samos®PRO

samos®PRO COMPACT-Hardware

Manual

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Info

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Subject to change.

Subject to technical changes for reasons of continued development.

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1 About this document

Please read this section and the *Safety [ch. 2, p. 10]* section carefully before documenting or working with the modular samosPRO safety control with COMPACT modules.

1.1 Function of this document

There are two sets of manuals with clearly delineated areas of application as well as installation instructions and brief instructions for each module for the samosPRO system with COMPACT modules.

- All samosPRO modules that can be used in connection with COMPACT modules and their functions are extensively described in this "samosPRO Hardware" manual. Use the hardware manual mainly for planning samosPRO safety controls.
  This hardware manual will guide **technical personnel of the machine manufacturer** and/or **machine operator** on safe installation, electric installation, commissioning, and maintenance of the modular samosPRO safety control.
  This hardware manual does **not** provide instructions for operating the machine into which the safety control is or will be integrated. Instructions on how to operate the machine are provided for this purpose.

- The "samosPLAN5+ Software" manual (BA000968) describes the software-supported configuration and parameterization of the samosPRO safety control with COMPACT modules. In addition, the software manual contains a description of the important diagnostic functions for operation and detailed information for identifying and eliminating errors. Use the software manual mainly when configuring, commissioning, and operating samosPRO safety controls.

- Each samosPRO module contains the installation instructions/brief instructions. These instructions provide information on the fundamental technical specifications of the modules and contain simple installation instructions. Use the installation instructions/brief instructions when installing the samosPRO safety control.

This Manual is a translation of the original documentation within the meaning of the Machinery Directive.

1.2 Target group

This manual is targeted toward **designers, developers,** and **operators** of systems that are to be safeguarded by a modular samosPRO safety control. They are also targeted toward persons integrating a samosPRO safety control into a machine, commissioning it for the first time, or maintaining such a system.

1.3 Information depth

This manual contains information on the modular samosPRO safety control with respect to the following topics:

- Installation
- Electrical installation
- Hardware commissioning
- Maintenance

- Error diagnostics and error elimination
- Item numbers
- Conformity and approval

Furthermore, specialized technical knowledge that is not provided in this document is required when designing and using Wieland safety equipment.

Essentially, the government and legal regulations must be adhered to when operating the modular samosPRO safety control.

NOTICE	**You can also use the website on the Internet and the CD** • http://www.wieland-electric.com • samosPRO-COMPACT CD Further information: *Order data [ch. 13, p. 88]*

There you will find the following:

- samosPLAN5+ software
- "samosPLAN5+ Software" manual (BA000968)
- This manual (BA000966) is available for display and printing in various languages

1.4 Scope of application

This manual is valid for all samosPRO safety control modules that are operated in connection with COMPACT modules and samosPLAN5+.

1.5 Abbreviations used

Contactless safety device	Contactless Safety Device
EDM	External Device Monitoring
PFHD	Probability of Dangerous Failure per Hour
OSSD	Output Signal Switching Device
SIL	Safety Integrity Level
PLC	Programmable Logic Controller

1.6 Symbols/icons and writing style/spelling standard used

| NOTICE | These are notes that provide you with information regarding particularities of a device or a software function. |

Warning!
A warning lets you know about specific or potential hazards. It is intended to protect you from accidents and help prevent damage to devices and systems.
- **Please read and follow the warnings carefully!**
  Failure to do so may negatively impact the safety functions and cause a hazardous state to occur.

ATTENTION

Menus and commands

The names of software menus, submenus, options, and commands, selection fields, and windows are written in **bold font**. Example: Click on **Edit** in the **File** menu.

2 Safety

This section is intended to support your safety and the safety of the system users.
➡ Please read this section carefully before you work with the modular samosPRO safety control or with a machine protected by a samosPRO.

2.1 Qualified persons

The modular samosPRO safety control may only be installed, commissioned, and maintained by qualified persons.

Qualified persons are those who

- have suitable technical training **and**
- have been trained by the machine operator in the operation and applicable safety guidelines **and**
- have access to the samosPRO operating instructions and have read said instructions and have duly noted these **and**
- have access to the operating instructions for the safety devices connected to the safety control (e.g. safety light curtain) and have read them and duly noted them.

2.2 Areas of application of the device

The modular samosPRO safety control is an adjustable control for safety applications. It is usable

- as per EN 61508 up to SIL 3
- as per EN 61131-6 up to SIL 3
- as per EN 62061 up to SIL CL 3
- as per EN ISO 13849-1:2006 to performance level e / category 4
- as per EN 81-1
- as per EN 50156-1
    - The safety function must be tested at least once annually
    - A consistent redundant structure must be implemented
    - If relay expansion modules are used, the correct switching of the relays must be monitored using feedback contacts (EDM)
    - The requirements of EN 50156-1, Section 10.5.6, must be considered

The level of safety actually achieved depends on the external wiring, the implementation of the wiring, the parameterization, the selection of the command encoder, and their arrangement on the machine.

Opto-electronic and tactile safety sensors (e.g. light curtains, laser scanners, safety switches, sensors, emergency stop switches) are connected and logically linked at the modular safety control. The corresponding actuators on the machine or systems can be securely switched off via the switch outputs of the safety control.

2.3 Proper use

The modular samosPRO safety control may only be operated under the following conditions:

- You are operating the control within the specified operating limits for voltage, temperature, etc. (see the following for further information: *Technical data [ch. 12, p. 70]*)
- You are operating the control within the specified areas of application. (Further information: *Areas of application of the device [ch. 2.2, p. 10]*)

The control may only be operated by qualified personnel and may only be used on a machine on which it has been installed and commissioned for the first time by a qualified person in accordance with this manual.

In the event of any other use or any changes to the device – including within the scope of installation – this shall nullify any sort of warranty claim with respect to Wieland Electric GmbH.

- The external power supply of the devices must able to bridge a short-term power outage of 20 ms in accordance with EN 60204. Suitable PELV- and SELV-capable power packs can be obtained as accessories from Wieland Electric.
- The modules for the samosPRO system correspond to class A, group 1, in accordance with EN 55011. Group 1 includes all ISM devices in which intentionally generated and/or wired HF power, which is required for the internal function of the device itself, occurs.

⚠️ **ATTENTION**	**Do not use in private areas** The samosPRO system fulfills the requirement for class A (industrial applications) according to the "Emitted interference" basic trade standard. Thus, the samosPRO system is only suitable for use in an industrial environment and not in private areas.

UL/CSA applications:

- Use lines that are suitable for a temperature range of 60 to 75°C.
- Tighten the screw terminals with a torque of 5-7 lbs/in.
- Only use in a pollution degree 2 environment.
- The modules must be supplied by a voltage source with protective isolation, which is protected by a fuse in accordance with UL 248 with a nominal power of 100 V, wherein V corresponds to the direct current power supply with a maximum value of 42.4 V DC, which means that the requirements of UL 508 for the current and voltage limits are met.
- The maximum permissible total current for the SP-SDIO modules with outputs Q1 to Q4 is I_{total} = 3.2 A.

NOTICE	The safety functions are not evaluated by UL. The approval corresponds to UL508, general applications.

2.4 General safety information and protective measures

Note the safety information and protective measures!
Note the following points in order to ensure proper use of the samosPRO safety control.

ATTENTION

- Please follow the standards and guidelines valid in your country when installing and using the samosPRO safety control.
- The national/international legal regulations apply to the installation and use of the samosPRO safety control as well as for the commissioning and repeated technical testing, particularly the following:
  – Machinery Directive 2006/42/EC
  – EMC Directive 2014/30/EC
  – Work Equipment Directive 2009/104/EC
  – Low-Voltage Directive 2014/35/EC
  – The accident prevention regulations/safety rules
  – RoHS (Restriction of Hazardous Substances) Directive 2011/65/EC
- Manufacturers and operators of a machine on which a samosPRO safety control is being used are responsible for coordinating with the proper authorities with regard to applicable safety guidelines/rules and complying with these.
- The notices, particularly the test notices, must be observed without fail.
  Further information: *Requirements for electric installation [ch. 7.1, p. 57]*
  The tests must be conducted by qualified persons or by those who are personally authorized and commissioned to do so and must always be fully documented at all times by a third-party.
- This manual must be provided to the operator of the machine on which the samosPRO safety control is being used. The machine operator must be trained by qualified persons and is required to read this manual.

2.5 Environmentally friendly behavior

The modular samosPRO safety control is designed such that it stresses the environment as little as possible. It uses only a minimum of power and resources.
➡ Make sure that you also carry out work while always considering the environment.

2.5.1 Disposal

The disposal of unusable or irreparable devices should always be done in accordance with the respectively valid country-specific waste-elimination guidelines (e.g. European Waste Code 16 02 14).

| NOTICE | We will be happy to help you in disposing of these devices. Simply contact us. |

2.5.2 Sorting of materials

ATTENTION

Important information
- The sorting of materials may only be carried out by qualified persons!
- Care must be used when disassembling the devices. There is a risk of injuries during this process.

Before you can route the devices to the environmentally-friendly recycling process, it is necessary to sort the various samosPRO materials.
➡ Separate the housing from the rest of the components (particularly from the PC board).
➡ Place the separated components into the corresponding recycling containers (see the following table).

Table 1: Overview of disposal according to components

Components	Disposal
Product	
Housing	Plastic recycling
PC boards, cables, connectors, and electric connecting pieces	Electronics recycling
Packaging	
Cardboard, paper	Paper/cardboard recycling

3 Product description

This section will provide you with information on the properties of the samosPRO system and describes the setup and function.

3.1 System properties
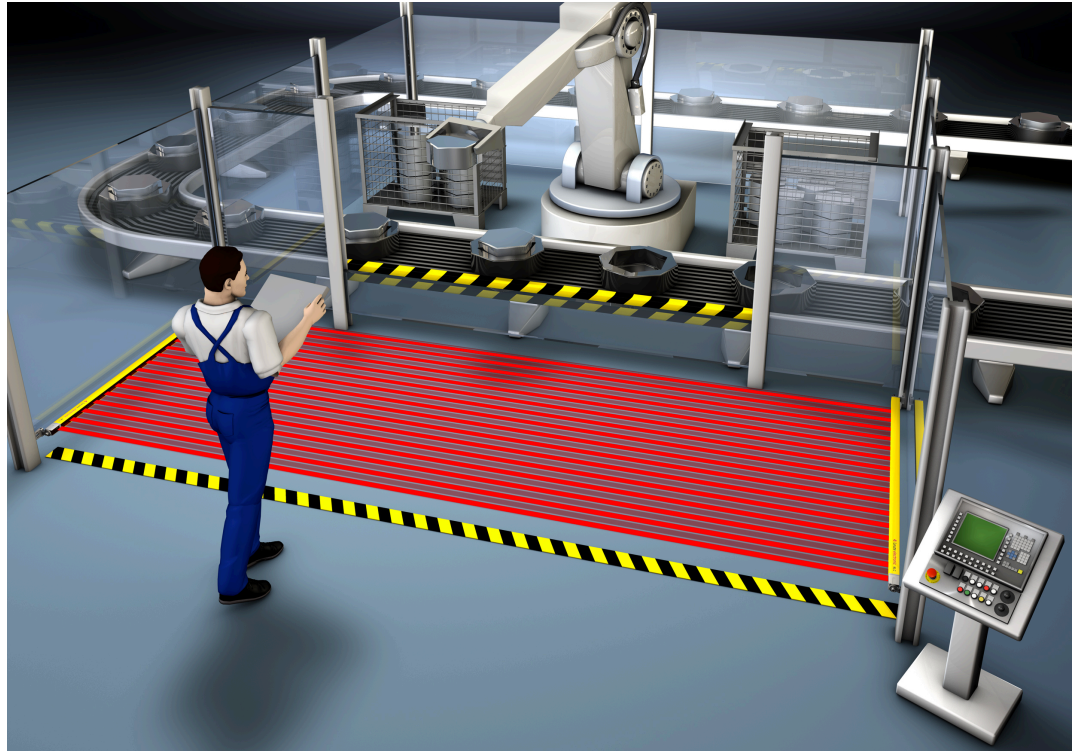
Illustration 1: Modular samosPRO safety control

The samosPRO system is characterized by the following system properties:

- Modular setup: 1 COMPACT module and up to 12 input/output expansion modules, each of which has an overall width of 22.5 mm
- 16 to 116 inputs and 4 to 56 outputs
- Programmable using samosPLAN5+
- Can use up to 300 standard and application-specific logical blocks
- Standard logical blocks: AND, OR, NOT, XNOR, XOR
- Application-specific logical blocks: Emergency stop, two-hand, muting, operating mode selection switch, reset, restart
- Can be integrated into different networks using gateways (e.g. ProfibusDP, CANopen, Modbus/TCP, etc.)

The samosPLAN5+ programming software is available for configuring the control tasks.

You can find the programming software on the Internet or on CD:

- http://www.wieland-electric.com

  or

- *samosPLAN5+ CD [ch. 13, p. 88]*

3.2 System setup

A samosPRO COMPACT system consists of the following modules and/or components:

- One COMPACT module
- One program removable storage
- The samosPLAN5+ programming software
- Up to two gateway modules
- Up to 12 additional SP-SDIO, SP-SDI and SP-DIO input/output modules
- In addition, SP-XX expansion modules can be used. This may be for example the SA-OR-Sx relay output expansions or the SNS4084K standstill monitor. These modules are shown in the report from samosPLAN5+ but cannot be logically connected to the modules of the Samos PRO COMPACT system.

  Further information on positioning this module: "samosPLAN5+ software" (BA000968) manual, section "Special case: SP-XX expansion module"
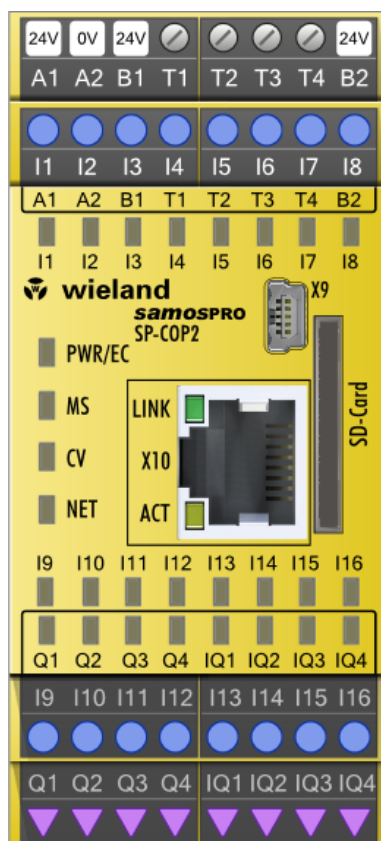
Illustration 2: Example of a minimum samosPRO system setup with SP-COP2
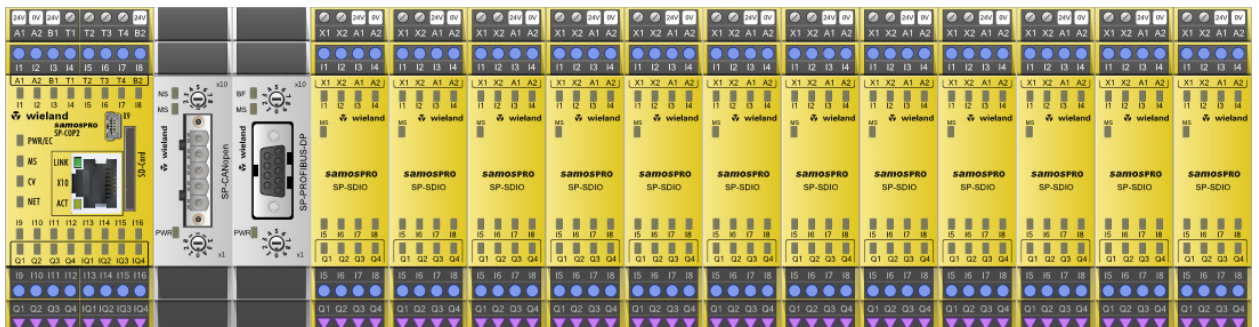
Illustration 3: Maximum samosPRO system setup

Table 2: Overview of modules (without program removable storage)

Type	Description	Inputs	Outputs	Logical blocks	Max. occurrence
SP-COP1	Controller module	20	4	300	1×
SP-COP2-EN	Controller module	16-20 [1]	4-8[1]	300	1×
SP-COP2-ENI	Controller module	16-20 [1]	4-8[1]		
SP-SDIO	Input/output expansion	8	4	–	12×
SP-SDI	Input expansion	8	–	–	
SA-OR-S1	Relay output expansion	–	4	–	4×[2]
SA-OR-S2	Relay output expansion	–	2	–	8×[2]
SP-DIO	Input/output expansion	8[1]	8[1]	–	12×
SP-PROFIBUS-DP	PROFIBUS DP gateway	–	–	–	2×
SP-CANopen	CANopen gateway	–	–	–	
SP-EN-ETC	EtherCAT Gateway	–	–	–	
[1] 4 inputs or 4 outputs can be configured as an option					
[2] Maximum 16 safe relay outputs					

3.3 Version, compatibility, and features

There are various module versions and function packages for the samosPRO product family that enable various functions. This section will give you an overview as to which module version, which function package, and/or which version of the samosPLAN5+ you will need to be able to use a certain function or a certain device.

Table 3: Module and software versions required

Feature / functionality	Available from module version			
	SP-COP1-x	SP-COP2-EN-x	SP-COP2-ENI-x	samosPLAN5+
Safe I/O (SP-SDIO, SP-SDI)	A-01	A-01	A-01	V1.0
Modbus TCP	---	---	A-01	V1.0
Profinet IO	---	---	B-01.xx	V1.2
Non-secure I/O (SP-DIO)	C-01.xx	C-01.xx	C-01.xx	V1.3
EtherCAT (SP-EN-ETC)	C-01.xx	C-01.xx	C-01.xx	V1.3
EtherNet/IP	---	---	D-01.xx	V1.4
Press functions[1]	D-01.xx	D-01.xx	D-01.xx	V1.4
[1] only available with module variants **-P** (example: SP-COP2-EN-**P**-x)				

Info

- You will find the module version on the type plate of the samosPRO modules.
- You can find the samosPLAN5+ version in the green **File menu** under **About**.
- You can obtain the latest version of the samosPLAN5+ on the Internet at http://www.wieland-electric.de.
- Newer modules are backwards-compatible, which means that each module can be replaced with a module having a higher module version.
- You can find the date of manufacture for a device on the type plate in the S/N field in the format <Product no.>yywwnnnnn (yy = year, ww = calendar week).

3.4 COMPACT module SP-COP1

3.4.1 Description

COMPACT module SP-COP1 is a central processing unit for the entire system in which all of the signals are monitored and logically processed according to the configuration stored in the SP-COP-CARD1 program removable storage. The module has safe inputs and outputs as well as test signal outputs. The system outputs are switched as a result of the processing. The internal safety bus in this case serves as a data interface.

Module versions

In addition to the basic version there is the SP-COP1-**P** compact module.

This has additional press control functions.

3.4.2 Display elements, interfaces, and terminal description

8 input LEDs

LED PWR/EC
MS LED
CV LED

8 input LEDs
4 output/
4 input LEDs

Mini-USB connection

SD slot for
SP-COP-CARD1
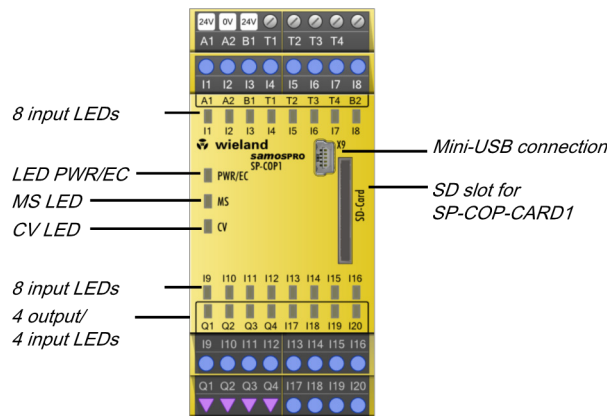
Illustration 4: SP-COP1 display elements

Table 4: 4 LED displays

LED	Meaning
PWR/EC	Display of the supply voltage state
	Display of an error through various *Flashing codes [ch. 10.3.1, p. 63]*
MS	Display of the *Module state [ch. 10.3.1, p. 63]*
CV	Display of the verification state of the *Control project [ch. 10.3.1, p. 63]*
Input LED I1 to I20	State display of the *Inputs [ch. 10.3.1, p. 63]*
Output LED Q1 to Q4	State display of the *Outputs [ch. 10.3.1, p. 63]*

Table 5: SP-COP1 pin assignment

Pin	assignment
A1	24 V supply voltage for all modules, except for supply of outputs
A2	GND of supply voltage
I1 - I20	Safe, digital inputs
Q1 - Q4	Safe, digital outputs
B1	24 V supply voltage of outputs Q1 - Q4
T1 - T4	Test signal outputs

USB interface

The main module has a mini-USB interface with the following functions:

- Transfer of the configuration from samosPLAN5+ to the program removable storage
- Reading of configuration from program removable storage in samosPLAN5+
- Diagnostics of the samosPRO systems with samosPLAN5+

Table 6: USB interface pin assignment

Connec-tor/bushing USB mini	Pin	Signal	Color	Assignment PC-side
	1	+5V		
	2	- data		
	3	+ data		
	5	GND		

NOTICE	• If the USB interface of the main module is permanently connected, then the maximum permissible cable length is 3 m. • Avoid using ground loops between the USB interface GND and the A2 connection of the main module, e.g. by using optocouplers.

3.4.3   Internal circuits
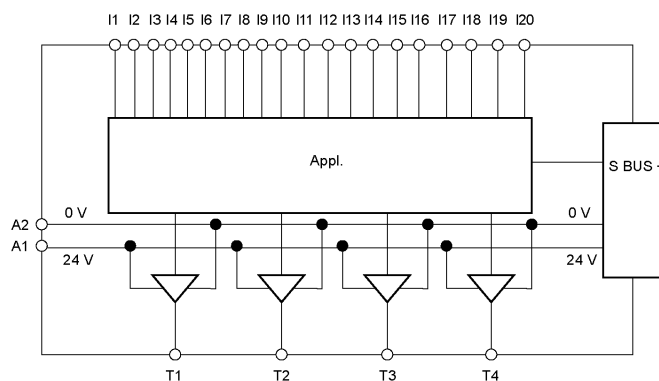
Illustration 5: Inputs and test pulses at an SP-COP1 module
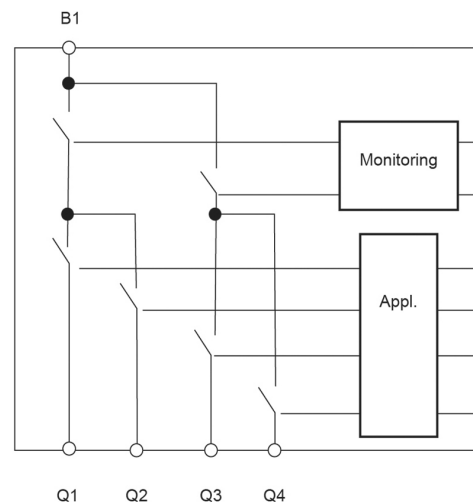
Illustration 6: Outputs at an SP-COP1 module

3.4.4 Limited short-circuit detection in the input circuits

ATTENTION

- One SP-COPx has four test signal generators T1 – T4.
- Short-circuits between test signal generators of an SP-COPx are detected. Between different modules the short circuit detection is then only ensured if the test gaps of the test signal generators are < 4 ms, the test periods ≥ 200 ms. In addition, the short circuit detection is only ensured if no more than 9 modules (SP-SDI / SP-SDIO) have been plugged in. Short-circuits after 24 V DC (after high) at inputs that are connected to test outputs are detected independently of the length of the test gaps.
  Make note of this during wiring (e.g. through separate routing or protected lines)!

3.4.5 Deactivating the test pulses at the outputs of the SP-COP1

It is possible to deactivate the test pulses at one or more output pairs. The outputs are combined into two output pairs with the SP-COP1. Q1/Q2 and Q3/Q4. The test pulses each act upon the two outputs of an output pair.

ATTENTION

Switching off the test pulses at one of the two outputs of an output pair will switch off the test pulses of the entire output pair!
Deactivating the test pulses at one or more safety outputs of an SP-COP reduces the safety parameters of both safety outputs of the respective output pair of this module.
- Be aware of this in order to ensure that your application corresponds to an appropriate risk analysis and risk avoidance strategy.
- You can find more detailed information on the safety parameters here: *Safety technology reference values [ch. 12.2, p. 73]*

ATTENTION

Be sure to use protected or separate cabling!
- If you deactivate the test pulses at one or more safety outputs, short-circuits at other output circuits cannot be detected. This affects the safety function!
- In the event of a short-circuit after 24 V, it will no longer be possible to switch off the output.
  Furthermore, it will not be possible to prevent reverse current from going into a switched-off output, which will influence the capability of switching off the outputs.

ATTENTION

Carry out cyclic tests when the test pulses at one or more safety outputs are deactivated!
Once you deactivate the test pulses at one or more safety outputs, conduct the following tests once a year:
- Switch off all of the safety outputs without test pulses simultaneously for at least one second via the logic program of the COMPACT module.
  OR
- Restart the samosPRO system by switching off the supply voltage.

You will thus deactivate the test pulses at an output of the SP-COP1:
➡ Connect an output element to the SP-COP module.
➡ Using the right mouse key, click on the output element and select the **Edit** command in the context menu.
➡ Deactivate the **Activation of test pulses of this output** option. The test pulses of this output will be switched off. A corresponding note will be displayed in the hardware configuration area under the respective SP-COP module.

3.4.6 Single-channel use of outputs on the SP-COP1

ATTENTION

Be sure to consider a potential brief switch to high with single-channel safety outputs!
In the event of an internal hardware error, single-channel safety outputs can switch to high once for 10 ms after the error has been detected.
- Consider this during your risk analysis and reduction strategy.
  Otherwise, there is a hazard for the operator of the machine.

3.5 COMPACT module SP-COP2-EN

3.5.1 Description

COMPACT module SP-COP2-EN is the central processing unit for the entire system in which all of the signals are monitored and logically processed according to the configuration stored in the SP-COP-CARD1 program removable storage. The module has safe inputs and outputs as well as test signal outputs. The system outputs are switched as a result of the processing. The internal safety bus in this case serves as a data interface.

Module versions

In addition to the basic version there is the SP-COP2-EN-**P** compact module.

This has additional press control functions.

3.5.2 Display elements, interfaces, and terminal description
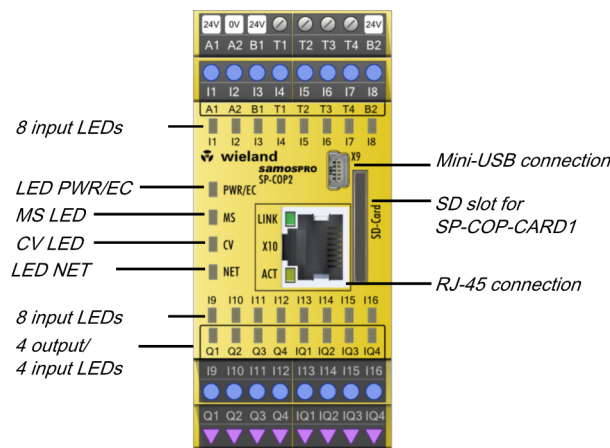
Illustration 7: SP-COP2-EN display elements

Table 7: SP-COP 2 LED displays

LED	Meaning
PWR/EC	Display of the supply voltage state
	Display of an error through various *Flashing codes [ch. 10.3.1, p. 63]*
MS	Display of the *Module state [ch. 10.3.1, p. 63]*
CV	Display of the verification state of the *Control project [ch. 10.3.1, p. 63]*
Input LED I1 to I16, IQ1 to IQ4	State display of the *Inputs [ch. 10.3.1, p. 63]*
Output LED Q1 to Q4, IQ1 to IQ4	State display of the *Outputs [ch. 10.3.1, p. 63]*

Table 8: Pinout SP-COP2

Pin	assignment
A1	24 V supply voltage for all modules, except for supply of outputs
A2	GND of supply voltage
I1 - I16	Safe, digital inputs
Q1 - Q4	Safe, digital outputs
IQ1 - IQ4	Safe, digital inputs or outputs (configurable through samosPLAN5+)

Pin	assignment
B1	24 V supply voltage of outputs Q1 - Q4
B2	24 V supply voltage of configurable outputs IQ1 - IQ4
T1 - T4	Test signal outputs

USB interface

The main module has a mini-USB interface with the following functions:

- Transfer of the configuration from samosPLAN5+ to the program removable storage
- Reading of configuration from program removable storage in samosPLAN5+
- Diagnostics of the samosPRO systems with samosPLAN5+

Table 9: USB interface pin assignment

Connec-tor/bushing USB	Pin	Signal
	1	+5V
	2	- data
	3	+ data
	5	GND
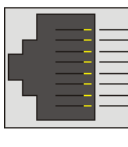
NOTICE	- If the USB interface of the main module is permanently connected, then the maximum permissible cable length is 3 m. - Avoid using ground loops between the USB interface GND and the A2 connection of the main module, e.g. by using optocouplers.

Ethernet interface

The main module has an Ethernet interface with the following functions:

- Transfer of the configuration from samosPLAN5+ to the program removable storage
- Reading of configuration from program removable storage in samosPLAN5+
- Diagnostics of the samosPRO systems with samosPLAN5+
- Continuous diagnostics of the samosPRO system via a connected PLC.

Table 10: RJ 45 bushing pin assignment

Connector/bushing RJ45	Pin	Signal (Auto MDI-X)
Pin1: RD+ Pin2: RD- Pin3: TD+ Pin4: n.c. Pin5: n.c. Pin6: TD- Pin7: n.c. Pin8: n.c.	1	RD+ / TD+
	2	RD- / TD-
	3	TD+ / RD+
	6	TD- / RD-

The device itself detects which cable type, patch cable or cross-link cable, is being used (Auto MDI-X), which is why the pin assignment does not matter with regard to the RD or TD signals.

3.5.3 Internal circuits

I1 I2 I3 I4 I5 I6 I7 I8 I9 I10 I11 I12 I13 I14 I15 I16 IQ1 IQ2 IQ3 IQ4

Appl.

S BUS +

A2   0 V   0 V
A1
      24 V   24 V

T1   T2   T3   T4

Illustration 8: Inputs and test pulses at an SP-COP2-EN module

B1   B2

Monitoring

Appl.

Q1   Q2   Q3   Q4   IQ1   IQ2   IQ3   IQ4

Illustration 9: Outputs at an SP-COP2-EN module

3.5.4 Limited short-circuit detection in the input circuits

ATTENTION

- One SP-COPx has four test signal generators T1 – T4.
- Short-circuits between test signal generators of an SP-COPx are detected. Between different modules the short circuit detection is then only ensure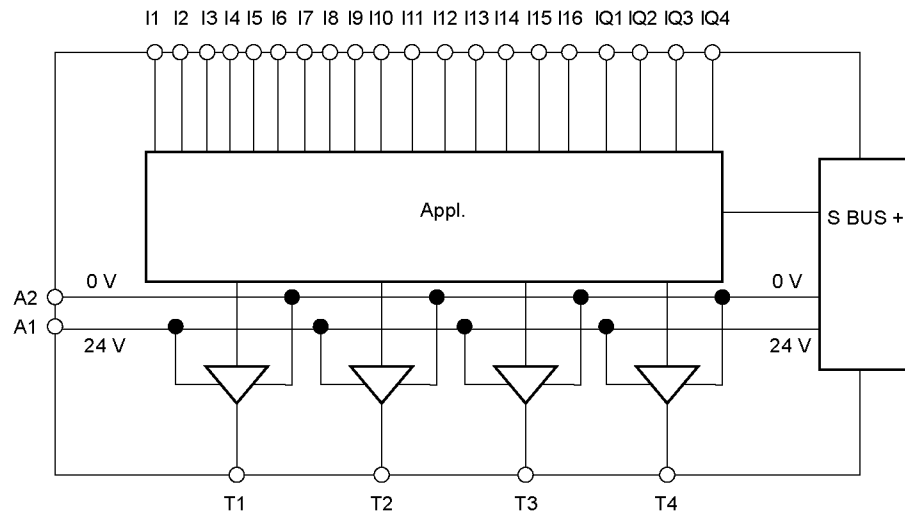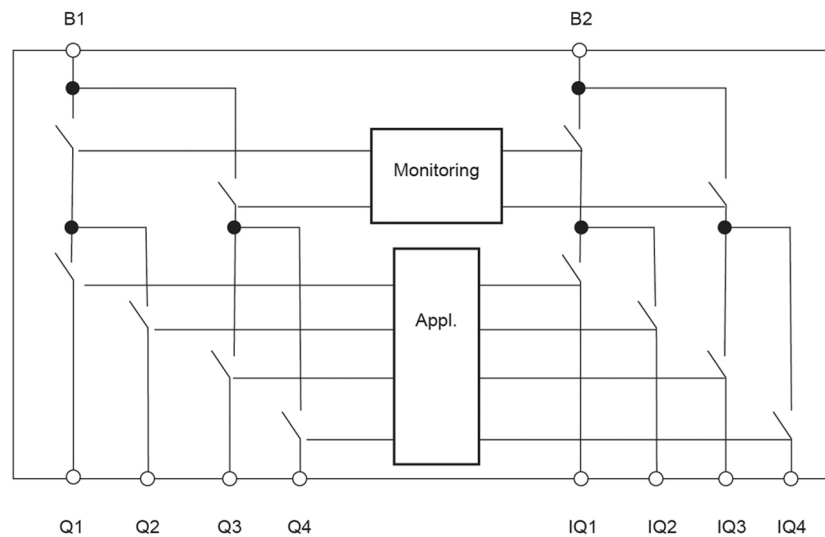d if the test gaps of the test signal generators are < 4 ms, the test periods ≥ 200 ms. In addition, the short circuit detection is only ensured if no more than 9 modules (SP-SDI / SP-SDIO) have been plugged in. Short-circuits after 24 V DC (after high) at inputs that are connected to test outputs are detected independently of the length of the test gaps.
  Make note of this during wiring (e.g. through separate routing or protected lines)!

3.5.5 Deactivating the test pulses at the outputs of the SP-COP2

It is possible to deactivate the test pulses at one or more output pairs. The outputs are combined into four output pairs with the SP-COP2: Q1/Q2, Q3/Q4, IQ1/IQ2, and IQ3/IQ4. The test pulses each act upon the two outputs of an output pair.

ATTENTION

Switching off the test pulses at one of the two outputs of an output pair will switch off the test pulses of the entire output pair!
Deactivating the test pulses at one or more safety outputs of an SP-COP reduces the safety parameters of both safety outputs of the respective output pair of this module.
- Be aware of this in order to ensure that your application corresponds to an appropriate risk analysis and risk avoidance strategy.
- You can find more detailed information on the safety parameters here: *Safety technology reference values [ch. 12.2, p. 73]*

ATTENTION

Be sure to use protected or separate cabling!
- If you deactivate the test pulses at one or more safety outputs, short-circuits at other output circuits cannot be detected. This affects the safety function!
- In the event of a short-circuit after 24 V, it will no longer be possible to switch off the output.

ATTENTION

Carry out cyclic tests when the test pulses at one or more safety outputs are deactivated!
Once you deactivate the test pulses at one or more safety outputs, conduct the following tests once a year:
- Switch off all of the safety outputs without test pulses simultaneously for at least one second via the logic program of the COMPACT module.
  OR
- Restart the samosPRO system by switching off the supply voltage.

You will thus deactivate the test pulses at an output of the SP-COP2:
➡ Connect an output element to the SP-COP module.
➡ Using the right mouse key, click on the output element and select the **Edit** command in the context menu.
➡ Deactivate the **Activation of test pulses of this output** option. The test pulses of this output will be switched off. A corresponding note will be displayed in the hardware configuration area under the respective SP-COP module.

3.5.6 Single-channel use of outputs on the SP-COP2

⚠️ **ATTENTION**	**Be sure to consider a potential brief switch to high with single-channel safety outputs!** In the event of an internal hardware error, single-channel safety outputs can switch to high once for 10 ms after the error has been detected. • Consider this during your risk analysis and reduction strategy. Otherwise, there is a hazard for the operator of the machine.

3.6 COMPACT module SP-COP2-ENI

3.6.1 Description

COMPACT module SP-COP2-ENI has the same functionality and has the same connections and the same displays as the *SP-COP2-EN [ch. 3.5, p. 21]*.

In addition, this module has the following gateway functionality on-board:

- Modbus/TCP interface
- PROFINET IO interface
- EtherNet/IP interface

Module versions

In addition to the basic version there is the SP-COP2-ENI-**P** compact module.

This has additional press control functions.

3.6.2 Display elements, error codes, and terminal description

The displays of the MS and CV LEDs as well as the terminal assignment of the USB and Ethernet interface are identical to those for the SP-COP2-EN controller module.

Further information: *Display elements, interfaces, and terminal description [ch. 3.5.2, p. 21]*

3.7 COMPACT SP-COP-CARD1 removable storage

3.7.1 Description

The system configuration of the entire samosPRO system is stored in the SP-COP-CARD1 program removable storage. This has the advantage that the samosPRO system does not have to be reconfigured when modules are replaced.

The COMPACT SP-COP-CARD1 removable storage is an SD card that is produced and formatted specially for use in COMPACT modules.

NOTICE	• The data stored in the SP-COP-CARD1 program removable storage will be retained even if the supply voltage is interrupted. • When replacing a module, make sure that the program removable storage is inserted into the appropriate COMPACT module. Mark all of the connection lines and plug connectors on the samosPRO system clearly to prevent mixups. • Commonly available SD cards cannot be used/inserted in samosPRO and COMPACT modules.

3.8 SP-SDIO input/output expansion module

3.8.1 Description

The SP-SDIO module is an input/output expansion with eight safe inputs and four safe outputs. It has two test signal generators: one for test output X1 and one for test output X2.

The SP-SDIO module offers the following functions:

- Monitoring of connected safety devices
  For further information: *Connecting devices [ch. 4, p. 37]*

- Forwarding the input information to the main module

- Receipt of control signals from the main module and corresponding switching of outputs

- Fast shut-off: Direct switch-off of the actuators connected on the module. This results in a significant reduction in the response time of the entire system. Only 8 ms are needed in the response times of the devices at the inputs and outputs in order to switch-off the outputs. The runtimes on the internal SBUS+ bus and the Logic Execution Time do not play any role in this case.
  Further information: *samosPRO system response times [ch. 12.1, p. 70]*

- Activating or deactivating test pulses at the outputs (Q1–Q4) with firmware version V2.00.0 and higher.

Module SP-SDIO cannot be operated alone; it always requires an SP-COP COMPACT module (see "samosPLAN5+" programming software).

It is possible to use multiple SP-SDIO84 modules simultaneously (see *System setup [ch. 3.2, p. 15]*). The voltage of the internal logic and the test outputs is supplied via the system connector and the internal SBUS+ bus. The voltage of the Q1–Q4 outputs of the SP-SDIO must be supplied directly via A1/A2 at the respective module.

⚠️ **ATTENTION**	**Limited short-circuit detection in the input circuits** • One SP-SDIO has two test signal generators, X1 and X2. • Short-circuits between test signal generators of an SP-SDI or SP-SDIO expansion module are detected. Between different modules the short circuit detection is then only ensured if the test gaps of the test signal generators are < 4 ms, the test periods ≥ 200 ms and no more than 9 modules (SP-SDI / SP-SDIO) have been plugged in. Short-circuits after 24 V DC (after high) at inputs that are connected to test outputs are detected independently of the length of the test gaps. **Make note of this during wiring (e.g. through separate routing or protected lines)!**

NOTICE	• The LEDs of inputs I1 to I8 indicate the state of the inputs at an update rate of about 64 ms.

3.8.2 Display elements and terminal assignment
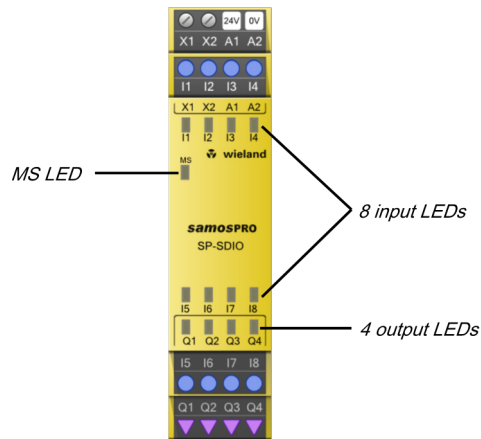
Illustration 10: SP-SDIO display elements

Flashing codes

Further information: *Device state and LED displays in the expansion modules (SP-SDIO, SP-SDI) [ch. 10.3.2, p. 65]*

Terminal assignment

Table 11: SP-SDIO terminal assignment reference

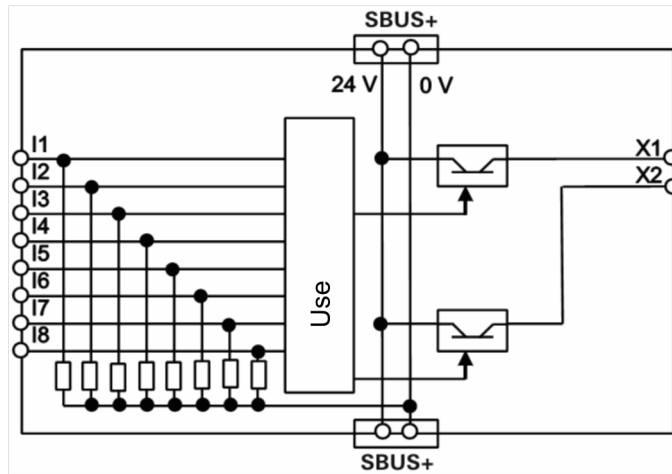| Terminal	assignment
X1/X2	Test output 1 / test output 2
I1–I4	Inputs 1 to 4
A1	24 V
A2	GND
I5–I8	Inputs 5 to 8
Q1–Q4	Outputs 1 to 4

3.8.3 Internal circuits

Illustration 11: Internal SP-SDIO circuits: Safe inputs and test outputs
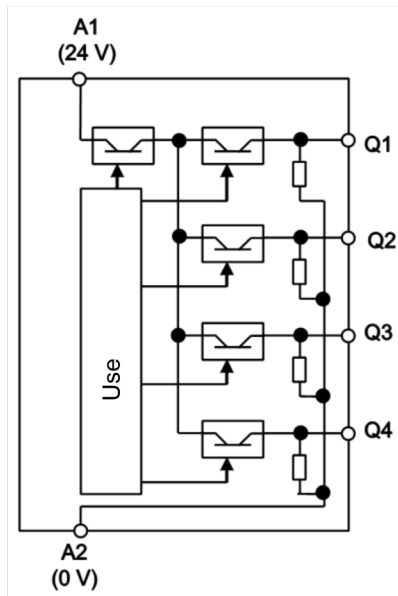

Illustration 12: Internal SP-SDIO circuits: Safety outputs

3.8.4 Deactivating the test pulses at the outputs of the SP-SDIO

With firmware version V2.00.0 and higher, it is possible to deactivate the test pulses at one or more outputs of SP-SDIO84-P1 modules.

ATTENTION	**Deactivating the test pulses at any output reduces the safety parameters of all outputs!** Deactivating the test pulses at one or more safety outputs of an SP-SDIO module reduces the safety parameters of all Q1 to Q4 safety outputs of this module. • Be aware of this in order to ensure that your application corresponds to an appropriate risk analysis and risk avoidance strategy. • You can find more detailed information on the safety parameters here: *Technical data [ch. 12, p. 70]*

ATTENTION	**Be sure to use protected or separate cabling!** • If you deactivate the test pulses at one or more safety outputs, short-circuits at other output circuits cannot be detected. This affects the safety function! • In the event of a short-circuit after 24 V, it will no longer be possible to switch off the output. Furthermore, it will not be possible to prevent reverse current from going into a switched-off output, which will influence the capability of switching off the outputs.

ATTENTION	**Carry out cyclic tests when the test pulses at one or more safety outputs are deactivated!** Once you deactivate the test pulses at one or more safety outputs, conduct the following tests once a year: • Switch off all of the safety outputs without test pulses simultaneously for at least one second via the logic program of the COMPACT module. OR • Restart the samosPRO system by switching off the supply voltage.

You will thus deactivate the test pulses at an output of the SP-SDIO:
➡ Connect an output element to the SP-SDIO module.
➡ Using the right mouse key, click on the output element and select the **Edit** command in the context menu.
➡ Deactivate the **Activation of test pulses of this output** option. The test pulses of this output will be switched off. A corresponding note will be displayed in the hardware configuration area under the respective SP-SDIO module.

3.8.5 Single-channel use of outputs on the SP-SDIO

ATTENTION	**Be sure to consider a potential brief switch to high with single-channel safety outputs!** In the event of an internal hardware error, single-channel safety outputs (Q1 to Q4) can switch to high once for 10 ms after the error has been detected. Consider this during your risk analysis and reduction strategy. Otherwise, there is a hazard for the operator of the machine.

3.9 SP-SDI input/output expansion module

3.9.1 Description

The SP-SDI module is an input expansion with eight safe inputs. If fulfills the following tasks:

- Monitoring of connected sensors
  For further information: *Connecting devices [ch. 4, p. 37]*

- Forwarding of input information to the COMPACT module

Module SP-SDI cannot be operated alone; it always requires an SP-COP COMPACT module (see "samosPLAN5+" programming software).

It is possible to use multiple SP-SDI modules simultaneously (see *System setup [ch. 3.2, p. 15]*). The voltage of the internal logic and the test outputs is supplied via the program removable storage and the internal SBUS+.

ATTENTION

Limited short-circuit detection in the input circuits
- One SP-SDI has two test signal generators. One test signal generator is responsible for the odd-numbered test outputs (X1, X3, X5, and X7), while the other is responsible for the even-numbered test outputs (X2, X4, X6, and X8).
- Short-circuits between test signal generators of an SP-SDI or SP-SDIO expansion module are detected. Between different modules the short circuit detection is then only ensured if the test gaps of the test signal generators are < 4 ms, the test periods ≥ 200 ms and no more than 9 modules (SP-SDI / SP-SDIO) have been plugged in. Short-circuits after 24 V DC (after High) at inputs that are connected to test outputs are detected independently of the length of the test gaps.
- Please ensure that the odd-numbered test outputs (X1, X3, X5, and X7) at the SP-SDI are connected to a common test signal generator and that the even-numbered test outputs (X2, X4, X6, and X8) are connected to another common test signal generator. Therefore, short-circuits between the odd-numbered test outputs (X1, X3, X5, and X7) cannot be detected. The same applies accordingly to the even-numbered test outputs (X2, X4, X6, and X8).
  Make note of this during wiring (e.g. through separate routing or protected lines)!

3.9.2 Display elements and terminal assignment

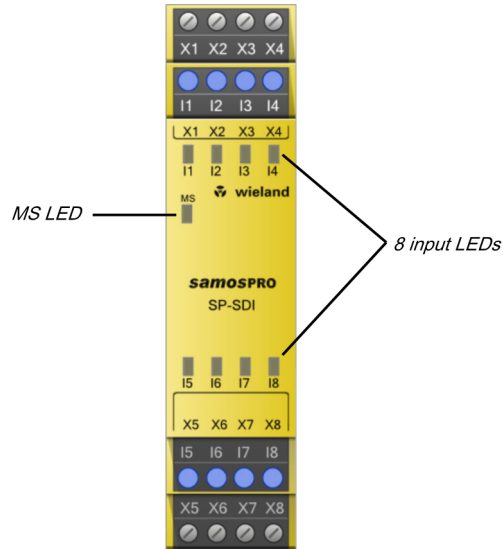| NOTICE	• The LEDs of inputs I1 to I8 indicate the state of the inputs at an update rate of about 64 ms.

Illustration 13: SP-SDI display elements

Flashing codes

Further information: *Device state and LED displays in the expansion modules (SP-SDIO, SP-SDI) [ch. 10.3.2, p. 65]*

Terminal assignment

Table 12: SP-SDI terminal assignment reference

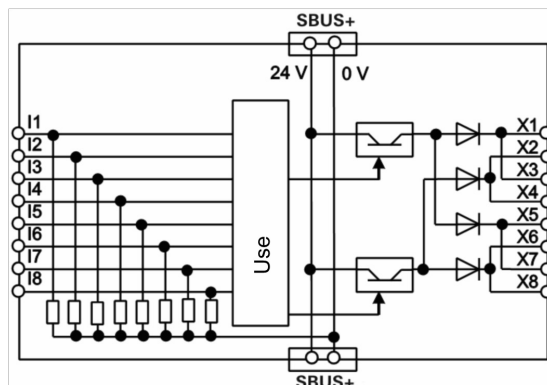| Terminal	assignment
X1/X3	Test signal 1
X2/X4	Test signal 2
I1 – I4	Inputs 1 to 4
I5 – I8	Inputs 5 to 8
X5/X7	Test signal 1
X6/X8	Test signal 2

3.9.3 Internal circuits

Illustration 14: Internal SP-SDI circuits: Safety inputs and test outputs

3.10 SP-DIO input/output expansion module

3.10.1 Description

The SP-DIO module is an input/output expansion with four non-secure inputs, four non-secure outputs and 4 non-secure input/output combinations whose function is configured using the samosPLAN5+ software.

The SP-DIO module offers the following functions:

- Monitoring of connected devices and sensors
  For further information: *Connecting devices [ch. 4, p. 37]*
- Forwarding the input information to the main module
- Receipt of control signals from the main module and corresponding switching of outputs

The SP-DIO module cannot be operated alone; it always requires an SP-COP COMPACT module (see "samosPLAN5+" programming software).

It is possible to use multiple SP-DIO modules simultaneously (see *System setup [ch. 3.2, p. 15]*). The voltage of the internal logic is supplied via the system connector and the internal SBUS+ bus. The voltage of the Y1–Y4 and IY5–IY8 outputs of the SP-DIO must be supplied directly via A1/A2 at the respective module.

Refresh rate

The LEDs of the I1–I4 inputs and the Y1–Y4 outputs or the inputs/outputs combination show the state with a refresh rate of approx. 4 ms.

Restricted selection of inputs

Only the single-channel inputs are available to be selected in the configuration for the SP-DIO expansion module, for example:
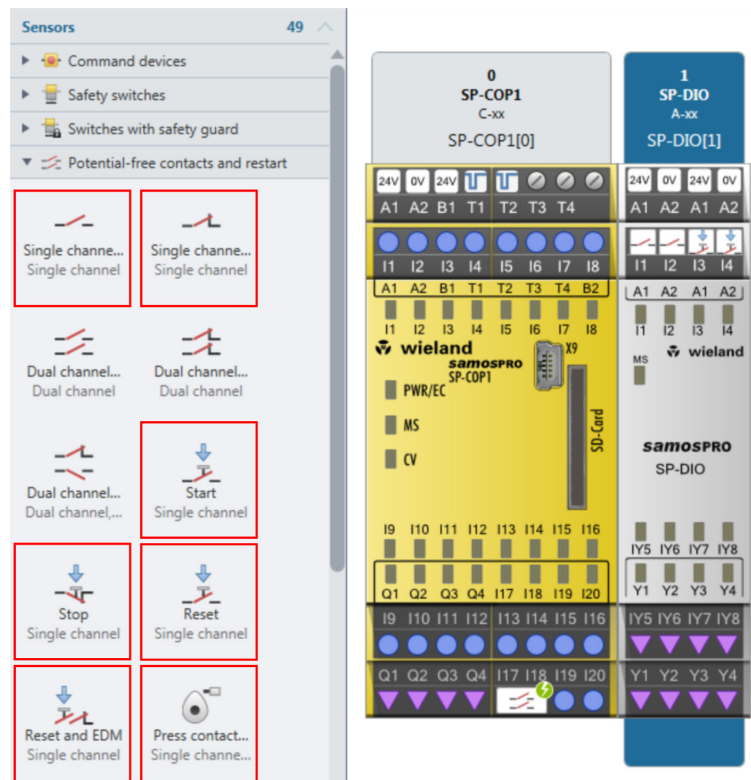

Illustration 15: Single-channel inputs for the 'SP-DIO' expansion module

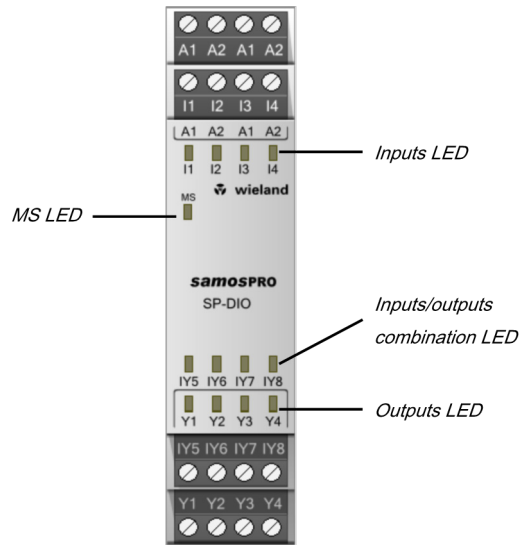### 3.10.2 Display elements and terminal assignment

Illustration 16: SP-DIO display elements

Flashing codes

Further information: *Device state and LED displays of the expansion module (SP-DIO) [ch. 10.3.3, p. 65]*

Terminal assignment

Table 13: SP-DIO terminal assignment reference

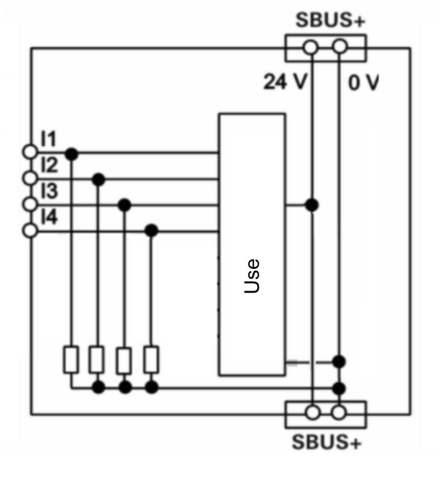| Terminal	assignment
A1	24 V
A2	GND
I1–I4	non-secure inputs 1 to 4
IY5–IY8	non-secure inputs/outputs combination 5 to 8
Y1–Y4	non-secure outputs 1 to 4

3.10.3 Internal circuits

Illustration 17: Internal switching circuit of the SP-DIO: non-secure inputs
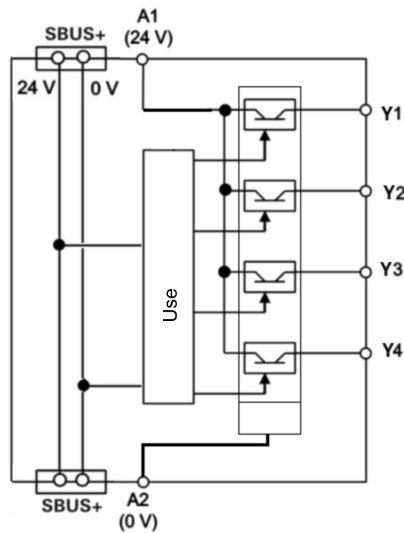

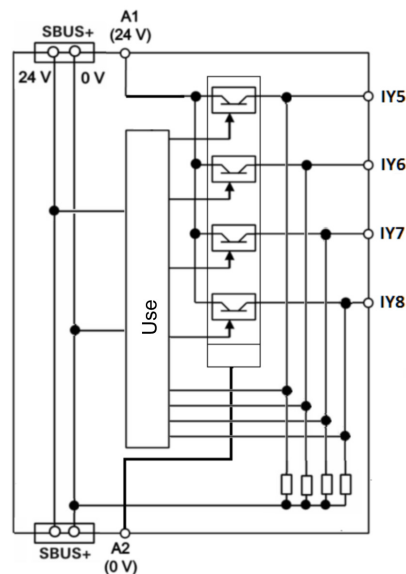*Illustration 18: Internal switching circuit of the SP-DIO: non-secure outputs*

Illustration 19: Internal switching circuit of the SP-DIO: non-secure inputs/outputs combination

ATTENTION

Use of the IY5–IY8 inputs/outputs
When using the combination connections as input, the signal input voltage to IY5–IY8 may never be greater than the supply voltage to A1/A2.

4 Connecting devices

This section describes the connection of safety sensors and actuators to the samosPRO system and provides setup information for selected functions.

The samosPRO system supports applications up to Performance Level PL e (as per EN ISO 13849-1) and up to Safety Integrity Level SIL CL3 (as per EN 62061).

The level of safety actually achieved depends on the external wiring, the implementation of the wiring, the parameterization, the selection of the safety sensors, and their arrangement on the machine. To this end, consider all of the required boundary conditions and evaluate them, for example, in a Failure Modes and Effects Analysis (FMEA).

You can find additional information to be noted during the electrical installation here: *Electrical installation [ch. 7, p. 57]*

Important information

⚠️ **ATTENTION**	**Loss of safety function due to incorrect configuration!** Carefully plan and implement configuration! **The configuration of the safety application must be precisely adapted to the circumstances of the system or machine to be monitored.** • Check to ensure that the configured safety application monitors the machine or system as you have planned and whether the safety of a configured application is being ensured at all times. This must be ensured in all operating modes and for all sub-applications. Document the results of this test! • Be sure to note the instructions for commissioning and daily testing in the operating instructions for the safety equipment integrated into the safety application. • Note the warning information and function descriptions for the safety equipment connected to the safety control. When in doubt, contact the respective manufacturer of the safety equipment. • Note that the minimum switch-off time of the connected sensors must be longer than the execution time of the logic function (for further information, see the "samosPLAN5+ Software" manual (BA000968), Time values and logic execution time). In this way you will ensure that the samosPRO system can detect the switching of sensors. The minimum switch-off time of sensors is typically listed in the technical data for the sensors.

⚠️ **ATTENTION**	**Protect single-channel inputs against short-circuits and cross-connections!** When a short-circuit to high occurs at a single-channel input with test pulses that were previously low, this signal can then look like a pulse for the logic. A short-circuit to high means that the signal is first to high and then is back to low after the error detection time. A pulse can be generated due to the error detection. Because of this, note the following specifications for single-channel signals with test pulses:

- If the short-circuit to high occurs at a single-channel input with test pulses that was previously high, this signal for the logic then looks like a delayed falling edge (transition from high to low).

- When a single-channel input is used and an unexpected pulse or a delayed falling edge (high to low) at this input can lead to a state causing a risk, then you must undertake the following measures:

  – Protected cabling for the signal in question (in order to prevent cross-connections with other signals)

  – No cross-connection detection, i.e. no connection with a test output
  This must be noted in particular for the following inputs:

  – Input reset at the function block reset

  – Input restart at the function block restart

  – Input restart at the function blocks for press applications (eccentric press contact monitor,

  – contact monitor for universal presses, cycle mode, press setup, single stroke monitoring, press automatic mode)

  – Input override at a function block for muting

  – Input reset at a function block for valve monitoring

  – Resetting of inputs to zero and setting at a start value on an event counter function block

NOTICE

• When using an odd-numbered test output, odd-numbered inputs must be used, while even-numbered inputs must be used when using an even-numbered test output.
• You have to use the test outputs of the module at which the device to be tested has been connected.

Report function in samosPLAN5+

After project planning, you will receive the following documentation in samosPLAN5+ under "Info -> Report":

• Logic report

• List of parts

• Wiring information

Table 14: Excerpt from exemplary documentation in samosPLAN5+

4.1 Safety command devices and electromechanical safety switches

4.1.1 Emergency stop buttons (e.g. SNH series)

Table 15: Connection

Electrical connection: Example from samosPLAN5+			
Single-channel, without testing	24V	I1	Contact between 24 V and I1
Single-channel, with testing	T2	I2	Contact between T2 and I2
Two-channel, without testing	24V	I3 I4	Channel 1: Contact between 24 V and I3 Channel 2: Contact between 24 V and I4
Two-channel, with testing	T1 T2	I5 I6	Channel 1: Contact between T1 and I5 Channel 2: Contact between T2 and I6

The pre-configured two-channel emergency stop buttons in samosPLAN5+ have equivalent switching contacts. In order to implement two-channel complementary switching contacts, you can find corresponding elements in the element window under the group of potential-free contacts.

Table 16: Functions

Function	Info
Testing	Possible
Series connection/cascading	Max. number of emergency stop buttons switched in series: note max. line resistance of 100 Ω
Synchronous time	4 ms to 30 ms

NOTICE You can find additional information in the operating instructions for the SNH emergency stop button.

4.1.2 Electromechanical safety switch without lock (e.g. SMS series)

Table 17: Electromechanical safety switch connection

Electrical connection: Example from samosPLAN5+			
Single-channel, without testing	24V	I1	Contact between Ub and I1
Single-channel, with testing	T2	I2	Contact between T2 and I2
Two-channel, without testing	24V	I3 I4	Channel 1: Contact between Ub and I3 Channel 2: Contact between Ub and I4
Two-channel, with testing	T1 T2	I5 I6	Channel 1: Contact between T1 and I5 Channel 2: Contact between T2 and I6

4.1.3 Electromechanical safety switch with lock (e.g. SIN series)

Table 18: Connection of locks

Electrical connection: Example from samosPLAN5+		
Single-channel, without testing	24V ▢ I1 ⌐⌐ ▢ Q1	Contact between Ub and I1 Inductor at Q1
Single-channel, with testing	T2 ▢ I2 ⌐⌐ ▢ Q2	Contact between T2 and I2 Inductor at Q2
Two-channel, without testing	24V ▢ I3 ▢ I4 ⌐⌐ ▢ Q3	Channel 1: Contact between Ub and I3 Channel 2: Contact between Ub and I4 Inductor at Q3
Two-channel, with testing	T1 ▢ I5 T2 ▢ I6 ⌐⌐ ▢ Q4	Channel 1: Contact between T1 and I1 Channel 2: Contact between T2 and I2 Inductor at Q1

Table 19: Functions with electromechanical safety switches and locks

Function	Info
Testing	Possible
Series connection/cascading	The max. number of emergency stop buttons switched in series is determined by the max. line resistance of 100 Ω.
Synchronous time	4 ms–30 s

NOTICE	You can find additional information in the operating instructions for the electromechanical safety switches.

4.1.4 Enable switch

Table 20: Enable switch connection

Electrical connection: Example from samosPLAN5+			
2 positions, without testing	24V	I1 I2	NC 1: between Ub and I1
			NC 2: between Ub and I2
2 positions, with testing	T1 T2	I3 I4	NC 1: between T1 and I3
			NC 2: between T2 and I4
3 positions, without testing	24V 24V	I1 I2 I3 I4	NC 1: between Ub and I1
			NC 2: between Ub and I2
			NO 1: between Ub and I3
			NO 2: between Ub and I4
3 positions, with testing	24V T1 T2	I5 I6 I7 I8	NC 1: between Ub and I5
			NC 2: between Ub and I6
			NO 1: between T1 and I7
			NO 2: between T2 and I8

Table 21: Functions

Function	Info
Testing	Possible
Series connection	Not possible
Synchronous time	4 ms–30 s

NOTICE You can find additional information in the operating instructions for the respective devices.

4.1.5 Two-hand control

Table 22: Two-hand control connection

Electrical connection: Example from samosPLAN5+				
Type IIIA, without tes-ting	24V	IIIA I1	—/—	Channel 1: Contact between 24 V and I1
	24V	IIIA I2	—/—	Channel 2: Contact between 24 V and I2
Type IIIC, without tes-ting	24V	IIIC I5	—/—	NO (normally open contact) between 24 V and I6 (I8)
	24V	IIIC I6	—/L	NC (normally closed contact) between 24 V and I5 (I7)
	24V	IIIC I7	—/—	
	24V	IIIC I8	—/L	

4.1.5.1 Type IIIA

With type IIIA, two equivalent inputs (make NC contacts for both two-hand buttons) are moni-tored.

A valid input signal is only generated when the ON state (H level) is present at both inputs within a time of 0.5 seconds (synchronous change, both two-hand buttons actuated) and both were previously in the OFF state (L level).

4.1.5.2 Type IIIC

With type IIIC, two pairs of equivalent inputs (NC (normally closed contact)/NO (normally open contact) contact pairs for both two-hand buttons) are monitored.

A valid input signal is only generated when the ON state (H/L level) is present at both inputs within a time of 0.5 seconds (synchronous change, both two-hand buttons actuated) and both were previously in the OFF state (L/H level).

NOTICE   You can find additional information in the operating instructions for two-hand control.

4.1.6 Safety mats and bumper

Table 23: Safety mats connection

Electrical connection: Example from samosPLAN5+		
Short-circuit-forming safety mat in 4-conductor technology, at test output	T1 T2 I1 I2	Channel 1: Contact between T1 and I1 Channel 2: Contact between T2 and I2
Short-circuit-forming multi-safety mat in 4-conductor technology, at test output	T1 T2 I3 I4	Channel 1: Contact between T1 and I1 Channel 2: Contact between T2 and I2

Table 24: Function of safety mats

Function	Info
Parallel connection	Possible
Series connection	Possible

⚠ ATTENTION

Make sure that the switch-off condition is sufficient!
The actuation period for safety mats and bumper must be at least as high as the maximum value for the "test period" of both test outputs used in order to ensure that the switch-off condition will be detected and that a sequencing error will not occur.

NOTICE You can find additional information in the operating instructions for the safety mats.

4.1.7 Diode pairs for safety mats

In order to connect multiple short-circuit safety mats to an SP-COP, SP-SDI, or SP-SDIO module, you have to use the following Wieland terminal block:

Type: WKFN 2.5 E/35 GO-URL

Order No.: 56.703.8755.9

The two internal diodes of this terminal block have a common anode that has to be connected to a test output (Tn or X) of the SP-COP, SP-SDI, or SP-SDIO module.

In order to connect to independent safety mats, you will need two terminal blocks.

Illustration 20: Block diagram of the internal wiring WKFN 2.5 E/35 GO-URL

4.1.8 Mode selection switch

Electrical connection: Example from samosPLAN5+		
Operating mode selection switch (1 from 2) to 24 V	24V I1 24V I2	Channel 1: Contact between 24 V and I1 Channel 2: Contact between 24 V and I2
Operating mode selection switch (1 from 2) to test output	T1 I3 T2 I4	Channel 1: Contact between T1 and I3 Channel 2: Contact between T2 and I4

Function	Info
Testing	Possible

NOTICE
- Operating mode selection switches without test pulses enable 2 to 8 operating modes; operating mode selection switches with test pulses enable 2 to 4 operating modes.
- When wiring the tested operating mode selection switches, note that when using an odd-numbered test output (X1, X3, X5, X7), odd-numbered inputs (I1, I3, I5, I7) must be used; when using an even-numbered test output (X2, X4, X6, X8), even-numbered inputs (I2, I4, I6, I8) must also be used.
- You can find additional information in the operating instructions for the operating mode selection switches.

4.1.9 Potential-free contacts

The samosPLAN5+ software provides a series of potential-free contacts for "free" designing of contact elements. In this manner, you can implement different NO (normally open contact)/NC (normally closed contact) combinations with and without testing. In addition, there are elements for a start and stop button, reset button, and device monitoring (EDM).

Table 25: Function of potential-free contacts

Function	Info
Testing	Possible
Series connection	Possible
Discrepancy time	Further information: "samosPLAN5+ Software" manual (BA000968)

4.2 Contactless safety sensors

4.2.1 Magnetic safety switches (e.g. SMA series)

4.2.1.1 Magnetic safety switches with equivalent inputs

Table 26: Connection of magnetic safety switches with equivalent inputs

Electrical connection: Example from samosPLAN5+			
With testing	T1 T2	I3 I4	Channel 1: Contact between T1 and I3
			Channel 2: Contact between T2 and I4

4.2.1.2 Magnetic safety switches with complementary inputs

Table 27: Connection of magnetic safety switches with antivalent inputs

Electrical connection: Example from samosPLAN5+			
With testing	T1 T2	I1 I2	NO contact between T1 and I1
			NC contact between T2 and I2

Table 28: Functions with magnetic safety switches

Function	Info
Testing	Possible
Series connection/cascading	Possible; note max. line resistance of 100 µ and correct setting of test pulse time
Discrepancy time	Preset at 1500 ms

NOTICE You can find additional information in the operating instructions for the magnetic safety switches.

4.2.2 Inductive safety switches

Table 29: Inductive safety switch connection

Electrical connection: Example from samosPLAN5+			
Inductive switch (serial)	T1	I5	Test input TE at T1
			Output A at I1
Inductive switch	24V	I7 I8	OSSD1 at I3
			OSSD2 at I4

Table 30: Functions with inductive safety switches

Function	Info
Testing	Necessary with serial inductive switches
Series connection/cascading	**Inductive switches (serial):** Up to six sensors per input. Maximum OFF-ON delay of the cascade is 10 ms (otherwise, the test gap will lead to switch-off). Note the maximum line resistance of 100 Ω and the correct setting of the test pulse time. **Inductive switch:** No cascading possible

NOTICE You can find additional information in the operating instructions for the inductive safety switches.

4.2.3 Transponder switches

Table 31: Transponder connection

Electrical connection: Example from samosPLAN5+		
With OSSD	24V I1 I2	OSSD1 at I1
		OSSD2 at I2

Table 32: Functions with transponders

Function	Info
Series connection/cascading	Possible, depending on type used

NOTICE	You can find additional information in the operating instructions for the respective transponder switch.

4.3 Testable single-beam safety light barriers

4.3.1 Testable type 2 single-beam safety light barriers

Table 33: Connecting testable type 2 single-beam safety light barriers

Electrical connection: Example from samosPLAN5+		
SLB type 2	T1 Type I3 ⎯⌐	Test input TE (transmitter) at T1 Output Q (receiver) at I3

⚠ **ATTENTION**

Note the safety information and protective measures!
Route the transmitter and receiver lines outside of the switchbox so that a short-circuit between these lines can be avoided, e.g. route them separately in separate sheathed cables or protected areas.

Table 34: Functions with testable type 2 single-beam safety light barriers

Function	Info
Testing	Possible
Series connec-tion/cascading	Possible, depending on the safety light barrier type used Note the maximum line resistance of 100 Ω.

NOTICE You can find additional information in the operating instructions for the type 2 single-beam safety light barriers.

4.3.2 Testable type 4 single-beam safety light barriers

Table 35: Functions with testable type 4 single-beam safety light barriers

Electrical connection: Example from samosPLAN5+		
SLB type 4	T2 Type I4 ⎯⌐	Test input TE (transmitter) at T2 Output Q (receiver) at I4

⚠ **ATTENTION**

Route the transmitter and receiver lines outside of the switchbox so that a short-circuit between these lines can be avoided, e.g. route them separately in separate sheathed cables or protected areas.

Table 35: Functions with testable type 4 single-beam safety light barriers

Function	Info
Testing	Required
Series connec-tion/cascading	Maximum of seven pairs per inputs Note the maximum line resistance of 100 Ω.

NOTICE You can find additional information in the operating instructions for the type 4 single-beam safety light barriers.

4.3.3 Customer-specific testable single-beam safety light barriers

You can find additional information on creating customer-specific elements here:
"samosPLAN5+ Software" manual (BA000968)

NOTICE	• Select the minimum value for the desired test gap in the settings of the customer-specific element dialog. • Regardless of the test gap, the entire OFF-ON delay of the cascade must be less than the maximum OFF-ON delay of the respective test output (as shown in the report for the samosPLAN5+) – 2 ms. Otherwise, the test gap will cause a switch-off. With SP-COP, SP-SDIO, or SP-SDI modules, this value = 12 ms – 2 ms = 10 ms. • Use a shielded or separate cable for the connections from the test output of the module (X1 to X8) to the test input of the transmitter and from the output of the receiver to the safe input of the module (I1 to I8). Otherwise, a short-circuit between the signals may prevent error detection by this test.

4.3.4 Information on installing testable single-beam safety light barriers

NOTICE	**Note the installation information in the operating instructions for the respective sensors and particularly the following points:** • Single-beam safety light barriers may only be used as access protection in accordance with EN ISO 13855. They may not be used as finger or hand protection. • Maintain the minimum distance to reflective surfaces. • The safety distance between the light beam and the danger point for the access protection must absolutely be adhered to.
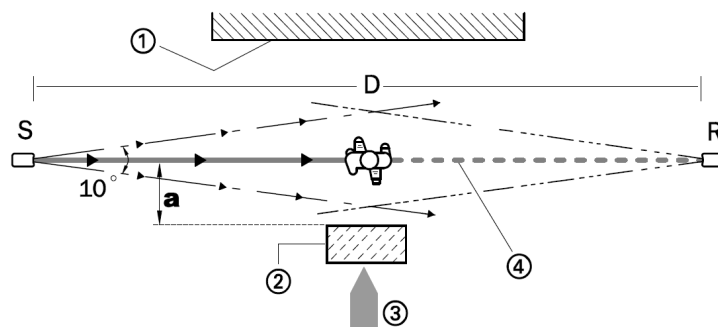
Illustration 21: Minimum distance "a" to reflective surfaces, correct installation, and alignment

S = transmitter	R = receiver	D = distance between transmitter and receiver

1 = border to the hazardous area

2 = reflective surface

3 = entry direction to the hazardous area

4 = optical axis

a = minimum distance to reflective surface
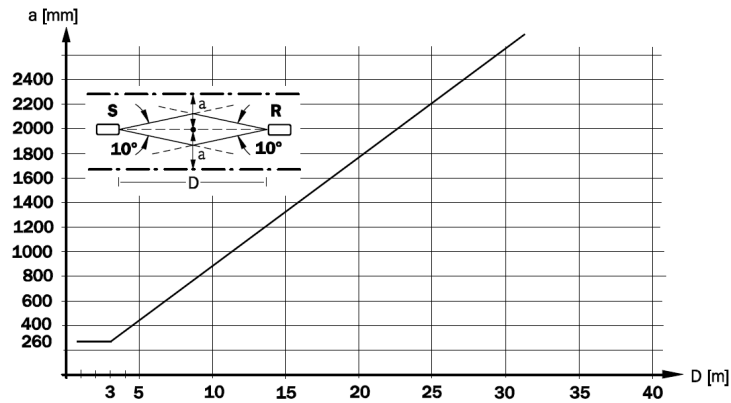
Illustration 22: Minimum distance "a" as a function of distance "D" for testable single-beam safety light barriers with 10° aperture angle

NOTICE	Diagrams of the safety light barriers can be found in the respective operating instructions.

NOTICE	**Avoid interaction between single-beam safety light barriers and between cascades** • If multiple single-beam safety light barrier pairs are used, the aperture angle of the sensors must absolutely be noted in order to prevent interaction. • If the transmitter is only installed on one side, the light beams must not overlap on the receiver side so that the light beam of the transmitter reaches two receivers. • With reciprocal installation of the transmitter and receiver, ensure that the light beam of transmitter S1 cannot be received by receiver R3 and that the light beam of transmitter S3 cannot be received by receiver R1.
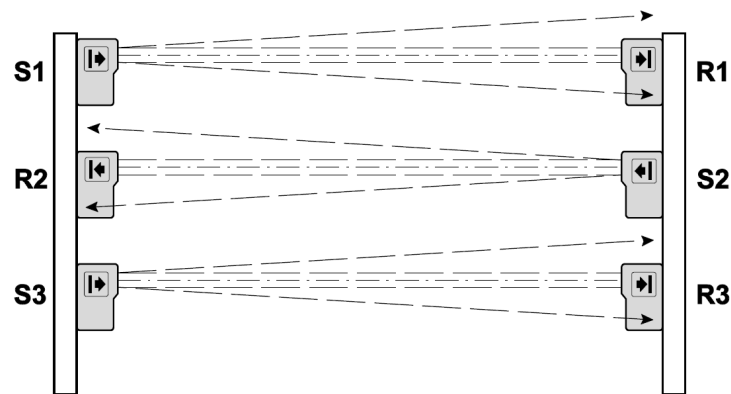
Illustration 23: Installation so as to prevent optical interaction

4.4 ESPE – Electro-sensitive protective equipment

Table 36: ESPE connection

Electrical connection: Example from samosPLAN5+			
SLC-2	24V I1 I2		OSSD1 (receiver) at I1 OSSD2 (receiver) at I2
SLC-4, SLD-4	24V I3 I4		OSSD1 (receiver) at I3 OSSD2 (receiver) at I4
Laser scanner ESPE type 3	24V I5 I6		OSSD1 (receiver) at I5 OSSD2 (receiver) at I6

NOTICE   You can find additional information in the operating instructions for the respective ESPE.

4.5 Safety outputs

ATTENTION

Safety-based devices must be suitable for safety-relevant signals!
An interruption in the function of safety outputs will lead to a loss of safety functions, which means that there will be a risk of severe injury.
- Do not connect any loads that exceed the rated values of the safety outputs.
- Wire the samosPRO system such that no 24 V DC signals can unintentionally make contact with the safety outputs.
- Connect the GND lines of the power supply to ground so that the devices do not switch on when the safety output line is at ground potential.
- Use suitable components or devices that fulfill the applicable guidelines and standards.
- Actuators can be wired at the output as single-channel. To ensure that the corresponding safety integrity levels can be adhered to, the lines must be routed such that short-circuits to other signals can be prevented, e.g. by routing them within protected areas such as switchboxes or in separate shielded cables.

5 Special functions

5.1 Muting

Muting is the automatic temporary bypassing of all safety-based functions of the control system or of the safety equipment. Muting is used when certain objects, e.g. pallets with material, may be moved into the hazardous area. During this transport, the muting function suppresses monitoring by the contactless safety device (ESPE), e.g. a safety light curtain.

Note the following information for the further procedure: "samosPLAN5+ Software" manual (BA000968), Function blocks for parallel muting, sequential muting, and cross muting

6 Installing/removing

This section describes the installation of modules for the samosPRO safety control.

6.1 Installing modules on standard rail

⚠ **ATTENTION**

This is only for switchboxes with protection class IP 54 or higher!
The samosPRO system is only suitable for installations in a switchbox having at least protection class IP 54.

Info

- ESD protection measures
  Note the suitable ESD protection measures during installation.
  Failure to do so could result in damage to the bus (internal safety bus).

- Protect connector openings
  Undertake suitable measures so that no foreign bodies can penetrate connector openings, particularly those for the program removable storage.

- Module width:
  The modules are placed in a mounting box that is 22.5 mm or 45 mm wide depending on type.

- Quality of standard rail
  The mounting boxes are suitable for 35-mm standard rails as per EN 60715.

- Sequence of modules:
  The SP-COPx controller module is inserted all the way to the left in a samosPRO system. The two optional gateways follow directly to the right next to the controller module.

- Save space for subsequent model replacement
  The modules are connected via the plug connection integrated into the housing. Note that the samosPRO modules must be pulled about 10 mm apart for a module replacement before the corresponding module can be removed from the standard rail.

- Standards to be considered
  Installation according to EN 50274

Procedure 1: Installation of main module SP-COPxxx

➡ Using a screwdriver, pull the snap-on foot outward.
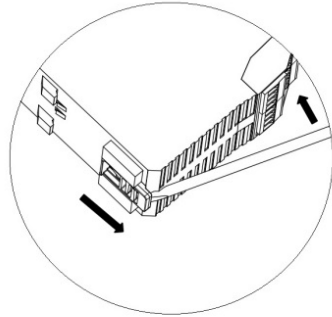
➡ Hang the module on the standard rail.
Important! Make sure that the grounding spring is seated correctly.
The grounding spring of the module must be placed on the standard rail so that it is secure and has good electrical conduction.
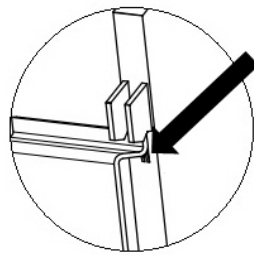
➡ Fold the module onto the standard rail.
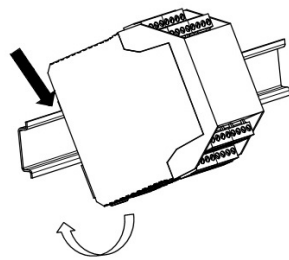
➡ Using a screwdriver, move the snap-on foot against the standard rail until the snap-on foot latches into position with an audible click.
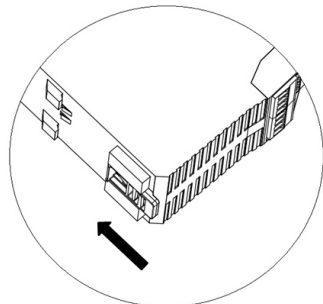
➡ Make sure that the module is securely seated on the standard rail.
Attempt to pull the module from the standard rail using slight pressure. If the module stays connected to the rail during this test, then the installation is correct.

Procedure 2: Installation of gateways or expansion modules

➡ Hang the module on the standard rail [A].
   Important! Make sure that the grounding spring [B] is seated correctly.
   The grounding spring of the module must be placed on the standard rail so that it is secure and has good electrical conduction.
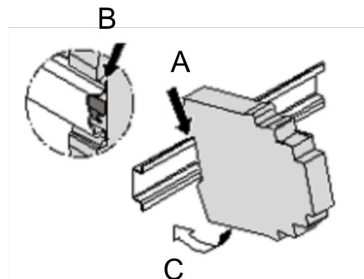
➡ Using slight pressure, fold the module onto the rail in the direction of the arrow [C] until the module audibly latches into position.
➡ Make sure that the module is securely seated on the standard rail.
   Attempt to pull the module from the standard rail using slight pressure. If the module stays connected to the rail during this test, then the installation is correct.
➡ If you are installing multiple modules:
   Push the modules together individually in the direction of the arrow until the lateral plug connection between the modules audibly latches into position.
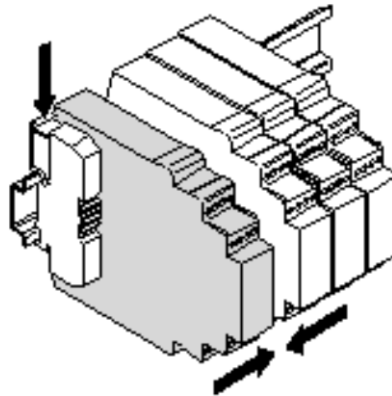
➡ Install an end cap into the module furthest to the left and another end cap into the module furthest to the right.

After installation

Once you have installed the modules, the following steps are required:

• *Connect the modules electrically. [ch. 4, p. 37]*

• Configure modules (see: "samosPLAN5+ Software" manual, BA000968).

• *Check the installation before first commissioning. [ch. 9.2, p. 61]*

6.2 Removing modules from normal rail

Procedure 1: Removal of main module SP-COPxxx

➡ Remove plug-in terminals with wiring [A] and remove the end terminals [B].
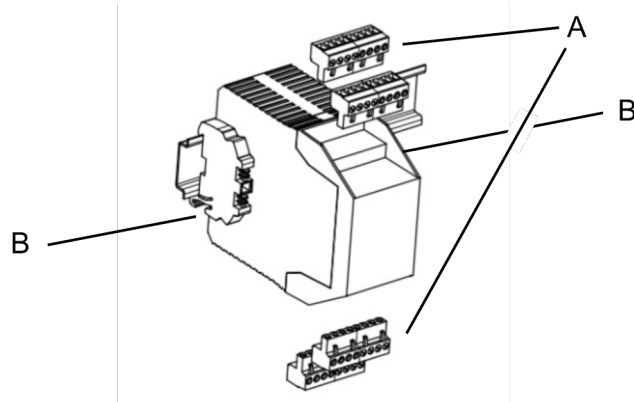
➡ With multiple modules:
   Pull the modules apart from one another individually in the direction of the arrow until the lateral plug connection is disconnected.
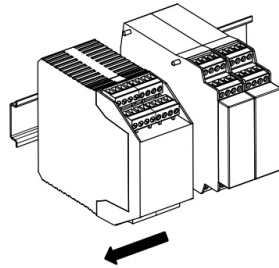
➡ Release the modules.
   To do this, pull the snap-on foot of the modules outward using a screwdriver.
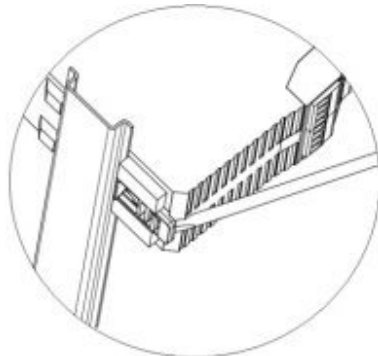
➡ Fold the module somewhat away from the standard rail and remove it from the rail.
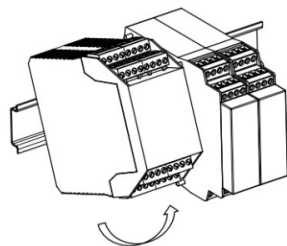
Procedure 2: Removing gateways or expansion modules

➡ Remove plug-in terminals with wiring [A] and remove the end terminals [B].
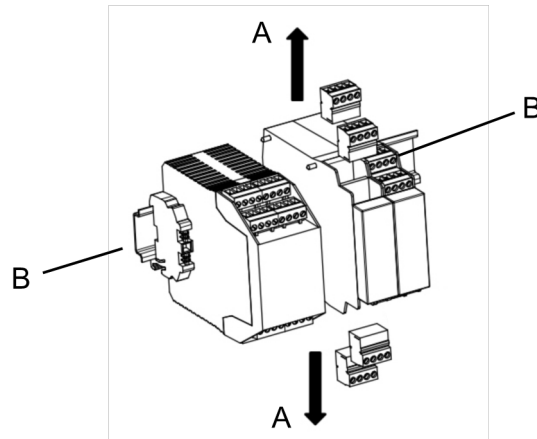
➡ With multiple modules:
Pull the modules apart from one another individually in the direction of the arrow [C] until the lateral plug connection is disconnected.
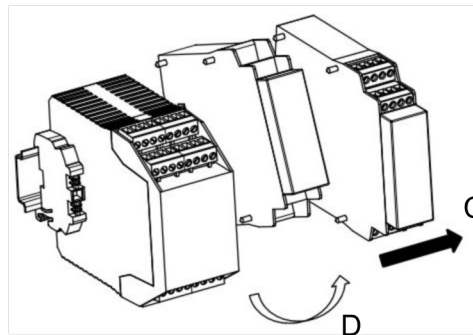
➡ Press on the module from above and fold the module away from the standard rail while it is in the pressed-down state [D].

7 Electrical installation

7.1 Requirements for electrical installation

This section describes the electrical installation of the samosPRO system in the switchbox. You can find additional information on the electrical connection of other devices to the samosPRO system in the section on the respective device (see *Product description [ch. 2.5.2, p. 13]*).

Safety information

⚠️ **ATTENTION**	**Switch off power to the entire system/machine!** It is possible for the system to be unintentionally started while you are connecting the devices.

⚠️ **ATTENTION**	**Note the corresponding safety standards!** All of the safety-related parts of the system (wiring, connected sensors and command encoders, configuration, device monitoring) must meet the respective standards (e.g. EN 62061 or EN ISO 13 849-1). This can mean that the safety-related signals must be designed redundantly or that single-channel signals must be routed in a protected manner, or that short-circuit detection will be required through the use of test outputs and/or regular function tests. • Note that short-circuit between test outputs and the corresponding input cannot be detected. • Consider whether a shielded cable or separate line routing will be required for these signals. • In the event of a short-circuit to 24 V at an output, it will no longer be possible to switch off the output. • Reverse current to a switched-off output of an SP-SDIO cannot be prevented and will influence the ability to switch off the outputs.

⚠️ **ATTENTION**	**Limited short-circuit detection in the input circuits** • One SP-COPx has four test signal generators T1 – T4. • One SP-SDI has two test signal generators. One test signal generator is responsible for the odd-numbered test outputs (X1, X3, X5, and X7), while the other is responsible for the even-numbered test outputs (X2, X4, X6, and X8). • Short-circuits between test signal generators of an SP-SDI or SP-SDIO expansion module are detected. Between different modules the short circuit detection is then only ensured if the test gaps of the test signal generators are < 4 ms, the test periods ≥ 200 ms and no more than 9 modules (SP-SDI / SP-SDIO) have been plugged in. Short-circuits after 24 V DC (after High) at inputs that are connected to test outputs are detected independently of the length of the test gaps. • Please ensure that the odd-numbered test outputs (X1, X3, X5, and X7) at the SP-SDI are connected to a common test signal generator and that the even-numbered test outputs (X2, X4, X6, and X8) are connected to another common test signal generator. Therefore, short-circuits between the odd-numbered test outputs (X1, X3, X5, and X7) cannot be detected. The same applies accordingly to the even-numbered test outputs (X2, X4, X6, and X8). **Make note of this during wiring (e.g. through separate routing or protected lines)!**

⚠️ **ATTENTION**	**Reverse current at inputs of SP-COP, SP-SDIO, or SP-SDI with breakdown of ground!** In the event of an internal or external ground breakdown, reverse current can flow from the supply voltage of the COMPACT module (terminal A2) to the safe inputs of the SP-COP, SP-SDIO, or SP-SDI modules. Make note of this if other inputs are connected in parallel to these inputs so that this reverse current does not lead to an unintentional high at the inputs connected in parallel.

Additional information

- The samosPRO safety control fulfills the EMC provisions in accordance with basic technical standard EN 61000-6-2 for the industrial sector.

- Industrial safety devices from Wieland Electric are only suitable for local direct-current applications. If the device is to be used in supply voltage networks, e.g. in accordance with IEC 61326-3-1, then additional safety measures must be implemented.

- Machines on which safety devices will be used must be installed and configured in accordance with the Lightning Protection Zone (LPZ) as per EN 62305-1. The required resistance level can be achieved by using external safety devices. The Surge Protection Devices (SPD) used must fulfill requirements in accordance with EN 61643-11.

- The system must prevent "Common Mode" malfunctions in a frequency range of 0 Hz to 150 kHz in accordance with IEC 61000-4-16.

- In order to ensure complete EMC safety, the support rail must be connected to FE.

- The samosPRO system must be installed in a switchbox with at least protection class IP 54.

- Carry out the electrical installation in accordance with EN 60204-1.

- The power supply of the devices must able to bridge a short-term power outage of 20 ms in accordance with EN 60204-1.

- The power supply must meet the regulations for low-voltage with safe disconnection (SELV, PELV) in accordance with EN 60664 and EN 50178 (equipping high-voltage systems with electronic equipment).

- You must connect all modules in the samosPRO system, the connected safety equipment and the voltage supplies to the same 0-V DC connection (GND).

- If the RS-232 interface of the controller module is used as an alternative to a gateway, then the maximum permissible cable length is 3 m.

- Avoid using ground loops between the USB interface GND and the A2 connection of the COMPACT module, e.g. by using optocouplers.

- Depending on external loads, particularly with inductive loads, it may be necessary to use additional external protective measures such as varistors or RC elements in order to protect the safety outputs. There are limits for the operation (see *Technical data [ch. 12, p. 70]*). Note that the response times may be delayed depending on the type of protective circuit.

- If a module is replaced, the correct terminal arrangement must be ensured, e.g. through labeling or corresponding cable routing.

- If it is possible for someone to access the protective equipment from the rear (e.g. a safety light curtain), then install the reset button such that it cannot be activated by a someone who is in the hazardous area. In addition, the operator must have a complete overview of the hazardous area when operating the reset button.

7.2 Internal wiring of the supply voltage
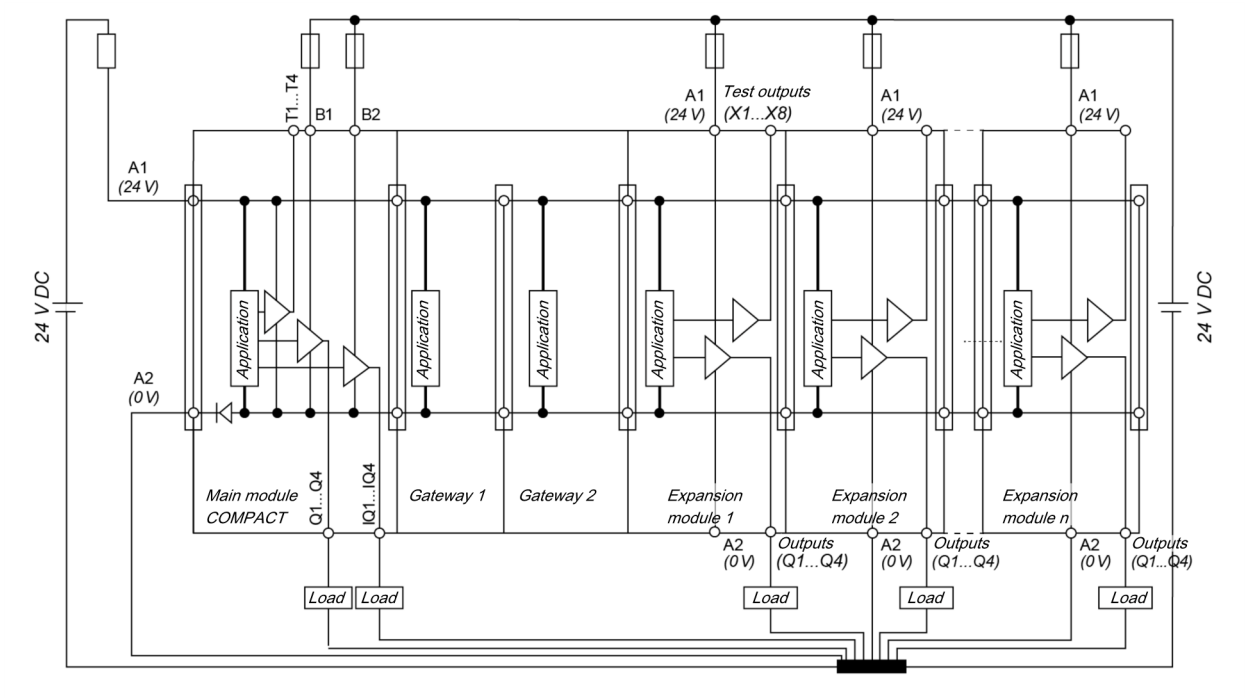
Illustration 24: Internal wiring of the samosPRO supply voltage

8 Configuration

<table>
<tr>
<td>⚠️
ATTENTION</td>
<td>**Check the protective function before commissioning and after any change!**
If you change the configuration, you must check the effectiveness of the protective function. To this end, note the test instructions in the operating instructions for the connected safety equipment.</td>
</tr>
</table>

Additional information

For configuring the samosPRO system, you will require the samosPLAN5+ software and the program removable storage.

The configuration and verification of devices that are connected to the safety control generally does not take place using the samosPLAN5+ software. These devices have their own mechanisms for configuration and verification.

- The system configuration of the entire samosPRO system is stored in the SP-COP-CARD1 program removable storage. This has the advantage that the system does not have to be reconfigured when modules and/or gateways are replaced.
- The data stored in the program removable storage will be retained even if the supply voltage is interrupted.
- It is possible to transfer configuration information via the USB or Ethernet interface.

9 Commissioning

⚠️ **ATTENTION**

Commissioning cannot take place without testing being conducted by a qualified person!
*   Before you place the system in which you use a samosPRO safety control in operation for the first time, it must be tested and documented for release by a qualified person.

⚠️ **ATTENTION**

Monitor the hazardous area!
*   Before commissioning, make sure that no one is inside the hazardous area.
*   Check the hazardous area and secure it against access by unauthorized people (e.g. place warning notices, set up blocks, etc.). Note the corresponding laws and local regulations.

9.1 Total acceptance of the application

You may only place the system into operation if the total acceptance inspection was passed successfully. The total acceptance inspection may only be done by appropriately trained personnel.

The total acceptance comprises the following test points:

Procedure
➡ Check whether all of the safety-related parts of the system (wiring, connected sensors and command encoders, configuration) meet the respective standards (e.g. EN 62061 or EN ISO 13 13849-1).
➡ Test the devices connected to the safety control in accordance with the test information in the corresponding operating instructions.
➡ Mark all of the connections (connection lines and plug connectors) on the safety control clearly and uniquely to prevent mixups. Because the samosPRO system has multiple connections with the same shape, make sure that connection lines or connectors that are disconnected are not unintentionally connected back to the wrong connection.
➡ Check the signal paths and the correct integration into higher-level controls.
➡ Check the correct data transmission from and to the samosPRO safety control.
➡ Check the logic program of the safety control.
➡ Carry out a complete validation of the safety functions of the system in each operating mode and an error simulation. Note in particular the response times of the individual applications.
➡ Fully document the configuration of the system, the individual devices, and the results of the safety check.
➡ To prevent unintentional overwriting of the configuration, activate the write protection of the configuration parameters in the samosPRO system. Changes are only possible if the write protection has been canceled.

9.2 Tests before initial commissioning

The tests before initial commissioning are used to confirm the safety requirements required in the national/international guidelines, particularly the Machinery or Work Equipment Directive (EC conformity).

Procedure
➡ Test the effectiveness of the safety equipment on the machine in all operating modes and functions that can be set on the machine.
➡ Make sure that operating personnel who will be working with the machine protected by the safety control are trained by qualified people from the machine operator before starting work. The machine operator is responsible for the training.

10 Diagnostics

10.1 What to do in the event of an error

⚠ ATTENTION

Do not operate the system in the event of an unclear error!
If you cannot clearly allocate or cannot safely eliminate an error:
• Place the machine out of operation.

⚠ ATTENTION

Carry out a complete function test after eliminating the error.
Once you have eliminated an error:
• Carry out a complete function test.

10.2 Error statuses

With certain error functions or a faulty configuration, the samosPRO safety control will go into a safe state. The LEDs for the individual modules of the safety control will indicate the respective error level.

There are various error levels depending on the type of error:

Configuration error
• The system is in the "Configuration required" state (MS LED flashing red (HZ)).
• Applications in all modules are in the stop mode.
• All safety outputs of the system are switched off.
• All safe process data are set at zero. Typically, the non-safety-related process data are also set at zero.

Repairable errors
• The applications in all modules will remain in the run state (MS LED for the affected modules will flash red/green alternating (1 Hz); MS LED of the unaffected modules will be lit green).
• If safety outputs are affected, then these safety outputs of the system will be switched off at a minimum.
• If safe inputs are affected, then the process data of these safe inputs at a minimum will be set at zero.

Critical errors
• The system is in the critical error state (MS LED of the module that has detected the critical error is flashing red (2 Hz). MS LED of the modules at which the error cause is unknown will be lit in red).
• Applications in all modules are in the stop mode.
• All safety outputs of the system are switched off.
• All safe process data are set at zero. Typically, the non-safety-related process data are also set at zero.

How to place the device back in operation:
➡ Eliminate the cause of the error in accordance with the displays of the MS and CV LEDs.
➡ With critical errors, switch off the supply voltage to the samosPRO system for at least 3 seconds and switch it back on.

10.3 Error displays in the state LEDs, error messages, and measures for error elimination

This section contains the most important error codes, potential causes, and potential measures for eliminating errors. These error codes and error messages can be displayed as well in the samosPLAN5+ **Diagnostics** view if you have established a connection with the samosPRO system.

NOTICE	• For information as to how you can carry out diagnostics, please see the following: "samosPLAN5+ Software" manual, "Diagnostics" view
	• You can find a list of all error messages here: *Complete list of error messages [ch. 14.3, p. 96]*

10.3.1 Device state and LED displays in the COMPACT modules (SP-COP1, SP-COP2-ENx)

Flash code meaning

Table 37: Key

Symbol	Meaning
◯	LED off
☀	LED flashing
●	LED lights up

Reference

Table 38: Device state and LED displays in the COMPACT modules

PWR/EC LED	Meaning	Additional info
Red flashing	An error has occurred in the control. All 24V outputs have been switched off. The control must be restarted with a power ON reset after the cause of the error has been eliminated. The number of flash pulses indicates the error class to which the occurring error belongs.	Number of flashing pulses = error class 2: Configuration data 3: Application 4: Self-test 5: Voltage/current monitoring 6: I/O modules 7: Cross-communication 8: Internal
Green flashing (1 Hz)	The supply voltage at A1, B1, or B2 is outside of the range of 16.8 V to 30 V.	
Green	The supply voltage at A1, B1, and B2 is within the range of 16.8 V to 30 V.	

MS LED module state	State	Additional info
Red flashing (1 Hz)	There is no project at the control or the project data is faulty (because, e.g., the number of inserted I/O modules does not match the project)	No module or faulty module configuration
Green flashing (1 Hz)	Project data adopted from control and I/O modules; waiting for start command	
Green	Control has started.	
Red/green flashing	One or more inputs have a cable break or short-circuit to 24V. Or there is a sequence/synchronous time error at a two-channel input. Or an output has a test error (e.g. short-circuit).	

Code-verified CV LED	Control behavior
Yellow flashing (1 Hz)	The project at the control has not been verified. The control will not start automatically after power ON reset.
Yellow	The project at the control has been verified. The control will start automatically after power ON reset.

NET	Meaning
Flashing green (for 3 s)	Connection setup with control

Input LED	Meaning	Additional info
Green flashing (1 Hz)	A single-channel input has a test error (cable break or short-circuit at 24 V) or the input was not configured in the project and 24 V is pending.	Applies to I1 to I16 and IQ1 to IQ4 if single-channel has been configured. Flashes synchronously with MS LED in red.
Green flashing, alternating (1 Hz)	Two-channel input has synchronous time error or a sequencing error or at least one of the two inputs has a test error (cable break or short-circuit at 24 V)	Applies to I1 to I16 and IQ1 to IQ4 if two-channel has been configured. Input pair flashing on and off
Off	Signal level at the input terminal is 0 V.	
Green	Signal level at the input terminal is 24V.	

Output LED	Meaning	Additional info
Green flashing (1 Hz)	Output has a test error.	Applies to Q1..Q4 and IQ1..IQ4
Off	Output is switched off.	
Green	Output is switched off.	

10.3.2 Device state and LED displays in the expansion modules (SP-SDIO, SP-SDI)

NOTICE The displays of the MS LED and the input LEDs I1 to I8 are identical to those for the SP-SDIO and SP-SDI expansion modules.

10.3.3 Device state and LED displays of the expansion module (SP-DIO)

Table 39: Displays of the MS LED
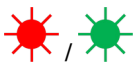
MS LED	Meaning	Info
	Supply voltage outside of operating range	Check supply voltage at terminals A1 and A2.
Red flashing (1 Hz)	Repairable external error	Check cable of flashing inputs and outputs. If all output LEDs are flashing, check the supply voltage of terminal A1 and A2 for this module.
Green flashing (1 Hz)	System in the stop state and waits for start command or the voltage supply to A1 / A2 is outside the range of 16.8V to 30V.	Start the application in samosPLAN5+. Check voltage supply to A1.
Green	System in the run state and the voltage supply to A1 is within the range of 16.8V to 30V.	
Red flashing (1 Hz)	Invalid configuration	
Red flashing (2 Hz)	Critical error (type 3) in the system; suspected in this module. Application has been stopped.	Switch supply voltage off and back on. If the error has not been eliminated after this has been done multiple times, then replace module. In order to contain the module affected, use the diagnostics display in samosPLAN5+.
Red	Critical error in the system; suspected in a different module. Application has been stopped.	Switch supply voltage off and back on. If the error has not been eliminated after this has been done multiple times, then replace module in which the red LED is flashing (2 Hz). In order to contain the module affected, use the diagnostics display in samosPLAN5+.

Table 40: Displays of input LEDs

Input LEDs (I1–I4 and IY5-IY8)	Meaning
○	Signal level at the input terminal is 0 V. Inputs actuated.
● Green	Signal level at the input terminal is 24V. Input is not actuated.

Table 41: Displays of output LEDs

Output LEDs (Y1-Y4 and IY5-IY8)	Meaning
○	Output is switched off.
● Green	Output is switched off.
☀ Green (1 Hz) synchronous with the red MS LED	Output has an error. (e.g. output driver overloaded)

10.4 Wieland Support

If you cannot eliminate an error with the help information contained in this section, then please contact the Wieland branch responsible for your area.

NOTICE If you send in a program removable storage for repair or analysis, you will receive it back in delivery condition (factory settings). Therefore, be sure to store the configuration(s) of your devices in the samosPLAN5+.

10.5 Expanded diagnostics

The samosPLAN5+ contains expanded diagnostics options. This enables you to further contain the problem if you have an unclear picture of the situation or availability issues.

Please see the following for more detailed information:

- "samosPLAN5+ Software" manual (BA000968)
- A complete list of all error messages is contained in the *Appendix [ch. 14.3, p. 96]*.

11 Maintenance

The following section provides information on regular tests and the replacement of samosPRO modules.

Do not attempt to remove, repair, or modify the samosPRO modules. This may lead to loss of safety functions. Furthermore, this will void any warranty claim you may have against Wieland Electric GmbH.

11.1 Regular testing of the safety equipment by qualified persons

➡ Test the system according to national valid regulations within the required time frames. This is necessary in order to discover any changes in the machine or manipulations to the safety equipment after initial commissioning.

➡ Every security application must be tested within a time interval specified by you. The effectiveness of the safety equipment must be tested by trained and qualified persons.

➡ If modifications have been carried out on the machine or safety equipment or the safety control has been retrofitted or maintained, then retest the system according to the checklist in the appendix.

➡ Carry out regular or daily inspections in order to keep the samosPRO modules in optimum operating condition.

➡ Check whether the implementation of the samosPRO modules contains all of the technical data for the device.

➡ Check the installation conditions and whether the wiring of the samosPRO modules has been completed correctly.

➡ Conduct regular verifications to ensure that the safety functions fulfill the requirements of the application and all regulations and standards (e.g. regular testing) in order to ensure the reliability of the safety functions.

11.2 Replacing devices

A critical error in one of the samosPRO modules will affect the entire network. Therefore, devices that have critical errors must be quickly repaired or replaced. We recommend keeping replacement samosPRO module devices at the ready so that you can reestablish network operation as quickly as possible.

11.2.1 Safety measures when replacing devices

Follow the following safety measures when replacing samosPRO modules:

- Do not attempt to dismantle or repair the samosPRO modules. This not only will void warranty claims against Wieland Electric, but it is also dangerous, because in this case it is not possible to test the original safety functions.
- Place the device back into a condition in which the safety will be ensured.
- Only carry out replacement when the power supply is switched off in order to prevent electric shock or unexpected behavior from the device.
- In order to enable further use of the system configuration, check the following:
  - Is the new module of the same type (same material number) and is the new module error-free after replacement?
  - Was the new module inserted into the same position at which the replaced module was?
  - Were all plug connections connected back at the correct location?
- If not, you will need to completely reconfigure the new system and commission it including all of the necessary tests (see *Commissioning [ch. 9, p. 61]*).

NOTICE
- After replacement, make sure that no errors are occurring with the new samosPRO modules.
- Be sure to carry out a function test before commissioning a replacement module.
- When you send in samosPRO modules for repair, generate a report of your project in samosPLAN5+ and carry out diagnostics; enclose a detailed description of the problem with the device, and send the samosPRO modules along with all available information to Wieland Electric.

12 Technical data

12.1 samosPRO system response times

The response time is the time that is required to activate the safety function.

Example: The time from which the safety light barrier is crossed until the machine stops.

In order to determine the response time of the samosPRO system, use the standard time plus the filter and test times.

Factor 1: Standard time

Maximum ON-OFF time from input to output without filter and test times:

Table 42: Calculating the time values

SP-COPx input	SDIO / SDI input	
2 x cycle time + 3.6 ms	2 x cycle time + 7.2 ms	**COPx output**
11.8 ms	--	**COPx FSO**
2 x cycle time + 6.9 ms	2 x cycle time + 10.6 ms	**SDIO output**
--	8.6 ms	**SDIO FSO**

- The cycle time must be obtained from samosPLAN5+ (lower right).
- FSO = Fast Shut-Off: This function can be used to achieve quicker switch-off times from input to output inside the module. FSO is a functional component in samosPLAN5+.

Factor 2: Filter time

When the ON-OFF filter is activated, the switch-off signal is delayed by the filter time set. This filter can be activated for each input in the samosPLAN5+ and acts upon the response time with + 8 ms.

Factor 3: Test times

If the input tests are carried out in single-channel input circuits with the assistance of tests outputs T1 to T4 or X1 to X8, this results in the response time for test times > 1 ms from the test time plus 12 ms (wait time until the test pulse occurs).

When using user-defined elements (SW manual 5.4.5) the response time can also be extended in two-channel input circuits if the selected test time is greater than 0.5 * test period minus 12 ms. The resulting additional response time should be calculated as follows:
additional response time = test time + 12ms - 0.5 * test period
(Only a positive result is evaluated, negative values are equal to zero)

For applications with a safety mat, the test period of the test generators connected must be applied to the response time. The following table provides the reaction times for the correspondingly set test periods.

Table 43: Test periods and response times

Test periods for both test outputs (ms)[1]		Additional response time
Test output 1	Test output 2	
40	40	20 ms
40	200-1000	40 ms
200	200	100 ms
200	400-1000	200 ms
400	400	300 ms
400	600-1000	400 ms
600	600	500 ms
600	800-1000	600 ms

Test periods for both test outputs (ms)[1]		Additional response time
Test output 1	Test output 2	
800	800	700 ms
800	1000	800 ms
1000	1000	900 ms

[1] Obtain the values from the report in samosPLAN5+.

Example

The following examples shows the determination of the response time of a safety function (sensor – logical function – actuator).

Table 44: Response time of a safety function

Sub-function	Time	Remarks
Response time of the sensor	+ 18.0 ms	Manufacturer information
Test time for testable sensors, e.g. type 2 contactless safety devices With testable sensors, the response time increases by the active test gap + 12 ms. Thus, with a test gap of 4 ms, there is an additional response time of 4 ms + 12 ms = 16 ms	+ 16.0 ms	Test generators T1 to T4 or X1 to X8
Filter time When the ON-OFF filter is active, + 8 ms	0.0 ms	samosPLAN5+
Standard time Compact input to Compact output With a cycle time of 4 ms.	+ 11.6 ms	See table: "Standard time"
Logics for switch-off delay times If function blocks with switch-off delay are used in the logic plan, then these times have to be added to the response time.	0.0 ms	samosPLAN5+
Actuator response time	+ 35.0 ms	Manufacturer information
Total time	**80.6 ms**	

12.1.1 Minimum switch-off time

The minimum switch-off time (e.g. of connected sensors) is the minimum time during which a switch-off condition must be present in order to be detected so that error-free switching is possible. The minimum switch-off time must be

- greater than the logic execution time and
- greater than the test gap + the maximum OFF/ON delay when the input is connected at test output X1–X8 and the test gap is > 1 ms, and
- greater than the test period + the maximum OFF/ON delay when safety mats or safety edges are being used.

12.1.2 Response time of the state flag

If an error is detected, the state data will be available in the logic editor in the next logic cycle. The time to detection of a state error depends, among other things, on the duration of the test period and can be up to 1 s.

12.1.3 Default values for non-secure or secure data

Data from gateways or the non-secure SP-DIO I/O expansion module are categorically not secure. Default values are taken up in the error state of the controller. The default value of IO data is 0 and the default value of state data is 1.

12.2 Safety technology reference values

12.2.1 samosPRO COMPACT (SP-COPx without I/O expansion)

Table 45: Safety technology reference values for samosPRO COMPACT (without I/O expansion)

| Configuration of safety outputs
Output groups:
Q1/Q2, Q3/Q4, IQ1/IQ2, IQ3/IQ4 | | | Characteristic values | | | |
			Safety Integrity Level (IEC 61508)[1]	Category (EN ISO 13849-1)	Performance level (EN ISO 13849-1)[1]	PFHd[2]
Single-channel or two-channel input	Two-channel outputs (with or without test pulses)		SIL3	4	PL e	$1.3 \cdot 10^{-9}$
	Single-channel output Q_n for an output group	Test pulses at all outputs of an output group activated	SIL3	4	PL e	$1.4 \cdot 10^{-9}$
		Test pulses at one output of the output group activated and test pulses at the other output of the output group deactivated. The value indicated refers to the output with activated test pulses.	SIL3	3	PL e	$1.4 \cdot 10^{-9}$
		Output test pulses deactivated	SIL2	3	PL d	$9.8 \cdot 10^{-9}$

[1] For detailed information regarding the safety configuration of your machine/system, please contact the Wieland Electric branch in charge of your area.

[2] Average probability of a hazard-causing failure per hour

12.2.2   samosPRO COMPACT (SP-COPx with I/O expansion SP-SDI and/or SP-SDIO)

Table 46: Safety technology reference values for samosPRO COMPACT (with I/O expansion)

Configuration of safety outputs Output groups: SP-COPx: Q1/Q2, Q3/Q4, IQ1/IQ2, IQ3/IQ4 SP-SDIO: Q1/Q2/Q3/Q4		Characteristic values			
		Safety Integrity Level (IEC 61508)[1]	Category (EN ISO 13849-1)	Performance level (EN ISO 13849-1)[1]	PFHd[2]
Single-channel or two-channel input	Two-channel outputs (with or without test pulses)	SIL3	4	PL e	$4.3 \cdot 10^{-9}$
	Single-channel output Q_n for an output group — Test pulses at all outputs of an output group activated	SIL3	4	PL e	$4.3 \cdot 10^{-9}$
	Test pulses at one output of the output group activated and test pulses at the other output of the output group deactivated. The value indicated refers to the output with activated test pulses.	SIL3	3	PL e	$4.3 \cdot 10^{-9}$
	Output test pulses deactivated	SIL2	3	PL d	$1.7 \cdot 10^{-8}$

[1] For detailed information regarding the safety configuration of your machine/system, please contact the Wieland Electric branch in charge of your area.

[2] Average probability of a hazard-causing failure per hour

12.3 Data sheet

12.3.1 SP-COP1 and SP-COP2-ENx modules

Table 47: SP-COP1 and SP-COP2-ENx data sheet

	SP-COP1 / SP-COP-xxx	
Safety Integrity Level	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)	
PFHd (average probability of a hazardous-causing failure per hour)		
T_M (usage time)	20 years (EN ISO 13849)	
Protection class	III (EN 61140)	
Protection type	IP 20 (EN 60529)	
Ambient temperature during operation	-25 to +65°C	
Storage temperature	-25 to +70 °C	
Humidity	10 to 95%, non-condensing	
Fatigue strength	5 … 150 Hz (EN 60068-2-6)	
Shock resistance • Continuous shock • Brief shock	 10 g, 16 ms (EN 60068-2-29) 30 g, 11 ms (EN 60068-2-27)	
Electromagnetic compatibility	Class A (EN 61000-6-2, EN 55011)	
Data interface	Internal bus (SBUS+)	
Configuration interface 1	USB mini	
Configuration interface 2	RJ 45	
Dimensions (W × H × L)	45 × 96 × 115 mm	
Weight	290 g (± 5%)	
Terminal and connection data	**Screw terminal**	**Spring-loaded terminal**
Single-wire or fine-strand	1 x 0.2–2.5 mm^2 2 x 0.2–1.0 mm^2	2 x 0.2–1.5 mm^2
Fine-strand with ferrules as per EN 46228	1 × 0.25–2.5 mm^2 or 2 × 0.25–1.0 mm^2	1 × 0.25–1.5 mm^2 (trapezoid crimping)
AWG	26-14	24-16
Maximum tightening torque	0.5–0.6 Nm	—
Stripping length	Max. 7 mm	

	SP-COP1 / SP-COP-xxx
Power supply for the system (A1, A2)	
Supply voltage	24 V DC (16.8 to 30 V DC)
Type of supply voltage	PELV or SELV
	The current for the powerpack must be limited to a maximum of 4 A – either by the powerpack itself or by a fuse
	UL 508: Use a galvanically isolated power supply with limited output voltage and power (42.4 VDC, 100 VA). The output voltage must be secured by a fuse that meets the standards according to UL 248. Connect all supply connections of the system to a common source and ensure a common ground connection when using several sources.
Power consumption Caution: The power consumption increases with each module that is connected to the system.	Max. 3.3 W
Short-circuit protection	4 A gG
Power supply for output groups B1 and B2 (B2: SP-COP2-ENx only)	
Supply voltage	24 V DC (16.8 to 30 V DC)
Type of supply voltage	PELV or SELV
	The current for the powerpack must be limited externally to a maximum of 8 A per output group (B1 and B2) – either by the powerpack itself or by a fuse.
Power consumption	2 x 0.3 W
Switch-on time	Max. 18 s
Short-circuit protective device	8 A gG
Input circuit SP-COP1: I1 to I20 / SP-COP2-ENx: I1 to I16, IQ1 to IQ4	
Input voltage HIGH	13 to 30 V DC
Input voltage LOW	-5 to +5 V DC
Input current HIGH	Type 2.3 mA / Max. 6 mA
Input current LOW	< 2 mA
Input capacity	10 nF
Input reverse current with ground breakdown [2]	< 0.1 mA

	SP-COP1 / SP-COP-xxx
Test outputs (T1 - T4)	
Number of outputs	4 (with 4 test signal generators)
Type of output	Semiconductor, push-pull, short-circuit-proof
Output voltage HIGH	U_{A1} - 1.2 V
Output current LOW	-10 mA (limited)
Output current HIGH	Single output: max. 120 mA
	Total of all test outputs: max. 120 mA
Test pulse rate (test period)	1 to 25 Hz, configurable
Test pulse duration (test gap)	1 to 100 ms, configurable
Load capacity	1 µF for test gap $\geq$ 4 ms
	0.22 µF for test gap 1 ms
Line resistance	< 100 Ω
Safety outputs SP-COP1: Q1 to Q4 / SP-COP2-ENx: Q1 to Q4, IQ1 - IQ4	
Number of outputs • SP-COP1: • SP-COP2-ENx	 4 8 (4 fixed and 4 selectable outputs)
Type of output	High-side MOSFET, short-circuit-proof and current-monitored
Output voltage HIGH	$U_{Qn} \geq U_{Bx}$ - 0.6 V
Output current HIGH	$\leq$ 4.0 A
Max. overload current/duration	$\leq$ 12 A / 8 ms
Total current I_{tot} $T_U \leq 45°C$ $T_U \leq 55\ °C$ $T_U \leq 65\ °C$	Per output pair (Q1/2, Q3/4, IQ1/2, IQ3/4) $\leq$ 4.0 A $\leq$ 2.5 A $\leq$ 1.6 A
Output test, can be deactivated [3,4,5] Test pulse width Test pulse rate	 $\leq$ 450 µs 10 Hz
Leakage current LOW[6]	< 0.1 mA
Load capacity	0.5 µF
Line resistance[7]	< 200 Ω
Maximum permissible coil energy without external protection elements[8]	< 0.125 J
Response time	Depends on logic setup (Details: *samosPRO system response times [ch. 12.1, p. 70]*)

[1] For detailed information regarding the safety configuration of your machine/system, please contact the Wieland Electric branch in charge of your area.

[2] Do not connect any other safe inputs in parallel when the reverse current could lead to a HIGH state at the other input.

[3] When activated; in that case, the outputs are tested regularly (brief LOW switching). When selecting the downstream control elements, make sure that the test pulses will not cause switch-off with the previously listed parameters or deactivate the test pulses at the outputs.

[4] When safety outputs are being used without test pulses, then either all of the safety outputs without test pulses must be switched off at least once a year simultaneously for at least one second or the samosPRO system must be restarted by switching off the supply voltage.

[5] If safety outputs are being used without test pulses:
Use shielded or separate cabling for safety outputs without output tests because short-circuits to 24 V will not be immediately detected.

[6] In the event of a fault (interruption in the 0 V line), the maximum of the leakage current will flow in the OSSD line. The downstream control element must determine this state as being LOW. An FPLC (Failsafe Programmable Logic Controller) must be able to detect this state.

[7] Limit the line resistance of the individual lines to the downstream control element to this value in order to ensure that a short-circuit will be reliably detected between the outputs. (Also see EN 60204, Safety of machinery - Electrical equipment of machines - Part 1: General requirements.)

[8] Examples of the resulting maximum coil inductivity:
1000 mH @ 0.5 A, 250 mH @ 1 A, 62.5 mH @ 2 A

12.3.2 SP-SDIO input/output expansion module

Table 48: SP-SDIO data sheet

	SP-SDIO	
T_M (usage time)	20 years (EN ISO 13849)[1]	
Protection class	III (EN 61140)	
Protection type	Terminals: IP 20 (EN 60529)	
	Housing: IP 40 (EN 60529)	
Ambient temperature during operation	-25 … +65 °C	
Storage temperature	-25 … +70 °C	
Humidity	10 to 95 %, non-condensing	
Fatigue strength	5 to 500 Hz/5 g (EN 60068-2-6)	
Shock resistance		
• Continuous shock	10 g, 16 ms (EN 60068-2-29)	
• Brief shock	30 g, 11 ms (EN 60068-2-27)	
Electromagnetic compatibility	Class A (EN 61000-6-2, EN 55011)	
System connection	Terminal with screw or spring-loaded connection	
Power consumption via SBUS+ without currents at X1, X2	max. 1.1 W	
Data interface	Internal bus (SBUS+)	
Dimensions (W × H × L)	22.5 × 96.5 × 120.8 mm	
Weight	164 g (± 5%)	
Terminal and connection data	**Screw terminal**	**Spring-loaded terminal**
Single-wire or fine-strand	1 x 0.2-2.5 mm² 2 x 0.2-1.0 mm²	2 x 0.2-1.5 mm²
Fine-strand with ferrules as per EN 46228	1 × 0.25–2.5 mm² or 2 × 0.25–1.0 mm²	1 × 0.25–1.5 mm²2 (trapezoid crimping)
AWG	26-14	24-16
Maximum tightening torque	0.5-0.6 Nm (4–5 lbf-in)	—
Stripping length	Max. 7 mm	
Output supply (A1, A2)		
Supply voltage	24 V DC (16.8 to 30 V DC)	
Type of supply voltage	PELV or SELV	
	The current for the powerpack must be limited to a maximum of 4 A – either by the powerpack itself or by a fuse.	
Power consumption	1W	
Switch-on time	Max. 18 s	
Short-circuit protective device	4 A gG (with tripping characteristic B or C)	

	SP-SDIO
Input circuit (I1–I8)	
Input voltage HIGH	13 to 30 V DC
Input voltage LOW	-5 to +5 V DC
Input current HIGH	2.4 to 3.8 mA
Input current LOW	-2.5 to 2.1 mA
Input reverse current with ground breakdown [2]	Max. 20 mA 1.5 kΩ effective reverse resistance for supply current
Input capacity	10 nF
Synchronous time	4 ms to 30 ms, configurable
Number of inputs	8
Test outputs (X1, X2)	
Number of outputs	2 (with 2 test signal generators)
Type of output	PNP semi-conductor, short-circuit-proof, short-circuit-monitored (configurable)
Output voltage HIGH	15 to 30 V DC (max. 1.8 V drop to terminal A1 on the controller module)
Output resistance LOW	22 Ω ± 10%, voltage limited at about 10 mA
Output current	Max. 120 mA at a test output (X1 or X2) Thus, a maximum of eight testable sensor cascades are possible per module with a maximum of 30 mA each. The total current of the samosPRO system is limited to a maximum of 1.28 A. This corresponds, for example, to a maximum of 32 testable sensor cascades with 30 mA each plus 64 tactile sensors at the inputs of expansion modules with 5 mA each.
Test pulse rate (test period)	1 to 25 Hz, configurable
Test pulse duration (test gap)	1 to 100 ms, configurable
Load capacity	1 µF for test gap ≥ 4 ms 0.5 µF for test gap 1 ms
Line resistance	< 100 Ω

	SP-SDIO
Safety outputs (Q1 to Q4)	
Number of outputs	4
Type of output	High-side MOSFET, short-circuit-proof
Output voltage HIGH	16 to 30 V DC (max. 0.8 V drop to terminal A1 on this module)
Leakage current LOW[3]	Max. 0.1 mA
Output current	Max. 4.0 A
Total current I_{tot} TU $\leq$ 45°C TU $\leq$ 55 °C TU $\leq$ 65°C UL/CSA applications	 Max. 4.0 A Max. 3.2 A Max. 2.5 A Max. 3.2 A
Test pulse width[4]	< 650 µs or deactivated[5,6]
Test pulse rate	Max. 5 Hz
Load capacity	0.5 µF
Line resistance[7]	Max. 5 Ω (e.g. 100 m × 1.5 mm² = 1.2 Ω)
Maximum permissible coil energy without external protection elements[8] Hardware version V1.00 Hardware version V1.01	 0.22 J 0.37 J
Response time	Depends on logic setup (Details: *samosPRO system response times [ch. 12.1, p. 70]*)
Data interface	Internal bus (SBUS+)

[1] When safety outputs are being used without test pulses, then either all of the safety outputs without test pulses must be switched off at least once a year simultaneously for at least one second or the samosPRO system must be restarted by switching off the supply voltage.

[2] Do not connect any other safe inputs in parallel when the reverse current could lead to a HIGH state at the other input.

[3] In the event of a fault (interruption in the 0 V line), the maximum of the leakage current will flow in the OSSD line. The downstream control element must determine this state as being LOW. An FPLC (Failsafe Programmable Logic Controller) must be able to detect this state.

[4] When activated; in that case, the outputs are tested regularly (brief LOW switching). When selecting the downstream control elements, make sure that the test pulses will not cause switch-off with the previously listed parameters or deactivate the test pulses at the outputs.

[5] When safety outputs are being used without test pulses, then either all of the safety outputs without test pulses must be switched off at least once a year simultaneously for at least one second or the samosPRO system must be restarted by switching off the supply voltage.

[6] If safety outputs are being used without test pulses:
Use shielded or separate cabling for safety outputs the test pulses of which have been deactivated, because a short-circuit to 24 V will not be immediately detected if the output is HIGH. In the event of a detected internal hardware error, this could affect the ability to switch off the other outputs through reverse current.

[7] Limit the line resistance of the individual lines to the downstream control element to this value in order to ensure that a short-circuit will be reliably detected between the outputs. (Also see EN 60204, Safety of machinery - Electrical equipment of machines - Part 1: General requirements.)

[8] Examples of the resulting maximum coil induction:
HW V1.00: 1760 mH @ 0.5 A, 440 mH @ 1 A, 110 mH @ 2 A
HW V1.01: 2960 mH @ 0.5 A, 740 mH @ 1 A, 185 mH @ 2 A

12.3.3 SP-SDI input/output expansion module

Table 49: SP-SDI data sheet

	SP-SDI	
Safety Integrity Level[1]	SIL3 (IEC 61508)	
Category	Category 4 (EN ISO 13849-1)	
Performance Level[1]	PL e (EN ISO 13849-1)	
PFHd (average probability of a hazardous-causing failure per hour)	$5.68 \cdot 10^{-9}$	
T_M (usage time)	20 years (EN ISO 13849)	
Protection class	III (EN 61140)	
Protection type	Terminals: IP 20 (EN 60529) Housing: IP 40 (EN 60529)	
Ambient temperature during operation	-25 to +55 °C	
Storage temperature	-25 to +70 °C	
Humidity	10 to 95%, non-condensing	
Climatic conditions	55°C, 95% relative humidity (EN 61131-2)	
Fatigue strength as per EN 61131-2	5 to 500 Hz	
Fatigue strength as per EN 60068-2-6	10 to 500 Hz/5 g	
Shock resistance • Continuous shock • Brief shock	 10 g, 16 ms (EN 60068-2-29) 30 g, 11 ms (EN 60068-2-27)	
Electromagnetic compatibility	Class A (EN 61000-6-2, EN 55011)	
System connection	Double-level spring-loaded terminals	
Power consumption via SBUS+ without currents at X1 to X8	Max. 1.4 W	
Terminal and connection data	Screw terminal	Spring-loaded terminal
Single-wire or fine-strand	1 x 0.2-2.5 mm^2 2 x 0.2-1.0 mm^2	2 x 0.2-1.5 mm^2
Fine-strand with ferrules as per EN 46228	1 × 0.25–2.5 mm² or 2 × 0.25–1.0 mm²	1 × 0.25–1.5 mm² (trapezoid crimping)
AWG	26-14	24-16
Maximum tightening torque	0.5-0.6 Nm (4–5 lbf-in)	—
Stripping length	Max. 7 mm	
Dimensions (W × H × L)	22.5 × 96.5 × 120.8 mm	
Weight	139 g (± 5%)	

	SP-SDI
Input circuit (I1 to I8)	
Input voltage HIGH	13 to 30 V DC
Input voltage LOW	-5 to +5 V DC
Input current HIGH	2.4 to 3.8 mA
Input current LOW	-2.5 to 2.1 mA
Input reverse current with ground breakdown [2]	Max. 20 mA 1.5 kΩ effective reverse resistance for supply current
Input capacity	Max. 10 nF
Synchronous time	4 ms to 30 ms, configurable
Number of inputs	8
Test outputs (X1 to X8)	
Number of outputs	8 (with two test signal generators)
Type of output	PNP semi-conductor, short-circuit-proof, cross-connection-monitored
Output voltage	16 to 30 V DC
Output current	Max. 120 mA at both of the two test signal generators (X1/X3/X5/X7 or X2/X4/X6/X8) Thus, a maximum of eight testable sensor cascades are possible per module with a maximum of 30 mA each. The total current of the samosPRO system is limited to a maximum of 1.28 A. This corresponds, for example, to 32 inputs of testable sensors with 30 mA and 64 inputs of SP-SDIO or SP-SDI modules.
Test pulse rate (test period)	1 to 25 Hz, configurable
Test pulse duration (test gap)	1 to 100 ms, configurable
Load capacity	1 µF for test gap ≥ 4 ms 0.5 µF for test gap 1 ms
Line resistance	< 100 Ω

[1]For detailed information regarding the safety configuration of your machine/system, please contact the Wieland Electric branch in charge of your area.

[2] Do not connect any other safe inputs in parallel when the reverse current could lead to a HIGH state at the other input.

12.3.4 SP-DIO input/output expansion module

Table 50: SP-DIO data sheet

	SP-DIO	
Protection class	III (EN 61140)	
Protection type	Terminals: IP 20 (EN 60529)	
	Housing: IP 40 (EN 60529)	
Ambient temperature during operation	-25 … +55 °C	
Storage temperature	-40 … +70 °C	
Humidity	10 ... 95%, non-condensing	
Fatigue strength	5 Hz… 150 Hz, 3.5 mm peak 1 g (EN 60068 2 6)	
Shock resistance	30 g, 11 ms (EN 60068-2-27)	
Electromagnetic compatibility	EN 61000 6 2, Class A (EN 55011) Emission	
	EN 61000-6-4 Immission	
System connection	Terminal with screw or spring-loaded connection	
Power consumption via SBUS+	max. 0.5 W	
Data interface	Internal bus (SBUS+)	
Dimensions (W × H × L)	22.5 × 96.5 × 120.8 mm	
Weight	150 g (± 5%)	
Terminal and connection data	**Screw terminal**	**Spring-loaded terminal**
Single-wire or fine-strand	1 x 0.2–2.5 mm^2	2 x 0.2-1.5 mm^2
	2 x 0.2-1.0 mm^2	
Fine-strand with ferrules as per EN 46228	1 × 0.25–2.5 mm² or	1 × 0.25–1.5 mm² (trapezoid crimping)
	2 × 0.25–1.0 mm²	
AWG	26-14	24-16
Maximum tightening torque	0.5-0.6 Nm (4–5 lbf-in)	—
Stripping length	Max. 7 mm	
Power supply (A1, A2)		
Supply voltage	24 V DC (16.8 to 30 V DC)	
Type of supply voltage	PELV or SELV	
Power consumption	max. 120 W (depending on load)	
Switch-on time	max. 18 s	
Short-circuit protective device	4 A gG (tripping characteristic B or C)	
Input circuit (I1–I4 & IY5-IY8)		
Number of inputs	4 to max. 8 (depending on configuration)	
Input voltage HIGH	13 V DC… 30 V DC	
Input voltage LOW	–3 V DC … +5 V DC	
Input current HIGH	2 mA … 3.5 mA	
Input current LOW	0 mA… 1.0 mA	

	SP-DIO
Outputs (Y1-Y4 & IY5-IY8)	
Number of outputs	4 to max. 8 (depending on configuration)4
Type of output	High-side MOSFET, short-circuit-proof
Output voltage	24 V DC (16.8 V DC … 30 V DC)
Output sum current I_{sum} max.	4 A
Output current per output max.	0.5 A
Derating sum current I_{sum} TU $\leq$ 45°C TU $\leq$ 55 °C TU $\leq$ 65°C	 Max. 4.0 A Max. 3.2 A Max. 2.5 A
Response time	Depending on logic setup (Details: *samosPRO system response times [ch. 12.1, p. 70]*)
Data interface	Internal bus (SBUS+)

12.4 Dimensional drawings

12.4.1 SP-COP1-xxx / SP-COP2-xxx controller modules
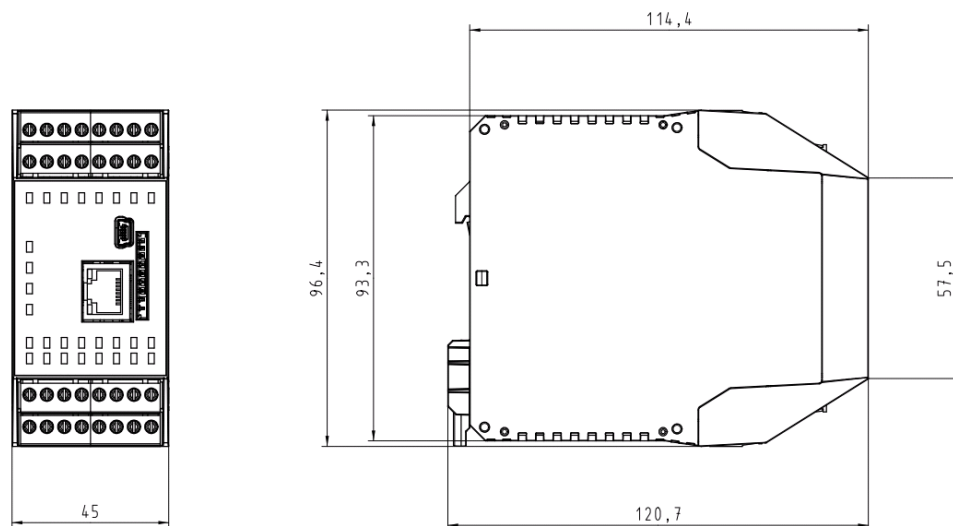
Illustration 25: SP-COP1 / SP-COP2 dimensions (mm)

12.4.2 SP-SDIO and SP-DIO input/output expansion / SP-SDI input expansion
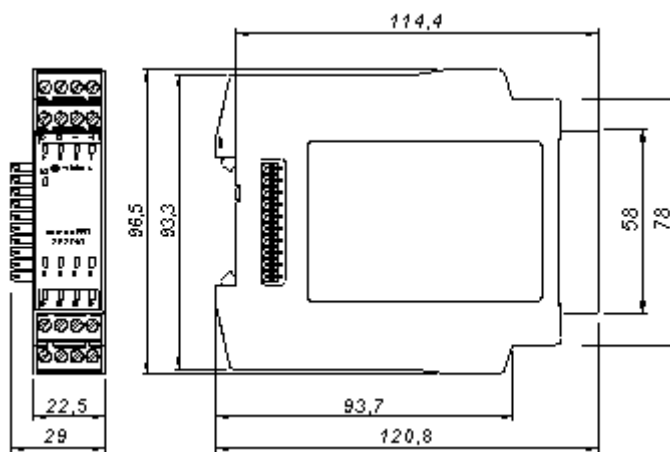
Illustration 26: SP-SDIO / SP-SDI, SP-DIO, SA-OR-S1 / SA-OR-S2 dimensions (mm)

12.4.3 WKFN 2.5 E/35 GO-URL Level terminal
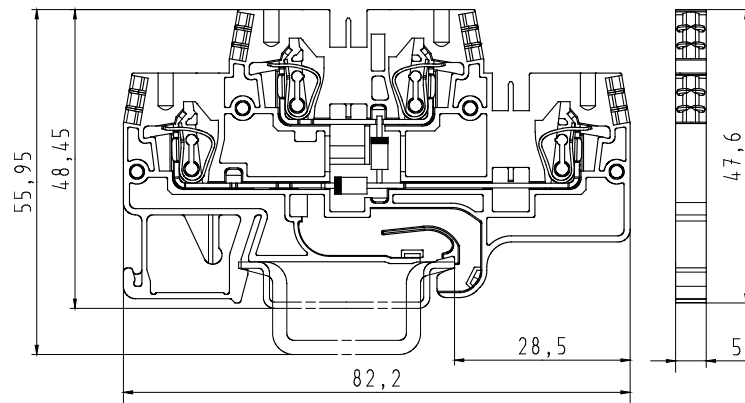
Illustration 27: WKFN 2.5 E/35 GO-URL dimensions (mm)

13 Order data

13.1 samosPRO – COMPACT – modules and accessories

Table 51: Part numbers for samosPRO safety control modules with COMPACT modules

Type	Description	Part number
SP-COP1-A	COMPACT module, USB connection, 20 inputs / 4 outputs Screw terminals, pluggable	R1.190.1110.0
SP-COP1-C	COMPACT module, USB connection, 20 inputs / 4 outputs Spring-loaded terminals, pluggable	R1.190.1120.0
SP-COP1-P-A	COMPACT module, USB connection, 20 inputs / 4 outputs with press function Screw terminals, pluggable	R1.190.1130.0
SP-COP1-P-C	COMPACT module, USB connection, 20 inputs / 4 outputs with press functions Spring-loaded terminals, pluggable	R1.190.1140.0
SP-COP2-EN-A	COMPACT module, USB and Ethernet connection, 16 inputs / 4 outputs and 4 configurable inputs or outputs Screw terminals, pluggable	R1.190.1210.0
SP-COP2-EN-C	COMPACT module, USB and Ethernet connection, 16 inputs / 4 outputs and 4 configurable inputs or outputs Spring-loaded terminals, pluggable	R1.190.1220.0
SP-COP2-EN-P-A	COMPACT module, USB and Ethernet connection, 16 inputs / 4 outputs and 4 configurable inputs or outputs with press functions Screw terminals, pluggable	R1.190.1230.0
SP-COP2-EN-P-C	COMPACT module, USB and Ethernet connection, 16 inputs / 4 outputs and 4 configurable inputs or outputs with press functions Spring-loaded terminals, pluggable	R1.190.1240.0
SP-COP2-ENI-A	COMPACT module, USB and industrial Ethernet connection, 16 inputs / 4 outputs and 4 configurable inputs or outputs Screw terminals, pluggable	R1.190.1310.0

Type	Description	Part number
SP-COP2-ENI-C	COMPACT module, USB and industrial Ethernet connection, 16 inputs / 4 outputs and 4 configurable inputs or outputs Spring-loaded terminals, pluggable	R1.190.1320.0
SP-COP2-ENI-P-A	COMPACT module, USB and industrial Ethernet connection, 16 inputs / 4 outputs and 4 configurable inputs or outputs with press functions Screw terminals, pluggable	R1.190.1330.0
SP-COP2-ENI-P-C	COMPACT module, USB and industrial Ethernet connection, 16 inputs / 4 outputs and 4 configurable inputs or outputs with press functions Spring-loaded terminals, pluggable	R1.190.1340.0
SP-COP-CARD1	Program removable storage	R1.190.1000.0
SP-CABLE-USB1	1.8 m USB configuration capable	R1.190.1010.0
SP-CABLE-ETH1	2 m Ethernet configuration capable	R1.190.1020.0
SP-PLAN5+	CD with samosPLAN5+ programming software and manuals	R1.190.1030.0
SP-COP-STARTER-SET	The set contains one each of SP-COP2-EN-A, SP-SDIO, SP-COP-CARD1, SP-PLAN5+, SP-CABLE-USB1	R1.190.1100.0
SP-CANopen	CANopen gateway	R1.190.0210.0
SP-PROFIBUS-DP	PROFIBUS-DP gateway	R1.190.0190.0
SP-SDIO84-P1-K-A	Input/output expansion with output test pulses 8 inputs/4 outputs Screw terminals, pluggable	R1.190.0030.0
SP-SDIO84-P1-K-C	Input/output expansion with output test pulses 8 inputs/4 outputs Spring-loaded terminals, pluggable	R1.190.0040.0
SP-SDI8-P1-K-A	Input expansion 8 inputs Screw terminals, pluggable	R1.190.0050.0
SP-SDI8-P1-K-C	Input expansion 8 inputs Spring-loaded terminals, pluggable	R1.190.0060.0
SP-DIO84-P1-K-A	Input/output expansion 4 inputs / 4 outputs and 4 configurable inputs or outputs Screw terminals, pluggable	R1.190.1050.0
SP-DIO84-P1-K-C	Input/output expansion 4 inputs / 4 outputs and 4 configurable inputs or outputs Spring-loaded terminals, pluggable	R1.190.1060.0
SP-EN-ETC	EtherCAT Gateway	R1.190.0160.0
WKFN 2.5 E/35 GO-URL	fasis series level terminal with diode	56.703.8755.9
APFN 2.5 E/35	Terminal plate for WKFN 2.5 E/35	07.312.7355.0

13.2 Modules for contact expansion

Type	Description	Part number
SNE 1	Forcibly actuated single relay, 24 V DC, plug socket, 2 changeovers	R1.188.3950.0
SNE 4004K-A	Contact expansion, 24 V DC, 4 NC (normally closed contact), 3 NO (normally open contact), Screw terminals, pluggable	R1.188.0590.0
SNE 4004K-C	Contact expansion, 24 V DC, 4 NC (normally closed contact), 3 NO (normally open contact), Spring-loaded terminals, pluggable	R1.188.1980.0
SNE 4012K-A	Contact expansion, 24 V DC, 2 NC (normally closed contact), 1 NO (normally open contact), Screw terminals, pluggable	R1.188.3910.0
SNE 4012K-C	Contact expansion, 24 V DC, 2 NC (normally closed contact), 1 NO (normally open contact), Spring-loaded terminals, pluggable	R1.188.3920.0
SNE 4024K-A	Contact expansion with 2 relay groups, 24 V DC, 2 x 2 NC (normally closed contact), 2 x 1 NO (normally open contact), Screw terminals, pluggable	R1.188.3930.0
SNE 4024K-C	Contact expansion with 2 relay groups, 24 V DC, 2 x 2 NC (normally closed contact), 2 x 1 NO (normally open contact), Spring-loaded terminals, pluggable	R1.188.3940.0
SNE 4028S-A	Contact expansion, 24 V DC, 8 NC (normally closed contact), 2 NO (normally open contact), Screw terminals, pluggable	R1.188.3120.0
SNE 4028S-C	Contact expansion, 24 V DC, 8 NC (normally closed contact), 2 NO (normally open contact), Screw terminals, pluggable	R1.188.3540.0

13.3 Other safety-related products

Our extensive line of additional safety-related products can be found in our catalog entitled "Safety First" (part No. 0860.0) or online at www.wieland-electric.com.

14 Appendix

14.1 Declaration of Conformity

Declaration of Conformity: Page 1

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QU-QP-APP-02/13_05-234-00

EG-Konformitätserklärung
EC-Declaration of Conformity

Wieland Electric GmbH
Brennerstraße 10-14
D-96052 Bamberg

erklärt in alleiniger Verantwortung, dass die unten bezeichneten Produkte
declares under its sole responsibility that the below indicated products

Modulare Sicherheitssteuerung samos®PRO
Typenbezeichnung: siehe Anlage
Configurable Safety System samos®PRO
Type designation: see attachment

in Übereinstimmung mit denen in der Anlage gelisteten Richtlinien und Standards hergestellt und geprüft worden sind.
are manufactured and tested in compliance to the attached listed directives and standards.

Name und Anschrift der Person, der für die Zusammenstellung der technischen Unterlagen verantwortlich ist:
Name and address of the person, who is responsible for the compilation of technical documents:

Klaus Stadelmaier; Manager R&D, ME-EE

Wieland Electric GmbH, Brennerstr. 10-14, 96052 Bamberg

Bamberg, den 16.01.2015   Wieland Electric GmbH

i.V.   i.V.

Klaus Stadelmaier   **Klaus Jungstädt**
Manager R&D   *Manager Approvals, Standards*

Für die Weiterverarbeitung der nicht selbständigen Betriebsmittel (Komponenten) sind die zutreffenden Errichtungsbestimmungen zu beachten. Beim Einbau in Geräte und elektrische Anlagen gilt zusätzlich die jeweils gültige Bestimmung für das Gerät oder die Anlage.
For the further processing of the non-separate entities (components) the relevant National Wiring Rules are to be considered. By assembling in appliances or electrical equipments the relevant standard of the appliance/ equipment additionally applies.

CE-Erklärung_samosPRO-COMPACT_QU-QP-APP-02_13_05-234-00.doc

Wieland Electric GmbH	Telefon +49 (0)951/9324-0	Geschäftsführer:	Vorsitzender des Beirats:	Registergericht
Brennerstraße 10 – 14	Telefax +49 (0)951/9324-198	Dr. Oliver Eitrich	Walter R. Kaiser	Bamberg HRB 105
D-96052 Bamberg	www.wieland-electric.com	Dr. Ulrich Schaarschmidt		

Declaration of Conformity: Page 2

Anlage zu EG-Konformitätserklärung QU-QP-APP-02/13_05-234-00
Attachment to CE-declaration QU-QP-APP-02/13_05-234-00

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Conformity with the requirements of the following European Directives	
2006/42/EG (EC)	Maschinenrichtlinie / Machinery Directive
2014/30/EG (EC)	EMV-Richtlinie / EMC-Directive
2011/65/EG (EC)	RoHS-Richtlinie / RoHS-Directive

wurde bescheinigt durch/ *has been certified by*:

Notifizierte Stelle/ Anschrift: **TÜV Rheinland Industrie Service GmbH**
Notified body/ address   Am Grauen Stein,
                                     51105 Köln

Kenn-Nr.:
No.:   0035

Bescheinigungsnummer /
Certification no   **01/205/5431.00/15**

Standards and/or normative documents	
EN 61000-4-2: 2009	Prüfung der Störfestigkeit gegen die Entladung statischer Elektrizität *Electrostatic discharge immunity test*
EN 61000-4-3:2006 +A1: 2007; +A2: 2010	Prüfung der Störfestigkeit gegen hochfrequente elektromagnetische Felder *Radiated, radio-frequency, electromagnetic field immunity test*
EN 61000-4-4: 2010	Prüfung der Störfestigkeit gegen schnelle transiente elektrische Störgrößen/ Burst *Electrical fast transient/burst immunity test*
EN 61000-4-5: 2007	Prüfung der Störfestigkeit gegen Stoßspannungen *Surge immunity test*
EN 61000-4-6:2009	Störfestigkeit gegen leitungsgeführte Störgrößen, induziert durch hochfrequente Felder *Immunity to conducted disturbances, induced by radio-frequency fields*
EN 61000-4-8: 2010	Prüfung der Störfestigkeit gegen Magnetfelder mit energietechnischen Frequenzen *Power frequency magnetic field immunity test*
EN 61000-4-11: 2005	Prüfungen der Störfestigkeit gegen Spannungseinbrüche, Kurzzeitunterbrechungen und Spannungsschwankungen *Voltage dips, short interruptions and voltage variations immunity tests*
EN 61508 Teil 1 bis 7:2010	Funktionale Sicherheit sicherheitsbezogener elektrischer/ elektronischer/ programmierbarer elektronischer Systeme - Teil 1: Allgemeine Anforderungen *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements*

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Declaration of Conformity: Page 3

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EN 62061:2005 + A1:2013, SIL CL 3	Funktionale Sicherheit sicherheitsbezogener elektrischer, elektronischer und programmierbarer elektronischer Steuerungssysteme *Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13849-1: 2008 + AC:2009 Performance level e, Kategorie 4	Sicherheit von Maschinen - Sicherheitsbezogene Teile von Steuerungen *Safety of machinery - Safety-related parts of control systems*
EN 50156-1:2004	Elektrische Ausrüstung von Feuerungsanlagen - Teil 1: Bestimmungen für die Anwendungsplanung und Errichtung *Electrical equipment for furnaces and ancillary equipment - Part 1: Requirements for application design and installation*
EN 60204-1:2014	Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen - Teil 1: Allgemeine Anforderungen *Safety of machinery - Electrical equipment of machines - Part 1: General requirements*
EN 50178: 1997	Ausrüstung von Starkstromanlagen mit elektronischen Betriebsmitteln *Electronic equipment for use in power installations*
EN 61511 Teil 1 bis 3: 2004	Funktionale Sicherheit - Sicherheitstechnische Systeme für die Prozessindustrie *Functional safety - Safety instrumented systems for the process industry sector*
EN 81-1/-2: 1998 + A3: 2009	Sicherheitsregeln für die Konstruktion und den Einbau von Aufzügen – *Safety rules fort the construction and installation of lifts –*
EN 61131-2: 2008	Speicherprogrammierbare Steuerungen - Teil 2: Betriebsmittelanforderungen und Prüfungen *Programmable controllers - Part 2: Equipment requirements and tests*
EN 61131-6: 2013	Speicherprogrammierbare Steuerungen - Teil 6: Funktionale Sicherheit *Programmable controllers. Part 6: Functional safety*

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Artikelnummer / Article No.	Typenbezeichnung / Type Designation	Seriennummernbereich / Range of serial numbers
R1.190.1210.0	SP-COP2-EN-A	R119012100015010000 - R119012100019529999
R1.190.1220.0	SP-COP2-EN-C	R119012200015010000 - R119012200019529999
R1.190.1310.0	SP-COP2-ENI-A	R119013100015010000 - R119013100019529999
R1.190.1320.0	SP-COP2-ENI-C	R119013200015010000 - R119013200019529999
R1.190.0030.0	SP-SDIO84-P1-K-A	R119000300015010000 - R119000300019529999
R1.190.0040.0	SP-SDIO84-P1-K -C	R119000400015010000 - R119000400019529999
R1.190.0050.0	SP-SDI8-P1-K-A	R119000500015010000 - R119000500019529999
R1.190.0060.0	SP-SDI8-P1-K -C	R119000600015010000 - R119000600019529999
R1.190.1000.0	SP-COP-CARD1	--

14.2 Checklist for manufacturers

The information in the following points must be available at least during first-time commissioning. It may vary depending on the application and the requirements from the manufacturer/supplier must be checked.

This checklist should be retained or stored with the machine documents so that it can be used as a reference during recurring tests.

NOTICE | This checklist is not a replacement for the first-time commissioning or the regular testing done by a qualified person.

Table 52: Checklist for first-time commissioning

Question	Yes		No	
Were the safety guidelines according to the directives/standards valid for the machine used as a basis?	Yes	o	No	o
Are the directives and standards used listed in the Declaration of Conformity?	Yes	o	No	o
Does the safety equipment correspond to the required category?	Yes	o	No	o
Are the required protective measures against electric shock effective (protection class)?	Yes	o	No	o
Has the protective function been checked in accordance with the testing information in this documentation? In particular: • Functional check of the command devices, sensors, and actuators connected to the safety control • Test of all switch-off paths	Yes	o	No	o
Have you ensured that a complete test of the safety functions has been carried out after every configuration change to the safety control?	Yes	o	No	o

14.3 Complete list of error messages

Table 53: Fehlermeldungen SP-COP

Error No.	Error type	Logbook message	System behavior	Remedy
00000001	Info	Function block log generator info	System continues to run	
00000002	Warning	Function block log generator warning	System continues to run	
00000003	Error	Function block log generator error	System continues to run	
10100001	Error	An unknown error occurred.	Connection terminated	Contact support
10100002	Error	An internal error occurred.	Connection terminated	Contact support
10100003	Error	Time exceeded when preparing a message for the control.	No connection	
10100004	Error	The value cannot be forced because force mode is inactive.	Connection kept	Activate force mode
10100005	Error	The control does not support the message type.	Connection terminated	
10100006	Error	The hash value of a read file is not valid.	Connection terminated	Contact support
10100007	Error	The header size in the message from the control is not plausible.	Connection terminated	Contact support
10100008	Error	The user data size in the message from the control is not plausible.	Connection terminated	Contact support
10100009	Error	The total data size does not match the number of received data.	Connection terminated	Retry Contact support
1010000A	Error	A data flow error in a segmented read message occurred.	No connection	Retry Contact support
1010000B	Error	The checksum in a message from the control is not valid.	Connection terminated	Contact support
1010000C	Error	Time exceeded when sending a message to the control. Possible reasons: Communication to SP-COP already exists; Ethernet or USB connection is interrupted.	Connection terminated	Check connections Contact support
1010000D	Error	A timeout occurred during receiving a message from the control. Possible reasons: Communication to SP-COP already exists; Ethernet or USB connection is interrupted.	Connection terminated	Check connections Contact support
1010000E	Error	Unexpected message received.	Connection terminated	Contact support
1010000F	Error	The message from the control is corrupt.	Connection terminated	Contact support
10100010	Error	The message from the control is corrupt.	Connection terminated	Contact support
10100011	Error	The message to the control could not be processed.	Connection terminated	Retry Contact support

Error No.	Error type	Logbook message	System behavior	Remedy
10100012	Error	The control could not positively respond to the request.	Connection kept	Retry Contact support
10100013	Error	The number of request retries has been exceeded.	Connection terminated	Retry Contact support
10100015	Error	Communication to the control could not be established.	No connection	Check connections Contact support
10100016	Error	The password is not valid for the user to be logged on.	Connection kept	Verify correct password
10100017	Error	The control could not accept the desired state.	Connection kept	Retry Contact support
10100018	Error	The memory card of the station is not plugged in.	Connection terminated	Insert valid SD-Card
10200002	Error	The project on the control is invalid.	No connection	Download new valid Project
10200003	Error	The verification status of project and control is not the same.	No connection	Re-verify project
10200004	Error	The PC project and project on the control could not be synched.	No connection	Reconnect Contact support
10200005	Error	Current user does not have permission to communicate with the control Connection has been closed.	No connection	Redefine user rights
10200006	Warning	The project on the target does not match the module configuration.	Connection kept	Update Project or Hardware
10200007	Error	An error is reported by the control		
10200008	Error	The checksum in samos®PLAN5+ and control deviates.		Contact support
10200009	Error	The waiting time permitted for the project has been exceeded.		Retry Contact support
1020000A	Info	The verification was cancelled.		Retry Contact support
1020000B	Warning	The incorrect project file is still running on the station and must be replaced with the updated project file. Please update the station by connecting and downloading the updated project again		Update the station with the fixed project
10300001	Error	The logic analyzer data could not be saved.		Check Windows file access
10300002	Error	The logic analyzer data could not be loaded.		Retry Contact support
10300003	Error	I/O could not be found.		Contact support
10400001	Error	The log messages could not be saved.		Check Windows file access
10400002	Error	The file contained more than 64 messages. Only the first 64 have been imported.		Reduce log message count
10400003	Error	The log messages could not be imported.		Contact support
10500001	Error	Login to control failed.		Retry Contact support

Error No.	Error type	Logbook message	System behavior	Remedy
10600001	Error	This user already exists. Please choose another user name.		Use other name
10600002	Error	Could not import user list.		Retry Contact support
10600003	Warning	The following users have not been imported because they already exist.		
10700001	Error	Project File could not be opened. File format is incorrect.		Update samosPLAN5+ and retry Contact support
10700002	Error	Creating project from module configuration failed!		Update samosPLAN5+ and retry Contact support
10700003	Error	Project file could not be saved!		Check Windows file access
10700004	Error	Project File could not be opened. File format is incorrect.		Update samosPLAN5+ and retry Contact support
10700005	Error	Library file could not be opened. File format is not correct.		Update samosPLAN5+ and retry Contact support
10700006	Error	Project structure is incorrect.		Update samosPLAN5+ and retry Contact support
10700008	Error	Could not load settings file. File is corrupt.		Update samosPLAN5+ and retry Contact support
10700009	Error	Failed to import library. Elements are already exist.		
1070000A	Error	File cannot be opened. Signature is not correct.		Update samosPLAN5+ and retry Contact support
1070000B	Error	Cannot load gateway configuration because the configuration is for another gateway type.		
1070000C	Error	Version of the project file is not supported by this version of the program. Please try it with the current version of samosPLAN5+.		Update samosPLAN5+ and retry Contact support
1070000D	Error	The configuration data for a module can't be loaded correctly.		Update samosPLAN5+ and retry Contact support
10800001	Warning	Forcing more than 10 values is not permitted.		
11000000	Error	The HTML help could not be found. Please check if it is installed correctly.		Repair or reinstall samosPLAN5+ Contact support

Error No.	Error type	Logbook message	System behavior	Remedy
12000000	Error	The version information was incorrect. Please contact Support.		Contact support
12000001	Error	Could not reach update server. Please check internet access		Check internet access
13000000	Error	Test gap exceeds half the maximum period duration.		Verify test parameters
13000001	Error	Test period exceeds maximum test period of input.		Verify test parameters
13000002	Error	A test period with these values for minimum and maximum cannot be configured.		Verify test parameters
13000003	Error	Test gap exceeds half the period duration.		Verify test parameters
13000004	Error	Required test parameters are not possible for at least one element on the module.		Verify test parameters
14000001	Error	Not enough space to insert elements on logic page.		Insert new logic sheet and reorganize the Functionblocks
14000002	Warning	Items could not be grouped.		
14000003	Error	Item is only allowed for grouping.		
14000004	Error	Maximum number of function blocks have already been created.		Simplify logic
14000005	Error	Failed to create residual memory.		Contact support
14000006	Error	Item is not allowed for grouping.		
14000007	Error	Function blocks are not compatible with the choosed CPU module.		If you want to use this CPU module, all related function blocks will be deleted.
14000008	Error	Selection cannot be grouped because there are more than 8 connections to inputs.		
14000009	Error	Selection cannot be grouped because there are more than 8 connections to outputs.		
1400000A	Error	No function blocks have been selected to group.		
15000001	Error	CRC calculation failed		Retry Contact support
15000002	Error	Report generation failed		Retry Contact support
22010140	Warning	Error in system configuration	System continues to run	Reload system configuration
220101F5	Warning	Error in system configuration	Configuration required	Reload system configuration
220101F6	Warning	Error in system configuration	Configuration required	Reload system configuration
220101F7	Warning	Error in system configuration	Configuration required	Reload system configuration
220101F8	Warning	Error in system configuration	Configuration required	Reload system configuration

Error No.	Error type	Logbook message	System behavior	Remedy
220101F9	Warning	Error in system configuration	Configuration required	Reload system configuration
220101FA	Warning	Error in system configuration	Configuration required	Reload system configuration
220101FC	Warning	Error in system configuration	Configuration required	Reload system configuration
22010226	Warning	Error in system configuration	Configuration required	Reload system configuration
22010227	Warning	Error in system configuration	Configuration required	Reload system configuration
22010228	Warning	Error in system configuration	Configuration required	Reload system configuration
22010231	Warning	Pulse period 0 must have pulse length 0.	Configuration required	Change system configuration and reload
22010232	Warning	Pulse length must be <= pulse period/2.	Configuration required	Change system configuration and reload
22010233	Warning	Impermissible test period (permissible: 0,40,200,400,600,800,1000).	Configuration required	Change system configuration and reload
22010234	Warning	Pulse length must be multiple of 4 and in range from 4 to 100ms	Configuration required	Change system configuration and reload
22010240	Warning	Maximum count of function blocks or mapping exceeded	Configuration required	Change system configuration and reload
22010241	Warning	The number of IO modules is different in the configuration	Configuration required	Change system configuration and reload
22010242	Warning	The number of Gateway modules is different in the configuration	Configuration required	Change system configuration and reload
22010243	Warning	The major version of the CPU module and project file differs.	Configuration required	Change system configuration and reload
22010244	Warning	The major version of the IO module and project file differs.	Configuration required	Change system configuration and reload
22010245	Warning	The major version of the gateway module and project file differs.	Configuration required	Change system configuration and reload
22010250	Warning	function blocks for presses are not supported by this device	Configuration required	Change system configuration and reload
2201xxxx	Warning	Error in the configuration	Configuration required	Change system configuration and reload
23010001	Warning	Processing error at I1/I2	System continues to run	
23010003	Warning	Processing error at I3/I4	System continues to run	
23010005	Warning	Processing error at I5/I6	System continues to run	
23010007	Warning	Processing error at I7/I8	System continues to run	
23010009	Warning	Processing error at I9/I10	System continues to run	
2301000B	Warning	Processing error at I11/I12	System continues to run	
2301000D	Warning	Processing error at I13/I14	System continues to run	

Error No.	Error type	Logbook message	System behavior	Remedy
2301000F	Warning	Processing error at I15/I16	System continues to run	
23010011	Warning	Processing error at IQ1/IQ2	System continues to run	
23010013	Warning	Processing error at IQ3/IQ4	System continues to run	
2301xxxx	Warning	Processing error at 2-channel input	System continues to run	
23020001	Warning	Synchronous time error I1/I2	System continues to run	
23020003	Warning	Synchronous time error I3/I4	System continues to run	
23020005	Warning	Synchronous time error I5/I6	System continues to run	
23020007	Warning	Synchronous time error I7/I8	System continues to run	
23020009	Warning	Synchronous time error I9/I10	System continues to run	
2302000B	Warning	Synchronous time error I11/I12	System continues to run	
2302000D	Warning	Synchronous time error I13/I14	System continues to run	
2302000F	Warning	Synchronous time error I15/I16	System continues to run	
23020011	Warning	Synchronous time error IQ1/IQ2	System continues to run	
23020013	Warning	Synchronous time error IQ3/IQ4	System continues to run	
2302xxxx	Warning	Synchronous time error at 2-channel input	System continues to run	
240A0000	Warning	Output error on Q1	System continues to run; affected outputs switch off	Check outputs
240A0001	Warning	Output error on Q2	System continues to run; affected outputs switch off	Check outputs
240A0002	Warning	Output error on Q3	System continues to run; affected outputs switch off	Check outputs
240A0003	Warning	Output error on Q4	System continues to run; affected outputs switch off	Check outputs
240A0004	Warning	Output error on IQ1	System continues to run; affected outputs switch off	Check outputs
240A0005	Warning	Output error on IQ2	System continues to run; affected outputs switch off	Check outputs
240A0006	Warning	Output error on IQ3	System continues to run; affected outputs switch off	Check outputs

Error No.	Error type	Logbook message	System behavior	Remedy
240A0007	Warning	Output error on IQ4	System continues to run; affected outputs switch off	Check outputs
240A0008	Warning	Output error on group Q1/Q2	System continues to run; affected outputs switch off	Check outputs
240A0009	Warning	Output error on group Q3/Q4	System continues to run; affected outputs switch off	Check outputs
240A000A	Warning	Output error on group IQ1/IQ2	System continues to run; affected outputs switch off	Check outputs
240A000B	Warning	Output error on group IQ3/IQ4	System continues to run; affected outputs switch off	Check outputs
240Axxxx	Error	Output error	System stop; voltage OFF-ON required	Check outputs
240B0001	Info	Output error at Q1/Q2 rectified	System continues to run	
240B0002	Info	Output error at Q3/Q4 rectified	System continues to run	
240B0003	Info	Output error at IQ1/IQ2 rectified	System continues to run	
240B0004	Info	Output error at IQ3/IQ4 rectified	System continues to run	
240Bxxxx	Info	Output error rectified	System continues to run	
240Dxxxx	Error	Error in system configuration	System stop; voltage OFF-ON required	Reload system configuration and restart
240Exxxx	Warning	Problem with forcing	System continues to run	Restart forcing
240Fxxxx	Warning	Problem with forcing	System continues to run	Restart forcing
2410xxxx	Warning	Problem with forcing	System continues to run	Restart forcing
2411xxxx	Warning	Problem with forcing	System continues to run	Restart forcing
2412xxxx	Warning	Problem with forcing	System continues to run	Restart forcing
2413xxxx	Warning	Problem with forcing	System continues to run	Restart forcing
2414xxxx	Warning	Problem with forcing	System continues to run	Restart forcing
2415xxxx	Warning	Problem with forcing	System continues to run	Restart forcing
2416xxxx	Warning	Connection problem	System stop	Restart
2417xxxx	Warning	Forcing time expired	System continues to run	-
2418xxxx	Error	Internal error	System stop; voltage OFF-ON required	Restart or make complaint
2419xxxx	Warning	Error in system configuration.	System continues to run	Reload system configuration

Error No.	Error type	Logbook message	System behavior	Remedy
241Axxxx	Warning	Output error	System continues to run	Check outputs
241B0001	Warning	Stuck-at-high at Q1	System continues to run	Check outputs
241B0002	Warning	Stuck-at-high at Q2	System continues to run	Check outputs
241B0003	Warning	Stuck-at-high at Q3	System continues to run	Check outputs
241B0004	Warning	Stuck-at-high at Q4	System continues to run	Check outputs
241B0005	Warning	Stuck-at-high at IQ1	System continues to run	Check outputs
241B0006	Warning	Stuck-at-high at IQ2	System continues to run	Check outputs
241B0007	Warning	Stuck-at-high at IQ3	System continues to run	Check outputs
241B0008	Warning	Stuck-at-high at IQ4	System continues to run	Check outputs
241Bxxxx	Warning	Output error	System continues to run	Check outputs
241D0001	Warning	Test pulse error at I1	System continues to run	Check cabling
241D0002	Warning	Test pulse error at I2	System continues to run	Check cabling
241D0003	Warning	Test pulse error at I3	System continues to run	Check cabling
241D0004	Warning	Test pulse error at I4	System continues to run	Check cabling
241D0005	Warning	Test pulse error at I5	System continues to run	Check cabling
241D0006	Warning	Test pulse error at I6	System continues to run	Check cabling
241D0007	Warning	Test pulse error at I7	System continues to run	Check cabling
241D0008	Warning	Test pulse error at I8	System continues to run	Check cabling
241D0009	Warning	Test pulse error at I9	System continues to run	Check cabling
241D000A	Warning	Test pulse error at I10	System continues to run	Check cabling
241D000B	Warning	Test pulse error at I11	System continues to run	Check cabling
241D000C	Warning	Test pulse error at I12	System continues to run	Check cabling
241D000D	Warning	Test pulse error at I13	System continues to run	Check cabling
241D000E	Warning	Test pulse error at I14	System continues to run	Check cabling
241D000F	Warning	Test pulse error at I15	System continues to run	Check cabling

Error No.	Error type	Logbook message	System behavior	Remedy
241D0010	Warning	Test pulse error at I16	System continues to run	Check cabling
241D0011	Warning	Test pulse error at IQ1	System continues to run	Check cabling
241D0012	Warning	Test pulse error at IQ2	System continues to run	Check cabling
241D0013	Warning	Test pulse error at IQ3	System continues to run	Check cabling
241D0014	Warning	Test pulse error at IQ4	System continues to run	Check cabling
241Dxxxx	Warning	Check of test pulse resulted in error	System continues to run	Check cabling
241Exxxx	Warning	Verification of project failed	System continues to run	Re-verification
241Fxxxx	Warning	Verification of project failed	System continues to run	Re-verification
2420xxxx	Warning	Verification of project failed	System continues to run	Re-verification
2421xxxx	Warning	Verification of project failed	System continues to run	Re-verification
2422xxxx	Warning	Verification of project failed	System continues to run	Re-verification
2423xxxx	Info	The verified project on the SD card has changed	System continues to run	
2433xxxx	Warning	Problem during fast shutoff	System continues to run	
2435xxxx	Warning	Safety mat cable break	System continues to run	Check cabling
2436xxxx	Warning	Check of a safety feature	System continues to run	Unverification of project
2437xxxx	Warning	Check of a safety feature	System continues to run	Reduce the number of forced inputs to less than or equal to 10
2438xxxx	Warning	Configuration data faulty	System continues to run	Modify project data or make complaint
2439xxxx	Error	The configuration changed during execution of the application	System stop; voltage OFF-ON required	Restart or make complaint
243Bxxxx	Warning	Configuration data faulty	System continues to run	Modify project data or make complaint
25010001	Warning	Supply voltage A1 too low	System continues to run	Supply voltage must be set correctly
25010002	Warning	Supply voltage B1 too low	System continues to run	Supply voltage must be set correctly
25010003	Warning	Supply voltage B2 too low	System continues to run	Supply voltage must be set correctly
2501xxxx	Warning	Supply voltage too low	System continues to run	Supply voltage must be set correctly
25020001	Warning	Supply voltage A1 too high	System continues to run	Supply voltage must be set correctly
25020002	Warning	Supply voltage B1 too high	System continues to run	Supply voltage must be set correctly

Error No.	Error type	Logbook message	System behavior	Remedy
25020003	Warning	Supply voltage B2 too high	System continues to run	Supply voltage must be set correctly
2502xxxx	Warning	Supply voltage too high	System continues to run	Supply voltage must be set correctly
2503xxx1	Error	Supply voltage A1 too low	System stop; voltage OFF-ON required	Supply voltage must be set correctly
2504xxx1	Error	Supply voltage A1 too high	System stop; voltage OFF-ON required	Supply voltage must be set correctly
2504xxx2	Error	Supply voltage B1 too high	System stop; voltage OFF-ON required	Supply voltage must be set correctly
2504xxx3	Error	Supply voltage B2 too high	System stop; voltage OFF-ON required	Supply voltage must be set correctly
2504xxxx	Error	Supply voltage too high	System stop; voltage OFF-ON required	Supply voltage must be set correctly
25050001	Info	Supply voltage A1 within normal range	System continues to run	
25050002	Info	Supply voltage B1 within normal range	System continues to run	
25050003	Info	Supply voltage B2 within normal range	System continues to run	
2505xxxx	Info	Supply voltage within normal range	System continues to run	
2509xxxx	Warning	External error	System continues to run	Check load current
2604xxxx	Warning	Internal/external error SBus	System continues to run	Reduce count of extension modules
2609xxxx	Warning	Error in system configuration.	System continues to run	Reload system configuration
260Axxxx	Warning	Error in system configuration.	System continues to run	Reload system configuration
260Bxxxx	Error	Too many I/O modules used	System stop; voltage OFF-ON required	Check number of modules
2733xxxx	Warning	Input discrepancy rectified	System continues to run	
28020000	Info	Values were changed	System continues to run	
2805xxxx	Warning	Communication interrupted	System continues to run	
2808xxxx	Warning	No program memory	Configuration required	Insert SD card
2809xxxx	Warning	Action not permitted	System continues to run	Execute correct action
280Axxxx	Warning	Ethernet connection too slow	System continues to run	
3409xxxx	Warning	Invalid force request	System continues to run	
340Axxxx	Warning	Invalid force request	System continues to run	
34290003	Warning	Synchronous time error I1/I2	System continues to run	

Error No.	Error type	Logbook message	System behavior	Remedy
3429000C	Warning	Synchronous time error I3/I4	System continues to run	
34290030	Warning	Synchronous time error I5/I6	System continues to run	
342900C0	Warning	Synchronous time error I7/I8	System continues to run	
3429xxxx	Warning	Dualchannel synchronous time error	System continues to run	
342A0003	Warning	Processing error at I1/I2	System continues to run	
342A000C	Warning	Processing error at I3/I4	System continues to run	
342A0030	Warning	Processing error at I5/I6	System continues to run	
342A00C0	Warning	Processing error at I7/I8	System continues to run	
342Axxxx	Warning	Processing error at 2-channel input	System continues to run	
36010001	Warning	external testpuls error at I1	System continues to run	
36010002	Warning	external testpuls error at I2	System continues to run	
36010004	Warning	external testpuls error at I3	System continues to run	
36010008	Warning	external testpuls error at I4	System continues to run	
36010010	Warning	external testpuls error at I5	System continues to run	
36010020	Warning	external testpuls error at I6	System continues to run	
36010040	Warning	external testpuls error at I7	System continues to run	
36010080	Warning	external testpuls error at I8	System continues to run	
3601xxxx	Warning	Error at external input test	System continues to run	
3602xxxx	Warning	Safety mat cable break	System continues to run	
3702xxxx	Warning	Short circuit, stuck-at-low, VCC or GND break	System continues to run	
37040003	Warning	Cross-comparison error at Q1/Q2	System continues to run	
3704000C	Warning	Cross-comparison error at Q3/Q4	System continues to run	
3704xxxx	Warning	Cross-reference error at the output	System continues to run	
37050001	Warning	Stuck-at-high at Q1	System continues to run	
37050002	Warning	Stuck-at-high at Q2	System continues to run	

Error No.	Error type	Logbook message	System behavior	Remedy
37050004	Warning	Stuck-at-high at Q3	System continues to run	
37050008	Warning	Stuck-at-high at Q4	System continues to run	
3705xxxx	Warning	Stuck-at-high at the output	System continues to run	
3801xxxx	Error	Power supply voltage error (logic voltage)	System stop; voltage OFF-ON required	
3802xxxx	Error	Power supply unit watchdog	System stop; voltage OFF-ON required	
3803xxxx	Error	Output voltage error	System stop; voltage OFF-ON required	
3806xxxx	Warning	GND break at A1 and A2	System continues to run	
3807xxxx	Warning	Supply voltage A1 too low	System continues to run	
3902xxxx	Warning	Error in system configuration	System continues to run	
3903xxxx	Warning	Error in system configuration	System continues to run	
3904xxxx	Warning	Error in system configuration	System continues to run	
3905xxxx	Warning	Error in system configuration	System continues to run	
3906xxxx	Warning	Error in system configuration	System continues to run	
3907xxxx	Warning	Error in system configuration	System continues to run	
3908xxxx	Warning	Error in system configuration	System continues to run	
3909xxxx	Warning	Error in system configuration	System continues to run	
390Axxxx	Warning	Error in system configuration	System continues to run	
390Bxxxx	Warning	Error in system configuration	System continues to run	
390Cxxxx	Warning	Error in system configuration	System continues to run	
390Dxxxx	Warning	Error in system configuration	System continues to run	
390Exxxx	Warning	Error in system configuration	System continues to run	
390Fxxxx	Warning	Error in system configuration	System continues to run	
3910xxxx	Warning	Error in system configuration	System continues to run	
3911xxxx	Warning	Error in system configuration	System continues to run	
3945xxxx	Warning	Fast shutoff control signal faulty	System continues to run	

Error No.	Error type	Logbook message	System behavior	Remedy
4102xxxx	Warning	CRC error in the configuration	System continues to run	
4103xxxx	Warning	Module type deviates	System continues to run	
4104xxxx	Warning	Module version deviates	System continues to run	
4106xxxx	Warning	Service data project not processed	System continues to run	
4302xxxx	Info	Service data project not processed	System continues to run	
4303xxxx	Info	Service data project not processed	System continues to run	
4304xxxx	Info	Service data project not processed	System continues to run	
4305xxxx	Info	Service data project not processed	System continues to run	
4306xxxx	Info	Service data project not processed	System continues to run	
4307xxxx	Info	Service data project not processed	System continues to run	
4309xxxx	Info	Service data project not processed	System continues to run	
430Bxxxx	Error	Gateway address outside permissible range	System stop; voltage OFF-ON required	
4501xxxx	Warning	Data loss in receive buffer due to very high bus load	System continues to run	
4502xxxx	Warning	CAN controller TEC or REC >= 96	System continues to run	
4503xxxx	Warning	CAN controller TEC or REC > 127	System continues to run	
4504xxxx	Warning	CAN controller TEC > 255	System continues to run	
4505xxxx	Warning	Transmission of a message was faulty	System continues to run	
4506xxxx	Warning	Data loss in transmit buffer due to overload	System continues to run	
4507xxxx	Error	Initialization was faulty	System stop; voltage OFF-ON required	
4508xxxx	Warning	Lifeguarding faulty	System continues to run	
4601xxxx	Error		System stop; voltage OFF-ON required	
4602xxxx	Error		System stop; voltage OFF-ON required	
4603xxxx	Error		System stop; voltage OFF-ON required	
4604xxxx	Warning		System continues to run	
4605xxxx	Warning		System continues to run	

Error No.	Error type	Logbook message	System behavior	Remedy
50xxxxxx	Warning	Modbus/TCP related error	System continues to run	
51xxxxxx	Warning	PROFINET IO related error	System continues to run	
5201xxxx	Error	Too many EtherNet/IP connections	System continues to run	
5202xxxx	Warning	Wrong EtherNet/IP data format	System continues to run	
5203xxxx	Warning	Wrong EtherNet/IP data format	System continues to run	
5204xxxx	Warning	Wrong EtherNet/IP data size	System continues to run	
5205xxxx	Warning	Wrong EtherNet/IP command	System continues to run	
5206xxxx	Warning	EtherNet/IP read error	System continues to run	
5209xxxx	Warning	Wrong EtherNet/IP data index	System continues to run	
520C00xx	Error	Wrong EtherNet/IP connection configuration	System continues to run	
520Fxxxx	Warning	EtherNet/IP timeout	System continues to run	
52xxxxxx	Warning	EtherNet/IP related error	System continues to run	
60000000	Info	Log file cleared	System continues to run	
60000001	Info	Base module firmware	System continues to run	
60000002	Info	Base module serial number	System continues to run	
60000003	Info	Project file read	System continues to run	
63xxxxxx	Warning	USB error	System continues to run	
640A0001	Warning	SD card cannot be read	Configuration required	
64xxxxxx	Warning	File system error on SD card	Configuration required	
65xxxxxx	Warning	Ethernet error	System continues to run	
680A0001	Warning	Supply voltage A1 too low	Configuration required	
690Fxxxx	Warning	Communication interrupted	-	
6A020001	Warning	Communication (Ethernet/USB) disrupted	System continues to run	
6A04xxxx	Warning	Communication (Ethernet/USB) disrupted	System continues to run	
6Axxxxxx	Warning	Communication error (Ethernet/USB)	System continues to run	

Error No.	Error type	Logbook message	System behavior	Remedy
6B03xxxx	Warning	Project file faulty	Configuration required	
6B04xxxx	Warning	Project file faulty	Configuration required	
6Bxxxxxx	Warning	File error	Configuration required	