wieland

samos®PRO

samos®PRO Hardware

Operating instructions

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CE

Contents

Contents

1 About this document

Please read the chapters 1 and 2 carefully before working with this documentation and the samos®PRO modular safety controller.

1.1 Function of this document

For the samos®PRO system there are three operating instructions with clearly distinguished fields of application as well as mounting instructions and brief instructions for each module.

- The "samos®PRO – Hardware" operating instructions describe all the samos®PRO modules and their functions in detail. Use the Hardware operating instructions in particular to configure samos®PRO safety controllers.
  These mounting instructions *instruct the technical staff of the machine manufacturer* and/or *of the machine operator* on the safe mounting, electrical installation, commissioning as well as maintenance of the samos®PRO modular safety controller.
  These operating instructions do *not* provide instructions for operating the machine in which the safety controller is, or will be, integrated. Information of this kind will be found in the operating instructions for the machine.
- The "samos®PLAN – Software" operating instructions describe the software-supported configuration and parameterization of the samos®PRO safety controller. In addition the software operating instructions contain the description of the diagnostics functions that are important for operation and detailed information for the identification and elimination of errors. Use the Software operating instructions in particular for the configuration, commissioning and operation of samos®PRO safety controllers.
- The “samos®PRO Gateways” operating instructions describe all samos®PRO gateways and their functions in detail.
  These operating instructions instruct the technical staff of the machine manufacturer and/or of the machine operator on the safe mounting, electrical installation, commissioning as well as maintenance of the samos®PRO gateways.
  Additionally the “samos®PRO gateways” operating instructions contain important information on the configuration of the gateways using the samos®PLAN software, on the data transfer to and from networks as well as information on status, planning and the related mapping.
- The mounting instructions/brief instructions are enclosed with each samos®PRO module. They inform on the basic technical specifications of the modules and contain simple mounting instructions. Use the mounting instructions/brief instructions when mounting the samos®PRO safety controller.

1.2 Target group

These operating instructions are addressed to the *planning engineers, designers* and *operators* of systems which are to be protected by a samos®PRO modular safety controller. It also addresses people who integrate the samos®PRO safety controller into a machine, commission it initially or who are in charge of servicing and maintaining the unit.

1.3 Depth of information

These operating instructions contain information on the samos®PRO modular safety controller in the following subjects:

- Mounting
- Electrical installation
- Hardware commissioning
- Care and maintenance
- Error diagnostics and remedying
- Part numbers
- Conformity and approval

Planning and using Wieland Electric protective devices also require specific technical skills which are not detailed in this documentation.
When operating the samos®PRO modular safety controller, the national, local and statutory rules and regulations must be observed.
The "Safe Machinery" guidelines contain general information about the topic of safety technology.

NOTE

We also refer you to the homepage on the Internet and the CD:
http://www.wieland-electric.com
samos®PLAN CD (see ordering information in the appendix)

Here you will find:
- Product and application animations
- Configuration aids
- These operating instructions in different languages for viewing and printing
- Configuration software samos®PLAN
- "samos®PRO Modular Safety Controller – Software" operating instructions
- samos®PRO gateways operating instructions
- EDS, GSD and GSDML files

1.4 Scope

These operating instructions are valid for all modules of the samos®PRO safety controller, with the exeption of the samos®PRO gateways.
These operating instructions are original operating instructions.

1.5 Abbreviations used

EDM	External device monitoring
EFI	Enhanced Function Interface
ESPE	Electro-sensitive protective equipment
NC	Normally closed
NO	Normally open
OSSD	Output signal switching device
PFHD	Probability of dangerous failure per hour
PLC	Programmable Logic Controller
SIL	Safety Integrity Level (safety class)
SILCL	Safety Integrity Level Claim Limit

1.6 Symbols used

Recommendations are designed to give you some assistance in your decision-making process with respect to a certain function or a technical measure.

Recommendation

Notes provide special information on the device.

NOTE

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

➡ Action

Warning!
A warning indicates concrete or potential dangers. They save you from harm.
Read warnings carefully and abide by them!

2 On safety

This chapter deals with your own safety and the safety of the equipment operators.

➡ Please read this chapter carefully before working with the samos®PRO modular safety controller or with the machine protected by the samos®PRO modular safety controller.

2.1 Qualified persons

The samos®PRO modular safety controller may only be installed, commissioned and serviced by qualified personnel.
Qualified persons are defined as persons who …

- have undergone the appropriate technical training

and

- have been instructed by the responsible machine operator in the operation of the machine and the current valid safety guidelines

and

- have access to the operating instructions of the samos®PRO and have read and familiarised themselves with them

and

- have access to the operating instructions for the protective devices (e.g. C4000) connected to the safety controller and have read and familiarised themselves with them.

2.2 Application areas for the device

The samos®PRO modular safety controller is a configurable controller for safety applications. It can be used

- in accordance with EN 61508 up to SIL3
- in accordance with EN 62061 up to SILCL3
- in accordance with EN ISO 13849-1:2006 up to Performance Level e / category 4
- in accordance with EN 50156-1
  - The safety function must be tested at least once a year
  - A consistent redundant structure has to be realized
  - When using relay expansion modules, proper switching of the relays must be monitored via the feedback contacts (EDM)
  - The requirements of EN 50156-1, chapter 10.5.6 must be considered

The degree of safety actually attained depends on the external circuit, the realization of the wiring, the parameter configuration, the choice of the pick-ups and their location at the machine.
Opto-electronic and tactile safety sensors (e.g. light curtains, laser scanners, safety switches, sensors, emergency stop pushbuttons) are connected to the modular safety controller and are linked logically. The corresponding actuators of the machines or systems can be switched off safely via the switching outputs of the safety controller.

2.3 Correct use

The samos®PRO modular safety controller may only be used within specific operating limits (voltage, temperature, etc., refer to the technical data in Chapter 12) in the sense of Section 2.2 "Application areas for the device". It may only be used by specialist personnel and only at the machine at which it was mounted and initially commissioned by qualified personnel in accordance with these operating instructions.

Wieland Electric GmbH accepts no claims for liability if the equipment is used in any other way or if modifications are made to the device, even in the context of mounting and installation.

- The external voltage supply of the device must be capable of buffering brief mains voltage failures of 20 ms as specified in EN 60204. Suitable PELV- and SELV-compatible power supply units are available as accessories from Wieland Electric.
- The modules of the samos®PRO system conform to Class A, Group 1, in accordance with EN 55011.
  Group 1 encompasses all the ISM devices in which intentionally generated and/or used conductor-bound RF energy that is required for the inner function of the device itself occurs.

The samos®PRO system fulfils the requirements of Class A (industrial applications) in accordance with the "Interference emission" basic specifications.
The samos®PRO system is therefore only suitable for use in an industrial environment and not for private use.

WARNING

UL/CSA applications

- Use 60°C/75°C conductors.
- The terminal tightening torque must be 5–7 lbs/in.
- To be used in a Pollution Degree 2 environment only.
- The modules shall be supplied by an isolating power source protected by an UL 248 fuse, rated max. 100/V, where V is the DC supply voltage with the maximum value of 42.4 V DC, such that the limited voltage/current requirements of UL 508 are met.
- Max. SDIO Q1 … Q4 total current Isum = 3.2 A
- The gateways SP-EN-PN, SP-EN-MOD and SP-EN-IP are intended to be used with Class 2. Therefore the main module must be supplied in this case with a Class 2 power source or Class 2 transformer in accordance with UL 1310 or UL 1585.

The safety functions are not evaluated by UL. The approval is accomplished according to UL 508, general use applications.

NOTE

2.4 General protective notes and protective measures

Observe the protective notes and measures!
Please observe the following items in order to ensure proper use of the samos®PRO safety controller.

WARNING

- When mounting, installing and using the samos®PRO safety controller, observe the standards and directives applicable in your country.
- The national/international rules and regulations apply to the installation, use and periodic technical inspection of the samos®PRO safety controller, in particular:
  – Machinery Directive 2006/42/EC
  – EMC Directive 2004/108/EC
  – Use of Work Equipment Directive 2009/104/EC
  – Low-Voltage Directive 2006/95/EC
  – The work safety regulations/safety rules
- Manufacturers and owners of the machine on which a samos®PRO safety controller is used are responsible for obtaining and observing all applicable safety regulations and rules.
- The notices, in particular the test notices (see Chapter 9, "Commissioning") of these operating instructions (e.g. on use, mounting, installation or integration into the existing machine controller) must be observed.
- The tests must be carried out by specialised personnel or specially qualified and authorised personnel and must be recorded and documented to ensure that the tests can be reconstructed and retraced at any time by third parties.
- These operating instructions must be made available to the user of the machine where the samos®PRO safety controller is used. The machine operator is to be instructed in the

use of the device by qualified personnel and must be instructed to read the operating instructions.

2.5 Environmental protection

The samos®PRO modular safety controller has been designed to minimise environmental impact. It uses only a minimum of power and natural resources.

➧ At work, always act in an environmentally responsible manner.

2.5.1 Disposal

Disposal of unusable or irreparable devices should always occur in accordance with the applicable country-specific waste-disposal regulations (e.g. European Waste Code 16 02 14).

NOTE

We would be pleased to be of assistance on the disposal of this device. Contact your local Wieland Electric representative.

2.5.2 Material separation

WARNING

- Material separation may only be performed by qualified personnel!
- Exercise care when disassembling the devices. The danger of injury is present.

Before you can turn over the devices for environmental-friendly recycling, you must separate the different materials of the samos®PRO from one another.

➧ Separate the housing from the remaining components (especially the PCB).

➧ Send the separated components to the corresponding recycling centres (see the following table).

Table 1: Overview of disposal by component

Component	Disposal
Product Housing PCBs, cables, plugs and electrical connection pieces	 Plastic recycling Electronics recycling
Packaging Cardboard, paper	 Paper/cardboard recycling

3 Product description

This chapter provides information on the features and properties of the samos®PRO system and describes the structure and operating principle.

3.1 System properties

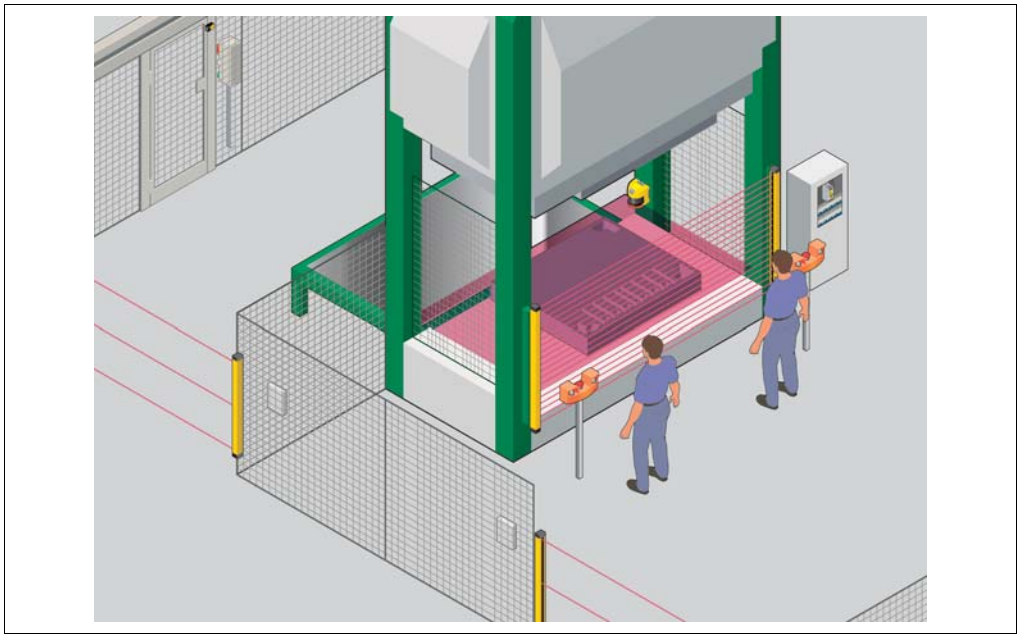


Fig. 1: samos® PRO modular safety controller

The samos®PRO system is characterised by the following system properties:

- Modular structure: 1 main module and up to 12 input/output extension modules, each with 22.5 mm compact width
- 8 to 96 inputs and 4 to 48 outputs
- Programmable
- Use of up to 255 standard and application-specific logic blocks
- Standard logic blocks: AND, OR, NOT, XNOR, XOR
- Application-specific logic blocks: Emergency stop, two-handed, muting, pressing, operating mode selector switch, reset, restart
- Can be integrated into various bus systems (e.g. PROFIBUS DP, Profinet, TCP/IP,...) by means of gateways
- Two EFI interfaces on the SP-SCON-NET main module, see section 3.6

The samos®PLAN configuration software is available for configuring the control tasks. The configuration software is available on the Internet or on the CD:

http://www.wieland-electric.com
samos®PLAN CD (see ordering information in the appendix)

3.2 System configuration

A samos®PRO system consists of the following modules:

- an SP-MEMORY system plug
- an SP-SCON or SP-SCON-NET main module
- up to two gateways
- up to twelve additional SP-SDIO and SP-SDI input/output extension modules,
- in addition up to eight SA-OR-S1 relay output modules and/or four SA-OR-S2 relay output modules (meaning a max. of 16 safe relay outputs).

NOTE Further modules of the samos® series may not be connected to the samos®PRO system.

Fig. 2: Examples for the minimum configuration of a samos® PRO system with SP-SCON and SP-SDIO

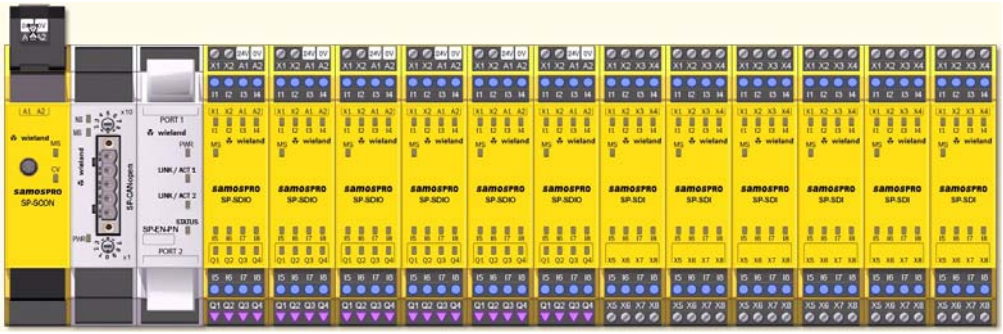


Fig. 3: Maximum configuration of the samos® PRO system (without relay output extensions)

Type	Kind	Inputs	Outputs	Logic blocks	Max. occurrence
SP-SCON	Main module	–	–	255	1 x
SP-SCON-NET	Main module	4 [1]	–	255	1 x
SP-SDIO	Input/output extension	8	4	–	12 x
SP-SDI	Input extension	8	–	–	
SA-OR-S2	Relay output extension	–	2	–	8× [2]
SA-OR-S1	Relay output extension	–	4	–	4× [2]
SP-PROFIBUS-DP	PROFIBUS-DP gateway	1 [3]	–	–	2×
SP-CANopen	CANopen gateway	1 [3]	–	–	
SP-DeviceNet	DeviceNet gateway	1 [3]	–	–	
SP-EN-PN	ProfiNET IO gateway	2 [4]	–	–	
SP-EN-MOD	Modbus TCP gateway	2 [4]	–	–	
SP-EN-IP	Ethernet/IP gateway	2 [4]	–	–	

Table 2: Overview of the modules

3.3 Version, compatibility and features

For the samos®PRO product family several firmware versions and function packages exist that allow different functions. This section gives an overview which firmware version, which function package and/or which version of the samos®PLAN software is required to use a certain function or device.

	Minimum required version		
Feature	**CPU**	**SDIO/SDI**	**samos®PLAN**
Logic offline simulation	– [5]	–	V1.2.0
Logic import/export	–	–	V1.3.0
Two S3000 on one EFI interface	V1.00	–	V1.2.2
Automatic wiring diagrams	–	–	V1.3.0
Central tag name editor	–	–	V1.3.0
samos®NET (only with SP-SCON-NET)	V2.00 (Step 2.xx)	–	V1.3.0
Logic block documentation within the Designer	–	–	V1.3.0
Input/output relation matrix	–	–	V1.3.0
Invertable inputs for some function blocks	V2.00 (Step 2.xx)	–	V1.3.0
New function blocks (e.g. Ramp down, Fast Shut Off with Bypass, Adjustable delays)	V2.00 (Step 2.xx)	–	V1.3.0
Verification without identical hardware possible	V2.00 (Step 2.xx)	–	V1.0.0
Test pulses on SDIO can be switched off	–	V2.00 (Step 2.xx)	V1.3.0
Input/output module diagnostic bits	V1.11 (Step 1.xx)	V2.00 (Step 2.xx)	V1.3.0
Several safety mats per SDIO/SDI	–	V1.13	V1.3.0
Device	**CPU**	**SDIO/SDI**	**samos®PLAN**
ProfiNET, Modbus TCP, Ethernet/IP gateways	V1.11 (Step 1.xx)	–	V1.2.0
CANopen, DeviceNet, CC-Link gateways	V1.11 (Step 1.xx)	–	V1.3.0
0-Speed SNS 40x4K	–	–	V1.3.0
ROHS conformity SDIO	–	V1.01 [6]	–

Table 3: Required firmware and software versions

[1] EFI terminals.
[2] Max. of 16 safe relay outputs.
[3] RS-485 socket.
[4] RJ45 sockets.
[5] "–" means "any" or "not applicable".
[6] All other modules from product launch onwards.

NOTES

- You can find the firmware version on the type label of the samos®PRO modules in the field “Software version“.
- In order to use modules with a newer firmware version, a new samos®PLAN version is required.
- The version of the samos®PLAN can be found in the **Extras** menu under **Info**.
- The newest version of the samos®PLAN can be obtained on the Internet under http://www.wieland-electric.com/ public/ we_en_support_download_center.AxCMS?ActiveID=1772 (choose Productgroup "Safety technology", Subgroup 1 "samos®PRO").
- The function package (Step 1.xx or Step 2.xx) must be selected in the samos®PLAN hardware configuration. Function package Step 2xx is available with samos®PLAN 1.3.0 and higher.
- In order to use function package Step 2.xx, the respective module must have at least firmware version V2.00. Otherwise you will receive an error message when you try to upload a configuration using Step 2.xx to a module with a lower firmware version.
- Newer modules are downward compatible so that any module can be replaced by a module with a higher firmware version.

3.4 System plug SP-MEMORY

The system configuration of the complete samos®PRO system is **only** stored in the system plug. This offers the advantage when terminal modules are replaced that the samos®PRO system does not have to be reconfigured.

NOTE

The data stored in the system plug are retained when the voltage supply is interrupted.

The main module and the inputs of the system are supplied with electricity exclusively through the system plug. The outputs, on the other hand, are supplied separately.

NOTE

- The current of the power supply unit that supplies the main module has to be limited to a maximum of 4 A – either by the power supply unit itself or by a fuse.
- If modules are replaced, ensure that the system plug is plugged into the suitable main module. Uniquely mark all the connection cables and connectors at the samos®PRO system in order to avoid confusion.

3.5 Main module SP-SCON

3.5.1 Description

The main module SP-SCON is the central process unit of the entire system in which all the signals are monitored and processed logically in accordance with the configuration stored in the system plug. The outputs of the system are switched as a result of the processing, whereby the SBUS+ serves as the data interface.

3.5.2 Display elements, error codes and terminal description

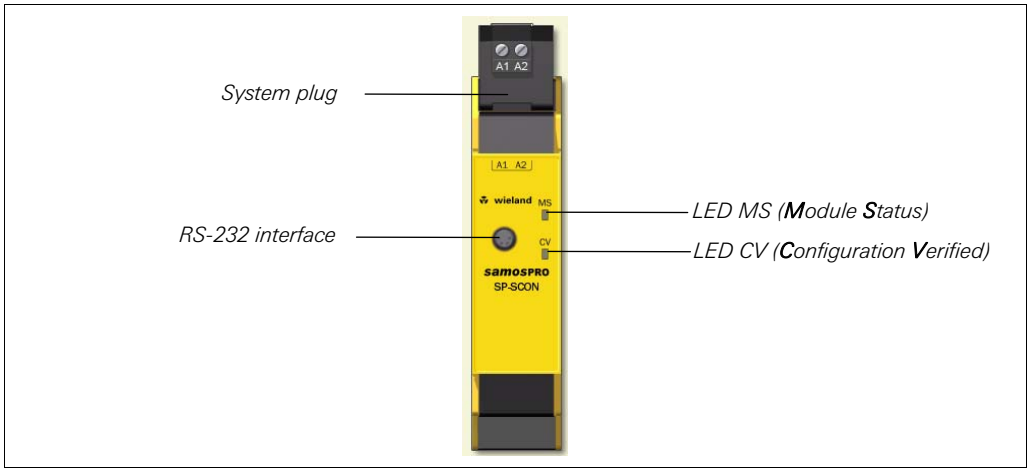


Fig. 4: Display elements SP-SCON

Pin	Assignment
A1	24 V voltage supply for all the modules, with the exception of the outputs
A2	GND of the voltage supply

Table 4: System plug pin assignment

Legend: ○ – off, ☼ *color* – flashes with *color*, ● *color* – LED *color* is active

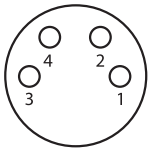
Table 5: Displays of the MS LED

MS LED	Meaning	Notes
○	Supply voltage is out of range	Switch on the supply voltage and check it at the terminals A1 and A2
☼ Red/green (1 Hz)	Self test or system initialization	Please wait ...
☼ Green (1 Hz)	System is in STOP state	Start the application in samos®PLAN.
☼ Green (2 Hz)	Identify (e.g. for samos®NET)	
● Green	System is in RUN state	
☼ Red (1 Hz)	Invalid configuration	Check the module type and version of the main module and extension modules whose MS LED flashes red/green. If appropriate, adapt the configuration using the samos®PLAN For detailed diagnostics, refer to the samos®PLAN
☼ Red (2 Hz)	Critical error in the system, possibly this module. Application is stopped. All outputs are switched off.	Switch the supply voltage off and on again If the error is not eliminated after multiple repetition, replace the module. For detailed diagnostics, refer to samos®PLAN.
● Red	Critical error in the system, possibly another module. Application is stopped. All outputs are switched off.	Switch the supply voltage off and on again. If the error is not eliminated after multiple repetition, replace the module which displays ☼ Red (2 Hz). If this does not help, use the diagnostic functions of samos®PLAN to narrow down the respective module.

Table 6: Displays of the CV LED

CV LED	Meaning	Note
○	Configuration in progress	
☼ Yellow (2 Hz)	Storing configuration data in the non-volatile memory (SA-MEMORY).	Supply voltage may not be interrupted until the storage process has been completed
☼ Yellow (1 Hz)	Unverified configuration	Verify configuration with the samos®PLAN software
● Yellow	Verified configuration	

Table 7: Pin assignment of RS-232 interface

Plug/socket	Pin	Signal	Colour	Assignment PC-sided RS.232 SubD (9 pins)
	1	Reserved	Brown	–
	2	RxD	White	Pin 3
	3	GND (Internally electrically connected with connection A2 of the main module)	Blue	Pin 5
	4	TxD	Black	Pin 2

3.6 Main module SP-SCON-NET

3.6.1 Description

The main module SP-SCON-NET has the same functions as the SP-SCON. Please observe the notes in chapter 3.5.
In addition this module has two EFI interfaces. If EFI-compatible devices are connected, the following additional functions can be used:

- Transferring the configuration from the samos®PLAN to the system plug and to the connected EFI-compatible devices
- Uploading the configuration from the system plug and the connected EFI-compatible devices to the samos®PLAN
- Diagnostics of the samos®PRO system and the connected EFI-compatible devices with the samos®PLAN
- Process data exchange between main module and EFI-compatible devices.
- Connection of up to four SP-SCON-NET main modules as a samos®NET system (see section 4.6 "samos®NET" on page 39).

For further information about EFI interfaces refer to section 4.6.2.

3.6.2 Display elements, error codes and terminal description

The displays of the MS and CV LEDs as well as the pin assignment of the RS-232 interface are identical with those of the SP-SCON, see section 3.5.2.

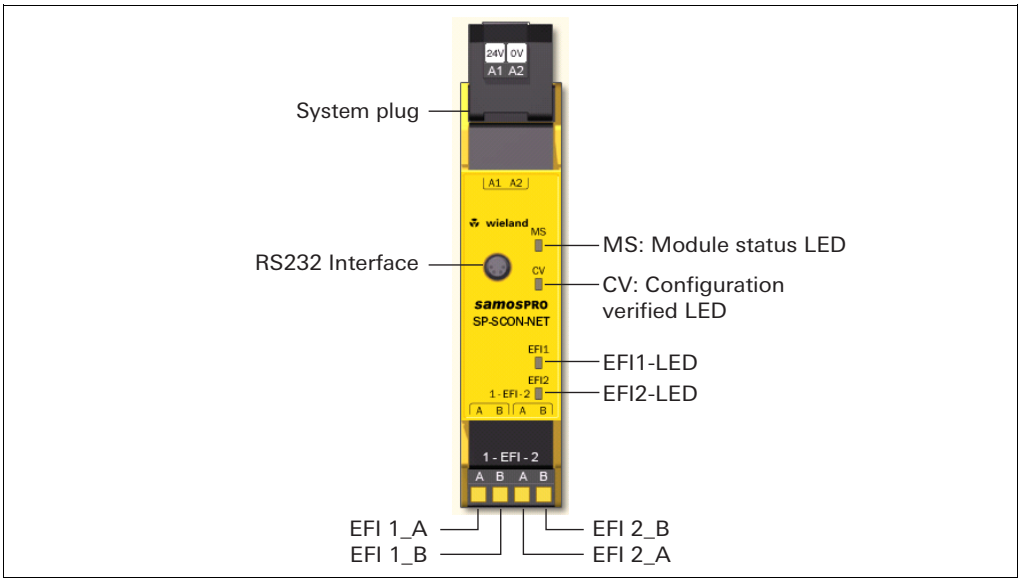


Fig. 5: Display elements SP-SCON-NET

Pin	Assignment
A1	24 V voltage supply for all the modules, with the exception of the outputs
A2	GND of the voltage supply

Table 8: System plug pin assignment

Legend: ○ – off, ☼ *color* – flashes with *color*, ● *color* – LED *color* is active

Table 9: Displays of the MS LED

MS LED	Meaning	Notes
○	Supply voltage is out of range	Switch on the supply voltage and check it at the terminals A1 and A2
☼ Red/green (1 Hz)	Self test or system initialization	Please wait ...
☼ Green (1 Hz)	System is in STOP state	Start the application in samos®PLAN.
☼ Green (2 Hz)	Identify (e.g. for samos®NET)	
● Green	System is in RUN state	
☼ Red (1 Hz)	Invalid configuration	Check the module type and version of the main module and extension modules whose MS LED flashes red/green. If appropriate, adapt the configuration using the samos®PLAN For detailed diagnostics, refer to the samos®PLAN
☼ Red (2 Hz)	Critical error in the system, possibly this module. Application is stopped. All outputs are switched off.	Switch the supply voltage off and on again If the error is not eliminated after multiple repetition, replace the module. For detailed diagnostics, refer to samos®PLAN.
● Red	Critical error in the system, possibly another module. Application is stopped. All outputs are switched off.	Switch the supply voltage off and on again. If the error is not eliminated after multiple repetition, replace the module which displays ☼ Red (2 Hz). If this does not help, use the diagnostic functions of samos®PLAN to narrow down the respective module.

Table 10: Displays of the CV LED

CV LED	Meaning	Note
○	Configuration in progress	
☼ Yellow (2 Hz)	Storing configuration data in the non-volatile memory (SA-MEMORY).	Supply voltage may not be interrupted until the storage process has been completed
☼ Yellow (1 Hz)	Unverified configuration	Verify configuration with the samos®PLAN software
● Yellow	Verified configuration	

EFI1 or EFI2-LED	Meaning	Note
○	OK	
● Red	Waiting for integration of any EFI compatible device or samos®NET station after power up	
☼ Red (1 Hz)	Error, e.g.: • Any expected EFI compatible device or samos®NET station not found within 3 minutes • Integration check failed • Communication interruption • EFI device address conflict • samos®NET ID conflict	Check the wiring. Later integration is still possible.
☼ Red (2 Hz alternating)	Identify, (e.g. for samos®NET)	

Table 11: Displays of the EFI LEDs

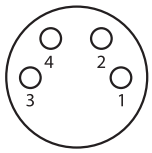
Plug/socket	Pin	Signal	Colour	Assignment PC-sided RS.232 SubD (9 pins)
	1	Reserved	Brown	–
	2	RxD	White	Pin 3
	3	GND (Internally electrically connected with connection A2 of the main module)	Blue	Pin 5
	4	TxD	Black	Pin 2

Table 12: Pin assignment of RS-232 interface

3.7 SP-SDIO input/output extension module

3.7.1 Description

The SP-SDIO module is an input/output extension with eight safety inputs and four safety outputs. It has two test signal generators: One for test output X1 and one for test output X2.
The SP-SDIO module fulfills the following tasks:

- Monitoring of the connected sensor equipment, also refer to Chapter 4.
- Passing on the input information to the main module
- Receiving the control signals from the main module and corresponding switching of the outputs
- Fast Shut Off: Direct switching off of the actuators connected to the module possible with main module SP-SCON or SP-SCON-NET firmware version V1.10.0 or higher and samos®PLAN version V1.1.0 or higher.
  This leads to a considerable reduction of the response time of the overall system. For switching off outputs, only 8 ms have to be added to the response times of the devices connected to the inputs and outputs. The response time on the internal SBUS+ bus as well as the logic execution time are irrelevant in this case. See also section 12.1 “Response times of the samos®PRO system” on page 70.
- Enabling or disabling of test pulses for outputs (Q1–Q4) with firmware version V2.00.0 or higher and samos®PLAN version V1.3.0 or higher.

The SP-SDIO module cannot be used alone and always requires a main module SP-SCON, see the samos®PLAN configuration software. The simultaneous use of several SP-SDIO modules is possible, see Chapter 3.2 "System configuration".

Voltage for the internal logic and the test outputs is supplied from the system plug via the SBUS+ internal bus. Voltage for the SDIO outputs Q1…Q4 must be supplied directly via A1/A2 on the respective module.

NOTES

- Short-circuits can be detected between any test signal generator of SP-SDI or SP-SDIO extension modules, even between different modules, provided that the test gap times are < 4 ms. Short circuits to 24 V DC (stuck at high) at inputs connected to test outputs are detected independently of the test gap time.
- The input I1…I8 LEDs display the input states with a refresh rate of approx. 64 ms.

3.7.2 Display elements, error codes and terminal description

Fig. 6: Display elements SP-SDIO

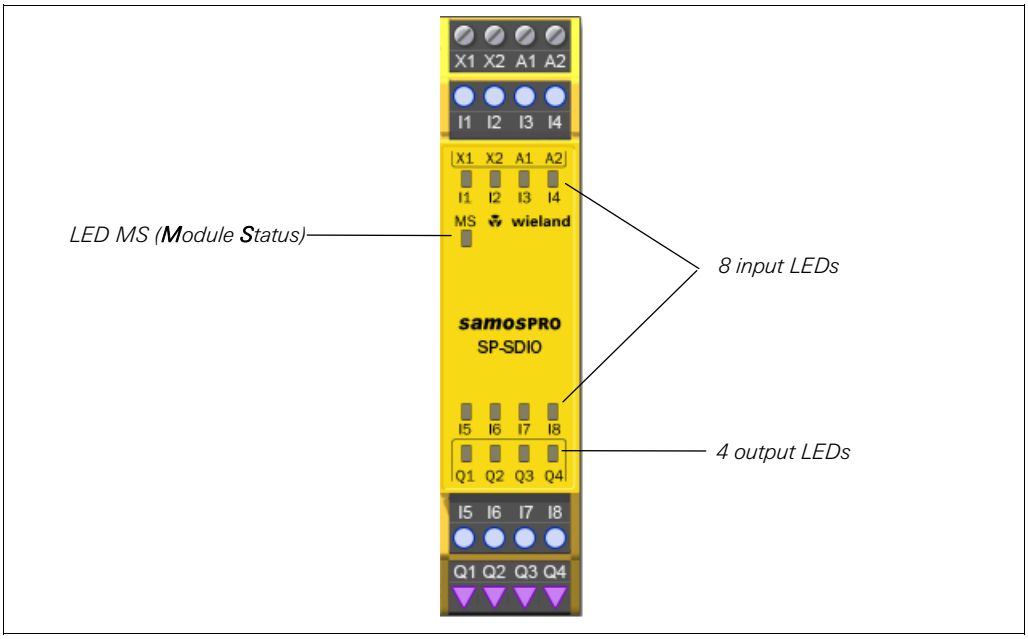


Table 13: Terminal assignment SP-SDIO

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

Legend: ○ – off, ☼ *color* – flashes with *color*, ● *color* – LED *color* is active

MS LED	Meaning	Notes
○	Supply voltage is out of range	Switch on the supply voltage and check it at the terminals A1 and A2
☼ Red/green (1 Hz)	Recoverable external error	Check the wiring of the flashing inputs and outputs. If all output LEDs flash, check the supply voltage at terminals A1 and A2 of this module.
☼ Green (1 Hz)	System is in STOP state	Start the application in samos®PLAN.
● Green	System is in RUN state	
☼ Red (1 Hz)	Invalid configuration	
☼ Red (2 Hz)	Critical error in the system, possibly this module. Application is stopped. All outputs are switched off.	Switch the supply voltage off and on again If the error is not eliminated after multiple repetition, replace the module. For detailed diagnostics, refer to samos®PLAN.
● Red	Critical error in the system, possibly another module. Application is stopped. All outputs are switched off.	Switch the supply voltage off and on again. If the error is not eliminated after multiple repetition, replace the module which displays ☼ Red (2 Hz). If this does not help, use the diagnostic functions of samos®PLAN to narrow down the respective module.

Table 14: Displays of the MS LED

Input LEDs (I1 ... I8) Output LEDs (Q1 ... Q4)	Meaning
○	Input/output is inactive
● Green	Input/output is active
☼ Green (1 Hz), synchronous with red MS LED	Input/output is inactive and there is a correctable error
☼ Green (1 Hz), alternating with red MS LED	Input/output is active and there is a correctable error

Table 15: Displays of the input/output LEDs

3.7.3 Internal circuits

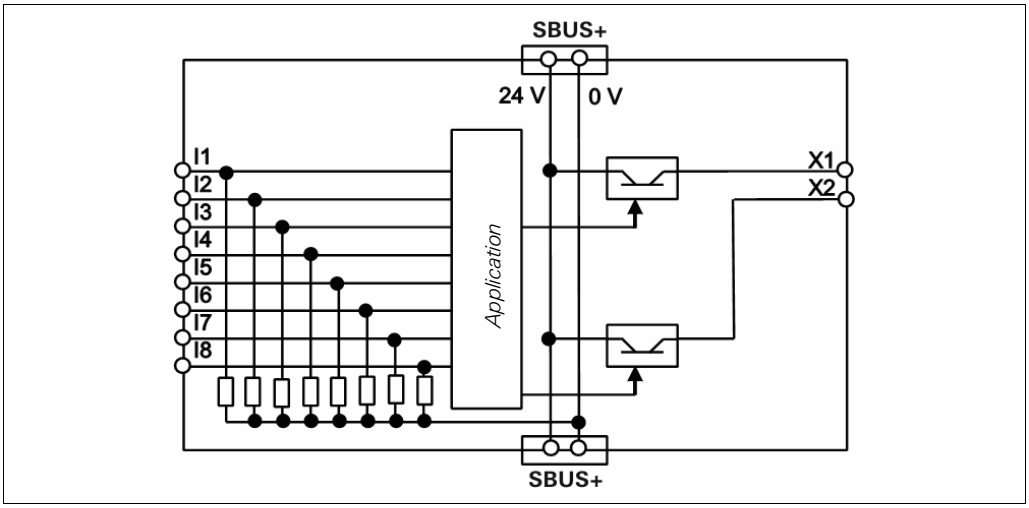
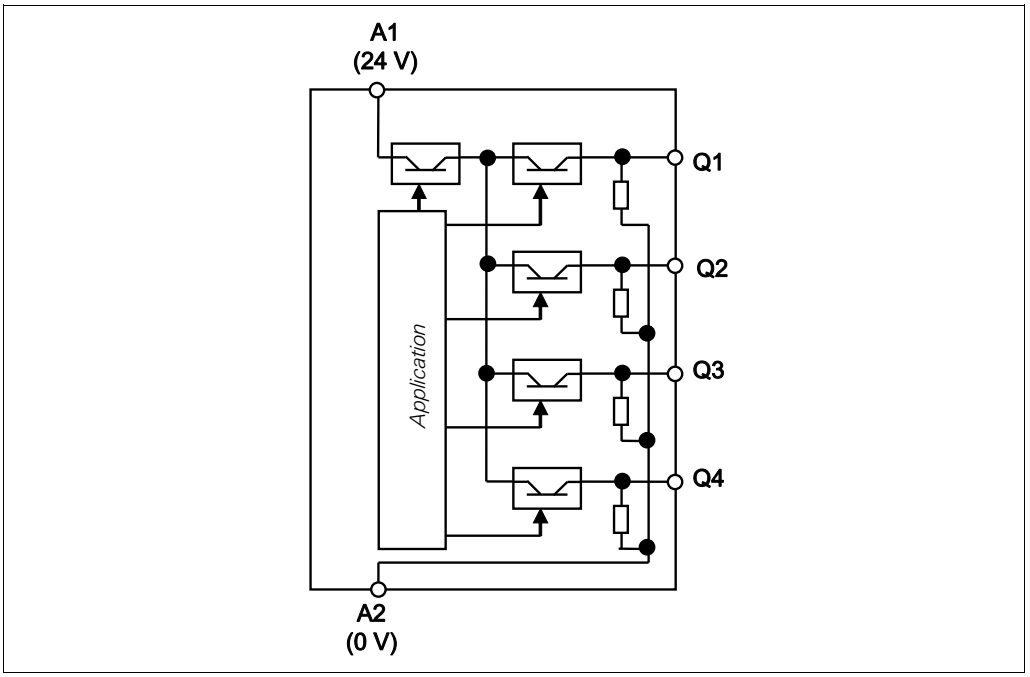


Fig. 7: Internal circuits SP-SDIO – safety inputs and test outputs

Fig. 8: Internal circuits SP-SDIO – safety outputs



3.7.4 Disabling the test pulses of SP-SDIO outputs

WARNING

The SP-SDIO84-P2 modules with firmware version V1.40.0 or higher have outputs were the testpulses are switched off permanently. For detailed information on the safety parameters see chapter 12 "Technical data" on page 60.

It is possible to disable the test pulses on one or several outputs of SP-SDIO84-P1 modules with firmware version V2.00.0 and higher.

WARNING

Disabling the test pulses of any output reduces the safety parameters of all outputs!
Disabling the test pulses of one or more safety outputs of an SP-SDIO module will reduce the safety parameters for all safety outputs Q1…Q4 of this module. Consider this to ensure that your application conforms to an appropriate risk analysis and avoidance strategy!
For detailed information on the safety parameters see chapter 12 "Technical data" on page 60.

Use protected or separate cabling!
If you disable the test pulses of one or more safety outputs, you have to use protected or separate cabling for the safety outputs with disabled test pulses, because a short circuit to 24 V can not be detected if the output is High. This could inhibit the switch-off capability for the other outputs in case of an internal detected hardware failure due to reverse powering.

Perform cyclic tests if the test pulses of any safety output are disabled!
If you disable the test pulses of one or more safety outputs, at least once per year either all safety outputs without test pulses have to be switched off at the same time for at least one second as a result of the logic program of the main module. Alternatively a power reset of the samos®PRO system has to be performed.

How to disable the test pulses of an SP-SDIO output:

- ➡ Connect an output element to the SP-SDIO module.
- ➡ Right click the output element and select **Edit...** from the context menu.
- ➡ Deactivate the option **Enable test pulses of this output**. The test pulses of this output are switched off. A notice will be displayed in the hardware configuration area under the respective SP-SDIO module.

3.7.5 Single channel usage of SP-SDIO outputs

Consider a possible brief High switching of single channel safety outputs!
In case of an internal hardware error, single channel safety outputs (Q1…Q4) can switch temporarily to High once for 10 ms after the error has been detected. Consider this for your risk analysis and reduction strategy. Otherwise the operator of the machine will be in danger.

3.8 SP-SDI input extension module

3.8.1 Description

The SP-SDI module is the input extension with eight safe inputs. It fulfills the following tasks:

- Monitoring of the connected sensor equipment, also refer to Chapter 4.
- Passing on the input information to the main module

The SP-SDI module cannot be used alone and always requires a main module SP-SCON, see the samos®PLAN configuration software. The simultaneous use of several SP-SDIO modules is possible, see Chapter 3.2 "System configuration".
Voltage for the internal logic and the test outputs is supplied from the system plug via the SBUS+ internal bus.

Limited short-circuit recognition!
An SP-SDI has two test signal generators. One test signal generator is responsible for the odd-numbered test outputs X1, X3, X5 and X7, the other for the even-numbered test outputs X2, X4, X6 and X8.

Short-circuits can be detected between any test signal generator of SP-SDI or SP-SDIO extension modules, even between different modules, provided that the test gap times are < 4 ms. Short circuits to 24 V DC (stuck at high) at inputs connected to test outputs are detected independently of the test gap time.

Please be aware that at the SP-SDI the odd-numbered test outputs X1, X3, X5 and X7 are connected to one 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 test outputs X1, X3, X5 and X7 cannot be detected. The same applies respectively for test outputs X2, X4, X6 and X8.

Take this into consideration during the wiring (e.g. separate routing, sheathed cables)!

3.8.2 Display elements, error codes and terminal description

The displays of the MS and CV LEDs as well as the input LEDs I1…I8 are identical with those of the SP-SDIO, see Section 3.7.2.

Fig. 9: Display elements SP-SDI

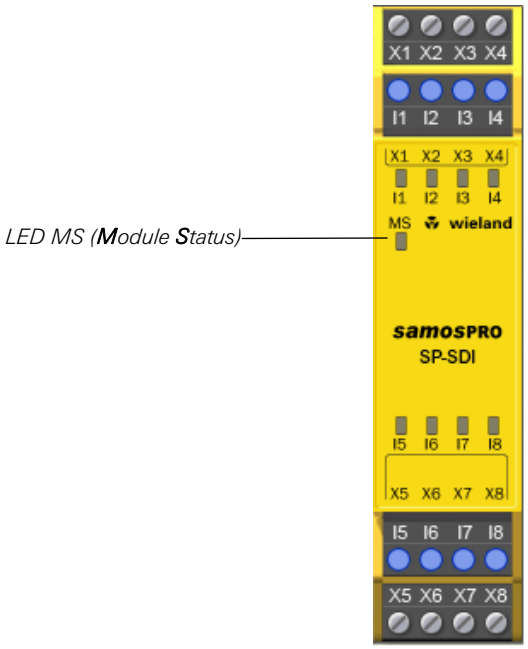
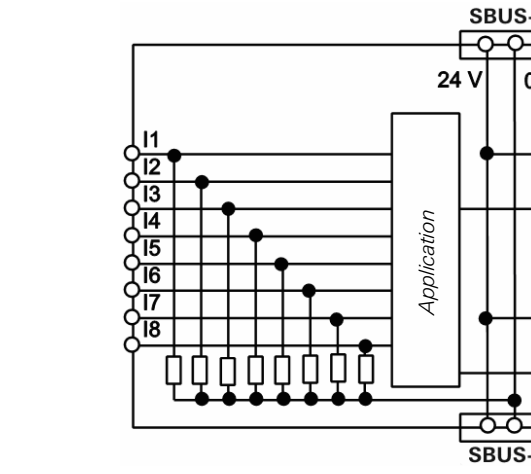


Table 16: Terminal assignment SP-SDI

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

3.8.3 Internal circuits

Fig. 10: Internal circuits SP-SDI – safety inputs and test outputs



3.9 SA-OR-S2/SA-OR-S1 relay output modules

3.9.1 Description

The SA-OR-S2/SA-OR-S1 relay output modules make dual-channel contact-based outputs with "positively driven relay contacts" available.
The SA-OR-S2/SA-OR-S1 relay output modules cannot be used independently, but are switched via an SP-SDIO module. To this purpose a control output of the SP-SDIO module (Q1…Q4) has to be jumpered to a control input of the relay output module (B1, B2), see the following figure.

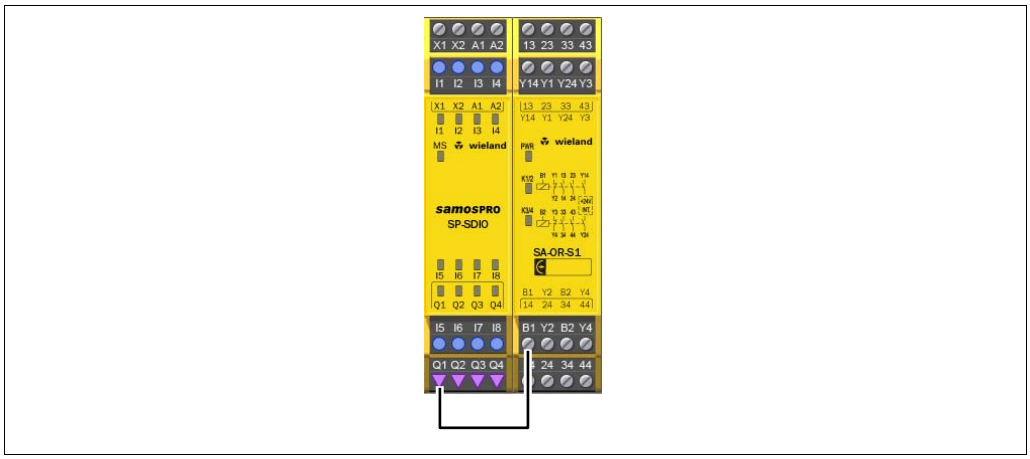


Fig. 11: Example of the inclusion of a relay module in the samos® PRO system

Monitor the feedback contacts using an EDM function block!
It is not sufficient to connect the control outputs B1 or B1/B2. Additionally, the feedback contacts Y1/Y2 on the SA-OR-S1 or the feedback contacts Y1/Y2 and Y3/Y4 on the SA-OR-S2 relais module must be monitored using an EDM function block in the samos®PRO logic editor.

WARNING

The relay output modules are not nodes on the SBUS+. Control signals cannot therefore be received from the main module.

NOTE

A maximum of four SA-OR-S2 relay output modules or eight SA-OR-S1 modules can be connected to a samos®PRO system, i.e. a maximum of 16 safe relay outputs are available.

SA-OR-S2

The SA-OR-S2 has one control input (B1). This controls two internal relays and forms a redundant switch-off path consisting of:

- two safe enabling circuits (13/14, 23/24), dual-channel and floating,
- a signaling circuit (Y14), dual-channel and non-isolated,
- a feedback EDM (Y1/Y2), dual-channel and floating.

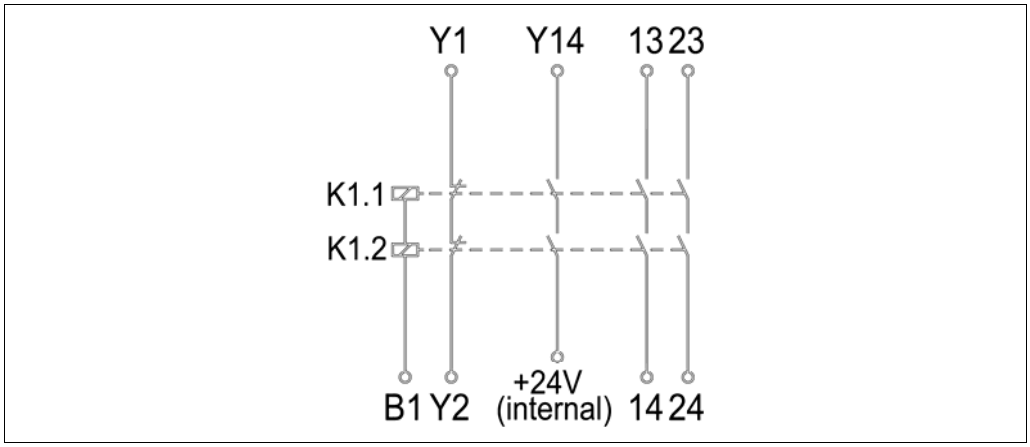


Fig. 12: Internal configuration SA-OR-S2

SA-OR-S1

The SA-OR-S1 has two control inputs (B1, B2). These control two times two internal relays that form two independently redundant switch-off paths.

Control input (B1) controls two internal relays and forms a redundant switch-off path consisting of:

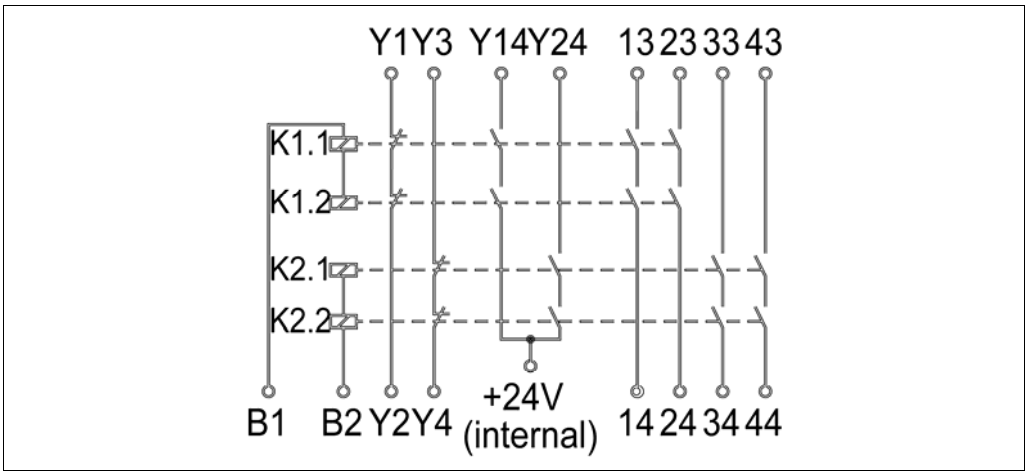
- two safe enabling circuits (13/14, 23/24), dual-channel and floating,
- a signaling circuit (Y14), dual-channel and non-isolated,
- a feedback EDM (Y1/Y2), dual-channel and floating.

Control input (B2) controls two internal relays and forms a redundant switch-off path consisting of:

- two safe enabling circuits (33/34, 43/44), dual-channel and floating,
- a signaling circuit (Y24), dual-channel and non-isolated,
- a feedback EDM (Y3/Y4), dual-channel and floating.

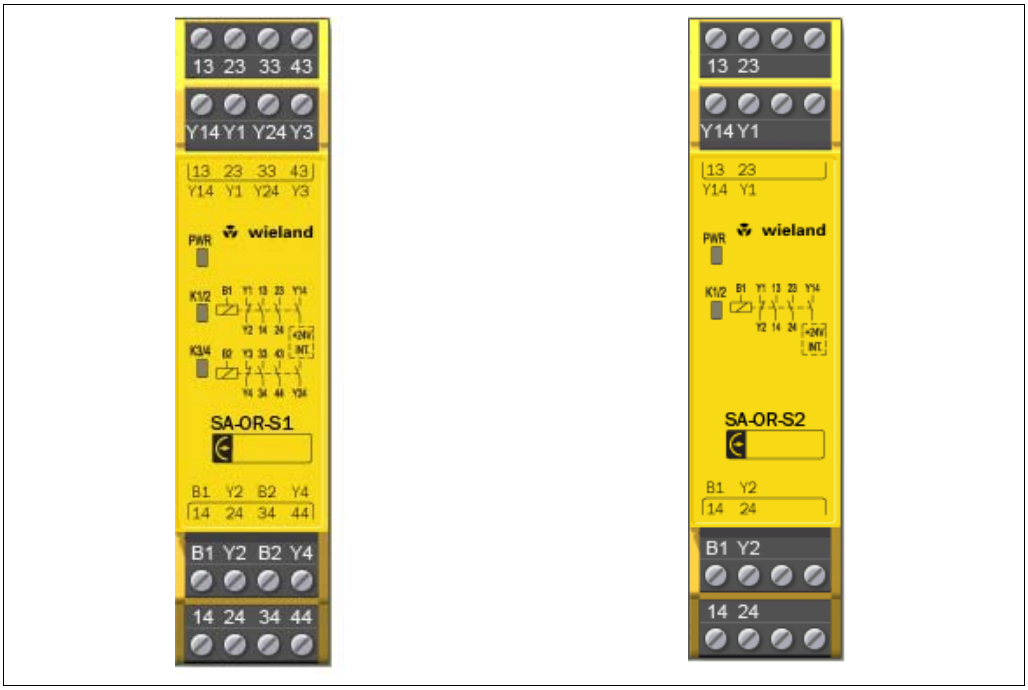
The SA-OR-S1 module thus has double the functionality of an SA-OR-S2.

Fig. 13: Internal configuration SA-OR-S2



3.9.2 Display elements and terminal description

Fig. 14: SA-OR-S1/ SA-OR-S2 display elements



Display	Meaning
PWR (green)	Supply voltage via safety bus is applied
K1/2 (green)	Relay K1/K2 – safety contacts closed
K3/4 (green)	Relay K3/K4 – safety contacts closed

Table 17: SA-OR-S1/ SA-OR-S2 displays

Assignment	Description
B1	Circuiting relay K1/K2
13/14 and 23/24	Safety contacts for switch-off circuit K1/K2
Y1/Y2	Feedback circuit external device monitoring (EDM) (NC contact)
Y14	NO contact safety contact K1/K2, current-limited (see Chapter 12 "Technical data" on Page 60)

Table 18: SA-OR-S1 terminals

Assignment	Description
B1	Circuiting relay K1/K2
B2	Circuiting relay K3/K4
13/14 and 23/24	Safety contacts for switch-off circuit outputs K1/K2
33/34 and 43/44	Safety contacts for switch-off circuit outputs K3/K4
Y1/Y2	Feedback EDM K1/K2 NC contact
Y3/Y4	Feedback EDM K3/K4 NC contact
Y14	NO contact safety contact K1/K2, current-limited (see Chapter 12 "Technical data" on Page 60)
Y24	NO contact safety contact K3/K4, current-limited (see Chapter 12 "Technical data" on Page 60)

Table 19: SA-OR-S2 terminals

4 Connecting devices

This section describes the connection of safety sensors and actuators to the samos®PRO system and provides configuration information for the selected functions.
The samos®PRO system supports applications up to Performance Level (PL) e (in accordance with EN ISO 13849-1) and up to Safety Integrity Level SILCL3 (in accordance with EN 62061).
To this purpose take all the required marginal conditions and evaluate these, for example, in a failure analysis (FMEA).
For further information that has to be taken into consideration during the electrical installation see Chapter 7, Electrical installation.

WARNING

Loss of the safety function through an incorrect configuration!

Plan and carry out configuration carefully!
The configuration of safety applications must be carried out with the greatest accuracy and must match the status and the condition of the machine or system to be monitored.

- Check whether the configured safety application monitors the machine or system as planned and whether the safety of a configured application is ensured at all times. This must be ensured in each operating mode and partial application. Document the result of this check!
- In each case, observe the instructions for commissioning and daily checking in the operating instructions of the protective devices integrated into the safety application!
- Note the warnings and function descriptions of protective devices connected to the safety controller! Contact the respective manufacturer of the protective device if in doubt!
- Take into account that the minimum switch-off time of the connected sensors must be greater than the execution time of the logic (see Chapter 4.6 "Logic editor" in the "samos®PRO Modular Safety Controller – Software" operating instructions and logic editor of the samos®PLAN) so that it is ensured that the samos®PRO system can detect the switching of the sensors. The minimum switch-off time of sensors is usually specified in the technical data of the sensors.

NOTE

- If an odd-numbered test output is used, odd-numbered inputs have to be used. If an even-numbered test output is used, even-numbered inputs have to be used.
- You have to use the test outputs of the module to which the device to be tested is connected.

WARNING

Protect single channel inputs against short circuits and cross circuits!
If a stuck-at-high error occurs on a single channel input with test pulses that was previously inactive, the logic may see a pulse for this signal. The stuck-at-high first causes the signal to become **Active** (High) and then after the error detection time back to **Inactive** (Low) again. Due to the error detection a pulse may be generated. Therefore single channel signals with test pulses need special attention:

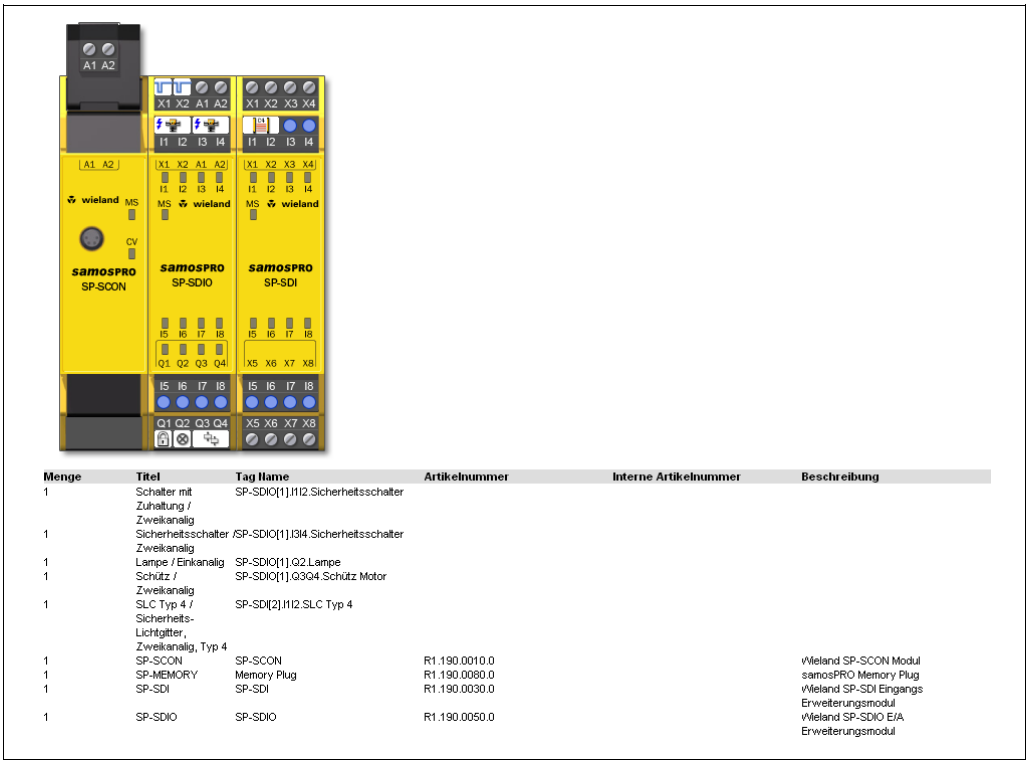
- If the stuck-at-high occurs on a single channel signal input with test pulses that was previously **Active** (High), the logic will see a delayed **Active** (High) to **Inactive** (Low) transition.
- If a single channel input is used and an unexpected pulse or a delayed falling edge at this input may lead to a dangerous situation, the following measures have to be taken:
  – Protected cabling of the related signal (to exclude cross circuits to other signals)
  – No cross circuit detection, i.e. no connection to test output (see the section “Parameterization of connected elements” in the samos®PLAN Software operating instructions.

  This needs especially to be considered for the following inputs:
  – Reset input on the Reset function block
  – Restart input on the Restart function block

– Restart input on the Press function blocks (Eccentric Press Contact, Universal Press Contact, N-break, Press Setup, Press Single Stroke, Press Automatic)
– Override input on a Muting function block
– Reset input on a Valve function block
– Reset input and Reload input on a Counter function block

After the configuration you obtain the following documentations in the samos®PLAN under "Info -> Report":

- Logic report
- Parts list
- Information on wiring



Menge	Titel	Tag Name	Artikelnummer	Interne Artikelnummer	Beschreibung
1	Schalter mit Zuhaltung / Zweikanalig	SP-SDIO[1].I1I2.Sicherheitsschalter			
1	Sicherheitsschalter Zweikanalig	/SP-SDIO[1].I3I4.Sicherheitsschalter			
1	Lampe / Einkanalig	SP-SDIO[1].Q2.Lampe			
1	Schütz / Zweikanalig	SP-SDIO[1].Q3Q4.Schütz Motor			
1	SLC Typ 4 / Sicherheits-Lichtgitter, Zweikanalig, Typ 4	SP-SDI[2].I1I2.SLC Typ 4			
1	SP-SCON	SP-SCON	R1.190.0010.0		Wieland SP-SCON Modul
1	SP-MEMORY	Memory Plug	R1.190.0080.0		samosPRO Memory Plug
1	SP-SDI	SP-SDI	R1.190.0030.0		Wieland SP-SDI Eingangs Erweiterungsmodul
1	SP-SDIO	SP-SDIO	R1.190.0050.0		Wieland SP-SDIO E/A Erweiterungsmodul

Fig. 15: Example extract of the documentation in the samos® PLAN

4.1 Safety command devices and electro-mechanical safety switches

4.1.1 Emergency stop pushbuttons

Table 20: Connection

Electrical connection: Example from samos®PLAN with SP-SDIO					
Single-channel, without testing	24V		I1	NC	Contact between 24 V and I1
Single-channel, with testing	X2		I2	NC	Contact between X2 and I2
Dual-channel, without testing	24V 24V		I3 I4	NC	Channel 1: Contact between 24 V and I3 Channel 2: Contact between 24 V and I4
Dual-channel, with testing	X1 X2		I5 I6	NC	Channel 1: Contact between X1 and I5 Channel 2: Contact between X2 and I6

The dual-channel emergency stop pushbuttons preconfigured in the samos®PLAN have equivalent switching contacts. Corresponding elements for implementing dual-channel antivalent switching contacts are available in the element window under the group of floating contacts.

Table 21: Functions

Function	Notes
Testing	Possible
Series connection / Cascading	Max. number of emergency stop pushbuttons connected in series: Take the max. line resistance of 100 Ω into account (see Chapter 12 "Technical data" on Page 60)
Discrepancy times	4 ms…30 s

NOTES

Further information is available in the respective operating instructions for the emergency stop pushbuttons.

4.1.2 Electro-mechanical safety switches with and without interlock

Table 22: Connection of electro-mechanical safety switches

Electrical connection: Example from samos®PLAN with SP-SDIO		
Single-channel, without testing		Contact between Ub and I1
Single-channel, with testing		Contact between X1 and I1
Dual-channel, without testing		Channel 1: Contact between Ub and I3 Channel 2: Contact between Ub and I4
Dual-channel, with testing		Channel 1: Contact between X1 and I5 Channel 2: Contact between X2 and I6

Table 23: Connection of interlocks

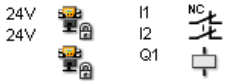
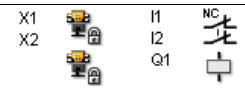
Electrical connection: Example from samos®PLAN with SP-SDIO		
Single-channel, without testing		Contact between Ub and I1 Coil at Q1
Single-channel, with testing		Contact between X2 and I2 Coil at Q2
Dual-channel, without testing		Channel 1: Contact between Ub and I3 Channel 2: Contact between Ub and I4 Coil at Q3
Dual-channel, with testing		Channel 1: Contact between X1 and I1 Channel 2: Contact between X2 and I2 Coil at Q1

Table 24: Functions with electro-mechanical safety switches and interlocks

Function	Notes
Testing	Possible
Series connection / Cascading	The max. number of series-connected emergency stop pushbuttons is determined by the max. line resistance of 100 Ω (see Chapter 12 "Technical data" on Page 60).
Discrepancy times	4 ms…30 s

NOTES

Further information is available in the operating instructions of the electro-mechanical safety switches.

4.1.3 Enabling switch

Electrical connection: Example from samos®PLAN with SP-SDIO		
2 positions, without testing		Channel 1: Contact E31 between Ub and I1 Channel 2: Contact E41 between Ub and I2
2 positions, with testing		Channel 1: Contact E31 between X1 and I3 Channel 2: Contact E41 between X2 and I4
3 positions, without testing		Channel 1: Contact E13 between Ub and I5 Channel 2: Contact E23 between Ub and I6 Channel 3: Contact E31 between Ub and I7 Channel 4: Contact E41 between Ub and I8
3 positions, with testing		Channel 1: Contact E13 between Ub and I1 Channel 2: Contact E23 between Ub and I2 Channel 3: Contact E31 between X1 and I3 Channel 4: Contact E41 between X2 and I4

Table 25: Connection

Function	Notes
Testing	Possible
Series connection	Not possible
Discrepancy times	4 ms…30 s

Table 26: Functions

Further information is available in the respective operating instructions.

NOTE

4.1.4 Two-hand control

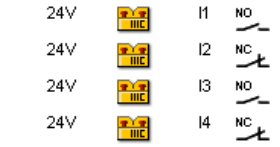
Electrical connection: Example from samos®PLAN with SP-SDIO		
Type IIIA without testing		Channel 1: Contact between 24 V and I1 Channel 2: Contact between X2 and I2
Type IIIC without testing		NC contact between 24 V and I1(I3) NO contact between 24 V and I2(I4)

Table 27: Connection of two-hand control

4.1.4.1 Type IIIA

At Type IIIA two equivalent inputs (NO contacts of the two two-hand buttons) are monitored.
A valid input signal is only generated if the ON state (H level) exists at both inputs within a period of 0.5 s (synchronous change, both two-hand buttons pressed) and if both were in the OFF state (L level) beforehand.

4.1.4.2 Type IIIC

At Type IIIC two pairs of antivalent inputs (NO/NC contact pairs of the two two-hand buttons) are monitored.
A valid input signal is only generated if the ON state (H/L level) exists at both inputs within a period of 0.5 s (synchronous change, both two-hand buttons pressed) and if both were in the OFF state (L/H level) beforehand.

Further information is available in the operating instructions of the two-hand control.

NOTE

4.1.5 Safety mats and bumpers

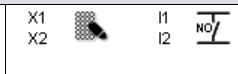
Electrical connection: Example from samos®PLAN with SP-SDIO		
Pressure-sensitive short-circuiting switching mats in 4-wire technology, with testing		Channel 1: Contact between X1 and I1 Channel 2: Contact between X2 and I2

Table 28: Connection of safety mats

Table 29: Function safety mats

Function	Notes
Testing	Possible
Series connection	Possible

WARNING

Ensure that the switch off condition is sufficient!
The switch off condition of safety mats and bumpers must be at least as high as the greatest value for the “test period” of both used test outputs to ensure that the switch off condition is detected and that no sequence error occurs.

NOTE

Further information is available in the operating instructions of the safety mats.

4.1.6 Diode-pair for safety mats

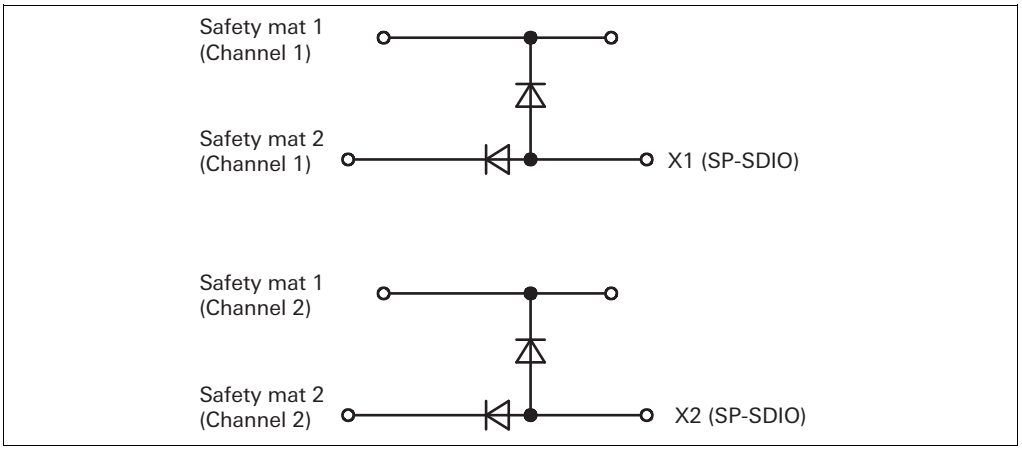
For connecting several short-circuiting switching mats to a SP-SDI or SP-SDIO module, a Wieland Electric terminal block

Type: WKFN 2,5 E/35 GO-URL
Ord.no. 56.703.8755.9

must be be used.

The two internal diodes of this terminal block have a common anode which must be connected to a test output (X1 or X2) of the SP-SDI or SP-SDIO module.
For connecting two independend safety mats, two terminal blocks are necessary.

Fig. 16: Block diagram of internal configuration of WKFN 2,5 E/35 GO-URL



4.1.7 Operating mode selector switch

Table 30: Connection of operating mode selector switch

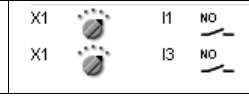
Electrical connection: Example from samos®PLAN with SP-SDIO		
Operating mode selector switch (1 of 2) with testing		Channel 1: Contact between 24 V and I1 Channel 2: Contact between 24 V and I2
Operating mode selector switch (1 of 2) without testing		Channel 1: Contact between X1 and I1 Channel 2: Contact between X1 and I3

Table 31: Function of operating mode selector switch

Function	Notes
Testing	Possible

NOTE

Untested variant switches can be used that allow selections between two and eight operating modes, test variant switches between two and four.

When wiring the tested operating mode selector switches it should be noted that odd-numbered inputs (I1, I3, I5, I7) have to be used if an odd-numbered test output (X1, X3, X5, X7) is used, and even-numbered inputs (I2, I4, I6, I8) have to be used if an even-numbered test output (X2, X4, X6, X8) is used.

Further information is available in the operating instructions of the operating mode selector switch.

4.1.8 Potential-free contacts

The samos®PLAN software makes a series of potential-free contacts available for "free" configuration of contact elements. This allows different NC-/NO-contact combinations with and without testing to be implemented. In addition elements are available for the start and stop button, reset button and external device monitoring (EDM).

Table 32: Function of potential-free contacts

Function	Notes
Testing	Possible
Series connection	Possible
Discrepancy times	see samos®PLAN software

4.2 Non-contact safety sensors

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

4.2.1.1 Magnetic safety switches with equivalent inputs

Table 33: Connection of magnetic safety switches with equivalent inputs

Electrical connection: Example from samos®PLAN with SP-SDIO		
With testing		Channel 1: Contact between X1 and I1 Channel 2: Contact between X2 and I2

4.2.1.2 Magnetic safety switches with complementary inputs

Table 34: Connection of magnetic safety switches with complementary inputs

Electrical connection: Example from samos®PLAN with SP-SDIO		
With testing		NC contact between X1 and I1 NO contact between X2 and I2

Table 35: Functions with magnetic safety switches

Function	Notes
Testing	Possible
Series connection / Cascading	Possible; observe max. line resistance of 100 Ω and correct setting of the test impulse time
Discrepancy times	1500 ms default

NOTES

Further information is available in the operating instructions of the magnetic safety switches.

4.2.2 Inductive safety switches

Table 36: Connection of inductive safety switches

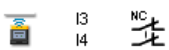
Electrical connection: Example from samos®PLAN with SP-SDIO		
Inductive switch, serial		Test input TE at X1 Output A at I1
Inductive switch		OSSD1 at I3 OSSD2 at I4

Table 37: Functions with inductive safety switches

Function	Notes
Testing	Necessary on inductive switch, serial
Series connection / Cascading	Inductive switch, serial: Up to 6 sensors per input. Max. off-on delay of the cascade 10 ms (otherwise the test gap will lead to switching off). Observe the max. line resistance of 100 Ohm and the correct setting of the test pulse time. Inductive switch: Cannot be cascaded.

NOTES

Further information is available in the operating instructions of the inductive safety switches.

4.2.3 Transponder switch

Table 38: Connection of transponders

Electrical connection: Example from samos®PLAN with SP-SDIO		
without testing		Ub at +LA, I1 at LA Ub at +LB, I2 at LB
with testing		X1 at +LA, I3 at LA X2 at +LB, I4 at LB
with OSSD		Ub at UB (T40), I5 at OA Ub at UB (T40), I6 at OB

Table 39: Functions with transponders

Function	Notes
Testing	Possible, depending on type
Series connection / Cascading	Possible, depending on type

NOTES

For further information refer to the operating instructions of the respective transponder switches.

4.3 Testable single-beam photoelectric safety switches

4.3.1 Testable Type 2 single-beam photoelectric safety switches

Table 40: Connection of testable Type 2 single-beam photoelectric safety switches

Electrical connection: Example from samos®PLAN with SP-SDIO		
SLB type 2		Test input TE (transmitter) at X1 Output Q (receiver) at I1

WARNING

Route the transmitter and receiver lines outside the control cabinet in such a manner that cross-circuiting between these lines can be excluded, for example in separate sheathed cables or in protected areas.

Table 41: Functions with testable Type 2 single-beam photoelectric safety switches

Function	Notes
Testing	Possible
Series connection / Cascading	Depending on type of photoelectric safety switch used. Take the max. line resistance of 100 Ω into account.

NOTE

For further information refer to the operating instructions of the testable Type 2 single-beam photoelectric safety switches.

4.3.2 Testable Type 4 single-beam photoelectric safety switches

Table 42: Connection of testable Type 4 single-beam photoelectric safety switches

Electrical connection: Example from samos®PLAN with SP-SDIO		
SLB type 4		Test input TE (transmitter) at X1 Output Q (receiver) at I1

WARNING

Route the transmitter and receiver lines outside the control cabinet in such a manner that cross-circuiting between these lines can be excluded, for example in separate sheathed cables or in protected areas.

Function	Notes
Testing	Necessary
Series connection / Cascading	Max. 10 pairs per input Take the max. line resistance of 100 Ω into account

Table 43: Functions with testable Type 4 single-beam photoelectric safety switches

NOTE

For further information refer to the operating instructions of the testable Type 4 single-beam photoelectric safety switches.

4.3.3 Customized testable single beam photoelectric safety switches

For information on how to create customized elements please see the samos®PLAN operating instructions (Wieland doc. no. BA000518).

Note

In the Settings dialog for the customized element, select the minimum value for the desired test gap.

Regardless of the test gap, the overall off-on-delay of the cascade must be smaller than the Max. off-on delay of the respective test output (as shown in the samos®PLAN report) – 2 ms. Otherwise the test gap will lead to switching off. For SP-SDIO or SP-SDI modules this value is = 12 ms – 2 ms = 10 ms.

Use protected or separate cabling for the test output of the module (X1...X8) to the test input of the transmitter and for the output of the receiver to the safety input of the module (I1..I8). Otherwise a cross circuit between these signals can inhibit the error detection by this test.

4.3.4 Information for mounting testable single-beam photoelectric safety switches

NOTES

Observe the information for mounting in the operating instructions of the respective sensors and in particular the following points:

- Single-beam photoelectric safety switches may only be used as access protection in accordance with pr EN 13855. Usage as finger and hand protection is not permissible.
- Observe the minimum distance to reflective surfaces.
- It is imperative that the safety distance between the light beam and hazardous point be observed at access protection.

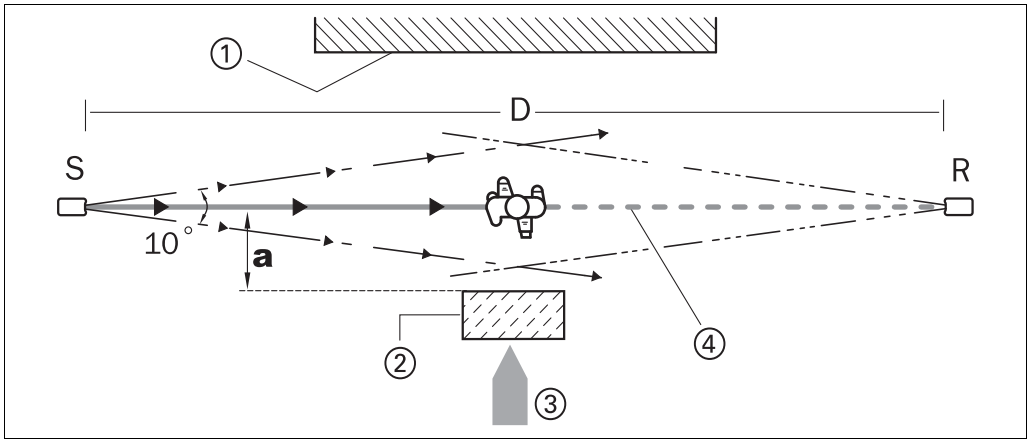


Fig. 17: Minimum distance "a" to reflective surfaces, correct mounting and alignment

S = Sender R = Receiver D = Distance between sender and receiver

1 = Limit to hazardous area
2 = Reflective surface
3 = Direction of access to hazardous area
4 = Optical axis
a = Minimum distance from reflective surfaces

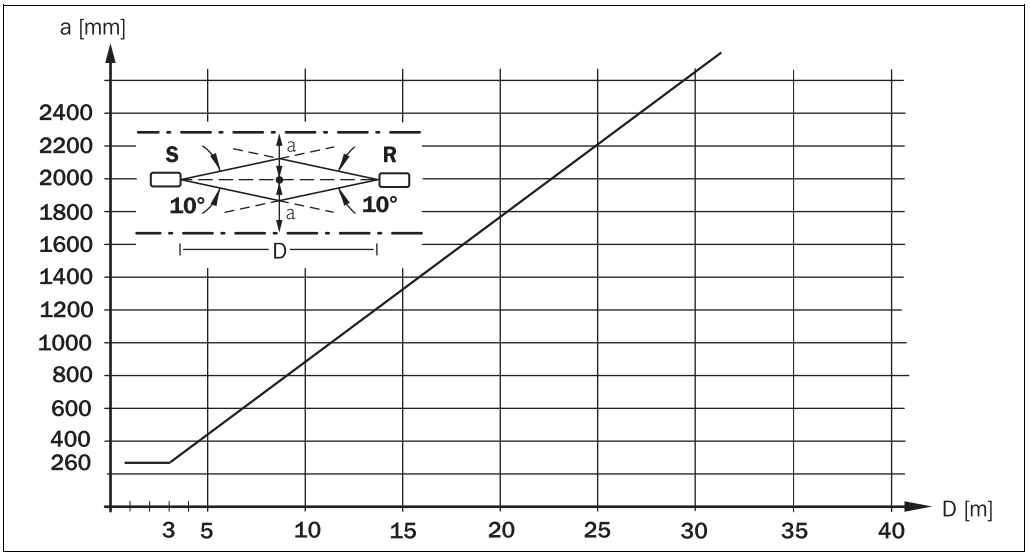


Fig. 18: Minimum distance "a" as a factor of the distance "D" for testable single-beam photoelectric safety switches with a field of view of 10°

NOTE

Diagrams for photoelectric safety switches are available in the respective operating instructions.

4.3.4.1 Avoiding mutual influence at single-beam photoelectric safety switches and between cascades

- If several single-beam photoelectric safety switch pairs are used, the field of view of the sensors has to be observed in order to prevent mutual influence.
- If the senders are only mounted on one side, the light beams may not overlap on the receiver side so that the light beam of one sender does not reach two receivers.
- If the senders and receivers are mounted alternatively, ensure that the light beam of Sender S1 cannot be received by Receiver R3 and that the light beam of Sender S3 cannot be received by Receiver R1.

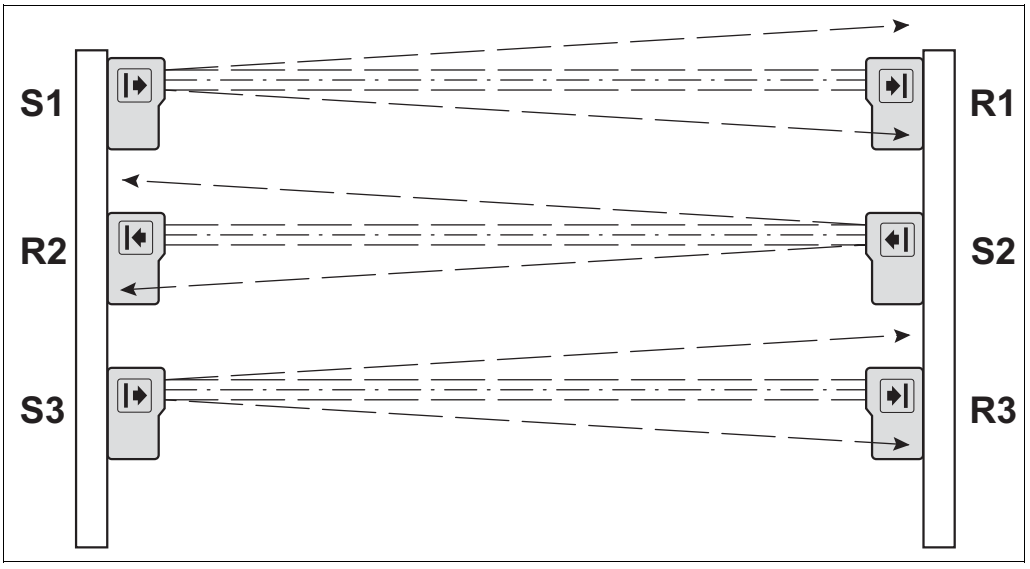


Fig. 19: Mounting to avoid mutual optical influence

4.4 Electro-sensitive protective equipment (ESPE)

Table 44: Connection ESPE

Electrical connection: Example from samos®PLAN with SP-SDIO		
SLC type 2, SLC type 3, SLC type 4		OSSD1 (receiver) at I1 OSSD2 (receiver) at I2

NOTE

Further information is available in the operating instructions of the corresponding ESPE.

4.5 Safety Outputs

Safety-oriented devices must be suitable for safety related signals!

A function interruption of safety outputs results in a loss of the safety functions so that the risk of serious injury exists.

- Do not connect any loads that exceed the rated values of the safety outputs.
- Wire the samos®PRO system so that 24 V DC signals cannot unintentionally contact safety outputs.
- Connect the GND wires of the power supply to earth so that the devices do not switch on when the safety output line is applied to frame potential.
- Use suitable components or devices that fulfil all the applicable regulations and standards.

Actuators at the outputs can be wired single-channeled. In order to maintain the respective Safety Integrity Level the lines have to be routed in such a manner that cross circuits to other live signals can be excluded, for example by routing them within protected areas such as in a control cabinet or in separate sheathed cables.

4.6 samos®NET

4.6.1 samos®NET overview

samos®NET allows you to combine up to four samos®PRO stations via EFI for safe data communication. Only SP-SCON-NET main modules can be used in a samos®NET system, the connection of SP-SCON modules is not possible.
The process data of each station (inputs and outputs, logic results etc.) can be made available immediately to all other stations in the samos®NET system. The Teach function allows to temporarily deactivate single stations without impairing the function of the overall system.

Features

- Safe connection of up to four samos®PRO stations via EFI
- Connection via EFI 1 or EFI 1 and 2
- Transfer/receive up to 52 bit of information per station (26 bit per EFI channel)
- Each bit can be assigned a global tag name
- Teaching simulates the presence of temporarily suspended (switched off) stations
- Any station can be used to address and configure the entire system
- The configuration of the entire samos®NET system is stored in a single project file

4.6.2 EFI communication and EMC

The EFI is a safe communication interface between devices of the samosPRO system.

Cables

Wieland Electric offers a 5-wire cable for the connection of EFI-compatible devices (see section 13.1 "Available modules and accessories" on page 73).
The 5-wire cable has a high EMC rating and can be used up to a length of 100 m. The 5 wires are typically used for the EFI1, EFI2, 24 V DC, 0 V DC contacts and for the functional earth.

Table 45: Cable types

Cable length	Type
Up to 40 m	2 × 2 × 0.25 mm²
40 to 100 m	2 × 2 × 0.34 mm²

Connecting the EFI cable to FE

To increase the EMC resistance of the bus communication, it is important to connect the EFI cable shield on one or both sides to functional earth.
Connect this shield to the same DIN rail to which the functional earth (FE) of the samos®PRO system is connected in order to minimize interferences on the EFI cable. The connection of the shield to FE should be close to the cable inlet of the control cabinet.

NOTES

- The FE terminal of the samos®PRO system is located at the bottom of the housing and connects automatically to the DIN rail when the module is mounted.
- If other cables are present within the same cable duct where the EFI cable is routed and these cables emit a high degree of EMC interference (drives or motor related), this can lead to availability problems in the application. In this case, it is recommended to install the EFI cable in a separate duct.

4.6.3 System requirements and restrictions

The minimum system requirements for samos®NET are as follows:

Table 46: Minimum system requirements for samos® NET

System component	Minimum version
Hardware	SP-SCON-NET with firmware version V2.00 or higher
Software	samos®PLAN version 1.3.0 or higher

The samos®NET system can be connected using only EFI 1 or using both EFI 1 and 2. The overall number of status bits per station that can be made available to the other stations in the samos®NET system depends on the connection method:

Table 47: Available status bits depending on the connection method

Connection method	Available status bits per station
EFI 1	26
EFI 1/2	52

4.6.4 Connection of a samos®NET system

Do not use buffering elements in a samos®NET system!
It is not allowed to use buffering elements such as e.g. CAN bridges, CAN repeaters or CAN optical light barriers in a samos®NET system. As a general rule, no components other than samos®PRO stations are allowed.

WARNING

There are two possibilities for wiring a samos®NET system:

- Connection via EFI1 (26 bits)
- Connection via EFI1 (26 bits) and EFI2 (26 bits)

Either way, always the identically named terminals have to be connected (e.g. EFI1 A on station A with EFI1 A on station B etc.).

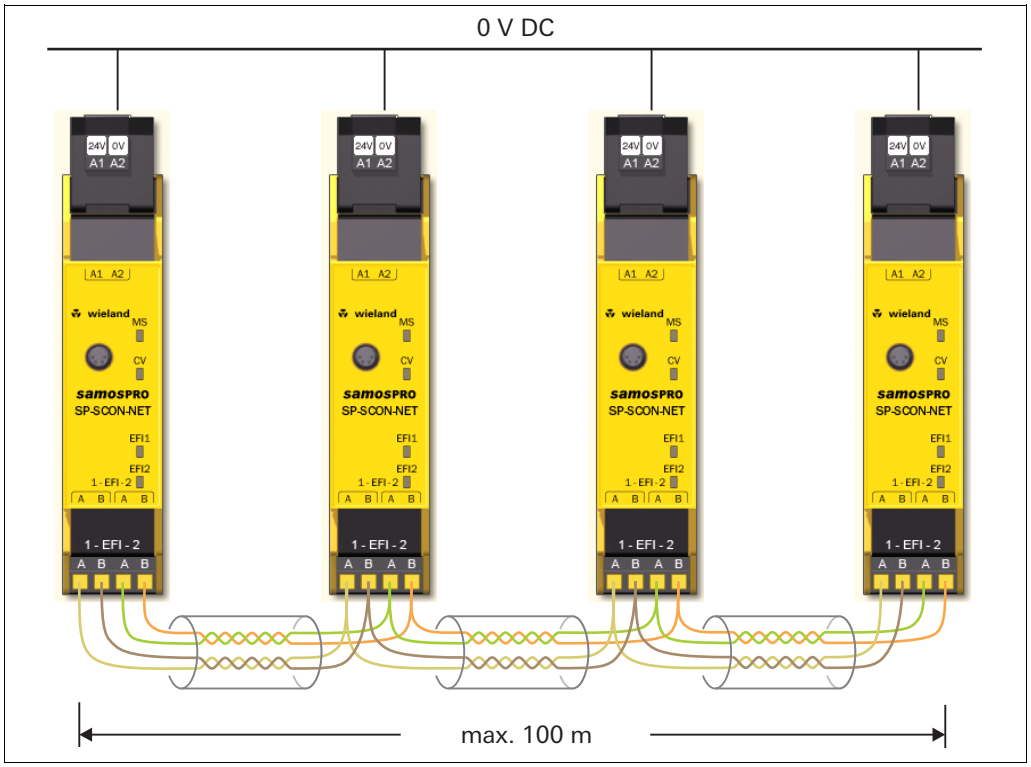


Fig. 20: Connection of samos® NET stations via EFI1 and EFI2

NOTES

- No termination is required for EFI connections on the CPU.
- Stub lines or star-shaped wiring are not permitted.
- The max. permitted cable length for EFI1 and EFI2 is 100 m each.
- Unused conductors must be connected to FE on both ends.

For suitable cables please see section 13.1 "Available modules and accessories" on page 73.

EMC measures

samos®NET cables are used for transferring communication signals. Electromagnetical influences may disturb the signal transfer and interrupt the samos®NET communication. In order to minimize electromagnetical interference, the following measures are required:

➡ Connect all inactive metallic parts (control cabinet doors and housing, mounting rails etc.) to the same reference potential.

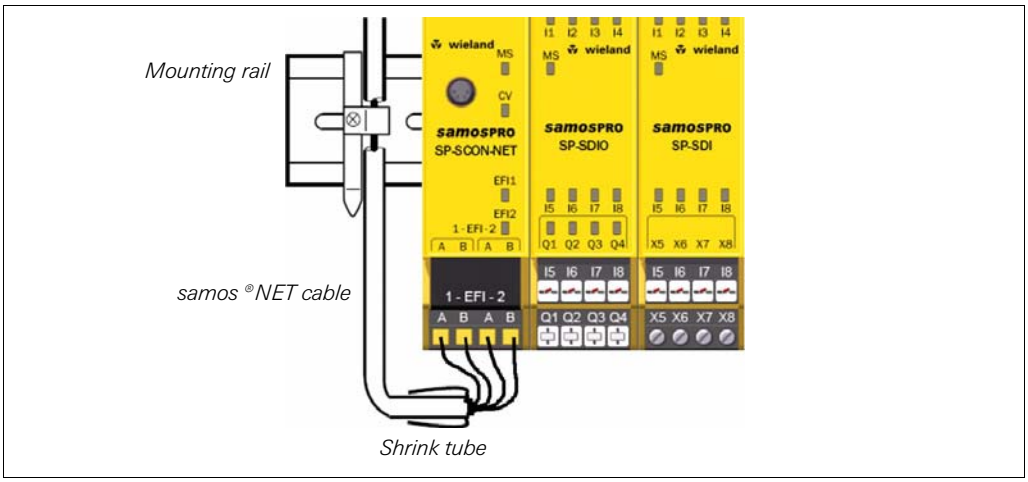
➡ Connect the reference potential to the protective earth conductor.

➡ Connect the protective earth conductor to the external earth potential.

➡ Connect the shield of the shielded cables to the reference potential directly at the entrance to the system (control cabinet, frame, mounting rail) using suitable cable clamps. The cable clamps must completely enclose the cable shield.

➡ Connect the cable shield **again** to the reference potential as close as possible to the SP-SCON-NET (e.g. on the mounting rail) using suitable cable clamps. The cable clamps must completely enclose the cable shield.

Fig. 21: Connection of the samos® NET cable shield to the mounting rail



➡ Keep the stripped cable ends as short as possible.

➡ Isolate the screening braiding end e.g. with a suitable shrink tube.

NOTES

- All connections must be made electrically well conducting with low impedance.
- Stub lines or star-shaped EFI wiring are not permitted.
- Load cables (e.g. for frequency changers, electronic speed controllers, contactors, brakes etc.) and small-signal cables (e.g. measuring lines, analog sensors, field bus lines etc.) must be layed separately and with low inductive coupling.

Potential equalisation

➡ Always connect the cable screen on both sides to earth potential. Be aware that the earth potential may differ on the earth connections. If this is the case, you must install an additional potential equalisation. Follow the relevant standards and regulations.

5 Special functions

5.1 Muting

Muting is the automatic temporary bypassing of all the safety-oriented functions of the control system or of the safety device. Muting is used when certain objects, such as pallets with material, may be moved into the hazardous area. During this transportation through electro-sensitive protective equipment (ESPE), such as a safety light curtain, the muting function suppresses monitoring by the ESPE.
Observe the information in the "samos®PLAN – Software" operating instructions for the further procedure.

6 Mounting/Dismantling

This chapter describes the mounting of the modules of the samos®PRO safety controller.

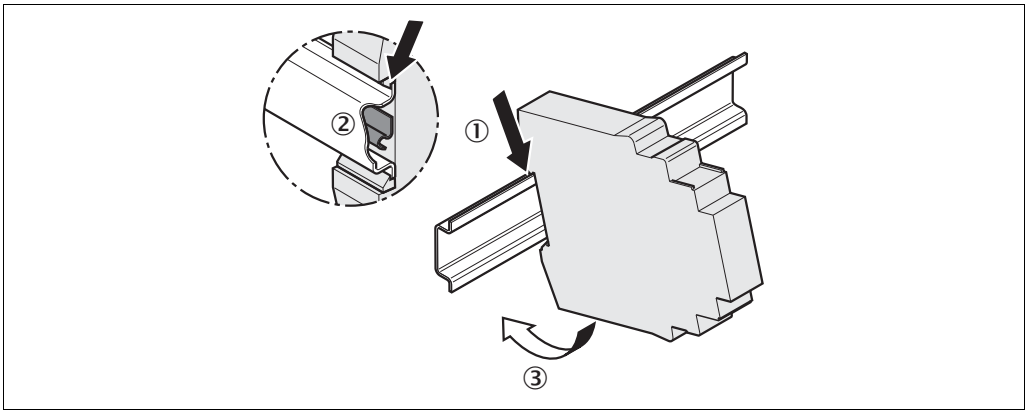
6.1 Steps for mounting the modules

WARNING

The samos®PRO system is only suitable for mounting in a control cabinet with at least IP 54 enclosure rating.

- In a samos®PRO system the main module SP-SCON or SP-SCON-NET is positioned at the far left.
- The two optional gateways follow directly to the right of the main module.
- Connect further samos®PRO extension modules (e.g. SP-SDIO or SP-SDI) on the right side of the gateways or on the right side of the main module, if no gateway is used.
- Connect any additional relay modules (UE410-2RO or UE410-4RO) on the far right of the entire samos®PRO system.
- The modules are located in a 22.5 mm wide modular system for 35 mm DIN rails to EN 60715.
- The modules are connected to each other via the SBUS+ plug connection integrated in the housing. Take into account that, when replacing a module, the samos®PRO modules have to be pushed approx. 10 mm apart before the corresponding module can be removed from the DIN rail.
- Mount the modules in accordance with EN 50274
- Ensure that suitable ESD protective measures are taken during mounting. Otherwise the SBUS+ bus may be damaged.
- Take suitable measures to ensure that foreign matter does not enter the connector openings, in particular that of the system plug.

Fig. 22: Mounting the module onto the DIN rail



➡ Hang the device onto the DIN rail (1).
➡ Ensure that the earthing spring contact is positioned correctly (2). The earthing spring contact of the module must contact the DIN rail securely to allow electrical conductivity.
➡ Latch the module onto the DIN rail by pressing it lightly in the direction of the arrow (3).

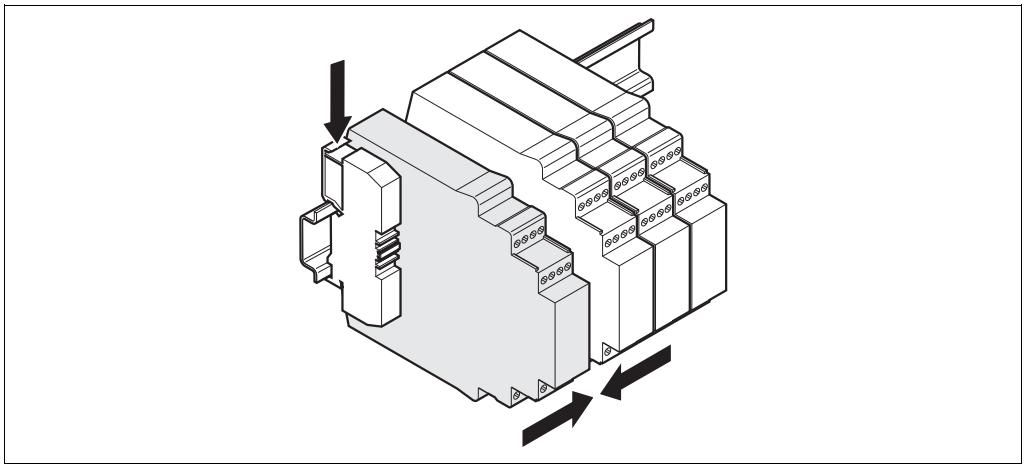


Fig. 23: Installing the end clips

➡ If there are several modules, slide the modules together individually in the direction of the arrow until the side plug connection latches in.
➡ Install the end clips on the right and left.

The following steps are necessary after mounting:

- Completing the electrical connections (Chapter 7)
- Configuration ("samos®PLAN – Software" operating instructions)
- Checking the installation (Chapter 9.2)

6.2 Steps for dismantling the modules

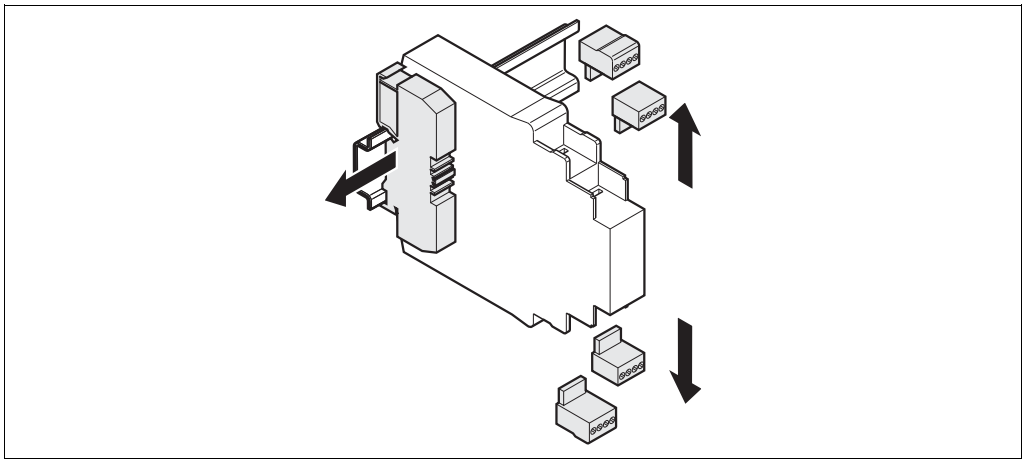
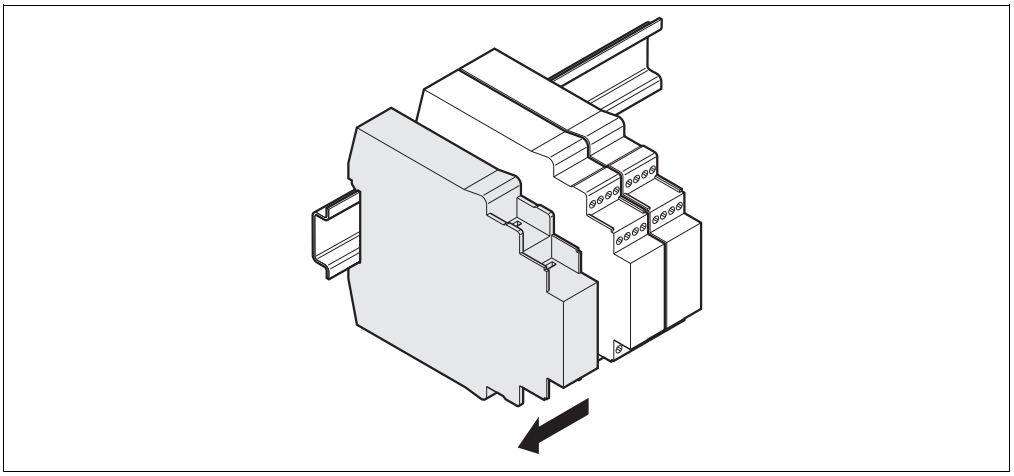


Fig. 24: Removing the removable terminals

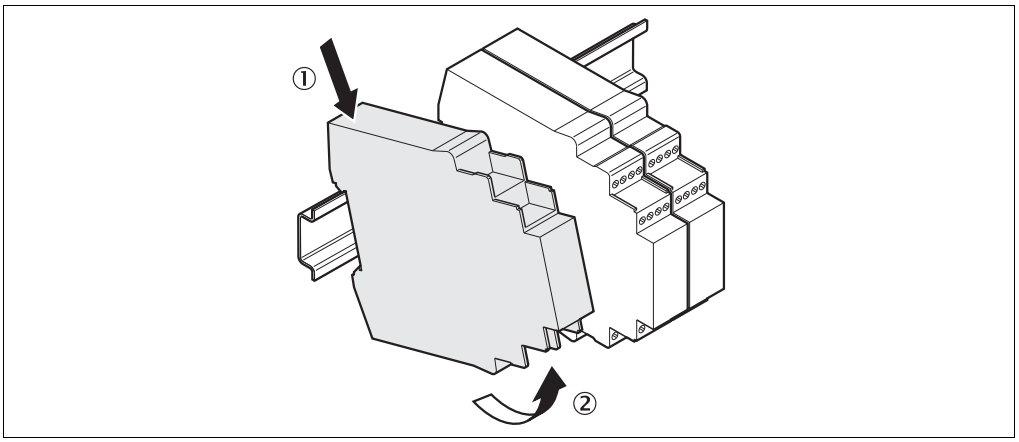
➡ Remove the removable terminals with wiring and the end clips.

Fig. 25: Disconnecting the plug connections



➡ If there are several modules, slide the modules away from each other individually in the direction of the arrow until the side plug connection is separated.

Fig. 26: Removing modules from the DIN rail



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

7 Electrical installation

7.1 Electrical installation requirements

NOTE

This chapter deals with the electrical installation of the samos®PRO system in the control cabinet. You will find additional information on the electrical connection of other devices to the samos®PRO system in the section on the respective device in chapter 4 “Connecting devices” on page 30.

WARNING

Switch the entire machine/system off line!
The system could start up unexpectedly while you are connecting the devices.

Observe the relevant safety standards!
All safety related parts of the installation (cabling, connected sensors and actuators, configuration settings, EDM) must be according to the relevant safety standards (e.g. IEC 62 061 or ISO EN 13 849-1). This may mean that safety related signals need to be redundant or that single channel signals need protected wiring or short circuit detection by using test outputs and/or periodical function tests.

- Take into account that short circuits between test outputs and the corresponding input cannot be detected.
- Consider if protected or separate cabling is required for these signals.

NOTES

- The samos®PRO safety controller fulfils the EMC requirements in accordance with the basic specification EN 61 000-6-2 for industrial use.
- WIELAND ELECTRIC industrial safety devices are designed for local DC supply applications only. If the device is used in power supply networks, e.g. according to IEC 61 326-3-1, additional protective measures have to be taken.
- Machines where safety devices are used must be installed and designed according to the Lightning Protection Zone (LPZ) according to EN 62 305-1. Required immunity levels can be achieved through the use of external protective devices. The installed surge protective devices (SPD) should meet the requirements according to EN 61 643-11.
- The installation must prevent common mode disturbances according to IEC 61 000-4-16 in the frequency range from 0 Hz to 150 kHz.
- To ensure full electromagnetic compatibility (EMC), the mounting rail has to be connected to functional earth (FE).
- The samos®PRO system must be mounted in a control cabinet with at least IP 54 enclosure rating.
- Electrical installation in accordance with EN 60 204-1
- The voltage supply of the devices must be capable of buffering brief mains voltage failures of 20 ms as specified in EN 60 204-1.
- The voltage supply has to fulfil the regulations for extra-low voltages with safe separation (PELV) in accordance with EN 60 664 and EN 50 178 (equipment of electrical power installation with electronic devices).
- You must connect all modules of the samos®PRO system, the connected protective devices (e.g. the EFI devices) as well as the voltage supply/ies with the same 0 V DC (GND). The GND of the RS-232 interface is connected internally to the GND of the supply of the main module (A2).
- If the RS-232 interface at the main module is used as an alternative to a gateway, the maximum permissible cable length is 3 m.
- Avoid ground loops between the GND of the RS-232 interface and the connection A2 of the main module, e.g. by using optocouplers.
- Depending on the external loads, especially for inductive loads, additional external protective elements, e.g. varistors or RC elements may be necessary in order to protect the safety outputs. For operating limits see section 12 “Technical data” on page 70. Take

into account that the response times may increase, depending on the type of protective element.

- If a module is replaced the correct terminal assignment has to be guaranteed, for example by labelling or suitable cable routing.
- If standing behind the protective devices (e.g. safety light curtain) is possible, mount the reset button so that it cannot be actuated by a person located in the hazardous area. When operating the control device of the reset button, the operator must have full visual command of the hazardous area.

WARNING

Limited short-circuit recognition!
An SP-SDI has two test signal generators. One test signal generator is responsible for the odd-numbered test outputs X1, X3, X5 and X7, the other for the even-numbered test outputs X2, X4, X6 and X8.

Short-circuits can be detected between any test signal generator of SP-SDI or SP-SDIO extension modules, even between different modules, provided that the test gap times are < 4 ms. Short circuits to 24 V DC (stuck at high) at inputs connected to test outputs are detected independently of the test gap time.

Please be aware that at the SP-SDI the odd-numbered test outputs X1, X3, X5 and X7 are connected to one 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 test outputs X1, X3, X5 and X7 cannot be detected. The same applies respectively for test outputs X2, X4, X6 and X8.

Take this into consideration during the wiring (e.g. separate routing, sheathed cables)!

Reverse current at SP-SDIO/SP-SDI inputs in case of ground interruption
In case of an internal or external ground interruption there can be a reverse current from the power supply of the main module (system plug terminal A2) to the safety inputs I1…I8 of SP-SDIO/SP-SDI modules. This must be considered if other inputs are connected in parallel to these inputs, so that this reverse current does not lead to an unintended High level at the parallel connected inputs.

7.2 Internal circuit power supply

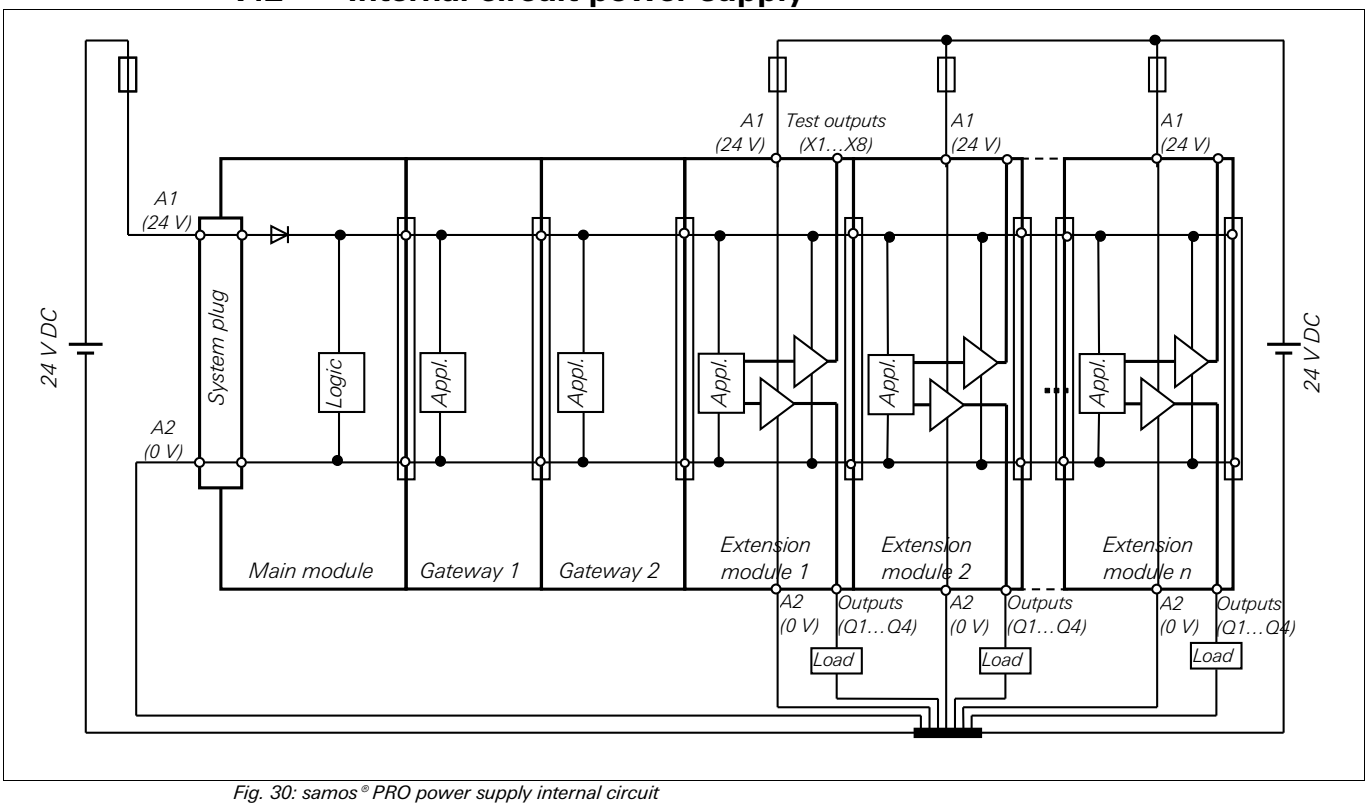


Fig. 30: samos® PRO power supply internal circuit

8 Configuration

Check the safety function before commissioning and after every change!

If you change the configuration, you must check the effectiveness of the safety function. Please observe the test notes in the operating instructions of the connected protective devices.

NOTES

The samos®PLAN software and the system plug are required to configure the samos®PRO system.

Configuration and verification of devices that are connected to the safety controller is generally not carried out via the samos®PLAN software. These devices have their own mechanisms for configuration and verification. One exception are EFI-compatible devices connected to the samos®PRO main module SP-SCON-NET (the EFI compatible devices can be found under “EFI elements” in the elements window). These devices can be configured directly in the samos®PLAN by double-clicking the icon, or alternatively configured and verified locally at the device via its RS-232 interface. The WIELAND ELECTRIC configuration and diagnostics software CDS is required for the configuration of the EFI-compatible devices.

- The system configuration of the complete samos®PRO system (with exception of the EFI-compatible devices) is stored in the system plug. This offers the advantage when extension modules or gateways are replaced that the system does not have to be reconfigured.
- The data stored in the system plug is retained when the voltage supply is interrupted.
- The transfer of configuration information via the EFI interface is possible.

9 Commissioning

Do not commission without a check by qualified personnel!
- Before initial commissioning of a system using a samos®PRO safety controller, it must be checked and released by qualified personnel.
- Check the hazardous area!

Ensure that no one is located in the hazardous area before commissioning.
- Check the hazardous area and secure it against being entered by people (e.g. set up warning signs, attach blocking ropes or similar). Observe the relevant laws and local regulations.

9.1 Full approval of the application

System commission may only be carried out if full approval was successful. Full approval may only be performed by professionals trained accordingly.
The full approval includes the following items to be checked:

- ➡ Check whether the attachment of components to the connections corresponds to the required Safety Integrity Level in accordance with EN 954-1 or EN 62061 and/or EN 13849-1.
- ➡ Check the devices connected to the safety controller in accordance with the test notes from the accompanying operating instructions.

NOTE The "Test before the first commissioning" chapter can be found for this in the operating instructions of the ESPE from Wieland Electric GmbH.

- ➡ Clearly mark all the connection cables and plugs at the safety controller in order to avoid confusion. Since the samos®PRO system has several connections of the same design, ensure that loosened connection cables are not connected back to the wrong connection.
- ➡ Check the signal paths and the correct inclusion in higher-level controllers.
- ➡ Check the correct data transfer from and to the samos®PRO safety controller.
- ➡ Check the logic program of the safety controller.
- ➡ Perform a complete validation of the safety functions of the system in each operating mode and an error simulation. Observe the response times of the individual applications in particular.
- ➡ Completely document the configuration of the system, the individual devices and the result of the safety check.
- ➡ In order to prevent unintentional overwriting of the configuration, activate the write protection of the configuration parameters of the samos®PRO system. Modifications are only possible if the write protection has been deactivated.

NOTE The software for the configuration documentation is available on the Internet under
http://www.wieland-electric.com
samos®PRO CD (see ordering information in the appendix)

9.2 Tests before the initial commissioning

The purpose of the initial commissioning tests is to confirm the safety requirements specified in the national/international rules and regulations, especially in the Machine and Work Equipment Directive (EC Conformity).

- ➡ Check the effectiveness of the protective device at the machine, using all the selectable operating modes and functions.
- ➡ Ensure that the operating personnel of the machine fitted with the safety controller become instructed by the qualified personnel of the machine owner before beginning work. Arranging the instruction is the responsibility of the machine owner.

10 Diagnostics

10.1 In the event of faults or errors

Cease operation if the cause of the malfunction has not been clearly identified!
Stop the machine if you cannot clearly identify or allocate the error and if you cannot safely remedy the malfunction.

Complete functional test after remedying malfunction!
Carry out a full functional test after a malfunction has been remedied.

10.2 ERROR operating states

With certain malfunctions or a faulty configuration, the samos®PRO safety controller enters the safe status. The LEDs of the individual modules of the safety controller indicate the corresponding error level.

Depending on the error there are different error levels:

Configuration error

- The system will be in state 'Configuration required' (MS LED flashes red, 1Hz).
- Applications in all modules are in operating state ‘Stop’.
- All safety outputs in the system are switched off.
- All safety process data is set to zero. Typically also not safety related process data is set to zero.

Recoverable error

- Applications in all modules remain in operating state 'Run' (MS LED of the effected modules flashes red/green alternating (1 Hz), MS LED of not effected modules glows green).
- If safety outputs are effected, then at least these safety outputs in the system are switched off.
- If safety inputs are effected, then at least the process data for these safety inputs are set to zero.

Critical fault

- The system will be in state Critical fault (MS LED of the module which detected the critical fault flashes red, 2 Hz). MS LED of the modules which are unclear about the error origin glows red).
- Applications in all modules are in operating state Stop.
- All safety outputs in the system are switched off.
- All safety process data is set to zero. Typically also not safety related process data is set to zero.

How to place the device back in operation:

➡ Rectify the cause of the malfunction in accordance with the display of the MS and CV LEDs.

➡ In the case of critical faults, switch the voltage supply of the samos®PRO off for at least 3 seconds and back on again.

10.3 Error displays of the status LEDs, error messages and rectification measures

This section lists and describes the most important error codes, possible causes and potential rectification measures. These error messages can be displayed in the **Diagnostics** standard view of the samos®PLAN if you are connected to the samos®PRO system.

NOTES

- For information on how to perform diagnostics see the "samos®PRO Hardware" operating instructions, chapter "Diagnostics standard view".
- Error displays for the individual modules and error elimination are described in the chapters on the individual modules, see chapters 3.5 to 3.8.3.

LED indication on module		Possible error codes	Possible reasons	Possible measures
Main module (SP-SCON or SP-SCON-NET)	**Extension module (SP-SDIO or SP-SDI)**			
MS = ☼ Red (1 Hz)	All extension modules: MS = ☼ Red (1 Hz) (firmware V2.00.0) or MS = ☼ Red/green (1 Hz) (firmware V1.xx.0)	Main module: 0x000E4006, 0x00160005, 0x000F0013	Configuration in system plug is incompatible because it is for a different main module type: • System plug has been used before in a system with different main module type (e.g. SP-SCON instead of SP-SCON-NET or vice versa). • Wrong main module type is used in the hardware installation.	• Download a configuration with the same main module type as in the hardware installation. • Replace the main module in the hardware installation by a module with the same module type as selected in the project file.
		Main module: 0x00170005, 0x000F0013	Configuration in system plug is incompatible because it is for a newer firmware version of the main module: • System plug has been configured for an incompatible higher main module firmware version (e.g. V2.00.0 instead of V1.11.0). • An older main module firmware version is used in the hardware installation.	• Download a configuration with the same or a smaller CPU firmware version (e.g. V1.xx instead of V2.xx). • Replace the main module in the hardware installation by a module with an equal or higher firmware version selected in the project file.
		Main module: 0x000E4013, 0x00274006	Configuration in system plug is incompatible for at least one extension module: • Extension module is missing in the hardware installation.	• Download a configuration with a matching list of extension modules. • Add missing extension module in the hardware installation.
		Main module: 0x000E0006, 0x0005000D. SP-SDIO/SP-SDI: 0x4901, 0x4904	Configuration in system plug is invalid: • The last configuration procedure has not been completed successfully, e.g. because the power supply has been turned off before writing to the system plug has been completed. • System plug hardware failure. • The system plug is empty (out-of-the-box value).	• Download the configuration again and ensure that the power supply at the main module is on until the download procedure has been completed. • Replace the system plug and download configuration again.

LED indication on module		Possible error codes	Possible reasons	Possible measures
Main module (SP-SCON or SP-SCON-NET)	**Extension module (SP-SDIO or SP-SDI)**			
MS = ☼ Red (1 Hz) EFI = ☼ Red (1 Hz)	All extension modules: MS = ☼ Red (1 Hz) (firmware V2.00.0) or MS = ☼ Red/green (1 Hz) (firmware V1.xx.0)	Main module: 0x0014000A	If SP-SCON-NET: EFI device address conflict: • There are at least 2 main modules with the same EFI address connected	• Change the EFI device address with samos®PLAN, either of the main module or of the connected device..
		Main module: 0x0015000A	If SP-SCON-NET and samos®NET: Wrong samos®NET ID: • EFI1 and EFI2 is swapped in the wiring. • There is at least 1 main module with a different samos®NET ID connected.	• Check wiring between the samos®NET stations: EFI1 connected with EFI1, and if applies EFI2 with EFI2. • Connect samos®NET stations with matching samos®NET IDs. • Download configuration to all samos®NET stations with same samos®NET IDs.
		Main module: 0x001F0006, 0x00230006	Configuration in system plug is incompatible for at least one extension module: • Wrong type or version of module (whose MS LED is flashing red or red/green). • Too many extension modules are connected.	• Download a configuration with the same module type and the same or a smaller firmware version for all extension modules. • Replace the affected extension module in the hardware installation by a module with the same module type and the same or smaller firmware version as selected in the project file.
MS = ☼ Green (1 Hz) CV = ☼ Yellow (1 Hz)	MS = ☼ Green (1 Hz)	--	System is in Stop state (ready to run).	Start application in samos®PLAN. For automatic start after power up a verification of the project is necessary with samos®PLAN.
MS = ☼ Green (1 Hz) CV = ● Yellow	MS = ☼ Green (1 Hz)	--	System is in Stop state (ready to run).	Start application in samos®PLAN.
MS = ● Green	MS = ● Green	--	System is in operation. No error detected.	--
MS = ● Green	One or more extension modules : MS = ☼ Red/green (1 Hz) (firmware V2.00.0) or MS = ☼ Red (1 Hz) (firmware V1.xx.0) and Q1+Q2+Q3+Q4 = ☼ Green (1 Hz)	SP-SDIO: 0x4804, 0x4806, 0x4807	Module power supply of SP-SDIO is too low or missing.	Check supply voltage at terminals A1 (24 V) and A2 (0 V) at the SP-SDIO module, also under worst case load conditions. Error is reset automatically after approx. 8 seconds, if the error reason no longer exists.

LED indication on module		Possible error codes	Possible reasons	Possible measures
Main module (SP-SCON or SP-SCON-NET)	**Extension module (SP-SDIO or SP-SDI)**			
MS = ● Green	One or more extension modules : MS = ☼ Red/green (1 Hz) (firmware V2.00.0) or MS = ☼ Red (1 Hz) (firmware V1.xx.0) and Q1 or Q2 or Q3 or Q4 = ☼ Green (1 Hz)	SP-SDIO: 0x4701, 0x4704. Main module: 0x0029C006	Short circuit to 24 V or cross circuit in wiring of safety output Q1.. Q4 (whose LED is flashing). • Capacitive load exceeded the allowed maximum value (e.g. by capacitor for spark quenching). • Follow on error in main module (0x0029C006) in combination with SP-SDIO firmware V1.xx.0. • Hardware failure of SP-SDIO module	• Check wiring of effected output. • Check capacitive load. To reset the error all outputs of the effected module have to be turned off from logic of main module by turning off related input signals, e.g. E-stop. Error reset can take up to 8 seconds. Alternatively power cycle the main module (required if 0x0029C006 occurred). • Replace SP-SDIO module.
		SP-SDIO: 0x4702	Short circuit to 0 V in wiring of safety output Q1.. Q4 (whose LED is flashing).	• Check wiring of effected output. To reset the error the effected outputs have to be turned off from logic of main module by turning off related input signals, e.g. E-stop.
MS = ● Green	One or more extension modules : MS = ☼ Red/green (1 Hz) (firmware V2.00.0) or MS = ☼ Red (1 Hz) (firmware V1.xx.0) and I1 or I2 or I3 or I4 or I5 or I6 or I7 or I8 = ☼ Green (1 Hz)	SP-SDIO/SP-SDI: 0x4601	For inputs which are connected to test output: • Short circuit to 24 V or cross circuit in wiring for tested sensors: • Short circuit to 24 V or cross circuit in wiring from X1, X2, .. or X8 to tactile switch or test input of testable input. • Short circuit to 24 V or cross circuit in wiring from tactile switch or output of testable sensor to I1, I2, …or I8. • Defect testable sensor. • Cable interruption in wiring for safety mat: • Cable interruption in wiring from X1, X2, .. or X8 to safety mat. • Cable interruption in wiring from safety mat to I1, I2, …or I8. • Defect safety mat.	• Check wiring of effected input. • Replace testable sensor. To reset the error turn off the effected input (input state Low/Low for equivalent dual channel inputs, Low/High for complementary dual channel inputs) or power cycle the main module.

LED indication on module		Possible error codes	Possible reasons	Possible measures
Main module (SP-SCON or SP-SCON-NET)	**Extension module (SP-SDIO or SP-SDI)**			
MS = ● Green	One or more extension modules : MS = ☼ Red/green (1 Hz) (firmware V2.00.0) or MS = ☼ Red (1 Hz) (firmware V1.xx.0) and I1+I2 or I3+I4 or I5+I6 or I7+I8 = ☼ Green (1 Hz)	SP-SDIO/SP-SDI: 0x4429 or 0x442A	Discrepancy error or sequence error at dual channel inputs (whose LEDs are flashing green): • Cable interruption or short circuit to 0 V at one of both input signals of the input pair. • Hardware failure of sensor, e.g. one of both contacts/outputs is permanently closed (High) or opened (Low). • Defect sensor (one of both signals does not change to the corresponding state to the other input within the configured discrepancy time. • Opening or closing of safety door was too slow so that the 2 contacts switches (e.g. reed contacts) did not switch within the configured discrepancy time. • Only one of both inputs has caused the switch off condition and has changed back to the on condition, without the other input having changed at all (sequence error).	• Check wiring of effected input and check switching capability of both contacts/outputs of the connected sensor. • Check mechanical dependency of both switches. • Replace switch/sensor in hardware installation To reset the error the effected input pair has to be Low/Low for equivalent dual channel inputs and Low/High for complementary dual channel inputs.
MS = ● Red	MS = ● Red	Main module: 0xXXXCXXXX. Extension modules: 0xXXXXCXXX (X= any value)	• Power supply 0 V at SP-SDIO module missing (firmware V1.xx.0 only). • Internal error in extension module. • Internal error in main module.	• Check connection of terminal A2 of SP-SDIO modules to 0 V of power supply. • Check installation for EMC influence (earthing of DIN rail, …). • To reset the error power cycle the main module. • If the error persists, then replace modules.
MS = ● Red	MS = ☼ Red (2 Hz) (with firmware V2.00.0)	Main module: 0xXXXCXXXX. Extension modules: 0xXXXXCXXX (X= any value)	Internal error in extension module (whose MS LED is flashing).	• Check installation for EMC influence (earthing of DIN rail, …). • To reset the error power cycle the main module. • If the error persists, then replace the module whose MS LED is flashing
MS = ☼ Red (2 Hz) (with firmware V2.00.0)	MS = ● Red	Main module: 0xXXXCXXXX. Extension modules: 0xXXXXCXXX (X= any value)	Internal error in main module or in the system.	• Check installation for EMC influence (earthing of DIN rail, …). • To reset the error power cycle the main module. • If the error persists, then replace subsequently main module and extension modules.

LED indication on module		Possible error codes	Possible reasons	Possible measures
Main module (SP-SCON or SP-SCON-NET)	**Extension module (SP-SDIO or SP-SDI)**			
MS = ● Red or ☼ Red (2 Hz)	MS = ● Red or ☼ Red (2 Hz)	Main module: 0x0006C002, 0x0007C002, 0x0001C005, 0x0003C006, 0x0005C006, 0x0029C006, 0x0003C013	• Follow on error for other critical errors. • Disturbance of main module internal signals due to heavy EMC disturbance. • Hardware failure in main module or any extension module.	• Check the other diagnosis messages for critical faults with almost the same time stamp. • To reset the error power cycle the main module. • If error persists, then replace subsequently main module and extension modules.
		Main module: 0x0001C013, 0x0004C013, 0x0005C013, 0x000CC013	• SBUS+ communication (backplane communication to I/O modules and to gateways) disturbed due to EMC disturbance. • SBUS+ communication (backplane communication to I/O modules and to gateways) disturbed due to critical fault in I/O modules. In this case this is a follow on error and there will be also other critical faults with almost the same time stamp (+/- 1 s) in the diagnosis history.	• To reset the error power cycle the main module. • Check installation for EMC aspects (FE connection of DIN rail and control cabinet, star wiring of 24 V power supply, local separation of power parts and control parts, …) • Check the other diagnosis messages with almost same time stamp.
		Main module: 0x002AC006	Unequal input data from extension module: • A dual channel input at SP-SDIO module or SP-SDI module has 2 signal dips (High to Low) with a time distance of 2 ms (e.g. test gaps of an OSSD output or bouncing relay contacts). • A signal channel input at SP-SDIO module or SP-SDI module changes state in intervals of 4 ms for a duration of 40 ms or more (e.g. proximity switch to a tooth wheel).	• To reset the error power cycle the main module. • Change the configuration by activating the ON-OFF filter and activating the OFF-ON filter for inputs of the effected SP-SDIO/SP-SDI module. Please be aware that this increases the response time for this signal by at least 8 ms.
		SP-SDIO/SP-SDI: 0xC306	Internal hardware failure of SP-SDIO or SP-SDI module.	• To reset the error power cycle the main module. • Replace SP-SDI/SP-SDIO module in hardware installation.
		SP-SDIO/SP-SDI: 0xC307	• Power supply at terminal A2 (GND) of SP-SDIO module interrupted. • Internal hardware failure of SP-SDIO or SP-SDI module.	• Check supply voltage at terminals A1 (24 V) and A2 (0 V) at the SP-SDIO module, also under worst case load conditions. • To reset the error power cycle the main module. • If the error persists, replace SP-SDI/SP-SDIO module in hardware installation.

LED indication on module		Possible error codes	Possible reasons	Possible measures
Main module (SP-SCON or SP-SCON-NET)	**Extension module (SP-SDIO or SP-SDI)**			
MS = ● Green	All extension modules: MS = ● Green	Main module: 0x000A0011	Function block error with dual channel input evaluation (e.g. Emergency stop, Magnetic switch): Discrepancy error at pair 1 of function block: • Cable interruption or short circuit to 0 V at one of both input signals of the input pair. • Hardware failure of sensor, e.g. one of both contacts/outputs is permanently closed (High) or opened (Low). • Defect sensor (one of both signals does not change to the corresponding state to the other input within the configured discrepancy time. • Opening or closing of safety door was too slow, so that the 2 contacts switches (e.g. reed contacts) did not switch within the configured discrepancy time.	• Check the wiring of the effected input and check switching capability of both contacts/outputs of the connected sensor. • Check mechanical dependency of both switches. • Replace switch/sensor in hardware installation To reset the error the effected input pair has to change within the configured discrepancy time from Low/Low to High/High for equivalent dual channel inputs, from Low/High to High/Low for complementary dual channel inputs.
		Main module 0x00100011	• Function block error (EDM or Valve monitor): Feedback signal did not follow the control signal within the max. feedback delay time. • Hardware failure of connected relay/valve or failure in the wiring. • Used relay/valve has greater switching delay for monitor contact.	• Increase Max. feedback delay time of the function block, if acceptable for the application. • Replace relay/valve in the hardware installation.

LED indication on module		Possible error codes	Possible reasons	Possible measures
Main module (SP-SCON or SP-SCON-NET)	**Extension module (SP-SDIO or SP-SDI)**			
All LEDs temporarily off and then LED test sequence.	All LEDs temporarily off and then LED test sequence.	Main module: 0x002D4006	• Power supply of main module had short voltage dip (to almost 0 V). • Power supply of main module had a voltage drop (approx. down to 6 V…16 V) and increased back to operating range.	• Ensure that power supply is capable to buffer power interruption up to 20 ms. • Ensure that power supply is capable to drive the load, so that switching of loads does not cause a drop of the supply voltage. • Check power supply wiring of main module. Use separate wires to other heavy loads to avoid voltage drops on the supply cable by other load currents.
		Main module: 0x003E4006	The system has performed a restart because interferences have been detected in the SBUS+ communication: • SBUS+ communication (back-plane communication to I/O modules and to gateways) disturbed due to EMC disturbance. • SBUS+ communication (back-plane communication to I/O modules and to gateways) disturbed due to critical fault in any extension module (I/O modules or gateway). In this case this is a follow on error and there will be also other critical faults with almost the same time stamp (+/- 1 s) in the diagnosis history.	• Check installation for EMC aspects (FE connection of DIN rail and control cabinet, star wiring of power supply (24 V and 0 V), local separation of power parts and control parts, …) • Check the other diagnosis messages with almost the same time stamp.

Table 48: Error codes and error messages of the samos® PRO system and possible rectification measures

10.4 Additional error displays of EFI-compatible devices

EFI-compatible devices (see chapter 4.6.2) have extended functions in connection with the SP-SCON-NET main module.

Error displays and error elimination are described in the operating instructions of the corresponding devices.

10.5 Wieland Electric support

If you cannot remedy a malfunction using the information in this chapter, please contact your local Wieland Electric branch.

NOTE When you send in a SP-MEMORY system plug for repair or analysis, it is returned in the state of delivery, i.e. with an empty configuration. Therefore save your configuration(s) to project files with samos®PLAN.

10.6 Extended diagnostics

The samos®PLAN contains extended diagnostic possibilities. If you cannot identify what kind of error is occurring or if you have serviceability problems, it allows you to locate the error more accurately.

For detailed information refer to the operating instructions of the samos®PLAN software.

11 Maintenance

The following section informs about regular tests and the exchange of samos®PRO modules.
Do not try to dismantle, repair or modify the samos®PRO modules. This can lead to a loss of the safety function(s). In addition Wieland Electric GmbH accepts no claims for liability.

11.1 Regular inspection of the protective device by qualified personnel

- ➧ Check the system at the inspection intervals specified in the national rules and regulations. This procedure ensures that any changes on the machine or manipulations of the protective device are detected before use/re-use.
- ➧ Each safety application must be checked at an interval specified by you. The effectiveness of the protective device must be checked by authorised commissioned persons.
- ➧ If any modifications have been made to the machine or the protective device, or if the safety controller has been changed or repaired, the system must be checked again as specified in the checklist in the Annex.
- ➧ Carry out regular or daily inspections in order to keep the samos®PRO modules in an optimal operating mode.
- ➧ Check whether the implementation of the samos®PRO modules fulfills all the technical data of the device.
- ➧ Check the mounting conditions and whether the wiring of the samos®PRO modules has been carried out correctly.
- ➧ Regularly verify that the safety functions fulfil the requirements of the application as well as all the regulations and standards (e.g. regular checking) in order to ensure the reliability of the safety functions.

11.2 Device replacement

A fault in the samos®PRO modules impairs the complete network. Devices that have faults must therefore be repaired or replaced rapidly. We recommend keeping spare devices of the samos®PRO modules at hand so that network operation can be re-established as fast as possible.

11.2.1.1 Safety measures for replacing devices

Observe the following safety measures when replacing the samos®PRO modules:

- Do not try to dismantle or repair the samos®PRO modules. Not only does Wieland Electric accept no claims for liability, but it is also dangerous because checking of the original safety functions is not possible in this case.
- Reset the device into a state in which safety is ensured.
- Carry out replacement only when the voltage supply is switched off in order to avoid an electric shock or unexpected device behaviour.
- In order to continue using the system configuration check:
  - Whether the new module is of the same type (same material number) and whether there is no error at the new module after the replacement and
  - That the new module is plugged at the same position as the replaced module.
- Otherwise you have to completely reconfigure and commission the new system, including all the necessary tests (see Chapter 9, "Commissioning" to this purpose).

NOTE

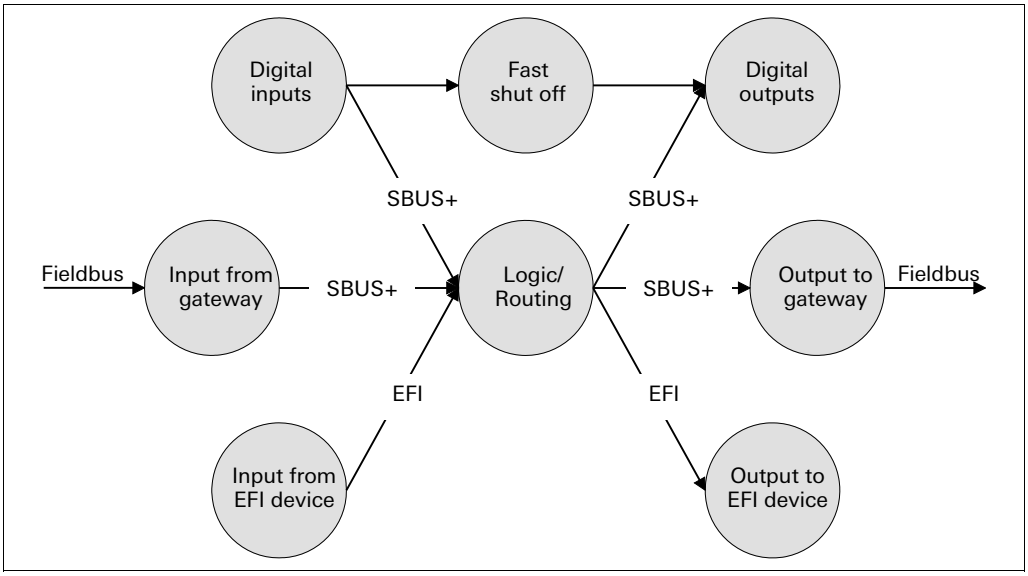
- After the replacement ensure that no errors arise with the new samos®PRO modules.
- Always carry out a function test before commissioning a replacement module.
- If you send in samos®PRO modules for repair, enclose a brief detailed description of the problem with the device and send the samos®PRO modules to Wieland Electric.

12 Technical data

12.1 Response times of the samos®PRO system

In order to calculate the response times of a samos®PRO system, all paths have to be taken into consideration.

Fig. 27: Response times within a samos® PRO system



Fast Shut Off

The Fast Shut Off function can be realised on a single SP-SDIO input/output extension module. A response time of 8 ms can be reached this way.

NOTE

The Fast Shut Off function has only an effect on the inputs and outputs of the same SP-SDIO input/output extension module.

samos®NET

The response time in a samos®NET system is increased for a remote input compared to a local input by 4.5 ms + 2 × logic execution time of the remote samos®NET station.

12.1.1 Calculation of the response times

The following table can be used to calculate the response times of corresponding paths within the samos®PRO system.

Evaluation		
1.) Response time of the considered input in the signal path	E1 or E2 or E3 (from table below)	
2a.) Response time of the logic	2 × logic execution time[1]	
	Delay through logic application[2] (e.g. On- or Off-delay function block)	
2b.) Response time of the routing (applies only for output to gateway)	No delay	0
3.) Response time of the considered output in the signal path	A1 or A2 or A3 (from table below)	
Total response time		

Occurrence	**Digital inputs**	
General	Response time of the sensor[3]	
General	Input processing time	6.5
If On/Off filter enabled	+ min. 8.0 ms[4]	
If I1 … I8 is connected at the test output X1 … X8	+ Max. off-on delay[1] of used test output	
a) Safety mats and bumpers b) Testable type 4 sensors (e.g. L41) c) All other sensors if test gap[1] is > 1 ms	+ Additional response time (see Table 50) + Test period[1] of the test output + Test gap[1] of the test output	
	Total E1	

Digital outputs	
Response time of the actuator	
Output processing time a) from logic (via SBUS+): + 4.5 ms b) from Fast Shut Off: + 1.5 ms	
Total A1	

Logic/Routing

Occurrence	**Input from EFI device**	
If EFI functions are used via EFI-compatible devices	Response time of the EFI data source (as a rule a sensor) for external OSSDs via EFI[3] or samos®NET remote station	
Constant: a) samos®NET	+ 0.5 ms	
	Total E2	

Output to EFI device	
Response time of the message receiver (e.g. scanner with protective field switching via EFI)[3]	
EFI cycle time of the EFI receiver[3] Constant: a) samos®NET: + 4 ms	
Total A2	

Occurrence	**Gateway — data from the network**	
General	Response time field bus for data input to gateway (e.g. from PLC)[3]	
General	2 × internal update interval for data from the gateway to the main module[5]	
a) If 1 gateway b) If 2 gateways	+ 5 ms + 1 ms	
	Total E3	

Gateway — data to the network	
Response time field bus for data from gateway (e.g. to PLC)[3]	
2 × internal update interval for data from the main module to the gateway[5]	
a) If 1 gateway: + 8 ms b) If 2 gateways: + 4 ms	
Total A3	

Table 49: Calculation of the response times of the samos® PRO system in ms

1) Take the values from the samos®PLAN report.
2) Time values have a tolerance of 10 ms, i.e. for each selected value 10 ms must be considered additionally for the response time. E.g. for a 10 ms Off delay, 20 ms must be used for the calculation.
3) Take values from the corresponding operating instructions
4) The switching off is delayed until the signal has been Low for 8 ms at least.
5) The update interval between the SP-SCON(-NET) and a samos®PRO gateway depends on the amount of data to be transferred and the number of gateways used in the system. Take the values from the samos®PLAN report. The update interval amounts to a multiple of 4 ms for each 10 bytes to be transferred to or from the gateway if the system contains one gateway. If two gateways are used the update rate amounts to a multiple of 8 ms.

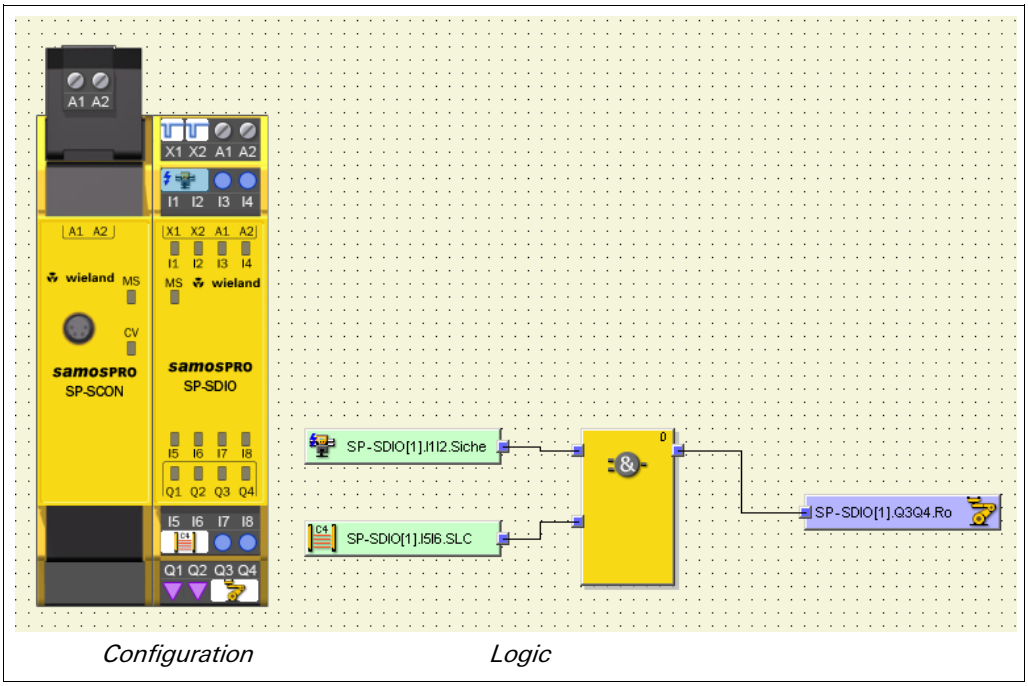
Table 50: Additional response time for safety mats and bumpers if I1 … I8 is connected to test output X1 … X8

Test period of 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
800	800	700 ms
800	1000	800 ms
1000	1000	900 ms

Example 1:

Calculation of the response time for a samos®PRO system consisting of an **SP-SCON** and an SP-SDIO

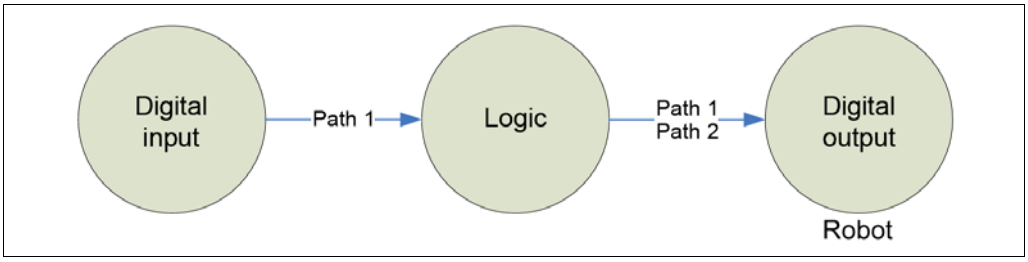
Fig. 28: Example of a samos® PRO system



Digital inputs: SP-SDIO[1].I1I2.: One two-channel safety switch
SP-SDIO[1].I5I6.: One safety light curtain
Digital outputs: SP-SDIO[1].Q3Q4.Robot: Robot, dual-channel

Two paths have to be considered and calculated separately:

Fig. 29: Response times within a samos® PRO system



[1] Take the values from the samos®PLAN report.

Occurrence	Digital inputs	
General	C4000 response time	14.0 ms
General	Input processing time	6.5 ms
When On/Off filter	8.0 ms	–
When X1…X8 is connected at the test output a) Safety mats and switching rails b) Testable sensors Type 4 (e.g. L41) c) All other sensors	 – – –	–
	Total E1	20.5 ms

Logic

Digital outputs	
Robot response time	40.0 ms
Output processing time	7.5 ms
Total A1	47.5 ms

Evaluation		
Response time of the considered input in Path 1	E1	20.5 ms
Response time of logic	2 x logic execution time	8.0 ms
	Delay through logic application	–
Response time of the considered output in Path 1	A1	47.5 ms
Total response time		**76.0 ms**

Table 51: Example for the calculation of the response time of Path 1 of a samos® PRO system

Example 2:

Calculation of the response time for a samos®NET system:

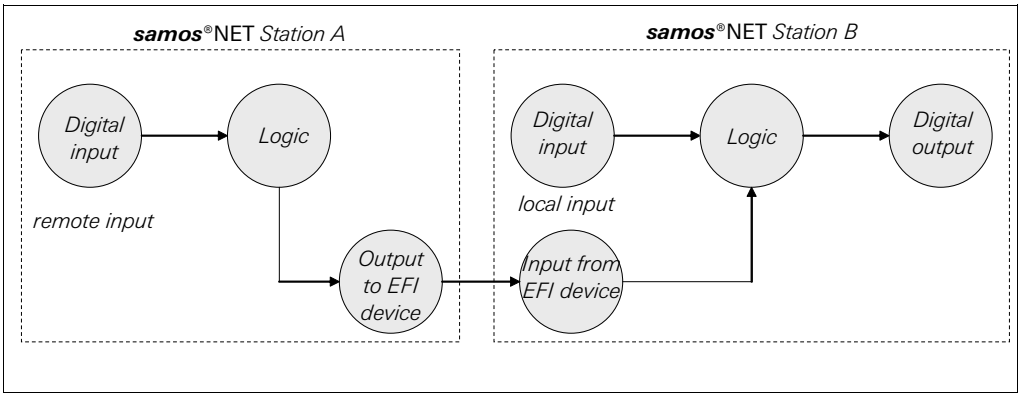


Fig. 30: Response times within a samos® NET system

samos®NET Station A

Logic execution time = 4 ms

samos®NET Station B

Logic execution time = 8 ms

Occurrence	Digital inputs		Logic	Output to EFI device	
General	Tactile sensor	0 ms		Response time of the message receiver (see Table below for samos®NET station B)	
General	Input processing time	6.5 ms			
When On/Off filter	8.0 ms	–		EFI cycle time of the EFI receiver a) Scanner: 24 ms b) Light grid: 4 ms c) samos®NET: 4 ms	4 ms
When X1 … X8 is connected at the test output...		–			
	Total E1	**6.5 ms**		**Total A2**	**4 ms**

Evaluation		
1.) Response time of the considered input in the signal path	E1	**6.5 ms**
2.) Response time of the logic	2 × logic execution time	**8.0 ms**
	Delay through logic application	**–**
3.) Response time of the considered output in the signal path	A1	**4.0 ms**
Total response time (from remote input to EFI)		**18.5 ms**

Occurrence	Input from EFI device		Logic	Digital outputs	
If EFI functions are used via EFI-compatible devices	Response time of the EFI data source (see table above for samos®NET station A)	18.5 ms		Response time of the actuator (Robot response time)	40.0 ms
	Constant (samos®NET)	0.5 ms		Output processing time	4.5 ms
	Total E2	**19.0 ms**		**Total A1**	**44.5 ms**

Evaluation		
Response time of the considered input in the signal path	E2	**19.0 ms**
Response time of logic	2 × logic execution time	**16.0 ms**
	Delay through logic application	**–**
Response time of the considered output in Path 2	A2	**44.5 ms**
Total response time (remote input to local output)		**79.5 ms**

Table 52: Example for the calculation of the response time of a remote input in a samos® NET system

12.1.2 Min. switch-off time

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

- greater than the logic execution time, and
- greater than the test gap + max. off-on delay, if the input is connected to test output X1…X8 and the test gap is > 1 ms, and
- greater than the test period + max. off-on delay, if safety mats or bumpers are used.

12.2 Data sheets

12.2.1 SP-SCON / SP-SCON-NET

Table 53: Data sheet SP-SCON / SP-SCON-NET

	SP-SCON	SP-SCON-NET
Category acc. to EN/ISO 13849	Category 4	
Safety Integrity Level [1)]	SIL3 (IEC 61508), SILCL3 (EN 62061)	
Performance Level [1)]	PL e (EN/ISO 13849)	
PFHd	$1.07 \cdot 10^{-9}$ 1/h	$1.69 \cdot 10^{-9}$ 1/h
T_M service life	20 years	
Ambient temperature in operation	–25…+55 °C	
Storage temperature	–40…+70 °C	
Humidity	10…95%, non-condensing	
Climatic conditions	Acc. to EN 61131-2 (55 °C, 95% rel. humidity)	
Rigidity	5…500 Hz, tested to EN 61131-2	
Enclosure rating acc. to EN/IEC 60529	Terminals: IP 40 Housing: IP 20	
Electromagnetic compatibility	EN 61131-2, EN 61000-6-2, EN 55011 (Class A)	
Number of EFI interfaces	0	2
Protection class	III	
Data interface	Backplane bus (SBUS+)	
Configuration interface	RS-232	
Cross-section of connecting wires	Single-core or finely stranded: 1 x 0.14…2.5 mm^2 or 2 x 0.14…0.75 mm^2 Finely stranded with ferrules to EN 46228: 1 x 0.25…2.5 mm^2 or 2 x 0.25 ... 0.5 mm^2	
EFI connection method	–	Dual level spring clamp terminals
Dimensions (W x H x D)	22.5 x 93.7 x 120.8 mm	
Weight	111 g (+/- 5%)	119 g (+/- 5%)
Power supply (A1, A2) via system plug SP-MEMORY		
Supply voltage	24 V DC (16.8…24…30 V DC)	
Type of supply voltage	PELV or SELV The current of the power supply unit that supplies the main module has to be limited to a maximum of 4 A – either by the power supply unit itself or by a fuse	
Power consumption	Max. 2.5 W	
Switch-on time	Max. 18 s	
Short-circuit protection	4 A gG	

[1)] For detailed information on the safety design of your machine/system, please contact your local Wieland Electric representative.

12.2.2 Datasheet SP-SDIO

Safety specific characteristics

Input configuration (I1…I8)	Single or dual channel input			
Safety output configuration (Q1…Q4)	Dual channel output	Single channel output with test pulses enabled for all outputs	Single channel output with test pulses enabled for this output and disabled for any other output	Single channel output with test pulses disabled for this output
Safety Integrity Level [1] (IEC 61·508)	SIL3	SIL3	SIL3	SIL2
Category (EN ISO 13·849-1)	Category 4	Category 4	Category 3	Category 3
Performance Level [1] (EN ISO 13849-1)	PLe	PLe	PLe	PLd
PFHd (mean probability of a dangerous failure per hour)	2.5×10^{-9}	6.0×10^{-9}	6.0×10^{-9}	18×10^{-9}

Table 54: Data sheet SP-SDIO

T_M service life	20 years
Ambient temperature in operation	–25…+55 °C
Storage temperature	–40…+70 °C
Humidity	10…95%, non-condensing
Climatic conditions	Acc. to EN 61131-2 (55°C, 95% rel. humidity)
Rigidity	5…500 Hz, tested to EN 61131-2
Enclosure rating acc. to EN/IEC 60529	Terminals: IP 40 Housing: IP 20
Electromagnetic compatibility	EN 61131-2 (Zone B), EN 61000-6-2, EN 55011 (Class A)
Protection class	III
Power input via internal bus without currents to X1, X2	max. 1.1 W
Cross-circuit of connecting wires	Single-core or finely stranded: 1 x 0.14…2.5 mm^2 or 2 x 0.14…0.75 mm^2 Finely stranded with ferrules to EN 46228: 1 x 0.25…2.5 mm^2 or 2 x 0.25…0,5 mm^2
Connection method	Two-tier spring terminals
Data interface	Backplane bus (SBUS+)
Dimensions (W x H x D)	22.5 x 93.7 x 120.8 mm
Weight	180 g

Power supply unit (A1, A2)

Supply voltage	24 V DC (16.8…24…30 V DC)
Type of supply voltage	PELV or SELV The current of the power supply unit that supplies the main module has to be limited to a maximum of 4 A – either by the power supply unit itself or by a fuse.
Power consumption	Max. 96 W, determined by the load at the outputs Q1 to Q4
Switch-on time	Max. 18 s
Short-circuit protection	4 A gG (with tripping characteristic B or C)

Input circuit (I1…I8)

Input voltage HIGH	13…30 V DC
Input voltage LOW	–5…+5 V DC
Input current HIGH	2.4…3.8 mA
Input current LOW	–2.5…+2.1 mA
Input reverse current in case of ground interruption [2]	Max. 20 mA 1.5 kΩ effective reverse resistance to power supply
Switching current (with mechanical contacts)	14.4 mA at 5 V 3 mA at 24 V
Input capacitance	Max. 10 nF
Discrepancy times	4 ms…30 s, configurable

[1] For detailed information on the safety design of your machine/system, please contact your local Wieland Electric representative.

[2] Do not switch other safety inputs in parallel, if the reverse current could lead to a High state at the other input.

Number of inputs	8

Control outputs (X1, X2)

Number of outputs	2 (with 2 test pulse generators)
Output type	PNP semiconductor, short-circuit protected, cross circuit monitoring
Output voltage	16…30 V DC
Output current	Max. 120 mA at a test output (X1 or X2) This means that a maximum of 8 testable sensor cascades per module with max. 30 mA each are possible. The total current of the samos®PRO systems is limited to a maximum of 1.28 A. This corresponds to e.g. 32 inputs of testable sensors with 30 mA each and 64 inputs of SP-SDIO or SP-SDI modules.
Test pulse rate	1…25 Hz, configurable
Test pulse duration	1…100 ms, configurable
Load capacity	1 µF for test gap 4 ms 0.5 µF for test gap 1 ms
Cable resistance	< 100

Safety outputs (Q1 … Q4)

Number of outputs	4
Output type	PNP semiconductor, short-circuit protected, cross-circuit monitoring
Output voltage HIGH	24 V DC (16.8…30 V DC)
Leakage current LOW [1]	Max. 0.1 mA
Output current	2 A
Total current Isum	Max. 3.2 A
Test pulse width [2]	< 650 µs or disabled [3] [4]
Test pulse rate	max. 5 Hz
Capacitive load	max. 0.5 µF
Cable resistance [5]	Max. 5 Ω (e.g. 100 m × 1.5 mm² = 1.2 Ω)
Response time	Depending on the logic configuration, for details see chapter 12.1

[1] In the case of a fault (0 V cable open circuit), maximally the leakage current flows in the OSSD cable. The downstream controller must detect this status as Low. An FPLC (Fail-safe Programmable Logic Controller) must be able to identify this status.

[2] When active, the outputs are tested cyclically (brief switching to Low). When selecting the downstream controllers, make sure that the test pulses do not result in deactivation when using the above parameters or disable the test pulses on the outputs.

[3] If safety outputs are used without test pulses, at least once per year either all safety outputs without test pulses have to be switched off at the same time for at least 1 second or alternatively a power reset has to be performed.

[4] If safety outputs are used without test pulses: Use protected or separate cabling for the safety outputs without test pulses, because a short circuit to 24 V can not be detected if the output is High. This could inhibit the switch-off capability for the other outputs in case of an internal detected hardware failure due to reverse powering.

[5] Make sure to limit the individual line core resistance to the downstream controller to this value to ensure that a short-circuit between the outputs is safely detected. (Also note EN 60204 Electrical Machine Equipment, Part 1: General Requirements.)

12.2.3 Datasheet SP-SDI

Table 55: Data sheet SP-SDI

Category acc. to EN 13849	Category 4
Safety Integrity Level	SIL3 (IEC 61508)
Performance Level	PL e (EN 13849-1)
PFHd	6% PFH for SIL3: $5.68 \cdot 10^{-9}$ 1/h
TM service life	20 years
Ambient temperature in operation	–25…+55 °C
Storage temperature	–40…+70 °C
Humidity	10…95%, non-condensing
Climatic conditions	Acc. to EN 61131-2 (55 °C, 95% rel. humidity)
Rigidity	5…500 Hz, tested to EN 61131-2
Enclosure rating acc. to EN/IEC 60529	Terminals: IP 40 Housing: IP 20
Electromagnetic compatibility	EN 61131-2 (Zone B), EN 61000-6-2, EN 55011 (Class A)
Protection class	III
Power input via internal bus without currents to X1… X8	Max. 1.4 W
Cross-circuit of connecting wires	Single-core or finely stranded: 1 x 0.14…2.5 mm^2 or 2 x 0.14…0.75 mm^2 Finely stranded with ferrules to EN 46228: 1 x 0.25…2.5 mm^2 or 2 x 0.25…0.5 mm^2
Connection method	Two-tier spring terminals
Data interface	Internal bus (SBUS+)
Dimensions (W x H x D)	22.5 x 93.7 x 120.8 mm
Weight	150 g
Input circuit (I1…I8)	
Input voltage HIGH	13…30 V DC
Input voltage LOW	–5…+5 V DC
Input current HIGH	2.4…3.8 mA
Input current LOW	–2.5…+2.1 mA
Discrepancy times	4 ms…30 s, configurable
Number of inputs	8
Test outputs (X1…X8)	
Number of outputs	8 (with 2 test pulse generators)
Output type	PNP semiconductor, short-circuit protected, cross-circuit monitoring
Output voltage	16 V DC…30 V DC
Output current	Max. 120 mA at each of the two test signal generators (X1/X3/X5/X7 or X2/X4/X6/X8) This means that a maximum of 8 testable sensor cascades per module with max. 30 mA each are possible. The total current of the samos®PRO systems is limited to a maximum of 1.28 mA. This corresponds to e.g. 32 inputs of testable sensors with 30 mA each and 64 inputs of SP-SDIO or SP-SDI modules.
Test pulse rate	1 Hz ... 25 Hz, configurable
Load capacity	1 µF for test pulse duration 4 ms 0.5 µF for test pulse duration 1 ms
Cable resistance	< 100 Ω

12.2.4 Datasheet SA-OR-S2/SA-OR-S1

Table 56: Data sheet SA-OR-S1/ SA-OR-S2

Supply circuit	
Supply voltage	24 V DC (19.2...30 V DC)
	If SA-OR-S1/4RO is connected and loading of the output current paths: U > 25 V AC/60 V DC (PELV) U < 25 V AC/60 V DC (SELV/PELV)
Power consumption	
SA-OR-S2	Max. 1 W
SA-OR-S1	Max. 2 W
Output circuit (13–14, 23-24, 33-34, 43-44)	
Number of NO contacts	
SA-OR-S2	2
SA-OR-S1	4
Number of NC contacts	
SA-OR-S2	1
SA-OR-S1	2
Switching voltage	250 V AC (5…275 V AC)
	230 V DC (5…275 V DC)
Switching current	10 mA at 5 V 2 mA at 24 V Max. 6 A
Total current	12 A
Response time [1]	30 ms
Output type	Volt-free NO contacts, positively driven
Contact material	$AgSnO_2$ with 1 µm Au
Output circuit fusing	6 A (gG), per current path
Utilisation category	AC-15: U_e 250 V, I_e 3 A
	DC-13: U_e 24 V, I_e 3 A
Output circuit (Y14, Y24)	
Output type	Non-isolated NO contact, positively driven, current-limited
Number of NO contacts Y14/24	
SA-OR-S2	1
SA-OR-S1	2
Output voltage	24 V DC (18…30 V DC)
Output current	Max. 75 mA The total output current is limited. The maximum total current of all the relay modules at Y14 or Y24 is I<80 mA
Load capacity	200 nF
General data	
Electrical isolation	
Supply circuit – input circuit	No
Supply circuit – output circuit	Yes
Input circuit – output circuit	Yes
Weight (without packaging)	
SA-OR-S2	0.16 kg
SA-OR-S1	0.19 kg
Operating data	
Ambient operating temperature	–25 °C…55 °C
Storage temperature	–25 °C…70°C
Humidity	10% to 95%, non-condensing
Climatic conditions	EN 61131-2
Mechanical strength	
Oscillation	EN 61131-2
Vibration stability (EN 60068-2-64)	5–500 Hz/5 grms

[1] Time from LOW at B1/B2 to relay drop-out

Electrical safety EN 50178	
Rated impulse withstand voltage (V_{imp})	4 kV
Overvoltage category	III
Pollution degree	2 inside, 3 outside
Rated voltage	300 V AC
Enclosure rating acc. to EN 60529 housing/terminals	IP 40/IP 20
Electromagnetic compatibility	EN 61131-2, EN 61000-6-2, EN 55011 Class A

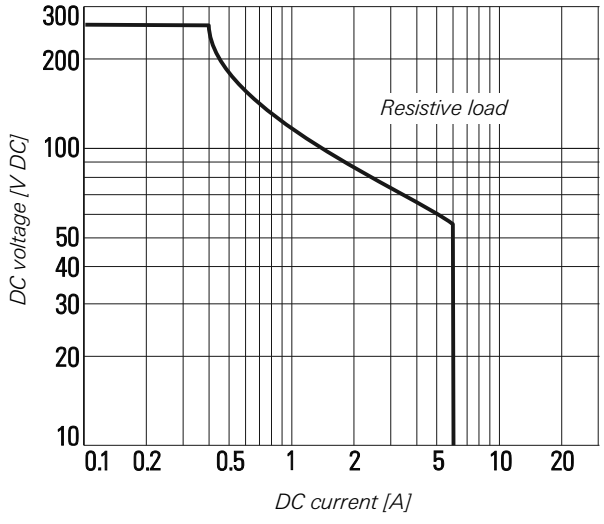
Terminal and connection data	
Single-core or finely stranded	1 x 0.14 mm² to 2.5 mm² or 2 x 0.14 mm² to 0.75 mm²
Finely stranded with ferrules to EN 46228	1 x 0.25 mm² to 2.5 mm² or 2 x 0.25 mm² to 0.5 mm²
Stripped length	8 mm
Maximum break-away torque	0,6 Nm
Functional safety in accordance with EN ISO 13849-1	PL e / Cat. 4
Functional safety in accordance with EN 61508 / EN 62061	SIL3 / SILCL 3

Table 57: PFHd values SA-OR-S2/SA-OR-S1

Load type	I[A]	Switching frequency	Switching operations per annum	B10d	PFHd
AC15	0.1	1/h	8760	10,000,000	5.00×10^{-10}
	0.75	**1/h**	**8760**	**4,150,000**	**1.20×10^{-09}**
	3	1/h	8760	400,000	1.20×10^{-08}
	5	1/h	8760	70,000	7.20×10^{-08}
DC13	1	1/h	8760	2,000,000	2.50×10^{-09}
	3	1/h	8760	450,000	1.10×10^{-08}
AC1	2	1/h	8760	1,000,000	5.00×10^{-09}
	4	1/h	8760	600,000	8.40×10^{-09}

Fig. 31: DC load breaking capacity output modules SA-OR-S2/SA-OR-S1

Max. DC load breaking capacity



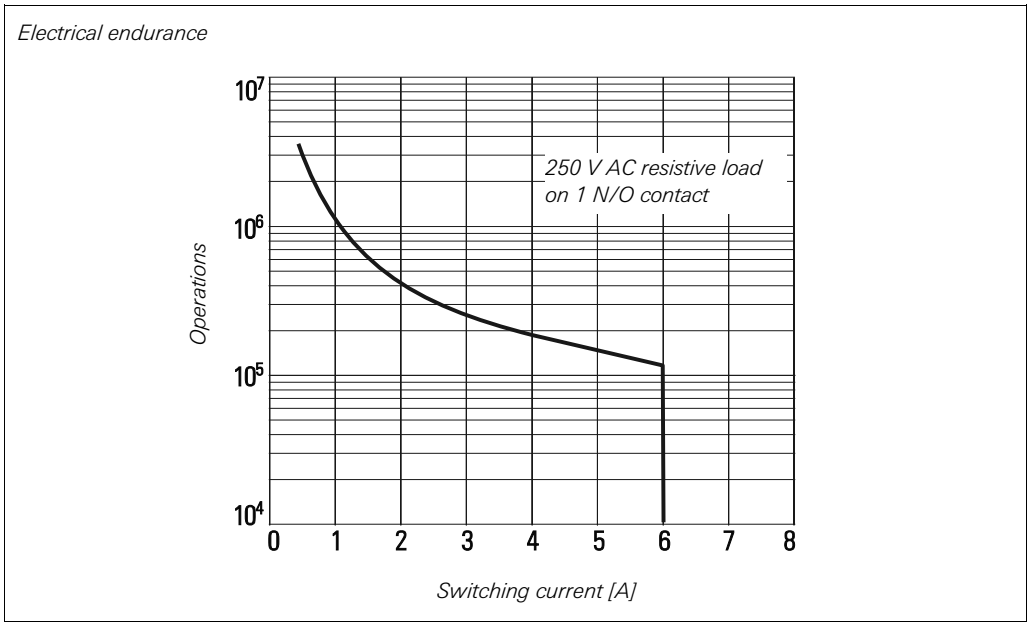
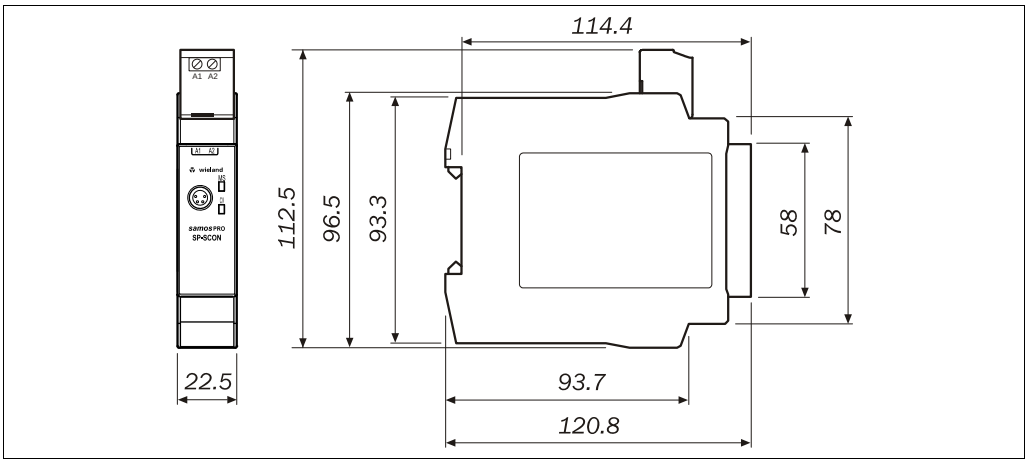


Fig. 32: Electrical endurance output modules SA-OR-S2/SA-OR-S1

12.3 Dimensional drawings

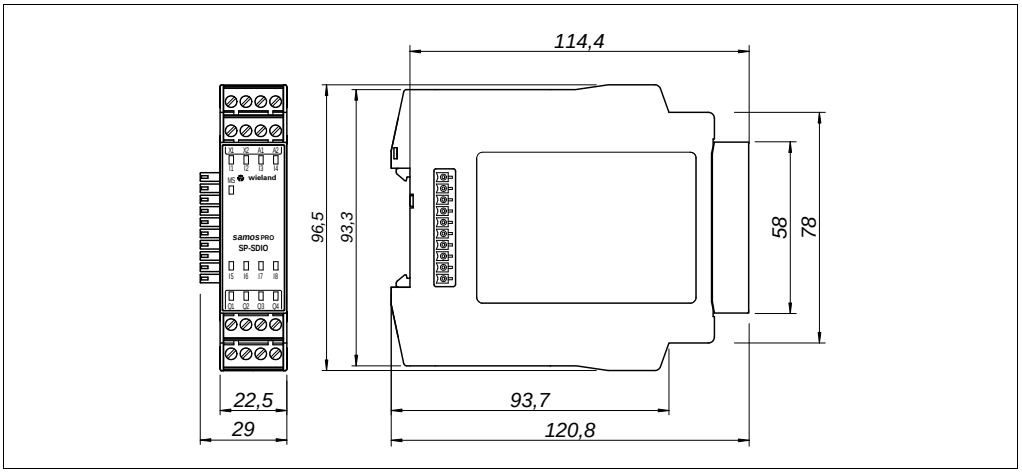
12.3.1 Main modules SP-SCON/SP-SCON-NET with system plug

Fig. 33: Dimensional drawing SP-SCON (mm)



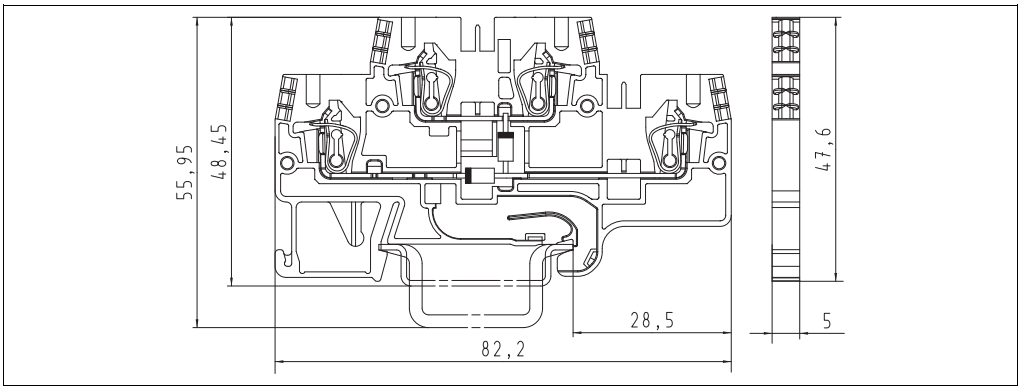
12.3.2 Input/output extension SP-SDIO / input extension SP-SDI / relay output modules SA-OR-S1 and SA-OR-S2

Fig. 34: Dimensional drawing SP-SDIO / SP-SDI, SA-OR-S1 / SA-OR-S2 (mm)



12.3.3 Terminal block WKFN 2,5 E/35 GO-URL

Fig. 35: Dimensional drawing (mm) WKFN 2,5 E/35 GO-URL



13 Ordering information

13.1 Available modules and accessories

Device type	Part	Part no.
SP-SCON-P1-K	Main module	R1.190.0010.0
SP-SCON-NET-P1-K	Main module, network capable Two-tier spring terminals, pluggable	R1.190.0020.0
SP-CANopen	CANopen gateway	R1.190.0210.0
SP-PROFIBUS-DP	PROFIBUS-DP gateway	R1.190.0190.0
SP-DeviceNet	DeviceNet gateway	R1.190.0230.0
SP-EN-MOD	Modbus/TCP gateway	R1.190.0130.0
SP-EN-PN	ProfiNet gateway	R1.190.0140.0
SP-EN-IP	EtherNet/IP gateway	R1.190.0150.0
SP-SDIO84-P1-K-A	Input/output extension, with output test pulses 8 inputs/4 outputs Two-tier screw terminals, pluggable	R1.190.0030.0
SP-SDIO84-P1-K-C	Input/output extension, with output test pulses 8 inputs/4 outputs Two-tier spring terminals, pluggable	R1.190.0040.0
SP-SDIO84-P2-K-C	Input/output extension, without output test pulses 8 inputs/4 outputs Two-tier spring terminals, pluggable	R1.190.0240.0
SP-SDI8-P1-K-A	Input extension 8 inputs Two-tier screw terminals, pluggable	R1.190.0050.0
SP-SDI8-P1-K-C	Input extension 8 inputs Two-tier spring terminals, pluggable	R1.190.0060.0
SA-OR-S1-4RK-A	Output module 2 NO contacts and 1 24-V DC alarm signal Two-tier screw terminals, pluggable	R1.180.0080.0
SA-OR-S2-2RK-A	Output module 4 NO contacts and 2 24-V DC alarm signals Two-tier screw terminals, pluggable	R1.180.0320.0
SA-OR-S1-4RK-C	Output module 2 NO contacts and 1 24-V DC alarm signal Two-tier spring terminals, pluggable	R1.180.0430.0
SA-OR-S2-2RK-C	Output module 4 NO contacts and 2 24-V DC alarm signals Two-tier spring terminals, pluggable	R1.180.0440.0
SP-PLAN	Programming software and manual	R1.190.0070.0
SP-MEMORY	System plug	R1.190.0080.0
SP-CABLE1	Configuration cable 2 m, M8, Sub D	R1.190.0090.0
SP-PRO-STARTER-SET	Set, consisting of one SP-SCON, SP-SDIO, SP-MEMORY, SP-PLAN, SP-CABLE1	R1.190.0100.0
SP-CABLE3	CAN-cable 2 x 2 x 0,34 mm2, with shield	00.102.5202.0
SP-FILTER1	Terminal block with filter	R1.190.0260.0
SP-FILTER2	Terminal block with filter	R1.190.0270.0
WKFN 2,5 E/35 GO-URL	***fasis*** terminal block with diodes	56.703.8755.9
APFN 2,5 E/35	Terminal plate for WKFN 2,5 E/35	07.312.7355.0

Table 58: Part numbers of samos® PRO safety controller modules

13.2 Devices

Our extensive range of products including further articles such as safety switches with the corresponding accessories is available in our catalogue "Safety first" (pt. no. 0152.0) or on the Internet under www.wieland-electric.com.
The following sections contain a selection.

13.2.1 Non-contact safety switches

Table 59: Part numbers of non-contact safety switches

Type	Design	Part no.
SMA 0113	quadratic block, with cable, NC/NO	R1.100.0113.0
SMA 0123	quadratic block, with cable, NO/NO	R1.100.0123.0
SMA 0119	quadratic block, with M8-connection, NC/NO	R1.100.0119.0
SMA 0129	quadratic block, with M8-connection, NO/NO	R1.100.0129.0
SMA 4100	spacer, quadratic (10 pcs.)	R1.100.4100.0
SMA 0213	rectangular block, with cable, NC/NO	R1.100.0213.0
SMA 0223	rectangular block, with cable, NO/NO	R1.100.0223.0
SMA 0219	rectangular block, with M8-connection, NC/NO	R1.100.0219.0
SMA 0229	rectangular block, with M8-connection, NO/NO	R1.100.0229.0
SMA 4200	spacer, rectangular (10 pcs.)	R1.100.4200.0
SMA 0313	cylindrical, with cable, NC/NO	R1.100.0313.0
SMA 0323	cylindrical, with cable, NO/NO	R1.100.0323.0
SMA 0219	cylindrical, with M8-connection, NC/NO	R1.100.0319.0
SMA 0329	cylindrical, with M8-connection, NO/NO	R1.100.0329.0
SMA 5004	cable, 5m	R1.100.5004.0
SMA 5005	cable, 10m	R1.100.5005.0

14 Annex

14.1 EC Declaration of Conformity

wieland
Elektrische Verbindungen

EG-Konformitätserklärung QU-QMA-02/08a_05-162-01

EC-Declaration of Conformity

Der Unterzeichner, der den nachstehenden Hersteller vertritt,
The undersigned, representing the following manufacturer

Wieland Electric GmbH
Brennerstraße 10-14
D-96052 Bamberg

erklärt hiermit, dass das Produkt/die Produkte
herewith declares that the product(s)

Eingangs-/Ausgangs-Modul,	Typ **samosPRO**	
Electronic Input/Output Module,	Type **samosPro**	
	SP-SCON-P1-K	
	SP-SDIO84-P1-K-A;	SP-SDIO84-P1-K-C,
	SP-SDI8-P1-K-A;	SP-SDI8-P1-K-C;
	SP-SCON-NET-P1-K DC24V	

in Übereinstimmung ist/sind mit den Bestimmungen der nachstehenden EG-Richtlinie(n) (einschließlich aller zutreffenden Änderungen), und dass die Normen und/oder technischen Spezifikationen, die auf der Umseite in Bezug genommen sind, zur Anwendung gelangt sind.

is/are in conformity with the provisions of the following EC directive(s) (including all applicable amendments) , and that the standards and/or technical specifications referenced overleaf have been applied.

Bamberg, den 04.02.2011

i.V. Klaus Stadelmaier
Manager Design Department, Electronics

Wieland Electric GmbH

i.V. Klaus Jungstädt
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.

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Registergericht
Bamberg HRB 105

Anlage zu EG-Konformitätserklärung QU-QMA-02/08a_05-162-01
Attachment to CE-declaration QU-QMA-02/08a_05-162-01

Conformity with the requirements of the following European Directives	
2006/95/EG(EC)	Niederspannungsrichtlinie/Low Voltage Directive
2004/108/EG(EC)6/EWG(EEC)	EMV-Richtlinie/EMC-Directive
2006/42/EG(EC)	Maschinenrichtlinie/Machinery Directive

Standards and/or normative documents	
EN 50178: 1997	Ausrüstung von Starkstromanlagen mit elektronischen Betriebsmitteln Electronic equipment for use in power installations
IEC 61508 Teile 1-7: 2001 **SIL 3**	Funktionale Sicherheit sicherheitsbezogener elektrischer/elektronischer programmierbarer elektronischer Systeme; Functional safety of electrical/electronic/programmable electronic safety-related systems
EN 62061: 2005 **SILCL3**	Funktionale Sicherheit sicherheitsbezogener elektrischer/elektronischer programmierbarer elektronischer Steuerungssysteme; Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
EN ISO 13849-1: 2006 **Performance level „e“**	Sicherheit von Maschinen –Sicherheitsbezogene Teile von Steuerungen – Teil 1: Allgemeine Gestaltungsleitsätze; Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN 61496-1: 2005	Sicherheit von Maschinen –Berührungslos wirkende Schutzeinrichtungen – Teil 1: Allgemeine Anforderungen und Prüfungen Safety of machinery - Electro-sensitive protective equipment - Part 1: General requirements and tests
EN 60204-1: 2004	Sicherheit von Maschinen – Elektrische Ausrüstung von Maschinen – Teil 1: Allgemeine Anforderungen Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 61000-6-4	Störaussendung für Industriebereiche EMC: Emission standard for industrial environments
EN 61000-6-2	Störfestigkeit für Industriebereiche EMC; Immunity for Industrial Environments
EN 61131-2: 2007	Speicherprogrammierbare Steuerungen - Teil 2: Betriebsmittelanforderungen und Prüfungen Programmable controllers - Part 2: Equipment requirements and tests
IEC 61326-3: 2004	Elektrische Mess-, Steuer-, Regel- u. Laborgeräte - EMV-Anforderungen - Teil 3: Störfestigkeitsanforderungen für Geräte, die in industriellen Anwendungen sicherheitsbezogene Funktionen haben oder für sicherheitsbezogene Funktionen vorgesehen sind Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 3: Immunity requirements for equipment performing or intended to perform safety related functions (functional safety) in industrial applications

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14.2 Manufacturer's checklist

Checklist for the manufacturer/installer for installation of the samos®PRO safety controller

The specifications for the following items listed must be available at least for the initial commissioning. They are dependent on the application, whose requirement must be checked by the manufacturer/installer.

This checklist should be retained/stored with the machine documentation so that you can use it as a reference for periodical tests.

1.	Have the safety rules and regulations been observed in compliance with the directives/standards applicable to the machine?	Yes ☐ No ☐
2.	Are the applied directives and standards listed in the declaration of conformity?	Yes ☐ No ☐
3.	Does the protective device comply with the required category?	Yes ☐ No ☐
4.	Are the required protective measures against electric shock in effect (protection class)?	Yes ☐ No ☐
5.	Has the protective function been checked in compliance with the test notes in this documentation? Especially: – Functional check of the command devices, sensors and actuators connected to the safety controller – Test of all switch-off paths	Yes ☐ No ☐
6.	Are you sure that the safety controller was tested fully for safety functionality after each configuration change?	Yes ☐ No ☐

This checklist does not replace initial commissioning and regular tests by qualified personnel.

14.3 List of tables

14.4 List of illustrations

Annex

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