

Industrial controls

Switching devices SIRIUS 3RF solid-state switching devices


Equipment Manual


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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

| |
|--|
|  DANGER |
| indicates that death or severe personal injury will result if proper precautions are not taken. |

| |
|---|
|  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. |


If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified persons are those who, because of their training and experience, are familiar with the installation, assembly, commissioning, operation, decommissioning and disassembly of the product and can recognize risks and avoid possible hazards.

Proper use of Siemens products

Note the following:

| |
|--|
|  WARNING |
| Siemens products may only be used for the application described in the catalog and the associated usage information. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed. |

Trademarks

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction

1.1 Purpose of the documentation

The SIRIUS 3RF solid-state switching device manual describes the solid-state switching devices and function modules. It contains information about configuration, commissioning and servicing.

For configuration, the manual contains links to dimensional drawings and technical specifications for the system components.

1.2 Change documentation

| Release number | Changes |
|----------------|--|
| 04/2026 | <ul style="list-style-type: none"> Changes in the "Safety instructions" chapter |
| 01/2026 | Initial release |

1.3 Scope of the documentation

The Equipment Manual is valid for the solid-state switching devices described herein. It contains a description of the devices that are valid at the time of publication.

1.4 Required basic knowledge

A general understanding of automation technology and low-voltage controls and distribution is required to comprehend this document.

1.5 Standards

The solid-state switching devices comply with the following standards:

- IEC / EN 60947-4-2
- IEC / EN 60947-4-3
- IEC / EN 60947-5-1
- CSA22.2
- UL 508

1.6 Target group

Configuration engineers

They should receive all explanations regarding the design of the solid-state switching devices for their application that are **not** provided in the Mall and catalog.

Commissioning engineers

All steps necessary for commissioning a load feeder with a solid-state switching device should be listed and explained.

Service engineers

The error messages and possible causes of the errors should be presented, along with how to remedy them. A procedure should be described.

1.7 Approvals/test reports

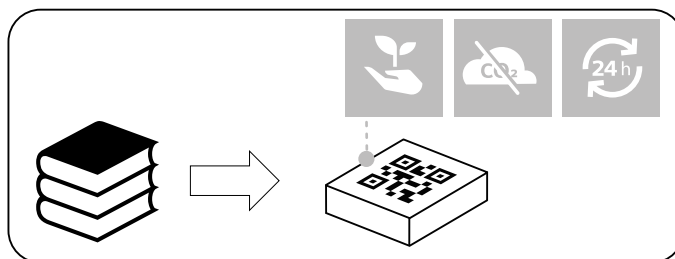
You can find an overview of the certifications available for low-voltage controls and distribution products and other technical documentation, updated daily, on the Internet (<https://sieportal.siemens.com/su/bmuTh>).

You can find more information in the Catalog IC 10 - SIRIUS "Industrial Controls", Chapter 06 (<https://support.industry.siemens.com/cs/ww/en/view/109771990>).

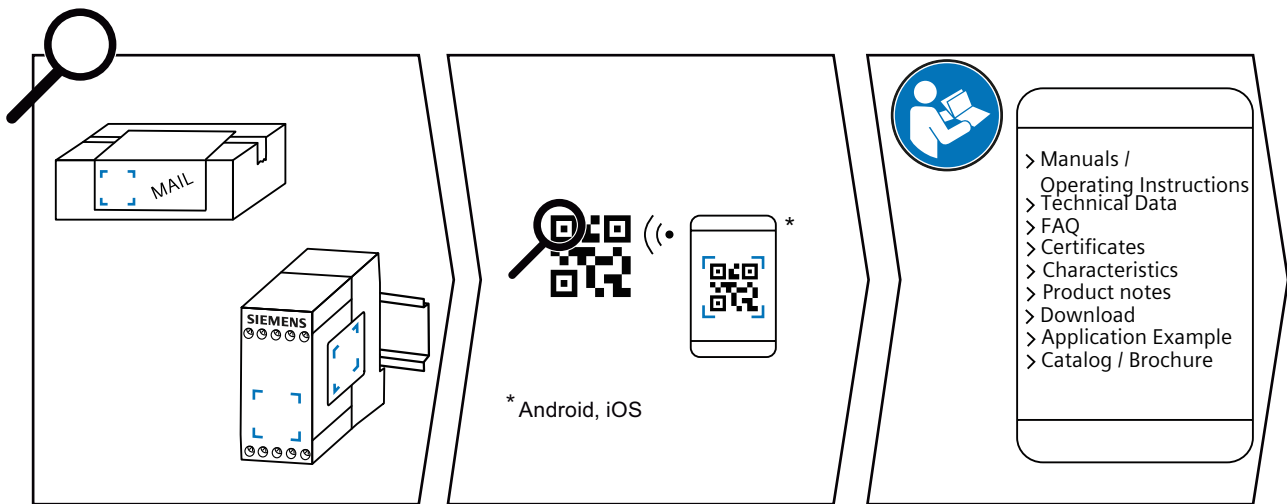
1.8 ID link

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.



1.9 Siemens SiePortal Support

At Siemens SiePortal Support you can obtain up-to-date information from our global support database: You can also define your personal workspace.

Support

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

- **Solution Guide**
Our AI functionality answers your questions based on verified technical product information.
- **Manuals/operating instructions**
Read online or download, available as PDF or individually configurable.
- **Downloads**
Here you will find updates, service packs, HSPs and much more for your product.
- **Certificates**
Clearly sorted according to approving authority, type and country.
- **Characteristics**
For support in planning and configuring your system.
- **Catalogs / Brochures**
Read online or download, available as PDF.
- **Technical data**
Technical product data for support in planning and implementing your project
- **Product announcements**
The latest information and news concerning our products.
- **Forum**
Harness the potential of our community.

1.11 Recycling and disposal

- **FAQs**
Answers to frequently asked questions
- **Application examples**
Function blocks, background and system descriptions, performance statements, demonstration systems, and application examples, clearly explained and represented.

Link: Siemens SiePortal Support (<https://sieportal.siemens.com/en-ww/support>)

mySiePortal

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

- **My conversations**
Overview of your previous conversations.
- **Installed products**
Your registered products are displayed here.
- **Service requests**
Overview of your previous support requests.
- **Lists & notifications**
Here you can view your search queries, favorites, notifications and lists of products.
- **Product data & documentation**
Easy access to CAX data, e.g. 3D models, 2D dimension drawings, EPLAN macros, device circuit diagrams
- **My Quicklinks**
Compile a list of frequently used links to access information more quickly.

1.10 Support Request

You can submit and manage support requests in the mySupport Cockpit. To do this, you must register once.

| | |
|-------------------------|--|
| Support request: | Internet (https://sieportal.siemens.com/en-us/mysieportal/support-requests/management) |
|-------------------------|--|

1.11 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.

1.12 Additional documentation

Here you will find additional documents that may be relevant to your products.

- Circularity Instruction 3RF5 (<https://support.industry.siemens.com/cs/ww/en/view/109998403>)
- Circularity Instruction 3RF3 (<https://support.industry.siemens.com/cs/ww/en/view/109998853>)
- FAQs: 3RF29 function modules - Voltage variants and connection (<https://support.industry.siemens.com/cs/ww/en/view/32151415>)

1.13 Article numbering system for solid-state switching devices

Article numbering system for 3RF3 solid-state contactors and solid-state relays

The following table shows the article numbering system for 3RF3 solid-state contactors and solid-state relays. The table describes what each position in the article number stands for. Each column of the article number positions describes a specific feature of the product using a number or letter.

| Product versions | | Article number positions | | | | | | | | |
|------------------------------------|---|--------------------------|-----|-----|-----|-----|------|------|------|---|
| | | 1st - 5th | 6th | 7th | 8th | 9th | 10th | 11th | 12th | |
| Device type | Solid-state relay | 3RF30 3RF31 3RF32 | – | – | – | – | – | – | – | – |
| | Solid-state contactor | 3RF33 3RF34 | – | – | – | – | – | – | – | – |
| Rated current | e.g. 20 = 20 A | – | x | x | – | – | – | – | – | – |
| Type of connection | Screw terminal | – | – | – | 1 | – | – | – | – | |
| | Spring-loaded terminal | | | | 2 | | | | | |
| | Ring cable lug connection | | | | 3 | | | | | |
| Switching function | Zero-point switching | – | – | – | – | A | – | – | – | |
| | Instantaneous switching | | | | | B | | | | |
| | Zero-point switching (short-circuit-proof with B MCB) | | | | | D | | | | |
| Number of controlled phases | 1-pole | – | – | – | – | – | A | – | – | |
| | 2-pole | | | | | | B | | | |
| | 3-pole | | | | | | C | | | |
| Rated control supply voltage U_s | 24 V DC | – | – | – | – | – | – | 0 | – | |
| | 24 V AC/DC | | | | | | | 1 | | |
| | 110 ... 230 V AC | | | | | | | 2 | | |
| | 4 ... 30 V DC | | | | | | | 4 | | |
| | 230 V AC | | | | | | | 5 | | |
| | 110 V DC | | | | | | | 6 | | |

1.13 Article numbering system for solid-state switching devices

| Product versions | | Article number positions | | | | | | | |
|--|---|--------------------------|-----|-----|-----|-----|------|------|------|
| | | 1st - 5th | 6th | 7th | 8th | 9th | 10th | 11th | 12th |
| Rated operational voltage U _e | 24 ... 230 V AC | – | – | – | – | – | – | – | 2 |
| | 48 ... 460 V AC | | | | | | | | 4 |
| | 48 ... 600 V AC (blocking voltage 1200 V) | | | | | | | | 5 |
| | 48 ... 600 V AC | | | | | | | | 6 |

Article numbering system for 3RF5 solid-state contactors and solid-state relays

The following table shows the article numbering system for 3RF5 solid-state contactors and solid-state relays. The table describes what each position in the article number stands for. Each column of the article number positions describes a specific feature of the product using a number or letter.

| Product versions | | Article number positions | | | | | | | |
|---|--|--------------------------|-----|-----|-----|-----|------|------|------|
| | | 1st - 5th | 6th | 7th | 8th | 9th | 10th | 11th | 12th |
| Device type | Solid-state relay | 3RF51 | – | – | – | – | – | – | – |
| | Solid-state contactor | 3RF53 | – | – | – | – | – | – | – |
| Rated current | 15 A | – | 1 | 5 | – | – | – | – | – |
| | 25 A | – | 2 | 5 | – | – | – | – | – |
| Type of connection | Screw terminal | – | – | – | 1 | – | – | – | – |
| Switching function | Instantaneous switching | – | – | – | – | B | – | – | – |
| Number of controlled phases | 1-pole | – | – | – | – | – | A | – | – |
| Rated control supply voltage U _s | 4 ... 30 V DC | – | – | – | – | – | – | 4 | – |
| | 110 V DC | | | | | | | 6 | |
| Rated operational voltage U _e | 24 ... 1100 V DC (U _{max} 1270 V) | – | – | – | – | – | – | – | 5 |
| | 24 ... 1350 V DC (U _{max} 1500 V) | | | | | | | | 7 |

Article numbering system for 3RF39 function modules

The following table shows the article numbering system for the function modules. The table describes what each position in the article number stands for. Each column of the article number positions describes a specific feature of the product using a number or letter.

| Product versions | | Article number positions | | | | | | | |
|--------------------------------------|-----------------|--------------------------|-----|-----|-----|-----|------|------|------|
| | | 1st - 5th | 6th | 7th | 8th | 9th | 10th | 11th | 12th |
| Device type | Function module | 3RF39 | – | – | – | – | – | – | – |
| Operational current at AC-1 at 400 V | e.g. 20 = 20 A | – | x | x | – | – | – | – | – |
| Irrelevant | | – | – | – | 0 | – | – | – | – |

1.13 Article numbering system for solid-state switching devices

| Product versions | | Article number positions | | | | | | | |
|---------------------------------------|----------------------------|--------------------------|-----|-----|-----|-----|------|------|------|
| | | 1st - 5th | 6th | 7th | 8th | 9th | 10th | 11th | 12th |
| Function module type | Converter | – | – | – | – | E | A | – | – |
| | Basic load monitoring | – | – | – | – | F | A | – | – |
| | Extended load monitoring | – | – | – | – | G | A | – | – |
| | Heating current monitoring | – | – | – | – | J | A | – | – |
| | Power controller | – | – | – | – | K | A | – | – |
| | Power regulator | – | – | – | – | H | A | – | – |
| Type of voltage | DC | – | – | – | – | – | – | 0 | – |
| | AC/DC | – | – | – | – | – | – | 1 | – |
| Operational voltage at AC at 50/60 Hz | 110 ... 230 V | – | – | – | – | – | – | – | 3 |
| | 400 ... 600 V | – | – | – | – | – | – | – | 6 |
| | – | – | – | – | – | – | – | – | 8 |

Safety instructions

2.1 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/global/en/products/automation/topic-areas/industrial-cybersecurity.html>).

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 at (<https://www.siemens.com/cert>):

2.2 General safety notes

Hazardous voltage

Disconnect the system and all devices from the power supply before starting work.

2.3 Electromagnetic compatibility (EMC) according to IEC 60947-4-1

This product is designed for use in Environment A. Use of this product in Environment B may cause unwanted electromagnetic interference, in which case the user may be required to take adequate mitigation measures.

2.4 Intended use

Improper use of the product

Improper use of the product and its accessories results in a risk of death, risk of 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.

2.5 Warning notice - Terminals

Hazardous voltage

The terminals of the solid-state switching device must not be touched when the device is connected to the power supply. Output terminals will have voltage present even when the control device is OFF.

2.6 Use of overvoltage protection

Use of overvoltage protection required

Use a suitable surge protection device in combination with the solid-state switching devices.

The maximum cut-off voltage should be 6000 V and the minimum energy processing capacity 100 J.

2.7 Qualified personnel

Qualified personnel required

Failure to follow proper procedures may result in personal injury and damage to property.

All work involved in connecting, commissioning and maintenance must be carried out by qualified, responsible personnel.

2.8 Electrostatic charge

Avoiding electrostatic charging

Electrostatic charging can damage components and devices.

When handling and installing the system components, ensure that the components are protected from electrostatic charge. Changes to the system configuration and wiring are permissible only when the supply voltage is switched off.

The connection of devices is permitted only when the voltage is switched off.

2.9 ESD Guidelines

ESD

All electronic devices are equipped with large-scale integrated ICs or components. Due to their design, these electronic elements are highly sensitive to overvoltage, and thus to any electrostatic discharge.

ESD devices are identified by the following symbol:



NOTICE

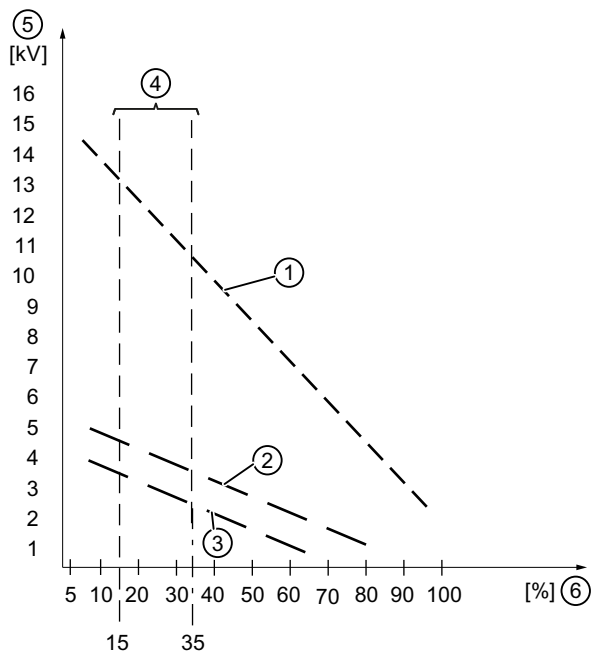
Electrostatic discharge

ESD devices can be destroyed by voltages well below the threshold of human perception. These static voltages develop when you touch a component or electrical connection of a device without having drained the static charges present on your body. The damage caused to a device by overvoltage is usually not immediately evident and is only noticed after an extended period of operation.

Electrostatic charging

Anyone who is not connected to the electrical potential of their surroundings can be electrostatically charged.

The diagram below shows the maximum electrostatic voltage which may build up on a person coming into contact with the materials specified in the diagram. These values are in conformity with the specifications of IEC 61000-4-2.



- ① Synthetic material
- ② Wool
- ③ Antistatic material, e.g. wood or concrete
- ④ E.g. office spaces without humidity control (in winter)
- ⑤ Voltage
- ⑥ Relative humidity

NOTICE**Protective measures against damage to equipment due to discharge of static electricity**

Electronic devices contain components that can be damaged by electrostatic discharge if they are handled improperly.

- **Grounding/discharge**

When handling electrostatic sensitive devices, ensure that your body, the workplace, and packaging are grounded. In this way, you can avoid becoming electrostatically charged. Discharge your body electrostatically immediately before touching an electronic component. To do this, touch a conductive, grounded object, e.g., a bare metal part of a switch cabinet or the water pipe.

Electrostatically sensitive devices should not be brought into contact with electrically insulating materials such as plastic film, plastic parts, insulating table supports, or clothing made of synthetic fibers.

- **Direct contact**

Only touch electrostatic sensitive devices when this is unavoidable (e.g. during maintenance work). Handle the devices, if possible, only by the plastic enclosure and without touching any chip pins or PCB traces. In this way, the discharged energy cannot reach or damage sensitive devices.

Discharge your body before taking any necessary measurements on a device. Do so by touching grounded metallic parts. Use only grounded measuring instruments.

Always place an electrostatic sensitive device on conductive bases.

- **Storage and transport**

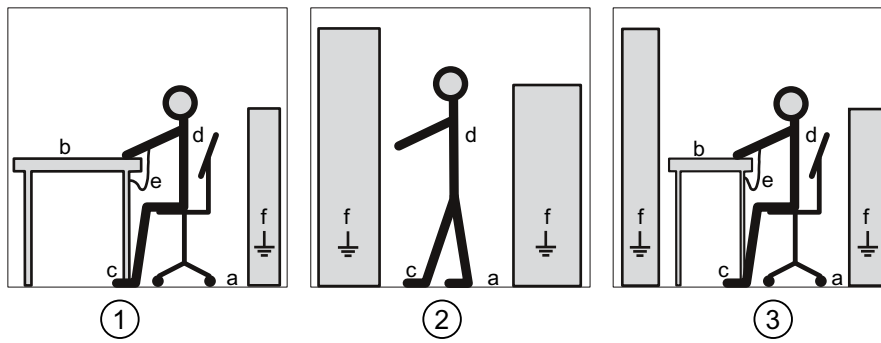
Always store and transport electrostatic sensitive devices or components in ESD-safe conductive packaging, e.g. metallized plastic or metal containers. Leave the device in its packaging until installation.

NOTICE**Storage and transport in non-conductive packaging**

If you have to store or transport the electrostatic sensitive device in non-conductive packaging, you must first pack the device in ESD-safe, conductive material, e.g., conductive foam rubber, ESD bag.

The diagrams below illustrate the required ESD protective measures for electrostatic sensitive devices.

2.10 Current information about operational safety



- ① ESD seat
- ② ESD standing position
- ③ ESD seat and ESD standing position

Protective measures

- a Conductive floor
- b ESD table
- c ESD shoes
- d ESD smock
- e ESD bracelet
- f Cabinet ground connection

2.10 Current information about operational safety

Important note for maintaining operational safety of your system

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 special newsletters containing information on product features that are (or could be) relevant to operation of safety-related systems. By subscribing to the appropriate newsletters, you will ensure that you are always up to date and able to make changes to your system when necessary:

- Safety Integrated (<https://new.siemens.com/global/en/products/automation/topic-areas/safety-integrated/factory-automation/newsletter.html>)
- Industrial controls (<https://new.siemens.com/global/en/products/automation/industrial-controls/forms/newsletter.html>)

Click "Subscribe to newsletter".

Description

3.1 Overview of solid-state switching devices

Description

SIRIUS 3RF solid-state switching devices contain power semiconductors that switch the current in the main circuit on and off. Compared to conventional relays or contactors, semiconductors close and reopen the circuit within a very short time without any mechanical or electrical wear. However, a disadvantage is the power loss in the main circuit, which is higher than with conventional contacts. In addition, when switched off, a small leakage current flows through the switched-off semiconductor.

The solid-state switching devices are particularly suitable for applications with a high switching frequency (> 1,000 switching operations per hour).

The product range of 3RF solid-state switching devices includes solid-state relays, solid-state contactors, and function modules.

The solid-state relays and contactors have the same power semiconductor design. Solid-state relays should preferably be used when many resistive loads are controlled in an application. They are mounted on specially designed collective heat sinks. The required performance is only achieved after mounting on a heat sink. The solid-state contactors, on the other hand, are already equipped with a heat sink and are therefore optimized for the specified rated current. For this reason, solid-state contactors should preferably be used in applications with few loads.

The solid-state relays and contactors of the 3RF3 product series are available in 1-pole (3RF30, 3RF31, and 3RF33) and 3-pole (3RF32 and 3RF34) versions and are suitable for use in AC networks. The devices in the 3RF5 product series, on the other hand, are specially designed for use in DC networks. 1-pole solid-state relays from the 3RF515 product series and 1-pole solid-state contactors from the 3RF525 product series are available.

The function modules can generally be used in conjunction with the 1-pole solid-state switching devices of the 3RF31 and 3RF33 product series. Special restrictions or exceptions apply to the individual variants of the function modules.

Special solid-state contactors can be used in conjunction with an electronic overload relay or a motor starter protector for the operational switching of motors up to 7.5 kW. For more information, see the Equipment Manual - SIRIUS 3RF34 Solid-State Switching Devices (<https://support.industry.siemens.com/cs/ww/en/view/60298187>).

Scope of application

The solid-state switching devices can be used in the electrical industry in applications that require a high switching frequency. The additional function modules make them suitable for load monitoring and control of power.

Area of application

The solid-state switching devices are intended for use in enclosed spaces in which no harsh operating conditions prevail, e.g. dust, caustic vapors, hazardous gases. Suitable enclosures must be provided for installation in dusty or damp rooms.

Benefits

High switching frequencies, long service life due to low wear.

3.2 Product series

3.2.1 Device versions

Depending on whether they are used in AC or DC networks, solid-state switching devices with thyristors are used in AC applications or with transistors in DC applications.

The solid-state contactors for operating motors can be interconnected with SIRIUS circuit breakers using link modules to easily set up fuseless load feeders. Alternatively, combinations with fuses or miniature circuit breakers are possible.

This allows the implementation of load feeders with type of coordination 1 for short-circuit currents of up to 10 kA.

Product versions

| Type | Solid-state relay | | | | Solid-state contactor | | |
|---------------------------------|-------------------|-------|-----------------|-----------------|-----------------------|-------|-----------------|
| | 1-pole 22.5 mm | | 1-pole 45 mm | 3-pole 45 mm | 1-pole 22.5 mm | | 3-pole 45 mm |
| | 3RF3 | 3RF5 | 3RF3 | 3RF3 | 3RF3 | 3RF5 | 3RF3 |
| Product series | 3RF31 | 3RF51 | 3RF30 | 3RF32 | 3RF33 | 3RF53 | 3RF34 |
| Complete unit "Ready to use" | – | | – | – | x | | x |
| Scope of applica- tion | AC | DC | AC | AC | AC | DC | AC |

–: not applicable

x: applicable

Connection technology

You can choose between the following connection technologies for the SIRIUS 3RF solid-state switching devices:

- Screw-type connection technology
- Spring-loaded connection technology
- Ring cable lug connection technology

Performance capability

The SIRIUS 3RF solid-state switching devices are designed for the following operating currents:

- Solid-state relays up to 90 A
- Solid-state contactors 6 to 80 A

Control supply voltages

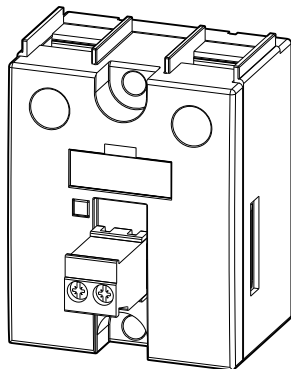
The SIRIUS 3RF solid-state switching devices are available in the following variants:

- 3RF3 solid-state switching devices:
 - 24 V DC
 - 24 V AC/DC
 - 110 ... 230 V AC
 - 4 ... 30 V DC
 - 230 V AC
 - 110 V DC
- 3RF5 solid-state switching devices:
 - 4 ... 30 V DC
 - 110 V DC

3.2.2 Solid-state relays and solid-state contactors

3.2.2.1 Solid-state relay 1-pole 3RF30 width 45 mm

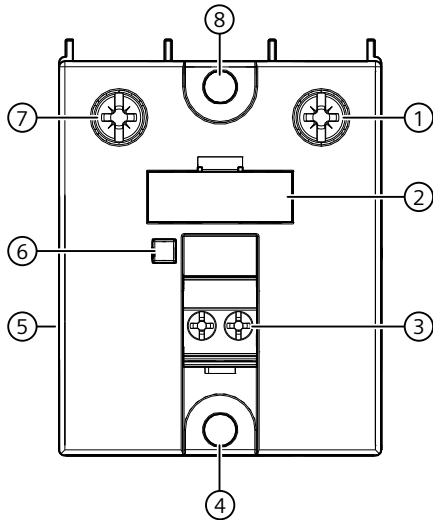
Description



The solid-state relays with a width of 45 mm provide for connection of the power supply lead and the load from above. This makes it easy to replace existing solid-state relays in existing

arrangements. The control cable is connected in a space-saving manner by simply plugging it in and laying the load and control cables separately.

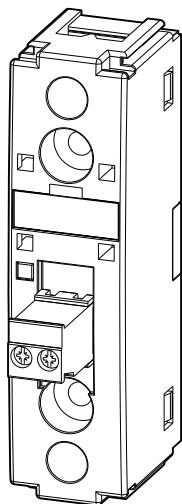
Setup



- ① 2/T main circuit terminal
- ② Labeling plate
- ③ Control connector with control circuit terminals (A1, A2)
- ④ Bottom installation opening
- ⑤ Cooling surface on the rear side
- ⑥ Status LED "ON" (yellow) for displaying operating states
- ⑦ 1/L main circuit terminal
- ⑧ Top installation opening

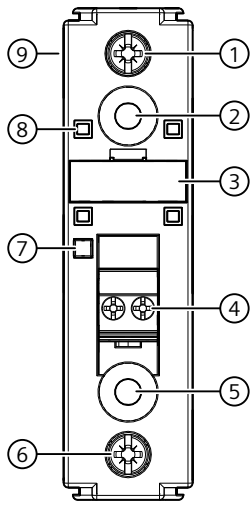
3.2.2.2 Solid-state relay 1-pole 3RF31 width 22.5 mm

Description



The 1-pole solid-state relays are electronic switching devices designed for wear-free and noise-free switching of AC loads. The solid-state relays are well suited for use in applications where many resistive loads are controlled, as they can be mounted on collective heat sinks to save space.

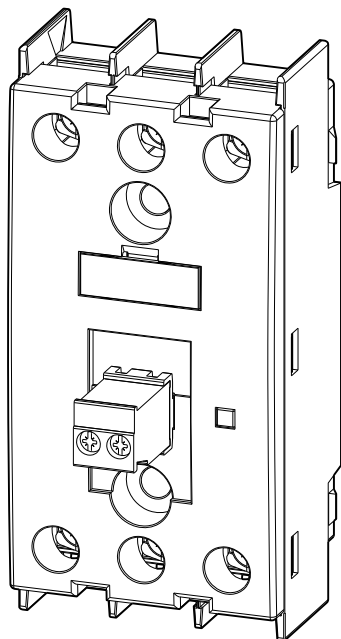
Setup



- ① 1/L main circuit terminal
- ② Top installation opening
- ③ Labeling plate
- ④ Control connector with control circuit terminals (A1, A2)
- ⑤ Bottom installation opening
- ⑥ 2/T main circuit terminal
- ⑦ Status LED "ON" (yellow) for displaying operating states
- ⑧ Connection point to function modules and assembly guide (4x)
- ⑨ Cooling surface on the rear side

3.2.2.3 3RF32 3-pole solid-state relays

Description



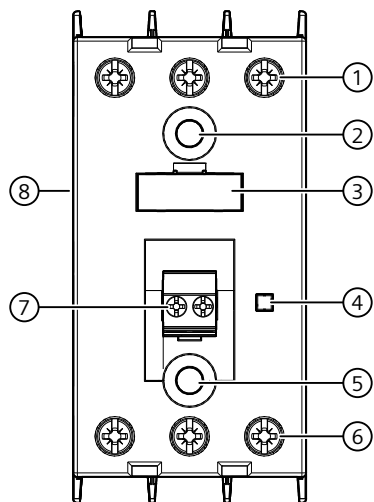
The 3-pole solid-state relays are electronic switching devices designed for wear-free and noise-free switching of AC loads. The solid-state relays are well suited for use in applications where many resistive loads are controlled, as they can be mounted on collective heat sinks to save space.

Product versions

The 3-pole solid-state relays are available in the following variants:

- 2-pole control: Suitable in particular for circuits without connection to the neutral conductor (article number: 3RF32...B..).
- 3-pole control: Suitable for star circuits with connection to the neutral conductor or for applications in which the system requires all phases to be switched (article number: 3RF32...C..).

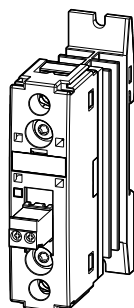
Setup



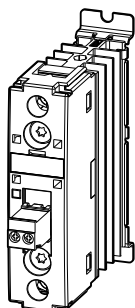
- ① Main circuit terminals (1/L1, 3/L2, 5/L3)
- ② Top installation opening
- ③ Labeling plate
- ④ Status LED "ON" (yellow) for displaying operating states
- ⑤ Bottom installation opening
- ⑥ Main circuit terminals (2/T1, 4/T2, 6/T3)
- ⑦ Control connector with control circuit terminals (A1, A2)
- ⑧ Cooling surface on the rear side

3.2.2.4 3RF33 1-pole solid-state contactors

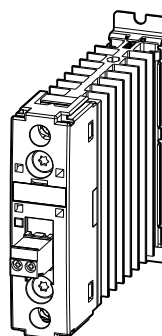
Description



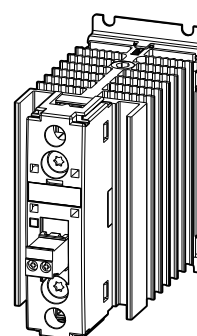
3RF3306



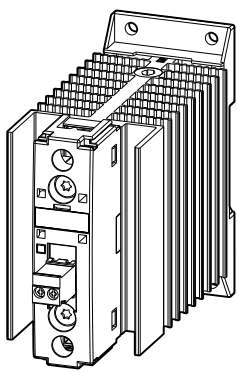
3RF3310



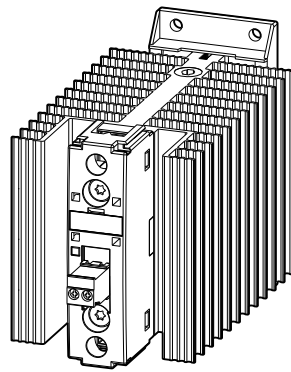
3RF3320
3RF3330



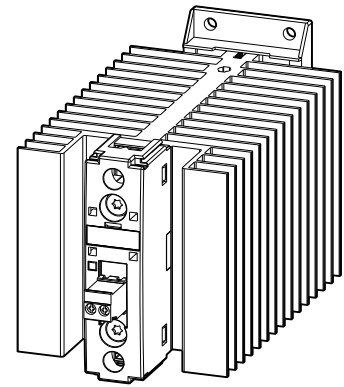
3RF3340



3RF3350



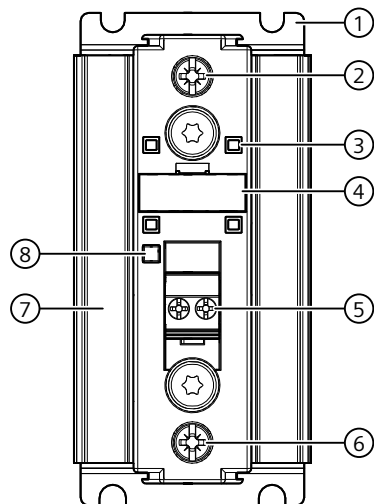
3RF3365



3RF3380

The 1-pole solid-state contactors are electronic switching devices designed for wear-free and noise-free switching of AC loads. The devices consist of a solid-state relay with a heat sink, which optimizes them for the specified rated current. Thanks to optimized power electronics, versions of 3RF3306 to 3RF3320 solid-state contactors can be mounted side-by-side without derating.

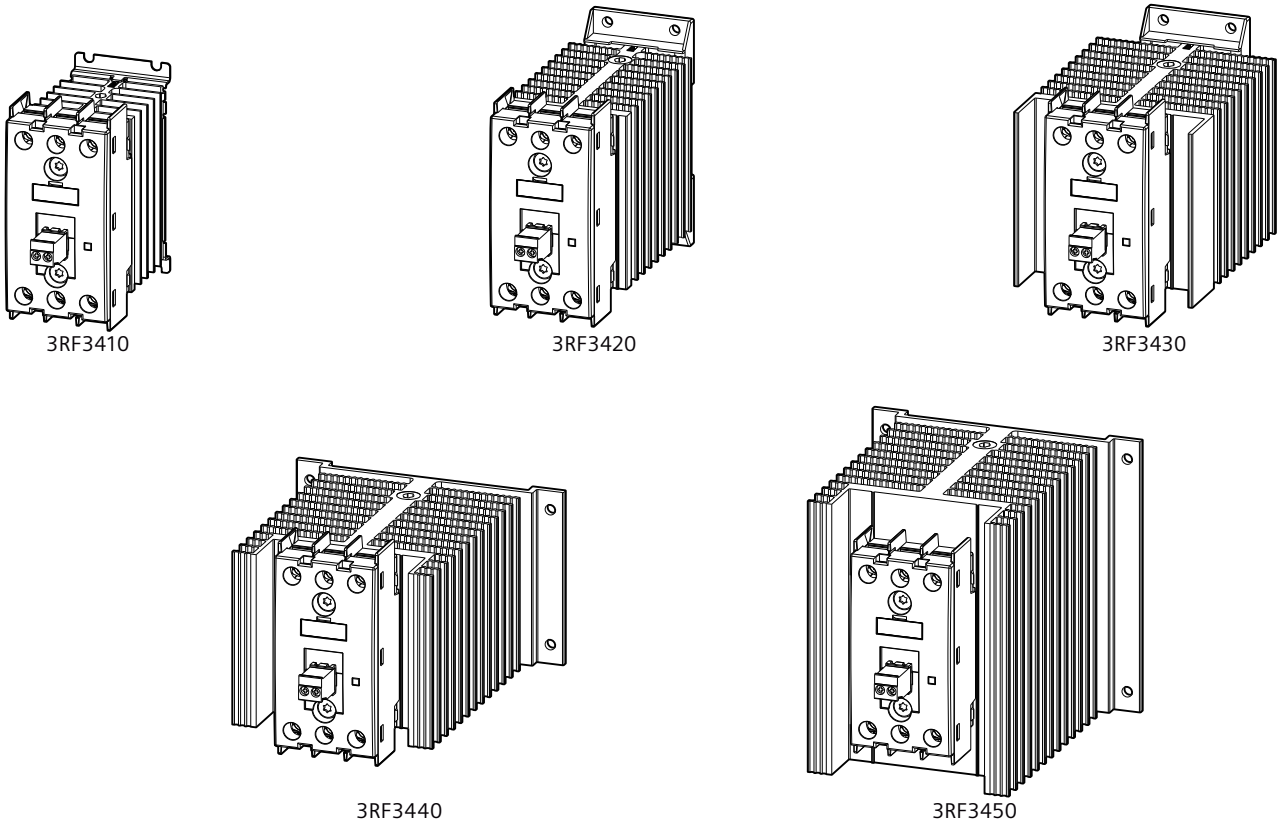
Setup



- ① DIN rail mount and/or mounting adapter with mounting openings
- ② 1/L main circuit terminal
- ③ Connection point to function modules and assembly guide (4x)
- ④ Labeling plate
- ⑤ Control connector with control circuit terminals (A1, A2)
- ⑥ 2/T main circuit terminal
- ⑦ Heat sink
- ⑧ Status LED "ON" (yellow) for displaying operating states

3.2.2.5 3RF34...-A... 3-pole solid-state contactors

Description



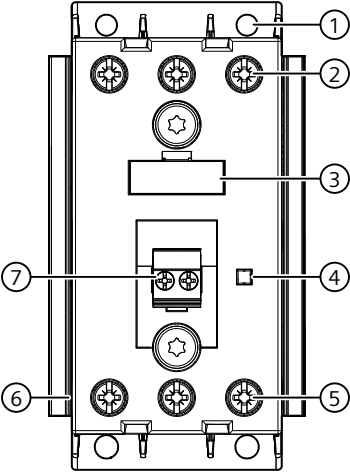
The 3-pole solid-state contactors are electronic switching devices designed for wear-free and noise-free switching of AC loads. The devices consist of a solid-state relay with a heat sink, which optimizes them for the specified rated current.

Product version

The 3-pole solid-state contactors for resistive loads up to 50 A are available in the following variants:

- 2-pole control: Suitable in particular for circuits without connection to the neutral conductor (article number: 3RF34...-A...).
- 3-pole control: Suitable for star circuits with connection to the neutral conductor or for applications in which the system requires all phases to be switched (article number: 3RF34...-A...).

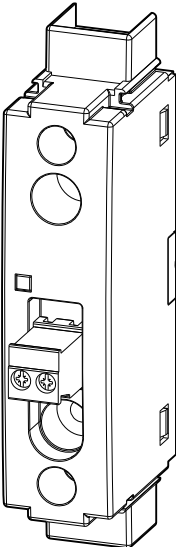
Setup



- ① DIN rail mount and/or mounting adapter with mounting openings
- ② Main circuit terminals (1/L1, 3/L2, 5/L3)
- ③ Labeling plate
- ④ Status LED "ON" (yellow) for displaying operating states
- ⑤ Main circuit terminals (2/T1, 4/T2, 6/T3)
- ⑥ Heat sink
- ⑦ Control connector with control circuit terminals (A1, A2)

3.2.2.6 3RF51 1-pole solid-state relays

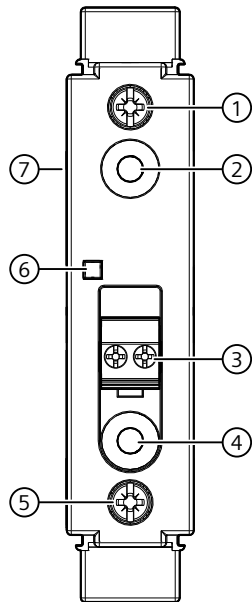
Description



The 1-pole 3RF5 solid-state relays are electronic switching devices designed specifically for DC applications with resistive loads up to 1,350 V. The solid-state relays are well suited for

use in applications where many resistive loads are controlled, as they can be mounted on collective heat sinks to save space.

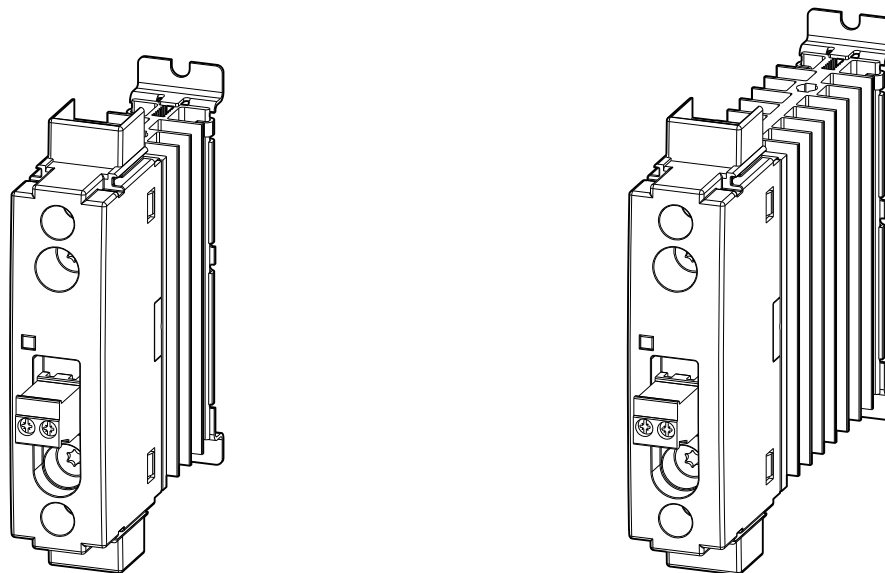
Setup



- ① 1/L+ main circuit terminal
- ② Top installation opening
- ③ Control connector with control circuit terminals (A1 +, A2 -)
- ④ Bottom installation opening
- ⑤ 2/T- main circuit terminal
- ⑥ Status LED "ON" (yellow) for displaying operating states
- ⑦ Cooling surface on the rear side

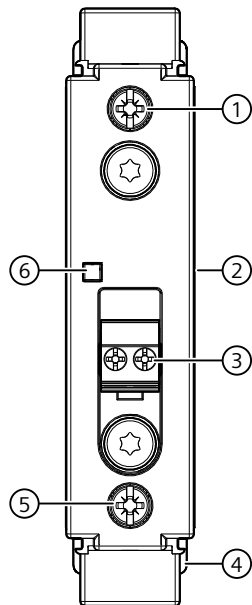
3.2.2.7 3RF53 1-pole solid-state contactors

Description



The 1-pole 3RF5 solid-state contactors are electronic switching devices designed specifically for DC applications with resistive loads up to 1,500 V. The devices consist of a solid-state relay with a heat sink, which optimizes them for the specified rated current.

Setup



- ① 1/L+ main circuit terminal
- ② Heat sink
- ③ Control connector with control circuit terminals (A1 +, A2 -)
- ④ DIN rail mount and mounting adapter with mounting openings
- ⑤ 2/T- main circuit terminal
- ⑥ Status LED "ON" (yellow) for displaying operating states

3.2.3 3RF39... function modules

The function modules expand the functionality of the solid-state switching devices. They are mounted by simply clicking them into place. This establishes all necessary connections to the solid-state switching device. The control connector of the solid-state relay or contactor can simply be reused.

For function modules with current measurement, feed the line to the load through the straight-through transformer and reattach the line to the solid-state switching device.

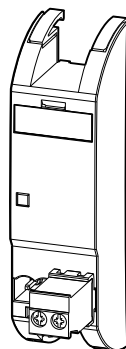
NOTICE

Compatibility of the function modules

The function modules cannot be used with the solid-state relays and contactors of the 3RF5 product series. When configuring the system, take into account the compatibility of the function modules with the solid-state relays and contactors.

3.2.3.1 Converter function module

Description



The converter converts analog control signals, such as those output by temperature controllers, into a pulse-width-modulated digital signal. The connected solid-state contactors and relays can therefore regulate the output of a load as a percentage.

Product versions

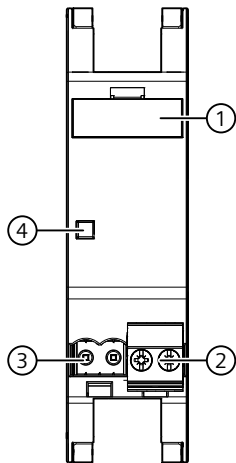
One variant of the converter is available (article number: 3RF3900-0EA18).

Compatible solid-state relays or solid-state contactors

The function module converter is compatible with the following products:

- 3RF31...0./1./4.
- 3RF32...A.4.
- 3RF33...0./1./4.
- 3RF34...A.4.

Setup



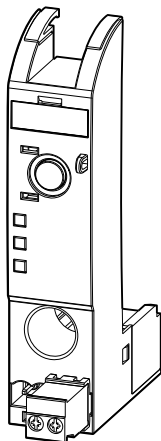
- ① Labeling plate
- ② Control connector of the function module (terminals 0 – 10 V)
- ③ Cut-out for control connector of the solid-state relay/contactor (terminals A1, A2)
- ④ Status LED "ON" (yellow) for displaying operating states

Scope of application

The function module is used for converting an analog input signal to an on/off ratio with the time basis 1 s. The module can only be used in conjunction with 3RF31, 3RF33 1-pole solid-state switching devices or 3RF32, 3RF34 3-pole devices. It can be used on versions with 24 V DC and 24 V AC/DC control supply voltage.

3.2.3.2 Function module load monitoring basic

Description



The function module load monitoring basic enables rapid detection of failures of up to 6 load elements, alloyed power semiconductors, or missing voltage or breaks in the load circuit.

A fault is indicated by one or more status LEDs and reported to the controller by way of a PLC-compatible output. The principle of operation is based on permanent monitoring of the current intensity. This value is continuously compared with the stored reference value, which is determined by the teach-in process. In order to detect the failure of one of several loads, the current difference must be 1/6 of the reference value.

Product versions

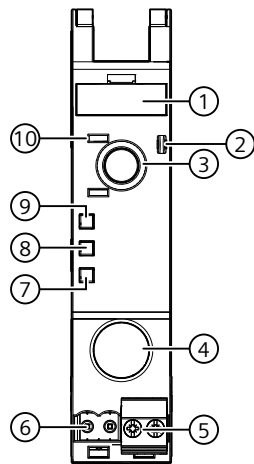
Variants with different rated operational currents are available (article number: 3RF39..-0F.08).

Compatible solid-state relays or solid-state contactors

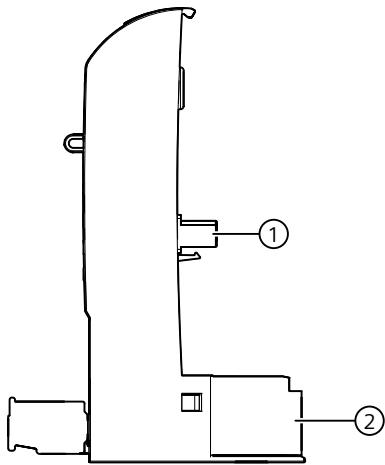
The function module load monitoring basic is compatible with the following products:

- 3RF31..-1..0./-1..4.
- 3RF33..-1..0./-1..4.

Setup



- ① Labeling plate
- ② Eye for lead seal for sealable cover cap
- ③ "TEACH/TEST" button for the teach-in process and for testing the system
- ④ Opening for connecting the cable to the solid-state relay/contactator
- ⑤ Control connector of the function module (terminals IN, OUT)
- ⑥ Cut-out for control connector of the solid-state relay/contactator (terminals A1, A2)
- ⑦ Status LED "FAULT" (red) for displaying faults
- ⑧ Status LED "ON" (yellow) for displaying operating states
- ⑨ Status LED "INPUT" (yellow) for displaying operating states
- ⑩ Cut-outs for sealable cover cap



- ① Control connector - connection point to the solid-state relay/contactor
- ② Straight-through transformers

Scope of application

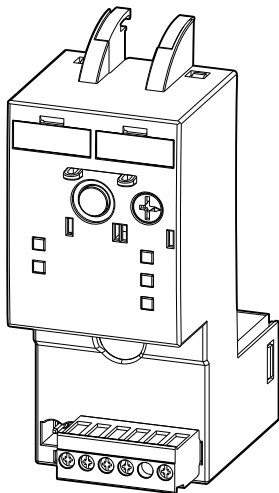
The device is used for monitoring one or more loads (partial loads).

Area of application

The function module can only be used in conjunction with a 3RF31 solid-state relay or a 3RF33 solid-state contactor. The solid-state switching devices with spring-loaded terminals in the load circuit are not suitable for load monitoring.

3.2.3.3 Function module load monitoring extended

Description



The function module load monitoring extended enables rapid detection of failures of up to 12 load elements, alloyed power semiconductors, or missing voltage or breaks in the load circuit. A fault is indicated by one or more status LEDs and reported to the controller by way of a PLC-compatible output. The principle of operation is based on permanent monitoring of the current intensity. This value is continuously compared with the stored reference value, which is determined by the teach-in process. In order to detect the failure of one of several loads, the current difference must be 1/12 of the reference value.

Product versions

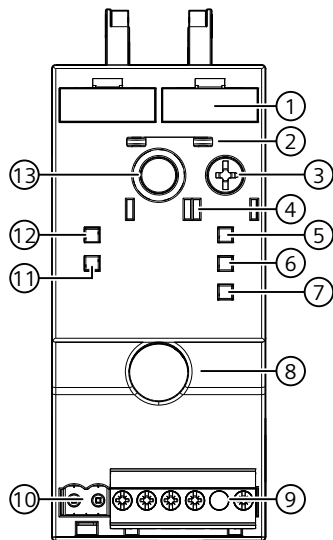
Variants with different rated operational currents and rated operational voltages are available (article number: 3RF39.0-0GA..).

Compatible solid-state relays or solid-state contactors

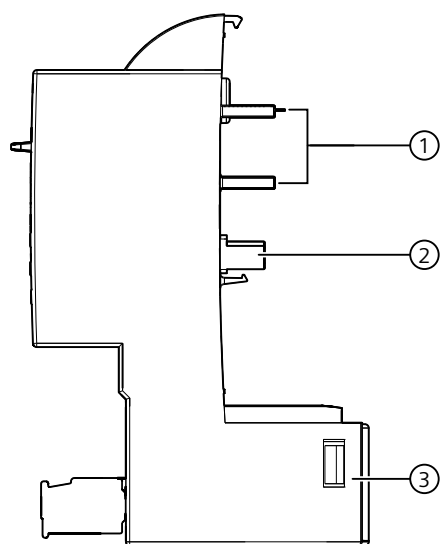
The function module load monitoring extended is compatible with the following products:

- 3RF31..-1..0./-3..0.
- 3RF31..-1..1./-3..1.
- 3RF31..-1..2./-3..2.
- 3RF31..-1..4./-3..4.
- 3RF33..-1..0./-3..0.
- 3RF33..-1..1./-3..1.
- 3RF33..-1..2./-3..2.
- 3RF33..-1..4./-3..4.

Setup



- ① Labeling plates
- ② Eye for lead seal for sealable cover cap
- ③ Rotary knob for setting the response delay and error storage
- ④ Cut-outs for sealable cover cap
- ⑤ Status LED "LOAD" (red) for displaying faults
- ⑥ Status LED "THYRISTOR" (red) for displaying faults
- ⑦ Status LED "SUPPLY" (red) for displaying faults
- ⑧ Opening for connecting the cable to the solid-state relay/contactors
- ⑨ Control connector of the function module (terminals IN, 14, 11, 12, L/N)
- ⑩ Cut-out for control connector of the solid-state relay/contactors (terminals A1, A2)
- ⑪ Status LED "ON" (yellow) for displaying operating states
- ⑫ Status LED "INPUT" (yellow) for displaying operating states
- ⑬ "TEACH/TEST" button for the teach-in process and for testing the system



- ① Contact point to the solid-state relay/contactor
- ② Control connector - connection point to the solid-state relay/contactor
- ③ Straight-through transformers

Scope of application

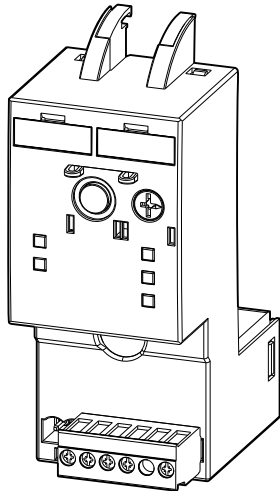
The device is used for monitoring one or more loads (partial loads).

Area of application

The function module can only be used in conjunction with a 3RF31 solid-state relay or a 3RF33 solid-state contactor. The solid-state switching devices with spring-loaded terminals in the load circuit are not suitable for load monitoring.

3.2.3.4 Function module heating current monitoring

Description



The function module heating current monitoring enables rapid detection of failures of up to 6 load elements, alloyed power semiconductors, or missing voltage or breaks in the load circuit. A fault is indicated by one or more status LEDs and reported to the controller by way of a PLC-compatible output. The principle of operation is based on permanent monitoring of the current intensity. This value is continuously compared with the stored reference value, which is determined by the teach-in process. In order to detect the failure of one of several loads, the current difference must be 1/6 of the reference value.

Product versions

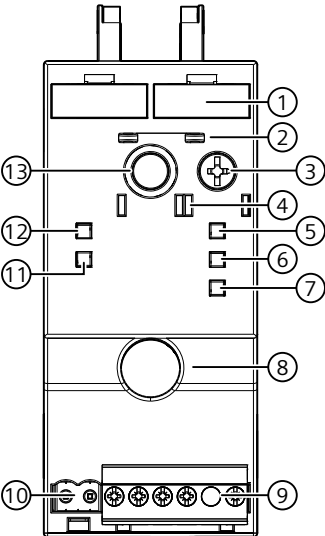
Variants with different rated operational currents and rated operational voltages as well as versions with integrated standby mode are available (article number: 3RF39..-OJA1.).

Compatible solid-state relays or solid-state contactors

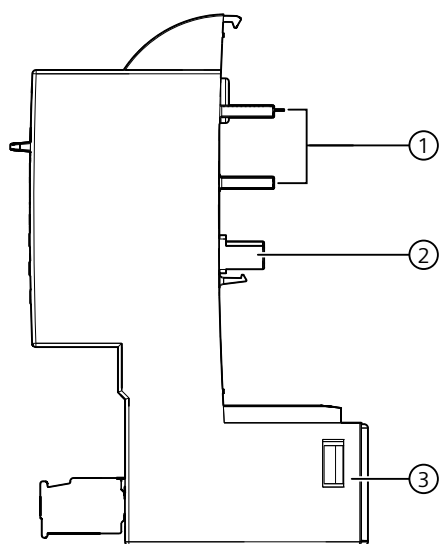
The function module heating current monitoring is compatible with the following products:

- 3RF31..-1..0./-3..0.
- 3RF31..-1..1./-3..1.
- 3RF31..-1..4./-3..4.
- 3RF33..-1..0./-3..0.
- 3RF33..-1..1./-3..1.
- 3RF33..-1..4./-3..4.

Setup



- ① Labeling plates
- ② Eye for lead seal for sealable cover cap
- ③ Rotary knob for setting the response delay and error storage
- ④ Cut-outs for sealable cover cap
- ⑤ Status LED "LOAD" (red) for displaying faults
- ⑥ Status LED "THYRISTOR" (red) for displaying faults
- ⑦ Status LED "SUPPLY" (red) for displaying faults
- ⑧ Opening for connecting the cable to the solid-state relay/contactors
- ⑨ Control connector of the function module (terminals IN, 14, 11, 12, L/N)
- ⑩ Cut-out for control connector of the solid-state relay/contactors (terminals A1, A2)
- ⑪ Status LED "ON" (yellow) for displaying operating states
- ⑫ Status LED "INPUT" (yellow) for displaying operating states
- ⑬ "TEACH/TEST" button for the teach-in process and for testing the system



- ① Contact point to the solid-state relay/contactator
- ② Control connector - connection point to the solid-state relay/contactator
- ③ Straight-through transformers

Scope of application

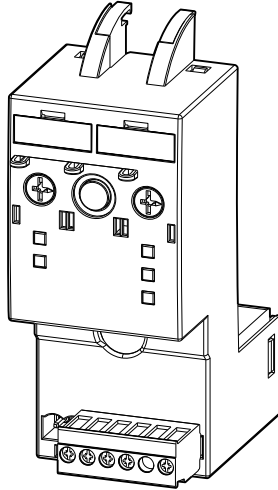
The device is used for monitoring one or more loads (partial loads).

Area of application

The function module can only be used in conjunction with a 3RF31 solid-state relay or a 3RF33 solid-state contactor. The solid-state switching devices with spring-loaded terminals in the load circuit are not suitable for load monitoring.

3.2.3.5 Function module power controller

Description



The power controller is a function module for the autonomous power control of complex heating systems and inductive loads.

The following functions have been integrated:

- Power controller: For adjusting the power of the connected load. The setpoint value is selected via a rotary knob on the module as a percentage of the 100% power value stored.
- Switch-on current limitation: With the aid of an adjustable voltage ramp, the inrush current is limited by means of phase control. This is useful above all with loads such as lamps or infrared sources which have an inrush transient current.
- Load circuit monitoring: For detecting load failure, partial load faults, alloyed power semiconductors, missing voltage, or a break in the load circuit

Product version

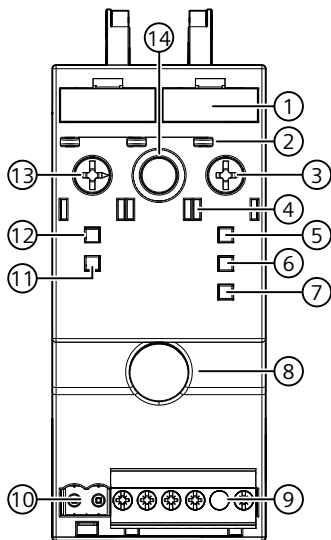
Variants with different rated operational currents and rated operational voltages are available (article number: 3RF39.0-OKA..).

Compatible solid-state relays or solid-state contactors

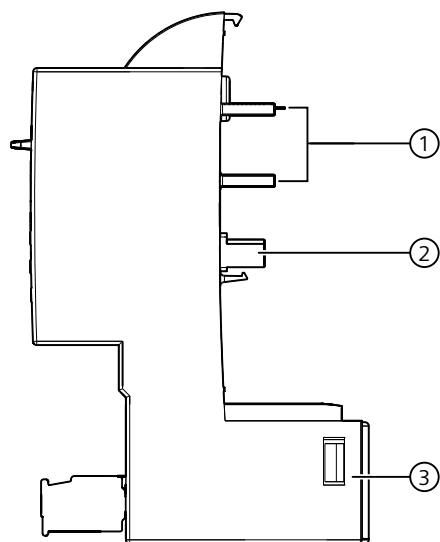
The function module power controller is compatible with the following products:

- 3RF31..-1..0./-3..0.
- 3RF31..-1..1./-3..1.
- 3RF31..-1..4./-3..4.
- 3RF33..-1..0./-3..0.
- 3RF33..-1..1./-3..1.
- 3RF33..-1..4./-3..4.

Setup



- ① Labeling plates
- ② Eye for lead seal for sealable cover cap
- ③ Rotary knob "P" for setpoint value specification
- ④ Cut-outs for sealable cover cap
- ⑤ Status LED "LOAD" (red) for displaying faults
- ⑥ Status LED "THYRISTOR" (red) for displaying faults
- ⑦ Status LED "SUPPLY" (red) for displaying faults
- ⑧ Opening for connecting the cable to the solid-state relay/contactors
- ⑨ Control connector of the function module (terminals IN, 0 10 V, 11, 12, L/N)
- ⑩ Cut-out for control connector of the solid-state relay/contactors (terminals A1, A2)
- ⑪ Status LED "ON" (yellow) for displaying operating states
- ⑫ Status LED "INPUT" (yellow) for displaying operating states
- ⑬ Rotary knob " t_r " for setting the full-wave control/generalized phase control and ramp time
- ⑭ "TEACH/TEST" button for the teach-in process and for testing the system



- ① Contact point to the solid-state relay/contactor
- ② Control connector - connection point to the solid-state relay/contactor
- ③ Straight-through transformers

Scope of application

The power controller can be used for:

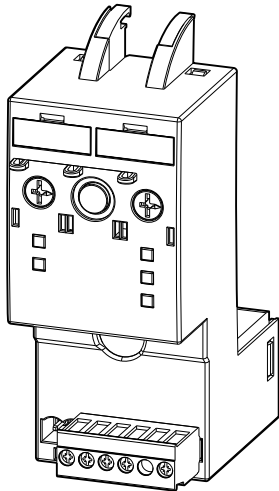
- Complex heating systems
- Inductive loads
- Loads with temperature-dependent resistor
- Loads with ageing after long-time service
- Simple indirect temperature control

Area of application

With the phase control operating mode, a partial load fault is detected by cyclic "scanning of the load".

3.2.3.6 Function module power regulator

Description



The power regulator is a function module for the autonomous power control of complex heating systems.

The following functions have been integrated:

- Power regulator with P-control: For adjusting the power of the connected load. The setpoint value is selected via a rotary knob on the module as a percentage of the 100% power value stored. Changes in the line voltage or in the load resistance are compensated in this case.
- Switch-on current limitation: With the aid of an adjustable voltage ramp, the inrush current is limited by means of phase control. This is useful above all with loads such as lamps which have an inrush transient current.
- Load circuit monitoring: For detecting load failure, alloyed power semiconductors, missing voltage, or a break in the load circuit. Partial load monitoring is not possible. Load fluctuations are compensated.

Product versions

Variants with different rated operational currents and rated operational voltages are available (article number: 3RF39.0-OHA..).

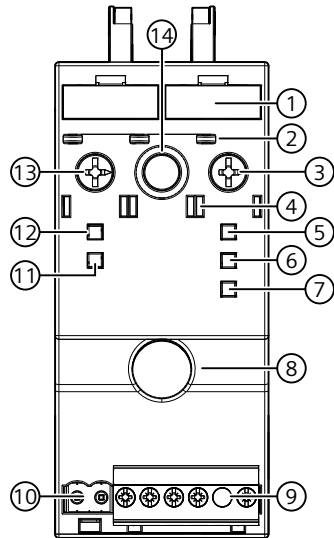
Compatible solid-state relays or solid-state contactors

The function module power regulator is compatible with the following products:

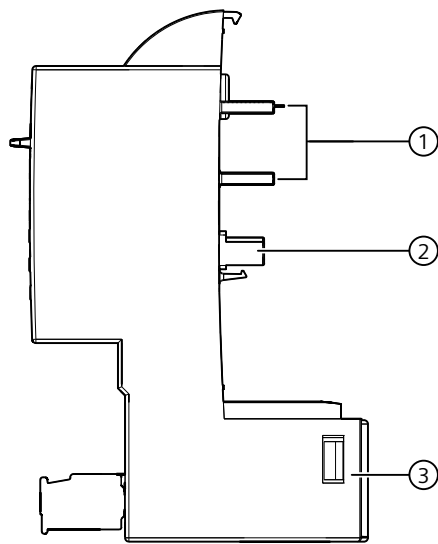
- 3RF31..-1..0./-3..0.
- 3RF31..-1..1./-3..1.
- 3RF31..-1..2./-3..2.
- 3RF31..-1..4./-3..4.

- 3RF33..-1..0./-3..0.
- 3RF33..-1..1./-3..1.
- 3RF33..-1..2./-3..2.
- 3RF33..-1..4./-3..4.

Setup



- ① Labeling plates
- ② Eye for lead seal for sealable cover cap
- ③ Rotary knob "P" for setpoint value specification
- ④ Cut-outs for sealable cover cap
- ⑤ Status LED "LOAD" (red) for displaying faults
- ⑥ Status LED "THYRISTOR" (red) for displaying faults
- ⑦ Status LED "SUPPLY" (red) for displaying faults
- ⑧ Opening for connecting the cable to the solid-state relay/contactors
- ⑨ Control connector of the function module (terminals IN, 0 10 V, 11, 12, L/N)
- ⑩ Cut-out for control connector of the solid-state relay/contactors (terminals A1, A2)
- ⑪ Status LED "ON" (yellow) for displaying operating states
- ⑫ Status LED "INPUT" (yellow) for displaying operating states
- ⑬ Rotary knob " t_r " for setting the full-wave control/generalized phase control and ramp time
- ⑭ "TEACH/TEST" button for the teach-in process and for testing the system



- ① Contact point to the solid-state relay/contactator
- ② Control connector - connection point to the solid-state relay/contactator
- ③ Straight-through transformers

Scope of application

The power regulator can be used for:

- Complex heating systems
- Inductive loads
- Loads with temperature-dependent resistor
- Loads with ageing after long-time service
- Simple indirect temperature control

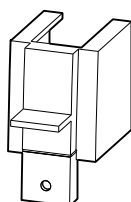
Area of application

With the phase control operating mode, a partial load fault is detected by cyclic "scanning of the load".

3.2.4 Accessories

3.2.4.1 Terminal cover

Description



With this terminal cover, degree of protection IP20 can be achieved on the front using ring cable lug connection technology. It can also be used for screw-type connection systems after simple adaptation.

Product version

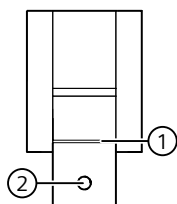
One variant of the terminal cover is available (article number: 3RF2900-3PA88).

Compatible solid-state relays or solid-state contactors

The terminal cover is compatible with the following products:

- 3RF31..-1..../-3....
- 3RF33..-1..../-3....

Setup



- ① Bottom part of the cover for the ring cable lug technology variants
- ② Opening for test probe

3.2.4.2 Replacement control connector

Description



The control connectors are used to connect the cables of the control circuit. They are available with 2 different connection technologies.

Product versions

Control connectors are available in 2 variants:

- Screw-type connection technology (article number: 3RF3900-1TA88)
- Spring-loaded connection system with 2 clamping points per contact (article number: 3RF3900-2TB88)

Compatible solid-state relays or solid-state contactors

The replacement control connectors are compatible with all solid-state switching devices.

3.2.4.3 Heat conducting foil for solid-state relay

Description

The heat conducting foil is required for mounting the solid-state relays. Alternatively, thermal paste can also be used for mounting.

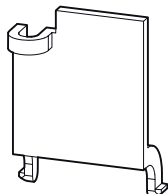
Product versions and compatible devices

Heat conducting foils are available in two variants:

- Suitable for solid-state relays in the 3RF30, 3RF31 and 3RF51 product series: 3RF3900-OWA88
- Suitable for solid-state relays in the 3RF32 product series: 3RF3900-OWB88

3.2.4.4 Sealable cover cap for function modules

Description



The sealable cover cap for function modules is used to prevent unauthorized adjustment of the adjustment knobs. Sealable cover caps for function modules must not be used in combination with a converter.

Product versions

One variant of the sealable cover cap is available (article number: 3RF2900-0RA88).

Compatible products

The sealable cover cap is compatible with the following products:

- Function module basic load monitoring (article number: 3RF39..-0F.08)
- Function module load monitoring extended (article number: 3RF39.0-0GA..)
- Function module heating current monitoring (article number: 3RF39..-0JA1.)
- Function module power controller (article number: 3RF39.0-0KA..)
- Function module power regulator (article number: 3RF39.0-0HA..)

3.2 Product series

Functions

4.1 Functions of the solid-state relays and solid-state contactors

4.1.1 Operational switching

Description

The solid-state switching devices enable the switching and protection of resistive and inductive loads in applications that require high switching frequencies.

4.1.2 "Zero-point switching" function

Description

The designs of solid-state switching devices that are designed for zero-point switching are particularly well suited for switching resistive loads. Zero-point switching solid-state switching devices switch the circuit when the sinusoidal alternating voltage reaches its zero point.

4.1.3 "Instantaneous switching" function

Description

In this version, the solid-state switching devices are specially matched to inductive loads. The instantaneous switching design of the solid-state switching device allows switching on and off at any point within the alternating voltage period.

4.1.4 "Short-circuit-proof" function

Description

With the solid-state contactors, in the "short-circuit-proof" version, it is possible to achieve short-circuit strength by combining them with a miniature circuit breaker with characteristic B.

4.1.5 "DC switching" function

Description

The 3RF5 solid-state switching devices are designed for switching resistive loads. The instantaneous switching design of the solid-state switching device ensures that switching on and off occurs immediately.

4.2 Functions of function modules

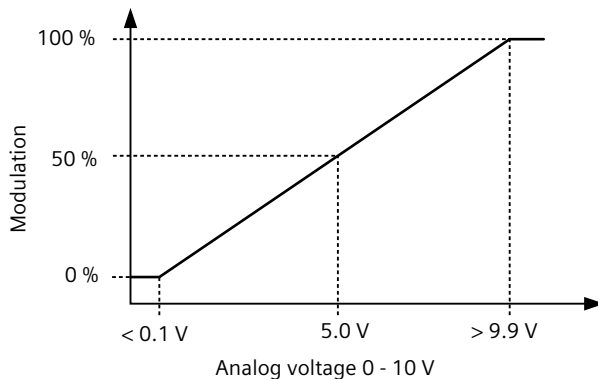
4.2.1 Function of the function module converter

Description

The function module converts analog control signals into a pulse-width-modulated digital signal.

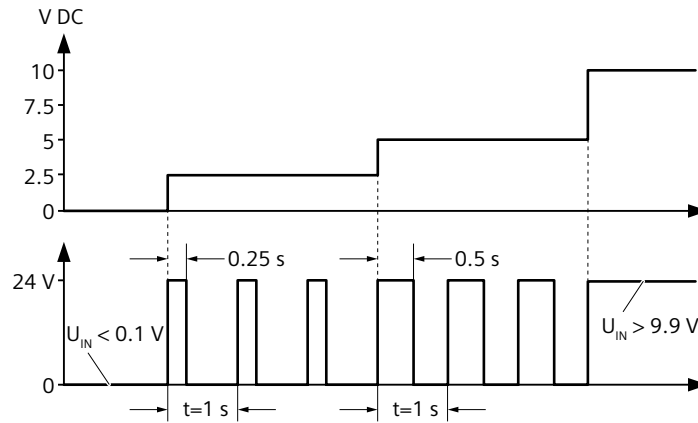
The analog input voltage level is converted into an ON and OFF switching time within a fixed period of approx. 1 second, e.g.: 3 V corresponds to 0.3 s ON and 0.7 s OFF. The conversion is linear between 0.1 V and 9.9 V. Below 0.1 V, the connected solid-state switching device is not activated; above 9.9 V, it is continuously switched on.

Characteristic curve analog output 0 - 10 V



The characteristic curve describes the modulation (Y axis) in relation to the analog voltage applied to the device. If the voltage is below 0.1 V, the solid-state switching device is not activated. If the voltage is greater than 9.9 V, the device is permanently activated.

Function diagram



The function diagram shows how the level of the analog input voltage affects the modulation of the solid-state switching device over time.

Scope of application

Conversion of an analog control signal into a pulse-width-modulated digital signal.

4.2.2 Function of the function module load monitoring basic

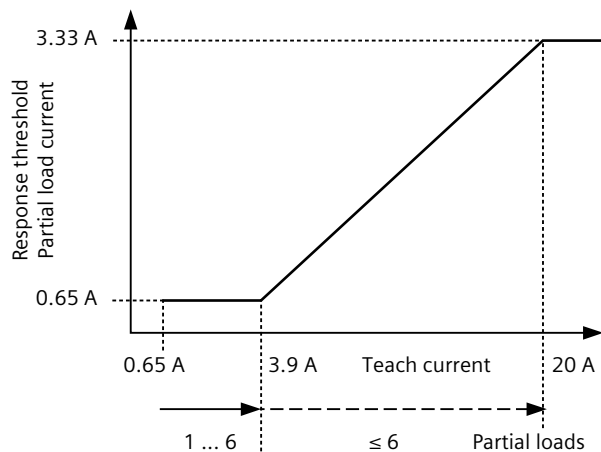
Description

The function module load monitoring basic monitors the level of the rated operational current. The current value of the rated operational current is continuously compared with the reference value stored during commissioning by pressing the TEACH/TEST button. If the currently measured current value drops by 1/6 of the reference value, but at least by the amount of the smallest partial load current, the function module detects a partial load fault.

The function module also detects thyristor faults and power failures.

In the event of a fault, after a response delay of 100 ms, the fault is reported to the controller via the OUT contact (digital output) and indicated by the FAULT LED on the function module.

Response threshold for partial load monitoring as a function of the total current



The characteristic curve shows, by way of example, the load change (Y axis) required for a partial load fault as a function of the teach current (X axis) of a function module with a current range of 20 A. The smallest partial load current must not fall below 0.65 A. For function modules with a current range of 6 A, the minimum partial load current must not fall below 0.25 A. The function module allows monitoring of 1 to 6 partial loads.

Scope of application

Monitoring of up to 6 heating elements with constant resistance on a solid-state relay or solid-state contactor.

4.2.3 Function of the function module load monitoring extended

Description

The function module load monitoring basic monitors the level of the rated operational current. The current value of the rated operational current is continuously compared with the reference value stored during commissioning by pressing the TEACH/TEST button. If the currently measured current value drops by 1/12 of the reference value, but at least by the amount of the smallest partial load current, the function module detects a partial load fault. An error is also signaled if the current value exceeds the maximum measuring range.

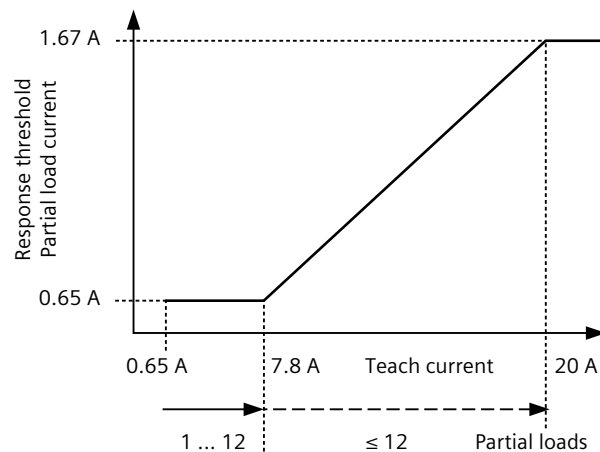
The function module also detects thyristor faults and power failures.

Any voltage fluctuations in the load circuit are compensated for and do not result in an error message.

In the event of an error, the error is reported to the controller via contact "11-12-14" (change-over contact) after the response delay has elapsed and is indicated by the LEDs on the function module.

The response delay in the event of an error can be set between 100 ms and 3 s using a rotary knob on the function module. The rotary knob also allows you to set whether the error message should be saved by the function module or not. If the "retentive" setting is selected, the error output remains set until the supply voltage at A1 and A2 is briefly disconnected for resetting. If the "non-retentive" setting is selected, the output is automatically reset immediately after the error has been rectified.

Response threshold for partial load monitoring as a function of the total current



The characteristic curve shows, by way of example, the load change (Y axis) required for a partial load fault as a function of the teach current (X axis) of a function module with a current range of 20 A. The smallest partial load current must not fall below 0.65 A.

For function modules with a current range of 50 A, the minimum partial load current must not fall below 1.6 A, and for a current range of 90 A, the minimum partial load current must not fall below 2.9 A. The function module allows monitoring of 1 to 12 partial loads.

Scope of application

Monitoring of up to 12 heating elements with constant resistance on a solid-state relay or contactor.

4.2.4 Function of the function module heating current monitoring

Description

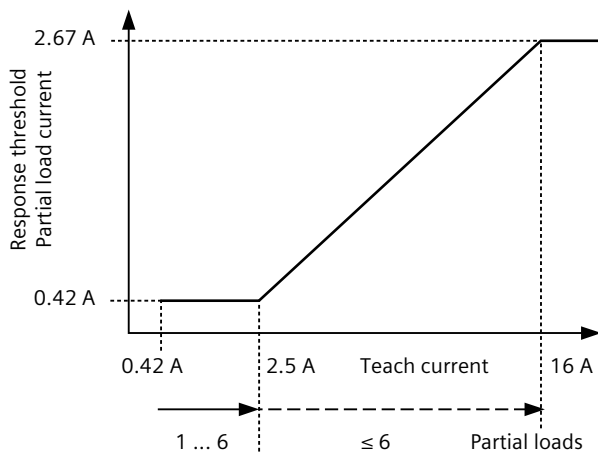
The function module heating current monitoring continuously monitors the current value. This value is continuously compared with the reference value (TEACH) stored once during commissioning. If the current drops by 1/6 of the reference value, but at least by the amount of the smallest partial load current, the module detects a partial load fault. An error is also signaled if the current exceeds the maximum measuring range. Voltage fluctuations in the load circuit are compensated and do not result in an error message.

In the event of an error, the error is reported to the controller via contact "11-12" (normally closed contact) after the response delay has elapsed and is indicated by the LEDs on the function module.

The response delay in the event of an error can be set between 100 ms and 3 s using a rotary knob on the module. You can also use the rotary knob to set whether the module saves the error message or not. Saving means that after an error has been rectified, the error output remains set until the supply voltage at A1-A2 is briefly removed for resetting. If the setting is "non-retentive", the output is automatically reset immediately after the error is corrected.

The function module also monitors thyristor faults and power failures.

Response threshold for partial load monitoring as a function of the total current



The characteristic curve shows, by way of example, the load change (Y axis) required for a partial load fault as a function of the teach current (X axis) of a function module with a current range of 16 A. The smallest partial load current must not fall below 0.42 A. For function modules with a current range of 32 A, the minimum partial load current must not fall below 0.8 A. The function module allows monitoring of 1 to 6 partial loads.

Scope of application

Monitoring of up to 6 heating elements with constant resistance on a solid-state relay or solid-state contactor.

4.2.5 Function of the function module power controller

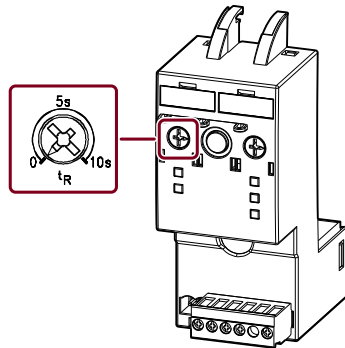
Description

The function module power controller can be used on all instantaneously switching solid-state switching devices. If only the full-wave control mode is used, the power controller can also be used on the "zero-point switching" solid-state switching devices.

Power control

The power controller adjusts the power as a percentage depending on the setpoint setting. Changes in the line voltage or in the load resistance are not compensated in this case. The modulation, the "on/off" ratio, and the phase control angle remain unchanged in accordance with the setpoint. Autonomous power control takes place between 0 and 100% of the setpoint setting.

Full-wave control



If the rotary knob "t_R" is set to 0 s, the power controller operates according to the full-wave control principle. The set power is converted into a pulse-width-modulated digital signal. The power controller controls the "ON" and "OFF" time of the solid-state switching device within a fixed cycle duration of 1 second (at 50 Hz) so that the specified power is applied to the load. The ON LED flashes in the same rhythm as the solid-state switching device switches "ON" and "OFF".

Generalized phase control

If the rotary knob "t_R" is set to a value greater than 0 s, the function module operates according to the generalized phase control principle. In generalized phase control, a reactor with at least 200 mH must be used in the load circuit to comply with the conducted disturbance voltage for industrial networks.

Setpoint input

The setpoint is specified either internally using the "P" rotary knob on the function module or externally via the 0 - 10 V analog input. 100% corresponds to continuous "On" for full-wave control and "180° current flow angle" for generalized phase control and therefore maximum power. With internal setpoint value specification, which can be adjusted using the rotary knob P, the function module is controlled via the IN terminal. Terminal 10 V has no function in this case. With an external setpoint value specification (rotary knob P turned all the way to the left = 0%), the module is controlled by applying the analog voltage 0-10 V. 0 - 10 V corresponds to 0 - 100% power. The power is converted linearly between 0.1 V and 9.9 V. Below 0.1 V, the switching device remains switched off; a voltage greater than 9.9 V is set to 100% power.

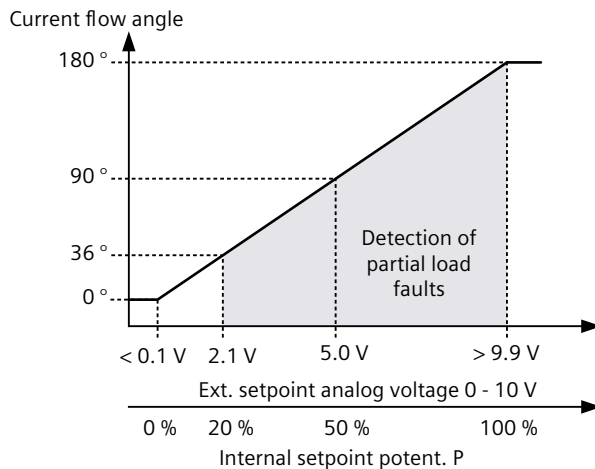
Switch-on current limitation

The rotary knob "t_r" is used to set a ramp time of up to 10 seconds for a voltage ramp during switch-on to limit the switch-on current. The set time refers to 100% power. For example, if a ramp time of 10 s is set and the power specification is 60%, then 60% power is reached after approx. 6 s.

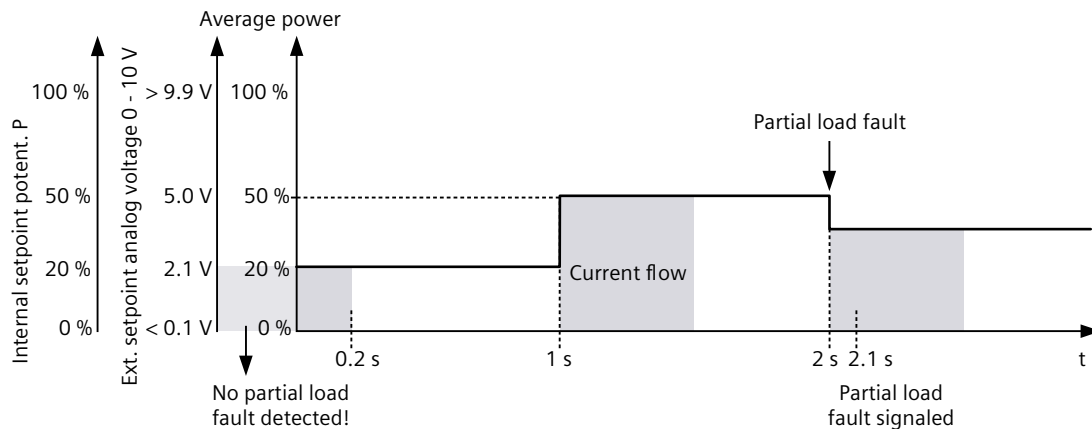
Line, load and thyristor monitoring

The power controller detects partial load, power failure and thyristor faults. The faults are indicated by the LEDs on the function module and the fault signaling output "11-12" (normally closed contact) is activated. The reference for load monitoring is the taught value. Up to 6 partial loads can be monitored. The response delay in the event of a fault is approx. 250 ms with full-wave control. With generalized phase control and setpoints > 50%, the response delay from the end of the ramp time is 500 ms. Partial load faults are only detected in the control range from 20 to 100%.

Detection of partial load faults with generalized phase control



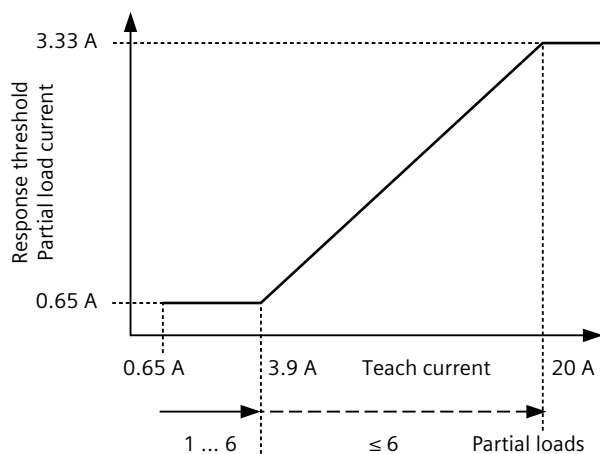
Detection of partial load faults with full-wave control



Intelligent voltage compensation ensures that fluctuations in the line voltage, regardless of the modulation, do not lead to fault detection due to changes in the load currents.

In phase control mode and with current flow angle $< 90^\circ$, the modulation is increased to 90° current flow angle for approx. 4 half-waves every 3 seconds in order to thus determine the correct voltage level for a loaded circuit. This increases the response time to partial load faults to 3 seconds. Due to the cyclical increase in modulation, the characteristic curve from setpoint to power is no longer linear.

Response threshold for partial load monitoring as a function of the total current



The characteristic curve shows the load change (Y axis) required for detecting a partial load fault as a function of the teach current (X axis) at 100% modulation of a function module with a current range of 20 A. With correspondingly lower modulation, the response threshold also decreases, but the minimum value of 0.65 A cannot be undershot. For function modules with a current range of 50 A or 90 A, the minimum partial load current must not fall below 1.6 A or 2.9 A, respectively.

Scope of application

Autonomous power control of complex heating systems, operation of loads with temperature-dependent resistors or with ageing after long-time service, and for simple indirect temperature control.

4.2.6 Function of the function module power regulator

Description

The function module power regulator can be used on all instantaneously switching solid-state switching devices. If only the full-wave control mode is used, the power regulator can also be used on the "zero-point switching" solid-state switching devices.

Power control

The power regulator constantly adjusts the power depending on the taught power and the setpoint setting. Changes in the line voltage or in the load resistance are compensated in this case. Autonomous power control takes place between 0 and 100% of the taught power.

Full-wave control

If the rotary knob t_r is set to 0 s (= all the way to the left), the power regulator operates according to the full-wave control principle. The set power is converted into a pulse-width-modulated digital signal. The power regulator controls the "ON" and "OFF" time of the solid-state switching device within a fixed cycle duration of 1 second (at 50 Hz) so that the specified power is applied to the load. The ON LED flashes in the same rhythm as the solid-state switching device switches ON and OFF.

Generalized phase control

If the rotary knob t_r is set to a value greater than 0 s, the function module operates according to the generalized phase control principle. The half-waves of the current are controlled in such a way that the setpoint value of the power at the load is achieved. In generalized phase control, a reactor with at least 200 mH must be used in the load circuit to comply with the conducted disturbance voltage for industrial networks.

Setpoint input

The setpoint is specified either internally using the P rotary knob on the function module or externally via the 0 - 10 V analog input. The reference for the power specification is the taught value. The taught power corresponds to 100%. With an internal setpoint value specification, which can be adjusted using the rotary knob P, the function module is controlled via the IN terminal. For this purpose, the potential of terminal A1 is used or the terminal is controlled via a PLC. Terminal 10 V has no function in this case. With an external setpoint value specification (rotary knob P turned all the way to the left), the function module is controlled by applying the analog voltage 0 - 10 V. 0 - 10 V corresponds to 0 - 100% power. The voltage is converted linearly between 0.1 V and 9.9 V. Below 0.1 V, the switching device remains switched off; a voltage greater than 9.9 V is set to 100% power.

Switch-on current limitation

The rotary knob t_R is also used to set a ramp time of up to 10 seconds for a voltage ramp during switch-on to limit the switch-on current. The set time refers to 100% power. For example, if a ramp time of 10 s is set and the power specification is 60%, then 60% power is reached after approx. 6 s.

Line, load and thyristor monitoring

The power regulator detects load, power failure and thyristor faults. A load error is also signaled if the current exceeds the maximum measuring range. The faults are indicated by the LEDs on the function module and the fault signaling output "11-12" (normally closed contact) is activated. The response delay in the event of a fault is approx. 100 ms.

Scope of application

Autonomous power control of complex heating systems, operation of loads with temperature-dependent resistors or with ageing after long-time service, and for simple indirect temperature control.

Application planning

When planning the application of a solid-state switching device, the following information must first be taken into account to select the appropriate product for the application in question.

- Required functionality
- Required load range
- Connection technology
- Ambient temperature
- Installation altitude

Note that the product's load capacity is reduced when used above 40 °C and 1000 m. The derating characteristics show you which product can carry your required rated current.

In addition to these criteria, the following information must also be taken into account:

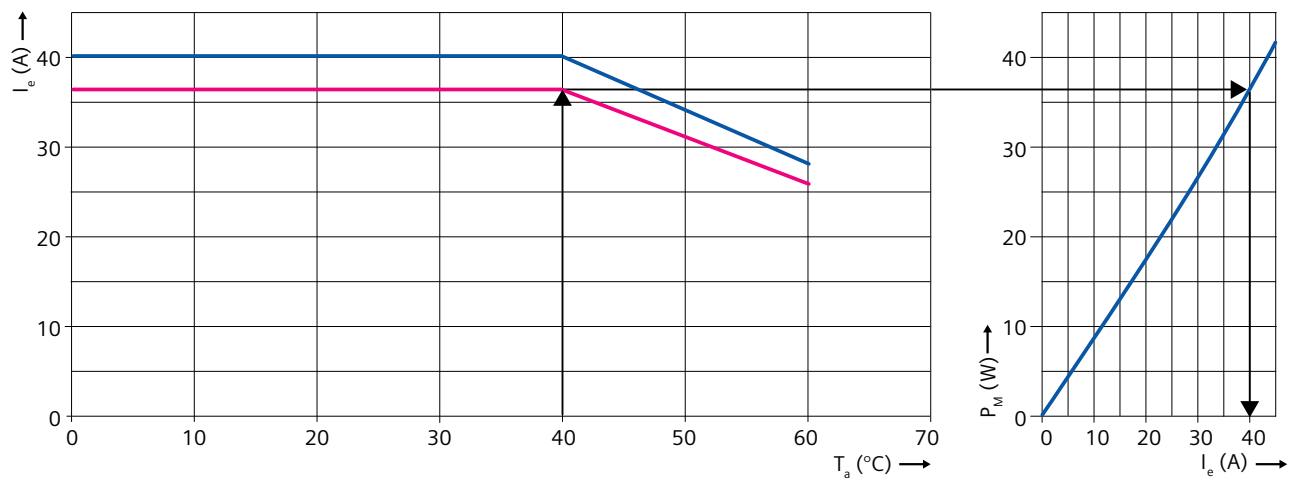
- Distance from neighboring components
- Mounting position
- Cabinet types
- Grounding measures
- Short-circuit protection
- Combination with fuses and circuit breakers when using solid-state relays or solid-state contactors
- Dimensioning of the heat sink when using a solid-state relay

5.1 Ambient temperature

The solid-state switching devices are designed for use at ambient temperatures ranging from -25 °C to +40 °C without reducing the permissible operational current. Observe the derating characteristic of the product in temperature ranges from + 40 °C to + 60 °C.

The following graphic shows an example of the derating characteristic for the product 3RF3310-1AA02. You can find the derating characteristic in the technical specifications for your product:

5.1 Ambient temperature



(left diagram) I_e according to IEC 60947-4-3 for stand-alone installation

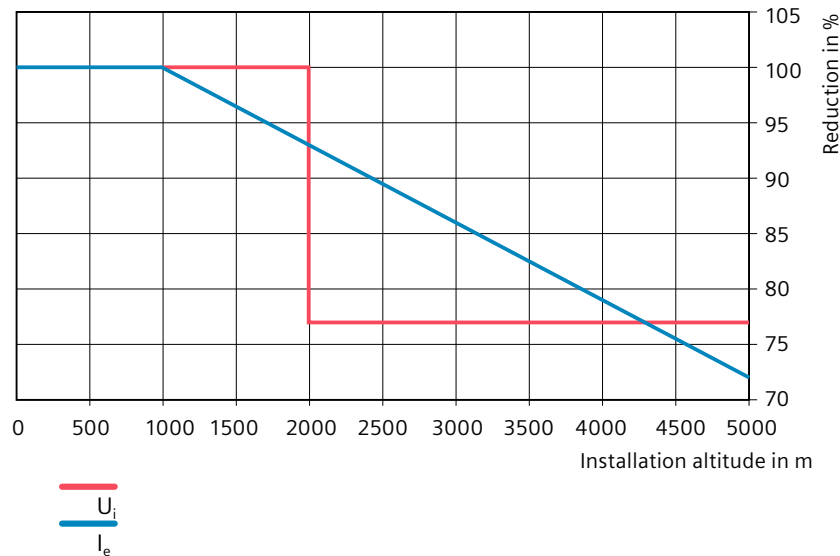
(left diagram) I_e according to IEC 60947-4-3 for side-by-side mounting

To read the permissible rated current that the device is allowed to carry, proceed as follows. First, draw a vertical line on the X axis starting from the current ambient temperature. Then, starting from the intersection with the characteristic curve, draw a horizontal line to the left to the Y axis. Read the permissible rated current.

You can read the module power loss as a function of the rated current using the characteristic curve on the right-hand side. To do this, draw a vertical line upwards from the present current value. Starting from the intersection with the characteristic curve, draw a horizontal line to the left to the Y axis. Now read the module power loss.

5.2 Installation altitude

The solid-state switching devices are approved for use up to 1000 m. The lower air density at altitudes above 1000 m affects the electrical characteristics of the solid-state switching devices. The reduction factors that must be observed when using solid-state switching devices at altitudes above 1000 m are shown below.



The reductions are shown as percentages. The reductions in the maximum values of the rated insulation voltage U_i and the rated current I_e as a function of the installation altitude are shown. The rated insulation voltage U_i is represented by the red characteristic curve. There are no restrictions up to an altitude of 2000 m. At installation altitudes greater than 2000 m, the maximum value is reduced to approx. 77%. The rated current I_e is represented by the blue characteristic curve. There are no restrictions up to an altitude of 1000 m. Above an installation altitude of 1000 m, the maximum rated current value decreases linearly. There is a reduction of approx. 7% per 1000 m.

5.3 Connection technology

You can choose between the following connection technologies for the solid-state switching devices:

- **Screw-type connection technology:** The screw-type connection technology is the standard for industrial switchgear. Open terminals and a plus-minus screw are just two features of this technology. Two conductors of up to 6 mm² can be connected in just one terminal.
- **Spring-loaded connection technology:** This innovative connection technology does not require any screwed connections. This means that very high vibration resistance is achieved. Two conductors of up to 2.5 mm² can be connected to each terminal.
- **Ring cable lug connection technology:** Ring cable lug connection technology uses ring cable lugs to establish electrical connections. A ring cable lug has a crimp sleeve for the wire and a ring-shaped tab that is secured with a screw. Ring cable lug connection technology allows larger conductor cross-sections, which are required for the more powerful variants, to be connected. Two lines of up to 25 mm² can be connected to each terminal.

The function modules are designed for solid-state switching devices with screw-type connection technology and ring cable lug technology. Only the converter is compatible with all connection technologies.

5.4 Selecting the right product based on the required functionality

Selecting the right product depends largely on the functionality that the product is required to perform.

Below are some criteria that will help you select the right product. There are also "zero-point switching" versions, which are suitable for switching resistive loads, and "instantaneous switching" versions, which are suitable for switching inductive loads.

Use of a solid-state relay

- Application with control of many resistive loads
- Use with application-specific heat sinks

Use of a solid-state contactor

- Direct use due to integrated heat sink optimized for the laser-marked rated current.
- Can be mounted on a DIN rail or mounting plate
- Special version: short-circuit-proof with B miniature circuit breaker

Use of the function modules

- Temperature control → function module converter
- Indirect temperature control → function module power regulator
- Conversion of an analog control signal into a pulse-width-modulated digital signal → function module converter
- Monitoring of up to 6 partial loads → function module load monitoring basic and function module heating current monitoring
- Monitoring of up to 12 partial loads → function module load monitoring extended
- Monitoring of critical heating systems → function module load monitoring
- Power control for heating elements and partial loads → function module power controller
- Control of small motors or inductive loads → function module power controller
- Autonomous power control for complex heating systems → function module power regulator
- Heating elements with temperature-dependent resistor or with ageing after long-time service → function module power regulator

5.5 Required load range

To select the appropriate solid-state switching device, determine the required rated current and the required rated voltage of the load to ensure that the solid-state switching device meets the requirements.

With the Solid-state switching devices 3RF configurator (<https://mall.industry.siemens.com/spice/cloudcm/configurator>) you can find the right version.

5.6 Utilization category

When selecting a suitable solid-state switching device, the utilization category of the device must be taken into account. The utilization category defines the operating conditions and switching tasks for which the device is designed. This includes the characteristic values for current, voltage, and power factor during switching on and off. Choosing the right utilization category ensures a long service life for the solid-state switching device, reliable switching function, and safe operation of the system.

The following list provides an overview of the recommended applications for each utilization category:

- AC-1: 1-pole non-inductive or slightly inductive loads for electronic switching devices
- AC-3: 3-pole motor loads for electronic switching devices
 - AC-3a: Without bridging contacts
 - AC-3b: With bridging contacts
- AC-15: Electromagnetic loads

5.7 Mounting position

The solid-state contactors can preferably be set up vertically (i.e. on a horizontally mounted DIN rail) or horizontally (i.e. on a vertically mounted DIN rail).

The mounting position of the solid-state relays is arbitrary; here, it depends on the heat dissipation provided by the heat sink used. Both stand-alone installation and side-by-side mounting are possible.

5.8 Cabinet types

The product can be installed inside a central control cabinet or a distributed control box.

5.9 Grounding measures

Some solid-state contactors are designed with special mounting feet that provide grounding to the DIN rail by snapping on.

For other solid-state contactors, grounding is achieved by connecting a grounding wire to the heat sink.

5.12 Distances from neighboring components

You will find the corresponding identification of the version in the selection and ordering data tables Catalog IC 10 (<https://support.industry.siemens.com/cs/ww/en/view/109747945>).

5.10 Short-circuit protection

The short-circuit strength in combination with fuses and circuit breakers is 100 kA at 400 V. Type of coordination 1 is observed, which means that after a short-circuit, the solid-state switching devices are defective and must be replaced.

The 3RF33.0-.DA... solid-state contactors are an exception. In combination with a miniature circuit breaker with B characteristic and 10 kA or 6 kA breaking capacity, these solid-state contactors comply with type of coordination 2. This means that the solid-state switching devices are not defective after a short-circuit and can continue to be used without replacement.

5.11 Combination with SIRIUS circuit breakers/fuses

The semiconductor protection of the SIRIUS 3RF solid-state switching devices can be achieved by using different protective devices. The use of the protective device depends on the application in question.

- SITOR full-range fuse
- SITOR semiconductor fuse
- Cable and line protection fuse gG
- Miniature circuit breaker characteristic B

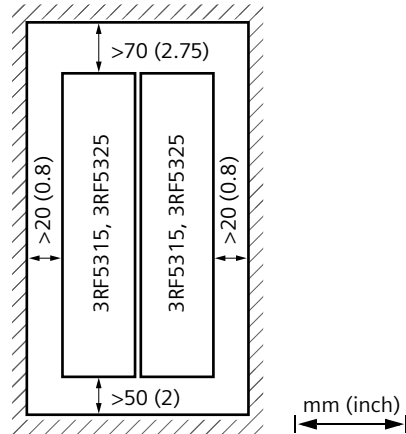
Refer to the technical data for your product to find out which protective device is suitable for your product.

5.12 Distances from neighboring components

When using solid-state switching devices, distances between the devices must be maintained for some versions. Some of the devices are suitable for side-by-side mounting.

Clearances to be observed for 3RF5 products

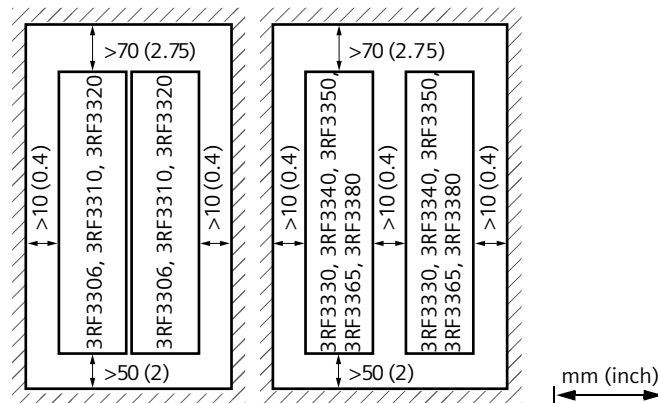
3RF5 devices are suitable for side-by-side mounting. A minimum lateral clearance of 20 mm must be maintained, 70 mm at the top, and 50 mm at the bottom from adjacent components.



Clearances to be observed for 3RF33 products

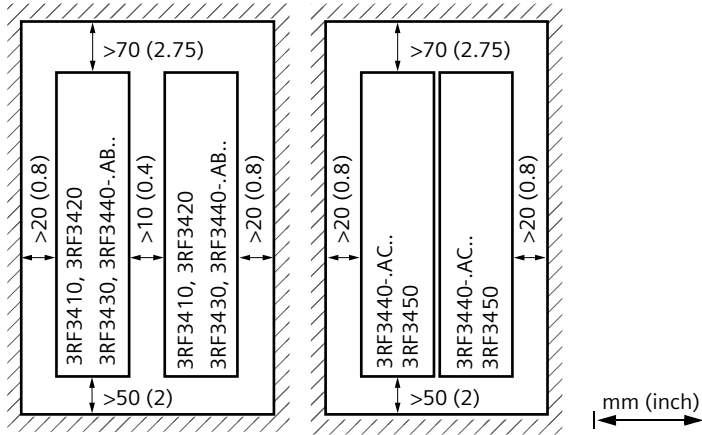
The device series 3RF3306, 3RF3310 and 3RF3320 are suitable for side-by-side mounting. A minimum lateral clearance of 10 mm must be maintained, 70 mm at the top, and 50 mm at the bottom from adjacent components.

For the 3RF3330, 3RF3340, 3RF3350, 3RF3365, and 3RF3380 device series, a minimum lateral clearance of 10 mm must be maintained, 70 mm at the top, and 50 mm at the bottom.



Clearances to be observed for 3RF34 products

For the 3RF3410, 3RF3420, 3RF3430 und 3RF3440-.AB.. device series, a minimum lateral clearance of 20 mm must be maintained, 70 mm at the top, and 50 mm at the bottom. The device series 3RF3440-.AC.. and 3RF3450 are suitable for side-by-side mounting. A minimum lateral clearance of 20 mm must be maintained, 70 mm at the top, and 50 mm at the bottom from adjacent components.



5.13 Dimensioning of the heat sink for a solid-state relay

Requirement

- A suitable solid-state relay is selected based on the load current.
- The maximum ambient temperature is known.
- The mounting conditions for the heat sink are known.

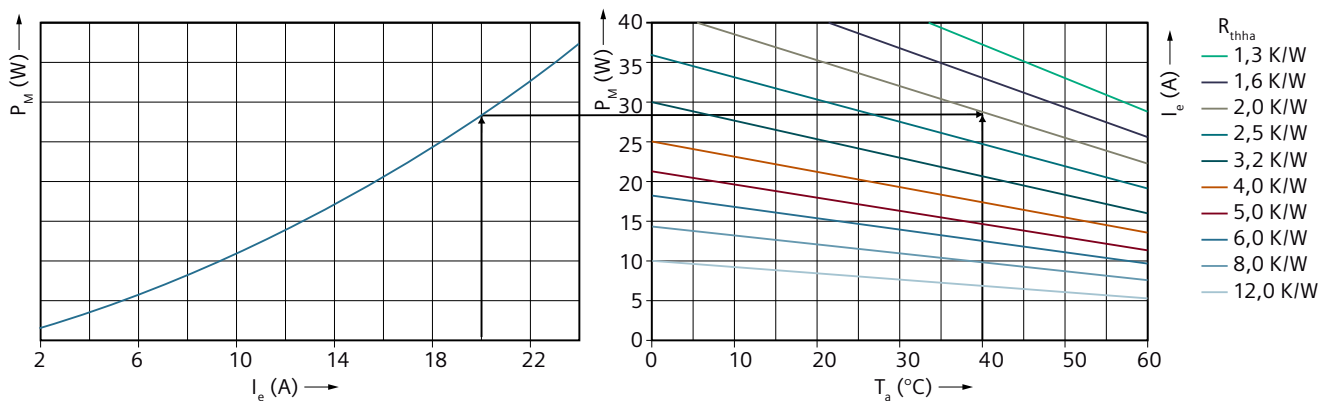
Instructions

1. Determine the module power loss P_M of the solid-state relay and the permissible thermal resistance R_{thK} (R_{thha}).
2. Determine the total power loss $P_{v\ total}$ and the permissible thermal resistance $R_{thK\ total}$ when using multiple relays on one heat sink.
3. Select a heat sink based on the permissible thermal resistance $R_{thK\ total}$.
4. Determine the actual R_{thK} from the diagram in the heat sink data sheet for the existing power loss.
5. Check whether the actual R_{thK} of the heat sink is less than the permissible thermal resistance.

Example

To determine the thermal resistance and find a suitable heat sink, proceed as follows:

1. Read the module power loss P_M on the left diagram depending on the device current I_e . In the example graphic, the module power loss P_M is approx. 28 W with a device current I_e of 20 A.
2. Draw a vertical guide line upwards on the right-hand diagram, starting from your current ambient temperature T_a of the application.
3. From the determined value of the module power loss P_M , draw a horizontal guide line to the right until it intersects with the guide line starting from the ambient temperature.
4. Now read the maximum thermal resistance R_{thK} (R_{thha}) of the relay using the legend on the right-hand side. In the example, the value of the maximum thermal resistance R_{thK} (R_{thha}) would be 2 K/W.
5. Now divide the value of the maximum thermal resistance R_{thK} (R_{thha}) that you have just determined by the number of relays that will be mounted on the heat sink to obtain $R_{thK total}$.
6. To determine $P_{v total}$, multiply the value of the determined module power loss P_M by the number of solid-state relays (assuming the solid-state relays carry the same current) that you want to use.
7. Now use the data sheet for a heat sink to determine a heat sink that is suitable for your application. Make sure that the actual R_{thK} value of the heat sink is less than the permissible thermal resistance $R_{thK total}$.



Result

- The selected heat sink has been correctly dimensioned.

More information

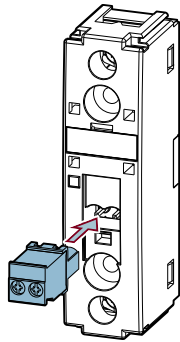
- Select a more powerful solid-state relay if you cannot find a heat sink for which the actual R_{thK} of the heat sink is less than the permissible thermal resistance of the solid-state relay.

Mounting

6.1 Mounting solid-state switching devices

Instructions

1. Insert the control connector of the solid-state switching device into the opening provided on the front of the device.



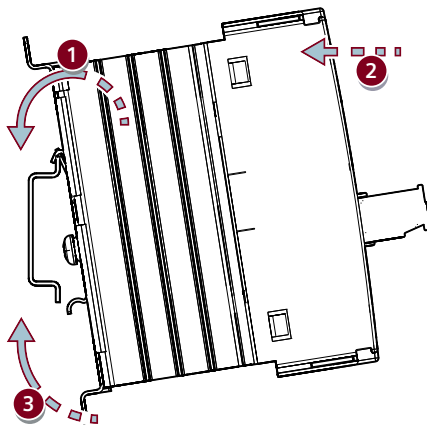
6.2 Mounting a solid-state contactor on a DIN rail

Requirement

- 35-mm DIN rail in accordance with DIN EN 60715 is mounted

Instructions

1. Snap the device onto the DIN rail.



6.3 Mounting the solid-state contactor on the mounting plate

Requirement

- 2 or 4 holes with thread or dowel on the flat surface with a spacing of 47.5 mm

Required tools

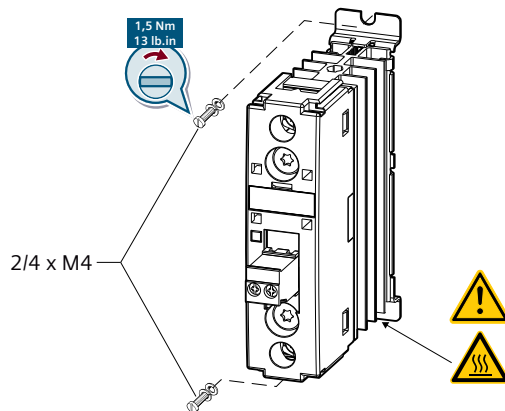
- 2 or 4 M4 screws

Required tools

- Screwdriver that matches the chosen screw.

Instructions

1. Mount the device on the mounting plate with the two screws. Tighten the screws with a tightening torque of 1.5 Nm.



6.4 Mounting the solid-state relay on a heat sink with thermal paste

Requirement

- 2 M4 holes in the heat sink with a spacing of 47.5 mm

Required tools

- Screwdriver that matches the chosen screw.

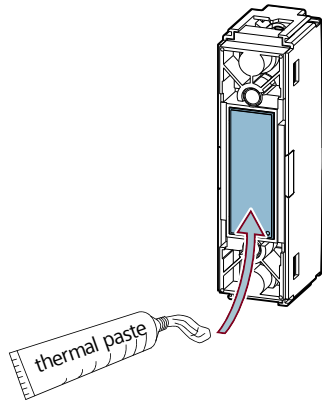
6.5 Mounting a solid-state relay on a heat sink with heat conducting foil

Required tools

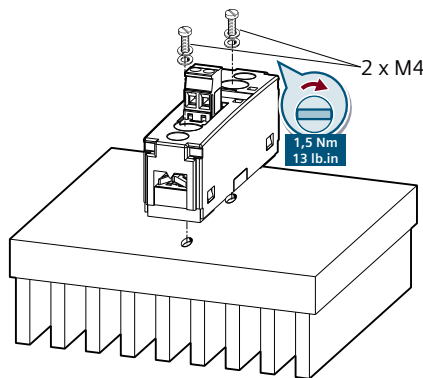
- Heat sink
- 2 M4 screws
- Thermal paste

Instructions

1. Apply the thermal paste to the rear of the solid-state relay.



2. Attach the solid-state relay to the heat sink using the screws. Tighten the screws to a torque of 1.5 Nm.



6.5 Mounting a solid-state relay on a heat sink with heat conducting foil

Requirement

- 2 M4 holes in the heat sink with a spacing of 47.5 mm

Essential accessories

- Heat conducting foil

Required tools

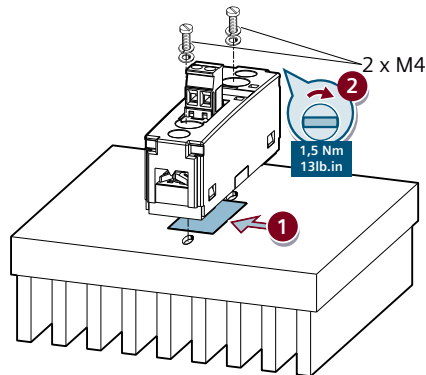
- Heat sink
- 2 screws M4

Required tools

- Screwdriver that matches the chosen screw.

Instructions

1. Place the heat conducting foil between the holes on the heat sink.
2. Attach the solid-state relay to the heat sink using the screws. Tighten the screws to a torque of 1.5 Nm.



6.6 Mounting a function module

6.6.1 Mounting the function module converter

Requirement

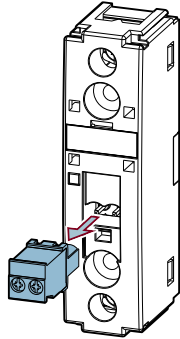
- Solid-state contactor or solid-state relay is mounted.

Essential accessories

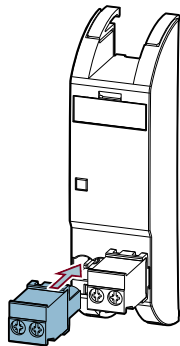
- Compatible solid-state contactor or solid-state relay

Instructions

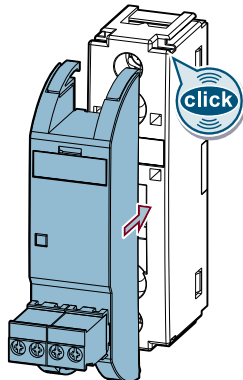
1. Remove the control connector from the solid-state contactor or solid-state relay.



2. Insert the removed control connector into the function module.



3. Plug the function module onto the solid-state contactor or solid-state relay until it clicks into place.



6.6.2 Mounting a function module load monitoring basic

Requirement

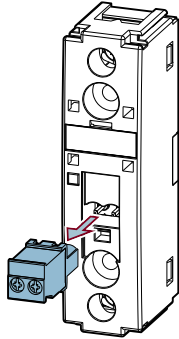
- 1-pole solid-state contactor or solid-state relay is mounted.

Essential accessories

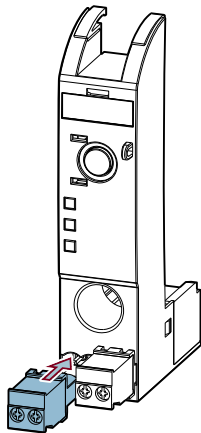
- 1-pole solid-state contactor or solid-state relay

Instructions

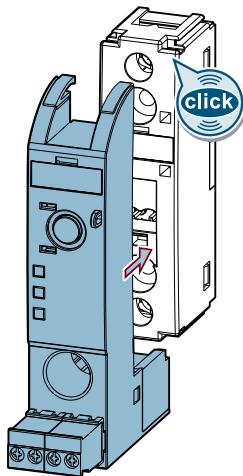
1. Remove the control connector from the solid-state contactor or solid-state relay.



2. Insert the removed control connector into the function module.



3. Plug the function module onto the solid-state contactor or solid-state relay until it clicks into place.



6.6.3 Mounting the function module load monitoring extended/heating current monitoring

Requirement

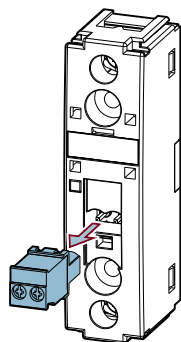
- Solid-state contactor or solid-state relay is mounted.

Essential accessories

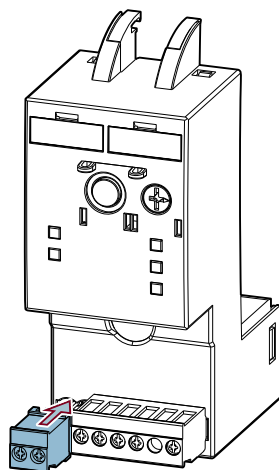
- Compatible solid-state contactor or solid-state relay

Instructions

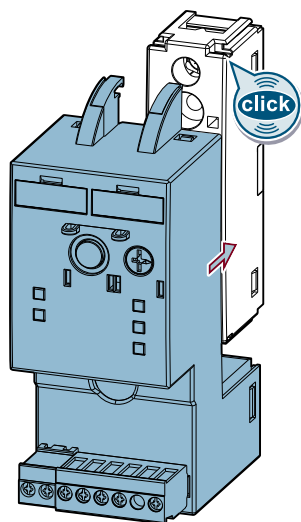
1. Remove the control connector from the solid-state contactor or solid-state relay.



2. Insert the removed control connector into the function module.



3. Plug the function module onto the solid-state contactor or solid-state relay until it clicks into place.



6.6.4 Mounting the function module power controller/power regulator

Requirement

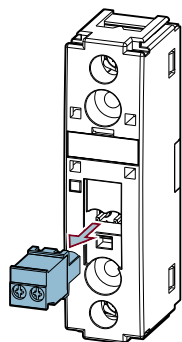
- Solid-state contactor or solid-state relay is mounted.

Essential accessories

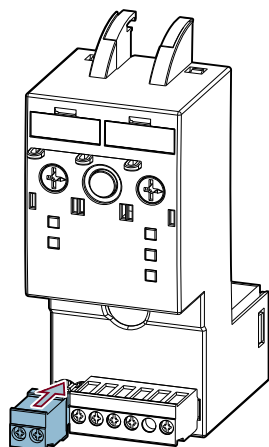
- Compatible solid-state contactor or solid-state relay

Instructions

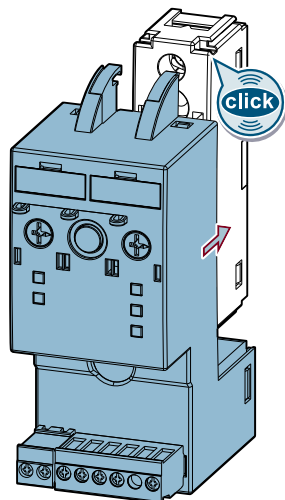
1. Remove the control connector from the solid-state contactor or solid-state relay.



2. Insert the removed control connector into the function module.



3. Plug the function module onto the solid-state contactor or solid-state relay until it clicks into place.



6.7 Mounting accessories

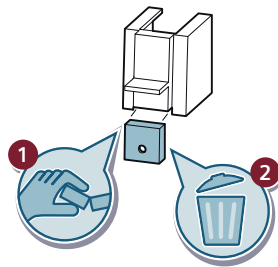
6.7.1 Mounting the terminal cover

Requirement

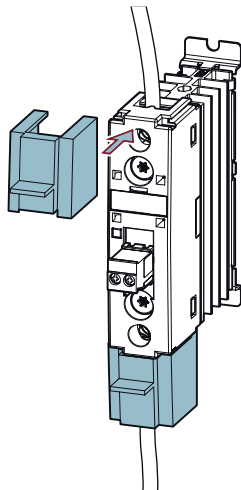
- The solid-state switching device is mounted and connected

Instructions for the screw-type connection system variants

1. Break away the lower part of the terminal cover with your fingers.

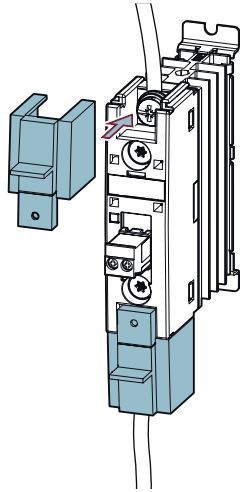


2. Slide the prepared terminal cover onto the solid-state switching device, starting from the front.



Instructions for the ring cable lug variants

1. Slide the terminal cover onto the solid-state switching device, starting from the front.



6.7.2 Mounting a sealable cover cap for function modules

Requirement

- The function module has been commissioned correctly for the application in question.

Required tools

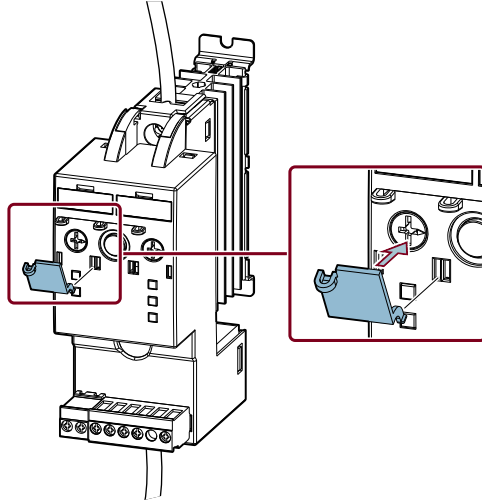
- Sealing pliers

Tools

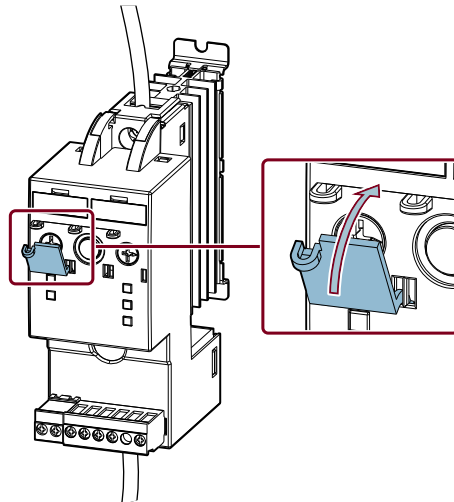
- Sealing wire

Instructions

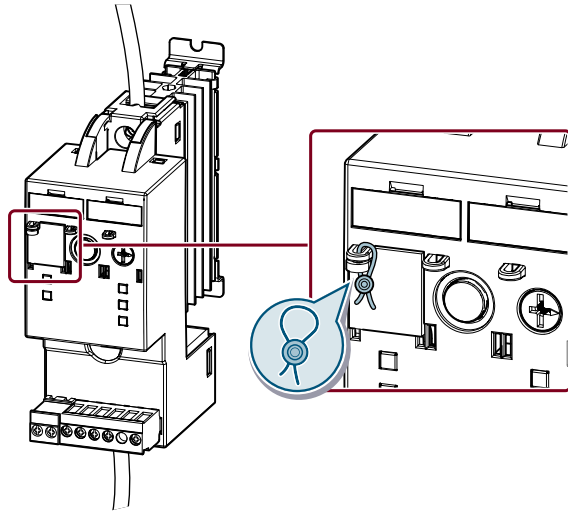
1. Insert the locking tabs of the sealable cover cap into the function module, either in a horizontal position or at an angle of up to approx. 60°.



2. Fold the sealable cover cap upwards.



3. Seal the sealable cover cap to the function module using a sealing wire and sealing pliers.

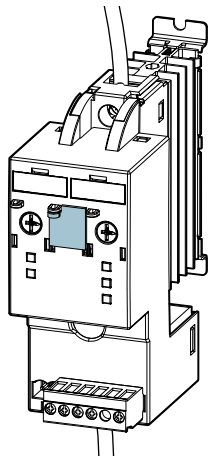


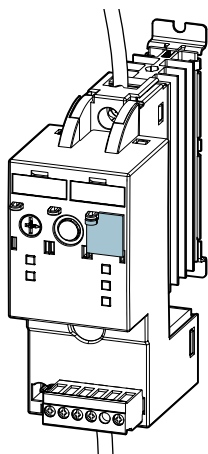
Benefits

The rotary knobs and the TEACH/TEST button on the function module are protected against access.

Area of application

Depending on the function module, you have various options for fitting the sealable cover cap.





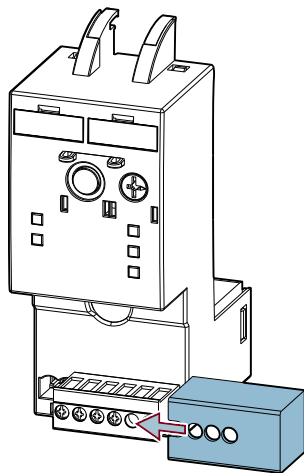
6.7.3 Mounting the cover of the terminal strips of the function modules

Area of application

The terminal strip cover is required to maintain the insulation distances according to the standard.


Instructions

1. Slide the cover onto the terminal strip of the function module.



Connecting

Safety instructions

| |
|---|
|  DANGER |
| Hazardous voltage. Can cause death or serious injury. |
| Disconnect the system and all devices from the power supply before starting work. |

Types of connection

For the solid-state switching devices, the following options are available for connecting the cables:

- Free wiring on screw-type terminals
- Free wiring on spring-loaded terminals
- Free wiring on ring cable lug connections

Openings for test probes

On solid-state switching devices with screw-type connection technology and ring cable lug technology, the test probes are applied to the terminal screws.

On solid-state switching devices with spring-loaded connection technology, special openings for test probes are provided on all terminals.

7.1 Connecting solid-state contactors and solid-state relays

7.1.1 Connecting the main circuit terminals of the 3RF3/3RF5 solid-state switching devices with screw-type connection technology

Safety instructions

| |
|--|
| NOTICE |
| Material damage due to incorrect wiring of the 3RF5 solid-state switching devices. |
| The positive pole of the incoming unit may only be connected to terminal L1. Polarity reversal will destroy the solid-state switching device. Wire the solid-state switching devices as intended. |

Requirement

Permitted conductor cross-sections of the main circuit terminals for a stripped length of 10 mm:

- Solid and stranded:
 - 2 x (1.5 ... 2.5) mm²
 - 2 x (2.5 ... 6.0) mm²
- Finely stranded with end sleeve:
 - 2 x (1.5 ... 2.5) mm²
 - 2 x (2.5 ... 6.0) mm²
 - 1 x (1 ... 10) mm²
- AWG cables:
 - 2x (14 ... 10)

Note

Connection of clamping points

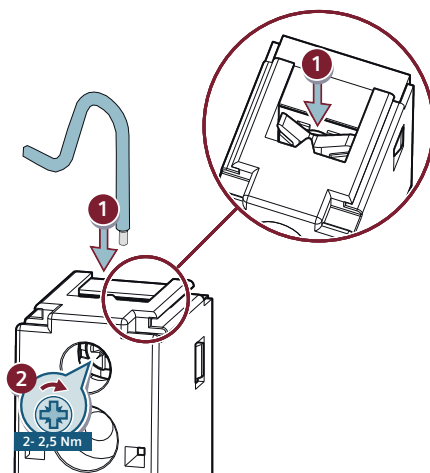
If two different conductor cross-sections are connected to one clamping point, both cross-sections must lie in one of the ranges specified.

Required tools

- Pozidriv screwdriver size PZ 2, Ø 5 ... 6 mm

Instructions

1. Insert the cables into the openings of the terminals.



2. Tighten the screws to a torque of 2.0 ... 2.5 Nm (18 ... 22 lb.in.).

7.1.2 Connecting the main circuit terminals of the 3RF3 solid-state switching devices with spring-loaded connection technology

Requirement

Permitted conductor cross-sections of the main circuit terminals for a stripped length of 10 mm:

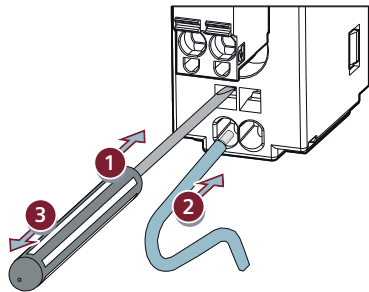
- Solid and stranded:
 - 2 x (0.5 ... 2.5) mm²
- Finely stranded with end sleeve:
 - 2 x (0.5 ... 1.5) mm²
- Finely stranded without end sleeve:
 - 2 x (0.5 ... 2.5) mm²
- AWG cables:
 - 2x (18 ... 14)

Required tools

- Flat-head screwdriver

Instructions

1. Open the spring by applying slight pressure in the opening provided using the screwdriver.



2. Insert the cable into the opening.
3. Release the pressure you are exerting with the screwdriver.

7.1.3 Connecting the main circuit terminals of the 3RF3 solid-state switching devices with ring cable lug connection technology

Requirement

Permitted conductor cross-sections of the main circuit terminals:

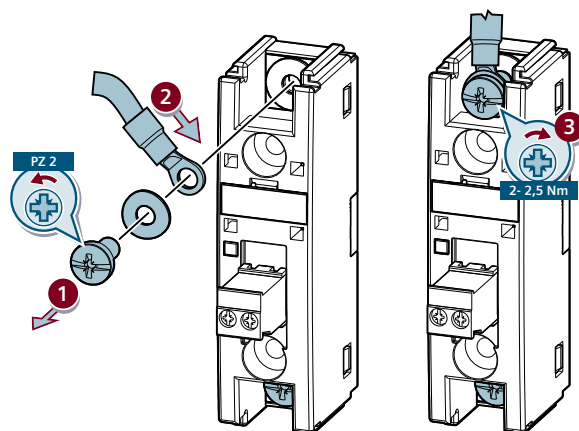
- JIS cable lug:
 - JIS C 2805 R 2 - 5 ... 14 - 5
- DIN cable lug:
 - DIN 46234 5 - 2.5 ... 5 - 25
- AWG cable lug:
 - AWG 12 - 4

Required tools

- Pozidriv screwdriver size PZ 2, \varnothing 5 ... 6 mm

Instructions

1. Loosen and remove the screw from the device.



2. Place the ring cable lug over the opening of the ring cable lug unit.
3. Tighten the screws to a torque of 2.0 ... 2.5 Nm (18 ... 22 lb.in).

7.1.4 Connecting the control circuit terminals of the solid-state switching devices with screw-type connection technology

Requirement

Permitted conductor cross-sections of the control circuit terminals for a stripped length of 7 mm:

- Solid:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1.0) mm²
- Finely stranded with end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1.0) mm²
- Finely stranded without end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1.0) mm²
- AWG cables:
 - 1x (20 ... 12)

Note

Connection of clamping points

If two different conductor cross-sections are connected to one clamping point, both cross-sections must lie in one of the ranges specified.

Required tools

- Pozidriv screwdriver size PZ 1, \varnothing 3.5 mm

Instructions

1. Insert the cables into the openings of the terminals.
2. Tighten the screws to a torque of 0.5 ... 0.6 Nm (4.5 ... 5.3 lb.in).

7.1.5 Connecting the control circuit terminals of the solid-state switching devices with spring-loaded connection technology

Requirement

Permitted conductor cross-sections of the control circuit terminals for a stripped length of 10 mm:

- Solid:
 - 1 x (0.5 ... 1.5) mm²
- Finely stranded with end sleeve:
 - 1 x (0.5 ... 2.5) mm²
- Finely stranded without end sleeve:
 - 1 x (0.5 ... 2.5) mm²
- AWG cables:
 - 1x (20 ... 12)

Required tools

- Flat-head screwdriver

Instructions

1. Open the spring by applying slight pressure in the opening provided using the screwdriver.
2. Insert the cable into the opening.
3. Release the pressure you are exerting with the screwdriver.

7.2 Connecting function modules

7.2.1 Connecting a function module converter

Requirement

Permitted conductor cross-sections of the control circuit terminals for a stripped length of 7 mm:

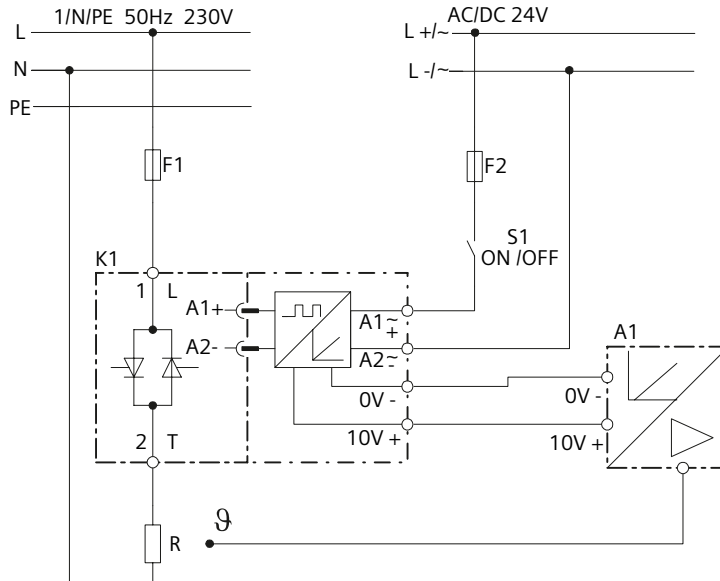
- Solid:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- Finely stranded with end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- Finely stranded without end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- AWG cables:
 - 1x (20 ... 12)

Required tools

- Pozidriv screwdriver size PZ 1, Ø 3.5 mm

Example circuit diagram

The following graphic shows an example circuit with the function module converter, mounted on a solid-state relay, and a temperature regulator with analog output. Installing the function module automatically establishes an internal connection between the solid-state switching devices (K1).



- A1 Temperature regulator with analog output
- F1 Main circuit fuse (semiconductor protection recommended)
- F2 Control circuit fuse
- K1 Solid-state switching device (1-pole) with plugged-on function module converter
- R Load resistance
- S1 ON/OFF switch

Instructions

1. Insert the cables into the terminal openings of the function module.
2. Tighten the screws to a torque of 0.5 ... 0.6 Nm (4.5 ... 5.3 lb.in).

7.2.2 Connecting a function module load monitoring basic

Requirement

Permitted conductor cross-sections of the control circuit terminals of the function module for a stripped length of 7 mm:

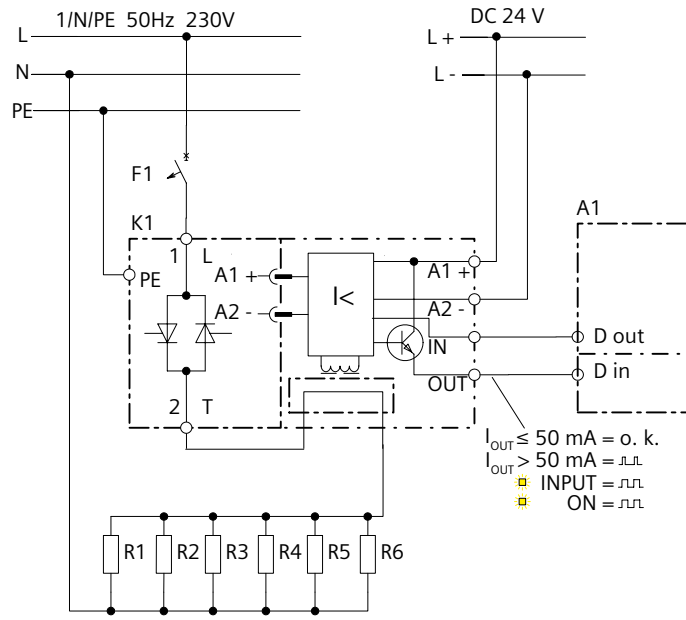
- Solid:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- Finely stranded with end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- Finely stranded without end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- AWG cables:
 - 1x (20 ... 12)

Required tools

- Pozidriv screwdriver size PZ 1, Ø 3.5 mm
- Pozidriv screwdriver size PZ 2, Ø 5 ... 6 mm

Example circuit diagram

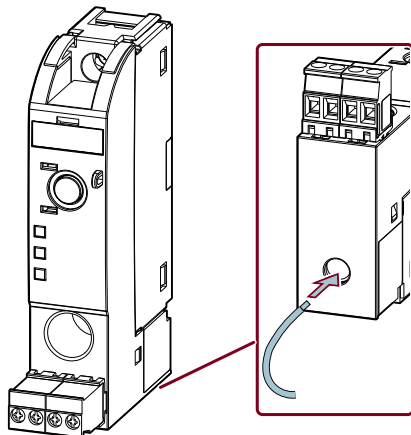
The following graphic shows an example circuit with the function module load monitoring basic, mounted on a solid-state relay, and a programmable logic controller. Installing the function module automatically establishes an internal connection between the solid-state switching devices (K1). The lower part of the function module acts as a straight-through transformer.



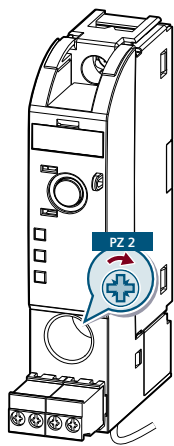
- A1 Programmable logic controller (PLC)
- F1 Miniature circuit breaker main circuit
- K1 Solid-state switching device (1-pole) with plugged-on function module load monitoring basic
- R 1-6 Load resistors

Instructions

1. Pass the line through the opening on the underside of the function module into the terminal of the solid-state switching device to connect the lower main circuit terminal of the solid-state relay.



2. Tighten the screw to a torque of 2.0 ... 2.5 Nm (18 ... 22 lb.in).



3. Insert the cables into the openings of the control circuit terminals.
4. Tighten the screws to a torque of 0.5 ... 0.6 Nm (4.5 ... 5.3 lb.in).

7.2.3 Connecting an function module load monitoring extended

Safety instructions

Observe the information in the following FAQ (<https://support.industry.siemens.com/cs/ww/en/view/32151415>).

| |
|--|
| NOTICE |
| Faults due to faulty voltage connection Material damage |
| The load voltage must be recorded to ensure correct operation of the device. For this reason, the function modules are equipped with a connection for the load voltage potential. Connecting the wrong voltage can lead to malfunctions. |
| Therefore, ensure that the voltage is checked before connection and that it matches the intended load voltage potential. |

Requirement

Permitted conductor cross-sections of the control circuit terminals of the function module for a stripped length of 7 mm:

- Solid:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- Finely stranded with end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- Finely stranded without end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- AWG cables:
 - 1x (20 ... 12)

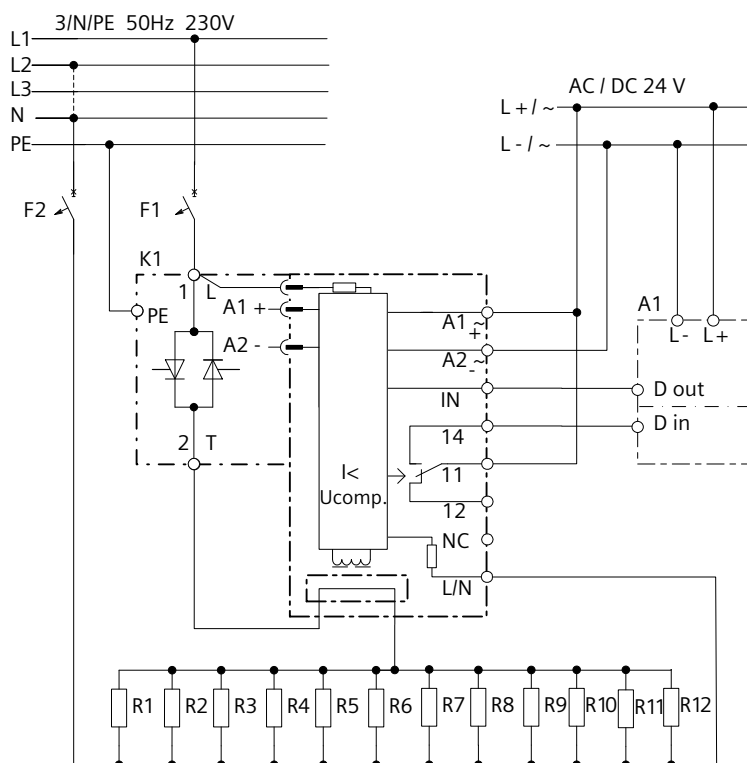
Required tools

- Pozidriv screwdriver size PZ 1, Ø 3.5 mm
- Pozidriv screwdriver size PZ 2, Ø 5 ... 6 mm

Example circuit diagram

The following graphic shows an example circuit with the function module load monitoring extended, mounted on a solid-state relay, and a programmable logic controller. Installing the function module automatically establishes an internal connection between the solid-state switching devices (K1). The lower part of the function module acts as a straight-through transformer. The voltage detection is not galvanically isolated ($3\text{ M}\Omega$ per path). Establish the PE connection in accordance with the regulations.

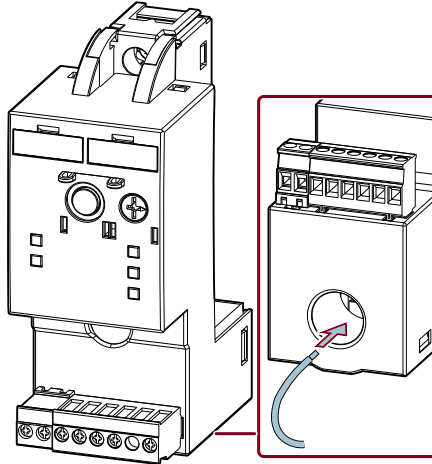
Depending on the operational voltage version, connect the L/N terminal of the function module either to the neutral conductor or to a second 2nd phase. When using a function module with an operational voltage range of 110 - 230 V, connect the L/N terminal to the neutral conductor. When using a function module with an operational voltage range of 400 - 600 V, connect the L/N terminal to a 2nd phase. Use an additional 2nd miniature circuit breaker.



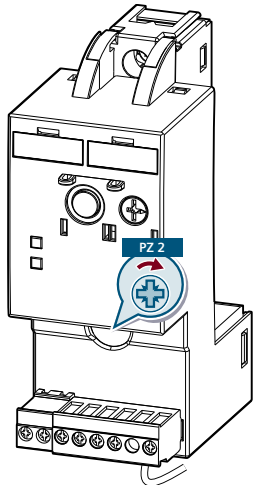
- A1 Programmable logic controller (PLC)
- F1 Miniature circuit breaker main circuit
- F2 Miniature circuit breaker main circuit
- K1 Solid-state switching device (1-pole) with plugged-on function module load monitoring extended
- R Load resistors
- 1-12

Instructions

1. Pass the line through the opening on the underside of the function module into the terminal of the solid-state switching device to connect the lower main circuit terminal of the solid-state relay.



2. Tighten the screws to a torque of 2.0 ... 2.5 Nm (18 ... 22 lb.in).



3. Insert the cables into the openings of the control circuit terminals.
4. Tighten the screws to a torque of 0.5 ... 0.6 Nm (4.5 ... 5.3 lb.in).

7.2.4 Connecting a function module heating current monitoring

Safety instructions

Observe the information in the following FAQ (<https://support.industry.siemens.com/cs/ww/en/view/32151415>).

| |
|--|
| NOTICE |
| Faults due to faulty voltage connection Material damage |
| The load voltage must be recorded to ensure correct operation of the device. For this reason, the function modules are equipped with a connection for the load voltage potential. Connecting the wrong voltage can lead to malfunctions. |
| Therefore, ensure that the voltage is checked before connection and that it matches the intended load voltage potential. |

Requirement

Permitted conductor cross-sections of the control circuit terminals of the function module for a stripped length of 7 mm:

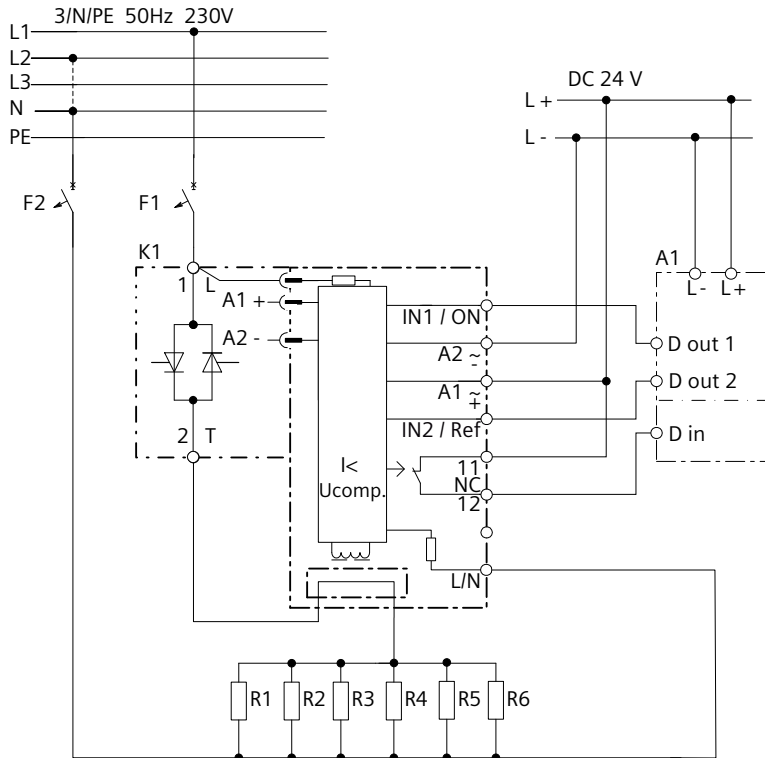
- Solid:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- Finely stranded with end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- Finely stranded without end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- AWG cables:
 - 1x (20 ... 12)

Required tools

- Pozidriv screwdriver size PZ 1, Ø 3.5 mm
- Pozidriv screwdriver size PZ 2, Ø 5 ... 6 mm

Example circuit diagram

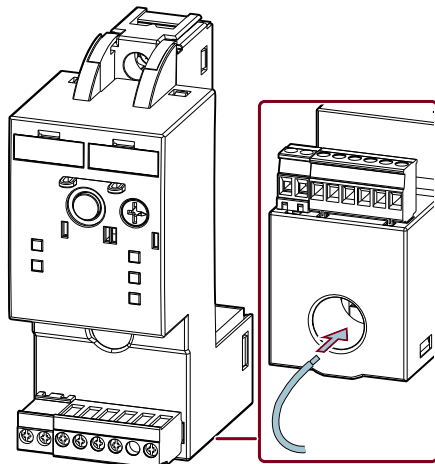
The following graphic shows an example circuit with the function module heating current monitoring, mounted on a solid-state relay, and a programmable logic controller. Installing the function module automatically establishes an internal connection between the solid-state switching devices (K1). The lower part of the function module acts as a straight-through transformer. The voltage detection is not galvanically isolated (3 MΩ per path). Depending on the operational voltage version, connect the L/N terminal of the function module either to the neutral conductor or to a second 2nd phase. When using a function module with an operational voltage range of 110 - 230 V, connect the L/N terminal to the neutral conductor. When using a function module with an operational voltage range of 400 - 600 V, connect the L/N terminal to a 2nd phase. Use an additional 2nd miniature circuit breaker. Ground L-.



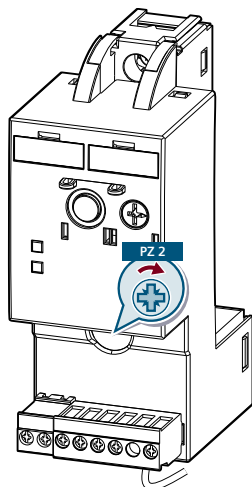
- A1 Programmable logic controller (PLC)
- F1 Miniature circuit breaker main circuit
- F2 Miniature circuit breaker main circuit
- K1 Solid-state switching device (1-pole) with plugged-on function module heating current monitoring
- R 1-6 Load resistors

Instructions

1. Pass the line through the opening on the underside of the function module into the terminal of the solid-state switching device to connect the lower main circuit terminal of the solid-state relay.



2. Tighten the screws to a torque of 2.0 ... 2.5 Nm (18 ... 22 lb.in).



3. Insert the cables into the openings of the control circuit terminals.
4. Tighten the screws to a torque of 0.5 ... 0.6 Nm (4.5 ... 5.3 lb.in).

7.2.5 Connecting a function module power controller

Safety instructions

Observe the information in the following FAQ (<https://support.industry.siemens.com/cs/ww/en/view/32151415>).

| |
|--|
| NOTICE |
| Faults due to faulty voltage connection Material damage |
| The load voltage must be recorded to ensure correct operation of the device. For this reason, the function modules are equipped with a connection for the load voltage potential. Connecting the wrong voltage can lead to malfunctions. |
| Therefore, ensure that the voltage is checked before connection and that it matches the intended load voltage potential. |

Requirement

Permitted conductor cross-sections of the control circuit terminals of the function module for a stripped length of 7 mm:

- Solid:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- Finely stranded with end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- Finely stranded without end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- AWG cables:
 - 1x (20 ... 12)

Required tools

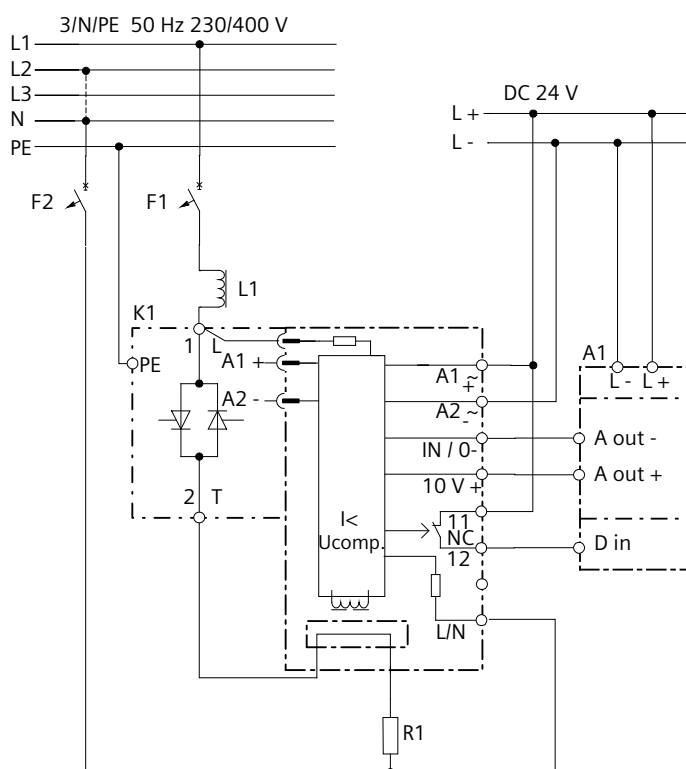
- Pozidriv screwdriver size PZ 1, Ø 3.5 mm
- Pozidriv screwdriver size PZ 2, Ø 5 ... 6 mm

Example circuit diagram

The following graphic shows an example circuit with the function module power controller, mounted on a solid-state relay, and a programmable logic controller. Installing the function module automatically establishes an internal connection between the solid-state switching devices (K1). The lower part of the function module acts as a straight-through transformer. The voltage detection is not galvanically isolated ($3\text{ M}\Omega$ per path). Make the PE connection in accordance with the regulations. Ground L-.

Use a reactor when operating with phase control to comply with the limit values for conducted disturbance voltage in accordance with Class A.

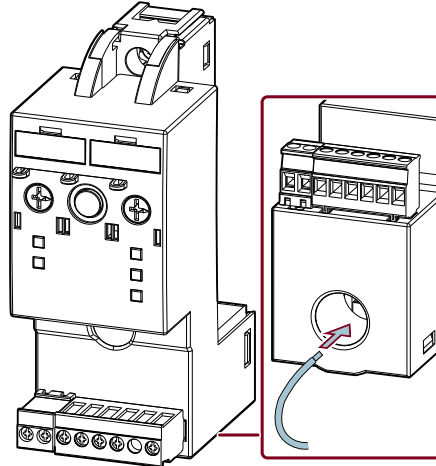
Connect the L/N terminal of the function module to either the neutral conductor or a second phase, depending on the operational voltage. When using a function module with an operational voltage range of 110 - 230 V, connect the L/N terminal to the neutral conductor. When using a function module with an operational voltage range of 400 - 600 V, connect the L/N terminal to a 2nd phase. Use an additional 2nd miniature circuit breaker.



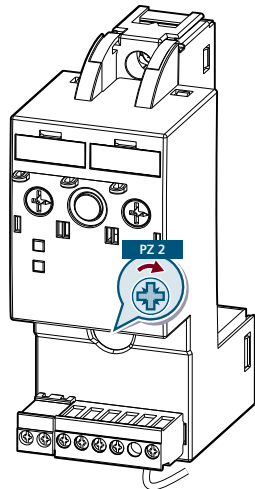
- A1 Programmable logic controller (PLC)
- F1 Miniature circuit breaker main circuit
- F2 Miniature circuit breaker main circuit
- K1 Solid-state switching device (1-pole) with plugged-on function module power controller
- R1 Load resistance
- L1 Reactor 200 μH

Instructions

1. Pass the line through the opening on the underside of the function module into the terminal of the solid-state switching device to connect the lower main circuit terminal of the solid-state relay.



2. Tighten the screws to a torque of 2.0 ... 2.5 Nm (18 ... 22 lb.in).



3. Insert the cables into the openings of the control circuit terminals.
4. Tighten the screws to a torque of 0.5 ... 0.6 Nm (4.5 ... 5.3 lb.in).

7.2.6 Connecting a function module power regulator

Safety instructions

Observe the information in the following FAQ (<https://support.industry.siemens.com/cs/ww/en/view/32151415>).

| |
|--|
| NOTICE |
| Faults due to faulty voltage connection Material damage |
| The load voltage must be recorded to ensure correct operation of the device. For this reason, the function modules are equipped with a connection for the load voltage potential. Connecting the wrong voltage can lead to malfunctions. |
| Therefore, ensure that the voltage is checked before connection and that it matches the intended load voltage potential. |

Requirement

Permitted conductor cross-sections of the control circuit terminals of the function module for a stripped length of 7 mm:

- Solid:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- Finely stranded with end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- Finely stranded without end sleeve:
 - 1 x (0.5 ... 2.5) mm²
 - 2 x (0.5 ... 1) mm²
- AWG cables:
 - 1x (20 ... 12)

Required tools

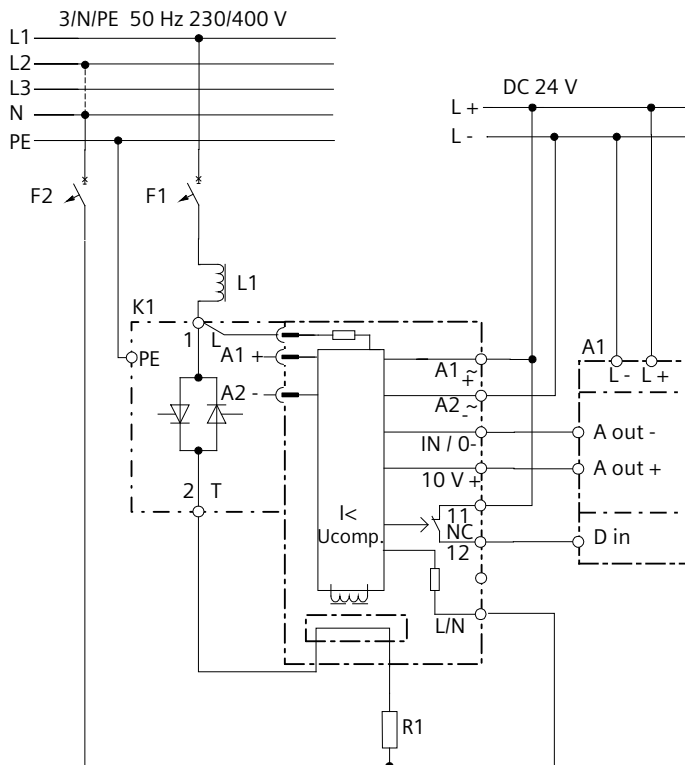
- Pozidriv screwdriver size PZ 1, Ø 3.5 mm
- Pozidriv screwdriver size PZ 2, Ø 5 ... 6 mm

Example circuit diagram

The following graphic shows an example circuit with the function module power regulator, mounted on a solid-state relay, and a programmable logic controller. Installing the function module automatically establishes an internal connection between the solid-state switching devices (K1). The lower part of the function module acts as a straight-through transformer. The voltage detection is not galvanically isolated (3 MΩ per path). Make the PE connection in accordance with the regulations. Ground L-.

Use a reactor when operating with phase control to comply with the limit values for conducted disturbance voltage in accordance with Class A.

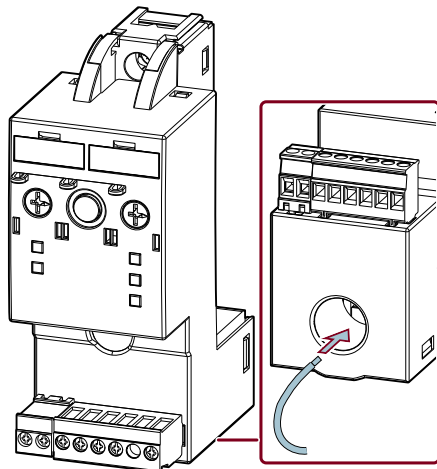
Connect the L/N terminal of the function module to either the neutral conductor or a second phase, depending on the operational voltage. When using a function module with an operational voltage range of 110 - 230 V, connect the L/N terminal to the neutral conductor. When using a function module with an operational voltage range of 400 - 600 V, connect the L/N terminal to a 2nd phase. Use an additional 2nd miniature circuit breaker.



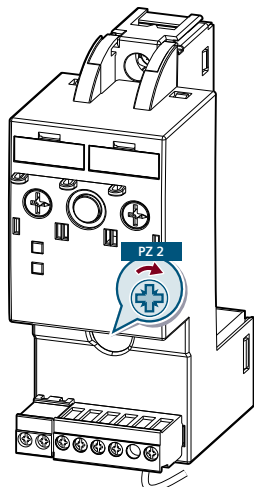
- A1 Programmable logic controller (PLC)
- F1 Miniature circuit breaker main circuit
- F2 Miniature circuit breaker main circuit
- K1 Solid-state switching device (1-pole) with plugged-on function module power controller
- R1 Load resistance
- L1 Reactor 200 μH

Instructions

1. Pass the line through the opening on the underside of the function module into the terminal of the solid-state switching device to connect the lower main circuit terminal of the solid-state relay.



2. Tighten the screws to a torque of 2.0 ... 2.5 Nm (18 ... 22 lb.in).



3. Insert the cables into the openings of the control circuit terminals.
4. Tighten the screws to a torque of 0.5 ... 0.6 Nm (4.5 ... 5.3 lb.in).

Operation/parameterization

8.1 Status LED "ON" of the solid-state switching devices

Description

If the ON LED on the solid-state switching devices lights up, this indicates the presence of the control supply voltage.
If the ON LED does not light up, this indicates that there is no control supply voltage on the device or that the device is defective.

8.2 Re-teaching the function modules

Requirement

- Solid-state relay or solid-state contactor is mounted.
- Solid-state relay or solid-state contactor is connected.
- Function module is mounted.
- Function module is connected.
- Load is connected.

Description

The teach process can be repeated at any time. It is irrelevant whether the function module is in the activated or deactivated state.

1. To repeat the teach process, either press the TEACH/TEST button for at least 3 seconds or apply a control signal to the IN2 / Ref input of the function module heating current monitoring for at least 100 ms.
2. The successful teach process is again indicated by the LEDs lighting up, equivalent to the 1st teach process.

Benefits

You need the option of re-teaching the function modules in the event of load changes or frequency changes in the main voltage in your application.

8.3 Setting the rotary knobs of the function modules

8.3.1 Setting the rotary knob t_R

Scope

- Function module power controller
- Function module power regulator

Description

If the rotary knob t_R is set to "0 s", the function module operates according to the full-wave control principle. The function module converts the set power into a pulse-width-modulated digital signal. Once the rotary knob t_R is set to a value greater than "0 s", the function module operates according to the generalized phase control principle. The half-waves of the current are controlled in such a way that the setpoint value of the power at the load is achieved. You can also set a ramp time between 0 and 10 s for a voltage ramp when switching on for switch-on current limitation using the t_R rotary knob.

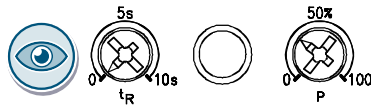
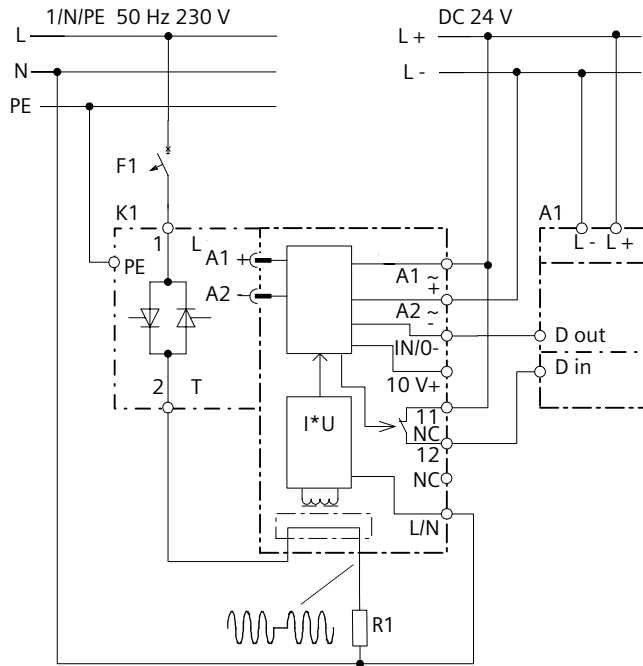
Required tools

- Flat-head screwdriver

Instructions

1. Use a screwdriver to set the rotary knob to the desired set value.

Example circuit diagram



8.3.2 Setting the rotary knob P

Scope

- Function module power controller
- Function module power regulator

Description

The setpoint can be specified using the rotary knob P on the function module. The rotary knob P allows you to set between 0 and 100% of the taught value. Since the setting of the rotary knob has no effect during the teach process, the set value "100%" corresponds to the taught power. Set the rotary knob P to 0% if you want to control the function module using an external setpoint setting.

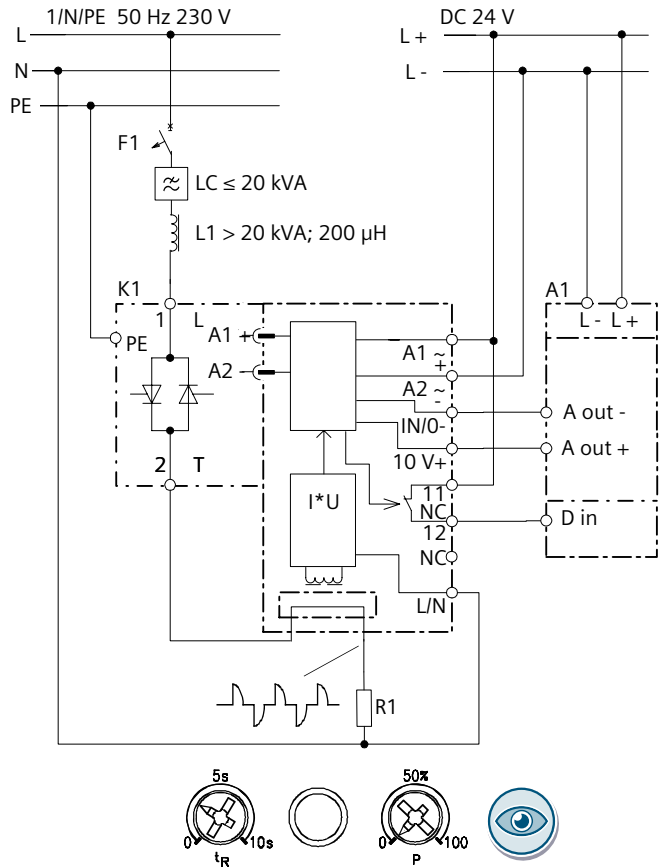
Required tools

- Flat-head screwdriver

Instructions

1. Use a screwdriver to set the rotary knob to the desired set value.

Example circuit diagram



8.3.3 Setting the "Response delay/error storage" rotary knob

Scope

- Function module load monitoring extended
- Function module heating current monitoring

Description

The response delay in the event of an error can be set between 100 ms and 3 s using a rotary knob on the module. You also use the rotary knob to set whether the module saves the error message or not.

- Retentive: After an error has been rectified, the error output remains set until the supply voltage at A1-A2 is briefly disconnected for resetting.
- Non-retentive: The output is reset immediately after the error has been rectified.

Required tools

- Flat-head screwdriver

Instructions

1. Use a screwdriver to set the rotary knob to the desired set value.

Commissioning

9.1 Commissioning a function module converter

Requirement

- The function module is mounted.
- The function module is connected.

Instructions

1. Apply a supply voltage of 24 V AC/DC to terminals A1 and A2.
2. As soon as the voltage at the 0 - 10 V analog input exceeds 0.1 V, the converter switches the solid-state switching device ON and OFF according to the analog input voltage.
3. To switch off the function module, reduce the analog voltage to below 0.1 V, or disconnect the supply voltage.

9.2 Commissioning the function module load monitoring basic

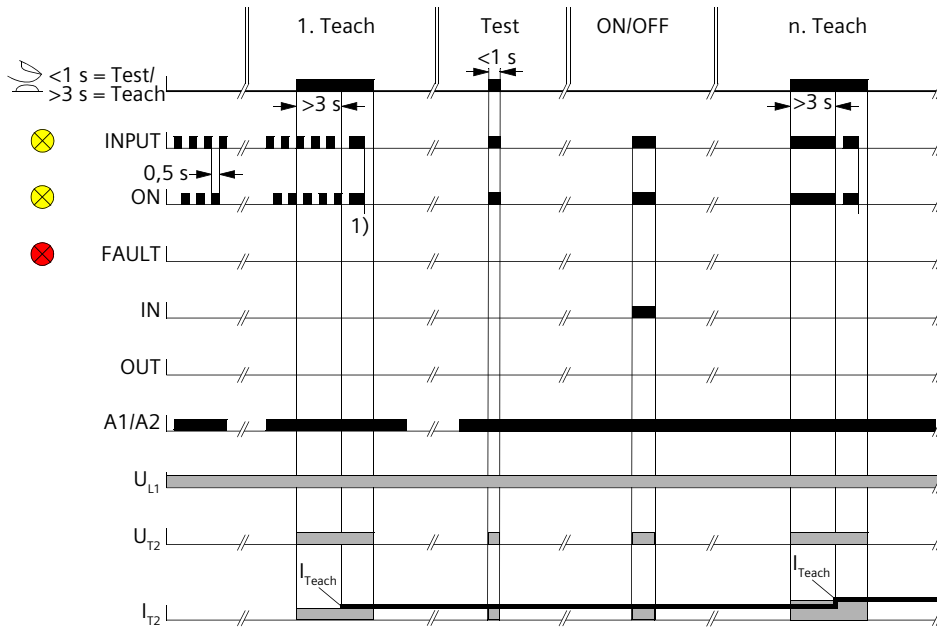
Requirement

- The function module is mounted.
- The function module is connected.

Instructions

1. Connect the supply voltage at terminals A1 and A2. The INPUT LED and the ON LED then flash alternately, as no TEACH process has yet taken place.
2. Press the TEACH/TEST button for at least 3 seconds. After this time, the load monitor records the current value flowing through the solid-state relay or contactor and saves it as a setpoint value.
3. The correct completion of the TEACH process is indicated by the two INPUT and ON LEDs lighting up simultaneously.
4. When the supply voltage is applied, you can briefly press the TEACH/TEST button (< 1 s) for test purposes. This functionality makes it possible to test the setup.
5. To perform another TEACH process, press the TEACH/TEST button again for at least 3 seconds.

Function diagram



1) Current value stored

9.3 Commissioning the function module load monitoring extended

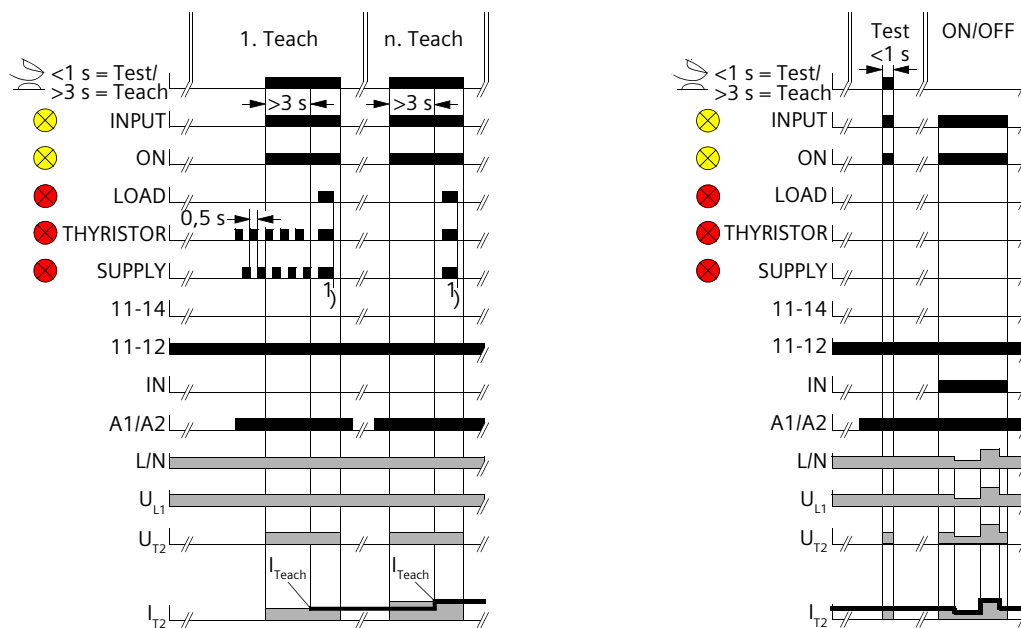
Requirement

- The function module is mounted.
- The function module is connected.

Instructions

1. Connect the supply voltage at terminals A1 and A2. The THYRISTOR LED and the SUPPLY LED then flash alternately, as no TEACH process has yet taken place.
2. Press the TEACH/TEST button for at least 3 seconds. After this time, the load monitor records the current value flowing through the solid-state relay or contactor and stores it as a setpoint value.
3. The correct completion of the TEACH process is indicated by the LOAD LED, THYRISTOR LED and SUPPLY LED lighting up simultaneously.
4. When the supply voltage is applied, you can briefly press the TEACH/TEST button (<math>< 1\text{ s}</math>) for test purposes. This functionality makes it possible to test the setup.
5. To perform another TEACH process, press the TEACH/TEST button again for at least 3 seconds.

Function diagram



1) Current value stored

9.4 Commissioning a function module heating current monitoring

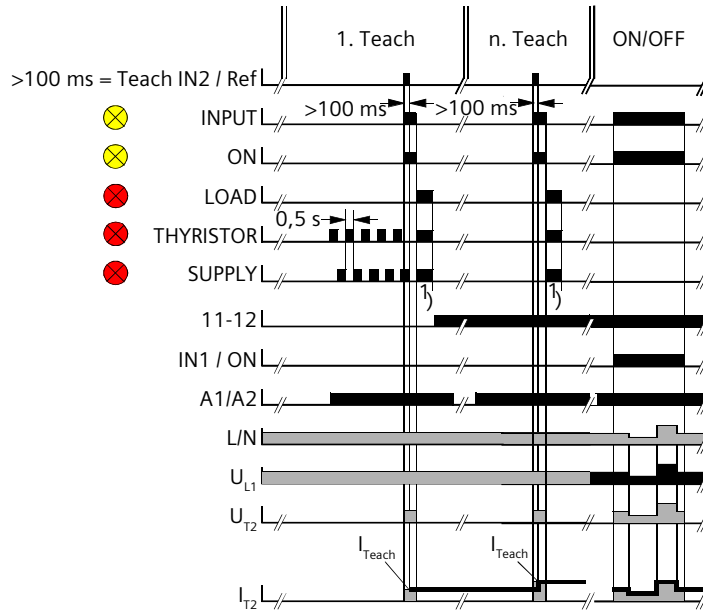
Requirement

- The function module is mounted.
- The function module is connected.

Instructions

1. Connect the supply voltage at terminals A1 and A2. The THYRISTOR LED and the SUPPLY LED then flash alternately, as no TEACH process has yet taken place. The error signaling output is set.
2. Apply a control signal to the IN2 / Ref input for at least 100 ms. After this time, the heating current monitor records the current flowing through the solid-state relay or contactor for approx. 500 ms and stores it as the setpoint value.
3. The correct completion of the TEACH process is indicated by the LOAD LED, THYRISTOR LED and SUPPLY LED lighting up simultaneously. The error signaling output is reset.
4. When the supply voltage is applied, you can briefly press the TEACH/TEST button ($< 1\text{ s}$) for test purposes. This functionality makes it possible to test the setup.
5. For a further TEACH process, apply a control signal to the IN2 / Ref input again for 100 ms.

Function diagram



1) Current value stored

9.5 Commissioning a function module power controller

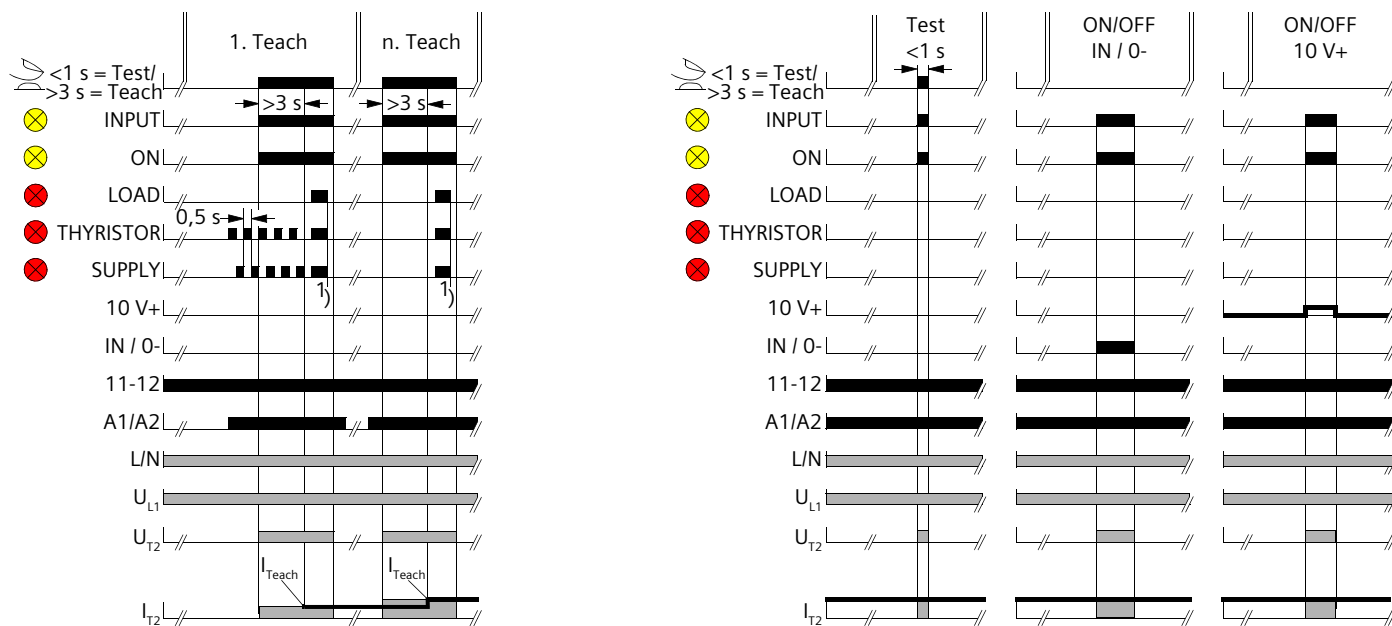
Requirement

- The function module is mounted.
- The function module is connected.

Instructions

1. Connect the supply voltage at terminals A1 and A2. The THYRISTOR LED and the SUPPLY LED then flash alternately, as no TEACH process has yet taken place.
2. Press the TEACH/TEST button for at least 3 seconds. After this time, the power controller records the voltage and current value that flows through the solid-state relay or contactor and stores the voltage and current value as a reference.
3. If a switch-on current limitation is set on the module, the power controller automatically runs through the voltage ramp and records the reference values at the end of the set time. The position of the rotary knob P has no influence on the TEACH process.
4. The correct completion of the TEACH process is indicated by the LOAD LED, THYRISTOR LED and SUPPLY LED lighting up simultaneously.
5. When the supply voltage is applied, you can briefly press the TEACH/TEST button (< 1 s) for test purposes. This functionality makes it possible to test the setup.
6. To perform another TEACH process, press the TEACH/TEST button again for at least 3 seconds.

Function diagram



1) Current value stored

9.6 Commissioning a function module power regulator

Requirement

- The function module is mounted.
- The function module is connected.

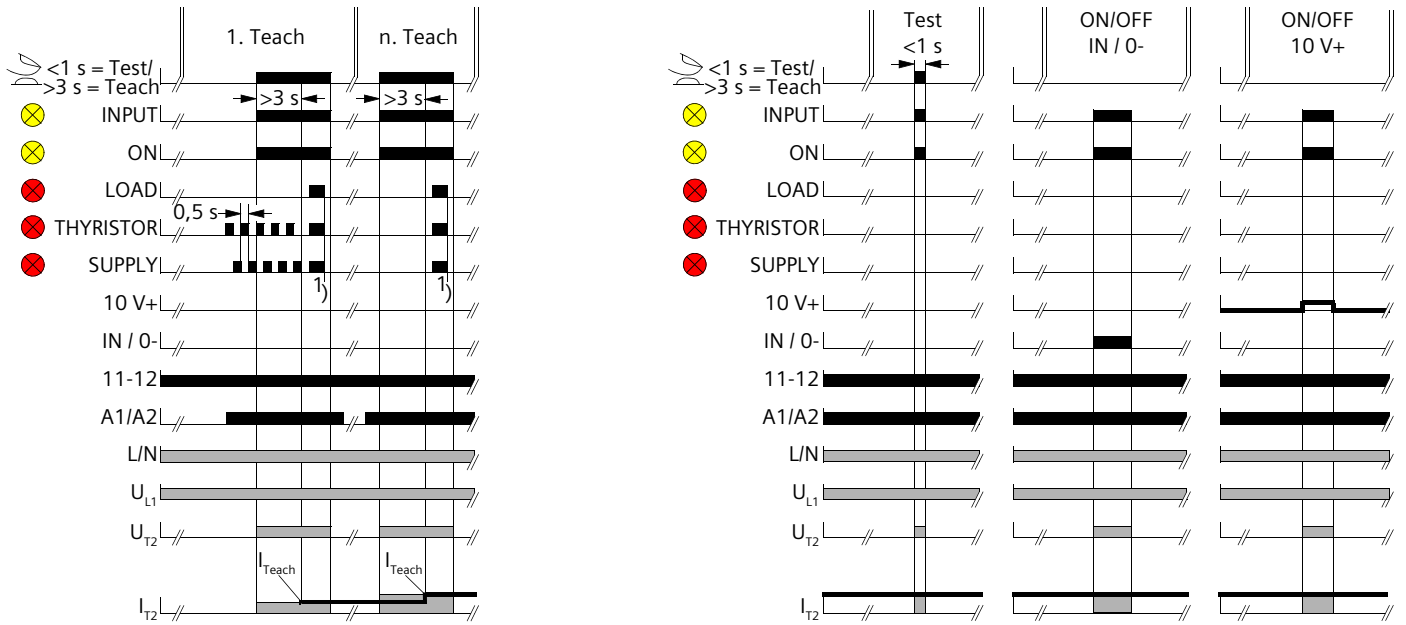
Instructions

1. Connect the supply voltage at terminals A1 and A2. The THYRISTOR LED and the SUPPLY LED then flash alternately, as no TEACH process has yet taken place.
2. Press the TEACH/TEST button for at least 3 seconds. After this time, the power controller records the voltage and current value that flows through the solid-state relay or contactor and stores the product of the voltage value and current value as the reference power.
3. If a switch-on current limitation is set on the module using the rotary knob t_{Rr} , the power controller automatically runs through the voltage ramp and records the reference power at the end of the set time. The position of the rotary knob P has no influence on the TEACH process.
4. The correct completion of the TEACH process is indicated by the LOAD LED, THYRISTOR LED and SUPPLY LED lighting up simultaneously.

9.6 Commissioning a function module power regulator

5. When the supply voltage is applied, you can briefly press the TEACH/TEST button (< 1 s) for test purposes. This functionality makes it possible to test the setup.
6. To perform another TEACH process, press the TEACH/TEST button again for at least 3 seconds.

Function diagram



1) Current value stored

Maintenance and service

10.1 Servicing solid-state switching devices

The 3RF solid-state switching devices are maintenance-free.

10.2 Repairing solid-state switching devices

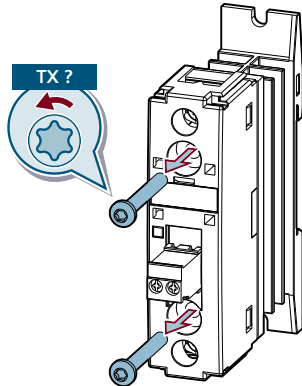
The solid-state contactors can be repaired.

Repairing 3RF3 solid-state contactors

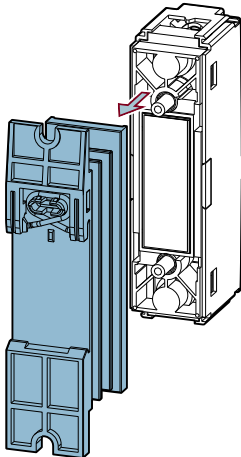
Instructions

With the solid-state contactors of the 3RF3 product series, it is possible to remove the heat sink including the DIN rail adapter.

1. Loosen the screws on the front of the device.



2. Remove the heat sink from the solid-state relay.



3. For versions with an aluminum heat sink, the DIN rail adapter can also be removed (see Repairing 3RF5 semiconductor contactors).

Result

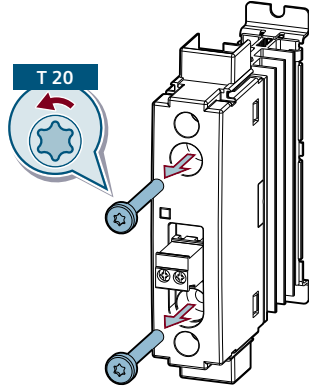
- You have a heat sink available and can attach it to a new solid-state relay together with a new heat conducting foil.

Repairing 3RF5 solid-state contactors

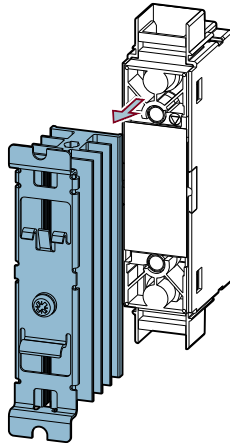
Instructions

It is possible to replace the DIN rail adapter and the heat sink for the solid-state contactors of the 3RF53 product series.

1. Loosen the screws on the front of the device.

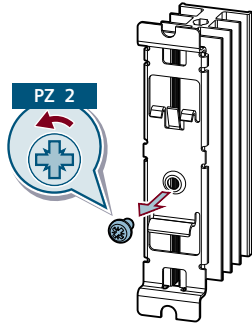


2. Remove the heat sink from the solid-state relay.

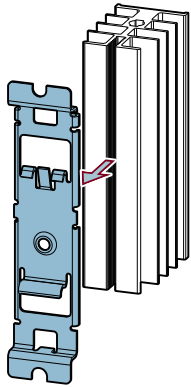


10.3 Restoring the factory settings of the function module

3. Remove the screw on the back of the device.



4. Remove the DIN rail adapter from the heat sink.



Result

- You have a heat sink and DIN rail adapter available and can attach these to a new solid-state relay together with a new heat conducting foil.

10.3 Restoring the factory settings of the function module

Instructions










1. Disconnect the load circuit.
2. Teach the function module in the same way as for first commissioning.




Result

The current transformer does not measure any current and resets the function module after approx. 3 seconds.

Error messages from the function modules

11.1 Error messages from the function module load monitoring basic



| Fault type | Signaling (LED display) | | Cause | Effect | Troubleshooting |
|--------------------------------|---|------------|---|--|--|
| Control supply voltage missing | <input type="checkbox"/> | No LED lit | No control supply voltage is present. The device is defective. | – | <ul style="list-style-type: none"> Check the application. Check the device. |
| Teach error |  | LED INPUT | No taught value available. Teach process not carried out successfully. | – | <ul style="list-style-type: none"> Teach the function module correctly. |
| |  | LED ON | | | |
| | <input type="checkbox"/> | LED FAULT | | | |
| Partial load fault |  | LED INPUT | The present current value has dropped by at least 1/6 of the reference value. Observe the minimum partial load current of the function module variant. | Error message signaling is set (OUT terminal). | <ul style="list-style-type: none"> Check the individual partial loads of the application. Check the height or presence of the power supply to the device. |
| |  | LED ON | | | |
| |  | LED FAULT | | | |
| Thyristor fault | <input type="checkbox"/> | LED INPUT | <ul style="list-style-type: none"> Input at terminal IN/0 is removed and current is still present. Short-circuit in the application. Alloying in the device. | Error message signaling is set (OUT terminal). | <ul style="list-style-type: none"> Check the device. Disconnect the circuit/de-energize the system and replace the device. Check the application/load for a short-circuit. |
| |  | LED ON | | | |
| |  | LED FAULT | | | |
| Power system fault |  | LED INPUT | No current is measured when switched on. | Error message signaling is set (OUT terminal). | <ul style="list-style-type: none"> Check the elements of your application connected upstream of the solid-state switching device. Check whether a load is connected. |
| | <input type="checkbox"/> | LED ON | | | |
| |  | LED FAULT | | | |




- : LED is off.
-  : LED lights up
-  : LED flashing
-  : LED flashes in opposition to another LED

11.2 Error messages from the function modules heating current monitoring, load monitoring extended, power controller and power regulator

| Fault type | Signaling (LED display) | | Cause | Effect | Troubleshooting | Acknowledgment |
|--------------------------------|--------------------------|---------------|--|--------------------------------|---|--|
| Control supply voltage missing | <input type="checkbox"/> | No LED lit | No control supply voltage is present. The device is defective. | – | <ul style="list-style-type: none"> Check the application. Check the device. | – |
| Teach error | <input type="checkbox"/> | LED INPUT | No taught value available. Teach process not carried out successfully. | – | <ul style="list-style-type: none"> Teach the function module correctly. | – |
| | <input type="checkbox"/> | LED ON | | | | |
| | <input type="checkbox"/> | LED LOAD | | | | |
| | | LED THYRISTOR | | | | |
| | | LED SUPPLY | | | | |
| Partial load fault | | LED INPUT | The present current value has dropped by at least 1/6 or 1/12 of the reference value. Observe the required minimum partial load current of the variant. Observe the minimum partial load current of the function module variant. | Error signaling output is set. | <ul style="list-style-type: none"> Check the individual partial loads of the application. Check the height or presence of the power supply to the device. | With "retentive" setting: Disconnection of the supply voltage at A1-A2 |
| | | LED ON | | | | |
| | | LED LOAD | | | | |
| | <input type="checkbox"/> | LED THYRISTOR | | | | |
| | <input type="checkbox"/> | LED SUPPLY | | | | |
| Thyristor fault | <input type="checkbox"/> | LED INPUT | <ul style="list-style-type: none"> Input at terminal IN/O is removed and current is still present. Short-circuit in the application. Alloying in the device. | Error signaling output is set. | <ul style="list-style-type: none"> Check the device. Disconnect the circuit/ de-energize the system and replace the device. Check the application/load for a short-circuit. | With "retentive" setting: Disconnection of the supply voltage at A1-A2 |
| | | LED ON | | | | |
| | <input type="checkbox"/> | LED LOAD | | | | |
| | | LED THYRISTOR | | | | |
| | <input type="checkbox"/> | LED SUPPLY | | | | |

11.2 Error messages from the function modules heating current monitoring, load monitoring extended, power controller and power regulator

| Fault type | Signaling (LED display) | Cause | Effect | Troubleshooting | Acknowledgment |
|--------------------|--|--|--------------------------------|--|--|
| Power system fault |  LED INPUT | No current is measured when switched on. | Error signaling output is set. | <ul style="list-style-type: none"> Check the elements of your application connected upstream of the solid-state switching device. Check whether a load is connected. | With "retentive" setting: Disconnection of the supply voltage at A1-A2 |
| | <input type="checkbox"/> LED ON | | | | |
| | <input type="checkbox"/> LED LOAD | | | | |
| | <input type="checkbox"/> LED THYRISTOR | | | | |
| |  LED SUPPLY | | | | |

- : LED is off.
-  : LED lights up
-  : LED flashing
-  : LED flashes in opposition to another LED

Examples/applications

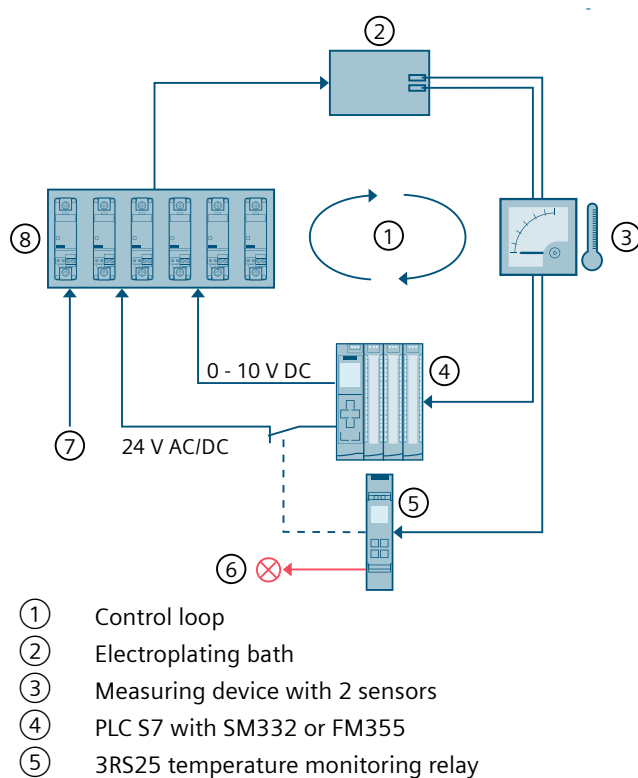
12.1 Application examples with the function modules

12.1.1 Application example with converter

Simple temperature control of an electroplating bath

This application example describes the temperature control of an electroplating bath for surface finishing of metal parts. Precise control of the bath temperature is a decisive process parameter for consistently high coating quality.

The heating of the electroplating bath is controlled by a SIRIUS solid-state switching device with a plug-in converter. The current temperature of the electroplating bath is continuously recorded by a measuring device with 2 sensors and forwarded to the heating control system. The control unit forwards the setpoint to the converter as an analog voltage 0-10 V DC. The converter converts the analog voltage into a pulse-width modulated digital signal with a cycle duration of 1 second and thus controls the ON and OFF time of the solid-state switching device. A SIRIUS 3RS25 temperature monitoring relay monitors this control loop in parallel. If necessary, a warning lamp is activated.



12.1 Application examples with the function modules

- ⑥ Warning lamp
- ⑦ Energy supplied
- ⑧ 3RF3 solid-state switching device with converter (article number: 3RF3900-EA18)

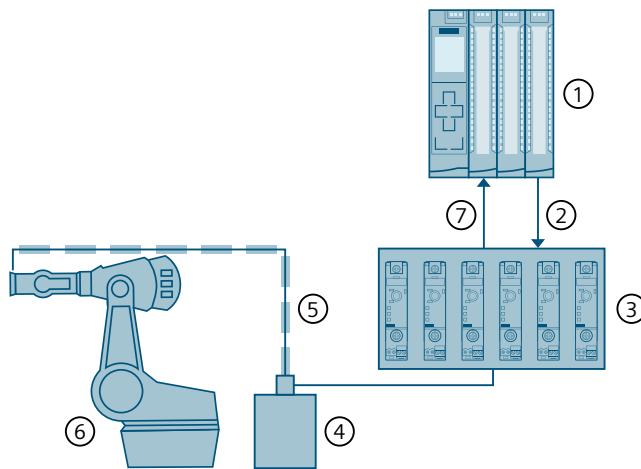
12.1.2 Application example with load monitoring basic

Adhesive dispensing robots in the automotive industry

This application example presents a solution for precise temperature control of adhesive dispensing systems in the automotive industry. The application described enables the reliable control of up to 50 adhesive dispensing systems within a production line, as typically used in windshield assembly or other adhesive dispensing applications in modern automotive manufacturing.

The system ensures precise temperature control of the hot adhesive over the entire transport distance of up to 40 meters, starting at the drum pump at 30 °C and ending at the robot head at 85 °C. Depending on the system design, the adhesive can be transported electrically, pneumatically, or hydraulically. The heater is controlled via solid-state switching devices. The individual heating zones, from the drum pump to the robot head, are monitored using the function module load monitoring basic. The required setpoint current for the respective heating zone is programmed using the TEACH/TEST button.

In addition, the function module reports partial load failure errors, power failure errors, and thyristor faults to the controller via the "OUT" contact as required.

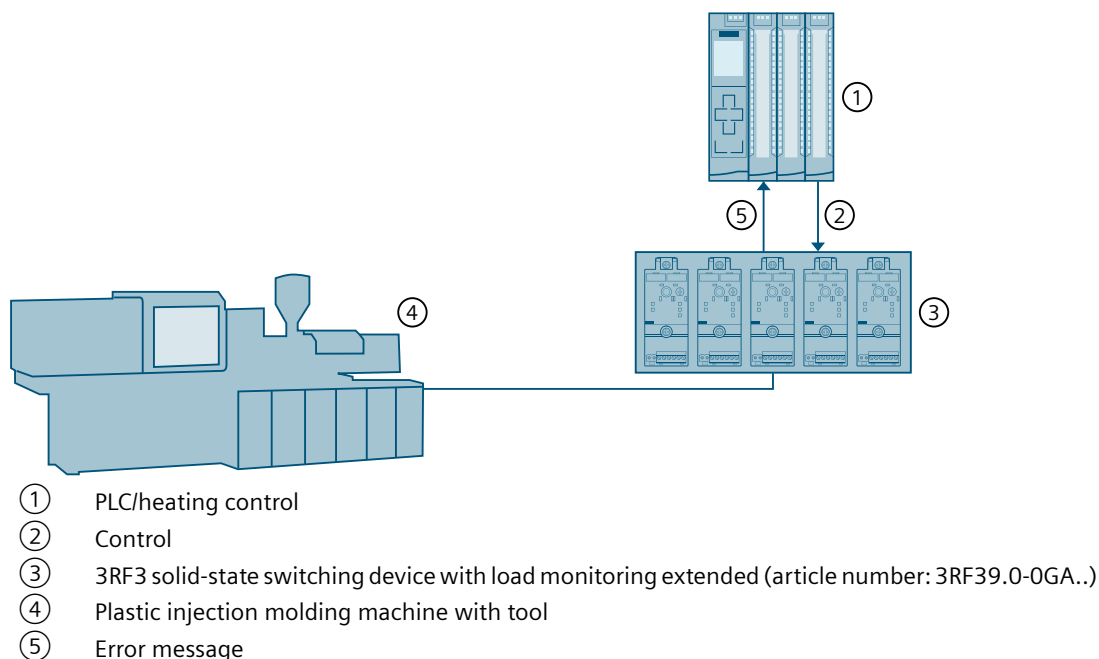


- ① PLC/heating control
- ② Control
- ③ 3RF3 solid-state switching device with load monitoring basic (article number: 3RF39...-OF.08)
- ④ Adhesive
- ⑤ Transport line of the adhesive to the robot head
- ⑥ Adhesive dispensing robot
- ⑦ Error message

12.1.3 Application example with load monitoring extended

Injection molding machine with tools in hot runner technology

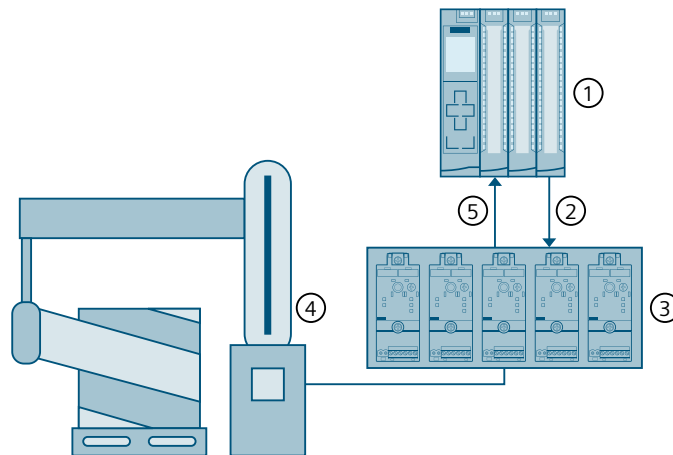
This application example presents a solution for precise temperature control of hot runner systems in injection molds. The application described enables the efficient production of high-quality plastic parts without disruptive sprue residues. The hot runner technology ensures that the liquid plastic is transported in a way that is particularly gentle on the material. The material is fed from the machine's injection cylinder through a temperature-controlled tube system directly into the mold. This produces plastic parts in which only a small point of the gate mark remains visible. The finished parts can be used directly without further post-processing and without loss of material. The heating zones are controlled by solid-state switching devices. The individual zones are monitored by the function module load monitoring extended. The module can control up to 12 zones per switching device. The required setpoint current for the application is taught using the TEACH/TEST button on the function module. In addition, the function module reports partial load failure errors, power failure errors, and thyristor faults to the controller as required. The function module also automatically compensates for voltage fluctuations, thereby avoiding unnecessary error messages.



12.1.4 Application example with heating current monitoring

Roll-fed thermoforming packaging machine

This application example presents a flexible solution for temperature control in roll-fed thermoforming packaging machines. This packaging technology is widely used in the food industry, medical technology, and for packaging industrial products. The packaging process is fully automatic: A plastic film is unwound from the roll and drawn into a heated tool under vacuum. There, the film is thermoformed into the desired packaging shape. After the product is placed in the molded packaging, it is sealed with a cover film, either under vacuum or in a protective gas atmosphere. The heating zones are controlled by solid-state switching devices. The individual zones are monitored by the function module heating current monitoring. The module can control up to 6 zones per switching device. After each changeover, the target current is programmed via the TEACH function using the controller. In addition, the function module reports partial load failure errors, power failure errors, and thyristor faults to the controller as required. The function module also automatically compensates for voltage fluctuations, thereby avoiding unnecessary error messages.

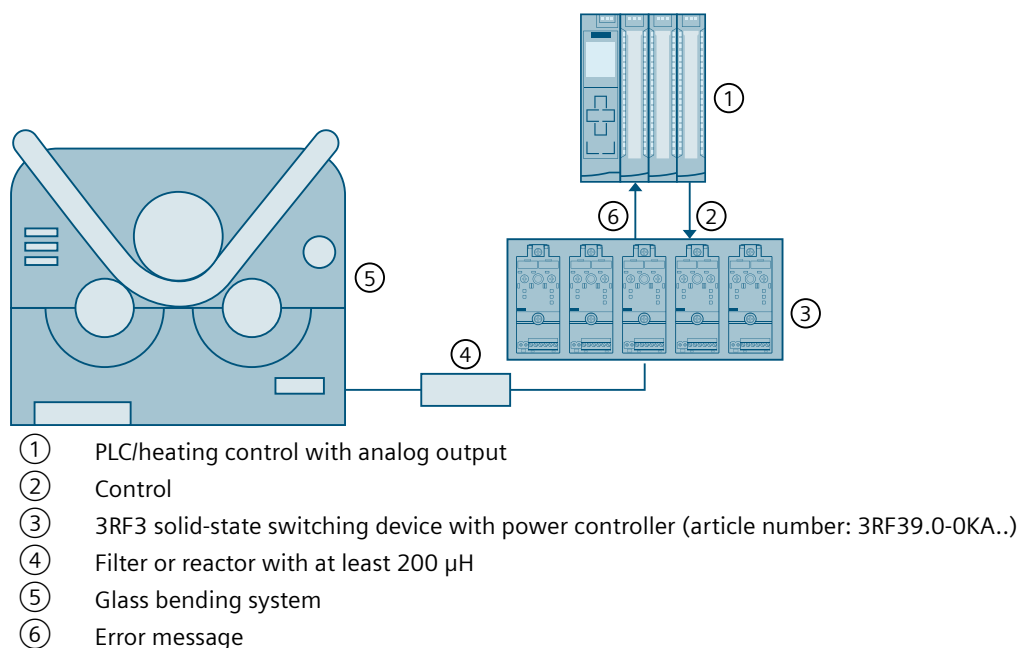


- ① PLC
- ② Control and Remote Teach
- ③ 3RF3 solid-state switching device with heating current monitoring (article number: 3RF39...-0JA1.)
- ④ Roll-fed thermoforming packaging machine
- ⑤ Error message

12.1.5 Application example with power controller

Glass bending system

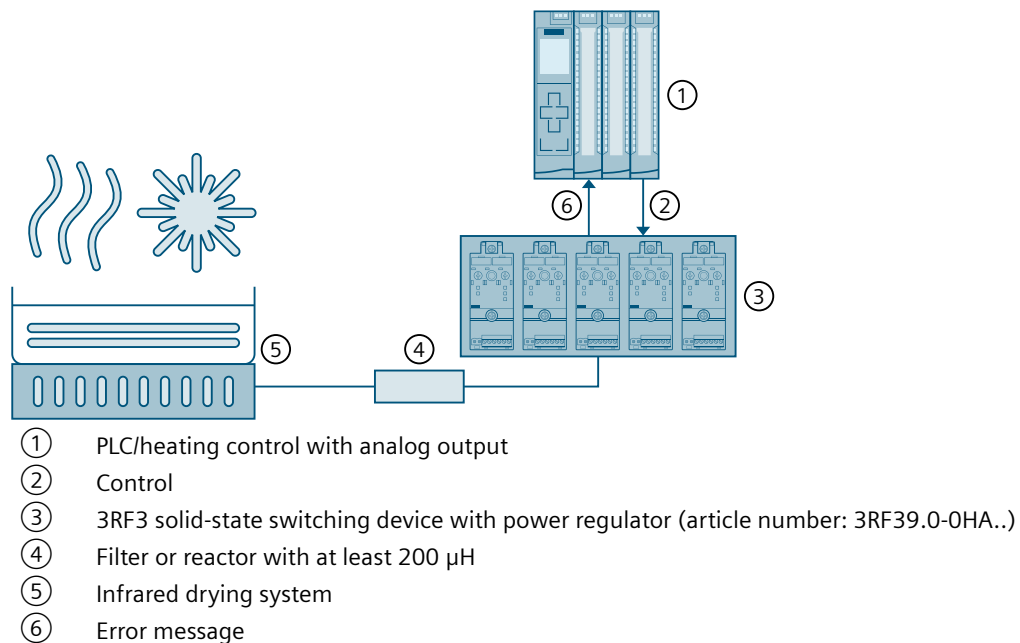
This application example presents a solution for temperature control in glass bending systems, where precise adherence to defined temperature profiles is crucial for the quality of the subsequent hydraulic forming process of the glass panes. The heaters are controlled by solid-state switching devices and the function module power controller. Several heaters are connected for each solid-state switching device. To ensure that the temperature profile is maintained precisely, the power controller detects the failure of a partial load. The required target power is programmed using the TEACH/TEST button. Precise temperature control is achieved by the generalized phase control of the function module power controller. This sensitive control ensures that the required temperature profile is maintained throughout the entire bending process. In addition to partial load failure, the power controller also reports load failure errors, power failure errors, and thyristor faults to the controller as required.



12.1.6 Application example with power regulator

Infrared drying system in the printing industry

This application example presents a solution for the precise control of infrared drying systems. The application enables freshly printed paper webs to be dried particularly quickly and gently, as required in modern printing processes. The infrared emitters are controlled with the solid-state switching devices and the function module power regulator, which in combination are well suited for the characteristic switch-on behavior of the infrared emitters. When cold, the infrared emitters have a very low resistance, which results in high inrush currents. The function module power regulator protects the infrared emitters from inrush current peaks through the integrated, variably adjustable switch-on ramp of 1 to 10 seconds. The required target power is programmed using the TEACH/TEST button. During operation, the heating power is precisely modulated via an analog 0-10 V DC control signal using generalized phase control, with the programmed TEACH value serving as a reference. The power regulator also detects voltage fluctuations and resistance changes and compensates for them. This functionality ensures constant heating power and therefore consistent drying results, regardless of mains fluctuations or ageing effects of the emitters. In addition, the function module reports load failure errors, power failure errors, and thyristor faults to the controller as required



12.2 Controlling three-phase current loads with the 3RF3 devices

To select the appropriate solid-state switching device, determine the required rated current and the required rated voltage of the load to ensure that the solid-state switching device meets the requirements.

With the Solid-state switching devices 3RF configurator (<https://mall.industry.siemens.com/spice/cloudcm/configurator>) you can find the right version.

12.2.1 Switching resistive loads with 3-pole 3RF3 devices

The switching of resistive loads in the three-phase network can be handled by 2-pole or 3-pole controlled devices.

The following principles apply to configuring:

- 2-pole controlled switching devices can be used if the load is connected in a delta or star connection without an N conductor.
- 3-pole controlled switching devices must be used if the load is connected in a star connection with connected N conductors or in a delta connection. They can be used with the other switching types as required.
- The switching devices must be designed for the conductor voltage and conductor current.

12.2.1.1 Application example star connection with 3-pole 3RF3 devices – 2-pole controlled

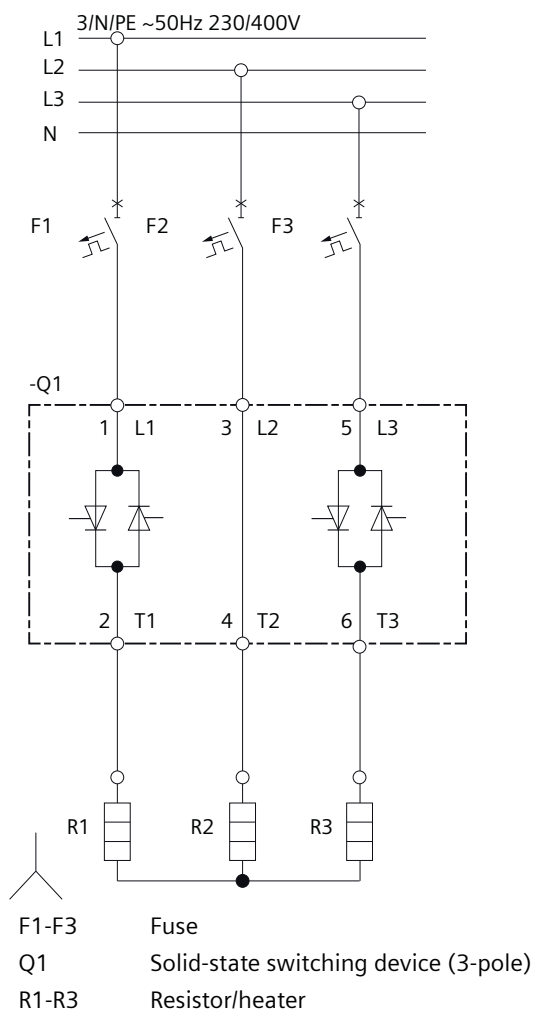
The following example situation exists:

Three 1-pole heaters, each with an output of 2 kW, are operated in a star connection in a 400 V three-phase network.

The conductor current has the value $I = P / U = 2,000 \text{ W} / 230 \text{ V} = 8.7 \text{ A}$.

The switching device must be designed for a rated voltage of 400 V and a conductor current of 8.7 A.

12.2 Controlling three-phase current loads with the 3RF3 devices



12.2.1.2 Application example delta connection with 3-pole 3RF3 devices – 2-pole controlled

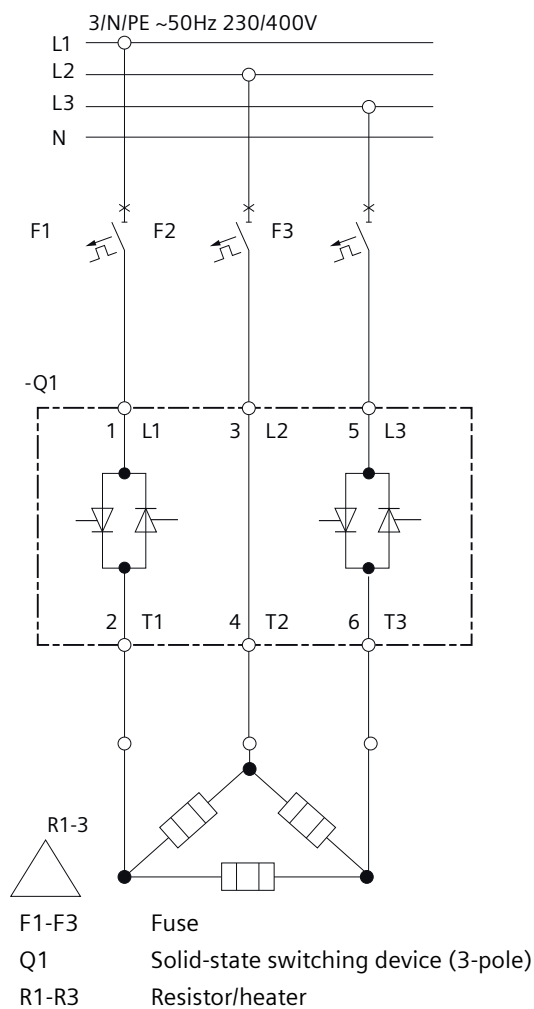
The following example situation exists:

Three 1-pole heaters, each with an output of 3 kW, are operated in a delta connection in a 400 V three-phase network.

The conductor current is $I = P / (U \times \sqrt{3}) = 9,000 \text{ W} / (400 \text{ V} \times 1.73) = 13 \text{ A}$.

The switching device must be designed for a rated voltage of 400 V and a current of 13 A.

12.2 Controlling three-phase current loads with the 3RF3 devices



12.2.1.3 Application example star connection with 3-pole 3RF3 devices – 3-pole controlled

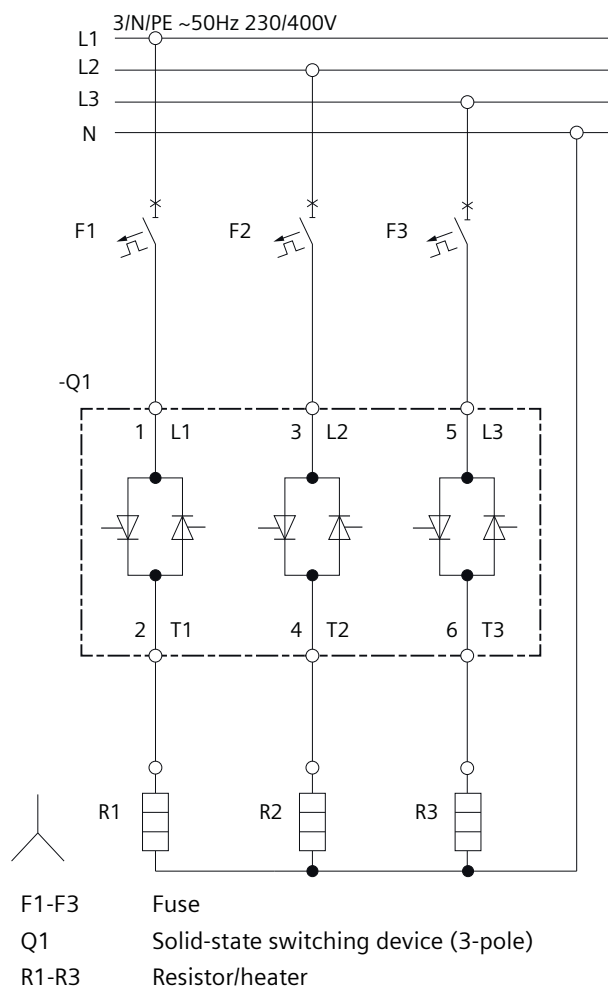
The following example situation exists:

Three 1-pole heaters, each with an output of 2.3 kW, are operated in a star connection with a connected N conductor in a 400 V three-phase network.

The conductor current has the value $I = P / U = 2,300 \text{ W} / 230 \text{ V} = 10 \text{ A}$.

The switching device must be designed for a rated voltage of 230 V and a current of 10 A.

12.2 Controlling three-phase current loads with the 3RF3 devices



12.2.1.4 Application example inside-delta circuit (delta connection) with 3-pole 3RF3 devices – 3-pole controlled

The following example situation exists:

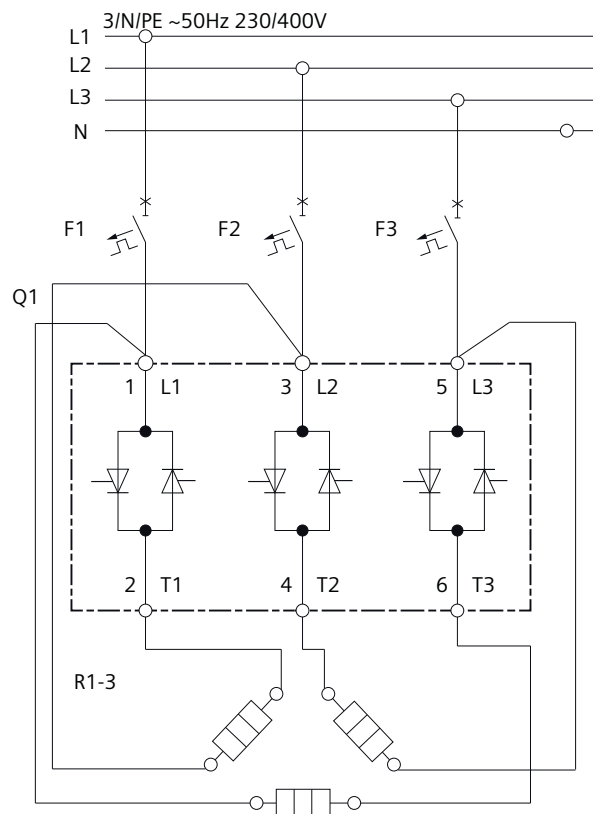
Three 1-pole heaters for 400 V with 3 kW power each are operated in series with the switching devices in a delta connection.

The conductor current is $I = P / (U \times \sqrt{3}) = 9,000 \text{ W} / (400 \text{ V} \times 1.73) = 13 \text{ A}$.

The phase current is $= P_{\text{single}} / U = 3,000 \text{ W} / 400 \text{ V} = 7.5 \text{ A}$.

The switching device must be designed for a rated voltage of 400 V and a phase current of 7.5 A.

12.2 Controlling three-phase current loads with the 3RF3 devices

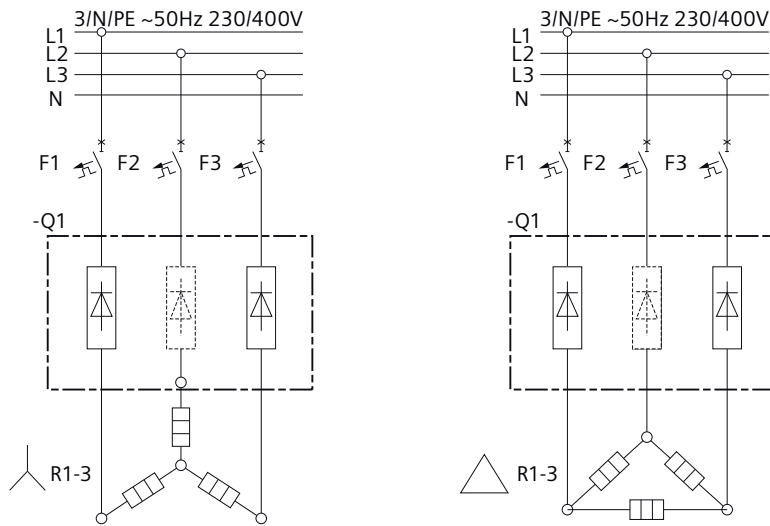


- | | |
|-------|---------------------------------------|
| F1-F3 | Fuse |
| Q1 | Solid-state switching device (3-pole) |
| R1-R3 | Resistor/heater |

With delta connection, the switching devices only have to be designed for the phase current, which means that the switching devices can be used more effectively.

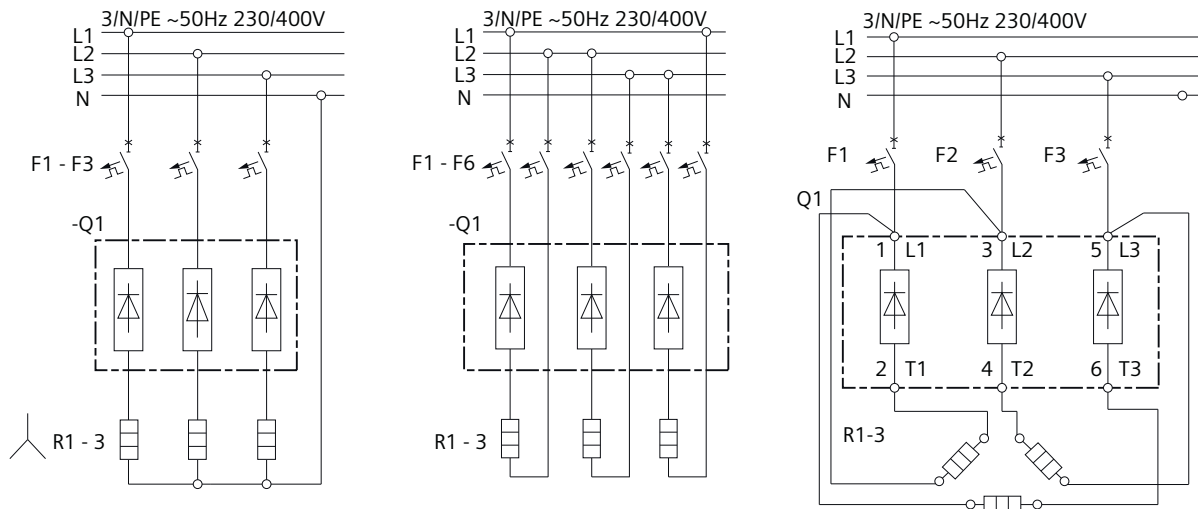
12.2.1.5 Overview of possible applications for the 3-pole 3RF3 devices

2-pole or 3-pole controlled solid-state switching devices



- F1-F3 Fuse
- Q1 Solid-state switching device (3-pole)
- R1-R3 Resistor/heater

3-pole controlled solid-state switching devices



- F1-F3 Fuse
- Q1 Solid-state switching device (3-pole)
- R1-R3 Resistor/heater

12.2.2 Switching resistive loads with 1-pole 3RF3 devices

Two or three 1-pole devices can be used to switch resistive loads in the three-phase network. The zero-point switching variants ($\cos \phi = 1$) are designed for operation with resistive loads.

The following principles apply to configuring:

- Two switching devices can be used if the load is connected in a delta or star connection without an N conductor. The inside-delta circuit is an exception.
- As not all phases need to be disconnected from the load during normal switching operation, one switching device can be omitted.
- The switching devices must be designed for the conductor voltage and conductor current.

12.2.2.1 Application example star connection with 1-pole 3RF3 devices – 2-pole controlled

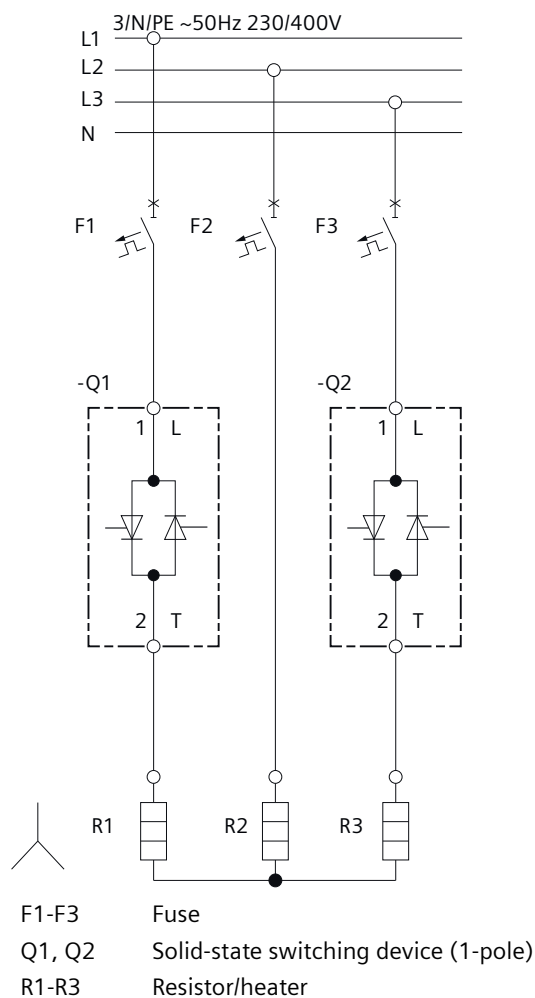
The following example situation exists:

Three 1-pole heaters, each with an output of 4 kW, are operated in a star connection in a 400 V three-phase network.

The conductor current has the value $I = P / U = 4,000 \text{ W} / 230 \text{ V} = 17.4 \text{ A}$.

The switching devices must be designed for a rated voltage of 400 V and a conductor current of 17.4 A.

12.2 Controlling three-phase current loads with the 3RF3 devices



12.2.2.2 Application example delta connection with 1-pole 3RF3 devices – 2-pole controlled

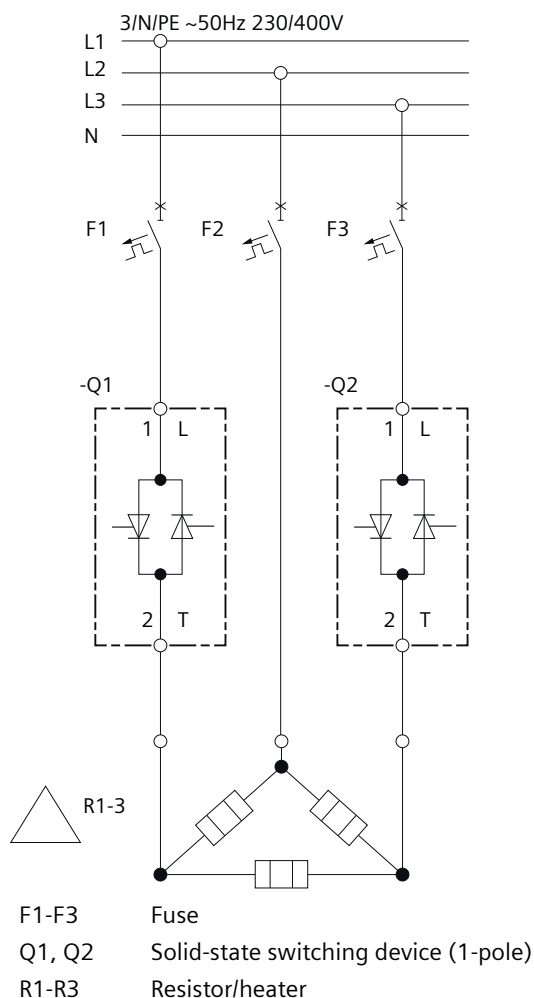
The following example situation exists:

Three 1-pole heaters, each with an output of 3 kW, are operated in a delta connection in a 400 V three-phase network.

The conductor current is $I = P / (U \times \sqrt{3}) = 9,000 \text{ W} / (400 \text{ V} \times 1.73) = 13 \text{ A}$.

The switching devices must be designed for a rated voltage of 400 V and a current of 13 A.

12.2 Controlling three-phase current loads with the 3RF3 devices



12.2.2.3 Application example star connection with 1-pole 3RF3 devices – 3-pole controlled

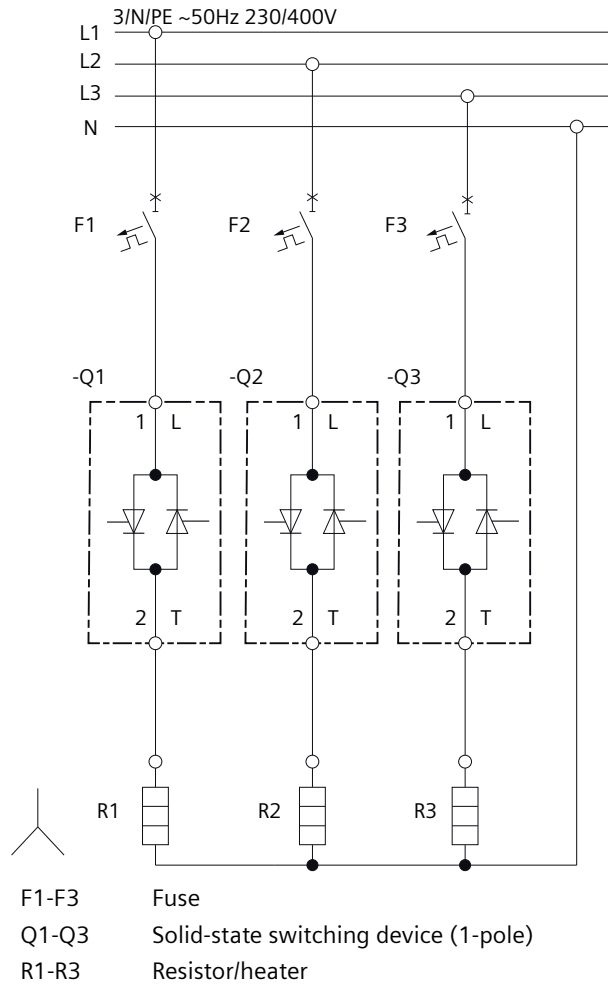
The following example situation exists:

Three 1-pole heaters, each with an output of 2.3 kW, are operated in a star connection with a connected N conductor in a 400 V three-phase network.

The conductor current has the value $I = P / U = 2,300 \text{ W} / 230 \text{ V} = 10 \text{ A}$.

The switching devices must be designed for a rated voltage of 230 V and a conductor current of 10 A.

12.2 Controlling three-phase current loads with the 3RF3 devices



12.2.3 Use of function modules in the three-phase network

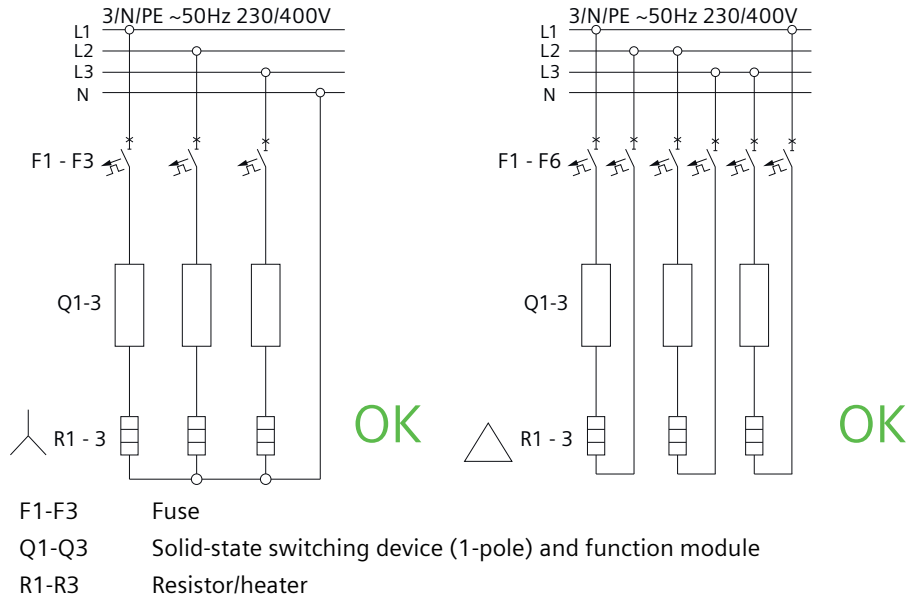
12.2.3.1 Use of the function modules load monitoring basic and extended in the three-phase network

The function modules load monitoring basic and extended can be used without restriction on 1-pole 3RF3 devices in the following applications.

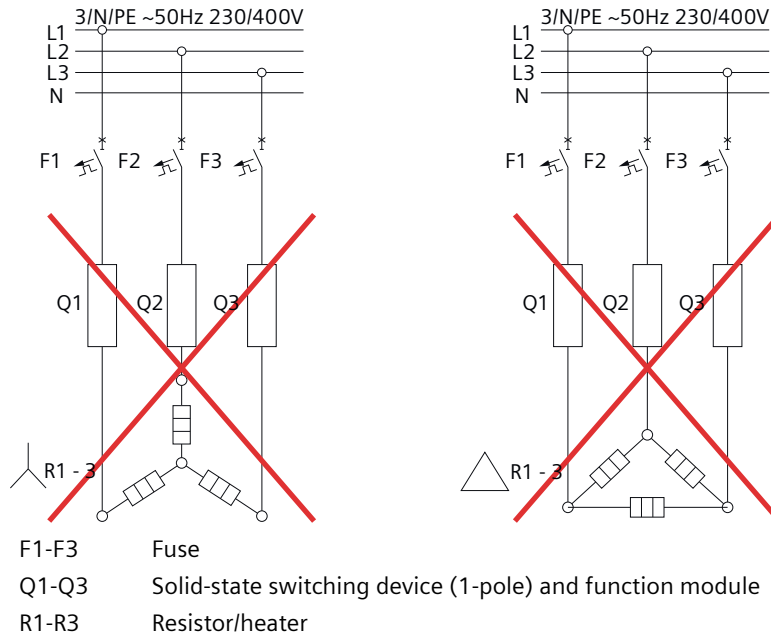
- 2-pole controlled in star or delta connection with resistive loads without connected N conductor.
- 3-pole controlled in star connection for resistive loads with connected N conductor.
- When operating motors in the three-phase network.

12.2.3.2 Use of the function modules converter, power controller and power regulator on 1-pole 3RF3 devices

Only use the function modules converter, power controller and power regulator on 1-pole 3RF3 solid-state switching devices in circuits in which the loads are independent of each other.

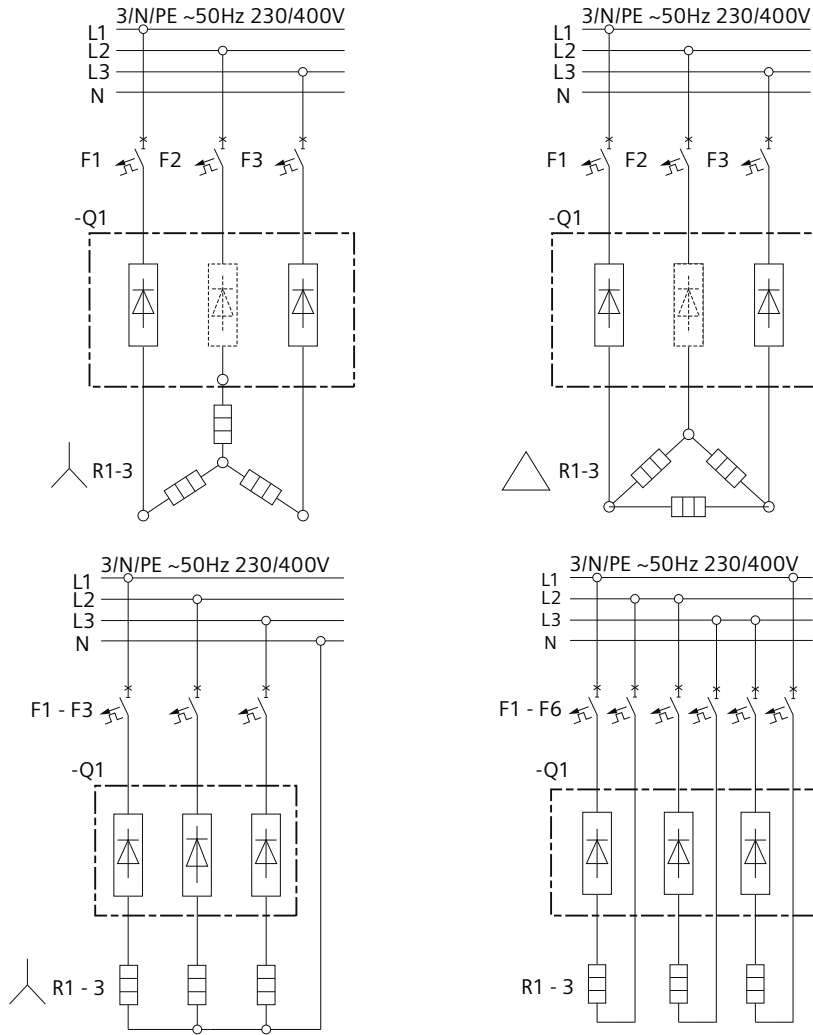


In the following examples, the converter, function modules power controller and power regulator are not working correctly because they do not switch on synchronously.



12.2.3.3 Use of the function module converter on 3-pole 3RF3 devices

The following graphic provides an insight into the possible applications of the function module converter when operating with 3-pole solid-state switching devices for three-phase circuits or 1-pole loads.



- F1- Fuse
- F6
- Q1 Solid-state switching device (3-pole) and function module converter
- R1- Resistor/heater
- R3

Technical specifications

13.1 Technical specifications in the Siemens SiePortal

Technical data sheet

You can find the technical specifications for the product in Siemens SiePortal (<https://sieportal.siemens.com/su/bldxc>).

1. Enter the article number of the desired device in the "Products" field.
2. Click the "Technical specifications" link in the result.

Dimensional drawings

14.1 CAx data in the Siemens SiePortal

You can find CAx data for the product in the SiePortal (<https://sieportal.siemens.com/su/bldxc>).

1. Enter the article number of the desired device in the "Products" field.
2. Click the "CAx data" link in the result.

Circuit diagrams

15.1 CAx data in the Siemens SiePortal

You can find CAx data for the product in the SiePortal (<https://sieportal.siemens.com/su/bldxc>).

1. Enter the article number of the desired device in the "Products" field.
2. Click the "CAx data" link in the result.

