INSTRUCTION MANUAL

VD4X

Vacuum circuit-breaker

Content

Your safety first – always!

That’s why our instruction manual begins with the following recommendations:

- Only install switchgear and/or switchboards in enclosed rooms suitable for electrical equipment.
- Ensure that installation, operation and maintenance are only performed by specialist electricians familiar with the switching device.
- Comply in full with the standards applicable at the point of installation, such as
  - the legally recognized standards (IEC / DIN VDE),
  - the connection conditions of the local electrical utility,
  - and the applicable safety at work regulations.
- Follow the instructions in the manual when performing any work on switching devices and switchgear.

Caution – Danger (including risk of personal injury)!

Pay special attention to any notes in the instruction manual which are marked with this warning symbol.

- Ensure that the technical data in the specification are not exceeded during operation of the switching device or switchgear.
- The instruction manual must be kept accessible to all persons entrusted with work on the switching device. It is to be ensured that the number of the instruction manual used is identical with the number on the type plate of the circuit-breaker.
- The user’s personnel bear unlimited responsibility in all matters affecting safety at work and the correct handling of the switchgear.
- Always observe the five safety rules set out in EN 50110 (VDE 0105) on establishing and securing the off-circuit condition at the place of work for the duration of work on the switchgear.

  Isolate
  Secure to prevent reconnection
  Check the off-circuit condition
  - **Earth and short-circuit**
  - **Cover or guard off adjacent live parts**

If you have any further questions on this manual or the product, your local ABB contact will be pleased to help you. You can also contact us direct using the contact data on the last page.

Summary

1.1 General
(Figures 2/1a and 2/1b)
The vacuum circuit-breakers of type VD4X are intended for installation in switchgear with gas-tight encapsulation. The vacuum circuit-breaker performs not only the usual functions of making, breaking and short-circuit breaking, but also performs the earthing function in conjunction with a three-position switch. The vacuum circuit-breaker is in stalled on a mounting plate, and thus facilitates for instance gas-tight installation in a gas-insulated panel.

1.2 Standards and specifications

1.2.1 Apparatus manufacture
The switchgear complies with the following speci fications in accordance with the relevant IEC and GB publications:
- IEC 62271-1, High-voltage switchgear and controlgear Part 1: Common specifications for alternating current switchgear and controlgear
- IEC 62271-100, High-voltage switchgear and controlgear Part 100: Alternating current circuit-breakers
- GB/T 11022-2011, Common specifications for high-voltage switchgear and controlgear standards
- GB/T 1984-2014, High-voltage alternating-current circuitbreakers

1.2.2 Installation and operation
The relevant specifications are to be taken into account during installation and operation, particularly:
- DIN VDE 0101 respectively IEC 61936-1, Power installations exceeding AC 1 kV
- VDE 0105 respectively DIN EN 50110, Operation of electrical installations
- DIN VDE 0141 respectively DIN EN 14387, Earthing systems for special power installations with rated voltages above 1 kV
- Accident prevention regulations issued by the appropriate professional bodies or comparable organizations
- Safety guidelines for auxiliary and operating materials
- Order related details provided by the switchgear manufacturer

1.3 Operating conditions

1.3.1 Normal operating conditions
Design to IEC 62271-1, High-voltage switchgear and controlgear, Part 1: Common specifications for alternating current switchgear and controlgear, with the following values:
- Ambient temperature
  - Maximum + 40 °C
  - Maximum 24 hour average + 35 °C
  - Minimum (according to “minus 5 indoor class”) – 15 °C
- Humidity
  - the average value of the relative humidity measured over a period of 24 h, does not exceed 95 %
  - the average value of the water vapour pressure, over a period of 24 h, does not exceed 2.2 kPa
  - the average value of the relative humidity, over a period of one month, does not exceed 90 %
  - the average value of water vapour pressure, over a period of one month, does not exceed 1.8 kPa
- Ambient air
  - The ambient air is not to be significantly contaminated by dust, smoke, corrosive or flammable gases, vapours or salt

1.3.2 Special operating conditions
Special operating conditions are to be agreed on by the manufacturer and user. The manufacturer must be consulted in advance about each special operating condition:
- Increased ambient temperature
  - Current carrying capacity is reduced
  - Provide additional ventilation for heat dissipation
- In areas with high humidity or major rapid temperature fluctuations, prevent condensation inside the low voltage compartment (e.g. by installing electric heaters in that compartment)

Technical data

2.1 Circuit-breaker VD4X

Rated voltage		kV	12	17.5	24	36	40.5
Maximum operating voltage		kV	12	17.5	24	36	40.5
Standards			IEC/GB	IEC	IEC/GB	IEC	IEC/GB
	ZX0.2		•	•	•		
Switchgear type	ZX1.2		•		•	•	•
	ZX2					•	•
Insulating gas system [1]							
Insulating gas			SF_6 [2]	SF_6 [2]	SF_6 [2]	SF_6 [2]	SF_6 [2]/AirPlus [3]
Alarm level for insulation (pae) at 20°C		kPa	120	120	120	120	120
Rated filling level for insulation (pae) 20°C		kPa	130	130	130	130	130
Electrical data							
Rated power frequency withstand voltage		kV	28 [5]/42 [6]	38 [5]	50 [5]/65 [6]	70 [5]	85 [5]/95 [6]
Rated lighting impulse withstand voltage		kV	75 [5]/75 [6]	95 [5]	125 [5]/125 [6]	170 [5]	185 [5]/185 [6]
Voltage apply to an absolute insulating gas pressure at 20°C		kPa	120	120	120	120	120
Rated frequency		Hz	50/60	50/60	50/60	50/60	50/60
Rated current		A	630 [7]/1250/1600/2000/2500				
Rated short-circuit breaking current		kA	25/31.5/40 [8]				
Rated short-circuit duration		s	3 [5]/4 [6]				
Rated operating sequence			O-0.3 s-CO-3 min-CO				

1) See instruction manual in ZX-Switchgear for further details.
2) Insulaitng gas: sulphur hexafluoride.
3) Only availiable in switchgear type ZX2.
5) Comply with IEC standards.
6) Comply with GB standards.
7) Only availiable in switchgear type ZX0.2 & ZX1.2.
8) Only availiable in 40.5kV with switchgear type ZX2.

Breaker type	**Rated Voltage**	**Rated current**	**Rated short-circuit breaking current symm. [8]**	**Rated short-circuit making current (peak) [8]**	**Rated short-circuit duration**	**Panel width**	**Pole centres**	**Permissible of vacuum-interrupter switching operations**
VD4X	**kV**	**A**	**kA**	**kA**	**s**	**mm**	**mm**	**Figure 2/2 Page 9**
…1212-31	12	…1250	…31.5	…80	4	600	150	Diagram A&B
…1225-31	12	1600…2500	…31.5	…80	4	800	210	Diagram A&B
…1712-31	17.5	…1250	…31.5	…80	4	600	150	Diagram A&B
…2412-31	24	…1250	…31.5	…80	4	600	150	Diagram A&B
…2425-31	24	1600…2500	…31.5	…80	4	800	210	Diagram A&B
…3612-31	36	…1250	…31.5	…80	4	600	150	Diagram A&B
…3625-31	36	…2500	…31.5	…80	4	800	210	Diagram A&B
…3625-40	36	1250…2500	…40	…100	4	800	210	Diagram C&D
…4012-31	40.5	…1250	…31.5	…80	4	600	150	Diagram A&B
…4025-31	40.5	…2500	…31.5	…80	4	800	210	Diagram A&B
…4025-40	40.5	…2500	…40	…100	4	800	210	Diagram C&D

8) For operating voltage lower than rated voltage, the same values as for rated voltage always apply. Higher values on request.

Guidelines values for function times at the rated supply voltage, without bay control and protection unit	
	Device time
Closing time	50 - 70 ms
Opening time	30 - 45 ms/27 - 45 ms [2]
Arcing time (at 50 Hz)	≤15 ms
Breaking time	≤60 ms
Minimum command time on closing	20 ms (120 ms [1])
Minimum command time on opening	20 ms (80 ms [1])

1) If the activating relay contact cannot interrupt the release coil itself.
2) For VD4X-U only.

2.2 Technical data – Equipment

2.2.1 Charging motor for stored-energy spring mechanism

Supply voltage		**Power consumption**	**Motor protection (ABB-Stotz-Automat) A**	**Charging time (maximum) [2] s**
V, AC	110	approx. 260 VA [3]	1.60 S 281 UC-K	15
	125		1.60	15
	220		0.75	15
	240		0.75	15
V, DC	24	approx. 200 … 260 W [3]	6.00 S 282 UC-K	15
	30		6.00	15
	48		4.00	15
	60		3.00	15
	110		1.60	15
	125		1.60	15
	220		0.75	15
	240		0.75	15

2.2.2 Releases / Blocking magnet

This table covers the basic equipment and all of the equipment possibilities for the various VD4X type series. The possible scope of equipment within a type series is shown in the corresponding list of switching devices.

The equipment provided in each individual case can be seen on the order documentation (see also “Equipment variants for the operating mechanism”).

Device		**Supply voltage (V) [3]**	**Power consumption (VA/W) [1]**
Shunt opening release [2]	-Y2, -Y9	DC: 24/30/48/60 V AC/DC: 110/220 V	250
Shunt closing release [2]	-Y3		
Blocking magnet	-Y1		10
Undervoltage release	-Y4		10
Indirect overcurrent release (not together with undervoltage release -Y4)	-Y7		
- two phase		-	3.5 [4] /15
- three phase		-	2.0 [4] / 15

1) Approximate figures.
2) Maximum command duration dependent on system setup and configuration.
3) Other voltages (AC and DC) on request.
4) With short-circuited intermediate current transformer.

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Figure 2/1a: Vacuum circuit-breaker, type VD4X, mechanism side with front plate.
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Figure 2/1b: Vacuum circuit-breaker, type VD4X, pole side.
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Figure 2/1c: Vacuum circuit-breaker, type VD4X, mechanism side with front plate.
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Figure 2/1d: Vacuum circuit-breaker, type VD4X, pole side.
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Figure 2/1e: Vacuum circuit-breaker, type VD4X, mechanism side with front plate.
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Figure 2/1f: Vacuum circuit-breaker, type VD4X, pole side.

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Figure 2/1a

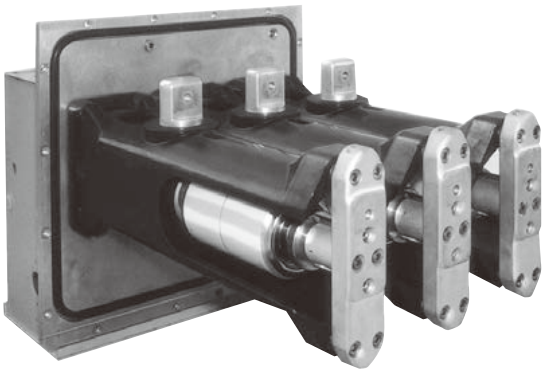

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Figure 2/1b

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Figure 2/1c

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Figure 2/1d

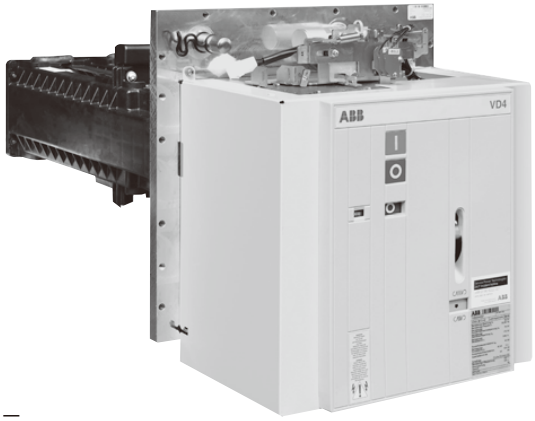

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Figure 2/1e

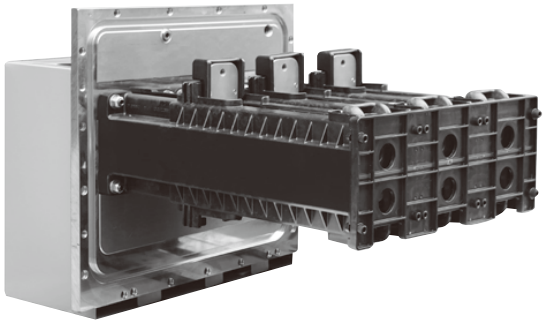

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Figure 2/1f

2.3 Permissible number of switching operations of the vacuum interrupters in relation to breaking current

Figure 2/2:
Permissible number of vacuum interrupter operating cycles n as a function of the breaking current Ia (Reference see section 2.1 – Technical data page [6])

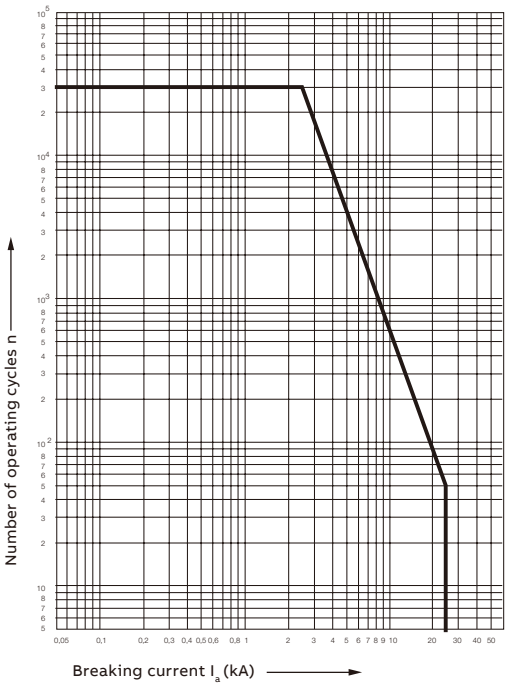


Diagram A

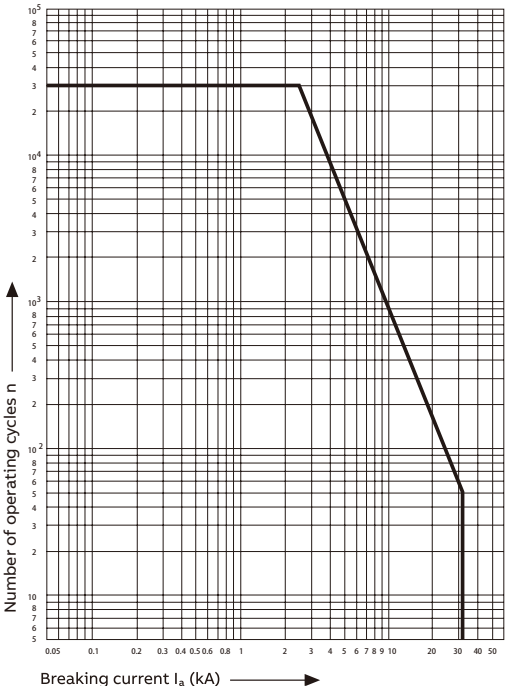


Diagram B

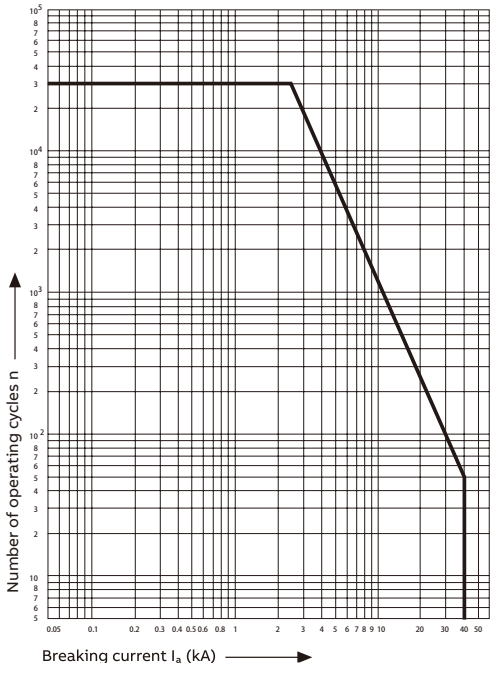


Diagram C

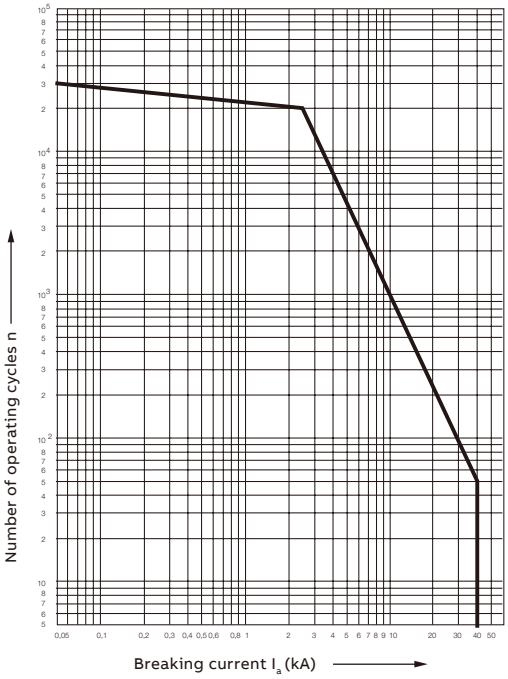
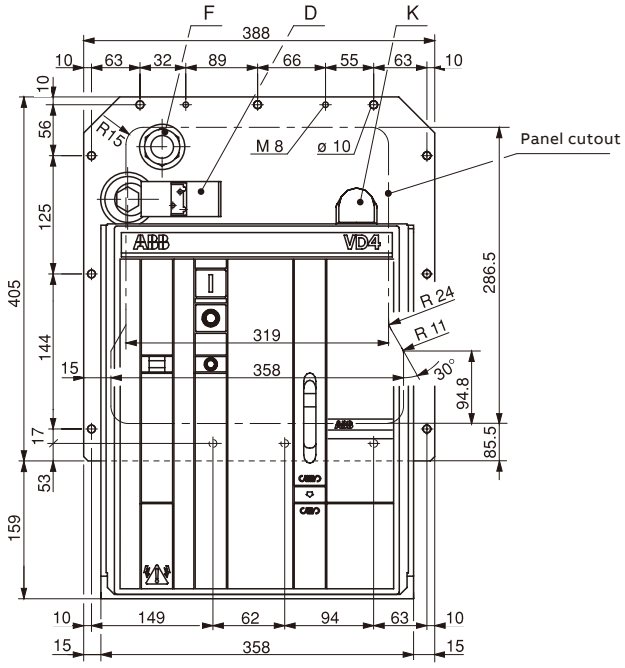
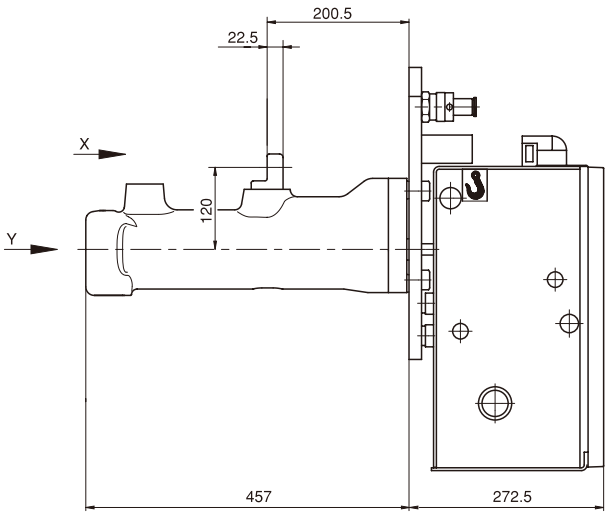


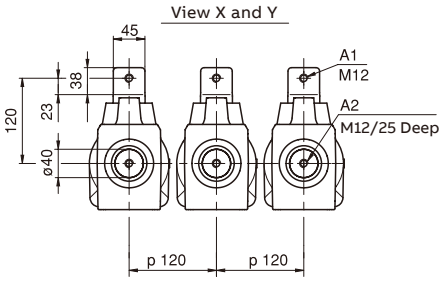
Diagram D

Figure 2/2

2.4 Dimensions







Terminal for rated curreut ≤630 A & -12/17.5/24 kV≤25 kV

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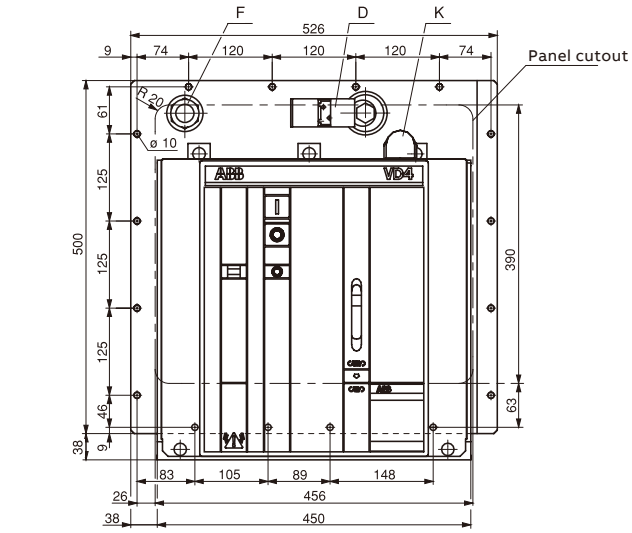
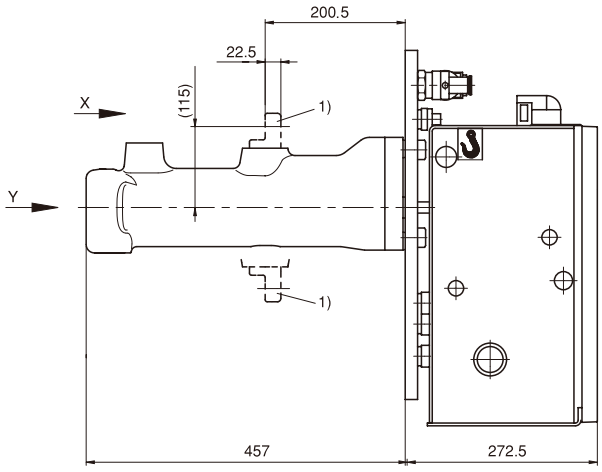
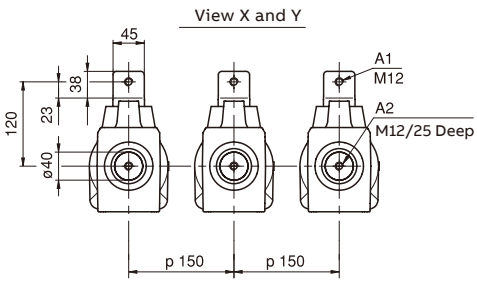
Figure 2/3

A1 = Terminal for conductor bar
A2 = Front terminal for conductor bar
D = Pressure sensor for circuit-breaker compartment
F = Filler connector for circuit-breaker compartment
K = Plug







Terminal for rated
curreut ≤1250 A
-12/17.5 kV≤31.5 kV
-24 kV≤25 kV

Figure 2/4

1) Busbar connection arranged above or bolow the breaker pole depending on the suitchgear system.

A1 = Terminal for conductor bar
A2 = Front terminal for conductor bar
D = Pressure sensor for circuit-breaker compartment
F = Filler connector for circuit-breaker compartment
K = Plug

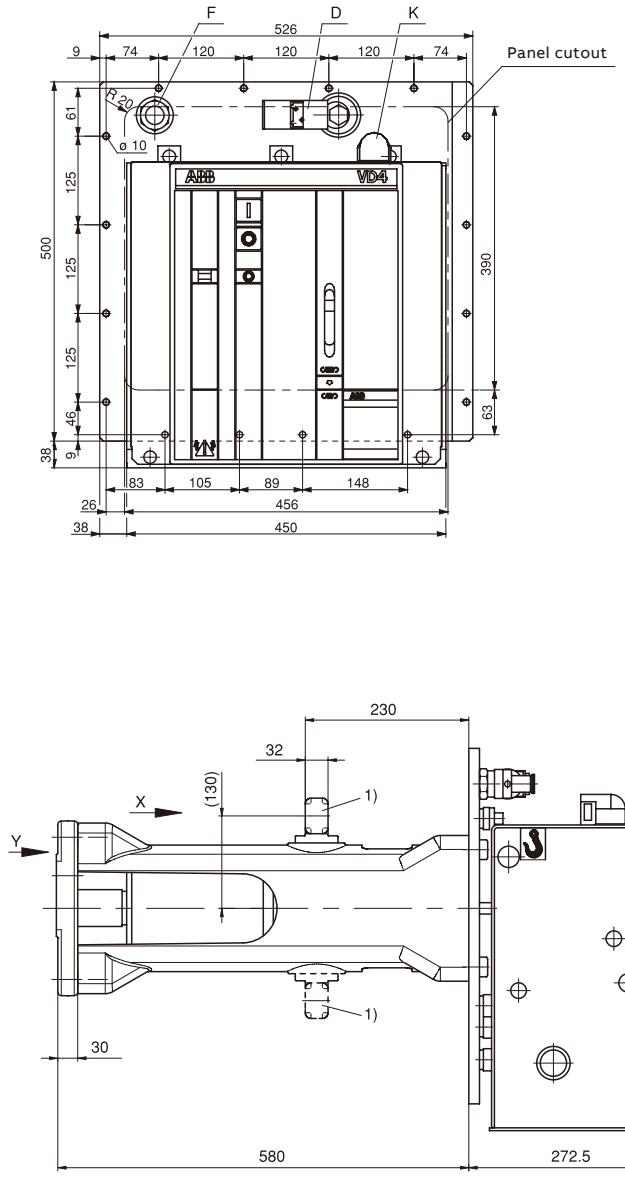


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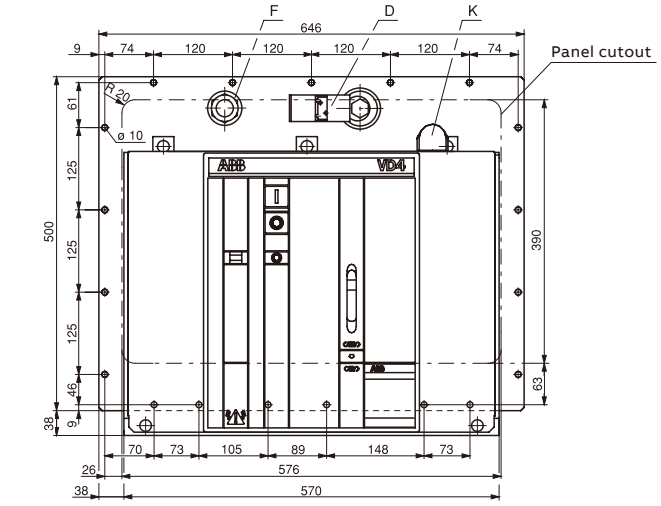
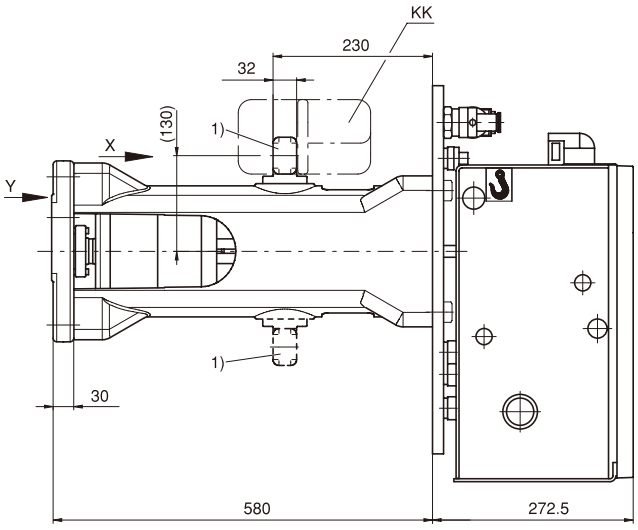
Figure 2/5

1) Busbar connection arranged above or bolow the breaker pole depending on the suitchgear system.

Terminal for rated curreut ≤1250 A
-12/17.5 /24/40.5 kV≤31.5 kV

A1 = Terminal for conductor bar
A2 = Front terminal for conductor bar
D = Pressure sensor for circuit-breaker compartment
F = Filler connector for circuit-breaker compartment
K = Plug





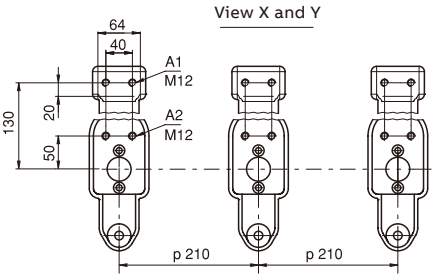


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Figure 2/6

Terminal for rated current >1250 A

1) Busbar connection arranged above or bolow the breaker pole depending on the suitchgear system.

A1 = Terminal for conductor bar
A2 = Front terminal for conductor bar
D = Pressure sensor for circuit-breaker compartment
F = Filler connector for circuit-breaker compartment
K = Plug

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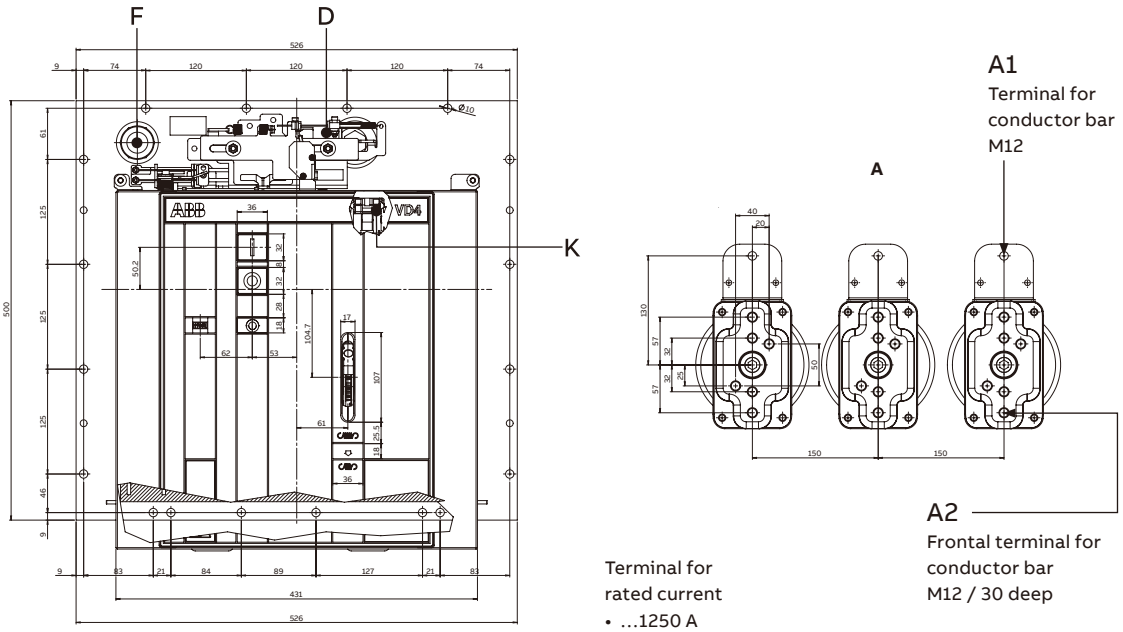
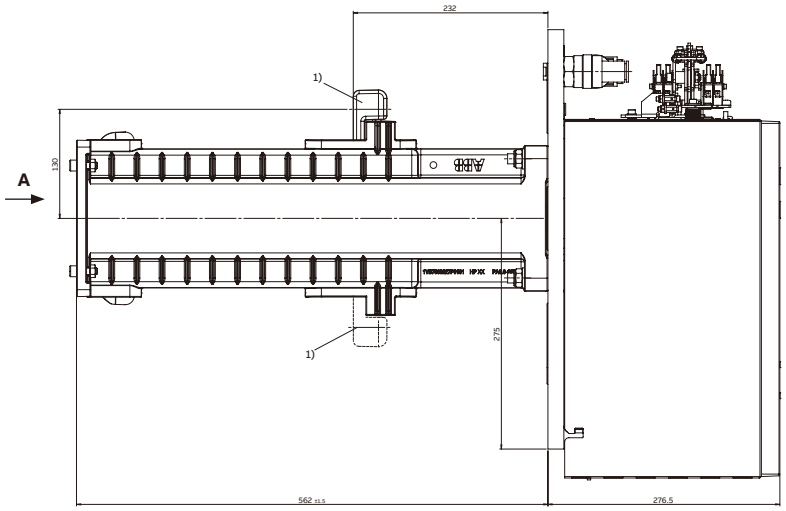
Figure 2/7:
Dimensional drawing of circuit-breaker, type VD4X, 3612-31 & 4012-25, p150.





1) Connection for conductor bar depends on switchgear and is positioned above or below the pole.

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Figure 2/7

A1 = Terminal for conductor bar
A2 = Front terminal for conductor bar
D = Pressure sensor for circuit-breaker compartment
F = Filler connector for circuit-breaker compartment
K = Plug

Structure and mode of action

3.1 Structure of the breaker poles
(Figures 3/1 to 3/3)
The horizontally arranged poles are mounted on mounting plate 9 at the rear part of breaker operating mechanism 1. The live parts of the breaker poles are located in the insulating material 11.

With the breaker closed, the current path leads from breaker terminal 13 at the front via the contacts in vacuum interrupter 15 to connecting bar terminal 12 above or below the breaker pole.

Switching motions are initiated by actuating rod 17. See figures 3/1 and 3/2.

The basic structure of a vacuum interrupter is shown in figure 3/3.

3.2 Structure of the operating mechanism
(Figures 3/1 to 3/8)
The operating mechanism is of the stored-energy spring type. The necessary operating energy is stored ready for activation by charging the spring energy storage mechanism. The stored-energy spring operating mechanism essentially consists of drum 23 containing the spiral spring, the charging system, the latching and operating mechanism and the linkages which transmit the force to the breaker poles. In addition, there are supplementary components such as releases and the controls and instruments located on the front of the enclosure.

The operating mechanism is fundamentally suitable for auto-reclosing and, due to the short motor charg ing times, also for multi-shot auto-reclosing.

The spring energy storage mechanism is charged by a motor (external activation and deactivation). Emer gency manual operation with a charging lever is possible.

There are rating plates with the main data of the switching device at front plate 1.1 and at the right of the mounting plate.

3.2.1 Operating mechanism equipment
1. Basic operating equipment:
   - Shunt release OFF -Y2
   - Shunt release ON -Y3
   - Mechanical ON push-button (2)
   - Mechanical OFF push-button (3)
   - Rotational auxiliary switches -BGB for annunciation purposes
   - Auxiliary switch -S7 for fault signalization
   - Mechanical position indicator (4)
   - Mechanical charge-state indicator (8) for the energy storage spring mechanism
   - Mechanical operating cycle counter (5)
   - Charging motor
   - Micro-switches -S1 for switching of the charging motor
   - Mechanical interlocks
     - Circuit-breaker/three position disconnector
     - Blocking magnet on circuit-breaker (optional)
     - Blocking of undervoltage release in the case of earthing
2. Additional equipment:
   - Second shunt release OFF -Y9
   - Undervoltage release -Y4
   - Indirect overcurrent release -Y7

Blocking magnet -Y1 mechanically blocks the ON half shaft on failure or absence of control voltage, and simultaneously uses the corresponding rotational auxiliary switch contact to interrupt the circuit of shunt release ON -Y3.

The wiring diagram for the circuit-breakers can be found in Figure 3/9 & 3/10.

3.3 Mode of action of the circuit-breaker
(Figures 3/1 to 3/8)

3.3.1 Charging of the spring energy storage mechanism

To provide the necessary motive energy, the spring energy storage mechanism is charged either auto matically (external activation and deactivation) by a charging motor or in emergency manual operation with a vertical

pumping action with charging lever 32, depending on the equipment fitted to the circuit-breaker. The charging condition is shown by mechanical charging condition indicator 8.

As a precondition for an auto-reclosing sequence, the mechanism is automatically (re-)charged after a closing operation by the charging motor.

3.3.2 Closing procedure
The closing process is started by activation of shunt release ON -Y3, or by the mechanical ON push-button. The release mechanism 24 then per mits mechanism shaft 27 to be rotated by the (previously) charged spiral spring. The moving con tact 15.3 in vacuum interrupter 15 is moved by cam disc 28 and further kinematic links until the contacts touch. In the further sequence of motion, spring arrangement 16 is tensioned and the approp riate amount of contact force thus applied. The available overtravel is greater than the maximum contact erosion during the service life of the vacuum interrupter. During the closing process, opening springs 25 are simultaneously tensioned.

3.3.3 Opening procedure
The opening procedure is initiated by activation of one of releases -Y2, -Y4, -Y7 or -Y9 or by mechanical OFF push-button 3. Release mechanism 24 then permits mechanism shaft 27 to be turned further by the spiral spring, which is still sufficiently charged. The opening spring 25, which is thus released, moves the contact 15.3 into the open position at a def ined speed.

Notes on activation of the releases
1. Only shunt release OFF (-Y2 and -Y9) and shunt release ON (-Y3) are provided for operational opening and closing.
   These three releases are rotary magnets, and are suitable for a high number of operating cycles.
2. The undervoltage release (-Y4) or the indirect overcurrent release (-Y7) are purely safety/protective tripping units and must not be used for operational switching.

3.3.4 Auto-reclosing sequence
An OFF-ON or OFF-ON-OFF auto-reclosing sequence is activated and monitored by the protection system. It is necessary for the spiral spring in the operating mechanism to be in the (re-)charged cond ition, with the circuit-breaker in the closed position. The (re-)charging process is carried out auto mat ically by the charging motor after closing of the breaker. If the charging motor breaks down, the charging process can be carried out or completed manually. Opening of the breaker is also possible during the (re-)charging process, but subsequent closing of the breaker is however blocked until the charging process has been completed.

3.3.5 Quenching principle of the vacuum interrupter
Due to the extremely low static interrupter chamber pressure of $<2x10^{-7}$ hPa, only a relatively small contact gap is required to achieve a high dielectric strength. The vacuum arc is extinguished on one of the first natural current zeros.

Due to the small contact gap and the high conductivity of the metal vapour plasma, the arc drop voltage, and additionally, due to the short arcing time, the associated arc energy, are extremely low, which has advantageous effects on the life of the contacts and thus on that of the vacuum interrupters.

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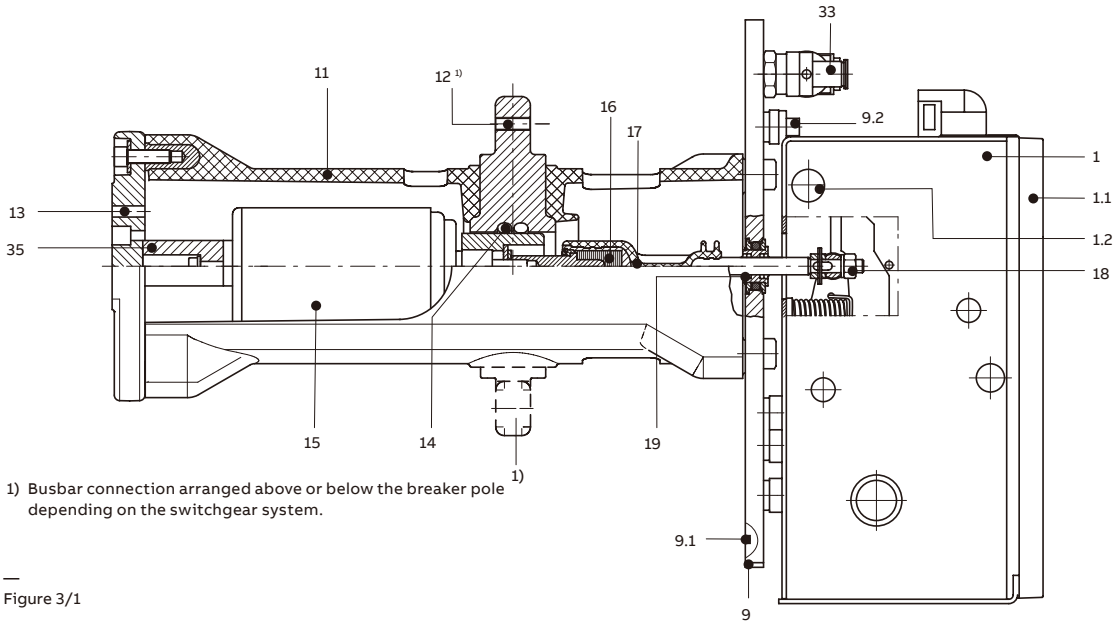
Figure 3/1: Sectional view of a vacuum circuit-breaker, type VD4 X.



1) Busbar connection arranged above or below the breaker pole depending on the switchgear system.

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Figure 3/1

1 Circuit-breaker operating mechanism
1.1 Front plate
1.2 Bore for handling, both sides
9 Mounting plate
9.1 O-ring
9.2 Operating mechanism mounting
11 Insulating material pole tube
12 Breaker terminal
13 Front breaker terminal
14 Spiral spring contact
15 Vacuum interrupter
16 Contact force spring
17 Insulating push-rod
18 Lock nut
18.1 Spring washer
18.2 Retaining plate
18.3 Positioning plate
18.4 Washer
19 Gas-tight thrust bushing
33 Pressure sensor for circuit-breaker compartment
35 Adapter

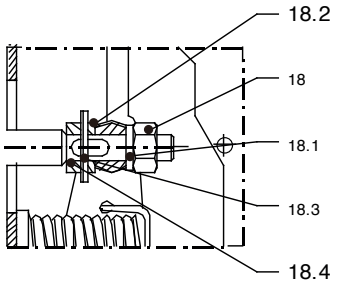

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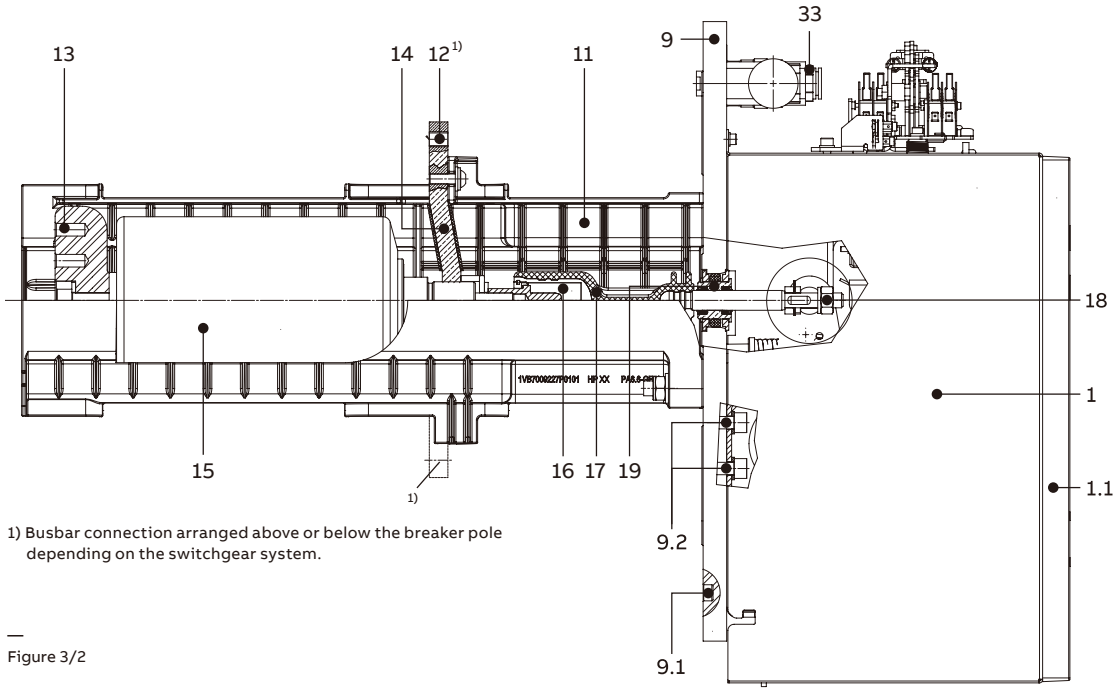
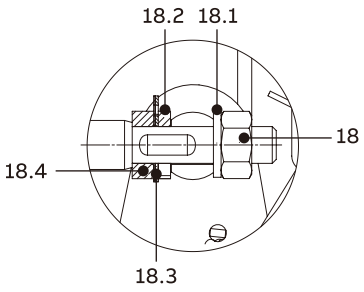
Figure 3/2: Sectional view of a vacuum circuit-breaker, type VD4X-U.
—
Figure 3/3: Partial section of vacuum interrupter, simplified schematic diagram (details are dependent on the stipulated ratings)

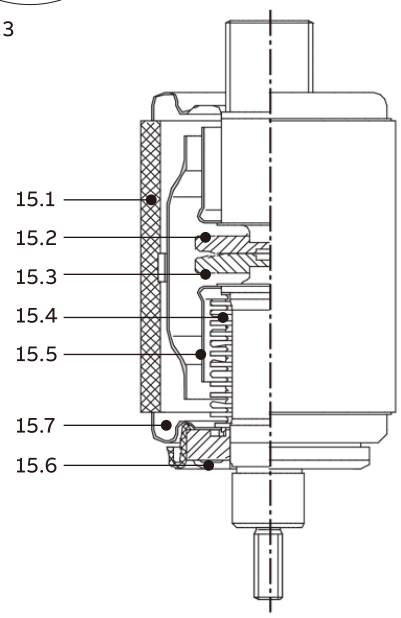


1) Busbar connection arranged above or below the breaker pole depending on the switchgear system.

—
Figure 3/2

1 Circuit-breaker operating mechanism
1.1 Front plate
9 Mounting plate
9.1 O-ring
9.2 Operating mechanism mounting
11 Insulating material pole half shell
12 Breaker terminal
13 Front breaker terminal
14 Flexible conductor
15 Vacuum interrupter
16 Contact force spring
17 Insulating push-rod
18 Lock nut
18.1 Spring washer
18.2 Retaining plate
18.3 Positioning plate
18.4 Washer
19 Gas-tight thrust bushing
33 Pressure sensor for circuit-breaker compartment





15.1 Insulator
15.2 Fixed contact
15.3 Moving contact
15.4 Metal bellows
15.5 Screen
15.6 Guide
15.7 Interrupter lid

—
Figure 3/3

—
Figure 3/4: Vacuum circuit-breaker type VD4X

—
Figure 3/5: Stored-energy spring mechanism with auxiliary equipment – front plate removed. Design variant where conventional secondary equipment is used

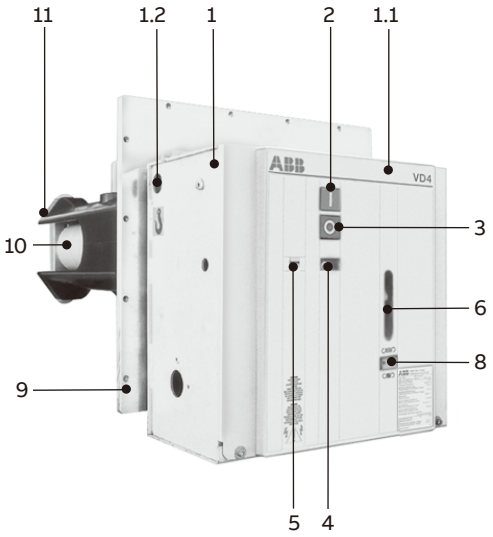


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Figure 3/4

1 Circuit-breaker operating mechanism
1.1 Front plate
1.2 Bore for handling, both sides
2 Mechanical ON push-button
3 Mechanical OFF push-button
4 Mechanical position indicator
5 Mechanical operating cycle counter
6 Recess for charging lever (emergency manual operation)
8 Mechanical charging condition indicator
9 Mounting plate
10 Breaker pole
11 Insulating material pole tube

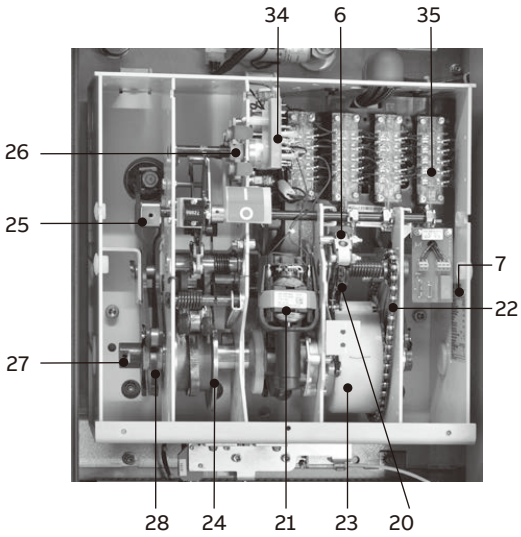

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Figure 3/5

6 Recess for charging lever 32
7 Rating plate
20 Ratchet wheel
21 Charging motor
22 Chain drive
23 Drum with spiral spring
24 Release and control mechanism on the mechanism shaft
25 Opening spring
26 Release and control mechanism area
27 Mechanism shaft
28 Cam disc
34 Magnet holder, complete
35 Auxiliary switch block (e.g. with -BGS1,-BGB2,-BGB1 and -BGB3)

—
Figure 3/6: Vacuum circuit-breaker type VD4X
—
Figure 3/7: Stored-energy spring mechanism with auxiliary equipment –front plate removed.
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Figure 3/8: Emergency manual operation of the circuit-breaker, shown with front plate

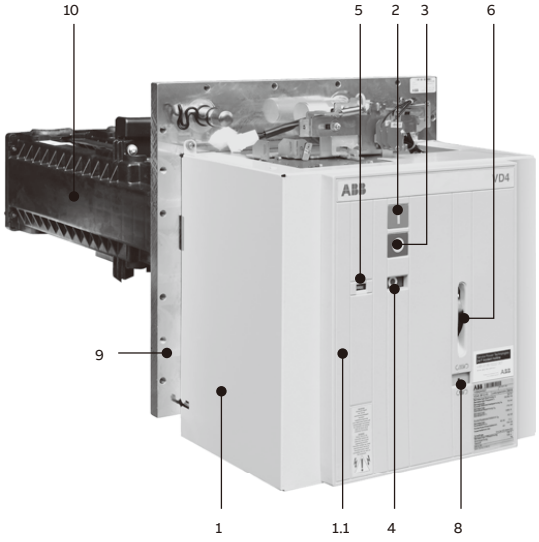

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Figure 3/6

1 Circuit-breaker operating mechanism
1.1 Front plate
2 Mechanical ON push-button
3 Mechanical OFF push-button
4 Mechanical position indicator
5 Mechanical operating cycle counter
6 Recess for charging lever (emergency manual operation)
8 Mechanical charging condition indicator
9 Mounting plate
10 Breaker pole

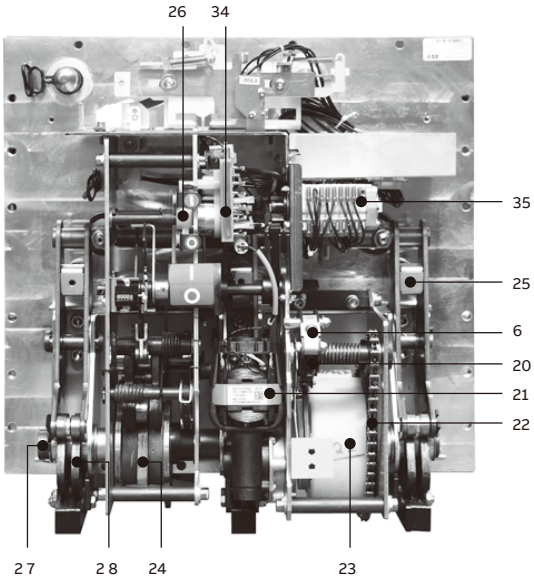

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Figure 3/7

6 Recess for charging lever 32
20 Ratchet wheel
21 Charging motor
22 Chain drive
23 Drum with spiral spring
24 Release and control mechanism on the mechanism shaft
25 Opening spring
26 Release and control mechanism area
27 Mechanism shaft
28 Cam disc
34 Magnet holder, complete
35 Auxiliary switch block -BGB

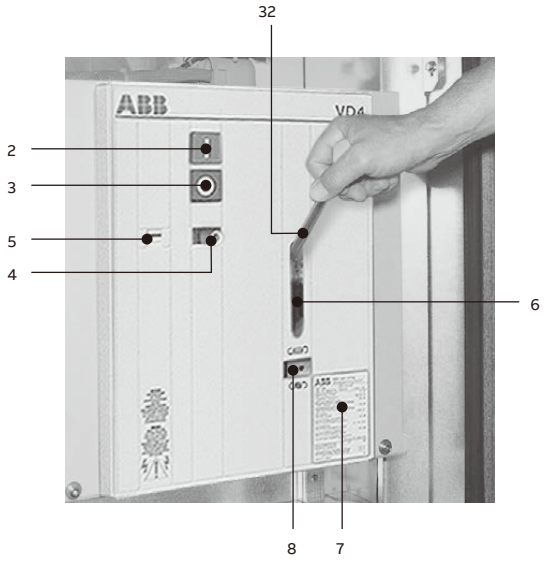

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Figure 3/8

2 Mechanical ON push-button
3 Mechanical OFF push-button
4 Mechanical position indicator
5 Mechanical operating cycle counter
6 Recess for charging lever
7 Rating plate
8 Mechanical charging condition indicator
32 Charging lever

—
Figure 3/9: Circuit breaker wiring diagram with conventional equipment.

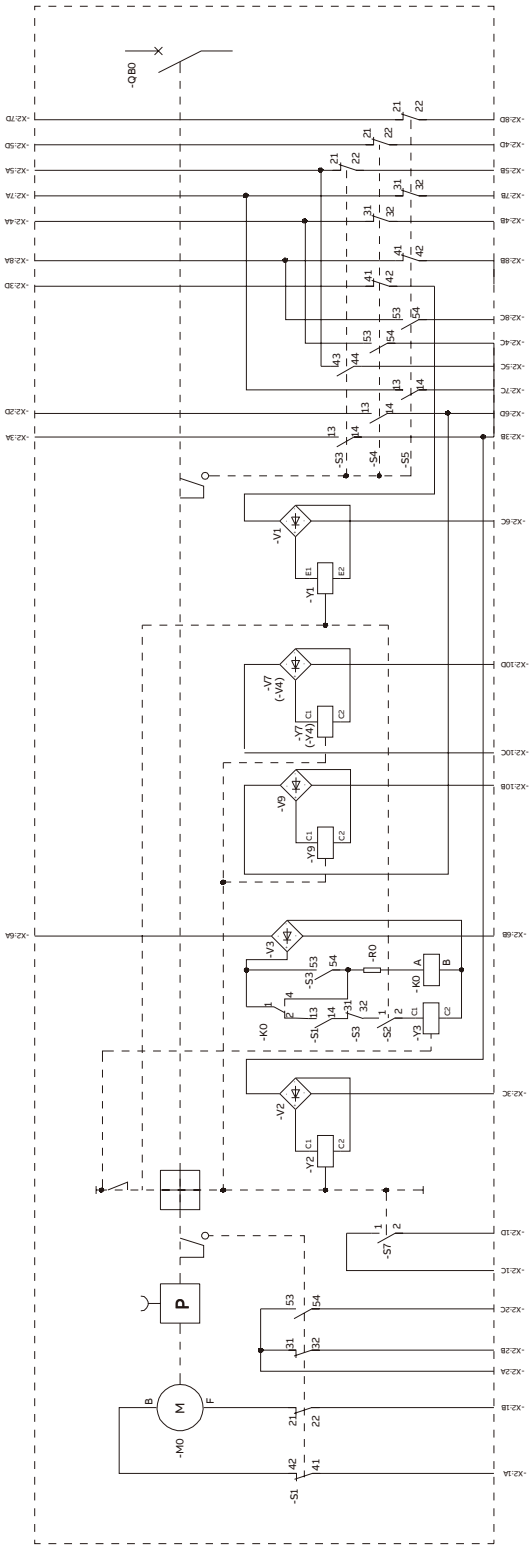

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Figure 3/9

Shown with the spring energy store in the discharged state. The wiring diagram comprises the basic components and all further equipment options for the various VD4X types. The scope of equipment possible within an individual type series is listed in the relevant switchgear list, and the equipment fitted in each individual case can be found in the order documentation.

Note
Shunt releases and blocking magnets are fun damentally wired with rectifiers (e.g. magnet holder 34 with integrated rectifiers -V1, -V2, -V3 and -V9).

Rectifiers function as free-wheeling diodes if d.c.-supply. No use of Figure 3/8, when -Y4 and -Y7 required.

-S1	Auxiliary switch on spring charging mechanism
-S2	Auxiliary switch on blocking magnet -RLE1 (optional)
-S2-1	Auxiliary switch for push button interlocking (optional)
-S3	Auxiliary switch on switch shaft
-S4	
-S5	
-S7	Wiping contact for circuit-breaker (≥35 ms tripped indication) (optional)
-S10	Auxiliary switch at mechanical close push button (optional)
-Y1	Closing block magnet with rectifier -V1 (optional)
-Y2	1 st shunt release off with rectifier -V2
-Y3	Closing release with rectifier -V3
-Y4	Undervoltage relay with rectifier -TB6 (optional)
-Y7	Inductive overcurrent relay with rectifier -V7 (optional)
-Y9	2 nd shunt release off with rectifier -V9 (optional)
-M0	Charging motor
-K0	Antipumping relay
-R0	Resistor for antipumping relay

1) If the fitting is without blocking magnet -Y1 bridge between -S3:42 and-Y3:C1. Opening contact -S3:22 will be connected same as other contacts.

See page 28 for comparison of VDE/IEC designations.

—
Figure 3/10: Circuit breaker wiring diagram with conventional equipment for VD4X-U.

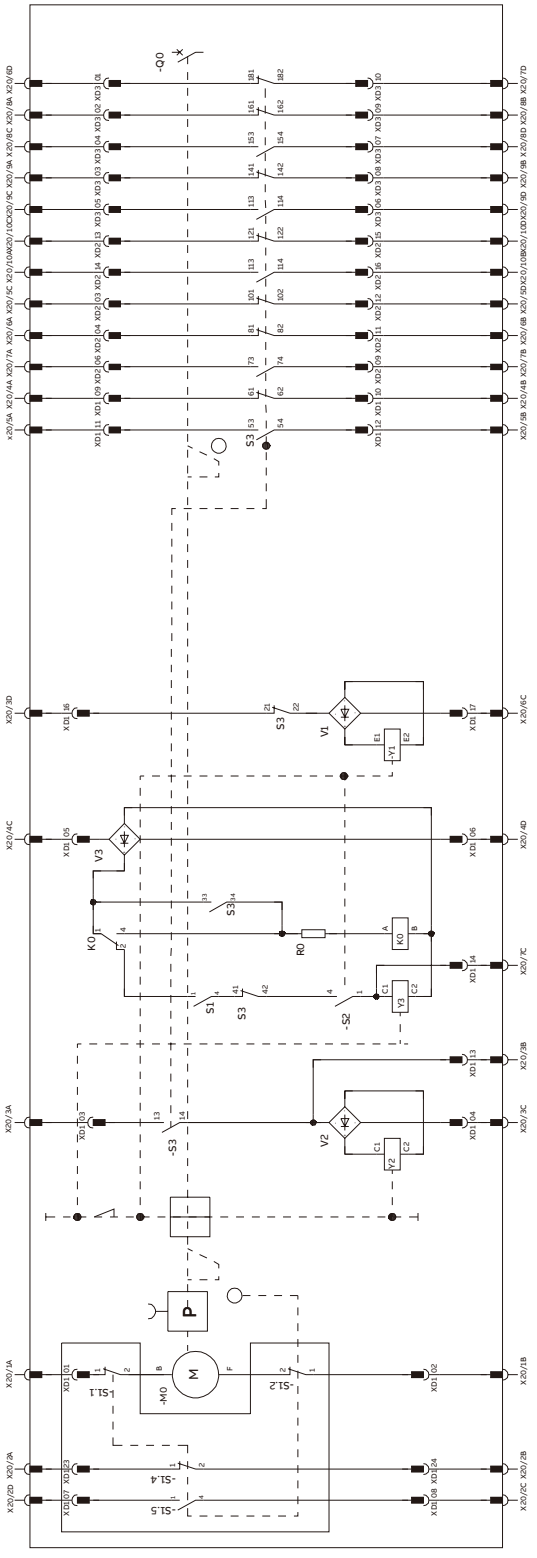

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Figure 3/10

Shown with the spring energy store in the discharged state. The wiring diagram comprises the basic components and all further equipment options for the various VD4X types. The scope of equipment possible within an individual type series is listed in the relevant switchgear list, and the equipment fitted in each individual case can be found in the order documentation.

Note
Shunt releases and blocking magnets are fun damentally wired with rectifiers (e.g. magnet holder 34 with integrated rectifiers -V1, -V2, -V3 and -V9).

Rectifiers function as free-wheeling diodes if d.c.-supply. No use of Figure 3/8, when -Y4 and -Y7 required.

-S1	Auxiliary switch on spring charging mechanism
-S2	Auxiliary switch on blocking magnet -RLE1 (optional)
-S2-1	Auxiliary switch for push button interlocking (optional)
-S3	Auxiliary switch on switch shaft
-S4	
-S5	
-S7	Wiping contact for circuit-breaker (≥35 ms tripped indication) (optional)
-S10	Auxiliary switch at mechanical close push button (optional)
-Y1	Closing block magnet with rectifier -V1 (optional)
-Y2	1 st shunt release off with rectifier -V2
-Y3	Closing release with rectifier -V3
-Y4	Undervoltage relay with rectifier -TB6 (optional)
-Y7	Inductive overcurrent relay with rectifier -V7 (optional)
-Y9	2 nd shunt release off with rectifier -V9 (optional)
-M0	Charging motor
-K0	Antipumping relay
-R0	Resistor for antipumping relay

1) If the fitting is without blocking magnet -Y1 bridge between -S3:42 and-Y3:C1. Opening contact -S3:22 will be connected same as other contacts.

See page 28 for comparison of VDE/IEC designations.

Commissioning / Operation

4.1 Notes on safety at work

- Operation is only permissible by specially trained personnel who are familiar with the characteristics of the particular switching device
- Observe the relevant specifications as set out in section 1.2
- Display the instruction manual in such a way that it is accessible to the operators at all times
- Due to safety reasons, the circuit-breaker has to be treated as “switched on” if the switching position can not be clearly determined

4.2 Circuit-breaker operation
(Figures 3/8)

4.2.1 Charging the spring energy storage mechanism

- Charging takes place automatically by the charging motor
- As a condition for an auto-reclosing sequence, the mechanism is automatically (re-)charged by the charging motor (external activation and deactivation) after a closing operation
- On failure of the charging motor, the charging process can be carried out or completed manually

4.2.2 Emergency manual operation

- Insert charging lever 32 into recess 6 and pump up and down for approx. 50 strokes until the charged condition is displayed
- When the charged condition is reached, the charging mechanism automatically disengages, and further strokes of the charging lever have no effect
- Key to the charging condition indicators


Discharged


Charged

4.2.3 Closing and opening operation
Closing operation:

- Operate the electrical control unit, e.g. by selecting it on the bay control and protection unit or press mechanical ON push-button 2

Opening operation:

- Operate the electrical control unit e.g. by selecting it on the bay control and protection unit, or press mechanical OFF push-button 3

Switching cycle counter and switching state indicator

a) Operating cycle and position display on the switching device:
   - The operating cycle counter 5 is automatically incremented by one complete figure with each switching operation. On completion of a switch ing operation the position indicator 4 in the window of front plate 1.1 shows the appropriate switch position.

b) Operating cycle and position display on the bay control and protection unit:
   - The number of operating cycles and the switch position can be called up in the user interface of the bay control and protection unit and dis played on its message display

Anti-pumping system

a) Anti-pumping device / conventional secondary equipment:
   - The anti-pumping relay -K0 (wiring diagram, Figure 3/9) prevents repeated ON-OFF switching cycles if, for instance, a continuous electrical switch-on command is present in case of switch tripping via reaction of the protective relay in case of primary-side fault. Switching-on is then only possible again after interruption of the switch-on command

b) Anti-pumping system / digital secondary equip ment:
   - The bay control and protection unit assigned to the switching device or the control system of the panel prevent repeated ON/OFF switching cycles.

4.2.4 Undervoltage release / Tee-off earthing
The use of undervoltage releases is optional. An interlock can be implemented as an option in order to prevent switching off of the circuit-breaker by the undervoltage release in case of voltage failure if a tee-off has been earthed

Maintenance

Maintenance serves to ensure trouble-free operation and achieve the longest possible working life of the switchgear. In accordance with DIN 31051, IEC 62271-1 it comprises the following closely related activities:

Inspection: Determination of the actual condition

Servicing: Preservation of a functional condition

Repair: Measures to restore the functional condition

5.1 5.1 General

Vacuum circuit-breakers are characterized by their simple and robust construction. They have a long life expectancy. Their operating mechanisms have a low maintenance requirement, and the interrupters are maintenance-free during their working life. There is no adverse effect on the vacuum, even from frequent switching of operating and short-circuit currents.

The servicing intervals and scope are determined by environmental influences, the switching sequences and number of short-circuit breaking operations.

Note

The following must be observed for all maintenance work:

- The relevant specifications in section “Standards and specifications”
- Notes on safety at work in section “Commissioning / Operation”
- Standards and specifications in the country of installation

Maintenance work may only be performed by fully trained personnel, observing all the relevant safety regulations. It is recommended that ABB after-sales service personnel should be called in, at least during the performance of servicing and repair work.

While the work is in progress, all supply voltage sources must also be disconnected and secured to prevent reconnection.

Note

In order to prevent accidents (particularly injury to hands!) extreme care should be taken during all repair work on the operating mechanism, especially with front plate removed.

The spiral spring in the spring energy storage mechanism, for instance, retains a basic tension which is independent of the charging and discharging processes during switching, so as to ensure correct function. This spring energy can be inadvertently released if work is performed incorrectly on the spring mechanism!

5.1.1 Service-life

Typical life-expectancies for VD4X circuit-breakers.

Vacuum interrupter

Up to 30,000 switching cycles (see section “Permissible numbers of switching cycles” page 9)

Device

Up to 30,000 operating cycles, depending on switch type and assuming conscientiously performed inspection and maintenance work and normal operating conditions.

5.2 Inspection and functional testing

5.2.1 Switching devices in general

- The proper condition of the switching device is to be verified by regular inspection
- Inspection at fixed intervals may be waived if the switchgear is permanently monitored by a qualified personnel
- The checks first and foremost comprise visual examination for contamination, corrosion and moisture
- In unusual operating conditions (including adverse climatic conditions) and/or special environmental pollutions (e.g. heavy contamination and aggressive atmosphere), inspection may also be necessary at shorter intervals
- If an incorrect condition is found, appropriate servicing measures are to be initiated

5.2.2 Stored-energy spring mechanism
Functional testing of the operating mechanism is to be performed:
- after 5,000 operating cycles or
- during servicing work as set out in section "Inspection, switching devices in general"

Prior to functional testing, switch the breaker off and isolate the outgoing feeder.

Note
Isolate and secure the working area in accordance with the safety regulations specified by DIN VDE/IEC.

Scope of functional testing
- Perform several switching operations under no-load, above all with circuit-breakers seldom operated in normal service
- Switch off the charging motor (if fitted) and discharge the spring energy storage mechanism by ON/OFF switching operations
- Examine visual the condition of the lubrication on rotary bearings, sliding surfaces, etc
- Check the proper mechanical/electrical sequence of the individual functions

5.2.3 Breaker pole
No inspection of the breaker pole above and beyond the stipulations of section "Inspection, switching devices in general" is necessary.

5.3 Servicing

5.3.1 Switching devices in general
All parts which are located within the gas compartment and are therefore inaccessible require no maintenance.

5.3.2 Stored-energy spring mechanism
Servicing of the operating mechanism is to be performed after 10,000 operating cycles.

Prior to servicing, open the circuit-breaker, isolate and secure the outgoing feeder to prevent reconnection.

Scope of servicing
- Switch off the charging motor and release the spring energy storage mechanism by closing and opening the breaker
- As a precaution, replace parts subject to high climatic and mechanical stresses

- For replacement of highly stressed parts, release the pretension of the spiral spring, noting the pretensioning dimension. Take care when handling springs
- Relubricate pawls, support shafts, sliding and rotating bearing surfaces. Lubricant: Isoflex Topas NB 52
- Check the fit of fasteners (e.g. locking pins) in cranks, pins, bolts etc. Check the tightness of fastening bolts
- Always replace any spring lock washers, split pins and other fasteners removed during the work with new parts when reassembling the equipment
- Check the general condition of the operating mechanism and recharge the spring to the pre-tensioning dimension noted
- Perform comprehensive mechanical and electrical functional tests (Observe the setting instructions)

Note
Above mentioned work may only be performed by servicing personnel from ABB or adequately trained specialist staff.

5.3.3 Breaker pole
The breaker pole with the vacuum interrupter is maintenance-free up to the permissible number of operating cycles as sent down in section "Permissible number of vacuum interrupter switching operations":
- When the permissible number of operating cycles as a function of the breaking current has been reached, the vacuum interrupters are to be replaced (see section 2.3)

Note
The above activities may only be performed by servicing personnel from ABB or adequately trained specialist staff, as they require work on the circuit-breaker itself.

5.4 Repair

5.4.1 Run-on block
Should irregularities occur in the area of the internal control mechanism and the charging function of the spring energy storage mechanism, a run-on block blocks the next closing operation in sequence.

This is a protective function to prevent damage to the circuit-breaker.

Release of the run-on block may only be performed by servicing personnel from ABB or adequately trained specialist stuff.

5.4.2 Replacement of circuit-breaker parts and ac cessories

- Only remove and reassemble circuit-breaker parts and accessories when the breaker has been switched off and the working area properly isolated and secured to prevent reconnection. The spring energy storage mechanism must be discharged
- All supply voltage sources must be disconnected and secured to prevent reconnection during the removal and installation work
- Connecting and adjusting elements 18 and 18.1 to 18.4 (see Figure 3/1) must be removed, inter alia, prior to removal of the circuit-breaker operating mechanism
- Only use original parts when replacing defective components

5.5 Spare parts and auxiliary materials

5.5.1 Auxiliary materials

Lubricant	Part-no. (order code)
Isoflex Topas NB 52	GCE0007249P0100

5.5.2 Spare parts

Designation	Item no.	Rated supply voltage
Rotational auxiliary switch on mechanism	-BB0	
Auxiliary switch on blocking magnet	-S2	
1 st shunt release OFF	-Y2	24 V … 240 V DC 110 V … 240 V AC
2nd shunt release OFF	-Y9	24 V … 240 V AC
Shunt release ON	-Y3	24 V … 240 V AC
Blocking magnet	-Y1	24 V … 240 V DC
Undervoltage release	-Y4	24 V … 220 V DC
Delayed undervoltage release	-Y7	
Indirect overcurrent release with intemediate		
Intermediate current transformer for indirect overcurrent release		
Magnet holder, complete (with integrated rectifiers -V1, -V2, -V3, -V9)		
Rectifier	-V4 / -V7	110 V … 240 V DC
Charging motor (with gearing)	-M0	110 V … 240 V AC

Application of the X-ray regulations

One of the physical properties of vacuum insulation is the possibility of X-ray emissions when the contact gap is open. The specified test performed by the Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig demonstrates that the local dosage output of 1 µSv/h at a distance of 10 cm from the touchable surface is not exceeded when the rated voltage is applied.

The results are as follows

- Testing of the switching device or the vacuum interrupter to VDE 0671 part 100 or IEC 62271-100 at the relevant rated power frequency withstand voltage may only be performed by trained personnel observing the stipulations of the EU basic standard (Stipulation 96/29/Euratom of the senate from 13 May 1996 (ABI.L 159 from 29 June 1996))
- Application of the rated voltage specified for the switching device by VDE 0671 part 100 or IEC 62271-100 is completely safe
- Higher voltages than the rated voltage or DC test voltage specified in VDE or IEC standards must not be applied
- The containment of the above mentioned local dosage output with the vacuum interrupter in the open position is dependent on maintenance of the specified distance between the contacts (which is automatically ensured with correct mechanism function and force transmission)
- Safety clearances must be maintained

Comparison of designations to IEC 81346-1/IEC 81346-2, IEC 61346-1/IEC 61346-2 and VDE-DIN 40719 Part 2

Designation	IEC 81346-1/ IEC 81346-2	IEC 61346-1/ IEC 61346-2	VDE DIN 40719 Teil 2
Auxiliary switch on mechanism	-BGS1	-BS1	-S1
Auxiliary switch on block magnet -RLE1	-BGL1	-BL1	-S2
Auxiliary switch for push button interlocking	-BGL2	-BL2	-S2.1
Rotational auxiliary switch on mechanism	-BGB	–	–
Auxiliary switch on switch shaft	-BGB1	-BB1	-S3
Fleeting contact ≥ 35 ms for c.b. tripped indication	-BGB4	-BB4	-S7
Auxiliary switch on mechanical close push button	-BGB7	-BB7	-S10
Closing block magnet	-RLE1	-RL1	-Y1
1 st Shunt release OFF	-MBO1	-MO1	-Y2
Closing release	-MBC	-MC	-Y3
Undervoltage release	-MBU	-MU	-Y4
Indirect overcurrent release	-MBO3	-MO3	-Y7
2 nd Shunt release OFF	-MBO2	-MO2	-Y9
Series rectifier for -RLE1	-TB4	-TR4	-V1
Series rectifier for -MBO1	-TB1	-TR1	-V2
Series rectifier for -MBC	-TB3	-TR3	-V3
Series rectifier for -MBU	-TB6	-TR6	-V4
Series rectifier for -MBO3	-TB7	-TR7	-V7
Series rectifier for -MBO2	-TB2	-TR2	-V9
Charging motor	-MAS	-MS	-M0
Anti-pumping relay	-KFN	-KN	-K0
Series resistor	-RAR	-RR	-R0
Circuit-breaker	-QAB	-QB0	-Q0

Remarks

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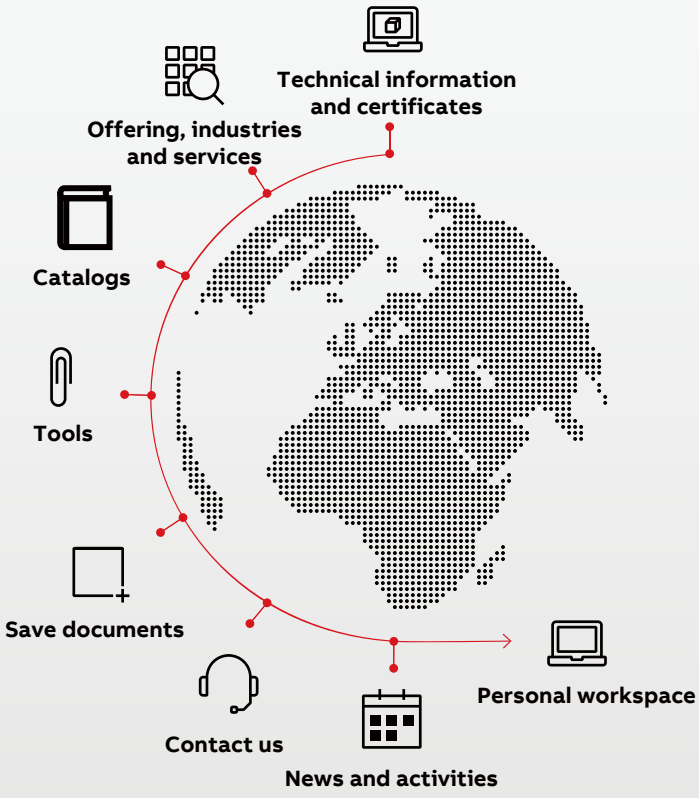

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