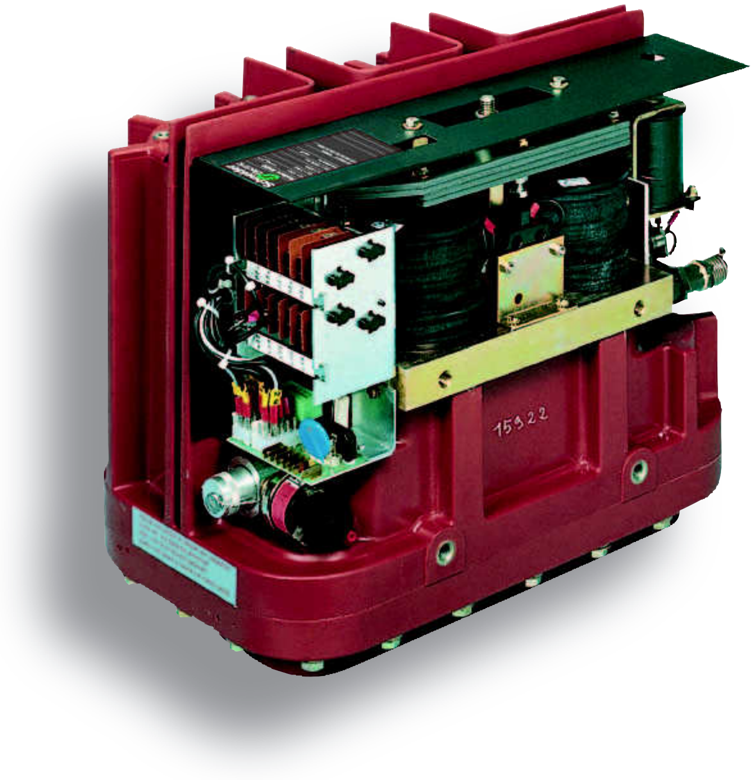
Medium Voltage Distribution

Rollarc R400 - R400D

Contactor 1 to 12 kV

Catalogue

2008



Schneider Electric

A new path for achieving your electrical installations

A comprehensive offer

The Rollarc range is part of a comprehensive offer of products that are perfectly coordinated to meet all medium and low voltage electrical distribution requirements. All of these products have been designed to work together: electrical, mechanical and communication compatibility.
The electrical installation is thus both optimised and has improved performance:
- better service continuity,
- increased personnel and equipment safety,
- guaranteed upgradeability,
- efficient monitoring and control.

You therefore have all the advantages at hand in terms of know-how and creativity for achieving optimised, safe, upgradeable and compliant installations.

Tools for facilitating the design and installation

With Schneider Electric, you have a complete range of tools to help you get to know and install the products whilst complying with current standards and good working practices. These tools, technical sheets and guides, design software, training courses, etc are regularly updated.

Schneider Electric is associating itself with your know-how and your creativity to produce optimised, safe, upgradeable and compliant installations

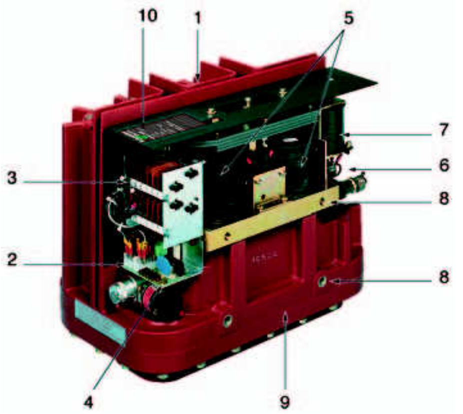
For a real partnership with you

A universal solution doesn't exist because each electrical installation is specific. The variety of combinations on offer allows you to truly customise the technical solutions.
You are able to express your creativity and put your know-how to best advantage when designing, manufacturing and exploiting an electrical installation.

Contents

Field of application and utilisation range

PE56761



1: MV connections
2: LV connections
3: auxiliary contacts
4: pressure switch
5: electromagnetic operating mechanism
6: mechanical latching device (R400D)
7: opening release
8: fixation points
9: insulating enclosure
10: rating plate

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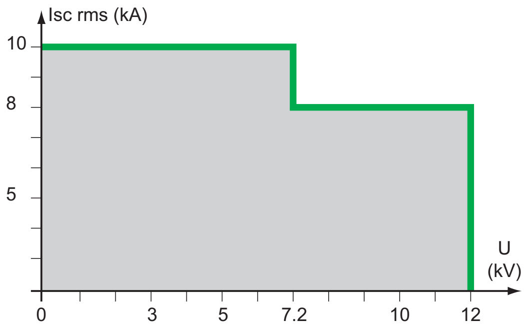


Description

The Rollarc three-pole indoor contactor uses sulphur hexafluoride **(SF6)** gas for insulation and circuit-breaking.
Circuit-breaking is based on the rotating arc principle. The basic version is made up of three pole units installed in the same insulating enclosure. The part of the enclosure containing the active parts of the poles is filled with SF6 gas at a gauge pressure of 2.5 bars.
There are two types of Rollarc contactors:
- The R400, with magnetic holding
- The R400D, with mechanical latching.

Main advantages

- A modern and tested circuit-breaking technique featuring SF6 safety
- No maintenance for active parts
- High mechanical and electrical endurance
- Low switching surges without additional devices (surge arrester)
- Insensitivity to the environment
- Gas pressure may be continuously monitored.

Field of application

Protection and control of:
- MV motors
- Capacitor banks and power transformers.

Utilisation range

Standards

Rollarc complies with the following standards and specifications:
- IEC publication 60470
- IEC 62271-105.

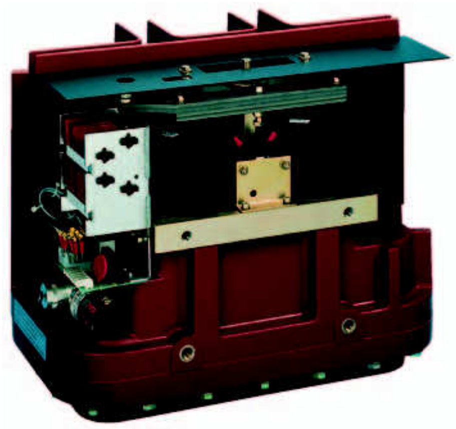
Installation references

- Solmer, Michelin, Shell, Esso, CFR, Pechiney, Naphtachimie, Usinor, Sacilor, Sollac
- Nuclear and conventional thermal power stations
- Mines de Saar (Germany)
- Nokia (Finland), Kafak (Sweden).

The Rollarc range

The Rollarc R400 and R400D contactors are available in three versions:

PE60247



Basic version
Contactor alone, without the cradle.

PE56762

Fixed version
The contactor with the control auxiliaries is mounted on a fixed cradle.

PE56763

Withdrawable version
The contactor with the control auxiliaries is mounted on a withdrawable cradle.

Fixed and withdrawable versions may be equipped with fuses when the short-circuit current is greater than the contactor rating.
The fuses used are of the indoor Fusarc CF type with strikers that actuate the contactor opening mechanism.

Description of the basic version

PE30250

Enclosure

The epoxy resin enclosure ensures:
- high mechanical strength enabling use as a support for the active parts and resistance to electromechanical stress.
- excellent dielectric strength due to the nature of the material and the design.
- a very reliable seal (sealed pressure system in compliance with standard IEC 60694).

The filling pressure remains constant throughout the life of the contactor.

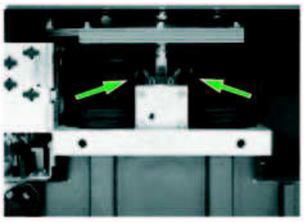
PE30251

Active parts and operating mechanism

The essential parts include the:
- arc interruption device,
- insulating rod which actuates the mobile contacts and the corresponding fixed terminal.

These parts are housed in an enclosure which is sealed for life and are thus totally insensitive to the environment. The resulting elimination of corrosion increases the reliability of the device.

PE56764



Electromagnetic coils

Rollarc is actuated by electromagnetic coils that ensure closing and hold the device in the closed position.

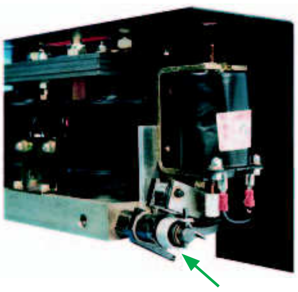
coil

PE30253

Auxiliary contacts

The auxiliary switch subassemblies are always mounted on the enclosure.

PE30254

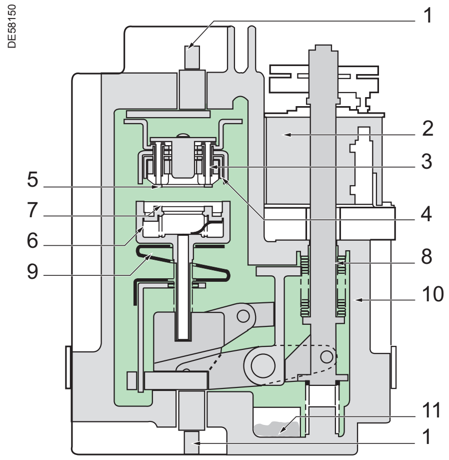


Mechanical latching

The R400D is actuated by electromagnetic coils that ensure closing of the device and has a mechanical latching device which holds the contactor in the closed position without a continuous power supply.
A release is used to free the latching mechanism.

Mechanical latching device

Description of the operation



1 - MV terminals
2 - Electromagnet
3 - Blowout coil
4 - Fixed main contact
5 - Fixed arcing contact
6 - Moving main contact
7 - Moving arcing contact
8 - Sealing bellows
9 - Flexible connector
10 - Enclosure
11 - Molecular sieve

Rollarc pole unit

Each pole unit consists of:

■ **a main circuit** composed of a fixed main contact (4) and a moving main contact (6)
■ **a breaking circuit** composed of a fixed arcing contact (5) and a moving arcing contact (7) that form two circular runners.
A blowout coil (3) is mounted in series in the circuit.
The main circuit that ensures the flow of the current is distinct from the breaking circuit in which the arc is produced.
■ a transmission mechanism for the transfer of energy from the operating mechanism to the mobile contacts.

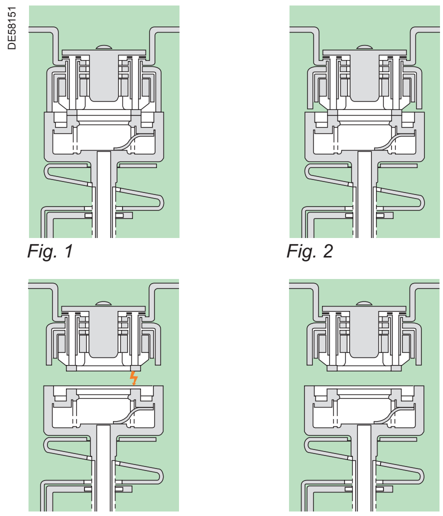


Fig. 1 *Fig. 2* *Fig. 3* *Fig. 4*

Operation

Rollarc 400 is a magnetic device that uses the rotating arc technique to interrupt the current.
■ at the beginning of an opening cycle, the main contacts and the arcing contacts are closed (fig.1).
■ isolation of the main circuit is achieved by the separation of the main contacts (fig. 2). The arcing contacts are still closed. The current flows through the coil, the arcing contacts and the flexible connector.
■ the arcing contacts open shortly after the main contacts. The resulting arc is made to rotate between the two circular runners of the arcing contacts by the electromagnetic field produced by the coil, the force of which depends on the current to be interrupted (fig. 3).
By design and due to phase shift between the current and the electromagnetic field, this force is still significant at zero current.
■ at zero current, the gap between the contacts recovers its initial dielectric strength thanks to the inherent qualities of SF6 gas (fig. 4).

Electrical characteristics

Electrical characteristics									
Rated voltage	Rated insulation level		Breaking capacity at U (kV)		Rated current (3)	Making capacity		Short time current	Mechanical endurance
Ur	impulse (1)	1 min			Ir		With fuses		
50-60 Hz	1.2/50 µs	50-60 Hz		With fuses (2)			(prospective current)	3 s	
kV	kV peak	kV rms	kA	kA	A	kA peak	kA	kA rms	
3.3 to 4.76	60	20	10	50	400	25	125	10	300 000 operations (magnetic holding)
7.2	60	20	10	50	400	25	125	10	100 000 operations (mechanical latching)
12	60	28	8	40	400	20	100	8	

Opening time at U	Breaking time	Closing time
Without relays: 20 to 40 ms	Without relays: 40 to 60 ms	Without relays: 75 to 145 ms
With relays: 30 to 50 ms	With relays: 50 to 70 ms	With relays: 85 to 155 ms

(1) Optional: 75 kV impulse/28 kV rms on basic version only

(2) Fusarc CF fuses: see sheet AC0479 (fuses 3-36 kV)

(3) 400 A continuous (no overload possible).

Control circuit		DC	AC
Rated supply voltage		48, 60, 110, 125, 220 V	110, 127, 220 V (4)
Power consumption:	Pick-up	1050 W	900 VA
	Seal-in	30 W	40 VA
	Opening	80 W	100 VA

(4) For other values, consult us

Auxiliary switches	
Rated current	10 A
Breaking capacity	DC: (L/R = 0.015 s) 0.5 A / 220 V
	AC: (p.f. = 0.3) 10 A / 220 V

Electrical endurance

This curve indicates the number of operations N according to the breaking current I, in class AC3 or AC4.

■ **R400**

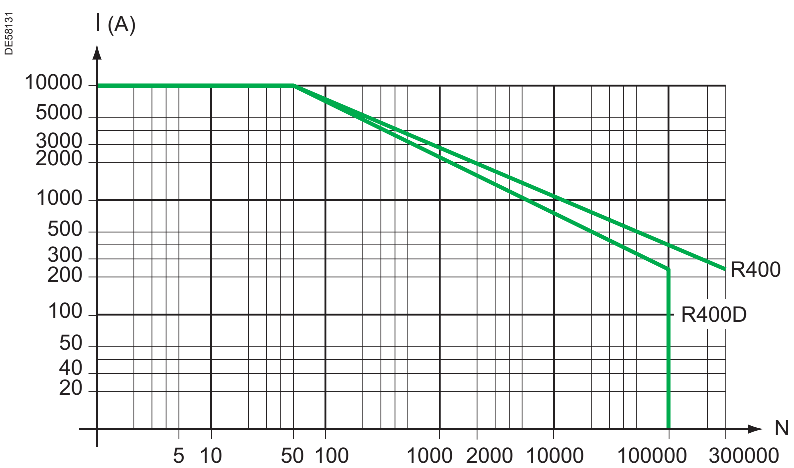
□ 300 000 operating cycles at 250 A

□ 50 operating cycles at 10 000 A.

■ **R400D**

□ 100 000 operating cycles at 200 A

□ 50 operating cycles at 10 000 A.



Maximum switching capacities

When the contactor is used in conjunction with fuses, the maximum switching capacities may be determined using the fuse curves and by taking into account:

- the characteristics of the load (motor starting currents, starting times, transformer inrush currents)
- the amplitude of the limited interrupted current which is a function of the prospective fault current and the fuses employed. The limited interrupted current should not exceed the electrodynamic withstand capacity of the contactor.

For values less than those presented in the table below, see:

- for motor control, page 22
- for transformers, technical sheet AC0479E.

Service voltage kV	Without fuses			With fuses						
	Motors (1) kW	Transfo. kVA	Capacitor banks kvar	Max. fuse rating see TS AC0479E (l = 292 mm)(2)	Motors in k (1)				Transformer (standard max. rating) kVA	Capacitors (single bank) Kvar
					5 s start Is/In = 6		10 s start Is/In = 6			
					Starts/h: 6	Starts/h: 12	Starts/h: 6	Starts/h: 12		
3.3	1560	1800	1255	250	1160	1060	1060	940	1000	790
3.6	1690	1965	1370	250	1260	1150	1150	1020	1250	865
4.16	1960	2270	1585	200	820	735	735	665	1000	800
6.6	3100	3600	2510	200	1295	1165	1165	1050	1600	1270
7.2	3380	3925	2740	200	1410	1270	1270	1145	1600	1385
10	4690	5455	3810	100	520	445	445	445	1250	960
12	5630	6545	4570	100	625	535	535	535	1600	1155

(1) With p.f. = 0.92 η = 0.94

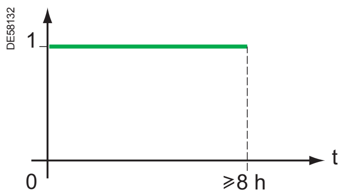
(2) For higher fuse ratings, consult us

***Note:** fuse ratings depend on the maximum power.*
For lower powers, the correct fuse rating must be determined (see page 21).

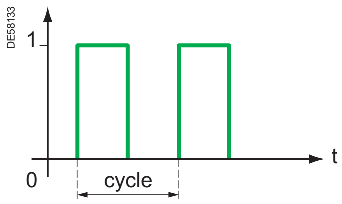
Contactor operating conditions

(without fuses)

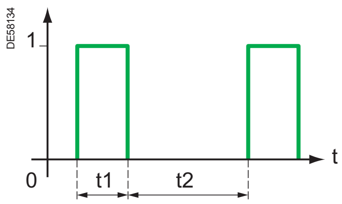
IEC standard 60470 (chapter 2) defines three types of contactor operation:



■ **Continuous operation**
In position 1, the contactor equilibrium temperature is reached.



■ **Periodical intermittent operation** (or intermittent)
In position 1, the contactor equilibrium temperature is not reached.



■ **Short-time operation**
In position 1, the contactor equilibrium temperature is not reached.
t1: standardized values 10 min - 30 min - 60 min - 90 min
t2: time required for the contactor to cool to the temperature of the cooling medium.

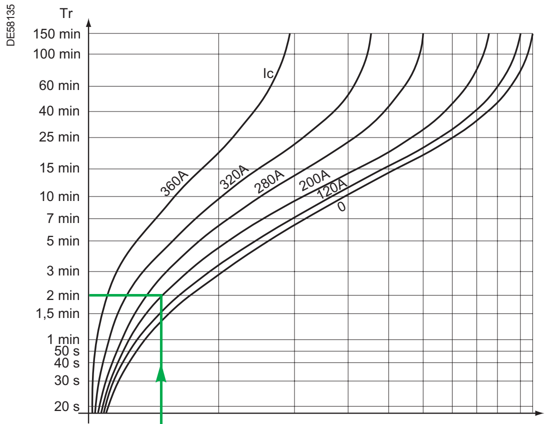


Fig. 2

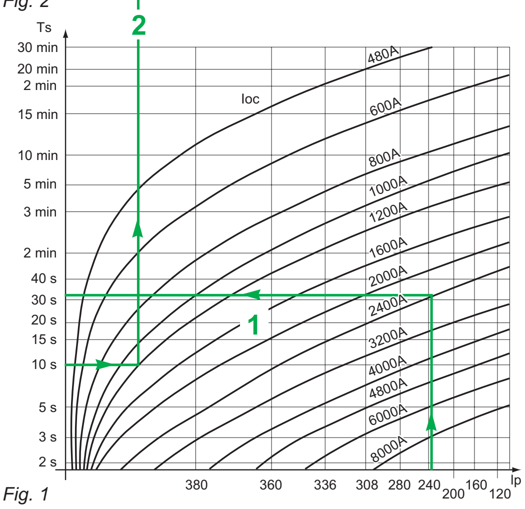


Fig. 1

Intermittent and short-time operation

Allowable overcurrents
The two sets of curves presented here can be used to determine allowable overcurrents in the Rollarc contactor.

■ The maximum value of an overcurrent and the cooling time
Using the permanent current value Ip, figure 1 can be used to determine the maximum duration of Toc along line 1.
The time required for cooling Tc to ensure that the equilibrium temperature is not exceeded may be determined using figure 2.
Example: a Rollarc contactor with a permanent operating current Ip = 240 A can withstand a temporary overload of 2400 A for 32 seconds.
The cooling time Tc is:
□ 25 minutes if the circuit is open
□ 28 minutes if a 120 A current flows through the contactor
□ 48 minutes if a 200 A current again flows through the contactor.

■ Cyclical overcurrent
the fourth parameter (see line 2 between figures 1 and 2) can be determined when three of the four below are known:
□ Ioc overcurrent
□ Toc duration of overcurrent
□ Ic cooling current
□ Tc duration of cooling.

Example:
Ioc 1200 A for 10 seconds
Tc 200 A for 2 minutes.

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Operating mechanism and equipment

Rollarc operating mechanism

The contactor is closed by an electromagnet (pick-up coil YF).

■ for the magnetically held contactor R400, two seal-in coils (YM) are inserted in the circuit at the end of closing. The contactor is tripped by the opening of the holding circuit.

■ for the mechanically latched contactor R400D, the contactor is held in closed position by the mechanical latching system. The contactor is tripped by a shunt trip which releases the latching device.

Auxiliary switches

Rollarc contactors are equipped with ten changeover common point auxiliary switches. Consult the equipment selection table for information on the number of available switches.

Pressure switch

The optional pressure switch for alarm indications closes a changeover switch if the gas pressure drop below 1.5 bars.
Contact breaking capacity:

■ AC (p.f. = 0.6) 2.2 A at 127 V

■ DC 0.5 A at 120 V - 0.4 A at 220 V.

Selection of accessories	Code	R400 magnetically held contactor			R400D magnetically latched contactor		
		Basic version AC/DC	Fixed version AC/DC	Withdrawable version AC/DC	Basic version AC/DC	Fixed version AC/DC	Withdrawable version AC/DC
Closing electromagnet	YF	■	■	■	■	■	■
Holding electromagnet (seal-in)	YM	■	■	■			
Shunt trip	YD				■	■	■
Number of auxiliary switches available (1)	CA	9	9	9	8	8	8
Pressure switch	P	■	■	■	■	■	■
Anti-pumping relay	KN				▲	■	■
Closing relay	KMF	▲	■	■	▲	■	■
Opening relay	KMO	▲	■	■	▲	■	■
Operation counter (1)	PC		□	□		□	□
Interlocking auxiliary switch (*)	SE		■	■		■	■
Interlock			□	□		□	□
“Service position” indication	SQ2			■			■
Equipment for MV fuses (fixing and “fuse blown” contacts)			□	□		□	□
Withdrawable fixed frame (2)				□			□
75 kV kit		□			□		
Mechanical interlock		□			□		

(1) The operations counter uses one auxiliary switch
(2) Device may be padlocked on the fixed frame (1 or 2 padlocks)
(*) The interlock switch is actuated by the operating handle

■ *Standard equipment*
▲ *Relay not supplied, wired by user (see diagrams)*
□ *Optional accessories*

Principle electrical diagram

Rollarc 400 basic version

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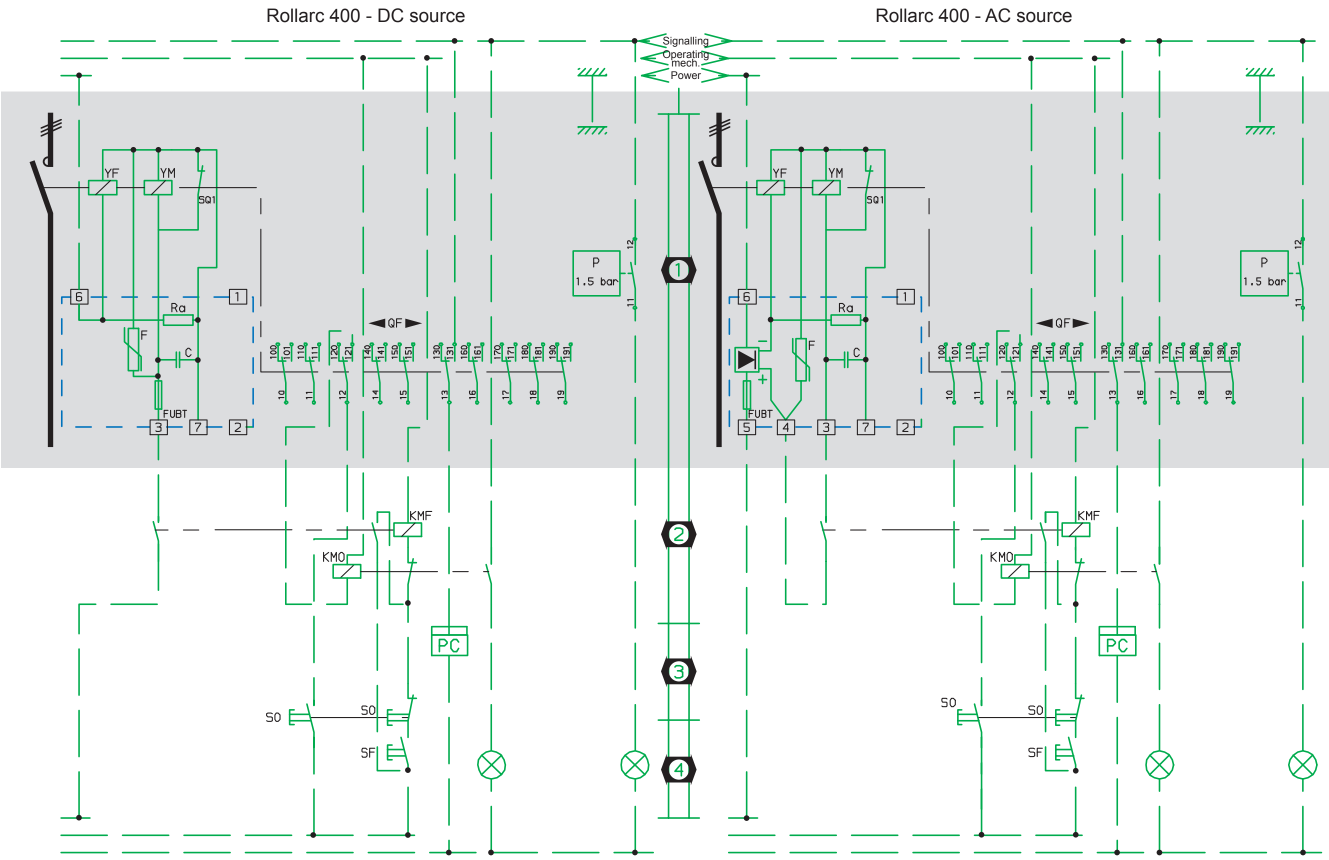

Standard Schneider Electric supply

1: control relay
2: recommended by Schneider Electric
3: options proposed by Schneider Electric
4: O/C control unit (not supplied by Schneider Electric)

—— – ——	mechanical links
— — —	Rollarc printed circuit alone
————	connections supplied
—— ——	connections not supplied

YF: closing coils ⎓ 1050 W ∿ 900 VA
YM: seal-in-coils ⎓ 30 W ∿ 40 VA
SQ1: limit switch. Seal-in coils contact
C: capacitor C = Iμf x 2 Umax = 250 V
Ra: resistance R = 1.2 KΩ
F: varistor Urms = 250 V type : GE Mov
I: breaking ∿ (p.f. = 0.3) 10 A/220 V
⎓ (L/R = 0.15) 0.5 A/220 V
P: closing pressure switch ∿ 2.2 A/220 V
⎓ 0.4 A/220 V

SO: opening push button
SF: closing push button
PC: 6-digit operation counter

FUBT: low voltage fuse

Un (V)	48	60-72	100-127	220-250
Ia (A)	10	3.15	2.5	1.25

KN: end of closing relay
KMF: closing relay
KMO: opening relay

See table below

Un (V)	48	110	220
Ia (A)	10	10	10
p.f. = 0.4 ∿ (A)	1.1	0.4	0.24
L/R = 40 ms ⎓ (A)	0.8	0.3	0.18

Coil consumption ⎓ 3 W
∿ 4 VA

Principle electrical diagram
Rollarc 400D basic version

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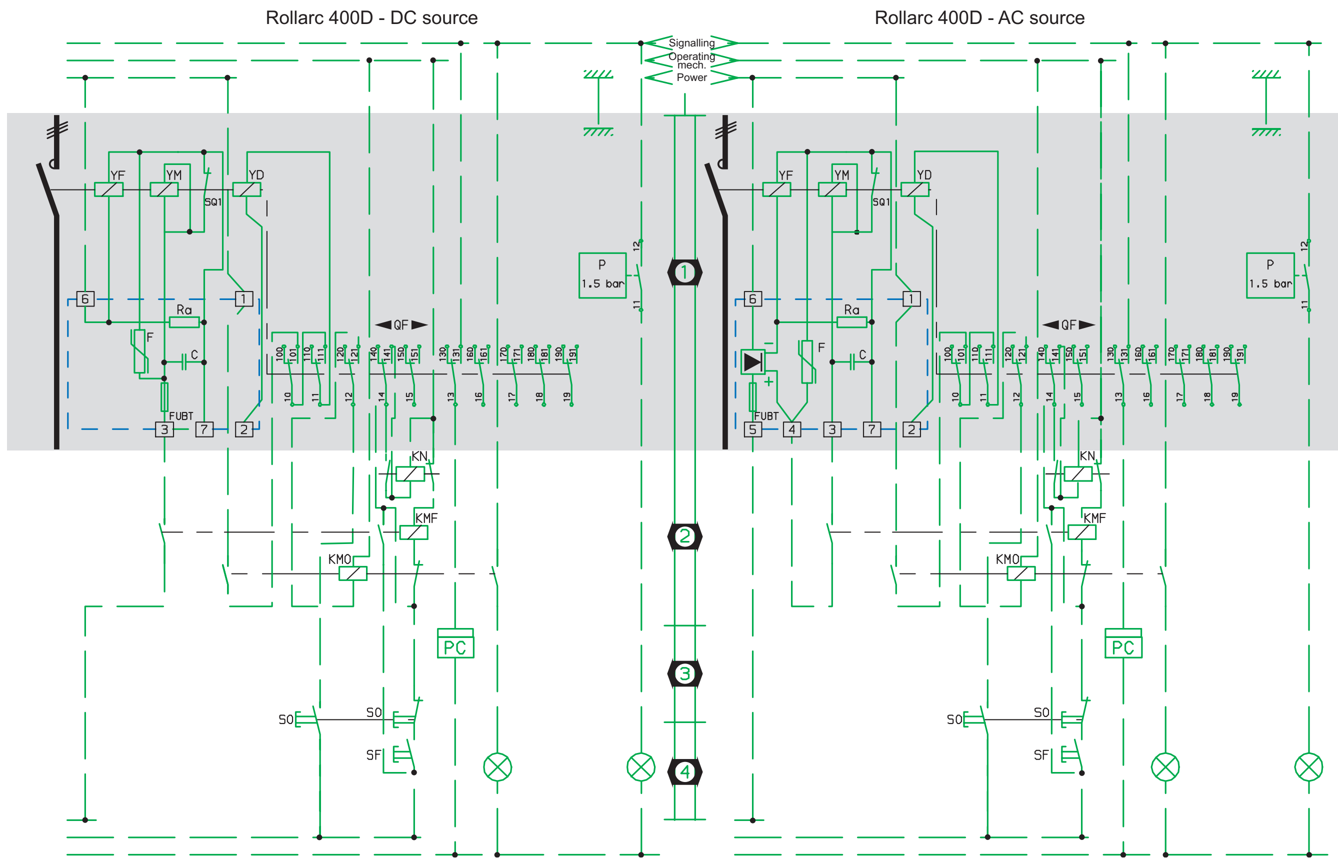

Standard Schneider Electric supply

1: control relay
2: recommended by Schneider Electric
3: options proposed by Schneider Electric
4: O/C control unit (not supplied by Schneider Electric)

— – —	mechanical links
— — —	Rollarc printed circuit alone
———	connections supplied
— —	connections not supplied

YD : shunt trip	⎓ 80 W	∿ 100 VA
YF: closing coils	⎓ 1050 W	∿ 900 VA
YM: seal-in-coils	⎓ 30 W	∿ 40 VA

SQ1: limit switch. Seal-in coils contact
C: capacitor C = 1µf x 2 Umax = 250 V
Ra: resistance R = 1.2 KΩ
F: varistor Urms = 250 V type : GE Mov
I: breaking ∿ (p.f. = 0.3) 10 A/220 V
⎓ (L/R = 0.15) 0.5 A/220 V
P: closing pressure switch ∿ 2.2 A/220 V
⎓ 0.4 A/220 V
SO: opening push button
SF: closing push button
PC: 6-digit operation counter

FUBT: low voltage fuse

Un (V)	48	60-72	100-127	220-250
Ia (A)	10	3.15	2.5	1.25

KN: end of closing relay
KMF: closing relay
KMO: opening relay
} *See table below*

Un (V)	48	110	220
Ia (A)	10	10	10
p.f. = 0.4 ∿ (A)	1.1	0.4	0.24
L/R = 40 ms ⎓ (A)	0.8	0.3	0.18

Coil consumption ⎓ 3 W
∿ 4 VA

Principle electrical diagram
Rollarc 400 fixed version with electrical auxiliaries

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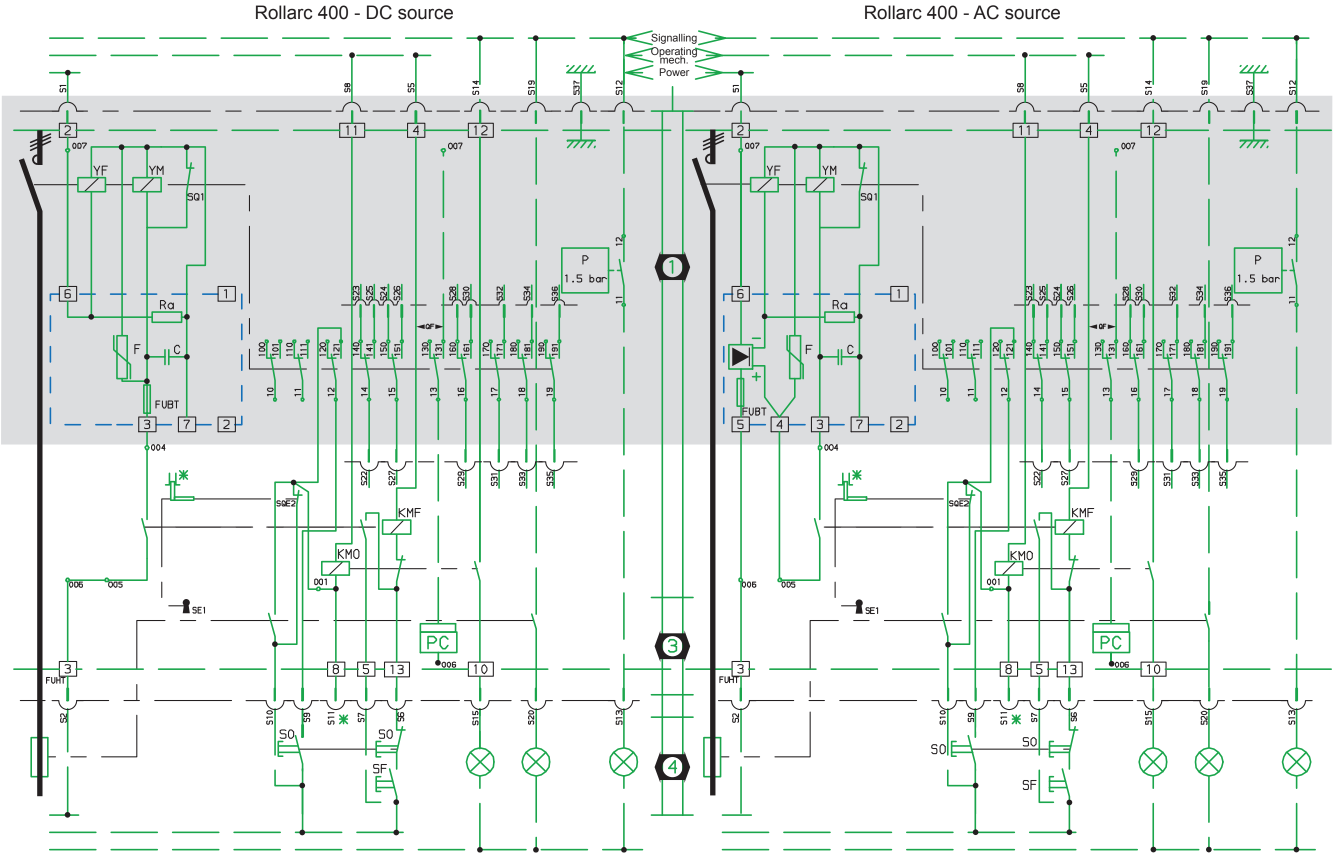

Standard Schneider Electric supply

1: control relay
2: recommended by Schneider Electric
3: options proposed by Schneider Electric
4: O/C control unit (not supplied by Schneider Electric)

— – — mechanical links
– – – Rollarc printed circuit alone
—— connections supplied
— — connections not supplied

YF: closing coils ⎓ 1050 W ∼ 900 VA
YM: seal-in-coils ⎓ 30 W ∼ 40 VA
SQ1: limit switch. Seal-in coils contact
C: capacitor C = Iμf x 2 Umax = 250 V
Ra: resistance R = 1.2 KΩ
F: varistor Urms = 250 V type : GE Mov
I: breaking ∼ (p.f. = 0.3) 10 A/220 V
⎓ (L/R = 0.15) 0.5 A/220 V
P: closing pressure switch ∼ 2.2 A/220 V
⎓ 0.4 A/220 V

SO: opening push button
SF: closing push button
PC: 6-digit operation counter

FUBT: low voltage fuse

Un (V)	48	60-72	100-127	220-250
Ia (A)	10	3.15	2.5	1.25

KN: end of closing relay
KMF: closing relay
KMO: opening relay
} *See table below*

Un (V)	48	110	220
Ia (A)	10	10	10
p.f. = 0.4 ∼ (A)	1.1	0.4	0.24
L/R = 40 ms ⎓ (A)	0.8	0.3	0.18

Coil consumption ⎓ 3 W
∼ 4 VA

Principle electrical diagram

Rollarc 400D fixed version with electrical auxiliaries

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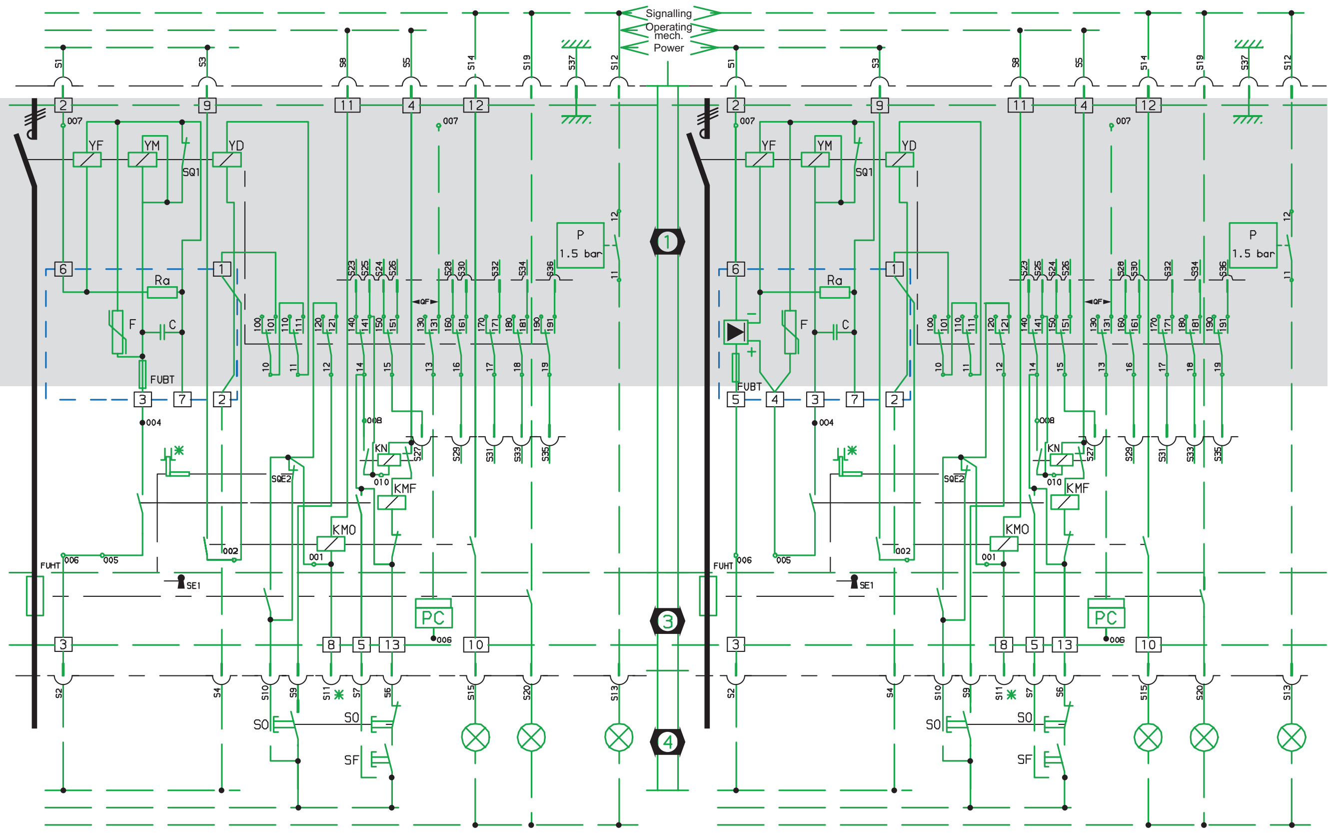

Standard Schneider Electric supply

1: control relay

2: recommended by Schneider Electric

3: options proposed by Schneider Electric

4: O/C control unit (not supplied by Schneider Electric)

— – — mechanical links

– – – Rollarc printed circuit alone

——— connections supplied

— — connections not supplied

YD : shunt trip ⎓ 80 W ∿ 100 VA

YF: closing coils ⎓ 1050 W ∿ 900 VA

YM: seal-in-coils ⎓ 30 W ∿ 40 VA

SQ1: limit switch. Seal-in coils contact

C: capacitor C = Iμf x 2 Umax = 250 V

Ra: resistance R = 1.2 KΩ

F: varistor Urms = 250 V type : GE Mov

I: breaking ∿ (p.f. = 0.3) 10 A/220 V

⎓ (L/R = 0.15) 0.5 A/220 V

P: closing pressure switch ∿ 2.2 A/220 V

⎓ 0.4 A/220 V

SO: opening push button

SF: closing push button

PC: 6-digit operation counter

FUBT: low voltage fuse

Un (V)	48	60-72	100-127	220-250
Ia (A)	10	3.15	2.5	1.25

KN: end of closing relay

KMF: closing relay

KMO: opening relay

} *See table below*

Un (V)	48	110	220
Ia (A)	10	10	10
p.f. = 0.4 ∿ (A)	1.1	0.4	0.24
L/R = 40 ms ⎓ (A)	0.8	0.3	0.18

Coil consumption ⎓ 3 W

∿ 4 VA

Principle electrical diagram

Rollarc 400 withdrawable version with electrical auxiliaries

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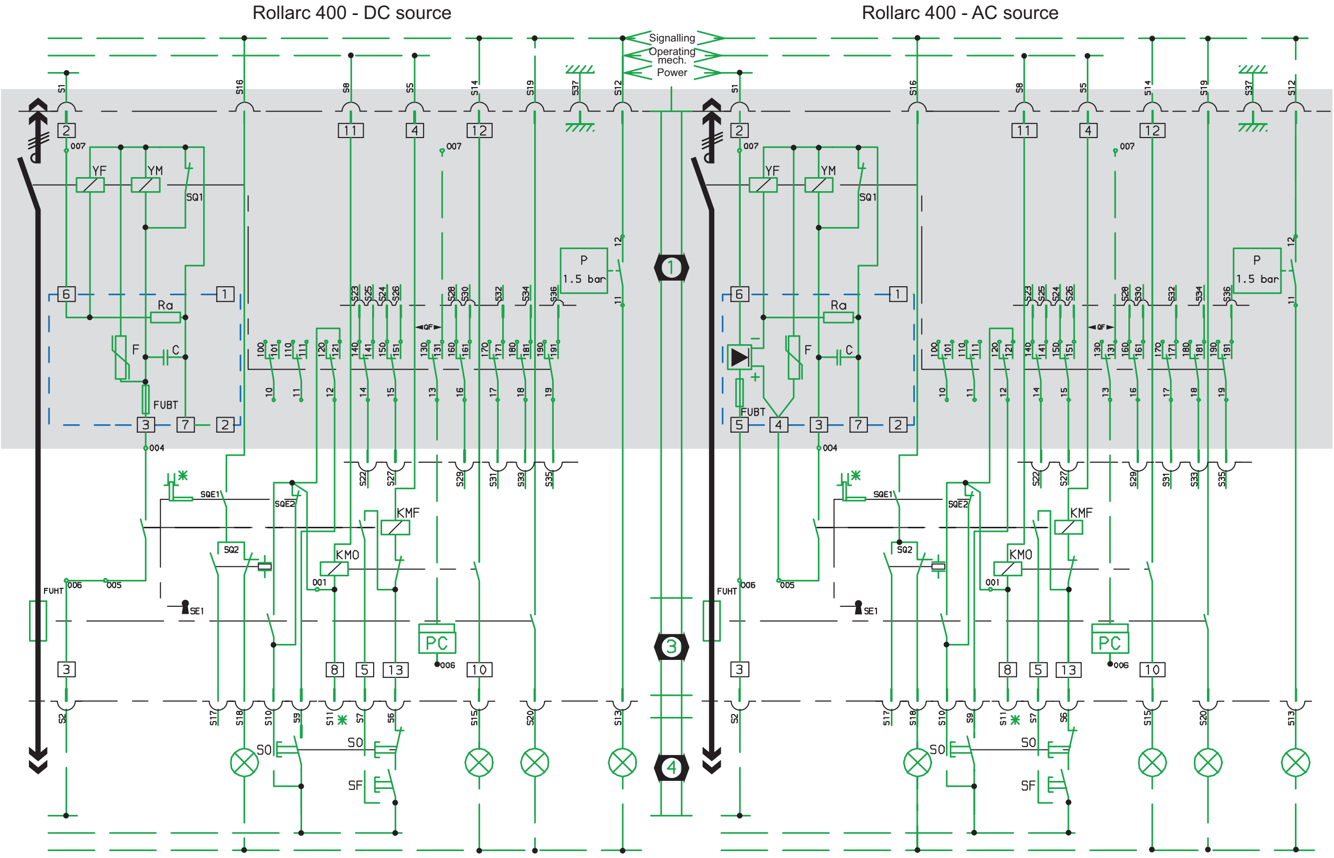


Standard Schneider Electric supply

1: control relay
2: recommended by Schneider Electric
3: options proposed by Schneider Electric
4: O/C control unit (not supplied by Schneider Electric)

— – — mechanical links
– – – Rollarc printed circuit alone
——— connections supplied
— — connections not supplied

YF: closing coils ⎓ 1050 W ∿ 900 VA
YM: seal-in-coils ⎓ 30 W ∿ 40 VA
SQ1: limit switch. Seal-in coils contact
C: capacitor C = Iµf x 2 Umax = 250 V
Ra: resistance R = 1.2 KΩ
F: varistor Urms = 250 V type : GE Mov
I: breaking ∿ (p.f. = 0.3) 10 A/220 V
⎓ (L/R = 0.15) 0.5 A/220 V
P: closing pressure switch ∿ 2.2 A/220 V
⎓ 0.4 A/220 V

SO: opening push button
SF: closing push button
PC: 6-digit operation counter

FUBT: low voltage fuse

Un (V)	48	60-72	100-127	220-250
Ia (A)	10	3.15	2.5	1.25

KN: end of closing relay
KMF: closing relay
KMO: opening relay
} *See table below*

Un (V)	48	110	220
Ia (A)	10	10	10
p.f. = 0.4 ∿ (A)	1.1	0.4	0.24
L/R = 40 ms ⎓ (A)	0.8	0.3	0.18

Coil consumption ⎓ 3 W
∿ 4 VA

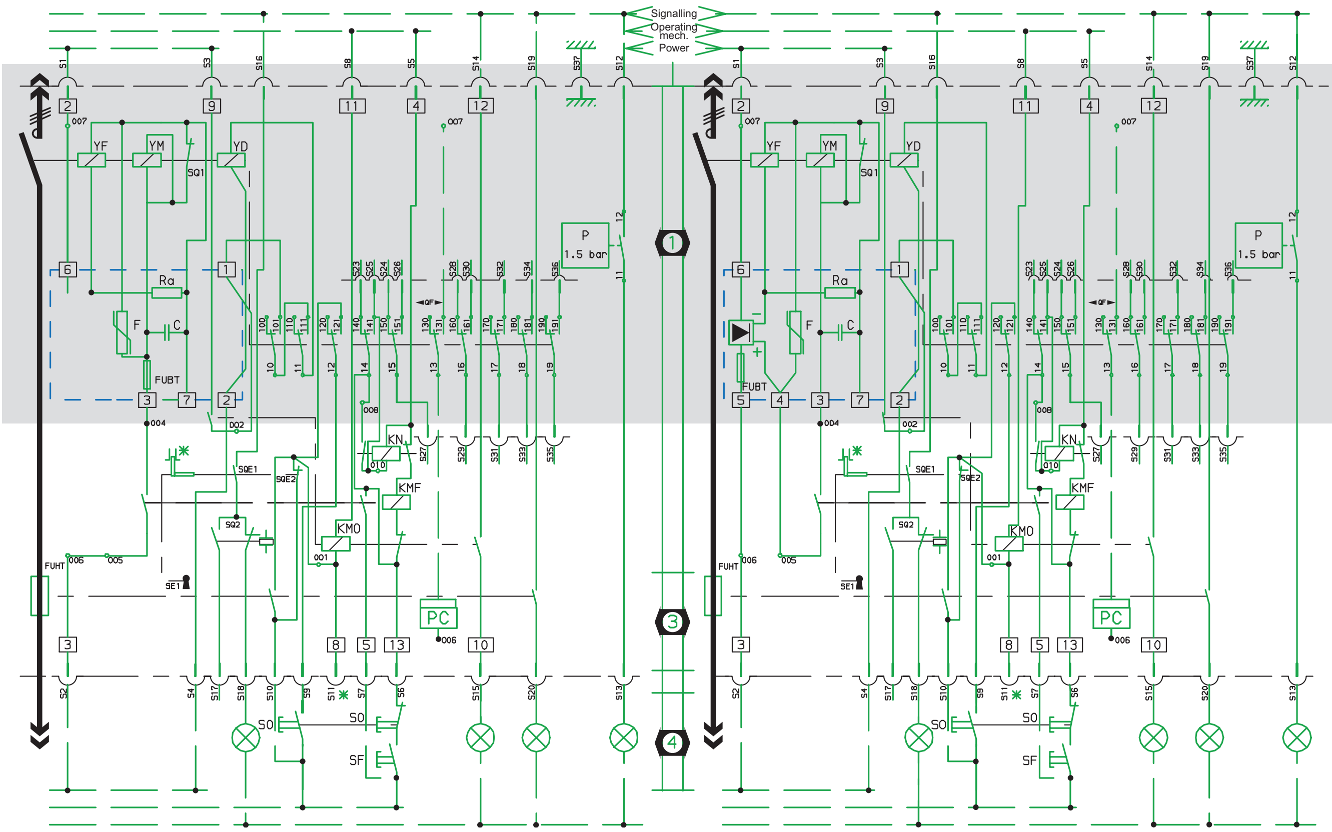
Principle electrical diagram

Rollarc 400D withdrawable version with electrical auxiliaries

DE58142EN

Rollarc 400D - DC source

Rollarc 400D - AC source



Standard Schneider Electric supply

1: control relay
2: recommended by Schneider Electric
3: options proposed by Schneider Electric
4: O/C control unit (not supplied by Schneider Electric)

— – — mechanical links
– – – Rollarc printed circuit alone
—— connections supplied
— — connections not supplied

YD : shunt trip ⎓ 80 W ∿ 100 VA
YF: closing coils ⎓ 1050 W ∿ 900 VA
YM: seal-in-coils ⎓ 30 W ∿ 40 VA
SQ1: limit switch. Seal-in coils contact
C: capacitor C = 1µf x 2 Umax = 250 V
Ra: resistance R = 1.2 KΩ
F: varistor Urms = 250 V type : GE Mov
I: breaking ∿ (p.f. = 0.3) 10 A/220 V
⎓ (L/R = 0.15) 0.5 A/220 V
P: closing pressure switch ∿ 2.2 A/220 V
⎓ 0.4 A/220 V

SO: opening push button
SF: closing push button
PC: 6-digit operation counter

FUBT: low voltage fuse

Un (V)	48	60-72	100-127	220-250
Ia (A)	10	3.15	2.5	1.25

KN: end of closing relay
KMF: closing relay
KMO: opening relay
} *See table below*

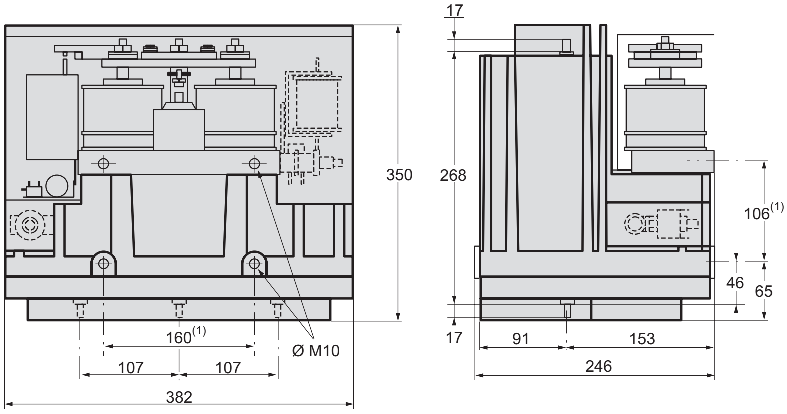
Un (V)	48	110	220
Ia (A)	10	10	10
p.f. = 0.4 ∿ (A)	1.1	0.4	0.24
L/R = 40 ms ⎓ (A)	0.8	0.3	0.18

Coil consumption ⎓ 3 W
∿ 4 VA

Dimensions

Basic version

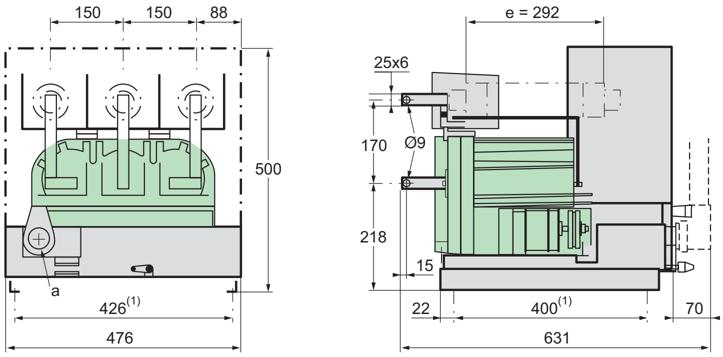
DE58143



(1) Mounting dimensions
Approximative weight: 35 kg

Fixed version

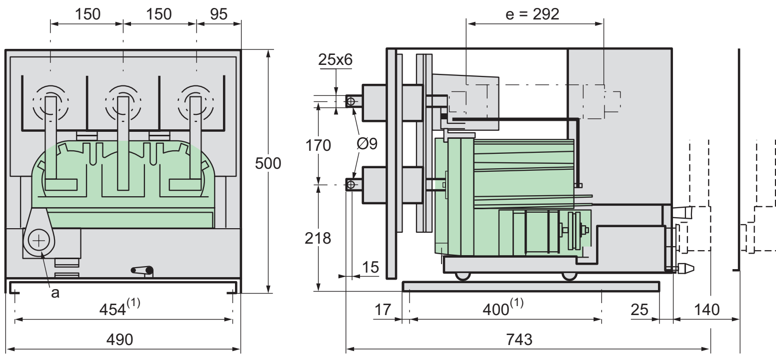
DE58144



a: LV connector
(1) Mounting dimensions
Approximative weight: 65 kg

Withdrawable version

DE58145

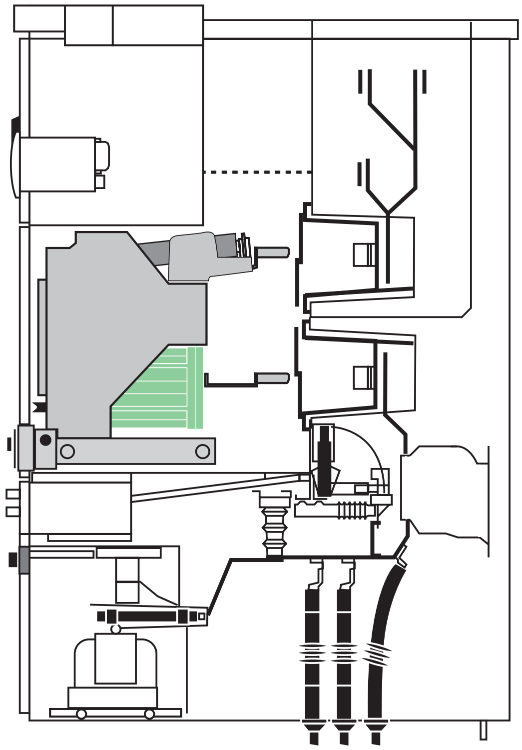


a: LV connector
(1) Mounting dimensions
Approximative weight: 85 kg

Withdrawable MCset factory-built cubicle

See technical sheet AC0467EN.

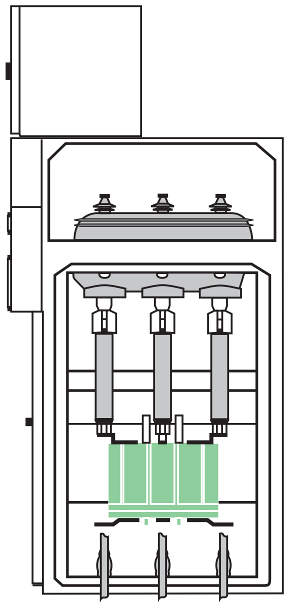
DE58146



SM6 factory-built cubicle

See technical sheet AMTED398078EN.

DE58147



Advantages of Rollarc

The Rollarc rotating arc contactor is a modern device with enhanced cooling of the arc by forced convection leading to the following advantages:

Long life

This results from:
- high product reliability
- very low wear of the active parts which require no maintenance
- the excellent sealing of the enclosure, eliminating the need for subsequent filling.

Mechanical endurance

The operating energy is reduced because arc rotation is directly created by the current to be interrupted.
The Rollarc contactor can do 300 000 operations in R400 version and 100 000 operations in R400D version.

Electrical endurance

The long life of the Rollarc is due to the negligible degeneration of the gas and to low wear of the contacts.
The energy dissipated in the arc is low due to:
- the intrinsic properties of the gas
- the short length of the arc
- the very short arcing time.

Wear of the arcing contacts can be checked without opening the poles. The unit is capable of breaking all load and short-circuit currents, even in the case of frequent operation. With very high breaking capacity for a contactor, the Rollarc can be used in a fuse-contactor assembly capable of protecting any circuit against all types of faults including overloads.

Low switching surges

The intrinsic properties of the gas and the soft break resulting from this technique means that switching surges are very low.
Concerning motor start-up, the unit is free from multiple prestrike and restrike phenomena which could damage the winding insulation.

Operating safety

The Rollarc contactor operates at a low relative pressure of 2.5 bars.

Continuous monitoring of the contactor pressure (optional)

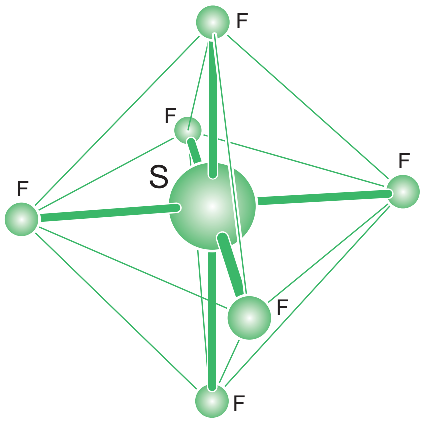
A pressure switch actuates a contact in the event of an accidental drop in the pressure of the SF6 gas in the Rollarc unit.

Insensitivity to external conditions

The Rollarc pole unit provides a totally gas-insulated system. It is a hermetically sealed enclosure filled with SF6 gas and housing the essential parts.
Rollarc is particularly suited to polluted environments such as mines, cement works, etc.

SF6 gas properties
The rotating arc technique

DE58148



Sulphur hexafluoride (SF6) gas properties

SF6 is **non-inflammable**, very stable, **non-toxic gas**, five times heavier than air.
Its dielectric strength is much higher than that of air at atmospheric pressure.

Gas for interruption

SF6 is “the” arc-interruption gas, combining the best properties:

- **high capacity for carrying away the heat produced by the arc**.

The latter is rapidly cooled by convection during the arcing period.

- **high radial thermal conduction and high electron capturing capacity**

When the current passes through zero, the arc is extinguished by the combination of two phenomena:

□ SF6 permits rapid heat exchange from the center of the arc toward the exterior.
□ fluorine atoms, which are highly electronegative, act as veritable “traps” for electrons.

Since it is electrons which are mainly responsible for electric conduction in the gas, the gap between the contacts recovers its initial dielectric strength through this electron capture phenomenon at zero current.

- **the decomposition of the SF6 molecule is reversible**

The same mass of gas is therefore always available, making the device self-sustained throughout its operating life.

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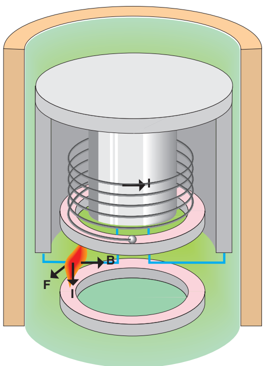


The rotating arc principle

The exceptional characteristics of SF6 gas are used to extinguish the electrical arc.
Cooling is enhanced by the relative movement between the arc and the gas.
In the rotating arc technique, the arc is set in motion between two circular arcing contacts (see figure opposite).
When the **arcing contacts** separate, the current to be interrupted flows through a solenoid, thus creating an electromagnetic field B.
When the **arcing contacts** separate, the arc appears between them. The arc is made to rotate between the two circular arcing contacts by force F, the combined result of the electromagnetic field and the current.
Force F is directly proportional to the square of the current to be interrupted.

This breaking technique therefore automatically adapts to the current to be interrupted:
When the current is high, the speed of rotation is high (speed of sound) and cooling is intense. Just before reaching zero current, the speed is still sufficient to make the arc rotate and thus contribute to the recovery of dielectric strength at zero current.
Wear of the arcing contacts is very low.
When the current is low, the speed of rotation is also low.
This leads to very soft breaking of the arc without surges, comparable to the widely appreciated performances of the air breaking technique.

Soft breaking

Breaking of inductive or capacitive currents

The Rollarc contactor does not generate voltage surges.
On some switchgear such surges occur during the breaking of low inductive or capacitive currents and can damage the insulation of connected devices.
With the rotating arc technique, the rotation speed of the arc is low for low currents and breaking is soft under all conditions:
- current chopping: (arc interruption before zero current) the chopping current is always less than 1 A, i.e. the voltage surge is very low for the load.
- multiple prestrikes and restrikes

Other phenomena exist that are much more dangerous to the load than the voltage surges resulting from current chopping. Such phenomena occur if the device tries to break high frequency currents.
High frequency currents appear when there is a dielectric breakdown (opening of contacts is too close to zero current) and produce high frequency waves that are very dangerous for motor insulation.
Given the relatively slow dielectric regeneration between its arcing contacts, the Rollarc contactor avoids breaking high frequency currents and multiple prestrike and restrike phenomena are prevented.
The Rollarc is thus the perfect motor control contactor.
It provides the user and the network with total security without requiring additional accessories such as surge arresters or RC systems.

Results of tests on Rollarc

Motor starting current	Busbar capacitance (Cb)	Busbar capacitance and compensation (Cb+Cc)	Overvoltage Pu (1)			Multiple restrikes
			Average	Standard deviation	Max.	
100 A	0.05 mF		1.76	0.18	2.35	none
100 A		1.8 mF	1.88	0.13	2.23	none
300 A	0.05 mF		1.69	0.10	1.90	none
300 A		1.8 mF	1.79	0.09	1.91	none

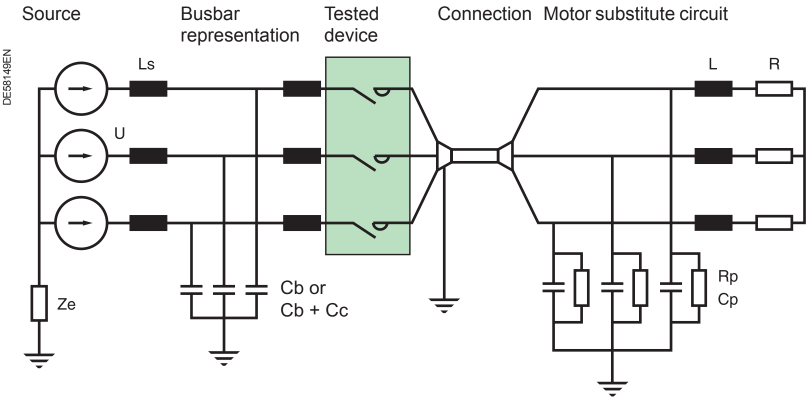
(1) $PU = \dfrac{\text{measured peak voltage}}{\dfrac{U\sqrt{2}}{\sqrt{3}}}$

Example: peak voltage $7.2 \times 1.76 \dfrac{U\sqrt{2}}{\sqrt{3}} = 10.35$ kV

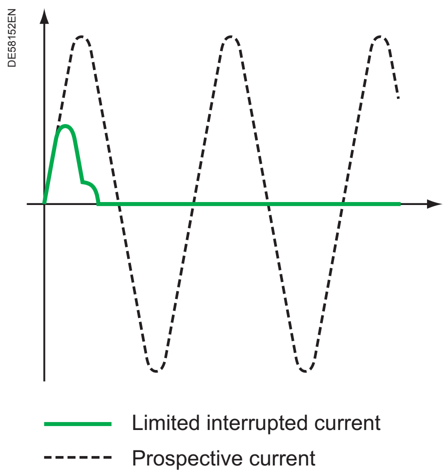
Test circuit diagram

100 A 7.2 kV and 300 A 7.2 kV

Tests according to IEC draft standard (17 A secretariat 291). Overvoltage levels depend on the breaking device, and also on the circuit. The IEC standard proposes a standard motor breaking circuit.



Ze: earth impedance
Ls: power supply inductance
Cp: load parallel capacitance
U: power supply voltage
Cc: compensation capacitance
Rp: load parallel resistance
Cb: capacitance of the bars
Lb: inductance of the bars
L: load inductance
R: load resistance



Fuse-contactor combinations

Principle
The contactor switches the load on and off during normal operation or an overload. The fuse ensures correct interruption of short-circuit currents according to the network short-circuit level. A “fuse-blown” device causes contactor opening.

Economic advantages
For a short-circuit level of 500 MVA, or of 50 kA at 6 kV, the saving in switchgear costs is more than 50% compared to a circuit breaker solution.

Technical advantages
Contactor: high switching rates and greater mechanical endurance than a circuit breaker.
Fuse: current limitation that considerably reduces the thermal and electrodynamic effects of a fault (fig. 1).

Transformer control and protection
Select the fuse using the table below.

Selection table (ratings in A)(1)

Service voltage (kV)	Type of fuse	Transformer rating (kVA)														
		25	**50**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**
3	Fusarc CF	16	25	50	50	63	80	80	125	125	125	160	200	250		
3.3		16	25	40	50	50	80	80	100	100	125	160	200	250		
5.5		10	16	31.5	31.5	40	50	50	63	80	100	125	125	160	200	
6		10	16	25	31.5	40	50	50	63	80	80	125	125	125	160	200
6.6		10	16	25	31.5	40	50	50	63	80	80	100	125	125	160	200
10		6.3	10	16	20	25	31.5	40	50	50	63	80	80	100	100	

(1) Installation without transformer overload

η = motor efficiency

Ua = rated motor voltage

Id = start up current

Td = start up time

Motor protection

The Fusarc CF fuse in association with a Rollarc contactor constitutes a particularly effective protection device for MV motors.

Fuse rating

The three charts given below enable the fuse rating to be determined when we know the motor power (P in kW) and its rated voltage (Ua in kV).
Chart 1: this gives the rated current In (A) according to P and Ua.
Chart 2: this gives the start-up current Id (A) according to In (A).
Chart 3: this gives the appropriate rating according Id and the start-up duration time td (s).

Comments

Chart 1 is plotted for a power factor of 0.92 and an efficiency of 0.94.
For values different to this, use the following equation: $In = \frac{P}{\eta \sqrt{3}\, Ua\, .\, p.f.}$

- chart 3 is given in the case of 6 start-ups spread over an hour or 2 successive startups .
- For n successive start-ups (n > 6), multiply td by $\frac{n}{6}$

For p successive start-ups (p > 2), multiply td by $\frac{p}{2}$
In the absence of any information, take td = 10 s.

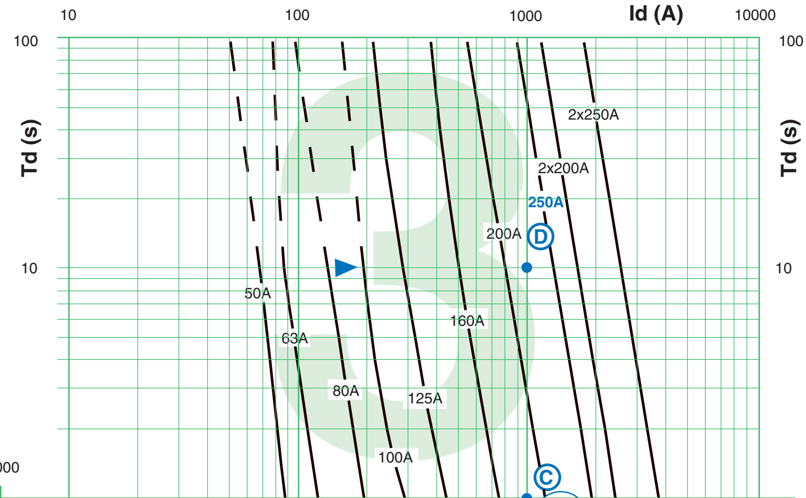
- if the motor start-up is not direct, the rating obtained using the charts below may be less than the full load current of the motor. In this case, we have to choose a rating 20% over the value of this current, to take account of the cubicle installation.

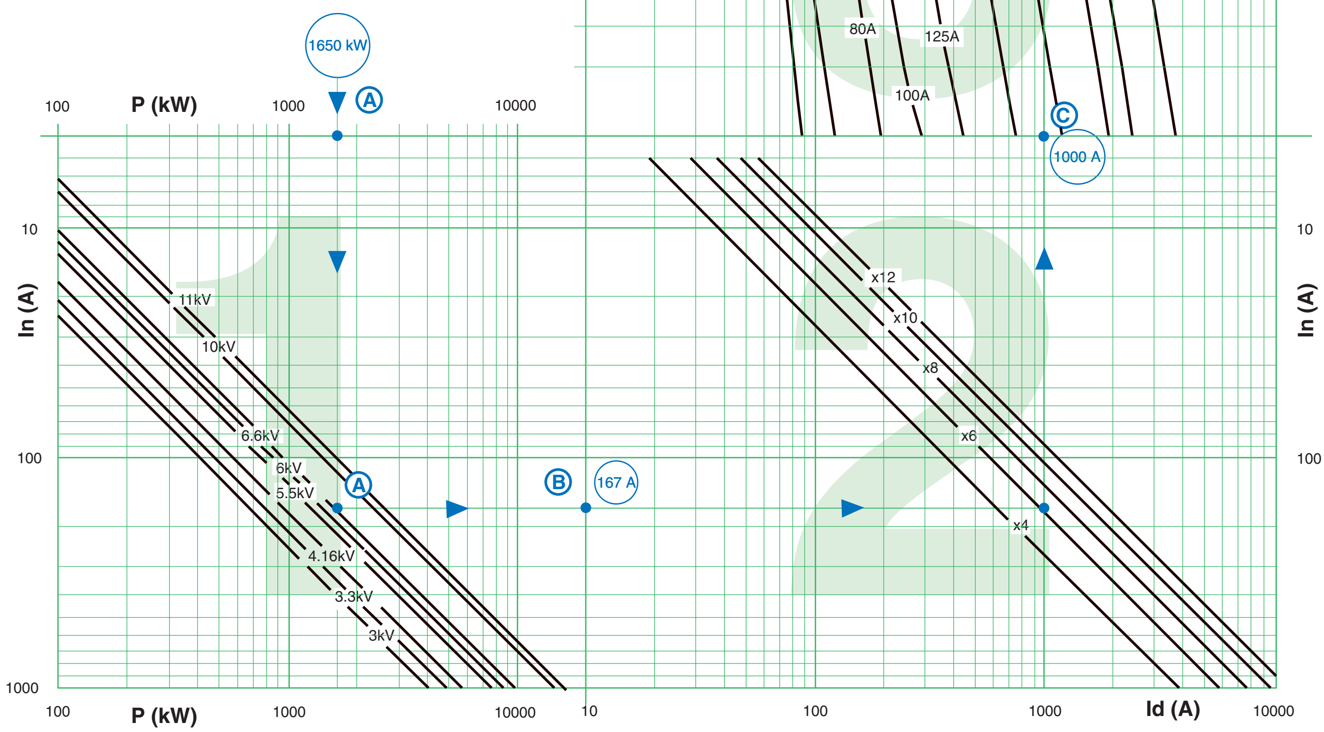
Example (in blue in the charts)

A 1650 kW motor powered at 6.6 kV (point A, chart 1) has a current of 167 A (point B).

The start-up current, 6 times greater than the rated current = 1000 A (point C, chart 2).

For a start-up time of 10 s, chart 3 shows a rating of 250 A (point D).





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Order form

Only one of the boxes (ticked X or filled ☐ by the needed value) have to be considered between each horizontal line.
Green box X corresponds to none priced functions.

Contactor R400, R400D

Quantity ☐

			R400 ☐		R400D ☐
Contactor type		Basic ☐	Fixed ☐		Withdrawable with cradle ☐
Characteristics			7.2 kV - 60 kVbil - 10 kA - 400 A ☐		12 kV - 60 kVbil - 8 kA - 400 A ☐
Closing trip release			48 Vdc ☐	110 Vdc ☐	220 Vdc ☐
			60 Vdc ☐	125 Vdc ☐	240 Vdc ☐
	50 Hz	100 Vac ☐	110 Vac ☐	125-127 Vac ☐	220 Vac ☐
	60 Hz	100 Vac ☐	110 Vac ☐		220 Vac ☐
Relay	50 Hz	100 Vac ☐	110 Vac ☐	125-127 Vac ☐	220 Vac ☐
	60 Hz	100 Vac ☐	110 Vac ☐		220 Vac ☐
Opening trip release (only in R400D)				60 Vdc ☐	125 Vdc ☐
			48 Vdc ☐	110 Vdc ☐	220-240 Vdc ☐
	50 Hz	100 Vac ☐	110 Vac ☐	125-127 Vac ☐	220 Vac ☐
	60 Hz	100 Vac ☐	110 Vac ☐		220 Vac ☐

Options

For basic type			
Mechanical interlocking between 2 contactors	500 mm ☐	650 mm ☐	800 mm ☐
For fixed or withdrawable type			
HV fuses equipment (fuses no supplied)			☐
Interlocking in open position (without lock)		Ronis ☐	Profalux ☐
Leaflets language		French ☐	English ☐