

3.4 Accessories

Accessories for frame size S00

The accessories for contactors that switch motors and for control relays are of the same type. The accessories are attached at the front.

Accessories for frame sizes S0 to S3

The accessories are (with few exceptions) the same for frame sizes S0 to S3. They can be attached in different ways:

- Auxiliary switches can be attached at the front or the side.
- Surge suppressors can be attached at the top or the bottom.

The following graphic shows you **the accessories for the contactors and control relays that switch motors of frame size S00:**

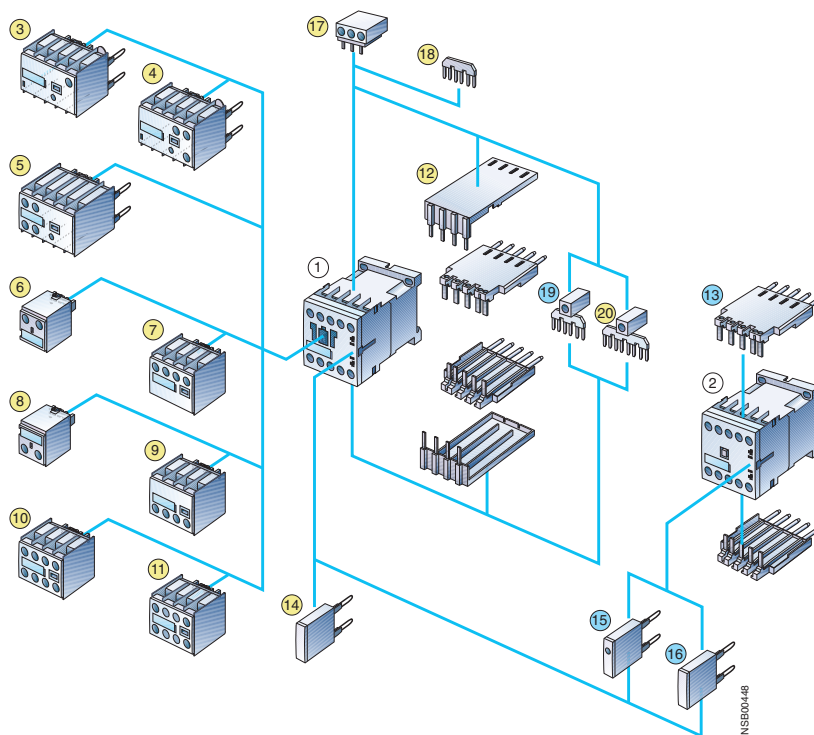


Fig. 3-35: Accessories for contactors of frame size S00

- 1 Contactor, frame size S00
- 2 Coupling relay
- 3 Solid-state time relay block, on-delay
- 4 Solid-state time relay block, off-delay
- 5 Auxiliary switch block, time-delay (on-delay or off-delay or wye-delta function)
- 6/7 1-pole auxiliary switch block, infeed from above or below
- 8/9 2-pole auxiliary switch block, infeed from above or below
- 10 4-pole auxiliary switch block (terminal markings in acc. with EN 50 012 or EN 50 005)
- 11 2-pole auxiliary switch block, standard or electronic type
- 12 Soldering pin adapter for contactors with 4-pole auxiliary switch block
- 13 Soldering pin adapter for contactors and contactor relays
- 14 Additional load module to increase the permissible residual current
- 15/16 Surge suppressor with and without LED
- 17 3-phase feed-in terminal
- 18 Parallel link (star-point link), 3-pole, without terminal
- 19 Parallel link, 3-pole, with terminal
- 20 Parallel link, 4-pole, with terminal

The following graphic shows you **the accessories for the control relays and contactor relays for auxiliary circuits of frame size S00**:

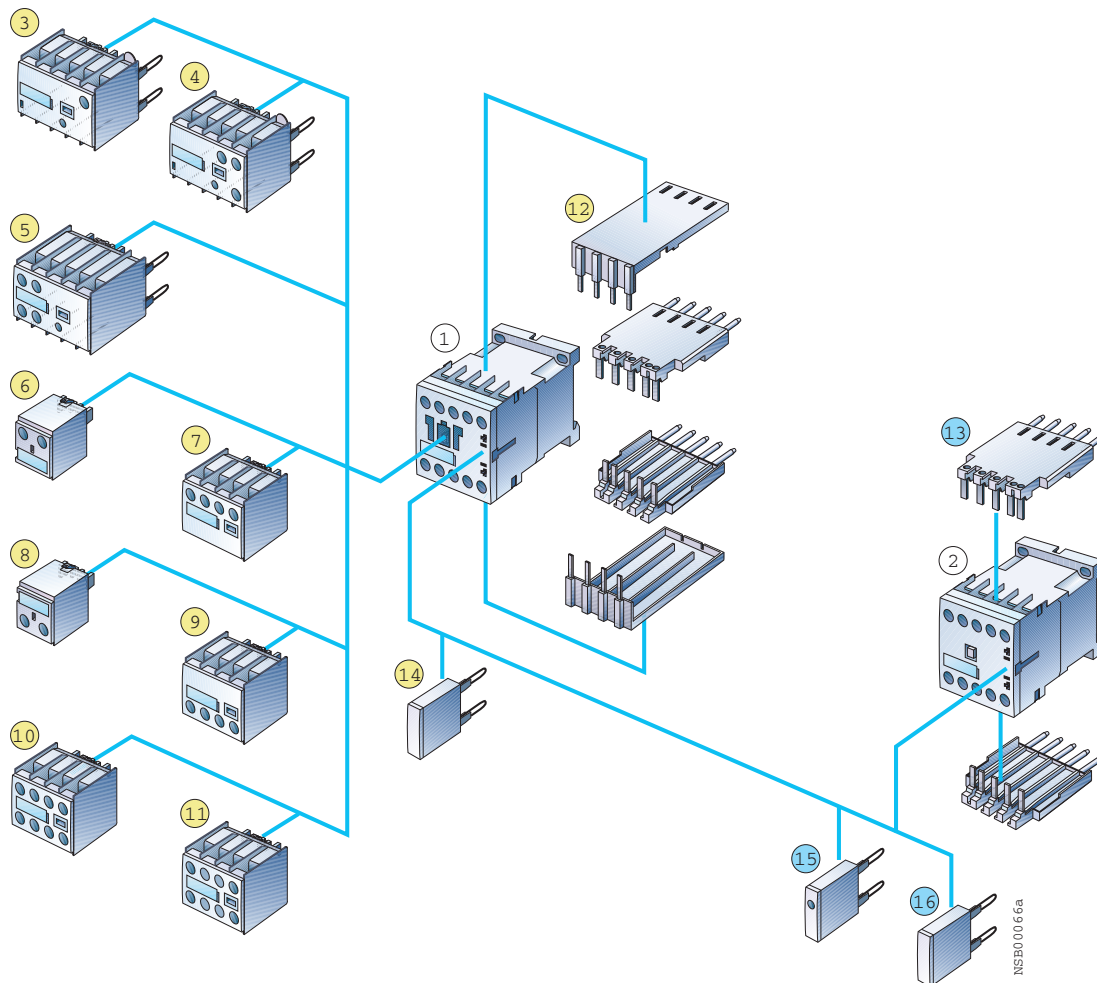


Fig. 3-36: Accessories for control relays/coupling relays of frame size S00

- 1 Control relay
- 2 Coupling relay for auxiliary circuits
- 3 Solid-state time relay block, on-delay
- 4 Solid-state time relay block, off-delay
- 5 Auxiliary switch block, time-delay (types: on-delay or off-delay)
- 6 1-pole auxiliary switch block, infeed from above
- 7 2-pole auxiliary switch block, infeed from above
- 8 1-pole auxiliary switch block, infeed from below
- 9 2-pole auxiliary switch block, infeed from below
- 10 4-pole auxiliary switch block (terminal markings in acc. with EN 50 011 or EN 50 005)
- 11 2-pole auxiliary switch block, standard or electronic type (terminal markings in acc. with EN 50 005)
- 12 Soldering pin adapter for control relays with 4-pole auxiliary switch block
- 13 Soldering pin adapter for control relays and contactor relays
- 14 Additional load module to increase the permissible residual current
- 15 Surge suppressor with LED
- 16 Surge suppressor without LED

The following graphic shows you **the accessories for the contactors of frame sizes S0 to S3**:

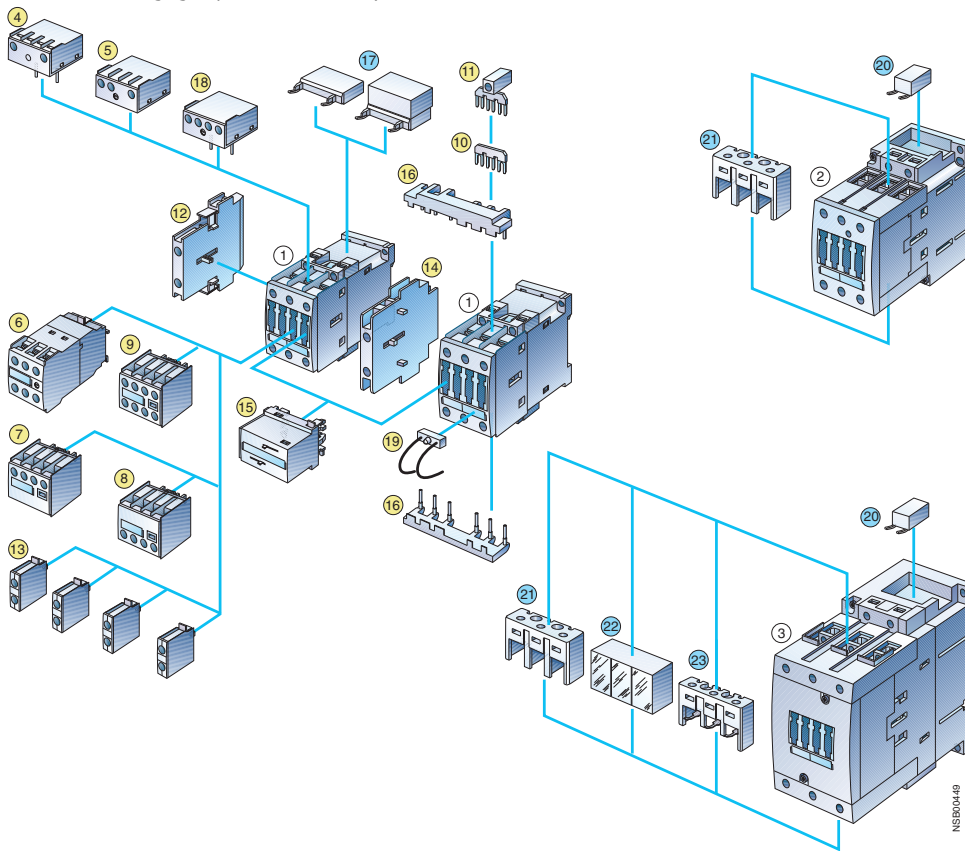


Fig. 3-37: Accessories for contactors of frame sizes S0 to S3

- 1 Contactor, frame size S0
- 2 Contactor, frame size S2
- 3 Contactor, frame size S3

For frame sizes S0 to S3:

- 4 Solid-state time relay block, on-delay
- 5 Solid-state time relay block, off-delay
- 6 Auxiliary switch block, time-delay (on-delay or off-delay or wye-delta function)
- 7 2-pole auxiliary switch block, infeed from above
- 8 2-pole auxiliary switch block, infeed from below
- 9 4-pole auxiliary switch block (Terminal markings in acc. with EN 50 012 or EN 50 005)
- 10 Parallel link (star-point link), 3-pole without terminal
- 11 Parallel link, 3-pole, with terminal
- 12 2-pole auxiliary switch block, attachable on the right or left side (Terminal markings in acc. with EN 50 012 or EN 50 005)
- 13 1-pole auxiliary switch block (a maximum of 4 can be snapped on)
- 14 Mechanical interlock, attachable at the side
- 15 Mechanical interlock, attachable at the front
- 16 Wiring modules above and below (reversing operation)
- 17 Surge suppressor (varistor, RC element, diode combination), attachable above or below (different for S0 and S2/S3)
- 18 Coupling link for direct attachment to the contactor coil
- 19 LED block to display the contactor function

For frame sizes S2 and S3 only:

- 20 Terminal for contactor coil for assembling contactor combinations
- 21 Terminal cover for box terminals

For frame sizes S3 only:

- 22 Terminal cover for lug connection and bar connection
- 23 Auxiliary connecting lead terminal, 3-pole

The following graphic shows you **the accessories for the contactors of frame sizes S6 to S12**:

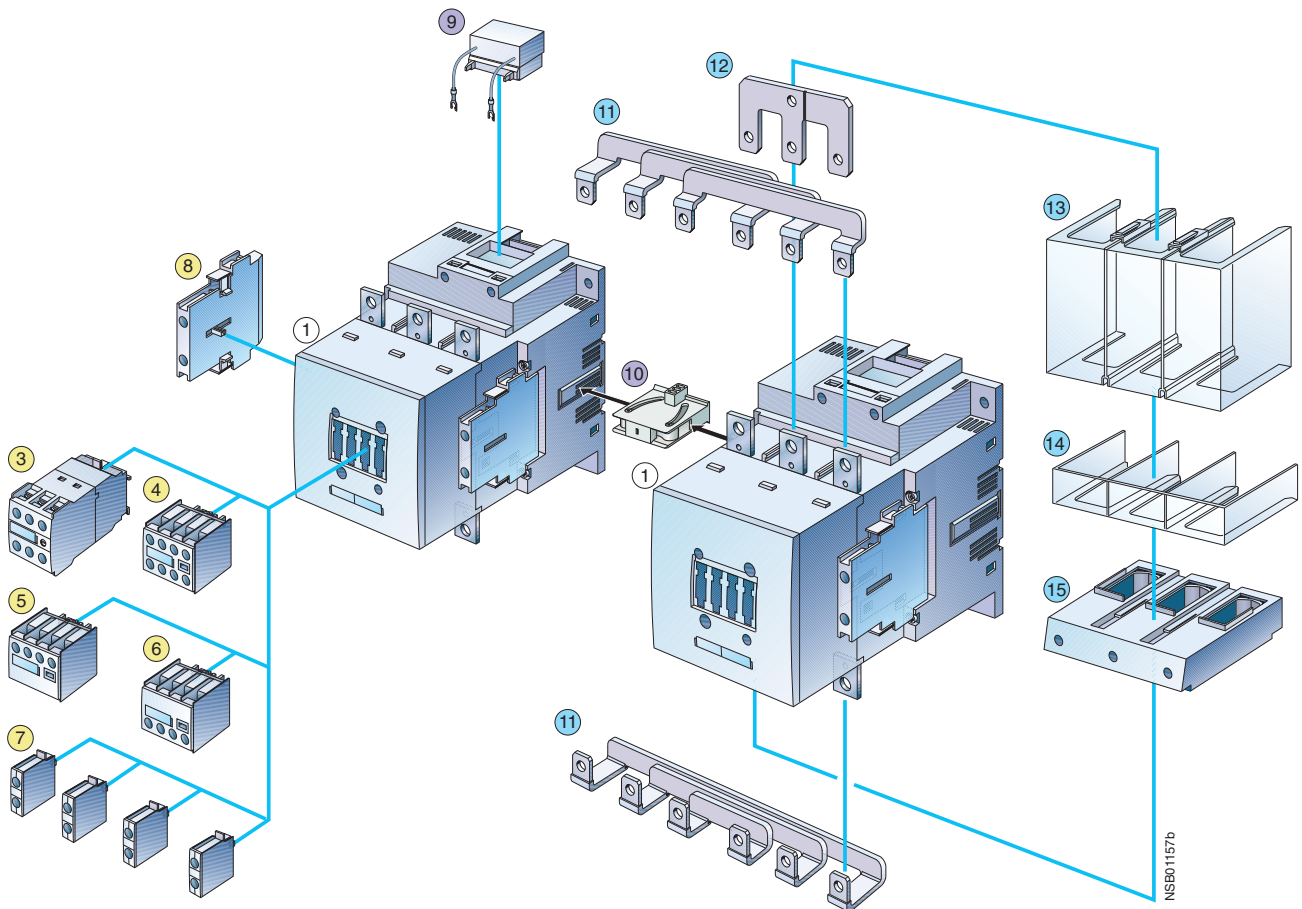


Fig. 3-38: Accessories for contactors of frame size S6 to S12

- 1** Air-break contactors 3RT10 and 3RT14, frame size S6, S10 and S12
 - 3** Auxiliary contact blocks, solid state time-delay (on- or off-delay or wye-delta function)
 - 4** 4-pole auxiliary contact block (terminal markings in acc. with DIN EN 50 012 or DIN EN 50 005)
 - 5** 2-pole auxiliary contact block, connection from above
 - 6** 2-pole auxiliary contact block, connection from below
 - 7** 1-pole auxiliary contact block (max. 4 can be snapped on) (terminal markings in acc. with DIN EN 50 012 or DIN EN 50 005)
 - 8** 2-pole side-mount auxiliary contact block, can be mounted on left or right side (terminal markings in acc. with DIN EN 50 012 or DIN EN 50 005)
 - 9** Surge suppressor (RC-element), for plugging into the top of the removable coil
 - 10** Mechanical interlock, side-mountable
 - 11** Wiring connectors (busbar) top and bottom (Reversing applications)
 - 12** Paralleling link (wye jumper), 3-pole, with through hole, vary per frame sizes S6 and S10/12
 - 13** Terminal cover for ring tongue- and busbar connection, vary per frame sizes S6 and S10/12
 - 14** Terminal cover for box terminals, vary per frame sizes S6 and S10/12
 - 15** Box terminals, vary per frame sizes S6 and S10/12
- 3 to 8:** Same accessories for frame sizes S0 to S12
9 and 10: Same accessories for frame sizes S6 to S12
11 to 15: Accessories vary depending on frame size

3.4.1 Attachable auxiliary switches for extending the auxiliary contacts

Integrated auxiliary contacts

Frame size S00

The contactors of frame size S00 have an auxiliary contact integrated in the basic unit.

Frame size S0 to S3

The contactors of frame sizes S0 to S3 do not have an integrated auxiliary contact in the basic unit.

Auxiliary switch blocks Formats

Auxiliary switch blocks for extending the auxiliary contacts are available with screw-type or Cage Clamp terminals to attach to contactors. They are available in the following formats:

- At the front: 1 to 4-pole for frame sizes S00 to S12
- At the side: 2-pole for frame sizes S0 to S12

Different auxiliary switch blocks can be added to the 3RT1 basic units, depending on the application:

The following can be snapped onto the front of the contactors:

- Frame sizes S00 to S12: a 4-pole auxiliary switch block
- or
- Frame sizes S0 to S12: up to four 1-pole auxiliary switch blocks

Frame sizes S0 to S12

If the depth of the installation space is limited, 2-pole auxiliary switches can be attached on the right and left side in frame sizes S0 to S12.

If 1-pole auxiliary switch blocks are used, note the location ID on the contactor.

1-pole/2-pole auxiliary switch blocks

1 or 2-pole auxiliary switch blocks that can be connected from above or below make the wiring simple and straightforward when setting up feeders. These auxiliary switch blocks are only available with a screw-type terminal. We recommend with the circuit breaker/MSP and contactor combination that you use auxiliary switch blocks that are connected from below. In the case of the contactor/overload relay combination, an auxiliary switch connected from above is more suitable.

Electronically optimized auxiliary switch blocks

The electronically optimized auxiliary switch blocks contain enclosed switching elements that are particularly suitable for switching low voltages and currents (hard gold-plated contacts) as well as for use in dusty atmospheres. The rated operational current is I_e /AC-14 and DC-13: 1 to 300 mA, voltage: 3 to 60 V.

The electronically optimized auxiliary switch blocks are available as screw-type or Cage Clamp terminal types:

- Frame size S00 (3RH1911-.NF.): Has two enclosed auxiliary contacts (1 NO contact + 1 NC contact, 2 NO or 2 NC contacts)
- Frame sizes S0 to S3 (3RH1921-.FE22): Has two enclosed auxiliary contacts and two standard auxiliary contacts, each 1 NO contact + 1 NC contact

The switched current is in acc. with the VDE 0435 regulation for relays.

Auxiliary contacts

The following table gives you an overview of all the available auxiliary contacts:

Auxiliary contacts and attachable accessories	Frame size S00	Frame sizes S0 to S12
Integrated auxiliary contact	1 integrated auxiliary contact	—
4-pole auxiliary switch	Attachable at the front	Attachable at the front
2-pole auxiliary switch	Attachable at the front	—
1-pole auxiliary switch	—	Attachable at the front
1-pole auxiliary switch (infeed from 1 side)	Attachable at the front	—
2-pole auxiliary switch (infeed from 1 side)	Attachable at the front	Attachable at the front
2-pole auxiliary switch	—	Attachable at the side
Time-delay auxiliary switch blocks	Attachable at the front	Attachable at the front
Electronically optimized auxiliary switches	Attachable at the front	Attachable at the front

Table 3-33: Auxiliary contact blocks

Adding to the auxiliary contacts

- The basic units of frame size S00 possess an integrated auxiliary contact and can be supplemented with up to 4 contacts using attachable auxiliary contacts.
- The basic units of frame sizes S0 to S3 do not have any auxiliary contacts, but auxiliary switches can be attached at the front or the side.
- Contactors of frame sizes S6 to S12 come with side mounted 2-pole auxiliary contact blocks:
 - Air-break and vacuum contactors with conventional / electronic coil: 2NO + 2NC
 - Air-break contactor with remaining lifetime indicator: 1NO + 1NC

They can accept additional side (for air-break and vacuum contactors) or front mount (only for air-break contactors) auxiliary contact blocks. For max. number of auxiliary contacts see topic, "Maximum number of auxiliary contacts".

The following table shows you the expansion options for the different frame sizes:

Frame size	Auxiliary switch block	Connection
S00	1, 3 and 4-pole (attachable at the front)	Screw-type/Cage Clamp terminal
	Feeder auxiliary switch (attachable at the front): <ul style="list-style-type: none"> • 1-pole (1 NO or 1 NC contact) • 2-pole (1 NO + 1 NC or 2 NO contacts) Infeed from above or below possible	Screw-type terminal
S0 to S12	1, and 4-pole (attachable at the front) 2-pole (attachable at the side)	Screw-type/Cage Screw-type terminal Clamp terminal
	Feeder auxiliary switch (attachable at the front): <ul style="list-style-type: none"> • 2-pole (1 NO + 1 NC contact) • 2-pole (2 NO or 2 NC contacts) Infeed from above or below possible	Screw-type terminal

Table 3-34: Expansion options for auxiliary contact blocks

Front mount Auxiliary contacts

Auxiliary contacts that can be attached at the front are hooked into the opening of the contactors and pulled down until they snap into place. They can be removed using the release lever in the middle.

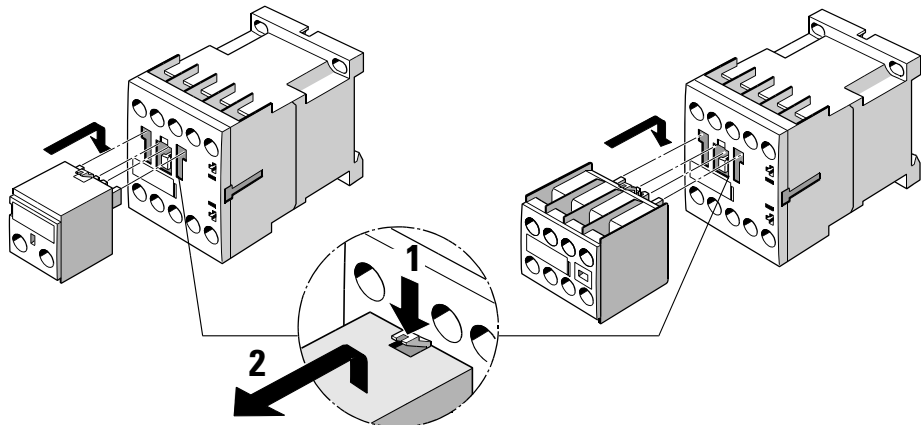


Fig. 3-39: Front mount auxiliary contacts

Auxiliary switches at side (S0 to S12)

The auxiliary switches are hooked onto the left or right side of the contactor and snapped onto it. They are removed again by pressing the ribbed surfaces.

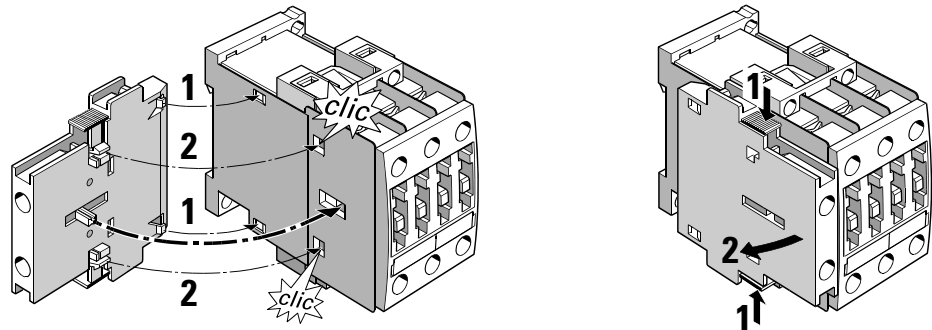


Fig. 3-40: Side mount auxiliary contacts

Note

When you use two 2-pole, side mount auxiliary contacts, you must attach an auxiliary switch block on the left and right in the interests of symmetry.

Maximum number of auxiliary contacts

The following table shows you the maximum number of auxiliary switches and their combination options:

Frame size S0 and S2 (3RT102./3RT103.)



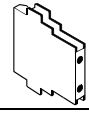
1 auxiliary contact element	4 auxiliary contact elements	2 auxiliary contact elements	A maximum of 4 auxiliary contacts can be attached, and you can use any type of auxiliary switch. When you use two 2-pole, auxiliary switch blocks at the side, you must attach a block on the left and right in the interests of symmetry. In some situations, it is permissible to have more auxiliary contacts in frame size S2 (for more details, please contact Technical Assistance).
			
max. 4	0	0	
max. 2	0	1	
0	1	0	
0	0	1+1	

Table 3-35: Possible auxiliary contact combinations (frame sizes S0/S2)

Frame size S3 (3RT104./3RT14)



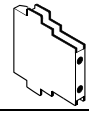
1 auxiliary contact element	4 auxiliary contact elements	2 auxiliary contact elements	A maximum of 8 auxiliary contacts can be attached. Please note the following: Of these 8 auxiliary contacts, a maximum of four can be NC contacts. Symmetry must be preserved in the case of auxiliary switch blocks attached at the side.
			
4	0	1+1	
0	1	1+1	
0	0	2+2	

Table 3-36: Possible auxiliary contact combinations (frame sizes S3 to S12)

Frame sizes S6 to S12 (3RT10/3RT12/3RT14)

Operation type	Contactor type	at operational range listed below	
		0.8 x U _{Smin}	0.85 x U _{Smin}
conventional 3RT1...-A	Air-break contactors 3RT10/14	8, of which 4 NC max.	9, of which max 6 NC
	Vacuum contactors 3RT12	8, of which 4 NC max.	8, of which max 6 NC
electronic 3RT1...-N	Air-break/Vacuum contactors	8, of which 4 NC max.	
with RLT 3RT1...-P/Q	Air-break contactors 3RT10/14	8, of which 4 NC max.	

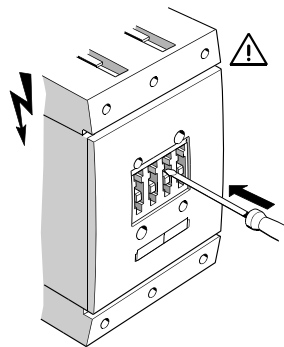
Table 3-37: Maximum number of auxiliary contacts

Note to the mounting of auxiliary contacts on S6 to S12

With using the mechanical interlock 3RA1954-2A:

- for contactors with conventional / electronic coil 3RT1...-A/N: an additional auxiliary contact block can be mounted between the contactors
- for contactors with remaining lifetime indicator RLT 3RT1...-P/Q: the left mounted auxiliary contact block of the right contactor must be removed.

Manual activation of the auxiliary contacts with S6 to S12



3RT10/14 air-break contactors can be activated for test purposes of the side mounted auxiliary contact by pushing the front side auxiliary contact fixture/contact position indicator. By doing this the main contacts would also touch, without resulting in contact resilience.

Attention

It must be certain that power to the contactor is disconnected!

Contactors with 4 main contacts and capacitor-switching contactors

	S00	S0	S2/S3
Contactors with 4 main contacts	4 auxiliary contacts	Maximum of 2 auxiliary contacts (attached at the side or snapped on at the top)	Maximum 4 auxiliary contacts (attached at the side or snapped on at the top)
Capacitor-switching contactors	An additional 2-pole auxiliary switch block on each side (3RH1921-1EA...: 2 NO, 2 NC or 1 NO + 1 NC contact)		

Table 3-38: Possible auxiliary switch combinations with 4-pole/capacitor-switching contactors

Switching of the auxiliary contact elements

With the standard type of auxiliary switch, when the contactors are switched on, first the NC contacts are opened and then the NO contacts are closed.

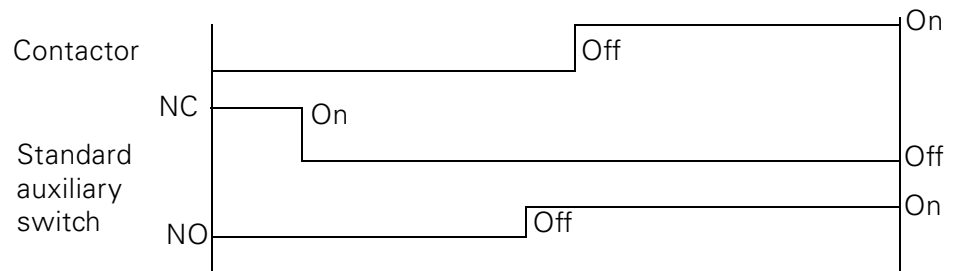


Fig. 3-41: Switching of the auxiliary contact elements

Auxiliary contact elements with make-before-break contacting

The following table shows Auxiliary contact elements with make-before-break contacting:

S00	Auxiliary switch type	S0 - S12	Auxiliary switch type
3RH1911-.FC22	22U, 2 NO + 2 NC contacts Screw-type/Cage Clamp terminal	3RH1921-.FC22	22U, 2 NO + 2 NC contacts Screw-type/Cage Clamp terminal
3RH1911-.FB11	11U, 1 NO + 1 NC contact Screw-type/Cage Clamp terminal		
3RH1911-.FB22	11/11U. 1 NO+1 NC+1PS ¹⁾ +1lagging NC ²⁾ contact Screw-type/Cage Clamp terminal		
		3RH1921-1CD01	1 NO contact, leading Screw-type terminal
		3RH1921-1CD10	1 NC contact, lagging Screw-type terminal

Table 3-39: Auxiliary switches with make-before-break contacting

- 1) Leading NO contact
- 2) Lagging NC contact

3.4.1.1 Terminal markings of the contactors frame sizes S00 to S12

In contactors of frame size S00 with an integrated auxiliary contact, the terminal marking complies with EN 50 012. This also applies to contactors that are available as complete devices, frame sizes:

- S0 to S3 with mounted auxiliary contact blocks 2 NO + 2 NC
- S6 to S12 with side mounted auxiliary contact blocks 2 NO + 2 NC

Expanding the contactors of frame size S00

All the contactors of frame size S00 (3 and 4-pole) can be expanded with auxiliary switch blocks with the identification numbers 40 to 02 in acc. with EN 50 005 as follows:

- Frame size S00 with an integrated auxiliary contact (identification number 10E or 01) for contactors with 3 or 5 auxiliary contacts
- Frame size S00 with 4 main contacts for contactors with 2 or 4 auxiliary contacts

Note

The identification numbers on the auxiliary switch blocks only apply to the attached auxiliary switches.

Expanding the contactors with 1 integrated NO contact, S00 (3RT101.-...01)

Contactors with one NO contact as an auxiliary contact with screw-type or Cage Clamp terminals, identification number 10E, can be expanded with auxiliary switch blocks with terminal markings in acc. with DIN EN 50 012 for contactors with 2, 4, and 5 auxiliary contacts. The terminal markings of the complete contactors comply with EN 50 012. The identification numbers 11E, 22E, 23E, and 32E on the auxiliary switch blocks apply to the complete contactors.

Important

Auxiliary switch blocks in acc. with EN 50 012 can only be combined with contactors of frame size S00 that have 1 NO contact in the basic unit because they are coded. These auxiliary switch blocks cannot be combined with contactors that have an NC contact in the basic unit (identification number 01).

Auxiliary contacts S00

The following graphic shows you the auxiliary contacts that can be used to expand the contactors of frame size S00 (terminal marking in acc. with EN 50 012 or EN 50 005):

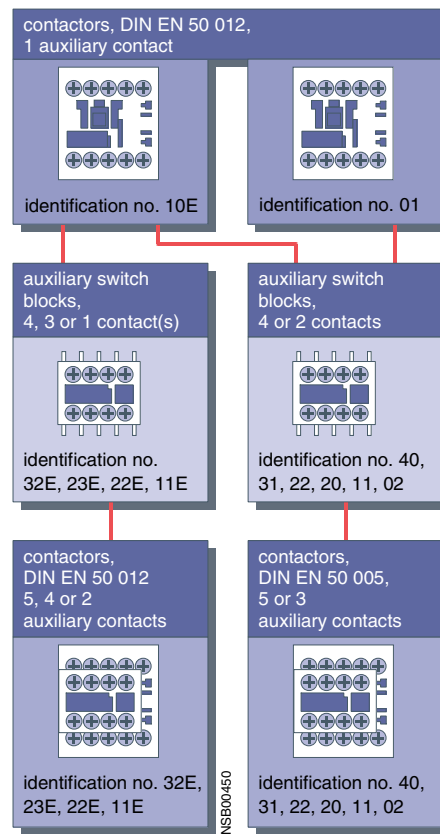


Fig. 3-42: Auxiliary contacts, contactors for switching motors (frame size S00)

Expanding the contactors of frame sizes S0 to S12

With contactors of frame sizes S0 to S3, you can also attach 1-pole auxiliary switch blocks instead of 4-pole auxiliary switch blocks.

The terminal markings of the 1-pole auxiliary switch blocks consist of sequence numbers (location ID) on the basic unit and function numbers on the auxiliary switch blocks.

**Auxiliary contacts
S0 to S12**

The following graphic shows you the front mount auxiliary contacts that can be used to expand the contactors of frame sizes S0 to S3 (terminal marking in acc. with EN 50 005 or EN 50 012):

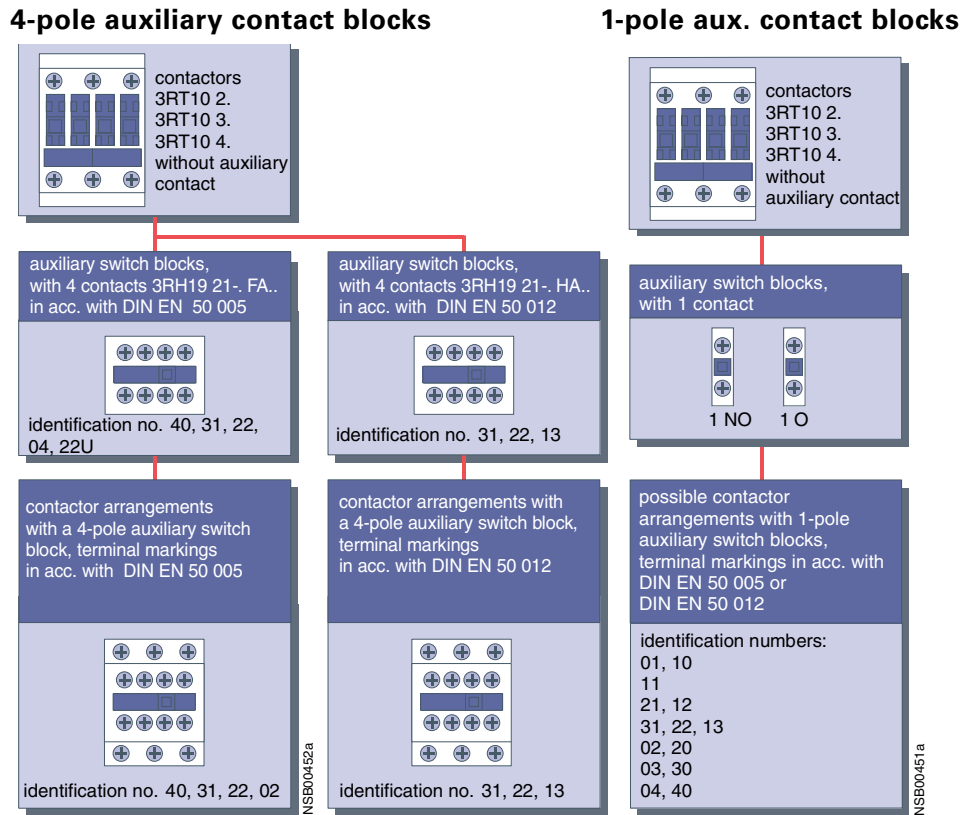


Fig. 3-43: Auxiliary contacts for contactors for the switching of motors (frame sizes S0 to S12)

3.4.1.2 Terminal markings of the contactors and control relays combined with auxiliary switch blocks

Terminal markings in acc. with DIN EN 50 005

The terminal markings for contactors are defined in EN 50 005 that contains general directives. The following summarizes the basic rules that apply to switching elements of auxiliary circuits:

- The terminals of auxiliary contact elements are designated by two-digit numbers.
- The digit in the unit place is a function number (NC contact: 1 and 2, NO contact: 3 and 4).
- The digit in the tens place is a sequence number (all the switching elements of the same function must have different sequence numbers).

Identification numbers (DIN EN 50 005)

The identification numbers mean: Switching devices with a fixed number of auxiliary contact elements (NO contacts or NC contacts) can be assigned a two-digit identification number. The first digit represents the number of NO contacts and the second one the number of NC contacts. There is no information on the sequence of NO contacts and NC contacts in the contactor/control relay.

Note

The identification numbers on the auxiliary switch blocks only apply to the attached auxiliary switches.

**DIN EN 50 012/
DIN EN 50 011**

For certain equipment such as auxiliary contact elements of contactors and control relays, the EN 50 012 and EN 50 011 standards also apply. The EN 50 012 defines the terminal markings and identification numbers for auxiliary contact elements of particular contactors. The terminal markings of the auxiliary contact elements match the terminal markings of corresponding control relays with the ID letter E (in acc. with EN 50 011). For auxiliary contact elements of contactors with the same identification number, the terminal marking must correspond to the sequence defined in the standard.

Graphical symbols for auxiliary contact elements

Below are some examples of graphical symbols for auxiliary contact elements of contactors that comply with EN 50 012:

Coil	Main contact elem.	ID no	Auxiliary contact elements	ID no	Auxiliary contact elements	ID no	Auxiliary contact elements
		31		22		13	
		41		32		23	

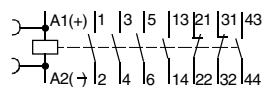
Fig. 3-44: Graphical symbols for auxiliary contact elements in acc. with EN 50 012 (excerpt)

Device circuit diagrams

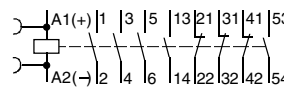
The following device circuit diagrams of the auxiliary switch blocks for contactors that switch motors contain the terminal markings in acc. with EN 50 012:

3RT101 Contactor (Frame size S00)

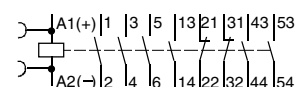
2NO + 2NC contacts
ID number: 22E



2NO + 3NC contacts
ID number: 23E

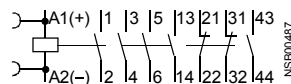


3NO + 2NC contacts
ID number: 32E



3RT102 contactors to 3RT107, 3RT12, 3RT14 (Frame sizes S0 to S12)

2NO + 2NC contacts
ID number: 22



4-pole Front mount auxiliary contact blocks 3RH1921-1HA/1XA...r

3NO + 1NC contacts 2NO+ 2NC contacts 2NO+ 2NC contacts 1NO + 3NC contacts
ID number: 31E ID number: 22 ID number: 22 ID number: 22

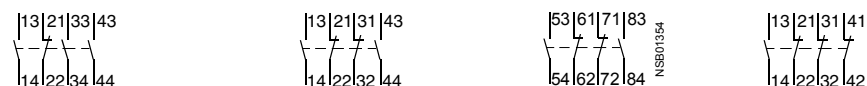


Fig. 3-45: Device circuit diagrams of the auxiliary switch blocks (DIN EN 50 012)

3.4.1.3 Auxiliary switches that can be attached to 3RH1 control relays

The 3RH1 control relays can be expanded by up to 4 contacts using attachable auxiliary switch blocks.

**Definition:
DIN EN 50 011**

The main standard for the designation of switching elements for the control relays is EN 50 011, which defines the terminal markings, identification numbers, and identification letters of certain control relays using a specific sequence of the switching elements. The number, type, and position of the switching elements must be specified using an identification number followed by an identification letter.

In the case of 8-pole control relays, the letter "E" means that four NO contacts have to be arranged on the lower (rear) contact level.

Expansion using auxiliary switch blocks

The following example of an control relay with 4 NO contacts (contact designation in acc. with EN 50 011 and EN 50 005) explains how auxiliary switch blocks are added on:

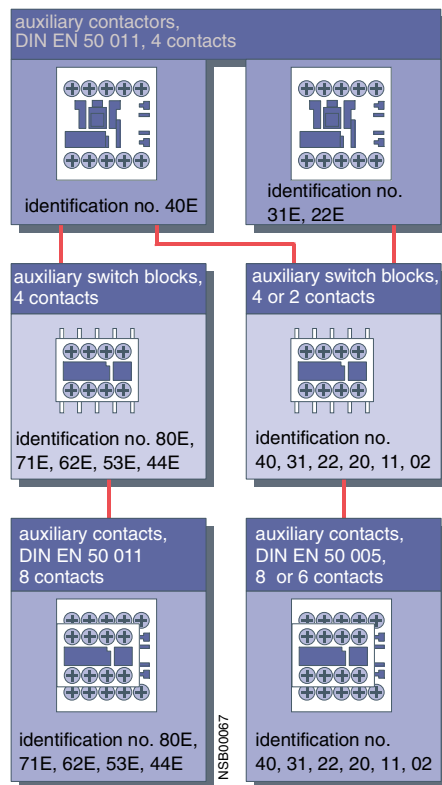


Fig. 3-46: Auxiliary contacts for control relays

Contact designation

Auxiliary switch blocks - for example, 3RH1911-1GA22 (2 NO + 2 NC contacts) in acc. with EN 50 011 - can only be attached to control relays with 4 NO contacts (3RH1140-.....) because they are coded. The identification number (62E) printed on the auxiliary switch block (6 NO + 2 NC contacts) applies to the whole contactor.

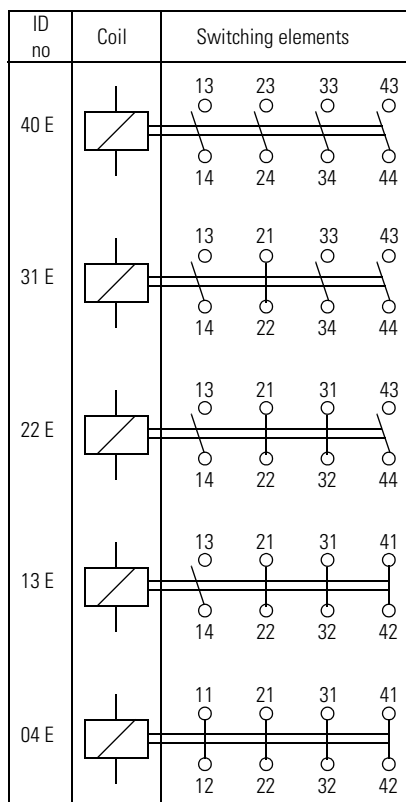
NO and NC contacts are in the same position on all the control relays with the identification number 62E (DIN EN 50 011).

This means contactors can be replaced without changing the wiring, which therefore makes wiring very easy. You can attach auxiliary switch blocks that comply with EN 50 005 on all 3RH11 control relays and 3RT101 motor contactors. For example, the 3RH1911-1FA22 auxiliary switch block (2 NO + 2 NC contacts) has the identification number 22, and this only applies to the attached auxiliary switch block.

Graphical symbols of the control relays

Below are some examples of graphical symbols for control relays with the identification letter E that comply with EN 50 011:

4-pole control relays



8-pole control relays

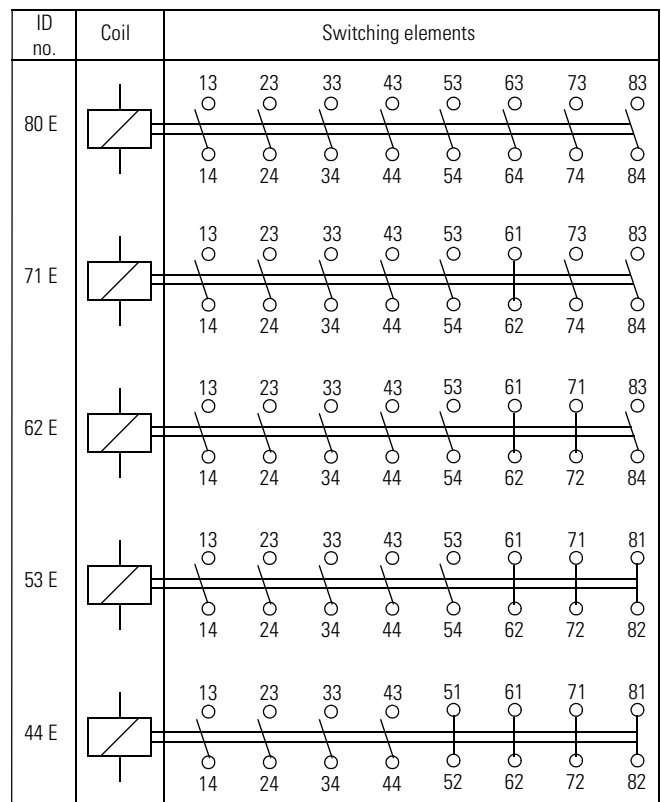


Fig. 3-47: Graphical symbols for auxiliary contactors (control relays) in acc. with EN 50 011 (excerpt)

Device circuit diagrams The following device circuit diagrams of the control relays contain terminal markings in acc. with EN 50 011:

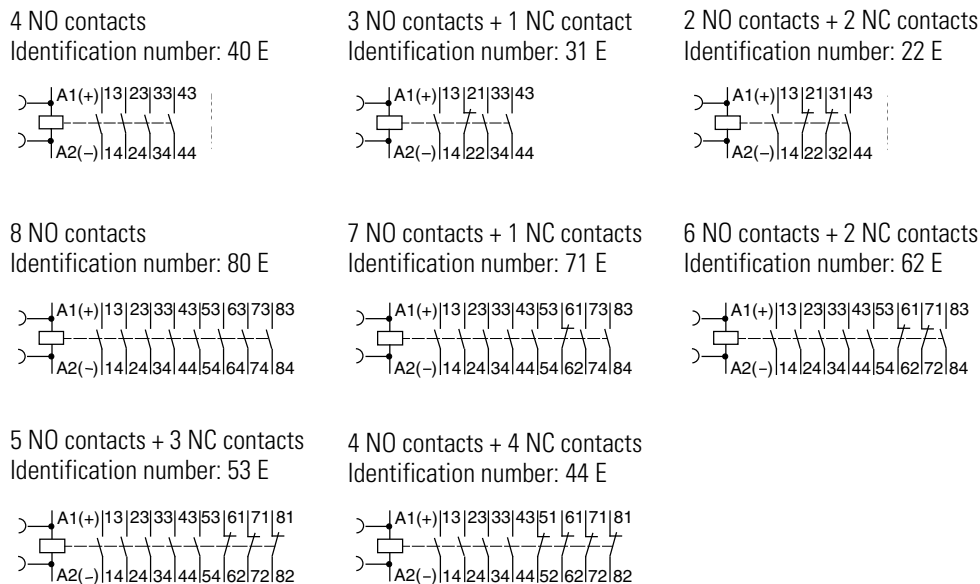


Fig. 3-48: Device circuit diagrams

Position diagrams The following position diagrams of the auxiliary switches of frame sizes S00 to S3 also apply to leading and lagging contacts:

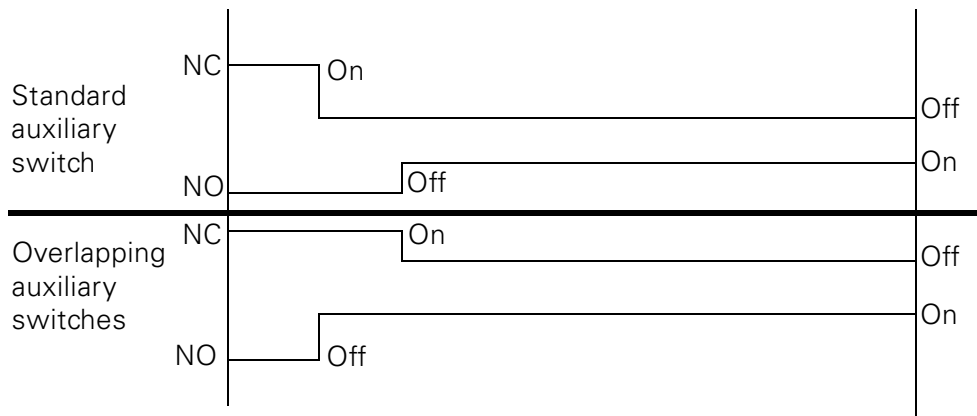


Fig. 3-49: Position diagrams of the auxiliary switches (frame sizes S0 to S3)

3.4.2 Time-delay auxiliary switches

Variants

The following variants of the time-delay auxiliary switch are available:

- On-delay
- Off-delay without auxiliary supply
- Wye-delta function

On-delay and off-delay functions

The time-delay auxiliary switch in the on-delay or off-delay variants has the following features:

- It facilitates time-delayed functions up to 100 s
- 3 single time areas
- Contains a relay with 1 NO contact and 1 NC contact that switches the on-delay or off-delay depending on the version.

Wye-delta function

The time-delay auxiliary switch with wye-delta function has the following features:

- Equipped with a delayed and an instantaneous NO contact between which there is an idle time of 50 ms.
- The delay time of the NO contact can be set at between 1.5 s to 30 seconds.
- The contactor on which the time-delay auxiliary switch block is mounted functions instantaneously.

Conductor cross-sections

The permissible conductor cross-sections correspond to the auxiliary conductor terminals of the corresponding frame size.

3.4.2.1 Frame size S00 (3RT1916-2E, -2F, -2G)

Description

The time-delay auxiliary switch of frame size S00 has the following features:

- The power supply is provided using plug-in contacts directly via the coil connections of the contactors, parallel to A1/A2.
- The time function is activated when the contactor that has the auxiliary switch block mounted on it is turned on.
- The off-delay version functions without an auxiliary supply.
- The minimum on-time is 200 ms.
- To dampen switching overvoltages of the contactor coil, a varistor is integrated in the time-delay auxiliary switch of frame size S00.

Information on mounting

Note about the off-delay without auxiliary supply function:

The position of the output contacts is not defined at shipment (bistable relay). Apply the control supply voltage once, and then switch it off again to set up the initial state of the contacts.

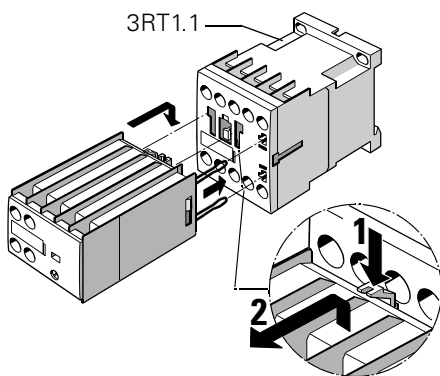
Important

The time-delay auxiliary switch cannot be added to contactor relays.

Installation/removal

Caution

Switch off the supply voltage to A1/A2 before you install or remove the time-delay auxiliary switch block.



The time-delay auxiliary switch is attached to the front of the contactor.

Fig. 3-50: Time-delay auxiliary switch block (frame size S00)

Connection

When they are attached, the connections for the rated control supply voltage are connected to the contactor below by the integrated spring contacts of the time-delay auxiliary switch.

Function diagrams

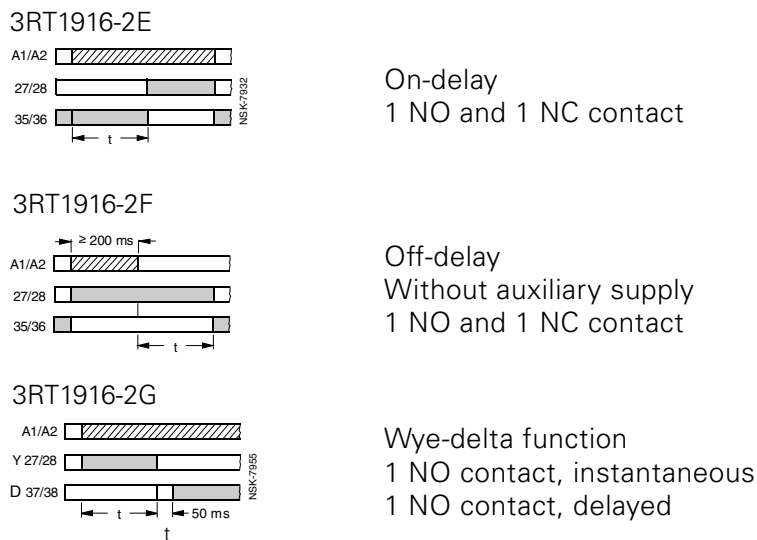


Fig. 3-51: Function diagrams of the time-delay auxiliary switches (frame size S00)

3.4.2.2 Frame sizes S0 to S12 (3RT1926-2E, -2F, -2G)

Description

The time-delay auxiliary switch for frame sizes S0 to S12 has the following features:

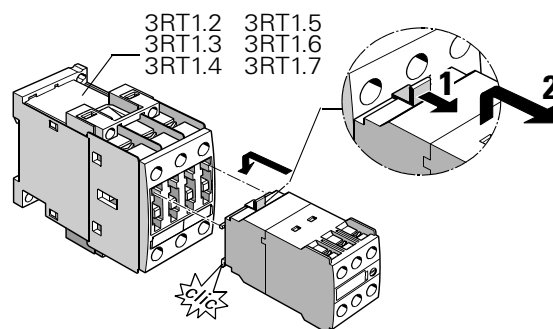
- The power supply of the time-delay auxiliary switch is via two terminals (A1/A2).
- The time delay for the time-delay auxiliary switch can be activated by parallel connection to any contactor coil, or by any source of voltage.
- The off-delay version works without an auxiliary supply.
- The minimum on-time is 200 ms.
- In addition to the time-delay auxiliary switch, a 1-pole auxiliary switch block can be snapped onto the front of the contactor.
- The time-delay auxiliary switch does not have any integrated overvoltage damping for the connected contactor.

Information on mounting

Note about the off-delay without auxiliary supply function:

The position of the output contacts is not defined at shipment (bistable relay). Apply the control supply voltage once, and then switch it off again to set up the initial state of the contacts.

Installation/removal



The time-delay auxiliary switch is attached to the front of the contactor.

Fig. 3-52: Time-delay auxiliary switch block (frame sizes S0 to S12)

Connection

The A1 and A2 terminals for the rated control supply voltage of the time-delay auxiliary switch are connected to the respective contactor with cables.

Terminal markings

Because an additional auxiliary switch block can be snapped onto the contactor, the terminals of the delayed contacts have been designated as -5/-6 (NC contact) and -7/-8 (NO contact).

Function diagrams

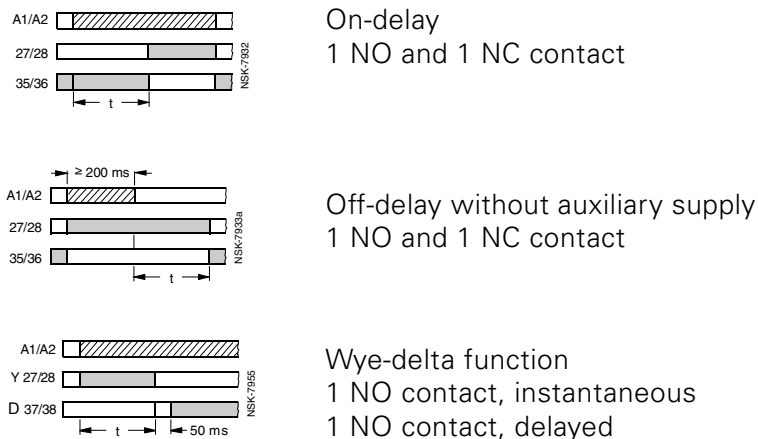


Fig. 3-53: Time-delay auxiliary switches, function diagrams (frame sizes S0 to S3)

3.4.3 Solid-state time relay blocks with semiconductor output

The solid-state time relay blocks are suitable for AC and DC operation. To dampen switching overvoltages of the contactor coil, a varistor is integrated.

Variants

The following variants of the time-delay auxiliary switch are available:

- On-delay (integrated varistor)
- Off-delay with auxiliary supply (integrated varistor)

On-delay and off-delay functions

The time-delay auxiliary switch in the on-delay or off-delay with an auxiliary supply has the following features:

- It facilitates time-delayed functions up to 100 seconds.
- 3 individual time ranges
- Contactors with a solid-state time relay block close and open with a delay according to the time set.

Connection: on-delay time relay block

The on-delay time relay block is connected in series to the contactor coil; the A1 terminal of the contactor coil must not be separately connected to the control supply.

Connection: off-delay time relay block

When an off-delay time relay block is attached, the contactor coil is connected via the time relay block; the A1 and A2 terminals of the contactor coil must not be separately connected to the control supply.

Conductor cross-sections

The permissible conductor cross-sections correspond to the auxiliary conductor terminals of the corresponding frame size.

Notes on configuration

The control of loads parallel to the start input is not permissible in AC operation. See the relevant circuit diagram ① below.

The off-delay solid-state time relay blocks (3RT1916-2D.../3RT1926-2D...) have a live start input (B1). With AC voltage, this can imitate the control of a parallel load on the B1 terminal. In this case, an additional load (contactor K3, for example) should be wired as shown in circuit diagram ②.

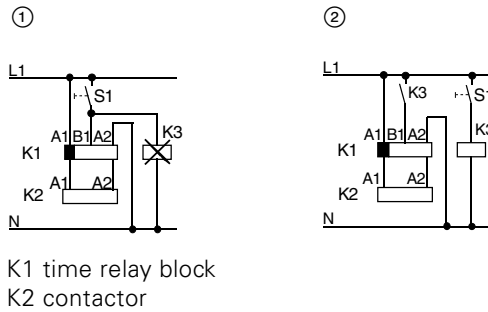


Fig. 3-54: Control of loads

3.4.3.1 Frame size S00 (3RT1916-2C, -2D)**Caution**

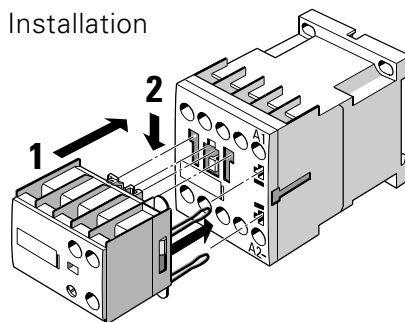
Switch off the supply voltage to A1/A2 before you install or remove the solid-state time relay block.

Installation/removal**Important**

The time-delay auxiliary switch cannot be attached to contactor relays.

The solid-state time relay block of frame size S00 is attached to the front of the contactor and latched into place with a pushing movement.

Installation



Removal

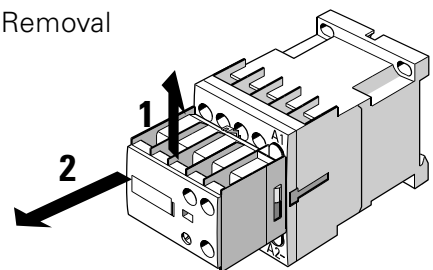


Fig. 3-55: Solid-state time relay block with semiconductor output, installation (frame size S00)

Connection

When the solid-state time relay block is installed, it is connected at the same time with the A1 and A2 coil connections of the contactor by the plug-in pins. Coil connections of the contactor that are not required are covered by covers on the housing of the time relay block, thus preventing inadvertent connection.

Function diagrams

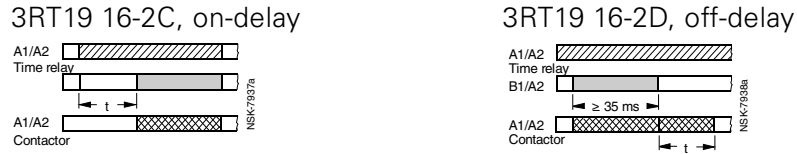


Fig. 3-56: Solid-state time relay block with semiconductor output, function diagrams (frame size S00)

Circuit diagrams

3RT19 16-2C... on-delay
Frame size S00

3RT19 16-2D... off-delay (with auxiliary voltage)
Frame size S00



- ① Solid-state time relay block
- ② Contactor

Fig. 3-57: Solid-state time relay with semiconductor output, circuit diagrams (frame size S00)

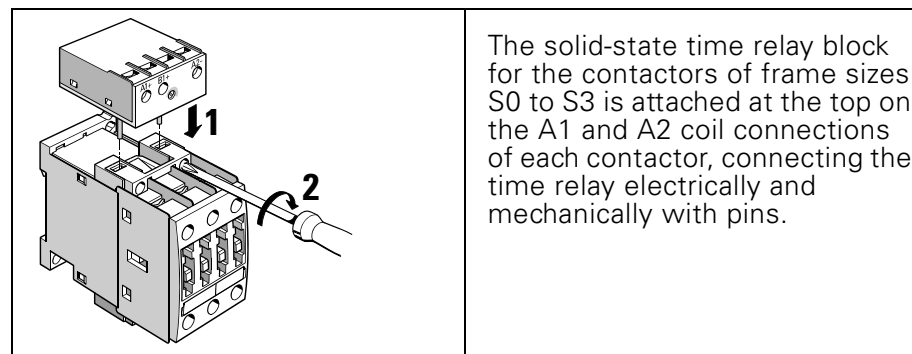
3.4.3.2 Frame sizes S0 to S3 (3RT19 26-2C, -2D)

Note on configuration

Caution

The solid-state time relay block with a semiconductor output (3RT1926-2C, -2D) must not be used for 3RT104 contactors of frame size S3 with $U_S \leq 42 \text{ V}$ because the coil current used for the output semiconductor is too high. The solid-state time relay block must not be attached to the lower coil connections.

Installation/removal

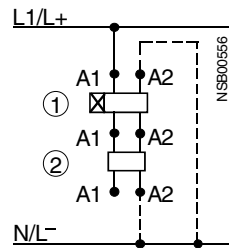


The solid-state time relay block for the contactors of frame sizes S0 to S3 is attached at the top on the A1 and A2 coil connections of each contactor, connecting the time relay electrically and mechanically with pins.

Fig. 3-58: Solid-state time relay with a semiconductor output, installation (frame size S0 to S3)

Circuit diagrams

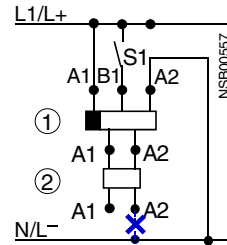
3RT19 26-2C...
on-delay
Frame size S0 to S3



A2 can either be connected to the contactor or the timing relay with N(L-).
--- connect as preferred

- ① time relay block
- ② contactor

3RT19 26-2D...
off-delay (with auxiliary supply voltage)
Frame size S0 to S3

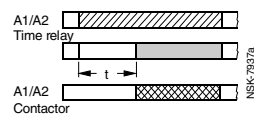


A2 may only be connected with N(L-) from the timing relay
x do not connect!

Fig. 3-59: Solid-state time relay with semiconductor output, circuit diagrams

Function diagrams

3RT19 26-2C..1, on-delay



3RT19 26-2D..1, off-delay

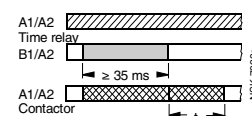


Fig. 3-60: Solid-state time relay with semiconductor output, function diagrams

3.4.4 Additional load module (3RT1916-1GA00)

Field of application

The additional load module for the contactors of frame size S00 is used to increase the permissible residual current and to limit the residual voltage of SIMATIC semiconductor outputs.

Mode of operation

Malfunctions can sometimes occur when SIRIUS contactors and auxiliary contactors of frame size S00 work together with SIMATIC output modules whose residual current at signal "0" is higher than is permissible for the contactors of frame size S00. The maximum permissible residual current of the electronic components is 3 mA for contactors of frame size S00 with a 230 VAC drive, and in the case of higher residual currents, the contactors no longer drop down.
The additional load module is used to ensure the safe switching off of S00 contactors in the case of direct control by programmable controllers via 230 VAC semiconductor outputs.
The additional load module takes on the function of overvoltage damping at the same time.

Technical specifications	Rated voltage	AC 50/60 Hz 180 V to 255 V
	Rated output power	1.65 W at 230 V
	Permissible contactor types	3RT1.1 3RT1.
	Associated coil type	P0 (230 V, 50/60 Hz) N2 (220 V, 50/60 Hz) P6 (220 V, 50 Hz/240 V, 60 Hz)
	Operating range	0.8 to 1.1 Us

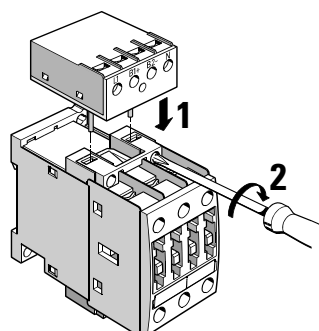
Installation The additional load is connected in parallel to the contactor coil. It has the same construction as the surge suppressor and is attached on the front of the contactors with or without an auxiliary switch block.

3.4.5 Coupling element for frame sizes S0 to S3 (3RH1924-1GP11)

Field of application The 3RH1924-1GP11 coupling link is intended for contactors of frame sizes S0 to S3. It can be controlled by a programmable controller output because the operating range of 17 to 30 VDC is permissible.

Mode of operation A contactor of frame size S0 to S3 can be controlled, for example, at 24 VDC with a low control level (< 0.5 W) from a programmable controller output. The control voltage for the coupling link and the rated control supply voltage for the contactor are electrically isolated. An LED indicates the switching state of the coupling link. To dampen switching overvoltages of the contactor coil, a varistor is integrated in the coupling link.

Installation **Caution**
Switch off the supply voltage applied to L1 and N before installation.



The coupling link is inserted with its two integrated mounting pins directly onto the coil connections of the contactor.

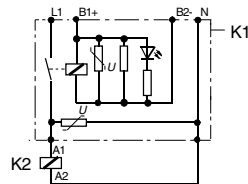
Fig. 3-61: Coupling link (frame sizes S0 to S3)

Conductor cross-sections

The permissible conductor cross-sections correspond to the auxiliary conductor terminals of the corresponding frame size.

Circuit diagram

Coupling link 3RH19 24-1GP11 for control from a PLC



K1 Coupling link
K2 Contactor

B1+/B2-: Control voltage 24 VDC

L1/N: Rated control supply voltage for the selected contactor

Fig. 3-62: Coupling link, circuit diagram (frame sizes S0 to S3)

Technical specifications

You can find the technical specifications of the coupling link in Section 3.6, "Technical specifications".

3.4.6 Surge suppression

When contactor coils are de-energized, overvoltage occurs (inductive load). Voltage peaks of up to 4 kV with a rate of rise in voltage of 1 kV/ms can result (showering arcs).

The consequences of this are:

- Heavy contact erosion and thus premature wearing of the contacts that switch the coil
- Unwanted signals can occur that may cause false signals in electronic controllers.

All contactor coils, therefore, should be damped against switching overvoltages, particularly when working with electronic controllers.

Oscillograms

The following oscillograms illustrate the behavior at disconnection of contactor coils without and with overvoltage damping:

Coils without surge suppression

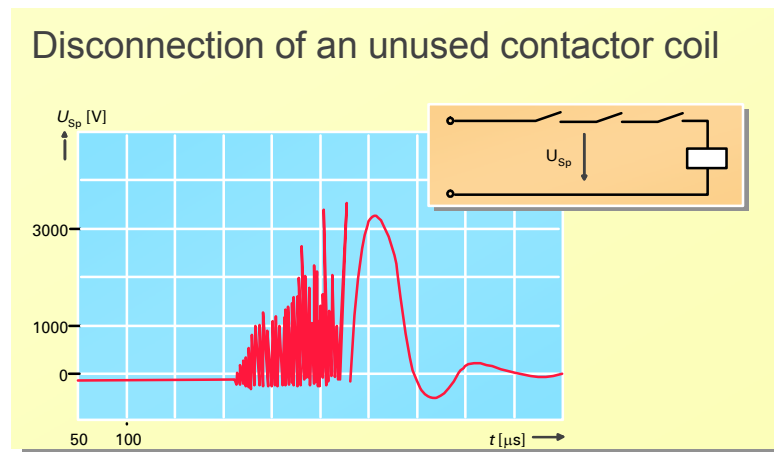


Fig. 3-63: Disconnecting contactor coil without suppression

Oscillogram of a de-energized coil of an auxiliary contactor. When suppression is not used:

Showering arcs can be clearly seen (voltage peaks of up to approximately 4 kV). After de-energization has been started, showering arcs occur for approximately 250 μ s, and after that the oscillation is only damped.

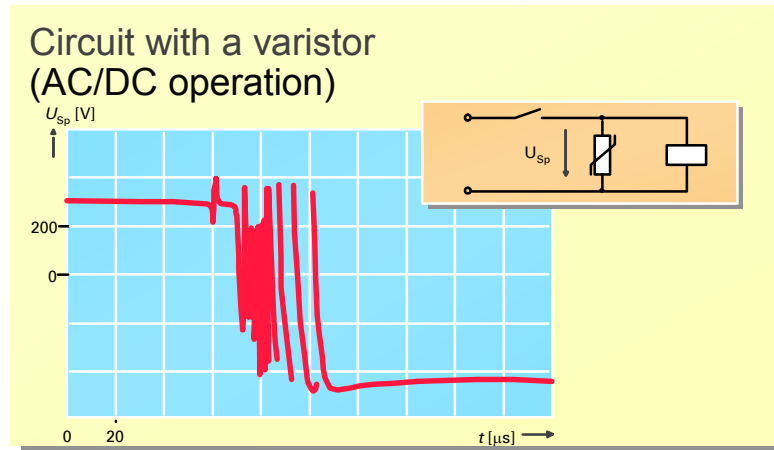
Varistor

Fig. 3-64: Circuit with a varistor (AC/DC operation)

This is what happens when a coil is de-energized that is connected to a varistor (voltage-dependent resistor): Voltage peaks still occur. They are cut off at approximately 400 V and have a shorter overall duration (approximately 50 μ s). (Note: The oscillogram is cut off, and the voltage is reduced to zero after approximately 3 ms.) A varistor is suitable for AC and DC operation. The Opening time of the contactor is extended by approximately 2 to 5 ms.

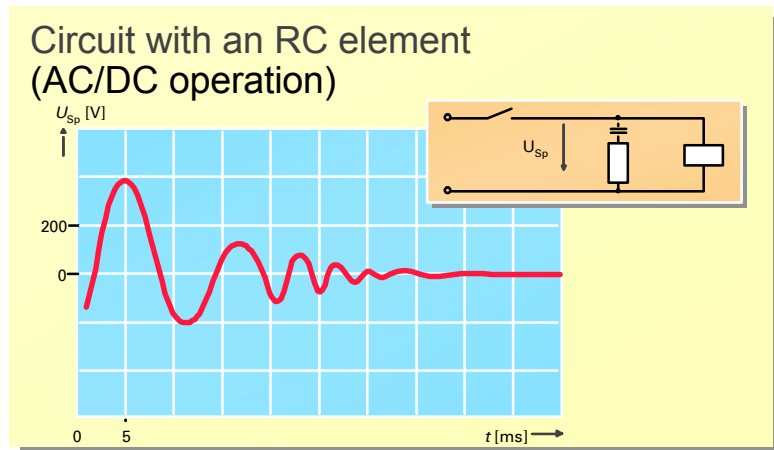
RC-Element

Fig. 3-65: Circuit with an RC element (AC/DC operation)

This is what happens when a coil is de-energized that is connected to an RC element: The amplitude and rate of rise of the switching overvoltage are reduced by the capacitor. Showering arcs no longer occur. The voltage swings briefly to 400 V and then slowly drops down. This represents ideal damping. Disadvantage: The component is larger and generally more expensive. RC elements are suitable for AC and DC operation. Only a minimal Opening time occurs (under 1 ms).

Diode

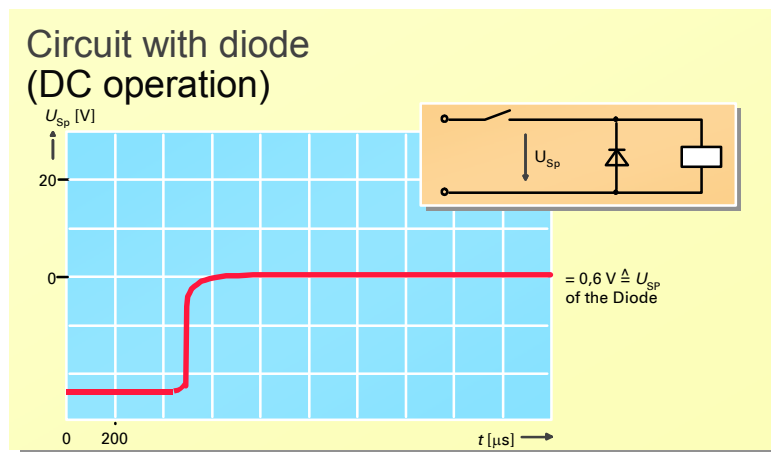


Fig. 3-66: Circuit with a diode (AC/DC operation)

This is what happens when a coil is de-energized that is connected to a diode:

Advantages: No overvoltage occurs during de-energization. The diode block becomes effective at 0.6 V.

Disadvantage: The diode can only be used for DC operation.

The opening time of the contactor is considerably increased and amounts to 6 to 9 times the normal opening time.

This increased break time can be used, if necessary, for control purposes, such as for bridging brief interruptions in voltage.

Zener diodes (diode combinations) are available for shorter opening times. The opening time then amounts to 2 to 6 times the normal opening time.

Surge suppressors

The following surge suppressors are available for the 3RT1 contactors:

Surge suppressor	With LED	Without LED			
	for S00	for S00	for S0	for S2, S3	for S6 to S12
Suppression diode	x	x	—	—	—
Diode combination: suppression diode and Zener diode	—	x	x	x	—
Varistor	x	x	x	x	integrated
RC element	—	x	x	x	x

Table 3-40: Surge suppressor

Selection aid

The following table gives you a comparison of the effects of the different surge suppressors:




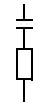
Surge suppressor	Suitable for control supply voltage	Overtoltage is limited	Effect
Suppression diode/ freewheeling diode 	DC	0.6 V	<ul style="list-style-type: none"> Opening time is considerably greater (6 to 10 times) A two-stage drop¹⁾ cannot be ruled out in the case of contactors as of frame size S0
Diode combination: suppression diode Zener diode 	DC	To Zener voltage	<ul style="list-style-type: none"> Opening time is greater (2 to 6 times) A 2-stage drop no longer occurs
Varistor 	AC/DC	To varistor voltage (current-dependent)	<ul style="list-style-type: none"> Opening time is only slightly greater (2 to 5 ms)
RC element 	AC/DC	Corresponds to the dimensioning	<ul style="list-style-type: none"> Opening time remains unchanged Rate of rise in voltage is damped

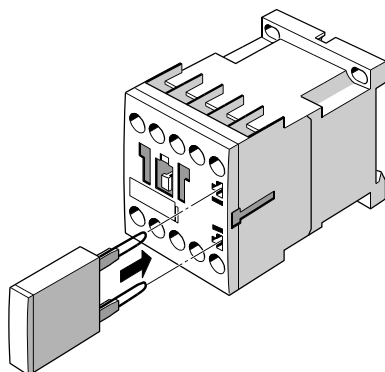
Table 3-41: How surge suppressors work

1) The rate of drop is reduced once or twice to zero for a few ms:

- A safe drop is always ensured in the case of switching without current.
- The contact pieces are subjected to a greater thermal load when switching with current. When switching at the upper current limit, this can result in overload.

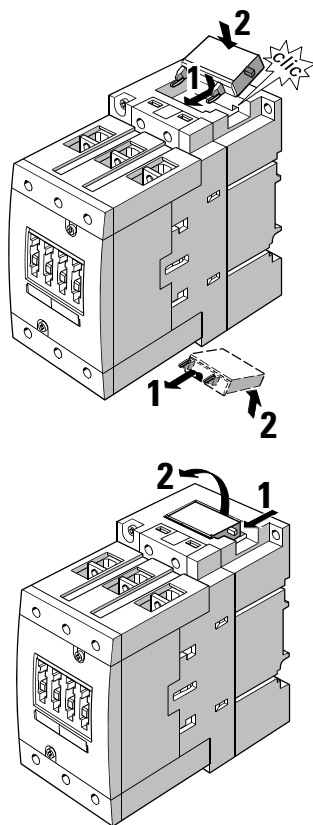
Installation

Frame size S00



The surge suppressor is attached on the front of the contactors. There is space next to the attached auxiliary switch block. The direction of attachment is defined by a code.

Frame size S0 to S3



Varistors, RC elements, and diode combinations can either be inserted and snapped on from above or below directly onto the coil terminals.

To remove them, press the varistors, RC elements, and diode combinations forwards, and remove them from the recess.

Fig. 3-67: Surge suppressors, installation

Installation instructions for frame sizes S0 to S3

Important

The 3RT1926-1E.00 diode combination is inserted from above. The direction of attachment is defined by a code. Alternatively, the 3RT1926-1T.00 diode combination can be inserted from below. The direction of attachment is not coded, but the terminals are marked with "+" and "-" so that the direction is clear.

3.4.7 Other accessories

3.4.7.1 LED module for indicating contactor control (3RT1926-1QT00)

Description	The LED module can be connected to the coil terminals of the contactors of frame sizes S0 to S3. It indicates the status of the contactors by means of yellow LEDs.
Mode of operation	The LED module can be used for AC/DC voltages of 24 V to 240 V. The LEDs are connected bidirectionally to protect against polarity reversal. Both LEDs light up in AC control, and one lights up in DC control, depending on the polarity.
Connection	The LED module is connected to the A1 and A2 coil terminals of the contactor.
Installation	The LED module is snapped onto the front in the openings intended for the inscription plate.

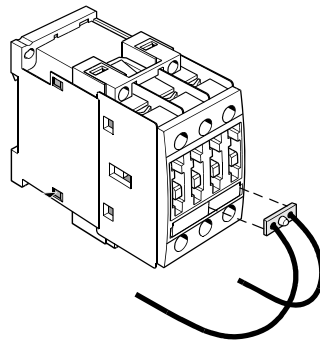


Fig. 3-68: LED module

3.4.7.2 Auxiliary connecting lead terminal, 3-pole for frame size S3 (3RT19 46-4F)

Using the 3-pole auxiliary lead terminal, auxiliary and control cables can be connected to the main cable terminals.

Conductor cross-sections of auxiliary connecting leads that can be connected:

Screw-type terminals (1 or 2 conductors can be connected)		
Single-core	mm ²	2 x (0.5 to 1.5); 2 x (0.75 to 2.5) in acc. with IEC 60 947; Max. 2 x (0.75 to 4)
Finely stranded with wire end ferrule	mm ²	2 x (0.5 to 1.5); 2 x (0.75 to 2.5)
AWG cables, single- or multi-core	AWG	2 x (20 to 16); 2 x (18 to 4); 1 x 12
Terminal screws		M3
Tightening torque	Nm	0.8 to 1.2 (7 to 10.3 lb.in)

Table 3-42: Conductor cross-sections of 3-pole auxiliary connecting lead terminals (for frame size S3)

3.4.7.3 Box terminal blocks

Main cable connections

Other than the 3RT1054 (55 kW/400 V/AC-3), that can optionally come with the box terminal block 3RT1955-4G, the S6 to S12 contactors come with busbar connection. For the direct connection of round cables or ribbon cable box terminal blocks (as accessories) can be used for frame sizes S6 to S12.

Control power take off

With the box terminal blocks for frame size S6 there is space to use the control power take off terminal 3TX7500-0A. The box terminal blocks for S10/12 have per main cable connection also a connection for control power take off..

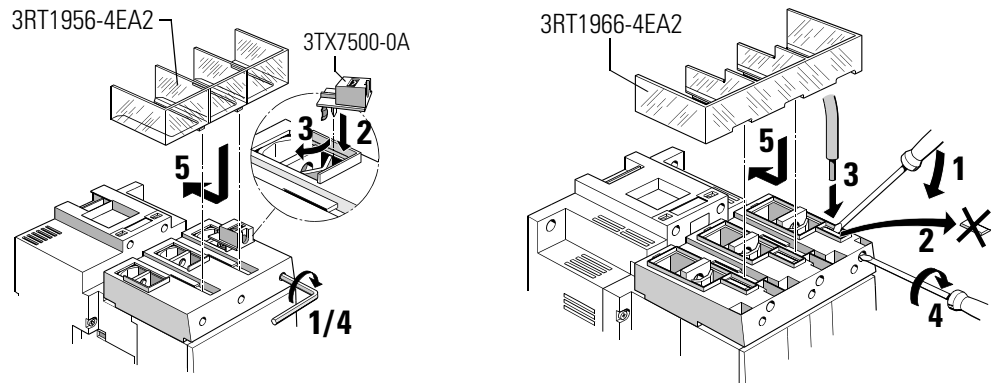


Fig. 3-69: Control power take off with the box terminal blocks

Frame size	box terminal block			Terminal cover
S6	connection cross-section	Order No.	Control power take off with 3TX7500-0A	Order No.
	up to 70 mm ²	3RT1955-4G		
	up to 120 mm ²	3RT1956-4G		
S10 and S12	up to 240 mm ²	3RT1966-4G	integrated	3RT1966-4EA2

3.4.7.4 EMC interference suppression module (3RT1916-1P.)

In the case of motors or various inductive loads, back-e.m.f (electromotive force) is produced when disconnected. This can produce voltage peaks of up to 4000 V with a frequency range of 1 kHz to 10 MHz and a rate of voltage variation of 0.1 to 20 V/ns. Capacitive coupling to various analog and digital signals makes suppression necessary in the load circuit.

Description

The connection of the main conducting path to the EMC suppression module reduces the contact sparking that is responsible for contact erosion and many of the disturbances, which in turn supports an EMC-compatible configuration.

Mode of operation

The EMC suppression module reduces through 3 phases the radio-frequency parts and the voltage peaks. The advantages of this are as follows:

- Longer service life of the contact pieces
- Higher operational reliability and high system availability

A fine grading within the performance class is not required because smaller motors have greater inductance due to their construction, and one EMC suppression module is thus sufficient for all non-stabilized drives up to 5.5 kW.

Variants

Two electrical variants are available:

- RC circuit
- Varistor switching

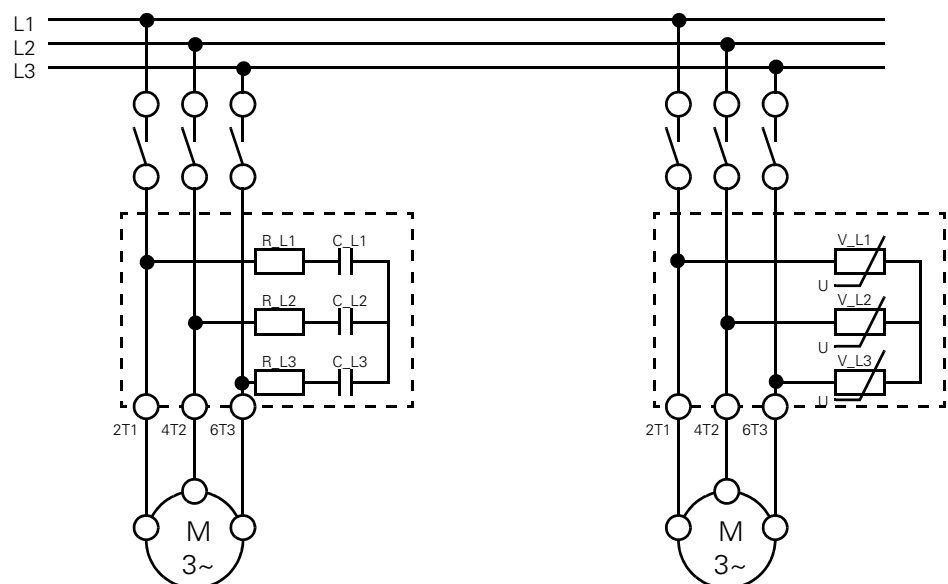
Circuit diagrams

Fig. 3-70: circuit diagrams

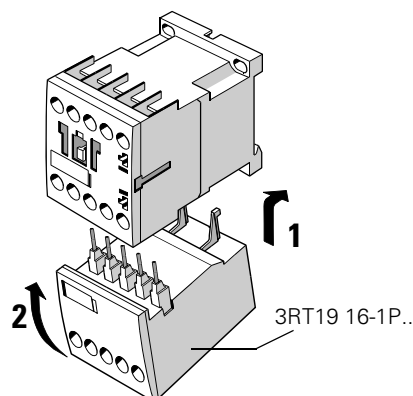
Installation

Fig. 3-71: EMC suppression module

The EMC suppression module is attached to the underside of the contactor. To do this, hook the EMC suppression module with both hooks onto the contactor, and push it upward until the connection pins of the EMC module are firmly in place in the terminal openings of the contactor.

RC circuit

The RC circuit is suitable:

- For reducing the rate of rise
- In RF damping

Effective suppression can be achieved for a wide range of applications.

Varistor circuit

A varistor circuit can absorb a high level of energy and can be used for frequencies from 10 to 400 Hz (stabilized drives). There is no limit below the buckling stress.

3.4.75 Soldering pin adapter for frame size S00 (3RT19 16-4KA.)

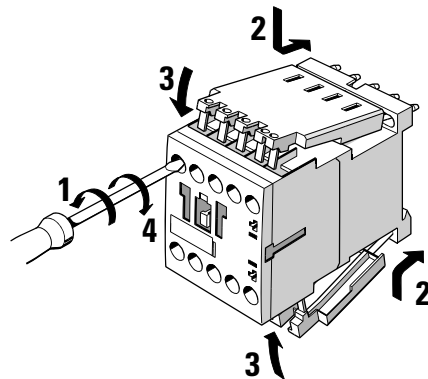
Description

The standard contactors of frame size S00 in the SIRIUS range can be soldered onto printed circuit boards by means of the soldering pin adapter.

Soldering pin connection is possible:

- For contactors with an integrated auxiliary contact
- For contactors with an attached 4-pole auxiliary switch block
- For the reversing wiring of the S00 contactors. This involves carrying out the reversing wiring before soldering it on the printed circuit board

Mounting main contacts



The soldering pin connectors are inserted above and below in the screw-type terminals of the contactors.

Fig. 3-72: Soldering pin connection, mounting

Mounting on 4-pole auxiliary switch block

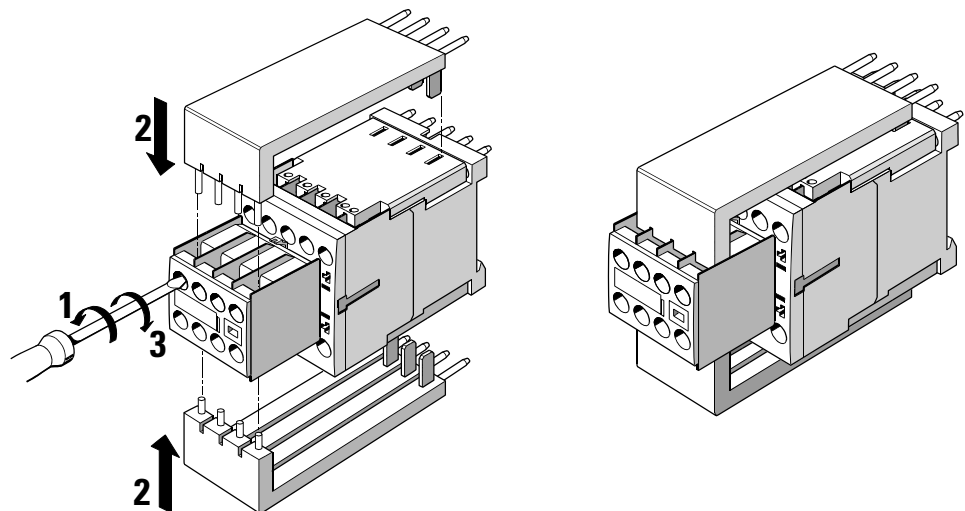


Fig. 3-73: Mounting the soldering pin connection on a 4-pole auxiliary switch block

Removing the spring

If necessary, the spring for attachment to the rail can be removed before the soldering pin connection is mounted.

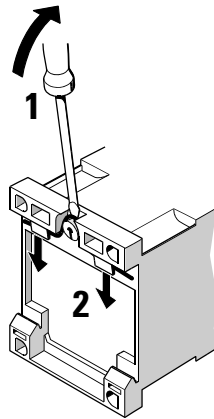


Fig. 3-74: Removing the spring from the soldering pin connection

3.4.7.6 Paralleling links (3RT19 .6-4B.31)

If the current paths of a multiple pole switching device are connected in parallel, then the total current is spread over the individual poles in accordance to their ohmic resistance and their mutual inductive interference. The ohmic resistance is mainly made up of the contact resistance of the contacts, whose value can change with erosion and oxidation. Therefore there is neither a symmetrical nor stabile distribution of current: individual current paths can become overloaded and the overload trip may operate prematurely causing nuisance tripping.

Continuous loading when connected in Parallel

As long as there aren't any other details in the catalog data, then the following applies for continuous loading when connected in parallel:

- When three current paths are connected in parallel then the continuous current can be 2.5 times of a single current path and 1.8- times the continuous current with two current paths connected in parallel. It should be noted that the making and breaking are not increased, because the contacts don't open and close at the same time and therefore the contacts of an individual current path must be able to make or break the entire current
- The wiring arrangement should be such that every current path has the same cable length.
- An eventual short-circuit current would be divided with relationship to the resistance of the current paths.

Attention: Thereby, the tripping current of an instantaneous electromagnetic short-circuit trip may not be reached.

Making/ breaking capacity

The magnitude of making and breaking capacities of contactors, related to load currents when connecting two/three poles in parallel are shown in the table below:

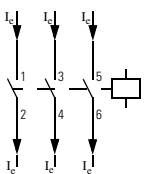
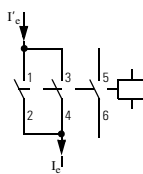
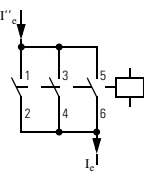
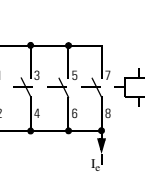
	 3-pole switching	 2 poles in parallel	 3 poles in parallel	 4 poles in parallel
Making capacity	12 x I _e (utilization category AC -4)	$\frac{12 \cdot I'e}{1,8} = 6,67 \cdot I'e$	$\frac{12 \cdot I''e}{2,5} = 4,8 \cdot I''e$	$\frac{12 \cdot I''e}{3,1} = 3,9 \cdot I''e$
Breaking capacity	10 x I _e (utilization category AC -4)	$\frac{10 \cdot I'e}{1,8} = 5,55 \cdot I'e$	$\frac{10 \cdot I''e}{2,5} = 4,0 \cdot I''e$	$\frac{10 \cdot I''e}{3,1} = 3,2 \cdot I''e$

Table 3-43: Parallel connection: making/breaking capacities

Designs

The following designs of Paralleling links are available:

Frame sizes	Design
S00 to S3	3-pole, without connection terminal (wye jumper) ²⁾
S00 to S3	3-pole, with connection terminal
S00	4-pole, with connection terminal
S6 to S12	3-pole, with through hole

Table 3-44: Paralleling links: designs

²⁾ accessory for wye-delta combinations

Installation

The paralleling links each be shortened a pole.

3.4.7.7 Sealing cover (3RT19 .6-4MA10)

With the use of contactors and control relays in safety related applications, it must be made certain that the manual activation of the contactor isn't possible.

For applications of this kind there is a sealing cover available as an accessory that prevents unintentional manual activation. It is a see-through moulded plastic cap with a clip that makes sealing the cover possible.

- Frame size S00: **3RT1916-4MA10**

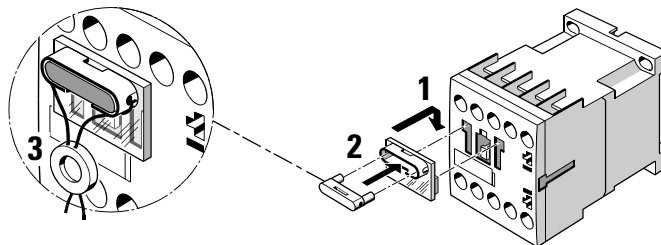


Fig. 3-75: Contactor frame size:S00 with sealable cover

- Frame sizes S0 to S12: **3RT1926-4MA10**

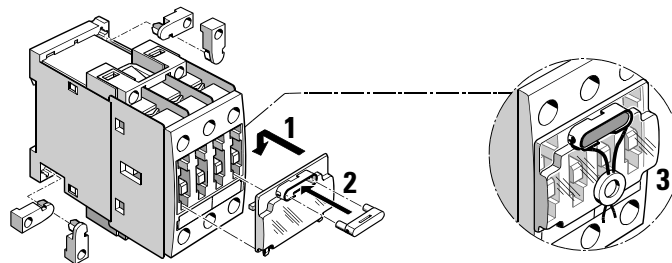


Fig. 3-76: Contactor frame size:S0 to S12 with sealable cover

3.4.7.8 Terminal covers for frame sizes S2 to S12

To increase safety there are terminal covers available for contactors with frame sizes S2 to S12:

Design	Function	required number	Frame sizes
Cover for box terminals 3RT19.6-4EA2	provides additional protection against shock	2 covers each are needed per contactor (for the main connections on top and bottom)	S2 to S12
Terminal cover for ring-tongue and busbar connection 3RT19.6-4EA1	to keep the clearance between phases from determined connection cross-sections, provides protection against shock		S3 to S12
Busbar cover used between the contactor and overload relay 3RB10 (3RT1966-4EA3 for S10 and S12 serves also as an adapter for the terminal cover 3RT1966-4EA1 with contactor combinations) 3RT19.6-4EA3	provides protection against shock	1	S6 to S12

Table 3-45: Covers

Installation

The following graphics show how to install the covers

Drawing	Procedure	Frame size
	<p>3RT19.6-4EA2 The terminal covers for the box terminals are pushed into the guides on the box terminals block then slid toward the back until it locks into place.</p>	<p>S2 to S12</p>
	<p>3RT19.6-4EA1 To mount the terminal covers for ring-tongue and busbar connection first remove the box terminals block (only with frame size S3), and slide the cover on the guide rails.</p>	<p>S3 to S12</p>

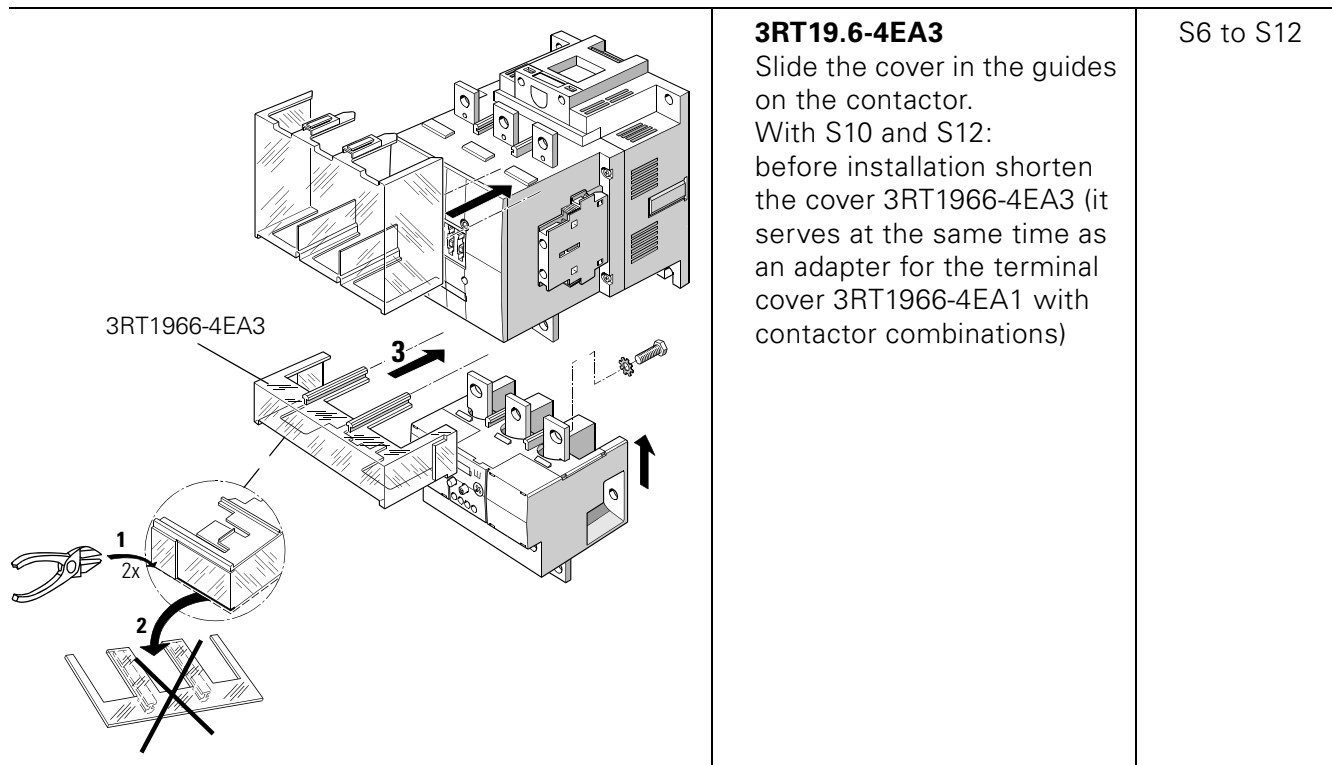


Fig. 3-77: Terminal covers