

Switching Devices – Contactors and Contactor Assemblies

Introduction

Overview



Size	S00	S0				S2					
Type	3RT101	3RT102				3RT103					
3RT10 contactors											
Type	3RT1015	3RT1016	3RT1017	3RT1023	3RT1024	3RT1025	3RT1026	3RT1034	3RT1035	3RT1036	
AC, DC operation	(p. 3/14, 3/18)			(p. 3/15, 3/19)			(p. 3/16, 3/20)				
AC-3											
I_e /AC-3/400 V	A	7	9	12	9	12	17	25	32	40	50
400 V	kW	3	4	5.5	4	5.5	7.5	11	15	18.5	22
230 V	kW	2.2	3	3	3	3	4	5.5	7.5	11	15
500 V	kW	3.5	4.5	5.5	4.5	7.5	10	11	18.5	22	30
690 V	3RT10/3RT12 kW	4	5.5	5.5	5.5	7.5	11	11	18.5	22	22
1 000 V	3RT10/3RT12 kW	--	--	--	--	--	--	--	--	--	--
AC-4 (for $I_a = 6 \times I_e$)											
400 V	kW	3	4	4	4	5.5	7.5	7.5	15	18.5	22
400 V	3RT10/3RT12 kW	1.15	2	2	2	2.6	3.5	4.4	8.2	9.5	12.6
(200 000 operating cycles)											
AC-1 (40 °C, ≤ 690 V)											
I_e	3RT10/3RT12 A	18	22	22	40	40	40	40	50	60	60
3RT14 AC-1 contactors											
Type					--				--		
I_e /AC-1/40 °C/≤ 690 V	A				--				--		
Accessories for contactors											
Auxiliary switch blocks	On front	3RH1911		(p. 3/34)	3RH1921		(p. 3/34)	3RH1921		(p. 3/34)	
	Lateral	--		(p. 3/38)	3RH1921		(p. 3/38)	3RH1921		(p. 3/38)	
Terminal covers		--			--				3RT1936-4EA2		(p. 3/46)
Box terminal blocks		--			--				--		
Surge suppressors		3RT1916		(p. 3/42)	3RT1926		(p. 3/42)	3RT1926/36		(p. 3/43)	
3RU1 and 3RB2 overload relays (Protection Equipment → Overload Relays)											
3RU11 , thermal, CLASS 10		3RU1116	0.1 ... 12 A (Chap.7)		3RU1126	1.8 ... 25 A (Chap.7)		3RU1136	5.5 ... 50 A (Chap.7)		
3RB20/21 , electronic, CLASS 5, 10, 20 and 30		3RB2016	0.1 ... 12 A (Chap.7)		3RB2026	3 ... 25 A (Chap.7)		3RB2036	6 ... 50 A (Chap.7)		
		3RB2116			3RB2126			3RB2136			
3RB22/23 , electronic, CLASS 5, 10, 20 and 30		3RB2.83 + 3RB2906	10 ... 100 A (Chap.7)		3RB2.83 + 3RB2906	10 ... 100 A (Chap.7)		3RB2.83 + 3RB2906	10 ... 100 A (Chap.7)		
3RV10 motor starter protectors (Protection Equipment → Motor Starter Protectors)											
Type		3RV1011	0.18 ... 12 A (Chap.5)		3RV1021	9 ... 25 A (Chap.7)		3RV1031	22 ... 50 A (Chap.7)		
Link modules		3RA1911	(Chap.5)		3RA1921	(Chap.7)		3RA1931	(Chap.7)		
3RA13 reversing contactor assemblies											
Complete units	Type	3RA1315	3RA1316	3RA1317	3RA1324	3RA1325	3RA1326	3RA1334	3RA1335	3RA1336	
		(p. 3/59)			(p. 3/60)			(p. 3/61)			
400 V	kW	3	4	5.5	5.5	7.5	11	15	18.5	22	
Assembly kits/wiring modules		3RA1913-2A		(p. 3/64)	3RA1923-2A		(p. 3/64)	3RA1933-2A		(p. 3/64)	
Mechanical interlocks		3RA1912-2H		(p. 3/63)	3RA1924-1A/-2B		(p. 3/63)	3RA1924-1A/-2B		(p. 3/63)	
3RA14 contactor assemblies for wye-delta starting											
Complete units	Type	3RA1415	3RA1416	3RA1423	3RA1425	3RA1434	3RA1435	3RA1436			
		(p. 3/68)		(p. 3/69)		(p. 3/70)	(p. 3/71)				
400 V	kW	5.5	7.5	11	15/18.5	22/30	37	45			
Assembly kits/wiring modules		3RA1913-2B		(p. 3/73)	3RA1923-2B		(p. 3/73)	3RA1933-2B/-2C		(p. 3/73)	

Overview

Standards

IEC 60947-1, EN 60947-1,
IEC 60947-4-1, EN 60947-4-1,
IEC 60947-5-1, EN 60947-5-1 (auxiliary switches)

The 3RT1 contactors are suitable for use in any climate. They are finger-safe according to EN 50274.

Connection methods

The 3RT1 contactors are available with screw terminals (box terminals) or spring-type terminals.

The size S3 contactors have removable box terminals for the main conductor connections. This permits connection of ring terminal lugs or busbars.

Contact reliability

If voltages ≤ 110 V and currents ≤ 100 mA are to be switched, the auxiliary contacts of the 3RT1 contactor or 3RH11 contactor relay should be used as they guarantee a high level of contact reliability.

These auxiliary contacts are particularly suitable for solid-state circuits with currents ≥ 1 mA at a voltage ≥ 17 V.

Short-circuit protection of the contactors

Short-circuit protection of the contactors without overload relay, see [Technical Specifications](#). For short-circuit protection of the contactors with overload relay, see [Configuration Manual "SIRIUS Configuration"](#):

<http://support.automation.siemens.com/WW/view/en/40625241>

To assemble fuseless motor feeders you must select combinations of motor starter protector/circuit breaker and contactor as explained in the section on fuseless load feeders.

Motor protection

3RU11 thermal overload relays or 3RB20/3RB21 electronic overload relays can be fitted to the 3RT1 contactors for protection against overload. The overload relays must be ordered separately.

Ratings of three-phase motors

The quoted rating (in kW) refers to the output power on the motor shaft (according to the nameplate).

Surge suppression

3RT1 contactors can be retrofitted with RC elements, varistors, diodes or diode assemblies (assembly of diode and Zener diode for short break times) for damping opening surges in the coil.

Note:

The OFF-delay of the NO contact and the ON-delay of the NC contact are increased if the contactor coils are attenuated against voltage peaks (noise suppression diode 6 to 10 times; diode assembly 2 to 6 times, varistor +2 to 5 ms).

Sizes S00 to S3, up to 45 kW

Auxiliary contact complement

Size S00 contactors have an auxiliary contact integrated in the basic unit. The basic units of sizes S0 to S3 are delivered only with the main contacts and can be extended with auxiliary switch blocks.

For sizes S0 to S3, complete units with mounted auxiliary switch blocks 2 NO + 2 NC are available (terminal designation according to EN 50012); the auxiliary switch block can be removed (for more information, see [Accessories, page 3/28](#)).

Note:

Auxiliary contact complement according to SUVA: Contactors with permanently mounted auxiliary switch block 2 NO + 2 NC are available for safety applications according to SUVA.

Surge suppression

The surge suppressors are plugged onto the front of size S00 contactors. Space is provided for them next to a snap-on auxiliary switch block.

For size S0 to S3 contactors, varistors and RC elements can be snapped on either on the top or directly below the coil terminals. Diode assemblies are available in 2 different versions on account of their polarity. Depending on the application they can be connected either only at the bottom (assembly with motor starter protector/circuit breaker) or only at the top (assembly with overload relay).

The plug-in direction of the diodes and diode assemblies is specified by coding.

Exceptions:

3RT1926-1T.00 and 3RT1936-1T.00,
in this case the plug-in direction is marked with "+" and "-".

Coupling contactors are supplied either without overvoltage damping or with a varistor or diode connected as standard, according to the version.

Sizes S6 to S12, > 45 to 250 kW

- 3RT10, contactors for switching motors
- 3RT12, vacuum contactors for switching motors
- 3RT14, contactors for AC-1 applications (see [Chapter 4](#))

Operating mechanism types

Two types of solenoid operation are available:

- Conventional operating mechanisms
- Solid-state operating mechanism (with 3 performance levels)

Control supply voltage

The contactors can be operated with an AC operating mechanism (50 to 60 Hz) as well as with DC.

Withdrawable coils

For simple coil replacement, e.g. if the application is replaced, the solenoid coil can be pulled out upwards after the release mechanism has been actuated and can be replaced by any other coil of the same size.

Auxiliary contact complement

Contactor sizes S6 to S12 are supplied with mounted auxiliary switch blocks.

For detailed information about the fitting of auxiliary switches, see [Accessories, page 3/28](#).

- 3RT10 and 3RT14 contactors:
Auxiliary contacts mounted laterally and on front
- 3RT12 vacuum contactors:
Auxiliary contacts mounted laterally

Contactors with conventional operating mechanism

3RT1...-A version

The solenoid coil is switched directly on and off with the control supply voltage U_s by way of terminals A1/A2.

Multi-voltage range for the control supply voltage U_s

Only one coil covers several close-lying control supply voltages which are used worldwide, e.g. 110–115–120–127 V AC/DC or 220–230–240 V AC/DC. Allowance is made in addition for an operating range of 0.8 times the lower ($U_{s\ min}$) and 1.1 times the upper ($U_{s\ max}$) rated control supply voltage within which the contactor switches reliably and no thermal overload occurs.

Power Contactors for Switching Motors

SIRIUS 3RT10 contactors, 3-pole, 3 ... 250 kW

Contactors with solid-state operating mechanism

The solenoid coil is supplied selectively with the power required for reliable switching and holding by upstream control electronics.

- Wide voltage range for the control supply voltage U_s : Compared with the conventional operating mechanism, the solid-state operating mechanism covers an even broader range of control supply voltages used worldwide within one coil version. For example, the coil for 200 to 277 V AC/DC ($U_{s\ min}$ to $U_{s\ max}$) covers the voltages 200-208-220-230-240-254-277 V used worldwide.
- Extended operating range 0.7 to 1.25 x U_s : The wide range for the rated control supply voltage and the additionally allowed coil operating range of $0.8 \times U_{s\ min}$ to $1.1 \times U_{s\ max}$ results in an extended coil operating range of at least 0.7 to 1.25 x U_s , within which the contactors will operate reliably, for the most common control supply voltages of 24, 110 and 230 V.
- Bridging temporary voltage dips: Control voltage failures dipping to 0 V (at A1/A2) are bridged for up to approx. 25 ms to avoid unintentional tripping.
- Defined ON and OFF thresholds: For voltages above $0.8 \times U_{s\ min}$ the electronics will reliably switch the contactor ON, and for voltages below the value $0.5 \times U_{s\ min}$ it is reliably switched OFF. The hysteresis in the switching thresholds prevents the main contacts from chattering as well as increased wear or welding when operated in weak, unstable networks. This also prevents thermal overloading of the contactor coil if the voltage applied is too low (contactor does not close properly and is continuously operated with overexcitation).
- Low control power consumption when closing and in the closed state.

Electromagnetic compatibility (EMC)

The contactors with solid-state operating mechanism conform to the requirements for operation in industrial plants:

- Interference immunity
 - Burst (IEC 61000-4-4): 4 kV
 - Surge (IEC 61000-4-5): 4 kV
 - Electrostatic discharge, ESD (IEC 61000-4-2): 8/15 kV
 - Electromagnetic field (IEC 61000-4-3): 10 V/m
- Emitted interference
 - Limit value class A according to EN 55011

Note:

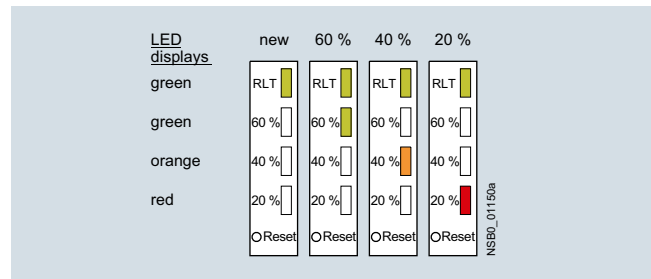
In connection with converters, the control cables must be routed separately from the load cables to the converter.

Indication of remaining lifetime (RLT)

Main contactor contacts are working parts which therefore must be replaced in good time when the end of their service life has been reached. The degree of contact erosion and thus the electrical endurance (= number of operating cycles) depends on the loading, utilization category, operating mode, etc. Up to now, routine checks or visual inspections by the maintenance personnel were needed in order to gain an insight into the state of the main contacts. The remaining lifetime indication function now takes over this task. It does not count the number of operating cycles – which does not provide information about contact erosion – but instead electronically identifies, evaluates and stores the actual progress of erosion of each one of the three main contacts, and outputs a warning when specified limits are reached. The stored data are not lost even if the control supply voltage for A1/A2 fails. After replacement of the main contacts, measurement of the remaining lifetime must be reset using the "RESET" button (hold down RESET button for about 2 s using a pen or similar tool).

Advantages:

- Signaling through relay contact when remaining lifetime is 20 %, i.e. contact material wear is 80 %
- Additional visual display of various levels of erosion by means of LEDs on the laterally mounted solid-state module when remaining lifetime is 60 % (green), 40 % (orange) and 20 % (red).

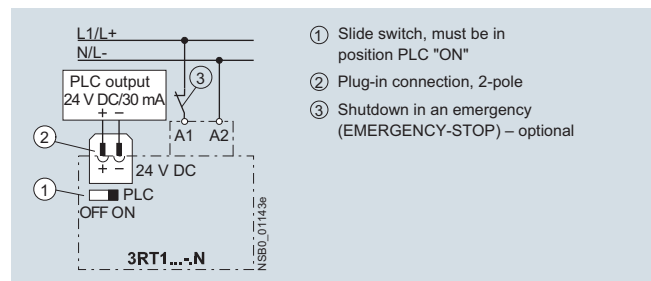


- Early warning to replace contacts
- Optimum utilization of contact material
- Visual inspection of the condition of contacts no longer necessary
- Reduction of ongoing operating costs
- Optimum planning of maintenance measures
- Avoidance of unforeseen plant downtimes

3RT1...-N version: for 24 V DC PLC output

2 control options:

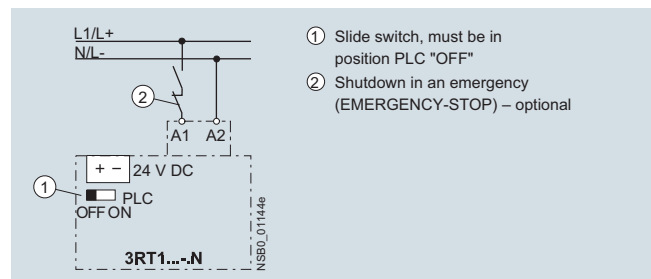
- Control without a coupling link directly through a 24 V DC ≥ 30 mA PLC output (IEC 61131-2). Connection by means of 2-pole plug-in connection. The screwless spring-type connection is part of the scope of supply. The control supply voltage which supplies the solenoid operating mechanism must be connected to A1/A2.



Note:

Before start up, the slide switch for PLC operation must be moved to the "PLC ON" position (setting ex works: "PLC OFF").

- Conventional control by applying the control supply voltage at A1/A2 through a switching contact.

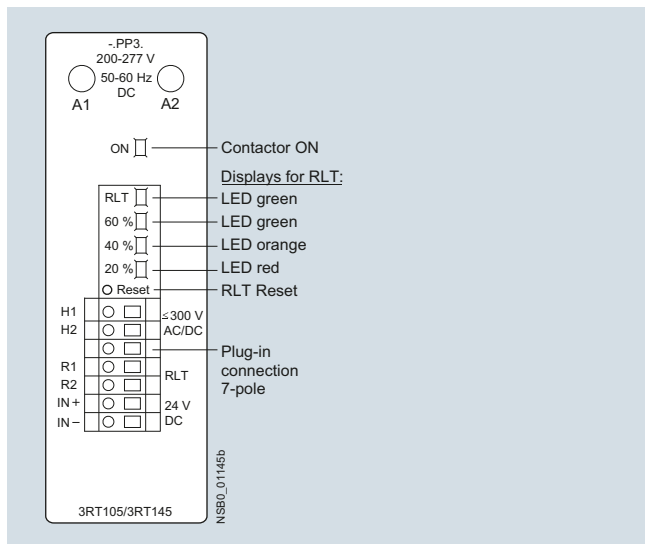


Note:

The slide switch must be in the "PLC OFF" position (= setting ex works).

SIRIUS 3RT10 contactors, 3-pole, 3 ... 250 kW

3RT1...-P version: for 24 V DC PLC output or PLC relay output, with remaining lifetime indicator (RLT)

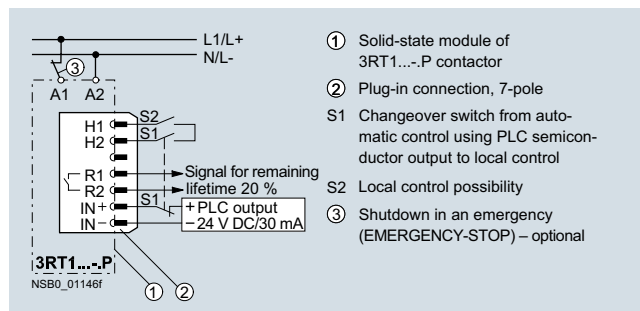


To supply the solenoid and the remaining lifetime indicator with power, the control supply voltage U_s must be connected to terminals A1/A2 of the laterally mounted electronic module. The control inputs of the contactor are connected to a 7-pole plug-in connection; the screwless spring-type connection is part of the scope of supply.

- The "Remaining Lifetime RLT" status signal is available at terminals R1/R2 through a floating relay contact (hard gold-plated, enclosed) and can be input to SIMOCODE, PLC or other devices for processing, for example. Permissible current-carrying capacity of the R1/R2 relay output:
 - I_e/AC -15/24 to 230 V: 3 A
 - I_e/DC -13/24 V: 1 A
- LED displays
 - The following states are indicated by means of LEDs on the laterally mounted solid-state module:
 - Contactor ON (energized state): green LED ("ON")
 - Indication of remaining lifetime

2 control options:

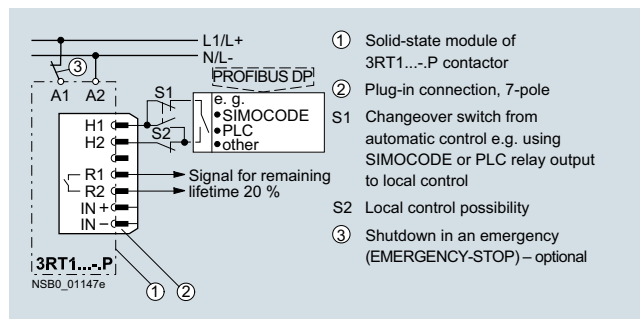
- Contactor control without a coupling link directly through a 24 V DC/≥ 30 mA PLC output (IEC 61131-2) by way of terminals IN+/IN-.



- ① Solid-state module of 3RT1...-P contactor
- ② Plug-in connection, 7-pole
- S1 Changeover switch from automatic control using PLC semiconductor output to local control
- S2 Local control possibility
- ③ Shutdown in an emergency (EMERGENCY-STOP) – optional

Possibility of switching from automatic control to local control by way of terminals H1/H2, i.e. automatic control through PLC or SIMOCODE/PROFIBUS DP can be deactivated e.g. at start-up or in the event of a fault and the contactor can be controlled manually.

- Contactor control through relay outputs at connections H1/H2, e.g. by
 - PLC or
 - SIMOCODE



- ① Solid-state module of 3RT1...-P contactor
- ② Plug-in connection, 7-pole
- S1 Changeover switch from automatic control e.g. using SIMOCODE or PLC relay output to local control
- S2 Local control possibility
- ③ Shutdown in an emergency (EMERGENCY-STOP) – optional

Contact loading: U_s /approx. 5 mA.

When operated through SIMOCODE, a communication link to PROFIBUS DP is also provided.

Article No. scheme

Digit of the article No.	1st - 3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th
SIRIUS power contactors	□ □ □	□	□	□	□	-	□	□	□	□	-	□	□	□
1st generation	3 RT													
Device type (e.g. 0 = 3-pole motor contactor, 3 = 4-pole AC-1 contactor)	1													
Size of the contactor (3 = S2, 4 = S3, 5 = S6, etc.)	□													
Power dependent on size (e.g. 45 = 37 kW)	□													
Connection type (1 = screw, 2 = spring)	□													
Operating range / solenoid coil circuit (e.g. A = AC standard / without)	□													
Rated control supply voltage (e.g. P0 = 230 V, 50 Hz)	□ □													
Auxiliary switches (e.g. S3: 0 = without auxiliary switches)	□													
Special version	□ □ □ □													
Example	3	R	T	1	0	4	5	-	1	A	P	0	0	

The Article No. scheme is presented here merely for information purposes and for better understanding of the logic behind the article numbers.

For your orders, please use the article numbers quoted in the catalog and in the Industry Mall.

Power Contactors for Switching Motors

SIRIUS 3RT10 contactors, 3-pole, 3 ... 250 kW

AC/DC operation (50 Hz to 60 Hz, DC)

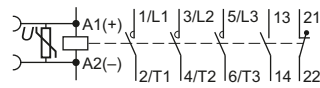
- Withdrawable coils with integrated coil switch (varistor)
- Auxiliary and control conductors: Screw terminals
- Main conductors: Busbar connections, for 3RT1054 (55 kW) box terminals¹⁾
- Indication of remaining lifetime (RLT)



3RT1056-6P..

Size	Rated data					AC-1, T_U : 40 °C	Auxiliary contacts, lateral		Rated control supply voltage U_s	DT	Screw terminals	PU (UNIT, SET, M)	PS*	PG
	AC-2 and AC-3, T_U : Up to 60 °C	Ratings ²⁾ of three-phase motors at 50 Hz and up to					Operational current I_e up to	Version						
	500 V	230 V	400 V	500 V	690 V	690 V	NO	NC	V AC/DC		Article No.	Price per PU		
	A	kW	kW	kW	kW	A								

Solid-state operating mechanisms - with 24 V DC PLC relay output - with RLT



S6	115	37	55	75	110	160	1	1	96 ... 127 200 ... 277	B B	3RT1054-1PF35 3RT1054-1PP35	1 1	1 unit 1 unit	41B 41B
	150	45	75	90	132	185	1	1	96 ... 127 200 ... 277	B B	3RT1055-6PF35 3RT1055-6PP35	1 1	1 unit 1 unit	41B 41B
	185	55	90	110	160	215	1	1	96 ... 127 200 ... 277	B B	3RT1056-6PF35 3RT1056-6PP35	1 1	1 unit 1 unit	41B 41B
	S10	225	55	110	160	200	275	1	1	96 ... 127 200 ... 277	B B	3RT1064-6PF35 3RT1064-6PP35	1 1	1 unit 1 unit
265		75	132	160	250	330	1	1	96 ... 127 200 ... 277	B B	3RT1065-6PF35 3RT1065-6PP35	1 1	1 unit 1 unit	41B 41B
300		90	160	200	250	330	1	1	96 ... 127 200 ... 277	B B	3RT1066-6PF35 3RT1066-6PP35	1 1	1 unit 1 unit	41B 41B
S12	400	132	200	250	400	430	1	1	96 ... 127 200 ... 277	B B	3RT1075-6PF35 3RT1075-6PP35	1 1	1 unit 1 unit	41B 41B
	500	160	250	355	400	610	1	1	96 ... 127 200 ... 277	B B	3RT1076-6PF35 3RT1076-6PP35	1 1	1 unit 1 unit	41B 41B

Other voltages [according to page 3/25](#) on request.

For accessories, [see page 3/38](#).

For spare parts, [see page 3/52](#).

¹⁾ Alternatively the 3RT1054-1 contactor (55 kW) can be supplied with busbar connections instead of box terminals. Without additional price. In the 8th position of the Article No., the "1" must be replaced with "6", e.g. 3RT1054-6..35.

²⁾ Guide value for 4-pole standard motors at 50 Hz 400 V AC. The actual starting and rated data of the motor to be switched must be considered when selecting the units.

Options

Rated control supply voltages, possible on request (change of 10th and 11th digit of the Article No.)

Rated control supply voltage U_s	Contactor type	3RT101	3RT10 2, 3RT10 3, 3RT10 4	3RT144	3RT13 1, 3RT15 1	3RT13 2 ... 3RT13 4, 3RT15 2, 3RT15 3	3RT1617, 3RT1627, 3RT1647
	Size	S00	S0, S2, S3	S3	S00	S0, S2, S3	S00, S0, S3

Sizes S2 and S3

AC operation

Solenoid coils for 50 Hz¹⁾

24 V AC	B0	B0	B0	B0	B0	B0	B0
42 V AC	D0	D0	D0	D0	--	--	--
48 V AC	H0	H0	H0	H0	--	--	--
110 V AC	F0	F0	F0	F0	F0	F0	F0
230 V AC	P0	P0	P0	P0	P0	P0	P0
240 V AC	U0	U0	U0	U0	U0	U0	U0
400 V AC	V0	V0	V0	V0	V0	V0	V0

Solenoid coils for 50 and 60 Hz¹⁾

24 V AC	B0	C2	C2	B0	C2	C2	C2
42 V AC	D0	D2	D2	D0	D2	--	--
48 V AC	H0	H2	H2	H0	H2	--	--
110 V AC	F0	G2	G2	F0	G2	G2	G2
220 V AC	N2	N2	N2	N2	N2	N2	N2
230 V AC	P0	L2	L2	P0	L2	L2	L2
240 V AC	P2	P2	P2	P2	P2	P2	P2

Solenoid coils (for USA and Canada²⁾)

50 Hz	60 Hz						
110 V AC	120 V AC	K6	K6	K6	K6	K6	K6
220 V AC	240 V AC	P6	P6	P6	P6	P6	P6

Solenoid coils (for Japan)

50/60 Hz ³⁾	60 Hz ⁴⁾						
100 V AC	110 V AC	G6	G6	G6	G6	G6	G6
200 V AC	220 V AC	N6	N6	N6	N6	N6	N6
400 V AC	440 V AC	R6	R6	R6	R6	R6	R6

DC operation

12 V DC	A4	--	--	A4	--	--	--
24 V DC	B4	B4	B4	B4	B4	--	--
42 V DC	D4	D4	D4	D4	D4	--	--
48 V DC	W4	W4	W4	W4	--	--	--
60 V DC	E4	E4	E4	--	--	--	--
110 V DC	F4	F4	F4	F4	F4	--	--
125 V DC	G4	G4	G4	G4	G4	--	--
220 V DC	M4	M4	M4	M4	M4	--	--
230 V DC	P4	P4	P4	P4	--	--	--

Examples

AC operation	3RT1034-1AP00	Contactors with screw terminals; with solenoid coil for 50 Hz for rated control supply voltage 230 V AC.
	3RT1034-1AG20	Contactors with screw terminals; with solenoid coil for 50/60Hz for rated control supply voltage 110 V AC.
DC operation	3RT1034-3BB40	Contactors with spring-type terminals; for rated control supply voltage 24 V DC.
	3RT1034-3BG40	Contactors with spring-type terminals; for rated control supply voltage 125 V DC.

Rated control supply voltage U_s	Contactor type	3RT1. 5.-.A 3RT1. 6.-.A 3RT1. 7.-.A	Rated control supply voltage U_s	Contactor type	3RT1. 5.-.N 3RT1. 6.-.N 3RT1. 7.-.N	3RT1. 5.-.P 3RT1. 6.-.P 3RT1. 7.-.P
$U_{s \min} \dots U_{s \max}^{5)}$	Size	S6, S10, S12	$U_{s \min} \dots U_{s \max}^{5)}$	Size	S6, S10, S12	S6, S10, S12

Sizes S6 to S12

UC operation (AC 50 ... 60 Hz, DC)

Conventional operating mechanisms

23 ... 26 V AC/DC	B3
42 ... 48 V AC/DC	D3
110 ... 127 V AC/DC	F3
200 ... 220 V AC/DC	M3
220 ... 240 V AC/DC	P3
240 ... 277 V AC/DC	U3
380 ... 420 V AC/DC	V3
440 ... 480 V AC/DC	R3
500 ... 550 V AC/DC	S3
575 ... 600 V AC/DC	T3

Solid-state operating mechanisms

21 ... 27.3 V AC/DC	B3	--
96 ... 127 V AC/DC	F3	F3
200 ... 277 V AC/DC	P3	P3

¹⁾ Coil operating range:
at 50 Hz: 0.8 to $1.1 \times U_s$
at 60 Hz: 0.85 to $1.1 \times U_s$.

²⁾ Coil operating range (sizes S2 and S3):
at 50 Hz and 60 Hz: 0.8 to $1.1 \times U_s$.

³⁾ Coil operating range (sizes S2 and S3):
at 50 Hz: 0.8 to $1.1 \times U_s$
at 60 Hz: 0.85 to $1.1 \times U_s$.

⁴⁾ Coil operating range:
at 60 Hz: 0.8 to $1.1 \times U_s$.

⁵⁾ Operating range:
 $0.8 \times U_{s \min}$ to $1.1 \times U_{s \max}$.