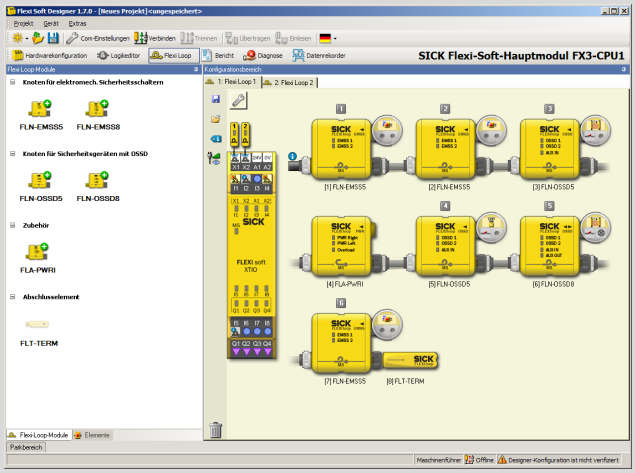
OPERATING INSTRUCTIONS

Flexi Loop in Flexi Soft Designer

Configuration software

SC-FSD

SICK
Sensor Intelligence.



Described product

Flexi Loop in Flexi Soft Designer

SC-FSD V1.8.0

Configuration software

Manufacturer

SICK AG
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Germany

Legal information

Original document

This document is an original document of SICK AG.

CE

Contents

1 About this document

1.1 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.

1.2 Scope

These operating instructions apply to the Flexi Soft Designer SC-FSD configuration software in conjunction with the safe series connection Flexi Loop in Flexi Soft Designer.

These operating instructions are included with SICK part number 8023208 (all available languages of this document).

Furthermore, the following documents contain information about the safe sensor cascade:

Table 1: Available documents

Document	Title	Part number
Operating instructions	Flexi Loop Safe Sensor Cascade Hardware	8023204
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

1.3 Target groups and structure of these operating instructions

These operating instructions are intended for the following target groups: project developers (planners, developers, designers) and maintenance personnel.

The structure of these operating instructions is based on the life cycle phases of the safe sensor cascade: project planning, configuration, and troubleshooting.

In many applications, therefore, the target groups consist of the manufacturer and the operator of the machine in which the safe sensor cascade integrated:

Table 2: Assignment of target groups

Area of responsibility	Target group	Special chapters of these operating instructions [1]
Manufacturer	Project developers (planners, developers, designers)	"Project planning", page 11 "Configuration", page 17
Operators	Maintenance personnel	"Troubleshooting", page 36

[1] Chapters not listed here are intended for all target groups. All target groups must follow all of the safety and warning instructions in all chapters of the operating instructions!

In other applications, the operating entity is also the manufacturer of the machine, with the target groups being assigned accordingly.

1.4 Additional information

www.sick.com

The following information is available on the Internet:

- versions 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)

1.5 Symbols and document conventions

In this operating instructions the following symbols are used:

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 for action

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

2 Safety information

2.1 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.

2.2 Intended use

The Flexi Soft Designer software is used to configure a Flexi Loop safe sensor cascade.

A Flexi Loop safe sensor cascade may only be used by qualified personnel and only on the machine on which it was installed and initially commissioned by qualified safety personnel in accordance with the operating instructions for the software and the hardware.

DANGER
If used in any other way or if alterations are made to the software or the devices – including in the context of mounting and installation – warranty claims submitted to SICK AG shall be rendered null and void.

- Pay attention to the safety notes and protective measures described in the “Flexi Loop Safe Sensor Cascade” and “Flexi Loop in the Flex Soft Designer Configuration Software” operating instructions.
- Check that the implementation of a safety-relevant functional logic is compliant with the requirements of national and international standards, paying particular attention to the control strategies and measures for minimizing risk that are prescribed for your application.

2.3 Requirements on the qualification of the personnel

Only qualified safety personnel are permitted to configure, 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.

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.

3 Product description

3.1 Operating principle of Flexi Soft

Data traffic in the safe sensor cascade is integrated into data traffic in the Flexi Soft safety controller.

Safe cut-off path

The safety information from the connected switches and sensors is collated and sent quickly and securely to the Flexi Soft controller.

In the logic editor, this status is represented by a single safe bit **Flexi Loop: safe input.** It is only with this bit that the following cut-off paths for the machines and systems to be monitored may be implemented.

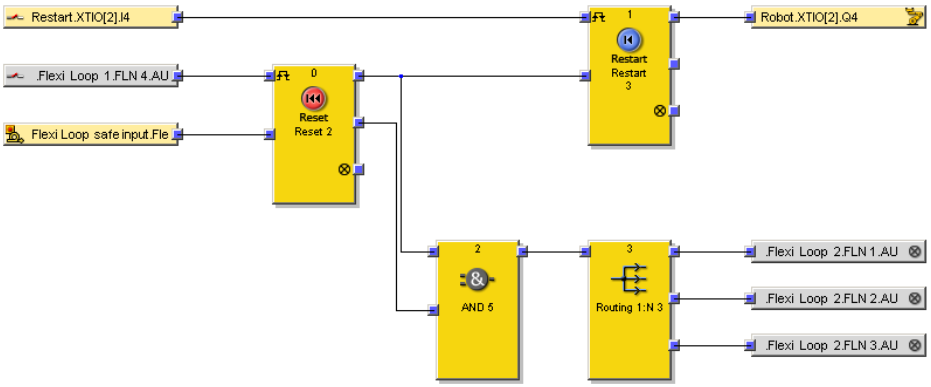

Figure 1: The Flexi Loop safe bit in the logic editor

Diagnostic information for the safe sensor cascade

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

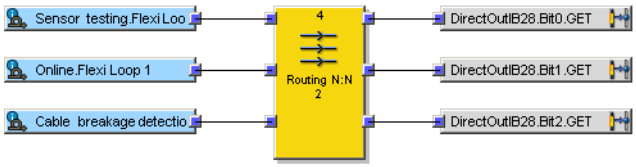

Figure 2: Diagnostic information in the logic editor

In the logic, the information is represented by the following bits (blue):

- Sensor testing: Indicates whether testing of all of the switches and sensors connected to the safe sensor cascade has been completed without errors.
- Online: Indicates whether communication is active inside the safe sensor cascade.
- Cable break detection: Indicates whether the connection cable between two Flexi Loop nodes is broken.

DANGER

Never use the diagnostics information for safety-related applications!

Only the single safety-related bit for the cut-off path is allowed to be used for safety-related applications.

Diagnostic information for the Flexi Loop nodes

Moreover, the following non-safe diagnostic information is also made available by every Flexi Loop node.

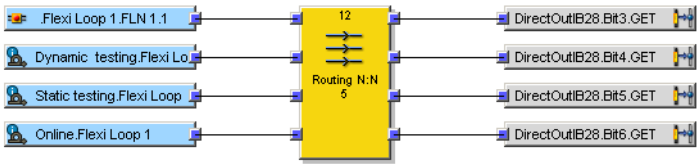

Figure 3: Diagnostic information for the individual Flexi Loop nodes in the logic editor

In the logic, the information is represented by the following bits (blue):

- Tag name of the connected element: The bit shows the status of the connected sensors or switches. It is used to evaluate which Flexi Loop nodes have been cut off.
- Dynamic testing: The bit shows discrepancy errors or sequence errors affecting the connected sensors or switches.
- Static testing: The bit shows electronic errors such as cross-circuits or short-circuits affecting the connected sensors or switches.
- Node detected: The bit shows whether a Flexi Loop node that has been configured in Flexi Soft Designer is actually physically present.
  - If the line is online, this bit shows whether the node has been found.
  - If a cable break has been detected, this bit shows whether this node is still located in the intact area of the cascade.

DANGER

Never use the diagnostics information for safety-related applications!

Only the single safety-related bit for the cut-off path is allowed to be used for safety-related applications.

The safety information and the non-safe information can be undergo further processing in the logic of the Flexi Soft safety controller or it can be forwarded to a PLC, for example, via a gateway (see "Configuration in the logic editor", page 29).

4 Project planning

4.1 Energy balance in Flexi Soft Designer

The energy balance in Flexi Soft Designer will assist you in configuring the safe sensor cascade.

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

The safe series connection is divided into segment, section, and line (see the “Flexi Loop Safe Series Connection Hardware” operating instructions, part no. 8023204). Flexi Soft Designer supports an option for the offline calculation or online measuring of the voltage drop in the sections of a line.

Configuring Flexi Loop modules

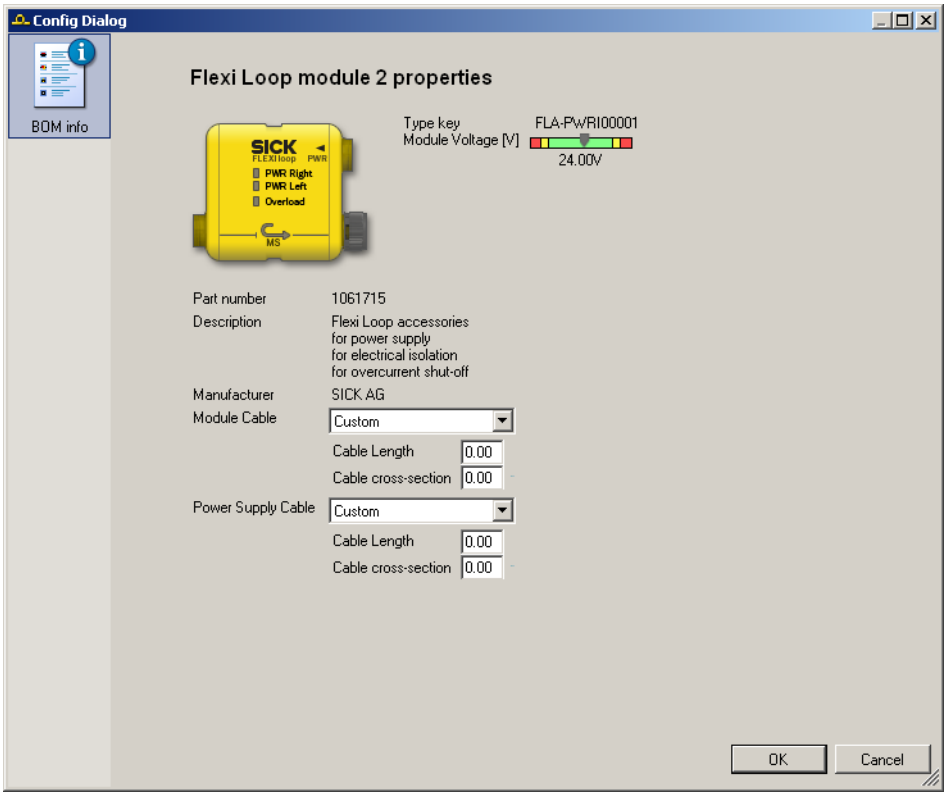

Figure 4: Configuring Flexi Loop modules

Define the module cable used for the PWRI power supply accessory and the cable used for the supply voltage:

- ▶ Select or define module cable.
- ▶ Select or define the cable for the supply voltage.

For the EMSS or OSSD Flexi Loop nodes define the module cable used and the sensor/actuator cable used:

- ▶ Select or define module cable.
- ▶ Select or define power supply cable.

You can select stipulated cables or define customer-specific cables:

- ▶ Select cable.
- ▶ Alternatively define customer-specific cable.
- ▶ Enter cable length in m.
- ▶ Enter core cross-section in mm^2.

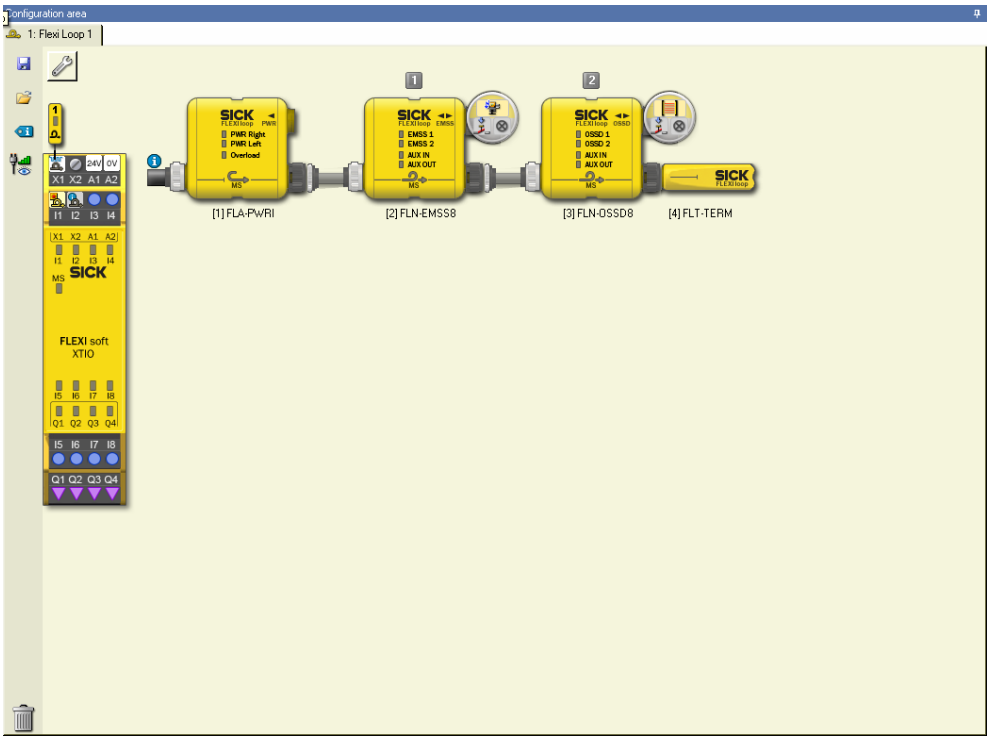

Figure 5: Switching to design

① Switching to design

- ▶ Click the button shown to open the configuration dialog.

Figure 6: Button to open the configuration dialog

✓ Flexi Soft Designer displays the energy balance.

Calculating voltage drop and power consumption

NOTE

The value to be entered for the input voltage and the input current calculated are valid for one section. A section extends from an incoming power supply to the next power supply accessory or as far as the terminator.

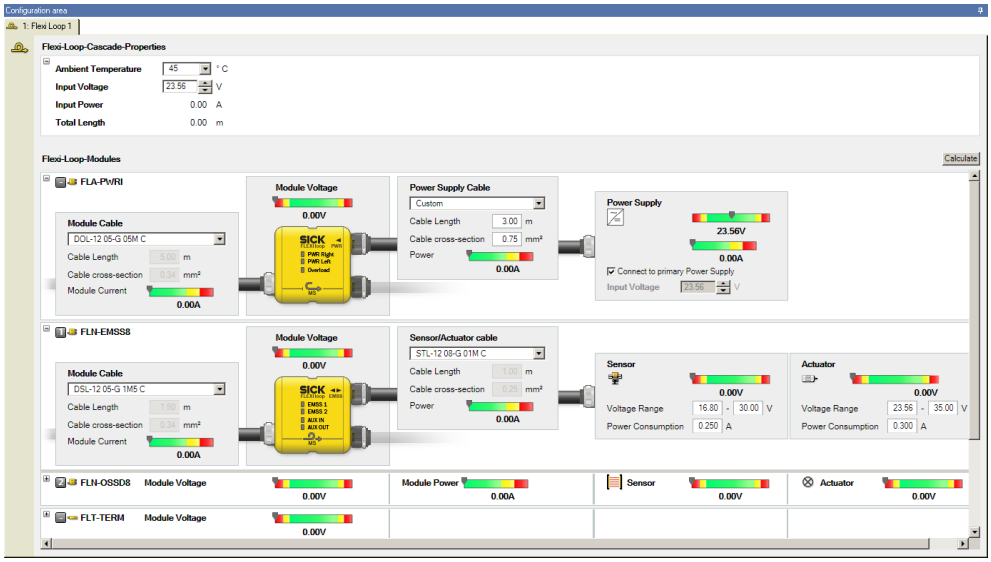

Figure 7: Calculating voltage drop and power consumption

① Maximum ambient temperature and input voltage
② Open detailed view of the Flexi Loop module
③ Data on the module cable
④ Data of the power supply cable and sensor/actuator cable
⑤ Voltage range of the sensor or actuator
⑥ Calculate button

- ▶ Select ambient temperature and enter input voltage.
- ▶ Open detailed view of the modules.
- ▶ If necessary, modify data on the module cables and sensor/actuator cables.
- ▶ Enter permitted input voltage range for the sensor or actuator.
- ▶ Enter current consumption of the sensor or actuator.
- ▶ Click on **Calculate**.
- ✓ Flexi Soft Designer calculates the voltage drop and the power consumption.

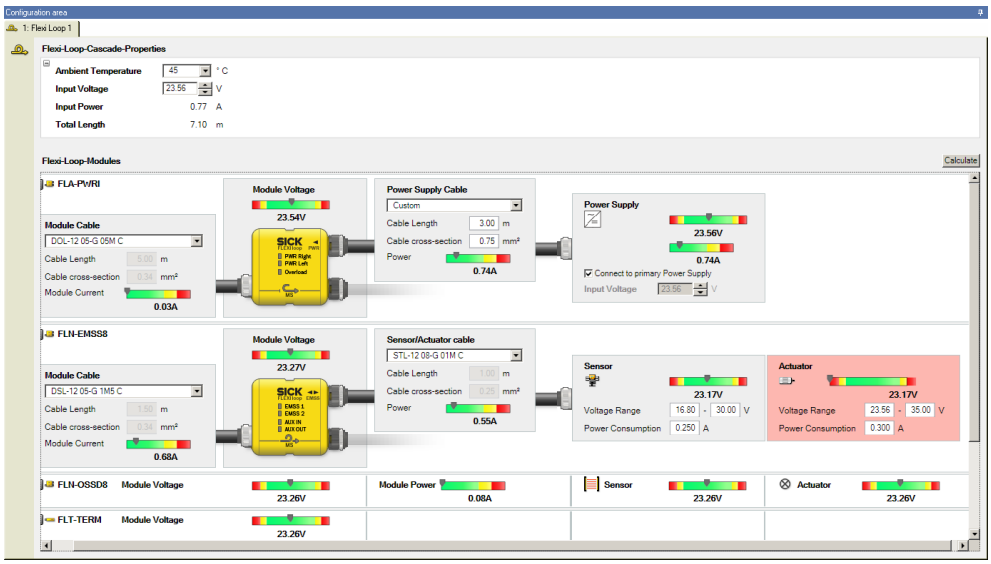

Figure 8: Calculated energy balance

① Total input current and length of the Flexi Loop string
② Module current
③ Module voltage

④ Current consumption sensor and actuator
⑤ Voltage on the sensor
⑥ Element with critical value

Flexi Soft Designer indicates the total of all currents flowing into the Flexi Loop line either directly or via the power supply accessory in the **input current** field.

4.2 Integration in the electrical control

4.2.1 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. [1)]
- 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.

1) 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.

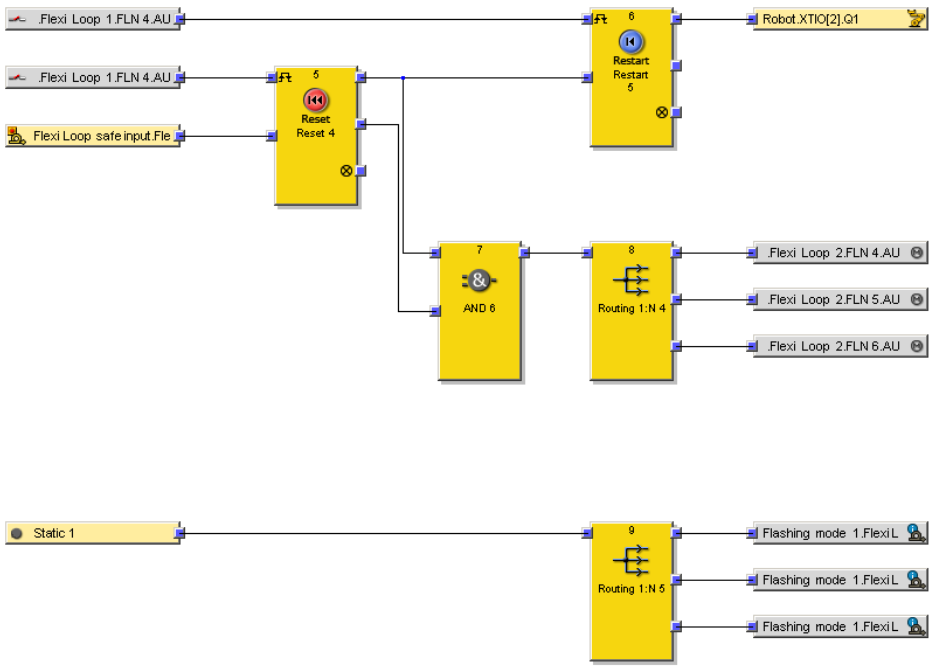

Figure 9: Implementation of reset and restart as well as the flashing mode in the logic editor

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**.

4.2.2 Implementation of a safety locking device

The **switch with dual-channel lock** (consisting of safety switch and lock) and **single-channel normally open** (actuator feedback signal) elements are connected to the Flexi Loop node.

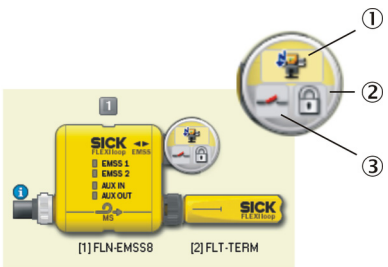

Figure 10: Elements on the EMSS node

① In = safety switch

② Out = locking device

③ In = single-channel N/O contact

In the logic editor, the **Flexi Loop safe input** safe input bit (safe cut-off signal for the corresponding Flexi Loop line) and the **single-channel normally open** non-safe input bit (for the actuator) must be processed in the application.

The **safety switch** diagnostic bit for the EMSS node can also be processed. It is by means of this process that the cut-off information is assigned to the corresponding node.

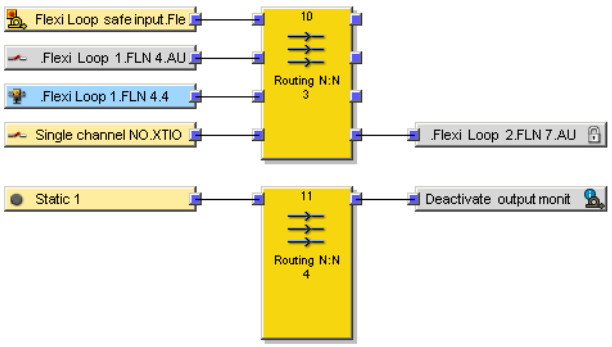

Figure 11: Locking device in the logic editor

The output bit **Interlock with locking** must be controlled by the application to lock the locking device.

Output monitoring must be deactivated with a **logic 1** input bit (see "Output options", page 32).

5 Configuration

5.1 Safety

DANGER
Test the protective device after any changes!

The entire protective device must be tested for correct operation after each change of the configuration.

5.2 Configuration in the Flexi Soft Designer

This chapter describes the functions on the safe sensor cascade that can be set via software. Some of the functions can be combined.

The “Flexi Soft in the Flexi Soft Designer Configuration Software” operating instructions contain essential and extensive information about using the Flexi Soft Designer.

5.2.1 Starting the configuration

To configure, there are two possible procedures:

- create a new project,
  e.g. to configure from scratch a Flexi Soft safety controller with a safe sensor cascade connected.
- open an existing project file,
  e.g. to add a safe sensor cascade.

5.2.2 Hardware configuration

5.2.2.1 Configuration prerequisites

At least one SC-FS-CPUx main module and one SC-FS-XTIO, SC-FS-XTDI, or SC-FS-XTDS expansion module must be positioned in the **Hardware configuration** view of Flexi Soft Designer.

Make sure that you first select the correct firmware in the **Modules** selection window.

5.2.2.2 System requirements Flexi Soft safety controller

To be able to use a safe sensor cascade on a Flexi Soft, you will need one main module and at least one expansion module. The following prerequisites apply for the modules:

Main modules

- SC-FS-CPUx

At least one expansion module

- SC-FS-XTIO
- SC-FS-XTDI
- SC-FS-XTDS

5.2.2.3 Selection of the Flexi Loop string

Up to eight safe sensor cascades can be connected to a safety controller.

A maximum of two safe sensor cascades can be connected to an extension module.

Each of these two safe sensor cascades forms a Flexi Loop line in the Flexi Soft Designer.

In the **Elements** selection window you can select these Flexi Loop strings. They are sequentially numbered from one to eight.

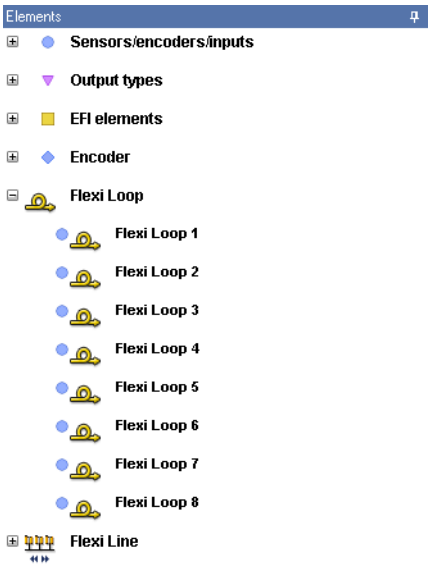

Figure 12: Flexi Loop strings 1 to 8

The number assignment is fixed. If you use the eighth Flexi Loop string, then in the following settings eight will always appear as the identification number.

Figure 13: Identification via Flexi Loop number

① Identification via Flexi Loop number

The device symbol and the tab have the same number.

5.2.2.4 Selection of the connections on the I/O module

- ▶ On the left in Flexi Soft Designer change to the **Elements** selection window.
- ▶ Choose **Flexi Loop**.
- ▶ Choose a Flexi Loop string.
- ✓ If you drag the Flexi Loop string over suitable free inputs or outputs in the configuration area using the mouse, the inputs or outputs will illuminate green.

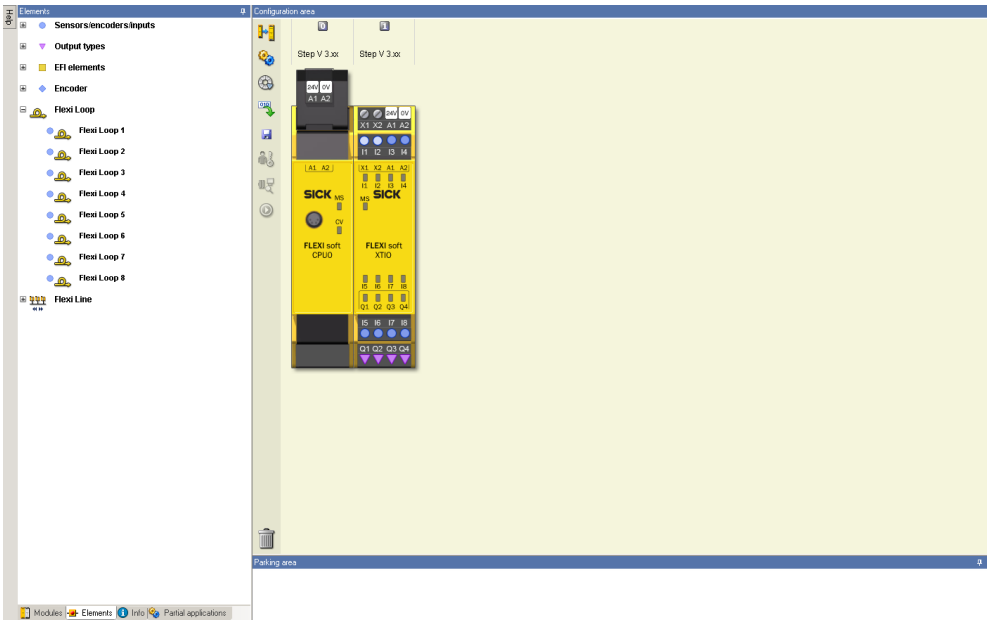

Figure 14: Selection of the Flexi Loop string

▶ Move the Flexi Loop line to a suitable position.
✓ The device symbol is now integrated into the view at this position.

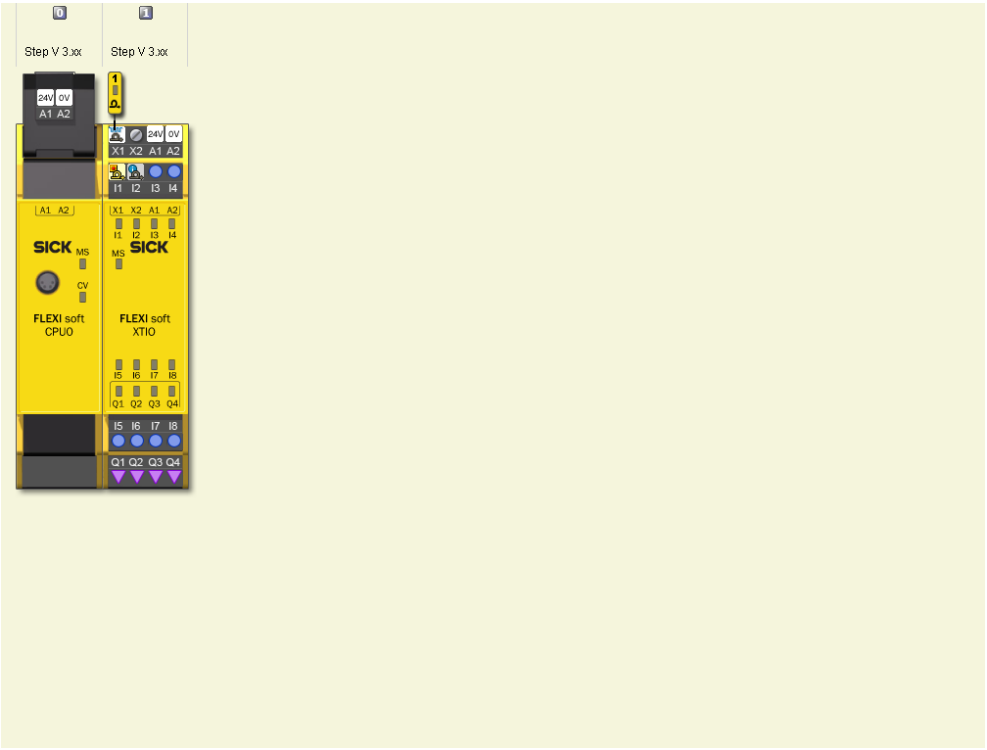

Figure 15: Connection symbols for a Flexi Loop line

A safe sensor cascade requires one output (X) and two inputs (I). The connections are labeled as follows:

 Output with Flexi Loop symbol

 Safe input with the safe bit

 Non-safe input with the data cable

When you position a Flexi Loop element, you define which terminals of an extension module communicate with the Flexi Loop protocol. The test output used (Xn), along with all safe inputs assigned to it, are no longer available for the connection of further tested input elements.

5.2.3 Flexi Loop configuration

▶ Change to the Flexi Loop configuration by changing to the **Flexi Loop** view.

Figure 16: Flexi Loop view

If there are additional interfaces (e.g. gateways) in your hardware configuration, then a selection list appears in **Interfaces.** Select **Flexi Loop** here.

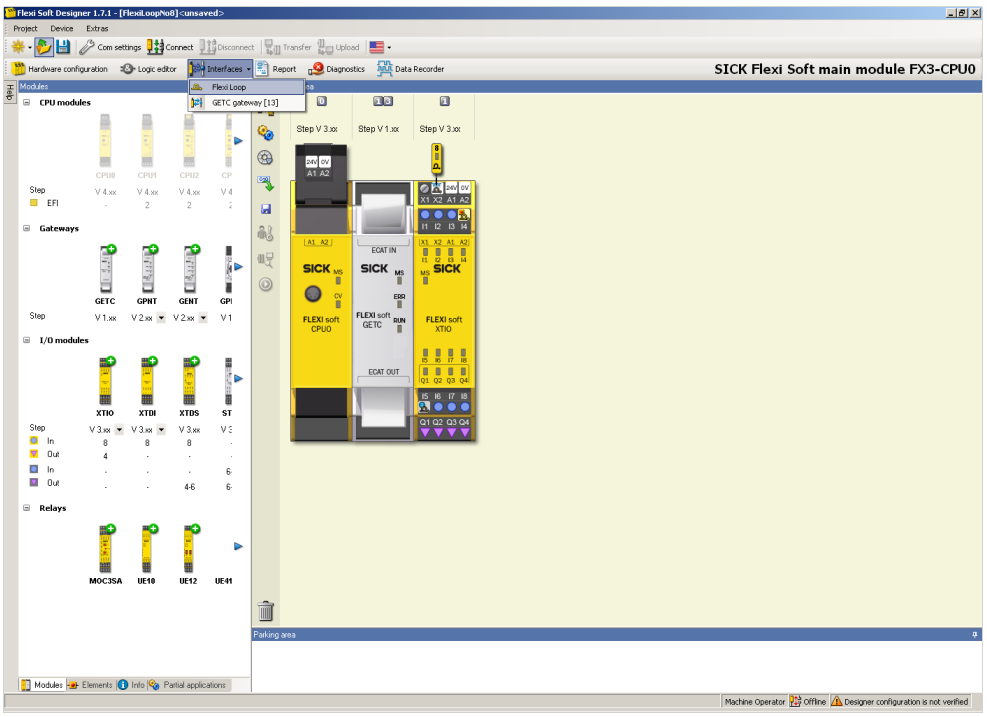

Figure 17: Selection of additional interfaces

5.2.3.1 Assembly of the safe sensor cascade

In the **Configuration area**, initially the expansion module to which the safe sensor cascade is connected is shown on the right.

- ▶ On the left, select the required Flexi Loop node or the required Flexi Loop accessory.

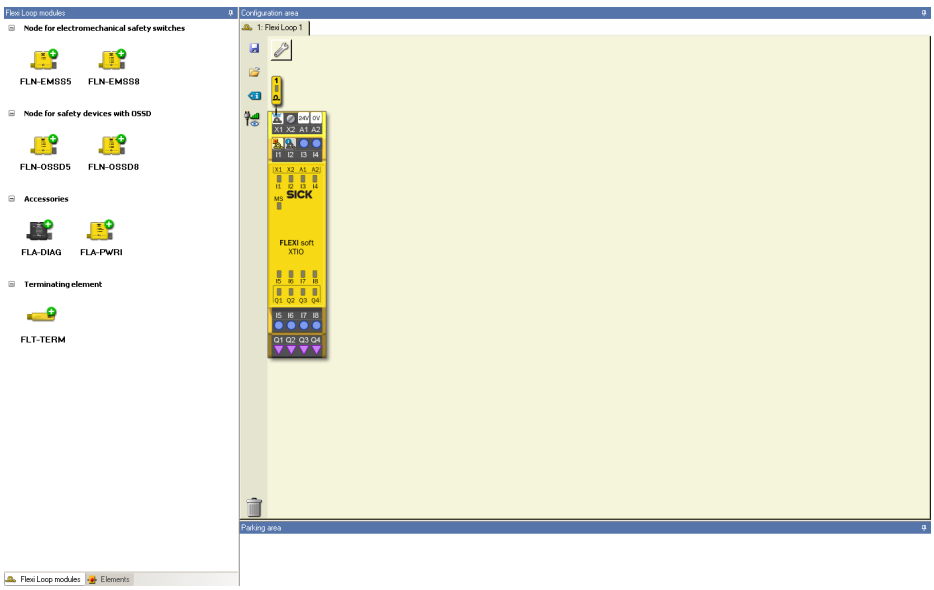

Figure 18: Selection of a Flexi Loop node

- ▶ Drag the Flexi Loop node or the Flexi Loop accessory to the right beside the I/O module.
- ✓ The Flexi Loop node or the Flexi Loop accessory is shown enlarged there.

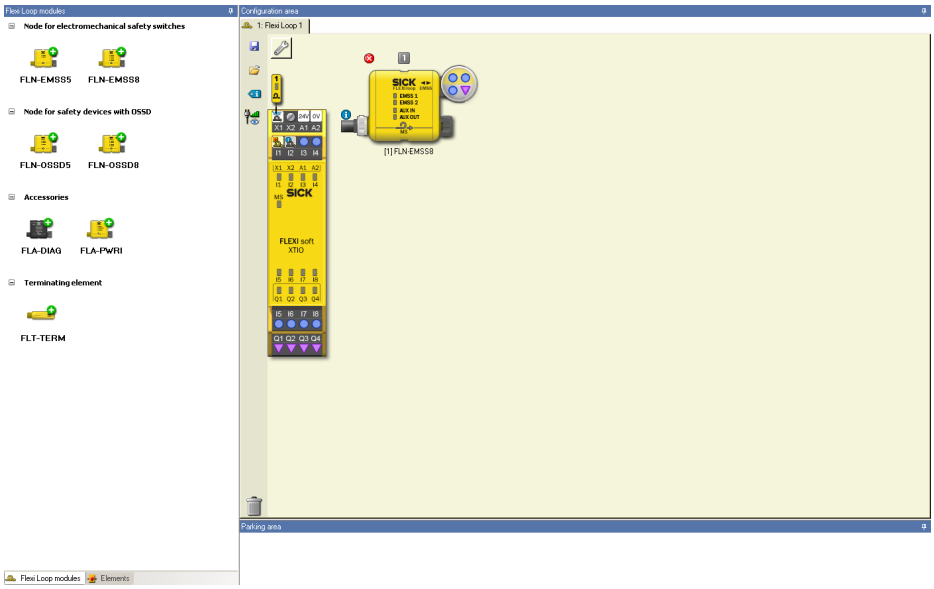

Figure 19: Flexi Loop node in the Flexi Loop configuration

- ▶ Drag the other Flexi Loop nodes or Flexi Loop accessories to the right beside the first Flexi Loop node.
- ▶ Terminate the last Flexi Loop node using a terminator.

A safe sensor cascade can contain up to 32 Flexi Loop nodes. Each Flexi Loop node is automatically given a node number. The count starts at the first Flexi Loop node connected to the I/O module and ends at the Flexi Loop node to which the terminator is connected.

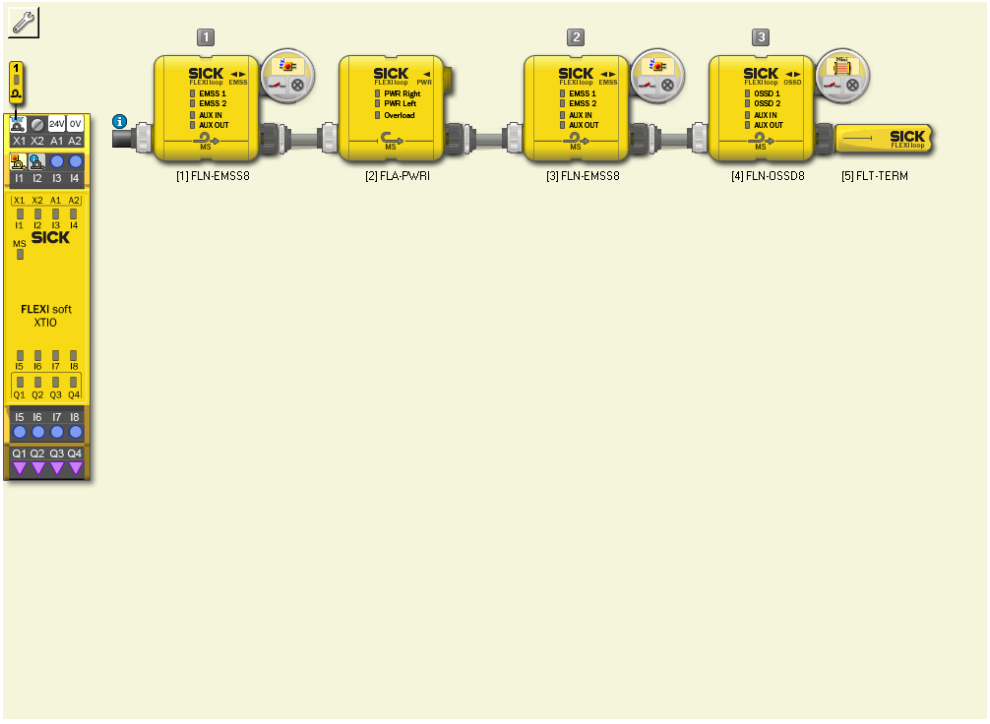

Figure 20: Counting of Flexi Loop nodes

① Logical numbering of the Flexi Loop nodes

② Physical numbering

Power supply accessories can be installed between the Flexi Loop nodes. These accessories are not assigned a logical number. Therefore, each Flexi Loop node and each Flexi Loop accessory is additionally assigned a physical number. However, this number has no impact on the maximum number of nodes.

In figure 20, the logical numbering of the Flexi Loop nodes is shown at the top and the physical numbering at the bottom.

5.2.3.2 Name of the Flexi Loop node or accessory

- ▶ Use the right mouse button to click the individual nodes and select **Edit...** on the context menu.
- ✓ The **Module properties** dialog box opens.

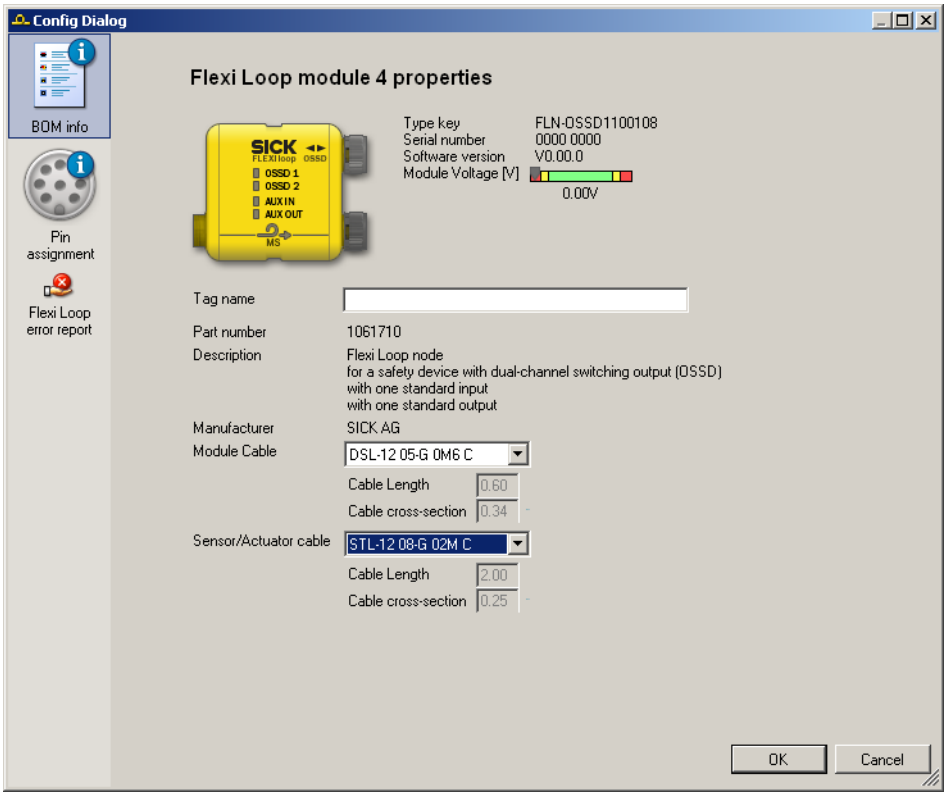

Figure 21: Module properties

The dialog box contains the following information on the Flexi Loop node:

- type code
- serial number
- software version
- module voltage
- part number
- description
- manufacturer
- module cable
- sensor/actuator cable

- ▶ Type a name for the related node in the **Tag name** field.
- ▶ Use meaningful names. The tag name is displayed in the logic editor and will aid you in identifying the input or output signal.

- In the **Module cable** field select a cable or select **Custom** and enter the cable length and wire cross-section.
- In the **Sensor/actuator cable** field select a cable or select **Custom** and enter the cable length and wire cross-section.

Pin assignment

- Click **Pin assignment** on the left.

✓ The pin assignment for the related female connectors is displayed.

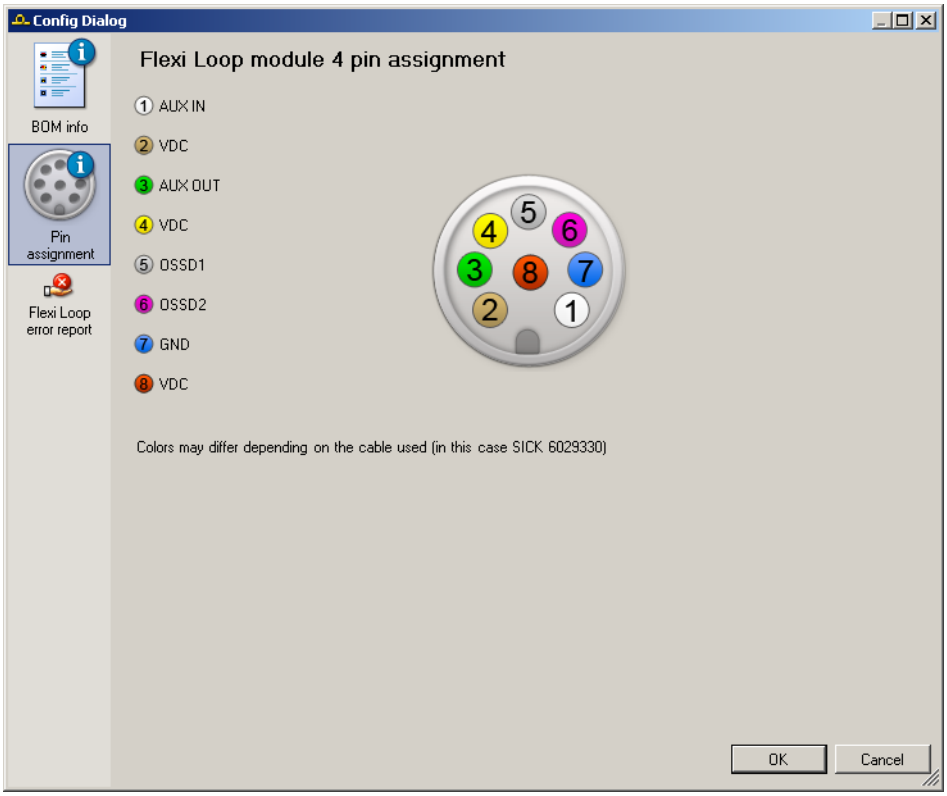

Figure 22: Pin assignment

Flexi Loop error report

In the event of errors, the **Flexi Loop error report** button is displayed on the left-hand side.

- Click **Flexi Loop error report** on the left.

✓ The errors that have occurred are displayed.

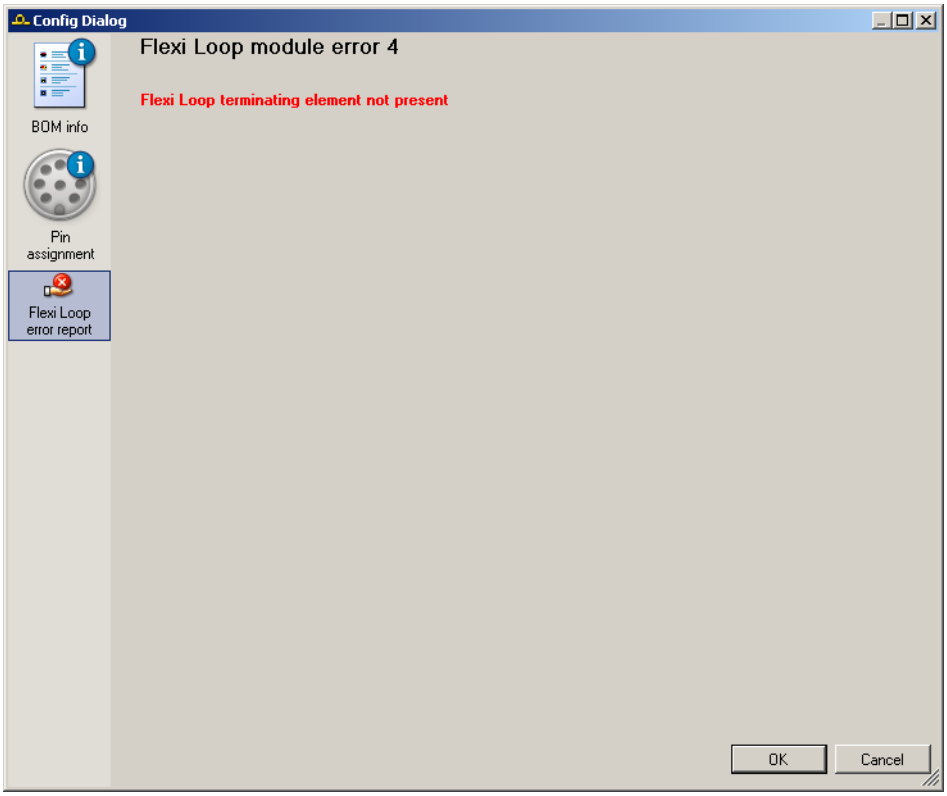

Figure 23: Flexi Loop error report

5.2.3.3 Disabling tamper protection

DANGER

Hazard due to disabling the protection against tampering!

If you disable the protection against tampering, then a Flexi Loop node can be removed or jumpered. In this situation the safe sensor cascade switches on despite the change.

Only disable the tamper protection if imperative for the implementation of the application. In this case prevent possible tampering by other measures (e.g. protected cable laying).

The node type used is saved for each position in a safe sensor cascade. In this way it is ensured that Flexi Loop nodes cannot be replaced with other types.

If you select the **Allow types other than configured** option, this tamper protection will be inactive. This option can be useful on setting up modular systems.

The number of Flexi Loop nodes configured in a safe sensor cascade is saved. In this way it is ensured Flexi Loop nodes are not replaced with other types, Flexi Loop nodes removed or added, or Flexi Loop nodes jumpered and the safe sensor cascade then switched back on again.

If you select the **Allow less nodes than configured** option, this tamper protection will be inactive. You can then, for example, set up modular systems on which the maximum number of modules is configured, but a smaller number of modules is allowed.

How to disable the tamper protection:

- ▶ In the configuration area click the **Flexi Loop setting** button.
- ✓ The following dialog box is opened:

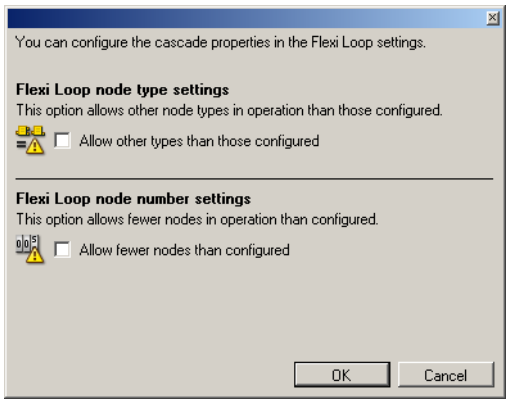

Figure 24: Disabling tamper protection

- Activate the desired option and click on **OK**.

5.2.4 Connecting sensors and switches

- Click in the bottom right of the Flexi Loop configuration to open the **Elements** window.

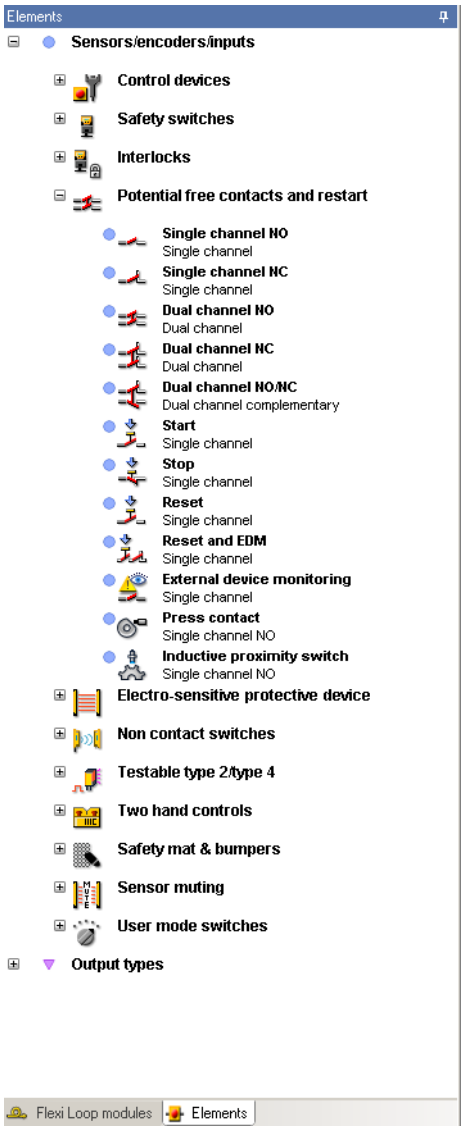

Figure 25: Changing to the elements

- ▶ Select an element.
- ✓ If you move the element over suitable free inputs or outputs, the inputs or outputs will illuminate green. The software automatically takes into account the necessary number of inputs or outputs.

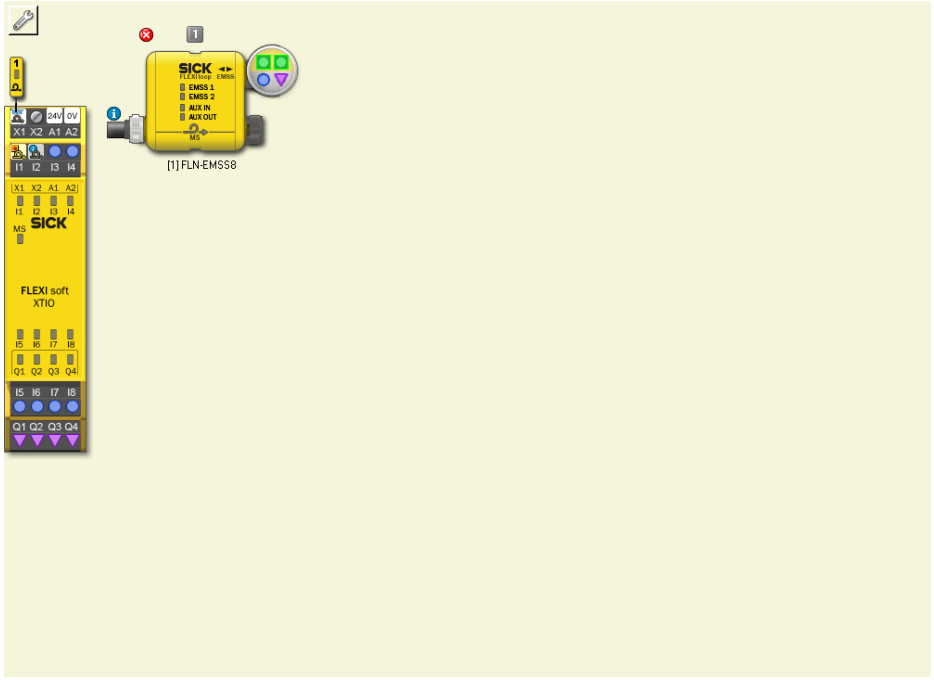

Figure 26: Suitable free inputs or outputs

- ▶ Drop the element at a suitable position.
- ✓ The device symbol is now integrated into the view at this position.

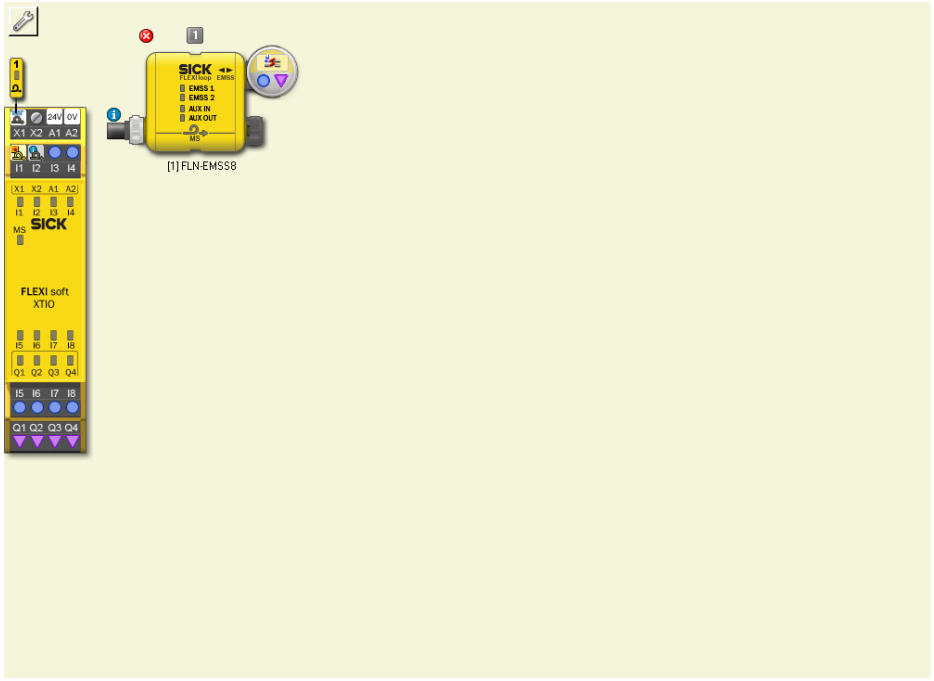

Figure 27: Flexi Loop node with element

How to delete or move elements:

- ▶ Move the element to other inputs/outputs or back to the **parking area** using the mouse.
- ▶ Delete the element by clicking the device symbol using the right mouse button and clicking **Delete** on the context menu.
- ▶ Alternatively you can drag the element to the **Recycle bin** at the bottom left of the configuration area.

5.2.4.1 Assigning tag names for the connected elements

If an element is in the configuration area, its parameters can be configured.

- ▶ Use the right mouse button to click the element and select **Edit...** on the context menu or double-click an element using the left mouse button.
- ✓ The **Element settings** window opens.
- ▶ Assign a **tag name** (identifiable name for the element). Use meaningful names. The tag names are displayed in the logic editor and are useful during configuration.

5.2.4.2 Export and Import of safe sensor cascades

You can export the configuration of a Flexi Loop string and, for instance, import it into another project. In this way you can copy a Flexi Loop string once configured.

Figure 28: Button to export the configuration

Figure 29: Button to import the configuration

5.3 Configuration in the logic editor

Once the safe sensor cascade has been configured and the sensors, switches and actuators have been connected, then the safe sensor cascade can be used in the logic editor.

Please note that due to the signal propagation times, a non-safe Flexi Loop input signal at AUX_IN 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.

5.3.1 Safe cut-off path

The safety information on the switches and sensors connected is combined and transmitted quickly and safely to the Flexi Soft.

In the Flexi Soft Designer logic editor, this status is represented by a single safe bit **Flexi Loop: safe input**. It is only with this bit that the following cut-off paths for the machines and systems to be monitored may be implemented.

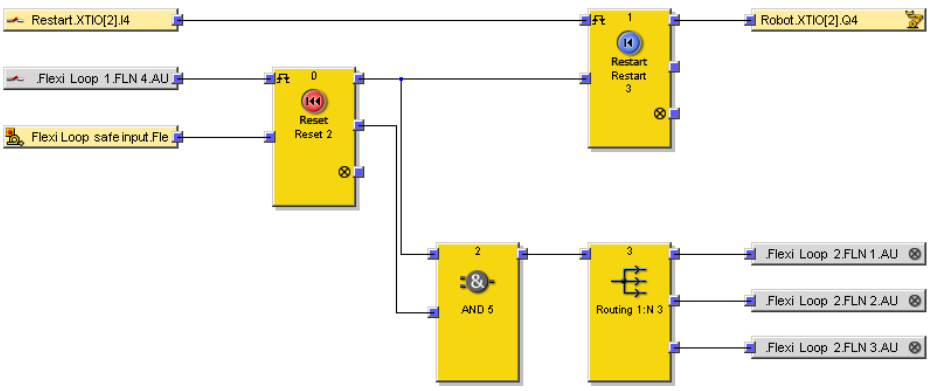

Figure 30: Flexi Loop in the logic editor of the Flexi Soft Designer

① Safe bit

- The bit is only 1 as long as a shutdown or an error has not occurred in any of the Flexi Loop nodes.
- The bit changes to 0 within the response time stated in the technical data if a shutdown has occurred or an error has occurred on one of the sensors or switches.

NOTE
When you hover the mouse over an element, its full name and additional information about the element is displayed.

5.3.2 Non-safe inputs and outputs

The non-safe inputs AUX_IN and outputs AUX_OUT are polled or set cyclically. The input or output signals are, therefore, available quickly in the logic or at the output. Exact response times are specified in the “Flexi Loop Safe Series Connection Hardware” operating instructions, part no. 8023204.

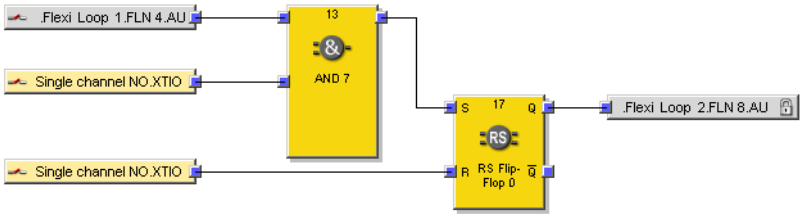

Figure 31: Non-safe inputs and outputs in the Flexi Soft Designer logic editor

① Non-safe input

② Non-safe output

The non-safe inputs and outputs are represented using the following bits (gray) in the logic:

- AUX_IN (**single-channel normally open...** in the example)
  - The bit is 1 if the non-safe input is active.
  - The bit is 0 if the non-safe input is inactive.
- AUX_OUT (**Lock.Fl...** in the example)
  - The bit is 1 if the non-safe output is active.
  - The bit is 0 if the non-safe output is inactive.

5.3.3 Diagnostics information on the safe sensor cascade

In addition non-safe diagnostics information on the states in the safe sensor cascade is sent to the Flexi Soft safety controller.

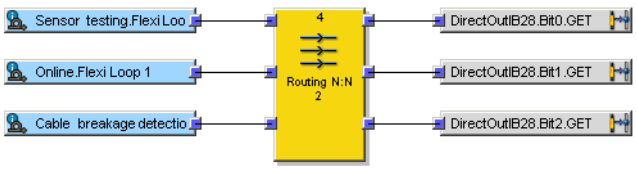

Figure 32: Diagnostics information in the Flexi Soft Designer logic editor

The information is represented using the following bits (blue) in the logic:

- Sensor testing: Indicates whether testing of all of the switches and sensors connected to the safe sensor cascade has been completed without errors.

  - The bit is 1 as long as the sensor test is successful on all the sensors and switches connected to the Flexi Loop nodes.
  - The bit is 0 if a static or dynamic error has occurred on one of the sensors or switches.
- Online: indicates whether the communication in the safe sensor cascade is active.
  - The bit is 1 if the communication in the safe sensor cascade is running.
  - The bit is 0 if the safe sensor cascade communication is interrupted.
- Cable break detection: Indicates whether the safe sensor cascade between two FLN nodes is broken.
  - The bit is 1 if the safe sensor cascade between two FLN nodes is broken.
  - The bit is 0 if there is no break.

DANGER

Never use the diagnostics information for safety-related applications!

Only the single safety-related bit for the cut-off path is allowed to be used for safety-related applications.

5.3.4 Diagnostics information on the individual Flexi Loop nodes

When the safe sensor cascade is **online**, the following non-safe diagnostic information (blue) is made available by each Flexi Loop node.

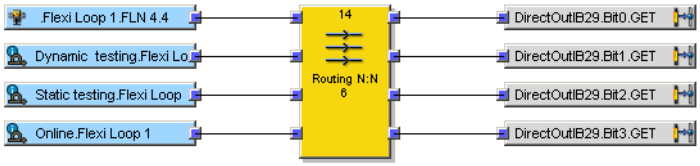

Figure 33: Diagnostics information on the individual Flexi Loop nodes in the Flexi Soft Designer logic editor

- Tag name of the element connected: The bit indicates the status of the sensors or switches connected. It is used to evaluate which Flexi Loop node has shut down.
  - The bit is 1 if there is no shutdown on the Flexi Loop node.
  - The bit is 0 if there is a shutdown.
- Dynamic testing: The bit indicates discrepancy or sequence errors on the sensors or switches connected.
  - The bit is 1 if no error occurred.
  - The bit is 0 if there is a discrepancy or sequence error.
- Static testing: The bit indicates electrical faults such as a cross-circuit or short-circuit on the sensors or switches connected.
  - The bit is 1 if no error occurred.
  - The bit is 0 if there is a cross-circuit or short-circuit.
- Node detected: The bit shows whether the Flexi Loop node is actually physically present.
  - The bit is 1 if the Flexi Loop node is present.
  - The bit is 0 if the Flexi Loop node is missing.

The safety information and the non-safe information can be further processed in the Flexi Soft safety controller logic or forwarded, e.g., via a gateway to a PLC.

NOTE

When the cascade is offline, all four bits are invalid unless the safe sensor cascade is affected by a cable break.

In the case of a cable break, the node bit is set as follows:

- The bit is 1 if the node is still located in the intact area of the cascade.
- The bit is 0 if the node is located outside the intact area of the cascade.

DANGER

Never use the diagnostics information for safety-related applications!

Only the single safety-related bit for the cut-off path is allowed to be used for safety-related applications.

5.3.5 Output options

The following output options are available for the Flexi Loop node:

- flashing mode 1 and 2 for each node
  - Flashing mode 1 causes lamps connected to AUX_OUT to flash at 1 Hz if the output is active.
  - Flashing mode 2 causes lamps connected to AUX_OUT to flash at 2 Hz if the output is active.

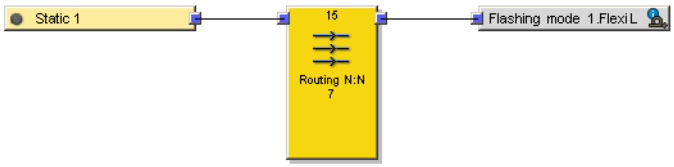

Figure 34: Activation of the flashing mode

- output monitoring
  On a Flexi Loop node with AUX_OUT and AUX_IN the output state is coupled to the input state by default. This feature means that the state of the output cannot change as long as the input is switched (in this way a flashing mode set is suppressed).

DANGER

If you use the input AUX_IN for resetting, you must never deactivate output monitoring!

By means of the output monitoring, for instance, the detection of an incorrect reset signal is prevented in the case of a cross-circuit between AUX_OUT and AUX_IN.

Set the bit if you wish to use the output AUX_OUT independently of the status of the input AUX_IN. This may be necessary, for example, for safety locking devices (see "Implementation of a safety locking device", page 15).

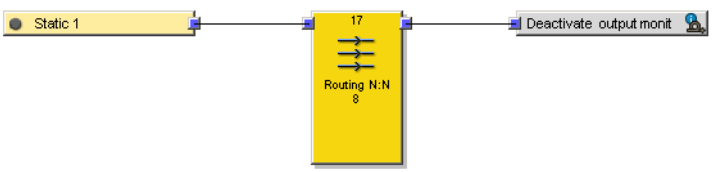

Figure 35: Deactivate the output monitoring

5.4 The safe sensor cascade in operation

Transferring the configuration

- ▶ Click the **Transfer** button on the toolbar.
- ✓ The transfer starts and a progress bar shows the progress.
  Next, you can start the main module.
- ▶ Click **Yes**.
- ✓ The Flexi Loop nodes and the Flexi Loop accessory are displayed in the Flexi Soft Designer during operation.

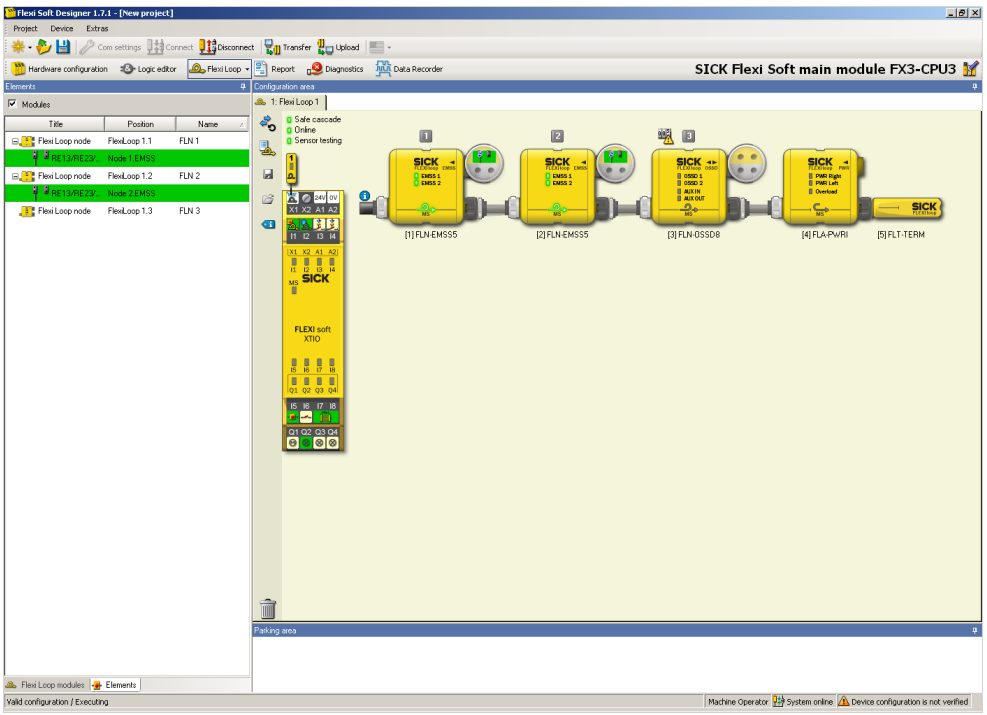

Figure 36: The safe sensor cascade in operation

In the **Flexi Loop** window you can see the LED statuses of the Flexi Loop node and the Flexi Loop accessory. The connected elements are listed in a table on the left-hand side of the window.

Restarting

Figure 37: Restart button

You can restart the safe sensor cascade using the button shown here.

Diagnostics

Figure 38: Diagnostics button

You can start the diagnostics on the safe sensor cascade using the button shown here.

Use the diagnostics if the Flexi Loop string is interrupted at a point. Flexi Soft Designer determines the number nodes still functioning.

If you start the diagnostics, the safe sensor cascade shuts down.

5.5 Connection to gateways

Using data set 1 the data can be transferred as usual via the related gateway to the higher level controller.

In data set 1 you will find the bytes of the safe sensor cascade in **Available data**.

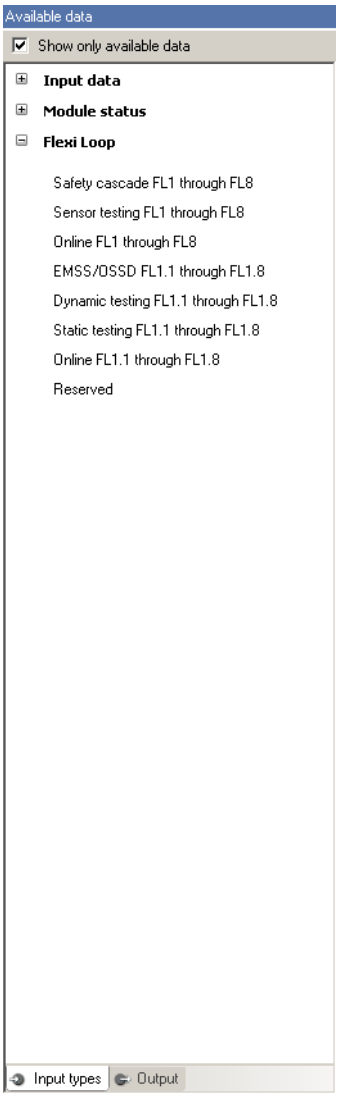

Figure 39: Available bytes of the safe sensor cascade

Using data set 1 it is possible to transfer 50 bytes and map these bytes in the gateway's data telegrams in the Flexi Soft Designer user interface.

5.6 Report

The **Report** window contains comprehensive information about the corresponding project, including a list of all configuration settings and wiring instructions.

NOTE

The report is an important part of the documentation of the safety-related validation of a machine or a system.

The report contains a **Flexi Loop** option under **Configuration** in the selection tree on the left-hand side.

If this option is selected, then the data on the safe sensor cascade, on the module to which the safe sensor cascade is connected and on each individual Flexi Loop node and Flexi Loop accessory are prepared on opening the report.

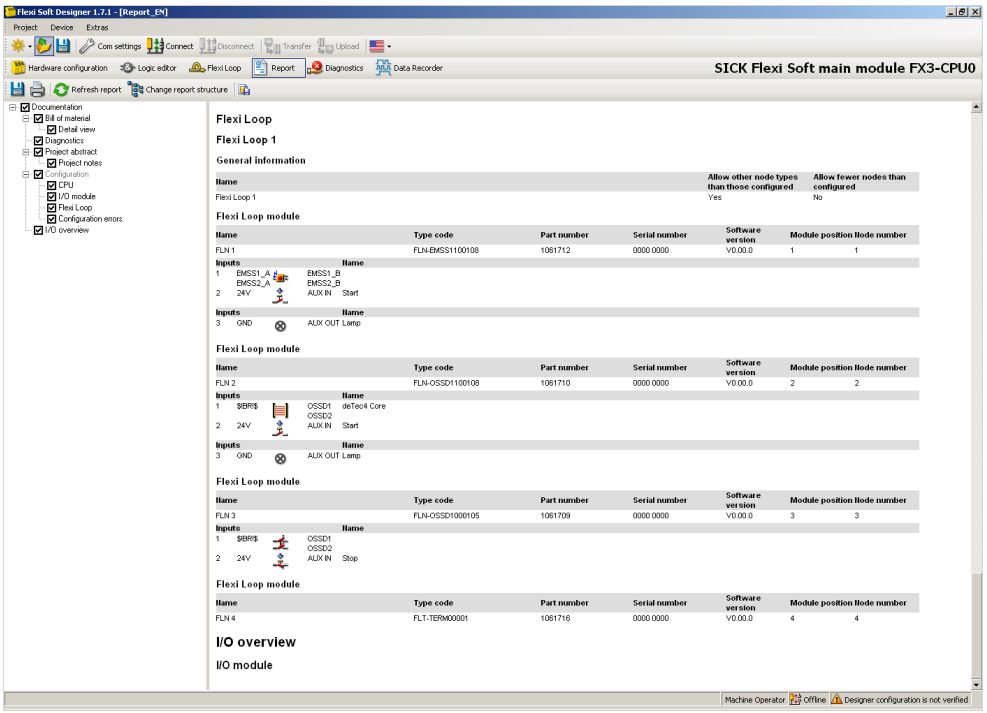

Figure 40: Report in the Flexi Soft Designer

The “Flexi Soft in the Flexi Soft Designer Configuration Software” operating instructions contain extensive information about using the report.

6 Troubleshooting

6.1 In the event of faults or errors

DANGER
In the event of unclear faults, cease operation! Stop the machine if you cannot clearly identify or allocate the error and if you cannot safely rectify the malfunction.

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.

6.2 SICK support

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

6.3 Diagnostics using Flexi Soft

Once you have completed your project and have established a connection to your Flexi Soft system, you can undertake diagnostics on your system in the Flexi Soft Designer. In the top half of the window for the **Diagnostics** view you can see a list of all messages, information, warnings and error messages for your system including the Flexi Loop node.

If you click one of the entries in the list, details on the selected message are displayed in the bottom half of the window.

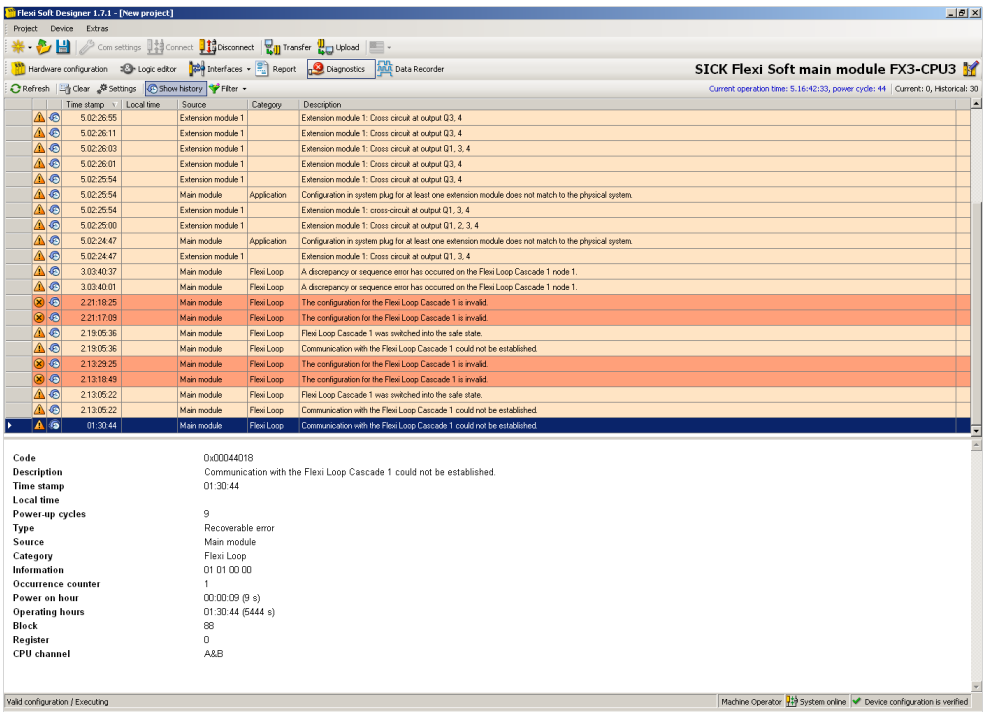

Figure 41: Diagnostics in the Flexi Soft Designer

The “Flexi Soft in the Flexi Soft Designer Configuration Software” operating instructions contain extensive information about diagnostics.

7 List of figures

8 List of tables

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