

Switching Devices – Soft Starters and Solid-State Switching Devices

Solid-State Switching Devices

Introduction



3RF21

3RF20

3RF22

3RF23

3RF24

3RF29

3RF34 (motor)

Article No.

Page

SIRIUS solid-state switching devices for switching resistive/inductive loads

Solid-state relays

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

6/72
6/77
6/81

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 Proof"

3RF23
3RF24

6/85
6/94

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

3RF2900-0EA18

6/105

Load monitoring

- For load monitoring of one or more loads (partial loads)

3RF29...-0FA08,
3RF29.0-0GA..

6/106

Heating current monitoring

- For load monitoring of one or more loads (partial loads); remote teach

3RF29...-0JA..

6/107

Power controllers

- For supplying the current by means of a solid-state switching device depending on a setpoint value. There is a choice of full-wave control and generalized phase control

3RF29...-0KA.

6/108

Power regulators

- 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..

6/109

SIRIUS solid-state switching devices for switching motors

Solid-state contactors

Solid-state contactors, solid-state reversing contactors

- Complete units in the insulated enclosure with integrated heat sink, "ready to use"
- Compact and space-saving design
- Version for motors, "instantaneous switching"

3RF34
3RF34

6/113
6/117

Solid-State Switching Devices for Resistive/Inductive Loads

Solid-State Contactors

General data

Overview

Solid-state contactors (with integrated heat sink)

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 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 systems. 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

Single-phase versions

The 3RF23 solid-state contactors 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 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 special version can be used in public networks up to 16 A without any additional measures such as interference suppressor filters. As a result, in terms of emitted interference, it conforms to limit value curve class B according to IEC 60947-4-3.

Special "Short-circuit proof" version

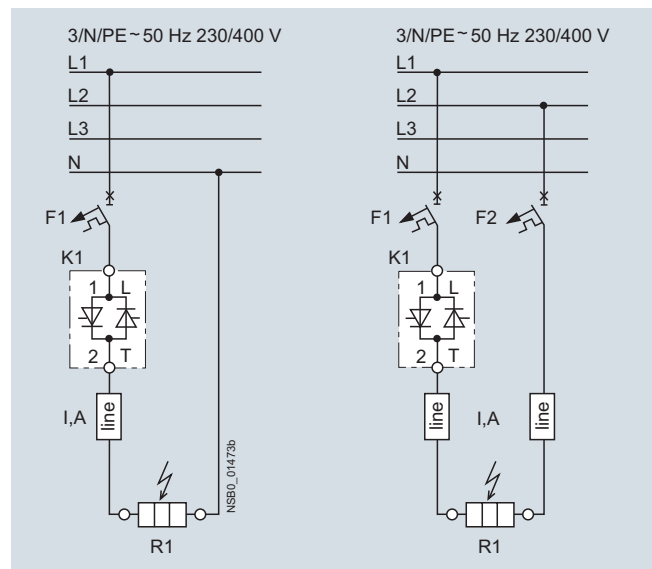
Skillful matching of the power semiconductor with the performance capacity of the solid-state contactor means that "short-circuit strength" can be achieved with a standard miniature circuit breaker. In combination with a B-type MCB or a conventional line protection fuse, the result is a short-circuit proof 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 B 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	1 mm ²	5 m
10 A	5SY4 110-6	1.5 mm ²	8 m
16 A	5SY4 116-6	1.5 mm ²	12 m
16 A	5SY4 116-6	2.5 mm ²	20 m
20 A	5SY4 120-6	2.5 mm ²	20 m
25 A	5SY4 125-6	2.5 mm ²	26 m

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



Solid-state contactor protection

The setup and installation above can also be used for the solid-state relays with a I^2t value of at least 6 600 A²s.

Three-phase versions

The three-phase solid-state contactors for resistive loads up to 50 A are available with

- Two-phase control (suitable in particular for circuits without connection to the neutral conductor) and
- Three-phase control (suitable for star circuits with connection to the neutral conductor or for applications in which the system requires all phases to be switched)

The converter function module can be snapped onto both versions for the simple power control of AC loads by means of analog signals.




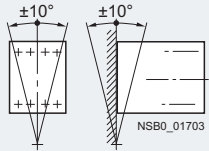
- Check the correct contactor size with the aid of the rated current diagram, taking account of the installation conditions

Solid-State Switching Devices for Resistive/Inductive Loads

Solid-State Contactors

SIRIUS 3RF24 solid-state contactors, three-phase

Technical specifications

Type	3RF24...-1....	3RF24...-2....	3RF24...-3....
Dimensions (W x H x D)	See page 6/95		
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 according to IEC 60947-4-3		Class A for industrial applications ¹⁾	
- Conducted interference voltage			
• 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 acc. to IEC 61000-4-4	kV	2/5.0 kHz; behavior criterion 2	
- 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 screws		M4	--
- Tightening torque	Nm	2 ... 2.5	
	lb.in	18 ... 22	
• Cable lugs		--	--
- According to DIN 46234			5-2.5 ... 5-25
- According to JIS C 2805			R 2-5 ... R 14-5
- Width, maximum	mm		12
Connection, auxiliary/control contacts			
• Conductor cross-section	mm	1 x (0.5 ... 2.5), 2 x (0.5 ... 1.0)	1 x (0.5 ... 2.5), 2 x (0.5 ... 1.0)
	AWG	AWG 20 ... 12	AWG 20 ... 12
• Stripped length	mm	7	7
• Terminal screw		M3	--
- Tightening torque,	Nm	0.5 ... 0.6	
∅ 3.5, PZ 1	lb.in	4.5 ... 5.3	
Grounding screw³⁾			
• Size (standard screw)		M5	
Permissible mounting position			
			

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. The versions 3RF24 ...-1AC55 comply with Class B for residential, business and commercial applications.

²⁾ If two different conductor cross-sections are connected to one clamping point, both cross-sections must lie in one of the ranges specified.

³⁾ The screw is not included in the scope of supply.

Solid-State Switching Devices for Resistive/Inductive Loads

Solid-State Contactors

SIRIUS 3RF24 solid-state contactors, three-phase

Type	Type current/ performance capacity ¹⁾ I_{AC-51} at 40 °C	Rated operational current I_e		Power loss at I_{AC-51}	Minimum load current	Max. off-state current	Rated peak withstand current I_{tsm}	I^2t value
	A	Acc. to IEC 60947-4-3 at 40 °C	Acc. to UL/CSA at 50 °C	W	A	mA	A	A ² s
Main circuit								
3RF2410-AB.5	10.5	7	7	23	0.1	10	200	200
3RF2420-AB.5	22	15	15	44	0.5	10	600	1800
3RF2430-AB.5	30	22	22	61	0.5	10	1200	7200
3RF2440-AB.5	40	30	30	80	0.5	10	1150	6600
3RF2450-AB.5	50	38	38	107	0.5	10	1150	6600
3RF2410-AC.5	10.5	7	7	31	0.5	10	300	450
3RF2420-AC.5	22	15	15	66	0.5	10	600	1800
3RF2430-AC.5	30	22	22	91	0.5	10	1200	7200
3RF2440-AC.5	40	30	30	121	0.5	10	1150	6600
3RF2450-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.

Type	Type current I_{AC-51}	Dimensions (W x H x D) (including heat sink)
	A	mm

Main circuit		
3RF2410-AB..	10.5	45 x 100 x 105
3RF2410-AC..		
3RF2420-AB..	22	67 x 100 x 112.5
3RF2420-AC..	22	89.5 x 100 x 112.5
3RF2430-AB..	30	

Type	Type current I_{AC-51}	Dimensions (W x H x D) (including heat sink)
	A	mm

Main circuit		
3RF2430-AC..	30	113.5 x 100 x 121
3RF2440-AB..	40	
3RF2440-AC..	40	157.5 x 100 x 121
3RF2450-AB..	50	
3RF2450-AC..	50	157.5 x 180 x 121

Type		3RF24...-AB.5	3RF24...-AC.5
Main circuit			
Controlled phases		2-phase	3-phase
Rated operational voltage U_e	V AC	48 ... 600	48 ... 600
• Operating range	V AC	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
Rate 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

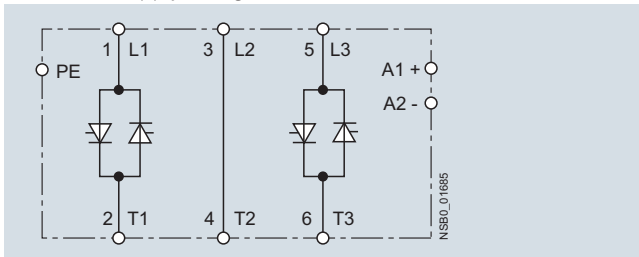
Solid-State Switching Devices for Resistive/Inductive Loads

Solid-State Contactors

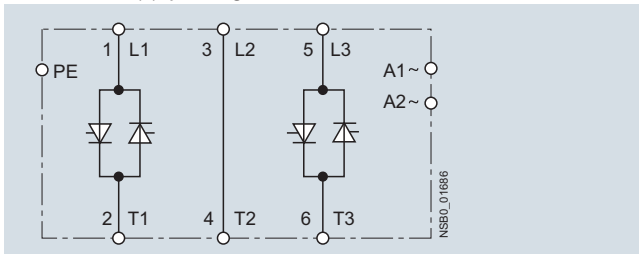
SIRIUS 3RF24 solid-state contactors, three-phase

Circuit diagrams

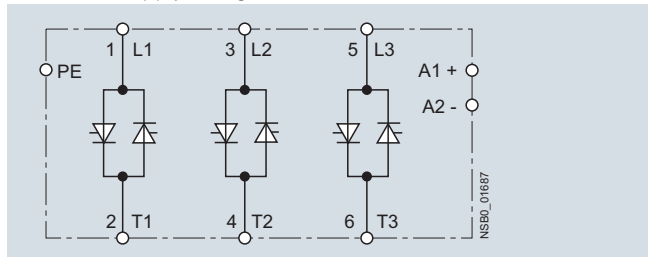
Two-phase controlled,
DC control supply voltage



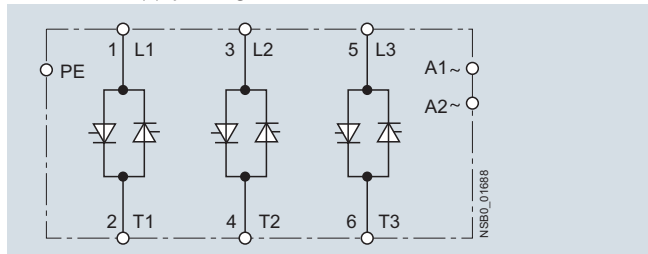
Two-phase controlled,
AC control supply voltage



Three-phase controlled,
DC control supply voltage



Three-phase controlled,
AC control supply voltage



6

Selection and ordering data

Type current/ performance capacity ¹⁾ I_{max}	Rated control supply voltage U_s	DT	Screw terminals	Configurator	PU (UNIT, SET, M)	PS*	PG
A	V						
			Article No.	Price per PU			

Zero-point switching · Integrated heat sink, rated operational voltage U_e 48 ... 600 V AC



3RF2420-1AB45

Two-phase controlled

10.5	4 ... 30 DC	A	3RF2410-1AB45	1	1 unit	41C
20		A	3RF2420-1AB45	1	1 unit	41C
30		A	3RF2430-1AB45	1	1 unit	41C
40		A	3RF2440-1AB45	1	1 unit	41C
50		A	3RF2450-1AB45	1	1 unit	41C
10.5	110 AC	B	3RF2410-1AB35	1	1 unit	41C
20		B	3RF2420-1AB35	1	1 unit	41C
30		B	3RF2430-1AB35	1	1 unit	41C
40		B	3RF2440-1AB35	1	1 unit	41C
50		B	3RF2450-1AB35	1	1 unit	41C
10.5	230 AC	B	3RF2410-1AB55	1	1 unit	41C
20		B	3RF2420-1AB55	1	1 unit	41C
30		A	3RF2430-1AB55	1	1 unit	41C
40		B	3RF2440-1AB55	1	1 unit	41C
50		B	3RF2450-1AB55	1	1 unit	41C



3RF2410-1AC45

Three-phase controlled

10.5	4 ... 30 DC	A	3RF2410-1AC45	1	1 unit	41C
20		A	3RF2420-1AC45	1	1 unit	41C
30		A	3RF2430-1AC45	1	1 unit	41C
40		A	3RF2440-1AC45	1	1 unit	41C
50		A	3RF2450-1AC45	1	1 unit	41C
10.5	110 AC	B	3RF2410-1AC35	1	1 unit	41C
20		B	3RF2420-1AC35	1	1 unit	41C
30		B	3RF2430-1AC35	1	1 unit	41C
40		B	3RF2440-1AC35	1	1 unit	41C
50		B	3RF2450-1AC35	1	1 unit	41C
10.5	230 AC	B	3RF2410-1AC55	1	1 unit	41C
20		B	3RF2420-1AC55	1	1 unit	41C
30		B	3RF2430-1AC55	1	1 unit	41C
40		B	3RF2440-1AC55	1	1 unit	41C
50		B	3RF2450-1AC55	1	1 unit	41C

Online configurator, see www.siemens.com/sirius/configurators.

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 characteristic curves, see page 6/70, "More Information".