Flexi Soft Modular Safety Controller

Hardware

SC-FS-CPU0, SC-FS-XTIO, SC-FS-XTDI, SC-FS-XTDS, SC-FS-STIO

SICK
Sensor Intelligence.

Described product

Flexi Soft Modular Safety Controller

Hardware

Manufacturer

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Legal information

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Original document

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1 Ordering information

1.1 Modules

Table 1: Part numbers of Flexi Soft safety controller modules

Description	Type	Part number
Main modules		
CPU0 main module with system plug	SC-FS-CPU0	1093563
Gateways		
EtherNet/IP gateway	SC-FS-GENT	1093569
Modbus® TCP gateway	SC-FS-GMOD	1093570
PROFINET IO gateway	SC-FS-GPNT	1093572
EtherCAT gateway	SC-FS-GETC	1093573
PROFIBUS DP gateway	SC-FS-GPRO	1093574
CANopen gateway	SC-FS-GCAN	1093575
DeviceNet gateway	SC-FS-GDEV	1093577
Expansion modules		
I/O module 8 safe inputs, 4 safe outputs, plug-in dual level spring terminals	SC-FS-XTIO	1093568
I/O module 8 safe inputs, plug-in dual level spring terminals	SC-FS-XTDI	1093622
I/O module 8 safe inputs, 4/6 non-safe outputs, plug-in dual-level spring terminals	SC-FS-XTDS	1097025
I/O module 6/8 non-safe inputs, 8/6 non-safe outputs, plug-in dual-level spring terminals	SC-FS-STIO	1097024

1.2 Accessories

Table 2: Part numbers for accessories for the Flexi Soft safety controller

Description	Part	Part number
Configuration cable, M8 on USB-A, 2 m	SC-FS-PC-CPU0	2099590

2 About this document

These operating instructions contain the information needed during the life cycle of the Flexi Soft modular safety controller.

They must be made available to all those who work with the Flexi Soft modular safety controller.

Please read these operating instructions carefully and make sure that you understand the content fully before working with the Flexi Soft modular safety controller.

2.1 Function of this document

There are operating instructions and mounting instructions for the Flexi Soft system, each covering clearly defined fields of application.

Table 3: Overview of the Flexi Soft documentation

Document type	Title	Contents	Purpose	Part number
Operating instructions	Flexi Soft modular safety controller Hardware	Description of the Flexi Soft modules and their functions	Instructions for technical personnel working for the machine manufacturer or operator on the safe mounting, electrical installation, and maintenance of the Flexi Soft safety controller	8022462
Operating instructions	Flexi Soft in Flexi Soft Designer Configuration software SC-FSD	Description of how to configure and set the parameters for the Flexi Soft safety controller plus key diagnostic functions using software. Also contains detailed information about identifying and rectifying faults	Instructions for technical personnel working for the machine manufacturer or operator on the safe configuration and commissioning, as well as the safe operation, of the Flexi Soft safety controller	8022491
Operating instructions	Flexi Soft Gateways Hardware	Description of the Flexi Soft gateways and their functions	To provide technical personnel working for the machine manufacturer/operator with instructions so that they can safely carry out the mounting, electrical installation, and maintenance work for the Flexi Soft gateways	8023212
Operating instructions	Flexi Soft gateways in Flexi Soft Designer Configuration Software	Description of how to configure and set the parameters for the Flexi Soft gateways using software, information about exchanging data in networks and about statuses, planning, and associated mapping	To provide technical personnel working for the machine manufacturer/operator with instructions so that they can safely configure and commission the Flexi Soft gateways	8023216
Operating instructions	Flexi Loop Safe Sensor Cascade Hardware	Description of the Flexi Loop safe sensor cascade and its functions	To provide technical personnel working for the machine manufacturer/operator with instructions so that they can safely carry out the mounting, electrical installation, and maintenance work for the Flexi Loop safe sensor cascade	8023204

Document type	Title	Contents	Purpose	Part number
Operating instructions	Flexi Loop Safe Sensor Cascade in Flexi Soft Designer Configuration Software	Description of how to configure and set the parameters for the Flexi Loop safe sensor cascade using software	To provide technical personnel working for the machine manufacturer/operator with instructions so that they can safely configure and commission the Flexi Loop safe sensor cascade	8023208

2.2 Scope

These operating instructions apply to all modules of the Flexi Soft safety controller with the following part numbers:

- 1093628
- 1093568
- 1093622
- 1097025
- 1097024

This document is included with the following SICK part numbers (this document in all available language versions):

8022462

2.3 Information depth

These operating instructions contain information about the Flexi Soft modular safety controller on the following topics:

- Mounting
- Electrical installation
- Hardware commissioning
- Fault diagnosis and troubleshooting
- Ordering information
- Conformity and approval

The planning and use of SICK protective devices requires technical skills that are not covered by this document.

The official and legal regulations for operating the Flexi Soft modular safety controller must always be complied with.

2.4 Target group

These operating instructions are intended for planning engineers, developers, and operators of equipment and systems which are protected by a Flexi Soft modular safety controller. They are also intended for people who are integrating the Flexi Soft safety controller into a machine, putting it into operation for the first time, or carrying out maintenance work.

2.5 Further information

www.sick.com

The following information is available via the Internet:

- The Flexi Soft operating instructions in various languages for viewing and printing
- The Flexi Soft Designer SC-FSD configuration software
- Data sheets
- CAD data for drawings and dimensional drawings
- EDS, ESI, GSD, and GSDML files
- Certificates (such as the EU declaration of conformity)

2.6 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.

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 flashing.
● The LED is illuminated continuously.

3   Safety information

This chapter contains general safety information about the Flexi Soft modular safety controller.

More safety information about specific usage situations for the Flexi Soft modular safety controller is available in the respective chapters.

3.1   General safety notes

> **DANGER**
> Follow the safety notes and protective measures.
> Observe the following to ensure that the Flexi Soft safety controller is used as intended.

> **NOTE**
> - Ensure compliance with the national standards and directives governing the mounting, installation, and use of the Flexi Soft safety controller.
> - The national and international legal specifications apply to the installation and use of the Flexi Soft safety controller, to its commissioning, and to technical inspections repeated at regular intervals.
> - The manufacturer and operator of the machine on which the Flexi Soft safety controller is used are responsible for coordinating and complying with all applicable safety specifications and regulations, in close cooperation with the relevant authorities.
> - The notes in these operating instructions (e.g., regarding use, mounting, installation, or integration into the machine controller), and in particular the notes about checks (see "Commissioning the hardware", page 39) must be observed.
> - The inspections must be carried out by qualified safety personnel or specially qualified and authorized personnel, and must be recorded and documented to ensure that the tests can be reconstructed and retraced by a third party at any time.

3.2   Intended use

The modular Flexi Soft safety controller is a configurable controller for safety applications. It can be used ...

- In accordance with IEC 61508 up to SIL3
- In accordance with EN 62061 up to SIL claim limit 3
- In accordance with EN ISO 13849-1 up to Performance Level e

The safety level actually achieved is determined by the external wiring, how the wiring is implemented, the configuration, the selection of command triggers, and how they are arranged on the machine.

> **DANGER**
> The Flexi Soft system is intended solely for use in industrial applications.
> The Flexi Soft system satisfies the requirements of the generic standard for radiated emission associated with industrial applications. The Flexi Soft system is, therefore, suitable solely for use industrial applications.

The use of the Flexi Soft safety controller is only permitted within the specified operating limits (voltage, temperature, etc., see "Technical data", page 60 and in the sense of the Requirements to be met by the electrical installation. It may only be used by qual-

ified safety personnel and only on the machine on which it was mounted and initially commissioned by qualified safety personnel in accordance with these operating instructions.

> **DANGER**
>
> Any other use or of modification to the system or devices – including in the context of mounting and installation – will render any claims against SICK AG under the warranty void.
>
> ▶ Please observe the safety notes and protective measures outlined in the "Flexi Soft Modular Safety Controller Hardware" operating instructions as well as "Flexi Soft in the Flexi Soft Designer Configuration Software".
> ▶ When using a safety-relevant control logic, check for compliance with the specifications described in national and international standards; in particular, check the controller strategies and risk reduction measures prescribed for your application.

The external power supply of the Flexi Soft modules must be capable of buffering brief power failures of 20 ms as specified in EN 60204-1, for example. Suitable PELV and SELV power supply units are available as accessories from SICK.

UL/CSA applications:

If the product is being used in accordance with UL 508 or CSA 22.2 No. 142, the following conditions must also be met:

- Use a fuse rated max. 4 A and min. 30 V DC to UL 248 to protect the 24 V power supply to the device.
- Use only copper wires with a minimum temperature resistance of 60 °C/75 °C, wire cross-section AWG 30–12 for screw terminals and AWG 24–16 for spring terminals.
- Tighten the screw terminals to a torque of 5 to 7 lb·in.
- Use the devices only in an environment with a maximum contamination level of 2.

> **NOTE**
>
> The safety functions are not UL-assessed. The approval corresponds to UL 508, general applications

3.3   Requirements for the qualification of personnel

The Flexi Soft modular safety controller must only be configured, mounted, connected, commissioned, and serviced by suitably qualified safety personnel.

Project planning

A person who 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 is considered qualified for project planning.

Mechanical mounting and commissioning

A person who has expertise and experience in the relevant field and is sufficiently familiar with the application of the protective device on the machine to assess whether or not it can be operated safely is considered qualified for mechanical installation and commissioning.

Electrical installation

A person who has expertise and experience in the relevant field and is sufficiently familiar with the application of the protective device on the machine to assess whether or not it can be operated safely is considered qualified for electrical installation and commissioning.

Configuration

A person who has expertise and experience in the relevant field and is sufficiently familiar with the application of the protective device on the machine to assess whether or not it can be operated safely is considered qualified for configuration.

Operation and maintenance

A person who has expertise and experience in the relevant field, is familiar with the application of the protective device on the machine, and has received instructions from the operator in how to operate the machine is considered qualified for operation and maintenance.

4 Product description

This chapter provides information about the properties of the Flexi Soft system and describes its construction and operating principle.

4.1 System characteristics

Sensors and switching elements (e.g. light curtains, laser scanners, switches, sensors, emergency stop pushbutton) are connected to the Flexi Soft modular safety controller and are linked logically. The corresponding actuators of the machines or systems can be switched off safely via the switching outputs of the safety controller.

The Flexi Soft system is distinguished by the following system characteristics:

- Modular design: 1 main module, up to 2 different gateways, and up to 12 expansion modules
- Up to 96 safe digital inputs
- Up to 12 safe analog inputs
- Up to 48 safe digital outputs or up to 96 non-safe digital outputs
- Configurable
- .Use of up to 255 logic and application-specific function blocks
- Logic function blocks, including, e.g., AND, OR, NOT, XNOR, XOR
- Application-specific function blocks including, e.g., emergency stop, two-hand, muting, presses, ramp-down detection, operating mode selector switch, reset, restart
- Can be integrated into different networks with gateways (EtherNet/IP, Modbus TCP, PROFINET IO, PROFIBUS DP, DeviceNet, CANopen and EtherCAT)

The Flexi Soft Designer SC-FSD configuration software is available for configuration of the control tasks.

You will find the configuration software on the Internet: **www.sick.com**

4.2 Construction and function

System construction

A Flexi Soft system consists of the following modules:

- 1 Flexi Soft main module (with Flexi Soft system plug)
- Up to 2 Flexi Soft gateways
- Up to 12 Flexi Soft expansion modules

ⓘ **NOTE**
Only those modules listed here can be connected to a Flexi Soft system; other modules are not permitted.

Figure 1: Example minimum configuration of Flexi Soft system with SC-FS-CPU0 and SC-FS-XTDI

Table 4: Overview of modules

Model	Type	Inputs	Outputs	Function blocks	Max. number
Main modules					
SC-FS-CPU0	Main module	–	–	255	1
Gateways					
SC-FS-GENT	EtherNet/IP gateway	2 [1]	–	–	2
SC-FS-GMOD	Modbus® TCP gateway	2 [1]	–	–	
SC-FS-GPNT	PROFINET IO gateway	2 [1]	–	–	
SC-FS-GETC	EtherCAT gateway	2 [1]	–	–	
SC-FS-GPRO	PROFIBUS DP gateway	1 [2]	–	–	
SC-FS-GCAN	CANopen gateway	1 [2]	–	–	
SC-FS-GDEV	DeviceNet gateway	1 [2]	–	–	
Expansion modules					
SC-FS-XTIO	I/O module	8	4	–	12
SC-FS-XTDI	I/O module	8	–	–	
SC-FS-XTDS	I/O module	8	4–6 [3]		
SC-FS-STIO	I/O module	6–8 [4]	6–8 [4]		

[1] RJ-45 sockets.
[2] RS-485 socket.
[3] Non-safe outputs. In addition, test outputs XY1 and XY2 can be used as additional non-safe outputs.
[4] The FX0-STIO features 6 non-safe inputs and 6 non-safe outputs. In addition, connections IY7 and IY8 can be used as non-safe inputs as well as non-safe outputs.

4.3 Modules

This chapter provides information about the properties and functions of the available modules and system components.

4.3.1 SC-FS-CPU0 main module

Description

The SC-FS-CPU0 main module is the central process unit of the entire system in which all signals are monitored and processed logically in accordance with the configuration stored in the system plug. The outputs of the system are switched as a result of the processing, whereby the FLEXBUS+ internal bus serves as the data interface.
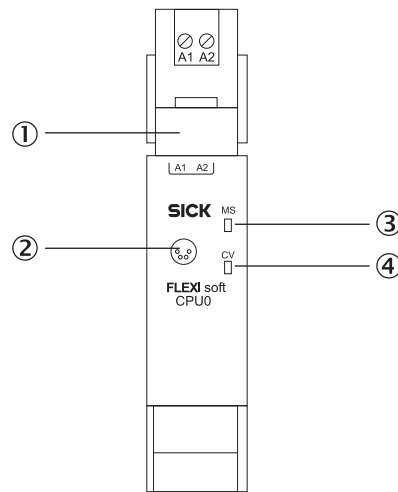
Figure 2: SC-FS-CPU0 main module

①   System plug
②   RS-232 interface
③   MS LED (**M**odule **S**tatus)
④   CV LED (**C**onfiguration **V**erified)

4.3.2   System plug

There is a system plug at each main module. The system configuration for the entire Flexi Soft system is stored only in the system plug. This is beneficial when replacing modules, because it means that a full reconfiguration of the Flexi Soft system is not required.

NOTE

• The main module and the internal logic of all expansion modules and gateways on the FLEXBUS+ as well as their inputs (I1 … I8) and test outputs (X1 to X8 as well as XY1 and XY2) are supplied electrically only via the system plug. The outputs are supplied separately, however (Q1 to Q4, Y1 to Y6 as well as IY7 and IY8).
• The data stored in the system plug are also retained in the event of any interruption in the voltage supply.
• Clearly and unambiguously mark all connections (connecting cables and plug connectors) on the safety controller to avoid mix-ups. The Flexi Soft system features several connections of the same design. Therefore, you must make sure that no unplugged connecting cables or plug connectors are accidentally connected to the wrong connection point.

4.3.3   SC-FS-XTIO I/O module

Description

The SC-FS-XTIO module is an input/output expansion module with 8 safe inputs and 4 safe outputs. It has 2 test pulse generators, one for test output X1 and one for test output X2.

The SC-FS-XTIO module offers the following functions:
• Monitoring of the connected safety devices (see "Connection of devices", page 35)
• Forwarding of information at inputs I1 to I8 to the main module
• Receipt of control signals from the main module and corresponding switching of outputs
• Fast shut-off: direct shutdown of the actuators connected to the module.

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This reduces the response time of the overall system. The response times of the devices at the inputs and outputs are extended by 8 ms in order to shut down the outputs. Run times on the FLEXBUS+ internal bus and the logic execution time are not relevant in this case (see "Response times of the Flexi Soft system", page 60).

- Activation or deactivation of the test signals at outputs Q1 to Q4

The SC-FS-XTIO module cannot be operated as a standalone module, but always requires an SC-FS-CPUx main module.

Simultaneous use of several SC-FS-XTIO modules is possible (see "Construction and function", page 13).

The power supply to the internal logic and the test outputs is provided via the system plug and the FLEXBUS+ internal bus.

The voltage supply of the outputs Q1 to Q4 of the SC-FS-XTIO must be provided directly via A1/A2 on the respective module.

---

i **NOTE**

- Short-circuits between any of the test signal generators for Flexi Soft expansion modules, including between test signal generators for different modules, are detected if test gaps of ≤ 4 ms and a test period of ≥ 200 ms have been set for the relevant test outputs.
- Short-circuits to 24 V DC (to high) at inputs that are connected to test outputs are detected regardless of the length of the test gaps and the test period.
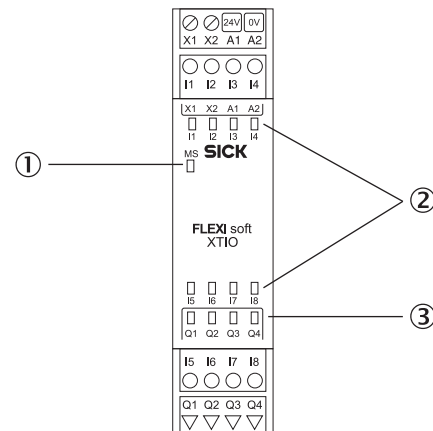
Figure 3: SC-FS-XTIO I/O module

① MS LED (**M**odule **S**tatus)
② 8 input LEDs
③ 4 output LEDs

4.3.3.1 Internal structure
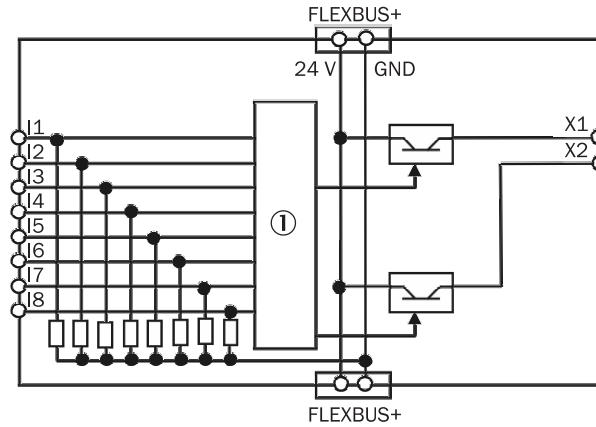
Figure 4: Internal circuits of the SC-FS-XTIO – safe inputs and test outputs
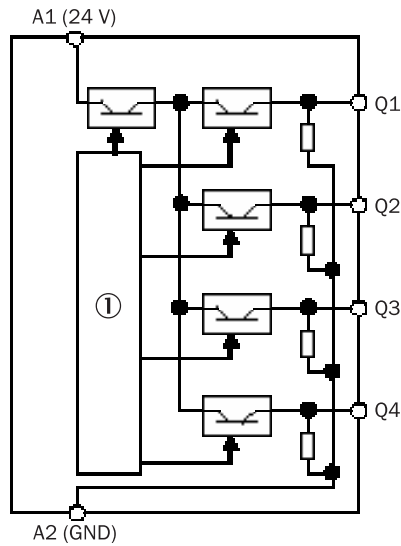
①   Internal logic

Figure 5: Internal circuits of the SC-FS-XTIO – safe outputs

①   Internal logic

4.3.3.2 Deactivating the test pulses at the outputs Q1 to Q4 of the C-FS-XTIO module

The test pulses at one or more outputs of SC-FS-XTIO modules can be deactivated with the SC-FS-XTIO.

⚠ **DANGER**

Deactivating the test signals at any output reduces the safety parameters of all outputs!

Deactivating the test pulses at one or more of the outputs Q1 to Q4 of an SC-FS-XTIO module reduces the safety parameters of all the outputs Q1 to Q4 of the module concerned. Please take this into account to ensure that your application is in line with an appropriate risk analysis and risk avoidance strategy.

Detailed information about safety parameters: see "Technical data", page 60.

Use protected or separate cabling.

If you deactivate the test signals at one or more of outputs Q1 to Q4, then you must use protected or separate cabling for these outputs, in order to avoid impairing the safety function of the other safe outputs. A short-circuit to 24 V cannot be detected if the output input is set to High. It is for this reason that when an internal hardware error is detected, the ability of the other outputs to shut down can be impaired due to 24 V reverse current flowing through this output.

Perform tests cyclically whenever the test signals at one or more safe outputs are deactivated.

If you deactivate the test signals at one or more of outputs Q1 to Q4, then the following tests must be performed at least once annually:

- All outputs without test signals must be shut down simultaneously for one second by the logic program of the main module.
  Or:
- Restart the Flexi Soft system by switching off the power supply.

4.3.3.3 Extended fault detection time for cross-circuits at outputs Q1 to Q4 of the SC-FS-XTIO for switching higher capacitive loads

With the SC-FS-XTIO, it is possible to configure an extended fault detection time for cross-circuits for the outputs Q1 to Q4 of SC-FS-XTIO modules.

This may be necessary to switch loads where the voltage at the load does not drop to the Low level as quickly as expected, with the result that if the standard error detection time is set, a cross-circuit error occurs immediately after switching off (change from High to Low). Examples of such instances include:

- Loads with a higher capacitance than is permitted for the output by default, including, e.g., the supply voltage for PLC output cards, which need to be connected with safety technology.
  For this application, the test pulse of the output must also be deactivated (see "Deactivating the test pulses at the outputs Q1 to Q4 of the C-FS-XTIO module", page 17).
- Inductive loads which cause an overshoot in the positive voltage range after the induction voltage has died down.

Table 5: Maximum extended fault detection times for cross-circuits on the SC-FS-XTIO

Switching of increased capacitive loads	Error detection time (maximum permitted time to Low level (≤ 3.5 V) after the output has been switched off (Q1 to Q4)
Deactivated	3 ms
Activated	43 ms

The capacitance which exceeds the value that is permitted by default for the output must be discharged to Low level at the customer's end once the output has been switched off. If this is not done within the maximum permitted time, a cross-circuit error will occur at the output, regardless of whether the test signals at this output are activated or deactivated.

> ⚠ **DANGER**
>
> You must make sure that the PLC output card is compatible with safety-related shutdown of the outputs as a result of the switching of the supply voltage.
>
> Ability to shut down safely can be impaired or even prevented by the following errors:
>
> - Failure to detect a cross-circuit at an output of the PLC output card leading to reverse infeed to the PLC card power supply. In some cases this error can be excluded by wiring inside a zone with sufficient protection.
> - Failure to detect an error on the PLC output card leading to infeed of an external supply to the PLC card power supply from another live signal.
> - Extension of the response time by a buffer capacitor in the PLC output card power supply.
>   Please note that the outputs of the SC-FS-XTIO modules are not capable of discharging this buffer capacitor because it is usually located downstream of a reverse polarity protection diode.

> ⚠ **DANGER**
>
> Please note the extended error detection time.
>
> Switching loads with increased capacitance also extends the error detection time. This applies primarily in the case of single-channel outputs.

Also see the operating instructions "Flexi Soft in the Flexi Soft Designer FC-FSD" (SICK part number 8022491).

4.3.3.4 Single-channel use of outputs on the SC-FS-XTIO

> ⚠ **DANGER**
>
> Note the possibility of brief switching to High with single-channel outputs.
>
> In the event of a hardware error, outputs (Q1 to Q4), which would normally be at Low, switch off subject to a delay or briefly switch to High until the error is detected and has been responded to. The error detection time plus the error response time is determined by the selected configuration for the output.

Table 6: Fault detection time and fault response time on the SC-FS-XTIO

Switching of increased capacitive loads	Error detection time + error response time
Deactivated	≤ 10 ms
Activated	≤ 50 ms

Take this into account in your risk analysis and strategy for risk reduction, primarily for single-channel outputs. Failure to do this will put the machine operator at risk.

4.3.4 SC-FS-XTDI I/O module

Description

The SC-FS-XTDI module is an input expansion module with 8 safe inputs. It has 2 test pulse generators, one for test outputs X1, X3, X5 and X7 and one for test outputs X2, X4, X6 and X8.

The SC-FS-XTDI module offers the following functions:
- Monitoring of the connected safety devices (see "Connection of devices", page 35)
- Forwarding of information at inputs I1 to I8 to the main module

The SC-FS-XTDI module cannot be operated as a standalone module, but always requires an SC-FS-CPUx main module.

Simultaneous use of several SC-FS-XTDI modules is possible (see "Construction and function", page 13).

The power supply to the internal logic and the test outputs is provided via the system plug and the FLEXBUS+ internal bus.

NOTE

A SC-FS-XTDI has two test pulse generators. One test pulse generator is responsible for the odd-numbered test outputs X1, X3, X5 and X7 and the other for the even-numbered test outputs X2, X4, X6 and X8.

- Short-circuits between any of the test signal generators for Flexi Soft expansion modules, including between test signal generators for different modules, are detected if test gaps of ≤ 4 ms and a test period of ≥ 200 ms have been set for the relevant test outputs.
- Short-circuits to 24 V DC (to high) at inputs that are connected to test outputs are detected regardless of the length of the test gaps and the test period.

DANGER

Restricted short-circuit detection!

Short-circuits between the odd number test outputs X1, X3, X5, and X7 cannot be detected if they are assigned to the same test signal generator. The same is true of the even number test outputs X2, X4, X6, and X8.

▶ Take this into account in the wiring (e.g., lay cables separately, use cable protection).
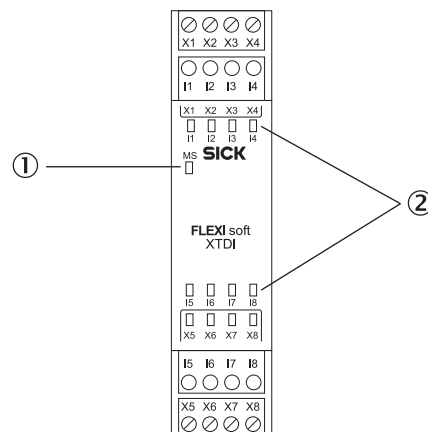

Figure 6: SC-FS-XTDI I/O module

① MS LED (**M**odule **S**tatus)
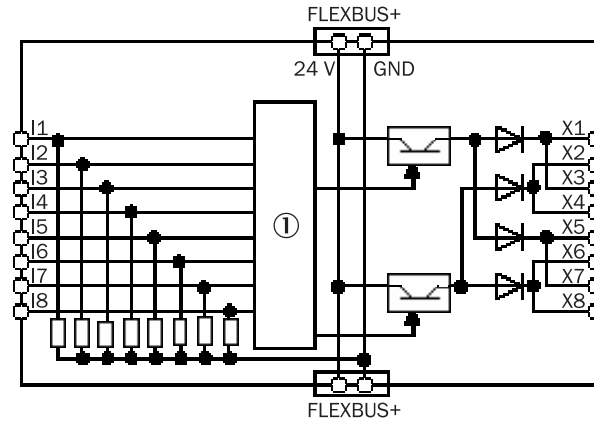② 8 input LEDs

4.3.4.1 Internal structure

Figure 7: Internal circuits of the SC-FS-XTDI – safe inputs and test outputs

① Internal logic

4.3.5 SC-FS-XTDS I/O module

Description

The SC-FS-XTDS module is an input/output expansion module with 8 safe inputs and 4 non-safe outputs. It has 2 optional test pulse generators, one for test output XY1 and one for test output XY2.

The SC-FS-XTDS module offers the following functions:
- Monitoring of the connected safety devices (see "Connection of devices", page 35)
- Forwarding of information at inputs I1 to I8 to the main module
- Receipt of control signals from the main module and corresponding switching of outputs
- Outputs XY1 and XY2 can be used as either test outputs or non-safe outputs.

> ⚠ **DANGER**
> Do not use the SC-FS-XTDS outputs for safety functions!
>
> The non-safe outputs XY1, XY2, and Y3 through Y6 of the SC-FS-XTDS must not be used without additional measures to achieve the required safety for non-safety-related functions. Otherwise, the operator of the machine may be put at risk.

The SC-FS-XTDS module cannot be operated as a standalone module, but always requires an FX3-CPUx main module.

Simultaneous use of several SC-FS-XTDS modules is possible (see "Construction and function", page 13).

The power supply to the internal logic and the test outputs is provided via the system plug and the FLEXBUS+ internal bus.

The voltage supply of the outputs Y3 to Y6 of the SC-FS-XTDS must be provided directly via A1/A2 on the respective module.

---

i **NOTE**

- Short-circuits between any of the test signal generators for Flexi Soft expansion modules, including between test signal generators for different modules, are detected if test gaps of ≤ 4 ms and a test period of ≥ 200 ms have been set for the relevant test outputs.
- Short-circuits to 24 V DC (to high) at inputs that are connected to test outputs are detected regardless of the length of the test gaps and the test period.
- If both outputs XY1 and XY2 are already being used as non-safe outputs, you can still connect a tested element to one of the inputs I1 to I8. However, a warning will be output nevertheless (i.e., this element will be displayed in read in the hardware configuration).

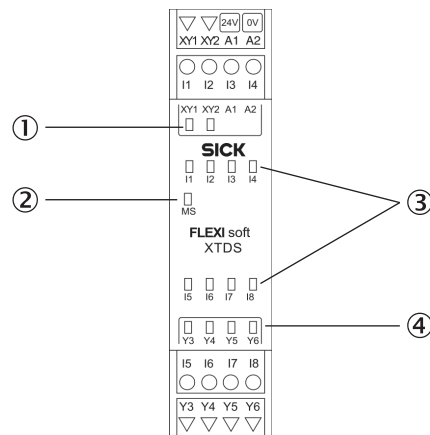*Figure 8: SC-FS-XTDS I/O module*

① 2 LEDs for test outputs or non-safe outputs
② MS LED (**M**odule **S**tatus)
③ 8 input LEDs
④ 4 output LEDs

4.3.5.1 Internal structure
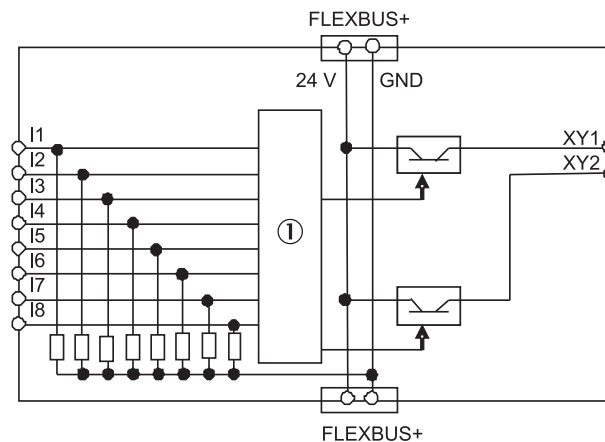
Figure 9: Internal circuits of the SC-FS-XTDS – safe inputs and test outputs
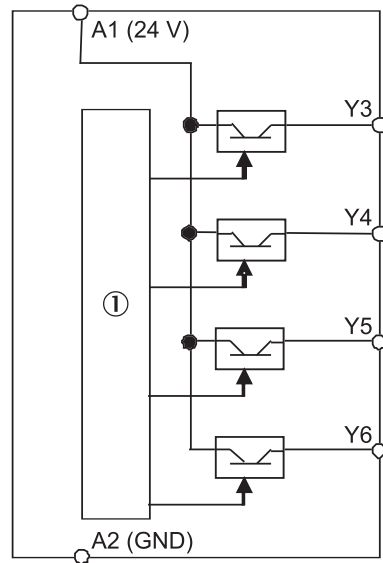
① Internal logic

Figure 10: Internal circuits of the SC-FS-XTDS – safe outputs

①   Internal logic

4.3.6   SC-FS-STIO I/O module

Description

The SC-FS-STIO module is an expansion module with 6 non-safe inputs, 6 non-safe out-puts, and 2 connections that can be used as either non-safe inputs or outputs.

The SC-FS-STIO module offers the following functions:
* Forwarding of information at inputs I1 to I6 to the main module
* Receipt of control signals from the main module and corresponding switching of outputs

⚠️ **DANGER**

Do not use the SC-FS-STIO for safety functions!

The SC-FS-STIO must not be used for safety-related functions. Otherwise, the operator of the machine may be put at risk.

The SC-FS-STIO module cannot be operated as a standalone module, but always requires an SC-FS-CPUx main module.

Simultaneous use of several SC-FS-STIO modules is possible (see "Construction and function", page 13).

The power supply to the internal logic is provided via the system plug and the FLEXBUS + internal bus.

The voltage supply of the outputs Y1 to Y6 and the IY7 and IY8 connections of the SC-FS-STIO must be provided directly via A1/A2 on the respective module.
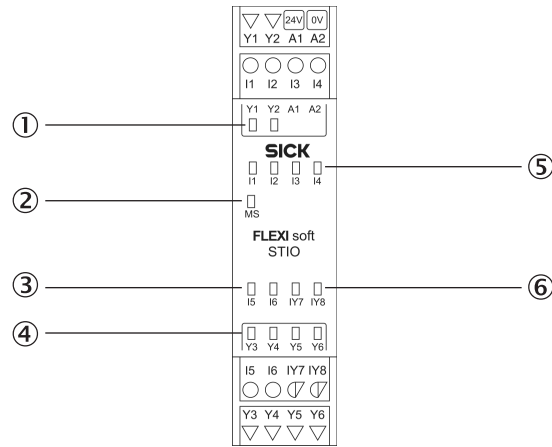
Figure 11: SC-FS-STIO I/O module

①	2 output LEDs
②	MS LED (**M**odule **S**tatus)
③	2 input LEDs
④	4 output LEDs
⑤	4 input LEDs
⑥	2 LEDs for configurable inputs or outputs

Use of the IY7 and IY8 connections on the SC-FS-STIO

You can use the IY7 and IY8 connections on a SC-FS-STIO module as non-safe inputs or non-safe outputs.

4.3.6.1 Internal structure
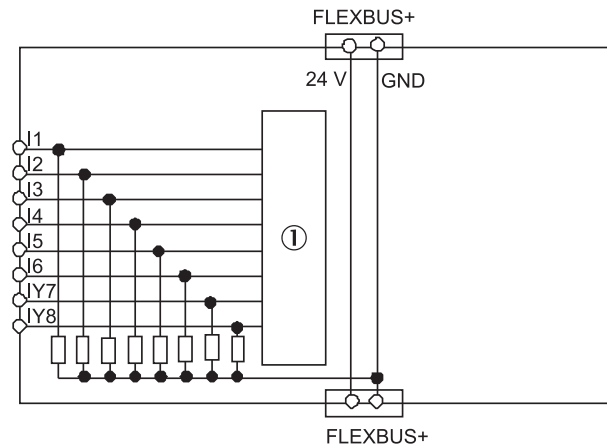
Figure 12: Internal circuits of the SC-FS-STIO – non-safe inputs

① Internal logic
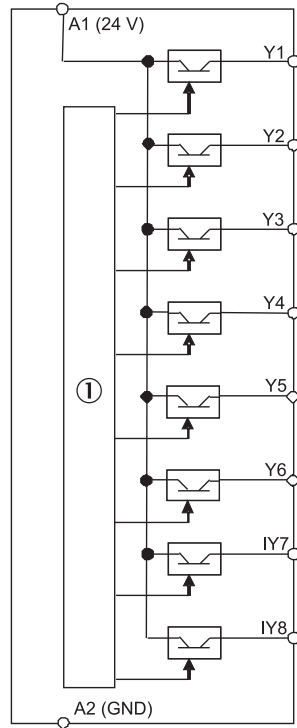
Figure 13: Internal circuits of the SC-FS-STIO – non-safe outputs

①   Internal logic

4.4   Interfaces

4.4.1   RS-232

Each main module has an RS-232 interface with the following functions:

- Transfer configuration from the configuration software to the system plug
- Import configuration from the system plug into the configuration software
- Diagnose the Flexi Soft system with the configuration software
- Continuous diagnosis of the Flexi Soft system via a connected PLC. The RS-232 interface can serve as an alternative to a gateway.

Table 7: Pin assignment of the RS-232 interface of the SC-FS-CPUx

Male connector/ Female connector	Pin	Signal	Color	Pin assignment on PC side RS-232 D-Sub (9-pin)
	1	Reserved	Brown	–
	2	RxD	White	Pin 3
	3	GND (connected electrically internally to connection A2 on the main module)	Blue	Pin 5
	4	TxD	Black	Pin 2

NOTE

- If the RS-232 interface of the main module is permanently connected as an alternative to a gateway, then the maximum permitted length of cable is 3 m.
- The GND of the RS-232 interface is connected internally to the GND of the main module's voltage supply (A2). Avoid ground loops between the GND connection of the RS-232 interface and the A2 connection of the main module, for instance by using optocouplers.

5 Mounting

5.1 Steps for mounting the module

⚠️ **DANGER**
The Flexi Soft system must be mounted in an environment corresponding to enclosure rating IP 54 (EN 60529), e.g., inside a control cabinet with enclosure rating IP 54.

You are not permitted to unplug modules from or connect modules to the Flexi Soft system while the supply voltage is switched on.

- Mount the modules according to EN 50274.
- Appropriate ESD protective measures must be taken during mounting. Failure to do this can damage the devices.
- Take suitable measures to ensure that foreign bodies cannot get into the openings of the connectors, in particular the system plug.
- The modules are housed inside a 22.5 mm wide housing for 35 mm standard rails compliant with EN 60715 (DIN mounting rail).
- The modules are interconnected via a FLEXBUS+ plug connector that is integrated into the housing. Please note that the Flexi Soft modules must be pushed apart by a width of approximately 10 mm before a module can be removed from the DIN mounting rail.
- Modules with ventilation slots (e.g., the EtherCAT gateway) must be mounted so that the air can circulate vertically. The ventilation slots must be positioned at the top and bottom.
- In a Flexi Soft system, the SC-FS-CPUx main module is always located on the far left.
- The two optional gateways then follow directly to the right of the main module.
- Mount all additional Flexi Soft expansion modules (e.g. SC-FS-XTIO or SC-FS-XTDI) on the right of the gateways or the main module if no gateway is used. The expansion modules can be mounted in any order.
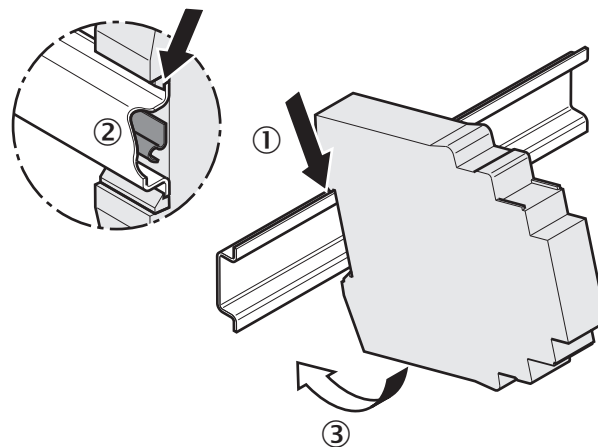
Figure 14: Mounting the module on the DIN mounting rail

▶ Make sure that the power supply to the Flexi Soft system is switched off.
▶ Attach the device to the DIN mounting rail (①).
▶ Make sure that the grounding spring ②) is sitting securely on the DIN mounting rail, making good contact in order to ensure good electrical conduction.
▶ Press the module down onto the DIN mounting rail by applying slight pressure in the direction of the arrow (③).
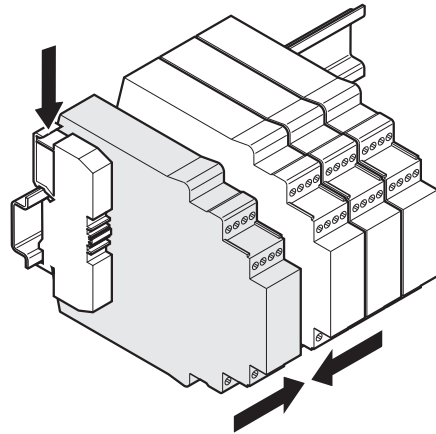
Figure 15: Attaching end clamps

▶ If multiple modules are present, slide each of the modules together in the direction of the arrow until the side-mounted plug connector engages.

▶ Install end pieces on the left and right sides.

The following steps are necessary after mounting and installation:

- Establish the electrical connections (see "Electrical installation", page 29)
- Configuration (Operating instructions "Flexi Soft in the Flexi Soft Designer Configuration Software" (SICK part number: 8022491)
- Check the installation (see "Checks before initial commissioning", page 39)

6 Electrical installation

> **NOTE**
> This chapter deals with the electrical installation of the Flexi Soft system inside the control cabinet. You will find additional information about the electrical connection of other devices to the Flexi Soft system in the section about the corresponding device: (see "Connection of devices", page 35).

6.1 Requirements to be met by the electrical installation

> ⚠️ **DANGER**
> **All work to connect the system/machine must be carried out with the power supply disconnected.**
>
> The system could inadvertently start while you are connecting the devices.
>
> **Ensure compliance with applicable safety standards.**
>
> All safety-related parts of the system (wiring, connected sensors and command triggers, configuration, external device monitoring) must meet the requirements of the relevant safety standards (e.g., EN 62061 or EN ISO 13849-1). This can mean that safety-related signals have to be set up with redundancy or that single-channel signals must be installed with protection or require short-circuit detection achieved by using test outputs and/or regular function tests.
>
> ▶ Please note that short-circuits between test outputs and the corresponding input cannot be detected.
> ▶ Check whether these signals require protected or separate cables.

NOTE

- The Flexi Soft safety controller meets the EMC requirements set out in the generic standard EN 61000-6-2 for industrial applications.
- Industrial safety devices by SICK are only suitable for local direct current applications. If the device is being used on power supply networks, e.g., in accordance with IEC 61326-3-1, additional protective measures must be taken.
- Machines on which safety devices are being used must be installed and dimensioned as appropriate for the lightning zone in accordance with EN 62305-1. The required level can be achieved by using external protective devices. The devices used to provide protection against overvoltage must meet the requirements set out in EN 61643-11.
- The equipment must prevent common-mode disturbance as set out in IEC 61000-4-16 in the frequency range from 0 Hz to 150 kHz.
- To establish full EMC safety, you must connect the DIN mounting rail to functional earth (FE).
- All electrical equipment must be installed in accordance with EN 60204-1.
- The external voltage supply of the Flexi Soft modules must be capable of buffering brief power failures of 20 ms as specified in EN 60204-1, for example.
- The power supply and all connected signals must meet the requirements for low voltages with safe isolation (SELV, PELV) as set out in EN 60664 and EN 50178 (electronic equipment for use in power installations).
- Make sure that all of the modules in the Flexi Soft system, the connected protective devices (e.g., the EFI-enabled devices) and actuators, as well as the power supplies, are connected to the same GND connection.
- Establish a star connection between the GND connections for the actuators at outputs Q1 to Q4 and the GND connection for the power supply. If you do not do this, an actuator (e.g., a relay) may pick up unexpectedly if there is a break in the common GND cable, at least one output is set to High, and at least one output for the actuators is set to Low.
- If the RS-232 interface on the main module is used as an alternative to a gateway, the maximum permissible cable length will be 3 m.
- The GND for the RS-232 interface is connected internally to the GND connection for the power supply to the main module (A2). Avoid ground loops between the GND connection of the RS-232 interface and connection A2 on the main module, e.g., by using optocouplers.
- Depending on the external loads and in particular in the case of inductive loads, additional external safety measures such as varistors or RC elements may be necessary in order to protect the outputs. For information on limitations in operation: . It should be noted that the response times may be extended depending on the type of suppressor.
- When a module is replaced, the terminals must be assigned correctly; this can be ensured, for example, by labeling or laying the cables accordingly.

⚠ **DANGER**

Limited short-circuit detection on the SC-FS-XTDI!

Short-circuits between the odd number test outputs X1, X3, X5, and X7 cannot be detected if they are assigned to the same test signal generator. The same is true of the even number test outputs X2, X4, X6, and X8.

Take this into account in the wiring (e.g., lay cables separately, use cable protection).

Reverse current at inputs of SC-FS-XTIO, SC-FS-XTDI, or SC-FS-XTDS in the event of ground interruption!

The loss of an internal or external ground connection may result in a reverse current flowing from the voltage supply of the main module (terminal A2 on the system plug) to the safe inputs I1 to I8 of SC-FS-XTIO, SC-FS-XTDI, or SC-FS-XTDS modules. If you connect multiple safe inputs in parallel, check whether this reverse current might lead to an unintentional high state. For information on reverse current in the event of the loss of a ground connection: see "Data sheet", page 63.

6.2   Description of the terminals

6.2.1   SC-FS-CPU0 main module
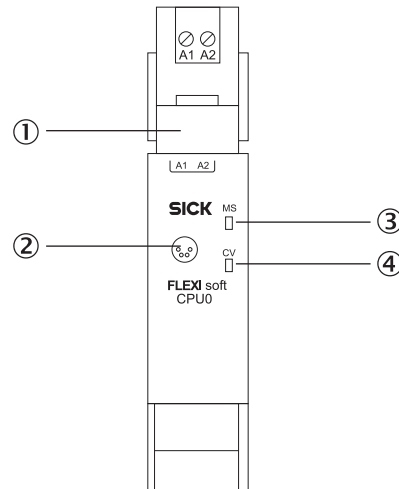
Figure 16: SC-FS-CPU0 main module

① System plug
② RS-232 interface
③ MS LED (**M**odule **S**tatus)
④ CV LED (**C**onfiguration **V**erified)

Table 8: Pin assignment on SC-FS-CPU0 main module with system plug

Terminal	Pin assignment
A1	24 V power supply for all modules, with the exception of the supply to the outputs (Q1 … Q4)
A2	Power supply GND

6.2.2 SC-FS-XTIO I/O module
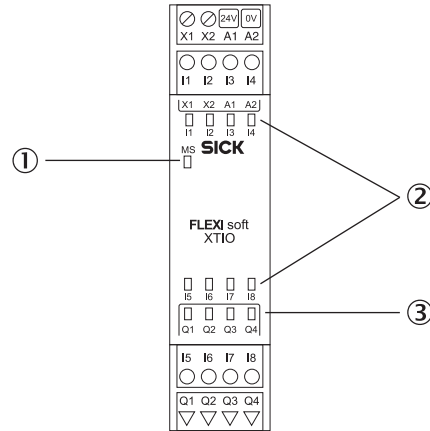
Figure 17: SC-FS-XTIO I/O module

①   MS LED (**M**odule **S**tatus)
②   8 input LEDs
③   4 output LEDs

Table 9: Pin assignment of SC-FS-XTIO I/O module

Terminal	Pin assignment
A1	24 V
A2	GND
I1 … I8	Safe inputs 1 to 8
Q1 … Q4	Safe outputs 1 to 4
X1/X2	Test output 1/Test output 2

6.2.3 SC-FS-XTDI I/O module
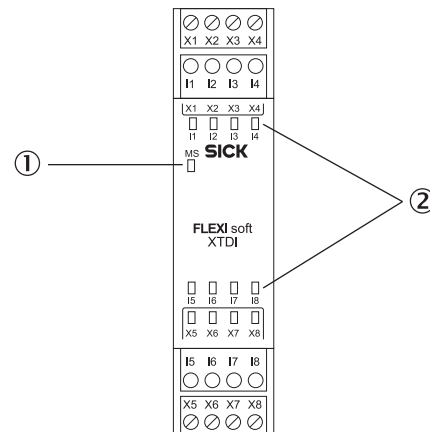
Figure 18: SC-FS-XTDI I/O module

①   MS LED (**M**odule **S**tatus)
②   8 input LEDs

Table 10: Pin assignment of SC-FS-XTDI I/O module

Terminal	Pin assignment
I1 … I8	Safe inputs 1 to 8
X1/X3/X5/X7	Test output 1 (test signal generator 1)

Terminal	Pin assignment
X2/X4/X6/X8	Test output 2 (test signal generator 2)

6.2.4 SC-FS-XTDS I/O module
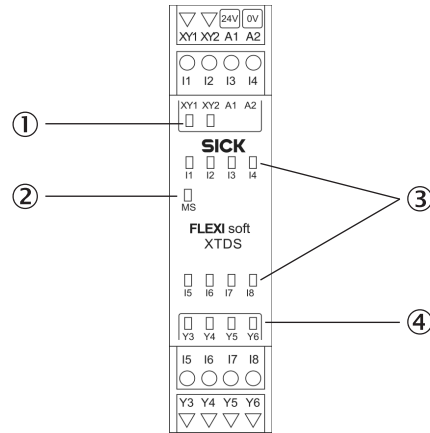
Figure 19: SC-FS-XTDS I/O module

① 2 LEDs for test outputs or non-safe outputs

② MS LED (**M**odule **S**tatus)

③ 8 input LEDs

④ 4 output LEDs

Table 11: Pin assignment of the SC-FS-XTDS I/O module

Terminal	Pin assignment
A1	24 V
A2	GND
I1 … I8	Safe inputs 1 to 8
Y3 … Y6	Non-safe outputs 3 to 6
XY1/XY2	Test output 1/Test output 2 or non-safe output 1/non-safe output 2

6.2.5 SC-FS-STIO I/O module
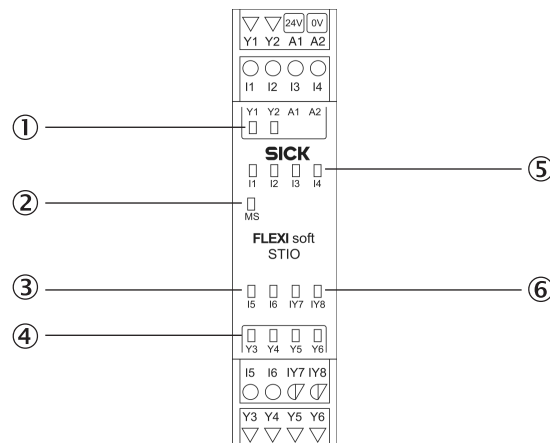
Figure 20: SC-FS-STIO I/O module

① 2 output LEDs

② MS LED (**M**odule **S**tatus)

③	2 input LEDs
④	4 output LEDs
⑤	4 input LEDs
⑥	2 LEDs for configurable inputs or outputs

Table 12: Pin assignment of the SC-FS-STIO I/O module

Terminal	Pin assignment
A1	24 V
A2	GND
I1 … I6	Non-safe inputs 1 to 6
IY7, IY8	Non-safe inputs 7 and 8 or non-safe outputs 7 and 8 (configurable)
Y1 … Y6	Non-safe inputs 1 to 6

6.3 Wiring for the power supply to a Flexi Soft system
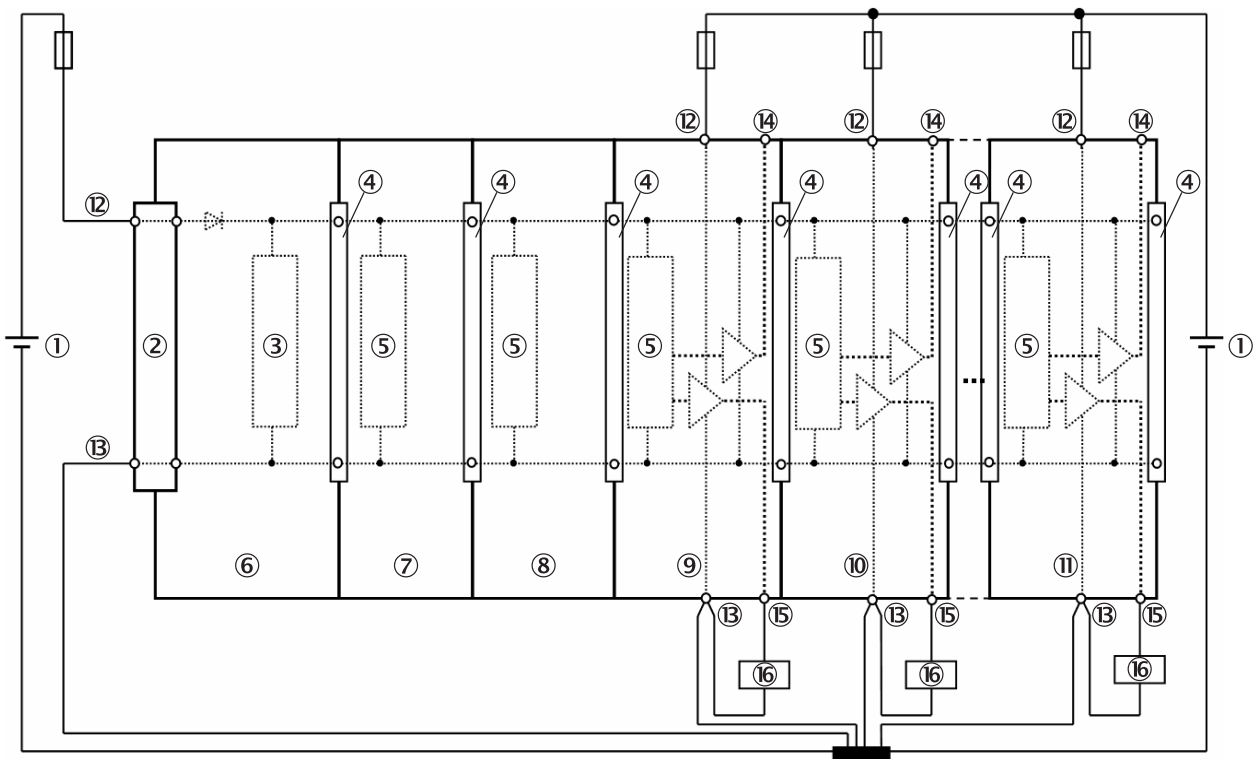
Figure 21: Wiring for the power supply to a Flexi Soft system

①	24 V DC
②	System plug
③	Logic
④	FLEXBUS+
⑤	Application
⑥	Main module
⑦	Gateway 1
⑧	Gateway 2
⑨	Expansion module 1
⑩	Expansion module 2
⑪	Expansion module n
⑫	A1 (24 V)

⑬   A2 (GND)

⑭   Test outputs (X1 ... X8)

⑮   Outputs (Q1 ... Q4)

⑯   Actuator

6.4   Connection of devices

This section describes the connection of safe and non-safe sensors, actuators, and switching elements to the Flexi Soft system and provides instructions for setting up selected functions.

The Flexi Soft system supports applications up to SIL3 (in accordance with IEC 61508) or SILCL3 (in accordance with EN 62061) and performance level PL e (in accordance with EN ISO 13849-1). The level of safety actually achieved is determined by the external wiring, how the wiring is implemented, the configuration, the selection of devices, and how they are arranged on the machine. Take all necessary boundary conditions into account and assess them, for example in a failure mode and effects analysis (FMEA).

Other points to be considered during electrical installation: see "Electrical installation", page 29.

⚠ **DANGER**
Loss of safety function due to incorrect configuration

▶   Take great care when planning and executing the configuration.

The configuration of the safety application must be precisely adapted to the prevailing conditions in the system or machine to be monitored.

▶   Check whether the configured safety application monitors the machine or system as you have planned and if the safety of a configured application is maintained at all times. This must be ensured in every operating mode and secondary application. The results of this check must be documented!

▶   You must always follow the instructions on commissioning and daily checks described in the operating instructions for the protective devices integrated into the safety application.

▶   Pay attention to the safety notes and descriptions of operation for the protective devices that are connected to the safety controller. If you are in any doubt, contact the manufacturer of the protective device concerned.

▶   Please note that the minimum switch-off time of the connected sensors must be longer than the logic execution time (see the chapter on the logic editor in the "Flexi Soft in the Flexi Soft Designer Configuration Software" operating instructions and the information in the logic editor about the logic execution time) in order to ensure that the Flexi Soft system can detect the sensors switching. The minimum switch-off time of the sensors is usually listed in the technical data for the sensors.

ℹ **NOTE**
Using test outputs

Some expansion modules have two or more test outputs.

•   You must use a test output of the module to which the device to be tested is connected.

•   If you are using a test output with an odd number (X1, X3, X5, X7, XY1), inputs with odd numbers (I1, I3, I5, I7) must be used; if you are using a test output with an even number (X2, X4, X6, X8, XY2), inputs with even numbers (I2, I4, I6, I8) must be used.

⚠️ **DANGER**

Protect the single-channel inputs against short-circuits and cross-circuits.

At a single-channel input with test signals which was previously Low, a short-circuit to High can look like a pulse for the logic due to the error detection. The short-circuit to high causes the signal to switch to High first and then back to Low after the error detection time. Therefore, single-channel signals with test signals require special attention.

- If the short-circuit to High occurs at a single-channel input with test signals that was previously High, this signal will look like a delayed falling edge (High-Low) to the logic.
- If an unexpected signal or a delayed falling edge (High-Low) at a single-channel input can lead to a dangerous state, you must take the following action:
  - Use protected cables for the corresponding signal (to prevent cross-circuits to other signals)
  - No cross-circuit detection, i.e., no connection to a test output (see section "Configuring connected elements" in the "Flexi Soft in the Flexi Soft Designer Configuration Software" operating instructions)

  This must be actioned in particular for the following inputs:
  - Reset input at Reset function block
  - Restart input at Restart function block
  - Restart input at the function block for press applications (contact monitor for eccentric press, contact monitor for universal presses, PSDI mode, set up press, press single stroke, press automatic)
  - Override input at a function block for muting
  - Reset input at a valve monitoring function block
  - Reset to zero input at a counter function block
  - Set to starting value input at a counter function block

Once the configuration is complete, you can use the configuration software to generate a report. This report includes the following information:

- Logic report
- Bill of materials
- Internal circuitry

6.4.1 Non-contact safety switches

6.4.1.1 Magnetic safety switches

Table 13: Connection of magnetic safety switches with equivalent inputs

Electrical connection: example with SC-FS-XTIO	
At test output	Channel 1: contact between X1 and I1 Channel 2: contact between X2 and I2

Table 14: Connection of magnetic safety switches with complementary inputs

Electrical connection: example with SC-FS-XTIO	
At test output	N/C contact between X1 and I3 N/O contact between X2 and I4

Table 15: Functions with magnetic safety switches

Function	Notes
Tested	Possible
Series connection/ cascading	Possible; note max. conductor resistance of 100 Ω and ensure test signal time is set correctly
Discrepancy time	Default setting: 1.5 s, see Flexi Soft Designer configuration software

> **NOTE**
> You will find more information in the operating instructions for the magnetic safety switches.

6.4.2 Testable single-beam photoelectric safety switches

6.4.2.1 User-defined testable single-beam photoelectric safety switches

For information on creating customized elements, please refer to the operating instructions "Flexi Soft in the Flexi Soft Designer Configuration Software" (SICK part number 8022491).

> **NOTE**
> - Configure the user-defined element in the Flexi Soft Designer with the minimum value for the required test gap.
> - Regardless of the test gap, the overall OFF-ON delay of the cascade must be smaller than the maximum OFF-ON delay of the respective test output (as shown in the configuration software report) –2 ms. Otherwise the test gap will lead to switching off. For SC-FS-XTIO or SC-FS-XTDI modules, this value is = 12 ms – 2 ms = 10 ms.
> - Use protected or separate cabling for the connections from the test output of the module (X1 to X8) to the test input of the sender and from the output of the receiver to the safe input of the module (I1 to I8). Otherwise, a cross-circuit between these signals may prevent the error detection achieved with this test.

6.4.3 Electro-sensitive protective devices

1. Connect OSSD1 to I1.
2. Connect OSSD2 to I2.

> **NOTE**
> Additional information on this can be found in the operating instructions for the relevant electro-sensitive protective device.

6.4.4 Safe outputs Q1 to Q4

> ⚠ **DANGER**
> Safety-related devices must be suitable for safety-relevant signals.
>
> A function interruption affecting outputs Q1 to Q4 will lead to the loss of the safety functions, introducing a risk of serious injury.
>
> - Do not connect any loads which exceed the rated values of outputs Q1 to Q4.
> - Establish a star connection between the GND connections for the actuators at outputs Q1 to Q4 and the GND connection for the power supply. If you do not do this, an actuator (e.g., a relay) could switch on inadvertently if the entire GND cable breaks off when at least one output is at High and at least one output for the actuators is at Low.

7 Configuration

⚠️ **DANGER**

Check the safety function every time you make a change.

If you change the configuration, you must subsequently check the effectiveness of the safety function again. Follow the test instructions in the operating instructions for the connected protective devices.

ⓘ **NOTE**

The Flexi Soft Designer SC-FSD software is required for configuration.

- The system configuration for the entire Flexi Soft system is stored in the system plug. This has the advantage that it is not necessary to reconfigure the system if expansion modules or gateways are replaced.
- The data saved in the system plug is retained even in the event of a power supply failure.

ⓘ **NOTE**

If two computers establish TCP/IP connections to the same Flexi Soft main module in parallel via port 9000 of a Flexi Soft Ethernet gateway, the Flexi Soft main module will only communicate via the most recently established connection. As a result, the other computer will establish a further connection without closing the ones already established. There comes a point when too many connections to the computers are open via the gateway and the only messages being exchanged on those computers are messages for maintaining these open connections (known as keep-alive messages). This causes the Flexi Soft station to switch to the "Lock-out" state.

Configuration of connected devices

Devices which are connected to the safety controller are **not** generally configured and verified with the Flexi Soft safety controller configuration software. These devices have their own configuration and verification mechanisms.

For more information, see the operating instructions for the corresponding device.

8 Commissioning the hardware

⚠️ **DANGER**

The hardware must not be commissioned unless it has been checked by qualified safety personnel.

Before the system in which you are using a Flexi Soft safety controller is put into operation for the first time, it must first be checked and approved by qualified safety personnel (this inspection and approval process must be recorded in writing).

Check the hazardous area!

Prior to commissioning, check that there is nobody inside the hazardous area.

▶ Check and secure the hazardous area to prevent entry (e.g., put up warning signs, erect barriers, etc.). Ensure compliance with statutory legislation and local regulations.

8.1 Overall acceptance of the application

You are only permitted to put the system into operation if the overall acceptance process was successful. Only trained specialists are permitted to deal with overall acceptance.

Overall acceptance comprises the following steps:

▶ Check that all safety-related parts of the system (wiring, connected sensors and command triggers, configuration) conform to the applicable safety standards (e.g., EN 62061 or EN ISO 13849-1).
▶ Check the devices connected to the safety controller against the test instructions in the corresponding operating instructions.

ℹ️ **NOTE**

See the "Check prior to initial commissioning" section in each of the operating instructions for the electro-sensitive protective devices from SICK AG for more information.

▶ Clearly label all connections (connecting cables and plug connectors) on the safety controller to avoid confusion. Since the Flexi Soft system has more than one connector of the same type, you must be sure that once connecting cables or plug connectors have been unplugged, they are not reconnected in the wrong position.
▶ Check the signal paths and check for correct integration into higher-level controllers.
▶ Check for correct data transmission from and to the Flexi Soft safety controller.
▶ Check the logic program for the safety controller.
▶ Run a full validation of the safety function of the system in each operating mode and simulate at least one error. Pay particular attention to the response times of the individual applications.
▶ Record the entire configuration process for the system and the individual devices, as well as the result of the safety inspection, in writing.
▶ To make it difficult to inadvertently overwrite the configuration, you can activate write protection for the configuration of the Flexi Soft system. Changes can then only be made if write protection has first been deactivated.

8.2 Checks before initial commissioning

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

▶ Check the effectiveness of the safety function on the machine in all operating modes and functions in which the machine can be set.

▶ Ensure that all operators have been instructed by qualified safety personnel employed by the machine user before they start working on a machine protected by the safety controller. Instruction is the responsibility of the machine user.

9 Operation

9.1 Status messages of the SC-FS-CPUx main modules

Information on the position of the LEDs on the SC-FS-CPU0 main module .

MS LED (all main modules)

Table 16: MS LED

MS LED	Meaning	Notes
○	Supply voltage out of range	Switch on the voltage supply of the Flexi Soft system and check at the A1 and A2 terminals of the main module.
☀ Red/green (1 Hz)	Self-test in progress or system initializing.	Please wait …
☀ Green (1 Hz)	System in Stop	The application can be started from within the configuration software.
☀ Green (2 Hz)	Identifying	–
● Green	System in Run	–
☀ Red (1 Hz)	Invalid configuration	Check module type and module version of main module and expansion modules on which the MS LED ☀ is flashing red/green. Modify the configuration if necessary. Use the configuration software diagnostic function.
☀ Red (2 Hz)	Serious error in the system, presumably in this module. The application was stopped. All outputs are switched off.	Switch the power supply off and then on again. If the problem still has not been remedied after multiple repetitions, replace this module. Use the configuration software diagnostic function.
● Red	Serious error in the system, presumably in a different module. The application was stopped. All outputs are switched off.	Switch the power supply off and then on again. If the problem still has not been remedied after multiple repetitions, replace the module showing ☀ red (2 Hz). If applicable, also use the diagnostic function in the configuration software to isolate the affected module.

CV LED (all main modules)

Table 17: CV LED

CV LED	Meaning	Note
○	Configuration in progress.	–
☀ Yellow (2 Hz)	Saving configuration data in the system plug (non-volatile memory)	Do not disconnect from power supply until save process has been completed.
☀ Yellow (1 Hz)	Unverified configuration	Verify the configuration with the configuration software.
● Yellow	Verified configuration	–

9.2 Status indications of the SC-FS-XTIO I/O module

Information on the position of the LEDs on the SC-FS-XTIO I/O module .

Table 18: Displays of the MS LED on the SC-FS-XTIO I/O module

MS LED	Meaning	Notes
○	Supply voltage out of range	Switch on the voltage supply of the Flexi Soft system and check at the A1 and A2 terminals of the main module.
☀ Red/green (1 Hz)	Recoverable external error	Check cabling of the flashing inputs and outputs. If all output LEDs are flashing, check the supply voltage of terminals A1 and A2 on this module.
☀ Green (1 Hz)	System in Stop	The application can be started from within the configuration software.
● Green	System in Run	
☀ Red (1 Hz)	Invalid configuration	
☀ Red (2 Hz)	Serious error in the system, presumably in this module. The application was stopped. All outputs are switched off.	Switch the power supply off and then on again. If the problem still has not been remedied after multiple repetitions, replace this module. Use the configuration software diagnostic function.
● Red	Serious error in the system, presumably in a different module. The application was stopped. All outputs are switched off.	Switch the power supply off and then on again. If the problem still has not been remedied after multiple repetitions, replace the module showing ☀ red (2 Hz). If applicable, also use the diagnostic function in the configuration software to isolate the affected module.

Table 19: Displays of the input and output LEDs on the SC-FS-XTIO I/O module

Input LEDs (I1 … I8) Output LEDs (Q1 … Q4)	Meaning
○	Input/output is deactivated.
● Green	Input/output is active.
☀ Green (1 Hz) synchronized with the red MS LED	Input/output is deactivated and there is a remediable error.
☀ Green (1 Hz) alternating with the red MS LED	Input/output is active and there is a remediable error.

ⓘ **NOTE**
The LEDs indicate the state and are updated approx. every 64 ms.

9.3 Status indications of the SC-FS-XTDI I/O module

Information on the position of the LEDs on the SC-FS-XDTI I/O module .

Table 20: Displays of the MS LED on the SC-FS-XTDI I/O module

MS LED	Meaning	Notes
○	Supply voltage out of range	Switch on the voltage supply of the Flexi Soft system and check at the A1 and A2 terminals of the main module.
☀ Red/green (1 Hz)	Recoverable external error	Check cabling of the flashing inputs. If all output LEDs are flashing, check the supply voltage of terminals A1 and A2 on this module.
☀ Green (1 Hz)	System in Stop	The application can be started from within the configuration software.
● Green	System in Run	
☀ Red (1 Hz)	Invalid configuration	
☀ Red (2 Hz)	Serious error in the system, presumably in this module. The application was stopped.	Switch the power supply off and then on again. If the problem still has not been remedied after multiple repetitions, replace this module. Use the configuration software diagnostic function.
● Red	Serious error in the system, presumably in a different module. The application was stopped.	Switch the power supply off and then on again. If the problem still has not been remedied after multiple repetitions, replace the module showing ☀ red (2 Hz). If applicable, also use the diagnostic function in the configuration software to isolate the affected module.

Table 21: Displays of the input LEDs on the SC-FS-XTDI I/O module

Input LEDs (I1 … I8)	Meaning
○	Input is deactivated.
● Green	Input is active.
☀ Green (1 Hz) synchronized with the red MS LED	Input is deactivated and there is a remediable error.
☀ Green (1 Hz) alternating with the red MS LED	Input is active and there is a remediable error.

NOTE
The LEDs indicate the state and are updated approx. every 64 ms.

9.4 Status indications of the SC-FS-XTDS I/O module

Information on the position of the LEDs on the SC-FS-XTDS I/O module .

Table 22: Displays of the MS LED on the SC-FS-XTDS I/O module

MS LED	Meaning	Notes
○	Supply voltage out of range	Switch on the voltage supply of the Flexi Soft system and check at the A1 and A2 terminals of the main module.
☀ Red/green (1 Hz)	Remediable external error	Check cabling of the flashing inputs and outputs. If all output LEDs are flashing, check the supply voltage of terminals A1 and A2 on this module.
☀ Green (1 Hz)	System in Stop	The application can be started from within the configuration software.
● Green	System in Run	
☀ Red (1 Hz)	Invalid configuration	
☀ Red (2 Hz)	Serious error in the system, presumably in this module. The application was stopped. All outputs are switched off.	Switch the power supply off and then on again. If the problem still has not been remedied after multiple repetitions, replace this module. Use the configuration software diagnostic function.
● Red	Serious error in the system, presumably in a different module. The application was stopped. All outputs are switched off.	Switch the power supply off and then on again. If the problem still has not been remedied after multiple repetitions, replace the module showing ☀ red (2 Hz). If applicable, also use the diagnostic function in the configuration software to isolate the affected module.

Table 23: Displays of the input and output LEDs on the SC-FS-XTDS I/O module

Input LEDs (I1 ... I8) Output LEDs (XY1, XY2, and Y3 ... Y6)	Meaning
○	Input/output is deactivated.
● Green	Input/output is active.
☀ Green (1 Hz) synchronized with the red MS LED	Input/output is deactivated and there is a remediable error.
☀ Green (1 Hz) alternating with the red MS LED	Input/output is active and there is a remediable error.

> **NOTE**
> The LEDs indicate the state and are updated approx. every 64 ms.

9.5 Status indications of the SC-FS-STIO I/O module

Information on the position of the LEDs on the SC-FS-STIO I/O module see figure 20, page 33.

Table 24: Displays of the MS LED on the SC-FS-STIO I/O module

MS LED	Meaning	Notes
○	Supply voltage out of range	Switch on the voltage supply of the Flexi Soft system and check at the A1 and A2 terminals of the main module.
☀ Red/ green (1 Hz)	Remediable external error	Check cabling of the flashing inputs and outputs. If all output LEDs are flashing, check the supply voltage of terminals A1 and A2 on this module.
☀ Green (1 Hz)	System in Stop	The application can be started from within the configuration software.
● Green	System in Run	
☀ Red (1 Hz)	Invalid configuration	
☀ Red (2 Hz)	Serious error in the system, presumably in this module. The application was stopped. All outputs are switched off.	Switch the power supply off and then on again. If the problem still has not been remedied after multiple repetitions, replace this module. Use the configuration software diagnostic function.
● Red	Serious error in the system, presumably in a different module. The application was stopped. All outputs are switched off.	Switch the power supply off and then on again. If the problem still has not been remedied after multiple repetitions, replace the module showing ☀ red (2 Hz). If applicable, also use the diagnostic function in the configuration software to isolate the affected module.

Table 25: Displays of the input / output LEDs on the SC-FS-STIO I/O module

Input LEDs (I1 … I6) Output LEDs (Y1 … Y6) Input/output LEDs (IY7, IY8)	Meaning
○	Input/output is deactivated.
● Green	Input/output is active.
☀ Green (1 Hz) synchronized with the red MS LED	Input/output is deactivated and there is a remediable error.
☀ Green (1 Hz) alternating with the red MS LED	Input/output is active and there is a remediable error.

NOTE

The LEDs indicate the state and are updated approx. every 64 ms.

10 Maintenance

This section provides information about regular checks and the replacement of Flexi Soft modules.

Do not attempt to remove, repair, or modify the Flexi Soft modules. This can lead to the loss of the safety function(s). It will also invalidate any warranty claims against SICK AG.

10.1 Regular thorough check of the safety function by qualified safety personnel

▶ Check the system following the inspection intervals specified in the national rules and regulations. This procedure ensures that any changes to the machine or tampering with the protective device are detected after initial commissioning.

▶ Every safety application must be checked at fixed intervals you define. The effectiveness of the safety function must be checked by qualified and authorized personnel.

▶ If changes have been made to the machine or safety function or if the safety controller has undergone retrofitting or repair work, e.g., if a module has been replaced, re-inspect the system using the checklist in the Appendix.

▶ Carry out regular inspections in order to keep the Flexi Soft modules in perfect working order.

▶ Check that the implementation of the Flexi Soft modules complies with all technical data.

▶ Check the mounting conditions and check that the Flexi Soft module wiring is correct.

▶ To ensure their reliability, check at regular intervals that the safety functions are meeting the requirements of the application as well as all applicable regulations and standards (e.g., regular thorough check).

10.2 Device replacement

A serious error in a Flexi Soft module will affect the entire network. Therefore, devices affected by serious errors must be repaired or replaced quickly. We recommend keeping a stock of spare Flexi Soft modules so that network operation can be restored as quickly as possible.

Follow the instructions for mounting and removing the Flexi Soft modules, see "Mounting", page 27 and see "How to dismantle the modules", page 58.

Safety measures for device replacement

Please note the following safety measures when replacing Flexi Soft modules:

• Do not attempt to break up or repair the Flexi Soft modules. In addition to invalidating any warranty claims against SICK AG, this is also dangerous, since there is no way of checking the original safety function.

• Restore the device to a safe state.

• Before replacing a device, always disconnect the power supply in order to prevent electric shock or unexpected device behavior.

• To continue to be able to use the system configuration, check:
  ○ Is the new module of the same type (same part number) and are there no errors affecting the module following replacement?
  ○ Has the new module been plugged in in the same position as the module that has been replaced?
  ○ Have all plug connectors been reconnected in the correct positions?

• Otherwise you will have to completely reconfigure and commission the new system, including carrying out all necessary thorough checks (see "Commissioning the hardware", page 39).

NOTE

- Following replacement, check that no errors are occurring with the new Flexi Soft modules.
- Always carry out a function test before commissioning a replacement module.
- If you want to send in a Flexi Soft module for repair, start by generating a report for your project in the configuration software which includes the diagnostic messages for the Flexi Soft system. Send this report, along with the Flexi Soft module concerned and a detailed description of the problem, to SICK, including all available information.
- When you send in a system plug for repair or analysis, it will be returned in the state of delivery, i.e. with an empty configuration. You should therefore save your configuration as a project file using the configuration software.

11   Diagnostics

11.1   Response to errors

⚠ **DANGER**

Cease operation if the cause of the malfunction has not been clearly identified.

Immediately stop machine operation if you cannot clearly identify the fault and if you cannot safely remedy the problem.

Check after troubleshooting

After remedying an error, analyze the effect(s) and check all affected safety functions.

11.2   Error states

The Flexi Soft safety controller will respond to certain malfunctions or configuration errors by switching to the safe state. The LEDs on the individual modules of the safety controller indicate the corresponding error state.

The error state will vary depending on the nature of the error:

Configuration error

- The system is in the Configuration required state (MS LED 🔆 red (1 Hz)).
- The applications in all modules are in the Stop state.
- All safe outputs of the system are switched off.
- All safe process data is set to zero. The non-safety-related process data is typically also set to zero.

Remediable error

- The applications in all modules remain in the Run state (MS LED on the affected modules = 🔆 alternate red/green (1 Hz), MS LED on modules that are not affected = ● green).
- If safe outputs of the system are affected, they are switched off as a minimum.
- If safe inputs are affected, the process data of these safe inputs is set to zero as a minimum.

Serious error

- The system is in the Serious error state (MS LED on the module that has detected the serious error = 🔆 red (2 Hz). MS LED on the modules on which the cause of the error is unknown = ● red).
- The applications in all modules are in the Stop state.
- All safe outputs of the system are switched off.
- All safe process data is set to zero. The non-safety-related process data is typically also set to zero.

To put the device back into operation:
▶ Remedy the cause of the error based on the MS, CV, and EFI LED displays.
▶ In the event of serious errors, switch the power supply to the Flexi Soft system off for at least 3 seconds and then switch it back on again.

11.3 Error displays shown by status LEDs, error messages, and troubleshooting measures

The most important error codes, possible causes, and possible troubleshooting measures are listed in this chapter. These error messages can be displayed with the diagnostics function of the configuration software if you have established a connection to the Flexi Soft system.

NOTE
- For information about how to perform diagnostics, please refer to the "Diagnostics view" section in the operating instructions "Flexi Soft in the Flexi Soft Designer Configuration Software" (SICK part number 8022491).
- Fault displays and troubleshooting for the individual modules are described in the sections on the corresponding modules.

Table 26: Error codes and error messages in the Flexi Soft system and possible troubleshooting measures

LED display on the module		Possible error codes	Possible causes	Possible measures
Main module SC-FS-CPUx	**Expansion module** [1]			
MS = ⚫ red (1 Hz)	All expansion modules: MS = ⚫ Red (1 Hz)	Main module: 0x000E4006, 0x00160005, 0x000F0013	The configuration in the system plug is incompatible, because it is intended for a different type of main module: • The system plug was used before in a system with a different main module type (e.g. SC-FS-CPU0 instead of SC-FS-CPU3 or vice versa). • An incorrect main module has been used in the hardware installation.	• Transfer a configuration with the same type of main module as in the hardware installation. • Replace the main module in the hardware installation with a main module of the same type as in the project file.
		Main module: 0x00170005, 0x000F0013	The configuration in the system plug is incompatible, because it is intended for more recent firmware version of the main module: • The system plug has been configured for an incompatible more recent firmware version of the main module (e.g., V2.00.0 instead of V1.11.0). • An older firmware version of the main module has been used in the hardware installation.	• Transfer a configuration with the same or an older firmware version (e.g, V1.xx.0 instead of V2.xx.0). • Replace the main module in the hardware installation with a module with a more recent or identical firmware version as in the project file.
		Main module: 0x000E4013, 0x00274006	The configuration in the system plug is incompatible with at least one expansion module: • An expansion module is missing in the hardware installation.	• Transfer a configuration with a suitable number of expansion modules. • Add the missing expansion module to the hardware installation.
		Main module: 0x000E0006, 0x0005000D SC-FS-XTIO/-XTDI: 0x4901, 0x4904	The configuration in the system plug is invalid: • The last configuration operation was not completed successfully, e.g., because the power supply was switched off before the write operation to the system plug was completed. • Hardware error in system plug • The system plug is empty (condition on delivery).	• Transfer the configuration again and make sure that the power supply at the main module remains switched on until the transfer operation is complete. • Replace the system plug and transfer the configuration again.
MS = ⚫ Red (1 Hz) EFI = ⚫ Red (1 Hz)	One or more expansion modules: MS = ⚫ Red (1 Hz)	Main module: 0x001F0006, 0x00230006, 0x00234006, 0x001F4006	The configuration in the system plug is incompatible with at least one expansion module: • Incorrect module type or incorrect module version (MS LED on module is flashing red or red/green). • Too many expansion modules are connected. (MS LED on module is flashing red or red/green.) • Expansion modules are missing. (MS LEDs on all other modules are flashing red or red/green.)	• Transfer a configuration with the same module type and the same or an older firmware version of all expansion modules. • Replace the expansion module affected in the hardware installation with a module of the same type and a firmware version that is older than or identical to the one in the project file.

LED display on the module		Possible error codes	Possible causes	Possible measures
Main module SC-FS-CPUx	Expansion module [1]			
MS = green (1 Hz) CV = yellow (1 Hz)	MS = green (1 Hz)	–	The system is in the Stop state (ready for operation).	The application can be started from within the configuration software. For automatic starting following power-up, the project must be verified with the configuration software.
MS = green (1 Hz) CV = yellow	MS = green (1 Hz)	–	The system is in the Stop state (ready for operation).	The application can be started from within the configuration software.
MS = green	MS = green	–	The system is in operation. No errors detected.	–
MS = green	One or more expansion modules: MS = Red/green (1 Hz) and Q1 + Q2 + Q3 + Q4 = green (1 Hz)	SC-FS-XTIO: 0x4804, 0x4806, 0x4807	The supply voltage of a SC-FS-XTIO module is too low or missing.	Check voltage supply at the terminals A1 (24 V) and A2 (GND) at the SC-FS-XTIO module, also under worst case conditions. The error is reset automatically after approx. 8 seconds if its cause is no longer present.
MS = ● green	One or more expansion modules: MS = Red/green (1 Hz) and Q1 or Q2 or Q3 or Q4 = green (1 Hz)	SC-FS-XTIO: 0x4701, 0x4702, 0x4704. 0x4705	• Short-circuit to 24 V or cross-circuit in the wiring of the safe output Q1 to Q4 (associated LED is flashing) • Capacitive load exceeds permissible maximum value (e.g., due to spark quenching capacitor). • Inductive load exceeds permissible maximum value. • Internal hardware fault in the SC-FS-XTIO module • Short-circuit to GND in the wiring of the safe output Q1 to Q4 (associated LED is flashing) • Voltage supply at the SC-FS-XTIO module interrupted temporarily	• Check the wiring of the affected output. • Check the capacitive load. • Check the inductive load. • Replace the SC-FS-XTIO module. To reset the error, all outputs of the affected module must be switched off by the logic of the main module by switching off the associated input signals (e.g., emergency stop). It can take up to 8 seconds to reset the error. Alternatively, reset the voltage at the main module.

LED display on the module		Possible error codes	Possible causes	Possible measures
Main module SC-FS-CPUx	Expansion module [1]			

MS = ● green	One or more expansion modules: MS = ☀ Red/green (1 Hz) and I1 or I2 or I3 or I4 or I5 or I6 or I7 or I8 = ☀ green (1 Hz)	SC-FS-XTIO/-XTDI: 0x4601	Inputs connected to a test output:
			
			• Short-circuit to 24 V or cross-circuit in the wiring of tested sensors:
			  ○ a) Short-circuit to 24 V or cross-circuit in the wiring of X1, X2, … or X8 to a tactile switch or to a test input of a testable input
			  ○ b) Short-circuit to 24 V or cross-circuit in the wiring of a tactile switch or an output of a testable sensor to I1, I2, … or I8
			• Defective testable sensor
			• Cable break in the wiring of a pressure-sensitive safety mat:
			  ○ a) Cable break in the wiring of X1, X2, … or X8 to the pressure-sensitive safety mat
			  ○ b) Cable break in the wiring from the pressure-sensitive safety mat to I1, I2, … or I8
			• Defective pressure-sensitive safety mat
				• Check the wiring of the affected input.
				• Replace the testable sensor.
				
				To reset the error, switch off the affected input (input state Low/Low for equivalent dual-channel inputs, Low/High for complementary dual-channel inputs) or reset the voltage at the main module.

MS = ● green	One or more expansion modules: MS = ☀ Red/green (1 Hz) and I1 + I2 or I3 + I4 or I5 + I6 or I7 + I8 = ☀ green (1 Hz)	SC-FS-XTIO/-XTDI: 0x4429 or 0x442A	Discrepancy error or sequence error at dual-channel inputs (associated LEDs flashing green): • Cable break or short-circuit to GND at one of the two input signals of the input pair • Sensor hardware error (e.g., is one of the two contacts/outputs permanently closed (High) or open (Low)). • Defective sensor (one of the two signals is not switching to a state corresponding to the other input within the configured discrepancy time). • The safety door opened or closed too slowly; as a result, both contact switches (e.g., reed contacts) did not switch within the configured discrepancy time. • Only one of the two inputs triggered the switch-off condition and then switched back to the ON state, while the value of the other input did not change at all (sequence error).	• Check the wiring of the affected input and check the switching capacity of the two contacts/outputs of the connected sensor. • Check the mechanical dependence of the two switches. • Replace the switch/sensor in the hardware installation. To reset the error, the affected input pair must be Low/Low in the case of equivalent dual-channel inputs and Low/High in the case of complementary dual-channel inputs.

LED display on the module		Possible error codes	Possible causes	Possible measures
Main module SC-FS-CPUx	Expansion module [1]			
MS = ● red	MS = ● red	Main module: 0xXXXCXXXX Expansion modules: 0xCXXX (X = random value)	• Internal error in the expansion module • Internal error in the main module	• Check the connection from terminal A2 of the SC-FS-XTIO modules to GND of the voltage supply. • Check the system for electromagnetic interference (grounding of the DIN mounting rail, etc.). • To reset the error, reset the voltage at the main module. • If the error persists, replace the modules.
MS = ● red	MS = ☀ Red (2 Hz)	Main module: 0xXXXCXXXX Expansion modules: 0xCXXX (X = random value)	Internal error in the expansion module (associated MS LED flashing)	• Check the system for electromagnetic interference (grounding of the DIN mounting rail, etc.). • To reset the error, reset the voltage at the main module. • If the error persists, replace the module on which the MS LED is flashing.
MS = ☀ Red (2 Hz)	MS = ● red	Main module: 0xXXXCXXXX Expansion modules: 0xCXXX (X = random value)	Internal error in the main module or in the system	• Check the system for electromagnetic interference (grounding of the DIN mounting rail, etc.). • To reset the error, reset the voltage at the main module. • If the error persists, replace the main module followed by the expansion modules.

LED display on the module		Possible error codes	Possible causes	Possible measures
Main module SC-FS-CPUx	Expansion module [1]			
MS = ● red or ☀ red (2 Hz)	MS = ● red or ☀ red (2 Hz)	Main module: 0x0006C002, 0x0007C002, 0x0001C005, 0x0003C006, 0x0005C006, 0x0029C006, 0x0003C013	• Consequential error further to another serious error • Fault affecting the internal signals of the main module caused by significant electromagnetic interference • Hardware error in the main module or in an expansion module	• Check the other diagnostic messages for serious errors with a very similar time stamp. • To reset the error, reset the voltage at the main module. • If the error persists, replace the main module followed by the expansion modules.
		Main module: 0x0001C013, 0x0004C013, 0x0005C013, 0x000CC013	• FLEXBUS+ communication (backplane communication to I/O modules) disturbed due to EMC interference. • FLEXBUS+ communication (backplane communication with I/O modules and gateways) disturbed due to a serious fault in I/O modules. This is a follow-on error and there will also be other serious faults with a practically identical time stamp (± 1 s) in the diagnostic history.	• To reset the error, reset the voltage at the main module. • Check the system with regard to electromagnetic interference (FE connection for DIN mounting rail and control cabinet, star wiring of the 24 V power supply, local isolation of load and control elements, etc.). • Check the other diagnostic messages with a very similar time stamp.
		Main module: 0x002AC006	Incompatible input data from the expansion module: • A dual-channel input at a SC-FS-XTIO or SC-FS-XTDI module has two signal dips (High to Low) in a time distance of 2 ms (e.g. test gaps of an OSSD output or bouncing relay contacts). • A signal input at a SC-FS-XTIO or SC-FS-XTDI module changes state in 4-ms intervals for a duration of 40 ms or more (e.g. proximity switch on a gear wheel).	• To reset the error, reset the voltage at the main module. • Change the configuration by activating the On-Off filter for the inputs of the affected SC-FS-XTIO or SC-FS-XTDI module. Please note that this increases the response time for this signal by at least 8 ms.

LED display on the module		Possible error codes	Possible causes	Possible measures
Main module SC-FS-CPUx	Expansion module [1)			
MS = ● red or ☀ red (2 Hz) (continued)	MS = ● red or ☀ red (2 Hz) (continued)	SC-FS-XTIO/-XTDI: 0xC306 Main module: 0x0029C006	• Internal hardware fault in the SC-FS-XTIO or SC-FS-XTDI module • Consequential error on main module: 0x0029C006	• To reset the error, reset the voltage at the main module. • Replace the SC-FS-XTIO or SC-FS-XTDI module in the hardware installation.
		SC-FS-XTIO/-XTDI: 0xC307 Main module: 0x0029C006	• Voltage supply at terminal A2 (GND) of SC-FS-XTIO module interrupted. • Internal hardware fault in the SC-FS-XTIO or SC-FS-XTDI module • Consequential error on main module: 0x0029C006	• Check supply voltage at the terminals A1 (24 V) and A2 (GND) at the SC-FS-XTIO module, also under worst case conditions. • To reset the error, reset the voltage at the main module. • Replace the SC-FS-XTDI or SC-FS-XTIO module in the hardware installation if the fault persists.
		SC-FS-XTIO/-XTDI: 0xC30A Main module: 0x0029C006	• Short-circuit to 24 V or cross-circuit in the wiring of the safe output Q1 to Q4 (associated LED is flashing) • Capacitive load exceeds permissible maximum value (e.g., due to spark quenching capacitor). • Inductive load exceeds permissible maximum value. • Internal hardware fault in the SC-FS-XTIO module • Consequential error on main module: 0x0029C006	• Check the wiring of the affected output. • Check the capacitive load. • Check the inductive load. • To reset the error, reset the voltage at the main module. • Replace the SC-FS-XTIO module in the hardware installation if the fault persists.

LED display on the module		Possible error codes	Possible causes	Possible measures
Main module SC-FS-CPUx	Expansion module [1)			
MS = ● green	All expansion modules: MS = ● green	Main module: 0x000A0011	• Function block error during dual-channel input evaluation (e.g., emergency stop, solenoid switch): discrepancy error at input pair 1 of the function block • Cable break or short-circuit to GND at one of the two input signals of the input pair • Sensor hardware error (e.g., is one of the two contacts/outputs permanently closed (High) or open (Low)). • Defective sensor (one of the two signals is not switching to a state corresponding to the other input within the configured discrepancy time). • The safety door opened or closed too slowly; as a result, both contact switches (e.g., reed contacts) did not switch within the configured discrepancy time.	• Check the wiring of the affected input and check the switching capacity of the two contacts/outputs of the connected sensor. • Check the mechanical dependence of the two switches. • Replace the switch/sensor in the hardware installation. To reset the error, the affected input pair must switch from Low/Low to High/High in the case of equivalent dual-channel inputs and from Low/High to High/Low in the case of complementary dual-channel inputs within the configured discrepancy time.
		Main module 0x00100011	• Function block error (external device monitoring or valve monitoring): The feedback signal was not sent in response to the control signal within the maximum feedback delay time. • Hardware error affecting the connected relay/valve or error in the wiring • The relay/valve used has a longer switching delay at the monitoring contact.	• Increase the maximum feedback delay time for the function block if this is compatible with your application. • Replace the relay/valve in the hardware installation.

LED display on the module		Possible error codes	Possible causes	Possible measures
Main module SC-FS-CPUx	**Expansion module [1]**			
All LEDs briefly off, then LED test sequence	All LEDs briefly off, then LED test sequence	Main module: 0x002D4006	• The power supply to the main module was affected by a brief voltage dip (almost to 0 V). • The voltage of the voltage supply to the main module dropped (to between approx. 6 V and 16 V) and then rose back into the operating range.	• Ensure that the power supply unit is able to jumper an interruption in the power supply lasting up to 20 ms. • Ensure that the power supply unit is able to operate the load so that load switching cannot cause the voltage to drop. • Check the wiring of the power supply to the main module. Use separate cables to other heavy loads in order to avoid a voltage dip on the supply cable caused by other load currents.
		Main module: 0x003E4006	The system has performed a restart due to faults occurring on the FLEXBUS+: • FLEXBUS+ communication (backplane communication with I/O modules and gateways) disturbed due to EMC interference • FLEXBUS+ communication (backplane communication with I/O modules and gateways) disturbed due to a serious fault in an expansion module (I/O module or gateway). This is a follow-on error and there will also be other serious faults with a practically identical time stamp (± 1 s) in the diagnostic history.	• Check the system with regard to electromagnetic interference (FE connection for DIN mounting rail and control cabinet, star wiring of the power supply (24 V and GND), local isolation of load and control elements, etc.). • Check the other diagnostic messages with a very similar time stamp.

[1] SC-FS-XTIO, SC-FS-XTDI, SC-FS-XTDS, and SC-FS-STIO

11.4   Error history

The diagnostic function of the configuration software allows you to read out the fault history from the Flexi Soft system and to store this in the report as a PDF file or to print it out. You will find detailed information in the operating instructions "Flexi Soft in the Flexi Soft Designer Configuration Software" (SICK part number 8022491).

11.5   SICK support

If you cannot remedy an error with the help of the information in the relevant Flexi Soft operating instructions, please contact your SICK subsidiary.

12 Decommissioning

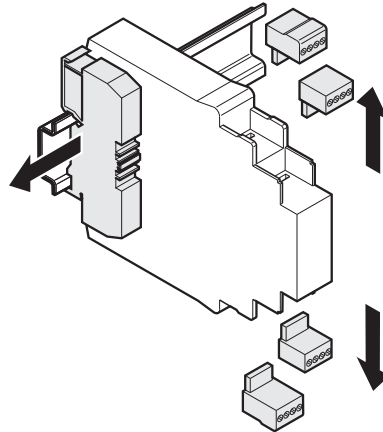## 12.1 How to dismantle the modules

Figure 22: Unplug the plug-in terminals.

▶ Remove the plug-in terminals including the wiring and the end pieces.
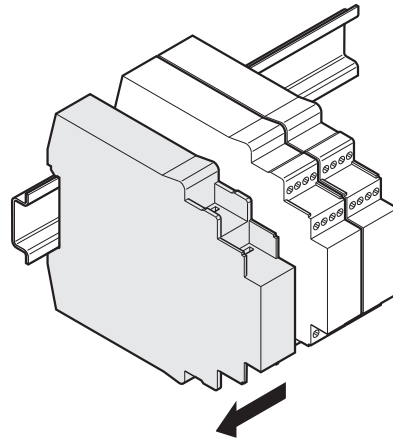
Figure 23: Disconnect the plug connectors.

▶ If multiple modules are present, slide each of the modules apart in the direction of the arrow until the side-mounted plug connector unlocks.
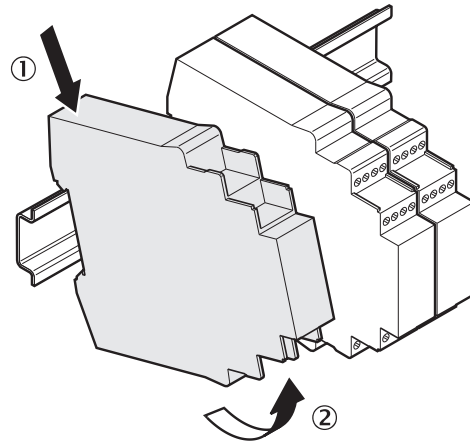
Figure 24: Remove the modules from the DIN mounting rail

▶ Press the module down at the rear (①) and remove it from the mounting rail (②) in the direction of the arrow while keeping it pressed down.

12.2 Disposal

Always dispose of unusable or irreparable devices in accordance with the applicable waste disposal regulations specific to your country (e.g., European waste disposal code 16 02 14).

NOTE
We will be glad to help you dispose of these devices. Please contact us.

12.3 Separation of materials

DANGER
Only qualified safety personnel are permitted to separate materials.
Exercise caution when dismantling devices. There is a risk of injury.

Before the devices can be submitted for environmentally-friendly recycling, the various materials of which the Flexi Soft safety controller is comprised must be separated.

▶ Separate the housing from the rest of the components (in particular from the printed circuit board).
▶ Submit the separated components for recycling as appropriate (see the table below).

Table 27: Overview of component disposal

Components	Disposal
Housing	Plastics recycling
Printed circuit boards, cables, male connectors, and electrical connectors	Electronics recycling
Packaging	Paper/cardboard recycling

13 Technical data

13.1 Minimum switch-off time

The minimum switch-off time (e.g., of connected sensors) is the minimum time for which a switch-off condition must be present in order to be detected by the Flexi Soft system. The minimum switch-off time must be...

- greater than the logic execution time +1 ms
  and
- greater than the test gap + the maximum OFF-ON delay if the device is connected to a Flexi Soft test output and the test gap is > 1 ms
  and
- Greater than the test period (i.e., the higher value of the two test outputs used) + the maximum OFF-ON delay if pressure-sensitive safety mats or bumpers are being used [1]

The minimum switch-off time of the sensors is usually listed in the technical data for the sensors.

13.2 Response times of the Flexi Soft system

All paths must be taken into account when calculating the response times in a Flexi Soft system.

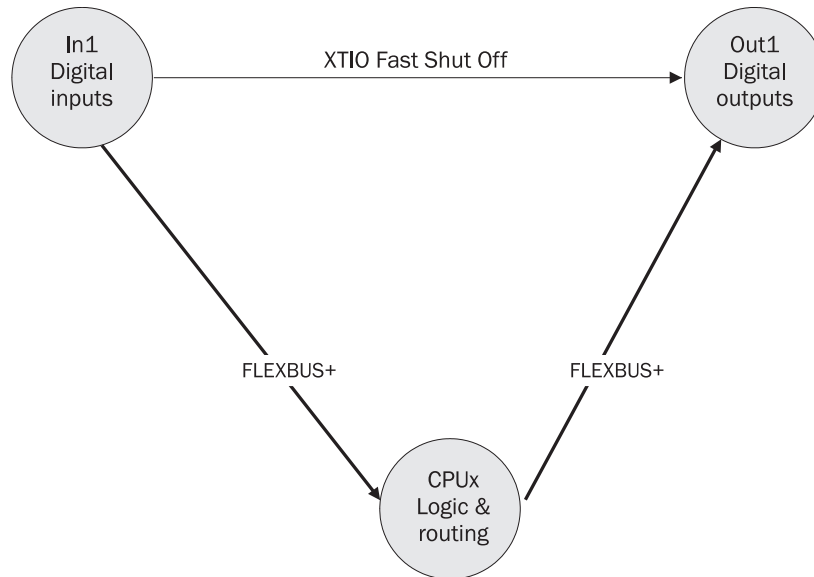*Figure 25: Response times within a Flexi Soft system*

Fast shut-off

The Fast Shut Off function can be realized on the SC-FS-XTIO I/O modules. A response time of 8 ms can be achieved with this function.

> **NOTE**
> The Fast Shut Off function only has an effect on the inputs/outputs of the same SC-FS-XTIO I/O module.

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[1] Take the values from the report in the configuration software.

Optimization of logic execution time

The logic program in the main module will be executed faster after activation of the **Logic execution time optimization** option in Flexi Soft Designer and deactivation of any functions that are not being used (Flexi Line, Flexi Loop, EFI including Flexi Link). This can reduce the logic execution time. Particularly in the case of complex applications, this means that a shorter processing time can be achieved and, in turn, a shorter response time.

> **NOTE**
>
> The minimum logic execution time of a Flexi Soft system is always 4 ms. It cannot be reduced further by means of optimization.
>
> Changes to the logic execution time can mean that changes have to be made to the configuration of the function blocks that are based on the logic execution time.

For further information on optimizing the logic execution time, please refer to the operating instructions "Flexi Soft in the Flexi Soft Designer Configuration Software" (SICK part number 8022491).

13.2.1   Calculation of the response time

The following table can be used to calculate the response time of associated paths within the Flexi Soft system.

Table 28: Calculation of the maximum response time of the Flexi Soft system in ms

1. Inputs	Response time of the input under consideration on the signal path	E1 or E2 or E3 or E4 or E5 (see corresponding table)	
2. Logic	a) Response time of the main module logic (SC-FS-CPUx logic)	2 × logic execution time [1]	
		Delay with logic application [2] (e.g., switch-on delay or switch-off delay function block)	
	b) Routing response time (only applicable on A3 output to the gateway)	No delay time	0 ms
	c) Response time of the Fast Shut Off logic (applies only to SC-FS-XTIO modules)	No delay	0 ms
3. Outputs	Response time of the output under consideration on the signal path	A1 or A2 or A3 or A4 (see corresponding table)	
Total response time			

[1] Take values from the configuration software report.
[2] Time values have a tolerance of 10 ms in addition to the logic execution time; i.e., 10 ms must be added to each selected value in order to calculate the response time. For example, in the case of a switch-off delay of 10 ms and a logic execution time of 12 ms, 32 ms must be used for the calculation.

Digital inputs (E1)

Table 29: Calculation of the maximum response time for the digital inputs (E1) in ms

General information	Sensor response time [1]	
General information	Input processing time	6.5 ms
If on/off filter active	+ min. filter time [2]	
If I1 ... I8 connected to test input X1 ... X8	+ max. OFF-ON delay [3] of the test output used	
a) Pressure-sensitive safety mats and bumpers	+ test period [3] of the test output; use higher value of the two test outputs	
b) Testable sensors Type 4	+ test period [3] of the test output	
c) All other sensors	+ test gap [3] of the test output (if test gap [3] > 1 ms)	
Total E1		

[1] Take value from the corresponding operating instructions.
[2] Switching off is delayed until the signal has been low for at least the selected filter time.
[3] Take values from the configuration software report.

Digital outputs (A1)

Table 30: Calculation of the maximum response time for the digital outputs (A1) in ms

General information	Response time of the actuator [1]	
General information	Output processing time a) From the logic (via FLEXBUS+): + 4.5 ms b) From fast shut-off: + 1.5 ms	
If you are using single-channel outputs	Potential switch-off delay in the event of an internal error, depending on whether an extended error detection time has been configured for the switching of capacitive loads: +10 ms or +50 ms [2]	
Total A1		

[1] Take value from the corresponding operating instructions.
[2] see "Extended fault detection time for cross-circuits at outputs Q1 to Q4 of the SC-FS-XTIO for switching higher capacitive loads", page 18 and see "Single-channel use of outputs on the SC-FS-XTIO", page 19.

Input of a gateway (E3)

Table 31: Calculation of the maximum response time for the input from a gateway (E3) in ms

General	Fieldbus response time for data to the gateway (e.g. from PLC) [1]	
General	2 x internal update interval for data from the gateway to the main module [2]	
a) with EtherCAT® gateway	–3 ms	
b) with other gateway	+5 ms	
With 2 gateways	–4 ms	
Sum total E3		

[1] Take the value from the relevant operating instructions.
[2] The update interval between the main module and a Flexi Soft gateway depends on the quantity of the data to be transmitted and the number of gateways in the system. Take the values from the report in the configuration software. The update interval is a multiple of 4 ms for every 10 bytes to be transmitted in or out of the gateway if the system contains a gateway. When two gateways are used, the update interval is a multiple of 8 ms.

Output to a gateway (A3)

Table 32: Calculation of the maximum response time for the output to a gateway (A3) in ms

General	Fieldbus response time for data from the gateway (e.g. to PLC) [1]	
General	2 x internal update interval for data from the main module to the gateway [2]	
a) with EtherCAT® gateway	0 ms	
b) with other gateway	+8 ms	
With 2 gateways	−4 ms	
Sum total A3		

[1]   Take the value from the relevant operating instructions.

[2]   The update interval between the main module and a Flexi Soft gateway depends on the quantity of the data to be transmitted and the number of gateways in the system. Take the values from the report in the configuration software. The update interval is a multiple of 4 ms for every 10 bytes to be transmitted in or out of the gateway if the system contains a gateway. When two gateways are used, the update interval is a multiple of 8 ms.

13.3   Data sheet

13.3.1   SC-FS-CPU0 main module

SC-FS-CPUx safety-related parameters

> ℹ **NOTE**
> The data for the safety technology parameters is based on an ambient temperature of +40 °C (the temperature usually used for the static calculation of the values).

Table 33: SC-FS-CPU0 safety-related parameters

	SC-FS-CPU0
Safety integrity level [1]	SIL3 (IEC 61508)
SIL claim limit [1]	SILCL3 (EN 62061)
Category	Category 4 (EN ISO 13849-1)
Performance level [1]	PL e (EN ISO 13849-1)
PFH_D	1.07×10^{-9}
T_M (mission time)	20 years (EN ISO 13849-1)

[1]   For more detailed information about the safety design and dimensioning of your machine/system, please contact your SICK subsidiary.

SC-FS-CPUx general data

Table 34: SC-FS-CPU0 general data

	SC-FS-CPU0
Conformity/approvals	CE, cULus, CCC, EAC
Protection class	III (EN 61140)
Enclosure rating	IP 20 (EN 60529)
Ambient operating temperature (UL/CSA: surrounding air temperature)	−25 ... +55 °C
Storage temperature	−25 ... +70 °C
Air humidity	10 ... 95%, non-condensing
Operating altitude	Max. 2,000 m above sea level (80 kPa)

	SC-FS-CPU0
Vibration resistance	5–150 Hz/1 G (EN 60068-2-6)
	10–500 Hz/3 G$_{rms}$ (EN 60068-2-64)
Shock resistance	
Continuous shock	15 g, 11 ms (EN 60068-2-27)
Single shock	30 g, 11 ms (EN 60068-2-27)
Interference immunity	EN 61000-6-2
Radiated emission	EN 61000-6-4
Number of EFI interfaces	0
Number of Flexi Line interfaces	0
Data interface	Internal bus (FLEXBUS+)
Configuration interface	RS-232
RS-232 connectivity	M8, 4-pin
Dimensions (W × H × D)	22.5 × 96.5 × 120.6 mm
Weight	111 g (±5%)

Power supply unit (A1, A2) for SC-FS-CPUx via system plug

Table 35: Power supply unit (A1, A2) for SC-FS-CPU0 via system plug

Supply voltage	24 V DC (16.8 … 24 … 30 V DC)
Supply voltage UL/CSA applications	24 V DC
Type of supply voltage	PELV or SELV
	The supply current for the module must be limited externally to max. 4 A – either by the power supply unit used or using a fuse.
Short-circuit protection	4 A gG (with tripping characteristics B or C)
Overvoltage category	II (EN 61131-2)
Power consumption	Max. 2.5 W
Power-up delay	Max. 18 s
Connectivity	Screw terminals
Wire cross-section	Single-wire or stranded: 0.14 … 2.5 mm²
	AWG to UL/CUL: 26 … 14

13.3.2 SC-FS-XTIO I/O module

SC-FS-XTIO safety-related parameters

> **NOTE**
> The data for the safety technology parameters is based on an ambient temperature of +40 °C (the temperature usually used for the static calculation of the values).

Table 36: SC-FS-XTIO safety-related parameters

	SC-FS-XTIO	
Safety integrity level [1]	SIL3 (IEC 61508)	
SIL claim limit [1]	SILCL3 (EN 62061)	
Category [2]		
For single-channel outputs with activated test signals at all safe outputs (Q1 … Q4)	Category 4 (EN ISO 13849-1) [3]	
For single-channel outputs with deactivated test signals at this or any other safe output (Q1 … Q4)	Category 3 (EN ISO 13849-1) [3] [4]	
For dual-channel outputs with or without deactivated test signals at this or any other safe output (Q1 … Q4)	Category 4 (EN ISO 13849-1) [4] [5]	
Performance level [1]	PL e (EN ISO 13849-1)	
PFH$_D$ [2]		
For single-channel outputs	4.8×10^{-9}	
For dual-channel outputs	0.9×10^{-9}	
T$_M$ (mission time)	20 years (EN ISO 13849-1) [4]	

[1] For more detailed information about the safety design and dimensioning of your machine/system, please contact your SICK subsidiary.

[2] Valid for single-channel outputs and dual-channel outputs.

[3] If single-channel outputs are being used: Use protected or separate cabling for these safe outputs, because although a short-circuit to 24 V can be detected, no other option is available for switching off.

[4] If safe outputs without test signals are being used, at least once a year either all safe outputs with test signals must be switched off at the same time for at least one second or the Flexi Soft system must be restarted by switching off the voltage supply.

[5] If safe outputs without test signals are being used: Use protected or separate cabling for the safe outputs whose test signals are deactivated, because a short-circuit to 24 V cannot be detected if the safe output is High. In the event of an internal hardware error being detected, the ability of the other safe outputs to shut down could be impaired by reverse current.

SC-FS-XTIO general data

Table 37: SC-FS-XTIO general data

	SC-FS-XTIO
Conformity/approvals	CE, cULus, CCC, EAC
Protection class	III (EN 61140)
Enclosure rating	IP 20 (EN 60529)
Ambient operating temperature (UL/CSA: surrounding air temperature)	–25 … +55 °C
Storage temperature	–25 … +70 °C
Air humidity	10 … 95%, non-condensing
Operating altitude	Max. 2,000 m above sea level (80 kPa)
Vibration resistance	5–150 Hz/1 G (EN 60068-2-6) 10–500 Hz/3 G$_{rms}$ (EN 60068-2-64)
Shock resistance	
Continuous shock	15 g, 11 ms (EN 60068-2-27)
Single shock	30 g, 11 ms (EN 60068-2-27)
Interference immunity	EN 61000-6-2

	SC-FS-XTIO
Radiated emission	EN 61000-6-4
Connectivity	Dual level spring terminals
Wire cross-section	Single-wire or stranded: 0.2 ... 1.5 mm² Stranded wire with ferrule: a) With plastic ferrule max. 0.75 mm² b) With plastic ferrule max. 1.5 mm² AWG to UL/CUL: 24 ... 16
Data interface	Internal bus (FLEXBUS+)
Power consumption via FLEXBUS+, no current at X1, X2	Max. 2.2 W
Dimensions (W × H × D)	22.5 × 96.5 × 120.6 mm
Weight	164 g (±5%)

Power supply unit (A1, A2) for SC-FS-XTIO

Table 38: Power supply unit (A1, A2) for SC-FS-XTIO

	SC-FS-XTIO
Supply voltage	24 V DC (16.8 ... 24 ... 30 V DC)
Supply voltage UL/CSA applications	24 V DC
Type of supply voltage	PELV or SELV The supply current for the module must be limited externally to max. 4 A – either by the power supply unit used or using a fuse.
Short-circuit protection	4 A gG (with tripping characteristics B or C)
Power consumption	Maximum 120 W (30 V x 4 A) determined by the load at outputs Q1 to Q4, plus maximum 1 W power consumption through the internal circuit
Power-up delay	Max. 18 s

Safe inputs (I1 ... I8) of SC-FS-XTIO

Table 39: Safe inputs (I1 ... I8) of SC-FS-XTIO

	SC-FS-XTIO
Number of inputs	8
Input voltage High	13 ... 30 V DC
Input voltage Low	–5 ... +5 V DC
Input current High	2.4 ... 3.8 mA
Input current Low	–2.5 ... +2.1 mA
Reverse current at input in the event of the loss of a ground connection [1]	Max. 2 mA
Switching current (for the connection of mechanical contacts)	14.4 mA at 5 V 3 mA at 24 V
Input pulse filter (pulses within these limits do not have any effect)	
Pulse width	Max. 0.9 ms
Pulse period	Min. 4 ms
Input capacity	Max. 10 nF + 10%

	SC-FS-XTIO
Discrepancy time	4 ms ... 30 s, configurable

1)   Do not connect any other safe inputs in parallel if the reverse current could lead to a High state at the other input.
2)   The hardware version of the Flexi Soft modules can be found in the hardware configuration of the Flexi Soft Designer configuration software in online mode or in the report, if you were previously online.

Test outputs (X1, X2) of SC-FS-XTIO

Table 40: Test outputs (X1, X2) of SC-FS-XTIO

	SC-FS-XTIO
Number of outputs	2 (with 2 test signal generators)
Type of output	PNP semiconductor, short-circuit protected, cross-circuit monitored
Output voltage High	15 ... 30 V DC (max. 1.8 V dip to terminal A1 of the main module)
Output resistance Low	≤ 33 Ω + 10%, current limited at approx. 10 mA
Output current	Max. 120 mA at every test output (X1 or X2). A maximum of 8 testable sensor cascades are thus possible per module, each with up to 30 mA, maximum. The total current of the Flexi Soft system for all outputs (X1 ... X8 and XY1 ... XY2) must not exceed 1.28 A. This corresponds, for example, to a maximum of 32 testable sensor cascades each with 30 mA plus 64 tactile sensors at inputs of expansion modules, each with 5 mA.
Test signal rate (test period)	40 ... 1,000 ms, configurable
Test pulse duration (test gap)	1 ... 100 ms, configurable
Load capacity	1 µF for test gap ≥ 4 ms 0.5 µF for test gap 1 ms
Cable resistance	< 100 Ω

Safe outputs (Q1 ... Q4) of SC-FS-XTIO

Table 41: Safe outputs (Q1 ... Q4) of SC-FS-

	SC-FS-XTIO
Number of outputs	4
Type of output	PNP semiconductors, short-circuit protected
Output voltage High	16 ... 30 V DC (max. 0.8 V dip to terminal A1 of the main module)
Leakage current Low	
Normal operation	Max. 0.1 mA
Fault 1)	Max. 2.0 mA
Output current	Max. 2.0 A
Sum current I_{sum}	
T_U ≤ 45 °C	Max. 4.0 A
T_U ≤ 55 °C	Max. 3.2 A
UL/CSA applications	Max. 3.2 A
Test pulse duration (test gap) 2)	< 650 µs or deactivated
Test signal rate (test period)	Min. 200 ms
Load capacity	≤ 0.5 µF
Cable resistance 3)	Max. 5 Ω (e.g., 100 m × 1.5 mm² = 1.2 Ω)

	SC-FS-XTIO
Maximum permitted coil energy without external protection elements [4]	0.37 J
Response time	Depending on the logic configuration, for details see: see table 28, page 61
Synchronicity of outputs Qx within a Flexi Soft station (time delay)[5]	Max. 1 ms
Possible switching to High in the event of an internal hardware error	10 ms or 50 ms, for details see: see "Single-channel use of outputs on the SC-FS-XTIO", page 19

[1] In the event of an error (interruption of the GND cable) with a minimum load resistance of 2.5 kΩ, the leakage current will flow as a maximum at the safe output. With lower load resistances, the leakage current may be higher, but in this case the output voltage is < 5 V. A downstream device such as a relay or an FPLC (fail-safe programmable logic controller), for example, must detect this state as Low.

[2] When activated, the outputs are tested regularly (brief Low switching). When selecting the downstream controllers, make sure that the test pulses with the listed parameters do not result in switching off, or deactivate the test pulses at the outputs.

[3] Limit the resistance of the individual cables to the downstream controller to this value to ensure that a short-circuit between the outputs is safely detected. (See also EN 60204 Electrical equipment of machines, Part 1: General requirements.)

[4] Examples for the resulting maximum coil induction based on the coil current:
- Hardware version V1.01: 2960 mH @ 0.5 A, 740 mH @ 1 A, 185 mH @ 2 A

External controllers are not required for inductive loads (e.g., contactors, relays, and valves) if this maximum coil energy is not exceeded.

< 3 ms or < 43 ms if an extended fault detection time for switching capacitive loads has been configured The overshoot can be reduced if necessary using an external parallel resistance.

[5] This includes switching off in the event of an error: In the case of a dual-channel output, both channels switch off within this time in the event of an error.

13.3.3 SC-FS-XTDI I/O module

SC-FS-XTDI safety-related parameters

ℹ️ **NOTE**
The data for the safety technology parameters is based on an ambient temperature of +40 °C (the temperature usually used for the static calculation of the values).

Table 42: SC-FS-XTDI safety-related parameters

	SC-FS-XTDI
Safety integrity level [1]	SIL3 (IEC 61508)
SIL claim limit [1]	SILCL3 (EN 62061)
Category	Category 4 (EN ISO 13849-1)
Performance level [1]	PL e (EN ISO 13849-1)
PFH_D	0.4×10^{-9}
T_M (mission time)	20 years (EN ISO 13849-1)

[1] For more detailed information about the safety design and dimensioning of your machine/system, please contact your SICK subsidiary.

SC-FS-XTDI general data

Table 43: SC-FS-XTDI general data

	SC-FS-XTDI
Conformity/approvals	CE, cULus, CCC, EAC
Protection class	III (EN 61140)
Enclosure rating	IP 20 (EN 60529)

	SC-FS-XTDI
Ambient operating temperature (UL/CSA: surrounding air temperature)	–25 … +55 °C
Storage temperature	–25 … +70 °C
Air humidity	10 … 95%, non-condensing
Operating altitude	Max. 2,000 m above sea level (80 kPa)
Vibration resistance	5–150 Hz/1 G (EN 60068-2-6) 10–500 Hz/3 G_{rms} (EN 60068-2-64)
Shock resistance	
Continuous shock	15 g, 11 ms (EN 60068-2-27)
Single shock	30 g, 11 ms (EN 60068-2-27)
Interference immunity	EN 61000-6-2
Radiated emission	EN 61000-6-4
Connectivity	Dual level spring terminals
Wire cross-section	Single-wire or stranded: 0.2 … 1.5 mm² Stranded wire with ferrule: a) With plastic ferrule max. 0.75 mm² b) With plastic ferrule max. 1.5 mm² AWG to UL/CUL: 24 … 16
Data interface	Internal bus (FLEXBUS+)
Power consumption via FLEXBUS+, no current at X1 … X8	Max. 2 W
Dimensions (W × H × D)	22.5 × 96.5 × 120.6 mm
Weight	139 g (±5%)

Safe inputs (I1 … I8) of SC-FS-XTDI

Table 44: Safe inputs (I1 … I8) of SC-FS-XTDI

	SC-FS-XTDI
Number of inputs	8
Input voltage High	13 … 30 V DC
Input voltage Low	–5 … +5 V DC
Input current High	2.4 … 3.8 mA
Input current Low	–2.5 … +2.1 mA
Reverse current at input in the event of the loss of a ground connection [1]	Max. 2 mA
Switching current (for the connection of mechanical contacts)	14.4 mA at 5 V 3 mA at 24 V
Input capacity	Max. 10 nF + 10%
Discrepancy time	4 ms … 30 s, configurable

[1]   Do not connect any other safe inputs in parallel if the reverse current could lead to a High state at the other input.

Test outputs (X1 … X8) of SC-FS-XTDI

Table 45: Test outputs (X1 … X8) of SC-FS-XTDI

	SC-FS-XTDI
Number of outputs	8 (with 2 test signal generators)
Type of output	PNP semiconductors, short-circuit protected, cross-circuit monitored
Output voltage High	15 … 30 V DC (max. 1.8 V dip to terminal A1 of the main module)
Output resistance Low	≤ 33 Ω + 10%, current limited at approx. 10 mA
Output current	Max. 120 mA at each of the two test signal generators (X1/X3/X5/X7 or X2/X4/X6/X8). A maximum of 8 testable sensor cascades are thus possible per module, each with up to 30 mA, maximum. The total current of the Flexi Soft system for all outputs (X1 … X8 and XY1 … XY2) must not exceed 1.28 A. This corresponds, for example, to a maximum of 32 testable sensor cascades each with 30 mA plus 64 tactile sensors at inputs of expansion modules, each with 5 mA.
Test signal rate (test period)	40 … 1,000 ms, configurable
Test pulse duration (test gap)	1 … 100 ms, configurable
Load capacity	1 µF for test gap ≥ 4 ms 0.5 µF for test gap 1 ms
Cable resistance	< 100 Ω

13.3.4 SC-FS-XTDS I/O module

SC-FS-XTDS safety parameters

ℹ️ **NOTE**
The data for the safety technology parameters is based on an ambient temperature of +40 °C (the temperature usually used for the static calculation of the values).

The safety technology parameters do not apply for outputs XY1, XY2, and Y3–Y6.

Table 46: SC-FS-XTDS safety parameters

	SC-FS-XTDS
Safety integrity level [1]	SIL3 (IEC 61508)
SIL claim limit [1]	SILCL3 (EN 62061)
Category	Category 4 (EN ISO 13849-1)
Performance level [1]	PL e (EN ISO 13849-1)
PFH_D	0.4×10^{-9}
T_M (mission time)	20 years (EN ISO 13849-1)

[1] For more detailed information about the safety design and dimensioning of your machine/system, please contact your SICK subsidiary.

SC-FS-XTDS general data

Table 47: SC-FS-XTDS general data

	SC-FS-XTDS
Conformity/approvals	CE, cULus, CCC, EAC
Protection class	III (EN 61140)
Enclosure rating	IP 20 (EN 60529)

	SC-FS-XTDS
Ambient operating temperature (UL/CSA: surrounding air temperature)	–25 … +55 °C
Storage temperature	–25 … +70 °C
Air humidity	10 … 95%, non-condensing
Operating altitude	Max. 2,000 m above sea level (80 kPa)
Vibration resistance	5–150 Hz/1 G (EN 60068-2-6) 10–500 Hz/3 G_{rms} (EN 60068-2-64)
Shock resistance	
Continuous shock	15 g, 11 ms (EN 60068-2-27)
Single shock	30 g, 11 ms (EN 60068-2-27)
Interference immunity	EN 61000-6-2
Radiated emission	EN 61000-6-4
Connectivity	Dual level spring terminals
Wire cross-section	Single-wire or stranded: 0.2 … 1.5 mm^2 Stranded wire with ferrule: a) With plastic ferrule max. 0.75 mm^2 b) With plastic ferrule max. 1.5 mm^2 AWG to UL/CUL: 24 … 16
Data interface	Internal bus (FLEXBUS+)
Power consumption via FLEXBUS+, no current at XY1 and XY2	Max. 1.5 W
Dimensions (W × H × D)	22.5 × 96.5 × 120.6 mm
Weight	139 g (±5%)

Power supply unit (A1, A2) for SC-FS-XTDS

Table 48: Power supply unit (A1, A2) for SC-FS-XTDS

	SC-FS-XTDS
Supply voltage	24 V DC (16.8 … 24 … 30 V DC)
Supply voltage UL/CSA applications	24 V DC
Type of supply voltage	PELV or SELV The supply current for the module must be limited externally to max. 4 A – either by the power supply unit used or using a fuse.
Short-circuit protection	4 A gG (with tripping characteristics B or C)
Power consumption	Max. 60 W (30 V × 2 A), determined by the load at outputs Y3 to Y6
Power-up delay	Max. 18 s

Safe inputs of the SC-FS-XTDS

Table 49: Safe inputs (I1 … I8) of the SC-FS-XTDS

	SC-FS-XTDS
Number of inputs	8
Input voltage High	13 … 30 V DC
Input voltage Low	–5 … +5 V DC
Input current high	2.4 … 3.8 mA
Input current Low	–2.5 … +2.1 mA

	SC-FS-XTDS
Reverse current at input in the event of the loss of a ground connection [1]	Max. 2 mA
Switching current (for the connection of mechanical contacts)	14.4 mA at 5 V 3 mA at 24 V
Input capacity	Max. 15 nF + 10%
Discrepancy time	4 ms ... 30 s, configurable

[1] Do not connect any other safe inputs in parallel if the reverse current could lead to a High state at the other input.

Outputs of the SC-FS-XTDS as test outputs

Table 50: Outputs (XY1 ... XY2) of the SC-FS-XTDS when using as test outputs

	SC-FS-XTDS
Number of outputs	2 (with 2 test signal generators)
Type of output	PNP semiconductors, short-circuit protected
Output voltage High	15 ... 30 V DC (max. 1.8 V dip to terminal A1 of the main module)
Output resistance Low	≤ 33 Ω + 10%, current limited at approx. 10 mA
Output current	Max. 120 mA at each of the two test signal generators (XY1 or XY2). A maximum of 8 testable sensor cascades are thus possible per module, each with up to 30 mA, maximum. The total current of the Flexi Soft system for all outputs (X1 ... X8 and XY1 ... XY2) must not exceed 1.28 A. This corresponds, for example, to a maximum of 32 testable sensor cascades each with 30 mA plus 64 tactile sensors at inputs of expansion modules, each with 5 mA.
Test signal rate (test period)	40 ... 1,000 ms, configurable
Test pulse duration (test gap)	1 ... 100 ms, configurable
Load capacity	1 μF for test gap ≥ 4 ms 0.5 μF for test gap 1 ms
Cable resistance	< 100 Ω

Non-safe outputs of the SC-FS-XTDS

Table 51: Non-safe outputs (Y3 ... Y6 and XY1 and XY2 when used as non-safe outputs) of the SC-FS-XTDS

	SC-FS-XTDS
Number of non-safe outputs	4 (6)
Type of output	PNP semiconductors, short-circuit protected
Output voltage High	16 ... 30 V DC (max. 0.8 V dip to terminal A1 of the main module)
Leakage current Low	
Normal operation	Max. 0.1 mA
Error [1]	Max. 1.0 mA
Output current	
XY1, XY2	Max. 120 mA
Y3 ... Y6	Max. 0.5 A
Maximum permitted coil energy without external protection elements [2]	0.37 J

	SC-FS-XTDS
Response time	Depending on the logic configuration, for details see: see table 28, page 61

[1]   In the event of an error (interruption of the GND cable) with a minimum load resistance of 2.5 kΩ, the leakage current will flow as a maximum at the output. With lower load resistances, the leakage current may be higher, but in this case the output voltage is < 5 V. A downstream device such as a relay or an FPLC (fail-safe programmable logic controller), for example, must detect this state as Low.

[2]   Examples for the resulting maximum coil induction: 2960 mH @ 0.5 A.

13.3.5   SC-FS-STIO I/O module

SC-FS-STIO general data

Table 52: SC-FS-STIO general data

	SC-FS-STIO
Conformity/approvals	CE, cULus, CCC, EAC
Protection class	III (EN 61140)
Enclosure rating	IP 20 (EN 60529)
Ambient operating temperature (UL/CSA: surrounding air temperature)	–25 ... +55 °C
Storage temperature	–25 ... +70 °C
Air humidity	10 ... 95%, non-condensing
Operating altitude	Max. 2,000 m above sea level (80 kPa)
Vibration resistance	5–150 Hz/1 G (EN 60068-2-6) 10–500 Hz/3 G_{rms} (EN 60068-2-64)
Shock resistance	
Continuous shock	15 g, 11 ms (EN 60068-2-27)
Single shock	30 g, 11 ms (EN 60068-2-27)
Interference immunity	EN 61000-6-2
Radiated emission	EN 61000-6-4
Connectivity	Dual level spring terminals
Wire cross-section	Single-wire or stranded: 0.2 ... 1.5 mm² Stranded wire with ferrule: a) With plastic ferrule max. 0.75 mm² b) With plastic ferrule max. 1.5 mm² AWG to UL/CUL: 24 ... 16
Data interface	Internal bus (FLEXBUS+)
Power consumption via FLEXBUS+	Max. 1.5 W
Dimensions (W × H × D)	22.5 × 96.5 × 120.6 mm
Weight	139 g (±5%)

Power supply unit (A1, A2) for SC-FS-STIO

Table 53: Power supply unit (A1, A2) for SC-FS-STIO

	SC-FS-STIO
Supply voltage	24 V DC (16.8 ... 24 ... 30 V DC)
Supply voltage UL/CSA applications	24 V DC
Type of supply voltage	PELV or SELV The supply current for the module must be limited externally to max. 4 A – either by the power supply unit used or using a fuse.

	SC-FS-STIO
Short-circuit protection	4 A gG (with tripping characteristics B or C)
Power consumption	Max. 120 W (30 V × 4 A), determined by the load at outputs Y1 to IY8
Power-up delay	Max. 18 s

SC-FS-STIO input circuit

Table 54: Input circuit (I1 ... IY8) of the SC-FS-STIO

	SC-FS-STIO
Number of non-safe inputs	6 (8)
Input voltage High	13 ... 30 V DC
Input voltage Low	–5 ... +5 V DC
Input current High	2.4 ... 3.8 mA
Input current Low	–2.5 ... +2.1 mA
Switching current (for the connection of mechanical contacts)	14.4 mA at 5 V 3 mA at 24 V
Input capacity	Max. 15 nF + 10%
Discrepancy time	4 ms ... 30 s, configurable

Non-safe outputs of the SC-FS-STIO

Table 55: Non-safe outputs (Y1 ... Y6 and IY7 and IY8) of the SC-FS-STIO

	SC-FS-STIO
Number of non-safe outputs	6 (8)
Type of output	PNP semiconductors, short-circuit protected
Output voltage High	16 ... 30 V DC (max. 0.8 V dip to terminal A1 of the main module)
Leakage current Low	
Normal operation	Max. 0.1 mA
Error [1]	Max. 1.0 mA
Output current	Max. 0.5 A
Maximum permitted coil energy without external protection elements [2]	0.37 J
Response time	Depending on the logic configuration, for details see: see table 28, page 61

[1] In the event of an error (interruption of the GND cable) with a minimum load resistance of 2.5 kΩ, the leakage current will flow as a maximum at the output. With lower load resistances, the leakage current may be higher, but in this case the output voltage is < 5 V. A downstream device such as a relay or an FPLC (fail-safe programmable logic controller), for example, must detect this state as Low.

[2] Examples for the resulting maximum coil induction: 2960 mH @ 0.5 A.

13.4 Dimensioned drawings

13.4.1 SC-FS-CPUx main modules with system plug
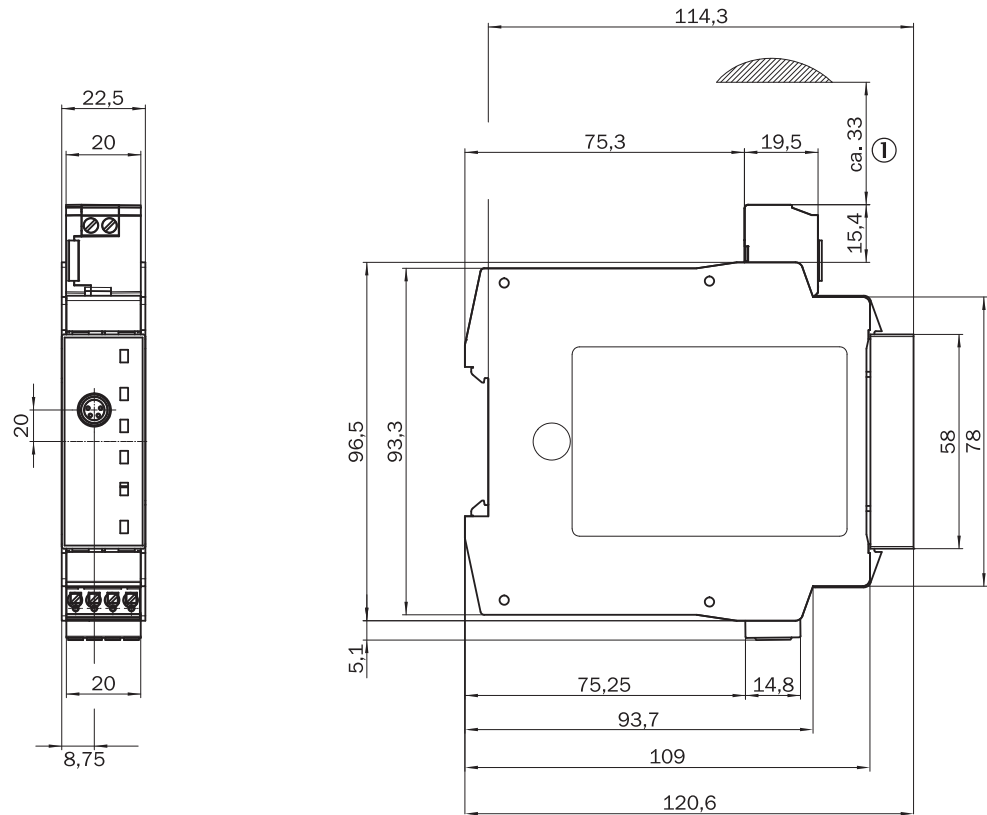
Figure 26: Dimensional drawing SC-FS-CPUx (mm)

① Connector range

13.4.2 SC-FS-XTIO, SC-FS-XTDI, SC-FS-XTDS, and SC-FS-STIO I/O modules
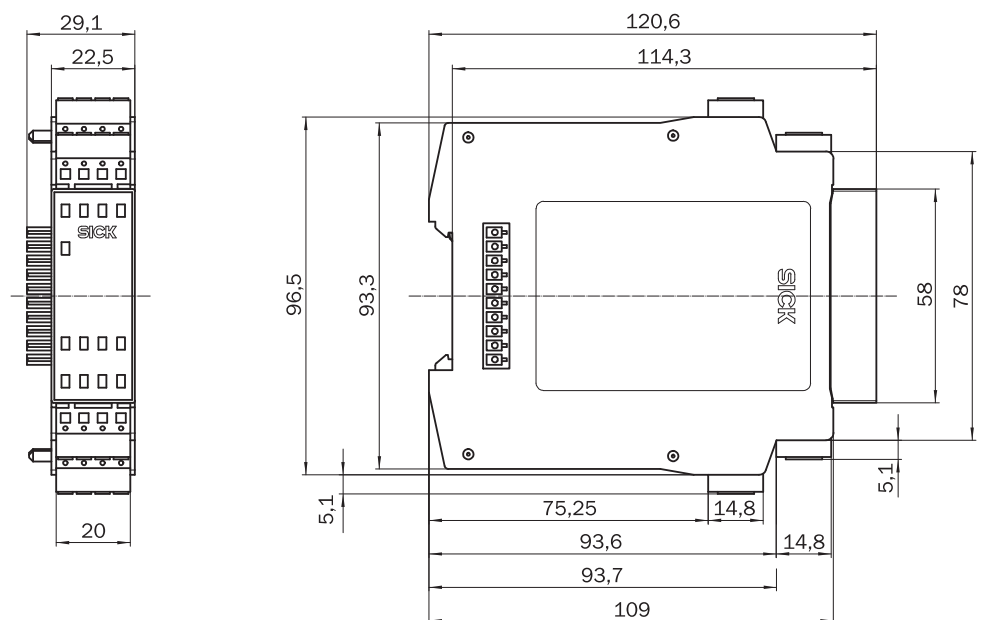
Figure 27: SC-FS-XTIO, SC-FS-XTDI, SC-FS-XTDS, and SC-FS-STIO dimensional drawing (mm)

14 Appendix

14.1 Compliance with EU directives

EU declaration of conformity (excerpt)

The undersigned, who represents the manufacturer below, hereby declares that the product complies with the regulations of the EU directive(s) below (including all relevant changes), and that it is based on the relevant standards and/or technical specifications.

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).

14.2 Checklist for the manufacturer

Checklist for the manufacturer/installer installing the Flexi Soft safety controller

The details on the items listed below must be available at the latest when the system is commissioned for the first time. However, they are dependent upon the application, the requirement 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 tests.

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

Have the safety rules and regulations been observed in compliance with the directives/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 correspond to the required category?	Yes ☐ No ☐
Are the required protective measures against electric shock in effect (protection class)?	Yes ☐ No ☐
Has the safety function been checked in compliance with the test notes of this documentation? In particular: Function check of the control devices, sensors, and actuators connected to the safety controller Check of all cut-off paths	Yes ☐ No ☐
Is there an assurance that a full thorough check of the safety function is carried out after every change to the configuration of the safety function?	Yes ☐ No ☐

15 List of abbreviations

ESPE

Electro-sensitive protective device

EDM

External device monitoring

EFI

Enhanced function interface = safe SICK device communication

FPLC

Fail-safe programmable logic controller

HMI

Human machine interface

OSSD

Output signal switching device

PFH$_D$

Probability of dangerous failure per hour

SIL

Safety integrity level

SILCL

Safety integrity level claim limit

PLC

Programmable logic controller

16 List of figures

17 List of tables

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