BERNSTEIN

DETECT

We make
safety happen.

# Programmable safety controllers

# SCR P and SCx

## Contents

# 1. About this document

## 1.1 Important to read!

It is the responsibility of the supervising engineer, the machine builder, the machine operator and/or the maintenance personnel or maintenance electrician to use and maintain this appliance in full compliance with all applicable regulations and standards. The device can only fulfill the required safety function if it is installed, operated and maintained in accordance with regulations. This manual attempts to provide complete instructions for installation, operation and maintenance. It is highly recommended that you read the entire manual. Please contact BERNSTEIN AG if you have any questions about the application or use of the appliance. Further information on international institutes for standardizing the performance of safety applications and safety devices can be found under "18. Standards and regulations" on page 253.

**WARNING: Obligations of the user**

It is the responsibility of the user:

- Carefully read, understand and follow all instructions for this appliance.
- Carry out a risk evaluation that takes into account the specific safety application. Information on the standard-compliant methodology can be found in ISO 12100.
- To determine which safety devices and principles are suitable based on the results of the risk evaluation and to implement these in compliance with all applicable local, regional and national laws and regulations. In this context, reference is also made to ISO 13849-1 and/or other suitable standards.
- To check that the complete safety system (including input and output devices and controls) is properly configured and installed, that it is functional and running as intended.
- Check regularly as required that the entire protection system is running as intended for the application.

**If these tasks are not followed, a hazardous situation may arise which could lead to serious or fatal injuries.**

## 1.2 Use of the warning notices

The safety instructions and explanations in this document are identified by warning symbols and must be observed for the safe use of the BERNSTEIN AG safety evaluation unit. If all safety instructions and warnings are not observed, safe operation is no longer necessarily guaranteed. These signal words and warning symbols are defined as follows.

| Signal word | Definition | Icon |
|---|---|---|
| WARNING | **Warnings of the "Warning" type** refer to potentially hazardous situations which, if not prevented, could result in serious injury or even death. | |
| CAUTION | **Caution" warnings** refer to potentially hazardous situations which, if not avoided, could result in minor or moderate injury or potential damage to property. | |

These instructions are intended to inform the machine designer and manufacturer, the end user and the maintenance personnel how to avoid incorrect use and how to use the BERNSTEIN safety evaluation system in such a way that the various requirements for safety applications are met. It is the responsibility of these persons to read and observe these instructions.

## 1.3 EU declarations of conformity

**EU/UK-Konformitätserklärung / EU/UK-Declaration of Conformity / UE/UK-Déclaration de conformité**

**This declaration of conformity corresponds to the European Standard DIN EN ISO/IEC 17050-1: Conformity assessment - Supplier's declaration of conformity - Part 1: General requirements.**
**Die Basis der Criteria are international Documents, in particular ISO/IEC Guideline 22, 1982, Information on manufacturer's declaration of conformity with standards or other technical specifications. The German language version is the original declaration of conformity. Other languages are translations of the original declaration of conformity.**

**This Declaration of Conformity is suitable to the European Standard EN ISO/IEC 17050-1: Conformity assessment - Supplier's declaration of conformity - Part 1: General requirements. The basis for the criteria has been found in international documentation, particularly in: ISO/IEC Guide 22, 1982, Information on manufacturer's declaration of conformity with standards or other technical specifications. The original Declaration of Conformity is the German language version. Other languages are a translation of the original Declaration of Conformity.**

**Cette déclaration de conformité correspond au Norme Européenne EN ISO/IEC 17050-1: Évaluation de la conformité - Déclaration de conformité du fournisseur - Partie 1: Exigences générales. La base des directives sont des documents internationaux répondant à ISO/IEC-Guide 22, 1982, Informations on manufacturer's declaration of conformity with standards or other technical specifications. The German version is la langue d'origine de la déclaration de conformité. Les autres langues ne sont qu'une traduction de la déclaration de conformité en langue allemande.**

Wir / We / Nous

**BERNSTEIN AG**
(Name of the supplier) / (Supplier's name) / (Nom du foumisseur)
**Hans-Bernstein-Strasse 1**
**D-32457 Porta Westfalica**
(Anschrift) / (Address) / (Adresse)

**declare under our sole responsibility that the product(s):**
declare under our sole responsibility that the product(s):
déclarons sous notre seule responsabilité que le(s) produit(s):

**Programmable safety controller Typ / Type: SCR-P...**

**...(see Betriebs- und Montageanleitung / refer to Installation and Operating Instructions / voir Instructions de service et de montage)**

(Name, type or model, batch or serial number, possibly sources and number of items) (Name, type or model, batch or serial number, possibly sources and number of items)
(Nom, type ou modèle, nº de lot, d'échantillon ou de série, éventuellement les sources et le nombre d'exemplaires)

**complies (complies) with the following guidelines:**
is (are) in conformity with the following directives:
est (sont) conforme(s) aux directives européennes:

**Machinery Directive / Machinery-Directive**
**2006/42/EC EMC Directive / EMC-Directive**
**2014/30/EU**
**RoHSII Directive / RoHSII Directive 2011/65/EU**

UK Richtlinien / UK Directives / UK Diréctives
**Supply of Machinery (Safety) Regulations 2008: 2008 No. 1597**

**This is documented by the compliance with the following standard(s):** This is documented by the accordance with the following standard(s): Notre justification est l'observation de la (des) norme(s) suivante(s):

**IEC 62061:2015; EN ISO 13849-1:2015**
**IEC 61508 Parts 1-7:2010; IEC 61131-2:2017**

Notified Body / Organisme Notifié

**NB 0035**
**TÜV Rheinland Industrieservice GmbH, Am Grauen Stein, 51105 Cologne EC-Type Examination Certificate Reg. no.:**
**01/205/5782.01/24**

**Name and address of authorized documentation:**
Name and address of authorized agent documentation:
Nom et adresse de la documentation autorisée:

Mr. Wolfgang Vogt
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Porta Westfalica, 2024-07-22
(Place and date of issue)
(Place and date of issue)
(Date et lieu)

i. V. Wolfgang Vogt
Compliance Officer Product
(Name, position, signature)
(Name, status, signature)
(Nom, fonction, signature)

**EU/UK-Konformitätserklärung / EU/UK-Declaration of Conformity / UE/UK-Déclaration de conformité**

**This declaration of conformity corresponds to the European Standard DIN EN ISO/IEC 17050-1: Conformity assessment - Supplier's declaration of conformity - Part 1: General requirements.**
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**declare under our sole responsibility that the product(s):**
declare under our sole responsibility that the product(s):
déclarons sous notre seule responsabilité que le(s) produit(s):

**SCx-...**

(Name, type or model, batch or serial number, possibly sources and number of items) (Name, type or model, batch or serial number, possibly sources and number of items)
(Nom, type ou modèle, nº de lot, d'échantillon ou de série, éventuellement les sources et le nombre d'éxemplaires)

**complies (complies) with the following guidelines:**
is (are) in conformity with the following directives:
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EU Directives / EU Directives / UE Diréctives
**Machinery Directive / Safety-of-Machinery-Directive 2006/42/EC**

UK Richtlinien / UK Directives / UK Diréctives
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# 2. Product description

The safety controller is a critical and indispensable part of any safety system. This is because safety controllers ensure that your safety functions are carried out correctly.
A programmable safety controller is often an ideal solution for safety control, as it offers more functions than a conventional safety relay and is more cost-effective than a safety PLC.
The BERNSTEIN safety evaluation unit is a user-friendly and easily configurable evaluation unit designed to monitor various safety and non-safety-related input functions and to provide safe start and stop functions for machines with hazards. The safety evaluation unit replaces numerous application-specific safety relay modules for safety input devices such as emergency stop switches, safety gate switches with interlocking, safety light curtains, two-hand controls, safety mats and many more.

other protective devices.

## 2.1 Technical terms used in this manual

The following technical terms are used in this manual:
Safety evaluation; evaluation: An abbreviated version that refers to the programmable safety controllers SCR P and SCx.
Programmable safety controller SCR P: The official name of the SCR P.
Programmable safety controller SCx: The official name of the SCx.

## 2.2 Software

The BERNSTEIN safety evaluation software is an application with a real-time display and diagnostic tools that you can use to perform the following tasks:
- Creating and editing configurations
- Testing a configuration in simulation mode
- Writing a configuration to the safety evaluation unit
- Reading the current configuration from the safety evaluation
- Display of real-time information, e.g. device status, diagnostic data
- Displaying error information

The software uses simple circuit and logic symbols that allow you to intuitively define the appropriate input functions and their properties. Once the required configuration, including device properties and
I/O control relationships was created on the Function view tab, the program automatically creates the corresponding circuit diagrams and ladder diagrams.
For more information, see "9.2 Software overview" on page 96.

## 2.3 USB ports

The micro USB port of the SCR P and SCx is used to connect the evaluations to the PC (via the USB cable). The SCR P-FPS programming stick can also be connected here. The programming stick is used to transfer a configuration created on the PC to the SCR P and SCx.

**CAUTION: Possible unintentional ground return**

The USB interface is implemented according to industry standards and is not isolated from the 24 V power supply.
The computer and the safety evaluation unit can become part of an unintentional ground return path for other connected devices via the USB cable. The PC and/or the safety evaluation unit could be damaged by high currents. This should be avoided as far as possible. BERNSTEIN therefore recommends connecting the USB cable to the PC as the only cable. If possible, the power supply unit should be disconnected from the laptop.
The USB interface is intended for downloading configurations and for temporary monitoring and troubleshooting. It is not designed for continuous operation.

## 2.4 Ethernet connection

The safety evaluation unit can be connected to a control or monitoring device (e.g. a higher-level machine controller) via an Ethernet connection. The connection is established using an Ethernet cable and can also be established via a network switch. Standard and crossover cables are supported. A shielded cable may be required in environments with high levels of interference.

## 2.5 Internal logic

The internal logic of the safety evaluation unit is designed in such a way that a safety output can only be switched on if all safety input signals and the self-monitoring signals of the safety evaluation unit are in the "On" state and report that there is no fault condition.
BERNSTEIN's safety evaluation software uses both logic and safety function blocks for the configuration of general and advanced applications.

 Logic blocks are based on Boolean logic laws (true or false). The following logic blocks are available:

- NOT
- AND
- OR
- NAND
- NOR
- XOR
- Bistable toggle switch (set priority and reset priority)
- See "9.6.1 Logic blocks" on page 101 for more information.

 Function blocks are pre-programmed blocks with integrated logic that contain different control elements to meet the requirements of both general and complex applications. The following function blocks are available:

- Bridging block
- Enabling switch block
- Latch reset block
- Muting block
- Two-hand control block
- Delay block

See "9.6.2 Function blocks" on page 103 for more information.

## 2.6 Password manager

A password is required to confirm a configuration, to write a configuration to the security evaluation and to access the password manager via the software.
See "9.13 SCx Password Manager" on page 115 and "9.14 SCR P Password Manager" on page 115 for more information.

## 2.7 Programming stick SCR P-FPS and USB programming adapter SCR P-PA

The SCR P-FPS programming stick is used to save a confirmed configuration.

**Important**: Check (via the software or using the inscription on the white label on the programming stick) whether the configuration transferred to the safety controller is correct.

Click on to access the options for the programming adapter:

- **Read:** Reads the current configuration from the programming stick and loads it into the configuration software.
- **Write:** Writes a confirmed configuration from the configuration software to the programming stick.
- **Lock:** Locks the programming stick and thus prevents configurations from being written to the stick (an empty drive cannot be locked).

**Note**: You cannot unlock the programming stick once it has been locked. It is therefore not possible to write to the stick again.

# 3. SCx Overview

With the option to add up to eight I/O expansion modules, the SCx expandable safety controller can be adapted to a wide range of machines, including large machines with multiple processes.

- Programming in just a few minutes with intuitive, user-friendly software
- Up to eight I/O expansion modules can be added as automation requirements grow or change
- Choose from four extension module models
- The expansion module models have a variety of safety inputs, semiconductor safety outputs and safety relay outputs
- Innovative live display function and diagnostics enable active monitoring of the I/O on a PC and support troubleshooting and commissioning
- Safety controllers and input modules enable the conversion of safety inputs into status outputs for efficient Terminal utilization
- Ethernet-enabled models can be configured for up to 256 virtual status outputs
- Optional SCR P-FPS programming stick for quick replacement and fast configuration without a PC
- Daisy Chain Diagnostic (DCD) provides detailed status and performance data from each connected safety device, which can be accessed using an HMI or similar device.

## 3.1 SCx models

All expandable and non-expandable basic controllers have 18 safety inputs, 8 convertible safety I/Os and 2 solid-state safety output pairs. Up to eight expansion modules in any combination of input and output modules can be added to the expandable base controller models. A communication gateway can be added to the expandable, Ethernet-capable models of the FID 6 and higher basic controller.

| Model | Display | Ethernet-capable | # Number of DCD channels |
|---|---|---|---|
| SCx-B-26-2T-8 | No | No | 8 |
| SCx-B-26-2T-7 | Yes | No | 8 |
| SCx-B-26-2T-6 | No | Yes | 8 |
| SCx-B-26-2T-5 | Yes | Yes | 8 |

Table 1: Expandable base models

| Model | Description |
|---|---|
| SCx-I-16 | Safety input module 16 inputs (4 convertible) |
| SCx-I-8 | Safety input module 8 inputs (2 convertible) |
| SCx-O-2T | 2 Two-channel solid-state safety output module |
| SCx-O-4T | 4 Two-channel solid-state safety output module |
| SCx-O-1R | 1 two-channel safety relay module |
| SCx-O-2R | 2 Dual-channel safety relay module |
| SCx-N-Cat | EtherCAT communication gateway |

Table 2: I/O extension modules

## 3.2 SCx functions and displays

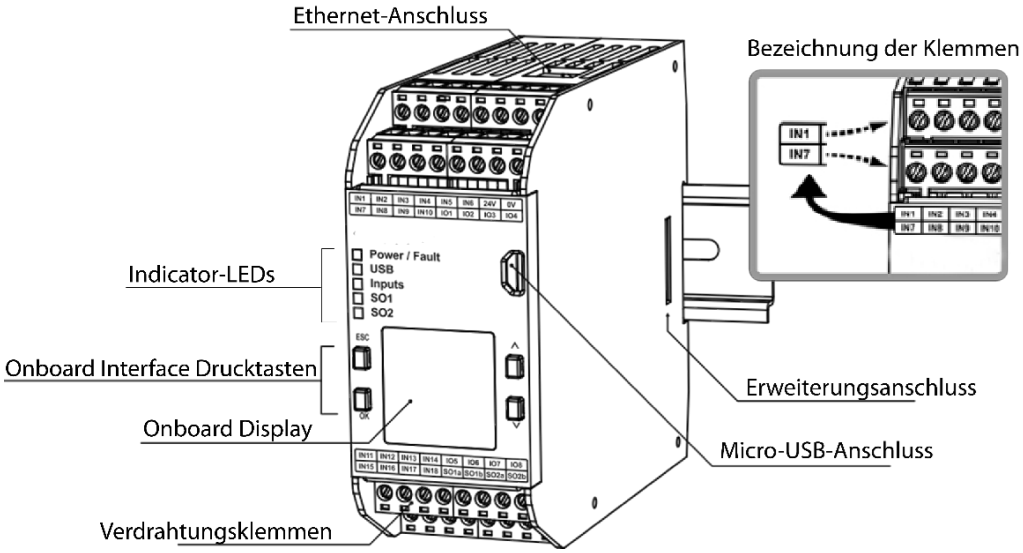



Figure 2: SCx features and displays

## 3.3 Input and output connections

### 3.3.1 SCx safety and non-safety-related input devices

The basic controller has 26 input terminals that can be used to monitor safety or non-safety devices; these devices can have either semiconductor or contact-based outputs. Some of the input terminals can be configured to either supply 24 V DC for monitoring contacts or to signal the status of an input or an output. The function of each input circuit depends on the type of device connected; this function is defined when configuring the controller.
Some of the input terminals of the SCx-B-26-2T-5 can be configured to monitor a chain of DCD-enabled devices; this functionality is set up during the configuration of the controller.
The SCx-I-8 and SCx-I-16 expansion modules add additional inputs to the safety control system. Contact BERNSTEIN AG if you require further information on connecting other devices not described in this manual.

### 3.3.2 SCx safety outputs

The safety outputs are intended to control limit switches (FSDs) and primary machine control elements (MPCEs), which are the last elements (in time) to control hazardous motion. These control elements include relays, contactors, solenoid valves, motor controllers and other devices that typically contain positively driven (mechanically coupled) monitoring contacts or electrical signals required for external device monitoring (EDM).
The safety controller has two independently controlled and redundant semiconductor safety outputs (terminals SO1a & SO1b and SO2a & SO2b). The safety controller's self-checking algorithm ensures that the outputs are switched on and off at the correct time in response to the assigned input signals.
Each redundant semiconductor safety output is designed to operate either in pairs or as two individual outputs. If they are controlled in pairs, the safety outputs are suitable for category 4 applications; if they operate independently, they are suitable for applications up to category 3 if a suitable fault exclusion has been used (see "Safety shutdowns" on page 70 and
"7.4.1 Resistance to faults and safety circuit principles according to ISO 13849-1" on page 33).
For more information on connection, semiconductor and safety relay outputs, monitoring of external devices, single or dual-channel safety stop circuits and configuration of safety outputs, see "7.8 Safety outputs" on page 60.
Additional solid state or safety relay outputs can be added to the basic controller by installing expansion output modules (SCx-O-2T, SCx-O-4T, SCx-O-1R and SCx-O-2R). Up to eight expansion modules can be added in any combination of input or output modules.
The safety outputs can be controlled by input devices that can be reset both automatically and manually.

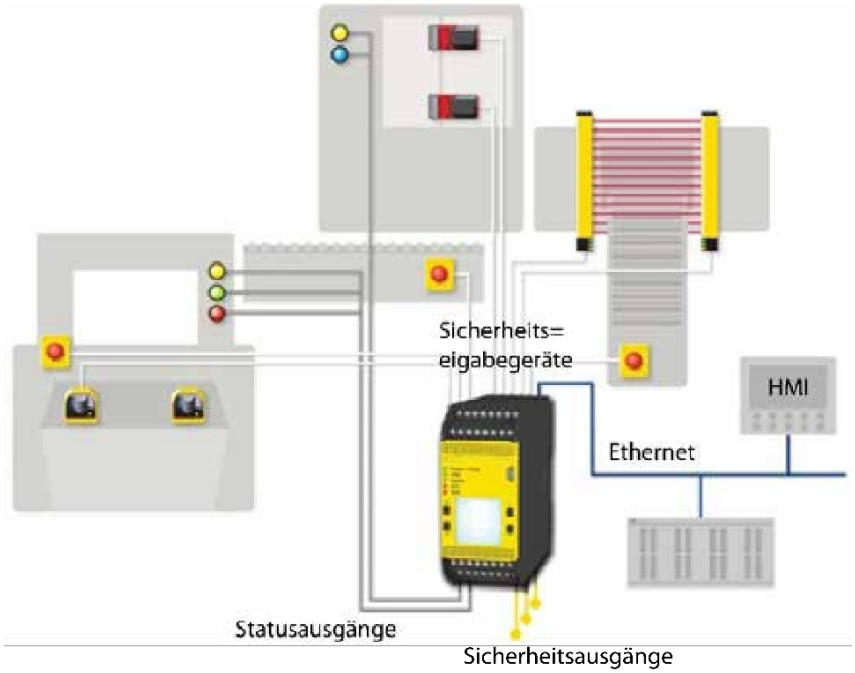



Figure 3: Safety outputs (application example)

**Functional locks in accordance with IEC 60204-1 and NFPA 79**
The safety controller is capable of executing two functional stop types:
- Category 0: uncontrolled stop with immediate interruption of the power supply to the secured machine
- Category 1: a controlled stop with a delay before the power is switched off from the protected machine

Delayed stops can be used in applications where machines require energy for a braking mechanism to stop the dangerous movement.

### 3.3.3 SCx status outputs and virtual status outputs

The base controller has eight convertible I/Os (labeled IOx) that can be used as status outputs capable of sending non-safety-related status signals to devices such as programmable logic controllers (PLCs) or indicator lights. In addition, any unused safety output terminals can be configured to perform the function of a status output with the benefit of a higher current capacity (see SCx specifications on page 20 for more information). For solid-state safety outputs configured as status outputs, the safety test pulses remain activated even if they are designated as status outputs. The signal convention of the status output can be configured as 24 V DC, 0 V DC or as cyclical switching on and off. For information on the specific functions of a status output, see "7.9.1 Signal logic for status outputs" on page 73.
Ethernet models can be configured using the software for up to 256 virtual status outputs on SCx safety controllers. These outputs can transmit the same information as the status outputs via the network.
For more information, see "7.10 Virtual status outputs" on page 76.

**WARNING:**
- **Status outputs and virtual status outputs are not safety outputs and can fail both in the On and Off state.**
- If a status output or a virtual status output is used to control a safety-critical application, a failure leading to a dangerous condition is possible and can result in serious injury or death.
- Never use a status output or virtual status output to control safety-critical applications.

### 3.4 SCx Automatic Terminal Optimization (ATO) function

Automatic terminal optimization (ATO) is a standard function on all SCx models. This function automatically combines up to two I/O terminals for two devices that require +24 V test pulses from the safety controller. If applicable, the software performs this automatically for each pair of devices added until no
I/O terminals are no longer available. Shared use is limited to two, as the screw terminals can accommodate up to two wires.
If desired, the terminals can be manually reassigned in the Device properties window.
The following illustrations show how the ATO function of the SCx optimizes the terminals for two gate switches.
This results in a total terminal assignment of six compared to eight if ATO is not used. The first gate switch (GS1) is added. This is a two-channel, four-wire gate switch, which has two
independent +24 V pulse outputs are required by the safety controller. IO1 is assigned as +24 V test pulse 1, which runs through channel 1 from GS1 to IN1. IO2 is assigned as +24 V test pulse 2, which runs from GS1 to IN2 via channel 2.
is running. If the second gate switch GS2 is added, it also uses IO1 and IO2, but IN3 and IN4 to monitor its two channels.

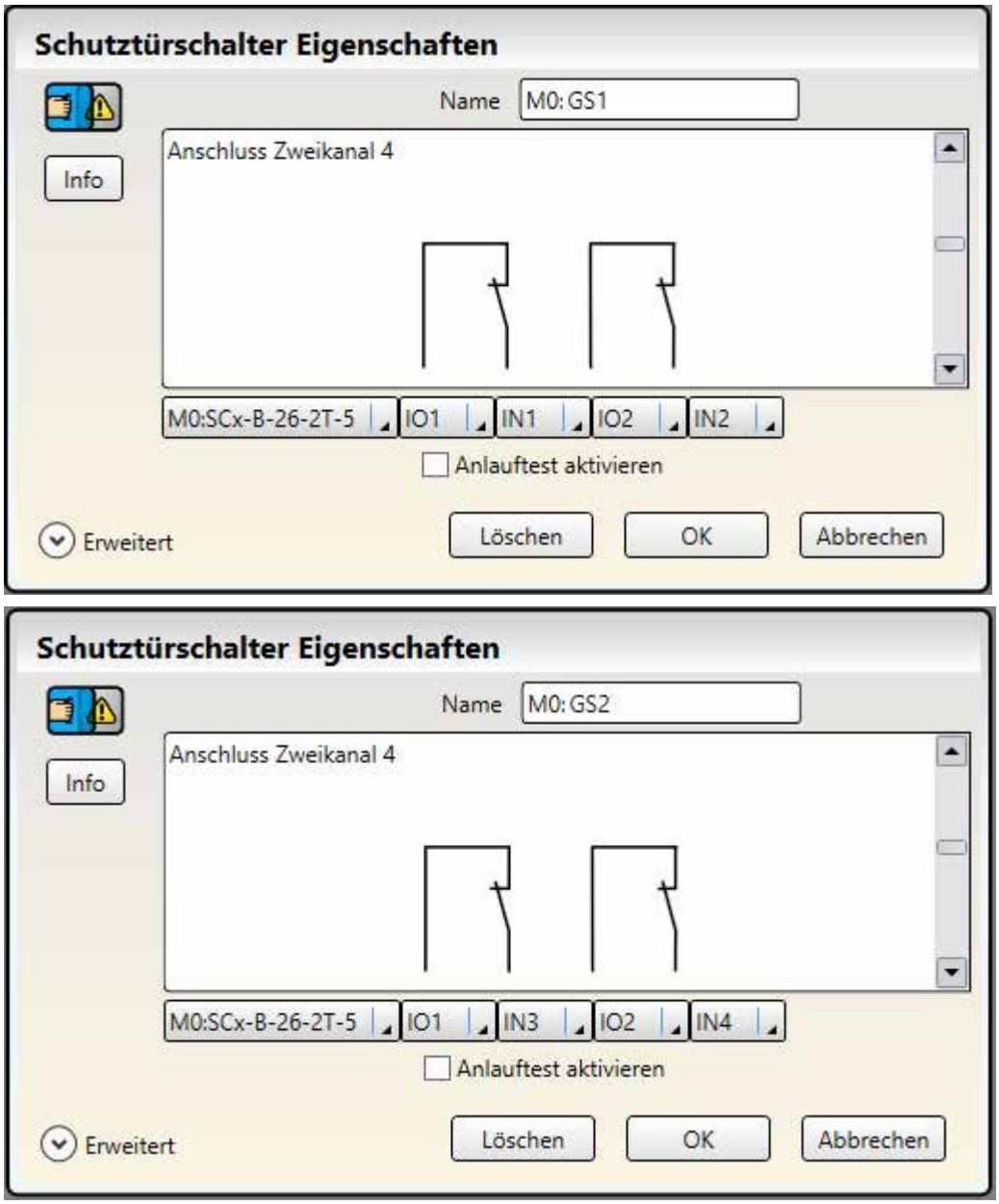



Figure 4: GS1 and GS2 Joint use of IO1 and IO2

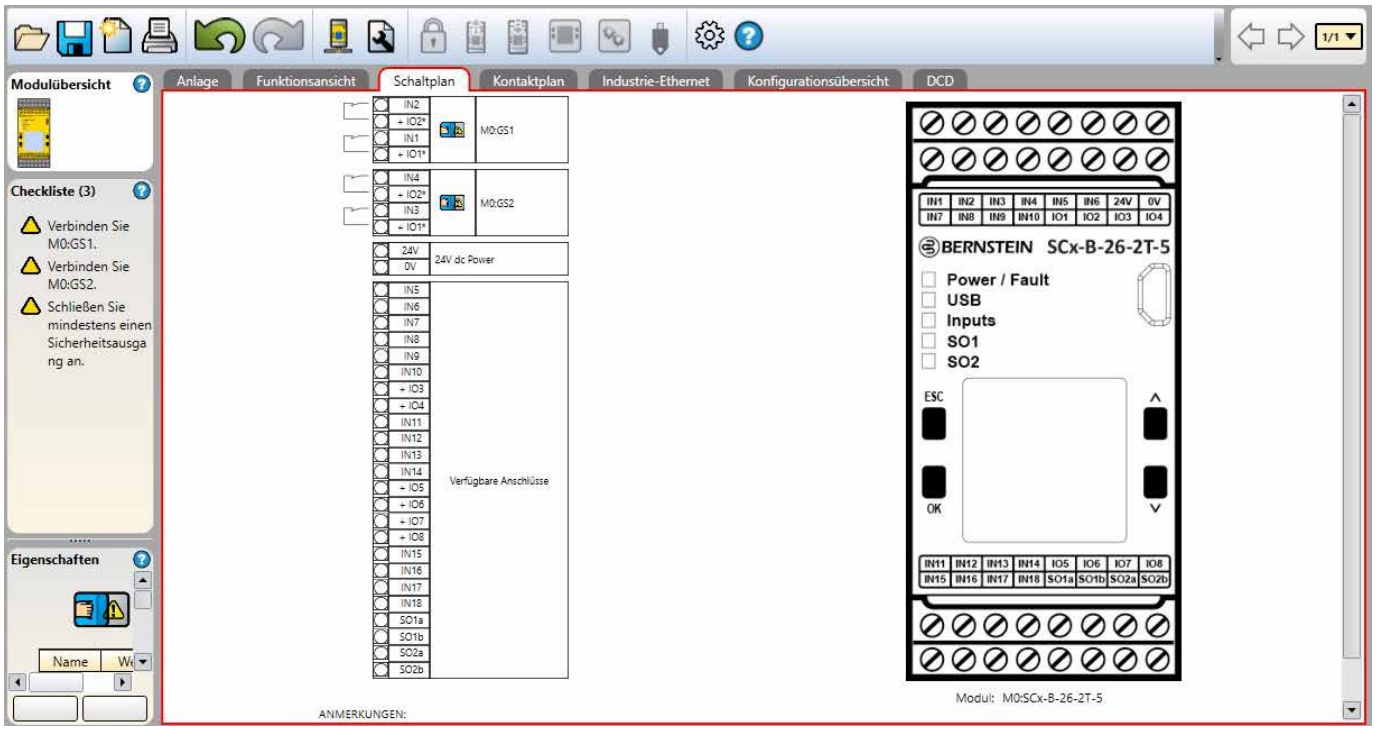



Figure 5: Circuit diagram tab view of the shared I/Os

## 4. SCR P Overview

The programmable safety controller SCR P from BERNSTEIN is a user-friendly and cost-effective alternative to safety relay modules. It replaces the functionality and performance of two independent safety relay modules, is configurable, easy to use and offers extended diagnostic functions.

For full technical information about this product, including installation instructions, application requirements and guidelines, EU Declaration of Conformity, technical specifications and accessories, see www.bernstein.eu and search for SCR P

Figure 6: Safety control SCR P

- Intuitive icon-based programming with configuration on the PC via drag & drop simplifies device setup and management
- Two 6 A safety relay outputs with three NO contacts each
- Ten inputs, four of which can be configured as non-safety-related outputs
- Innovative daisy chain diagnostics (DCD)
- Automatic port optimization (ATO) can increase the number of inputs from 10 to 14
- Bidirectional communication via Industrial Ethernet
  - 256 virtual non-safety-related status outputs
  - 80 virtual non-safety-related inputs (reset, on/off, cancel switch-off delay, muting activation)
  - Providing the DCD diagnostic data
- Programming stick type SCR P-FPS for quick replacement and fast configuration without a PC (see "14.12 SCR P using the SCR P-FPS" on page 235)

## 4.1 Versions of the SCR P

| Type designation | Description |
|---|---|
| **SCR P-10-6R-4** | Programmable safety controller - 10 inputs (4 configurable outputs), 2x 3-pole safety relay outputs, daisy chain diagnostics, industrial Ethernet-based protocols |

## 4.2 Functions and displays of the SCR P

The connection points are designed as spring-loaded terminals.
**Wire size:** 0.2 mm² to 2.08 mm², 24 to 14 AWG

☞ **Important:** The connection terminals are only intended for one cable. If more than one cable is attached to a connection, cables can become loose or completely detached and cause short circuits.
Use wire with wire end ferrules or wire end clips. Tinned wires are not recommended. After inserting the wire into the terminal, check that it is firmly seated by pulling on the wire. If the wire comes loose, another wiring solution should be considered.

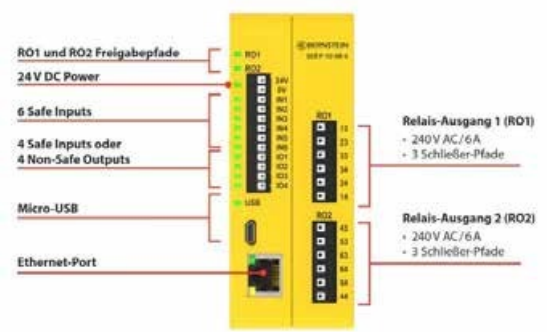



Figure 7: Functions and displays

## 4.3 SCR P: FID

Over time, BERNSTEIN adds new functions to some devices. The Function ID (FID) identifies the features and functions included in a particular model. In general, a higher FID number corresponds to a larger feature set. Configurations with a higher FID are not supported by a safety evaluation unit with a lower FID.
The safety evaluators of type SCR P are FID2 devices.

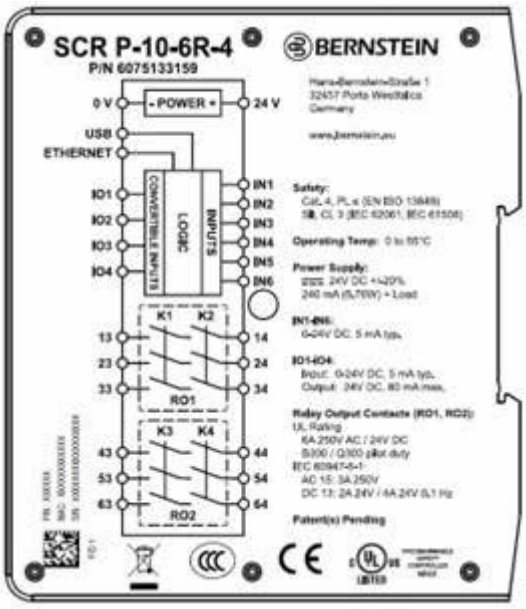



Figure 8: Example of printing on the SCR P

## 4.4 Input and output connections

### 4.4.1 SCR P Safety inputs and non-safety-related inputs

The SCR P has 10 input connections that can be used to monitor safety-related or non-safety-related devices. These devices can contain semiconductor outputs or contact-based outputs.
Some of the inputs can be configured so that they either supply 24 V DC for safety contacts or signal the status of an input or output. The function of the input circuits depends on the type of device connected. The function is defined when configuring the evaluation.

### 4.4.2 Safety relay outputs on the SCR P

The SCR P has two independent relay outputs, each with three enable paths.
The safety outputs are used to control power control elements, which are the last components in the chain of safety-related parts for controlling the dangerous machine movement. These control elements include relays, contactors, solenoid valves, motor controls and other components, some with positively driven (mechanically connected) safety contacts, or electrical signals required for monitoring a feedback loop (EDM).

**Functional shutdown in accordance with IEC 60204-1 and ANSI NFPA79**

The safety evaluation can be configured for two different types of stop categories:
Category 0: an uncontrolled shutdown with immediate interruption of the supply to the monitored machine Category 1: a controlled shutdown with a delay before the supply to the monitored machine is interrupted
Decelerating cut-outs can be used in applications where power is required for a braking mechanism to stop the dangerous machine movement.

### 4.4.3 Status outputs and virtual status outputs on the SCR P

Up to 256 virtual status outputs can be configured via the software to communicate information via the network. These outputs can be used to send non-safety-related status signals to devices such as programmable logic controllers (PLCs) or human-machine interfaces (HMIs). For more information, see "7.10 Virtual status outputs" on page 76.
The SCR P has four configurable I/Os (labeled as IOx) that can be used as status outputs for direct control of indicator lamps or hardwiring to PLC inputs. These outputs can be used to transmit non-safety-related signals.

**WARNING:**

- **The status outputs and virtual status outputs are not safety outputs and can have errors both when switched on and off.**
- If a status output or a virtual status output is used to control a safety-critical application, a failure leading to a dangerous state is possible, which could result in serious or fatal injury.
- A status output or a virtual status output must never be used to control safety-critical applications.

## 4.5 Function of the SCR P for the automatic optimization of connections (ATO) for external terminal blocks (ETB)

The function for the automatic optimization of connections (ATO) for external terminal blocks (ETB) is a standard function on all SCR P models and is activated by default.
The ATO function can extend the 10 connections on the SCR P so that it can be used with additional inputs by optimizing the connections and using ETBs. When adding, deleting or editing devices, the software automatically ensures the optimum assignment of the connections, thereby enabling minimum wiring with maximum utilization of the connections.
ATO is an intelligent function that provides all available device types and configuration options when creating the configuration. If all input and input/output connections are occupied and another device is added, ATO searches for devices that require +24 V test pulses from the safety evaluation unit. These devices are combined via an external terminal block (ETB) to free up an input/output connection. Each ETB allows up to three different devices to share the +24 V signal of a single input/output.
If desired, ATO can be deactivated by editing the module properties of the SCR P in the software. ETBs are then still active, but you must manually reassign the input/output connections as required in order to achieve optimum utilization of the connections.

# 5. Sp ecifications and requirements

## 5.1 SCx Specifications

### ■ Basic controller and expansion modules

**Mechanical load**

**Shock:** 15 g for 11 ms, half sine wave, 18 shocks in total (according to IEC 61131-2)
**Vibration:** 3.5 mm occasional / 1.75 mm continuous at 5 Hz to 9 Hz, 1.0 g occasional and 0.5 g continuous at 9 Hz to 150 Hz: all at 10 sweep cycles per axis (according to IEC 611312)

**Security**

Category 4, PL e (EN ISO 13849) SIL CL 3 (IEC 62061, IEC 61508)

**Standards for product performance**

See "18. Standards and regulations" on page 253 for a list of US and international standards applicable in the industry.

**EMC**

Meets or exceeds all EMC requirements in accordance with IEC 61131-2, IEC 62061 Annex E, Table E.1 (increased immunity values), IEC 61326-1:2006 and IEC61326-31:2008

**Operating conditions**

**Temperature:** 0 °C to +55 °C (+32 °F to +131 °F)
**Storage temperature:** -30 °C to +65 °C (-22 °F to +149 °F)
**Humidity:** 90% at +50 °C maximum relative humidity (non-condensing)
**Operating altitude:** maximum 2000 m (6562 ft) in accordance with IEC 61010-1

**Environmental assessment**

NEMA 1 (IEC IP20), for use in NEMA 3 (IEC IP54) or better enclosures

**Removable screw terminals**

**Wire size:** 24 to 12 AWG (0.2 to 3.31 $mm^2$)
**Wire strip length:** 7 to 8 mm (0.275 in to 0.315 in)
**Tightening torque:** 0.565 Nm (5.0 lbf in)

**Removable terminal connections**

**Important:** The terminals are only designed for one wire. If more than one wire is connected to a terminal, a wire may come loose or be completely disconnected from the terminal, causing a short circuit. If more than one wire is required, a ferrule or an external terminal block should be used.
**Wire size:** 24 to 16 AWG (0.20 to 1.31 $mm^2$)
**Length of the wire strip:** 8.00 mm (0.315 inch)

☞ **Important:** The power supply must meet the requirements for extra-low voltages with protective separation (SELV, PELV).

### ■ SCx-B-26-2T-5, SCx-B-26-2T-8, SCx-B-26-2T-7 and SCx-B-26-2T-6 - Basic safety control modules

**Mechanical load**

**Shock:** 15 g for 11 ms, half sine wave, 18 shocks in total (according to IEC 61131-2)
**Vibration:** 3.5 mm occasional / 1.75 mm continuous at 5 Hz to 9 Hz, 1.0 g occasional and 0.5 g continuous at 9 Hz to 150 Hz: all at 10 sweep cycles per axis (according to IEC 611312)

**Electricity**

24 V DC ± 20% (incl. ripple), 100 mA without load
**Ethernet models:** add 40 mA **Display models:** add 20 mA
**Expandable models:** 3.6 A maximum bus load

**Network interface (Ethernet models only)**

Ethernet 10/100 Base-T/TX, modular RJ45 connection selectable automatic negotiation or manual rate and duplex Auto MDI/MDIX (Auto-Cross)
**Protocols:**[4] EtherNet/IP™ (with PCCC), Modbus® TCP, PROFINET® (FID 2 or higher), and EtherCAT® (requires SCx-N-Cat gateway)
**Data:** 64 configurable virtual status outputs on SCx safety controllers with FID 1 or 256 virtual status outputs on SCx safety controllers with FID 2 or higher; error diagnostic codes and messages; access to the error log

[4] EtherNet/IP™ is a trademark of ODVA, Inc; Modbus® is a registered trademark of Schneider Electric USA, Inc; PROFINET® is a registered trademark of PROFIBUS Nutzerorganisation e.V.; EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

**Convertible I/O**
Output current: maximum 80 mA (overcurrent protected) Test pulses: approx. 1 ms every 25 ms to 75 ms
**Automatic terminal optimization function**
Up to two devices
**Test pulse**
Width: maximum 200 µs
Rate: 200 ms typical
**Protection of the output**
All semiconductor outputs (safety and non-safety outputs) are protected against short circuits to 0 V or +24 V protected, including overcurrent conditions
**Safety assessments PFH**
**[1/h]:** 1.05 × 10-9
**Proof test interval:** 20 years
**Safety inputs (and convertible I/O when used as inputs) Input ON threshold:**
> 15 V DC (guaranteed switched on), max. 30 V DC. **Input OFF threshold:** < 5 V DC and < 2 mA, -3 V DC min.
**Input ON current:** 5 mA typical at 24 V DC, 50 mA peak current for contact cleaning at 24 V DC
**Resistance of the input line:** 300 Ω max. (150 Ω per line)
**Input requirements for a 4-wire switching mat:**
- Max. Capacity between the plates: 0.22 µF
- Max. Capacity between base plate and earth: 0.22 µF
- Max. Resistance between the 2 input terminals of a panel: 20 Ω

**Solid-state safety outputs**
0.5 A max. at 24 V DC (1.0 V DC max. drop), 1 A max. inrush
**threshold Output OFF:** 1.7 V DC typical (2.0 V DC max.)
**Output leakage current:** 50 µA max. with open 0 V **load:**
max. 0.1 µF, max. 1 H, max. 10 Ω per line
**Response and recovery times**
**Response time between input and output (input stop to output off):** see the configuration overview in the software, as it can vary.
**Restart time:** Switch-on delay (if set) plus 250 ms typical (400 ms maximum)
**Output xA to output xB switch on differentially (used as a pair, not split):** 5 ms max.
**Switch on output X to output Y Differential (same input, same delay, any module):** 3 sampling times + 25 ms maximum
**Virtual input (Mute Enable and On/Off) Timing (FID 2 or higher):** RPI + 200 ms typical
**Virtual input (manual reset and abort delay) (FID 2 or higher):** see "7.7 Virtual non-safety-related input devices" on page 57 for details
**OFF delay tolerance**
The maximum is the response time specified in the configuration overview plus 0.02%.
The minimum is the configured OFF delay time minus 0.02% (assuming no power failure or fault)
**ON delay tolerance**
The maximum is the configured switch-on delay plus 0.02% plus 250 ms typical (400 ms maximum) The minimum is the configured switch-on delay minus 0.02%.

**Certifications**

Programmable safety controller 3NBN

**Conformity**

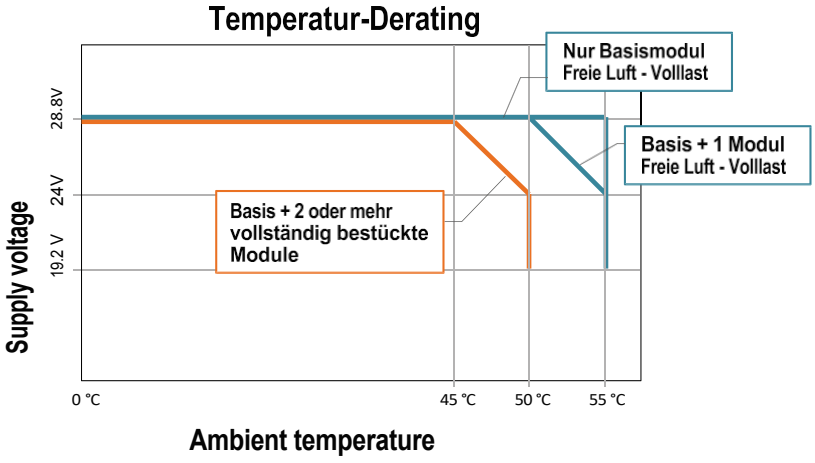



Figure 9: SCx-DCD temperature derating

## ■ SCx-O-2T and SCx-O-4T solid-state safety output modules Solid-state safety outputs

**SCx-O-2T:** 0.75 A maximum at 24 V DC (1.0 V DC maximum drop)
**SCx-O-4TSCx-O-4T:** 0.5 A maximum at 24 V DC (1.0 V DC maximum drop)
**Inrush current:** 2 A maximum
**Output off threshold:** 1.7 V DC typical (2.0 V DC maximum)
**Output leakage current:** 50 µA max. with open 0 V load: 0.1 µF max., 1 H max., 10 Ω max. per line

**Safety assessments PFH**
**[1/h]:** $5.8 \times ^{10\text{-}10}$
**Proof test interval:** 20 years

**External power supply**
**SCx-O-2T:** 24 V DC ± 20% (including ripple); 0.075 A no-load, 3.075 A maximum load **SCx-O-4T:** 24 V DC ± 20% (including ripple); 0.1 A no-load, 4.1 A maximum load **Maximum switch-on delay:** 5 seconds after the base controller
**Limited insulation:** maximum ±30 V DC, based on 0 V at the base controller

**Bus power**
0,02 A

**Test pulse**
**Width:** maximum 200 µs
**Rate:** 200 ms typical

**Protection of the output**
All semiconductor outputs (safety and non-safety outputs) are protected against short circuits to 0 V or +24 V, including overcurrent conditions

**Certifications**

Programmable safety controller 3NBN

**Conformity**

## ■ SCx-I-8 and SCx-I-16 safety input modules

**Convertible I/O**
**Current consumption:** maximum 80 mA at 55 °C (131 °F) operating ambient temperature (overcurrent protected)
**Test pulses:** approx. 1 ms every 25 ms to 75 ms

**Bus power**
**SCx-I-8:** 0.07 A without load; 0.23 A maximum load
**SCx-I-16:** 0.09 A without load; 0.41 A maximum load

**Safety assessments PFH**
**[1/h]:** $4 \times ^{10\text{-}10}$
**Proof test interval:** 20 years

**Safety inputs (and convertible I/O when used as inputs) Switch-on threshold:** > 15 V DC (guaranteed switched on), maximum 30 V DC **Input-off threshold:** < 5 V DC and < 2 mA, minimum -3 V DC
**Input inrush current:** 5 mA typical at 24 V DC, 50 mA peak current for contact cleaning at 24 V DC
**Resistance of the input line:** 300 Ω max. (150 Ω per line)
**Input requirements for a 4-wire switching mat:**
- Maximum capacitance between the plates: 0.22 µF
- Maximum capacitance between base plate and ground: 0.22 µF
- Maximum resistance between the 2 input terminals of a panel: 20 Ω

**Protection of the output**
The convertible inputs are protected against short circuits to 0 V or +24 V, including overcurrent conditions

**Certifications**

Programmable safety controller 3NBN

**Conformity**

■ **SCx-O-1R and SCx-O-2R safety relay modules Bus current**

**SCx-O-1R:** 0.125 A (outputs switched on)

**SCx-O-2R:** 0.15 A (outputs switched on)

**Maximum power**

2000 VA, 240 W

**Electrical service life**

50,000 cycles at full resistance load

**Overvoltage category**

III

**Degree of soiling**

2

**Mechanical service life**

40,000,000 cycles

**Switching capacity UL/NEMA:**

- **NO contact:** 6 A 250 V AC/24 V DC resistive; B300/Q300 control mode
- **NC contacts:** 2.5 A 150 V AC/24 V DC ohmic; Q300 pilot operation

**IEC 60947-5-1:**

**NO contact:** 6 A 250 V AC/DC continuous; AC 15: 3 A 250 V; DC13: 1 A 24 V/4 A 24 V 0.1 Hz

- **NC contacts:** 2.5 A 150 V AC/DC continuous; AC 15: 1 A 150 V; DC13: 1 A 24 V/4 A 24 V 0.1 Hz

**Contact values for maintaining the 5 µm AgNi gold coating**

| | Minimum | Maximum |
|---|---|---|
| Tension | 100 mV AC/DC | 60 V AC/DC |
| Performance | 1 mW (1 mVA) | 7 W (7 VA) |
| Electricity | 1 mA | 300 mA |

**Note:** Transient suppression is recommended when switching inductive loads. Install suppressors above the load. Never install interference suppressors above the output contacts.

**Safety assessments PFH**

**[1/h]:** $7.6 \times {}^{10\text{-}10}$

**Proof test interval:** 20 years

**B10d Values**

| Tension | Electricity | B10d |
|---|---|---|
| 230 V AC | 3 A | 300.000 |
| 230 V AC | 1 A | 750.000 |
| 24 V DC | ≤ 2 A | 1.500.000 |

**WARNING:** Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.

The overcurrent protection must be provided in accordance with the table supplied, depending on the end product application. Overcurrent protection can be provided by an external fuse or a class 2 current-limiting power supply.
The supply cable wires < 24 AWG must not be spliced. Further information on product support can be found at www.bernstein.eu.

| Wiring (AWG) | Required overcurrent protection (amperes) |
|---|---|
| 20 | 5.0 |
| 22 | 3.0 |
| 24 | 2.0 |
| 26 | 1.0 |
| 28 | 0.8 |
| 30 | 0.5 |

**Certifications**

Programmable safety controller 3NBN

**Conformity**

■ **SCx-N-Cat EtherCAT communication gateway module**

**Network interface**

EtherCAT® 5

**Data transfer rate:** 100 Mbits/s, 100 Base-T autosensing

**Connection type:** Two RJ-45 sockets

**Mechanical load**

**Shock:** 15 g for 11 ms, half sine wave, 18 shocks in total (according to IEC 61131-2)

**Vibration:** 3.5 mm occasional / 1.75 mm continuous at 5 Hz to 9 Hz, 1.0 g occasional and 0.5 g continuous at 9 Hz to 150 Hz: all at 10 sweep cycles per axis (according to IEC 611312)

**EMC**

Meets or exceeds all EMC requirements in accordance with IEC 61131-2, IEC 62061 Annex E, Table E.1 (increased immunity values), IEC 61326-1:2006 and IEC61326-3-1:2008

**Bus power**

0,06 A

**Operating conditions**

**Temperature:** 0 °C to +55 °C (+32 °F to +131 °F)

**Storage temperature:** -30 °C to +65 °C (-22 °F to +149 °F)

**Humidity:** 90% at +50 °C maximum relative humidity (non-condensing)

**Operating altitude:** maximum 2000 m (6562 ft) in accordance with IEC 61010-1

**Environmental assessment**

NEMA 1 (IEC IP20), for use in NEMA 3 (IEC IP54) or better enclosures

**Certifications**

## 5.2 Sp ecifications for the SCR P

**Power supply**

**Current:**

Max. 240 mA, no load (relay on)

Max. 530 mA, full load (IO1 to IO4 used as auxiliary outputs)

**Safety inputs (and configurable I/O when used as inputs) Switch-on threshold for input:**

> 15 V DC (guaranteed on), max. 30 V DC **Switch-off threshold for input:** < 5 V DC and < 2 mA, min. - 3 V DC minimum

**Switch-on threshold value for input:** 5 mA typical at 24 V DC, 50 mA contact cleaning peak current at 24 V DC

**Resistance of the input lines:** max. 300 Ohm (150 Ohm per line)

**Input requirements for a 4-wire safety mat:**

- Max. Capacity between plates: 0.22 µF[1]
- Max. Capacitance between bottom plate and earth: 0.22 µF[1]
- Max. Resistance between the 2 input terminals of the same plate: 20 Ω

**Configurable I/O**

**Power supply:** max. 80 mA (overcurrent protection)

**Test pulses:** ~1 ms every 25 to 75 ms

**Daisy chain diagnosis**

Up to two diagnostic circuits can be connected (IN3+4 and IN5+6) Up to 32 DCD subscribers per diagnostic circuit

**Function for the automatic optimization of connections**

Up to three devices can be connected with terminal blocks provided by the user

**Network interface**

Ethernet 10/100 Base-T/TX, modular RJ45 connection

Selectable automatic negotiation or manual rate and duplex Auto-MDI/MDIX (automatic crossover)

**Protocols:** EtherNet/IP (with PCCC), Modbus/TCP and PROFI-NET

**Data:** 256 configurable virtual status outputs; error diagnostic codes and messages; access to error log

**Response and standby times**

**Response time (from the end of the input until the output is switched off):** see configuration overview in the software, as this can vary.

**Input recovery time (stop to start):** 250 ms typical, 400 ms max.

**Timeout function for virtual input (muting activation and on/off):** RPI + 200 ms typical

**Timeout function for virtual input (manual reset and abort delay):** Details can be found under "7.7 Virtual non-safety-related input devices" on page 57.

**Delay tolerance**

±(0.02 % + 2 scan times)

**Safety outputs**

3 NO contacts per output channel (RO1 and RO2). Each NO contact is a series connection of two contacts of two forcibly guided (mechanically connected) relays. RO1 consists of relays K1 and K2. RO2 consists of relays K3 and K4.

**Contacts**

AgNi + 0.2 µm gold

**Overvoltage category**

Voltage from 1 V to 150 V AC/DC at the output relay contact: Category III Voltage output relay contact from 151 V to 250 V AC/DC: Category II (Category III if suitable overvoltage protection is provided as described in this document).

**Rated current of the individual contacts**

When using several contact outputs, observe the temperature deduction diagram.

| | Minimum | Maximum |
|---|---|---|
| Tension | 10 V AC/DC | 250 V AC / 24 V DC |
| Electricity | 10 mA AC/DC | 6 A |
| Performance | 100 mW (100 mVA) | 200 W (2000 VA) |

[1] If the Safety Mats are used together on a configurable I/O, this is the total capacity of all Safety Mats that may be used.

**Operating conditions**
**Temperature:** 0 °C to +55 °C (+32 °F to +131 °F) (see temperature deduction diagram)
**Storage temperature:** -30 °C to +65 °C (-22 °F to +149 °F)
**Humidity:** 90 % maximum relative humidity at +50 °C (non-condensing)
**Operating altitude:** max. 2000 m (max. 6562 ft.)
**Protection class**
IP20 to IEC (NEMA 1), for use in enclosures to IP54 to IEC (NEMA 3) or higher
**Mechanical load**
**Shock resistance:** 15 g for 11 ms, half-sine, 18 shocks in total (according to IEC 61131-2)
**Vibration resistance:** 3.5 mm occasional/1.75 mm continuous vibration at 5 Hz to 9 Hz, 1.0 g occasional and 0.5 g continuous vibration at 9 Hz to 150 Hz: all at 10 cycles per axis (in accordance with IEC 61131-2)
**Service life of the mechanics**
20,000,000 cycles
**Service life of the electrics**
50. 00Switching cycles at full resistive
load UL auxiliary power B300 Q300
**B10d values**

| Tension | Electricity | B10d |
|---|---|---|
| 230 V AC | 2 A | 350.000 |
| 230 V AC | 1 A | 1.000.000 |
| 24 V DC | ≤ 4 A | 10.000.000 |

**Spring-loaded terminals**
**Switching capacity (IEC 60947-5-1)**

| | |
|---|---|
| AC 15 | NO contact: 250 V AC, 3 A |
| DC 13 | NO contact: 24 V DC, 2 A |
| DC 13 at 0.1 Hz | NO contact: 24 V DC, 4 A |

**Important:** The terminal connections are only intended for one cable. If more than one cable is attached to a connection, cables can become loose or completely detached and cause short circuits.
Use wire with ferrules or wire end clips. Tinned wires are not recommended.
After inserting the wire into the connection, pull on the wire and check that it is firmly seated. If the wire comes loose, another wiring solution should be considered.

**EMC**
Meets or exceeds all EMC requirements for immunity according to IEC 61326-3-1:2012 and emissions according to CISPR 11:2004 for Group 1, Class A devices

**Note:** An overvoltage limiter should be integrated for switching inductive loads. Install overvoltage limiters across all loads. Never install overvoltage limiters across output contacts (see warning).

**Security**
Category 4 PL e (EN ISO 13849-1) SIL CL 3 (IEC 62061, IEC 61508)

**WARNING:** The electrical connections must be made by qualified persons in accordance with local and national laws and regulations for electrical connections.

Overcurrent protection is required. This must be provided by the application of the end product in accordance with the specified table.
Overcurrent protection can be provided by external fuses or via a class 2 power supply unit with current limiting. Power supply wires < 0.20mm² (24 AWG) must not be connected. Further product support is available at www.bernstein.eu.

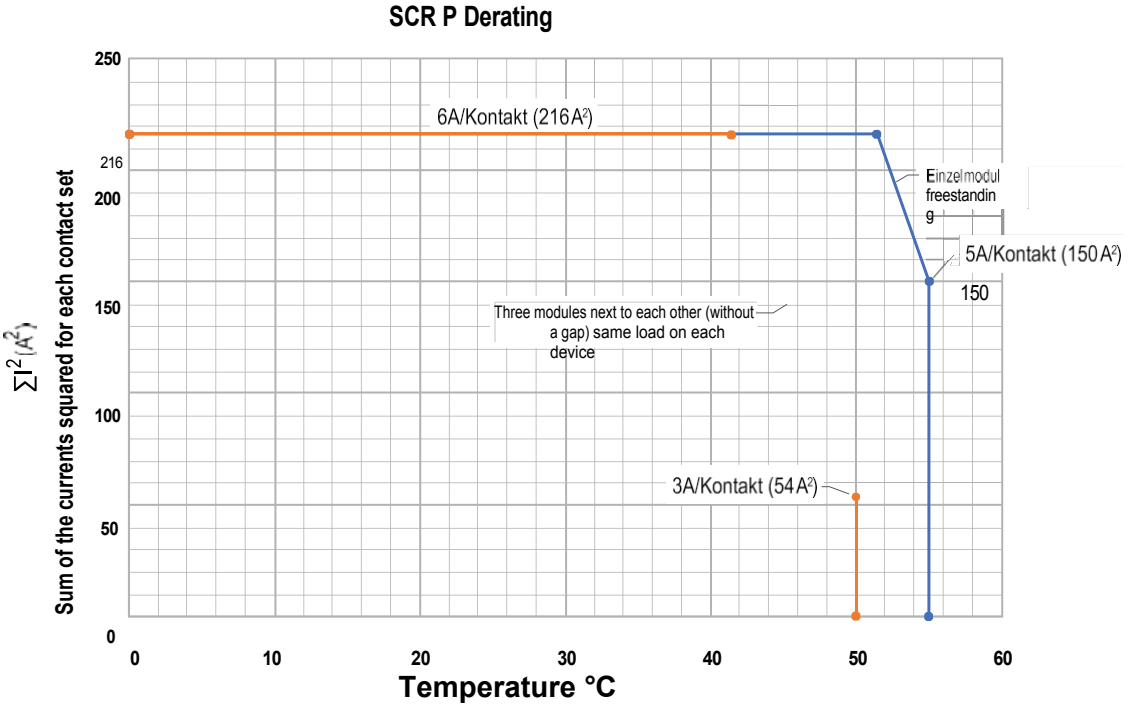
**Safety class PFH**
**[1/h]:** 5.01 × 10
**Service life:** 20 years

| Power supply wires (mm² / AWG) | Required overcurrent protection (A) |
|---|---|
| 0,50 / 20 | 5,0 |
| 0,32 / 22 | 3.0 |
| 0,20 / 24 | 2.0 |
| 0,13 / 26 | 1.0 |
| 0,08 / 28 | 0.8 |
| 0,05 / 30 | 0.5 |

**Product standards**
In section "18. Standards and regulations" on page 253 you will find a list of the applicable international and US industry standards.

**Certifications**

**Conformity**



| Example for the calculation of the temperature deduction | |
|---|---|
| Single device, free-standing | Three modules |
| $\sum I^2 = I_1^2 + I_2^2 + I_3^2 + I^2{}_4 + I^2{}_5 + I^2{}_6$ | $\sum I^2 = I_1^2 + I_2^2 + I_3^2 + I_4^2 + I_5^2 + I_6^2$ (all six modules) |
| $I_1$ = 4 A (NO contact output RO1 channel 1) | → $I_1$ = 4 A |
| $I_2$ = 4 A (NO contact output RO1 channel 2) | → $I_2$ = 4 A |
| $I_3$ = 4 A (NO contact output RO1 channel 3) | → $I_3$ = 4 A |
| $I_4$ = 4 A (NO contact output RO2 channel 4) | → $I_4$ = 4 A |
| $I_5$ = 4 A (NO contact output RO2 channel 5) | → $I_5$ = 4 A |
| $I_6$ = 4 A (NO contact output RO2 channel 6) | → $I_6$ = 4 A |

| Example for the calculation of the temperature deduction | |
|---|---|
| Single device, free-standing | Three modules |
| $\sum I^2 = 4^2 + 4^2 + 4^2 + 4^2 + 4^2 + 4^2 = 96\ A^2$ | → $\sum I^2 = 4^2 + 4^2 + 4^2 + 4^2 + 4^2 + 4^2 = 96\ A^2$ |
| $T_{max}$ = 55 °C | → $T_{max}$ = 46 °C |

### 5.3 Dimensions

All dimensions are given in millimeters unless otherwise stated.

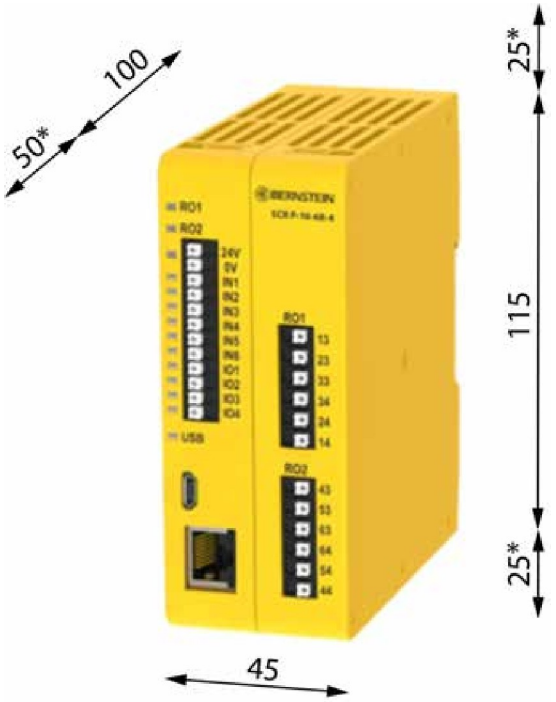



Figure 10: Dimensions of the SCR P

* smallest installation distance


Figure 11: Dimensions of the basic control unit


Figure 12: Dimensions of the extension module


Figure 14: Dimensions of the EtherCat module

* smallest installation distance

## 5.4 System requirements for the PC

**Important:** Administrator rights are required for the driver installation of the safety evaluation (driver required for communication with the safety evaluation).

| | |
|---|---|
| **Operating system:** | Microsoft Windows 7, Windows 8 (except Windows RT) or Windows 102 |
| **System encryption type:** | 32-bit, 64-bit |
| **Hard disk space:** | 80 MB (plus up to 280 MB for Microsoft .NET 4.0 if it is not already installed) |
| **Random access memory (RAM):** | At least 512 MB, at least 1 GB recommended |
| **Processor:** | At least 1 GHz, 2 GHz+ recommended |
| **Screen resolution:** | Color screen with at least 1024 × 768 pixels, color screen with 1650 × 1050 pixels recommended |
| **Third-party software:** | Microsoft .NET 4.0 (included in the installation program), PDF viewer program (e.g. Adobe Acrobat) |
| **USB port:** | USB 2.0 (no configuration required) |

# 6. System installation

## 6.1 I nstallation of the software

**Important:** Administrator rights are required for the driver installation of the safety evaluation (driver required for communication with the safety evaluation).

1. Download the latest version of the software here: www.bernstein.eu/downloads.
2. Navigate to the downloaded file and open it.
3. Click Next to start the installation process.
4. Confirm the target storage location for the software, the availability for users and click Next.
5. Click Next to start the installation.
6. Depending on the system settings, a pop-up window may appear asking you whether you want to allow the BERNSTEIN software to make changes to your computer. Click Yes.
7. Click Close to exit the installation program.

Open the **configuration software from** the **workstation** or via the **Start menu**.

## 6.2 Installation of the safety evaluation

To ensure reliable operation, the operating data must not be exceeded. The switch cabinet housing must allow appropriate heat dissipation so that the temperature of the air around the safety evaluation unit cannot exceed the maximum operating temperature (see "5. Specifications and requirements" on page 18).

**Important**: Install the safety evaluation unit in a suitable location that is not subject to strong vibrations.

**CAUTION:** Electrostatic discharge (ESD) can cause damage to electronic devices. To prevent this, you should follow the appropriate application instructions for handling electrostatic discharges: For example, wear an approved grounding wrist strap or touch a grounded object before handling the modules. Further information on handling electromagnetic discharges can be found in ANSI/ESD S20.20.

### 6.2.1 Assembly instructions

The safety evaluation unit is mounted on a standardized 35 mm DIN rail. It must be housed in a NEMA 3 (IEC IP54) or better enclosure. The evaluation unit should be mounted on a vertical surface with ventilation slots on the top and bottom to allow for natural convection cooling.
The installation instructions must be observed so that the safety evaluation unit is not damaged.
**Installation** of the programmable safety controller SCR P:

- Tilt the top of the module slightly backwards and place the module on the DIN rail.
- Align the module straight above the rail.
- Lower the module onto the rail.

**Remove** the programmable safety controller SCR P:

1. Press the bottom of the module upwards.
2. Tilt the top of the module slightly forwards.
3. Lower the module as soon as the upper fixed clamp has become detached from the DIN rail.

# 7. Considerations before installation

## 7.1 Suitable application

The correct use of the safety evaluation depends on the type of machine and the protective devices for which an interface with the safety evaluation must be established. **If you have any doubts as to whether the machine is compatible with this evaluation unit, please contact BERNSTEIN AG**.

**WARNING: No independent protective device**

This device is considered an auxiliary device and is used to reinforce protective devices that limit or eliminate sources of danger to persons without requiring any action by a person. Failure to use suitable protective devices for hazards based on a risk evaluation, local regulations and the relevant standards can lead to serious or fatal injuries.

**WARNING: The user is responsible for the safe use of this appliance**

The application examples described in this document refer to general security applications. Each of these applications has its own specific requirements.

All safety requirements must be met and all installation instructions followed. If you have any questions on the subject of technical safety measures, please contact the BERNSTEIN AG application consultants at the telephone numbers or addresses listed in this document.

**WARNING: Read this section carefully before installing the system**

The Bernstein AG safety evaluation unit is a control device that is normally used together with the protective device of a machine. How well it can perform this function depends on the suitability of the application, the correct mechanical and electrical installation of the safety evaluation unit and the connection to the machine to be monitored.

Failure to follow all mounting, installation, connection and inspection procedures as directed may result in the safety evaluation unit not providing the protection for which it was designed. The user is responsible for compliance with all local and national laws, rules and regulations regarding the installation and use of this device in each individual application. All safety requirements must be met and all technical installation and maintenance instructions contained in this document must be followed.

## 7.2 SCx applications

The Safety Controller can be used wherever safety modules are used. The Safety Controller is suitable for many types of applications including, but not limited to:

- Two-hand operation with mute function
- Robot welding/processing cells with two-zone muting
- Material handling operations that require multiple inputs and bypass functions
- Manually loaded rotary charging stations
- Several applications for two-hand control stations
- Stages of lean production
- Dynamic monitoring of single or double-pole solenoid valves or press safety valves

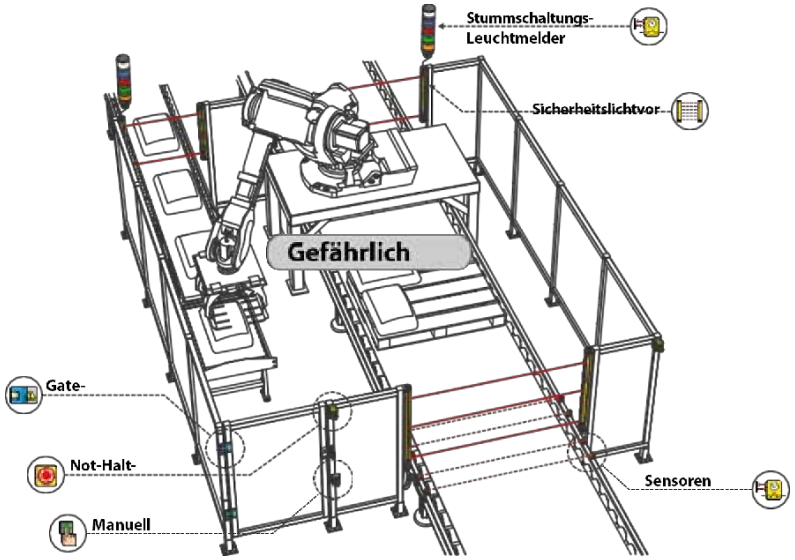



Figure 15: Application example robot cell

## 7.3 SCR P applications

The SCR P safety evaluation unit is ideal for all small to medium-sized machines that would normally use two independent safety relay modules.

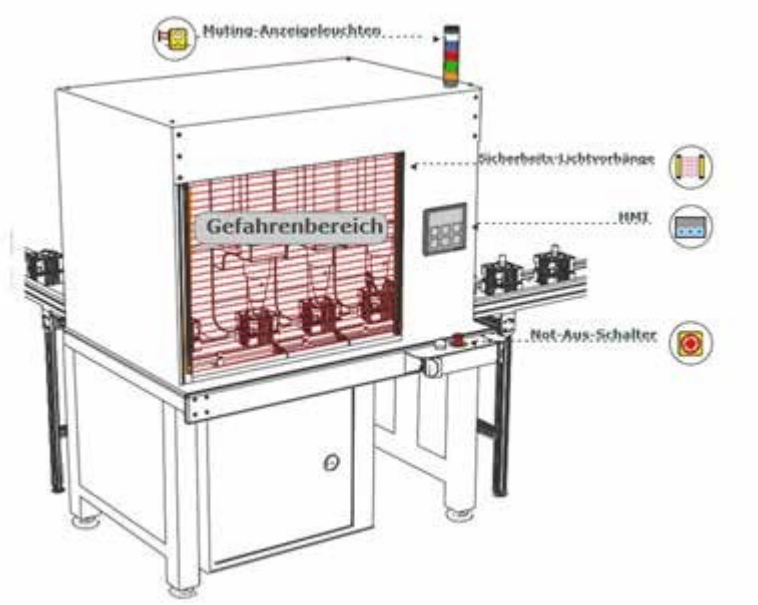



Figure 16: Application example 1 for the SCR P

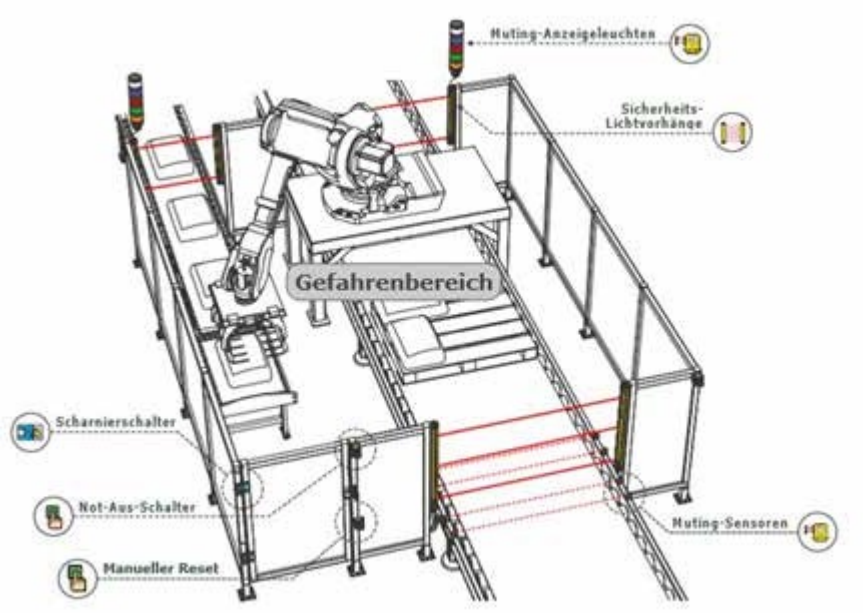



Figure 17: Application example 2 for the SCR P

## 7.4 Safe input functions

The safety evaluation unit monitors the status of the safety switching devices that are connected to it. In general, the safety output switches on or remains switched on if all input devices that have been configured to control a specific safety output are in the On state. If at least one of the
safety input devices changes from the on state to the off state, the safety input switches off. Some special functions can be assigned to the safety inputs to temporarily cancel the stop signal under predefined circumstances so that the safety output remains switched on. These include muting and bypassing, for example.
The safety evaluation unit can detect input faults in certain input circuits that would otherwise lead to the loss of the safety function. If such errors are detected, the safety evaluation switches off the associated outputs until the errors have been eliminated. The function blocks used in the configuration affect the safety outputs. The configuration must be checked carefully if errors occur in input devices.
The following methods, among others, can be used to eliminate or minimize the probability of such errors:

- Physical separation of the connecting cables from each other and from secondary energy sources.
- Lay the connecting cables in separate cable ducts or protective conduits.
- All control elements (safety evaluation unit, connection modules, safety sensors and switch-off elements) are located next to each other on a control panel and the elements are directly connected to each other with short cables.
- Proper installation of multi-core cables and multiple conductors laid with strain reliefs. Excessive tightening of a clamping strain relief can cause a short circuit at this point.
- Use of components with positive opening as described in IEC 60947-5-1, installed in accordance with IEC 14119.
- Regularly check the function of the safety function.
- Training of operators, maintenance personnel and other persons involved in the operation and maintenance of the machine so that they can identify and immediately rectify any faults.

**Note:** Observe the manufacturer's installation, operating and maintenance instructions as well as all applicable regulations. If you have any questions about the devices connected to the safety evaluation unit, please contact Bernstein AG.

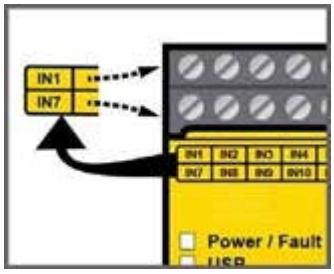
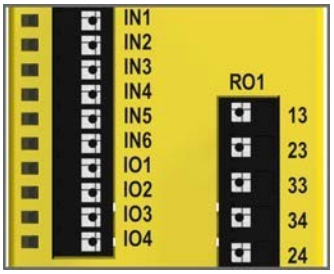



Figure 18: Position of the SCx




terminalsFigure 19: Position of the input and output connections on the SCR P

**WARNING: Input device and safety level**

The safety evaluation unit can monitor numerous different safe input devices. The user must carry out a risk evaluation of the safety application to determine which safety level must be achieved and how the input devices must therefore be correctly connected to the safety evaluation unit. The user must also take measures
to eliminate or minimize possible input signal errors or faults that could lead to the loss of safety functions.

### 7.4.1 W ire resistance to faults and safety circuit principles in accordance with ISO 13849-1

Safety circuits comprise the safety-related functions of a machine that reduce the risk. These safety-related functions can prevent a machine from starting or stop a machine movement. The failure of a safety-related function or its associated safety circuit normally leads to an increased risk.
The resistance of a safety circuit to failure depends on several factors, including fault tolerance, risk mitigation, reliable and proven components, proven safety principles and other design features.
Depending on the risk associated with the machine or its operation, a suitable level of resistance of the safety circuits to faults (performance) must be included in this design. The following standards go into more detail on safety levels: ISO 13849-1 Safety-related parts of control systems.

**Safety levels of safety circuits**

Safety circuits have been divided into categories and performance levels in international and European standards, depending on their ability to maintain their safety function in the event of a fault and the statistical probability of such a fault. ISO 13849-1 goes into more detail on the fault tolerance of safety circuits and describes the circuit architecture or structure (categories) and the required performance level (PL) of safety functions under foreseeable conditions.
Fault resilience typically includes redundant control and self-monitoring circuits and is roughly equivalent to ISO 13849-1, Category 3 or 4 and/or Performance Level "d" or "e" (see ANSI B11.19).
Perform a risk evaluation to verify the appropriate application, correct connections and risk mitigation (see ANSI B11.0 or ISO 12100). The risk evaluation must be carried out in order to determine the
The risk assessment must take into account all local regulations and relevant standards, e.g. European Type C standards.
This risk evaluation must take into account all local regulations and relevant standards, e.g. the European Type C standards.
The safety evaluation inputs are designed for applications up to and including category 4 PL e (ISO 13849-1) and SIL 3 (IEC 61508 and IEC 62061). The actual safety level of the circuits depends on the configuration, the correct installation of the external circuits and the type and installation of the safety switching devices. It is the responsibility of the user to carry out a safety assessment of the overall configuration and to ensure full compliance with all regulations and standards.
The following sections refer only to applications of categories 2, 3 and 4 according to ISO 13849-1. The circuits of the input devices in the following table are frequently used in safety applications. However, other solutions are also possible depending on fault exclusion and risk evaluation. The following table shows the circuits of the input devices and the respective possible safety level if all fault detection and fault exclusion requirements are met.

**WARNING: Risk evaluation**

The safety level of safety circuits can be strongly influenced by the design and installation of safety devices and the type of connection of these devices. A risk evaluation must be carried out to determine the appropriate safety level of the safety circuits.
This is to ensure that the expected risk reduction is achieved and that all relevant regulations and standards are met.

**WARNING: Dual-channel contact-based inputs with only 2 or 3 connections**

Detection of a short circuit between two input channels (contact inputs, but no antivalent contacts) is not possible if both contacts are closed. A short circuit can be detected if the input is in the Off state for at least 2 seconds (see tip on INx and IOx input connections in "7.5 Options for safety input devices" on page 36).

**WARNING:**

- **Category 2 or 3 input short-circuits**
- It is not possible to detect a short circuit between two input channels (contact inputs, but no complementary contacts) if they are supplied from the same source (e.g. the same terminal of the safety evaluation unit for a two-channel connection with 3 connection terminals, or from an external 24 V supply) and if both contacts are closed.
- Such a short circuit can only be detected if both contacts are open and the short circuit lasts for at least 2 seconds.

**Error exclusion**

An important concept in the requirements of ISO 13849-1 is the probability of a fault occurring. This can be reduced by a method known as "fault exclusion". This is based on the assumption that the possibility of certain, precisely defined faults can be reduced by design, installation or technical means to such an extent that the remaining faults are largely negligible - or, in the case of risk evaluation, can be excluded.
can be "excluded".
Fault exclusion is a tool that designers can use when developing the safety-related parts of the control system and in the risk assessment process. With fault exclusion, the designer can exclude the possibility of multiple faults and justify this with the risk assessment process in order to achieve the desired fault tolerance in accordance with the requirements of ISO 13849-1/2.
The requirements for the fault tolerance of safety circuits (category/performance level) in accordance with ISO 13849-1 vary considerably in different applications. BERNSTEIN AG always recommends the highest level of safety for each application. Nevertheless, it is the user's responsibility to install, operate and maintain each safety system safely and to comply with all applicable laws and regulations.

**WARNING: Risk evaluation**

The safety level of safety circuits can be strongly influenced by the design and installation of safety devices and the type of connection of these devices. In order to determine the appropriate safety level of the safety circuits, a risk evaluation must be carried out. This is to ensure that the expected risk reduction is achieved and that all relevant regulations and standards are met.

### 7.4.2 Properties of safety entrances

The safety evaluation is configured via the software to support many types of safety switching devices. See "8.2 Adding inputs and status outputs" on page 77 for more information on configuring the inputs.

**Reset logic: manual or automatic reset**

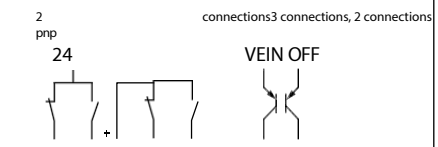
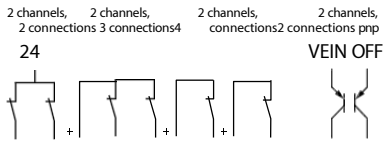
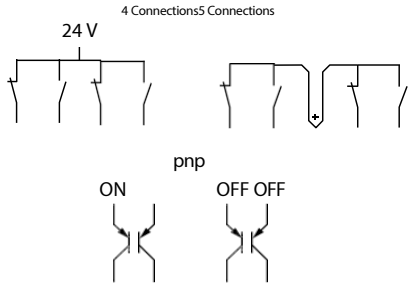
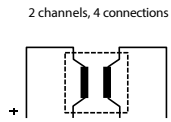
A manual reset may be required for safety inputs by using a LatchResetBlock or by configuring a safety output for a LatchReset so that the safety outputs they control can only switch back on after an acknowledgement. This is sometimes referred to as "latch mode" because the safety output is latched in the off state until a reset is performed. If a safety input is configured for automatic reset mode, the safety outputs controlled by it switch back on when the input device switches to the On state (provided that all other control inputs are also in the On state).

**Connection of input devices**

The safety evaluation system must know which device signal lines are connected to which terminals so that it can apply the correct signal monitoring methods, switch-on and switch-off functions, time functions and error functions. The connection terminals are assigned automatically during the configuration process and can be changed manually via the software.

### Types of signal state changes

Two types of status changes can be used when monitoring the signals of two-channel safety inputs: simultaneous or non-simultaneous.

| Input circuit | Time control for change of state of the input signal | |
|---|---|---|
| | **Off state: Safety output switches off when [3]:** | **On state: Safety output switches on when [4]:** |
| **Two-channel A and B antivalent**<br>  | At least 1 channel input (A or B) is in the off state. | **Simultaneous:** A and B are both in the off state and then both switch to the on state within 3 seconds.<br>**Not simultaneously:** A and B are both in the off state and then both switch to the on state without a limited time window. |
| **Dual-channel A and B**<br>  | | |
| **Dual-channel A and B 2x antivalent**<br>  | At least 1 channel (A or B) of a contact pair in the off state. | **Simultaneous:** A and B are in the off state, then both contact pairs switch to the on state within 400 ms (150 ms with two-hand control); both channels are in the on state within 3 s (0.5 s with two-hand control).<br>**Non-simultaneous:** A and B are in the Off state at the same time, then both contact pairs switch to the On state within 3 seconds. Channel A and channel B switch to the On state without a limited time window. |
| **4-wire safety mat**<br>  | One of the following conditions is met:<br>• Input channels short-circuited to each other (normal operation)<br>• At least one cable is disconnected<br>• One of the open channels is recorded as closed<br>• One of the closed channels is recorded as open | Each channel has i t s own specific impulses. |

### Signal debounce times

**Switch-off bounce times( from 6 ms to 1000 ms in 1-ms intervals, except 6 ms to 1500 ms for muting-sensors).** The switch-off bounce time is the permitted time limit for the input signal to switch from the ON state to the OFF state.
(24 VDC) to the final OFF state (0 VDC). This time limit may need to be increased in cases where strong device vibrations, mechanical shocks or other disturbances result in longer signal transition times. If the debounce time is set too short under these harsh conditions, the system may detect a fault and enter a lockout state. The default setting is 6 ms.

3 safety outputs switch off if one of the controlling inputs is in the off state.

4 Safety outputs only switch on if all controlling inputs are in the On state and after a manual reset has been carried out (if at least one of these safety inputs has been configured for manual reset and was in its Off state).

**CAUTION: Debounce time and response time**

Changes to the debounce time can affect the response time of the safety output (to switch off). This value is calculated and displayed for each safety output when a configuration is created.

**Switch-on debounce times (from 10 ms to 1000 ms in 1 ms intervals, except 10 ms to 1500 ms for muting sensors).** The switch-on debounce time is the permitted time limit for the input signal to transition from the off state (0 V DC) to the final on state (24 V DC). This time limit may need to be increased in cases where strong device vibrations, mechanical shocks or other disturbances lead to longer signal transition times. If the debounce time is set too short under these harsh conditions, the system may detect a fault and enter a blocking state. The default setting is 50 ms.

## 7.5 Options for security input devices

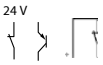
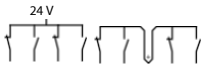
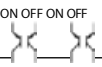
| General circuit symbols | | Circuits shown in the on-state | | | | | | | Circuits shown in stop state | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ES | GS | OS | RP | PS | SM | DCD | THC | ED |
| **1 and 2 connections 1 channel** (see note 1) |   | Cat.2 | Cat.2 | Cat.2 | Cat.2 | Cat.2 | | | | |
| **2 and 3 connections 2 channels** (see note 2) |   | Cat.3 | Cat.3 | Cat.3 | Cat.3 | Cat.3 | | | Type IIIa Cat.1 Type IIIb Cat.3 | Cat.3 |
| **2 connections 2 channels PNP with integrated monitoring** (see note 3) |   | Cat.4 | Cat.4 | Cat.4 | Cat.4 | Cat.4 | | Cat.4 | Type IIIa Cat.1 | Cat.4 |
| **3 and 4 connections 2 channels** (see notes 2 and 4) |  | Cat.4 | Cat.4 | Cat.4 | Cat.4 | Cat.4 | | | Type IIIa Cat.1 Type IIIb Cat.3 | Cat.4 |
| **2 and 3 connections 2 channels Antivalent** |   | | Cat.4 | Cat.4 | Cat.4 | Cat.4 | | | | Cat.4 |
| **2 connections 2 channels Antivalent PNP output** |   | | Cat.4 | Cat.4 | Cat.4 | Cat.4 | | | | Cat.4 |
| **4 and 5 Connections 2 channels Antivalent** |   | | Cat.4 | | | | | | Type IIIc Cat.4 | Cat.4 |
| **4 connections, 2 channels Antvalenter PNP output** |   | | Cat.4 | | | | | | Type IIIc Cat.4 | Cat.4 |
| **Safety mat with 4 connections** |  | | | | | | Cat.3 | | | |

*Figure14: Input circuit categories (instructions)*

**WARNING: Incomplete information -** Many installation considerations are necessary for the proper use of input devices, but are not covered in this document. **Therefore, the relevant installation instructions for the device must be followed to ensure safe use of the device**

**WARNING:** This table contains a list of the highest possible safety categories for common safety-related input device circuits. If the additional requirements specified in the notes below are not possible due to limitations of the safety device or installation, or if, for example, all terminals of the IOx input are in use on the safety evaluation unit, the highest safety category may not be possible.

**Tip: INx and IOx input terminals:** These circuits can be manually configured to meet the requirements for Category 4 circuits. To do this, the first standard input terminal (INx) is changed to any available convertible terminal (IOx), see below. These circuits detect short circuits to other circuits and between channels if the input has been in the off state for at least 2 seconds.



### 7.5.1 Safety levels of safety circuits

The requirements for the safety level or performance level in accordance with ISO 13849-1 for the use of interlocking devices vary greatly. While BERNSTEIN AG always recommends the highest safety level for each application, it is the responsibility of the user to install, use and maintain each safety system safely and to comply with all applicable laws and regulations.
The safety level must sufficiently reduce the risk of the hazards of the machine identified in the risk evaluation.

### 7.5.2 Enabling switch

An enabling switch is a manually operated control device which, when continuously actuated together with a start button, allows the initiation of a machine cycle. Standards covering the design and use of enabling switches include: ISO 12100-1/-2, IEC 60204-1, ANSI/NFPA 79, ANSI/RIA R15.06 and ANSI B11.19.
The enabling switch actively controls the cancellation of a stop signal during a section of machine operation in which a hazardous situation may occur. The enabling switch allows a dangerous machine part to run, but must not start it. An enabling switch can control one or more safety outputs. When the activation signal switches from the off state to the on state, the safety evaluation switches to enable mode. A separate machine command signal from another device is required to start a dangerous machine movement. **The enabling switch must have the final ability to switch off or stop the dangerous machine movement.**

### 7.5.3 N ot-stop switch

The safety inputs of the safety evaluation unit can be used to monitor emergency stop switches.

**WARNING:**

- **Do not mute or bypass emergency stop devices**
- The emergency stop function becomes ineffective when muting or bridging the safety outputs.
- In accordance with ANSI B11.19, ANSI NFPA79 and IEC/EN 60204-1, the emergency stop function must remain active at all times.

**WARNING:** The emergency stop configuration of the safety evaluation prevents the emergency stop switch inputs from being muted or bridged. However, the user must still ensure that the emergency stop switch remains active at all times.

**WARNING: Reset function required**
International standards stipulate that once the cause of a stop condition has been eliminated (e.g. triggering an emergency stop button, closing an interlocked safety guard, etc.) a reset routine is performed. **If the machine is allowed to restart without activating the normal start command or the normal start device, an unsafe condition may occur. This could result i n serious injury or death.**

In addition to the requirements listed in this section, the design and installation of the emergency stop device must comply with ANSI NFPA 79 or ISO 13850. The stop function shall be either a Category 0 or Category 1 function (see ANSI NFPA79).

**Requirements for emergency stop switches**
Emergency stop switches must have one or two safety contacts that are closed when the switch is in the operational position. Once activated, the emergency stop switch must open all its safety-related contacts and a deliberate action must be required (turning, pulling or unlocking) to return the switch to the operational position with closed contacts. The switch must have positive opening in accordance with IEC 60947-5-1. A mechanical force exerted on such a switch is transmitted directly to the contacts and forces them to open. This ensures that the switch contacts open each time the switch is activated.

The ANSI NFPA 79, ANSI B11.19, IEC/EN 60204-1 and ISO 13850 standards specify additional requirements for emergency stop switches, including
- Emergency stop switches must be fitted to each control stand and other control panels where an emergency stop is required.
- It must be possible to actuate off and emergency stop switches at any time from any control stand and any control panel to which they are attached. Emergency stop switches must not be muted or bypassed.
- Triggering devices of emergency stop switches must be red on a yellow background. Emergency stop switches triggered by pressure or impact must be designed as mushroom or rough hand switches
- The emergency stop switch must remain in the off position after actuation.

**Note:** For some applications it may be necessary to observe further regulations. The user is responsible for compliance with all relevant regulations.

### 7.5.4 rope pull switch

Steel wire ropes are used for rope pull switches with an emergency stop function (safety rope pull switches). These switches enable emergency stop actuation over a distance, e.g. along a conveyor belt.
Many of the same requirements apply to safety rope pull switches as to emergency stop pushbuttons, such as direct (positively driven) operation as described in IEC 60947-5-1.
See "7.5.3 Emergency stop switch" on page 37 for more information.
Safety rope pull switches must be capable of responding not only to a rope pull, but also to a sag or break in the rope. Safety rope pull switches must also have a locking function that requires a manual reset after actuation.

**Guidelines for the installation of safety rope pull switches**
The ANSI NFPA 79, ANSI B11.19, IEC/EN 60204-1 and ISO 13850 standards specify the requirements for the installation of safety rope pull switches, among other things:
- Safety rope pull switches must be installed where the emergency stop function is required.
- Safety rope pull switches must be permanently ready for operation, easily visible and easily accessible. Muting or bridging is not permitted.
- Safety rope pull switches must tension the rope evenly.
- Ropes and adjusting parts must be red.
- The safety rope pull switch must be able to respond to a force in any direction.
- The switch must fulfill the following conditions:
  - It must have a self-locking function that requires a manual reset after actuation.
  - It must be designed to be positive opening.
  - He must report a sag or break in the rope or cable.

**Further guidelines for installation:**
- The cable must be easily accessible, red in color for emergency stop functions and visible along its entire length. Markings may be attached to the rope or cable to increase its visibility.
- Mounting points, including brackets, must be firm and leave sufficient space around the rope or cable so that it is easily accessible.
- The rope or cable must run smoothly over all brackets. Cable pulleys are recommended. Lubrication may be required. Contamination of the system, for example by dirt, metal chips or filing dust, etc., must be prevented as this could impair operation.
- Only use rope pulleys (not lifting eyes) when the rope is guided around corners or when the direction is changed - even for slight changes in direction.

- Never lay the rope or cable through tubes.
- Never attach weights to the rope
- A counter spring is recommended to ensure conformity with the non-directional operation of the wire rope or cable hoist. This must be installed on the load support structure (machine frame, wall, etc.).
- The temperature has an effect on the cable tension. The rope or cable expands (becomes longer) when the temperature rises and contracts (becomes shorter) when the temperature falls. If there are significant temperature fluctuations, the tension setting must be checked frequently.

**WARNING**: Failure to follow the installation instructions and procedures may render the safety rope pull switch system ineffective or cause it to fail. This could cause an unsafe condition resulting in serious or fatal injury.

### 7.5.5 Protective stop (safety stop)

A protective stop is intended for the connection of various devices, which may include protective devices and supplementary devices. This stop function is a type of operational interruption that allows a controlled shutdown for safety purposes. The function can be activated and reset automatically or manually.

**Requirements for protective stop (safety stop)**
The required safety level of safety circuits is determined by a risk evaluation and results in the permissible safety category (see "7.4.1 Resistance to faults and safety circuit principles according to ISO 13849-1" on page 33). The protective stop circuit must monitor the protected danger point by
stops dangerous machine movements and interrupts the supply to the machine drives. This is usually a Category 0 or Category 1 stop in accordance with ANSI NFPA 79 and IEC 60204-1.

### 7.5.6 Interlocked safety guard or safety gate

The safety inputs of the safety evaluation unit can be used to monitor electrically interlocked safety guards or safety doors.

**Requirements for safety switches**
The following general requirements and considerations apply to the installation of interlocking devices and safety gates. In addition, the applicable regulations must be observed to ensure that all requirements are met.
Dangerous machines that are secured by the interlocking device must be prevented from operating as long as the guard is not closed. If the guard opens while a hazard is present, a stop command must be sent to the machine's shutdown elements. Closing the
The dangerous machine movement must not be initiated by the protective device alone. A separate process must be required for this. The safety switches must not be used as a mechanical stop.
The guard must be positioned at a sufficient distance from the danger zone (so that the dangerous machine movement can stop before the guard opens sufficiently to allow access to the danger zone). It must open either sideways or away from the danger point and not into the guarded area. The possibility of the guard closing automatically and activating the interlocking circuit should also be ruled out. In addition, the installation must prevent personnel from reaching over, under, through or past the guard and reaching the monitored danger point. Openings in the guard must not allow access to the point of operation (see OSHA 29CFR1910.217 Table O-10, ANSI B11.19, ISO 13857, ISO14120/EN953 or another suitable standard). The guarding must be strong enough to prevent the hazards from escaping from the guarded area by ejection, falling or being ejected by the machine.
The safety switches, trigger switches, sensors and magnets must be constructed and installed in such a way that they cannot be easily bypassed. They must be securely fastened so that their physical position cannot change. Reliable fasteners that cannot be removed without tools must be used for this purpose. The mounting slots in the enclosures are for initial adjustment only. The final mounting holes must be used for permanent fixing.

**WARNING: Area safety applications**
If the application could cause a risk of back pedaling (e.g. in area guarding), either the guard or the main stop controls/shutdown elements of the guarded machine must cause an interlock with restart interlock as a result of a stop command (e.g. the interruption of the detection field of a light curtain, or the opening of a gate or guard protected by a safety switch). This interlocking state can only be reset by actuating a reset switch, which is different from the normal devices.
is disconnected to initiate the machine cycle. The switch must be positioned as described in this document. Lockout/tagout procedures in accordance with ANSI Z244.1 may be required or an additional protective device must be used in accordance with the safety requirements in ANSI B11 or other applicable standards if a stepping hazard cannot be eliminated or reduced to an acceptable level of risk. **Failure to follow these instructions could result in serious or fatal injury**

### 7.5.7 Optosensor

The safety inputs of the safety evaluation unit can be used to monitor the devices on an optical basis, where detection is carried out using light.

**Requirements for optical sensors**
For use as protective devices, optosensors are described in the IEC 61496-1/-2/-3 standard as active optoelectronic protective devices (AOPD) and active optoelectronic protective devices responding to diffuse reflection (AOPDDR).
AOPDs include safety light curtains and single or multiple light beam safety devices. These devices generally meet the requirements for type 2 or type 4 designs. A type 2 device may be used in a category 2 application in accordance with ISO 13849-1, and a type 4 device may be used in a category 4 application.
AOPDDRs include area or laser scanners. These devices are mainly classified as type 3 and can therefore be used in category 3 applications.
In addition, optical safety devices must be installed at an appropriate minimum safety distance in accordance with the applicable standards. The applicable standards and the manufacturer's documentation for your device must be observed for the appropriate calculations. The response time between the outputs of the safety evaluation and the individual safety inputs is specified on the Configuration overview tab in the software.
If the application involves a walking-behind hazard (the risk that a person could pass through the beams of the optical device and stand on the hazardous side without being detected), additional protective devices may be required and the manual reset should be selected (see "7.6.1 Manual reset input" on page 55).

### 7.5.8 Two-hand control

The safety evaluation unit can be used as a control unit for most driven machines where the machine cycle is controlled by an operator.
The operating elements of the two-hand control (THC) must be arranged in such a way that the hazardous movement is completed or stopped before the operator can release one or both buttons and reach the hazardous area (see "Calculating the safety distance (minimum distance) for two-hand controls" on page 41). The safety inputs of the safety evaluation unit are used to monitor the triggering of the manual controls and therefore fulfill the functionality requirements of safety category III in accordance with IEC60204-1 and ISO 13851 (EN 574) and the requirements in accordance with ANSI NFPA79 and ANSI B11.19 for two-hand controls, which include the following:
- Simultaneous actuation by both hands within a time frame of 500 ms.
- If this time limit is exceeded, both two-hand switches must be released before a new operation can be started.
- Uninterrupted operation during a hazardous state.
- Ending the danger state when one of the two-hand controls is released.
- Release and actuate both manual controls again to reinitiate the dangerous machine movement or dangerous state.
- The appropriate level of effectiveness of the safety function (e.g. control reliability, category/effectiveness level, or relevant regulation or standard, or safety level) determined by a risk evaluation.

**WARNING: Monitoring the operating location**

When properly installed, a two-hand control only provides protection for the machine operator's hands. It may also be necessary to install additional protective devices, such as safety light curtains, additional two-hand controls and/or fixed guards to protect personnel **from dangerous machinery.**

**The lack of suitable protective equipment on dangerous machines can lead to hazardous situations and, as a result, to serious or fatal injuries.**

**CAUTION: Two-hand controls**

The environment in which the two-hand controls are installed must not adversely affect the triggering devices. Heavy soiling or other environmental influences can result in long response times or incorrect on-state of mechanical buttons or ergonomic buttons. This can be a source of danger.

The safety level achieved (e.g. category in accordance with ISO 13849-1) depends in part on the type of circuit selected. The following must be taken into account when installing two-hand controls:

- Possible faults that would lead to short circuits, broken springs or mechanical seizure, due to which the release of a two-hand control would not be detected.
- Heavy soiling or other environmental influences that cause long response times when released, or incorrect on-state of the two-hand controls, e.g. a stuck mechanical linkage.
- Protection against accidental or unintentional actuation (e.g. mounting position, rings, covers or panels).
- Reduction of the possibility of bypassing (e.g. two-hand switches must be far enough apart so that they cannot be operated with a single arm - normally at least 550 mm in a straight line in accordance with ISO 13851).
- The functional reliability and assembly of external logic elements.
- Proper electrical installation in accordance with NEC and NFPA79 or IEC 60204.

**CAUTION: Installation of two-hand controls must not allow accidental operation**

Absolutely reliable protection of the two-hand control against misuse is not possible. **However, U.S. and international regulations require the system operator to locate and protect the two-hand controls in a manner that minimizes the possibility of intentional bypassing or inadvertent operation**

**Calculation of the safety distance (minimum distance) for two-hand controls**

**CAUTION: The machine control unit must have a restart interlock**

In accordance with US and international standards for single-stroke or single-stroke machines, the machine control must have a suitable restart interlock.

This BERNSTEIN device can be used to perform a restart interlock, but a risk assessment must be carried out to determine its suitability for this type of use.

The operator of the two-hand controls must not be able to reach the danger zone with one hand or any other part of the body before the machine movement comes to a standstill. Calculate the safety distance (minimum distance) using the formula below.

**WARNING: Arrangement of the two-hand controls**

**Two-hand controls must be installed at a safe distance from moving machine parts.** The applicable standard must be observed. It must not be possible for machine operators or other unqualified persons to change the position of the safety device. **Failure to maintain the required safety distance can result in serious or even fatal injuries.**

### Applications in USA

The formula for safety distance according to ANSI B11.19:
Clutch-operated machines with partial rotation (the machine and its controls allow the machine to stop movement during the dangerous part of the machine cycle)

**Ds = K x (Ts + Tr) + Dpf**

Clutch-operated machines with full rotation (the machine and its controls are designed so that one machine cycle is completed)

**Ds = K x (Tm + Tr + Th)**

**Ds**
the safety distance (in inches)

**K**
the OSHA/ANSI recommended hand speed constant (in inches per second); this is calculated at 63 in/s in most cases, but can vary from 63 in/s to 100 in/s depending on the circumstances of the application;
no incontrovertible values; when determining the value of K, the employer should consider all factors including the physical abilities of the operator.

**Th**
the response time of the slower two-hand control (from the time a manual switch is released until the switch is opened);
Th is usually not relevant for purely mechanical switches. However, Th should be taken into account when calculating safety distances if electronic or electromechanical manual controls are used

**Tm**
the maximum time (in seconds) that the machine needs to stop all movements after it has been switched off. For clutch-operated presses with full rotation and only one engagement point, Tm is equal to the time required for one and a half rotations of the crankshaft. For clutch-operated presses with full rotation and multiple engagement points, Tm is calculated as follows:

**Tm = (1/2 + 1/N) x Tcy**

**N =** Number of clutch engagement points per revolution
**Tcy =** time required (in seconds) for one complete revolution of the crankshaft

**Tr**
the response time of the safety evaluation measured from the time at which a stop signal is received from one of the manual controls. The response time of the safety evaluation unit can be found on the Configuration overview tab in the software.

**Ts**
the total stopping time of the machine (in seconds) from the first stop signal to a complete stop, including the stopping times for all relevant controls, measured at maximum machine speed
Ts is usually measured with a stop time measuring device. If a specified machine stop time is used in the calculation of T, at least 20% should be added as a safety factor to allow for any ageing of the braking system. If the stopping time of the two redundant machine controls is not the same, the longer of the two times must be used to calculate the safety distance.

### Applications in Europe

The formula for minimum distance according to EN 13855:

**S = (K x T) + C**

**S**
the minimum distance (in millimeters)

**K**
the hand speed constant recommended by EN 13855 (in millimeters per second); in most cases this is calculated at 1600 mm/s, but can vary from 1600 to 2500 mm/s depending on the circumstances of the application;
no incontrovertible values; when determining the value of K, the employer should take into account all factors including the physical abilities of the operator.

**T**
the total response time until the machine comes to a standstill (in seconds), from the physical triggering of the safety device to the standstill of the entire machine.

**C**
the added distance due to the penetration depth factor is equal to 250 mm according to EN 13855. The C-factor according to EN 13855 can be reduced to 0 if the risk of penetration is eliminated; however, the safety distance must always be at least 100 mm.

### 7.5.9 Safety mat


The safety evaluation unit can be used to monitor pressure-sensitive safety mats and safety edges.
The safety mat input on the safety evaluation unit is used to monitor the correct functioning of 4-wire safety mats with presence detection (sensors). Several safety mats can be connected in series to a safety evaluation unit. The maximum resistance per input is 150 Ohm (see "Connection options for safety mats" on page 46).



**Important:** The safety evaluation is not suitable for monitoring 2-core mats, buffers or edges (with or without measuring resistors).

The safety evaluation monitors the contacts (contact plates) and the wiring of one or more safety mats for faults and prevents the machine from restarting if a fault is detected. The safety evaluation unit can execute a reset routine after the operator has left the safety mat, or if the safety evaluation unit is used in auto-reset mode, the reset function must be executed by the machine controller. This prevents the machine from restarting automatically after the mat has been left.

**WARNING: Arrangement of the two-hand controls**

**Application of Safety Mats:** The requirements for the use of safety mats vary in terms of performance level as described in ISO 13849-1 and ISO 13856. BERNSTEIN AG always recommends the highest level of safety for each application. However, it is the responsibility of the user to install, operate and maintain each safety system safely and to comply with all applicable laws and regulations.
Do not use Safety Mats for inching operation to initiate machine movement (such as in an automatic machine actuation application) because faults in the mat and the connecting wiring may cause the machine cycle to start or restart unexpectedly.
Do not use safety mats to activate the hazardous machine movement or to give a start command to the machine controller just by stepping on the mat (e.g. at an operator station). Reverse logic/negative logic is used in this type of application and certain failures (e.g. power failure on the module) can lead to a faulty activation signal.

**Requirements for Safety Mats**
The following are minimum requirements for the design, construction and installation of four-wire safety mats for connection to the safety evaluation system. These requirements are a summary of the following standards: ISO 13856-1, ANSI/RIA R15.06 and ANSI B11.19. The user must inform himself of all relevant regulations and standards and ensure that all relevant regulations and standards are met.

**Design and construction of the safety mat system**
The sensor of the safety mat system, the safety evaluation and any additional devices must have a response time fast enough to minimize the possibility of a person stepping lightly and quickly over the detection surface of the mat (less than 100 to 200 ms, depending on the relevant standard).
For a safety mat system, the minimum object sensitivity of the sensor must be such that the sensor detects objects with a weight of at least 30 kg on a round, flat test object with a diameter of 80 mm on the detection surface, the mat including joints and connection points. The effective detection surface or the effective detection area must be recognizable and may include one or more sensors. The supplier of the safety mat should specify this minimum weight and the minimum diameter as the minimum object sensitivity of the sensor.
User modifications to the triggering force and response time are not permitted (ISO 13856-1). The sensor should be manufactured in such a way that foreseeable defects (e.g. oxidation of the contact elements), which could reduce the detection sensitivity, are prevented.

The protection class of the sensor must be at least IP54. If the sensor is designed for use under water according to the specifications, the housing protection class of the sensor must be at least IP67. The connection cables may require special attention. Wicking can cause liquid to enter the mat and possibly cause loss of sensor sensitivity. It may be necessary to place the ends of the connection cables in an enclosure with a suitable degree of protection.
The sensor must not be adversely affected by the environmental conditions for which the system is intended, i.e. the effects of liquids and other contaminants must be considered (e.g. long-term exposure to some liquids may cause weakening or swelling of the sensor housing material and lead to a hazardous condition).
The top of the sensor should be permanently non-slip or otherwise minimize the possibility of slipping under the expected operating conditions.
The four-wire connection between the connection cables and the sensor must be able to withstand pulling or carrying the sensor by its cable without the sensor failing and causing a dangerous condition (e.g. broken connections due to jerky pulling, continuous pulling or continuous bending). Otherwise, other means must be used to prevent such failures, e.g. a cable that detaches without damage and creates a safe condition.

**Installation of safety mats**
The condition of the mounting surface and the preparation for the Safety Mat must meet the requirements specified by the sensor manufacturer. Irregularities in the mounting surfaces can impair the function of the sensor and must be reduced to an acceptable minimum. The mounting surface should be flat and clean. Any accumulation of liquids under or around the sensor must be avoided. The risk of failure due to dirt deposits, turning chips or other materials under the sensor or the associated mounting parts must be prevented. Particular attention should be paid to the joints between the sensors to ensure that no foreign objects get under or into the sensor.
Any damage (e.g. cuts, tears, wear or punctures) to the outer insulating sheath of the connecting cable or to external parts of the safety mat must be repaired immediately or the corresponding parts replaced. Ingress of material (including dirt particles, insects, liquid, moisture or turning chips) that may be next to the safety mat can cause the sensor to corrode or lose its sensitivity.
Each Safety Mat must be routinely checked and tested in accordance with the manufacturer's recommendations. The operating specifications (e.g. the number of switching operations) must not be exceeded.
Each Safety Mat must be securely mounted to prevent accidental movement or unauthorized removal. Methods include secure beveling, tamper-resistant or disposable fasteners, and recessed bottoms or mounting surfaces in addition to the use of large and heavy mats.
Each Safety Mat must be installed in such a way that tripping hazards are minimized (especially in the direction of hazardous machine parts). A trip hazard may exist if the height difference of an adjacent horizontal surface is 4 mm or more. Tripping hazards must be minimized at joints, connection points and edges.
and minimized when using additional covers. Methods include mounting the sensor flush with the floor (recessed into the floor so that it is flush with the surrounding ground) or a ramp that does not deviate more than 20° from the horizontal. Use high-contrast colors or markings to indicate ramps and edges.
The safety mat system must be large enough and positioned in such a way that nobody can enter the danger zone without being detected and that nobody can reach the danger point before the dangerous machine movement has come to a standstill. To ensure that it is not possible to reach the danger point by reaching around or over the detection area of the safety device, additional safety devices may be required.
With a safety mat installation, the possibility of someone stepping over the detection surface and not being detected must be taken into account. ANSI and international standards require a minimum distance from the sensor surface (the smallest distance between the edge of the mat and the point of operation) of 750 mm to 1200 mm, depending on the application and relevant standard. The possibility of stepping on machine supports or other objects in order to bypass or climb over the sensor must also be prevented.

### Safety distance (minimum distance) for safety mats

As a stand-alone protective device, the Safety Mat must be mounted with such a safety distance (minimum distance) that the outer edge of the sensing face is at or behind the safety distance, unless the Safety Mat is used exclusively to prevent a start/restart or exclusively for an interspace protective device (see ANSI B11.19, ANSI/RIA R15.06 and ISO 13855).
The safety distance (minimum distance) required for an application depends on several factors, including the speed of the hand (or person), the total system stop time (which includes several response time components) and the entry depth factor. The user must determine the correct distance based on the relevant standard or take other measures to ensure that no one can be exposed to the hazards.

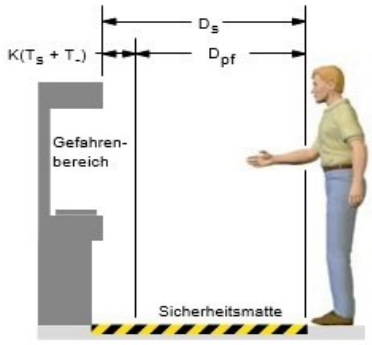



Figure 20: Determining the safety distance for the safety mat

**Applications in USA**

The formula for safety distance according to ANSI B11.19:

**Ds = K x (Ts + Tr) + Dpf**

**Ds**
the safety distance (in inches)

**Tr**
the response time of the safety evaluation measured from the time at which a stop signal is received from one of the manual controls. The response time of the safety evaluation can be found on the Configuration overview tab in the software.

**Ts**
the total stopping time of the machine (in seconds) from the first stop signal to a complete stop, including the stopping times for all relevant controls, measured at maximum machine speed
Ts is usually measured with a stop time measuring device. If a specified machine stop time is used in the calculation of T, at least 20% should be added as a safety factor to allow for any ageing of the braking system. If the stopping time of the two redundant machine controls is not the same, the longer of the two times must be used to calculate the safety distance.

**K**
the OSHA/ANSI recommended hand speed constant (in inches per second); this is calculated at 63 in/s in most cases, but can vary from 63 in/s to 100 in/s depending on the circumstances of the application;
no incontrovertible values; when determining the value of K, the employer should take into account all factors including the physical abilities of the operator.

**Dpf**
the additional distance due to the entry depth factor equals 48
in according to ANSI B11.19

**Applications in Europe**

The formula for minimum distance according to EN 13855:

**S = (K x T) + C**

**S**
the minimum distance (in millimeters)

**K**
the hand speed constant recommended by EN 13855 (in millimeters per second); in most cases this is calculated at 1600 mm/s, but can vary from 1600 to 2500 mm/s depending on the circumstances of the application;
no incontrovertible values; when determining the value of K, the employer should take into account all factors including the physical abilities of the operator.

**Applications in Europe**

**T**

the minimum distance (in millimeters)

**C**

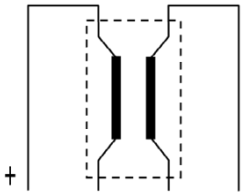
the hand speed constant recommended by EN 13855 (in millimeters per second); in most cases this is calculated at 1600 mm/s, but can vary from 1600 to 2500 mm/s depending on the circumstances of the application;
no incontrovertible values; when determining the value of K, the employer should take into account all factors including the physical abilities of the operator.

**Connection options for safety mats**

Pressure-sensitive mats and pressure-sensitive floors must meet the requirements of the category for which they are specified and labeled. These categories are defined in ISO 13849-1.
The safety mat, its safety evaluation and all output signal switching devices must at least meet the safety requirements for category 1. See ISO 13856-1 (EN 1760-1) and ISO 13849-1 for more information on the relevant requirements.
**The safety evaluation unit was developed for monitoring 4-wire safety mats, but is** not compatible **with 2-wire devices** (mats, measuring edges etc. with two conductors and one measuring resistor)**.**

**4-core**

This circuit generally meets the requirements for category 2 or category 3 devices in accordance with ISO 13849-1, depending on the degree of protection and installation of the mat(s). The
Safety evaluation switches to a blocking mode if an open circuit, a short circuit to 0 V or a short circuit to another circuit is detected.




### 7.5.10 Muting sensor

Muting of safety devices is the automatically controlled cancellation of one or more stop signals of safety inputs during a section of machine operation if there is no immediate danger or if access to the danger point is secured. The muting sensors can be assigned to one or more of the following safety switching devices:

- Safety gate switch (interlocking switch)
- Optosensors
- Two-hand controls
- Safety mats
- Protective holding devices

U.S. and international standards require the user to design, install and operate the safety system in a manner that protects personnel and minimizes the possibility of bypassing the safety device.

**Examples of muting sensors and switches**

**WARNING: Avoid dangerous installations**

**Two or four independent position switches must be set or positioned correctly so that they only close when the hazard is no longer present and open again when the machine cycle is complete or the hazard is present again. Incorrect setting or position of the switches can lead to injury or death.**
The user is responsible for compliance with all local and national laws, rules and regulations governing the use of safety equipment in a specific application. Ensure that all legal regulations are complied with and that all installation and maintenance instructions contained in this manual are followed

**Optoelectronic sensors (through-beam sensors)**

Through-beam sensors should be configured for dark switching (DO) and have open (non-conductive) output contacts when switched off. The transmitter and receiver of each pair should be supplied from the same source in order to avoid common mode errors as far as possible.

**Optoelectronic sensors (retro-reflective sensors with polarization filter)**
The user must ensure that accidental activation due to shiny or reflective surfaces is not possible.
Use a sensor configured as a light switching (light switching or normally open output) if muting is triggered when the reflective object or reflective tape is detected (output position). Use a sensor configured as dark switching (dark switching or normally closed output) if a blocked beam path triggers the muting state (input/output). In both situations, the output contacts must be open (non-conductive) when the power supply is interrupted.

**Positive opening safety switches**
Normally, two (or four) independent switches with at least one closed safety contact each are used to trigger the muting cycle. In an application that uses only one switch with one operating element and two closed contacts, an unsafe situation can arise.

**Inductive proximity sensors**
Inductive proximity sensors are commonly used to trigger a muting cycle when a metal surface is detected. Do not use two-wire sensors because excessive leakage currents can cause false on-states. Only use three- or four-wire sensors with PNP outputs or contact outputs that are independent of the power supply.

**Requirements for muting devices**
The muting devices must at least meet the following requirements:
- At least two independent hard-wired muting devices must be used.
- The muting devices must have either normally open contacts, pnp outputs (each of which must meet the input requirements listed in "5. Specifications and requirements" on page 18) or antivalent switching behavior. At least one of these contacts must close when the switch is actuated and open (or not conduct) when the switch is not actuated or when the power supply is switched off.
- The activation of the inputs for the muting function must come from separate devices. These devices must be installed separately to prevent an unsafe muting condition that can result from incorrect setting, misalignment or two faults with the same cause, e.g. physical damage to the mounting surface. Only one of these devices may be based on a programmable logic controller (PLC).
- The muting devices must be installed in such a way that they cannot be easily overridden or bypassed.
- The muting devices must be mounted in such a way that their position and orientation cannot be easily changed.
- It must not be possible for environmental conditions (e.g. extreme air pollution) to trigger a muting state.
- The muting devices must not be set for delays or other timing functions (unless such functions are performed in such a way that the failure of a single component does not prevent the elimination of the hazard and allows further machine cycles as long as the fault has not been rectified and no hazard is created by extending the muting period).

### 7.5.11 Bypass switch


A guard override is a manually activated and temporary removal of one or more stop signals for the safety inputs under supervision when there is no immediate danger. This is usually done by setting an override mode with a key switch to facilitate machine commissioning, belt alignment/adjustments, robot programming and process troubleshooting.
Bypass switches can be assigned to one or more of the following safety input devices:
- Safety gate switch (interlocking switch)
- Optosensors
- Two-hand controls
- Safety mats
- Protective stop

**Requirements for bypassing protective devices**
The following requirements apply to the bridging of a protective device[5]:

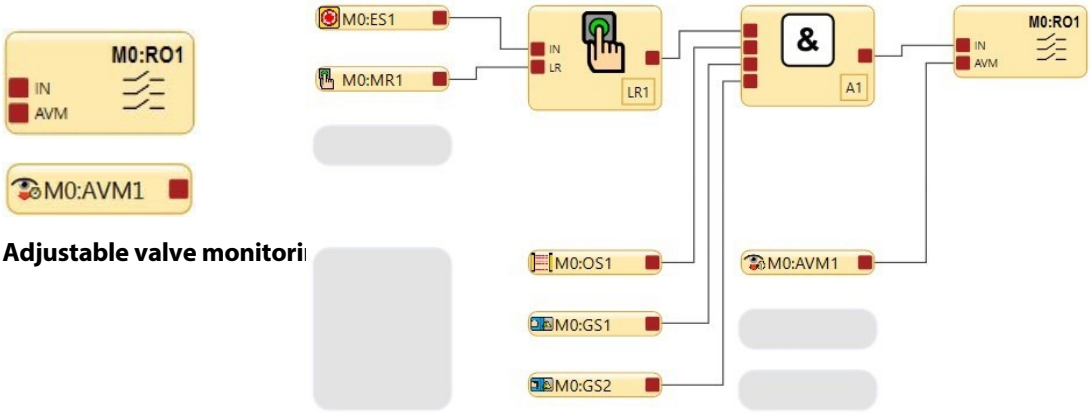
- The bridging function must be limited in time.
- It must be possible to supervise the device for setting or activating the override.
- Automatic machine operation must be prevented by restricting the movement range, speed or power (e.g. only use in jog mode, with single stroke or at low speed). The override mode must not be used for production.
- Additional protective equipment must be provided. Personnel must not be exposed to any hazards.
- The bypass device must be fully visible from the safety device to be bypassed.
- It must only be possible to initiate the movement using an inching switch.
- All emergency stop switches must remain active.
- The override device must be used with the same safety level as the safety device.
- Bridging the safety device must be clearly recognizable from the location of the safety device.
- Personnel must be instructed in the use of the safety device and the override.
- Risk evaluation and risk reduction (in accordance with the relevant standard) must be carried out.
- Resetting, actuating, releasing or activating the safety guard must not initiate any dangerous machine movement or create a hazardous situation.
- The bypassing of a safety device must not be confused with muting, which is the temporary automatic suspension of the safety function of a safety device during a non-hazardous section of the machine cycle. Muting can be used to give a machine or a process manually or automatically without having to initiate a stop command. Another term that is often confused with bridging is blanking. Blanking involves deactivating part of the detection range of an optical safety device (e.g. deactivating one or more beams of a safety light curtain so that a specific beam interruption is ignored).

### 7.5.12 AVM function (Adjustable Valve Monitoring)

The AVM function (Adjustable Valve (Device) Monitoring) is comparable to the one-channel external device monitoring EDM (One-Channel External Device Monitoring, see "External device monitoring (EDM)" on page 67). The AVM function monitors the status of devices that are controlled by the safety output to which the function is assigned. If the safety output switches off, the AVM input must be in the "On" state.
(with a voltage of +24 V DC applied) before the AVM timer expires; otherwise a lockout occurs. The AVM input must also show "On" when the safety output attempts to switch on; otherwise it will be blocked.

5 This summary was prepared with reference to the following standards: ANSI NFPA79, ANSI/RIA R15.06, ISO 13849-1 (EN954-1), IEC60204-1 and ANSI B11.19.

**Adjustable valve monitori**



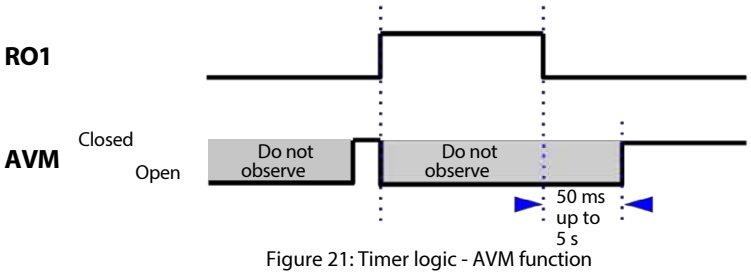




Figure 21: Timer logic - AVM function

Adjustable valve monitoring (AVM) is a method for checking the operation of 2-channel valves. The positively driven NC monitoring contacts of the valves serve as inputs for detecting a "welded on state" as a fault condition and prevent the safety evaluation outputs from being switched on.

**Note:** A period from 50 ms to 5 s can be set in 50 ms intervals (the factory setting is 50 ms).

The AVM function is useful for dynamic monitoring of devices that are controlled by the safety output, but which react slowly, stagnate or fail in the activated state or position and whose operation must be checked after a stop signal has occurred. Possible applications include, for example, single or double solenoid valves for controlling clutch/brake mechanisms and position sensors that monitor the initial position of a linear drive.
The synchronization or checking of a maximum time difference between several devices, e.g. double valves, can be achieved by assigning several AVM functions to a safety output and configuring the AVM timer with the same values. Any number of AVM inputs can be assigned to a safety output. An input signal can be generated by a relay contact or a transistor output.

**WARNING:**

- **AVM operation (Adjustable Valve Monitoring)**
- If the AVM function is used, the safety outputs only switch ON when the requirements for the AVM input are met. This could lead to a switch-on delay until the configured AVM monitoring time.
- The user must ensure that the AVM monitoring time is configured appropriately for the application and that all persons involved with the machine are informed of the possibility of the switch-on delay effect, as this is not necessarily easy for machine operators or other personnel to recognize.

### 7.5.13 DCD inputs

Via the safety inputs DCD inputs SCR P:
- IN3/IN4
- IN5/IN6

SCx:
- IN1/IN2
- IN3/IN4
- IN5/IN6
- IN7/IN8
- IN9/IN10
- IN11/IN12
- IN13/IN14
- IN15/IN16

devices with DCD (Daisy Chain Diagnostic) data can be monitored - even in a series connection - such as SRF safety sensors from BERNSTEIN. SRF safety sensors from BERNSTEIN use RFID technology for detection. DCD devices such as SRF safety sensors must be installed with an appropriate safety distance (minimum distance) in accordance with the application standards. For the appropriate calculations, the applicable
standards and the specific documentation for the device must be observed. The response time between the outputs of the safety monitoring system and the individual safety inputs is specified on the Configuration overview tab in the software. This time must be added to the response time of the DCD series circuit.
The active transistor outputs of the DCD devices can (and must) detect external short circuits to the power supply, to earth and to each other. The devices are disabled if such a short circuit is detected.
If the application involves a walking-behind hazard (a person could step through an open safety gate and stand on the hazard side undetected), other protective devices may be required and manual reset should be selected. See "7.6.1 Manual reset input" on page 55.

**Note:** In a long series or in series with many DCD devices, the voltage of the first unit (closest to the connector plug) must remain above 19.5 volts for the series to function properly.

**Note:** If the entire row consists only of door switches, the configuration rules for a safety gate switch apply.

### 7.5.14 Cycle initiation for press control function block

This function is available with SCx.
A single momentary actuator can be used as a triggering device for small hydraulic/pneumatic presses when used with the Press Control function block and configured for single actuator control. This is an initiation input for starting the press cycle. When single actuator control is selected, the operator can start the cycle with this input and then release it and perform other tasks.

**CAUTION:** Other precautions must be taken to ensure that operators are protected from the hazards as their hands are not required to engage the button throughout the movement of the press.

Access to the danger point must be secured by means other than a switch-on button, e.g. with light curtains, gates, etc. These safety devices must also be connected to the inputs of the Press Control function block.
The input for cycle initiation can be connected to the GO node of the Press Control Function Block or to the IN node of a bypass block that is connected to the GO node of the Press Control Function Block. The cycle trigger must be mounted in a location that complies with the following warnings.

**WARNING:**

- **Proper installation of cycle releases**
- Failure to properly install the cycle triggers can result in serious injury or death.
- Install the cycle triggers so that they are only accessible from outside the secured room and in full view. Cycle releases must not be accessible from inside the secured room. Secure cycle releases against unauthorized or accidental actuation (e.g. using rings or protective devices). If there are dangerous areas that cannot be seen from the cycle releases, additional safety devices must be provided.

### 7.5.15 SQS Press control Sequential stop (SQS) function

This function is available with SCx.
The Press Control Sequential Stop (SQS) input signals to the press control system that the press ram has reached a position where there is no longer a risk of crushing (less than 6 mm gap). The downward movement of the press ram stops at this point. The operator can take his hands off the two-hand control to make sure that the workpiece is in the correct position (the Mutable Safety input is muted at this point). Once the operator has ensured that the workpiece is in the correct position, they press the foot switch input to end the downward stroke.

**Note:**

The method described above is one way of controlling the press control process. There are three permissible processes:

1. The two-hand control input (TC1) switches on the GO input to move the ram to the SQS point. Release TC1 and switch on FS1 to switch on the foot switch input and drive the pile driver to the lower lift point (BOS), release the foot switch input (FS1) and switch on TC1 to lift the pile driver.
2. FS1 switches on the GO input to move the ram to the SQS point, release FS1. By switching FS1 on again, the ram is moved to the BOS point and then back to the TOS point (Top of Stroke). (The Ft Switch input disappears when FS1 is connected to the GO node).
3. TC1 switches on the GO input to move the plunger to the SQS point, release TC1. When TC1 is activated again, the ram moves to the BOS point and then back to the TOS point (top end of stroke). (To set up the system for this method, do NOT select the foot pedal node in the function block for press control inputs).

The "Sequential Stop" input is normally used when "Dual Pressure" is selected. The dual pressure function requires four safety outputs (up, down, low pressure and high pressure). For this reason, the "Sequential Stop" input is not available on non-expandable models.

The "Sequential Stop" input can mute the "Mutable Safety" input directly or together with the "Sequential Stop" input. "Press Control Mute Sensor" to mute the "Mutable Safety" input of the press control system (for the "Press Control Mute Sensor" input, see "Press Control Mute Sensor" on page 53).
The sequential stop input can be single or dual channel, depending on the requirements of the system. The input devices must be positioned so that the press plunger stops in a position that does not have a gap large enough for a finger to enter (the gap must be less than 6 mm/0.25 inch).

**Note:** If a single-channel configuration is selected for the "Sequential Stop" input, i t must function together with the "Press Control Mute Sensor" input in order to mute the "Press Control Mutable Safety Stop" input. If a two-channel configuration is selected for the "Sequential Stop" input, it can mute the "Press Control Mutable Safety Stop" input directly itself.

U.S. and international standards require the user to arrange, install and operate the safety system in a manner that protects personnel and minimizes the possibility of circumventing the protection.

**WARNING:**
- Avoid dangerous installations
- A single channel SQS device is not permitted unless used in conjunction with a Press Control Mute Sensor (PCMS) input device. If a dual channel SQS input without PCMS is used, each SQS channel must be an independent position switch and properly set or positioned so that it closes only when the hazard is no longer present and reopens when the cycle is complete or the hazard reappears. Failure to properly set or position the switches can result in injury or death.
- The user is responsible for complying with all local, state and national laws, rules and regulations, Rules and regulations relating to the use of safety equipment in a particular application are complied with. Ensure that all relevant regulatory requirements are met and that all installation and maintenance instructions contained in the relevant manuals are followed.

SQS devices must at least meet the following requirements. If the SQS device is used as a mute input with the Press Control Mute Sensor, the pair must meet the following requirements.

1. There must be at least two independent, hard-wired devices.
2. The devices must have one of the following options: Normally open contacts, PNP outputs (both of which must meet the input requirements listed under Specifications and Requirements on page 20), or complementary switching behavior. At least one of these contacts must close when the switch is actuated and must open (or not conduct) when the switch is not actuated or is in the off state.
3. Activation of the inputs of this muting function must originate from separate sources. These sources must be mounted separately to avoid an unsafe condition caused by an incorrect setting, misalignment or a single common mode error, such as physical damage to the mounting surface. Only one of these sources may be routed through or influenced by a PLC or similar device.
4. The devices must be installed in such a way that they cannot be easily overcome or bypassed.
5. The devices must be installed in such a way that their position and alignment cannot be easily changed.
6. It must not be possible for ambient conditions, such as extreme air pollution, to trigger the mute state.
7. The devices must not use delay or other timing functions unless these functions are implemented in such a way that no single component failure prevents the elimination of the hazard, subsequent machine cycles are prevented until the fault is corrected, and no hazard is created by extending the mute time.

### 7.5.16 Press control Mute sensor

This function is available with SCx.
Muting of safety devices is an automatically controlled interruption of the mute input of the press control function block during part of the press cycle when there is no immediate danger or when access to the danger is protected by other means. Assign the press control mute sensors to the M sensor input of the press control input function block to mute one or more of the following safety input devices along with the sequential stop input (SQS):

- Switch for safety interlocks (locking)
- Optical sensors
- Safety mats
- Protective stops

According to US and international standards, the user must set up, install and operate the safety system in such a way that personnel are protected and the possibility of overcoming the safety devices is minimized.

**WARNING:**
- Avoid dangerous installations
- Two (1 SQS and 1 Press Control Mute sensor) or four (2 SQS and 2 Press Control Mute sensors) independent position switches must be set or positioned correctly so that they only close when the hazard is no longer present and open again when the cycle is complete or the hazard is present again. If the switches are not set or positioned correctly, this can result in injury or death.
- The user is responsible for complying with all local, state and national laws, rules, regulations and requirements relating to the use of safety equipment in a particular application. Ensure that all applicable regulatory requirements are met and that all installation and maintenance instructions contained in the appropriate manuals are followed.

The Press Control Mute Sensor (with the SQS device) must at least meet the following requirements:
1. There must be at least two independent, hard-wired devices.
2. The devices must have one of the following options: Normally open contacts, PNP outputs (both of which must meet the input requirements listed in "5. Specifications and Requirements" on page 18), or complementary switching behavior. At least one of these contacts must close when the switch is actuated and must open (or not conduct) when the switch is not actuated or is in the off state.
3. Activation of the inputs of this muting function must originate from separate sources. These sources must be mounted separately to avoid an unsafe condition caused by an incorrect setting, misalignment or a single common mode error, such as physical damage to the mounting surface. Only one of these sources may be routed through or influenced by a PLC or similar device.
4. The devices must be installed in such a way that they cannot be easily overcome or bypassed.
5. The devices must be installed in such a way that their position and alignment cannot be easily changed.
6. It must not be possible for ambient conditions, such as extreme air pollution, to trigger the mute state.
7. The devices must not use delay or other timing functions unless these functions are implemented in such a way that no single component failure prevents the elimination of the hazard, subsequent machine cycles are prevented until the fault is rectified, and no hazard is created by extending the mute time.

### 7.5.17  Foot switch

This function is available with SCx.
The foot switch input (FS1) can be used in various ways with the Press Control function blocks:
- It can be connected to the GO node of the press control function block as a cycle trigger if the block is set to single actuator control.
- It can be connected to the GO node of the Press Control function block if it is configured for the Manual Upstroke setting and the SQS input is activated. (Activating the FS1 input drives the RAM to the SQS point. At this point, the FS1 is enabled. As the Mutable Safety Stop input is now muted, the operator can set the workpiece. By switching FS1 on again, the RAM is driven to the BOS point and then back to the TOS point).
- It can be used as described in the following section.

The foot switch input can be added to the press control input function block and configured when the SQS input is configured. The press stops at the SQS input so that the operator can take his hands off the two-hand control input. The operator can make sure that the workpiece is positioned correctly and sometimes needs to hold the workpiece in position. The operator can then operate the input device connected to the foot switch input to restart the press and complete the process.
The input of the foot switch can also be configured to the Press GO node. In this case, the foot switch can be used with and without SQS configuration. This allows more flexibility in the use cases.
A physical on/off input or a footswitch input can be connected to the footswitch input of the Press Control Input function block. The device can be a foot switch, but also other triggering devices.
Access to the hazard must be prevented by means other than the variable safety stop entrance (e.g. the inner opening must be finger-safe, i.e. less than 6 mm/0.25 inch). Protection can also be provided by
safety devices that are connected to the non-changeable Safety Stop input.

## 7.6 Non safety-related input devices

Non-safety-related input devices include manual reset devices, on/off switches, muting and enabling devices and inputs for canceling time delays.

**Manual reset devices:** are used to generate a reset signal for an output or function block that has been configured for a manual reset when operator action is required to turn on the output of that block. Resets can also be created with a virtual reset input. See "7.7 Virtual non-safety-related input devices" on page 57.

**WARNING: Unmonitored resets**

If a reset is configured without monitoring (either for an interlocked output or a system reset) and all other conditions for a reset are met, the safety outputs are switched on immediately by a short circuit from the reset connection to +24 V.

**On/off switch:** Sends an on or off command to the machine. If all controlling safety inputs are in the On state, the safety output can be switched on or off with this function. This is a single-channel signal; 24 V DC results in an on state and 0 V DC results in an off state. An input for switching on/off can be added without assignment to a safety output, which means that this input can only control one status output. An on/off switch can also be created with a virtual input.
See "7.7 Virtual non-safety-related input devices" on page 57.

**Muting activation switch:** signals to the safety evaluation unit whether the muting sensors are permitted to perform a muting function. If the muting activation function is configured, the muting sensors are not activated for muting as long as the muting activation signal is not in the ON state. This is a single-channel signal; 24 V DC is required for activation (ON) and 0 V DC for deactivation (stop). A muting activation switch can also be created with a virtual input. See "7.7 Virtual non-safety-related input devices" on page 57.

**Devices for canceling switch-off delays:** Provide the option to cancel a configured switch-off delay time. This function has the following effect:

- It ensures that the safety or delay block output remains switched on.
- It switches the safety or delay block output off immediately after the safety evaluation unit receives a signal to cancel the off-delay.
- If the "Control input" setting is selected for **Abort type**, the safety or delay block output remains switched on if the input is switched on again before the end of the delay.

A status output function (output delay running) indicates when an abort delay input can be activated to keep the safety output switched on with the switch-off delay. A device for canceling switch-off delays can also be created with a virtual input. See "7.7 Virtual non-safety-related input devices" on page 57.

### Timer for canceling off-delays

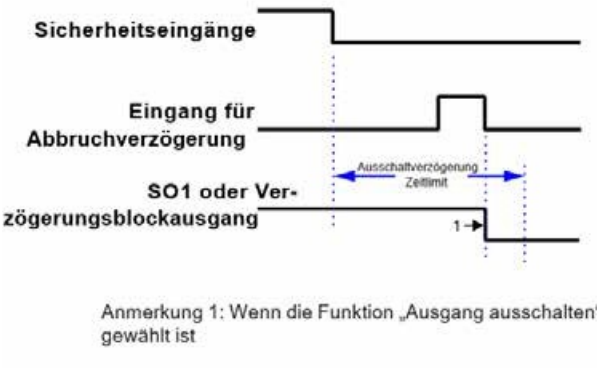



Figure 22: Safety input remains in stop mode

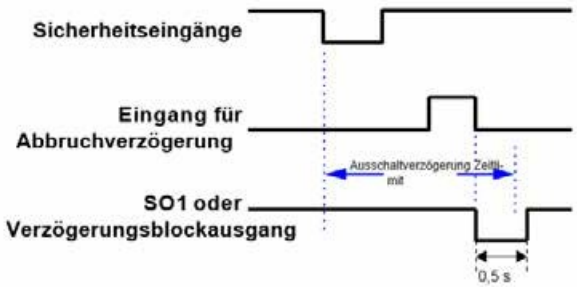



Figure 23: Output switches off

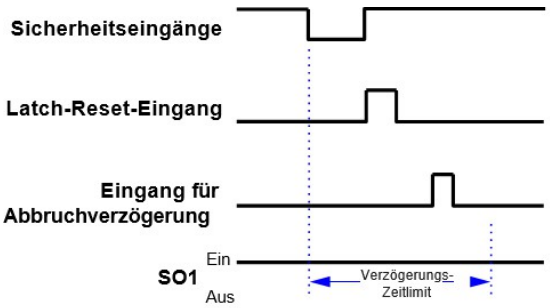



Figure 24: Output remains switched on for safety inputs with latch reset

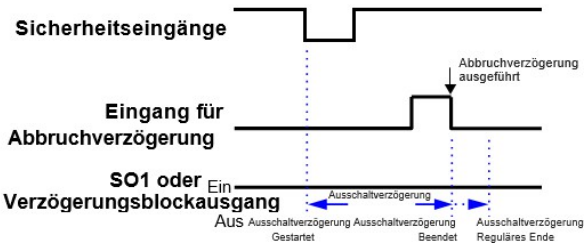



Figure 25: Output remains switched on for safety inputs without latch reset

### 7.6.1 M anual reset input

The manual reset input can be configured to perform any combination of the following functions (see "8.2 Adding inputs and status outputs" on page 77):

**Reset safety inputs**

Moves the output of the latch reset blocks from the latched state to the on state when the IN node is in the on state.

**Reset of safety outputs**

Switches the output on if the output block configured for the latch reset is switched on. Exceptions:
A safety output cannot be configured to use a manual reset if it is connected to a two-hand control input or an enabling switch function block.

**System reset**

Resets the system from a locked state caused by a system error to the on state. Possible scenarios in which a system reset may be required:

- Signals are recorded on unused connections.
- Timeout in configuration mode
- Exiting configuration mode
- Internal errors

**Output error reset**

Clears the error and enables the output to switch back on when the cause of the error has been eliminated. Possible scenarios in which an output error reset may be required:

- Output error
- EDM or AVM error

**Manual reset when power is switched on**

Allows various latch reset blocks and/or output blocks to be controlled by a single reset input after the mains is switched on.

**Exit release mode**

A reset is required to exit the release mode.

**Input display group reset**

Sets the Track **input group** function of the status output and the function of the virtual function **Track input group** of the status output.

**The reset switch must be mounted in a position that meets the requirements of the following**

**Warnings fulfilled.** A key-operated reset switch provides a degree of control by the operator or supervisor because the key can be removed from the switch and taken into the protected area. However, this does not prevent unauthorized or accidental resets with spare keys in the possession of others; nor does it prevent other persons from entering the monitored area unnoticed (risk of being stepped behind).

**WARNING: Reset switch positions**

**All reset switches must only be accessible from the outside and must allow an unrestricted view of the danger zone. Reset switches must also be located out of reach from the protected area and** protected **against unauthorized or unintentional actuation** (e.g. by using rings or protective devices). If areas cannot be seen from the reset switches, additional safety devices must be provided. **If these instructions are not followed, serious or fatal injuries may result**.

**Important:** Resetting a safety device must not start a dangerous machine movement. To ensure safe working procedures, a safe start-up procedure must be followed and the person performing the reset must check that the entire danger zone is clear of people before **resetting any safety device**. If an area cannot be seen from where the reset switch is located, additional safety devices must be used, at least visual and audible warnings about the machine start-up.

**Note: Automatic reset** allows an output to switch back to the on state without intervention by a person as soon as the input devices switch to the on state and all other logic blocks are in the on state.
Automatic reset is normally used in applications in which the person is constantly detected by the safety sensors.

**WARNING: Automatic start-up**

During mains switch-on, the safety outputs and latch reset blocks configured for automatic mains switch-on switch on their outputs if all associated inputs are in the ON state. If a manual reset is required, the outputs must be configured for a manual mains switch-on mode.

**Automatic & manual reset inputs assigned to the same safety output**

By default, the safety outputs are configured for automatic reset (switching mode). They can be configured as a latch reset using the "Properties of relay output" attribute of the safety output (see "10. Function blocks" on page 126).
Safety inputs operate as an automatic reset unless a latch reset block is added. If a latch reset block is added in series with an output configured for latch reset mode, the same or other manual reset input devices can be used to reset the latch reset block and interlock.
of the safety output can be used. If the same input device for manual reset is used for both purposes and all inputs are in the On state, a single reset action unlocks the function block and the output block. When using different input devices for manual reset, the input device associated with the
safety output can be activated last. This can be used to force a reset sequence, which can be used to reduce or eliminate the risk of backdriving in area safety devices (see "7.4.2
Properties of safety inputs" on page 34).
If the controlling inputs to a latch reset block or a safety output block are not in the On state, the reset for the block in question is ignored.

**Reset signal requests**

Reset input devices can be configured for monitored or non-monitored operation:
**Monitored reset:** The reset signal must switch from off (0 V DC) to on (24 V DC) and then off again (0 V DC). The duration of the On state must be 0.5 seconds to 2 seconds. This is referred to as a falling edge reset.
**Unmonitored reset:** The reset signal must only switch from Off (0 V DC) to On (24 V DC) and remain On for at least 0.5 seconds. After the reset, the reset signal can be either On or Off. This is referred to as a rising edge reset.

## 7.7 Virtual tual non-safety-related input devices

The virtual non-safety-related input devices include devices for manual reset, on/off switching, muting activation and canceling a switch-off delay.

**WARNING:** Virtual non-safety-related inputs must never be used to control safety-critical applications. If a virtual non-safety-related input is used to control a safety-critical application, a dangerous failure is possible, which can lead to serious or fatal injuries

**Important:** Resetting a safety device must not start a dangerous machine movement. To ensure safe working procedures, a safe start-up procedure must be followed and the person performing the reset must check that the entire danger zone is clear of personnel before resetting any safety device. If an area cannot be seen from where the reset switch is located, additional safety devices must be used, at least visual and audible warnings about the machine start-up.

### 7.7.1 Vir tual manual reset and canceling a time delay (RCD)

According to section 5.2.2 of the EN ISO 13849-1:2015 standard, a "conscious action" by the machine operator is required to reset a safety function. Traditionally, this requirement is met by using a mechanical switch and connecting the associated cables to the specified terminals on the safety evaluation unit. In the case of a monitored reset, the contacts must first be opened, then closed and then opened again within the correct time period. If the time period is neither too short nor too long, the action is evaluated as deliberate and the reset is carried out.
BERNSTEIN AG has developed a virtual reset solution that requires a conscious action. For example, an HMI can be used instead of the mechanical switch. Instead of the lines, a unique actuation code is used for each safety evaluation in the network. In addition, each virtual reset within an evaluation is assigned to a specific bit in a register. This bit must be assigned together with the
Actuation code is written and deleted in a coordinated manner. If the steps are executed in the correct sequence and within the correct time frame, the action is considered deliberate and the reset is executed.
The standards do not require a "conscious action" to perform a virtual cancelation of a time delay, but to avoid further complexity, BERNSTEIN AG has implemented this function in the same way as the virtual manual reset.
The user must define matching actuation codes on the safety evaluation unit and the controlling network device (PLC, HMI, etc.). The actuation code is part of the network settings and is not included in the CRC for the configuration. There is no factory setting for the actuation code. The user must set up such a code on the **Network Settings** screen. The activation code can be activated for up to 2 seconds to be effective. Different security evaluations in the same network should have different activation codes.
The HMI/PLC programmer can choose between two different methods depending on preference: a feedback-based sequence and a time-switched sequence. These methods are described in the following figures. The actual location of the register depends on which protocol is used.

**Virtual reset sequence or abort sequence of a time delay (RCD) - feedback method**

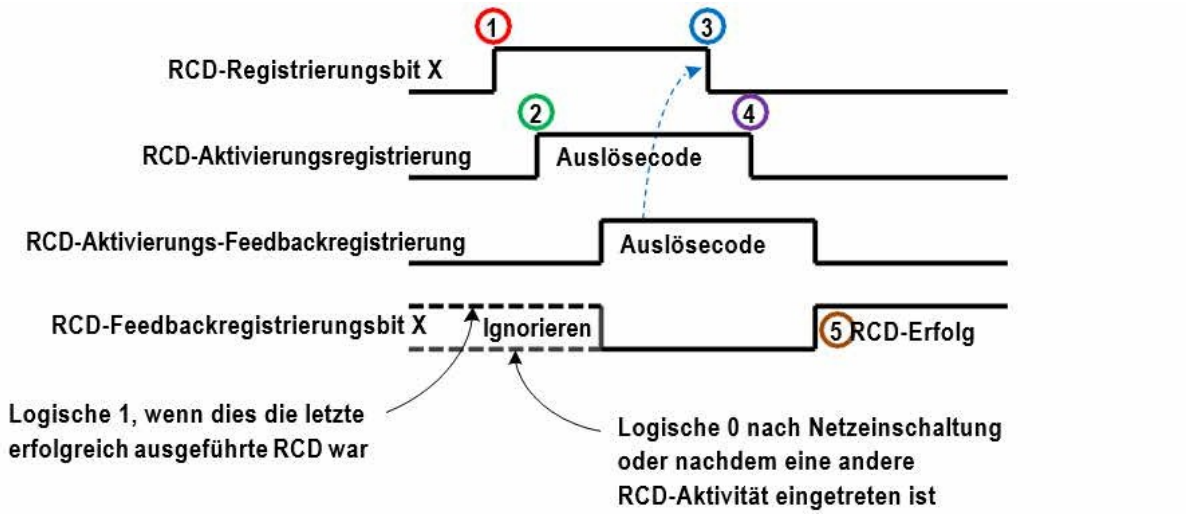



Figure 26: Virtual R eset sequence or abort sequence of a time delay (RCD) - feedback method

1. Write a logical 1 to the RCD register bit(s) that correspond to the desired virtual reset or cancel function.
2. Write the activation code into the RCD activation register at the same time or sometime later.
3. Monitor the RCD activation feedback register so that the activation code is displayed (125 ms typical). Then write a logical 0 to the RCD register bit.
4. Write the activation code to the RCD activation register at the same time or sometime later. This step must be completed within 2 seconds of the first code being written (step 2).
5. Monitor the RCD feedback register, if desired, to determine if the desired reset or cancel function has been accepted (175 ms typical).

**Virtual reset sequence or abort sequence of a time delay (RCD) - time-switched method**

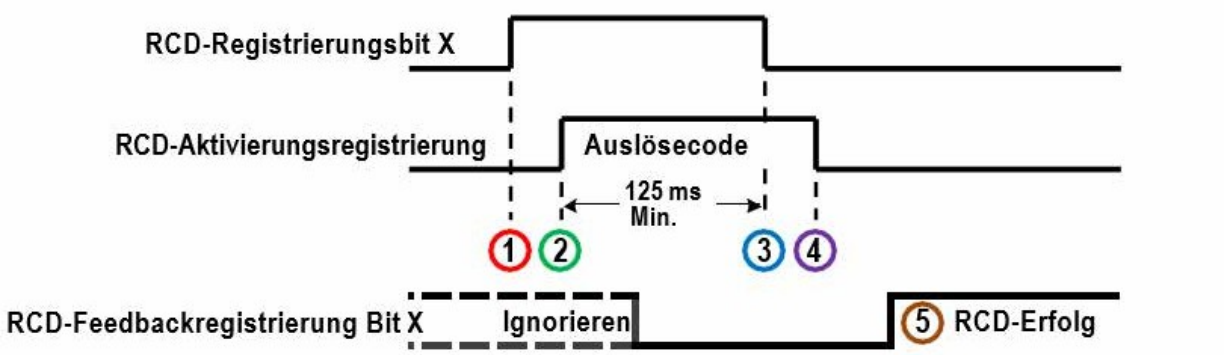



Figure 27: Virtual reset sequence or abort sequence of a time delay (RCD) - time-switched method

1. Write a logical 1 to the RCD register bit(s) that correspond to the desired virtual reset or cancel function.
2. Write the activation code in the RCD activation register at the same time or sometime later.
3. Write a logical 0 to the RCD register bit at least 125 ms after step 2.
4. At the same time or sometime later, write the activation code (write a logical 0 in the RCD activation register). This step must be completed within 2 seconds of the first code being written (step 2).
5. Monitor the RCD feedback register, if desired, to determine if the desired reset or cancel function has been accepted (175 ms typical).

**Virtual manual reset devices:** are used to generate a reset signal for an output or function block that has been configured for a manual reset when operator action is required to turn on the output of that block. Resets can also be created with a physical reset input. See "7.6 Non-safety-related input devices" on page 54.

**WARNING: Virtual manual reset**

A virtual manual reset configured to perform a manual power-on function together with devices in different locations on the same network should be avoided unless the security of all hazardous areas has been confirmed.

**Virtual devices for canceling switch-off delays:** Provide the option to cancel a configured switch-off delay time. This function has the following effect:

- It ensures that the safety or delay block output remains switched on.
- It switches the safety or delay block output off immediately after the safety evaluation unit receives a signal to cancel the off-delay.
- If the "Control input" setting is selected for Abort type, the safety or delay block output remains switched on if the input is switched on again before the end of the delay.

A status output function (output delay running) indicates when an input can be activated to keep the safety output switched on with the switch-off delay. A device for canceling switch-off delays can also be created with a physical input.
See "7.6 Non-safety-related input devices" on page 54.

**Timeout function for the virtual termination of a switch-off delay**

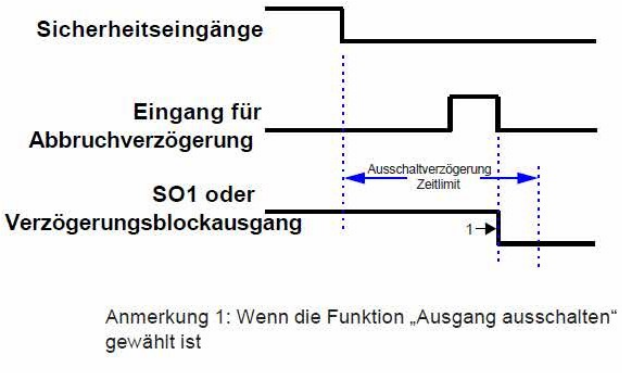



Figure 28: Safety input remains in stop mode

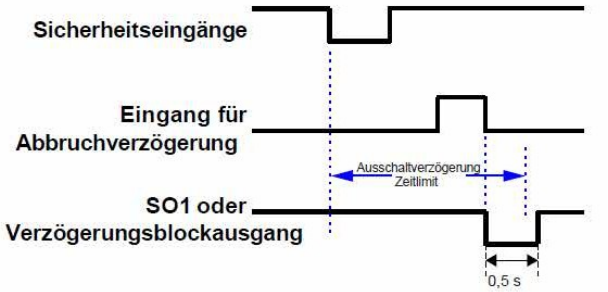



Figure 29: Output switches off

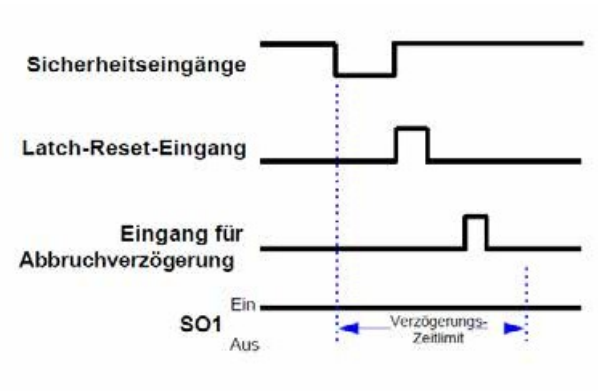



Figure 30: Output remains switched on for safety inputs with latch reset

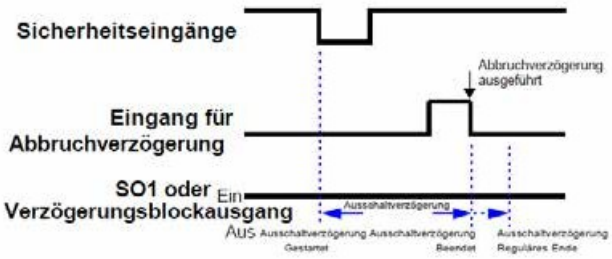



Figure 31: Output remains switched on for safety inputs without latch reset

### 7.7.2 Virtual switch-on/switch-off and muting activation

**Virtual switch-on/switch-off**

Sends a switch-on or switch-off command to the machine. If all controlling safety inputs are in the ON state, the safety output can be switched on or off with this function. The on state is a logical 1 and the off state is a logical 0. A virtual on/off input can be added without assignment to a safety output in order to control a non-safety-related status output. An On/Off switch can also be created with a physical input. See "7.6 Non-safety-related input devices" on page 54.

**Virtual muting activation**

Signals to the safety evaluation system when the muting sensors are permitted to perform a muting function. If the muting activation function is configured, the muting sensors are not activated for muting as long as the muting activation signal is not in the On state. The activated state (on state) is a logical 1 and the deactivated state (stop state) is a logical 0. A muting activation switch can also be created with a physical input. See "7.6 Non-safety-related input devices" on page 54.

## 7.8 Safety outputs SCx

The base module has two pairs of semiconductor safety outputs (terminals SO1a and b and SO2a and b). These outputs each supply up to 500 mA at 24 V DC. Each redundant solid-state safety output can be configured to operate individually or in pairs, e.g. SO1a independently of SO1b or SO1 as a dual-channel output.
Additional safety outputs can be added to expandable models of the basic controller by installing I/O modules. These additional safety outputs can be galvanically isolated relay outputs that can be used to control/switch a wide range of features (see "5.1 SCx specifications" on page 18).

**SCR P**

The SCR P has two galvanically isolated redundant relay outputs. Each relay output has three independent contact sets. See "5.2 Specifications for the SCR P" on page 23 for information on nominal values and deratings.

**WARNING:** The safety outputs must be connected to the machine control system in such a way that the safety-relevant part of the machine control system interrupts the enable path to the shutdown elements of the machine in order to bring about a safe state.
Do not connect control elements (e.g. PLC, PES or PC) that could fail in such a way that the safety shutdown command is lost or that the safety function can be canceled, overridden or bypassed, unless the connection is made with the same or a higher safety level.

The following list contains a description of other functions and attributes that can be configured in the **Properties** window for the safety output function block (see "8.2 Adding inputs and status outputs" on page 77):

**EDM (external device monitoring)**

Enables the safety evaluation unit to monitor the connected devices (safety sensors and shutdown elements) for the correct response to the shutdown command of the safety outputs. **It is strongly recommended to** include **EDM (or AVM)** in the machine design and in the configuration of the safety evaluation unit to ensure adequate fault tolerance of the safety circuits (see "7.8.3 EDM and shutdown device connection" on page 67).

**AVM (adjustable valve monitoring)**

Enables the safety evaluation system to monitor valves and other devices that react slowly, stagnate or fail when activated or in an activated position and whose operation must be checked after a stop signal has occurred. Up to three AVM inputs can be selected,
if EDM is not used. **It is strongly recommended to** include **AVM (or EDM)** in the machine design and in the configuration of the safety evaluation in order to ensure adequate fault tolerance of the safety circuits (see "7.5.12 AVM function (Adjustable Valve Monitoring)" on page 48).

**LR (latch reset)**

Ensures that the RO output remains switched off until the input changes to the on state and a manual reset is performed. See "7.6.1 Manual reset input" on page 55 for more information.

**RE (activate reset)**

This option is only displayed if **LR (latch reset)** is activated. The **latch reset** can be controlled by selecting **Enable reset** to limit the resetting of the safety output to the on state.

**FR (system error reset)**

Provides a manual reset function if input errors occur. The FR node must be connected to the manual reset switch or signal. This function is used to keep the RO output off until the input device fault is corrected, the faulty device is in the on state and a manual reset has been performed. This function replaces the method of switching the power off and on again to reset the safety evaluation. See "7.6.1 Manual reset input" on page 55 for more information.

**Start-up mode**

The safety output can be configured for three start-up scenarios (operating characteristics when the power supply is applied):

- Normal start-up mode (standard)
- Manual mains connection
- Automatic mains connection

See "7.6.1 Manual reset input" on page 55 for more information.

**Sharing (safety outputs) - SCx only**

This option is only available for solid-state safety outputs. Each redundant solid-state safety output can be configured to operate individually or in pairs (default).

Splitting a semiconductor safety output creates two independent single-channel outputs (the control of SO1a is independent of SO1b). To combine a split safety output, open the Mx:SOxA Properties window and click on Connect.

**Switch-on and switch-off delays**

Each safety output can be configured to operate either with a switch-on delay or with a switch-off delay (see Figure 21 on page 55), whereby the output is only activated after the time limit has expired.
switches on or off. An output cannot have a switch-on and switch-off delay at the same time. The time limit for the switch-on and switch-off delay can be set in levels of 1 millisecond from 100 milliseconds to 5 minutes.

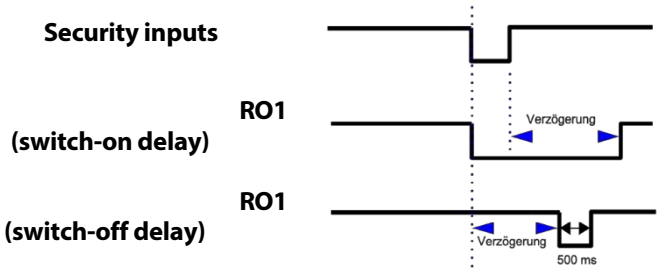



Figure 32: Timing diagram: switch-on and switch-off delay for safety outputs

**WARNING:**

- **However, a switch-off delay time can end immediately in the event of a power interruption or power failure.**
- If these instructions are not followed, serious or fatal injuries may result.
- The switch-off delay time of a safety output is also observed if the safety input that caused the start of the timer for the switch-off delay switches back to the on state before the delay time has elapsed. If such an immediate shutdown of a machine could pose a potential hazard, additional safety measures must be taken to prevent injuries

Two safety outputs can be linked together if one of the safety outputs is configured for a switch-off delay and no delay has been configured for the other output. After linking, the output does not switch on again immediately without a delay if the controlling input is switched on during a switch-off delay, as shown in Figure 22 on page 58. How to link two safety outputs:

1. Open the **Properties** window for the safety output that requires a switch-off delay.
2. Select "Off delay" from the Delay of safety output drop-down list.

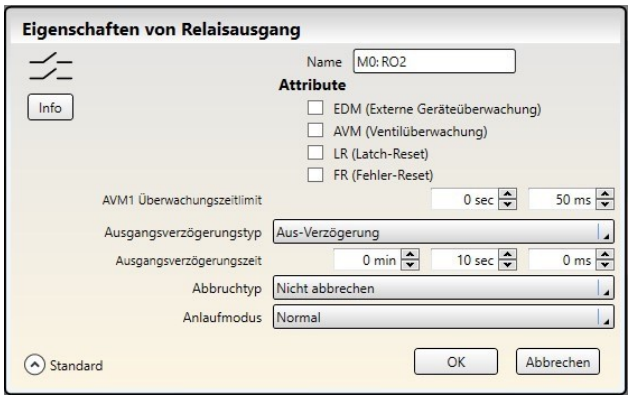



Figure 33: Selection ale example for safety output delay: switch-off delay

Two safety outputs can be linked together if one of the safety outputs is configured for a switch-off delay and no delay has been configured for the other output. After linking, the output does not switch on again immediately without a delay if the controlling input is switched on during a switch-off delay, as shown in Figure 22 on page 58. How to link two safety outputs:

1. Open the **Properties** window for the safety output that requires a switch-off delay.
2. Select "Off delay" from the Delay of safety output drop-down list.
3. Set the desired switch-off delay time.
4. Click on **OK.**
5. Open the **Properties** window for the safety output that is to be linked to the safety output with switch-off delay.
6. From the Connection to safety output drop-down list, select the safety output with switch-off delay to which you want to link this safety output.

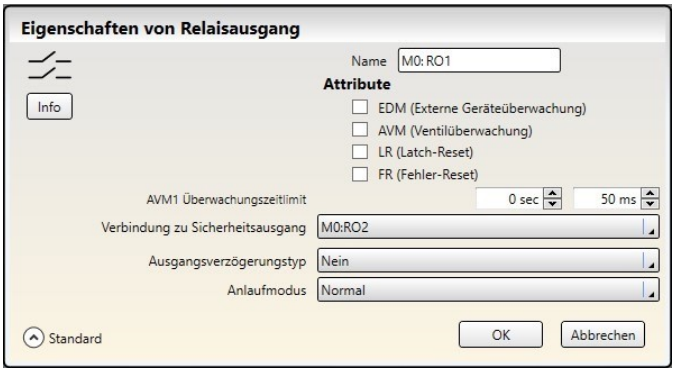



Figure 34: Selection example for interlinking with safety output

**Note:** The two safety outputs must be connected to the same input or inputs so that they are displayed as available for linking.

7. Click on OK. The linked safety output is marked with a linking symbol.

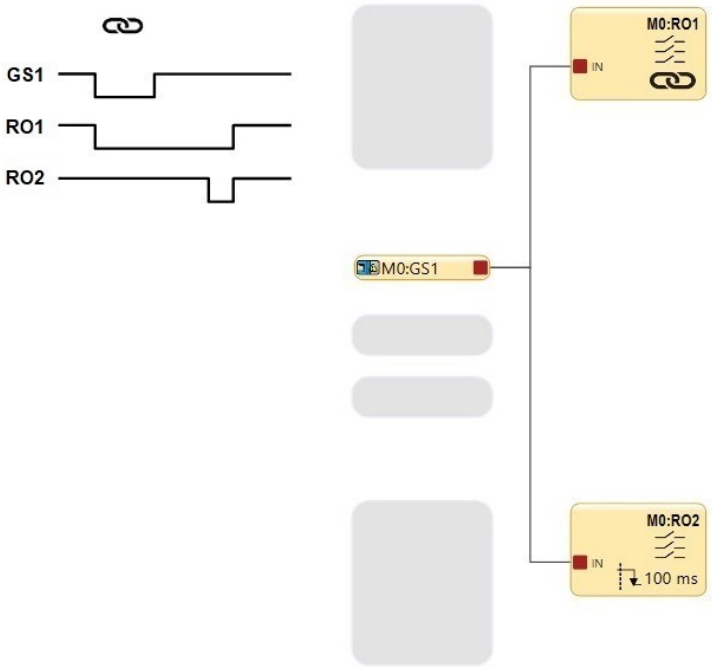



Figure 35: Timing diagram: Interlinked safety outputs

### 7.8.1 Solid-state safety outputs

This function is available with SCx.
The semiconductor safety outputs, e.g. SO1a and b as well as SO2a and b, are actively monitored to detect short circuits to the supply voltage, to each other and to other voltage sources, and are designed for category 4 safety applications. If a fault is detected on one channel of a safety output pair, both outputs attempt to switch off and go into a blocking state. The output without a fault is able to switch off the dangerous movement.
A safety output that is used individually (split) is also actively monitored to detect short circuits to other voltage sources, but cannot perform any actions. Take extreme care when wiring the terminals and routing the wires to avoid the possibility of short circuits to other voltage sources, including other safety outputs. Each split safety output is sufficient for Category 3 applications due to an internal series connection of two switching devices, but an external short circuit must be prevented.

**Important:** If solid-state safety output modules (SCx-O-2T or SCx-O-4T) are used, power must be supplied to these modules either before or within 5 seconds of applying power to the base controller if separate power supplies are used.

**Note:** Each solid-state safety output module (SCx-O-2T or SCx-O-4T) has two 24 V connections and two 0 V connections. Only one of them is required for the power supply of the respective module. The second set can be used to bridge the power supply of the next module.

**WARNING:**

- **Single-channel (split) outputs for use in safety-critical applications**
- Failure to use proper fault exclusion procedures when using single-channel outputs in safety-critical applications can result in loss of safety control and serious injury or death.
- When a single-channel output is used in a safety-critical application, the principles of fault exclusion must be considered to ensure safe Category 3 operation. An example of a proper fault exclusion method is routing
  and management of single-channel output wires so that short circuits to other outputs or other voltage sources are not possible.

Whenever possible, the integration of external device monitoring (EDM) and/or adjustable valve monitoring (AVM) is strongly recommended to monitor controlled devices (safety sensors and shutdown elements) for unsafe failures. See External Device Monitoring (EDM) on page 70 for more information.

**Wiring of the outputs**

The safety outputs must be connected to the machine control system in such a way that the safety-related control system of the machine interrupts the circuit or the power supply to the primary control element(s) of the machine (shutdown elements), resulting in a non-hazardous condition.
When using limit switches (safety sensors), this is usually achieved if the safety outputs are connected to the output terminals.
state. Read "5.1 SCx specifications" on page 18 before making connections and connecting the safety controller to the machine.
The degree of integrity of the safety circuit must be determined by a risk assessment; this degree depends on the configuration, the proper installation of the external circuit and the type and installation of the controlled devices (safety sensors and shutdown elements). The semiconductor safety outputs are suitable for applications
category 4 PL e / SIL 3 when controlled in pairs (not split), and for applications up to category 3 PL d / SIL 2 when operating independently (split) if a suitable fault exclusion has been used. See Figure 41 on page 72 for connection examples.

**WARNING:**

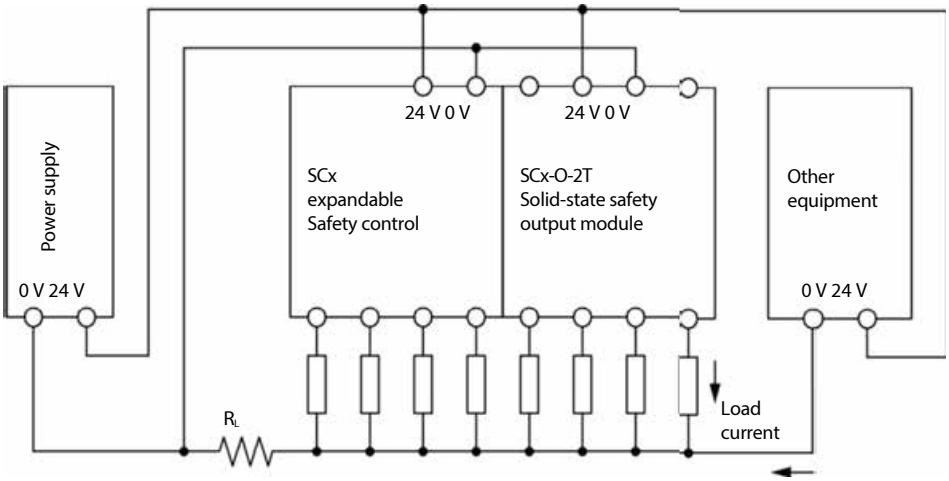
- **Safety output Line resistance**
- A resistance greater than 10 ohms could mask a short circuit between the dual-channel safety outputs and cause an unsafe condition that could result in serious injury or death.
- The resistance of the cables must not exceed 10 Ohm.

**Common installation of the outlets**

Take into account the line resistance of the common 0 V line and the currents flowing in this line to avoid unwanted interlocks. Note the position of the resistance symbol in the following diagram, which represents the resistance of the 0 V line (RL).

Methods to avoid this situation include:

- Use thicker or shorter cables to reduce the resistance (RL ) of the common 0 V wire
- Disconnect the common 0 V line from the loads connected to the safety controller and the common 0 V line from other devices that are supplied via the common 24 V supply.



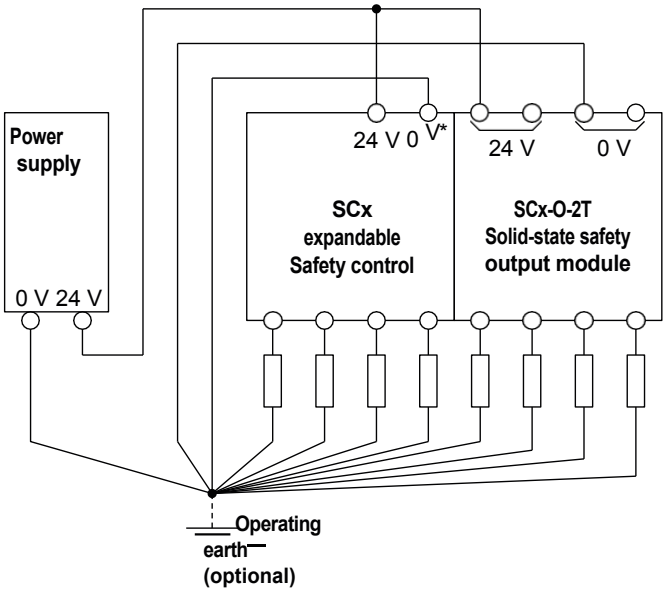

$R_L$ = Common supply line used by several loads or systems.

The shared use of cables with a small cross-section can lead to faults at semiconductor outputs.

Figure 36: Common installation of the outputs

**Note:** When the safety output is switched off, the voltage at this output terminal must fall below 1.7 V in relation to the 0 V terminal on this module. If the voltage is higher than 1.7 V, the safety controller decides that the output is still switched on, resulting in a lockout. Consider using larger gauge conductors, shorter conductors or using a single point grounding scheme similar to the diagrams below.

Preferred 0 V wiring diagram when using a single power supply unit




* The voltage for all safety input devices (including all input expansion modules) should be measured with respect to the 0 V terminal of the base controller.

Preferred 0 V wiring diagram when using separate power supplies

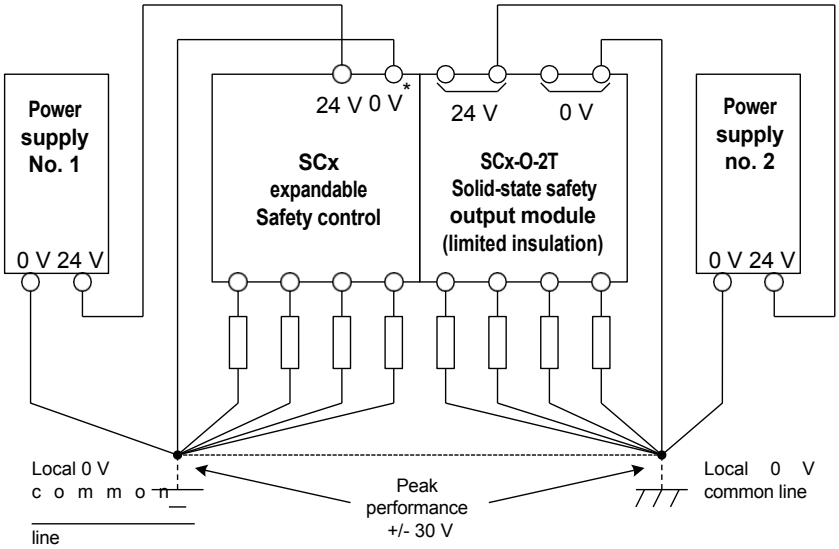



Figure 37: Circuit diagram - Recommended earthing

### 7.8.2 Safety relay outputs

The SCR P has galvanically isolated, redundant relay outputs that can be used to control/switch a wide range of electrical devices ("5.2 Specifications for the SCR P" on page 23). In contrast to a safety transistor output, a single safety relay output (Mx:ROx) in an output module functions as a group and cannot be split.
The safety relay outputs are controlled and monitored by the SCR P. No additional cables are required for this.
For circuits that require maximum safety and reliability, each safety output must be capable of stopping the movement of the machine protected by a safety output in an emergency when used in pairs (two normally open contacts). When used individually (a single N/O contact output), the fault exclusion must ensure that no faults can occur that would lead to a loss of the safety function, for example a short circuit to another safety output or another circuit.

Where possible, the inclusion of external device monitoring (EDM) and/or adjustable valve monitoring (AVM) is strongly recommended in order to monitor the connected devices for faults that could jeopardize safety. See "External device monitoring (EDM)" on page 67 for more information.

**Output connections**: The safety relay outputs must be connected to the machine control system in such a way that the safety-relevant part of the machine control system interrupts the circuit or the supply to the machine's shutdown elements and brings about a non-hazardous state.
Observe "5.2 Specifications for the SCR P" on page 23 before connecting the safety evaluation unit to the machine.
The safety level must be determined by the risk evaluation. This level depends on the configuration, the proper installation of the external circuits and the type and installation of the controlled devices.
(safety sensors and switch-off elements). The safety relay outputs are suitable for category 4 PL e/SIL 3. See Figure 25 on page 59 for connection examples.

☞ **Important:** It is the user's responsibility to protect all relay outputs with suitable short-circuit protection.

**Installations in overvoltage categories II and III (EN 50178 and IEC 60664-1)**

The SCR P is approved for overvoltage category III if voltages of 1 V to 150 V AC/DC are present at the output relay contacts. They are approved for overvoltage category II if voltages of 151 V to 250 V AC/DC are present at the output relay contacts and no other protective measures are in place to limit potential overvoltages in the operating voltage.
The SCR P can be used in environments of
Overvoltage category III (at a voltage of 151 V to 250 V AC/DC) if overvoltage protection devices (e.g. arc suppressors) have been installed to ensure that either the electrical interference to be protected by the SCR P is reduced to the level of overvoltage category II, or if additional external insulation has been installed to protect both the SCR P and the operator from the higher voltages of a category III environment.

**For installations of overvoltage category III with voltages of 151 V to 250 V AC/DC applied to the output contacts**, the SCR P may be used under the conditions of a higher overvoltage category if adequate overvoltage protection is provided. Suitable methods:

- an overvoltage protection device,
- a transformer with insulated windings,
- a distribution system with several branch lines (which can dissipate the energy from voltage peaks),
- sufficient capacity to absorb the energy of voltage peaks,
- a resistor or comparable damping device to dissipate the energy of voltage peaks. When switching inductive AC loads, the outputs of the SCR P should be protected by installing appropriate arc suppressors. However, if arc suppressors are used, they must be installed between the load to be switched (e.g. between the coils of external safety relays) and never between the output contacts of the SCR P (see WARNING, Arc suppressors).

### 7.8.3 EDM- and switch-off device

**connection External device monitoring**

**(EDM)**

The safety outputs of the safety evaluation unit can control external relays, contactors or other components that have a set of positively driven (mechanically connected) contacts with a normally closed contact that can be used to monitor the status of the normally open contacts of the switch-off devices. The monitoring contact is in the closed state when the component is switched off. This allows the safety evaluation
detect whether the connected components are responding to the safety output or whether the NO contacts are possibly welded or blocked in the ON state.
The EDM function provides a method of monitoring these faults and ensuring the functionality of a two-channel system including the shutdown elements.
An individual EDM input can be assigned to one or more safety outputs. To do this, open the **Properties** window for the safety output and activate **EDM**. Then add **External Device Monitoring** from the **Safety Input** tab in the **Add Devices** window (accessed from the **Devices** tab or the **Function View** tab) and connect the **External Device Monitoring** input to the **EDM node** of the Safety Output.
The EDM inputs can be configured as single-channel monitoring or dual-channel monitoring. Single-channel EDM inputs are used when the OSSD outputs directly control the deactivation of the switch-off elements or external devices.

- **Single-channel monitoring:** This is a series connection of closed positively driven monitoring contacts, each of which belongs to one of the devices controlled by the safety outputs of the evaluation unit. The monitoring contacts must be closed before a system reset can be carried out on the outputs of the safety evaluation unit (either manually or automatically). After a reset has been carried out and the safety outputs switch on, the status of the monitoring contacts is no longer monitored and can change. However, the monitor contacts must
must be closed within 250 milliseconds after the safety outputs change from On to Off. See Figure 27 on page 59.
- **Dual-channel monitoring:** This involves the connection of independent closed monitoring contacts, each of which is mechanically connected to a device controlled by the safety evaluation unit. Both EDM inputs must be closed before a reset can be performed on the safety evaluation unit and the OSSDs can be switched on. While the OSSDs are switched on, the inputs can change their status (either both open or both closed). If the inputs remain in the opposite state for longer than 250 milliseconds, a blocking state occurs. See Figure 29 on page 62.
- **No monitoring (default):** If no monitoring is desired, do not activate the EDM node of the safety output. If the safety evaluation does not use a feedback loop in category 3 or 4 applications, the user must ensure that a single failure or an accumulation of failures of the external devices does not lead to a dangerous condition and that a subsequent machine start is prevented.

**CAUTION: EDM configuration**

If the EDM function is not required during use, the user is responsible for ensuring that this does not result in a dangerous situation.

**CAUTION: Connecting the external device monitoring (EDM)**

Connect at least one positively driven monitoring NC contact of each external device so that the status of the individual switch-off elements can be monitored (see illustration).
This monitors the correct operation of the shut-off elements. **Use the monitoring contacts of the shut-off elements to maintain the safety level.**

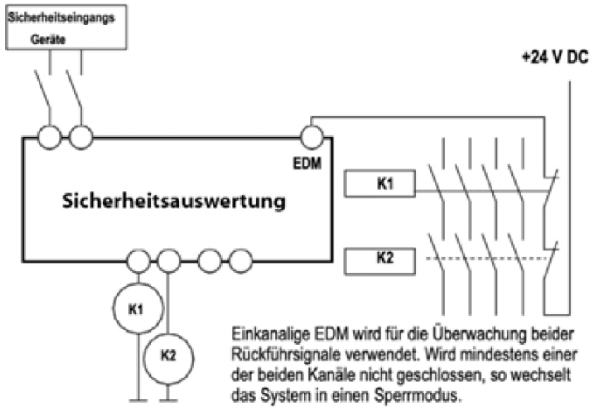



Figure 38: Connection of the external dual-channel device monitoring (single-channel EMD

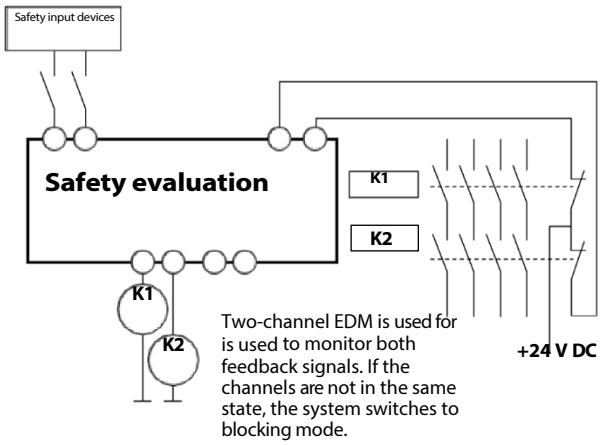
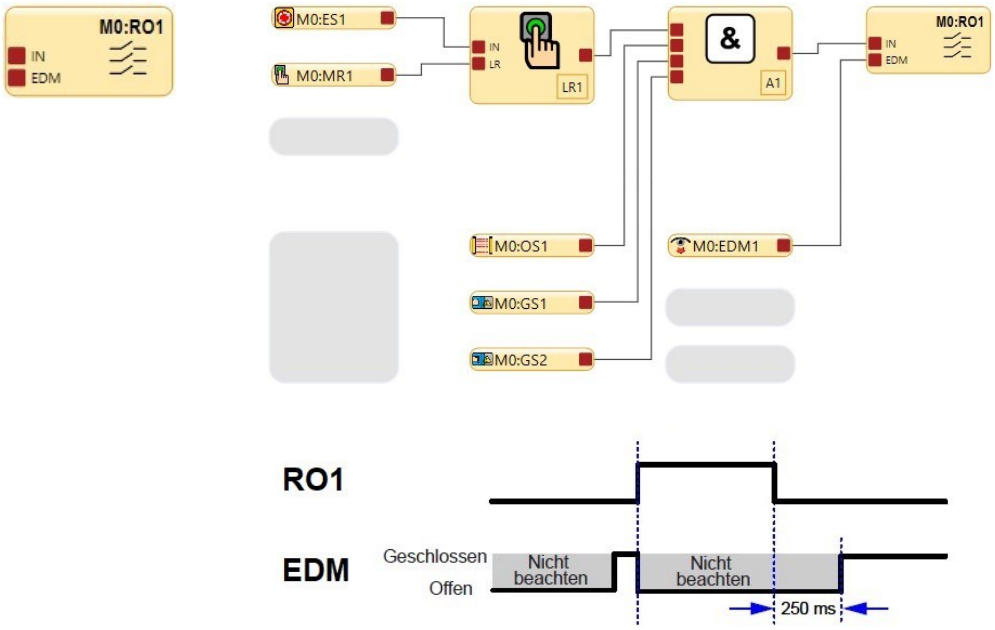



Figure 39: Connection of the external dual-channel device monitoring. (dual-channel EDM)




External device monitoring (EDM) is a method of checking the operation of two-channel shutdown devices. The positively driven NC monitoring contacts of the safety sensors and switch-off elements serve as inputs for detecting a welded on state as a fault condition and prevent the outputs of the safety evaluation unit from being switched on.

Figure 40: Time diagram: Status of the single-channel external device monitoring in relation to the safety output

With two-channel external device monitoring, both channels must be closed before the corresponding safety outputs are switched on, as shown below.

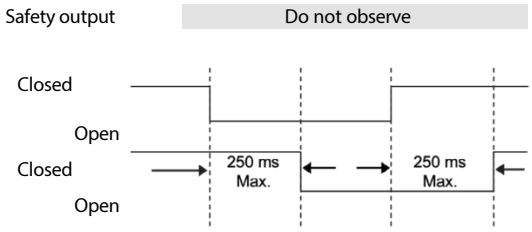



Figure 41: Timing diagram: Dual-channel EDM, t i m i n g between channels

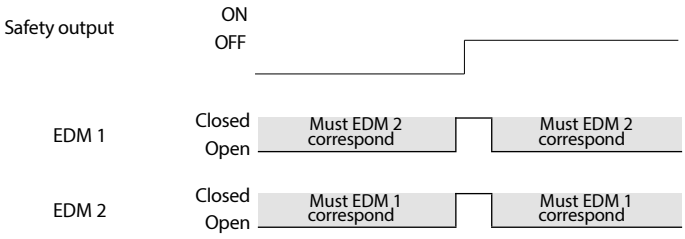



Figure 42: Timing diagram: Status of the two-channel external device monitoring in relation to the safety output

### Safety shutdowns

A safety shutdown causes a defined stop of the machine movement and an interruption of the supply voltage from the drives (provided that this does not create any additional hazards). A safety cut-out usually comprises at least two normally open contacts of positively driven (mechanically connected) relays, which are monitored to detect certain faults (via a mechanically connected normally closed contact) to prevent the loss of the safety function.
Usually, safety cut-outs are series circuits of at least two normally open contacts that come from two separate positively driven relays, each of which is connected to a separate safety output of the
Safety evaluation can be activated. The safety function is based on the use of redundant contacts to monitor a single danger point, so that if one contact fails in the on state, the second contact stops the dangerous machine movement and prevents the next machine start from occurring.
The safety cut-outs must be connected in such a way that the protective function cannot be canceled, deactivated or bypassed, unless the same or a higher degree of safety is achieved as that of the safety system to which the safety evaluation belongs.

**WARNING:**

- **Install surge limiters or arc suppressors correctly**
- If these instructions are not followed, serious or fatal injuries may result.
- Install arc suppressors or overvoltage limiters over the coils of the disconnectors as shown. Do not install these directly on the contacts of the
  Switch-off elements. In such a configuration, a failure of the arc suppressors or overvoltage limiters in the form of a short circuit is possible.

**WARNING: Connecting the safety outputs**

To ensure correct operation, the output parameters of the safety evaluation unit and the input parameters of the machine must be taken into account when connecting the safety outputs to the machine inputs.
The control circuit of the machine must be designed in such a way that the following requirements are met:

- The maximum cable resistance value between the safety transistor outputs of the safety controller and the machine inputs must not be exceeded.
- The maximum blocking voltage of the safety transistor output of the safety evaluation unit must not lead to a switched-on state.
- The maximum leakage current of the safety transistor output of the safety controller due to the loss of the 0 V line must not lead to a switched-on state.

**If the safety outputs are not connected correctly to the monitored machine, serious or fatal injuries may result.**

**WARNING: Risk of electric shock and dangerous energy**

**Always disconnect the power supply from the safety system (e.g. device, module, connections, etc.) and the monitored machine before connecting connections or replacing components.**

The electrical installation and wiring must be carried out by qualified persons. The applicable electrical standards and wiring regulations must be observed, for example
IEC/EN 60204-, NEC (National Electric Code), or ANSI NFPA79, as well as all applicable local standards and regulations.

**This may require lockout/tagout procedures.** See ISO 14118, OSHA 29CFR1910.147, ANSI Z244-1, or the appropriate hazardous energy control standard.

**WARNING: Connecting the safety outputs**

- **Wire the device correctly**
- If the safety evaluation unit is incorrectly wired to the respective machine, this could result in a hazardous situation that could cause serious injury or death.
- Proper wiring of the safety evaluation unit is the responsibility of the user. The wiring configurations apply generally and are only intended to illustrate the importance of proper installation.

### General SCx connection: Safety output with EDM

The solid-state safety outputs SO2, SO3 and SO4 can be wired in a similar way.

If a solid-state safety output has been split into two individual outputs, each output requires its own EDM or AVM input for monitoring.

The DC ground (0 Vdc) must be between the 0 Vdc terminal of the module and the ground of the load (e.g. FSD).

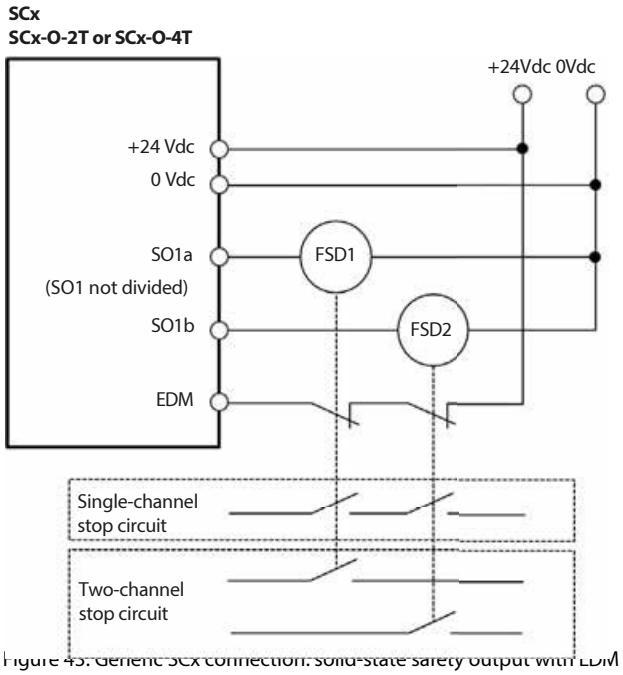



Figure 43: Generic SCx connection: solid-state safety output with EDM

The safety relay outputs 43/44, 53/54 and 61/62 can be wired in a similar way, but require a separate EDM or AVM input for monitoring.

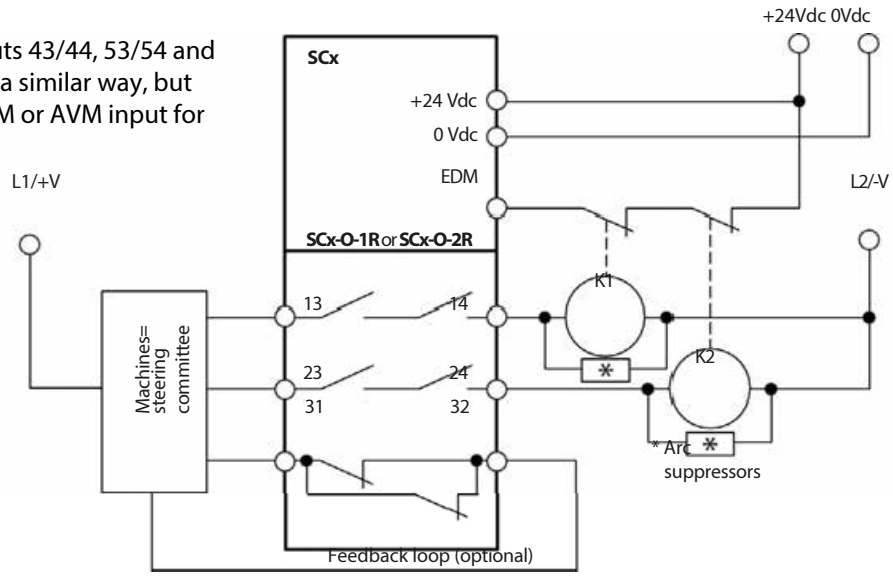



Figure 44: General SCx connection: safety relay output (two-channel) with EDM

**WARNING:**

- **Proper installation of arc or transient suppressors**
- Failure to follow these instructions may result in serious injury or death.
- Install any protective circuits over the coils of the machine's primary control elements as shown. Do not install protective circuits directly across the output contacts of the safety or interface module. In such a configuration, it is possible for protective circuits to fail as a short circuit.

### Typical connection of the SCR P: Safety output with EDM

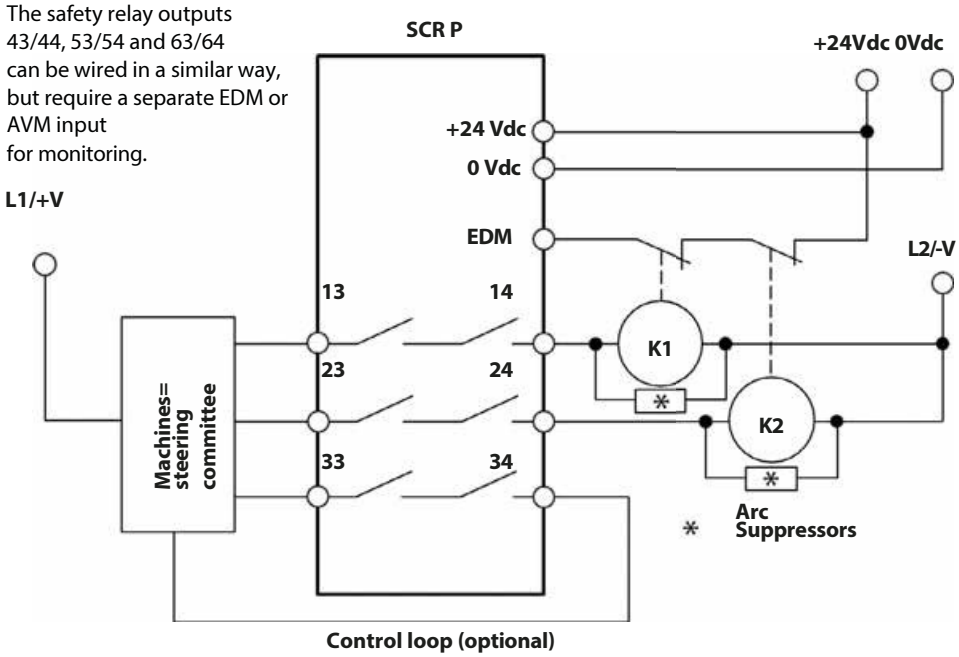



Figure 45: Typical A nterconnection of the SCR P: Safety relay output (two-channel) with EDM

## 7.9 Status outputs

### 7.9.1 Signal logic for status outputs

**Note:** You must not use the safety outputs on the SCR P as status outputs

Two signal logics are available for each status output: "PNP on" (supplies 24 V DC) or "PNP off" (non-conductive). The default logic is "Active = PNP on".

Table 3: Signal logic for status outputs

| Function | Signal logic | | | |
|---|---|---|---|---|
| | Active = PNP on | | Active = PNP off | |
| | Status output status | | Status output status | |
| | +24 V DC | +24 V DC | From | 24 V DC |
| **Bridging** | Bridged | Not bridged | Bridged | Not bridged |
| **Muting** | Muted | Not muted | Muted | Not muted |
| **Output delay running** | Delay | No delay | Delay | No delay |
| **Display input status** | A | Stop | A | Stop |
| **Display input error** | Error | OK | Error | OK |
| **Display any input error** | Error | OK | Error | OK |
| **Input display group** | Stop initiated | Other input caused stop | Stop initiated | Other input caused stop |
| **Display initial status** | RO one | RO from | RO one | RO from |
| **Display output error** | Error | OK | Error | OK |
| **Display output error, all** | Error | OK | Error | OK |
| **Display logical output status** | Logical one | Logical from | Logical one | Logical from |

| Function | Signal logic | | | |
|---|---|---|---|---|
| | Active = PNP on | | Active = PNP off | |
| | Status output status | | Status output status | |
| | +24 V DC | +24 V DC | From | 24 V DC |
| **Track the status of the delay block** | A | Stop | A | Stop |
| **Waiting for manual reset** | Reset required | Not fulfilled | Reset required | Not fulfilled |
| **System lock** | Locked | RUN mode | Locked | RUN mode |

### 7.9.2 Sta tus output function

**SCR P:** Up to 4 configurable inputs can be used as status outputs. **SCx:** Up to 8 configurable inputs can be used as status outputs. Status outputs can be configured to perform the following functions:

**Bridging**

Indicates when a specific safety input is bypassed.

**Muting**

Specifies a muting enable status for a specific mutable safety input:

- ON if a mutable input is muted
- OFF if a mutable input is not muted
- The display flashes if the conditions for starting the muting of the safety device are met (an inactive muting cycle, the muting-capable safety input is in the off state).
  and at least one muting sensor is in the off state (blocking state)). Not available for virtual status output.
- ON during active muting (no bypass function) of a mutable safety input

**Output delay running**

Indicates that the switch-on or switch-off delay is active.

**Display input status**

Indicates the status of a specific security input.

**Display input error**

Indicates that a specific safety input has an error.

**Display any input error**

Indicates that some safety input has an error.

**Input group display**

Indicates the status of a group of safety inputs, for example, which safety input was switched off first. After this function has been displayed, it can be reactivated by a configured reset input. Up to three input groups can be tracked.

**Display initial status**

Indicates the physical status (On or Off) of a specific safety output.

**Display output error**

Indicates that a specific safety output has an error.

**Display output error, all**

Indicates that some safety output has an error.

**Display logical output status**

Indicates the logical status of a specific safety output. Example: The logical status is Off, but the safety output is in the switch-off delay and is not yet physically switched off.

**Track the status of the delay block**

Indicates the status of a specific function block.

**Press tracking function block**

Displays the status of a series of press function events; see "7.9.3 Press control status output functionality" on page 75 for more information.

**Waiting for manual reset**

Indicates that a specific configured reset is required.

**Note:** If the manual reset input is connected to a reset OR block, this status output cannot be used.

**System lock**

Indicates a non-functional blocking state, for example an unassigned input that is connected to the 24 V supply.

### 7.9.3 Pr ess control Status output functionality

The press control function block has several inputs and outputs. This results in a status output function that is not just a simple on/off for a single element. The status output of the press control block has seven different events that can be signaled via the status output. The status output of the press control block can be configured to provide one, two or three signals. Each signal from the status output of the press control block can be as follows:

- Massive
- 2 pulses per second

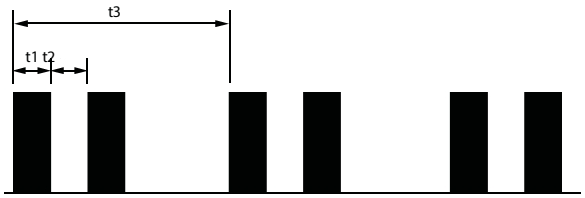



Figure 46: 2 pulses per second

t1 = 100 ms, t2 = 100 ms and t3 = 1 s

- 3 pulses per second

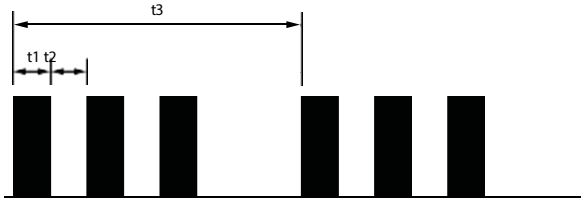



Figure 47: 3 pulses per second

t1 = 100 ms, t2 = 100 ms and t3 = 1 s

The status output of the press control block is only available as a physical status output. Each physical status output can be used to signal three different events.
The following illustration shows the default settings for the status output of the press control function block:

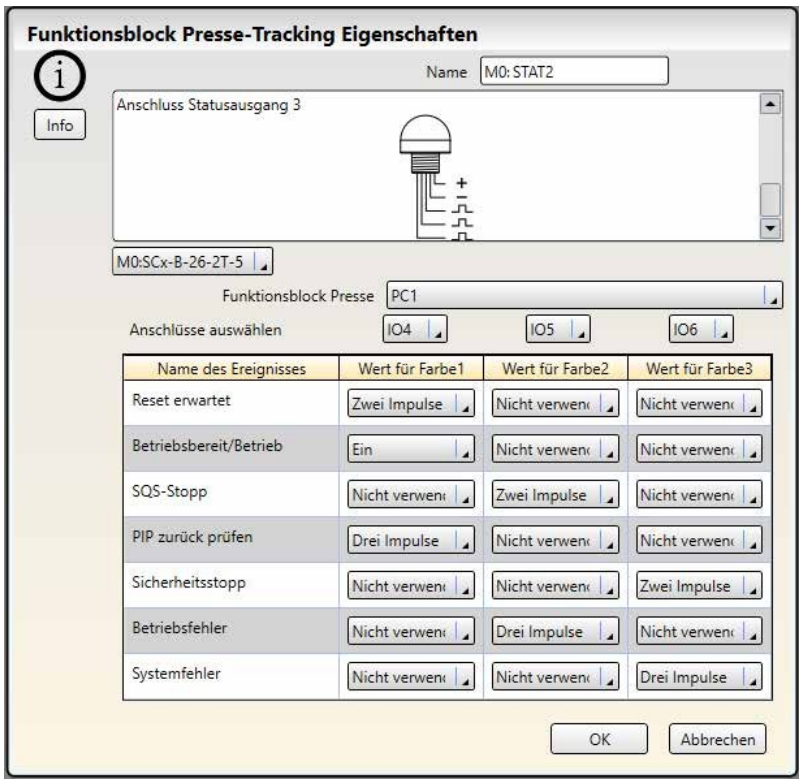



Figure 48: Track Press function block properties

The default setting of the function block configures three of the IO pins as status outputs. If not all seven events need to be displayed for a particular application, use the slider on the right in the illustration to select fewer pins. If you move the slider up one position, the number of connections is reduced to two; if you move the slider up two positions, the number of connections is reduced to one.

The functions of the individual events are as follows:

- **Wait for reset - Turns** on when a reset input is required after the non-changeable and changeable (if configured) safety stop inputs return to the ON state.
- **Ready to Run/Run** - Lights up whenever the press is ready for operation (changeable and non-changeable safety stop inputs are switched on and reset) or the press is running in the up or down stroke.
- **SQS Stop** - **Switches** on when the press ram reaches the "Sequence Stop" point
- **PIP Checkback Alarm - Turns** on when the press is operational and an attempt is made to start a press cycle and the PIP (Part in Place) input, if configured, is off or has not turned off and then back on (part not removed and replaced).
- **Safety Stop - Turns** on when either the variable or non-variable safety stop input is turned off, the GO input node goes low (if configured for manual upstroke setting), before SQS, BOS or TOS is reached (depending on the settings and

  the part of the process).
- **Operating fault - Switches** on if mutually exclusive operating inputs are switched on (e.g. TOS and BOS, TOS and SQS, TOS and PCMS, SQS and BOS, etc.; if more than 3 seconds elapse between the SQS and PCMS signals, both switch on if configured).
- **System error - Switches** on if there is a system error.

### 7.10 Virtual tual status outputs

Up to 256 virtual status outputs can be added to SCR P and SCx safety evaluations. These outputs can transmit the same information via the network as the status outputs. See "7.9.2 Status output function" on page 74 for more information. The **Auto Configure** function on the **Industrial Ethernet** tab in the software automatically configures the virtual status outputs for a combination of frequently used functions based on the current configuration. This function is best used after the configuration has been defined. The configuration of the virtual status outputs can be revised manually after using the **Configure automatically** function. The information available via the network corresponds to the logical status of the inputs and outputs within 100 ms for the
tables of the virtual status outputs (these can be displayed via the software) and within 1 second for the other tables. The logical status of the inputs and outputs is determined after all internal debounce times have expired and all tests have been completed. See "9.10 Industrial Ethernet tab" on page 108 for more information on configuring the virtual status outputs.

Power and status information of the connected DCD series circuits and the individual devices within the series circuit can be called up via the safety evaluation SCR P and SCx.

16 word (16 bit) data is available for the status of each connected series circuit.

For each device within the series connection, 3 word (16 bit) administrative and 18 byte (8 bit) specific data are available (1 word = 16 bit; 1 byte = 8 bit).

Further information can be found in chapter "12.4.12 Flags" on page 172.

# 8. First steps

Switch on the safety evaluation unit and check that the operation LED lights up green (ON).

## 8.1 Creating a configuration for the first time

The following steps are required to complete and confirm the configuration (write to the evaluation):

1. Definition of a safety application (risk evaluation)
   - Determination of the required components
   - Determination of the required security level
2. Install the software for the safety evaluation of BERNSTEIN AG. See "6.1 Installing the software" on page 28
3. Familiarize yourself with the options in the software. See "9.2 Software overview" on page 96.
4. Start a new project by clicking on **New project/ Recently used files**.
5. Define the **project settings**. See "9.4  Project settings" on page 98.
6. Add safety inputs, non-safety-related inputs and status outputs. See "8.2 Adding inputs and status outputs" on page 77.
7. Design the control logic. See "8.3 Designing the control logic" on page 82.
8. Set optional switch-on or switch-off delay times for safety outputs.
9. If used, configure the network settings. See "9.10.1.1 Network settings: Modbus/TCP, Ethernet/IP, PCCC  " on page 109 or"9.10.1.2 Network settings:PROFINET  " on page 110.
10. Save and confirm the configuration. See "8.4 Saving and confirming a configuration" on page 82.

The following steps are optional and can be used to support the system installation.

1. Change the access rights for the configuration.
2. Use the **Configuration overview** tab to check the detailed device information and response times. See "9.11 Configuration overview tab" on page 113.
3. Print the configuration views, including the **configuration overview** and the **Network settings**. See "9.12 Print options" on page 114
4. Configuration tests with the simulation mode. See "9.17 Simulation mode" on page 121.

## 8.2 H ing inputs and status outputs

Safety and non-safety-related inputs can be added via the **Devices** tab or **Function view**. Status outputs can only be added via the **Devices** tab. If inputs are added via the Devices tab, they are automatically added to the **Function view** tab. All inputs and **logic** and **function blocks** can be moved on the **Function view** tab. The **safety outputs** are listed statically on the right-hand side.

### 8.2.1 Adding safety and non-safety-related inputs

**Note:** Virtual non-safety-related inputs can only be accessed via the **Function view** available.

1. In the **Devices** view, under the module to which the switching device is to be connected, click on (the module


Figure 49: Safety inputs (virtual non-safety-related inputs only available via the **Function view** tab)


Figure 50: Non-safety-related inputs (virtual non-safety-related inputs only available via the **Function view** tab)

and the terminals can be changed via the Properties window for the **input device**), or to a placeholder on the **Function view** tab.

2. Click on **Safety input or Non-safety input** to add input devices:
3. Select the appropriate device settings:

**General settings**

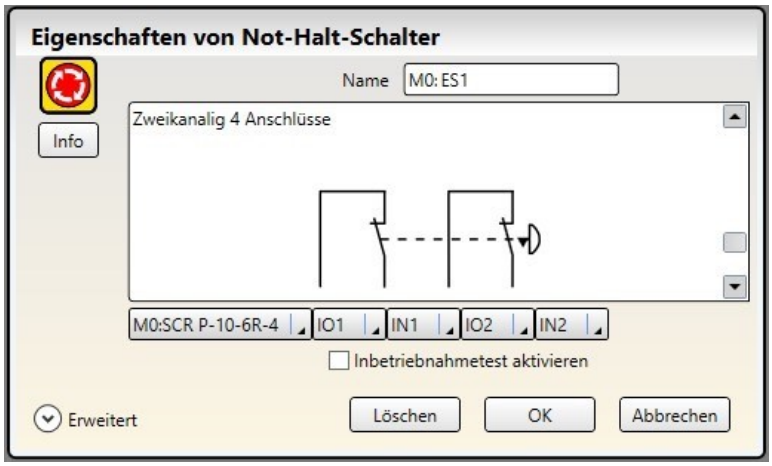



Figure 51: General settings for safety inputs

- Name: the name of the input device. This is generated automatically and can be changed by the user.
- Circuit type: the appropriate circuit and signal convention options for the selected input device.
- Module: the module to which the input device is connected.
- Input/output terminals: the assignment of the input terminals for the selected device on the selected module.
- Activate start-up test (if applicable): an optional test of the safety switching device as a precautionary measure that is required after every start-up.
- Reset options (if applicable): various options for the reset, e.g. "Manual start", "System reset" and "System reset". "Reset input display group".

**Advanced settings (if applicable):**

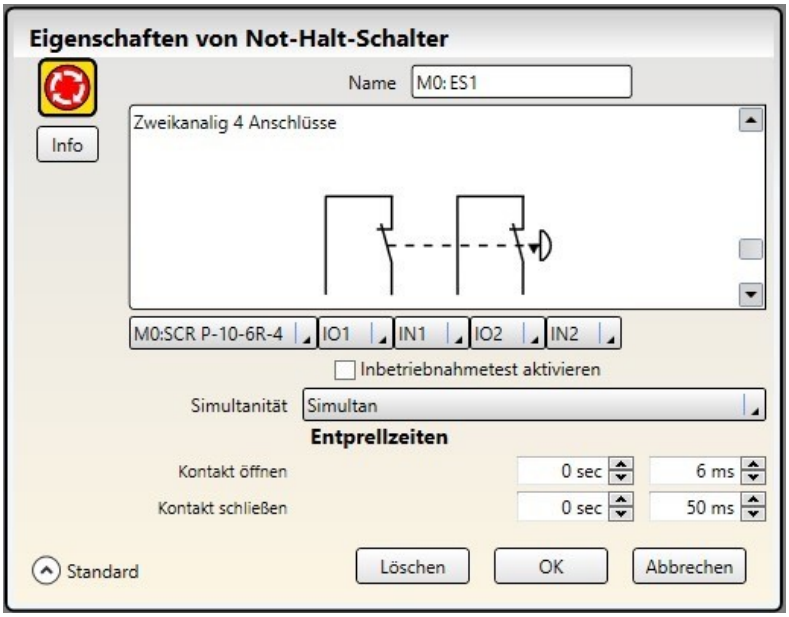



Figure 52: Extended settings for safety inputs

- Simultaneity (if applicable): "Simultaneous" or "Non-simultaneous" (for definitions, see "19. Glossary" on page 255).
- Debounce times: the time for the signal to transition to a different state.
- Monitored/not monitored (if applicable).

**DCD device properties (if applicable):**


Figure 53: DCD device properties for safety inputs

- Name: the name of the input device. This is generated automatically and can be changed by the user.
- Input/output terminals: the assignment of the input terminals for the selected device on the selected module.
- Number of devices (required): The number of DCD devices connected in series in the application
- Position, name and type: The position, relative to the SCR P, the name and type (e.g. door switch) of the DCD device in the application
- Debounce times: The time for the signal to transition to another state.

**Note:** If the entire row consists only of door switches, the configuration rules for a safety gate switch apply.

### 8.2.2 Adding status outputs

1. On the Devices tab, click on under the module for which the status monitoring is to be carried out.
2. Click on Status outputs to add **status monitoring**.

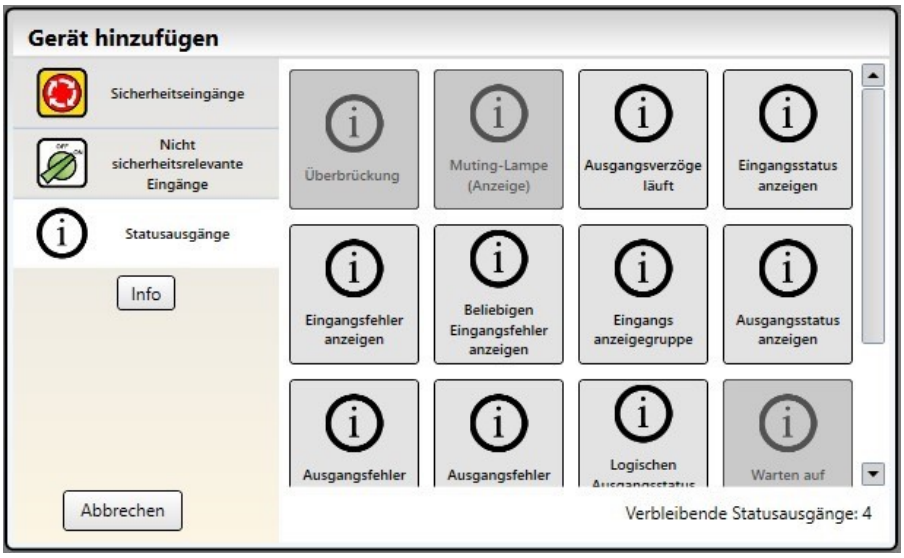



Figure 54: Status outputs

3. Select the appropriate settings for status outputs:

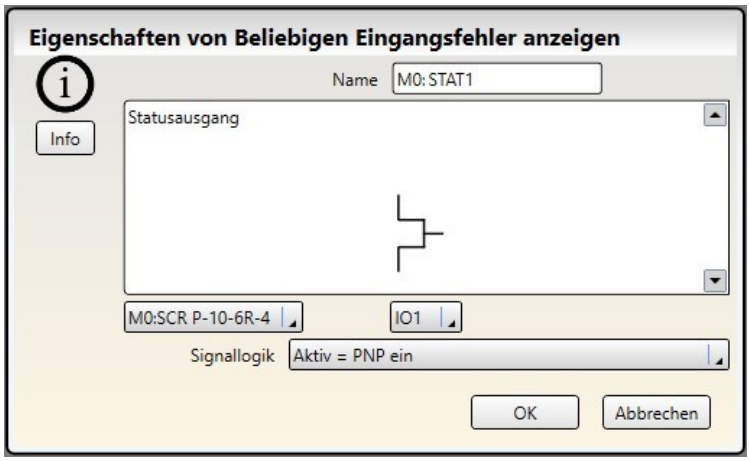



Figure 55: Status output properties

- Name
- Module
- I/O (if applicable)
- Clamp
- Input or output (if applicable)
- Signal logic

### 8.3 Designing the control logic To

**design the control logic:**

1. Add the desired **safety** and **non-safety-related inputs**:
   - On the Devices tab: Click on ✚ under the module to which the input is to be connected (the module can be changed in the **Properties** window for the input).
   - On the **Function view** tab: Click on an empty placeholder in the left-hand column.
   - See "8.2 Adding inputs and status outputs" on page 77 for more information and device properties.
2. Add **logic** and/or **function blocks** (see "9.6.1 Logic blocks" on page 101 and "9.6.2 Function blocks" on page 103) by clicking on any empty placeholder in the middle area.

**Note:** The response time of the safety outputs can increase if a large number of blocks are added to the configuration. Use the function and logic blocks efficiently to achieve optimum response times

3. Establish the appropriate connections between the added inputs, function and **logic blocks** and the safety outputs.

**Note:** The **checklist** on the left-hand side shows the connections required for a valid configuration. All connections listed there must be connected. The safety evaluator does not accept invalid

**Important:** To help you create a valid configuration, the program displays helpful tooltips if you try to connect an invalid port

[7] status outputs can be configured if the status of an input device or an output needs to be communicated. The IOx terminals are used for these status signals.

### 8.4 Sp eichern and confirm a configuration

Confirmation is a verification process in which the security evaluation checks the configuration generated by the software for logical integrity and completeness. The user must check and confirm the result before the configuration can be saved and used by the device. Once the configuration has been confirmed, it can be sent to a safety evaluation or saved on a PC or SCR P-FPS drive.

**WARNING:**
- Complete commissioning test
- Failure to comply with this commissioning test procedure can result in serious or fatal injuries.
- Once the configuration has been confirmed, the operation of the safety evaluation unit must be fully tested (commissioning test) before it can be used to control hazards.

**Saving a configuration:**

1. Click on **Save project**.
2. Select **Save as**.
3. Navigate to the folder in which you want to save the configuration.
4. Name the file (the file name can be identical to or different from the configuration name).
5. Click on **Save**.

**Confirm a configuration** (the safety evaluation unit must be switched on and connected to the PC via the USB cable):

1. Click on .
2. Click on **Write configuration to evaluation**.
3. Enter the password when prompted (the default password is 1901). The screen **Switch to config. mode** is opened.
4. Click **Next** to switch to configuration mode. Once the **Configuration is read from the evaluation** process has been completed, the **Confirmation of configuration** screen opens.
5. Check whether the configuration is correct.
6. Scroll to the end of the configuration and click **Confirm.**
7. Click **Close** once the process of **writing the configuration to the evaluation** is complete.

**Remark:** -

- The network settings are sent separately from the configuration settings. Click on **Send** in the **Network settings** window to write the network settings to the security evaluation.
- SCR P: The network settings are only sent automatically if the factory settings are configured on the SCR P for the security evaluation. Otherwise, you must use the **Network settings** window.
- SCR P: The passwords are only written automatically if the factory settings for the security evaluation are configured on the SCR P and the configuration has been confirmed. Otherwise, use the **Password Manager** window to write passwords to an SCR P.

When configuring an SCR P, the "Do you want to change the passwords for the evaluation?" screen may be displayed.

8. Change the passwords for the SCR P if necessary or if you are prompted to do so.
9. Switch the safety evaluation off and on again or carry out a system reset for the changes to take effect.

**Note:** It is advisable to save the configuration you have just confirmed. Confirmed configurations have a different file format (.xcc) than unconfirmed configurations (.xsc). Confirmed configurations are required to load the respective configuration into an SCR P-FPS drive. Click **Save as** to save the configuration.

### 8.4.1 Writing a confirmed configuration to an SCR P-FPS using the programming tool

1. Connect the SCR P-FPS to the SCR P-PA programming adapter.
2. With the BERNSTEIN Safety Controller software running, plug the programming adapter into a USB port on the PC. The SCR P-FPS symbol should become active (slightly darker than grayed out).
3. Click on and select **Write SCR P-FPS**.

**Note:** If **Write SCR P-FPS** is grayed out, the configuration is not a .xcc (confirmed version).

4. Check the desired passwords.
5. Click on **Send to SCR P-FPS**.
   The Write configuration to SCR P-FPS drive window opens.

**Note:** During this process, all data (configuration, network settings and passwords) are copied to the SCR P-FPS drive.

6. Once the process is complete, click on Save confirmed configuration and then on Close, or click on Close if the file has already been saved on the PC.

### 8.4.2 Notes on confirming or writing a configuration to a configured SCR P or SCx

User settings and passwords influence how the system reacts when a configuration is confirmed or when a confirmed configuration is written to a configured SCR P or SCx.

**User1**

1. Click on **Write configuration to evaluation** to confirm a configuration or to write a confirmed configuration to a configured safety evaluation.
2. Enter the password "User1".
3. The confirmation or write process begins.

At the end of the confirmation or write process, the security evaluation has received the following data:

- New passwords
- New configuration

The network settings are not changed.

**User2 or User3 - Confirm or write configuration successfully**

This scenario requires the following settings for user2 or user3:

- **Authorization to change the configuration** = activated
- **Authorization to change the network settings** = activated OR deactivated

1. Click on **Write configuration to evaluation** to confirm a configuration or to write a confirmed configuration to a configured safety evaluation.
2. Enter the password for user2 or user3.
3. The confirmation or write process begins.

At the end of the confirmation or write process, the security evaluation has received the following data:

- New configuration

Passwords and network settings are not changed.

**User2 or User3 - Confirm or write configuration not successful**

This scenario requires the following settings for user2 or user3:

- **Authorization to change the configuration** = deactivated
- **Authorization to change the network settings** = activated OR deactivated

1. Click on **Write configuration to evaluation** to confirm a configuration or to write a confirmed configuration to a configured safety evaluation.
2. Enter the password for user2 or user3.
3. The confirmation or write process is canceled.

## 8.5 Example configurations

The software contains several sample configurations that demonstrate various safety control functions or applications. To access these configurations, go to **Open Project> Sample Projects** and select the desired project.
The SCx has three groupings of sample configurations:
Applications - **Contains** examples of simple possible applications for the controller. Two of the examples are replacements for obsolete modules.
**Documentation - Contains** examples. Most of the examples contained here are described in the following sections, one example is described in the quick guide (available online).
**Examples - Contains** three sections: **Function Blocks, Logic Blocks** and **Safety Outputs**. These examples show the functionality of the different blocks. For example, to see how a bypass block works, select **Function blocks > Bypass block (all functions activated)** and run it in simulation mode.
There are several example configurations for the SCR P-10-6R-4. These examples cover typical applications of the SCR P-10-6R-4 model. Use the examples as a starting point and modify them to suit your specific requirements.

### SCx example configuration

This section describes the design of the example configuration "3 Zone Muting Instruction Manual", which can be found in the SCx example program **documentation** section. This example configuration is for a palletizing robot application that uses an SCx safety controller, an SCx-I-8 safety input module, three optical sensors (muting is added via the software), two interlock switches, a manual reset and an emergency stop button.

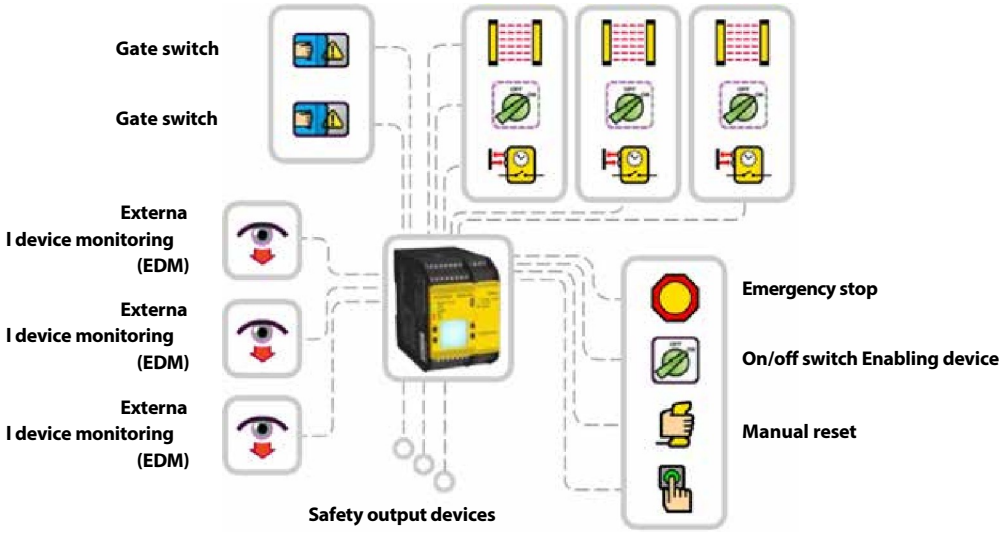



Figure 56: Schematic representation of an example configuration

To design the configuration for this application:

1. Click on **New project**.
2. Define the project settings. See "9.4Project settings " on page 98.
3. Select the Base Controller model. See Equipment tab on page 106 (for this configuration, only the **Is expandable** field needs to be selected).
4. Add the SCx-I-16 expansion module by clicking on to the right of the base controller.
   - Click on **Input modules**.
   - Select **SCx-I-16**.

| Input | Quantity | Type | Module | Terminals | Circuit |
|---|---|---|---|---|---|
| **Emergency stop** | 1 | Security entrance | SCx-I-16 | IO1, IN1, IN2 | Dual-channel 3-terminal |
| **Enabling device** | 1 | Security entrance | SCx-I-16 | IO1, IN3, IN4 | Dual-channel 3-terminal |
| **External device monitoring** | 3 | Security entrance | Base | 1. IO3<br>2. IO4<br>3. IO5 | Single-channel 1 terminal |
| **Gate switch** | 2 | Security entrance | Base | 1. IO1, IN15, IN16<br>2. IO2, IN17, IN18 | Dual-channel 3-terminal |
| **Manual reset** | 1 | Non-security input | SCx-I-16 | IN6 | Single-channel 1 terminal |
| **Muting a sensor pair** | 3 | Security entrance | Base | 1. IN9, IN10<br>2. IN11, IN12<br>3. IN13, IN14 | Two-channel 2-terminal |
| **Activate muting** | 3 | Non-security input | Base | 1. IN1<br>2. IN2<br>3. IO8 | Single-channel 1 terminal |
| **On-Off** | 1 | Non-security input | SCx-I-16 | IN5 | Single-channel 1 terminal |
| **Optical sensor** | 3 | Security entrance | Base | 1. IN3, IN4<br>2. IN5, IN6<br>3. IN7, IN8 | Dual-channel PNP |

5. Add the following inputs and only change the circuit type:

☞ **Tip:** You will notice that not all entries are placed on page 1. There are two solutions to keep the configuration on one page. Carry out one of the following steps:

1. Add a **link** to a block on another page - click on one of the empty placeholders in the middle area, select **Link** and select the block on the next page. Only blocks from other pages can be added as a **link**.
2. Reassign page - by default, all inputs added on the **Equipment** tab are placed on the **Function View** tab on the first available placeholder in the left-hand column. However, the inputs can be moved to any position in the middle area. Move one of the blocks to one of the placeholders in the middle area. Switch to the page that contains the block to be moved. Select the block and change the page assignment below the **Properties** table

6. Go to the **Functional view** tab.
7. Split **M0:SO2**:
   - Double-click on **M0:SO2** or select it and click on **Edit** in the **Properties** table.
   - Click on **Share**.
8. Add the following **function blocks** by clicking on one of the empty placeholders in the middle area of the **Function view** tab (for more information, see "9.6.2 Function blocks" on page 103):
   - **Muting block x 3** (**Muting mode**: One Pair, **ME (Mute Enable)**: Unchecked)
   - **Activating the device lock (ES**: Checked, **JOG (Jog)**: Checked
9. Add the following **logic blocks** by clicking on one of the empty placeholders in the middle area of the Function view tab (for more information, see "9.6.1 Logic blocks" on page 101):
   - **AND** with 2 input nodes
   - **AND** with 4 input nodes
10. Connect the following to each **muting block**:
    - 1 x **optical sensor** (IN node)
    - 1 x **mute sensor pair** (MP1 node)
    - 1 x **mute release** (ME node)
11. Connect **Gate Switch** x 2 to the AND block with 2 nodes.
12. Connect the **muting block** x 3 and the AND block with 2 nodes to the AND block with 4 nodes.
13. Connect one of the **muting blocks** to one of the split safety outputs (**M0:SO2A** or **M0:SO2B**) and one to the other split safety output.
14. **Connect** the following to the **enabling device block**:
    - **Emergency stop** (ES node)
    - **Enabling device** (ED node)
    - AND block with four input nodes (IN nodes)
    - Manual reset (RST node)
    - **On-Off (**JOG node)
15. Connect the **enabling device block** to the remaining safety output (**M0:SO1**).
16. Activate EDM (External Device Monitoring) in each of the **safety output properties** windows.
17. Connect the **External device monitoring** input once to each of the safety outputs. The example configuration is complete.

Safety outputs. The sample configuration is complete.

**Note:** At this point, you can reposition the blocks on the **Function view** tab to achieve a better configuration flow, as shown in the following illustration:

**Note:** At this point, you can reposition the blocks on the **Function view** tab to achieve a better configuration flow, as shown in the following illustration:

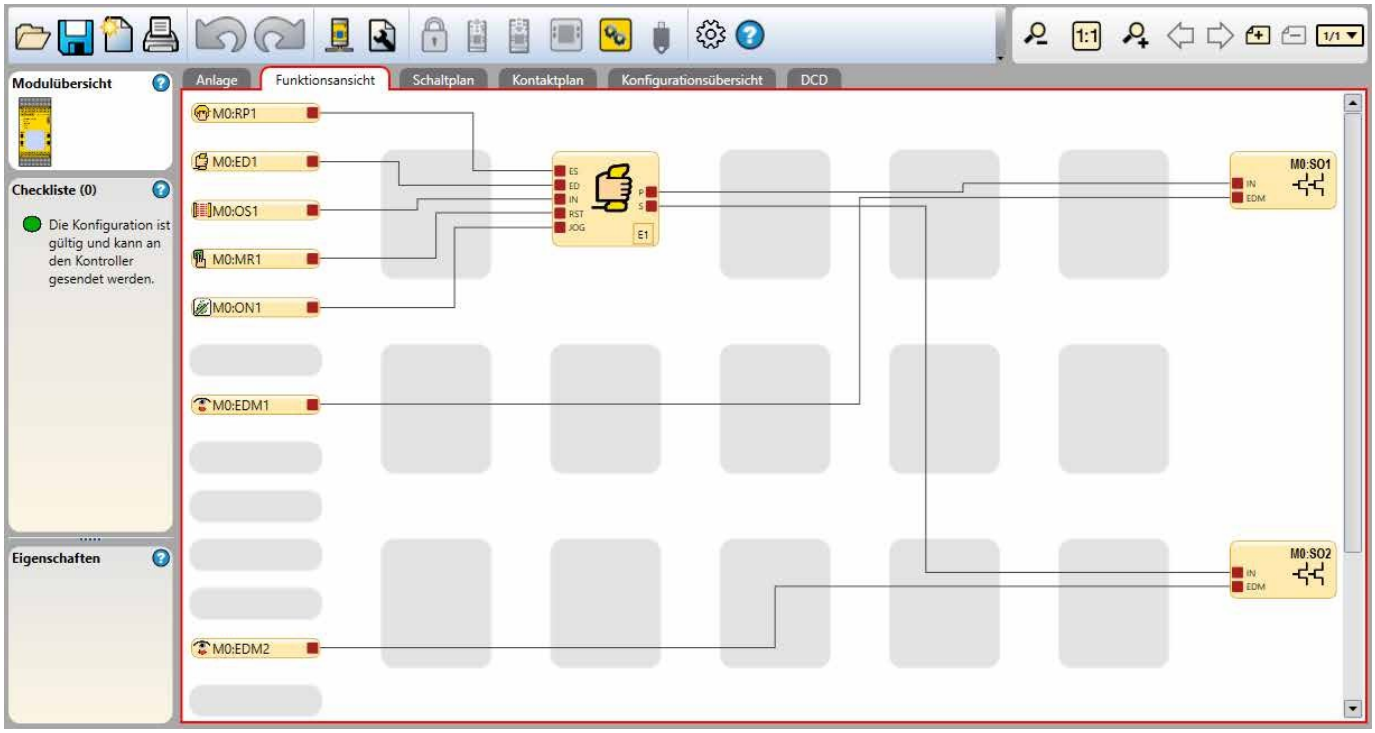



Figure 57: Figure 66: Example configuration - Tab. **Function view**

### 8.5.1 SCx: Simple press control with changeable safety input Example configuration

This section describes the structure of a simple press control, which can be found in the section Documentation of the SCx sample programs.
This example configuration is for a simple hydraulic/pneumatic press application that requires a SCx safety controller, inputs for the press status, a cycle release, a manual reset, an optical safety sensor and an emergency stop switch.

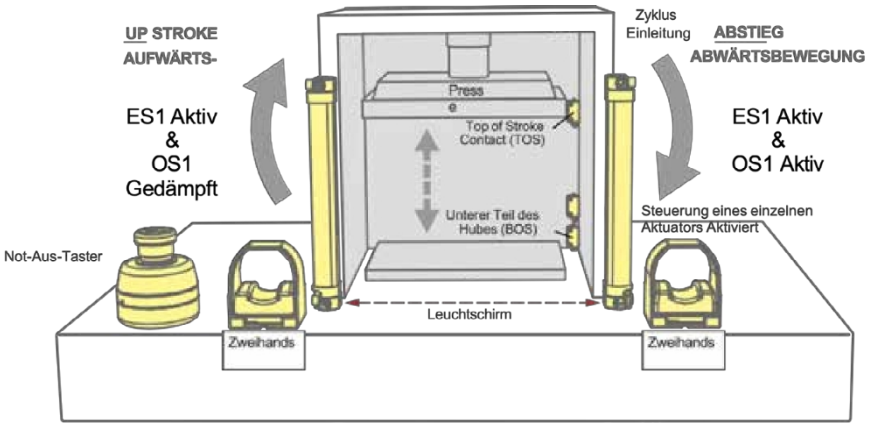



Figure 58: Figure 67: Simple example configuration of the press control system

To design the configuration for this application:

1. Click on **New project**.
2. Define the project settings. See "9.4Project settings " on page 98.
3. Select the desired Base. Controller model. See Equipment tab on page 106.

| Input | Quantity | Type | Terminals | Circuit |
|---|---|---|---|---|
| Introduction of the cycle | 1 | Security entrance | IN1, IN2 | Two-channel 2-terminal |
| TOS (on/off) | 1 | Non-security | IN5 | Single-channel 1 terminal |
| BOS (on/off) | 1 | Non-security | IN6 | Single-channel 1 terminal |
| Manual reset | 1 | Non-security | IN7 | Single-channel 1 terminal |
| Emergency stop | 1 | Security entrance | IN10, IN11 | Two-channel 2-terminal |
| Optical sensor | 1 | Security entrance | IN8, IN9 | Dual-channel PNP |

4. Add the following inputs by changing the name and circuit type as required.
5. Go to the **Functional view** tab.
6. Add the Press control function block and configure it.
   a. Click on one of the empty placeholders in the middle area of the **Function view** tab. For more information, see "9.6.2 Function blocks" on page 103.
   b. Select **function blocks** and select **Press control.**
   c. In the **Press Control Properties** window, select the **PCI (Press Control Input Function Block)** option and **Single**

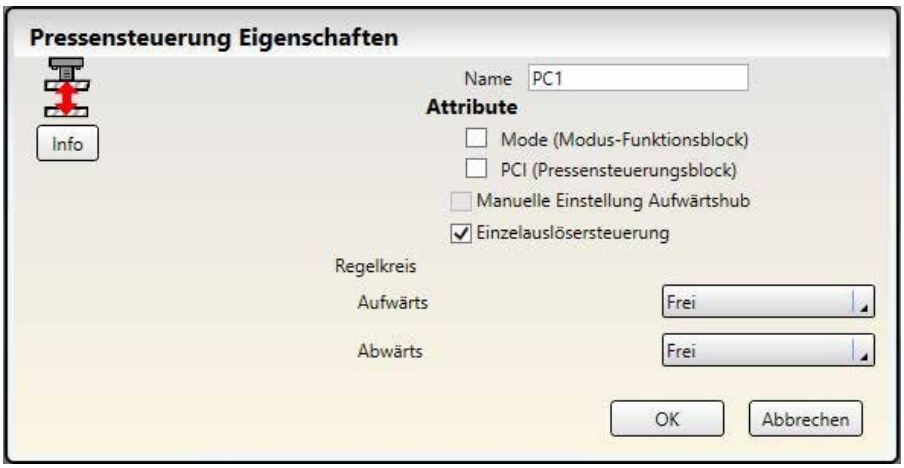



Figure 59: Properties of the press control

**Actuator Control.**
The check mark in the **Manual upstroke setting** field disappears. d. Click on **OK**.
**The Press control input properties** window opens.
e. Figure 69: Properties of the press control inputs
f. Select **M Safety (Mutable Safety Stop)**.
g. Click on **OK**.

7. Connect the following:
   - Input for cycle initiation at the GO node of the press control function block
   - TOS to the TOS nodes of the Press Control function block
   - BOS to the BOS nodes of the Press Control function block
   - Manual reset to the RST node of the Press Control function block
   - Emergency stop on the NM safety nodes of the press control function block
   - Optical sensor on the safety node M of the Press Control Input function block
8. Connect the output node U of the Press Control function block to SO1 (change the name of SO1 to "Up Stroke").
9. Connect the output node D of the Press Control function block to SO2 (change the name of SO2 to "Dwn Strk"). The sample configuration is complete.

**Note:** At this point, you can reposition the blocks on the **Function view** tab to achieve a better configuration flow, as shown in the following illustration:

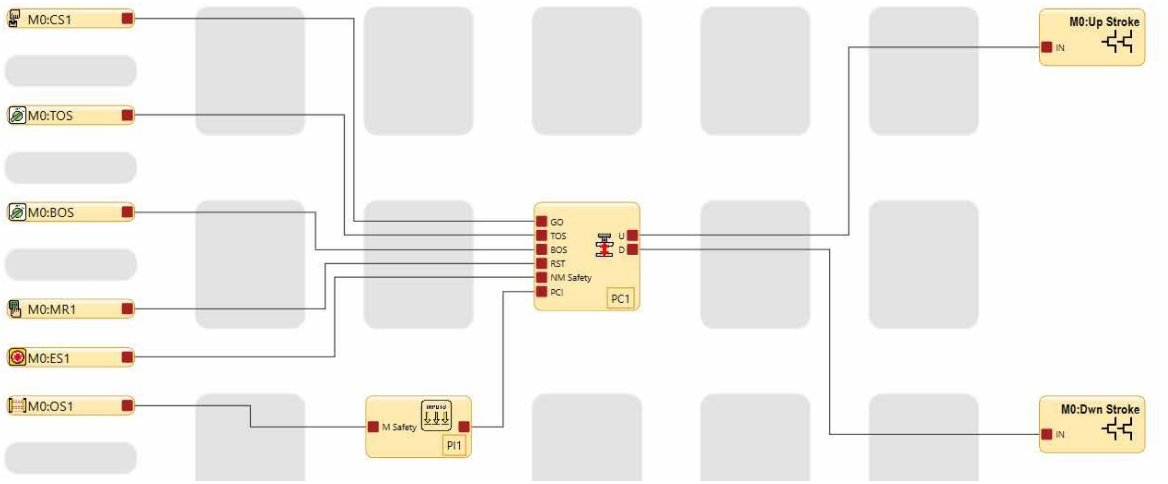



Figure 60: Figure 70: Position function block

**SCx: Simulate the operation of the simple press control configuration**
The functionality of the simple configuration of the press control is simulated below:

1. Click on to enter simulation mode.
2. Click on **Play** to switch on the simulation timer (similar to switching on the machine).
3. Switch the emergency stop, optical sensor and TOS inputs to the ON state (green).
4. Click on the reset input MR1. The press control function block should switch to ON (green).
5. Click on input CS1 to reach the ON (green) state. The SCx output Dwn Strk becomes ON (green).
6. Click the TOS input to the OFF state (red).
7. Click on the BOS input to switch it on (green). The "Dwn Strk" output is switched off (red) and the "Up Stroke" output is switched on (green).
8. Click on the BOS input OFF (red).
9. Click on the TOS input to switch it on (green). The up-stroke output is switched off (red).
10. Switch the CS1 input to the OFF state (red). This can be done at any time after the Dwn Strk output has been switched to ON (green).
11. Click the optical sensor input to the OFF state (red) and then back to the ON state (green). The system is ready to start the next cycle by switching the CS1 input back on.

If the optical sensor or the emergency stop switch is switched off during the up or down stroke, the MR1 input must be switched over, then the CS1 must switch the Up Stroke output to ON.

### 8.5.2 SCx: Example configuration of the press control with all functions

This section describes the structure of a press control system that uses all possible functions (except AVM). The sample configuration can be found in the section Documentation of the SCx sample programs.
This example configuration is for a more complex hydraulic/pneumatic press application utilizing an SCx safety controller, SCx-O-4T safety output module, press status inputs, cycle start, manual reset, optical safety sensor, sequential stop, mute sensor, foot switch input and emergency stop button.

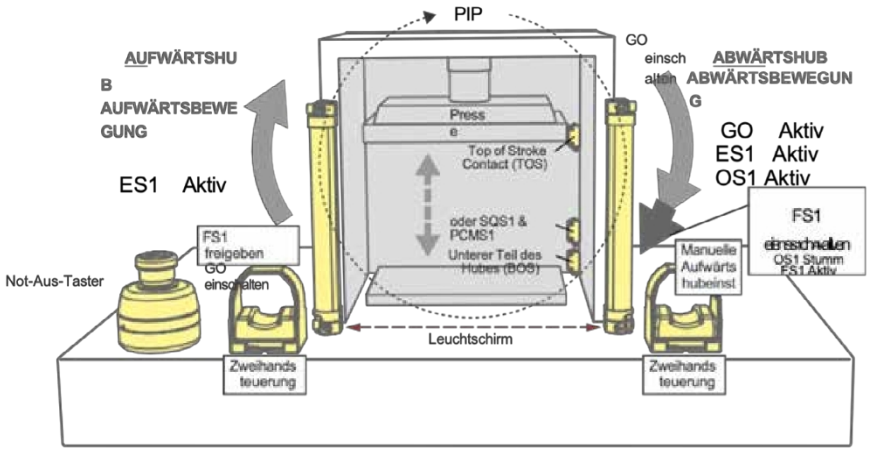



Figure 61: Example of the configuration of the press control with all functions

To design the configuration for this application:

1. Click on **New project**.
2. Define the project settings. See "9.4Project settings " on page 98.
3. Select the desired Base Controller model. See Equipment tab on page 106 (only the **Is expandable** option needs to be selected for this configuration).
4. Add the SCx-O-4T extension module.
   a. Click to the right of the base controller.
   b. Click on **Output modules**.
   c. Select SCx-O-4T.
5. Add the following inputs by changing the name and circuit type as required.

| Input | Number. | Type | Terminals | Circuit |
|---|---|---|---|---|
| Two-hand control | 1 | Security entrance | IN9, IN10 | Dual-channel PNP |
| TOS (ON/OFF) | 1 | Non-security | IN1 | Single-channel 1 terminal |
| BOS (ON/OFF) | 1 | Non-security | IN2 | Single-channel 1 terminal |
| Manual reset | 1 | Non-security | IN11 | Single-channel 1 terminal |
| Emergency stop | 1 | Security entrance | IO1, IN3, IN4 | Dual-channel 3-terminal |
| Running (ON/OFF) | 1 | Non-security | IN12 | Single-channel 1 terminal |
| Up (ON/OFF) | 1 | Non-security | IN13 | Single-channel 1 terminal |
| Down (ON/OFF) | 1 | Non-security | IN14 | Single-channel 1 terminal |
| PIP (ON/OFF) | 1 | Non-security | IN5 | Single-channel 1 terminal |
| Press control SQS | 1 | Security entrance | IN6 | Single-channel 1 terminal |
| Foot switch | 1 | Security entrance | IO2 | Single-channel 1 terminal |
| Press control Mute sensor | 1 | Security entrance | IO3 | Single-channel 1 terminal |
| Optical sensor | 1 | Security entrance | IN7, IN8 | Dual-channel PNP |

6.
7. Go to the **Functional view** tab**.**
8. Add the Press control function block and configure it.
   a. Click on one of the empty placeholders in the middle area of the **Function view** tab. For more information, see "9.6.2 Function blocks" on page 103.
   b. Select **function blocks** and select **Press control**.
   c. In the **Press** Control **properties** window**,** select the **mode (Mode Function Block)** and **PCI (Press**


Figure 62: Properties of the press control

**Control Input Function Block)**. Leave the **Manual upstroke setting** box checked.


Figure 63: Properties of the press control inputs

   d. Click on **OK**. **The Press control input properties** window opens.
   e. Activate all checkboxes. Note that three further options are displayed when **SQS** is selected; select these too (all six boxes should be checked).
   f. Click on **OK**. The **Mode properties** window is displayed.
   g. Click on **OK**.
9. Connect the following to the mode selection block:
   - Execute input in the "Execute input" node
   - Up input to the Inch Up input node
   - Down input to the Inch Down input node
10. Connect the following to the Press Control Inputs Block:
   - Part-In-Place (PIP) input to the PIP input node
   - Sequential stop (SQS) Input to the SQS input node
   - Foot switch input to input node Ft Switch
   - Press Control Mute Sensor (PCMS) on the input node M Sensor
   - Optical sensor at the M Safety input nodes
11. Connect the following to the press control block:
   - Two-hand control input to the GO input node
   - TOS at the TOS input node
   - BOS at the BOS input nodes
   - Manual reset on the RST input node

- Emergency stop at the NM Safety input nodes

12. Connect the output node U of the Press Control function block to SO1 (change the name of SO1 to "UPSO1").
13. Connect the output node D of the Press Control function block to SO2 (change the name of SO2 to "DOWNSO2").
14. Go to page 2 of the Functional view tab (use the arrow in the top right-hand corner).
15. Create a reference node for PCx-H and another one for PCx-L.
16. Connect the PCx-H to SO1 (change the name of SO1 to "HIGHSO1").
17. Connect the PCx-L to SO2 (change the name of SO2 to "LOWSO2"). The configuration of the sample is complete.

**Note:** At this point, it can be helpful to reposition the blocks in the **function view** to improve the configuration flow, as shown in the following illustration.

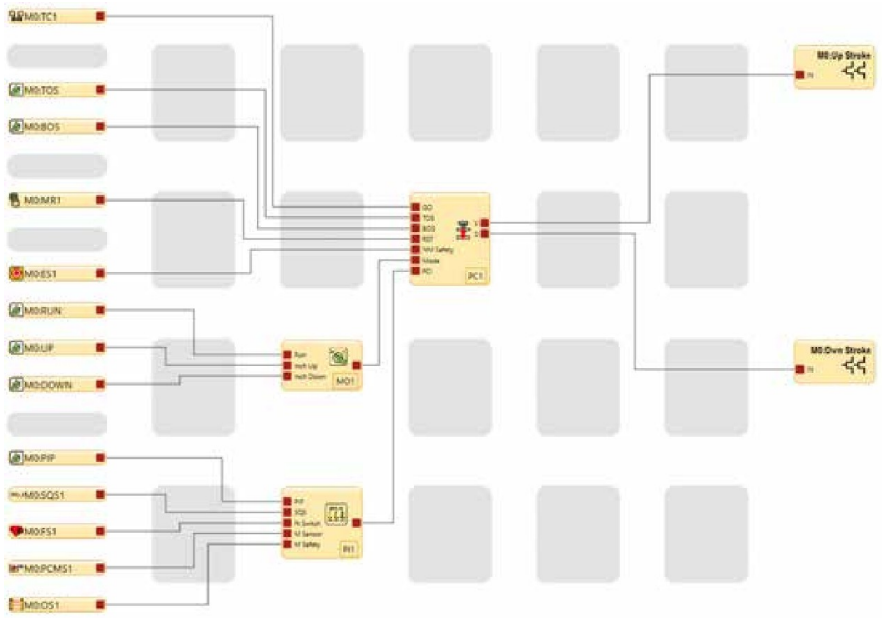


Figure 64: Position function block

**SCx: Simulate the functionality of the press control configuration with all functions**

The following describes how you can simulate the operation of this press control configuration:

1. Click on to enter simulation mode.
2. Click on Play to switch on the simulation timer (similar to switching on the machine).
3. Switch the emergency stop, optical sensor, TOS and Run inputs to the On (green) state.
4. Click on the reset input MR1. The Press Control function block and the LOWSO2 output should change to the On (green) state. This is on page 2; click on the arrow at the top right to change the page.
5. Click on the PIP input to switch it on (green).
6. Click on input TC1 to switch it on (green). The DOWNSO2 output is switched on (green).
7. Click the TOS input to the Off state (red).
8. Click on the SQS1 and PCMS1 inputs to set them to the On state (green). The DOWNSO2 output is switched off (red), the LOWSO2 output is switched off (red) and the HIGHSO1 output (page 2) is switched on (green).
9. Click the TC1 input to the off state (red).
10. Click on input FS1 to switch it on (green). The DOWNSO2 output is switched on (green).
11. Click the BOS input to the On state (green). The DOWNSO2 output and the HIGHSO1 output (page 2) are switched off (red) and the LOWSO2 output (page 2) is switched on (green).
12. Click on input FS1 to set it to the off state (red).
13. Click on input TC1 to switch it on (green). The UPSO1 output is switched on (green).
14. Click the BOS, PCMS1 and SQS1 inputs into the off state (red).
15. Click on the TOS input to switch it on (green). The UPSO1 output is switched off (red).
16. Click the TC1 input to the off state (red).
17. Click on the input of the optical sensor to switch it off (red), click on the PIP input to switch it off (red), then back to the on state (green) and then click on the input of the optical sensor to switch it off (red). optical sensor to switch it on again (green).

The system is ready to start the next cycle by switching the TC1 input back to the on state (green). If the TC1 input is switched off during the downward stroke (red), the downward stroke is not changed by switching it back on; the press continues with the downward stroke. To make the press move upwards (instead of downwards) after switching off the TC1 input, click on the MR1 input and then switch the TC1 input back on. If the optical sensor or the emergency stop switch is switched off during the up or down stroke
the TC1 input should be switched off, then the MR1 input should be activated, and then switching on TC1 switches on the UP-SO1 output.

# 9. Software

The BERNSTEIN safety evaluation software is an application with a real-time display and diagnostic tools that allows you to perform the following tasks:

- Creating and editing configurations
- Testing a configuration in simulation mode
- Writing a configuration to the safety evaluation unit
- Reading the current configuration from the safety evaluation
- Display of real-time information, e.g. device status, diagnostic data
- Displaying error information

The software uses simple circuit and logic symbols that allow you to intuitively define the appropriate input functions and their properties. Once the required configuration, including device properties and I/O control relationships, has been created on the Function view tab, the program automatically creates the corresponding circuit and contact diagrams.

Under "8.1 Creating a configuration" on page 77, you will find information on the configuration creation process.

Under "9.7 Wiring diagram tab" on page 104 you will find information on connecting devices and "9.8 Ladder diagram tab" on page 105 shows the configuration's ladder diagrams.

See "9.16 Live mode" on page 118 for runtime information on the safety evaluation.

## 9.1 Abbreviations

| Abbreviation[8] | **Description** |
|---|---|
| **AVM** | Adjustable valve monitoring input node of the safety outputs |
| **AVMx** | Adjustable valve monitoring input |
| **BP** | Bypass input nodes of the bypass blocks and muting blocks |
| **BPx** | Bypass switch input |
| **BOS** | Underside of the stroke input node of the Press Control blocks (SCx only) |
| **CD** | Cancel delay input nodes of the safety outputs, delay blocks and one-shot blocks |
| **CDx** | Cancel delay input |
| **CSx** | Cycle initiation input |
| **DCD** | Daisy chain diagnosis |
| **ED** | Release input nodes of the release blocks |
| **EDx** | Activating the device input |
| **EDM** | External device Monitoring input node of the safety outputs |
| **EDMx** | External device Monitoring input |
| **ES** | Emergency stop input node of the enabling device blocks |
| **ESx** | Emergency stop input |
| **ETB** | External terminal strip (SCR P only) |
| **FID** | Identification of features |
| **FSx** | Foot switch input |
| **FR** | Fault reset input node of the safety outputs |
| **Ft switch** | Foot switch input node of the Press Control Blocks (SCx only) |

[8] The suffix 'x' indicates the automatically assigned number.

| Abbreviation[8] | **Description** |
|---|---|
| **GO** | Cycle start input node of the press control blocks (SCx only) |
| **GSx** | Gate switch input |
| **JOG** | Jog input node of the enabling device blocks |
| **IN** | Normal input node of function blocks and safety output blocks |
| **LR** | Latch reset input node of the latch reset block and the safety outputs |
| **ME** | Mute-enable input nodes of the muting blocks and two-hand control blocks |
| **MEx** | Mute activation input |
| **MP1** | First muting sensor pair input node in muting blocks and two-hand control blocks |
| **MP2** | Second muting sensor pair input node (muting blocks only) |
| **M Security** | Mutable safety input nodes of the press control blocks (SCx only) |
| **M Sensor** | Press Control Mute Sensor input node of the Press Control blocks (SCx only) |
| **Mx** | Base controller and expansion modules (in the order shown on the Equipment tab) |
| **MRx** | Manual reset input |
| **MSPx** | Muting the sensor pair input |
| **NM Security** | Non-changeable safety input node of the Press Control blocks (SCx only) |
| **ONx** | On-off input |
| **OSx** | Optical sensor input |
| **PCMSx** | Press control Mute sensor input |
| **PIP** | Component in Place input node of the Press Control blocks (SCx only) |
| **PSx** | Protective input Stop |
| **RE** | Reset enable input nodes of the latch reset blocks and the safety outputs |
| **ROx** | Relay contact |
| **RPI** | Desired package interval |
| **RPx** | Cable pull input |
| **RST** | Reset nodes of the SR flip-flop, RS flip-flop, latch reset blocks, press control blocks and enabling device blocks |
| **RUNNING** | Input nodes of the standard operating mode (RUN) of the Press Control Mode Blocks (SCx only) |
| **SET** | Set the nodes of the SR and RS flip-flop modules |
| **SMx** | Step switch input |
| **SOx** | Security output |
| **SQS** | Sequential stop input node of the Press Control blocks (SCx only) |
| **SQSx** | Press control SQS (Sequential Stop) input |
| **STATx** | Status output |
| **TC** | Two-hand control input node of the two-hand control blocks |
| **TCx** | Two-hand control input |
| **TOS** | Upper stroke input node of the Press Control blocks (SCx only) |

[8] The suffix 'x' indicates the automatically assigned number.

## 9.2 Softw are overview

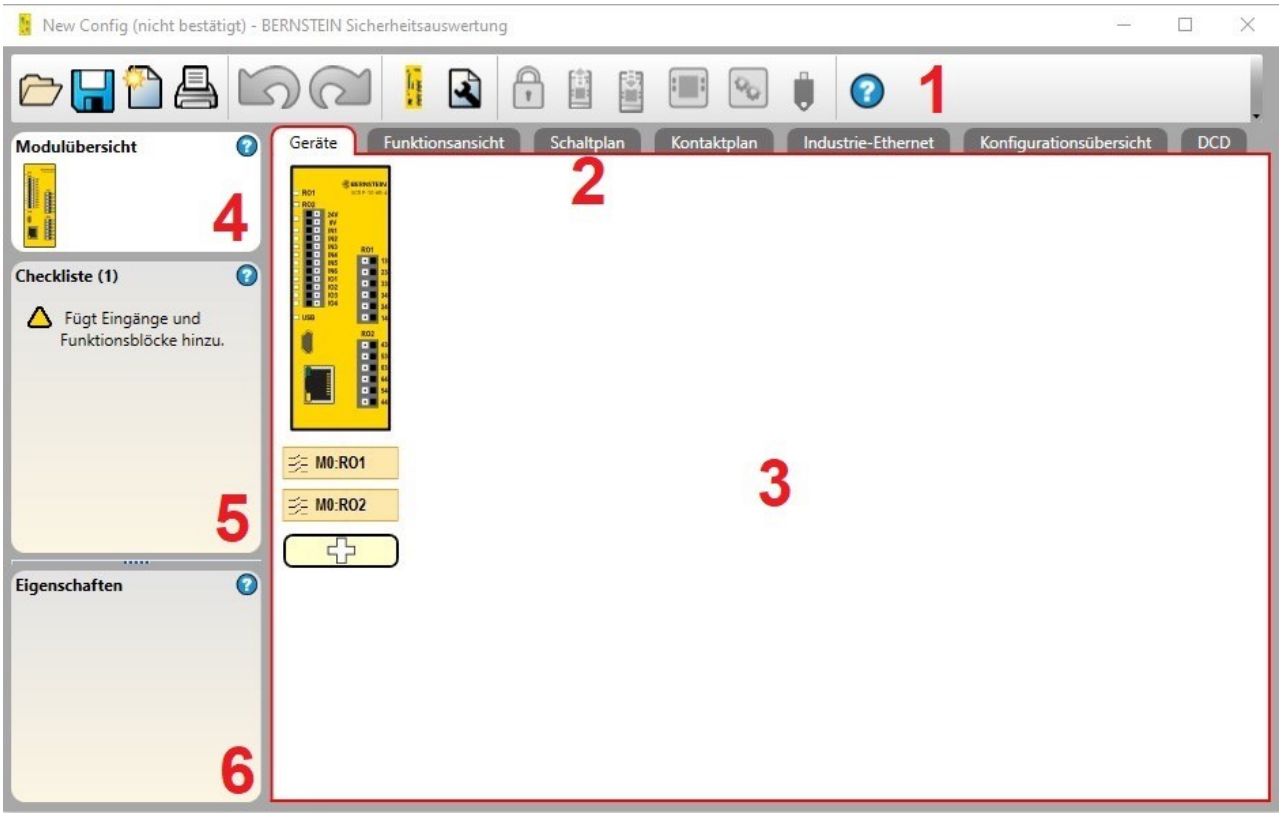



Figure 65: Software for the safety evaluation of BERNSTEIN

1. Navigation" toolbar
2. Tabs for worksheets and diagrams
3. Selected view
4. Module overview
5. Checklist
6. Properties

### (1) Navigation" toolbar

Starts a new project

Opens an existing project, opens one of the recently edited projects or opens sample projects

Saves the project under the user-defined path.

Prints a customizable

Cancels up to 10 previously executed actions.

Restores up to 10 previously undone actions

Displays the network settings and writes them to the security evaluation.

Opens the project settings

Opens the password manager

Reads data from the safety evaluation (upload), e.g. error log, configuration data, network settings and device information.

Writes data to the security evaluation (download), e.g. configuration data and settings

Starts the live mode

configuration overviewStarts the simulation mode

Status of the drive connection to the SCR P-PA or SCR P-FPS.

Opens the help options.
5. Help: Opens the help topics.
6. About: Shows the version number of the software and the warning about the user's obligations.
7. Release notes: Displays the release notes for all software versions.
8. Symbols: Switch between the symbols in US and European format.
9. Support information: Describes how you can request help from BERNSTEN.
10. Language: Selection of the language options for the software.

**(2) Tabs for worksheets and diagrams**

**Devices:** Shows an editable overview of all connected devices.

**Function view:** Shows the configured control logic.

**Wiring diagram:** Shows a connection diagram for the SCR P (e.g. for the electrician).

**Ladder diagram:** Shows a symbolic representation of the configured protection logic (e.g. for the machine designer or control technician).

**Industrial Ethernet** (if activated): Shows the current network configuration.

**Configuration overview:** Shows a detailed configuration overview of the SCR P.

**Live mode (if activated):** Shows the live mode data, including current errors. Simulation mode (if activated): Shows the simulation mode data.

**DCD:** Shows the current configuration of the DCD diagnostic series.

**(3) Selected view**

Shows the selected tab (the illustration shows the **Devices** view**).**

**(4) Module overview**

Shows the configurable safety evaluation SCR P.

**(5) Checklist**

Shows necessary actions for creating the configuration and for rectifying pending errors.

**(6) Properties**

Shows the properties of the selected device, function block or connection (the properties cannot be edited in this view; click **Edit** to make changes).

to be carried out).

**Delete:** Deletes the selected element.

**Edit:** Shows the settings for the selected device or the selected function block. See "15.1 Software: Troubleshooting" on page 238 for information on troubleshooting in connection with the software functions.

## 9.3 New project

Click **New project** to select the desired controller and **open** the **Start new project** screen. This screen contains project information that is only available when creating a project for the first time and is not **available** via the **Project settings** screen.

**SCx**

All checkboxes are activated by default. The following options are available:

**Has display**

Activate this checkbox if your control device has a display. If it is activated, a "d" after the "-2" in the model number is displayed in the software.

**Features Industrial Ethernet**

Activate this checkbox if your control unit has Industrial Ethernet. If this checkbox is activated, an "e" is displayed after the "-2" in the model number displayed in the software.

**SCR P**

**Deactivate automatic terminal optimization (SCR P only)**

Activate or deactivate automatic terminal optimization, which enables the number of inputs to be extended via an external terminal block (ETB).

**Note:** The project information listed above is included in the Project Settings (project settings) are not available, but can be edited using the Edit function of the Module Properties.

## 9.4 Project settings

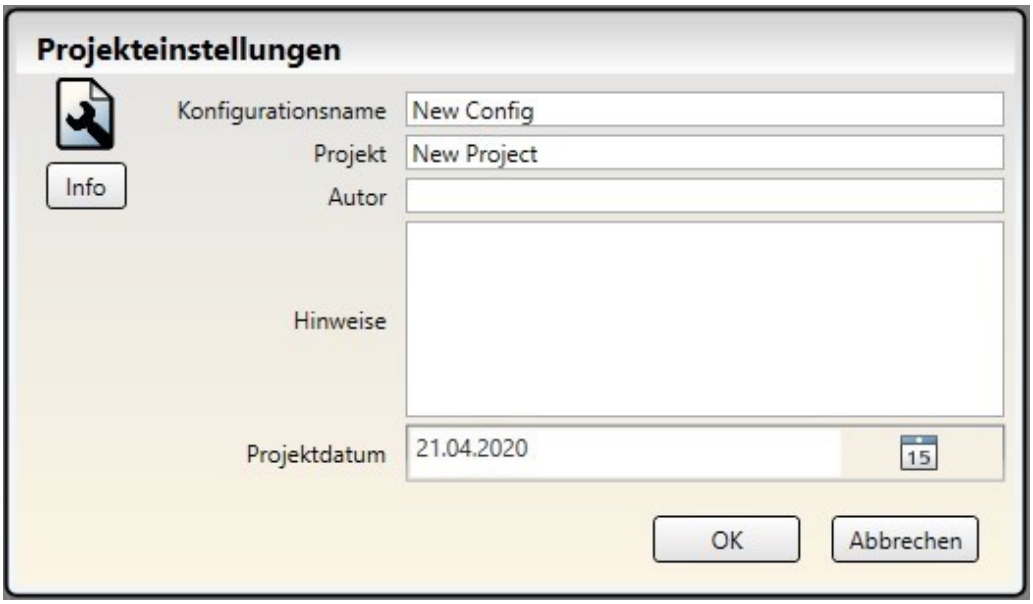



Figure 66: Project settings

Additional information can be stored for each project and each configuration so that the created configuration can be identified more easily afterwards. To enter this information, click on **Project settings**.

**Configuration name**

The name of the configuration (e.g. within a project). The configuration is different from the file name.

**Project**

The project name. This is helpful for distinguishing between different application areas.

**Author**

The person who creates the configuration.

**Notes**

Additional information on this configuration or project.

**Project date**

The date on which the project or configuration was created.

## 9.5 Devices tab

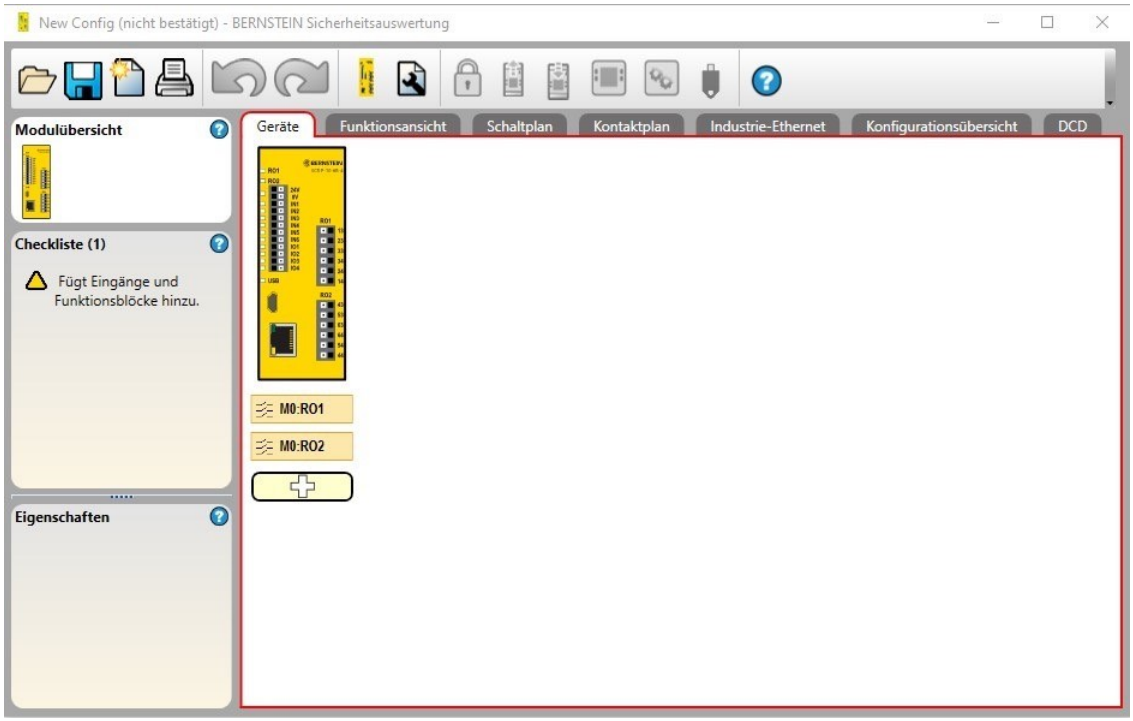



Figure 67: : Example: Devices tab

The **Devices** tab is used to add safety inputs and status outputs.

Adjust the SCR P by either double-clicking on the module or selecting it and clicking on **Edit** under the **Properties** table on the left and then selecting the appropriate features (automatic optimization of connections). The properties of safety and non-safety-related inputs, status outputs, logic blocks and function blocks are also configured by either double-clicking on the relevant block or selecting it and clicking on **Edit** under the **Properties** table. Click on the block again to deselect it.

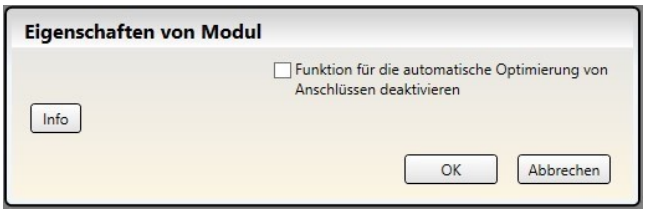



Figure 68: Properties of the SCR P module

## 9.6 Function view tab

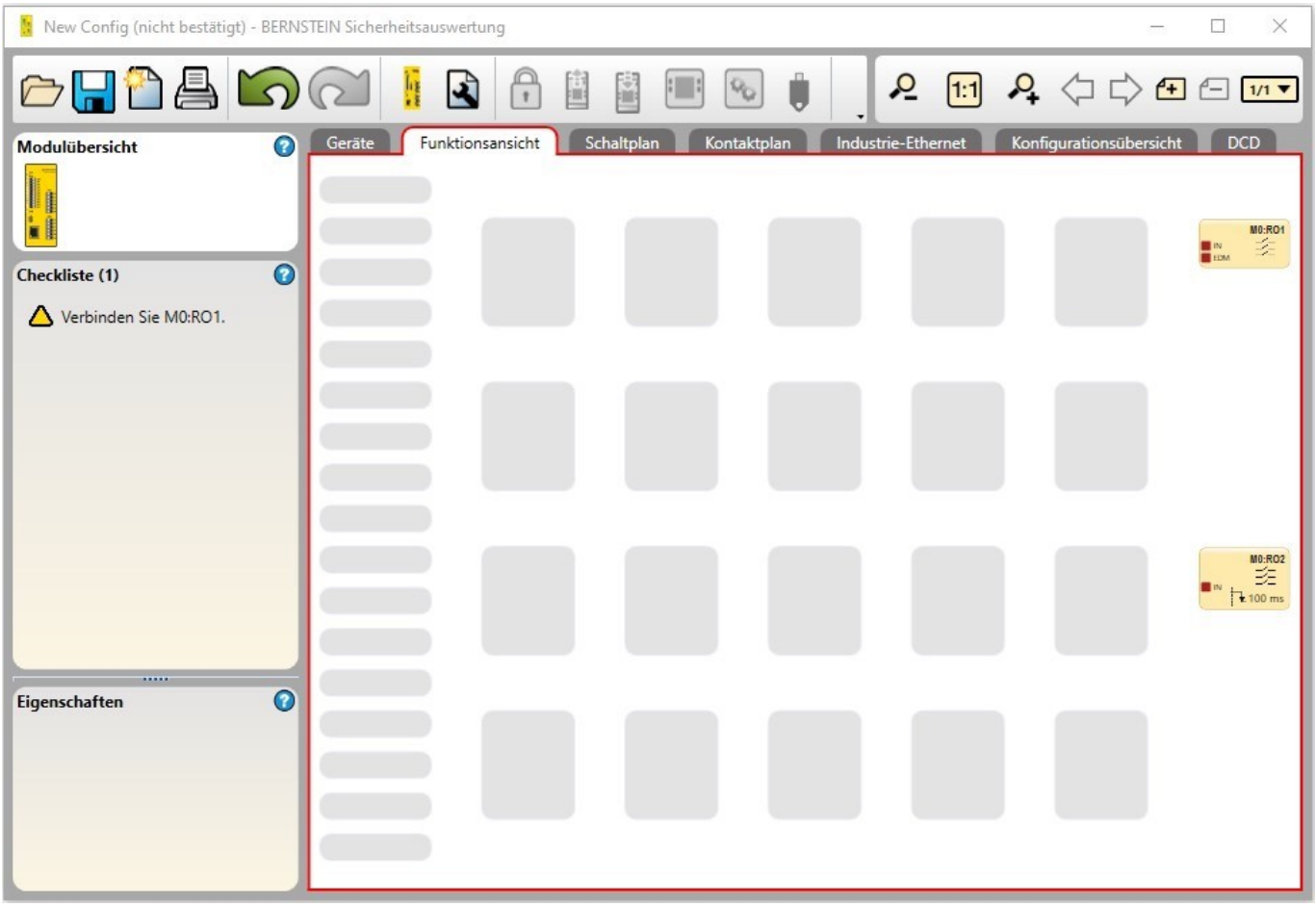



Figure 69: Function view tab

The control logic is created via the **Function view** tab. The left-hand column of the **Function view** tab is used for safety inputs and non-safety-related inputs, the middle area is used for logic and function blocks and the right-hand column is reserved for safety outputs.
Safety inputs and non-safety-related inputs can be moved from the left to the middle area and vice versa. Function and logic blocks can only be moved within the middle area. Outputs are placed statically by the program and cannot be moved. Reference blocks of any type can be placed anywhere in the left and middle areas.

☞ **Important:** The BERNSTEIN safety evaluation software is intended to help create a valid configuration. However, it is the user's responsibility to check the integrity, safety and functionality of the configuration using the "13.2 Commissioning check" on page 218.

You can carry out the following processes on the **Function view** tab:

1. Adapt the representation of the control logic by shifting the position of inputs, function blocks and logic blocks
2. Undo the last actions performed (maximum 10) and **restore**
3. Add more pages for larger configurations using the "Page navigation" toolbar (see Figure 43 on page 75)
4. Zoom in and out of the diagram view using the zoom function or automatically adjust it to the optimum aspect ratio for the current window size (see Figure 43 on page 75)


Figure 70: "Page navigation" and "Diagram size" toolbar

5. Navigate through the pages by clicking on the left and right arrows at the top right of the software in the page navigation area
6. Edit the properties of all blocks either by double-clicking on a block or by selecting a block and clicking on **Edit** under the **Properties** table
7. Delete a block or a connection by selecting the element and then either pressing the **Delete key** on the keyboard or clicking **Delete** in the **Properties** table

**Note:** The deletion of the object is not confirmed. You can confirm the deletion by clicking on **Undo** Undo.

By default, all inputs that are added on the **Devices** tab are set to the first available placeholder in the left-hand column on the **Function view** tab. There are two ways to move signals between different pages. To do this, carry out one of the following steps:

1. Add a **reference** to the block that is on another page. Click here-to on an empty placeholder in the middle area, select **Reference** and select the block that is on the next page. Only blocks from other pages can be added as a **reference**.
2. Reassign the page: On the page where you want to keep the configuration, move one of the blocks to a placeholder in the middle area. Call up the page that contains the block, which is to be moved. Select the block and change the page assignment under the table **Properties**.

### 9.6.1 Logic blocks

Logic blocks are used to create Boolean (true or false) functional relationships between inputs, outputs and other logic and function blocks. Logic blocks accept suitable safety inputs, non-safety-related inputs or safety outputs as input conditions. The status of the output reflects the result of the Boolean logic from the combination of the statuses of its inputs (**1** = On, **0** = Off, **x** = Do not observe).

**CAUTION: Inverted logic**

It is not recommended to use inverted logic configurations in safety applications where a hazardous situation may occur.

The signal states can be inverted by using the logic blocks NOT, NAND and NOR, or by checking the checkboxes for "Invert output" or "Invert input source" (if available). With a logic block input, the inverted logic treats an off state (0 or off) as "1" (true or on) and causes an output to switch on. It is assumed that all inputs have been activated. Similarly, the inverted logic also leads to the reverse function of an output when the block becomes "true" (the output switches from On to Off). As certain fault conditions would lead to the loss of the signal, e.g. interrupted cable lines, earth fault or short circuit to 0 V, interruption of the power supply to the protective device, etc.,
inverted logic is not normally used in safety applications. A hazardous situation can occur if a stop signal is interrupted at a safety input. This can cause a safety output to switch on.

**AND**

(EU)

(US)

The output value is based on the logical AND relationship between 2 to 5 inputs.

The output is switched on when all inputs are switched on.

| Input 1 | Input 2 | Output |
|---|---|---|
| 0 | x | 0 |
| x | 0 | 0 |
| 1 | 1 | 1 |

**OR**

(EU)

(US)

The output value is based on the logical OR relationship between 2 to 5 inputs.

The output is switched on if at least one input is switched on.

| Input 1 | Input 2 | Output |
|---|---|---|
| 0 | 0 | 0 |
| 1 | x | 1 |
| x | 1 | 1 |

**NAND**

(EU)


(US)

The output value is based on the logical AND relationship between 2 to 5 inputs.

The output is switched on when all inputs are switched on

| Input 1 | Input 2 | Output |
|---|---|---|
| 0 | x | 1 |
| x | 0 | 1 |
| 1 | 1 | 0 |

**NOR**

(EU)


(US)

The output value is based on the logical OR relationship between 2 to 5 inputs.

The output is switched on when all inputs are switched on

| Input 1 | Input 2 | Output |
|---|---|---|
| 0 | 0 | 1 |
| 1 | x | 0 |
| x | 1 | 0 |

**XOR**

(EU)


(US)

The output value is based on the logical OR relationship between 2 to 5 inputs.

The output is switched on if only one input (only) is switched on.

| Input 1 | Input 2 | Output |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 1 | 0 |

**NOT**

(EU)


(US)

The exit is in the opposite state to the entrance.

| Entrance | Output |
|---|---|
| 0 | 1 |
| 1 | 0 |

**RS flip-flop**


This block is reset-dominant (reset has priority if both inputs are switched on).

| Input 1 (set) | Input 2 (Reset) | Output |
|---|---|---|
| 0 | 0 | Value remains the same |
| 0 | 1 | 0 (Reset) |
| 1 | 0 | 1 (set) |
| 1 | 1 | 0 (Reset has priority) |

**SR Flip-flop**


This block is set-dominant (set has priority if both inputs are switched on).

| Input 1 (set) | Input 2 (Reset) | Output |
|---|---|---|
| 0 | 0 | Value remains the same |
| 0 | 1 | 0 (Reset) |
| 1 | 0 | 1 (set) |
| 1 | 1 | 0 (Reset has priority) |

### 9.6.2 F unction blocks

Function blocks provide integrated functions for most common applications in one block. Although it is possible to design a configuration without function blocks, the use of function blocks offers significant efficiency, ease of use and improved functionality

Most function blocks expect the corresponding safety input device to be connected to them. The checklist on the left generates a notification if the required connections are missing. Depending on the application, some function blocks may be connected to other function blocks and/or logic blocks.

Dual-channel safety input devices have two separate signal lines. On some devices, both dual-channel signals are positive (+24 V DC) when the device is in the run state. Other devices may have a complementary circuit structure where one channel is at 24 V DC and the other at 0 V DC when the device is in the Run state. In this manual, the convention run state/stop state is used instead of referring to a safety input device as ON (24 V DC) or OFF (0 V DC).

## 9.7 Circuit diagram tab

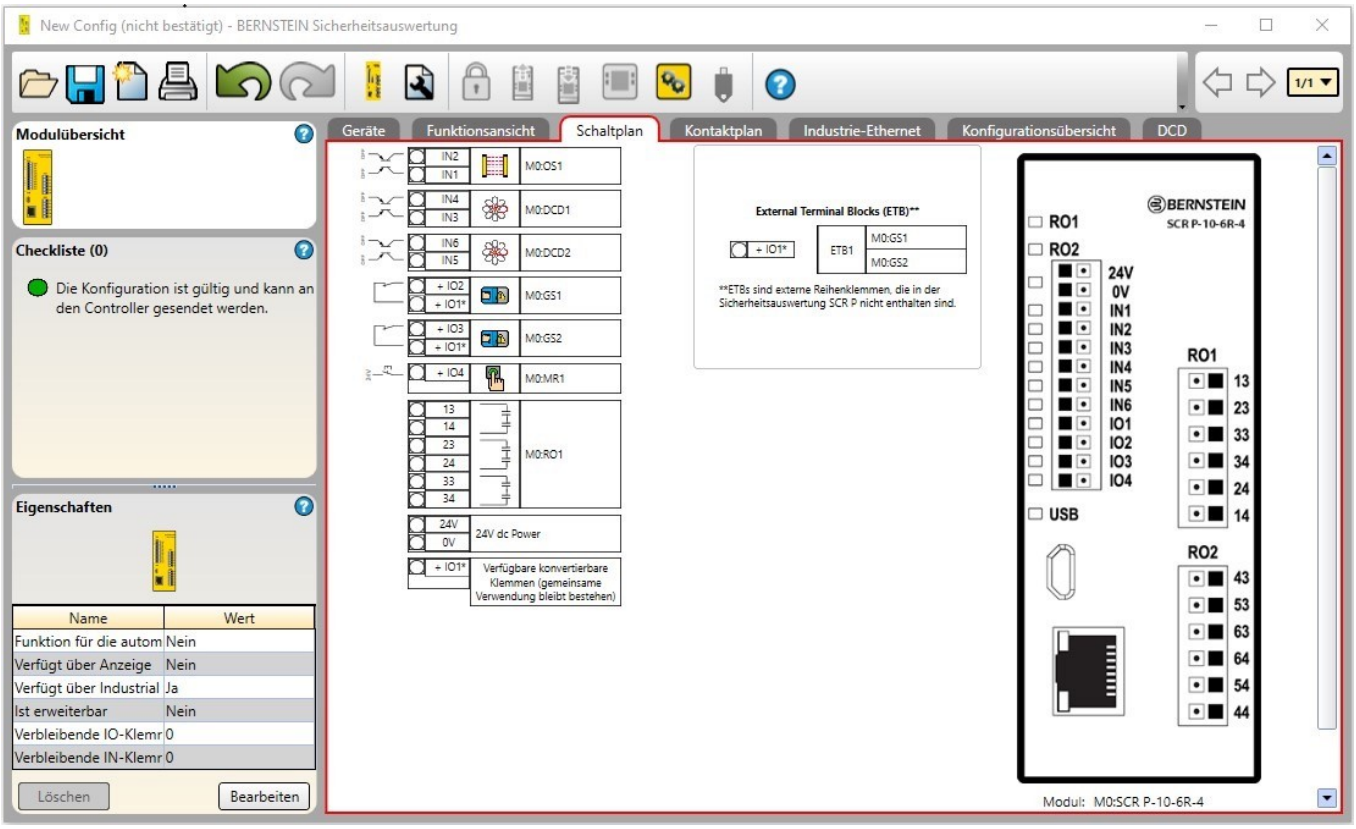



Figure 71: Circuit diagram tab: SCR P with external terminal blocks

The **Wiring diagram** tab shows the pin assignments and the electrical circuits for the safety and non-safety-related inputs, safety outputs and status outputs as well as any unassigned connections that are available for the selected module. Use the circuit diagram as a guide for the physical connection of the devices. Navigate between the modules using the "Page navigation" toolbar at the top right of the software.

## 9.8 Ladder Diagram tab

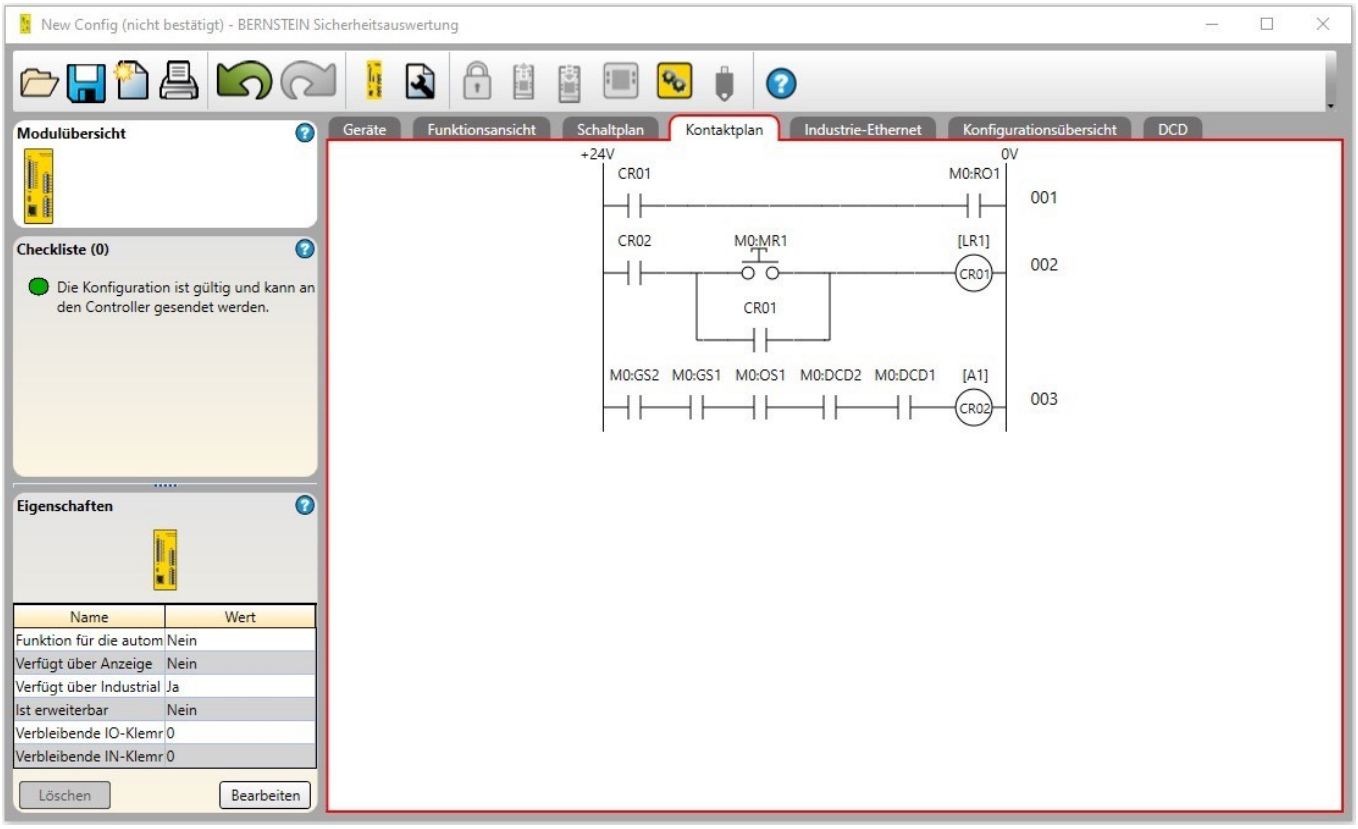



Figure 72: Ladder diagram tab

The **ladder diagram** view shows a simplified illustration of the relay logic of the configuration

## 9.9 DCD tab

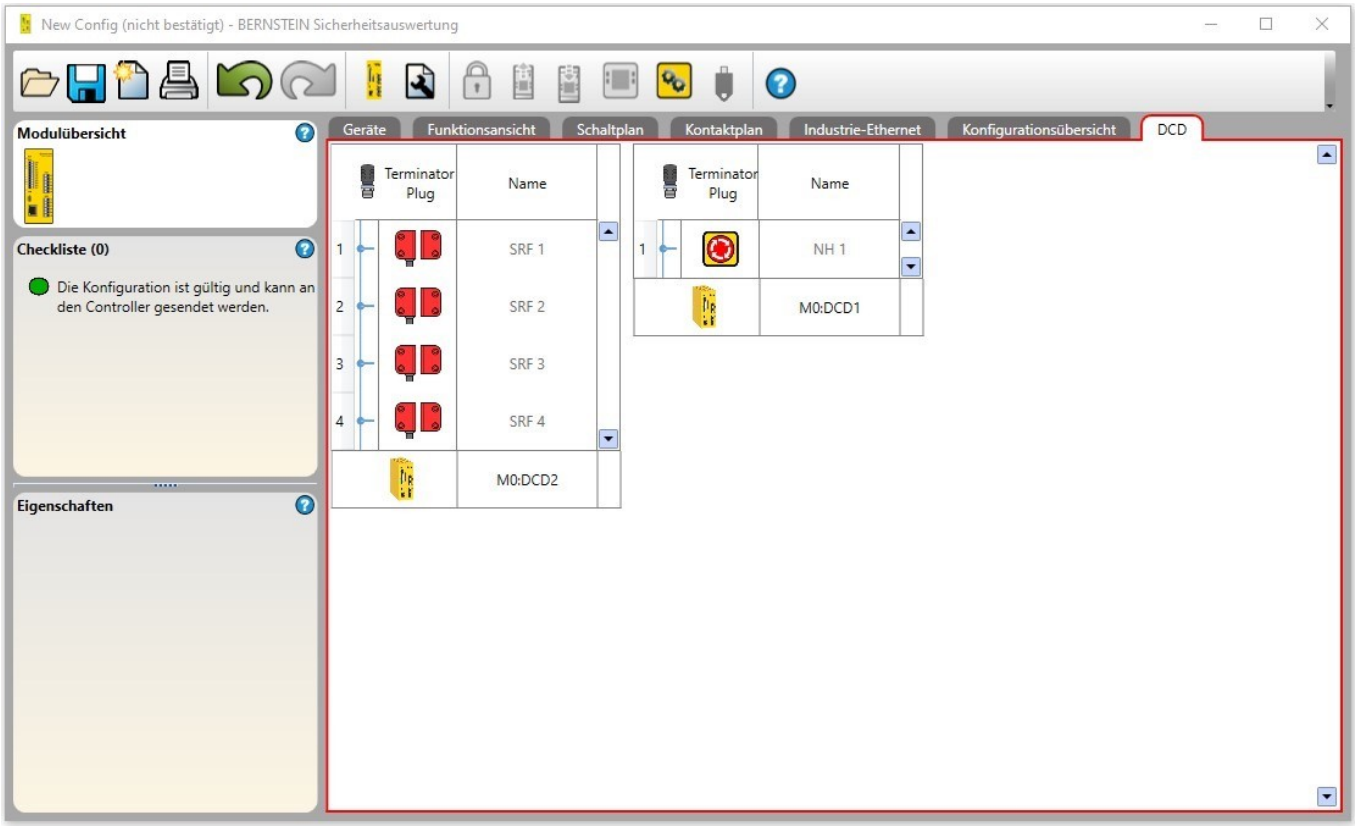



Figure 73: DCD tab

The DCD tab shows the arrangement and names of the connected DCD devices in each DCD series.

In "Live" mode, the DCD register shows current information about the connected device (updated approx. every second). In the following example, a door sensor is not actuated, as shown by the red color in the "Status" column. In addition, the corresponding actuator is shown in white in the "Actuator" column.

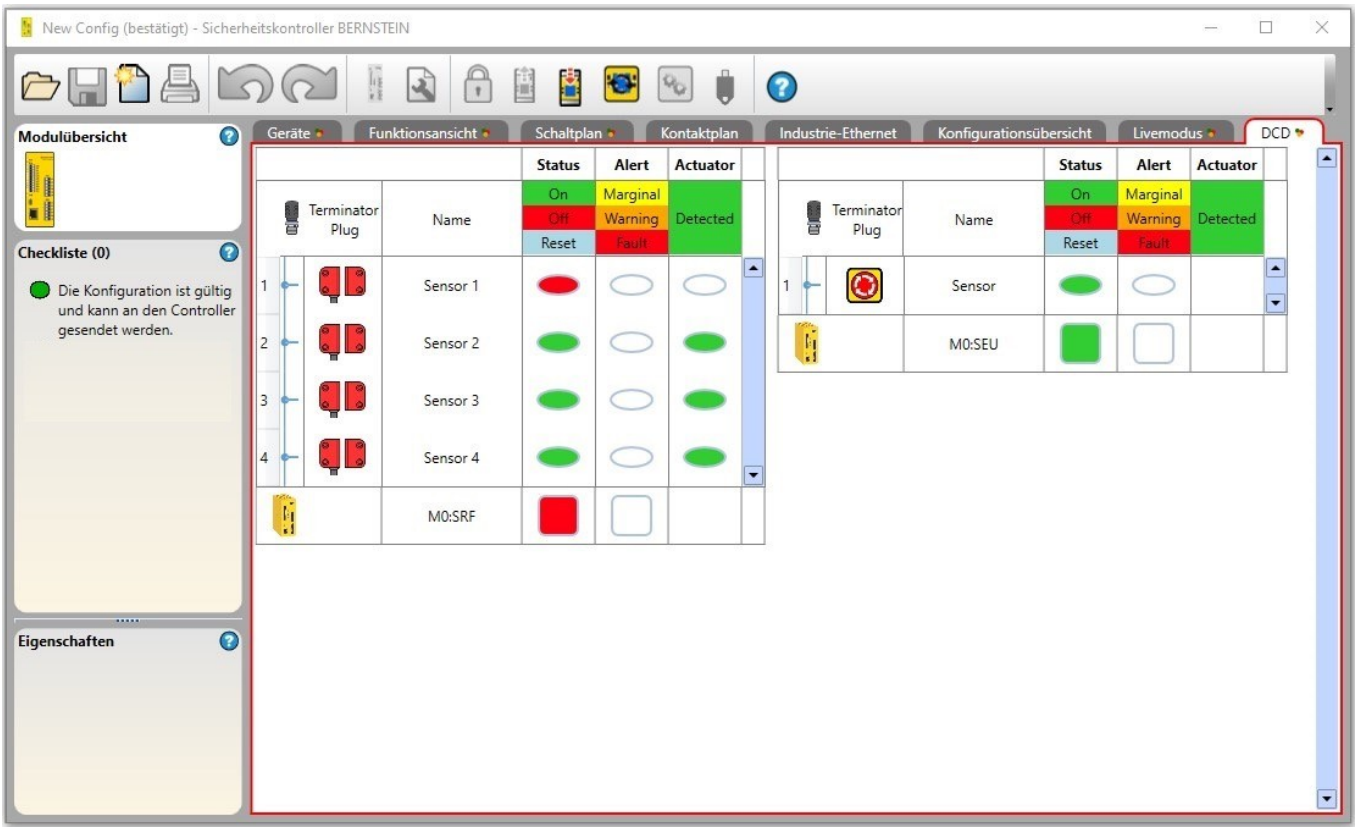



Figure 74: DCD tab in "Live" mode with non-actuated sensor

In "Live" mode, clicking on a DCD device displays its diagnostic data. This includes input and output data and whether the associated actuator has been detected, if applicable.

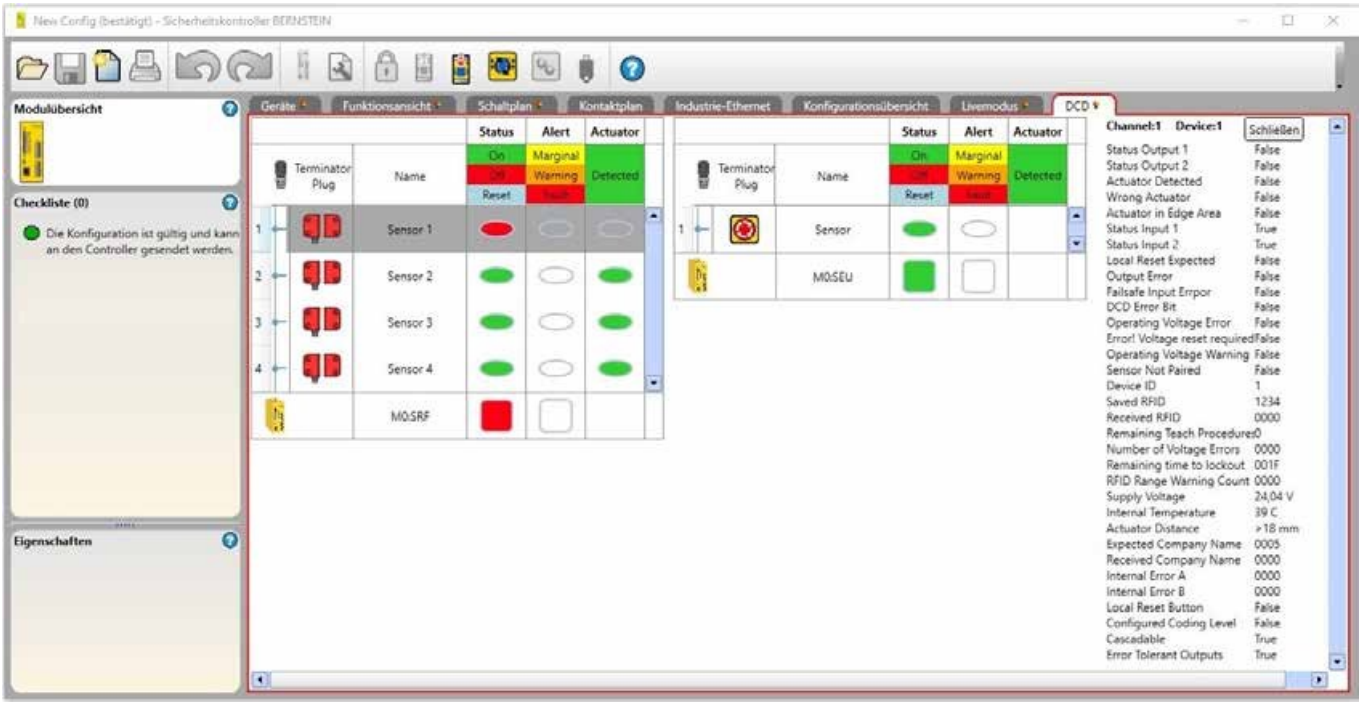



Figure 75: DCD tab in "Live" mode with diagnostic data

## 9.10 Industrial Ethernet tab

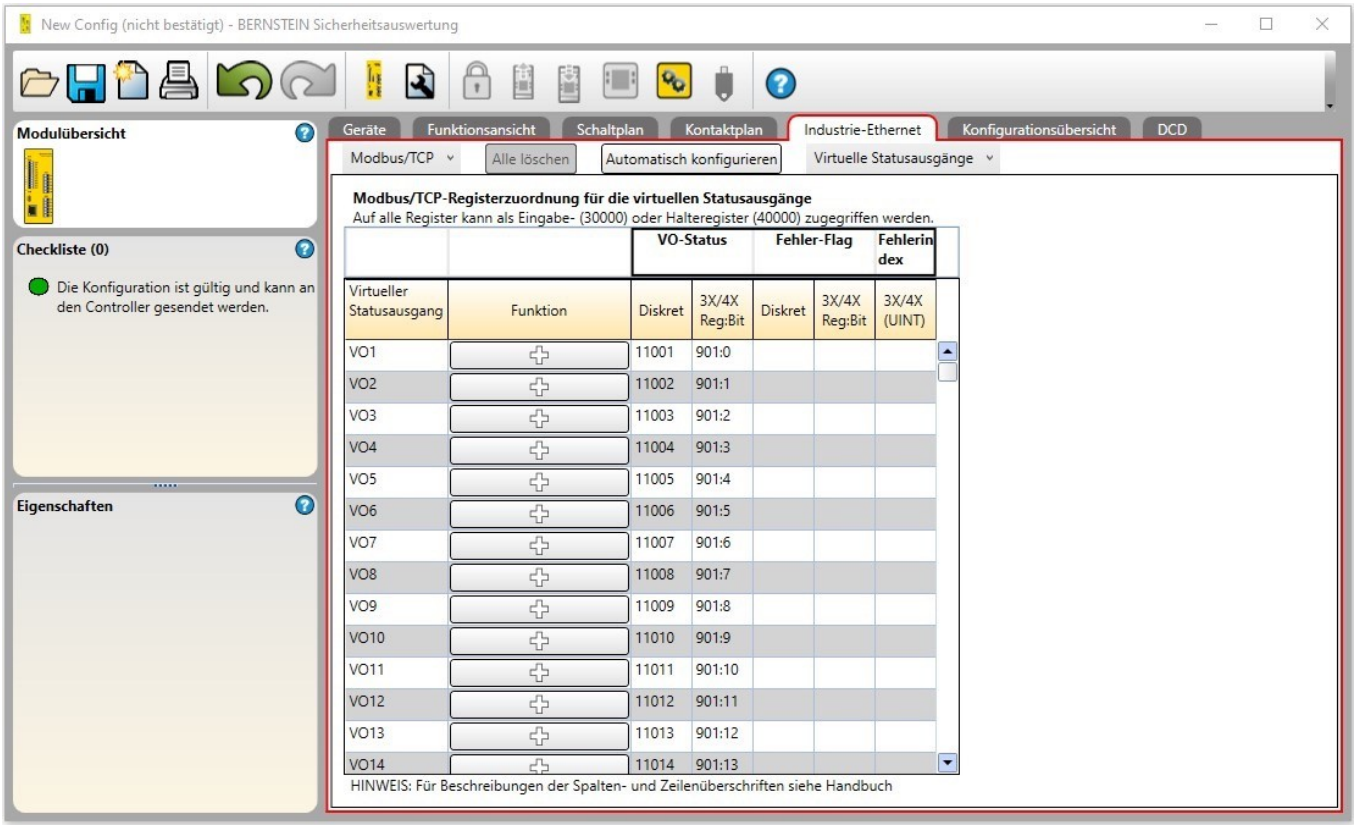



Figure 76: Industrial Ethernet tab

The virtual status outputs can be configured via the network on the Industrial Ethernet tab in the software. This view contains the same functions as the **Status outputs** option (added in the **Devices** view) (see "7.9.1 Signal logic for status outputs" on page 73 and "7.9.2 Status output function" on page 74
for detailed information). The following Industrial Ethernet protocols can be selected and used: PROFINET, Modbus/TCP, Ethernet/IP input groups, Ethernet/IP explicit messages and PCCC protocols. Up to 256 virtual status outputs can be added.

Access the **Industrial Ethernet** tab:

1. Click on **Network settings**.
2. Select **Activate network interface**.
3. Adjust the settings if necessary (see "9.10.1.1 Network settings: Modbus/TCP, Ethernet/IP, PCCC" on page 109 or"9.10.1.2 Network settings:PROFINET" on page 110).
4. Click on **OK**.

Use the **Configure automatically** function on the **Industrial Ethernet** tab in the software to automatically configure the virtual status outputs for a combination of frequently used functions based on the current configuration. In the **Function** column next to one of the **VOx cells**, click to add a virtual status output manually. Functions of all virtual status outputs can be changed by clicking on the button containing the name of the function of the virtual status output or by clicking on
**Edit** under the **Properties** table if "VOx" is selected.

### 9.10.1 Network settings

#### 9.10.1.1 Network no positions: Modbus/TCP, Ethernet/IP, PCCC

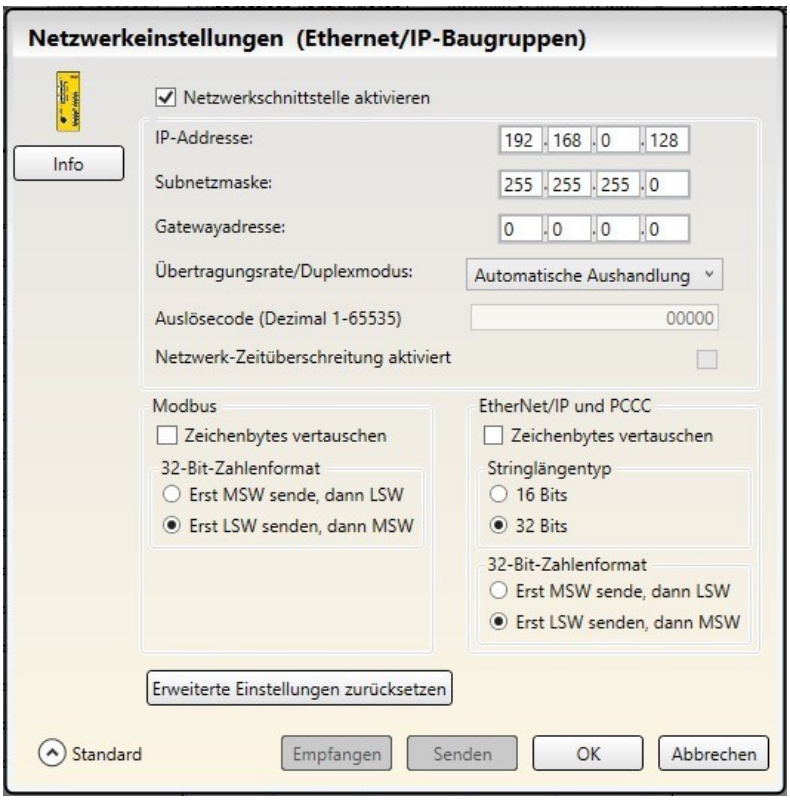



Figure 77: Network settings

Click on **Network settings** in the software to open the **Network settings** window. In the case of a Modbus/TCP connection, port 502 is used as the default TCP port in accordance with the specification. This value is not displayed in the **Network settings** window.

| Name of the setting | Factory preset value |
|---|---|
| **IP address** | 192.168.0.128 |
| **Subnet mask** | 255.255.255.0 |
| **Gateway address** | 0.0.0.0 |
| **Transmission rate/duplex mode** | Automatic negotiation |

The **Advanced** option allows you to further configure the Modbus/TCP and Ethernet/IP settings, such as "Swap character bytes", "MSW and LSW send precession" and "String length type" (Ethernet/IP and PCCC). Click on **Send** to write the network settings to the security evaluation. The network settings are sent separately from the configuration settings. Click on **Network timeout enabled** to deactivate configured virtual on/off switches or virtual muting activations in the event of a network timeout. The network timeout has been set to 5 seconds.

**Note:** Use the **password manager** to activate or deactivate the authorization to change the network setting for user2 and user3.

#### 9.10.1.2 N echnology settings: PROFINET

After selecting the PROFINET protocol in the software on the **Industrial Ethernet** tab, c l i c k o n **Network settings** to open the Network settings window


Figure 78: Network settings - PROFINET

Click on **Send** to write the network settings to the security evaluation. The network settings are sent separately from the configuration settings.
Click on **Network timeout enabled** to deactivate all configured virtual switch-on/switch-off or virtual muting activations in the event of a network timeout. The network timeout has been set to 5 seconds.

**Note:** Use the **password manager** to activate or deactivate the authorization to change the network setting for user2 and user3.

### 9.10.2 Creation of a file with PLC tags/labels

Use the BERNSTEIN safety evaluation software to generate a .csv or .xml file with the names of all virtual status outputs and inputs.
If you want to use the names created in the safety evaluation software as PLC tags/labels, import the .csv or .xml file into the PLC software used in the Ethernet/IP modules or PROFINET area.
First create all status outputs and inputs that you want to use in the safety evaluation software. If necessary, assign a trigger code under **Network settings**. Then make sure that the desired protocol is selected (either Ethernet/IP modules or PROFINET).

#### Create CSV file for Ethernet/IP modules

Two elements must be known:

- The name that is assigned to the safety evaluation in the PLC. This is required to generate the file that is to be imported into the PLC software of the Ethernet/IP module.
- Which input and output module instances are to be requested.

1. Ensure that on the **Industrial Ethernet** tab in the **Ethernet/IP modules** selection list is selected.
2. Click on **Export**.
   The **Export as CSV** window opens


Figure 79: Export as CSV

3. In the **Name of evaluation** field, enter the name that is assigned to the safety evaluation in the PLC software.
4. **Select** the desired instance from the **Select instance** list.
   The selection of the instance depends on which instances are requested.

| Instance name | Output module | Input module |
|---|---|---|
| **Status/error** | 112 | 100 |
| **Error index words** | 112 | 101 |
| **Reset/cancel delay** | 112 | 103 |
| **VI status/error** | 113 | 100 |
| **VI error index words** | 113 | 101 |
| **VI reset/abort delay** | 113 | 103 |
| **VRCD Plus DCD** | 114 | 104 |

When using virtual inputs (VI), 113 or 114 must be defined for the output module of the PLC. This is necessary so that the PLC can send the virtual input words to the safety evaluation unit.
If information is required at the DCD inputs, an output module defined with 114 must be used so that the virtual inputs (if used) and the additional words for requesting the DCD information can be sent (VRCD stands for virtual reset / cancel delay).

5. Click on **Export**.
6. Save the .csv file in the desired location.

The .csv file can be imported directly into the PLC software of the Ethernet/IP module. However, it can also be opened with any software that can read .csv files (e.g. Microsoft Excel).

### Create XML file for PROFINET

Three elements must be known:

- The name that is assigned to the safety evaluation in the PLC. This is required to generate the file that is to be imported into the PROFINET PLC software.
- Address path to PLC slot 1
- Address path to PLC slot 13
- Address path to PLC slot 20
- Address path to PLC slot 21

1. Make sure that **Profinet** is selected in the selection list on the **Industrial Ethernet** tab.
2. Click on **Export.** The **Export as XML** window opens.


Figure 80: Export as XML

3. In the **Name of evaluation** field, enter the name that is assigned to the safety evaluation in the PLC software.
4. In the **Address path to PLC slot 1** field, enter the start of the address path to slot 1 (status outputs).
5. In the **Address path to PLC slot 13** field, enter the start of the address path to slot 13 (virtual inputs).
6. In the **Address path to PLC slot 20** field, enter the start of the address path to slot 20 (DCD status information module).

7. In the **Address path to PLC slot** 21 field, enter the start of the address path to slot 21 (module for information on individual DCD devices).
8. Click on **Export**.
9. Save the .xml file in the desired location.

The .csv file can be imported directly into the PROFINET PLC software. However, it can also be opened with any software that can read .csv files (e.g. Microsoft Excel).

### 9.10.3 Ethernet/IP group objects

**Note:** The EDS file is available for download at the following link: www.bernstein.eu.

#### Input group objects (T->O)

| Instance ID | Data length (16-bit words) | Description |
|---|---|---|
| **100 (0x64)** | 8 | Used to access the basic information via the virtual status outputs 1-64. |
| **101 (0x65)** | 104 | Used to access the extended information (except basic information) via the virtual status outputs. |
| **102 (0x66)** | 150 | Used to access the error log information and does not contain any information on the virtual status outputs. |
| **103 (0x67)** | 35 | Used to access general information about virtual status outputs 1-256 and feedback information about virtual reset and virtual inputs for canceling a time delay. |
| **104 (0x68)** | 111 | Used to access general information about virtual status outputs 1-256 and feedback information about virtual reset and virtual inputs to cancel a time delay and to support communication with DCD devices. |

#### Output group object (O->T)

| Instance ID | Data length (16-bit words) | Description |
|---|---|---|
| 112 (0x70) | 2 | Reserved |
| 113 (0x71) | 11 | Used to control virtual inputs (on/off, muting activation, reset, canceling a time delay). |
| 114 (0x72) | 16 | Used to control virtual inputs (on/off, muting activation, reset, canceling a time delay) and to support communication with DCD devices. |

#### Configuration group object

The configuration group object is not implemented. However, some Ethernet/IP clients require such an object. In this case, instance ID 128 (0×80) with a data length of 0 is used.
Specify INT as the data type of the communication format.
Set the required packet interval (RPI) to at least 150.

## 9.11 Configuration overview tab

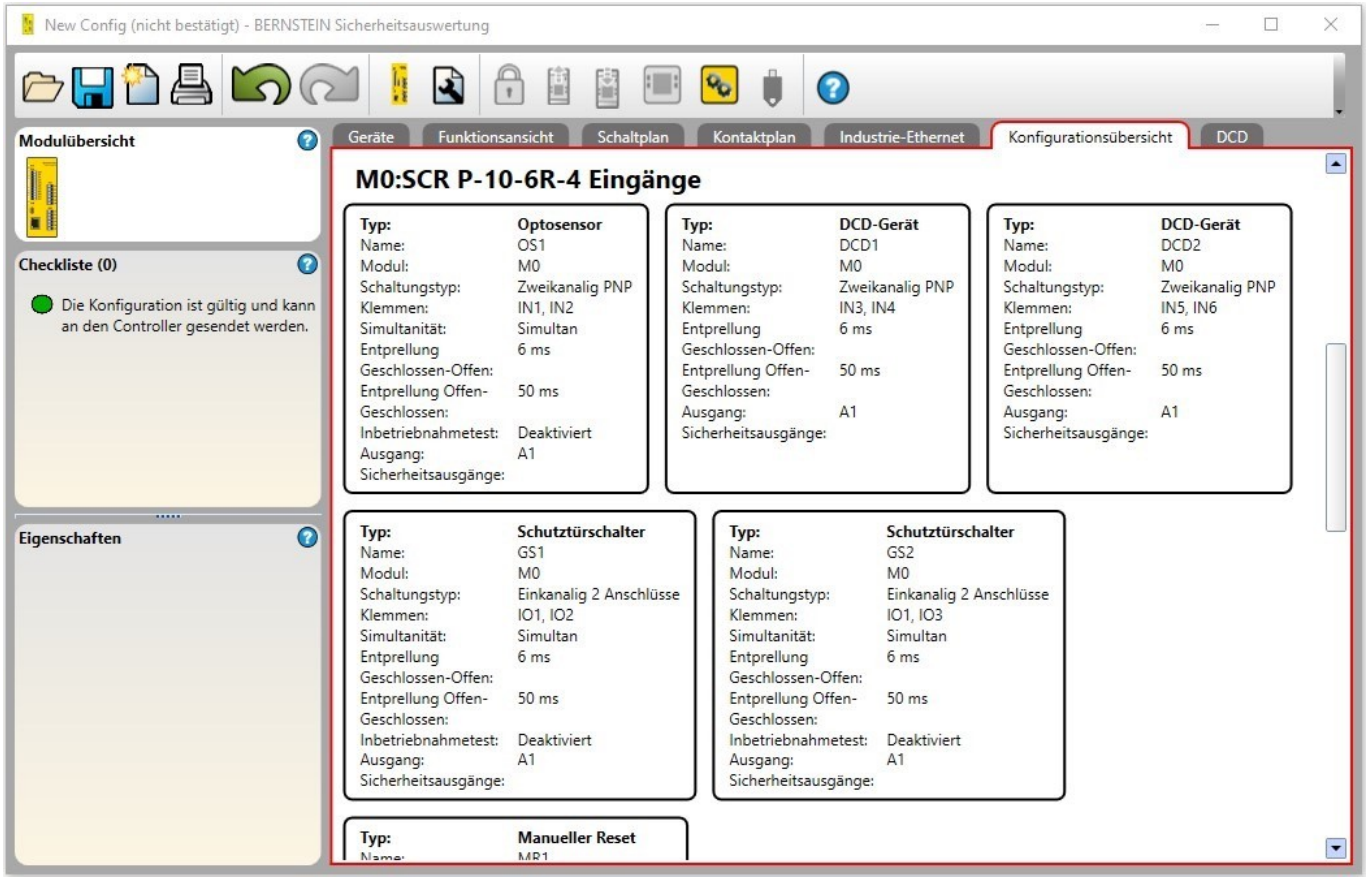



Figure 81: Configuration overview tab

Detailed information about all configured inputs, function and logic blocks, safety outputs, status outputs and the associated response times are displayed in text format on the **Configuration overview** tab.

## 9.12 Print options

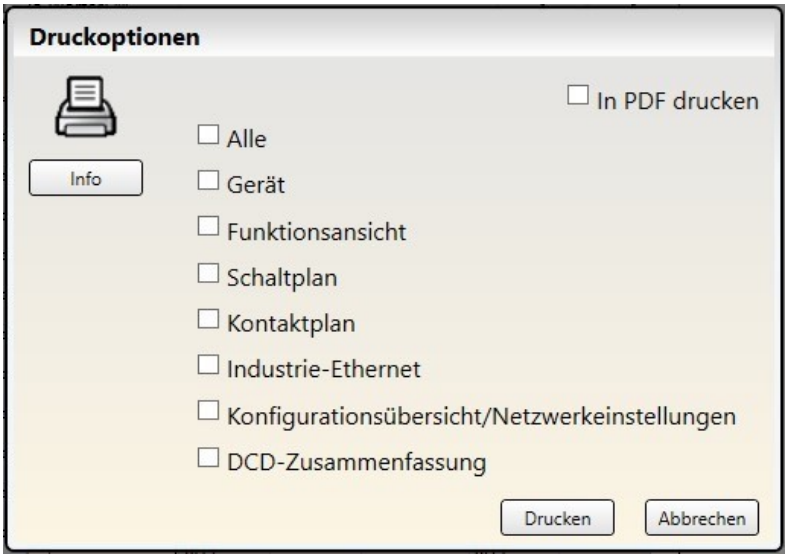



Figure 82: Print options

The software offers several options for printing the configuration. In the toolbar, click on **Print** to call up the **Print options** window.

The following print options are available:

- **All:** Prints all views, including the **network settings.**
- **Devices:** Prints the **Devices** tab**.**
- **Function view:** Prints the **Function view** tab**.**
- **Circuit diagram:** Prints the **Circuit diagram** tab.
- **Ladder diagram:** Prints the **Ladder Diagram** tab**.**
- **Industrial Ethernet**: Prints the **Industrial Ethernet** tab**.**
- **Configuration overview/network settings:** Prints the **configuration overview** and the **Network settings** (if applicable).
- **DCD summary:** Prints the DCD tab. Print options:
- **Print to PDF:** Prints the selection in a PDF file that is saved in a user-defined location.
- **Print:** Opens the Windows standard dialog for printing and sends the selection to the user-defined printer.

### 9.13 SCx P assword manager

**Password Manager** is available when a safety controller is connected to the PC via a USB port. The information displayed in the **password manager** comes from the security evaluation.


Figure 83: Password manager

Click on **Password Manager** in the software toolbar to edit the access rights for the configuration. The security control stores up to three user passwords to manage different levels of access to the configuration settings. The password for User1 provides full read/write access and the ability to set access levels for User2 and User3 (user names cannot be changed). Basic information, such as network settings, wiring diagrams and diagnostic information, can also be accessed without a password. A configuration saved on a PC or SCR P-FPS drive is not password-protected.

User2 or User3 can write the configuration to the security control if **the change to the configuration** is permitted. You can change the network settings if the Allowed **to change network settings** option **is activated**. For software version 4.1 or earlier, the Show configuration option is available for User2 and User3 and can be activated if **Require password to display configuration** for User1 is activated. The respective passwords are required.

Click on **Save** to save the password information for the current configuration in the software and write it to the security controller.

**Note:** The factory default passwords for User1, User2 and User3 are 1901, 1902 and 1903 respectively. It is strongly recommended to change the factory default passwords.

Only user1 can reset the SCx to the factory settings.

### 9.14 SCR P Password manager

**Password Manager** is available when a security evaluation unit is connected to the PC via a USB port. The information displayed in the **password manager** comes from the security evaluation.


Figure 84: Password manager

Click on **Password Manager** in the software toolbar to edit the access rights for the configuration. The security evaluation saves up to three user passwords to manage different levels of access to the configuration settings. The password for user1 enables unrestricted read and write access and the option to set access levels for user2 and user3 (user names cannot be changed). The configuration, network settings, circuit diagrams and diagnostic information can be accessed without a password. Configurations saved on a PC or SCR P-FPS drive are not password protected.

User2 or User3 can write the configuration to the security evaluation if **authorization to change the configuration** is activated. These users can change the network settings if **authorization to change the network settings** is activated. The respective passwords must be entered.
Click on **Save** to save the password information for the current configuration in the software and write it to the security evaluation.

**Note:** The factory default passwords for User1, User2 and User3 are 1901, 1902 and 1903 respectively. It is strongly recommended to change the factory default passwords.

Only user1 can reset the SCR P to the factory settings.

### 9.15 Displaying and importing data

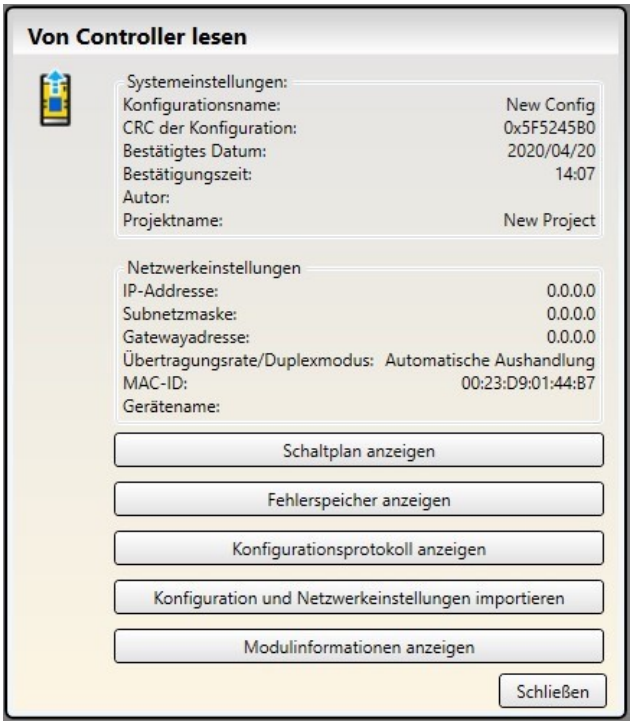
Current data (e.g. model number and firmware version, configuration and network settings as well as circuit diagram) can be displayed or copied using the BERNSTEIN AG safety evaluation software.

**Read from evaluation** is available if a safety evaluation unit is connected to the PC via USB.

**Display a snapshot of the system and network settings**

In the software toolbar, click on **Read from the evaluation**. The current settings for the safety evaluation are displayed:

- Configuration name
- CRC of the configuration
- Date of confirmation
- Time of confirmation
- Author
- Project name
- IP address
- Subnet mask
- Gateway address
- Transfer rate/duplex mode
- MAC ID




Display a snapshot of the system and network settings

**Displaying and importing data**

Click on **Read from the evaluation** to display the following information:

- **Circuit diagram:** Removes all other tabs and worksheets from the software and only shows the views **Circuit diagram** and **devices**.
- **Error log:** The history of the last 10 errors.

**Note:** The numbering of the error logs increases to a maximum of 4,294,967,295, provided that the safety evaluation unit is not switched off and on again. After switching the safety evaluation unit off and on again, the numbering of the error logs starts again at 1. Deleting the error log (via the safety evaluation unit software) removes the log history; however, the numbering is retained.

- **Configuration log:** history of up to 10 recently used configurations (only the current configuration can be displayed or imported)
- **Module information**

Click on **Import configuration and network settings** to call up the current configuration and the current network settings of the security evaluation.

## 9.16 Liv emodus

**Live mode** is available if a safety evaluation unit is connected to the PC via USB.

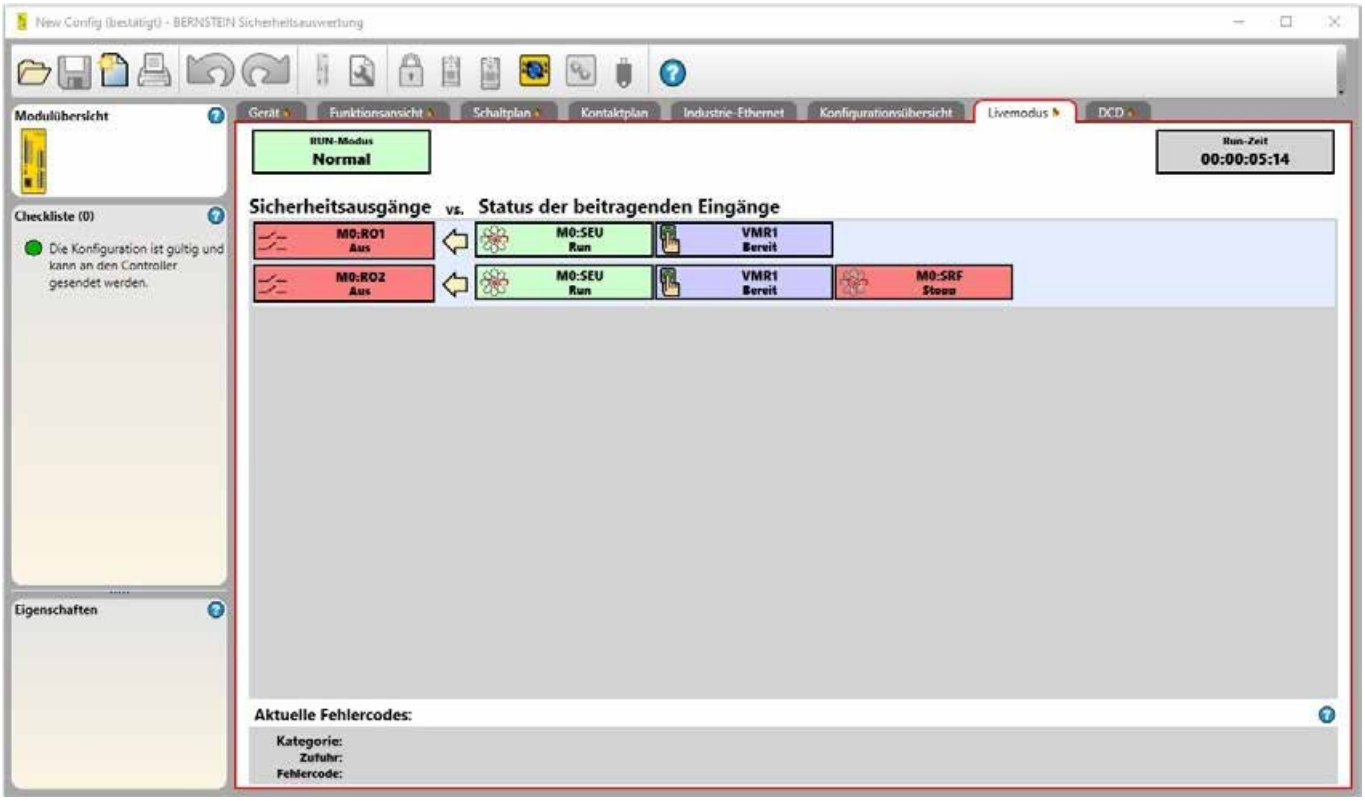



Figure 85: Runtime - Live mode tab

The **Live mode** tab can be accessed after clicking on **Live mode** in the toolbar. When **live mode** is activated, changes to the configuration on all tabs are deactivated. The **Live mode** tab contains additional information on devices and errors, including an error code (see "15.6 SCR P error code table" on page 249 for the description and possible remedies). The runtime data is also updated in the **function view,** in the **devices** and **circuit diagram** views, which provide a visual representation of the respective device status.

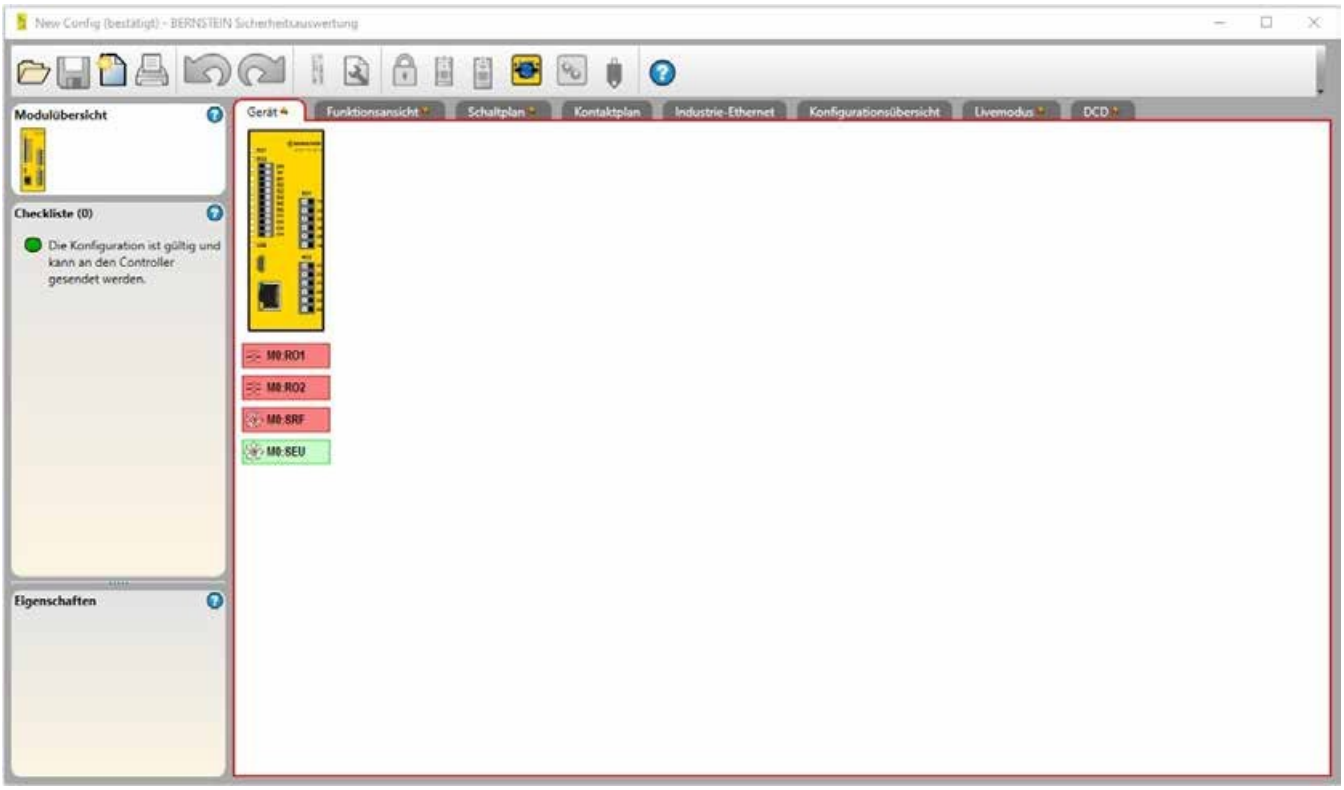



Figure 86: Devices tab

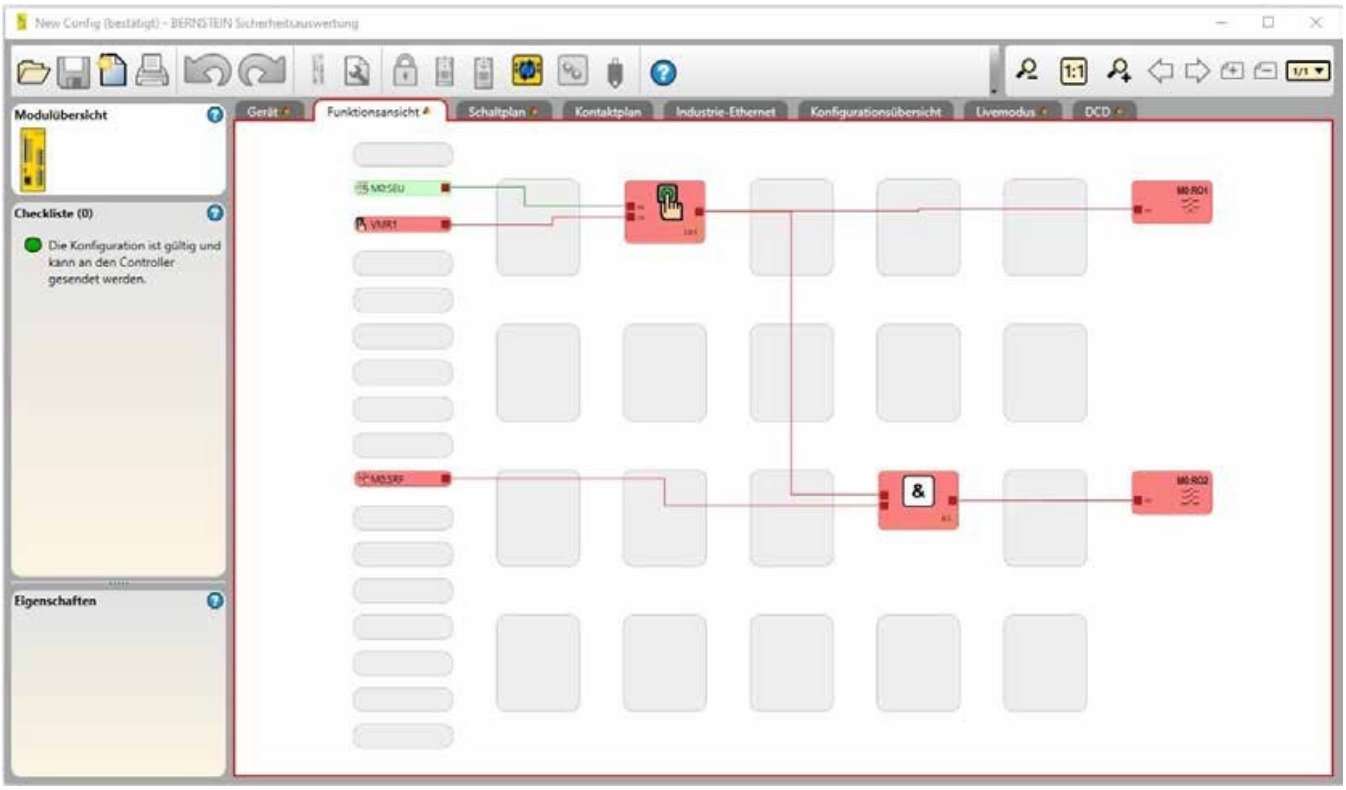



Figure 87: Runtime - Function view tab

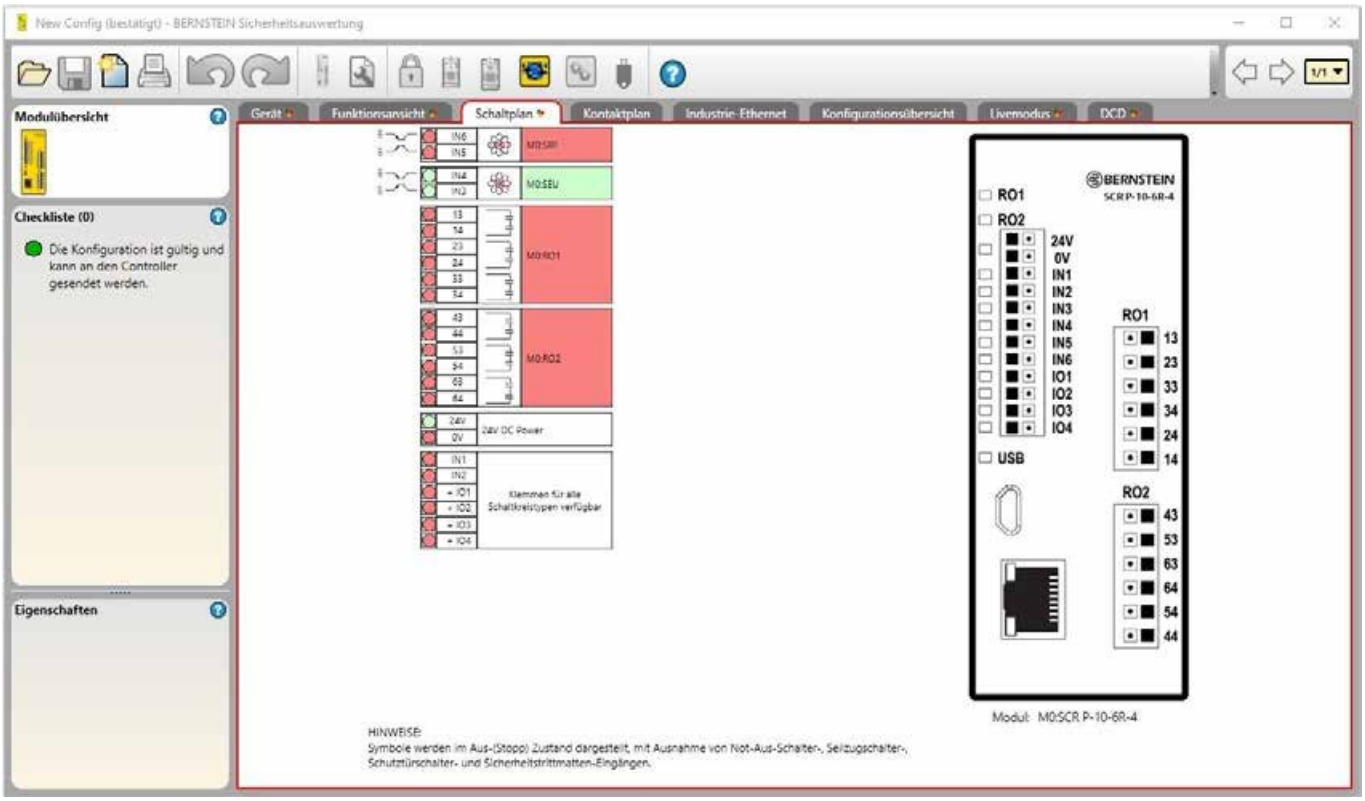
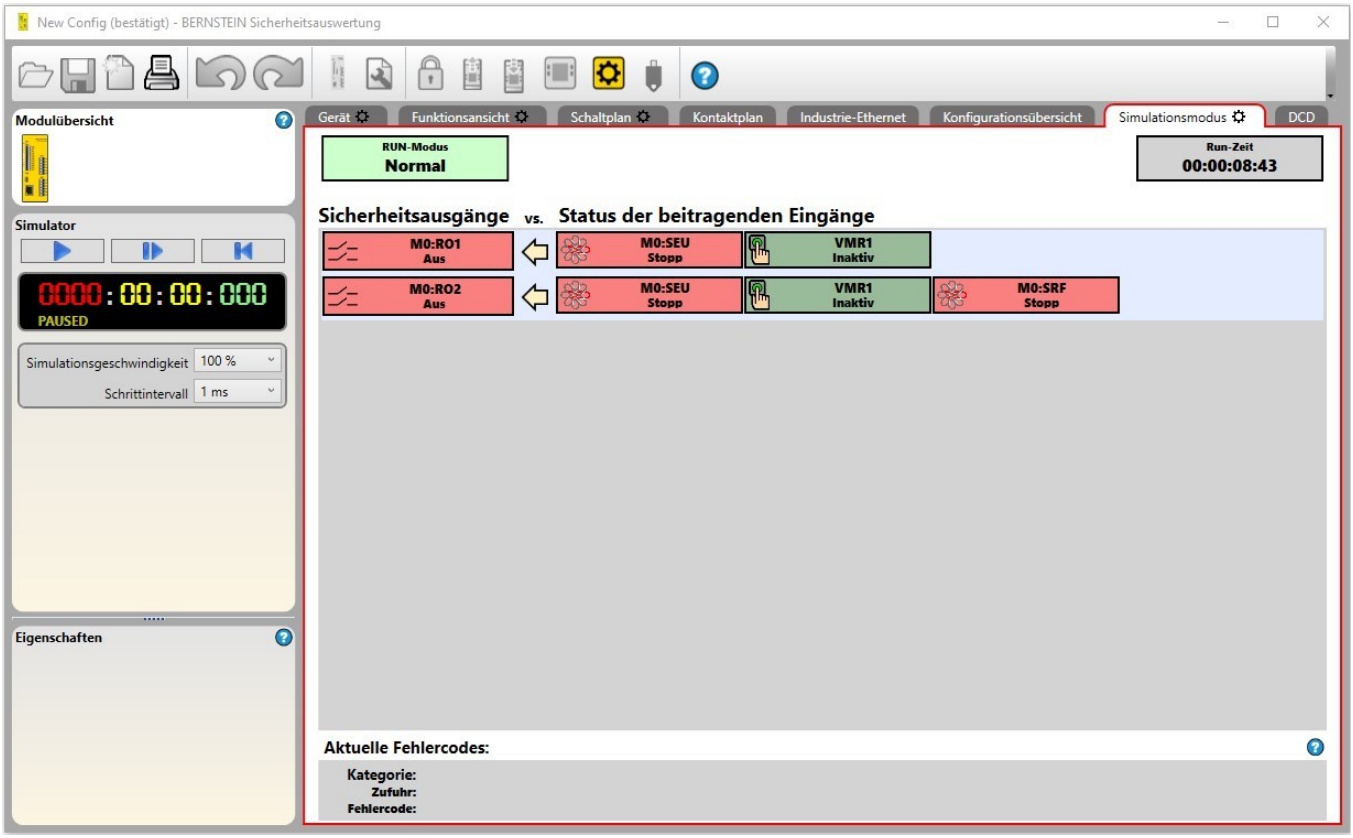



Figure 88: Runtime - Circuit diagram tab


Figure 89: Runtime - DCD tab

## 9.17 Simulation mode




The **Simulation mode** tab can be accessed by clicking on **Simulation mode** in the toolbar. The simulation mode options are available on the left-hand side of the screen. The **Simulation Mode** tab contains information that is only available for viewing. You cannot click on the "Output" and "Input" elements in this view.

**Note:** When using DCD devices, only the overall output signal of the series/chain is simulated, not that of the individual devices.

[Play/Pause] Starts the simulation time running at the specified simulation speed or stops the simulation time temporarily.

[Single step] Advances the simulation time by one step to the specified step interval.

[Reset] Resets the timer to zero and the equipment to the initial off state.


[Timer] Displays the elapsed time in hours, minutes, seconds and thousandths of a second.

**Simulation speed:** Defines the speed of the simulation.

- 1 %
- 10%
- 100 % (standard speed)
- 500 %
- 2.000 %

**Step interval:** Defines the time interval by which the single-step button advances when it is pressed. The size of the interval depends on the size of the configuration.

Select **Play** to start the simulation. The timer runs and the rotating gears indicate that the simulation is running. The **Function view**, **Devices** and **Circuit diagram** tabs are updated so that the simulated device states are displayed visually. The configuration can be tested in this way. Click on the elements to be tested. Their color and status change accordingly. Red indicates the stopped or switched off state. Green indicates the switched-on status. Yellow indicates an error state. Orange indicates that the input was switched on before the simulation was started. Due to a necessary start-up and switch-off test, the output must first be switched off before it can be recognized as switched on.

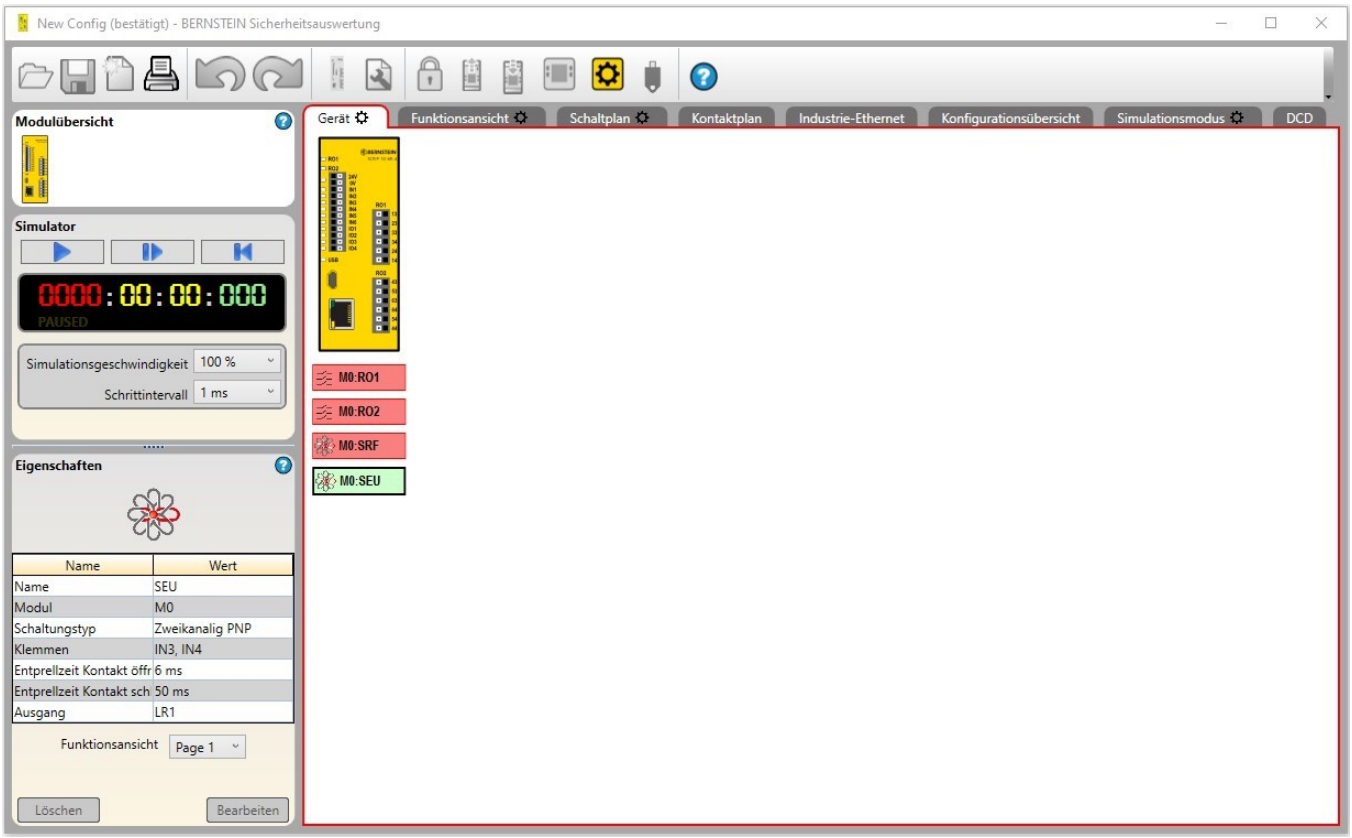



Figure 90: Simulation mode: Devices tab

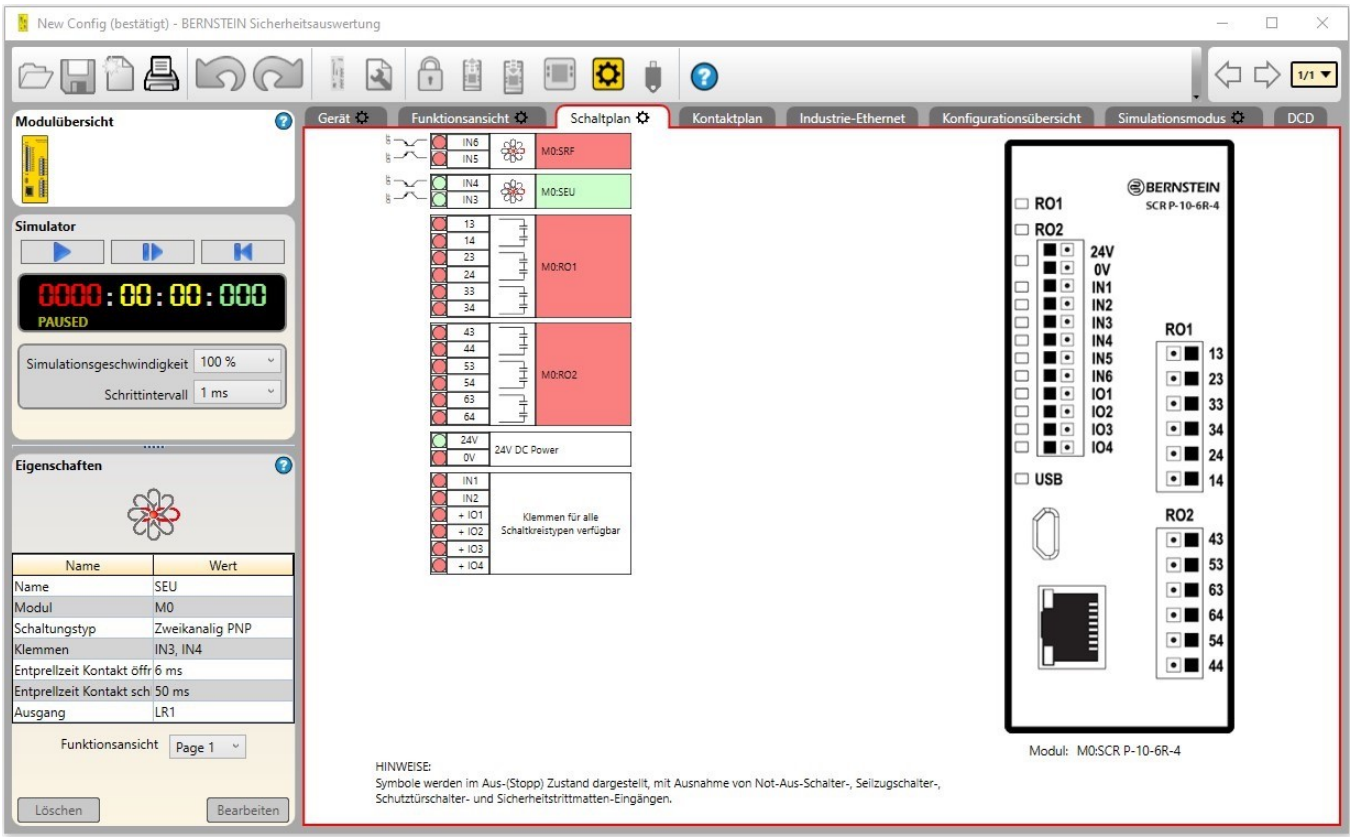



Figure 91: Simulation mode: Circuit diagram tab

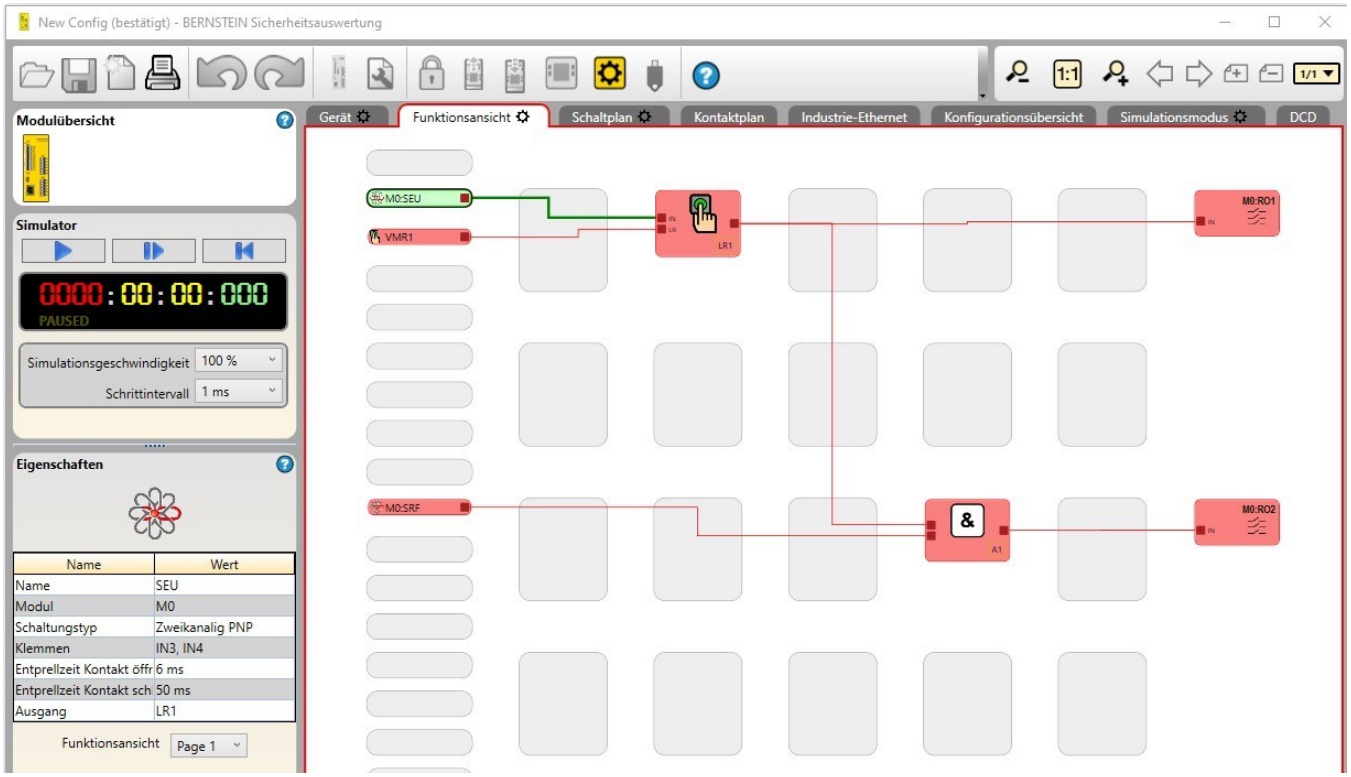



Figure 92: Simulation mode: Function view tab

### 9.17.1 Action time control mode

In simulation mode and on the **Function view** tab, certain elements that are in action delay modes are displayed in purple. The status bar shows the countdown of the timer associated with the element.

The following illustrations show the different element states:

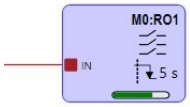



Figure 93: Safety output in time-controlled switch-off delay mode

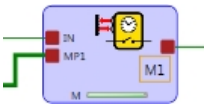



Figure 94: Muting block in the mode for time-controlled muting

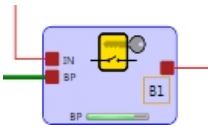



Figure 95: Bypass block in time-controlled bypass mode

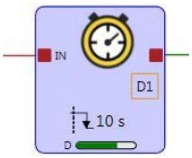



Figure 96: Delay block

**Note:** When using DCD devices, only the overall output signal of the series/chain is simulated, not that of the individual devices.

## 9.18 Refer ence signals

**Important: Display for muting status**

The configuration software contains reference signals that represent the status of the outputs, inputs and both the function and logic blocks. A reference signal for a safety output
can be used to control another safety output. With this type of configuration, the physical on-state of the controlling safety output is not known. If the on-state of the safety output is critical for application safety, an external feedback mechanism is required. Note that this evaluation is in the safe state when the outputs are switched off. If it is critical that safety output 1 i s switched on before safety output 2 switches on, the device controlled by safety output 1 must be monitored so that an input signal is generated with which safety output 2 can be controlled.
can be controlled. The reference signal for safety output 1 may not be suitable in this case.

Figure 96 on page 128 shows how a safety output can control another safety output. If manual reset **M0:MR1** is selected, this switches on safety output **M0:RO2**. This then switches on safety output **M0:RO1**.

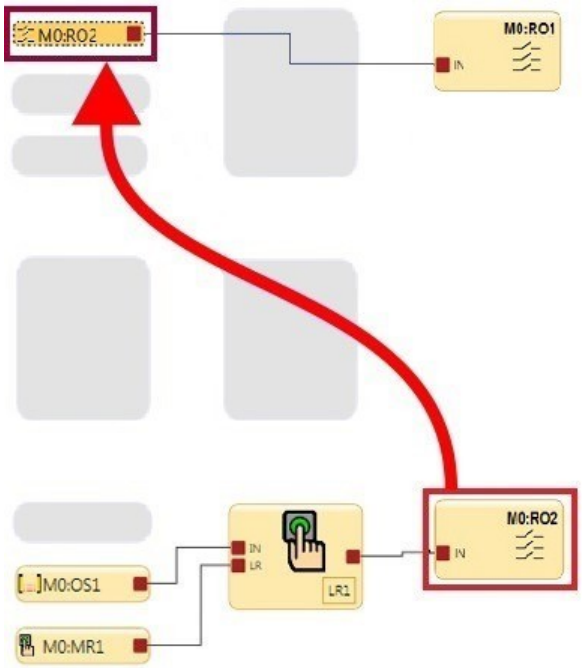



Figure 97: Safety output controlled by another safety output

## 10. F unction blocks

Function blocks contain integrated functions for the most common applications in one block. In principle, it is possible to create a configuration without function blocks, but the use of function blocks offers substantial efficiency advantages, is more user-friendly and is characterized by greater functionality.

For most function blocks, it is assumed that the corresponding safety switching device is connected to them. The **checklist** on the left creates a notification if a mandatory connection has not been connected. Depending on the application, some function blocks can be connected to other function blocks and/or logic blocks.

Dual-channel safety inputs have two separate signal lines. For many components, both signals are positive (+ 24 V DC) when the safety switching device is in the ON state. Other devices may have an antivalent circuit structure where one channel is 24 V DC and the other is 0 V DC when the safety switching device is in the ON state. Instead of referring to a safety switching device as being switched on (e.g. 24 V DC) or switched off (e.g. 0 V DC), the terms on-state and off-state are used in this manual.

**Bridging block**

| Standard node | Additional nodes | Notes |
|---|---|---|
| IN BP | - | If the BP node is inactive, the safety signal passes through the bypass block. If the BP node is active, the output of the block is switched on regardless of the status of the IN node (if the **Output switches off when both** nodes **are** active checkbox is selected).<br>**inputs (IN and BP)** are **switched on are** deactivated). The output of the associated bypass block switches off when the bypass timer expires. |

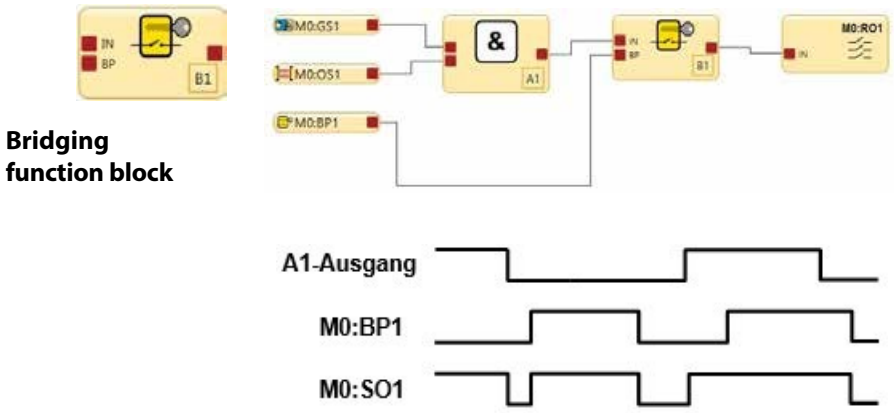



Figure 98: Timing diagram: Bridging block

**Time limit for bypass** - To limit the time period in which the bypass of the safety switching devices should be active, a time limit must be set for the bypass function. The time limit can be set from 1 second (factory setting) to 12 hours and cannot be deactivated. Only one time limit can be set that affects the bypassing of all safety devices. Once the time limit has expired, the bypass is stopped and control of the safety outputs is returned to the corresponding safety inputs.

**Bypass for two-hand control** - The safety evaluation unit issues a stop signal if the safety inputs of a two-hand control are bypassed and one of the inputs is actuated at the same time. This ensures that the operator does not mistakenly assume that the two-hand control is functional without knowing that the two-hand control has been bypassed and no longer fulfills its protective function.

**Locking/labeling**

In accordance with ISO 14118, ISO 12100, OSHA 29CFR 1910.147, ANSI 2244.1 or other relevant standards, note that bypassing a protective device does not contradict the requirements contained in the standards.

**WARNING: Limited use of the override function**
**The bridging function is not intended for production purposes. It is used exclusively for temporary or intermittent measures, for example to clear the defined area of a safety light curtain if a material jam has occurred.** When using the bridging function, the user must ensure that the function is installed and used in accordance with the standards (e.g. IEC/EN60204-1 or ANSI NFPA79).

### Safe working methods and instructions

Safe work procedures provide individuals with the opportunity to control their exposure to hazards through the use of written procedures for specific tasks and the associated hazards. Consideration must also be given to the possibility that a person could bypass the guarding and then either not put it back into operation or not alert other personnel to the existing bypass. In both cases, a hazardous situation can arise. To prevent this, a safe working procedure can be developed, for example. Furthermore, it must be ensured that the personnel are instructed accordingly and follow this workflow correctly.

### Delay block

With the delay block, users can configure a switch-on or switch-off delay of up to 5 minutes (in 1-ms increments).

| Standard node | Additional nodes | Notes |
|---|---|---|
| IN | - | Depending on the selection, a transition of the signal to another state at the input node is delayed by the output delay time by either the output remaining switched off (switch-on delay) or the output remaining switched on (switch-off delay). |

**Note:** The actual delay time of a delay function block or a safety output with delay can be up to 1 scan time longer than the
Delay time setting. Several delay blocks or delay outputs in series increase the total delay time by up to 1 scan per delay function. Example: 3 function blocks for the switch-off delay of 100 ms each in series and a scan time of 15 ms can lead to an actual delay time of up to 345 ms (300 ms + 45 ms).

The node for canceling a time delay is a configurable node that can only be selected for a switch-off delay.

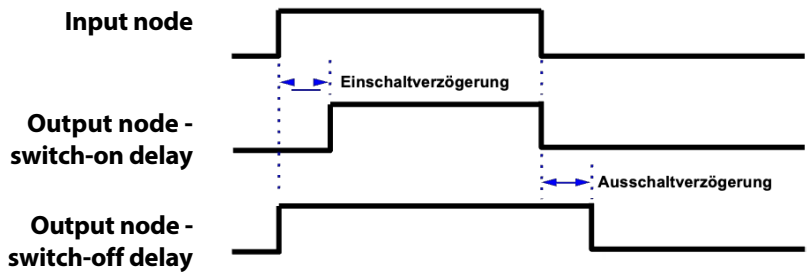



Figure 99: Timing diagram for delay block

**CAUTION: Delay time affecting the response time**
The switch-off delay time can significantly increase the response time of the safety controller. This affects the position of the protective devices, whose installation is based on the formulas for (minimum) safety distance or is otherwise influenced by the time calculation for reaching a non-hazardous state. The increase in response time must be taken into account when installing the protective devices.

**Note:** The response time specified on the **Configuration overview** tab is a maximum time. This may vary depending on the use of the delay blocks or other logical blocks (e.g. OR functions). It is the responsibility of the user to determine, check and calculate the correct response time


Figure 100: Delay ögerungsblock properties

The user can configure the following in the **Delay block properties** window:

**Name**
The name of the entrance.

**Delay of the safety output**

- None
- Switch-off delay
- Switch-on delay

**Output delay time**

Available if either switch-off delay or switch-on delay has been selected as the setting for the safety output delay.
Delay time: 1 ms to 5 min, in 1-ms increments. The factory setting is 100 ms.

**Demolition type**

Available if the switch-off delay has been selected as the setting for the safety output delay.

- No termination
- Control input
- Abort delay node

**Final logic**

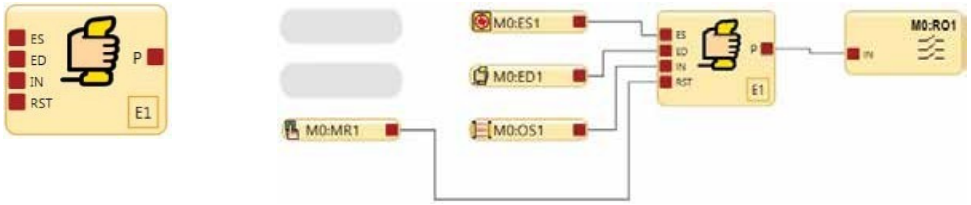
Available if Abort delay node was selected as the setting for the abort type.

- Leave output switched on
- Switch off output

**Enabling switch block**

| Standard node | Additional nodes | Notes |
|---|---|---|
| ED<br>IN<br>RST | ES<br>JOG | An enabling switch block must be connected directly to an output block. This method ensures that the final control of the output lies with the operator holding the enabling switch. The ES node is to be used for safety signals that should not be bypassed by the ED node. If no other inputs of the function block are configured, it is not necessary to use a function block for enabling switches). |

**Enabling switch function block**



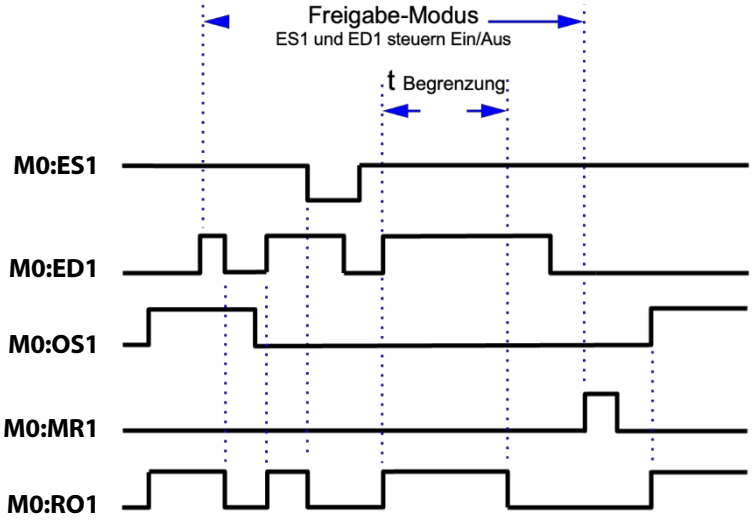
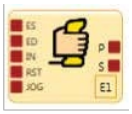




Figure 101: Timing diagram: Enabling switch, simple configuration

**Enabling switch function block**



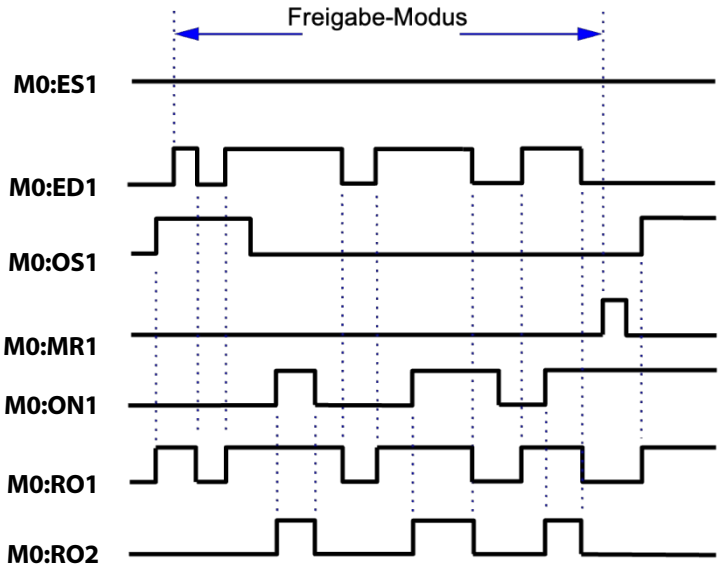




Figure 102: Timing diagram: Enabling switch

1 enable mode starts when the enabling switch ED1 is switched to the on state. ED1 and ES input devices have on/off control sovereignty in enable mode.
When MR1 is used to perform a reset, the normal on state is restored and OS1 and ES1 have on/off control authority.

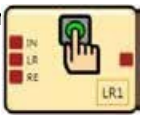
**To end the enable mode**, the enabling switch must be in the off state and an enabling switch block reset must be carried out.

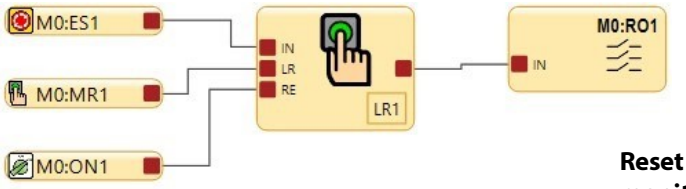
**The time limit for the enabling switch** can be set between 1 second (factory setting) and 30 minutes and cannot be switched off. When the time limit has expired, the associated safety outputs switch off. To start a new enable mode cycle with the original time limit value for the manual reset, the enabling switch must be switched from On to Off and back to On again.
All switch-on and switch-off delay times associated with the safety outputs that are controlled by the enabling switch function are taken into account during enable mode

### Latch reset block

| Standard node | Additional nodes | Notes |
|---|---|---|
| IN<br>LR | RE | The RE node (activate reset) can be used to activate or deactivate the latch reset function. If all input devices connected to the IN node are in the On state and the<br>RE input signal in the On state, the LR function block can be reset manually so that its output switches on. See Figure 48 on page 79; the reference signal RO2 is connected to the<br>RE node connected. |

**Enabling switch fu block**




**Reset signal not monitored:**

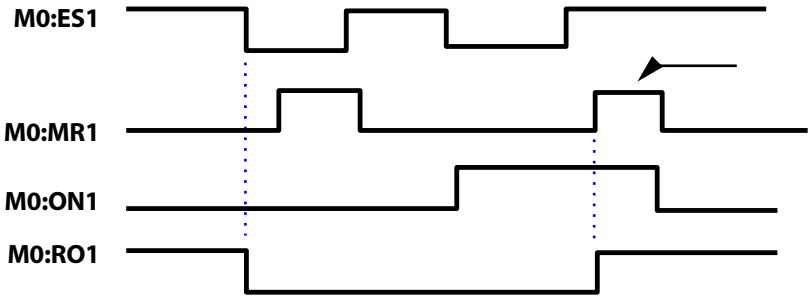
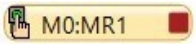
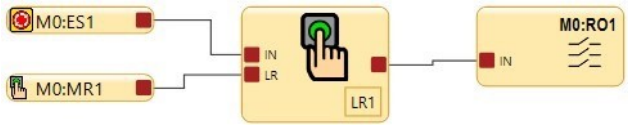



Figure 103: Timing diagram: Latch reset block

The latch reset function block LR1 switches off its output and the safety output RO1 when the emergency stop switch changes to the stop state.
The lock-off state can be reset if the reset activation RE of LR1 detects that the RO2 reference signal is in the on state. MR1 is used to perform the reset.

**Manual reset Entrance**



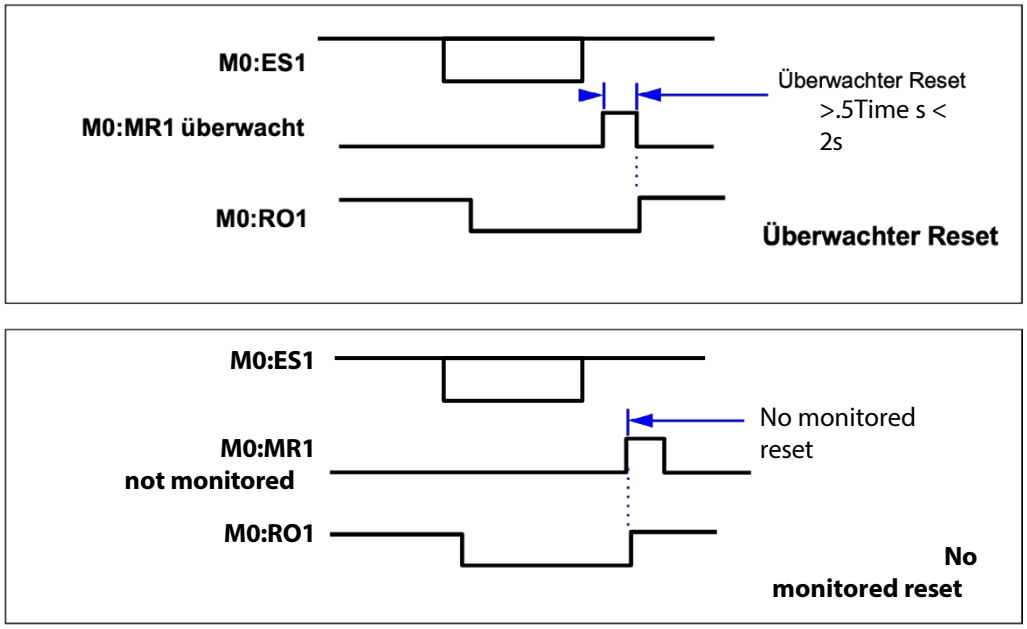
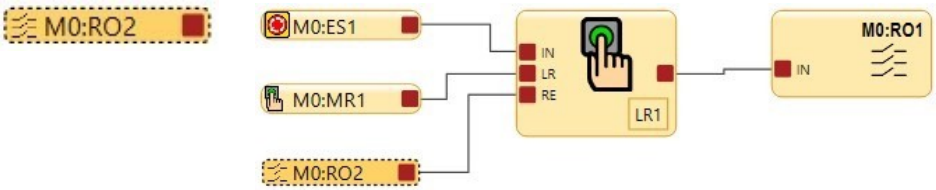




Figure 104: Timing diagram: Latch reset block, monitored/non-monitored reset

The input device for manual reset can be configured for one or two types of reset signals: Monitored and Non-Monitored

**Reference signals** 


A reference signal is used to:

- Controlling an output based on the status of another output
- Display the status of an output, input, safety function or logic block on another page.

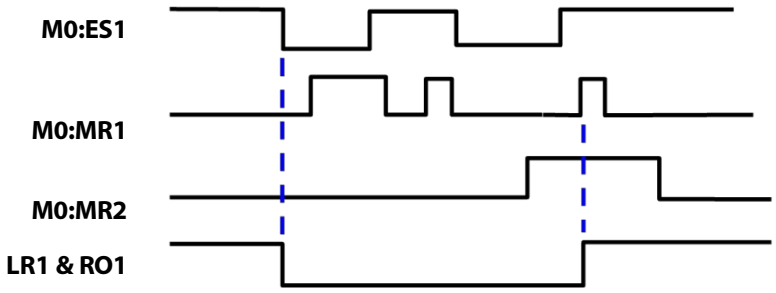



Figure 105: Timing diagram: Latch reset block and referenced safety output

If output RO2 is switched on, the status of the reference signal RO2 is On. In the function block shown above, the reference signal RO2 is connected to the reset activation node RE of latch reset block LR1. A reset (switch-on) of LR1 is only possible if ES1 is in the On state and RO2 is switched on.

To use the referenced safety outputs, see "9.18 Reference signals" on page 125.

**Reference signals** 


In the figure below, the reference signal A3 is located on side 1 of the function block diagram, and the A3 AND block is located on side 2. The output node on the A3 AND block can also be used on side 2 for another safety function.

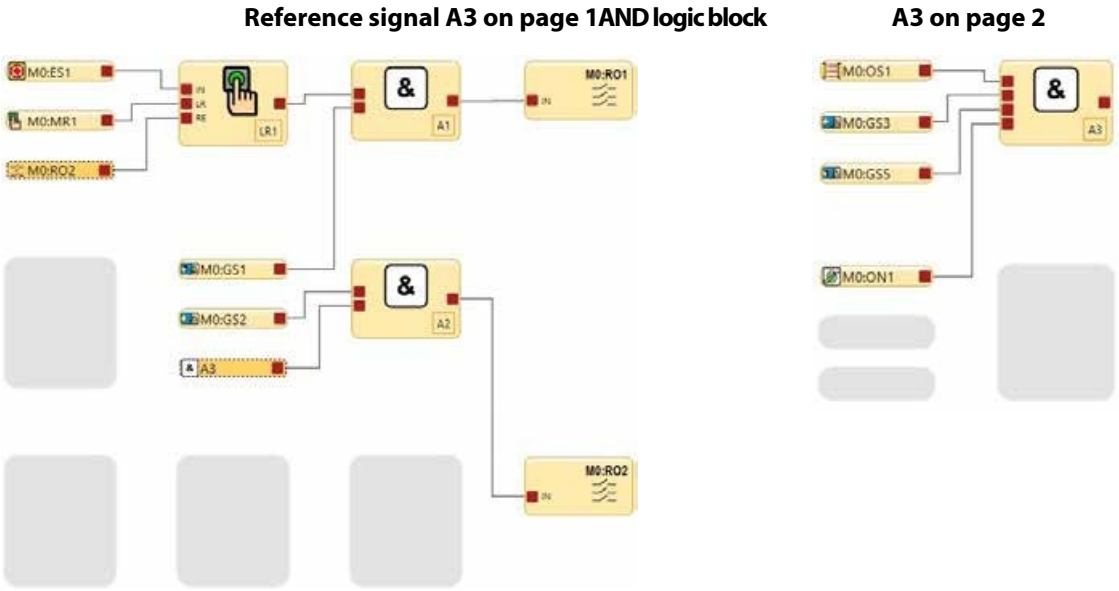



Figure 106: Latch reset and referenced safety output and AND block

**Latch reset muting Function**

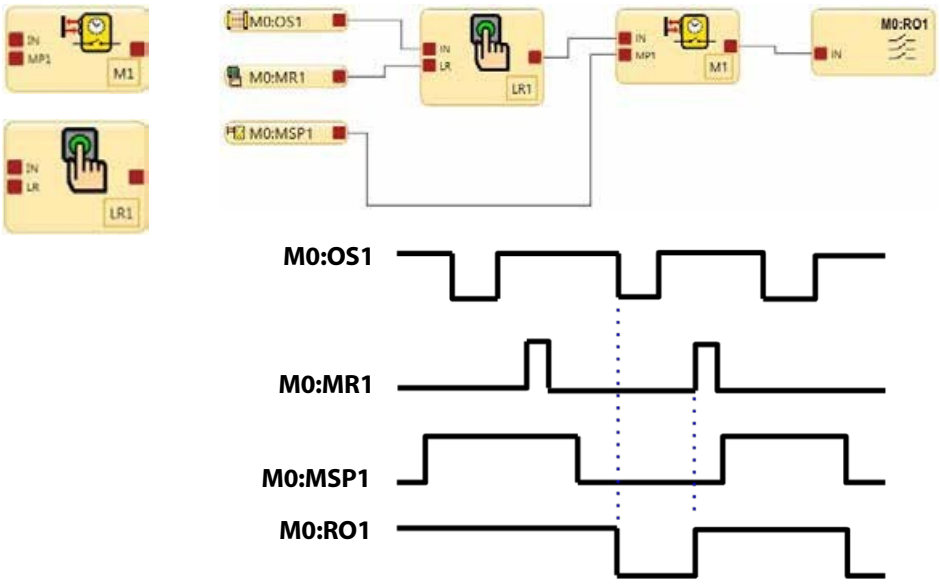
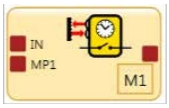



Figure 107: Timing diagram: Latch reset block and muting block

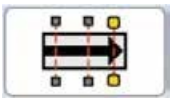
When OS1 goes into a stop state for a guard in a valid muting cycle, the latch reset function block is latched and a reset signal is required to keep RO1 on after the end of muting.
If OS1 switches to the stop state in a valid muting cycle and no reset signal is detected, RO1 switches off after the end of muting.

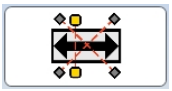
### Muting function block

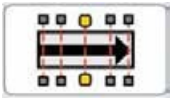
| Standard node | Additional nodes | Notes |
|---|---|---|
| IN<br>MP1 | ME<br>BP<br>MP2 | The input blocks for muting sensor pairs must be connected directly to the muting function block. |

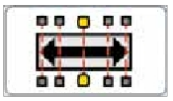



Five muting function types are listed below. The following timing diagrams show the function detail and the sequence of status changes of the sensors/protective devices for each muting function type.

1-  **One direction - 1 muting sensor pair**

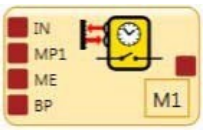
2-  **Two directions- 1 muting sensor pair**

1-  **One direction - 2 muting sensor pairs**

2-  **Two directions - 2 muting sensor pairs**

2-  **Two directions - 1 muting sensor pair**

Figure 108: Muting block: Function types




There are two types of muting bridges:
- Muting-dependent override
- Bridging (normal)

In the Muting block properties menu in the advanced settings, the option to select a bypass or a muting-dependent override is possible if the checkbox for bypass is activated.

The muting-dependent override is used to temporarily restart an incomplete muting cycle (e.g. after the muting time limit has expired). In this case, at least one muting sensor must be activated while the protective device is in the stop state.

The normal bypass is used to temporarily bypass the protective device in order to switch on the output of the function block or to keep it switched on.

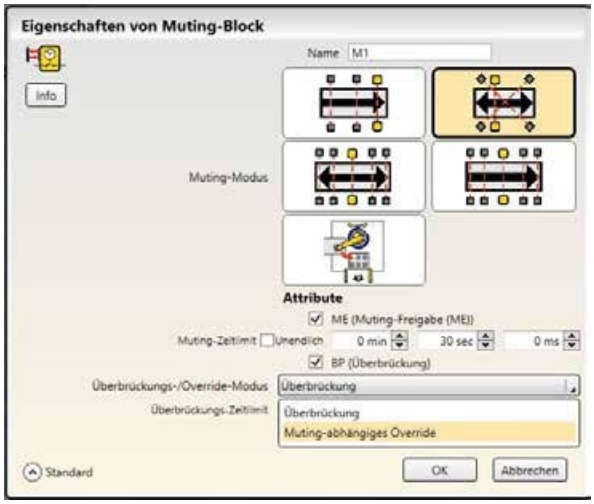



Figure 109: Muting block: Options for bridging/override mode

**Muting-dependent Override**

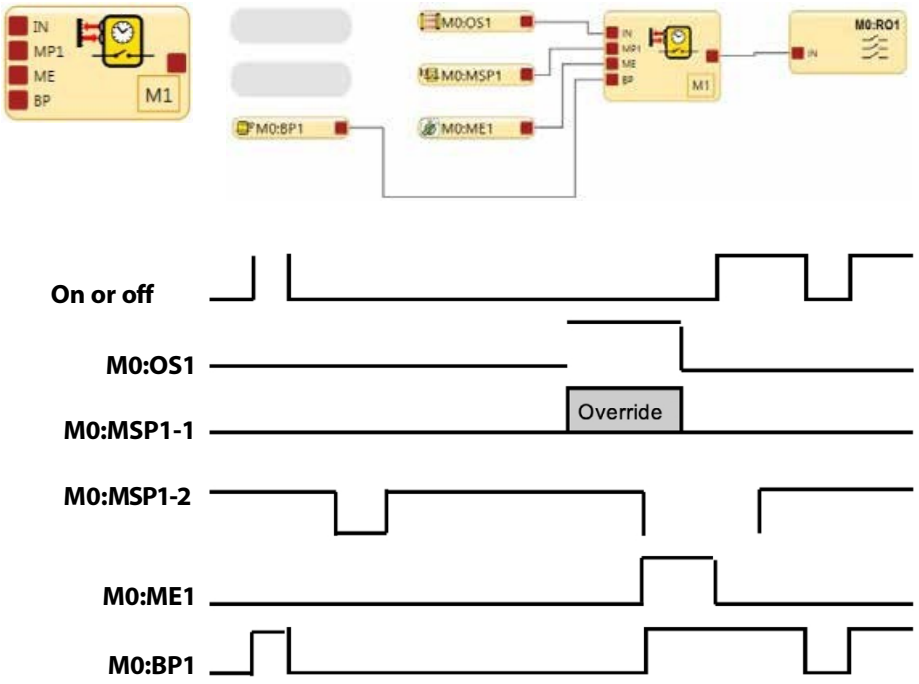



Figure 110: Muting-dependent override

**Muting bridging**

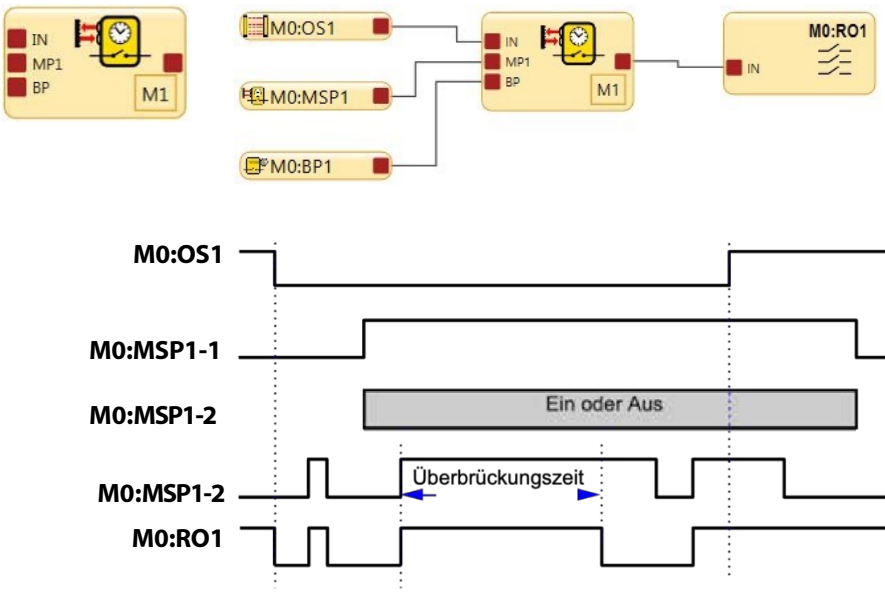



Figure 111: Muting bridge

**Muting function 1-direction - 1 sensor pair**

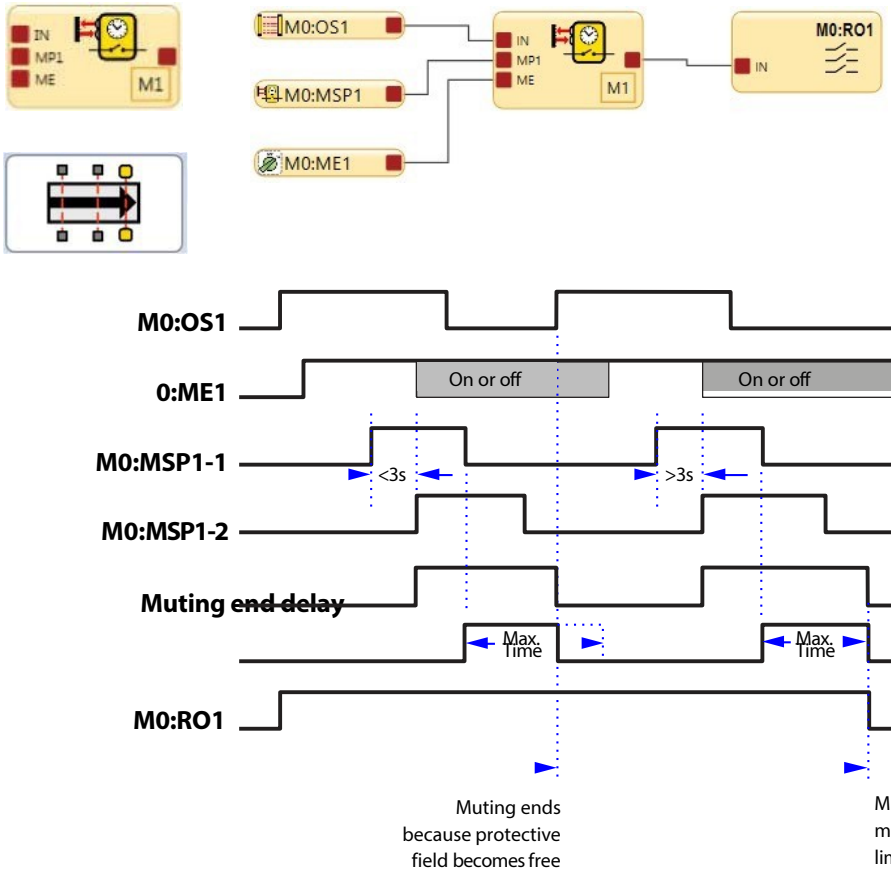
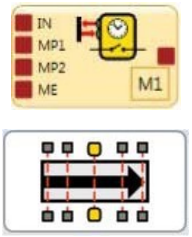
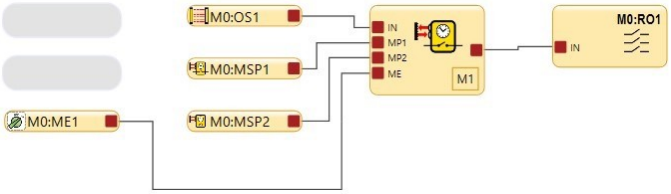



Figure 112: Timing diagram: Unidirectional muting block, one muting sensor pair

**Note:** MO:OS1 must be blocked before either MSP1-1 or MSP1-2 becomes free.

**Muting function 1-direction - 2 sensor pairs**



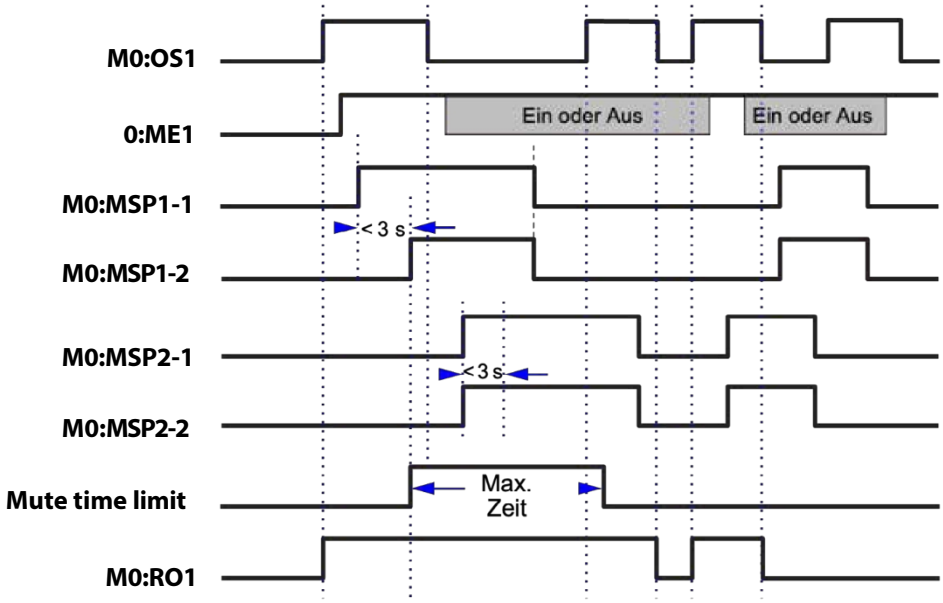
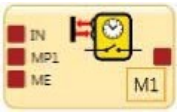
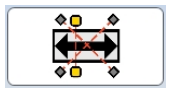
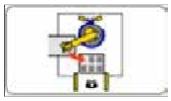



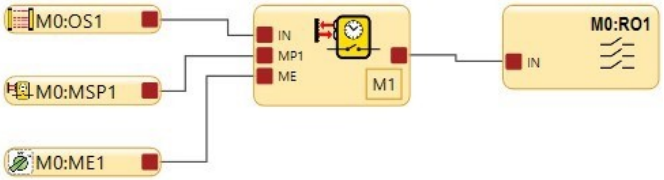

Figure 113: Timing diagram: Unidirectional muting block, two muting sensor pairs

**Muting function 2 directions - 1 Sensor pair**







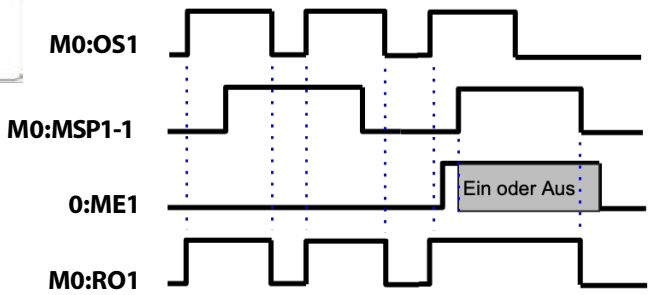
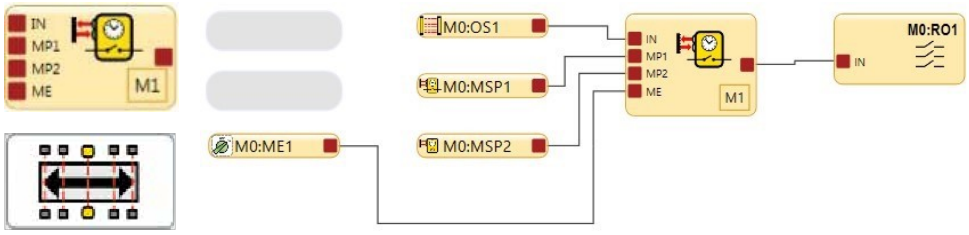




Figure 114: Timing diagram: Bidirectional muting block, one muting sensor pair

**Muting function 2 directions - 2 sensor pairs**



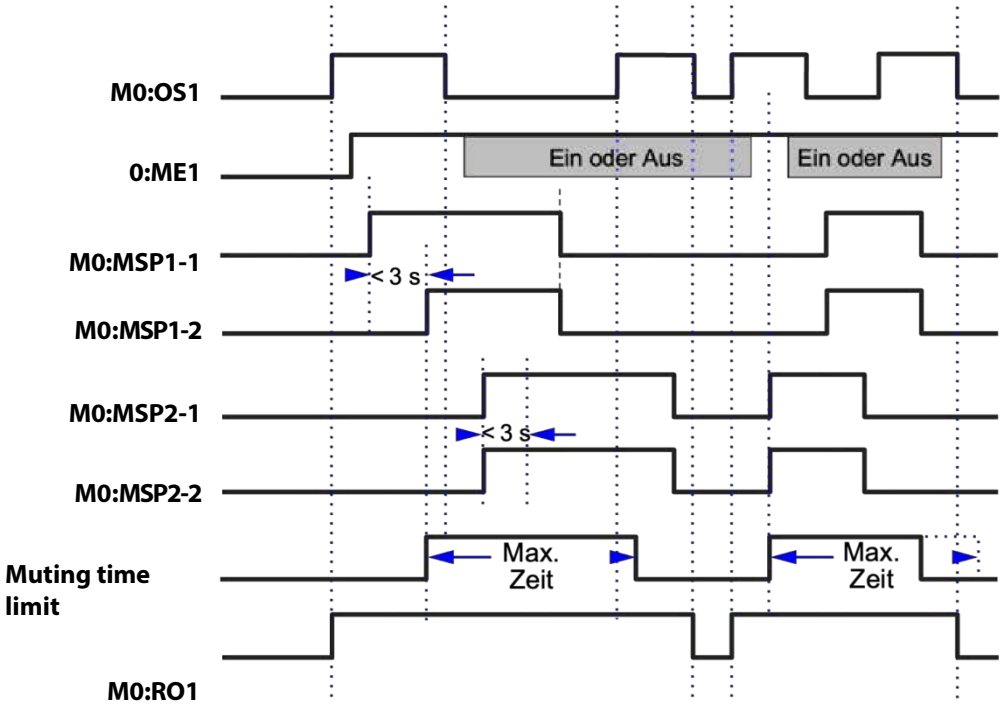




Figure 115: Timing diagram: Bidirectional muting block, two muting sensor pairs

**WICHTIG** **Emergency stop priority when using the muting function**

**Incorrect emergency stop control**

**NOT RECOMMENDED**

The configuration at the top right shows OS1 and the emergency stop switch ES1 with a latch reset LR1, which is connected to a muting function via the AND function. In this case, ES1 and OS1 are both muted.
If an active muting cycle is running and the emergency stop switch is actuated (switched to the stop state), RO1 does not switch off. This leads to a loss of the safety function and can cause a potentially dangerous situation.

**Correct emergency stop control**
In the configuration on the right, OS1
is connected directly to the muting block M1. M1 and ES1 are both inputs for AND A1. In this case, M1 and ES1 both control RO1.

If an active muting cycle is running and the emergency stop switch is actuated (switched to the stop state), RO1 switches off.

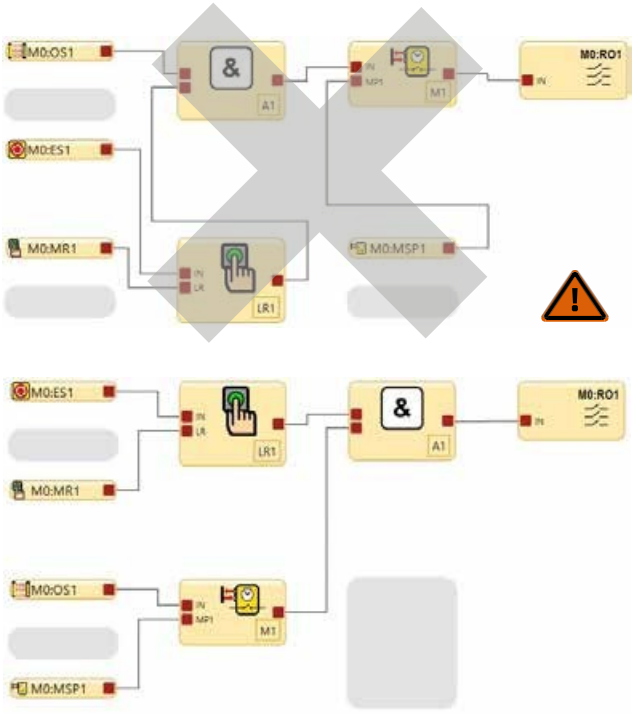



Figure 116: : Emergency stop switch and muting function

Emergency stop switches, rope pull switches, enabling switches, external device monitoring and bypass switches are not mutable devices or functions.
A muting system must be used for muting the primary protective device:

1. recognize the non-hazardous part of the machine cycle,
2. the selection of the correct muting devices,
3. include the correct assembly and installation of such equipment.

**WARNING:**

- **Use muting and bridging in such a way that the risk to personnel is kept to a minimum.**
- If these rules are not followed, a dangerous condition may arise which could lead to serious or fatal injuries.
- Protection against unintentional cancelation of stop signals by using one or more divers-redundant muting sensor pairs or a two-channel override switch with safety key.
- Configure appropriate time limits for the muting and bridging functions.

The safety evaluation unit can monitor and react to redundant signals that initiate muting. Muting then cancels the protective function by ignoring the status of the input device to which the muting function has been assigned. This allows, for example, an object or person to pass through the defined area of a safety light curtain without generating a stop command. This is not to be confused with blanking, where one or more beams in a safety light curtain are deactivated, resulting in a coarser resolution.
Muting can be triggered by a number of external devices. This function offers a range of options so that the system can be tailored to the requirements of a specific application.
A muting sensor pair must be triggered at the same time (maximum 3 seconds apart). This reduces the probability of a common cause error or deliberate bypassing. Directional muting, where sensor pair 1 must be blocked first, can also reduce the possibility of bypassing.
At least two muting sensors are required for each muting process. Muting usually occurs 100 ms after the second muting sensor input is actuated. One or two muting sensor pairs can be assigned to one or more safety inputs so that their assigned safety outputs can remain switched on to complete the operation.

**WARNING: Restrictions with regard to the muting function**

Muting is only permitted during the non-hazardous part of the machine cycle.

A muting application must be designed so that the failure of a single component does not prevent the stop command or enable further machine cycles as long as the fault has not been rectified.

**WARNING: Muting inputs must be redundant**

**It is not permitted to use a single switch, a single device or a single relay with two normally open contacts for the muting inputs.** This single device with multiple outputs could fail and cause muting of the system at an incorrect time.
**This can create a dangerous situation.**

**Optional muting attributes**

The input for the muting sensor pair and the muting block have various optional functions that can be used to minimize the possibility of unauthorized manipulation and an unintentional muting cycle.

**Muting enable (ME)**

The input for muting activation is specified as not safety-relevant. If the input is closed or activated for a virtual input, the evaluation allows muting. Opening the input during muting has no effect.

Typical applications for muting activation include

- To enable the machine control system to generate a time period for the start of muting
- To prevent muting from occurring
- To reduce the likelihood of unauthorized or unintentional bypassing of the security system

The optional muting activation function (ME) can be configured to ensure that a muting function is only permitted at the appropriate time. If an ME input device has been assigned to a muting-capable safety input, this safety input can only be muted if the ME switch is in the activated state (24 V DC) at the time the muting cycle starts (or in the active state in the case of a virtual input). An ME input device can be assigned to one or more muting blocks.

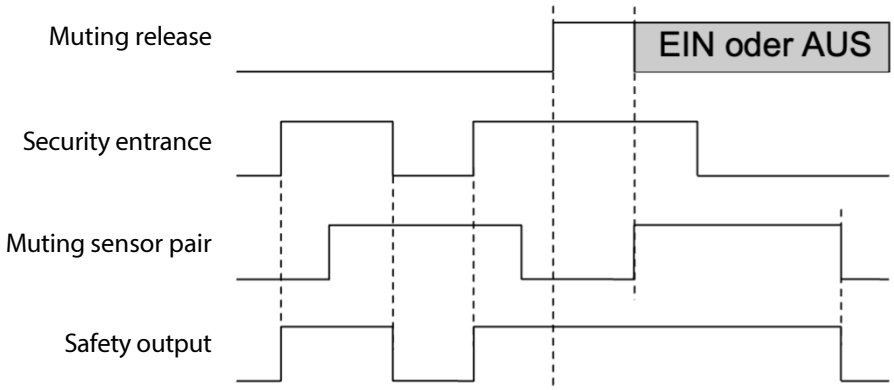



Figure 117: Timing diagram: a muting sensor pair with muting release

**Reset function for simultaneity monitoring**

The input for muting activation can also be used to reset the simultaneity monitoring of the muting sensor inputs. If one input is active for more than 3 seconds before the second input becomes active, the simultaneity monitoring prevents a muting cycle from occurring. This may be due to the normal stopping of an assembly line, which blocks a muting device and causes the simultaneity monitoring time to expire.
If the ME input switches (closed-open-closed or, in the case of a virtual input, activated-deactivated-activated) while a muting input is active, the simultaneity monitoring is reset and if the second muting input becomes active within 3 seconds, a normal muting cycle begins. The function can only reset the monitoring once per muting cycle (i.e. all muting inputs M1-M4 must open before another reset can take place).

**Bridging**

An optional **bridging/override mode** can be activated. To do this, activate the **Bridging** field in the **Muting block** properties window. Two bridging/override modes are available: **Bridging** and **muting-dependent override**. The **override mode** is used to temporarily bypass the safety device so that the output of the function block remains switched on or can be switched on.
The **muting-dependent override** mode is used to manually override an incomplete muting cycle (e.g. after the muting time limit has expired). In this case, muting sensors must be activated to initiate the override while the safety device is in the off state.

**Muting lamp output (ML)**

Depending on the risk evaluation and applicable standards, some applications may require a luminaire (or other means) to indicate when the safety device (e.g. a light curtain) is muted. The
Safety evaluation issues a signal via the muting status output, which indicates that the safety function is temporarily disabled.

☞ **Important: Display for muting status**

A display for the muted status of the safety device must be set up and be clearly visible from the location of the muted safety device. The operation of the indicator may need to be checked by the operator at suitable intervals.

### Muting time limit

The muting time limit allows you to set a maximum time period during which muting should be permitted. This function prevents deliberate bypassing of the mute sensors to initiate inappropriate muting. It is also useful for detecting a common cause error that would affect all mute sensors in the application. A time limit of 1 s to 30 min can be set in 100 millisecond increments (the factory setting is 30 s). The infinite (deactivated) setting can also be selected for the muting time limit. The monitoring time is started when the second mute sensor pair fulfills the simultaneity requirement (within 3 seconds of the first sensor pair being activated). When the time has elapsed, muting ends regardless of the signals from the mute sensors. If the muted input device is in the off state, the associated muting block switches off.

**WARNING: Muting time limit.**

An infinite time should only be selected (deactivated) for the muting time limit if the possibility of a faulty or unwanted muting cycle is minimized in accordance with the machine's risk evaluation. The user is responsible for ensuring that this does not create a dangerous situation.

### Muting switch-off delay time

A delay time can be configured to extend the muting state until the selected time (1, 2, 3, 4 or 5 seconds) after the muting sensor pair no longer signals a muting state. The
Switch-off delay is normally used for safety light curtains or multiple light beam systems in pure work cell output applications where the muting sensors are only on one side of the protective field. The muting block output remains switched on for up to 5 seconds after the first muting device has been released or until the muted safety switching device (muting block input) switches back to the on state, whereby the first event is decisive.

### Muting on start-up

This function initiates a muting cycle after the power supply to the safety evaluation unit has been switched on. If the muting on start-up function is selected, muting is initiated under the following conditions:

- If the muting activation input is switched on (if configured)
- When the inputs of the safety device are activated (in the on state)
- If the muting sensors M1-M2 (or M3-M4, if used, but not all four) are closed

If **automatic mains activation** is configured, the safety evaluation allows the input devices approx. 2 seconds to activate so that systems that are not active immediately on start-up are supported.

If **manual power-on** is configured and all other conditions are met, the first valid startup reset after the muted safety inputs have been activated (on-state or closed) will result in a muting cycle. The Muting on startup function should only be used if the safety of the system can be guaranteed during the expected muting cycle and if the use of this function is the result of a risk evaluation and is necessary for the operation of the respective machine.

**WARNING:**

The muting on start-up function should only be used for applications where:

- muting of the system (M1 and M2 closed) is required during start-up and that this does not pose any danger to persons under any circumstances.

### Debounce times for muting sensor pair

The input debounce times, which can be configured under the **Advanced settings** in the properties window for the **muting sensor pair**, can be used to extend a muting cycle beyond the removal of the muting sensor signal. By configuring the switch-off bounce time, the muting cycle can be extended by up to 1.5 seconds (1500 ms) so that the safety switching device can switch on. The start of the muting cycle can also be delayed by configuring the switch-on delay time.

**Requirements for the muting function**

The start and end of a muting cycle are triggered by signals from a muting sensor pair. The switching options for the muting device are configurable and are displayed in the **Properties** window for the muting sensor pair. A proper muting signal is generated when both channels of the muting device switch to the muting active state while the muted safety device is in the on state.
The safety evaluation monitors the muting devices to ensure that their outputs switch on within 3 seconds. If the inputs do not meet this simultaneity requirement, muting cannot take place.
Various types and combinations of muting devices can be used, including: optoelectronic sensors, inductive proximity sensors, limit switches, positively driven safety switches and sensor switches.

**Deflecting mirrors, optical safety systems and muting**

Mirrors are usually used with safety light curtains and single/multi-beam safety systems to protect the protective field from several sides. If the safety light curtain is muted, the protective function is canceled on all sides. It must not be possible for persons to enter the protective field unnoticed and without issuing a stop command to the machine control unit. This additional safety device is normally provided by additional devices that remain active while the primary safety device is muting.
Mirrors are therefore not usually permitted for applications with muting.

**Multiple safety devices with presence detection**

Muting of multiple safety devices with presence detection (PSSDs) or a PSSD with multiple detection zones is not recommended if a person can enter the monitored area without being detected and without a stop command being sent to the machine control unit. If muting is performed at several detection zones, as is the case when deflecting mirrors are used (see Deflecting mirrors, optical **safety systems and muting on page 145**), it is possible for persons to enter the protected zone through an area or access point subject to muting without being detected.

For example, in an entry/exit application where the muting cycle is initiated by a pallet entering a cell, if muting is performed on both the entry and exit PSSDs, a person can enter the monitored area by "exiting" the cell. A suitable solution to the problem would be muting the entry and exit with separate safety devices.

**WARNING: Securing multiple areas**
**It is not permitted to secure multiple areas with mirrors or multiple detection fields if personnel can enter the hazardous area during system muting**
**and is not detected by an additional safety device that sends a stop command to the machine.**

## 10.1 One Shot Block

The one-shot block enables the user-configurable pulsed switch-on state of a maximum of 5 minutes in 1 ms steps.

| Standard node | Additional nodes | Notes |
|---|---|---|
| IN | CD | A change of state of the input signal from low to high causes the output node to go high for the configured time and then switch off. |

**Note:** The actual length of the one-shot time can be up to 1 scan time longer than the set time.

The "Cancel Delay" node is a configurable node for the one-shot block. The "Cancel Delay" input switches off the output node of the one-shot block immediately after it is detected (due to human and system delays, shorter one-shots will most likely be terminated before a cancel delay can take effect).

**CAUTION:** The delay time of a pulse affects the reaction time**.**

One-shot timing can significantly increase the reaction time of the safety controller. This affects the positioning of protective devices whose installation is determined by the safety distance formulas (minimum distance) or is otherwise influenced by the time it takes to reach a non-hazardous state. The extension of the response time must be taken into account when installing protective devices.

**Note:** The response time specified on the "Configuration overview" tab is a maximum time that can change depending on the use of delay blocks, one-shot blocks and other logic blocks (e.g. OR functions). It is the user's responsibility to determine, check and install the appropriate response time.

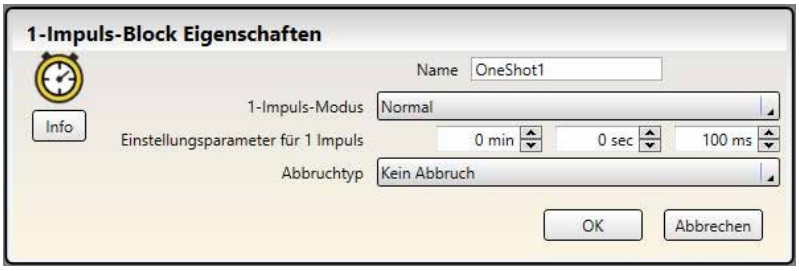



Figure 118: One-shot properties

The user can configure the following in the One Shot properties window:

**Name**

Create a name with up to 10 characters for the function block.

**One-shot mode**

- Normal
- Heartbeat

**One Shot setting parameters**

One-time recording time: 1 ms to 5 minutes, in steps of 1 ms. The default setting is 100 ms.

**Cancel type**

- Do not cancel
- Cancel delay node

**One-shot mode**

If the "Normal" mode is selected, the output node is switched on when the input node is switched on. The output remains switched on for the time specified in the One Shot setting, regardless of state changes at the input. (See "Figure 119: Typical normal one-shot timing diagrams" on page 142).

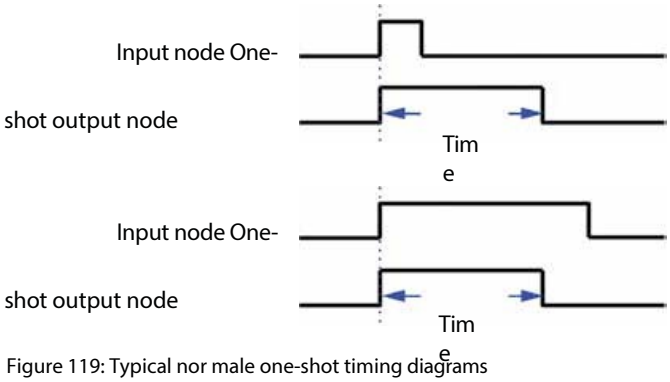



Figure 119: Typical nor male one-shot timing diagrams

**Note:** The switch-on time of the safety output is reduced by the switch-on delay of the safety output (approx. 60 ms). The shorter the switch-on delay, the greater the reduction (larger percentage of the desired pulse).

If heartbeat mode is selected, the output node is switched on when the input node is switched on. The output remains switched on for the time set for the one-shot setting. The timer set for the One Shot is reset when the input node switches OFF and then ON again. (See
"Figure 120: Heartbeat One Shot Timing Diagram" on page 142).

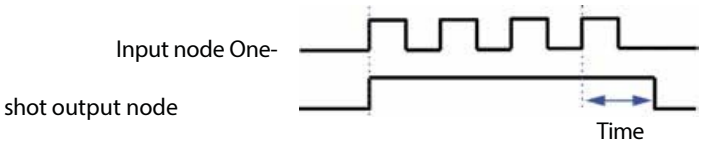



Figure 120: Heartbeat One Shot timing diagram

## 10.2 Control of the press

The Press Control function block is intended for use with simple hydraulic/pneumatic presses. The following standards apply:

- B11.2-2013, Safety requirements for hydraulic and pneumatic power presses
- EN ISO 16092-1:2018, Safety of machine tools - Part 1 - General safety requirements
- EN ISO 16092-3, Safety of machine tools - Part 3 - Safety requirements for hydraulic presses
- EN ISO 16092-4, General safety requirements - Part 4 - Safety requirements for pneumatic presses

It is the sole responsibility of the user to ensure that its application complies with these and all other relevant standards (including other press standards).

**WARNING:**

- The press control function block contains a starting device (triggers a dangerous movement).
- Failure to follow these instructions may result in serious injury or death.
- The qualified person must ensure that the activation (transition to the ON state) of a stopped safety device (emergency stop, rope pull, optical sensor, safety mat, protective stop, etc.) by a user does not trigger a dangerous movement if it is connected to an already activated function block of the press control (ON state).

**WARNING:**

- Install this device correctly.
- It is the sole responsibility of the user to ensure that this BERNSTEIN appliance is installed and connected to the protected machine by qualified persons in accordance with these instructions and the applicable safety regulations. Failure to follow these instructions may result in serious injury or death.
- If all assembly, installation, connection and verification procedures are not properly followed, the BERNSTEIN device may not provide the protection for which it was designed. It is the user's responsibility to ensure that all local, state and national laws, rules, codes or regulations relating to the installation and use of this control system in a particular application are met. Ensure that all legal requirements are met and that all technical installation and maintenance instructions contained in this manual are followed.

| Standard node | Additional nodes | Notes |
|---|---|---|
| GO<br>TOS<br>BOS<br>RST<br>NM Security | PCI mode | If you select the Mode or PCI (Press Control Input) inputs, each generates its own function block of inputs, which are connected to the Press Control function block. Further Information can be found under "10.2.1 Function block mode" on page 145 and "10.2.2 Press control inputs function block" on page 146. |

The Press control function block contains attributes that can be activated or deactivated.

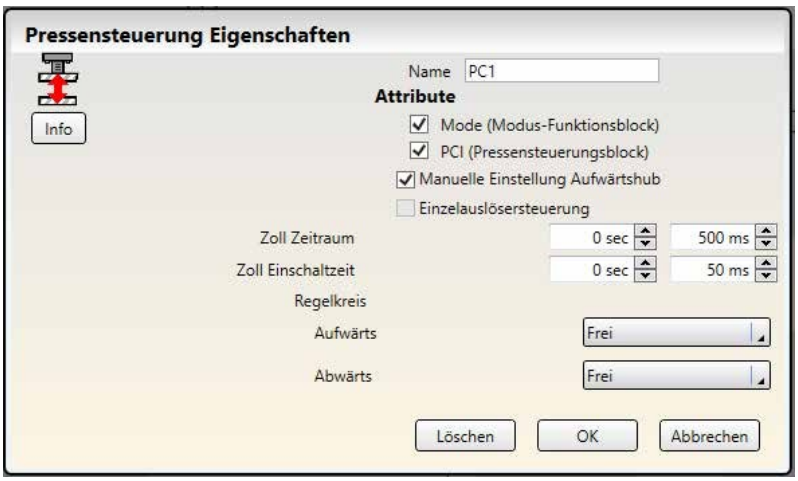



Figure 121: Properties of the press control

The additional nodes that can be added to the press control function block create their own new function blocks. The Mode function block is added when the Mode attribute is selected. The
Press Control Inputs Function Block is added when the PCI attribute field is selected. The other two attributes, Manual Upstroke Adjustment and Single Drive Control, cannot both be selected.

If the manual upstroke setting is configured, the GO input must be kept ON during the entire cycle (both down and up). Only a two-hand control input or a foot switch input can be connected to the GO input node.

When single drive control is configured, the GO input acts like a start button and only needs to remain on long enough to start the process. Only one cycle initiation input, one foot switch input or one two-hand control input can be connected to the GO input node.

**WARNING:**

- Press the hazard warnings for the upward stroke.
- If there is a hazard during the upstroke, failure to use the manual upstroke adjustment can result in serious injury or death.
- With Single Actuator Control, the upward stroke of the press must not pose any danger, as the variable safety stop input is muted during the upward stroke.

The other function of the Press Control function block is Closed Loop Control. Activating Closed Loop Control forces the controller to check whether the devices connected to the noted outputs have been switched off if the signal to switch off came before the next output can be switched on. For more information, see Closed-loop control on page 158.

### 10.2.1 Mo dus function block

The Mode function block is added when the Mode attribute is selected in the properties of the press control.
The Mode Function Block selection allows you to add a function selector switch. The three inputs for the Press Function Block are Run, Inch Up and Inch Down.

**Note:** According to the press standards, the mode selector switch (or menu) should have at least these three positions and an off position. The off position would not be a safety off state, but a press in a non-run state input (will not be connected to the controller, but the three mode inputs would also be in the off state). If all 3 mode inputs are inactive/off, then the Press Mode FB will remain off (red).


Figure 122: Inputs of the press control function block

When the Mode function block is selected in the Press Control function block, the Inch Period and Inch On Time parameters are added to the Press Control function block. These parameters are user-defined values for the system to ensure that the press does not move too quickly when jogging (typically used in set-up mode).

**Note:** The EN ISO 16092-3:2018 standard specifies that the inch speed in inch mode must not be higher than 10 mm/second.

- An inch procedure is an intermittent movement of the ram to slowly move it up or down, typically for maintenance or tool adjustment.
- The **inch period** is the complete cycle time, on and off, of an intermittent movement of the slider
- The **Inch On Time** is the On part of the Inch Period (switching on the output period to control the slide movement)
- When setting the period and switch-on times, take into account the delays in initiating movement and stopping movement to ensure the correct inch speed when the GO input is held closed for several inch periods.

**WARNING:**
- Speed of the press in inch mode.
- Excessive speed of the sled in inch mode can lead to serious injury or death.
- When setting the "Inch Period" and "Inch On Time", make sure that the carriage moves at a safe speed in jog mode.

### 10.2.2 Pr esse Control inputs Function block

The Press Control Inputs function block is added when the PCI attribute field is selected in the press control properties. If the PCI function block is selected, other press control attributes can be activated.


Figure 123: Properties of the press control inputs

The standard nodes of the PCI block are the PIP input (Part in Place), the SQS input (Sequential Stop) and the M Safety input (Mutable Safety Stop). When SQS is selected, the Ft Switch (Foot Switch) and M Sensor (Press Mute Sensor) inputs are available as options and the Dual Pressure attribute becomes available (this allows high and low pressure outputs to be added to the standard up and down outputs).
Use the PIP input in press controls where the press should not run if no part is present. The PIP input must be high for the press cycle to start. After the press has left BOS, the PIP input must go low and then high again before the next press cycle can be started; this can happen before or after the press reaches TOS.
Use the SQS input in press controls where the press ram is lowered to a finger-safe point. At this point, the Mutable Safety Stop input can be muted, the operator can enable the two-hand control input (TC1) (configured to the GO input of the press control function block) and grip the workpiece if required. When the Ft Switch (FS1) input is triggered, the press ram moves to the bottom of the stroke where it stops.

**Note:** The procedure described above is a method for controlling the Press Control process with configured SQS. There are three permitted processes:

1. TC1 switches on the GO input to drive the pile driver to the SQS point. Release TC1 and switch on FS1 to switch on the Ft Switch input and move the pile driver to the BOS point, release FS1 and switch on TC1 to raise the pile driver.
2. FS1 switches on the GO input to move the ram to the SQS point. Release FS1. By switching FS1 on again, the ram is moved to the BOS point and then back to the TOS point. (The Ft Switch input disappears when FS1 is connected to the GO node).
3. TC1 switches on the GO input to move the pile driver to the SQS point, release TC1. Switching TC1 on again moves the pile driver to the BOS point and then back to the SQS point.
   TOS point. (To set up the system for this method, do NOT select the Ft Switch node in the Press Control Inputs function block).

The M-Sensor input can be used in conjunction with the SQS input to mute the Mutable Safety Stop input when it reaches a finger-safe position.
If the SQS input and double pressure are configured in the Press control input function block, two new outputs are added to the Press control function block. The output nodes H (High) and L (Low) are added in addition to the standard outputs U (for Up, disengage or return stroke) and D (for Down, engage or return stroke). The H node is used to switch on the high pressure to end the last part of the stroke. The
L output is used to switch on the standard pressure (low pressure) to bring the slide to the SQS point and return to the starting position.

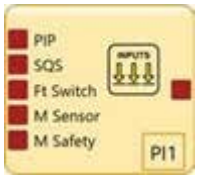
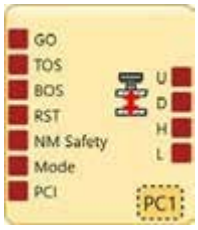



Figure 124: Press control




inputFigure 125: Press control function block

### 10.2.3 Examples of function blocks for press control

This section contains two example configurations.
Below you will find an example of a simple configuration for a small press.

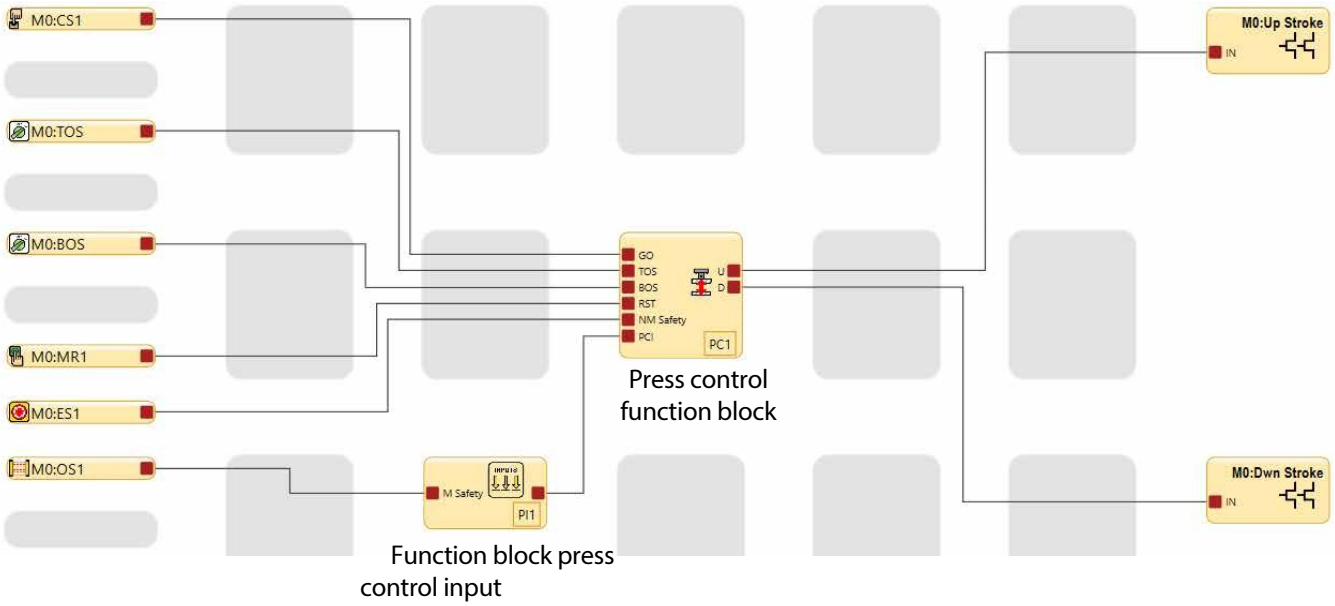



Figure 126: Example configuration for a small press

The press control function block requires the correct sequence of input signals for proper operation. ES1, OS1 and TOS must be in the "Run" state (and have been reset) before the CS1 input can switch on the corresponding output. As soon as the CS1 input has started the process, either the ES1 input, the OS1 input or the end of the cycle (TOS switches back on) has the authority to switch off. See the timing diagram below or the simulation description in "8.5.1 SCx: Simple press control with changeable safety input example configuration" on page 88.
The following time diagram shows the correct sequence of the inputs of the press control function block, which leads to correct operation of the outputs when single drive control is activated.

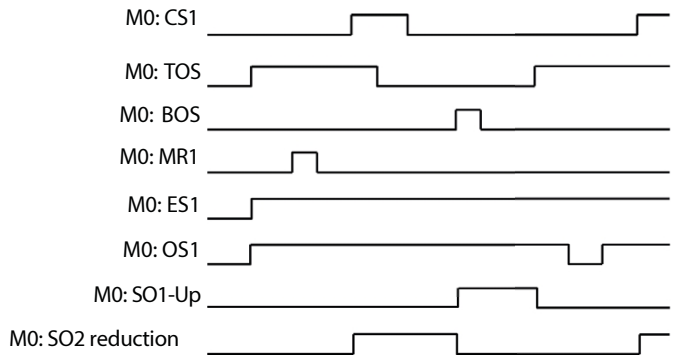



Figure 127: Timing diagram for press control, control with one actuator

The following shows a configuration that uses most of the functions of the Press Control function block.

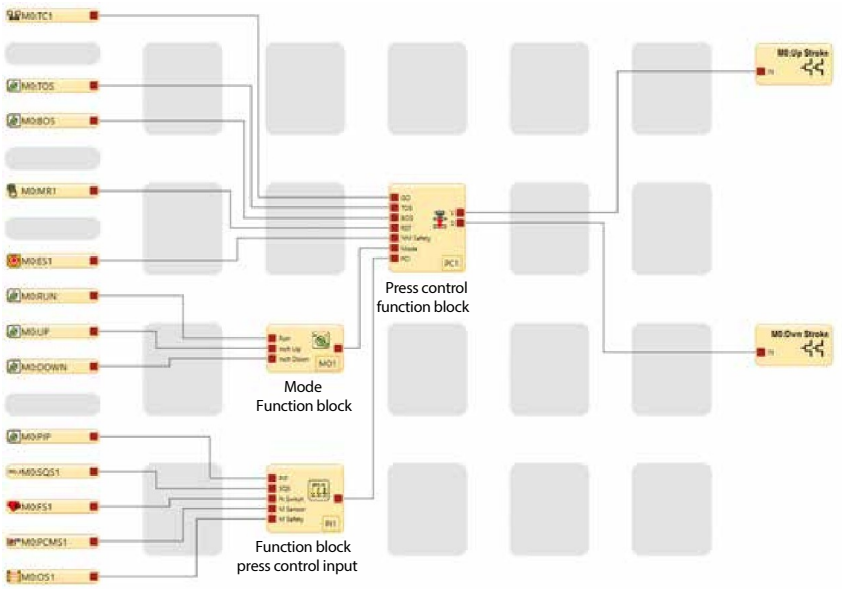



Figure 128: Press control - example configuration

The press control function block requires the correct sequence of input signals for proper operation. This configuration uses the manual upstroke setting. ES1, OS1, PIP and TOS must be in the Run state (and have been reset) before the TC1 input can switch on the corresponding output.
During the downstroke, the TC1 input starts the process and the ES1 input, OS1 input, TC1 input or reaching the sequential stop input (SQS turns on) has the authority to turn off. When the press reaches the SQS point (SQS and PCMS switch on), it stops and the OS1 is muted. The TC1 can be released. To end the stroke, switch on the FS1 input.
During the rest of the
For downward strokes, the ES1 input, the FS1 input or the BOS (switch on) has the authority to switch off. When BOS is reached, the FS1 input is enabled and TC1 is used to return the press to the TOS position.
During the upstroke, the TC1 input, the ES1 input, the OS1 input or reaching the TOS position have the switch-off authorization. See the time table below or the simulation description in SCx: "8.5.2 SCx: Example configuration of the press control with all functions" on page 90.
The following timing diagram shows the correct sequence of the inputs of the press control function block, which results in correct operation of the outputs when the manual upstroke setting is activated.

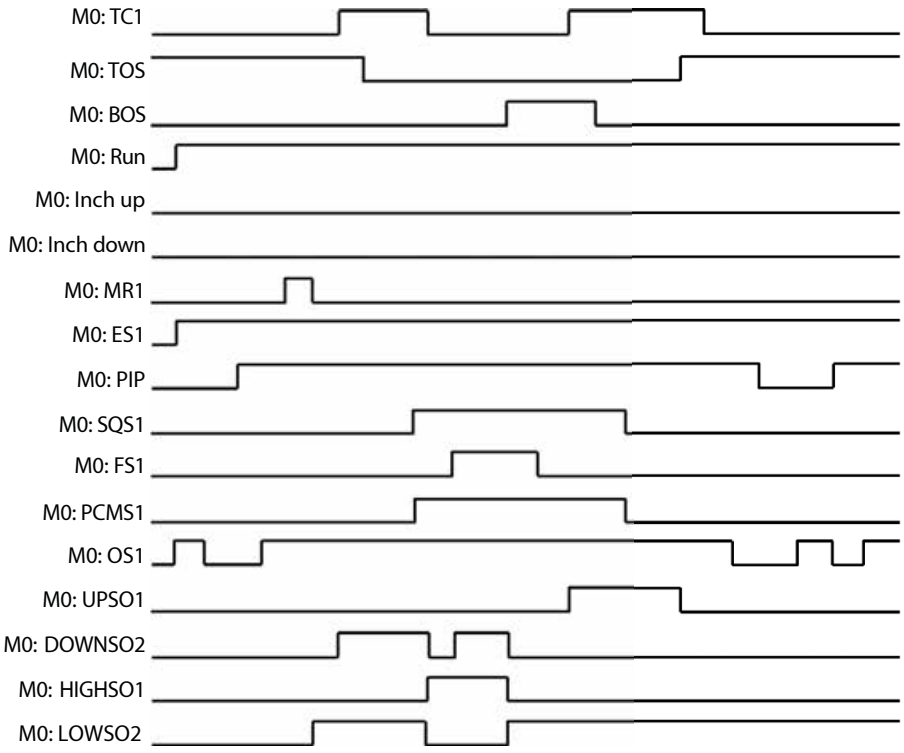



Figure 129: Press control timing diagram with manual upward stroke setting

### 10.3.1 Closed control loop

The press control function block offers the option of activating closed-loop control.
By activating closed-loop control, the controller is forced to check whether the devices connected to the specified outputs are switched off when the signal to switch off is given before the next output is enabled to switch on.
For use of the closed control loop:

1. An AVM node must be added to the desired safety output, which is controlled by the Press Control function block.
2. The AVM input provides information about the status of the respective press valve.
3. The press control function block must be configured for closed-loop control for each output. See the properties of the press control in the following illustration.

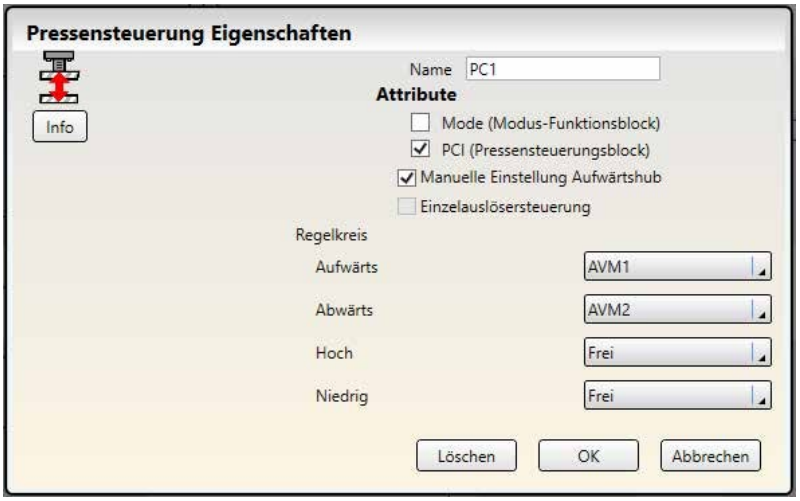



Figure 130: Closed control loop

In this example, the closed-loop control is set to ensure that the Up output valve is switched off before allowing other functions. It also ensures that the "Up" valve is closed before the "Up" output is activated.

## 10.3 Two-hand control block

| Standard node | Additional nodes | Notes |
|---|---|---|
| TC (up to 4 TC nodes) | IN<br>MP<br>ME | The inputs for two-hand controls must be connected either directly to a two-hand control block or indirectly via a bridging block connected to a two-hand control block. It is not possible to use an input for a two-hand control without a two-hand control block. The IN node can be used to connect input devices that must first be switched on before the two-hand control can switch on the outputs. |

**Two-hand control functi block**

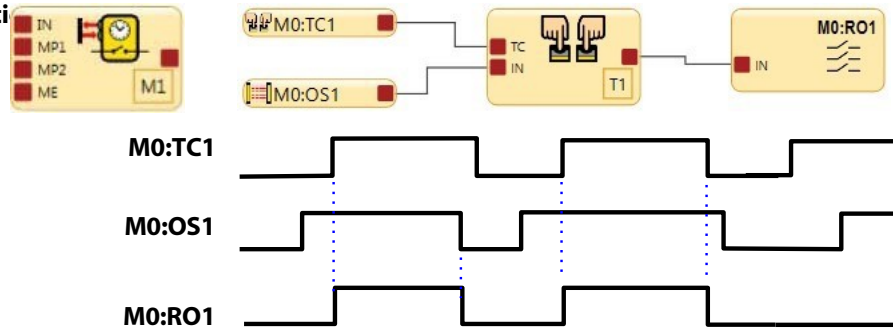



Figure 131: Timing diagram: Two-hand control block

Either the TC1 input or the OS1 input has switch-off priority. OS1 must be in the on state before TC1 can switch on the output of T1 and RO1.

**Two-hand control and bridging functions on blocks**

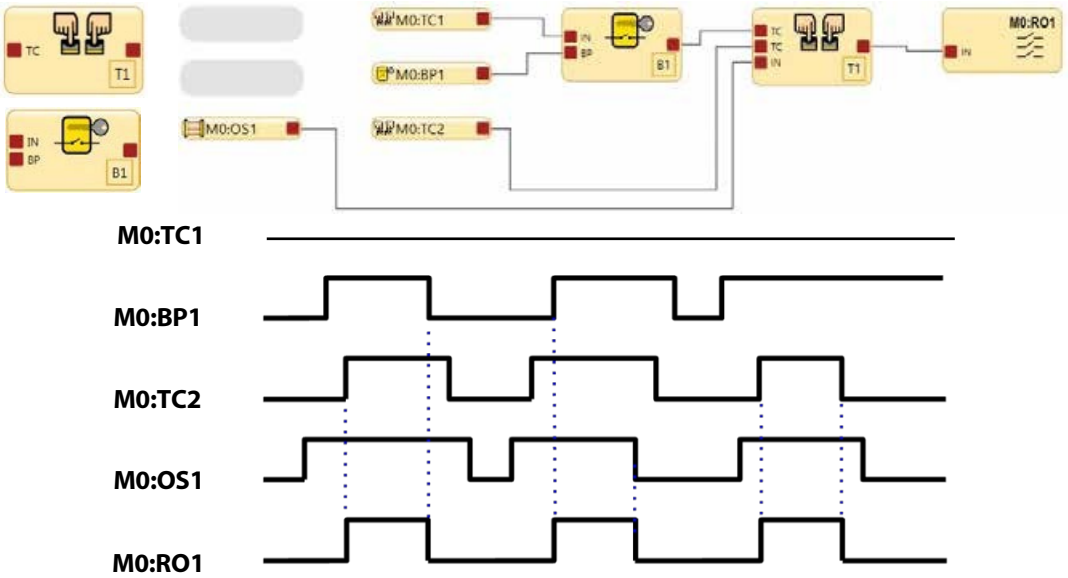



Figure 132: Timing diagram: Two-hand control block and bridging blocks

The two-hand control elements TC2 and the bypass switch BP1 must be in the on state and they must be the last devices in the time sequence to switch to the on state in order for the TC1 function block to switch on.

**Two-hand control and bridging function blocks**

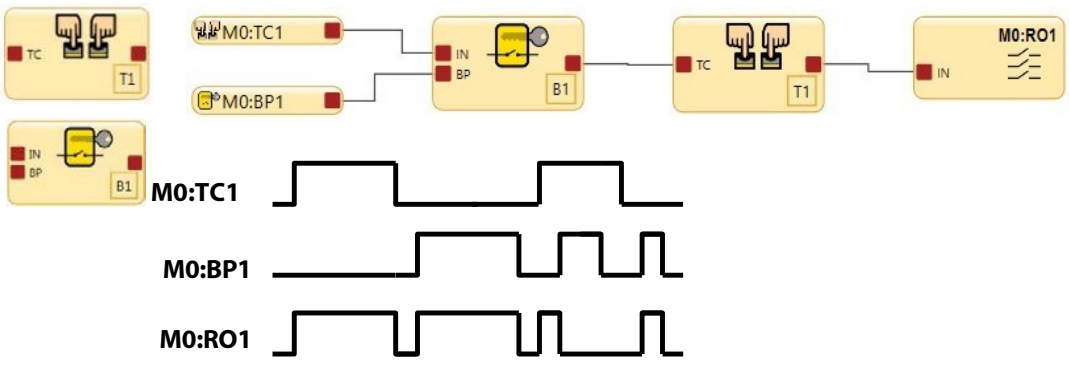



Figure 133: Timing diagram: Two-hand control block and bypass blocks with 1 i n p u t for two-hand control

If the TC1 controls and the BP1 bypass switch are active at the same time, the output of the B1 bypass function block and the output of the two-hand control function block switch off.
The outputs for B1 and T1 only switch on when either the TC1 operating elements or the BP1 switch are in the on state.

## Two-hand control and bridging function blocks

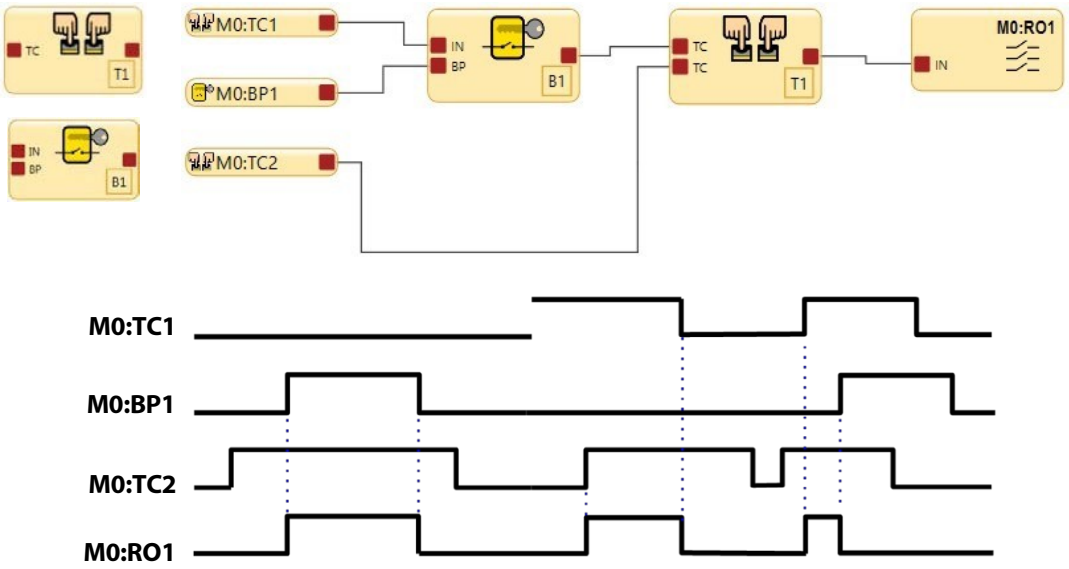



Figure 134: Timing diagram: Two-hand control block and bridging blocks with 2 inputs for two-hand control

The override function can be used with the TC2 controls to switch on the safety output.
If the TC1 controls are not bypassed, they must be used together with the TC2 controls to switch on the safety output. If the TC1 controls and the override switch are both in the on state, TI and RO1 cannot be switched on or will switch off.

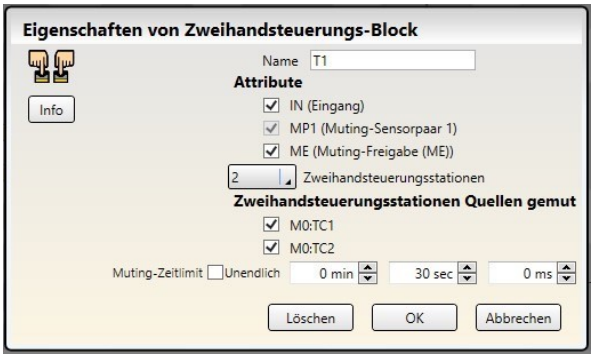



Figure 135: Muting options for two-hand controls

To configure the muting option for two-hand control, the TC control elements must first be connected to the two-hand control function block in the function view. The checkboxes (blue square at the top) in the Properties menu show the names of all input devices for
TC operating elements. Only the station fields of the two-hand control whose checkboxes are activated are muted.

**Two-hand control with muting:**

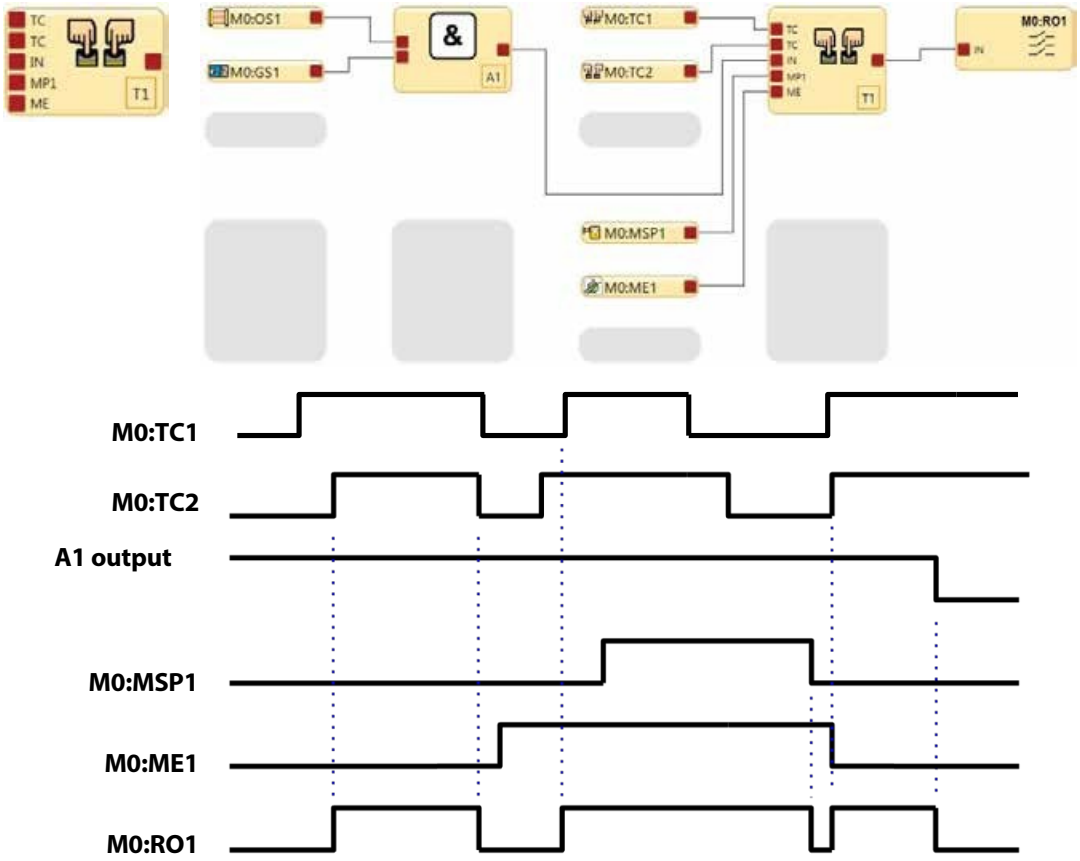



Figure 136: Timing diagram: Two-hand control block with muting

The control elements C1 and TC2 can initiate a two-hand cycle if the muting enable ME1 is not active.
ME1 must be active so that the MSP1 muting sensors leave SO switched on after the TC1 and TC2 operating elements have switched to the stop state.

**Protection of the two-hand control against activation on start-up.** The logic of the two-hand control of the safety evaluation unit does not allow the assigned safety output to switch on when the operating voltage is applied as long as the operating elements of the two-hand control are in the On state. The operating elements of the two-hand control must switch to the Off state and back to the On state before the safety output can switch on. Safety outputs that are assigned to a two-hand control device do not have a manual reset option.

## 10.4 Two-hand control block (SCx FID 4 and higher and SCR P FID 2 and higher)

With SCx and SCR P, the TC input can be mapped directly to an output or a logic block. The two-hand control function block can be mapped directly to an output or a logic block.
If the machine has several operators and each operator has to operate their two-hand control, use the two-hand control function block, in which several TC inputs can be selected.
If the system has a hold function (TC inputs that trigger an action that makes it safe, then operators can remove their hands while the process is completed), use the two-hand control function block with the muting function selected.
If the machine has certain safety features that must be (and remain) fulfilled for the TC input to allow the machine to operate, use the two-hand control function block with the IN node selected.

- If the IN node is switched off, activating the two-hand input does not result in any actions.
- If the Two-Hand Control function block is switched on and the TC block is switched off, the output switches off.
- If the IN node goes back to "High", the output remains switched off until the TC inputs go to "Off" and back to "High".

**WARNING:**

- Two-hand controls are starting devices (trigger a dangerous movement).
- Failure to follow these instructions may result in serious injury or death.
- The competent person must ensure that the activation (transition to the ON state) of a stopping safety device (emergency stop, rope pull, optical sensor, safety mat, safety stop, etc.) by a user does not trigger a dangerous movement if it is logically connected to an already activated TC input or a two-hand control function block
(ON state).

## 11. SCx onboard interface

With the exception of special settings, the integrated interface of the SCx safety controller displays the System status screen when it is switched on

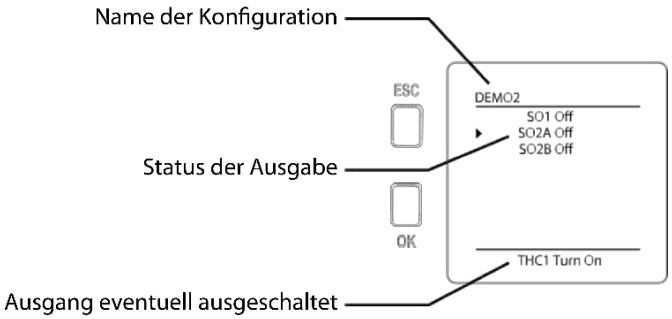



Figure 137: Onboard interface at startup

To access other information via the integrated interface, press the Escape button to open the to call up the **system menu**.


Figure 138: Onboard **interface system menu**

**System status**

Displays the current status of the safety outputs and, if selected, the inputs connected to this output (see Figure 156 on page 163).

**Fault diagnosis**

Displays the current errors, the error log and an option to delete the error log (see Searching for and rectifying errors on page 334).

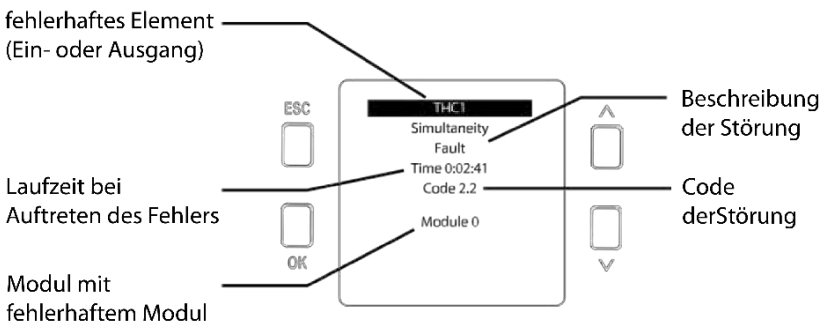



Figure 139: Integrated interface fault diagnosis

Use the arrow buttons to navigate to other error codes.

**Configuration mode**

Enters configuration mode (password required) and allows access to copy or write the configuration to and from the SCR P-FPS drive (see "11.1 SCx configuration mode" on page 155).

**Summary of the configuration**

Enables access to terminal assignments, network settings and the CRC configuration.

**Model #**

Displays the current model number and the versions of the individual microcontrollers.

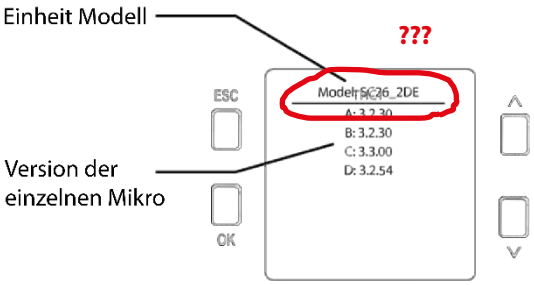



Figure 140: On-board interface - model #

If extension modules are connected to the safety controller, use the arrow buttons to display the versions of the extension modules.

**Setting the display contrast**

Allows you to set the display brightness.

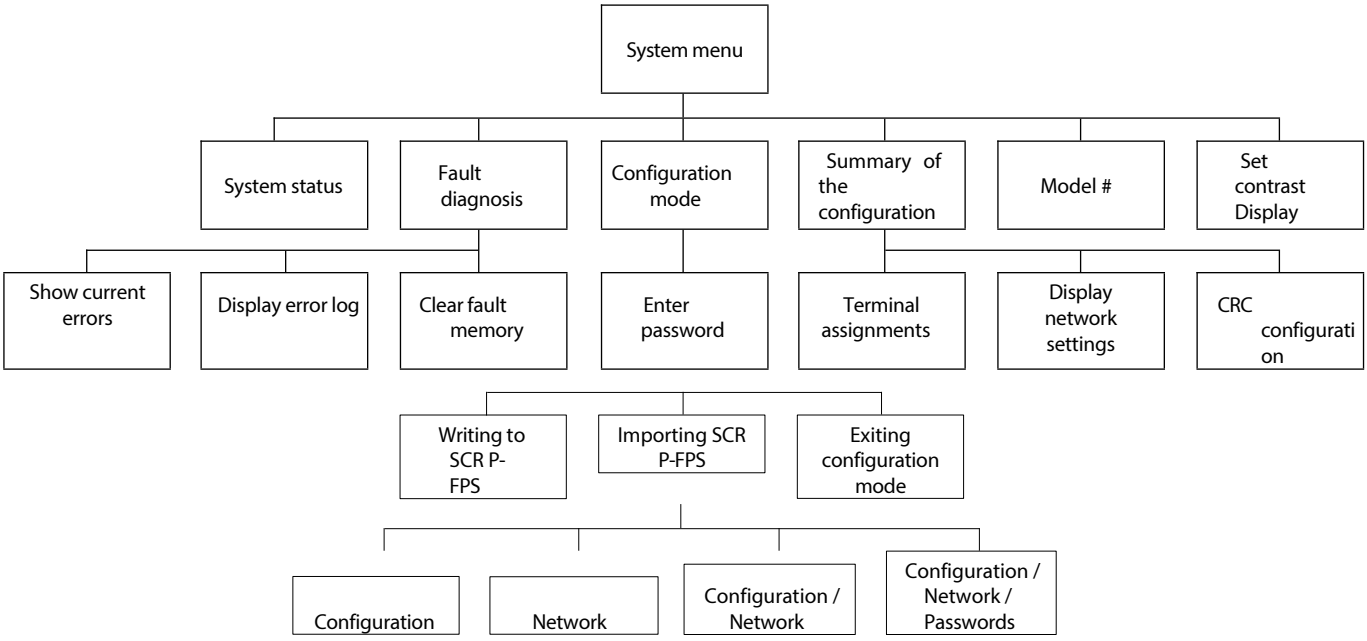



Figure 141: Map of the onboard interface

### 11.1 SCx-K onfiguration mode

The configuration mode offers options for sending the current configuration to an SCR P-FPS drive and for receiving a configuration from the SCR P-FPS drive.

**Note:** A password is required to access the **"Configuration mode"** menu

**Important:** The safety outputs are switched off when **configuration mode** is called up.

**For writing data to the SCR P-FPS drive via the integrated interface:**

1. Connect the SCR P-FPS to the safety controller.
2. Select the **Configuration mode** option in the **system menu**.
3. Enter the password.
4. Press and hold **OK** until the **Configuration mode** menu appears.
5. Select Write to **SCR P-FPS**.

**Note:** When writing to the SCR P-FPS, all data (configuration, network settings and passwords) are copied to the SCR P-FPS drive.

6. Wait until the write process is complete.
7. Reset the system.

**To import data from the SCR P-FPS drive via the integrated interface:**

1. Connect the SCR P-FPS drive to the safety control unit.
2. Select the **Configuration mode** option in the **system menu**.
3. Enter the password.
4. Press and hold **OK** until the **Configuration mode** menu appears.
5. Select **Import from SCR P-FPS**:
   - For configuration only, select **Configuration**
   - For the network settings only, select **Network settings**
   - For configuration and network settings, select Configuration/Network
   - For all data, i.e. configuration, network settings and user passwords, select **Configuration/Network/Passwords**
6. Wait until the import process is complete.
7. Reset the system.

# 12. Industrial Ethernet - Overview

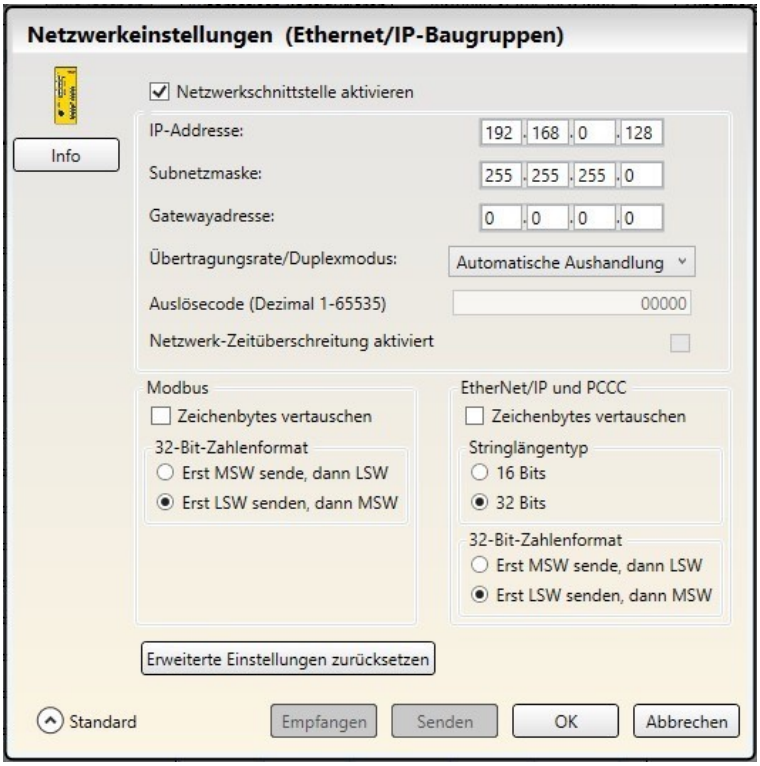
## 12.1 Configuration of the safety evaluation

Make sure that the **Enable network interface** option is checked and the network settings are configured according to the selected protocol.

1. Connect the safety evaluation unit to the PC via the USB cable.
2. Open the configuration software for the BERNSTEIN safety evaluation system.
3. Click on **Network settings**.
4. Select the **Enable network interface** checkbox**.**
5. Configure the IP address and subnet mask according to your network.

**Note:** When using DCD devices, only the overall output signal of the series/chain is simulated, not that of the individual devices.

6. Click on **Send**.
7. Click on the **Advanced** arrow to configure the advanced network settings if necessary. The default values for the Ethernet port and the Industrial Ethernet of the safety evaluation unit are specified below.




8. Enter the corresponding password to change the configuration and network settings for the security evaluation.
9. Make sure that the security evaluation has a valid and confirmed configuration file. The Ethernet port is

activated.

## 12.2 Industrial Ethernet - Definitions

The following are descriptions of the table rows and columns (in alphabetical order) for the tabs of the **Industrial Ethernet** view in the software.

| Data type | Description |
|---|---|
| **UINT** | Unsigned integer (unsigned integer) - 16 bit |
| **UDINT** | Unsigned double integer (unsigned double integer) - 32 bit |
| **Word (word)** | Bit string (bit character string) - 16 bits |
| **Dword (data word)** | Bit string (bit string) - 32 bits |
| **String (character string)** | Two ASCII characters per word (see protocol-based string information below) |
| **Octet (Octet)** | Represents each byte as a decimal number separated by a dot |
| **Hex (hexadecimal number)** | Represents each half-byte as a hexadecimal number in pairs and separated by spaces |
| **Byte** | Bit string (bit string) - 8 bits |

Table 4: Data types

**Byte:Bit**

Specifies the byte offset followed by the specific bit.

**Error flag**

If a particular tracked input or output causes a blocking state, a flag associated with that virtual output is set to 1. In Modbus/TCP, this can be read as a discrete input signal, input register or the input and output register.

**Error index**

If the error flag bit is set for a virtual output, the error index contains a number that is translated into an error code. Example: An error index 41 can contain a number 201, which is translated into error code 2.1; the number 412 would be translated into error code 4.12 ("15.6 SCR P error code table" on page 249 for more information).

**Function**

The function that determines the status of the relevant virtual output. Operating mode

**Operating mode**

| Value for operating mode | Description |
|---|---|
| 1 (0x01) | Normal operation (including I/O errors, if present) |
| 2 (0x02) | Configuration mode |
| 4 (0x04) | System lock |
| 65 (0x41) | Waiting for system reset/exiting configuration mode |
| 129 (0x81) | Calling up the configuration mode |

**Reg:Bit**

Specifies the offset of 30000 or 40000 followed by the specific bit in the register.

**Reserved**

Registers that are reserved for internal use.

**Seconds since system start**

The time in seconds since the safety evaluation system was switched on. Can be used in conjunction with the time stamp in the error log and a real-time clock reference to determine the time at which an error occurred.

**String (Ethernet/IP and PCCC protocol)**

The standard format for the Ethernet/IP character string format has a length of 32 bits, which precedes the character string (suitable for ControlLogix). When configuring the **network settings** via the software, you can change this setting to a length of 16 bits. This corresponds to the standard CIP
"String" in the **Advanced** menu**.** However, when reading an input group that contains a string with a length of 16 bits, the string length is preceded by an additional 16-bit word (0x0000).
The string itself is a packed ASCII expression (2 characters per word). In some systems, the character order may appear reversed or mixed up. For example, the word "System" can appear as
"yStsme" should be displayed. You can change the characters so that the words can be read correctly. To do this, select the "Swap character bytes" option in the **Advanced** menu in the **Network settings** window.

**String (Modbus/TCP protocol)**

The string format is a packed ASCII expression (2 characters per word). In some systems, the character order may appear reversed or mixed up. For example, the word "System" may be displayed as "yStsme". You can change the characters so that the words can be read correctly. To do this, select the "Swap character bytes" option in the Advanced menu in the **Network settings** window.
Although the string length is specified, this is not usually required for Modbus/TCP systems. If the string length for Modbus/TCP is used, the length format corresponds to the settings used for Ethernet/IP.

**Timestamp**

The time in seconds after the grid connection at which the error occurred.

**Virtual status output**

The reference characteristic value associated with a specific virtual status output, for example VO10 denotes virtual status output 10.

**VO status**

Specifies the storage location of a bit that indicates the status of a virtual status output. In the case of Modbus/TCP, the status of the virtual status output can be read as a discrete input signal, as part of an input register or an input and output register. The specified register is the offset of 30000 or 40000, followed by the specific bit location in the register

## 12.3 Retrieving current error information

Follow the steps described below to retrieve information about network communications for a currently existing error:

- Read the Error index location to retrieve the error index value.
- Search for the index value in the "15.6 SCR P error code table" on page 249 to call up an error description and steps for rectifying the error.

## 12.4 EtherNet/IP™

In this context, EtherNet/IP™ refers specifically to EtherNet/IP transport class 1, which is sometimes also referred to as cyclic EtherNet/IP I/O data transmission or implicit message transmission. The connection provides near-real-time data transmission to and from the PLC and the target device.

**VO status/error (100):**

- O>T PLC output/safety evaluation input module 112 (0×70), size 2 16-bit registers
- T>O PLC input/safety evaluation output module 100 (0×64), size 8 16-bit registers

**Error index words (101):**

- O>T PLC output/safety evaluation input module 112 (0×70), size 2 16-bit registers
- T>O PLC input/ safety evaluation output Module 101 (0×65), size 104 16-bit registers

**Error log only (102):**

- O>T PLC output/safety evaluation input module 112 (0×70), size 2 16-bit registers
- T>O PLC input/ safety evaluation output Module 102 (0×66), size 150 16-bit registers

**Reset/cancel delay (103):**

- O>T PLC output/safety evaluation input module 112 (0×70), size 2 16-bit registers
- T>O PLC input/safety evaluation output Module 103 (0×67), size 35 16-bit registers

**VI- Status/error (100):**[15]

- O>T PLC output/safety evaluation input module 113 (0×71), size 11 16-bit registers
- T>O PLC input/safety evaluation output module 100 (0×64), size 8 16-bit registers

**Error index words (101):** [15]

- O>T PLC output/safety evaluation input module 113 (0×71), size 11 16-bit registers
- T>O PLC input/safety evaluation output Module 101 (0×65), size 104 16-bit registers

**VI- Reset/cancel delay (103):** [15]

- O>T PLC output/safety evaluation input module 113 (0×71), size 11 16-bit registers
- T>O PLC input/safety evaluation output module 103 (0×67), size 35 16-bit registers

**VRCD Plus DCD (104)**:[15]

- O>T PLC output/safety evaluation input module 114 (0×72), size 14 16-bit registers
- T>O PLC input/safety evaluation output module 104 (0×68), size 112 16-bit registers

### 12.4.1 Safety evaluation inputs (outputs from the PLC) O > T

The safety evaluation can use instance 112 (0×70) with a size of two registers (16-bit) to send the virtual inputs 1-32.

| WORD # | WORD NAME | DATA TYPE |
|---|---|---|
| 0 | Virtual input On/Off (1-16) | 16-bit integer |
| 1 | Virtual input on/off (17-32) | 16-bit integer |

Table 5: Table 2: PLC output module instance 112 (0×70) - Safety evaluation inputs O > T

15 Select one of the connections O > T assembly instance 113 (0×71) or 114 (0×72) to use the virtual input/termination delay

### 12.4.2 Inputs Safety evaluation (outputs from the PLC) O > T

The safety evaluation uses instance 113 (0x71) with a size of eleven registers (16-bit) for the input module (PLC output) when sending virtual inputs, resets and abort delays.

| WORD # | WORD NAME | DATA TYPE |
|---|---|---|
| 0 | Virtual input On/Off (1-16) | 16-bit integer |
| 1 | Virtual input on/off (17-32) | 16-bit integer |
| 2 | Virtual input on/off (33-48) | 16-bit integer |
| 3 | Virtual input on/off (49-64) | 16-bit integer |
| 4 | reserved | 16-bit integer |
| 5 | reserved | 16-bit integer |
| 6 | reserved | 16-bit integer |
| 7 | reserved | 16-bit integer |
| 8 | Virtual reset/cancel delay (1-16) [RCD register bits] (see "7.7.1 Virtual manual reset and canceling a time delay (RCD)" on page 57) | 16-bit integer |
| 9 | reserved | 16-bit integer |
| 10 | RCD trigger code [RCD activation register] (see "7.7.1 Virtual manual reset and canceling a time delay (RCD)" on page 57) | 16-bit integer |

Table 6: PLC output module instance 113 (0x71) - Safety evaluation inputs O > T

### 12.4.3 Inputs Safety evaluation (outputs from the PLC) O > T

The safety evaluation uses instance 114 (0×72) with a size of 14 registers (16-bit) as its input group (PLC output) when it retrieves virtual inputs, resets and abort delays and to retrieve power and status information on the DCD devices.

| WORD # | WORD NAME | DATA TYPE |
|---|---|---|
| 0 | Virtual input On/Off (1-16) | 16-bit integer |
| 1 | Virtual input on/off (17-32) | 16-bit integer |
| 2 | Virtual input on/off (33-48) | 16-bit integer |
| 3 | Virtual input on/off (49-64) | 16-bit integer |
| 4 | reserved | 16-bit integer |
| 5 | reserved | 16-bit integer |
| 6 | reserved | 16-bit integer |
| 7 | reserved | 16-bit integer |
| 8 | Virtual reset/cancel delay (1-16) [RCD register bits] (see "7.7.1 Virtual manual reset and canceling a time delay (RCD)" on page 57) | 16-bit integer |
| 9 | reserved | 16-bit integer |
| 10 | RCD trigger code [RCD activation register] (see "7.7.1 Virtual manual reset and canceling a time delay (RCD)" on page 57) | 16-bit integer |
| 11 | DCD reading request | 16-bit integer |
| 12 | DCD series requested | 16-bit integer |
| 13 | DCD device requested | 16-bit integer |

Table 7: PLC output module instance 114 (0×72) - Safety evaluation inputs O > T

#### 10.4.3.1Request performance and status information on an individual device via DCD

1. Word 12: Select the DCD series circuit in which the relevant device is connected (1 or 2).
2. Word 13: Select DCD device number (1 to 32).
3. Word 11: Change from 0 to 1 to perform a single read operation.
4. Go to PLC input module instance 104 (0×68), words 103-112, to read the device-specific data response.

### 12.4.4 Configuration module object of the safety evaluation

The safety evaluation does not use a configuration module object.
As some EtherNet/IP clients require this object, use instance 128 (0×80) with a size of zero registers (16-bit).

### 12.4.5 Safety evaluation outputs (inputs to the PLC) T > O

Five options are available for module objects of the safety evaluation outputs.

- The first and smallest option contains information on the virtual outputs and whether there are errors there.
- The second option contains additional extended data such as the reason why the respective safety outputs are inactive, as well as further descriptive error information for the virtual outputs.
- The third option is used exclusively to access the error log of the safety evaluation.
- The fourth option is used for the feedback of the virtual manual resets and the termination of a switch-off delay.
- The fifth option allows access to feedback and DCD information, to the virtual manual reset and the abort delays.

All five options are presented in the following sections.

### 12.4.6 PLC input module instance 100 (0×64) - 8 registers (VO status/error)

This module instance only contains general information on the status of the first 64 virtual outputs.

| WORD # | WORD NAME | DATA TYPE |
|---|---|---|
| 0 | VO1-VO16 (see flags on page 188) | 16-bit integer |
| 1 | VO17-VO32 (see flags on page 188) | 16-bit integer |
| 2 | VO33-VO48 (see flags on page 188) | 16-bit integer |
| 3 | VO49-VO64 (see flags on page 188) | 16-bit integer |
| 4 | Error bits for VO1-VO16 (see Flags on page 188) | 16-bit integer |
| 5 | Error bits for VO17-VO32 (see Flags on page 188) | 16-bit integer |
| 6 | Error bits for VO33-VO48 (see Flags on page 188) | 16-bit integer |
| 7 | Error bits for VO49-VO64 (see Flags on page 188) | 16-bit integer |

Table 8: PLC input module instance 100 (0×64) - Safety evaluation outputs T > O

### 12.4.7 PLC input Assembly instance 101 (0×65) - 104 Registers

(error index words)
The module instance contains the status of the first 64 virtual outputs as well as extended information on possible error codes and the status of the 2 safety outputs.

| WORD # | WORD NAME | DATA TYPE |
|---|---|---|
| 0 | VO1-VO16 (see flags on page 188) | 16-bit integer |
| 1 | VO17-VO32 (see flags on page 188) | 16-bit integer |
| 2 | VO33-VO48 (see flags on page 188) | 16-bit integer |
| 3 | VO49-VO64 (see flags on page 188) | 16-bit integer |
| 4 | Error bits for VO1-VO16 (see Flags on page 188) | 16-bit integer |
| 5 | Error bits for VO17-VO32 (see Flags on page 188) | 16-bit integer |
| 6 | Error bits for VO33-VO48 (see Flags on page 188) | 16-bit integer |
| 7 | Error bits for VO49-VO64 (see Flags on page 188) | 16-bit integer |
| 8-39 | reserved | 16-bit integer |
| 40 | VO1 error index | 16-bit integer |
| 41 | VO2 error index | 16-bit integer |
| 42 | VO3 error index | 16-bit integer |
| 43 | VO4 error index | 16-bit integer |
| 44 | VO5 error index | 16-bit integer |
| 45 | VO6 error index | 16-bit integer |
| 46 | VO7 error index | 16-bit integer |
| 47 | VO8 error index | 16-bit integer |
| 48 | VO9 error index | 16-bit integer |
| 49 | VO10 error index | 16-bit integer |
| 50 | VO11 error index | 16-bit integer |
| 51 | VO12 error index | 16-bit integer |
| 52 | VO13 error index | 16-bit integer |
| 53 | VO14 error index | 16-bit integer |
| 54 | VO15 error index | 16-bit integer |
| 55 | VO16 error index | 16-bit integer |
| 56 | VO17 error index | 16-bit integer |
| 57 | VO18 error index | 16-bit integer |
| 58 | VO19 error index | 16-bit integer |
| 59 | VO20 error index | 16-bit integer |
| 60 | VO21 error index | 16-bit integer |
| 61 | VO22 error index | 16-bit integer |
| 62 | VO23 error index | 16-bit integer |
| 63 | VO24 error index | 16-bit integer |
| 64 | VO25 error index | 16-bit integer |
| 65 | VO26 error index | 16-bit integer |
| 66 | VO27 error index | 16-bit integer |
| 67 | VO28 error index | 16-bit integer |
| 68 | VO29 error index | 16-bit integer |
| 69 | VO30 error index | 16-bit integer |
| 70 | VO31 error index | 16-bit integer |
| 71 | VO32 error index | 16-bit integer |
| 72 | VO33 error index | 16-bit integer |
| 73 | VO34 error index | 16-bit integer |
| 74 | VO35 error index | 16-bit integer |

| WORD # | WORD NAME | DATA TYPE |
|---|---|---|
| 75 | VO36 error index | 16-bit integer |
| 76 | VO37 error index | 16-bit integer |
| 77 | VO38 error index | 16-bit integer |
| 78 | VO39 error index | 16-bit integer |
| 79 | VO40 error index | 16-bit integer |
| 80 | VO41 error index | 16-bit integer |
| 81 | VO42 error index | 16-bit integer |
| 82 | VO43 error index | 16-bit integer |
| 83 | VO44 error index | 16-bit integer |
| 84 | VO45 error index | 16-bit integer |
| 85 | VO46 error index | 16-bit integer |
| 86 | VO47 error index | 16-bit integer |
| 87 | VO48 error index | 16-bit integer |
| 88 | VO49 error index | 16-bit integer |
| 89 | VO50 error index | 16-bit integer |
| 90 | VO51 error index | 16-bit integer |
| 91 | VO52 error index | 16-bit integer |
| 92 | VO53 error index | 16-bit integer |
| 93 | VO54 error index | 16-bit integer |
| 94 | VO55 error index | 16-bit integer |
| 95 | VO56 error index | 16-bit integer |
| 96 | VO57 error index | 16-bit integer |
| 97 | VO58 error index | 16-bit integer |
| 98 | VO59 error index | 16-bit integer |
| 99 | VO60 error index | 16-bit integer |
| 100 | VO61 error index | 16-bit integer |
| 101 | VO62 error index | 16-bit integer |
| 102 | VO63 error index | 16-bit integer |
| 103 | VO64 error index | 16-bit integer |

PLC input module instance 101 (0×65) - Safety evaluation outputs T > O

**Error index words of a virtual output (VO)**

The error index number of a virtual output can be used to display the error code associated with a specific virtual output as a single 16-bit integer. This value corresponds to the value of the error message index for a specific virtual output. See "15.6 SCR P error code table" on page 249 and "15.5 SCx error code table" on page 243. Note: Not every virtual output has a linked error index.

### 12.4.8 PLC input module instance 102 (0×66) - 150 registers (error log only)

This module instance is used exclusively to access the error log information on the safety evaluation unit.

**Note:** This module instance only contains information on the status of the virtual outputs.

The safety evaluation can save 10 errors in the log. Error no. 1 is the most recent error. The higher the number, the older the error.

| WORD # | WORD NAME | DATA TYPE |
|---|---|---|
| 0-1 | Error no. 1 Timestamp | 32-bit integer |
| 2-9 | Error no. 1 I/O or system name | Double word length + 12 ASCII characters |
| 10 | Error no. 1 Error code | 16-bit integer |
| 11 | Error no. 1 Extended error code | 16-bit integer |
| 12 | Error no. 1 Error message index | 16-bit integer |
| 13-14 | reserved | 16-bit integer |
| 15-16 | Error no. 2 Timestamp | 32-bit integer |
| 17-24 | Error no. 2 I/O or system name | Double word length + 12 ASCII characters |
| 25 | Error no. 2 Error code | 16-bit integer |
| 26 | Error no. 2 Extended error code | 16-bit integer |
| 27 | Error no. 2 Error message index | 16-bit integer |
| 28-29 | reserved | 16-bit integer |
| 30-31 | Error no. 3 Timestamp | 32-bit integer |
| 32-39 | Error no. 3 I/O or system name | Double word length + 12 ASCII characters |
| 40 | Error no. 3 Error code | 16-bit integer |
| 41 | Error no. 3 Extended error code | 16-bit integer |
| 42 | Error no. 3 Error message index | 16-bit integer |
| 43-44 | reserved | 16-bit integer |
| 45-46 | Error no. 4 Timestamp | 32-bit integer |
| 47-54 | Error no. 4 I/O or system name | Double word length + 12 ASCII characters |
| 55 | Error no. 4 Error code | 16-bit integer |
| 56 | Error no. 4 Extended error code | 16-bit integer |
| 57 | Error no. 4 Error message index | 16-bit integer |
| 58-59 | reserved | 16-bit integer |
| 60-61 | Error no. 5 Timestamp | 32-bit integer |
| 62-69 | Error no. 5 I/O or system name | Double word length + 12 ASCII characters |
| 70 | Error no. 5 Error code | 16-bit integer |
| 71 | Error no. 5 Extended error code | 16-bit integer |
| 72 | Error no. 5 Error message index | 16-bit integer |
| 73-74 | reserved | 16-bit integer |
| 75-76 | Error no. 6 Timestamp | 32-bit integer |
| 77-84 | Error no. 6 I/O or system name | Double word length + 12 ASCII characters |
| 85 | Error no. 6 Error code | 16-bit integer |
| 86 | Error no. 6 Extended error code | 16-bit integer |
| 87 | Error no. 6 Error message index | 16-bit integer |
| 88-89 | reserved | 16-bit integer |
| 90-91 | Error no. 7 Timestamp | 32-bit integer |
| 92-99 | Error no. 7 I/O or system name | Double word length + 12 ASCII characters |

| WORD # | WORD NAME | DATA TYPE |
|---|---|---|
| 100 | Error no. 7 Error code | 16-bit integer |
| 101 | Error no. 7 Extended error code | 16-bit integer |
| 102 | Error no. 7 Error message index | 16-bit integer |
| 103-104 | reserved | 16-bit integer |
| 105-106 | Error no. 8 Timestamp | 32-bit integer |
| 107-114 | Error no. 8 I/O or system name | Double word length + 12 ASCII characters |
| 115 | Error no. 8 Error code | 16-bit integer |
| 116 | Error no. 8 Extended error code | 16-bit integer |
| 117 | Error no. 8 Error message index | 16-bit integer |
| 118-119 | reserved | 16-bit integer |
| 120-121 | Error no. 9 Timestamp | 32-bit integer |
| 122-129 | Error no. 9 I/O or system name | Double word length + 12 ASCII characters |
| 130 | Error no. 9 Error code | 16-bit integer |
| 131 | Error no. 9 Extended error code | 16-bit integer |
| 132 | Error no. 9 Error message index | 16-bit integer |
| 133-134 | reserved | 16-bit integer |
| 135-136 | Error no. 10 Timestamp | 32-bit integer |
| 137-144 | Error no. 10 I/O or system name | Double word length + 12 ASCII characters |
| 145 | Error no. 10 Error code | 16-bit integer |
| 146 | Error no. 10 Extended error code | 16-bit integer |
| 147 | Error no. 10 Error message index | 16-bit integer |
| 148-149 | reserved | 16-bit integer |

Table 9: : PLC input module instance 102 (0-66) - Safety evaluation outputs T > O

**Incorrect time stamp**

The relative time in seconds after the error occurred. Measured from time 0, i.e. the last time at which the safety evaluation was switched on.

**I/O or system name**

This is an ASCII string that describes the origin of the error.

**Error code, extended error code, error index message**

The safety evaluation error code is made up of the error code and the extended error code. The format of the error code is error code "dot" extended error code. For example, the safety evaluation error code 2.1 is specified by error code 2 and the extended error code 1. The index value of the error message is the error code and the extended error code together and includes a leading zero with the extended error code if required. For example, the safety evaluation error code 2.1 is indicated by the error message index 201. With the index value of the error message, the complete error code can be conveniently retrieved using only a single 16-bit register value.

### 12.4.9 PLC input module instance 103 (0×67) - 35 registers (reset/abort delay)

This module instance transmits the status of all 256 virtual outputs and errors and provides the necessary feedback information for the execution of virtual reset and abort delays.

| WORD # | WORD NAME | DATA TYPE |
|---|---|---|
| 0 | VO1-VO16 (see flags on page 188) | 16-bit integer |
| 1 | VO17-VO32 (see flags on page 188) | 16-bit integer |
| 2 | VO33-VO48 (see flags on page 188) | 16-bit integer |
| 3 | VO49-VO64 (see flags on page 188) | 16-bit integer |
| 4 | VO65-VO80 (see Extended flags on page 189) | 16-bit integer |
| 5 | VO81-VO96 (see Extended flags on page 189) | 16-bit integer |
| 6 | VO97-VO112 (see Extended flags on page 189) | 16-bit integer |
| 7 | VO113-VO128 (see Extended flags on page 189) | 16-bit integer |
| 8 | VO129-VO144 (see Extended flags on page 189) | 16-bit integer |
| 9 | VO145-VO160 (see Extended flags on page 189) | 16-bit integer |
| 10 | VO161-VO176 (see Extended flags on page 189) | 16-bit integer |
| 11 | VO177-VO192 (see Extended flags on page 189) | 16-bit integer |
| 12 | VO193-VO208 (see Extended flags on page 189) | 16-bit integer |
| 13 | VO209-VO224 (see Extended flags on page 189) | 16-bit integer |
| 14 | VO225-VO240 (see Extended flags on page 189) | 16-bit integer |
| 15 | VO241-VO256 (see Extended flags on page 189) | 16-bit integer |
| 16 | Error bits for VO1-VO16 (see Flags on page 188) | 16-bit integer |
| 17 | Error bits for VO17-VO32 (see Flags on page 188) | 16-bit integer |
| 18 | Error bits for VO33-VO48 (see Flags on page 188) | 16-bit integer |
| 19 | Error bits for VO49-VO64 (see Flags on page 188) | 16-bit integer |
| 20 | Error bits for VO65-VO80 (see Extended flags on page 189) | 16-bit integer |
| 21 | Error bits for VO81-VO96 (see Extended flags on page 189) | 16-bit integer |
| 22 | Error bits for VO97-VO112 (see Extended flags on page 189) | 16-bit integer |
| 23 | Error bits for VO113-VO128 (see Extended flags on page 189) | 16-bit integer |
| 24 | Error bits for VO129-VO144 (see Extended flags on page 189) | 16-bit integer |
| 25 | Error bits for VO145-VO160 (see Extended flags on page 189) | 16-bit integer |
| 26 | Error bits for VO161-VO176 (see Extended flags on page 189) | 16-bit integer |
| 27 | Error bits for VO177-VO192 (see Extended flags on page 189) | 16-bit integer |
| 28 | Error bits for VO193-VO208 (see Extended flags on page 189) | 16-bit integer |
| 29 | Error bits for VO209-VO224 (see Extended flags on page 189) | 16-bit integer |
| 30 | Error bits for VO225-VO240 (see Extended flags on page 189) | 16-bit integer |
| 31 | Error bits for VO241-VO256 (see Extended flags on page 189) | 16-bit integer |

| WORD # | WORD NAME | DATA TYPE |
|---|---|---|
| 32 | Virtual reset/cancel delay (1-16) Feedback [RCD feedback register bits] (see Virtual manual reset and cancel delay sequence (RCD) on page 52) | 16-bit integer |
| 33 | reserved | 16-bit integer |
| 34 | RCD trigger code feedback [RCD activation feedback register] (see Virtual manual reset and abort delay sequence (RCD) on page 52. | 16-bit integer |

Table 10: PLC input module instance 103 (0-67) - Safety evaluation outputs T > O

### 12.4.10 PLC input module instance 104 (0×68) - 112 Register (reset/cancel delay + DCD)

This module instance transmits the status of all 256 virtual outputs and errors and provides the necessary feedback information for the execution of virtual reset and abort delays. It also transmits the power and status information for DCD devices.

| WORD # | WORD NAME | DATA TYPE |
|---|---|---|
| 0 | VO1-VO16 (see flags on page 188) | 16-bit integer |
| 1 | VO17-VO32 (see flags on page 188) | 16-bit integer |
| 2 | VO33-VO48 (see flags on page 188) | 16-bit integer |
| 3 | VO49-VO64 (see flags on page 188) | 16-bit integer |
| 4 | VO65-VO80 (see Extended flags on page 189) | 16-bit integer |
| 5 | VO81-VO96 (see Extended flags on page 189) | 16-bit integer |
| 6 | VO97-VO112 (see Extended flags on page 189) | 16-bit integer |
| 7 | VO113-VO128 (see Extended flags on page 189) | 16-bit integer |
| 8 | VO129-VO144 (see Extended flags on page 189) | 16-bit integer |
| 9 | VO145-VO160 (see Extended flags on page 189) | 16-bit integer |
| 10 | VO161-VO176 (see Extended flags on page 189) | 16-bit integer |
| 11 | VO177-VO192 (see Extended flags on page 189) | 16-bit integer |
| 12 | VO193-VO208 (see Extended flags on page 189) | 16-bit integer |
| 13 | VO209-VO224 (see Extended flags on page 189) | 16-bit integer |
| 14 | VO225-VO240 (see Extended flags on page 189) | 16-bit integer |
| 15 | VO241-VO256 (see Extended flags on page 189) | 16-bit integer |
| 16 | Error bits for VO1-VO16 (see Flags on page 188) | 16-bit integer |
| 17 | Error bits for VO17-VO32 (see Flags on page 188) | 16-bit integer |
| 18 | Error bits for VO33-VO48 (see Flags on page 188) | 16-bit integer |
| 19 | Error bits for VO49-VO64 (see Flags on page 188) | 16-bit integer |
| 20 | Error bits for VO65-VO80 (see Extended flags on page 189) | 16-bit integer |
| 21 | Error bits for VO81-VO96 (see Extended flags on page 189) | 16-bit integer |
| 22 | Error bits for VO97-VO112 (see Extended flags on page 189) | 16-bit integer |
| 23 | Error bits for VO113-VO128 (see Extended flags on page 189) | 16-bit integer |
| 24 | Error bits for VO129-VO144 (see Extended flags on page 189) | 16-bit integer |
| 25 | Error bits for VO145-VO160 (see Extended flags on page 189) | 16-bit integer |
| 26 | Error bits for VO161-VO176 (see Extended flags on page 189) | 16-bit integer |
| 27 | Error bits for VO177-VO192 (see Extended flags on page 189) | 16-bit integer |

| WORD # | WORD NAME | DATA TYPE |
|---|---|---|
| 28 | Error bits for VO193-VO208 (see Extended flags on page 189) | 16-bit integer |
| 29 | Error bits for VO209-VO224 (see Extended flags on page 189) | 16-bit integer |
| 30 | Error bits for VO225-VO240 (see Extended flags on page 189) | 16-bit integer |
| 31 | Error bits for VO241-VO256 (see Extended flags on page 189) | 16-bit integer |
| 32 | Virtual reset/cancel delay (1-16) Feedback [RCD feedback register bits] (see Virtual manual reset and cancel delay sequence (RCD) on page 52) | 16-bit integer |
| 33 | reserved | 16-bit integer |
| 34 | RCD trigger code feedback [RCD activation feedback register] (see Virtual manual reset and abort delay sequence (RCD) on page 52) | 16-bit integer |
| 35-36 | DCD system status - row 1 Number of devices | 32-bit integer |
| 37-38 | DCD system status - Series 2 Number of devices | 32-bit integer |
| 39-40 | DCD system status - row 1 Device on/off status | 32-bit integer |
| 41-42 | DCD system status - row 2 Device on/off status | 32-bit integer |
| 43-44 | DCD system status - row 1 Error status | 32-bit integer |
| 45-46 | DCD system status - row 2 Error status | 32-bit integer |
| 47-48 | DCD system status - row 1 actuator in the edge area | 32-bit integer |
| 49-50 | DCD system status - row 2 actuators in the edge area | 32-bit integer |
| 51-52 | DCD system status - row 1 Warning status | 32-bit integer |
| 53-54 | DCD system status - row 2 Warning status | 32-bit integer |
| 55-56 | DCD system status - row 1 Reset status | 32-bit integer |
| 57-58 | DCD system status - row 2 Reset status | 32-bit integer |
| 59-60 | DCD system status - Series 1 trigger detected | 32-bit integer |
| 61-62 | DCD system status - row 2 triggers detected | 32-bit integer |
| 63-64 | DCD system status - row 1 System status | 32-bit integer |
| 65-66 | DCD system status - row 2 System status | 32-bit integer |
| 67-99 | reserved | 16-bit integer |
| 100 | DCD reading request confirmation | 16-bit integer |
| 101 | DCD series (requested) Confirmation | 16-bit integer |
| 102 | DCD device (requested) Confirmation | 16-bit integer |
| 103-112 | Specific data of individual DCD devices (see Specific data of individual DCD devices on page 219) | 16-bit integer |

Figure 142: PLC input module instance 104 (0-68) - Safety evaluation outputs T > O

### 12.4.11 Error examples

The following illustration shows an error from the error log of the safety evaluation configuration software.

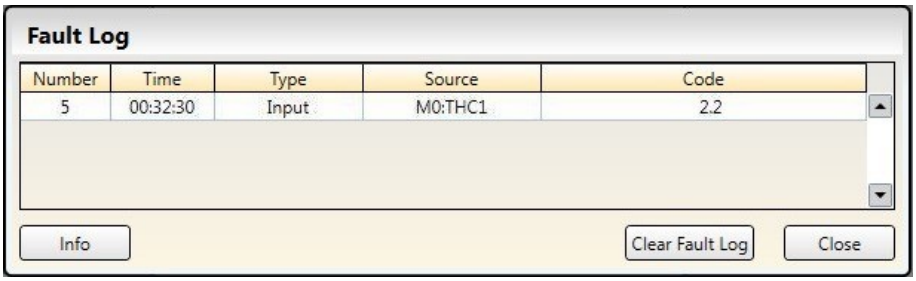



Figure 143: Error log with 1 error

The following figure shows the same error as can be seen in the Ethernet/IP registers.

| | | | | |
|---|---|---|---|---|
| - SCx or SCR P: I | {...} | {...} | | AB:ETHER |
| - SCx or SCR P: I.Data | {...} | {...} | Decimal | INT[150] |
| + SCx or SCR P: I.Data[0] | 1950 | | Decimal | INT |
| + SCx or SCR P: I.Data[1] | 0 | | Decimal | INT |
| + SCx or SCR P: I.Data[2] | 4 | | Decimal | INT |
| + SCx or SCR P: I.Data[3] | 0 | | Decimal | INT |
| + SCx or SCR P: I.Data[4] | 'HT' | | ASCII | INT |
| + SCx or SCR P: I.Data[5] | '1C' | | ASCII | INT |
| + SCx or SCR P: I.Data[6] | 0 | | Decimal | INT |
| + SCx or SCR P: I.Data[7] | 0 | | Decimal | INT |
| + SCx or SCR P: I.Data[8] | 0 | | Decimal | INT |
| + SCx or SCR P: I.Data[9] | 0 | | Decimal | INT |
| + SCx or SCR P: I.Data[10] | 2 | | Decimal | INT |
| + SCx or SCR P: I.Data[11] | 2 | | Decimal | INT |
| + SCx or SCR P: I.Data[12] | 202 | | Decimal | INT |
| + SCx or SCR P: I.Data[13] | 34 | | Decimal | INT |
| + SCx or SCR P: I.Data[14] | 1 | | Decimal | INT |

Figure 144: EtherNet/IP register with 1 error

Note the ControlLogix string format in which the ASCII characters are specified: two per register, downwards. "THC1" becomes "HT" in register 4, followed by "1C" in register 5.
Error number 202 = error code 2.2 (simultaneity error). Further information on errors can be found at "15.5 SCx error code table" on page 243.
The following figure shows two errors in the error log of the SCR P software.

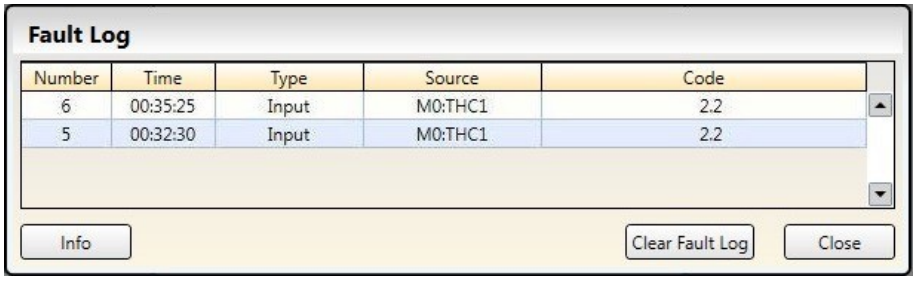



Figure 145: Error log with two errors

The following illustration shows the two identical errors in the PLC registers. The newer error no. 2 is displayed in the list before error no. 1

| | | | | | |
|---|---|---|---|---|---|
| - SCx: I | | {...} | {...} | | AB:ETHER_... |
| - SCx: I.Data | | {...} | {...} | Decimal | INT[150] |
| + SCx: I.Data[0] | Timestamp | 2125 | Error no. 2 | Decimal | INT |
| + SCx: I.Data[1] | | 0 | | Decimal | INT |
| + SCx: I.Data[2] | I/O or system length (number of ASCII characters | 4 | | Decimal | INT |
| + SCx: I.Data[3] | | 0 | | Decimal | INT |
| + SCx: I.Data[4] | I/O or system length (space for 12 of the ASCII characters | 'HT' | | ASCII | INT |
| + SCx: I.Data[5] | | '1C' | | ASCII | INT |
| + SCx: I.Data[6] | | 0 | | Decimal | INT |
| + SCx: I.Data[7] | | 0 | | Decimal | INT |
| + SCx: I.Data[8] | | 0 | | Decimal | INT |
| + SCx: I.Data[9] | | 0 | | Decimal | INT |
| + SCx: I.Data[10] | Error code | 2 | | Decimal | INT |
| + SCx: I.Data[11] | Extended error code Incorrect | 2 | | Decimal | INT |
| + SCx: I.Data[12] | Error message index | 202 | | Decimal | INT |
| + SCx: I.Data[13] | Reserved | 34 | | Decimal | INT |
| + SCx: I.Data[14] | | 1 | | Decimal | INT |
| + SCx: I.Data[15] | Timestamp | 1950 | Error no. 1 | Decimal | INT |
| + SCx: I.Data[16] | | 0 | | Decimal | INT |
| + SCx: I.Data[17] | I/O or system length (number of ASCII characters | 4 | | Decimal | INT |
| + SCx: I.Data[18] | | 0 | | Decimal | INT |
| + SCx: I.Data[19] | I/O or system length (space for 12 of the ASCII characters | 'HT' | | ASCII | INT |
| + SCx: I.Data[20] | | '1C' | | ASCII | INT |
| + SCx: I.Data[21] | | 0 | | Decimal | INT |
| + SCx: I.Data[22] | | 0 | | Decimal | INT |
| + SCx: I.Data[23] | | 0 | | Decimal | INT |
| + SCx: I.Data[24] | | 0 | | Decimal | INT |
| + SCx: I.Data[25] | Error code | 2 | | Decimal | INT |
| + SCx: I.Data[26] | Extended error code Incorrect | 2 | | Decimal | INT |
| + SCx: I.Data[27] | Error message index | 202 | | Decimal | INT |
| + SCx: I.Data[28] | Reserved | 34 | | Decimal | INT |
| + SCx: I.Data[29] | | 1 | | Decimal | INT |

Table 11: EtherNet/IP register with two errors

### 12.4.12 Flags

The words 0 to 7 defined below are displayed as the first 8 words in the assembly instances 100, 101 and 103.

| **Bit position** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| VO16 | VO15 | VO14 | VO13 | VO12 | VO11 | VO10 | VO9 | VO8 | VO7 | VO6 | VO5 | VO4 | VO3 | VO2 | VO1 |

Table 12: Word no. 0, virtual output 1-16

| **Bit position** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| VO32 | VO31 | VO30 | VO29 | VO28 | VO27 | VO26 | VO25 | VO24 | VO23 | VO22 | VO21 | VO20 | VO19 | VO18 | VO17 |

Table 13: Word no. 1, virtual output 17-32

| **Bit position** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| VO48 | VO47 | VO46 | VO45 | VO44 | VO43 | VO42 | VO41 | VO40 | VO39 | VO38 | VO37 | VO36 | VO35 | VO34 | VO33 |

Table 14: Word No. 2, Virtual output 33-48

| **Bit position** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| VO64 | VO63 | VO62 | VO61 | VO60 | VO59 | VO58 | VO57 | VO56 | VO55 | VO54 | VO53 | VO52 | VO51 | VO50 | VO49 |

Table 15: Word No. 3, Virtual output 49-64

**Note:** Not every virtual output has a defined error flag.

| **Bit position** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| VO16 | VO15 | VO14 | VO13 | VO12 | VO11 | VO10 | VO9 | VO8 | VO7 | VO6 | VO5 | VO4 | VO3 | VO2 | VO1 |

Table 16: Word no. 4, error flag bits for virtual output 1-16

**Note:** Not every virtual output has a defined error flag.

| **Bit position** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| VO32 | VO31 | VO30 | VO29 | VO28 | VO27 | VO26 | VO25 | VO24 | VO23 | VO22 | VO21 | VO20 | VO19 | VO18 | VO17 |

Table 17: Word no. 5, error flag bits for virtual output 17-32

**Note:** Not every virtual output has a defined error flag.

| **Bit position** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| VO48 | VO47 | VO46 | VO45 | VO44 | VO43 | VO42 | VO41 | VO40 | VO39 | VO38 | VO37 | VO36 | VO35 | VO34 | VO33 |

Table 18: Word No. 6, error flag bits for virtual output 33-48

| **Bit position** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| VO64 | VO63 | VO62 | VO61 | VO60 | VO59 | VO58 | VO57 | VO56 | VO55 | VO54 | VO53 | VO52 | VO51 | VO50 | VO49 |

Table 19: Word No. 7, error flag bits for vital output 49-64

**Note:** Not every virtual output has a defined error flag.

### 12.4.13 Extended flags

In addition to the first 64 virtual outputs listed above, a further 192 virtual outputs were added for assembly instance 103 (256 in total). The error flag bits are shifted downwards in order to transmit all 256 outputs in succession.

The words 0 to 3 are identical as shown under Flags on page 188. In the case of assembly instance 103, the following changes are made:

- Word no. 4 - Virtual outputs 65 to 80 with VO65 in bit 0 and VO80 in bit 15
- Word no. 5 - Virtual outputs 81 to 96 with VO81 in bit 0 and VO96 in bit 15
- Word no. 6 - Virtual outputs 97 to 112 with VO97 in bit 0 and VO112 in bit 15
- Word no. 7 - Virtual outputs 113 to 128 with VO113 in bit 0 and VO128 in bit 15
- Word no. 8 - Virtual outputs 129 to 144 with VO129 in bit 0 and VO144 in bit 15
- Word no. 9 - Virtual outputs 145 to 160 with VO145 in bit 0 and VO160 in bit 15
- Word no. 10 - Virtual outputs 161 to 176 with VO161 in bit 0 and VO176 in bit 15
- Word no. 11 - Virtual outputs 177 to 192 with VO177 in bit 0 and VO192 in bit 15
- Word no. 12 - Virtual outputs 193 to 208 with VO193 in bit 0 and VO208 in bit 15
- Word no. 13 - Virtual outputs 209 to 224 with VO209 in bit 0 and VO224 in bit 15
- Word no. 14 - Virtual outputs 225 to 240 with VO225 in bit 0 and VO240 in bit 15
- Word no. 15 - Virtual outputs 241 to 256 with VO241 in bit 0 and VO256 in bit 15
- Word No. 16 to No. 19 are the same as Word No. 4 to No. 7 as shown under Flags on page 188
- Word no. 20 - Error bits for VO65 to VO80 with error VO65 in bit 0 and VO80 in bit 15
- ...
- Word no. 31 - Error bits for VO241 to VO256 with error VO241 in bit 0 and VO256 in bit 15

## 12.5 Modbus/TCP

The Modbus/TCP protocol offers the option of transferring device information using registers and coil blocks defined by the slave device.
In this section, registers and coil blocks of the safety evaluation are defined. According to the specification, Modbus/TCP uses TCP port 502.
The following registers are used to send output values from the safety evaluation unit to the PLC.
The information in these registers can be read as input registers (30000) with the Modbus function code 04 (read input register). The same values can also be read as holding registers (40000) with the Modbus function code 03 (read holding register). The status information for all virtual outputs and the corresponding error flags contained in the first 8 registers can also be read as inputs (10000) with the Modbus function code 02 (read input status).

### 12.5.1 The first 64 virtual outputs and virtual output errors (inputs 10001-10128)

| Input no. | NAME |
|---|---|
| 10001 | VO1 |
| 10002 | VO2 |
| 10003 | VO3 |
| ... | ... |
| 10063 | VO63 |
| 10064 | VO64 |

| Input no. | NAME |
|---|---|
| 10065 | VO1 error bit |
| 10066 | VO2 error bit |
| 10067 | VO3 error bit |
| ... | ... |
| 10127 | VO63 error bit |
| 10128 | VO64 error bit |

Table 20: : 02: Read input status

### 12.5.2 All 256 virtual outputs and virtual output errors. (Inputs 11001-11256, 12001-12256)

| Input no. | NAME |
|---|---|
| 11001 | VO1 |
| 11002 | VO2 |
| 11003 | VO3 |
| ... | ... |
| 11255 | VO255 |
| 11256 | VO256 |

| Input no. | NAME |
|---|---|
| 12001 | VO1 error bit |
| 12002 | VO2 error bit |
| 12003 | VO3 error bit |
| ... | ... |
| 12255 | VO255 error bit |
| 12256 | VO256 error bit |

Table 21: 02: Read input status

### 12.5.3 Virtual inputs, virtual reset/cancel delay and feedback (coils 3001-30064, 4001-4016, inputs 15001-15016)

See Virtual manual reset and cancel delay sequence (RCD) on page 52.

| Input no. | NAME |
|---|---|
| 3001 | VI1 on/off |
| 3002 | VI2 on/off |
| ... | ... |
| 3064 | VI 64 on/off |
| 4001 | VRCD1 on/off |
| 4002 | VRCD2 on/off |
| ... | ... |
| 4016 | VRCD16 on/off |

| Input no. | NAME |
|---|---|
| 15001 | VRCD1 Feedback |
| 15002 | VRCD2 Feedback |
| ... | ... |
| 15016 | VRCD16 Feedback |

Table 22: 05: Write single coil; 02: Read input status

### 12.5.4 Safety evaluation output register (Modbus/TCP input or holding register)

| Entry reg. No. | Holder reg. No. | WORDNAME | DATA TYPE |
|---|---|---|---|
| 1 | 1 | VO1-VO16 (see flags on page 198) | 16-bit integer |
| 2 | 2 | VO17-VO32 (see flags on page 198) | 16-bit integer |
| 3 | 3 | VO33-VO48 (see flags on page 198) | 16-bit integer |
| 4 | 4 | VO49-VO64 (see flags on page 198) | 16-bit integer |
| 5 | 5 | Error bits for VO1-VO16 (see Flags on page 198) | 16-bit integer |
| 6 | 6 | Error bits for VO17-VO32 (see Flags on page 198) | 16-bit integer |
| 7 | 7 | Error bits for VO33-VO48 (see Flags on page 198) | 16-bit integer |
| 8 | 8 | Error bits for VO49-VO64 (see Flags on page 198) | 16-bit integer |
| | 9 | Virtual input On/Off (1-16) | 16-bit integer |
| | 10 | Virtual input on/off (17-32) | 16-bit integer |
| | 11 | Virtual input on/off (33-48) | 16-bit integer |
| | 12 | Virtual input on/off (49-64) | 16-bit integer |
| 13-16 | 13-16 | reserved | 16-bit integer |
| | 17 | Virtual reset/cancel delay (1-16) [RCD register bits] (see Virtual manual reset and cancel delay sequence (RCD) on page 52) | 16-bit integer |
| 18 | 18 | reserved | 16-bit integer |
| | 19 | RCD trip code [RCD activation register] (see Virtual manual reset and abort delay sequence (RCD) on page 52) | 16-bit integer |
| 20 | 20 | Virtual reset/cancel delay (1-16) Feedback [RCD feedback register bits] (see Virtual manual reset and cancel delay sequence (RCD) on page 52) | 16-bit integer |
| 21 | 21 | reserved | 16-bit integer |
| 22 | 22 | RCD trigger code feedback [RCD activation feedback register] (see Virtual manual reset and abort delay sequence (RCD) on page 52) | 16-bit integer |
| 23-40 | 23-40 | reserved | 16-bit integer |
| 41 | 41 | VO1 error index | 16-bit integer |
| 42 | 42 | VO2 error index | 16-bit integer |
| 43 | 43 | VO3 error index | 16-bit integer |
| 44 | 44 | VO4 error index | 16-bit integer |
| 45 | 45 | VO5 error index | 16-bit integer |
| 46 | 46 | VO6 error index | 16-bit integer |
| 47 | 47 | VO7 error index | 16-bit integer |
| 48 | 48 | VO8 error index | 16-bit integer |
| 49 | 49 | VO9 error index | 16-bit integer |
| 50 | 50 | VO10 error index | 16-bit integer |
| 51 | 51 | VO11 error index | 16-bit integer |

| Entry reg. No. | Holder reg. No. | WORDNAME | DATA TYPE |
|---|---|---|---|
| 52 | 52 | VO12 error index | 16-bit integer |
| 53 | 53 | VO13 error index | 16-bit integer |
| 54 | 54 | VO14 error index | 16-bit integer |
| 55 | 55 | VO15 error index | 16-bit integer |
| 56 | 56 | VO16 error index | 16-bit integer |
| 57 | 57 | VO17 error index | 16-bit integer |
| 58 | 58 | VO18 error index | 16-bit integer |
| 59 | 59 | VO19 error index | 16-bit integer |
| 60 | 60 | VO20 error index | 16-bit integer |
| 61 | 61 | VO21 error index | 16-bit integer |
| 62 | 62 | VO22 error index | 16-bit integer |
| 63 | 63 | VO23 error index | 16-bit integer |
| 64 | 64 | VO24 error index | 16-bit integer |
| 65 | 65 | VO25 error index | 16-bit integer |
| 66 | 66 | VO26 error index | 16-bit integer |
| 67 | 67 | VO27 error index | 16-bit integer |
| 68 | 68 | VO28 error index | 16-bit integer |
| 69 | 69 | VO29 error index | 16-bit integer |
| 70 | 70 | VO30 error index | 16-bit integer |
| 71 | 71 | VO31 error index | 16-bit integer |
| 72 | 72 | VO32 error index | 16-bit integer |
| 73 | 73 | VO33 error index | 16-bit integer |
| 74 | 74 | VO34 error index | 16-bit integer |
| 75 | 75 | VO35 error index | 16-bit integer |
| 76 | 76 | VO36 error index | 16-bit integer |
| 77 | 77 | VO37 error index | 16-bit integer |
| 78 | 78 | VO38 error index | 16-bit integer |
| 79 | 79 | VO39 error index | 16-bit integer |
| 80 | 80 | VO40 error index | 16-bit integer |
| 81 | 81 | VO41 error index | 16-bit integer |
| 82 | 82 | VO42 error index | 16-bit integer |
| 83 | 83 | VO43 error index | 16-bit integer |
| 84 | 84 | VO44 error index | 16-bit integer |
| 85 | 85 | VO45 error index | 16-bit integer |
| 86 | 86 | VO46 error index | 16-bit integer |
| 87 | 87 | VO47 error index | 16-bit integer |
| 88 | 88 | VO48 error index | 16-bit integer |
| 89 | 89 | VO49 error index | 16-bit integer |
| 90 | 90 | VO50 error index | 16-bit integer |
| 91 | 91 | VO51 error index | 16-bit integer |
| 92 | 92 | VO52 error index | 16-bit integer |
| 93 | 93 | VO53 error index | 16-bit integer |
| 94 | 94 | VO54 error index | 16-bit integer |

| Entry reg. No. | Holder reg. No. | WORDNAME | DATA TYPE |
|---|---|---|---|
| 95 | 95 | VO55 error index | 16-bit integer |
| 96 | 96 | VO56 error index | 16-bit integer |
| 97 | 97 | VO57 error index | 16-bit integer |
| 98 | 98 | VO58 error index | 16-bit integer |
| 99 | 99 | VO59 error index | 16-bit integer |
| 100 | 100 | VO60 error index | 16-bit integer |
| 101 | 101 | VO61 error index | 16-bit integer |
| 102 | 102 | VO62 error index | 16-bit integer |
| 103 | 103 | VO63 error index | 16-bit integer |
| 104 | 104 | VO64 error index | 16-bit integer |
| 105-106 | 105-106 | Complete VO1 error code | 32-bit integer |
| 107-108 | 107-108 | Complete VO2 error code | 32-bit integer |
| 109-110 | 109-110 | Complete VO3 error code | 32-bit integer |
| 111-112 | 111-112 | Complete VO4 error code | 32-bit integer |
| 113-114 | 113-114 | Complete VO5 error code | 32-bit integer |
| 115-116 | 115-116 | Complete VO6 error code | 32-bit integer |
| 117-118 | 117-118 | Complete VO7 error code | 32-bit integer |
| 119-120 | 119-120 | Complete VO8 error code | 32-bit integer |
| 121-122 | 121-122 | Complete VO9 error code | 32-bit integer |
| 123-124 | 123-124 | Complete VO10 error code | 32-bit integer |
| 125-126 | 125-126 | Complete VO11 error code | 32-bit integer |
| 127-128 | 127-128 | Complete VO12 error code | 32-bit integer |
| 129-130 | 129-130 | Complete VO13 error code | 32-bit integer |
| 131-132 | 131-132 | Complete VO14 error code | 32-bit integer |
| 133-134 | 133-134 | Complete VO15 error code | 32-bit integer |
| 135-136 | 135-136 | Complete VO16 error code | 32-bit integer |
| 137-138 | 137-138 | Complete VO17 error code | 32-bit integer |
| 139-140 | 139-140 | Complete VO18 error code | 32-bit integer |
| 141-142 | 141-142 | Complete VO19 error code | 32-bit integer |
| 143-144 | 143-144 | Complete VO20 error code | 32-bit integer |
| 145-146 | 145-146 | Complete VO21 error code | 32-bit integer |
| 147-148 | 147-148 | Complete VO22 error code | 32-bit integer |
| 149-150 | 149-150 | Complete VO23 error code | 32-bit integer |
| 151-152 | 151-152 | Complete VO24 error code | 32-bit integer |
| 153-154 | 153-154 | Complete VO25 error code | 32-bit integer |
| 155-156 | 155-156 | Complete VO26 error code | 32-bit integer |
| 157-158 | 157-158 | Complete VO27 error code | 32-bit integer |
| 159-160 | 159-160 | Complete VO28 error code | 32-bit integer |
| 161-162 | 161-162 | Complete VO29 error code | 32-bit integer |
| 163-164 | 163-164 | Complete VO30 error code | 32-bit integer |
| 165-166 | 165-166 | Complete VO31 error code | 32-bit integer |
| 167-168 | 167-168 | Complete VO32 error code | 32-bit integer |
| 169-170 | 169-170 | Complete VO33 error code | 32-bit integer |
| 171-172 | 171-172 | Complete VO34 error code | 32-bit integer |

| Entry reg. No. | Holder reg. No. | WORDNAME | DATA TYPE |
|---|---|---|---|
| 173-174 | 173-174 | Complete VO35 error code | 32-bit integer |
| 175-176 | 175-176 | Complete VO36 error code | 32-bit integer |
| 177-178 | 177-178 | Complete VO37 error code | 32-bit integer |
| 179-180 | 179-180 | Complete VO38 error code | 32-bit integer |
| 181-182 | 181-182 | Complete VO39 error code | 32-bit integer |
| 183-184 | 183-184 | Complete VO40 error code | 32-bit integer |
| 185-186 | 185-186 | Complete VO41 error code | 32-bit integer |
| 187-188 | 187-188 | Complete VO42 error code | 32-bit integer |
| 189-190 | 189-190 | Complete VO43 error code | 32-bit integer |
| 191-192 | 191-192 | Complete VO44 error code | 32-bit integer |
| 193-194 | 193-194 | Complete VO45 error code | 32-bit integer |
| 195-196 | 195-196 | Complete VO46 error code | 32-bit integer |
| 197-198 | 197-198 | Complete VO47 error code | 32-bit integer |
| 199-200 | 199-200 | Complete VO48 error code | 32-bit integer |
| 201-202 | 201-202 | Complete VO49 error code | 32-bit integer |
| 203-204 | 203-204 | Complete VO50 error code | 32-bit integer |
| 205-206 | 205-206 | Complete VO51 error code | 32-bit integer |
| 207-208 | 207-208 | Complete VO52 error code | 32-bit integer |
| 209-210 | 209-210 | Complete VO53 error code | 32-bit integer |
| 211-212 | 211-212 | Complete VO54 error code | 32-bit integer |
| 213-214 | 213-214 | Complete VO55 error code | 32-bit integer |
| 215-216 | 215-216 | Complete VO56 error code | 32-bit integer |
| 217-218 | 217-218 | Complete VO57 error code | 32-bit integer |
| 219-220 | 219-220 | Complete VO58 error code | 32-bit integer |
| 221-222 | 221-222 | Complete VO59 error code | 32-bit integer |
| 223-224 | 223-224 | Complete VO60 error code | 32-bit integer |
| 225-226 | 225-226 | Complete VO61 error code | 32-bit integer |
| 227-228 | 227-228 | Complete VO62 error code | 32-bit integer |
| 229-230 | 229-230 | Complete VO63 error code | 32-bit integer |
| 231-232 | 231-232 | Complete VO64 error code | 32-bit integer |
| 233-234 | 233-234 | Error no. 1 Timestamp | 32-bit integer |
| 235-242 | 235-242 | Error no. 1 I/O or system name | Double word length + 12 ASCII characters |
| 243 | 243 | Error no. 1 Error code | 16-bit integer |
| 244 | 244 | Error no. 1 Extended error code | 16-bit integer |
| 245 | 245 | Error no. 1 Error message index | 16-bit integer |
| 246-247 | 246-247 | reserved | 16-bit integer |
| 248-249 | 248-249 | Error no. 2 Timestamp | 32-bit integer |
| 250-257 | 250-257 | Error no. 2 I/O or system name | Double word length + 12 ASCII characters |
| 258 | 258 | Error no. 2 Error code | 16-bit integer |
| 259 | 259 | Error no. 2 Extended error code | 16-bit integer |
| 260 | 260 | Error no. 2 Error message index | 16-bit integer |
| 261-262 | 261-262 | reserved | 16-bit integer |
| 263-264 | 263-264 | Error no. 3 Timestamp | 32-bit integer |

| Entry reg. No. | Holder reg. No. | WORDNAME | DATA TYPE |
|---|---|---|---|
| 265-272 | 265-272 | Error no. 3 I/O or system name | Double word length + 12 ASCII characters |
| 273 | 273 | Error no. 3 Error code | 16-bit integer |
| 274 | 274 | Error no. 3 Extended error code | 16-bit integer |
| 275 | 275 | Error no. 3 Error message index | 16-bit integer |
| 276-277 | 276-277 | reserved | 16-bit integer |
| 278-279 | 278-279 | Error no. 4 Timestamp | 32-bit integer |
| 280-287 | 280-287 | Error no. 4 I/O or system name | Double word length + 12 ASCII characters |
| 288 | 288 | Error no. 4 Error code | 16-bit integer |
| 289 | 289 | Error no. 4 Extended error code | 16-bit integer |
| 290 | 290 | Error no. 4 Error message index | 16-bit integer |
| 291-292 | 291-292 | reserved | 16-bit integer |
| 293-294 | 293-294 | Error no. 5 Timestamp | 32-bit integer |
| 295-302 | 295-302 | Error no. 5 I/O or system name | Double word length + 12 ASCII characters |
| 303 | 303 | Error no. 5 Error code | 16-bit integer |
| 304 | 304 | Error no. 5 Extended error code | 16-bit integer |
| 305 | 305 | Error no. 5 Error message index | 16-bit integer |
| 306-307 | 306-307 | reserved | 16-bit integer |
| 308-309 | 308-309 | Error no. 6 Timestamp | 32-bit integer |
| 310-317 | 310-317 | Error no. 6 I/O or system name | Double word length + 12 ASCII characters |
| 318 | 318 | Error no. 6 Error code | 16-bit integer |
| 319 | 319 | Error no. 6 Extended error code | 16-bit integer |
| 320 | 320 | Error no. 6 Error message index | 16-bit integer |
| 321-322 | 321-322 | reserved | 16-bit integer |
| 323-324 | 323-324 | Error no. 7 Timestamp | 32-bit integer |
| 325-332 | 325-332 | Error no. 7 I/O or system name | Double word length + 12 ASCII characters |
| 333 | 333 | Error no. 7 Error code | 16-bit integer |
| 334 | 334 | Error no. 7 Extended error code | 16-bit integer |
| 335 | 335 | Error no. 7 Error message index | 16-bit integer |
| 336-337 | 336-337 | reserved | 16-bit integer |
| 338-339 | 338-339 | Error no. 8 Timestamp | 32-bit integer |
| 340-347 | 340-347 | Error no. 8 I/O or system name | Double word length + 12 ASCII characters |
| 348 | 348 | Error no. 8 Error code | 16-bit integer |
| 349 | 349 | Error no. 8 Extended error code | 16-bit integer |
| 350 | 350 | Error no. 8 Error message index | 16-bit integer |
| 351-352 | 351-352 | reserved | 16-bit integer |
| 353-354 | 353-354 | Error no. 9 Timestamp | 32-bit integer |
| 355-362 | 355-362 | Error no. 9 I/O or system name | Double word length + 12 ASCII characters |
| 363 | 363 | Error no. 9 Error code | 16-bit integer |
| 364 | 364 | Error no. 9 Extended error code | 16-bit integer |
| 365 | 365 | Error no. 9 Error message index | 16-bit integer |
| 366-367 | 366-367 | reserved | 16-bit integer |
| 368-369 | 368-369 | Error no. 10 Timestamp | 32-bit integer |

| Entry reg. No. | Holder reg. No. | WORDNAME | DATA TYPE |
|---|---|---|---|
| 370-377 | 370-377 | Error no. 10 I/O or system name | Double word length + 12-ASCII characters |
| 378 | 378 | Error no. 10 Error code | 16-bit integer |
| 379 | 379 | Error no. 10 Extended error code | 16-bit integer |
| 380 | 380 | Error no. 10 Error message index | 16-bit integer |
| 381-382 | 381-382 | reserved | 16-bit integer |
| 383-384 | 383-384 | Seconds since system start | 32-bit integer |
| 385 | 385 | Operating mode | 16-bit integer |
| 386-395 | 386-395 | ConfigName | Double word length + 16-ASCII characters |
| 396-397 | 396-397 | Config. CRC | 32-bit integer |
| 398-900 | 398-900 | reserved | 16-bit integer |
| 901 | 901 | VO1-VO16 (see flags on page 198) | 16-bit integer |
| 902 | 902 | VO17-VO32 (see flags on page 198) | 16-bit integer |
| 903 | 903 | VO33-VO48 (see flags on page 198) | 16-bit integer |
| 904 | 904 | VO49-VO64 (see flags on page 198) | 16-bit integer |
| 905 | 905 | VO65-VO80 (see Extended flags on page 199) | 16-bit integer |
| 906 | 906 | VO81-VO96 (see Extended flags on page 199) | 16-bit integer |
| 907 | 907 | VO97-VO112 (see Extended flags on page 199) | 16-bit integer |
| 908 | 908 | VO113-VO128 (see Extended flags on page 199) | 16-bit integer |
| 909 | 909 | VO129-VO144 (see Extended flags on page 199) | 16-bit integer |
| 910 | 910 | VO145-VO160 (see Extended flags on page 199) | 16-bit integer |
| 911 | 911 | VO161-VO176 (see Extended flags on page 199) | 16-bit integer |
| 912 | 912 | VO177-VO192 (see Extended flags on page 199) | 16-bit integer |
| 913 | 913 | VO193-VO208 (see Extended flags on page 199) | 16-bit integer |
| 914 | 914 | VO209-VO224 (see Extended flags on page 199) | 16-bit integer |
| 915 | 915 | VO225-VO240 (see Extended flags on page 199) | 16-bit integer |
| 916 | 916 | VO241-VO256 (see Extended flags on page 199) | 16-bit integer |
| 917 | 917 | Error bits for VO1-VO16 (see Flags on page 198) | 16-bit integer |
| 918 | 918 | Error bits for VO17-VO32 (see Flags on page 198) | 16-bit integer |
| 919 | 919 | Error bits for VO33-VO48 (see Flags on page 198) | 16-bit integer |
| 920 | 920 | Error bits for VO49-VO64 (see Flags on page 198) | 16-bit integer |
| 921 | 921 | Error bits for VO65-VO80 (see Extended flags on page 199) | 16-bit integer |

| Entry reg. No. | Holder reg. No. | WORDNAME | DATA TYPE |
|---|---|---|---|
| 922 | 922 | Error bits for VO81-VO96 (see Extended flags on page 199) | 16-bit integer |
| 923 | 923 | Error bits for VO97-VO112 (see Extended flags on page 199) | 16-bit integer |
| 924 | 924 | Error bits for VO113-VO128 (see Extended flags on page 199) | 16-bit integer |
| 925 | 925 | Error bits for VO129-VO144 (see Extended flags on page 199) | 16-bit integer |
| 926 | 926 | Error bits for VO145-VO160 (see Extended flags on page 199) | 16-bit integer |
| 926 | 926 | Error bits for VO161-VO176 (see Extended flags on page 199) | 16-bit integer |
| 928 | 928 | Error bits for VO177-VO192 (see Extended flags on page 199) | 16-bit integer |
| 929 | 929 | Error bits for VO193-VO208 (see Extended flags on page 199) | 16-bit integer |
| 930 | 930 | Error bits for VO209-VO224 (see Extended flags on page 199) | 16-bit integer |
| 931 | 931 | Error bits for VO225-VO240 (see Extended flags on page 199) | 16-bit integer |
| 932 | 932 | Error bits for VO241-VO256 (see Extended flags on page 199) | 16-bit integer |
| 933-934 | 933-934 | RCD bits feedback (see Virtual manual reset and abort delay sequence (RCD) on page 52) | 32-bit integer |
| 935 | 935 | RCD activation feedback (see Virtual manual reset and abort delay sequence (RCD) on page 52) | 16-bit integer |
| 936 | 936 | VO1 error index | 16-bit integer |
| 937 | 937 | VO2 error index | 16-bit integer |
| 938 | 938 | VO3 error index | 16-bit integer |
| ... | ... | ... | ... |
| 1190 | 1190 | VO256 error index | 16-bit integer |
| 1191-1192 | 1191-1192 | Complete VO1 error code | 32-bit integer |
| 1193-1194 | 1193-1194 | Complete VO2 error code | 32-bit integer |
| 1195-1196 | 1195-1196 | Complete VO3 error code | 32-bit integer |
| 1197-1198 | 1197-1198 | Complete VO4 error code | 32-bit integer |
| ... | ... | ... | ... |
| 1702-1703 | 1702-1703 | Complete VO256 error code | 32-bit integer |
| 1704-1705 | 1704-1705 | DCD system status - row 1 Number of devices | 32-bit integer |
| 1706-1707 | 1706-1707 | DCD system status - Series 2 Number of devices | 32-bit integer |
| 1708-1709 | 1708-1709 | DCD system status - row 1 Device on/off status | 32-bit integer |
| 1710-1711 | 1710-1711 | DCD system status - row 2 Device on/off status | 32-bit integer |
| 1712-1713 | 1712-1713 | DCD system status - row 1 Error status | 32-bit integer |
| 1714-1715 | 1714-1715 | DCD system status - row 2 Error status | 32-bit integer |
| 1716-1717 | 1716-1717 | DCD system status - row 1 actuator in the edge area | 32-bit integer |
| 1718-1719 | 1718-1719 | DCD system status - row 2 actuators in the edge area | 32-bit integer |

| Entry reg. No. | Holder reg. No. | WORDNAME | DATA TYPE |
|---|---|---|---|
| 1720-1721 | 1720-1721 | DCD system status - row 1 Warning status | 32-bit integer |
| 1722-1723 | 1722-1723 | DCD system status - row 2 Warning status | 32-bit integer |
| 1724-1725 | 1724-1725 | DCD system status - row 1 Reset status | 32-bit integer |
| 1726-1727 | 1726-1727 | DCD system status - row 2 Reset status | 32-bit integer |
| 1728-1729 | 1728-1729 | DCD system status - Series 1 trigger detected | 32-bit integer |
| 1730-1731 | 1730-1731 | DCD system status - row 2 triggers detected | 32-bit integer |
| 1732-1733 | 1732-1733 | DCD system status - row 1 System status | 32-bit integer |
| 1734-1735 | 1734-1735 | DCD system status - row 2 System status | 32-bit integer |
| 1736-1768 | 1736-1768 | reserved | 16-bit integer |
| 1769 | 1769 | DCD reading request confirmation | 16-bit integer |
| 1770 | 1770 | DCD series requested confirmation | 16-bit integer |
| 1771 | 1771 | DCD device requested confirmation | 16-bit integer |
| 1772-1780 | 1772-1780 | Specific data of individual DCD devices26 | 16-bit integer |
| | 1781 | DCD reading request | 16-bit integer |
| | 1782 | DCD series requested | 16-bit integer |
| | 1783 | DCD device requested | 16-bit integer |

Table 25: Output register

### 12.5.5 Request performance and status information on an individual device via DCD

1. Holding register 1782: Select the DCD series circuit in which the relevant device is connected (1 or 2).
2. Holding register 1783: Select DCD device number (1 to 32).
3. Holding register 1781: Change from 0 to 1 to perform a single read operation.
4. Holding register 1772-1780: Requested device-specific data of the device.

### 12.5.6 Flags

The registers 1 to 8 defined below are displayed as the first 8 words in the register assignment.

This represents the first 64 virtual outputs and the associated error flags. The information in these registers can be read as input registers (30000) with the Modbus function code 04 (read input register).
The same values can also be read as holding registers (40000) with the Modbus function code 03 (read holding register).

| Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VO16 | VO15 | VO14 | VO13 | VO12 | VO11 | VO10 | VO9 | VO8 | VO7 | VO6 | VO5 | VO4 | VO3 | VO2 | VO1 |

Table 23: Virtual output 1-16
Input register 30001 or holding register 40001 of the PLC, also inputs 10001-16 or coils 00001-16

| Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VO32 | VO31 | VO30 | VO29 | VO28 | VO27 | VO26 | VO25 | VO24 | VO23 | VO22 | VO21 | VO20 | VO19 | VO18 | VO17 |

Table 24: Virtual output 17-32
Input register 30002 or holding register 40002 of the PLC, also inputs 10017-32 or coils 00017-32

| Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VO48 | VO47 | VO46 | VO45 | VO44 | VO43 | VO42 | VO41 | VO40 | VO39 | VO38 | VO37 | VO36 | VO35 | VO34 | VO33 |

Table 26: Virtual output 33-48
Input register 30003 or holding register 40003 of the PLC, also inputs 10033-48 or coils 00033-48

| Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VO64 | VO63 | VO62 | VO61 | VO60 | VO59 | VO58 | VO57 | VO56 | VO55 | VO54 | VO53 | VO52 | VO51 | VO50 | VO49 |

Table 27: Virtual output 49-64
Input register 30004 or holding register 40004 of the PLC, also inputs 10049-64 or coils 00049-64

| Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VO16-Error | VO15-Error | VO14-Error | VO13-Error | VO12-Error | VO11-Error | VO10-Error | VO9-Error | VO8-Error | VO7-Error | VO6-Error | VO5-Error | VO4-Error | VO3-Error | VO2-Error | VO1-Error |

Table 31: Virtual output error 1-16
Input register 30005 or holding register 40005 of the PLC, also inputs 10033-48 or coils 00033-48

| Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VO32-Error | VO31-Error | VO30-Error | VO29-Error | VO28-Error | VO27-Error | VO26-Error | VO25-Error | VO24-Error | VO23-Error | VO22-Error | VO21-Error | VO20-Error | VO19-Error | VO18-Error | VO17-Error |

Table 28: Virtual output error 17-32
Input register 30006 or holding register 40006 of the PLC, also inputs 10049-64 or coils 00049-64

| Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VO48-Error | VO47-Error | VO46-Error | VO45-Error | VO44-Error | VO43-Error | VO42-Error | VO41-Error | VO40-Error | VO39-Error | VO38-Error | VO37-Error | VO36-Error | VO35-Error | VO34-Error | VO33-Error |

Table 29: Virtual output error 33-48
Input register 30007 or holding register 40007 of the PLC, also inputs 10033-48 or coils 00033-48

| Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VO64-Error | VO63-Error | VO62-Error | VO61-Error | VO60-Error | VO59-Error | VO58-Error | VO57-Error | VO56-Error | VO55-Error | VO54-Error | VO53-Error | VO52-Error | VO51-Error | VO50-Error | VO49-Error |

Table 30: Table 29: Virtual output error 49-64
Input register 30008 or holding register 40008 of the PLC, also inputs 10049-64 or coils 00049-64

### 12.5.7 Extended flags

All 256 virtual outputs can be accessed as shown under Flags on page 198.

Inputs 11001 to 11256 represent all 256 possible virtual outputs. These virtual outputs can also be read as input registers 901-916 or holding registers 901-916.

Inputs 12001 to 12256 are all 256 virtual output errors. These virtual output errors can also be read as input registers 917-932 or holding registers 917-932.

## 12.6 PROFINET®

PROFINET®28 is a data communication protocol for industrial automation and processes. PROFINET IO defines how controllers (I/O controllers) and peripheral devices (I/O devices) exchange data in real time.
The safety evaluation unit from BERNSTEIN supports PROFINET IO. The data communication protocol is TCP/IP; the data transmission medium is copper wire; the conformity class of PROFINET is CC-A.29

**Note:** In this document, outputs from the safety evaluation unit to the controller (PLC) are referred to as "inputs". Outputs from the controller (PLC) to the safety evaluation unit are referred to as "Outputs" means

### 12.6.1 PROFINET and safety evaluation

PROFINET real-time data is sent and received via slots.

**Note:** The GSDML file is available for download at http://www.bernstein.eu/downloads.

### 12.6.2 GSD file (General Station Description)

The GSD file (General Station Description) contains all module information, such as

- Configuration data
- Data information (throughput counter, inspection status, etc.)
- Diagnosis

### 12.6.3 PROFINET IO data model

The PROFINET IO data model is based on the typical, expandable field device with a backplane and several slots.
Modules and submodules can be inserted for different functions.
Modules are plugged into slots, submodules into sub-slots. In the PROFINET IO data model, slot 0 sub-slot 1 is reserved for the device access point (DAP) or the network interface. Both modules and submodules are used to control the type and volume of data sent to the controller (PLC).

- A submodule is usually designated as an input type, output type or combined input/output type.
- An input submodule is used to send data to the controller (PLC).
- An output submodule is used to receive data from the controller (PLC).
- The combined input/output submodule receives and transmits data in both directions.

[26] PROFINET® is a registered trademark of the PROFIBUS Nutzerorganisation e.V.
27CC-A ensures that the device meets the minimum requirements for functionality and interoperability

### 12.6.4 Configuration of the safety evaluation for a PROFINET IO connection

1. Connect the safety evaluation unit to the PC via a USB cable.
2. Open the configuration software for the BERNSTEIN safety evaluation unit and click on the **Industrial Ethernet** tab.
3. Select **Profinet** from the drop-down list on the left.
4. Click on to add information to the PROFINET submodules. Tip: For this task **automatic configuration** can be helpful.
5. Enter the corresponding password to change the configuration and network settings for the security evaluation.
6. Make sure that the security evaluation has a valid and confirmed configuration file.

**Note:** If a virtual reset or abort delay is used, the trigger code must be created in the **network settings**. The code must then be **sent** to the security controller via **Send** in the **network settings**.

### 12.6.5 Description of the modules

This table shows the I/O direction from the point of view of the PLC.

| connector space | Module function | I/O | Module name | Module size (byte) |
|---|---|---|---|---|
| 1 | User-defined status bits (0-31) | Incoming | 4 status bytes, bits 0..31_1 | 4 |
| 2 | User-defined status bits (32-63) | Incoming | 4 status bytes, bits 0..31_2 | 4 |
| 3 | Safety evaluation Error bits (0-31) | Incoming | 4 status bytes, bits 0..31_3 | 4 |
| 4 | Safety evaluation error bits (32-63) | Incoming | 4 status bytes, bits 0..31_4 | 4 |
| 5 | Safety evaluation Input status bits (0-31) | Incoming | 4 status bytes, bits 0..31_5 | 4 |
| 6 | Safety evaluation of input status bits (32-63) | Incoming | 4 status bytes, bits 0..31_6 | 4 |
| 7 | Safety evaluation input status bits (64-95) | Incoming | 4 status bytes, bits 0..31_7 | 4 |
| 8 | Safety evaluation input status bits (96-127) | Incoming | 4 status bytes, bits 0..31_8 | 4 |
| 9 | Safety evaluation input status bits (128-159) | Incoming | 4 status bytes, bits 0..31_9 | 4 |
| 10 | Safety evaluation output status bits (0-31) | Incoming | 4 status bytes, bits 0..31_10 | 4 |
| 11 | Safety evaluation output status bits (32-63) | Incoming | 4 status bytes, bits 0..31_11 | 4 |
| 12 | Safety evaluation output status bits (64-95) | Incoming | 4 status bytes, bits 0..31_12 | 4 |
| 13 | Virtual I/O (on/off/muting activation) Bits (0-63) | Starting from | 8 bytes Virtual ON/OFF/MA Data_1 | 8 |
| 14 | Virtual reset/cancel delay bits (0-16) | Starting from | 2 byte RCD Data_1 | 2 |
| 15 | Trigger code for reset/abort delay | Starting from | 2 byte RCD tripping Code_1 | 2 |
| 16 | Virtual reset/cancel delay Bits (0-16) Feedback | Incoming | RCD Data Feedback Register_1 | 2 |
| 17 | Trigger code for reset/cancel delay Feedback | Incoming | RCD Passcode Feedback Register_1 | 2 |
| 18[30] | Error log | Incoming | Error log buffer module | 300 |
| 19[30] | System information | Incoming | System information module | 30 |
| 20 | DCD status | Incoming | DCD status information module | 128 |
| 21 | Information on individual DCD devices | Incoming/outgoing | DCD-<br>Single status information module | 24 in detail<br>6 outgoing |

Table 32: Allocation of slots

[26] The error log and the system information module are not used by the standard connection.

#### 12.6.5.1 User-defined status bits

Slots 1 and 2 (64 bits) are always occupied by the user-defined status bit modules. These modules contain any information from the virtual status outputs.

The bit information to be transmitted is defined in the **Industrial Ethernet** tab of the configuration software.

| PLC input data name | Input data type |
|---|---|
| User-defined status bits 0-7 | Byte |
| User-defined status bits 8-15 | Byte |
| User-defined status bits 16-23 | Byte |
| User-defined status bits 24-31 | Byte |

| PLC output data name | Output data type |
|---|---|
| Not applicable | Not applicable |

Table 33: User-defined status bits (0-31) Module (Ident 0×100) [fixed in slot 1]

| PLC input data name | Input data type |
|---|---|
| User-defined status bits 32-39 | Byte |
| User-defined status bits 40-47 | Byte |
| User-defined status bits 48-55 | Byte |
| User-defined status bits 56-63 | Byte |

| PLC output data name | Output data type |
|---|---|
| Not applicable | Not applicable |

Table 34: User-defined status bits (32-63) Module (Ident 0×100) [fixed in slot 2)

#### 12.6.5.2 Error bits

Information about errors in the safety evaluation is transmitted via slots 3 and 4 (64 bits). The bit information to be transmitted is defined in the **Industrial Ethernet** tab of the configuration software.

| PLC input data name | Input data type |
|---|---|
| Error bits 0-7 | Byte |
| Error bits 8-15 | Byte |
| Error bits 16-23 | Byte |
| Error bits 24-31 | Byte |

Table 35: Safety evaluation error bits (0-31) module (Ident 0×100) [fixed in slot 3]

| PLC input data name | Input data type |
|---|---|
| Error bits 32-39 | Byte |
| Error bits 40-47 | Byte |
| Error bits 48-55 | Byte |
| Error bits 56-63 | Byte |

| PLC output data name | Output data type |
|---|---|
| Not applicable | Not applicable |

Table 36: Safety evaluation error bits (32-63) module (Ident 0×100) [fixed in slot 4]

#### 12.6.5.3 Input status bits

Slots 5 to 9 (160 bits) are always reserved for the input status information of the safety inputs. The bit information to be transmitted is defined in the **Industrial Ethernet** tab of the configuration software.

| PLC input data name | Input data type | PLC output data name | Output data type |
|---|---|---|---|
| Input status bits 0-7 | Byte | Not applicable | Not applicable |
| Input status bits 8-15 | Byte | | |
| Input status bits 16-23 | Byte | | |
| Input status bits 24-31 | Byte | | |

Table 37: Safety evaluation input status bits (0-31) module (Ident 0×100) [fixed in slot 5]

| PLC input data name | Input data type | PLC output data name | Output data type |
|---|---|---|---|
| Input status bits 32-39 | Byte | Not applicable | Not applicable |
| Input status bits 40-47 | Byte | | |
| Input status bits 48-55 | Byte | | |
| Input status bits 56-63 | Byte | | |

Table 38: Safety evaluation input status bits (32-63) module (Ident 0×100) [fixed in slot 6]

| PLC input data name | Input data type | PLC output data name | Output data type |
|---|---|---|---|
| Input status bits 64-71 | Byte | Not applicable | Not applicable |
| Input status bits 72-79 | Byte | | |
| Input status bits 80-87 | Byte | | |
| Input status bits 88-95 | Byte | | |

Table 39: Safety evaluation input status bits (64-95) module (Ident 0×100) [fixed in slot 7]

| PLC input data name | Input data type | PLC output data name | Output data type |
|---|---|---|---|
| Input status bits 96-103 | Byte | Not applicable | Not applicable |
| Input status bits 104-111 | Byte | | |
| Input status bits 112-119 | Byte | | |
| Input status bits 120-127 | Byte | | |

Table 40: Safety evaluation input status bits (96-127) module (Ident 0×100) [fixed in slot 8]

| PLC input data name | Input data type | PLC output data name | Output data type |
|---|---|---|---|
| Input status bits 128-135 | Byte | Not applicable | Not applicable |
| Input status bits 136-143 | Byte | | |
| Input status bits 144-151 | Byte | | |
| Input status bits 152-159 | Byte | | |

Table 41: Safety evaluation input status bits (128-159) module (Ident 0×100) [fixed in slot 9]

#### 12.6.5.4 Output status bits

Slots 10 to 12 (96 bits) are always reserved for the output status information of the safety outputs. The bit information to be transmitted is defined in the **Industrial Ethernet** tab of the configuration software.

| PLC input data name | Input data type | PLC output data name | Output data type |
|---|---|---|---|
| Output status bits 0-7 | Byte | Not applicable | Not applicable |
| Output status bits 8-15 | Byte | | |
| Output status bits 16-23 | Byte | | |
| Output status bits 24-31 | Byte | | |

Table 42: Safety evaluation output status bits (0-31) module (Ident 0×100) [fixed in slot 10]

| PLC input data name | Input data type | PLC output data name | Output data type |
|---|---|---|---|
| Output status bits 32-39 | Byte | Not applicable | Not applicable |
| Output status bits 40-47 | Byte | | |
| Output status bits 48-55 | Byte | | |
| Output status bits 56-63 | Byte | | |

Table 43: Safety evaluation output status bits (32-63) Module (Ident 0×100) [fixed in slot 11]

| PLC input data name | Input data type | PLC output data name | Output data type |
|---|---|---|---|
| Output status bits 64-71 | Byte | Not applicable | Not applicable |
| Output status bits 72-79 | Byte | | |
| Output status bits 80-87 | Byte | | |
| Output status bits 88-95 | Byte | | |

Table 44: Safety evaluation output status bits (64-95) Module (Ident 0×100) [fixed in slot 12)

#### 12.6.5.5 Output status bits

Slots 10 to 12 (96 bits) are always reserved for the output status information of the safety outputs. The bit information to be transmitted is defined in the **Industrial Ethernet** tab of the configuration software.

| PLC input data name | Input data type |
|---|---|
| Not applicable | Not applicable |

| PLC output data name | Output data type |
|---|---|
| Virtual switch on/off/MA bits 0-7 | Byte |
| Virtual switch on/off/MA bits 8-15 | Byte |
| Virtual switch on/off/MA bits 16-23 | Byte |
| Virtual switch on/off/MA bits 24-31 | Byte |
| Virtual switch on/off/MA bits 32-39 | Byte |
| Virtual switch on/off/MA bits 40-47 | Byte |
| Virtual switch on/off/MA bits 48-55 | Byte |
| Virtual switch on/off/MA bits 56-63 | Byte |

Table 45: Virtual switch-on/switch-off and muting activation bits (0-63) Module (Ident 0×200) [fixed in slot 13]

#### 12.6.5.6 Reset/cancel delay bits (VRCD)

Slot 14 (16 bits) contains all virtual, non-safety-related inputs that can be used for the virtual reset and abort delay.
See Virtual manual reset and cancel delay sequence (RCD) on page 52.

| PLC input data name | Input data type |
|---|---|
| Not applicable | Not applicable |

| PLC output data name | Output data type |
|---|---|
| VRCD bits 0-7 | Byte |
| VRCD bits 8-15 | Byte |

Table 46: Virtual reset/cancel delay bits (0-63) module (Ident 0×300) [fixed in slot 14]

#### 12.6.5.7 Reset/cancel delay Tripping code (RCD)

Slot 15 (1 word) contains the RCD trip code, which is used for the virtual reset/abort delay
See Virtual manual reset and cancel delay sequence (RCD) on page 52.

| PLC input data name | Input data type |
|---|---|
| Not applicable | Not applicable |

| PLC output data name | Output data type |
|---|---|
| Trigger code for reset/abort delay | Unsigned 16 |

Table 47: Module for the trigger code for the reset and abort delay (Ident 0×301) [fixed in slot 15)

#### 12.6.5.8 Virtual reset/cancel delay Feedback bits

Slot 16 (16 bits) contains the feedback bits for the 16 reset/cancel delay bits in slot 14. These are used to confirm receipt and mirror the corresponding bit from slot 14 for a complete reset/cancel delay.
Handshake back.

See Virtual manual reset and cancel delay sequence (RCD) on page 52.

| PLC input data name | Input data type | PLC output data name | Output data type |
|---|---|---|---|
| VRCD feedback bits 0-7 | Byte | Not applicable | Not applicable |
| VRCD feedback bits 8-15 | Byte | | |

Table 48: Virtual reset/cancel delay feedback bits (0-63) module (Ident 0×400) [fixed in slot 16]

#### 12.6.5.9 Reset/cancel delay Trigger code feedback

Slot 17 (1 word) contains the feedback value of the RCD trip code from slot 15. This value is used to confirm receipt and mirrors the value from slot 15 for a complete handshake.

See Virtual manual reset and cancel delay sequence (RCD) on page 52.

| PLC input data name | Input data type | PLC output data name | Output data type |
|---|---|---|---|
| Trigger code for reset/cancel delay Feedback | Unsigned 16 | Not applicable | Not applicable |

Table 49: Module for the trigger code for the reset/cancel delay (Ident 0×401) [fixed in slot 17]

#### 12.6.5.10 Error log entries

The optional error log buffer module can be plugged into slot 18.

| PLC input data name | Input data type | PLC output data name | Output data type |
|---|---|---|---|
| Error log entry 1 (most recent) | 15 words | Not applicable | Not applicable |
| Error log entry 2 | 15 words | | |
| Error log entry 3 | 15 words | | |
| Error log entry 4 | 15 words | | |
| Error log entry 5 | 15 words | | |
| Error log entry 6 | 15 words | | |
| Error log entry 7 | 15 words | | |
| Error log entry 8 | 15 words | | |
| Error log entry 9 | 15 words | | |
| Error log entry 10 (oldest) | 15 words | | |

Table 50: Safety evaluation error log buffer module (Ident 0×500) [optional; fixed in slot 18 if used]

| Error log entry | Type | Length (words) |
|---|---|---|
| Timestamp | UDINT | 2 |
| Name Length | DWORD | 2 |
| Name string | String | 6 |
| Error code | WORD | 1 |
| Extended error code | WORD | 1 |
| Error index message | WORD | 1 |
| reserved | WORD | 2 |

Table 51: Structure of error log entry

#### 12.6.5.11 Buffer for system information

The optional system information buffer module can be plugged into slot 19.

| PLC input data name | Input data type | PLC output data name | Output data type |
|---|---|---|---|
| Buffer for system information | 30 words | Not applicable | Not applicable |

Table 52: Safety evaluation system information buffer module (Ident 0×600) [optional; fixed in slot 19 if used]

| Buffer for system information | Type | Length (words) |
|---|---|---|
| Seconds since system start | UDINT | 2 |
| Operating mode | WORD | 1 |
| Length of the configuration name | DWORD | 2 |
| Configuration name | String | 8 |
| Config. CRC | WORD | 2 |

Table 53: : Structure of system information entry

**Seconds since system start**

The 32-bit integer representation of the number of seconds since the safety evaluation was switched on.

**Operating mode**

The current operating status of the safety evaluation.

| Value for operating mode | Description |
|---|---|
| 1 (0×01) | Normal operation (including I/O errors, if present) |
| 2 (0×02) | Configuration mode |
| 4 (0×04) | System lock |
| 65 (0×41) | Waiting for system reset/exiting configuration mode |
| 129 (0×81) | Calling up the configuration mode |

**Length of the configuration name**

The number of ASCII characters in the "Configuration name".

**Configuration name**

An ASCII string describing the origin of the error.

**Config. CRC**

The value of the cyclic redundancy check (CRC) for the current safety evaluation configuration

### 12.6.5.12 DCD status information module

The optional DCD status information module can be plugged into slot 20.

| PLC input data name | Input data type |
|---|---|
| DCD system status - row 1 Number of devices | Unsigned 32 |
| DCD system status - Series 2 Number of devices | Unsigned 32 |
| DCD system status - row 1 Device on/off status | Unsigned 32 |
| DCD system status - row 2 Device on/off status | Unsigned 32 |
| DCD system status - row 1 Error status | Unsigned 32 |
| DCD system status - row 2 Error status | Unsigned 32 |
| DCD system status - row 1 actuator in the edge area | Unsigned 32 |
| DCD system status - row 2 actuators in the edge area | Unsigned 32 |
| DCD system status - row 1 Warning status | Unsigned 32 |
| DCD system status - row 2 Warning status | Unsigned 32 |
| DCD system status - row 1 Reset status | Unsigned 32 |
| DCD system status - row 2 Reset status | Unsigned 32 |
| DCD system status - Series 1 trigger detected | Unsigned 32 |
| DCD system status - Series 2 trigger detected | Unsigned 32 |
| DCD system status - row 1 System status | Unsigned 32 |
| DCD system status - row 2 System status | Unsigned 32 |
| 64 bytes reserved | Byte |

| PLC output data name | Output data type |
|---|---|
| Not applicable | Unsigned 16 |

Table 54: Safety evaluation DCD status information module [optional]; fixed in slot 20 if used

### 12.6.5.13 Module for information on individual DCD devices

The optional module for information on individual DCD devices can be plugged into slot 21.

| PLC input data name | Input data type |
|---|---|
| DCD reading request confirmation | Unsigned 16 |
| DCD series requested confirmation | Unsigned 16 |
| DCD device requested confirmation | Unsigned 16 |
| DCD data of the requested device (18 bytes) | Byte |

| PLC output data name | Output data type |
|---|---|
| DCD reading request | Unsigned 16 |
| DCD series requested | Unsigned 16 |
| DCD device requested | Unsigned 16 |

Table 55: Safety evaluation DCD single information module [optional]; fixed in slot 21 if used

### 12.6.6 Request performance and status information on an individual device via DCD

1. DCD series requested: Select the DCD series circuit in which the device in question is connected (1 or 2).
2. DCD device requested: Select DCD device number (1 to 32).
3. DCD read request: Change from 0 to 1 to perform a single read operation.
4. DCD data of the requested device: Requested device-specific data of the device.

### 12.6.7 Configuration guide

Installing the GSD file

Install the GSD file in the Siemens TIA Portal according to these instructions. You can also use these instructions as a basis for installing the GSD file in another controller (PLC).

1. Download the GSD file from http://www.bernstein.eu/downloads.
2. Call up the software in the TIA Portal from Siemens.
3. Click on **Open existing project**.
4. Select a project and open it.
5. Click on **Devices and networks** after the project has been uploaded.

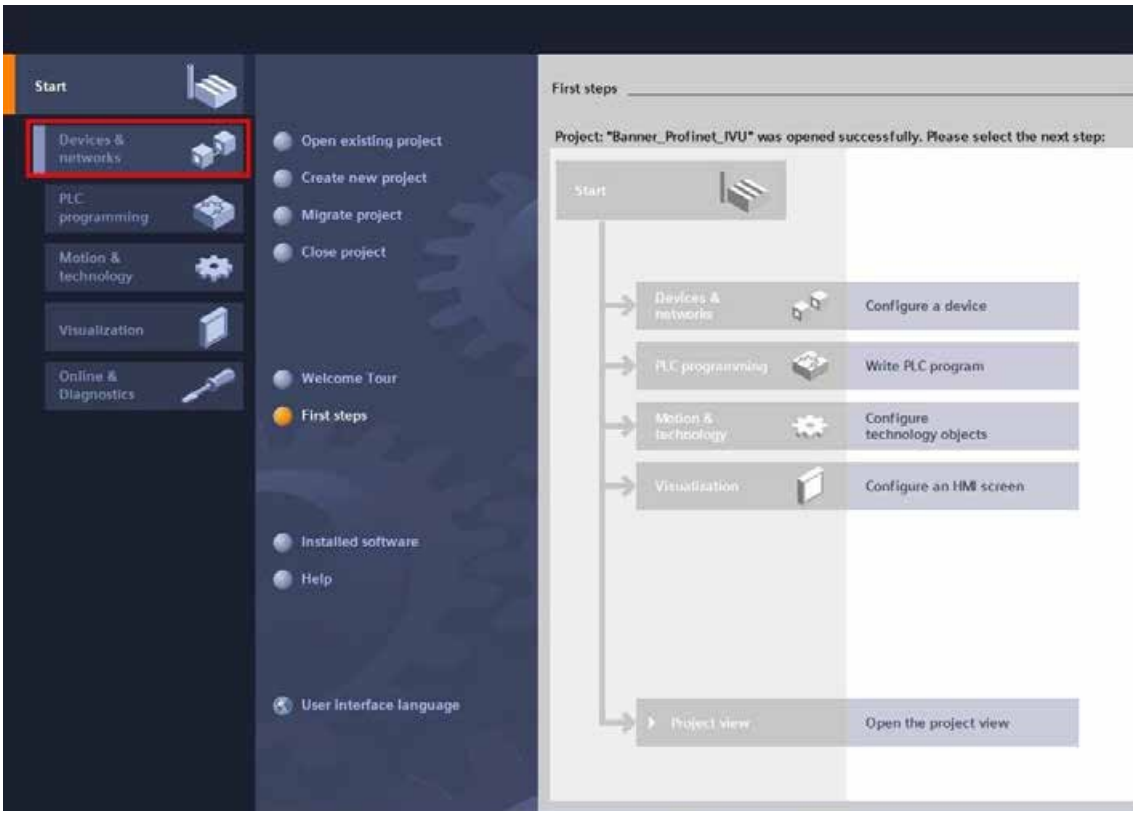



Figure 146: Devices and networks

6. Click on **Configure networks**

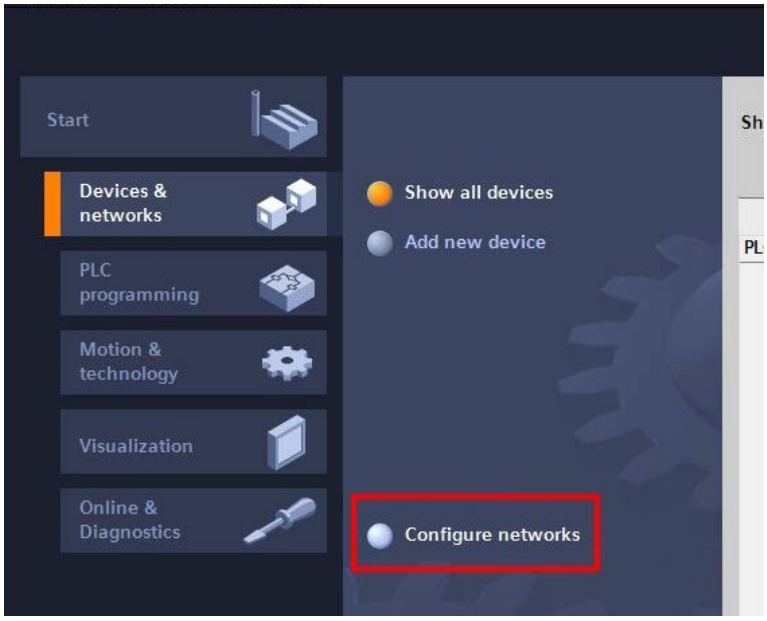



Figure 147: Configuring networks

**The network view is displayed.**

7. Click on **Options** and select **Manage GSD file (General Station Description)**

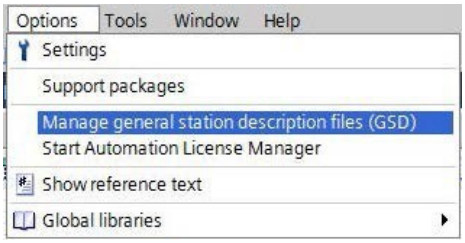



Figure 148: Options - Install GSD file

off. The Install **GSD file (General Station Description)** window opens.

8. Click on the Browse button (...) to the right of the **Source path** arrow**.**

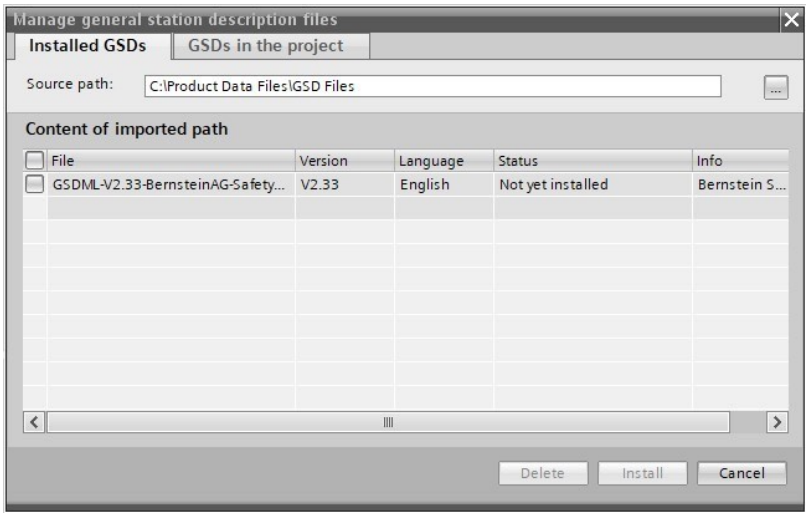



Figure 149: : Manage GSD files

9. Navigate to the location where you downloaded the GSD file for the safety evaluation.
10. Select the GDS file of the security evaluation.
11. Click on **Install**

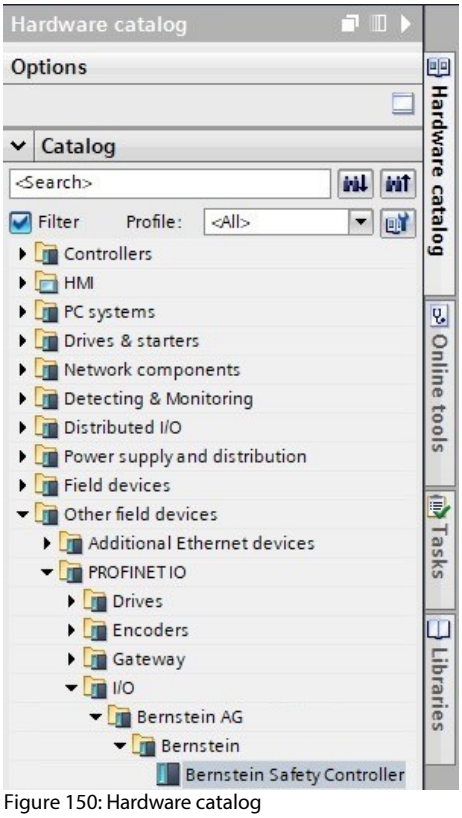



Figure 150: Hardware catalog

The GSD file of the safety evaluation unit is installed by the system and stored in the **hardware catalog**. In the example above, the GSD file for the safety evaluation unit is located under **Other field devices > PROFINET IO > I/O > BERNSTEIN AG > BERNSTEIN.**

**Note:** If the GSD file of the safety evaluation is not installed correctly, save the log and contact BERNSTEIN AG

### Changing the IP address of devices

Change the IP address of the safety evaluation unit according to these instructions using the software in the TIA Portal from Siemens. You can also use these instructions as a basis if you are using a different controller (PLC).

1. Call up the software in the TIA Portal from Siemens.
2. Click on **Open existing project**.
3. Select a project and open it.
4. Click on **Devices and networks** after the project has been uploaded to open the **network view**. to call up the network view. The network view is displayed.
5. Double-click on the safety evaluation to open the **device view**.


Figure 151: Figure 115: Network view

6. In the **device view**, click on the safety evaluation in the graphics area to open the **Module properties**. You can now configure the module.
7. Click on **Properties**.
8. Click on **General.**
9. Select **PROFINET interface > Ethernet addresses**.
10. **Select Specify IP address in the project**.

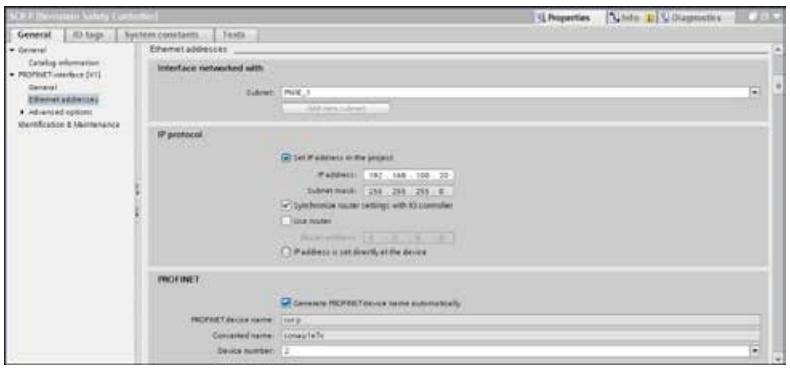


Figure 152: : Ethernet addresses

The project defines the IP address of the device.

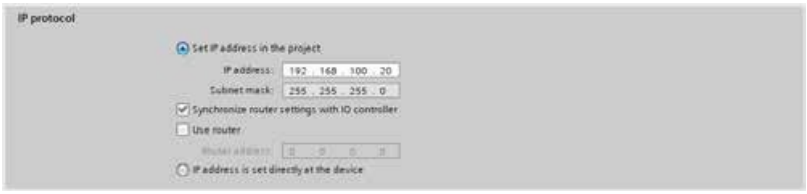



Figure 153: : Set IP address

11. Enter the IP address.
12. Right-click on the device icon and select Online and diagnostics. The **Online and diagnostics** window is displayed.

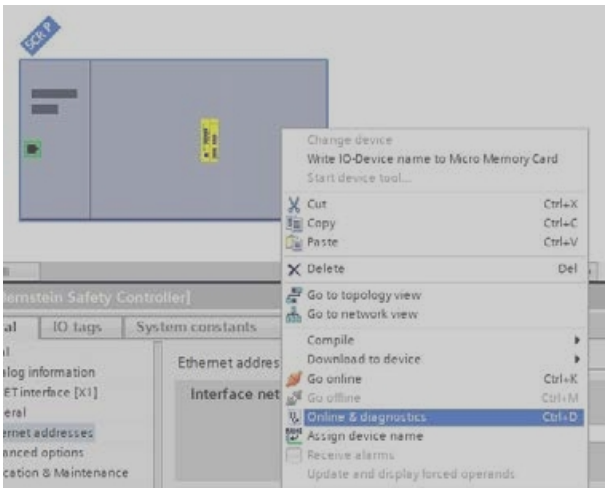



Figure 154: Select "Online and diagnoses

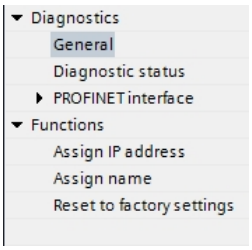



Figure 155: Online and diagnoses

13. Select Assign **IP address** under **Functions**
14. Click on **Accessible devices**.
    The **Select device** window searches for the network for available devices.

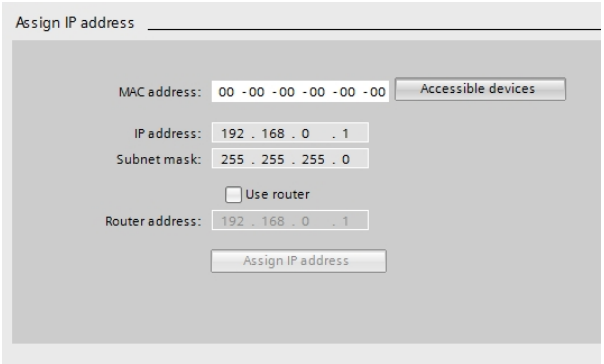



Figure 156: Assign IP address - Accessible devices

15. Determine the device you want to customize using the MAC address and select it.
16. Click on **Apply**.

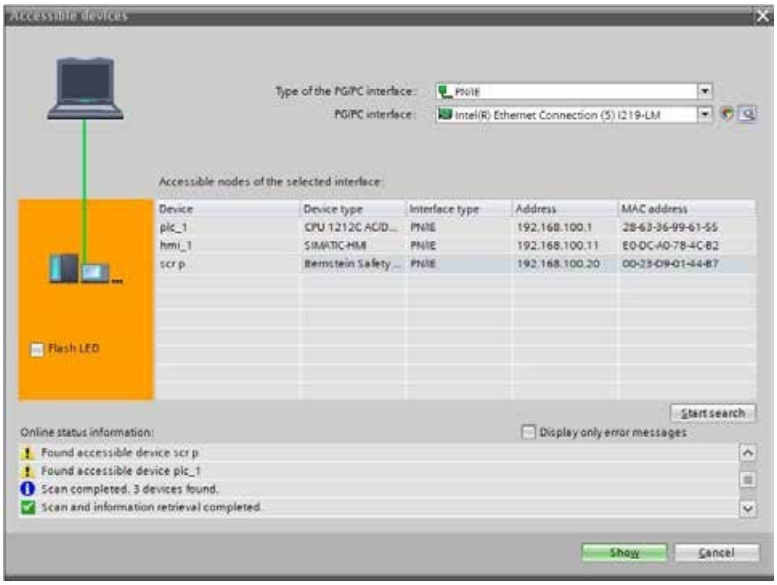
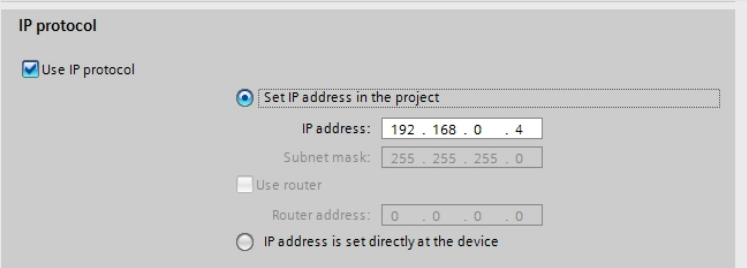



Figure 157: Select device and apply changes

The IP address for the device is updated.

17. Click on **Assign IP address** to complete the step. This step is completed for all devices.

**Note:** PROFINET devices generally do not have an IP address at startup (IP address = all zeros). However, controllers (PLCs) generally require an IP address in order to connect to the SCR P safety evaluation unit from BERNSTEIN and to define the device configuration.
By default, each safety evaluation unit is assigned the IP address 192.168.0.128 on delivery from the factory. The default address can be changed using the BERNSTEIN configuration software.
The safety evaluation unit retrieves its IP address immediately after activation of the PROFINET protocol in the safety evaluation unit, but before the PLC has recognized the safety evaluation unit and connected to it. After the PLC has detected and connected to the safety evaluation unit, the behavior of the IP address depends on how the PLC has been configured to assign the IP address of the safety evaluation unit. Two configuration options are available.




- The IP address is defined in the project: If the PLC is instructed to assign the IP address of the safety evaluation unit (e.g. using the **Set IP address in project** option in the Siemens TIA Portal), the safety evaluation unit receives the specific address. To do this, however, the program must first be loaded into the PLC and executed.
  If the safety evaluation unit is restarted after it has been recognized and configured by the PLC, it has the IP address 0.0.0.0 until the PLC has recognized the safety evaluation unit and reassigned it the specified address.
  If no IP address is assigned to the safety evaluation unit, it can still be assigned using the BERNSTEIN configuration software. However, if this address differs from the address specified in the PLC, the safety evaluation unit will use the address specified in the PLC again as soon as the PLC becomes active again.
- The IP address is defined in the device: If the PLC is instructed that the IP address of the safety evaluation unit is configured in the device (e.g. using the **IP address is defined directly in the device** option in the TIA Portal from Siemens), the safety evaluation unit always retrieves the IP address assigned via configuration software from BERNSTEIN.

These configuration options comply with the PROFINET standard.

### Changing the device name

Change the name of the safety evaluation unit according to these instructions in the Siemens TIA Portal. You can also use these instructions as a basis if you are using a different controller (PLC).

1. Open the project and click on **Devices and networks** to call up the **network view**.

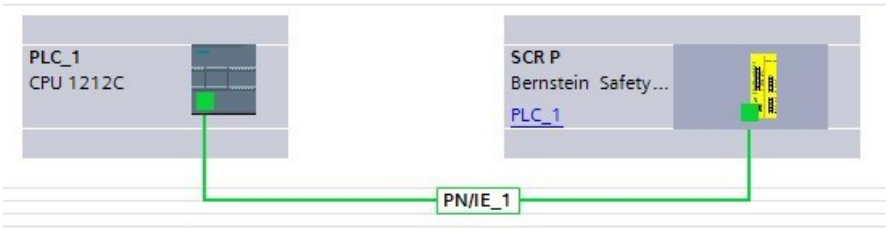



Figure 158: Network view

The **network view** is displayed.

2. Right-click on the security evaluation and **select Assign device name**.

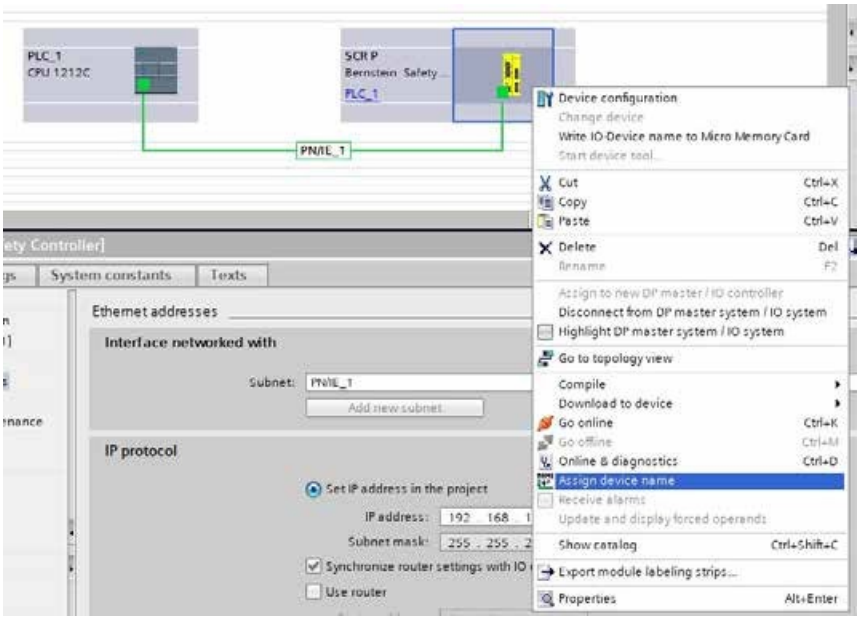
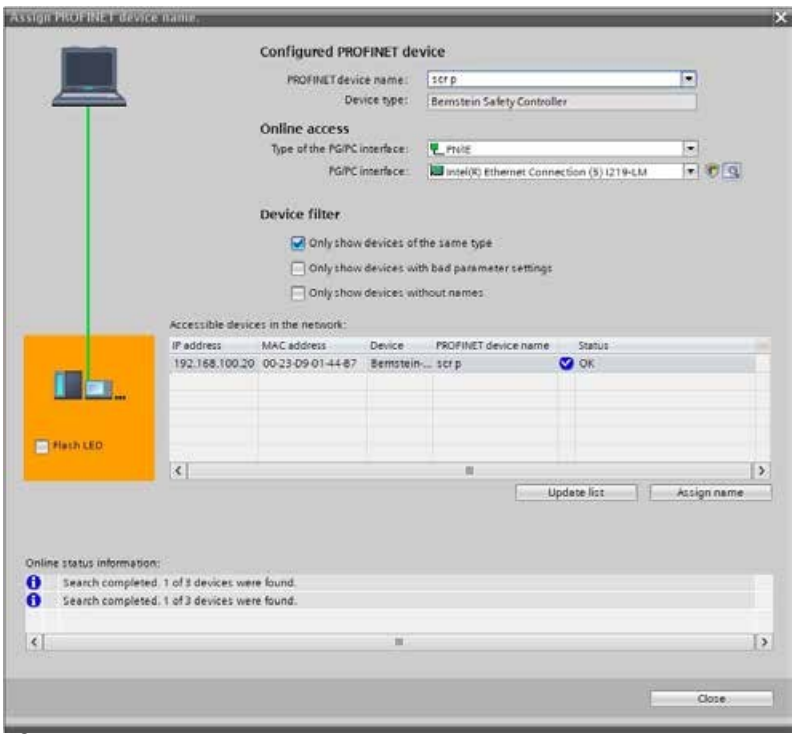



Figure 159: Ethernet addresses

The **Assign PROFINET device name** window is displayed and the software searches for devices of the same type



3. Enter the desired name in the PROFINET device name field.

**Note:** Each name may only be used once

4. Click on **Assign name**.
   The device now has a PROFINET name.

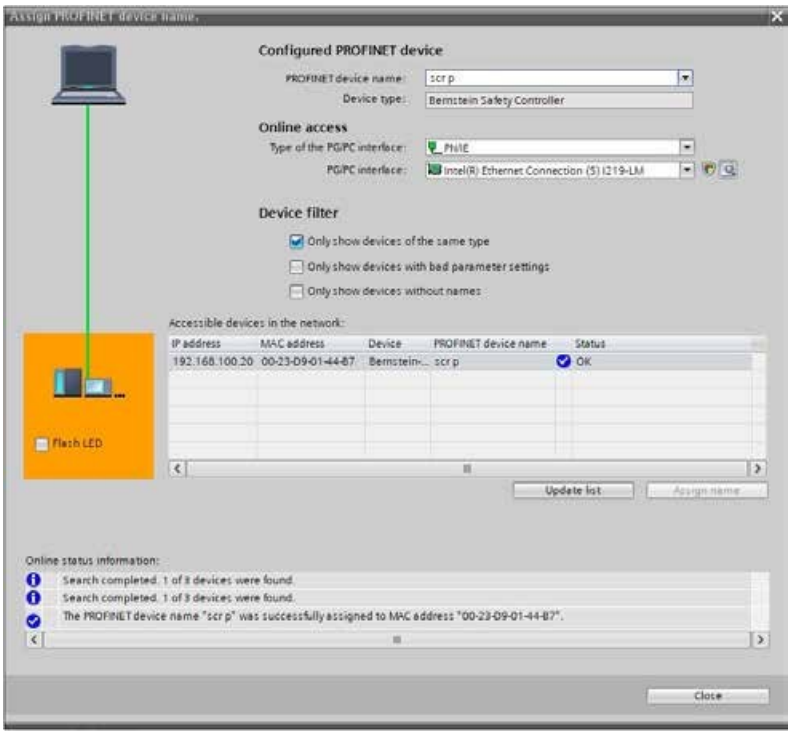


Figure 161: Ethernet addresses

## 12.7 EtherCAT®

EtherCAT® 57 is a data communication protocol for industrial automation processes. EtherCAT IO defines how controllers (IO controllers) and peripheral devices (IO devices) exchange data in real time.

The BERNSTEIN Safety Controller supports EtherCAT IO. The EtherCAT protocol follows the IEC 61158 standard; the data transmission medium is copper wire.

**Note:** In this document, the outputs of the safety controller are referred to as "inputs" for the controller (PLC). The outputs of the controller (PLC) are referred to as "inputs" for the safety controller.

### 12.7.1 EtherCAT® and the safety controllers

This section contains instructions for SCx safety controllers with the designation FID 6 on the product label. The XSeCAT EtherCAT communication gateway must be installed on the safety controller.
EtherCAT real-time data is sent and received via process data objects (PDO).

**Note:** The ESI file is available for download at www.bernstein.eu.

### 12.7.2 EtherCAT® Slave Information (ESI) file

The EtherCAT slave information file (ESI) contains module information such as:
- Configuration data
- Data information (number of runs, test status, etc.)
- Diagnostics

### 12.7.3 EtherCAT® IO data model

The EtherCAT IO data model is based on the typical, expandable field device, which has a backplane with slots.
Each slot is either a Tx-PDO (Transmit Process Data Object) or an Rx-PDO (Received Process Data Object). The Tx-PDO or Rx-PDO is divided into data structures. The majority of the SCx data is divided into PDOs with 4 bytes of data. The PDOs DCD, RCD, Fault Log and System Information have their own structures.

- A PDO is designated either as Tx (Transmit) or Rx (Received).
- A Transmit PDO is used to send data to the controller (PLC).
- A Received PDO is used to receive data from the controller (PLC)

### 12.7.4 Configuring the safety controller for EtherCAT® IO connection

1. Connect the safety controller to the PC using the SC-USB2 USB cable.
2. Open the BERNSTEIN Safety Controller software and click on the Industrial Ethernet tab.
3. Make sure that the EtherCAT Communication Gateway has been added to the Equipment tab of the project file. The EtherCAT tab should be displayed automatically, as the EtherCAT Communication Gateway is located in Equipment tab.
4. Click on to add information to the EtherCAT process data object (PDO). Auto Configure can help you with this task.
5. Enter the appropriate password to change the configuration and network settings for security control.
6. Make sure that the safety controller has a valid and confirmed configuration file.

**Note:** If a virtual reset or an abort delay is used, an activation code must be created in the **network settings**. The code must then be **sent** to the security controller using **Send** in the **network settings**.

**Note:** ClickSet IP is not available for EtherCAT**.**

### 12.7.5 Creating a PLCopenXML for EtherCAT® for TwinCAT® 3.0

Two points must be known:

- The name of the project in TwinCAT [62]
- The name of the safety controller in the system

This information is available in the PLC software. The following figure is an example from the Beckhoff TwinCAT 3.0 software.

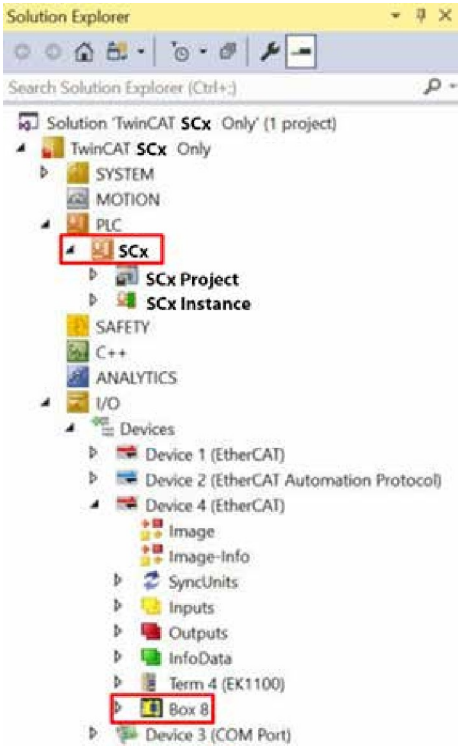



Figure 162: Solution Explorer

1. In the BERNSTEIN Safety Controller software on the **Industrial Ethernet** tab, make sure that **EtherCAT** is selected in the list on the left-hand side.
2. Click on **Export**.
   The **Export to XML** window opens.

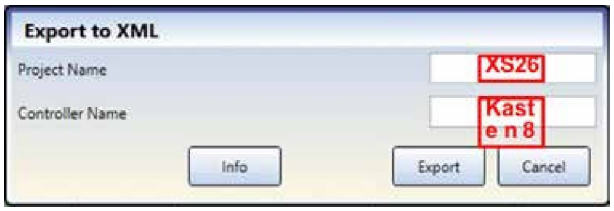



Figure 163: Export to XML - no DCD chain

[62] TwinCAT® is a registered trademark of Beckhoff Automation GmbH, Germany, and is licensed by the same.

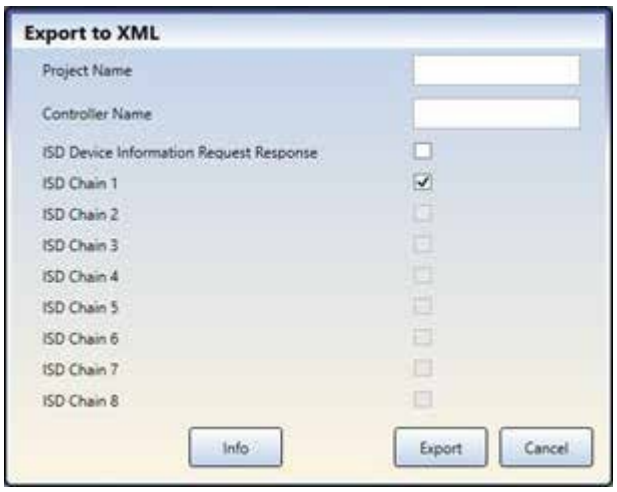



Figure 164: Exporting to XML - with DCD chains

3. Enter the information in the window.
   a. Enter the name of the project in the PLC software in the **Project name** field. See point 1 in Figure 159 on page 202. In this example, it is SCx.
   b. Enter the name of the safety controller in the PLC software in the **Controller name** field. See point 2 in Figure 159 on page 202. In this example, it is Box 8.
4. Click on **Export**.
5. Save the PLCopenXML file in the desired location.

The PLCopenXML file can be imported directly into the Beckhoff TwinCAT software or opened with any software that can read an .xml file.

### 12.7.6 Description of process data objects

In this table, the I/O direction is seen from the point of view of the PLC.

| PDO | Name | IO | Size (bytes) |
|---|---|---|---|
| 1A00 | User-defined VS TxPDO [1] 0×1A00 | Under | 4 |
| 1A01 | User-defined VS TxPDO [2] 0×1A01 | Under | 4 |
| 1A02 | Error VS TxPDO [1] 0×1A02 | Under | 4 |
| 1A03 | Error VS TxPDO [2] 0×1A03 | Under | 4 |
| 1A04 | Inputs VS TxPDO[1] 0×1A04 | Under | 4 |
| 1A05 | Inputs VS TxPDO[2] 0×1A05 | Under | 4 |
| 1A06 | Inputs VS TxPDO[3] 0×1A06 | Under | 4 |
| 1A07 | Inputs VS TxPDO[4] 0×1A07 | Under | 4 |
| 1A08 | Inputs VS TxPDO[5] 0×1A08 | Under | 4 |
| 1A09 | Outputs VS TxPDO[1] 0×1A09 | Under | 4 |
| 1A0A | Outputs VS TxPDO[2] 0×1A0A | Under | 4 |
| 1A0B | Outputs VS TxPDO[3] 0×1A0B | Under | 4 |
| 1A0C | Reset, cancel delay feedback TxPDO 0×1A0C | Under | 4 |
| 1A10 | DCD Device information Answer 0×1A10 [64] | Under | 56 |
| 1A20 | System status of the DCD chain 1 TxPDO 0×1A20 [64] | Under | 32 |
| 1A3A | ECAT module status TxPDO 0x1A3A | Under | 4 |
| 1600 | On/Off, mute VI RxPDO [1] 0×1600 | From | 4 |
| 1601 | On/Off, mute VI RxPDO [2] 0×1601 | From | 4 |
| 1602 | Reset, cancel delay control RxPDO 0×1610 | From | 4 |
| 1610 | DCD Request for device information RxPDO 0×1610 [64] | From | 6 |

Table 56: PDO assignment

### User-defined status bits

PDO 1 and PDO 2 are filled with user-defined status bit process data objects (PDO). These PDOs contain 64-bit virtual status output information of any type.

| PLC input data Name | Input data Type |
|---|---|
| User-defined VS TxPDO [1] 0×1A00 Byte 0 | BYTE |
| User-defined VS TxPDO [1] 0×1A00 Byte 1 | BYTE |
| User-defined VS TxPDO [1] 0×1A00 Byte 2 | BYTE |
| User-defined VS TxPDO [1] 0×1A00 Byte 3 | BYTE |

Table 57: User-defined VS TxPDO [1] 0×1A00

| PLC input data Name | Input data Type |
|---|---|
| User-defined VS TxPDO [2] 0×1A00 Byte 0 | BYTE |
| User-defined VS TxPDO [2] 0×1A00 Byte 1 | BYTE |
| User-defined VS TxPDO [2] 0×1A00 Byte 2 | BYTE |
| User-defined VS TxPDO [2] 0×1A00 Byte 3 | BYTE |

Table 58: User-defined VS TxPDO [2] 0×1A01

### Fault bits

PDO 3 and PDO 4 are filled with 64 bits of virtual status output information from the safety controller.

| PLC input data Name | Input data Type |
|---|---|
| Faults VS TxPDO [1] 0×1A02 Byte 0 | BYTE |
| Faults VS TxPDO [1] 0×1A02 Byte 1 | BYTE |
| Error VS TxPDO [1] 0×1A02 Byte 2 | BYTE |
| Error VS TxPDO [1] 0×1A02 Byte 3 | BYTE |

Table 59: Error VS TxPDO [1] 0×1A02

| PLC input data Name | Input data Type |
|---|---|
| Error VS TxPDO [2] 0×1A03 Byte 0 | BYTE |
| Faults VS TxPDO [2] 0×1A03 Byte 1 | BYTE |
| Error VS TxPDO [2] 0×1A03 Byte 2 | BYTE |
| Error VS TxPDO [2] 0×1A03 Byte 3 | BYTE |

Table 60: Error VS TxPDO [1] 0×1A02

[64] This PDO assignment is switched off by default.

**Input status bits**
PDO 5 to PDO 9 are reserved for 160 bits of input information of the safety controller. An expandable safety controller can have up to 154 inputs if all eight possible expansion cards are used as
16-channel inputs can be used (in addition to the 26 inputs built into the basic controller).

| PLC input data Name | Input data Type |
|---|---|
| Inputs VS TxPDO [1] 0×1A04 Byte 0 | BYTE |
| Inputs VS TxPDO [1] 0×1A04 Byte 1 | BYTE |
| Inputs VS TxPDO [1] 0×1A04 Byte 2 | BYTE |
| Inputs VS TxPDO [1] 0×1A04 Byte 3 | BYTE |

Table 61: Inputs VS TxPDO [1] 0×1A04

| PLC input data Name | Input data Type |
|---|---|
| Inputs VS TxPDO [2] 0×1A05 Byte 0 | BYTE |
| Inputs VS TxPDO [2] 0×1A05 Byte 1 | BYTE |
| Inputs VS TxPDO [2] 0×1A05 Byte 2 | BYTE |
| Inputs VS TxPDO [2] 0×1A05 Byte 3 | BYTE |

Table 62: Inputs VS TxPDO [2] 0×1A05

| PLC input data Name | Input data Type |
|---|---|
| Inputs VS TxPDO [3] 0×1A06 Byte 0 | BYTE |
| Inputs VS TxPDO [3] 0×1A06 Byte 1 | BYTE |
| Inputs VS TxPDO [3] 0×1A06 Byte 2 | BYTE |
| Inputs VS TxPDO [3] 0×1A06 Byte 3 | BYTE |

Table 63: Inputs VS TxPDO [3] 0×1A06

| PLC input data Name | Input data Type |
|---|---|
| Inputs VS TxPDO [4] 0×1A07 Byte 0 | BYTE |
| Inputs VS TxPDO [4] 0×1A07 Byte 1 | BYTE |
| Inputs VS TxPDO [4] 0×1A07 Byte 2 | BYTE |
| Inputs VS TxPDO [4] 0×1A07 Byte 3 | BYTE |

Table 64: Inputs VS TxPDO [4] 0×1A07

| PLC input data Name | Input data Type |
|---|---|
| Inputs VS TxPDO [5] 0×1A08 Byte 0 | BYTE |
| Inputs VS TxPDO [5] 0×1A08 Byte 1 | BYTE |
| Inputs VS TxPDO [5] 0×1A08 Byte 2 | BYTE |
| Inputs VS TxPDO [5] 0×1A08 Byte 3 | BYTE |

Table 65: Inputs VS TxPDO [5] 0×1A08

**Output status bits**
PDO 10 to PDO 12 are reserved for 96 virtual status output bits of the safety control type.

| PLC input data Name | Input data Type |
|---|---|
| Outputs VS TxPDO [1] 0×1A09 Byte 0 | BYTE |
| Outputs VS TxPDO [1] 0×1A09 Byte 1 | BYTE |
| Outputs VS TxPDO [1] 0×1A09 Byte 2 | BYTE |
| Outputs VS TxPDO [1] 0×1A09 Byte 3 | BYTE |

Table 66: Outputs VS TxPDO [1] 0×1A09

| PLC input data Name | Input data Type |
|---|---|
| Outputs VS TxPDO [2] 0×1A0A Byte 0 | BYTE |
| Outputs VS TxPDO [2] 0×1A0A Byte 1 | BYTE |
| Outputs VS TxPDO [2] 0×1A0A Byte 2 | BYTE |
| Outputs VS TxPDO [2] 0×1A0A Byte 3 | BYTE |

Table 67: Outputs VS TxPDO [2] 0×1A0A

| PLC input data Name | Input data Type |
|---|---|
| Outputs VS TxPDO [3] 0×1A0B Byte 0 | BYTE |
| Outputs VS TxPDO [3] 0×1A0B Byte 1 | BYTE |
| Outputs VS TxPDO [3] 0×1A0B Byte 2 | BYTE |
| Outputs VS TxPDO [3] 0×1A0B Byte 3 | BYTE |

Table 68: Outputs VS TxPDO [3] 0×1A0B

**Virtual reset, termination delay (RCD) Feedback**
PDO 13 contains the feedback of the RCD actuation code as well as 16 virtual non-safety-related inputs. They are used in the virtual reset, cancel-delay sequence.
See "7.7.1 Virtual manual reset and canceling a time delay (RCD)" on page 57.

| PLC input data Name | Input data Type |
|---|---|
| RCD actuation code feedback | BYTE |
| Reset, cancel delay feedback TxPDO [1] 0×1A0C Byte 0 | BYTE |
| Reset, cancel delay feedback TxPDO [1] 0×1A0C Byte 1 | BYTE |

Table 69: Virtual reset, abort delay

**DCD device information Answer**
PDO 14 contains the response data for communication with a single DCD device.
See also Requesting performance and status information for an individual device via DCD on page 50 and DCD Individual device-specific data - detailed description on page 202.

| PLC input data Name | Input data Type |
|---|---|
| DCD request confirmation | UINT |
| DCD chain confirmation | UINT |
| DCD device confirmation | UINT |
| DCD device information [66] | ARRAY[0..17] from BYTE |
| Detected device [0-15] in a chain | ARRAY[0..15] from BYTE |
| Detected device [16-31] in a chain | ARRAY[0..15] from BYTE |

Table 70: Virtual reset, abort delay

**DCD Individual device information-specific data Detailed description**
Specifies the data format for PLC Input Data Name: DCD device information.
See Response to DCD device information on page 291.

| Information on | Byte.word | Data Size |
|---|---|---|
| Error at the safety input | 0.0 | 1-bit |
| Reserved | 0.1 | 1-bit |
| Sensor not paired | 0.2 | 1-bit |
| DCD data error | 0.3 | 1-bit |
| Incorrect actuator/button status/input status | 0.4 | 1-bit |
| Border area/key status/input status | 0.5 | 1-bit |
| Actuator recognized | 0.6 | 1-bit |
| Output error | 0.7 | 1-bit |

| Information on | Byte.word | Data Size |
|---|---|---|
| Input 2 | 1.0 | 1-bit |
| Input 1 | 1.1 | 1-bit |
| Local reset Expected | 1.2 | 1-bit |
| Operating voltage warning | 1.3 | 1-bit |
| Operating voltage error | 1.4 | 1-bit |
| Output 2 | 1.5 | 1-bit |
| Output 1 | 1.6 | 1-bit |
| Power Cycle required | 1.7 | 1-bit |
| Fault-tolerant outputs | 2.0 | 1-bit |
| Local reset unit | 2.1 | 1-bit |
| Cascadable | 2.2 | 1-bit |
| High coding level | 2.3 | 1-bit |
| Remaining teach-ins | 2.7 to 2.4 | 4-bit |
| Device ID | 3.4 to 3.0 | 5-bit |
| Range Number of warnings | 4.2 to 3.5 | 6-bit |
| Output switch-off time | 4.7 to 4.3 | 5-bit |
| Number of voltage faults | 5 | 8-bit |
| Indoor temperature | 6 | 8-bit |
| Actuating element distance | 7 | 8-bit |
| Supply voltage | 8 | 8-bit |
| Expected name of the company | 9.3 to 9.0 | 4-bit |
| Received company name | 9.7 to 9.4 | 4-bit |
| Expected code | 11 to 10 | 16-bit |
| Received code | 13 to 12 | 16-bit |
| Internal error A | 15 to 14 | 16-bit |
| Internal error B | 17 to 16 | 16-bit |

Table 71: DCD Individual device data

[66] For the data format, see DCD Individual device information - Specific data - Detailed description on page 292.

**System status of the DCD chain - 8 chains**
PDO 15 to PDO 22 comprise the specific data of a single DCD chain. Each chain has its own data.

| PLC input data Name | Input data Type |
|---|---|
| Number of inputs in the chain # | UDINT |
| Chain Status of the chain # [67] | ARRAY[0..27] from BYTE |

Table 72: Individual DCD chains Status

**Status of the chain #-specific data Detailed description**
Specifies the data format for PLC Input Data Name: Chain status of the chain #. See System status of the DCD chain - 8 chains on page 293.

| Information on | Data Size |
|---|---|
| Chain # Number of devices | 32-bit |
| Chain # Device on/off (see DCD System Status Words on page 206) | 32-bit |
| Chain # Fault Status (see DCD System Status Words on page 206) | 32-bit |
| Chain # Marginal Status (see DCD System Status Words on page 206) | 32-bit |
| Chain # Alert Status (see DCD System Status Words on page 206) | 32-bit |
| Chain # Reset status (see DCD System Status Words on page 206) | 32-bit |
| Chain # Actuator Recognized (see DCD System Status Words on page 206) | 32-bit |
| Chain # System status (see DCD chain system status on page 50) | 32-bit |

Table 73: DCD individual chain data

**EtherCAT module status**

| PLC input data Name | Input data Type |
|---|---|
| ECAT module status | UINT |
| Operating mode | UINT |

**Virtual On, Off, Mute Activation bits**
PDO 25 is filled with 64 virtual non-safety-related inputs that can be used as virtual inputs/outputs (to the safety controller) or virtual mute inputs (to the safety controller).

| PLC output data Name | Output data type |
|---|---|
| On/Off, mute enable VI RxPDO [1] 0×1600 byte 0 | BYTE |
| On/Off, mute enable VI RxPDO [1] 0×1600 byte 1 | BYTE |
| On/Off, mute enable VI RxPDO [1] 0×1600 byte 2 | BYTE |
| On/Off, mute enable VI RxPDO [1] 0×1600 byte 3 | BYTE |

Table 74: Virtual On, Off, Mute Activation bits Bits 0×1600

| PLC output data Name | Output data type |
|---|---|
| On/Off, mute enable VI RxPDO [2] 0×1601 Byte 0 | BYTE |
| On/Off, mute enable VI RxPDO [2] 0×1601 Byte 1 | BYTE |
| On/Off, mute enable VI RxPDO [2] 0×1601 Byte 2 | BYTE |
| On/Off, mute enable VI RxPDO [2] 0×1601 Byte 3 | BYTE |

Table 75: Virtual On, Off, Mute Activation bits Bits 0×1601

**Virtual reset, termination delay (RCD) control**
PDO 26 contains the RCD Actuation Code, an important code word that is used in the virtual Reset, Cancel Delay sequence.
See Virtual manual reset and cancel delay sequence (RCD) on page 61. This PDO also contains sixteen virtual non-safety-related inputs that can be used in the virtual reset and cancel delay sequence.

| PLC input data Name | Input data Type |
|---|---|
| RCD actuation code | UDINT |
| Reset, abort Dealy Control RxPDO [1] 0×1602 Byte 0 | BYTE |
| Reset, cancel Dealy Control RxPDO [1] 0×1602 Byte 1 | BYTE |

Table 76: RCD control

**DCD information request for individual devices**
PDO 27 contains the response data for communication with a single DCD device.
See also Requesting performance and status information for an individual device via DCD on page 50 and DCD Individual device-specific data - detailed description on page 202.

| PLC input data Name | Input data Type |
|---|---|
| DCD read request | UINT |
| DCD chain requested | UINT |
| DCD device requested | UINT |

Table 77: DCD request for individual device information

### 12.7.7 Configuration instructions

**Installing the ESI file**
Use these instructions to install the ESI file in the Beckhoff TwinCAT 3 software.
1. Download the ESI file from www.bernstein.eu.
2. Navigate to the `TwinCAT/3.1/Config/Io/EtherCAT` folder.
3. Move the ESI file to this folder.
   The ESI will be available at the next program start in TwinCAT.

**Adding the safety controller to a project**
Use these instructions to add an SCx device to a TwinCAT project.
1. Start the TwinCAT 3 software.
2. Open a project.
3. Expand the I/O selection.
4. Right-click on the device to which the BERNSTEIN Safety Controller should belong.

**Adding the safety controller to a project**

Use these instructions to add an SCx device to a TwinCAT project.

1. Start the TwinCAT 3 software.
2. Open a project.
3. Expand the I/O selection.
4. Right-click on the device to which the BERNSTEIN Safety Controller should belong.
5. Select the option **Add new item**.
   "BERNSTEIN AG" is listed. Optionally, you can use the search and enter SCx to quickly select the ESI.
6. Select the **SCx EtherCAT module**.
7. Change the **name** as required for your system.
8. Click **OK** to add the security control to the system.

### 12.7.8 EtherCAT® PDO change

The EtherCAT PDO can be changed. Only a certain set of data is activated by default.
It is possible to switch on PDOs that are currently switched off and at the same time switch off PDOs that are currently switched on. By adapting the PDOs, only the data required for the application can be sent and received.
The smaller the PDO, the easier it is to fit into the assigned packet size for EtherCAT. Use the following instructions to switch PDO on and off as required.

**Access to the PDO menu**

1. Double-click on the BERNSTEIN Safety Controller in the I/O structure in the TwinCAT Solution Explorer. A window opens. The **General** tab is active by default.
2. Click on the **Process data** tab.
   This is the tab that allows you to switch PDO on and off.
3. Make a note of the outputs and inputs in the **Sync** Manager window.

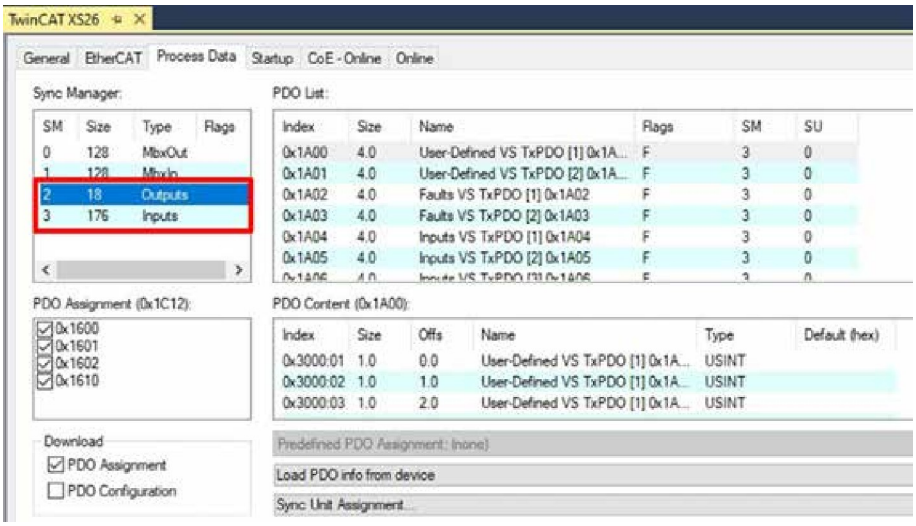



Figure 165: Output and inputs in the Sync Manager

**Switch off PDO**

This example procedure switches off an output PDO.

1. **Select** either **outputs** or **inputs** in the **Sync Manager** window in TwinCAT.
2. Examine the **PDO assignment** area for outputs.
3. Deactivate the checkbox for the element that you want to switch off. In this example, PDO 0×1610 (DCD Device Information Request) is switched off.

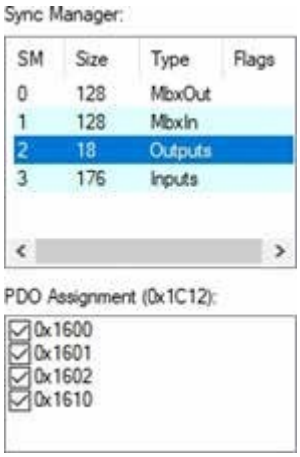
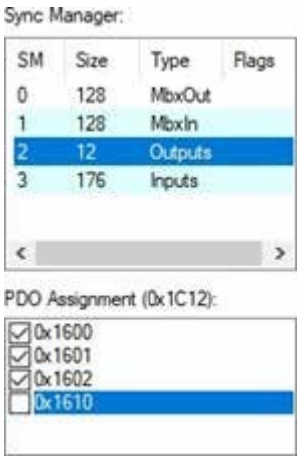



Figure 166: PDO assignment - All




outputsFigure 167: PDO assignment - 0×1610

4. Repeat this process as required for all elements that need to be switched off.

**Switching on a PDO**

This example procedure switches on an input PDO.

1. **Select** either **outputs** or **inputs** in the **Sync Manager** window in TwinCAT.
2. Examine the **PDO assignment** area for inputs.
3. Activate the checkbox for the element or elements that you want to switch on.
   In this example, PDO 0×1A20 and 0×1A21 (DCD Status Chain 1 and DCD Status Chain 2) are switched on.

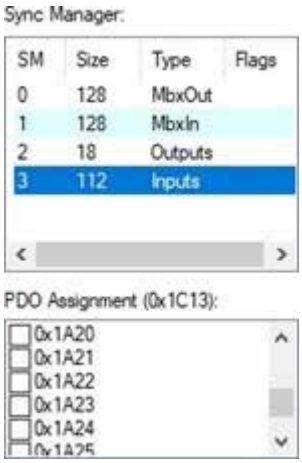
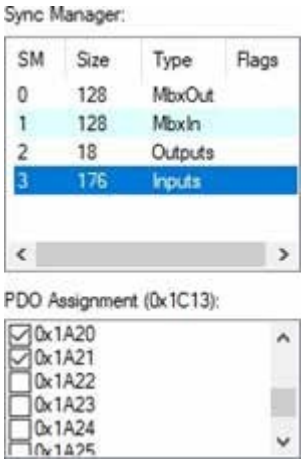



Figure 168: PDO assignment - All




inputsFigure 169:
PDO assignment - two inputs selected

## 12.8 Daisy Chain Diagnosis - DCD

### 12.8.1 Request performance and status information on an individual device via DCD

Please refer to the respective chapters of the industrial Ethernet used.

### 12.8.2 DCD series System status

The system status of the DCD series consists of several words that can be quickly accessed by the PLC without having to send a request to the safety evaluation system in advance. In this way, the PLC can quickly evaluate whether there are problems with the DCD series circuit.

This information has the following format:

| Information on | Type | Data size |
|---|---|---|
| Number of devices in the DCD series does not match the configuration | SCR P warning | 1 bit |
| The order of the devices in the DCD series does not match the configuration | SCR P and SCx warning | 1 bit |
| No DCD data was received from the configured DCD series | SCR P warning | 1 bit |
| Invalid (non-DCD-capable) device found in the DCD series | SCR P warning | 1 bit |
| Reserved | | 1 bit |
| DCD series terminating plug missing | DCD status | 1 bit |
| SRF actuator not taught-in (high-coded or unique-coded) | DCD error | 1 bit |
| Incorrect SRF actuator detected (high-coded or unique-coded) | DCD error | 1 bit |
| Internal error in a DCD device | DCD error | 1 bit |
| Output error detected in a DCD device, timer (20 min.) started to switch off the outputs | DCD error | 1 bit |
| Reserved | | 2 bit |
| DCD series OSSD status | DCD status | 1 bit |

Table 78: DCD series system status

### 12.8.3 Specific data of individual DCD devices

For DCD-capable devices, the specific data of individual devices has the following format:

| Information on | Abbreviation | Data size |
|---|---|---|
| Input error acknowledgement required | EF | 1 bit |
| reserved | – | 1 bit |
| Actuator not taught-in (SRF) | BE | 1-bit |
| DCD data error | CE | 1-bit |
| Incorrect actuator (SRF) / status of safety contact 2 (SEU) | FB | 1-bit |
| Actuator in the edge area (SRF) / Safety contact 1 status (SEU) | BB | 1-bit |
| Actuator recognized (SRF) | RB | 1-bit |
| Output error: Cross connection detected | QA | 1-bit |
| Status of safety input 2 | E2 | 1-bit |
| Status of safety input 1 | E1 | 1-bit |
| Local reset expected | LS | 1-bit |
| Operating voltage Warning | UW | 1-bit |
| Operating voltage error | UF | 1-bit |
| Status of safety output 2 | Q2 | 1-bit |
| Status of safety output 1 | Q1 | 1-bit |
| Stop mode: Restart of the component required | MF | 1-bit |
| With fault-tolerant output | MQ | 1-bit |
| With local reset | MS | 1-bit |
| Series connectable | RS | 1-bit |
| With high (or unique) coding | HC | 1-bit |
| Number of remaining teach operations (up-coded or unique-coded) | RTP | 4-bit |
| Device ID | – | 5-bit |
| Counter Actuator in the edge area (SRF) | – | 6-bit |
| Output error: Timer cross-connection (20 min.) | – | 5-bit |
| Counter Operating voltage warning | – | 8-bit |
| Temperature | – | 8-bit |
| Actuator distance | – | 8-bit |
| Operating voltage | – | 8-bit |
| Expected manufacturer code | – | 4-bit |
| Received manufacturer code | – | 4-bit |
| Expected actuator ID | – | 16-bit |
| Received actuator ID | – | 16-bit |
| Internal error A | – | 16-bit |
| Internal error B | – | 16-bit |

Table 79: Specific data of individual DCD devices

20 Information on the conversion of internal temperature, trigger distance and operating voltage can be found under "12.8.4 Information on temperature, voltage and distance conversion" on page 216

### 12.8.4 Inf ormation on temperature, voltage and distance conversion

Download an AOI (add-on instruction) from http://www.bernstein.eu, which you can integrate into the PLC program to convert the retrieved values into real values.

### 12.8.5 Supply voltage

The actual voltage value is calculated from the ADC value sent to the PLC multiplied by 0.1835. Operating voltage = ADC value × 0.1835

### 12.8.6 Indoor temperature

First shift the remaining ADC value by 2 bits. Then convert the binary measured value into a number. If the number corresponds to the ADC value in the following table, simply read off the temperature. If the number is between the measured values in the table, calculate the actual temperature using the following formula.

**Internal Temperature = ((A-L) / (H-L)) × 5 + T**

**A**
the ADC value obtained from the safety evaluation
**L**
the ADC value in the look-up table is less than or equal to A
**H**
the ADC value in the look-up table is greater than A
**T**
the temperature associated with the L value

| ADC measured value | Temperature (°C) |
|---|---|
| 41 | -40 |
| 54 | -35 |
| 69 | -30 |
| 88 | -25 |
| 110 | -20 |
| 136 | -15 |
| 165 | -10 |
| 199 | -5 |
| 237 | 0 |
| 278 | 5 |
| 321 | 10 |
| 367 | 15 |
| 414 | 20 |
| 461 | 25 |
| 508 | 30 |
| 554 | 35 |
| 598 | 40 |
| 640 | 45 |
| 679 | 50 |
| 715 | 55 |
| 748 | 60 |
| 778 | 65 |
| 804 | 70 |
| 829 | 75 |
| 850 | 80 |
| 869 | 85 |
| 886 | 90 |
| 901 | 95 |
| 914 | 100 |
| 926 | 105 |
| 936 | 110 |

Table 80: Temperature

### 12.8.7 Actuator distance

Convert the binary measured value into a number. If the number corresponds to the ADC value in the following table, simply read off the distance. If the number is between the measured values in the table, calculate the actual distance using the following formula.

**Actuator Distance = ((A-L) / (H-L)) + D**

**A**
the ADC value obtained from the safety evaluation

**L**
the ADC value in the look-up table is less than or equal to A

**H**
the ADC value in the look-up table is greater than A

**D**
the distance in connection with the L-value

| ADC measured value | Distance (mm) |
|---|---|
| <62 | <7 |
| 62 | 7 |
| 65 | 8 |
| 77 | 9 |
| 110 | 10 |
| 133 | 11 |
| 148 | 12 |
| 158 | 13 |
| 163 | 14 |
| 169 | 15 |
| 172 | 16 |
| 176 | 17 |
| 180 | 18 |
| >180 | >18 |

Table 81: Actuator distance

# 13. System check

## 13.1 Z schedule for mandatory inspections

Checking the configuration and functionality of the safety evaluation includes testing each safety and non-safety-related input device together with each output device. While the inputs are switched individually from the on state to the off state, it must be checked whether the safety outputs switch on and off as expected.

**WARNING: Do not use the machine if the system is not working properly.**

**If not all of these checks can be carried out, the use of the safe machine control system** that this BERNSTEIN AG device contains **must be refrained from** until the defect or fault has been rectified. the problem has been rectified. **Attempting to use the safe machine control under such conditions can result in serious or fatal injury.**

A comprehensive test must be carried out to check the operation of the safety evaluation unit and the functionality of the intended configuration. "13.2.2 Setup before commissioning, commissioning and regulartest routines" on page 219 is intended to help with the preparation of a configuration-specific checklist for each application. This specific checklist must be made available to the maintenance personnel for the commissioning test and regular function tests. A similar, simplified checklist for the daily inspection routine should be prepared for the operator (or authorized person). It is strongly recommended that copies of the wiring diagrams, circuit diagrams and configuration summary are kept available for the test procedures.

**WARNING:**

- **Carry out regular checks**
- If these checks are not carried out, a hazardous situation may arise which could lead to serious or fatal injuries.
- The commissioning test as well as regular and daily checks on the safety system must be carried out by qualified personnel at the scheduled times to ensure that the safety system is functioning as intended

**Commissioning test**: A qualified person must carry out a commissioning test on the safety system before the safety circuits of the monitored machine can be put into operation and after each setup or change to the configuration of the safety evaluation unit.

**Regular (semi-annual) inspection:** A qualified person must also carry out a new commissioning test on the safety system every six months (every 6 months) or at regular intervals in accordance with the applicable local or national regulations.

**Daily function tests:** An authorized person must also check the correct functioning of the risk reduction measures in accordance with the manufacturer's recommendations every day the monitored machine is used.

**WARNING: Before switching on the machine**

Ensure that there are no personnel or unwanted materials (e.g. tools) in the monitored area before the power supply to the monitored machine is switched on. **Failure to follow these instructions may result in serious or fatal injury.**

## 13.2 Inb etriebnahmeprüfung

**Check the following before carrying out the procedure:**

1. None of the relay output connections of the entire safety evaluation system may be connected to the machine.
2. The power supply must have been disconnected from the machine and there must be no power connection to the machine's controls or drives.

The permanent connections will be connected at a later date.

### 13.2.1 Checking the system operation

The commissioning test must be carried out by a qualified person. It may only be carried out after the safety evaluation unit has been configured and the safety systems and protective devices connected to the inputs of the evaluation unit have been properly installed and configured (see "7.5 Options for safety input devices" on page 36 and the relevant standards).

The commissioning test must be carried out in the following two cases:

1. When the safety evaluation is installed for the first time, to ensure correct installation.
2. Each time maintenance work or changes are made to the system or to the machine monitored by the system to ensure that the safety evaluation system continues to function correctly (see "13.1 Schedule for mandatory checks" on page 218).

**During the first part of the commissioning test, the safety evaluation and connected safety systems must be checked without the power supply to the machine drive having been established.** The final connections to the machine drive may only be made after these systems have been checked.

**Check the following:**

- **The lines of the safety outputs are galvanically isolated** (i.e. not short-circuited to each other or to other circuits or to earth).
- If they are used, the connections of the external device monitoring (EDM) must be connected to +24 V DC via the NC monitoring contacts of the devices connected to the safety outputs, as specified in the description in "External device monitoring (EDM)" on page 67 and in the circuit diagrams.
- The correct configuration file for your application has been installed in the security evaluation.
- All input and output terminals have been connected in accordance with the appropriate sections and comply with NEC and local electrical codes.

This allows the safety evaluation and the connected safety systems to be checked separately before the power supply to the machine drive is established.

### 13.2.2 S etup before commissioning, commissioning and regular test routines

In the initial configuration check phase, there are two ways of checking that the safety outputs change status at the scheduled times (open the **Configuration overview** in the software to display the start-up test and the configuration settings for mains connection):

- Observe the LEDs assigned to the inputs and outputs. If the input LED lights up green, the input is switched on (or 24 V). If the input LED lights up red, the input is switched off (or 0 V). Similarly, the corresponding LED lights up green when the RO1 and RO2 output contacts are closed. However, if the contacts are open, the LED lights up red.
- Start **live mode** in the software (the safety evaluation unit must be switched on and connected to the PC with a USB cable).

**Start-up configuration**

When the mains is switched on, the outputs connected to two-hand control, override or enabling switch functions do not switch on. After switching on the mains, these devices must be switched to the off state and back to the on state so that their associated outputs switch on.

**When configured for normal mains connection**

If the interlock function is not used: Check that the safety outputs switch on after switching on the mains.
If an input device or an output uses the interlock function: Check that the safety outputs are not switched on after mains switch-on until the specific manual latch reset operations have been carried out.

**When configured for automatic mains connection**

Check that all safety outputs are switched on within approx. 5 seconds (outputs with activated switch-on delay may switch on later).

10 For definitions, see "19. Glossary" on page 255.

**When configured for manual mains connection**

Check that all safety outputs remain OFF after switching on the mains.
Wait at least 10 seconds after switching on the mains and carry out the reset for manual mains switch-on.
Check that the safety outputs are switched on (outputs with activated switch-on delay may switch on later).

**CAUTION: Checking the function of the inputs and outputs**

The qualified person is responsible for cycling the input devices (on-state and off-state) to verify that the safety outputs turn on and off to provide the intended protective functions under normal operating conditions and foreseeable conditions.
fault conditions. The configuration of the individual safety evaluations must be carefully assessed and tested to ensure that an interruption to the power supply
for a safety switching device, the safety evaluation or the inverted input signal from a safety switching device do not cause an unintended on-state, muting state or bridging state of the safety outputs.

**Note:** If the display for an input or output flashes red, see "15. Troubleshooting" on page 238

**Operation of the safety switching devices (emergency stop switch, rope pull switch, optosensor, safety mat, protective stop)**

1. With the associated safety outputs switched on, actuate each safety switching device individually once.
2. Ensure that each associated safety output switches off with the correct switch-off delay, if applicable.
3. While the safety device is in the on state:
   - **If a safety switching device is configured with a latch reset function:**
     1. Check that all safety outputs remain switched off.
     2. Perform a latch reset to switch on the outputs.
     3. Check whether the individual safety outputs switch on.
   - **If no latch reset functions are used:** Check whether the safety output switches on.

**Important**: Always test the safety devices in accordance with the recommendations of the manufacturer of the respective device.

**The following sequence of steps applies: If a certain function or device is not part of the application, skip the step and continue to the next item on the checklist or to the last commissioning step.**

**Two-hand control function without muting**

1. Make sure that the operating elements of the two-hand control are in the off state.
2. Make sure that all other inputs connected to the two-hand control function are in the On state and activate the operating elements of the two-hand control to switch on the connected safety input.
3. Check that the connected safety output remains switched off unless both control elements are activated at intervals of 0.5 seconds.
4. Check that the safety output switches off and remains switched off when one hand is removed and replaced (while the other control element remains in the on state).
5. Check that switching a safety input (not an operating element of the two-hand control) to the off state results in the connected safety output being switched off or remaining switched off.
6. If several pairs of two-hand control elements are used, the additional control elements must be activated before the safety output switches on. Check that the safety output switches off and remains switched off when one hand is removed and replaced (while the other control element remains in the on state).

**Two-hand control function with muting**

1. Carry out the check steps described above for the two-hand control function.
2. Activate the two operating elements of the two-hand control and then activate the MP1 sensors.
3. With the MSP1 sensors activated, remove your hands from the two-hand control and check that the safety output remains switched on.
4. Check that all safety outputs remain switched off if one of the following conditions occurs:
   - The MSP1 sensors are switched to the off state.
   - The muting time limit expires.
5. For multiple controls for two-hand controls with at least one pair of non-mutable controls: Ensure that the safety outputs turn off when one or both hands are removed from each non-muted control during an active muting cycle.

**Bidirectional (2-way) muting function (also applies to the muting function of area controls)**

1. With the safety device muted in the On state, activate the muting activation input (if used) and then activate each muting sensor in turn within 3 seconds.
2. Generate a stop command from the muted protective device:
   a. Check whether the associated safety outputs remain switched on.
   b. If a muting time limit has been configured, check whether the associated safety outputs are switched off when the muting timer expires.
   c. Repeat the above steps for each muting sensor pair.
   d. Check the individual muted protective devices for proper operation.
   e. Generate a stop command individually from the non-muted protective devices while the devices are in the muting cycle and check whether the associated safety outputs switch off.
   f. Check the muting process in reverse by repeating the process described above, but activate the muting sensors in reverse order.

**Unidirectional (1-way) muting function**

1. With non-activated muting sensors, muted protective devices in the ON state and switched-on safety outputs:
   a. Activate the muting sensor pair 1.
   b. Switch the muted safety device to the off state.
   c. Activate the muting sensor pair 2.
   d. Deactivate the muting sensor pair 1.
2. Check that the associated safety output remains in the off state during the entire process.
3. Repeat the test in the wrong direction (muting sensor pair 2, then protective device, then muting sensor pair 1).
4. Check that the output switches off when the protective device switches to the off state

**If a muting time limit has been configured**

Check that the associated safety outputs switch off when the muting timer expires.

**Muting function with mains connection mode (does not apply to two-hand control)**

1. Switch off the power supply to the safety evaluation unit.
2. Activate the muting activation input (if used).
3. Activate a suitable muting sensor pair to start a muting cycle.
4. Ensure that all mutable safety devices are in the on state.
5. Switch on the power supply for safety evaluation.
6. Check that the safety output switches on and that a muting cycle starts.
7. Repeat this test with the mutable safety device in the off state.
8. Check whether the safety output remains switched off.

**Muting function with muting-dependent override**

1. Make sure that the muting sensors are not activated and that the muting protective devices are in the on state.
2. Check whether the associated safety outputs are switched on.
3. Switch the protective device to the off state.
4. Check whether the safety output is switched off.
5. Activate one of the muting sensors.
6. Check whether the optional muting light is flashing.

7. Start the muting-dependent override by activating the override switch.
8. Check whether the safety output is switched on.
9. Check whether the safety output is switched off if one of the following conditions is met:
   - Time limit for override expires
   - The muting sensors are deactivated.
   - The override device is deactivated.

**Muting function with bridging**

1. Check that every safety input that can be muted or bypassed is in the off state.
2. If the override switch is in the on state, check the following:
   a. Whether the associated safety outputs switch on.
   b. Whether the associated safety outputs switch off when the override timer expires.
3. Switch the bypass switch to the on state and check whether the associated safety outputs switch on.
4. Switch the associated non-bridged input devices (individually) to the off state and check whether the associated safety outputs switch off while the bridging switch is in the on state.

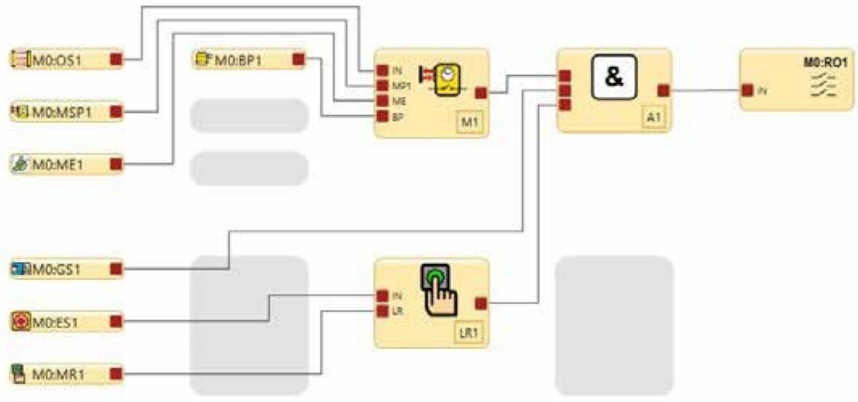



Figure 170: Setup: Inputs without bridging

**Bridging function**

1. Check whether the associated safety outputs are switched off if the safety inputs to be bridged are in the off state.
2. If the override switch is in the on state, check the following:
   a. Whether the associated safety outputs switch on.
   b. Whether the associated safety outputs switch off when the override timer expires.
3. Switch the bypass switch to the on state and check whether the associated safety outputs switch on.
4. Switch the input devices that are not bypassed to the off state one after the other and check whether the associated safety outputs switch off while the bypass switch is in the on state.

**Switch-off delay function for safety outputs**

1. With one of the control inputs in the off state and the delayed safety output in the off-delay state, check whether the safety output switches off after the time delay has elapsed.
2. With one of the control inputs in the Off state and an active switch-off delay time, switch the input to the On state and check whether the safety output is switched on and remains switched on.

**Switch-off delay function for safety outputs - input for canceling a time delay** Activate the input for canceling the time delay while the associated inputs are in the off state and while the switch-off delay of the safety output is active, and check whether the safety output switches off immediately.

**Switch-off delay function for safety outputs - Control inputs**

1. With one of the control inputs in the off state and while the delayed safety output is in the off-delay state, switch the input to the on state.
2. Check whether the safety output is switched on and remains switched on.

**Switch-off delay function for safety outputs and latch reset**

1. Ensure that the associated input devices are in the On state so that the delayed safety output is switched on.
2. Start the switch-off delay time by switching an input device to the off state.
3. Switch the input device back to the on state during the switch-off delay time and press the reset button.
4. Check whether the delayed output switches off at the end of the delay and whether it remains switched off (a latch reset signal during the delay time is ignored).

**Enabling switch function without secondary switch-on output**

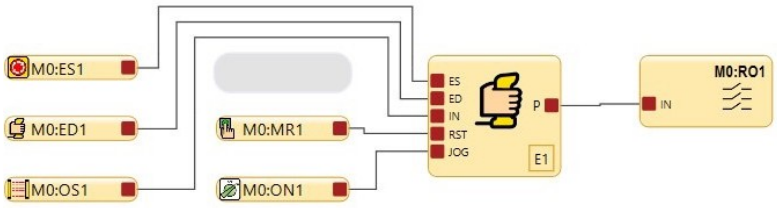



Figure 171: Setup: Enabling switch function without secondary switch-on output

1. While the associated inputs are in the On state and the enabling switch is in the Off state, check whether the safety output is switched on.
2. While the enabling switch is still in the on state and the associated safety output is switched on, check whether the safety output switches off when the enabling switch timer expires.
3. Switch the enabling switch back to the off state and then back to the on state and check whether the safety outputs switch on.
4. Switch the enabling switch to the off state and check whether the associated safety outputs switch off.
5. Switch the individual emergency stop and rope pull switches connected to the enabling switch function to the Off state and check in each case in turn whether the associated safety outputs are switched on and are in enable mode.
6. Perform a reset while the enabling switch is in the off state.
7. Check whether the control unit is now based on the associated input devices of the enabling switch function:
   a. If one or more input devices are in the off state, check whether the output is switched off.
   b. If all input devices are in the on state, check whether the output is switched on

**Enabling switch function - With advance switching function at the secondary output**

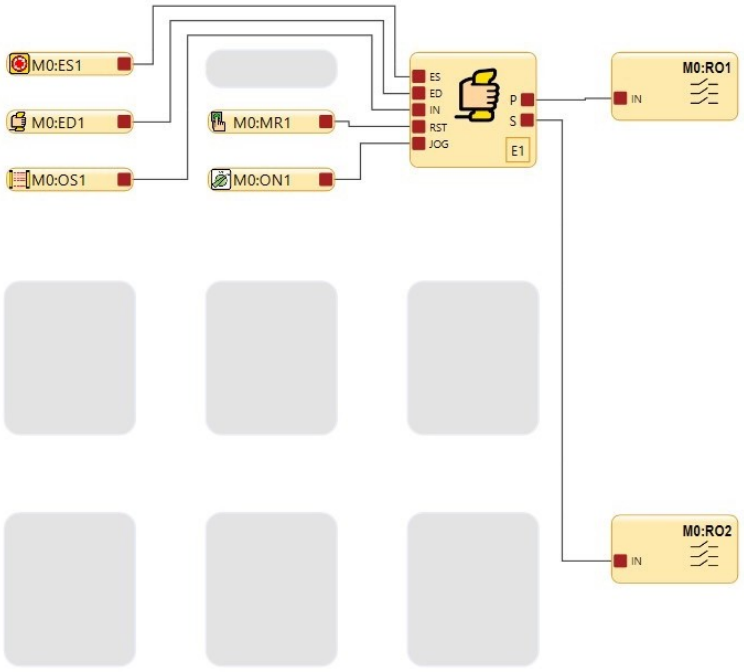



Figure 172: Setup: Enabling switch function - with advance switching function at the secondary output

1. While the Enabling switch and the Advance button are in the On state and control the primary safety output, check whether the output switches off when either the Enabling switch or the Advance button is switched to the Off state.
2. While the enabling switch controls the primary safety output and the advance button controls the secondary output, check whether the primary output performs the following switching operations:
   a. Switching on when the enabling switch is in the on state.
   b. Switches off when the enabling switch is in the off state and the advance button is in the on state.
3. Check whether the output only switches on when the enabling switch is in the on state and the advance button is in the on state.
4. Check whether the secondary output performs the following switching operations:
   a. Switching on when the enabling switch and the advance button are in the on state. b. Switching off when the enabling switch or the advance button is in the off state.

## 14. Information on status and operation

Operate the SCx safety controller either via the integrated interface or via the software to monitor the current status.
The SCR P safety evaluation can be monitored via the software in order to permanently monitor the status.

### 14.1 Status of the LED indicators on the SCx

| LED | Status | Meaning |
|---|---|---|
| **All** | From | Initialization mode |
| | Sequence:<br>Green ON for 0.5 s<br>Red ON for 0.5 s<br>Off for min. 0.5 s | Applied power |
| **Performance/ malfunction** | OFF | Switch off |
| | Green: ON | Operating mode |
| | Green: Flashing | Configuration mode OR Manual switch-on mode |
| | Red: Flashing | Manual switch-on mode |
| **USB (FID 2 or earlier basic controller)** | OFF | No connection to the PC established |
| | Green: ON | Connection to the PC established |
| | Green: Flashes for 5 s, then OFF | Conformity of the SCR P-FPS configuration |
| | Red: Flashes for 5 s, then OFF | SCR P-FPS configuration does not match |
| **USB (FID 3 or higher basic controller)** | OFF | No connection established and configured Safety controller |
| | Green: ON | USB cable, connected to a configured safety controller |
| | Green: Flashing | No connection established and factory setting Safety Controller OR<br>USB cable connected and factory setting Safety Controller |
| | Green: Flashing for 4 s, then green ON | Configured new SCR P-FPS[72] (interlocked or unlocked) connected to a factory-set safety controller |
| | Green: Flashes for 5 s, then OFF | Configured and unlocked new SCx[72] connected to a configured security controller with matching configuration, matching passwords and matching or non-matching network settings OR<br>The old SCR P-FPS[73] is inserted into the FID 3 or a newer controller (configured or preset at the factory) and has a suitable configuration |
| | Green: Flashing for 5 s, then flashing red | Configured and locked new SCR P-FPS[72] connected to a configured safety controller with matching configuration and passwords, but not matching network settings |
| | Red: Flashing | Configured new SCR P-FPS[72] (locked or unlocked) plugged into a configured safety controller with a mismatched configuration, mismatched password or empty SCR P-FPS<br>OR<br>Empty SCR P-FPS, connected to a factory-set safety controller or a configured safety controller |
| | Red: Flashes for 5 s, then OFF | Old SCR P-FPS[73] is used in FID 3 or later control units (configured or factory set) and has a mismatched configuration |
| **Inputs** | Green: ON | No input errors |
| | Red: Flashing | One or more inputs are in the "Blocked" state. |

[72] "New SCR P-FPS": an SCR P-FPS that contains information created with the BERNSTEIN Safety Controller software version 4.2 or higher, or that was created by an FID 3 or higher Safety Controller.

[73] "Old SCR P-FPS": an SCR P-FPS that contains information that was created with the BERNSTEIN Safety Controller Software Version 4.1 or earlier, or that was created by a safety controller FID 2 or earlier.

| LED | Status | Meaning |
|---|---|---|
| **SO1, SO2** | OFF | Output not configured |
| | Green: ON | Safety output ON |
| | Red: ON | Safety output OFF |
| | Red: Flashing | Error detected at safety output or EDM error detected or AVM error detected |

| LED status for split outputs | Meaning |
|---|---|
| Green: ON | Both outputs are ON |
| Red: ON | SOxa and/or SOxb is OFF |
| Red: Flashing | SOxa and/or SOxb error detected |

| Ethernet diagnostics LEDs | | |
|---|---|---|
| **Yellow LED** | **Green LED** | **Description** |
| ON | Varies depending on data traffic | Connection established/normal operation |
| OFF | OFF | Hardware failure |

| Yellow and green LEDs flash synchronously | Description |
|---|---|
| Flashes 5 times and then flashes briefly several times. | Normal start-up |
| 1 Flashing every 3 seconds | Contact BERNSTEIN AG |
| Repeated sequence of two flashes | In the last 60 seconds, a cable was disconnected in the active state. |
| Repeated sequence of three flashes | One cable is disconnected. |
| Repeated sequence of four flashes | Network not activated in the configuration. |
| Repeated sequence of five or more flashes | Contact BERNSTEIN AG |

| PROFINET Flash command | Meaning |
|---|---|
| The LEDs on the base controller flash for 4 seconds<br>  | The flashing LEDs indicate that the base controller is connected. This is the result of the "Flash LED" command from the PROFINET network. |

### 14.2 Status displays of the input modules

The following information relates to the SCx-I-8 and SCx-I-16 models

| LED | Status | Meaning |
|---|---|---|
| **All** | Sequence:<br>Green ON for 0.5 s<br>Red ON for 0.5 s<br>OFF for at least 0.5 s | Applied power |
| | OFF | Initialization mode |

### 14.3 Output module (solid-state or relay) Status displays

The following information relates to the SCx-O-2T, SCx-O-4T, SCx-O-1R and SCx-O-1R models.

| LED | Status | Meaning |
|---|---|---|
| **All** | Sequence:<br>Green ON for 0.5 s<br>Red ON for 0.5 s<br>OFF for at least 0.5 s | Applied power |
| | OFF | Initialization mode |
| **Energy display** | OFF | Switch off |
| | Green: ON | Switch on the power |
| | Red: Flashing | Locking status when not in use |
| **Send/receive display** | Green: ON | Transmission or receipt of data |
| | Red: ON | No communication |
| | Red: Flashing | Communication error detected<br>OR<br>Safety bus communication problem |
| **Indicators for safety performance** | OFF | Output not configured |
| | Green: ON | Two single-channel safety outputs (both ON) OR two-channel or one single-channel safety output ON |
| | Red: ON | Two single-channel safety outputs (1 ON and 1 OFF) |
| | Red: ON | Two single-channel safety outputs (both OFF) OR two-channel or one single-channel safety output OFF (other channel not used) |
| | Red: Flashing | Safety Error detected at the output |

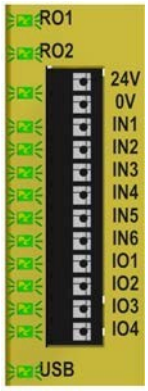
### 14.4 Status of the LED displays on the SCR P

The status of the safety evaluation can be determined using the following table. As long as the safety evaluation is not switched off, the LEDs are always switched on.

| LED | Status | Meaning |
|---|---|---|
| **All** | From | Initialization mode |
| | Sequence:<br>Green ON for 0.5 s<br>Red ON for 0.5 s<br>Off for min. 0.5 s | Switched on |
| **Supply/ error** (1) | Green constant | 24 V DC connected |
| | Flashing green | Configuration or manual mains connection mode Configuration via SCR P-FPS: Switching the power supply off and on again |
| | Flashing red | Locked state |
| **USB** (1) | Green constant | USB cable connected or SCR P-FPS plugged in |
| | Flashing green | Safety evaluation in factory state; neither USB cable connected nor SCR P-FPS plugged in |
| | Green fast flashing for 3 s, then constant | Configured (locked or unlocked) SCR P-FPS plugged into a safety evaluation unit in factory state; configuration, network settings and passwords are transferred from the SCR P-FPS to the safety evaluation unit |
| | Flashing green for 3 s, then constant | Configured and unlocked SCR P-FPS plugged into a configured safety evaluation unit with matching configuration and matching passwords<br>**Note:** If the network settings do not match, the network settings are transferred from the security evaluation to an unlocked SCR P-FPS. No network settings are transferred to a locked SCR P-FPS. |
| | Flashing green quickly for 3 s, then flashing red | Configured and locked SCR P-FPS plugged into a configured safety evaluation unit with matching configuration and matching passwords, but not matching network settings |
| | Red constant | Configured safety evaluation; neither USB cable connected nor SCR P-FPS plugged in |
| | Flashing red | Configured and locked SCR P-FPS plugged into a configured safety evaluation unit with matching configuration and matching passwords, but not matching network settings |
| **Inputs** (10) | Green constant | 24 V DC and no error<br>Input configured as status output and active |
| | Red constant | 0 V DC and no error |
| | Red constant | Input configured as status output and inactive |
| | Flashing red | All connections of a faulty input (including shared connections) |
| **RO1, RO2** (2) | Green constant | On (contacts closed) |
| | Red constant | Off (contacts open) or not configured |
| | Flashing red | Safety output error detected or EDM error detected or AVM error detected |

| **Ethernet diagnostics LEDs** | | |
|---|---|---|
| **Yellow LED** | **Green LED** | **Description** |
| A | Flashes during data transmission | Connection established/normal operation |
| From | From | Hardware error |

| **Yellow and green LEDs flash synchronously** | **Description** |
|---|---|
| Flashes 5 times and then flashes briefly several times. | Normal start-up |
| 1 Flashing every 3 seconds | Contact BERNSTEIN AG |
| Repeated sequence of two flashes | In the last 60 seconds, a cable was disconnected in the active state. |
| Repeated sequence of three flashes | One cable is disconnected. |
| Repeated sequence of four flashes | Network not activated in the configuration. |
| Repeated sequence of five or more flashes | Contact BERNSTEIN AG |

| **PROFINET blink command** | **Meaning** |
|---|---|
| All LEDs flash twice per second for 4 seconds.   | The flashing LEDs indicate that the SCR P is connected. This is the result of the "LED flashing" command from the PROFINET network. |

### 14.5 Live mode information: Software

To display real-time information about the run mode on a PC, the safety evaluation unit must be connected to the computer using the USB cable. Click on **Live Mode** to access the **Live Mode** tab. This function continuously updates and displays data, including data on the start, stop and run times.

error states of all inputs and outputs, as well as the error code table. The **Devices** and **Function view** tabs also contain a device-specific visual display of the data. See Live mode on page 165 for more information.
The "Live mode" tab contains the same information that can also be shown on the display of the SCx safety controller.

### 14.6 Information on live mode: Onboard interface

To view real-time operating mode information on the safety controller display (models with display), select System Status 74 from the system menu (see SCx Onboard Interface on page 163 for a navigation map). The system status shows the status of the input device and the safety output; the fault diagnosis shows current fault information (a brief description, corrective measures and the fault code) and provides access to the fault log. For more information, see SCx Onboard Interface on page 163.

The display of the safety controller provides the same information that can also be displayed via the live mode function of the software.

### 14.7 Locking states

Input blocking states are usually rectified by repairing the fault and switching the input off and on again.
Disable conditions on the outputs (including EDM and AVM faults) are corrected by repairing the fault and then switching through the reset input connected to the fault/reset (FR) input on the safety output.
System faults, such as low supply voltage, overtemperature or voltage detected at unassigned inputs, can be cleared by switching through the system reset input (any reset input can be assigned for the system reset). Only one physical or virtual reset button can be configured to perform this operation.
A system reset is carried out to eliminate blocking states that are not associated with safety inputs or outputs. A blocking state is a reaction of the safety evaluation system in which it switches off all affected safety outputs if a safety-relevant error is detected. To rectify this state, all errors must be eliminated and a system reset performed. As long as the error that caused the disable state has not been rectified, the disable state will occur again after the system reset.

A system reset is required under the following conditions:

1. For restarting after a system lockout
2. To start the safety evaluation after a new configuration has been downloaded

If internal errors occur, the system reset will probably not work. In order for the system to resume operation, the mains power supply must be switched off and on again.

**WARNING: Unmonitored resets**
**If a reset is configured without monitoring (either for an interlocked output or a system reset)** and all other conditions for a reset are met, **the safety outputs are switched on immediately by a short circuit from the reset connection to +24 V**.

**WARNING: Check before resetting**
When carrying out a system reset procedure, the user must ensure that all potential danger zones are clear and that there are no persons or unwanted materials (e.g. tools) that could be exposed to danger. **Failure to follow these instructions may result in serious or fatal injury. Failure to follow these instructions may result in serious or fatal injury.**

### 14.8 After a lock state

To remove a lock status:

- Follow the recommendation in the error display (models with display)
- Follow the recommended steps and checks listed in "15.5 SCx fault code table" on page 243 or "15.6 SCR P fault code table" on page 249.
- Performing a system reset
- Switch the power supply off and on again and carry out a system reset if necessary.

If these steps do not resolve the blocking condition, contact BERNSTEIN AG (see"17.2 Repairsand warranty" on page 252).

### 14.9 SCR P and SCx: Automatic optimization of connections

Use the following steps to create a sample configuration that uses the automatic port optimization (ATO) function.

**Note:** This procedure serves only as an example

1. Click on **New project** to start a new project.
2. Define the project settings and click **OK**.

**Note**: Make sure that the **Disable function for the automatic optimization of connections** checkbox is **deactivated**.

The project is created.

3. On the **Devices** tab under the security evaluation, click ✚. The **Add device** window opens.
4. Add an emergency stop switch and click **OK** to accept the default settings.
5. Click on ✚.
6. Add an optical sensor and click **OK** to accept the default settings.
7. Click on ✚.
8. Add a safety gate switch and click **OK** to accept the default settings.
9. Switch to the **Wiring diagram** tab and read off which connections are assigned.

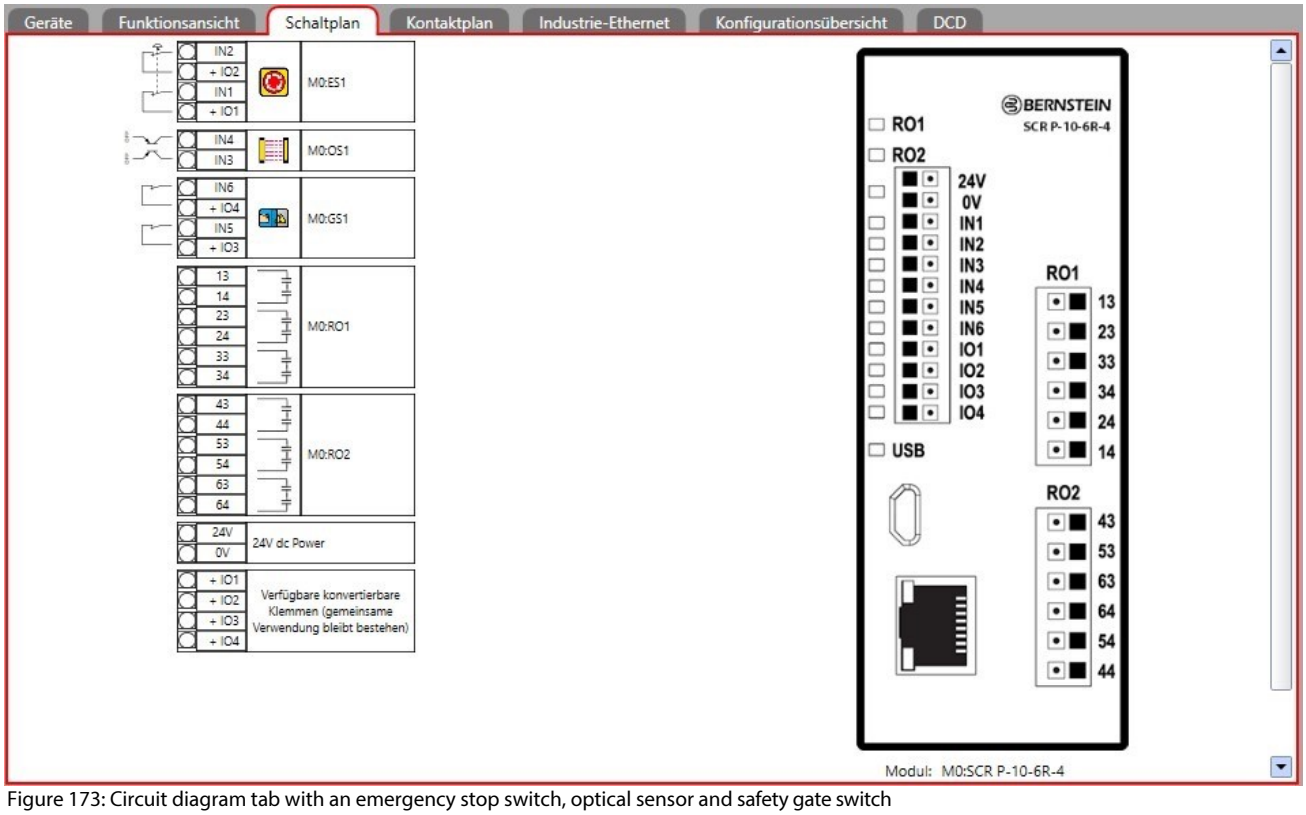



Figure 173: Circuit diagram tab with an emergency stop switch, optical sensor and safety gate switch

10. Switch to the Devices tab and click on ✚.
11. Add a second safety gate switch and click OK to accept the default settings.

12. Switch to the **Wiring diagram** tab and note that external terminal blocks (ETB) have been added for the second safety gate switch.

**Note:** The external terminal blocks are provided by the user.

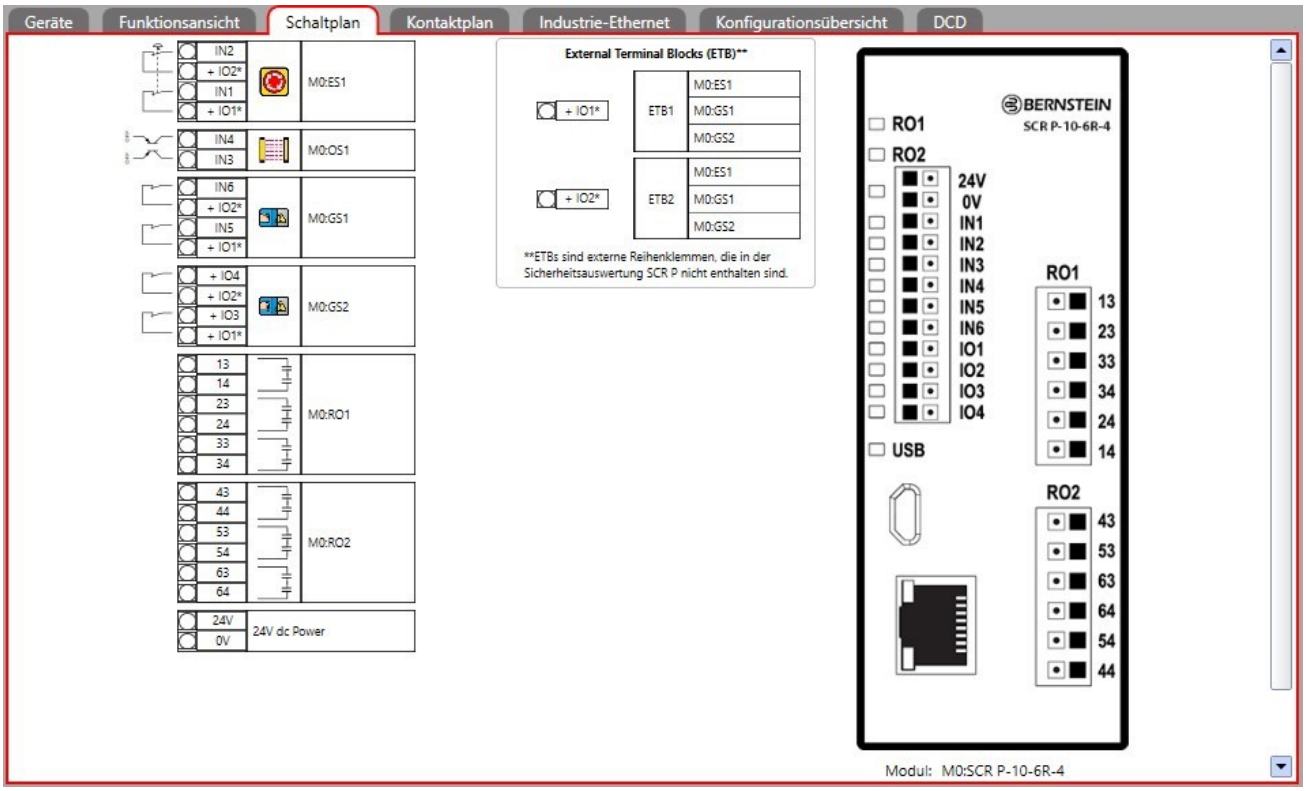



Figure 174: **Circuit diagram** tab with three emergency stop buttons and ETBs

## 14.10 Example configuration for the SCR P and SCx without automatic optimization of connections

Use the following steps to create a sample configuration in which the function for the automatic optimization of connections (ATO) is deactivated.

**Note:** This procedure serves only as an example

1. Click on **New** project to start a new project.
2. Specify the project settings, activate the **Disable function for automatic optimization of connections** checkbox and click **OK**.

**Note**: Make sure that the **Disable function for the automatic optimization of connections** checkbox is activated.

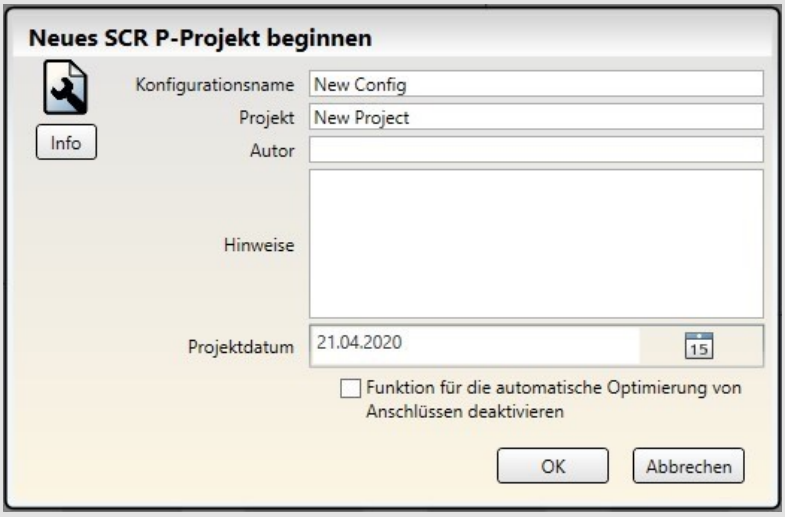



Figure 175: Deactivate function for automatic optimization of connections selected

The project is created.

3. On the **Devices** tab under the security evaluation, click . The **Add device** window opens.
4. Add an emergency stop button and click **OK** to accept the default settings.
5. Click on .
6. Add an optical sensor and click **OK** to accept the default settings.
7. Click on .
8. Add a safety gate switch and click **OK** to accept the default settings.
9. Switch to the Wiring diagram tab and read which connections are assigned there

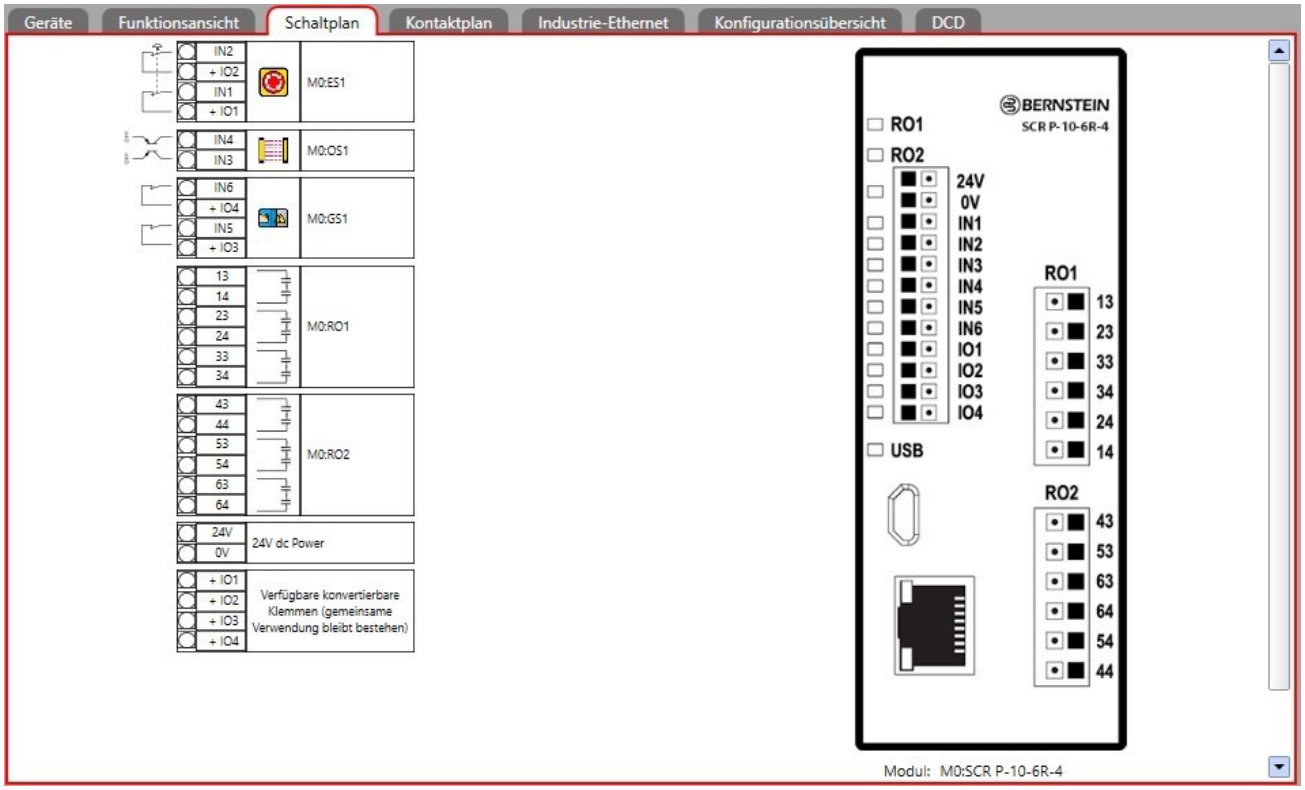



Figure 176: Circuit diagram tab with an emergency stop switch, optical sensor and safety gate switch

10. Switch to the **Devices** tab and try adding another safety gate switch.
    No further devices can be added ( is not displayed) as the ATO function is deactivated and the connections are not sufficient to support further devices.
11. Switch to the **Function view** tab and try adding another safety gate switch.
    No further devices can be added here either, as the ATO function is deactivated.
12. Click on **Cancel**.
13. On the **Function view** tab, click on the safety gate switch and then on **Edit** to change the properties.
    a. Change the connections IO3 and IO4 to IO1 and IO2 respectively.

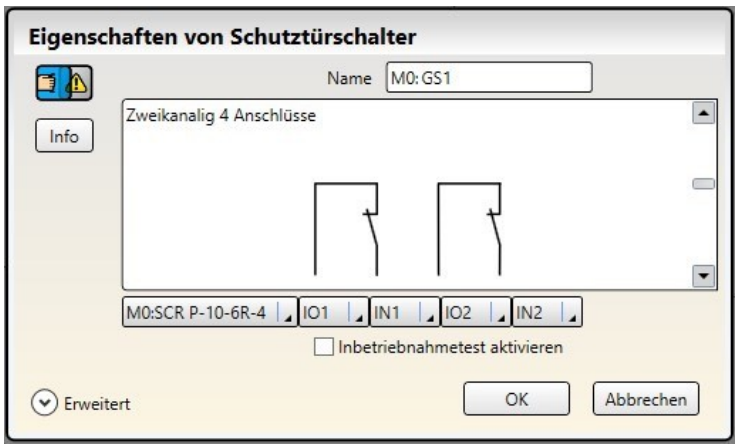



Figure 177: Safety gate switch properties

    b. Click on **OK**.

14. Switch to the **Wiring diagram** tab and note that external terminal blocks (ETB) have been added in accordance with the change to the connection assignments of the safety gate switch.

**Note:** The external terminal blocks are provided by the user

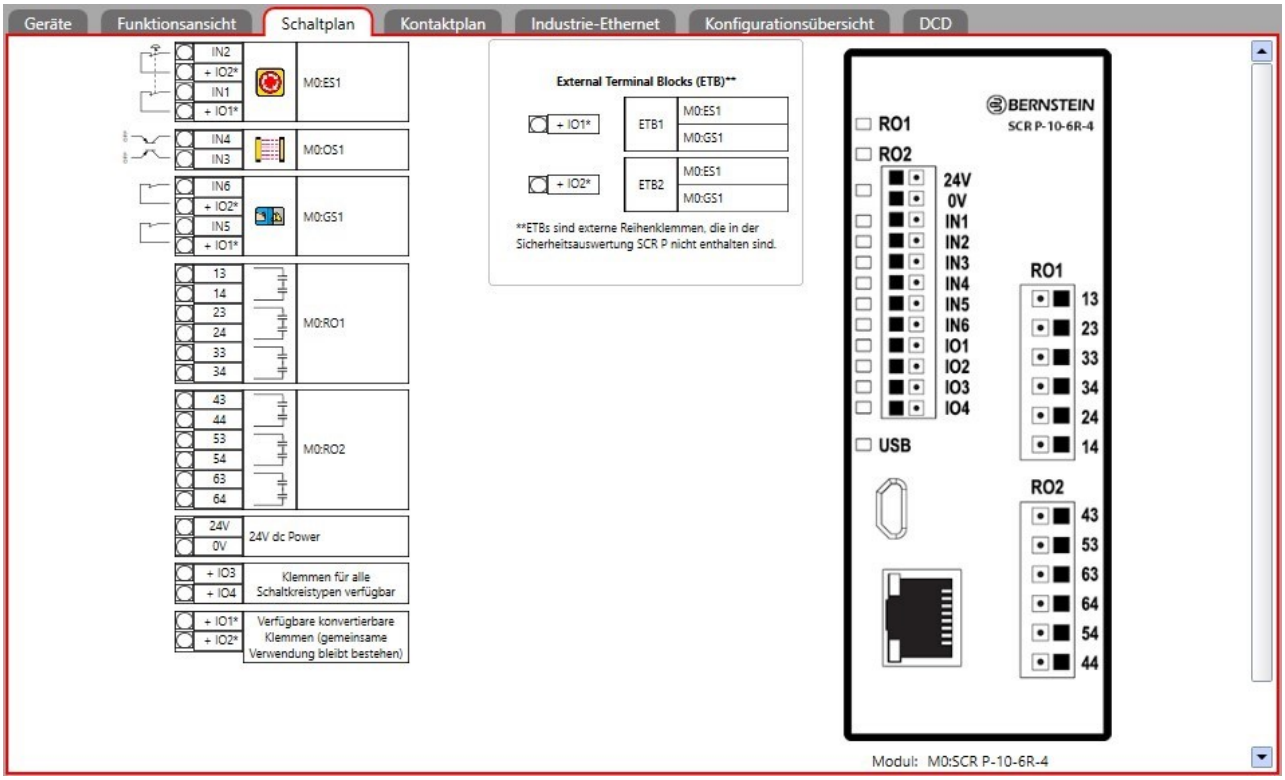



Figure 178: Circuit diagram tab with an emergency stop switch, optical sensor, safety gate switch and ETBs

15. Switch to the **Function view** tab and try adding another safety gate switch.
    An additional safety gate switch can now be added as the connection optimization was carried out manually.
16. Add a second safety gate switch and click **OK** to accept the default settings.

17. Switch to the **Circuit diagram** tab. You can now see that the second safety gate switch has been added and that no further ETB has been added.

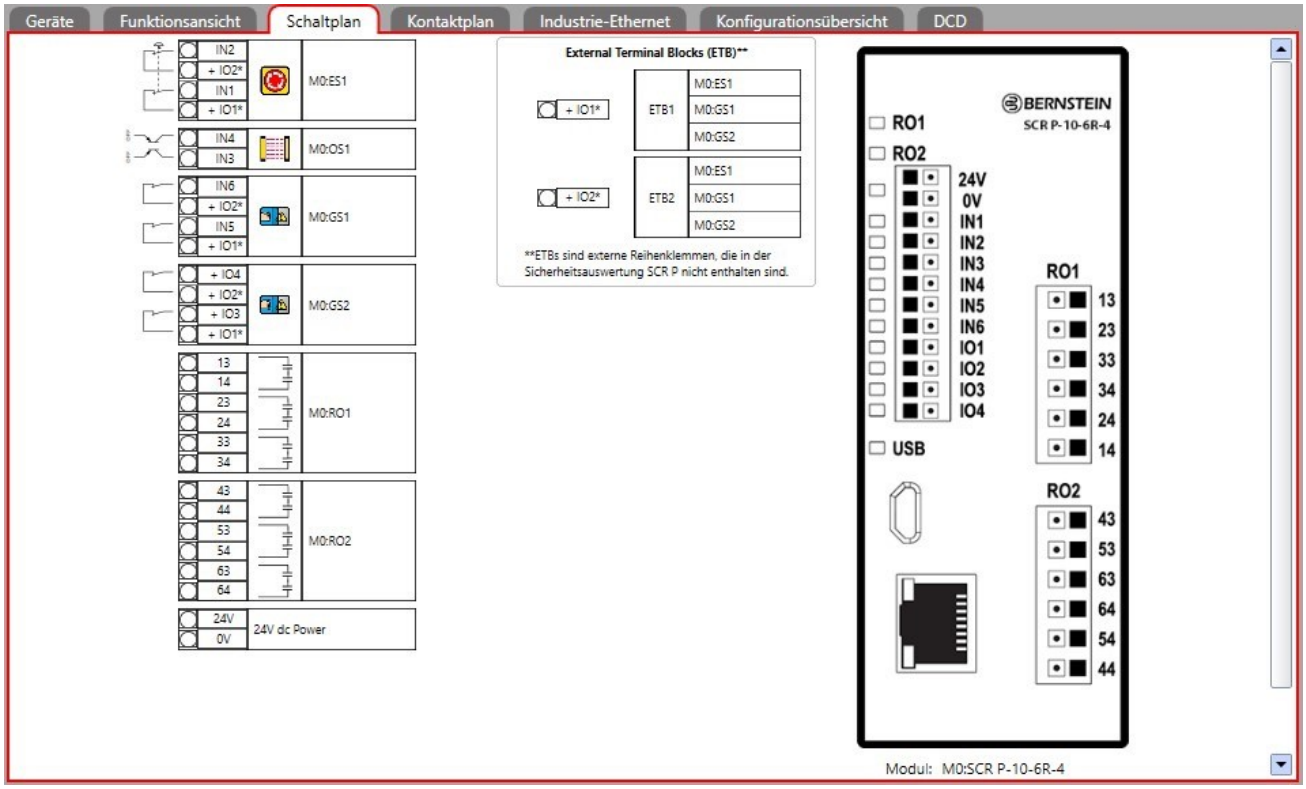



Figure 179: **Circuit diagram** tab with emergency stop switch, optical sensor, safety gate switches and ETBs

### 14.11 SCx models with integrated interface: Using the SCR P-FPS

Use an SCR P-FPS to:

- Saving a confirmed configuration
- Quick configuration of multiple SCx safety controllers with the same configuration
- Replacing an SCx safety controller with another one with SCR P-FPS (FID 3 or higher)

**Note:** The BERNSTEIN Programming Adapter (SCR P-PA) and the BERNSTEIN Safety Controller Software are required to write a confirmed configuration to an SCR P-FPS. This restricts access to authorized personnel. A configuration can also be written to an SCR P-FPS using a safety controller with an integrated interface.

**Note:** The LEDs behave the same with or without the onboard interface (for more information, see SCx models without onboard interface: Using the SCR P-FPS on page 321), but the following procedure focuses on what happens on the display.

### 14.12 SCR P using the SCR P-FPS

With an SCR P-FPS you have the following options:

1. Quickly configure multiple SCR P safety evaluations with the same configuration
2. Replace one SCR P safety evaluation unit with another (using the SCR P-FPS from the old safety evaluation unit)

**Note:** To write a confirmed configuration to an SCR P-FPS, you need the programming tool (SCR P-PA) and the software from BERNSTEIN AG. This restricts access to authorized personnel.

1. Create the desired configuration in the software.
2. Confirm the configuration by uploading it to an SCR P.
3. Check and confirm the results.
   After verification and confirmation, the configuration can be saved and used by the SCR P.
4. Write the confirmed configuration to the SCR P-FPS using the programming tool.

**Note:** Only confirmed configurations can be saved on the SCR P-FPS

5. Label the configuration that you save on the SCR P-FPS.
6. Connect the voltage source to the desired SCR P (new safety evaluation unit or replacement safety evaluation unit).
   - According to the factory settings, a green illuminated operation/error LED on the SCR P safety monitoring unit together with a green flashing USB LED indicates that the SCR P is waiting for a configuration.
   - If the SCR P has been configured, the operation/error LED lights up green and the USB LED lights up red.
7. Plug the SCR P-FPS into the micro USB port on the SCR P.

   **Safety evaluation with factory settings**
   - The USB LED flashes for 3 seconds and then lights up constantly. The configuration, network settings and passwords are then automatically downloaded to the security evaluation unit. The operation/error LED then flashes green to indicate that the security evaluation unit is waiting to be switched off and on again.

   **Configured safety evaluation**
   - If the configuration and the passwords on the security evaluation unit and on the SCR P-FPS match, the USB LED flashes for 3 seconds and then lights up constantly. If the network settings do not match, the network settings are transferred to the SCR P-FPS after 3 seconds, provided the SCR P-FPS is not locked. If the SCR P-FPS is locked, the SCR P switches to a locked state.
   - If the configuration or the passwords on the safety evaluation unit and the SCR P-FPS do not match, the USB LED flashes red. If the SCR P-FPS is not disconnected from the safety evaluation unit within 3 seconds, the operation/error LED and the USB LED flash red and the SCR P switches to a locked state due to the discrepancy.
8. Switch the device off and on again.
   The operation/error LED lights up green, the USB LED lights up green (if the SCR P-FPS is still connected) or red (if no SCR P-FPS or no USB cable is connected), and the input and output LEDs indicate the actual input status.

The safety evaluation unit is ready for commissioning. See "13.2 Commissioning test" on page 218.

### 14.13 Reset SCx or SCR P to the factory settings

You can use the following procedure to reset the SCx or SCR P to the factory settings. SCx or SCR P must be switched on and connected to the PC via the USB cable.

1. Click on .
2. Click on **Restore factory settings**.
   A warning message is then displayed that all settings will be reset to the factory settings.
3. Click on **Next**.
   The **Enter password** screen opens.
4. Enter the password User1 and click **OK**.
   SCx or SCR P is reset to the factory settings and a confirmation window is displayed.
5. Click on **OK.**
6. **Switch the device off and on again.**
   This restores the factory settings.

### 14.14 Factory settings

The following table lists some of the factory settings for the safety evaluation unit and the software

| Setting | Factory setting | Product |
|---|---|---|
| AVM function | 50 ms | SCX, SCR P |
| Switch-off bounce time | 6 ms | SCx, SCR P |
| EDM | No EDM monitoring | SCx, SCR P |
| Function block: Bridging block - standard node | IN, BP | SCx, SCR P |
| Function block: Bridging time limit | 1 s | SCx, SCR P |
| Function block: Delay block - standard node | IN | SCx, SCR P |
| Function block: Delay block - switch-off delay | 100 ms | SCx, SCR P |
| Function block: Enabling switch block - Standard node | ED, IN, RST | SCx, SCR P |
| Function block: Enabling switch block - Time limit | 1 s | SCx, SCR P |
| Function block: Latch reset block - standard node | IN, LR | SCx, SCR P |
| Function block: Muting block - standard node | IN, MP1 | SCx, SCR P |
| Function block: Muting block - time limit | 30 s | SCx, SCR P |
| Function block: Two-hand control block - standard node | TC | SCx, SCR P |
| Function block: One Shot Block-Default Nodes | IN | SCx |
| Function Block: One Shot Block-Time Limit | 100 ms | SCx |
| Industrial Ethernet: Character string (EtherNet/IP and PCCC protocol) | 32 bit | SCx, SCR P |
| Network settings: Gateway address | 0.0.0.0 | SCx, SCR P |
| Network settings: IP address | 192.168.0.128 | SCx, SCR P |
| Network settings: Connection speed and duplex mode | Automatic negotiation | SCx, SCR P |
| Network settings: Subnet mask | 255.255.255.0 | SCx, SCR P |
| Network settings: TCP port | 502 | SCx, SCR P |
| Switch-on bounce time | 50 ms | SCx, SCR P |
| Password user1 | 1901 | SCx, SCR P |
| Password user2 | 1902 | SCx, SCR P |
| Password user3 | 1903 | SCx, SCR P |
| Start-up mode | Normal | SCR P |
| Safety outputs | Automatic reset (switching mode) | SCx, SCR P |
| Safety outputs: Start-up mode | Normal | SCx |
| Safety outputs: Share (safety outputs) | Function in pairs | SCx |
| Simulation mode: Simulation speed | 1 | SCx, SCR P |
| Automatic optimization of connections | Activated | SCR P |
| Signal logic for status outputs | Active = PNP on | SCx, SCR P |
| Flashing frequency status output | No | SCx |

# 15. F troubleshooting

The safety evaluation unit has been developed and tested for high resistance to a wide range of electrical interference sources found in industrial environments. However, strong sources of electrical interference that generate electromagnetic and high-frequency interference signals beyond these limits can cause random switching or blocking states. If random switching or blocking states occur, check the following:

- The operating voltage at 24 V DC +/- 20 % is
- The cables are securely attached to each individual connection
- Whether there are high-voltage interference sources, high-frequency interference sources or high-voltage lines next to the safety monitoring system or along lines connected to the monitoring system
- Suitable overvoltage limiters are fitted to the output loads
- Whether the ambient temperature of the safety evaluation unit is within the rated range for ambient temperature (see "5. Specifications and requirements" on page 18)

## 15.1 Softw are: Troubleshooting

**Live mode button is not available (grayed out)**

1. Ensure that the USB cable is connected to both the computer and the safety evaluation unit.

**Note:** To write a confirmed configuration to an SCR P-FPS, you need the programming tool (SCR P-PA) and the software from BERNSTEIN AG. This restricts access to authorized personnel.

2. Check whether the safety evaluation unit is installed correctly; see "15.3 Checking the driver installation" on page 241
3. Exit the software.
4. Disconnect the safety evaluation unit and reconnect it.
5. Start the software.

**The configuration cannot be read by the safety evaluation system or cannot be sent to the safety evaluation system (buttons grayed out).**

1. Make sure that **live mode** is deactivated.
2. Ensure that the USB cable is connected to both the computer and the safety evaluation unit.

**Note:** The use of the BERNSTEIN USB cable is preferable. When using other USB cables, you must ensure that the cable contains a data conductor. Many charging cables for cell phones do not have a data conductor.

3. Check whether the safety evaluation unit is installed correctly; see "15.3 Checking the driver installation" on page 241.
4. Exit the software.
5. Disconnect the safety evaluation unit and reconnect it.
6. Start the software.

**A block cannot be moved to another position**

Not all blocks can be moved. Some blocks can only be moved within certain areas.

1. **Safety outputs** are inserted statically and cannot be moved. If you create a **reference to a safety output**, it can be moved to any position in the left and middle area.
2. The **safety** and **non-safety-related inputs** can be moved to any position in the left and center area.
3. The **function** and **logic blocks** can only be moved within the middle area.

## 15.2 Software: Error codes

The following table contains a list of the error codes that are output when an invalid connection is attempted between the blocks on the Function view tab.

| Software code | Error |
|---|---|
| A.1 | This connection creates a loop in the processing of the safety signals. |
| A.2 | There is already a connection from this block. |
| A.3 | A block may not be connected to itself. |
| B.2 | This bridging block is connected to the two-hand control block. You can only connect one two-hand control input to the IN node. |
| B.3 | This bridging block is already connected to another block. |
| B.4 | This bridging block is connected to the TC node of a two-hand control block and cannot be connected to other blocks. |
| B.5 | The two-hand control block cannot be connected to the IN node of this bridging block because the option "Output switches off when both inputs (IN and BP) are on" is activated. |
| B.6 | The IN node of a bypass block cannot be connected to inputs for emergency stop switches and rope pull switches. |
| B.7 | The IN node of a bypass block cannot be connected via other blocks with inputs for emergency stop switches and rope pull switches. |
| C.1 | Only one input can be connected to the CD node to cancel an off-delay. |
| C.2 | An input for canceling an off-delay can only be connected to the CD node of a safety output. |
| D.1 | This input for external device monitoring is configured for a two-channel 2-terminal circuit and can only be connected to the EDM node of a safety output. |
| E1 | The output nodes for an enabling switch block (P or S) can only be connected to the IN node of a safety output. |
| E.2 | The IN node of an enabling switch block cannot be connected to inputs for emergency stop switches and rope pull switches. |
| E.3 | The ED node of an enabling switch block can only be connected to the input for an enabling switch. |
| E.4 | The ED node of an enabling switch block cannot be connected via other blocks with inputs for emergency stop switches and rope pull switches. |
| E.5 | An enabling switch block in which an input for a two-hand control is connected to the IN node cannot be connected to a safety output in which the "Off delay" setting is selected as the delay of the safety output. |
| E.6 | The secondary output node S of an enabling switch block can only be connected to the IN node of a safety output. |
| F.1 | Emergency stop and pull-wire switch inputs cannot be muted. |
| F.2 | Emergency stop and pull-wire switch inputs cannot be connected to a latch reset block that is connected to a muting block. |

| Software code | Error |
|---|---|
| F.3 | A latch reset block that is connected to an input for an emergency stop or rope pull switch cannot be connected to a muting block. |
| G.1 | Only a manual reset input can be connected to the FR node of a safety output. |
| G.2 | Only a manual reset input can be connected to the LR node of a latch reset block or a safety output. |
| G.3 | Only a manual reset input can be connected to the RST node of an enabling switch block. |
| G.4 | A manual reset input can only be connected to the LR and FR nodes of a safety output, the LR node of a latch reset block, the RST node of an enabling switch block and the SET and RST nodes of the flip-flop block. |
| H.1 | This latch reset block is already connected to another function block. |
| H.2 | The latch reset block cannot be connected to other input nodes. |
| I.1 | Only the inputs for muting sensor pair, optosensor, safety gate switch, safety mat or circuit breaker can be connected to the MP1 and MP2 nodes of a muting block or to the MP1 node of a two-hand control block. |
| I.2 | The MP1 and MP2 nodes of a muting block and the MP1 node of a two-hand control block can be connected to inputs that only use two-channel circuits. |
| I.3 | The input for muting sensor pair can only be connected to the MP1 and MP2 nodes of a muting block or to the MP1 node of a two-hand control block. |
| J.1 | A two-hand control block can only be connected to an enabling switch block (IN node) or a safety output (IN node). |
| J.3 | Only two-hand control inputs or bridging blocks with two-hand control inputs connected to them can be connected to the TC node of a two-hand control block. |
| K.1 | A two-hand control input can only be connected to a two-hand control block (TC node) or a bridging block (IN node). |
| K.2 | A safety output for which the "Off delay" setting is selected for the delay of the safety output cannot be connected to a two-hand control block. |
| K.3 | A safety output for which the setting for the delay of the safety output is "Off delay" is selected, cannot be connected to a two-hand control block via an enabling switch block. |
| L.1 | This safety output is deactivated due to a status output that uses its terminals. |
| L.2 | The IN node of a safety output cannot be connected to the inputs for external device monitoring, adjustable valve monitoring, muting sensor pair, bypass switch, manual reset, muting release or canceling the off delay. |
| L.3 | A safety output block with the LR (latch reset) function activated cannot be connected to two-hand control blocks or enabling switch blocks. |
| L.4 | A safety output block for which the "Manual reset" setting is selected for the start-up mode cannot be connected to two-hand control blocks or enabling switch blocks. |

## 15.3 Üb verifying the driver installation

**Windows 7, 8 and 10**

1. Click on **Start**.
2. Enter "Device Manager" in the Search programs/files field at the bottom of the menu and click on **Device Manager** if Windows has found this program.
3. Expand the Connections (**COM & LPT**) drop-down menu.
4. Search for **Safety Controller,** followed by a COM port number (e.g. COM3). The entry must not contain an exclamation mark, a red × or a down arrow. If you do not see any of these indicators, your device is installed correctly. If one of these indicators is displayed, rectify the problems using the instructions that follow this table.

**Windows 7, 8 and 10**

**SCR P-FPS driver**

1. Expand the **USB controller** drop-down menu**.**
2. Search for **SC Programmer A** and **SC Programmer B**. Neither of these two entries must contain an exclamation mark, a red × or a down arrow. If you do not see any of these indicators, your device is installed correctly. If one of these indicators is displayed, rectify the problems using the instructions that follow this table.

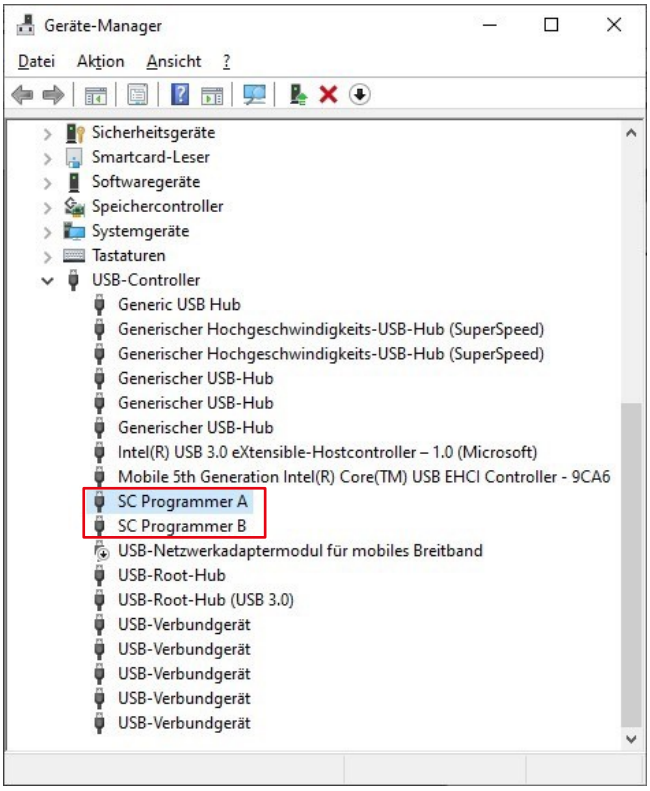



Figure 180: SCR P-FPS driver correctly installed

**To fix the problems indicated by an exclamation mark, a red × or a down arrow:**

1. Make sure that your device is activated:
   a. Right-click on the entry with the indicator.
   b. If you see **Deactivate**, the device is activated. If you see **Activate**, the device is deactivated.
      - If the device is activated, continue with further troubleshooting.
      - If the device is deactivated, click on **Activate**. If this does not remove the license plate, continue with the next step.
2. Disconnect the USB cable either from the safety evaluation unit or from the computer, wait a few seconds and then reconnect the cable. If this does not remove the license plate, proceed to the next step.
3. Connect the security evaluation unit to another USB port. If this does not remove the license plate, continue with the next step.
4. Restart your computer. If this does not remove the license plate, continue with the next step.
5. Uninstall the software under **Add/Remove Programs** or Programs and **Features** in the **Control Panel** and then reinstall it. If this does not remove the license plate, continue with the next step.
6. Please contact a BERNSTEIN AG application engineer.

### 15.4 Troubleshooting and error correction

Depending on the configuration, the safety evaluation can detect different input, output and system errors, including:

1. A welded contact
2. An open contact
3. A short circuit between channels
4. An earth fault
5. A short circuit to a voltage source
6. A short circuit to another input
7. A loose or open connection
8. An exceeded operating time limit
9. A voltage dip
10. An overtemperature condition

Use the **Live mode** tab in the software on a PC that is connected to the safety evaluation unit via the USB cable. Fault diagnostics are also available via the network. A further message may be displayed with information on how the error can be rectified.

**Note:** The error log is deleted when the power supply for the safety evaluation is switched off and on again.

### 15.5 SCx-F ehlercode table

The following table lists the error code of the safety controller, the displayed message, any additional messages and the steps to rectify the error.
The error code and the extended error code together form the error code of the safety controller. The format for the error code is error code 'dot' extended error code. For example, a safety controller error code of 2.1 is represented by an error code of 2 and an extended error code of 1. The error message index value is the error code and the extended error code together and may include a leading zero with the extended error code. For example, a safety control error code of 2.1 is represented by an error message index of 201.
The error message index value is a convenient way to get the full error code while reading only a single 16-bit register.

**Note:** An error code of 1.1 is different from an error code of 1.10 (the zero is significant).

| Fault code | Displayed message | Additional message | Steps for rectification |
|---|---|---|---|
| 1.1 | Fault output | Base controller or solid-state module Check for shorts Relay module n/a | **Base controller** or solid-state module<br>A safety output appears ON although it should be OFF:<br>• Check whether there is a short circuit with the external voltage source.<br>• Check the size of the common DC cable connected to the safety output loads. The cable must be a heavy gauge wire or as short as possible to minimize resistance and voltage drop. If necessary, use a separate DC common conductor for each output pair and/or avoid sharing this DC common return path with other devices (see Installing the common conductor on page 67).<br>**Relay module**<br>• Replace relay module |
| 1.2 | Fault output | Base controller or solid-state module Check for short circuits Relay module n/ | **Base controller or solid-state module**<br>A safety output detects a fault on another voltage source while the output is switched on:<br>• Check for a short circuit between the safety outputs<br>• Check whether there is a short circuit with the external voltage source.<br>• Check compatibility of the chargers<br>• Check the size of the common DC cable connected to the safety output loads. The cable must be a heavy gauge wire or as short as possible to minimize resistance and voltage drop. If necessary, use a separate DC common conductor for each pair of outputs and/or avoid sharing this DC common return path with other devices (see Installing the common conductor on page 67).<br>**Relay module**<br>• Replace relay module |
| 1.3 - 1.8 | Internal fault | - | Internal fault - Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 1.9 | Fault output | Internal relay failure | • Replace relay module |
| 1.10 | Fault output | Check time of receipt | Sequence timing error: SCR P-10-6R-4<br>• Perform a system reset to delete the error. |

| Fault code | Displayed message | Additional message | Steps for rectification |
|---|---|---|---|
| 2.1 | Simultaneity error | Cycle input | In the case of a two-channel input or a complementary input where both inputs are in the "Run" state, one input goes into the "Stop" state and then back into the "Run" state.<br>In the case of a dual complementary input where both input pairs were in the "Run" state, one input pair went into the "Stop" state and then back into the "Run" state.<br>• Check the cabling<br>• Check the input signals<br>• Consider adjusting the debouncing times |
| 2.2 | Disruption of simultaneity | Cycle input | With a two-channel input or a complementary input, one input changed to the operating state, but the other input did not follow the change within 3 seconds.<br>With a dual complementary input, one input pair changed to the "Run" state, but the other input pair did not follow the change within 3 seconds.<br>• Check the cabling<br>• Check the timing of the input signal |
| 2.3 or 2,5 | Simultaneity error | Cycle input | In the case of a dual complementary input, where both inputs of a complementary pair are in the Run state, one input of this complementary pair changes to the Stop state and then back to the Run state:<br>• Check the cabling<br>• Check the input signals<br>• Check the power supply that provides input signals<br>• Consider adjusting the debouncing times |
| 2.4 or 2.6 | Disruption of simultaneity | Cycle input | In the case of a dual-complementary input, one input of a complementary pair changed to the run state, but the other input of the same complementary pair did not follow the change within the time limit:<br>• Check the cabling<br>• Check the timing of the input signal |
| 2.7 | Internal fault | | Internal fault - Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 2.8 - 2.9 | Input fault | Check terminal xx | The entrance is high:<br>• Check for short circuits to other inputs or other voltage sources<br>• Check the compatibility of the input devices<br>• Check for incorrectly wired terminals (output terminal wired to incorrect input terminal) |
| 2.10 | Input fault | Check terminal xx | • Check for a short circuit between the inputs |
| 2.11 - 2.12 | Input fault | Check terminal xx | • Check for short circuit to earth |
| 2.13 | Input fault | Check terminal xx | Input is stuck<br>• Check for short circuit to earth |
| 2.14 | Input fault | Check terminal xx | Missing test pulses:<br>• Check for a short circuit to other inputs or other voltage sources |
| 2.15 | Open line | Check terminal xx | • Check for an open line |
| 2.16 - 2.18 | Input fault | Check terminal xx | Missing test pulses:<br>• Check for a short circuit to other inputs or other voltage sources |
| 2.19 | Open line | Check terminal xx | • Check for an open line |
| 2.20 | Input fault | Check terminal xx | Missing test pulses:<br>• Check for short circuit to earth |
| 2.21 | Open line | Check terminal xx | • Check for an open line |
| 2.22 - 2.23 | Input fault | Check terminal xx | • Check for an unstable signal at the input |
| 2.24 | Activated input with bypass | Performing a system reset | A two-hand control input was activated (switched on) while it was bridged. |

| Fault code | Displayed message | Additional message | Steps for rectification |
|---|---|---|---|
| 2.25 | Input fault | Monitoring timer has expired before AVM was closed | After the associated safety output has been switched off, the AVM input has not closed before the AVM monitoring time has expired:<br>• The AVM may not be connected; check the cabling to the AVM<br>• Either the AVM is not connected or its response to switching off the safety output is too slow<br>• Check the cabling to the AVM<br>• Check the timing setting; increase the setting if necessary.<br>• Contact BERNSTEIN AG |
| 2.26 | Input fault | AVM not closed when the output is switched on | The AVM input was open, but should have been closed when the associated safety output received the ON command:<br>• The AVM may not be connected; check the cabling to the AVM |
| 3.1 | EDMxx error | Check terminal xx | The EDM contact was opened before the safety outputs were switched on:<br>• Check whether a contactor or relay is stuck.<br>• Check for an open wire |
| 3.2 | EDMxx error | Check terminal xx | EDM contact(s) did not close within 250 ms after the safety outputs were switched off:<br>• Check whether the contactor or relay is slow or stuck.<br>• Check for an open wire |
| 3.4 | EDMxx error | Check terminal xx | EDM contact pair is not set correctly for longer than 250 ms:<br>• Check whether the contactor or relay is slow or stuck.<br>• Check for an open wire |
| 3.5 | EDMxx error | Check terminal xx | • Check for an unstable signal at the input |
| 3.6 | EDMxx error | Check terminal xx | • Check for short circuit to earth |
| 3.7 | EDMxx error | Check terminal xx | • Check for a short circuit between the inputs |
| 3.8 | AVMxx error | Performing a system reset | After this safety output has been switched off, an AVM input connected to this output has not closed before its AVM monitoring time has expired:<br>• The AVM may not be connected or its response t o switching off the safety output is too slow<br>• Check the AVM input and then perform a system reset to clear the error. |
| 3.9 | Input fault | AVM not closed when the output is switched on | The AVM input was open, but should have been closed when the associated safety output received the On command:<br>• The AVM may not be connected; check the cabling to the AVM |
| 3.10 | Internal fault | - | Internal fault - Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.x | - | - | See the following table. |
| 5.1 - 5.3 | Internal fault | - | Internal fault - Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 6.xx | Internal fault | - | Invalid configuration data. Possible internal error:<br>• Try to write a new configuration to the safety controller |
| 7.1 | Error in the press control | Check TOS and BOS | TOS and BOS inputs switched on simultaneously<br>• Check for short circuits at the TOS and BOS inputs<br>• Check the functionality of the TOS and BOS device7.17 |

| Fault code | Displayed message | Additional message | Steps for rectification |
|---|---|---|---|
| 7.2 | Error in the press control | TOS and SQS check | TOS and SQS inputs switched on simultaneously<br>• Check for short circuits at the TOS and SQS inputs<br>• Check whether the TOS and SQS devices are working. |
| 7.3 | Error in the press control | Check TOS and PCMS | TOS and PCMS inputs switched on simultaneously<br>• Check for short circuits at the TOS and PCMS inputs<br>• Check whether the TOS and PCMS devices are working. |
| SCR P-10-6R-4 7.4 | Error in the press control | SQS and BOS check | Error in the sequence of SQS and BOS (BOS was switched on before SQS)<br>• Check the wiring of the SQS and BOS sensors<br>• Checking the placement and function of the SQS and BOS sensors |
| 7.5 | Error in the press control | Check TOS | TOS timeout error (the internal time limit of 30 seconds was exceeded during the automatic upstroke)<br>• Check the cabling of the TOS system<br>• Checking the placement and function of the TOS sensor |
| 7.6 | Error in the press control | Check BOS | BOS timeout error (the internal time limit of 30 seconds was exceeded during the automatic downstroke)<br>• Check the wiring of the BOS system<br>• Check that the BOS sensor is correctly positioned and working. |
| 7.7 | Error in the press control | Inputs for selection of the test mode | Mode selection error (more than one mode selection input switched on at the same time)<br>• Check the wiring of the inputs for the operating status<br>• Check the mode selector switch for faults |
| 7.8 | Error in the press control | - | Index error (internal configuration error)<br>Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 7.9 | Error in the press control | Check foot switch input | Foot switch error (when configured with an SQS, the input node Ft Switch was switched on instead of the input node GO)<br>• Sequencing errors<br>• If the problem persists, check the wiring of the THC and footswitch inputs. |
| 7.10 | Error in the press control | Check cylinder | Downward AVM error (downward AVM is in an incorrect state compared to the expected state)<br>• Check AVM cabling<br>• Check AVM sensor and down stroke system |
| 7.11 | Error in the press control | Testing cylinders | Upward AVM error (upward AVM is in an incorrect state compared to the expected state)<br>• Checking the AVM cabling<br>• Check the AVM sensor and the Up Stroke system |
| 7.12 | Error in the press control | Check high cylinder | High AVM error (High AVM is in an incorrect state compared to the expected state)<br>• Check high AVM cabling<br>• Check high AVM sensor and high lift system |
| 7.13 | Error in the press control | Check low cylinder | Low AVM Error (Low AVM is in the wrong s t a t e compared to the expected state)<br>• Check low AVM cabling<br>• Check low AVM sensor and low stroke system |
| 7.14 | Error in the press control | From SQS to PCMS Simultaneity | Simultaneity error between SQS a n d PCMS (3-second limit between inputs exceeded)<br>• Checking the cabling of SQS and PCMS<br>• Check the placement of SQS and PCMS taking into account the loading speed |
| 7.15 | Error in the press control | Check SQS status | SQS status error (SQS status level not as expected during the press cycle)<br>• Check the wiring of the SQS input<br>• Check the placement of the SQS sensor and its functionality |
| 7.16 | Error in the press control | Check PCMS status | PCMS status error (PCMS status level not as expected during the press cycle)<br>• Check the wiring of the PCMS input<br>• Check the placement of the PCMS sensor and its functionality |

| Fault code | Message displayed | Additional message | Steps for rectification |
|---|---|---|---|
| 7.17 | Error in the press control | Check TOS status | TOS status error (TOS status level not as expected during the press cycle)<br>• Check the wiring of the TOS input<br>• Check the placement of the TOS sensor and its functionality |
| 7.18 | Error in the press control | Check BOS status | BOS status error (BOS status level not as expected during the press cycle)<br>• Check the wiring of the BOS input<br>• Check the placement of the BOS sensor and its functionality |
| 10.xx | Internal fault | - | Internal fault - Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |

For error codes 4.x, check the error log for additional errors to determine the specific module in which the original error occurred.

| Fault code | Displayed message | Additional message | Steps for rectification |
|---|---|---|---|
| 4.1 | Supply voltage low | Check the power supply | The supply voltage has fallen below the rated voltage for longer than 6 ms:<br>• Check the voltage and current of the power supply unit<br>• Check whether there is an overload at the outputs that could cause the power supply unit to limit the current. |
| 4.2 | Internal fault | | A configuration parameter has been damaged. To repair the configuration:<br>• Replace the configuration using a backup copy of the configuration<br>• Recreate the configuration using the software a n d write it to the safety controller. |
| 4.3 - 4.11 | Internal fault | - | Internal fault: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.12 | Configuration Timeout | Check configuration | The safety controller was left in configuration mode for longer than one hour without a button being pressed.<br>• Switch on the power<br>• Performing a system reset |
| 4.13 | Configuration Timeout | Confirm the configuratio n | The safety controller was left in configuration mode for more than one hour without receiving commands from the software.<br>• Switch on the power<br>• Performing a system reset |
| 4.14 | Configuration Unconfirmed | Confirm the configuratio n | The configuration was not confirmed after editing:<br>• Confirm the configuration via the software |
| 4.15 - 4.19 | Internal fault | - | Internal fault: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.20 | Unassigned terminal in use | Check terminal xx | This terminal is not assigned to any device in the current configuration and should not be active:<br>• Check the cabling |
| 4.21 - 4.34 | Internal fault | - | Internal fault: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.35 | Overtemperature | - | An internal overtemperature condition has occurred. Check whether the ambient and output load conditions correspond to the specifications of the safety controller. |
| 4.36 - 4.39 | Internal fault | - | Internal fault: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.40 - 4.41 | Errors in the module communicat ion | Check module perform ance | An output expansion module has lost contact with the basic control unit. |
| 4.42 | Module mismatch | - | The detected module or modules do not match the configuration of the safety controller. |

| Fault code | Displayed message | Additional message | Steps for rectification |
|---|---|---|---|
| 4.43 | Errors in the module communication | Check module performance | An extension module has lost contact with the base controller. |
| 4.44 - 4.45 | Internal fault | - | Internal fault: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.46 - 4.47 | Internal fault | - | Internal fault: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.48 | Unused output | Check output wiring | Voltage was detected at an unconfirmed terminal. |
| 4.49 - 4.55 | Internal fault | - | Internal fault - Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.56 | Display Comm Failure | - | Display (onboard interface) communication error:<br>• Switch off the power supply to the safety controller. If the error code persists, contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.57 - 4.59 | Internal fault | - | Internal fault: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.60 | Fault output | Check for shorts | An output terminal has detected a short circuit. Check the output error for details. |
| 4.61 | Inconsistencies in the configuration | - | A feature contained in the loaded configuration (e.g. DCD inputs, virtual inputs, expansion modules) is not supported by this control model. The configuration is now confirmed and can be saved as a confirmed configuration and/or written to an SCR P-FPS. The configuration is not executed on this model.<br>• Remove the functions not supported by this model.<br>• Load the configuration onto a model that supports the selected functions. |

### 15.6 SCR P -Error code table

The following table lists the error code of the safety controller, the displayed message, any additional messages and the steps to rectify the error.
The error code and the extended error code together form the error code of the safety controller. The format for the error code is error code 'dot' extended error code. For example, a safety controller error code of 2.1 is represented by an error code of 2 and an extended error code of 1. The error message index value is the error code and the extended error code together and may include a leading zero with the extended error code. For example, a safety control error code of 2.1 is represented by an error message index of 201.
The error message index value is a convenient way to get the full error code while reading only a single 16-bit register.

**Note:** An error code of 1.1 is different from an error code of 1.10 (the zero is significant).

| Error code | Error description | Solution steps |
|---|---|---|
| 1.1 - 1.2 | Output error | Replace safety evaluation |
| 1.3 - 1.8 | Internal error | Internal fault: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252) |
| 1.9 | Output error | Replace safety evaluation |
| 1.10 | Output error | Sequence timing error:<br>• Perform a system reset to delete the error |
| 2.1 | Simultaneity error | On a two-channel input or an antivalent input with both inputs in the On state, one input went into the Off state and then back into the On state.<br>On a dual-antivalent input with both input pairs in the on state, one input pair went into the off state and back into the on state.<br>• Check wiring<br>• Check input signals<br>• Adjust the debounce times if necessary<br>• Switch input |
| 2.2 | Simultaneity error | At a double-antivalent input with both inputs of an antivalent pair in the on state, one input of this antivalent pair went into the off state and back into the on state.<br>• Check wiring<br>• Check input signals<br>• Check whether the power supply is providing input signals<br>• Adjust the debounce times if necessary<br>• Switch input |
| 2.4 or 2.6 | Simultaneity error | At a double-antivalent input, one input from an antivalent pair went into the on state, but the other input from the same antivalent pair did not follow within the time limit.<br>• Check wiring<br>• Check the time response of the input signals<br>• Switch input |
| 2.7 | Internal error | Internal fault: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252) |
| 2.8 - 2.9 | Input error | Input blocked in the on state:<br>• Check whether there are short circuits to other inputs or to another voltage source<br>• Check the compatibility of the input device |

| Error code | Error description | Solution steps |
|---|---|---|
| 2.10 | Input error | • Check whether there is a short circuit between the inputs |
| 2.11 - 2.12 | Input error | • Check whether there is an earth fault |
| 2.13 | Input error | Input blocked in the off state<br>• Check whether there is an earth fault |
| 2.14 | Input error | Missing test impulses:<br>• Check whether there is a short circuit to other inputs or to another voltage source |
| 2.15 | Line interruption | • Check whether there is a line interruption |
| 2.16 - 2.18 | Input error | Missing test pulses:<br>• Check whether there is a short circuit to other inputs or to another voltage source |
| 2.19 | Line interruption | • Check whether there is a line interruption |
| 2.20 | Input error | Missing test pulses:<br>• Check whether there is an earth fault |
| 2.21 | Line interruption | • Check whether there is a line interruption |
| 2.22 - 2.23 | Input error | • Check whether there is an unstable signal at the input |
| 2.24 | Input activated during bridging | A two-hand control was activated (switched on) while it was bypassed |
| 2.25 | Input error | After the associated safety output has switched off, the AVM input was not closed before its AVM monitoring time expired:<br>• The AVM may be disconnected. Check the wiring to the AVM.<br>• Either the AVM is disconnected or it reacts too slowly to the safety output being switched off.<br>• Check cable connections to the AVM<br>• Check timer setting and increase if necessary<br>• Contact BERNSTEIN AG |
| 2.26 | Input error | The AVM input was open, but should have closed when the switch-on command was sent to the connected safety output:<br>• The AVM may be disconnected. Check the wiring to the AVM. |
| 3.1 | EDMxx error | EDM contact was opened before the safety outputs switched on:<br>• Check whether the contact maker or relay are welded in the on state<br>• Check for line interruptions |
| 3.2 | EDMxx error | EDM contacts were not closed within 250 ms after the safety outputs were switched off:<br>• Check whether the contact maker or relay drops out too slowly or is welded in the on state.<br>• Check for line interruptions |
| 3.3 | EDMxx error | EDM contacts were opened before the safety outputs were switched on:<br>• Check whether the contact maker or relay are welded in the on state<br>• Check for line interruptions |
| 3.4 | EDMxx error | Contacts of the two feedback circuits (EDM contact pair) in different states for longer than 250 ms.<br>• Check whether the contact maker or relay drops out too slowly or is welded in the on state.<br>• Check for line interruptions |
| 3.5 | EDMxx error | • Check whether there is an unstable signal at the input |
| 3.6 | EDMxx error | • Check whether there is an earth fault |
| 3.7 | EDMxx error | • Check whether there is a short circuit between the inputs |
| 3.8 | AVMxx error | After the associated safety output has switched off, an AVM input connected to this output was not closed before its AVM monitoring time expired:<br>• Either the AVM is disconnected or it reacts too slowly to the safety output being switched off.<br>• Check the AVM input and then perform a system reset to clear the error |

| Error code | Error description | Solution steps |
|---|---|---|
| 3.9 | Input error | The AVM input was open, but should have closed when the switch-on command was sent to the connected safety output:<br>• The AVM may be disconnected. Check the wiring to the AVM. |
| 3.10 | Internal error | Internal fault: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252) |
| 4.1 | Operating voltage too low | Operating voltage longer than 6 ms below the minimum supply voltage:<br>• Check the operating voltage and current values of the supply voltage source<br>• Check whether there is an overload at the outputs that could cause the power supply to limit the current |
| 4.2 | Internal error | A configuration parameter has been damaged. To rectify the condition:<br>• Replace the configuration using a backup copy of the configuration<br>• Create the configuration again via the software and write it to the safety evaluation |
| 4.3-4.12 | Internal error | Internal error: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.13 | Configuration timeout | The safety evaluation remained in configuration mode for more than an hour without receiving commands from the software. |
| 4.14 | Internal error | Configuration was not confirmed after processing:<br>• Confirm configuration via the software |
| 4.15-4.19 | Configuration timeout | Internal error: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.20 | Configuration unconfirmed | This connection is not assigned to any device in the current configuration and should not be active:<br>• Check wiring |
| 4.21-4.34 | Internal error | Internal error: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.35 | Overtemperature | An internal overtemperature condition has occurred. Check whether the ambient and output load conditions correspond to the specifications for the safety evaluation. |
| 4.36-4.47 | Internal error | Internal error: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.48 | Unused output | Voltage was detected at an unknown terminal. |
| 4.49-4.59 | Internal error | Internal error: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 4.60 | Output error | An output connection has detected a short circuit. Check the output error for more information. |
| 5.1-5.3 | Internal error | Internal error: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |
| 6.xx | Internal error | Invalid configuration data. Possible internal error:<br>• Try to write a new configuration to the safety evaluation |
| 10.xx | Internal error | Internal error: Contact BERNSTEIN AG (see "17.2 Repairs and warranty" on page 252). |

## 16. Components and accessories

| Type designation | Description | Product |
|---|---|---|
| **USB cable A/Micro-B** | USB cable | SCx, SCR P |
| **SCR P-PA** | Programming adapter | SCx, SCR P |
| **SCR P-FPS** | Programming stick | SCx, SCR P |

# 17. Customer service and maintenance

## 17.1 Cleaning

1. **Disconnect the supply voltage from the safety evaluation unit.**
2. Wipe the polycarbonate housing with a soft cloth moistened with a solution of a gentle cleaning agent and warm water.

## 17.2 Repairs atures and warranty

Contact BERNSTEIN AG for troubleshooting of this appliance. **Do not attempt to repair this appliance. It does not contain any parts or components that can be replaced on site.** If a BERNSTEIN application technician comes to the conclusion that this device, a part or a component thereof is defective, the technician will explain the Bernstein AG RMA (Return Merchandise Authorization) procedure for the return of goods.

☞ **Important:** If the technician instructs you to return the appliance, please pack it carefully. Transport damage during return is not covered by the warranty.

To enable BERNSTEIN AG to rectify problems while the PC is connected to the safety evaluation, call up Help in the software and click on "Support information". Click on Save diagnosis (under Help > Support information) to generate a file with status information. This information may be useful for the support team at BERNSTEIN AG. Send the file to BERNSTEIN AG and follow the instructions on the screen.

## 17.3 Contact us

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## 17.4 Disclaimer

BERNSTEIN does not guarantee the applicability and compatibility of the software components with the hardware and software used by the customer. Our liability for the usability and an error-free and permanent
BERNSTEIN shall not be liable for the functionality of the software provided for download or for any direct or indirect damage caused by it; in particular, liability for system failures, data loss and other damage to software and hardware as well as for loss of profit, business interruption, loss of production and costs of replacement procurement shall be excluded. Excluded from the exclusion of liability is liability for damages caused by BERNSTEIN intentionally or through gross negligence, as well as liability for damages resulting from injury to life, limb or health.
health due to a breach of duty for which BERNSTEIN is responsible, as well as liability for intentionally concealed defects. Insofar as liability is not excluded because it is based on a breach of a material contractual obligation, our liability shall be limited to the foreseeable damage typical of the contract, except in cases of intent or gross negligence.

The German language version is the original operating and installation instructions. Other languages are translations of the original operating and installation instructions.

# 18. N orms and regulations

The following is a list of standards for this BERNSTEIN appliance; this is for the information of users of this appliance. The indication of these standards does not imply that the appliance complies with every standard. The standards met are listed under the specifications in this manual.

## 18.1 Applicable European and international standards

EN ISO 12100: Safety of machinery - General principles for design - Risk evaluation and risk reduction ISO 13857 Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
ISO 13850 (EN 418): Emergency stop devices, Functional aspects - Design principles EN 574: Two-hand control devices - Functional aspects - Design principles
IEC 62061: Safety of machinery - Functional safety of safety-related electrical, electronic and programmable control systems
EN ISO 13849-1: Safety-related parts of control systems
ISO 13855 (EN 999): Safety of machinery - Positioning of guards with regard to approach speeds of parts of the human body
ISO 14119 (EN 1088): Interlocking devices associated with guards - Principles for design and selection EN 60204-1: Electrical equipment of machines - Part 1: General requirements IEC 61496: Electro-sensitive protective equipment
IEC 60529: Degrees of protection provided by enclosures
IEC 60947-1: Low-voltage switchgear and controlgear - General requirements
IEC 60947-5-1: Low-voltage switchgear and controlgear - Control circuit devices and switching elements; Electromechanical control circuit devices
IEC 60947-5-5: Low-voltage switchgear and controlgear - Electrical emergency stop device with mechanical interlocking function IEC 61508: Functional safety of electrical/electronic/programmable electronic safety-related systems IEC 62046 Safety of machinery - Application of protective devices for the detection of the presence of persons

## 18.2 Applicable US standards

ANSI B11.0: Safety of Machinery, General Requirements, and Risk Assessment
ANSI B11.1: Mechanical Power Presses
ANSI B11.2: Hydraulic Power Presses ANSI B11.3: Power Press Brakes
ANSI B11.4: Shears (separators)
ANSI B11.5: Iron Workers ANSI B11.6: Lathes
ANSI B11.7: Cold Headers and Cold Formers
ANSI B11.8: Drilling, Milling, and Boring
ANSI B11.9: Grinding Machines
ANSI B11.10: Metal Sawing Machines ANSI B11.11: Gear Cutting Machines
ANSI B11.12: Roll Forming and Roll Bending Machines
ANSI B11.13: Single- and Multiple-Spindle Automatic Bar and Chucking Machines
ANSI B11.14: Coil Slitting Machines
ANSI B11.15: Pipe, Tube, and Shape Bending Machines
ANSI B11.16: Metal Powder Compacting Presses
ANSI B11.17: Horizontal Extrusion Presses
ANSI B11.18: Machinery and Machine Systems for the Processing of Coiled Strip, Sheet, and Plate
ANSI B11.19: Performance Criteria for Safeguarding
ANSI B11.20: Manufacturing Systems ANSI B11.21: Machine Tools Using Lasers
ANSI B11.22: Numerically Controlled Turning Machines (Digitally Controlled Turning Machines)
ANSI B11.23: Machining Centers
ANSI B11.24: Transfer Machines ANSI/RIA R15.06: Safety Requirements for Industrial Robots and Robot Systems Industrial robots and robot systems)
ANSI NFPA 79: Electrical Standard for Industrial Machinery
ANSI/PMMI B155.1: Package Machinery and Packaging-Related Converting Machinery - Safety Requirements

### 18.3 Applicable OSHA regulations

The OSHA documents cited are from the following sources: Code of Federal Regulations, Title 29, Parts 1900 through 1910
OSHA 29 CFR 1910.212: General Requirements for (Guarding of) All Machines
OSHA 29 CFR 1910.147: The Control of Hazardous Energy (lockout/tagout)
OSHA 29 CFR 1910.217: (Guarding of) Mechanical Power Presses

## 19. Glossar

**A**

**Automatic reset**

The setting for controlling the safety input in which the assigned safety output switches on automatically when all its assigned inputs are in the On state.

**Authorized person**

A person who has been authorized in writing by the employer to carry out a specific test routine on the basis of appropriate training and suitability.

**Switch-off bounce time**

The time required to bypass a flickering input signal or input contact bounces in order to prevent disruptive triggering of the safety evaluation. Adjustable from 6 ms to 100 ms. Standard setting is 50 ms for muting sensors, 6 ms for other devices.

**Response time of the machine**

The time between the activation of a machine shutdown device and the establishment of a safe state by stopping the dangerous machine movement.

**Switch-off signal**

The signal of the safety output that results when at least one of its associated input device signals changes to the off state. In this manual, the safety output is described as switched off or in the off state if the signal is nominally 0 V DC.

**C**

**Change of state (COS)**

Change of state, i.e. the change of an input signal when it changes from on to off or from off to on.

**Complementary contacts**

Two contact sets, each in the opposite state.

**Simultaneous (also "at the same time" or "simultaneity")**

The setting in which both channels must be switched off simultaneously before they are switched on again. If this condition is not met, the input is in an error state.

**D**

**DCD**

Daisy chain diagnostics enables the transmission of comprehensive diagnostic data from each DCD device, even when such devices are connected in series (see the respective operating instructions for a detailed description of the diagnostic data provided by a specific DCD device).

**Diverse redundancy**

The practice of using components, circuits or operating different designs, architectures or functions to achieve redundancy and reduce the possibility of common cause failures. If this condition is not met, the input is in an error state.

**E**

**Two-channel**

The use of redundant signal lines for each safety input or safety output.

**Switch-on signal**

The signal of the safety output that results when all its associated input device signals change to the on state. In this manual, the safety output is referred to as switched on or in the on state when the signal is nominally 24 V DC.

**Switch-on bounce time**

The time required to bypass a flickering input signal or input contact bounce to prevent unwanted machine start-up. Adjustable from 10 ms to 500 ms. The factory setting is 50 ms.

**Single channel**

The use of only one signal line for each safety input or safety output.

## F

**Error**

A device condition characterized by the inability to perform a specific function. However, this does not include inability during preventive maintenance or other scheduled actions or due to lack of external resources. An error often results from other errors in the device itself, but can also occur without a previous error.

**Fixed protective device**

Grilles, barriers or other mechanical barriers that are attached to the frame of the machine and are intended to prevent personnel from entering the danger zone of a machine without restricting the view of the operating location. The maximum size of the openings is determined by the applicable standard, e.g. ISO 13857

## G

**Simultaneous (also "simultaneous" or "simultaneity")**

The setting in which both channels must be switched off at the same time AND must be switched on again at intervals of no more than 3 seconds. If both conditions are not met, the input is in a

## H

**Risk of evasion**

Dangers due to walking behind the curtain arise in applications in which persons can walk through a safety device (which issues a stop command to eliminate the danger) and then continue to enter the monitored area, e.g. as part of area guarding. Their presence is then no longer detected and there is a risk of the machine starting up or restarting unexpectedly while people are still in the monitored area.

## M

**Manual reset**

Configuration for controlling the safety relay in which the assigned safety output only switches on after a manual reset has been carried out, provided the other associated inputs are in the On state.

## Q

**Qualified person**

A person who can successfully demonstrate through a recognized educational or professional certificate, or through extensive knowledge and the appropriate training or experience, that he or she is able to solve problems relating to and working with the subject matter in question.

## S

**Safety extra-low voltage (SELV)**

Particularly low separate or protective voltage supply, for earthed circuits. According to IEC 61140: "A SELV system is an electrical system whose voltage must not exceed extra-low voltages (25 V AC QMW or 60 V DC ripple-free) under normal conditions and under individual faults, including earthing faults in other circuits."

**Stop signal**

The input signal monitored by the safety evaluation unit which, when detected, causes one or more safety outputs to switch off. In this manual, either the input device or the device signal is referred to as being in the off state.

**System reset**

A configurable reset of one or more safety outputs with which they are switched on again (when configured for manual start-up or after an interlocked state due to fault detection) after the safety evaluation system is switched on.

## T

**Test on start-up**

For certain safety devices, such as safety light curtains or shut-off gates, it may be advantageous to test the device at least once for proper operation during start-up.

BERNSTEIN

DETECT We make safety happen.

PROTECT We keep safe your visions.

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