3

3RT1 contactors/ 3RH1 control relays

3.1 Specifications/regulations/approvals

Regulations

The following regulations apply to 3RT contactors:
- IEC 60 947-1, EN 60 947-1 (VDE 0660 Part 100), which includes the general specifications for low- voltage switching devices.
- IEC 60 947-4-1, EN 60 947-4-1 (VDE 0660 Part 102), which contains, in particular, the requirements for contactors and motor starters.

The following regulations apply to 3RH contactor relays:
- IEC 60 947-1, EN 60 947-1 (VDE 0660 Part 100), which includes the general specifications for low-voltage switching devices.
- IEC 60 947-5-1, EN 60 947-5-1 (VDE 0660 Part 200) which includes, in particular, the requirements for control equipment and switching elements for the control, signaling, locking, etc. of switchgear and controlgear.

Standards

The following standards apply to the terminal markings of the contactors:
- EN 50 012: terminal markings and identification numbers for auxiliary contact elements of particular contactors (also applies to contactors with a built-in auxiliary switch block)
- EN 50 011: terminal markings, identification numbers, and identification letters for particular auxiliary contactors (also applies to auxiliary contactors with a built-in auxiliary switch block)
- EN 50 005: terminal markings and identification numbers, general rules

Approvals/ test reports

Confirmation of approvals and test certificates and characteristics can be obtained on the Internet/intranet:
http://support.automation.siemens.com/WW/view/en/20025979/134200

Shock protection

The shock protection provided is in acc. with DIN VDE 0106, Part 100.

3.1.1 Utilization categories

In acc. with EN 60 947-4-1, the purpose of the contactors and the stress placed on them is indicated by the utilization category together with details of the rated operational current or motor output and the rated voltage.

The following tables list the definitions of the utilization categories for low-voltage switching devices and contactors from IEC 60 947 (VDE 0660). The rated operational voltages for the various utilization categories are listed in the low-voltage switching devices catalog.

Utilization category for AC voltages

AC	Utilization category for AC voltages	Switching capacity I/I_e		Electrical service life I/I_e	
		On	Off	On	Off
AC-1	Non-inductive load or a slightly inductive load	1.5	1.5	1	1
AC-2	Slip ring motors: switch on, switch off	4	4	2.5	2.5
AC-3	Squirrel-cage motors: switch on, switch off during the run	10	8	6	1
AC-4	Squirrel-cage motors: switch on, plugging or reversing, inching	12	10	6	6
AC-6b	Switching of capacitor banks	—		—	

Table 3-1: Utilization categories, test conditions for AC voltage

Definition of AC-1 to AC-6b

The definitions of the utilization categories AC-1 to AC-6b for main circuits can be found in the relevant regulations.
The main areas of application for contactors are:

- AC-3 operation: switching of squirrel-cage motors
- AC-1 operation: switching of resistive loads
- AC-4 operation: plugging, reversing, inching
- AC-6b operation: switching of capacitor banks

Test conditions

Test conditions for the various utilization categories:

- In AC-1 operation, the contactor must be able to switch 1.5 times the rated operational current on and off.
- In AC-3 operation, the starting currents of the motors must be controlled. In other words, the contactor must be able to switch on 10 times the rated operational current (I_e), and switch off 8 times the I_e.
- In AC-4 operation, the contactor must be able to switch off or on 12 times the rated operational current (I_e) and 10 times the I_e. This represents extremely high stress for contactors because the high starting currents of the motors have to be switched off.
- In AC-6b operation, the rated values of capacitor loads may be derived from capacitor switching tests or on the basis of existing experience and research.

The breaking current is decisive in calculating the electrical service life:

- In AC-1 and AC-3 operation, 1 x I_e must be assumed.
- In AC-4 operation, 6 x I_e must be assumed because the contactor also has to switch off the motor during startup.

Utilization category for DC voltages

DC	Utilization category for DC voltages	Switching capacity I/I_e Make/break	Time constant $^L/_R$ (ms)
DC-1	Non-inductive load or a slightly inductive load, resistance furnaces	1.5	1
DC-3	Shunt motors: switching on, plugging, reversing, inching	4	2.5
DC-5	Series motors: switching on, plugging, reversing, inching	4	15

Table 3-2: Utilization categories, test conditions for DC voltages

Definition of DC-1 to DC-5

The definitions of the utilization categories DC-1 to DC-6 apply to main circuits for switching DC voltage.
The main areas of application for contactors are:
- DC-3/DC-5 operation: switching of shunt or series motors
- DC-1 operation: switching of resistive loads, resistance furnaces

Note
In the information on DC switching capacity in previous documents, the utilization categories DC-2 and DC-4 correspond to the current utilization categories DC-3 and DC-5.

Utilization category for AC voltage (auxiliary contact elements)

AC	Utilization category for AC voltage (auxiliary contact elements)	Switching capacity		
		Make	Break	
		I/I_e	I/I_e	$\cos\varphi$
AC-12	Control of resistive load and semiconductor load in the input circuits of optocouplers	1	1	0.9
AC-14	Control of a small electromagnetic load (max. 72 VA)	6	1	0.3
AC-15	Control of an electromagnetic load (greater than 72 VA)	10	1	0.3

Table 3-3: Utilization categories, test conditions for AC voltage (auxiliary contact elements)

Definition of AC-12 to AC-15

IEC 60 947-5-1/EN 60 947-5-1 (VDE 0660 Part 200) contains the definitions of the utilization categories AC-12 to AC-15 for switching elements for the control, signaling, locking, etc. of switchgear and controlgear.
The main areas of application for auxiliary contactors are:
- AC-14/AC-15 operation: switching of contactor coils, solenoid valves, for example.
- AC-14/AC-12 operation: switching of resistive loads, for example.

Rated operational currents

The rated operational currents for the various utilization categories are listed in the low-voltage switching devices catalog. The test specifications given in the table for each utilization category represent the scale for the making and breaking capacity of the auxiliary contacts.

Example

3RT1016 contactor:
I_e/AC-15 of the auxiliary contact: 6 A/230 V
Making capacity: 10 x I_e/AC-15 = 60 A

- This enables the contactor coil with the current consumption of 60 A to be switched on.
- Only the holding current is decisive for switching off the contactor coil.

According to regulations, the auxiliary contact must normally be able to switch off the rated operational current.

Utilization category for DC voltage (auxiliary contact elements)

DC	Utilization category for DC voltage (auxiliary contact elements)	Switching capacity		
		Make	Break	
		I/I_e	I/I_e	L/R (ms)
DC-12	Control of resistive load and semiconductor load in the input circuits of optocouplers	1	1	1
DC-13	Control of solenoids	1	1	300

Table 3-4: Utilization categories, test conditions for DC voltage (auxiliary contact elements)

Definition of DC-12 and DC-13

The DC voltage switching capacity of auxiliary contacts is defined in utilization categories DC-12 and DC-13.
The main areas of application for contactors are:

- DC-12: switching of resistive loads (typical application)
- DC-13: switching of inductive loads, such as contactor coils and solenoid valves

In DC operation, the difference in stress is also determined by the L/R time constant. This must be specified by the user.

3.1.2 Positively driven operation

Regulations

The regulations for positively driven operation are:

- For contactors: IEC 60 947-4-1, Appendix H (draft 17B/996/DC)
- For control relays: IEC 60 947-5-1, Amendment 2, Annex L, edition 10.1999
- ZH 1/457: Safety rules for controllers on power-operated presses
- SUVA: Accident prevention guidelines of the Schweizer Unfallversicherungsanstalt (Swiss institute for accident insurance)

SIRIUS contactors comply with these regulations.

Definition: positively driven contacts

Positively driven contacts are contacts that are mechanically connected with one another in such a way that the NC contacts and NO contacts can never be closed at the same time. This means ensuring that there is a distance between the contacts of at least 0.5 mm throughout the entire service life of the contactor, even when there is a defect, such as when the contact has been wrongly welded (ZH 1/457).

Positively driven operation in the case of 3RT1/3RH11

Positively driven operation occurs in:
- 3RT101 contactors and 3 RH11 auxiliary contactors in frame size S00 in both the basic unit and in the auxiliary switch block and also between the basic unit and the built-on auxiliary switch block
- 3RT1 contactors in frame sizes S0 to S3 between the main contacts and the normally closed auxiliary contacts. In other words, if the main contact is welded, the normally closed auxiliary contact will not close.

Positively driven operation does not occur in the case of:
- Electronically optimized auxiliary switch blocks in frame size S00

Positively driven operation is not compulsory for normal controllers. It is, however, imperative for protective circuits.

3.1.3 Safe isolation

The term "safe isolation" occurs in connection with safety/protective extra-low voltage (SELV/PELV) and functional extra-low voltage (FELV). Safe isolation reliably prevents voltage that is capable of causing electric shock from transferring to the safely isolated voltage (e.g. to safety extra-low voltage that is applied to or switched to the same device).
Safe isolation is also becoming increasingly important due to the more widespread use of electronic systems in high-voltage installations.

Definition

Circuits are safely isolated when a single fault does not result in a transfer of voltage from one circuit to another. Faults to be taken into account are, for example, a bent or loose conductive part, a bent soldering pin, broken winding wire, a screw that has fallen out, or a broken partition wall in a device.

Regulations

IEC 61 140 (replacing VDE 0106 Part 101/IEC 536) lists basic requirements that can be met using safe isolation between circuits in electrical equipment.
Basic requirements are, for example:
- Double or reinforced insulation
- Protective screening
- Combination of double or reinforced insulation and protective screening

The insulation must be resistant to aging throughout the expected service life.

Circuits without protective extra-low voltage or functional extra-low voltage do not require safe isolation.

Safe isolation in the case of 3RT1 and 3RH1 contactors

If the conducting paths of a contactor are operated with different voltages, the requirements for safe isolation must be met.
In the case of the 3RT1 and 3RH1 contactors, safe isolation is ensured up to the following voltage:
- The values for the safe isolation between the main power circuit and the auxiliary circuit/coil connection are found in the following tables:

I Main power circuit - Control circuit

	S00 Contactor/Control relay	S0	S2	S3	S6 to S12
3-pole devices	690 V*	400 V	400 V	690 V	690 V
4-pole devices	400 V	400 V	400 V	690 V	—
	*with unused auxiliary circuit		—	—	—

II Main power circuit - Auxiliary circuit

	S00	S0	S2	S3	S6 to S12
Integ. auxiliary circuit	400 V	—	—	—	—
Front mount auxiliary circuit.	690 V*	500 V	500 V	500 V	690 V
Side mount auxiliary circuit.	No	690 V	500 V	690 V	690 V
	*4-pole auxiliary contact block				—

III Control circuit - Auxiliary circuit

	S00	S0	S2	S3	S6 to S12
Integ. auxiliary circuit	400 V	—	—	—	—
Front mount auxiliary circuit..	690 V*	690 V	690 V	690 V	690 V
Side mount auxiliary circuit.	No	500 V	690 V	690 V	690 V
	*4-pole auxiliary contact block				—

IV Auxiliary circuit - Auxiliary circuit (contactor relay)

	S00	
Basic unit - contact block	690 V*	*4-auxiliary contact block
Basic unit	400 V	
Contact block	400 V	

V Main power circuit - Main power circuit

S00	S0	S2	S3	S6 to S12
400 V	400 V	400 V	400 V	400 V

All the data are power system specifications with 10 % overvoltage in volts [V]. 400 V + 10 % corresponds to 415 V + 5 % and 500 V + 10 % corresponds to 525 V + 5 %.

Attention
In the table, the voltage that can cause electric shock and that must be safely isolated is critical. If the voltages 400 V and 24 V are to be safely isolated from one another, contactors with safe isolation up to 400 V must be used between the two points of connection used.

3.1.4 Explanation of terms

Safety extra-low voltage

Safety extra-low voltage (SELV) allows circuits with a rated voltage of up to 50 VAC or 120 VDC to be operated ungrounded. The higher voltage is safely isolated from the SELV circuits.
Safety extra-low voltage helps protect people.

Functional extra-low voltage

Functional extra-low voltage (FELV) allows circuits with a rated voltage of up to 50 VAC or 120 VDC to be operated. It does not, however, meet the requirements of safety extra-low voltage and is therefore subject to additional conditions. FELV is implemented using a ground terminal.
Functional extra-low voltage helps protect devices (e.g. programmable controllers).

PELV

PELV (protective extra-low voltage) has the same requirements as safety extra-low voltage, except for the fact that the circuit and/or exposed conductive part is/are grounded (so it is basically grounded SELV).

3.2 Device description

The SIRIUS contactors are components of the SIRIUS modular system and can therefore offer the typical benefits of SIRIUS when it comes to the selection of components and the assembly and operation of controllers and load feeders.

The SIRIUS range of contactors encompasses the following:

- Contactors for switching motors of up to 250 kW/400 V (400 Hp /460 V)
- Vacuum contactors for switching of motors from 110 to 250 kW/400 V (150 to 400 Hp/460 V)
- Auxiliary contactors with the contact variants 4 NO, 3 NO +1 NC, and 2 NO + 2 NC
- Contactor relays for system-specific cooperation with electronic controllers
- Contactors for particular applications:
  - Contactors with 4 main contacts
  - Capacitor switching contactors
  - Contactors for switching resistive loads
  - Contactors with an extended operating range
  - Contactor combinations

Frame sizes

The SIRIUS range of contactors covers everything up to 250 kW(400 Hp) in 7 sizes. Each frame size covers multiple standard motor ratings:

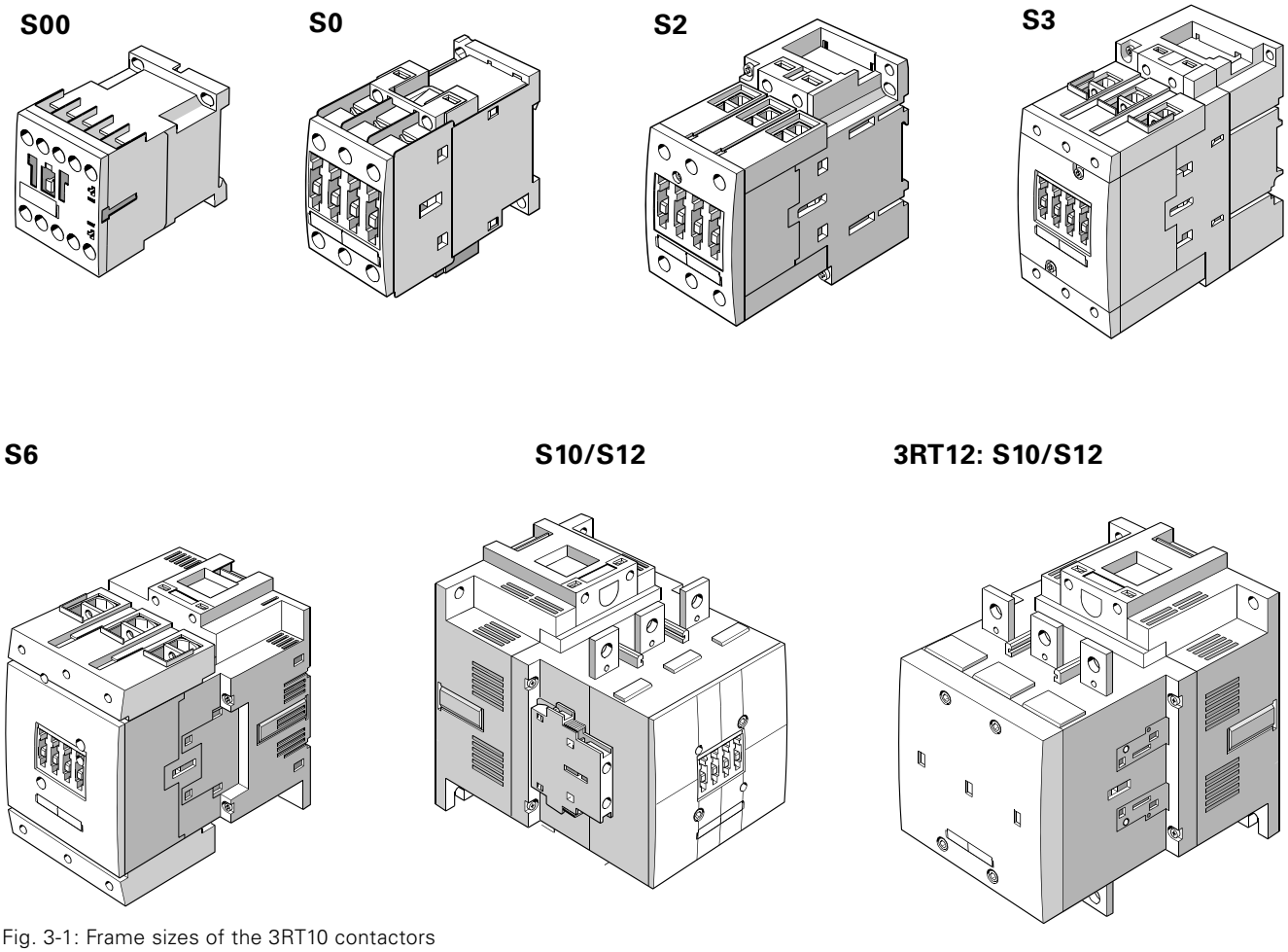


Fig. 3-1: Frame sizes of the 3RT10 contactors

Performance ranges The following table specifies the performance ranges for the frame sizes of the 3RT10 and 3RT12 contactors:

Frame size		S00			S0				S2				S3		
Order-Number		3RT10..			3RT10..				3RT10..				3RT10..		
		15	16	17	23	24	25	26	33	34	35	36	44	45	46
P/AC-3/400	kW	3	4	5.5	4	5.5	7.5	11	13	15	18.5	22	30	37	45
Hp/460V/60Hz	HP	3	5	7.5	5	7.5	10	15	20	25	30	40	50	60	75
to 400 V:									up to 500 V:						
I_e/AC-3	A	7	9	12	9	12	17	25	28	32	40	50	65	80	95
Width	mm	45			45				55				70		

Frame sizes		**S6**			**S10**						**S12**			
Order-Number		3RT10..			3RT10..			3RT12..			3RT10..		3RT12..	
		54	55	56	64	65	66	64	65	66	75	76	75	76
P/AC-3/400	kW	55	75	90	110	132	160	110	132	160	200	250	200	250
Hp/460V/60Hz	HP	100	125	150	150	200	250	150	200	250	300	400	300	400
to 500 V:								to 1000 V:			to 500 V:		to 1000 V:	
I_e/AC-3	A	115	150	185	225	265	300	225	265	300	400	500	400	500
Width	mm	120			145						160			

Table 3-5: Performance ranges of the 3RT10/3RT12 contactors

The following table provides an overview of the existing variants of the 3RT contactors and 3RH control relays:

Design		Frame size
3RT10 contactors	AC/DC operation To operate motors, 3-pole, up to 250 kW/400 V (400 HP/460 V) I_e/AC-1 up to 40 °C: up to 610 A up to 690 V I_e/AC-3 up to 60 °C: up to 500 A/400 V	S00 to S12
3RT12 Vacuum contactors	AC/DC operation To operate motors, 3-pole, up to 250 kW/400 V (400 HP/460 V) I_e/AC-1up to 40 °C: up to 610 A up to 1000 V I_e/AC-3 up to 60 °C: up to 500 A up to 1000 V	S10 to S12
3RT14 contactors	AC/DC operation To switch resistive loads, 3-pole I_e/AC-1 up to 40 °C: to 690 A to 690 V	S3 to S12
3RT13 contactors	AC/DC operation, 4 main contacts (NO contacts) To switch resistive loads, up to 92 kW/400 V I_e/AC-1 up to 40 °C: up to 140 A to 690 V	S00 to S3
3RT15 contactors	AC/DC operation, 4 main contacts (2 NO contacts + 2 NC contacts) To switch three-phase induction motors up to 18.5 kW/400 V I_e/AC-3 up to 60 °C: up to 40 A to 400 V	S00 to S2
3RT16 contactors	AC operation To switch three-phase capacitors up to 50 kvar/400 V	S00, S0 and S3
3RH control relays/3RT contactors	DC operation with an extended operating range: 0.7 to 1.25 x U_S 3RT: to switch motors up to 45 kW/400 V I_e/AC-3 up to 70 °C: 95 A to 400 V 3RH: to switch auxiliary circuits I_e/AC-15/AC-14 up to 70 °C: 6 A/230 V	S00 to S3
3RT contactor relays (interface)	DC operation with an extended operating range: 0.7 to 1.25 x U_S To switch motors, 3-pole, up to 11 kW/400 V I_e/AC-3 up to 60 °C: 25 A to 400 V	S00 and S0
3RA13 contactor combinations	AC/DC operation To reverse up to 45 kW/400 V, I_e/AC-3: 95 A/400 V	S00 to S3**1)** S6 to S12**2)**
3RA14 contactor combinations	AC/DC operation, for wye-delta startup up to 75 kW/400 V, I_e/AC-3: 150 A/400 V	S00-S00-S00 to S3-S3-S2**1)** S6-S6-S3 to S12-S12-S10**2)**
3RH11 auxiliary contactors	AC/DC operation, to switch auxiliary circuits, 4-pole (basic unit) I_e/AC-15/AC-14 up to 60 °C: 6 A/230 V	S00
3RH14 latched auxiliary contactors	AC/DC operation, to switch auxiliary circuits, 4-pole (basic unit) I_e/AC-15/AC-14 up to 60 °C: 6 A/230 V	S00
3RH11 control relays (interface))	DC operation with an extended operating range (0.7 to 1.25 x $U_{S)}$ to switch auxiliary circuits, 4-pole I_e/AC-15/AC-14 up to 60 °C: 6 A/230 V	S00

Table 3-6: 3RT/3RH, Designs

1) Pre-wired and tested
2) available as components for self-assembly

Auxiliary contacts and snap-on accessories

- A uniform and diverse range of auxiliary switches and accessories that can be quickly upgraded and replaced is available for 3RT1 contactors up to 45 kW for various applications.
- The 3RH auxiliary contactors can be extended to form variants with a maximum of 8 poles using attachable 2 or 4-pole auxiliary switch blocks.
- Wiring kits with and without mechanical interlocking are available for putting together 3RA contactor combinations for reversing and for wye-delta starting.

The accessories are described in detail in Section 3.4, "Accessories".

3.2.1 Coil systems S00 to S3

AC coil for AC-control	• Automatic reduction from high closing power to low holding power • Short switching times
DC coil for DC-control	• Larger unit volumes (to achieve a tensile force comparable to that of an AC coil) • Closing power = holding power • Longer switching times

Table 3-7: Coil systems

3.2.2 Coil systems S6 to S12

The SIRIUS-contactor frame sizes S6 to S12 include the following designs:

- Air-break contactors in 3 frame sizes
  - 3RT10, switching of motors
  - 3RT14, AC-1-applications
- 3RT12 Vacuum contactors in 2 frame sizes for the switching of motors
- 2 magnetic coils, both for UC-operation:
  - conventional coil
  - electronic coil
- Withdrawable coils

Coil types "conventional" and "electronic"

The similarities between the two coil types are:
UC-operation, this means the contactors can be controlled with either AC (40 to 60 Hz) or DC.
Integrated coil protective circuit with varistor. For most applications, this should be a sufficient protective circuit against the switching overvoltage of the magnetic coil. For especially sensitive applications where further steps to dampen the effects may be necessary, an additional RC-element (accessory) can be plugged in.
Exception:
For the designs with the Remaining lifetime indicator an additional RC-element cannot be plugged in.

The following graphic shows the withdrawable coils for the air-break and vacuum contactors in frame sizes S6 to S12:

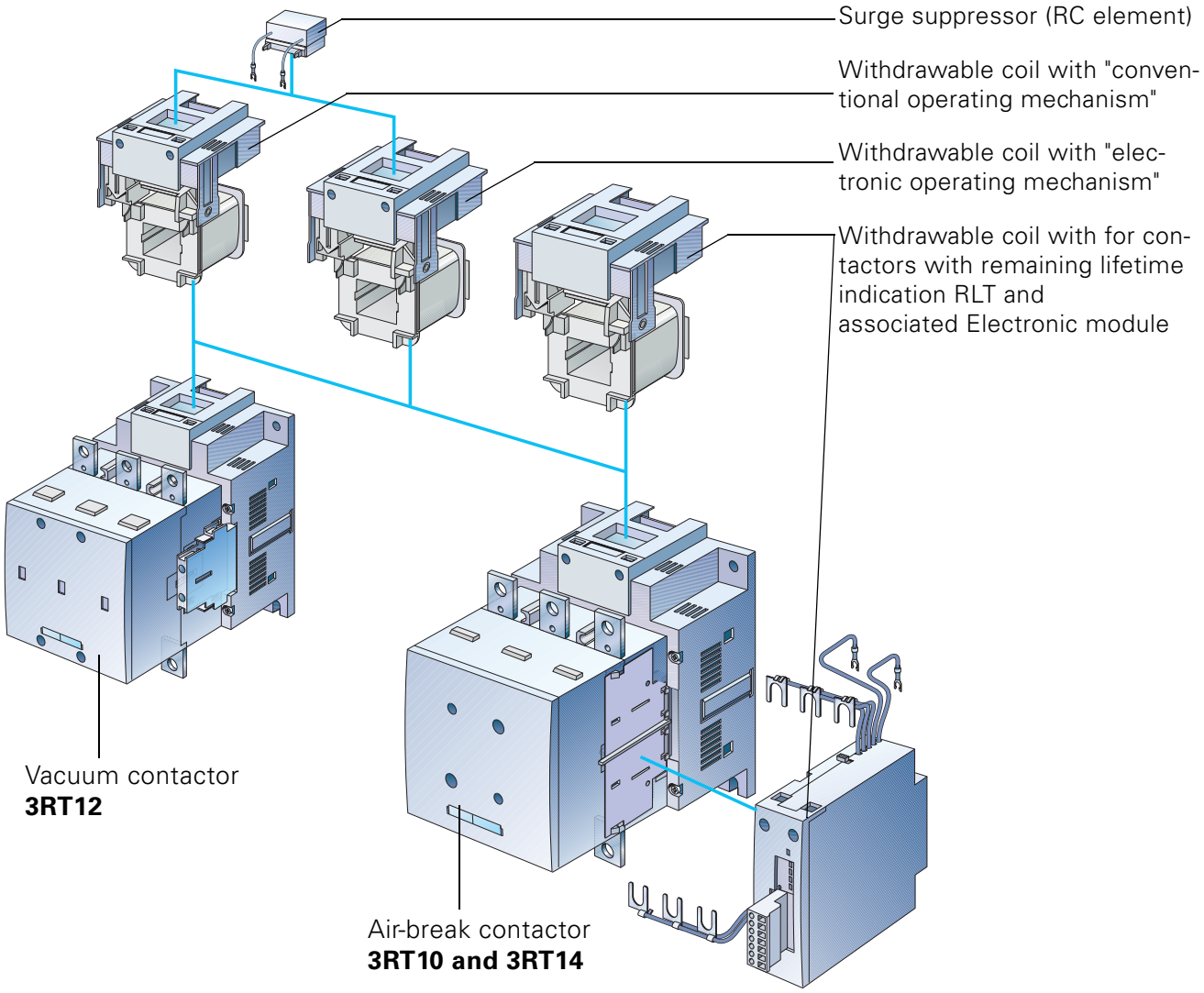


Fig. 3-2: Withdrawable coils for the air-break and vacuum contactors frame sizes S6 to S12

3.2.2.1 The conventional coil

The control voltage is directly connected to the magnetic coil over the A1/A2 terminals to close and open the switch. After the coil is energized and the contacts close, a built-in changeover contact (SPDT) switches the magnetic coil from pick-up - to holding coil (DC-economy connection).

Control voltage

Several control voltages that are close to each other can be covered with a single coil, for example UC 220 - 230 - 240 V.

Coil voltage tolerance

The operational range is 0.8 x $U_{s\ min}$ - 1.1 x $U_{s\ max}$.
That means for example: 0.8 x 220 V - 1.1 x 240 V.

3.2.2.2 The electronic coil, in general

The magnetic coil is supplied with the power necessary for reliable switching and holding by internal series-connected control electronics.

Emergency-Stop

Attention
The control of the coil with a semi-conductor element, the control inputs (PLC, AS-Interface), may not be used for Emergency-Stop purposes.
For Emergency-Stop the contactor must be turned off over A1/A2 terminals

Control voltage

Compared to the conventional coil, the electronic coil covers an even wider range of globally available control voltages within a single coil variation, for example UC 200-208-220-230-240-254-277 V.

Extended coil voltage tolerance 0.7 – 1.25×U_S

When you take the coil voltage tolerance of $0.8 \times U_{S\ min}$ – $1.1 \times U_{S\ max}$ into consideration along with the wide rated voltage range of the electronic coil you'll find that the most common control voltages of 24, 110, 230 and 240 V have an extended coil voltage tolerance of at least $0.7 – 1.25 \times U_S$ in which the contactor will function properly.

Defined pick-up voltage and drop-out voltage thresholds

The control electronics monitor the incoming control voltage to an allowable lower limit value with which the contactor can reliably function.
- The coil picks-up at a control voltage $\geq 0.8 \times U_{S\ min}$
- The coil drops-out at a control voltage $\leq 0.5 \times U_{S\ min}$

With the Hysteresis in the switching threshold, chattering of the main contacts is avoided and thereby also avoiding increased wear or welding when in operation with weak, instable power networks.
The pick-up voltage threshold prevents coil burn out when someone applies too low of a control voltage to the coil, such as can happen with a conventional coil.

Short term bridging during voltage dips

The loss of control voltage to the coil (0 V on A1/A2) is bridged up to about 25 ms which prevents unwanted coil drop-out.

Electromagnetic compatibility (EMC)

The contactors with electronic coils meet the necessary requirements with regards to noise immunity/ emitted interference for the use in industrial applications:.

Noise immunity	Burst	IEC 61 000-4-4	4 kV
	Surge	IEC 61 000-4-5	4 kV
	Electrostatic discharge, ESD	IEC 61 000-4-2	8/15 kV
	Electromagnetic field	IEC 61 000-4-3	10 V/m
Emitted interference	Limiting value	EN 55 011	A

Table 3-8: Electromagnetic compatibility

Planning note
When in operation in or around converter power circuits, it should be noted that the control wiring to the contactor should be installed separately from the load side wiring of the converter.

3.2.2.3 Electronic coil

Designs The electronic coil comes in three different designs to choose from:

Design		for contactor type
3RT1...-.**N**	for PLC-output 24 V DC	3RT10 / 14 Air-break contactors 3RT12 Vacuum contactor
3RT1...-.**P**	for PLC-output 24 V DC or PLC-relay output; with Remaining lifetime indicator RLT	3RT10 / 14 Air-break contactors
3RT1...-.**Q**	with integrated AS-Interface-port; with Remaining lifetime indicator RLT	

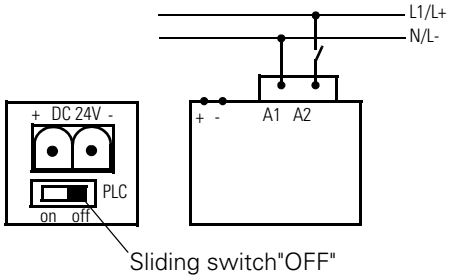
Table 3-9: Electronic coil

Electronic coil design 3RT1...-.N for PLC-output 24 V DC

There are 2 ways to control the contactor:
- using A1/A2 terminals
- using a PLC-output, 24 V DC

Control

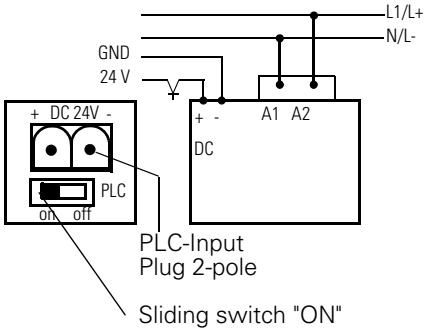
Control using A1 / A2 terminals



The contactor is controlled in the conventional manner by applying the control voltage to the A1/A2 terminals from a switching contact

Note
The small sliding switch on the front left side of the withdrawable coil needs to be in the "OFF" position (this is the default setting from the factory). Otherwise, the contactor cannot be activated at the A1/A2 terminals.

Control using PLC

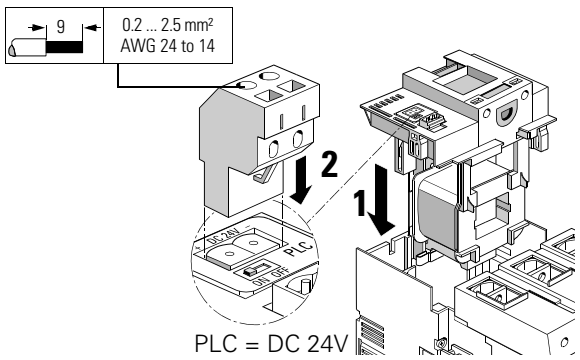


The contactor is controlled directly by the PLC without a coupling device:
- with 24 V DC
- over PLC-control input (EN 61 131-2/Type 2)
- with current consumption ≤ 30 mA
- with an operational range of 17 to 30 V DC

The control voltage to energize the magnetic coil is connected at A1/A2.

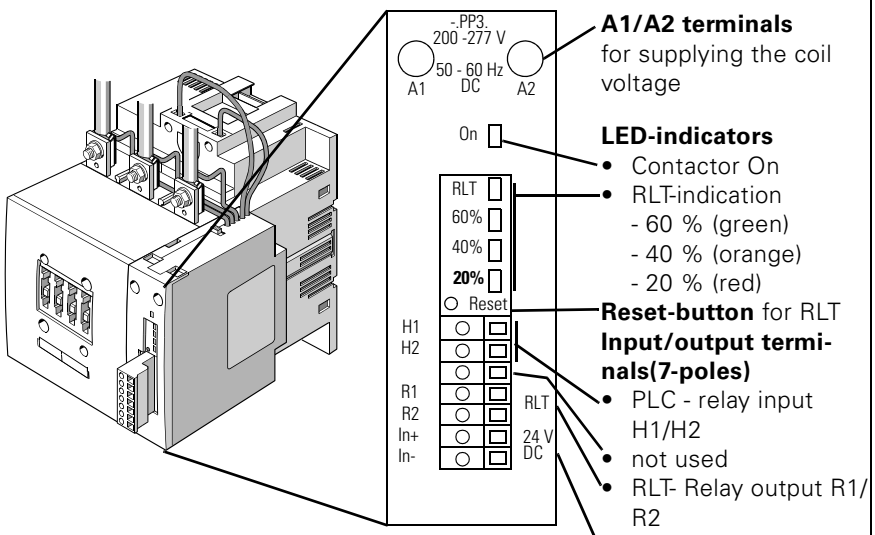
Note
The small sliding switch on the front left side of the withdrawable coil needs to be set to the "ON" position before use (the default setting from the factory is"OFF").

PLC-connection



The PLC - connects to a 2 pole plug-in connector on the front left side of the withdrawable coil (The Cage Clamp- plug-in connector comes with delivery). The polarity is marked on the plug-in connector.
The complete control electronics are contained in the withdrawable coil. The magnetic coil and the control electronics make up one device.

Design 3RT1...-.P for PLC-output, 24 V DC or PLC-relay output with remaining lifetime indication, RLT



A1/A2 terminals
for supplying the coil voltage

LED-indicators
- Contactor On
- RLT-indication
  - 60 % (green)
  - 40 % (orange)
  - 20 % (red)

Reset-button for RLT

Input/output terminals(7-poles)
- PLC - relay input H1/H2
- not used
- RLT- Relay output R1/R2
- PLC-Input 24 V DC , IN+/IN-

The entire electronics portion of the models with remaining lifetime indication RLT is contained in a side mounted electronic module. The withdrawable coil piece (for RLT) only contains the magnetic coil. The coil is connected to the side mounted electronic module by wires with tab connectors in order to avoid confusion with other coils when changing them out.
The cables connected to the line and load side of the contactor are used for the remaining lifetime indication RLT detection.

"Remaining lifetime RLT" warning signal

When the remaining lifetime reaches 20 %, a warning signal is provided over a free floating relay contact (NO, hard-gold plated, encapsulated) at the R1/R2 terminals and can be processed through SIMOCODE-DP inputs, PLC inputs or elsewhere.
Current ratings of the R1/R2 relay output:
- Ie/AC-15 at 24 ... 230 V: 3 A
- Ie/DC-13 at 24 V: 1 A

Control

The contactor can be controlled:
- by PLC-output 24 V DC
- by a relay output, for example from a PLC, SIMOCODE-DP.

Power supply

The control voltage *U*s needs to be applied to the A1/A2 terminals of the side mounted electronic module, this supplies power for the magnetic coil and the remaining lifetime indication.

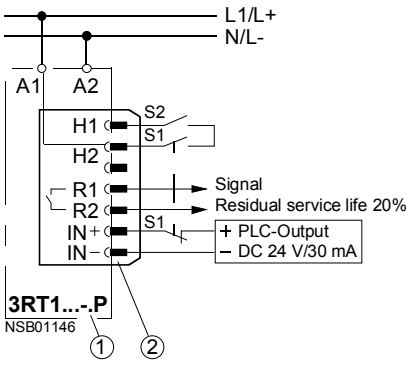
Control inputs

The control inputs for the contactor are connected on the 7-pole terminal block (The terminals supplied with the unit have Cage Clamp-Technology).

Switching from Automatic-/Manual control

Control of the contactor can be switched from automatic control to manual control using the input terminals H1/H2. Manual control may be required at start-up or to switch the contactor after loss of power on a PLC or SIMOCODE-DP device.

Control with a PLC with 24 V DC



① Electronic module of 3RT1...-.P contactor
② Plug-in connection, 7-pole

S1 Changeover switch from automatic control via PLC semiconductor output to on-site control

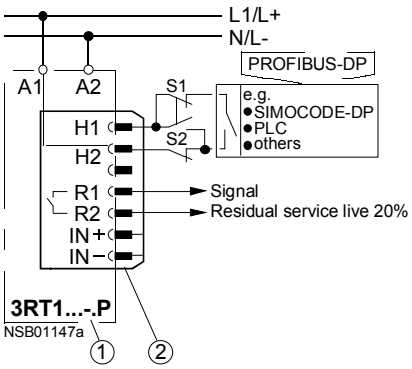
S2 On-site control option

Control directly from a PLC with 24 V DC without a coupling device

- via PLC -control input IN+/IN– (EN 61 131-2/Type 2)
- Current consumption ≤ 30 mA
- Operational range17 to 30 V DC

Note
H2 and A1 are internally connected and therefore have the same voltage potential

Control using relay outputs



① Electronic module of 3RT1...-.P contactor
② Plug in connection, 7-pole

S1 Changeover switch from automatic control, e.g., via SIMOCODE-DP or PLC relay output on-site control option

S2 On-site control option

Control using relay outputs, for example from:

- PLC
- SIMOCODE-DP (3UF5)

Relay outputs can control the contactor through the H1/H2 terminals.
The relay contacts are loaded to about 5 mA plus the control voltage applied at the A1/A2 terminals

Note
H2 and A1 are internally connected and therefore have the same voltage potential

Wiring example

Contactor combinations with PLC-Control 24 V DC

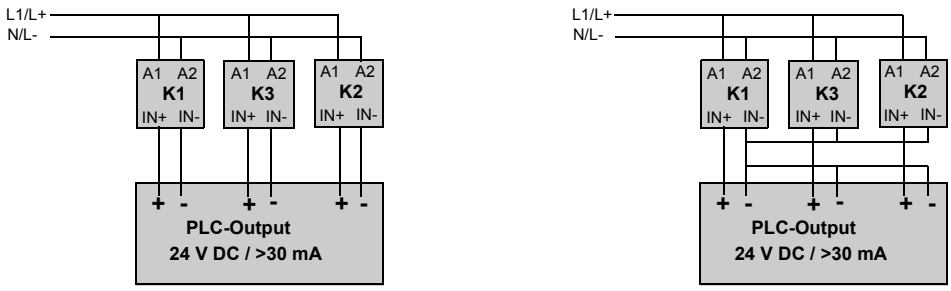


Fig. 3-3: Wiring example: Contactor combinations with PLC control 24 V DC

Contactor combinations with relay control

Important Note

- The terminals H1 shouldn't be bridged, otherwise all of the contactors will close when only one contactor should close.
- The terminals H2 shouldn't be bridged, otherwise the internal connection of A1 to H2 can be overloaded in the event of a failure.

Control using relay outputs with a common source

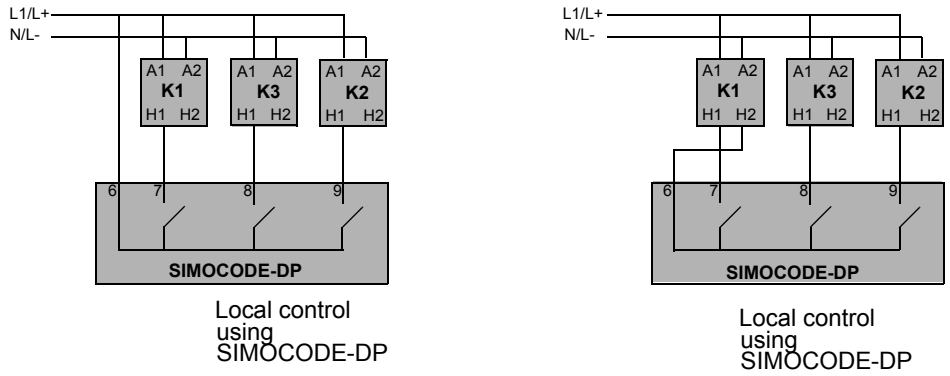


Fig. 3-4: Wiring example: Control using relay outputs with a common source.

Control using electrically isolated/ free floating relay outputs

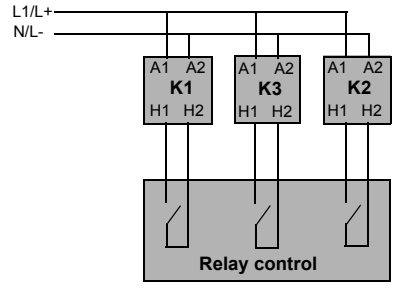
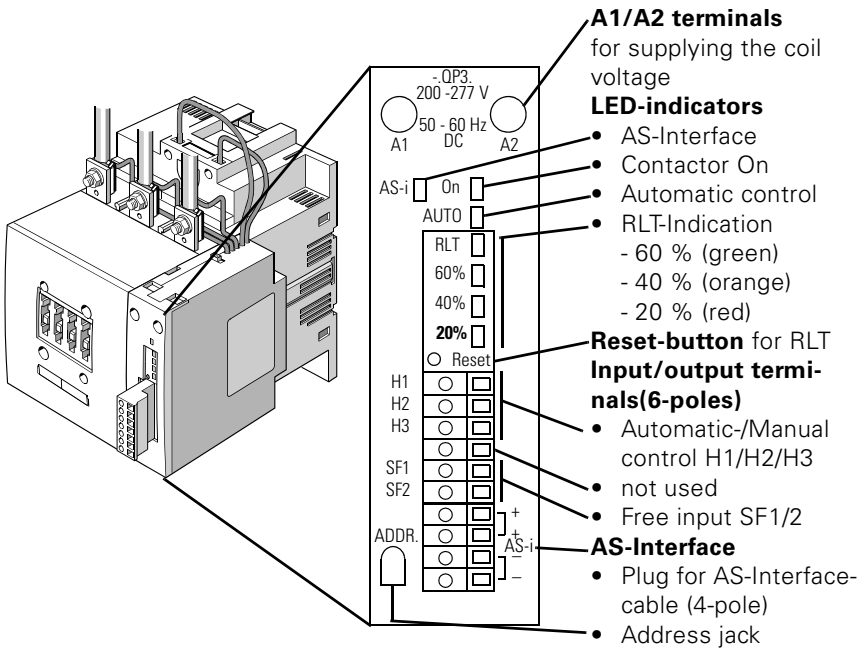


Fig. 3-5: Wiring example: Control using electrically isolated/ free floating relay outputs

Design 3RT1...-.Q with integrated AS-Interface-connection, with remaining lifetime indication RLT



The entire electronics portion of the models with remaining lifetime indication RLT is contained in a side mounted electronic module. The withdrawable coil piece only contains the magnetic coil. The coil is connected to the side mounted electronic module by wires with tab connectors in order to avoid a mix-up with other coils when changing out coils.
The cables connected to the line and load side of the contactor are used for the remaining lifetime indication RLT detection.

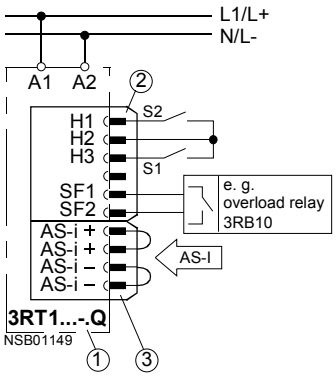
Control

The control voltage *U*s needs to be applied to the A1/A2 terminals of the side mounted electronic module. This supplies power for the magnetic coil and the remaining lifetime indication.
The control of the contactor takes place using the integrated AS-Interface connection. Inputs and outputs are connected using 2 plug-in connectors; 6-poles for external switching and 4-poles for AS-Interface-connection (The device comes with the plug-in terminals in Cage Clamp-Technology)

Switching from Automatic-/Manual control

Control of the contactor can be switched from automatic control to manual control using the input terminals H1/H2/H3. That means the contactor can be manually controlled at start-up or after power loss due to disruption/malfunction of the automatic control using AS-Interface.

Controlling the contactor using AS-Interface



① Electrinics module of 3RT1...-.Q contactor
② Plug-in connection, 6-pole
③ Plug-in connection, 4-pole

S1 Changeover switch from automatic control, e. g. via AS-Interface, to local control
- S1 open: automatic mode

S2 Local control option

Controlling the contactor using AS-Interface

The AS-Interface + / AS-Interface – terminals are located on a 4 pole plug-in connector that is separate from the other terminals. Each terminal has two Cage Clamp connections. The two AS-Interface + and AS-Interface – terminals are jumpered as shown.

- The advantages are:
  - The AS-Interface-cable isn't interrupted if the terminal connector is removed
  - new addressing isn't necessary
  - The contactor remains functional using the local control inputs on its own 6 pole terminal connector

Control signals using AS-Interface

- Contactor ON/OFF

Warning signals using AS-Interface

- Contactor ON/OFF
- Automatic-/Manual control
- Remaining lifetime indicator RLT
- Signals on the free input SF1/ SF2 , such as Overload relay trip

Note

H2 and A1 are internally connected and have the same voltage potential.

Actuator-Sensor-Interface: Technical Data

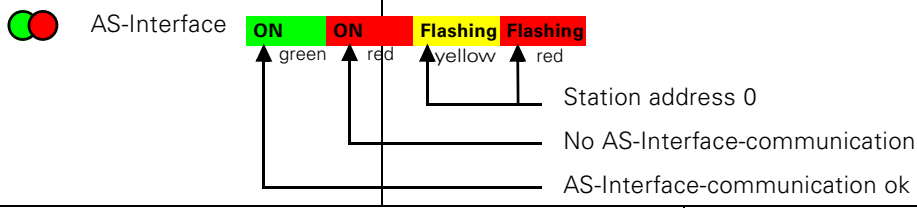
I/O-Configuration (Hex) ID-Code (Hex)			7 F	
Operational voltage		V	25.5 to 31.6 (in acc. with the AS-Interface-specification)	
Current draw/AS-Interface		mA	max. 20	
Contact rating SF 1/2		mA	3 to 6	
Watchdog-Function (disconnection of the outputs with AS-Interface-fault)			built in	
Indicator reaction	**LED**		**Status**	**Status description**
While in operation the LEDs show the status, as shown to the right				
Diagnosing the contactors using the application program				
•Inputs			•Outputs	
Input signals	Device status		Output signals	Device status
DI0 "ready"	0	Device not ready/Manual operation	DO0 "running" 0	Contactor OFF
	1	Device ready/Automatic operation	1	Contactor ON
DI1 "running"	0	Contactor OFF	DO1 0	—
	1	Contactor ON	1	—
DI2 "remaining life time"	0	Remaining lifetime RLT > 20%	DO2 0	—
	1	Remaining lifetime RLT < 20%	1	—
DI3 "free input"	0	No input signal at SF 1/2	DO3 0	—
	1	Input signal at SF 1/2	1	—

Table 3-10: Actuator-Sensor-Interface, technical data

3.2.2.4 Remaining life time indication RLT (RLT = remaining life time)

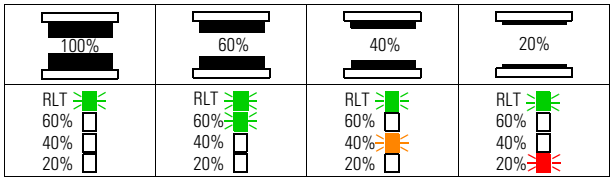
For the 3RT10 and 3RT14 air-break contactors there is an option with the electronic coils with the attribute "remaining lifetime indication RLT". The function of RLT is that it detects the wear of the main contacts and indicates optically and electrically a pending contact change for the plant operator.

Function

The main contacts of the contactor are wearing parts and should be changed quickly once they reach the end of their service life. The erosion of the contact material and therefore the electrical service life (=the number of operations) depends on the load, utilization category, duty type, etc.. Routine inspections / visual checks by maintenance staff are needed to provide information as to the condition of the main contacts. The "Remaining lifetime indicator" eliminates this task. The number of operations isn't counted – because that doesn't provide any information on contact wear. The actual progress of contact erosion on each one of the 3 main contacts is determined electronically. It is evaluated and then stored. When a determined limit is reached, a warning signal is sent. Stored data is not lost if there is a loss of the control voltage.
After changing the main contacts the remaining lifetime indication needs to be reset by pressing the RESET button. This will restart the evaluation process.

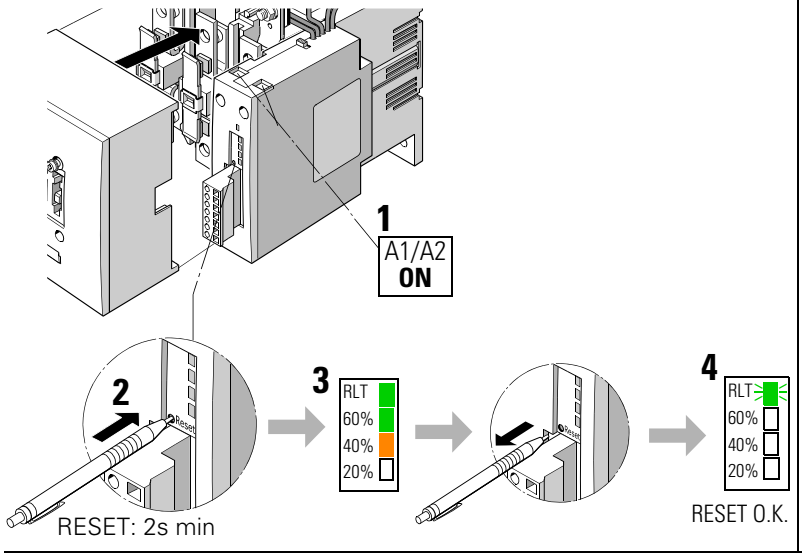
Warning signals

The warnings are sent either using a free floating relay contact or using the integrated AS-Interface connection. Once 20 % of the remaining lifetime is reached, which means that 80 % of the contact material is worn and the changing of the main contacts should be planned.



The various erosion levels are shown using LEDs on the contactors' side mounted electronic module:
60 % of the remaining lifetime (green LED)
40 % (orange)
20 % (red)

Resetting the remaining lifetime indicator RLT



When resetting the remaining lifetime indicator after changing the main contacts the following needs to be considered:

- The control voltage must be applied to A1/A2 **(1) and** the contactor must be off.
- Press the RESET-button on the side mounted electronic module with a ball point pen or something similar for about 2 sec. **(2)** until the green LED "RLT" is the only one lit **(3)**
  = Reset complete **(4)**

Advantages of Remaining lifetime indication RLT

- Timely notification for the switching of the main contacts
- Optimal use of the contact material
- Makes visual inspection of the contacts unnecessary
- Reduces the maintenance costs
- Optimizes planning for maintenance steps
- Avoids unforeseen system shutdown

Notes for the use of contactors with remaining lifetime indication RLT

Use in rotor circuits by wound-rotor motor

A typical measuring parameter of the RLT function is the voltage over the main contacts of the contactor when breaking (turning off the contactor). However, voltage levels in rotor circuits can vary depending on slip, so that they not suitable for evaluation and could lead to premature warning of the RLT.

Residual current across the main contacts

The resistance of the individual measuring circuits across the main contacts is 4.8 MOhm per pole. This high ohm resistance value eliminates hazardous shock current, or rather touch potential, on the load side when the contactor is turned off.

Operational switching at terminals A1/A2

Operational switching at terminals A1/A2 leads to an error message from the RLT. The control inputs (PLC, AS-Interface) should be used for the operational switching. Exceptions are installation shutdowns; the measuring value remains stored (E²PROM). Use the control inputs PLC/AS-Interface for the operational switching of the contactor.

3.2.3 Short-circuit protection for SIRIUS contactors

Section 3.7, "Technical specifications", has information on short-circuit protection. Fuses and circuit breakers can be used as short-circuit protective devices for the contactors.
The test criteria that apply in this case are stipulated by EN 60 947-4-1 (VDE 0660 Part 102).

Coordination types

Two types of assignment are defined in the standards that correspond to two different levels of damage.
The following applies to both types of assignment:
In the event of a short-circuit, the short-circuit protective device used must be able to disconnect the overcurrent that occurs. Persons or other parts of the system must not be put at risk.

Coordination type 1

The load feeder (e.g. motor starter) can be inoperable after each short-circuit. Damage to the contactor and the overload relay is permissible and it is only possible to continue operation after defective devices have been repaired or replaced.

Coordination type 2

After a short-circuit, there must be no damage to the load feeder devices. However, the contactor contacts can weld if they can be easily separated again without distorting the contact pieces.

"weld free"

There is information in the catalog, for weld free protection of the contactors that needs to be taken into account.

Contactors with overload relay

If contactors are combined with an overload relay, a smaller fuse should be used as specified in the controls catalog for permissible short-circuit protection fuses for motor starters.

3.2.4 Operation

3.2.4.1 General information

Degree of protection

The degree of protection of the SIRIUS contactors is IP00/IP20.

Warning
When the supply voltage and load are present, the contactor must not be actuated by pressing the contact support. It is permissible, however, to carry out tests with an extra-low test voltage (e.g. ≤ 24 V).

Mechanical life

A significant criteria for the economical use of contactors is their mechanical endurance. This is expressed in the number of operations that are possible without placing a load on the conducting path. You cannot expect too much in terms of mechanical endurance from switches that have to work with a relatively high contact load, such as isolators and circuit breakers, without neglecting their cost-efficiency. Contactors, on the other hand, are switching devices designed specifically for very high numbers of on/off operations. The following table shows you the mechanical endurance of 3RT1 contactors:

Device	Mechanical endurance
Basic unit, frame size S00	30 mill. operating cycles
Basic unit, frame size S00 with built-on auxiliary switch block	10 mill. operating cycles
Basic unit, frame sizes S0 to S12	10 mill. operating cycles
Basic units, frame sizes S00 to S3 with built-on, electronically optimized auxiliary switch block	5 mill. operating cycles

Table 3-11: Mechanical service life

When there is no arcing during switching the mechanical endurance can be optimized if low current is used (for example, 17 V 5 mA).

Display of the contactor function

The 3RT1926 LED indicator block can be connected to the coil connections of the contactors in frame sizes S00 to S3. It indicates the status of the contactors by means of the yellow LED. The indicator block can be snapped onto the front in the opening intended for the inscription plate.
The advantage is that the LED indicator block can be used for AC/DC voltages of 24 V to 240 V and that it is protected against polarity reversal.

3.2.4.2 Contact reliability

In industrial control engineering, conventional contactor controls are often combined with electronic control systems. Combining these systems gives rise to higher demands than those when using only conventional contactor controls.
An important requirement is that the signal generators (auxiliary contacts of contactors, for example) display high contact reliability at low voltages and currents, while retaining their full switching capacity at high voltages.

Switching with auxiliary contacts (≤ 110 V and ≤ 100 mA)

The following applies to the contactors of the SIRIUS range:
If voltages ≤ 110 V and currents ≤ 100 mA are to be switched, the auxiliary contacts of the 3RT1 contactors or the 3RH1 auxiliary contactors should be used instead of the main contacts because of their contact reliability. This comes from their high contact stability due, in particular, to the shape of the contact pieces (cross-ribbing).
This ensures that the points of contact remain conductive in spite of surface contamination.

These auxiliary contacts are suitable for electronic circuits (programmable controllers) with voltages > 17 V and currents in the milliampere range (test circuit: 17 V, 5 mA).

Cross-ribbing

Surface contamination is the most common cause of control circuit contact faults. Cross-ribbing the contact areas is an extremely effective way of increasing contact reliability. All the auxiliary contacts of the SIRIUS contactors have this feature.
The following illustration show you how cross-ribbing is particularly effective against surface contamination due to the high number of contact areas and high surface pressure:

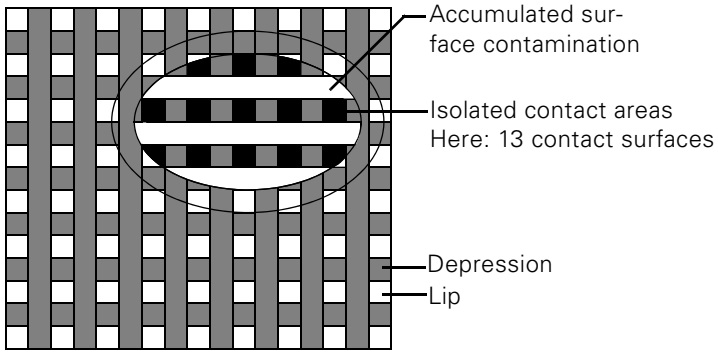


Fig. 3-6: Contact areas

Contact reliability of the auxiliary contacts

The contact areas of the SIRIUS auxiliary contacts display a high degree of contact reliability. Fault frequency rates of $H_F \leq 10^{-8}$ (i. e. < 1 fault per 100 mill. operating cycles at 17 V, 1 mA) have been registered.
These values apply to auxiliary contacts that are either integrated in the contactor housing or can be snapped on as auxiliary switch blocks.
In the case of built-on auxiliary switch blocks at the side, fault frequency rates are between 10^{-6} and 10^{-8}.
The tests are based on the requirements placed on signal generators by electronic controllers.
This means that with the auxiliary contacts of the SIRIUS contactors or auxiliary contactors, the permissible contact resistance is only exceeded once during a total of 10^8 (100 million) switching operations. During a long period of operation, therefore, a fault is not expected to occur, irrespective of the number of switching operations.
A restriction applies in the case of auxiliary switch blocks built on at the side.

Definition of switch fault frequency H_F

The fault frequency H_F is defined as the number of contact faults that occur during a certain number of switching operations.

3.2.4.3 Electrical service life

Electrical service life of the main contacts

The service life of the contacts consists of:

- at rated operational current I_e is defined in acc. with utilization category AC-4 (switching off 6 times the rated operational current):
  200 000 operating cycles
- at mixed modes - in other words, if normal switching mode (the rated operational current is switched off in acc. with utilization category AC-3) is mixed with occasional inching mode (several times the rated operational current is switched in acc. with utilization category AC-4):
  the service life can be roughly calculated with the following formula:

$$X = \frac{A}{1 + \frac{C}{100} \cdot \left(\frac{A}{B} - 1\right)}$$

Key to the formula:

X Contact service life in mixed mode in operating cycles
A Contact service life in normal operation (I_a=I_e) in operating cycles
B Contact service life in inching mode (I_a = a multiple of I_e) in operating cycles
C Percentage of the total number of switching operations accounted for by inching operations

Characteristic curve: contact service life of the main contacts

The following characteristic curves illustrate the contact service life of contactors when switching inductive three-phase loads (AC-1/AC-3), irrespective of the breaking current and rated operational voltage. The prerequisites are arbitrary (i.e. not synchronous with the phase relation of the control station operating the network).

I_a = breaking current
I_e = rated operational current
P_N = rated output of three-phase induction motors with squirrel cage at 400 V

Frame size S00

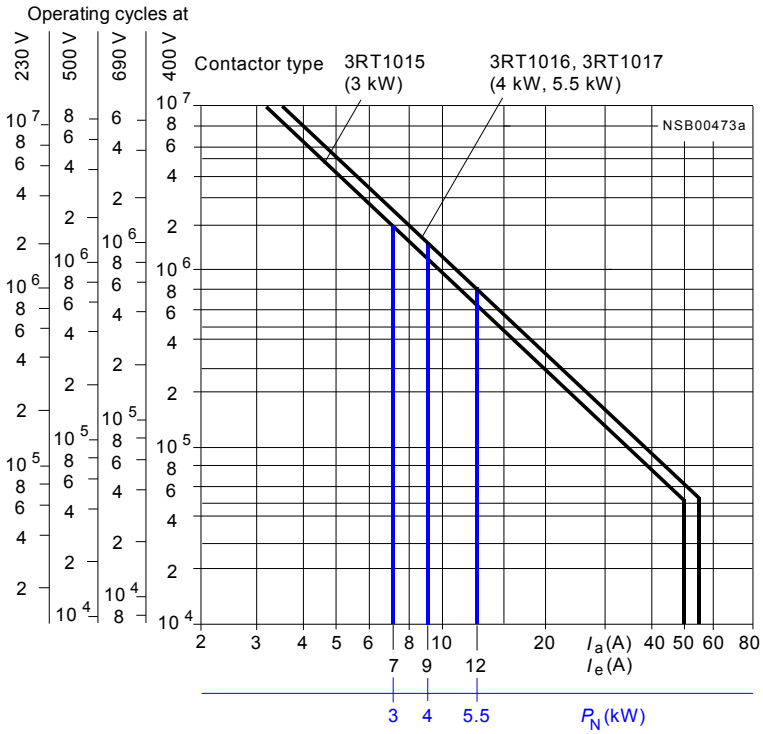


Fig. 3-7: Characteristic curve of the electrical service life of the main contacts (frame size S00)

Frame size S0

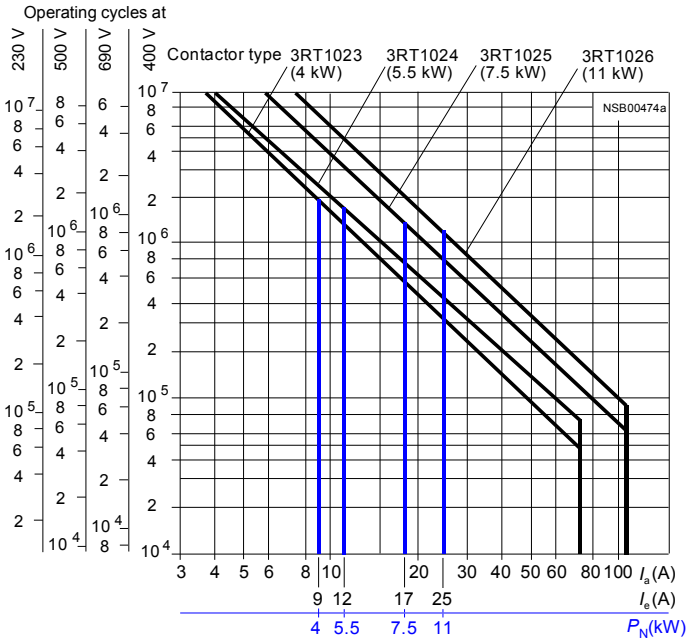


Fig. 3-8: Characteristic curve of the electrical service life of the main contacts (Frame size S0)

Frame size S2

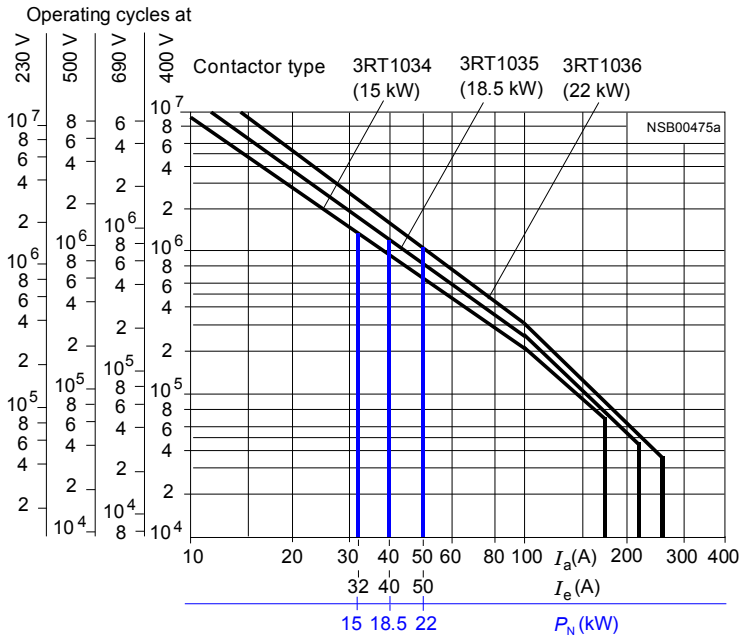


Fig. 3-9: Characteristic curve of the electrical service life of the main contacts (Frame size S2)

Frame size S3

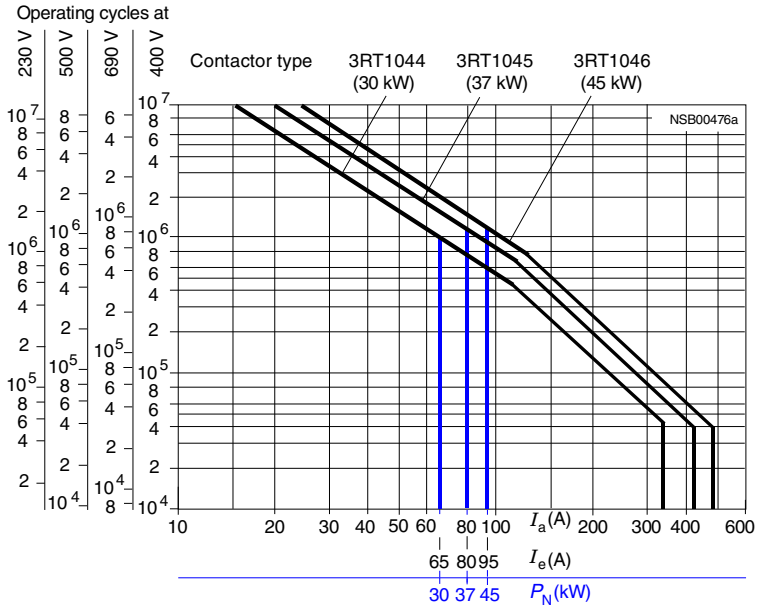


Fig. 3-10: Characteristic curve of the electrical service life of the main contacts (Frame size S3)

Frame sizes S6 to S12

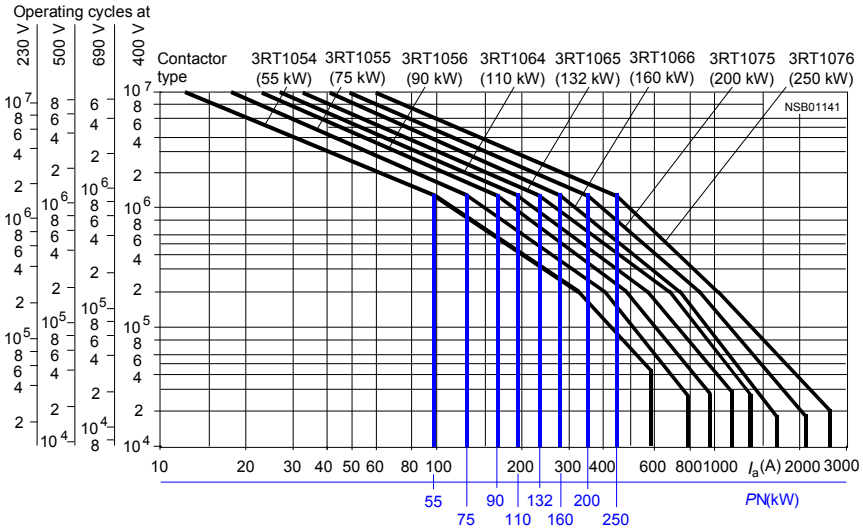


Fig. 3-11: Characteristic curve of the electrical service life of the main contacts (Frame size S6 to S12)

3RT12 Vacuum contactor

Frame sizes S10 and S12

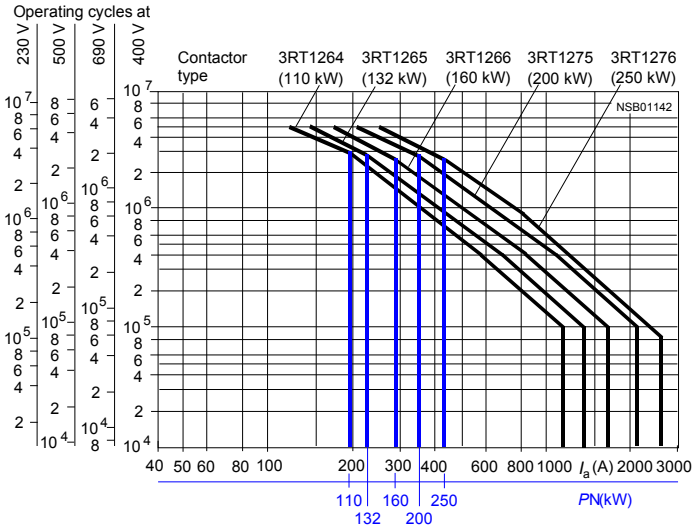


Fig. 3-12: Characteristic curve of the electrical service life of the main contacts of the Vacuum contactors (Frame sizes S10/S12)

Characteristic curve: contact service life of the auxiliary contacts

The contact service life depends on the breaking current. The prerequisites are arbitrary (i.e. not synchronous with the phase relation of the control station operating the network).
The characteristic curves apply to:

- Integrated 3RT10 auxiliary contacts
- 3RH1911 auxiliary switch blocks for contactors in frame size S00
- 3RH1921 auxiliary switch blocks for contactors in frame sizes S0 to S3

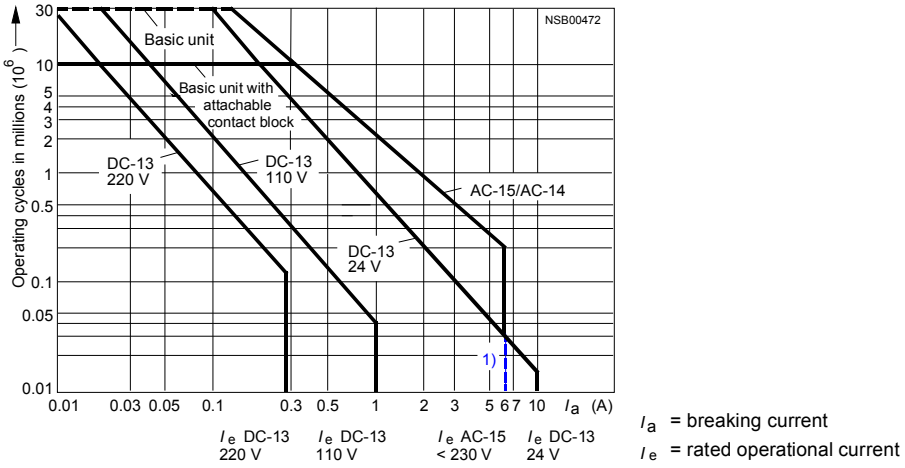


Fig. 3-13: Characteristic curve of the electrical service life of the auxiliary contacts

1) DC-13: built-on auxiliary switch blocks for frame size S00: 6 A

3.2.4.4 Ambient temperature

General information

The 3RT10 contactors are designed for use with an ambient temperature of -25 °C to +60 °C. Special designs are available to be used at -35 °C to +70 °C.

Use at higher ambient temperatures

The use of contactors in frame sizes S00 to S3 at higher ambient temperatures is possible when different limitations are taken into consideration.

Short time operation at $T_U \leq$ 80 °C

For the duration of 1 hour the contactor may be used up to a maximum ambient temperature of Tu ≤ 80 °C without derating the rated current. However, this requires that an average 24 hour mean ambient temperature of Tu ≤ 60 °C is not exceeded.
Limitation:
Contactors that contain electronic components or are combined with electronic accessories (for example integrated surge suppressor, electronic interface,...) may only be used up to a max. ambient temperature of Tu ≤ 60 °C.

Constant operation at an ambient temperature of Tu > 60 °C

The constant operation of the 3RT10 contactors at an ambient temperature of Tu > 60 °C is possible under the following guidelines.

Mounting

For better heat dissipation for contactors without side-mounted auxiliary contacts they should be mounted with a minimum 10 mm clearance when mounting side by side.
The following declarations are based on this clearance distance.

Thermal load carrying capacity of the main circuit

The standard contactors are designed for a max. ambient temperature of Tu = 60 °C.
For use of the contactors at higher ambient temperatures up to **max. 70 °C**, then the normal rated operational current Ie/AC-1 (or Ie/DC-1) and the operating frequency must be reduced.
The following calculations can be used:

$$Ie_{max.,Tu} = Ie/AC\text{-}1 \bullet \frac{60°C}{Tu} \qquad Ie_{max.,Tu} = Ie/DC\text{-}1 \bullet \frac{60°C}{Tu}$$

$$z_{max.,Tu} = z \bullet \frac{60°C}{Tu}$$

$Ie_{max.,Tu}$ =	the calculated rated current of the contactor at increased ambient temperature
Ie/ AC-1 bzw. Ie/ DC-1 =	Rated current of the contactor at the particular utilization category and Tu ≤ 60 °C
Tu=	Actual ambient temperature at Tu > 60 °C

Coil voltage tolerance

So that the contactor coil isn't thermally overloaded with the increased ambient temperature, the voltage tolerance of the rated coil voltage Us needs to be limited according to the Table.

Tu	S00	S0 to S3
60 °C	0.85 to 1.1 Us	0.8 to 1.1 Us
70 °C	0.85 to 1.0 Us	0.8 to 1.0 Us

Table 3-12: Coil voltage tolerance

Service life

The use of the contactors at higher ambient temperatures leads to increased stress of the plastic material, main circuits and the operating mechanism. This results in the reduction of the mechanical service life and time to failure of the contactor. The time to failure is decisively influenced by the running time.
The following table shows the reduced service life values:

	S00	**S0 to S3**	**S00 to S3**
Ambient temperature Tu	Mechanical service life [x10^6 operations		Time to failure [years]
≤ 60 °C	30	10	20
65 °C	15	5	15
70 °C	3	1	10

Table 3-13: Service life of the contactor 3RT10

The data given for the time to failure is based on a running time of 100 %. At a running time of 50 % the values are doubled.

Use of the contactors, frames sizes S00 to S3 at low ambient temperatures

The contactors in frame sizes S00 to S3 can be used with a minimum ambient temperature of Tu ³ -50 °C with up to a 50 % reduction mechanical service life.
The other catalog data remains the same.
There are steps that need to be taken against condensation (for example, control panel heating).
In low ambient temperature applications, high operating frequency and running time is less critical than low operating frequency and running time.
Contactors that contain electronic components or are combined with electronic accessories may not be used under Tu = -40 °C

3.3 Application and areas of use

Various switching devices are available for switching electrical loads. The contactor is the most suitable device for frequent switching operations. Contactors are the most commonly used switching device in industry, mechanical engineering and in switchgear and controlgear. Due to the increased automation in manufacturing, contactors have become more important. This has also increased the variety of loads that must be controlled.

Automated production systems are considerably more sensitive to operational malfunctions than manually operated systems. Each fault on an electrical device means downtime, waste, loss of production, and investment in order to get the system up and running again.
For this reason, we concentrated on high reliability when developing the SIRIUS contactor range. This includes, increased service life, high contact reliability, and the possibility to use the contactors at higher ambient temperatures in the enclosure. It is possible to use the contactors up to 60 °C without derating when the devices are installed in a row.

To deal with the variety of possible applications, there are also contactor variants for special applications, such as for switching resistive loads or capacitors. This is in addition to the main 3RT10 range of contactors for switching motors.
The different contactor ranges and their possible applications are described in the following subsections.

3.3.1 3RT10 contactors with 3 main contacts for switching motors

Field of application

The 3-pole 3RT10 contactors use 3 NO contacts as main contacts. They are mainly used to switch three-phase induction motors.

Frame sizes

The full performance range from 3 to 250 kW/400 V (utilization categories AC-2 and AC-3) (up to 400 HP/460 V UL508) is covered by 7 frame sizes. The frame sizes cover most of the standard motor outputs.

Dimensions

The contactors are provided with alternating or direct current magnetic systems. The required panel areas of the devices of the two operating mechanism types are the same. For frame sizes S0 to S3, the installation depth for contactors with the DC magnet system is between 10 mm and 15 mm greater than for the variants with the AC magnet system.

Power ratings

All the specified power and current ratings apply to an ambient temperature of 60 °C without derating.
For use at increased ambient temperatures see section 3.2.4.4 "Ambient temperature".

Increasing the power

The ease of expansion is an advantage for configuration. In many applications there is enough space to retrofit the contactor with the next higher rating class and thus increase motor output.

3.3.2 3RT14 contactors with 3 main contacts for switching resistive loads (AC-1)

Field of application

The 3RT14 contactors with 3 main contacts for switching resistive loads are used for applications in the AC-1 utilization category:

- Switching of resistive loads such as heating systems or resistance furnaces
- Applications in which a low switching capacity is sufficient
- Applications in which high continuous currents occur without peaks (e.g. as a generator contactor or in the case of variable-speed drives.

Switching capacity

1.5 times the I_e/AC-1 can be switched on and off. Switching off higher currents, with the emergency stop, for example, is possible up to 8 times the I_e/AC-3 current.

Comparison: 3RT14/ 3RT10

The following table shows you the difference between the 3RT14 and 3RT10 contactors for normal AC-3 applications:

	Contact material	Conducting paths
3RT14	Contact material with high current-carrying capacity and better thermal properties	Larger conducting paths that permit better cooling
3RT10	Contact material that ensures better switching capacity	

Table 3-14: Comparison between the 3RT14 and 3RT10 contactors

Planning note

The 3RT10 range of contactors for switching motors also has a specific AC-1 switching capacity. However the more economic solution would be to use the 3RT14 AC-1 contactor for this specific purpose.

Accessories

You can use the same accessories for the 3RT14 contactors as you can for the 3RT10 contactors.

3.3.3 3RT12 Vacuum contactors

Unlike the 3RT10 and 3RT14 air-break contactors – whose main contacts have to work in the air and under atmospheric conditions– The switching paths of the 3RT12 vacuum contactors are in hermetically encapsulated vacuum-switching tubes. They don't produce any open arching nor any switching gases.
Therefore a minimal clearance to grounded parts is not required.
The following graphic shows sectional view of the vacuum tube:

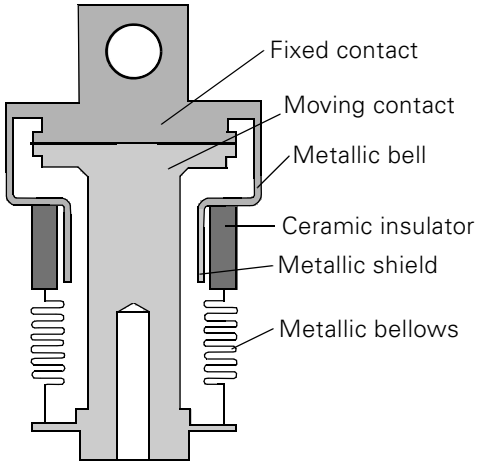


Fig. 3-14: sectional view: Vacuum-tube

Applications

The main areas of application of the 3RT12 Vacuum contactor are:
- Frequent switching (AC-3, AC-4)
- Heavy starting
- 1000 V

Attention
Vacuum contactors are not generally suitable for switching DC current!

Operation notes for the switching of motors with rated voltages > 500 V

A surge suppression module (RC-element and Varistor) connected on the load side of the contactor (T1/T2/T3) is recommended in order to dampen overvoltages and protect the insulation of the motor winding from multiple arching when switching off three-phase induction motors.
This module isn't required if the motors that are being switched have insulation set up for the operation with converters.

Attention
The main circuit surge suppressors are not needed in converter circuits! They can be destroyed by voltage peaks and harmonics and lead to phase to phase short circuits.

Main Circuit - Surge suppressor modules

The main circuit surge suppressors are available with the following rated operational voltages:

- 500 V < Ue <= 690 V: 3RT1966-1PV3
- 690 V < Ue <= 1000 V: 3RT1966-1PV4

The surge suppressor is connected:

- with a 35 cm long, built-in cable separate from the contactor
- on the load side of the contactor 2-T1/4-T2/6-T3

Wiring schematic

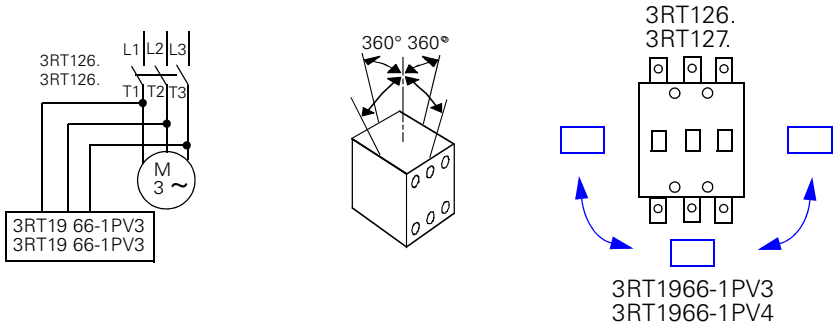


Fig. 3-15: Vacuum contactor, wiring schematic

Cable connection

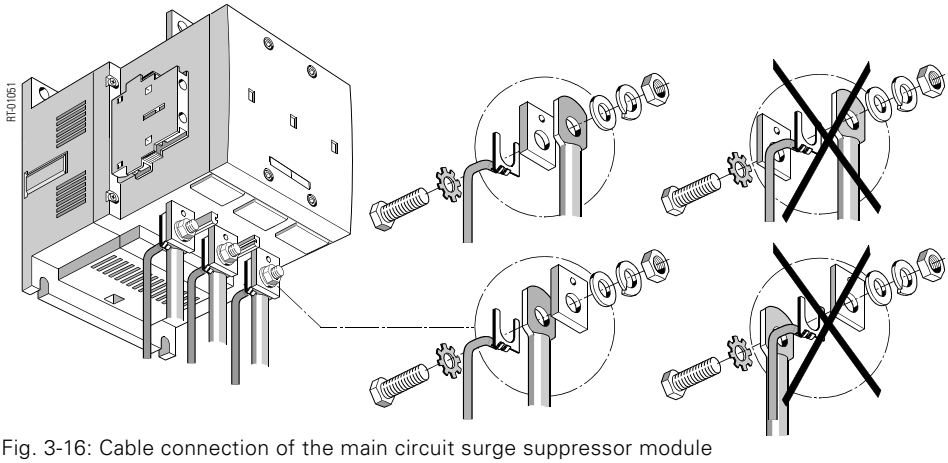


Fig. 3-16: Cable connection of the main circuit surge suppressor module

Dimensional drawings

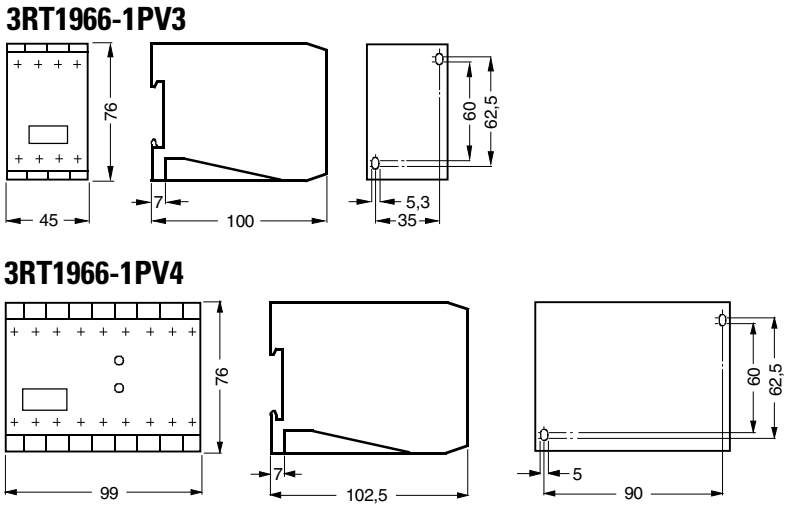
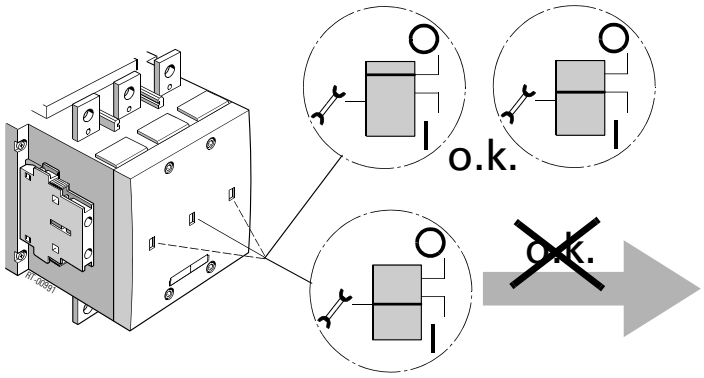


Fig. 3-17: Dimensions

Position and contact erosion indicator



The 3 position indicators on the front plate of the contactor are also contact erosion and wear indicators for all three vacuum tubes.
If the indicator on any one of the tubes goes under the limit marker then all 3 vacuum tube need to be replaced.

Tube replacement

For the tube replacement, disconnect the size T25 Torx-screws (see section 3.5.4 "Contact replacement").

3.3.4 3RT13 and 3RT15 contactors with 4 main contacts

Model

There are two variants of the contactors with 4 main contacts:
- 3RT13 with 4 NO contacts
- 3RT15 with 2 NO + 2 NC contacts

You can use the same accessories for both the 3-pole SIRIUS contactors and the 4-pole variants.

Field of application

The following table gives the fields of application for the 3RT13 and 3RT15 contactors:

3RT13 contactors with 4 NO contacts	3RT15 contactors with 2 NO + 2 NC contacts
• Switching of resistive loads • Isolation of networks with ungrounded or badly grounded neutral conductors • Supply switch-overs in the case of alternative AC power supplies • As a contactor - for example, in variable-speed drives that only have to carry the current, not switch it	• Pole switch-over in the case of crane-type motors • Switching of 2 separate loads • Breaking contactor

Table 3-15: Applications of 4-pole contactors

Auxiliary contact

The following table specifies the maximum number of auxiliary contacts that can be attached:

Frame size S00	Frame size S0	Frame sizes S2 and S3
4 auxiliary contacts	Maximum 2 auxiliary contacts (added on the side or snapped on the front)	Maximum of 4 auxiliary contacts (added on the side or snapped on the front)

Table 3-16: 4-pole contactors and auxiliary contacts

Contactor combination with mechanical interlocking

The 4-pole 3RT13 contactors with 4 NO contacts as main contacts in frame sizes S0 to S3 are suitable for putting together contactor combinations with mechanical interlocks for use in supply switch-overs.

3.3.5 3RT16 capacitor contactors

Field of application

3RT16 capacitor-switching contactors are used to switch power capacitors that are used in reactive-current compensation.

Frame sizes

The capacitor-switching contactors are available in frame sizes S00, S0 and S3 with the rating levels 12.5, 25 kvar, and 50 kvar at 400 V.

S00 **S3**

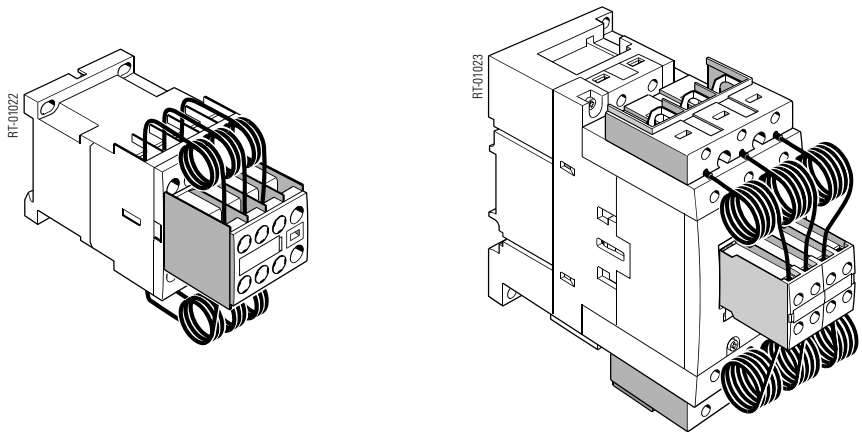


Fig. 3-18: Capacitor contactors (frame sizes S0 and S2)

Auxiliary contacts

The auxiliary contact block attached onto the capacitor contactor contains three leading NO contacts and a normal NO contact that can be assigned as you wish. In Frame size S00, an additional 1 NC contact is available in the base unit. A 2-pole auxiliary switch block can also be attached to the side of the frame size S3 capacitor contactors (variants: 2 NO contacts, 2 NC contacts, or 1 NO + 1 NC contact).

Switching capacitors/ banks of capacitors

A single capacitor can normally be switched on because the current is limited by the inductance of the upstream transformer and the cables. It is more difficult to switch banks of capacitors (parallel connection of a capacitor to capacitors already present) because the current is now only limited by the low inductance of the connecting leads and the capacitors.
This problem is solved with capacitor-switching contactors using precharging resistors.

Precharging resistors

The precharging resistors are an integral part of the contactor in 3RT16 capacitor-switching contactors. They are switched on via leading auxiliary contacts before the main contacts close. This results in damping down to approximately 10 % of the undamped peak currents. Damping of peaks in the making current prevents disturbances to the network.

Important
When switching banks of capacitors make sure that you adhere to the specified minimum inductance between the capacitors connected in parallel.

3RT10. capacitor switching capacity

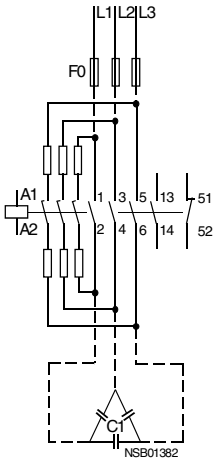
The normal 3RT10 contactors for switching motors also have a certain capacitor switching capacity. Details of this can be found in Section 3.7, Technical specifications: Utilization category AC-6b, switching of individual capacitors and switching of low-inductance three-phase capacitors. The tables contain information on the switching of individual capacitors and the switching of banks of capacitors.

Operation

Caution
Only switch to discharged capacitors! Do not carry out a function test by hand.
The precharging resistors must not be removed as this will damage the contact pieces in circuits with a load.

Circuit diagram

S00



S0 and S3

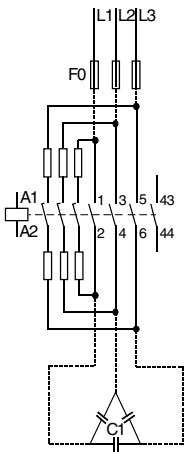


Fig. 3-19: Capacitor contactors, circuit diagram

3.3.6 Contactors with an extended operating range

Field of application

The contactors with an extended operating range use a DC magnetic coil. They are used in systems with strong fluctuations in the control supply voltage and at the same time high ambient temperatures, such as railway applications in extreme climatic conditions, rolling mills, etc.

Standards

Contactors with an extended operating range comply with the following standards:
- IEC 60 947-4-1
- EN 60 947-4-1 (VDE 0660 Part 102)
- The requirements of IEC 60 077

They are shockproof in acc. with DIN VDE 0106 Part 100.
Exception: the series resistor in frame sizes S0 to S3

Control current circuits and auxiliary current circuits

The magnet coils of the contactors have an extended operating range of 0.7 to 1.25 x U_S and are wired with varistors as standard to provide protection against overvoltage. This increases the time to contact opening when compared with standard contactors by 2 ms to 5 ms.

With/without a series resistor

The 3RH11 and 3RT10 contactors with the suffix -0LA0 at digits 13 to 16 in the order number are used where several auxiliary contacts are required, in addition to a wide operating range and a high ambient temperature of 70 °C. Up to 4 auxiliary contacts can be used in these variants.
If fewer auxiliary contacts are required, contactors with the same extended operating range that work without a series resistor are available up to frame size S0.
As an alternative to the contactors with a series resistor there is the electronic control module available for contactors in frame sizes S0 to S3.
Advantages:
- no increase in the mounting width of the series resistor
- lower contact current closing rating
- no auxiliary contact needed for the control of the series resistor

The three ranges are described in more detail below

3.3.6.1 Contactors with series resister (3RH11...-0LA0/3RT10...-0LA0)

The DC magnetic systems of these contactors are, due to their increased operating range, turned on with a defined overexcitation. As a result of the power up, there is a switch over to the hold-in coil via the series resistor.

Designs in frame size S00

Control relays and contactors of frame size S00 are available with the following:
- A built-on block that contains the series resistor (the NC contact required for the switch-over is integrated in the basic unit and is already wired).
- Integrated varistor
- A 4-pole auxiliary switch block (in acc. with EN 50 005) can also be built on.

Designs for frame sizes S0 to S3

Contactors of frame sizes S0 to S3 are fitted on the front with an auxiliary switch block with 2 NO contacts + 2 NC contacts. The separate series resistor that is attached next to the contactor on the 35 mm rail has connecting leads for contactor attachment. An NC contact of the auxiliary switch block is required for the switch-over to hold-in coil level. A circuit diagram with the terminal points is attached on each contactor.

Auxiliary contacts

One NC contact of the auxiliary contacts is required for the series resistor. The number of auxiliary contacts that are available beyond this is listed in the selection and order data. With frame size S00, the auxiliary switch block must be ordered separately.
An increase of the mountable auxiliary contacts is only possible with frame size S00.

Installation

The following types of installation are permissible for contactors and control relays in ambient temperatures of up to 70 °C:
Frame size S00: installation in series
Frame sizes S0 to S3: The resistor block must be installed on the right side of the contactor because of the connecting leads there.

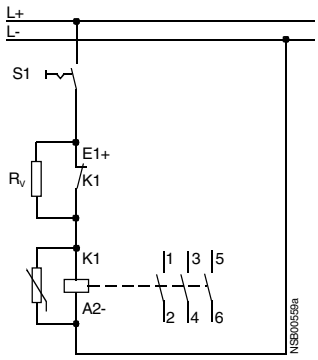
Dimensions

When the resistor is mounted, the contactors of frame sizes S0 to S3 become wider (see Section 3.6, Dimensioned drawings).

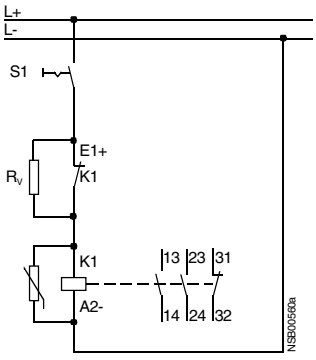
Circuit diagrams

Frame size S00

Terminal markings in acc. with
DIN EN 50 012
Contactors 3RT1017-2K.42-0LA0



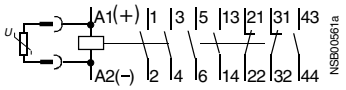
Terminal markings in acc. with
DIN EN 50 005
Control relays
3RH1122-2K.40-0LA0



Series resistor R_V attached
NC contact wired
2 NO + 1 NC contacts available

Fig. 3-20: Contactors with an extended operating range, circuit diagrams

Frame sizes S0 to S3
Terminal markings in acc. with EN 50 012
Contactors 3RT102.-, 3RT103.-, 3RT104.-3K.44-0LA0
With front-mounted 4-pole auxiliary switch block 3RH1921-1HA22



2 NO + 2 NC contacts
Identification number 22

Fig. 3-21: Contactors with an extended operating range, terminal markings

The NC contact at 21/22 is needed for the wiring of the series resistor

Circuit diagram for wiring of the series resistor

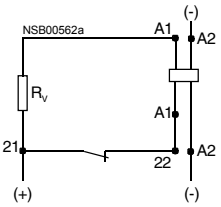


Fig. 3-22: Contactors with an extended operating range, circuit diagram

3.3.6.2 Contactors with electronic control module frame sizes S0 to S3 (3RT10..-.X40-0LA2)

Design

The contactors are controlled using a line side electronic control module. These ensure an operating range of 0.7 to 1.25 U_S at an ambient temperature of 70 °C. The coil has a integrated varistor to dampen the switching overvoltage of the coil. This causes an increase contact opening time compared to the standard contactors of about 2 ms to 5 ms. The contactors with an electronic control module are also offered as a complete device.

Auxiliary contacts

The mounting of auxiliary contacts corresponds to the corresponding standard contactors.

Installation

These contactor designs can be mounted side-by-side in frame sizes S0 to S3 at ambient temperatures up to 70 °C.

Ambient temperature

The allowable ambient temperature for the operation of the contactors (at the full operational range of the coils) is - 40 °C to + 70 °C. At constant operation with temperatures of > + 55 °C there is a reduction of mechanical service life, the loadability of the main conducting paths and the reliable switching frequency.

Dimensions

With the top mounted electronic control module, the height of the contactor is increased up to 34 mm (for dimensional drawings see section 3.6 "dimensional drawings").

Circuit diagram and terminal connections

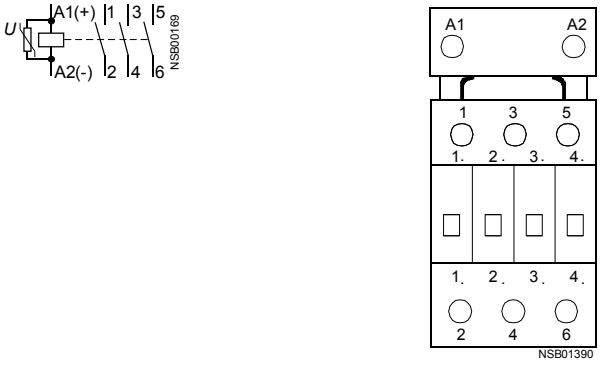


Fig. 3-23: Contactor with electronic control module, circuit diagram + terminal connections

3.3.6.3 Contactors with an extended operating range (3RH1122-2K.40, 3RT1017-2K.4., 3RT102.-3K.40)

Contactors of frame size S00: 3RH11 22-2K.40, 3RT1017-2K.4. and frame size S0: 3RT102.-3K.40 have the following features:

- Extended operating range of 0.7 to 1.25 x U_S
- The magnet coils are wired with a varistor; an additional series resistor is not required

Note the following:

- Frame size S00: an auxiliary switch block cannot be attached
- Frame size S0: a maximum of two 1-pole auxiliary switch blocks can be attached

Installation

At an ambient temperature > 60 °C $\leq$ 70 °C, there must be spacing of 10 mm when installing in series.

Ambient temperature

The permissible ambient temperature for operating the contactors at the full operating range of the magnet coils is -35 °C to +70 °C. During continuous operation with temperatures > +55 °C, the mechanical service life, the current-carrying capacity of the conducting paths, and the switching frequency are reduced.

3.3.7 3RH1 control relays

Control relays are switching devices for auxiliary circuits for controlling, signaling, and interlocking. Control relays have to meet specific requirements in terms of clear terminal markings and have a time- and cost-saving terminal system.
The SIRIUS 3RH1 control relays (frame size S00) meet these requirements

Terminal markings

The terminal markings comply with EN 50 011 and EN 50 005 (for a more detailed explanation, see Section 3.4.1 "Auxiliary switches").

Frame size and features

3RH1 control relays are available as follows:
- Frame size S00
- With AC or DC operation
- Same construction as the motor contactor of frame size S00
- 4-pole basic version
- Can be extended to 8 poles with snap-on auxiliary switch blocks
- Screw-type or Cage Clamp terminals

Screw-type terminals

The 3RH1 control relays have captive screws (cross-tip Pozidriv, size 2), with all the terminal points open on delivery. The screwdriver guides allow screw-driving machines to be used.

Cage Clamp-Terminals

The 3RH11 control relays are also available with Cage Clamp terminals - a screwless terminal system. This type of terminal is particularly suitable if strong shock or vibration can be expected at the installation location. These terminals are also suitable for two-conductor connections. All the terminals are accessible from the front and are easily visible.

Soldering pin connections

Both the 4-pole basic version as well as the control relays that have an auxiliary switch block attached at the front (see Section 3.4, Accessories) can be soldered onto printed circuit boards using a soldering pin adapter.

Contact reliability

All the switching elements of the 3RH1 control relays are equipped with contact pieces that have particularly high contact stability, ensuring high contact reliability even at low voltages and currents. This subject is discussed in detail in Section 3.2.3.2, "Contact reliability".

3RH14 latched auxiliary contactors

If there is a short circuit in the low-voltage network, or when large drive motors are switched on directly, the control supply voltage for the auxiliary contactors may fail briefly or fall below the permissible tolerance level. To ensure continuous operation, the variant with mechanical latching (3RH14) can be used with the auxiliary contactors.
These auxiliary contactors latch mechanically after power-up and remain in an energized state even in the event of a power failure. The auxiliary contactor can be unlocked electrically using an interlock release magnet or manually using a button on the front of the attached latched block. When the voltage returns, the production program can be resumed immediately without resetting times due to the storage feature of the auxiliary contactors. The contactor coil and the coil of the release magnet are both designed for continuous operation.
The power input is the same for the contactor coil and the release coil. The mechanical service life is 1 million operating cycles.

3.3.8 3RT10 contactor relays for switching motors (interface) and 3RH11 control relays for switching auxiliary circuits

Contactor relays are available in the SIRIUS modular system for switching motors and auxiliary circuits for the purpose of smooth interaction with electronic controllers. These are variants of the 3RT10/3RH11 contactor series with the following features:

- Low power input
- Wide operating range of the magnet coil 0.7 to 1.25 x U_S
- High contact reliability of the auxiliary contacts
- Integrated or attachable overvoltage damping

Contact reliability

The high contact reliability of the auxiliary contacts ensures that false signals do not occur even at low switching capacities. With a voltage of 17 V and a current of 1 mA, there is on average less than one contact fault per 100 million switching operations.

Overvoltage damping

Overvoltage damping protects sensitive output levels of electronic controllers against switching overvoltages of the coil.

Extended operating range

The operating range of the coil of the contactor relays covers a voltage range from 0.7 to 1.25 x U_S (U_S= rated control supply voltage). This wide operating range is required for the supply voltage of electronic controllers with the required voltage tolerances.
The supply voltage of electronic controllers with 24 VDC covers the range 20.4 V to 28.8 V in acc. with DIN 19 240. If you take into consideration an additional loss of voltage of up to 3 V during the output phases, the contactor drive must be able to operate perfectly with voltages between 17.4 V and 28.8 V. The 3RT10 and 3RH11 contactor relays for electronic controllers operate safely from 17 V to 30 V, which corresponds to a voltage range of 0.7 x U_S to 1.25 x Us. This is a considerably wider operating range than that of 0.85 to 1.1 x U_S for contactors and auxiliary contactors in acc. with IEC 60 947, DIN EN 60 947 (VDE 0660).

Voltage ranges

The following graphic shows you the voltage ranges for electronic controllers and drives of contactors and contactor relays with a rated control supply voltage of U_S = 24 VDC:

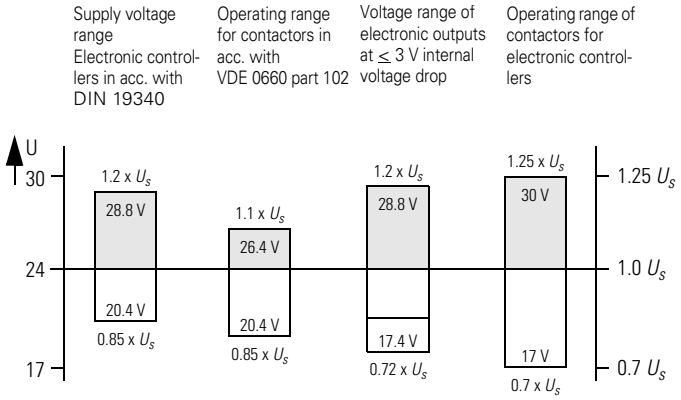


Fig. 3-24: Contactor relays: voltage ranges

Auxiliary contact blocks

Auxiliary contact blocks can be built on as follows:
Frame size S00: none
Frame size S0: a maximum of two 1-pole auxiliary contact blocks

Power consumption

Variant 1: The power input of the magnet coils for contactor relays in frame size S00 is 2.3 W at 24 VDC (operating range: 0.7 to 1.25 x U_S).

Variant 2: Contactor relays with reduced coil performance in frame size S00, P = 1.4 W at 24 VDC (operating range: 0.85 to 1.85 U_S).

The power input of magnet coils for contactor relays in frame size S0 is 4.2 W at 24 VDC (operating range: 0.7 to 1.25 x U_S).

3.3.9 3RA13 Contactor combinations for reversing

3RA13 reversing contactor combinations are available pre-assembled from the factory or as components for self-assembly

- S00 to S3: pre-assembled from the factory or as kit for self-assembly
  Frame sizes S2 and S3 are delivered already mounted on a base plate.
- S6 to S12 as a kit for self-assembly

The same accessories can be used as for the basic contactors of the corresponding frame size (see Section 3.4).
For motor protection an overload relay must be attached.

4-pole contactor combinations for reversing can be put together in frame sizes S0 and S2..

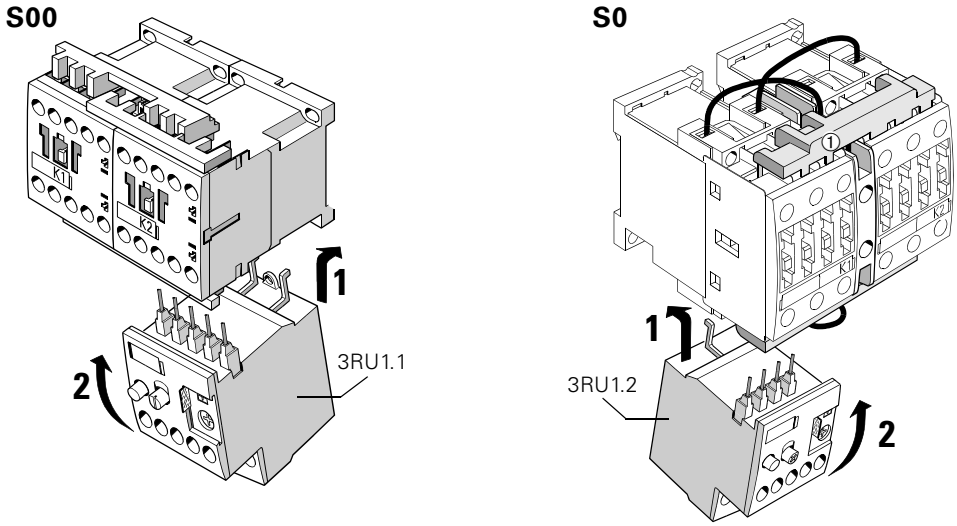


Fig. 3-25: Fully assembled contactor combination for reversing (frame sizes S00 and S0)

Approvals

The ⓢ and ⓤ approvals only apply to complete contactor combinations and not to combinations that have been field assembled from separate components.

Switch-over time

If the contactors are interlocked by means of their auxiliary switches (electrical interlocking) or by mechanical interlocking, there is no overlapping of the contacts and the arcing time between the contactors at switch-over.
The switching times of the contactors are not affected by the mechanical interlock.

Note
At voltages of >500 V a switch-over pause of 50 ms must be included.
AC-operated 3RT10 contactors in reversing or Dahlander mode require an NC contact interlock and a switch-over pause of 50 ms.

Auxiliary contact elements

Different auxiliary switches can be attached (at the front or the side) to the 3RA1 reversing combination. An integrated auxiliary switch contact is available in frame size S00.

Accessories

The following accessories for the basic units can also be used for contactor combinations for reversing:
- Auxiliary switch blocks (at the front/side)
- Surge suppressors
- Soldering pin adapters (frame size S00)

The following accessories are designed specifically for contactor combinations for reversing:
- Locking devices for mechanical interlocking
- Locking devices for mechanical and electrical interlocking (at the front/side)
- Terminals for contactor coils (for frame sizes S0 to S3)
- Mechanical connectors
- Wiring modules

Terminals for contactor coils

To reach the coil terminals A1 and A2 of the frame sizes S2 and S3 reversing contactor combinations more easily, you can use extension terminals for contactor coils.
For each combination, 2 x A1 and 1 x A2 are required.

Wiring module

Wiring modules are available to enable you to carry out different types of wiring (Dahlander wiring, for example).
You can find out how to mount the wiring modules in the diagrams of the self-assembly kits.

Mechanical interlocking

Mechanical interlocking (for frame sizes S0 to S3) is available in 2 variants:
- Attachable at the front (contactor spacing: 0 mm)
- Attachable at the side with integrated NC contact for electronic interlocking
- S6 to S12: attachable at the side (no height adjustment necessary)

Note
If you want NC contact interlocking, you must use contactors with 1 NC contact in the basic unit with the 3RT1 contactors of frame size S00.

Mechanical interlock installation

The following graphics show you how to install the front mount mechanical interlock for frame size S0:

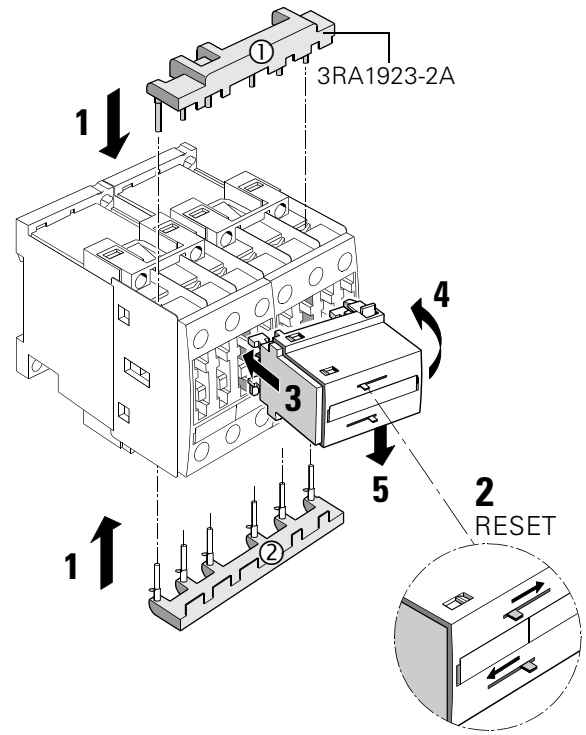
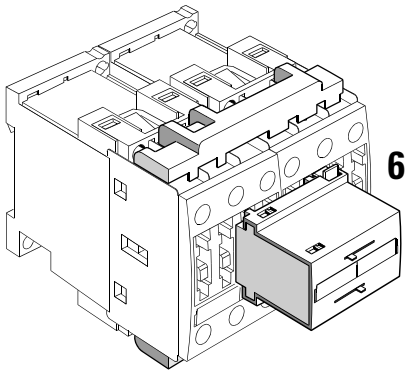
Drawing: Frame size S0	Step	Procedure
	**1**	Attach both of the wiring modules in order to connect the main conducting paths. Shown as the circled numbers: ① = Top wiring module ② = Bottom wiring module
	2	Push the sliding switch on the upper portion of the mechanical interlock to RESET, in order to be sure of the conditional state of the module.
	3/4/5	First attach the mechanical interlock in the contact opening of the left contactor **(3)**, then with a swinging motion attach the mechanical interlock in contact opening of the right contactor **(4)** and pull the interlock downward until it sits securely in place **(5)**.
	**6**	In the proper operational condition, the upper sliding switch on the front side of the mechanical interlock is to the left and the lower sliding switch is to the right.

Table 3-17: Installation of the front mounted mechanical interlock (frame size S0)

The following graphics show you how to install the front mount mechanical interlock with frame sizes S2 and S3:

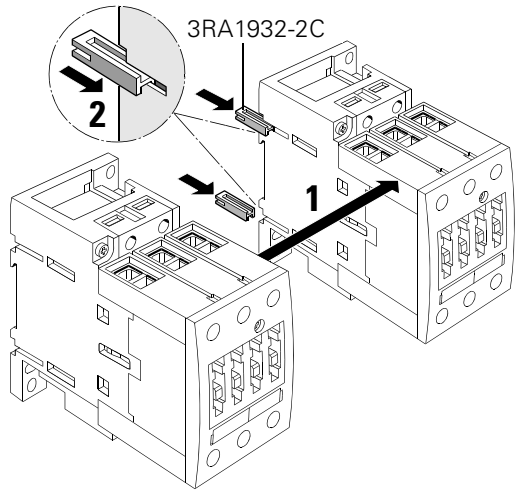
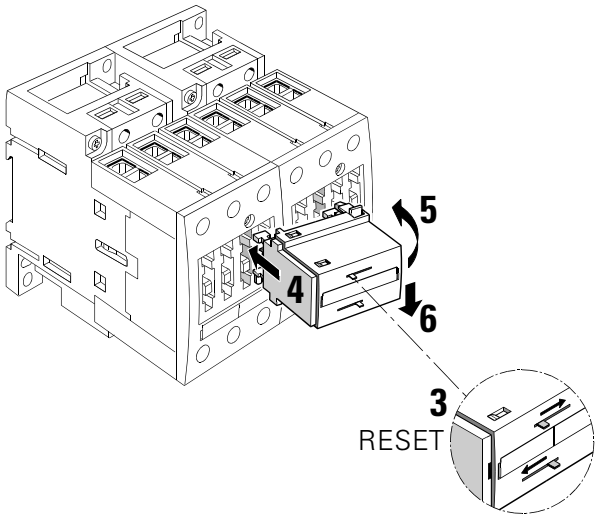
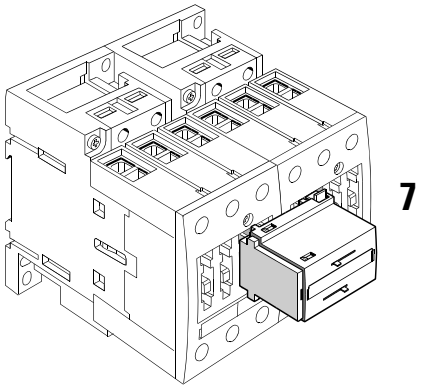
Drawing: Frame sizes S2/S3	Step	Procedure
	**1/2**	Place the contactors even to one another **(1)** and plug-in both of the connection clips to the backside **(2)**.
	**3**	Push the sliding switch on the upper portion of the mechanical interlock to RESET, in order to be sure of the conditional state of the module **(3)**. First attach the mechanical interlock in the contact opening of the left contactor **(4)**, then with a swinging motion attach the mechanical interlock in contact opening of the right contactor **(5)** and pull the interlock downward until it sits securely in place **(6)**.
	**7**	In the proper operational condition, the upper sliding switch on the front side of the mechanical interlock is to the left and the lower sliding switch is to the right.

Table 3-18: Installation of the front mounted mechanical interlock (frame size S2/S3)

The following graphic shows you how to install the side mount mechanical interlock with frame sizes S6 to S12:

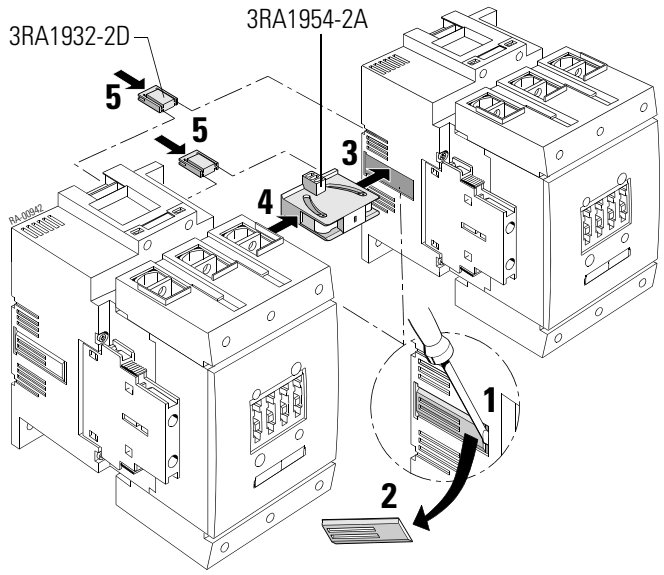
Drawing: Frame sizes S6/S10/S12	Step	Procedure
	**1/2**	Remove the covers that block the opening for mechanical interlock on both contactors **(1/2)**.
	3/4	Insert the mechanical interlock into the left and right openings respectively in order to mechanically interlock the contactors **(3/4)**.
	5	With frame size S6: The contactors can be mechanically connected on the backside with both connection clips **(5)**. **Note** Frame sizes S6 to S12 can be interlocked comfortably without height adjustment

Table 3-19: Installation of the side mounted mechanical interlock (frame size S6 to S12)

Assembly kits for contactor combinations

The following accessories are components of the self-assembly kits and they are described in the diagrams of the relevant kit:
- side mount mechanical interlock
- Mechanical connectors
- Wiring modules

Assembly kits for reversing combinations

The following table shows you the components of the kit for the contactor combination for reversing in frame size S00 and explains how to put it together:

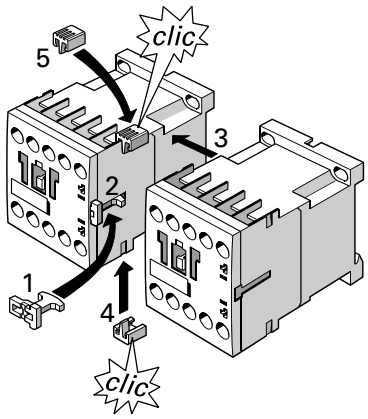
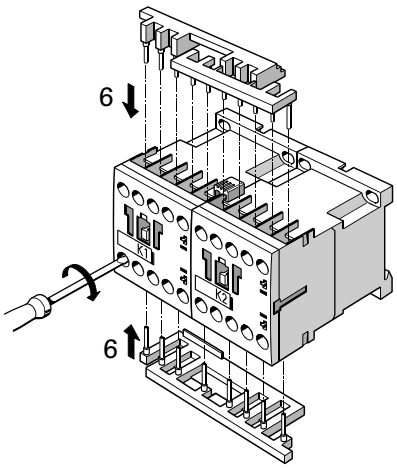
Drawing: frame size S00	Step	Procedure
	**1/2/3**	Mount the mechanical interlock between the two contactors.
	4/5	Press the two connecting clips from above and below onto the two contactors.
	**6**	Attach the wiring modules to connect the main conducting paths and to electrically interlock the two contactors (3RT10.1). Make sure that the wiring modules are flush with the contactor at the side.

Table 3-20: Assembling the contactor combination for reversing (frame size S00)

Electrical interlock

Note
Contactors with an NC contact in the basic unit (3RT101.) are required for the electrical interlock.

The following table shows you the components of the kit for the contactor combination for reversing in frame size S0 and explains how to put it together:

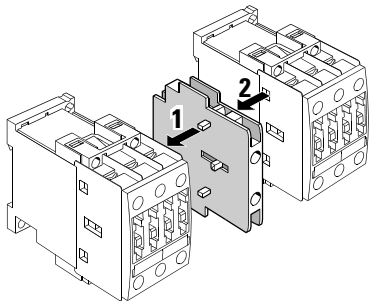
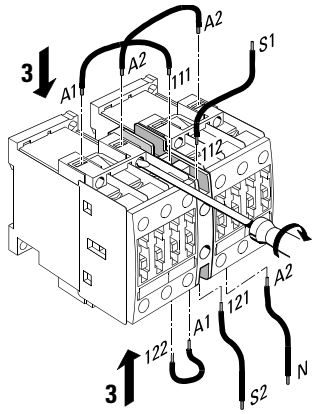
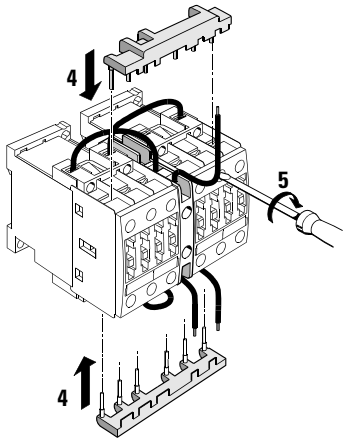
Drawing: frame size S0	Step	Procedure
	**1/2**	Mount the mechanical interlock between the two contactors.
	**3**	Wire the actuating voltage and the electrical reversing interlock using the auxiliary conducting paths.
	**4/5**	Attach the wiring modules in order to connect the main conducting paths and tighten the terminals.

Table 3-21: Assembling the contactor combination for reversing (frame size S0)

The following table shows you the components of the kits for the contactor combination for reversing in frame size S2 and S3 and explains how to put it together:

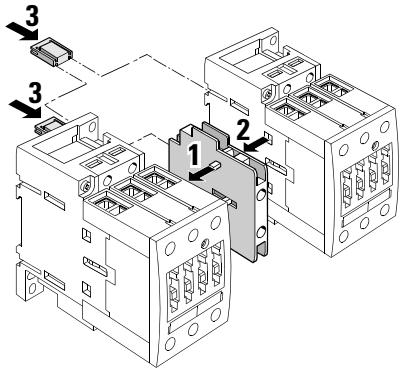
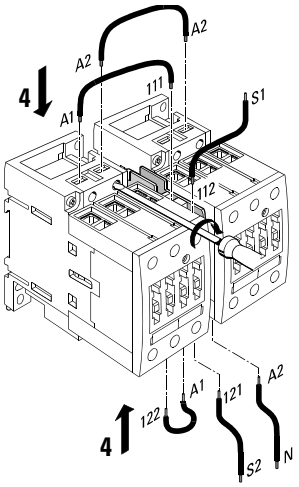
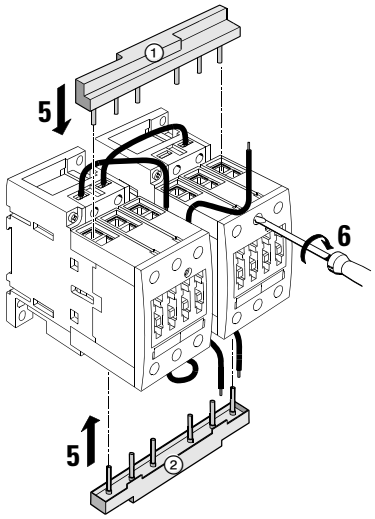
Drawing: frame size S2 (S3)	Step	Procedure
	**1/2/3**	Mount the mechanical interlock between the two contactors**.** Then insert the 2 connecting clips (10 mm spacing) on the back of the two contactors.
	**4**	Wire the actuating voltage and the electrical reversing interlock using the auxiliary conducting paths.
	**5/6**	Attach the wiring modules **(5)** in order to connect the main conducting paths and tighten the terminals **(6)**.

Table 3-22: Assembling the contactor combination for reversing (frame sizes S2/S3)

The following graphic shows you how to assemble the components of the kits for the reversing contactor combination for in frame size S6:

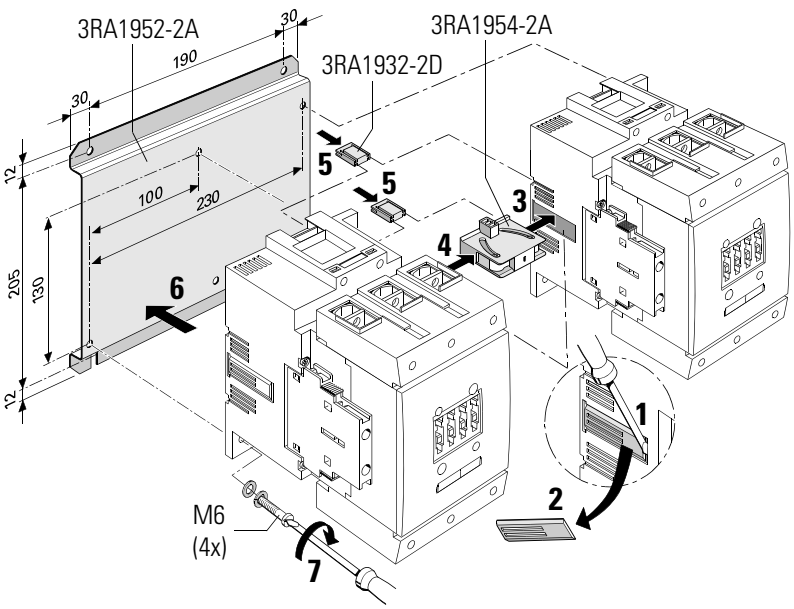
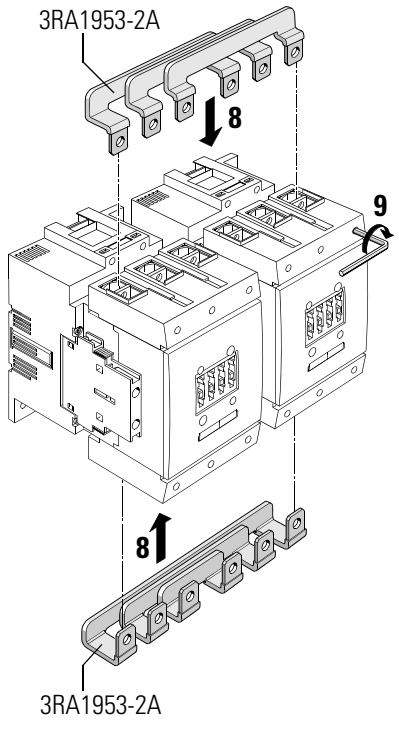
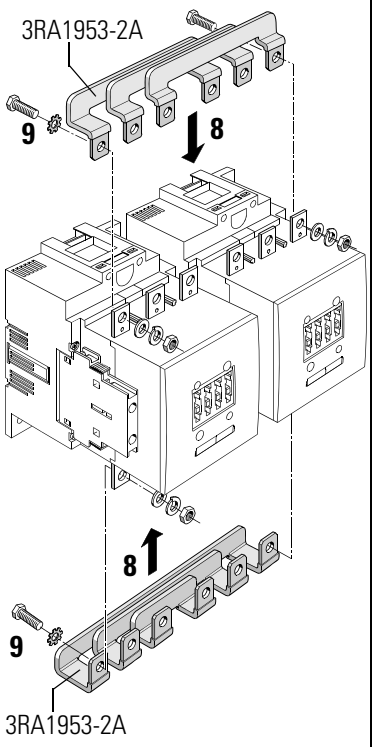
Drawing: Frame size S6	Step	Procedure
	**1/2**	Remove the covers that block the opening for mechanical interlock on both contactors.
	3/4	Insert the mechanical interlock into the left and right openings respectively in order to mechanically interlock the contactors.
	5	Plug-in both of the connection clips to the backside of the contactor.
	6/7	Mount the reversing contactor combination to the mounting plate.
Contactors with box lugs  Contactors with busbar connection 	**8/9**	Attach both of the wiring modules **(8)** in order to connect the main conducting paths and tighten down the wiring connections **(9)**.

Table 3-23: Assembly of reversing contactor combination (frame size S6)

The following graphic shows you how to assemble the components of the kits for the reversing contactor combination for in frame sizes S10 and S12:

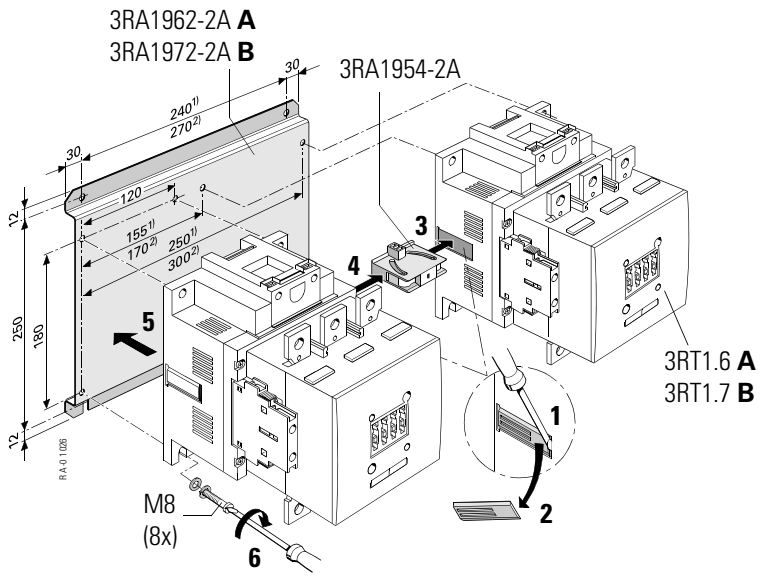
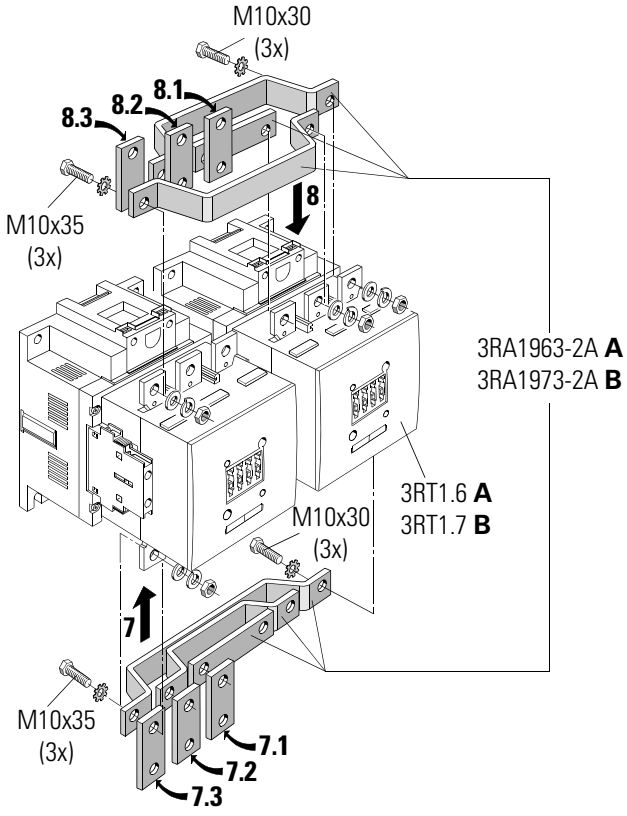
Drawing: Frame size S6	Step	Procedure
	**1/2**	Remove the covers that block the opening for mechanical interlock on both contactors.
	3/4	Insert the mechanical interlock into the left and right openings respectively in order to mechanically interlock the contactors.
	5/6	Mount the reversing contactor combination to the mounting plate.
	**7**	First mount the bottom wiring module **(7)** with the extension pieces **(7.1/7.2/7.3)** in order to connect the main conducting paths and tighten down the wiring connections
	8	Mount the top wiring module **(8)** with the extension pieces **(8.1/8.2/8.3)** in order to connect the main conducting paths and tighten down the wiring connections

Table 3-24: Assembly of reversing contactor combination (frame sizes S10 and S12)

4-pole contactor combination for reversing

4-pole contactor combinations for reversing are available in frame sizes S0 and S2. You will require the following to mount these combinations:

- Frame size S0: locking device for mechanical interlock
- Frame size S2: locking device for mechanical interlock and 2 connecting clips

The following graphic shows you how to set up the 4-pole contactor combination for reversing in frame size S0:

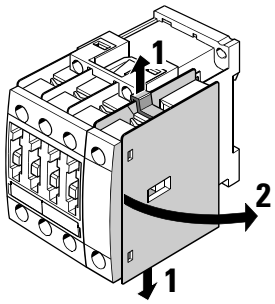
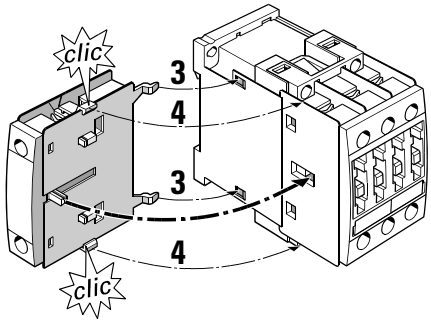
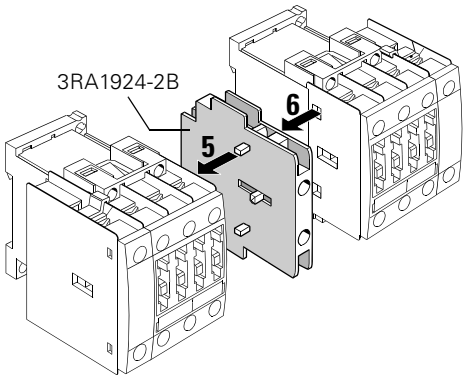
Drawing: frame size S0	Step	Procedure
	**1/2**	Remove the 4th pole from one of the two contactors by releasing the snap catch **(1)**.
	**3/4**	Put the 4th pole on the other side of the same contactor by placing the catches on the pole into the openings shown on the contactor and snapping the pole onto the contactor.
	**5/6**	Mount the mechanical interlock between the two contactors **(5/6)**.

Table 3-25: 4-pole contactor combination for reversing (frame size S0)

Assembly of the contactors in frame size S0 with front interlocking

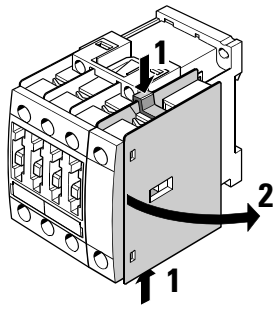
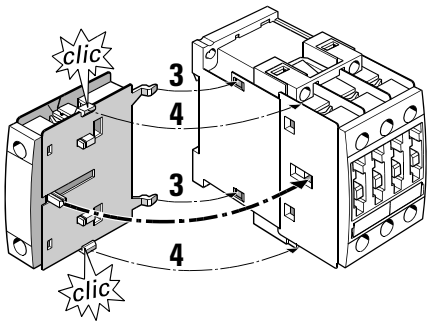
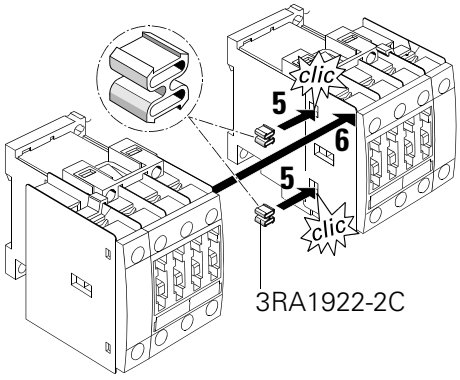
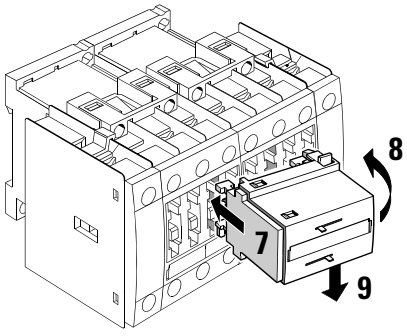
Drawing: frame size S0	Step	Procedure
	**1/2**	Remove the 4th pole of the left contactor by pressing the ribbed surfaces at the top and bottom at the same time **(1)** and then removing the pole **(2)**.
	**3/4**	Attach the pole to the left side of the same contactor.
	**5/6**	Put the contactors together by inserting two mechanical couplers (3RA1922-2C) in the appropriate openings of the contactor **(5),** and then press the other contactor onto these mechanical couplers **(6)**.
	**7/8/9**	Mount the mechanical interlock at the front (3RA1924-1A) over the two contactors.

Table 3-26: 4-pole reversing contactor combination with front interlock (frame size S0)

The following graphic shows you how to assemble the 4-pole reversing contactor combination in frame size S2:

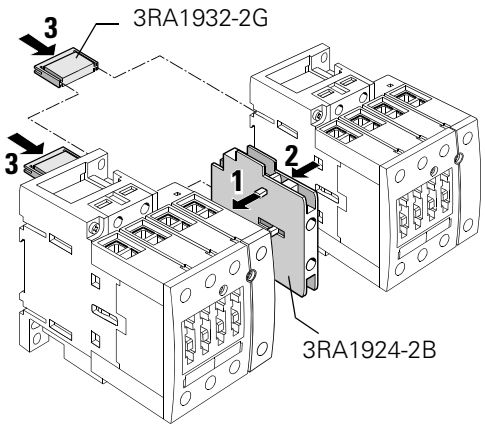
Drawing: frame size S2	Step	Procedure
	**1/2**	Mount the mechanical interlock between the two contactors.
	3	Insert the 2 connecting clips on the back of the two contactors.

Table 3-27: 4-pole reversing contactor combination (frame size S2)

NO contact function not interlocked

If contactors in frame size S00 are used with 1 NO contact that is intended for an auxiliary function (e.g. as a signaling device), the wiring module must be separated. The illustration below shows you the wiring for this function:

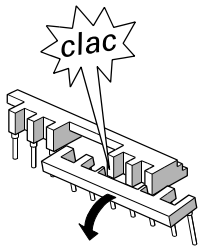


Fig. 3-26: NC contact wiring for the electrical interlock (frame size S00)

Mounting and connection

The contactor combinations for reversing have screw-type connections that are suitable for both panel mounting and snap-on mounting on a 35 mm rail.

Conductor cross-sections

The permissible conductor cross-sections of the contactor combinations for reversing correspond to those of the basic units for the corresponding frame size.

Circuit diagrams

Main circuit: S00 to S12

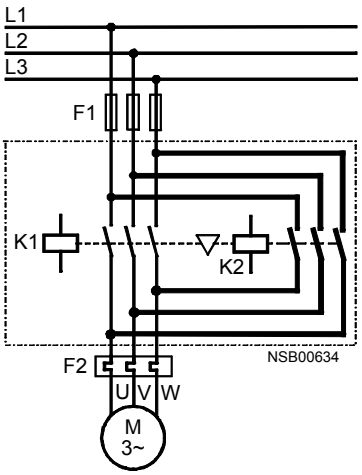


Fig. 3-27: Reversing contactor combination, main circuit (frame sizes S00 to S3)

Control circuit: S00

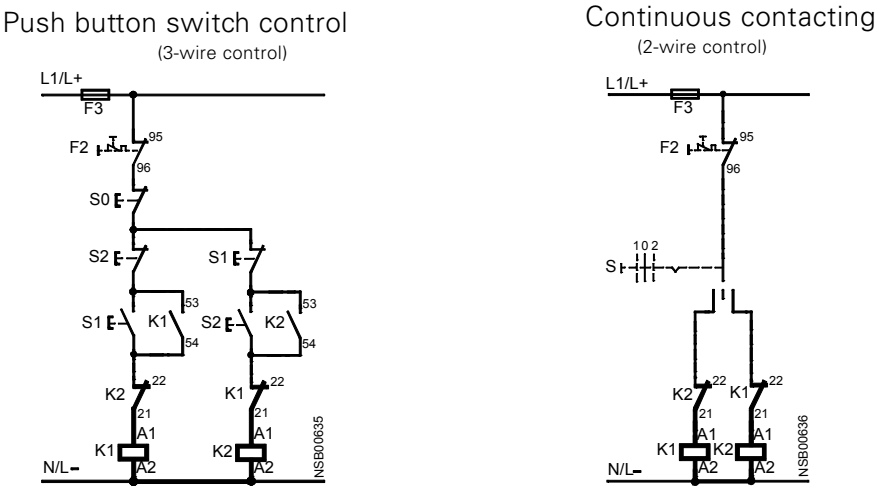


Fig. 3-28: Reversing contactor combination, control circuit (frame size S00)

S0 "Off" button
S1 "Clockwise rotation on" button
S2 "Counterclockwise rotation on" button
S "Right/off/left" selector switch

K1 Clockwise rotation contactor
K2 Counterclockwise rotation contactor

F1 Fuses for main circuit
F2 Overload relay
F3 Fuses for control circuit

Control circuit: S0 to S12

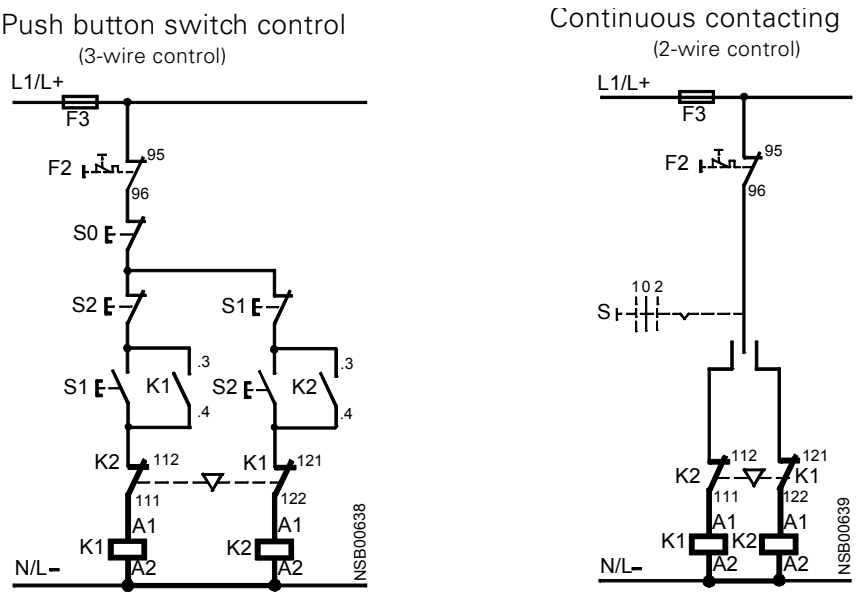


Fig. 3-29: Reversing contactor combination for control circuit (frame sizes S0 to S3)

Technical specifications The technical specifications of the contactor combinations for reversing correspond to those of the basic units for the corresponding frame size.

3.3.10 3RT14 Wye-delta combinations

The 3RA1 wye-delta combinations in frame sizes S00 to S3 are available as follows:

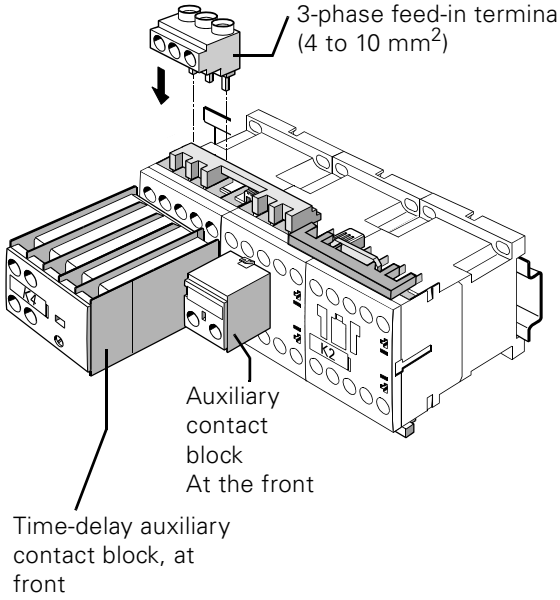
- Fully assembled with the usual auxiliary switches in the following frame sizes:
  - S00-S00-S00
  - S0-S0-S0
  - S2-S2-S0
  - S2-S2-S2
  - S3-S3-S2

  Frame sizes S2 to S3 are delivered already mounted on a base plate.
- In USA sold only for self-assembly.
- S00 to S12 As a kit for self-assembly.

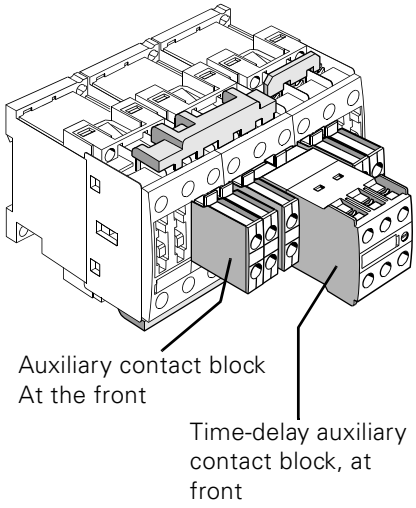
The same accessories can be used as for the basic units of the corresponding frame size (see Section 3.4, "Contactor accessories").

The following graphics show you the fully assembled wye-delta combinations in frame sizes S00 to S2:

Frame size S00



Frame size S0



Frame size S2

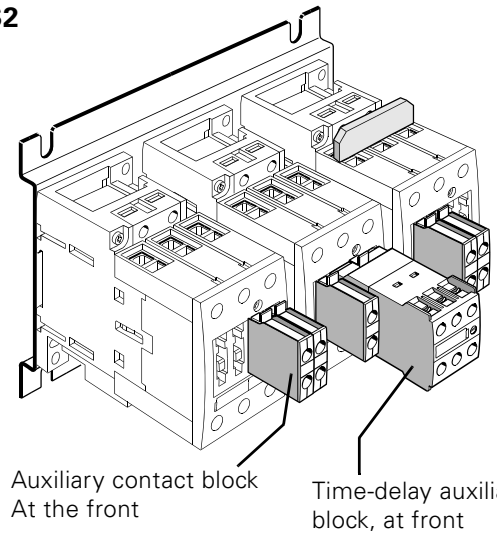


Fig. 3-30: Wye-delta combinations (Frame sizes S00, S0, S2)

Frame size S2

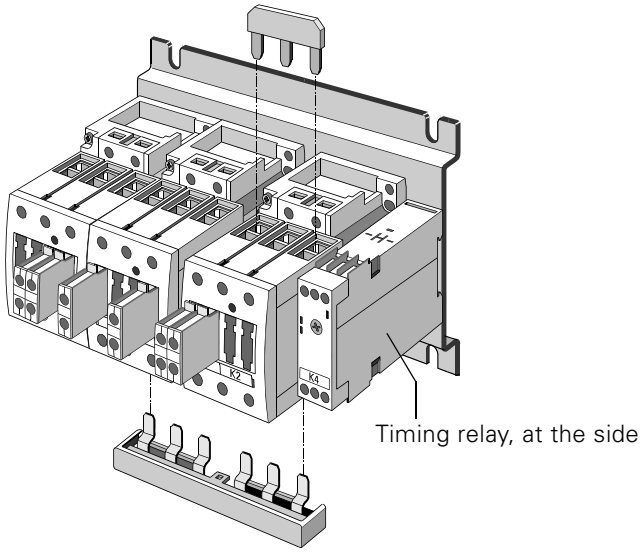


Fig. 3-31: Wye-delta combination (frame size S2)

Field of application

The wye-delta combination is used to start three-phase induction motors which require a low load torque during startup.

Starting current ratio

Wye-delta starting can only be used when the motor normally operates in delta mode, starts with no load, or if the load torque during the wye startup is small and does not increase rapidly.
In the wye stage, the motors can be loaded with approximately 50 % (torque class KL16) and 30 % (KL10) of its rated torque.
The starting torque is reduced to approximately 1/3 of the value at direct power-up.
The starting current is approximately 2 to 2.7 times the rated current for the motor.

Switch-over

Switching from the wye to the delta stage can only be carried out once the motor has completed startup to the rated speed.
The required switch-over time delay and interlock is included in the contactor combination.

Important
Motors that require an early switch-over are not suitable for wye-delta starting.

Overload protection

The fully assembled combinations are not equipped with overload protection. Overload relay (3RU11) and tripping devices for thermistor motor protection must be ordered separately.
The overload relays can be attached to the contactor directly or set up separately. The overload relay is set to 0.58 times the set current I_e. See Chapter 4 on overload relays for further information.

Components of the wye-delta-combinations

The following table shows you the features of the fully assembled wye-delta combinations with time-delay auxiliary switch blocks with the wye-delta function (3RT19.6-2B...) and solid-state time relays with semiconductor output and the possible configuration, if you use the self-assembly kit:

	Frame size S00	**Frame sizes S0 to S3**	**Frame sizes S6 to S12**
Fully assembled	At front (time-delay auxiliary switch block)	at the side (timing relay)	—
Kit	At front	• at the side (timing relay) • At front (time-delay auxiliary contact block)	• at the side (timing relay) • At front (time-delay auxiliary contact block)

Table 3-28: Configuration of the wye-delta combinations

Important
If a time-delay auxiliary switch block is mounted on the front of K3, an auxiliary switch block can only be mounted on the side of K3.

Accessories

The following basic unit accessories can also be used for wye-delta combinations:
- Auxiliary switch blocks (front, side)
- Surge suppressors
- Time-delay auxiliary switch blocks with wye-delta function

In addition, there are special accessories available for the wye-delta combinations:
- 3-phase feed-in terminals
- Wye-point links (parallel links)
- Terminals for contactor coils (S2/S3)
- Mechanical connectors
- Wiring modules

Terminal for contactor coils

In order to more easily reach coil terminals A1 and A2 in the wye-delta combination from contactors in frame sizes S2 and S3, extension terminals for contactor coils can be used.
For each combination, 2 x A1 and 1 x A2 are required.

Infeed

With conductor cross-sections > 2 x 2.5 mm^2 and 1 x > 4 mm^2, a feed-in terminal block must be used for the wye-delta combination in frame size S00. This makes the following conductor cross-sections possible:
- Frame size S00: up to 6 mm^2
- Frame size S0: up to 25 mm^2
- Frame size S2: up to 50 mm^2

Kits

The following graphic shows you the components of the kit for the wye-delta combination in frame size S00 and explains how to put it together:

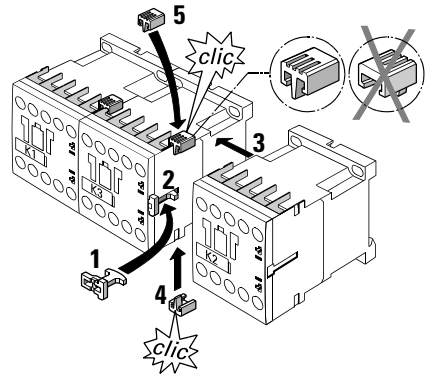
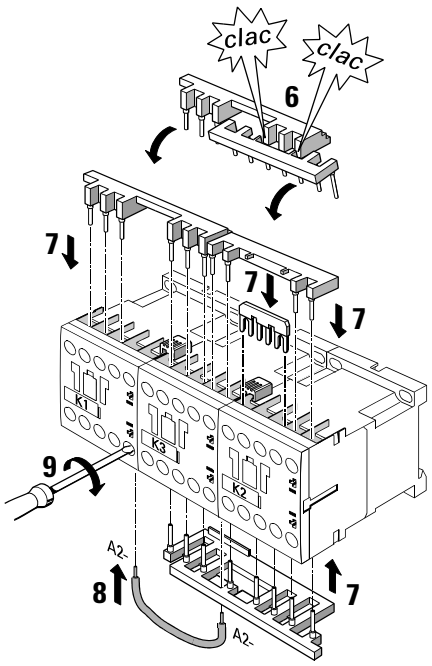
Drawing: frame size S00	Step	Procedure
	**1/2/3**	Place the mechanical interlock in the opening on the right side of the delta contactor K3. Push the wye contactor K2 and the delta contactor K3 together.
	4/5	Press a connecting clip for both the top and bottom onto the two contactors **(3)**. Make sure the clips are on the correct side.
	**6/7**	Break the upper link module off at the notches **(6)**, and attach the wiring modules and the wye jumper, to connect the main conducting paths (between line contactor (K1) and delta contactor (K3) and at the same time to interlock the combination electrically (K3-K2)).
	8/9	Wire A2 and tighten the terminal screws.

Table 3-29: Assembly of the wye-delta combination in frame size S00

The following graphic shows you the components of the kits for the wye-delta combinations in frame sizes S0 to S3 and explains how to put it together:

Note
In NAFTA applications, a mechanical interlock is required between contactors K2 and K3.

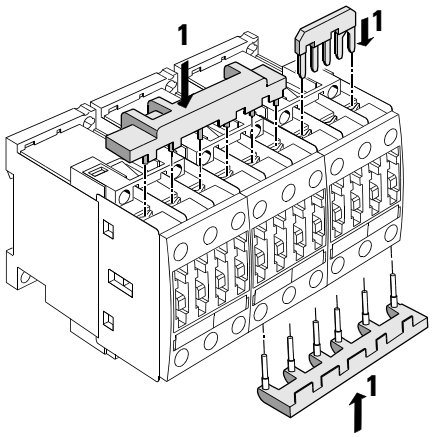
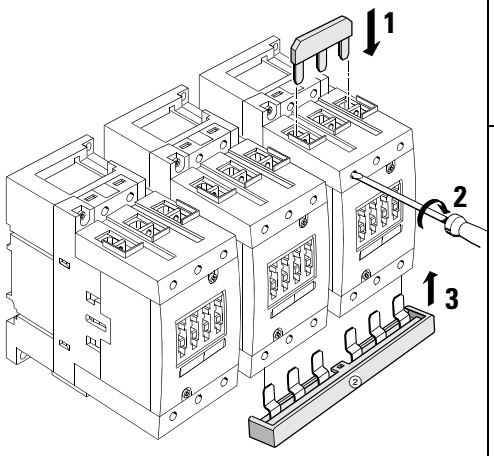
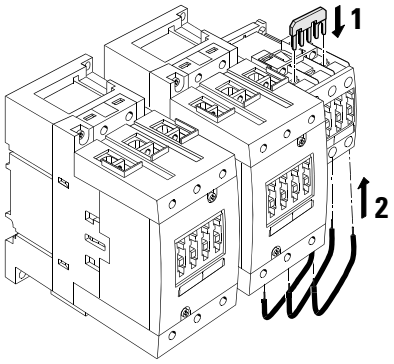
Drawing: frame size S0	Step	Procedure
	1	Attach the wiring modules and the wye-point link in order to connect the main conducting paths and to interlock the combination electrically.
Drawing: frame size S2 (S3)	**Step**	**Procedure**
	1/2	Place the wye-point link on the wye contactor. Tighten the main connections.
	3	Place the wiring module on the contactor undersides to connect the main conducting paths.
Drawing: frame sizes S3-S3-S2	**Step**	**Procedure**
	1	Attach the wye-point link to the wye contactor.
	2	Attach the wiring module to the contactor undersides to connect the main conducting paths.

Table 3-30: Assembly of the wye-delta combinations in frame sizes S0 to S3

The following graphic shows you the components of the kits for the wye-delta combinations in frame sizes S6 to S12 and explains how to put it together

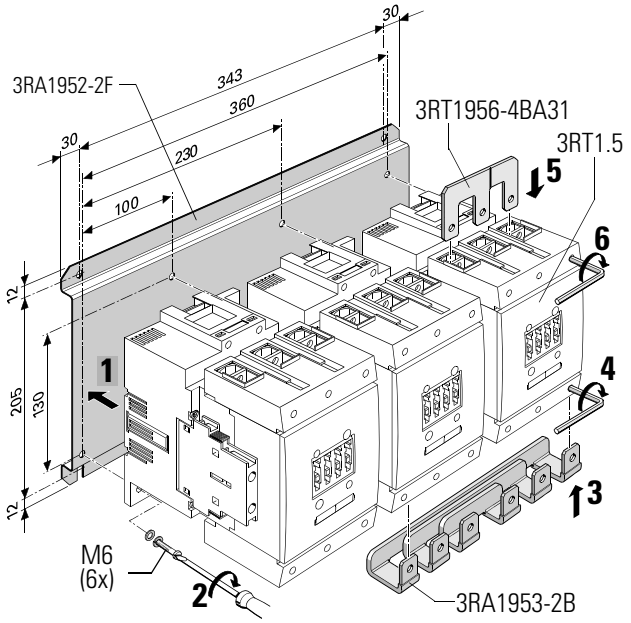
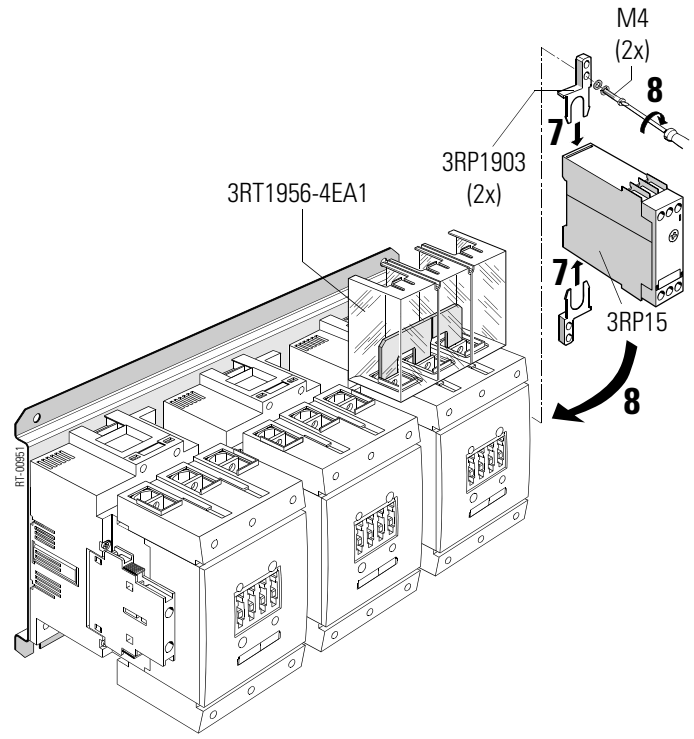
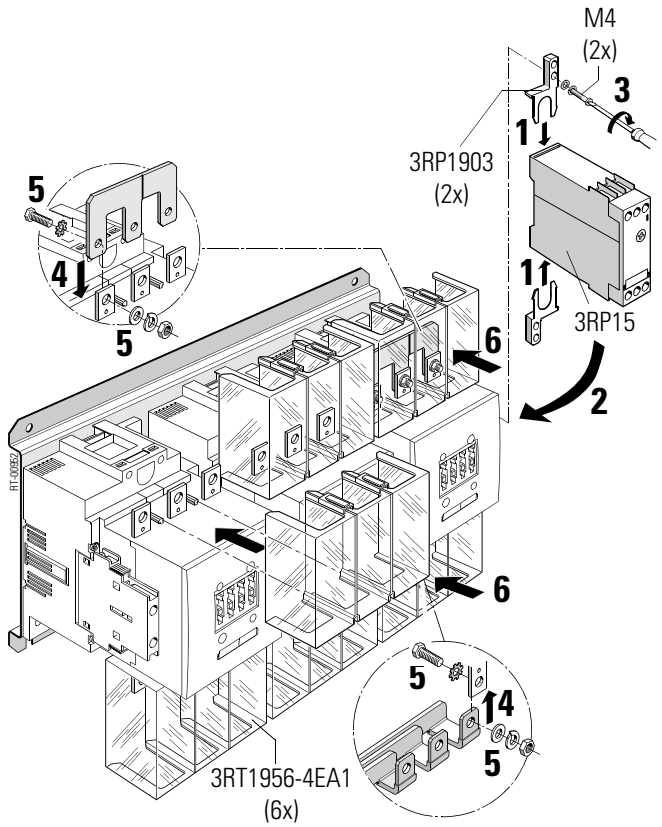
Drawing: Frame size S6 - S6 - S6	Step	Procedure
	**1/2**	Mount the wye-delta combination to the mounting plate.
	3/4	Set the bottom wiring module in place and tighten down them to the main connections.
	5/6	Set the wye-jumper in place tighten down them to the main connections.
	**7/8**	Push in the "push-in lugs" for panel mounting the timing relay and then screw mount the timing relay to the mounting plate.

Table 3-31: Assembly of the wye-delta combinations in frame size S6

Drawing: frame size S6 - S6 - S6	Step	Procedure
		Without box lugs:
	1/2/3	Push in the "push-in lugs" for panel mounting the timing relay and then screw mount the timing relay to the mounting plate.
	4/5	Screw the bottom wiring kit and the wye jumper on top to the connection busbars.
	6	Slide the connection covers on.

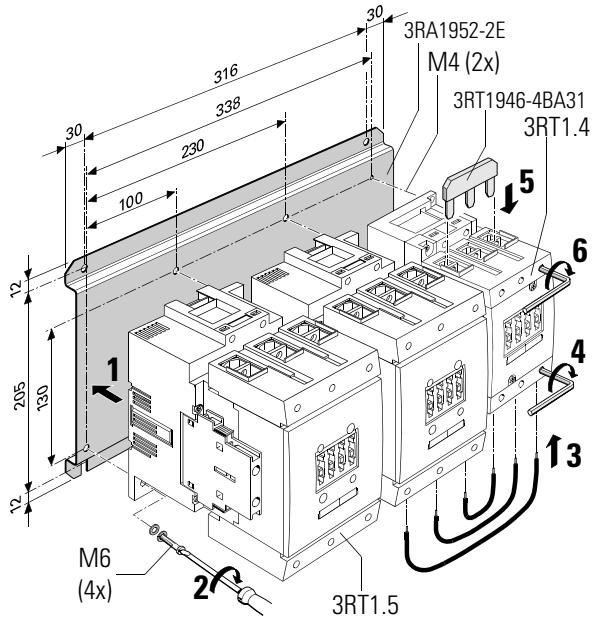
Drawing: frame size S6 - S6 - S3	Step	Procedure
	**1/2**	Mount the wye-delta combination to the mounting plate.
	3/4	Wire the main current paths of the delta contactor and the wye contactor and tighten down the main connections.
	5/6	Set the wye-jumper in place and tighten down the main connections.

Table 3-31: (cont.)Assembly of the wye-delta combinations in frame size S6

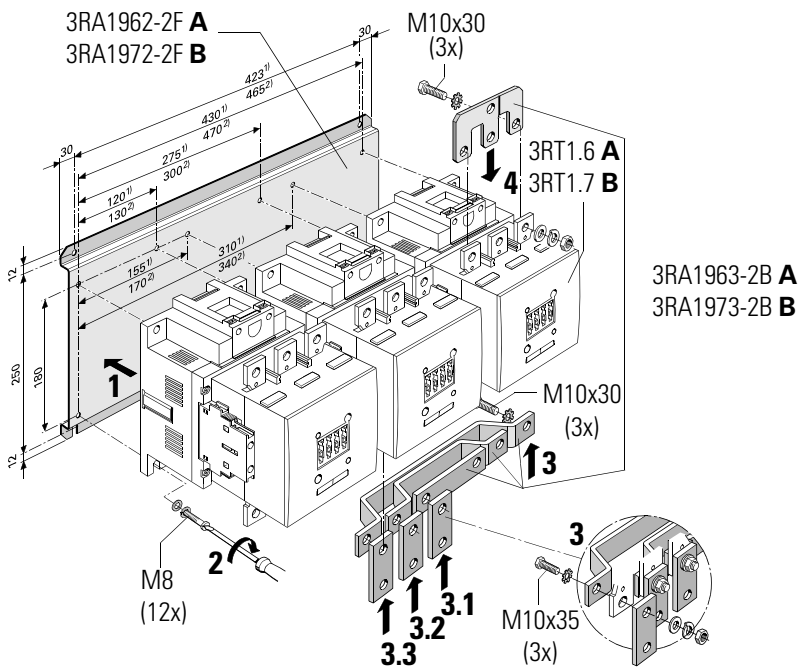
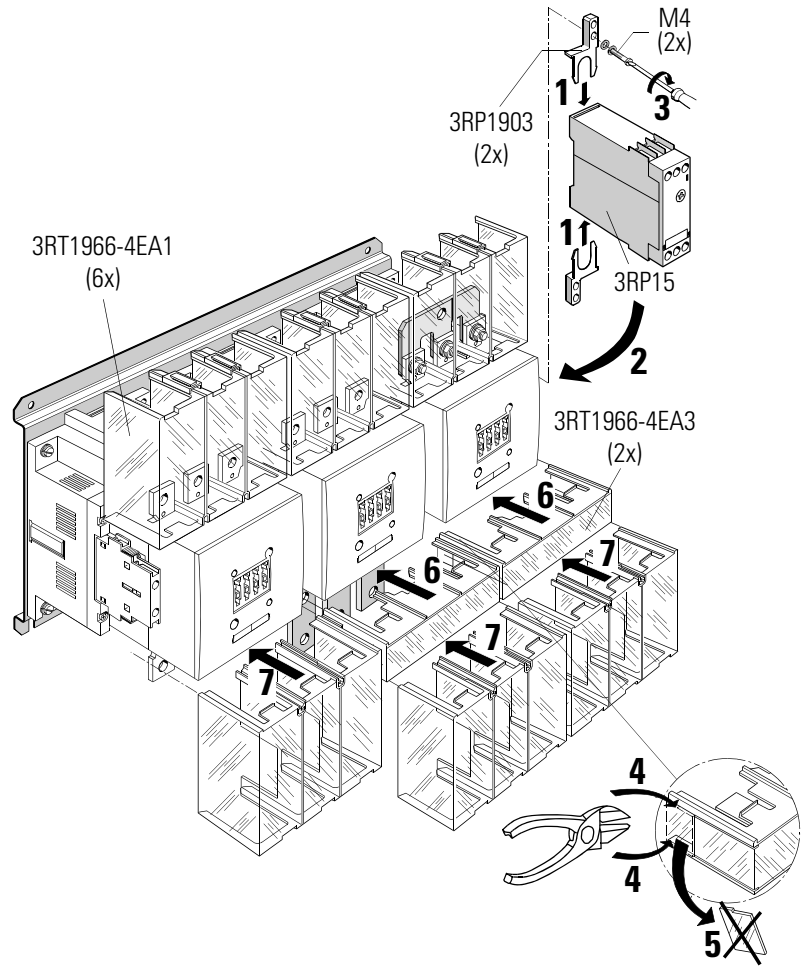
Drawing: Frame size S10 (S12) - S10 (S12) - S10 (S12)	Step	Procedure
	**1/2**	Mount the wye-delta combination to the mounting plate. **(1/2)**.
	3/4	Screw the bottom wiring kit busbar connections **(3/3.1/3.2/3.3)** and the wye jumper on top to the busbar connections **(4)**.
	**1/2/3**	Push in the "push-in lugs" for panel mounting the timing relay and then screw mount the timing relay to the mounting plate.
	4/5	Break off the extension pieces on the covers for the wiring module.
	6/7	Slide on the covers for the wiring module and the connection covers.

Table 3-32: Assembly of the wye-delta combinations in frame sizes S10/S12

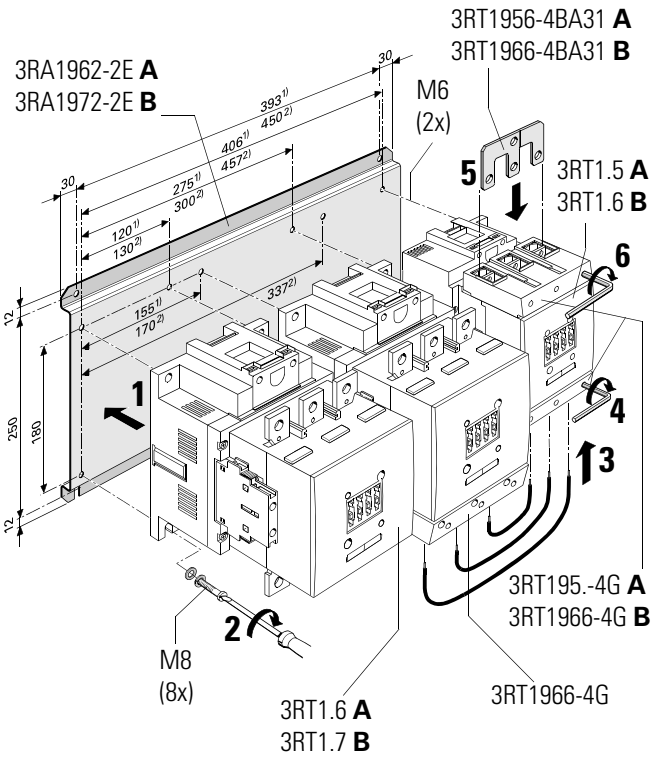
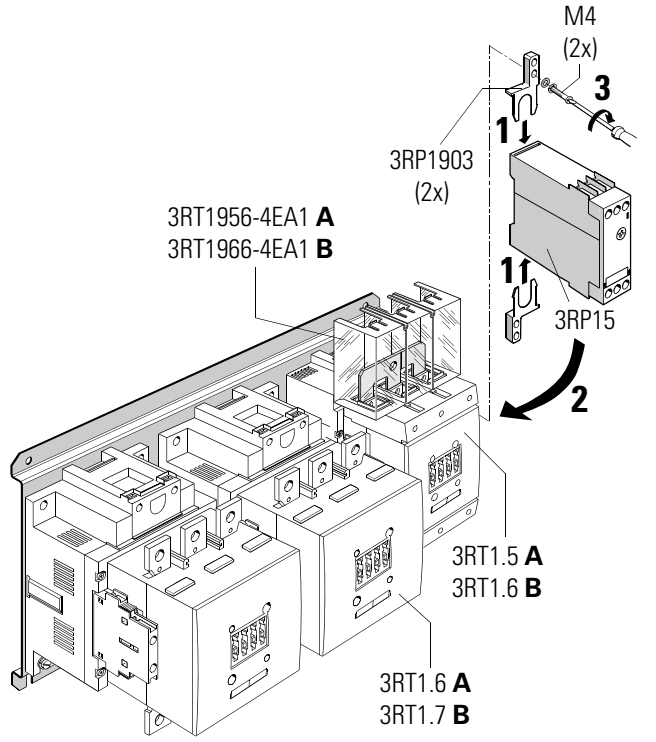
Drawing: Frame sizes S10 (S12) - S10 (S12) - S6 (S10)	Step	Procedure
	**1/2**	Mount the wye-delta combination to the mounting plate.
	3/4	Wire the main current paths of the delta contactor and the wye contactor and tighten down the main connections.
	5/6	Set the wye-jumper in place and tighten down the main connections.
	**1/2/3**	Push in the "push-in lugs" for panel mounting the timing relay and then screw mount the timing relay to the mounting plate.

Table 3-32: Assembly of the wye-delta combinations in frame sizes S10/S12

Compensating for different depths for the mechanical interlock

In wye-delta combinations with contactors of different frame sizes, it is necessary to compensate for the mounting depth of the smaller contactor. One frame size is the maximum difference possible.
The following depth compensation must be made for a mechanical interlock attached at the side:

- S2-S2-S0: K3: 1.5 mm; K2: 0 mm
- S3-S3-S2: K3: 0 mm; K2: 27.5 mm

Mounting and connection

The wye-delta combinations have screw-type connections that are suitable for both screw-on and snap-on mounting on the 35 mm rail.

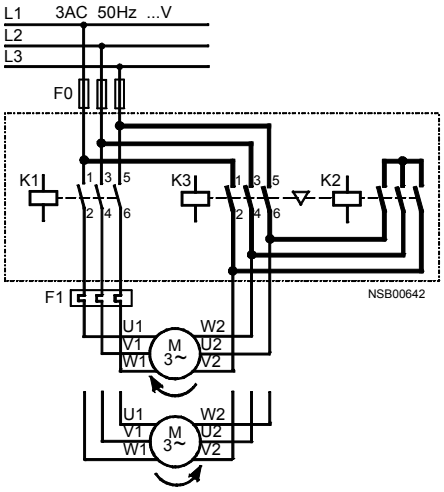
Conductor cross-sections

The permissible conductor cross-sections of the wye-delta combinations correspond to those of the basic units for the corresponding frame size.

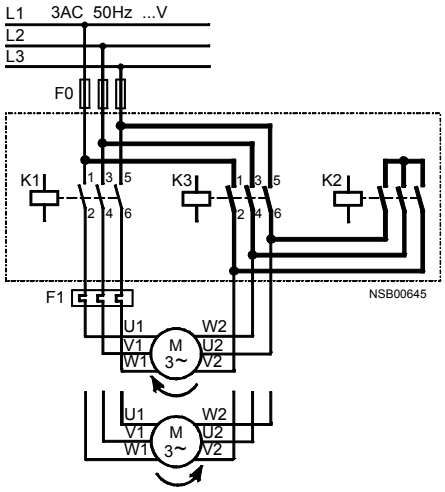
Circuit diagrams

Main circuit:

S00



S0



S2 to S12

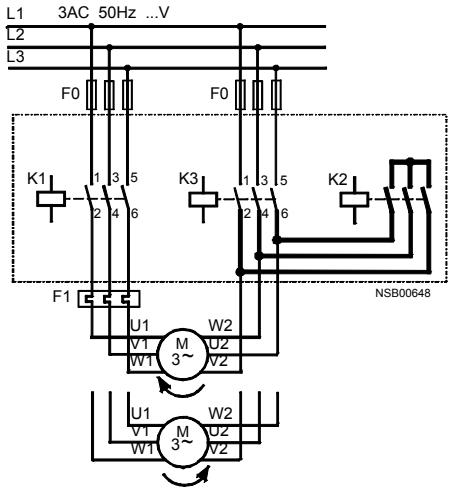


Fig. 3-32: Wye-delta combinations, main power circuit (frame sizes S00 to S12)

Control circuit S00

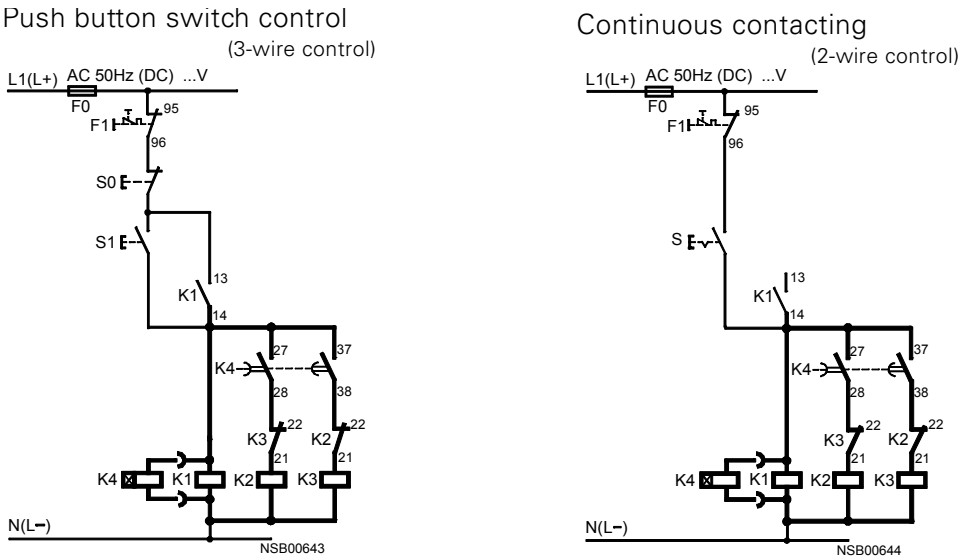


Fig. 3-33: Wye-delta combinations, control circuit (frame size S00)

Control circuit: S0 to S12

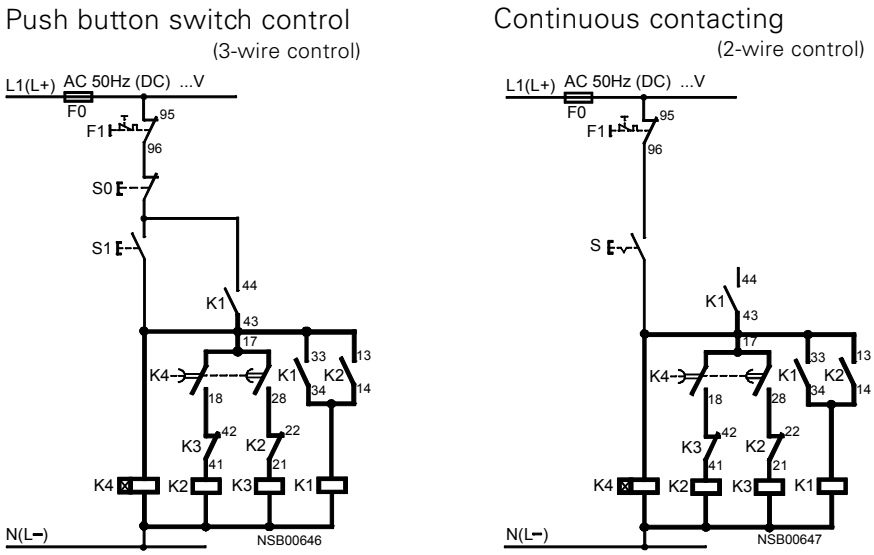


Fig. 3-34: Wye-delta combinations, control circuit (frame sizes S0 to S12)

S0 "Off" button
S1 "On" button
S Continuous contact maker
K1 Line contactor
K2 Wye contactor
K3 Delta contactor
K4 Time-delay auxiliary switch block or time relay
F0 Fuses
F1 Overload relay

Technical Data

The technical specifications of the wye-delta combinations correspond to those of the basic units for the corresponding frame size.