Controls – Solid-State Switching Devices

4

Introduction

Overview


3RF21


3RF20


3RF23


3RF29

		Order No.	Page
SIRIUS SC solid-state switching devices			
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	4/6 4/12
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 designs "Low Noise" and "Short-Circuit Resistant"	3RF23	4/16
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	3RF29 00-0EA18	4/27
Load monitoring	• For load monitoring of one or more loads (partial loads)	3RF29 20-0FA08, 3RF29 .0-0GA..	4/28
Heating current monitoring	• For load monitoring of one or more loads (partial loads)	3RF29 ..-0JA..	4/28
Power controllers	• For supplying the current by means of a solid-state switching device depending on a setpoint value Closed-loop control: Full wave control or generalized phase control	3RF29 .0-0HA..	4/29

Overview

SIRIUS SC solid-state switching devices

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

SIRIUS SC – for almost unending activity

Conventional electromechanical switching devices are 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 SC solid-state switching devices we provide you with solid-state relays and contactors with a particularly long service life – 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 SC solid-state switching devices have become firmly established in industrial use. 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, thanks to its silent switching SIRIUS SC is also ideally suited to noise-sensitive areas such as offices or hospitals.

The most reliable solution for any application

Compared with mechanical switching devices, our SIRIUS SC solid-state switching devices stand out because of 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 SC family is universally applicable. Depending on the individual requirements of the application, our modular switching devices can also be quite easily expanded by the addition of standardized function modules.

Always on the sunny side with SIRIUS SC

Because SIRIUS SC 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 installation and start-up, you save not only time but also expenses.

Type	Solid-state relays		Solid-state contactor	Function module				
	22.5 mm	45 mm		Converters	Load monitoring		Heating current monitoring	Power controllers
					Basic	Extended		
Usage								
Simple use of existing solid-state relays	❑	✓	❑	--	--	--	--	--
Complete "Ready to use"	❑	❑	✓	--	--	--	--	--
Space-saving	✓	--	✓	✓	✓	--	--	--
Can be extended with modular function modules	✓	--	✓	--	--	--	--	--
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 setpoints with "Teach" button	--	--	--	--	✓	✓	--	✓
"Remote Teach" input for setting setpoints	--	--	--	--	--	--	✓	--
Installation								
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 controls	✓	--	✓	--	✓	✓	✓	✓
Connection of load circuit from above	--	✓	--	--	--	--	--	--

✓ Function is available

❑ Function is possible

General data

Design

There is no typical design of a load feeder with solid-state relays or solid-state contactors; instead, the great variety of connection systems and control voltages offers universal application opportunities. SIRIUS SC 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.

Function

Connection technique

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

Screw connection system

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-loaded 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 mm^2 can be connected to each terminal. As a result, loads of up to 20 A can be dealt with.

Ring terminal end connection

The ring terminal end connection is equipped with an M5 screw. Ring terminal ends of up to 25 mm^2 can be connected. In this way it is possible to connect even high powers with current intensities of up to 90 A safely. Finger-safety is provided in this case too with a special cover.

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 SC 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 power systems with high interference voltages. Separate protective measures, such as a protective circuit with a varistor, are not necessary in most cases.

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

Maximum load integral

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

You can find more information on the Internet at:

http://www.siemens.com/siriussc

More information

Notes on integration in the load feeders

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

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

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

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

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

Suitable filters can be ordered from EPCOS AG.

You can find more information on the Internet at:

http://www.epcos.com

Overview

Solid-state relays

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

The solid-state relays are available in 2 different widths:

- 3RF21 solid-state relay with a width of 22.5 mm
- 3RF20 solid-state relay with a width of 45 mm

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 drives in packet distribution systems, operation is carried out safely and noiselessly.

More information

Selecting solid-state relays

When selecting solid-state relays, in addition to information about the power system, the load and the ambient conditions it is also necessary to know details of the planned design. The 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/siriussc

3RF21 solid-state relays, 22.5 mm

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 arrangement, with the power infeed from above and connection of the load 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		
Site altitude	m	0 ... 1000; derating from 1000		
Shock resistance According to IEC 60068-2-27	g/ms	15/11		
Vibration resistance According to IEC 60068-2-6	*g*	2		
Degree of protection		IP20		
Electromagnetic compatibility (EMC)				
• Emitted interference				
- Conducted interference voltage according to IEC 60947-4-3		Class A for industrial applications		
- Emitted, high-frequency interference voltage according to IEC 60947-4-3		Class A for industrial applications		
• Interference immunity				
- Electrostatic discharge according to IEC 61000-4-2 (corresponds to degree of severity 3)	kV	Contact discharge 4; air discharge 8; behavior criterion 2		
- Induced RF fields according to IEC 61000-4-6	MHz	0.15 ... 80; 140 dBµV; behavior criterion 1		
- Burst according to IEC 61000-4-4	kV	2/5.0 kHz; behavior criterion 1		
- Surge according to IEC 61000-4-5	kV	Conductor – ground 2; conductor – conductor 1; behavior criterion 2		
Connection technique		**Screw terminal**	**Spring-loaded connection**	**Ring cable connection**
Main contact connection				
• Conductor cross-section				
- Solid	mm^2	2 x (1.5 ... 2.5), 2 x (2.5 ... 6)	2 x (0.5 ... 2.5)	--
- Finely stranded with end sleeve	mm^2	2 x (1 ... 2.5), 2 x (2.5 ... 6), 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 conductors		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

Type		3RF21 ..-...2	3RF21 ..-...4	3RF21 ..-...5	3RF21 ..-....6
Main circuit					
Rated operational voltage U_e	V	24 ... 230	230 ... 460	48 ... 600	400 ... 600
• Tolerance	%	-15/+10			
• Rated frequency	Hz	50/60 ± 10 %			
Rated insulation voltage U_i	V	600			
Blocking voltage	V	800	1 200		1 600
Rage of voltage rise	V/µs	1 000			

Order No.	I_{max} [1] at R_{thha}/T_u = 40 °C		I_e according to IEC 60947-4-3 at R_{thha}/T_u = 40 °C		I_e according 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	2.0	20	1.7	28.6	0.1	10
3RF21 30-1....	30	1.1	30	1.1	30	0.88	44.2	0.5	10
3RF21 50-1....	50	0.68	50	0.68	50	0.53	66	0.5	10
3RF21 50-2....	50	0.68	20	4.2	20	3.3	66	0.5	10
3RF21 50-3....	50	0.68	50	0.48	50	0.53	66	0.5	10
3RF21 70-1....	70	0.40	50	0.95	50	0.80	94	0.5	10
3RF21 90-1....	88	0.33	50	1.25	50	1.02	118	0.5	10
3RF21 90-2....	88	0.33	20	5.0	20	4.0	118	0.5	10
3RF21 90-3....	88	0.33	88	0.33	83	0.29	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.

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.6	400	800
3RF21 50-.....	600	1 800
3RF21 70-..A.2	1 200	7 200
3RF21 70-..A.4	1 200	7 200
3RF21 70-..A.5	1 200	7 200
3RF21 70-..A.6	1 150	6 600
3RF21 90-.....	1 150	6 600

Type		**3RF21 ..-...0**	**3RF21 ..-...2**	**3RF21 ..-...4**
Control circuit				
Method of operation		DC operation	AC operation	DC operation
Rated control supply voltage U_s	V	24 according to EN 61131-2	110 ... 230	4 ... 30
Rated frequency of the control supply voltage	Hz	--	50/60	--
Rated control voltage U_c	V	30	253	30
Rated control current at U_s	mA	15	6	15
Response voltage	V	15	90	4
• For tripping current	mA	2	2	2
Drop-out voltage	V	5	40	1
Operating times				
• ON-delay	ms	1 + additional max. one half-wave [1]	40 + additional max. one half-wave [1]	1 + additional max. one half-wave [1]
• OFF delay	ms	1+ additional max. one half-wave	40 + additional max. one half-wave	1 + additional max. one half-wave

1) Only for zero-point-switching devices.

3RF21 solid-state relays, 22.5 mm

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

The solid-state protection for the SIRIUS SC controlgear can be used with different protective devices. This allows protection by means of, for example, LV HRC fuse links of gL/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 SC control gear.

If a fuse is used with a higher rated current than specified, solid-state 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 gL/gG operational class and for SITOR full range fuses 3NE1, the minimum cross-sections for the conductor to be connected must be taken into account.

Order No.	All-range fuse	Solid-state protection fuse				Cable and line protection fuse				
	LV design gR/SITOR 3NE1	LV design aR/SITOR 3NE8	Cylindrical design			LV design gL/gG 3NA	Cylindrical design			DIAZED quick 5SB
			10 x 38 mm aR/SITOR 3NC1 0	14 x 51 mm aR/SITOR 3NC1 4	22 x 58 mm aR/SITOR 3NC2 2		10 × 38 mm gL/gG 3NW	14 × 51 mm gL/gG 3NW	22 × 58 mm gL/gG 3NW	
3RF21 2.-...2	3NE1814-0	3NE8015-1	3NC1020	3NC1420	3NC2220	3NA2803	3NW6001-1	3NW6101-1	--	5SB171
3RF21 2.-...4	3NE1813-0	3NE8015-1	3NC1016	3NC1420	3NC2220	3NA2801	--	3NW6101-1	--	5SB141
3RF21 3.-...2	3NE1815-0	3NE8003-1	3NC1032	3NC1432	3NC2232	3NA2803	--	3NW6103-1	--	5SB311
3RF21 3.-...4	3NE1815-0	3NE8003-1	3NC1025[2)]	3NC1432	3NC2232	3NA2803	--	3NW6101-1	--	5SB171
3RF21 3.-....6	3NE1815-0	3NE8003-1	3NC1032	3NC1432	3NC2232	3NA2803-6	--	--	--	--
3RF21 5.-...2	3NE1817-0	3NE8017-1	--	3NC1450	3NC2250	3NA2810	--	3NW6107-1	3NW6207-1	5SB321
3RF21 5.-...4	3NE1802-0	3NE8017-1	--	3NC1450	3NC2250	3NA2807	--	--	3NW6205-1	5SB311
3RF21 5.-....6	3NE1803-0	3NE8017-1	--	3NC1450	3NC2250	3NA2807-6	--	--	--	--
3RF21 7.-...2[3)]	3NE1820-0	3NE8020-1	--	--	3NC2280	3NA2817	--	--	3NW6217-1	5SB331
3RF21 7.-...4[3)]	3NE1020-2	3NE8020-1	--	--	3NC2280	3NA2812	--	--	3NW6212-1	5SB321
3RF21 7.-...5[3)]	3NE1020-2	3NE8020-1	--	--	3NC2280	3NA2812	--	--	3NW6212-1	5SB321
3RF21 7.-...6[3)]	3NE1020-2	3NE8020-1	--	--	3NC2280	3NA2812-6	--	--	--	--
3RF21 9.-...2[3)]	3NE1021-2	3NE8021-1	--	--	3NC2200	3NA2817	--	--	3NW6217-1	5SB331
3RF21 9.-...4[3)]	3NE1021-2	3NE8021-1	--	--	3NC2280[2)]	3NA2812	--	--	3NW6212-1	5SB321
3RF21 9.-...6[3)]	3NE1020-2[2)]	3NE8021-1	--	--	3NC2280[2)]	3NA2812-6	--	--	--	--

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

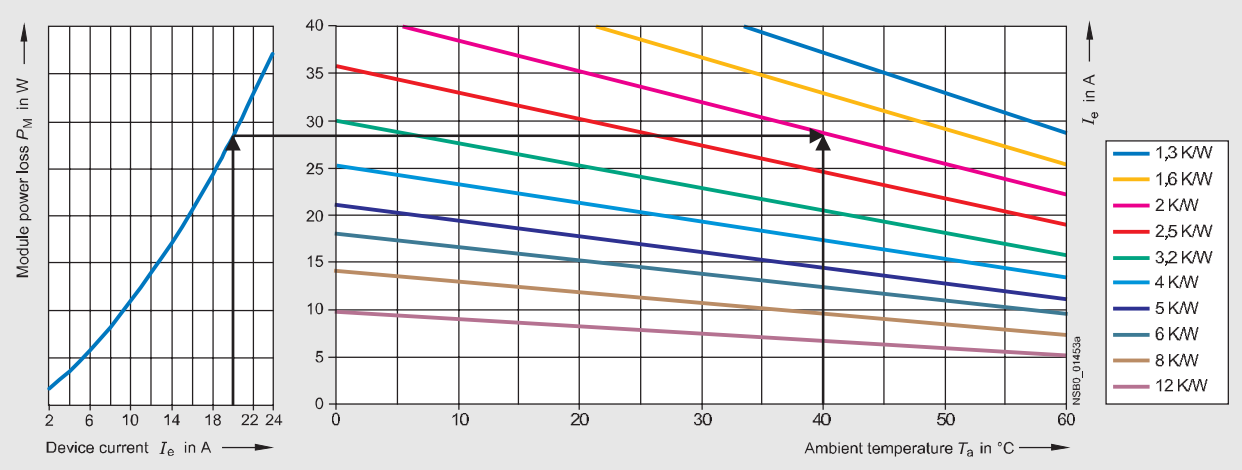
1) Type of coordination "2" according to EN 60947-4-1:
In the event of a short-circuit, the controlgear in the load feeder must not endanger persons or the installation. They must be suitable for further operation. For fused configurations, the protective device must be replaced.

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

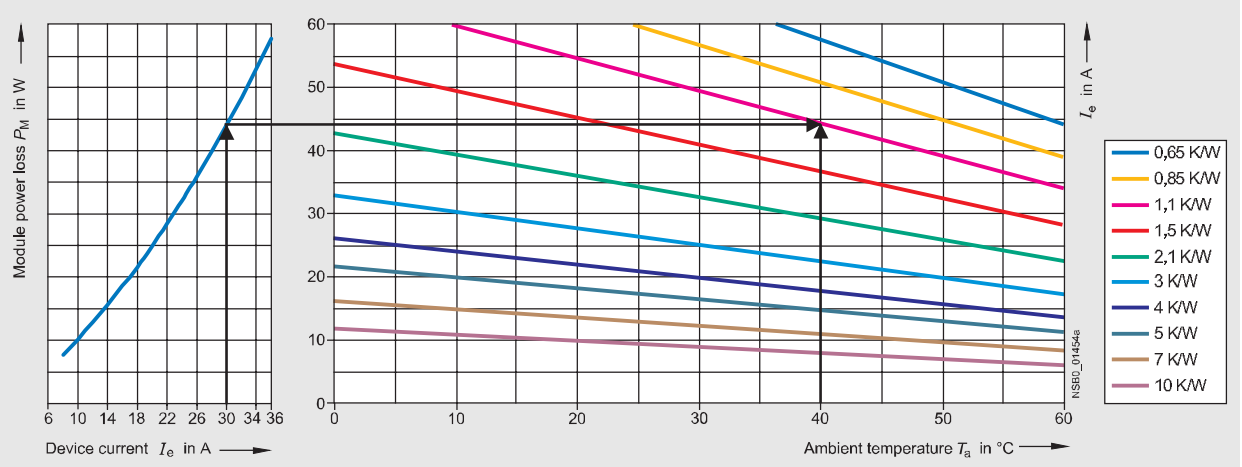
3) These versions can also be protected against short-circuits with miniature circuit-breakers as described in the notes on "SIRIUS SC Solid-State Contactors → Special Version Short-Circuit Resistant" .

Characteristic curves

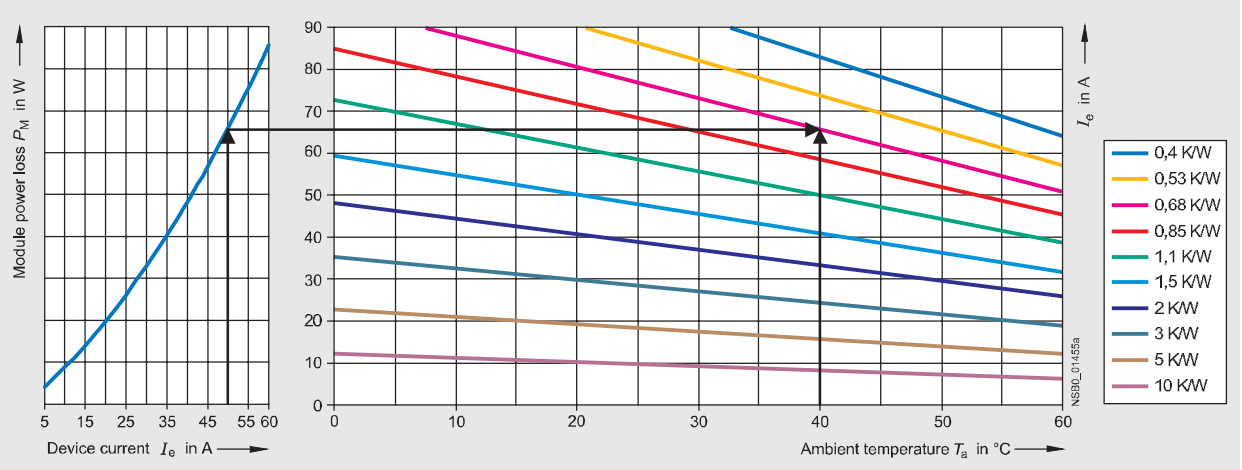
Dependence of the device current I_e on the ambient temperature T_a



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



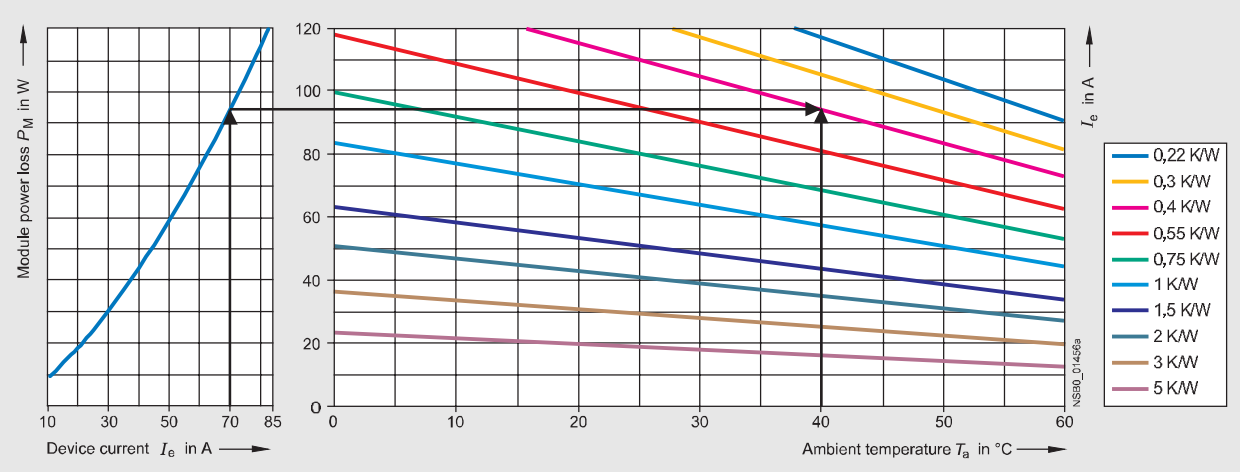
Type current 30 A (3RF21 30, 3RF20 30)



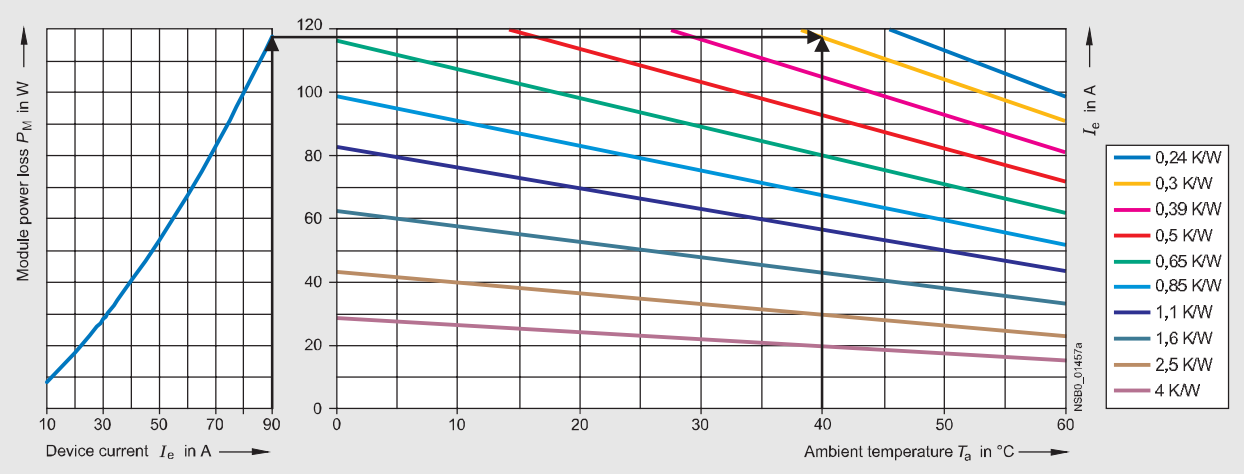
Type current 50 A (3RF21 50, 3RF20 50)

1) For arrangement example see next page.

3RF21 solid-state relays, 22.5 mm



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.

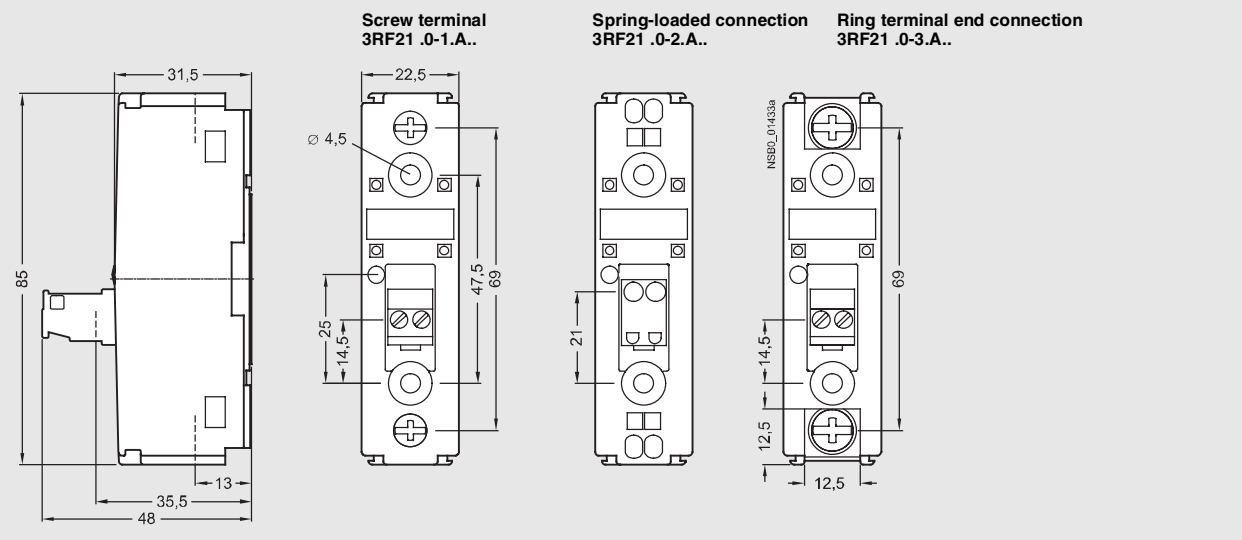
This results in:

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

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

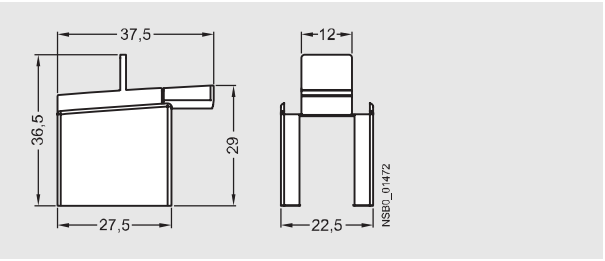
Dimensional drawings

Solid-state relays



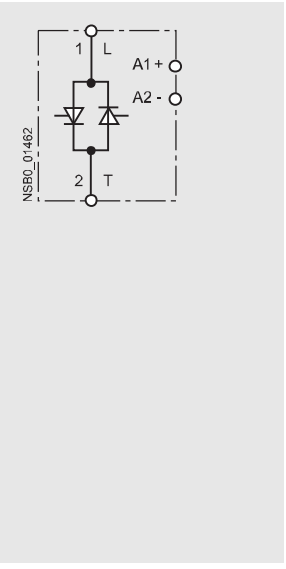
Terminal cover

3RF29 00-3PA88

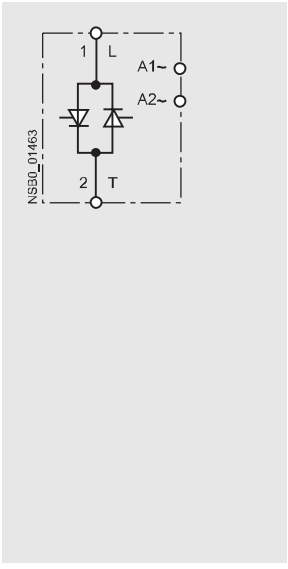


Schematics

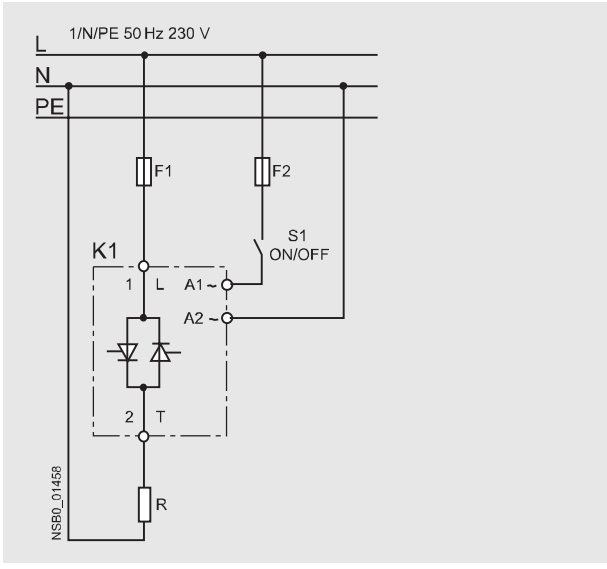
Version
DC control supply voltage



Version
AC control supply voltage



Switching example



3RF20 solid-state relays, 45 mm

Overview

45 mm solid-state relays

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

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	230 ... 460	48 ... 600	400 ... 600
• Tolerance	%	-15/+10			
• Rated frequency	Hz	50/60 ± 10 %			
Rated insulation voltage U_i	V	600			
Blocking voltage	V	800	1 200		1 600
Rage of voltage rise	V/µs	1 000			

Order No.	I_{max} [1] at R_{thha}/T_u = 40 °C		I_e according to IEC 60947-4-3 at R_{thha}/T_u = 40 °C		I_e according 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	2.0	20	1.7	28.6	0.1	10
3RF20 30-1.A..	30	1.1	30	1.1	30	0.88	44.2	0.5	10
3RF20 50-1.A..	50	0.68	50	0.68	50	0.53	66	0.5	10
3RF20 70-1.A..	70	0.40	50	0.95	50	0.80	94	0.5	10
3RF20 90-1.A..	88	0.33	50	1.25	50	1.02	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.

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	300	450
3RF20 30-1.A.4	300	450
3RF20 30-1.A.6	400	800
3RF20 50-1.A..	600	1 800
3RF20 70-1.A.2	1 200	7 200
3RF20 70-1.A.4	1 200	7 200
3RF20 70-1.A.5	1 200	7 200
3RF20 70-1.A.6	1 150	6 600
3RF20 90-1.A..	1 150	6 600

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 according to EN 61131-2	110 … 230	4 … 30
Rated frequency of the control supply voltage	Hz	--	50/60 ± 10 %	--
Rated control voltage U_c	V	30	253	30
Rated control current at U_S	mA	15	6	15
Response voltage	V	15	90	4
• For tripping current	mA	2	2	2
Drop-out voltage	V	5	40	1
Operating times				
• ON-delay	ms	1 + additional max. one half-wave [1]	40 + additional max. one half-wave [1]	1 + additional max. one half-wave [1]
• OFF delay	ms	1 + additional max. one half-wave	40 + additional max. one half-wave	1 + additional max. one half-wave

1) Only for zero-point-switching devices.

3RF20 solid-state relays, 45 mm

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

The solid-state protection for the SIRIUS SC controlgear can be used with different protective devices. This allows protection by means of LV HRC fuse links of gL/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 SC controlgear.

If a fuse is used with a higher rated current than specified, solid-state 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 gL/gG operational class and for SITOR full range fuses 3NE1, the minimum cross-sections for the conductor to be connected must be taken into account.

Order No.	All-range fuse	Solid-state protection fuse				Cable and line protection fuse				
	LV design gR/SITOR 3NE1	LV design aR/SITOR 3NE8	Cylindrical design			LV design gL/gG 3NA	Cylindrical design			DIAZED quick 5SB
			10 x 38 mm aR/SITOR 3NC1 0	14 x 51 mm aR/SITOR 3NC1 4	22 x 58 mm aR/SITOR 3NC2 2		10 × 38 mm gL/gG 3NW	14 × 51 mm gL/gG 3NW	22 × 58 mm gL/gG 3NW	
3RF20 20-1.A.2	3NE1814-0	3NE8015-1	3NC1020	3NC1420	3NC2220	3NA2803	3NW6001-1	3NW6101-1	--	5SB171
3RF20 20-1.A.4	3NE1813-0	3NE8015-1	3NC1016	3NC1420	3NC2220	3NA2801	--	3NW6101-1	--	5SB141
3RF20 30-1.A.2	3NE1815-0	3NE8003-1	3NC1032	3NC1432	3NC2232	3NA2803	--	3NW6103-1	--	5SB311
3RF20 30-1.A.4	3NE1815-0	3NE8003-1	3NC1025[2)]	3NC1432	3NC2232	3NA2803	--	3NW6101-1	--	5SB171
3RF20 30-1.A.6	3NE1815-0	3NE8003-1	3NC1032	3NC1432	3NC2232	3NA2803-6	--	--	--	--
3RF20 50-1.A.2	3NE1817-0	3NE8017-1	--	3NC1450	3NC2250	3NA2810	--	3NW6107-1	3NW6207-1	5SB321
3RF20 50-1.A.4	3NE1802-0	3NE8017-1	--	3NC1450	3NC2250	3NA2807	--	--	3NW6205-1	5SB311
3RF20 50-1.A.6	3NE1803-0	3NE8017-1	--	3NC1450	3NC2250	3NA2807-6	--	--	--	--
3RF20 70-1.A.2[3)]	3NE1820-0	3NE8020-1	--	--	3NC2280	3NA2817	--	--	3NW6217-1	5SB331
3RF20 70-1.A.4[3)]	3NE1020-2	3NE8020-1	--	--	3NC2280	3NA2812	--	--	3NW6212-1	5SB321
3RF20 70-1.A.5[3)]	3NE1020-2	3NE8020-1	--	--	3NC2280	3NA2812	--	--	3NW6212-1	5SB321
3RF20 70-1.A.6[3)]	3NE1020-2	3NE8020-1	--	--	3NC2280	3NA2812-6	--	--	--	--
3RF20 90-1.A.2[3)]	3NE1021-2	3NE8021-1	--	--	3NC2200	3NA2817	--	--	3NW6217-1	5SB331
3RF20 90-1.A.4[3)]	3NE1021-2	3NE8021-1	--	--	3NC2280[2)]	3NA2812	--	--	3NW6212-1	5SB321
3RF20 90-1.A.6[3)]	3NE1020-2[2)]	3NE8021-1	--	--	3NC2280[2)]	3NA2812-6	--	--	--	--

Suitable fuse holders, fuse bases and controlgear 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 controlgear 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.

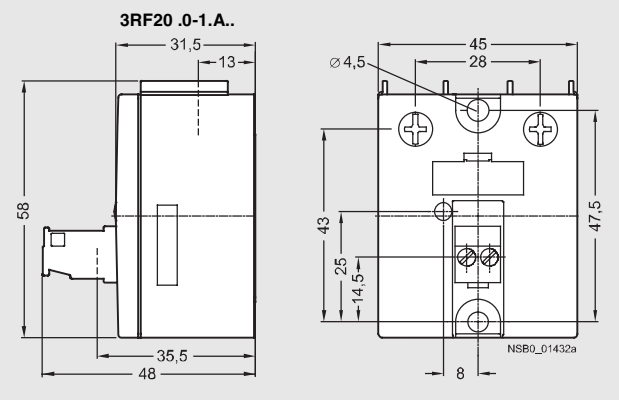
2) These fuses have a smaller rated current than the solid-state relays.

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

Characteristic curves

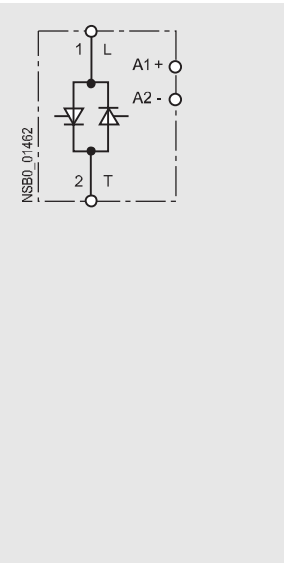
See 3RF21 solid-state relays, 22.5 mm

Dimensional drawings

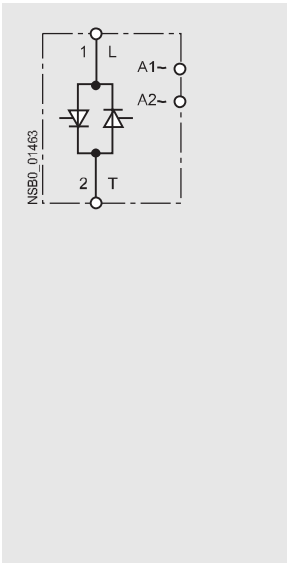


Schematics

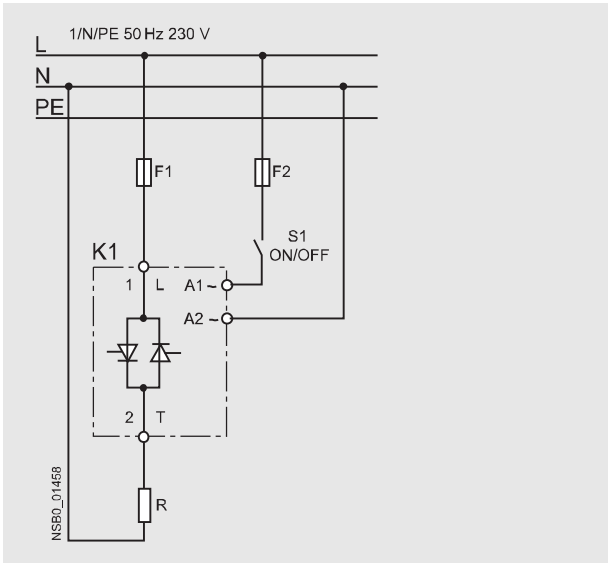
Version
DC control supply voltage



Version
AC control supply voltage



Switching example



General data

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 intensities of up to 88 A are achieved. Like all of our solid-state switching devices, one of their particular advantages is their compact and space-saving design. With their insulated mounting foot they can easily be snapped onto a standard mounting rail, or they can be mounted on carrier plates with fixing screws. This insulation enables them to be used in circuits with protective extra-low voltage (PELV) or safety extra-low voltage (SELV) in building engineering. For other applications, such as for extended personal safety, the heat sink can be grounded through a screw connection.

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 drives in packet distribution systems, operation is carried out safely and noiselessly.

Special "Low noise" version

Thanks to a special control circuit, this special design can be used in public networks up to 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

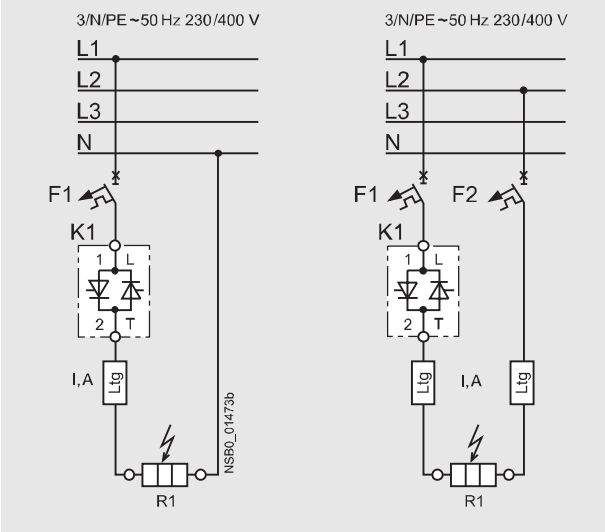
Skilful matching of the power semiconductor with the performance of the solid-state contactor means that "short-circuit strength" can be achieved with a standard miniature circuit-breaker. In combination with a B-type MCB or a conventional fuse, the result is a short-circuit resistant feeder.

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 conductor 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	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^{2}s.

More information

Selecting solid-state contactors

The solid-state contactors are selected on the basis of details of the power system, 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 design conditions

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			
Site altitude	m	0 ... 1000; derating from 1000			
Shock resistance According to IEC 60068-2-27	g/ms	15/11			
Vibration resistance According to IEC 60068-2-6	*g*	2			
Degree of protection		IP20			
Electromagnetic compatibility (EMC)					
• Emitted interference according 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 according to IEC 61000-4-2 (corresponds to degree of severity 3)	kV	Contact discharge 4; air discharge 8; behavior criterion 2			
- Induced RF fields according to IEC 61000-4-6	MHz	0.15 ... 80; 140 dBµV; behavior criterion 1			
- Burst according to IEC 61000-4-4	kV	2/5.0 kHz; behavior criterion 1			
- Surge according 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 technique		**Screw terminal**	**Spring-loaded connection**	**Ring cable connection**
Main contact connection				
• Conductor cross-section				
- Solid	mm^2	2 x (1.5 ... 2.5), 2 x (2.5 ... 6)	2 x (0.5 ... 2.5)	--
- Finely stranded with end sleeve	mm^2	2 x (1 ... 2.5), 2 x (2.5 ... 6), 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 conductors		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		-		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) 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

Type		3RF23 ..-....2	3RF23 ..-....4	3RF23 ..-....5	3RF23 ..-....6
Main circuit					
Rated operational voltage U_e	V	24 ... 230	230 ... 460	48 ... 600	400 ... 600
• Tolerance	%	-15/+10			
• Rated frequency	Hz	50/60 ± 10 %			
Rated insulation voltage U_i	V	600			
Blocking voltage	V	800	1 200		1 600
Rage of voltage rise	V/µs	1 000			

3RF23 solid-state contactors

Order No.	Type current AC-51[1] for I_{max} at 40 °C	according to IEC 60947-4-3 for 40°C	according 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	A^2s
Main circuit								
3RF23 1.-.A..2	10.5	7.5	9.6	11	0.1	10	200	200
3RF23 1.-.A..4							200	200
3RF23 1.-.A..6							400	800
3RF23 2.-.A..2	20	13.2	17.6	20	0.5	10	600	1 800
3RF23 2.-.A..4						10	600	1 800
3RF23 2.-.A..5						10	600	1 800
3RF23 2.-.A..6						10	600	1 800
3RF23 2.-.C..2						25	600	1 800
3RF23 2.-.C..4						25	600	1 800
3RF23 2.-.D..2						10	1 150	6 600
3RF23 2.-.D..4						10	1 150	6 600
3RF23 3.-.A..2	30	22	27	33	0.5	10	600	1 800
3RF23 3.-.A..4						10	600	1 800
3RF23 3.-.A..6						10	600	1 800
3RF23 3.-.C..2						25	600	1 800
3RF23 3.-.D..4						10	1 150	6 600
3RF23 4.-.A..2	40	33	36	44	0.5	10	1 200	7 200
3RF23 4.-.A..4							1 200	7 200
3RF23 4.-.A..5							1 200	7 200
3RF23 4.-.A..6							1 150	6 600
3RF23 5.-.A..2	50	36	45	54	0.5	10	1 150	6 600
3RF23 5.-.A..4								
3RF23 5.-.A..5								
3RF23 5.-.A..6								
3RF23 7.-.A..2	70	70	62	83	0.5	10	1 150	6 600
3RF23 7.-.A..4								
3RF23 7.-.A..5								
3RF23 7.-.A..6								
3RF23 9.-.A..2	88	88	80	117	0.5	10	1 150	6 600
3RF23 9.-.A..4								
3RF23 9.-.A..5								
3RF23 9.-.A..6								

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 4/20.

Order No.	Type current AC-51[1] for I_{max} at 40 °C	according to IEC 60947-4-3 for 40 °C	according to UL/CSA for 50 °C	Type current AC-15 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	A^2s
Main circuit										
3RF23 1.-.B..2	10.5	7.5	9.6	6	1200 1/h 50% ON -time	11	0.1	10	200	200
3RF23 1.-.B..4									200	200
3RF23 1.-.B..6									400	800
3RF23 2.-.B..2	20	13.2	17.6	12	1200 1/h 50% ON -time	20	0.5	10	600	1 800
3RF23 2.-.B..4										
3RF23 2.-.B..6										
3RF23 3.-.B..2	30	22	27	15	1200 1/h 50% ON -time	33	0.5	10	600	1800
3RF23 3.-.B..4										
3RF23 3.-.B..6										
3RF23 4.-.B..2	40	33	36	20	1200 1/h 50% ON -time	44	0.5	10	1 200	7 200
3RF23 4.-.B..4									1 200	7 200
3RF23 4.-.B..6									1 150	6 600
3RF23 5.-.B..2	50	36	45	25	1200 1/h 50% ON -time	54	0.5	10	1 150	6 600
3RF23 5.-.B..4										
3RF23 5.-.B..6										
3RF23 7.-.B..2	70	70	62	27.5	1200 1/h 50% ON -time	83	0.5	10	1 150	6 600
3RF23 7.-.B..4										
3RF23 7.-.B..6										
3RF23 9.-.B..2	88	88	80	30	1200 1/h 50% ON -time	117	0.5	10	1 150	6 600
3RF23 9.-.B..4										
3RF23 9.-.B..6										

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 4/20.

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 according to EN 61131-2	24 AC/DC	110 ... 230 AC	4 ... 30 DC
Rated frequency of the control supply voltage	Hz	--	AC 50/60 Hz / -- DC	50/60 ± 10%	--
Actuating voltage, max.	V	30	26.5 AC / 30 DC	253	30
Rated control current at U_s	A	15	15	6	15
Response voltage • For tripping current	V mA	15 > 2	14 AC / 15 DC > 2	90 > 2	4 > 2
Drop-out voltage	V	5	5	40	1
Operating times • ON-delay	ms	1 + additional max. one half-wave[1)]	AC: 40 + additional max. one half-wave[1)] DC: 1 + additional max. one half-wave[1)]	40 + additional max. one half-wave[1)]	1 + additional max. one half-wave[1)]
• OFF delay	ms	1 + additional max. one half-wave	AC: 1 + additional max. one half-wave DC: 1 + additional max. one half-wave	40 + additional max. one half-wave	1 + additional max. one half-wave

1) Only for zero-point-switching devices.

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

The solid-state protection for the SIRIUS SC controlgear can be used with different protective devices. This allows protection by means of LV HRC fuse links of gL/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 SC control gear.

If a fuse is used with a higher rated current than specified, solid-state 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 gL/gG operational class and for SITOR full range fuses 3NE1, the minimum cross-sections for the conductor to be connected must be taken into account.

Order No.	All-range fuse	Solid-state protection fuse				Cable and line protection fuse				
	LV design gR/SITOR 3NE1	LV design aR/SITOR 3NE8	Cylindrical design			LV design gL/gG 3NA	Cylindrical design			DIAZED quick 5SB
			10 × 38 mm aR/SITOR 3NC1 0	14 × 51 mm aR/SITOR 3NC1 4	22 × 58 mm aR/SITOR 3NC2 2		10 × 38 mm gL/gG 3NW	14 × 51 mm gL/gG 3NW	22 × 58 mm gL/gG 3NW	
3RF23 1.-....2	3NE1813-0	3NE8015-1	3NC1010	3NC1410	3NC2220	3NA2803	3NW6001-1	3NW6101-1	--	5SB141
3RF23 1.-....4	3NE1813-0	3NE8015-1	3NC1010	3NC1410	3NC2220	3NA2801	3NW6001-1	3NW6101-1	--	5SB141
3RF23 1.-....6	3NE1813-0	3NE8015-1	3NC1010	3NC1410	3NC2220	3NA2803-6	--	--	--	--
3RF23 2.-....2	3NE1814-0	3NE8015-1	3NC1020	3NC1420	3NC2220	3NA2807	3NW6007-1	3NW6107-1	3NW6207-1	5SB171
3RF23 2.-....4	3NE1814-0	3NE8015-1	3NC1020	3NC1420	3NC2220	3NA2807	3NW6005-1	3NW6105-1	3NW6205-1	5SB171
3RF23 2.-....5	3NE1814-0	3NE8015-1	3NC1020	3NC1420	3NC2220	3NA2807-6	--	--	--	--
3RF23 2.-....6	3NE1814-0	3NE8015-1	3NC1020	3NC1420	3NC2220	3NA2807-6	--	--	--	--
3RF23 3.-....2	3NE1803-0	3NE8003-1	3NC1032	3NC1432	3NC2232	3NA2810	--	3NW6107-1	3NW6207-1	5SB311
3RF23 3.-....4	3NE1803-0	3NE8003-1	3NC1032	3NC1432	3NC2232	3NA2807	--	3NW6105-1	3NW6205-1	5SB311
3RF23 3.-....6	3NE1803-0	3NE8003-1	3NC1032	3NC1432	3NC2232	3NA2807-6	--	--	--	--
3RF23 4.-....2	3NE1802-0	3NE8017-1	--	3NC1440	3NC2240	3NA2817	--	3NW6117-1	3NW6217-1	5SB321
3RF23 4.-....4	3NE1802-0	3NE8017-1	--	3NC1440	3NC2240	3NA2812	--	3NW6112-1	3NW6212-1	5SB321
3RF23 4.-....5	3NE1802-0	3NE8017-1	--	3NC1440	3NC2240	3NA2812-6	--	--	--	--
3RF23 4.-....6	3NE1802-0	3NE8017-1	--	3NC1440	3NC2240	3NA2812-6	--	--	--	--
3RF23 5.-....2	3NE1817-0	3NE8018-1	--	3NC1450	3NC2250	3NA2817	--	3NW6117-1	3NW6217-1	5SB321
3RF23 5.-....4	3NE1817-0	3NE8018-1	--	3NC1450	3NC2250	3NA2812	--	--	3NW6210-1	5SB321
3RF23 5.-....5	3NE1817-0	3NE8018-1	--	3NC1450	3NC2250	3NA2812-6	--	--		
3RF23 5.-....6	3NE1817-0	3NE8018-1	--	3NC1450	3NC2250	3NA2812-6	--	--	--	--
3RF23 7.-....2	3NE1820-0	3NE8020-1	--	--	3NC2280	3NA2817	--	--	3NW6217-1	5SB331
3RF23 7.-....4	3NE1020-2	3NE8020-1	--	--	3NC2280	3NA2812	--	--	3NW6210-1	5SB321
3RF23 7.-....5	3NE1020-2	3NE8020-1	--	--	3NC2280	3NA2812-6	--	--	--	--
3RF23 7.-....6	3NE1020-2	3NE8020-1	--	--	3NC2280	3NA2812-6	--	--	--	--
3RF23 9.-....2	3NE1021-2	3NE8021-1	--	--	3NC2200	3NA2817	--	--	3NW6217-1	5SB331
3RF23 9.-....4	3NE1021-2	3NE8021-1	--	--	3NC2280[2)]	3NA2812	--	--	3NW6210-1	5SB321
3RF23 9.-....5	3NE1020-2[2)]	3NE8021-1	--	--	3NC2280[2)]	3NA2812-6	--	--	--	--
3RF23 9.-....6	3NE1020-2[2)]	3NE8021-1	--	--	3NC2280[2)]	3NA2812-6	--	--	--	--

Suitable fuse holders, fuse bases and controlgear 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 controlgear 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.

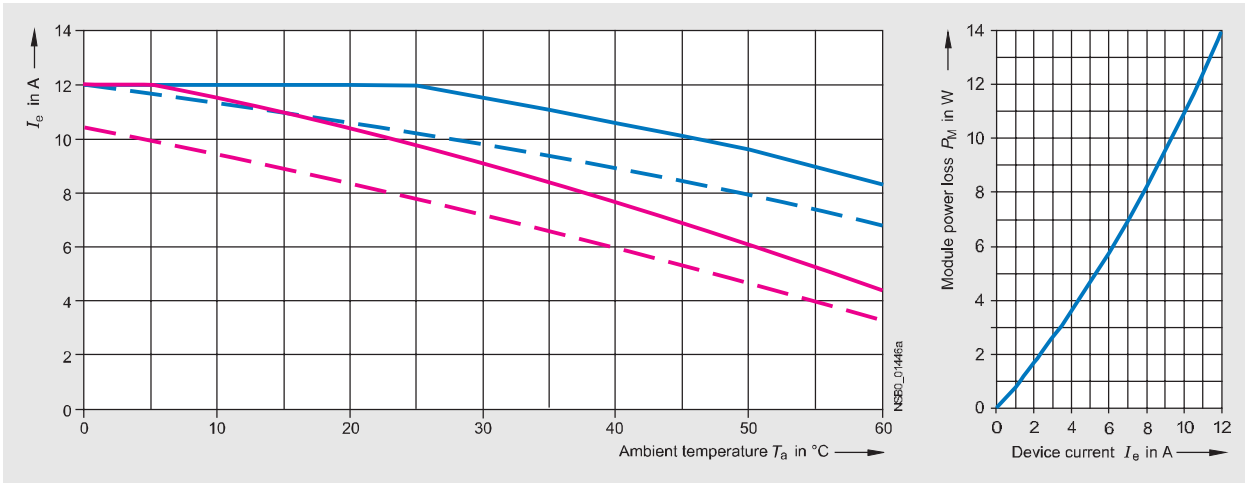
2) These fuses have a smaller rated current than the solid-state contactors.

3RF23 solid-state contactors

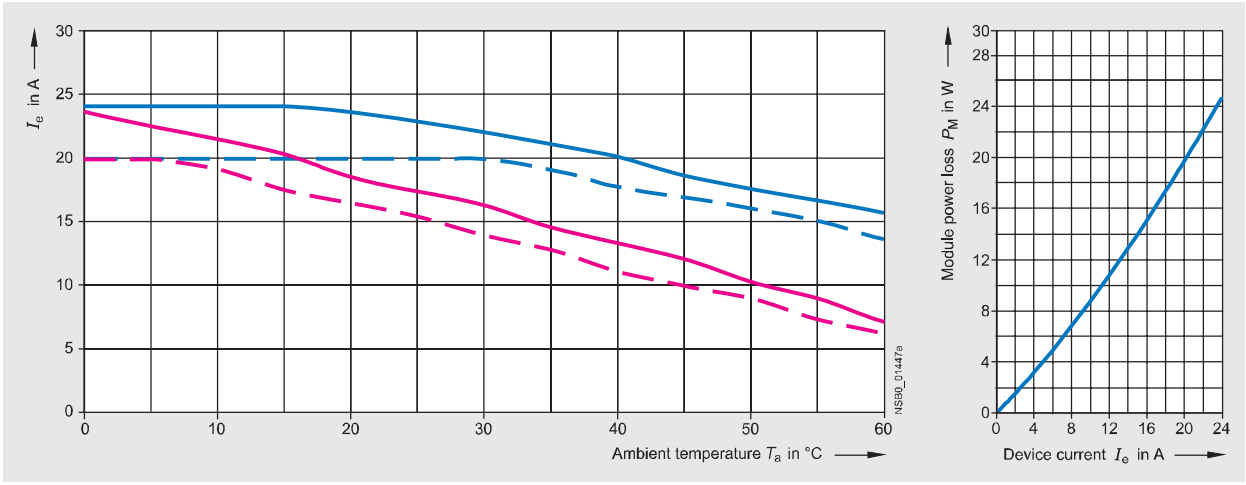
Characteristic curves

Derating curves

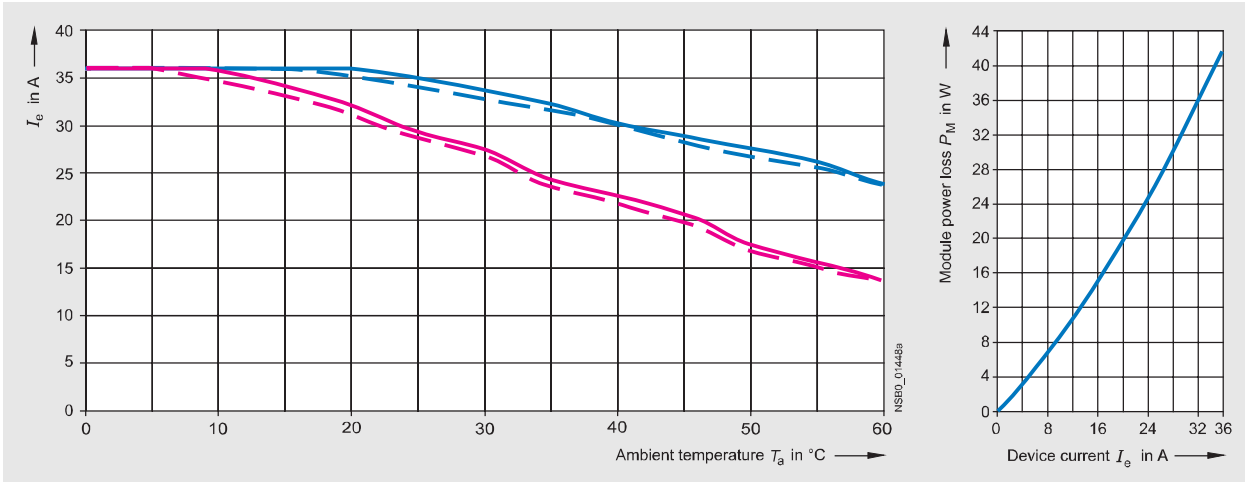
For derating see the characteristic curves on page 4/22.



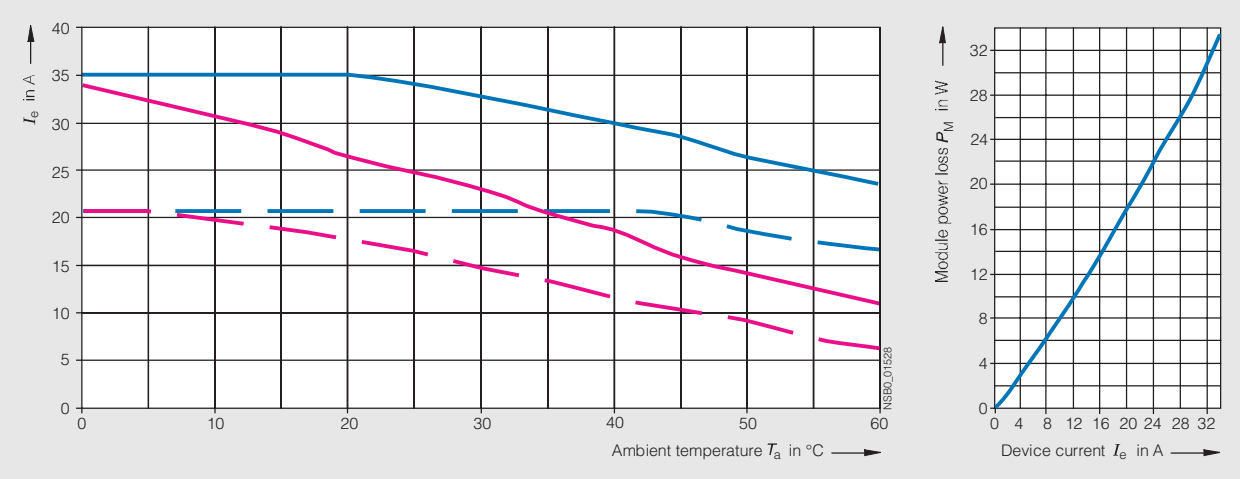
Type current 10.5 A (3RF23 10)



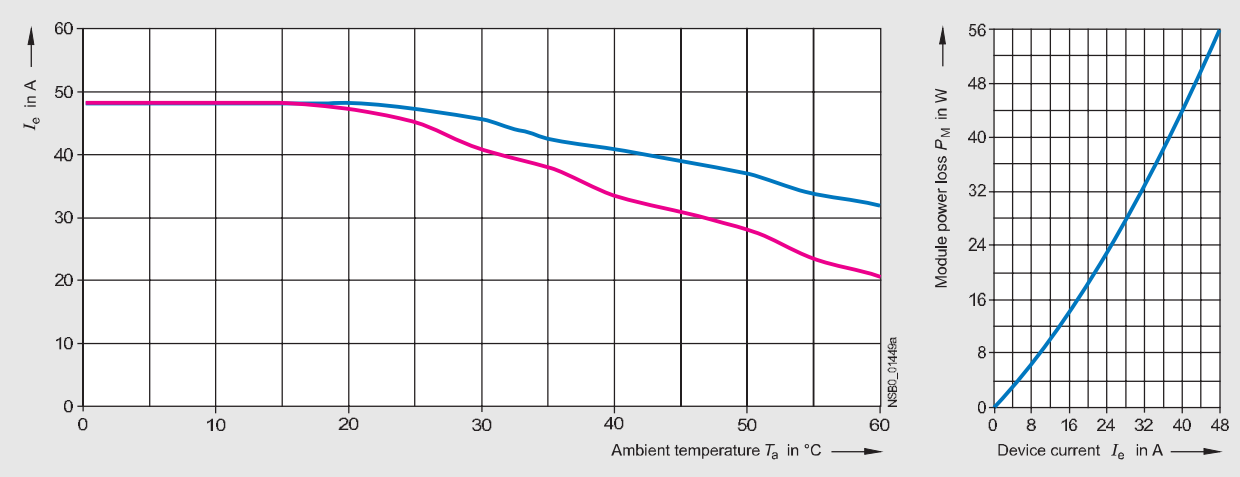
Type current 20 A (3RF23 20)



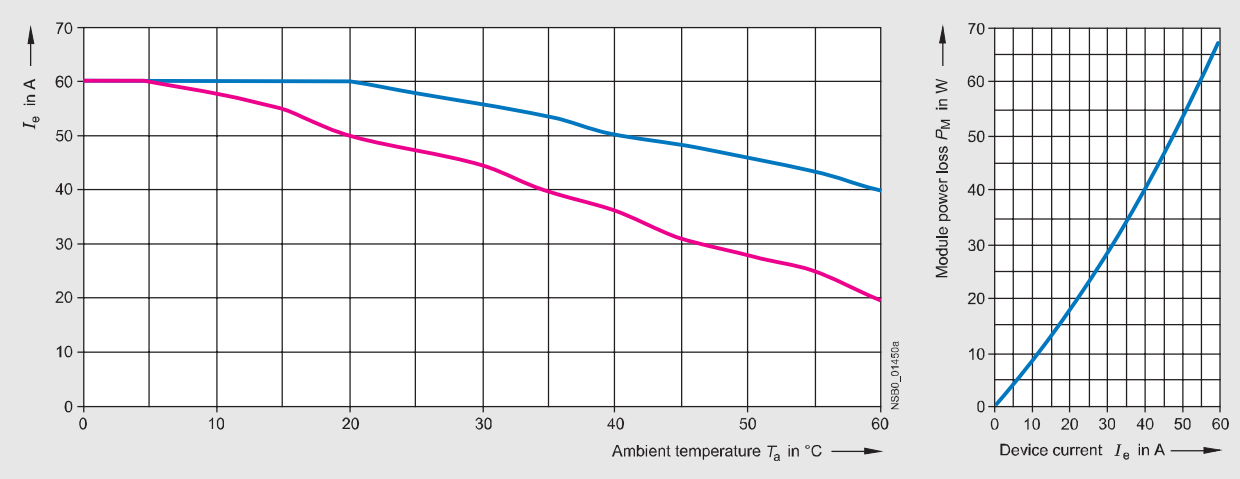
Type current 30 A (3RF23 30-.AA.., -.BA.., -.CA..)



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

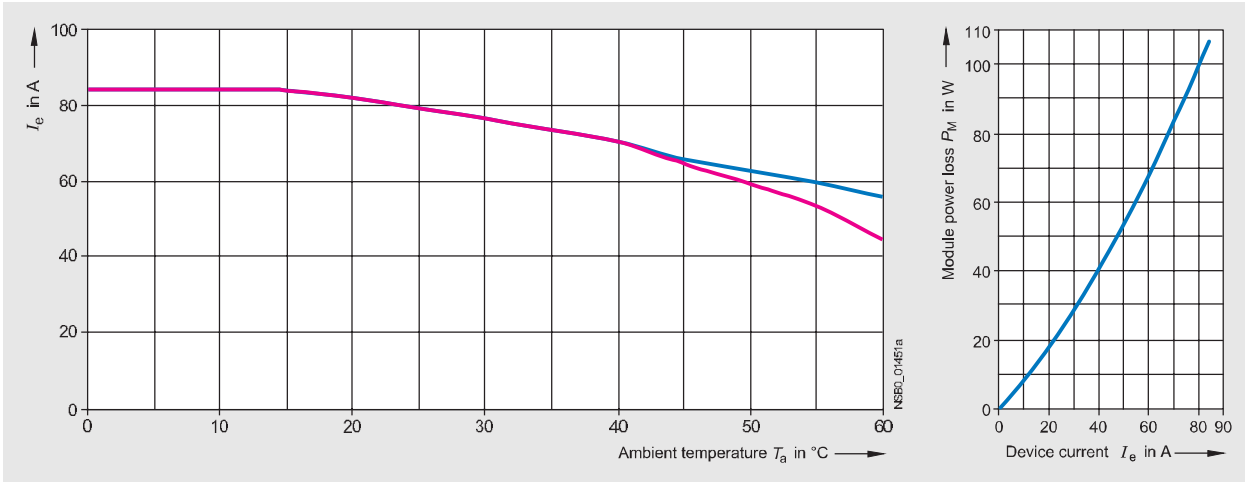


Type current 40 A (3RF23 40)[1)]

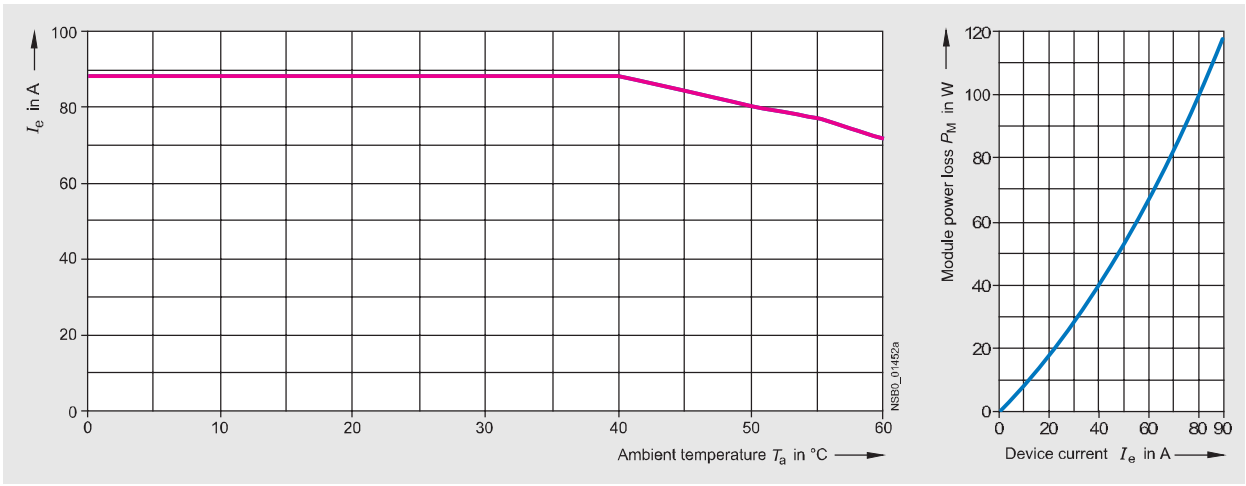


Type current 50 A (3RF23 50)[1)]

3RF23 solid-state contactors



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



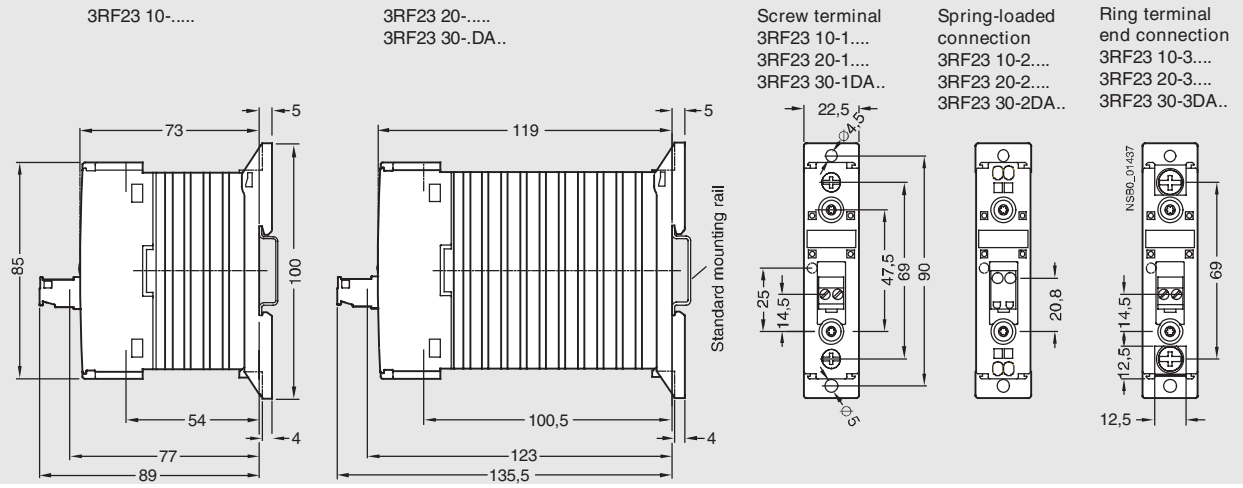
Type current 88 A (3RF23 90)[1)]

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

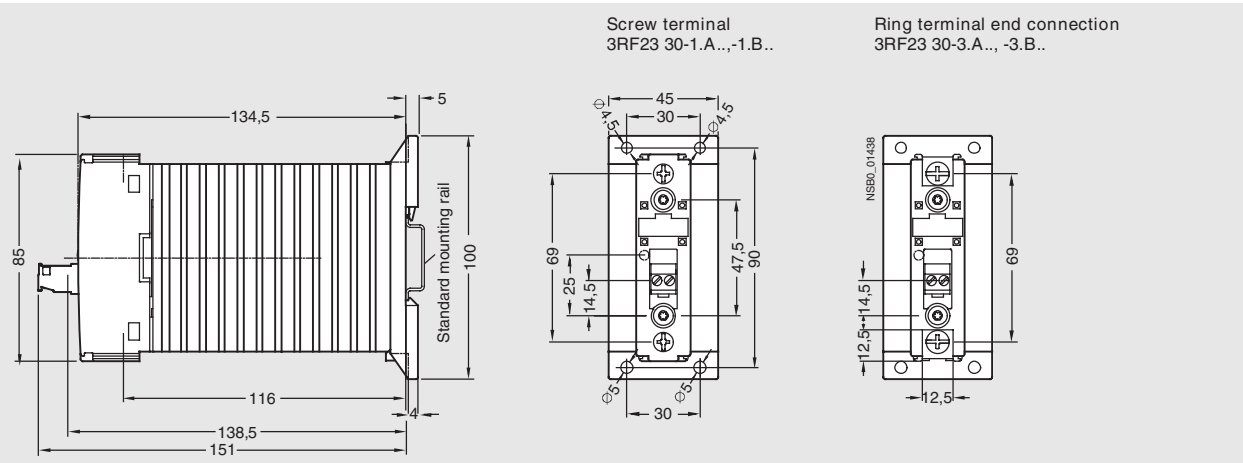
1) Identical current/temperature curves for stand-alone and side-by-side installation.

Dimensional drawings

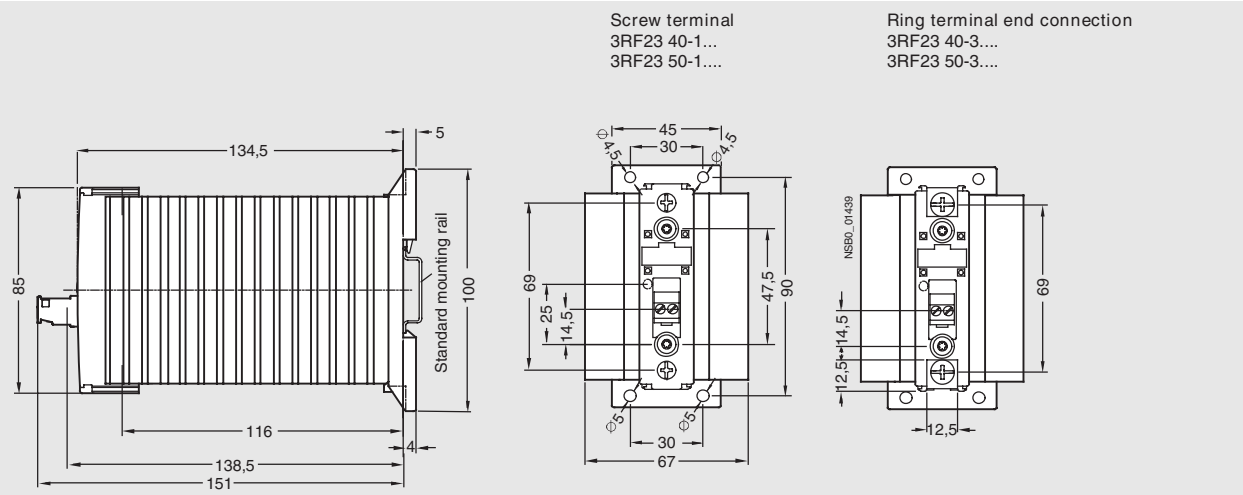
Type current 10.5 A and 20 A



Type current 30 A

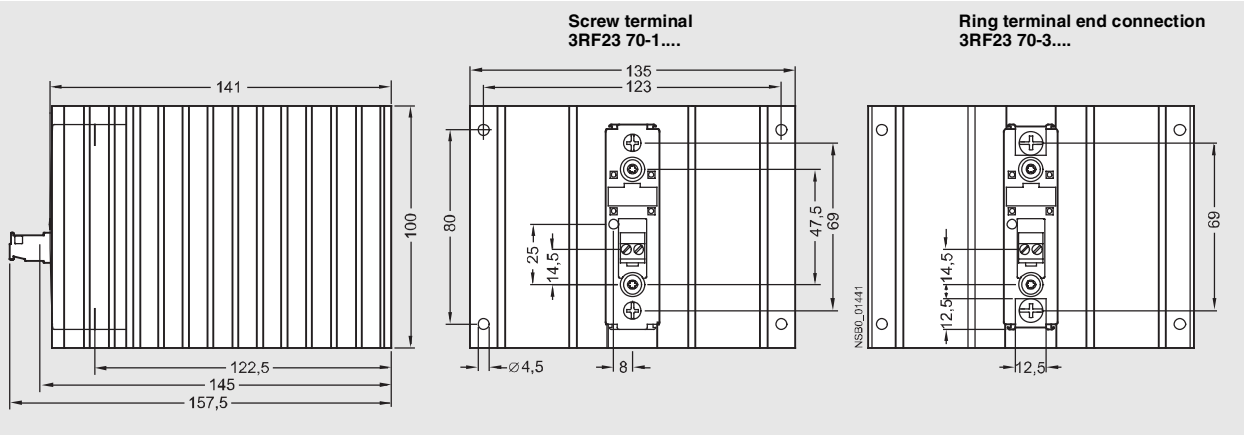


Type current 40 A and 50 A

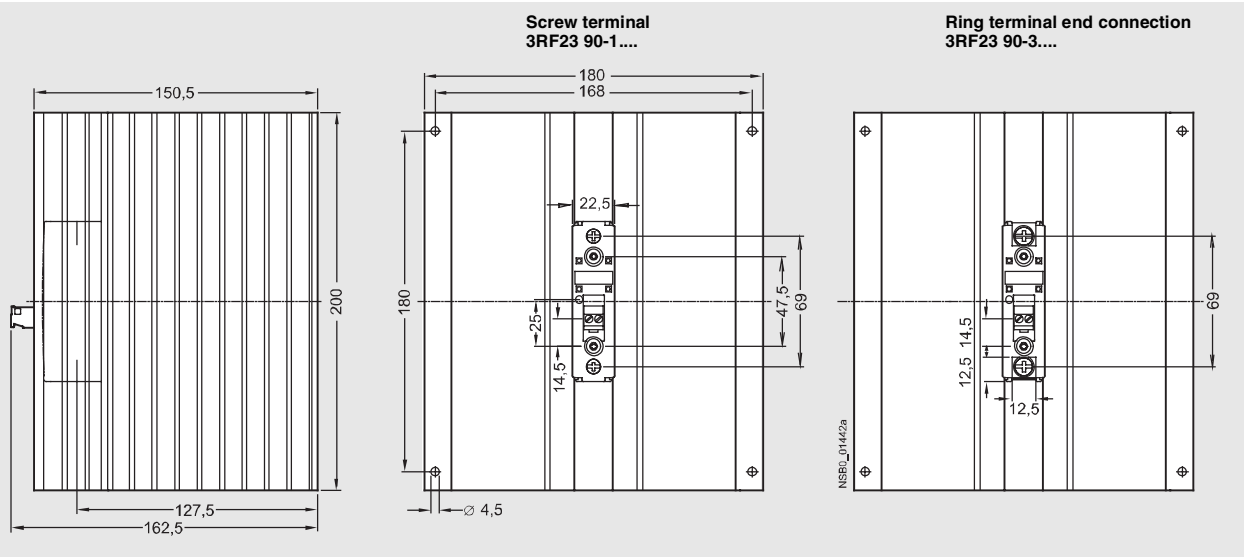


3RF23 solid-state contactors

Type current 70 A

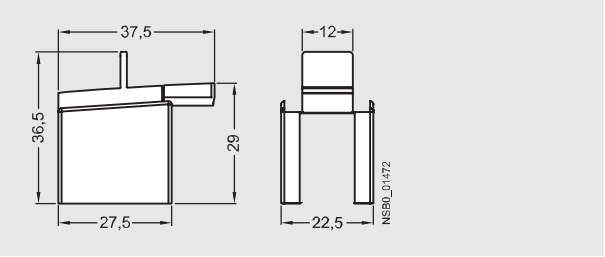


Type current 88 A



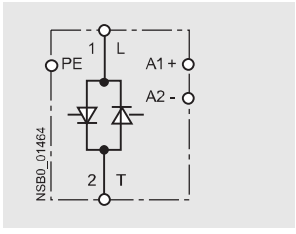
Terminal cover

3RF29 00-3PA88

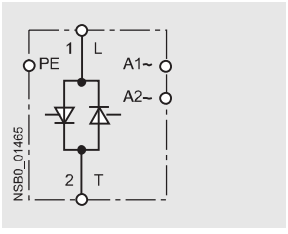


Schematics

Version
DC control supply voltage



Version
AC control supply voltage



Overview

Function modules for SIRIUS SC 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

Technical specifications

Type		3RF29 ..-.E...	3RF29 ..-.F...	3RF29 ..-.G...	3RF29 ..-.H...	3RF29 ..-.J...
General data						
Ambient temperature						
• During operation, derating from 40 °C	°C	-25 ... +60				
• During storage	°C	-55 ... +80				
Site altitude	m	0 ... 1000; derating from 1000				
Shock resistance According to IEC 60068-2-27	g/ms	15/11				
Vibration resistance According to IEC 60068-2-27	*g*	2				
Degree of protection		IP20				
Electromagnetic compatibility (EMC)						
• Emitted interference						
- Conducted interference voltage according to IEC 60947-4-3		Class A for industrial applications[1)]				
- Emitted, high-frequency interference voltage according to IEC 60947-4-3		Class A for industrial applications				
• Interference immunity						
- Electrostatic discharge according to IEC 61000-4-2 (corresponds to degree of severity 3)	kV	Contact discharge 4; air discharge 8; behavior criterion 2				
- Induced RF fields according to IEC 61000-4-6	MHz	0.15 ... 80; 140 dBµV; behavior criterion 1				
- Burst according to IEC 61000-4-4		2 kV/5.0 kHz; behavior criterion 1				
- Surge according to IEC 61000-4-5	kV	Conductor – ground 2; conductor – conductor 1; behavior criterion 2				
Connection, auxiliary/control contacts, screw terminal						
• 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	0.5 ... 0.6				
Converter, diameter of hole	mm	--	7	17		

1) Note limitations for power controller function module on

General data

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
• Tolerance	%	--		-15/+10	
• Rated frequency	Hz	--		50/60	
Rated insulation voltage U_i	V	--		600	
Voltage detection					
• 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 ..-.H..6	3RF29 ..-.J..3	3RF29 ..-.J..6
Main circuit					
Rated operational voltage U_e	V	110 ... 230	400 ... 600	110 ... 230	400 ... 600
• Tolerance	%	-15/+10			
• Rated frequency	Hz	50/60			
Rated insulation voltage U_i	V	600			
Voltage detection					
• 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	Hz	--	50/60	50/60
of the control supply voltage				
Actuating voltage, max.	V	30	30	121
Rated control current	mA	15	15	15
At maximum voltage				
Response voltage	V	15	15	90
• For tripping current	mA	2	2	2
Drop-out voltage	V	5	5	15

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

Type		3RF29 20-.H	3RF29 50-.H	3RF29 90-.H	3RF29 16-.J	3RF29 32-.J
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	

Overview

Converters for SIRIUS SC solid-state switching devices

These modules are used to convert analog drive 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

Installation

Easy snapping onto the 3RF21 solid-state relays or 3RF23 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 used on 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 to 9.9 V. At voltages below 0.1 V the connected switching device is not activated, while at voltages above 9.9 V the connected switching device is always activated.

Load monitoring and heating current monitoring

Overview

Load monitoring for SIRIUS SC 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 operating principle is based on permanent monitoring of the current intensity. 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 and heating current monitoring) 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

Installation

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 power 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. During this process the two lower (red[1]) LEDs flash alternately; simultaneous maintained 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.

LED	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 and heating current monitoring

Depending on the setting of the "response time" potentiometer, a deviation of at least 1/12 of the stored setpoint value – or 1/6 of the heating current monitoring – 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 and heating current 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 time delay. This means that the fault output is activated and the "Fault" ("Thyristor"[1]) LED lights up.

Supply fault

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

1) "Extended" load monitoring and heating current monitoring

Overview

Power controllers for SIRIUS SC solid-state switching devices

The following functions have been integrated:

- **Power control regulator with proportional-action control** for adjusting the power of the connected load. Here, the setpoint is set with a rotary knob on the module as a percentage with reference to the 100 % power stored as a setpoint. In this way the power is kept constant even in the event of voltage fluctuations or a change in load resistance.
- **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.

Application

The power controller adjusts the current in the connected load by means of a solid-state switching device depending on a setpoint. Changes in the mains voltage or in the load resistance are thus compensated by the power controller. The setpoint 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 by 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 by changing the current flow angle. In order to observe the limit values of the conducted interference voltage for industrial networks, a choke rated at at least 200 µH must be included in the load circuit.

Design

Installation

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 power connection. The cable to the load is simply pushed through and secured with the terminal screw.

Function

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 maintained 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.

Setpoint selection

The setting on the setpoint potentiometer (P) determines how the setpoint selection is to be made:

External setpoint selection

At 0 % 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 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.

Supply fault

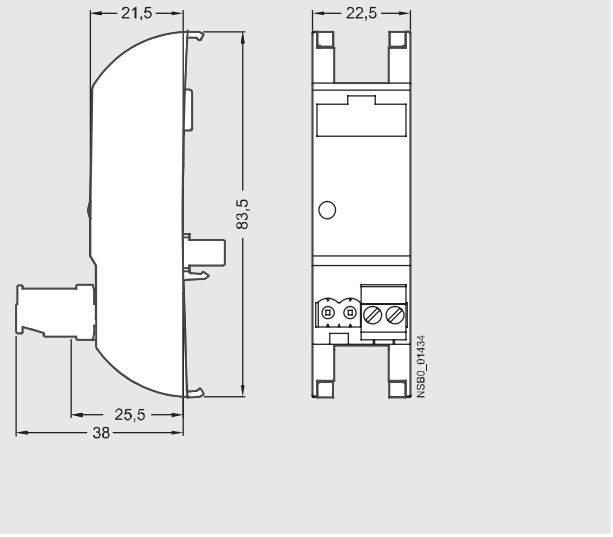
If no current is measured in the energized state, the device triggers a supply fault. The fault relay is activated and the "Supply" LED lights up.

Project planning aids

Dimensional drawings

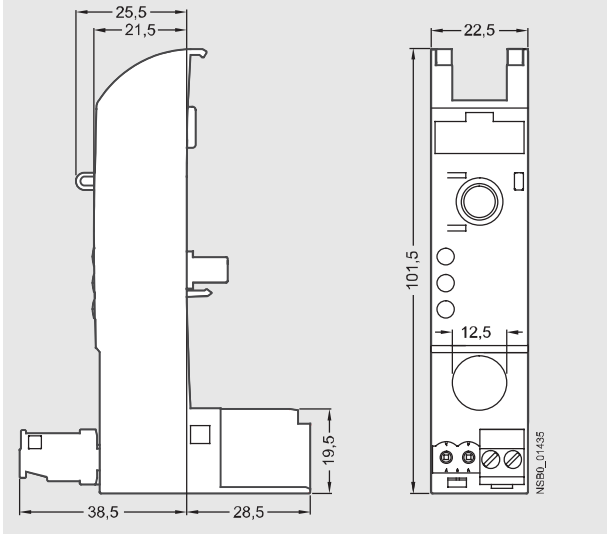
Converters

3RF29 00-0EA18



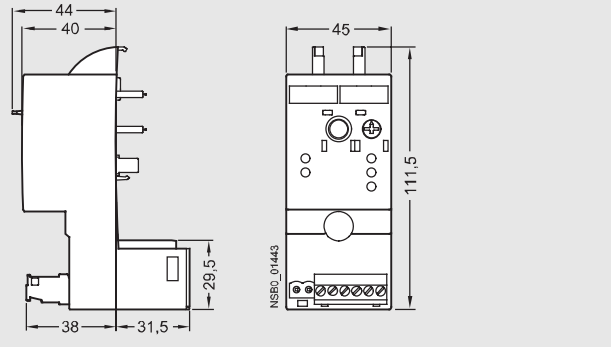
Basic load monitoring

3RF29 00-0FA08



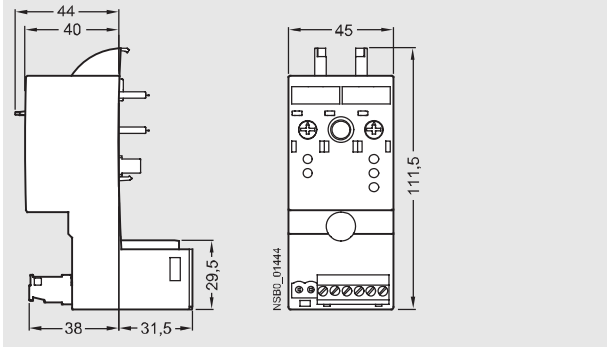
"Extended" load monitoring and heating current monitoring

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



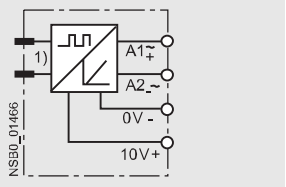
Power controllers

3RF29 ..-0HA..

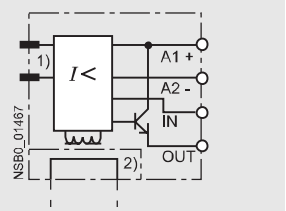


Schematics

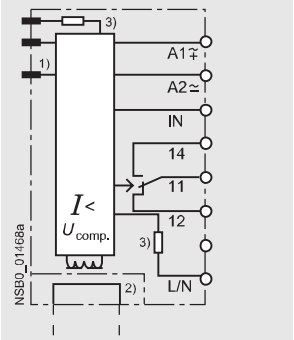
Converters



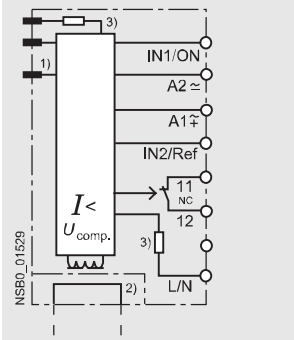
Basic load monitoring



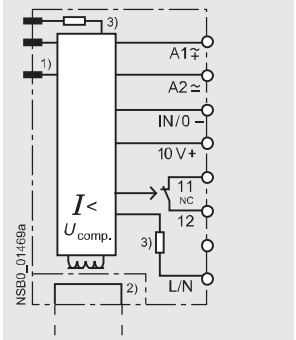
Extended load monitoring



Heating current monitoring



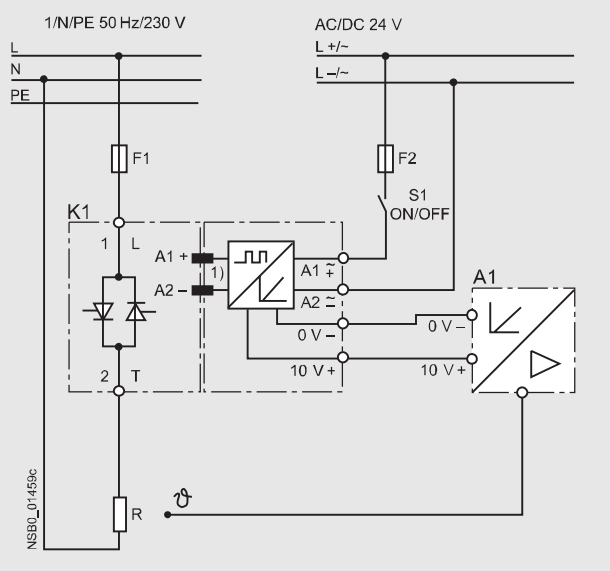
Power controllers



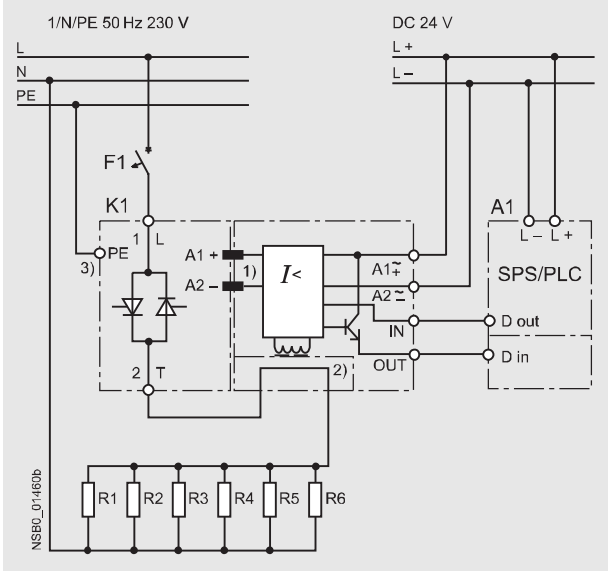
1) Internal connection.
2) Straight-through transformers.
3) Voltage detection not electrically isolated (3 MΩ per path).

Switching examples

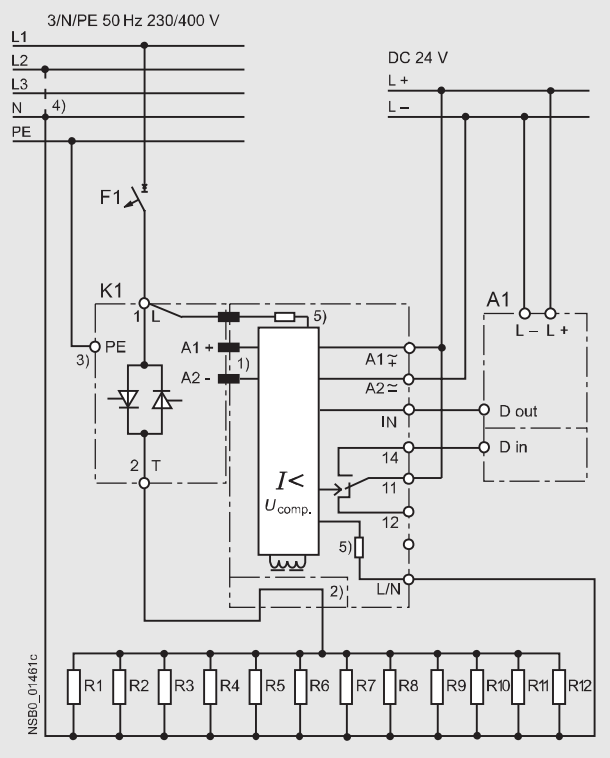
Converters



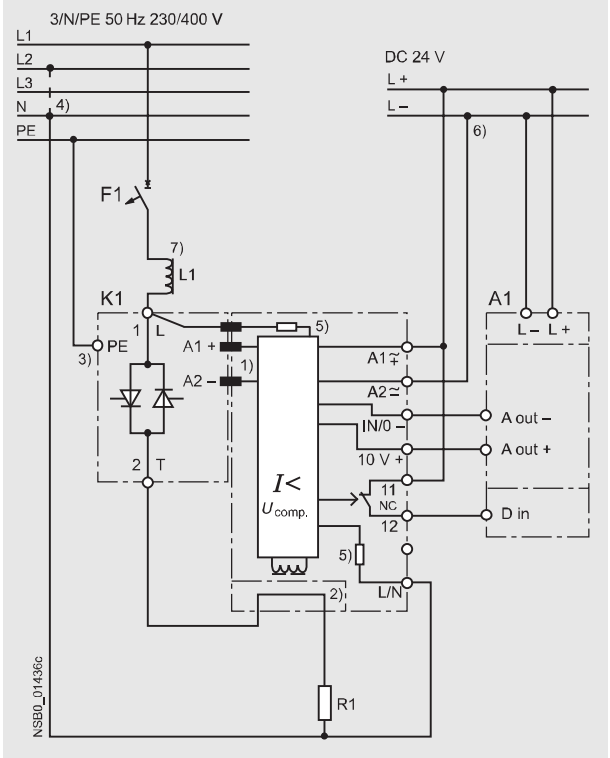
Basic load monitoring



Extended load monitoring



Power controllers



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:
- Load monitoring/power controller 3RF29 ..-0.A.**3** on neutral conductor N (e.g. 230 V),
- Load monitoring/pwoer controller 3RF29 ..-0.A.**6** on a second phase (e.g. 400 V).
5) Voltage detection not electrically isolated (3 MΩ per path).
6) Grounding of connection L- is recommended.
7) A 200 µH choke 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.

Notes