DISTRIBUTION SOLUTIONS

ConVac

Medium-voltage (MV) vacuum contactor

Indoor vacuum contactor for motor switching, transformers, capacitor banks switching and power factor correction systems. The suitable solution for industries, utility, service-providing and shipbuilding sectors.
For circuits up to 50 kA fault levels when equipped with fuses.
The use of vacuum interrupters guarantees excellent operational performances of apparatus in harsh environmental conditions requiring many hourly operating sequences.

Table of contents

ConVac:
its strengths, your benefits

Productivity

Efficiency

Productivity
Maximize your results

Easy to install
- All electrical connections are plug-and-socket with integrated terminal box. This method saves up to 40% of wiring time

Efficiency
Optimize your investments

Affordable range
- Panel design optimization thanks to common and flexible installation position between ConVac 7 and ConVac 12 400 A units

Optimized logistics
- ConVac 7 400 A conforms to IEC, UL and CSA standards. All ConVac units are provided with common and interchangeable plug-in accessories to reduce the customization time up to 80%

Description

—
1

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2

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3

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01 Front view ConVac7 400A
02 Front view ConVac7 800A
03 Vacuum interrupter

—
The MV ConVac contactor operates in AC and is used to control devices requiring a high number of hourly operating sequences.

ConVac is a unique solution based on a linear electromagnetic actuator that moves in line with the moving contact of the vacuum interrupters to guarantee the best performance and long, reliable mechanical life.
ConVac is made of three separate poles improving its dielectric and mechanical performances. Mechanically or electrically latched version are available on request.

ConVac webpage :
Other ConVac versions

Tap on QR code to open the link

Applications
ConVac contactors are suitable for controlling electrical apparatus in industries, in service-providing and shipbuilding sectors, etc. Thanks to its vacuum breaking technology, they can operate in particularly challenging environments. They are ideal for controlling motors, transformers, capacitor banks, switching systems, etc.
Fitted with fuses, they can be used in circuits with up to 50 kA fault levels.

IEC air-insulated secondary switchgear UniSec

Tap on QR code to open the link

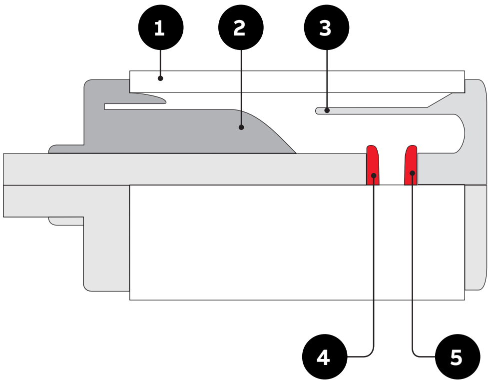
Compliance with the Standards
- All versions are provided with certification according to IEC 62271-106, Convac 7 is also certified according UL 347 (UR: UL recognized), also covering CSA C22.2 standards
- Marine certification available in a dedicated configuration on ConVac 7 and ConVac 12, for more information please contact ABB

- The operating characteristics conform to IEC 60721-3-3
- The operating temperature conforms to IEC 60068 and IEEE C37-09: Lowest and highest temperature -30 °C...+70 °C tested with thermal cycles of 16h at highest or lowest temperature
- Altitude: < 1000 m a.s.l.

For other conditions, please contact ABB.

Main technical characteristics
- Average chopping current value: < 0.5 A
- Maintenance-free
- Suitable for installation in MV MCC switchgears, MV soft starters and MECB switchgears
- High number of operating sequences
- Direct monitoring of contact wear
- Long electrical and mechanical life
- Remote control
- Multi-voltage feeder

Interruption principle
The main contacts operate inside the vacuum interrupters.
Rapid separation of the fixed and moving contacts in each contactor interrupter occurs on opening.
Contact overheating, generated when the contacts separate, leads to the formation of metallic vapors that can sustain the electric arc up to the first current zero crossing.
When the current crosses zero, cooling of the metallic vapors restores a high dielectric strength able to withstand high recovery voltage values.



1 Ceramic enclosure
2 Seal diaphragm
3 Metal screen
4 Moving contact
5 Fixed contact

Schematic cross-section of the vacuum interrupter.

Description

The ABB MV contactor offering includes a linear mono-stable electromagnetic actuator. This actuator is able to perform an axial movement in relation to the moving contact of the the vacuum interrupter. This reduces mechanical stress and optimizes the mechanical behavior with positive effects on reliability.


DNV·GL

MANAGEMENT SYSTEM CERTIFICATE

ABB S.p.A.
Electrification Products Division
Medium Voltage Products

Unità Operativa: Via Friuli, 4 - 24044 Dalmine (BG) - Italy

UNI EN ISO 9001:2008 (ISO 9001:2008)

ACCREDIA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MANAGEMENT SYSTEM CERTIFICATE

ABB S.p.A.
Electrification Products Division
Medium Voltage Products

Unità Operativa: Via Friuli, 4 - 24044 Dalmine (BG) - Italy

UNI EN ISO 14001:2004 (ISO 14001:2004)

ACCREDIA


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MANAGEMENT SYSTEM CERTIFICATE

ABB S.p.A.
Electrification Products Division
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Unità Operativa: Via Friuli, 4 - 24044 Dalmine (BG) - Italy

BS OHSAS 18001:2007

ACCREDIA


ACCREDIA

CERTIFICATO DI ACCREDITAMENTO
Accreditation Certificate

0253 Rev. 1

ABB S.p.A. Power Products Division

Available versions

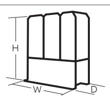
Electrical latching
Closing takes place by supplying auxiliary power to the multi-voltage feeder. On the other hand, opening occurs when the auxiliary power is interrupted either intentionally (by means of a command) or unintentionally (due to lack of auxiliary power in the installation).

Mechanical latching
As in the electrical latching, closing takes place by supplying auxiliary power to the multi-voltage feeder. However, when the contactor reaches the closed position, this is manteined by a mechanical device.
Opening takes place when the opening coil is supplied. This releases the mechanical lock and allows the opening springs to operate.

The contactor can be ordered in the standard version (fig. 1) or without the front cover.

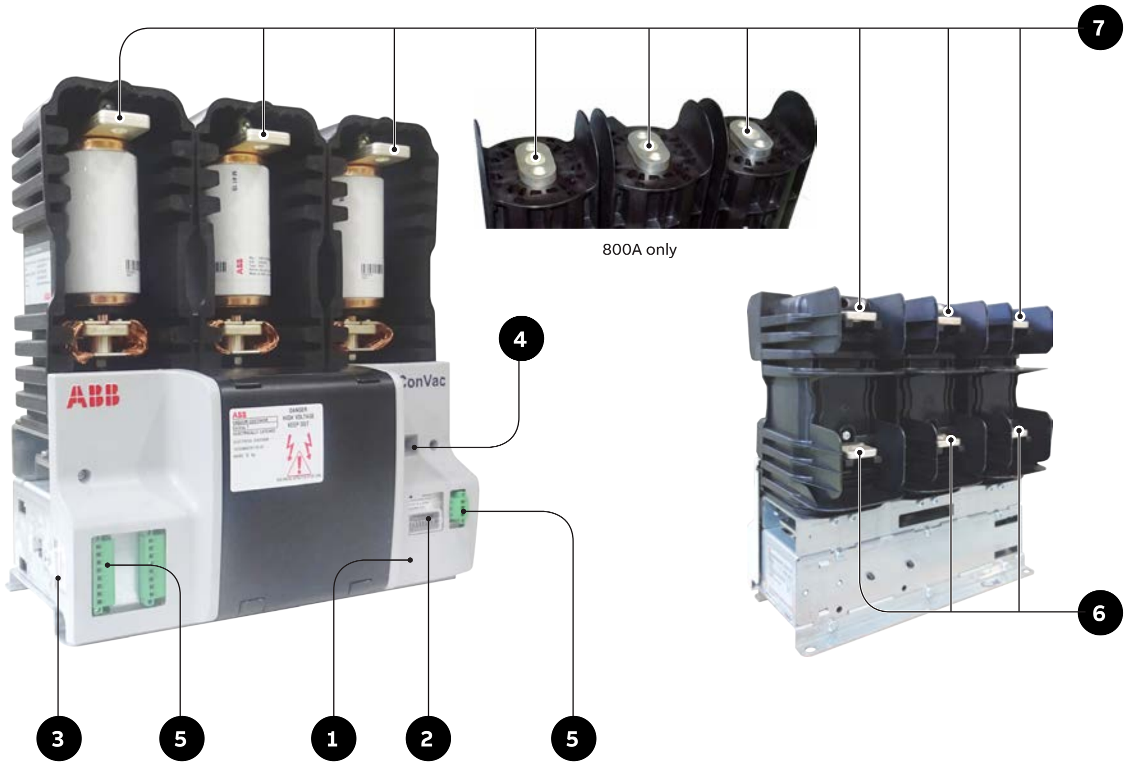
Environmental Management System
Conforms to ISO 14001 Standards, certified by an independent external organization.

Health and Safety Management System
Conforms to OHSAS 18001 Standards, certified by an independent external organization.

Parameters		IEC62271-106 (04-2021)					UL347 6th edition	UL347 7th edition	UL347 7th edition
		Ref. std	Value	Value	Value	Ref. std	Value	Value	Value
Contactor type			**ConVac 7 400A**	**ConVac 12 400A**	**ConVac-S**		**ConVac 7 400A**	**ConVac 7R 400A**	**ConVac 7 800A**
Rated voltages									
Rated voltage [Ur]	[kV]	5.2	7.2	12	12	4.1	7.2	7.2	7.2
Rated insulation level [Ud] at 50/60Hz	(1 min) [kV]	5.3	20 (32[6])	28 (42[6])	28 (42[6])	4.2	20 (32[6])	20	20
Rated insulation level (Up), impulse	[kVp]	5.3	60	75	75	4.2	60	60	60
Rated frequency [fr]	[Hz]	5.4	50-60	50-60	50-60	-	50-60	50-60	50-60
Rated current									
Rated operational current (Ie)	[A]	5.101	400 [7]	400 [7]	400 [7]	4.101	400 [7]	400 [7]	800
Thermal current (Ith)	[A]	9.102.5	440	440	440	4.4.101	400	400	800
Short-circuit and overload performance									
Short-time withstand current [Ik] + rated duration [tk] or rated momentary current	[A]	5.6 5.8	6000x1sec 4000x4sec	6000x1sec 4000x4sec	6000x1sec 4000x4sec	4.6.2 4.7.2	6000x1sec	6000x1sec	12500x1sec
Rated peak current	[kA peak]	5.7	15.6	15.6	15.6	4.6.1	-	-	-
Short-time withstand current for 30 s	[A]	7.6	2400	2400	2400	6.202	2400	2400	5000
Short-circuit breaking current (Isc)- combined with fuses	[kA rms]	5.107	50	50	50	4.107 4.202	50 (Class E2[1-2])	50 (Class E2[1-2])	50 (Class E2[3])
Rated short-circuit making current (Ima)- combined with fuses	[kA rms]	5.107	130 [5]	130 [5]	130 [5]	4.107 4.202	-	-	•
Damage classification		5.107.2.3	C	C	C	-	-	-	-
Short-circuit breaking capacity at 7.2kV	[kA]	5.107	5	6	6	4.202	6 at 60Hz (Class E1)	6 at 60Hz (Class E1)	12.5 at 60Hz (Class E1)
Short-circuit making capacity	[kA]	5.107	13	15.6	15.6	4.202	15 at 60Hz (Class E1)	15 at 60Hz (Class E1)	32.5 at 60Hz (Class E1)
Short-circuit sequence		7.103	CO-3'-CO-3'CO	CO-3'-CO-3'CO	CO-3'-CO-3'CO	4.202	CO-2'-CO-2'CO	CO-2'-CO-2'CO	CO-2'-CO-2'CO
Rated making and breaking capacities, by utilization category of use	Category	5.104	AC-4	AC-4	AC-4	-	-	-	-
Rated making and breaking capacities and overload	[kA]	-	-	-	-	4.103 6.102	10CO at 4kA 40CO at 2.4kA	10CO at 4kA 40CO at 2.4kA	10CO at 8kA 40CO at 2.4kA
Capacitive switching capabilities (62271-106 / IEEE C37.09a)		5.112	-	-	-	IEEE C37.09a			-
Configuration			back to back	back to back	back to back	-	back to back	back to back	-
Restrike performance	Class		class C1/C2 [6]	class C1/C2 [6]	class C1/C2 [6]	-	class C1/C2 [6]	class C1/C2 [6]	-
Rated current	[A]		250	250/160	250/250	-	250	250	-
Inrush peak	[kA peak]		8	8/6	8/6	-	8	8	-
Inrush current frequency	[Hz]		2500	2500/4250	2500	-	2500	2500	-
Mechanical life									
Rated duty (Electr. latching/Mech. latching)	[Cycles/hour]	5.102	1.200/1.200	1.200/1.200	900/300	4.102.2	1.200/1.200	900/300	900/300
Life – Electrical latching	[Cycles]	7.102	1.000.000	1.000.000	250.000	6.101	1.000.000	1.000.000	300.000
Life – Mechanical latching	[Cycles]	7.102	250.000	250.000	50.000	6.101	250.000	100.000	100.000
Rated supply voltage of switching devices, and of auxiliary and control circuits (Ua)		5.9	-	-	-	4.8, 4.9	-	-	-
Feeder type 1 (Drive unit and closing coil)	[Vdc - Vac 50-60Hz]	-	110÷125	110÷125	110÷125	-	110÷125	110÷125	110÷125
Feeder type 2 (Drive unit and closing coil)	[Vdc - Vac 50-60Hz]	-	220÷240	220÷240	220÷240		220÷240	220÷240	220÷240
Pick-up voltage	[Vdc - Vac 50-60Hz]	-	80%	80%	80%	-	80%	80%	80%
Drop-out voltage	[Vdc - Vac 50-60Hz]	-	65%	65%	65%	-	65%	65%	65%
Opening coil-Kit RiMe (only for latched contactors)	[Vdc - Vac 50-60Hz]	-	24-48 Vdc 110-125 Vac dc 220-240 Vac dc	24-48 Vdc 110-125 Vac dc 220-240 Vac dc	24-48 Vdc 110-125 Vac dc 220-240 Vac dc	-	24-48 Vdc 110-125 Vac dc 220-240 Vac dc	24-48 Vdc 110-125 Vac dc 220-240 Vac dc	24-48 Vdc 110-125 Vac dc 220-240 Vac dc
Operating time									
Opening time - Electrically latched [8-9]	[ms]	-	70÷100	70÷100	70÷100	-	70÷100	45÷80	45÷80
Opening time - Mechanically latched (kit RiMe) [8]	[ms]	-	15÷35	15÷35	15÷35	-	15÷35	15÷35	15÷35
Closing time	[ms]	-	40÷70	40÷70	40÷70	-	40÷70	40÷70	40÷70
Operating temperature	[°C]	IEC 60068	-30÷+70	-30÷+70	-30÷+70	C37.09	-30÷+40 [4]	-30÷+40 [4]	-30÷+40 [4]
Weight		-	15-20 [kg]	15-20 [kg]	15-20 [kg]	-	33-44 [lbs]	38-49 [lbs]	44-55 [lbs]
Overall dimensions (Electrically latched)  – High	H	-	377 [mm]	380 [mm]	380 [mm]	-	14,8 [inch]	15 [inch]	17,7 [inch]
Overall dimensions – Width	W	-	342 [mm]	342 [mm]	342 [mm]	-	13,5 [inch]	14,4 [inch]	13,8 [inch]
Overall dimensions – Depth	D	-	210 [mm]	230 [mm]	230 [mm]	-	8,3 [inch]	8,3 [inch]	9,2 [inch]

1) UL Class E2 interrupting capability with R/C Mersen fuse A072B2DAR0-18R
2) For UL Class E2 interrupting capability with R/C Mersen fuse A072B2DAR0-24R: require ConVac 7R version
3) UL Class E2 interrupting capability with R/C Mersen fuse A072B3DBR0-57X
4) For higher temperature please contact ABB
5) Highest prospective peak current. Highest cut-off current of the SCPD intended is 45kA
6) Higher rated insulation level [Ud] and class C2 available on High performance version - for UL rating please ask ABB
7) 400A not applicable for capacitive switching, maximum operative current for capacitive switching is 250A
8) Interval of time between the instant of energizing the opening release, the contactor being in the closed position, and the instant when the arcing contacts have separated in all poles.
9) For marine application please ask ABB

Selection and ordering



1. Feeder/Control Module

ConVac contactors are equipped with a multi-voltage electronic feeder able to cover a wide variety of auxiliary voltages.
The available auxiliary voltages are:

- Feeder 1: 110-125V DC / AC (50/60HZ)
- Feeder 2: 220-240V DC / AC (50/60HZ)

Feeders are plug-in and the auxiliary voltage can be switched from feeder 1 to feeder 2 and vice versa by simply replacing the electronic device.
See table 1 for the power required to operate the contactor:

Supply Voltage	In-rush power	Holding force
110/125 Vdc-ac 50/60Hz	7A / 10.5A x 200ms	50 W
220/230Vac 50-60Hz – 220/240Vdc		

2. Pulse counter

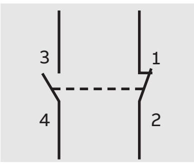
On request, the contactor can be equipped with an electric pulse counter which counts and provides a visual indication of the closing inputs/command (mechanical latching) or of the opening inputs/ command (electrical latching).

3. Auxiliary contacts

The contactor is equipped with positively driven, class 1 (according IEC 62271-1) auxiliary contacts. Three options are available:

3a Two normally open plus two normally closed
3b Four normally open plus four normally closed
3c Six normally open plus six normally closed

Each auxiliary block (composed by one normally open and one normally closed contact as for schematic picture) has to be supplied at the same voltage.



Electrical characteristics:

IEC

Class (according to IEC 62271-1)	Rated DC current	Rated short-time withstand current	Breaking capacity 110 V ≤ Ua ≤ 250 V
1	10A	100A/30ms	440W

UL

Breaking capacity according to UL standards: (UL file No. E160730)
B300 – AC-15 : 240V 1.5A / 120V 3A
Q300 – DC-13 : 250V 0.27A / 125V 0.55A
The auxiliary contacts are housed in a plug-in box that can be easily replaced by the customer by switching from one option to the other without any other adjustments required.

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3a

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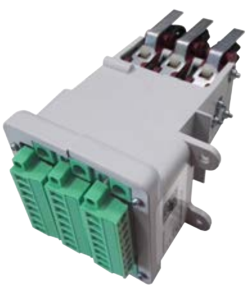
3b



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3c

4. Open/Close indicator

Indicates the state of the contactor:

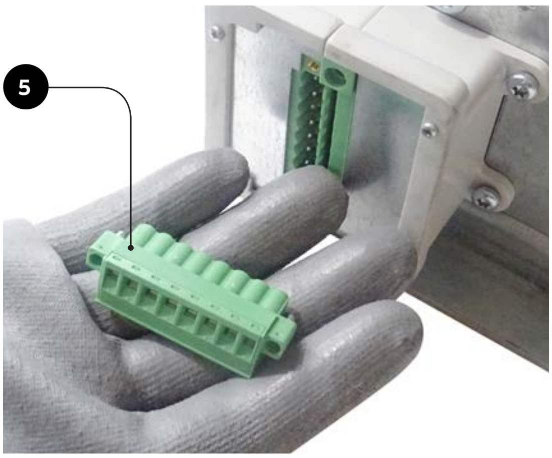
Green: contactor open

Red: contactor closed

5. Terminals

To ensure the maximum flexibility of installation, the electrical devices are equipped with a plug connector with integrated terminal box. It is therefore possible to:

- Unplug the connector
- Prepare the panel wiring separately
- Plug-in the connector when the contactor is installed in the panel



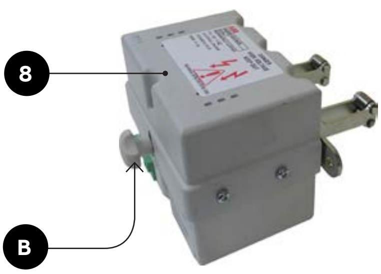
Selection and ordering

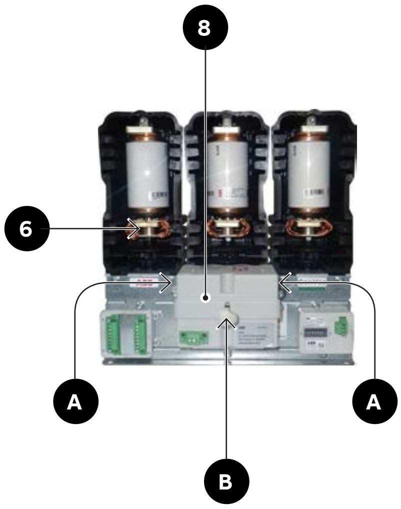
6-7. Terminals
Installation is extremely flexible since connection to the MV upper terminals of the 400 A contactor can be made on both the rear and front sides (7), on 800 A units the connection is on top of the pole and therefore possible from back and front. The lower phases (6) are connected from the back only.

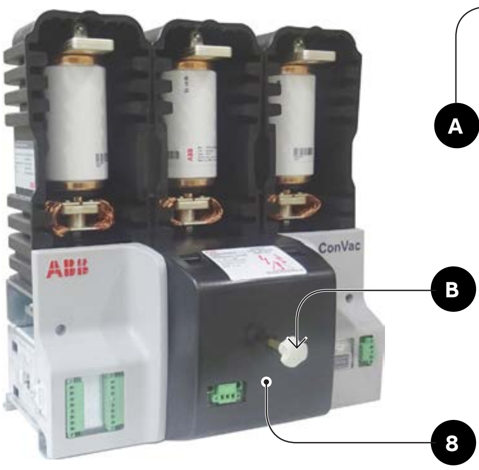
8. Mechanical latching
To upgrade the electrically latched contactor to a mechanically latched one the specific device RiMe can be ordered as optional accessory.
The device is the plug-in type and can be ordered separately from the contactor. It does not need any adjustments or settings.
Assembly only requires two screws (A).
The device is also equipped with a mechanical pull rod to allow emergency opening in the manual mode (B) and with an internal switch to interrupt opening coil supply after the opening operation, this in order to avoid risk of coil overheating and avoid usage ConVac auxiliary contacts.

Electrical characteristic:

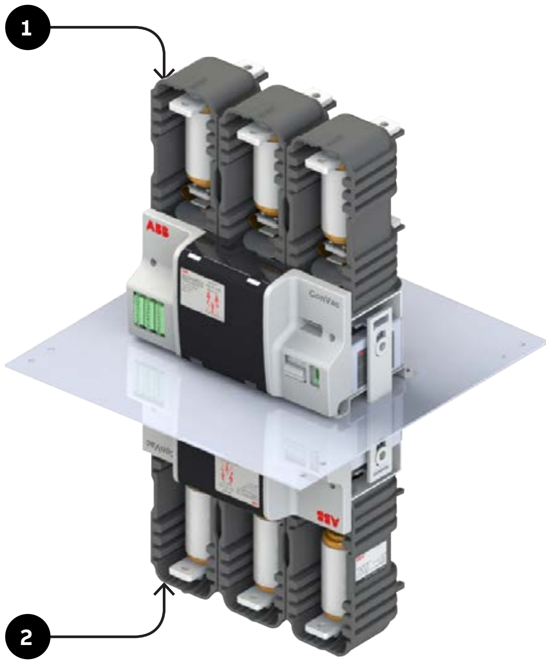
Voltage	peak	time
24	40A	100ms
48..60	25A	100ms
110..125Vac/dc	10A	100ms
220..240Vac/dc	7A	100ms



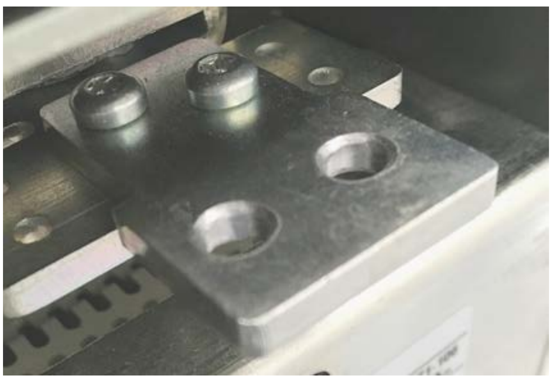




9. Mechanical and electrical interlock between two contactors
A link interconnects two contactors of the same rating (not available on ConVac 7R and ConVac 7 800 A units), one of which is on the upper level of the bearing plate ([1]) and the other on the opposite side of the same plate ([2]).
The device does not need to be adjusted and prevents the contactors from being both in the closed position at the same time. Please contact ABB for this application.



10. Interface with external devices
Two holes on a small shaft (accessory to be required at order stage) for the customer use are provided on both sides of the apparatus. The purpose is to provide an interface from the contactor towards the outside environment.
Please refer to the instruction manual for more details.



Specific product characteristics

Electromagnetic compatibility

ConVac vacuum contactor ensures operation without unwarranted trips when interference caused by electronic apparatus, atmospheric disturbance occurs.
ConVac does not produce interference with electronic apparatus installed close to the contactor.
The above conforms to IEC 62271-1, 62271-106, 61000- 6-2, 61000-6-4 Standards and to the European Directive 89/336 EEC regarding electromagnetic compatibility (EMC).

Altitude

It is well-known that the insulating properties of air decrease as the altitude increases.
This phenomenon must always be taken into account when the equipment is to be installed over 1000 m above sea level. In this case, standards IEC 62271-2 or C37.20.2 are applicable.
High performance version guarantee a higher level of power frequency withstand voltage, for instance 32kV at 7,2 kV. This allow ConVac 7HP and ConVac 12HP to guarantee IEC 62271-106 power frequency withstand voltage levels:
-20kV at 7.2kV
-28kV at 12kV
even, for instance, at 3000mt (9843 ft) without derating.
Regarding fuses, please consult the fuse manufacturer for an assessment.
For altitude higher than 3000mt (9843 ft) please contact ABB

Tropicalization

The metal parts in ConVac vacuum contactors are treated against corrosive factors class C, as specified by UNI 3564-65 and ANSI/ IEEE C37.20.2 Standards.
Galvanization is performed in compliance with UNI ISO 2081 Standards, classification code Fe/Zn 12, i.e. thickness 12x10^{-5} m, protected by a conversion layer formed mainly by chromates in accordance with UNI ISO 4520.

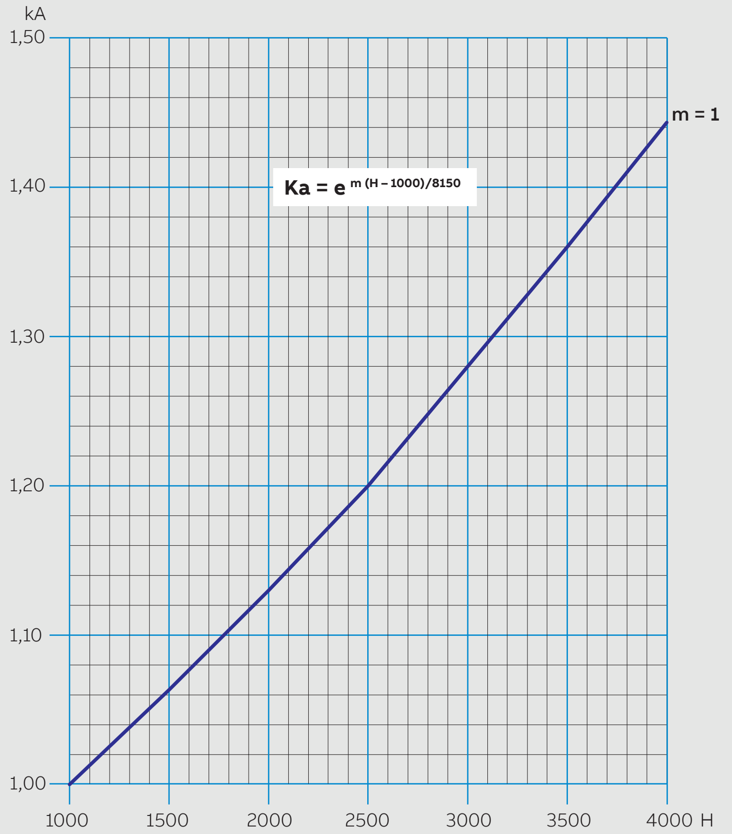
Graph for determining the Ka correction factor according to altitude, Example (IEC):

- Installation altitude: 2000 m
- Service at a rated voltage of 7 kV
- Power frequency withstand voltage 20 kV rms
- Impulse withstand voltage 60 kVp
- Ka Factor = 1.13 (see graph)

Taking the above parameters into consideration, the apparatus must have the following withstand values (test performed at zero altitude i.e. at sea level):

- power frequency withstand voltage equal to: 20 x 1.13 = 22.6 kVrms
- impulse withstand voltage equal to: 60 x 1.13 = 67.8 kVp.

Installations at an altitude of 2000 m above sea level with 7 kV service voltage require apparatus with 12 kV rated voltage characterized by 28 kV rms power frequency insulation levels and 75 kVp impulse withstand voltage.
ConVac 7 ensures 32 kV power frequency withstand voltage and can therefore be used in this case, with the application of surge arresters to limit impulse withstand voltage to 60kVp.

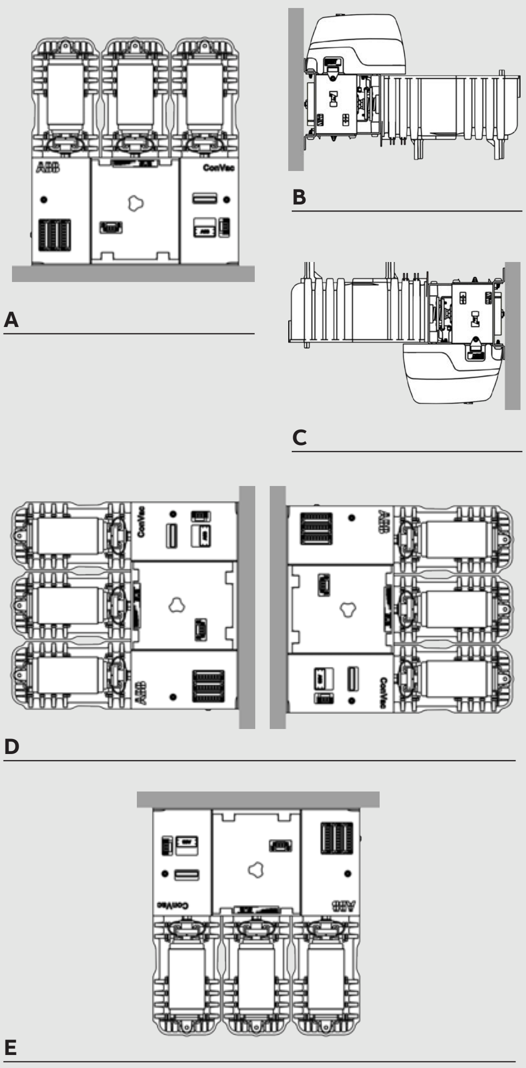


Ka = $e^{mH/8150 \text{ with } m=1}$
H = altitude in meters
m = value relating to power frequency withstand voltage, lightning impulse withstand voltage and line-to-line voltage. Value defined for m = 1

Installation

Contactor performance remains unaltered in the indicated installation positions:

A) Floor-mounted with moving contacts at the bottom
B) Wall-mounted with horizontal moving contacts and terminals at the bottom
C) Wall-mounted with horizontal moving contacts and terminals at the top
D) Wall-mounted with horizontal moving contacts, interrupters on the front (or rear) and vertical terminals
E) Ceiling-mounted with moving contacts at the top (not applicable for 800 A units)



Specific product characteristics

Use of fuses according to load

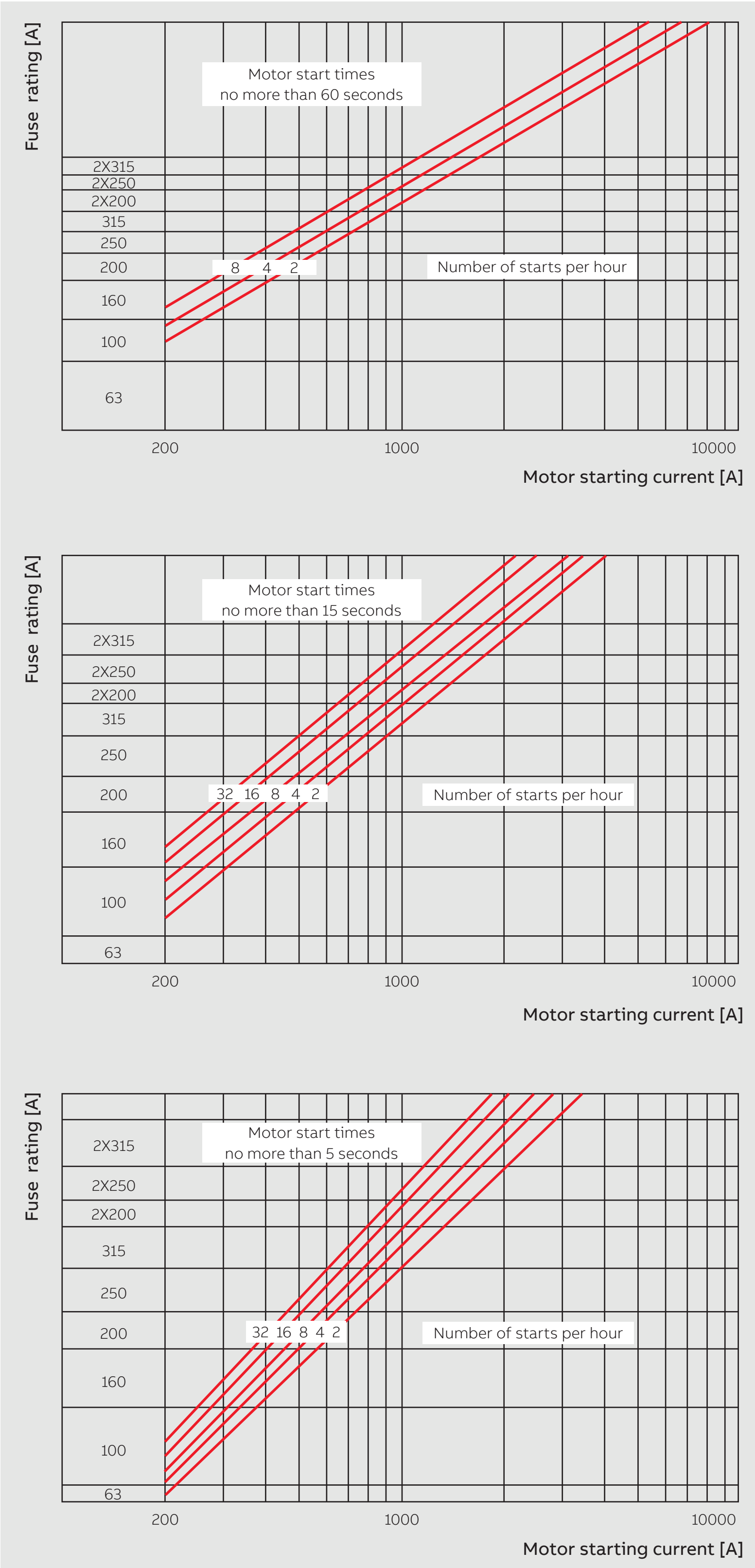


Fig. A

Motor control and protection
The motors are supplied at low voltage, generally up to a power of 630 kW. Beyond this power, MV supply is preferrable (from 3 to 12 kV) so as to reduce costs and the dimensions of the apparatus forming the circuit.
ConVac contactors can be used for voltages from 2.2 kV to 12 kV.
To ensure protection against short-circuits, the contactors must be used in conjunction with current limiting fuses.
This solution allow to furtherly reduce the cost of the components downstream to the contactor (cables, current transformers, busbar, cable anchoring devices, etc.) thanks to the short circuit current limitation provided by the fuses.

How to choose motor protection fuses for ConVac contactors.
Only use fuses with medium dimensions and striker conforming to Standards DIN 43625 and BS 2692 can be used.
The electrical characteristics must comply with:
- IEC 60282-1 Standard for IEC market
- R-type for ANSI/UL market

The customer is responsible for selecting a brand of fuse that conforms to the specifications above and for selecting the actual fuse. The choice must be made on the basis of the trip curves provided by the manufacturer and according to the characteristics of the contactor.

Table for choosing the K factor

Un (kV)	In (A)					
3.6	63	100	160	200	250	315
7.2	63	100	160	200	250	315
12	63	100	160	200	-	-
K	0.75	0.75	0.7	0.7	0.6	0.6

Fig. B

ABB high voltage modular induction motors

ABB high voltage rib cooled induction motors

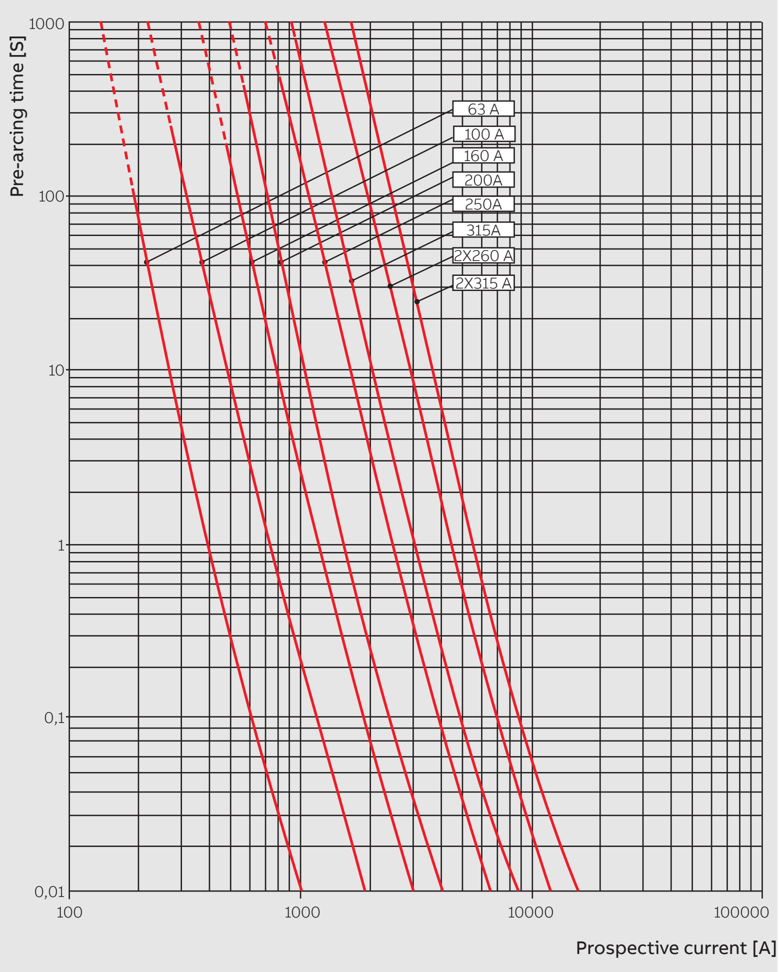


Fig. B

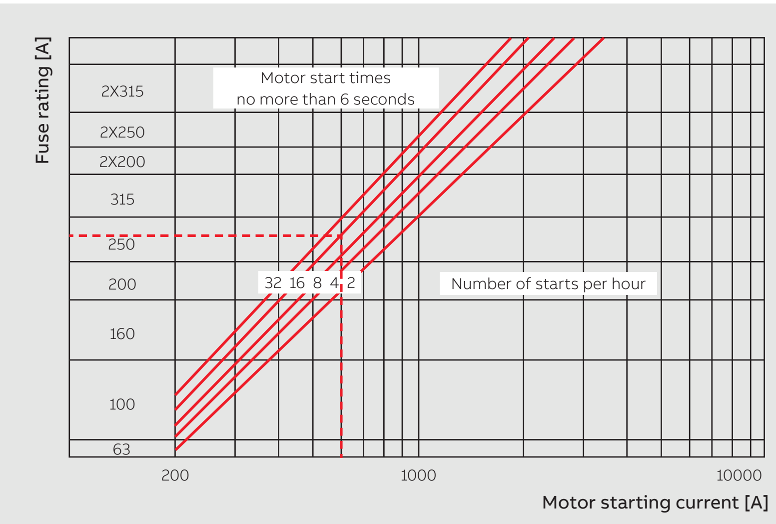


Fig. C

Please refer to the below instructions to select the correct ABB fuses.

DIN fuses
ABB CMF fuses are used for motor protection.

Tap on QR code to open the link

To select the correct fuses, first assess the service conditions by considering the following parameters:
- Supply voltage
- Inrush current
- Inrush time
- Number of starts/hour
- Motor full load current
- Short-circuit current of installation

One of the criteria to bear in mind when choosing the fuse is trip coordination with the other protection, such as relays.
This will ensure that the contactor, the motor, and all other equipment on the load side of the circuit (which could be damaged by prolonged overloads or by specific let through energy (I^2t) that exceeds the withstand rating), are adequately protected.
Short-circuit protection is provided by fuses.
The rated current of the fuses must always be higher than that of the motor to prevent them from tripping on start-up. However, this method of selection does not allow them to be used as protection against repeated overloads.
In any case, they do not provide this protection, especially with the current values up to the end of the initial asymptotic extension of the characteristic curve.
For this reason, always install an inverse time delay trip or definite time delay relay for protection against overloads.

This protection must be coordinated with that of the fuse. The characteristics of the relay and fuse curves must intersect in a point that allows:
1. Motor protection against overcurrents due to overloads, single-phase operation, blocked rotor and repeated starts. Protection is provided by an indirect inverse time delay trip or definite time delay relay which acts on the contactor.

Specific product characteristics

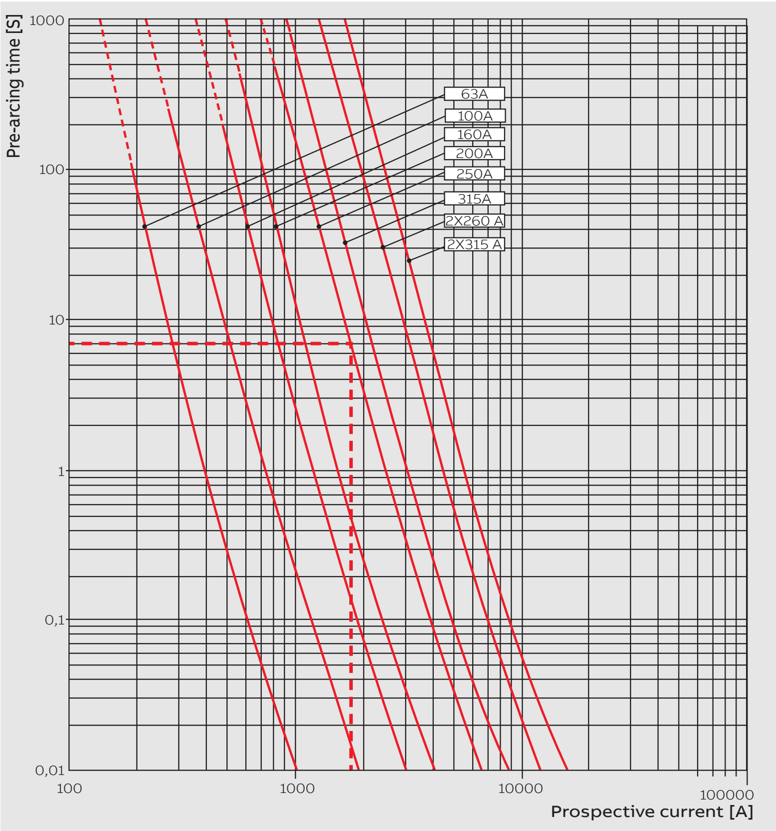


Fig. C1

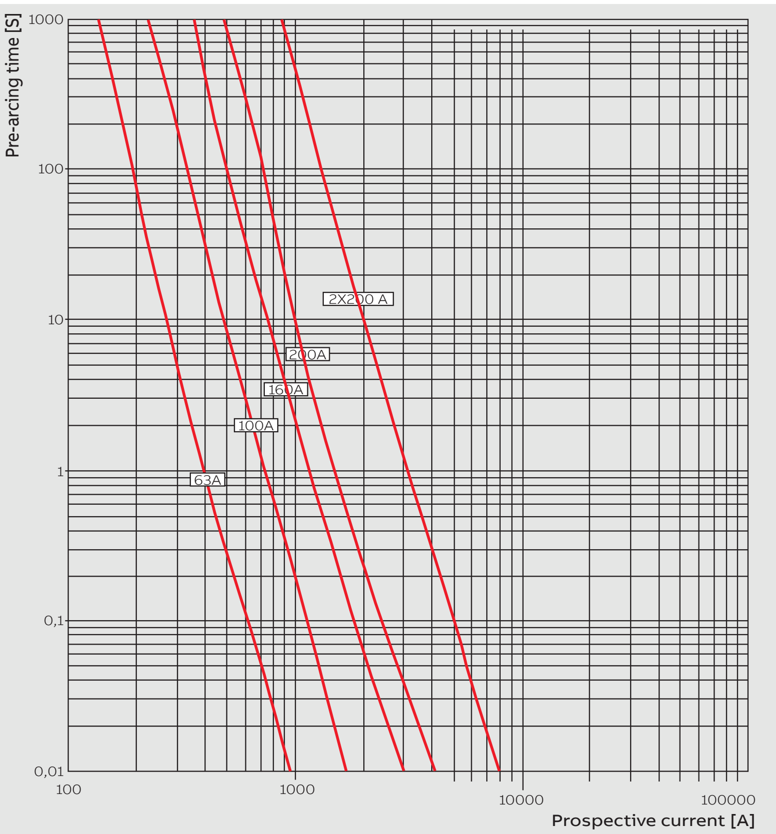


Fig. C2

2. Protection of the circuit against fault currents of low value between phases and towards earth is provided by an inverse time delay trip or definite time delay release, which must only trip for short-circuits that can be interrupted by the contactor.
3. Protection of the circuit against fault currents that are higher than the breaking capacity of the contactor up to the maximum internal arc withstand current. Protection is provided by the fuse.

Motor protection and control

Tap on QR code to open the link

Parameters to be monitored to verify the service conditions:

Rated voltage (Un):

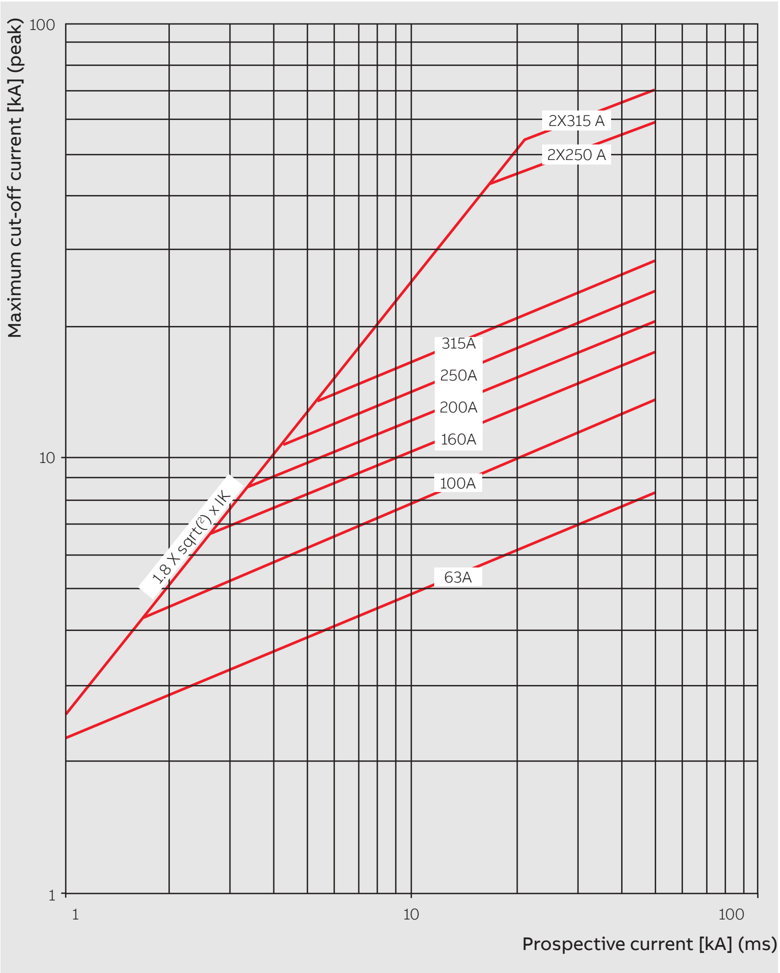
- Should be the same as the service voltage of the installation.
- Check that the insulation level of the network is higher than the switching overvoltage value generated by the fuses. In the fuses manufactured by ABB, this value is well below the limit established by standard IEC 60282-1.

Rated current (In):

- Must be selected by consulting the diagrams in fig. A. They refer to motors starting at regular time intervals except for the first two starts of each hourly cycle, which can take place in immediate succession.
- Each diagram refers to a different starting time: 6 s - 15 s - 60 s, respectively. If there are two starts close together, check that the starting current does not exceed the value of I_f x K
- “I_f” is the fuse melting current in correspondence to the starting time of the motor (see Fig. C1 for 3.6kV and 7.2kV - Fig. C2 for 12kV), while K is a minor factor of the unit which depends on the “In” of the fuse. The table in fig B. gives K factor in relation to the rated current of the fuse.

Full-load current (FLC):

- The rated current of the fuse must be 1.33 times the full load rated current of the motor, or higher. This condition is always obtained for motors started at full voltage, for which the procedure to select the rated current of the fuse imposes values higher than 1.33 In.



Short-circuit current

- The short-circuit current limiting curves in fig. D allow the short-circuit current on the load side of the ABB fuses affected by the fault to be assessed. For ANSI fuses please refer to Mersen equivalent curve for fuses indicated in footer of page 11 table.
- Short-circuit current limitation on the load side of the fuses allows the equipment to be sized as a function of the devices protected by the fuses, e.g. the cables.

Example of fuse-inverse time delay trip relay coordination for overload

Motor data:	
Pn :	1000kW
Un :	6kV
Istart :	~ 5In = 650A
Tstart :	6s
No. hourly operations:	16

With reference to the curve with 6 s starting time in fig. A, draw a vertical line on the value of the starting current (650 A). This line intersects the 16 hourly starts line in the 250 A fuse area (Fig. C1). Note in the melting time curve that the 250 A fuse melts in 6 s (starting time) when 1800 A current passes through it.
In the table in fig. B, the K coefficient for the 250 A size is 0.6, therefore:

I_f x K = 1800 x 0.6 = 1080 A

As this value is higher than the starting current (650 A), the use of a 250 A fuse is also correct in the case of two starts close together.
Observing the melting curve of the 250 A fuse, an inverse time delay trip or a defined time delay relay are required for protection against overloads.
To be considered that prolonged over-heating beyond the temperature limit of the insulating materials will compromise the life expectancy of the electric machines.

If the contactor is self-supplied by means of a VT or CPT, protection fuses will intervene cutting primary voltage to the VT/CPT, resulting in an immediate voltage drop in the contactor supply. Auxiliary voltage interruption will open the electrically latched contactor while the fuse melts regardless of the presence of a relay.
In this situation, it is important to check that the let-through current generated by the fuse during the contactor opening time is within the breaking capacity of the contactor.
ABB provides a dedicate capacitor device for this purpose. The device keeps the contactor in close position for the time required to guarantee coordination.

Motor starting

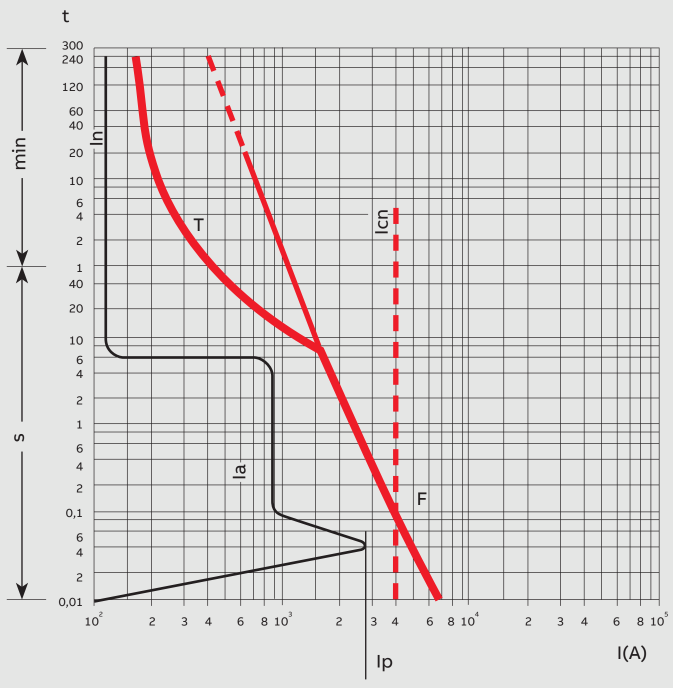
Motor starting poses the problem of high current consumption on inrush.
In most cases, since these are asynchronous motors, the starting current can be:

- asynchronous with simple squirrel cage 4.5 ... 5.5 In
- asynchronous with double squirrel cage 5 ... 7 In
- asynchronous with wound motor: low values, depending on the choice of starting resistors

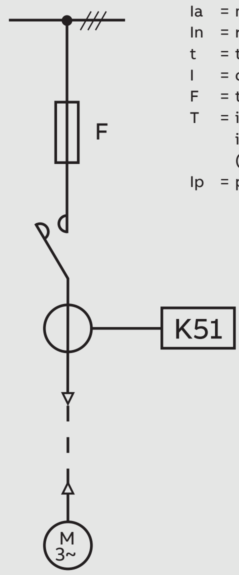
Specific product characteristics

The starting current will not be available if the short-circuit power of the network is not sufficiently high and it can cause a voltage drop for the whole duration of the starting, which cannot be tolerated by loads derived from the network itself. A voltage drop between 15 and 20 percent is usually considered acceptable, in case of non standard users. The full voltage start condition can be checked analytically in most cases. If the calculations show that the starting power causes a higher voltage drop than that allowed, start with reduced voltage with a consequent reduction in the starting current. In this case, starting is generally performed by a stepdown autotransformer. For large motors could be advisable to use a transformer dedicated exclusively to the machine, which can be slightly oversized in relation to the power required for the the motor: starting therefore takes place at reduced voltage without the rest of the installation being affected. Any motor starting, control, protection and measurement layout can be created by combining different enclosures, with contactors appropriately fitted with accessories. Fig. F shows some typical wiring diagrams.

Fig. E shows the graph of the motor described in the example.



Wiring diagram.



Icn = maximum short-circuit current in amperes that the contactor can interrupt
Ia = motor starting current in amperes
In = rated current of motor in amperes
t = time in seconds
I = current in amperes
F = time-current characteristic of the 250 A fuse
T = inverse time delay trip characteristics of the indirect relay for protection against overloads (K51)
Ip = peak value of the motor inrush current

Fig. E - Graph showing coordination between the 250 A ABB CMF fuse and inverse time delay trip release.

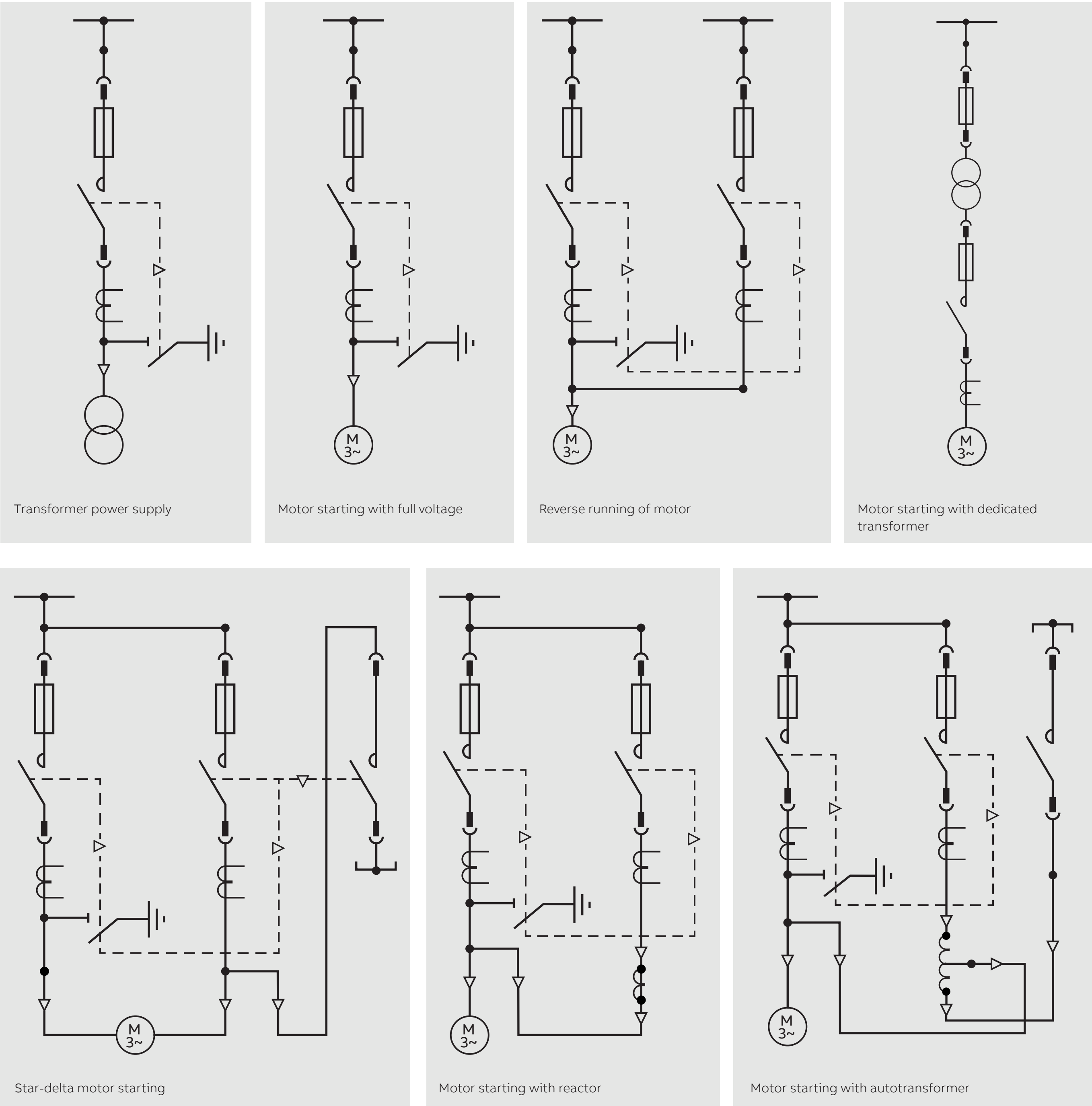


Fig. F - Typical diagrams of transformer power supply and motor starting

Specific product characteristics

Transformer protection and fuse selection
When contactors are used for transformer control and protection, they are fitted with a dedicated type of current limiting fuses which ensure selectivity in relation to other protection devices and support the high transformer inrush currents without deteriorating.
Unlike motors, in this case, protection against overcurrents on the MV side of the transformer is not essential as this task is accomplished by the protection on the low voltage side.
Protection on the MV side can therefore be entrusted to this fuse alone. This must be selected by taking the no-load inrush current into account. For smaller transformers made with grain-orientated laminations this value can reach 10 times the rated current.
Circuit breaker (CB) closing occurs at maximum inrush current, which corresponds to the moment in which the voltage crosses zero.
Another result to be guaranteed is the protection against faults in the secondary (low voltage) winding and his connection to the circuit breaker. Use of fuses with too high rated current shall be avoided as this could increase the tripping time, while under these fault conditions it is important to ensure tripping within a short time.
A rapid check of the short-circuit current on secondary terminals of the transformer and on the supply side of the CB connected to the secondary winding (if positioned far from the transformer), allow to double-check the tripping time on the fuse intervention curve.
The table below consider both conditions, a rated current sufficiently high to prevent unwanted fuse intervention in no-load inrush phase and a value which guarantees protection of the transformer against faults on the low voltage side.

Selection table for fuses for transformers

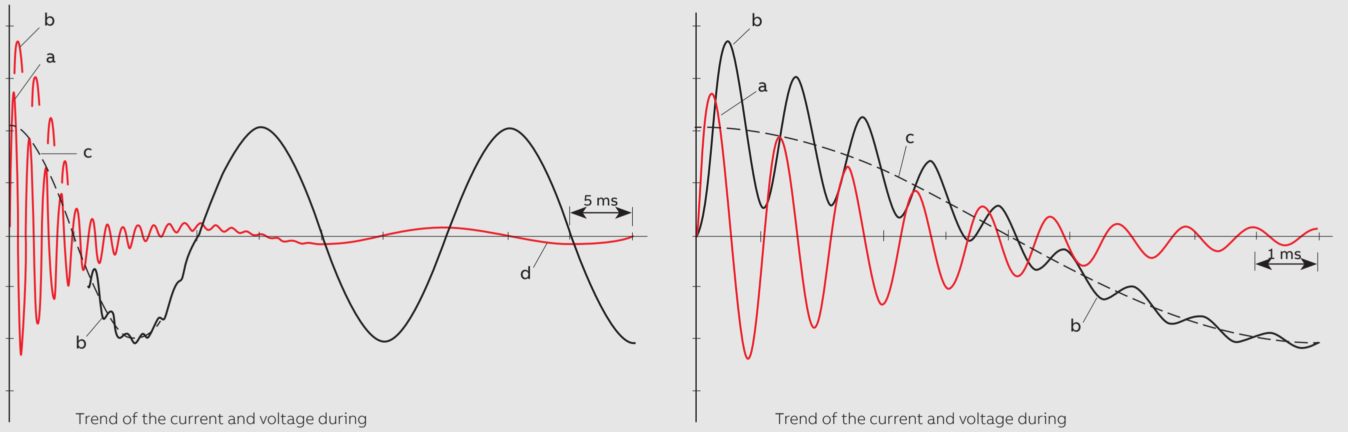
Rated voltage of the transformer	**Rated power of transformer [kVA]**																		**Rated voltage of the fuse**
	25	50	75	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	
[kV]	Rated current of fuse CEF [A]																		[kV]
3	16	25	25	40	40	50	63	80	100	125	160	200	250	315	2x250	2x315			3.6/7.2
5	10	16	25	25	25	40	40	50	63	80	100	125	160	200	250	315	2x250	2x315	
6	6.3(1)	16	16	25	25	25	40	40	50	63	80	100	125	160	200	250	315	2x250	
10	4(1)	10	16	16	16	20	20	25	31.5	40	50	63	80	100	125	160	200	2x160	12
12	2.5(1)	6.3	10	16	16	16	20	20	25	40	40	50	63	80	100	125	160	200	

Use CMF fuses.
(1) Use CEF-VT

Capacitor switching
When it comes to switching capacitor banks, the choice of a contactor and fuses suitable for switching-in/out the bank while guaranteeing protection in the case of overloads or short-circuits requires particular care.
The presence of current transients when a capacitor bank is switched-in requires accurate calculation procedures.

The capacitor switching application can normally be of two types:

1. Single bank installation (single three-phase capacitor bank)
   In installations of this sort there is only one type of switching-in transient, called switching-in transient of a single capacitor bank to the network.
   An example of a typical current transient is illustrated in fig. A.
2. Back-to-back installation (several three-phase capacitor banks in parallel, which can be switched-in separately).
   In installations of this sort there are two types of switching-in transients:
   a. when the first capacitor bank is switched-in a switching-in transient of a capacitor bank to the network occurs
   b. when the other banks are switched-in a switching-in transient of a capacitor bank to the network with other banks already supplied in parallel occurs. In this case, the current transient is the type shown in fig. B

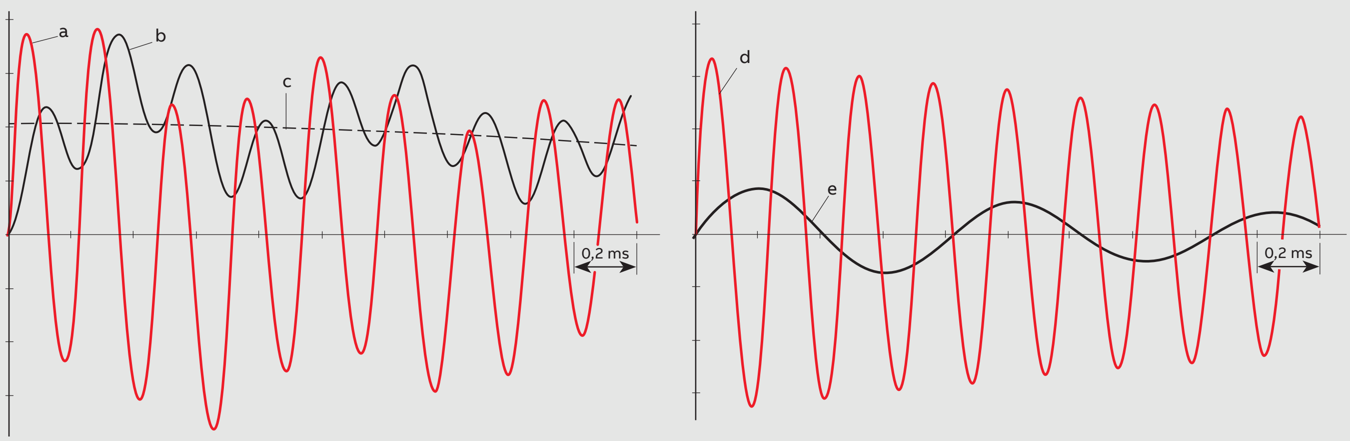


Trend of the current and voltage during and after the switching-in transient.

Trend of the current and voltage during the first 10 ms of the switching-in transient.

a = Switching-in transient current: first peak at 600 A peak and 920 Hz frequency.
b = 400 kVAR transient voltage at the bank terminals.
c = Power supply phase voltage 10/÷3 = 5.8 kV.
d = Rated current of bank at 50 Hz: 23.1 A.

Fig. A - Example of a current transient when a single capacitor bank is switched-in.



Trend of the current and voltage during the first 2 ms of the switching-in transient.

Trend of the two components of the total current (see graph above).

a = Switching-in transient current: 1800 A peak and 4280 Hz frequency.
b = 400 kVAR transient voltage at the bank terminals
c = Power supply phase voltage: 10/÷3 = 5.8 kV.
d = Component at 4280 Hz frequency of the inrush transient current.
e = Component at 1260 Hz frequency of the inrush transient current.

Fig. B - Example of a current transient when a capacitor bank is switched-in with another already supplied.

Specific product characteristics

Choice of contactors for switching-in capacitor banks (not applicable on 800 A units)
Standards CEI 33-7 and IEC 871-1/2 specify that capacitor banks:
"... must be able to operate correctly under overload conditions with up to 1.3 In rms value of the line current, without considering the transients".
Thus the switching, protection and connection devices must be designed to continuously withstand a current 1.3 times higher than the current there would be at rated sine wave voltage and frequency.
On the basis of the rms value of the capacitance, the tolerance of which can be +10 percent of the rated value, a device must be chosen for a maximum current value of 1.3 x 1.10 = 1.43 times the rated current of the bank.
ConVac contactors fully fulfil the requirements of IEC 62271-106 and ANSI C37.09a (within limits in table on page 11) Standards, and are certified class C1 or C2 for back-to-back capacitor bank switching see rating in table on page 11.

Single bank
The parameters of the current transient, peak values and own frequency, which are present when the bank is switched into the network, are usually of a considerably smaller size than those in the case of multiple banks.

Two or more banks (back-to-back)
When there are several capacitor banks, calculations regarding the installation must be made, considering the case of a single bank being switched-in with the other capacitor banks already switched-in.
Under these conditions, check that:
- maximum inrush current does not exceed the value given below (see table);
- inrush current frequency does not exceed the value given below (see table).

	Capacitive current	Maximum inrush current		Ip (kA) x f (Hz)
ConVac 7	250A (C2)	8kAp	2.500 Hz	20000
ConVac 12	160A (C2)	6kAp	4.250 Hz	15000
ConVac-S	250A (C2)	6kAp	2.500 Hz	15000

For maximum inrush current values below 8 kA, the inrush frequency can be increased so that the product of current by frequency results as less than
Ip (kA) x f (Hz) = 8 x 2.500 = 20.000

for instance:
Ip (kA) = 5kA the maximum admissible inrush frequency becomes
f (Hz) = 20.000 / 5 = 4.000Hz

This rule can be applied to inrush currents below 8kAp, corresponding to the maximum value, which must not be exceeded even when the frequency is lower than 2500Hz.
Refer to ANSI C37.012 or IEC 62271-100 Annex H to calculate the inrush current and frequency.
If the calculations result in inrush current and frequency values which are higher than the maximum allowed, then air reactors of a suitable value must be installed in the the circuit, while the cables connected must also be considered.
Use of reactors is also recommended when there are frequent operating sequences with high inrush frequencies.

Environmental protection program
ConVac contactors are manufactured in compliance with ISO 14000 Standards (Environmental Management Directives).
The production processes comply with the Standards for environmental protection in terms of:
- Raw materials
- Production of waste.

All this is achieved thanks to the environmental management system adopted in the production facility, as certified by the Certification Authority.
Careful selection of materials, processes and packing during the design stage minimizes environmental impact during the life cycle of the product (LCA - Life Cycle Assessment).
The products are easy to dismantle and the components can be easily separated for recycling at the end of the useful life of the apparatus. For this purpose, all the insulating components are marked according to ISO 11469 (2^{nd} ed. 15.05.2000) standards.

For higher performances please check also:

VD4-CS

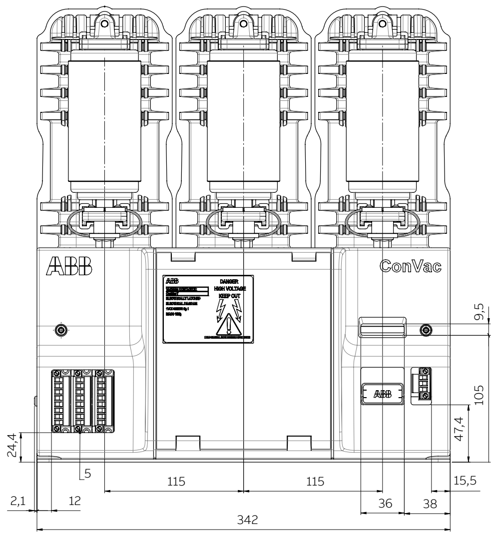
DS1

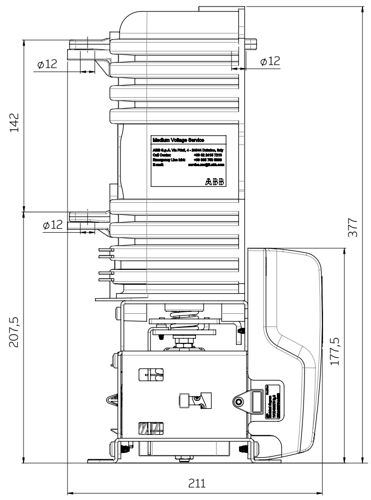
Tap on QR code to open the link

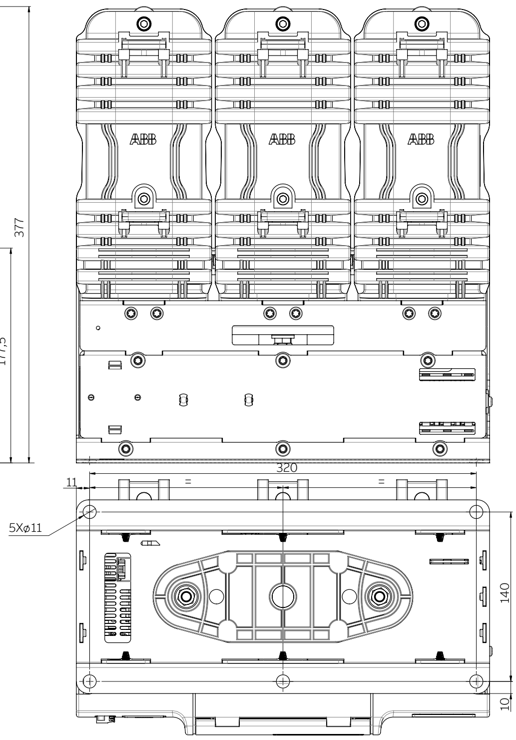
Overall dimensions

ConVac 7

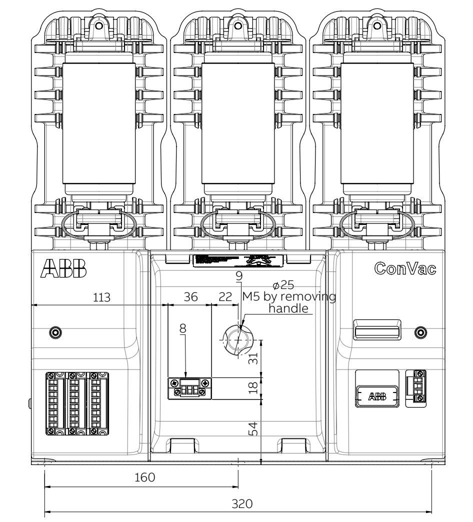
Electrically latched version

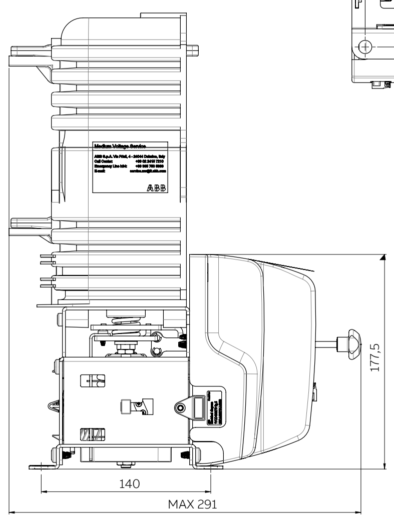






Mechanically latched version

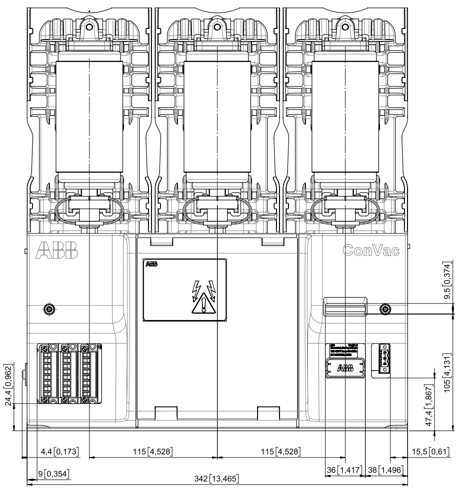


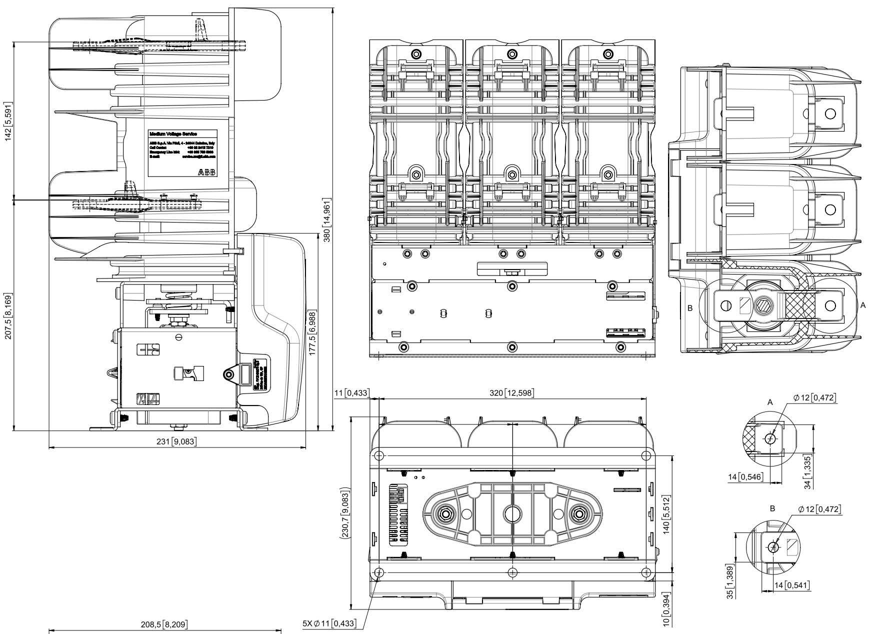


Overall dimensions

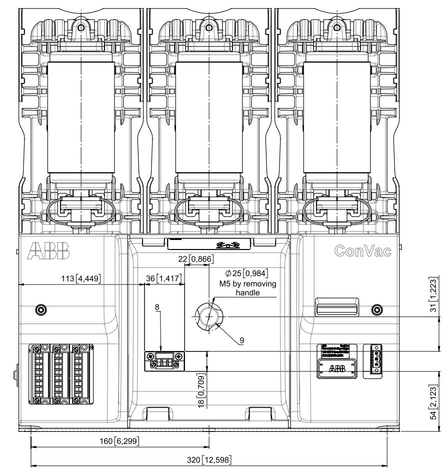
ConVac 12 - ConVac-S

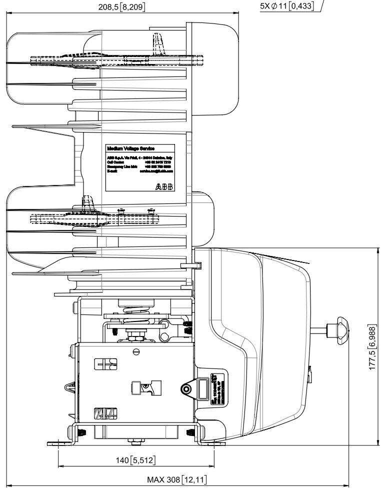
Electrically latched version





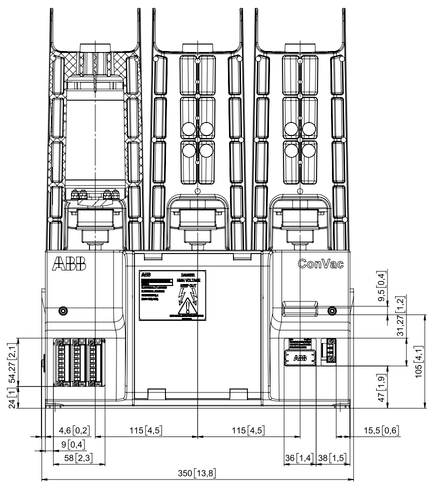
Mechanically latched version

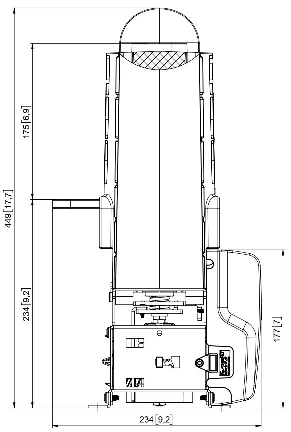


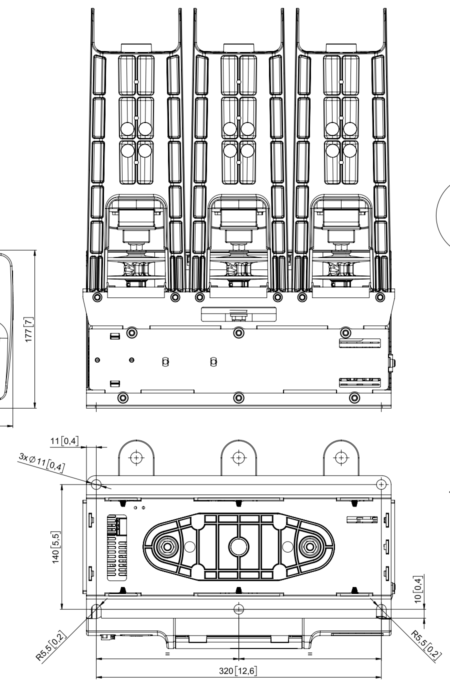


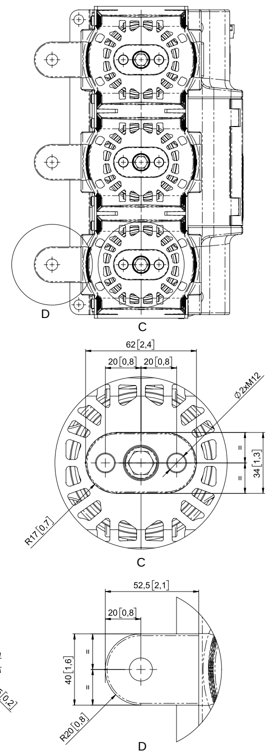
ConVac 7 800A

Electrically latched version









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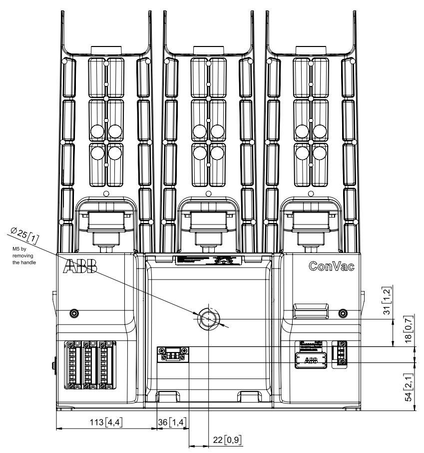
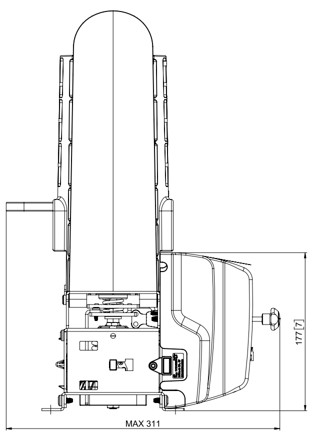
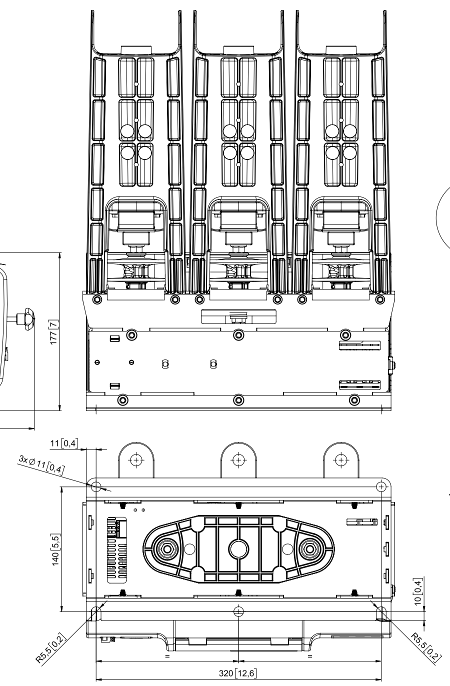
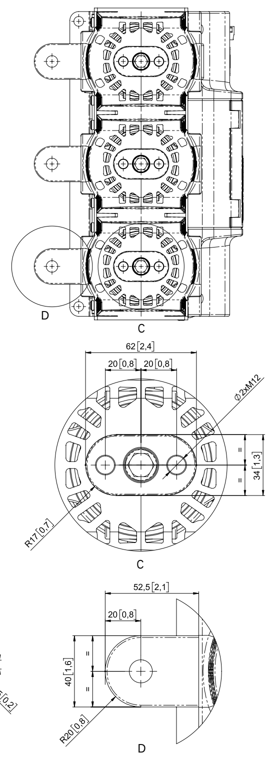


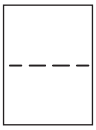


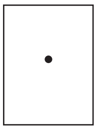


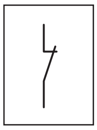


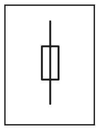
Electric circuit diagram

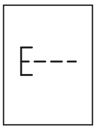
Graphical symbols for circuit diagrams (60617 IEC and 60617 CEI EN Standards)

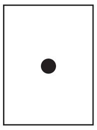

Mechanical, pneumatic or hydraulic connection (link)

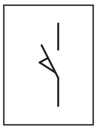

Connection of conductors

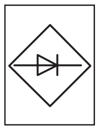

Break contact

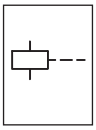

Fuse (general symbol)

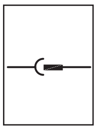

Push-button operating mechanism

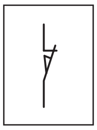

Terminal

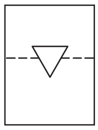

Make position contact (limit)

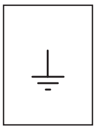

Rectifier with two half waves (bridge)

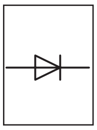

Operated by electromagnetic actuator

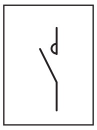

Plug and socket (male and female)

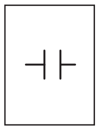

Break position contact (limit)

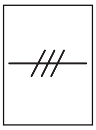

Mechanical interlock

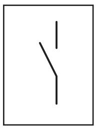

Earth, ground (general symbol)

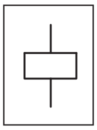

Semiconductor diode (general symbol)

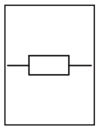

Contactor (contact open in the unoperated position)

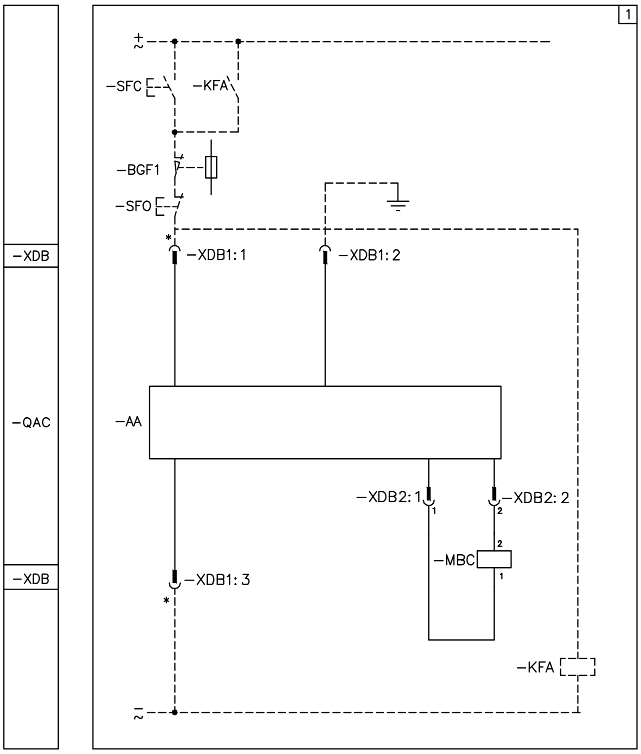

Capacitor

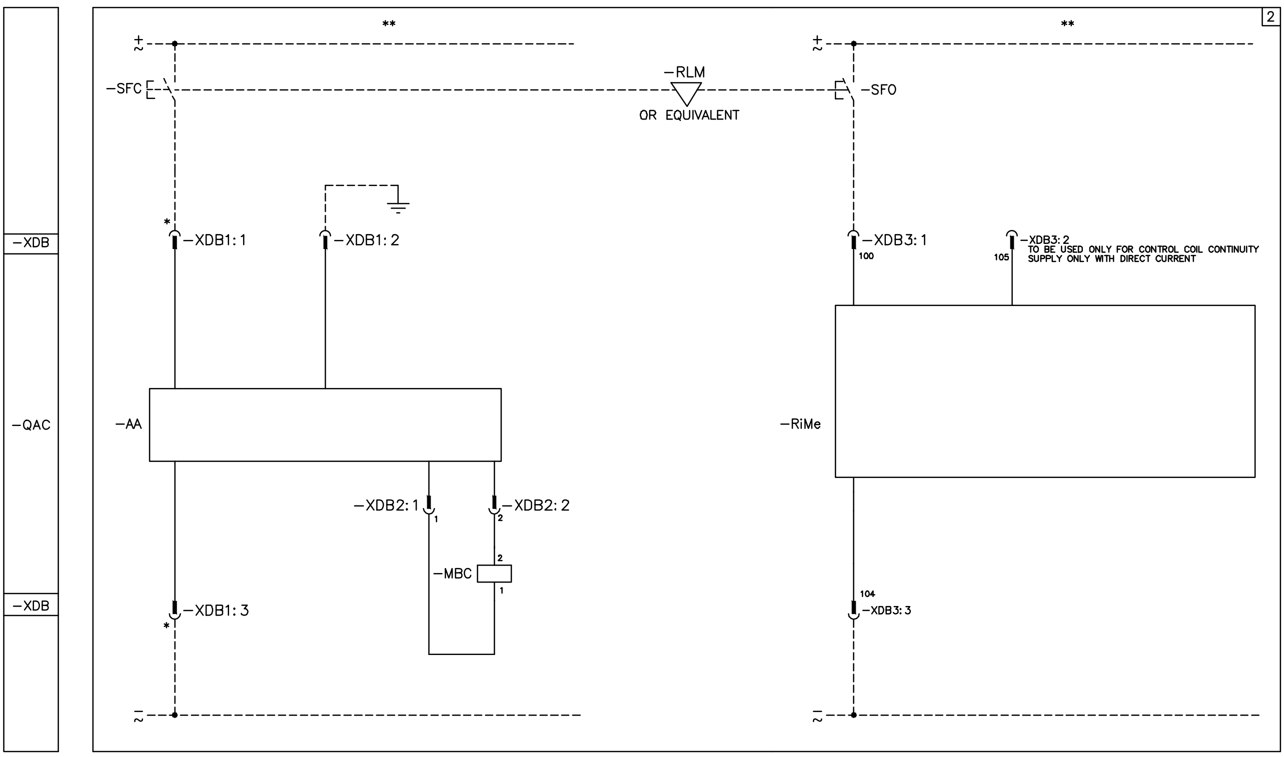

Three conductors


Make contact

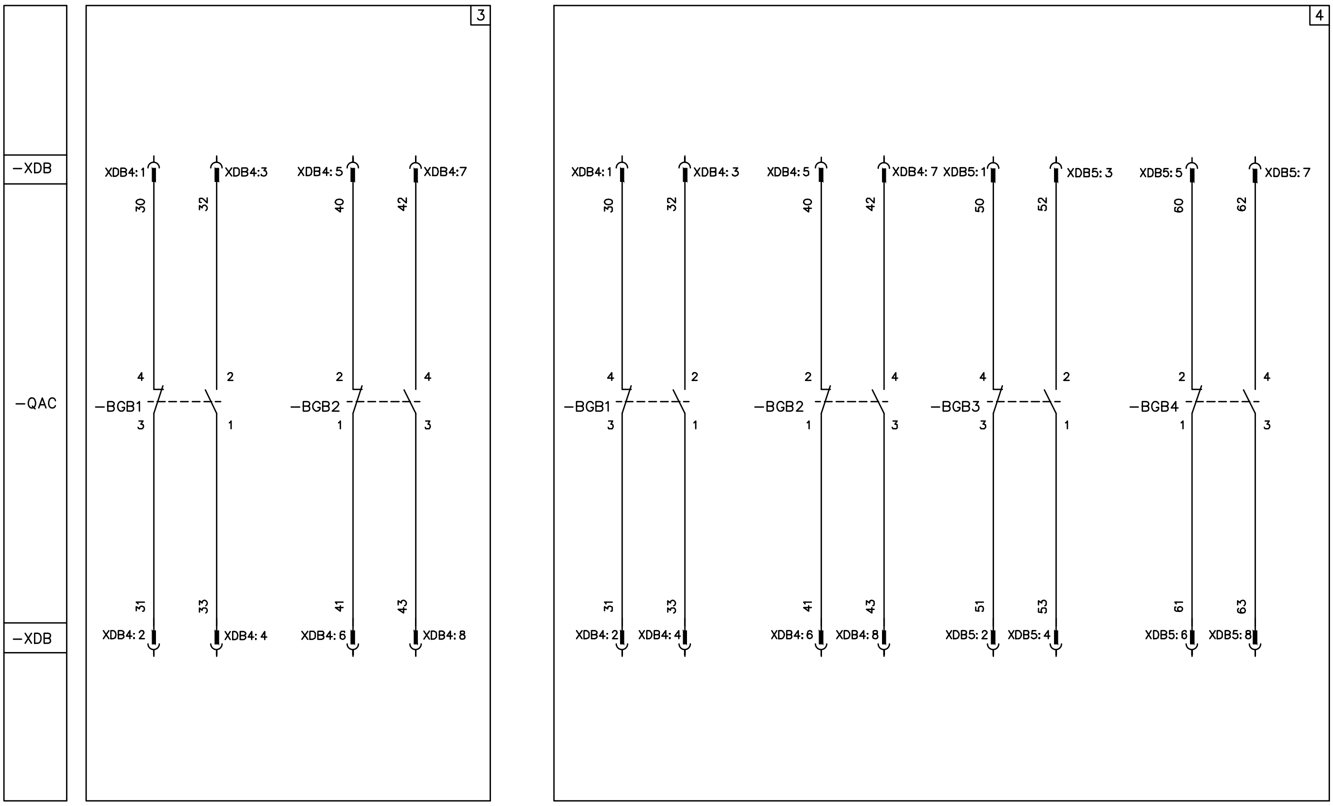

Operating mechanism (general symbol)

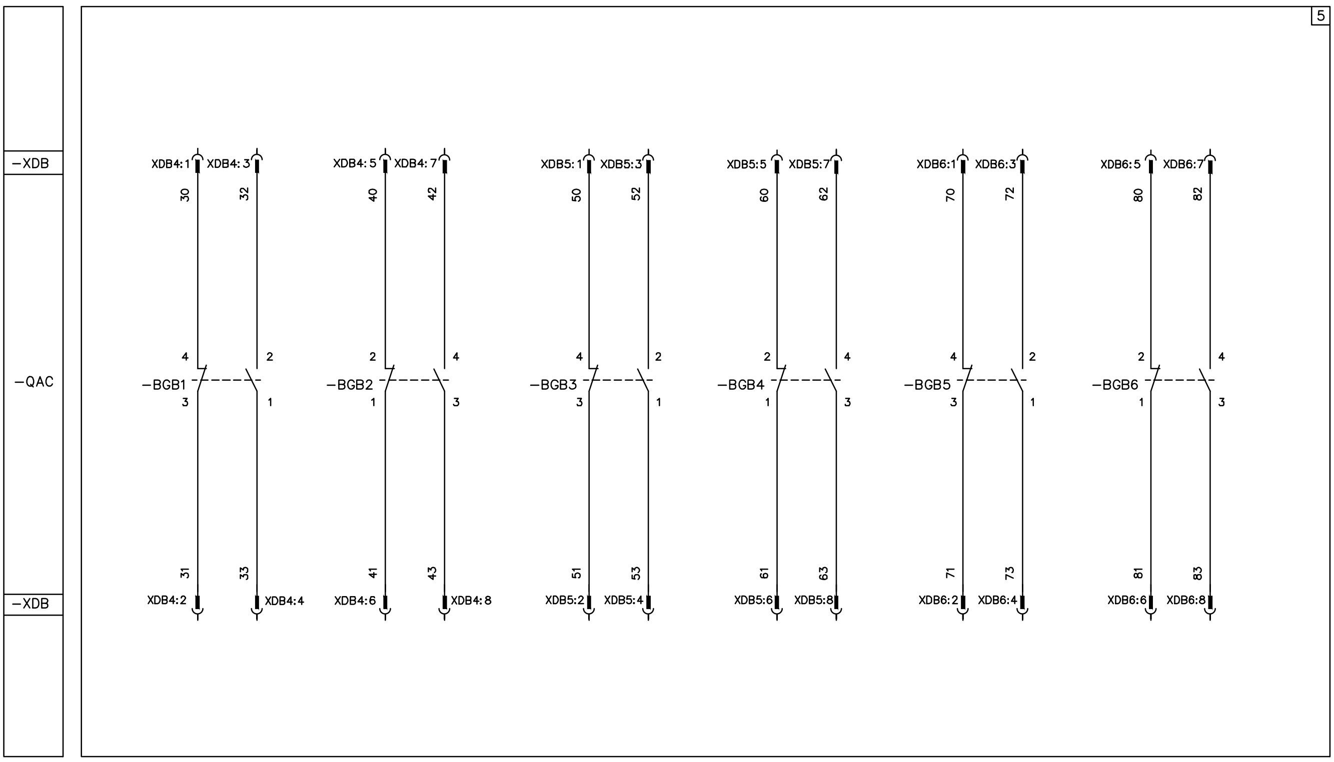

Resistor


1
–XDB
–QAC
–XDB
–SFC
–KFA
–BGF1
–SFO
–XDB1: 1
–XDB1: 2
–AA
–XDB2: 1
–XDB2: 2
–MBC
–XDB1: 3
–KFA


2
**
**
–XDB
–QAC
–XDB
–SFC
–RLM
OR EQUIVALENT
–SFO
–XDB1: 1
–XDB1: 2
–XDB3: 1
100
–XDB3: 2
TO BE USED ONLY FOR CONTROL COIL CONTINUITY
SUPPLY ONLY WITH DIRECT CURRENT
105
–AA
–RiMe
–XDB2: 1
–XDB2: 2
–MBC
–XDB1: 3
104
–XDB3: 3

Electric circuit diagram





The contactor circuits are illustrated in the diagrams below by way of example. In view of product development and for specific applications, refer to the electric circuit diagram provided with each apparatus.

Operating state shown

The diagram illustrates the following conditions:

- contactor open
- circuits de-energized
- -BGS1: NC contact but shown in the state of contactor open and circuits de-energized.

Key		
☐	=	Reference number of the diagram figure
*	=	See note indicated by the letter
-KFA	=	Auxiliary control relay or contactor (use ABB contactor type B7 or BC7 or equivalent)
-QAC	=	Contactor
-MBC	=	Closing coil
-BGF1	=	Position contact of MV fuse
-BGB1 to -BGB6	=	Contactor auxiliary contacts
-SFC	=	Push-button or contact for contactor closing
-SFO	=	Push-button or contact for contactor opening
-RD	=	Diode
-XDB	=	Connectors for the contactor circuits
-PGC	=	Electric operation counter
-RLM	=	Mechanical interlock
- - - -	=	At customer’s charge. Use the diagram given or equivalent diagrams.

Description of diagram figures		
Fig. 1	=	Control circuits of contactor
Fig. 2	=	Control circuits of contactor with mechanical latching (RIMe)
Fig. 3	=	Auxiliary contacts. Version with 4 contacts
Fig. 4	=	Auxiliary contacts. Version with 8 contacts
Fig. 5	=	Auxiliary contacts. Version with 12 contacts
Fig. 11	=	Electric operation counter

Incompatibility			
The circuits indicated in the following figures cannot be supplied at the same time on the same contactor:			
1-2	**3-4**	**3-5**	**4-5**

Notes	
A)	The contactor is delivered complete with the sole applications specified in the ABB order confirmation. Consult the catalog of the apparatus when making out the order.
B)	Control command duration (-SFO and -SFC) at rated voltage Ua Fig. 1 and Fig. 2: -SFC minimun 300ms, -SFO minimum 300ms. Shorter command duration on request.

Notes

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More product information:
abb.com/mediumvoltage
Your contact center:
abb.com/contactcenters
More service information:
abb.com/service

—
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