SIEMENS

# Industrial Controls

# Safety engineering
# SIRIUS 3SK1 safety relays

Equipment Manual


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| ⚠ WARNING |
| --- |
| indicates that death or severe personal injury **may** result if proper precautions are not taken. |

| ⚠ CAUTION |
| --- |
| indicates that minor personal injury can result if proper precautions are not taken. |

| NOTICE |
| --- |
| indicates that property damage can result if proper precautions are not taken. |

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℗ 11/2025 Subject to change

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# Introduction

# 1

## 1.1 Purpose of this manual

This manual contains a detailed description of SIRIUS 3SK1 safety relays and components that can be used with them.

This manual provides you with the information you require to configure, install, connect and diagnose 3SK1 safety relays. A few application examples provide you with a clear and practice-oriented introduction.

## 1.2 Target group

The manual is intended for everyone involved in the following tasks:

- Planning and configuring systems
- Installation
- Commissioning
- Service and maintenance

## 1.3 Required basic knowledge

A general knowledge of the following areas is needed in order to understand this manual:

- Low-voltage switchgear
- Digital circuit logic
- Automation systems
- Safety systems

## 1.4 Topics covered

| Chapter | Content |
|---|---|
| 1. Introduction (Page 11) | Information on this manual |
| 2. Safety instructions (Page 29) | Safety instructions and intended use |
| 3. Description (Page 39) | Properties of the safety relays:<br>• 3SK111 Standard basic units<br>• 3SK112 Advanced basic units<br>• 3SK121 output expansions<br>• 3SK122 input expansions<br>• 3SK123 power supply |
| 4. Safety engineering - General (Page 51) | • Safety function<br>• Basic terms<br>• Additional notes |
| 5. System design (Page 69) | • 3SK1 Standard system configuration<br>• 3SK1 Advanced system configuration |
| 6. 3SK1 / 3RQ1 devices (Page 85) | • 3SK1 Standard<br>• 3SK1 Advanced<br>• 3SK1 output expansion<br>• 3RQ1 expansions |
| 7. Assembly (Page 141) | • Safety instructions<br>• Assembly and disassembly procedure |
| 8. Connecting (Page 175) | • Procedure for connecting/wiring/disconnecting<br>• Plugging on and sealing the memory module<br>• Grounding |
| 9. Commissioning (Page 215) | • Device replacement<br>• Wear-related service life |
| 10. Diagnostics (Page 229) | • Diagnostics options<br>• Diagnostics concept<br>• Device diagnostics via LEDs/displays |
| 11. Technical specifications (Page 235) | • Technical specifications |
| 12. Dimension drawings (Page 249) | • Dimension drawings<br>• Drilling plans |
| 13. Circuit diagrams (Page 251) | • Circuit diagrams |
| 14. Spare parts/accessories (Page 293) | • Spare parts<br>• Accessories |

| Chapter | Content |
|---|---|
| 15. Examples/applications (Page 267) | • Examples of connecting sensors, actuators and complete applications |
| 16. MLFB structure (Page 299) | • Product versions and article numbers |

## 1.5 Validity range

This equipment manual is valid for the SIRIUS 3SK1 safety relays. It describes the components that are valid at the time of publication.

**Note**

**Additional information on system components**

The following devices can be combined with 3SK1 safety relays using 3ZY12 device connectors:

- 3RM1 Failsafe motor starters with 24 V DC supply voltage
- 3RQ1 force-guided coupling relay with 24 V DC supply voltage

Detailed information on these devices can be found in the associated product information, see chapter Additional documentation (Page 26).
This manual contains additional information about these devices that must be observed when using them with 3SK1 safety relays.

SIEMENS reserves the right to include updated information about new components or new versions of components in a product information

# 1.6 Siemens Industry Online Support

## Information and service

At Siemens Industry Online Support you can obtain up-to-date information from our global support database:

- Product support
- Application examples
- Forum
- mySupport

**Link:** Siemens Industry Online Support (https://support.industry.siemens.com/cs/de/en)

## Product support

You can find information and comprehensive know-how covering all aspects of your product here:

- **FAQs**

  Answers to frequently asked questions
- **Manuals/operating instructions**

  Read online or download, available as PDF or individually configurable.
- **Certificates**

  Clearly sorted according to approving authority, type and country.
- **Characteristics**

  For support in planning and configuring your system.
- **Product announcements**

  The latest information and news concerning our products.
- **Downloads**

  Here you will find updates, service packs, HSPs and much more for your product.
- **Application examples**

  Function blocks, background and system descriptions, performance statements, demonstration systems, and application examples, clearly explained and represented.
- **Technical data**

  Technical product data for support in planning and implementing your project

**Link:** Product support (https://support.industry.siemens.com/cs/ww/en/ps)

### mySupport

The following functions are available in your personal work area "mySupport":

- **Support Request**

  Search for request number, product or subject

- **My filters**

  With filters, you limit the content of the online support to different focal points.

- **My favorites**

  With favorites you bookmark articles and products that you need frequently.

- **My notifications**

  Your personal mailbox for exchanging information and managing your contacts. You can compile your own individual newsletter in the "Notifications" section.

- **My products**

  With product lists you can virtually map your control cabinet, your system or your entire automation project.

- **My documentation**

  Configure your individual documentation from different manuals.

- **CAx data**

  Easy access to CAx data, e.g. 3D models, 2D dimension drawings, EPLAN macros, device circuit diagrams

- **My IBase registrations**

  Register your Siemens products, systems and software.

# 1.7 Siemens Industry Online Support app

### Siemens Industry Online Support app

The Siemens Industry Online Support app provides you access to all the device-specific information available on the Siemens Industry Online Support portal for a particular article number, such as operating instructions, manuals, data sheets, FAQs etc.

The Siemens Industry Online Support app is available for Android and iOS:



Android



iOS

## 1.8 DataMatrix code

A DataMatrix code is lasered onto the lower terminal cover of all 3SK1-series safety relays.

DataMatrix codes are standardized in ISO/IEC 16022. The DataMatrix codes on Siemens devices use ECC200 coding for powerful error correction.

The following device information is encoded in the DataMatrix codes as a bit stream:

- Article number (MLFB)
- Serial number
- MAC address, if applicable

This information is stored in the following format in the DataMatrix code:

| | | | |
|---|---|---|---|
| 1P | Article number | + | S serial number<br>(+ 23S MAC address) |
| Data identifier | Net content | Separator | |

**Note**

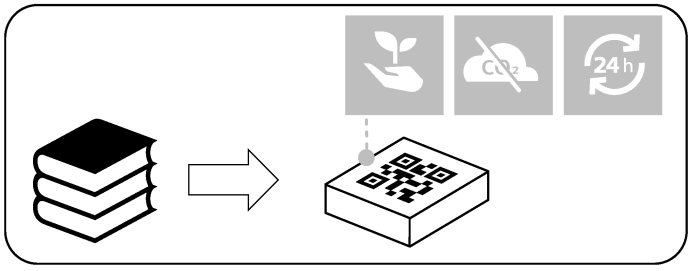
The information content is displayed without spaces.

This machine-readable information simplifies and accelerates handling of the respective devices.
As well as fast access to the serial numbers of the respective devices for unique identification, the DataMatrix codes simplify communication with Siemens Technical Support.

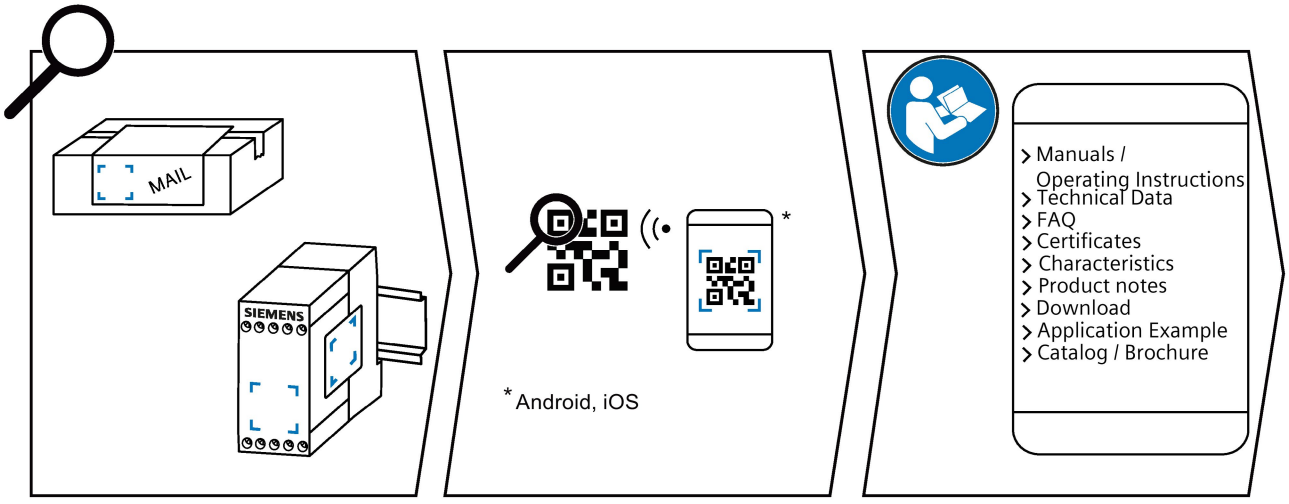
# 1.9 ID link

## ID link for the digital nameplate

The ID link is a globally unique identifier according to IEC 61406-1, which you can find as a QR code on your product. The ID link takes you to the digital nameplate of your product. Using the ID link saves paper and energy.




Scan the QR code on the product or on the packaging label with a smartphone camera, barcode scanner, or reader app. Call the ID-Link. In the digital nameplate, you will find product data, manuals, declarations of conformity, certificates, and other helpful information about your product.



# 1.10 Configurator for 3SK1 safety relays

## Configurator

Various configurators are available on the Internet to assist you with configuration.

The configurator for safety relays with accessories is an easy-to-use selection and engineering tool. You can select the individual components and plan your system in accordance with your specific requirements. You can save your selection, export it as a text file or you can order it directly.

The configurator automatically compiles a document list of the information available in Service & Support for every component. You can use it as the basis for putting together your system documentation.

**Link:**

Configurator (https://imp.siemens.com/siemens3sk/configurator)

# 1.11 Evaluation of safety functions

## Safety Evaluation Tool

The Siemens Safety Evaluation Tool for the IEC 62061 and ISO 13849-1 standards supports you in evaluating the safety functions of your machine. The online tool, which is approved by the German Technical Inspectorate, guides you step by step, from specifying the structure of the safety system and selecting the components to determining the achieved safety integrity level (SIL/PL). The final result is a standard-compliant report that you can integrate as proof of safety into the documentation.

Link to the Safety Evaluation Tool (http://www.siemens.com/safety-evaluation-tool)

## Safety Integrated

Just like the safety relay, the Safety Evaluation Tool is part of Safety Integrated, the intelligent safety solution from Siemens that features a complete product range. Our certified safety technology complies with all relevant standards and is already included in the Safety Evaluation Tool.

Link to Safety Integrated (http://www.siemens.com/safety-integrated)

## 1.12 Support Request

Use the Support Request online form to send your question directly to Technical Support:

| | |
|---|---|
| **Support Request:** | Internet (https://www.siemens.com/support-request) |

## 1.13 User responsibility for system design and function

The products described here were developed to perform safety-related functions as part of an overall installation or machine.

A complete, safety-related system is generally equipped with sensors, evaluation units, and signaling units, and uses reliable shutdown concepts.

It is the responsibility of the manufacturer of a system or machine to ensure that the product functions properly.
Siemens AG, its regional offices, and associated companies (hereinafter referred to as "Siemens") cannot guarantee all the properties of an entire plant, system or machine that has not been designed by Siemens.

Nor can Siemens assume liability for recommendations that appear or are implied in the following description. No new guarantee, warranty, or liability claims beyond the scope of the Siemens general terms of supply are to be derived or inferred from the following description.

# 1.14 Additional documentation

## List of references

In this list of references, you will find further manuals that may be of interest for your configuration. They are available to download from the Internet free of charge. You can create your own individual system documentation in the Siemens Industry Online Support under "mySupport".

- SIRIUS 3SK2 safety relays (https://support.industry.siemens.com/cs/us/en/view/109444336)
- SIRIUS 3RQ1 force-guided coupling relays (https://support.industry.siemens.com/cs/us/en/view/109996284)
- SIRIUS 3RM1 motor starters (https://support.industry.siemens.com/cs/us/en/view/66295730/192166324747)
- SIRIUS Safety Integrated Application Manual (https://support.industry.siemens.com/cs/ww/en/view/81366718)

## Interesting links and FAQs

- Permissible cable lengths of 3SK1 Standard and Advanced (https://support.industry.siemens.com/cs/us/en/view/91198365)
- Discrepancy time between the switching of NC contacts and NO contacts and/or between the switching of two NC contacts in 3SK1 safety relays (https://support.industry.siemens.com/cs/us/en/view/90301470)
- Switching different voltages in one device / protective separation (https://support.industry.siemens.com/cs/us/en/view/90528474)
- Start function of the SIRIUS 3SK1 safety relays (https://support.industry.siemens.com/cs/us/en/view/103655974)
- Switching capacity of semiconductor outputs on 3SK1 safety relays (https://support.industry.siemens.com/cs/us/en/view/90259432)
- 3SK1 safety relays - short-circuit protection of the enabling circuits (https://support.industry.siemens.com/cs/us/en/view/86125122)
- Extension of the application range for SIRIUS 3SK1 and 3SK2 safety relays up to an installation altitude of 4000 m (https://support.industry.siemens.com/cs/us/en/view/109792701)
- Connecting IN F/S inputs from different 3SK1111 Standard devices in parallel or connecting to 24 V DC (https://support.industry.siemens.com/cs/us/en/view/109481261)
- Safety Evaluation Tool (https://www.siemens.com/global/en/products/automation/topic-areas/safety-integrated/factory-automation/support/tia-safety-evaluation-tool.html)
- Systematic industrial safety engineering: Safety Integrated (https://support.industry.siemens.com/cs/us/en/view/109747812)

## 1.15 Change documentation

| Product version | New features |
|---|---|
| 02/2013 | Initial release |
| 02/2014 | Integration of 3RM1 Failsafe motor starters |
| 09/2015 | Revision of the manual |
| 04/2021 | Revision of the manual and incorporation of the 3RQ1 coupling relay |
| 11/2025 | Revision of the manual |

# Safety instructions

# 2

## 2.1 General safety notes

**Note**

**SIL 3 acc. to IEC 62061 / PL e / Cat. 4 acc. to ISO 13849-1**

The 3SK11 / 3RQ12 safety relays are designed in such a way as to allow implementation of applications up to SIL 3 according to IEC 62061 and PL e / Cat. 4 according to EN ISO 13849-1.

**Note**

**SIL 2 acc. to IEC 62061 / PL c / Cat. 2 according to ISO 13849-1 for 3RQ10 coupling relay**

The 3RQ10 force-guided safety-related coupling relays are designed in such a way as to allow implementation of applications up to SIL 2 acc. to IEC 62061, PL c / Cat. 2 acc. to ISO 13849-1.

**⚠ WARNING**

**Hazardous voltage.**
**Can cause death, serious injury, or property damage.**

Hazardous electrical voltage can cause electric shock, burns, and damage to property.

- Turn off and lock out all power supplying the system and device before working on the device.
- To ensure protection against the hazard of electric shock when the terminal cover is open, screw in all clamping screws that are not needed to clamp conductors.
- Close the terminal covers and always keep them closed during operation.

**⚠ WARNING**

**Loss of safety functions.**
**Can cause death, serious injury, or property damage.**

3SK1, 3RQ1 output expansions and 3RM1 Failsafe motor starters that are connected to a 3SK safety relay via 3ZY12 device connectors are supplied with voltage via the device connectors.

Do not directly connect any separate supply voltage to an output expansion 3SK1 (A1/A2), 3RQ1 (A1/A2), or to a 3RM1 Failsafe (A1/A2) motor starter, as otherwise the safety function will be bypassed.

**Note**

**Safe state**

The basis of the safety function is the definition of the safe state. In the case of safety relays, this is the "OFF state", i.e. an open contact for sensors or shutdown of the actuators.

**DANGER**

**Hazardous voltage. Can cause death or serious injury**

To ensure touch protection and degree of protection IP20, screw in all screws which are not used for conductor clamping and close the terminal covers.

**WARNING**

**Protection against electrically conductive contamination!**

**Can cause death, serious injury, or property damage.**

The devices must be protected against conductive contamination while taking account of the ambient conditions. One way you can do this is to install the devices in a control cabinet with the appropriate degree of protection.

You will find more information in the IEC 60529 standard "Degrees of protection provided by enclosures (IP Code)" and in the "Technical specifications (Page 235)" section.

**WARNING**

**Loss of safety function when adjusting slide switch on 3SK1 output expansions.**
**Can cause death, serious injury, or property damage.**

- Use one of the optionally available cover sealings to protect the slide switch of the 3SK1 safety relays against unauthorized and unintentional adjustment.

**WARNING**

**Safe functional extra-low voltage**

The 3SK1 safety relays with a supply voltage of 24 V DC must be operated with safe functional extra-low voltage (SELV, PELV). This means these modules must only be subjected to a voltage of Um even in the event of a fault. **The following applies for these 3SK1 safety relays:** $U_m < 60.0$ V.
You will find more detailed information about safe functional extra-low voltage in the data sheets of the power supplies to be used.

**WARNING**

**When performing the light test: Ensure safe state**

As a result of light tests performed at the semiconductor outputs, the level changes to the ON state for up to 2.5 ms. Users are responsible for ensuring that this does not result in any actuator changing to the active state.

**NOTICE**

**Material damage caused by electrostatic charging**

When handling and installing 3SK1 safety relays, ensure that the components are protected from being electrostatically charged. Changes to the system configuration and wiring are only permissible while the supply voltage is switched off.
Connection of 3SK1 safety relays is only permissible when the power supply units (PELV and SELV) are switched off.

**CAUTION**

**Noise immunity / grounding**

The following must be grounded in accordance with the regulations to ensure noise immunity of the 3SK1 safety relays:

- PELV / SELV power supply units
  (please also note the documentation for the respective power supply unit in this regard).

## 2.2 Recycling and disposal

For environmentally-friendly recycling and disposal of your old device, contact a company certified for the disposal of used electrical and electronic equipment, and dispose of the device as specified in the regulations for your particular country.

## 2.3 Intended use

**⚠ WARNING**

**Incorrect use of hardware products.**
**Can cause death, serious injury, or property damage.**

This equipment is only allowed to be used for the applications described in the catalog and in the technical description, and only in conjunction with non-Siemens equipment and components recommended by Siemens.

Correct transport, storage, installation and assembly, as well as careful operation and maintenance, are required to ensure that the product operates safely and without faults.

Before you run any sample programs or programs you have written yourself, make sure that running the plant cannot cause injury to anyone else or damage to the machine itself.

EU note regarding machine safety: Commissioning is absolutely prohibited until it has been ensured that the machine in which the component described here is to be installed complies with the stipulations of the Directive 2006/42/EC.

**⚠ WARNING**

**Loss of the safety functions through changes to the system.**
**Can cause death, serious injury, or property damage.**

To ensure the safety of the system, any changes to it or any replacement of defective components must be followed by a thorough and successfully completed function test of the system.

A complete function test consists of the following tests:

- Configuration test (test of the configuration)
- System test (wiring test of the connected sensors and actuators)

**WARNING**

**Loss of the safety functions due to missing function test.**
**Can cause death, serious injury, or property damage.**

In accordance with RFU CNB/M/11.050, when using actuators such as 3SK1 output expansions, contactors or relays in continuous duty in factory automation applications, an operation inspection interval (shutdown test) ≤ 1 year for SIL 2 according to IEC 62061 or PL d with Cat. 3 according to ISO 13849 is required. ≤ 1 month for SIL 3 according to IEC 62061 or PL e with Cat. 3 or Cat. 4 according to ISO 13849 applies. Only then do the safety characteristic values apply.

Exception: An operation inspection interval ≤ 1 year is also permissible for SIL3 applications in the process industry (according to IEC 61511), exclusively for low-demand use, due to a significantly lower failure rate probability of the electromechanical components. This does not apply to safety-related applications according to the Machinery Directive 2006 / 42 / EC.

**Function test procedure for actuators with contacts:**

- Actuate the connected sensors.
- Check their effect on the safety relay and the downstream actuators*.
- Activate the safety relay via the connected sensors.
- Check their effect on the safety relay and the downstream actuators*.
- Defective devices must be replaced.

*Since the read-back time of the delayable output functions is retriggerable, the actuation duration for switching on and off for the regular function test must be longer than the time set in the "Switching time" parameter. Only in this way can it be ensured that the expected switching status has also been set on the connected actuator.

## 2.4 Safety information for hazardous areas

**⚠ WARNING**

**Explosion hazard in hazardous areas.**
**Can Cause Death, Serious Injury, or Property Damage.**

The components of the safety relay are **not** suitable for installation in hazardous areas.

Please contact your ATEX specialist.

## 2.5 Current information about operational safety

### Important note for maintaining operational safety of your system

**⚠ WARNING**

**Loss of safety functions due to obsolete information.**

**Can cause death, serious injury, or property damage.**

Please take note of our latest information

Systems with safety-related characteristics are subject to special operational safety requirements on the part of the operator. The supplier is also obliged to comply with special product monitoring measures. For this reason, we publish a special newsletter containing information on product developments and features that are (or could be) relevant to operation of safety-related systems. By subscribing to the appropriate newsletter, you will ensure that you are always up-to-date and able to make changes to your system, when necessary:

For this purpose, go to the page: Safety Integrated for industrial safety technology (http://www.siemens.com/safety-integrated)

## 2.6 Cybersecurity information

Siemens provides products and solutions with industrial cybersecurity functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial cybersecurity concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial cybersecurity measures that may be implemented, please visit
https://www.siemens.com/cybersecurity-industry.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Cybersecurity RSS Feed under
https://new.siemens.com/cert.

## 2.7 Electromagnetic compatibility (EMC) according to IEC 60947-5-1

This product is designed for Environment A. It may produce radio interference in domestic environments, in which case the user may be required to take adequate mitigation measures.

# Description

# 3

## 3.1 Application areas for safety systems

### Safety systems

Safety systems are part of machines and plants. Their task is to minimize possible hazards for humans, machines and the environment. To this end, they monitor safety functions such as Emergency Stop and switch off the plant or system in a safety-oriented fashion. A safety system consists of sensors for sensing signals of the protection equipment (e.g. protective doors) from safety relays (e.g. 3SK safety relays) that evaluate these signals, and of actuators (e.g. 3RM1 Failsafe motor starters; 3RT contactors) that are controlled by the safety system and respond accordingly.

In most countries in the world there are binding regulations on the safeguarding of machines and plants. For Europe, the European Machinery Directive (2006 / 42 / EC) defines the basic requirements for machine safety. The technical specifications are set out in harmonized standards, such as IEC 62061 or ISO 13849-1, with the highest classification for manufacturing automation, SIL 3 or PL e / Cat. 4.

### 3SK1 safety relays

SIRIUS 3SK1 safety relays are used mainly in autonomous safety applications that are not connected to a safety-related bus system. Here they are used to evaluate sensors and ensure safety-related shutdown when required. They also check and monitor the sensors, actuators and safety-oriented functions of the safety relay.

The 3SK1 Standard safety relays are used for simple safety applications.

The 3SK1 Advanced can be used flexibly and offer extensive safety functions. With 3SK1 Advanced in particular, extensions are easy to implement and are supplemented by device connectors.

In addition to the 3SK12 output expansions for contact multiplication, the 3RQ1 force-guided coupling relays can also be used as expansions.

For seamless integration into the main circuit, 3RM1 fail-safe motor starters are available.

The device connectors take over the complete wiring of the control signals between the individual devices. As many as 5 devices can be added on the output side using the device connectors.

Input expansions are also possible in addition to the expansion on the output side. This enables up to 5 additional two-channel sensor circuits to be acquired.

Since the 3SK1 Advanced is a system with a 24 V DC power supply, a power supply is also available for other voltage levels.

### Device connector interface

3SK1 Advanced safety relays can be connected to the following actuators using 3ZY12 device connectors:

- 3SK1 output expansions (24 V DC)
- 3RQ1 output expansions (24 V DC)
- 3RM1 Failsafe motor starters (24 V DC)

In addition, the 3SK1 Advanced safety relays can be expanded with additional sensor inputs using 3SK1220 input expansions. The 3ZY12 device connectors can be used to control 3SK1 and 3RQ1 output expansions, 3RM1 Failsafe safety-related motor starters, monitor them for correct functioning, and connect the 3SK1220 input expansions.
The device connectors quickly, easily and flawlessly take over the safety-oriented wiring. This reduces your wiring effort and costs and possible troubleshooting.

# 3.2 Features and functions

## 3.2.1 Device overview

### 3SK1 basic units Standard

| Designation | Voltages | Article number |
|---|---|---|
| 3SK1 basic unit Standard instantaneous (with relay outputs) | 24 V AC/DC | 3SK1111-xAB30 |
| | 110 ... 240 V AC/DC | 3SK1111-xAW20 |
| 3SK1 basic unit Standard instantaneous (with semiconductor outputs) | 24 V DC | 3SK1112-xBB40 |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal

### 3SK1 basic units Advanced

| Designation | Voltages | Article number |
|---|---|---|
| 3SK1 Advanced basic unit instantaneous (with relay outputs) | 24 V DC | 3SK1121-xAB40 |
| 3SK1 Advanced basic unit time-delayed (with relay outputs) | 24 V DC | 3SK1121-xCB4y |
| 3SK1 Advanced basic unit instantaneous (with semiconductor outputs) | 24 V DC | 3SK1122-xAB40 |
| 3SK1 Advanced basic unit time-delayed (with semiconductor outputs) | 24 V DC | 3SK1122-xCB4y |
| 3SK1 Advanced basic unit 17.5 mm instantaneous (with semiconductor output) | 24 V DC | 3SK1120-xAB40 |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal
y = 1: 0.05 ... 3 s; y = 2: 0.5 ... 30 s; y = 4: 5 ... 300 s

## Expansion units

| Designation | Voltages | Article number |
|---|---|---|
| 3SK1211 output expansion | 24 V AC | 3SK1211-xBB00 |
| | 24 V DC | 3SK1211-xBB40 |
| | 110 ... 240 V AC/DC | 3SK1211-xBW20 |
| 3SK1213 output expansion | 24 V DC | 3SK1213-xAB40 |
| | 115 V AC | 3SK1213-xAJ20 |
| | 240 V AC | 3SK1213-xAL20 |
| 3RQ1 output expansion | 24 V DC | 3RQ1y00-xzB00 |
| | 24 ... 240 V AC/DC | 3RQ1y00-xzW00 |
| 3SK1220 input expansion | 24 V DC | 3SK1220-xAB40 |
| 3SK1230 power supply | 110 ... 240 V AC/DC | 3SK1230-xAW20 |
| 3RM1 Failsafe direct-on-line starters | 24 V DC | 3RM11..-xAA4 |
| 3RM1 Failsafe reversing starters | 24 V DC | 3RM13..-xAA4 |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal
x = 3: (3RM1 only) mixed connection system: Control circuit realized as spring-loaded (push-in) terminal and main circuit as screw terminal
y = 0: SIL 2 / PL c; y = 2: SIL 3 / PL e
z = E: 1NO 1NC; z = G: 2NO 1NC; z = H: 2NO 2NC; z = L: 4NO 1NC

## Overview of the safety-related outputs

| Type and number of safety-related outputs | | | | | | |
|---|---|---|---|---|---|---|
| **Advanced** | **Relays** | | **Semiconductors** | | **Semiconductor signaling circuits** | **Device connectors** |
| | Instantaneous | Time-delayed | Instantaneous | Time-delayed | | |
| 3SK1121-.AB40 | 3NO 1NC | - | - | - | 1 | ✓ |
| 3SK1121-.CB4. | 2NO | 2NO | - | - | - | ✓ |
| 3SK1122-.AB40 | - | - | 3 | - | 1 | ✓ |
| 3SK1122-.CB4. | - | - | 2 | 2 | - | ✓ |
| 3SK1120-.AB40 | - | - | 1 | - | - | ✓ |
| **Standard** | | | | | | |
| 3SK1111-.A..0 | 3NO 1NC | - | - | - | 1 | - |
| 3SK1112-.BB40 | - | - | 2 | - | 1 | - |
| **Output expansions** | | | | | | |
| 4RO | | | | | | |
| 3SK1211 | 4NO 1NC | | - | - | - | ✓ (for 24 V DC) |
| 3RO | | | | | | |
| 3SK1213 | 3NO 1NC | - | - | - | - | ✓ (for 24 V DC) |
| **3RQ1 output expansion** | | | | | | |
| 3RQ1000-.E<br>3RQ1200-.E<br>(SIL 3 / PL e) | 1NO 1NC | - | - | - | - | ✓ (for 24 V DC) |
| 3RQ1000-.G | 2NO 1NC | - | - | - | - | ✓ (for 24 V DC) |
| 3RQ1000-.H | 2NO 2NC | - | - | - | - | ✓ (for 24 V DC) |
| 3RQ1000-.L | 4NO 1NC | - | - | - | - | ✓ (for 24 V DC) |

## 3.2.2 Functional scope of the 3SK1 basic units

| Function | 3SK1 Standard | | 3SK1 Advanced | |
|---|---|---|---|---|
| | Type of safety-related outputs | | | |
| | Relays | Semiconductors | Relays | Semiconductors |
| **Sensors** | | | | |
| Mechanical sensors | ✓ | ✓ | ✓ | ✓ |
| Non-floating sensors | ✓ | ✓ | ✓ | ✓ |
| Antivalent sensors | Not possible | Not possible | ✓ | ✓ |
| Sensor number can be increased | Not possible | Cascading only | ✓ | ✓ |
| **Parameter** | | | | |
| Type of start (autostart/monitored start) | ✓ | ✓ | ✓ | ✓ |
| Sensor connection, 2 x single-channel / 1 x two-channel | By wiring | ✓ | ✓ | ✓ |
| Cross-circuit detection OFF / ON | By wiring | ✓ | ✓ | ✓ |
| Start-up test OFF / ON | No start-up test | ✓ | ✓ | ✓ |
| Monitoring of two-hand control units | Not possible | Not possible | ✓ | ✓ |
| **Safety-related outputs** | | | | |
| Instantaneous | ✓ | ✓ | ✓ | ✓ |
| Time-delayed | None | None | ✓ | ✓ |
| Expandable with relay outputs | By wiring | By wiring | ✓ | ✓ |
| Device connector | Cannot be used | Cannot be used | ✓ | ✓ |
| **Rated control supply voltage** | | | | |
| 24 V DC | ✓ | ✓ | ✓ | ✓ |
| 110 ... 240 V AC/DC | ✓ | Not possible | ✓[1)] | ✓[1)] |

[1)] Possible using 3SK1230 power supply and device connector

## 3.2.3 3SK1 Standard system configuration

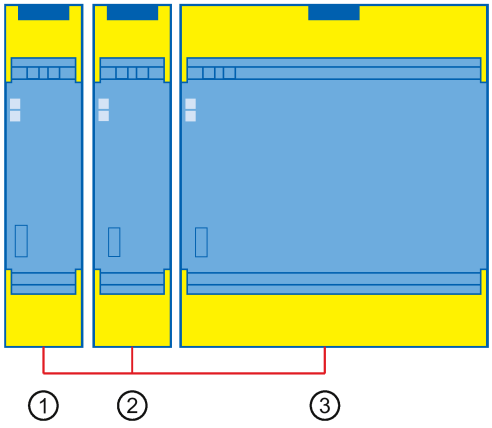
### Components and wiring

A 3SK1 Standard system can comprise the following devices:

- Basic units (one basic unit per system)
  - 3SK1111 Standard basic unit instantaneous (with relay outputs) (Page 86)
  - 3SK1112 Standard basic unit instantaneous (with semiconductor outputs) (Page 92)
- Output expansions
  - Output expansion 3SK1211 (Page 125)
  - Output expansion 3SK1213 (Page 128)
  - 3RQ1 output expansion

Connect the devices by wiring them.

### Typical 3SK1 Standard system configuration




① 3SK1 Standard basic unit
② 3SK1211 output expansion
③ 3SK1213 output expansion

## 3.2.4 3SK1 Advanced system configuration

### Components and wiring

A 3SK1 Advanced system can comprise the following devices:

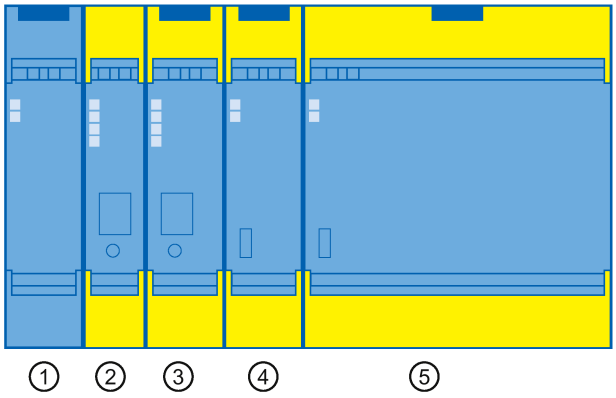
- Basic units (one basic unit per system)
  - 3SK1121 Advanced basic unit instantaneous (with relay outputs) (Page 103)
  - 3SK1121 Advanced basic unit time-delayed (with relay outputs) (Page 107)
  - 3SK1122 Advanced basic unit instantaneous (with semiconductor outputs) (Page 111)
  - 3SK1122 Advanced basic unit time-delayed (with semiconductor outputs) (Page 115)
  - 3SK1120 Advanced basic unit instantaneous (with semiconductor outputs) (Page 119)
- Input expansions
  - Power supply 3SK1230 (Page 137)
  - Input expansion 3SK1220 (Page 133)
- Output expansions
  - Output expansion 3SK1211 (Page 125)
  - Output expansion 3SK1213 (Page 128)
  - 3RQ1 output expansion
  - Output expansion for 3RM1 Failsafe motor starter. You can find more information in the SIRIUS 3RM1 motor starters (http://support.automation.siemens.com/WW/view/en/66295730) manual.

Connect the devices with 3ZY12 device connectors or by wiring them.

If you use 3ZY12 device connectors, there is no need for wiring between the basic unit and the expansion unit(s). In this case, all necessary signals are exchanged via the device connector.

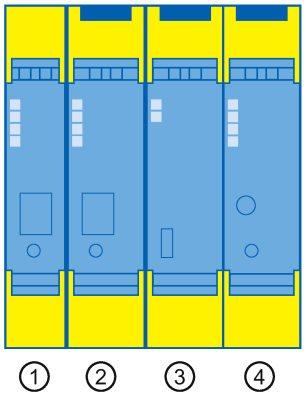
You will find the rules for configurations with device connectors in the section "3SK1 Advanced system configuration (Page 70)".

## Typical 3SK1 Advanced system configuration



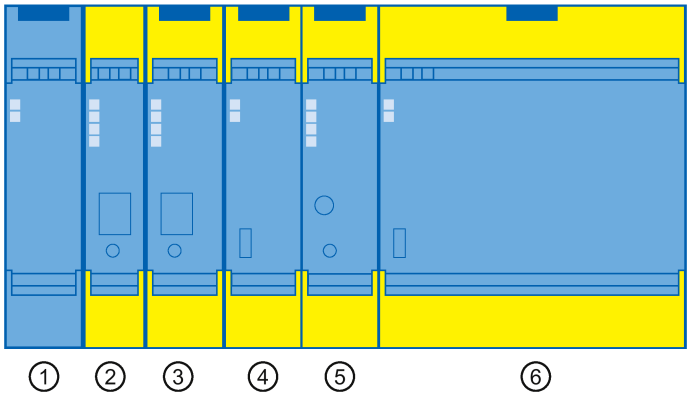

① 3SK1230 power supply
② 3SK1220 input expansion
③ 3SK1Advanced basic unit
④ 3SK1211 or 3RQ1 output expansion
⑤ 3SK1213 output expansion

## Example 1 of a 3SK1 Advanced system configuration with 3RM1 Failsafe motor starter



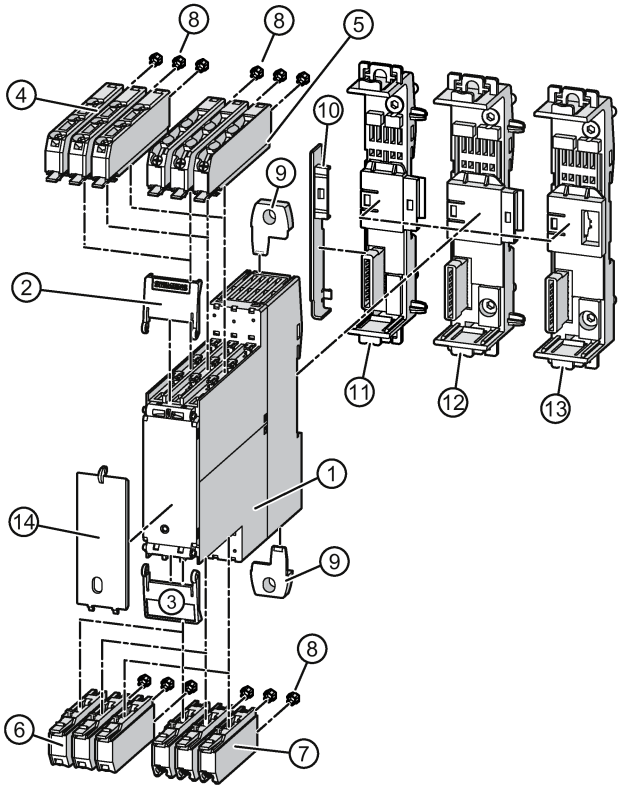

① 3SK1220 input expansion
② 3SK1Advanced basic unit
③ 3SK1211 or 3RQ1 output expansion
④ Output expansion for 3RM1Failsafe motor starter

## Example 2 of a 3SK1 Advanced system configuration with 3RM1 Failsafe motor starter




① 3SK1230 power supply
② 3SK1220 input expansion
③ 3SK1Advanced basic unit
④ 3SK1211 or 3RQ1 output expansion
⑤ Output expansion for 3RM1Failsafe motor starter
⑥ 3SK1213 output expansion

## 3.2.5 Components and accessories




① 3SK1 safety relay (basic unit/expansion unit)
② Top cover flap
③ Bottom cover flap
④ Terminals, 3-pole, spring-loaded (push-in), 1 x 2.5 mm²
⑤ Terminals, 3-pole, screw-type, 1 x 2.5 mm²
⑥ Terminals, 2-pole, spring-loaded (push-in), 1 x 2.5 mm²
⑦ Terminals, 2-pole, screw-type, 1 x 2.5 mm²
⑧ Coding pins
⑨ Push-in lugs for wall mounting
⑩ Cover
⑪ Device connector for 3SK1 safety relay, 17.5 mm wide
⑫ Device connector for 3SK1 safety relay, 22.5 mm wide
⑬ Device termination connector for 3SK1 safety relay, 17.5 / 22.5 mm wide
⑭ Sealable cover

# Safety systems - General information

# 4

## 4.1 What is safety?

Safety defines a state in which the risk of damage is reduced to a tolerable level, or which can be regarded as risk-free. Following on from this definition, functional safety concerns persons, machines and the environment.

The objective of safety systems is to reduce the risk for humans and machines that is posed by a use case to an acceptable level. The first step is, therefore, to identify the risk of a use case. In order to make a reliable assessment regarding the application, each individual function of a machine or plant must be analyzed for potential hazards.

For further information, refer to the brochure "Safety of machines and plants" which is available here as a download: Functional safety (http://www.siemens.com/safety).

## 4.2 Safety function

A safety function describes the reaction of a machine/plant when a specific event occurs (e.g. opening of a protective door). Execution of the safety function(s) is carried out by a safety-related control system. This usually comprises three subsystems, **detecting**, **evaluating** and reacting.

**Detecting** (sensors):

- Detecting a safety requirement,
  e. g.: EMERGENCY STOP or a sensor for monitoring a hazardous area (light array, laser scanner, etc.) is operated.

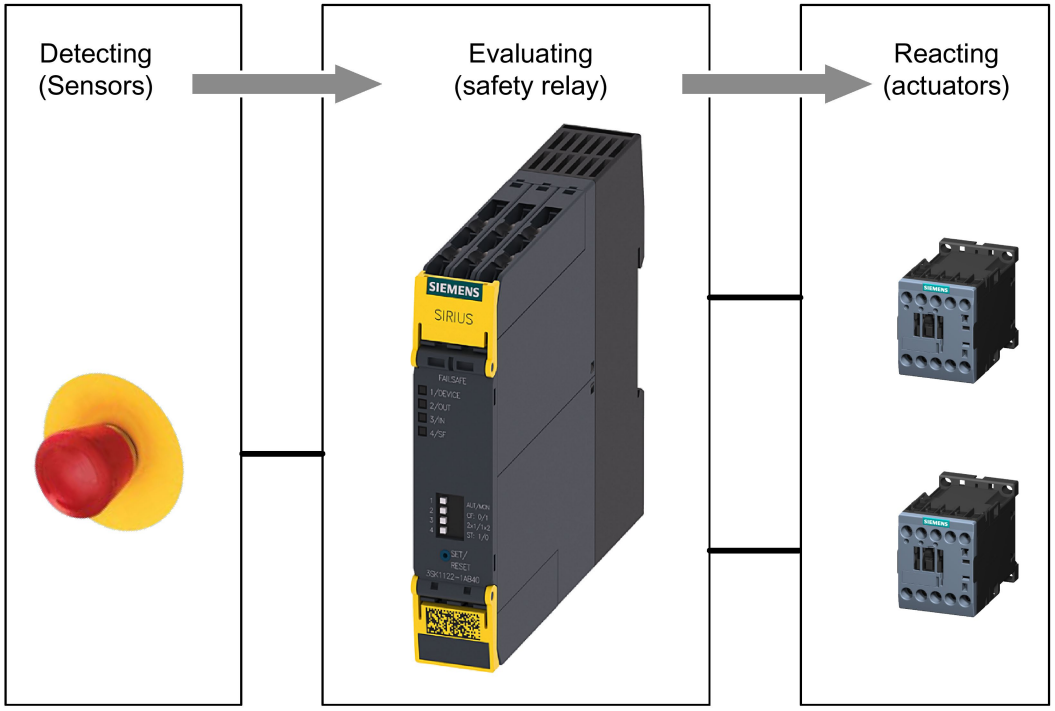
**Evaluating** (safety relay):

- Detecting a safety requirement and safely initiating the reaction (e.g. switching off the safety-related outputs).
- Monitoring the correct operation of sensors and actuators.
- Initiating a reaction upon detection of faults.

The 3SK1 products described in this manual are evaluation units for safety functions.

**Reacting** (actuators):

- Switching off the hazard by means of downstream actuators.



# 4.3 Basic terminology

## 4.3.1 Redundancy/single-channel and two-channel

### Redundancy

With redundancy, more than one component is implemented for the same function, so a faulty function of a component is performed instead by the other component(s).

A redundant configuration reduces the probability of a function failing due to a single defective component. This requirement is essential for achieving SIL 3 according to IEC 62061, SIL 3 according to IEC 61508 and PL e (Cat. 4) according to ISO 13849-1 (also necessary for SIL 2 / PL d under certain circumstances).

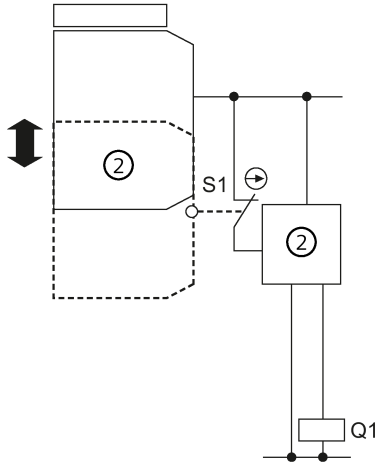
The simplest form of redundancy is **two-channel redundancy.**

If a circuit fails, two-channel redundancy or appropriate wiring ensures that the safety function is maintained.

In a redundant system configuration, the subsystems for detecting and reacting must also be implemented with two-channel redundancy.

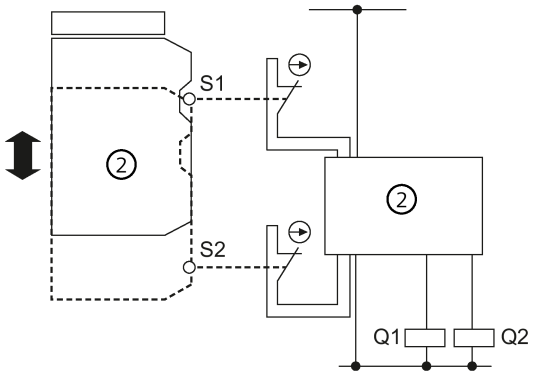
**Note**

All SIRIUS Safety devices that comply with SIL 3 according to IEC 62061, SIL 3 according to IEC 61508 and PL e (Cat. 4) according to ISO 13849-1 are redundantly configured with regard to the internal logic as well as with regard to the output circuits.




① Mechanical position switches
② Safety relay

Figure 4-1 Single-channel safety-related control system




① Mechanical position switches
② Safety relay

Figure 4-2 Two-channel safety-related control system

## 4.3.2 Cross-circuit detection

Cross-circuit detection is a diagnostic function of a safety relay that detects short-circuits and cross-circuits between the input channels (sensor circuits) during two-channel sensing or reading. A cross-circuit can be caused, for example, by a cable casing being squashed. In devices without cross-circuit detection, this can mean that a two-channel EMERGENCY STOP circuit does not trip even though only one NC contact is faulty (secondary error).

With 3SK1 devices, a cross-circuit is detected in the sensor circuits by means of signals with different clock pulses. If the clocked signals overlap, the device detects a cross-circuit. With 3SK1 basic units, cross-circuit detection can be deactivated to allow electronic sensors to be evaluated (that monitor themselves as well as the cable to the evaluation unit).

## 4.3.3 Enabling circuit (safety-related output)

An enabling circuit provides a safety-related output signal. From an external viewpoint, enabling circuits usually act as NO contacts (however, in terms of functionality, safety-oriented opening is always the most important aspect).

An individual enabling circuit that is redundantly configured internally in the safety relay can be used for SIL 3 / PL e.

*Note: Enabling current paths can also be used for signaling purposes.*

3SK1 safety relays are only equipped with enabling circuits with NO functionality. This means that when the safety function is triggered, or a fault is detected, the enabling circuits will always transfer to the safe state (NO contact open).

### 4.3.4 Signaling circuit

A current signaling path provides a safety-related output signal.

With 3SK1 relays, the signaling circuits are always implemented as NC circuits. This means that when the safety function is triggered, or a fault is detected, the signaling circuits will close.

With 3SK1 semiconductor devices, the signaling circuits are always implemented as NO circuits. This means that when the safety function is triggered, or a fault is detected, the signaling circuits will open.

### 4.3.5 Feedback circuit

A feedback circuit is used to monitor controlled actuators (e.g. relays or load contactors) with positively-driven contacts or mirror contacts. The safety-related outputs can only be activated if the feedback circuit is closed.

**Note**

When 3SK1 expansion units are used on 3ZY12 device connectors with 3SK1 Advanced basic units, it is not necessary to incorporate the expansion modules in the feedback circuit wiring. This is implemented internally via the device connector.

**⚠ DANGER**

**Ensuring electrical safety and safety function**

The normally closed contact of 3RQ12. is designed for a voltage of 24 V DC. If higher voltages occur, electrical safety cannot be ensured due to the voltage clearance distances. If the 3RQ12. is integrated in a system with a device connector, the feedback circuit is routed via the device connector. Connection of external voltage is not necessary and not permitted. Connecting external voltage can bypass the safety function.

### 4.3.6 Stop category

**Stop category 0**

Non-controlled shutdown by immediately switching off the power to the machine's drive elements.

**Stop category 1**

Controlled stopping where the energy feed is interrupted with a time delay or is only interrupted once standstill has been reached.

**Note**

Time-delayed shutdown of safety-related outputs in accordance with Stop category 1 is not ensured under all operating states.

In the case of some internal device faults, and when disconnecting the supply voltage, these safety-related outputs are switched off **instantaneously**.

### 4.3.7 Start function and start types

#### 4.3.7.1 Automatic start

For an automatic start, the device is started without manual confirmation, but only after the input image has been checked and a positive test of the safety relay has been conducted. This function is also known as dynamic operation and is not permissible for EMERGENCY STOP devices. Safety devices for prohibited danger zones (e.g. position switches, light arrays, safety shutdown mats) can use the automatic start function if this does not pose any risk.

**Note**

An automatic start is not permitted for EMERGENCY STOP devices.

Information about start response in the system configuration of 3SK1 Advanced units can be found in the chapter "Explanations of device function (Page 218)".

### 4.3.7.2 Manual start

For a manual start, the device is started by operating the START button, but only after the input image has been checked and a positive test of the safety relay has been conducted. With a manual start, the START button is not monitored for correct functioning. A positive edge of the START button is sufficient for starting.

**Note**

The "manual start" function is only available with the 3SK1111 safety relays (slide switch at Autostart position).

**Note**

Manual start is not permitted for EMERGENCY STOP devices.

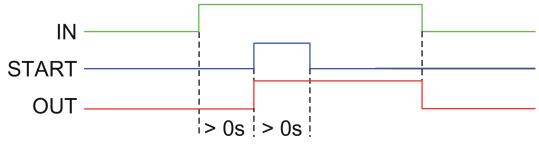



Figure 4-3 "Manual start" start function

### 4.3.7.3 Monitored start

For a monitored start, the device is started by operating the START button, but only after the input image has been checked and a positive test of the safety relay has been conducted.

Contrary to the manual start, the monitored start evaluates a **signal change** of the START button. This means that the START button cannot be bypassed (misuse). For PL e (ISO 13849-1) as well as SIL 3 (IEC 62061), the monitored start must be used in the case of EMERGENCY STOP. For other safety sensors/functions, the necessity for a monitored start command depends on the risk assessment.

If the START button is operated for more than 2 seconds, the 3SK1 basic unit detects a wiring short-circuit in the START button and switches to the fault state (Device = green; SF = flashing red; Out = flashing yellow; IN = off)

**Note**

In the delivery state of the 3SK1 safety relays, the start type is set to "Monitored start".

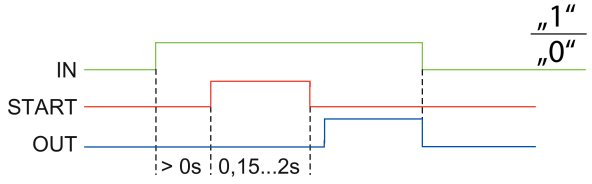



Figure 4-4 "Monitored start" start function

### 4.3.8 Two-hand operation/synchronism

Synchronous sensor operation is a special form of simultaneity of sensors.

In this case, it is not sufficient for sensor contacts 1 and 2 to be switched to the closed state "at any different times". Instead, they must be closed within 0.5 seconds.

Synchronism of sensors is required, in particular, in the case of two-hand operation of presses. This ensures that the presses only become active when the sensors are operated simultaneously with both hands. This minimizes the risk of the operator getting a hand in the press.

With the 3SK1 safety relays, you can achieve applications up to type IIIc according to ISO 13851 (applications up to PL e / Cat. 4 according to ISO 13849-1 or SIL 3 according to IEC 62061).

**Note**

In the delivery state of 3SK1 safety relays, monitoring of time synchronism is deactivated. Monitoring of time synchronism can be activated using the following adjustable parameters for 3SK112 Advanced:

- Jumper T1/PAR (NO/NC evaluation)
- DIP switches (1) Autostart
- DIP switches (3) 2x 1-channel

**Note**

The 3SK1 Advanced safety relays exclusively support two-hand control units with 2 NO contacts.

**Note**

Two-hand control must be labeled according to ISO 13851. You can find information on determining the response time in the section entitled Response times (Page 225).

**Note**

Depending on the type of sensors used for two-hand operation, either cross-circuit detection must be activated for mechanical sensors or electronic sensors with OSSD outputs must be used.

### 4.3.9 Discrepancy monitoring

Discrepancy monitoring is a diagnostics function that monitors, in the case of sensors with two contacts, whether dependence of the two contacts is correctly fulfilled. As a result, faults on one contact of the sensor can be detected. For example, such faults can be a stuck contact or a short-circuit between the supplying test clock pulse and the return line from the sensor to the input. In the case of sensors without discrepancy monitoring, this can mean that a two-channel emergency stop circuit does not trip even though only one NC contact is faulty (secondary error).

In the case of the safety devices, discrepancy monitoring is set depending on the monitoring function. In the case of some functions (protective door, protective door with tumbler and universal monitoring), discrepancy monitoring can be deactivated, for example to ensure that certain variants of protective doors with tumbler do not have to be opened after every unlocking.

If the discrepancy time is set to infinite, any amount of time can elapse between closing of the first and the second contacts. However, a discrepancy fault is signaled if both contacts are closed and only one contact is opened and then closed again.

### 4.3.10 Cascading

Cascading of safety relays is used for tripping safety relays in series.

Several safety functions can then be logically connected to a shared shutdown path. Several safety-related outputs can be created for selective shutdown of drive elements.

The connection between the individual modules must be arranged on one side only, because cascading from the last relay to the first one would create a loop which would prevent starting.

Cascading is implemented within a control cabinet in a single-channel configuration; this is even permissible with SIL 3 / PL e, because cable routing within a control cabinet is protected against short-circuits and short-circuiting to P potential (fault exclusion in accordance with ISO 13849-2).

The 3SK1 Advanced device series offers an extremely convenient solution for cascading. Input expansions can be easily connected to the evaluation unit by means of device connectors.

### 4.3.11 Startup testing

The sensor or protection equipment must be properly operated once after the supply voltage is restored before the enables for the safety relay can be switched through. Startup testing ensures that any errors in the sensors are detected (again), because safety relays lose their ability to store errors at zero voltage.

Unauthorized manipulation of the protection equipment can also be detected through startup testing.

The plant operator decides whether startup testing should be performed (risk assessment). No general statements apply.

Possible start-up testing applications:

- Seasonally operated machines
- Function test after extensive maintenance/repair work
- Implementation of a test routine for safety functions without automatic test (e.g. EMERGENCY STOP)

**Note**

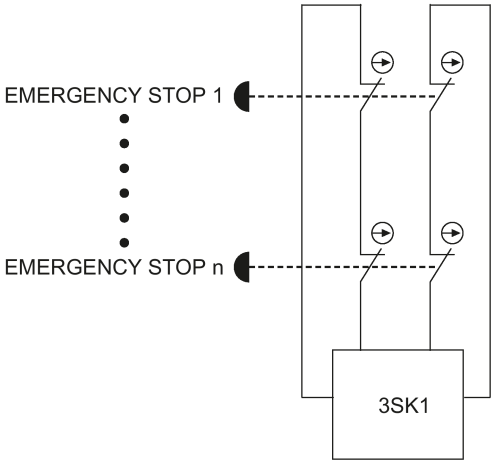
In the delivery state of 3SK1 safety relays, startup testing is deactivated.

# 4.4 Additional notes

## 4.4.1 Series connection of sensors

### Series connection of EMERGENCY STOP command devices

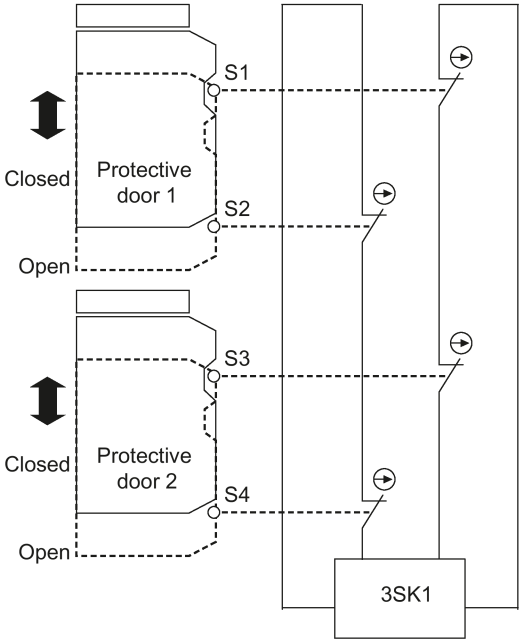
It is possible to connect EMERGENCY STOP command elements in series up to the highest safety level (SIL 3 according to IEC 62061, SIL 3 according to IEC 61508, and PL e (Cat. 4) according to ISO 13849-1) because it is assumed that only one EMERGENCY STOP is operated at a time. This ensures that errors and defects can be detected.



### Series connection of mechanical position switches

In general, position switches may be connected in series if measures ensure that several protective doors are not regularly opened simultaneously (otherwise a fault cannot be detected).

For safety level SIL 3 according to IEC 62061, SIL3 according to IEC 61508, and PL e (Cat. 4) according to ISO 13849-1, however, they must **never** be connected in series because every hazardous error must be detected (independently of the operating personnel).




## 4.4.2 Use of magnetically operated switches

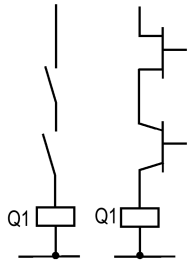
If magnetically operated switches are used, the magnetic contacts may weld on account of capacitive effects. The reason for this is that a high peak current may occur when switching these loads (e.g. also cable capacitances). A corresponding fuse protection with the rated current of the magnetically operated switch must be provided if the device/sensor combinations have not been explicitly enabled.

For more details, please refer to the documentation of the magnetically operated switch.

## 4.4.3 Connection of actuators

### Outputs switching to P potential

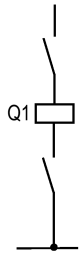
If an actuator is connected with pp-switching, the two redundant contact blocks of the safety relay's enabling circuit are located in the supply line to the actuator.
Advantage: The actuator's return line is directly connected.
Disadvantage: Protected cable installation is necessary to ensure that the system can still be switched off in the event of a fault.




### Outputs pm-switching

If an actuator is connected with pm-switching, one contact block is located in the supply line to the actuator and one contact block is located in the return line. In contrast to the pp-switching solution, no protected cable installation is necessary, as it is always ensured that the actuator can be switched off even in the event of a fault.

Advantage: No protected cable installation is necessary to ensure that the system can still be switched off in the event of a fault.
Disadvantage: The actuator's return line is not directly connected.




### Reading back the switching status of the actuators

There are basically two types of actuators. On the one hand, there are actuators that monitor themselves (e.g. fail-safe motor or soft starters, frequency converters, safe control inputs for other safety relays) and, on the other hand, there are actuators that are monitored by the safety relay (e.g. contactors, auxiliary contactors, coupling relays, or valves).

## Protection of enabling circuits

If the enabling circuits on the safety relays are designed as relay outputs, they must be protected in accordance with the specifications in order to avoid common cause faults (e.g. welding of both redundant contacts) so that the actuators can always be switched off.

Electronic outputs do not usually require protection as they are designed to be short-circuit-proof. However, the specifications must be checked here, too.

## Protective circuits of the actuators

For capacitive and inductive loads, a suitable protective circuit must be provided. In this way, electromagnetic interference can be suppressed and contact service life increased.

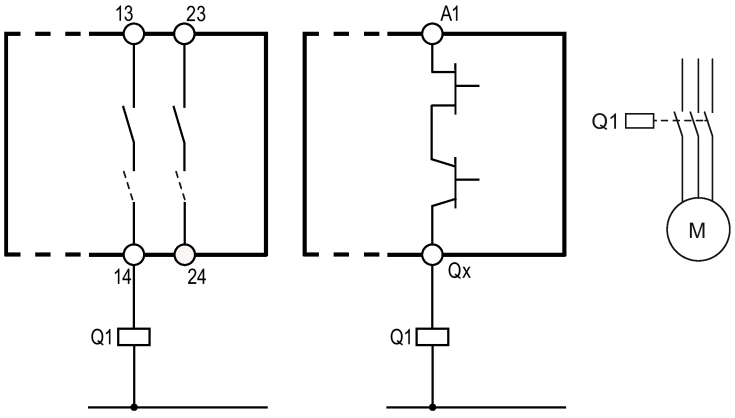
**Note**

You can find more information on protective circuits for contactors in the equipment manual SIRIUS Innovations - SIRIUS 3RT2 Contactors/Contactor Assemblies. (https://support.industry.siemens.com/cs/us/en/view/60306557)

**Note**

To achieve the Performance Level / Safety Integrity Level given in the following examples, the actuators shown must be monitored in the feedback circuit of the corresponding safety relay.

### Actuator wiring up to PL c / Cat. 2 according to ISO 13849-1, or SIL 1 according to IEC 62061




### Actuator wiring up to PL e / Cat. 4 according to ISO 13849-1, or SIL 3 according to IEC 62061

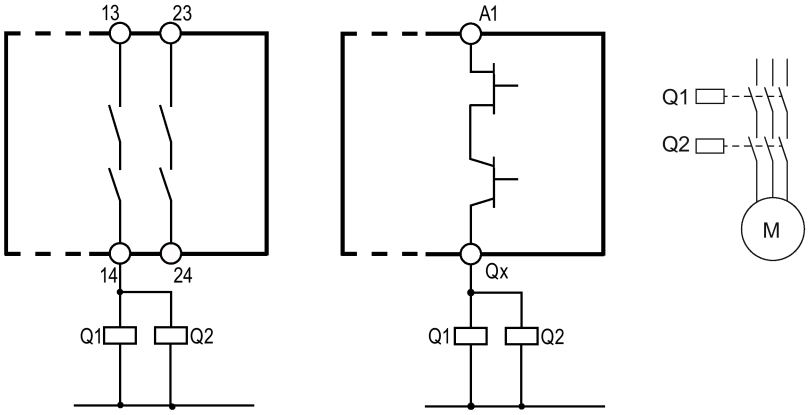



Figure 4-5 This interconnection is only possible with devices with semiconductor outputs from E02 / V1.1.0 onwards

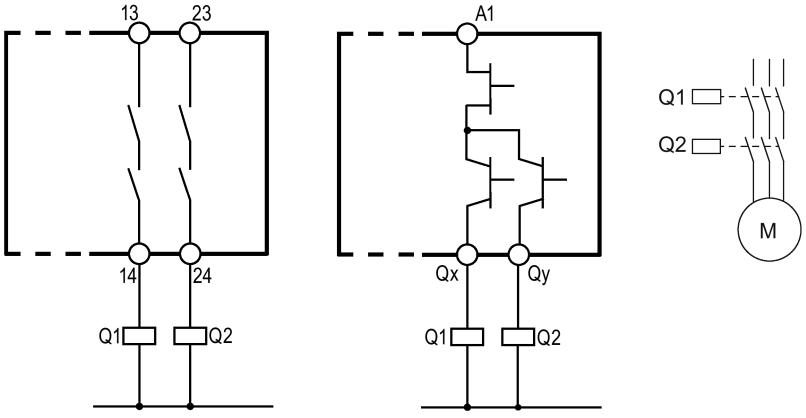
**WARNING**

PL e/Cat. 4 according to ISO 13849-1 or SIL 3 according to IEC 62061 can only be achieved with cross-circuit-proof/short-circuit to P-proof laying of the control cables from the relay output (e.g. 14) to the control relays/contactors (Q1 and Q2) (e.g. as a separately sheathed cable or in its own cable duct).

**Note**

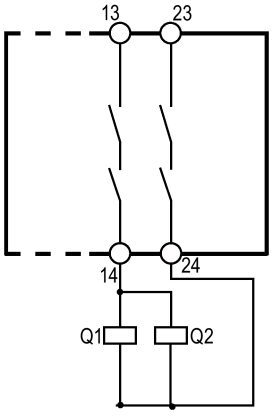
In the case of 3SK1..2 and 3SK1120 (devices with semiconductor outputs with firmware (FW) version V1.0.0 and product version E01) it is not possible to achieve PL d/e / Cat. 3/4 according to ISO 13849-1 or SIL 2/3 according to IEC 62061 with the wiring shown above.

### Actuator wiring up to PL e / Cat. 4 according to ISO 13849-1, or SIL 3 according to IEC 62061




Refer to the information on the operation inspection interval in section General safety notes (Page 29)

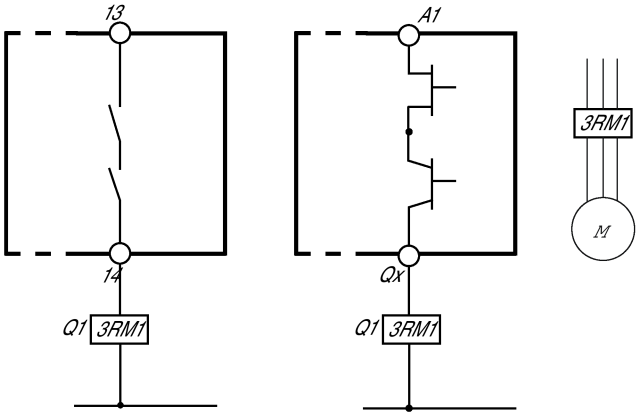
### Actuator wiring up to PL e / Cat. 4 according to ISO 13849-1, or SIL 3 according to IEC 62061




**Note**

PL e / Cat. 4 according to ISO 13849-1 or SIL 3 according to IEC 62061 can be achieved here without protected routing, as the actuators can always be switched off in the event of a fault.

## Actuator wiring with 3RM1 up to PL e / Cat. 4 according to ISO 13849-1 or SIL 3 according to IEC 62061




**Note**

PL e/Cat. 4 according to ISO 13849-1 or SIL 3 according to IEC 62061 can only be achieved with cross-circuit-proof/short-circuit to P-proof laying of the control cables from the relay output (e.g. 14) to the 3RM1 Failsafe motor starter (e.g. as a separately sheathed cable or in its own cable duct). Thanks to the intrinsic safety of the 3RM1 Failsafe motor starter, monitoring by the upstream 3SK1 safety relay (via feedback circuit) is not necessary here.

**Note**

In the case of 3SK1..2 and 3SK1120 (devices with semiconductor outputs with firmware (FW) version V1.0.0 and product version E01) it is not possible to achieve PL d/e / Cat. 3/4 according to ISO 13849-1 or SIL 2/3 according to IEC 62061 with the wiring shown above.

More detailed technical information is available in the "SIRIUS 3RM1 motor starters (http://support.automation.siemens.com/WW/view/en/66295730)" manual on the Internet.

## See also

SIRIUS Innovations - SIRIUS 3RT2 Contactors/Contactor Assemblies manual (http://support.automation.siemens.com/WW/view/en/60306557)

# System configuration

5

## 5.1 3SK1 Standard system configuration

- The 3SK1 Standard devices are designed for implementing simple safety functions. Therefore, no system expansion, e.g. using device connectors, is provided for these devices.
- Safety-related outputs are expanded using external wiring.
- Output expansions must be controlled via a safety-related output of the basic unit. Use of device connectors is not possible.
- The NC circuit of the 3SK1 / 3RQ1 output expansion must be looped into the feedback circuit (T4-INF/S) of the basic unit.

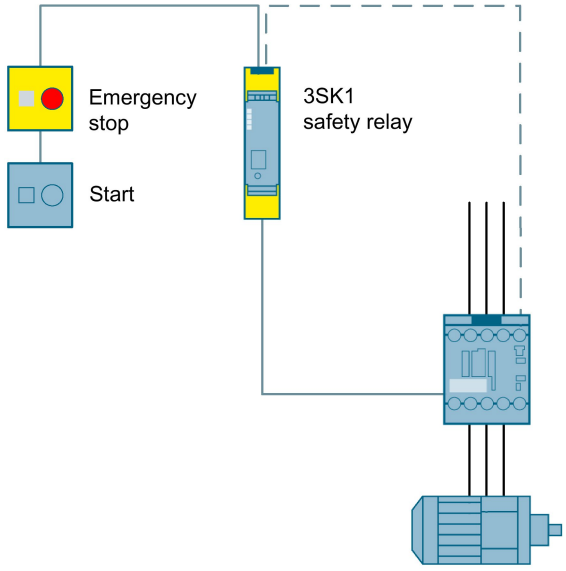



Figure 5-1 3SK1 Standard system configuration

# 5.2 3SK1 Advanced system configuration

## 5.2.1 3SK1 Advanced system configuration

- Expansion of the safety-related outputs of 3SK1 Advanced basic units by means of external wiring is always possible.
- The NC circuit of the 3SK1 / 3RQ1 output expansions must be looped into the feedback circuit (T4-INF) of the basic unit.
- Expandable on the input and output sides using device connector 3ZY12.
- The output expansions are controlled via the connection interface. With the 3SK1 / 3RQ12 output expansions, the feedback circuit is also evaluated via the connection interface. External wiring of the output expansion is therefore only necessary for 3RQ10 if SIL 2 / PL c is to be achieved. With 3RQ10, SIL 1 / PL c can also be achieved without feedback circuit wiring.
- When using the 3SK1 Advanced device series with output expansion with the device connectors described, all enabling and signaling circuits of the basic unit and output expansion can be used as required.
- The input expansions, as well as the output expansions mounted on the 3ZY12 device connector, are supplied with voltage via the 3ZY12 device connector. The supply voltage is only connected once on the basic unit (24 V DC) or the 3SK1230 power supply (110 ... 240 V AC/DC).
- Motor feeders up to 3 kW (400 V) can be implemented quickly and easily using 3RM1 Failsafe motor starters. The motor starters can be easily connected as output expansions in the 3SK1 system.

**Note**

In the configuration with a 3SK1 Advanced basic unit on a 3ZY12 device connector, 3RM1 Failsafe motor starters and 3RQ1 fail-safe coupling relays can only be controlled by the instantaneous enabling signal of the 3SK1 unit. If control of the 3RM1 Failsafe motor starters and 3RQ1 fail-safe coupling relays by means of the time-delayed output is desired, this can only be done by wiring the time-delayed safety-related outputs of the 3SK1 basic unit.

Information about start response in the system configuration of 3SK1 Advanced units can be found in the chapter "Explanations of device function (Page 218)".

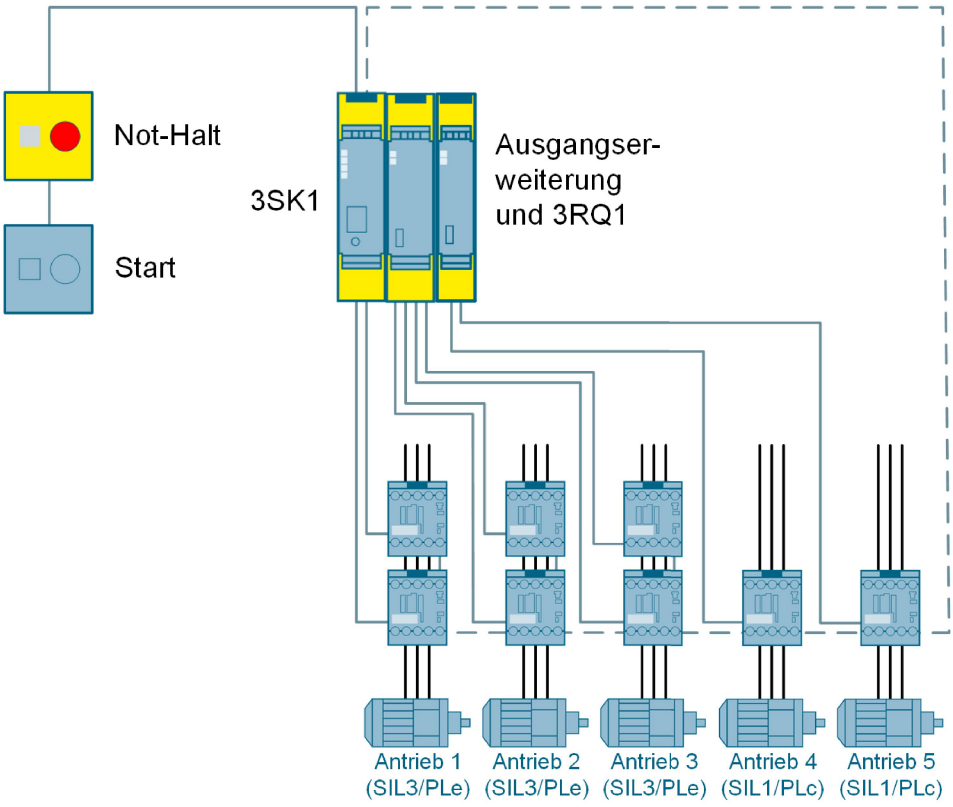



Figure 5-2 3SK1 Advanced system configuration

## General

- All basic units can be operated as a stand-alone device without a device connector.
- 3SK1220 input expansions and the 3SK1230 power supply must always be connected on the left of the basic unit.
- Output expansions (3SK121, 3RQ1 and 3RM1 Failsafe motor starters) must always be connected on the right of the basic unit.
- Depending on the system configuration, only one 3SK1 Advanced basic unit is permissible.

### Expansion on the input side

- An input expansion evaluates the sensor states and generates an enabling signal for the basic unit depending on the start condition. The enabling signal is then acquired by an input expansion on the right-hand side, or acquired by the basic unit and ANDed with its sensor statuses.
- If an (additional) input expansion is detected on the left when the basic device or an input expansion powers up, it will be loaded into the device configuration.
- Information about start response in the system configuration of 3SK1 Advanced units can be found in the chapter "Explanations of device function (Page 218)".
- The 3ZY12 device connector used below the final device must be fitted with a cover on the left side (included with the device termination connectors).
- A 3SK1230 power supply can also be used in the 3SK system. This 3SK1230 power supply must always be plugged into the system on the extreme left. No more than one 3SK1230 power supply is admissible for each system.
- If a 3SK1230 power supply is used, **no** additional, external 24 V DC voltage is permitted to be connected to a basic unit.
- If only input expansions and no 3SK12 or 3RQ1 output expansions and no 3RM1 fail-safe motor starters are used in the system configuration, a device termination connector must be used under the basic unit. The slide switch of the termination connector must then be set to position 2 (switch down).

**Note**

There is no device termination connector with slide switch for the 3SK1120-.AB40 device variant. Therefore, in addition to the input expansion, an 3SK12 or 3RQ1 output expansion with the corresponding device termination connector must also be used for this variant.

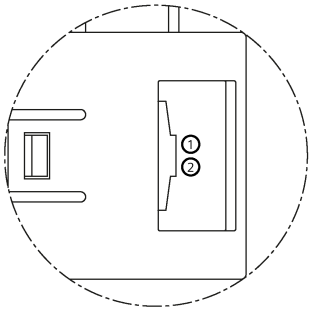
### Output expansion

- If an output expansion is detected on the right when the device powers up, this will be loaded into the device configuration. The internal feedback circuit of the contact extension is evaluated and checked.
- In the case of a change to the device configuration during operation, error mode is activated immediately. A restart can only be performed by switching the device off and on again.
- If both the 3SK1211 / 3RQ1 output expansion and 3RM1 Failsafe motor starters are used in a system, the 3RM1 Failsafe motor starters must be positioned on the right of the 3SK1211 / 3RQ1 output expansions.
- If a 3SK1213 output expansion is used in the system, this must always be the final station in the system (on the right) and must be fitted with a 3ZY1212-0FA01 device termination connector.

  Only one 3SK1213 output expansion can be used in the system with a device connector; further 3SK1213 output expansions can be optionally interfaced by wiring.

- On the 3SK121 output expansions, a slide switch on the device front must be used to set whether the (UNDELAYED, switch position 2) or (DELAYED, , switch position 1) output signal of the basic unit is to trigger a response. If a purely instantaneous 3SK112 basic unit is used, the slide switch MUST be set to "UNDELAYED", switch position 2.
- The 3RQ1 output expansions do not have a slide switch and always react to the UNDELAYED output signal.
- Similarly, the fail-safe 3RM1 motor starters do not have a slide switch. These also respond to the UNDELAYED output signal.
- For 3RM1 Failsafe motor starters, distances to adjacent devices must be maintained above certain load limits/temperature ranges. To this end, there are appropriate device connectors for looping through signals (3ZY1212-2AB00).

  You will find more information on the configuration guidelines for 3RM1 Failsafe motor starters in the SIRIUS 3RM1 motor starters (http://support.automation.siemens.com/WW/view/en/66295730) manual, in the chapter "Load feeders - protection against short-circuit".
- If control of the 3RM1 Failsafe motor starters or of the 3RQ1 output expansions by means of the time-delayed output is desired, this can only be done by wiring the time-delayed safety-related output of the 3SK1 basic unit.
- If the last device on the right is a 3SK12 or 3RQ1 output expansion, a device termination connector must ALWAYS be used under this device. The switch must be set to position 1 (switch at the top).
- There is no switch on the device termination connector for motor starter 3RM1 that needs to be set.
- There is no switch on the 17.5 mm device termination connector for 3RQ1 that needs to be set.
- 22.5 mm device termination connector for 3SK1 / 3RQ1:




① Under 3SK1211 and 3RQ1 output expansion with 22.5 mm width: The switch of the device termination connector must be closed, i.e. in position 1 at the top.

② Below basic unit: The switch of the device termination connector must be open, i.e. in position 2 at the bottom.

## 5.2.2 Maximum system configuration

### Maximum system configuration when supplying with 24 V DC on the basic unit

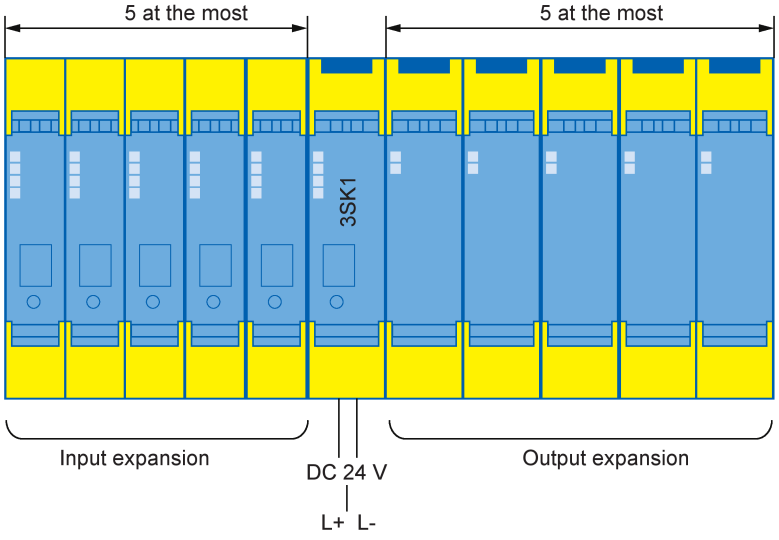
- Only one 3SK1 basic unit is permitted per system.
- A maximum of 5 expansions are permitted on the left of the basic unit and 5 expansions on the right.

**WARNING**

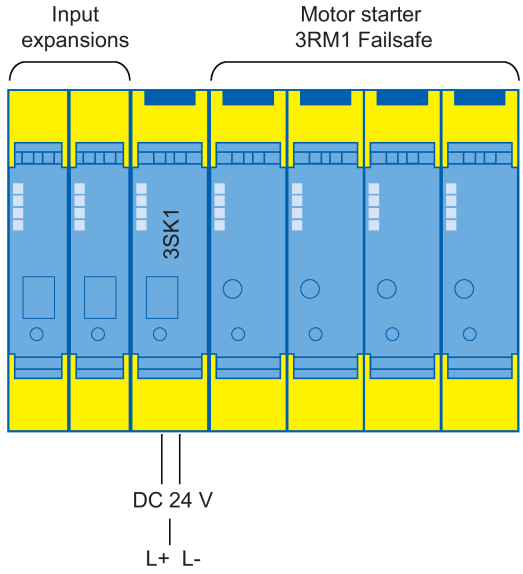
The safety function is not guaranteed if more than one basic unit or the maximum number of extensions are used.

### Changes to the system configuration

Changes to the system configuration in safety mode always result in a device error. Restarting, by disconnecting and reconnecting the operating voltage (Power OFF/ON), is a mandatory requirement.



Example of a configuration with connection of 24 V DC on the basic unit and 3RM1 Failsafe motor starter




## Maximum system configuration when supplying with 24 V DC with 3SK1230 power supply

When using the 3SK1230 power supply, the maximum system configuration can be calculated as follows:
Up to 10 "system units" can be connected to a 3SK1230 power supply. The individual devices occupy a different number of system units here.

**Note**

With this configuration too, up to 5 expansions are permitted to the left of the basic unit and 5 expansions are permitted on the right.

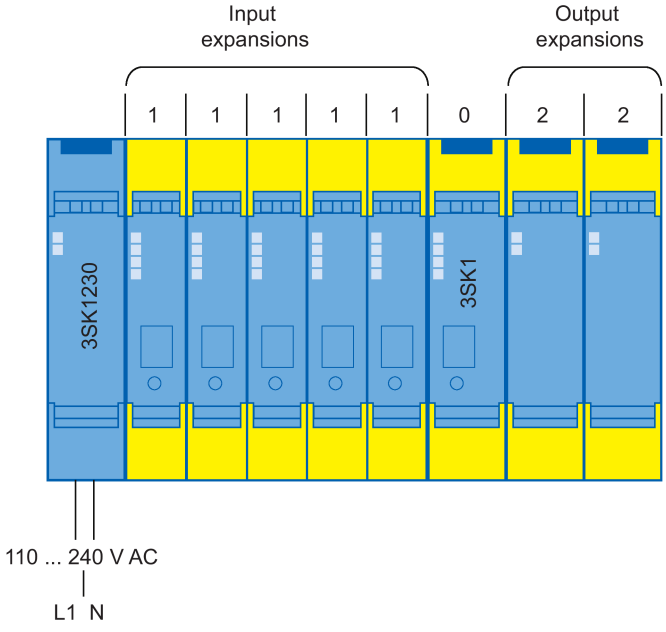
**Note**

When using the 3SK1230 power supply, only 3SK1121 basic units with relay outputs should be used in the system configuration. When using 3SK1122 devices with semiconductor outputs, the power supply is additionally loaded with the output current of the semiconductor outputs, which, depending on the level of the output current, can lead to a restriction of the maximum system configuration.

| Device | System unit |
|---|---|
| 3SK1220 input expansion | 1 |
| 3SK1230 power supply | 0 |
| 3SK112 basic units | 0 |
| 3SK1211 output expansion | 2 |
| 3SK1213 output expansion | 2 |
| 3RQ1 output expansion | 2 |
| 3RM1 Failsafe motor starters | 4 |

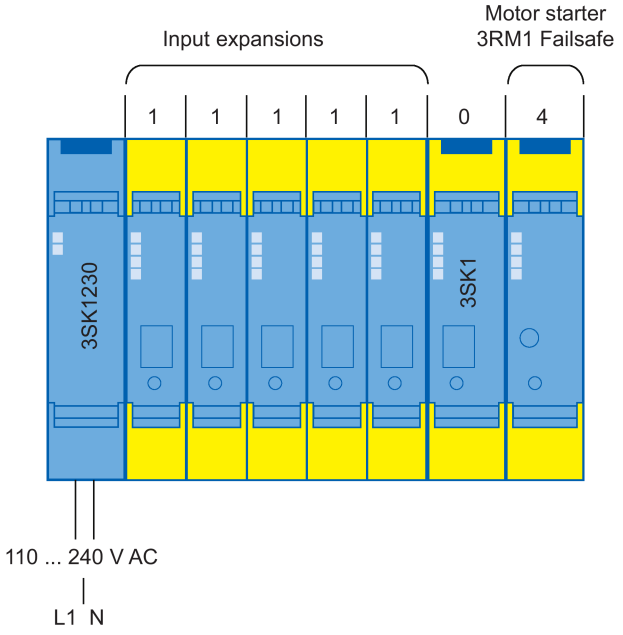
Example 1)
1 x 3SK1230 power supply; 5 x 3SK1220 input expansion; 1 x 3SK112 basic unit; 2 x 3SK1211 output expansion

9 system units



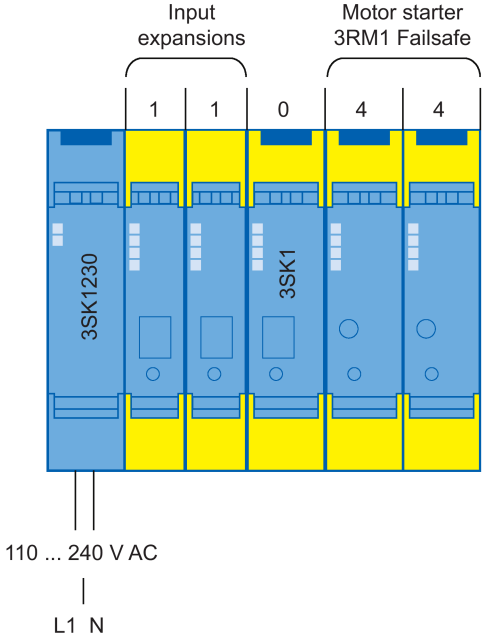
Example 2)
1 x 3SK1230 power supply; 5 x 3SK1220 input expansion; 1 x 3SK112 basic unit; 1 x 3RM1 Failsafe motor starter

9 system units




Example 3)
1 x 3SK1230 power supply; 2 x 3SK1220 input expansion; 1 x 3SK112 basic unit; 2 x 3RM1 Failsafe motor starter

10 system units



## 5.2.3 3ZY12 device connectors

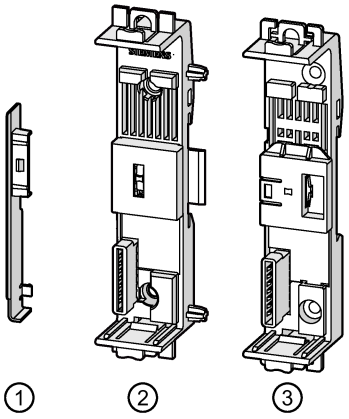
The device connectors are used to connect the various devices of the 3SK system to each other. This saves wiring costs and prevents errors. There are basically 3 types of device connectors:

Type 1: Device connectors for 3SK1 safety relays and 3RQ1 force-guided coupling relays.

Type 2: Device connectors for 3RM1 motor starters

Type 3: Device connectors for parameterizable 3SK2 safety relays

The type is indicated on the nameplate of each connector.

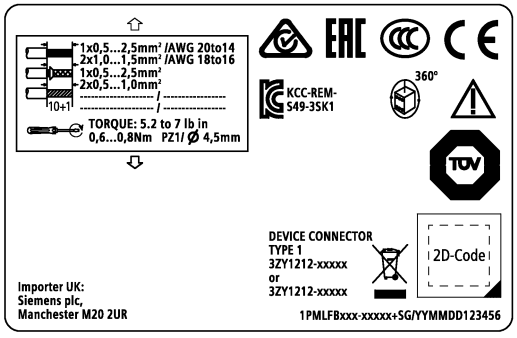



① Cover (included in the scope of supply of each device termination connector.)

② 3ZY12 device connectors

③ 3ZY12 device termination connectors

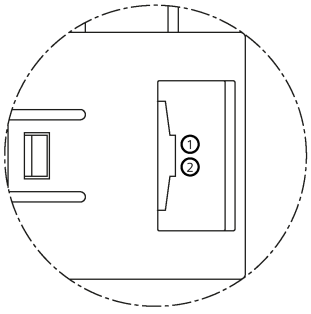
The order number for the appropriate device connectors is specified on the nameplate of each device.



| Article number | Device connector for | Type |
|---|---|---|
| 3ZY1212-1BA00 | 3SK1 safety relay<br>3SK1 / 3RQ1 output expansion<br>Width 17.5 mm | Type 1 |
| 3ZY1212-2BA00 | 3SK1 safety relay<br>3SK1 / 3RQ1 output expansion<br>Width 22.5 mm | Type 1 |
| 3ZY1212-2EA00 | 3RM1 motor starter<br>Width 22.5 mm | Type 2 |
| 3ZY1212-2AB00 | Device connector for looping through signals<br>Width 22.5 mm | - |
| 3ZY1210-2AA00 | Device connector without function<br>Width 22.5 mm | - |

| Article number | Device termination connector for | Type 2 |
|---|---|---|
| 3ZY1212-2FA00 | 3RM1 motor starter<br>Width 22.5 mm | Type 2 |
| 3ZY1212-2DA00 | 3SK1 safety relay<br>3SK1 / 3RQ1 output expansion<br>Width 22.5 mm | Type 1 |
| 3ZY1212-1DA00 | 3RQ1 output expansion<br>Width 17.5 mm | Type 1 |
| 3ZY1212-0FA01 | Set for 3SK1 safety relay, > 45 mm wide<br>Set consists of 3ZY1212-2FA00 device connector and 3ZY1210-2AA00 device connector | Type 1 |

The device termination connectors, except for 3ZY1212-1DA00, have a slide switch. Depending on the installation position, the switch must be set as follows to ensure correct system operation:




① Under 3SK1211 and 3RQ1 output expansion with 22.5 mm width: The switch of the device termination connector must be closed, i.e. in position 1 at the top.

② Below basic unit: The switch of the device termination connector must be open, i.e. in position 2 at the bottom.

The device termination connector 3ZY1212-1DA00 does not have a slide switch and can therefore only be used under 3RQ1 with a width of 17.5 mm.

**⚠ DANGER**

**Ensuring electrical safety and safety function**

The normally closed contact of 3RQ12. is designed for a voltage of 24 V DC. If higher voltages occur, electrical safety cannot be ensured due to the voltage clearance distances. If the 3RQ12. is integrated in a system with a device connector, the feedback circuit is routed via the device connector. Connection of external voltage is not necessary and not permitted. Connecting external voltage can bypass the safety function.

### 24 V DC supply voltage from an external power supply unit

**⚠ WARNING**

**Supply voltage must only be fed in on the basic unit**

The supply voltage of 24 V DC must only be fed in on the basic unit, otherwise the safety function is bypassed.

**Note**

If expansion units are controlled via the 3ZY12 device connector, additional feeding of the control supply voltage (A1/A2) at one of the output expansions leads to a fault in the system configuration.

It is not permitted to supply 24 V DC to an expansion component or 3RM1 Failsafe motor starter.

**NOTICE**

**24 V DC power supply through 3SK1230**

When device connectors are used, only one 3SK1230 power supply is permitted in each system.

The 3SK1230 power supply must always be located on the extreme left.

**⚠ WARNING**

**Power supply by means of the 3SK1230 power supply**

If a 3SK1230 power supply is used, an additional (external) 24 V DC connection is not permitted (this also applies to the cascading input, as well as to non-floating sensors).

## 5.2.4 Further notes on points to be observed in the system setup

### Arrangement for mixed start types

If input expansions and basic devices with different start types are parameterized within a system setup, a certain sequence must be observed.

The monitored start should only be parameterized on devices at the far left of the setup, and the automatic start on the devices on the right.

For example, all emergency stop command devices that require a monitored start are connected to the devices on the left, and all sensors that allow automatic start are connected to devices on the right.

If this sequence is not followed, the last device that is parameterized with monitored start always requests a starting command, even if a device to its left that triggered the shutdown is parameterized with automatic start.

### Wiring multiple start buttons

If multiple devices with monitored start are parameterized, a single start button can be used that acts on these devices simultaneously. In this case, the respective start inputs only need to be bridged. To make this possible, the starting command is stored by the respective device, provided that its own switch-on conditions are met and only the enabling signal from the device on the left is missing.

### Saving the starting command

If sensors that require a monitored start are connected to multiple devices, the monitored start must be configured on each of these devices. In this case, it is not permissible to parameterize only the last device with monitored start and to wire the start button only to this device.

The risk here is that, in the example shown above, the basic device (right) can store a starting command even though the emergency stop command device has not yet been unlocked. The machine would then start immediately after the emergency stop command device was unlocked. This is not permitted.

| **NOTICE** |
| --- |
| **Unexpected start**<br>If sensors that require a monitored start are connected to multiple devices, the monitored start must be configured on each of these devices. In this case, it is not permissible to parameterize only the last device with monitored start and to wire the start button only to this device.<br>The risk here is that, in the example shown above, the basic device (right) can store a starting command even though the emergency stop command device has not yet been unlocked. The machine would then start immediately after the emergency stop command device was unlocked.<br>This is not permitted. |

### Start behavior when using the INK input

In the SIRIUS 3SK1 safety relays, the sensor circuit, the cascading input, and the signal from the device connector for the selected start type are simplified and linked together. The parameterized start type therefore applies to all three signals. If a monitored start is parameterized, a starting command is required to restart the device, regardless of which of these signals caused the shutdown

### See also

Start function of the SIRIUS 3SK1 safety relays
(https://support.industry.siemens.com/cs/us/en/view/103655974)

## 5.2.5 Overview of device connectors and switch positions

### Use of device connectors

- A device connector is always necessary when other devices have to be plugged in.
- A device termination connector is always required in the system for the last module on the right.

**Note**

Use of the device connectors to expand the Advanced basic units is optional.

The device connectors cannot be used with the Standard series.

**Note**

Only safety relays with a supply voltage of **24 V DC** may be used on the 3ZY12 device connectors.

**Note**

If expansion units are controlled via the 3ZY12 device connector, additional feeding of the control supply voltage (A1/A2) at one of the output expansions leads to a fault in the system configuration.

The following device connectors are required for the various enclosure widths of the Advanced device series:

| Devices | Device connector for 3SK1 safety relay 17.5 mm 3ZY1212-1BA00 | Device connector for 3SK1 safety relay 22.5 mm 3ZY1212-2BA00 | Device termination connector for 3SK1 safety relay 22.5 mm 3ZY1212-2DA00 | Device termination connector for 3RQ1 17.5 mm 3ZY1212-1DA00 |
|---|---|---|---|---|
| **3SK1 Advanced basic units** | | | | |
| 3SK1121 | - | x | x | - |
| 3SK1122 | - | x | x | - |
| 3SK1120 | x | - | - | - |
| **Output expansions 3SK1** | | | | |
| 3SK1211 (4RO) | - | x | x | - |
| 3SK1213 (3RO) | - | - | - | - |
| **3RQ1 output expansions** | | | | |
| 3RQ1*E/G* (17.5 mm) | x | - | - | x |
| 3RQ1*H/L* (22.5 mm) | - | x | x | - |
| **Input expansions 3SK1** | | | | |
| 3SK1220 | x | - | - | - |
| 3SK1230 power supply | - | x | - | - |
| **3RM1 Failsafe motor starters** | | | | |
| 3RM1 | - | - | - | - |

| Devices | Device connector for 3RM1 motor starter 22.5 mm 3ZY1212-2EA00 | Device termination connector for 3RM1 motor starter 22.5 mm 3ZY1212-2FA00 | Device termination connector set for enclosures > 45 mm[1)] 3ZY1212-0FA01 | Device connector for looping through signals 22.5 mm 3ZY1212-2AB00 |
|---|---|---|---|---|
| **3SK1 Advanced basic units** | | | | |
| 3SK1121 | - | - | - | - |
| 3SK1122 | - | - | - | - |
| 3SK1120 | - | - | - | - |
| **Output expansions 3SK1** | | | | |
| 3SK1211 (4RO) | - | - | - | - |
| 3SK1213 (3RO) | - | - | x | - |
| **3RQ1 output expansions** | | | | |
| 3RQ1*E/G* (17.5 mm) | - | - | - | - |
| 3RQ1*H/L* (22.5 mm) | - | - | - | - |
| **Input expansions 3SK1** | | | | |
| 3SK1220 | - | - | - | - |
| 3SK1230 power supply | - | - | - | - |
| **3RM1 Failsafe motor starters** | | | | |
| 3RM1 | x | x | - | x |

[1)] Set consists of 3ZY1212-2FA00 device connector and 3ZY1210-2AA00 device connector

**Note**

If a basic unit is expanded on the right, the last output expansion must be terminated with a device termination connector of the corresponding device.

If a basic unit is only expanded on the left, a device termination connector for 3SK1 safety relays must be mounted below the basic unit.

**Note**

When using a 3SK1120 device with a device connector, at least one output expansion is also required, as there is no 17.5 mm device connector with slide switch. A device connector is only available for the 3RQ1 coupling relay with hard-wired termination.

# 3SK1 / 3RQ1 devices

# 6

## 6.1 3SK1 standard

### 6.1.1 General information

The safety relays of the Standard series can be configured as stand-alone devices or as an expansion solution with conventional wiring technology.

**The focus of the Standard series is on:**

- Single devices for simple safety applications
- Output-side expansion by means of expansion units and external wiring
- No expansion on the input side

### 6.1.2 Applications

- EMERGENCY OFF / EMERGENCY STOP monitoring.
- Monitoring of protective doors with electromechanical position switches, solid-state position switches, or solenoid switches.
- Monitoring of contact-free protection equipment, e.g. light arrays/light barriers, or laser scanners.

3SK1 Standard safety relays can be used in EMERGENCY OFF/EMERGENCY STOP devices according to ISO 13850 and in safety circuits according to VDE 0113-1 and/or IEC 60204-1. Depending on the external circuitry, it is possible to achieve SIL 3 according to IEC 62061 or IEC 61508 and PL e (Cat. 4) according to ISO 13849-1.
The safety relays comply with EN 50156-2 (electrical equipment for furnaces and ancillary equipment).

## 6.1.3 3SK1111 Standard basic unit instantaneous (with relay outputs)

### 6.1.3.1 General information

#### Article number

| | |
|---|---|
| 3SK1111-xAB30 | 24 V AC/DC |
| 3SK1111-xAW20 | 110 ... 240 V AC / DC<br>(wide-range supply) |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal

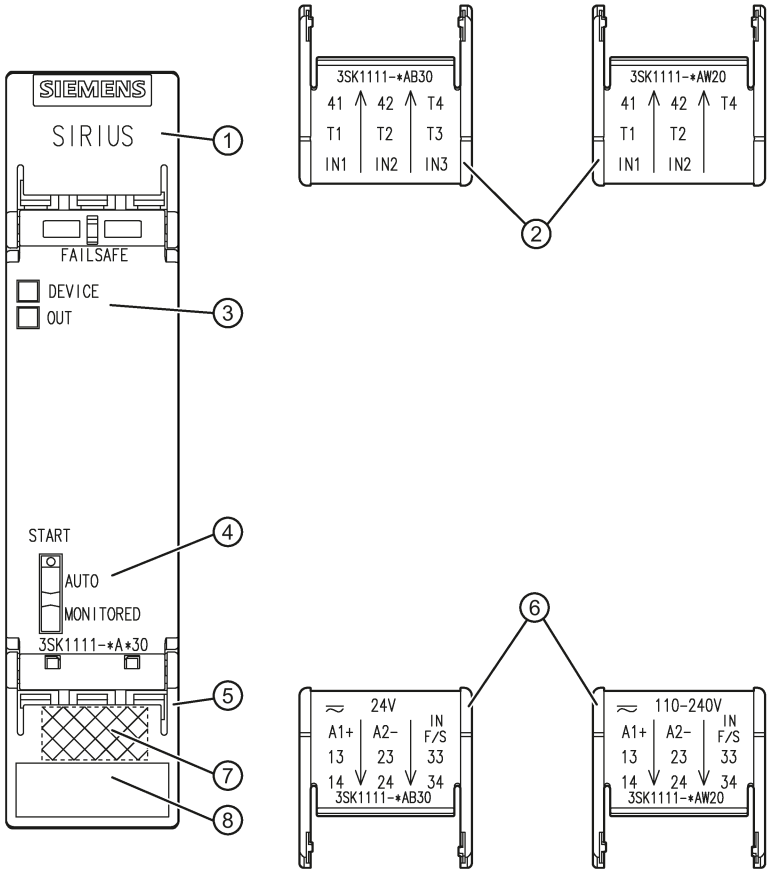
#### Device features

- 2 sensor inputs (channels 1 and 2)
- 1 input for feedback circuit and START button
- 3 safety-related outputs (NO contacts),
- 1 semiconductor signaling circuit (non-safety-related circuit, NC contact)
- 2 LEDs for displaying the operating states
- Slide switch for function setting
- Single-channel or two-channel connection
- Cross-circuit detection between sensor channels 1 and 2
- Enclosure width 22.5 mm
- Removable terminals

### 6.1.3.2 Function description

The 3SK1111 Standard basic unit is a 2-channel safety relay for EMERGENCY OFF and EMERGENCY STOP equipment in accordance with IEC 60204-1.
The device is equipped with force-guided relays and monitors itself during every ON/OFF cycle.
The device has 3 safety-related outputs as NO circuits and one semiconductor signaling circuit (non-safety-related circuit, NC contact).
On the front of the device there is a slide switch for function setting and 2 LEDs for displaying the operating states.

### 6.1.3.3 Design




① Top cover flap
② Top cover flap; internal inscription
③ Display LEDs
④ Slide switch
⑤ Bottom cover flap
⑥ Bottom cover flap; internal inscription
⑦ DataMatrix code
⑧ Device identification label

### 6.1.3.4 Terminal assignment

| Terminal | Explanation |
|---|---|
| A1 | L+ |
| A2 | N- |
| IN1 | Sensor channel 1 |
| IN2 | Sensor channel 2 |
| IN3 | Non-floating sensor evaluation [1] |
| INF/S | Feedback circuit/START button |
| T1 | Test output 1 (for IN1) |
| T2 | Test output 2 (for IN2) |
| T3 | Test output 3 (for IN3) [1] |
| T4 | Test output 4 (for INF/S) |
| 13 - 14<br>23 - 24<br>33 - 34 | Safety-related outputs (NO contact, relay contact) |
| 41 - 42 | Relay signaling circuits (NC contacts) |
| Floating: | Sensors T1/IN1 and T2/IN2<br>Jumper T3/IN3 |
| Non-floating | Sensors IN1 and IN3[1]<br>Jumper T2/IN2 |

[1] For 24 V AC/DC variant only

### 6.1.3.5 Inputs

The device has either 3 or 4 inputs for safe signal processing: IN1, IN2 or IN3 (only 24 V devices for connecting floating sensors) INF/S:

The inputs IN1 and IN2 can be operated in two-channel mode with cross-circuit detection. A single-channel control is also possible and is described in chapter 3SK1111 Standard relay 1-channel, with monitored start (Page 269), tables 7- 1 to 7- 4.

If no feedback circuit is to be used in the application, this must be jumpered with the corresponding test output.

## Voltage variant 24 V:

**Connecting floating sensors:**

When floating sensors are used, sensor inputs T1/IN1 and T2/IN2 must be used and T3/IN3 must additionally be jumpered for two-channel sensor connection.

**Connecting non-floating sensors:**

With non-floating sensors, cross-circuit detection must be deactivated.
This is implemented by the following pin assignment on the 3SK1111-.AB30:

IN1 and IN3 must be used as the input terminal for the two-channel non-floating sensor. In addition, T2/IN2 must be jumpered.

### Voltage variant 110 V ... 240 V AC/DC:

Only **floating sensors** can be connected to the 3SK1111-.AW20 device version.

The 2-channel sensor is connected via T1/IN1 and T2/IN2.

### Connection of magnetically operated switches

When connecting magnetically operated switches to the inputs, observe the information in chapter Use of magnetically operated switches (Page 62).

## 6.1.3.6 Outputs

The safety relay has the following outputs:

- Safety-related outputs (relays), NO contacts: 13/14, 23/24, 33/34
- Non-safety-related outputs (semiconductor signaling circuit; relays), NC contacts: 41/42

## 6.1.3.7 Display of the operating state

Two LEDs and a slide switch indicate the operating state and functioning of the device:

- DEVICE
- OUT

### LED displays

| **LED** | | **Operation** | | | |
|---|---|---|---|---|---|
| DEVICE | OUT | Line | Sensor | START button | Safety-related output |
| Green | Green | ON | Not actuated | Actuated | Closed |
| Green | OFF | | Actuated | --- | Open |
| Green | OFF | | Not actuated | --- | Open |
| | | **Error** | | | |
| OFF | OFF | Cross circuit or no power supply | | | Open |

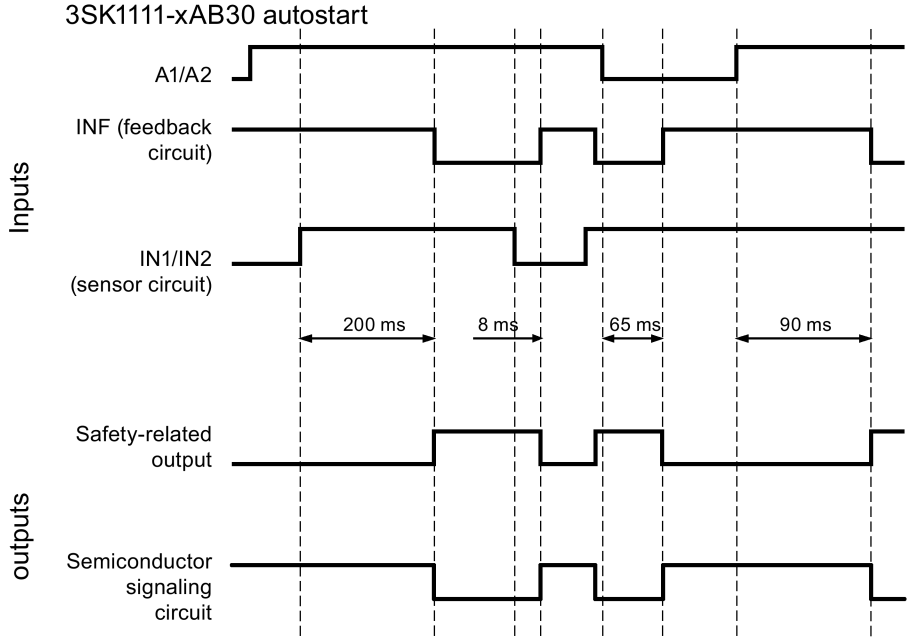
### 6.1.3.8 Function setting

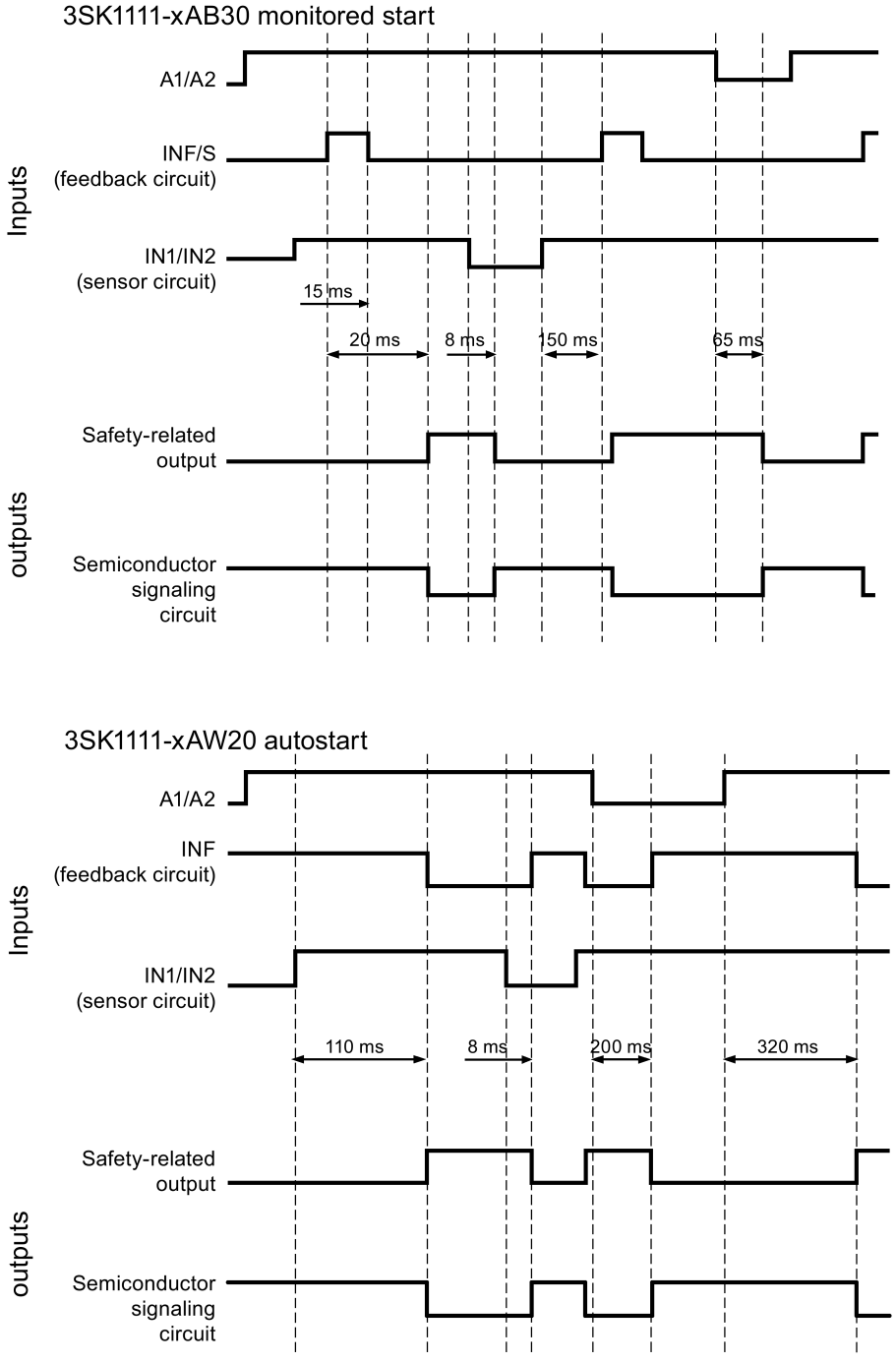
#### Setting the functions

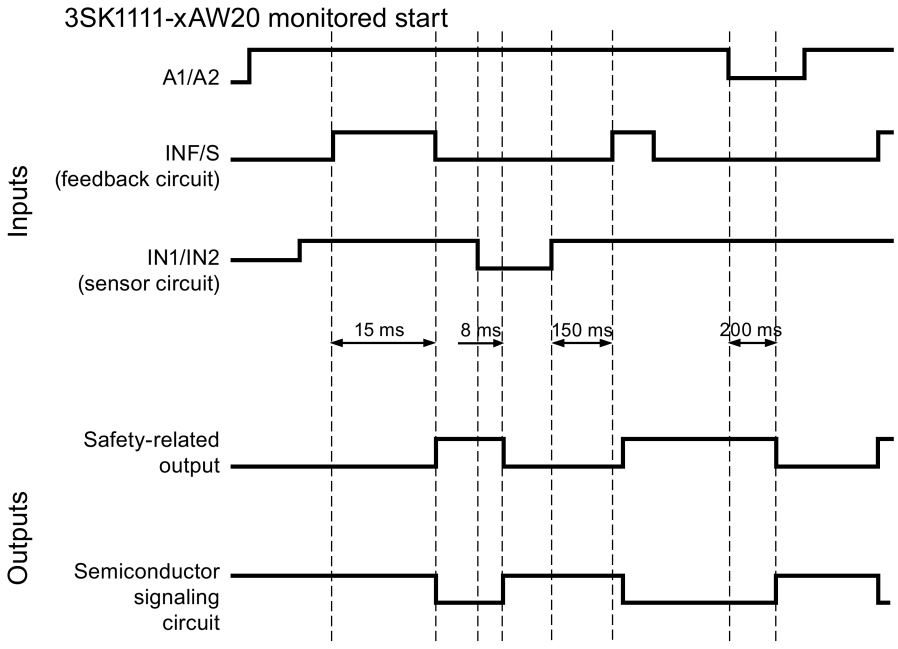
| Slide switch | | |
|---|---|---|
| Start<br>AUTO<br>MONITORED | AUTO | Autostart |
| | MONITORED | Monitored start |

In the delivery state, the slide switch is at the bottom (monitored start).

#### State diagrams 3SK1111




3SK1111-xAB30 monitored start
A1/A2
INF/S
(feedback circuit)
Inputs
IN1/IN2
(sensor circuit)
15 ms
20 ms
8 ms
150 ms
65 ms
Safety-related
output
outputs
Semiconductor
signaling
circuit
3SK1111-xAW20 autostart
A1/A2
INF
(feedback circuit)
Inputs
IN1/IN2
(sensor circuit)
110 ms
8 ms
200 ms
320 ms
Safety-related
output
outputs
Semiconductor
signaling
circuit




## 6.1.4 3SK1112 Standard basic unit instantaneous (with semiconductor outputs)

### 6.1.4.1 General information

#### Article number

| | |
|---|---|
| 3SK1112-xBB40 | 24 V DC |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal

#### Device features

- 4-way DIP switch for function setting (parameterization)
- SET/RESET button
- 4 LEDs for status and function display
- 2 sensor inputs (channels 1 and 2)
- 1 input (cascading circuit)
- 1 input (START pushbutton circuit)
- 1 input (feedback circuit)
- 2 test outputs
- 2 safety-related semiconductor outputs
- 1 semiconductor signaling circuit

- Enclosure width 22.5 mm
- Removable terminals

**⚠ WARNING**

**Continuous operation**

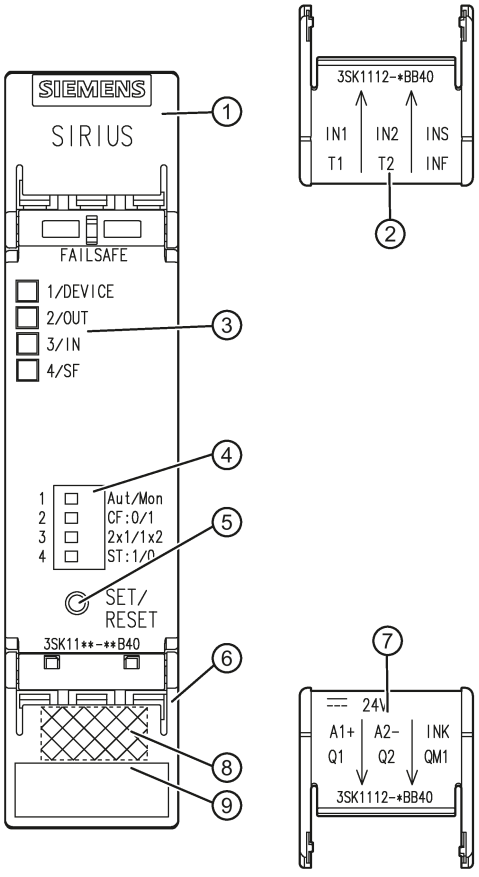
Devices up to E01/V1.0.0:
In continuous operation for PL e/Cat. 4 according to ISO 13849-1 or IEC 62061, the key safety values apply where the operation inspection interval (status change of the outputs) is ≤ 1 year.

Devices from E02/V1.1.0:
In continuous operation for PL e/Cat. 4 according to ISO 13849-1 or IEC 62061, the key safety values apply where the operation inspection interval (status change of the outputs) is ≤ 20 years.

### 6.1.4.2 Function description

The 3SK1112 safety relay has 2 safety-related semiconductor outputs and one non-safety-related signaling circuit.
On the front of the device there is a 4-way DIP switch for function setting and 4 LEDs for status and function display.
The SET/RESET button is used to load function settings and to restart the device (reset).
On commissioning, the device runs through a self-test. This checks that the internal electronics and firmware are functioning correctly. All internal safety-critical parts of the circuit are cyclically monitored for faults during operation. The semiconductor outputs cyclically run through a light/dark test for up to 2.5 ms (dynamically) to verify their correct functioning.

### 6.1.4.3 Design




① Top cover flap
② Top cover flap; internal inscription
③ Display LEDs
④ DIP switch
⑤ SET/RESET button
⑥ Bottom cover flap
⑦ Bottom cover flap; internal inscription
⑧ DataMatrix code
⑨ Device identification label

### 6.1.4.4 Terminal assignment

| Terminal | Explanation |
|---|---|
| A1 | + |
| A2 | - |
| IN1 | Sensor channel 1 |
| IN2 | Sensor channel 2 |
| INS | START pushbutton circuit |
| INF | Feedback circuit |
| INK | Cascading circuit |
| T1 | Test output 1 (for IN1) |
| T2 | Test output 2 (for IN2, INF) |
| Q1 | Semiconductor output 1 (switching to P potential, 24 V DC) |
| Q2 | Semiconductor output 2 (switching to P potential, 24 V DC) |
| QM1 | Semiconductor signaling circuit 1 (switching to P potential, 24 V DC) |

### 6.1.4.5 Inputs

The device has five inputs for safe signal processing: IN1, IN2, INS, INF, INK:

- IN1: sensor input channel 1
- IN2: sensor input channel 2
- INS: START pushbutton circuit (start after rising and falling edge)
- INF: feedback circuit (checked for closed state: before switching on)
- INK: cascading circuit (cascading input/normal switching duty)
- The cascading circuit is AND-connected with the IN1 and IN2 sensor inputs.
- START button circuit and cascading circuit are activated with a static +24 V DC signal.
- With cross-circuit detection activated, the following inputs are checked for cross-circuits and short-circuits to P: IN1/T1 to IN2/T2 and INF/T2. The inputs then receive their supplies from the test outputs T1 and T2.
- If "without cross-circuit detection" is set on the device, inputs IN1 and IN2 are not checked for cross-circuits.
- If the unit is parameterized to 2 x 1-channel with DIP switch 3, the sensor circuit that is not used (T1/IN1 or T2/IN2) must be bypassed.

**Note**

If the inputs IN1 and IN2 are operated with the test cycles T1 / T2 despite cross-circuit detection being deactivated, a cross-circuit between IN1 and IN2 will result in an error at the input INF, as this is also supplied with T2. If this is not desired, the inputs IN1 and IN2 must be supplied externally with 24 V DC.

**Note**

**Observe the following special points during commissioning of the 3SK1112 safety relay:**

The cascading input must be connected to terminal A1 if it is not to be used.

Monitoring of the feedback circuits is not optional.

### 6.1.4.6 Outputs

The safety relay has the following outputs:

- Q1, Q2: safety-related semiconductor outputs with dynamic monitoring, switching to P potential
- QM1: non-safety-related semiconductor signaling circuit, switching to P potential

The safety-related semiconductor outputs and the safety-related semiconductor signaling circuit are short-circuit-proof.

### 6.1.4.7 Display of the operating state

Four LEDs and one DIP switch indicate the operating state and functioning of the device:

- (1) DEVICE
- (2) OUT
- (3) IN
- (4) SF

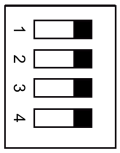
The four LEDs show the following:

- Operating mode: Diagnostics
- Configuration mode: DIP setting

For an explanation of the operating state display, see Section Diagnostics (Page 229)

### 6.1.4.8 Function setting

Table 6- 1 **DIP switch**

| Switch position: left | Schematic | DIP switch No. | Switch position: right |
|---|---|---|---|
| Autostart |  | 1 | Monitored start |
| Cross-circuit detection deactivated | | 2 | Cross-circuit detection activated |
| 2 x single-channel sensor connection | | 3 | 1 x two-channel sensor connection |
| Start-up test ON | | 4 | Start-up test OFF |

In the delivery state, all the DIP switches are in switch position: right.

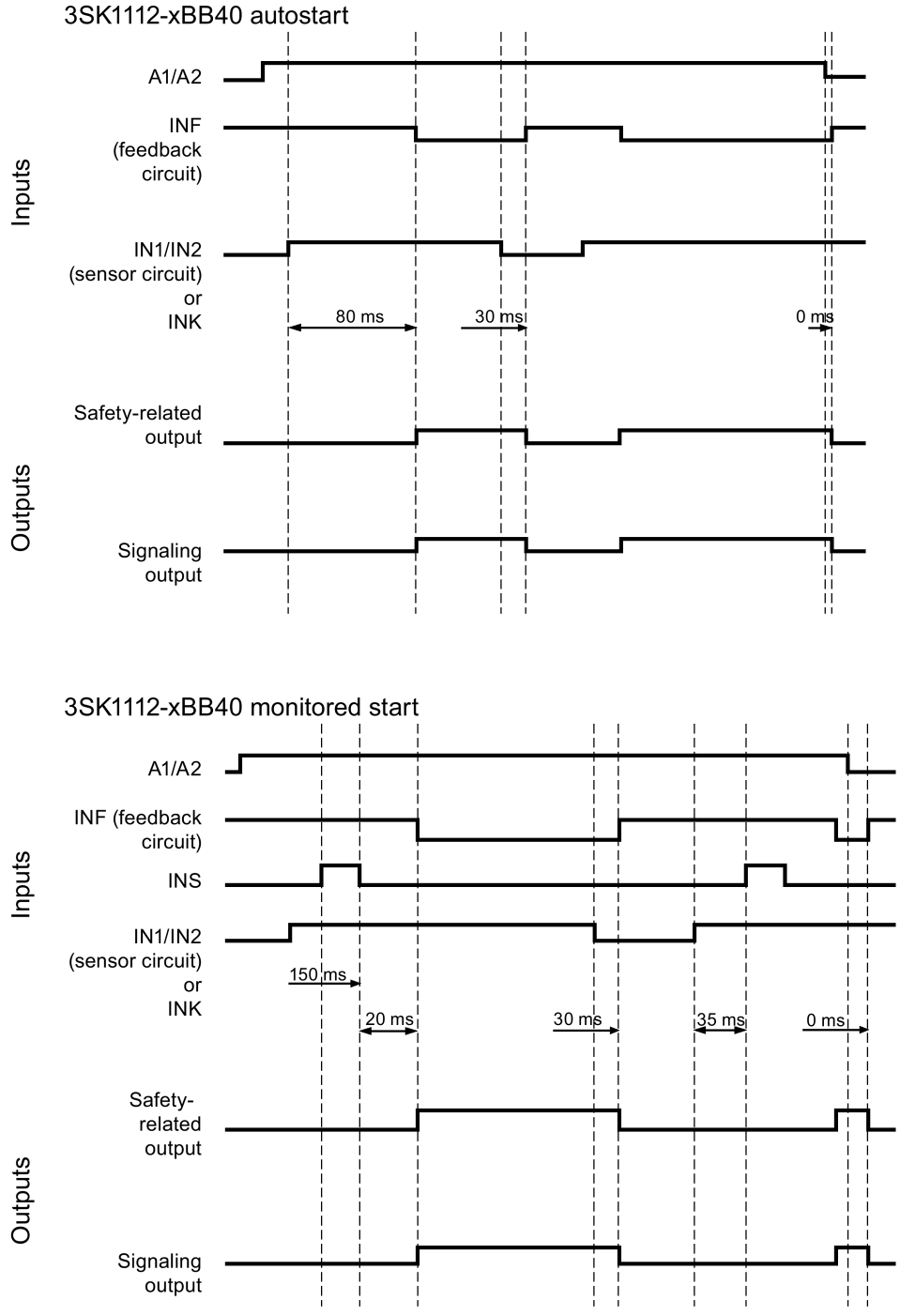
Table 6- 2 **SET/RESET button**

| Function of the SET/RESET button | Status of the indicating LEDs | Function |
|---|---|---|
| SET | "DEVICE" LED flashing yellow | • **Press key for about 1 s**<br>The parameterization is loaded |
| RESET | "DEVICE" LED red | • **Press key for about 1 s**<br>=> The device restarts without the supply voltage having to be switched off |
| | "DEVICE" LED flashing green yellow | |
| | "SF" LED red | |

**Note**

The SET/RESET pushbutton only triggers a reset for the device on which the button is pressed.

## State diagrams 3SK1112



# 6.2 3SK1 Advanced

## 6.2.1 General information

The safety relays of the Advanced device series comprise basic devices and input and output expansions. The Advanced safety relays can be connected by means of a 3ZY12 device connector.
When configuring the system, it must be ensured that input expansions are always mounted on the left, and output expansions (3SK121 or 3RM1 Failsafe motor starter) on the right of the basic unit. For control supply voltages of 110 ... 240 V AC/DC, the Advanced device series can be supplied with the necessary 24 V DC voltage from the 3SK1230 power supply (which must be positioned on the extreme left in the system).

**The focus of the Advanced relay series is on:**

- Single devices that can be flexibly parameterized
- Expandability using 3ZY12 device connector on both input and output side
- Basic units with time-delayed safety-related outputs

## 6.2.2 Applications

- EMERGENCY OFF / EMERGENCY STOP monitoring.
- Monitoring of protective doors with electromechanical position switches, solid-state position switches, or solenoid switches.
- Monitoring of contact-free protection equipment, e.g. light arrays/light barriers, or laser scanners.

The 3SK1 Advanced safety relays can be used in EMERGENCY OFF and EMERGENCY STOP devices according to IEC 60204-1 and in safety circuits according to VDE 0113-1 and/or EN 60204-1, e.g. in circuits in which controlled shutdown, STOP Category 1, is necessary.
Depending on the external circuitry, it is possible to achieve SIL 3 according to IEC 62061 or IEC 61508 and PL e (Cat. 4) according to ISO 13849-1.
The safety relays comply with EN 50156-2 (electrical equipment for furnaces and ancillary equipment).
You can use the 3SK1 Advanced safety relays to achieve two-hand control applications up to type IIIc in compliance with ISO 13851.

## 6.2.3 General device features

**Device properties:**

- 4-way DIP switch for function setting (parameterization)
- SET/RESET button
- 4 LEDs for status and function display
- 2 sensor inputs (channels 1 and 2)
- 1 input (cascading circuit)
- 1 input (START pushbutton circuit)
- NO contact/NC contact evaluation via external jumper (T1/PAR)
- Connecting interface for 3ZY12 device connectors
- Removable terminals

## 6.2.4 Function description

There is a 4-way DIP switch for function setting and 4 LEDs for status and function display on the front of the 3SK1 Advanced basic units. A SET/RESET button can be used to load function settings and to perform a device restart (reset). On commissioning, the devices runs a self-test in which the internal electronics and firmware are checked for correct functioning. All internal parts of the circuit are cyclically monitored for faults during operation. In the case of units with semiconductor outputs, they cyclically run through a light/dark test for up to 2.5 ms (dynamically) to verify their correct functioning. The safety relays can be expanded using 3ZY12 device connectors with input and output expansions.

**3SK1 Advanced basic unit time-delayed only:**

These basic units have 2 time-delayed and 2 instantaneous safety-related outputs (NO circuits) or outputs switching to P potential.

Four LEDs and one DIP switch indicate the operating state and functioning of the device:

- (1) DEVICE
- (2) OUT
- (3) IN
- (4) SF

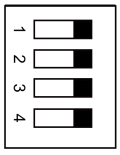
The four LEDs show the following:

- Operating mode: Diagnostics
- Configuration mode: DIP setting

For an explanation of the operating state display, see Section Diagnostics (Page 229)

## 6.2.5 Functions

Table 6- 3 **DIP switch**

| Switch position: left | Schematic | DIP switch No. | Switch position: right |
|---|---|---|---|
| Autostart |  | 1 | Monitored start |
| Cross-circuit detection deactivated | | 2 | Cross-circuit detection activated |
| 2 x single-channel sensor connection | | 3 | 1 x two-channel sensor connection |
| Start-up test ON | | 4 | Start-up test OFF |



In the delivery state, all the DIP switches are in switch position: right.

### Terminal parameterization:

Jumper on terminals T1/PAR = NO/NC evaluation

Table 6- 4 **SET/RESET button**

| Function of the SET/RESET button | Status of the indicating LEDs | Function |
|---|---|---|
| SET | "DEVICE" LED flashing yellow | • **Press key for about 1 s**<br>The parameterization is loaded |
| RESET | "DEVICE" LED red | • **Press key for about 1 s**<br>=> The device restarts without the supply voltage having to be switched off |
| | "DEVICE" LED flashing green yellow | |
| | "SF" LED red | |

**Note**

The SET/RESET pushbutton only triggers a reset for the device on which the button is pressed.

### Potentiometer for time setting

Potentiometer for infinite time setting of the time-delayed safety-related outputs on the Advanced basic units (with time-delayed safety-related outputs).

- 3SK112.-.CB41 setting range: 0.05 ... 3 s
- 3SK112.-.CB42 setting range: 0.5 ... 30 s
- 3SK112.-.CB44 setting range: 5 ... 300 s

**Note**

The delay time ends when the voltage is disconnected. The time-delayed contacts change switch position.

### Using the cascading input

The cascading input must be controlled with a 24 V DC signal. The voltage source of the 24 V DC signal must correspond to the voltage source of the safety relay's supply voltage (A1).

**Note**

**Observe the following during commissioning of 3SK1 Advanced safety relays:**

The cascading input must be connected to terminal A1 if it is not to be used.

Monitoring of the feedback circuits is not optional.

### Parameterization "2 x single-channel"

If the unit is parameterized to 2 x single-channel with DIP switch 3, the sensor circuit that is not used (T1/IN1 or T2/IN2) must be bypassed.

## 6.2.6 3SK1121 Advanced basic unit instantaneous (with relay outputs)

### 6.2.6.1 Device features

#### Article number

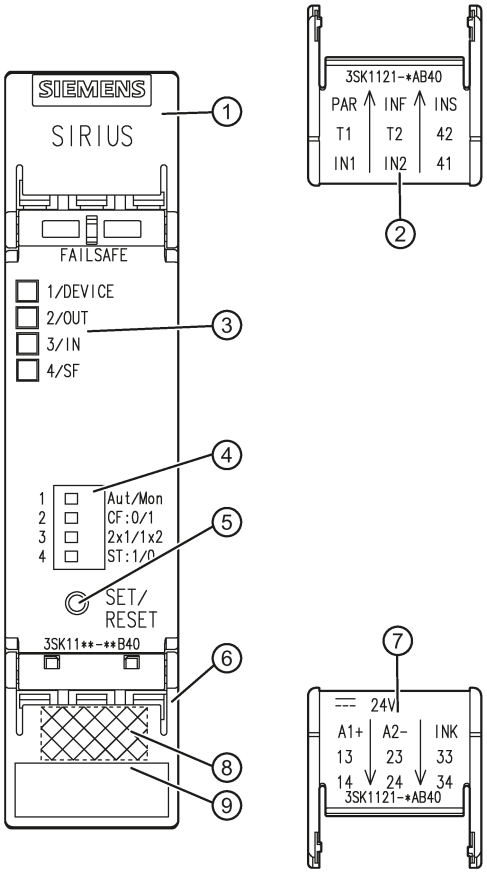
| | |
|---|---|
| 3SK1121-xAB40 | 24 V DC |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal

### 6.2.6.2 Function description

The 3SK1121 Advanced basic unit has three safety-related relay outputs and one non-safety-related signaling circuit.

### 6.2.6.3 Design

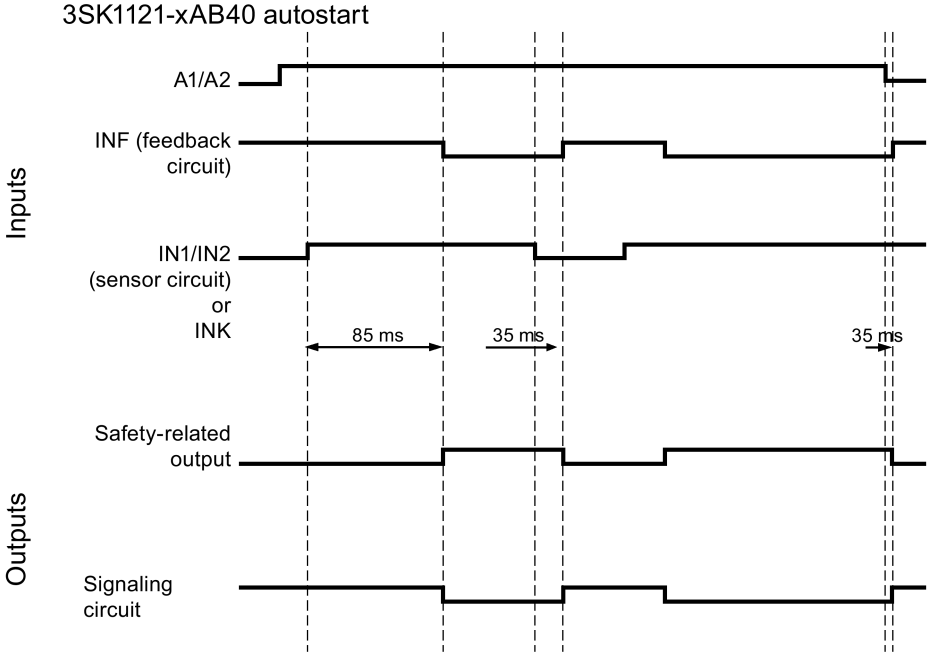


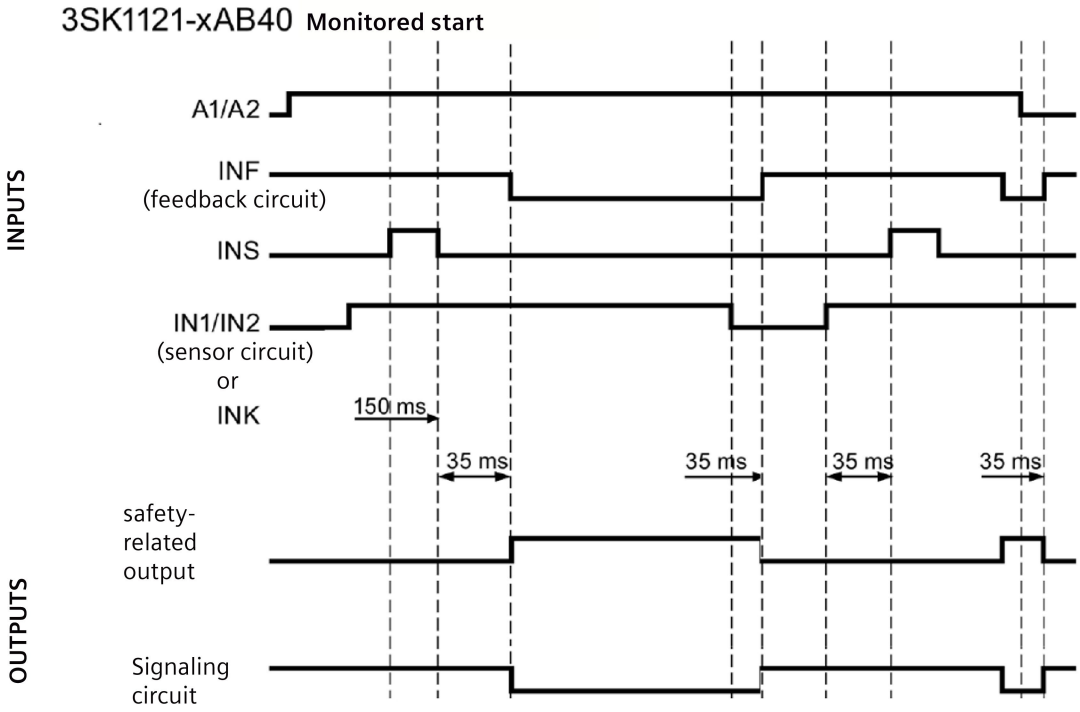

① Top cover flap
② Top cover flap; internal inscription
③ Display LEDs
④ DIP switch
⑤ SET/RESET button
⑥ Bottom cover flap
⑦ Bottom cover flap; internal inscription
⑧ DataMatrix code
⑨ Device identification label

### 6.2.6.4 Terminal assignment

| Terminal | Explanation |
|---|---|
| A1 | + |
| A2 | - |
| IN1 | Sensor channel 1 |
| IN2 | Sensor channel 2 |
| PAR | NO contact/NC contact evaluation |
| INS | START pushbutton circuit |
| INF | Feedback circuit |
| INK | Cascading circuit |
| T1 | Test output 1 (for IN1, PAR) |
| T2 | Test output 2 (for IN2, INF) |
| 13 - 14<br>23 - 24<br>33 - 34 | Safety-related outputs (NO contact, relay contact) |
| 41 - 42 | Semiconductor signaling circuits (NC contact, relay contact) |

**State diagram 3SK1121**




3SK1121-xAB40 Monitored start
INPUTS
A1/A2
INF
(feedback circuit)
INS
IN1/IN2
(sensor circuit)
or
INK
150 ms
35 ms
35 ms
35 ms
35 ms
OUTPUTS
safety-
related
output
Signaling
circuit

## 6.2.7 3SK1121 Advanced basic unit time-delayed (with relay outputs)

### 6.2.7.1 Device features

#### Article number

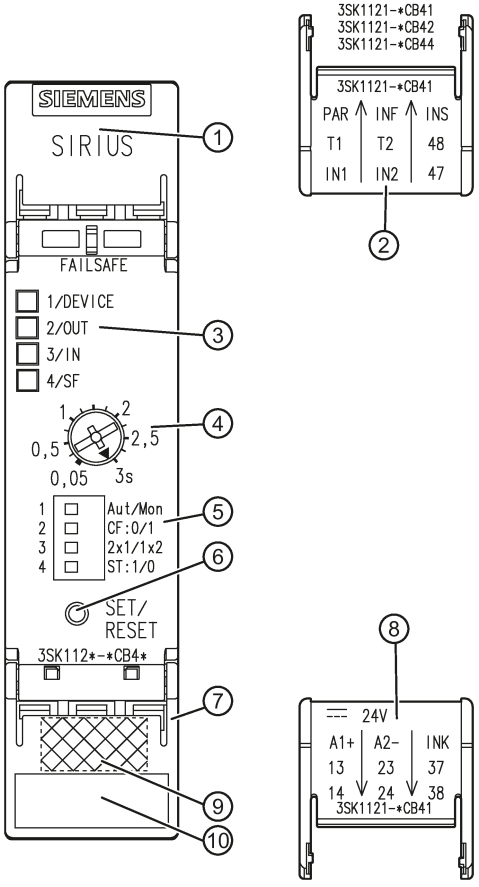
| | |
|---|---|
| 3SK1121-xCB4y | 24 V DC |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal
y = delay: 1 = 0.05 ... 3 s; 2 = 0.5 ... 30 s; 4 = 5 ... 300 s

#### Additional / alternative device characteristics

- 2 instantaneous safety-related outputs (NO contacts)
- 2 time-delayed safety-related outputs (NO contacts),
- Potentiometer for setting the delay time
- Time function: With OFF-delay

### 6.2.7.2 Design

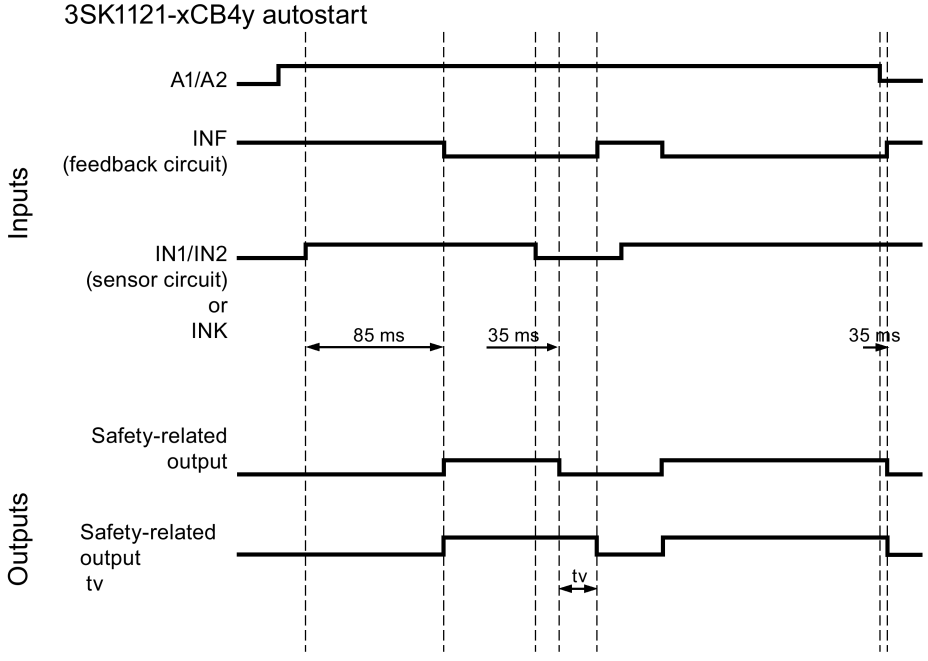


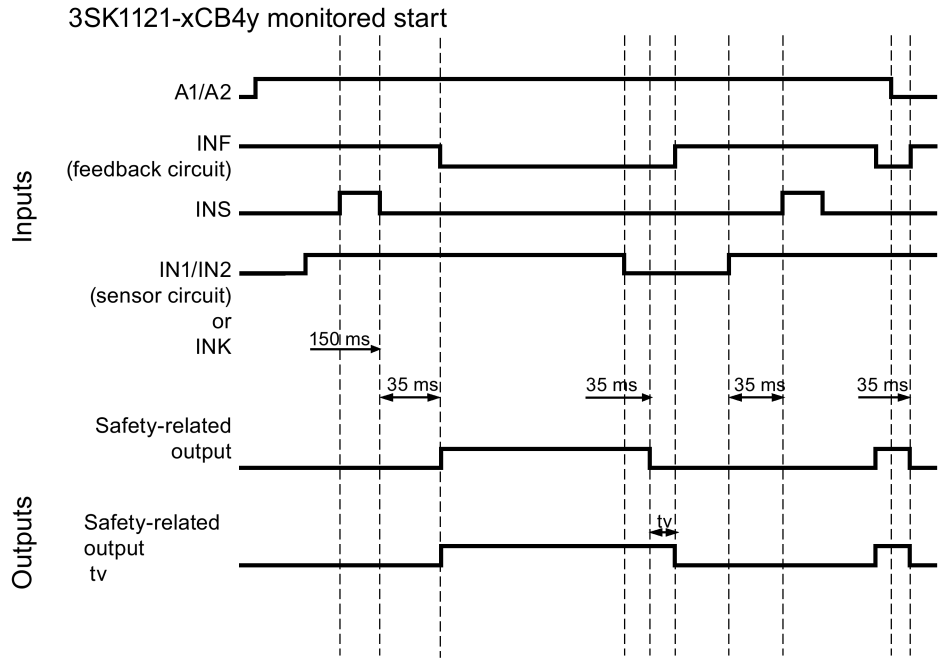

① Top cover flap
② Top cover flap; internal inscription
③ Display LEDs
④ Potentiometer for setting the delay time
⑤ DIP switch
⑥ SET/RESET button
⑦ Bottom cover flap
⑧ Bottom cover flap; internal inscription
⑨ DataMatrix code
⑩ Device identification label

### 6.2.7.3 Terminal assignment

| Terminal | Explanation |
|---|---|
| A1 | + |
| A2 | - |
| IN1 | Sensor channel 1 |
| IN2 | Sensor channel 2 |
| PAR | NO contact/NC contact evaluation |
| INS | START pushbutton circuit |
| INF | Feedback circuit |
| INK | Cascading circuit |
| T1 | Test output 1 (for IN1, PAR) |
| T2 | Test output 2 (for IN2, INF) |
| 13 - 14 | Instantaneous safety-related output 1 (NO contact, relay contact) |
| 23 - 24 | Instantaneous safety-related output 2 (NO contact, relay contact) |
| 37 - 38 | Delayed safety-related output 1 (NO contact, relay contact) |
| 47 - 48 | Delayed safety-related output 2 (NO contact, relay contact) |

### State diagrams 3SK1121-xCB4y




3SK1121-xCB4y monitored start
Inputs
A1/A2
INF
(feedback circuit)
INS
IN1/IN2
(sensor circuit)
or
INK
150 ms
35 ms
35 ms
35 ms
35 ms
Outputs
Safety-related
output
Safety-related
output
tv
tv

## 6.2.8 3SK1122 Advanced basic unit instantaneous (with semiconductor outputs)

### 6.2.8.1 Device features

#### Article number

| | |
|---|---|
| 3SK1122-xAB40 | 24 V DC |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal

#### Additional or alternative device features

- 3 safety-related semiconductor outputs
- 1 semiconductor signaling circuit

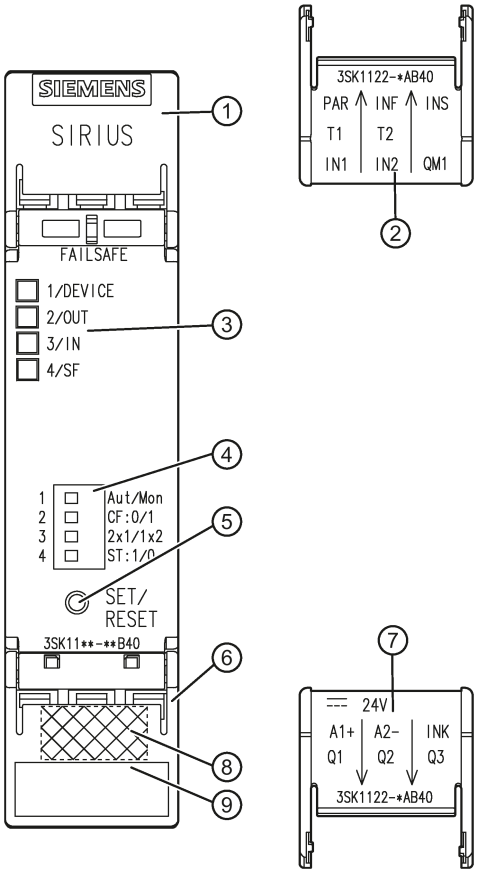
**⚠ WARNING**

**Continuous operation**

Devices up to E01/V1.0.0:
In continuous operation for PL e/Cat. 4 according to ISO 13849-1 or IEC 62061, the key safety values apply where the operation inspection interval (status change of the outputs) is ≤ 1 year.

Devices from E02/V1.1.0:
In continuous operation for PL e/Cat. 4 according to ISO 13849-1 or IEC 62061, the key safety values apply where the operation inspection interval (status change of the outputs) is ≤ 20 years.

### 6.2.8.2 Design

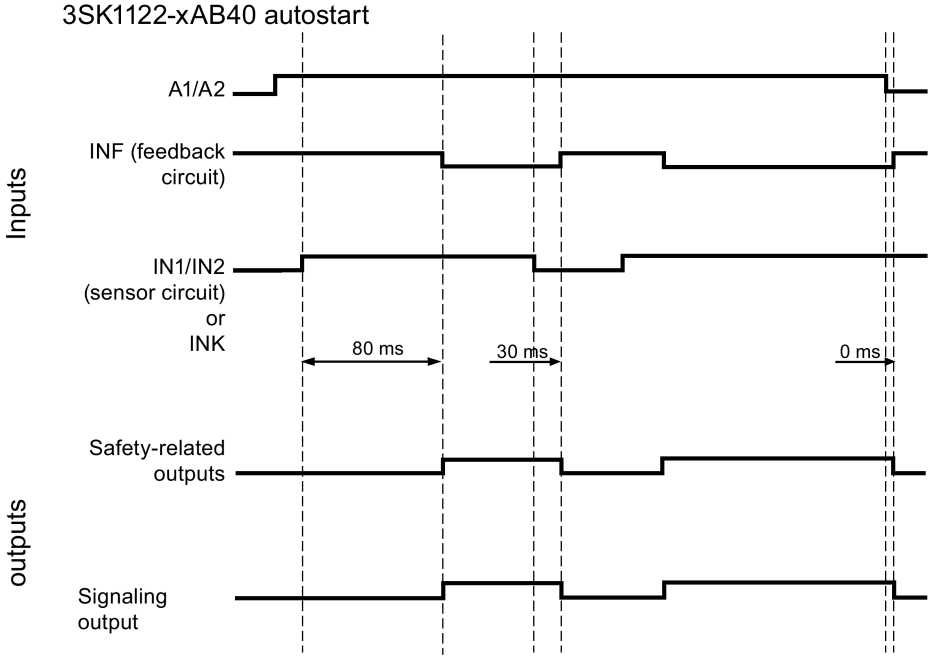


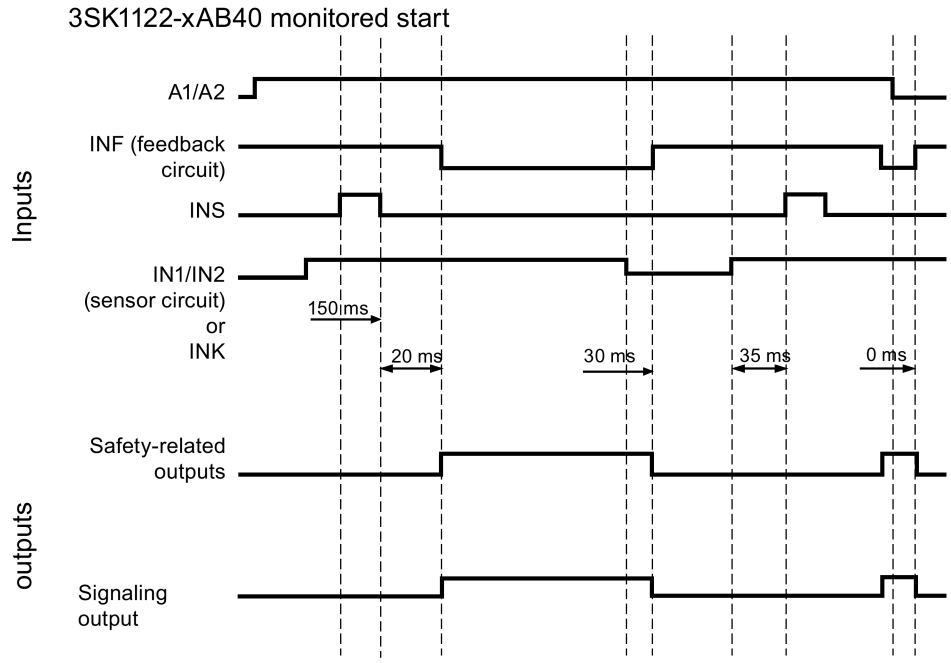

① Top cover flap
② Top cover flap; internal inscription
③ Display LEDs
④ DIP switch
⑤ SET/RESET button
⑥ Bottom cover flap
⑦ Bottom cover flap; internal inscription
⑧ DataMatrix code
⑨ Device identification label

### 6.2.8.3 Terminal assignment

| Terminal | Explanation |
|---|---|
| A1 | + |
| A2 | - |
| IN1 | Sensor channel 1 |
| IN2 | Sensor channel 2 |
| PAR | NO contact/NC contact evaluation |
| INS | START pushbutton circuit |
| INF | Feedback circuit |
| INK | Cascading circuit |
| T1 | Test output 1 (for IN1, PAR) |
| T2 | Test output 2 (for IN2, INF) |
| Q1 | Safety-related output 1<br>(switching to P potential, 24 V DC) |
| Q2 | Safety-related output 2<br>(switching to P potential, 24 V DC) |
| Q3 | Safety-related output 3<br>(switching to P potential, 24 V DC) |
| QM1 | Semiconductor signaling circuit 1<br>(switching to P potential, 24 V DC) |

### State diagrams 3SK1122-xAB40




3SK1122-xAB40 monitored start
Inputs
A1/A2
INF (feedback circuit)
INS
IN1/IN2 (sensor circuit) or INK
150 ms
20 ms
30 ms
35 ms
0 ms
outputs
Safety-related outputs
Signaling output

## 6.2.9 3SK1122 Advanced basic unit time-delayed (with semiconductor outputs)

### 6.2.9.1 Device features

#### Article number

| | |
|---|---|
| 3SK1122-xCB4y | 24 V DC |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal
y = delay: 1 = 0.05 ... 3 s; 2 = 0.5 ... 30 s; 4 = 5 ... 300 s

#### Additional / alternative device characteristics

- 2 instantaneous semiconductor outputs
- 2 time-delayed semiconductor outputs
- Potentiometer for setting the delay time
- Time function: With OFF-delay

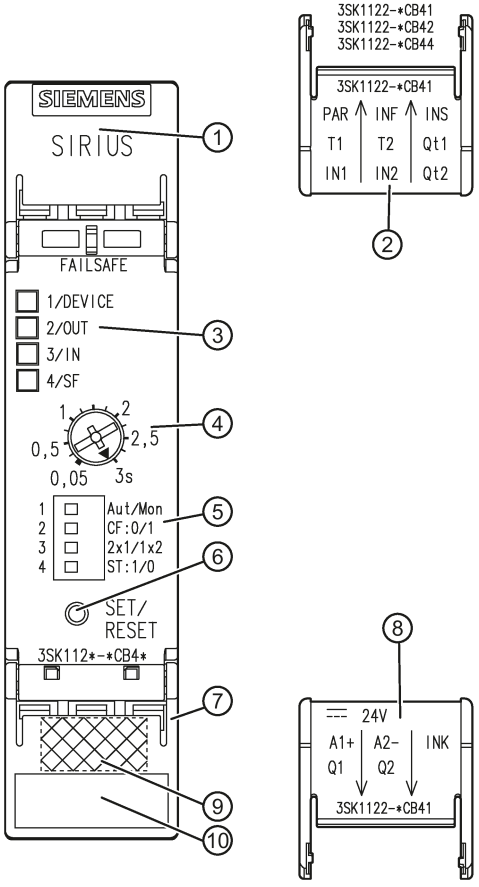
**WARNING**

**Continuous operation**

Devices up to E01/V1.0.0:
In continuous operation for PL e/Cat. 4 in accordance with ISO 13849-1 or SILCL 3 in accordance with IEC 62061, the key safety values apply where the function test interval (state change of the outputs) ≤ 1 year.

Devices from E02/V1.1.0:
In continuous operation for PL e/Cat. 4 in accordance with ISO 13849-1 or SILCL 3 in accordance with IEC 62061, the key safety values apply where the function test interval (state change of the outputs) ≤ 20 years.

### 6.2.9.2 Design

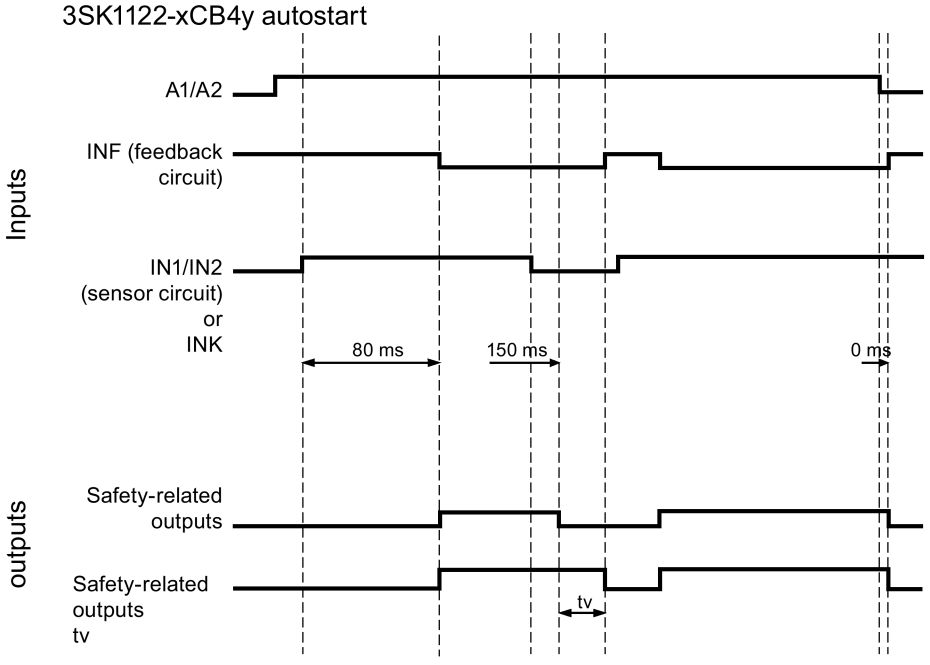


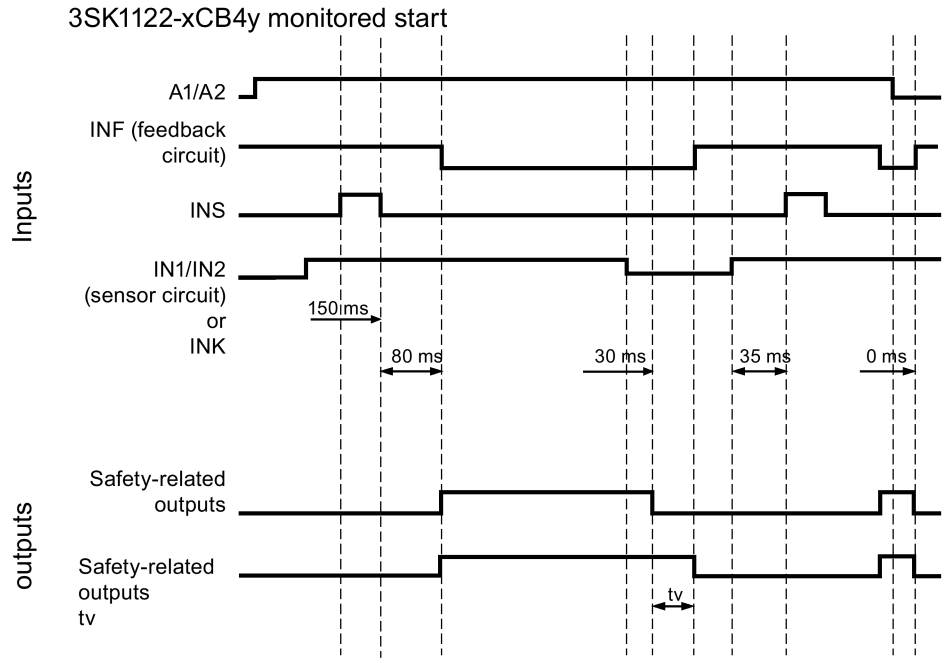

① Top cover flap
② Top cover flap; internal inscription
③ Display LEDs
④ Potentiometer for setting the delay time
⑤ DIP switch
⑥ SET/RESET button
⑦ Bottom cover flap
⑧ Bottom cover flap; internal inscription
⑨ DataMatrix code
⑩ Device identification label

### 6.2.9.3 Terminal assignment

| Terminal | Explanation |
|---|---|
| A1 | + |
| A2 | - |
| IN1 | Sensor channel 1 |
| IN2 | Sensor channel 2 |
| PAR | NO contact/NC contact evaluation |
| INS | START pushbutton circuit |
| INF | Feedback circuit |
| INK | Cascading circuit / normal switching duty |
| T1 | Test output 1 (for IN1, PAR) |
| T2 | Test output 2 (for IN2, INF) |
| Q1 | Instantaneous safety-related output 1<br>(switching to P potential, 24 V DC) |
| Q2 | Instantaneous safety-related output 2<br>(switching to P potential, 24 V DC) |
| Qt1 | Time-delayed safety-related output 1<br>(switching to P potential, 24 V DC) |
| Qt2 | Time-delayed safety-related output 2<br>(switching to P potential, 24 V DC) |

### State diagrams 3SK1122-xCB4y




3SK1122-xCB4y monitored start
Inputs
A1/A2
INF (feedback circuit)
INS
IN1/IN2 (sensor circuit) or INK
150ms
80 ms
30 ms
35 ms
0 ms
outputs
Safety-related outputs
Safety-related outputs tv
tv

## 6.2.10 3SK1120 Advanced basic unit instantaneous (with semiconductor outputs)

### 6.2.10.1 Device features

#### Article number

| | |
|---|---|
| 3SK1120-xAB40 | 24 V DC |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal

#### Additional or alternative device features

- 1 safety-related semiconductor output
- The following design variants are possible for the 3SK1120 Advanced basic unit:
  - In operation without using device connectors, up to PL e/Cat. 4 in accordance with ISO 13849-1 or SILCL 3 in accordance with IEC 62061 can be achieved for devices from E02/V 1.1.0.

    **⚠ WARNING**

    **Operation without using device connectors for E01/V1.0.0 devices**

    In operation without using device connectors, up to PL c / Cat. 2 in accordance with ISO 13849-1 or SILCL 2 in accordance with IEC 62061 can be achieved.

  - Operation using device connectors

    In operation using device connectors and using at least one output expansion (3SK1211, 3SK1213, 3RQ1) or one 3RM1 Failsafe motor starter, up to PL e/Cat. 4 according to ISO 13849-1 or SILCL 3 according to IEC 62061 can be achieved.

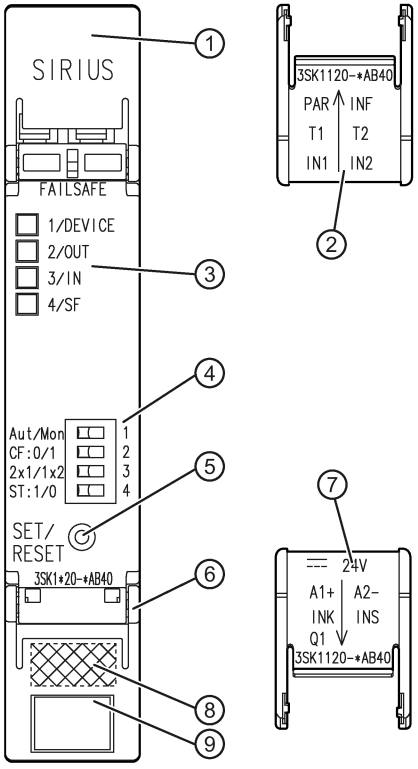
    **⚠ WARNING**

    **Continuous operation**

    Devices up to E01/V1.0.0:
    In continuous operation for PL e/Cat. 4 according to ISO 13849-1 or IEC 62061, the key safety values apply where the operation inspection interval (status change of the outputs) is ≤ 1 year.

    Devices from E02/V1.1.0:
    In continuous operation for PL e/Cat. 4 according to ISO 13849-1 or IEC 62061, the key safety values apply where the operation inspection interval (status change of the outputs) is ≤ 20 years.

### 6.2.10.2 Design



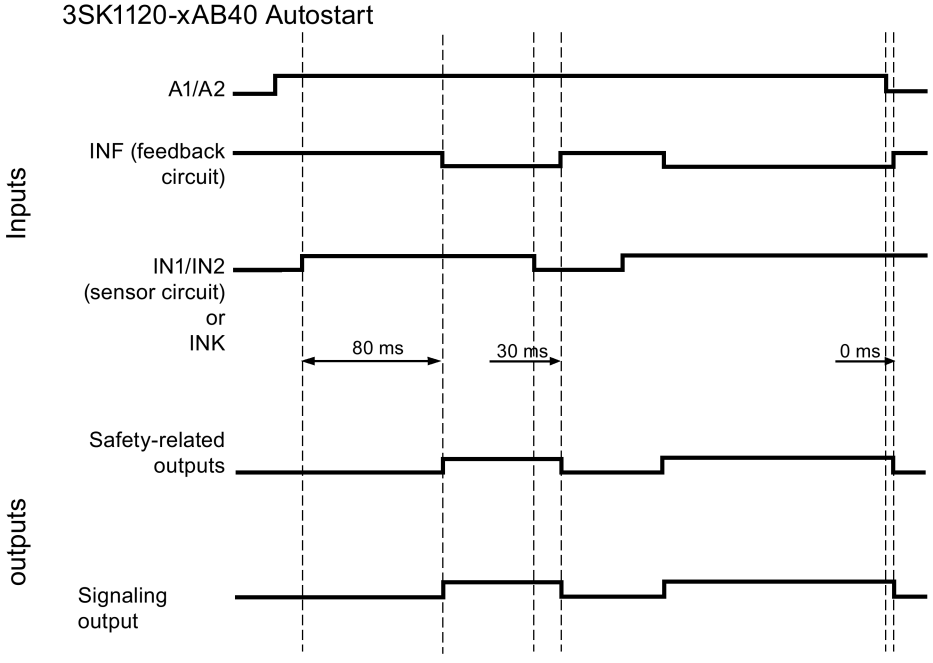

① Top cover flap
② Top cover flap; internal inscription
③ Display LEDs
④ DIP switch
⑤ SET/RESET button
⑥ Bottom cover flap
⑦ Bottom cover flap; internal inscription
⑧ DataMatrix code
⑨ Device identification label

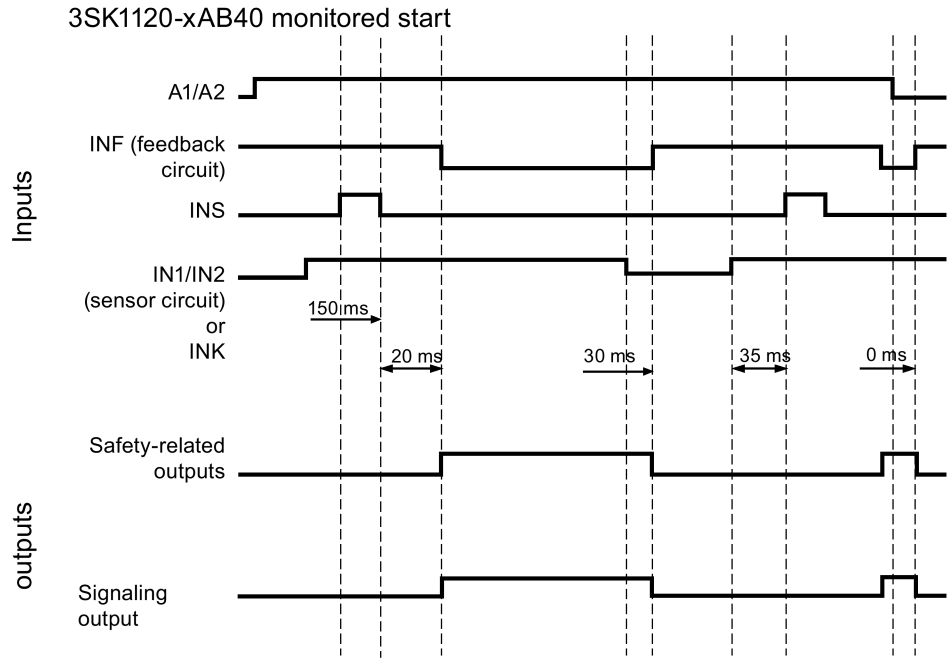
### 6.2.10.3 Terminal assignment

| Terminal | Explanation |
|---|---|
| A1 | + |
| A2 | - |
| IN1 | Sensor channel 1 |
| IN2 | Sensor channel 2 |
| PAR | NO contact/NC contact evaluation |
| INS | START pushbutton circuit |
| INF | Feedback circuit |
| INK | Cascading circuit |
| T1 | Test output 1 (for IN1, PAR) |
| T2 | Test output 2 (for IN2, INF) |
| Q1 | Safety-related output 1<br>(switching to P potential, 24 V DC) |

### 6.2.10.4 Status diagrams

#### State diagrams 3SK1120-xAB40




3SK1120-xAB40 monitored start
Inputs
A1/A2
INF (feedback circuit)
INS
IN1/IN2 (sensor circuit) or INK
150 ms
20 ms
30 ms
35 ms
0 ms
outputs
Safety-related outputs
Signaling output

# 6.3 3SK1 output expansions

## 6.3.1 Applications

The 3SK1 output expansions are used to expand the safety-related outputs. The maximum achievable Performance Level PL/Cat. according to ISO 13849-1, SIL according to IEC 62061, SIL according to IEC 62061 or IEC 61508 corresponds to the Performance Level PL and SIL of the basic unit when the external wiring (connection between basic unit and output expansion) is configured as fail-safe (e.g. basic unit and output expansion are connected using 3ZY12 device connector).
The output expansions can be controlled via the supply voltage (A1/A2) or using 3ZY12 device connectors[1)].

[1)] For 24 V DC variant only

**Note**

If expansion units are controlled via the 3ZY12 device connector, additional feeding of the control supply voltage (A1/A2) at one of the output expansions leads to a fault in the system configuration.

**Note**

**Use of the output expansions on 3ZY12 device connectors**

You can switch between instantaneous or delayed control of the basic unit using the slide switch of the output expansion (see also the chapter "3SK1 Advanced system configuration (Page 70)").

**Note**

**Using the output expansions with conventional wiring**

The slide switch has **no** function here.

If you require Stop category 1 outputs for the output expansion, terminals A1/A2 of the output expansion must be connected to outputs 38 or 48 on 3SK1 basic units with relay outputs or to Q1t/Q2t (in the case of 3SK1 with semiconductor outputs).

## 6.3.2 Function description

The operating state of the 3SK1 output expansions is displayed on the DEVICE LED.

The 3SK1211 output expansions (4RO) have four safety-related outputs as NO circuits, and the 3SK1213 output expansions (3RO) have three. They each have one positively-driven NC circuit. The output expansions can be activated via any output of the basic unit via (A1). The NC circuit 51/52 of 3SK1211 (4RO) or 41/42 of 3SK1213 (3RO) is used for monitoring the output expansions.

In the 24 V DC variants, the expansion units can be activated and evaluated via the 3ZY12 device connectors.

## 6.3.3 Display of the operating state

### Display of the operating state

The operating state and functioning of the device are indicated by an LED:

- (1) DEVICE

### Operating states

| LED | State | Meaning |
|---|---|---|
| **DEVICE** | **Control supply voltage** | **Safety-related outputs** |
| OFF | OFF | Open |
| Green | ON | Closed |

## 6.3.4 Function setting

### Setting the activation (slide switch only for 24 V variants)

The interface input for activating the output expansion can be selected using a slide switch on the front of the device.

| Slide switch | Interface input |
|---|---|
| Top | Outputs switch with time delay (as in basic unit) |
| Bottom | Outputs switch instantaneously |

When using an instantaneous basic unit, the slide switch must be in the instantaneous position (bottom).

## 6.3.5 Output expansion 3SK1211

### 6.3.5.1 Device features

#### Article number

| | |
|---|---|
| 3SK1211-xBB00 | 24 V AC |
| 3SK1211-xBB40 | 24 V DC |
| 3SK1211-xBW20 | 110 ... 240 V AC / DC (wide-range supply) |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal

#### Supply:

**24 V AC:**

- Control via 24 V transformer is possible

**24 V DC:**

- An SELV / PELV power supply must be used for the infeed

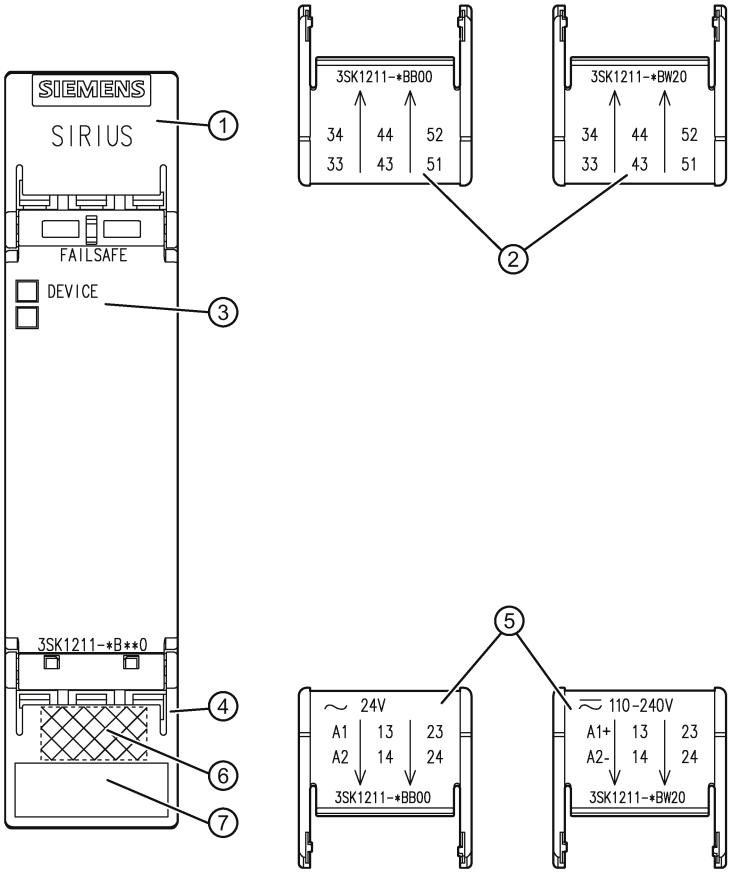
**110 ... 240 V AC/DC:**

- Direct line supply connection L/N

#### Device properties:

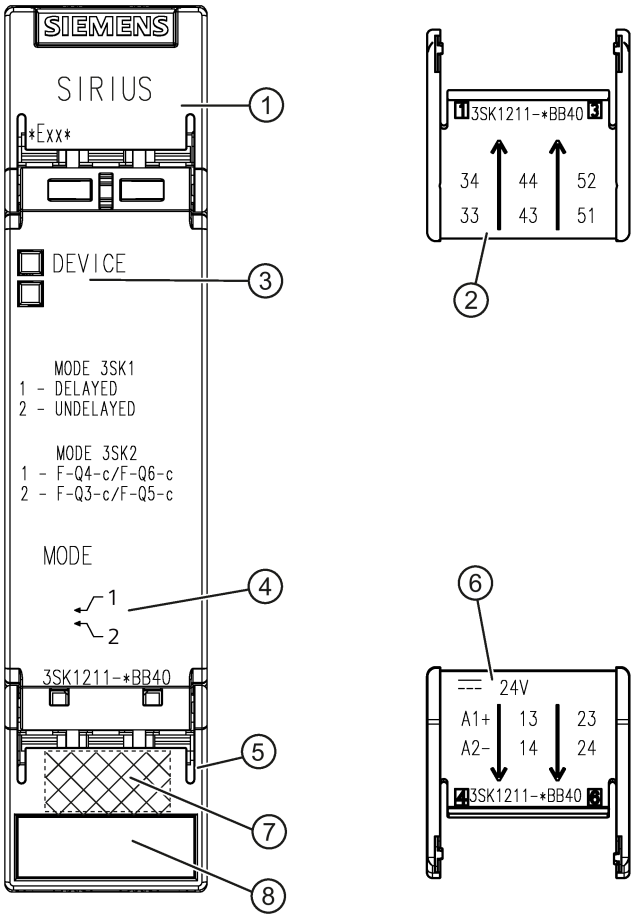
- For 24 V DC variant only: Slide switch for selecting the control type (time-delayed / instantaneous)
- 1 LED for status display
- 4 safety-related outputs (NO contacts),
- 1 NC circuit as feedback contact for the 3SK1211 output expansion to the upstream basic unit
- 3ZY12 device connectors.
- Enclosure width 22.5 mm
- Removable terminals

### 6.3.5.2 Design of 3SK1211-.B..0




① Top cover flap
② Top cover flap; internal inscription
③ Display LEDs
④ Bottom cover flap
⑤ Bottom cover flap; internal inscription
⑥ DataMatrix code
⑦ Device identification label

### 6.3.5.3 Design of 3SK1211-.BB40




① Top cover flap
② Top cover flap; internal inscription
③ Display LEDs
④ Slide switch
⑤ Bottom cover flap
⑥ Bottom cover flap; internal inscription
⑦ DataMatrix code
⑧ Device identification label

#### 6.3.5.4 Terminal assignment

| Terminal | Explanation |
|---|---|
| A1 | + (L+ for 3SK1211-.BW20) |
| A2 | - (N- for 3SK1211-.BW20) |
| 13 - 14 | Safety-related output 1 (NO contact, relay contact) |
| 23 - 24 | Safety-related output 2 (NO contact, relay contact) |
| 33 - 34 | Safety-related output 3 (NO contact, relay contact) |
| 43 - 44 | Safety-related output 4 (NO contact, relay contact) |
| 51 - 52 | NC circuit as feedback contact (NC, relay contact) |

### 6.3.6 Output expansion 3SK1213

#### 6.3.6.1 Device features

**Article number**

| | |
|---|---|
| 3SK1213-xAB40 | 24 V DC |
| 3SK1213-xAJ20 | 115 V AC |
| 3SK1213-xAL20 | 230 V AC |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal

**Supply:**

**24 V DC:**

- An SELV / PELV power supply must be used for the infeed

**115 V AC and 230 V AC**

- Direct line supply connection L/N

**Device properties:**

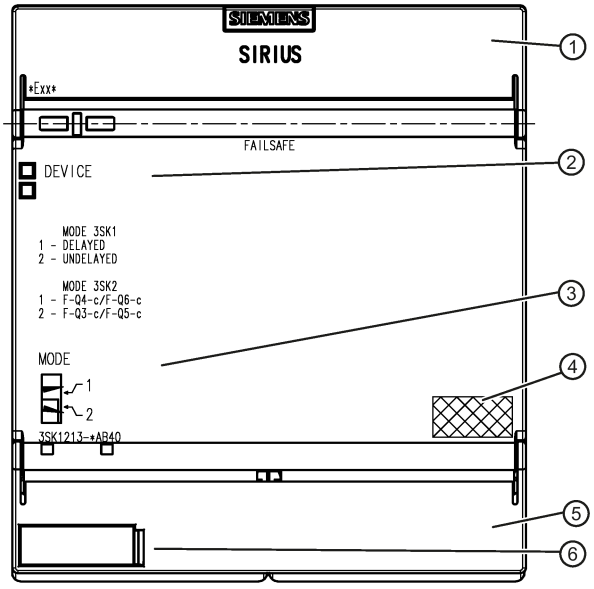
- For 24 V DC variant only: Slide switch for selecting the control type (time-delayed / instantaneous)
- 1 LED for status display
- 3 safety-related outputs (NO contacts),
- 1 NC circuit as feedback contact for the 3SK1213 output expansion for the upstream basic unit
- 3ZY12 device connectors.

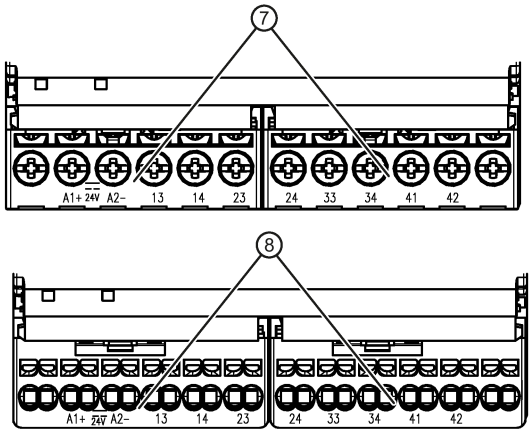
- Enclosure width 90 mm
- Removable terminals

### Using 3ZY12 device connectors

The 3SK1213 output expansion must always be terminated with a device termination connector set for the 3SK1 safety relay, size > 45 mm (3ZY1212-0FA01). Expansion on the right-hand side is then no longer possible.

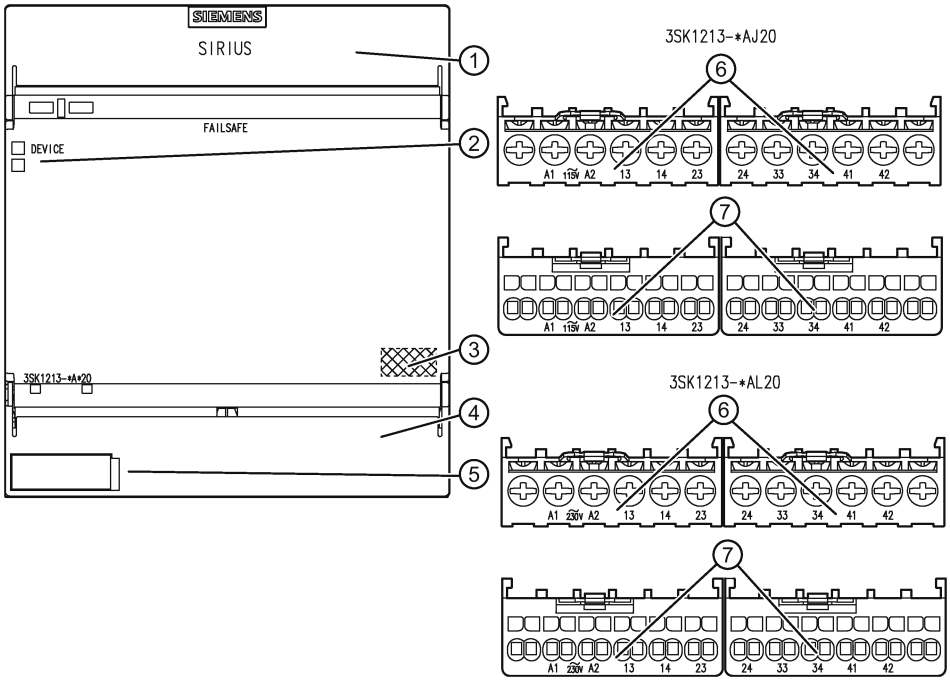
## 6.3.6.2 Design of 3SK1213-.AB40




① Top cover flap
② Display LEDs
③ Slide switch
④ DataMatrix code
⑤ Bottom cover flap
⑥ Device identification label
⑦ Screw-type terminals
⑧ Spring-loaded terminal

### 6.3.6.3 Design of 3SK1213-.A.20




① Top cover flap
② Display LEDs
③ DataMatrix code
④ Bottom cover flap
⑤ Device identification label
⑥ Screw-type terminals
⑦ Spring-loaded terminal

### 6.3.6.4 Terminal assignment

| Terminal | Description |
|---|---|
| A1 | + |
| A2 | - |
| 13 - 14 | Safety-related output 1 (NO contact, relay contact) |
| 23 - 24 | Safety-related output 2 (NO contact, relay contact) |
| 33 - 34 | Safety-related output 3 (NO contact, relay contact) |
| 41 - 42 | NC circuit as feedback contact (NC, relay contact) |

### 6.3.7 3RM1 Failsafe motor starters

3RM1 Failsafe motor starters can be used wherever combinations of contactors and overload relays were previously used.

3RM1 Failsafe motor starters are used in the following areas, for example:

- Conveyor technology
- Logistics systems
- Production machines
- Machine tools
- Small elevators

Thanks to the additional functionality of safety-related shutdown, the 3RM11 Failsafe and 3RM13 Failsafe motor starter variants are ideally suited to safety-related applications in the 3SK1 system up to SIL 3 according to IEC 62061 and PL e/Cat. 4 according to ISO 13849-1.

The maximum achievable Performance Level PL/Cat. according to ISO 13849-1, SIL according to IEC 62061 or according to IEC 61508 corresponds to the Performance Level PL and SIL of the 3SK1 basic unit when the external wiring (connection between basic unit and output expansion) is configured as fail-safe (e.g. basic unit and 3RM1 Failsafe motor starter are connected using 3ZY12 device connector).

3RM1 Failsafe motor starters can be controlled via the supply voltage (A1/A2) or via 3ZY12 device connectors (24 V DC variant only).

**Note**

If expansion units are controlled via the 3ZY12 device connector, additional feeding of the control supply voltage (A1/A2) at one of the output expansions leads to a fault in the system configuration.

**Note**

In the configuration with a 3SK1 Advanced basic unit on a 3ZY12 device connector, 3RM1 Failsafe motor starters can only be controlled by the instantaneous enable signal of the 3SK1 unit. If control of the 3RM1 Failsafe motor starters by means of the time-delayed output is desired, this can only be done by wiring the time-delayed safety-related output of the 3SK1 basic unit.

More detailed technical information is available in the SIRIUS 3RM1 motor starters (http://support.automation.siemens.com/WW/view/en/66295730) manual on the Internet.

## 6.4 3RQ1 output expansion

The 3RQ1 output expansions are used to expand the safety-related outputs. The maximum achievable Performance Level PL/Cat. according to ISO 13849-1, SIL according to IEC 62061 or according to IEC 61508 is SIL 2 / PL, or for 3RQ12. SIL 3 / PL e. To achieve this, you must realize the external wiring, i.e. the connection between the basic unit and 3RQ1 output expansion, in a fail-safe manner, e.g. with the 3ZY12 device connector.
With the 3RQ10., SIL 2 in accordance with IEC 62061 can only be achieved by means of additional feedback circuit wiring of the 3RQ1 normally closed contact in the safety circuit of the 3SK1 basic unit.

The 3RQ12. output expansions are certified up to SIL 3 / PL e in accordance with IEC 62061 / ISO 13849. With these variants, the feedback circuit is situated on the device connector, that is to say, additional wiring of the feedback circuit is not necessary.

**Note**

If expansion units are controlled via the 3ZY12 device connector, additional feeding of the control supply voltage (A1/A2) at one of the output expansions leads to a fault in the system configuration.

**Note**

**Using the output expansions with conventional wiring**

If you require Stop category 1 outputs for the output expansion, terminals A1/A2 of the output expansion must be connected to outputs 38 or 48 on 3SK1 basic units with relay outputs or to Q1t/Q2t (in the case of 3SK1 with semiconductor outputs).

**WARNING**

**Ensuring electrical safety and safety function**

The normally closed contact of 3RQ12. is designed for a voltage of 24 V DC. If higher voltages occur, electrical safety cannot be ensured due to the voltage clearance distances. If the 3RQ12. is integrated in a system with a device connector, the feedback circuit is routed via the device connector. Connection of external voltage is not necessary and not permitted. Connecting external voltage can bypass the safety function.

More detailed technical information is available in the Force-guided SIRIUS 3RQ1 coupling relays (https://support.industry.siemens.com/cs/us/en/view/109996284) manual.

# 6.5 3SK1 input expansions

## 6.5.1 Input expansion 3SK1220

### 6.5.1.1 Device features

**Article number**

| | |
|---|---|
| 3SK1220-xAB40 | 24 V DC |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal

**Device properties:**

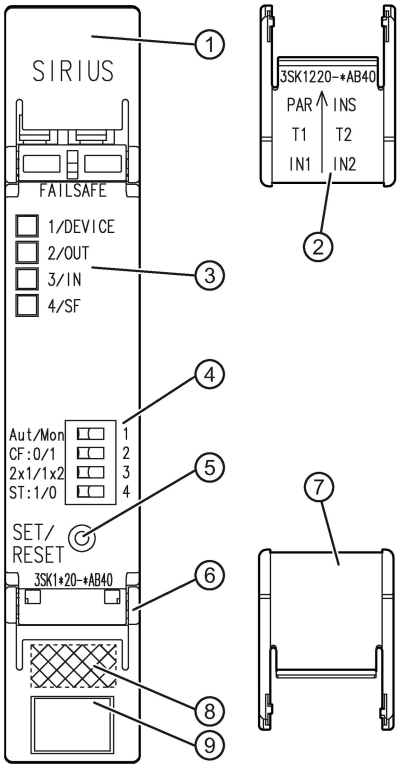
- 4-way DIP switch for function setting (parameterization)
- NO contact/NC contact evaluation via external jumper
- SET/RESET button
- 4 LEDs for status and function display
- 1 input (ON button circuit)
- 2 test outputs
- Enclosure width 17.5 mm
- Removable terminals
- Mounting exclusively on 3ZY12 device connectors

### 6.5.1.2 Applications

The number of sensor inputs for a basic unit can be expanded using input expansions. Input expansions must always be mounted to the left of a basic unit.

The input expansion 3SK1220 is certified to SIL 3/PL e.
The SILCL/PL achieved by the overall system depends on the external connection of sensors and actuators.
The input expansion 3SK1220 is supplied via the 3ZY12 device connectors.

### 6.5.1.3 Design




① Top cover flap
② Top cover flap; internal inscription
③ Display LEDs
④ DIP switch
⑤ SET/RESET button
⑥ Bottom cover flap
⑦ Bottom cover flap; internal inscription
⑧ DataMatrix code
⑨ Device identification label

### 6.5.1.4 Terminal assignment

| Terminal | Explanation |
|---|---|
| IN1 | Sensor channel 1 |
| IN2 | Sensor channel 2 |
| PAR | NO contact/NC contact evaluation |
| INS | ON button circuit |
| T1 | Test output 1 (for IN1, PAR) |
| T2 | Test output 2 (for IN2, INF) |

#### 6.5.1.5 Display of the operating state

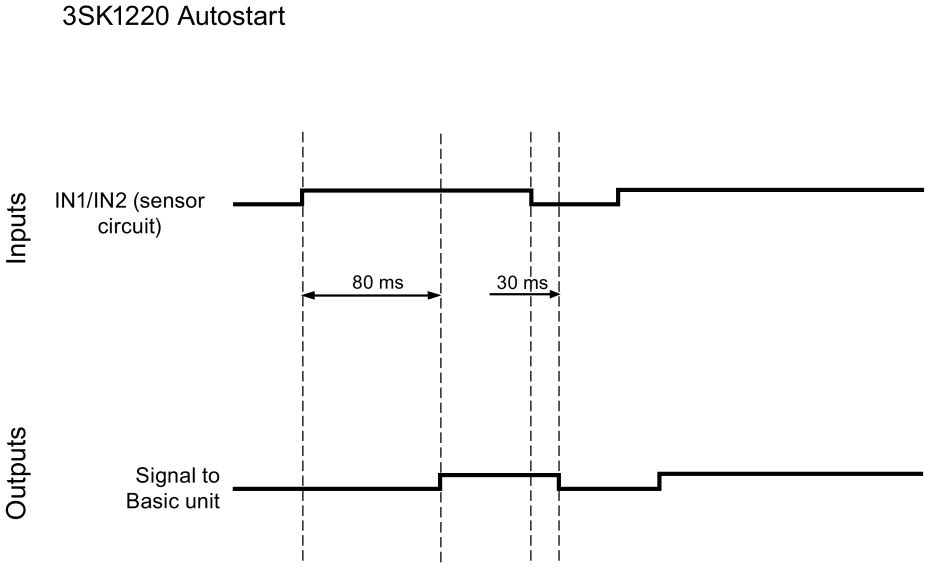
You can find additional information on this under "Advanced" in the Chapter Function description (Page 100).

#### 6.5.1.6 Function setting

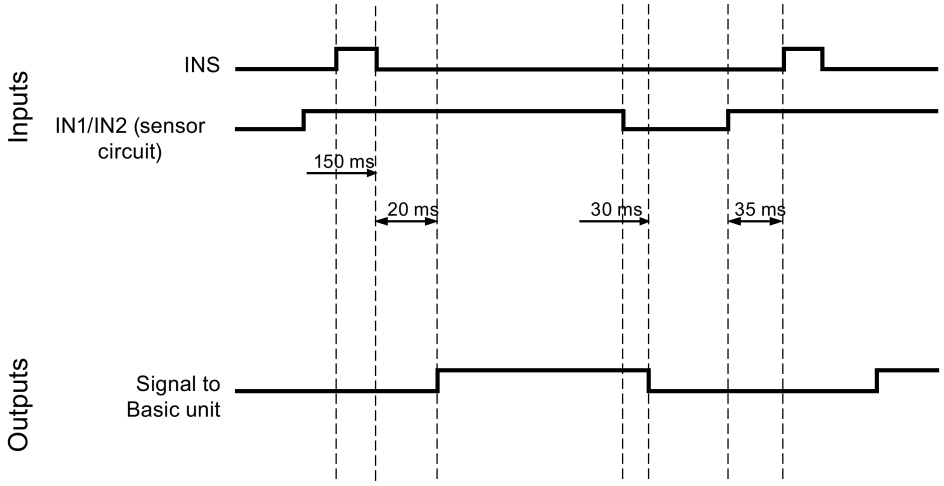
### DIP switch settings

You can find additional information on this under "Advanced" in the Chapter Functions (Page 101).

### State diagrams 3SK1220



3SK1220 Monitored start



## 6.5.2 Power supply 3SK1230

### 6.5.2.1 Device features

#### Article number

| | |
|---|---|
| 3SK1230-xAW20 | 110 ... 240 V AC/DC |

x = 1: Screw-type terminal; x = 2: Spring-loaded (push-in) terminal

#### Device properties:

- Wide-range input: 110 ... 240 V AC/DC
- Rated output voltage: 24 V DC
- Rated output current: 0.6 A
- 1 LED for status display
- Connection interface
- Enclosure width 22.5 mm
- Removable terminals

**Note**

Due to the output current of the 3SK1230 power supply (= 0.6 A), the use of 3SK1 basic units with **semiconductor outputs** is only possible to a limited extent. The output current of all semiconductor outputs can be **up to 0.4 A** here (depending on the system configuration).

### 6.5.2.2 Applications

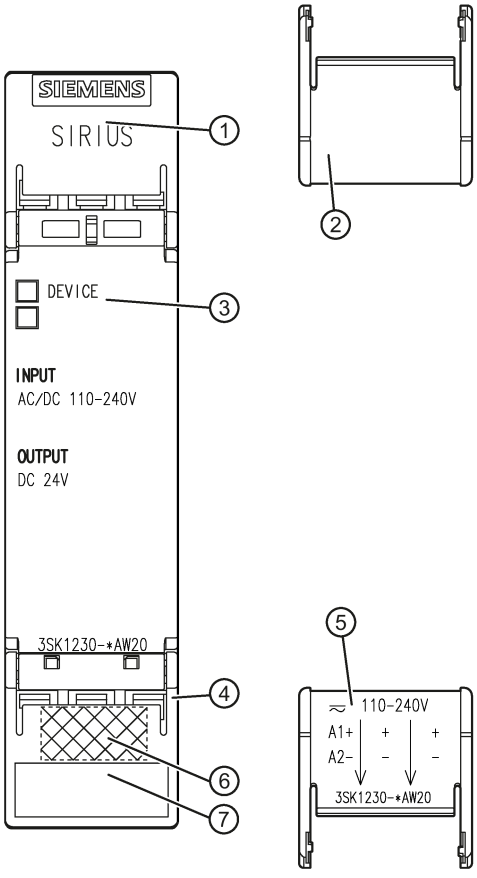
The 3SK1230 power supply generates a stabilized output voltage of 24 V DC from 110 ... 240 V AC/DC. The 3SK1230 power supply can supply the 3SK1 Advanced device series with 24 V DC via 3ZY12 device connectors or via the +/– output terminals.

The "INS" START pushbutton input of the 3SK1 device series must be supplied from the 3SK1230 power supply.

| **NOTICE** |
|---|
| The 3SK1230 power supply is only suitable for use in the 3SK1 system. Use as a power supply for other devices is not permitted. |

| **NOTICE** |
| --- |
| Two power supplies in parallel are not permissible. Only one 3SK1230 power supply is permitted in each system configuration. |

### 6.5.2.3 Design




① Top cover flap
② Top cover flap; internal inscription
③ Display LEDs
④ Bottom cover flap
⑤ Bottom cover flap; internal inscription
⑥ DataMatrix code
⑦ Device identification label

### 6.5.2.4 Terminal assignment

| Terminal | Explanation |
|---|---|
| A1 | L+ |
| A2 | N- |
| + | +24 V DC |
| + | +24 V DC |
| - | - Mass |
| - | - Mass |

### 6.5.2.5 Display of the operating state

#### Display of the operating state

The operating state and functioning of the device are indicated by an LED:

- (1) DEVICE

#### Operating states

| LED | State | Meaning |
|---|---|---|
| DEVICE | Green | Output voltage OK |
| | Flashing | Overload |
| | OFF | No voltage |

# Mounting

# 7

## 7.1 Warning notices

**⚠ WARNING**

**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**

Hazardous electrical voltages can cause electric shock, burns and damage.

- Turn off and lock out all power supplying the system and device before working on the device.
- To ensure protection against the hazard of electric shock when the terminal cover is open, screw in all terminal screws that are not needed to clamp conductors.
- Close the terminal covers and always keep them closed during operation.

**⚠ DANGER**

**Hazardous voltage. Can cause death or serious injury**

To ensure touch protection and degree of protection IP20, screw in all screws which are not used for conductor clamping and close the terminal covers.

## 7.2 Mounting the devices on a DIN rail

### Requirements

- A horizontal 35 mm wide mounting rail in accordance with DIN EN 60715 has been properly secured at the installation location.
- Clearances: The distance to be maintained to the side with side-by-side mounting is 0 mm. The distance to be maintained to the side from grounded parts is 5 mm.

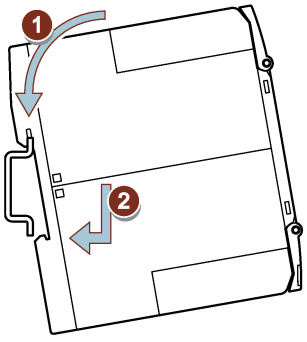
**Note**

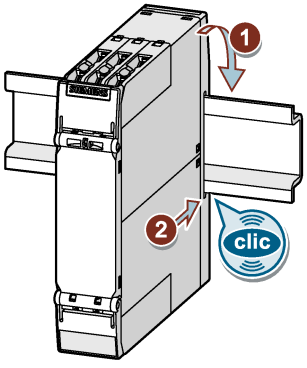
Under harsh conditions such as strong vibrations or assembly on a vertical DIN rail it is recommended to use an end retainer both at the beginning and at the end of the device group.

For example, 8WA1808 end retainers can be used for this purpose.

### Procedure

The figures show 22.5 mm devices. The 17.5 mm and 90 mm devices are mounted correspondingly.




1. Place the back of the device onto the upper edge of the standard mounting rail.
2. Press the lower half of the device against the DIN rail until the device engages.

## See also

Technical data (Page 235)

## 7.3 Removing the devices from a DIN rail

**⚠ WARNING**

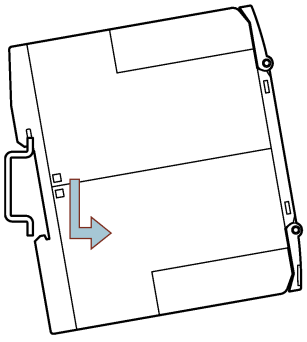
**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**

Before starting work, therefore, disconnect the system and devices from the power supply.

### Requirements

- The terminals have been removed or disconnected.

### Procedure



1. Press the device downwards.
2. Pull the lower half of the device away from the standard mounting rail.
3. Lift the device from the upper edge of the standard mounting rail.

# 7.4 Mounting 22.5 mm/17.5 mm devices with device connectors on a DIN rail

## Requirements

- A horizontal 35 mm wide mounting rail in accordance with DIN EN 60715 has been properly secured at the installation location.
- Clearances: The distance to be maintained to the side with side-by-side mounting is 0 mm. The distance to be maintained to the side from grounded parts is 5 mm.
- Please observe the information about the mounting position in the technical data (Page 235).
- Device connectors:
  Refer to the accessories list for the relevant article number in the chapter "Accessories (Page 293)".

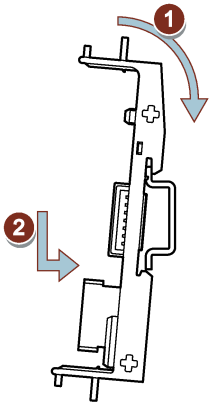
**Note**

Under harsh conditions such as strong vibrations or assembly on a vertical DIN rail it is recommended to use an end retainer both at the beginning and at the end of the device group.

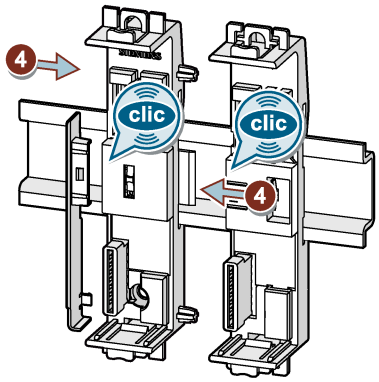
For example, 8WA1808 end retainers can be used for this purpose.

## Procedure

The figures show 22.5 mm devices. The 17.5 mm devices are mounted correspondingly.

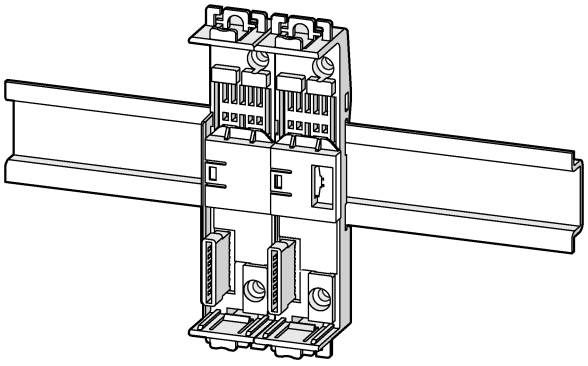


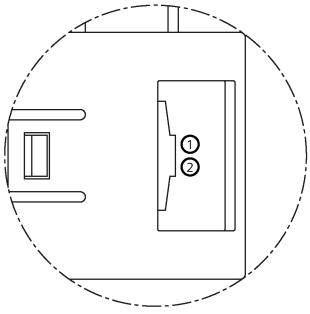

1. Place the back of the device connector on the upper edge of the standard mounting rail.
2. Press the lower half of the device connector against the standard mounting rail until the connector engages. Repeat the procedure with all the required device connectors.




4. Push the device connectors together until they engage.

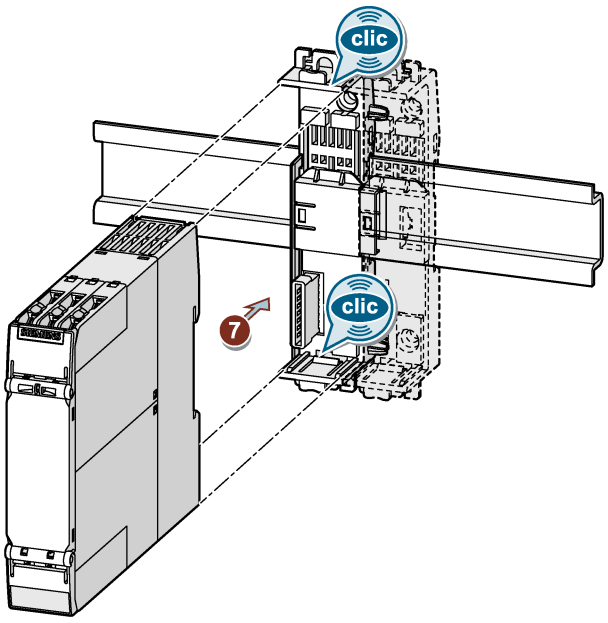
5. Mount the cover on the left of the first device connector. The cover is included in the scope of supply of the device terminator.



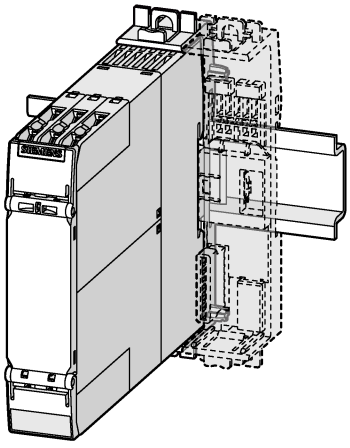



6. Set the slide switch in the device termination connector for the 3SK1 safety relay to the following positions:

- Below 3SK1211 output expansion
  Position ① (top; i.e. closed)
- Below 3SK1 basic device
  Position ② (bottom; i.e. open)




7. Mount the device on the device connector.



8. Mount all the devices required for the system configuration in accordance with the respective installation guidelines on the device connectors.

## 7.5 Removing 22.5 mm/17.5 mm devices with device connectors from a standard mounting rail

**WARNING**

**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**

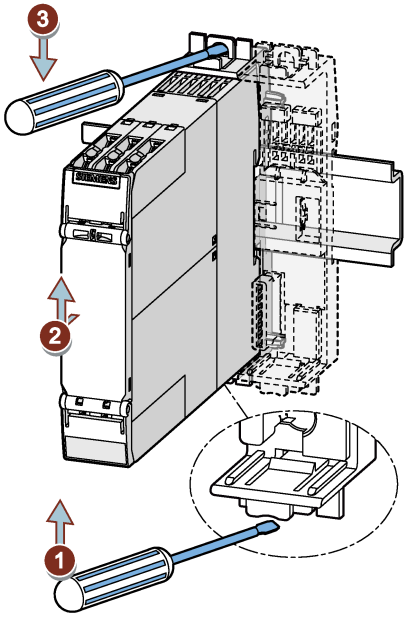
Before starting work, therefore, disconnect the system and devices from the power supply.

### Requirements

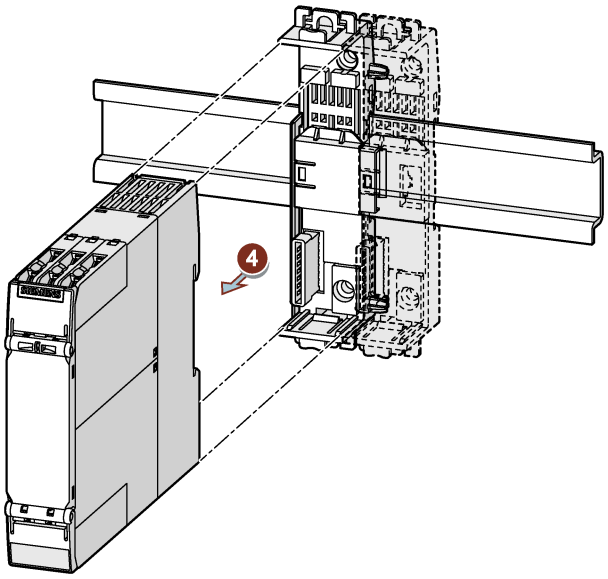
- The terminals have been removed or disconnected.

### Procedure

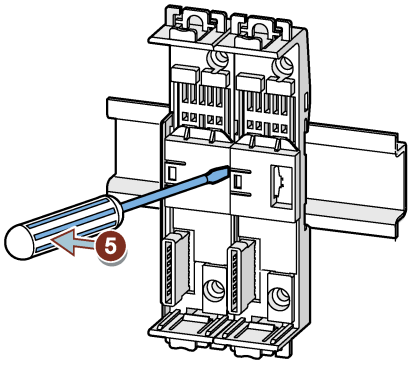
The figures show 22.5 mm devices. The 17.5 mm devices are removed correspondingly.



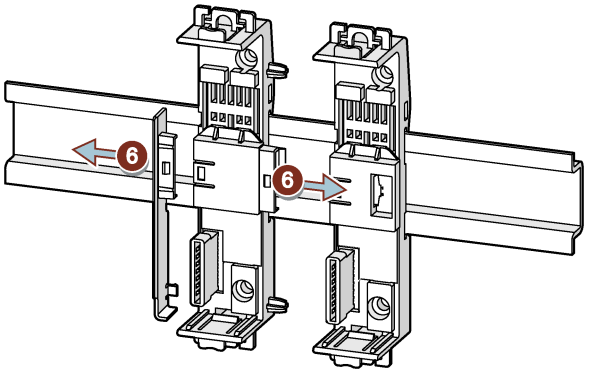

1. Unlock the device using a screwdriver.
2. Pull the lower half of the device away from the device connector.
3. Unlock the device using a screwdriver.



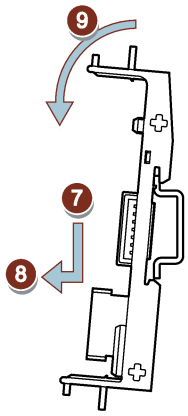

4. Pull the device away from the device connector.




5. Separate the device connectors using a screwdriver.




6. Remove the cover.



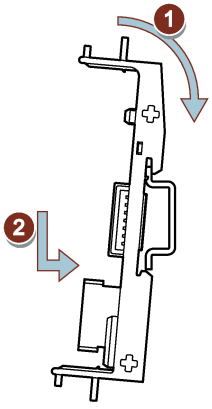

7. Press the device connector down.
8. Pull the lower half of the device connector away from the standard mounting rail.
9. Lift the device connector from the upper edge of the standard mounting rail.

## 7.6 Mounting 90 mm devices with device connectors on a standard mounting rail

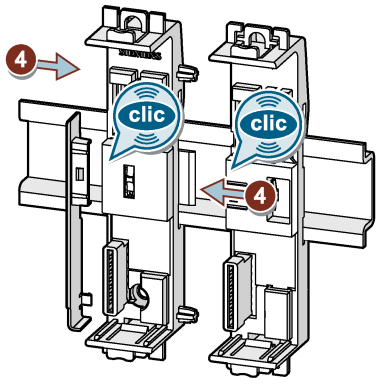
### Requirements

- A horizontal 35 mm wide mounting rail in accordance with DIN EN 60715 has been properly secured at the installation location.
- Clearances: The distance to be maintained to the side with side-by-side mounting is 0 mm. The distance to be maintained to the side from grounded parts is 5 mm.
- Please observe the information about the mounting position in the technical data (Page 235).
- Use the device termination connector set for 3SK1 safety relays, > 45 mm wide. Refer to the accessories list for the relevant article number in the chapter "Accessories (Page 293)".
- Please observe the obligatory mounting rules in the chapter: "3SK1 Advanced system configuration (Page 70)".

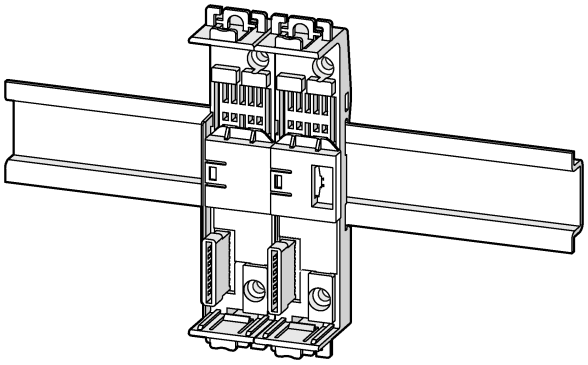
### Procedure



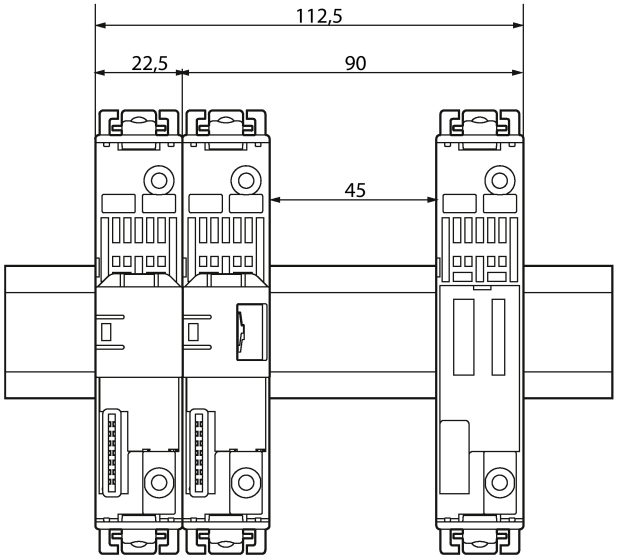

1. Hang the back of the device connector onto the upper edge of the standard mounting rail.
2. Press the lower half of the device connector against the standard mounting rail until the connector engages.
3. Repeat the procedure with all the required device connectors.



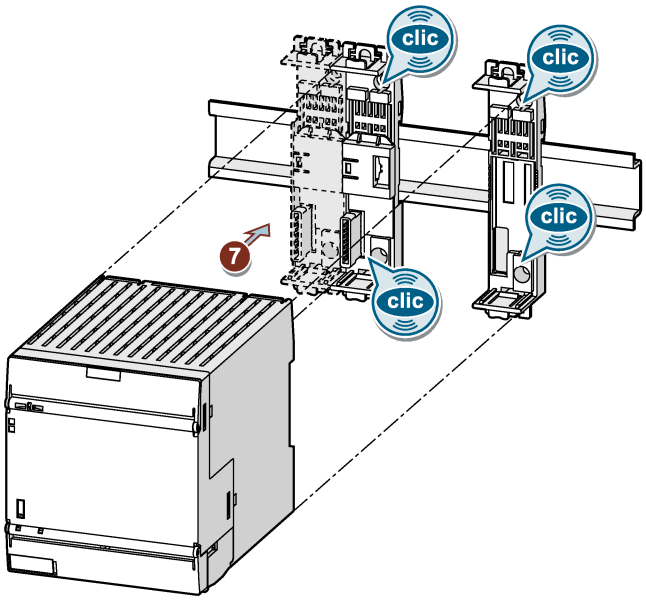

4. Push the device connectors together until they engage.



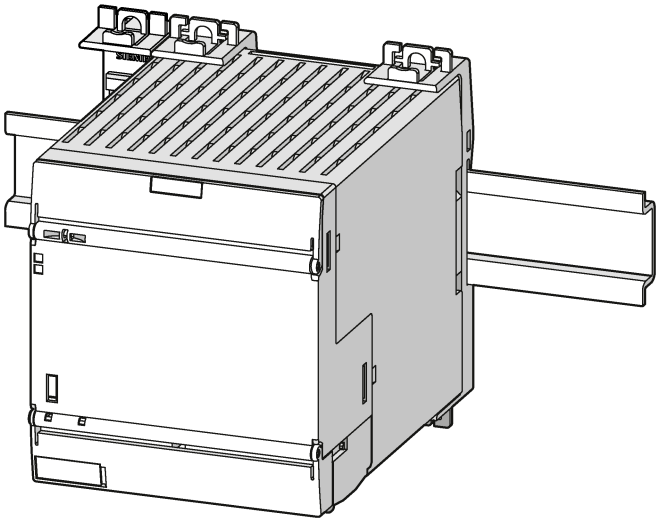
5. Mount the cover on the left of the first device connector piece and the device connectors supplied in the set for enclosures of 45 mm upwards (right-hand side).




6. Note the clearances required for the 90 mm devices.




7. Mount the 3SK1213 output expansion on the device connectors.



8. Mount all the devices required for the system configuration on the device connectors in accordance with the respective installation guidelines.

## 7.7 Removing 90 mm devices with device connectors from a standard mounting rail

**WARNING**

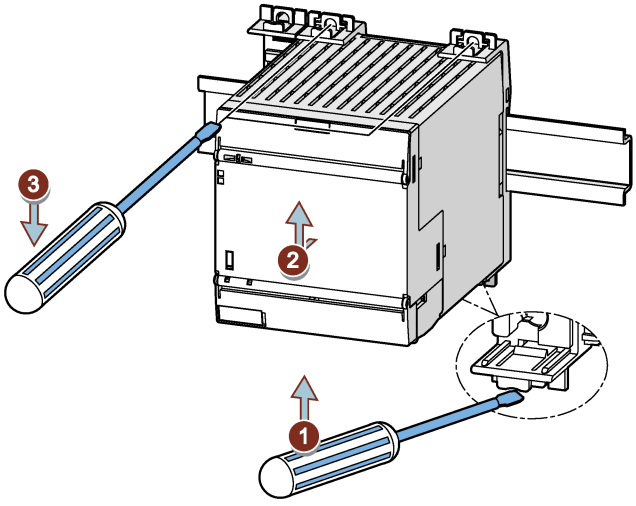
**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**

Before starting work, therefore, disconnect the system and devices from the power supply.

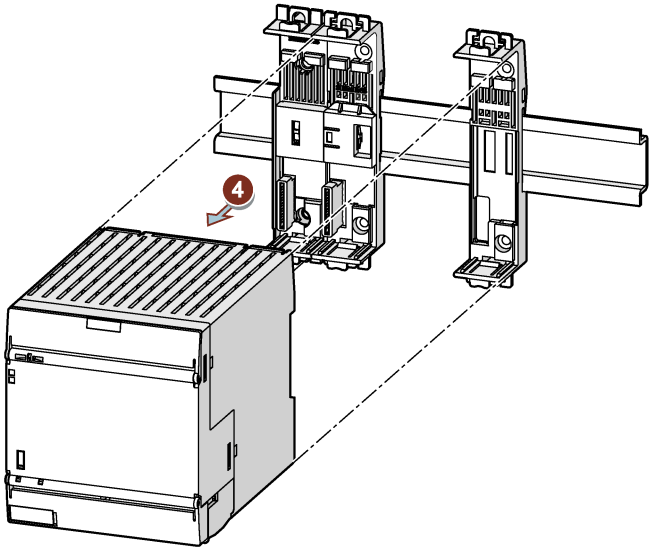
### Requirements

- The terminals have been removed or disconnected.

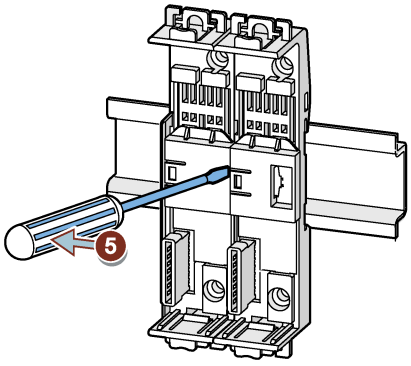
### Procedure



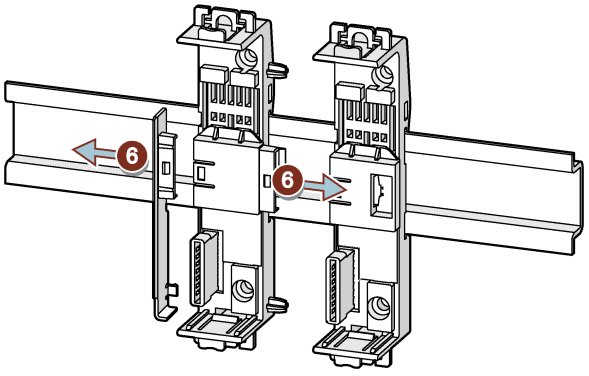

1. Unlock the device using a screwdriver.
2. Pull the lower half of the device away from the device connector.
3. Unlock the device using a screwdriver.



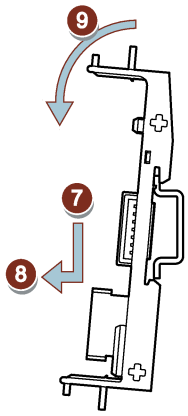

4. Pull the device away from the device connector.




5. Separate the device connectors using a screwdriver.




6. Disassemble the terminating section.




7. Press the device connector down.
8. Pull the lower half of the device connector away from the standard mounting rail.
9. Lift the device connector from the upper edge of the standard mounting rail.

# 7.8 Mounting the devices on a level surface

## Requirements

- Mounting position: Any (except 3SK1213). With 3SK1213: +/- 22.5° lateral inclination.
- Clearances: The distance to be maintained to the side with side-by-side mounting is 0 mm. The distance to be maintained to the side from grounded parts is 5 mm.
- Properly executed drill holes with thread or plug on the level surface.

  For details of the distances between the drilled holes, refer to the relevant dimension drawings.
- For devices with 17.5 mm/22.5 mm, 2 cap screws suitable for the holes, e.g. M4 x 12 acc. to DIN 784. 4 screws are required for devices with 90 mm.
- Plastic push-in lugs: Refer to the accessories list for the relevant article number in the chapter "Accessories (Page 293)".

## Procedure

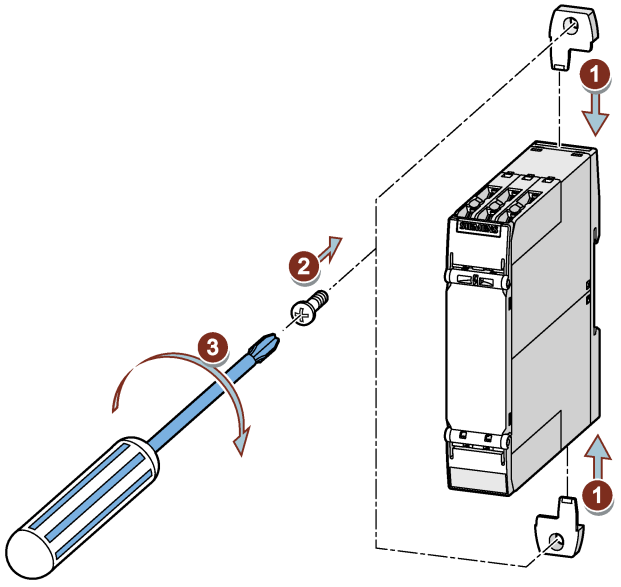



Figure 7-1 17.5 mm and 22.5 mm devices

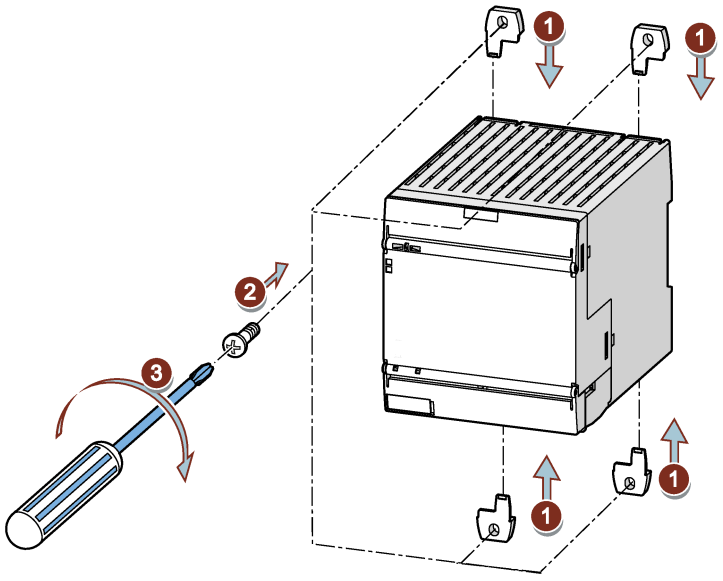



Figure 7-2 90 mm device

1. Insert the push-in lugs into the openings provided on the device until they engage.
2. Hold the device up to the surface prepared for screw fastening.
3. Insert the screws through the elongated holes into the push-in lugs.
4. Screw the device onto the level surface so that it is secure.

Tightening torque: 1 Nm

## 7.9 Removing the devices from a level surface

| WARNING |
| --- |
| **Hazardous voltage** |
| **Can cause death, serious injury, or property damage.** |
| Before starting work, therefore, disconnect the system and devices from the power supply. |

### Requirements

- The terminals have been removed or disconnected.

### Procedure

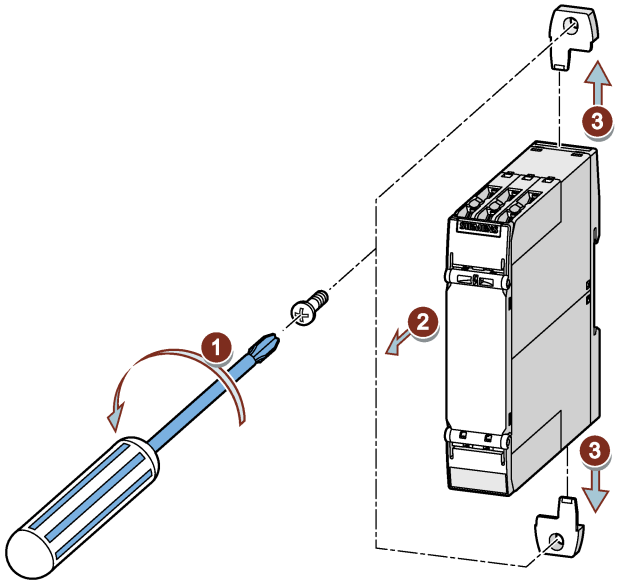



Figure 7-3 Removing 17.5 mm and 22.5 mm devices

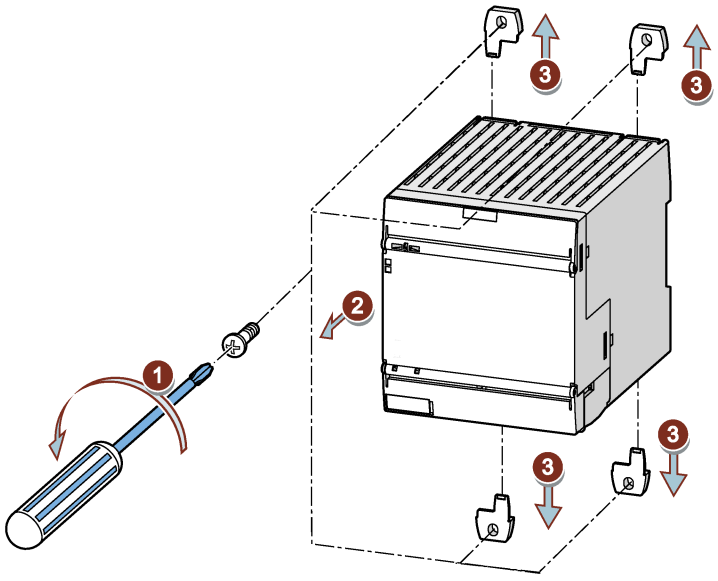



Figure 7-4 Removing 90 mm devices

1. Hold the device firmly.
2. Unscrew the cap screws.
3. Lift the device from the level surface.
4. Remove the push-in lugs from the device.

# 7.10 Mounting the 22.5 mm/17.5 mm devices with device connectors on a level surface

## Requirements

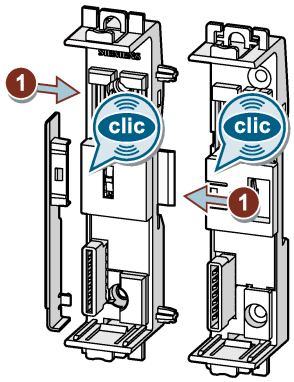
Please note the following requirements for mounting on a level surface:

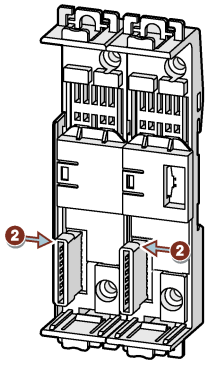
- Please observe the information about the mounting position in the technical data (Page 235).
- Clearances: The distance to be maintained to the side with side-by-side mounting is 0 mm. The distance to be maintained to the side from grounded parts is 5 mm.
- Two properly executed drill holes (per device connector) with thread or plug on the level surface.
- Two cap screws (per device connector), e.g. M4 x12 according to DIN 784, that match the holes.
- Device connector

  Refer to the accessories list for the relevant article number in the chapter "Accessories (Page 293)".

### Procedure for mounting on a level surface

The figures show 22.5 mm devices. The 17.5 mm devices are mounted correspondingly.

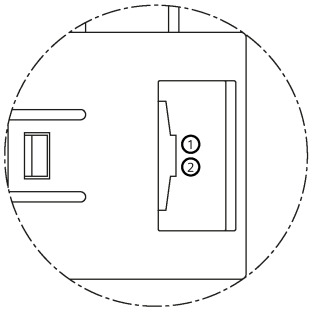


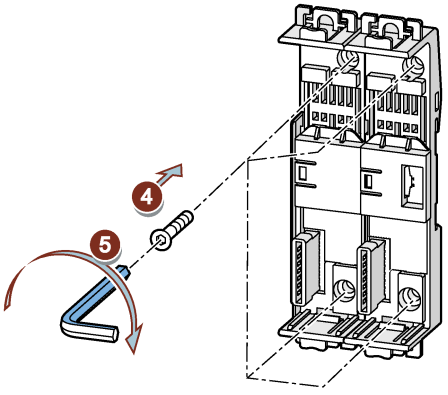

Push the device connectors together until they engage.

1. Mount the cover on the left of the first device connector. The cover is included in the scope of supply of the device terminator.
2. Set the slide switch in the device termination connector for the 3SK1 safety relays to the following positions:
   - Below 3SK1211 output expansion
     Position ① (top; i.e. closed)
   - Below 3SK1 basic device
     Position ② (bottom; i.e. open)

   (The device termination connectors for the 3RM1 Failsafe motor starters do not feature a slide switch.)



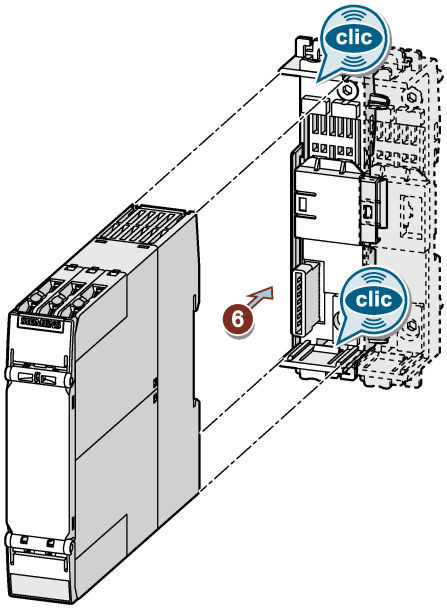

3. Hold the device connector against the level surface prepared for screw fastening.



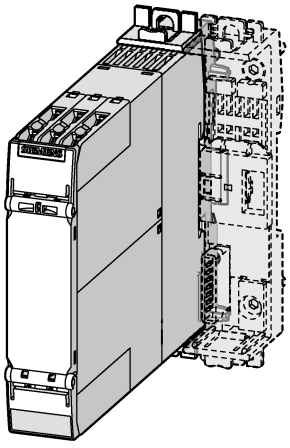

4. Insert the screws through the holes in the device connectors.
5. Screw the device connector securely onto the level surface.

   Tightening torques:

   – Top: < 0.1 Nm
   – Bottom: 1 Nm




6. Mount the device on the device connector.



7. Mount all the devices required for the system configuration in accordance with the respective installation guidelines on the device connectors.

# 7.11 Removing the 22.5 mm/17.5 mm devices with device connectors from a level surface

**⚠ WARNING**

**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**

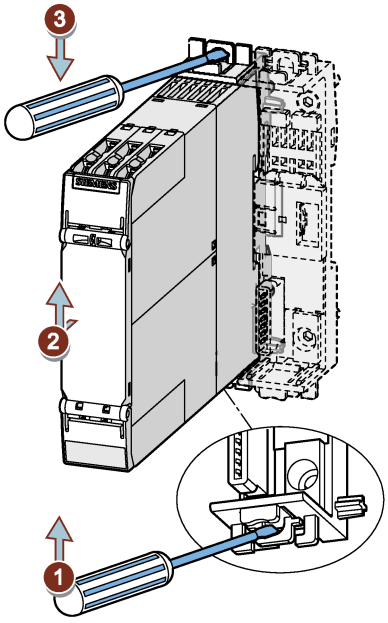
Before starting work, therefore, disconnect the system and devices from the power supply.

## Requirements

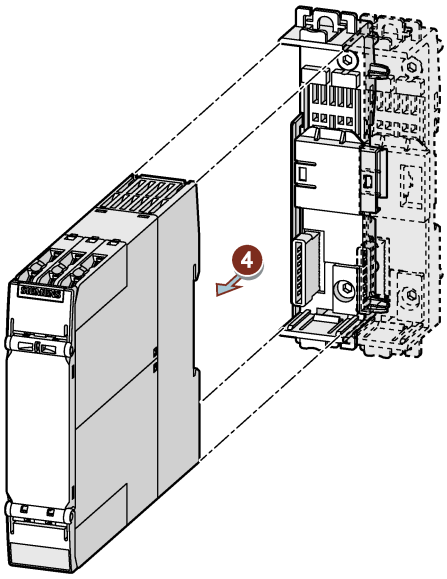
- The terminals have been removed or disconnected.

## Procedure

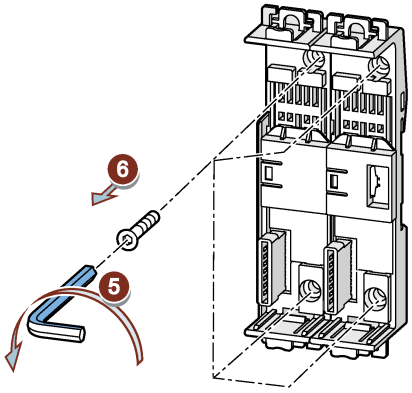
The figures show 22.5 mm devices. The 17.5 mm devices are removed correspondingly.



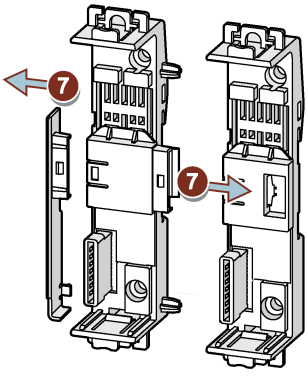

1. Unlock the device (below) using a screwdriver.
2. Pull the lower half of the device away from the device connector.
3. Unlock the device (above) using a screwdriver.




4. Pull the device away from the device connector.




5. Release the screws.
6. Separate the device connectors.




7. Remove the cover.

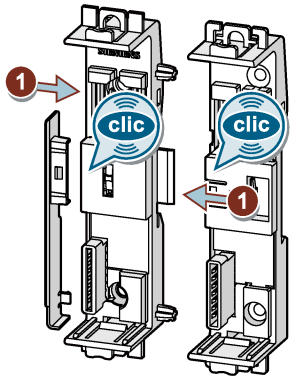
# 7.12 Mounting the 90 mm devices with device connectors on a flat surface

## Requirements

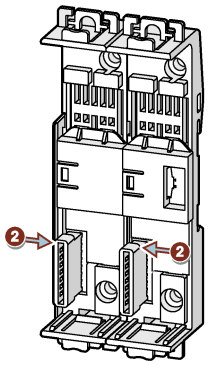
Please note the following requirements for mounting on a level surface:

- Please observe the information about the mounting position in the technical data (Page 235).
- Clearances: The distance to be maintained to the side with side-by-side mounting is 0 mm. The distance to be maintained to the side from grounded parts is 5 mm.
- Two properly executed drill holes with thread or plug on the level surface (per device connector).
- Two M4 x 12 screws in accordance with DIN 784 (per device connector) to fit the holes.
- Use the device termination connector set for 3SK1 safety relays, > 45 mm wide. Refer to the accessories list for the relevant article number in the chapter "Accessories (Page 293)".

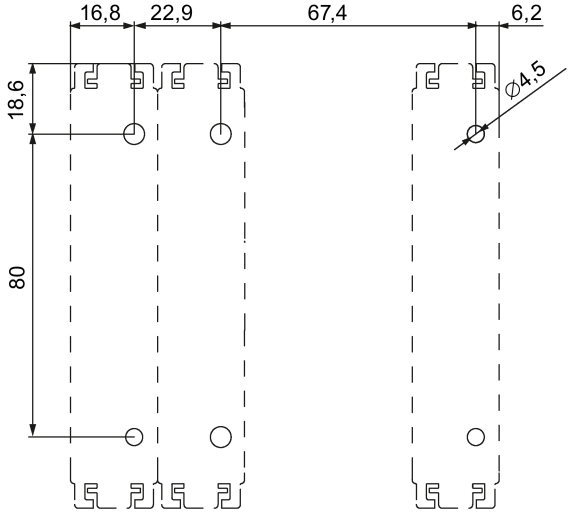
## Procedure




1. Push the device connectors together until they engage.



2. Mount the cover on the left of the first device connector.



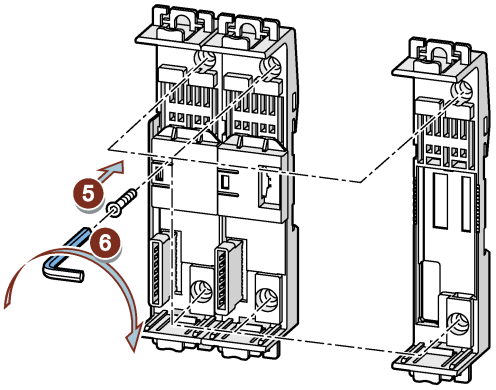

3. Note the clearances required for the 90 mm devices.

Mount the device connector supplied in the set for enclosures of 45 mm upwards (right-hand side).

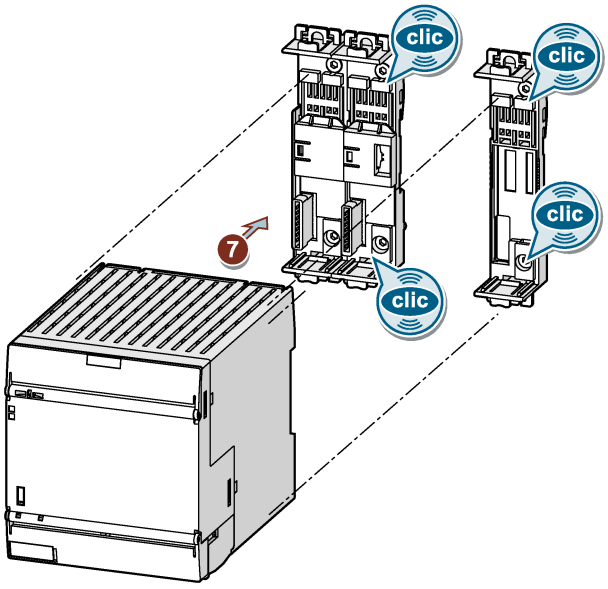
Tightening torques:

– Top: < 0.1 Nm
– Bottom: 1 Nm

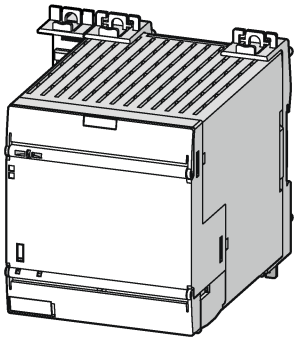
4. Hold the device connector against the level surface prepared for screw fastening.




5. Insert the screws through the holes in the device connectors.
6. Screw the device connector securely onto the level surface.




7. Mount the 3SK1213 output expansion on the device connectors.



8. Mount all the devices required for the system configuration in accordance with the respective installation guidelines on the device connectors.

## 7.13 Removing the 90 mm devices with device connectors from a flat surface

**WARNING**

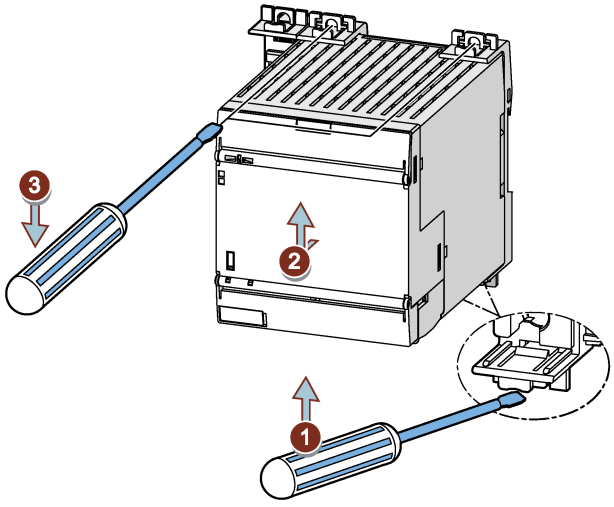
**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**

Before starting work, therefore, disconnect the system and devices from the power supply.

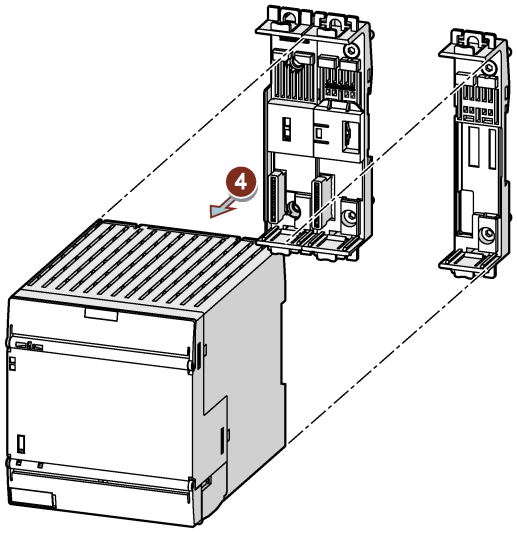
### Requirements

- The terminals have been removed or disconnected.

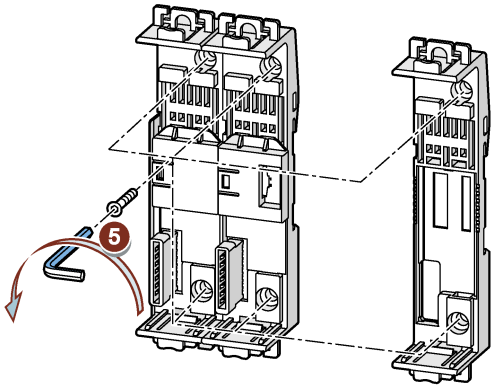
### Procedure



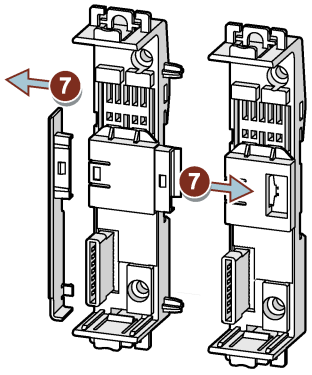

1. Unlock the device (bottom) using a screwdriver.
2. Pull the lower half of the device away from the device connector.
3. Unlock the device (top) using a screwdriver.




4. Pull the device away from the device connector.




5. Release the screws.
6. Separate the device connectors.

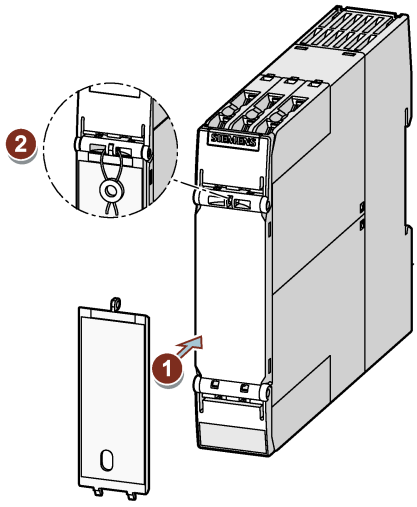



7. Remove the cover.

## 7.14 Mounting the sealable cover

The sealable cover (3ZY1321-1AA00 for 17.5 mm devices, 3ZY1321-2AA00 for 22.5 mm/90 mm devices) can be used to secure the DIP switches (and, if present, the potentiometers for setting the delay time) of the safety relays against unauthorized or unintended adjustment.

### Mounting the sealable cover




1. Attach the hooks on the cover to the openings on the device and fold the cover up.
2. Seal the cover to secure it against unauthorized removal.
   Sealing wire diameter, max.: 2 mm

## 7.15 Terminal coding

You can provide the terminals with coding pins (3ZY1440-1AA00). This helps you to avoid errors when replacing the terminals.

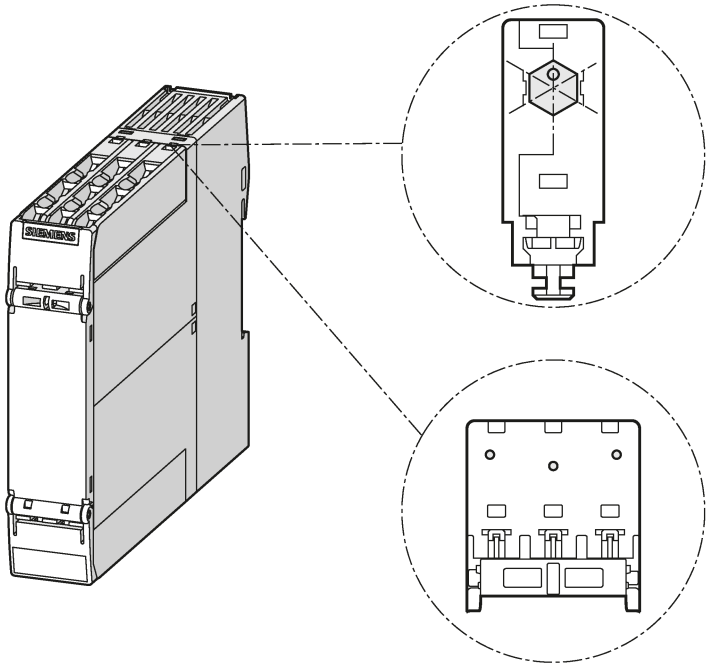


Figure 7-5 Module with coding pins

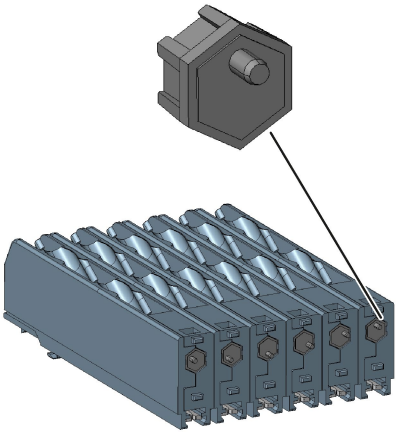


Figure 7-6 Stud position rotated by 60° in each case

# Connection

# 8

## 8.1 Warning notices

**⚠ WARNING**

**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**

Hazardous electrical voltages can cause electric shock, burns and damage.

- Turn off and lock out all power supplying the system and device before working on the device.
- To ensure protection against the hazard of electric shock when the terminal cover is open, screw in all terminal screws that are not needed to clamp conductors.
- Close the terminal covers and always keep them closed during operation.

**⚠ DANGER**

**Hazardous voltage. Can cause death or serious injury**

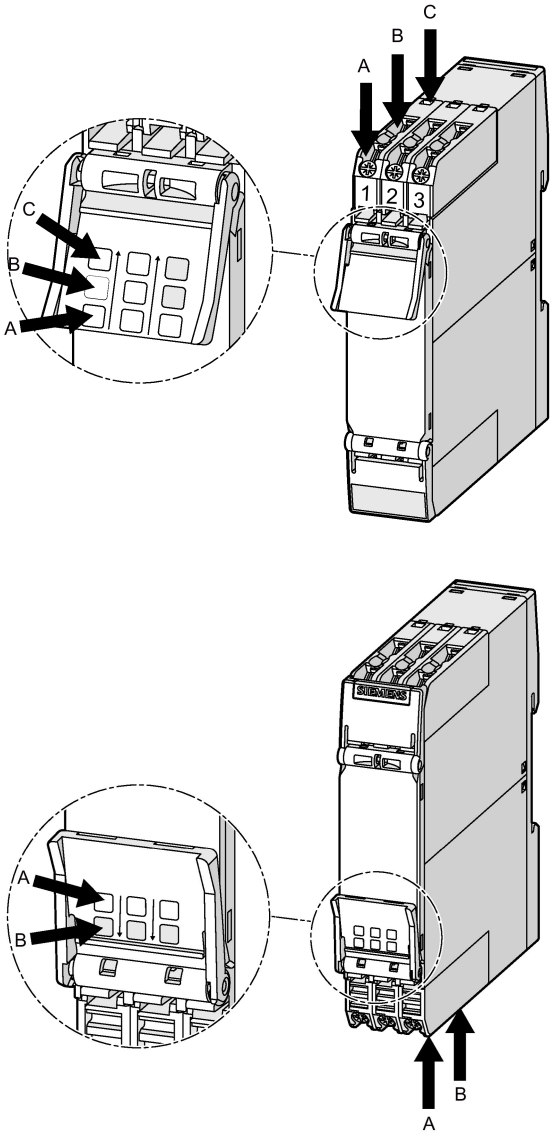
To ensure touch protection and degree of protection IP20, screw in all screws which are not used for conductor clamping and close the terminal covers.

# 8.2 22.5 mm/17.5 mm devices

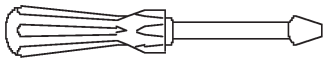
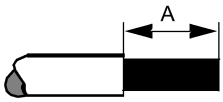
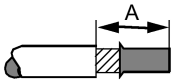
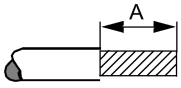
## 8.2.1 Terminal assignment

### Location of the connections

The inside faces of the terminal covers are labeled with the designations of the relevant terminals. The position of the label corresponds to the position of the respective terminal.



## 8.2.2 Connection data for 3SK1 screw terminal

| | **Specification and value for removable terminals with screw terminal** |
|---|---|
| Screwdriver<br> | Cross-tip screwdriver<br>Size: PZ 1x80 (⌀ 4.5 mm)<br>Torque: 0.6 to 0.8 Nm |
| Rigid cable<br> | A = 10 mm<br>1 x 0.5 ... 2.5 mm²<br>2 x 1.0 ... 1.5 mm² |
| Flexible conductor with end sleeve<br> | A = 10 mm<br>1 x 0.5 ... 2.5 mm²<br>2 x 0.5 ... 1.0 mm² |
| Flexible cable<br> | Not permissible |
| AWG | 1 x 20 to 14<br>2 x 18 to 16 |

## 8.2.3 Connecting the screw terminals

**WARNING**

**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**

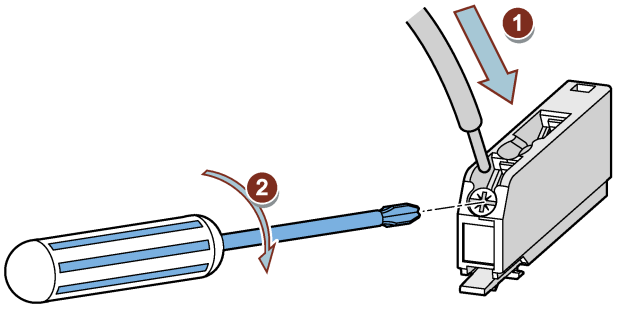
Before starting work, therefore, disconnect the system and devices from the power supply.

### Tools and materials

- Cross-tip screwdriver size PZ 1 x 80.
- For suitable connection cross-sections of the cables, see the chapter "Connection data for 3SK1 screw terminal (Page 177)".

### Procedure

1. Insert the relevant cable into square on the screw-type terminal until it engages.
2. Hold the cable in the screw-type terminal.




3. Tighten the screw with a torque of 0.6 ... 0.8 Nm.
4. Pull on the cable to ensure it is screwed tight.

### 8.2.4 Disconnecting the screw terminals

**⚠ WARNING**

**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**

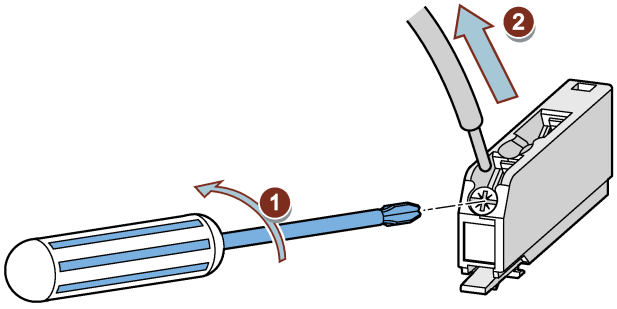
Before starting work, therefore, disconnect the system and devices from the power supply.

#### Tools

- Cross-tip screwdriver size PZ 1 x 80

#### Procedure

1. Unscrew the screw of the screw-type terminal.
2. Remove the cable from the unscrewed screw terminal.



## 8.2.5 Wiring rules for spring-loaded terminal (push-in system)

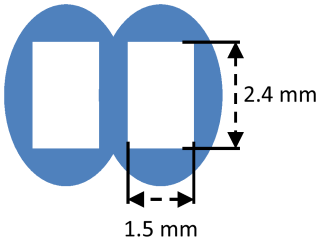
### Notes on handling spring-loaded terminals (push-in system)

The terminal area of the spring-loaded (push-in) terminals is rectangular, and the maximum overall dimensions of the conductor to be wired must not exceed 1.5 x 2.4 mm (control current terminals).

Attention must be paid to the orientation of the terminal area, which may call for vertical fitting of rectangularly crimped cables.
To make optimum use of available terminal area, you are advised to choose a form of crimping that creates a corresponding rectangular contour. Trapezoidal crimping is generally very highly suitable in this case.

When use is made of a cable that utilizes the full overall height, the terminal's spring is deflected to the maximum. Therefore, removal of this cable may become a problem because it requires further deflection of the spring.

Control current terminals




Terminal area of control current terminals

## 8.2.6 Connection data for 3SK1 spring-loaded terminal (push-in system)

| Connection data for ... | | Control current terminals |
|---|---|---|
| Connectable conductor cross-sections for solid cables | | 2 x 0.5 ... 2 x 1.5 mm² |
| | | (AWG[1]): 20 ... 16) |
| Connectable conductor cross-sections for flexible cables | Without end sleeve | 2 x 0.5 ... 2 x 1.5 mm² |
| | | (AWG[1]): 20 ... 16) |
| | With end sleeve (with and without plastic sleeve) | 2 x 0.5 ... 2 x 1.0 mm² [2] |
| | | (AWG[1]): 20 ... 18) |
| | With TWIN end sleeve | --- |
| | | --- |
| Cable stripping length | | 10 ... 11 mm |
| End sleeves according to DIN 46228-4 with plastic sleeve | | 10 mm |

[1] AWG: American Wire Gauge (AWG does not define use of end sleeves)
[2] When 2 x 1.0 mm² end sleeves with a plastic sleeve are used, space problems may arise with the sleeves; as an alternative, you are advised to use end sleeves without plastic sleeves

## 8.2.7 Connection data for 3RQ1 spring-loaded terminal (push-in system)

| Connection data for ... | | Control current terminals |
|---|---|---|
| Connectable conductor cross-sections for solid cables | | 1 x (0.5 .. 4.0) mm² |
| | | (AWG[1]: 1 x 20 to 12) |
| Connectable conductor cross-sections for flexible cables | Without end sleeve | 1 x (0.5 ... 4.0) mm² |
| | | (AWG[1]: 1 x 20 to 12) |
| | With end sleeve (with and without plastic sleeve) | 1 x (0.5 ... 2.5) mm² |
| | | (AWG[1]: 1 x 20 to 12) |
| Cable stripping length | | 10 mm |
| End sleeves according to DIN 46228-4 with plastic sleeve | | 10 mm |

1) AWG: American Wire Gauge (AWG does not define use of end sleeves)

## 8.2.8 Connecting spring-loaded (push-in) terminals

**WARNING**

**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**

Before starting work, therefore, disconnect the system and devices from the power supply.

The spring-loaded (push-in) system allows wiring without tools for rigid conductors or conductors equipped with end sleeves.

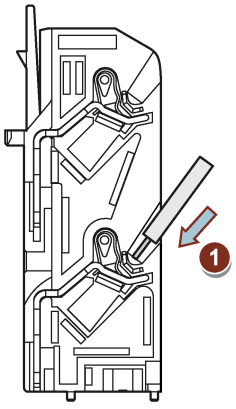
A screwdriver is required for wiring finely-stranded or stranded conductors without end sleeves on spring-loaded (push-in) terminals.

### Tools and materials

- 0.5 x 3 mm screwdriver DIN 5264 (for finely-stranded conductors only).
- For suitable connection cross-sections of the cables, see the chapter "Connection data for 3SK1 screw terminal (Page 177)".

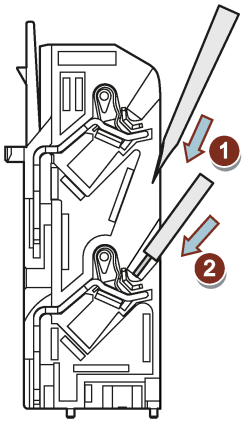
## Procedure

### Rigid cables or cables equipped with end sleeves




1. Insert the cable into the oval opening as far as it will go.
2. Pull on the cable to ensure it is tight.

### Finely-stranded cables




1. Insert the screwdriver in the rectangular opening to open the terminal (oval opening).
2. Insert the cable as far as it will go into the oval opening and remove the screwdriver.
3. Pull on the cable to ensure it is tight.

## 8.2.9 Disconnect the spring-loaded (push-in) terminal

**⚠ WARNING**

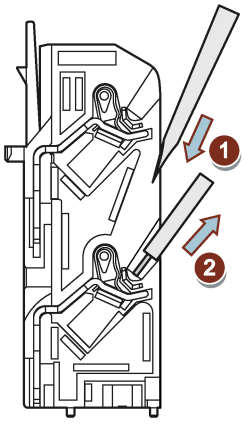
**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**

Before starting work, therefore, disconnect the system and devices from the power supply.

### Tools

- Screwdriver DIN 5264 of the size 0.5 x 3 mm

### Procedure




1. Insert the screwdriver into the rectangular opening of the spring-loaded (push-in) terminal until it engages.
2. Remove the cable from the oval opening.
3. Remove the screwdriver.

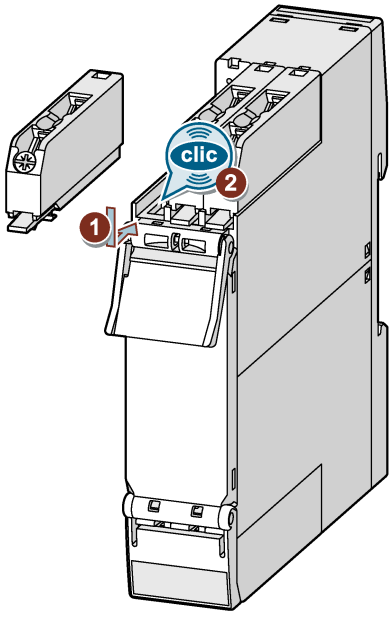
## 8.2.10 Attaching the terminals

| **WARNING** |
| --- |
| **Hazardous voltage**<br>**Can Cause Death, Serious Injury, or Property Damage.**<br>Before starting work, therefore, disconnect the system and devices from the power supply. |

### Requirements

You must have removed the terminals, for the purpose of replacing a device, for example.

### Procedure when plugging in the terminals

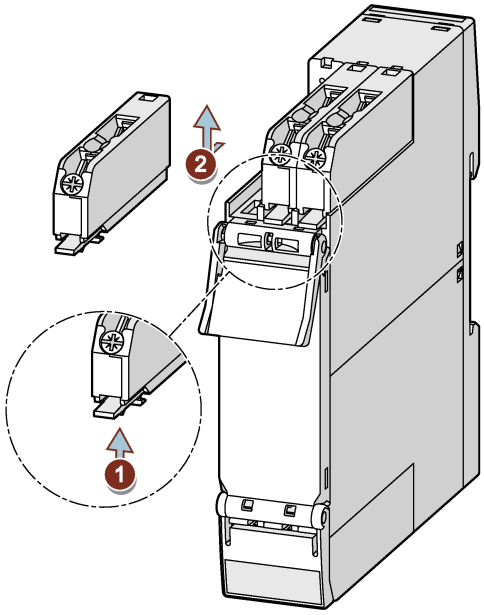



1. Insert the detachable terminals into the guide rail of the device.
2. Slide the detachable terminals back until they audibly engage.

## 8.2.11 Disconnecting

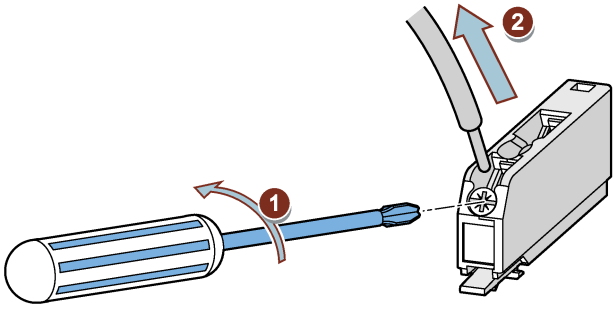
| ⚠ WARNING |
| --- |
| **Hazardous voltage** |
| Can Cause Death, Serious Injury, or Property Damage. |
| Before starting work, therefore, disconnect the system and devices from the power supply. |

### Removing terminals from the device



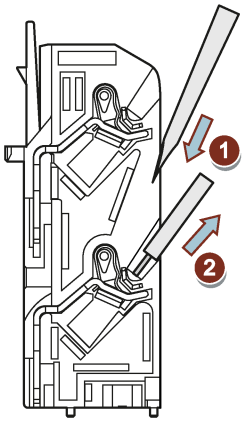

1. Press the clip of the terminals upwards.
2. Pull the terminals out to the front.
3. Lift the terminals out of the guide rail of the device.

### Screw terminals: Disconnecting the conductor




1. Unscrew the screw of the screw-type terminal.
2. Remove the cable from the unscrewed screw-type terminal.

### Push-in terminals Disconnecting the conductor



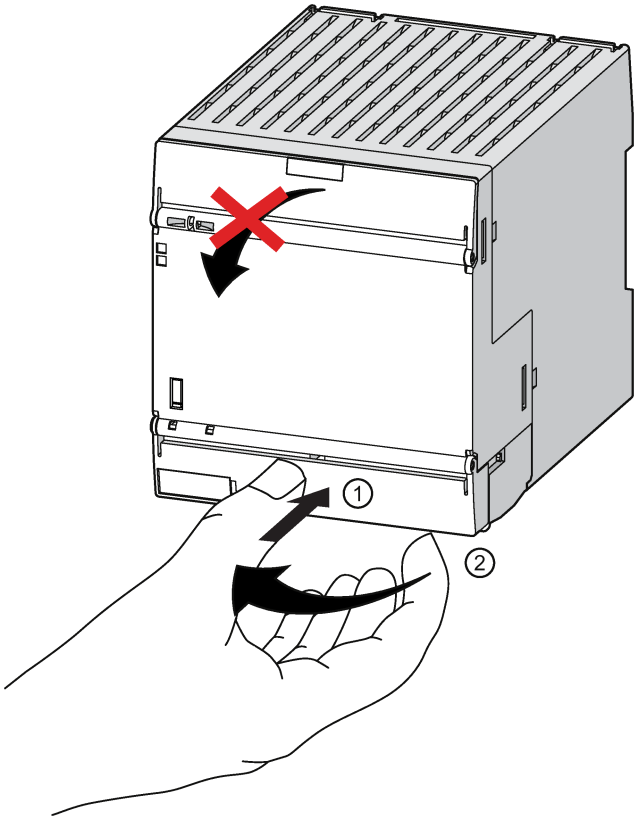

1. Insert the screwdriver into the rectangular opening of the push-in terminal until it engages. Please observe a 10° horizontal angular deviation of the screwdriver to the oval opening.
2. Remove the cable from the oval opening.
3. Remove the screwdriver.

# 8.3 Devices 90 mm

## 8.3.1 Opening the terminal cover

| ⚠ WARNING |
| --- |
| **Hazardous voltage** |
| **Can Cause Death, Serious Injury, or Property Damage.** |
| Before starting work, therefore, disconnect the system and devices from the power supply. |

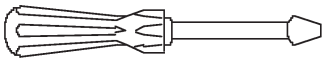
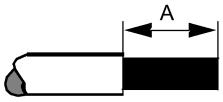
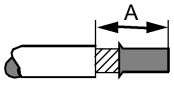
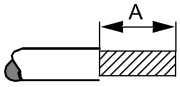
### Positions of the terminals and opening the terminal cover




Ther removable terminals are located under the **lower** terminal cover.

To open the terminal cover, press on it in the middle ① and lift it up ②.

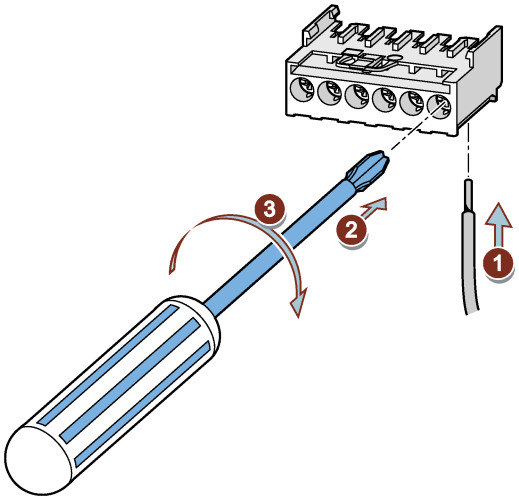
## 8.3.2 Connection data for terminals

| | **Screwdriver for removable terminals with screw terminal** | **Screwdriver for removable terminals with spring-loaded connection** |
|---|---|---|
| Screwdriver  | Cross-tip screwdriver<br>Size: PZ 1 (⌀ 4 mm)<br>Torque: 0.8 to 1.2 Nm | Screwdriver<br>Size: 0 or 1 (width to 3 mm) for raising the terminal springs<br>DIN 5264-A; 0.5 x 3 |
| Rigid cable   | A = 10 mm<br>1 x 0.5 ... 4.0 mm²<br>2 x 0.5 ... 2.5 mm² | A = 10 mm<br>1 x 0.5 ... 1.5 mm²<br>2 x 0.5 ... 1.5 mm² |
| Flexible cable with end sleeve/cable lug   | A = 10 mm<br>1 x 0.5 ... 2.5 mm²<br>2 x 0.5 ... 1.5 mm² | A = 10 mm<br>1 x 0.5 ... 1.5 mm²<br>2 x 0.5 ... 1.5 mm² |
| Flexible cable   | Not permissible | A = 10 mm<br>1 x 0.5 ... 1.5 mm²<br>2 x 0.5 ... 1.5 mm² |
| AWG | 1 x 20 to 12<br>2 x 18 to 14 | 1 x 20 to 16<br>2 x 20 to 16 |

## 8.3.3 Connecting terminals

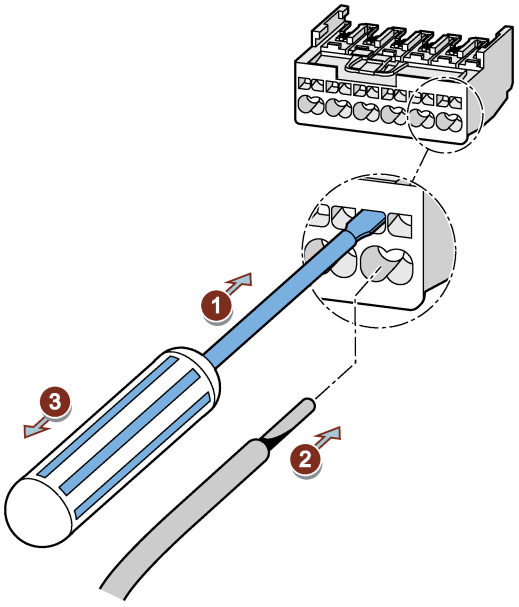
| ⚠ WARNING |
| --- |
| **Hazardous voltage**<br>**Can cause death, serious injury, or property damage.**<br>Before starting work, therefore, disconnect the system and devices from the power supply. |

### Procedure for screw terminal blocks




1. Insert the relevant cable into square on the screw-type terminal until it engages.
2. Hold the cable in the screw-type terminal.
3. Tighten the screw of the terminal in which the cable is inserted.
4. Pull on the cable to ensure it is screwed tight.

### Procedure for spring-loaded terminals




1. To release the terminal springs, insert the screwdriver as far as it will go into the rectangular opening of the spring-loaded terminal. Please observe a 10° horizontal angular deviation of the screwdriver to the oval opening.
2. Insert the cable into the oval opening as far as it will go.
3. Hold the cable in the spring-loaded terminal.
4. Remove the screwdriver.
5. Pull on the cable to ensure it is tight.

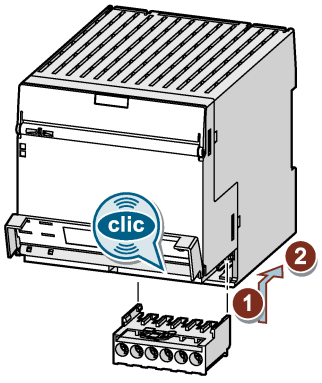
## 8.3.4 Mounting terminals

| WARNING |
| --- |
| **Hazardous voltage**<br>**Can Cause Death, Serious Injury, or Property Damage.**<br>Before starting work, therefore, disconnect the system and devices from the power supply. |

### Requirements

You must have removed the terminals, for the purpose of replacing a device, for example.

### Procedure for mounting terminals




1. Insert the detachable terminals into the guide rail of the device.
2. Slide the detachable terminals back until they audibly engage.
3. Check that the clip of the removable terminals closes flush with the front panel.

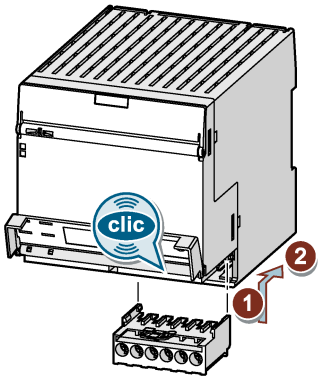
## 8.3.5 Disconnecting

**WARNING**

**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**

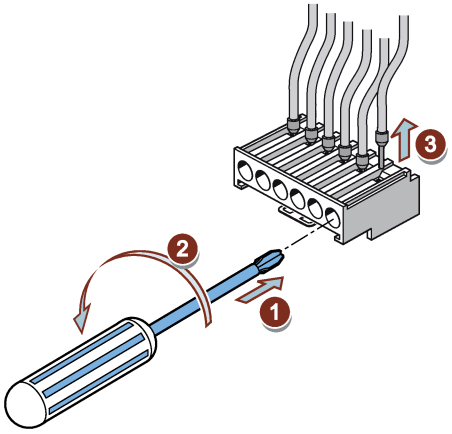
Before starting work, therefore, disconnect the system and devices from the power supply.

### Removing terminals from the device



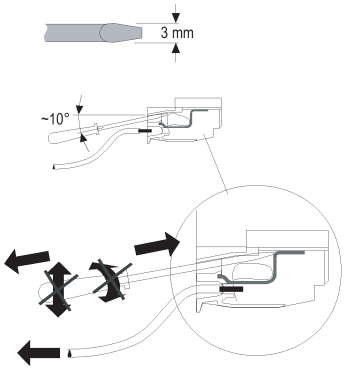

1. Insert a flat-head screwdriver between the clip of the terminals and the front panel.
2. Pull the terminals out to the front.
3. Lift the terminals out of the guide rail of the device.

## Disconnecting the screw terminal




1. Insert the screwdriver into the screw-type terminal.
2. Unscrew the screw of the screw-type terminal.
3. Remove the cable from the unscrewed screw-type terminal.

## Disconnecting the spring-loaded terminal




1. Insert the flat-head screwdriver into the rectangular opening of the spring-loaded terminal until it engages. Please observe a 10° horizontal angular deviation of the screwdriver to the oval opening.
2. Remove the cable from the oval opening.
3. Remove the screwdriver.

## 8.4 Device replacement

**⚠ WARNING**

**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**

Before starting work, therefore, disconnect the system and devices from the power supply.

When replacing a device, you do not need to re-wire it. The terminals can be disconnected from the defective device and then connected to the new device.

You can provide the terminals with coding pins. These are to help you avoid errors when replacing the terminals (see the chapter "Terminal coding (Page 174)" for more details).

### Replacing the module

**⚠ WARNING**

**Hazardous Voltage**
**Can Cause Death, Serious Injury, or Property Damage.**
**Carry out function test of the plant**

To ensure the safety of the system, a full functional test must be conducted and a successful result obtained after a device has been replaced.

**Note**

Only replace a defective device with a device of an identical article number.

1. Disconnect the defective device at the terminals.
   2. Chapter for 22.5 mm / 17.5 mm devices "Disconnecting (Page 185)"
   3. Chapter for 90 mm devices "Disconnecting (Page 192)"
4. Deinstall the defective device.
   5. Chapter "Removing the devices from a DIN rail (Page 144)"
   6. Chapter "Removing 22.5 mm/17.5 mm devices with device connectors from a standard mounting rail (Page 148)"
   7. Chapter "Removing 90 mm devices with device connectors from a standard mounting rail (Page 154)"

8. Mount the new device
   9. Chapter "Mounting the devices on a level surface (Page 157)"
   10. Chapter "Mounting the devices on a DIN rail (Page 142)"
   11. Chapter "Mounting the 90 mm devices with device connectors on a flat surface (Page 167)"
   12. Chapter "Mounting the 22.5 mm/17.5 mm devices with device connectors on a level surface (Page 161)"
   13. Chapter "Mounting the 90 mm devices with device connectors on a flat surface (Page 167)"
14. Connect the defective device at the terminals
   15. Chapter for 22.5 mm / 17.5 mm devices "Connecting the screw terminals (Page 178)", "Connecting spring-loaded (push-in) terminals (Page 181)" and "Attaching the terminals (Page 184)"
   16. Chapter for 90 mm devices "Connecting terminals (Page 189)" and "Mounting terminals (Page 191)"
17. Set the DIP switches/slide switches and, if applicable, the times according to the defective device.

After applying the supply voltage, the new 3SK1 basic unit checks whether the hardware configuration matches the device configuration.

If there are no deviations, the system re-enters safety mode.

## 8.5 PAR input for NC contact/NO contact evaluation

The PAR parameterization input is used to set how two-channel sensors are to be evaluated by the device.
If the PAR input is not connected, sensor evaluation is performed on two NO contacts.
If there is a jumper between the test cycle output T1 and the PAR input, sensor evaluation is performed on an NC/NO combination.

If two-hand operation is to be used on the devices, the PAR input has a different function. In combination with the settings of the DIP switches Start type and Sensor evaluation, the PAR input is used to activate two-hand evaluation:

- Jumper T1/PAR (NO/NC evaluation)
- DIP switches (1) Autostart
- DIP switches (3) 2x 1-channel

## 8.6 INK input for cascading

The INK cascading input is set up redundantly from the terminal in the device.
With protected installation, safety applications up to Performance Level e (PL e) or Safety Integrity Level 3 (SIL 3) can be implemented.
This applies if the connected sensor or output is suitable.

The INK cascading input can be used for the following applications:

- Safe connection of safety relays
  In this application, a higher-level safety relay switches off the 3SK1 safety relay via the cascading input via a safe output.
- Additional safety sensor circuit
  The cascading input INK is AND-linked with the sensor inputs IN1 and IN2.
  The cascading input can be connected to 1-channel safety sensors (forced opening). The start function for the INK cascading input corresponds to the start response of sensor inputs IN1 and IN2 (autostart or monitored start).
- Functional switching
  The INK cascading input can also be used for functional switching (not safe).

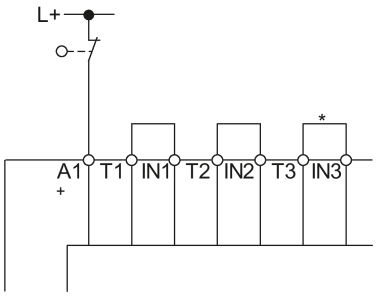
# 8.7 Connection of sensors

## 8.7.1 Connection to 3SK1111

### 8.7.1.1 1-channel sensor

1-channel sensors can be connected via the A1 supply line or via the sensor inputs.

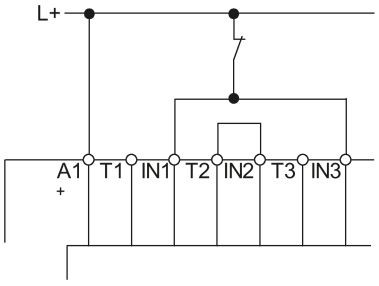
Sensor in A1 supply line:



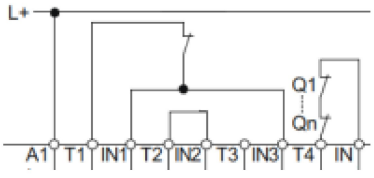

* For 3SK1111-.AB30 basic unit only

No cross-circuit detection; maximum achievable SIL1, PL c

Sensor at sensor input:

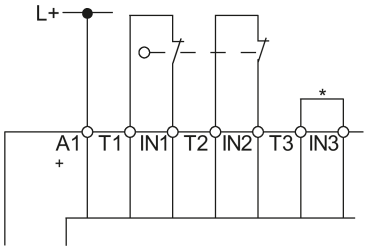



No cross-circuit detection; maximum achievable SIL1, PL c




With this device variant, cross-circuit detection is also not possible via T1.

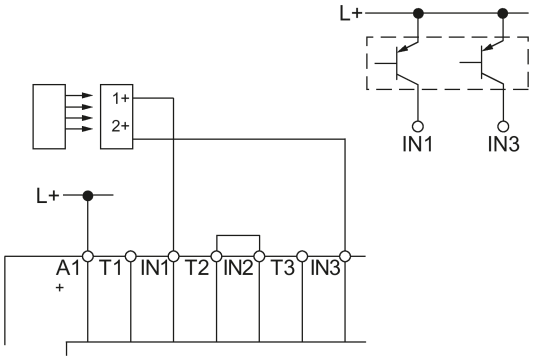
### 8.7.1.2 Emergency stop 2-channel




* For 3SK1111-.AB30 basic unit only

With cross-circuit detection; maximum achievable SIL3, PL e

### 8.7.1.3 Sensor with solid-state outputs




No cross-circuit detection in 3SK1 relays, the sensor monitors the outputs; maximum achievable SIL3, PL e

**Note**

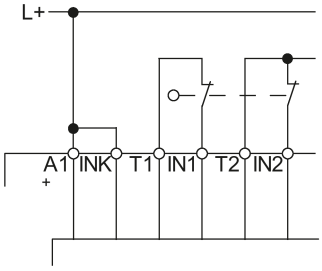
**Note on discrepancy monitoring time for signal changes of a two-channel input signal for 3SK1 safety relays**

A discrepancy error is detected when a two-channel sensor switches on only one channel. This then leads to the enabling circuits being switched off and a change to the error state. Both sensor contacts must be in the actuated position (NC open) at any given time for the 3SK1 to be switched on again.

If there is a discrepancy error in the 3SK1111 safety relays, the enabling circuits open, but only the DEVICE LED lights up green (the OUT LED is off). The enabling circuits also remain open in the event of a signal change from 0 to 1. If the second channel then switches (1 to 0 to 1), the enabling circuits are enabled (immediately for autostart; after a starting command for monitored starting).

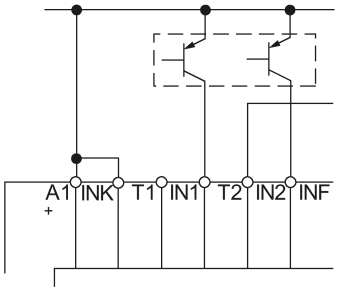
## 8.7.2 Connection to 3SK112; 3SK122 and 3SK112

### 8.7.2.1 Emergency stop 2-channel



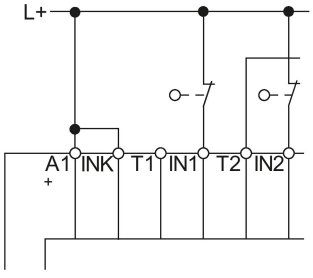

With cross-circuit detection; maximum achievable SIL3, PL e

### 8.7.2.2 Sensor with solid-state outputs




No cross-circuit detection in 3SK1 relays, the sensor monitors the outputs; maximum achievable SIL3, PL e

### 8.7.2.3 2x 1-channel sensor

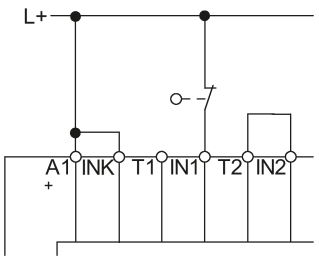



No cross-circuit detection, maximum achievable SIL1, PL c

The signal from the two sensor inputs is logically AND-linked in the device. This means that the enabling circuits only switch when both sensors are closed.

Set the "2x1/1x2" DIP switch to position 2x1 (switch on the left)

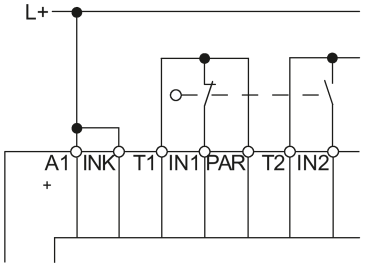
### 8.7.2.4 1x 1-channel sensor




No cross-circuit detection, maximum achievable SIL1, PL c

Set the "2x1/1x2" DIP switch to position 2x1 (switch on the left)

### 8.7.2.5 2-channel sensor with NC/NO contacts

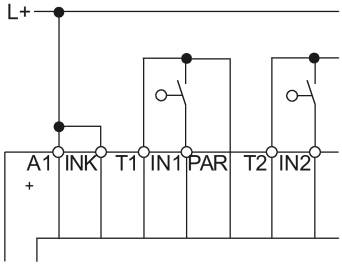



With cross-circuit detection, maximum achievable SIL3, PL e

The NC/NO evaluation is activated by means of a wire jumper between output T1 and input PAR.

The use of 24 V DC at the PAR input is not permitted and will result in a cross circuit error.

### 8.7.2.6 Two-hand operation




With cross-circuit detection, maximum achievable SIL3, PL e, maximum achievable according to ISO 13851 Type IIIc

Two-hand evaluation is activated by means of a wire jumper between output T1 and input PAR and the switch position of the DIP switch "2x1/1x2" set to position 2x1 (switch left)

The use of 24 V DC at the PAR input is not permitted and will result in a cross circuit error.

**⚠ WARNING**

**Loss of safety function with two-hand operation type IIIc with input type S/S**

**Can cause death, serious injury, or property damage.**

The two-hand operation type IIIc with input type S/S loses its safety function if there is a cross circuit between one of the inputs and the corresponding test cycle. This bypasses the button. The discrepancy monitoring only recognizes this error after both buttons have been released. And only then is it prevented from being switched on again.

For two-hand operation units type IIIc with input type S/S, lay all outgoing and return cables cross-circuit proof, e.g. as a separately sheathed cable or in an armored conduit.

**Note**

If the inputs IN1 and IN2 are operated with the test cycles T1/T2 despite cross-circuit detection being deactivated, a cross circuit between IN1 and IN2 will result in an error at the input INF, as this is also supplied with T2. If this is not desired, the inputs IN1 and IN2 must be supplied externally with 24 V DC.

## 8.7.3 Use of magnetic switches

**⚠ WARNING**

**Dangerous condition of the system due to welding of magnetic switches**

**Use of magnetic switches**

If magnetically operated switches are used, the magnetic contacts may weld on account of capacitive effects. The reason for this is that a high peak current may occur when switching these loads (e.g. also cable capacitances). A corresponding fuse protection with the rated current of the magnetic switch must be provided if the device/sensor combinations have not been explicitly enabled.
For more details, please refer to the documentation of the magnetic switch.

## 8.8 Connection of actuators

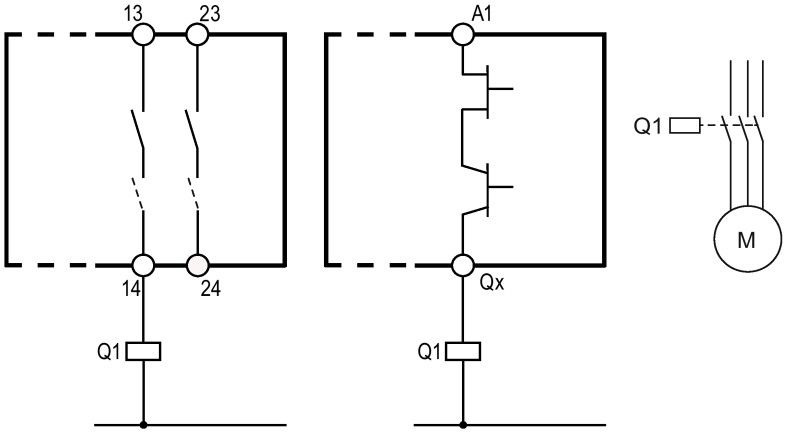
**Note**

To achieve the Performance Level / Safety Integrity Level given in the following examples, the actuators shown must be monitored in the feedback circuit of the corresponding safety relay.

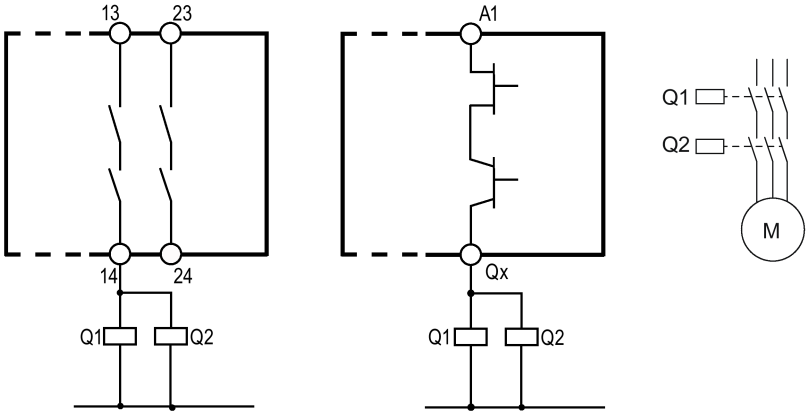
**Note**

For capacitive and inductive loads, we recommend an adequate protective circuit. In this way, electromagnetic interference can be suppressed and contact service life increased.

### Actuator wiring up to PL c acc. to ISO 13849-1, or SIL CL 1 acc. to IEC 62061



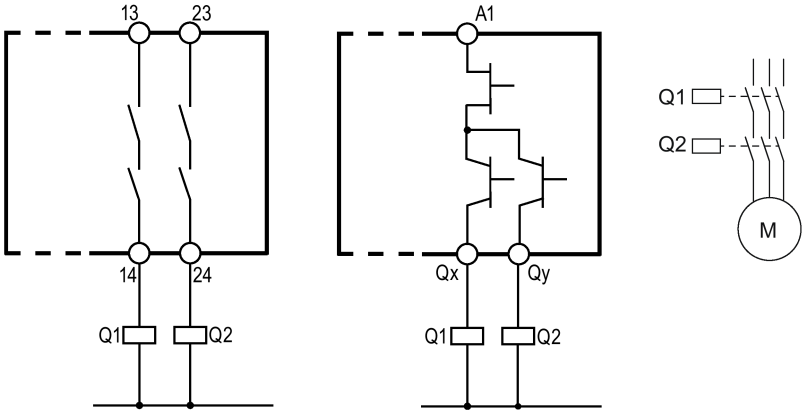
### Actuator wiring for protected laying up to PL e / Cat. 4 acc. to ISO 13849-1, or SIL CL 3 acc. to IEC 62061



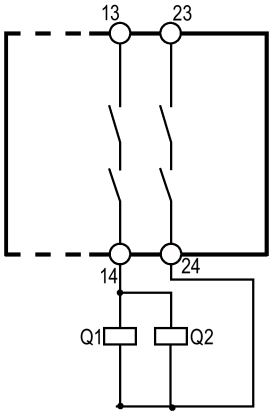

**WARNING**

Laying of the control cables PL e acc. to ISO 13849-1 or SIL CL 3 acc. to IEC 62061 can only be achieved with cross-circuit-proof/short-circuit-proof laying of the control cables from the relay output (e.g. 14) to the control relays/contactors (Q1 and Q2) (e.g. as a separately sheathed cable or in its own cable duct). Restrictions with regard to the safety levels attainable in the individual controllers must be taken into account. Please refer to the specifications in the relevant device manual.

### Actuator wiring up to PL e acc. to ISO 13849-1, or SIL CL 3 acc. to IEC 62061



### Actuator wiring up to PL e acc. to ISO 13849-1, or SIL CL 3 acc. to IEC 62061 with relay outputs PN-switching




**Note**

**Note regarding the use of different voltages on the relay release circuits.**

Different voltages can be switched, e.g. 24 V DC in one enabling circuit and 230 V AC in another enabling circuit, by means of the floating contacts of 3SK1 with relay enabling circuits. The enabling circuits do not feature protective separation from each other, however.

All the other devices with relay enabling circuits have basic insulation between control circuits and enabling circuits and also between enabling circuits.

Only the 3SK1213 output expansions feature protective separation between the enabling circuits and the electronics of 300 V. They also only have basic insulation between the enabling circuits.

If the application requires a protective separation between the enabling circuits for safety reasons, contactors or coupling relays with a corresponding protective separation must be used, for example.

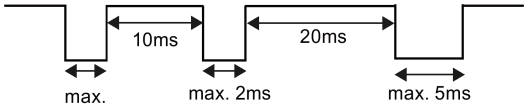
**Note**

In the case of 3SK1..2 and 3SK1120 (devices with semiconductor outputs with firmware (FW) version V1.0.0 and product version E01) it is not possible to achieve PL d/e / Cat. 3/4 according to ISO 13849-1 or SIL 2/3 according to IEC 62061 with the wiring shown above.

### Dark test

The common driver and the individual channel drivers are tested alternately in test cycles.

- A test cycle takes place every 10 ms and lasts a maximum of 2 ms.
- If the test fails twice, another test is performed after 20 ms, which can last up to 5 ms. If this test also returns a negative result, the device enters a safe error state. If the result is correct, another test lasting a maximum of 2 ms is performed every 5 ms.
- The pulse duration is dynamic, which means that the dark test times are maximum values. If the safety relay detects the correct signal state before the maximum time has elapsed, the dark test is terminated.



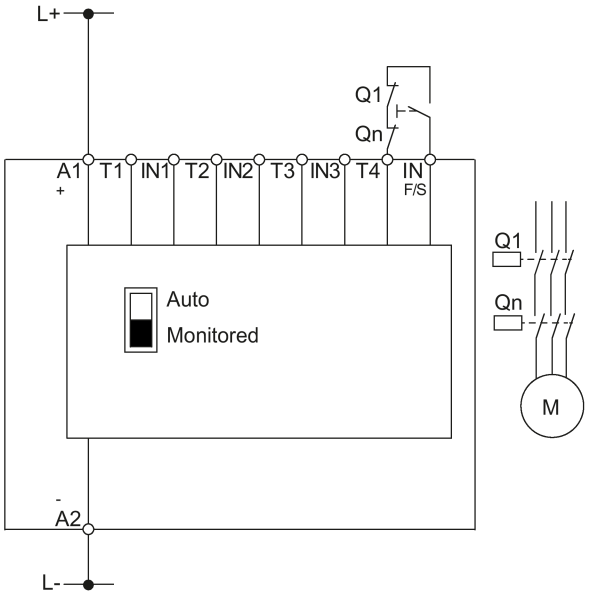

### Monitoring the feedback circuit

Monitoring of the actuator technology is a diagnostic function and thus contributes significantly to the achieved SIL or PL of the respective subsystem. In the case of electromechanical components (e.g. relays or contactors), a forced auxiliary contact (mirror contact) of the component is often fed back to the safety relay and evaluated there. This is referred to as monitoring the feedback circuit or reading back the contactors. This is particularly necessary in a redundant setup. If one of the two contactors became welded without being detected, the two-channel system would become a single-channel system. Instead, contact welding is detected and a new switch on is prevented until the fault is rectified.

# 8.9 Start button connection

## 8.9.1 Connection to 3SK1111

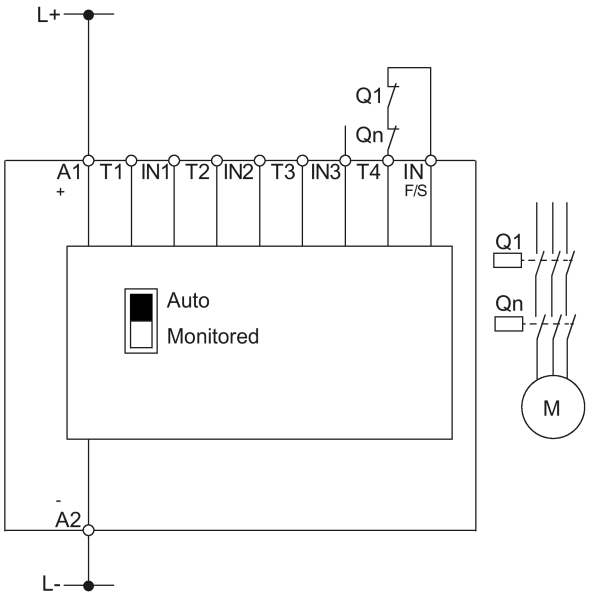
The 3SK1111 safety relays have a combined input for the start button and the feedback circuit monitoring. The contacts of the feedback circuit and the start button must be wired in series between the T4 output and the IN F/S input.




If the 3SK1111 is used with automatic start, only the feedback circuit must be wired between the T4 output and the IN F/S input.

**Note**

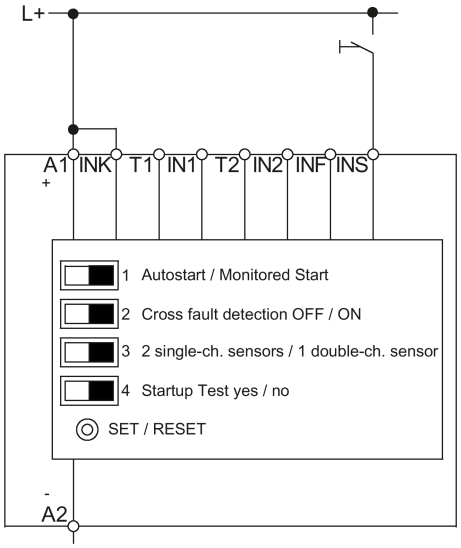
Since the IN F/S input is supplied from the T4 output, it is not possible to start several 3SK1111 devices simultaneously by wiring the IN F/S inputs in parallel.
It is also not possible to use 24 V DC instead of T4.




## 8.9.2 Connection to 3SK1112; 3SK122 and 3SK112

If a start button is only to affect one device or safety function, a single start button must be used for each device.

Start button connection:



**Note**

In the SIRIUS 3SK112, 3SK122 and 3SK112 safety relays, the sensor circuit, the cascading input and, if applicable, the signal from the device connector are linked together using an AND function. The parameterized start type thus applies to all three signals. If a monitored start is parameterized, a starting command is required to restart the device, regardless of which of these signals caused the shutdown.

#### 8.9.2.1 Different start types in the system configuration

If input expansions and basic devices with different start types are parameterized within a system setup, a certain sequence must be observed.

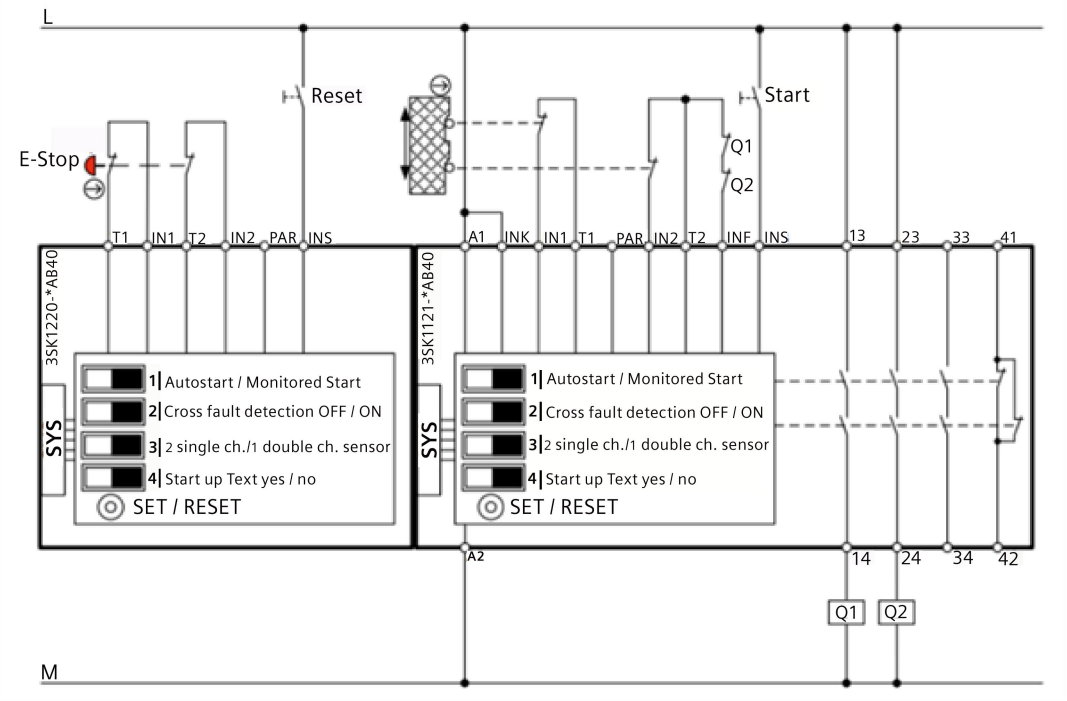
The monitored start should only be parameterized on devices at the far left of the setup, and the automatic start on the devices on the right.

For example, all emergency stop command devices that require a monitored start are connected to the devices on the left, and all sensors that allow automatic start are connected to devices on the right.

If this sequence is not followed, the last device that is parameterized with monitored start always requests a starting command, even if a device to its left that triggered the shutdown is parameterized with automatic start.

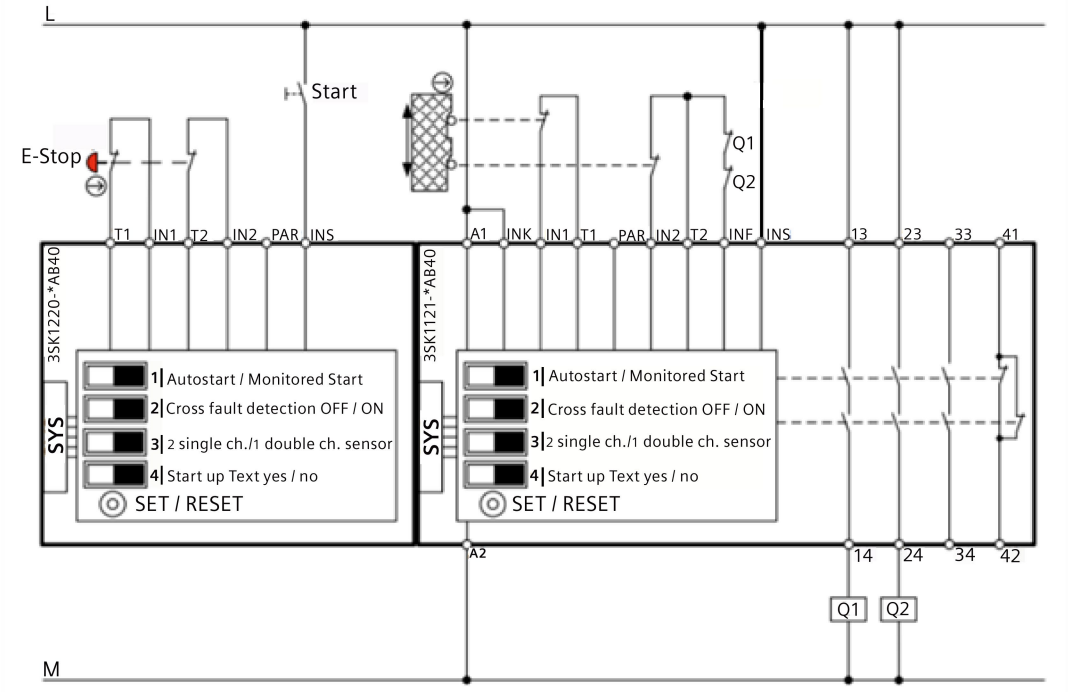
### 8.9.2.2 Starting multiple devices or safety functions separately

If separate start buttons are to be used to activate only one device or safety function at a time, they must be wired individually. This is necessary, for example, if the entire hazardous area cannot be seen from every position and safety functions must be reset individually and locally. In the example shown below, both start buttons must be pressed one after the other after the emergency stop command device has been activated.



### 8.9.2.3 Starting multiple devices or safety functions together

If multiple devices or safety functions with monitored start are parameterized, a single start button can be used that acts on these devices simultaneously. In this case, the respective start inputs only need to be wired in parallel.




To make this possible, the starting command is stored by the respective device, provided that its own switch-on conditions are met and only the enabling signal from the device on the left is missing.

This is the case in the configuration shown above when the start button is pressed but the emergency stop command device has not yet been unlocked. In this state, the IN LED flashes yellow on the basic unit (right) and green on the input expansion (left).

**Note**

**Dangerous condition of the system due to unintentional start-up**

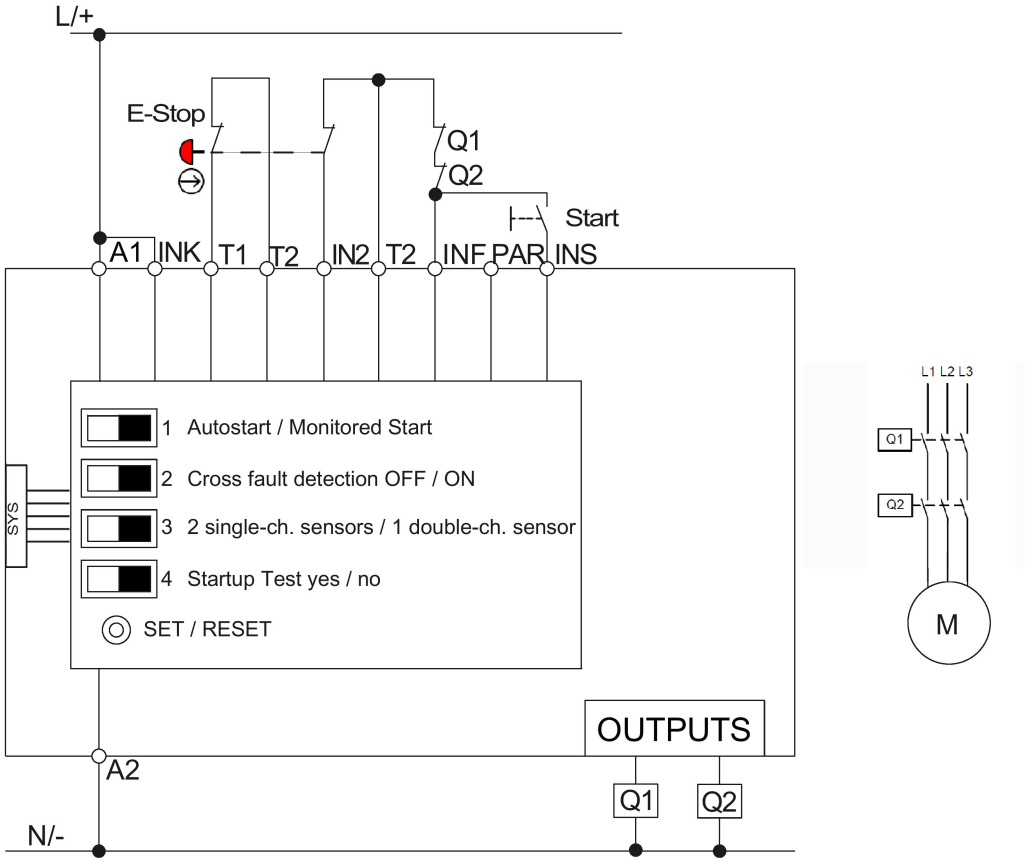
If sensors that require a monitored start are connected to multiple devices, the monitored start must be configured on each of these devices. In this case, it is not permissible to parameterize only the last device with monitored start and to wire the start button only to this device. The risk here is that, in the example shown above, the basic device (right) can store a starting command even though the emergency stop command device has not yet been unlocked. The machine would then start immediately after the emergency stop command device was unlocked.

**Start button INS:**

- One start button per device
- One start button per system set-up

### 8.9.2.4 No automatic start of a feedback circuit error correction

If the 3SK1 safety relay detects a feedback circuit error, it enters the safe state as long as the feedback circuit error persists. If a start signal is detected during this time, the device starts after the feedback circuit error has been eliminated.
This behavior can be changed with the start button interconnection shown below.



# 8.10 Cable lengths

## 8.10.1 3SK1111 Standard basic units

The sum of the cable lengths of all sensor circuits when using a copper cable with 1.5 mm² and a capacity of 150 nF/km must not exceed 2000 m.

This means that the total length of the cables for the three sensor inputs IN1, IN2 and IN3 (for non-floating sensors) and INF/S must not exceed 2000 m. The cable length includes the distances from the device to the sensors and back again.

Example:

- 2-channel EMERGENCY STOP at a distance of 400 m → 4 cables with 400 m each = 1600 m
- 2 contactors in the control cabinet at a distance of 4 m → 2 cables with 4 m each = 8 m

**Total:** 1600 m + 8 m = 1608 m < 2000 m
Result within the permissible cable length of < 2000 m

## 8.10.2 3SK1112; 3SK112 and 3SK122 cable lengths

### Cable length without use of the test outputs

The sum of the cable lengths per sensor circuit when using a copper cable with 1.5 mm² and a capacity of 150 nF/km must not exceed 4000 m.

The maximum cable length of 4000 m is only possible without using the test outputs (i.e. with external supply to the sensor and deactivated cross-circuit detection on the 3SK1).

This means that the total length of the cables (sum of the outgoing and return cables) for a two-channel sensor, for example, must not exceed 8000 m.

The difference to the 3SK1111 Standard basic units with relay enabling circuits is that the lengths of the cables of a sensor circuit must be taken into account and the sum does not have to be calculated across all sensor circuits.

Example:

- 2-channel EMERGENCY STOP at a distance of 400 m → 2 cables (one contact in each sensor circuit) with 400 m each = 800 m

**Total:** 800 m < 4000 m
Result within the permissible cable length of < 4000 m

### Cable length with use of the test outputs

When the inputs are controlled via the test outputs, the dynamic response of the signals results in a maximum cable length of 1000 m per sensor circuit.

Example:

- 2-channel EMERGENCY STOP at a distance of 400 m → 2 cables (one contact in each sensor circuit) with 400 m each = 800 m

**Total:** 800 m < 1000 m
Result within the permissible cable length of < 1000 m

**Note**

The cable lengths shown were determined for individual devices under the specified constraints. Electrical or electromagnetic interference from other devices or applications, such as cable routing, can affect the maximum achievable cable lengths.

The relevant EMC measures must still be taken into account.

# Commissioning

# 9

**Note**

Since commissioning of the 3SK1 safety relays is an important, safety-related step, it must be carried out by qualified personnel.

**⚠ WARNING**

**Hazardous voltage**

**Can cause death, serious injury, or property damage.**
**Carry out function test of the plant.**

To guarantee the safety of the system, a full functional test must be carried out and successfully concluded following commissioning.

# 9.1 Procedure for configuration

## 9.1.1 Procedure 3SK1 Standard

3SK1 Standard safety relays are commissioned by applying the operating voltage. They have only one slide switch, which is used to set the start type (automatic or monitored start). The switch must be set according to the desired start type.

The 3SK1 Standard safety relays with semiconductor outputs (3SK1112) are an exception. Like the 3SK1 Advanced safety relays, they have four DIP switches. The functions and setting options of the DIP switches on these devices are identical to those on the 3SK1 Advanced. Only device connectors cannot be used, and there is no option for NO/NC evaluation via the PAR input.

## 9.1.2 Procedure 3SK1 Advanced

**General:**

3SK1 Advanced safety relays are commissioned by applying the operating voltage.

After the supply voltage has been applied, all LEDs show a green light for about 1 s (lamp test).

The LEDs then go out for approx. 0.5 s. The device configuration is then displayed on the configuration LEDs for approx. 3 s.

If no configuration change (DIP, PAR, potentiometer, input expansion, output expansion) has been detected, the device changes automatically to safety mode and is ready for operation.

However, if the device detects a deviation of the set parameters from the saved configuration, it remains in safe configuration mode until the new configuration is accepted by pressing the SET/RESET button.

**Note**

**Observe the following during commissioning**

The cascading input must be bypassed (24 V DC) if it is not to be used.

Monitoring of the feedback circuits is not optional.

**General:**

- It is only possible to change the configuration (DIP switch, NC/NO evaluation, potentiometer, input and output expansion) in configuration mode. Modifications during operation are not accepted.
- A configuration change (DIP switch, NC/NO evaluation, potentiometer) is indicated in safety mode by the "DEVICE" LED flashing green/yellow, but does not change the device function.
- In safety mode, if a change in the system configuration (input and output expansion) is detected, the device switches to error mode ("DEVICE" LED and "SF" LED red). A restart is only possible using Power OFF/ON.

## Procedure for configuring a basic unit

1. Set the configuration (DIP, PAR, potentiometer, input expansion, output expansion) in accordance with the desired function.
2. Connect the supply voltage.
3. If the device detects a modified configuration, it remains in configuration mode (LEDs flash) during power up.
4. Confirm the new configuration by operating the SET/RESET pushbutton for more than 1s.
5. The configuration has been accepted and the device changes to safety mode.

**Note**

**Configuration and setting the delay time**

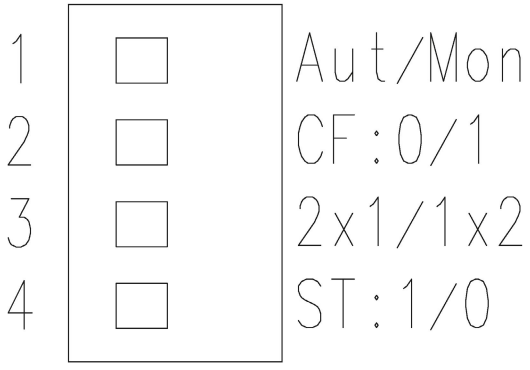
The configuration must only ever be modified after disconnecting the power supply.

In safety mode, an adjustment to the potentiometer does not result in a change to the parameterized delay time.
A change to the potentiometer setting made during operation is not accepted and is indicated in safety mode by a yellow/green flashing "DEVICE" LED. The device can be restarted by performing a RESET (pressing the SET/RESET button) or by disconnecting and reconnecting the supply voltage. Following a restart, the device remains in safety configuration mode during power up (all safety-related outputs are shut down) until the new delay time is accepted by pressing the SET/RESET button.

# 9.2 Setting the device functions

## 9.2.1 Setting the DIP switches

The assignment and sequence of the DIP switches is identical for all 3SK1 device variants that have 4 DIP switches.




### Explanation of the device functions (DIP switches)

| DIP switch | Parameter | Function |
|---|---|---|
| 1 | Start type | • **Autostart:** The safety-related outputs are switched to the active position as soon as the switch-on condition is satisfied at the sensor inputs IN1, IN2, INF and INK. The START button connecting terminal INS is not queried.<br>• **Monitored start:** The safety-related outputs are switched to the active position as soon as the switch-on condition is met at the IN1, IN2, INF and INK sensor inputs and the START button at the INS terminal is actuated (start with the falling edge). |
| 2 | Cross-circuit detection | Cross-circuit detection is only possible with floating sensors. The sensors must be connected between T1 - IN1 and T2 – IN2. At the terminals IN1 and PAR (if used), the test signal of terminal T1 is expected; at the terminals IN2 and INF , the test signal of T2 is expected. The device detects a sensor fault if the signal at the terminals IN1, PAR or IN2, INF does not match the test signals T1, T2.<br>Cross-circuit detection must be deactivated if electronic sensors such as light arrays or laser scanners are connected. The 3SK1 now no longer monitors the sensor inputs for cross-circuit detection. Usually, the outputs of safety sensors (OSSD) are already monitored for cross-circuits in the sensor. A 24 V signal at the PAR or INF terminals results in a fault (cross-circuit at the input). |
| 3 | Sensor evaluation | • **1 sensor with 2 contacts** 1 x two-channel; NC/NC.<br>It is expected here that both contacts be open simultaneously.<br>With the additional connection of T1 to PAR, this DIP parameterization applies to ONE two-channel sensor with NC/NO contacts.<br>• **2 sensors with one contact each** 2 x single-channel; NC / NC.<br>In this case, both sensors are AND-connected. Simultaneity is not monitored. |
| 4 | Startup testing | After a power failure, startup testing requires that the sensors at IN1 and IN2 are actuated once by the system operator. |

**Note**

**Note on discrepancy monitoring time for signal changes of a two-channel input signal for 3SK1 safety relays**

A discrepancy error is detected when a two-channel sensor switches on only one channel. This then leads to the enabling circuits being switched off and a change to the error state.

Both sensor contacts must be in the actuated position (NC open, NO closed) at any given time for the 3SK1 to be switched on again.

On 3SK1 safety relays, the discrepancy time (the time between the switching of the NC contact and the switching of the NO contact or between the switching of two NC contacts) is not monitored, i.e. it is infinite. It also does not matter which sensor contact opens or closes first.

Discrepancy monitoring is only active if the sensor evaluation is performed as a 1 x 2-channel sensor (DIP switch 3 on the right).
Discrepancy monitoring is available for floating and non-floating electronic OSSD inputs that are connected as 2-channel inputs.

Discrepancy cannot be monitored for connected 1-channel sensors (DIP switch 3 left).

## 9.2.2 Function of the cascading input (INK terminal)

- **Safe combination of safety relays**
  In this application, a higher-level safety relay switches off the 3SK1 safety relay via the cascading input via a safe output.
  Example:
  an EMERGENCY STOP circuit is to deactivate the entire installation as a higher-level circuit. Several function groups (e.g., protective doors) that disconnect locally can be operated as subordinate units.

**⚠ WARNING**

**Application / safety relay safety level**

The safety level PL/SIL of the application corresponds to the lowest safety level of a subsystem of the application when errors are excluded (protected wiring of the control cable).

- **Additional safety sensor circuit**
  The INK cascading input is AND-linked with the sensor inputs IN1, IN2.
  PL e according to ISO 13849-1, or SIL 3 according to IEC 62061 can be achieved if the cascading input is wired with 1-channel (positive opening) safety sensors (supply via A1 / +24 V, identical potential to A1) and if the connecting cable is laid in a protected fashion.
  The start function for the cascading input INK corresponds to the start response of sensor inputs IN1 and IN2 (autostart or monitored start).
  The cascading input INK can be controlled with floating or solid-state contact blocks (switching to P potential). Floating contact blocks must be connected between A1 / +24 V (identical potential to A1) and the cascading input.

- **Normal switching duty**
  The INK cascading input can also be used for normal switching duty (not safe). The INK cascading input can be controlled in this case with floating contact blocks or with solid-state contact blocks (switching to P potential).
  Floating contact blocks must be connected between A1 / +24 V and INK .
  It is important to note that the start function of cascading input INK corresponds to the start function of sensor inputs IN1, IN2 .

| **NOTICE** |
| --- |
| The operating cycles of operational switching must be taken into account when determining the wear life of electromechanical outputs due to use. |

## 9.2.3 Function of the parameterization input (PAR terminal)

The PAR parameterization input is used to set how two-channel sensors are to be evaluated by the device.
If the PAR input is not connected, sensor evaluation is performed on two NO contacts.
If there is a jumper between the test cycle output T1 and the PAR input, sensor evaluation is performed on an NC/NO combination.

**Note**

**Different behavior of the PAR input during two-hand operation**

If two-hand operation is to be used on the devices, the PAR input has a different function. In combination with the settings of the DIP switches Start type (1) and Sensor evaluation (3), the PAR input is used to activate two-hand evaluation:

- Jumper T1/PAR (NO/NC evaluation)
- DIP switches (1) Autostart
- DIP switches (3) 2x 1-channel

### 9.2.4 Setting of the delay time

On the 3SK1 device variants with potentiometers, this is used to set the time delay between the instantaneous and delayed outputs. There are different device variants with different time ranges.

To set the corresponding time, adjust the potentiometer with a screwdriver until the arrow tip of the potentiometer points to the corresponding value on the scale.

When using a 3SK1 safety relay with instantaneous and time-delayed contacts, the two following safety instructions must always be observed:

**NOTICE**

**In the event of external faults such as:**

- Cross circuit
- Short circuit to ground
- Current-source short circuit

and to access the configuration mode for copying a delay time after a reset, the following device behavior must always be taken into account:

The outputs of stop category 0 switch instantaneously, while the outputs of stop category 1 have a time delay.
The sequence cannot be interrupted.
Exception: Switching off the power supply.

**NOTICE**

**Saving the starting command:**

1. If the safe state is restored during the delay time (e.g. the protective door is closed) and the START button is actuated, the safety-related outputs switch to the active position immediately after the delay time has elapsed.
   The actuation of the START button is saved.
   The OFF-delayed enabling contacts or outputs of the 3SK112-CB4 safety relays. (Relay and semiconductor outputs) cannot be retriggered. This means that if an OFF command in the sensor circuit is canceled before the delay time has elapsed, the delay time still elapses in full length. If a starting command has been issued during this time or if autostart has been set, after this time has elapsed the OFF-delayed enabling contacts switch off briefly and switch on again immediately with the instantaneous enabling contacts (starting command is saved).
2. If a sensor is actuated at an input expansion within the system configuration, the entire system is disconnected. If the sensor at the input expansion is activated (e.g. protective door is open) and the START button on the basic unit is actuated, this command will be saved by the basic unit. This results in an automatic start of the system once the sensor at the input expansion is reset (for example, a protective door is closed again). This system response is identical in the system configuration for all 3SK1 basic units.

For additional notes/explanations on this topic, see the following FAQ

| NOTICE |
| --- |
| **Observe the following in the case of protective doors with tumblers:** |
| If the voltage $U_s$ is disconnected on devices with time-delayed outputs between switching the instantaneous outputs and the time-delayed outputs, the delay time expires when the voltage $U_s$ is restored, and the time-delayed contacts change their switch positions. |

## 9.2.5 Setting the start method

Some 3SK1 Standard device variants have only a single slide switch on the front of the device. This switch is used to set the start behavior of these devices.

- Switch position up (AUTO), an automatic start takes place
- Switch position down (MONITORED), a monitored start takes place. This means that a valid start signal must be detected at the start input in order to start the application.

On the 3SK1 Advanced and some 3SK1 Standard device variants with four DIP switches, the start type is set using DIP switch 1. For more information, see chapter Setting the DIP switches (Page 218).

## 9.2.6 Assignment of the output expansions

The 3SK12 output expansions for an operating voltage of 24 V DC have a slide switch on the front of the device. If these output expansions are used in a system configuration with device connectors, the switch is used to determine whether the output expansion switches synchronously with the delayed or undelayed outputs of the basic unit.
If the output expansions are operated via terminals A1 and A2 directly on the device, i.e. without using device connectors, the switch has no function.

- Switch position up (DELAYED), the expansion switches synchronously with the delayed outputs of the basic unit
- Switch position down (UNDELAYED), the expansion switches synchronously with the undelayed outputs of the basic unit

The 3SK12 output expansions for other voltage ranges do not have a slide switch, as they cannot be used with device connectors. They are always operated via terminals A1 and A2.

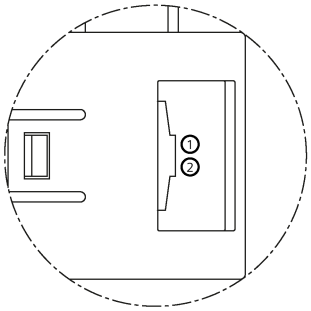
**Note**

**3RM1 motor starters and 3RQ1 coupling relays do not have a switch**

The 3RM1 motor starters and 3RQ1 coupling relays do not have a switch, although they can be operated with device connectors.
These devices always respond synchronously to the undelayed outputs of the basic units.

### 9.2.7 Setting the device termination connectors

The device termination connectors have a slide switch. This must be set depending on the installation location.




① Under 3SK1211 and 3RQ1 output expansion with 22.5 mm width: The switch of the device termination connector must be closed, i.e. in position 1 at the top.

② Below basic unit: The switch of the device termination connector must be open, i.e. in position 2 at the bottom.

More information is provided in chapter System design (Page 69).

## 9.3 Transfer of the selected parameters

### Procedure for transferring the parameters to a basic unit

1. Set the configuration (DIP, PAR, potentiometer, input expansion, output expansion) according to the desired function.
2. Connect the supply voltage.
3. If the device detects a modified configuration, during start-up it remains in configuration mode (LEDs flashing).
4. Confirm the new configuration by actuating the SET/RESET button for more than 1 s.
5. The configuration has been accepted and the device changes to safety mode.

### General

- It is only possible to change the configuration (DIP switch, NC/NO evaluation, potentiometer, input and output expansion) in configuration mode.

Modifications during operation are not accepted.

- A configuration change (DIP switch, NC/NO evaluation, potentiometer) is indicated in safety mode by the "DEVICE" LED flashing green/yellow, but does not change the device function.
- In safety mode, if a change in the system configuration (input and output expansion) is detected, the device switches to error mode ("DEVICE" LED and "SF" LED red). A restart is only possible with Power OFF/ON.

**Note**

**Configuration and setting the delay time**

The configuration must only ever be modified after disconnecting the power supply.

In safety mode, an adjustment to the potentiometer does not result in a change to the parameterized delay time. A changed potentiometer setting made during operation is not accepted and is indicated in safety mode by a yellow/green flashing "DEVICE" LED. A RESET (pressing the SET/RESET button) or switching the supply voltage off and on again will restart the device. After restarting, the device remains in safe configuration mode during start-up (all safety-related outputs are switched off) until the new delay time is accepted by pressing the SET/RESET button.

## 9.4 Response times

### Verification of response times in the case of safety circuits

When safety equipment is commissioned, steps must be taken to verify that a safety-related output will switch off within a maximum permissible response time if the input signal changes at the relevant input.

To provide this verification, you must determine the total response time of the application you have configured.

**⚠ WARNING**

**Hazardous system state**
**Can cause death, serious injury, or property damage.**

Note that the calculation of the response time affects the level of safety and governs the overall design of the system.

The response times can be found in the data sheets for the respective devices in Siemens Industry Online Support.

### Calculation of the response times

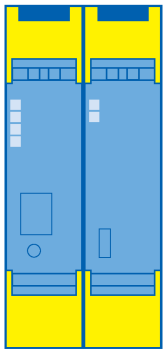
To calculate the response times of the overall system configuration, you must add up the individual response times of all input expansions affected by deactivation and also the response time of the basic unit.

If output expansions are used, the response times of the relevant output module are also added to the total time from the sensor to the actuator.

| Overview of response times | |
|---|---|
| 3SK1220 input expansion | 40 ms |
| 3SK1112* basic unit | 40 ms |
| 3SK1211 output expansion | 10 ms |
| 3SK1213 output expansion | 20 ms |
| 3RM1 fail-safe motor starter | 120 ms |
| 3RQ1 force-guided coupling relays | 35 ms |

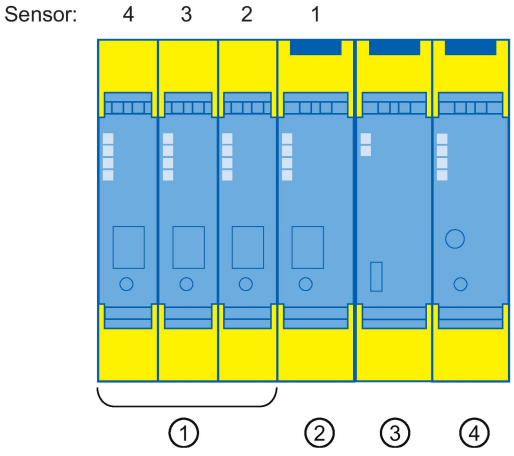
## Examples

**Example 1**
3SK1121-.AB40 + 3SK1211.BB40



Response time: 40 ms 50 ms

**Example 2**
3 x 3SK1220 + 3SK1122-.AB40 + 3SK1211-.BB40 + 3RM1 Failsafe motor starter




① 3SK1220 input expansions
② 3SK1122 basic unit
③ 3SK1211 output expansion
④ 3RM1 Failsafe motor starter

Abbreviations in the following formulas:
GG = basic unit; EE = input expansion; AE = output expansion

In the event of shutdown by sensor 1, the total response time is calculated as follows:

- Basic unit = 40 ms
- 3SK1211 output expansion = GG + AE = 40 ms + 10 ms = 50 ms
- 3RM1 Failsafe = GG + 3RM1 Failsafe = 40 ms + 3RM1 Failsafe motor starter response time

In the event of shutdown by sensor 3, the total response time is calculated as follows:

- Basic unit = GG + EE 1 + EE 2 = 3 x 40 ms = 120 ms
- 3SK1211 output expansion = GG + EE 1 + EE 2 + AE 3SK1211 = 120 ms + 10 ms = 130 ms
- 3RM1 Failsafe = 120 ms + 3RM1 Failsafe motor starter response time

In the event of shutdown by sensor 4, the total response time is calculated as follows:

- Basic unit = 3 x EE response time + GG response time = 160 ms
- 3SK1211 output expansion = total response time EE with GG + AE = 170 ms
- 3RM1 Failsafe = 160 ms + 3RM1 Failsafe motor starter response time

# Diagnostics

# 10

## 10.1 3SK1 Standard

| LED | | Operation | | | |
|---|---|---|---|---|---|
| **DEVICE** | **OUT** | **Line** | **Sensor** | **START button** | **Safety-related output** |
| Green | Green | ON | Not actuated | Actuated | Closed |
| Green | OFF | | Actuated | - | Open |
| Green | OFF | | Not actuated | - | Open |
| | | **Error** | | | |
| OFF | OFF | Cross circuit or no power supply | | | Open |

# 10.2 3SK1 Advanced basic units and input expansion

## 10.2.1 Overview

| LED | Display | Explanation |
|---|---|---|
| (1) DEVICE | OFF* | No voltage, group error<br>Configuration mode DIP (1) position: **left** |
| | Green | Device is ready for operation<br>Power-up: hardware test |
| | Green flashing | No startup testing<br>Short-circuit on the SET/RESET button |
| | Yellow | Power-up DIP (1) position: **right** |
| | Yellow flashing | Configuration mode DIP (1) position: **right** |
| | Green/yellow flashing | Configuration changed |
| | Red | Device error |
| (2) OUT | OFF* | Output inactive<br>Configuration mode DIP (2) position: **left** |
| | Green | Output active<br>Power-up: hardware test |
| | Green flashing | Feedback circuit error<br>Short-circuit on the SET/RESET button |
| | Yellow | Power-up DIP (2) position: **right** |
| | Yellow flashing | Configuration mode DIP (2) position: right<br>START button pressed too long |
| | Green/yellow flashing | Instantaneous outputs inactive, delayed outputs active |
| (3) IN | OFF* | Start conditions not fulfilled<br>Configuration mode DIP (3) position: **left** |
| | Green | Start conditions fulfilled<br>Power-up: hardware test |
| | Green flashing | • If 1 x two-channel: Simultaneity of sensors not fulfilled<br>• Two-hand operation: time monitoring violated<br>• With monitored start: START button not yet pressed<br>Short-circuit on the SET/RESET button |
| | Yellow | Power-up DIP (3) position: **right** |
| | Yellow flashing | Short-circuit of T1/T2 to ground or 24 V<br>With input expansion: missing enabling signal of input expansion<br>Group error: Cross circuit at input<br>Configuration mode DIP (3) position: **right** |
| | Flickering yellow | Configuration mode: Special two-hand operation configuration |
| | Flickering red | Configuration mode: impermissible configuration |

| LED | Display | Explanation |
|---|---|---|
| (4) SF | OFF* | No group error,<br>Configuration mode DIP (4) position: **left** |
| | Green | Power-up: hardware test |
| | Green flashing | Short-circuit on the SET/RESET button |
| | Yellow | Power-up DIP (4) position: **right** |
| | Yellow flashing | Configuration mode DIP (4) position: **right** |
| | Red | Group error, e.g. cross-circuit at input, short-circuit to P, device configuration changed. |
| | Red flashing | Error message (e.g. short-circuit T1/T2, violation of simultaneity, violation of two-hand operation timeout, feedback circuit error, START-button pressed too long, connection of control supply voltage (A1/A2) to an expansion unit that is connected via a device connector) |

* LED flashes briefly in configuration mode due to lamp test

## 10.2.2 Power-up

### Display mode during power-up / parameterization in configuration mode

| LED | Display | Explanation |
|---|---|---|
| (1) DEVICE | Yellow or yellow flashing | Monitored start |
| | OFF | Autostart |
| (2) OUT | Yellow or yellow flashing | Cross-circuit detection ON |
| | OFF | Cross-circuit detection off |
| (3) IN | Yellow or yellow flashing | 1 x two-channel |
| | Flickering yellow | Configuration mode: Special two-hand operation configuration |
| | Flickering red | Configuration mode: impermissible configuration |
| | OFF | 2 x single-channel |
| (4) SF | Yellow or yellow flashing | Startup testing off |
| | OFF | Startup testing ON |

## 10.2.3 Error statuses

| LED | Display | Explanation |
|---|---|---|
| (1) DEVICE | Red | Device error |
| (4) SF | Red | Group error |
| | Red flashing | Fault message |

## 10.2.4 Diagnostics

### Power-up

| Explanation | DEVICE | OUT | IN | SF |
|---|---|---|---|---|
| Hardware test<br>Note: Input expansions remain in this state until acknowledged by the device on the right-hand side. | Green | Green | Green | Green |
| The SET/RESET button is stuck, or has been pressed too long. The device remains in this state until the button is released again. | Green flashing | Green flashing | Green flashing | Green flashing |
| Display of DIP switch configuration. | If the DIP switch position is at ON (right), the relevant LED shows a yellow light. | | | |

### Configuration

| Explanation | DEVICE | OUT | IN | SF |
|---|---|---|---|---|
| Indication of a modified configuration. | If the DIP switch position is at ON (right), the relevant LED flashes yellow | | | |
| Special configuration, two-hand operation<br>NC/NO, autostart, 2 x single-channel. | Off | If the DIP switch position is at ON (right), the relevant LED flashes yellow | Flickering yellow | If the DIP switch position is at ON (right), the relevant LED flashes yellow |
| Impermissible configuration<br>NC/NO, monitored start, 2 x single-channel | Yellow flashing | If the DIP switch position is at ON (right), the relevant LED flashes yellow | Flickering red | If the DIP switch position is at ON (right), the relevant LED flashes yellow |
| All DIP switches are in OFF position (left) | All LEDs light up briefly (yellow) at intervals | | | |

## Safety mode

| Explanation | DEVICE | OUT | IN | SF |
|---|---|---|---|---|
| No startup testing. | Green flashing | Off | Off | Off |
| Device ready for operation, all outputs OFF. | Green | Off | Off | Off |
| Device ready for operation, all outputs ON. | Green | Green | Green | Off |
| Device ready for operation, instantaneous outputs OFF, time-delayed outputs ON. | Green | Green/yellow flashing | Off | Off |
| If "monitored start": START button not yet pressed. | Green | Off | Green flashing | Off |
| With input expansion: Missing enabling signal of input expansion. | Green | Off | Yellow flashing | Off |
| Configuration has been changed (PAR, DIP switch, potentiometer) | Green/yellow flashing | — [1] | — [1] | — [1] |
| If 1 x two-channel: Simultaneity violated<br>If two-hand operation: Time monitoring violated. | Green | Off | Green flashing | Red flashing |
| Short-circuit test clock output T1 or T2 | Green[2] | Off | Yellow flashing | Red flashing |
| If "monitored start": START button was pressed too long or has a short-circuit. | Green | Yellow flashing | Off | Red flashing |
| Feedback circuit error | Green | Green flashing | Green | Red flashing |

[1] Dependent on device status
[2] Green flashing DEVICE LED: No startup testing

## Error mode

| Explanation | DEVICE | OUT | IN | SF |
|---|---|---|---|---|
| Device error<br>Restart possible by pressing the SET/RESET button. | Red | Off[3] | Off[3] | Off[3] |
| Group error<br>Restart possible by pressing the SET/RESET button | Off[3] | Off[3] | Off[3] | Red |
| Group error, cross-circuit at input<br>Restart possible by pressing the SET/RESET button. | Off[3] | Off[3] | Yellow flashing[3] | Red |
| System stop<br>Restart only possible by disconnecting and re-connecting the operating voltage. | Red | Off[3] | Off[3] | Red |

[3] On time-delayed devices, the LED flashes green/yellow provided the time-delayed outputs are still switched on

# 11 Technical data

## 11.1 Technical specifications in the Siemens SiePortal

### Technical data sheet

You can find the technical specifications for the product in Siemens SiePortal.

1. Enter the article number of the desired device in the "Products" field.
2. Click the "Technical specifications" link in the result.

### See also

SIOS technical specifications (https://support.industry.siemens.com/cs/ww/en/ps/)

## 11.2 Overview tables

### Overview tables technical data

You will find overview tables with technical data in the "Product information" tab in our online ordering system (https://sieportal.siemens.com/en-us/products-services/10143262?tree=CatalogTree).

## 11.3 Switching capacity of the solid-state outputs

The switching capacity of semiconductor outputs at DC-13 / 24 V refers to the current carrying capacity of a single safe output.

- Maximum load per output:
- 3SK1112 / 3SK1122 - 2 A
- 3SK1120 - 0.5 A
- Signaling output - 0.5 A

The maximum permissible total current of all outputs is always the total loading of all individual outputs.

This results in the following values:

| **Safety relay** | **Max. permissible total current** |
|---|---|
| 3SK1112 | 4.5 A |
| 3SK1120 | 0.5 A |
| 3SK1122-.AB40 | 6.5 A |
| 3SK1122-.CB4. | 8 A |

## 11.4 Electrical endurance

You can find FAQs and more tables on the topic of electrical endurance on the Internet (https://support.industry.siemens.com/cs/us/en/view/109995353).

### 11.4.1 Electrical endurance of 3SK1 basic units

#### Electrical endurance of 3SK1 safety relays for the following device versions

3SK1121-.AB40
3SK1111-.AB30
3SK1111-.AW20
3SK1211-.BB40
3SK1211-.BB00
3SK1211-.BW20
3RQ1000-.HB00
3RQ1000-.LB00
3RQ1000-.HW00
3RQ1000-.LW00

| Utilization category | $U_e$ (V) | $I_e$ (A) | $B10_d$ value (operating cycles) | Electrical endurance of safety-related outputs (typical) |
|---|---|---|---|---|
| AC-1 | 240 | 5 | 500,000 | 85,000 |
| | | 4 | 860,000 | 140,000 |
| | | 2 | 1,300,000 | 210,000 |
| AC-15 | 240 | 4 | 300,000 | 50,000 |
| | | 3 | 850,000 | 85,000 |
| | | 1 | 1,100,000 | 120,000 |
| DC-13 | 24 | 5 | 300,000 | 50,000 |
| | | 2 | 2,000,000 | 230,000 |
| | | 1 | 7,000,000 | 1,100,000 |
| DC-1 | 24 | 5 | | 500,000 |

## 11.4.2 Electrical endurance of 3SK1121-.CB4. basic unit, time-delayed

### Electrical endurance of 3SK1 safety relays for the version 3SK1121-.CB4.

| Utilization category | $U_e$ (V) | $I_e$ (A) | $B10_d$ value (operating cycles) | Electrical endurance of safety-related outputs (typical) |
|---|---|---|---|---|
| AC-1 | 240 | 5 | 500,000 | 100,000 |
| | | 4 | 600,000 | 100,000 |
| | | 2 | 1,000,000 | 170,000 |
| AC-15 | 240 | 3 | 400,000 | 70,000 |
| | | 0.1 | 10,000,000 | 1,500,000 |
| DC-13 | 24 | 3 | 450,000 | 110,000 |
| | | 1 | 2,000,000 | 480,000 |
| DC-1 | 24 | 5 | | 500,000 |

## 11.4.3 Electrical endurance of 3SK1213 output expansion

### Electrical endurance of 3SK1 safety relays for the following device versions

3SK1213-.AB40

3SK1213-.AJ20

3SK1213-.AL20

| Utilization category | $U_e$ (V) | $I_e$ (A) | $B10_d$ value (operating cycles) | Electrical endurance of safety-related outputs (typical) |
|---|---|---|---|---|
| AC-1 | 240 | 10 | 1,370,000 | 1,000,000 |
| AC-15 | 240 | 10 | 1,370,000 | 1,000,000 |
| DC-13 | 24 | 6 | 1,370,000 | 1,000,000 |

## 11.4.4 Electrical endurance when using in furnaces according to EN 50156-2

### Electrical endurance of 3SK1 safety relays

**Note**

In order to rule out faults when using the devices to equip furnaces in accordance with EN 50156-2, the load (utilization category) listed below must not be exceeded.

If fault exclusion is not necessary, the same values apply to the wear-related service life as for use in functional safety.

The electrical endurance is ≥ 250,000 operating cycles under the following conditions:

| **Utilization category** | **3SK111; 3SK1121; 3SK1211; 3RQ1000-.HB00; 3RQ1000-.LB00; 3RQ1000-.HW00; 3RQ1000-.LW00** | **3SK1213** |
|---|---|---|
| AC-1, 240 V | 1.5 A | 10.0 A |
| AC-15, 240 V | 0.2 A | 10.0 A |
| DC-13, 24 V | 2.0 A | 3.0 A |

## 11.5 Short-circuit protection of the relay enabling circuits

In order to protect the relay outputs of the devices from welding and thus from the possible loss of the safety function, they must be protected accordingly.
Possible methods of protection are:

- Fuses
- Miniature circuit breakers
- SITOP Select selectivity modules

**Note**

**Short-circuit protection for 3SK1..2 devices with semiconductor outputs**

The safe outputs and the signaling circuit are short-circuit-proof. They have one short-circuit-proof driver each. In addition, the outputs are deactivated in the event of a short-circuit.

### 11.5.1 Fuses and miniature circuit breakers

Information on protection with fuses and miniature circuit breakers can be found in the data sheets for the respective devices. For more information, see the Technical specifications (Page 235) section.

If you are not using a power supply from the SITOP series listed, you can determine suitability by referring to the technical specifications of the power supply unit you are using.
Observe the following conditions for this purpose:
**4A - Characteristic A**

Make sure that a current of at least 13 A flows for 20 ms or 20 A for 10 ms in the event of a short-circuit at the actuator (downstream of enabling circuit).

**4A - Characteristic B**

Make sure that a current of at least 22 A flows for 20 ms or 40 A for 10 ms in the event of a short-circuit at the actuator (downstream of enabling circuit).

**4A - Characteristic C**

Make sure that a current of at least 40 A flows for 20 ms or 80 A for 10 ms in the event of a short-circuit at the actuator (downstream of enabling circuit).

### Short-circuit protection with fuses and miniature circuit breaker at voltages up to 300 V

The following are generally released for short-circuit protection of the NO and NC contacts up to the rated insulation voltage value of 300 V:

- 3SK1..1 safety relays
- Fuse links: gL/gG: 6 A or
- Miniature circuit breaker type A: 3 A or type B: 2 A or type C: 1 A

**Note**

It is not possible to use MCBs with higher rated values for 3SK1213 safety relays. The maximum current is only achieved with melting fuses.

**Note**

In the case of 3SK1..2 and 3SK1120 (devices with semiconductor outputs with firmware (FW) version V1.0.0 and product version E01) it is not possible to achieve PL d/e / Cat. 3/4 according to ISO 13849-1 or SIL 2/3 according to IEC 62061 with the wiring shown above.

## 11.5.2 Use of miniature circuit breakers and SITOP power supply units

### Miniature circuit breaker characteristic A:

| Size of miniature circuit breaker | SITOP power supply unit(s) (article number) |
|---|---|
| 1 A | **2.5 A rated current:**<br>6EP1332-2BA10<br>**5 A rated current:**<br>6EP1333-3BA00, 6EP1333-2BA01, 6EP1333-2AA01<br>**10 A rated current:**<br>6EP1334-3BA00, 6EP1334-2BA01, 6EP1334-2AA01, 6EP1434-2BA10<br>**20 A rated current:**<br>6EP1336-3BA00, 6EP1336-3BA10, 6EP1436-3BA00, 6EP1436-3BA10, 6EP1436-2BA10<br>**40 A rated current:**<br>6EP1337-3BA00, 6EP1437-3BA00, 6EP1437-3BA10, 6EP1437-2BA20 |
| 1.6 A | **5 A rated current:**<br>6EP1333-3BA00, 6EP1333-2BA01, 6EP1333-2AA01<br>**10 A rated current:**<br>6EP1334-3BA00, 6EP1334-2BA01, 6EP1334-2AA01, 6EP1434-2BA10<br>**20 A rated current:**<br>6EP1336-3BA00, 6EP1336-3BA10, 6EP1436-3BA00, 6EP1436-3BA10, 6EP1436-2BA10<br>**40 A rated current:**<br>6EP1337-3BA00, 6EP1437-3BA00, 6EP1437-3BA10, 6EP1437-2BA20 |
| 2 A | **5 A rated current:**<br>6EP1333-3BA00, 6EP1333-2BA01, 6EP1333-2AA01<br>**10 A rated current:**<br>6EP1334-3BA00, 6EP1334-2BA01, 6EP1334-2AA01, 6EP1434-2BA10<br>**20 A rated current**:<br>6EP1336-3BA00, 6EP1336-3BA10, 6EP1436-3BA00, 6EP1436-3BA10, 6EP1436-2BA10<br>**40 A rated current:**<br>6EP1337-3BA00, 6EP1437-3BA00, 6EP1437-3BA10, 6EP1437-2BA20 |
| 3 A | **5 A rated current:**<br>6EP1333-2BA01, 6EP1333-2AA01<br>**10 A rated current:**<br>6EP1334-3BA00, 6EP1334-2BA01, 6EP1334-2AA01, 6EP1434-2BA10<br>**20 A rated current:**<br>6EP1336-3BA00, 6EP1336-3BA10, 6EP1436-3BA00, 6EP1436-3BA10, 6EP1436-2BA10<br>**40 A rated current:**<br>6EP1337-3BA00, 6EP1437-3BA00, 6EP1437-3BA10, 6EP1437-2BA20 |
| 4 A | **10 A rated current:**<br>6EP1334-3BA00, 6EP1334-2BA01, 6EP1334-2AA01<br>**20 A rated current:**<br>6EP1336-3BA00, 6EP1336-3BA10, 6EP1436-3BA00, 6EP1436-3BA10, 6EP1436-2BA10<br>**40 A rated current:**<br>6EP1337-3BA00, 6EP1437-3BA00, 6EP1437-3BA10, 6EP1437-2BA20 |

### Miniature circuit breaker characteristic B:

| Size of miniature circuit breaker | SITOP power supply unit(s) (article number) |
|---|---|
| 1 A | **20 A rated current:**<br>6EP1336-3BA00, 6EP1336-3BA10, 6EP1436-3BA00, 6EP1436-3BA10<br>**40 A rated current:**<br>6EP1337-3BA00, 6EP1437-3BA00, 6EP1437-3BA10, 6EP1437-2BA20 |
| 1.6 A | |
| 2 A | |
| 3 A | |
| 4 A | |

### Miniature circuit breaker characteristic C:

| Size of miniature circuit breaker | SITOP power supply unit(s) (article number) |
|---|---|
| 1 A | **5 A rated current:**<br>6EP1333-3BA00, 6EP1333-2BA01, 6EP1333-2AA01<br>**10 A rated current:**<br>6EP1334-3BA00, 6EP1334-2BA01, 6EP1334-2AA01, 6EP1434-2BA10<br>**20 A rated current:**<br>6EP1336-3BA00, 6EP1336-3BA10, 6EP1436-3BA00, 6EP1436-3BA10, 6EP1436-2BA10<br>**40 A rated current:**<br>6EP1337-3BA00, 6EP1437-3BA00, 6EP1437-3BA10, 6EP1437-2BA20 |
| 1.6 A | **10 A rated current:**<br>6EP1334-3BA00, 6EP1334-2BA01, 6EP1334-2AA01<br>**20 A rated current:**<br>6EP1336-3BA00, 6EP1336-3BA10, 6EP1436-3BA00, 6EP1436-3BA10, 6EP1436-2BA10<br>**40 A rated current:**<br>6EP1337-3BA00, 6EP1437-3BA00, 6EP1437-3BA10, 6EP1437-2BA20 |
| 2 A | **10 A rated current:**<br>6EP1334-3BA00, 6EP1334-2BA01, 6EP1334-2AA01<br>**20 A rated current:**<br>6EP1336-3BA00, 6EP1336-3BA10, 6EP1436-3BA00, 6EP1436-3BA10, 6EP1436-2BA10<br>**40 A rated current:**<br>6EP1337-3BA00, 6EP1437-3BA00, 6EP1437-3BA10, 6EP1437-2BA20 |
| 3 A | **20 A rated current:**<br>6EP1336-3BA00, 6EP1336-3BA10, 6EP1436-3BA00, 6EP1436-3BA10<br>**40 A rated current:**<br>6EP1337-3BA00, 6EP1437-3BA00, 6EP1437-3BA10, 6EP1437-2BA20 |
| 4 A | **20 A rated current:**<br>6EP1336-3BA00, 6EP1336-3BA10, 6EP1436-3BA00, 6EP1436-3BA10<br>**40 A rated current:**<br>6EP1337-3BA00, 6EP1437-3BA00, 6EP1437-3BA10, 6EP1437-2BA20 |

### 11.5.3 Use of miniature circuit breakers and other 24 V DC power supply units

SIRIUS 3SK1 safety relays can be protected against short-circuit in 24 V DC circuits with MCBs up to 4 A.

However, the size of the MCB able to be used depends a great deal on the size of the power supply unit used. Not every 24 V DC power supply unit is able to trigger the MCBs used fast enough and therefore prevent the destruction of the relay contacts in the event of a short-circuit.

If you are not using a power supply from the SITOP series listed, you can determine suitability by referring to the technical specifications of the power supply unit you are using.
Observe the following general conditions:

- **4A - Characteristic A**

Make sure that a current of at least 13 A flows for 20 ms or 20 A for 10 ms in the event of a short-circuit at the actuator (downstream of enabling circuit).

- **4A - Characteristic B**

Make sure that a current of at least 22 A flows for 20 ms or 40 A for 10 ms in the event of a short-circuit at the actuator (downstream of enabling circuit).

- **4A - Characteristic C**

Make sure that a current of at least 40 A flows for 20 ms or 80 A for 10 ms in the event of a short-circuit at the actuator (downstream of enabling circuit).

### 11.5.4 Use of fuses and miniature circuit breaker at voltages up to 300 V

The following are generally released for short-circuit protection of the NO and NC contacts up to the rated insulation voltage value of 300 V:

**3SK1..1 safety relays**
Fuse links: gL/gG: 6 A
or
miniature circuit breaker type A: 3 A or type B: 2 A or type C: 1 A

**3SK1213 safety relays**
Fuse links: gL/gG: 16 A
or
miniature circuit breaker type A: 6 A or type B: 4 A or type C: 4 A

**Note**

It is not possible to use MCBs with higher rated values for 3SK1213 safety relays. The maximum current is only achieved with melting fuses.

### 11.5.5 SITOP Select selectivity modules

It is also permissible to protect the contacting enabling and signaling circuits of the SIRIUS SK1..1 and 3SK1..3 safety relays with the following modules. However, the set rated current of the output used must not exceed the maximum permissible continuous thermal current of the respective enabling or signaling circuit.

- 6EP1961-2BA00 (SITOP Select)
- 6EP1961-2BA21 / 6EP1961-2BA41 (SITOP PSE200U 4 x 10 A)
- 6EP4437-7FB00-3CX0 (SITOP SEL1200 4 x 10 A)
- 6EP4438-7FB00-3DX0 (SITOP SEL1200 8 x 10 A)
- 6EP4438-7FC00-3DX0 (SITOP SEL1200 Ex 8 x 10 A)
- 6EP4437-7EB00-3CX0 (SITOP SEL1400 4 x 10 A)
- 6EP4438-7EB00-3DX0 (SITOP SEL1400 8 x 10 A)
- 6EP4438-7EC00-3DX0 (SITOP SEL1400 Ex 8 x 10 A)

## 11.6 Short-circuit protection of semiconductor outputs

The safe outputs and the signaling circuit of the 3SK1..2 devices are short-circuit-proof. They have one short-circuit-proof driver each. In addition, the outputs are deactivated in the event of a short-circuit.

## 11.7 At installation altitudes above 2000 m

If SIRIUS 3SK1 safety relays are used at installation altitudes of up to 2000 m above mean sea level, the information in the respective data sheets applies. The devices can also be used at installation altitudes of up to 4000 m above mean sea level. Compared to an installation altitude of 2000 m above sea level, the following conditions must be observed.

1. **Mains / main power feed:**

- Maintaining the maximum permissible system voltage of 300 V with reduced overvoltage category II (e.g. isolating transformer or by using surge arresters or line filters)
- Reducing the system voltage to ≤ 150 V according to IEC 60664-1 (e.g. 115 V mains) while maintaining overvoltage category III

**2. Cooling**

Reduction of the previous maximum ambient temperature to 80% (from 60° C to 48° C).

**3. Error rate**

The safety parameters must be adjusted for the following devices:

3SK1112-xBB40 PFD4000m 1.8 x 10-05
3SK1120-xAB40 PFD4000m 1.8 x 10-05
3SK1121-xAB40 PFD4000m 1.8 x 10-05
3SK1121-xCB4y PFD4000m 1.8 x 10-05
3SK1122-xAB40 PFD4000m 1.8 x 10-05
3SK1122-xCB4y PFD4000m 1.8 x 10-05
3SK1220-xAB40 PFD4000m 1.8 x 10-05

The safety characteristics of all other 3SK1 devices remain unchanged.

# Dimension drawings

# 12

## 12.1 CAx data in the Siemens SiePortal

You can find CAx data for the product in the SiePortal (https://support.industry.siemens.com/cs/ww/en/ps/).

1. Enter the article number of the desired device in the "Products" field.
2. Click the "CAx data" link in the result.

# Circuit diagrams

# 13

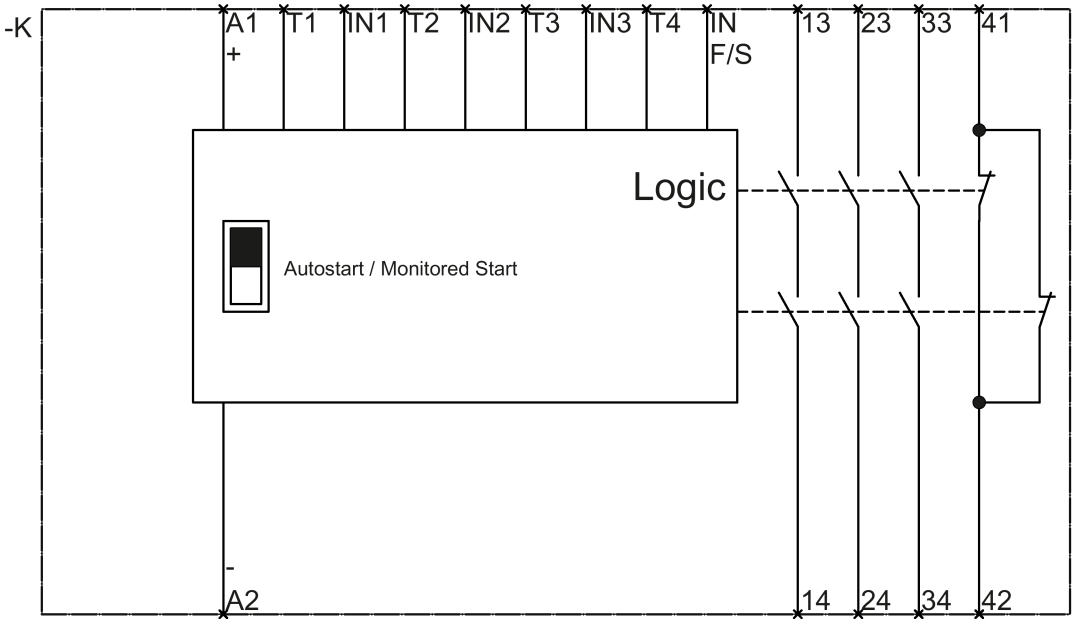
## 13.1 CAx data in the Siemens SiePortal

You can find CAx data for the product in the SiePortal (https://support.industry.siemens.com/cs/ww/en/ps/).

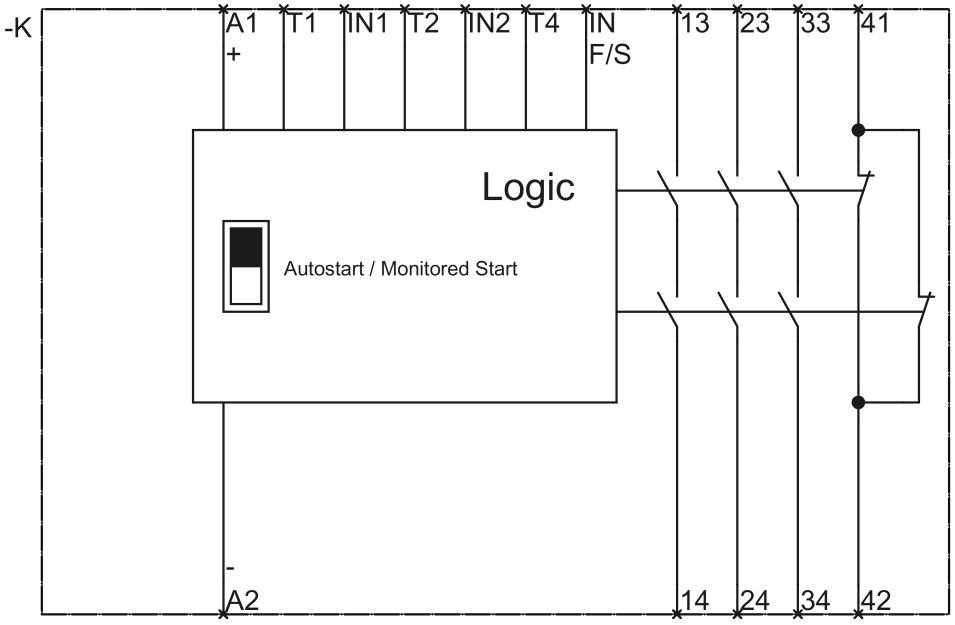
1. Enter the article number of the desired device in the "Products" field.
2. Click the "CAx data" link in the result.

## 13.2 Internal circuit diagrams for 3SK1 Standard basic units

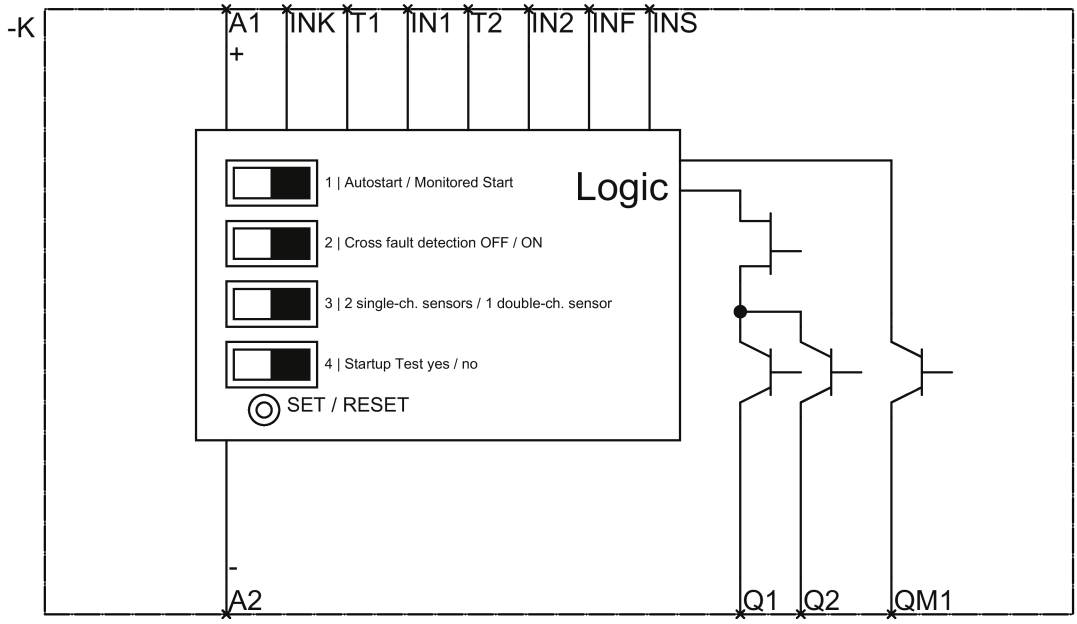
**Basic unit 3SK1111-.AB30 Standard relay instantaneous (24 V)**




**Basic unit 3SK1111-.AW20 Standard relay instantaneous (110 - 240 V)**

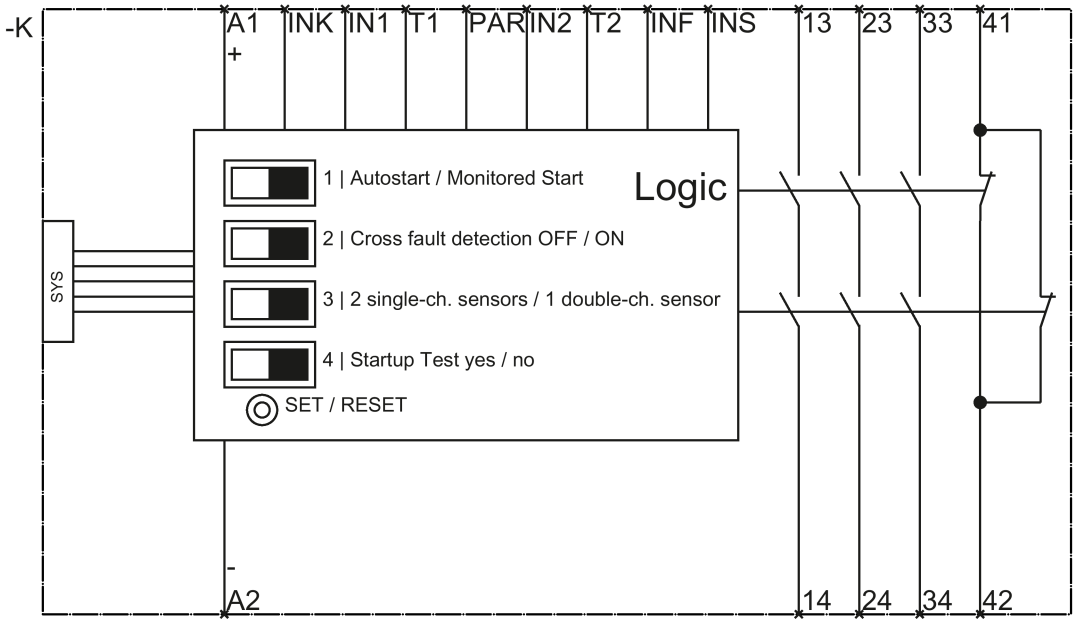


## Basic unit 3SK1112-.BB40 Standard instantaneous

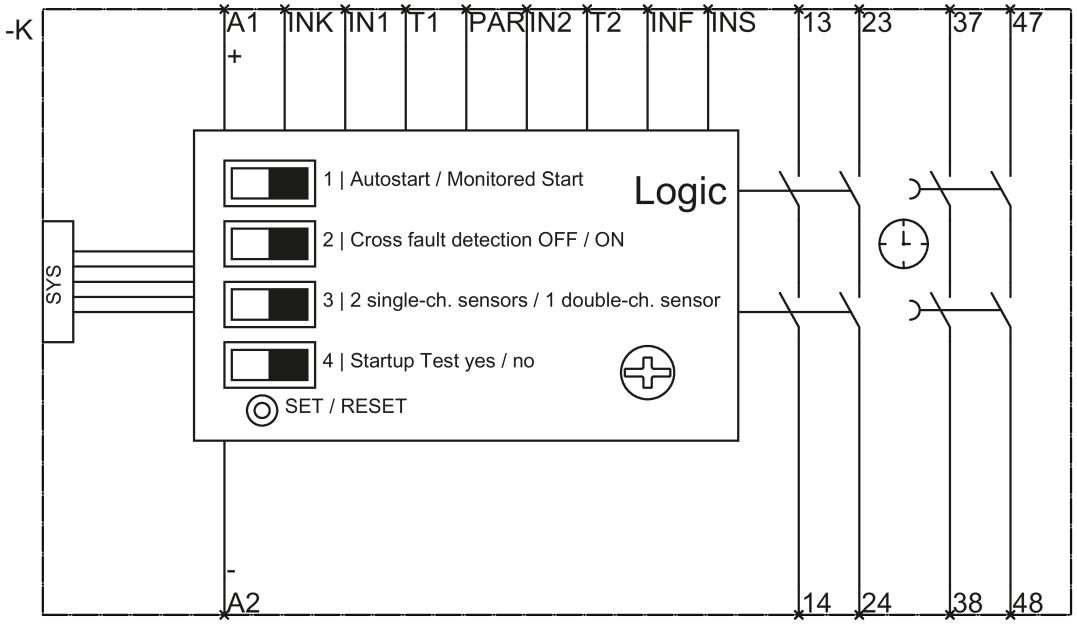


## 13.3 Internal circuit diagrams for 3SK1 Advanced basic units

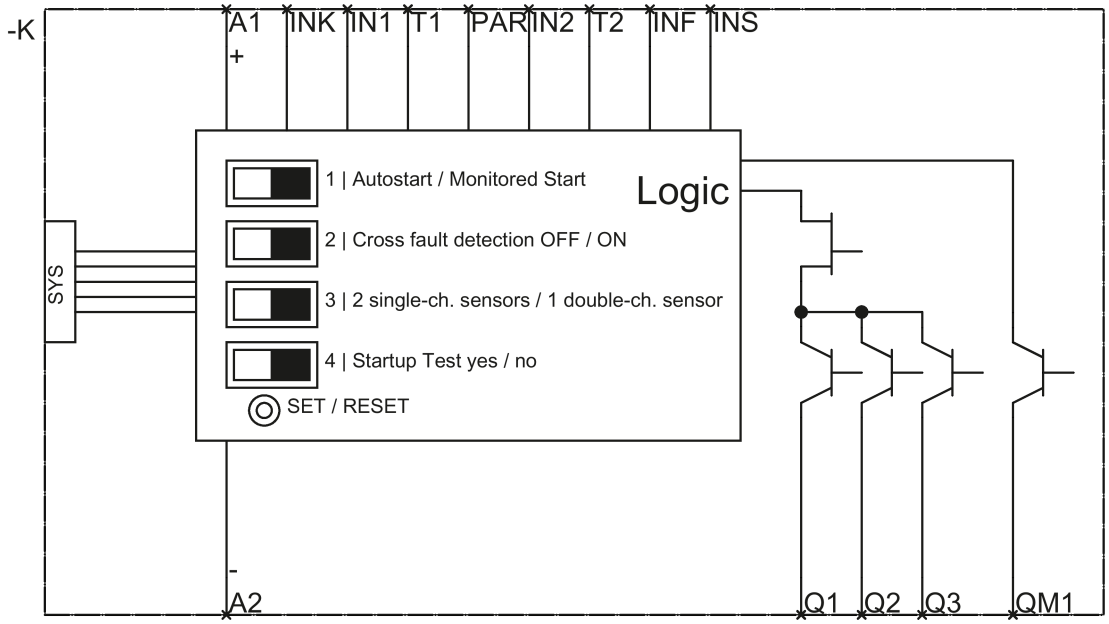
### Basic unit 3SK1121-.AB40 Advanced relay instantaneous



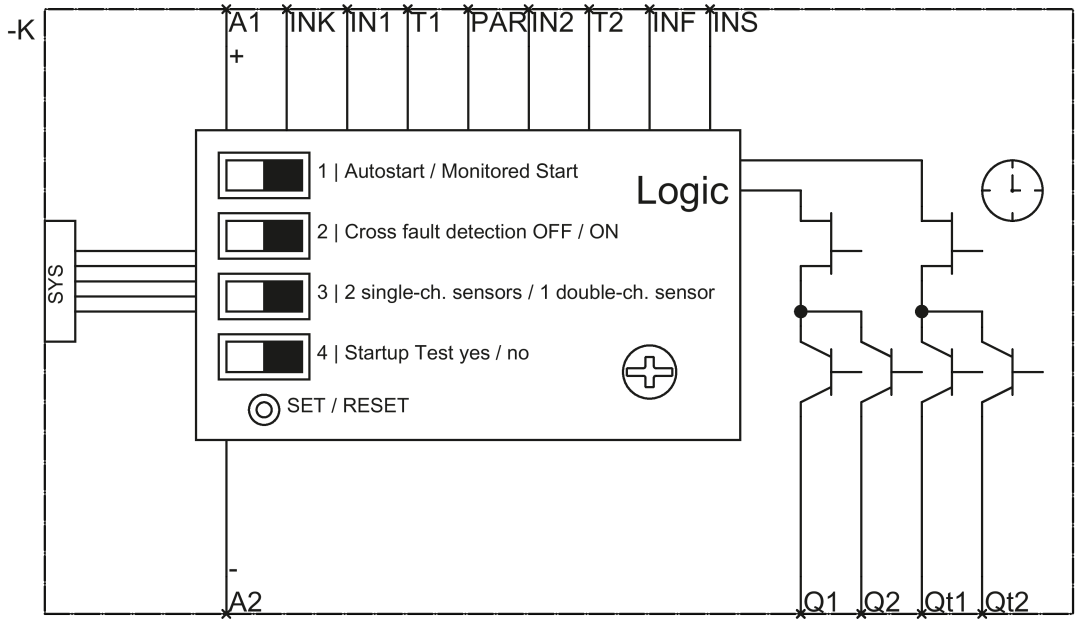

### Basic unit 3SK1121-.CB4. Advanced relay time-delayed



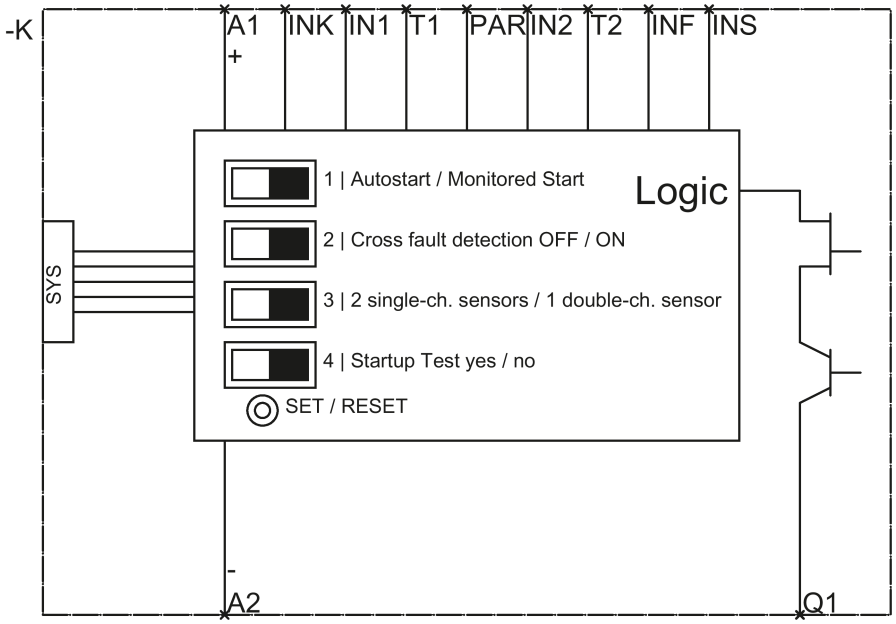
### Basic unit 3SK1122-.AB40 Advanced solid-state instantaneous




### Basic unit 3SK1122-.CB4. Advanced solid-state time-delayed

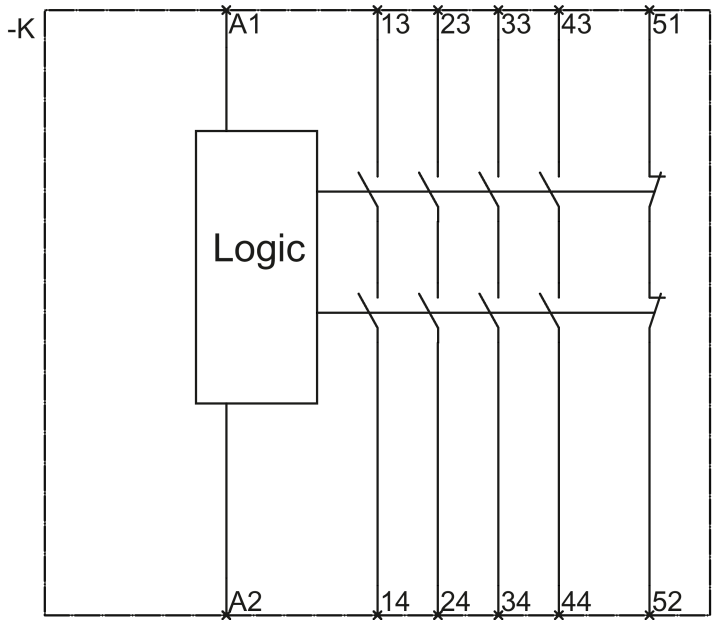


**Basic unit 3SK1120-.AB40 Advanced 17.5 mm solid-state instantaneous**

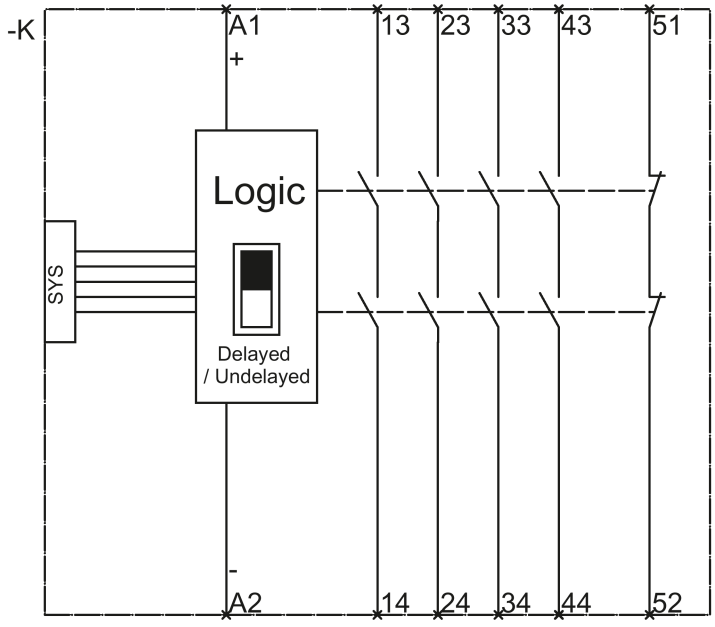


## 13.4 Internal circuit diagrams for expansion units

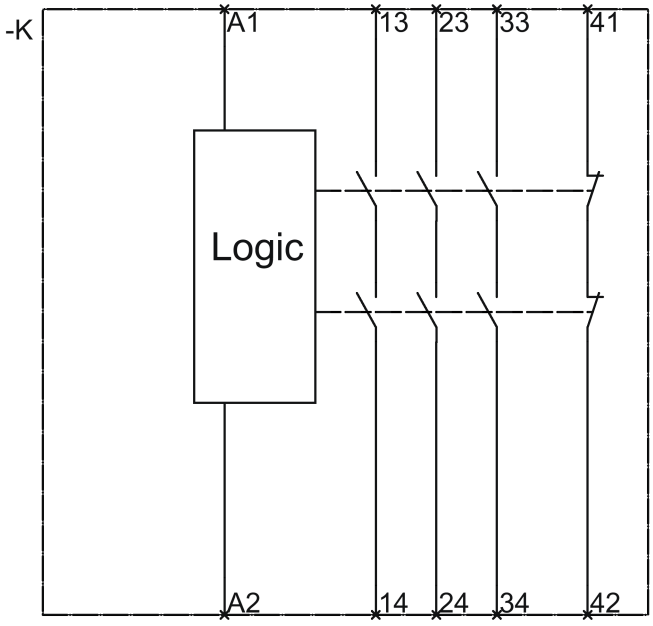
### 3SK1211 output expansion (110 - 240 V)



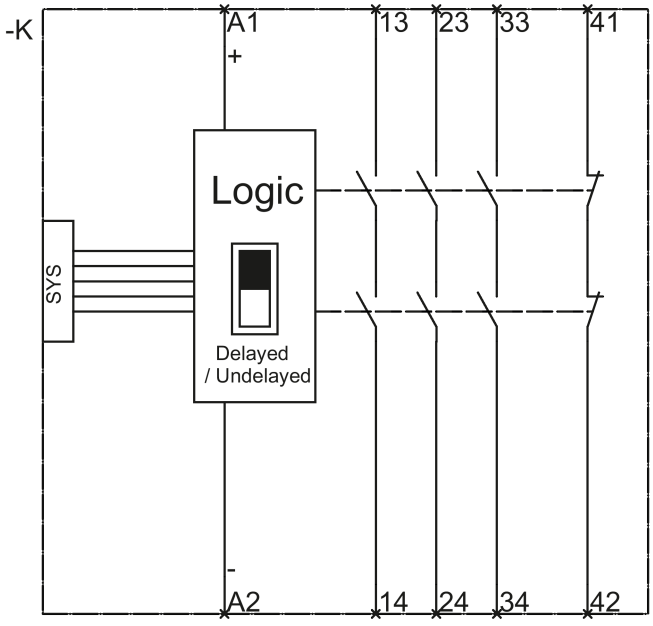

### 3SK1211 output expansion (24 V DC)



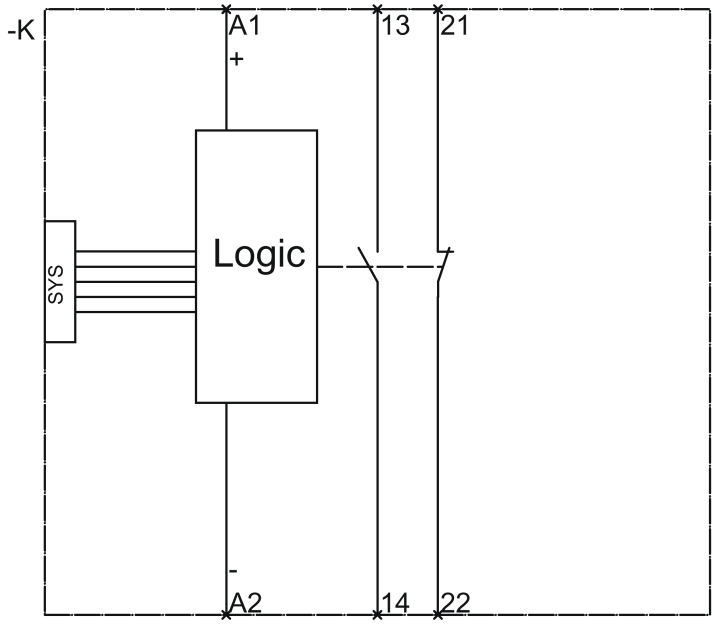
### 3SK1213-.A.20 output expansion (110 - 240 V)



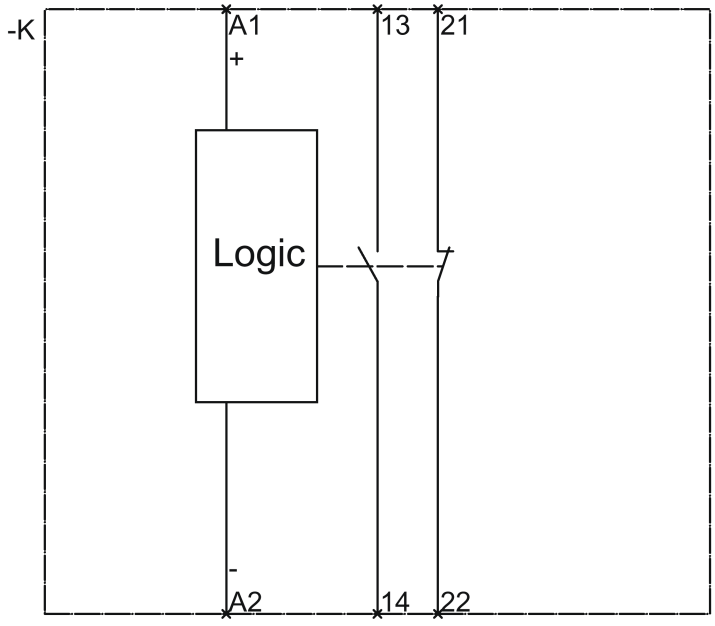

### 3SK1213-.AB40 output expansion (24 V DC)



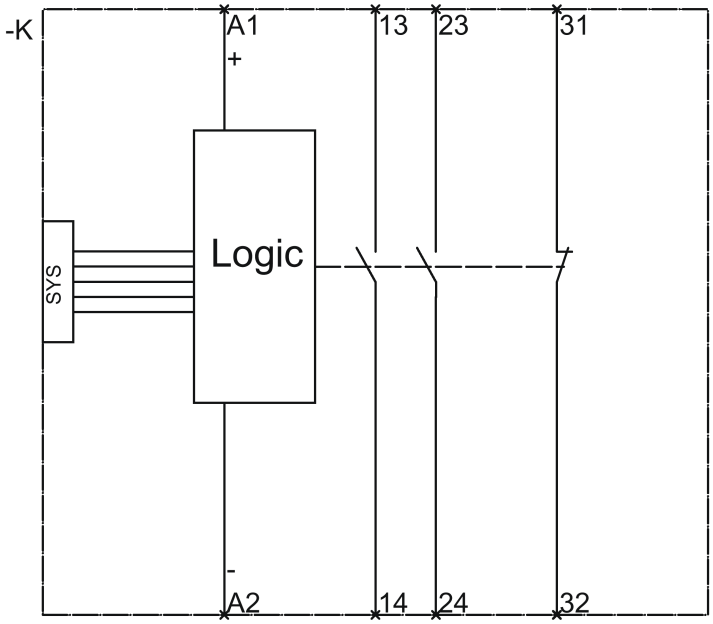
**Output expansion 3RQ1000-.EB00 (24 V DC)**



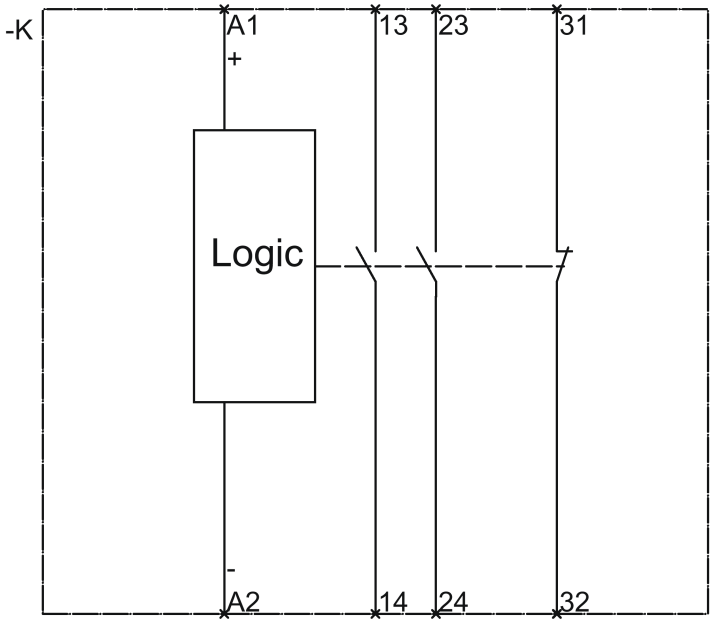

**Output expansion 3RQ1000-.EW00 (24 - 240 V AC/DC)**



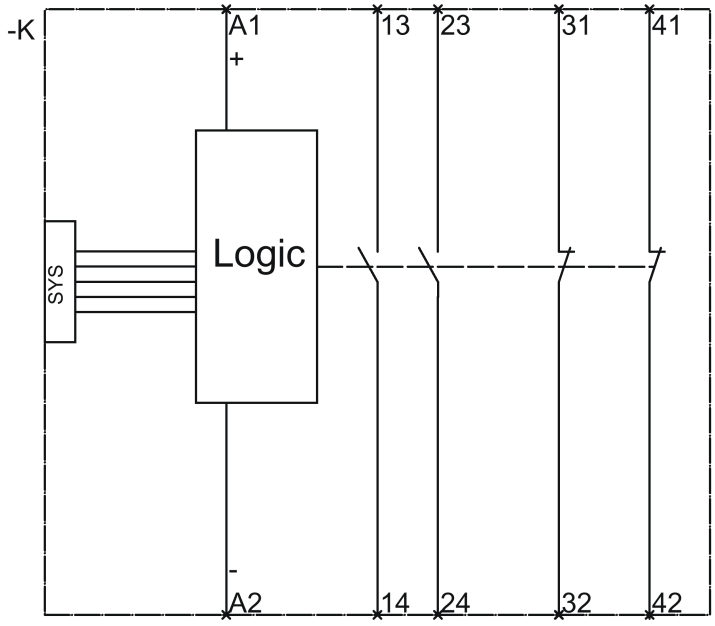
**Output expansion 3RQ1000-.GB00 (24 V DC)**



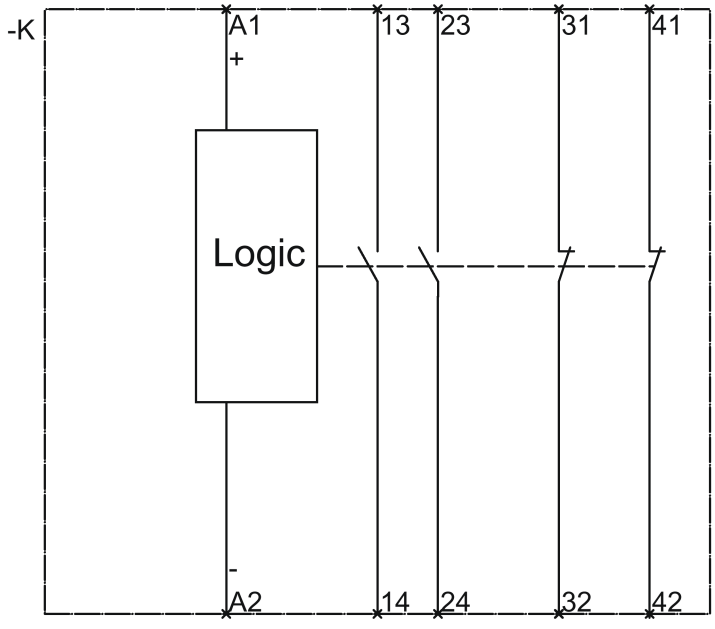

**Output expansion 3RQ1000-.GW00 (24 - 240 V AC/DC)**



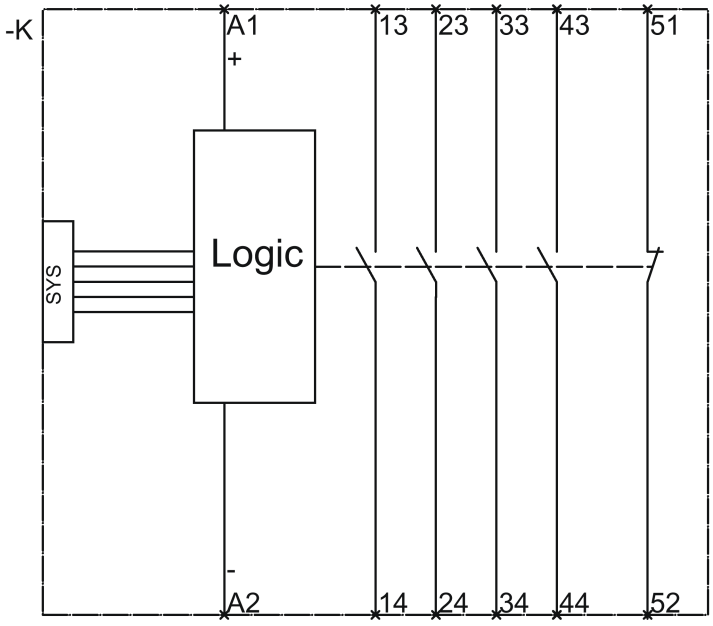
**Output expansion 3RQ1000-.HB00 (24 V DC)**



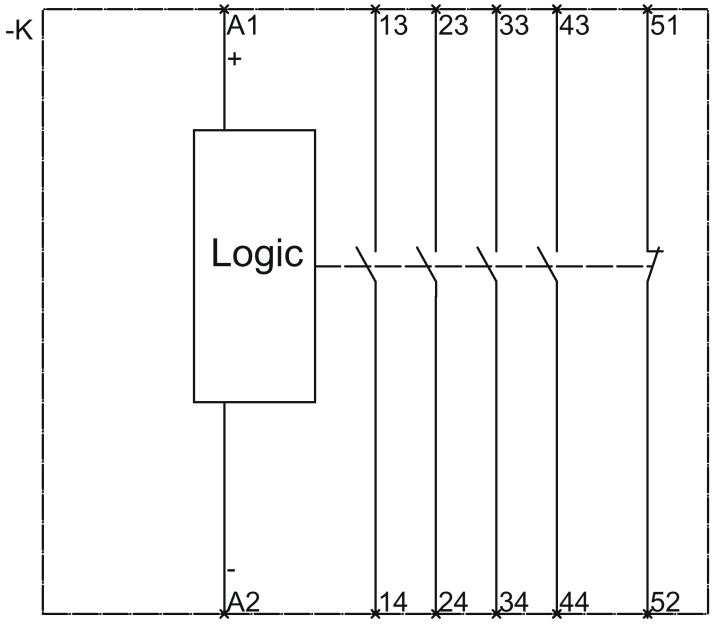

**Output expansion 3RQ1000-.HW00 (24 - 240 V AC/DC)**



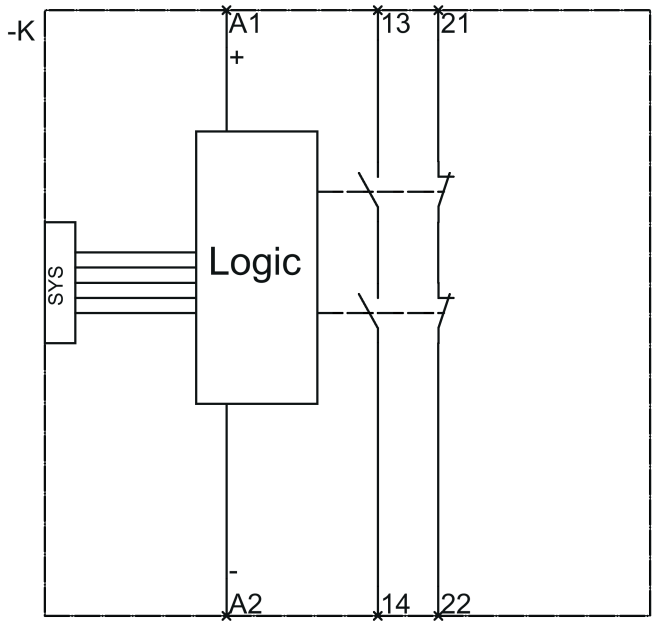
**Output expansion 3RQ1000-.LB00 (24 V DC)**



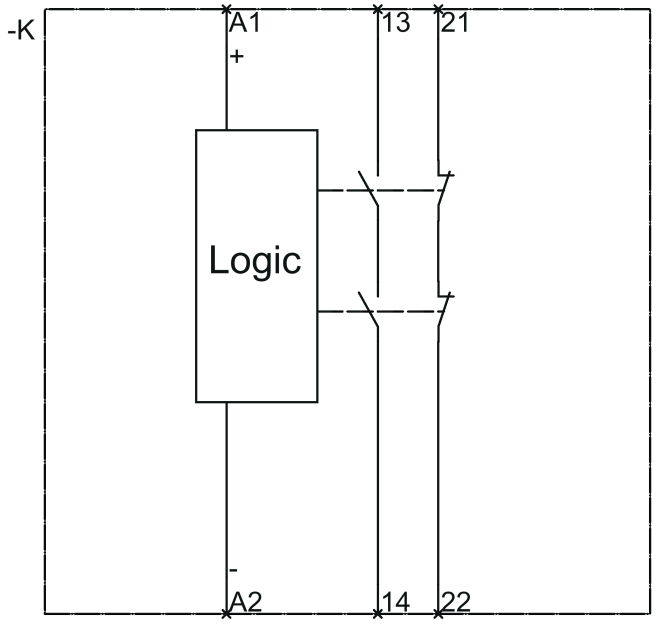

**Output expansion 3RQ1000-.LW00 (24 - 240 V AC/DC)**



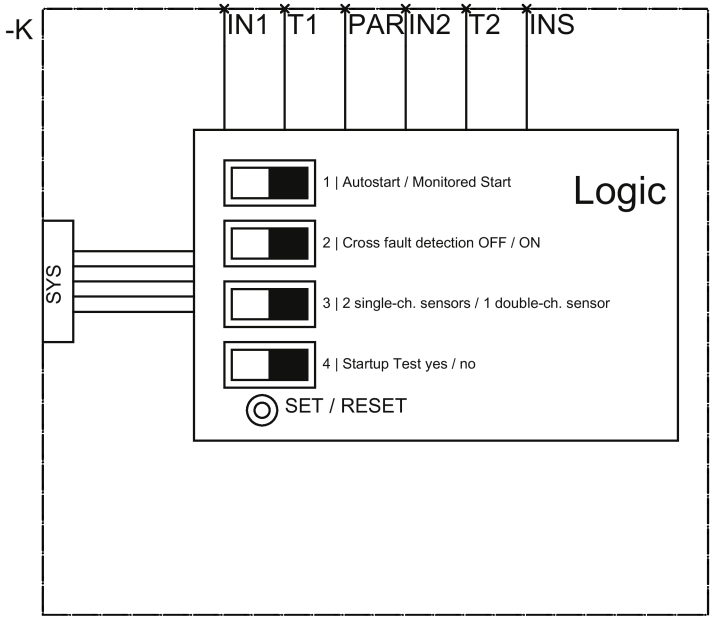
**Output expansion 3RQ1200-.EB00 (24 V DC)**



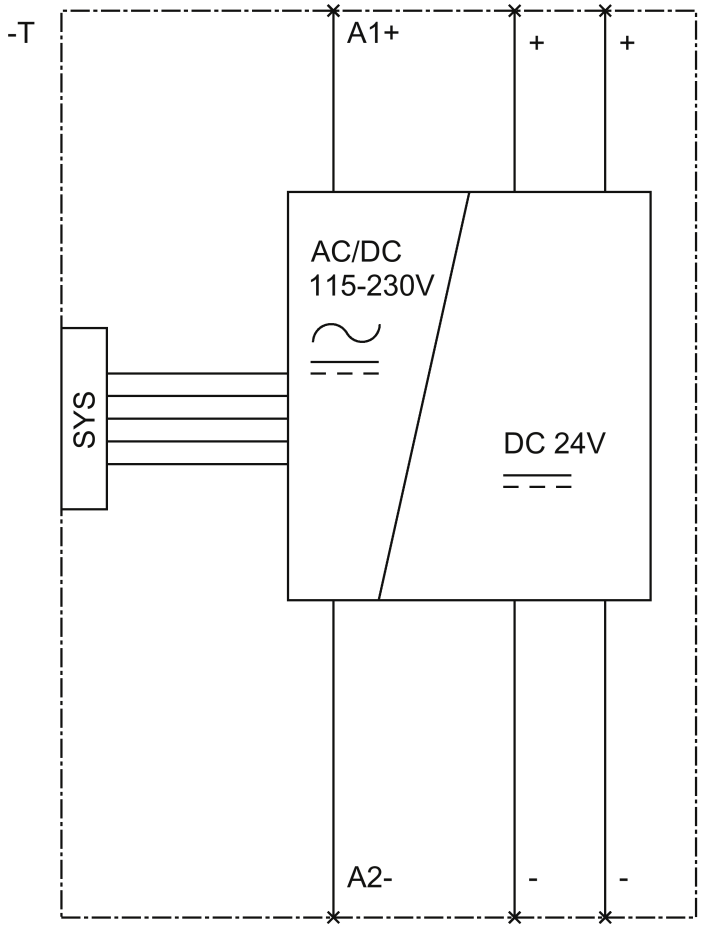

**Output expansion 3RQ1200-.EW00 (24 - 240 V AC/DC)**



## 3SK1220 input expansion



**3SK1230 power supply**



# Examples/applications

# 14

## 14.1 User responsibility for system design and function

The products described here were developed to perform safety-related functions as part of an overall installation or machine.

A complete, safety-related system is generally equipped with sensors, evaluation units, and signaling units, and uses reliable shutdown concepts.

It is the responsibility of the manufacturer to ensure that the system or machine is functioning properly as a whole.

Siemens AG, its regional offices, and associated companies (hereinafter referred to as "Siemens") cannot guarantee all the properties of a whole installation or machine that has not been designed by Siemens.

Nor can Siemens assume liability for recommendations that appear or are implied in the following description. No new guarantee, warranty, or liability claims beyond the scope of the Siemens general terms of supply are to be derived or inferred from the following description.

### Safety instructions

**⚠ WARNING**

**Hazardous system state due to unverified safety-related characteristics**
**Can cause death, serious injury, or damage to property.**

If you use components in your system that do not conform to the safety-related characteristics, safety functions may be deactivated.

The application examples listed in this document are intended only to assist comprehension of the topics covered. For this reason, always check whether the respective application example is actually suitable for your actual use case and that it would correspond to the resulting safety requirements. Use the safety-related characteristics provided for verification for this purpose.

**WARNING**

**Hazardous system state due to unverified components**
**Can cause death, serious injury, or damage to property.**

If you use components in your system that do not conform to the safety-related characteristics, safety functions may be deactivated.

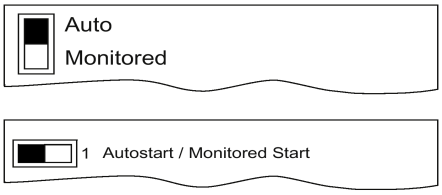
The application examples mention components that are not covered by this documentation. Before using any component, check whether its characteristics comply with the current legal requirements for functional safety.

You can obtain up-to-date information in our Newsletter (http://www.siemens.com/safety-integrated).

With regard to all application examples, also observe the safety instructions (Page 29).

**Note**

The black fields show the positions of the switches. The "Autostart" function is selected in each case.



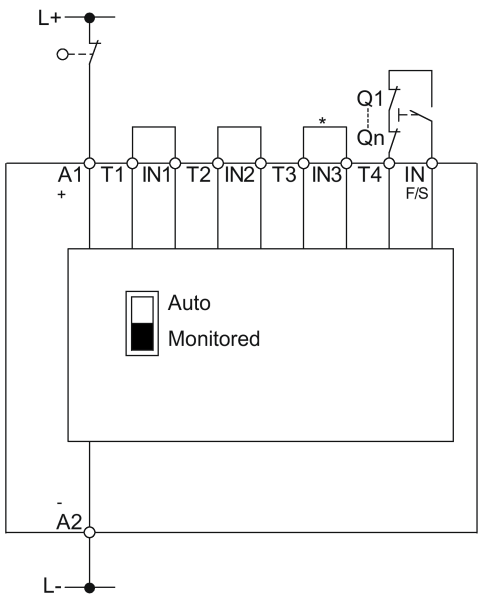

If use of the feedback circuit is not desired for the application, this has to be jumpered with the corresponding test output.

# Typical circuits

## 14.1.1 3SK1 Standard

### 14.1.1.1 3SK1111 Standard relay 1-channel, with monitored start

Table 14- 1 Typical circuit 1:
Single-channel, with monitored start




* For 3SK1111-.AB30 basic unit only

- Monitored start
- 3SK1111 Standard relay
- Sensor: 1 NC contact

| Slide switch | |
|---|---|
| **Auto** | **Monitored** |
| — | ON<br>Bottom |

| | |
|---|---|
| Up to PL in accordance with ISO 13849-1 | c |
| Up to Safety Integrity Level (SIL) acc. to IEC 62061 | 1 |

For more information, see the chapter on two-hand operation/synchronism (Page 58)and the chapter on using magnetic switches (Page 62).

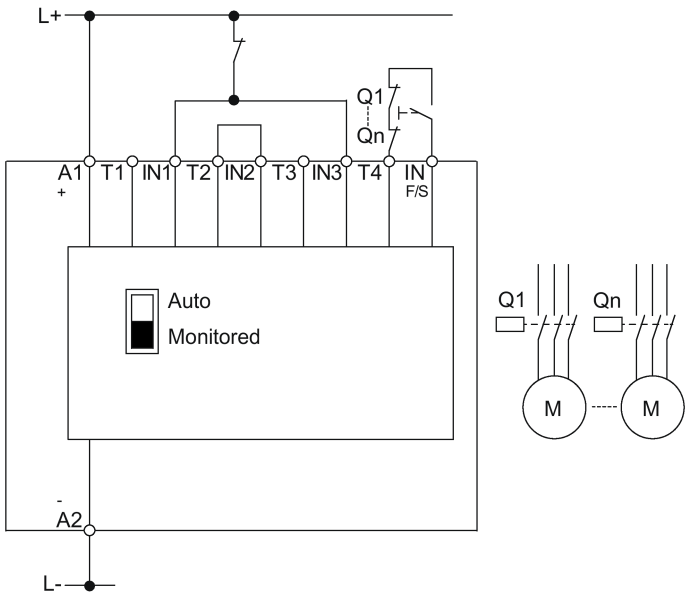
### See also

SIAM manual (https://support.industry.siemens.com/cs/ww/en/view/81366718)

FAQs on 3SK1 (https://support.industry.siemens.com/cs/ww/en/ps/16382/faq)

### 14.1.1.2 3SK1111 Standard relay 1-channel, with monitored start

Table 14- 2 Typical circuit 2:
Single-channel, with monitored start



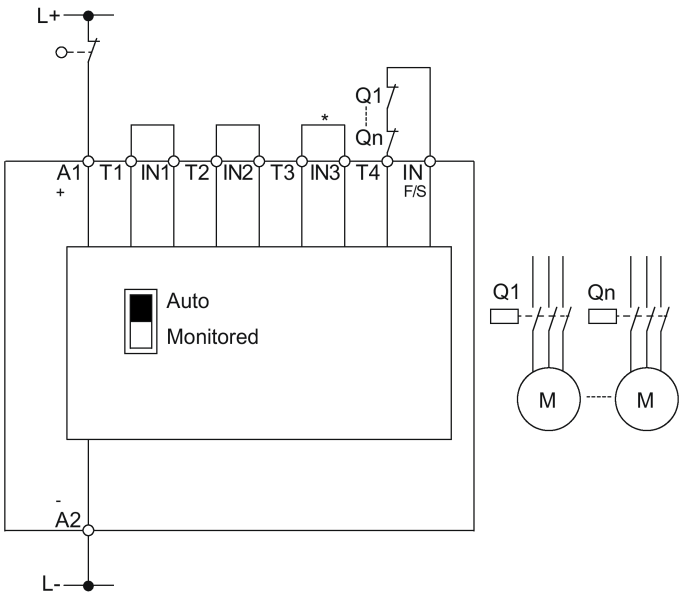

- Monitored start
- 3SK1111-.AB30 Standard relay
- Sensor: 1 NC contact

| Slide switch | |
|---|---|
| **Auto** | **Monitored** |
| — | ON<br>Bottom |

| | |
|---|---|
| Up to PL in accordance with ISO 13849-1 | c |
| Up to Safety Integrity Level (SIL) acc. to IEC 62061 | 1 |

### 14.1.1.3 3SK1111 Standard relay 1-channel, with autostart

Table 14- 3 Typical circuit 3:
single-channel, with autostart




* For 3SK1111-.AB30 basic unit only

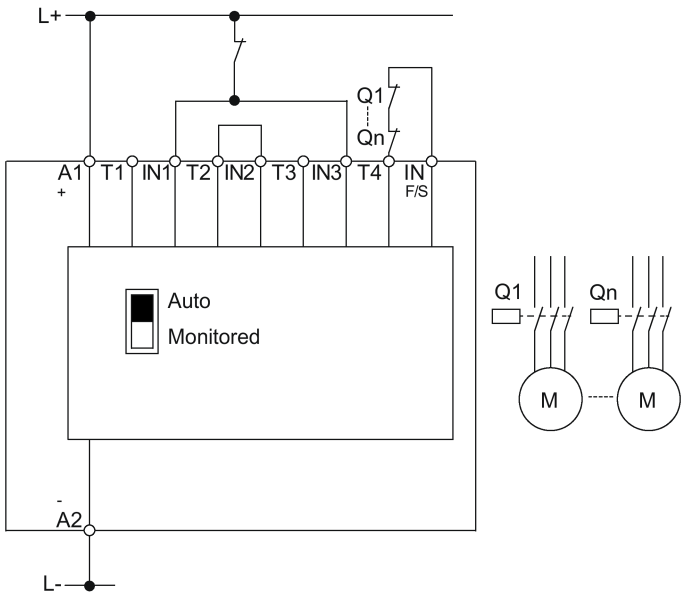
- Autostart
- 3SK1111 Standard relay
- Sensor: 1 NC contact

| Slide switch | |
|---|---|
| **Auto** | **Monitored** |
| ON<br>Top | — |

| | |
|---|---|
| Up to PL in accordance with ISO 13849-1 | c |
| Up to Safety Integrity Level (SIL) acc. to IEC 62061 | 1 |

### 14.1.1.4 3SK1111 Standard relay 1-channel, with autostart

Table 14- 4 Typical circuit 4:
single-channel, with autostart



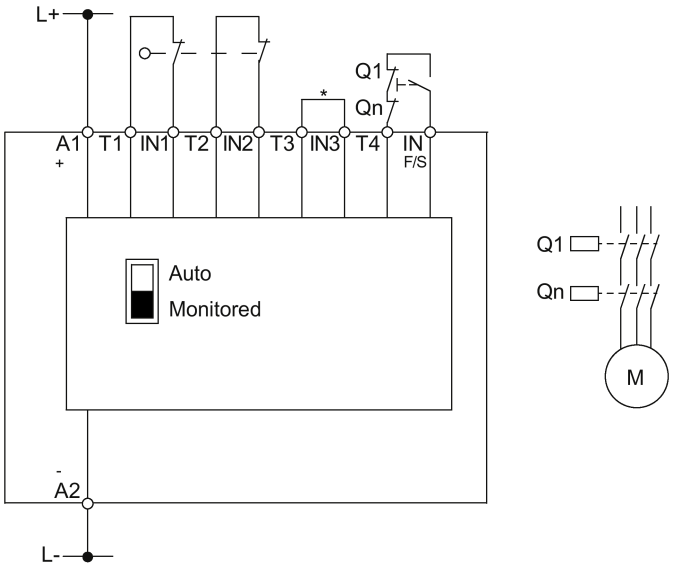

- Autostart
- 3SK1111-.AB30 Standard relay
- Sensor: 1 NC contact

| Slide switch | |
|---|---|
| **Auto** | **Monitored** |
| ON<br>Top | — |

| | |
|---|---|
| Up to PL in accordance with ISO 13849-1 | c |
| Up to Safety Integrity Level (SIL) acc. to IEC 62061 | 1 |

### 14.1.1.5 3SK1111 Standard relay 2-channel, with cross-circuit detection, with monitored start

Table 14- 5 Typical circuit 5:
2-channel EMERGENCY STOP, with cross-circuit detection, with monitored start




* For 3SK1111-.AB30 basic unit only

- Monitored start
- With cross-circuit detection
- Sensor: 2 NC contacts
- 3SK1111 Standard relay

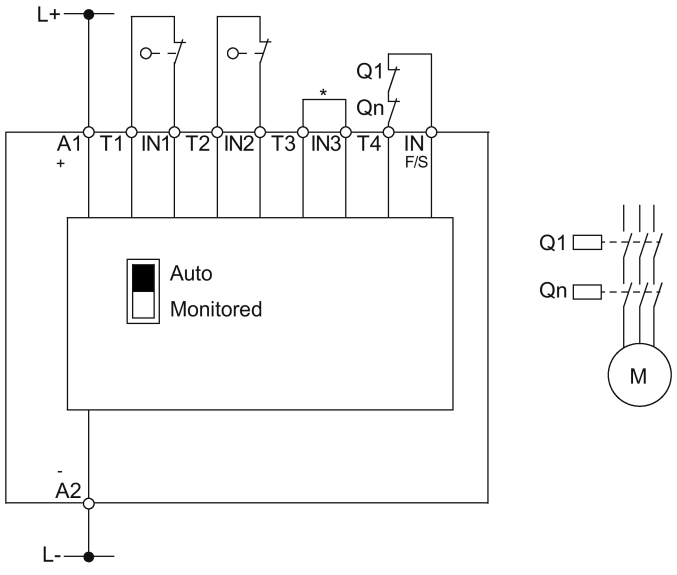
Slide switch

| **Auto** | **Monitored** |
|---|---|
| — | ON<br>Bottom |

| | |
|---|---|
| Up to PL in accordance with ISO 13849-1 | e |
| Up to Safety Integrity Level (SIL) acc. to IEC 62061 | 3 |

### 14.1.1.6 3SK1111 Standard relay 2-channel, with cross-circuit detection, with autostart

Table 14- 6 Typical circuit 6:
Two-channel, with cross-circuit detection, with autostart




* For 3SK1111-.AB30 basic unit only

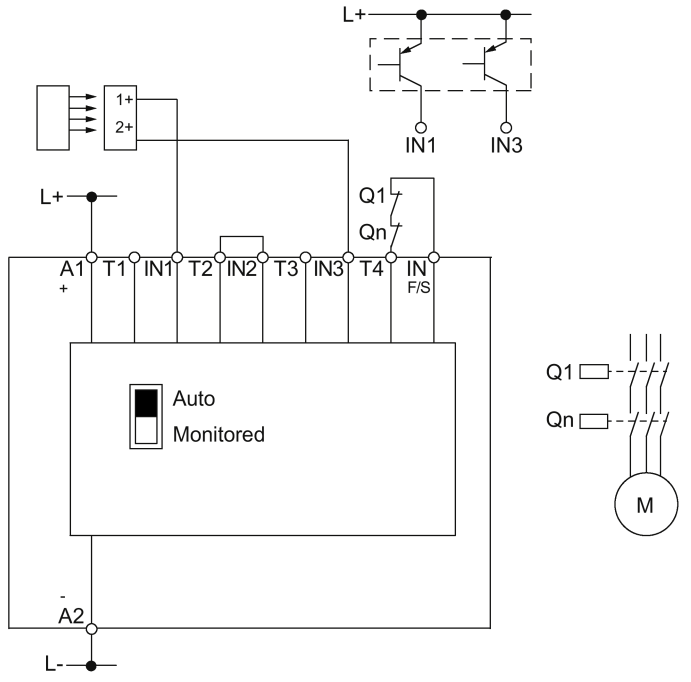
- Autostart
- With cross-circuit detection
- Sensor: 2 NC contacts
- 3SK1111 Standard relay

| Slide switch | |
|---|---|
| **Auto** | **Monitored** |
| ON<br>Top | — |

| | |
|---|---|
| Up to PL in accordance with ISO 13849-1 | e |
| Up to Safety Integrity Level (SIL) acc. to IEC 62061 | 3 |

### 14.1.1.7 3SK1111 Standard relay sensors with solid-state outputs, without cross-circuit detection, with autostart

Table 14- 7 Typical circuit 7:
Sensors with solid-state outputs, without cross-circuit detection, with autostart




- Autostart
- Without cross-circuit detection
- Sensor: 2-channel non-floating
- 3SK1111-.AB30 Standard relay

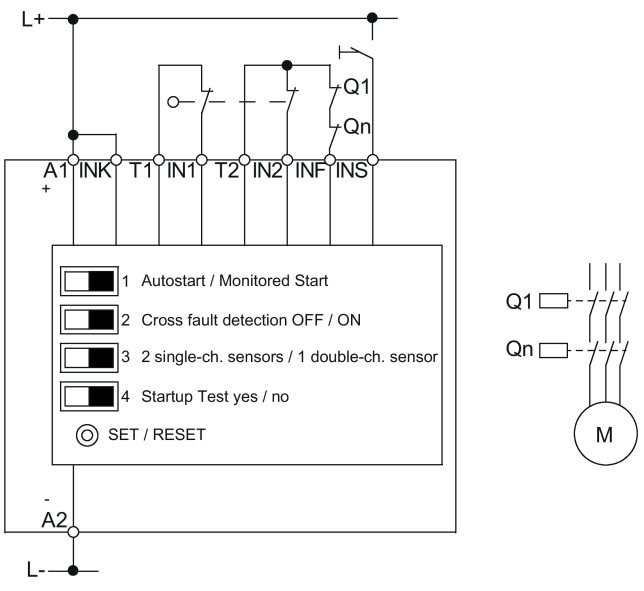
| Slide switch | |
|---|---|
| **Auto** | **Monitored** |
| ON<br>Top | — |

| | |
|---|---|
| Up to PL in accordance with ISO 13849-1 | e |
| Up to Safety Integrity Level (SIL) acc. to IEC 62061 | 3 |

## 14.1.2 3SK1 Advanced

### 14.1.2.1 3SK1 Advanced and 3SK1112 Standard relay EMERGENCY STOP 2-channel, with cross-circuit detection, with monitored start

Table 14- 8 Typical circuit 8: EMERGENCY STOP two-channel, with cross-circuit detection, with monitored start

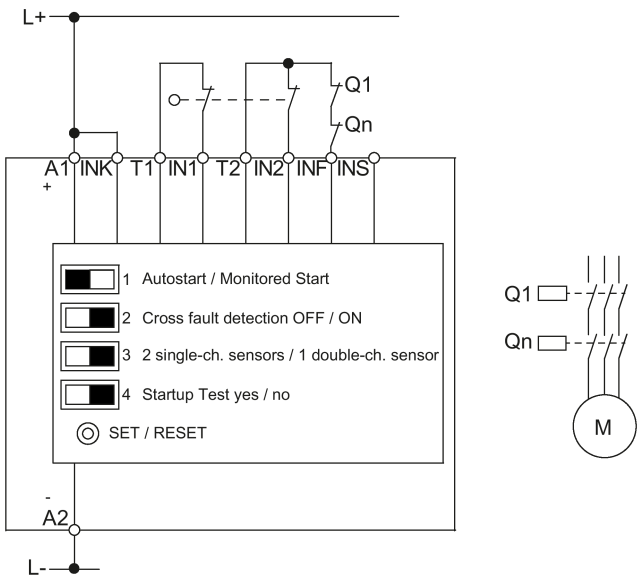



- Monitored start
- With cross-circuit detection
- 1 x two-channel
- Sensor: 2 NC contacts
- 3SK1112 Standard solid-state and 3SK112 / 3SK122 Advanced

| DIP switch | | | |
|---|---|---|---|
| **1** | **2** | **3** | **4** |
| ON<br>Right | ON<br>Right | ON<br>Right | — |
| Up to PL in accordance with ISO 13849-1 | | | e |
| Up to Safety Integrity Level (SIL) acc. to IEC 62061 | | | 3 |

### 14.1.2.2 3SK1 Advanced and 3SK1112 Standard relay EMERGENCY STOP 2-channel, with cross-circuit detection, with autostart

Table 14- 9 Typical circuit 9: Two-channel, with cross-circuit detection, with autostart

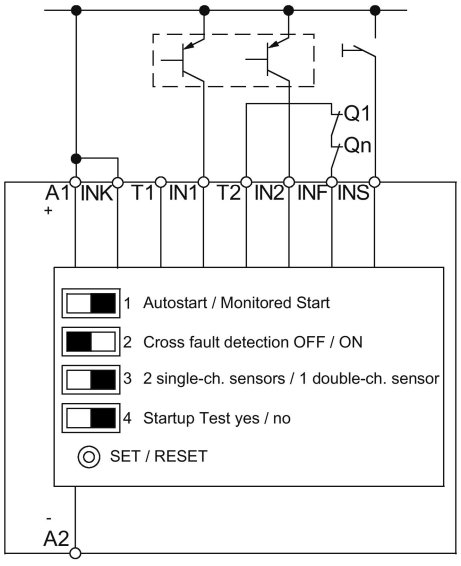


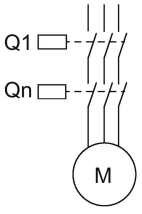

- Autostart
- With cross-circuit detection
- 1 x two-channel
- Sensor: 2 NC contacts
- 3SK1112 Standard solid-state and 3SK112 / 3SK122 Advanced

| DIP switch | | | |
|---|---|---|---|
| **1** | **2** | **3** | **4** |
| OFF<br>Left | ON<br>Right | ON<br>Right | — |
| Up to PL in accordance with ISO 13849-1 | | | e |
| Up to Safety Integrity Level (SIL) acc. to IEC 62061 | | | 3 |

### 14.1.2.3 3SK1 Advanced and 3SK1112 Standard relay sensors with solid-state outputs, without cross-circuit detection, with monitored start

Table 14- 10 Typical circuit 10:
Electronic sensor, 2-channel, without cross-circuit detection, with monitored start




- Monitored start
- Without cross-circuit detection
- 1 x two-channel
- Sensor: 2-channel non-floating
- 3SK1112 Standard solid-state and 3SK112 / 3SK122 Advanced

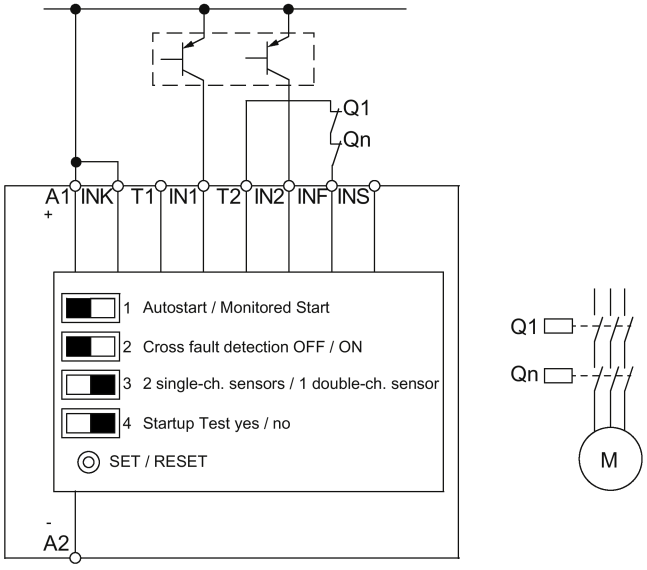
DIP switch

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ON<br>Right | OFF<br>Left | ON<br>Right | — |

| | |
|---|---|
| Up to PL in accordance with ISO 13849-1 | e |
| Up to Safety Integrity Level (SIL) acc. to IEC 62061 | 3 |

### 14.1.2.4 3SK1 Advanced and 3SK1112 Standard relay sensors with solid-state outputs, without cross-circuit detection, with autostart

Table 14- 11 Typical circuit 11:
Electronic sensor, two-channel, without cross-circuit detection, with autostart

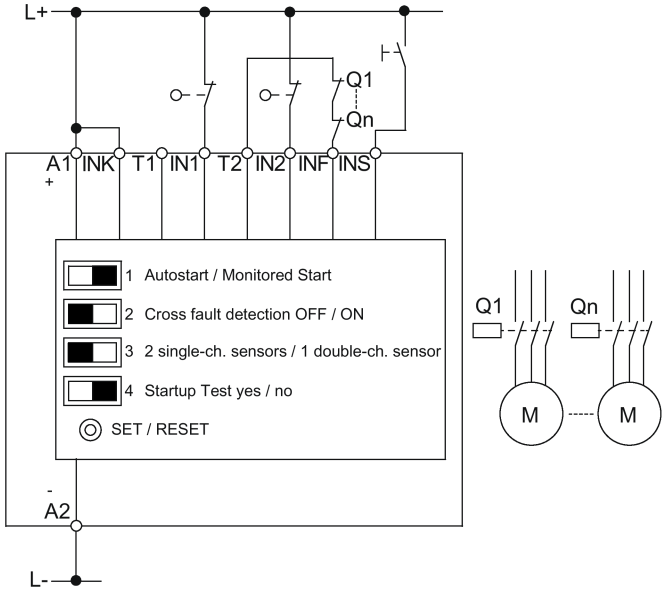



- Autostart
- Without cross-circuit detection
- 1 x two-channel
- Sensor: 2-channel non-floating
- 3SK1112 Standard solid-state and 3SK112 / 3SK122 Advanced

| DIP switch | | | |
|---|---|---|---|
| **1** | **2** | **3** | **4** |
| OFF<br>Left | OFF<br>Left | ON<br>Right | — |
| Up to PL in accordance with ISO 13849-1 | | | e |
| Up to Safety Integrity Level (SIL) acc. to IEC 62061 | | | 3 |

### 14.1.2.5 3SK1 Advanced and 3SK1112 Standard relay 2x 1-channel, without cross-circuit detection, with monitored start

Table 14- 12 Typical circuit 12: 2 x single-channel, without cross-circuit detection, with monitored start




- Monitored start
- Without cross-circuit detection
- 2 x single-channel
- Sensor: 2 x single-channel NC sensors
- 3SK1112 Standard solid-state and 3SK112 / 3SK122 Advanced

DIP switch

| **1** | **2** | **3** | **4** |
|---|---|---|---|
| ON<br>Right | OFF<br>Left | OFF<br>Left | — |

| | |
|---|---|
| Up to PL in accordance with ISO 13849-1 | c |
| Up to Safety Integrity Level (SIL) acc. to IEC 62061 | 1 |

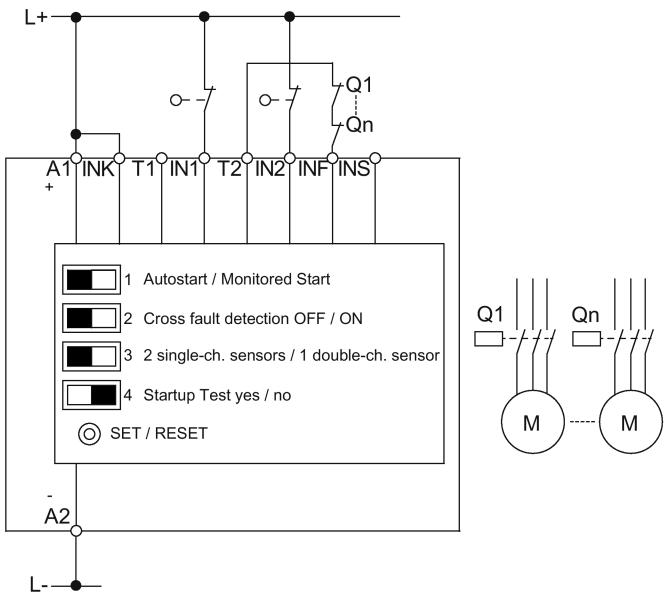
**Note**

**Single-channel connection**

If only one single-channel sensor is used, the other sensor circuit must be jumpered.

### 14.1.2.6 3SK1 Advanced and 3SK1112 Standard relay 2x 1-channel, without cross-circuit detection, with autostart

Table 14- 13 Typical circuit 13: 2 x single-channel, without cross-circuit detection, with autostart




- Autostart
- Without cross-circuit detection
- 2 x single-channel
- Sensor: 2 x single-channel NC
- 3SK1112 Standard solid-state and 3SK112 / 3SK122 Advanced

| DIP switch | | | |
|---|---|---|---|
| **1** | **2** | **3** | **4** |
| OFF<br>Left | OFF<br>Left | OFF<br>Left | — |

| | |
|---|---|
| Up to PL in accordance with ISO 13849-1 | c |
| Up to Safety Integrity Level (SIL) acc. to IEC 62061 | 1 |

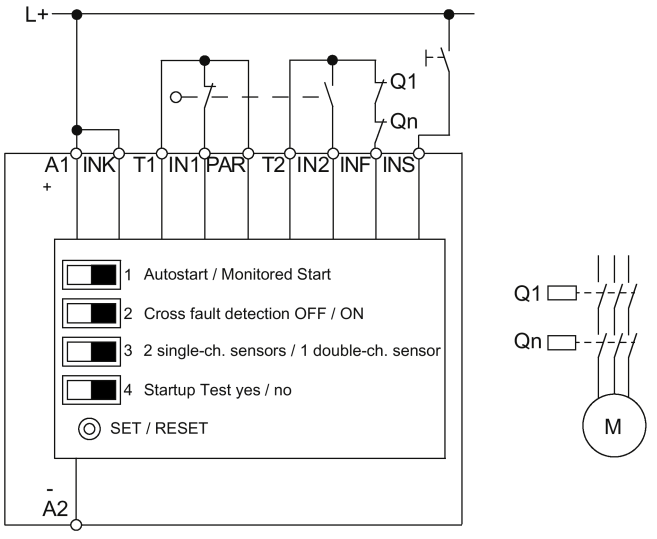
**Note**

**Single-channel connection**

If only one single-channel sensor is used, the other sensor circuit must be jumpered.

### 14.1.2.7 3SK1 Advanced 1NC/1NO sensor, with cross-circuit detection, with monitored start

Table 14- 14 Typical circuit 14:
1NC/1NO sensor, with cross-circuit detection, with monitored start




- Monitored start
- With cross-circuit detection
- 1 x two-channel
- Jumper T1/PAR for NC/NO evaluation
- Sensor: NC/NO sensor
- 3SK112 / 3SK122 Advanced

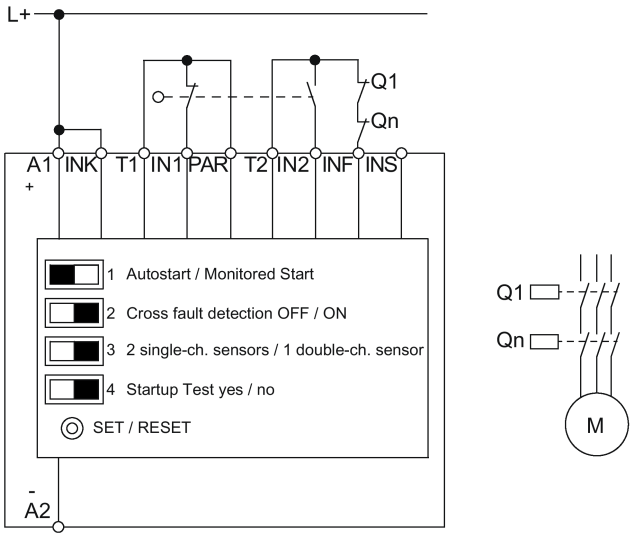
DIP switch

| **1** | **2** | **3** | **4** |
|---|---|---|---|
| ON<br>Right | ON<br>Right | ON<br>Right | — |

| | |
|---|---|
| Up to PL in accordance with ISO 13849-1 | e |
| Up to Safety Integrity Level (SIL) acc. to IEC 61508 | 3 |

### 14.1.2.8 3SK1 Advanced 1NC/1NO sensor, with cross-circuit detection, with monitored start

Table 14- 15 Typical circuit 15:
1NC/1NO sensor, with cross-circuit detection, with autostart

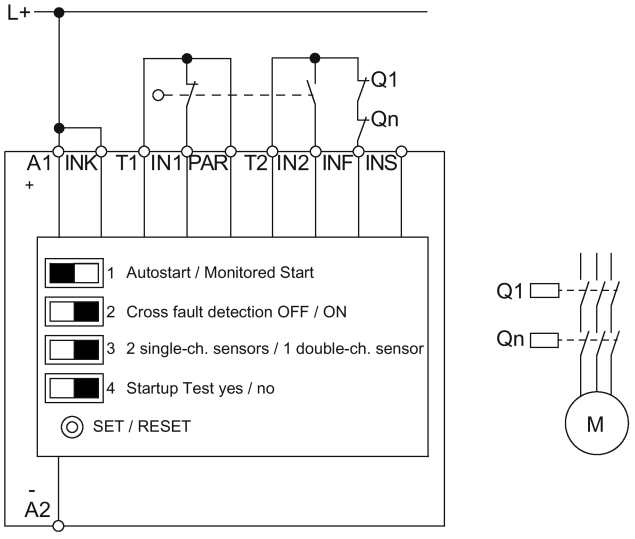



- Autostart
- With cross-circuit detection
- 1 x two-channel
- Jumper T1/PAR for NC/NO evaluation
- Sensor: NC/NO sensor
- 3SK112 / 3SK122 Advanced

| DIP switch | | | |
|---|---|---|---|
| **1** | **2** | **3** | **4** |
| OFF<br>Left | ON<br>Right | ON<br>Right | — |
| PL in accordance with ISO 13849-1 | | | e |
| Safety Integrity Level (SIL) acc. to IEC 61508 | | | 3 |

### 14.1.2.9 3SK1 Advanced 1 NC/1 NO sensor, with cross-circuit detection, with autostart

Table 14- 16 Typical circuit 15:
1NC/1NO sensor, with cross-circuit detection, with autostart

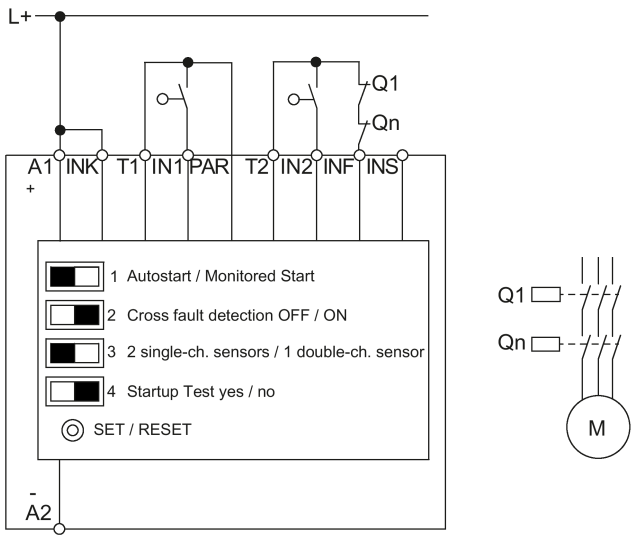



- Autostart
- With cross-circuit detection
- 1 x two-channel
- Jumper T1/PAR for NC/NO evaluation
- Sensor: NC/NO sensor
- 3SK112 / 3SK122 Advanced

| DIP switch | | | |
|---|---|---|---|
| **1** | **2** | **3** | **4** |
| OFF<br>Left | ON<br>Right | ON<br>Right | — |
| PL in accordance with ISO 13849-1 | | | e |
| Safety Integrity Level (SIL) acc. to IEC 61508 | | | 3 |

### 14.1.2.10 3SK1 Advanced two-hand operation with cross-circuit detection, with autostart

Table 14- 17 Typical circuit 16:
Two-hand operation with cross-circuit detection, with autostart




- Autostart
- With cross-circuit detection
- 2 x single-channel
- Jumper T1/PAR for NC/NO evaluation
- Sensor: Two-hand NO/NO sensor
- 3SK112 / 3SK122 Advanced

| DIP switch | | | |
|---|---|---|---|
| **1** | **2** | **3** | **4** |
| OFF<br>Left | ON<br>Right | OFF<br>Left | — |
| PL in accordance with ISO 13849-1 | | | e |
| Safety Integrity Level (SIL) acc. to IEC 61508 | | | 3 |

You can find more information on two-hand operation in chapter Two-hand operation/synchronism (Page 58).

**WARNING**

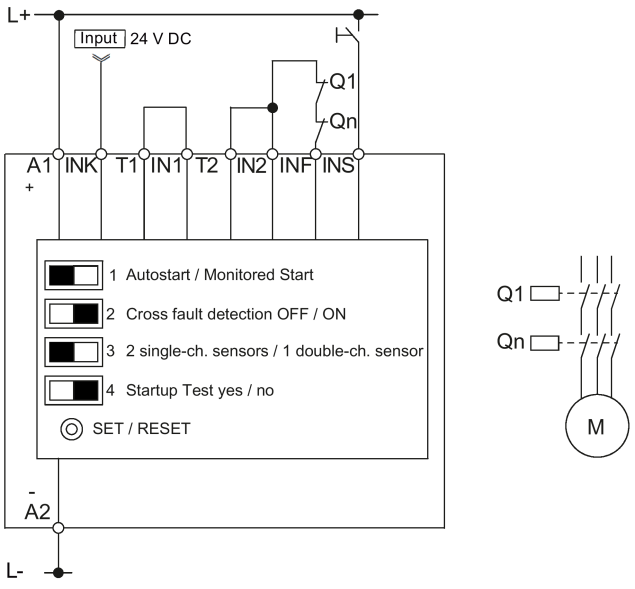
**Loss of safety function with two-hand operation type IIIc with input type S/S**

**Can cause death, serious injury, or property damage.**

The two-hand operation type IIIc with input type S/S loses its safety function if there is a cross circuit between one of the inputs and the corresponding test cycle. This bypasses the button. The discrepancy monitoring only recognizes this error after both buttons have been released. Only then will switching on again be prevented.
For two-hand operation units type IIIc with input type S/S, lay all outgoing and return cables cross-circuit proof, e.g. as a separately sheathed cable or in an armored conduit.

### 14.1.2.11 3SK1 Advanced cascading input with monitored start

Table 14- 18 Typical circuit diagram 17:
Advanced cascading input with monitored start




- Monitored start
- Sensor: 1-channel[1]
- 3SK1112 Standard solid-state and 3SK112/3SK122 Advanced

| DIP switch | | | |
|---|---|---|---|
| **1** | **2** | **3** | **4** |
| ON<br>Right | --- | --- | — |

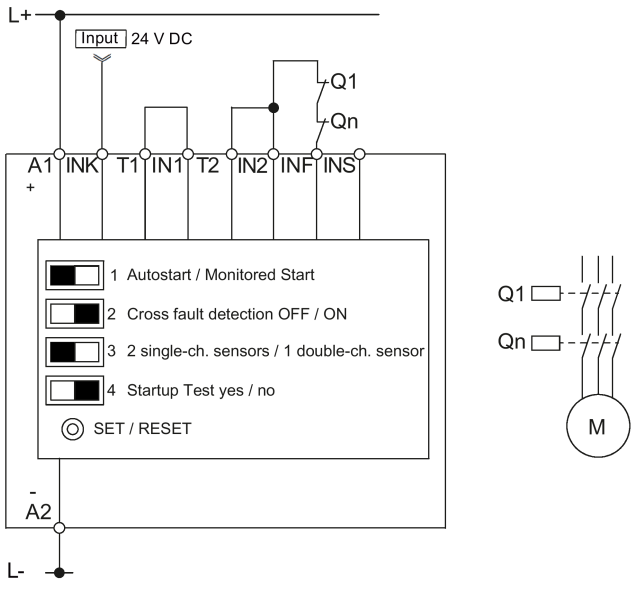
| | |
|---|---|
| PL in accordance with ISO 13849-1 | e |
| Safety Integrity Level (SIL) acc. to IEC 62061 | 3 |

[1] Safety level PL/SIL of the application always corresponds to the lowest safety level of a subsystem of the application.

Consequently, in order to achieve SIL 3/PL e, the connected sensor must be appropriately qualified via the INK input and an error exclusion (protected laying of the control line) must be applied.

### 14.1.2.12 3SK1 Advanced cascading input with autostart

Table 14- 19 Typical circuit diagram 18:
Autostart – single-channel via cascading input INK




- Autostart
- Sensor: 1-channel[1]
- 3SK1112 Standard solid-state and 3SK112/3SK122 Advanced

| DIP switch | | | |
|---|---|---|---|
| **1** | **2** | **3** | **4** |
| OFF<br>Left | --- | --- | — |
| PL in accordance with ISO 13849-1 | | | e |
| Safety Integrity Level (SIL) acc. to IEC 62061 | | | 3 |

[1] Safety level PL/SIL of the application always corresponds to the lowest safety level of a subsystem of the application.

Consequently, in order to achieve SIL 3/PL e, the connected sensor must be appropriately qualified via the INK input and an error exclusion (protected laying of the control line) must be applied.

# 14.2 Typical circuits of 3SK1 safety relays with 3RM1 Failsafe motor starters

## 14.2.1 3SK1 Advanced with 3RM1 Failsafe motor starter via device connector

The 3RM13 Failsafe motor starter (24 V DC variant) is connected to a 3SK112 safety relay via a 3ZY12 device connector.

The two directions of rotation are switched on and off operationally via IN1 and IN2, e.g. with a PLC.

The control supply voltage (L+ and L-) to the motor starters is deactivated by the 3SK112 safety relay and the system is in a safe state.

**⚠ WARNING**

**Bypassing the safety function when using device connectors**

When operating with a 3SK112 safety relay and a device connector, the supply voltage for 3RM1 Failsafe motor starters is established via the device connectors.

In this case, do not connect anything to terminals A1 and A2 of the 3RM1 Failsafe motor starters in order to prevent bypassing of the safety function.

**⚠ WARNING**

**Only motor starters of type 3RM1 Failsafe are permitted in the system configuration**

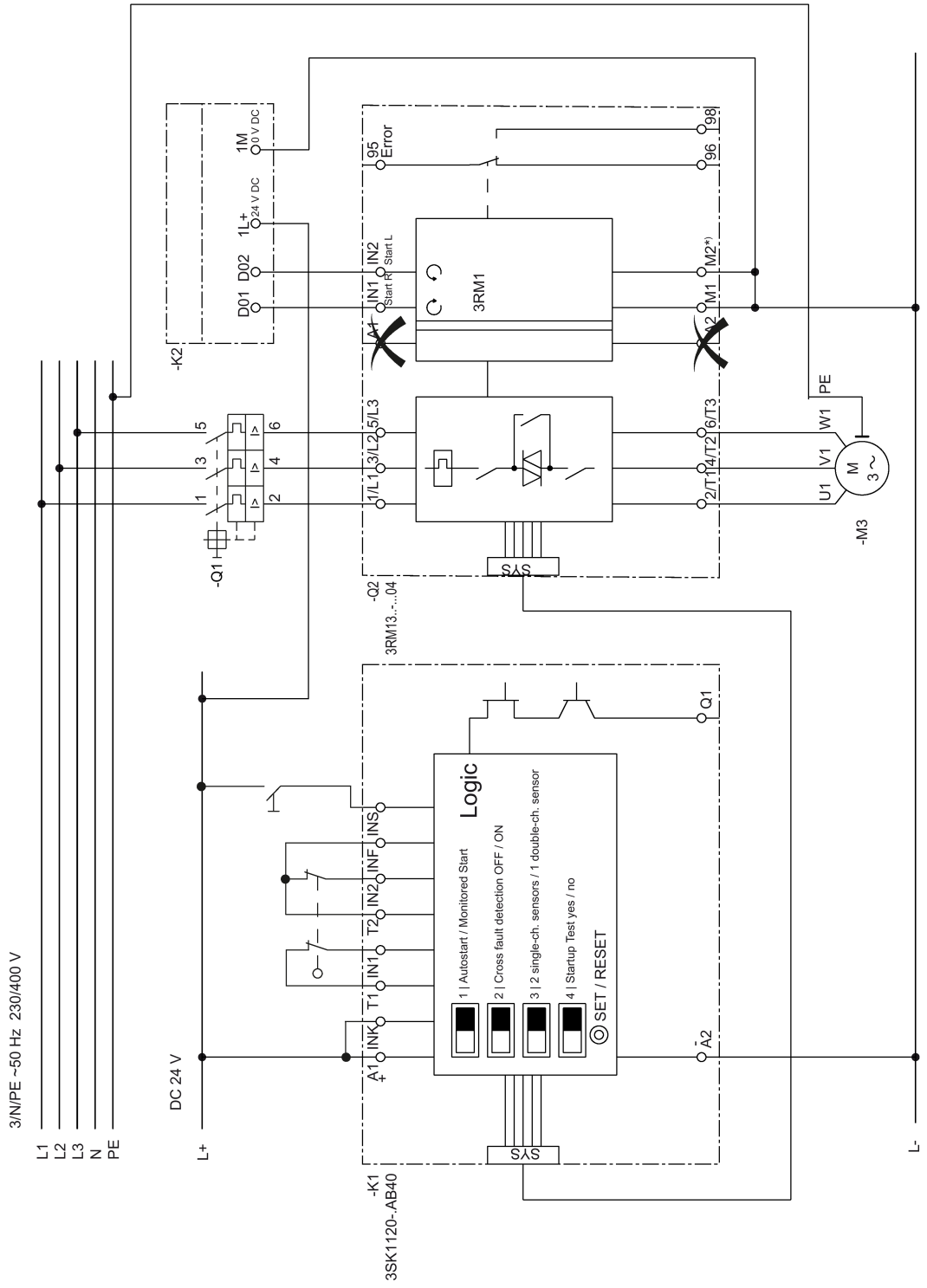
Only motor starters of type 3RM1 Failsafe are permitted in the 3SK1 system configuration. When using non-safety-related 3RM1 motor starters, non-reactive operation is not guaranteed, which may result in the loss of the safety function.

**Note**

**SIL 3 according to IEC 62061 / PL e according to ISO 13849-1**

A safety-related application up to SIL 3 acc. to IEC 62061, PL e/Cat. 4 acc. to EN ISO 13849-1 can be implemented in this way.

To achieve SIL 3/PL e/Cat. 4 for the safety-related application, all components of the safety functions (detecting/evaluating/reacting) must be designed accordingly.




* If there is a common reference potential for the two inputs, it suffices to establish a ground connection.

If there are separate potentials or controls, both connections must be assigned.

### 14.2.2 3SK1 relay wired with 3RM1 Failsafe motor starter

The 3RM13 Failsafe motor starter (230 V supply voltage) is connected to a 3SK1 safety relay.

The two directions of rotation are switched on and off operationally via IN1 and IN2, e.g. with separate switches.

**⚠ WARNING**

**Bypassing the safety function in the event of a fault with 3RM11/3RM13 Failsafe motor starters with 110 to 230 V AC/110 V DC control supply voltage**

The control signal for the control inputs in the case of 3RM11/3RM13 Failsafe motor starters with 110 to 230 V AC control supply voltage must come from A1. Otherwise, the safety function is bypassed in the event of a fault. Thus, only relay outputs are admissible when using a PLC.

Do not use a separate control voltage. Only use the relay outputs when using a PLC.

The control supply voltage (L1 and N) to the motor starters is deactivated by the 3SK1 safety relay and the system is in a safe state.

**Note**

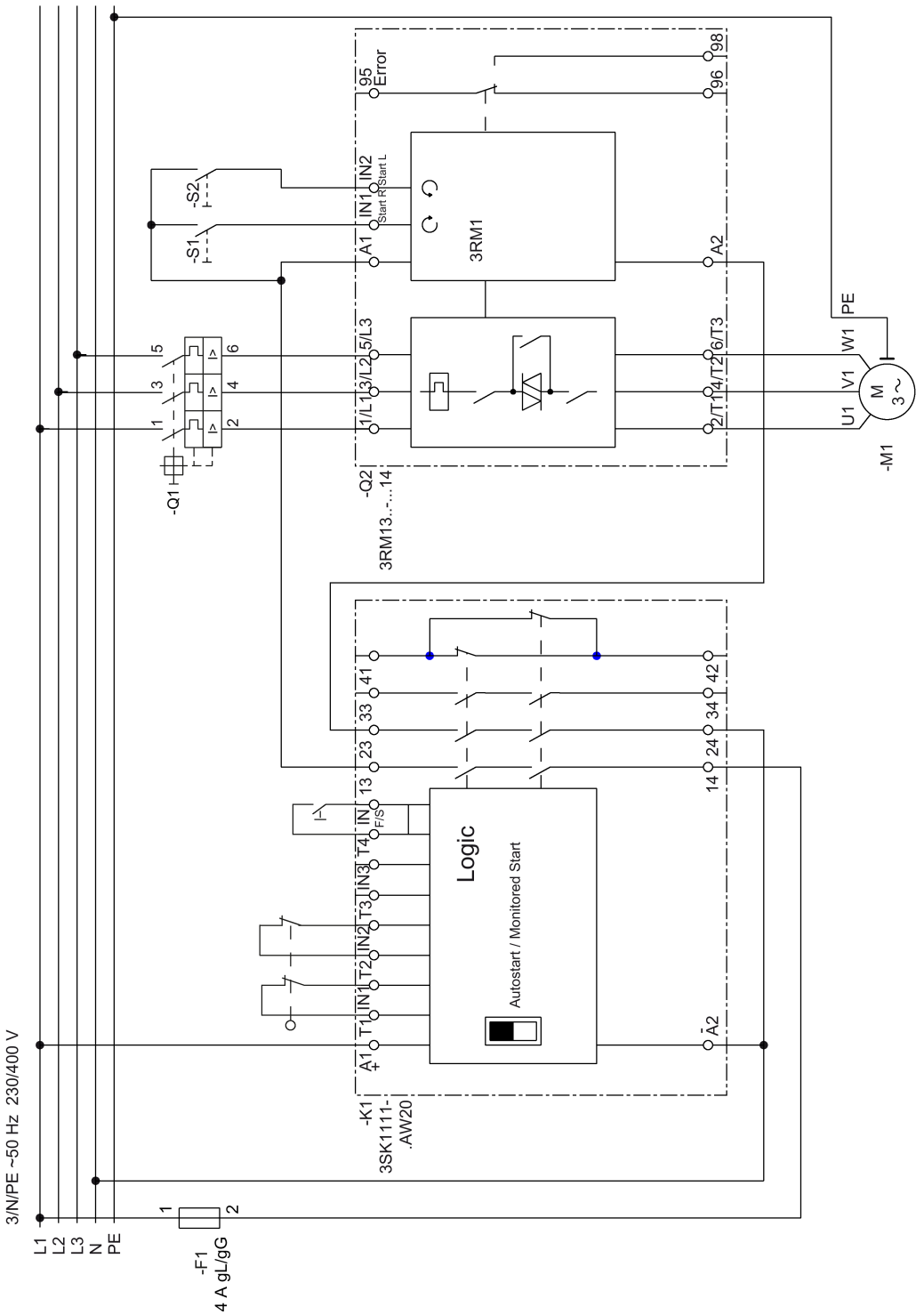
**SIL 3 acc. to IEC 62061, PL e / Cat. 4 acc. to ISO 13849-1**

A safety-related application up to SIL 3 acc. to IEC 62061, PL e/Cat. 4 acc. to EN ISO 13849-1 can be implemented in this way.

To achieve SIL 3/PL e/Cat. 4 for the safety-related application, all components of the safety functions (detecting/evaluating/reacting) must be designed accordingly.

**Note**

A fuse must be fitted as short-circuit protection (4 A gL/gG) in the supply line to the supply voltage of 3RM1 (L1).


3/N/PE ~50 Hz 230/400 V
L1
L2
L3
N
PE
-F1
4 A gL/gG
-K1
3SK1111-
.AW20
-Q2
3RM13...-....14
-S1
-S2
-Q1
-M1
3RM1
Logic
Autostart / Monitored Start
Error
Start R
Start L
M
3~

## 14.3 Additional applications

Further applications with descriptions, circuit diagrams in EPLAN format, and evaluation in the Safety Evaluation in TIA Selection Tool (SE@TST) can be found in the SIRIUS Safety Integrated Application Manual in the SiePortal.
(https://support.industry.siemens.com/cs/document/83150405?lc=en-WW)

FAQs on 3SK1 relays (https://sieportal.siemens.com/su/blF45)

Application examples for 3SK1 relays (https://sieportal.siemens.com/su/blF47)

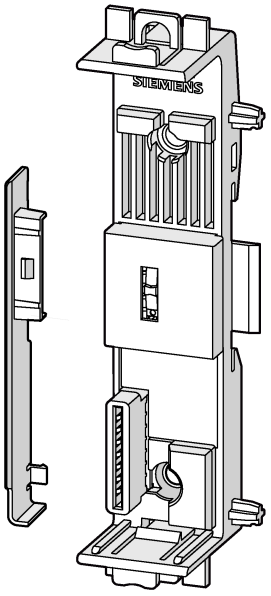
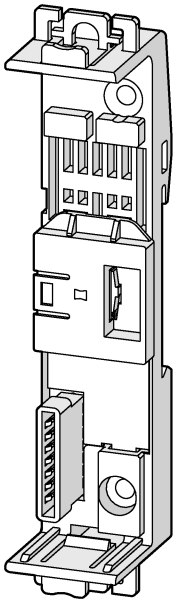
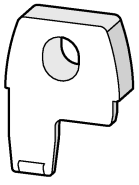
# Accessories

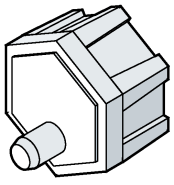
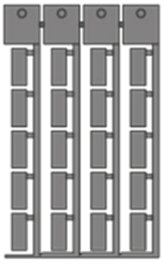
# 15

## 15.1 Accessories for 3SK1

The following accessories are available for the 3SK1 safety relay system.

| Designation | Article number | Image |
|---|---|---|
| SIRIUS terminal 2-pole screw-type terminal<br>2 x 1.5 mm² or 1 x 2.5 mm² | 3ZY1121-1BA00 | <br>Example 3ZY1121-1BA00 |
| SIRIUS terminal 3-pole screw-type terminal<br>2 x 1.5 mm² or 1 x 2.5 mm² | 3ZY1131-1BA00 | |
| SIRIUS terminal 2-pole screw-type terminal<br>2 x 2.5 mm² or 1 x 4 mm² | 3ZY1122-1BA00 | |
| SIRIUS spring-loaded terminal (push-in) 2-pole<br>2 x 1.5 mm² or 1 x 2.5 mm² | 3ZY1121-2BA00 | <br>Example 3ZY1121-2BA00 |
| SIRIUS spring-loaded terminal (push-in) 3-pole<br>2 x 1.5 mm² or 1 x 2.5 mm² | 3ZY1131-2BA00 | |
| SIRIUS spring-loaded terminal (push-in)<br>2-pole 2 x 2.5 mm² or 1 x 4 mm² | 3ZY1122-2BA00 | |

| Designation | Article number | Image |
|---|---|---|
| SIRIUS device connector for 3SK1 / 3RQ1 safety relay, 17.5 mm wide | 3ZY1212-1BA00 |  |
| SIRIUS device connector for 3RQ1 safety relay, 17.5 mm wide | 3ZY1212-1DA00 | |
| SIRIUS device connector for 3SK1 / 3RQ1 safety relay, 22.5 mm wide | 3ZY1212-2BA00 | |
| SIRIUS device termination connector for 3SK1 / 3RQ1 safety relay, 22.5 mm wide | 3ZY1212-2DA00 | |
| SIRIUS device connector for 3RM1 motor starters, 22.5 mm wide | 3ZY1212-2EA00 | |
| SIRIUS device termination connector for 3RM1 motor starters, 22.5 mm wide | 3ZY1212-2FA00 | |
| SIRIUS device termination connector set for 3SK1 safety relay, ≥ 45 mm wide | 3ZY1212-0FA01 | |
| SIRIUS device connector for looping through signals, 22.5 mm wide (for 3RM1 motor starters) | 3ZY1212-2AB00 | |
| SIRIUS device connector for height compensation without electrical function, 22.5 mm wide | 3ZY1210-2AA00 |  |
| SIRIUS push-in lugs for wall mounting (Contents: 12 units) | 3ZY1311-0AA00 |  |

| Designation | Article number | Image |
|---|---|---|
| SIRIUS sealable cover, 17.5 mm | 3ZY1321-1AA00 |  |
| SIRIUS sealable cover, 22.5 mm | 3ZY1321-2AA00 | |
| Coding pins for SIRIUS terminals | 3ZY1440-1AA00 |  |
| SIRIUS device identification label<br>17 sheets of 48 labels; size 10 x 7 mm | 3RT2900-1SB10 |  |
| SIRIUS device identification label<br>17 sheets of 20 labels; size 20 x 7 mm | 3RT2900-1SB20 | |
| SIRIUS device identification label<br>10 sheets of 306 adhesive labels; size 19 x 6 mm | 3RT2900-1SB60 | |

**Use of removable terminals for 3SK1**

The following removable terminals are available for the safety relays for pre-wiring of the terminals in the control cabinet, or for replacing terminals:

| 3SK1 safety relays | Terminal | | |
|---|---|---|---|
| | 2-pin | 3-pin | 2-pin |
| | 3ZY1121-*BA00 | 3ZY1131-*BA00 | 3ZY1122-*BA00 |
| **3SK1 Advanced basic units** | | | |
| 3SK1111 | --- | ✓ | --- |
| 3SK1112 | ✓ | --- | --- |
| 3SK1120 | --- | ✓ | --- |
| 3SK1121 | --- | ✓ | --- |
| 3SK1122 | ✓ bottom | ✓ top | --- |
| **Output expansions** | | | |
| 3SK1211 | ✓ | --- | --- |
| 3SK1213 | --- | --- | --- |
| 3RQ1 | --- | --- | ✓ |
| **Input expansions** | | | |
| 3SK1220 | --- | ✓ top | --- |
| 3SK1230 | ✓ bottom | --- | --- |

* - 1 Screw terminal

* - 2 Spring-loaded terminal (push-in)

**Device connectors for 3SK112., 3SK12.. and 3SK2**

Device connectors can be used to interconnect multiple devices of the 3SK-/3RM-/3RQ1 system. It is not possible to use device connectors with the 3SK1 Standard.

Device connectors are available in different designs specifically for the 3SK safety relays:

| For type | Device connector | | | |
|---|---|---|---|---|
| | 3ZY1212-1BA00-2BA00 | 3ZY1212-2BA00 | 3ZY1212-2GA00 | 3ZY1212-4GA01 |
| | For 3SK1/3RQ1, 17.5 mm wide | For 3SK1/3RQ1, 22.5 mm wide | For 3SK2, 22.5 mm wide | For 3SK2, 45 mm wide |
| **3SK1 Advanced basic units** | | | | |
| 3SK1120 | ✓ | -- | -- | -- |
| 3SK1121 | -- | ✓ | -- | -- |
| 3SK1122 | -- | ✓ | -- | -- |
| **3SK2 basic units** | | | | |
| 3SK2112 | -- | -- | ✓ | -- |
| 3SK2122 | -- | -- | -- | ✓ |
| **Output expansions** | | | | |
| 3SK1211 | -- | ✓ | -- | -- |
| 3SK1213 | -- | -- | -- | -- |
| 3RQ1 17.5 mm | ✓ | -- | -- | -- |
| 3RQ, 22.5 mm | -- | ✓ | -- | -- |
| **Input expansions** | | | | |
| 3SK1220 | ✓ | -- | -- | -- |
| 3SK1230 | -- | ✓ | -- | -- |

✓ Possible

-- Not possible

| For type | Device termination connector | | |
|---|---|---|---|
| | **3ZY1212-1DA00** | **3ZY1212-2DA00** | **3ZY1212-0FA01** |
| | **For 3RQ1, 17.5 mm wide** | **For 3SK1/3RQ1, 22.5 mm wide** | **For 3SK1, set for enclosures ≥ 45 mm** |
| **3SK1 Advanced basic units** | | | |
| 3SK1120 | -- | -- | -- |
| 3SK1121 | -- | ✓ | -- |
| 3SK1122 | -- | ✓ | -- |
| **3SK2 basic units** | | | |
| 3SK2112 | -- | -- | -- |
| 3SK2122 | -- | -- | -- |
| **Output expansions** | | | |
| 3SK1211 | -- | ✓ | -- |
| 3SK1213 | -- | -- | ✓ |
| 3RQ1<br>17.5 mm | ✓ | -- | -- |
| 3RQ,<br>22.5 mm | -- | ✓ | -- |
| **Input expansions** | | | |
| 3SK1220 | -- | -- | -- |
| 3SK1230 | -- | -- | -- |

✓ Possible

-- Not possible

# MLFB structure

# 16

Table 16- 1 Article numbers

| **Product versions** | | **Article number** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **3SK1 safety relays** | | **3SK1 x** | **x** | **x** | **-x** | **x** | **x** | **x** | **x** | **-xxxx** |
| Device type | Basic unit | 1 | | | | | | | | |
| | Expansion unit | 2 | | | | | | | | |
| Device variant | 3SK11: Standard;<br>3SK12: Output expansion | | 1 | | | | | | | |
| | 3SK11 Advanced;<br>3SK12: Input expansion | | 2 | | | | | | | |
| Type of outputs | Relay outputs | | | 1 | | | | | | |
| | Semiconductor outputs | | | 2 | | | | | | |
| | Power outputs | | | 3 | | | | | | |
| Type of connection | Screw terminal | | | | 1 | | | | | |
| | Spring-type terminal (push-in) | | | | 2 | | | | | |
| Control circuit/actuation | 3SK11: 3 enabling circuits | | | | | A | | | | |
| | 3SK11: 2 enabling circuits | | | | | B | | | | |
| | 3SK11: 4 enabling circuits | | | | | C | | | | |
| Type of control supply voltage | 3SK1213: 24 V AC, 50/60 Hz | | | | | | B | 0 | | |
| | 3SK1: 24 V AC/DC, 50/60 Hz | | | | | | B | 3 | | |
| | 3SK1: 24 V DC | | | | | | B | 4 | | |
| | 3SK1213: 115 V AC, 50/60 Hz | | | | | | J | 2 | | |
| | 3SK1213: 230 V AC, 50/60 Hz | | | | | | L | 2 | | |
| | 3SK1: 110 ... 240 V AC/DC, 50/60 Hz | | | | | | W | 2 | | |
| Time delay | None | | | | | | | | 0 | |
| | 0.05 ... 3 s | | | | | | | | 1 | |
| | 0.5 ... 30 s | | | | | | | | 2 | |
| | 5 ... 300 s | | | | | | | | 4 | |
| Versions | with protective coating on printed circuit board | | | | | | | | | 0AX0 |
| Example | | 3SK1 111-1AB30 | | | | | | | | |