected, e.g. in order to supply it directly with a separate power supply unit, several power supply units are switched in parallel. Loss of the GND connection can lead to overcurrent and cable fires.

▶ Never disconnect the connection cables of the Flexi Loop nodes.

To the power source for the Flexi Soft safety controller

A1 = VDC
A2 = GND
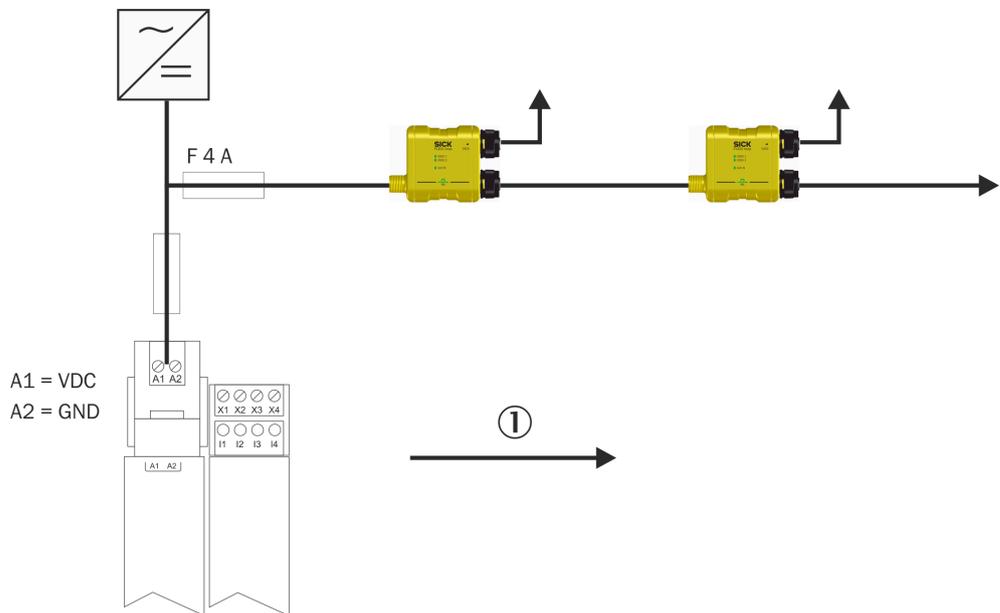
Figure 17: Direct connection to the power source for the Flexi Soft safety controller

① Power flow
② Data flow

ℹ️ **NOTE**
Limit the current flowing through a section of the safe sensor cascade to a maximum of 4 A!

If you connect a safe sensor cascade directly to the power source for the safety controller, then you must limit the current to 4 A by means of suitable measures.

The power supply must then either shut down automatically at currents above 4 A, or you must insert a 4 A slow-blow fuse in-line.

[2] Make sure the current drawn via VDC and AUX_OUT flows back via the GND pin.

Via PWRI power supply accessory (recommended)
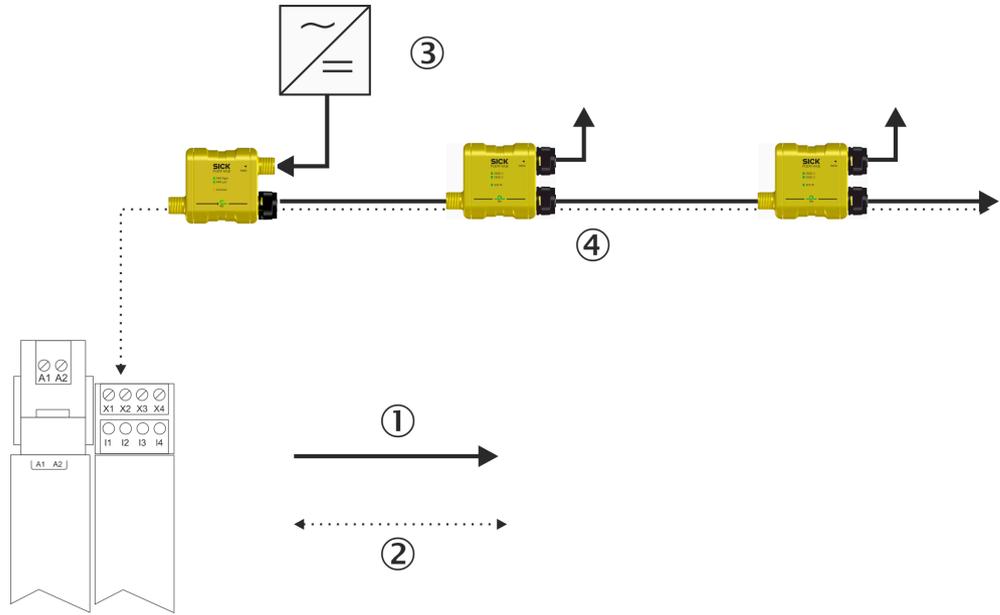
Figure 18: Connection via PWRI power supply accessory

①   Power flow

②   Data flow

③   Power supply

④   Max. 4 A

If you supply a safe sensor cascade via the PWRI power supply accessory, this accessory will monitor the current and shut down in case of overcurrent. In addition the operating voltage in each section is monitored.

5.2.5   Division into sections

If higher currents are required, the safe series connection can be divided into individual sections (see "Subdivision of the safe sensor cascade", page 14).
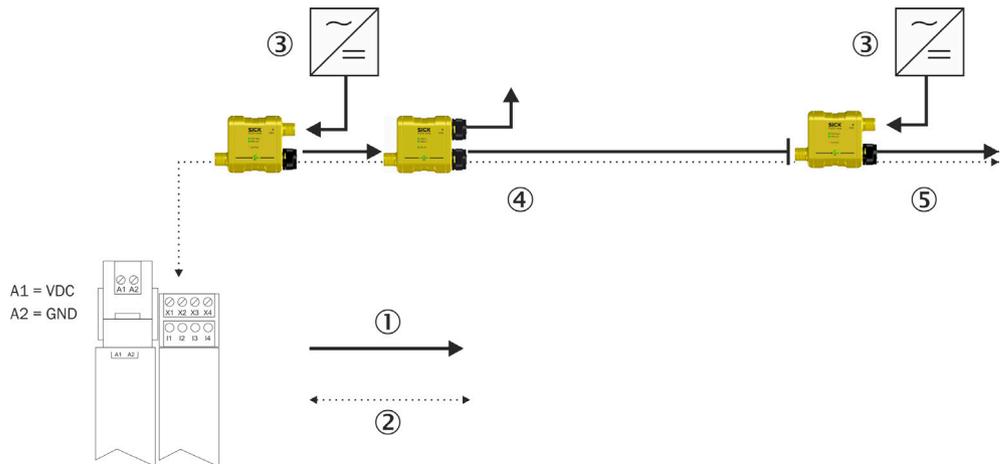
Figure 19: Division into sections

①   Power flow

②   Data flow

③   Power supplies

④   Section 1 max. 4 A

⑤   Section 2 max. 4 A

The PWRI power supply accessory monitors the current in the individual Flexi Loop sections and shuts down in case of overcurrent. In addition the operating voltage in each section is monitored.

The voltage supply of the following Flexi Loop nodes and the connected sensor is electrically isolated from the upstream Flexi Loop nodes by the power supply accessory.

5.3   Voltage drop via cables, Flexi Loop nodes and Flexi Loop accessories

The voltage VDC must be present at each input on a Flexi Loop node and a Flexi Loop accessory in the range from 16.8 … 30 V DC!

The voltage drop over the safe sensor cascade is dependent on the following factors:

- number of Flexi Loop nodes (internal power consumption)
- current consumption of the sensors and actuators connected
- length of the cables
- cross-section of the wire
- ambient temperature

5.3.1   Examples for the voltage drop

In the following examples an input voltage of 24 V DC is assumed.

Number of nodes

The first examples show how the voltage drop behaves based on the number of Flexi Loop nodes. They assume that no devices are connected to the Flexi Loop nodes and that, instead, current flow only occurs as a result of the nodes' own consumption (e.g., during exclusive operation with a Flexi Loop node of type SC-FLN-EMSS5).

The following table shows that although the voltage reduces at the individual Flexi Loop nodes due to the voltage drop, it is still high enough at the 10th Flexi Loop node.

Table 6: Example voltage drop on 10 Flexi Loop nodes

Segment	Wire cross-section [mm²]	Cable length [m]	Voltage VDC [V]	Current consumption of connected devices [A]
1	0.34	15.00	**23.10**	0.00
2	0.34	15.00	**22.29**	0.00
…				
9	0.34	15.00	**18.98**	0.00
10	0.34	15.00	**18.85**	0.00

However, if 15 Flexi Loop nodes are used in the same conditions, the input voltage drops below the permissible value from the 7th Flexi Loop node.

Table 7: Example voltage drop on 15 Flexi Loop nodes

Segment	Wire cross-section [mm²]	Cable length [m]	Voltage VDC [V]	Current consumption of connected devices [A]
1	0.34	15.00	**22.68**	0.00
2	0.34	15.00	**21.44**	0.00
...				
6	0.34	15.00	**17.33**	0.00
7	0.34	15.00	**16.52**	0.00
...				
15	0.34	15.00	**13.08**	0.00

Solution example with PWRI power supply accessory

By using a PWRI power supply accessory after the 11th Flexi Loop node, the input voltage is adequate at all Flexi Loop nodes.

Table 8: Example voltage drop on 15 Flexi Loop nodes with PWRI

Segment	Wire cross-section [mm²]	Cable length [m]	Voltage VDC [V]	Current consumption of connected devices [A]
1	0.34	15.00	**23.02**	0.00
2	0.34	15.00	**22.12**	0.00
...				
11	0.34	15.00	**17.86**	0.00
FLA-PWRI				
1	0.34	15.00	**23.02**	0.00
...				
4	0.34	15.00	**20.58**	0.00

Solution example with increased wire cross-section

Using a wire cross-section of 0.75 mm² will ensure that a sufficient input voltage is available even at the 15th Flexi Loop node.

Table 9: Example voltage drop on 15 Flexi Loop nodes with wire cross-section 0.75 mm²

Segment	Wire cross-section [mm²]	Cable length [m]	Voltage VDC [V]	Current consumption of connected devices [A]
1	0.75	15.00	**23.38**	0.00
2	0.75	15.00	**22.80**	0.00
...				
14	0.75	15.00	**18.96**	0.00
15	0.75	15.00	**18.89**	0.00

Devices with current consumption

If devices with a current consumption are connected to the Flexi Loop node (in the example with 0.5 A and with 1.5 A), the input voltage drops below the permissible value from the 2nd Flexi Loop node.

Table 10: Example voltage drop due to current consumption of connected devices

Segment	Wire cross-section [mm²]	Cable length [m]	Voltage VDC [V]	Current consumption of connected devices [A]
1	0.34	15.00	**20.00**	0.50
2	0.34	15.00	**16.86**	1.50
3	0.34	15.00	**16.14**	0.00
...				
10	0.34	15.00	**13.42**	0.00

Solution example with PWRI power supply accessory

By using a PWRI power supply accessory after the 5th Flexi Loop node, the input voltage is adequate at all 10 Flexi Loop nodes.

Table 11: Example voltage drop on 10 Flexi Loop nodes with PWRI

Segment	Wire cross-section [mm²]	Cable length [m]	Voltage VDC [V]	Current consumption of connected devices [A]
1	0.34	15.00	**23.02**	0.50
2	0.34	15.00	**22.12**	1.50
...				
5	0.34	15.00	**17.07**	0.00
SC-FLA-PWRI				
1	0.34	15.00	**23.97**	0.00
...				
5	0.34	15.00	**22.93**	0.00

Solution example with increased wire cross-section

Using a wire cross-section of 0.75 mm² will ensure that a sufficient input voltage is available even at the 10th Flexi Loop node.

Table 12: Example voltage drop at 10 Flexi Loop nodes with wire cross-section 0.75 mm²

Segment	Wire cross-section [mm²]	Cable length [m]	VoltageVDC [V]	Current consumption of connected devices [A]
1	0.75	15.00	**23.84**	0.50
2	0.75	15.00	**22.37**	1.50
...				
9	0.75	15.00	**20.82**	0.00
10	0.75	15.00	**20.76**	0.00

5.3.2 Possible solutions

If the voltage drop over a Flexi Loop segment or Flexi Loop section is too high, i.e. there is an excessively low input voltage at a node, then ...

- increase the wire cross-section.
- if possible shorten the cables.
- install the PWRI power supply accessory.

NOTE

Flexi Soft Designer supports an option for the offline calculation or online measuring of the voltage drop (see the "Flexi Loop in the Flexi Soft Designer" operating instructions, part no. 8023208).

If you require additional information and support during planning, please contact your local SICK subsidiary.

5.4 Supply of OSSD devices

DANGER

Danger due to overcurrent

Non-compliance can lead to cable fires.

If multiple power supply units in a Flexi Loop section are connected in parallel, the loss of the GND connection can lead to overcurrent and cable fires.

▶ Always supply connected OSSD devices with power via the OSSD female connector of Flexi Loop node SC-FLN-OSSD5 or SC-FLN-OSSD8.
▶ OSSD devices must always be connected to the same voltage supply as the Flexi Loop node to which they are connected.
▶ Always use the power supply accessory to connect additional power supply units.
▶ **Never** use a separate power supply unit to supply power directly to a connected OSSD device.

5.5 Integration in the electrical control

5.5.1 Implementation of reset

5.5.1.1 Reset with the Flexi Soft safety controller

To implement reset and restart, pay attention to the following notes:

DANGER

▶ Connect the control switch for restarting to a separate input. This input must **not be located on the same safe sensor cascade as the input for the reset button!**

▶ In the Flexi Soft Designer, use a **reset** function block to reset the protective devices.
▶ Connect, e.g., one or more reset buttons to the non-safe inputs (AUX_IN) of the SC-FLN-EMSS8 or SC-FLN-OSSD8 Flexi Loop nodes.
▶ If you use further non-safe inputs (AUX_IN) on the Flexi Loop nodes for purposes other than reset, make sure these do not fulfill any reset condition. [3]
▶ Connect a **restart** function block downstream to restart the machine.
▶ Signal propagation times via Flexi Loop communication always result in longer signal times (pulse durations) in the Flexi Soft logic.

NOTE

Please note that due to the signal propagation times, a Flexi Loop input signal may be longer in the Flexi Soft logic (longer pulse duration) than the original signal. The same applies for the Flexi Loop output signals at AUX_OUT.

▶ Set the minimum **reset propagation time** of the **reset** and **restart** function blocks to 100 ms.

---

[3] Reset is realized by pressing and releasing the reset button. This action generates an active high pulse lasting at least 100 ms and maximum 30 s.
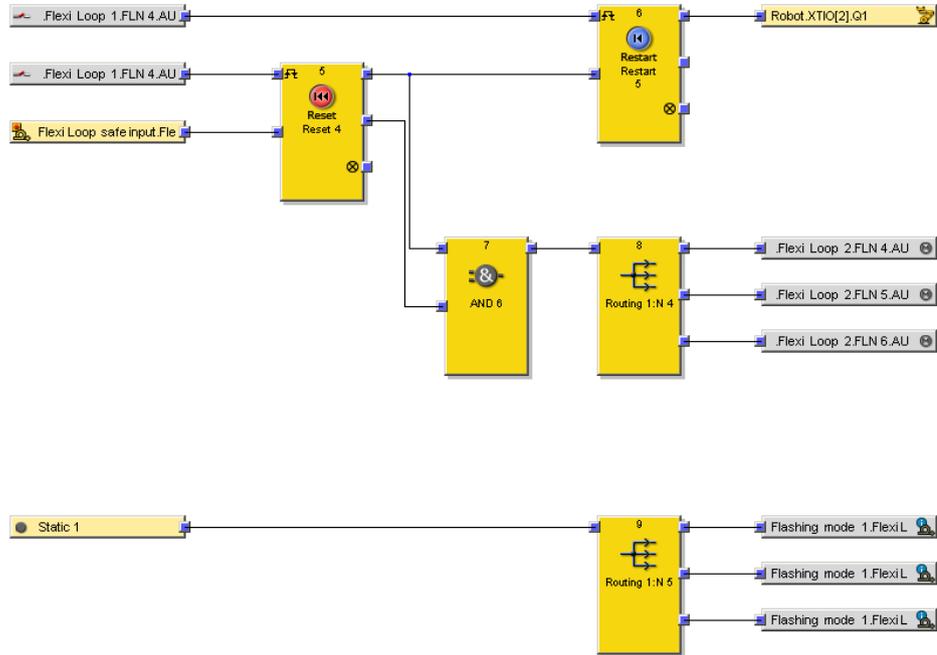
Figure 20: Implementation of reset and restart as well as the flashing mode in the logic editor

The implementation of reset and restart is shown at the top of the example.

The implementation of the flash mode is shown at the bottom of the example.

Flashing on Reset required

Due to the signal propagation times, you cannot use the **reset required** output of the **reset** function block to have status signals (e.g., lamps) flashing at the non-safe outputs of the Flexi Loop nodes. The Flexi Loop nodes provide the **flash mode 1** and **flash mode 2** output options for this purpose.

In the previous example, **flash mode 1** for all three Flexi Loop nodes is switched on through the **logic 1** input bit and the **routing** function block.

The actual condition **Reset required** is realized by the AND operation on the **Enable** and the **Enable condition**.

5.5.2 Implementation of a safety locking device

Connection to EMSS node

The safety switching contacts of a spring-locked safety locking device are connected to the EMSS connections of the Flexi Loop node. Guard position monitoring for the protective device and the interlocking device must be implemented with the same switching element. If output monitoring of the Flexi Loop node is deactivated, the actuator signal for the lock can be connected at the AUX_IN input. The interlocking device for the safety locking device is connected at the AUX_OUT output.

Implementation with the Flexi Soft safety controller

The lock must be implemented in the Flexi Soft Designer logic editor (see the "Flexi Loop in the Flexi Soft Designer" operating instructions, part no. 8014522).
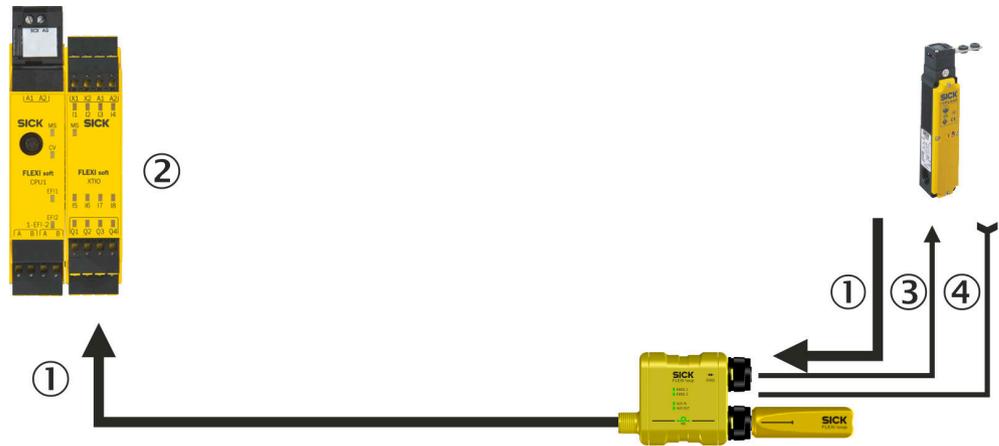
Figure 21: Lock with the Flexi Soft safety controller

①   Safe cut-off path (guard position monitoring of the protective device and the interlocking device)

②   Flexi Soft safety controller

③   Signal for interlocking device

④   Actuator status signal

6 Mounting

6.1 Mounting in a cable channel

Due to its size, the Flexi Loop node can be mounted in a cable channel with a width ≥40 mm.
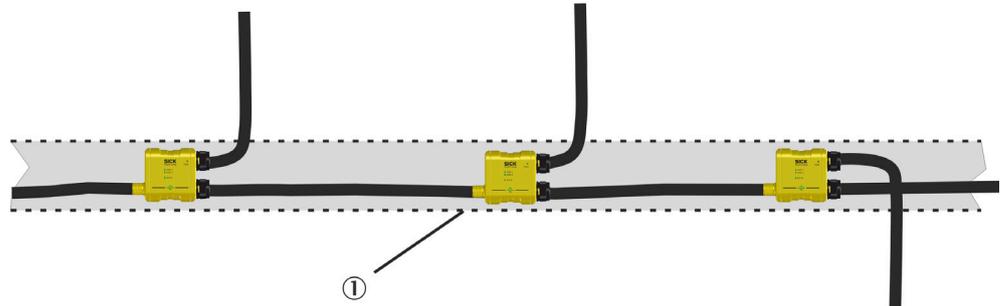

Figure 22: Mounting in a cable channel

① Cable channel
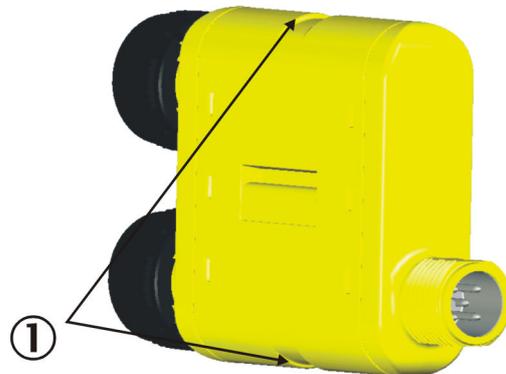
6.2 Mounting with cable tie

Figure 23: Mounting with cable tie

① Slot for cable tie

The Flexi Loop nodes have a slot on the top and bottom ①. These slots are used for mounting using a cable tie.

6.3 Mounting with C-Fix bracket

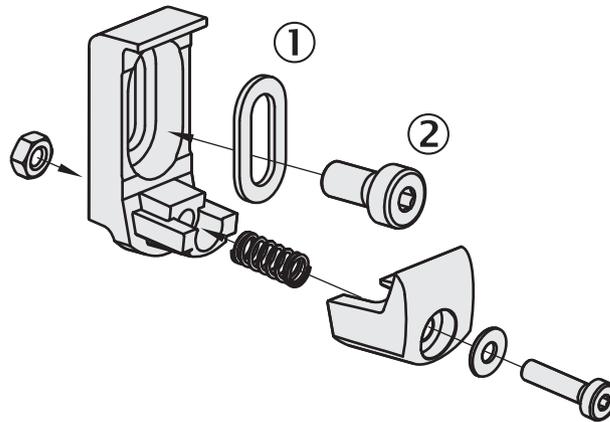The Flexi Loop nodes can be installed with what is known as a C-Fix bracket.

Figure 24: C-Fix bracket

①   Washer

②   Fixing screws M5 (not included)

How to install a Flexi Loop node with a C-Fix bracket:

Figure 25: Mounting the Flexi Loop node with C-Fix bracket

▶   Mount the C-Fix bracket (①) on a flat surface.
▶   Fasten the M4 screws with a torque of about 3 Nm. Higher torques can damage
         the bracket while lower torques do not provide adequate fixation to prevent mov-
         ing.
▶   Insert the Flexi Loop node into the C-Fix bracket and press downward gently (②).
▶   Turn the Flexi Loop node backwards (③) until the C-Fix bracket engages in the
         housing slot of the Flexi Loop node (④).
▶   Fasten the M3 screws of the C-Fix bracket with a torque of about 1.5 Nm to fix the
         Flexi Loop nodes (⑤).

Mounting on mounting profiles with T-slots

The C-Fix brackets are suitable for mounting the Flexi Loop nodes on mounting profiles
with T-slots.

7 Electrical installation

7.1 Safety

⚠️ **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.

▶ Always used a suitable power supply.

▶ Make sure that the outputs of the safety controller have no effect on the machine during electrical installation.

ℹ️ **NOTE**

- The safe sensor cascade complies with the Radio Safety Requirements (EMC) for the industrial sector (Radio Safety Class A). It may cause radio interference if used in a residential area.
- All electrical equipment must be installed conforming to EN 60204-1.
- The device voltage supply must be capable of buffering brief power failures of 20 ms, for example, as specified in EN 602041 .
- The voltage supply and all connected signals must meet the requirements for extra-low voltages with safe separation (SELV / PELV) as specified in EN 60664.
- All safety sensors and actuators connected as well as wiring and installation have to fulfil the required safety characteristics.
- On the replacement of a Flexi Loop node, it must be ensured the pin assignment is made correctly, e.g. by marking or laying in a suitable manner.
- The safe sensor cascade must be disconnected from the voltage supply before any changes are made.

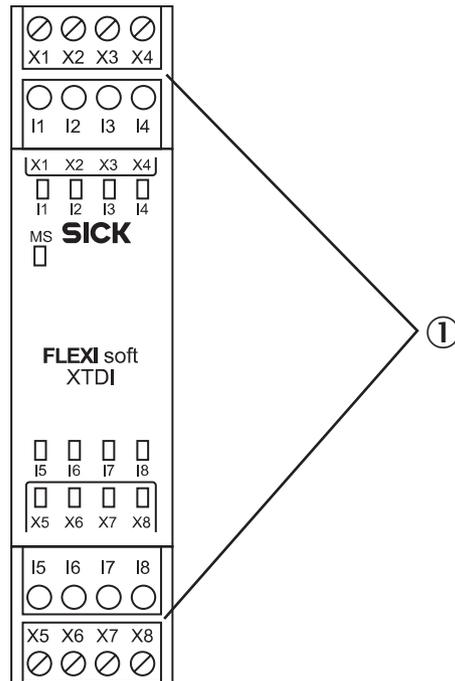## 7.2 Connections

7.2.1 Connection to Flexi Soft

Figure 26: Terminals on Flexi Soft expansion modules

①   Terminals for inputs and outputs

The figure shows the terminals for inputs and outputs based on the example of the SC-FS-XTDI expansion module. The terminal pin assignments are listed in the "Flexi Soft Modular Safety Controller Hardware" operating instructions.

The safe sensor cascade is connected to one output (X) and two safe inputs (I) of an I/O module.

The safe sensor cascade can be connected to the same voltage supply as the safety controller. However, the current must be limited to 4 A.
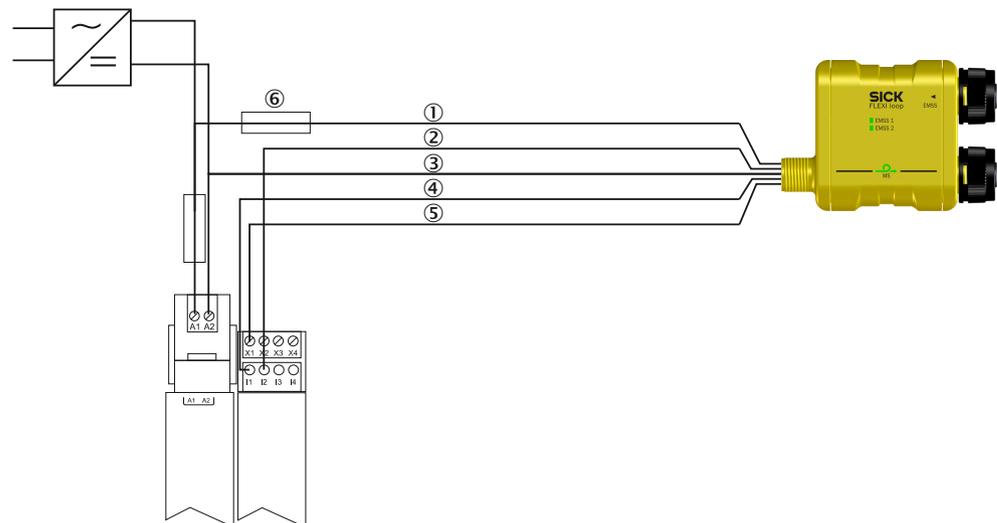

Figure 27: Connection example with Flexi Soft

①   VDC

② DATA_OUT

③ GND

④ SAFE_OUT

⑤ DATA_IN

⑥ Fuse with 4 A

Use 5-pin cables with an M12 female connector and open cable ends to connect the safe series connection.

Connection example with Flexi Soft

Table 13: Connection example with Flexi Soft

Flexi Loop pin	Flexi Loop signal	SC-FS-XTDI ter-minal	Flexi Soft signal
1	VDC	A1	VDC
2	DATA_OUT	I2	DATA_IN
3	GND	A2	GND
4	SAFE_OUT	I1	SAFE_IN
5	DATA_IN	X1	DATA_OUT

NOTE

The output for the DATA_OUT signal and the input for the SAFE_IN signal on the Flexi Soft safety controller must be compatible.

- When X1 is used, I1 must be used.
- When X2 is used, I2 must be used.
- Etc.

You can select any input for the DATA_IN data return path.
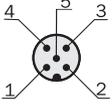
7.2.2 Connections of the Flexi Loop nodes

Figure 28: Connections of the Flexi Loop nodes

① FL_IN (male connector)

② FL_OUT (female connector)

FL_IN 5-pin

The pin assignment is required to connect the first Flexi Loop node of a safe series connection to a Flexi Soft safety controller (see "Connection to Flexi Soft", page 35).

Table 14: Pin assignment FL_IN (male connector)

Male connector	Pin	Signal	Meaning	Color [1]
	1	VDC	24 V supply voltage	Brown
	2	DATA_OUT	Output to the Flexi Soft input In + 1	White
	3	GND	GND supply voltage	Blue
	4	SAFE_OUT	Safe shutdown signal Output to the Flexi Soft input In	Black
	5	DATA_IN	Input from the Flexi Soft output Xn	Gray

[1] The stated colors apply on the usage of pre-assembled cables (should be checked).

7.2.3 Connection of the Flexi Loop nodes within a safe sensor cascade

Within the safe sensor cascade the individual Flexi Loop nodes are connected using 1:1 cables (male/female connector) via FL_OUT and FL_IN.

NOTE

▶ Only use cables with straight male or female connectors.
▶ **Never** connect two Flexi Loop nodes directly by plugging the male connector of one into the female connector of the other.
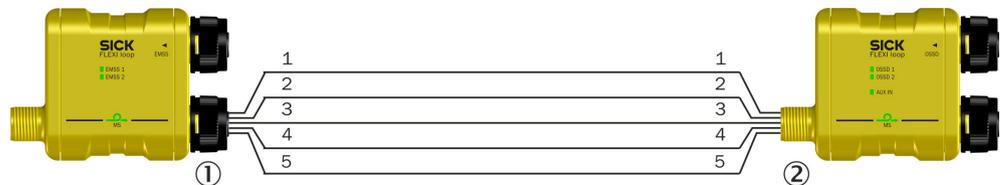
Figure 29: Connection of the Flexi Loop nodes within a safe sensor cascade

① FL_OUT (female connector)
② FL_IN (male connector)

DANGER
Danger due to overcurrent

Non-compliance can lead to cable fires.

If the cables of the safe sensor cascade are disconnected, e.g. in order to supply it directly with a separate power supply unit, several power supply units are switched in parallel. Loss of the GND connection can lead to overcurrent and cable fires.

▶ Never disconnect the connection cables of the Flexi Loop nodes.

7.2.4 Connections of the EMSS Flexi Loop node

Figure 30: Connections of the EMSS Flexi Loop node

① EMSS (female connector)

EMSS 5-pin

Table 15: Pin assignment EMSS 5-pin (female connector)

Female connector	Pin	Signal	Meaning	Color [1]
	1	EMSS1_A	Switching contact 1, connection A	Brown
	2	EMSS1_B	Switching contact 1, connection B	White
	3	EMSS2_A	Switching contact 2, connection A [2]	Blue
	4	EMSS2_B	Switching contact 2, connection B	Black
	5	EMSS2_A	Switching contact 2, connection A [2]	Gray

[1] The stated colors apply on the usage of pre-assembled cables (should be checked).
[2] You can either use Pin 3 or Pin 5 as connection A of switching contact 2.

EMSS 8-pin

Table 16: Pin assignment EMSS 8-pin (female connector)

Female connector	Pin	Signal	Meaning	Color [1]
	1	VDC	24 V supply voltage	White
	2	AUX_IN	Non-safe input	Brown
	3	EMSS1_A	Switching contact 1, connection A	Green
	4	EMSS1_B	Switching contact 1, connection B	Yellow
	5	AUX_OUT	Non-safe output	Gray
	6	GND	GND supply voltage	Pink
	7	EMSS2_A	Switching contact 2, connection A	Blue
	8	EMSS2_B	Switching contact 2, connection B	Red

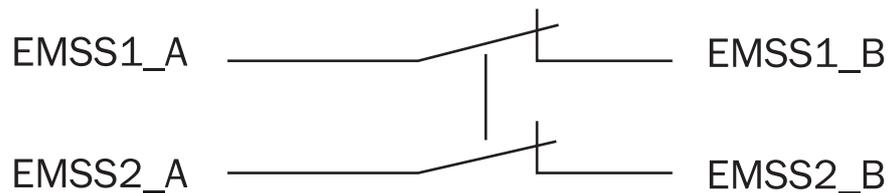[1] The stated colors apply on the usage of pre-assembled cables (should be checked).

Figure 31: Connection sketch dual-channel equivalent switch

An example application for the connection of a lock:

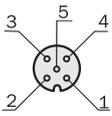### 7.2.5 Connections of the OSSD Flexi Loop node

Figure 32: Connections of the OSSD Flexi Loop node

① OSSD (female connector)

OSSD 5-pin

*Table 17: Pin assignment OSSD 5-pin (female connector)*

Female connector	Pin	Signal	Meaning	Color [1]
	1	VDC	24 V supply voltage for safety device	Brown
	2	OSSD1	Input OSSD1	White
	3	GND	GND supply voltage for safety device	Blue
	4	OSSD2	Input OSSD2	Black
	5	AUX_IN	Non-safe input	Gray

[1] The stated colors apply on the usage of pre-assembled cables (should be checked).

OSSD 8-pin

Table 18: Pin assignment OSSD 8-pin (female connector)
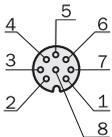
Female connector	Pin	Signal	Meaning	Color [1]
	1	AUX_IN	Non-safe input	White
	2	VDC	24 V supply voltage for safety device	Brown
	3	AUX_OUT	Non-safe output	Green
	4	VDC	24 V supply voltage for safety device	Yellow
	5	OSSD1	Input OSSD1	Gray
	6	OSSD2	Input OSSD2	Pink
	7	GND	GND supply voltage for safety device	Blue
	8	VDC	24 V supply voltage for safety device	Red

[1] The stated colors apply on the usage of pre-assembled cables (should be checked).

⚠️ **DANGER**

Danger due to overcurrent

Non-compliance can lead to cable fires.

If multiple power supply units in a Flexi Loop section are connected in parallel, the loss of the GND connection can lead to overcurrent and cable fires.

- ▶ Always supply connected OSSD devices with power via the OSSD female connector of Flexi Loop node SC-FLN-OSSD5 or SC-FLN-OSSD8.
- ▶ OSSD devices must always be connected to the same voltage supply as the Flexi Loop node to which they are connected.
- ▶ Always use the power supply accessory to connect additional power supply units.
- ▶ **Never** use a separate power supply unit to supply power directly to a connected OSSD device.

7.2.6 Connections of the PWRI power supply accessory

Figure 33: Connections of the PWRI power supply accessory

① PWRI (male connector)

PWRI 5-pin

Table 19: Pin assignment PWRI 5-pin (male connector)

Male connector	Pin	Signal	Meaning	Color [1]
	1	VDC	24 V supply voltage of the power supply connected	Brown
	2	VDC		White
	3	GND	GND from the power supply connected	Blue
	4	GND		Black
	5	NC	Not connected	Gray

[1] The stated colors apply on the usage of pre-assembled cables (should be checked).

8 Commissioning

8.1 Safety

> ⚠️ **DANGER**
> Hazard due to lack of effectiveness of the protective device
>
> ▶ Before commissioning the machine, make sure that the machine is first checked and released by qualified safety personnel.
> ▶ Only operate the machine with a perfectly functioning protective device.

8.2 Display sequence during switching on

After switching on an LED test is undertaken. During this test each LED illuminates briefly in each available color. The LED test is displayed simultaneously on all Flexi Loop nodes.

Synchronization of the Flexi Loop nodes then gets underway. After this, the LEDs indicate the corresponding operational status (see "Status indicators", page 20).

8.3 Test notes

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

These checks must always be performed.

8.3.1 Thorough checks before the initial commissioning

▶ Check the effectiveness of the protective device on the machine for all operating modes selectable on the machine against the checklist in the appendix (see "Checklist for the manufacturer", page 56).

8.3.2 Regular thorough check of the protective device by qualified safety personnel

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

8.3.3 Daily functional checks of the protective device

The effectiveness of the protective device must be checked daily by a specialist or by authorized personnel.

9 Troubleshooting

9.1 In the event of faults or errors

> ⚠️ **DANGER**
> Hazard due to lack of effectiveness of the protective device
> Cease operation if the cause of a malfunction has not been clearly identified.
>
> ▶ Take the machine out of operation if an error cannot be clearly identified and safely remedied.

> ℹ️ **NOTE**
> ▶ The safe sensor cascade must be disconnected from the voltage supply before any changes are made.
> ▶ Restart the system after restoring a lost connection or repairing a cable break.

9.2 SICK support

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

9.3 Indications of the LEDs

9.3.1 MS LED
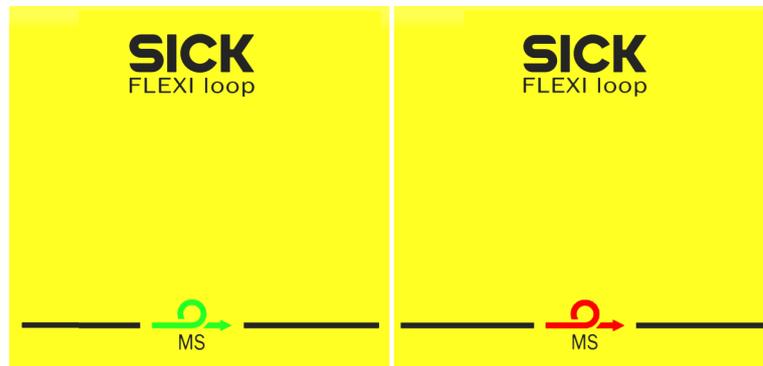
Figure 34: MS LED

The Flexi Loop nodes and the Flexi Loop accessories have an LED which displays the communication status and the status of the Flexi Loop node. The designation MS (= module status) comes from the Flexi Soft safety controller.

The indications on the LED have the following meaning:

Table 20: Displays of the MS LEDs

MS	Meaning
● Green	The safe sensor cascade is in operation on this and all downstream nodes and on all Flexi Loop accessories. No error occurred. For Flexi Loop nodes SC-FLN-EMSS5, SC-FLN-EMSS8, SC-FLN-OSSD5, and SC-FLN-OSSD8: If both EMSS LEDs or both OSSD LEDs are not constantly illuminated green on this node, then the safe sensor cascade has been shut down by this node.
○	No operating voltage, or voltage too low

MS	Meaning
⚡ Green (1 Hz)	A downstream Flexi Loop node has shut down or a discrepancy or sequence error has occurred on a downstream Flexi Loop node.
⚡ Green (0.5 Hz)	Connection to Flexi Loop communication driver (e.g., Flexi Soft) exists but communication with the safe sensor cascade has been interrupted. Or: More than 32 Flexi Loop nodes connected to a line.
⚡ Green (2 Hz)	Initialization phase, establishing communication.
⚡ Green (1 Hz)	Communication interrupted, no connection to the Flexi Loop communication driver (e.g. Flexi Soft)
⚡ Red/green (2 Hz)	Configuration error • Too many or too few nodes are connected to the safe sensor cascade. Or: • This node is not configured in this location (incorrect type or incorrect number).
⚡ Red (1 Hz)	An error has occurred at this Flexi Loop node. The nature of the error is indicated by the combination of EMSS LEDs or OSSD-LEDs (see "LEDs of the EMSS Flexi Loop nodes", page 44 or see "LEDs of the OSSD Flexi Loop nodes", page 45).
⚡ Red (2 Hz)	A critical error has occurred on a downstream node.
● Red	A critical error occurred on this node. The error can under certain circumstances be cleared by switching off and on again.

Large distances can be covered using the safe sensor cascade. For this reason the flashing of the MS LEDs indicates the direction in which it is necessary to go from the controller to reach the Flexi Loop node on which the shutdown or the error occurred.

> **NOTE**
> Start at the control cabinet and head toward the terminator until you find the Flexi Loop node whose LED is no longer flashing green at a frequency of 1 Hz.
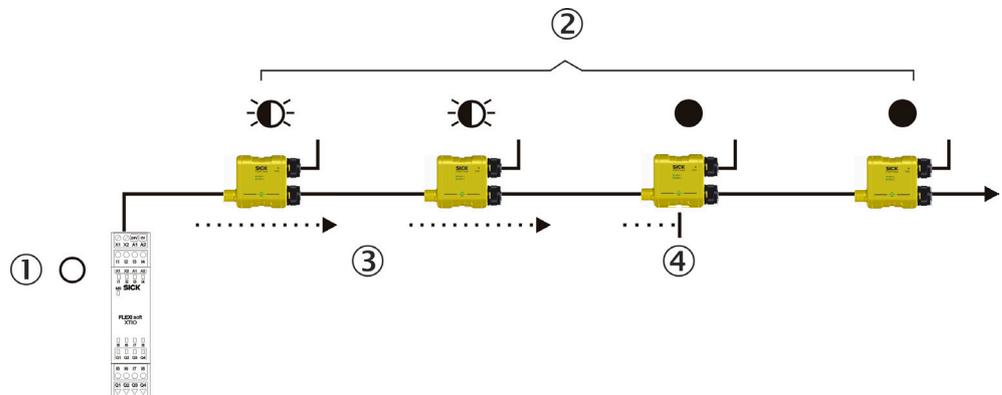

Figure 35: Direction indication on the MS LEDs

①   I LED on the Flexi Soft
②   MS LEDs of the Flexi Loop nodes
③   Direction of propagation to the shutdown
④   Flexi Loop node with shutdown

The shutdown of the safe sensor cascade is indicated on the safety controller by the LED for the input; this LED is off. The shutdown or the error occurred on the first Flexi Loop node in the direction of propagation on which the MS LED is no longer flashing green at 1 Hz.
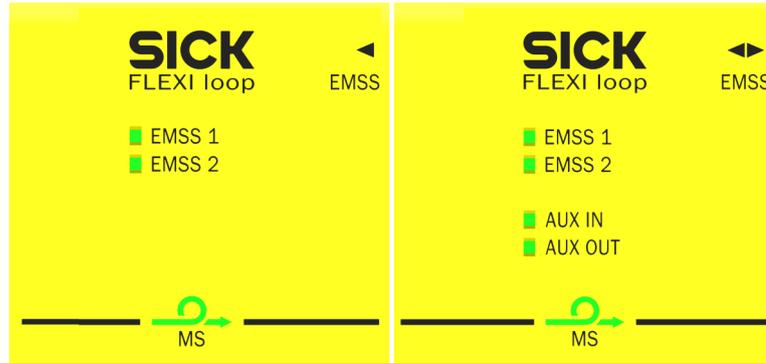
9.3.2 LEDs of the EMSS Flexi Loop nodes

Figure 36: LEDs of the EMSS Flexi Loop nodes

Table 21: EMSS LEDs and MS LED of the EMSS Flexi Loop nodes

EMSS1/2	MS	Meaning
● Green	–	Switch contact 1 or 2 on the safety switch closed, no error
○	–	Switch contact 1 or 2 on the safety switch open, no error
☼ Green	☼ Red	Discrepancy or sequence error, related switch contact is closed.
☼ Green	☼ Red	Discrepancy or sequence error, related switch contact is open.

- If an error is only indicated on one of the LEDs EMSS1 or EMSS2 (the other is either illuminated green or is off), then there is a discrepancy error.
- If an error is indicated on both LEDs EMSS1 and EMSS2, there is a sequence error.

Table 22: AUX_IN LED of the EMSS Flexi Loop nodes

AUX_IN (8-pin variant only)	Meaning
● Green	Non-safe input is active.
○	Non-safe input is inactive.

Table 23: AUX_OUT LED of the EMSS Flexi Loop nodes

AUX_OUT (8-pin variant only)	Meaning
● Green	Non-safe output is active.
○	Non-safe output is inactive.

9.3.3 LEDs of the OSSD Flexi Loop nodes

Figure 37: LEDs of the OSSD Flexi Loop nodes

Table 24: OSSD LEDs and MS LED of the OSSD Flexi Loop nodes

OSSD1/2	MS	Meaning
● Green	–	Connected OSSD in the ON state, no error
○	–	Connected OSSD in the OFF state, no error
☼ Green	☼ Red	Discrepancy or sequence error, related connection is high.
☼ Green	☼ Red	Discrepancy or sequence error, related connection is low.

Table 25: AUX_IN LED of the OSSD Flexi Loop nodes

AUX_IN	Meaning
● Green	Non-safe input is active.
○	Non-safe input is inactive.

Table 26: AUX_OUT LED of the OSSD Flexi Loop nodes

AUX_OUT (8-pin variant only)	Meaning
● Green	Non-safe output is active.
○	Non-safe output is inactive.

9.3.4 LEDs of the PWRI power supply accessory
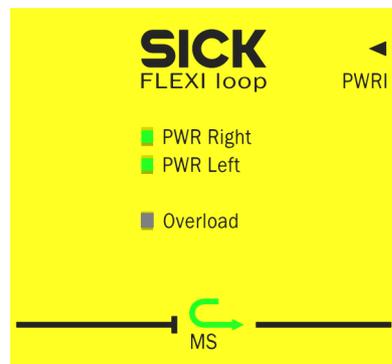
Figure 38: LEDs of the PWRI power supply accessory

Table 27: PWR Right LED of the PWRI power supply accessory

PWR Right	Meaning
● Green	Input voltage on the right side (on the male connector PWRI) is in the stipulated range
○	No or excessively low input voltage on the right side (on the male connector PWRI)

Table 28: PWR Left LED of the PWRI power supply accessory

PWR Left	Meaning
● Green	Operating voltage in the left section in the stipulated range
○	No or excessively low operating voltage in the left section

Table 29: Overload LED of the PWRI power supply accessory

Overload	Meaning
○	Output current in the normal range
☼ Red (1 Hz)	Output load is critical but not yet cut off. If this continues, cut-off will occur (see "PWRI power supply accessory", page 50).
● Red	Overload, all sections to the right of the power supply accessory are shut down. If the load drops below the re-enable value, the power supply accessory switches back on.
☼ Red (2 Hz)	Emergency shutdown, this error can only be cleared by switching off and on again.

9.4 Extended diagnostics

Usage on Flexi Soft

The software for configuring the Flexi Soft safety controller supports advanced diagnostic options. These options allow you to further isolate the problem if the error situation is unclear or if there are availability issues. You will find detailed information in the "Flexi Loop in the Flexi Soft Designer" operating instructions, part no. 8023208.

10 Technical data

10.1 Data sheet

10.1.1 Overall system

Table 30: Data sheet overall system

	Overall system
Safety technology parameters [1] [2]	
Safety Integrity Level	SIL3 (IEC 61508)
SIL claim limit	SIL claim limit (EN 62061)
Category	Category 4 (EN ISO 13849-1)
Performance Level	PL e (EN ISO 13849-1)
PFHd (mean probability of a dangerous failure per hour) for a Flexi Loop safe sensor cascade	0.76×10^{-9}
T_M (mission time)	20 years

[1]   For detailed information on the safety design of your machine/system, please contact your local SICK subsidiary.
[2]   This information relates to an ambient temperature of +40 °C, which is normally used for the statistical calculation of the values.

10.1.2 All Flexi Loop nodes and Flexi Loop accessories

Table 31: Flexi Loop nodes and Flexi Loop accessories data sheet

	Flexi Loop nodes and Flexi Loop accessories
General data	
Protection class	III (EN 61140)
Enclosure rating	IP 65 and IP 67 (EN 60529) UL type 1
Ambient temperature in operation	–25 ... +55 °C
Storage temperature	–25 ... +70 °C
Shock resistance	
Continuous shock	10 g, 16 ms (EN 60068-2-64)
Single shock	30 g, 11 ms (EN 60068-2-27)
Electromagnetic compatibility	Class A (EN 61000-6-2, EN 55011)
Dimensions [1] (W × H × D)	68.15 × 48 × 18 mm
Weight [1]	28 g (±5 %)
Housing material	Polycarbonate (PC) Acrylonitrile butadiene styrene (ABS) Polyester
M12 plug connector torque	Max. 0.2 Nm
Response time with Flexi Soft	For the response time of the Flexi Soft safety controller (see section "Calculating response times" in the Flexi Soft hardware operating instructions), the following value must be added to the total E1 (case b = type 4 testable sensors): 10 ms
Minimum cut-off time	

	Flexi Loop nodes and Flexi Loop accessories
SC-FLN-OSSDx [7] SC-FLN-EMSSx [8]	10 ms 40 ms
Minimum restart time [2]	120 ms
Max. power-up delay following switching on of supply voltage SC-FLN-OSSDx and SC-FLN-EMSSx SC-FLA-PWRI	 5 s 10 s
Propagation times for diagnostic bits and bits of non-safe inputs and outputs	
AUX_IN [3]	
1 ... 8 Flexi Loop nodes 9 ... 16 Flexi Loop nodes 17 ... 24 Flexi Loop nodes 25 ... 32 Flexi Loop nodes	404 ms 540 ms 668 ms 796 ms
AUX_OUT [3]	
1 ... 8 Flexi Loop nodes 9 ... 16 Flexi Loop nodes 17 ... 24 Flexi Loop nodes 25 ... 32 Flexi Loop nodes	305 ms 441 ms 569 ms 697 ms
DIAG_IN [3] [4]	
1 ... 8 Flexi Loop nodes 9 ... 16 Flexi Loop nodes 17 ... 24 Flexi Loop nodes 25 ... 32 Flexi Loop nodes	712 ms 1,400 ms 2,288 ms 3,376 ms
DIAG_OUT [3] [4]	
1 ... 8 Flexi Loop nodes 9 ... 16 Flexi Loop nodes 17 ... 24 Flexi Loop nodes 25 ... 32 Flexi Loop nodes	708 ms 1,396 ms 2,284 ms 3,372 ms
Electrical data	
Supply voltage (U_V)	16.8 ... 30 V DC
Supply voltage for UL / CSA applications	24 V DC
Type of supply voltage	SELV or PELV
Overvoltage cut-off	At 34.5 V DC ±2 V DC
Undervoltage cut-off	At 15.5 V DC ±1 V DC
Maximum current at 40 °C	4 A [5]
Maximum current at 55 °C	3.19 A
Current in Flexi Loop communication inputs	3 ... 6.2 mA
Maximum short-circuit currents (Flexi Loop communication and test outputs)	13.5 mA
Current consumption	
SC-FLN-OSSDx	45 mA
SC-FLN-EMSSx	55 mA
SC-FLA-PWRI	30 mA (PWR left) / 55 mA (PWR right)
SC-FLT-TERM	30 mA

	Flexi Loop nodes and Flexi Loop accessories
System connection	M12 male/female connector [6]

1) Not terminator.
2) Minimum time which must elapse following switching off before a restart.
3) Applies for a runtime within the logic of 4 ms.
4) Applies when an event occurs.
5) The current for the power supply unit used for the Flexi Loop must be limited externally to max. 4 A either by the power supply unit itself or using a fuse.
6) Terminator, male connector only.
7) Time without sensor; the data from the connected sensors also applies.
8) Included automatically in the calculation of the overall response time for the safety controller and the safe sensor cascade.

10.1.3 EMSS Flexi Loop nodes (SC-FLN-EMSS5 and SC-FLN-EMSS8)

Table 32: Data sheet for EMSS Flexi Loop nodes

	SC-FLN-EMSS5 SC-FLN-EMSS8
EMSS inputs/outputs	
Test pulse duration (test gap)	12 ms
Test period	40 ms
Current due to test pulses via switching contacts	3 ... 6.2 mA AC [1] at U_V –3 V
Discrepancy time monitoring	3 s

1) Alternating current pulsating with test gaps.

Additional data for 8-pin variant SC-FLN-EMSS8

Table 33: Additional data for variant SC-FLN-EMSS8

	SC-FLN-EMSS8
Non-safe input (AUX_IN)	
Logic level switching points	
HIGH	> 13 V/3.5 mA
LOW	< 5 V/2.5 mA
Maximum input current	6.2 mA
Debouncing	100 ms
Non-safe output (AUX_OUT)	
Type of output	High-side driver, short-circuit protected
Output current	Max. 500 mA
Permissible capacitive load	Max. 1 µF
Internal discharging resistance	Typically 200 kOhm

10.1.4 OSSD Flexi Loop nodes (SC-FLN-OSSD5 and SC-FLN-OSSD8)

Table 34: Data sheet OSSD Flexi Loop node

	SC-FLN-OSSD5 SC-FLN-OSSD8
OSSD inputs	
Input voltage HIGH	13 ... 30 V DC
Input voltage LOW	–5 ... +5 V DC
Input current HIGH	3.5 ... 6.2 mA
Input current LOW	–2.5 ... +2.5 mA

	SC-FLN-OSSD5 SC-FLN-OSSD8
Test pulse duration (test spacing) [1]	<1 ms
Discrepancy time monitoring	3 s
Voltage supply for OSSD devices	
Supply voltage	16.8 … 30 V DC
Maximum current	
SC-FLN-OSSD5 at 40 °C	3.9 A
SC-FLN-OSSD8 at 40 °C	2 A
SC-FLN-OSSD5 at 55 °C	3.1 A
SC-FLN-OSSD8 at 55 °C	1.5 A
Non-safe input (AUX_IN)	
Logic level switching points	
HIGH	>13 V/3.5 mA
LOW	<5 V/2.5 mA
Maximum input current	6.2 mA
Debouncing	100 ms

[1]   Is defined by the OSSD device.

Additional data for 8-pin variant SC-FLN-OSSD8

Table 35: Additional data for variant SC-FLN-OSSD8

	SC-FLN-OSSD8
Non-safe output (AUX_OUT)	
Type of output	Highside driver, short-circuit protected
Output current	Max. 500 mA
Permissible capacitive load	Max. 1 µF
Internal discharging resistance	Typical 200 kOhm

10.1.5   Terminator

Table 36: Data sheet for SC-FLT-TERM terminator

	SC-FLT-TERM
Dimensions terminator (W × H × D)	54 × 13.6 × 13.6 mm
Weight terminator	8 g (±5 %)
Current consumption	30 mA

10.1.6   PWRI power supply accessory

Table 37: Data sheet PWRI power supply accessory

	SC-FLA-PWR1
Electrical data	
Internal resistance	Approx. 50 mΩ
Output current monitoring	
Permissible capacitive load	Max. 4.7 mF

	SC-FLA-PWR1
Permissible inductive load	Max. L = 0.74 J/I² e.g.: 0.18 H @ 2.0 A 2.90 H @ 0.5 A
Overcurrent monitoring	
Inrush current within 20 ms	Max. 40 A
Surge when switched on with capacitive load change	Max. 20 A

Characteristic curve
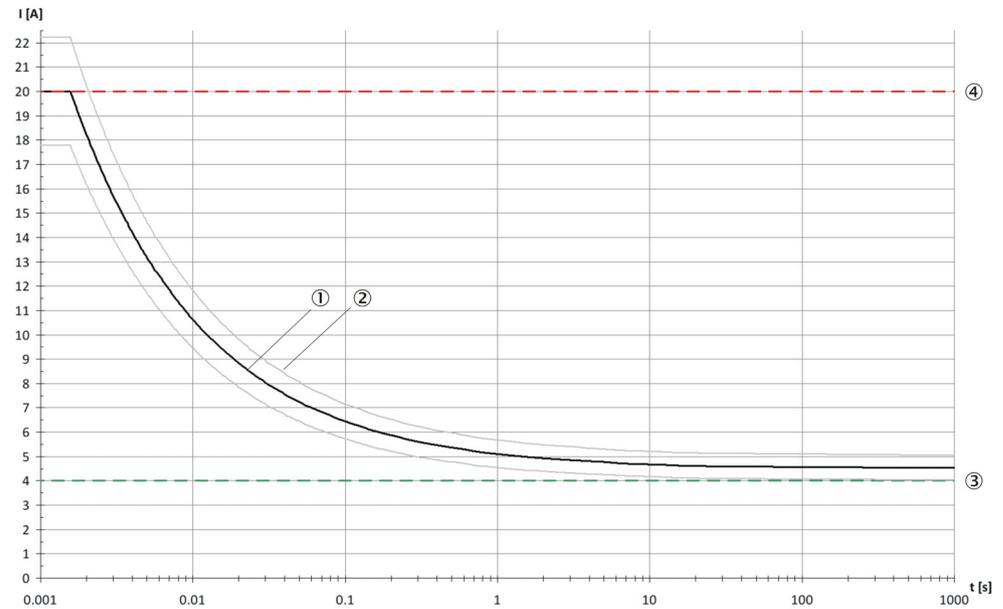
Figure 39: Characteristic curve for PWRI power supply accessory

①   Current characteristic at 40 °C

②   Tolerance

③   Permissible continuous current

④   Emergency shutdown

10.2 Dimensional drawings

10.2.1 Dimensional drawing Flexi Loop node
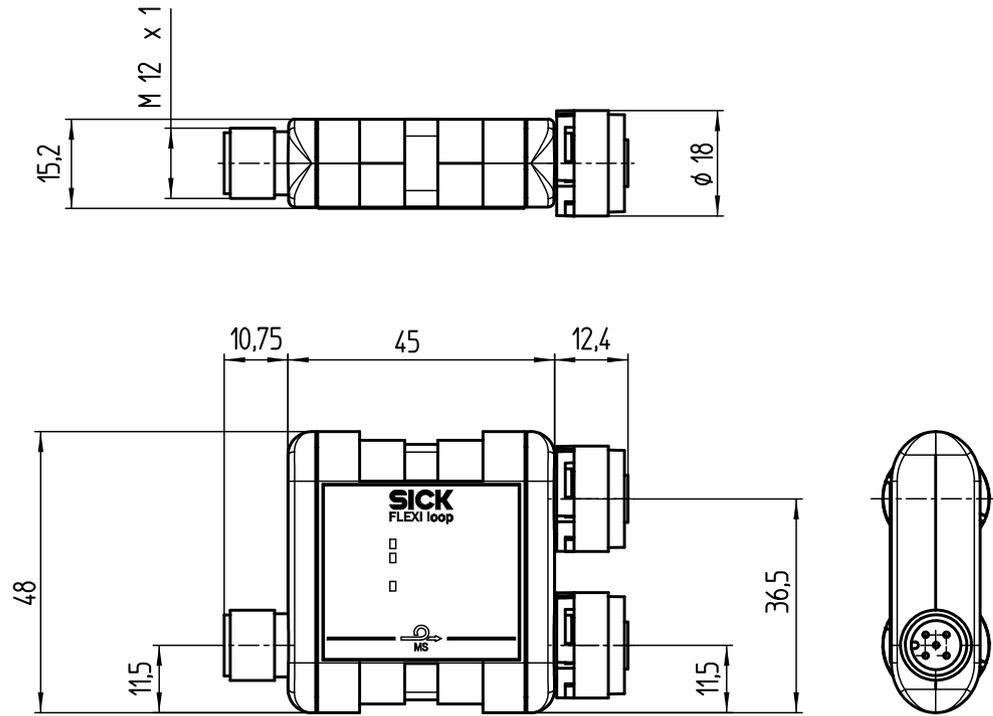
Figure 40: Dimensional drawing Flexi Loop node (mm)

10.2.2 Dimensional drawing PWRI power supply accessory
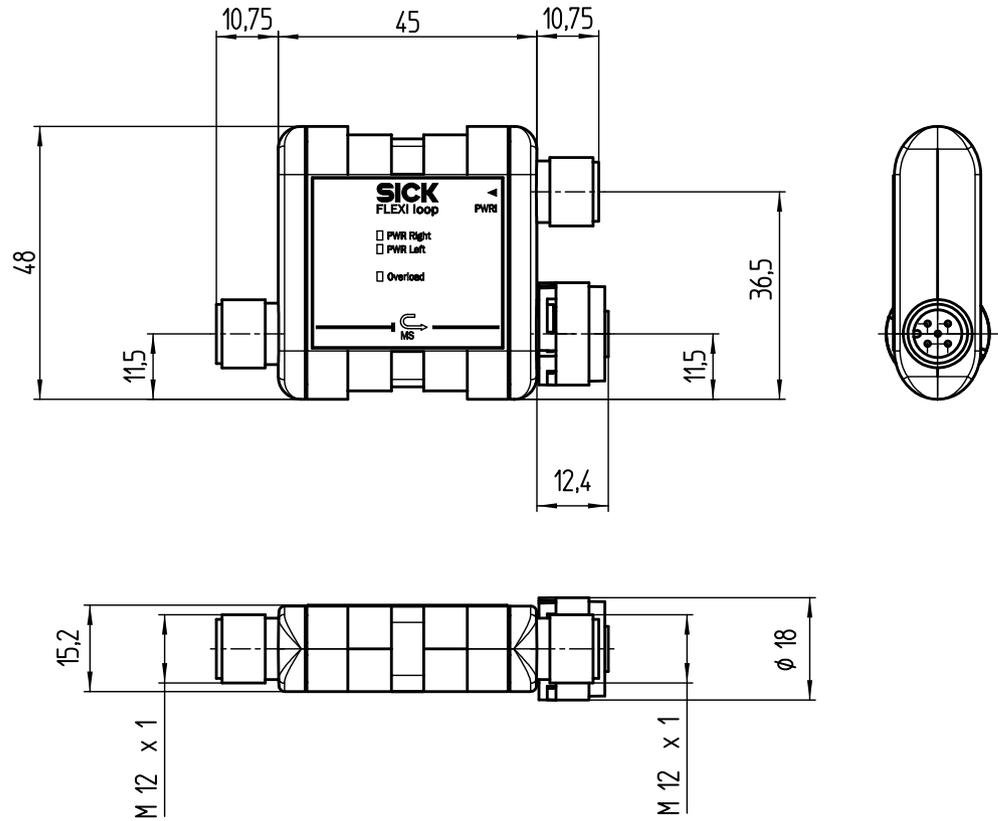
Figure 41: Dimensional drawing PWRI power supply accessory (mm)

10.2.3 Dimensional drawing terminator
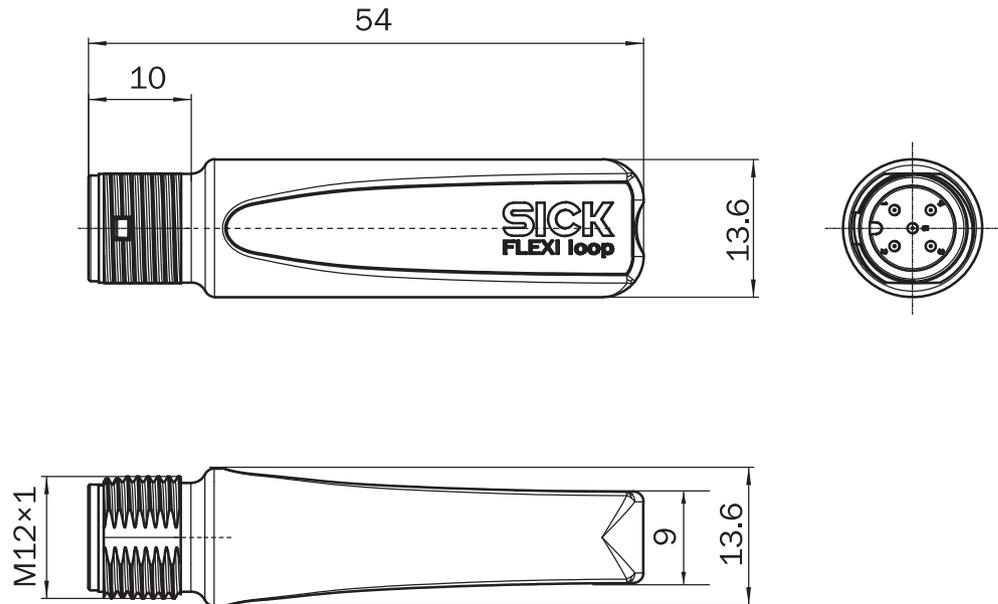
Figure 42: Dimensional drawing Flexi Loop termination element (mm)

11 Accessories

11.1 Mounting accessories

Table 38: Part numbers mounting accessories

Part	Part number
C-Fix bracket	2103178

12 Annex

12.1 Compliance with EU directives

EU declaration of conformity (excerpt)

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

Complete EU declaration of conformity for download

You can call up the EU declaration of conformity and the current operating instructions for the protective device by entering the part number in the search field at www.sick.com (part number: see the type label entry in the "Ident. no." field).

12.2 Checklist for the manufacturer

Checklist for manufacturers / installers for the installation of the Flexi Soft safety controller

The details on the items listed below must be available when the system is commissioned for the first time at the latest. However, they are determined by the application, the requirements of which must be reviewed by the manufacturer / installer.

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

This checklist does not replace initial commissioning or periodic thorough checks by qualified safety personnel.

Table 39: Checklist for the manufacturer

Have the safety rules and regulations been observed in compliance with the directives/standards applicable to the machine?	Yes ☐	No ☐
Are the applied directives and standards listed in the declaration of conformity?	Yes ☐	No ☐
Does the protective device comply with the required category?	Yes ☐	No ☐
Are the required protective measures against electric shock in effect (protection class)?	Yes ☐	No ☐
Has the protective function been checked in compliance with the test notes of this documentation? In particular: functional check of the input devices, sensors and actuators connected to the safety controller thorough check of all cut-off paths	Yes ☐	No ☐
Are you sure that the safety controller was tested fully for safety functionality after each configuration change?	Yes ☐	No ☐

13   List of figures

14 List of tables

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