OPERATING INSTRUCTIONS

Flexi IO XTDO1

Expansion module - IO

FLX3-XTDO00S14

SICK
Sensor Intelligence.

Described product

Flexi IO XTDO1

Manufacturer

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Legal information

Original document

This document is an original document of SICK AG.

CE

Contents

1 Ordering information

1.1 Ordering information for main module

Table 1: Ordering information for main module

Part	Type	Part number
CPUc1 main module • 20 safety capable inputs • 8 test outputs • 4 safety outputs	FLX3-CPUC100S14	1119023

1.2 Ordering information for expansion module

Ordering information for IO expansion module

Table 2: Ordering information for IO expansion module

Part	Type	Part number
Expansion module XTDI1 • 8 safety capable inputs • 8 test outputs	FLX3-XTDI100S14	1119028
Expansion module XTDO1 • 8 safety capable inputs • 8 safety outputs	FLX3-XTDO100S14	1119027

2 About this document

2.1 Purpose of this document

These operating instructions contain the information required during the life cycle of the safety controller.

Operating instructions of the safety controller must be made available to all people who work with the device.

2.2 Scope

These operating instructions apply to the Flexi Compact safety controller.

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

- 8026638

2.3 Target groups and structure of these operating instructions

These operating instructions are intended for the following target groups: project developers (planners, developers, designers), installers, electricians, safety experts (such as CE authorized representatives, compliance officers, people who test and approve the application), operators, and maintenance personnel.

These operating instructions are organized by the life phases of the device: project planning, mounting, electrical installation, commissioning, operation and maintenance.

The table below shows the target groups and how – for many applications – these are typically divided up between the manufacturer and the entity operating the machine in which the device is to be integrated:

Area of responsibility	Target group	Specific chapters of these operating instructions [1]
Manufacturer	Project developers (planners, developers, designers)	Project planning, page 12 Technical data, page 31
	Installers	Mounting, page 16
	Electricians	Electrical installation, page 18
	Safety experts	Project planning, page 12 Commissioning, page 22 Technical data, page 31
Operating entity	Operators	Troubleshooting, page 25
	Maintenance staff	Troubleshooting, page 25 Ordering information, page 5

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

In other applications, the operating organization is also the manufacturer of the equipment with the corresponding allocation of the target groups.

2.4 Further information

www.sick.com

The following information is available via the Internet:

- This document in other languages
- Data sheets and application examples

- CAD files and dimensional drawings
- Certificates (such as the EU declaration of conformity)
- Guide for Safe Machinery. Six steps to a safe machine
- Safety Designer (software for configuring safety solutions made by SICK AG)

2.5 Symbols and document conventions

The following symbols and conventions are used in this document:

Safety notes and other notes

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

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

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

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

NOTE
Indicates useful tips and recommendations.

Instructions to action

▶ The arrow denotes instructions to action.

1. The sequence of instructions for action is numbered.
2. Follow the order in which the numbered instructions are given.

✓ The check mark denotes the result of an instruction.

3 Safety information

3.1 General safety notes

This chapter contains general safety information about the safety controller.

Further safety information is provided in the respective chapters to cover the specific situations in which the product may be used.

DANGER

If the device is not integrated in the way intended by the manufacturer, the protective function of the device can be impaired. The dangerous state may be ended too late.

- Plan the integration of the safety component in accordance with the machine requirements, see "Project planning", page 12.

3.2 Intended use

The Flexi Compact safety controller is a freely configurable control for safety applications. Sensors and switching elements (e.g. light curtains, laser scanners, switches, sensors, encoders, emergency stop pushbuttons) are connected to the 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.

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

The safety controller system is only suitable for use in industrial environments.

3.3 Improper use

Among others, the safety controller is not suitable for the following applications:

- Outdoors
- Underwater
- In explosion-hazardous areas
- In residential areas

3.4 Requirements for the qualification of personnel

The protective device must be planned in, installed, connected, commissioned, and serviced by qualified safety personnel only.

Project planning

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

Mechanical mounting, electrical installation, and commissioning

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

Operation and maintenance

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

4 Product description

4.1 Configuration of the safety controller

Configuration of the safety controller

A safety controller comprises the following components:

- A main module
- Up to 12 optional expansion modules

4.2 Overview of the module

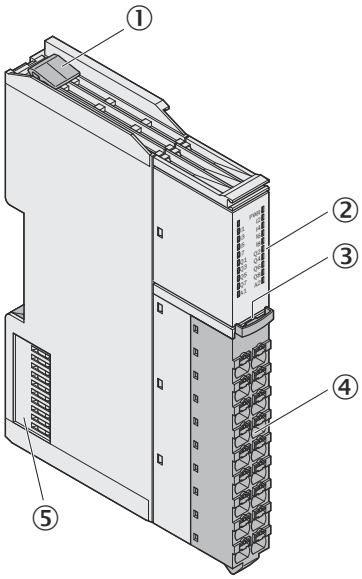


Figure 1: FLX3-XTDO1 IO expansion module

① Release element of the module
② Status indicators (LEDs)
③ Front connector unlocking
④ Front connector with terminals
⑤ Backplane bus

4.3 Configuration and function

Prerequisites

- The module can only be operated with a main module.

Configuration

Table 3: Interfaces of the module

Description	Quantity
Safety capable inputs	8
Safety capable outputs	8

Function

The module is a safe digital input/output expansion module.

The module offers the following functions:

- Monitoring of the connected safety devices
- Switching of the connected safety devices
- Special IO functions (e.g., fast shut off)

Complementary information

- Safety outputs have test pulses for detecting short-circuits in the wiring.
- Voltage is supplied to the module via the backplane bus. Communication with the main module of the safety controller also occurs via the backplane bus.
- Voltage is supplied directly to the safety outputs Q via A1 / A2 on the module.

4.4 Status indicators

Status indicators

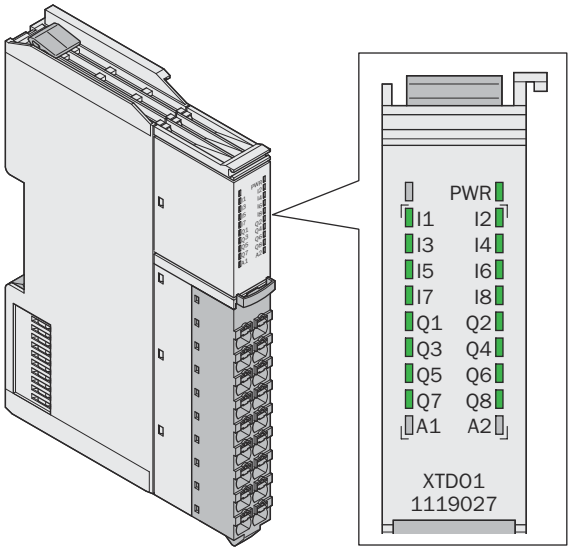


Figure 2: LEDs for indicating the status

The arrangement of the status indicators corresponds to the arrangement of the terminals.

Status indicator

Table 4: Status indicator

Labeling	Color	Function
PWR	Green/Red	Device status [1]
I1 ... I8	Green	Safety capable input 1 ... 8
Q1 ... Q8	Green	Safety capable output 1 ... 8

[1] Does not indicate whether the local auxiliary supply at A1 and A2 for the safety outputs is currently within the supply voltage range.

Further topics

- "Troubleshooting", page 25

5 Project planning

5.1 Manufacturer of the machine

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

- ▶ Carry out a risk assessment before using the safety controller.
- ▶ Do not manipulate, open or modify the components of the safety controller.
- ▶ Make sure the safety controller is only repaired by the manufacturer or by someone authorized by the manufacturer. Improper repair can lead to a loss of the protective function.

5.2 Operating entity of the machine

DANGER
Failure to observe operator obligations
Hazard due to lack of effectiveness of the protective device

- ▶ Changes to the machine and changes to the hardware or the logic programming of the safety controller necessitate a new risk assessment. The results of this risk assessment may require the entity operating the machine to meet the obligations of a manufacturer.
- ▶ Apart from the procedures described in this document, the components of the safety controller must not be opened or modified.
- ▶ Do not carry out any repair work on components. Improper repair of the safety controller can lead to a loss of the protective function.

5.3 Design

Mounting

- Environment meets the requirements of IP54 or higher, e.g., IP54 control cabinet.
- Mounting on a 35 mm × 7.5 mm mounting rail in accordance with IEC 60715.
- The mounting rail is connected to the functional earth.
- Mounting rail is mounted on a mounting plate.
- Mounting plate is connected to functional earth.
- Mounting in a vertical orientation (on a horizontal mounting rail).
- Take suitable ESD protection measures.

Air circulation

To ensure sufficient air circulation and cooling, sufficient distance must be kept in the control cabinet above and below the module.

Provide an adequate clearance in front of the module (front side) for the connected cables.

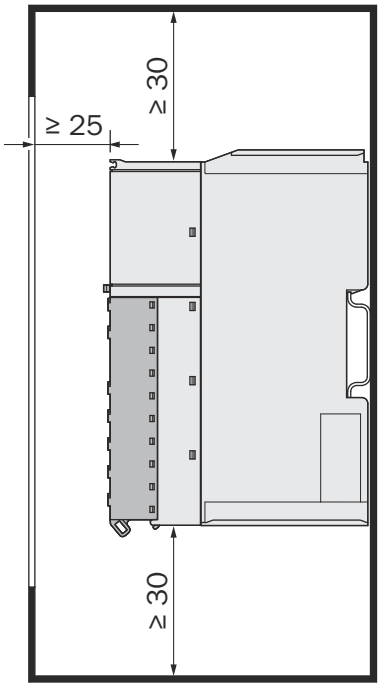


Figure 3: Clearances for adequate air circulation

Required distance:

- Above and below the module: ≥ 30 mm
- In front of the module: ≥ 25 mm

5.4 Electrical integration

5.4.1 Internal circuitry

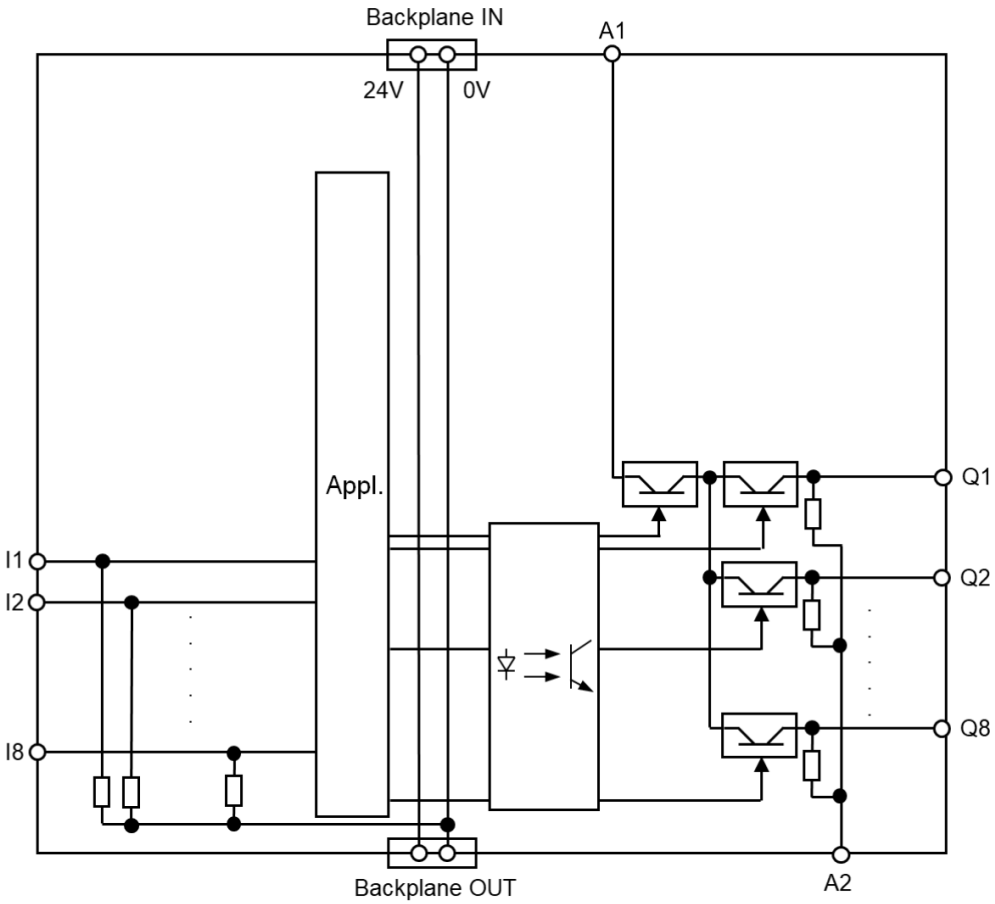


Figure 4: Internal circuitry XTDO

5.4.2 Safety outputs

Important information

WARNING
Ineffectiveness of the protective device

In the event of a fault, a single safety output (Q) can switch off after a delay or briefly switch to High. The response time increases depending on the configuration of the output. The dangerous state may not be stopped or not be stopped in a timely manner in the event of non-compliance.

- ▶ Take the increased response time into consideration in the risk analysis.
- ▶ Take the possible reduced safety level into consideration in the risk analysis.

Fault detection by testing

The following faults can be detected by testing an element:

- Short-circuits between any of the safety outputs.
  You can detect a cross-circuit between the safety outputs of 12 sequential modules.
- Short circuits to 24 V DC (to High) on safety outputs.
- Actuator wiring short-circuits to 24 V.

Further topics

- "Device connection", page 18
- "Configuring elements"

5.5 Testing plan

Testing plan

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

In addition, the device must be checked for correct functioning after each change to the configuration.

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

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

- Thorough check during commissioning and modifications
- Regular thorough check

Thorough check during commissioning and modifications

The following points are helpful when planning the thorough check:

- Does the thorough check have to be completed by qualified safety personnel?
- Can the thorough check be completed by personnel specially qualified and authorized to do so?
- Does the thorough check have to be documented in a traceable manner?
- Can the thorough check be carried out according to a check list?
- Do the machine operators know the function of the protective device?
- Have the machine operators been trained to work on the machine?
- Have the machine operators been notified about modifications to the machine?

▶ Define all guidelines for the thorough check.

Regular thorough check

The following points are helpful when planning the thorough check:

- Which thorough check must be carried out and how is it carried out?
- How often does the thorough check have to be carried out?
- Do the machine operators have to be notified of the thorough check and do they need to be instructed accordingly?

▶ Define all guidelines for the thorough check.

6 Mounting

6.1 Safety

WARNING
Electrical voltage
There is a risk of injury from electrocution while connecting the devices.

▶ Disconnect the power for the entire plant/machine.

WARNING
Unintended start of the plant/machine
The plant/machine could inadvertently start while you are connecting the devices.

▶ Disconnect the power for the entire plant/machine.

NOTICE
Enclosure rating IP20 only applies if the front connector is mounted.

6.2 Mounting procedure

For information on the mounting process, please see the operating instructions:

- “Flexi Compact” (SICK part number 8024573)

6.3 Module exchange

Approach

1. Disconnect module and the connected components from all voltage sources.
2. Take front connector with connected cables off the defective device: Press the unlocking mechanism of the front connector downwards and pull out the front connector.

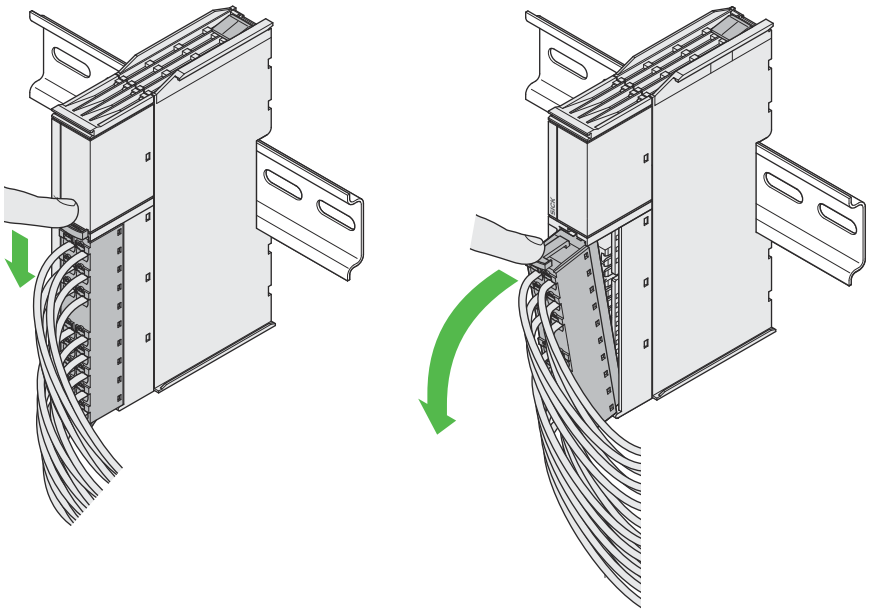


Figure 5: Dismantle front connector

3. Dismantle the defective module.

4. Mount new module.
5. Mount front connector with connected cables to the new module: First mount in the module with bent hook and then engage in the housing.

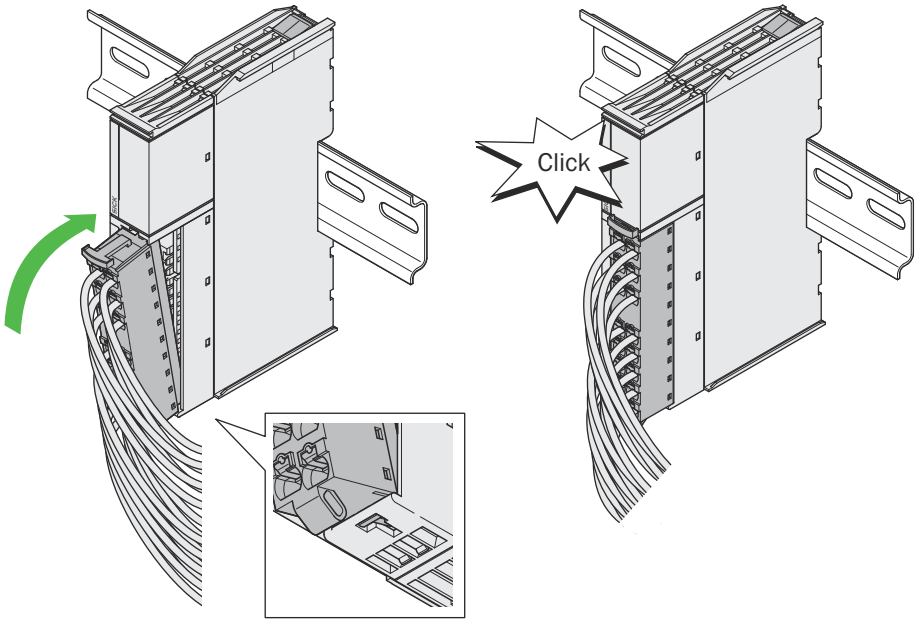


Figure 6: Mount the front connector

✓ The front connector engages with an audible click.

7 Electrical installation

7.1 Safety

WARNING
Electrical voltage
There is a risk of injury from electrocution while connecting the devices.

▶ Disconnect the power for the entire plant/machine.

WARNING
Unintended start of the plant/machine
The plant/machine could inadvertently start while you are connecting the devices.

▶ Disconnect the power for the entire plant/machine.

NOTICE
Enclosure rating IP20 only applies if the front connector is mounted.

7.2 Device connection

Prerequisites

Electrical connection requirement:

- Electrical installation is performed in accordance with EN 60204-1.
- The mounting rail is connected to the functional earth.
- The voltage supply and connected signals meet the requirements for extra-low voltages with safe separation (EN 60664) or NEC Class 2 (UL 1310).
- The external voltage supply must be capable of buffering brief power failures of 20 ms as specified in EN 60204-1. Suitable power supply units are available as accessories from SICK.
- The GND of all connected devices must have the same potential as A2 of the main module. Exceptions are actuators which are connected to an expansion module with its own voltage supply.
- The GND connections of the actuators to the safety outputs are in star formation with the GND connection of the voltage supply.

Pin assignment

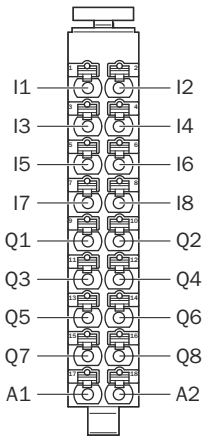


Figure 7: Terminals on front connector

Table 5: Front connector pin assignment

Terminal	Pin assignment	Description
1	I1	Safety capable input
2	I2	
3	I3	
4	I4	
5	I5	
6	I6	
7	I7	
8	I8	
9	Q1	Safety output
10	Q2	
11	Q3	
12	Q4	
13	Q5	
14	Q6	
15	Q7	
16	Q8	
17	A1	24 V voltage supply of outputs Q1 to Q8 [1]
18	A2	GND voltage supply of outputs Q1 to Q8 [1]

[1] The voltage can be supplied using a separate power supply unit without a reference potential to the main module.

Complementary information

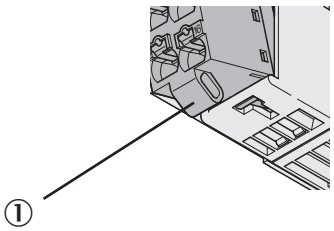


Figure 8: Eyelet on front connector

① Eyelet for cable tie

Connected cables can be fastened to the front connector eyelet using a cable tie. This relieves the strain on the cables.

Further topics

- "Electrical integration", page 14

7.3 Coding

Overview

You can code the front connector and its modules. A uniquely coded front connector only fits a uniquely coded module. Coding prevents the front connectors from getting mixed up.

Coding options

- 1-of-7 coding: 7 front connectors can be uniquely coded.

	Coding						
	1	2	3	4	5	6	7
Front connector 1	□	■	■	■	■	■	■
Front connector 2	■	□	■	■	■	■	■
...				...			
Front connector 7	■	■	■	■	■	■	□

- 2-of-7 coding: 21 front connectors can be uniquely coded.

	Coding						
	1	2	3	4	5	6	7
Front connector 1	□	□	■	■	■	■	■
Front connector 2	■	□	□	■	■	■	■
...				...			
Front connector 6	■	■	■	■	■	□	□
Front connector 7	□	■	■	■	■	■	□
...				...			

- 3-of-7 coding: 35 front connectors can be uniquely coded.

	Coding						
	1	2	3	4	5	6	7
Front connector 1	□	□	□	■	■	■	■
Front connector 2	■	□	□	□	■	■	■
...				...			
Front connector 5	■	■	■	■	□	□	□
Front connector 6	□	□	■	■	■	■	□
...				...			

7.3.1 Coding front connector and module

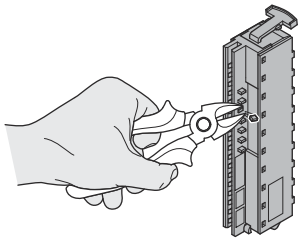
Prerequisites

- Slotted screwdriver 3.5 mm × 0.6 mm
- Diagonal cutter

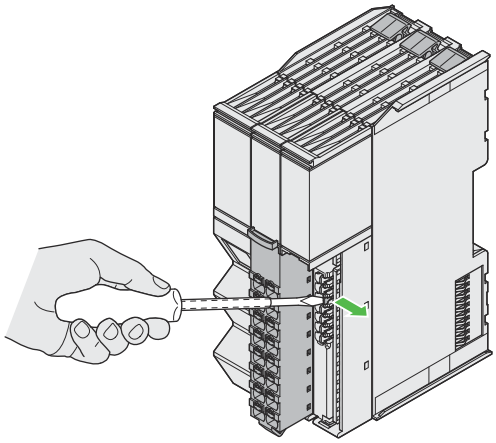
Approach

Each front connector contains seven coding ribs. The modules have seven coding elements each for each front connector.

1. Remove the coding ribs on the front connector with wire cutters.



2. Insert the slotted screwdriver vertically on the left next to the respective coding element.



3. Tip the coding element to the right with a slotted screwdriver.
✓ The coding element engages.

Complementary information

You can not reattach a removed coding rib to the front connector.

If you turn a coding element on a module several times, it can break off. This means there is no active coding function in this case. However, you can continue to use the module.

8 Commissioning

8.1 Check during commissioning and modifications

The test is intended to ensure that the hazardous area is monitored by the protective device and any attempted access to the hazardous area is prevented.

- ▶ Carry out the checks according to the instructions from the manufacturer of the machine and from the operating entity.

9 Operation

9.1 Regular thorough check

The test is intended to ensure that the hazardous area is monitored by the protective device and any attempted access to the hazardous area is prevented.

- ▶ Carry out the checks according to the instructions from the manufacturer of the machine and from the operating entity.

10 Maintenance

10.1 Regular thorough check

The test is intended to ensure that the hazardous area is monitored by the protective device and any attempted access to the hazardous area is prevented.

- ▶ Carry out the checks according to the instructions from the manufacturer of the machine and from the operating entity.

11 Troubleshooting

11.1 Status indicators

Possible indications

Table 6: PWR and CV indications

Display PWR	Display CV Main module	Description	Measures
○	○	No supply voltage	▶ Check terminals A1 and A2. ▶ Switch on the supply voltage to the main module.
☼ Red / green (1 Hz)	○	Self-test is in progress or the safety controller is being initializing.	
☼ Green (1 Hz)	see table 7, page 25	Application is ready to run.	▶ Press the start button in the configuration software.
☼ Red / green (1 Hz)	see table 7, page 25	Application is running. A recoverable external error is present at this module.	▶ Check the cabling of the flashing inputs and outputs.
● Green	see table 7, page 25	Application is running.	
☼ Red (1 Hz)	○	Configuration is invalid.	▶ Check the module type and version. ▶ Adjust the configuration using the configuration software. ▶ Run diagnostics using the configuration software.
☼ Red (2 Hz)	○	Critical error, presumably at this module. The application was stopped. All outputs of the safety controller are switched off.	▶ Switch the supply voltage off and then on again. ▶ If the fault persists, replace the module. ▶ Run diagnostics using the configuration software.
● Red	○	Critical error, presumably at another module. The application was stopped. All outputs of the safety controller are switched off.	▶ Switch the supply voltage off and then on again. ▶ If the fault persists, replace the module where the PWR ☼ is showing red (2 Hz). ▶ Run diagnostics using the configuration software.

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

Table 7: CV indications

Display CV	Description	Measures
○	see table 6, page 25	
● Yellow	Configuration is verified.	
☼ Yellow (1 Hz)	Configuration is not verified.	▶ Verify the configuration using the configuration software.
☼ Yellow (2 Hz)	See the Flexi Compact Safety Controller operating instructions (8024573)	
☼ Yellow (lights up every 2 s)	See the Flexi Compact Safety Controller operating instructions (8024573)	

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

Table 8: I indications (safety capable input)

Display I	Description	Measures
○	Input is inactive (LOW).	
● Green	Input is active (HIGH).	
☼ Green (1 Hz) in sync with the red PWR indication	Input is inactive (LOW) and a recoverable external error is present.	▶ Check cabling of the flashing inputs. A short-circuit to GND or cable break may be present.
☼ Green (1 Hz) in sync with the green PWR indication	Input is active (HIGH) and a recoverable external error is present.	▶ Check cabling of the flashing inputs. A short-circuit to 24 V or a cross-circuit to another signal may be present.

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

Table 9: Q indications (safety output)

Display Q	Description	Measures
○	Output is inactive (LOW).	
● Green	Output is active (HIGH).	
☼ Green (1 Hz) in sync with the red PWR indication	Output is inactive (LOW) and a recoverable external error is present.	▶ Check cabling of the flashing outputs. A short-circuit to GND or a cross-circuit between outputs may be present. ▶ If all indicators of the configured outputs are flashing, check the supply voltage of the A1 and A2 terminals.
☼ Green (1 Hz) in sync with the green PWR indication	Output is active (HIGH) and a recoverable external error is present.	▶ Check cabling of the flashing outputs. A short-circuit to 24 V or a cross-circuit between outputs may be present.

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

Complementary information

The input and output indicators display the status of the terminals with a refresh rate of approx. 50 ms.

Further topics

- "Status indicators", page 11

11.2 Possible faults

Important information

NOTE
If a fault response can result in an undesired valid status, you should evaluate the associated status bits in the logic to initiate suitable measures.

Possible faults and their causes

Table 10: Faults in the logic

Fault	Responses	Causes
Voltage supply A1 / A2 of the main module is lower than the operating range	• Safety controller switches to the **No supply voltage** status • **Voltage supply** module status bit = 0 • Status indicators are off	• Fault in the voltage supply • Line break • Interruption due to a fuse

Fault	Responses	Causes
Voltage supply of the main module is higher than the operating range	• Safety controller switches to the critical error status • **Internal error** module status bit = 0	• Fault in the voltage supply • Short-circuit to other voltage-carrying line

Table 11: Faults in the safety capable inputs (I)

Fault	Responses	Causes
Electro-mechanical switch/safety switch (EMSS), safety sensors with test input, Flexi Loop: safety capable input is Low instead of High	• Process data bit of the affected input = 0	• Short-circuit to another line e.g., GND • Error in the sensor • Line break
Electro-mechanical switch/safety switch (EMSS), safety sensors with test input, Flexi Loop: test pulses from the associated test output X are not detected correctly (short-circuit detection)	• Process data bit of the affected input = 0 • **Status Ix** process data status bit = 0 • Module status bit of the affected **Status Ix** input = 0	• Short-circuit to other voltage-carrying line • Error in the sensor (for externally tested sensors)
Dual-channel electro-mechanical safety switch (EMSS), safety sensors with monitored semiconductor outputs (OSSD): equivalent/complementary safety capable inputs exhibit different/the same values.	• Process data bit of the affected input = 0 • **Status Ix, Iy dual-channel evaluation** process data status bit = 0 • Module status bit of the affected **Status Ix, Iy dual-channel evaluation** input = 0	• Short-circuit to another line e.g., GND • Error in the sensor • Line break • Discrepancy time • Sequence error
Safety pressure mats: safety capable input is Low instead of test pulse signal from the associated test output X	• Process data bit of the affected input pair = 0 • **Status Ix** process data status bit = 0 • Module status bit of the affected **Status Ix** input = 0	• Line break Test output → sensor • Line break Sensor → safety capable input
Safety pressure mats: safety capable input is High instead of test pulse signal from the associated test output X	• Process data bit of the affected input = 0 • **Status Ix, Iy dual-channel evaluation** process data status bit = 0 • Module status bit of the affected **Status Ix, Iy dual-channel evaluation** input = 0	• Short-circuit to other voltage-carrying line
Internal error detected in input evaluation	• Safety controller switches to the critical error status • **Internal error** module status bit = 0	• Internal device error

Table 12: Faults in the safety outputs (Q)

Fault	Responses	Causes
Auxiliary voltage supply A1 / A2 for the safety outputs is lower than the operating range	• All safety outputs of the module are switched off • **Output voltage supply** process data status bit = 0 • **Auxiliary voltage supply** module status bit = 0	• Fault in the voltage supply • Line break • Interruption due to a fuse
Auxiliary voltage supply A1 / A2 for the safety outputs is higher than the operating range	• **Internal error** module status bit = 0 • **Auxiliary voltage supply** module status bit = 0	• Fault in the voltage supply • Short-circuit to other voltage-carrying line
Output voltage level is Low instead of High when the output is “On”, overload/overcurrent[1) 2)]	• Associated output/associated output pair is switched off • Depending on the load, the affected output may pulsate temporarily until the final switch-off • **Status Qx short-circuit to Low** process data status bit = 0 • **Status Qx short-circuit to Low** module status bit = 0	• Short-circuit or resistance drop under load • Short-circuit to another line e.g., GND
Output voltage level is High instead of Low when the output is “Off”[3)]	• All safety outputs of the module are switched off • **Output voltage supply** process data status bit = 0[4)] • **Status Qx short-circuit to High** process data status bit = 0 • **Status Qx short-circuit to High** module status bit = 0	• Short-circuit to other voltage-carrying line
Test pulses are not detected correctly when the output is “On”[3) 5)]		• Short-circuit to other voltage-carrying line • Capacitive load too high
Internal error detected	• Safety controller switches to the critical error status • **Internal error** module status bit = 0	• Internal device error • Capacitive load too high

1) Depending on the voltage supply used, an overcurrent can also result in the voltage supply dropping out.
2) Reset of the error: set the process data bit of the safety output to 0.
3) Reset of the error: the process data bits for all safety outputs of the module are simultaneously 0 and the output level is Low.
4) In the case of a High instead of a Low on a safety output, the supply to all safety outputs is switched off internally. If the cause of a short-circuit is in the wiring to 24 V, then the affected signal remains High and all other signals switch to Low.
Check if this is an undesired but valid signal value for the receiver, e.g., for the switching of the monitoring case of a SICK safety laser scanner by means of a complementary signal.
5) Depending on the size of the capacitive load, this may lead in certain cases to an incorrect interpretation as an internal error since the effect on the output voltage is only temporary.

Critical error status

Consequences of the critical error status:

- All applications are stopped.
- All safety outputs are switched off.
- All process data = 0
- Evaluation of the process data status bits in the logic is no longer possible.
- Only limited diagnostics can be performed in the critical error status.

Alternatives to resetting the critical error status:

- Restart by switching the voltage supply off and on again
- Software reset using the configuration software

Complementary information

The status indicators and diagnostic messages may provide additional information.

Further topics

- "Status indicators", page 25
- "Input elements"

12 Decommissioning

12.1 Disposal

Approach

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

Complementary information

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

13 Technical data

13.1 Data sheet

Safety-related parameters

Table 13: Safety-related characteristic data - safety capable inputs (I)

	Safety capable inputs (I)			
	Single-channel		Dual channel	
	Without test pulses[1]	With test pulses	Without test pulses[2]	With test pulses
Safety integrity level (IEC 61508)	SIL 2	SIL 3	SIL 3	SIL 3
SIL claim limit (IEC 62061)	SILCL 2	SILCL 3	SILCL 3	SILCL 3
Cate-gory (ISO 13849-1)	Category 3	Category 4	Category 4	Category 4
Performance level (ISO 13849-1)	PL d	PL e	PL e	PL e
PFH_D (h^{-1})	1×10^{-9}	1×10^{-9}	0.5×10^{-9}	0.5×10^{-9}
PFD_{avg}	4×10^{-5}	4×10^{-5}	4×10^{-5}	4×10^{-5}
$MTTF_D$ ISO 13849-1 [years]	500	500	500	500
T_M ISO 13849-1 [years]	20	20	20	20

1) If you are using single-channel safety inputs (I) without test pulses for a safety-related application, then a protected or separate cabling is required for these safety inputs in order to achieve the safety-related characteristics. Reason: Short-circuits to the supply voltage or cross-circuits are not detected.

2) If you are using dual-channel safety capable inputs (I) without test pulses, the safety function must be requested at least once a year.

Table 14: Safety-related characteristic data - CPU logic processing

	CPU logic processing
Safety integrity level (IEC 61508)	SIL 3
SIL claim limit (IEC 62061)	SILCL 3
Category (ISO 13849-1)	Category 4
Performance level (ISO 13849-1)	PL e
PFH_D (h^{-1})	3×10^{-9}
PFD_{avg}	20×10^{-5}
$MTTF_D$ ISO 13849-1 [years]	500
T_M ISO 13849-1 [years]	20

Table 15: Safety-related characteristic data - safety outputs (Q)

	Safety outputs (Q)			
	Single-channel[1]		Dual channel	
	Without test pulses[2] [3]	With test pulses	Without test pulses[2] [3]	With test pulses
Safety integrity level (IEC 61508)	SIL 3	SIL 3	SIL 3	SIL 3
SIL claim limit (IEC 62061)	SILCL 3	SILCL 3	SILCL 3	SILCL 3
Category (ISO 13849-1)				
With test pulses on all safety outputs of a module		Category 4		Category 4
Without test pulses on one or more safety outputs of a module	Category 3	Category 3	Category 4	Category 4
Performance level (ISO 13849-1)	PL e	PL e	PL e	PL e
PFH_D (h^{-1})	5×10^{-9}	0.5×10^{-9}	5×10^{-9}	0.5×10^{-9}
PFD_{avg}	30×10^{-5}	4×10^{-5}	30×10^{-5}	4×10^{-5}
$MTTF_D$ ISO 13849-1 [years]	500	500	500	500
T_M ISO 13849-1 [years]	20	20	20	20

1) If you are using single-channel safety outputs (Q) for a safety-related application, then a protected or separate cabling is required for these safety outputs in order to achieve the safety-related characteristics. Reason: While short-circuits to the supply voltage or cross-circuits to other outputs can be detected, no other option to switch-off the device exist.

2) If you are using single-channel or dual-channel safety outputs (Q) without test pulses, then a protected or separate cabling is required for these safety outputs in order to achieve the safety-related characteristics. Reason: Short-circuits to the supply voltage or cross-circuits to other outputs are not detected in the switched-on state without test pulses.
This also applies if an output is used for a non-safety related application. Reason: Even if an internal hardware error is detected, the switch-off capability of the other safety outputs may be impaired by reverse currents.

3) If you are using single-channel/dual-channel safety outputs (Q) without test pulses for a safety-related application, then one of the following measures is required in order to achieve the safety-related characteristics:
- Restart the safety controller once a year.
- Manually switch off all safety outputs simultaneously for min. 2 s once a year. The supply voltage to the outputs must be within the operating range during this manual test.

General data

Table 16: General data

Climatic conditions	
Ambient operating temperature	
At altitudes up to 2,000 m above sea level	–25 °C ... +55 °C

At altitudes up to 2,000 m above sea level ... 3,000 m above sea level	–25 °C ... +50 °C
At altitudes 3,000 m above sea level ... 4,000 m above sea level	–25 °C ... +45 °C
Storage temperature	–25 °C ... +70 °C
Air humidity	10% ... 95%, non-condensing
Operating altitude	Max. 4,000 m above sea level
Mechanical strength	
Vibration resistance	5 Hz ... 200 Hz / 1 g (EN 60068-2-6)
Shock resistance, single shock	15 g, 11 ms (EN 60068-2-27)
Operating data	
Protection class	III (EN 61140)
Immunity to interference	EN 61000-6-2
Emitted interference	EN 61000-6-4
Connections	
Connection type	Spring terminals
Wire cross-section	Single wire or fine-stranded wire: 0.14 mm^2 ... 1.5 mm^2 Fine-stranded wire with ferrule: a) with plastic ferrule max. 1.0 mm^2 b) without plastic ferrule max. 1.0 mm^2 AWG according to UL/CSA: 26 ... 14 For UL and CSA applications: Use copper conductors only min. rated for 85 °C.
Housing	
Enclosure rating	IP20 (EN 60529)
Contamination rating	2 (IEC 61010-1)
Control device type	Open device (IEC 61010-2-201)
Weight (± 5%)	111 g

Voltage supply (A1 / A2)

Table 17: Voltage supply

Supply voltage U_B	+24 V DC
Tolerance of supply voltage	–30% / +25% (16.8 V ... 30 V)
Type of supply voltage	PELV or SELV The supply current must be limited externally to max. 4 A – either by the voltage supply unit used, or by means of a fuse.
Max. power loss	4.9 W
Power consumption at nominal voltage (without outputs)	2.4 W
Short-circuit protection [1)]	Max. 4 A/Min. 30 V Safety fuse with triggering characteristic: slow-blow UL/CSA applications: UL-listed fuse according to UL 248-14 required
Overvoltage category	II (EN 61131-2)

Type of terminal connections	Spring terminals

1) When selecting the voltage supply for the safety controller, you need to take into the account the no load current of all modules of the station, and the peak current consumption of all electrical consumers connected to the outputs of the safety controller. The maximum permissible supply current depends, amongst other things, on the ambient temperature and must not exceed the permitted value of 8 A (Ta = 55 °C). Take into consideration the effect of lack of ventilation or the power loss in cables or other devices on the ambient temperature in the control cabinet.

Safety capable inputs (I)

Table 18: Technical data for the safety capable inputs (I)

Input voltage High	11 V DC ... 30 V DC
Input voltage Low	–3 V DC ... +5 V DC
Max. input voltage range [1]	–60 V DC ... +60 V DC
Input current high	2.1 mA ... 6 mA
Input current Low	≤ 1.9 mA
Reverse current at input in case of loss of ground connection[2]	≤ 100 µA
Input capacitance	15 nF
Discrepancy time	4 ms ... 30 s, configurable

1) No damage to the input in this voltage range.
2) Do not connect any other safety capable inputs in parallel if the reverse current could lead to a High state on the other input.

Safety outputs (Q)

Table 19: Technical data for the safety outputs (Q)

Type of output	PNP semiconductor, short-circuit protected
Output voltage High	U_B –3 V DC ... U_B
Max. output voltage Low [1]	–50 V DC ... –30 V DC
Maximum reverse voltage at Low [2]	3 V DC
Leakage current Low	
Normal operation	< 1 mA
Dual channel	< 2 mA
Fault [3]	< 1 mA
Output current	Max. 2 A
Sum current I_{sum}	
T_U ≤ 55 °C	4 A
Test pulse duration[4]	< 650 µs or deactivated
Test pulse frequency	≥ 190 ms
Cross-circuit detection using test pulses[5]	
Cable resistance	Max. 2.5 Ω (z. B. 100 m × 1.5 mm^2 = 1.2 Ω)
Output current, dual-channel outputs	Max. 1 A per output
Load capacity	≤ 0.5 µF
Load capacity when connected via diode	≤ 1,000 µF
Inductive load at nominal voltage	
@2 A	100 mH
@1 A	1.6 H

@0.5 A	20 H

1) Max. –30 V DC, to avoid damaging the output.
Max. –50 V DC, for fast switch-off of inductive loads.
2) Higher voltages are evaluated as a cross-circuit fault
3) In the event of a fault (GND line open circuit) and with a load resistance of at least 2.5 kΩ, no more than the specified leakage current flows on the safety output. For lower load resistances, the leakage current may be greater however the output voltage will be < 5 V in this case. A downstream device, for example a relay or a FPLC (fail-safe programmable logic controller) must detect this state as Low.
4) When activated, the outputs are tested regularly (brief switching to Low). When selecting the downstream control elements, ensure that the test pulses with the specified parameters do not result in a switch-off, or deactivate the test pulses on the outputs yourself.
5) Safety outputs (Q) with test pulses only detect cross-circuits reliably (i.e. already in the switched-on state and not just after a switch-off) if these values for the supply cable and the connected control element are not exceeded. Otherwise further measures will be required, for example protected or separate cabling. (See also EN 60204 Electrical equipment of machines, Part 1: General requirements.)

13.2 Dimensional drawings

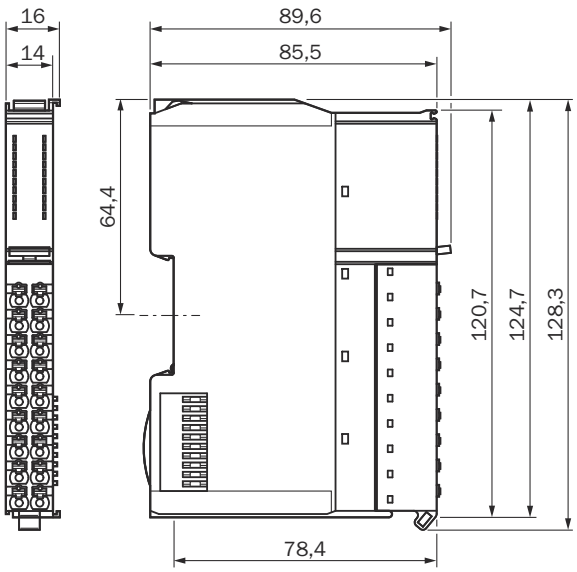


Figure 9: Dimensional drawing

14 Annex

14.1 Compliance with EU directives

EU declaration of conformity (extract)

The undersigned, representing the manufacturer, herewith declares that the product is in conformity with the provisions of the following EU directive(s) (including all applicable amendments), and that the standards and/or technical specifications stated in the EU declaration of conformity have been used as a basis for this.

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).

15 List of figures

16 List of tables

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