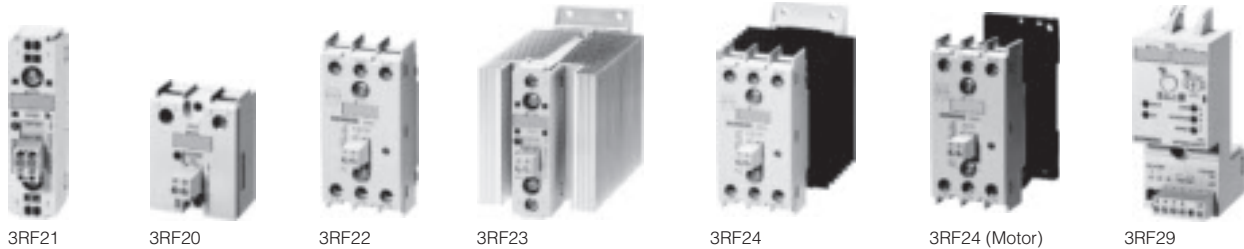


Overview



SIRIUS 3RF2 solid-state switching devices

Solid-state switching devices for resistive loads

- Solid-state relays
- Solid-state contactors
- Function modules

Solid-state switching devices for switching motors

- Solid-state contactors
- Solid state reversing contactors

The most reliable solution for any application

Compared to electro mechanical contactors, our SIRIUS 3RF2 solid-state switching devices stand out due to their considerably longer service life. Thanks to the high product quality, their switching is extremely precise, reliable and, above all, insusceptible to faults. With its variable connection methods and a wide spread of control voltages, the SIRIUS 3RF2 family is universally applicable. Depending on the individual requirements of the application, our modular switchgear can also be quite easily expanded by the addition of standardized function modules.

Semiconductor relays

SIRIUS SC semiconductor relays are suitable for surface mounting on existing cooling surfaces. Installation is quick and easy, involving just two screws. Depending on the nature of the heat sink, the capacity reaches up to 88 A on resistive loads. The 3RF21 semiconductor relays can be expanded with various function modules to adapt them to individual applications.

The semiconductor relays are available in 2 different widths:

- 3RF21 semiconductor relay with a width of 22.5 mm
- 3RF20 and 3RF22 semiconductor relay with a width of 45 mm

Both variants are only available in the "zero-point switching" version. This standard version is ideally suited for operation with resistive loads.

Selecting semiconductor relays

When selecting semiconductor relays, in addition to information about the power system, the load and the ambient conditions it is also necessary to know details of the planned design. The semiconductor relays can only conform to their specific technical specifications if they are mounted with appropriate care on an adequately dimensioned heat sink. The following procedure is recommended:

- Determine the rated current of the load and the mains voltage
- Select the relay design and choose a semiconductor relay with higher rated current than the load requires
- Determine the thermal resistance of the proposed heat sink
- Check the correct relay size with the aid of the diagram

Solid-state contactors for switching motors

The solid-state contactors for switching motors are intended for frequently switching on and off three-phase current operating mechanisms up to 5 HP and reversing up to 3 HP. The

devices are constructed with complete insulation and can be mounted directly to 3RV1 MSPs and SIRIUS overload relays, resulting in a very simple integration into motor feeders.

These three-phase solid-state contactors are equipped with a two-phase control which is particularly suitable for typical motor current circuits without connecting to the neutral conductor.

Important features:

- Insulated enclosure with integrated heat sink
- Degree of protection IP20
- Integrated mounting foot to snap on a standard mounting rail or for assembly onto a support plate
- Variety of connection methods
- Plug-in control connection
- Display via LEDs

Selecting solid-state contactors

The solid-state contactors are selected on the basis of details of the network, the load and the ambient conditions. As the solid-state contactors are already equipped with an optimally matched heat sink, the selection process is considerably simpler than that for solid-state relays.

The following procedure is recommended:

- Determine the rated current of the load and the mains voltage
- Select a solid-state contactor with the same or higher rated current than the load
- Testing the maximum permissible switching frequency based on the characteristic curves. To do this, the starting current, the starting time and the motor load in the operating phase must be known.
- If the permissible switching frequency is below the desired frequency, it is possible to achieve an increase by overdimensioning the motor.

Benefits

- Devices with integrated heat sink, "ready to use"
- Compact and space-saving design
- Reversing contactors with integrated interlocking

Application

Standards and approvals

- IEC 60947-4-3
- UL 508, CSA for North America¹⁾
- CE marking for Europe
- C-Tick approval for Australia

¹⁾ Please note: For reversing motor applications use overvoltage protection device Type 3TX7462-3L; max. cut-off-voltage 6000 V; min. energy handling capability 100 J.

Solid-State Switching Devices

General data

Type	Solid-state relays			Solid-state contactors		Function modules					
	1-phase 22.5 mm	45 mm	3-phase 45 mm	1-phase	3-phase	Converter	Load monitoring Basic	Extended	Heating current monitoring	Power control regulator	Circuit- breaker
Usage											
Simple use of existing solid-state relays	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	--	--	--	--	--	--
Complete device "Ready to use"	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	--	--	--	--	--	--
Space-saving	<input checked="" type="checkbox"/>	--	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	--	--	--	--
Can be extended with modular function modules	<input checked="" type="checkbox"/>	--	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	--	--	--	--	--	--
Frequent switching and monitoring of loads and solid-state relays/solid-state contactors	--	--	--	--	--	--	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Monitoring of up to 6 partial loads	--	--	--	--	--	--	<input checked="" type="checkbox"/>	--	<input checked="" type="checkbox"/>	--	--
Monitoring of more than 6 partial loads	--	--	--	--	--	--	--	<input checked="" type="checkbox"/>	--	--	--
Control of the heating power through an analog input	--	--	--	--	--	<input checked="" type="checkbox"/>	--	--	--	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Power control	--	--	--	--	--	--	--	--	--	--	<input checked="" type="checkbox"/>
Startup											
Easy setting of setpoints with "Teach" button	--	--	--	--	--	--	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	--	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
"Remote Teach" input for setting setpoints	--	--	--	--	--	--	--	--	<input checked="" type="checkbox"/>	--	--
Mounting											
Mounting onto mounting rails or mounting plates	--	--	--	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	--	--	--	--	--	--
Can be snapped directly onto a solid-state relay or contactor	--	--	--	--	--	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
For use with "Coolplate" heat sink	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	--	--	--	--	--	--	--	--
Cable routing											
Connection of load circuit as for controls	<input checked="" type="checkbox"/>	--	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	--	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Connection of load circuit from above	--	<input checked="" type="checkbox"/>	--	--	--	--	--	--	--	--	--

Function is available

Function is possible

Note: Permissible for use at altitudes of more than 2500 m above sea level with the following derating for 3RF2 Devices:

Site altitude 2500 m above sea level:

- Reduction of rated insulation voltage to $0,93 \times U_i$
- Reduction of load current to $0,93 \times I_e$

Site altitude 3000 m above sea level:

- Reduction of rated insulation voltage to $0,88 \times U_i$
- Reduction of load current to $0,9 \times I_e$

Site altitude 4000 m above sea level:

- Reduction of rated insulation voltage to $0,79 \times U_i$
- Reduction of load current to $0,8 \times I_e$

Site altitude 5000 m above sea level:

- Reduction of rated insulation voltage to $0,75 \times U_i$
- Reduction of load current to $0,7 \times I_e$

These ratings apply to a maximum ambient temperature of 40 °C (140 °F).

Benefits

- Considerable space savings thanks to a width of only 22.5 mm
- Variety of connection techniques: screw connection, spring-type connection or ring terminal end, makes for easy terminations
- Flexible for a wide range of applications with function modules for retrofitting
- Possibility of fuseless short-circuit resistant design

Advantages:

- Saves time and costs with easy wiring, simple installation and fast commissioning
- Extremely long life, low maintenance, rugged and reliable
- Space-saving and safe thanks to side-by-side mounting up to an ambient temperature of +60 °C
- Modular design: standardized function modules and heat sinks can be used in conjunction with 22.5 mm style semiconductor relays to satisfy unique application requirements
- Vibration-resistant and shock-resistant spring-loaded terminal connection system provides a superior connection even under tough conditions

Area of application

Applications

Solid-state relays

SIRIUS solid-state relays are suitable for surface mounting on existing cooling surfaces. Installation is quick and easy, involving just two screws. The special technology of the power semiconductor ensures there is excellent thermal contact with the heat sink. Depending on the nature of the heat sink, the capacity reaches up to 88 A on resistive loads.

The solid-state relays are available in three different versions:

- 3RF21 single-phase solid-state relay with a width of 22.5 mm
- 3RF20 single-phase solid-state relay with a width of 45 mm
- 3RF22 three-phase solid-state relay with a width of 45 mm

The 3RF21 and 3RF22 solid-state relays can be expanded with various function modules to adapt them to individual applications.

Solid-state contactors

The complete units consist of a solid-state relay plus optimized heat sink, and are therefore ready to use. They offer defined rated currents to make selection as easy as possible. Depending on the version, current intensities of up to 88 A are achieved. Like all of our solid-state switching devices, one of their particular advantages is their compact and space-saving design.

With their insulated mounting foot they can easily be snapped onto a standard mounting rail, or they can be mounted on carrier plates with fixing screws. This insulation enables them to be used in circuits with protective extra-low voltage (PELV) or safety extra-low voltage (SELV) in building engineering. For other applications, such as for extended personal safety, the heat sink can be grounded through a screw terminal.

The solid-state contactors are available in two different versions:

- 3RF23 single-phase solid-state contactors
- 3RF24 three-phase solid-state contactors

3RF22 three-phase solid-state relay with a width of 45 mm

With its compact design, which stays the same even at currents of up to 55 A, the 3RF22 solid-state relay is the ultimate in space-saving construction, at a width of 45 mm. Installation on cooling surfaces is quick and easy, involving just two screws. The logical connection arrangement, with the power infeed from above and connection of the load from below, ensures tidy installation in the control cabinet.

3RF24 three-phase solid-state contactors

The compact design enables small compact units with currents up to 50 A. All special features of the solid-state relays for saving time and space are effective here too.

Example plastic machine industry:

Thanks to their high switching endurance, SIRIUS SC semiconductor switching devices are ideally suited for use in the control of electroheat. This is because the more precise the temperature regulation process has to be, the higher the switching frequency needs to be. The accurate regulation of electroheat is used for example in many processes in the plastic machine industry:

- Band heaters heat the extrudate to the correct temperature in plastic extruders
- Heat emitters heat plastic blanks to the correct temperature
- Heat drums dry plastic granules
- Heating channels keep molds at the correct temperature in order to manufacture different plastic parts without defects.

The powerful SIRIUS SC semiconductor relays and contactors can be used to control several heating loads at the same time. By using a load monitoring module the individual partial loads can easily be monitored, and in the event of a failure a signal is generated which can be sent to the controller.

Protecting the semiconductor relays and semiconductor contactors with 5 SY supplemental protectors.

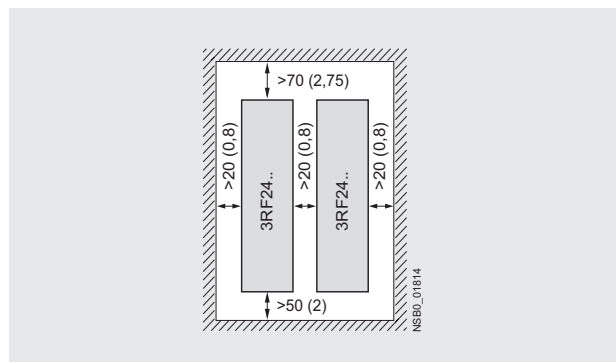
Short-circuit protection and line protection with 5 SY supplemental protectors is easy to achieve with SIRIUS SC semiconductor relays and semiconductor contactors in comparison with designing load feeders with fuses. A special version of the semiconductor contactors can be protected against damage in the case of a short-circuit with 5 SY supplementary protector with type B tripping characteristic. This allows the low-cost and simple design of fuseless load feeders with full protection of the switching device.

Design

There is no typical design of a load feeder with semiconductor relays or semiconductor contactors; instead, the great variety of connection systems and control voltages offers universal application opportunities. SIRIUS SC semiconductor relays and semiconductor contactors can be installed in fuseless or fused feeders, as required.

There are special versions with which it is even possible to achieve short-circuit strength in a fuseless design.

Mounting regulations



Distances for stand-alone installation

General data

Functions

Connection

All SIRIUS SC semiconductor switching devices are characterized by the great variety of connection methods. You can choose between the following connection techniques:

SIGUT connection system (screw)

The SIGUT connection system is the standard among industrial switching devices. Open terminals and a plus-minus screw are just two features of this technology. Two conductors of up to 6 mm^2 ¹⁾ can be connected in just one terminal. As a result, loads of up to 50 A can be connected.

Spring-loaded connection system

This innovative technology holds the conductor without screw connection. This means that very high vibration resistance is achieved. Two conductors of up to 2.5 mm^2 ¹⁾ can be connected to each terminal. As a result, loads of up to 20 A can be dealt with.

Ring terminal end connection

The ring terminal end connection is equipped with an M5 screw. Ring terminal ends of up to 25 mm^2 can be connected. In this way it is possible to connect conductors with up to 88 A safely. Additional finger safety can be provided with a special cover.

Switching types

In order to guarantee an optimized control method for different loads, the functionality of our semiconductor switching devices can be adapted accordingly.

The "**zero-point switching**" method is ideal for resistive loads, i.e. where the power semiconductor is activated at zero voltage.

For inductive loads, on the other hand, for example in the case of valves, it is better to go with "**instantaneous switching**". By distributing the ON point over the entire sine curve of the mains voltage, disturbances are reduced to a minimum.

Function

Two-phase controlled version

In many three-phase applications there is no need of a three-phase controller. Loads in a delta circuit or wye circuit, which have no connection to the neutral conductor, can be safely switched on and off using only two phases.

Nevertheless, the 3RF22 and 3RF24 three-phase solid-state switching devices provide the possibility of connecting all three phases to the switching device, with the middle phase looped directly through the device. Thanks to the lower power loss compared to a three-phase controlled device it is possible for the mounted accessories to be more compact.

Three-phase controlled version

This version is used in three-phase applications which have to switch all phases on and off for system reasons or in the case of loads in a wye circuit with connection to the neutral conductor.

Performance characteristics

The performance of the semiconductor switching devices are substantially determined by the type of power semiconductors used and the internal design. In the case of the SIRIUS SC semiconductor contactors and semiconductor relays, only thyristors are used instead of less powerful Triacs.

Two of the most important features of thyristors are the blocking voltage and the maximum load integral:

Blocking voltage

Thyristors with a high blocking voltage can also be operated without difficulty in power systems with high interference voltages. Separate protective measures, such as a protective circuit with a varistor, are not necessary in most cases.

With SIRIUS SC, for example, thyristors with 800 V blocking voltage are fitted for operation in power systems up to 230 V. Thyristors with up to 1600 V are used for power systems with higher voltages.

Maximum load integral

One of the purposes of specifying the maximum load integral (I^2t) is to determine the rating of the short-circuit protection. Only a large power semiconductor with a correspondingly high I^2t value can be given appropriate protection against destruction from a short-circuit by means of a protective device matched to the application. However, SIRIUS SC is also characterized by the optimum matching of the thyristors (I^2t value) with the rated currents. The rated currents specified on the devices in conformance with EN 60947-4-3 were confirmed by extensive testing.

1) For mm^2 to AWG conversion see page 19/21 of Industrial Controls catalog.

Integration

Notes on integration in the load feeders

The SIRIUS solid-state switching devices are very easy to integrate into the load feeders thanks to their industrial connection technology and design.

Particular attention must however be paid to the circumstances of the installation and ambient conditions, as the performance of the solid-state switching devices is largely dependent on these. Depending on the version, certain restrictions must be observed. Detailed information, for example in relation to solid-state contactors about the minimum spacing and to solid-state relays about the choice of heat sink, is given in the product data sheets and the technical specifications.

Despite the rugged power semiconductors that are used, solid-state switching devices respond more sensitively to short-circuits in the load feeder. Consequently, special precautions have to be taken against destruction, depending on the type of design.

Siemens generally recommends using SITOP solid-state protection fuses. These fuses also provide protection against destruction in the event of a short-circuit even when the solid-state contactors and solid-state relays are fully utilized.

Alternatively, if there is lower loading, protection can also be provided by standard fuses or miniature circuit-breakers. This protection is achieved by overdimensioning the solid-state switching devices accordingly. The technical specifications in the product data sheets contain details about solid-state fuse protection itself and about the use of the SIRIUS devices with conventional protection equipment.

The SIRIUS solid-state switching devices are suitable for interference-free operation in industrial power systems without further measures. If they are used in public power systems, it may be necessary for conducted interference to be reduced by means of filters. This does not include the special solid-state contactors of type 3RF23...CA.. "Low Noise". These comply with the class B limit values up to a rated current of 16 A. If other versions are used, and at currents of over 16 A, standard filters can be used in order to comply with the limit values. The decisive factors when it comes to selecting the filters are essentially the current loading and the other parameters (operational voltage, design type, etc.) in the load feeder.

Suitable filters can be ordered from EPCOS AG.

You can find more information on the Internet at:

<http://www.epcos.com>

SIRIUS SC Solid-State Switching Devices

Solid-State Relays

SIRIUS SC solid-state contactors general data / technical data

Overview

The complete self-contained units consist of a semiconductor relay plus optimized heat sink, and are ready to use. They offer defined rated currents to make selection as easy as possible. Depending on the version, current ranges of up to 88 A are achieved. Like all of our semiconductor switching devices, one of their particular advantages is their compact and space-saving design. With their insulated mounting foot they can easily be snapped onto a standard mounting rail, or they can be mounted on carrier plates with fixing screws. This insulation enables them to be used in circuits with protective extra-low voltage (PELV) or safety extra-low voltage (SELV) in building engineering. For other applications, such as for extended personal safety, the heat sink can be grounded through a screw connection.

Version for resistive loads, "zero-point switching"

This standard version is often used for switching resistive heaters on and off.

Version for inductive loads, "instantaneous switching"

In this version the semiconductor contactor is specifically matched to inductive loads. Whether it is a matter of frequent actuation of the valves in a filling plant or starting and stopping small motors in packet distribution systems, operation is carried out safely and noiselessly.

Special "low noise" version

Thanks to a special control circuit, this special design can be used in public networks up to 25 A without any additional measures such as interference suppressor filters. As a result it conforms to limit value curve class B in accordance with EN 60947-4-3 in terms of emitted interference.

Special "short-circuit" version

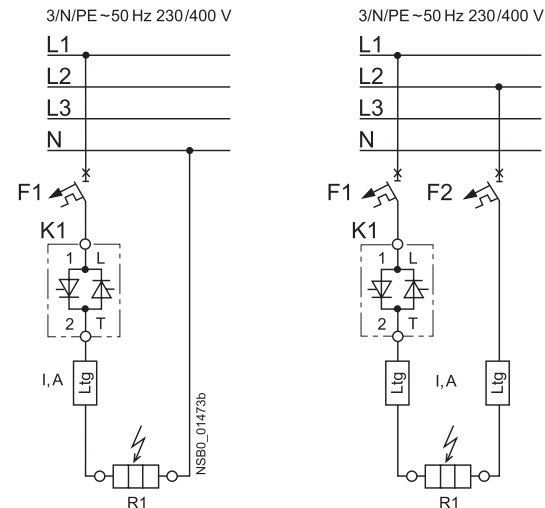
Skilful matching of the power semiconductor with the performance of the semiconductor contactor means that "short-circuit strength" can be achieved with a standard supplementary protector. In combination with a B-type 5 SY or a conventional fuse, the result is a short-circuit resistant feeder.

In order to achieve problem-free short-circuit protection by means of supplementary protector, however, certain boundary conditions must be observed. As the magnitude and duration of the short-circuit current are determined not only by the short-circuit breaking response of the supplementary protector but also the properties of the wiring system, such as the internal

resistance of the input to the network and damping by switching devices and cables, particular attention must also be paid to these parameters. The necessary cable lengths are therefore shown for the main factor, the conductor resistance, in the table below.

The following supplementary protectors with a B characteristic and 10 kA breaking capacity protect the 3RF2320-.DA.. semiconductor contactors in the event of short-circuits on the load and the specified conductor cross-sections and lengths:

Rated current of miniature circuit-breakers	Example of type	Max. conductor cross-section ¹⁾	Min. cable length from contactor to load
6 A	5SY4 106-6	1 mm ²	5 m
10 A	5SY4 110-6	1.5 mm ²	8 m
16 A	5SY4 116-6	1.5 mm ²	12 m
16 A	5SY4 116-6	2.5 mm ²	20 m
20 A	5SY4 120-6	2.5 mm ²	20 m
25 A	5SY4 125-6	5.5 mm ²	26 m



The setup and installation above can also be used for the semiconductor relays with a I^2t value of at least 6600 A²s.

1) See page 19/21 of Industrial Controls catalog for mm² to AWG conversion chart.