SIEMENS

Industrial Controls

SIRIUS Innovations

SIRIUS 3RF34 Solid-state switching devices

Manual

Edition 08/2014

Answers for industry.

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Industrial Controls

Solid-state switching devices SIRIUS Innovations - SIRIUS 3RF34 solid-state switching devices

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 personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

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⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. 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.

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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

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Purpose of the manual

This manual describes the 3RF34 solid-state switching devices and provides the following information:

- Information for integrating the solid-state switching devices into the system environment.
- Information on necessary hardware components.
- Information on installing, connecting and configuring the solid-state switching devices.
- Technical information such as dimension drawings and unit wiring diagrams.

The information in this manual enables you to configure and commission the solid-state switching devices.

Required basic knowledge

To understand these operating instructions you should have a general knowledge of automation engineering and low-voltage switchgear.

Scope of the manual

The manual is valid for these solid-state switching devices. It contains a description of the devices that is valid at the time of publication.

Further documentation

To install and connect the solid-state switching devices, you require the operating instructions of the solid-state switching devices used.

You can find a list of operating instructions and an overview of the manuals pertaining to SIRIUS Innovations in the appendix "References (Page 89)".

Recycling and disposal

These devices can be recycled thanks to their low pollutant content. For environmentally-friendly recycling and disposal of your electronic waste, please contact a company certified for the disposal of electronic waste.

Up-to-the-minute information

You can obtain further assistance by calling the following numbers:

Technical Assistance:

Telephone: +49 (911) 895-5900 (8 a.m. to 5 p.m. CET)

Fax: +49 (911) 895-5907

or on the Internet at:

E-mail: (mailto:technical-assistance@siemens.com)

Internet: (www.siemens.com/industrial-controls/technical-assistance)

Correction sheet

A correction sheet is included at the end of the manual. Please use it to record your suggestions for improvements, additions and corrections, and return the sheet to us. This will help us to improve the next edition of the manual.

Standards

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Correct usage

Note

Radio frequency interference in residential areas

This product is a Class A device. Its use in residential areas can cause radio frequency interference.

In this case, the user can be held liable for taking additional measures to attenuate such interference.

Safety measures

⚠ CAUTION

Inter-phase short circuit due to overvoltage on solid-state reversing contactors

In the event of a short circuit, the switching devices in the load feeder can put persons and property at risk.

For fused configurations, the protective device has to be replaced following a short circuit.

To reduce the risk of an inter-phase short circuit due to overvoltage, we recommend connecting a 3TX7 462-3L type varistor between L1 and L3. We recommend a fused design with semiconductor protection to provide short-circuit protection.

Note

Inter-phase short circuit with solid-state reversing contactors in automatic mode

If the primary voltage is applied at the solid-state reversing contactors at the same time as the control voltage is switched on, the integrated RC surge suppressor may respond in some cases. If it does, dependent on actuation, two thyristors in the reversing circuit may activate, thereby producing an inter-phase short circuit.

To be sure of avoiding this response, once the primary voltage has been applied, a delay of 40 ms should be allowed to elapse before the control inputs are activated.

NOTICE
Electromagnetic interference on the solid-state reversing contactors Star-connected three-phase motors (particularly <1 kW) with electromechanical contactors can cause significant electromagnetic interference. Such interference can cause solid-state reversing contactors being used in the vicinity to malfunction. Provision should be made for appropriate EMC surge suppressors on the sources of interference.

2.1 Standards

Standards and approvals

- IEC 60947-4-2
- UL 508, CSA for North America [1)]
- CE mark for Europe
- C-Tick approval for Australia
- CCC for China

[1)] Please note: Use overvoltage protection device;
max. cut-off-voltage 6000 V;
min. energy handling capability 100J.

Applicable standards

The product meets the requirements of the following standards:

Table 2- 1 Applied standards (product)

Applications	Standard
Device standard	DIN IEC 60947-4-2
Terminal designations/Terminal markings	DIN EN 50011
Degree of protection IP20	DIN IEC 0529
Vibration resistance	DIN IEC 60068-2-6
Shock resistance	DIN IEC 60068-2-27
EMC standard	DIN IEC 60947-4-2; DIN IEC 61000-4-2; DIN IEC 61000-4-6; DIN IEC 61000-4-4; DIN IEC 61000-4-5
Resistance to extreme climates	DIN IEC 60068-2-61 (sequence of tests), DIN IEC 60068-2-30 (damp heat), DIN IEC 60068-2-2 (dry heat), DIN IEC 60068-2-1 (cold), DIN IEC 60068-2-14 (temperature change)

Reference

The standards from Catalog IC 10 "SIRIUS industrial controls" in the appendix always apply. You will find extracts from the most important standards relating to the innovations from the SIRIUS modular system in the appendix entitled "References" under "SIRIUS Innovations manuals (Page 90)" in the "SIRIUS Innovations - system overview" manual.

Product description

3

3.1 Device versions

Solid-state switching devices are primarily used in single-phase applications, which have to meet the following requirements:

- Very high switching frequencies (> 1000 switching operations per hour)
- Resistive loads

The SIRIUS modular system features single- and three-phase solid-state contactors and solid-state relays for the frequent switching of resistive loads. Three-phase solid-state contactors and solid-state reversing contactors are available for switching motorized loads. Standardized function modules for various applications complete the range of SIRIUS solid-state switching devices.

The solid-state contactor and solid-state reversing contactor versions listed in this manual are intended specifically for operation on three-phase motors up to 7.5 kW.

You can find more detailed information in the appendix "More information (Page 92)".

Overview

These 2-phase controlled instantaneous switching solid-state switching devices are operated in two mounting widths in an insulating enclosure:

- In 45 mm width
  - Up to 5.2 A as solid-state contactor (motor contactor) or
  - Up to 5.4 A as solid-state reversing contactor and
- In 90 mm width
  - Up to 16 A as solid-state contactor or
  - Up to 7.4 A as solid-state reversing contactor

This means that it is possible to operate motors up to 7.5 kW.

The solid-state contactors and solid-state reversing contactors for screw-type connection can be connected directly to a motor starter protector with a 3RA2921-1BA00 link module. Direct mounting of a 3RB30/3RB31 solid-state overload relay and, in some cases, a 3RR2 current monitoring relay, is also possible. This provides a time-saving way of implementing rapid-switching motor feeders with and without fuses.

Versions

The following table provides an overview of the versions of the 3RF34 instantaneous switching solid-state contactors for switching motors.

Table 3- 1 Versions of solid-state switching devices

Characteristic	Versions	
Version	Solid-state contactor	Solid-state reversing contactor
Description	Complete devices in insulated enclosures for frequent switching on and switching off of AC drives.	Compact design of the reversing circuit for frequent switching on and switching off of AC drives with continuous reversal of the direction of rotation
Order numbers	3RF34..-.BB..	3RF34..-.BD..
Size	S0	
Width (motor power[1])/max. rated operational current)	• 45 mm (motors up to 2.2 kW, 5.2 A) • 90 mm (motors up to 7.5 kW, 16 A)	• 45 mm (motors up to 2.2 kW, 5.4 A) • 90 mm (motors up to 3.0 kW, 7.4 A)
Number of poles	3	3
Connection system	Screw-type and spring-loaded terminals	Screw-type
Rated operating voltage	Up to 600 V	Up to 480 V
Rated control supply voltage	24 V DC and 110 to 230 V AC	
Switching delay ON-delay OFF-delay	 1 ms (24 V DC), 5 ms (110 to 230 V AC) 1 ms (24 V DC), 30 ms (110 to 230 V AC) plus up to one half-wave	 5 ms (24 V DC), 20 ms (110 to 230 V AC) 5 ms (24 V DC), 10 ms (110 to 230 V AC) plus up to one half-wave
Interlock time	60 to 100 ms (24 V DC), 50 to 100 ms (110 to 230 V AC)	
Enclosure	Insulated (no grounding required)	
Control connections	Screw-type connection system and spring-loaded connection system, removable terminal for auxiliary circuit wiring (2 contacts)	Screw-type connection system, removable terminal for auxiliary circuit wiring (3 contacts)

[1] Rating data relates to 400 V line voltage

3.2 Applications

Solid-state switching devices for switching motors

The **solid-state contactors** for the wear-free and noiseless switching of motors are designed for the frequent switching on and switching off of AC drives up to 7.5 kW as well as for reversing up to 3.0 kW. The devices are fully insulated and can be mounted directly on motor starter protectors and overload relays or SIRIUS current monitoring relays, which makes them really easy to integrate into motor feeders.

These 3-phase solid-state contactors are equipped with a 2-phase control which is particularly suitable for typical motor circuits without a connection to the neutral conductor.

The integration of four current paths to form a single reversing circuit, accommodated in one enclosure, makes the **solid-state reversing contactor** a particularly compact solution. Unlike conventional systems which require two contactors, width can be reduced by up to 50% with the 3-phase solid-state reversing contactors. Devices with a width of 45 mm cover motors up to 2.2 kW and those with a width of 90 mm cover motors up to 3 kW.

Integration in the SIRIUS modular system facilitates connection to a SIRIUS motor starter protector via a link module or to a 3RB30/3RB31 solid-state overload relay or a 3RR2 current monitoring relay without additional steps. As a result, fuseless or fused motor feeders can be implemented quickly and easily.

Main features:

- Insulated enclosure with integrated heat sink
- Degree of protection IP20
- Integrated mounting foot for snapping on a DIN rail or mounting on a support plate
- Variety of connection systems
- Plug-in control connection
- LED to indicate control voltage

Reference

More information ...	Can be found ...
About link modules	In the chapter titled Description (Page 56)
About the overload relay	In the appendix titled "References" under SIRIUS Innovations manuals (Page 90) in the "3UG4/3RR2 monitoring relays" manual
About current monitoring relays	

3.3 Application environment

General operating conditions

The following table lists the general operating conditions under which the product may be operated.

Table 3- 2 General operating conditions

Operating conditions	Value
Degree of protection	IP20
Ambient temperature during operation	- 25 to 60 °C
Installation altitude	0 to 1000 m; at > 1,000 m seek advice from Technical Assistance (www.siemens.com/industrial-controls/technical-assistance)
Shock resistance	15 g/11 ms; acc. to DIN IEC 68-2-27
Vibration resistance	2 g; acc. to DIN IEC 68-2-6
EMC conditions	Acc. to DIN IEC 60947-4-2, DIN IEC 61000-4-2, DIN IEC 61000-4-4, DIN IEC 61000-4-5, and DIN IEC 61000-4-6,
Insulation strength 50/60 Hz	4,000 V_{rms}

Reference

More information ...	Can be found in the chapter titled ...
About operating conditions for solid-state switching devices	Technical data (Page 59)

In accordance with the product standard IEC 60947-4-2, the solid-state switching devices are designed for motors with maximum 8 times the starting current conditions (I/Ie < 8).

For dimensioning for motors with higher starting current conditions (typically I/Ie > 8), the maximum permissible rated operational current has to be reduced in accordance with the following table:

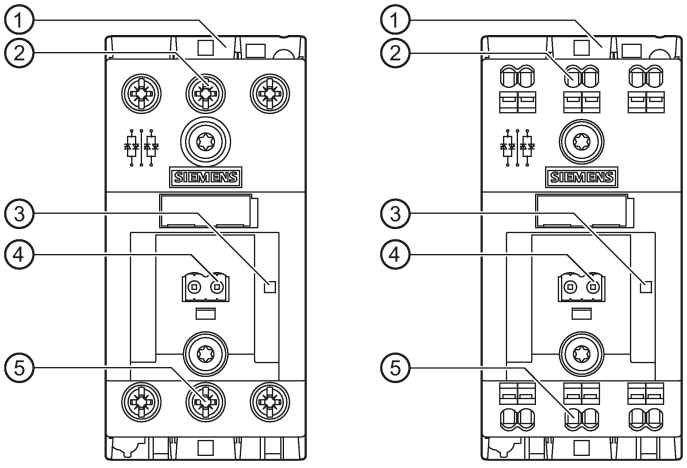
Solid-state switching devices

IeAC53a [A] at 40 °C		Solid-state contactors				Solid-state reversing contactor		
		3RF3405-.BB..	3RF3410-.BB..	3RF3412-.BB..	3RF3416-.BB..	3RF34 03-.BD.4	3RF34 05-.BD.4	3RF34 10-.BD.4
max. starting current conditions								
<= 8 times	Ie	5,2	9,2	12,5	16,0	3,8	5,4	7,4
8.5 times	Ie	4,9	8,7	11,8	15,1	3,6	5,1	7,0
9 times	Ie	4,6	8,2	11,1	14,2	3,4	4,8	6,6
9.5 times	Ie	4,4	7,7	10,5	13,5	3,2	4,5	6,2
10 times	Ie	4,2	7,4	10,0	12,8	3,0	4,3	5,9

3.4 Solid-state switching devices

Operator controls and equipment

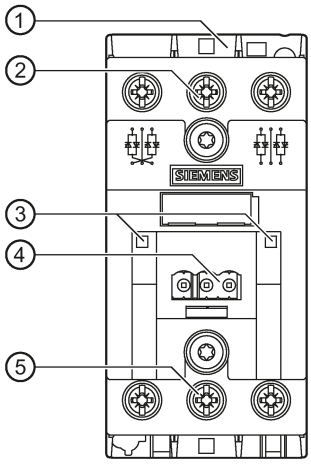
Solid-state contactor



	Operator control/Equipment	Function
1	Solid-state contactor	Frequent switching on and switching off of AC drives
2	Screw-type connection system/ Spring-loaded connection system	Main circuit terminals infeed/line side
3	LED	The yellow LED lights up when the control voltage is applied.
4	Plug-in control connection (2 terminals)	Removable terminals for the control circuit
5	Screw-type connection system/ Spring-loaded connection system	Main circuit terminals outgoing feeder motor/load side

Figure 3-1 Solid-state contactor overview - Screw-type connection system and spring-loaded connection system

Solid-state reversing contactor

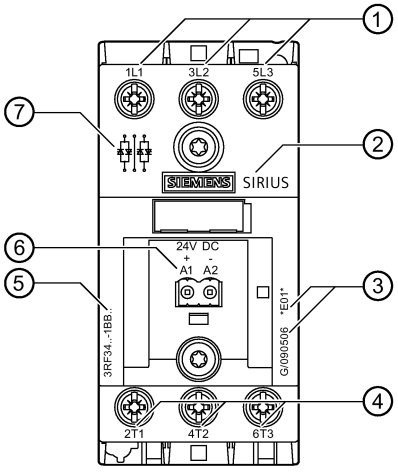


	Operator control/Equipment	Function
1	Solid-state contactor	Frequent switching on and switching off of AC drives
2	Screw-type connection system	Main circuit terminals infeed/line side
3	LEDs	The left-hand LED lights up yellow when counterclockwise rotation is activated (control voltage applied at terminal A1 and A2). The right-hand LED lights up yellow when clockwise rotation is activated (control voltage applied at terminal A3 and A2).
4	Plug-in control connection (3 terminals)	Removable terminals for the control circuit
5	Screw-type connection system	Main circuit terminals outgoing feeder motor/load side

Figure 3-2 Solid-state reversing contactor overview - Screw-type connection system

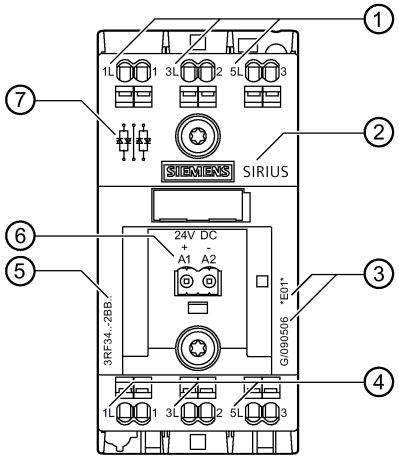
3.5 Device labels

Device labels



1 Labeling to identify the main circuit terminals infeed/line side
2 SIRIUS (device group)
3 Production date/Product version
4 Labeling to identify the main circuit terminals outgoing feeder motor/load side
5 Order designation
6 Labeling to identify the control circuit terminals and indication of the control voltage (See also the diagrams below, "Labeling on solid-state contactors, zoom view".)
7 Circuit diagram

Figure 3-3 Labeling to identify solid-state contactors with screw-type connection system



1 Labeling to identify the main circuit terminals infeed/line side
2 SIRIUS (device group)
3 Production date/Product version
4 Labeling to identify the main circuit terminals outgoing feeder motor/load side
5 Order designation
6 Labeling to identify the control circuit terminals and indication of the control voltage (See also the diagrams below, "Labeling on solid-state contactors, zoom view".)
7 Circuit diagram

Figure 3-4 Labeling to identify solid-state contactors with spring-loaded terminals

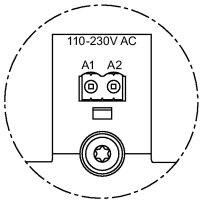


Figure 3-5 Labeling on solid-state contactors with AC control voltage, zoom view

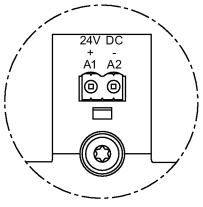
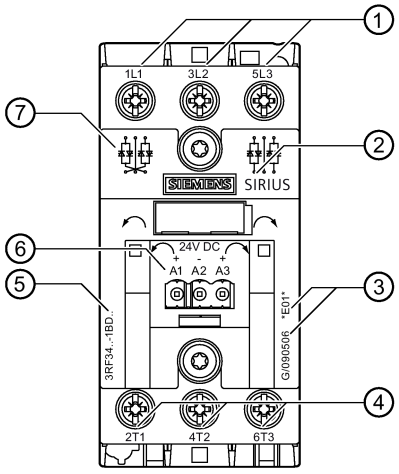


Figure 3-6 Labeling on solid-state contactors with DC control voltage, zoom view



1 Labeling to identify the main circuit terminals infeed/line side
2 SIRIUS (device group)
3 Production date/Product version
4 Labeling to identify the main circuit terminals outgoing feeder motor/load side
5 Order designation
6 Labeling to identify the control circuit terminals and indication of the control voltage
(See also the diagrams below, "Labeling on solid-state reversing contactors, zoom view".)
7 Circuit diagram

Figure 3-7 Labeling to identify solid-state reversing contactors with screw connection

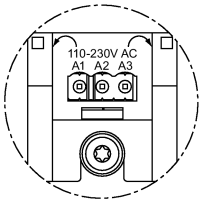


Figure 3-8 Labeling on solid-state reversing contactors with AC control voltage, zoom view

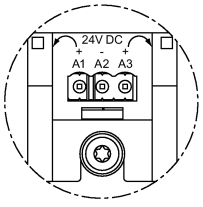


Figure 3-9 Labeling on solid-state reversing contactors with DC control voltage, zoom view

3.6 Advantages of solid-state switching devices

Technical advantages/Customer benefits

Table 3- 3 Advantages of solid-state switching devices

Technical highlights	Customer benefits
Top customer benefits	
Removable terminals for auxiliary circuit wiring	Avoidance of wiring errors if devices need to be replaced
Integrated electrical interlocking	Cost savings and fault avoidance
All motor contactors available in spring-loaded connection system	Improved operational reliability and quicker wiring
Wear-free switching	Long contact service life avoids cyclic replacement in applications with high switching frequency. The system is in operation for longer.
Other customer benefits	
Screw connection with practical cross-sections	Flexible cable selection based on application at hand
Link modules from motor starter protector to switching device	Fast, fault-free assembly for screw-type connection system
Noise-free switching	Can be used in residential environments thank to reduced switching noise
Integrated combination tests for fuseless and fused assembly	Planning reliability
Comprehensive approvals	Global applicability
Uniform tools and torques for all devices	Quick and easy installation
Only a small number of different power versions up to 7.5 kW	Easy configuration
Versions supporting wide voltage range 110 to 230 V AC	Saves storage costs thanks to a reduction of the number of variants at the customer end
Extensive CAx data provision	Easy and fault-free configuration
Data sheets in 10 languages per order number	Daily updated technical data available in 10 languages

Product combinations

4

Since the products from the innovative SIRIUS modular system are matched to one another both electrically and mechanically, they can be combined quickly and easily.

Screw-type 3RF34 solid-state switching devices can be combined with the following devices:

- 3RV20 motor starter protectors (with 3RA2921-1BA00 link module)
- 3RB3 solid-state overload relays
- 3RR2 current monitoring relays

Reference

More information ...	Can be found ...
About device combinations with solid-state switching devices	in the configuration guide titled "Configuring SIRIUS Innovations - Selection data for load feeders in fuseless and fused designs" (order no.: 3ZX1012-0RA21-1AC0)

Functions

5

Performance features

The performance of the solid-state switching devices is essentially determined by the type of power semiconductors used and the internal design. In the case of SIRIUS solid-state contactors and solid-state relays, only thyristors are used in place 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 networks with high interference voltages. Separate protective measures, such as a protective circuit with a varistor, are not necessary in most cases.

For example, in the case of SIRIUS solid-state switching devices, thyristors with a blocking voltage of 800 V are fitted for operation in networks up to 230 V. Thyristors with up to 1600 V are used for networks 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 in the form of a protective device matched to the application. However, SIRIUS solid-state switching devices are also characterized by the optimum matching of the thyristors (I^2t value) to the rated currents. The rated currents specified on the devices according to DIN EN 60947-4-2 have been confirmed by extensive testing.

Increased switching service life

Compared with conventional switching devices, solid-state switching devices have an extremely long switching service life:

Table 5- 1 Comparison of conventional switching devices with solid-state switching devices

Characteristic	Conventional switching devices	Solid-state switching devices
Switching service life	1 to 3 million operating cycles	More than 100 million operating cycles
Power loss	Low	High
Control power	High	Low
Shock/vibration resistance	Average	Very high
Noise development	Average	None
Electrical isolation	Given	None
Arcing	Given	None

Reference

More information ...	Can be found in the chapter titled ...
About the performance features of solid-state switching devices	Technical data (Page 59)

5.1 Actuation of solid-state switching devices

Solid-state contactors

Solid-state contactors are used for the frequent switching on of motors. The switch-on command is sent to the solid-state contactor when the control voltage is connected to terminals A1/A2. The power semiconductors are actuated after a short dwell time has elapsed.

Solid-state reversing contactors

The solid-state reversing contactors are dimensioned for the frequent reversing of motors. Dependent upon which control input is activated, two pairs of power semiconductors are actuated. If both inputs are activated at the same time, the device locks and no current will flow. Changing from one direction of rotation to the other is locked for a period of approx. 50 to 100 ms.

Planning/configuring

6

6.1 Selecting solid-state switching devices

Selecting solid-state contactors

Solid-state contactors are selected on the basis of the line, the load, and the ambient conditions.

The following procedure is recommended:

- Determine the rated current of the load and the line voltage.
- Select a solid-state contactor with a rated current which is higher than or at least equal to the load.
- Check the maximum permissible switching frequency based on the characteristic curves. To do this, you must know the starting current, the start time, and the motorized load during the operating phase.
- If the permissible switching frequency is below the required switching frequency, it can only be increased by overdimensioning the motor.
- Alternatively, the correct device size can be determined by entering the line data, the motor data, the application, and the ambient conditions in the "Selection of solid-state contactors for switching motors (https://eb.automation.siemens.com/spicecad/dc-web-app/main/index.jsf)" tool on the Internet.

Load feeders

There is no such thing as a typical design for a load feeder with solid-state relays or solid-state contactors. Rather, the variety of connection systems and control voltages support universal possible applications. SIRIUS solid-state relays and solid-state contactors can be installed in either fuseless or fused feeders.

Reference

More information ...	Can be found ...
About tested load feeders	in the configuration guide titled "Configuring SIRIUS Innovations - Selection data for load feeders in fuseless and fused designs" (order no.: 3ZX1012-0RA21-1AC0)
About the maximum permissible switching frequency	in the chapter titled "Technical data (Page 59)"

6.2 SIRIUS Innovations system configurator

Reference

To assist you with configuration, the "SIRIUS Innovations system configurator" is at your disposal on the Internet. Here, you can gather together all necessary products before the actual configuration process and you can realize complete projects virtually.

You can find the "SIRIUS Innovations system configurator" on the Internet (www.siemens.com/industrial-controls/configurators).

6.3 Configuration: Selecting solid-state contactors for motors

Program description

Selecting solid-state switching devices with the "Selection of solid-state contactors for switching motors" tool

The "Selection of solid-state contactors for motors" tool provides a quick and easy way of dimensioning solid-state switching devices correctly.
Based on the details about the motor, the load cycle, and the environmental requirements, the switching device load is calculated and a suitable type is selected. The complete order number then appears in the "Result" field.

The program can be accessed via the following links:

- Configurator (https://mall.automation.siemens.com/WW/guest/bizLogic/bizGotoConfig.asp?ConfigID=4&ConfigType=3RF2&lang=en): (Selection of solid-state contactors for motors)
- Selection of solid-state contactors for switching motors (https://eb.automation.siemens.com/spicecad/dc-web-app/main/index.jsf)

Note

Dimensioning and sizing the motor and the corresponding protection devices

The user is responsible for dimensioning and sizing the motor and the corresponding protection devices correctly. In the case of very high switching frequencies, we recommend the use of thermistor motor protection. The use of motor starter protectors or overload relays for motor overload protection may not be suitable under some circumstances.

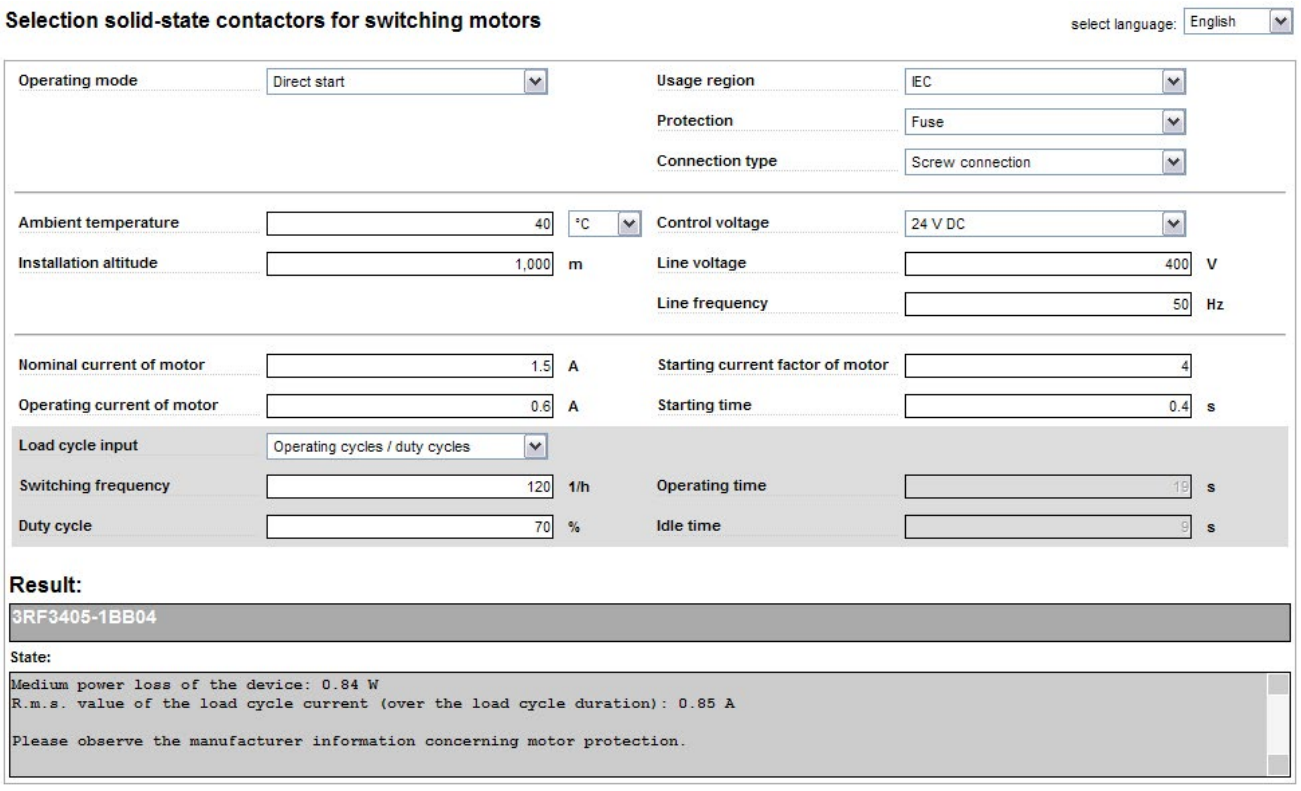


Figure 6-1 Program desktop: "Selection of solid-state contactors for motors"

Procedure:

Start by defining the operating mode. Select "Direct start" or "Reverse operation" to launch the calculation process. You can then proceed as you wish. The results are recalculated every time you make an entry. Some entries will restrict other parameters which can be selected (this is indicated by messages in the "State" field).
If your entries result in errors, these will also be displayed in the "State" field.
Once the entries have been modified accordingly and the calculation has been completed, the order number of a suitable device will be appear in the "Result" field. The order number can then be copied for ordering in the Mall (http://www.siemens.com/automation/mall).

Selecting a new "Operating mode" resets the tool completely. The tool can be set to the following languages via the "Language" button: English; German; Italian; Spanish; Portuguese.

Information about input parameters

- "Operating mode"
  Selection between a motor contactor or a reversing contactor
- "Usage region"
  Selection of the application environment, selection of a design conforming to either IEC standards or UL regulations
- "Protection"
  The short-circuit protection of the solid-state switching devices (using circuit breakers or fuses) affects the rated current.
- "Temperature unit"
  Entries can be made in either degrees Celsius or degrees Fahrenheit.
- "Environment temperature"
  The ambient temperature at the installation location. Temperatures above 40 °C / 104 °F will impose restrictions on the rated current of the device.
- "Control voltage"
  The control voltage selected determines the device type.
- "Altitude of site"
  The installation altitude at the installation location. Altitudes higher than 1000 m above sea level (amsl) will impose restrictions on the rated current of the device.
- Network parameters
  - "Network voltage"
    The "Network voltage" selection determines the device version.
  - "Network frequency"
    The entry is required so that the current load can be calculated correctly.

- Motor parameters
  - "Nominal current of motor"
    The "Nominal current of motor" is indicated on the motor's nameplate.
  - "Operating current of motor"
    This value is the current actually consumed during the operating phase; a measurement may need to be taken in order to ascertain it. Alternatively, this value can be estimated on the basis of the load data.
  - "Starting current factor of motor"
    The value has to be taken from the motor's technical data. It essentially determines the current load of the switching device during starting.
  - "Starting time"
    This is the time the motor needs to complete a startup process.
- "Load cycle input"
  A load cycle comprises a starting phase, an operating phase and an idle phase.
  The load cycle time is the sum of these phases. There are two possible ways of entering the load cycle.
  One is to enter the operating cycles and the duty cycle, the other is to enter the operating time and the idle time.
  - "Operating cycles"
    The number of load cycles in an hour; in the case of reversing contactors every load cycle counts, regardless of counterclockwise or clockwise running.
  - "Duty cycle"
    Ratio of the sum of the starting time and the operating time to the total load cycle time.
  - "Operating time"
    Time during which the rated motor current flows.
  - "Idle time"
    Duration of the current-free phase.

6.4 Short-circuit protection

6.4.1 Mounting accessories for the load feeder conforming to IEC

6.4.1.1 3RF34 solid-state contactors - coordination 1 and 2 conforming to IEC (fused design)

Combining 3RF34 solid-state contactors, type of coordination 1 (type 1), with 3RB3 overload relays

3RF34 solid-state contactors can be combined with the following 3RB3 overload relays in conformance with type of coordination 1 (type 1):

Table 6- 1 Order designations for 3RB3 overload relays

Overload relay		Solid-state contactor		Maximum permissible fuse links at 400 V; operating class gG	
Order designation	Adjustment range	Order designation	Rated current	Order designation	Rated current
3RB3.2.-N..	0.32 to 1.25 A	3RF3405-xBByz	4 A	3NW6210-1 3NA6810-6	25 A
3RB3.2.-P..	1 to 4 A	3RF3405-xBByz	4 A		
3RB3.2.-S..	3 to 12 A	3RF3405-xBByz	4 A		
3RB3.2.-N..	0.32 to 1.25 A	3RF3410-xBByz	7.8 A	3NW6217-1 3NA6817-6	40 A
3RB3.2.-P..	1 to 4 A	3RF3410-xBByz	7.8 A		
3RB3.2.-S..	3 to 12 A	3RF3410-xBByz	7.8 A		
3RB3.2.-Q..	6 to 25 A	3RF3410-xBByz	7.8 A		
3RB3.2.-N..	0.32 to 1.25 A	3RF3412-xBByz	9.5 A	3NW6117-1 3NA6817-6	40 A
3RB3.2.-P..	1 to 4 A	3RF3412-xBByz	9.5 A		
3RB3.2.-S..	3 to 12 A	3RF3412-xBByz	9.5 A		
3RB3.2.-Q..	6 to 25 A	3RF3412-xBByz	9.5 A		
3RB3.2.-N..	0.32 to 1.25 A	3RF3416-xBByz	11 A	3NW6117-1 3NA6817-6	40 A
3RB3.2.-P..	1 to 4 A	3RF3416-xBByz	11 A		
3RB3.2.-S..	3 to 12 A	3RF3416-xBByz	11 A		
3RB3.2.-Q..	6 to 25 A	3RF3416-xBByz	11 A		

Table 6- 2 Supplements to order numbers:

x = type of connection system	**1** = screw connection **2** = spring-loaded terminals
y = type of control voltage	**0** = 24 V DC acc. to EN 61131-2 **2** = 110 to 230 AC
z = type of rated control voltage	**4** = 48 to 480 V **6** = 48 to 600 V

Combining 3RF34 solid-state contactors, type of coordination 2 (type 2), with 3RB3 overload relays

3RF34 solid-state contactors can be combined with the following 3RB3 overload relays in conformance with type of coordination 2 (type 2):

Table 6- 3 Order designations for 3RB3 overload relays

Overload relay		Solid-state contactor		Maximum permissible fuse links at 400 V		
Order designation	Adjustment range	Order designation	Rated current	Order designation	Rated current	Operating class
3RB3.2.-N..	0.32 to 1.25 A	3RF3405-xBByz	4 A	3NA3801-6 5SB2 31	6 A	gG
3RB3.2.-P..	1 to 4 A	3RF3405-xBByz	4 A	3NC1020	20 A	aR
3RB3.2.-S..	3 to 12 A	3RF3405-xBByz	4 A	3NC1020	20 A	aR
3RB3.2.-N..	0.32 to 1.25 A	3RF3410-xBByz	7.8 A	3NA3801-6 5SB2 31	6 A	gG
3RB3.2.-P..	1 to 4 A	3RF3410-xBByz	7.8 A	3NE1802-0 3NE8020-1 3NW6205-1	40 A 80 A 16 A	gR aR aR
3RB3.2.-S..	3 to 12 A	3RF3410-xBByz	7.8 A	3NE1802-0 3NE8020-1 3NW6205-1	40 A 80 A 16 A	gR aR aR
3RB3.2.-Q..	6 to 25 A	3RF3410-xBByz	7.8 A	3NE1802-0 3NE8020-1 3NW6205-1	40 A 80 A 16 A	gR aR aR
3RB3.2.-N..	0.32 to 1.25 A	3RF3412-xBByz	9.5 A	3NA3801-6 5SB2 31	6 A	gG
3RB3.2.-P..	1 to 4 A	3RF3412-xBByz	9.5 A	3NA3807-6 5SB2 71	20 A	gG
3RB3.2.-S..	3 to 12 A	3RF3412-xBByz	9.5 A	3NE1818-0 3NC2200	63 A 100 A	gR aR
3RB3.2.-Q..	6 to 25 A	3RF3412-xBByz	9.5 A	3NE1818-0 3NC2200	63 A 100 A	gR aR
3RB3.2.-N..	0.32 to 1.25 A	3RF3416-xBByz	11 A	3NA3801-6 5SB2 31	6 A	gG
3RB3.2.-P..	1 to 4 A	3RF3416-xBByz	11 A	3NA3807-6 5SB2 71	20 A	gG
3RB3.2.-S..	3 to 12 A	3RF3416-xBByz	11 A	3NA3812	32 A	gG
3RB3.2.-Q..	6 to 25 A	3RF3416-xBByz	11 A	3NA3812	32 A	gG

Table 6- 4 Supplements to order numbers:

x = type of connection system	**1** = screw connection **2** = spring-loaded terminals
y = type of control voltage	**0** = 24 V DC acc. to EN 61131-2 **2** = 110 to 230 AC
z = type of rated control voltage	**4** = 48 to 480 V **6** = 48 to 600 V

Note

For details of the fuseless design (coordination of motor starter protectors), see Technical data (Page 59).

6.4.1.2 3RF34 solid-state reversing contactors - coordination 1 and 2 conforming to IEC (fused design)

Combining 3RF34 solid-state reversing contactors, type of coordination 1 (type 1), with 3RB3 overload relays

3RF34 solid-state reversing contactors can be combined with the following 3RB3 overload relays in conformance with type of coordination 1 (type 1):

Table 6- 5 Order designations for 3RB3 overload relays

Overload relay		Solid-state reversing contactor		Maximum permissible fuse links at 400 V, operating class gG	
Order designation	Adjustment range	Order designation	Rated current	Order designation	Rated current
3RB3.2.-N..	0.32 to 1.25 A	3RF3403-xBDyz	3.8 A	3NW6210-1 3NA6810-6	25 A
3RB3.2.-P..	1 to 4 A	3RF3403-xBDyz	3.8 A		
3RB3.2.-S..	3 to 12 A	3RF3403-xBDyz	3.8 A		
3RB3.2.-N..	0.32 to 1.25 A	3RF3405-xBDyz	5.4 A	3NW6217-1 3NA6817-6	40 A
3RB3.2.-P..	1 to 4 A	3RF3405-xBDyz	5.4 A		
3RB3.2.-S..	3 to 12 A	3RF3405-xBDyz	5.4 A		
3RB3.2.-N..	0.32 to 1.25 A	3RF3410-xBDyz	7.4 A	3NW6117-1 3NA6817-6	40 A
3RB3.2.-P..	1 to 4 A	3RF3410-xBDyz	7.4 A		
3RB3.2.-S..	3 to 12 A	3RF3410-xBDyz	7.4 A		
3RB3.2.-Q..	6 to 25 A	3RF3410-xBDyz	7.4 A		

Table 6- 6 Supplements to order numbers:

x = type of connection system	**1** = screw connection **2** = spring-loaded terminals
y = type of control voltage	**0** = 24 V DC acc. to EN 61131-2 **2** = 110 to 230 AC
z = type of rated control voltage	**4** = 48 to 480 V **6** = 48 to 600 V

Combining 3RF34 solid-state reversing contactors, type of coordination 2 (type 2), with 3RB3 overload relays

3RF34 solid-state reversing contactors can be combined with the following 3RB3 overload relays in conformance with type of coordination 2 (type 2):

Table 6- 7 Order designations for 3RB3 overload relays

Overload relay		Solid-state reversing contactor		Maximum permissible fuse links at 400 V		
Order designation	Adjustment range	Order designation	Rated current	Order designation	Rated current	Operating class
3RB3.2.-N..	0.32 to 1.25 A	3RF3403-xBDyz	3.8 A	3NA3801-6 5SB2 31	6 A	gG
3RB3.2.-P..	1 to 4 A	3RF3403-xBDyz	3.8 A	3NC1020	20 A	aR
3RB3.2.-S..	3 to 12 A	3RF3403-xBDyz	3.8 A	3NC1020	20 A	aR
3RB3.2.-N..	0.32 to 1.25 A	3RF3405-xBDyz	5.4 A	3NA3801-6 5SB2 31	6 A	gG
3RB3.2.-P..	1 to 4 A	3RF3405-xBDyz	5.4 A	3NE1802-0 3NE8020-1	40 A 80 A	gR aR
3RB3.2.-S..	3 to 12 A	3RF3405-xBDyz	5.4 A	3NE1802-0 3NE8020-1	40 A 80 A	gR aR
3RB3.2.-N..	0.32 to 1.25 A	3RF3410-xBDyz	7.4 A	3NA3801-6 5SB2 31	6 A	gG
3RB3.2.-P..	1 to 4 A	3RF3410-xBDyz	7.4 A	3NE1802-0 3NE8020-1	40 A 80 A	gR aR
3RB3.2.-S..	3 to 12 A	3RF3410-xBDyz	7.4 A	3NE1802-0 3NE8020-1	40 A 80 A	gR aR
3RB3.2.-Q..	6 to 25 A	3RF3410-xBDyz	7.4 A	3NE1802-0 3NE8020-1	40 A 80 A	gR aR

Table 6- 8 Supplements to order numbers:

x = type of connection system	**1** = screw connection **2** = spring-loaded terminals
y = type of control voltage	**0** = 24 V DC acc. to EN 61131-2 **2** = 110 to 230 AC
z = type of rated control voltage	**4** = 48 to 480 V **6** = 48 to 600 V

Note

For details of the fuseless design (coordination of motor starter protectors), see Technical data (Page 59).

6.4.2 Mounting accessories for the load feeder conforming to UL

6.4.2.1 SCCR short-circuit current ratings

SCCR short-circuit current ratings

- The SCCR (Short Circuit Current Rating) indicates the maximum permissible short-circuit current for a switching device. A higher value can only be achieved in combination with protection devices such as fuses or circuit breakers.
- This rating is required for mounting accessories in control cabinets conforming to UL 508A. The switching device or switchgear assembly with the lowest value specifies the value for the entire control cabinet.
  A low value makes engineering the supply voltage for the control cabinet difficult.
- 3RF3 solid-state switching devices have a standard short-circuit value of 5 kA conforming to UL 508.
- Tests with a short-circuit value of 65 kA (High Capacity Short Circuit Current Ratings) have also been carried out. The UL reports include details of possible combinations with Class CC and Class J fuses, as well as with a number of circuit breakers.

6.4.2.2 Fuses

Fuse ratings for solid-state contactors

Table 6- 9 Fuses for protecting against high short-circuit currents

	Fuses				
3RF34	**Max. size [A]**	**Class**	**Type**	**Current [kA]**	**Voltage [V]**
3RF3405-.BB	25	J	TD	65	480
3RF3405-.BB	45	J	TD	65	600
3RF3410-.BB	45	J	TD	65	480
3RF3410-.BB	45	J	TD	65	600
3RF3412-.BB	45	J	TD	65	480
3RF3412-.BB	50	J	TD	65	600
3RF3416-.BB	50	J	TD	65	480
3RF3416-.BB	50	J	TD	65	600

Fuse ratings for solid-state reversing contactors

Table 6- 10 Fuses for protecting against high short-circuit currents

Fuses					
3RF34	**Max. size [A]**	**Class**	**Type**	**Current [kA]**	**Voltage [V]**
3RF3403-.BD	45	J	TD	65	480
3RF3405-.BD	45	J	TD	65	480
3RF3410-.BD	45	J	TD	65	480

Circuit breakers for protecting against high short-circuit currents

Table 6- 11 Circuit breaker ratings for solid-state contactors

Fuses				
3RF34	**Max. size [A]**	**Type**	**Current [kA]**	**Voltage [V]**
3RF3405-.BB	4	3RV1721	50	480
3RF3405-.BB	4	3RV1721	10	600
3RF3410-.BB	8	3RV1721	5	600
3RF3412-.BB	8	3RV1721	5	600
3RF3416-.BB	8	3RV1721	5	600
3RF3416-.BB	10	3RV1721	5	600

Table 6- 12 Circuit breaker ratings for solid-state reversing contactors

Fuses				
3RF34	**Max. size [A]**	**Type**	**Current [kA]**	**Voltage [V]**
3RF3403-.BD	4	3RV1721	50	480
3RF3405-.BD	5	3RV1721	30	480
3RF3410-.BD	8	3RV1721	5	480

Note

Short-circuit currents

Short-circuit currents can result in material damage.

When combining solid-state switching devices and overload relays the device with the lowest rated value is decisive as regards short-circuit fuse protection.

Semiconductor fuses

SITOR fuses can be used as an alternative to UL fuses. Here too, the relevant data has been included in the UL reports. Protection of the semiconductors is much better when SITOR semiconductor fuses are used (comparable with type of coordination type 2).

The following applies to UL applications:
SITOR fuses are not feeder protective devices but only "special purpose fuses".

Table 6- 13 Fuse protection with semiconductor fuses

	Fuse			
3RF34	**Max. size [A]**	**Type**	**Current [kA]**	**Voltage [V]**
3RF3405-.BB	16	3NE1813-0	65	480
3RF3405-.BB	32	3NE4101	65	480
3RF3405-.BB	25	3NE8715-1	65	480
3RF3405-.BB	25	3NE8015-1	65	480
3RF3405-.BB	35	3NE1803-0	65	600
3RF3405-.BB	50	3NE4117	65	600
3RF3405-.BB	50	3NE8717-1	65	600
3RF3405-.BB	63	3NE8018-1	65	600
3RF3410-.BB	35	3NE1803-0	65	600
3RF3410-.BB	50	3NE4117	65	600
3RF3410-.BB	50	3NE8717-1	65	600
3RF3410-.BB	63	3NE8018-1	65	600
3RF3412-.BB	63	3NE1818-0	65	480
3RF3412-.BB	50	3NE1817-0	65	600
3RF3412-.BB	50	3NE4117	65	600
3RF3412-.BB	50	3NE8717-1	65	600
3RF3412-.BB	63	3NE8018-1	65	600
3RF3412-.BB	80	3NE1020-2	65	600
3RF3416-.BB	63	3NE1818-0	65	480
3RF3416-.BB	50	3NE1817-0	65	600
3RF3416-.BB	50	3NE4117	65	600
3RF3416-.BB	50	3NE8717-1	65	600
3RF3416-.BB	63	3NE8018-1	65	600
3RF3416-.BB	80	3NE1020-2	65	600
3RF3403-.BD	35	3NE1803-0	65	480
3RF3403-.BD	50	3NE4117	65	480
3RF3403-.BD	50	3NE8717-1	65	480
3RF3403-.BD	63	3NE8018-1	65	480
3RF3405-.BD	35	3NE1803-0	65	480
3RF3405-.BD	50	3NE4117	65	480
3RF3405-.BD	50	3NE8717-1	65	480

	Fuse			
3RF34	**Max. size [A]**	**Type**	**Current [kA]**	**Voltage [V]**
3RF3405-.BD	63	3NE8018-1	65	480
3RF3410-.BD	35	3NE1803-0	65	480
3RF3410-.BD	50	3NE4117	65	480
3RF3410-.BD	50	3NE8717-1	65	480
3RF3410-.BD	63	3NE8018-1	65	480

Application planning

7

Notes about integration into load feeders

Thanks to their industrial connection system and type of design, SIRIUS solid-state switching devices can be integrated into load feeders very easily.

However, particular attention must be paid to the circumstances of installation and ambient conditions, as the performance of the solid-state switching devices is very much dependent on these. Each design will impose certain restrictions which have to be taken into account. Detailed information about minimum clearances can be found in the chapter titled Technical data (Page 59), as well as in the product data sheets.

Despite the rugged nature of the power semiconductors used, solid-state switching devices are sensitive to short circuits in the load feeder. Consequently, special precautions have to be taken against irreparable damage as appropriate for the type of design.

The use of SITOR semiconductor fuses is generally recommended. These fuses provide protection against irreparable damage in the event of a short circuit even in applications where full use is being made of solid-state contactors.

Alternatively, in the case of a lower load, 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 data and the product data sheets contain information about protection based on semiconductor fuses only as well as on the use of SIRIUS devices with conventional protective devices.

Solid-state motor and reversing contactors can easily be combined with 3RV motor starter protectors and circuit breakers, 3RB3 solid-state overload relays and 3RR2 current monitoring relays from the SIRIUS modular system. As a result, fuseless and fused motor feeders can be implemented easily and without taking up too much space.

Note

Running star-connected three-phase motors (particularly with power ratings < 1 kW) with electromechanical contactors can cause significant electromagnetic interference. Such interference, which exceeds permissible limit values, can cause solid-state switching devices operating in the vicinity to malfunction.

In the case of high levels of electromagnetic interference we recommend equipping motors up to 5.5 kW which are controlled using 3RT20 1 electromechanical contactors with EMC surge suppressors. 3-phase RC interference suppression modules like the 3RT29 16-1PA1 (up to 400 V) provide the best filtering effect. Corresponding modules for the contactors are listed in the product chapter titled "Contactors and contactor assemblies", under "Accessories". Varistor interference suppression modules should not be used, as they are not capable of filtering out rapid transients to the required extent.

7.1 Application areas

7.1.1 Switching motors

The contactors for switching motors are "instantaneous switching", since this method is particularly suited for inductive loads. The random distribution of the ON point across the entire sine curve of the line voltage reduces faults to a minimum.

7.1.2 Use in a photovoltaic plant

Advantages of using solid-state reversing contactors in a photovoltaic plant:

- Actuation of motors to track the solar panels
- Very long service life and compact design
- Space-saving installation - normal contactors require double the space and would have to be replaced too frequently
- Minimal cabling

No solutions using frequency converters have been implemented on thermal grounds and for reasons of cost.

Mounting

8

8.1 Mounting instructions

Mounting options

The solid-state switching devices are mounted by

- Snapping them onto a DIN rail or
- Screwing them to a base plate

Minimum clearances

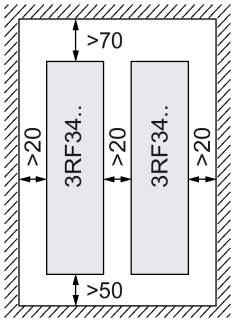


Figure 8-1 Clearances for stand-alone assembly (dimensions in mm)

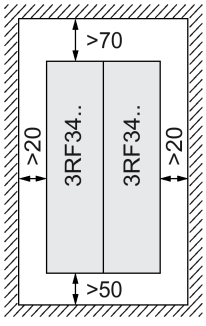


Figure 8-2 Clearances for mounting side by side (dimensions in mm)

Mounting position

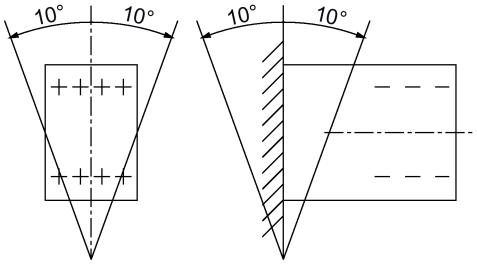


Figure 8-3 Mounting position

Drill hole spacing

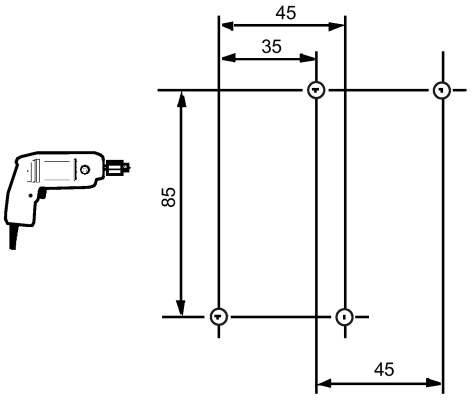


Figure 8-4 Drill hole spacing for screw mounting (dimensions in mm)

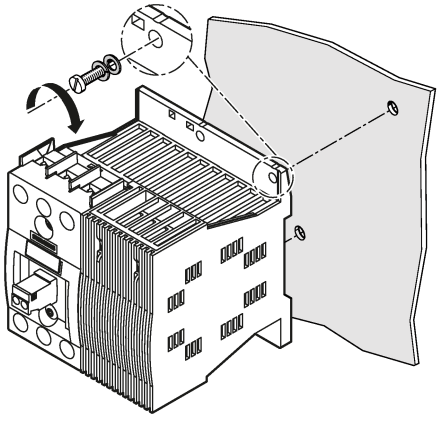
Note

The drilling plan is valid for devices with a width of 90 mm. It is sufficient to drill two holes for devices with a width of 45 mm.

8.2 Screw mounting

Screw mounting

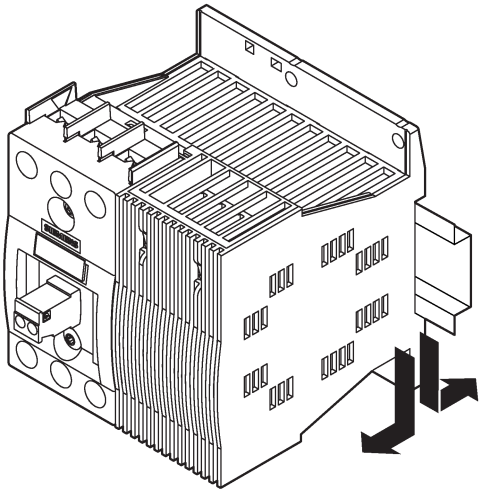
Table 8- 1 Mounting (solid-state switching devices)

Step	Operating instruction	Figure
1	Using two M4 screws (maximum tightening torque 1.5 Nm), plain washers, and spring washers, screw the solid-state contactor tight into the designated drill holes diagonally.	

8.3 Snapping onto/off DIN rail (snap-on mounting)

Snapping onto DIN rail

Table 8- 2 Mounting (solid-state switching devices)

Step	Operating instruction	Figure
1	Position the device on the top edge of the DIN rail and press down until it snaps onto the bottom edge of the DIN rail.	

Connection

9

Connection system

SIRIUS solid-state switching devices are characterized by the wide variety of connection systems they support. You can choose from the following connection systems:

Screw-type connection system

Screw-type connection system is the standard technology for industrial switching devices. Open terminals and a plus/minus screw are just two of its features. Two conductors up to 6 mm² or one conductor with a cross-section of 10 mm² can be flexibly connected in a single terminal.

Spring-loaded connection system

This innovative technology does not use any screw connections. As a result, it is highly resistant to vibration. Two conductors up to 2.5 mm² can be connected per terminal.

Reference

More information ...	Can be found in the chapter titled ...
About conductor cross-sections of solid-state switching devices	• Conductor cross-sections for solid-state contactors (Page 61) • Conductor cross-sections for solid-state reversing contactors (Page 62)

9.1 Solid-state contactor

Terminals

Table 9- 1 Solid-state contactor

Terminal	Designation
L1, L2, L3	Main circuit terminals infeed/line side
T1, T2, T3	Main circuit terminals outgoing feeder motor/load side
A1~	Control supply voltage AC operation
A2~	Control supply voltage AC operation
A1+	Control supply voltage DC operation (plus)
A2-	Control supply voltage DC operation (minus)

9.2 Solid-state reversing contactor

Terminals

Table 9- 2 Solid-state reversing contactor

Terminal	Designation
L1, L2, L3	Main circuit terminals infeed/line side
T1, T2, T3	Main circuit terminals outgoing feeder motor/load side
A1~	Control supply voltage AC operation
A2~	Control supply voltage AC operation, reference potential for A1/A3
A3~	Control supply voltage AC operation
A1+	Control supply voltage DC operation (plus)
A2-	Control supply voltage DC operation (minus), reference potential for A1/A3
A3+	Control supply voltage DC operation (plus)

9.3 Connection cross-sections

Conductor cross-sections

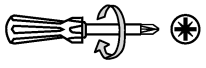
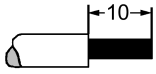
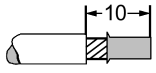
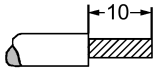
Due to SIRIUS being a modular system, the conductor cross-sections of all the devices of one size are identical.

9.3.1 Conductor cross-sections for screw-type connection systems

Conductor cross-sections for screw-type connection systems

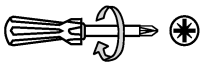
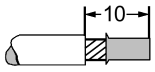
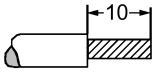
The tables below define the permissible conductor cross-sections for main terminals and auxiliary conductor connections in size S0 for screw-type connection systems.

Table 9- 3 Main conductors of size S0 with M4 combination screws

		Solid-state contactors and solid-state reversing contactors
Tool		Pozidriv size PZ 2, Ø 5 to 6 mm
Tightening torque		2.0 to 2.5 Nm
Solid		2 x (1.5 to 2.5) mm^2
		2 x (1.5 to 6) mm^2
Finely stranded with end sleeve (DIN 46 228 Part 1)		2 x (1 to 2.5) mm²
		2 x (2.5 to 6) mm²
Finely stranded without end sleeve		1 x 10 mm^2
AWG		2 x (14 to 10)

1) Only 1 conductor can be clamped on the stand-alone assembly support.

Table 9- 4 Auxiliary conductors of size S0 with M3 combination screws

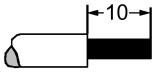
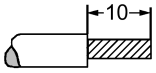
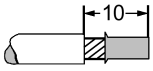
		Solid-state contactors and solid-state reversing contactors
Tool		Pozidriv size PZ 2, Ø 5 to 6 mm
Tightening torque		0.5 to 0.6 Nm
Conductor cross-section with end sleeve (DIN 46 228 Part 1)		2 x (0.5 to 2.5) mm²
Conductor cross-section without end sleeve		2 x (0.5 to 1.0) mm²
AWG		20 to 12

9.3.2 Conductor cross-sections for spring-loaded connection systems

Conductor cross-sections for spring-loaded connection systems

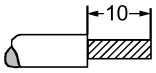
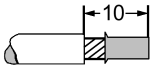
The tables below define the permissible conductor cross-sections for main terminals and auxiliary conductor connections in size S0 for spring-loaded connection systems.

Table 9- 5 Main conductors of size S0

		Solid-state contactors *)
Tool		Ø 3.5 x 0.5 (8WA2880/8WA2803) Ø 3.0 x 0.5 (3RA2808-1A)
Solid		2 x (0.5 to 2.5) mm²
Finely stranded without end sleeve		2 x (0.5 to 1.5) mm²
Finely stranded with end sleeve (DIN 46 228 Part 1)		2 x (0.5 to 2.5) mm²
AWG		2 x (18 to 14)

*) Solid-state reversing contactors are available with screw connection only.

Table 9- 6 Auxiliary conductors of size S0

		Solid-state contactors *)
Tool		-
Conductor cross-section without end sleeve		-
Conductor cross-section with end sleeve		0.5 to 2.5 mm²
AWG		20 to 12

*) Solid-state reversing contactors are available with screw connection only.

FAQs - Frequently asked questions

10

Troubleshooting/FAQs

Table 10- 1 Questions/Answers/Solutions

Frequently asked questions	Answers/Solutions
Do solid-state switching devices galvanically isolate the main current path?	No, solid-state switching devices are not capable of galvanic isolation. When the supply is disconnected, a low leakage current (approx. 10 mA) still flows. To carry out maintenance work on the load side, an additional switching device with isolating features has to be used.
One frequency converter is to be used to control two motors. At high switching frequencies, the load switches between motors 1 and 2. Are solid-state contactors suitable for this application?	Solid-state contactors are not suitable for switching loads in circuits with frequency converters or soft-starting devices. The non-sinusoidal voltage waveform would damage important solid-state contactor components beyond repair.
Can current paths be connected in parallel to increase current carrying capacity?	Parallel connection of current paths is not permissible. As the contact resistances of the thyristors vary greatly, the current paths would be put under significant asymmetrical load. As a result, the current path with the lowest contact resistance would be subject to thermal overload.
Minimum load currents are given in the technical data for 3RF34 solid-state contactors. What happens if these are undershot?	The minimum load current for 3RF3405-.BB.4 solid-state switching devices is 0.1 A. For all other variants the minimum load current is 0.5 A. Undershooting the minimum load current can cause the solid-state contactor to shut down in each half-wave prior to zero crossing of current (current cuts in and out - similar to generalized phase control). Therefore, the minimum value should not be undershot. Proposed solution: Connect a load (e.g. a resistive load) in parallel to increase the load current accordingly.
Are there auxiliary switches for the solid-state contactors?	We often hear requests for the switching state to be fed back to the controller. Since for physical reasons there are no auxiliary switches connected to the main circuit in the case of solid-state switching devices, it is not possible to signal the switching state directly. The state of the switching device or, better, that of the motor, can be signaled to the controller via the 3RR2 current monitoring module. The solid-state contactors can be expanded for load monitoring with the screw-on 3RR2 current monitoring relays. These relays monitor the connected load, providing a means of feeding back the state of the entire load feeder to the controller.

Accessories

11

11.1 Accessories overview

For maximum flexibility, accessories can be added to the solid-state switching devices as required, easily, and without the need for tools.

Table 11- 1 Accessories for solid-state switching devices

Accessories	Solid-state contactor	Solid-state reversing contactor
Insulated 3-phase busbar system for spring-loaded connection for three solid-state contactors	✓	–
Insulated 3-phase busbar system for spring-loaded connection for four solid-state contactors	✓	–
3RT2916-4JA02 insulating stop for spring-loaded connection	✓	–
Busbar adapter for 40 mm system	✓	✓
Busbar adapter for 60 mm system	✓	✓
Link module for motor starter protector	✓	✓
Connection adapter to the overload relay	✓	✓

11.2 Insulating stop

11.2.1 Description

The 3RT2916-4JA02 insulating stop is designed for solid-state contactors with spring-loaded connections and ensures that the conductor insulation is kept back in the case of conductor cross-sections up to 1 mm^2. An insulating stop unit comprises 5 pairs of terminals. As illustrated below, it plugs into the spring-loaded cable entries (max. conductor cross-section up to 2.5 mm^2).

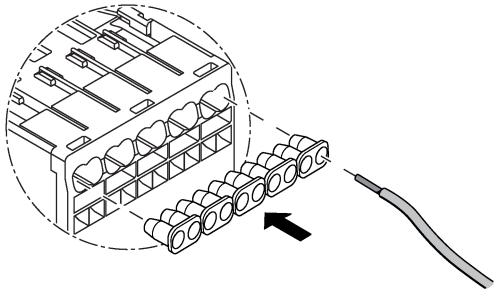


Figure 11-1 Insulating stop 3RT2916-4JA02

11.3 Link module for motor starter protector

11.3.1 Description

Link modules to establish the electrical and mechanical connections between solid-state contactor and motor starter protector are required if you wish to use load feeders. The link module for attaching the 3RV2 motor starter protector attaches easily to the contactors.

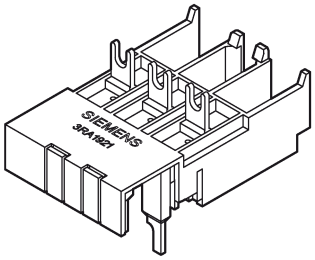


Figure 11-2 Link module 3RA2921-1BA00 for motor starter protector

Reference

More information ...	Can be found ...
About link modules	in the appendix titled "References" under "SIRIUS Innovations manuals (Page 90)" in the "SIRIUS Innovations - SIRIUS 3RA21/22 load feeders" manual.
About mounting solid-state contactors and motor starter protectors	In the chapter titled "Mounting/Disassembly (Page 57)"

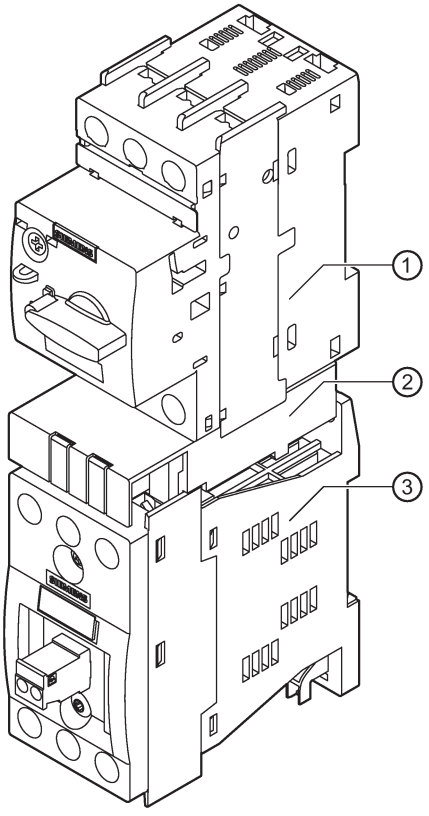
11.3.2 Mounting/Disassembly

Mounting/disassembly of the link module for the motor starter protector

Before a motor starter protector can be attached to the solid-state contactor/solid-state reversing contactor, a link module must be installed between the two devices. The insulated design of the devices means that grounding is not required.

Side-by-side mounting facilitates the installation of several devices one next to the other. The devices can be mounted with screws or snapped onto DIN rails.

The example in the figure below illustrates the mounting of the link module on a solid-state contactor.



1 Motor starter protector
2 Link module
3 Solid-state contactor

Figure 11-3 Setup: Motor starter protector, link module, solid-state contactor

11.4 Connection adapter to the overload relay

11.4.1 Description

Connection adapters to establish the electrical and mechanical connections between the solid-state contactor and overload relay are required if you wish to use load feeders.

The connection adapter is snapped onto the housing of the 3RF34 contactor and accommodates the fastening hooks of the 3RB3 overload relays or of the 3RR2 current monitoring relays when they are fitted directly.

Figure 11-4 3RF3900-0QA88 connection adapter to the overload relay

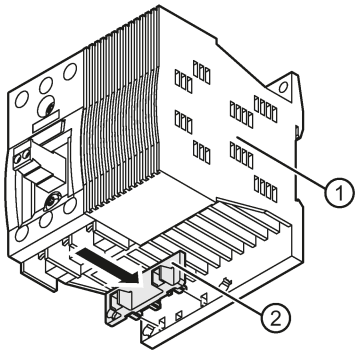
11.4.2 Mounting/disassembly

Mounting/disassembly of the connection adapter to the overload relay

Before an overload relay can be attached to the solid-state contactor/solid-state reversing contactor, a connection adapter must be installed between the two devices. The insulated design of the devices means that grounding is not required.

Side-by-side mounting facilitates the installation of several devices one next to the other. The devices can be mounted with screws or snapped onto DIN rails.

The example in the figure below illustrates the mounting of the connection adapter on a solid-state contactor.



① Solid-state contactor

② Connection adapter

Setup: overload relay, connection adapter, solid-state contactor

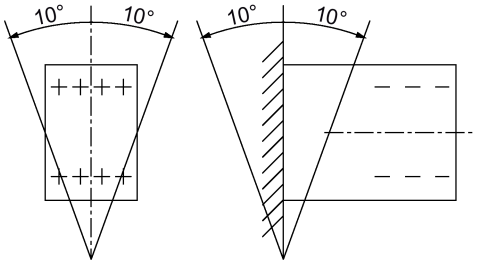
Technical data

12

12.1 General data

Table 12- 1 Solid-state switching devices - General data

General data		
Ambient temperature		
Operation, derating as of 40 °C	°C	- 25 to + 60
Storage	°C	- 55 to + 80
Installation altitude	m	0 to 1000; at > 1,000 m seek advice from Technical Assistance (www.siemens.com/industrial-controls/technical-assistance)
Shock resistance according to DIN IEC 60068-2-27	*g*/ms	15/11
Vibration resistance; acc. to DIN IEC 60068-2-6	*g*	2
Degree of protection		IP20
Electromagnetic compatibility (EMC)		
• Emitted interference acc. to DIN IEC 60947-4-2		
- Conducted interference		Class A for industrial environments[1)]
- Emitted high-frequency interference voltage		Class A for industrial environments
• Immunity[2)]		
- Electrostatic discharge acc. to DIN IEC 61000-4-2 (corresponds to severity 3)	kV	Contact discharge: 4; air discharge: 8; behavior criterion 2
- Induced conducted RF fields acc. to DIN IEC 61000-4-6	MHz	0.15 to 80, 140 dBµV, behavior criterion 1
- High-frequency, electromagnetic fields acc. to DIN IEC 61000-4-3	MHz	80 to 3,000; test level 10 V/m; behavior criterion 1
- Burst acc. to DIN IEC 61000-4-4	kV	2/5.0 kHz; behavior criterion 1
- Surge acc. to DIN IEC 61000-4-5[3)]	kV	Conductor - protective conductor 2; conductor - conductor: 1; behavior criterion 2
Connection type		
• Solid-state contactor		Screw-type and spring-loaded
• Solid-state reversing contactor		Screw-type connection system

General data			
Permissible mounting position			
Insulation strength at 50/60 Hz (main/control circuit to floor)	V rms	4000	

1) These products are Class A products. Their use in residential areas can cause radio frequency interference. In this case, the user can be held liable for taking additional measures to attenuate such interference.

2) Running star-connected three-phase motors (particularly < 1 kW) with electromechanical contactors can cause significant electromagnetic interference. Such interference can cause solid-state reversing contactors being used in the vicinity to malfunction. Provision should be made for appropriate EMC surge suppressors on the sources of interference. Suitable surge suppressors are described in Chapter 6 of Catalog IC10.

3) For solid-state reversing contactors, the following applies: To maintain the values a 3TX7 462-3L surge suppressor (see Catalog IC10) should be used between phases L1 and L3, as close as possible to the reversing contactor.

Reference

More information ...	Can be found in the chapter titled ...
About the environments in which solid-state switching devices are used	Application environment (Page 18)

12.2 Conductor cross-sections for solid-state contactors

Conductor cross-sections for solid-state contactors

Table 12- 2 Connection of main contacts with screw-type connection system or spring-loaded connection system

Connection, main contacts		Screw connection	Spring-loaded connection
Conductor cross-section			
• Solid	mm²	2 x (1.5 to 2.5), 2 x (1.5 to 6)	2 x (0.5 to 2.5)
• Finely stranded with end sleeve	mm²	2 x (1.5 to 2.5), 2 x (1.5 to 6)	2 x (0.5 to 1.5)
• Finely stranded without end sleeve	mm²	1 x 10	2 x (0.5 to 2.5)
• Solid or stranded	AWG	2 x (14 to 10)	2 x (18 to 14)
Stripped length	mm	10	10
Connection screw		M4	—
Tightening torque	Nm	2 to 2.5	—
D 5 to 6 mm/PZ 2	lb in	18 to 22	—

Table 12- 3 Connection of main contacts and control contacts with screw-type connection system or spring-loaded connection system

Connection, auxiliary contacts, and control contacts		Screw connection	Spring-loaded connection
Conductor cross-section with end sleeve	mm²	1 x (0.5 to 2.5),	0.5 to 2.5
Conductor cross-section without end sleeve	mm²	2 x (0.5 to 1.0)	
	AWG	20 to 12	20 to 12
Stripped length	mm	7	10
Connection screw		M3	—
Tightening torque	Nm	0.5 to 0.6	—
D 3.5/PZ 1	lb in	4.5 to 5.3	—

Reference

More information ...	Can be found in the chapter titled ...
About connection systems and terminal designations	Connection (Page 49)

12.3 Conductor cross-sections for solid-state reversing contactors

Conductor cross-sections for solid-state reversing contactors

Table 12- 4 Connection of main terminals with screw-type connection system

Connection, main contacts		Screw-type connection system
Conductor cross-section		
• Solid	mm²	2 x (1.5 to 2.5), 2 x (1.5 to 6)
• Finely stranded with end sleeve	mm²	2 x (1.5 to 2.5), 2 x (1.5 to 6)
• Finely stranded without end sleeve	mm²	1 x 10
• Solid or stranded	AWG	2 x (14 to 10)
Stripped length	mm	10
Connection screw		M4
Tightening torque	Nm	2 to 2.5
D 5 to 6 mm/PZ 2	lb.in	18 to 22

Table 12- 5 Connection of main contacts and control contacts with screw-type connection system

Connection, auxiliary contacts, and control contacts		Screw-type connection system
Conductor cross-section with end sleeve	mm²	1 x (0.5 to 2.5)
Conductor cross-section without end sleeve	mm²	2 x (0.5 to 1.0)
	AWG	20 to 12
Stripped length	mm	7
Connection screw		M3
Tightening torque	Nm	0.5 to 0.6
D 3.5/PZ 1	lb.in	4.5 to 5.3

Reference

More information ...	Can be found in the chapter titled ...
About connection systems and terminal designations	Connection (Page 49)

12.4 Solid-state contactors 3RF34, 3-phase, screw connection

Solid-state contactors - instantaneous switching - 2-phase controlled

Table 12- 6 Rated operational voltage U_e 48 to 480 V

		3RF3405-1BB04	3RF3410-1BB04	3RF3412-1BB04	3RF3416-1BB04
Connection type		Screw connection			
Rated operational current I_e	A	5.2	9.2	12.5	16
Rated power at I_e and U_e 400 V	kW	2.2	4.0	5.5	7.5
Rated control supply voltage U_s	V	DC 24 acc to. EN 61131-2			
Weight approx.	kg	0.250	0.380	0.380	0.380

Table 12- 7 Rated operational voltage U_e 48 to 480 V

		3RF3405-1BB24	3RF3410-1BB24	3RF3412-1BB24	3RF3416-1BB24
Connection type		Screw connection			
Rated operational current I_e	A	5.2	9.2	12.5	16
Rated power at I_e and U_e 400 V	kW	2.2	4.0	5.5	7.5
Rated control supply voltage U_s	V	AC 110 to 230			
Weight approx.	kg	0.250	0.380	0.380	0.380

Table 12- 8 Rated operational voltage U_e 48 to 600 V, blocking voltage 1,600 V

		3RF3405-1BB06	3RF3410-1BB06	3RF3412-1BB06	3RF3416-1BB06
Connection type		Screw connection			
Rated operational current I_e	A	5.2	9.2	12.5	16
Rated power at I_e and U_e 400 V	kW	2.2	4.0	5.5	7.5
Rated control supply voltage U_s	V	DC 24 acc to. EN 61131-2			
Weight approx.	kg	0.250	0.380	0.380	0.380

Table 12- 9 Rated operational voltage U_e 48 to 600 V, blocking voltage 1,600 V

		3RF3405-1BB26	3RF3410-1BB26	3RF3412-1BB26	3RF3416-1BB26
Connection type		Screw connection			
Rated operational current I_e	A	5.2	9.2	12.5	16
Rated power at I_e and U_e 400 V	kW	2.2	4.0	5.5	7.5
Rated control supply voltage U_s	V	AC 110 to 230			
Weight approx.	kg	0.250	0.380	0.380	0.380

12.5 Solid-state contactors 3RF34, 3-phase, spring-loaded terminals

Solid-state contactors - instantaneous switching - 2-phase controlled

Table 12- 10 Rated operational voltage U_e 48 to 480 V

		3RF3405-2BB04	3RF3410-2BB04	3RF3412-2BB04	3RF3416-2BB04
Connection type		Spring-loaded terminals			
Rated operational current I_e	A	5,2	9,2	12,5	16
Rated power at I_e and U_e 400 V	kW	2,2	4,0	5,5	7,5
Rated control supply voltage U_s	V	DC 24 acc. to EN 61131-2			
Weight approx.	kg	0,250	0,380	0,380	0,380

Table 12- 11 Rated operational voltage U_e 48 to 480 V

		3RF3405-2BB24	3RF3410-2BB24	3RF3412-2BB24	3RF3416-2BB24
Connection type		Spring-loaded terminals			
Rated operational current I_e	A	5,2	9,2	12,5	16
Rated power at I_e and U_e 400 V	kW	2,2	4,0	5,5	7,5
Rated control supply voltage U_s	V	AC 110 to 230			
Weight approx.	kg	0,250	0,380	0,380	0,380

Table 12- 12 Rated operational voltage U_e 48 to 600 V, blocking voltage 1,600 V

		3RF3405-2BB06	3RF3410-2BB06	3RF3412-2BB06	3RF3416-2BB06
Connection type		Spring-loaded terminals			
Rated operational current I_e	A	5,2	9,2	12,5	16
Rated power at I_e and U_e 400 V	kW	2,2	4,0	5,5	7,5
Rated control supply voltage U_s	V	DC 24 acc. to EN 61131-2			
Weight approx.	kg	0,250	0,380	0,380	0,380

Table 12- 13 Rated operational voltage U_e 48 to 600 V, blocking voltage 1,600 V

		3RF3405-2BB26	3RF3410-2BB26	3RF3412-2BB26	3RF3416-2BB26
Connection type		Spring-loaded terminals			
Rated operational current I_e	A	5,2	9,2	12,5	16
Rated power at I_e and U_e 400 V	kW	2,2	4,0	5,5	7,5
Rated control supply voltage U_s	V	AC 110 to 230			
Weight approx.	kg	0,250	0,380	0,380	0,380

Reference

More information ...	Can be found in the chapter titled ...
About connection systems and terminal designations	Connection (Page 49)
About derating of the rated operational current at high starting current conditions	Application environment (Page 18)

12.6 Solid-state contactors - fuseless design with CLASS 10 motor starter protector

Fuseless design with CLASS 10 motor starter protector

Table 12- 14 Main circuit

Order no.		3RF3405-.BB..	3RF3410-.BB..	3RF3412-.BB..	3RF3416-.BB..
Rated operational current I_{AC-53} [1] acc. to IEC 60947-4-2					
At 40 °C	A	5.2 (4.5) [2]	9.2	12.5	16
At 50℃	A	4.6 (4.0) [2]	8.4	11.5	14
At 60 °C	A	4.2 (3.5) [2]	7.6	10.5	12.5
Power loss at I_{AC-53} at 40 °C	W	10 (8) [2]	16	22	28
Short-circuit protection with type of coordination "1" at operational voltage U_e up to 440 V					
Motor starter protector	Type	3RV2011-1GA10	3RV2011-1JA10	3RV2011-1KA10	3RV2011-4AA10
I_q	kA	50	5	5	3

[1] Use overvoltage protection device; max. cut-off-voltage 6,000 V; min. energy handling capability 100 J

[2] The reduced values in brackets apply in the case of a directly mounted motor starter protector combined with side-by-side mounting.

12.7 Solid-state contactors - fused design with 3RB30 overload relay

Fused design with directly mounted 3RB30 overload relay

Table 12- 15 Main circuit

Order no.		3RF3405-.BB.4	3RF3405-.BB.6	3RF3410-.BB..
Rated operational current I_{AC-53} 1) acc. to IEC 60947-4-2				
At 40 °C	A	4 (3.5) 2)	4 (3.5) 2)	7.8
UL/CSA at 50 °C	A	3.6 (3.2) 2)	3.6 (3.2) 2)	7
At 60 °C	A	3.2 (2.9) 2	3.2 (2.9) 2	6.2
Power loss at I_{AC-53} at 40 °C	W	7 (6) 2)	7 (6) 2)	13
Minimum load current	A	0.1	0.5	0.5
Max. leakage current	mA	10	10	10
Rated peak withstand current I_{tsm}	A	200	600	600
I^2t value	A^2s	200	1800	1800

Table 12- 16 Main circuit

Order no.		3RF3412-.BB.4	3RF3412-.BB.6	3RF3416-.BB..
Rated operational current I_{AC-53} 1) acc. to IEC 60947-4-2				
At 40 °C	A	9.5	9.5	11
UL/CSA at 50 °C	A	8.5	8.5	10
At 60 °C	A	7.6	7.6	9
Power loss at I_{AC-53} at 40 °C	W	16	16	18
Minimum load current	A	0.5	0.5	0.5
Max. leakage current	mA	10	10	10
Rated peak withstand current I_{tsm}	A	1200	1150	1150
I^2t value	A^2s	7200	6600	6600

1) Use overvoltage protection device; max. cut-off-voltage 6,000 V; min. energy handling capability 100 J

2) The reduced values in brackets apply in the case of a directly mounted motor starter protector combined with side-by-side mounting.

12.8 Solid-state contactors - main circuit, 2-phase controlled

Solid-state contactor, 2-phase controlled

Table 12- 17 Main circuit

Order no.		3RF34..- BB.4	3RF34..- BB.6
Controlled phases		2-phase	2-phase
Rated operational voltage U_e			
Operating range	V	40 ... 506	40 ... 660
Rated frequency	Hz	50 / 60 ± 10 %	50 / 60 ± 10 %
Rated insulation voltage U_s	V	600	600
Rated impulse withstand voltage U_{imp}	kV	6	6
Blocking voltage	V	1200	1600
Voltage gradient	V/µs	1000	1000

12.9 Solid-state contactors with control circuit

Solid-state contactor with control circuit

Table 12- 18 Control circuit A1 - A2:

Order no.		3RF34..- BB0.	3RF34..- BB2.
Method of operation		DC operation	AC operation
Rated control supply voltage *Us*	V	DC 24 acc to. EN 61131-2	AC 110 to 230
Rated control supply voltage, max. *Us*	V	DC 30	AC 253
Rated frequency of control supply voltage	Hz	—	50 / 60 ± 10 %
Typical actuating current	mA	20	15
Response voltage	V	15	90
Drop-out voltage	V	5	< 40
Switching times			
• ON-delay	ms	1	5
• OFF-delay	ms	1 + max. one half-wave	30 + max. one half-wave

12.10 Solid-state reversing contactor with integration of four current paths to form a single reversing circuit

Solid-state reversing contactor - instantaneous switching - 2-phase controlled - screw connection

Table 12- 19 Rated operational voltage U_e 48 to 480 V

Order no.		3RF34 03-1BD04	3RF34 05-1BD04	3RF34 10-1BD04
Rated operational current I_e	A	3,8	5,4	7,4
Rated power at I_e and U_e 400 V	kW	1,5	2,2	3,0
Rated control supply voltage U_s	V	DC 24 acc. to EN 61131-2		
Weight per PU approx.	kg	0,280	0,280	0,410

Table 12- 20 Rated operational voltage U_e 48 to 480 V

Order no.		3RF34 03-1BD24	3RF34 05-1BD24	3RF34 10-1BD24
Rated operational current I_e	A	3,8	5,4	7,4
Rated power at I_e and U_e 400 V	kW	1,5	2,2	3,0
Rated control supply voltage U_s	V	AC 110 to 230		
Weight per PU approx.	kg	0,280	0,280	0,410

Reference

More information ...	Can be found in the chapter titled ...
About derating of the rated operational current at high starting current conditions	Application environment (Page 18)

12.11 Solid-state contactors - fuseless design with CLASS 10 motor starter protector

Fuseless design with CLASS 10 motor starter protector

Table 12- 21 Main circuit

Order no.		3RF34 03-.BD.4	3RF34 05-.BD.4	3RF34 10-.BD.4
Rated operational current I_{AC-53}[1] acc. to IEC 60947-4-2				
at 40 °C	A	3.8 (3.4)	5.4 (4.8)	7.4
UL/CSA at 50 °C	A	3.5 (3.1)	5 (4.3)	6.8
at 60 °C	A	3.2 (2.8)	4.6 (3.8)	6.2
Power loss at I_{AC-53} at 40 °C	W	7 (6)	9 (8)	13
Short-circuit protection with type of coordination "1" at operational voltage U_e up to 440 V				
Motor starter protector	Type	3RV20 11-1FA10	3RV20 11-1GA10	3RV20 11-1JA10
I_q	kA	50	50	10

[1] The reduced values in brackets apply in the case of a directly mounted motor starter protector combined with side-by-side mounting.

[2] To reduce the risk of an inter-phase short circuit due to overvoltage, we recommend connecting a 3TX7 462-3L type varistor between phases L1 and L3, as close as possible to the switching device. We recommend a design with semiconductor protection to provide short-circuit protection.

12.12 Solid-state contactor - fused design with 3RB30 overload relay

Fused design with directly mounted 3RB30 overload relay

Table 12- 22 Main circuit

Order no.		3RF34 03-.BD.4	3RF34 05-.BD.4	3RF34 10-.BD.4
Rated operational current I_{AC-53}[1] acc. to IEC 60947-4-2				
At 40 °C	A	3.8 (3.4)	5.4 (4.8)	7.4
UL/CSA at 50 °C	A	3.5 (3.1)	5 (4.3)	6.8
At 60 °C	A	3.2 (2.8)	4.6 (3.8)	6.2
Power loss at I_{AC-53} at 40 °C	W	7 (6)	9 (8)	13
Minimum load current	A	0.5	0.5	0.5
Max. leakage current	mA	10	10	10
Rated peak withstand current I_{tsm}	A	600	600	600
I^2t value	A^2s	1800	1800	1800

1) The reduced values in brackets apply in the case of a directly mounted motor starter protector combined with side-by-side mounting.

2) To reduce the risk of an inter-phase short circuit due to overvoltage, we recommend connecting a 3TX7 462-3L type varistor between phases L1 and L3, as close as possible to the switching device. We recommend a design with semiconductor protection to provide short-circuit protection.

12.13 Solid-state reversing contactor - main circuit, 2-phase controlled

Solid-state reversing contactor, 2-phase controlled

Table 12- 23 Main circuit

Order no.		3RF34..- BD.4
Controlled phases		2-phase
Rated operational voltage		
Operating range U_e	V	40 ... 506
Rated frequency	Hz	50 / 60 ± 10 %
Rated insulation voltage U_s	V	600
Rated impulse withstand voltage U_{imp}	kV	6
Blocking voltage	V	1200
Voltage gradient	V/µs	1000

12.14 Solid-state reversing contactor with control circuit

Solid-state reversing contactor with control circuit

Table 12- 24 Control circuit A1 - A2:

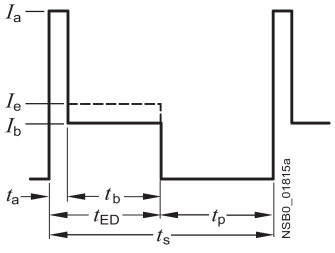
Order no.		3RF34..- BD0.	3RF34..- BD2.
Method of operation		DC operation	AC operation
Rated control supply voltage *Us*	V	DC 24 acc to. EN 61131-2	AC 110 to 230
Rated control supply voltage, max. *Us*	V	DC 30	AC 253
Rated frequency of control supply voltage	Hz	—	50 / 60 ± 10 %
Typical actuating current	mA	20	15
Response voltage	V	15	90
Drop-out voltage	V	5	< 40
Switching times			
• ON-delay	ms	5	20
• OFF-delay	ms	5 + max. one half-wave	10 + max. one half-wave
• Locking time	ms	60 - 100	50 - 100

12.15 Characteristics - switching frequency/load

12.15.1 Characteristics for the solid-state contactor

Switching frequency characteristic for the solid-state contactor

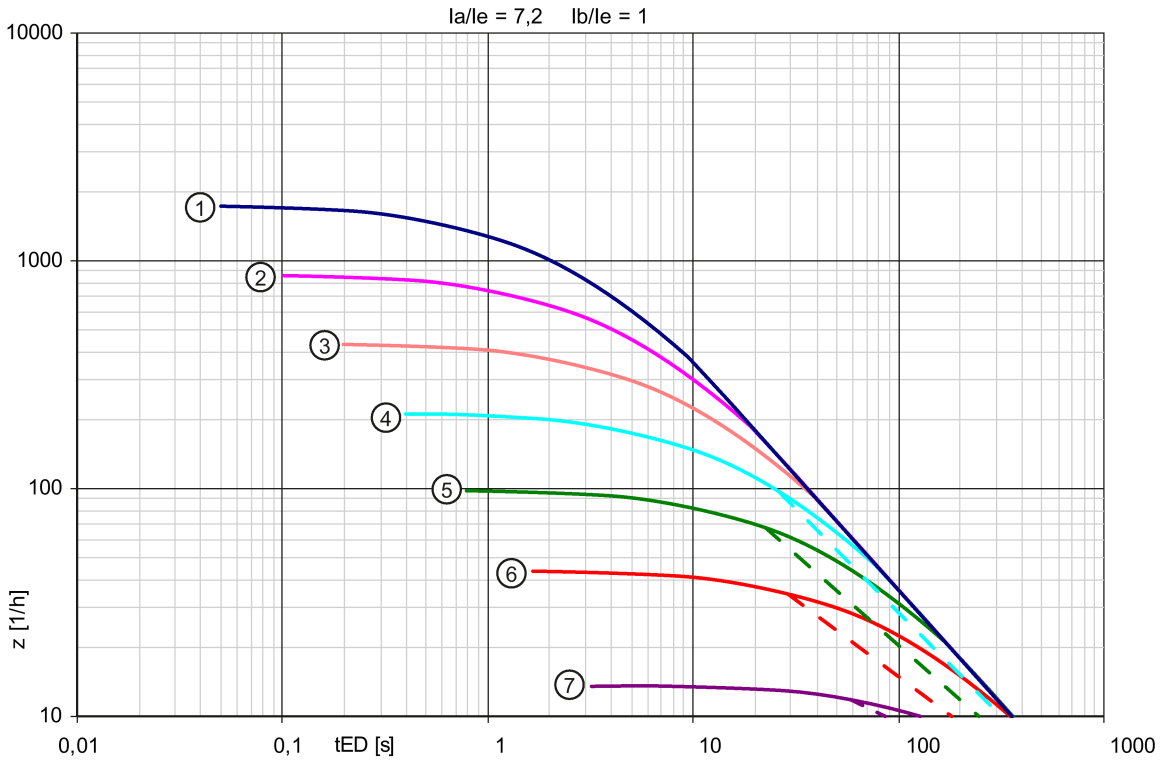
Motor's operating data



I_a Motor's direct starting current
I_e Motor's rated operational current
I_b Motor's operational current
t_a Motor's start time
t_b Operating time
t_p Idle time
t_{ED} ON period
t_s Operating cycle

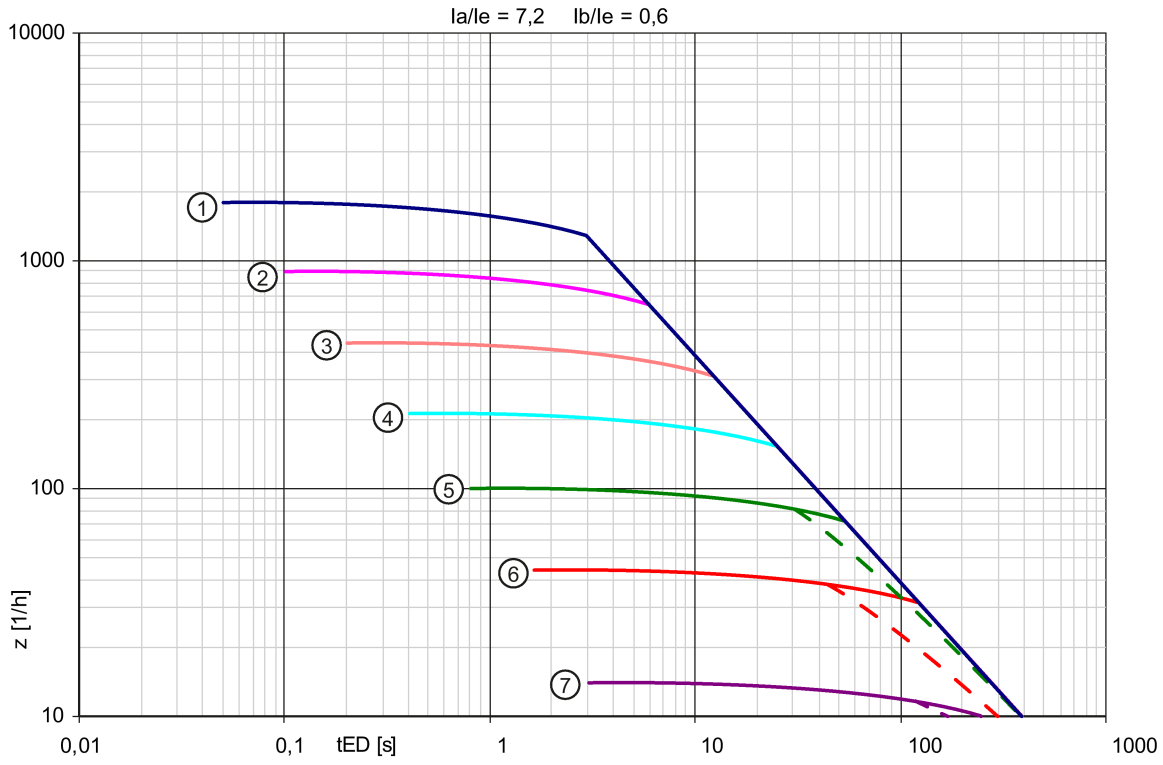
$$ED\ [\%] = \frac{t_{ED}}{t_s} \times 100\%$$

Figure 12-1 Switching frequency characteristics - load diagram



1 t_a = 0.05 s
2 t_a = 0.1 s
3 t_a = 0.2 s
4 t_a = 0.4 s
5 t_a = 0.8 s
6 t_a = 1.6 s
7 t_a = 3.2 s

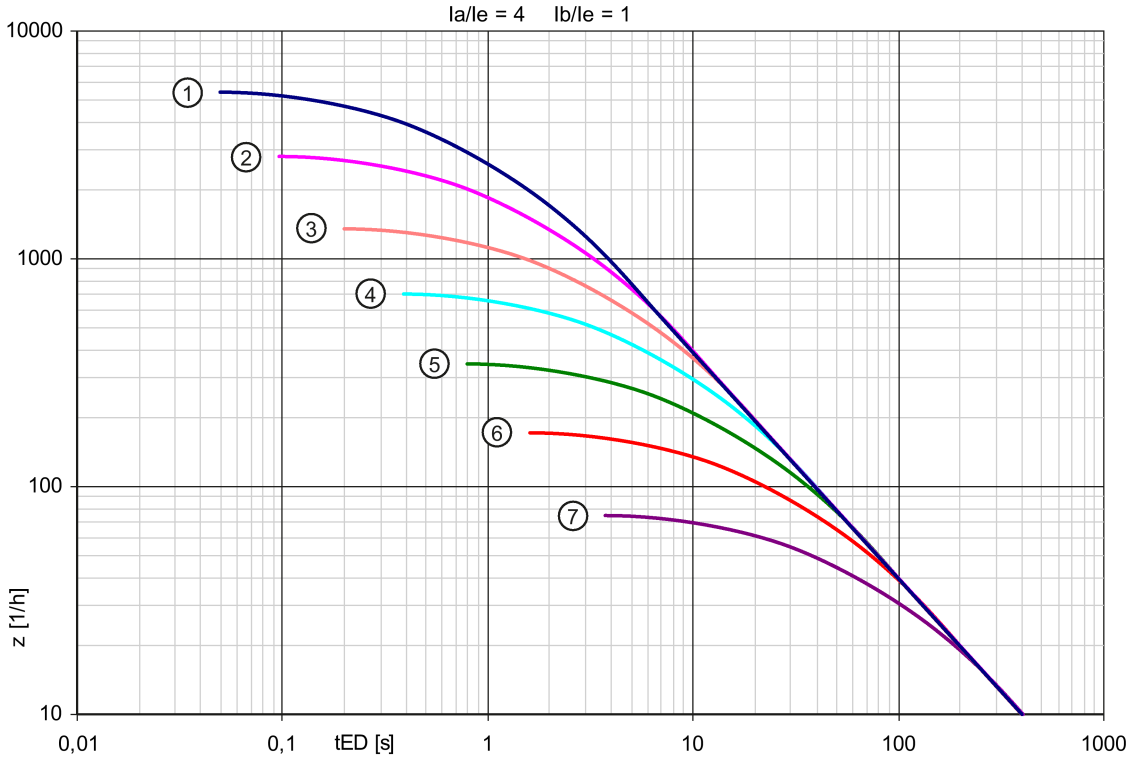
Figure 12-2 Maximum permissible switching frequency z depending on the starting time t_a and the ON period t_{ED} for motors with a starting current of 4 to 7.2 times the rated current and with full load [1)]



1 t_a = 0.05 s
2 t_a = 0.1 s
3 t_a = 0.2 s
4 t_a = 0.4 s
5 t_a = 0.8 s
6 t_a = 1.6 s
7 t_a = 3.2 s

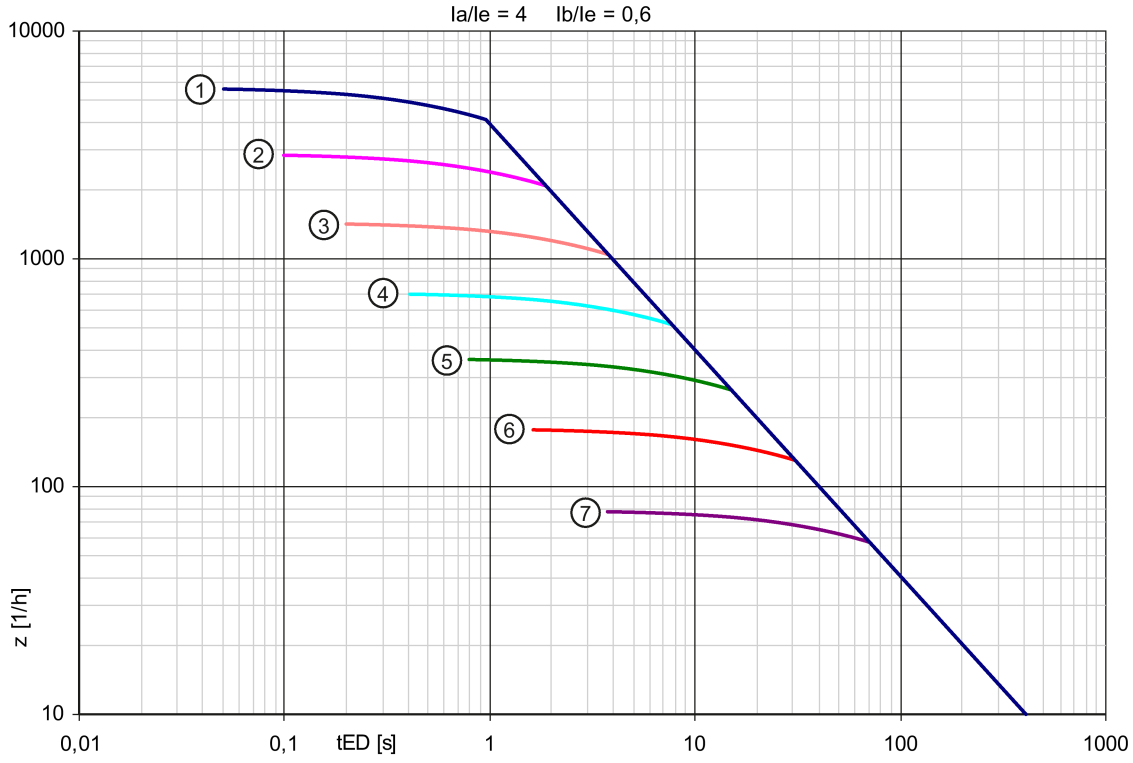
Figure 12-3 Maximum permissible switching frequency z depending on the starting time t_a and the ON period t_{ED} for motors with a starting current of 4 to 7.2 times the rated current and 60% load [1)]

[1)] The dashed curves apply to the high currents during operation with a motor starter protector.



1 t_a = 0.05 s
2 t_a = 0.1 s
3 t_a = 0.2 s
4 t_a = 0.4 s
5 t_a = 0.8 s
6 t_a = 1.6 s
7 t_a = 3.2 s

Figure 12-4 Maximum permissible switching frequency z depending on the starting time t_a and the ON period t_{ED} for motors with a starting current of up to 4 times the rated current and with full load



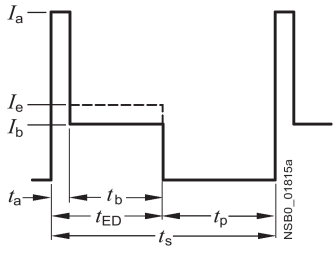
1 t_a = 0.05 s
2 t_a = 0.1 s
3 t_a = 0.2 s
4 t_a = 0.4 s
5 t_a = 0.8 s
6 t_a = 1.6 s
7 t_a = 3.2 s

Figure 12-5 Maximum permissible switching frequency z depending on the starting time t_a and the ON period t_{ED} for motors with a starting current of up to 4 times the rated current and 60% load

12.15.2 Characteristics for the solid-state reversing contactor

Switching frequency characteristic for the solid-state reversing contactor

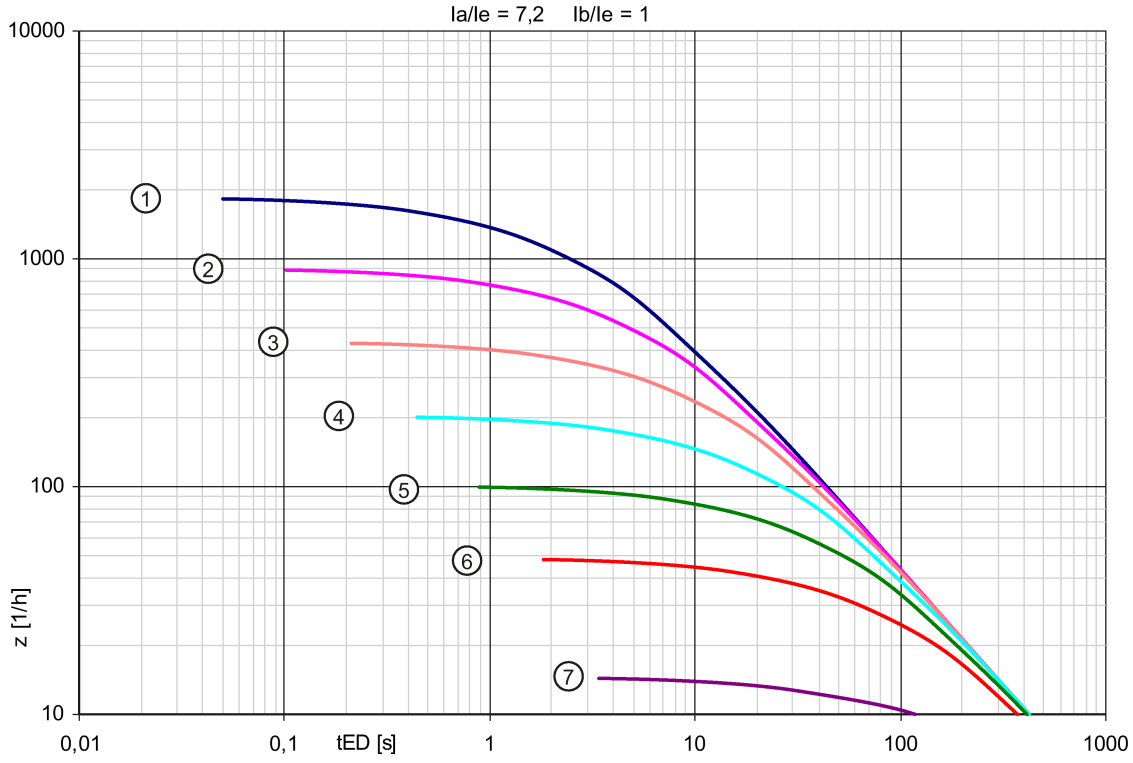
Motor's operating data



I_a Direct-on-line starting current
I_e Rated operational current
I_b Operating current
t_a Start time
t_a Operating time
t_p Idle time
t_{ED} ON period
t_s Operating cycle

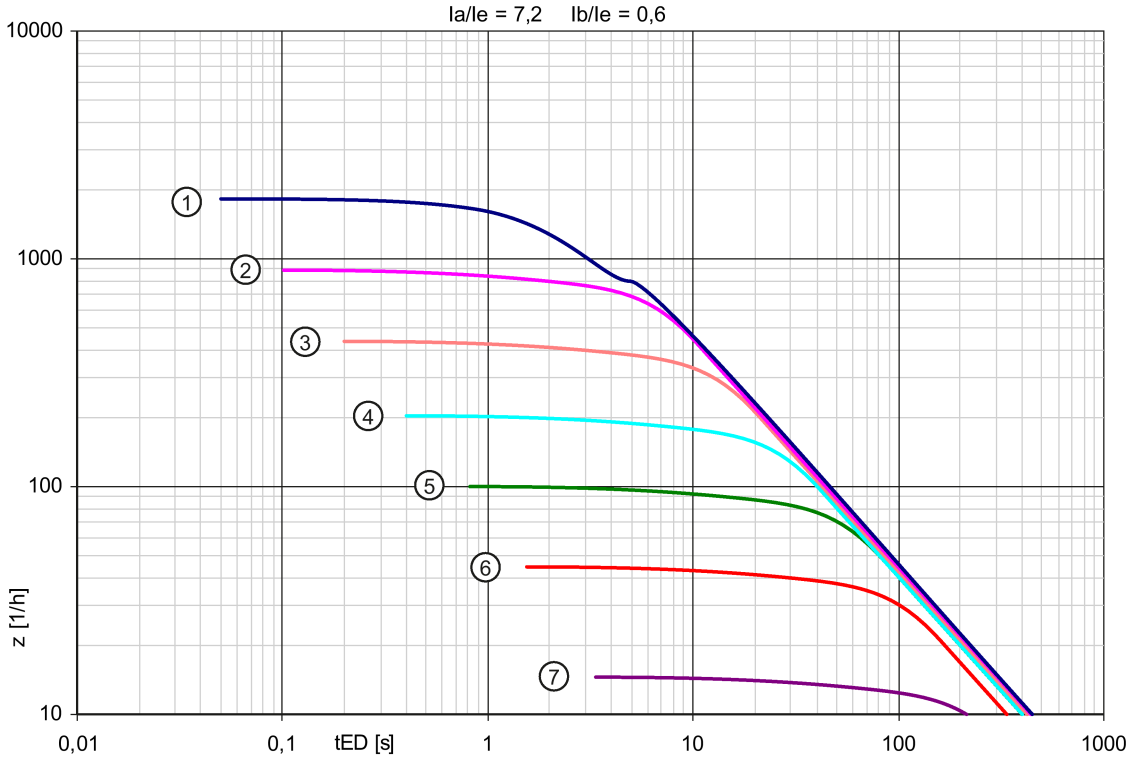
$$\text{ED [\%]} = \frac{t_{ED}}{t_s} \times 100\%$$

Figure 12-6 Switching frequency characteristics - load diagram



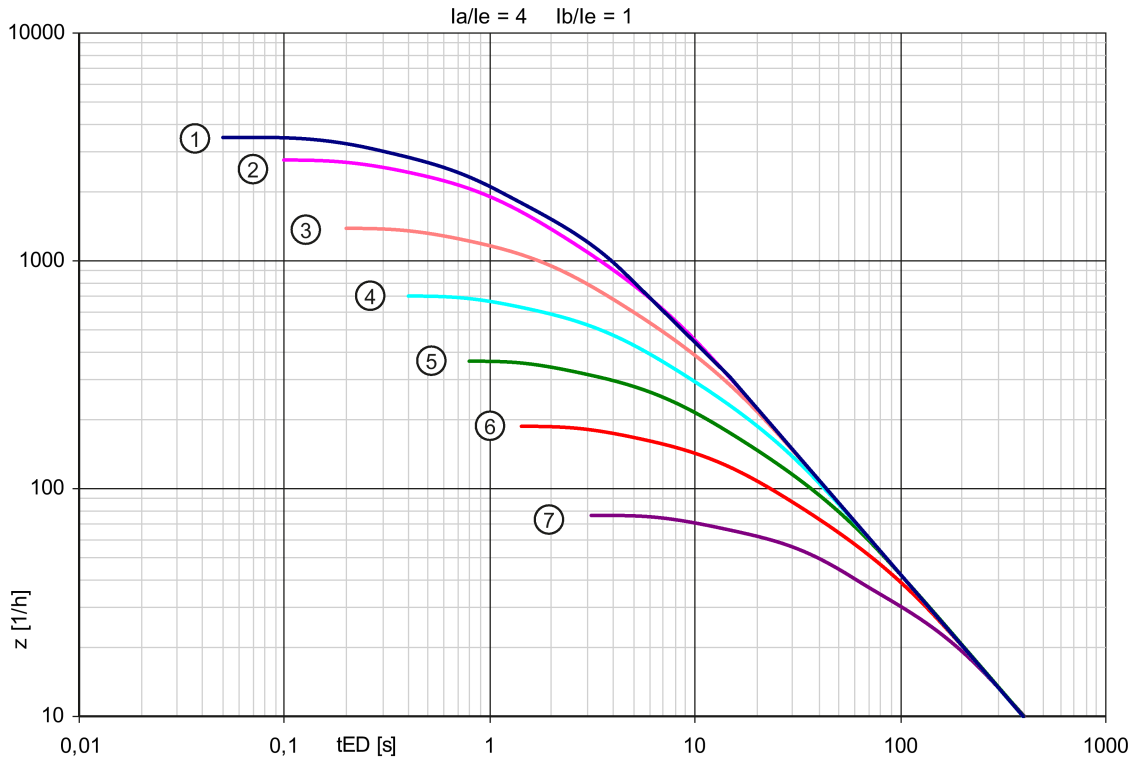
1 t_a = 0.05 s
2 t_a = 0.1 s
3 t_a = 0.2 s
4 t_a = 0.4 s
5 t_a = 0.8 s
6 t_a = 1.6 s
7 t_a = 3.2 s

Figure 12-7 Maximum permissible switching frequency z depending on the starting time t_a and the ON period t_{ED} for motors with a starting current of 4 to 7.2 times the rated current and with full load



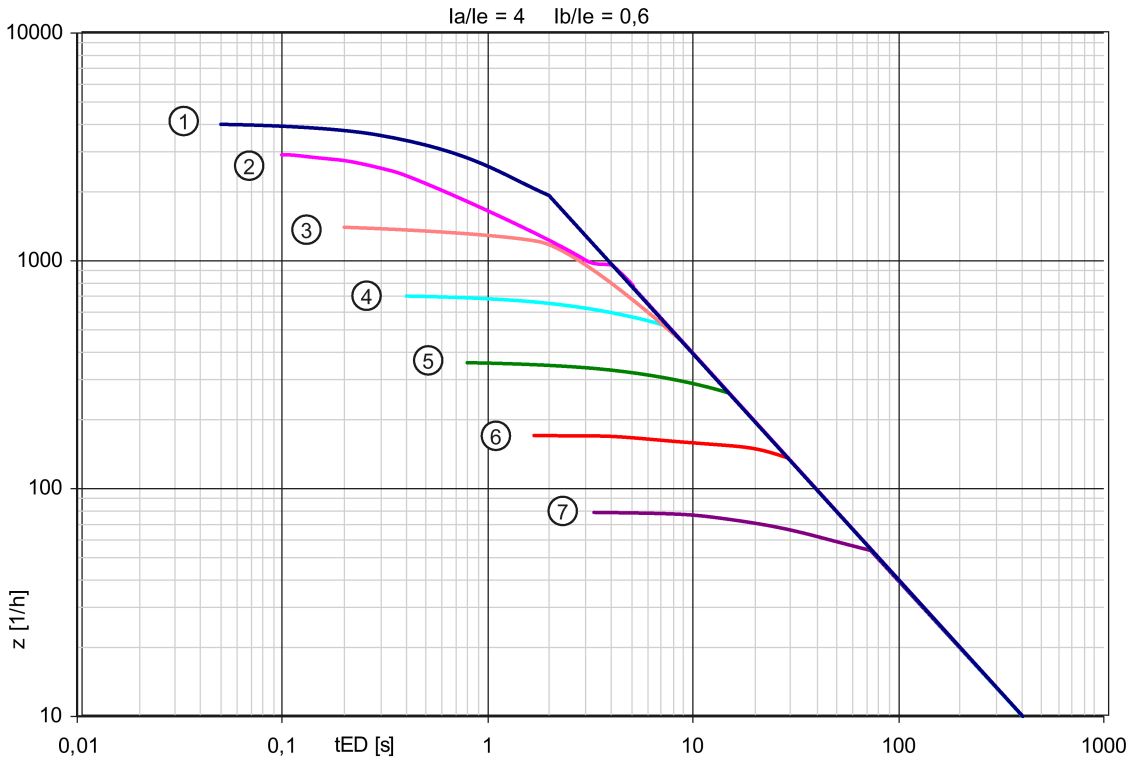
1 t_a = 0.05 s
2 t_a = 0.1 s
3 t_a = 0.2 s
4 t_a = 0.4 s
5 t_a = 0.8 s
6 t_a = 1.6 s
7 t_a = 3.2 s

Figure 12-8 Maximum permissible switching frequency z depending on the starting time t_a and the ON period t_{ED} for motors with a starting current of 4 to 7.2 times the rated current and 60% load



1 t_a = 0.05 s
2 t_a = 0.1 s
3 t_a = 0.2 s
4 t_a = 0.4 s
5 t_a = 0.8 s
6 t_a = 1.6 s
7 t_a = 3.2 s

Figure 12-9 Maximum permissible switching frequency z depending on the starting time t_a and the ON period t_{ED} for motors with a starting current of up to 4 times the rated current and with full load



1 t_a = 0.05 s
2 t_a = 0.1 s
3 t_a = 0.2 s
4 t_a = 0.4 s
5 t_a = 0.8 s
6 t_a = 1.6 s
7 t_a = 3.2 s

Figure 12-10 Maximum permissible switching frequency z depending on the starting time t_a and the ON period t_{ED} for motors with a starting current of up to 4 times the rated current and 60% load

Circuit diagrams

13

Internal circuit diagrams

You can find the internal circuit diagrams for SIRIUS Innovations products online in the image database (www.siemens.com/industrial-controls/bilddb).

Enter the order number of the device in the "Order number" field and, in the "Type of object" selection menu on the left-hand side, select "Unit wiring diagram".

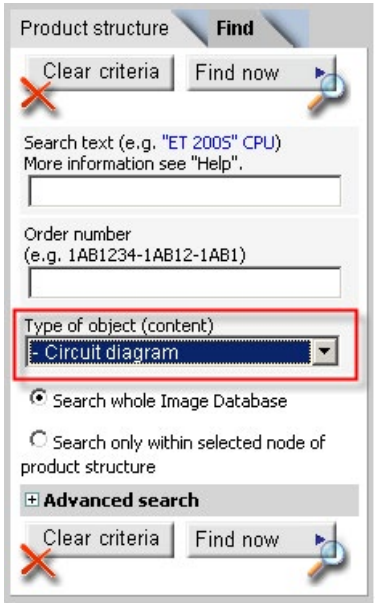


Figure 13-1 Image database

3RF34 solid-state switching devices

3RF34..-.BB2.

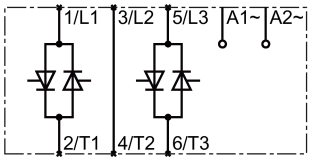


Figure 13-2 Solid-state contactor, 3-phase, AC control voltage

3RF34..-.BD2.

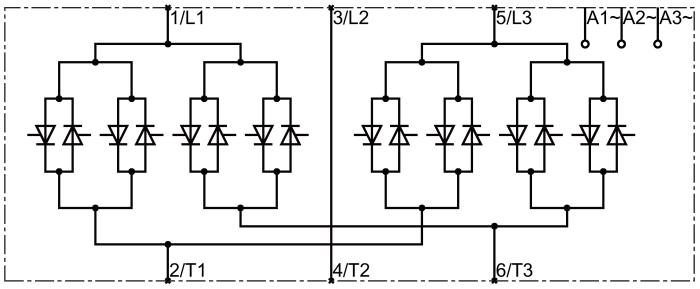


Figure 13-3 Solid-state reversing contactor, 3-phase, AC control voltage

3RF34..-.BB0.

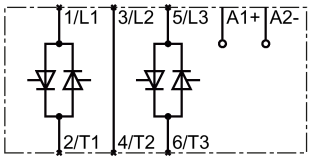


Figure 13-4 Solid-state contactor, 3-phase, DC control voltage

3RF34..-.BD0.

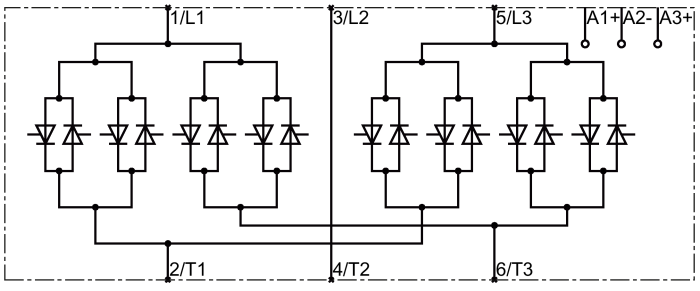
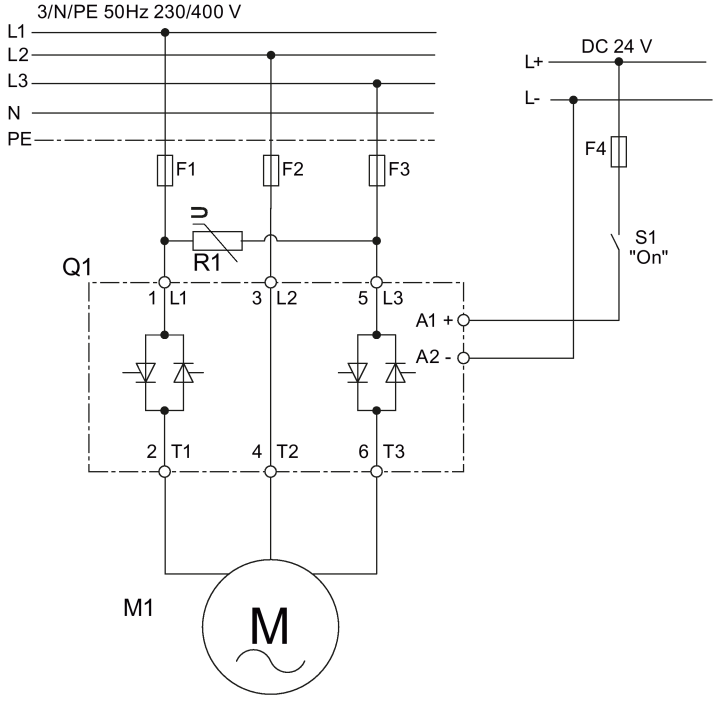


Figure 13-5 Solid-state reversing contactor, 3-phase, DC control voltage

Example circuit diagrams

The figures below show the example circuit diagrams for the solid-state contactors and solid-state reversing contactors

Example circuit diagram for the solid-state contactor for motorized loads



F1 - 3 Main circuit fuses (solid-state contactor recommended)

F4 Control circuit fuse

Q1 3RF34 solid-state contactor for motorized loads

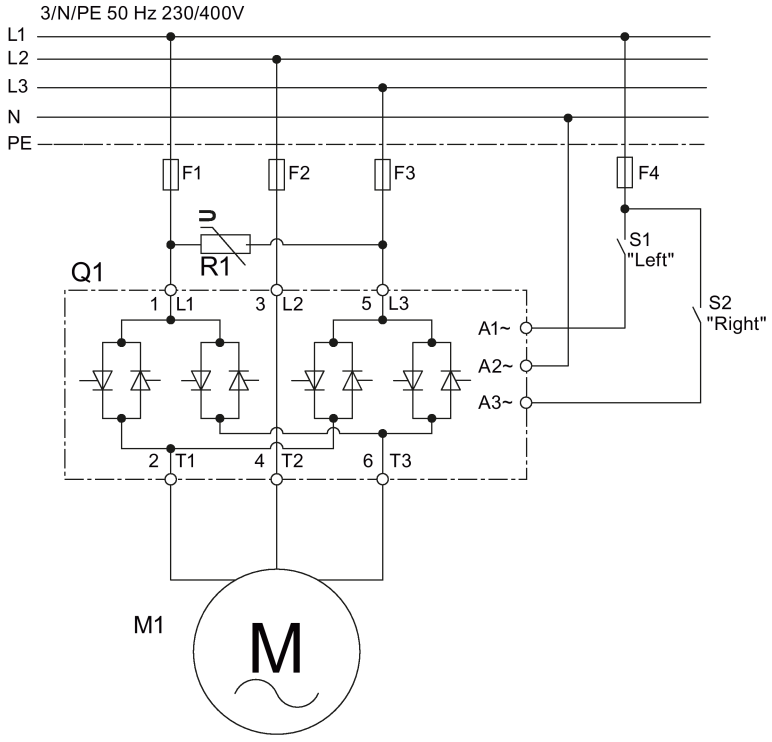
M1 Motor

R1 Varistor 3TX7 462-3L (recommended to maintain "surge" immunity)

S1 "ON" switch

Figure 13-6 Example circuit diagram: Fused motor feeder with solid-state contactor for motorized loads with DC control circuit

Example circuit diagram for the solid-state reversing contactor



F1 - 3 Main circuit fuses (solid-state contactor recommended)

F4 Control circuit fuse

Q1 3RF34 solid-state reversing contactor

M1 Motor

R1 Varistor 3TX7 462-3L (recommended to maintain "surge" immunity)

S1 "Left" switch

S2 "Right" switch

Figure 13-7 Example circuit diagram: Fused motor feeder with solid-state reversing contactor with AC control circuit

Types of coordination

A

Types of coordination

Standard DIN EN 60947-4-1 (VDE 0660 Part 102) or IEC 60947-4-1 distinguishes between two types of coordination (type of coordination), which are referred to as coordination type "1" and coordination type "2". In the case of both types of coordination, the short-circuit is reliably mastered. the only differences are in the extent of the damage sustained by the device following a short circuit.

Type of coordination 1

The load feeder may be non-operational after a short circuit has been cleared. Damage to the contactor and the overload release is also permissible.

Type of coordination 2

After short-circuit disconnection, there must be no damage to the overload release or to any other part. The load feeder can resume operation without needing to be renewed. Welding of the contactor contacts only is permitted if these can be separated easily without significant deformation.

References

B

B.1 References

Further references

You will find further information about the 3RF34 solid-state switching devices on the Internet (http://support.automation.siemens.com/WW/view/en/20368269/133300).

In addition to this manual, please refer to the operating instructions and manuals for any accessories. You can download the relevant documentation from the Internet (www.siemens.com/industrial-controls/manuals). Simply enter the order number of the relevant item into the search field.

Operating instructions

Title	Order number
SIRIUS solid-state contactors/solid-state reversing contactors (3RF34..-.BB.. and 3RF34..-.BD..)	3ZX1012-0RF34-2AA1

B.2 SIRIUS Innovations manuals

SIRIUS Innovations manuals

You can download the SIRIUS Innovations manuals from the Internet (www.siemens.com/industrial-controls/manuals).

Simply enter the order number of the relevant item into the search field.

Information about ...	Is available in ...
• SIRIUS Innovations - System Overview	• "SIRIUS Innovations - System Overview" manual (Order number: 3ZX1012-0RA01-5AC1)
• 3RT2, 3RH2, and 3RA23/24 contactors and contactor assemblies	• "SIRIUS Innovations - SIRIUS 3RT2 Contactors/Contactor Assemblies" manual (Order number: 3ZX1012-0RT20-5AB1)
• 3RF34 solid-state switching devices	• "SIRIUS Innovations - SIRIUS 3RF34 solid-state switching devices" manual (Order number: 3ZX1012-0RF34-5AC1)
• 3RW soft starters	• "SIRIUS 3RW30/3RW40 Soft Starters" (http://support.automation.siemens.com/WW/view/en/38752095) manual (Order number: 3ZX1012-0RW30-1AC1) • "SIRIUS 3RW44 Soft Starters" (http://support.automation.siemens.com/WW/view/en/21772518) manual (Order number.: 3ZX1012-0RW30-1AC1)
• 3RV2 motor starter protectors	• "SIRIUS Innovations - SIRIUS 3RV2 motor starter protector" manual (Order number: 3ZX1012-0RV20-5AC1)
• 3RU2, 3RB30/31 overload relays	• "SIRIUS Innovations - SIRIUS 3RU2/3RB3 overload relays" manual (Order number: 3ZX1012-0RU20-5AC1)
• 3RB24 electronic overload relay	• "3RB24 electronic overload relay for IO-Link" manual (Order number: 3ZX1012-0RB24-0AC0)
• 3UG4 monitoring relay/3RR2 current monitoring relay	• "3UG4/3RR2 monitoring relays" manual (Order number: 3ZX1012-0UG40-0AC0)
• 3RS1/3RS2 temperature monitoring relays	• "3RS1/3RS2 temperature monitoring relays" manual (Order number: 3ZX1012-0RS10-1AC1)
• 3UG48 monitoring relays	• "3UG48 monitoring relay for IO-Link" manual (Order number: 3ZX1012-0UG48-0AC1)
• 3RS14/3RS15 temperature monitoring relays	• "3RS14/3RS15 temperature monitoring relay for IO-Link" manual (Order number: 3ZX1012-0RS14-0AC0)

Information about ...	Is available in ...
• 3RA21/22 load feeders	• "SIRIUS Innovations - SIRIUS 3RA21/3RA22 load feeders" manual (Order number: 3ZX1012-0RA21-5AC1)
• 3RA6 compact starters	• "SIRIUS 3RA6 Compact Starter" (http://support.automation.siemens.com/WW/view/en/27865747) manual (order number: 3RA6992-0A)
• 3RA28 function modules for mounting on contactors	• "SIRIUS Innovations - SIRIUS 3RA28 function modules for mounting on 3RT2 contactors" (Order number: 3ZX1012-0RA28-5AC1)
• 3RA27 function modules for connection to the higher-level control	• "Function Modules for AS-Interface" (http://support.automation.siemens.com/WW/view/en/39318922) manual (order number: 3ZX1012-0RA27-0AC0) • "Function Modules for IO-Link" (http://support.automation.siemens.com/WW/view/en/39319600) manual (order number: 3ZX1012-0RA27-1AC1)
• 4SI SIRIUS electronic module (3RK1005-0LB00-0AA0)"	• "4SI SIRIUS electronic module (3RK1005-0LB00-0AA0)" manual (Order number:3ZX1012-0LB00-0AA1)

B.3 More information

More information

More information is available from Siemens on the Internet via the following links.

- **Product documentation**
  You will find a list of manuals/operating instructions, characteristic curves, and certificates on the Internet (www.siemens.com/industrial-controls/support).
- **Product information**
  Catalogs and other informative documents can be obtained from the Information Center and Download Center (www.siemens.com/industrial-controls/infomaterial).
- **Online ordering system**
  You will find the online ordering system with all the latest data on the ordering and information platform (www.siemens.com/industrial-controls/mall).
- **Technical Assistance**
  Siemens supports you with all technical product and system enquiries – both before and after delivery. You can access our Service & Support Portal on the Internet (www.siemens.com/industrial-controls/technical-assistance). You can also submit your question directly to a technical consultant using our support request service.

Dimension drawings (dimensions in mm)

C

Note

All dimensions are specified in mm.

C.1 Solid-state switching devices

Solid-state contactor

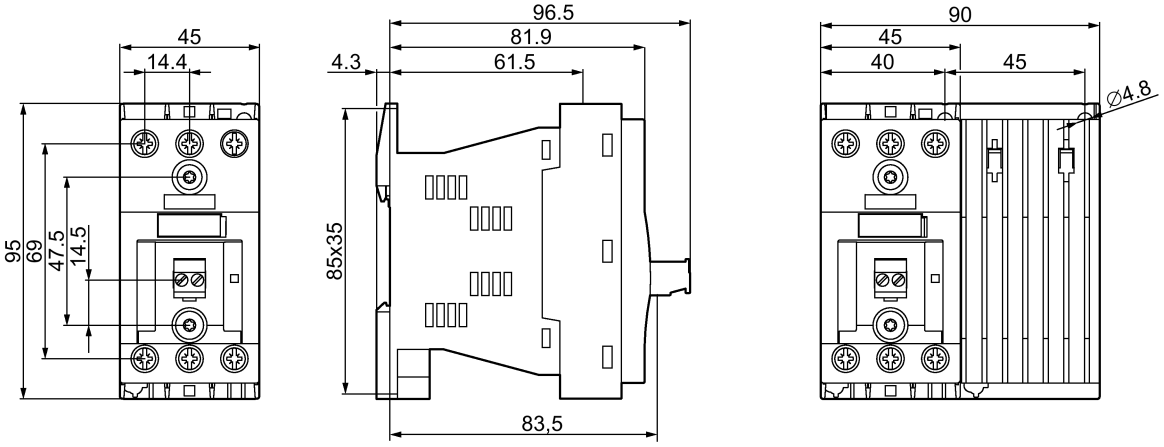


Figure C-1 Solid-state contactor

Solid-state reversing contactor

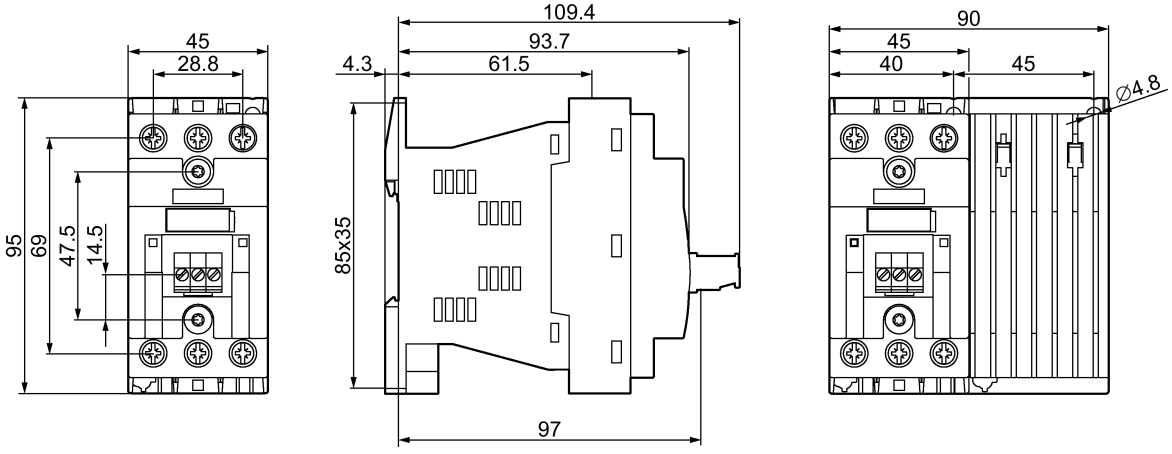


Figure C-2 Solid-state reversing contactor

C.2 Link module for motor starter protector

Accessories

Link module 3RA2921-1BA00 for 3RV20 motor starter protector

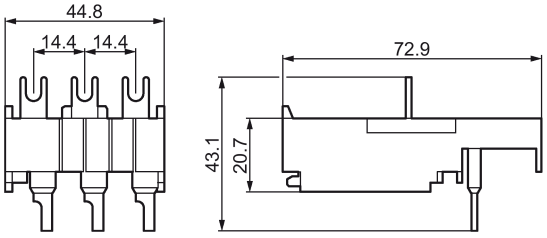


Figure C-3 Link module for motor starter protector

Correction sheet

D

Correction sheet

Have you noticed any errors while reading this manual? If so, please use this form to tell us about them. We welcome comments and suggestions for improvement.

Fax response

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Table D- 1 Errors, comments, and suggestions for improvements

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