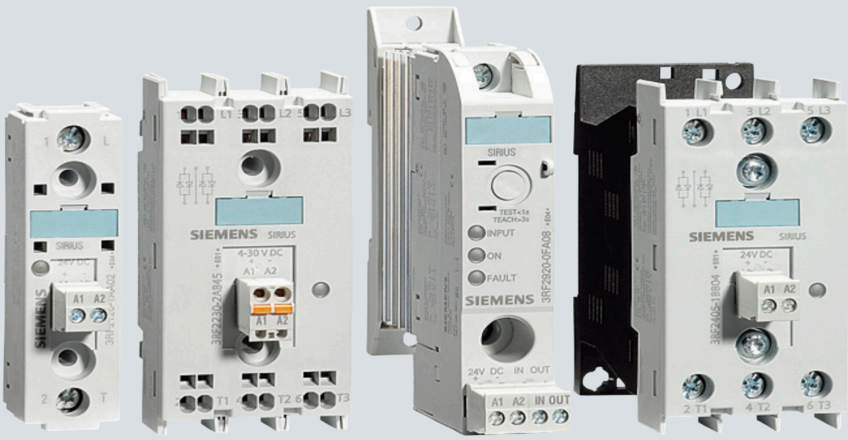
Controls

Solid-State Switching Devices

Reference Manual · April 2009



Low-Voltage Controls and Distribution

SIEMENS

Controls – Solid-State Switching Devices

Introduction

Overview

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3RF24 (Motor)

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Solid-state relays			
22.5 mm solid-state relays, 45 mm solid-state relays	• Widths of 22.5 mm and 45 mm • Compact and space-saving design • "Zero-point switching" version • Mounting onto existing heat sinks	3RF21, 3RF20 3RF22	9 15 19
Solid-state contactors			
Solid-state contactors	• Complete units comprising a solid-state relay and an optimized heat sink, "ready to use" • Compact and space-saving design • Versions for resistive loads "zero-point switching" and inductive loads "instantaneous switching" • Special versions "Low noise" and "Short-circuit resistant"	3RF23 3RF24	26 35
Function modules	For extending the functionality of the 3RF21 solid-state relays and the 3RF23 solid-state contactors for many different applications:		
Converters	• For converting an analog input signal into an on/off ratio; can also be used on 3RF22 and 3RF24 three-phase switching devices	3RF29 00-0EA18	46
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SIRIUS solid-state switching devices for switching motors			
Solid-state contactors			
Solid-state contactors, solid-state reversing contactors	• Complete units comprising in the insulated enclosure with integrated heat sink, "ready to use" • Compact and space-saving design • Version for motors, "instantaneous switching"	3RF24	55

Overview

SIRIUS 3RF2 solid-state switching devices

The 3RF solid-state switching devices reliably switch a wide range of different loads with alternating voltages in 50 and 60 Hz systems.

Solid-state switching devices for resistive loads

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

Solid-state switching devices for switching motors

- Solid-state contactors
- Solid-state reversing contactors

SIRIUS 3RF2 – for almost unending activity

Conventional electromechanical controlgear is often overtaxed by the rise in the number of switching operations. A high switching frequency results in frequent failure and short replacement cycles. However, this does not have to be the case, because with the latest generation of our SIRIUS 3RF2 solid-state switching devices we provide you with solid-state relays and contactors with a particularly long endurance – for almost unending activity even under the toughest conditions and under high mechanical load, but also in noise-sensitive areas.

Proved time and again in service

SIRIUS 3RF2 solid-state switching devices have firmly established in industrial applications. They are used above all in applications where loads are switched frequently – mainly with resistive load controllers, with the control of electrical heat or the control of valves and motors in conveyor systems. In addition to its use in areas with high switching frequencies, their silent switching means that SIRIUS is also ideally suited for use in noise-sensitive areas, such as offices or hospitals.

The most reliable solution for any application

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

Also for switching motors

In order to achieve higher productivity, the switching frequency is continuously increased. It is no problem for our SIRIUS solid-state contactors to switch motors. With induction motors up to 7.5 kW, they can reliably withstand even the highest switching frequencies. Even a continuous change in the direction of rotation is possible with the solid-state reversing contactors. Both versions can be perfectly combined with components from the SIRIUS modular system. Connecting with SIRIUS motor starter protectors or SIRIUS overload relay can be implemented without any further steps.

Always on the sunny side with SIRIUS

Because SIRIUS 3RF2 offers even more:

- The space-saving and compact side-by-side mounting ensures reliable operation up to an ambient temperature of +60 °C.
- Thanks to fast configuration and the ease of mounting and start-up, you save not only time but also expenses.

Connection methods

The devices are available with screw terminals (box terminals), spring-type terminals or ring terminal lugs.

	Screw terminals
	Spring-type terminals
	Ring terminal lug connections
	These connections are indicated in the Technical specifications by orange backgrounds.

General data

Overview

Type	Solid-state relays			Solid-state contactors		Function modules					
	Single-phase		Three-phase	Single-phase	Three-phase	Converters	Load monitoring		Heating current monitoring	Power controllers	Power regulators
	22.5 mm	45 mm	45 mm				Basic	Extended			
Usage											
Simple use of existing solid-state relays	❑	✓	❑	❑	❑	--	--	--	--	--	--
Complete unit "Ready to use"	❑	❑	❑	✓	✓	--	--	--	--	--	--
Space-saving	✓	--	✓	✓	✓	✓	✓	--	--	--	--
Can be extended with modular function modules	✓	--	1)	✓	1)	--	--	--	--	--	--
Frequent switching and monitoring of loads and solid-state relays/solid-state contactors	--	--	--	--	--	--	✓	✓	✓	✓	✓
Monitoring of up to 6 partial loads	--	--	--	--	--	--	✓	--	✓	✓	--
Monitoring of more than 6 partial loads	--	--	--	--	--	--	--	✓	--	--	--
Control of the heating power through an analog input	--	--	--	--	--	✓	--	--	--	✓	✓
Power control	--	--	--	--	--	--	--	--	--	--	✓
Startup											
Easy setting of setpoint values with "Teach" button	--	--	--	--	--	--	✓	✓	--	✓	✓
"Remote Teach" input for setting setpoints	--	--	--	--	--	--	--	--	✓	--	--
Mounting											
Mounting onto mounting rails or mounting plates	--	--	--	✓	✓	--	--	--	--	--	--
Can be snapped directly onto a solid-state relay or contactor	--	--	--	--	--	✓	✓	✓	✓	✓	✓
For use with "Coolplate" heat sink	✓	✓	✓	--	--	--	--	--	--	--	--
Cable routing											
Connection of load circuit as for controlgear	✓	--	✓	✓	✓	--	✓	✓	✓	✓	✓
Connection of load circuit from above	--	✓	--	--	--	--	--	--	--	--	--

✓ Function is available

❑ Function is possible

1) The converter can also be used with three-phase devices.

Design

There is no typical design of a load feeder with solid-state relays or solid-state contactors; instead, the great variety of connection methods and control voltages offers universal application opportunities. SIRIUS solid-state relays and solid-state contactors can be installed in fuseless or fused feeders, as required. There are special versions with which it is even possible to achieve short-circuit strength in a fuseless design.

Connection methods

All SIRIUS solid-state switching devices are characterized by the great variance of connection methods. You can choose between the following connection methods:

Screw connection

The screw connection system is the standard among industrial controls. Open terminals and a plus-minus screw are just two features of this technology. Two conductors of up to 6 mm² can be connected in just one terminal. As a result, loads of up to 50 A can be connected.

Spring-type terminal connection system

This innovative technology manages without any screw connection. This means that very high vibration resistance is achieved. Two conductors of up to 2.5 mm² can be connected to each terminal. As a result, loads of up to 20 A can be dealt with.

Ring terminal lug connection

The ring terminal lug connection is equipped with an M5 screw. Ring terminal lugs of up to 25 mm² can be connected. In this way it is possible to connect even high powers with current strengths of up to 90 A safely. Finger-safety is provided in this case too with a special cover.

Function

Switching functions

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

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

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

Performance characteristics

The performance of the solid-state switching devices is substantially determined by the type of power semiconductors used and the internal design. In the case of the 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, thyristors with 800 V blocking voltage are fitted in the devices for operation in networks up to 230 V. Thyristors with up to 1600 V are used for power systems with higher voltages.

Maximum load integral

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

You can find more information on the Internet at:

http://www.siemens.com/cd/is_schalten/html_76/schalt.htm

Integration

Notes on integration in the load feeders

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

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

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

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

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

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

Suitable filters can be ordered from EPCOS AG.

You can find more information on the Internet at:

http://www.epcos.com

General data

Overview

Solid-state relays

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

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

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

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

Version for resistive loads, "zero-point switching"

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

Version for inductive loads, "instantaneous switching"

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

Single-phase solid-state relay with a width of 22.5 mm

With its compact design, which stays the same even at currents of up to 88 A, the 3RF21 solid-state relay is the ultimate in space-saving construction, at a width of 22.5 mm. The logical connection method, with the power infeed from above and load connection from below, ensures tidy installation in the control cabinet.

Single-phase solid-state relay with a width of 45 mm

The solid-state relays with a width of 45 mm provide for connection of the power supply lead and the load from above. This makes it easy to replace existing solid-state relays in existing arrangements. The connection of the control cable also saves space in much the same way as the 22.5 mm design, as it is simply plugged on.

Three-phase solid-state relay with a width of 45 mm

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

The three-phase solid-state relays are available with

- two-phase control and
- three-phase control.

Function

Three-phase solid-state switching devices

Two-phase controlled version

A three-phase control system is not required for many three-phase current applications. Loads in a delta circuit or star circuit which have no connection to the neutral conductor can also be safely switched on and off using just two phases.

Nevertheless, the three-phase 3RF22 and 3RF24 solid-state switching devices permit all three phases to be connected to the switching device, in which case the middle phase is looped directly through the device. Compared to a three-phase controlled device, the lower power loss allows more compact installations.

Three-phase controlled version

This version is used for three-phase current applications in which the system requires all phases to be switched on and off, or for loads in a star circuit with connection to the neutral conductor.

Configuration

Selecting solid-state relays

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

The following procedure is recommended:

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

You can find more information on the Internet at:

http://www.siemens.com/cd/is_schalten/html_76/schalt.htm

Overview

22.5 mm solid-state relays

With its compact design, which stays the same even at currents of up to 88 A, the 3RF21 solid-state relay is the ultimate in space-saving construction, at a width of 22.5 mm. The logical connection method, with the power infeed from above and load connection from below, ensures tidy installation in the control cabinet.

Technical specifications

Type		3RF21 ..-1....	3RF21 ..-2....	3RF21 ..-3....
General data				
Ambient temperature				
• During operation, derating from 40 °C	°C	-25 ... + 60		
• During storage	°C	-55 ... + 80		
Installation altitude	m	0 ... 1000; derating from 1000		
Shock resistance acc. to IEC 60068-2-27	*g*/ms	15/11		
Vibration resistance acc. to IEC 60068-2-6	*g*	2		
Degree of protection		IP20		
Electromagnetic compatibility (EMC)				
• Emitted interference				
- Conducted interference voltage acc. to IEC 60947-4-3		Class A for industrial applications		
- Emitted, high-frequency interference voltage acc. to IEC 60947-4-3		Class A for industrial applications		
• Interference immunity				
- Electrostatic discharge acc. to IEC 61000-4-2 (corresponds to degree of severity 3)	kV	Contact discharge 4; air discharge 8; behavior criterion 2		
- Induced RF fields acc. to IEC 61000-4-6	MHz	0.15 ... 80; 140 dBµV; behavior criterion 1		
- Burst acc. to IEC 61000-4-4	kV	2/5.0 kHz; behavior criterion 1		
- Surge acc. to IEC 61000-4-5	kV	Conductor - ground 2; conductor - conductor 1; behavior criterion 2		
Connection type		**Screw terminals**	**Spring-type terminals**	**Ring terminal lug connections**
Connection, main contacts				
• Conductor cross-section				
- Solid	mm^2	2 x (1.5 ... 2.5)[1], 2 x (2.5 ... 6)[1]	2 x (0.5 ... 2.5)	--
- Finely stranded with end sleeve	mm^2	2 x (1 ... 2.5)[1], 2 x (2.5 ... 6)[1], 1 x 10	2 x (0.5 ... 1.5)	--
- Finely stranded without end sleeve	mm^2	-	2 x (0.5 ... 2.5)	--
- Solid or stranded, AWG cables		2 x (AWG 14 ... 10)	2 x (AWG 18 ... 14)	--
• Terminal screw		M4	--	M5
• Tightening torque	Nm lb.in	2 ... 2.5 7 ... 10.3	-- --	2.5 ... 2 10.3 ... 7
• Cable lug				
- DIN		--	--	DIN 46234 -5-2.5, -5-6, -5-10, -5-16, -5-25
- JIS		--	--	JIS C 2805 R 2-5, 5.5-5, 8-5, 14-5
Connection, auxiliary/control contacts				
• Conductor cross-section	mm AWG	1 x (0.5 ... 2.5), 2 x (0.5 ... 1.0) 20 ... 12	0.5 ... 2.5 20 ... 12	1 x (0.5 ... 2.5), 2 x (0.5 ... 1.0) 20 ... 12
• Stripped length	mm	7	10	7
• Terminal screw		M3	--	M3
• Tightening torque	Nm lb.in	0.5 ... 0.6 4.5 ... 5.3	-- --	0.5 ... 0.6 4.5 ... 5.3

1) If two different conductor cross-sections are connected to one clamping point, both cross-sections must lie in the range specified. If identical cross-sections are used, this restriction does not apply.

3RF21 solid-state relays, single-phase, 22.5 mm

Order No.	I_{max} 1) at R_{thha}/T_u = 40 °C		I_e acc. to IEC 60947-4-3 at R_{thha}/T_u = 40 °C		I_e acc. to UL/CSA at R_{thha}/T_u = 50 °C		Power loss at I_{max}	Minimum load current	Leakage current
	A	K/W	A	K/W	A	K/W	W	A	mA
Main circuit									
3RF21 20-.....	20	2.0	20	1.7	20	1.3	28.6	0.1	10
3RF21 30-1....	30	1.1	30	0.79	30	0.56	44.2	0.5	10
3RF21 50-1....	50	0.68	50	0.48	50	0.33	66	0.5	10
3RF21 50-2....	50	0.68	20	2.6	20	2.9	66	0.5	10
3RF21 50-3....	50	0.68	50	0.48	50	0.33	66	0.5	10
3RF21 70-1....	70	0.40	50	0.77	50	0.6	94	0.5	10
3RF21 90-1....	88	0.33	50	0.94	50	0.85	118	0.5	10
3RF21 90-2....	88	0.33	20	2.8	20	3.5	118	0.5	10
3RF21 90-3....	88	0.33	88	0.22	83	0.19	118	0.5	10

1) I_{max} provides information about the performance of the solid-state relay. The actual permitted rated operational current I_e can be smaller depending on the connection method and cooling conditions.

Note: The required heat sinks for the corresponding load currents can be determined from the characteristic curves, page 12. The minimum thickness values for the mounting surface must be observed.

Order No.	Rated impulse withstand capacity I_{tsm}	I^2t value
	A	A^2s
Main circuit		
3RF21 20-.....	200	200
3RF21 30-..A.2	300	450
3RF21 30-..A.4	300	450
3RF21 30-..A.5	300	450
3RF21 30-..A.6	400	800
3RF21 50-.....	600	1800
3RF21 70-..A.2	1200	7200
3RF21 70-..A.4	1200	7200
3RF21 70-..A.5	1200	7200
3RF21 70-..A.6	1150	6600
3RF21 90-.....	1150	6600

Type		3RF21 ..-....2	3RF21 ..-....4	3RF21 ..-....5	3RF21 ..-....6
Main circuit					
Rated operational voltage U_e	V	24 ... 230	48 ... 460	48 ... 600	48 ... 600
• Operating range	V	20 ... 253	40 ... 506	40 ... 660	40 ... 660
• Rated frequency	Hz	50/60 ± 10 %			
Rated insulation voltage U_i	V	600			
Blocking voltage	V	800	1200		1600
Rage of voltage rise	V/µs	1000			

Type		3RF21 ..-...0.	3RF21 ..-...1.		3RF21 ..-...2.	3RF21 ..-...4.
Control circuit						
Method of operation		DC operation	AC/DC operation		AC operation	DC operation
Rated control supply voltage U_s	V	24 acc. to EN 61131-2	24 AC	24 DC	110 ... 230	4 ... 30
Rated frequency of the control supply voltage	Hz	--	50/60 ± 10 %	--	50/60 ± 10 %	--
Control supply voltage, max.	V	30	26.5 AC	30 DC	253	30
Typical actuating current	mA	20 / Low Power: 6.5 1)	20	20	15	20
Response voltage	V	15	14 AC	15 DC	90	4
Drop-out voltage	V	5	5 AC	5 DC	40	1
Operating times						
• ON-delay	ms	1 + max. one half-wave 2)	10 + max. one half-wave 2)		40 + max. one half-wave 2)	1 + max. one half-wave 2)
• OFF-delay	ms	1 + max. one half-wave	15 + max. one half-wave		40 + max. one half-wave	1 + max. one half-wave

1) Applies to the version "Low Power" 3RF21 ..-.AA..-**0KN0**.
2) Only for zero-point-switching devices.

Fused version with semiconductor protection (similar to type of coordination "2")[1)]

The semiconductor protection for the SIRIUS controls can be used with different protective devices. This allows protection by means of LV HRC fuses of gG operational class or miniature circuit breakers. Siemens recommends the use of special SITOR semiconductor fuses. The table below lists the maximum permissible fuses for each SIRIUS control.

If a fuse is used with a higher rated current than specified, semiconductor protection is no longer guaranteed. However, smaller fuses with a lower rated current for the load can be used without problems.

For protective devices with gG operational class and for SITOR 3NE1 all-range fuses, the minimum cross-sections for the conductor to be connected must be taken into account.

Order No.	All-range fuses		Semiconductor fuses/partial-range fuses			
	LV HRC design	Cylindrical design	LV HRC design	Cylindrical design		
	gR/SITOR	gR/NEOZED[2)]	aR/SITOR	aR/SITOR	aR/SITOR	aR/SITOR
		SILIZED		10 mm x 38 mm	14 mm x 51 mm	22 mm x 58 mm
	3NE1	5SE1	3NE8	3NC1 0	3NC1 4	3NC2 2
3RF21 20-...2	3NE1 814-0	5SE1 325	3NE8 015-1	3NC1 020	3NC1 420	3NC2 220
3RF21 20-...4	3NE1 813-0[4)]	5SE1 320	3NE8 015-1	3NC1 016[4)]	3NC1 420	3NC2 220
3RF21 20-....5[3)]	3NE1 813-0[4)]	5SE1 320	3NE8 015-1	3NC1 016[4)]	3NC1 420	3NC2 220
3RF21 30-...2	3NE1 815-0[4)]	5SE1 335	3NE8 003-1	3NC1 032	3NC1 432	3NC2 232
3RF21 30-...4	3NE1 815-0[4)]	5SE1 325[4)]	3NE8 003-1	3NC1 025[4)]	3NC1 430	3NC2 232
3RF21 30-....5[3)]	3NE1 815-0[4)]	5SE1 325[4)]	3NE8 003-1	3NC1 025[4)]	3NC1 430	3NC2 232
3RF21 30-...6	3NE1 815-0[4)]	--	3NE8 003-1	3NC1 032	3NC1 432	3NC2 232
3RF21 50-...2	3NE1 817-0	5SE1 350	3NE8 017-1	--	3NC1 450	3NC2 250
3RF21 50-...4	3NE1 802-0[4)]	5SE1 335[4)]	3NE8 017-1	--	3NC1 450	3NC2 250
3RF21 50-....5[3)]	3NE1 802-0[4)]	5SE1 335[4)]	3NE8 017-1	--	3NC1 450	3NC2 250
3RF21 50-...6	3NE1 803-0[4)]	--	3NE8 017-1	--	3NC1 450	3NC2 250
3RF21 70-...2[5)]	3NE1 820-0	5SE1 363[4)]	3NE8 020-1	--	--	3NC2 280
3RF21 70-...4[5)]	3NE1 020-2	5SE1 363[4)]	3NE8 020-1	--	--	3NC2 280
3RF21 70-....5[3)5)]	3NE1 020-2	--	3NE8 020-1	--	--	3NC2 280
3RF21 70-...6[5)]	3NE1 020-2	--	3NE8 020-1	--	--	3NC2 280
3RF21 90-...2[5)]	3NE1 021-2	--	3NE8 021-1	--	--	3NC2 200
3RF21 90-...4[5)]	3NE1 021-2	--	3NE8 021-1	--	--	3NC2 280[4)]
3RF21 90-....5[3)5)]	3NE1 021-2	--	3NE8 021-1	--	--	3NC2 280[4)]
3RF21 90-...6[5)]	3NE1 817-0[4)]	--	3NE8 021-1	--	--	3NC2 280[4)]

Order No.	Cable and line protection fuses				
	LV HRC design[4)]	Cylindrical design[4)]			DIAZED[4)]
	gG	gG	gG	gG	quick
		10 mm x 38 mm	14 mm x 51 mm	22 mm x 58 mm	
	3NA2	3NW6 0	3NW6 1	3NW6 2	5SB
3RF21 20-...2	3NA2 803	3NW6 000-1	3NW6 101-1	--	5SB1 41
3RF21 20-...4	3NA2 801	--	3NW6 101-1	--	5SB1 41
3RF21 20-....5[3)]	3NA2 801	--	3NW6 101-1	--	5SB1 41
3RF21 30-...2	3NA2 803	--	3NW6 103-1	--	5SB1 71
3RF21 30-...4	3NA2 803	--	3NW6 101-1	--	5SB1 71
3RF21 30-....5[3)]	3NA2 803	--	3NW6 101-1	--	5SB1 71
3RF21 30-...6	3NA2 803-6	--	--	--	--
3RF21 50-...2	3NA2 810	--	3NW6 107-1	3NW6 207-1	5SB3 11
3RF21 50-...4	3NA2 807	--	--	3NW6 205-1	5SB3 11
3RF21 50-....5[3)]	3NA2 807	--	--	3NW6 205-1	5SB3 11
3RF21 50-...6	3NA2 807-6	--	--	--	--
3RF21 70-...2[5)]	3NA2 817	--	--	3NW6 217-1	5SB3 31
3RF21 70-...4[5)]	3NA2 812	--	--	3NW6 212-1	5SB3 31
3RF21 70-....5[3)5)]	3NA2 812	--	--	3NW6 212-1	--
3RF21 70-...6[5)]	3NA2 812-6	--	--	--	--
3RF21 90-...2[5)]	3NA2 817	--	--	3NW6 217-1	--
3RF21 90-...4[5)]	3NA2 812	--	--	3NW6 212-1	--
3RF21 90-....5[3)5)]	3NA2 812	--	--	3NW6 212-1	--
3RF21 90-...6[5)]	3NA2 812-6	--	--	--	--

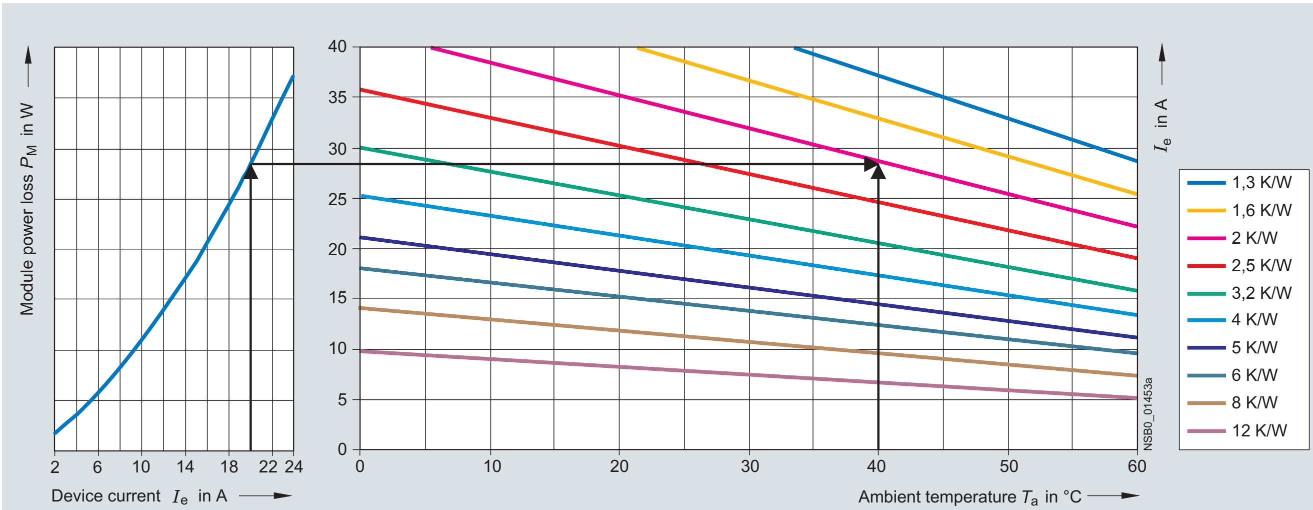
Suitable fuse holders, fuse bases and controls can be found in Catalog LV 1, Chapter 19.

1) Type of coordination "2" according to EN 60947-4-1:
In the event of a short-circuit, the controls in the load feeder must not endanger persons or the installation. They must be suitable for further operation. For fused configurations, the protective device must be replaced.
2) For use only with operational voltage U_e up to 400 V.
3) For use only with operational voltage U_e up to 506 V.
4) These fuses have a smaller rated current than the solid-state relays.
5) These versions can also be protected against short-circuits with miniature circuit breakers as described in the notes on "SIRIUS Solid-State Contactors → Special Version Short-Circuit Resistant".

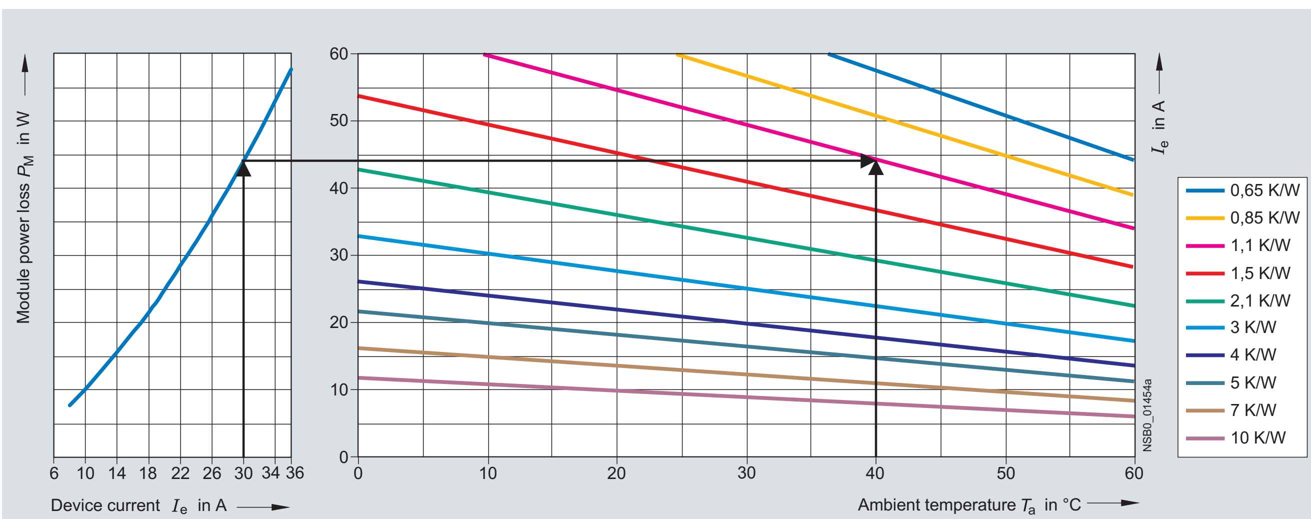
3RF21 solid-state relays, single-phase, 22.5 mm

Characteristic curves

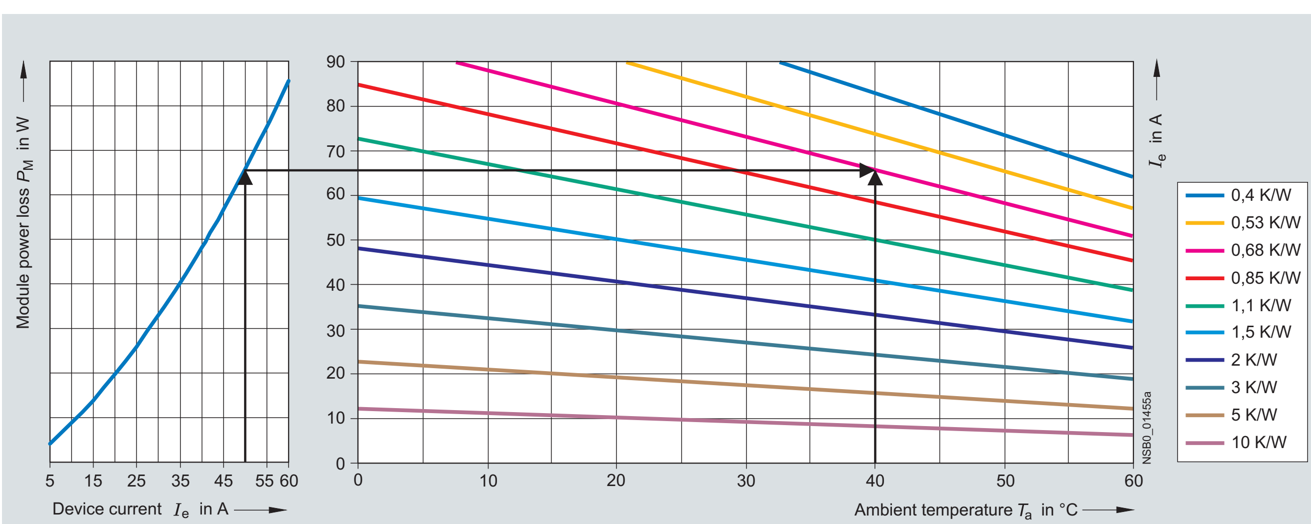
Dependence of the device current I_e on the ambient temperature T_a and the heat sink resistance R_{thha}



Type current 20 A (3RF21 20, 3RF20 20)[1)]

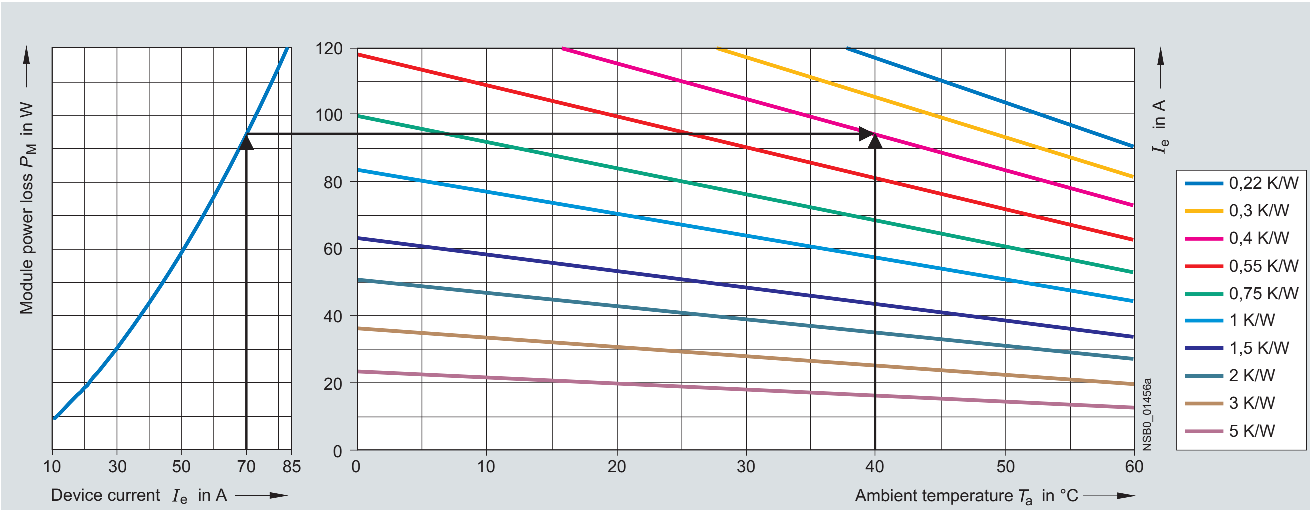


Type current 30 A (3RF21 30, 3RF20 30)

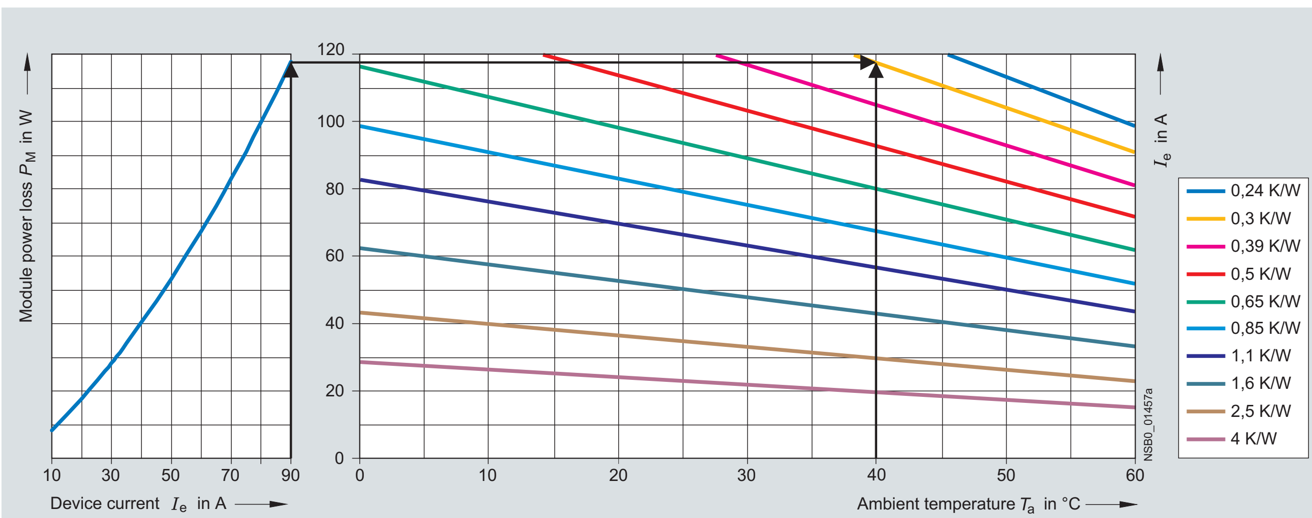


Type current 50 A (3RF21 50, 3RF20 50)

1) For arrangement example see next page.



Type current 70 A (3RF21 70, 3RF20 70)



Type current 90 A (3RF21 90, 3RF20 90)

Arrangement example

Given conditions: I_e = 20 A and T_a = 40 C. The task is to find the thermal resistance R_{thha} and the heat sink overtemperature dT_{ha}.

From the diagram on the left →P_M = 28 W,
from the diagram on the right →R_{thha} = 2.0 K/W.

This results in:

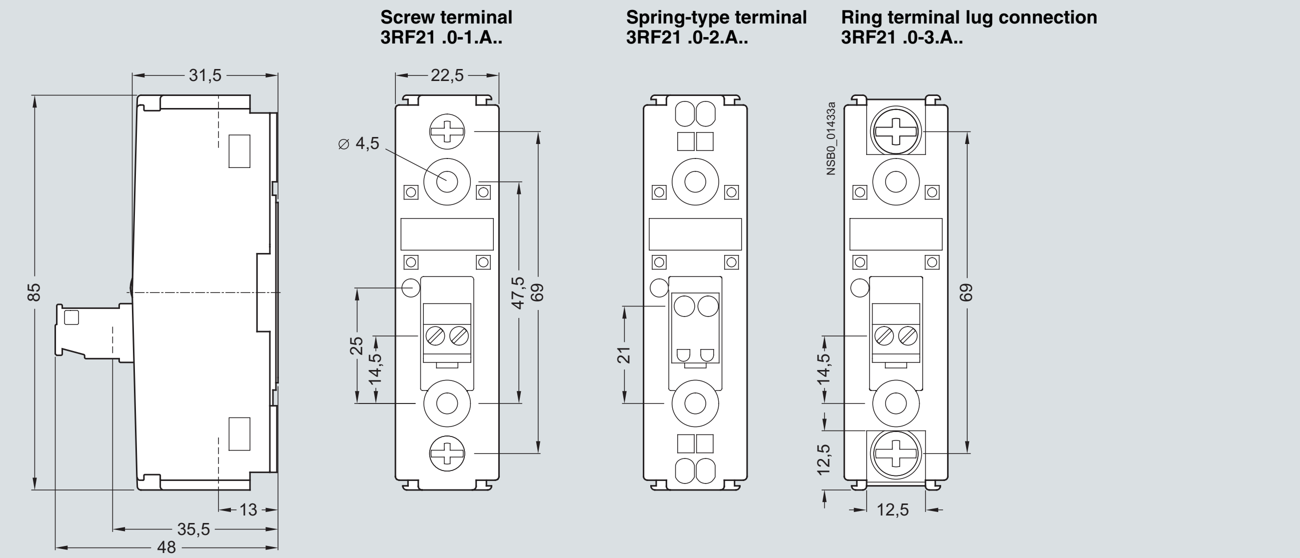
$dT_{ha} = R_{thha} \times$ PM = 2.0 K/W × 28 W = 56 K.

At dT_{ha} = 56 K the heat sink must therefore have an R_{thha} = 2.0 K/W.

3RF21 solid-state relays, single-phase, 22.5 mm

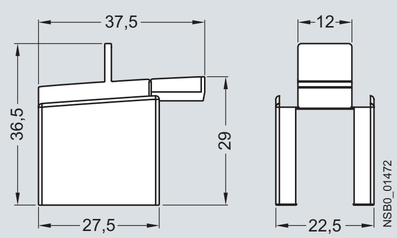
Dimensional drawings

Solid-state relays



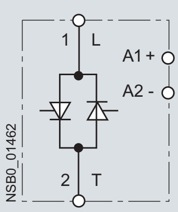
Terminal cover

3RF29 00-3PA88

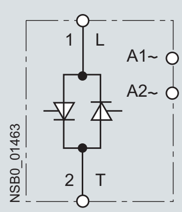


Schematics

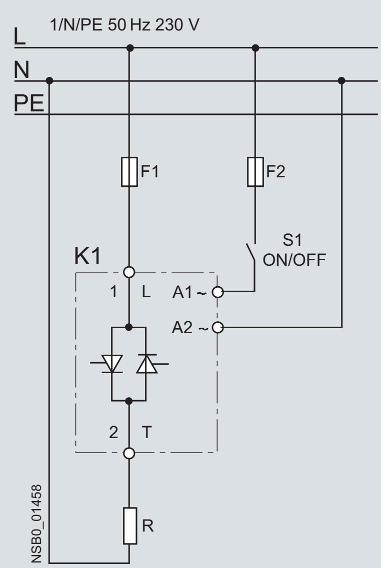
Version
DC control supply voltage



Version
AC control supply voltage



Switching example



Overview

45 mm solid-state relays

The solid-state relays with a width of 45 mm provide for connection of the power supply lead and the load from above. This makes it easy to replace existing solid-state relays in existing arrangements. The connection of the control cable also saves space in much the same way as the 22.5 mm design, as it is simply plugged on.

Technical specifications

Type		3RF20 ..-1....	3RF20 ..-4....
General data			
Ambient temperature			
• During operation, derating from 40 °C	°C	-25 ... +60	
• During storage	°C	-55 ... +80	
Installation altitude	m	0 ... 1000; derating from 1000	
Shock resistance acc. to IEC 60068-2-27	*g*/ms	15/11	
Vibration resistance acc. to IEC 60068-2-6	*g*	2	
Degree of protection		IP20	
Electromagnetic compatibility (EMC)			
• Emitted interference			
- Conducted interference voltage acc. to IEC 60947-4-3		Class A for industrial applications	
- Emitted, high-frequency interference voltage acc. to IEC 60947-4-3		Class A for industrial applications	
• Interference immunity			
- Electrostatic discharge acc. to IEC 61000-4-2 (corresponds to degree of severity 3)	kV	Contact discharge 4; air discharge 8; behavior criterion 2	
- Induced RF fields acc. to IEC 61000-4-6	MHz	0.15 ... 80; 140 dBμV; behavior criterion 1	
- Burst acc. to IEC 61000-4-4	kV	2/5.0 kHz; behavior criterion 1	
- Surge acc. to IEC 61000-4-5	kV	Conductor - ground 2; conductor - conductor 1; behavior criterion 2	
Connection type		**Screw terminals**	**Spring-type terminals**
Connection, main contacts			
• Conductor cross-section			
- Solid	mm^2	2 x (1.5 ... 2.5)[1)], 2 x (2.5 ... 6)[1)]	--
- Finely stranded with end sleeve	mm^2	2 x (1 ... 2.5)[1)], 2 x (2.5 ... 6)[1)], 1 x 10	--
- Solid or stranded, AWG cables		2x (AWG 14 ... 10)	--
• Terminal screw		M4	--
• Tightening torque	Nm lb.in	2 ... 2.5 7 ... 10.3	-- --
Connection, auxiliary/control contacts			
• Conductor cross-section	mm^2	1 x (0.5 ... 2.5), 2 x (0.5 ... 1.0), AWG 20 ... 12	0.5 ... 2.5, AWG 20 ... 12
• Stripped length	mm	7	10
• Terminal screw		M3	--
• Tightening torque	Nm lb.in	0.5 ... 0.6 4.5 ... 5.3	-- --

1) If two different conductor cross-sections are connected to one clamping point, both cross-sections must lie in the range specified. If identical cross-sections are used, this restriction does not apply.

3RF20 solid-state relays, single-phase, 45 mm

Order No.	I_{max} [1] at R_{thha}/T_u = 40 °C		I_e acc. to IEC 60947-4-3 at R_{thha}/T_u = 40 °C		I_e acc. to UL/CSA at R_{thha}/T_u = 50 °C		Power loss at I_{max}	Minimum load current	Leakage current
	A	K/W	A	K/W	A	K/W	W	A	mA
Main circuit									
3RF20 20-1.A..	20	2.0	20	1.7	20	1.3	28.6	0.1	10
3RF20 30-1.A..	30	1.1	30	0.79	30	0.56	44.2	0.5	10
3RF20 50-1.A..	50	0.68	50	0.48	50	0.33	66	0.5	10
3RF20 70-1.A..	70	0.40	50	0.77	50	0.6	94	0.5	10
3RF20 90-1.A..	88	0.33	50	0.94	50	0.85	118	0.5	10

1) I_{max} provides information about the performance of the solid-state relay. The actual permitted rated operational current I_e can be smaller depending on the connection method and cooling conditions.

Note: The required heat sinks for the corresponding load currents can be determined from the characteristic curves, *page 12**. The minimum thickness values for the mounting surface must be observed.*

Order No.	Rated impulse withstand capacity I_{tsm}	I^2t value
	A	A^2s
Main circuit		
3RF20 20-1.A..	200	200
3RF20 30-1.A.2 **3RF20 30-1.A.4** **3RF20 30-1.A.6**	300 300 400	450 450 800
3RF20 50-1.A..	600	1800
3RF20 70-1.A.2 **3RF20 70-1.A.4** **3RF20 70-1.A.5** **3RF20 70-1.A.6**	1200 1200 1200 1150	7200 7200 7200 6600
3RF20 90-1.A..	1150	6600

Type		3RF20 .0-1.A.2	3RF20 .0-1.A.4	3RF20 .0-1.A.5	3RF20 .0-1.A.6
Main circuit					
Rated operational voltage U_e	V	24 ... 230	48 ... 460	48 ... 600	48 ... 600
• Operating range	V	20 ... 253	40 ... 506	40 ... 660	40 ... 660
• Rated frequency	Hz	50/60 ± 10 %			
Rated insulation voltage U_i	V	600			
Blocking voltage	V	800	1200		1600
Rage of voltage rise	V/µs	1000			

Type		3RF20 .0-1.A0.	3RF20 .0-1.A2.	3RF20 .0-1.A4.
Control circuit				
Method of operation		DC operation	AC operation	DC operation
Rated control supply voltage U_S	V	24 acc. to EN 61131-2	110 … 230	4 … 30
Rated frequency of the control supply voltage	Hz	--	50/60 ± 10 %	--
Control supply voltage, max.	V	30	253	30
Typical actuating current	mA	20	15	20
Response voltage	V	15	90	4
Drop-out voltage	V	5	40	1
Operating times				
• ON-delay	ms	1 + max. one half-wave[1]	40 + max. one half-wave[1]	1 + max. one half-wave[1]
• OFF-delay	ms	1 + max. one half-wave	40 + max. one half-wave	1 + max. one half-wave

1) Only for zero-point-switching devices.

Fused version with semiconductor protection (similar to type of coordination "2")[1)]

The semiconductor protection for the SIRIUS controls can be used with different protective devices. This allows protection by means of LV HRC fuses of gG operational class or miniature circuit breakers. Siemens recommends the use of special SITOR semiconductor fuses. The table below lists the maximum permissible fuses for each SIRIUS control.

If a fuse is used with a higher rated current than specified, semiconductor protection is no longer guaranteed. However, smaller fuses with a lower rated current for the load can be used without problems.

For protective devices with gG operational class and for SITOR 3NE1 all-range fuses, the minimum cross-sections for the conductor to be connected must be taken into account.

Order No.	**All-range fuses**		**Semiconductor fuses/partial-range fuses**			
	LV HRC design	Cylindrical design	LV HRC design	Cylindrical design		
	gR/SITOR	gR/NEOZED[2)]	aR/SITOR	aR/SITOR	aR/SITOR	aR/SITOR
		SILIZED		10 mm x 38 mm	14 mm x 51 mm	22 mm x 58 mm
	3NE1	5SE1	3NE8	3NC1 0	3NC1 4	3NC2 2
3RF20 20-1.A.2	3 NE1 814-0	5SE1 325	3 NE8 015-1	3NC1 020	3NC1 420	3NC2 220
3RF20 20-1.A.4	3 NE1 813-0[4)]	5SE1 320	3 NE8 015-1	3NC1 016[4)]	3NC1 420	3NC2 220
3RF20 20-1.A.5[3)]	3 NE1 813-0[4)]	5SE1 320	3 NE8 015-1	3NC1 016[4)]	3NC1 420	3NC2 220
3RF20 30-1.A.2	3 NE1 815-0[4)]	5SE1 335	3 NE8 003-1	3NC1 032	3NC1 432	3NC2 232
3RF20 30-1.A.4	3 NE1 815-0[4)]	5SE1 325[4)]	3 NE8 003-1	3NC1 025[4)]	3NC1 430	3NC2 232
3RF20 30-1.A.6	3 NE1 815-0[4)]	--	3 NE8 003-1	3NC1 032	3NC1 432	3NC2 232
3RF20 50-1.A.2	3 NE1 817-0	5SE1 350	3 NE8 017-1	--	3NC1 450	3NC2 250
3RF20 50-1.A.4	3 NE1 802-0[4)]	5SE1 335[4)]	3 NE8 017-1	--	3NC1 450	3NC2 250
3RF20 50-1.A.5[3)]	3 NE1 802-0[4)]	5SE1 335[4)]	3 NE8 017-1	--	3NC1 450	3NC2 250
3RF20 50-1.A.6	3 NE1 803-0[4)]	--	3 NE8 017-1	--	3NC1 450	3NC2 250
3RF20 70-1.A.2[5)]	3 NE1 820-0	5SE1 363[4)]	3 NE8 020-1	--	--	3NC2 280
3RF20 70-1.A.4[5)]	3 NE1 020-2	5SE1 363[4)]	3 NE8 020-1	--	--	3NC2 280
3RF20 70-1.A.5[3)5)]	3 NE1 020-2	--	3 NE8 020-1	--	--	3NC2 280
3RF20 70-1.A.6[5)]	3 NE1 020-2	--	3 NE8 020-1	--	--	3NC2 280
3RF20 90-1.A.2[5)]	3 NE1 021-2	--	3 NE8 021-1	--	--	3NC2 200
3RF20 90-1.A.4[5)]	3 NE1 021-2	--	3 NE8 021-1	--	--	3NC2 280[4)]
3RF20 90-1.A.5[3)5)]	3 NE1 021-2	--	3 NE8 021-1	--	--	3NC2 280[4)]
3RF20 90-1.A.6[5)]	3 NE1 817-0[4)]	--	3 NE8 021-1	--	--	3NC2 280[4)]

Order No.	**Cable and line protection fuses**				
	LV HRC design[4)]	Cylindrical design[4)]			DIAZED[4)]
	gG	gG	gG	gG	quick
		10 mm x 38 mm	14 mm x 51 mm	22 mm x 58 mm	
	3NA2	3NW6 0	3NW6 1	3NW6 2	5SB
3RF20 20-1.A.2	3NA2 803	3NW6 001-1	3NW6 101-1	--	5SB1 41
3RF20 20-1.A.4	3NA2 801	--	3NW6 101-1	--	5SB1 41
3RF20 20-1.A.5[3)]	3NA2 801	--	3NW6 101-1	--	5SB1 41
3RF20 30-1.A.2	3NA2 803	--	3NW6 103-1	--	5SB1 71
3RF20 30-1.A.4	3NA2 803	--	3NW6 101-1	--	5SB1 71
3RF20 30-1.A.6	3NA2 803-6	--	--	--	--
3RF20 50-1.A.2	3NA2 810	--	3NW6 107-1	3NW6 207-1	5SB3 11
3RF20 50-1.A.4	3NA2 807	--	--	3NW6 205-1	5SB3 11
3RF20 50-1.A.5[3)]	3NA2 807	--	--	3NW6 205-1	5SB3 11
3RF20 50-1.A.6	3NA2 807-6	--	--	--	--
3RF20 70-1.A.2[5)]	3NA2 817	--	--	3NW6 217-1	5SB3 31
3RF20 70-1.A.4[5)]	3NA2 812	--	--	3NW6 212-1	5SB3 31
3RF20 70-1.A.5[3)5)]	3NA2 812	--	--	3NW6 212-1	--
3RF20 70-1.A.6[5)]	3NA2 812-6	--	--	--	--
3RF20 90-1.A.2[5)]	3NA2 817	--	--	3NW6 217-1	--
3RF20 90-1.A.4[5)]	3NA2 812	--	--	3NW6 212-1	--
3RF20 90-1.A.5[3)5)]	3NA2 812	--	--	3NW6 212-1	--
3RF20 90-1.A.6[5)]	3NA2 812-6	--	--	--	--

Suitable fuse holders, fuse bases and controls can be found in Catalog LV 1, Chapter 19.

1) Type of coordination "2" according to EN 60947-4-1:
In the event of a short-circuit, the controls in the load feeder must not endanger persons or the installation. They must be suitable for further operation. For fused configurations, the protective device must be replaced.

2) For use only with operational voltage U_e up to 400 V.

3) For use only with operational voltage U_e up to 506 V.

4) These fuses have a smaller rated current than the solid-state relays.

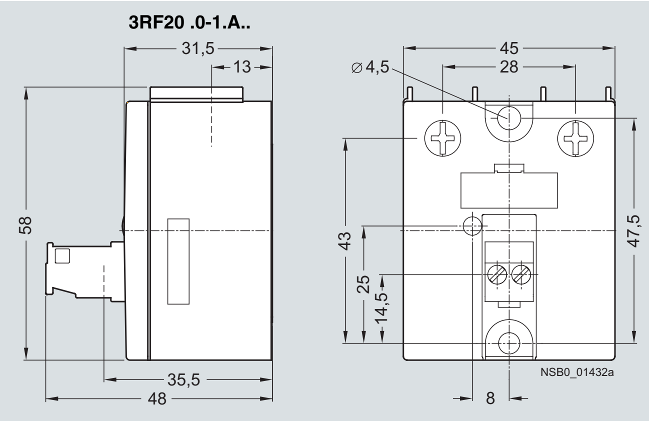
5) These versions can also be protected against short-circuits with miniature circuit breakers as described in the notes on "SIRIUS Solid-State Contactors →Special Version Short-Circuit Resistant".

Characteristic curves

See 3RF21 solid-state relays, page *12*.

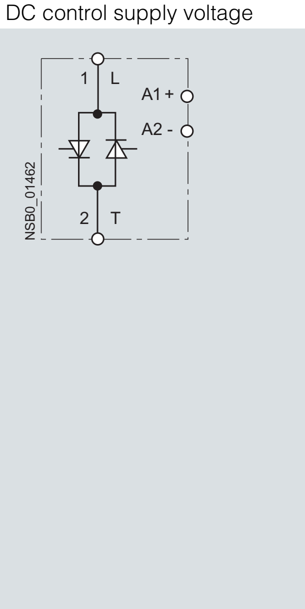
3RF20 solid-state relays, single-phase, 45 mm

Dimensional drawings

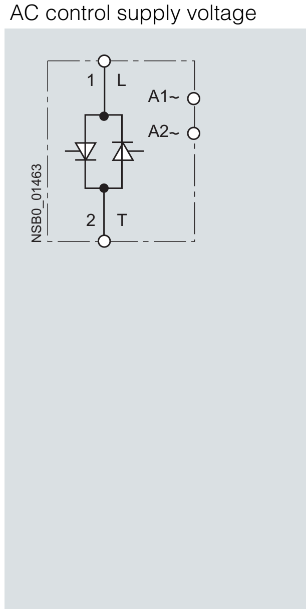


Schematics

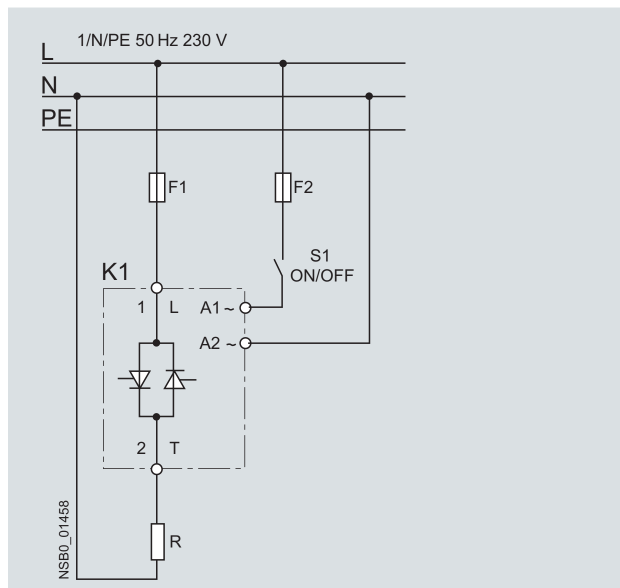
Version
DC control supply voltage



Version
AC control supply voltage



Switching example



3RF22 solid-state relays, three-phase, 45 mm

Overview

45 mm solid-state relays

The 3RF22 solid-state relays with a width of 45 mm provide space advantages over solutions with single-phase versions. The logical connection method, with the power infeed from above and load connection from below, ensures tidy installation in the control cabinet.

Important features:
- LED display
- Variety of connection methods
- Plug-in control connection
- Degree of protection IP20
- Zero-point switching
- Two- or three-phase controlled

Technical specifications

Type		3RF22 ..-1....	3RF22 ..-2....	3RF22 ..-3....
General data				
Ambient temperature				
• During operation, derating from 40 °C	°C	-25 ... + 60		
• During storage	°C	-55 ... + 80		
Installation altitude	m	0 ... 1000; > 1000 ask Technical Assistance		
Shock resistance acc. to IEC 60068-2-27	*g*/ms	15/11		
Vibration resistance acc. to IEC 60068-2-6	*g*	2		
Degree of protection		IP20		
Insulation strength at 50/60 Hz (main/control circuit to floor)	V rms	4000		
Electromagnetic compatibility (EMC)				
• Emitted interference				
- Conducted interference voltage acc. to IEC 60947-4-3		Class A for industrial applications[1]		
- Emitted, high-frequency interference voltage acc. to IEC 60947-4-3		Class A for industrial applications		
• Interference immunity				
- Electrostatic discharge acc. to IEC 61000-4-2 (corresponds to degree of severity 3)	kV	Contact discharge 4; air discharge 8; behavior criterion 2		
- Induced RF fields acc. to IEC 61000-4-6	MHz	0.15 ... 80; 140 dBμV; behavior criterion 1		
- Burst acc. to IEC 61000-4-4	kV	2/5.0 kHz; behavior criterion 1		
- Surge acc. to IEC 61000-4-5	kV	Conductor - ground 2; conductor - conductor 1; behavior criterion 2		
Connection type		**Screw terminals**	**Spring-type terminals**	**Ring terminal lug connection**
Connection, main contacts				
• Conductor cross-section				
- Solid	mm^2	2 x (1.5 ... 2.5)[2], 2 x (2.5 ... 6)[2]	2 x (0.5 ... 2.5)	--
- Finely stranded with end sleeve	mm^2	2 x (1 ... 2.5)[2], 2 x (2.5 ... 6)[2], 1 x 10	2 x (0.5 ... 1.5)	--
- Finely stranded without end sleeve	mm^2	--	2 x (0.5 ... 2.5)	--
- Solid or stranded, AWG cables		2 x (AWG 14 ... 10)	2 x (AWG 18 ... 14)	--
• Stripped length	mm	10	10	
• Terminal screw		M4	--	M5
- Tightening torque, ∅ 5 ... 6 mm, PZ 2	Nm lb.in	2 ... 2.5 18 ... 22		2.5 ... 2 18 ... 22
• Cable lug		--	--	
- Acc. to DIN 46234				5-2.5 ... 5-25
- Acc. to JIS C 2805				R 2-5 ... 14-5
Connection, auxiliary/control contacts				
• Conductor cross-section, with or without end sleeve	mm AWG	1 x (0.5 ... 2.5), 2 x (0.5 ... 1.0) 20 ... 12	0.5 ... 2.5 20 ... 12	1 x (0.5 ... 2.5), 2 x (0.5 ... 1.0) 20 ... 12
• Stripped length	mm	7	10	7
• Terminal screw		M3	--	M3
- Tightening torque, ∅ 3.5, PZ 1	Nm lb.in	0.5 ... 0.6 4.5 ... 5.3		0.5 ... 0.6 4.5 ... 5.3

1) These products were built as Class A devices. The use of these devices in residential areas could result in lead in radio interference. In this case these may be required to introduce additional interference suppression measures.

2) If two different conductor cross-sections are connected to one clamping point, both cross-sections must lie in the range specified. If identical cross-sections are used, this restriction does not apply.

3RF22 solid-state relays, three-phase, 45 mm

Order No.	I_{max} 1) at R_{thha}/T_u = 40 °C		I_e acc. to IEC 60947-4-3 at R_{thha}/T_u = 40 °C		I_e acc. to UL/CSA at R_{thha}/T_u = 50 °C		Power loss at I_{max}	Minimum load current	Max. leakage current
	A	K/W	A	K/W	A	K/W	W	A	mA
Main circuit									
3RF22 30-. AB..	30	0.57	30	0.57	30	0.44	81	0.5	10
3RF22 55-1AB.. **3RF22 55-2AB..** **3RF22 55-3AB..**	55	0.18	50 20 50	0.27 1.83 0.27	50 20 50	0.19 1.58 0.19	151	0.5	10
3RF22 30-. AC..	30	0.33	30	0.33	30	0.25	122	0.5	10
3RF22 55-1AC.. **3RF22 55-2AC..** **3RF22 55-3AC..**	55	0.09	50 20 50	0.15 1.19 0.15	50 20 50	0.1 1.02 0.1	226	0.5	10

1) I_{max} provides information about the performance of the solid-state relay. The actual permitted rated operational current I_e can be smaller depending on the connection method and cooling conditions.

Note: The required heat sinks for the corresponding load currents can be determined from the characteristic curves, page 22. The minimum thickness values for the mounting surface must be observed.

Order No.	Rated impulse withstand capacity I_{tsm}	I^2t value
	A	A^2s
Main circuit		
3RF22 30-....5	300	450
3RF22 55-....5	600	1800

Type		3RF22 ..-.AB.5	3RF22 ..-.AC.5
Main circuit			
Controlled phases		Two-phase	Three-phase
Rated operational voltage U_e	V	48 ... 600	48 ... 600
• Operating range	V	40 ... 660	40 ... 660
• Rated frequency	Hz	50/60 ± 10 %	50/60 ± 10 %
Rated insulation voltage U_i	V	600	600
Rated impulse withstand voltage U_{imp}	kV	6	6
Blocking voltage	V	1200	1200
Rage of voltage rise	V/µs	1000	1000

Type		3RF22 ..-.A.3.	3RF22 ..-.A.4.
Control circuit			
Method of operation		AC operation	DC operation
Rated control supply voltage U_s	V	110	4 ... 30
Rated frequency of the control supply voltage		50/60 ± 10 %	--
Control supply voltage, max.	V	121	30
Typical actuating current	mA	15	30
Response voltage	V	90	4
Drop-out voltage	V	< 40	1
Operating times			
• ON-delay	ms	40 + max. one half-wave	1 + max. one half-wave
• OFF-delay	ms	40 + max. one half-wave	1 + max. one half-wave

Fused version with semiconductor protection (similar to type of coordination "2")[1)]

The semiconductor protection for the 3RF22 controls can be used with different protective devices. Siemens recommends the use of special SITOR semiconductor fuses. The table below lists the maximum permissible fuses for each 3RF22 control.

If a fuse is used with a higher rated current than specified, semiconductor protection is no longer guaranteed. However, smaller fuses with a lower rated current for the load can be used without problems.

Order No.	**All-range fuses**		**Semiconductor fuses/partial-range fuses**			
	LV HRC design	Cylindrical design	LV HRC design	Cylindrical design		
	gR/SITOR	gR/NEOZED[2)]	aR/SITOR	aR/SITOR	aR/SITOR	aR/SITOR
	3NE1	SILIZED 5SE1	3NE8	10 mm x 38 mm 3NC1 0	14 mm x 51 mm 3NC1 4	22 mm x 58 mm 3NC2 2
Operational voltage U_e up to 460 V (+10 %)						
3RF22 30-.....	3NE1 814-0[3)]	5SE1 325[3)]	3NE8 003-1	3NC1 032	3NC1 430	3NC2 232
3RF22 55-.....	3NE1 802-0[3)]	5SE1 350[3)]	3NE8 018-1	--	3NC1 450	3NC2 263
Operational voltage U_e up to 600 V (+10 %)						
3RF22 30-.....	3NE1 814-0[3)]	--	3NE8 003-1	3NC1 025[3)]	3NC1 430	3NC2 232
3RF22 55-.....	3NE1 803-0[3)]	--	3NE8 018-1	--	3NC1 450[3)]	3NC2 250[3)]

Order No.	**Cable and line protection fuses**				
	LV HRC design[3)]	Cylindrical design[3)]			DIAZED[3)]
	gG	gG	gG	gG	quick
	3NA3	10 mm x 38 mm 3NW6 0	14 mm x 51 mm 3NW6 1	22 mm x 58 mm 3NW6 2	5SB
Operational voltage U_e up to 460 V (+10 %)					
3RF22 30-.....	3NA3 803-6	--	3NW6 101-1	3NW6 205-1	5SB1 71
3RF22 55-.....	3NA3 807-6	--	--	--	5SB3 11
Operational voltage U_e up to 600 V (+10 %)					
3RF22 30-.....	3NA3 803-6	--	--	--	--
3RF22 55-.....	3NA3 805-6	--	--	--	--

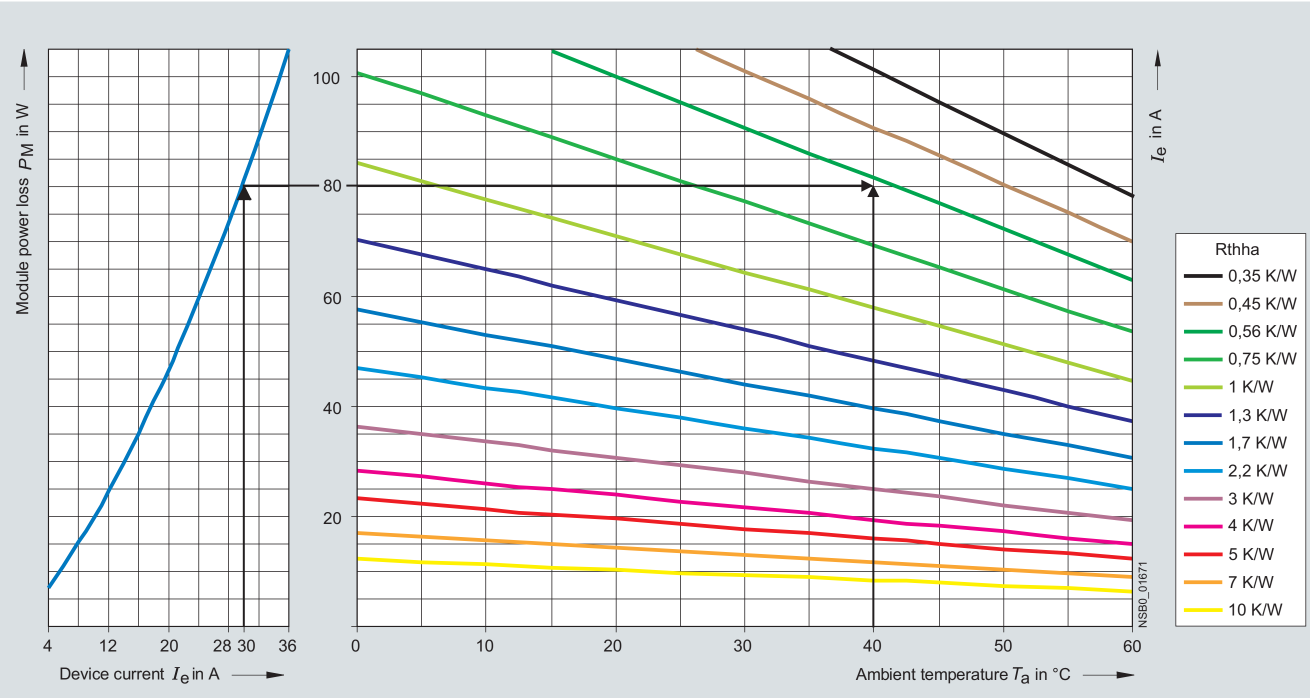
Suitable fuse holders, fuse bases and controls can be found in Catalog LV 1, Chapter 19.

1) Type of coordination "2" according to EN 60947-4-1:
In the event of a short-circuit, the controls in the load feeder must not endanger persons or the installation. They must be suitable for further operation. For fused configurations, the protective device must be replaced.
2) For use only with operational voltage U_e up to 400 V.
3) These fuses have a smaller rated current than the solid-state relays.

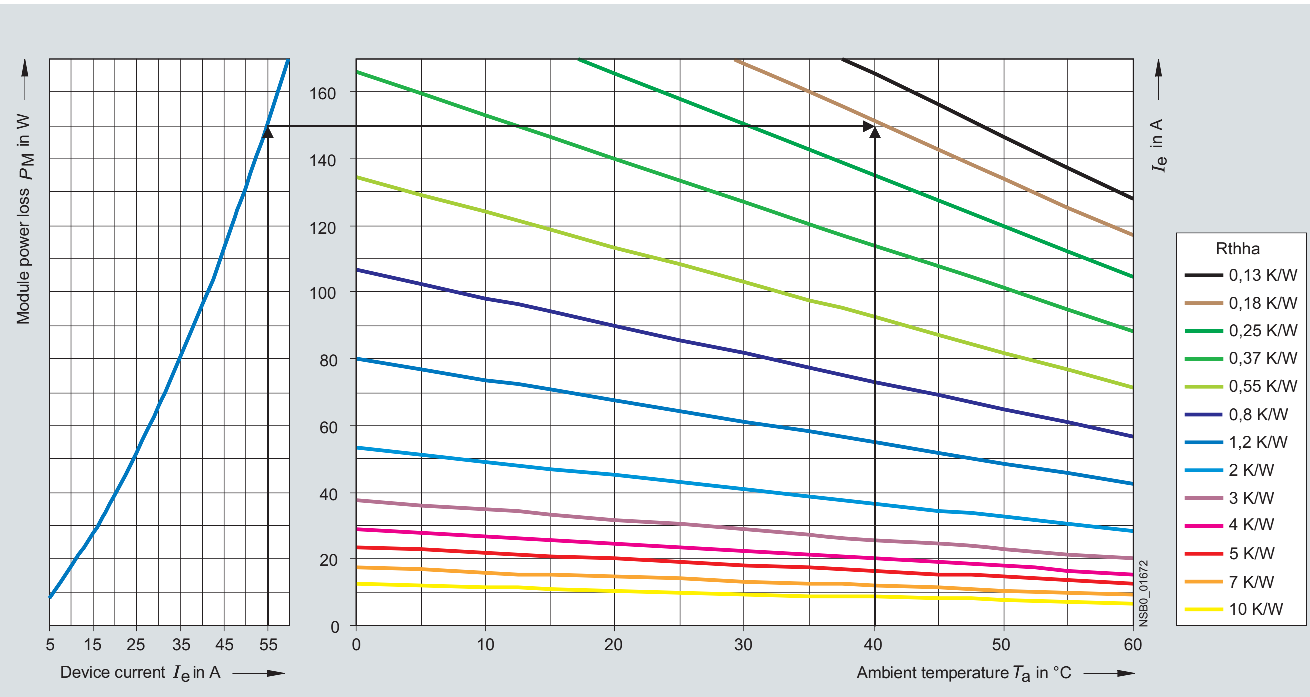
3RF22 solid-state relays, three-phase, 45 mm

Characteristic curves

Dependence of the device current I_e on the ambient temperature T_a and the heat sink resistance R_{thha} (two-phase controlled)

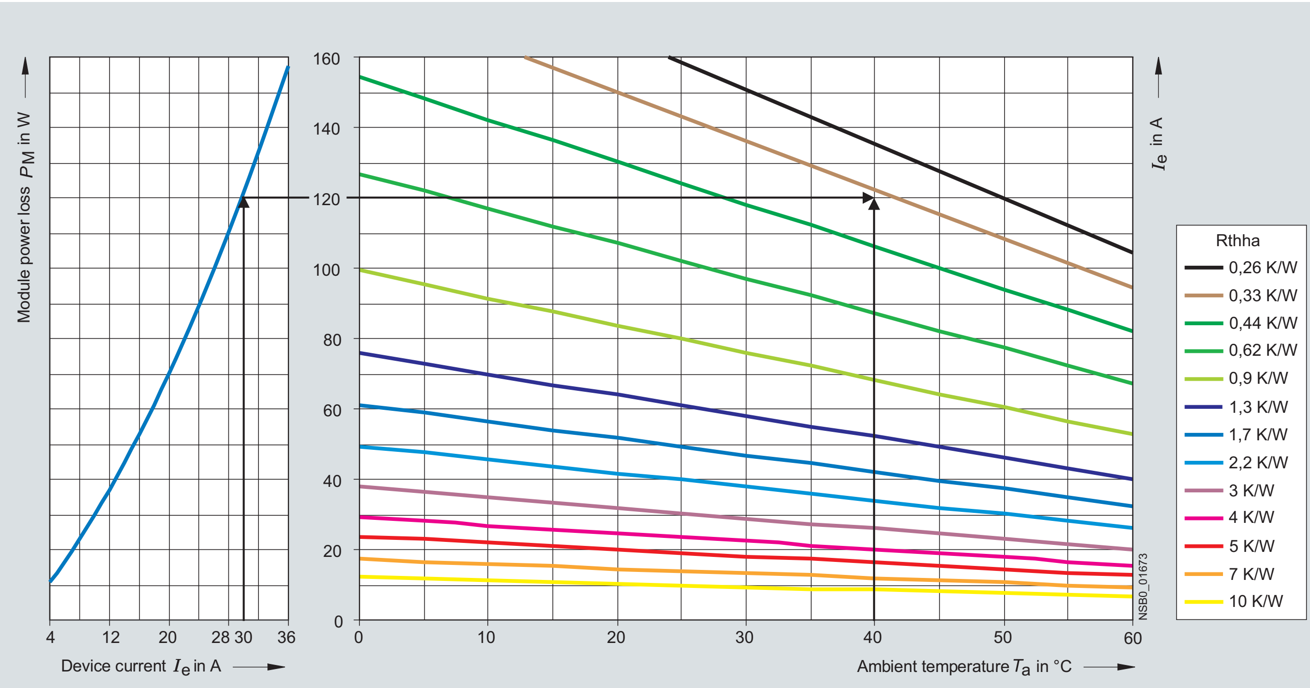


Type current 30 A (3RF22 30-.AB..)

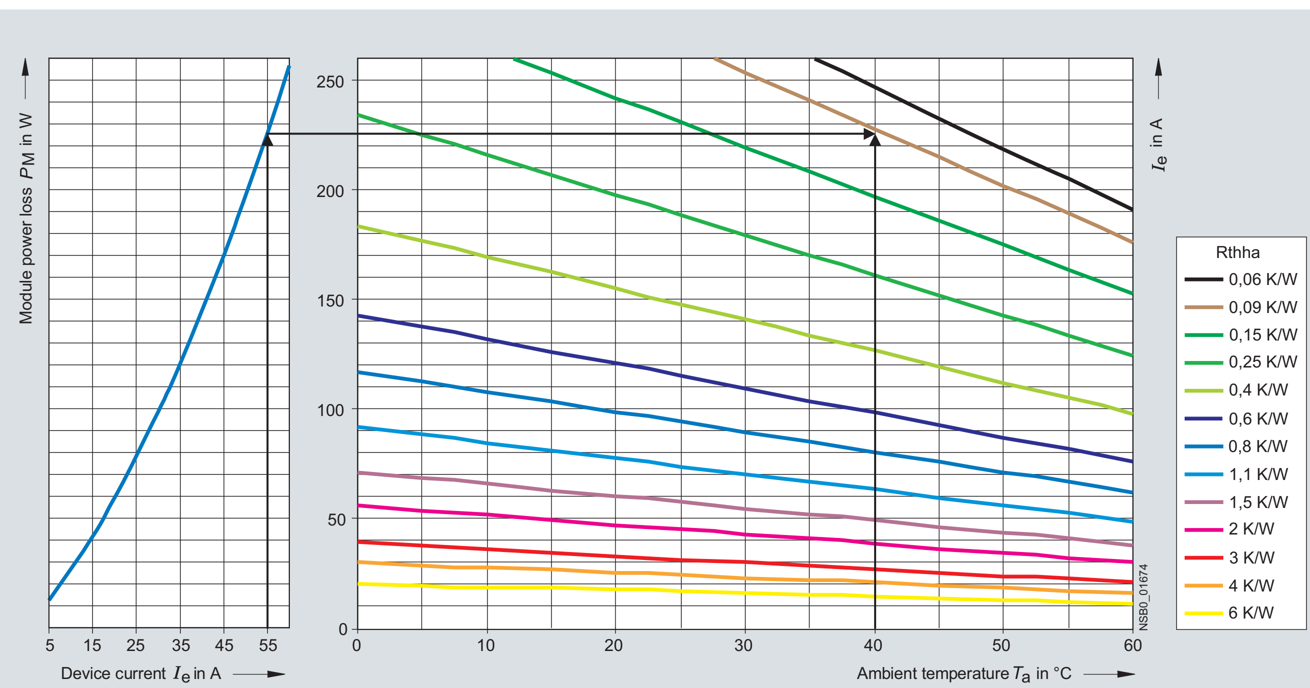


Type current 55 A (3RF22 55-.AB..)

Dependence of the device current I_e on the ambient temperature T_a and the heat sink resistance R_{thha} (three-phase controlled)



Type current 30 A (3RF22 30-.AC..)



Type current 55 A (3RF22 55-.AC..)

Arrangement example

Given conditions: I_e = 55 A and T_a = 40 C. The task is to find the thermal resistance R_{thha} and the heat sink overtemperature dT_{ha}.

From the diagram on the left →P_M = 227 W,
from the diagram on the right →R_{thha} = 0.09 K/W.

This results in:

dT_{ha} = R_{thha} × PM = 0.09 K/W × 227 W = 20.4 K.

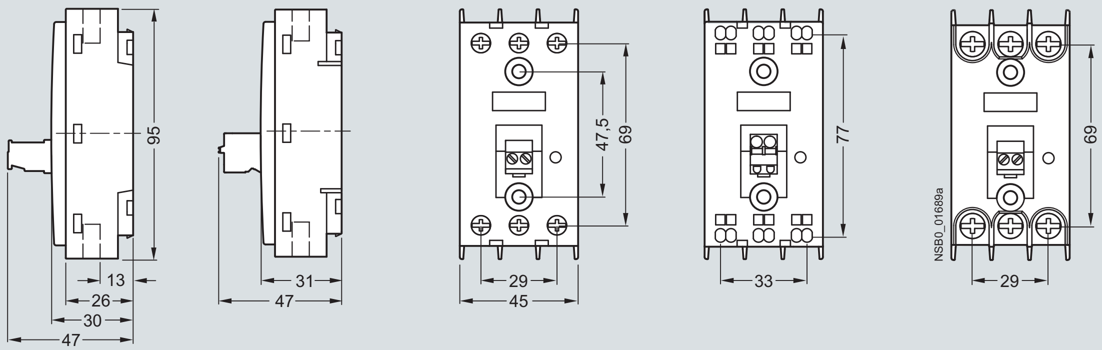
At dT_{ha} = 20.4 K the heat sink must therefore have an R_{thha} = 0.09 K/W.

3RF22 solid-state relays, three-phase, 45 mm

Dimensional drawings

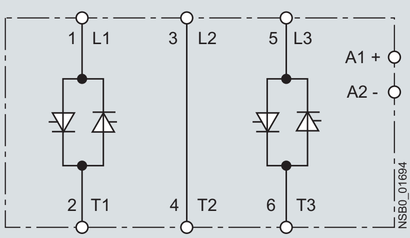
Solid-state relays

Screw terminal | Spring-type terminal | **Screw terminal 3RF22 ..-1....** | **Spring-type terminal 3RF22 ..-2....** | **Ring terminal lug connection 3RF22 ..-3....**

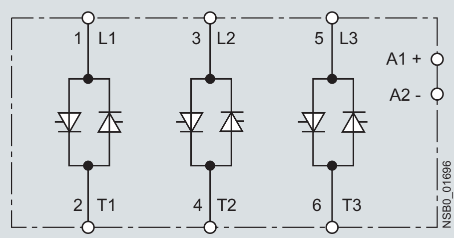


Schematics

Two-phase controlled,
DC control supply voltage



Three-phase controlled,
DC control supply voltage



Overview

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

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

The solid-state contactors are available in 2 different versions:

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

Version for resistive loads, "zero-point switching"

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

Version for inductive loads, "instantaneous switching"

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

Special "Low noise" version

Thanks to a special control circuit, this zero-point-switching special version can be used in public networks up to 16 A without any additional measures such as interference suppressor filters. As a result it conforms to limit value curve class B according to EN 60947-4-3 in terms of emitted interference.

Special "Short-circuit resistant" version

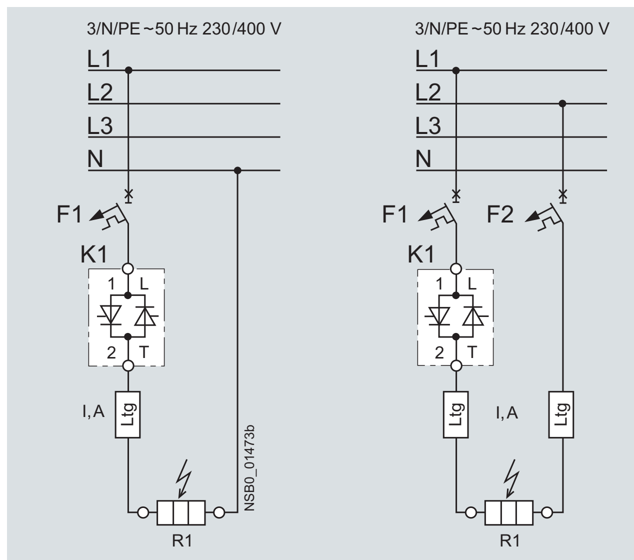
Skillful matching of the zero-point switching power semiconductor with the performance of the solid-state contactor means that "short-circuit strength" can be achieved with a standard miniature circuit breaker. In combination with a B-type MCB or a conventional line protection fuse, the result is a short-circuit resistant feeder.

In order to achieve problem-free short-circuit protection by means of miniature circuit breakers, however, certain boundary conditions must be observed. As the magnitude and duration of the short-circuit current are determined not only by the short-circuit breaking response of the miniature circuit breaker but also the properties of the wiring system, such as the internal resistance of the input to the network and damping by controls and cables, particular attention must also be paid to these parameters. The necessary cable lengths are therefore shown for the main factor, the line resistance, in the table below.

The following miniature circuit breakers with a type B tripping characteristic and 10 kA or 6 kA breaking capacity protect the 3RF23..-.DA.. solid-state contactors in the event of short-circuits on the load and the specified conductor cross-sections and lengths:

Rated current of the miniature circuit breaker	Example of type[1)]	Max. conductor cross-section	Minimum cable length from contactor to load
6 A	5SY4 106-6, 5SX2 106-6	1 mm^2	5 m
10 A	5SY4 110-6, 5SX2 110-6	1.5 mm^2	8 m
16 A	5SY4 116-6, 5SX2 116-6	1.5 mm^2	12 m
16 A	5SY4 116-6, 5SX2 116-6	2.5 mm^2	20 m
20 A	5SY4 120-6, 5SX2 120-6	2.5 mm^2	20 m
25 A	5SY4 125-6, 5SX2 125-6	2.5 mm^2	26 m

1) The miniature circuit breakers can be used up to a maximum rated voltage of 480 V!



The setup and installation above can also be used for the solid-state relays with a I^2t value of at least 6600 A^2s.

More information

Selecting solid-state contactors

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

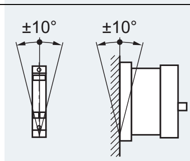
The following procedure is recommended:

- Determine the rated current of the load and the mains voltage
- Select a solid-state contactor with the same or higher rated current than the load
- Check the correct contactor size with the aid of the rated current diagram, taking account of the installation conditions

3RF23 solid-state contactors, single-phase

Technical specifications

Order No.		3RF23 ..-.A...	3RF23 ..-.B...	3RF23 ..-.C...	3RF23 ..-.D...
General data					
Ambient temperature					
• During operation, derating from 40 °C	°C	-25 ... +60			
• During storage	°C	-55 ... +80			
Installation altitude	m	0 ... 1000; derating from 1000			
Shock resistance acc. to IEC 60068-2-27	*g*/ms	15/11			
Vibration resistance acc. to IEC 60068-2-6	*g*	2			
Degree of protection		IP20			
Electromagnetic compatibility (EMC)					
• Emitted interference acc. to IEC 60947-4-3 - Conducted interference voltage - Emitted, high-frequency interference voltage		Class A for industrial applications		Class A for industrial applications; Class B for residential/ business/ commercial applications up to 16 A, AC51 Low Noise	Class A for industrial applications
• Interference immunity					
- Electrostatic discharge acc. to IEC 61000-4-2 (corresponds to degree of severity 3)	kV	Contact discharge 4; air discharge 8; behavior criterion 2			
- Induced RF fields acc. to IEC 61000-4-6	MHz	0.15 ... 80; 140 dBμV; behavior criterion 1			
- Burst acc. to IEC 61000-4-4	kV	2/5.0 kHz; behavior criterion 1			
- Surge acc. to IEC 61000-4-5	kV	Conductor - ground 2; conductor - conductor 1; behavior criterion 2			

Order No.		3RF23 ..-1....	3RF23 ..-2....	3RF23 ..-3....
General data				
Connection type		**Screw terminals**	**Spring-type terminals**	**Ring terminal lug connections**
Connection, main contacts				
• Conductor cross-section				
- Solid	mm^2	2 x (1.5 ... 2.5)[1], 2 x (2.5 ... 6)[1]	2x (0.5 ... 2.5)	--
- Finely stranded with end sleeve	mm^2	2 x (1 ... 2.5)[1], 2 x (2.5 ... 6)[1], 1 x 10	2x (0.5 ... 1.5)	--
- Finely stranded without end sleeve	mm^2	--	2x (0.5 ... 2.5)	--
- Solid or stranded, AWG cables		2 x (AWG 14 ... 10)	2 x (AWG 18 ... 14)	--
• Terminal screw		M4	--	M5
• Tightening torque	Nm lb.in	2 ... 2.5 7 ... 10.3	-- --	2 ... 2.5 7 ... 10.3
• Cable lug - DIN - JIS		--	--	DIN 46234 -5-2.5, -5-6, -5-10, -5-16, -5-25 JIS C 2805 R 2-5, 5.5-5, 8-5, 14-5
Connection, auxiliary/control contacts				
• Conductor cross-section	mm AWG	1 x (0.5 ... 2.5)[1], 2 x (0.5 ... 1.0) AWG 20 ... 12	0.5 ... 2.5 AWG 20 ... 12	1 x (0.5 ... 2.5), 2 x (0.5 ... 1.0) AWG 20 ... 12
• Stripped length	mm	7	10	7
• Terminal screw		M3	--	M3
• Tightening torque	Nm lb.in	0.5 ... 0.6 4.5 ... 5.3	-- --	0.5 ... 0.6 4.5 ... 5.3
Permissible mounting positions				

1) If two different conductor cross-sections are connected to one clamping point, both cross-sections must lie in the range specified. If identical cross-sections are used, this restriction does not apply.

Type		3RF23 ..-....2	3RF23 ..-....4	3RF23 ..-....5	3RF23 ..-....6
Main circuit					
Rated operational voltage U_e	V	24 ... 230	48 ... 460	48 ... 600	48 ... 600
• Operating range	V	20 ... 253	40 ... 506	40 ... 660	40 ... 660
• Rated frequency	Hz	50/60 ± 10 %			
Rated insulation voltage U_i	V	600			
Blocking voltage	V	800	1200		1600
Rage of voltage rise	V/μs	1000			

Type		3RF23 ..-...0.	3RF23 ..-...1.		3RF23 ..-...2.	3RF23 ..-...4.
Control circuit						
Method of operation		DC operation	AC/DC operation		AC operation	DC operation
Rated control supply voltage U_s	V	24 DC acc. to EN 61131-2	24 AC	24 DC	110 ... 230 AC	4 ... 30 DC
Rated frequency of the control supply voltage	Hz	--	50/60 ± 10 %	--	50/60 ± 10 %	--
Actuating voltage, max.	V	30	26.5 AC	30 DC	253	30
Typical actuating current	mA	20/Low Power: <10[1)]	20	20	15	20
Response voltage	V	15	14 AC	15 DC	90	4
Drop-out voltage	V	5	5 AC	55 DC	40	1
Operating times						
• ON-delay	ms	1 + max. one half-wave[2)]	10 + max. one half-wave[2)]		40 + max. one half-wave[2)]	1 + max. one half-wave[2)]
• OFF-delay	ms	1 + max. one half-wave	15 + max. one half-wave		40 + max. one half-wave	1 + max. one half-wave

1) Applies to the version "Low Power" 3RF23 ..-.AA..-**0KN0**.

2) Only for zero-point-switching devices.

3RF23 solid-state contactors, single-phase

Order No.	Type current AC-51[1)] For I_{max} at 40 °C	Acc. to IEC 60947-4-3 for 40 °C	Acc. to UL/CSA for 50 °C	Power loss at I_{max}	Minimum load current	Leakage current	Rated impulse withstand capacity I_{tsm}	I^2t value
	A	A	A	W	A	mA	A	A²s
Main circuit								
3RF23 1.-.A..2 **3RF23 1.-.A..4** **3RF23 1.-.A..5** **3RF23 1.-.A..6**	10.5	7.5	9.6	11	0.1	10	200 200 200 400	200 200 200 800
3RF23 2.-.A..2 **3RF23 2.-.A..4** **3RF23 2.-.A..5** **3RF23 2.-.A..6** **3RF23 2.-.C..2** **3RF23 2.-.C..4** **3RF23 2.-.D..2** **3RF23 2.-.D..4**	20	13.2	17.6	20	0.5	10 10 10 10 25 25 10 10	600 600 600 600 600 600 1150 1150	1800 1800 1800 1800 1800 1800 6600 6600
3RF23 3.-.A..2 **3RF23 3.-.A..4** **3RF23 3.-.A..5** **3RF23 3.-.A..6** **3RF23 3.-.C..2** **3RF23 3.-.D..4**	30	22	27	33	0.5	10 10 10 10 25 10	600 600 600 600 600 1150	1800 1800 1800 1800 1800 6600
3RF23 4.-.A..2 **3RF23 4.-.A..4** **3RF23 4.-.A..5** **3RF23 4.-.A..6**	40	33	36	44	0.5	10	1200 1200 1200 1150	7200 7200 7200 6600
3RF23 5.-.A..2 **3RF23 5.-.A..4** **3RF23 5.-.A..5** **3RF23 5.-.A..6**	50	36	45	54	0.5	10	1150	6600
3RF23 7.-.A..2 **3RF23 7.-.A..4** **3RF23 7.-.A..5** **3RF23 7.-.A..6**	70	70	62	83	0.5	10	1150	6600
3RF23 9.-.A..2 **3RF23 9.-.A..4** **3RF23 9.-.A..5** **3RF23 9.-.A..6**	88	88	80	117	0.5	10	1150	6600

1) The type current provides information about the performance of the solid-state contactor. The actual permitted rated operational current I_e can be smaller depending on the connection method and start-up conditions.
For derating see the characteristic curves on page 30.

Order No.	Type current AC-51[1)] For I_{max} at 40 °C	Acc. to IEC 60947-4-3 for 40 °C	Acc. to UL/CSA for 50 °C	Type current AC-15 10 x I_e for 60 ms	Parameters	Power loss at I_{max}	Minimum load current	Leakage current	Rated impulse withstand capacity I_{tsm}	I^2t value
	A	A	A	A		W	A	mA	A	A²s
Main circuit										
3RF23 1.-.B..2 **3RF23 1.-.B..4** **3RF23 1.-.B..6**	10.5	7.5	9.6	6	1200 1/h 50 % ON period	11	0.1	10	200 200 400	200 200 800
3RF23 2.-.B..2 **3RF23 2.-.B..4** **3RF23 2.-.B..6**	20	13.2	17.6	12	1200 1/h 50 % ON period	20	0.5	10	600	1800
3RF23 3.-.B..2 **3RF23 3.-.B..4** **3RF23 3.-.B..6**	30	22	27	15	1200 1/h 50 % ON period	33	0.5	10	600	1800
3RF23 4.-.B..2 **3RF23 4.-.B..4** **3RF23 4.-.B..6**	40	33	36	20	1200 1/h 50 % ON period	44	0.5	10	1200 1200 1150	7200 7200 6600
3RF23 5.-.B..2 **3RF23 5.-.B..4** **3RF23 5.-.B..6**	50	36	45	25	1200 1/h 50 % ON period	54	0.5	10	1150	6600
3RF23 7.-.B..2 **3RF23 7.-.B..4** **3RF23 7.-.B..6**	70	70	62	27.5	1200 1/h 50 % ON period	83	0.5	10	1150	6600
3RF23 9.-.B..2 **3RF23 9.-.B..4** **3RF23 9.-.B..6**	88	88	80	30	1200 1/h 50 % ON period	117	0.5	10	1150	6600

1) The type current provides information about the performance of the solid-state contactor. The actual permitted rated operational current I_e can be smaller depending on the connection method and start-up conditions.
For derating see the characteristic curves on page 30.

Fused version with semiconductor protection (similar to type of coordination "2")[1)]

The semiconductor protection for the SIRIUS controls can be used with different protective devices. This allows protection by means of LV HRC fuses of gG operational class or miniature circuit breakers. Siemens recommends the use of special SITOR semiconductor fuses. The table below lists the maximum permissible fuses for each SIRIUS control.

If a fuse is used with a higher rated current than specified, semiconductor protection is no longer guaranteed. However, smaller fuses with a lower rated current for the load can be used without problems.

For protective devices with gG operational class and for SITOR 3NE1 all-range fuses, the minimum cross-sections for the conductor to be connected must be taken into account.

Order No.	**All-range fuses**		**Semiconductor fuses/partial-range fuses**			
	LV HRC design	Cylindrical design	LV HRC design	Cylindrical design		
	gR/SITOR	gR/NEOZED[2)]	aR/SITOR	aR/SITOR	aR/SITOR	aR/SITOR
		SILIZED		10 mm x 38 mm	14 mm x 51 mm	22 mm x 58 mm
	3NE1	5SE1	3NE8	3NC1 0	3NC1 4	3NC2 2
3RF23 1.-.....	3NE1813-0	5SE1 316	3NE8 015-1	3NC1 010	3NC1 410	3NC2 220
3RF23 2.-.....	3NE1814-0	5SE1 325	3NE8 015-1	3NC1 020	3NC1 420	3NC2 220
3RF23 3.-.....	3NE1803-0	5SE1 335	3NE8 003-1	3NC1 032	3NC1 432	3NC2 232
3RF23 4.-.....	3NE1802-0	5SE1 350	3NE8 017-1	--	3NC1 440	3NC2 240
3RF23 5.-.....	3NE1817-0	5SE1 363	3NE8 018-1	--	3NC1 450	3NC2 250
3RF23 7.-....2	3NE1820-0	--	3NE8 020-1	--	--	3NC2 280
3RF23 7.-....4	3NE1020-2	--	3NE8 020-1	--	--	3NC2 280
3RF23 7.-....5[3)]	3NE1020-2	--	3NE8 020-1	--	--	3NC2 280
3RF23 7.-....6	3NE1020-2	--	3NE8 020-1	--	--	3NC2 280
3RF23 9.-....2	3NE1021-2	--	3NE8 021-1	--	--	3NC2 200
3RF23 9.-....4	3NE1021-2	--	3NE8 021-1	--	--	3NC2 280[4)]
3RF23 9.-....5[3)]	3NE1021-2	--	3NE8 021-1	--	--	3NC2 280[4)]
3RF23 9.-....6	3NE1020-2[4)]	--	3NE8 021-1	--	--	3NC2 280[4)]

Order No.	**Cable and line protection fuses**				
	LV HRC design	Cylindrical design			DIAZED
	gG	gG	gG	gG	quick
		10 mm x 38 mm	14 mm x 51 mm	22 mm x 58 mm	
	3NA6	3NW6 0	3NW6 1	3NW6 2	5SB
3RF23 1.-....2	3NA6 803	3NW6 001-1[4)]	3NW6 101-1[4)]	--	5SB1 41
3RF23 1.-....4	3NA6 801	3NW6 001-1[4)]	3NW6 101-1[4)]	--	5SB1 41
3RF23 1.-....5[3)]	3NA6 801	3NW6 001-1[4)]	3NW6 101-1[3]	--	5SB1 41
3RF23 1.-....6	3NA6 803-6	--	--	--	--
3RF23 2.-....2	3NA6 807	3NW6 007-1[4)]	3NW6 107-1	3NW6 207-1	5SB1 71
3RF23 2.-....4	3NA6 807	3NW6 005-1[4)]	3NW6 105-1[4)]	3NW6 205-1[4)]	5SB1 71
3RF23 2.-....5[3)]	3NA6 807	3NW6 005-1[4)]	3NW6 105-1[4)]	3NW6 205-1[4)]	5SB1 71
3RF23 2.-....6	3NA6 807-6	--	--	--	--
3RF23 3.-....2	3NA6 810[4)]	--	3NW6 107-1[4)]	3NW6 207-1	5SB3 11
3RF23 3.-....4	3NA6 807[4)]	--	3NW6 105-1[4)]	3NW6 205-1[4)]	5SB3 11
3RF23 3.-....5[3)]	3NA6 807[4)]	--	3NW6 105-1[4)]	3NW6 205-1[4)]	5SB3 11
3RF23 3.-....6	3NA6 807-6[4)]	--	--	--	--
3RF23 4.-....2	3NA6 817	--	3NW6 117-1	3NW6 217-1	5SB3 21
3RF23 4.-....4	3NA6 812[4)]	--	3NW6 112-1[4)]	3NW6 212-1[4)]	5SB3 21
3RF23 4.-....5[3)]	3NA6 812[4)]	--	3NW6 112-1[4)]	3NW6 212-1[4)]	5SB3 21
3RF23 4.-....6	--	--	--	--	--
3RF23 5.-....2	--	--	--	3NW6 217-1[4)]	5SB3 21
3RF23 5.-....4	--	--	--	--	5SB3 21
3RF23 5.-....5[3)]	--	--	--	--	5SB3 21
3RF23 5.-....6	--	--	--	--	--
3RF23 7.-....2	--	--	--	--	5SB3 21[4)]
3RF23 7.-....4	--	--	--	--	5SB3 21[4)]
3RF23 7.-....5[3)]	--	--	--	--	5SB3 21[4)]
3RF23 7.-....6	--	--	--	--	--
3RF23 9.-....2	--	--	--	--	5SB3 31[4)]
3RF23 9.-....4	--	--	--	--	5SB3 21[4)]
3RF23 9.-....5[3)]	--	--	--	--	5SB3 21[4)]
3RF23 9.-....6	--	--	--	--	--

Suitable fuse holders, fuse bases and controls can be found in Catalog LV 1, Chapter 19.

1) Type of coordination "2" according to EN 60947-4-1:
In the event of a short-circuit, the controls in the load feeder must not endanger persons or the installation. They must be suitable for further operation. For fused configurations, the protective device must be replaced.

2) For use only with operational voltage U_e up to 400 V.

3) For use only with operational voltage U_e up to 506 V.

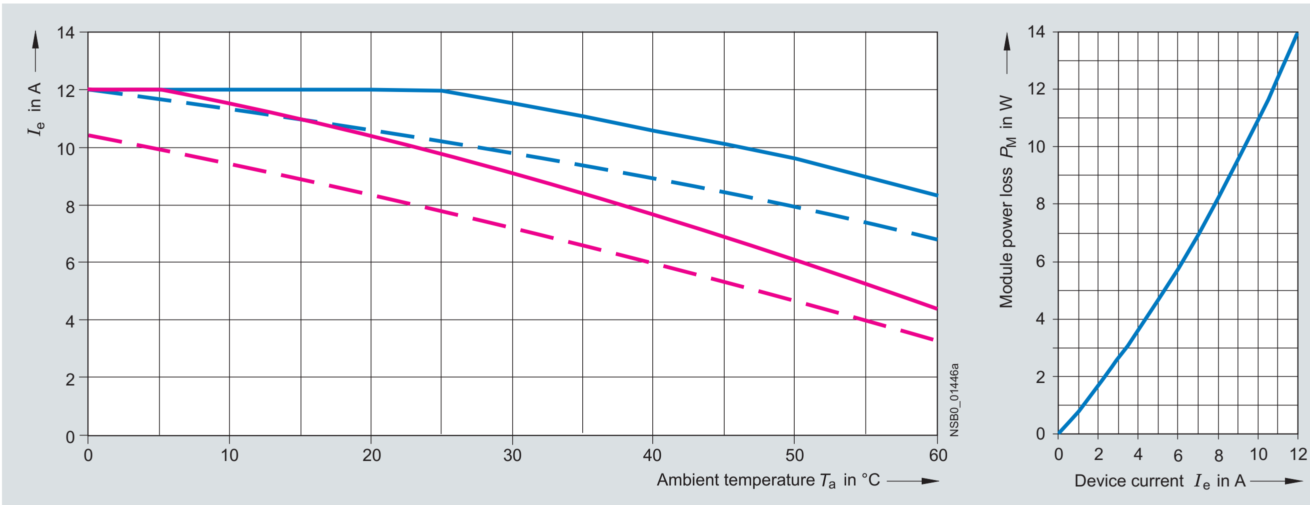
4) These fuses have a smaller rated current than the solid-state contactors.

3RF23 solid-state contactors, single-phase

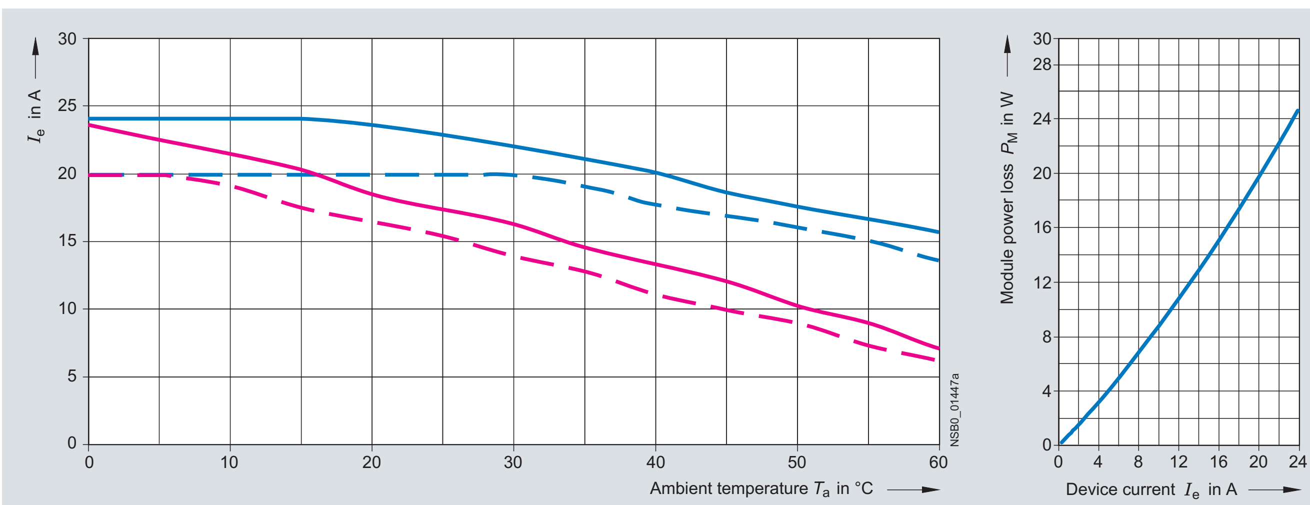
Characteristic curves

Derating curves

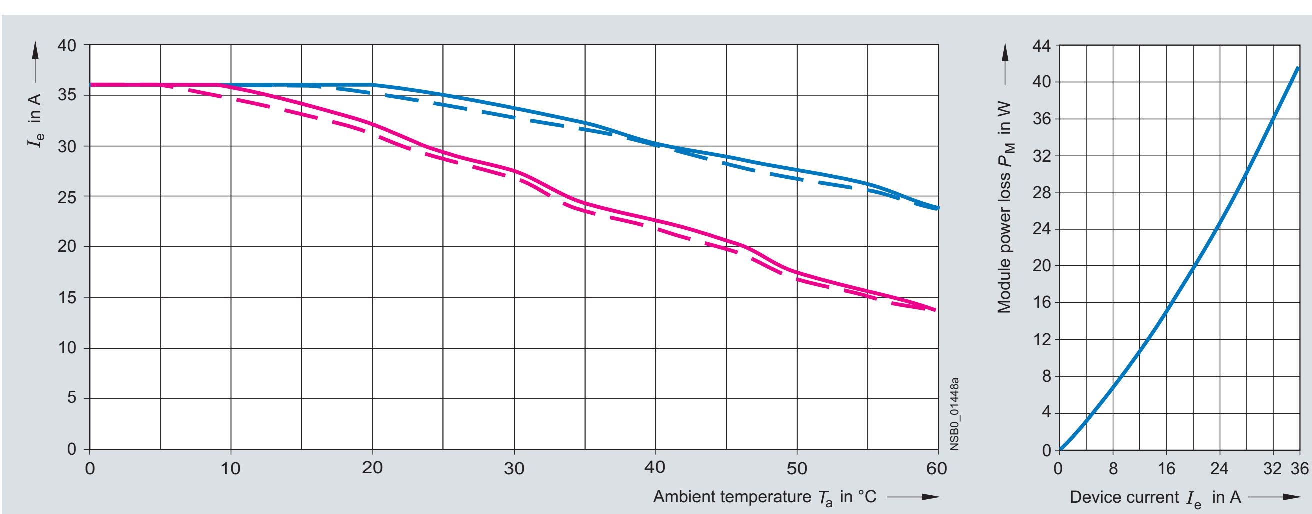
For designation of the characteristic curves see page 32.



Type current 10.5 A (3RF23 10)

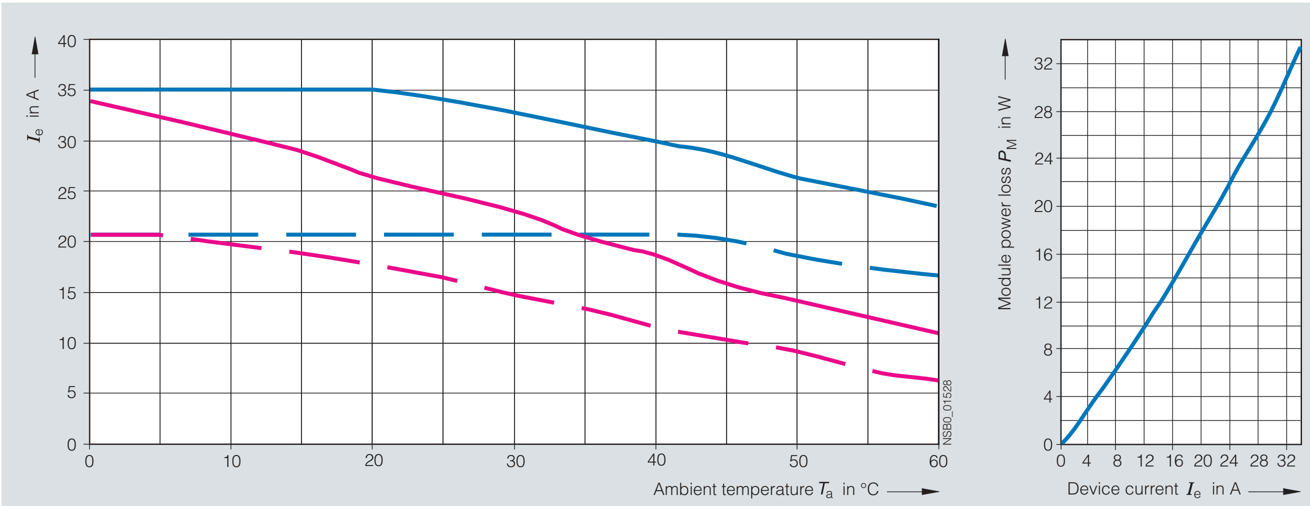


Type current 20 A (3RF23 20)

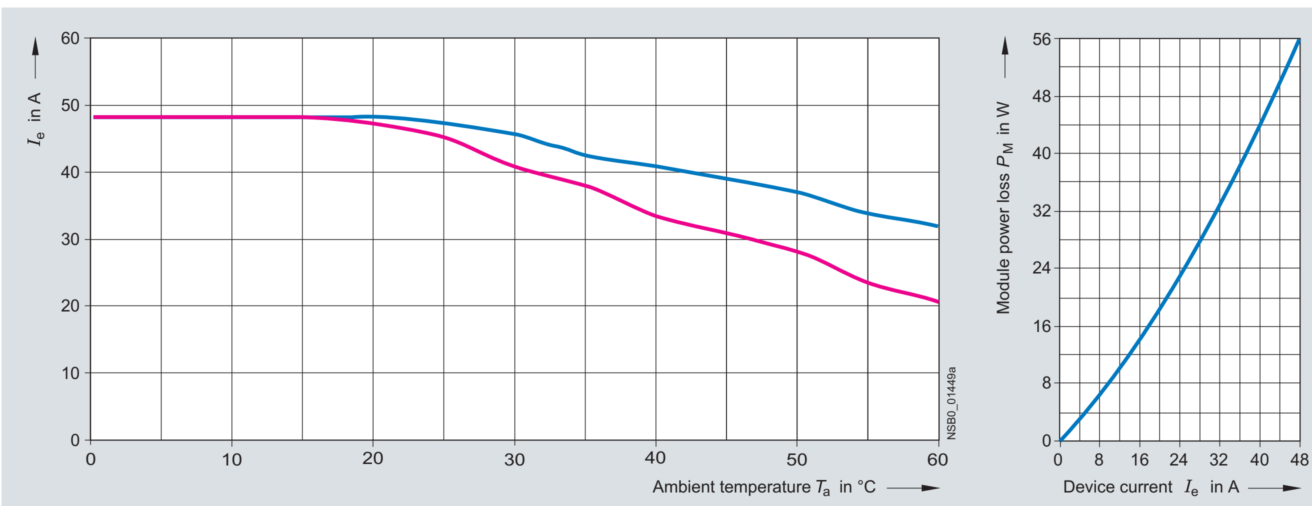


Type current 30 A (3RF23 30-.AA.., -.BA.., -.CA..)

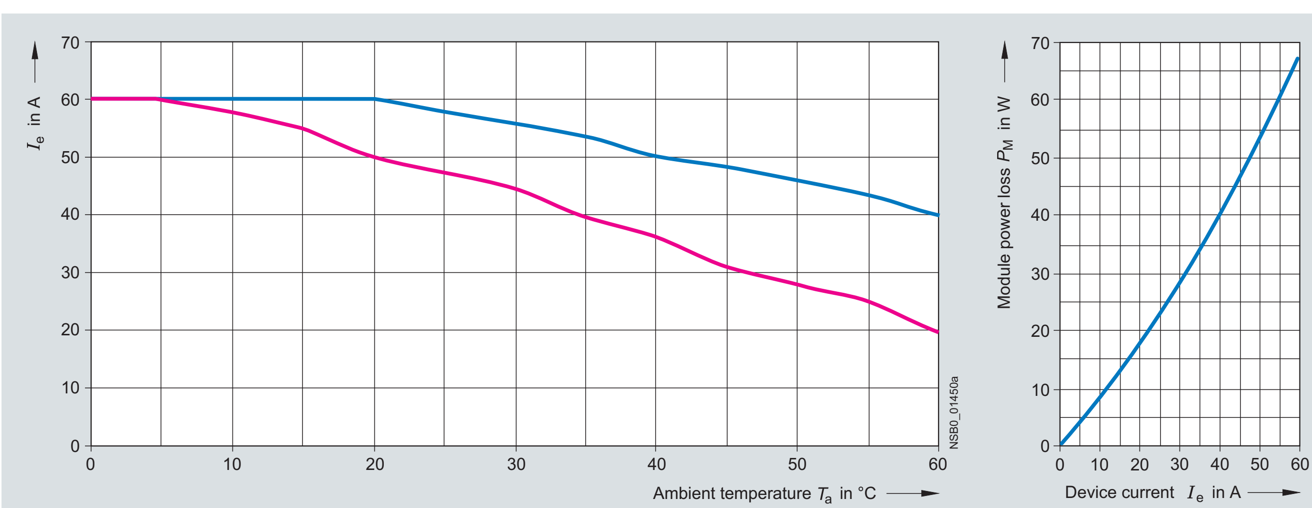
3RF23 solid-state contactors, single-phase



Type current 30 A (3RF23 30-.DA..)



Type current 40 A (3RF23 40)[1)]



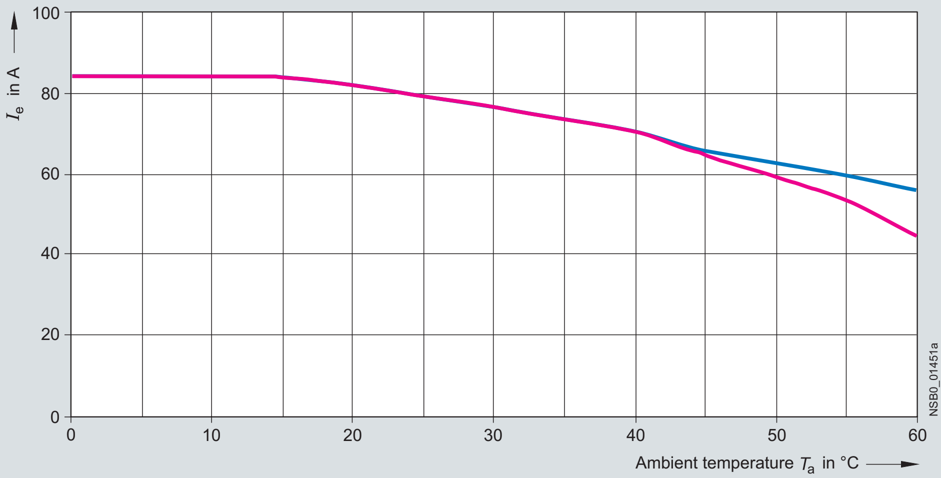
Type current 50 A (3RF23 50)[1)]

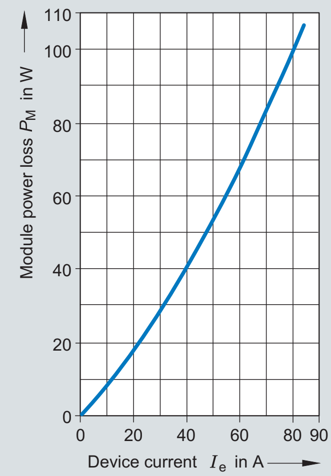
- I_{max} Thermal limit current for individual mounting
- I_{max} Thermal limit current for side-by-side mounting
- I_{IEC} Current acc. to IEC 947-4-3 for individual mounting
- I_{IEC} Current acc. to IEC 947-4-3 for side-by-side mounting

Note: When loaded with IIEC, the maximum overtemperature at the heat sink is 50 K.

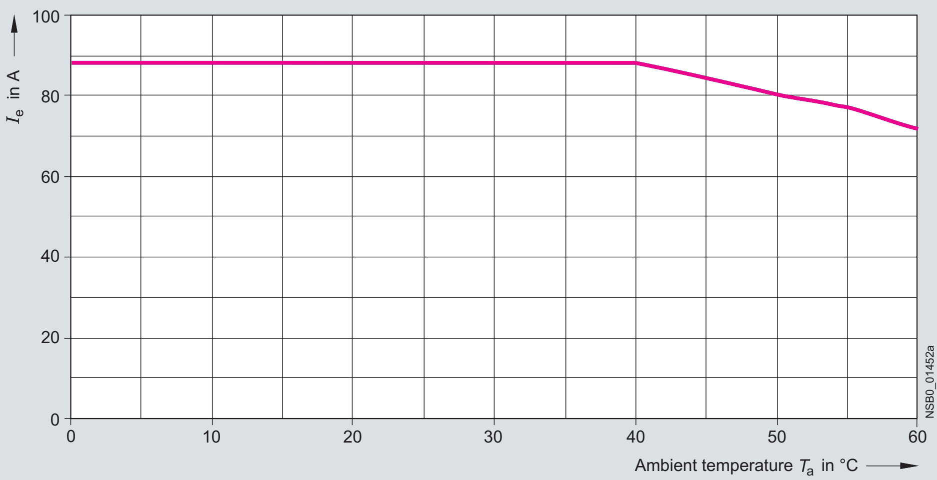
1) Identical current/temperature curves for stand-alone and side-by-side installation.

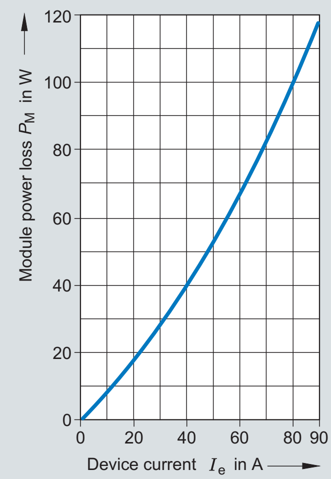
3RF23 solid-state contactors, single-phase





Type current 70 A (3RF23 70)[1)]



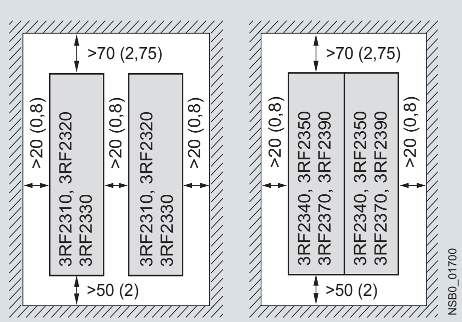


Type current 88 A (3RF23 90)[1)2)]

- I_{max} Thermal limit current for individual mounting
- I_{max} Thermal limit current for side-by-side mounting
- I_{IEC} Current acc. to IEC 947-4-3 for individual mounting
- I_{IEC} Current acc. to IEC 947-4-3 for side-by-side mounting

Note: When loaded with IIEC, the maximum overtemperature at the heat sink is 50 K.

Mounting regulations

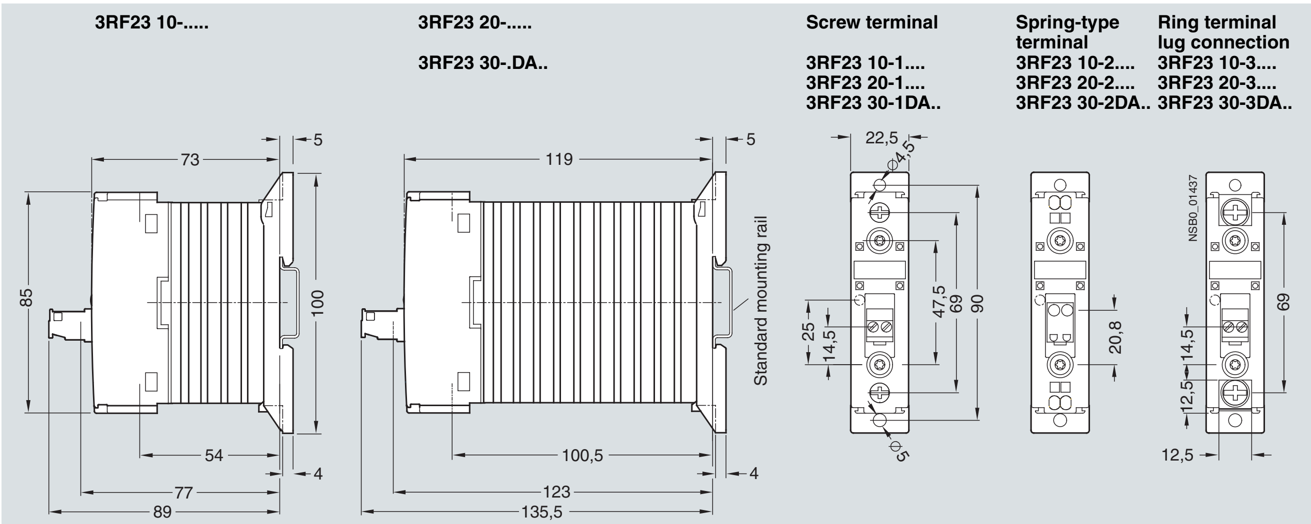


Clearances for stand-alone and side-by-side installation

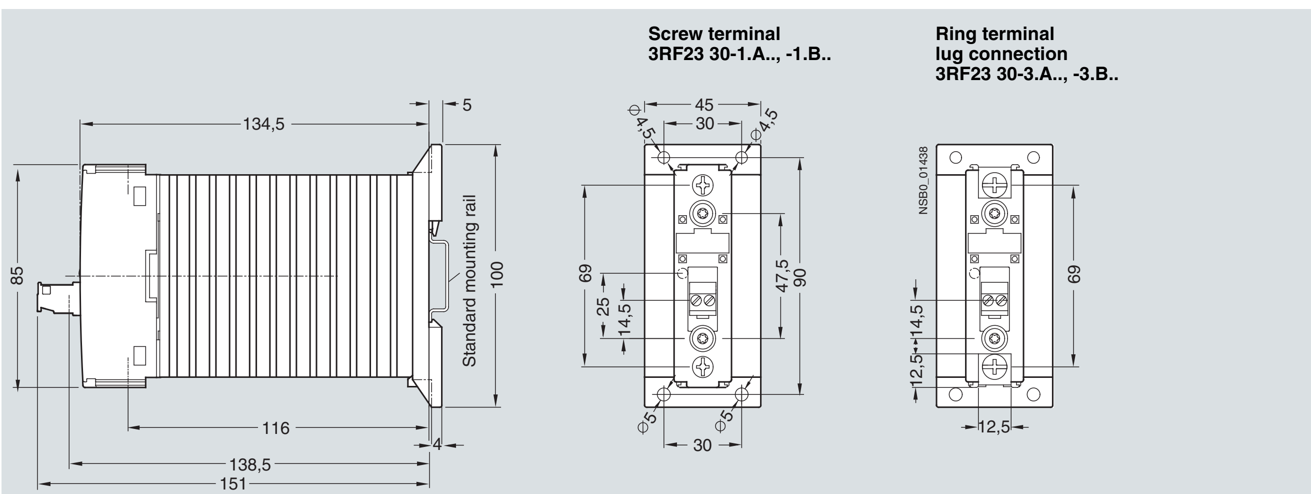
1) Identical current/temperature curves for stand-alone and side-by-side installation.
2) I_{max} and I_{IEC} have identical curves.

Dimensional drawings

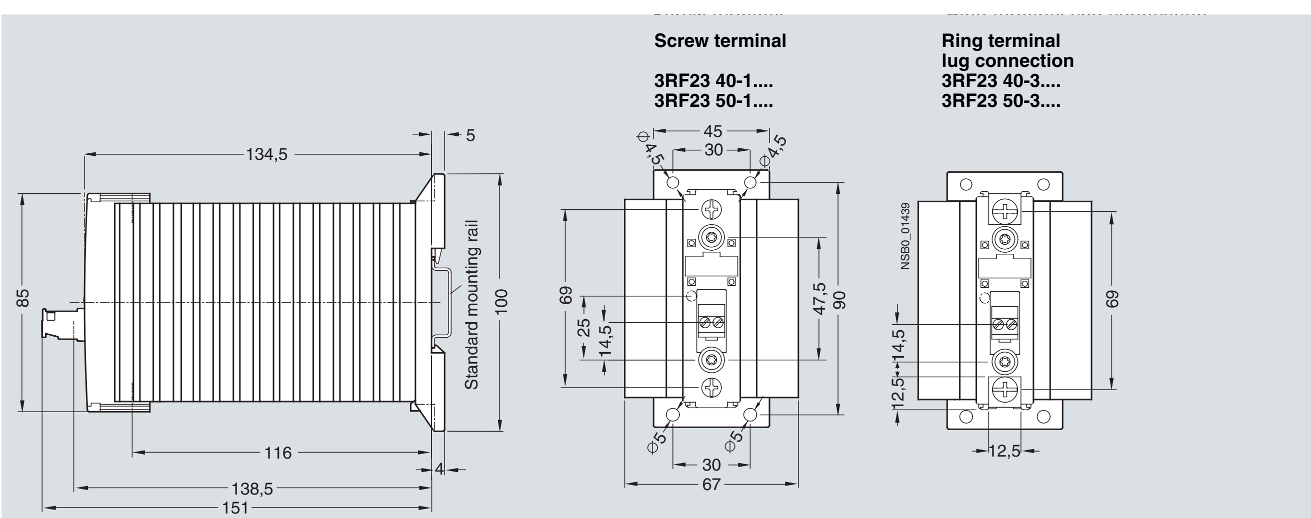
Type current 10.5 A and 20 A



Type current 30 A

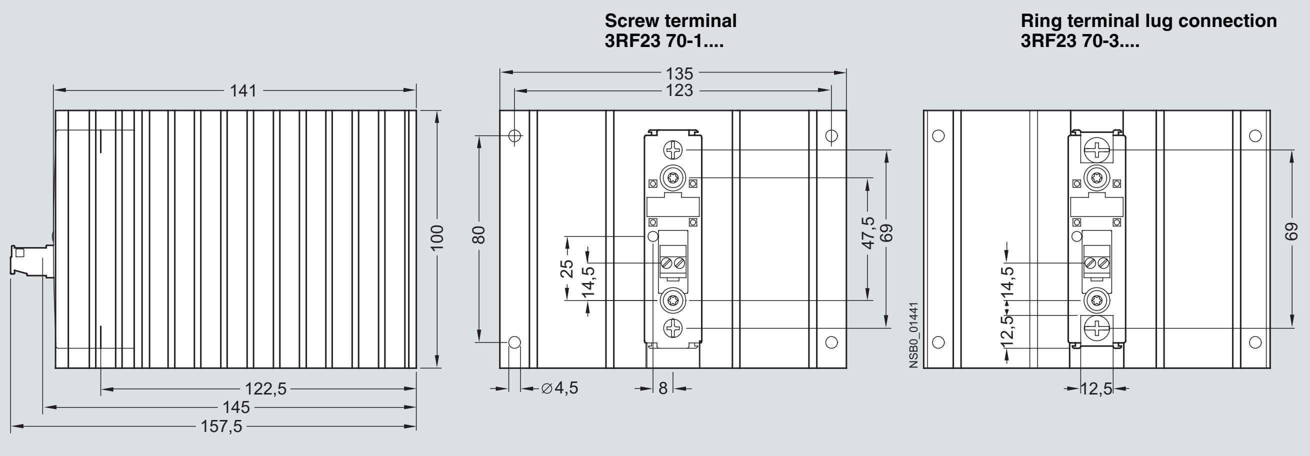


Type current 40 A and 50 A

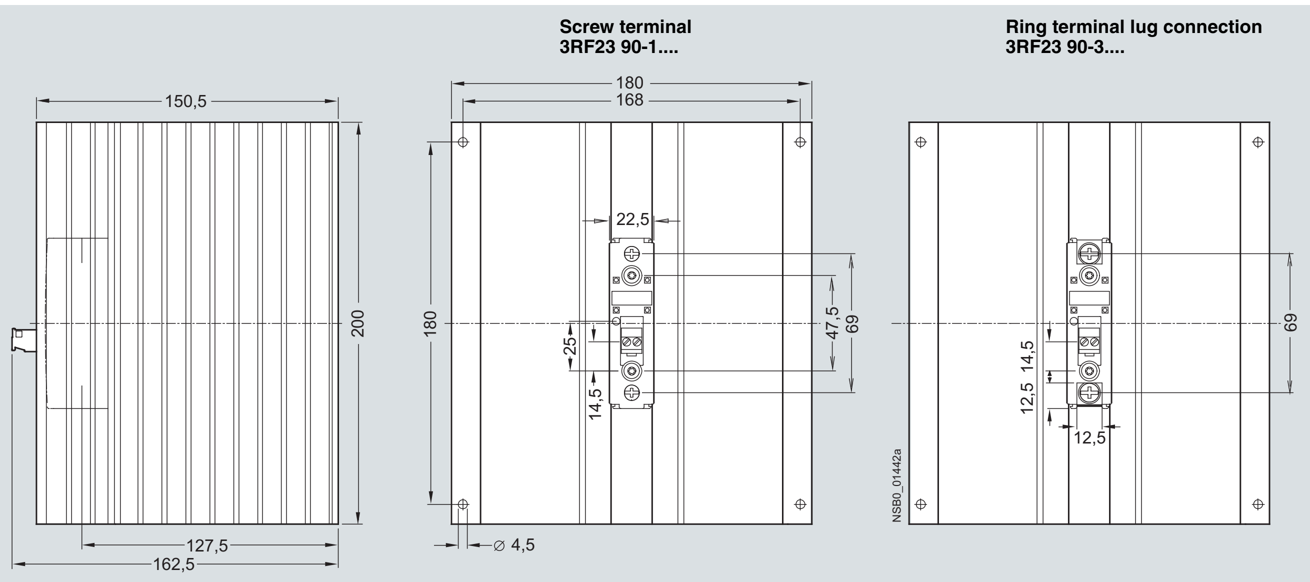


3RF23 solid-state contactors, single-phase

Type current 70 A

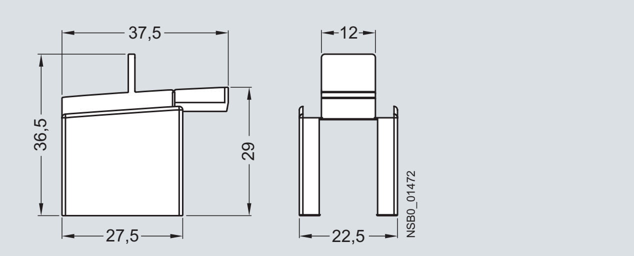


Type current 88 A



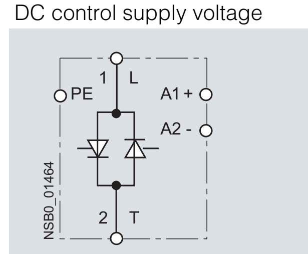
Terminal cover

3RF29 00-3PA88

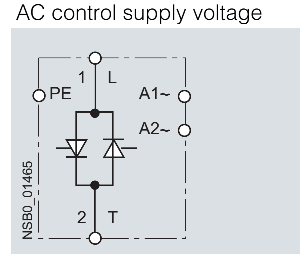


Schematics

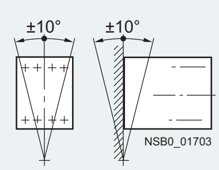
Version
DC control supply voltage



Version
AC control supply voltage



Technical specifications

Order No.		3RF24 ..-1....	3RF24 ..-2....	3RF24 ..-3....
General data				
Ambient temperature				
• During operation, derating from 40 °C	°C	-25 ... +60		
• During storage	°C	-55 ... +80		
Installation altitude	m	0 ... 1000; derating from 1000		
Shock resistance acc. to IEC 60068-2-27	*g*/ms	15/11		
Vibration resistance acc. to IEC 60068-2-6	*g*	2		
Degree of protection		IP20		
Insulation strength at 50/60 Hz (main/control circuit to floor)	V rms	4000		
Electromagnetic compatibility (EMC)				
• Emitted interference acc. to IEC 60947-4-3				
- Conducted interference voltage		Class A for industrial applications[1]		
- Emitted, high-frequency interference voltage		Class A for industrial applications		
• Interference immunity				
- Electrostatic discharge acc. to IEC 61000-4-2 (corresponds to degree of severity 3)	kV	Contact discharge 4; air discharge 8; behavior criterion 2		
- Induced RF fields acc. to IEC 61000-4-6	MHz	0.15 ... 80; 140 dBµV; behavior criterion 1		
- Burst acc. to IEC 61000-4-4	kV	2/5.0 kHz; behavior criterion 1		
- Surge acc. to IEC 61000-4-5	kV	Conductor - ground 2; conductor - conductor 1; behavior criterion 2		
Connection type		**Screw terminals**	**Spring-type terminals**	**Ring terminal lug connections**
Connection, main contacts				
• Conductor cross-section				
- Solid	mm^2	2 x (1.5 ... 2.5)[2], 2 x (2.5 ... 6)[2]	2x (0.5 ... 2.5)	--
- Finely stranded with end sleeve	mm^2	2 x (1 ... 2.5)[2], 2 x (2.5 ... 6)[2], 1 x 10	2x (0.5 ... 1.5)	--
- Finely stranded without end sleeve	mm^2	--	2x (0.5 ... 2.5)	--
- Solid or stranded, AWG cables		2 x (AWG 14 ... 10)	2 x (AWG 18 ... 14)	--
• Stripped length	mm	10	10	--
• Terminal screw		M4	--	M5
- Tightening torque	Nm	2 ... 2.5		2 ... 2.5
	lb.in	18 ... 22		18 ... 22
• Cable lug		--	--	
- Acc. to DIN 46234				5-2.5 ... 5-25
- Acc. to JIS C 2805				R 2-5 ,,, 14-5
Connection, auxiliary/control contacts				
• Conductor cross-section	mm	1 x (0.5 ... 2.5), 2 x (0.5 ... 1.0)	0.5 ... 2.5	1 x (0.5 ... 2.5), 2 x (0.5 ... 1.0)
	AWG	AWG 20 ... 12	AWG 20 ... 12	AWG 20 ... 12
• Stripped length	mm	7	10	7
• Terminal screw		M3	--	M3
- Tightening torque, Ø 3.5, PZ 1	Nm	0.5 ... 0.6		0.5 ... 0.6
	lb.in	4.5 ... 5.3		4.5 ... 5.3
Permissible mounting positions				

1) These products were built as Class A devices. The use of these devices in residential areas could result in lead in radio interference. In this case these may be required to introduce additional interference suppression measures.

2) If two different conductor cross-sections are connected to one clamping point, both cross-sections must lie in the range specified. If identical cross-sections are used, this restriction does not apply.

3RF24 solid-state contactors, three-phase

Order No.	Type current I_{AC-51} at 40 °C	Rated operational current I_e Acc. to IEC 60947-4-3 for 40 °C	Acc. to UL/CSA for 50 °C	Power loss at I_{AC-51}	Minimum load current	Max. leakage current	Rated impulse withstand capacity I_{tsm}	I^2t value
	A	A	A	W	A	mA	A	A²s
Main circuit								
3RF24 10-.AB.5	10.5	7	7	23	0.1	10	200	200
3RF24 20-.AB.5	22	15	15	44	0.5	10	600	1800
3RF24 30-.AB.5	30	22	22	61	0.5	10	1200	7200
3RF24 40-.AB.5	40	30	30	80	0.5	10	1150	6600
3RF24 50-.AB.5	50	38	38	107	0.5	10	1150	6600
3RF24 10-.AC.5	10.5	7	7	31	0.1	10	300	450
3RF24 20-.AC.5	22	15	15	66	0.5	10	600	1800
3RF24 30-.AC.5	30	22	22	91	0.5	10	1200	7200
3RF24 40-.AC.5	40	30	30	121	0.5	10	1150	6600
3RF24 50-.AC.5	50	38	38	160	0.5	10	1150	6600

1) The type current provides information about the performance of the solid-state contactor. The actual permitted rated operational current I_e can be smaller depending on the connection method and start-up conditions.
For derating see the characteristic curves on page 38.

Type		3RF24 ..-.AB.5	3RF24 ..-.AC.5
Main circuit			
Controlled phases		Two-phase	Three-phase
Rated operational voltage U_e	V	48 ... 600	48 ... 600
• Operating range	V	40 ... 660	40 ... 660
• Rated frequency	Hz	50/60 ± 10 %	50/60 ± 10 %
Rated insulation voltage U_i	V	600	600
Rated impulse withstand voltage U_{imp}	kV	6	6
Blocking voltage	V	1200	1200
Rage of voltage rise	V/µs	1000	1000

Type		3RF24 ..-...3.	3RF24 ..-...4.	3RF24 ..-...5.
Control circuit				
Method of operation		AC operation	DC operation	AC operation
Rated control supply voltage U_s	V	110	4 ... 30	190 ... 230
Rated frequency of the control supply voltage	Hz	50/60 ± 10 %	--	50/60 ± 10 %
Actuating voltage, max.	V	121	30	253
Typical actuating current	mA	15	30	15
Response voltage	V	90	4	180
Drop-out voltage	V	< 40	< 1	< 40
Operating times				
• ON-delay	ms	40 + max. one half-wave	1 + max. one half-wave	40 + max. one half-wave
• OFF-delay	ms	40 + max. one half-wave	1 + max. one half-wave	40 + max. one half-wave

Fused version with semiconductor protection (similar to type of coordination "2")[1)]

The semiconductor protection for the 3RF24 controls can be used with different protective devices. Siemens recommends the use of special SITOR semiconductor fuses. The table below lists the maximum permissible fuses for each 3RF24 control.

If a fuse is used with a higher rated current than specified, semi-conductor protection is no longer guaranteed. However, smaller fuses with a lower rated current for the load can be used without problems.

Order No.	All-range fuses		Semiconductor fuses/partial-range fuses			
	LV HRC design	Cylindrical design	LV HRC design	Cylindrical design		
	gR/SITOR	gR/NEOZED[2)]	aR/SITOR	aR/SITOR	aR/SITOR	aR/SITOR
		SILIZED		10 mm x 38 mm	14 mm x 51 mm	22 mm x 58 mm
	3NE1	5SE1	3NE8	3NC1 0	3NC1 4	3NC2 2
Operational voltage U_e up to 460 V (+10 %)						
3RF24 10-.A...	3NE1 813-0	5SE1 310	3NE8 015-1	3NC1 012	3NC1 415	3NC2 220
3RF24 20-.A...	3NE1 814-0	5SE1 320	3NE8 015-1	3NC1 025	3NC1 425	3NC2 225
3RF24 30-.A...	3NE1 803-0	5SE1 335	3NE8 003-1	3NC1 032	3NC1 432	3NC2 232
3RF24 40-.A...	3NE1 802-0	5SE1 350	3NE8 017-1	--	3NC1 450	3NC2 250
3RF24 50-.A...	3NE1 817-0	5SE1 350	3NE8 018-1	--	3NC1 450	3NC2 263
Operational voltage U_e up to 600 V (+10 %)						
3RF24 10-.A...	3NE1 813-0	--	3NE8 015-1	3NC1 012	3NC1 415	3NC2 220
3RF24 20-.A...	3NE1 814-0	--	3NE8 015-1	3NC1 025	3NC1 425	3NC2 225
3RF24 30-.A...	3NE1 803-0	--	3NE8 003-1	3NC1 032	3NC1 432	3NC2 232
3RF24 40-.A...	3NE1 802-0	--	3NE8 017-1	--	3NC1 450	3NC2 250
3RF24 50-.A...	3NE1 817-0	--	3NE8 018-1	--	3NC1 450	3NC2 263

Order No.	Cable and line protection fuses				
	LV HRC design	Cylindrical design			DIAZED
	gG	gG	gG	gG	quick
		10 mm x 38 mm	14 mm x 51 mm	22 mm x 58 mm	
	3NA6	3NW6 0	3NW6 1	3NW6 2	5SB
Operational voltage U_e up to 460 V (+10 %)					
3RF24 10-.AB..	3NA3 801[3)]	3NW6 001-1[3)]	3NW6 101-1[3)]	--	5SB1 31[3)]
3RF24 10-.AC..	3NA3 803	3NW6 001-1[3)]	3NW6 101-1[3)]	--	5SB1 61
3RF24 20-.A...	3NA3 805[3)]	3NW6 005-1[3)]	3NW6 105-1[3)]	3NW6 205-1[3)]	5SB1 81
3RF24 30-.A...	3NA3 812	--	3NW6 112-1	--	5SB3 11
3RF24 40-.A...	3NA3 812[3)]	--	3NW6 112-1[3)]	3NW6 210-1[3)]	5SB3 21
3RF24 50-.A...	3NA3 812[3)]	--	--	3NW6 210-1[3)]	5SB3 21[3)]

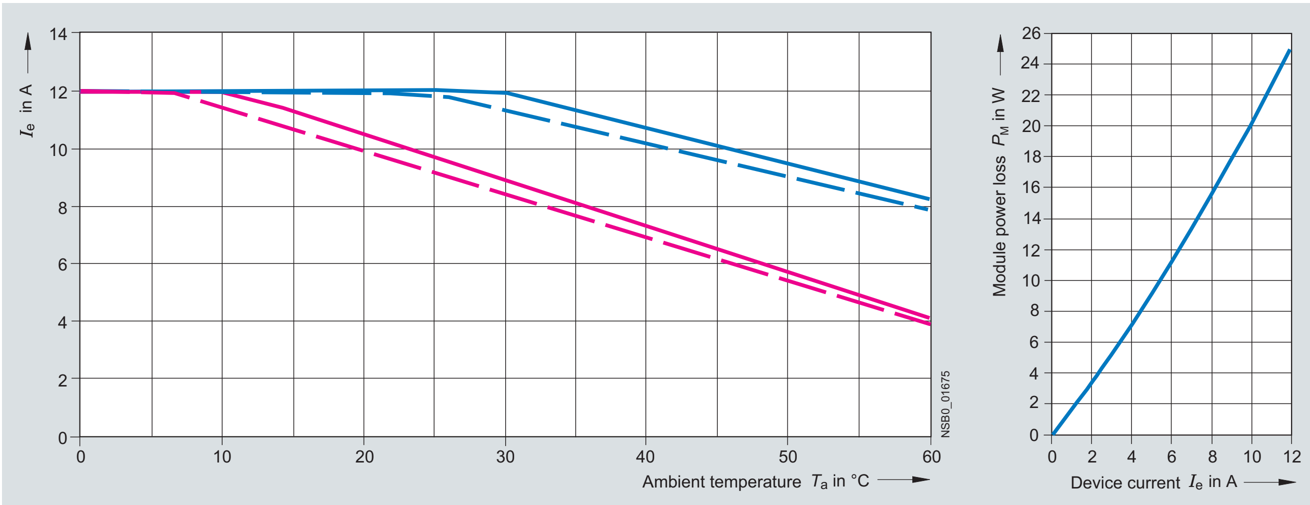
Suitable fuse holders, fuse bases and controls can be found in Catalog LV 1, Chapter 19.

1) Type of coordination "2" according to EN 60947-4-1: In the event of a short-circuit, the controls in the load feeder must not endanger persons or the installation. They must be suitable for further operation. For fused configurations, the protective device must be replaced.
2) For use only with operational voltage U_e up to 400 V.
3) These fuses have a smaller rated current than the solid-state contactors.

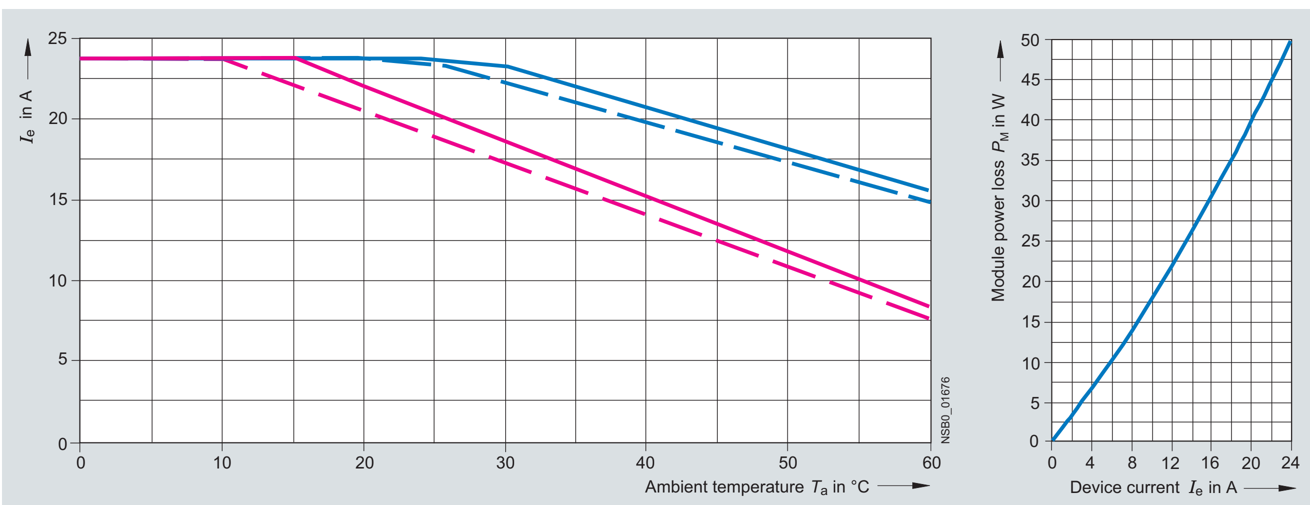
3RF24 solid-state contactors, three-phase

Characteristic curves

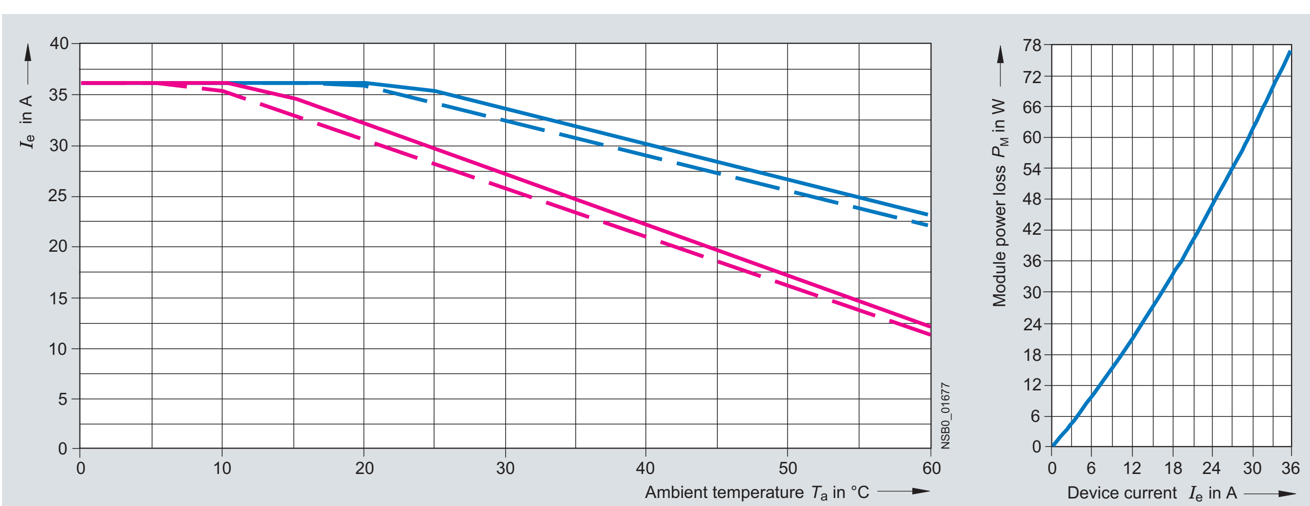
Derating curves, two-phase controlled



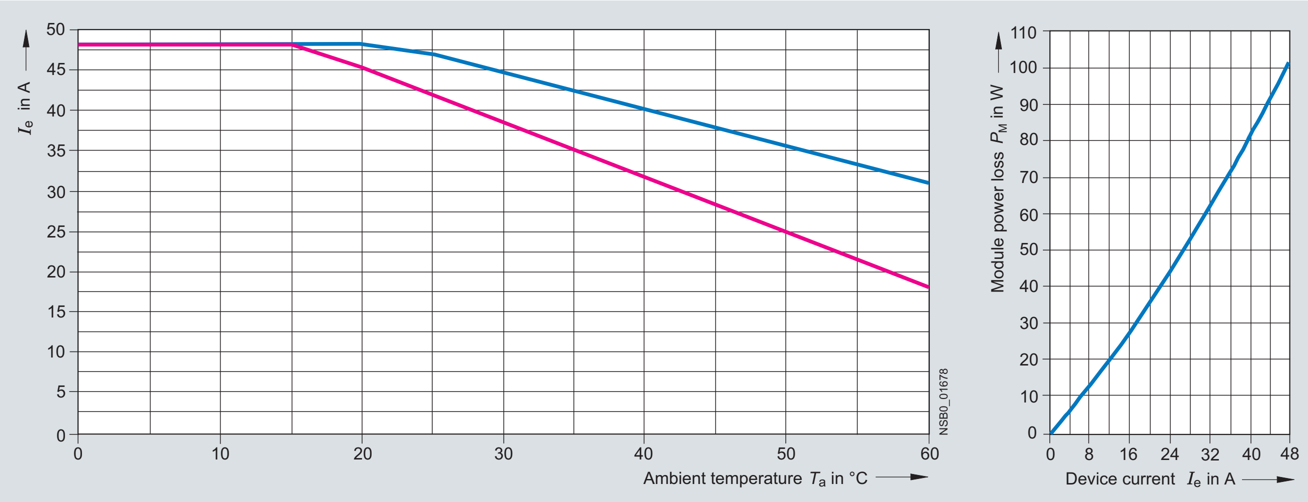
Type current 10.5 A (3RF24 10-.AB..)



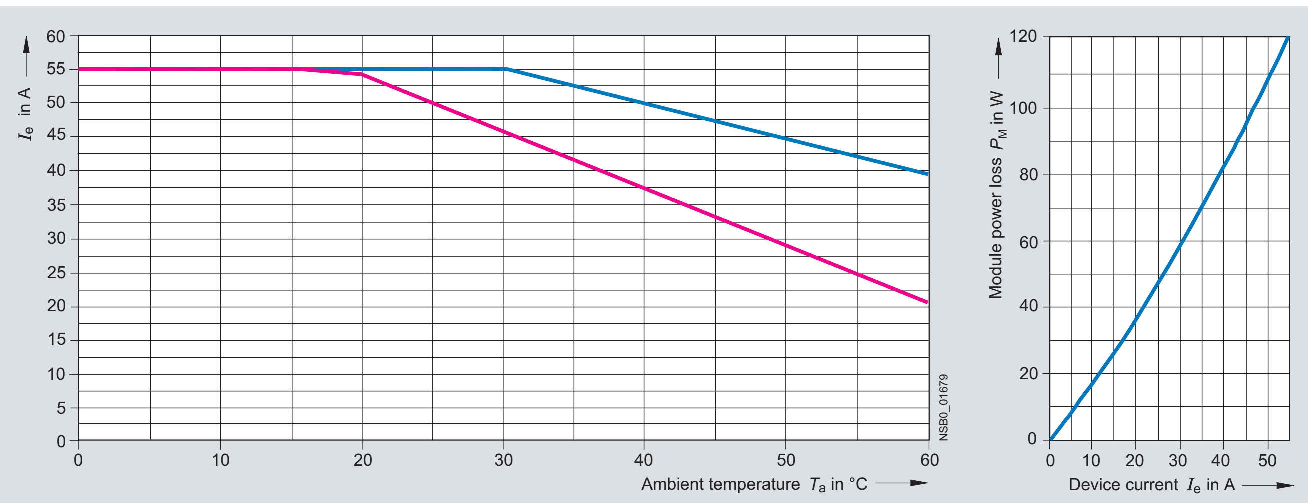
Type current 20 A (3RF24 20-.AB..)



Type current 30 A (3RF24 30-.AB..)



Type current 40 A (3RF24 40-.AB..)[1)]

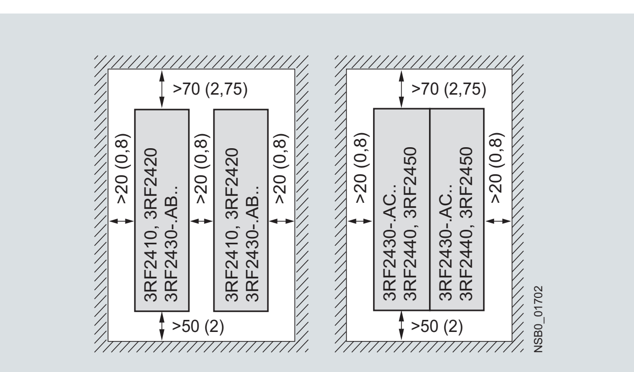


Type current 50 A (3RF24 50-.AB..)[1)]

- I_{max} Thermal limit current for individual mounting
- I_{max} Thermal limit current for side-by-side mounting
- I_{IEC} Current acc. to IEC 947-4-3 for individual mounting
- I_{IEC} Current acc. to IEC 947-4-3 for side-by-side mounting

Note: When loaded with IIEC, the maximum overtemperature at the heat sink is 50 K.

Mounting regulations

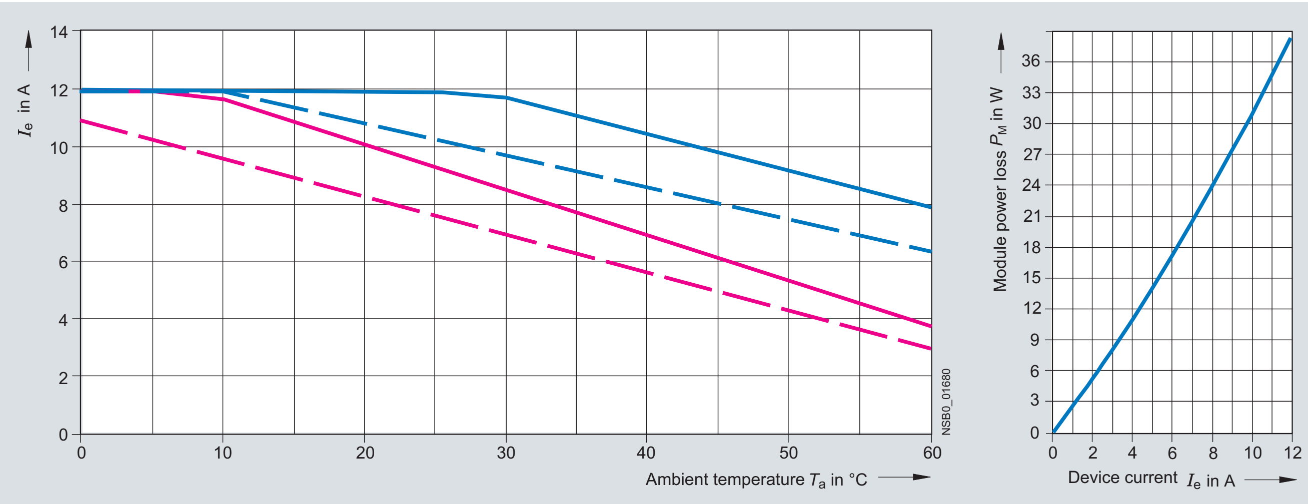


Clearances for stand-alone and side-by-side installation

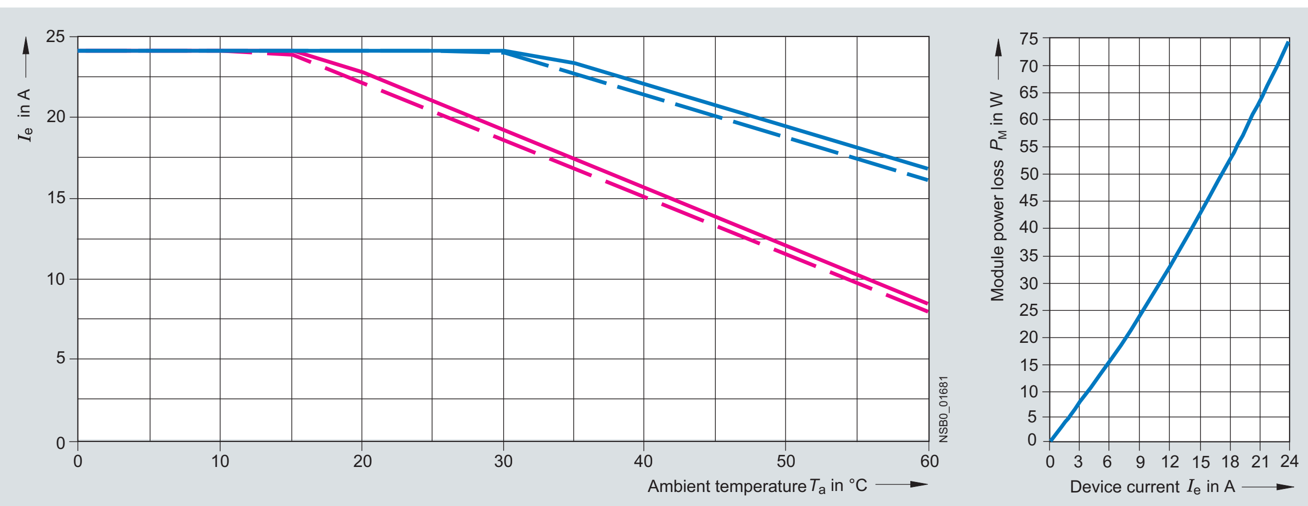
1) Identical current/temperature curves for stand-alone and side-by-side installation.

3RF24 solid-state contactors, three-phase

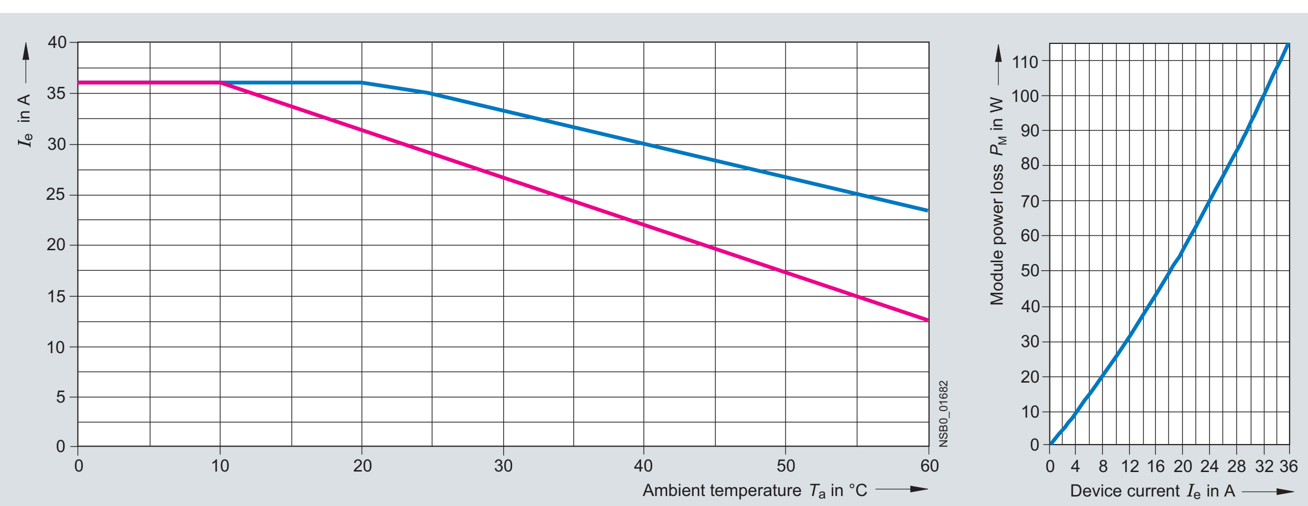
Derating curves, three-phase controlled



Type current 10.5 A (3RF24 10-.AC..)

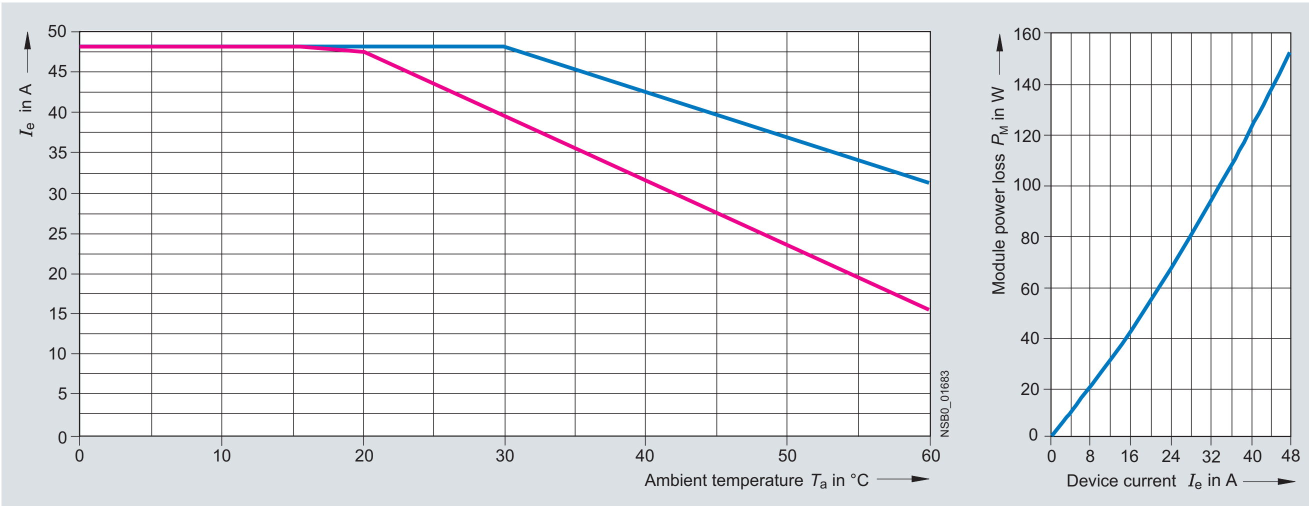


Type current 20 A (3RF24 20-.AC..)

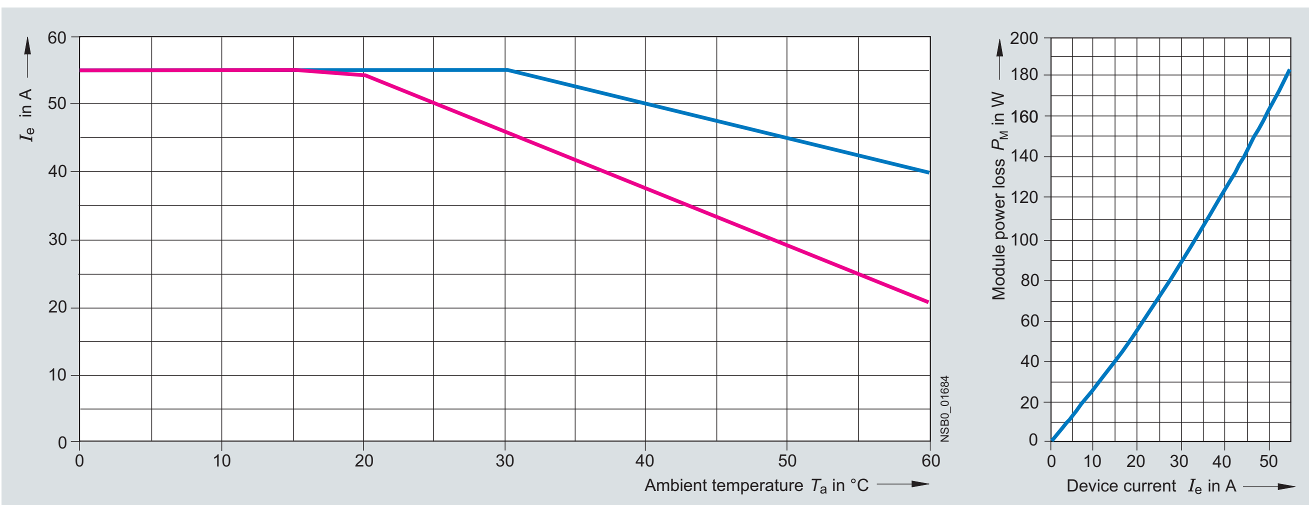


Type current 30 A (3RF24 30-.AC..)[1)]

1) Identical current/temperature curves for stand-alone and side-by-side installation.



Type current 40 A (3RF24 40-.AC..)[1)]

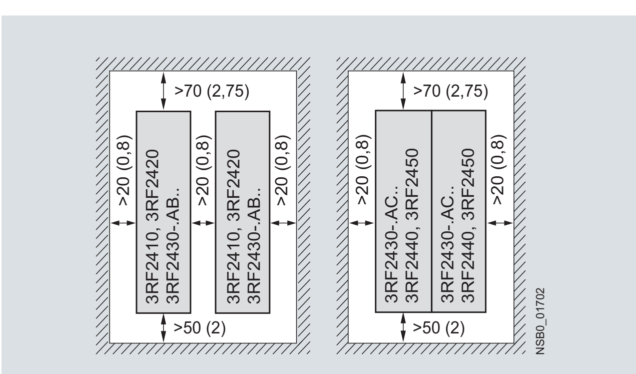


Type current 50 A (3RF24 50-.AC..)[1)]

I_{max} Thermal limit current for individual mounting
I_{max} Thermal limit current for side-by-side mounting
I_{IEC} Current acc. to IEC 947-4-3 for individual mounting
I_{IEC} Current acc. to IEC 947-4-3 for side-by-side mounting

Note: When loaded with IIEC, the maximum overtemperature at the heat sink is 50 K.

Mounting regulations



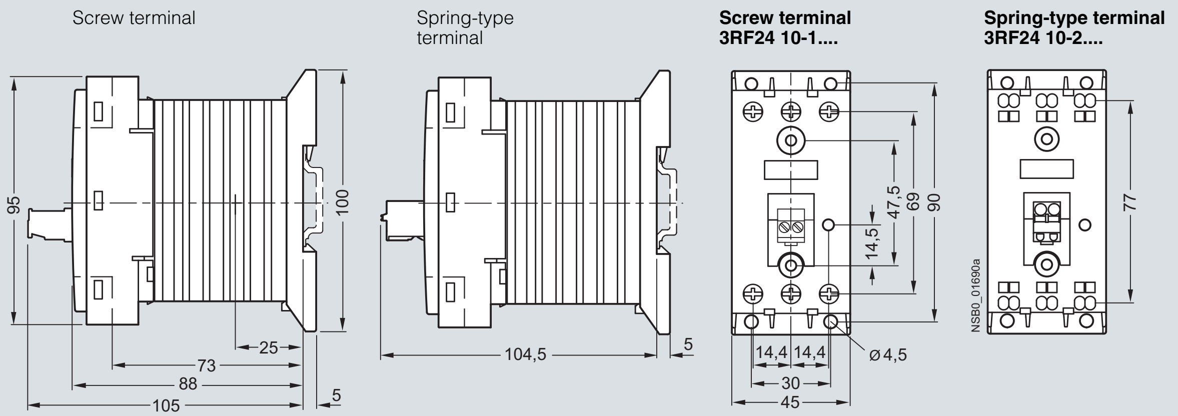
Clearances for stand-alone and side-by-side installation

1) Identical current/temperature curves for stand-alone and side-by-side installation.

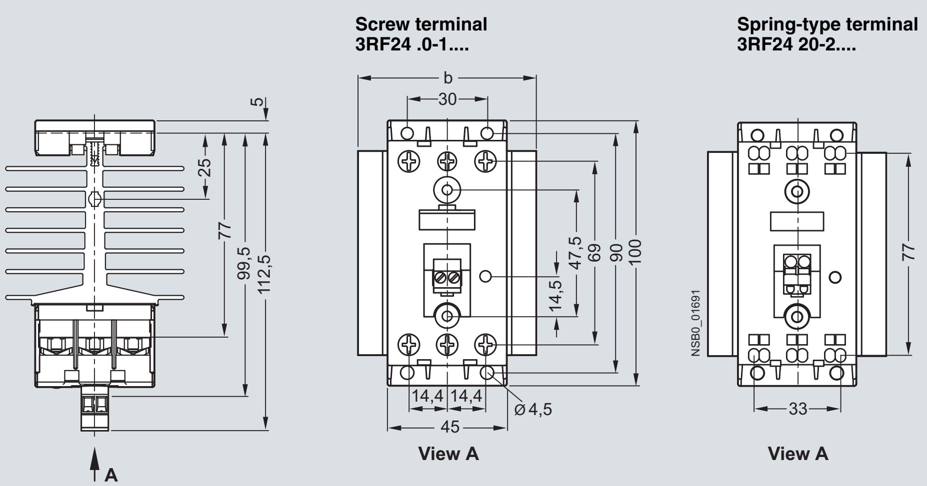
3RF24 solid-state contactors, three-phase

Dimensional drawings

Type current 10.5 A



Type current 20 A; 30 A (two-phase controlled)

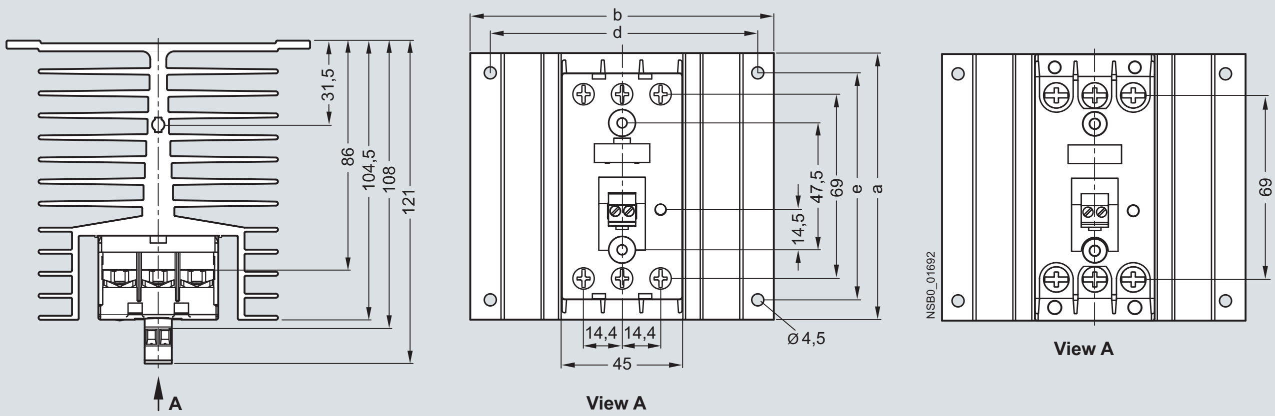


	b
3RF2420-.AB..	67
3RF2420-.AC.. 3RF2430-.AB..	89,5

Type current 30 A (three-phase controlled); 40 A, 50 A

Screw terminal
3RF24 .0-1....

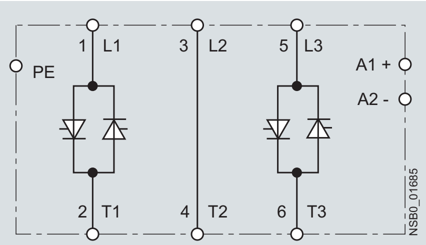
Ring terminal lug connection
3RF24 50-3....



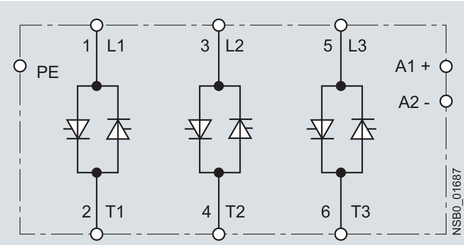
	a	b	d	e
3RF2430-.AC.. 3RF2440-.AB..	100	113,5	100	85
3RF2440-.AC.. 3RF2450-.AB..	100	157,5	146	80
3RF2450-.AC..	180	157,5	146	160

Schematics

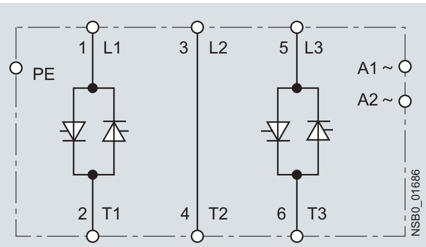
Two-phase controlled,
DC control supply voltage



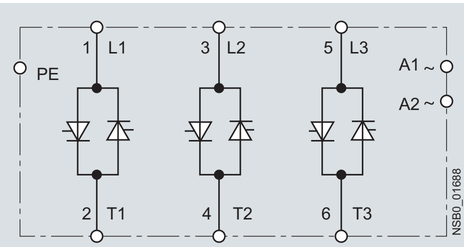
Three-phase controlled,
DC control supply voltage



Two-phase controlled,
AC control supply voltage



Three-phase controlled,
AC control supply voltage



General data

Overview

Function modules for SIRIUS 3RF2 solid-state switching devices

A great variety of applications demand an expanded range of functionality. With our function modules, these requirements can be met really easily. The modules are mounted simply by clicking them into place; straight away the necessary connections are made with the solid-state relay or contactor. The plug-in connection to control the solid-state switching devices can simply remain in use.

The following function modules are available:

- Converters
- Load monitoring
- Heating current monitoring
- Power controllers
- Power regulators

With the exception of the converter, the function modules can be used only with single-phase solid-state switching devices.

Technical specifications

Type		3RF29 ..-.E...	3RF29 ..-.F...	3RF29 ..-.G...	3RF29 ..-.H...	3RF29 ..-.J...	3RF29 ..-.K...
General data							
Ambient temperature							
• During operation, derating from 40 °C	°C	-25 ... +60					
• During storage	°C	-55 ... +80					
Installation altitude	m	0 ... 1000; derating from 1000					
Shock resistance acc. to IEC 60068-2-27	g/ms	15/11					
Vibration resistance acc. to IEC 60068-2-6	g	2					
Degree of protection		IP20					
Electromagnetic compatibility (EMC)							
• Emitted interference							
- Conducted interference voltage acc. to IEC 60947-4-3		Class A for industrial applications[1)]					
- Emitted, high-frequency interference voltage acc. to IEC 60947-4-3		Class A for industrial applications					
• Interference immunity							
- Electrostatic discharge acc. to IEC 61000-4-2 (corresponds to degree of severity 3)	kV	Contact discharge 4; air discharge 8; behavior criterion 2					
- Induced RF fields acc. to IEC 61000-4-6	MHz	0.15 ... 80; 140 dBµV; behavior criterion 1					
- Burst acc. to IEC 61000-4-4		2 kV/5.0 kHz; behavior criterion 1					
- Surge acc. to IEC 61000-4-5	kV	Conductor - ground 2; conductor - conductor 1; behavior criterion 2					
Connection, auxiliary/control contacts, screw terminals							
• Conductor cross-section	mm^2	1 x (0.5 ... 2.5), 2 x (0.5 ... 1.0), 1 x (AWG 20 ... 12)					
• Stripped length	mm	7					
• Terminal screw		M3					
• Tightening torque	Nm lb.in	0.5 ... 0.6 4.5 ... 5.3					
Converter, feed-through opening							
• Diameter	mm	--	7	17			

1) Note limitations for power controller function modules. These modules were built as Class A devices. The use of these devices in residential areas could result in lead in radio interference. In this case these may be required to introduce additional interference suppression measures.

Type		3RF29 ..-.E..8	3RF29 ..-.F..8	3RF29 ..-.G..3	3RF29 ..-.G..6
Main circuit					
Rated operational voltage U_e	V	-- [1]		110 ... 230	400 ... 600
• Operating range	V	--		93.5 ... 253	340 ... 660
• Rated frequency	Hz	--		50/60	
Rated insulation voltage U_i	V	--		600	
Voltage measuring					
• Measuring range	V	--		93.5 ... 253	340 ... 660
Mains voltage, fluctuation compensation	%	--		20	

1) Versions are independent of the main circuit.

Type		3RF29 ..-.H..3 3RF29 ..-.K..3	3RF29 ..-.H..6 3RF29 ..-.K..6	3RF29 ..-.J..3	3RF29 ..-.J..6
Main circuit					
Rated operational voltage U_e	V	110 ... 230	400 ... 600	110 ... 230	400 ... 600
• Operating range	V	93.5 ... 253	340 ... 660	93.5 ... 253	340 ... 660
• Rated frequency	Hz	50/60			
Rated insulation voltage U_i	V	600			
Voltage measuring					
• Measuring range	V	93.5 ... 253	340 ... 660	93.5 ... 253	340 ... 660
Mains voltage, fluctuation compensation	%	20			

Type		3RF29 ..-...0.	3RF29 ..-...1.	3RF29 ..-...3.
Control circuit				
Method of operation		DC operation	AC/DC operation	AC operation
Rated control supply voltage U_s	V	24	24	110
Rated control current	mA	15	15	15
Rated frequency of the control supply voltage	Hz	--	50/60	50/60
Actuating voltage, max.	V	30	30	121
Rated control current At maximum voltage	mA	15	15	15
Response voltage	V	15	15	90
• For operating current	mA	2	2	2
Drop-out voltage	V	5	5	15

Type		3RF29 06-0FA08	3RF29 20-0FA08	3RF29 20-0GA..	3RF29 50-0GA..	3RF29 90-0GA..
Current measurement						
Rated operational current I_e	A	6	20	20	50	90
Current measurement						
• Teach range	A	0.25 ... 6	0.65 ... 20	0.56 ... 20	1.62 ... 50	2.93 ... 90
• Measuring range	A	0 ... 6.6	0 ... 22	0 ... 22	0 ... 55	0 ... 99
• Minimum partial load current	A	0.25	0.65	0.65	1.6	2.9
Number of partial loads		1 ... 6	1 ... 6	1 ... 12		

Type		3RF29 20-0HA..	3RF29 50-0HA..	3RF29 90-0HA..	3RF29 16-0JA..	3RF29 32-0JA..
Current measurement						
Rated operational current I_e	A	20	50	90	16	32
Current measurement						
• Teach range	A	4 ... 20	10 ... 50	18 ... 90	0.42 ... 16	0.8 ... 32
• Measuring range	A	0 ... 22	0 ... 55	4 ... 99	0 ... 16	0 ... 32
• Minimum partial load current	A	--			0.42	0.8
Number of partial loads		--			1 ... 6	

Type		3RF29 04-0KA..	3RF29 20-0KA..	3RF29 50-0KA..	3RF29 90-0KA..
Current measurement					
Rated operational current I_e	A	4	20	50	90
Current measurement					
• Teach range	A	0.15 ... 4	0.65 ... 20	1.6 ... 50	2.9 ... 90
• Measuring range	A	0 ... 4	0 ... 22	0 ... 55	0 ... 99
• Minimum partial load current	A	--	0.65	1.6	2.9
Number of partial loads			1 ... 6		

Converters

Overview

Converters for 3RF2 solid-state switching devices

These modules are used to convert analog control signals, such as those output from many temperature controllers for example, into a pulse-width-modulated digital signal. The connected solid-state contactors and relays can therefore regulate the output of a load as a percentage.

Design

Mounting

Easy snapping onto the 3RF21/3RF22 solid-state relays or 3RF23/3RF24 solid-state contactors establishes the connections to the solid-state switching devices. The connector on the solid-state switching devices from the control circuit can be plugged onto the converter without rewiring.

Function

The analog value from a temperature controller is present at the 0 ... 10 V terminals. This controls the on-to-off period, as a function of voltage. The period duration is predefined at one second. Conversion of the analog voltage is linear in the voltage range from 0.1 ... 9.9 V. At voltages below approx. 0.1 V the connected switching device is not activated, while at voltages above approx. 9.9 V the connected switching device is always activated.

Overview

Load monitoring for 3RF2 single-phase solid-state switching devices

Many faults can be quickly detected by monitoring a load circuit connected to the solid-state switching device, as made possible with this module. Examples include the failure of load elements (up to 6 in the basic version or up to 12 in the extended version), alloyed power semiconductors, a lack of voltage or a break in a load circuit. A fault is indicated by one or more LEDs and reported to the controller by way of a PLC-compatible output.

The principle of operation is based on permanent monitoring of the current strength. This figure is continuously compared with the reference value stored once during commissioning by the simple press of a button. In order to detect the failure of one of several loads, the current difference must be 1/6 (in the basic version) or 1/12 (in the extended version) of the reference value. In the event of a fault, an output is actuated and one or more LEDs indicate the fault.

Design

Mounting

Easy snapping onto the 3RF21 solid-state relays or 3RF23 solid-state contactors establishes the connections to the solid-state switching devices. Because of the special design, the straight-through transformer of the load monitoring module covers the lower main circuit connection. The cable to the load is simply pushed through and secured with the terminal screw.

Function

The function module is activated when an "ON" signal is applied (IN terminal). The module constantly monitors the current level and compares this with the setpoint value.

Startup

Pressing the Teach button or actuating the input IN2 switches the device on; the current through the solid-state switching device is detected and is stored as the setpoint value. During this process the two lower (red[1)]) LEDs flash alternately; simultaneous continuous light from the 3 (red[1)]) LEDs indicates the conclusion of the teaching process.

The Teach button can also be used to switch on the connected solid-state switching device briefly for test purposes. In this case the "ON" LED is switched on.

Partial load faults, "Basic" load monitoring

If a deviation of at least 1/6 of the stored setpoint value is detected, a fault is signaled. The fault is indicated by a "Fault" LED and by activation of the fault signaling output.

LEDs	**OK**	**Fault**		
		Partial load failure/ load short-circuit	Thyristor defect	Mains failure/ Fuse rupture
ON/OFF	✓	✓	--	✓
Current flowing	✓	✓	✓	--
Group fault	--	✓	✓	✓

✓ LED is lit

-- LED is not lit

Partial load faults, "Extended" load monitoring

Depending on the setting of the "response time" potentiometer, a deviation of at least 1/12 of the stored setpoint value after a response time of between 100 ms and 3 s is signaled as a fault. The fault is indicated by a "Load" LED and by activation of the fault signaling output.

The potentiometer can also be used to determine the response behavior of the fault signaling output. When delay values are set in the left-hand half, the fault signal is stored. This can only be reset by switching on and off by means of the control supply voltage.

When settings are made on the right-hand side, the fault output is automatically reset after the deviation has been corrected.

Voltage compensation, "Extended" load monitoring

In addition to the current, the load voltage is also detected. This makes it possible to compensate for influences on the current strength resulting from voltage fluctuations.

Thyristor fault

If a current greater than the leakage current of the controls is measured in the deenergized state, the device triggers a thyristor fault after the set delay time. This means that the fault output is activated and the "Fault" ("Thyristor"[1)]) LED lights up.

Power system fault

If no current is measured in the energized state, the device triggers a power system fault after the set delay time. This means that the fault output is activated and the "Fault" ("Supply"[1)]) LED lights up.

1) Only "Extended" load monitoring.

Heating current monitoring

Overview

Heating current monitoring for 3RF2 single-phase solid-state switching devices

Many faults can be quickly detected by monitoring a load circuit connected to the solid-state switching device, as made possible with this module. Examples include the failure of up to 6 load elements, alloyed power semiconductors, a lack of voltage or a break in a load circuit. A fault is indicated by LEDs and reported to the controller by way of a relay output (NC contact).

The principle of operation is based on permanent monitoring of the current strength. This figure is continuously compared with the reference value stored once during commissioning. In order to detect the failure of one of several loads, the current difference must be 1/6 of the reference value. In the event of a fault, an output is actuated and the LEDs indicate the fault.

The heating current monitoring has a teach input and therefore differs from the load monitoring. This remote teaching function enables simple adjustment to changing loads without manual intervention.

Design

Mounting

Easy snapping onto the 3RF21 solid-state relays or 3RF23 solid-state contactors establishes the connections to the solid-state switching devices. Because of the special design, the straight-through transformer of the heating current monitoring module covers the lower main circuit connection. The cable to the load is simply pushed through and secured with the terminal screw.

Function

The function module is activated when an "ON" signal is applied (IN1 terminal). The module constantly monitors the current level and compares this with the setpoint value.

Startup

Actuating the input IN2 switches the device on; the current through the solid-state switching device is detected and is stored as the setpoint value. During this process the two lower (red) LEDs flash alternately; simultaneous continuous light from the 3 (red) LEDs indicates the conclusion of the teaching process.

Partial load faults

Depending on the setting of the "response time" potentiometer, a deviation of at least 1/6 of the stored setpoint value after a response time of between 100 ms and 3 s is signaled as a fault. The fault is indicated by a "Load" LED and by activation of the fault signaling output.

The potentiometer can also be used to determine the response behavior of the fault signaling output. When delay values are set in the left-hand half, the fault signal is stored. This can only be reset by switching on and off by means of the control supply voltage.

When settings are made on the right-hand side, the fault output is automatically reset after the deviation has been corrected.

Voltage compensation

In addition to the current, the load voltage is also detected. This makes it possible to compensate for influences on the current strength resulting from voltage fluctuations.

Thyristor fault

If a current greater than the leakage current of the controls is measured in the deenergized state, the device triggers a thyristor fault after the set delay time. The fault output is activated and the "Thyristor" LED lights up.

Power system fault

If no current is measured in the energized state, the device triggers a power system fault after the set delay time. The fault output is activated and the "Supply" LED lights up.

Overview

Power controllers for 3RF2 single-phase solid-state switching devices

The power controller is a function module for the autonomous power control of complex heating systems and inductive loads, for the operation of loads with temperature-dependent resistors and for simple indirect control of temperature.

The power controller can be used on the instantaneously switching 3RF21 and 3RF23 solid-state switching devices (single-phase). If only the full-wave operating mode is used, the power controller can also be used on the "zero-point switching" solid-state relays and contactors.

The following functions have been integrated:

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

Special versions

3RF29 04-0KA13-0KC0

During the Teaching process the connected solid-state relay or contactor is not activated; i. e. no current flow takes place. No current reference value is stored. No part-load monitoring!

3RF29 ..-0KA1.-0KT0

No part-load monitoring!

Design

Mounting

Easy snapping onto the 3RF21 solid-state relays or 3RF23 solid-state contactors establishes the connections to the solid-state switching devices. Because of the special design, the straight-through transformer of the function module covers the lower main circuit connection. The cable to the load is simply pushed through and secured with the terminal screw.

Function

Power control

The power controller sets the load current of the solid-state switching device depending on a setpoint value as a percentage. It does not compensate for changes in the mains voltage or load resistance. The modulation, the On/Off ratio or the phase angle, remains unchanged according to the setpoint value. The autonomous power control is performed between 0 and 100 % of the setpoint selection.

Full-wave control

If the left potentiometer t_R is set to 0 s (= far left), then the power controller operates according to the principle of full-wave control. The power set, be it internal or external, is converted into a pulse-width-modulated digital signal. The power controller controls the On and Off time of the solid-state switching device within a fixed period duration of 1 s so that the selected power is applied to the load. The "ON" LED flashes in the same rhythm as the solid-state switching device switches on and off.

Generalized phase control

If the left potentiometer t_R is set to greater than 0 s, then the power controller operates according to the principle of generalized phase control.

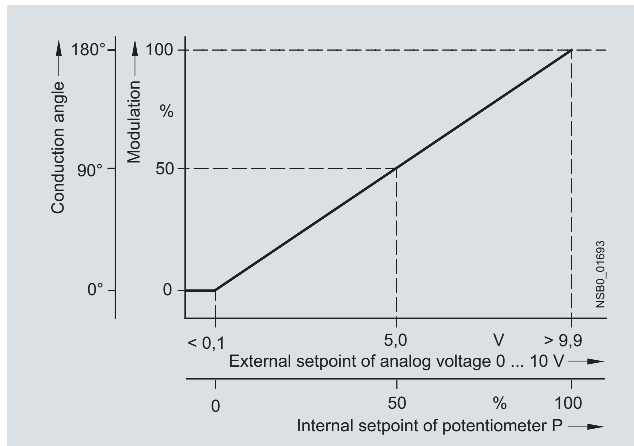
In order to observe the limit values of the conducted interference voltage for industrial networks, the load circuit must include a reactor with a rating of at least 200 μH.

For SIDAC reactors for generalized phase control mode see page 50.

Setpoint selection

The setpoint selection is set either internally with the right-hand potentiometer P to 0 ... 100 % on the module or externally using the analog input 0 ... 10 V.

In the case of full-wave control, 100 % corresponds to continuously On and, in the case of generalized phase control, to a conduction angle of 180° – and therefore maximum output.



Input characteristic

Internal setpoint selection

In the case of internal setpoint selection, the module is controlled over the IN terminal. Terminal 10 has no function.

External setpoint selection

With external setpoint selection (potentiometer P far left = 0 %) the module is actuated by applying the analog voltage 0 ... 10 V. 0 ... 10 V corresponds to 0 ... 100 % power. Conversion of the voltage is linear between 0.1 and 9.9 V. Below 0.1 V the switching device remains off; at voltages above 9.9 V the power is always set to 100 %.

Inrush current limitation

The ramp time (t_R) for a voltage ramp on switching on is set with the left potentiometer for the purpose of inrush current limitation. The set time refers to a power of 100 %. If, for example, a ramp time of 10 s is set and the power setpoint selection is 60 %, then the power of 60 % will be reached after approx. 6 s.

Line, load and thyristor monitoring

The power controller identifies partial load faults, mains failure and thyristor faults. The faults are indicated by the LEDs on the module and the fault output is actuated. The reference for the load monitoring is the taught value. A maximum of 6 partial loads can be monitored.

The response delay in the event of a fault amounts to approx. 100 ms in the case of full-wave control. In the case of generalized phase control and setpoint values > 50 % the response delay amounts to 500 ms from the end of the ramp time.

The detection of partial load faults takes place only in the control range from 20 ... 100 %.

Power regulators

Overview

Power regulators for 3RF2 single-phase solid-state switching devices

The power regulator is a function module for the autonomous power control of complex heating systems, for the operation of loads with temperature-dependent resistors and for simple indirect control of temperature.

The power regulator can be used on the instantaneously switching 3RF21 and 3RF23 solid-state switching devices (single-phase). If only the full-wave operating mode is used, the power regulator can also be used on the zero-point-switching solid-state relays and contactors.

The following functions have been integrated:

- Power controller with proportional-action control for adjusting the power of the connected load. Here, the setpoint value is set with a rotary knob on the module as a percentage with reference to the 100 % power stored as a setpoint value. Changes in the mains voltage or in the load resistance are compensated in this case.
- Inrush current limitation: With the aid of an adjustable voltage ramp, the inrush current is limited by means of phase control. This is useful above all with loads such as lamps which have an inrush transient current.
- Load circuit monitoring for detecting load failure, alloyed power semiconductors, lack of voltage or a break in the load circuit.

Design

Mounting

Easy snapping onto the 3RF21 solid-state relays or 3RF23 solid-state contactors establishes the connections to the solid-state switching devices. Because of the special design, the straight-through transformer of the function module covers the lower main circuit connection. The cable to the load is simply pushed through and secured with the terminal screw.

Function

Power control

The power regulator adjusts the current in the connected load by means of a solid-state switching device depending on a setpoint value. Changes in the mains voltage or in the load resistance are thus compensated by the power regulator. The setpoint value can be predefined externally as a 0 to 10 V signal or internally by means of a potentiometer. Depending on the setting of the potentiometer (t_R), the adjustment is carried out according to the principle of full-wave control or generalized phase control.

Full-wave control

In this operating mode the output is adjusted to the required setpoint value changing the on-to-off period. The period duration is predefined at one second.

Generalized phase control

In this operating mode the output is adjusted to the required setpoint value by changing the current flow angle. The half-waves of the current are adjusted to produce the selected setpoint value of the power at the load.

In order to observe the limit values of the conducted interference voltage for industrial networks, the load circuit must include a reactor with a rating of at least 200 μH.

SIDAC reactors for generalized phase control mode

Power control regulators, power regulators	**Reactors** Rated voltage		
Type	Up to 230 V	Up to 480 V	Up to 660 V
3RF2904-0KA.	4EM4700-8CB00	4EM4915-0CB00	4EM5007-7CB00
3RF2920-0KA./-0HA.	4EM4700-8CB00	4EM4915-0CB00	4EM5007-7CB00
3RF2950-0KA./-0HA.	4EM5001-1CB00	4EM6100-6CB00	4EM6204-0CB00
3RF2990-0KA./-0HA.	4EM6100-5CB00	4EM5316-7CB00	4EM5412-0CB00

Setpoint selection

The setpoint selection is set either internally with the right-hand potentiometer P to 0 ... 100 % on the module or externally using the analog input 0 ... 10 V.

External setpoint selection

At 0 % on the potentiometer the setpoint selection is set using an external 0 ... 10 V analog signal (terminals IN / 0 ... 10 V). The device is switched on and off via the power supply (terminals A1/A2).

Internal setpoint selection

Above 0 % the setpoint is set using the potentiometer. To allow this, the potential at terminal A1 must additionally be applied at the IN terminal. After removal of the "ON" signal, the switching module is switched off.

Inrush current limitation

The ramp time (t_R) for a voltage ramp on switching on is set with the left potentiometer for the purpose of inrush current limitation. If a time longer than 0 s is set, the device operates according to the generalized phase control principle. If 0 s is set, there is no voltage ramp and the device operates according to the principle of full-wave control.

Load fault

If upon switching on with voltage applied the current flowing is not greater than the leakage current of the control, the device triggers a load fault. The fault relay is activated and the "Load" LED lights up.

Thyristor fault

If a current greater than the leakage current of the control is measured in the deenergized state, the device triggers a thyristor fault. The fault relay is activated and the "Thyristor" LED lights up.

Power system fault

If no current is measured in the energized state, the device triggers a power system fault. The fault relay is activated and the "Supply" LED lights up.

Startup

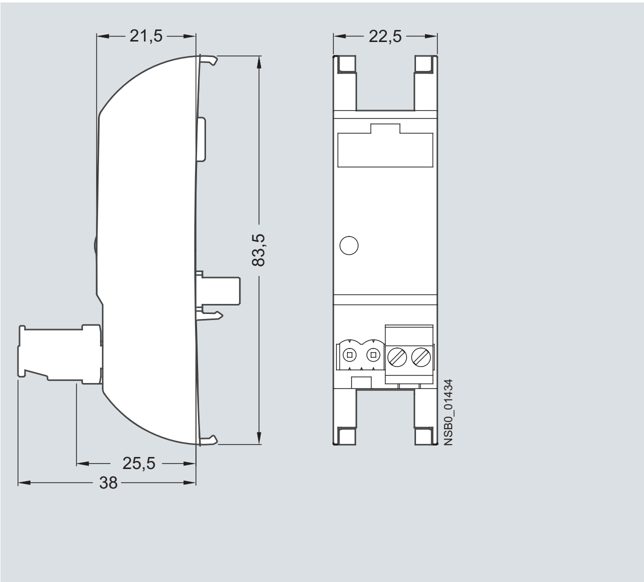
Pressing the "Teach" button switches the device on; the current through the solid-state switching device and the mains voltage are detected and stored. The resultant output is taken as the 100 % output for the setpoint selection. During this process the two lower red LEDs flash alternately. Simultaneous continuous light from the three red LEDs indicates the completion of the "Teach" process.

The "Teach" button can also be used to switch on the connected solid-state switching device briefly for test purposes. In this case the "ON" LED is switched on.

Dimensional drawings

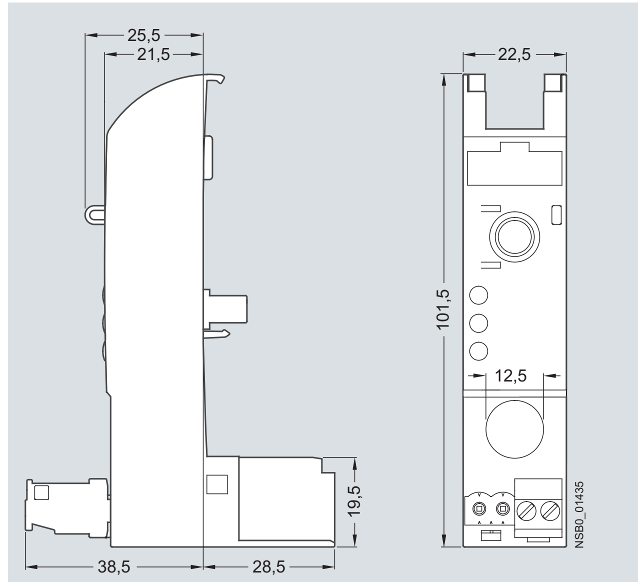
Converters

3RF29 00-0EA18



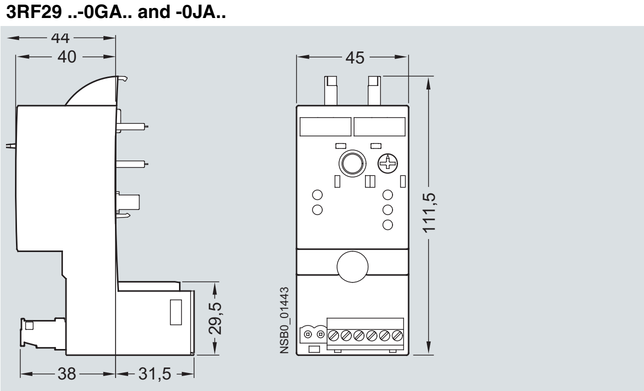
Basic load monitoring

3RF29 ..-0FA08



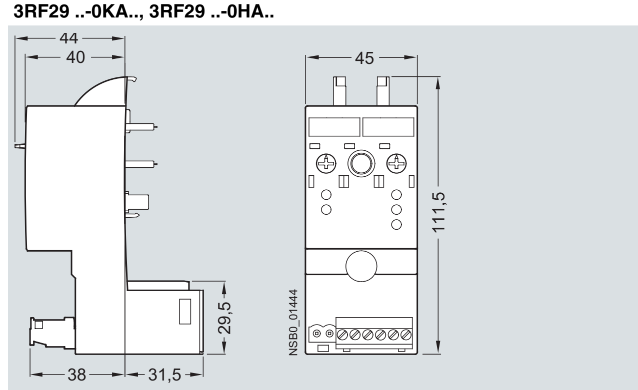
"Extended" load monitoring and heating current monitoring

3RF29 ..-0GA.. and -0JA..



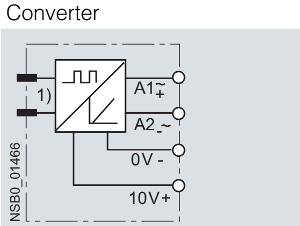
Power controllers and regulators

3RF29 ..-0KA.., 3RF29 ..-0HA..

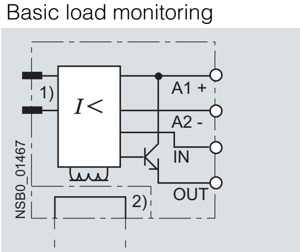


Schematics

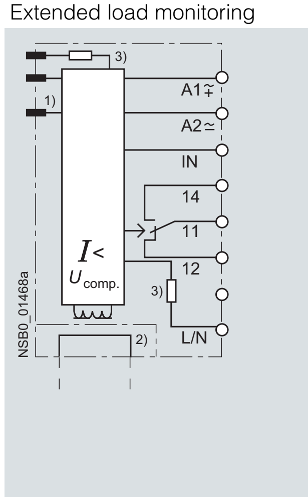
Converter



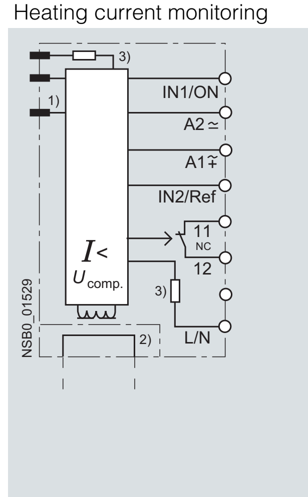
Basic load monitoring



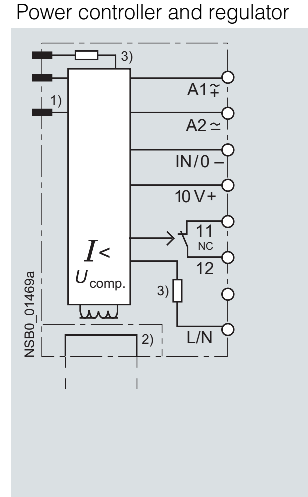
Extended load monitoring



Heating current monitoring



Power controller and regulator



1) Internal connection.

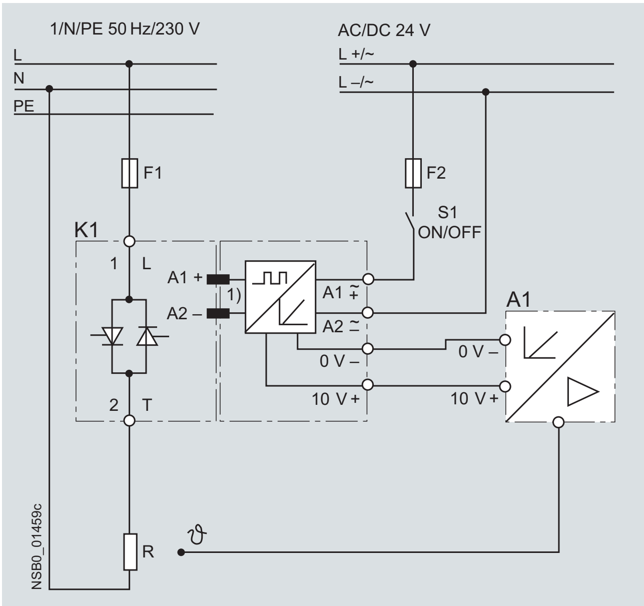
2) Straight-through transformers.

3) Voltage measuring not electrically isolated (3 MΩ per path).

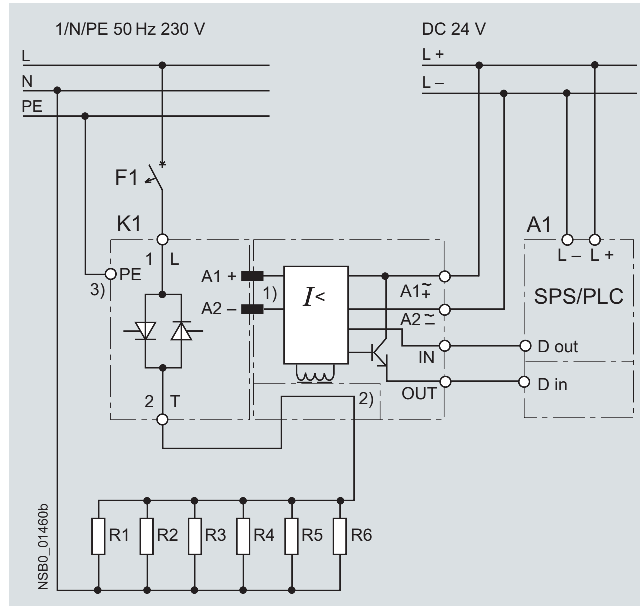
Project planning aids

Switching examples

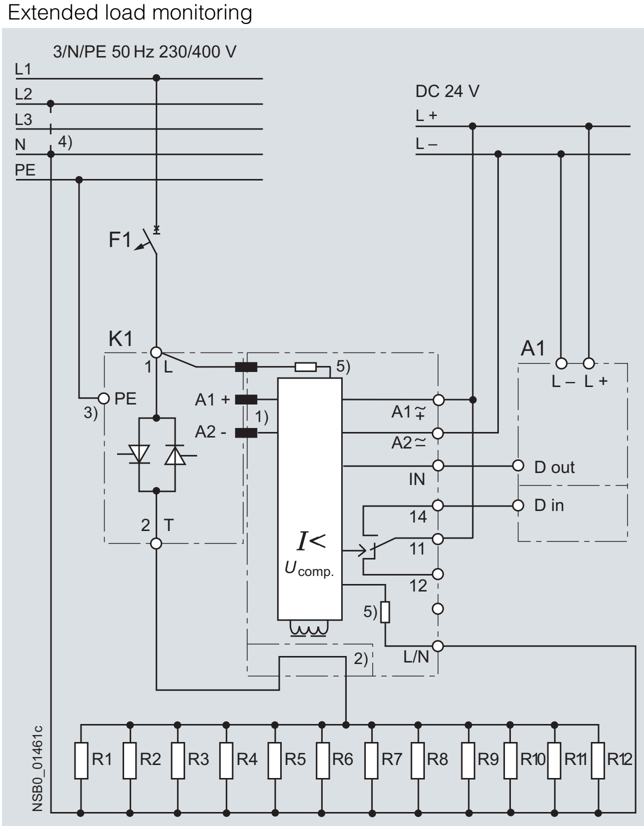
Converter



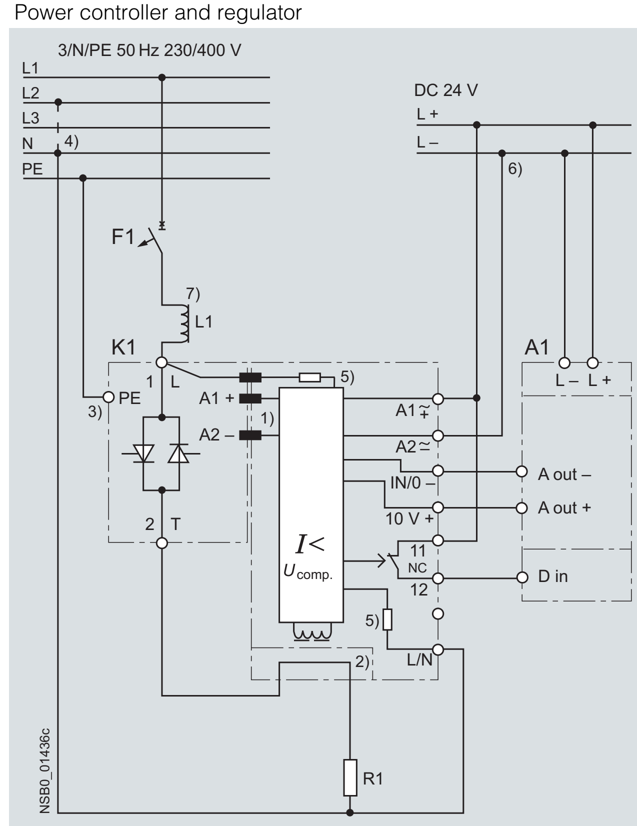
Basic load monitoring



Extended load monitoring

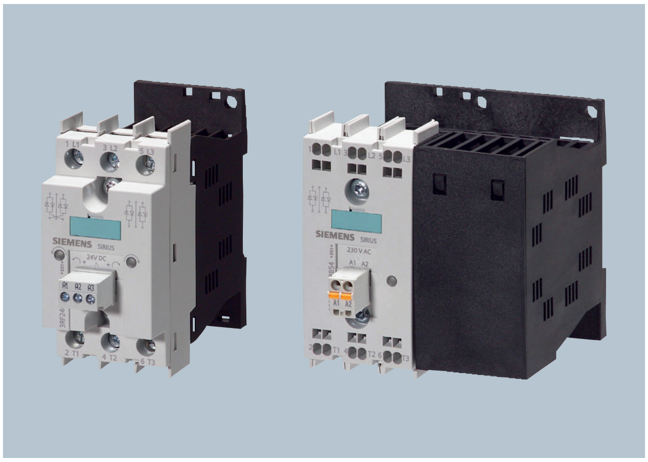


Power controller and regulator



1) Internal connection to the solid-state relay/contactor.
2) Straight-through transformer.
3) Make PE/ground connection according to installation regulations.
4) Connection of L/N contact with:
   - 3RF29 ..-0.A.**3** load monitoring/power controller on neutral conductor N (e. g. 230 V),
   - 3RF29 ..-0.A.**6** load monitoring/power controller on a second phase (e. g. 400 V).
5) Voltage measuring not electrically isolated (3 MΩ per path).
6) Grounding of connection L- is recommended.
7) A 200 μH reactor must be used when operating with leading-edge phase in order to observe the limit values of the conducted interference voltage according to Class A.

Overview



Solid-state contactors for switching motors

The solid-state contactors for switching motors are intended for frequently switching on and off three-phase current operating mechanisms up to 7.5 kW and reversing up to 3.0 kW. The devices are constructed with complete insulation and can be mounted directly on circuit breakers and SIRIUS overload relays, resulting in a very simple integration into motor feeders.

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

Important features:

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

Selecting solid-state contactors

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

The following procedure is recommended:

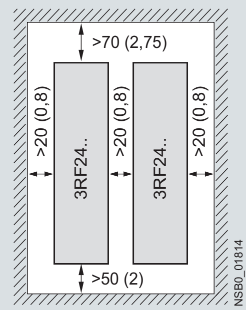
- Determine the rated current of the load and the mains voltage
- Select a solid-state contactor with the same or higher rated current than the load
- Testing the maximum permissible switching frequency based on the characteristic curves (see pages 58 and 64). To do this, the starting current, the starting time and the motor loaded in in the operating phase must be known.
- If the permissible switching frequency is under the desired frequency, it is possible to achieve an increase by overdimensioning the motor!

Design

Load feeders

There is no typical design of a load feeder with solid-state relays or solid-state contactors; instead, the great variety of connection methods and control voltages offers universal application opportunities. SIRIUS solid-state relays and solid-state contactors can be installed in fuseless or fused feeders, as required. There are special versions with which it is even possible to achieve short-circuit strength in a fuseless design.

Mounting regulations



Clearances for stand-alone installation

Connection methods

All SIRIUS solid-state switching devices are characterized by the great variance of connection methods. You can choose between the following connection methods:

Screw connection

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

Spring-type terminals

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

General data

Function

Switching functions

The contactors to switch motors are "Instantaneous switching", because this method is particularly suited for inductive loads. By distributing the ON point over the entire sine curve of the mains voltage, disturbances are reduced to a minimum.

Performance characteristics

The performance of the solid-state switching devices is substantially determined by the type of power semiconductors used and the internal design. In the case of the 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, for the SIRIUS solid-state switching devices e. g. thyristors with 800 V blocking voltage are built in for operation in networks up to 230 V. Thyristors with up to 1600 V are used for power systems with higher voltages.

Maximum load integral

One of the purposes of specifying the maximum load integral (I^2t) is to determine the rating of the short-circuit protection. Only a large power semiconductor with a correspondingly high I^2t value can be given appropriate protection against destruction from a short-circuit by means of a protective device matched to the application. However, the 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 EN 60947-4-3 were confirmed by extensive testing.

You can find more information on the Internet at:

http://www.siemens.com/cd/is_schalten/html_76/schalt.htm

Integration

Notes on integration in the load feeders

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

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

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

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

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

Semiconductor motor and reversing contactors can be easily combined with the 3RV motor starter protectors and 3RB2 overload relay from the SIRIUS modular system. Thus, fuseless and fuse motor feeders can be designed easily and in a space-saving manner.

Note:

The operation of wye-connected three-phase induction motors (especially with ratings < 1 kW) with electromechanical contactors can lead to very high EMC interference. Solid-state switching devices being used in the vicinity may be affected by this interference which lies above the permissible limit values.

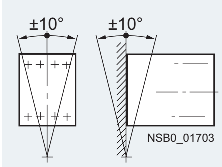
In case of high EMC interference we recommend that motors up to 5.5 kW controlled by 3RT10 1. electromechanical contactors be equipped with EMC suppressor circuits. The best filtering effect is achieved with three-phase RC interference suppression modules such as 3RT19 16-1PA1 up to 400 V. Suitable modules for the contactors can be found in Chapter 3 under "Accessories and Spare Parts". Varistor interference suppression modules should not be used because they are unsatisfactory at filtering out rapid transients.

Overview

These two-phase controlled, instantaneous switching solid-state contactors in the insulting enclosure are offered in 45 mm width to 5.2 A – and in 90 mm width to 16 A. This means that it is possible to operate motors up to 7.5 kW.

The devices can use a link module to directly connect to a circuit breaker. Direct mounting of a 3RB20 solid-state overload relay is also possible. Rapid-switching fuseless and fuse motor feeders can thereby be implemented in a time-saving manner.

Technical specifications

Order No.		3RF24 ..-1BB..	3RF24 ..-2BB..
General data			
Ambient temperature			
• During operation, derating from 40 °C	°C	-25 ... +60	
• During storage	°C	-55 ... +80	
Installation altitude	m	0 ... 1000; derating over 1000 m upon request	
Shock resistance acc. to IEC 60068-2-27	*g*/ms	15/11	
Vibration resistance acc. to IEC 60068-2-6	*g*	2	
Degree of protection		IP20	
Insulation strength at 50/60 Hz (main/control circuit to floor)	V rms	4000	
Electromagnetic compatibility (EMC)			
• Emitted interference acc. to IEC 60947-4-3			
- Conducted interference voltage		Class A for industrial applications[1)]	
- Emitted, high-frequency interference voltage		Class A for industrial applications	
• Interference immunity			
- Electrostatic discharge acc. to IEC 61000-4-2 (corresponds to degree of severity 3)	kV	Contact discharge 4; air discharge 8; behavior criterion 2	
- Induced RF fields acc. to IEC 61000-4-6	MHz	0.15 ... 80; 140 dBµV; behavior criterion 1	
- Burst acc. to IEC 61000-4-4	kV	2/5 kHz; behavior criterion 1	
- Surge acc. to IEC 61000-4-5	kV	Conductor - ground 2; conductor - conductor 1; behavior criterion 2	
Connection type		**Screw terminals**	**Spring-type terminals**
Connection, main contacts			
• Conductor cross-section			
- Solid	mm^2	2 x (1.5 ... 2.5)[2)], 2 x (2.5 ... 6)[2)]	2x (0.5 ... 2.5)
- Finely stranded with end sleeve	mm^2	2 x (1 ... 2.5)[2)], 2 x (2.5 ... 6)[2)], 1 x 10	2x (0.5 ... 1.5)
- Finely stranded without end sleeve	mm^2	--	2x (0.5 ... 2.5)
- Solid or stranded, AWG cables		2 x (AWG 14 ... 10)	2 x (AWG 18 ... 14)
• Stripped length	mm	10	10
• Terminal screw		M4	--
- Tightening torque	Nm lb.in	2 ... 2.5 18 ... 22	
Connection, auxiliary/control contacts			
• Conductor cross-section			
- With/without end sleeve	mm AWG	1 x (0.5 ... 2.5), 2 x (0.5 ... 1.0) AWG 20 ... 12	0.5 ... 2.5 AWG 20 ... 12
• Stripped length	mm	7	10
• Terminal screw		M3	--
- Tightening torque, (∅ 3.5, PZ 1)	Nm lb.in	0.5 ... 0.6 4.5 ... 5.3	
Permissible mounting positions			

1) These products were built as Class A devices. The use of these devices in residential areas could result in lead in radio interference. In this case these may be required to introduce additional interference suppression measures.

2) If two different conductor cross-sections are connected to one clamping point, both cross-sections must lie in the range specified. If identical cross-sections are used, this restriction does not apply.

3RF24 solid-state contactors, three-phase

Order No.	Fuseless design with motor starter protector CLASS 10 Rated operational current I_{AC-53} 1) acc. to IEC 60947-4-2 at 40 °C	UL/CSA, at 50 °C	at 60 °C	Power loss at I_{AC-53} at 40 °C	Short-circuit protection with type of coordination "1" at an operational voltage of U_e to 440 V Motor starter protector	I_q
	A	A	A	W	Type	kA
Main circuit						
3RF24 05-.BB..	5.2 (4.5)	4.6 (4.0)	4.2 (3.5)	10 (8)	3RV1 021-1GA10	50
3RF24 10-.BB..	9.2	8.4	7.6	16	3RV1 021-1JA10	20
3RF24 12-.BB..	12.5	11.5	10.5	22	3RV1 021-1KA10	5
3RF24 16-.BB..	16	14	12.5	28	3RV1 021-4AA10	5

Order No.	Fused design with directly connected 3RB20 overload relay Rated operational current I_{AC-53} acc. to IEC 60947-4-2 at 40 °C	UL/CSA, at 50 °C	at 60 °C	Power loss at I_{AC-53} at 40 °C	Minimum load current	Max. leakage current	Rated impulse withstand capacity I_{tsm}	I^2t value
	A	A	A	W	A	A	A	A^2s
Main circuit								
3RF24 05-.BB.4	4	3.6	3.2	7	0.5	10	200	200
3RF24 05-.BB.6							600	1800
3RF24 10-.BB..	7.8	7	6.2	13	0.5	10	600	1800
3RF24 12-.BB.4	9.5	8.5	7.6	16	0.5	10	1200	7200
3RF24 12-.BB.6							1150	6600
3RF24 16-.BB..	11	10	9	18	0.5	10	1150	6600

Type		**3RF24 ..-.BB.4**	**3RF24 ..-.BB.6**
Main circuit			
Controlled phases		Two-phase	Two-phase
Rated operational voltage U_e	V	48 ... 460	48 ... 600
• Operating range	V	40 ... 506	40 ... 660
• Rated frequency	Hz	50/60 ± 10 %	50/60 ± 10 %
Rated insulation voltage U_i	V	600	600
Rated impulse withstand voltage U_{imp}	kV	6	6
Blocking voltage	V	1200	1600
Rage of voltage rise	V/µs	1000	1000

Type		**3RF24 ..-.BB0.**	**3RF24 ..-.BB2.**
Control circuit			
Method of operation		DC operation	AC operation
Rated control supply voltage U_s	V	24 acc. to EN 61131-2	110 ... 230
Rated frequency of the control supply voltage	Hz	--	50/60 ± 10 %
Control supply voltage, max.		30	253
Typical actuating current	mA	20	15
Response voltage	V	15	90
Drop-out voltage	V	5	< 40
Operating times			
• ON-delay	ms	1	5
• OFF-delay	ms	1 + max. one half-wave	30 + max. one half-wave

1) The reduced values in brackets apply to a directly mounted circuit breaker and simultaneous butt-mounting.

Fused version with semiconductor protection (similar to type of coordination "2")[1)]

The semiconductor protection for the 3RF24 controls can be used with different protective devices. Siemens recommends the use of special SITOR semiconductor fuses. The table below lists the maximum permissible fuses for each 3RF24 control.

If a fuse is used with a higher rated current than specified, semiconductor protection is no longer guaranteed. However, smaller fuses with a lower rated current up to a lower rated current of the load can only be used after the behavior of the existing load alternation has been tested.

Order No.	**All-range fuses gR**		**Semiconductor fuses aR**				**Cable and line protection fuses**				
			LV HRC design	Cylindrical design			LV HRC design	Cylindrical design			
	LV HRC design SITOR 3NE1	Cylindr. design NEOZED 3SE1[2)]	SITOR 3NE8	10 mm x 38 mm SITOR 3NC1	14 mm x 51 mm SITOR 3NC1	22 mm x 58 mm SITOR 3NC2	gG 3NA3	10 mm x 38 mm gG 3NW6	14 mm x 51 mm gG 3NW6	22 mm x 58 mm gG 3NW6	DIAZED quick 5SB1
Operational voltage U_e up to 506 V											
3RF24 05-.BB.4	3NE1 813-0	5SE1 320	3NE8 015-1	3NC1 020	3NC1 415	3NC2 220	3NA3 801-6	3NW6 001-1	3NW6 101-1	--	5SB1 71
3RF24 10-.BB.4	3NE1 802-0	5SE1 335	3NE8 020-1	3NC1 032	3NC1 450	3NC2 263	3NA3 805-6	3NW6 005-1	3NW6 105-1	3NW6 205-1	5SB3 11
3RF24 12-.BB.4	3NE1 818-0	5SE1 363	3NE8 021-1	3NC1 032	3NC1 450	3NC2 280	3NA3 810-6	3NW6 010-1	3NW6 116-1	3NW6 210-1	5SB3 21
3RF24 16-.BB.4	3NE1 818-0	5SE1 363	3NE8 022-1	3NC1 032	3NC1 450	3NC2 280	3NA3 812-6	3NW6 010-1	3NW6 116-1	3NW6 210-1	5SB3 22
Operational voltage U_e up to 660 V											
3RF24 05-.BB.6	3NE1 813-0	--	3NE8 015-1	3NC1 016	3NC1 420	3NC2 220	3NA3 801-6	--	--	--	--
3RF24 10-.BB.6	3NE1 803-0	--	3NE8 018-1	3NC1 032	3NC1 450	3NC2 250	3NA3 805-6	--	--	--	--
3RF24 12-.BB.6	3NE1 817-0	--	3NE8 021-1	3NC1 032	3NC1 450	3NC2 280	3NA3 810-6	--	--	--	--
3RF24 16-.BB.6	3NE1 817-0	--	3NE8 022-1	3NC1 032	3NC1 450	3NC2 280	3NA3 812-6	--	--	--	--

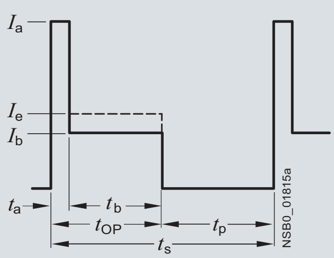
Suitable fuse holders, fuse bases and controls can be found in Catalog LV 1, Chapter 19.

1) Type of coordination "2" according to EN 60947-4-1: In the event of a short-circuit, the controls in the load feeder must not endanger persons or the installation. They must be suitable for further operation. For fused configurations, the protective device must be replaced.

2) For use only with operational voltage U_e up to 400 V.

Characteristic curves

Load diagram of motor



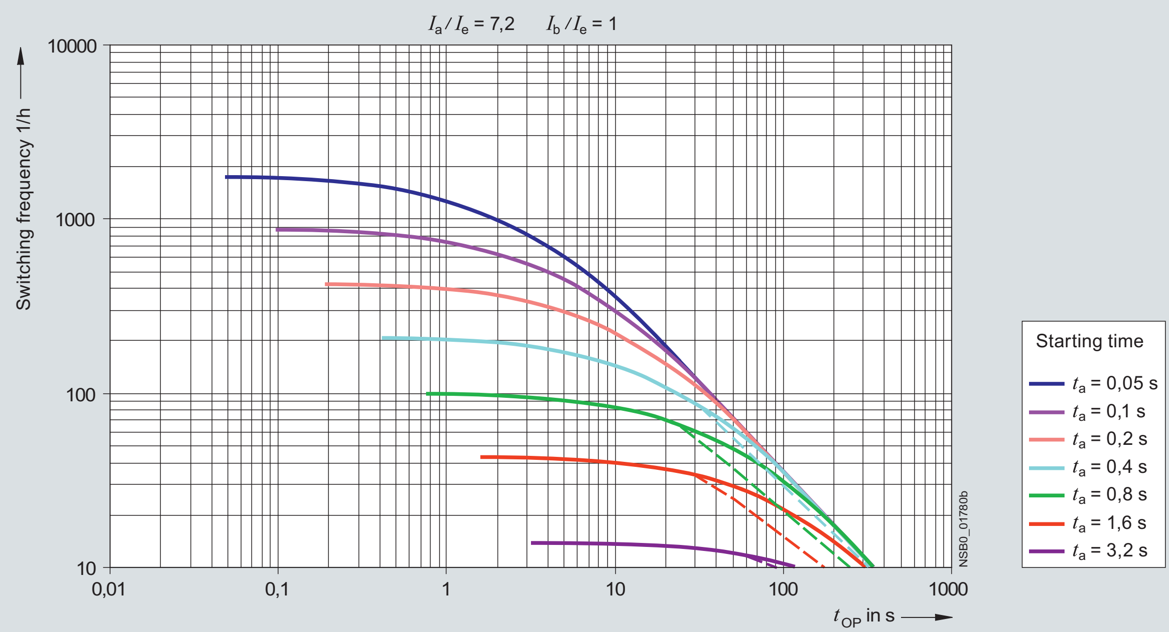
Operating data of motor

I_a Direct starting current
I_e Rated operational current
I_b Operational current
t_a Starting time
t_b Operating time
t_p Interval time
t_{OP} ON period
t_s Operating cycle

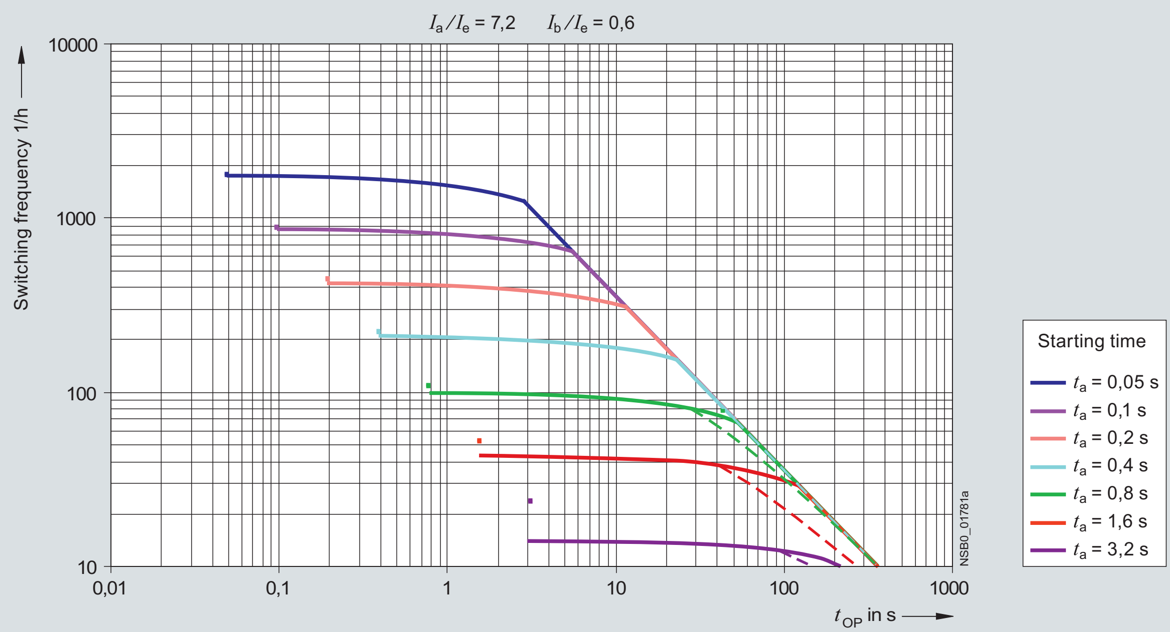
$$OP\,[\%] = \frac{t_{OP}}{t_s} \times 100\ \%$$

3RF24 solid-state contactors, three-phase

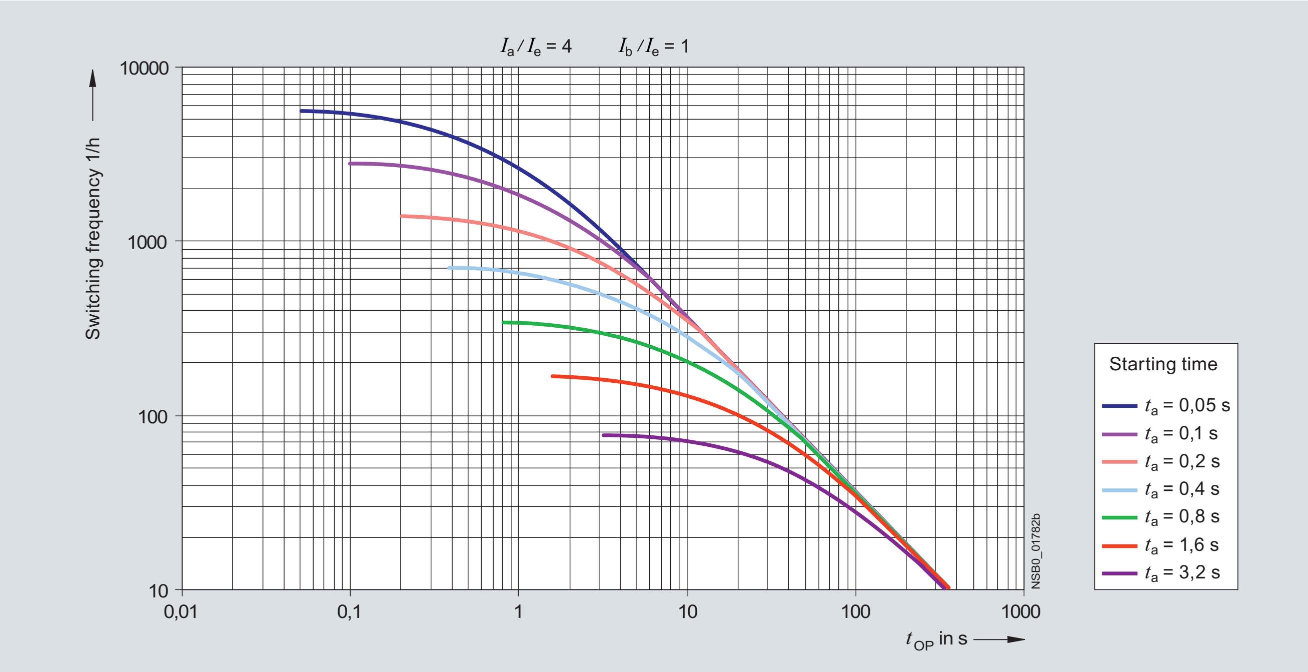
Maximum permissible switching frequency depending on the starting time t_a and the ON period t_{OP}



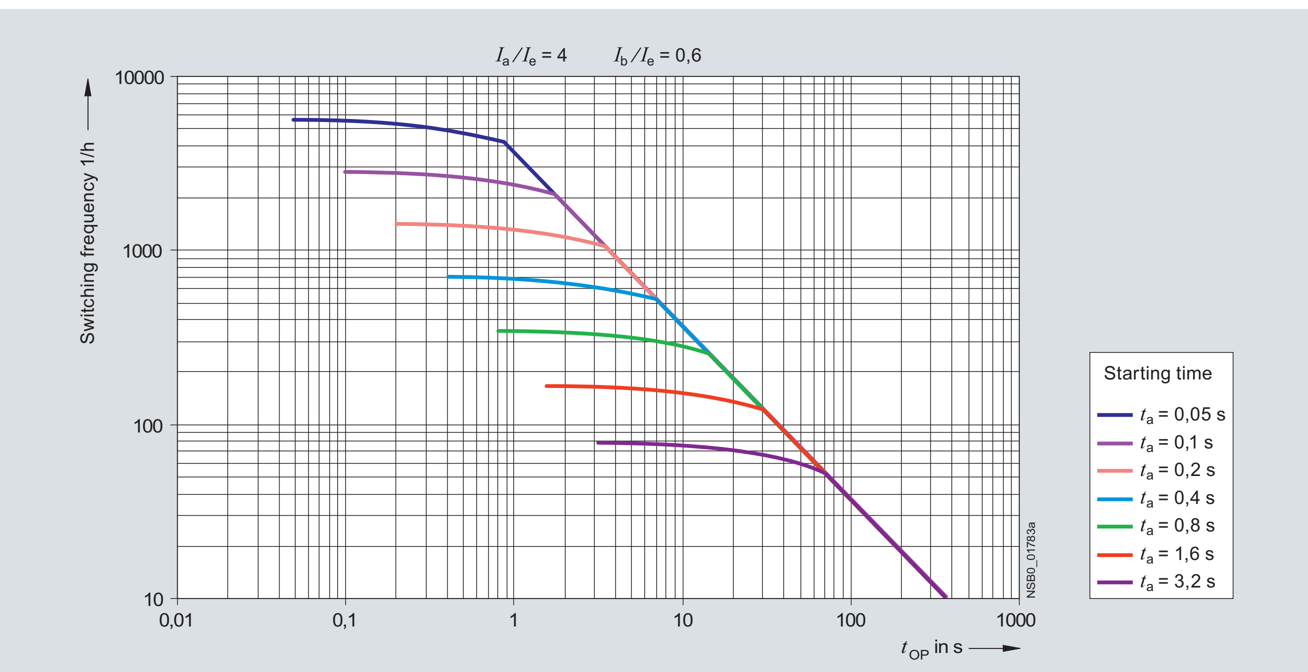
For motors with a starting current of 4 to 7.2 times the rated current and with a full load
(the dashed curves apply to the high currents during operation with motor starter protector)



For motors with a starting current of 4 to 7.2 times the rated current and with 60 % load
(the dashed curves apply to the high currents during operation with motor starter protector)



For motors with a starting current of up to 4 times the rated current and with a full load

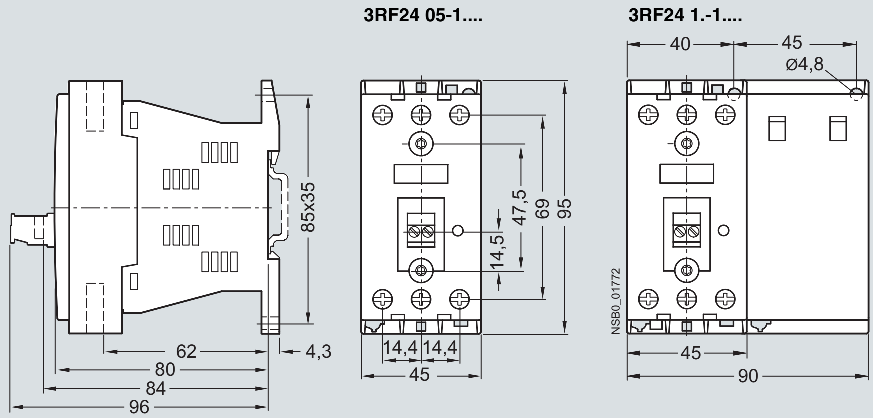


For motors with a starting current of up to 4 times the rated current and with a 60 % load

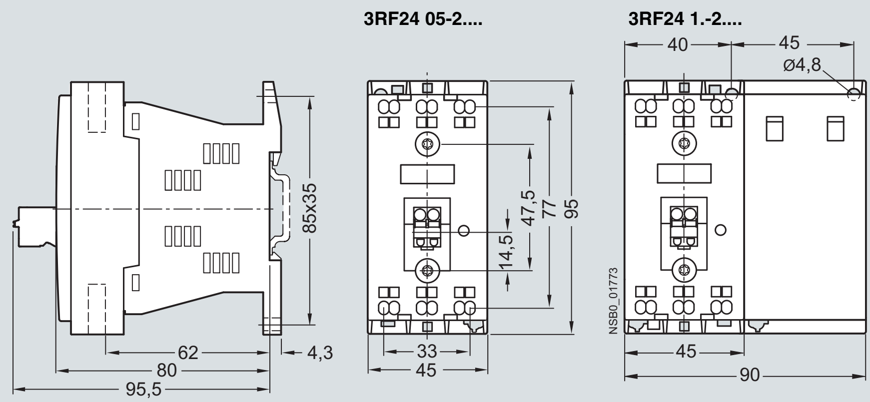
3RF24 solid-state contactors, three-phase

Dimensional drawings

Screw terminals

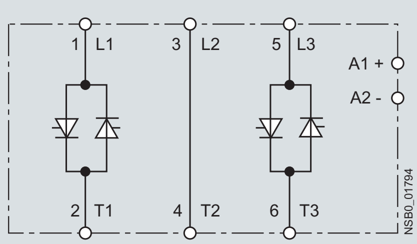


Spring-type terminals

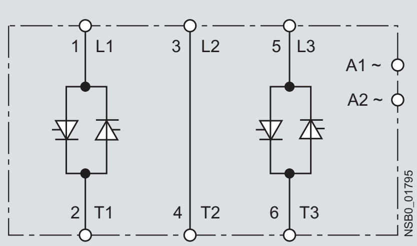


Schematics

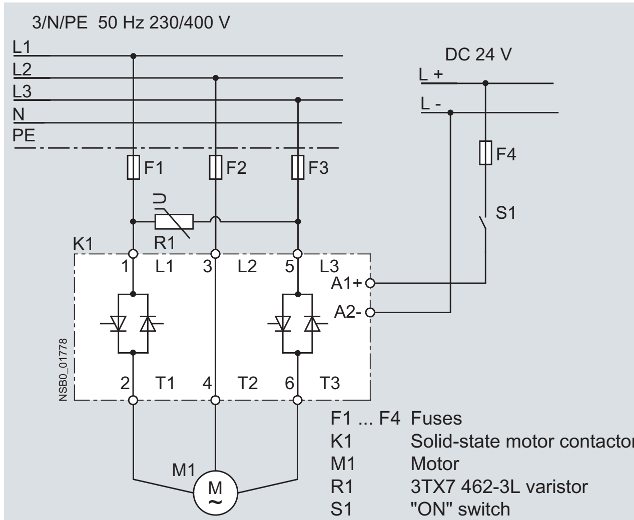
Two-phase controlled,
DC control supply voltage



Two-phase controlled,
AC control supply voltage



Sample schematic

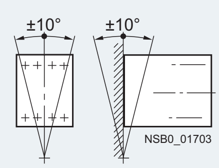


Overview

The integration of four conducting paths to a reverse switch, combined in one enclosure makes this device a particularly compact solution. Compared to conventional systems, for which two contactors are required, it is possible to save up to 50 % width with the three-phase reversing contactors. Devices with 45 mm width cover motors up to 2.2 kW – and those with 90 mm width up to 3 kW.

Due to the integration into the SIRIUS modular system, it is possible to make a connection to a SIRIUS motor starter protector using a link module or with a 3RB20 solid-state overload relay without additional steps. It is possible to mount fuseless or fused motor feeders easily and quickly.

Technical specifications

Order No.		**3RF24 ..-1BD..**
General data		
Ambient temperature		
• During operation, derating from 40 °C	°C	-25 ... +60
• During storage	°C	-55 ... +80
Installation altitude	m	0 ... 1000; derating over 1000 m upon request
Shock resistance acc. to IEC 60068-2-27	*g*/ms	15/11
Vibration resistance acc. to IEC 60068-2-6	*g*	2
Degree of protection		IP20
Insulation strength at 50/60 Hz (main/control circuit to floor)	V rms	4000
Electromagnetic compatibility (EMC)		
• Emitted interference acc. to IEC 60947-4-3		
- Conducted interference voltage		Class A for industrial applications[1)]
- Emitted, high-frequency interference voltage		Class A for industrial applications
• Interference immunity		
- Electrostatic discharge acc. to IEC 61000-4-2 (corresponds to degree of severity 3)	kV	Contact discharge 4; air discharge 8; behavior criterion 2
- Induced RF fields acc. to IEC 61000-4-6	MHz	0.15 ... 80; 140 dBμV; behavior criterion 1
- Burst acc. to IEC 61000-4-4	kV	2/5 kHz; behavior criterion 1
- Surge acc. to IEC 61000-4-5[2)]	kV	Conductor - ground 2; conductor - conductor 1; behavior criterion 2
Connection type		**Screw terminals**
Connection, main contacts		
• Conductor cross-section		
- Solid	mm^2	2 x (1.5 ... 2.5)[3)], 2 x (2.5 ... 6)[3)]
- Finely stranded with end sleeve	mm^2	2 x (1 ... 2.5)[3)], 2 x (2.5 ... 6)[3)], 1 x 10
- Finely stranded without end sleeve	mm^2	--
- Solid or stranded, AWG cables		2 x (AWG 14 ... 10)
• Stripped length	mm	10
• Terminal screw		M4
- Tightening torque	Nm lb.in	2 ... 2.5 18 ... 22
Connection, auxiliary/control contacts		
• Conductor cross-section		
- With/without end sleeve	mm AWG	1 x (0.5 ... 2.5), 2 x (0.5 ... 1.0) AWG 20 ... 12
• Stripped length	mm	7
• Terminal screw		M3
- Tightening torque, (∅ 3.5, PZ 1)	Nm lb.in	0.5 ... 0.6 4.5 ... 5.3
Permissible mounting positions		

1) These products were built as Class A devices. The use of these devices in residential areas could result in lead in radio interference. In this case these may be required to introduce additional interference suppression measures.

2) To maintain the values, a 3TX7 462-3L surge suppressor (see Catalog LV 1, Chapter 3, page 3/119) should be used between the phases L1 and L3 as close as possible to the switchgear.

3) If two different conductor cross-sections are connected to one clamping point, both cross-sections must lie in the range specified. If identical cross-sections are used, this restriction does not apply.

3RF24 solid-state reversing contactors, three-phase

Order No.	Fuseless design with motor starter protector CLASS 10					
	Rated operational current I_{AC-53} 1) acc. to IEC 60947-4-2			Power loss at I_{AC-53}	Short-circuit protection with type of coordination "1" at an operational voltage of U_e to 440 V	
	at 40 °C	UL/CSA, at 50 °C	at 60 °C	at 40 °C	Motor starter protector	I_q
	A	A	A	W	Type	kA
Main circuit						
3RF24 03-.BD.4	3.8 (3.4)	3.5 (3.1)	3.2 (2.8)	7 (6)	3RV1 021-1FA10	50
3RF24 05-.BD.4	5.4 (4.8)	5 (4.3)	4.6 (3.8)	9 (8)	3RV1 021-1GA10	50
3RF24 10-.BD.4	7.4	6.8	6.2	13	3RV1 021-1JA10	10

Order No.	Fused design with directly connected 3RB20 overload relay				Minimum load current	Max. leakage current	Rated impulse withstand capacity I_{tsm}	I^2t value
	Rated operational current I_{AC-53} acc. to IEC 60947-4-2			Power loss at I_{AC-53}				
	at 40 °C	UL/CSA, at 50 °C	at 60 °C	at 40 °C				
	A	A	A	W	A	mA	A	A^2s
Main circuit								
3RF24 03-.BD.4	3.8	3.5	3.2	6	0.5	10	200	200
3RF24 05-.BD.4	5.4	5	4.6	8	0.5	10	600	1800
3RF24 10-.BD.4	7.4	6.8	6.2	16	0.5	10	600	1800

Type		**3RF24 ..-.BD.4**
Main circuit		
Controlled phases		Two-phase
Rated operational voltage U_e 2)	V	48 ... 460
• Operating range	V	40 ... 506
• Rated frequency	Hz	50/60 ± 10 %
Rated insulation voltage U_i	V	600
Rated impulse withstand voltage U_{imp}	kV	6
Blocking voltage	V	1200
Rage of voltage rise	V/µs	1000

Type		**3RF24 ..-.BD0.**	**3RF24 ..-.BD2.**
Control circuit			
Method of operation		DC operation	AC operation
Rated control supply voltage U_s	V	24 acc. to EN 61131-2	110 ... 230
Rated frequency of the control supply voltage	Hz	--	50/60 ± 10 %
Control supply voltage, maximum	V	30	253
Typical actuating current	mA	15	10
Response voltage	V	15	90
Drop-out voltage	V	5	< 40
Operating times			
• ON-delay	ms	5	20
• OFF-delay	ms	5 + max. one half-wave	10 + max. one half-wave
• Interlocking time	ms	60 ... 100	50 ... 100

1) The reduced values in brackets apply to a directly mounted circuit breaker and simultaneous butt-mounting.

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

Fused version with semiconductor protection (similar to type of coordination "2")[1)]

The semiconductor protection for the 3RF24 controls can be used with different protective devices. Siemens recommends the use of special SITOR semiconductor fuses. The table below lists the maximum permissible fuses for each 3RF24 control.

If a fuse is used with a higher rated current than specified, semiconductor protection is no longer guaranteed. However, smaller fuses with a lower rated current up to a lower rated current of the load can only be used after the behavior of the existing load alternation has been tested.

Order No.	All-range fuses gR		Semiconductor fuses aR				Cable and line protection fuses			
			LV HRC design	Cylindrical design			LV HRC design	Cylindrical design		
	LV HRC design SITOR 3NE1	Cylindr. design NEOZED 3SE1[2)]	SITOR 3NE8	10 mm x 38 mm SITOR 3NC1	14 mm x 51 mm SITOR 3NC1	22 mm x 58 mm SITOR 3NC2	gG 3NA3	10 mm x 38 mm gG 3NW6	14 mm x 51 mm gG 3NW6	DIAZED quick 5SB1
Operational voltage U_e up to 506 V										
3RF24 03-.BD..	3NE1 813-0	5SE1 335	3NE8 015-1	3NC1 020	3NC1 415	3NC2 220	3NA3 801-6	3NW6 001-1	3NW6 101-1	5SB1 71
3RF24 05-.BD..	3NE1 802-0	5SE1 335	3NE8 020-1	3NC1 032	3NC1 450	3NC2 263	3NA3 805-6	--	--	5SB3 11
3RF24 10-.BD..	3NE1 802-0	5SE1 335	3NE8 020-1	3NC1 032	3NC1 450	3NC2 263	3NA3 805-6	--	--	5SB3 11

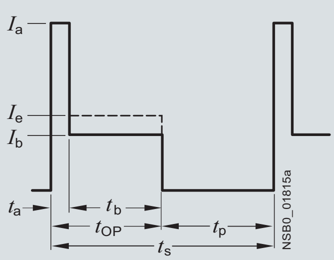
Suitable fuse holders, fuse bases and controls can be found in Catalog LV 1, Chapter 19.

1) Type of coordination "2" according to EN 60947-4-1: In the event of a short-circuit, the controls in the load feeder must not endanger persons or the installation. They must be suitable for further operation. For fused configurations, the protective device must be replaced.

2) For use only with operational voltage U_e up to 400 V.

Characteristic curves

Load diagram of motor



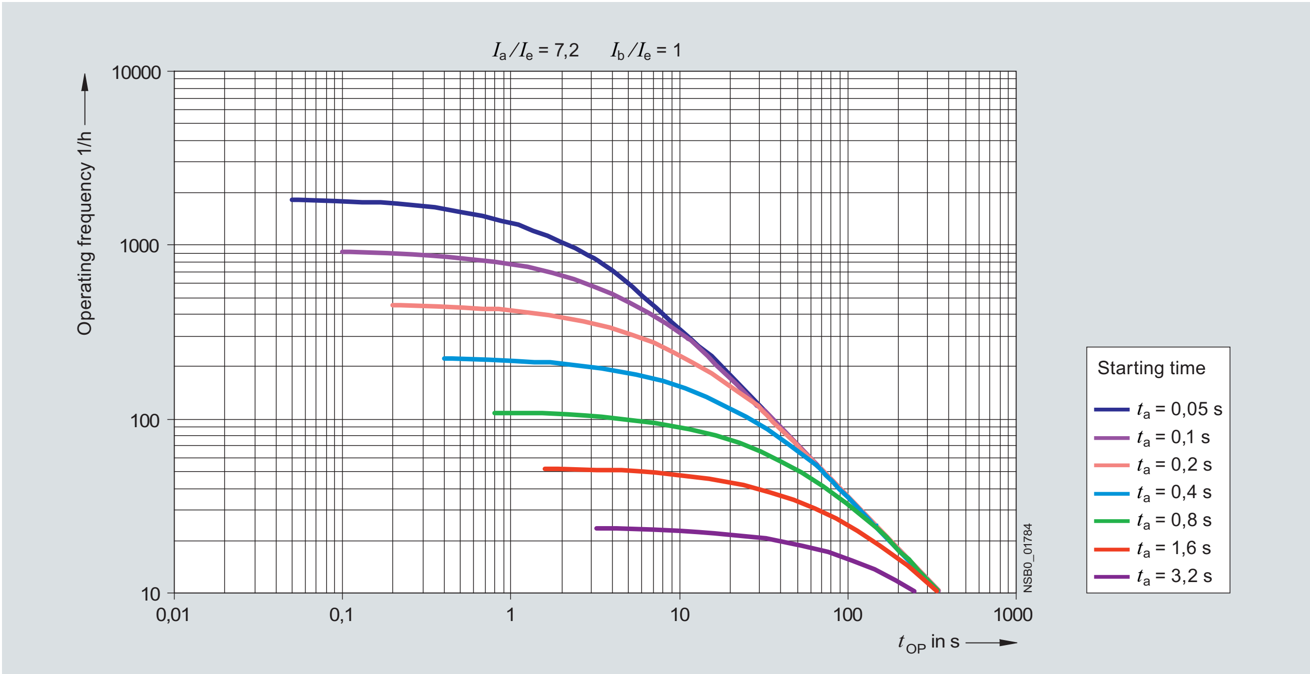
Operating data of motor

I_a Direct starting current
I_e Rated operational current
I_b Operational current
t_a Starting time
t_b Operating time
t_p Interval time
t_{OP} ON period
t_s Operating cycle

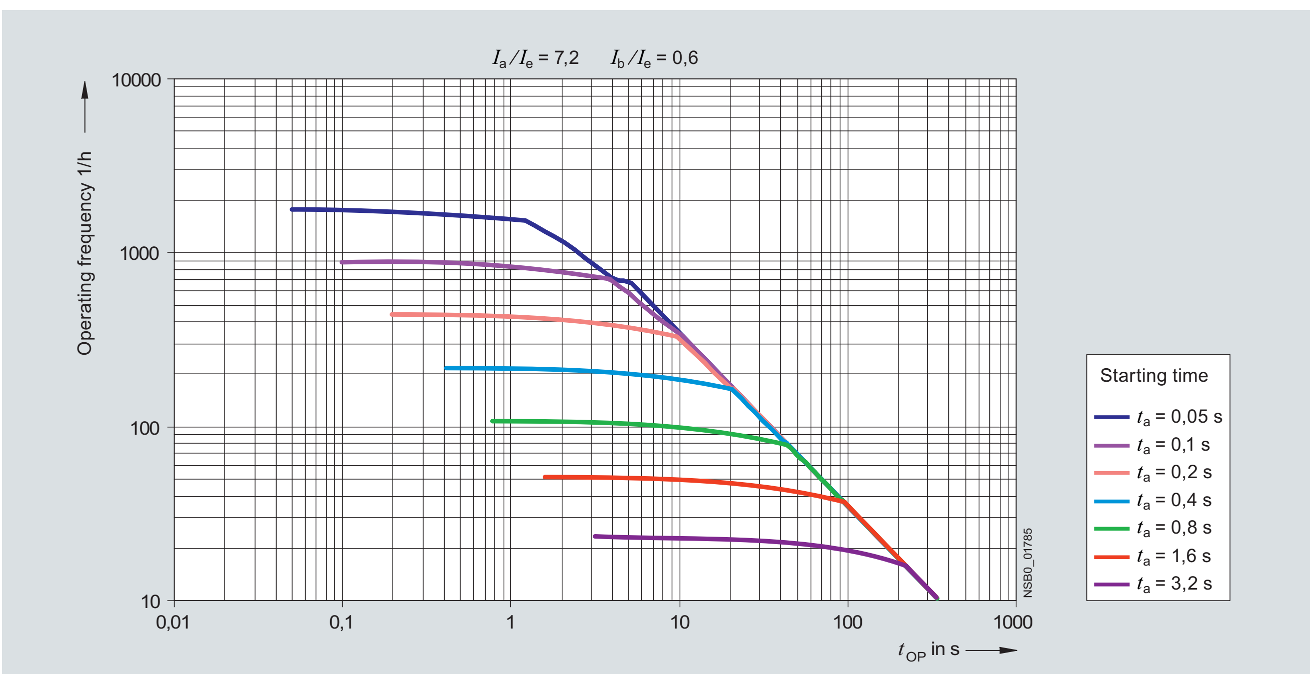
$$OP\ [\%] = \frac{t_{OP}}{t_s} \times 100\ \%$$

3RF24 solid-state reversing contactors, three-phase

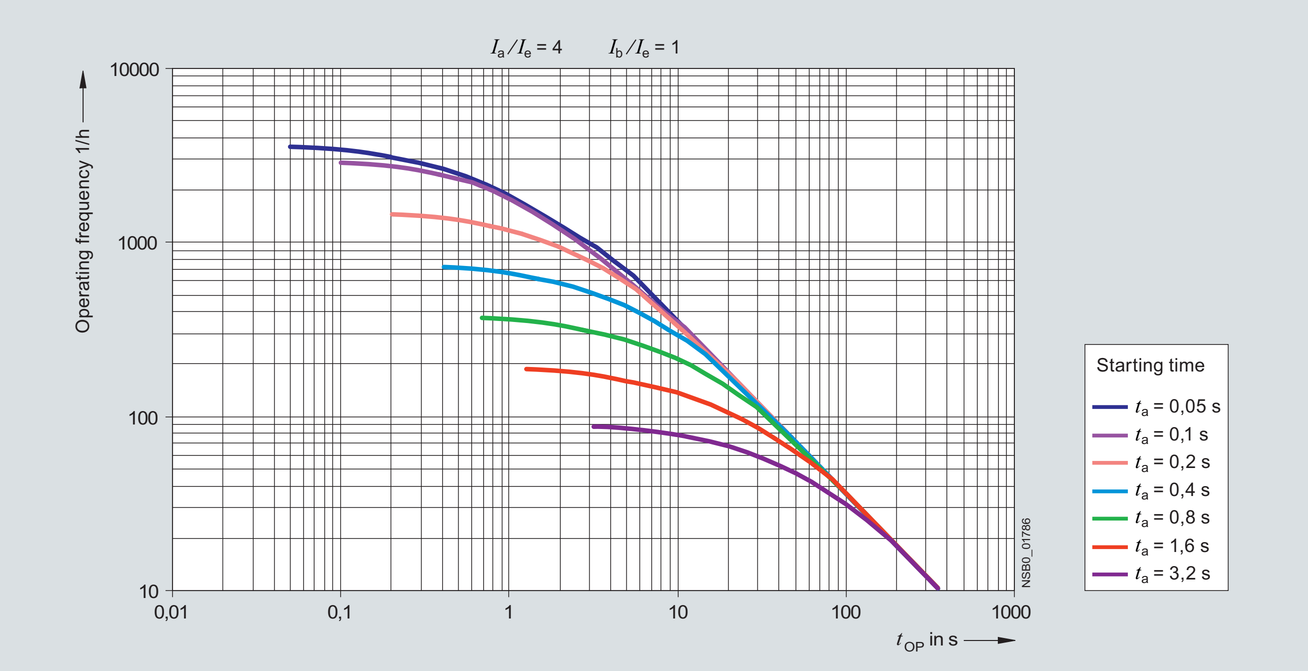
Maximum permissible switching frequency depending on the starting time t_a and the ON period t_{OP}



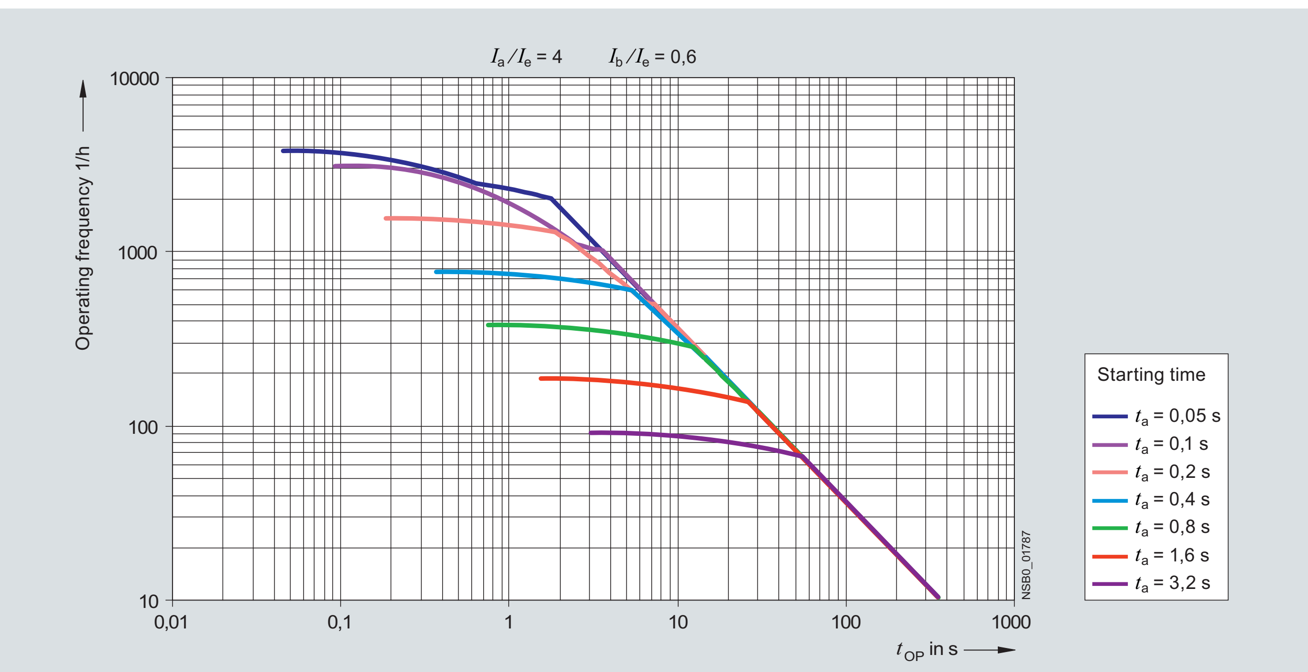
For motors with a starting current of 4 to 7.2 times the rated current and with a full load



For motors with a starting current of 4 to 7.2 times the rated current and with a 60 % load



For motors with a starting current of up to 4 times the rated current and with a full load

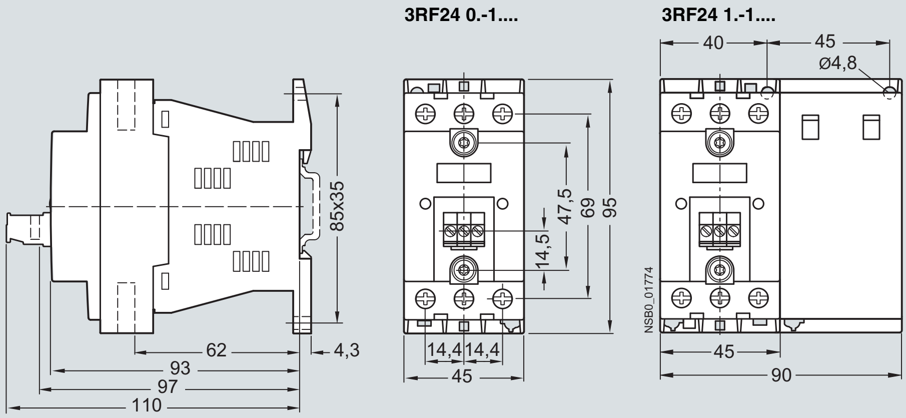


For motors with a starting current of up to 4 times the rated current and with a 60 % load

3RF24 solid-state reversing contactors, three-phase

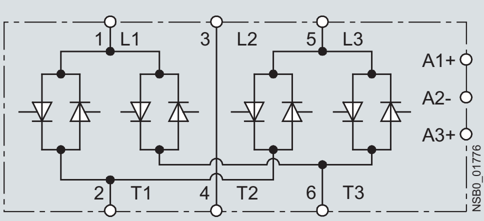
Dimensional drawings

Screw terminals

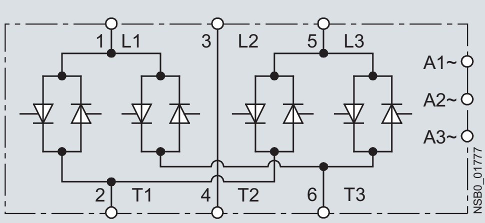


Schematics

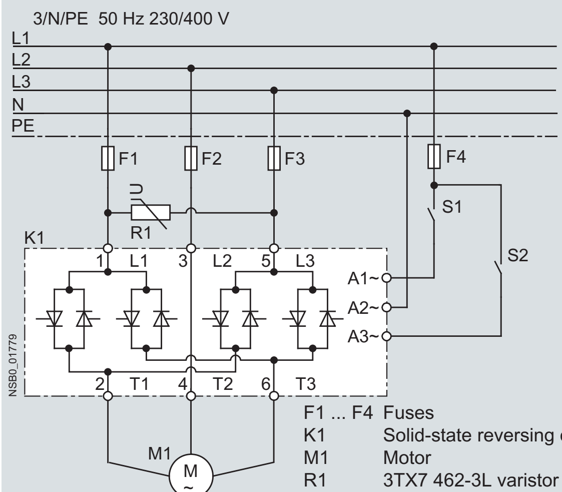
Two-phase controlled,
DC control supply voltage



Two-phase controlled,
AC control supply voltage



Sample schematic



F1 ... F4	Fuses
K1	Solid-state reversing contactor
M1	Motor
R1	3TX7 462-3L varistor
S1	"Counterclockwise" switch
S2	"Clockwise" switch

Get more information

Low-Voltage Controls and Distribution
www.siemens.com/lowvoltage

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