Medium voltage products

eVD4
Installation and service instructions
12 ... 17.5 kV - 630 ... 2500 A - 16 ... 40 kA

For your safety! 1

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Power and productivity
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For your safety!

- Make sure that the installation room (spaces, divisions and environment) is suitable for the electrical apparatus.
- Check that all the installation, putting into service and maintenance operations are carried out by qualified personnel with suitable knowledge of the apparatus.
- Make sure that the pertinent standards and laws are complied with during installation, putting into service and maintenance, so that the installations conform to the rules of good working practice and safety in the work pace.
- Strictly follow the information given in this instruction manual.
- Check that the rated performance of the apparatus is not exceeded during service.
- Check that the personnel operating the apparatus have this instruction manual to hand as well as the necessary information for correct intervention.
- Pay special attention to the danger notes indicated in the manual by the following symbol:

Responsible behaviour safeguards your own and others' safety!

For any requests, please contact the ABB Assistance Service.

I. Introduction

This publication contains the information needed to install medium voltage eVD4 circuit-breakers and put them into service.
For correct use of the product, please read it carefully.
Like all the apparatus we manufacture, the eVD4 circuit-breakers are designed for different installation configurations. However, this apparatus allows further technical-construction modifications (at the customer's request) to adapt to special installation requirements.
Consequently, the information given below may sometimes not contain instructions concerning special configurations. Apart from this manual, it is therefore always necessary to consult the latest technical documentation (electric circuit and wiring diagrams, assembly and installation drawings, any protection coordination studies, etc.), especially regarding any variants requested in relation to the standardised configurations.
Only use original spare parts for maintenance operations.
For further information, please also see the technical catalogue of the circuit-breaker and the spare parts catalogue.

All the installation, putting into service, running and maintenance operations must be carried out by skilled personnel with in-depth knowledge of the apparatus.

II. Environmental protection programme

The eVD4 circuit-breakers are manufactured in accordance with the ISO 14000 Standards (Guidelines for environmental management).
The production processes are carried out in compliance with the Standards for environmental protection in terms of reduction in energy consumption as well as in raw materials and production of waste materials.
All this is thanks to the environmental management system utilized in the facility where the medium voltage apparatus is manufactured.

1. Packing and transport

The circuit-breaker is shipped in special packing, in the open position and with the spring released.
Each piece of apparatus is protected by a plastic cover to prevent water from infiltrating during the loading and unloading stages and to keep the dust off during storage.

2. Checking on receipt

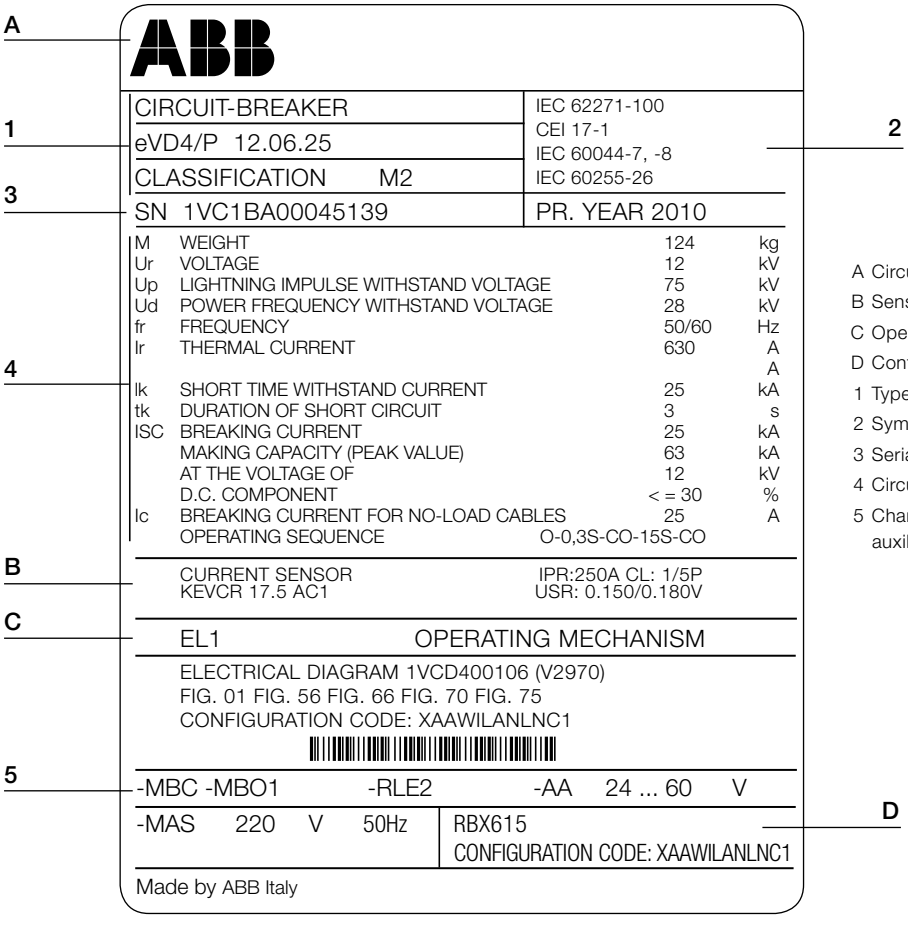
Before carrying out any operation, always make sure that the spring of the operating mechanism is released and that the apparatus is in the open position.

On receipt, immediate check the condition of the packing and the color of the “SHOCK WATCH” (fig. 1a) impact indicator..

Fig. 1a

When the “SHOCKWATCH” impact indicator is WHITE it means that the packing has not sustained any serious shock during transport. Open the packing, check the condition of the apparatus and correspondence of the nameplate data (see fig. 1b) with the data specified in the shipping note and in the order acknowledgement sent by ABB.

If the “SHOCKWATCH” impact indicator is RED, follow the instructions indicated on the plate.
Opening the packing does not damage its components, therefore it can be remade using the original material supplied.
Also make sure that all the materials described in the shipping note are included in the supply.
Should any damage or irregularity be noted in the supply on unpacking, notify ABB (directly or through the agent or supplier) as soon as possible and in any case within five days of receipt.
The apparatus is only supplied with the accessories specified at the time of ordering and validated in the order confirmation sent by ABB.
The accompanying documents included in the shipping packing are:
– instruction manual (this document)
– test certification
– identification label
– copy of the shipping documents
– electric wiring diagram.
Other documents which are sent prior to shipment of the apparatus are:
– order confirmation
– original shipping advice note
– any drawings or documents referring to special configurations/conditions.



A Circuit-breaker rating plate
B Sensor rating plate
C Operating mechanism rating plate
D Configuration code
1 Type of apparatus
2 Symbols of compliance with Standards
3 Serial number
4 Circuit-breaker characteristics
5 Characteristics of the operating mechanism auxiliaries

Fig. 1b

Meaning of the configuration code

The configuration code is a string of characters which briefly describes some of the circuit-breaker characteristics.
Each character represents an individual component or a characteristic.
The table below shows the rules for creating the configuration code. The configuration code is indicated on the rating plate (fig. 1).

Configuration code

Presence of I/O extension												
	NO	N										
	YES	X										
License level												
	Feeder 1		A									
	Feeder 2		B									
	Feeder 3		C									
	Motor 1		G									
	Motor 2		H									
	Full functionality		Z									
Communication module type												
	Two-channel Ethernet			A								
	Two-channel serial			B								
	Two-channel optic fibre			C								
	None			N								
CB type												
	Fixed				F							
	Withdrawable (manual truck)				W							
	Withdrawable (motorized truck)				M							
Rated current of sensors												
	Combisensor					C						
	Current sensor					I						
Voltage range												
	LV (48...60 V dc)						L					
	HV (110...250 V dc)						H					
Sensor type												
	K1 – 250 A							A				
	K2 – K3 – 500 A							B				
-RL1 presence												
	NO								N			
	Yes								L			
-RL2 presence												
	NO									N		
	Yes									L		
Auto-reclosing												
	NO										N	
	Yes										L	
Communication protocol												
	IEC61850+MODBUS											C
	IEC61850											A
	MODBUS											B
	MODBUS RTU											D
	DNP3											E
Language												
	English											1
	English & German											2
	English & Swedish											3
	English & Spanish											4
	English & Russian											5
	English & Portuguese (Brazilian)											6

3. Storage

When a period of storage is foreseen, our workshops can (on request) provide suitable packing for the specified storage conditions.
On receipt the apparatus must be carefully unpacked and checked as described in Checking on receipt (chap. 2).
If immediate installation is not possible, the apparatus must be packed again with the original material supplied.
Insert packets of special hygroscopic substances inside the packing, with at least one standard packet for piece of apparatus.

If immediate installation is not possible, store the apparatus in a covered, well-ventilated, dry, dust-free, non-corrosice place, well away from any easily flammable materials and at a temperature between -5 °C and +40 °C (for lower temperatures, please ask ABB).
Avoid accidental impact or positions that stress the structure of the apparatus.

4. Handling

Before carrying out any operations, always make sure that the operating mechanism spring is released and that the apparatus is in the open position.
To lift and handle the circuit-breaker, proceed as follows (fig. 2):
– use a special lifting tool (1) (not supplied) fitted with ropes with safety hooks (2);
– insert the hooks (2) in the supports (3) fixed to the frame of the circuit-breaker and lift. Put the hooks (2) into the support holes (3) according to the type of apparatus (see table);
– on completion of the operation (and in any case before putting into service) unhook the lifting tool (1) and dismantle the supports (3) from the frame.

During handling, take great care not to stress the insulating parts and the terminals of the circuit-breaker.

The apparatus must not be handled by putting lifting devices directly under the apparatus itself. Should it be necessary to use this technique, put the circuit-breaker onto a pallet or a sturdy supporting surface (see fig. 3).
In any case, it is always advisable to carry out lifting using the supports (3).

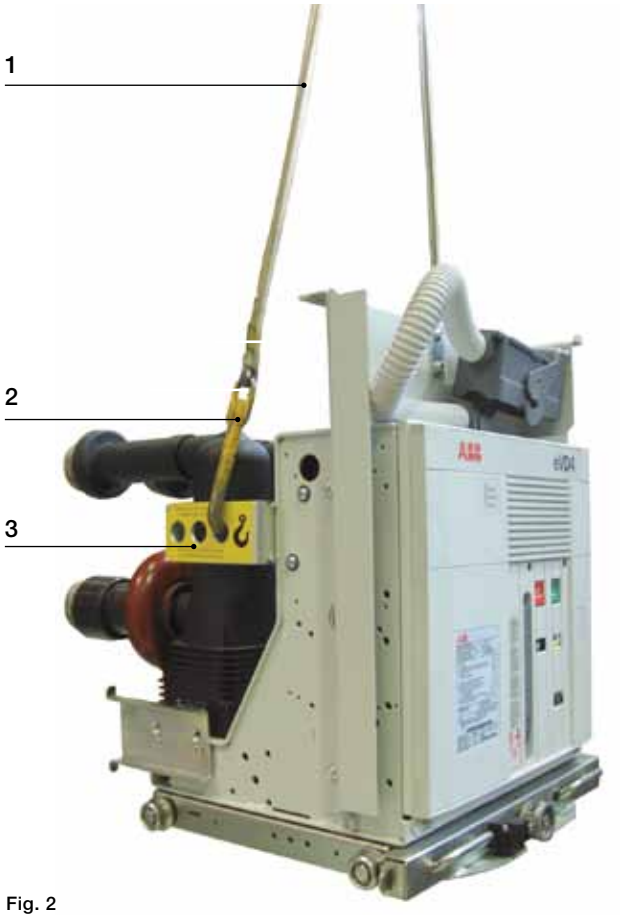
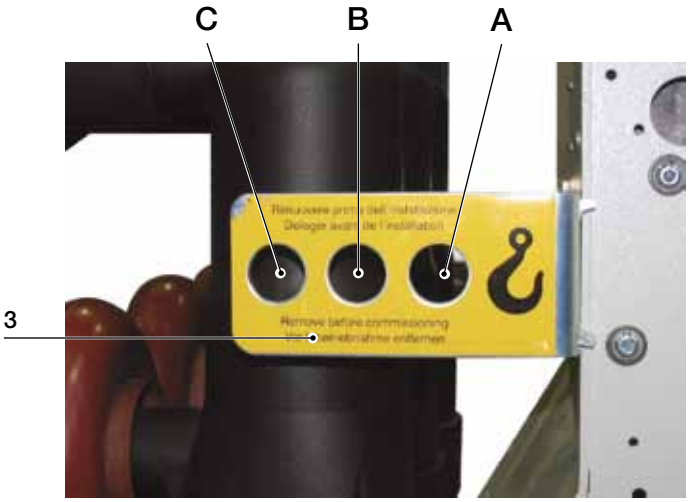


Fig. 2



Version	Pole centre distance	Rated current	Hole
Fixed	150-210 mm	up to 1250 A	A
Fixed	275 mm	from 1600 to 2500 A	A
Fixed	210 mm	from 1600 to 2000 A	A
Withdrawable	150 mm	up to 1250 A	A
Withdrawable	210 mm	from 1600 to 2000 A	B
Withdrawable	275 mm	up to 1250 A	B
Withdrawable	275 mm	from 1600 to 2500 A	C
Withdrawable	210 mm	up to 1250 A	C

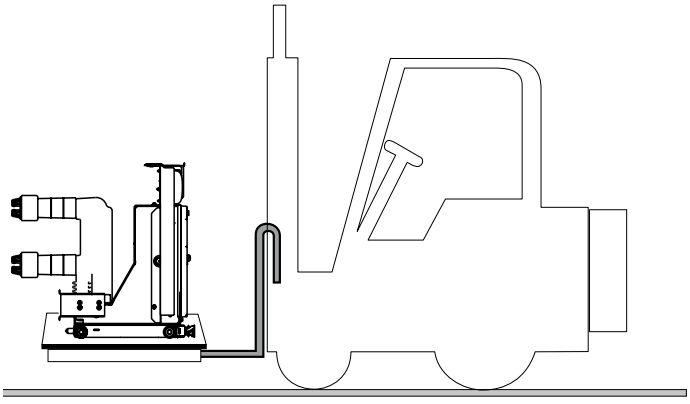


Fig. 3

5. Description

5.1. General

The eVD4 series of vacuum circuit-breakers are apparatus for indoor installation. For the electrical performances, please refer to the corresponding technical catalogue.
For special installation requirements, please contact ABB.
The following versions are available:
– fixed
– withdrawable for UniGear ZS1 switchgear and PowerCube units.

Vacuum circuit-breakers have particular advantages when used in systems with a high operation frequency and/or which involve a certain number of short-circuit interruptions. The eVD4 vacuum circuit-breakers comprise the circuit-breaker, sensor, protection and control functions in a single solution.
eVD4 circuit-breakers include an RBX615 relays and current and voltage sensors. The multi-function RBX615 unit is an Intelligent Electronic Device (IED), has a vast range of protection and control functions and makes the eVD4 a complete product, able to satisfy the needs of modern electric installations.
The “combisensor” version sensors allow simultaneous and precise measurements of both current and voltage. Integration of the multi-purpose electronics and of the sensors on board the circuit-breaker is done in the factory and is followed by a careful testing stage which allows the functionality of the whole system to be checked before the product is sold. These checks, together with the many self-diagnosis functions of the IED make the eVD4 stand out for their highly reliable operation and low maintenance required.
eVD4 vacuum circuit-breakers are derived from the VD4 series of which they possess the same reliability and sturdy construction.

5.2. Reference standards

The eVD4 vacuum circuit-breakers conform to the specifications of the following Standards:

– IEC 62271- 100	VDE 0670 part 1000
– IEC 62271-1	DIN VDE 0670 part 104
– IEC 61000-4	DIN VDE 0847 part 4
– IEC 60255-26	
– IEC 60044 -7 -8	

5.3. Composition

The eVD4 circuit-breaker is a system consisting of:
– vacuum circuit-breaker with mechanical stored energy and free release operating mechanism (5)
– RBX615 electronic unit to carry out the protection, control, measurement, monitoring and self-diagnosis functions (3)
– embedded sensors for current and voltage measurement (2)
– Human Machine Interface (HMI), allowing all the RBX615 functions to be managed from the low voltage compartment door.
– Web HMI, allowing most of the HMI functions to be used by means of
a web browser.

The actuator works on the circuit-breaker poles by means of special kinematics. The operating mechanism springs provide the energy needed to activate the driving gear.
The circuit-breaker operating position is monitored thanks to two inductive sensors
The basic circuit-breaker version also has the following instruments:
– manual device for loading the operating mechanism
– mechanical open/closed state indicator
– mechanical indicator of springs loaded
– mechanical operation counter
– opening and closing pushbuttons.

The withdrawable version has a truck (15), either manual or motorized, consisting of a steel sheet structure with wheels, on which the circuit-breaker is installed with the relative auxiliary components, the isolating contacts for electric connection with the switchgear and the multi-pole connector for connection of the circuit-breaker auxiliary circuits.
After being racked into the switchgear and hooked up, the withdrawable circuit-breaker functions in the following positions: racked-out, isolated for test (with the connector inserted) and racked-in.
The racked-in circuit-breaker is automatically earthed by means of the truck wheels.
The mechanical actuator of the circuit-breaker and the relative operating pushbuttons are accessible from the front.
Withdrawable circuit-breakers of the same type and characteristics are interchangeable, but the connector coding prevents incorrect combinations between circuit-breaker and switchgear.

5.3.1. Structure

Fixed circuit-breaker (fig. 4/a)
Withdrawable circuit-breaker (fig. 4/b).

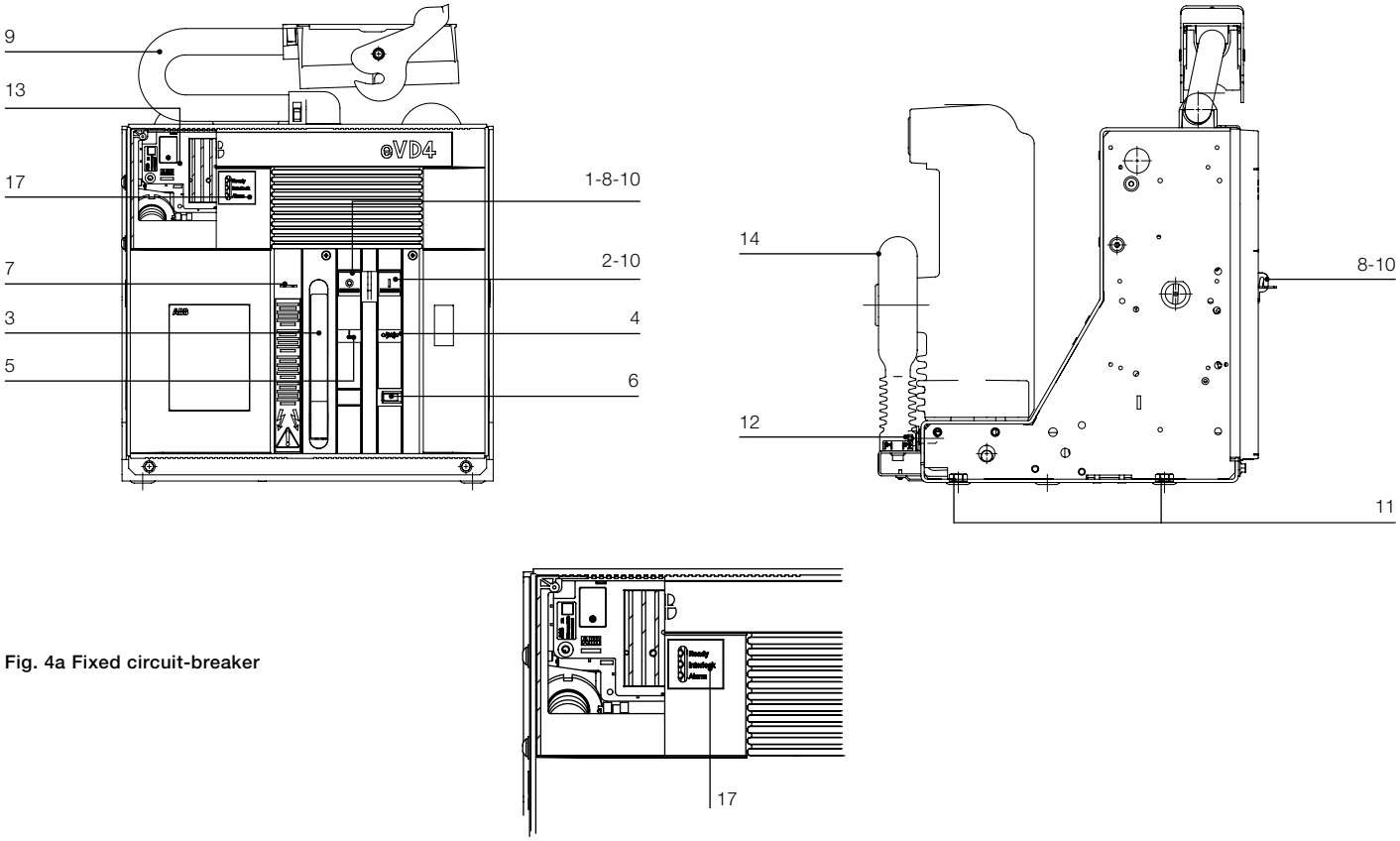


Fig. 4a Fixed circuit-breaker

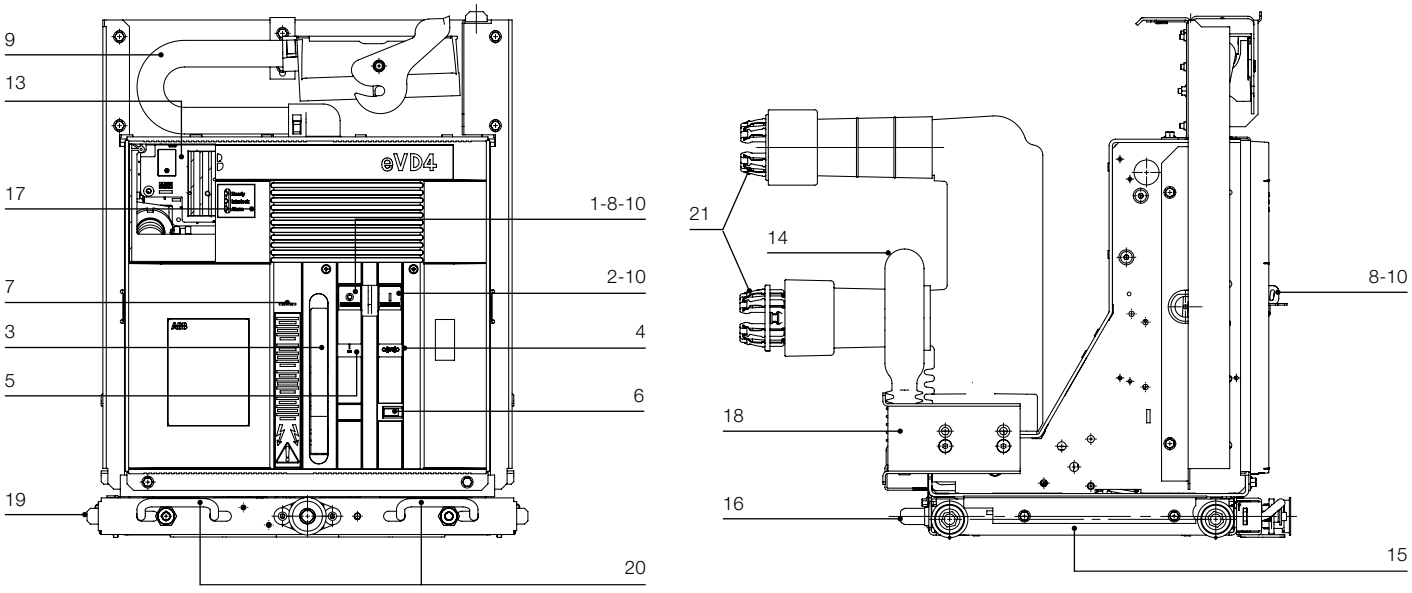


Fig. 4b Withdrawable circuit-breaker

1 Opening pushbutton
2 Closing pushbutton
3 Lever for manual closing spring loading
4 Signalling device for closing spring loaded (yellow) and released (white)
5 Signalling device for circuit-breaker open/closed
6 Operation counter
7 Key lock in the open position (on request)
8 Padlock in the open position (on request)
9 Connector (Plug)
10 Pushbutton protection (on request)
11 M12 fixing devices (250x400)
12 Earth terminal M12
13 Electronics
14 Current and voltage sensors
15 Motorized truck on request for UniGear panels
16 Centring pins
17 Signalling LED
18 Slides for operating the switchgear shutters
19 Locks for hooking into the fixed part
20 Handles for activating the locks (19)
21 Isolating contacts
22 Operating lever

5.3.2. Poles

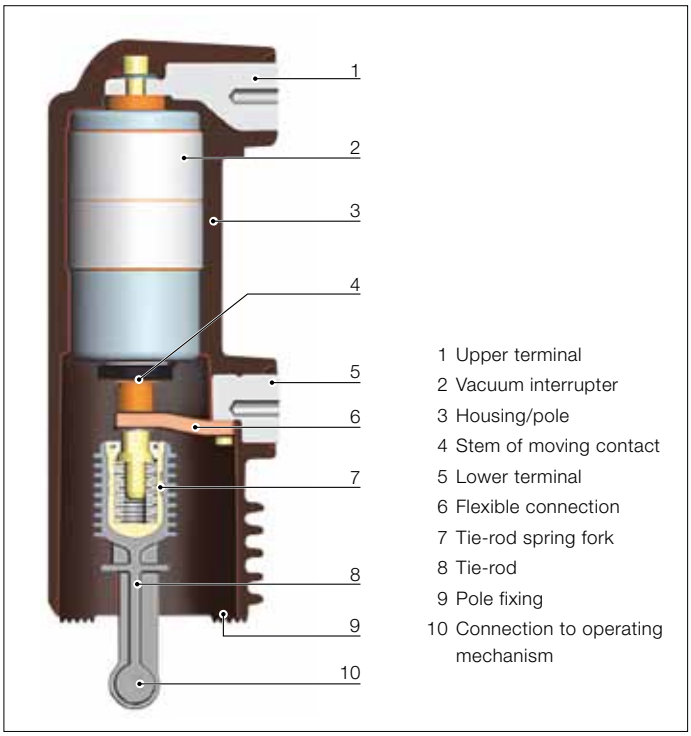
The eVD4 series vacuum circuit-breaker has poles with the vacuum interrupter embedded in resin or thermoplastic material. Embedding the interrupter makes the circuit-breaker poles particularly sturdy and protects the interrupter against shocks, dust deposits and humidity.
The vacuum interrupter houses the contacts and forms the interruption chamber.
The vacuum circuit-breaker does not require any interruption and insulating means. In fact, the interrupter does not contain ionisable material.
When the contacts separate, an electric arc formed only by fusion and vaporization of the contact material is generated in any case. The electric arc is sustained by the external energy until the current is nullified near its natural zero. At that instant, the sharp reduction in the density of the charge conveyed and rapid condensation of the metallic vapour very rapidly leads to the dielectric properties being restored.

Embedded pole with vacuum interrupter.

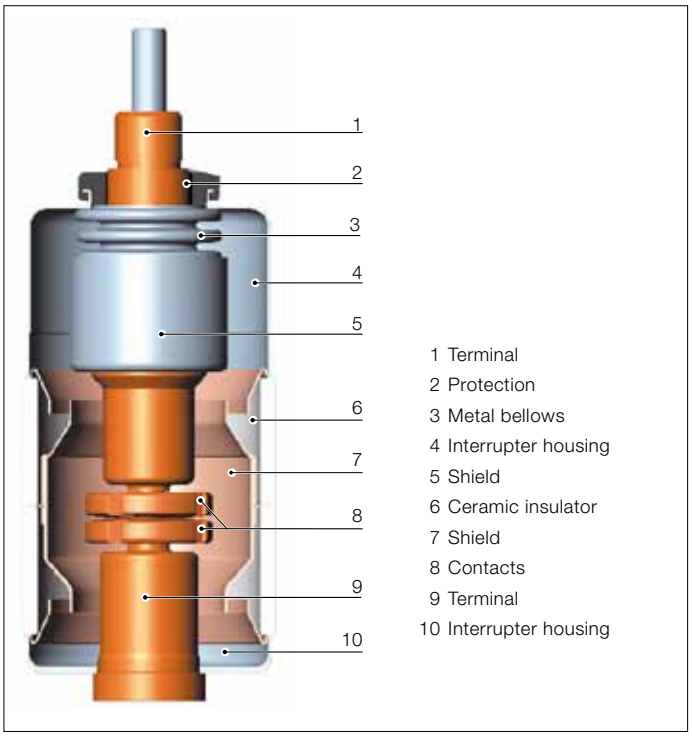
The vacuum interrupter therefore recovers its insulating capacity and the capacity to sustain the transient return voltage, definitively extinguishing the arc.
Since a high dielectric strength can be reached in the vacuum even with minimum distances, circuit breaking is guaranteed even when separation of the contacts takes place a few milliseconds before the current passes through natural zero.

The particular geometry of the contacts and of the material used, together with reduced duration of the arc and the low arcing voltage, ensure minimum contact wear and a long life. Moreover, the vacuum prevents their oxidation and contamination.

For the trip curves, see paragraph 7.2.3.



Vacuum interrupter embedded in the pole.



Vacuum interrupter.

5.3.3 Breaking principle

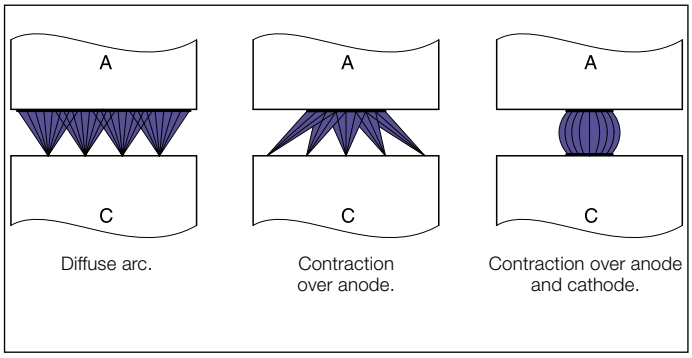
In a vacuum interrupter, the electric arc begins at the instant the contacts separate, persists until zero current is reached and can be influenced by the magnetic field.

Diffuse or contracted vacuum arc

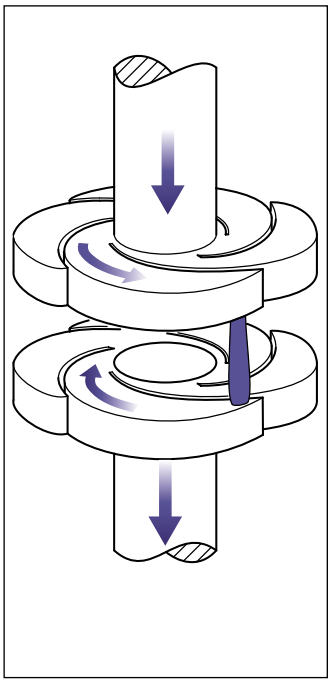
Individual points of fusion form on the surface of the cathode following separation of the contacts. This leads to formation of metallic vapours that support the arc itself.
The diffuse arc is characterized by expansion over the surface of the contact and by evenly distributed thermal stress.
The electric arc is always the diffuse type at the rated current value of the interrupter. There is very little erosion of the contact and a very high number of interruptions.
As the value of the interrupted current increases (beyond the rated value), the electric arc tends to change from diffuse to contracted owing to the Hall effect.
Starting from the anode, the arc contracts and tends to concentrate as the current increases. There is a temperature increase in the affected area, and the contact is therefore subjected to thermal stress.
To prevent the contacts from overheating and becoming eroded, the arc is kept rotating. By rotating, the arc resembles a moving conductor through which the current passes.

Spiral geometry of ABB interrupter contacts

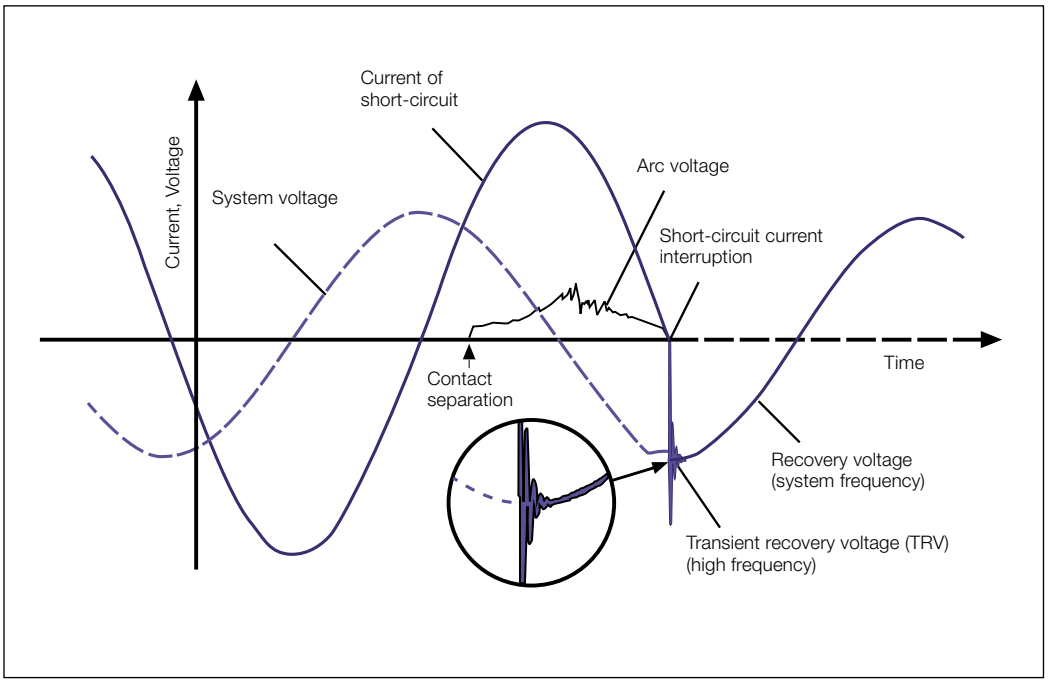
The special geometry of the spiral contacts generates a radial magnetic field in all areas of the arc column, concentrated over the contact circumferences.
An electromagnetic force is self-generated and this acts tangentially, causing rapid arc rotation around the contact axis.
This means the arc is forced to rotate and to involve a wider surface than that of a fixed contracted arc.
Apart from minimising thermal stress on the contacts, all this makes contact erosion negligible and, above all, allows the interruption process to be controlled even with very high short-circuits.
ABB vacuum interrupters are zero-current interrupters and are free of any re-striking.
Rapid reduction in the current charge and rapid condensation of the metal vapours simultaneously with the zero current, allows maximum dielectric strength to be restored between the interrupter contacts within a few microseconds.



Schematic diagram of the transition from a diffuse arc to a contracted arc in a vacuum interrupter.



Radial magnetic field contact arrangement with a rotating vacuum arc.



Development of current and voltage trends during a single phase vacuum interruption process.

Versions available

The eVD4 circuit-breakers are available in the fixed and withdrawable version with front operating mechanism.
The withdrawable version is available for UniGear ZS1 switchgear and PowerCube units.

Fields of application

The eVD4 circuit-breakers are used in power distribution for control and protection of cables, overhead lines, transformer and distribution substations, motors, transformers, generators and capacitor banks.

Standards

The eVD4 circuit-breakers comply with the IEC 62271-100, VDE 0671-part.100, CEI17-1-file 1375 Standards and those of major industrialised countries.
The eVD4 circuit-breakers have undergone the tests indicated below and guarantee the safety and reliability of the apparatus in service in any installation.

- **Type tests:** heating, withstand insulation at power frequency, withstand insulation at lightning impulse, short-time and peak withstand current, mechanical life, short-circuit current making and breaking capacity and interruption of vacuum cables.
- **Individual tests:** insulation of the main circuits with voltage at power frequency, auxiliary circuit and operating mechanism insulation, measurement of the main circuit resistance, mechanical and electrical operation.

Service safety

Thanks to the complete range of mechanical and electrical locks (available on request), it is possible to construct safe distribution switchgear with the eVD4 circuit-breakers.
The locking devices have been designed to prevent incorrect operations and allow the installations to be inspected whilst guaranteeing maximum operator safety.
Key locks or padlocks enable opening and closing operations and/or racking in and racking out.
The racking-out device with the door closed only allows the circuit-breaker to be racked into or out of the switchgear only with the door closed.
Anti-racking-in locks prevent circuit-breakers with different rated currents from being racked in, and the racking-in operation with the circuit-breaker closed.

5.3.4 EL operating mechanism

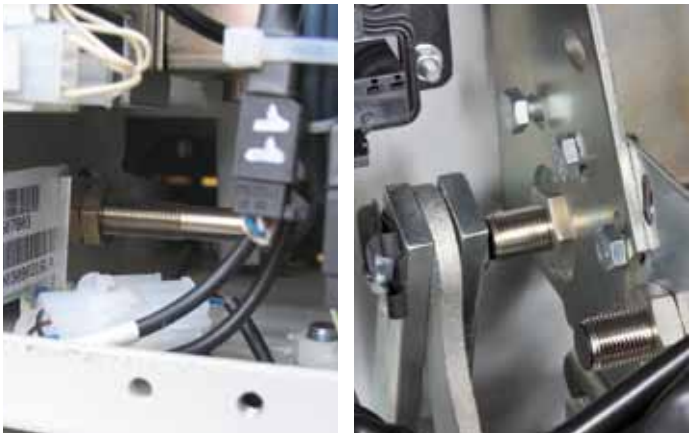
The eVD4 circuit-breakers are equipped with an EL spring operating mechanisms.
The EL operating mechanism is designed to cover the range of circuit-breakers indicated in the following table.

Type of operating mechanism	Breaking capacity
EL1 - EL2	up to 31.5 kA
EL3	up to 40 kA

The operating mechanism is of mechanical stored energy and free trip type. These characteristics allow opening and closing operations independent of the operator. The open/closed and springs loaded/released states are visible from the front of the circuit-breaker and are detected by the relay by means of inductive proximity sensors.
The operating mechanism is of very simple conception, characterised by few components and great reliability.
It can be customised with a wide range of accessories which are easy and rapid to install.

5.3.5. Position and springs loaded sensors

The use of two inductive position sensors allows the circuit-breaker state (open - closed – intermediate anomalous position) to be detected without using auxiliary contacts, allowing continuous monitoring of the system.
A further inductive sensor detects whether the spring is completely loaded.



Open-closed, spring loaded/released proximity sensors.

5.3.6. Current and voltage sensors

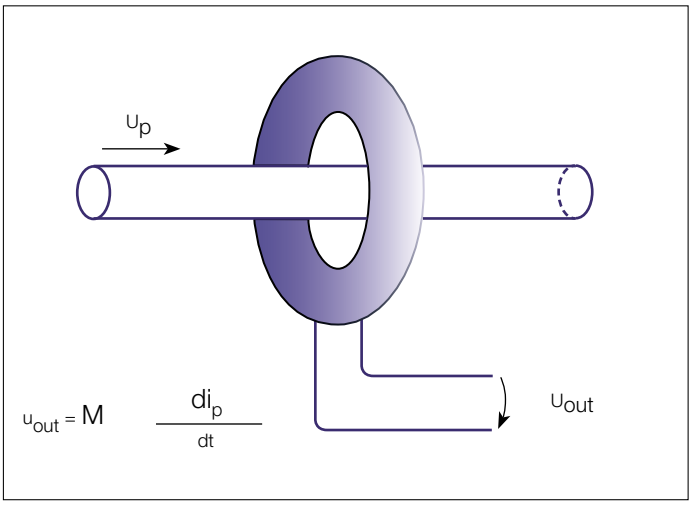
– Rogowski sensors: only for current measurement in the versions of eVD4 where voltage measurement is not required.
– Combisensor sensors: allow current and voltage measurement. Together with the Rogowski coil they integrate a capacitive divider for measuring the voltage applied to each pole.

This new generation of sensors is characterised by limited dimensions, better performance compared to traditional current and voltage transformers and a higher degree of standardization.

5.3.6.1 Rogowski coils

A uniform winding on a closed circular support with a constant cross section and without the ferromagnetic core. The voltage induced in the winding is directly proportional to the let-through current variation.

Combined current voltage sensor applied to the circuit-breaker poles.

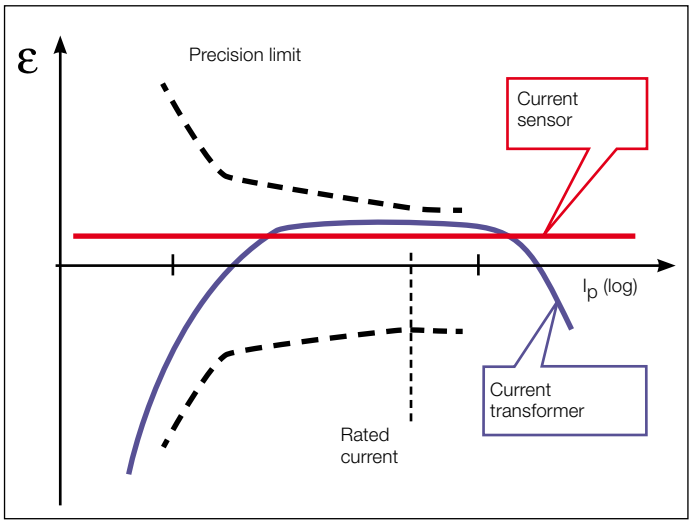


General diagram of the Rogowski coil (current sensor).

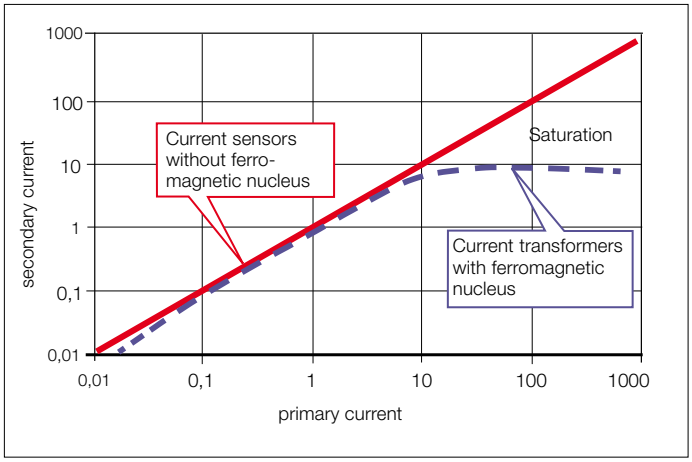
There are many advantages provided by using the Rogowski coil, among which are:

– absolute linearity of the output signal according to the one measured
– no saturation
– no currents magnetizing the metal nucleus, which is important at low values for the current transformers
– no hysteresis phenomena.

These characteristics allowed the eVD4 circuit-breaker to be designed with just three sensor sizes able to cover all rated current values from 50 to 2500 A, and to protect against short-circuits up to 40 kA.



Extent of error "ε"made by the current sensors and by traditional current transformers.

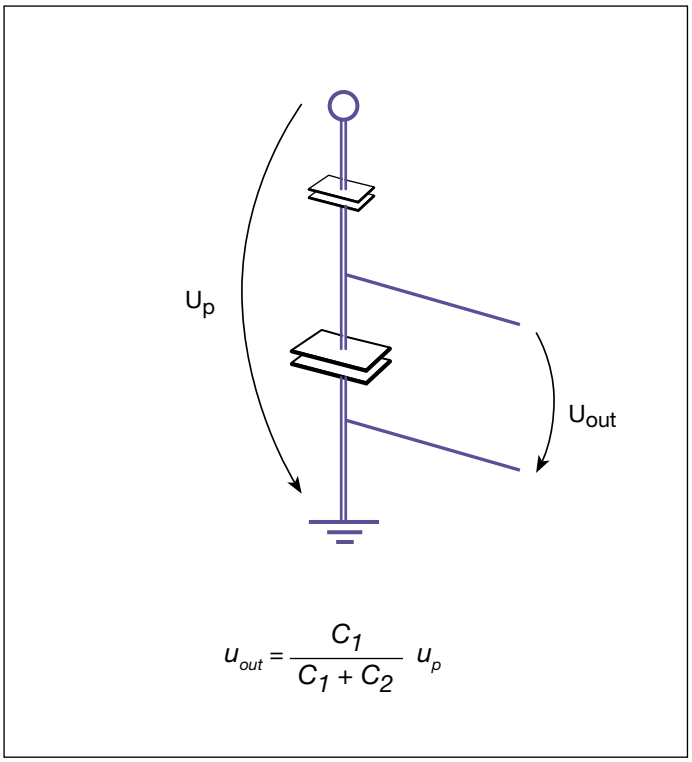


Response characteristic of the Rogowski coil compared with that of a current transformer.

The extent of error "ε" made by the Rogowski current sensors is constant and independent of the primary current value. This means the error can be eliminated with an appropriate characteristic correction factor of the sensor. Traditional current transformers have an error which depends on the primary current. For this reason, the error committed is not constant so cannot be corrected and, furthermore, takes on substantial values at the extremities of the primary current application range.
Since they are fully integrated and tested in the factory, the eVD4 circuit-breakers take advantage of this concept to obtain an excellent measurement performance. During production of each eVD4 the RBX615 is calibrated with the characteristic correction factors of the current and voltage sensors mounted on that particular circuit-breaker.

5.3.6.2 Capacitive divider

The capacitive element is made up of a cylindrical metal surface, facing the circuit-breaker bushing. The output signal is a voltage directly proportional to the primary voltage.
The voltage sensors are characterized by absence of any ferroresonance phenomena and their insensitivity to the effects of the direct components. A single divider covers the service range of voltages up to the rated voltage of the circuit-breaker.



General diagram of the capacitive divider (voltage sensor).

5.3.6.3 Types and characteristics of the sensors used in the eVD4 circuit-breaker

eVD4 circuit-breakers, which do not include voltage measurement, use KEVCR AC1 and KEVCR BC1 current sensors with rated currents of 1250, 2000 and 2500 A respectively.
KEVCR AA1 and KEVCR BA1 type sensors are used for the eVD4 with voltage measurement.

	Sensor		voltage	accuracy	voltage data	current	accuracy	current data
K1	COMBISENSOR	KEVCR 17.5 AA1	Kn 10000: 1	cl: 1/3P	Ku 1.9/8h	Ipr: 250A	cl: 1/5P	Usr: 0.150/0.180V
	CURRENT SENSOR	KEVCR 17.5 AC1	–	–	–	Ipr: 250A	cl: 1/5P	Usr: 0.150/0.180V
K2	COMBISENSOR	KEVCR 17.5 BA1	Kn 10000: 1	cl: 1/3P	Ku 1.9/8h	Ipr: 500A	cl: 1/5P	Usr: 0.150/0.180V
	CURRENT SENSOR	KEVCR 17.5 BC1	–	–	–	Ipr: 500A	cl: 1/5P	Usr: 0.150/0.180V
K3	COMBISENSOR	KEVCR 17.5 CA1	Kn 10000: 1	cl: 1/3P	Ku 1.9/8h	Ipr: 500A	cl: 1/5P	Usr: 0.150/0.180V
	CURRENT SENSOR	KEVCR 17.5 CC1	–	–	–	Ipr: 500A	cl: 1/5P	Usr: 0.150/0.180V

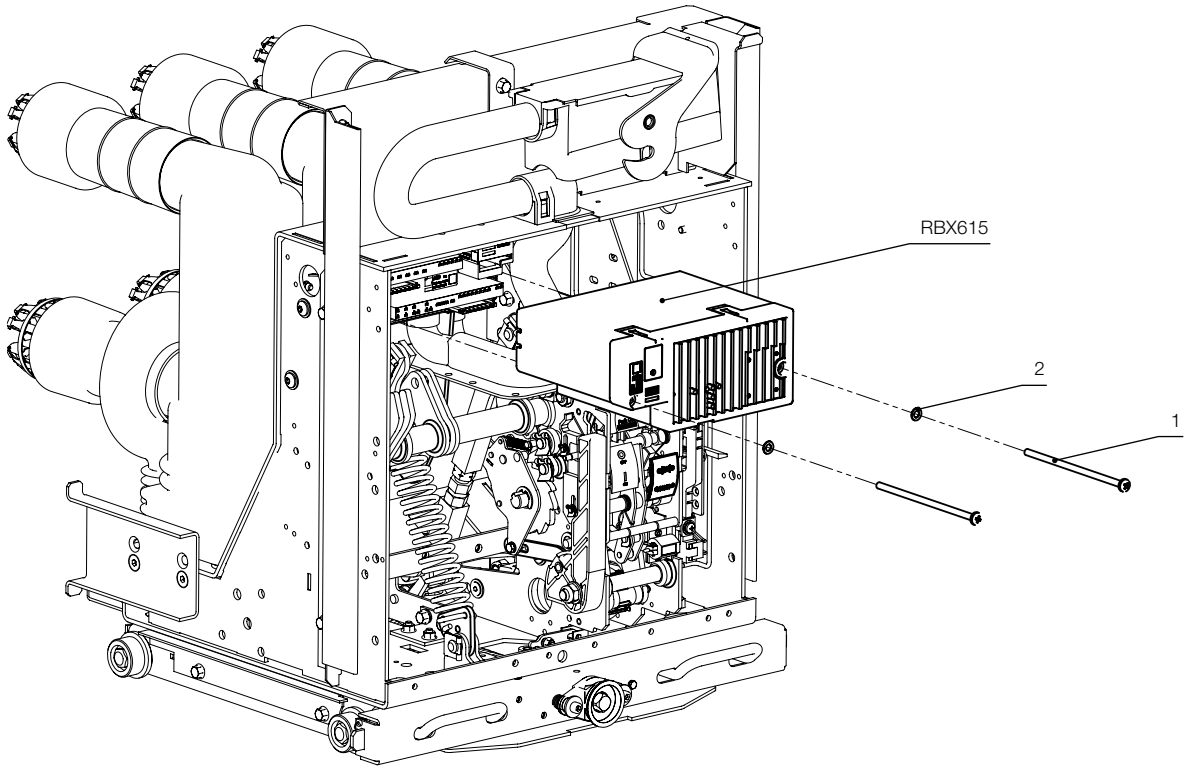
5.3.7 RVX615 protection and control unit

RBX615 is a line protection relay dedicated to protection, measurement and monitoring of utility substations and industrial electrical systems.
The new protection relay has been designed to implement the whole potential of the IEC 61850 Standard on the subject of communication and interoperability of the automation devices for substations.
The RBX615 relay guarantees general protection of overhead lines, cable lines and busbar systems of distribution substations and adapts to any radial distribution network regardless of the earthing principle.
To dismantle it, after having removed the front screen, simply unscrew the screws in pos. 1 and extract the device.
To assemble it, insert the device making sure that it couples correctly and fully into the fixed part and tighten the screws (1) complete with spring washers (2) applying a tightening torque of 1.5 N/m.

N.B. Before carrying out this operation, make sure that the circuit-breaker is open with the springs released, and disconnected from the main circuit and from the auxiliary power supply.

5.3.7.1 Protection and control

The RBX615 relay offers protection against short-circuit, directional and non-directional protection, overcurrent protection with definite delay trip and protection against thermal overload.
It also has a directional and non-directional earth fault protection, a protection against sensitive earth fault (SEF) and a protection against earth fault with measurement of the transients, including detection of intermittent earth faults in wired networks, as well as an overvoltage and undervoltage protection.
Finally, the relay includes a flexible automatic multiple reclosing function to eliminate faults due to an arc on overhead lines.
Apart from the series of line protections, the RBX615 relay offers protection for motors against phase reversal and thermal overload, monitoring of the number of start-ups and of rotor block.
The RBX615 relay includes basic functions which make control of a circuit-breaker easier by means of the relay HMI or a remote control system. To protect the relay against access by unauthorized people and to maintain the integrity of information, the relay is provided with a user authentication system based on four-level role, with individual passwords for the inspector, operator, technician and administrator levels.
Access control applies to the front of the HMI (Human Machine Interface), to the HMI based on the web browser and to the configuration and setting tool for relay PCM600.



5.3.7.2 Standardized communication

The RBX615 unit supports the new IEC 61850 communication Standard regarding devices in substations.
It also supports standard industrial protocols such as Modbus® TCP/IP and RTU.
Implementation of the IEC 61850 communication Standard for substations in the RBX615 unit, includes both vertical communication (towards the substation network) and horizontal communication (between the switchgear relays), among which are communication by means of GOOSE messaging and parameter setting according to the IEC 61850-8-1 Standard.

5.3.7.3 Virtual GOOSE wiring for interlock

Implementation of the IEC 61850 Standard in the RBX615 relay also includes rapid horizontal relay-relay communication by means of the station bus. By using GOOSE communication (Generic Object Oriented Substation Event), the RBX615 relay of the incoming and outgoing lines of a substation operates in synergy so as to form a stable, reliable and high speed protection system. Protection based on GOOSE communication is obtained simply by configuring the relays. The operating availability of the protection is guaranteed by constant monitoring of the protection relays and their GOOSE communication by means of the station bus. Separate physical wiring is not required for horizontal communication among the switchgear units.

5.3.7.4 Preventive status monitoring

To guarantee operative availability of the protection, the RBX615 relay includes a wide range of monitoring functions to supervise the hardware and software, communication, the circuit-breaker trip circuit and the circuit-breaker itself. Depending on the configuration selected, the relay monitors the state of wear of the circuit-breaker and the time for loading the circuit-breaker operating mechanism springs. The relay also measures the operation time and counts the number of circuit-breaker operations, therefore collecting the basic information to program suitable maintenance.

5.3.7.5 Rapid configuration and putting into service

Thanks to the standard pre-configurations available, the RBX615 unit can be configured and put into service extremely rapidly once the specific application settings have been defined.
The standard pre-configurations are easily customisable by means of the PCM600 ACT (Application Configuration Tool) software, by means of which the user can create complex logics according to the specific substation requirements. The high degree of flexibility and configurability of the protection and control unit makes the eVD4 circuit-breaker very versatile and suitable for all types of use.

Plug of the circuit-breaker auxiliary circuits and for RBX615 unit communication towards the switchgear.

5.3.7.6 Distinctive features of the RBX615 relay

– Protection against earth fault and of the directional and non-directional phase, protection against sensitive earth fault and protection against earth fault with measurement of the transients, also effective against intermittent earth faults on wired lines
– Full specific protection of motors
– Series of voltage protections
– Connectivity of the device and interoperability of the system according to the IEC 61850 Standard for communication between substations
– Thanks to the GOOSE communication, physical copper wiring among the switchgear units is not necessary to obtain a high speed interlock
– More powerful functionality of the oscilloperturbograph. High sampling frequency, increased quantity of recordings, analogue and binary channels and flexible activation principle.
– A single device for setting the relay, configuring the signals and managing the fault recorder.

5.3.7.7 Binary inputs and outputs

Thanks to an optional digital I/O card, the RBX615 unit provides a total of 10 binary inputs and 6 binary outputs that can be, freely programmed by the user, plus a further 7 inputs and 6 outputs assigned to predefined functions.

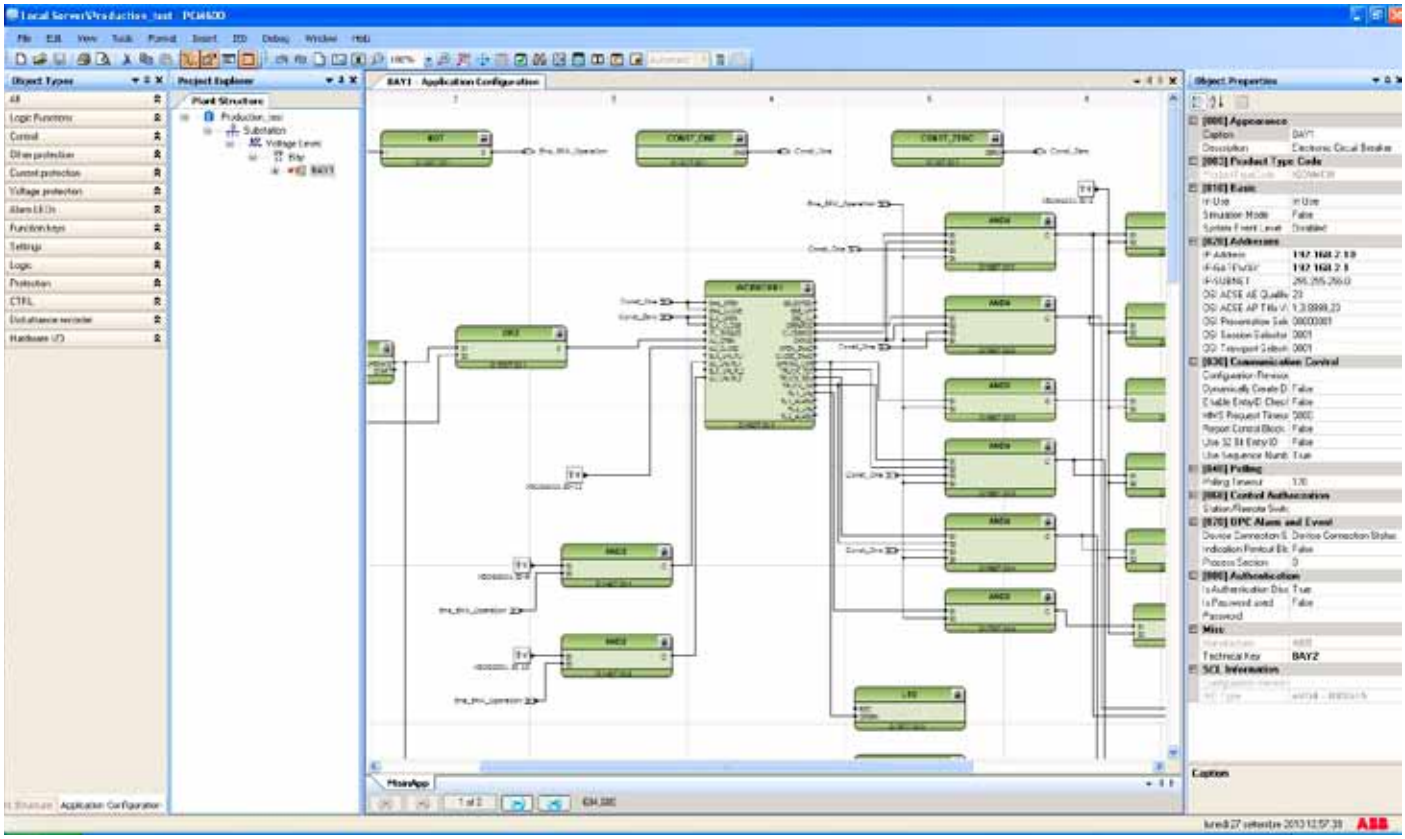
The binary inputs and outputs of the relay are available in the low voltage compartment of the switchgear by means of the circuit-breaker plug-socket contacts.
eVD4 makes three communication modules:
– Ethernet RJ45 electrical communication
– RS485 serial electrical communication
– Ethernet LC optical communication.
The module is available with single and double door, which allows a physical communication redundancy to be made.
The communication ports are available in the low voltage compartment of the switchgear by means of the appropriate circuit-breaker plug connectors.
The Ethernet port available on the front of the LHMI allows a point-to-point connection to be made between a PC and the RBX615 multi-purpose unit.
This port allows use of the WHMI (Web Human Machine Interface) and full control of the RBX615 unit by means of the PCM600 configurator.

5.3.7.8 Auxiliary power supply

Type LV: 48-60 V d.c.
Type HV: 110-250 V d.c.

5.3.7.9 Additional devices

PCM600 ver. 2.3 or higher for setting, signal configuration and recorder management.
User interface based on the web browser (IE 7.0 or higher).



PCM600 and the Application Configuration Tool.

5.3.7.10. Characteristics and configuration settings of the relay

Standard Pre-configurations

The RBX615 protection and control unit is available with five alternative pre-configurations.

Description	Configuration
Non-directional overcurrent protection and non-directional earth fault protection	Feeder 1 (F1)
Non-directional overcurrent protection and directional earth fault protection based on measurement of the phase voltages	Feeder 2 (F2)
Directional overcurrent protection, directional earth fault protection based on measurement of the phase voltages and undervoltage and overvoltage protection	Feeder 3 (F3)
Motor protections based on measurement of the currents	Motor 1 (M1)
Motor protections based on measurement of the current and voltages	Motor 2 (M2)

Functions	IEC 61850	IEC 60617	IEC - ANSI	Pre-configurations				
				F1	F2	F3	M1	M2
Performance								
Three-phase overcurrent, non-directional, first threshold	PHLPTOC1	3I> (1)	51P-1 (1)	•	•	-	•	•
Three-phase overcurrent, non-directional, second threshold	PHHPTOC1	3I>> (1)	51P-2 (1)	•	•	-	-	-
	PHHPTOC2	3I>> (2)	51P-2 (2)	•	•	-	-	-
Three-phase overcurrent, non-directional, third threshold	PHLPTOC1	3I>>> (1)	50P/51P (1)	•	•	•	•	•
Three-phase overcurrent, directional, first threshold	DPHLPDOC1	3I> → (1)	67-1 (1)	-	-	•	-	-
	DPHLPDOC2	3I> → (2)	67-1 (2)	-	-	•	-	-
Three-phase overcurrent, directional, second threshold	DPHHPDOC1	3I>> →	67-2	-	-	•	-	-
Earth fault, non-directional, first threshold	EFLPTOC1	I0> (1)	51N-1 (1)	•	-	-	•	-
	EFLPTOC2	I0> (2)	51N-1 (2)	•	-	-	-	-
Earth fault, non-directional, second threshold	EFHPTOC1	I0>> (1)	51N-2 (1)	•	•	•	•	•
Earth fault, non-directional, third threshold	EFIPTOC1	I0>>> (1)	50N/51N (1)	•	-	-	-	-
Earth fault, directional, first threshold	DEFLPDEF1	I0> → (1)	67N-1 (1)	-	•	•	-	•
	DEFLPDEF2	I0> → (2)	67N-1 (2)	-	•	•	-	-
Earth fault, directional, second threshold	DEFHPDEF1	I0>> →	67N-2	-	•	•	-	-
Protection against reverse sequence overcurrent	NSPTOC1	I2> (1)	46 (1)	•	•	•	•	•
	NSPTOC2	I2> (2)	46 (2)	•	•	•	•	•
Protection against phase discontinuity	PDNSPTOC1	I2/I1	46PD	•	•	•	-	-
Residual overvoltage	ROVPTOV1	U0> (1)	59G (1)	-	•	•	-	-
	ROVPTOV2	U0> (2)	59G (2)	-	•	•	-	-
	ROVPTOV3	U0> (3)	59G (3)	-	•	•	-	-
Three-phase undervoltage	PHPTUV1	3U< (1)	27 (1)	-	-	•	-	•
	PHPTUV2	3U< (2)	27 (2)	-	-	•	-	-
	PHPTUV3	3U< (3)	27 (3)	-	-	•	-	-
Three-phase overvoltage	PHPTOV1	3U> (1)	59 (1)	-	-	•	-	-
	PHPTOV2	3U> (2)	59 (2)	-	-	•	-	-
	PHPTOV3	3U> (3)	59 (3)	-	-	•	-	-
Protection against three-phase positive sequence undervoltage	PSPTUV1	U1<	47U+	-	-	•	-	•
Protection against three-phase negative sequence undervoltage	NSPTOV1	U2>	47O-	-	-	•	-	•
Three-phase thermal line, cable and distribution transformer overload	T1PTTR1	3Ith>F	49F	•	•	•	-	-
Protection against reverse sequence overcurrent for motors	MNSPTOC1	I2>M (1)	46M (1)	-	-	-	•	•
	MNSPTOC2	I2>M (2)	46M (2)	-	-	-	•	•
Protection against under-power	LOFLPTUC1	3I<	37	-	-	-	•	•
Rotor block	JAMPTOC1	Ist>	51LR	-	-	-	•	•
Motor start-up	STTPMSU1	Is2t n<	49.66.48.51LR	-	-	-	•	•
Protection against phase reversal	PREVPTOC	I2>>	46R	-	-	-	•	•
Protection against three-phase thermal overload, for motors	MPTTR1	3Ith>M	49M	-	-	-	•	•
Circuit-breaker fault	CCBRBRF1	3I>/I0>BF	51BF/51NBF	•	•	•	•	•
Three-phase inrush current detector	INRPHAR1	3I2f>	68	•	•	•	-	-
Trip management	TRPPTRC1	Master Trip (1)	94/86 (1)	•	•	•	•	•
	TRPPTRC2	Master Trip (2)	94/86 (2)	•	•	•	•	•

• available
○ on request

Functions	IEC 61850	IEC 60617	IEC - ANSI	Pre-configurations				
				F1	F2	F3	M1	M2
Control								
Fixed circuit-breaker control	FCBXCBR1	I ↔ O CB	I ↔ O CB	•	•	•	•	•
Withdrawable circuit-breaker control	WCBXCBR1	I ↔ O CB	I ↔ O CB	•	•	•	•	•
Earthing switch state signalling	ESSXSWI1	I ↔ O ES	I ↔ O ES	•	•	•	•	•
Earthing switch control	MESXSWI1	I ↔ O ES	I ↔ O ES	•	•	•	•	•
Truck control	TRXSWI	I ↔ O DC	I ↔ O DC	•	•	•	•	•
Control of H bridges	HBGAPC1	HBC	HBC	•	•	•	•	•
	HBGAPC2	HBC	HBC	•	•	•	•	•
Emergency starting	ESMGAPC1	ESTART	ESTART	•	•	•	•	•
Auto-reclosing	DARREC1	I ↔ O	79	○	○	○	-	-
Supervision and monitoring								
Monitoring of the circuit-breaker conditions	SSCBR1	CBCM	CBCM	•	•	•	•	•
Supervision of the state of the shunt opening release	OCSSCBR1	TCS (Open)	TCM (Open)	•	•	•	•	•
Supervision of the state of the shunt closing release	CCSSCBR1	TCS (Close)	TCM (Close)	•	•	•	•	•
Monitoring of fuse fault	SEQRFUF1	FUSEF	60	-	-	•	-	•
Counter of the overall duration of starting	MDSOPT1	OPTS	OPTM	-	-	-	•	•
Measurement								
Disturbance recorder	RDRE1	-	-	•	•	•	•	•
Measurement of three-phase currents	CMMXU1	3I	3I	•	•	•	•	•
Measurement of current sequence	CSMSQI1	I1, I2, I0	I1, I2, I0	•	•	•	•	•
Measurement of homopolar current	RESCMMXU1	I0	In	•	•	•	•	•
Measurement of three-phase voltages	VVMUX1	3U	3U	-	•	•	-	•
Measurement of homopolar voltage	RESVMMXU1	U0	Vn	-	•	•	-	•
Measurement of voltage sequences	VSMSQI1	U1, U2, U0	U1, U2, U0	-	•	•	-	•
Measurement of three-phase energy and power	PEMMXU1	P.E	P.E	-	•	•	-	•
Temperature sensor	VDSTMP	VDTS	VDTM	-	•	•	-	•

• available
○ on request

5.3.7.11. LHMI (Local Human Machine Interface)

The LHMI (to be installed in the low voltage compartment) allows configuration, monitoring and control of the RBX615. The LHMI of the IED contains the following parts:

– Display
– Pushbuttons
– LED indicators
– Communication port
– USB port (reserved for Service)
– Housing for SD memory (reserved for future applications)
– Wireless adapter (reserved for future applications)

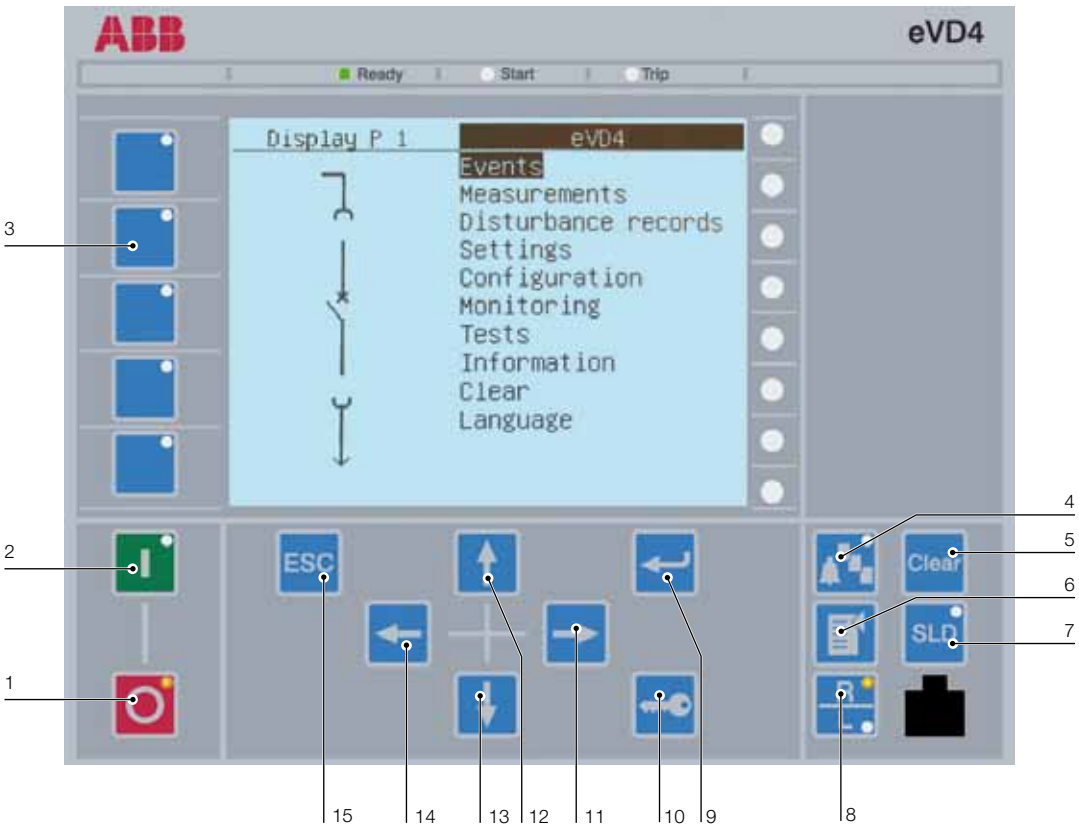
5.3.7.12. LCD Display

The local HMI locale (LHMI) includes a graphic display which supports two character sizes according to the language selected. The number of characters and lines displayed depends on the size of the character.

5.3.7.13. Keyboard

The LHMI keyboard includes a set of buttons allowing the operator to browse the various different menus so as to display the measurements and alarms, and configure the parameters. By means of the buttons, it is also possible to give an opening or closing command to the eVD4, reset the alarm indications and switch between the remote or local control modes.

Local Human Machine Interface



1 Opening
2 Closing
3 Function/application keys
4 LED page key
5 Delete
6 Menu
7 Single Line diagram
8 Local/Remote
9 Confirm
10 Password
11 Right
12 Up
13 Down
14 Left
15 Escape

When the local control mode has been configured, it is possible to open and close the circuit-breaker with the control button.

Name	Function
Closing	Closes the eVD4
Opening	Opens the eVD4

5.3.7.14. Navigation

The arrow buttons are used for browsing. To scroll through the information presented in the menus, simply press the various arrow buttons or keep them pressed.

Name	Function
ESC Escape	– Abandon the configuration mode without saving the values
	– Cancel certain actions
	– Adjust the display contrast in combination with the buttons  or 
	– Change the language in combination with 
	– Start the test on the display in combination with 
	– Cancel a character when editing a string in combination with Clear
	– Insert a space when editing a string in combination with 
 Confirm	– Insert parameters in setting mode
	– Confirm a new configured value
 Up  Down	– Move up and down inside the menu
	– Change the value of a figure when configuring a new value of a parameter
 Left	– Move left and right in the menu
 Right	– Change the figure being configured
 Key	– Activate the Logging-in procedure, when the user is not authenticated
	– Logging-out

5.3.7.15 Controls

Name	Function
 Menu	– Access the main menu directly during display of another menu
	– Display the default screen of the main menu
 R/L	Change the RBF615 control mode (remote or local)
	– When the R LED is on, remote control is enabled and local control is disabled
	– When the LED L is on, local control is enabled and remote control is disabled
	– When no LED is on, both the controls are enabled
Clear Cancel	– Activates the Clear/Reset screen
	– Cancel indications and LEDs. When the Clear button is kept pressed, the first three seconds cause cancellation of the indications, the following three seconds cause cancellation of the alarm LED. It requires a user with appropriate rights
 Alarm pages	– Allows scrolling of the various pages giving indications about the alarm LEDs
SLD SLD	– Activates the single-line diagram on the left-hand side of the display

5.3.7.16. LEDs

The LHMI includes three LEDs for indicating the state of the protections and of the relay functions. A further 8 alarm LEDs are available on the front of the LHMI. By means of these 8 LEDs it is possible to display the state of 24 alarms organized into three pages. The “Alarm page” button allows switching among the various LED pages. These LEDs can be configured by means of PCM600.

LHMI functions

Protection and alarm indications. There are three LEDs which indicate the state of the protections: Ready, Start and Trip.

Ready Led

LED state	Description
Off	The auxiliary power supply voltage is disconnected
On	Normal functionality
Flashing	There has been an internal fault or the IED is in the test mode. Internal faults are accompanied by an error message.

Start Led

LED state	Description
Off	Normal functionality
On	One of the protection functions is above threshold, a notification message is displayed at the same time. – If various protections are above threshold within a short time interval, notification regarding the last function which has passed into the first threshold is shown.
Flashing	One of the functions is blocked. – The blocked indication disappears when the block is removed or when the function is reset.

Trip Led

LED state	Description
Off	Normal functionality
On	One of the protection functions has tripped, a notification message is displayed at the same time. – The trip indication remains on and must be reset by means of the communication or by means of the Clear button  .

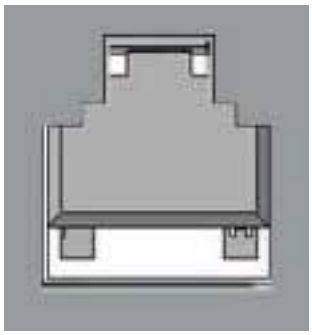
5.3.7.17. Parameter management

The LHMI allows the IED parameters to be accessed. Three types of parameters can be read or written:
– Numerical values
– Strings
– Enumeration

The numerical values are presented both in full and decimal form with one minimum and one maximum value. The string parameters can be entered character by character. The enumerated parameters have a set of pre-established values within which they can vary.

5.3.7.18. Front communication port

The RJ45 type communication port allows connection to the RBX615 relay.



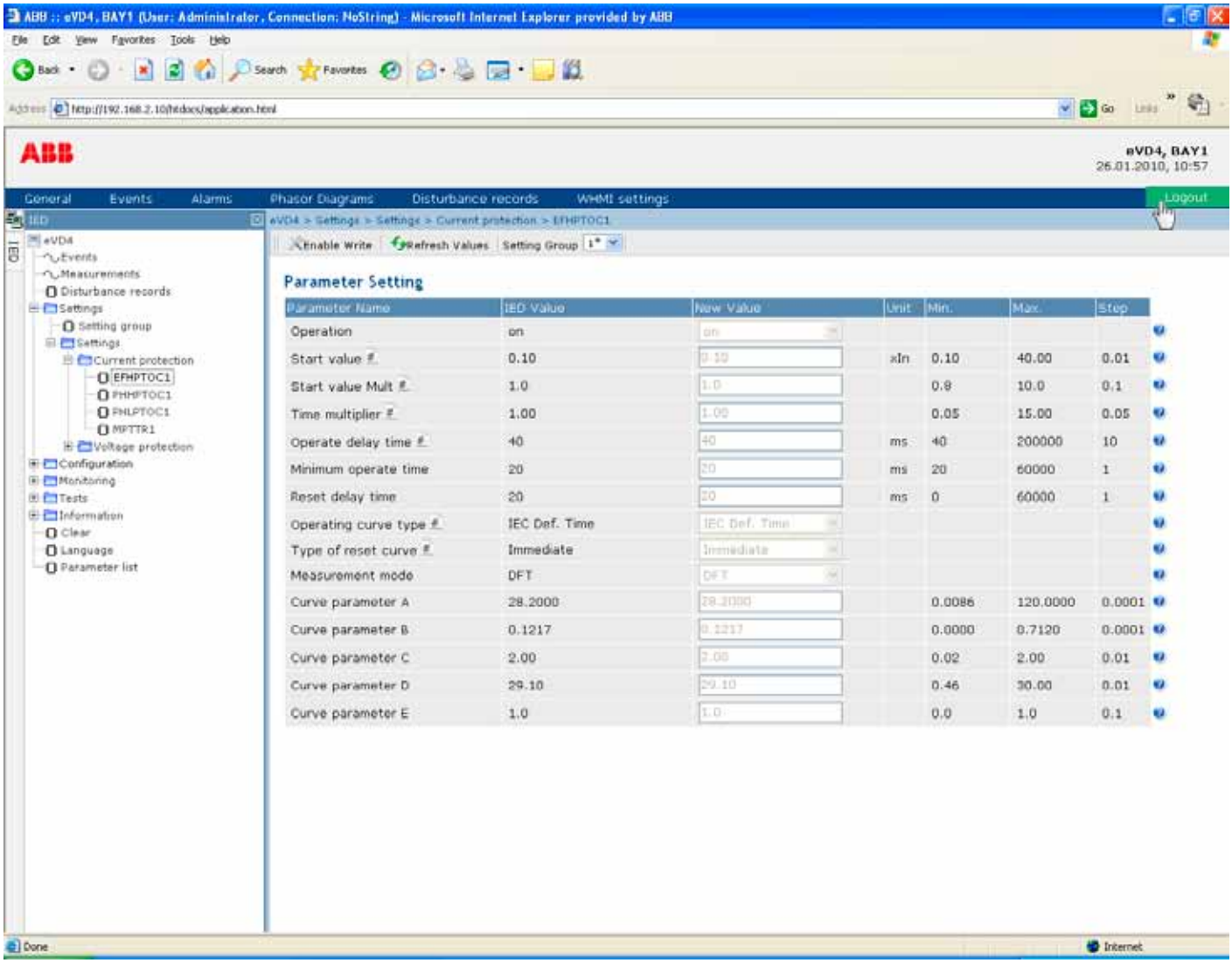
When a computer is connected with the IED, the DHCP server of the IED for the front port assigns an IP address to the computer. The IP address of the front port is fixed and is 192.168.0.254

5.3.7.19. WHMI

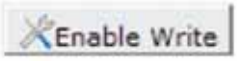
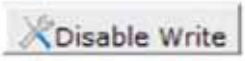
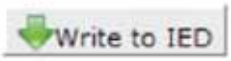
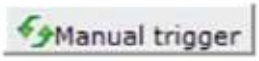
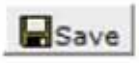
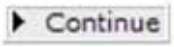
The WHMI allows the user to access the IED by means of a web browser. The version of web browser supported is Internet Explorer 7.0 or more recent.
The WHMI is disabled by default. To enable the WHMI, select Main/Menu/Configuration/HMI/Web HMI mode by means of the LHMI. For the change to become effective, the IED must be restarted.
The WHMI offers the following functions:
– Alarm notifications and list of events
– Supervision of the system
– Configuration of the parameters
– Display of the measurements
– Recordings of Disturbances (Disturbance recorder)
– Phasor diagram

WHMI menu tree structure

The WHMI can be used:
– Locally by connecting your laptop to the LHMI by means of the communication port
– Remotely by means of a LANIWAN network



5.3.7.20. WHMI control buttons

Name	Description
	Enabling parameter editing.
	Disabling parameter editing.
	Writing parameters to the IED.
	Refreshing parameter values.
	Printing out parameters.
	Committing changes to IED's, non-volatile flash memory.
	Rejecting changes.
	Showing context sensitive help messages.
	Clearing events.
	Triggering the disturbance recorder manually.
	Saving values to CSV file format.
	Freezing the values so that updates are not displayed.
	Receiving continuous updates to the monitoring view.
	Deleting the disturbance record.
	Deleting all disturbance records.
	Uploading part one of a disturbance record.
	Uploading part two of a disturbance record.

5.3.7.21. Authorizations

Different user profiles, each with different rights and default passwords have been implemented in both the LHMI and WHMI.
The default password can only be changed by a user with administrator rights.
Access by means of authentication is disabled by default in the LHMI and can be enabled either by means of the LHMI or by means of the WHMI Main Menu/Configuration/Authorization.
On the other hand, for the WHMI access is always present by means of authentication.
The following table gives the different user profiles with their relative rights.

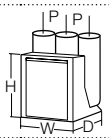
User	Rights
Viewer	Read only access
Operator	- Select the local or remote control mode locally - Change setting group - Cancel the alarm LEDs and the text notifications
Engineer	- Configure the parameters - Cancel the list of events - Cancel the disturbance recorder - Change the system configurations: IP addresses, speed of the serial communication port - Configure the IED in test mode - Change language
Administrator	- All those mentioned above - Change the passwords

5.4. Fixed circuit-breakers

The fixed circuit-breaker (fig. 4/a paragraph 5.3.1) is the basic version complete with structure and front protection screen. The fixing holes are made in the lower part of the structure.
The cord with the connector (18) (plug) for connecting the electrical accessories of the operating mechanism comes out of connector (9). The earthing screw is placed in the rear part of the circuit-breaker. For further details, see the caption to figure 4/a in paragraph 5.3.1.

5.4.1. General characteristics of fixed circuit-breakers

General characteristics of fixed circuit-breakers (12 kV)

Circuit-breaker		eVD4 12					
Standards	IEC 62271-100	•					
	VDE 0671; CEI EN 62271-100 file 7642	•					
Rated voltage	Ur [kV]	12					
Rated insulation voltage	Us [kV]	12					
Withstand voltage at 50 Hz	Ud (1 min) [kV]	42					
Impulse withstand voltage	Up [kV]	75					
Rated frequency	fr [Hz]	50-60					
Rated thermal current (40°C)	Ir [A]	630	630	630	1250	1250	1250
Rated breaking capacity (symmetrical rated short-circuit current)	Isc [kA]	16	16	16	16	16	16
		20	20	20	20	20	20
		25	25	25	25	25	25
		31.5	31.5	31.5	31.5	31.5	31.5
		—	—	—	—	—	—
Short-time withstand current (3s)	Ik [kA]	16	16	16	16	16	16
		20	20	20	20	20	20
		25	25	25	25	25	25
		31.5	31.5	31.5	31.5	31.5	31.5
		—	—	—	—	—	—
Making capacity	Ip [kA]	40	40	40	40	40	40
		50	50	50	50	50	50
		63	63	63	63	63	63
		80	80	80	80	80	80
		—	—	—	—	—	—
Sequence of operations	[O - 0.3 s - CO - 15 s - CO]	•	•	•	•	•	•
Opening time	[ms]	33 ... 60					
Arcing time	[ms]	10 ... 15					
Total breaking time	[ms]	43 ... 75					
Closing time	[ms]	60 ... 80					
Maximum overall dimensions 	H [mm]	461	461	461	461	461	461
	W [mm]	450	570	700	450	570	700
	D [mm]	464	483	483	464	483	483
	Pole centre-distance P [mm]	150	210	275	150	210	275
Weight	[kg]	73	75	79	73	75	79
Standardized dimensions table	1VCD	000156	000157	000158	000156	000157	000158
Operating temperature	[°C]	- 5 ... + 40 (1)					
Tropicalization	IEC: 60068-2-30, 60721-2-1	•					
Electromagnetic compatibility	IEC: 62271-1	•					

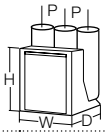
(1) For lower temperature please ask ABB.

5.4.3. Standard fittings for fixed circuit-breakers

The basic versions of the fixed circuit-breakers are three-pole and fitted with:
– EL type manual operating mechanism
– mechanical signalling device for closing spring loaded/released
– mechanical signalling device for circuit-breaker open/closed
– closing pushbutton, opening pushbutton and operation counter
– lever for manual closing spring loading
– shunt opening release (-MBO1)
– shunt closing release (-MBC)
– cord with connector (plug only) for auxiliary circuits, with striker pins which do not allow insertion of the plug in the socket if the rated current of the circuit-breaker is lower than the rated current of the panel
– RBX615 protection and control unit
– Human Machine Interface (HMI).

	eVD4 12								
	•								
	•								
	12								
	12								
	42								
	75								
	50-60								
	1250	1250	1600	1600	1600	1600	2000	2000	2500
	—	—	—	—	—	—	—	—	—
	—	—	20	20	—	—	20	20	20
	—	—	25	25	—	—	25	25	25
	—	—	31.5	31.5	—	—	31.5	31.5	31.5
	40	40	—	—	40	40	40	—	40
	—	—	—	—	—	—	—	—	—
	—	—	20	20	—	—	20	20	20
	—	—	25	25	—	—	25	25	25
	—	—	31.5	31.5	—	—	31.5	31.5	31.5
	40	40	—	—	40	40	40	—	40
	—	—	—	—	—	—	—	—	—
	—	—	50	50	—	—	50	50	50
	—	—	63	63	—	—	63	63	63
	—	—	80	80	—	—	80	80	80
	100	100	—	—	100	100	100	—	100
	•	•	•	•	•	•	•	•	•
	33 ... 60								
	10 ... 15								
	43 ... 75								
	60 ... 80								
	589	589	599	599	589	589	599	599	599
	570	700	570	700	570	700	570	700	700
	483	483	483	483	483	483	483	483	483
	210	275	210	275	210	275	210	275	275
	84	84	98	105	84	84	98	105	160
	000161	000162	000159	000160	000161	000162	000159	000160	000176
	- 5 ... + 40 (1)								
	•								
	•								

General characteristics of fixed circuit-breakers (17.5 kV)

Circuit-breaker		eVD4 17					
Standards	IEC 62271-100	•					
	VDE 0671; CEI EN 62271-100 file 7642	•					
Rated voltage	Ur [kV]	17.5					
Rated insulation voltage	Us [kV]	17.5					
Withstand voltage at 50 Hz	Ud (1 min) [kV]	42					
Impulse withstand voltage	Up [kV]	95					
Rated frequency	fr [Hz]	50-60					
Rated thermal current (40°C)	Ir [A]	630	630	630	1250	1250	1250
Rated breaking capacity (symmetrical rated short-circuit current)	Isc [kA]	16	16	16	16	16	16
		20	20	20	20	20	20
		25	25	25	25	25	25
		31.5	31.5	31.5	31.5	31.5	31.5
		—	—	—	—	—	—
Short-time withstand current (3s)	Ik [kA]	16	16	16	16	16	16
		20	20	20	20	20	20
		25	25	25	25	25	25
		31.5	31.5	31.5	31.5	31.5	31.5
		—	—	—	—	—	—
Making capacity	Ip [kA]	40	40	40	40	40	40
		50	50	50	50	50	50
		63	63	63	63	63	63
		80	80	80	80	80	80
		—	—	—	—	—	—
Sequence of operations	[O - 0.3 s - CO - 15 s - CO]	•	•	•	•	•	•
Opening time	[ms]	33 ... 60					
Arcing time	[ms]	10 ... 15					
Total breaking time	[ms]	43 ... 75					
Closing time	[ms]	60 ... 80					
Maximum overall dimensions 	H [mm]	461	461	461	461	461	461
	W [mm]	450	570	700	450	570	700
	D [mm]	464	483	483	464	483	483
	Pole centre-distance P [mm]	150	210	275	150	210	275
Weight	[kg]	73	75	79	73	75	79
Standardized dimensions table	1VCD	000156	000157	000158	000156	000157	000158
Operating temperature	[°C]	- 5 ... + 40 (1)					
Tropicalization	IEC: 60068-2-30, 60721-2-1	•					
Electromagnetic compatibility	IEC: 62271-1	•					

(1) For lower temperature please ask ABB.

	eVD4 17								
	•								
	•								
	17.5								
	17.5								
	42								
	95								
	50-60								
	1250	1250	1600	1600	1600	1600	2000	2000	2500
	—	—	—	—	—	—	—	—	—
	—	—	20	20	—	—	20	20	20
	—	—	25	25	—	—	25	25	25
	—	—	31.5	31.5	—	—	31.5	31.5	31.5
	40	40	—	—	40	40	40	—	40
	—	—	—	—	—	—	—	—	—
	—	—	20	20	—	—	20	20	20
	—	—	25	25	—	—	25	25	25
	—	—	31.5	31.5	—	—	31.5	31.5	31.5
	40	40	—	—	40	40	40	—	40
	—	—	—	—	—	—	—	—	—
	—	—	50	50	—	—	50	50	50
	—	—	63	63	—	—	63	63	63
	—	—	80	80	—	—	80	80	80
	100	100	—	—	100	100	100	—	100
	•	•	•	•	•	•	•	•	•
	33 ... 60								
	10 ... 15								
	43 ... 75								
	60 ... 80								
	589	589	599	599	589	589	599	599	599
	570	700	570	700	570	700	570	700	700
	483	483	483	483	483	483	483	483	483
	210	275	210	275	210	275	210	275	275
	84	84	98	105	84	84	98	105	160
	000161	000162	000159	000160	000161	000162	000159	000160	000176
	- 5 ... + 40 (1)								
	•								
	•								

5.4.2. Types of fixed version circuit-breakers available

Ur	Isc	Rated thermal current (40 °C) [A]								Circuit-breaker type
		H=461			H=589		H=599			
		D=424			D=424		D=424			
		u/l=205			u/l=310		u/l=310			
kV	kA	l/g=217.5			l/g=238		l/g=237.5			
		P=150	P=210	P=275	P=210	P=275	P=150	P=210	P=275	
		W=450	W=570	W=700	W=570	W=700	W=450	W=570	W=700	
12	16	630								eVD4 12.06.16 p150
	20	630								eVD4 12.06.20 p150
	25	630								eVD4 12.06.25 p150
	31.5	630								eVD4 12.06.32 p150
	16	1250								eVD4 12.12.16 p150
	20	1250								eVD4 12.12.20 p150
	25	1250								eVD4 12.12.25 p150
	31.5	1250								eVD4 12.12.32 p150
	20						1600			eVD4 12.16.20 p150
	25						1600			eVD4 12.16.25 p150
	31.5						1600			eVD4 12.16.32 p150
	16		630							eVD4 12.06.16 p210
	20		630							eVD4 12.06.20 p210
	25		630							eVD4 12.06.25 p210
	31.5		630							eVD4 12.06.32 p210
	16		1250							eVD4 12.12.16 p210
	20		1250							eVD4 12.12.20 p210
	25		1250							eVD4 12.12.25 p210
	31.5		1250							eVD4 12.12.32 p210
	40				1250					eVD4 12.12.40 p210
	20							1600		eVD4 12.16.20 p210
	25							1600		eVD4 12.16.25 p210
	31.5							1600		eVD4 12.16.32 p210
	40				1600					eVD4 12.16.40 p210
	20							2000		eVD4 12.20.20 p210
	25							2000		eVD4 12.20.25 p210
	31.5							2000		eVD4 12.20.32 p210
	40							2000		eVD4 12.20.40 p210
	16			630						eVD4 12.06.16 p275
	20			630						eVD4 12.06.20 p275
	25			630						eVD4 12.06.25 p275
	31.5			630						eVD4 12.06.32 p275
	16			1250						eVD4 12.12.16 p275
	20			1250						eVD4 12.12.20 p275
	25			1250						eVD4 12.12.25 p275
	31.5			1250						eVD4 12.12.32 p275
	40					1250				eVD4 12.12.40 p275
	20								1600	eVD4 12.16.20 p275
	25								1600	eVD4 12.16.25 p275
	31.5								1600	eVD4 12.16.32 p275
	40					1600				eVD4 12.16.40 p275
	20								2000	eVD4 12.20.20 p275
	25								2000	eVD4 12.20.25 p275
	31.5								2000	eVD4 12.20.32 p275
	20								2500	eVD4 12.25.20 p275
	25								2500	eVD4 12.25.25 p275
	31.5								2500	eVD4 12.25.32 p275
	40								2500	eVD4 12.25.40 p275

H = height of circuit-breaker
W = width of circuit-breaker
D = depth of circuit-breaker
u/l = distance between upper and lower terminal
l/g = distance between lower terminal and bearing surface of circuit-breaker
p = horizontal centre-distance of poles

eVD4 fixed circuit-breaker without lower and upper terminals (17.5 kV)

Ur	Isc	Rated thermal current (40 °C) [A]								Circuit-breaker type
		H=461			H=589		H=599			
		D=424			D=424		D=424			
kV	kA	u/l=205			u/l=310		u/l=310			
		l/g=217.5			l/g=238		l/g=237.5			
		P=150	P=210	P=275	P=210	P=275	P=150	P=210	P=275	
		W=450	W=570	W=700	W=570	W=700	W=450	W=570	W=700	
17.5	16	630								eVD4 17.06.16 p150
	20	630								eVD4 17.06.20 p150
	25	630								eVD4 17.06.25 p150
	31.5	630								eVD4 17.06.32 p150
	16	1250								eVD4 17.12.16 p150
	20	1250								eVD4 17.12.20 p150
	25	1250								eVD4 17.12.25 p150
	31.5	1250								eVD4 17.12.32 p150
	20						1600			eVD4 17.16.20 p150
	25						1600			eVD4 17.16.25 p150
	31.5						1600			eVD4 17.16.32 p150
	16		630							eVD4 17.06.16 p210
	20		630							eVD4 17.06.20 p210
	25		630							eVD4 17.06.25 p210
	31.5		630							eVD4 17.06.32 p210
	16		1250							eVD4 17.12.16 p210
	20		1250							eVD4 17.12.20 p210
	25		1250							eVD4 17.12.25 p210
	31.5		1250							eVD4 17.12.32 p210
	40				1250					eVD4 17.12.40 p210
	20							1600		eVD4 17.16.20 p210
	25							1600		eVD4 17.16.25 p210
	31.5							1600		eVD4 17.16.32 p210
	40				1600					eVD4 17.16.40 p210
	20							2000		eVD4 17.20.20 p210
	25							2000		eVD4 17.20.25 p210
	31.5							2000		eVD4 17.20.32 p210
	40							2000		eVD4 17.20.40 p210
	16			630						eVD4 17.06.16 p275
	20			630						eVD4 17.06.20 p275
	25			630						eVD4 17.06.25 p275
	31.5			630						eVD4 17.06.32 p275
	16			1250						eVD4 17.12.16 p275
	20			1250						eVD4 17.12.20 p275
	25			1250						eVD4 17.12.25 p275
	31.5			1250						eVD4 17.12.32 p275
	40					1250				eVD4 17.12.40 p275
	20								1600	eVD4 17.16.20 p275
	25								1600	eVD4 17.16.25 p275
	31.5								1600	eVD4 17.16.32 p275
	40					1600				eVD4 17.16.40 p275
	20								2000	eVD4 17.20.20 p275
	25								2000	eVD4 17.20.25 p275
	31.5								2000	eVD4 17.20.32 p275
	20								2500	eVD4 17.25.20 p275
	25								2500	eVD4 17.25.25 p275
	31.5								2500	eVD4 17.25.32 p275
	40								2500	eVD4 17.25.40 p275

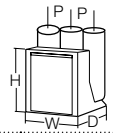
H = height of circuit-breaker
W = width of circuit-breaker
D = depth of circuit-breaker
u/l = distance between upper and lower terminal
l/g = distance between lower terminal and bearing surface of circuit-breaker
p = horizontal centre-distance of poles

5.5. Withdrawable circuit-breakers

The withdrawable circuit-breakers are available for UniGear ZS1 switchgear and PowerCube units (see fig. 4/b paragraph 5.3.1).
They consist of a truck on which the supporting structure of the circuit-breaker is fixed.
The cord with the connector (18) (plug) for connecting the electrical accessories of the operating mechanism comes out of the connector (9).
The strikers for operating the contacts (connected/isolated) placed in the switchgear are fixed in the top part of the circuit-breaker.
The slides (19) for operating the segregation shutters of the medium voltage contacts of the enclosure or of the switchgear are fixed on the sides of the circuit-breaker.
The crosspiece with the handles (20) for hooking up the circuit-breaker for the racking-in/out operations by means of the special operating lever (22) is mounted on the front part of the circuit-breaker truck.
The circuit-breaker is completed with the isolating contacts (21).

5.5.1. General characteristics of withdrawable circuit-breakers for UniGear ZS1 switchgear

General characteristics of withdrawable circuit-breakers (12 kV)

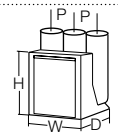
Circuit-breaker			eVD4/P 12			
Standards		IEC 62271-100	•			
		VDE 0671; CEI EN 62271-100 file 7642	•			
Rated voltage		Ur [kV]	12			
Rated insulation voltage		Us [kV]	12			
Withstand voltage at 50 Hz		Ud (1 min) [kV]	42			
Impulse withstand voltage		Up [kV]	75			
Rated frequency		fr [Hz]	50-60			
Rated thermal current (40 °C) (1)		Ir [A]	630	1250	1250	1250
Rated breaking capacity (symmetrical rated short-circuit current)		Isc [kA]	16	16	—	—
			20	20	—	—
			25	25	—	—
			31.5	31.5	—	—
			—	—	40	40
Short-time withstand current (3s)		Ik [kA]	16	16	—	—
			20	20	—	—
			25	25	—	—
			31.5	31.5	—	—
			—	—	40	40
Making capacity		Ip [kA]	40	40	—	—
			50	50	—	—
			63	63	—	—
			80	80	—	—
			—	—	100	100
Sequence of operations		[O - 0.3 s - CO - 15 s - CO]	•	•	•	•
Opening time		[ms]	33 ... 60			
Arcing time		[ms]	10 ... 15			
Total breaking time		[ms]	43 ... 75			
Closing time		[ms]	60 ... 80			
Maximum overall dimensions		H [mm]	628	628	691	691
		W [mm]	503	503	653	853
		D [mm]	662	662	641	642
		Pole centre-distance P [mm]	150	150	210	275
Weight		[kg]	116	116	174	176
Standardized dimensions table		1VCD	000163	000163	000166	000167
Operating temperature		[°C]	- 5 ... + 40 (2)			
Tropicalization		IEC: 60068-2-30, 60721-2-1	•			
Electromagnetic compatibility		IEC: 62271-1	•			

(1) Rated current guaranteed when circuit-breaker is installed in UniGear ZS1 switchgear and with 40 °C ambient temperature
(2) For lower temperature please ask ABB.

The withdrawable circuit-breaker is fitted with special locks on the front crosspiece, which allow hooking up into the corresponding couplings of the switchgear. The locks can only be activated by the handles with the truck fully resting against the crosspiece.
The operating lever (22) must be fully inserted (also see par. 7.5.). A lock prevents the truck from advancing into the enclosure or fixed part when the earthing switch is closed. Another lock prevents racking-in and racking-out with the circuit-breaker closed. With the truck in an intermediate position between isolated and connected, a further lock prevents circuit-breaker closing (either mechanical or electrical).
A locking magnet is also mounted on the truck which, when de-energised, prevents the truck racking-in operation.
An additional mechanical interlock is available (which requires adequate accessories on fixed part). This interlock prevents the circuit-breaker racking-in/racking-out with the door open.

	eVD4/P 12						
	•						
	•						
	12						
	12						
	42						
	75						
	50-60						
	1600	1600	1600	1600	2000	2000	2500
	—	—	—	—	—	—	—
	20	20	—	—	20	20	20
	25	25	—	—	25	25	25
	31.5	31.5	—	—	31.5	31.5	31.5
	—	—	40	40	40	40	40
	—	—	—	—	—	—	—
	20	20	—	—	20	20	20
	25	25	—	—	25	25	25
	31.5	31.5	—	—	31.5	31.5	31.5
	—	—	40	40	40	40	40
	—	—	—	—	—	—	—
	50	50	—	—	50	50	50
	63	63	—	—	63	63	63
	80	80	—	—	80	80	80
	—	—	100	100	100	100	100
	•	•	•	•	•	•	•
	33 ... 60						
	10 ... 15						
	43 ... 75						
	60 ... 80						
	691	691	691	691	691	691	691
	653	853	653	853	653	853	853
	640	640	641	641	640	640	640
	210	275	210	275	210	275	275
	160	166	174	176	160	166	221
	000164	000165	000166	000167	000164	000165	000175
	- 5 ... + 40 (2)						
	•						
	•						

General characteristics of withdrawable circuit-breakers (17.5 kV)

Circuit-breaker			eVD4/P 17			
Standards		IEC 62271-100	•			
		VDE 0671; CEI EN 62271-100 file 7642	•			
Rated voltage		Ur [kV]	17.5			
Rated insulation voltage		Us [kV]	17.5			
Withstand voltage at 50 Hz		Ud (1 min) [kV]	42			
Impulse withstand voltage		Up [kV]	95			
Rated frequency		fr [Hz]	50-60			
Rated thermal current (40 °C) (1)		Ir [A]	630	1250	1250	1250
Rated breaking capacity (symmetrical rated short-circuit current)		Isc [kA]	16	16	—	—
			20	20	—	—
			25	25	—	—
			31.5	31.5	—	—
			—	—	40	40
Short-time withstand current (3s)		Ik [kA]	16	16	—	—
			20	20	—	—
			25	25	—	—
			31.5	31.5	—	—
			—	—	40	40
Making capacity		Ip [kA]	40	40	—	—
			50	50	—	—
			63	63	—	—
			80	80	—	—
			—	—	100	100
Sequence of operations		[O - 0.3 s - CO - 15 s - CO]	•	•	•	•
Opening time		[ms]	33 ... 60			
Arcing time		[ms]	10 ... 15			
Total breaking time		[ms]	43 ... 75			
Closing time		[ms]	60 ... 80			
Maximum overall dimensions		H [mm]	628	628	691	691
		W [mm]	503	503	653	853
		D [mm]	662	662	641	642
		Pole centre-distance P [mm]	150	150	210	275
Weight		[kg]	116	116	174	176
Standardized dimensions table		1VCD	000163	000163	000166	000167
Operating temperature		[°C]	- 5 ... + 40 (2)			
Tropicalization		IEC: 60068-2-30, 60721-2-1	•			
Electromagnetic compatibility		IEC: 62271-1	•			

(1) Rated current guaranteed when circuit-breaker is installed in UniGear ZS1 switchgear and with 40 °C ambient temperature
(2) For lower temperature please ask ABB.

	eVD4/P 17						
	•						
	•						
	17.5						
	17.5						
	42						
	95						
	50-60						
	1600	1600	1600	1600	2000	2000	2500
	—	—	—	—	—	—	—
	20	20	—	—	20	20	20
	25	25	—	—	25	25	25
	31.5	31.5	—	—	31.5	31.5	31.5
	—	—	40	40	40	40	40
	—	—	—	—	—	—	—
	20	20	—	—	20	20	20
	25	25	—	—	25	25	25
	31.5	31.5	—	—	31.5	31.5	31.5
	—	—	40	40	40	40	40
	—	—	—	—	—	—	—
	50	50	—	—	50	50	50
	63	63	—	—	63	63	63
	80	80	—	—	80	80	80
	—	—	100	100	100	100	100
	•	•	•	•	•	•	•
	33 ... 60						
	10 ... 15						
	43 ... 75						
	60 ... 80						
	691	691	691	691	691	691	691
	653	853	653	853	653	853	853
	640	640	641	641	640	640	640
	210	275	210	275	210	275	275
	160	166	174	176	160	166	221
	000164	000165	000166	000167	000164	000165	000175
	- 5 ... + 40 (2)						
	•						
	•						

5.5.2. Types of withdrawable circuit-breakers available for UniGear ZS1 switchgear

eVD4/P withdrawable circuit-breakers (12 kV)

Ur	Isc	Rated thermal current (40 °C) [A]				Circuit-breaker type
kV	kA	W=503	W=653	W=853	W=853	
		P=150	P=210	P=275	P=275	
		u/l=205	u/l=310	u/l=310	u/l=310	
		ø=35	ø=79	ø=79	ø=109	
12	16	630				eVD4/P 12.06.16 p150
	20	630				eVD4/P 12.06.20 p150
	25	630				eVD4/P 12.06.25 p150
	31.5	630				eVD4/P 12.06.32 p150
	16	1250				eVD4/P 12.12.16 p150
	20	1250				eVD4/P 12.12.20 p150
	25	1250				eVD4/P 12.12.25 p150
	31.5	1250				eVD4/P 12.12.32 p150
	40		1250			eVD4/P 12.12.40 p210
	20		1600			eVD4/P 12.16.20 p210
	25		1600			eVD4/P 12.16.25 p210
	31.5		1600			eVD4/P 12.16.32 p210
	40		1600			eVD4/P 12.16.40 p210
	20		2000			eVD4/P 12.20.20 p210
	25		2000			eVD4/P 12.20.25 p210
	31.5		2000			eVD4/P 12.20.32 p210
	40		2000			eVD4/P 12.20.40 p210
	40			1250		eVD4/P 12.12.40 p275
	20			1600		eVD4/P 12.16.20 p275
	25			1600		eVD4/P 12.16.25 p275
	31.5			1600		eVD4/P 12.16.32 p275
	40			1600		eVD4/P 12.16.40 p275
	20			2000		eVD4/P 12.20.20 p275
	25			2000		eVD4/P 12.20.25 p275
	31.5			2000		eVD4/P 12.20.32 p275
	40			2000		eVD4/P 12.20.40 p275
	20				2500	eVD4/P 12.25.20 p275
	25				2500	eVD4/P 12.25.25 p275
	31.5				2500	eVD4/P 12.25.32 p275
	40				2500	eVD4/P 12.25.40 p275

W = width of circuit-breaker
P = horizontal centre-distance of poles
u/l = distance between upper and lower terminal
ø = diameter of isolating contacts

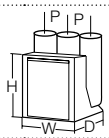
eVD4/P withdrawable circuit-breakers (17.5 kV)

Ur	Isc	Rated thermal current (40 °C) [A]				Circuit-breaker type
		W=503	W=653	W=853	W=853	
		P=150	P=210	P=275	P=275	
kV	kA	u/l=205	u/l=310	u/l=310	u/l=310	
		ø=35	ø=79	ø=79	ø=109	
17,5	16	630				eVD4/P 17.06.16 p150
	20	630				eVD4/P 17.06.20 p150
	25	630				eVD4/P 17.06.25 p150
	31.5	630				eVD4/P 17.06.32 p150
	16	1250				eVD4/P 17.12.16 p150
	20	1250				eVD4/P 17.12.20 p150
	25	1250				eVD4/P 17.12.25 p150
	31.5	1250				eVD4/P 17.12.32 p150
	40		1250			eVD4/P 17.12.40 p210
	20		1600			eVD4/P 17.16.20 p210
	25		1600			eVD4/P 17.16.25 p210
	31.5		1600			eVD4/P 17.16.32 p210
	40		1600			eVD4/P 17.16.40 p210
	20		2000			eVD4/P 17.20.20 p210
	25		2000			eVD4/P 17.20.25 p210
	31.5		2000			eVD4/P 17.20.32 p210
	40		2000			eVD4/P 17.20.40 p210
	40			1250		eVD4/P 17.12.40 p275
	20			1600		eVD4/P 17.16.20 p275
	25			1600		eVD4/P 17.16.25 p275
	31.5			1600		eVD4/P 17.16.32 p275
	40			1600		eVD4/P 17.16.40 p275
	20			2000		eVD4/P 17.20.20 p275
	25			2000		eVD4/P 17.20.25 p275
	31.5			2000		eVD4/P 17.20.32 p275
	40			2000		eVD4/P 17.20.40 p275
	20				2500	eVD4/P 17.25.20 p275
	25				2500	eVD4/P 17.25.25 p275
	31.5				2500	eVD4/P 17.25.32 p275
	40				2500	eVD4/P 17.25.40 p275

W = width of circuit-breaker
P = horizontal centre-distance of poles
u/l = distance between upper and lower terminal
ø = diameter of isolating contacts

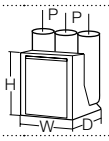
5.5.3. Types of withdrawable circuit-breakers available for PowerCube units

eVD4/P withdrawable circuit-breakers (12 kV)

Circuit-breaker			eVD4/P 12						
		PowerCube unit	PB1		PB2				PB3
Standards		IEC 62271-100	•		•				•
		VDE 0671; CEI EN 62271-100 file 7642	•		•				•
Rated voltage		Ur [kV]	12		12				12
Rated insulation voltage		Us [kV]	12		12				12
Withstand voltage at 50 Hz		Ud (1 min) [kV]	42		42				42
Impulse withstand voltage		Up [kV]	75		75				75
Rated frequency		fr [Hz]	50-60		50-60				50-60
Rated thermal current (40 °C) (1)		Ir [A]	630	1250	1250	1600	1600	2000	2500
Rated breaking capacity (symmetrical rated short-circuit current)		Isc [kA]	16	16	—	—	—	—	—
			20	20	—	20	—	20	20
			25	25	—	25	—	25	25
			31.5	31.5	—	31.5	—	31.5	31.5
			—	—	40	—	40	40	40
Short-time withstand current (3s)		Ik [kA]	16	16	—	—	—	—	—
			20	20	—	20	—	20	20
			25	25	—	25	—	25	25
			31.5	31.5	—	31.5	—	31.5	31.5
			—	—	40	—	40	40	40
Making capacity		Ip [kA]	40	40	—	—	—	—	—
			50	50	—	50	—	50	50
			63	63	—	63	—	63	63
			80	80	—	80	—	80	80
			—	—	100	—	100	100	100
Sequence of operations		[O - 0.3 s - CO - 15 s - CO]	•		•				•
Opening time		[ms]	33 ... 60		33 ... 60				33 ... 60
Arcing time		[ms]	10 ... 15		10 ... 15				10 ... 15
Total breaking time		[ms]	43 ... 75		43 ... 75				43 ... 75
Closing time		[ms]	60 ... 80		60 ... 80				60 ... 80
Maximum overall dimensions		H [mm]	621	621	691	691	691	691	691
		W [mm]	503	503	653	653	653	653	853
		D [mm]	662	662	641	640	641	640	640
		Pole centre-distance P [mm]	150	150	210	210	210	210	275
Weight		[kg]	116	116	174	160	174	160	221
Standardized dimensions table		1VCD	000163	000163	000166	000164	000166	000164	000175
Operating temperature		[°C]	- 5 ... + 40 (2)		- 5 ... + 40 (2)				- 5 ... + 40 (2)
Tropicalization		IEC: 60068-2-30, 60721-2-1	•		•				•
Electromagnetic compatibility		IEC: 62271-1	•		•				•

(1) Rated current guaranteed when circuit-breaker is installed in a PowerCube enclosure and with 40 °C ambient temperature
(2) For lower temperature please ask ABB.

eVD4/P withdrawable circuit-breakers (17.5 kV)

Circuit-breaker			eVD4/P 17						
		PowerCube unit	PB1		PB2				PB3
Standards		IEC 62271-100	•		•				•
		VDE 0671; CEI EN 62271-100 file 7642	•		•				•
Rated voltage		Ur [kV]	17.5		17.5				12
Rated insulation voltage		Us [kV]	17.5		17.5				12
Withstand voltage at 50 Hz		Ud (1 min) [kV]	42		42				42
Impulse withstand voltage		Up [kV]	95		95				75
Rated frequency		fr [Hz]	50-60		50-60				50-60
Rated thermal current (40 °C) (1)		Ir [A]	630	1250	1250	1600	1600	2000	2500
Rated breaking capacity (symmetrical rated short-circuit current)		Isc [kA]	16	16	—	—	—	—	—
			20	20	—	20	—	20	20
			25	25	—	25	—	25	25
			31.5	31.5	—	31.5	—	31.5	31.5
			—	—	40	—	40	40	40
Short-time withstand current (3s)		Ik [kA]	16	16	—	—	—	—	—
			20	20	—	20	—	20	20
			25	25	—	25	—	25	25
			31.5	31.5	—	31.5	—	31.5	31.5
			—	—	40	—	40	40	40
Making capacity		Ip [kA]	40	40	—	—	—	—	—
			50	50	—	50	—	50	50
			63	63	—	63	—	63	63
			80	80	—	80	—	80	80
			—	—	100	—	100	100	100
Sequence of operations		[O - 0.3 s - CO - 15 s - CO]	•		•				•
Opening time		[ms]	33 ... 60		33 ... 60				33 ... 60
Arcing time		[ms]	10 ... 15		10 ... 15				10 ... 15
Total breaking time		[ms]	43 ... 75		43 ... 75				43 ... 75
Closing time		[ms]	60 ... 80		60 ... 80				60 ... 80
Maximum overall dimensions		H [mm]	621	621	691	691	691	691	691
		W [mm]	503	503	653	653	653	653	853
		D [mm]	662	662	641	640	641	640	640
		Pole centre-distance P [mm]	150	150	210	210	210	210	275
Weight		[kg]	116	116	174	160	174	160	221
Standardized dimensions table		1VCD	000163	000163	000166	000164	000166	000164	000175
Operating temperature		[°C]	- 5 ... + 40 (2)		- 5 ... + 40 (2)				- 5 ... + 40 (2)
Tropicalization		IEC: 60068-2-30, 60721-2-1	•		•				•
Electromagnetic compatibility		IEC: 62271-1	•		•				•

(1) Rated current guaranteed when circuit-breaker is installed in a PowerCube enclosure and with 40 °C ambient temperature
(2) For lower temperature please ask ABB.

5.6. Characteristics of the electrical accessories

RBX615 relay

Un	Type LV: 48 ... 60 V d.c.
	Type HV: 110 ... 250 V d.c.
Operating limits	75 ... 110% Un
Inrush power (Ps)	60 W
Inrush time	< 400 ms
Continuous power consumption (Pc)	< 15 W
Relay power on release impulse	< 150 W
Insulation voltage	2 kV
Electric I/O characteristics	see technical manual

– Shunt opening release (-MBO1)
– Shunt closing release (-MBC)

Un	Depending on the power supply voltage of the RBX615 relay
Opening time	35 ... 60 ms
Closing time	40 ... 70 ms
Insulation voltage	2000 V 50 Hz (for 1 min)

Additional shunt opening release (-MBO4)

Characteristics	
Un	24 ... 30 ~ 132 V d.c.
Un	48 - 60 - 110 - 120 - 127 - 220 ... 240 – V a.c./d.c. 50/60 Hz
Operating limits	70 ... 110% Un
Inrush power (Ps)	d.c. 200 W; a.c. = 200 VA
Inrush time	approx. 100 ms
Continuous power consumption (Pc)	d.c. = 5 W; a.c. = 5 VA
Opening time	33 ... 60 ms
Insulation voltage	2000 V 50 Hz (for 1 min)

Undervoltage release (-MBU)

Un	24 - 30 - 48 - 60 - 110 - 125 - 220 - 250 V–
Un	48 - 60 - 110 - 120 - 127 - 220 ... 240 V~ 50 Hz
Un	110 - 120 ... 127 - 220 ... 240 V~ 60 Hz
Operating limits	
– circuit-breaker opening	35-70% Un
– circuit-breaker closing	85-110% Un
Inrush power (Ps)	d.c. 200 W; a.c. = 200 VA
Inrush time	circa 100 ms
Continuous power consumption	d.c. = 5 W; a.c. = 5 VA
Opening time	30 ms
Insulation voltage	2000 V 50 Hz (for 1 min)

Electronic time delay device for undervoltage release (mounted outside the circuit-breaker)

Un	24 ... 30 - 48 - 60 - 110 ... 127 - 220 ... 250 V–
Un	48 - 60 - 110 ... 127 - 220 ... 240 V~ 50/60 Hz
Adjustable opening time (release + time delay device)	0.5-1-1.5-2-3 s

Motor for motorised truck (-MAT) (only for UniGear ZS1 withdrawable circuit-breakers)

Un	Depending on the RBX615 relay power supply voltage
Operating limits	85 ... 110% Un
Rated power (Pn)	40 W

Motor operator (-MAS)

Characteristics	
Un	24...30 - 48...60 - 110...130 - 220...250 V–
Un	100...130 - 220...250 V ~ 50/60 Hz
Operating limits	85 ... 110% Un
Inrush power(Ps)	≤ 40 kA
	d.c.=600 W; a.c.=600 VA
Rated power (Pn)	d.c.=200 W; a.c.=200 VA
Inrush time	0.2 s
Charging time	6-7 s
Insulation voltage	2000 V 50 Hz (for 1 min)

– Locking magnet on the truck (-RLE2) (*)
– Locking magnet on the actuator (-RLE1)

Un	Depending on the RBX615 relay power supply voltage

(*) Not available for versions with motorized truck.

6. Instructions for operating the circuit-breaker

6.1. Safety indications

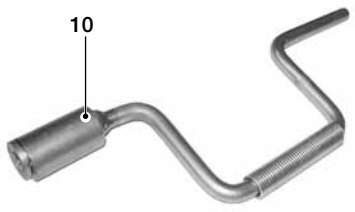
The eVD4 circuit-breakers guarantee a minimum IP2X degree of protection when installed in the following conditions:
- **fixed circuit-breaker, installed behind a protective metal net**
- **withdrawable circuit-breaker, installed in switchgear.**

Under these conditions the operator is totally guaranteed against accidental contact with moving parts.

Should mechanical operations be carried out on the circuit-breaker outside the switchgear, take great care of the moving parts.
If the operations are prevented, do not force the mechanical interlocks and check that the operating sequence is correct.
Racking the circuit-breaker in and out of the switchgear must be done gradually to avoid shocks which may deform the mechanical interlocks.

6.2. Switching and signalling parts

eVD4 circuit-breakers for UniGear switchgear and PowerCube units (fig. 6a).



1 Key lock (if provided) (*)
2 Lever for manually loading the closing spring
3 Coupling lever for racking-out operation (only for withdrawable circuit-breakers)
4 Opening pushbutton
5 Closing pushbutton
6 Signalling device for circuit-breaker open/closed
7 Signalling device for closing spring loaded/released
8 Operation counter.
9 Handles for operating the truck locks (only for withdrawable circuit-breakers)
10 Operating lever for circuit-breaker racking-in/out

(*) Warning! To activate the key lock: open the circuit-breaker, keep the opening pushbutton depressed, then turn the key and remove it from its seat.

Fig. 6a

6.3. Circuit-breaker closing and opening operations

Circuit-breaker operation can be either manual or electrical (fig. 6 - fig. 7).

a) Manual closing spring loading for eVD4 circuit-breakers for UniGear switchgear and PowerCube units (fig. 7a)

Repeatedly operate the loading lever (2) (maximum rotation angle of the lever: about 90°) until the yellow indicator (7) appears.
The maximum forces which can normally be applied to the lever are <150 N for the EL1operating mechanism, <200 N for the EL2 operating mechanism and <250 N for the EL3 operating mechanism.
For the type of operating mechanism, please refer to the rating plate in fig. 1.

b) Electric spring loading operation

On request, the circuit-breaker can be fitted with a geared motor for automatic closing spring loading.
The geared motor automatically reloads the spring after each closing operation until the yellow indicator (7) appears.
If the power is cut off during loading, the geared motor stops and automatically starts reloading the springs again when the power returns.
In any case, it is always possible to complete the loading operation manually.

Fig. 7a

c) Circuit-breaker closing

c1 Circuit-breaker closing from the front

The operation can only be carried out with the closing spring completely loaded.
For manual closing, press the button (5 - fig. 6a).
When there is a shunt closing release, the operation can also be carried out remotely by means of a special control circuit.
Closing having taken place is indicated by the signalling device (6 - fig. 6a).

c2 Closing the circuit-breaker by means of HMI

The operation can only be carried out with the circuit-breaker open and the closing spring fully loaded and by means of the shunt closing release.

Nota
Make sure that the control mode is set to “Local”

(the LED alongside the letter L on button 

must be on), otherwise press the control mode selection button until the LED alongside L comes on.

a) Select the Single Line Diagram (SLD) section

by means of the SLD button 

; the top bar on the display shows the part dedicated to the SLD (it turns black)

b) When the SLD is selected, use the “up” and “down” arrow buttons to select the circuit-breaker symbol.

c) When the CB is selected, press the green closing button  to close the circuit-breaker

The circuit-breaker will close and this will be indicated by the SLD and by the LED light on the green closing button “I”, the right-hand side of the display dedicated to the menu will now be active again.

d) Confirm the closing command by using the “enter” arrow 

d) Circuit-breaker opening

d1 Circuit-breaker opening from the front

For manual opening, press the button (4 - fig. 6a).
When there is a shunt opening release, the operation can also be carried out remotely by means of a special control circuit.
Opening having taken place is indicated by the signalling device (6 - fig. 6a).

d2 Circuit-breaker opening from the front

The opening operation is always enabled and is carried out by means of the shunt opening release.

Nota

Make sure that the control mode is set to “Local” (the LED alongside the letter L on button  must be on), otherwise press the control mode selection button until the LED alongside L comes on.
After having carried out the instructions in points a), b), c) and d), comply with the following indications to open the circuit-breaker:

e) select SLD with the SLD button

f) select the circuit-breaker by means of the arrow buttons

g) press the red “O” button to open the circuit-breaker

h) confirm the opening operation with the “enter” arrow button

The circuit-breaker will open and this will be indicated by the SLD and by the LED light on the red opening button “O”, the right-hand part of the display dedicated to the menu will now be active again.

7. Installation

7.1. General information

Correct installation is of primary importance. The manufacturer's instructions must be carefully studied and followed. It is good practice to use gloves for handling the pieces during installation

7.2. Installation and operating conditions

The following Standards must be taken into particular consideration during installation and service:
- IEC 62271-1/DIN VDE 0101
- VDE 0105: Electrical installation service
- DIN VDE 0141: Earthing systems for plants with rated voltage higher than 1 kV.
- All the accident prevention regulations in force in the relative countries.

7.2.1. Normal operating conditions

Follow the recommendations in the IEC 62271-1 and 62271-100 Standards. In more detail:

Ambient temperature	
Maximum	+ 40 °C
Average maximum over 24 hours	+ 35 °C
Minimum (according to class – 5), apparatus for indoor installation (*)	– 5 °C

(*) For lower temperatures, please ask ABB.

Humidity
The average value of the relative humidity, measured for a period longer than 24 hours, must not exceed 95%.
The average value of the pressure of the water vapour, measured for a period longer than 24 hours, must not exceed 2.2 kPa.
The average value of the relative humidity, measured for a period longer than 1 month, must not exceed 90%.
The average value of the pressure of the water vapour, measured for a period longer than 1 month, must not exceed 1.8 kPa.

Altitude
≤ 1000 m above sea level.

7.2.2. Special operating conditions

Installation over 1000 m a.s.l.
Possible within the limits permitted by reduction of the dielectric resistance of the air.

Increase in the ambient temperature
Reduction in the rated current.
Encourage heat dissipation with appropriate additional ventilation.

Climate
To avoid the risk of corrosion or other damage in areas with a high level of humidity, and/or with rapid and extensive temperature variations, take appropriate steps (for example, by using suitable electric heaters) to prevent condensation.

For special installation requirements or other operating conditions, please contact ABB.

The areas involved by the passage of power conductors or auxiliary circuit conductors must be protected against access by animals which might cause damage or disservices.

7.2.3. Trip curves

The following graphs show the admissible number of closing-opening cycles (No.) of the vacuum interrupters, according to the breaking capacity (Ia).

Caption (Figs. 8...)

No.=Number of closing-opening cycles allowed for the vacuum interrupters.

Ia =Breaking capacity of the vacuum interrupters.

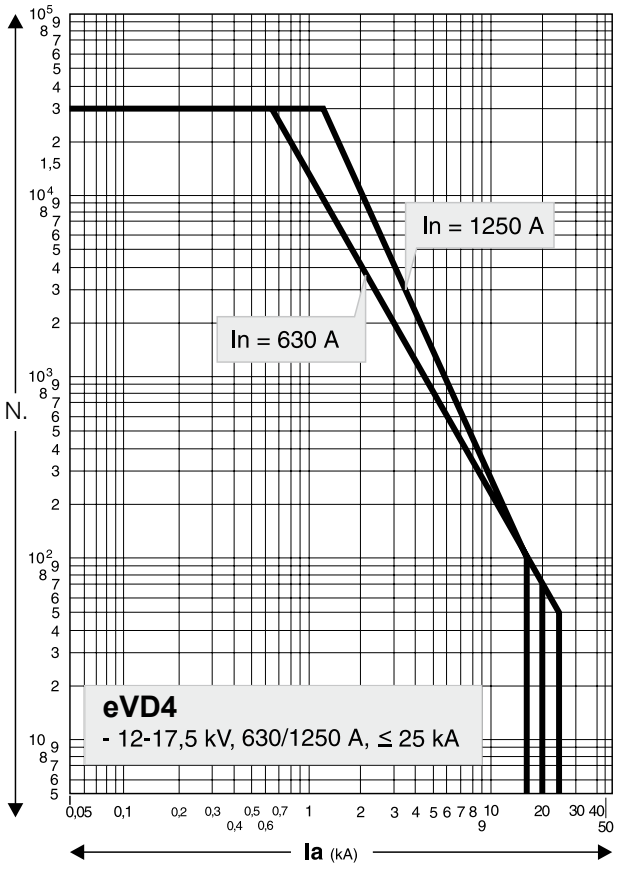


Fig. 8a

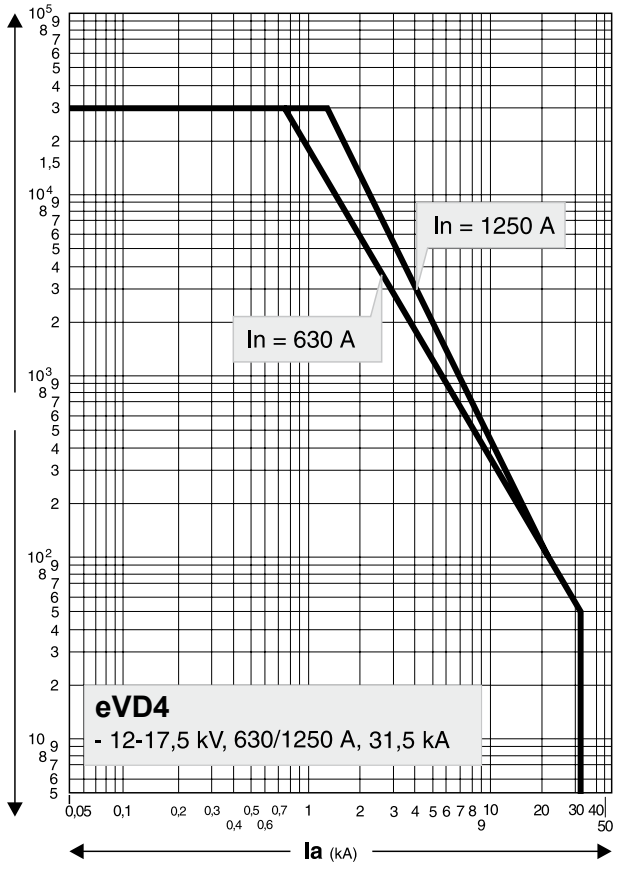


Fig. 8b

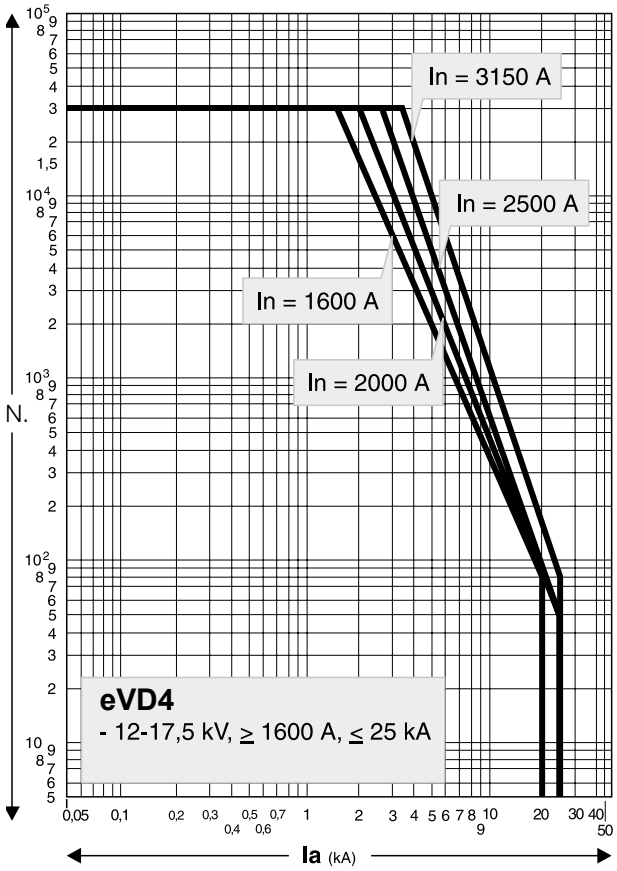


Fig. 8c

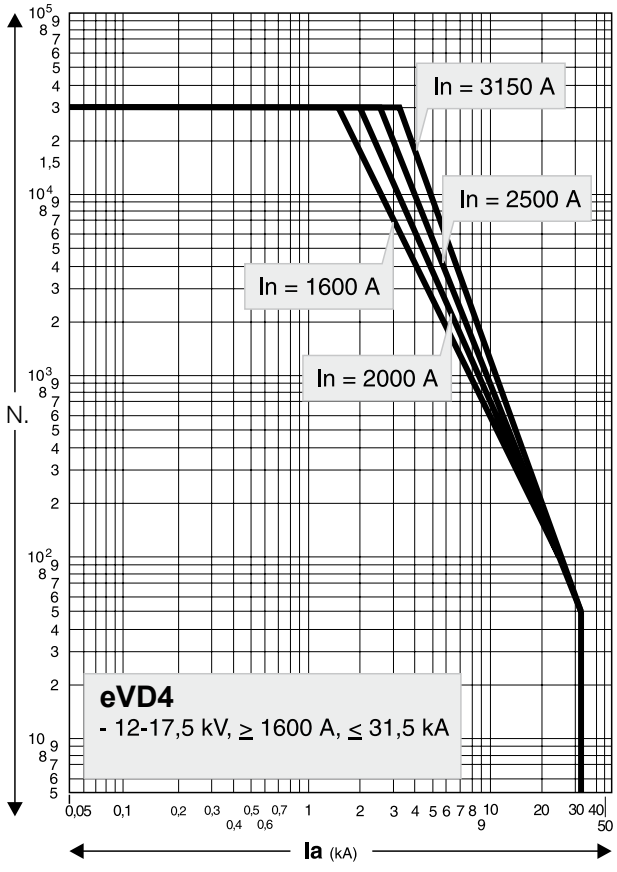


Fig. 8d

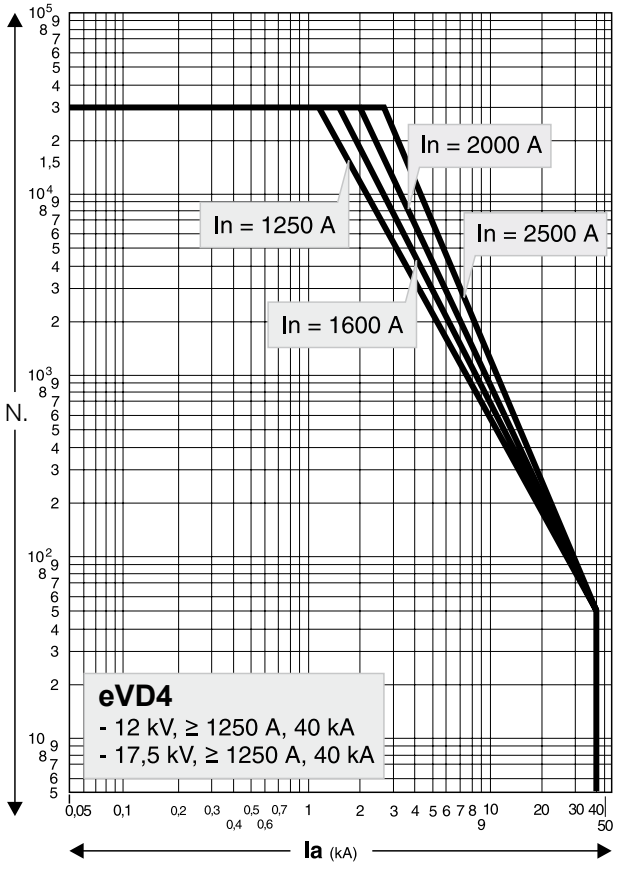


Fig. 8e

7.3. Preliminary operations

– Clean the insulating parts with clean dry cloths.
– Check that the top and bottom terminals are clean and free of any deformation caused by shocks received during transport or storage.

7.4. Installation of fixed circuit-breakers

The circuit-breaker can be mounted directly on supporting frames to be provided by the customer, or on a special supporting truck (available on request).
The circuit-breaker, with supporting truck, must be suitably fixed to the floor of its compartment by the customer.
The truck wheels must run on a carefully levelled surface.
A minimum degree of protection (IP2X) must be guaranteed from the front towards live parts.

7.5. Installation of withdrawable circuit-breakers in UniGear ZS1 switchgear and PowerCube units

The withdrawable circuit-breakers are pre-engineered for use in UniGear ZS1 switchgear and PowerCube units.
For racking-in/racking-out of the switchgear, fully insert the lever (1) (fig. 9) in the appropriate seat (2) and turn it clockwise for racking-in, and anti-clockwise for racking-out, until the end of travel positions are reached.
Circuit-breaker racking-in/-out must be carried out gradually to avoid shocks which may deform the mechanical interlocks and the limit switches.
The torque normally required to carry out racking-in and racking-out is ≤25 Nm.
This value must not be exceeded. If operations are prevented or difficult, do not force them and check that the operating sequence is correct.

Nota
To complete the racking-in/out operation, about 20 rotations of the lever are required for circuit-breakers up to 17,5 kV – pole centre distance 150 mm and about 15 for circuit-breakers up to 17,5 kV – pole centre distance 210-275 mm.

When the circuit-breaker has reached the isolated for test/isolated position, it can be considered in switchgear and earthed by means of the truck wheels.
Withdrawable circuit-breakers of the same version, and therefore with the same dimensions, are interchangeable.
However, when, for example, different electrical accessory fittings are provided, a different code for the plug of the auxiliary circuits prevents incorrect combinations between panels and circuit-breakers.
For the circuit-breaker installation operations, also refer to the technical documentation of the above-mentioned switchgear.

- **The racking-in/-out operations must always be carried out with the circuit-breaker open.**
- **When putting into service for the first time, it is advisable to charge the circuit-breaker operating mechanisms manually so as not to overload the auxiliary power supply circuit.**

7.5.1. Circuit-breakers with withdrawable motorized truck

Carry out the racking-in/racking-out test of the motorized truck in the same way as for a manual truck, following the instructions below:
– Rack the circuit-breaker into the switchgear in the open and isolated position, with the power supply to the motor circuit cut off and with the enclosure door closed.
– Insert the manual racking-in lever (1) in the special coupling (2) Fig. 9, and take the motorized truck to about half its run between the isolated for test and the connected position. The torque required for truck handling is ≤ 25 Nm. In the case of accidental reversal of the truck motor power supply polarity, this operation allows a possible error in direction to be dealt with without any damage.
Verification checks:
a) motor rotation **clockwise** during circuit-breaker racking-in.
b) motor rotation **anticlockwise** during circuit-breaker racking-out.
– Remove the manual lever (1) from the coupling (2) Fig. 9
– Power the truck motor circuit.
– Activate the control for the electrical racking-in operation. When racking-in has taken place, check correct changeover of the relative auxiliary contact.
– On completion, activate the control for the electrical racking-out operation. When racking-out has taken place, check correct changeover of the relative auxiliary contact.
– If there is a motor fault during a racking-in or racking-out operation, in an emergency the truck can be taken to the end of its run manually, after first cutting off the power supply to the motor power supply circuit and then, using the manual lever, work in the same way as with the manual truck.

- **By means of the chain transmission, truck handling carried out using the manual lever makes the truck motor armature rotate which, behaving like a generator, can cause inverse voltage at the connection terminals.**
- **This may damage the permanent magnet of the motor, therefore all the truck racking-in and racking-out operations carried out using the manual lever must be done without power in the motor circuit.**

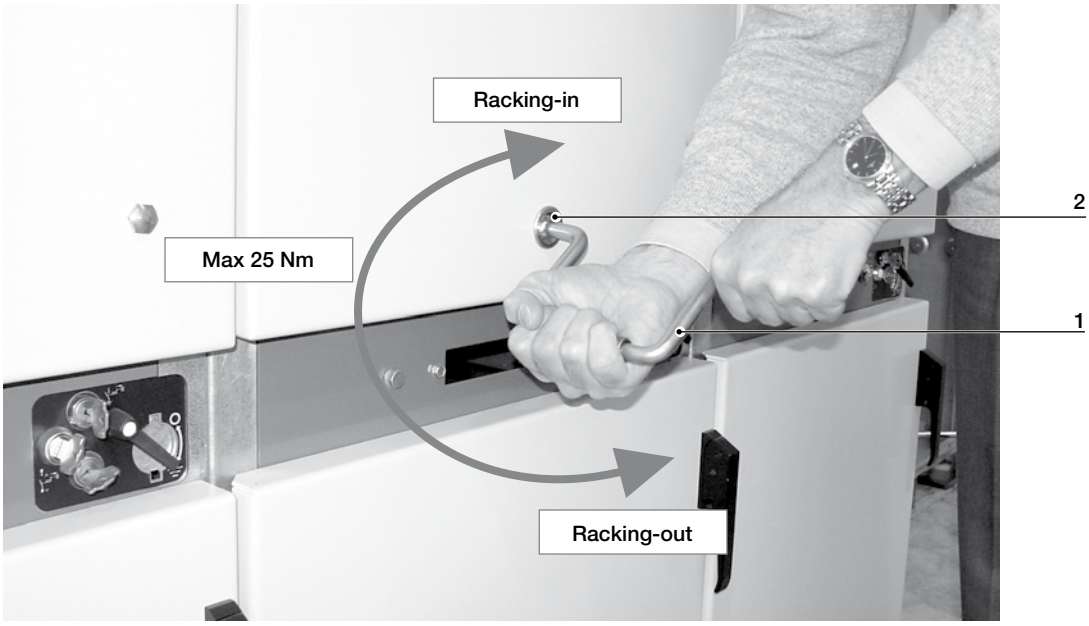


Fig. 9

7.5.2. Circuit-breaker racking-in and racking-out with a motorized truck by means of HMI

Racking-out operation

The operation can only be carried out with the circuit-breaker open.

Note

Make sure that the control mode is set to “Local”

(the LED alongside the letter L on button  smust be on), otherwise press the control mode selection button until the LED alongside L comes on.

a) Select the Single Line Diagram section (SLD)

by means of the SLD button  ; the top bar of the display shows the part dedicated to the SLD (it turns black)

b) When the SLD is selected, use the “up”

and “down” arrow buttons to select the truck symbol 

c) when the Truck is selected,
press the red opening button 
to rack-in the circuit-breaker

d) Confirm the racking-in command 
using the “enter” arrow
The truck symbol in the SLD will be updated as a consequence and the right-hand side of the display dedicated to the menu will now be active again.

The racking-in operation can only be carried out with the circuit-breaker open.

Note
Make sure that the control mode is set to “Local”

(the LED alongside the letter L on button 

must be on), otherwise press the control mode selection button until the LED alongside L comes on.

After having carried out the instructions in points a), b), c) and d), comply with the following indications to open the circuit-breaker:

i) select SLD, with the SLD button
j) select the truck symbol by means of the arrow button
k) press the green button “I” to rack-in the circuit-breaker
l) confirm the racking-in operation with the “enter” arrow button

The truck motor is activated causing circuit-breaker racking-in. The truck symbol in the SLD will consequently be updated. The right-hand side of the display dedicated to the menu will now be active again.

7.6. HMI installation instructions

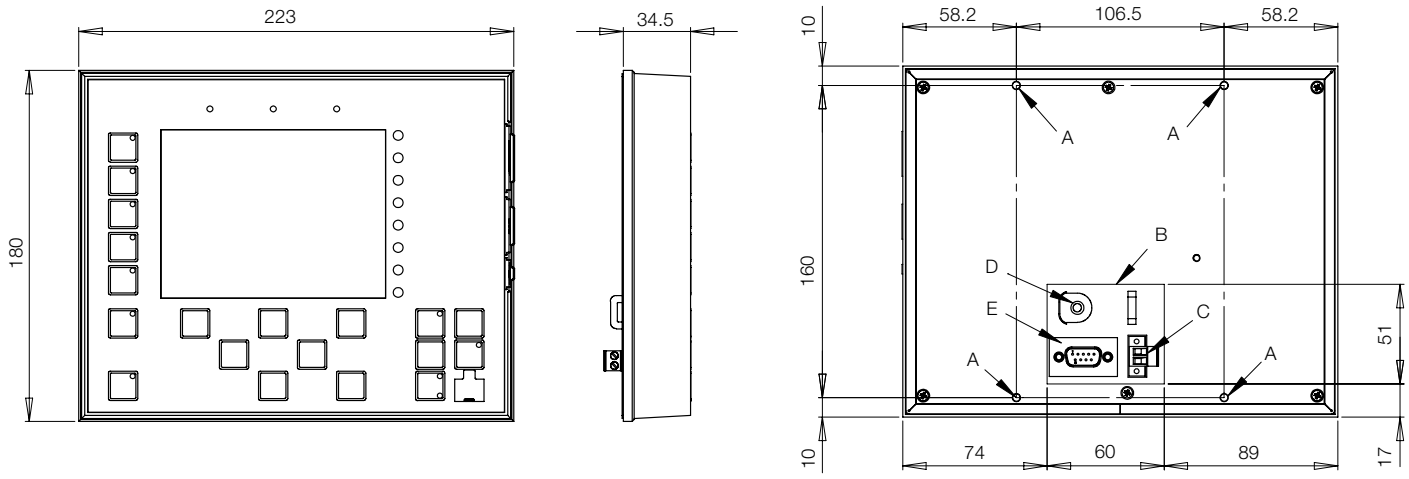
1) Drill the panel according to the HMI dimensional drawing (the dimensions are given in mm).
2) Drill the 4 holes for the M4 screws to fix the HMI.
3) Assemble the HMI using M4 screws and tighten the screws appropriately.
4) Fit the earthing cable in the special connector using M4 type screws.

   For the HMI earthing connection use a copper braid cable of Round Multistrand Cable type. Make sure that there is no paint, rust or anything else on the contact surface between the cable and the connector of the special HMI.

   Connect the other end of the cable to a safe earthing point of the switchgear.
5) Fit the communication cable in the special HMI connector 9 PIN -DSUB (-XDB31).

   The serial cable is supplied with the eVD4 socket Kit.
6) Assemble the two-pole power supply connector of the HMI (-XDB32).

   Note:
   The HMI can be supplied both in direct current and in alternating current (V = 48 ... 250 V d.c./a.c.).



A) 4 x Ø 4.5 mm holes for fixing M4 screws
B) Cable connection drilling
C) HMI –XBD22 power supply connector
D) Earthing hole for M4 screw
E) –XBD21 9 pin D-SUB connector for HMI signal communication

7.7. Power circuit connections of fixed circuit-breakers

7.7.1. General recommendations

– Select the cross section of the conductors according to the service current and the short-circuit current of the installation.
– Prepare special pole insulators near the terminals of the fixed circuit-breaker or of the enclosure, sized according to the electrodynamic forces deriving from the short-circuit current of the installation.

7.7.2. Assembly of the connections

– Check that the contact surfaces of the connections are flat, and are free of any burrs, traces of oxidation or deformation caused by drilling or impacts received.
– Depending on the conductor material and the surface treatment used, carry out the operations indicated in table T1 on the contact surface of the conductor.

Assembly procedure

– Put the connections in contact with the circuit-breaker terminals, taking care to avoid mechanical stress (traction / compression) on, for example, the conducting busbars on the terminals.
– Insert a spring washer and a flat washer between the head of the bolt and the connection.
– It is advisable to use bolts according to DIN class 8.8 Standards, also referring to what is indicated in table T2.
– In the case of cable connections, strictly follow the manufacturer's instructions to make the terminals.

T1

Bare copper
– Clean with a fine file or emery cloth.
– Tighten fully and cover the contact surfaces with 5RX Moly type grease.

Copper or silver-plated aluminium
– Clean with a rough dry cloth.
– Only in the case of obstinate traces of oxidation, clean with a very fine grain emery cloth taking care not to remove the surface layer.
– If necessary, restore the surface treatment.

Bare aluminium
– Clean with a metal brush or emery cloth.
– Cover the contact surfaces again immediately with neutral grease.
– Insert the copper-aluminium bimetal with polished surfaces (copper side in contact with the terminal; aluminium side in contact with the connection) between the aluminium connection and the copper terminal.

T2

Bolt	Recommended tightening torque (1)	
	Without lubricant	With lubricant (2)
M6	10 Nm	4.5 Nm
M8	30 Nm	10 Nm
M10	40 Nm	20 Nm
M12	70 Nm	40 Nm
M16	200 Nm	80 Nm

(1) The nominal tightening torque is based on 0.14 friction coefficient of the thread (distributed value the thread is subjected to, which in some cases is not negligible). The nominal tightening torque with lubricant is according to the DIN 43673 Standards.
(2) Oil or grease. Thread and contact surfaces of the lubricated heads. Take into account the deviations from the general Standards table (for example, for systems in contact or terminals) as foreseen in the specific technical documentation. The thread and contact surfaces of the bolt heads must be slightly oiled or greased, so as to obtain a correct nominal tightening torque.

7.8. Earthing

Earth the fixed version circuit-breaker by means of the special screw marked with the relative symbol.
Clean and degrease the area around the screw to a diameter of about 30 mm and, on completion of assembly, cover the joint again with Vaseline grease.
Use a conductor (busbar or braid) with a cross section conforming to the Standards in force.

7.9. Connection of the auxiliary circuits

Note: the minimum cross section of the wires used for the auxiliary circuits must not be less than the one used for the internal wiring. Furthermore, they must be insulated for 3 kV test voltage.

7.9.1. Socket wiring Kit

The eVD4 socket wiring kit allows simple and rapid construction of the panel wiring part. It consists of:
– 58-pin socket pre-engineered for Ethernet electric ports (1)
– Cables 1.5 metres long with 2.5 mm^2 cross section copper cables for the power connections and with 1 mm^2 cross section for the signal connections
– Serial cable 1.5 m long for the signal connection with the HMI fitted with special connector on the end (2)
– 2 Ethernet connection modules 1.5 m long with cylindrical connector on the socket side and RJ45 connector on the other end. Allows easy integration of the eVD4 in communication systems based on Ethernet (3)

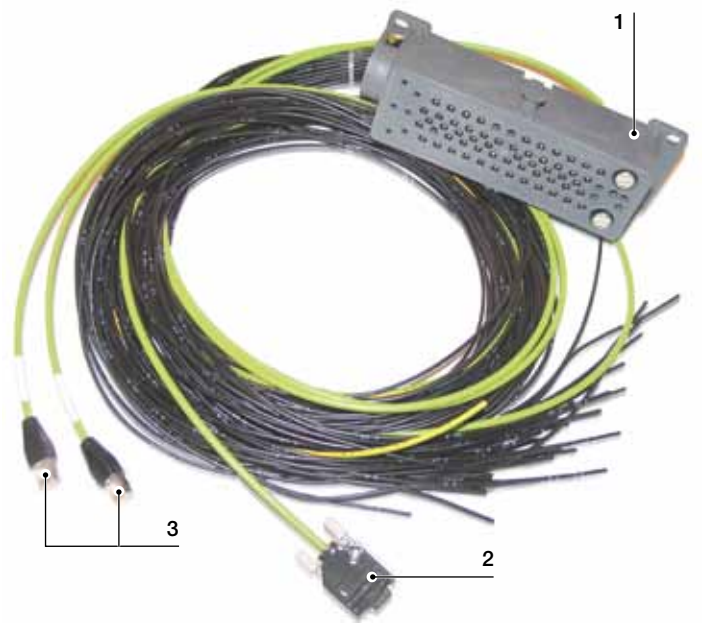


Fig. 10

7.9.2. Withdrawable and fixed circuit-breaker

The auxiliary circuits of the withdrawable and fixed circuit-breaker are fully factory-wired up to the connector (fig. 11). For external connections, refer to the electric wiring diagram of the switchgear.

eVD4 circuit-breaker for UniGear switchgear and PowerCube units.

Fig. 11

8. Putting into service

8.1. General procedures

All the operations regarding putting into service must be carried out by ABB personnel or by suitably qualified customer personnel with in-depth knowledge of the apparatus and of the installation. Should the operations be prevented, do not force the mechanical interlocks and check that the operating sequence is correct.
The operating forces which can be applied for racking-in withdrawable circuit-breakers are indicated in paragraph 7.5.

Before putting the circuit-breaker into service, carry out the following operations:
- check tightness of the power connections to the circuit-breaker terminals;
- establish the setting of the primary electronic overcurrent release (if provided);
- check that the value of the power supply voltage of the auxiliary circuits is between 85% and 110% of the rated voltage of the electrical accessories;
- check that no foreign bodies, such as bits of packing, have got into the moving parts;
- check that there is a sufficient exchange of air in the installation place to avoid overtemperatures;
- also carry out the checks indicated in table T3.

T3

ITEM	INSPECTED	PROCEDURE	POSITIVE CHECK
1	Insulation resistance.	**Medium voltage circuit** With a 2500 V megger, measure the insulation resistance between the phases and the exposed conductive part of the circuit.	The insulation resistance should be at least 50 Mohm and in any case constant over time.
		Auxiliary circuits With a 500 V megger (if the apparatus installed allows this), measure the insulation resistance between the auxiliary circuits and the exposed conductive part. N.B. Before carrying out this operation, remove the RBX615 unit (refer to paragraph 5.3.7.) and prevent the terminals leading to connectors 401 and 402 of the socket (connectors for the communication card) from being powered.	The insulation resistance should be a few Mohm and in any case constant over time.
2	Auxiliary circuits.	Check that the connections to the control circuit are correct: proceed with the relative power supply.	Operations and signals normal.
3	RBX615 unit operation	With the auxiliary circuit powered, check that the ready LED (both on the RBX615 unit and on the HMI) is on.	The LEDs are on and not flashing.
4	Manual operating mechanism.	Carry out a few closing and opening operations both from the front of the circuit-breaker and from HMI (see chap. 6). N.B. If these applications are present, make sure that the locking magnet on the operating mechanism (-RLE1) is energized and that the undervoltage release (-MBU) is powered.	The operations and relative signals take place normally.
5	Motor operator (if provided).	Supply the spring charging geared motor at the relative rated voltage.	The spring is loaded normally. The signals are normal. With the spring loaded, the geared motor stops.
		Carry out a few closing and opening operations both from the front of the circuit-breaker and from HMI (see chap. 6). N.B. If these applications are present, make sure that the locking magnet on the operating mechanism (-RLE1) is energized and that the undervoltage release (-MBU) is powered.	The geared motor reloads the spring after each closing operation.
6	Undervoltage release (if provided).	Supply the undervoltage release at the relative rated voltage and carry out the circuit-breaker closing operation.	The circuit-breaker closes normally. The signals are normal.
		De-energize the release.	The circuit-breaker opens. The signal changes over.
7	Key lock (if provided).	Open the circuit-breaker, keep the opening pushbutton pressed, then turn the key and remove it from its seat. Attempt the circuit-breaker closing operation.	Neither manual nor electrical closing takes place.
		Put the key back in and turn it 90°. Carry out the closing operation.	Both electrical and manual closing take place normally; in this position the key cannot be removed.
8	Locking electromagnet (-RLE1) (if provided).	With circuit-breaker open, spring loaded, RBX615 unit and locking electromagnet (-RLE1) not powered, attempt manual circuit-breaker closing.	Closing not is possible.
9	Locking electromagnet on the circuit-breaker truck (-RLE2) (if provided).	With the circuit-breaker open in the isolated for test position, the RBX615 unit and locking electromagnet (-RLE2) not powered, try to rack the circuit-breaker in.	Racking-in is not possible.
		Supply the RBX615 unit, make sure that the electromagnet (-RLE2) is energized and carry out the racking-in operation.	Racking-in takes place correctly.

9. Maintenance

The maintenance operations are aimed at keeping the apparatus in good working condition for as long as possible. In accordance with what is specified in the IEC 61208 / DIN 31 051 Standards, the following operations must be carried out.

Inspection: Finding out the actual conditions
Servicing: Measures to be taken to maintain the specific conditions
Repairs: Measurements to be taken to restore the specific conditions.

9.1. General information

Vacuum circuit-breakers are characterised by simple, sturdy construction and a long life.
The operating mechanism requires maintenance and functional inspections to reach its expected operating-life (see par. 9.3.2.).
The vacuum interrupters are maintenance-free for their whole operating life.
Vacuum interruption does not produce any harmful effects even when there are frequent trips at the rated and short-circuit current.
The interventions during service and their aim are determined by environmental conditions, by the sequence of operations and by the short-circuit trips.

Note
Comply with the following Standards for maintenance work:
– the relative specifications given in the chapter on “Standards and Specifications”;
– labour safety regulations in the chapter on “Putting into service and operations”;
– standards and specifications of the country where the apparatus is installed.

The maintenance operations must only be carried out by trained personnel who follow all the safety regulations.
Furthermore, it is advisable to call in ABB personnel, at least in cases for checking the performances in service and for repairs.
Cut the power supply off and put the apparatus under safe conditions during the maintenance operations.

Before carrying out any operations, check that the circuit-breaker is open, with the spring discharged and that it is not powered (medium voltage circuit and auxiliary circuits).

9.1.1. Operating life expectancy

The operating life expectancy for the eVD4 circuit-breakers is as follows:
– vacuum interrupters: up to 30,000 operations, according to their type (see par. 7.2.3. Trip curves);
– actuator and transmission system: up to 30,000 operations, under normal operating conditions, according to the type of circuit-breaker and with regular maintenance (see par. 9.3.2.);
– with operations correctly executed it is possible to carry out up to 1000 racking-out/in operations (as prescribed in the IEC 60271-200 Standards);
– the data regarding the operating life are basically applicable to all the components which cannot be directly affected by operator activity. The behaviour of manually operated components (moving parts of isolatable parts, etc.) can vary.

9.2. Inspections and functional tests

9.2.1. Breaking devices in general

– Check the conditions of the interruption devices with regular inspections.
– Inspection at fixed intervals can be avoided when the apparatus is permanently under the control of qualified personnel.
– The checks must, first of all, include visual inspection to check for any contamination, traces of corrosion or electrical discharge phenomena.
– Carry out more frequent inspections when there are unusual operating conditions (including severe climatic conditions) and in the case of environmental pollution (e.g. high level of contamination or an atmosphere with aggressive agents).
– Visual inspection of the isolating contacts. Remember to turn the contact system alternately in order to keep the internal surface of the contact areas clean. The contact areas must be cleaned when there are signs of overheating (discoloured surface) (also see Repairs).
– In the case of abnormal conditions, take suitable servicing measures (see Servicing par.).

9.2.2. Stored energy spring operating mechanism

Carry out the functional test of the operating mechanism after 5,000 operations or during normal maintenance operations as specified in par. 9.2.1.
Before doing the test, open the circuit-breaker and carry out the following operations:
– in the case of withdrawable circuit-breakers, set the circuit-breaker in the isolated for test position
– in the case of fixed circuit-breakers: cut off the power supply to the medium voltage circuit.

Note
Insulate the work area and make it safe, following the safety regulations specified in the IEC/DIN VDE Standards.

Functional test

– With the circuit-breaker not connected to the load, carry out a few opening and closing operations.
– If required, cut off the power supplied to the spring loading motor. Release the spring by closing and opening the circuit-breaker with the closing and opening pushbuttons.
– Visually inspect the lubrication conditions of the tulip isolating contacts, of the sliding surfaces, etc.
– Check correct electrical and mechanical operation of the various devices, with particular attention to the interlocks.

– The screws and nuts are tightened in the factory and correct tightening is marked with a coloured sign. No further tightening operations should be required during the operating life of the circuit-breaker. Should the screws or nuts need to be re-tightened after maintenance operations, always replace them and comply with the values given in fig. 12.

9.2.3. Circuit-breaker pole

No other check is necessary, except what has already been specified in par. 9.2.1.

9.2.4. Withdrawable assembly (truck and circuit-breaker)

Visually inspect the components, especially those which may be damaged by incorrect operations (also see table in chap. 8).
Visually inspect the isolating contacts and make sure that all the contact parts are clean, especially in cases where signs of overheating are found (also see par. 9.4.).
Visually inspect the locks and perform functional tests to make sure that they function properly and activate without abnormal force - maximum 25 N (also see table in chap. 8).

Screw tightness test

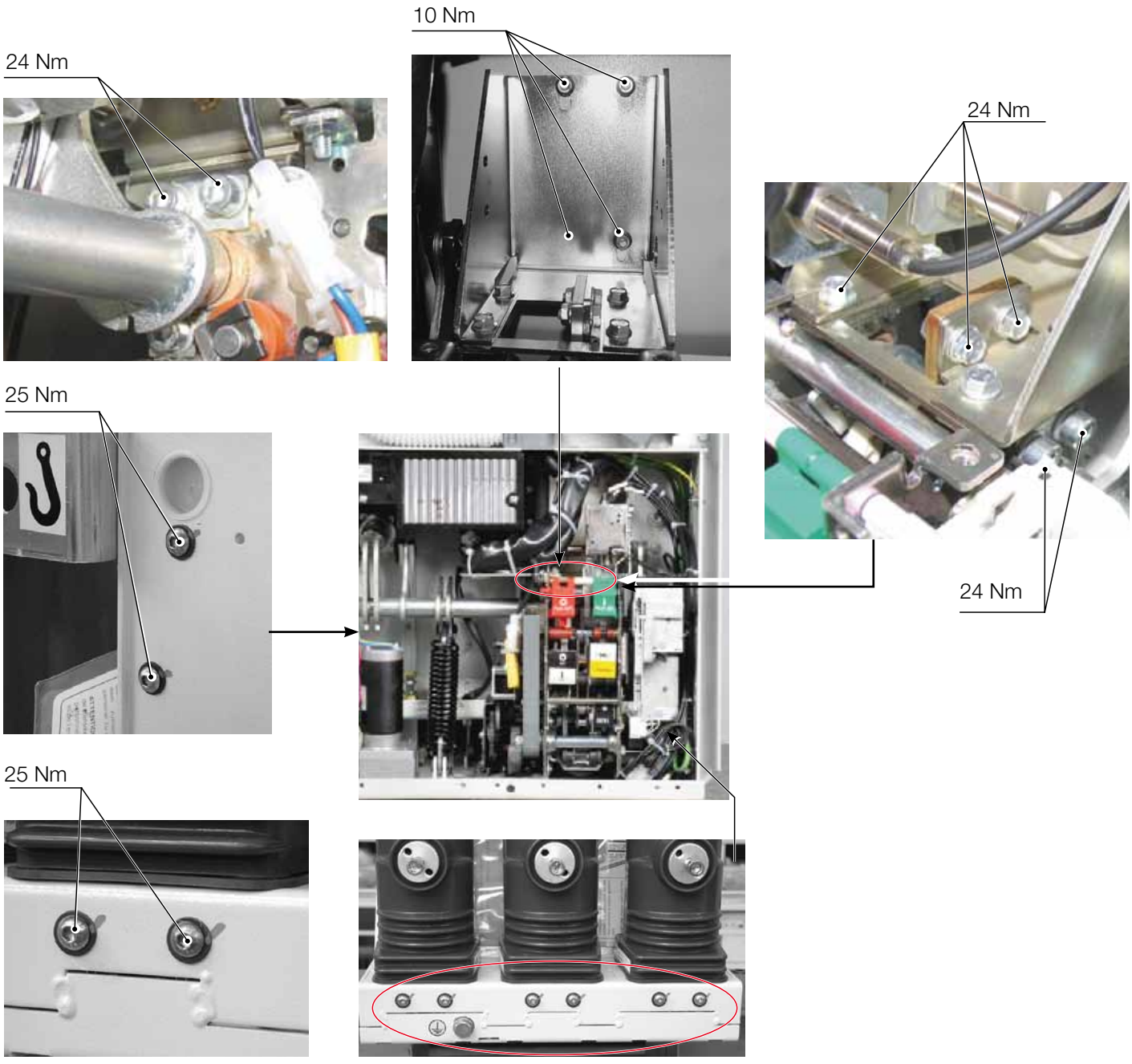


Fig. 12

9.3. Servicing

9.3.1. Breaking devices in general

Should it have been necessary to clean the devices during the inspections, according to the instructions in par. 9.2.1., comply with the following procedure:

- isolate the work area and make it safe, following the safety regulations specified in the IEC/DIN VDE Standards;
- general cleaning of surfaces:
  - dry and eliminate light deposits of dirt with a soft dry cloth;
  - more resistant dirt can be removed using slightly alkaline domestic type detergent or Rivolta BWR 210 type detergent;
- cleaning insulating surfaces and conductive parts:
  - light dirt: with Rivolta BWR 210 detergent;
  - resistant dirt: with cold detergent type 716.

After cleaning, rinse thoroughly with clean water and dry carefully.

Note
Only use detergents without halogens and never 1.1.1-trichloroethane, trichloroethylene or carbon tetrachloride!

9.3.2. Tripping devices: actuator and transmission system

Circuit-breakers up to 31.5 kA and up to 2500 A

To ensure correct operation of the circuit-breaker, inspection and maintenance of the tripping devices is recommended every 10,000 operations. For this purpose, please contact the ABB Service office.
Complete replacement of the actuator, shock absorber and of the other transmission system parts (shaft, main levers, safety rings, etc.) must be carried out after 30,000 operations.

Circuit-breakers up to 40 kA and up to 2500 A

To ensure correct operation of the circuit-breaker, inspection and maintenance of the tripping devices is recommended every 10,000 operations. For this purpose, please contact the ABB Service office.
Complete replacement of the actuator must be carried out every 10,000 operations.
Complete replacement of the shock absorber and of the other transmission system parts (shaft, main levers, safety rings, etc.) must be carried out after 30,000 operations.

Note
Dismantling and replacement of the operating mechanism (trip box) can only be carried out by ABB personnel or by skilled and specially trained personnel, particularly for the necessary adjustments.

Details regarding servicing

- When required, cut off the power supply to the spring loading motor and manually release the operating mechanism spring by closing and opening the circuit-breaker.
- Replace the parts subjected to mechanical stress or stress due to particular environmental conditions (contact an ABB service centre).

Note
These operations can only be carried out by ABB personnel or by skilled and specially trained personnel.

9.3.3. Circuit-breaker pole

The circuit-breaker pole and relative vacuum interrupter are maintenance-free until the maximum number of electrical operations for the type of interrupter is reached (see par. 7.2.3. Trip curves).
The operating life of the vacuum interrupter is defined by the sum of the ultimate currents corresponding to the specific type of interrupter in accordance with what is indicated in the graphs of par. 7.2.3. Trip curves: when the sum of the ultimate currents is reached, the whole pole must be replaced.

Note
Dismantling and replacement of the pole can only be carried out by ABB personnel or by skilled and specially trained personnel, particularly with regard to the necessary adjustments.

To carry out the interrupter test without dismantling the circuit-breaker pole, use:
– the VIDAR vacuum tester, manufactured by the Programma Electric GmbH, Bad Homberg v.d.H.

To check vacuum tightness of the interrupter, the following test values must be set on the VIDAR tester:

Rated voltage of the circuit-breaker	d.c. test voltage
12 kV	40 kV
17.5 kV	40 kV

The test must always be carried out with the circuit-breaker open with the contacts at the nominal distance (12 kV and 17.5 kV).
Procedure for testing the degree of vacuum of the circuit-breaker pole interrupter:

– turn the power supply off and make the working area safe by following the safety regulations specified in the IEC/DIN VDE Standards;
– remove the RBX615 device (see paragraph 5.3.7.);
– open the circuit-breaker;
– earth a terminal of each circuit-breaker pole;
– connect the earth terminal of the VIDAR tester to the circuit-breaker structure;
– connect the high voltage terminal of the VIDAR tester to the terminal of the circuit-breaker pole not connected to earth (L1 phase) and carry out the test. Repeat the test for phases L2 and L3.

Note
The tester connection cables can produce an indication due to the capacitive effect. In this case the cables must not be removed.

9.4. Repairs

Replacement of spare parts and accessories must only be carried out by ABB personnel or suitably qualified and specially trained personnel.
Always work with the circuit-breaker open and locked so that it cannot be closed again, with the work area isolated and made safe.
The operating mechanism spring must be released.
All power supply sources must be disconnected and made safe against reclosing during removal and installation operations.

Should maintenance be carried out by the customer's personnel, responsibility for the interventions remains with the customer. Replacement of parts not included in the "List of spare parts/accessories" (par. 12.1.) must only be carried out by ABB personnel. In particular:
– complete pole with bushings/connections
– actuator and transmission system
– closing spring set
– opening spring
– shock-absorber.

10. Application of X-ray emission standards

One of the physical properties of vacuum insulation is the possibility of X-ray emission when the interrupter contacts are open.
The specific tests carried out at the PTB laboratories (Physikalisch-Technische Bundesanstalt, in Brunswick - Germany) show that local emission at a distance of 10 cm from the interrupter or pole surface does not exceed 1 mSv/h.

It follows that:
- at the rated service voltage the use of vacuum interrupters is absolutely safe;
- application of the withstand voltage at power frequency, according to the IEC 62271-100 and VDE 0670 Standards, is safe;
- a voltage higher than the withstand voltage at power frequency or of a test voltage in direct current, specified in the IEC and VDE Standards, cannot be used;
- limitation of the above-mentioned local phenomena, with interrupters with open contacts, depends on keeping the specific distance between the contacts.
  This condition is intrinsically guaranteed by correct operation of the operating mechanism and by the adjustments of the transmission system.

11. Spare parts and accessories

All assembly operations of spare parts/accessories must be carried out following the instructions enclosed with the spare parts, by ABB personnel or by suitably qualified customer personnel with in-depth knowledge of the apparatus (IEC 62271) and of all the Standards aimed at ensuring that these interventions are carried out in safe conditions. Should the maintenance be carried out by the customer's personnel, responsibility for the interventions remains with the customer. Before carrying out any operation, always make sure that the circuit-breaker is open, the spring released and that it is not energised (medium voltage circuit and auxiliary circuits).

To order circuit-breaker spare parts/accessories, refer to the ordering sales codes indicated in the technical catalogue and always state the following:
– type of circuit-breaker
– rated voltage of the circuit-breaker
– rated thermal current of the circuit-breaker
– breaking capacity of the circuit-breaker
– serial number of the circuit-breaker
– rated voltage of any electrical spare parts.

For availability and to order spare parts, please contact our Service office.

11.1. List of spare parts

– Shunt opening release
– Additional shunt opening release
– Undervoltage release
– Time delay device for undervoltage release
– Shunt closing release
– Spring loading geared motor with electrical signalling of spring loaded
– Locking electromagnet on the operating mechanism
– Key to lock in open position
– Isolation interlock with the door
– Protection for opening pushbutton
– Protection for closing pushbutton
– Locking electromagnet on the withdrawable truck
– Set of six tulip contacts
– RBX615 protection and control unit
– Human machine Interface (HMI)
– eVD4 socket Kit.

12. Electric circuit diagrams

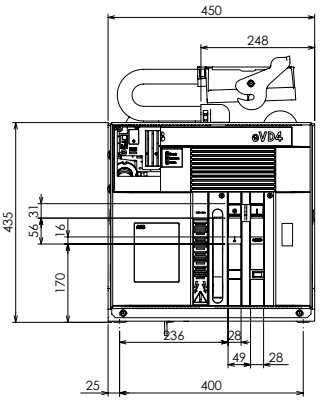
The standard eVD4 circuit-breaker electric circuit diagrams are as follows:
– 1VCD400137: Fixed circuit-breakers
– 1VCD400106: Withdrawable circuit-breakers

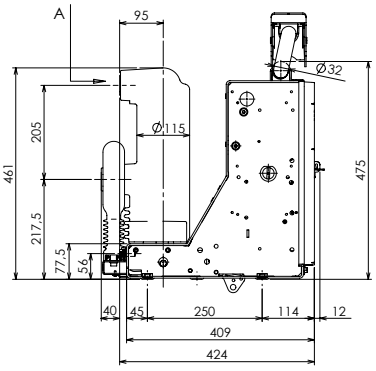
Each circuit-breaker is always provided with the standard electric circuit diagram or with a specific diagram in the case of a circuit-breaker with non-standard wiring.

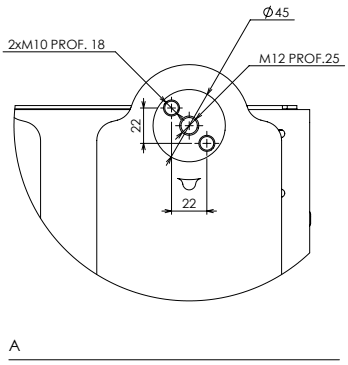
13. Overall dimensions

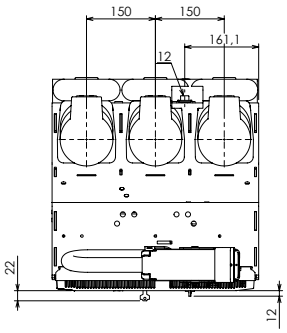
Fixed circuit-breakers

eVD4		
TN	1VCD000156	
Ur	12	kV
	17.5	kV
Ir	630	A
	1250	A
Isc	16	kA
	20	kA
	25	kA
	31.5	kA



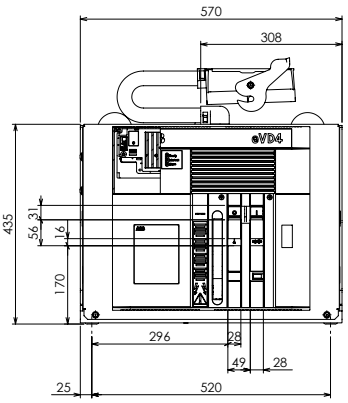


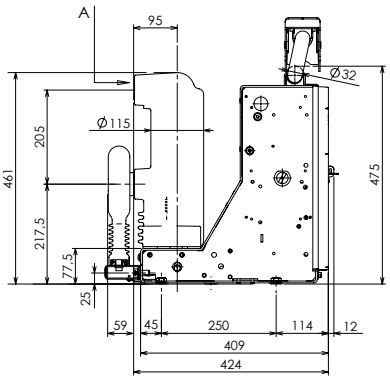


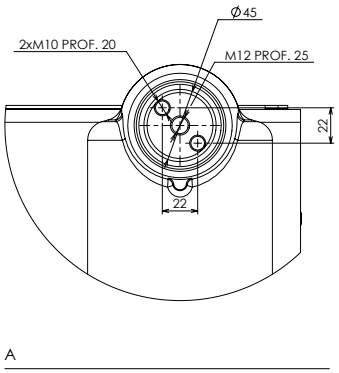


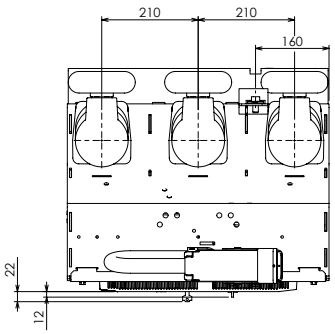
Fixed circuit-breakers

eVD4		
TN	1VCD000157	
Ur	12-17.5	kV
Ir	630	A
	1250	A
Isc	16	kA
	20	kA
	25	kA
	31.5	kA



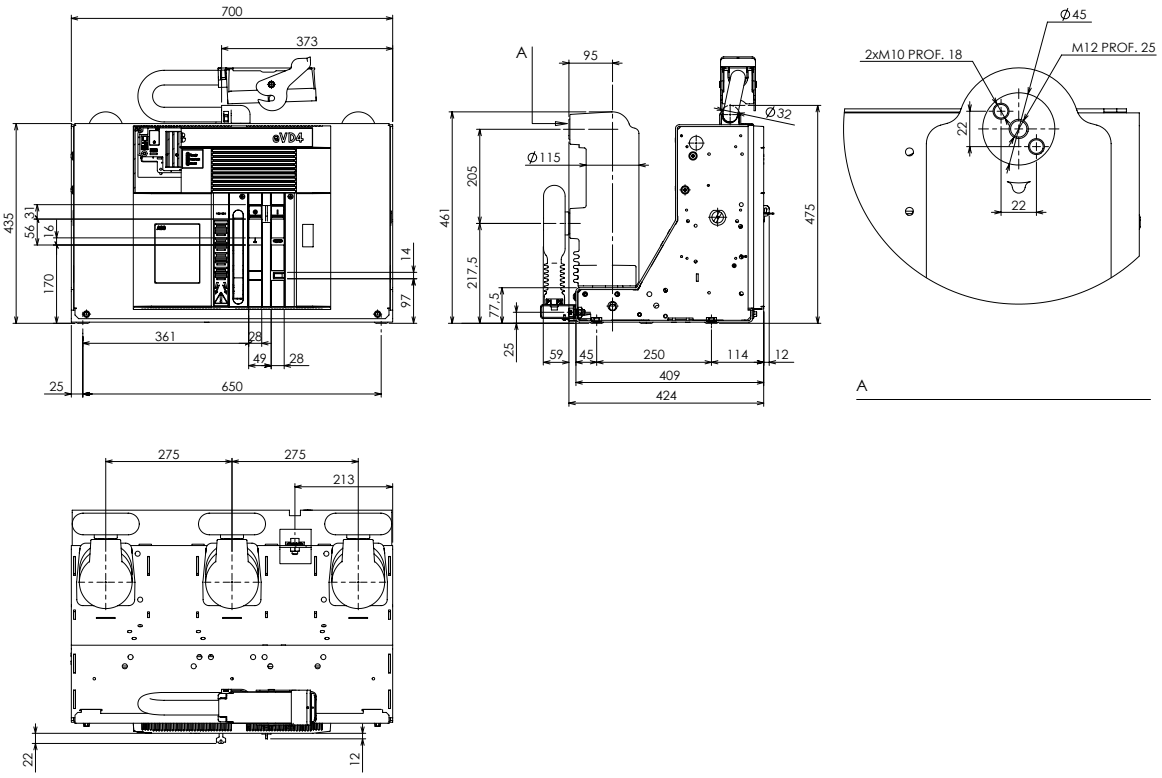






Fixed circuit-breakers

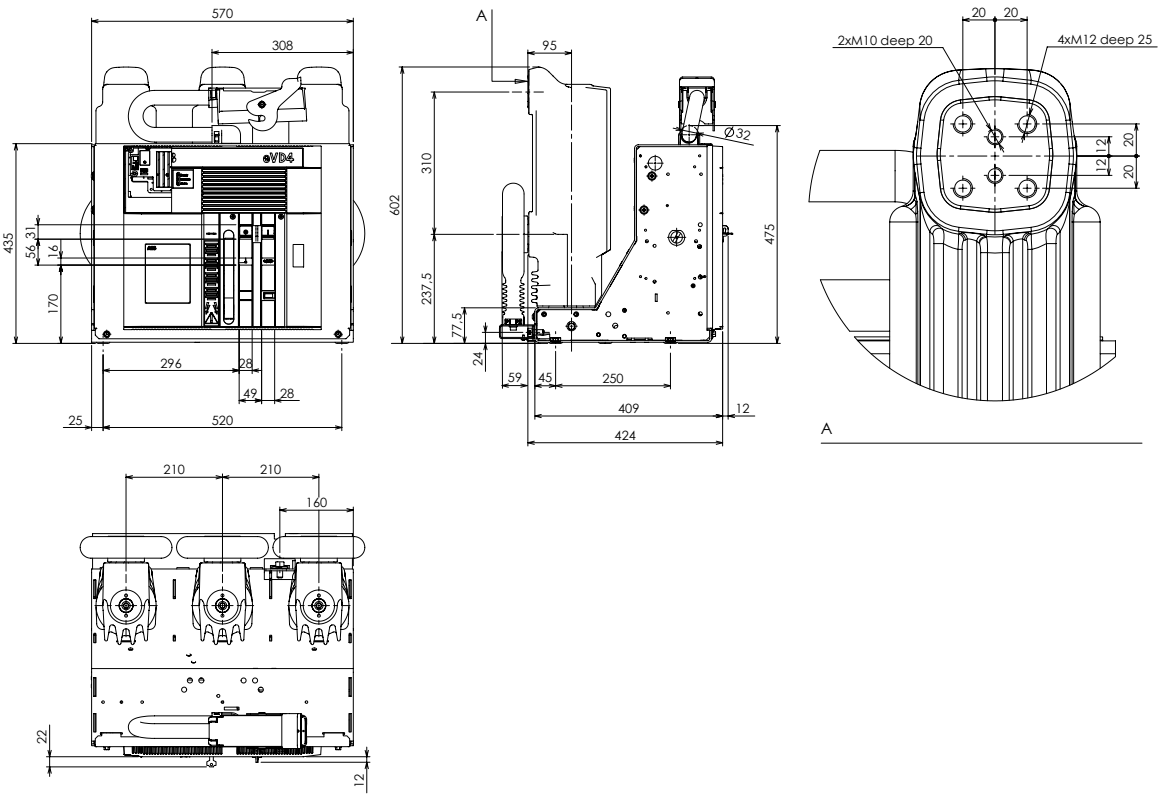
eVD4		
TN	1VCD000158	
Ur	12-17.5	kV
Ir	630	A
	1250	A
Isc	20	kA
	25	kA
	31.5	kA



Fixed circuit-breakers

eVD4		
TN	1VCD000159	
Ur	12	kV
	17.5	kV
Ir	1600	A
	2000	A
Isc	20	kA
	25	kA
	31.5	kA
	40 (*)	kA

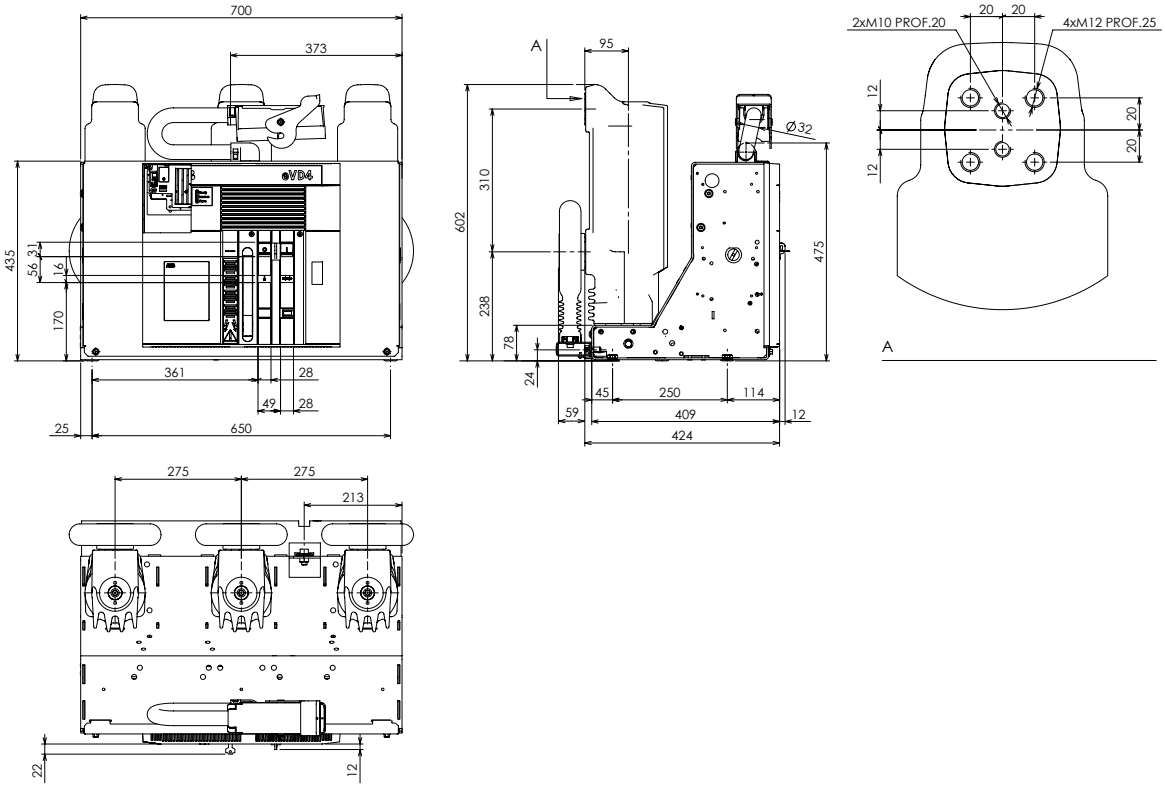
(*) only 2000 A



(*) Fixing interchangeability with the previous series (345 x 650).

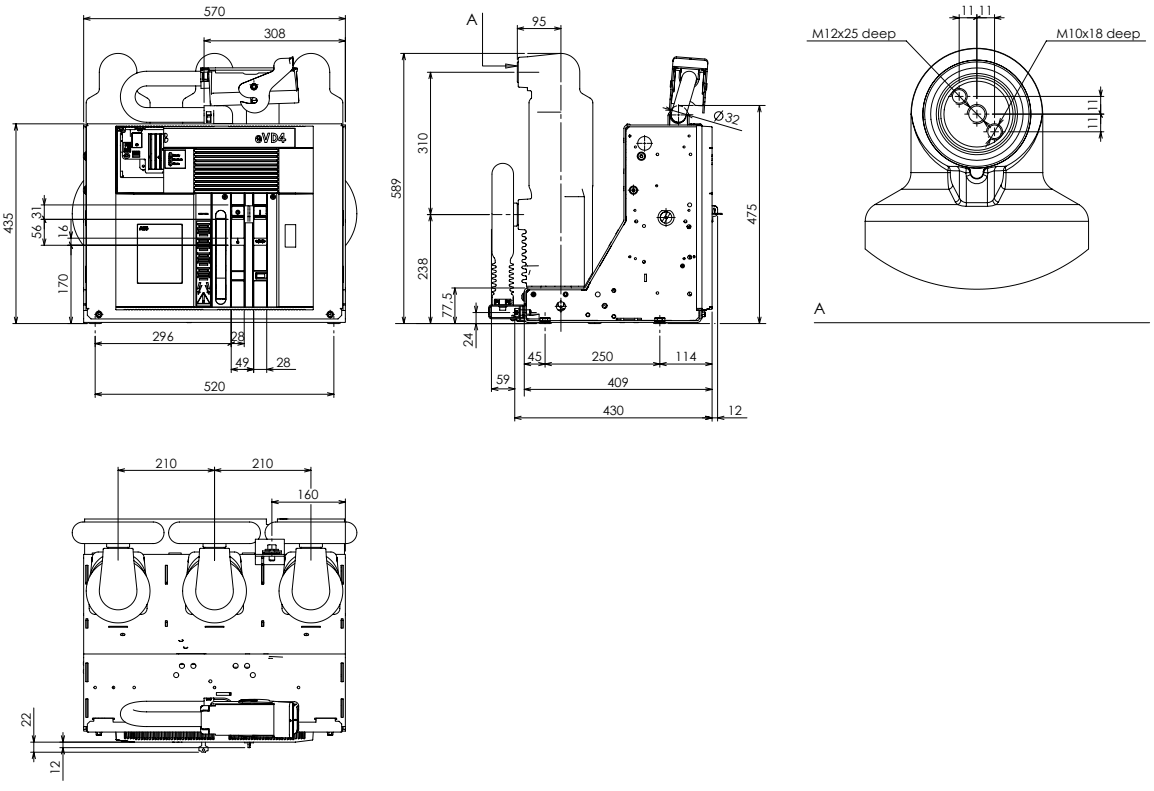
Fixed circuit-breakers

eVD4		
TN	1VCD000160	
Ur	12	kV
	17.5	kV
Ir	1600	A
	2000	A
Isc	20	kA
	25	kA
	31.5	kA



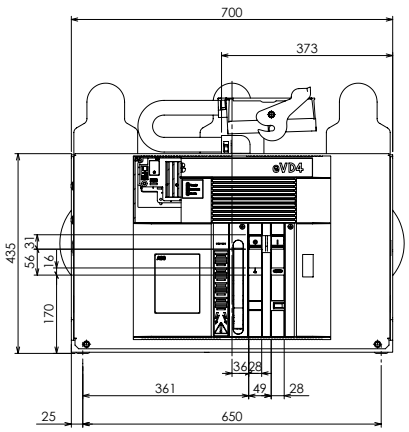
Fixed circuit-breakers

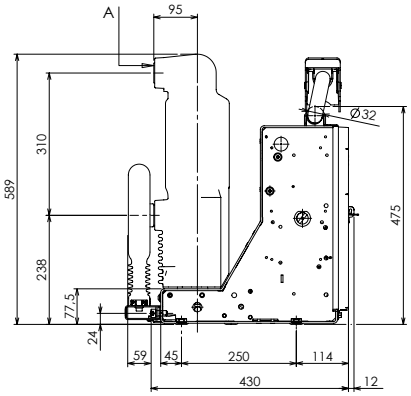
eVD4		
TN	1VCD000161	
Ur	12	kV
	17.5	kV
Ir	1250	A
	1600	A
Isc	40	kA

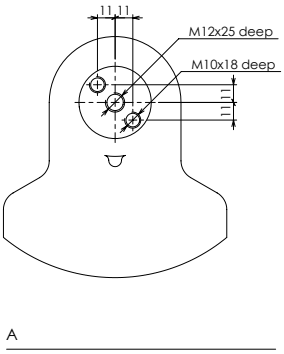


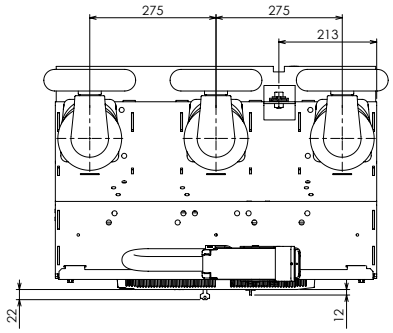
Fixed circuit-breaker

eVD4		
TN	1VCD000162	
Ur	12	kV
	17.5	kV
Ir	1250	A
	1600	A
Isc	40	kA



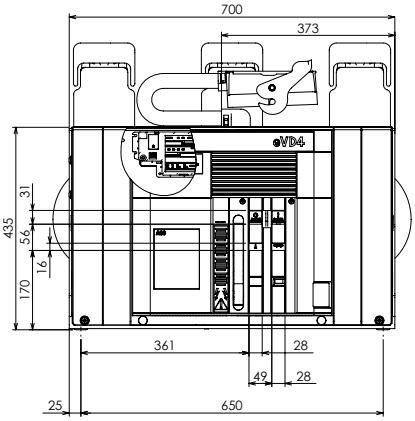


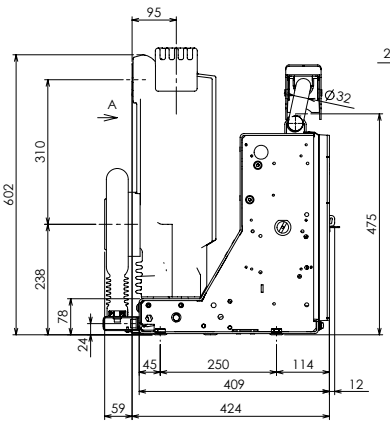


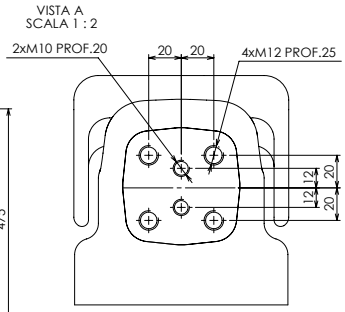


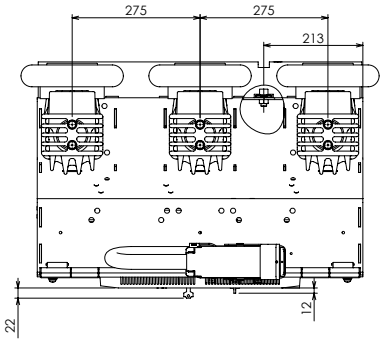
Fixed circuit-breaker

eVD4		
TN	1VCD000176	
Ur	12	kV
	17.5	kV
Ir	2500	A
Isc	20	kA
	25	kA
	31.5	kA
	40	kA



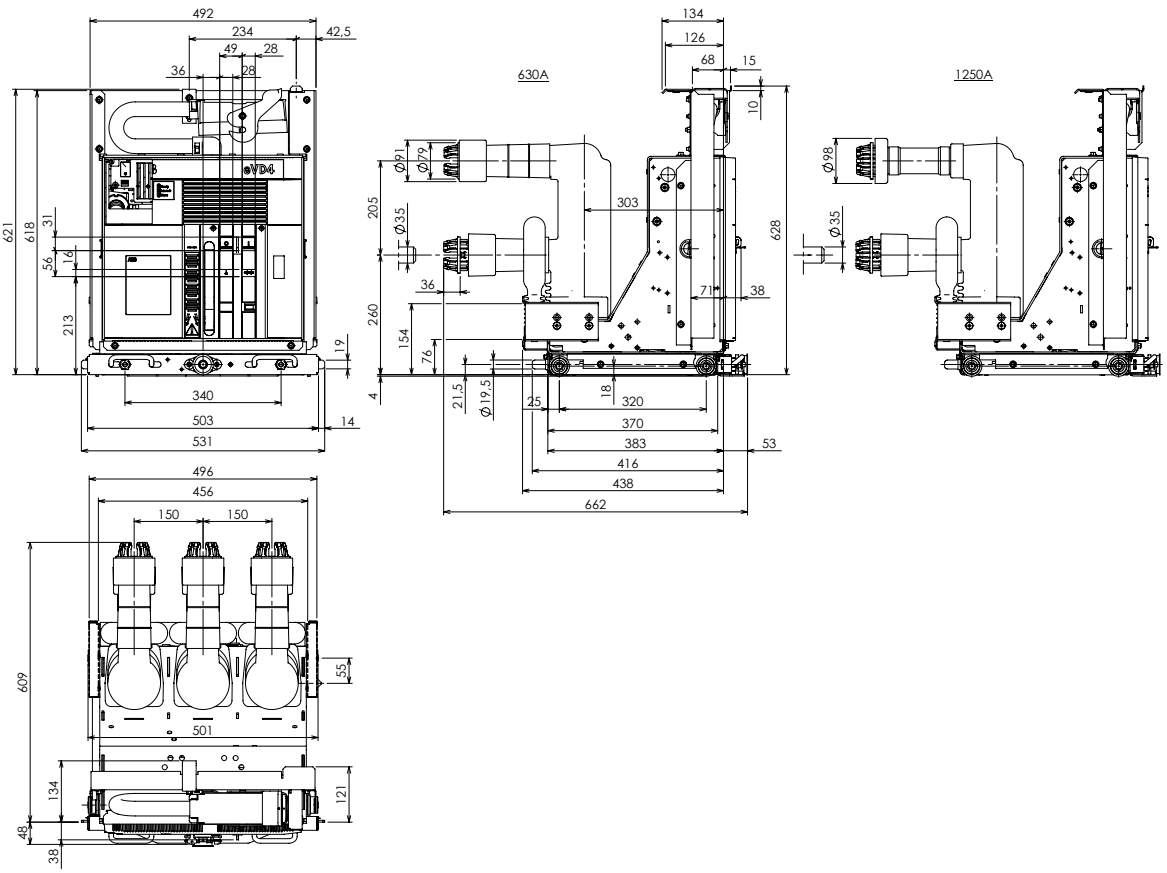






Withdrawable circuit-breakers for UniGear ZS1 switchgear and PowerCube units

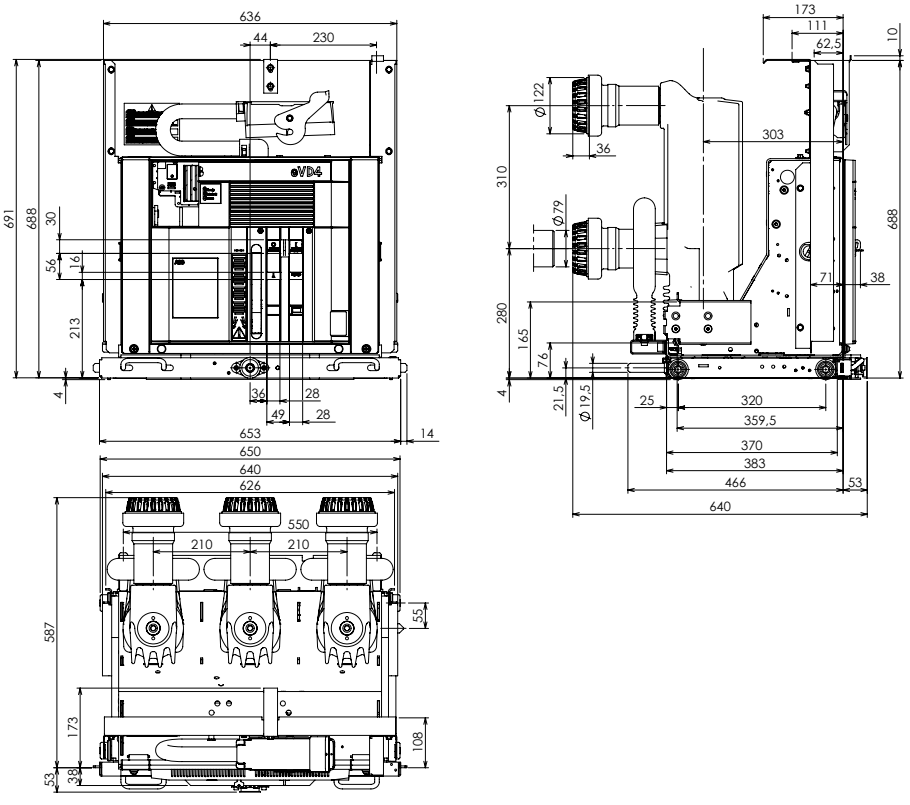
eVD4/P		
TN	1VCD000163	
Ur	12	kV
	17.5	kV
Ir	630	A
	1250	A
Isc	16	kA
	20	kA
	25	kA
	31.5	kA



Withdrawable circuit-breakers for UniGear ZS1 switchgear and PowerCube units

eVD4/P		
TN	1VCD000164	
Ur	12	kV
	17.5	kV
Ir	1600	A
	2000	A
Isc	20	kA
	25	kA
	31.5	kA
	40 (*)	kA

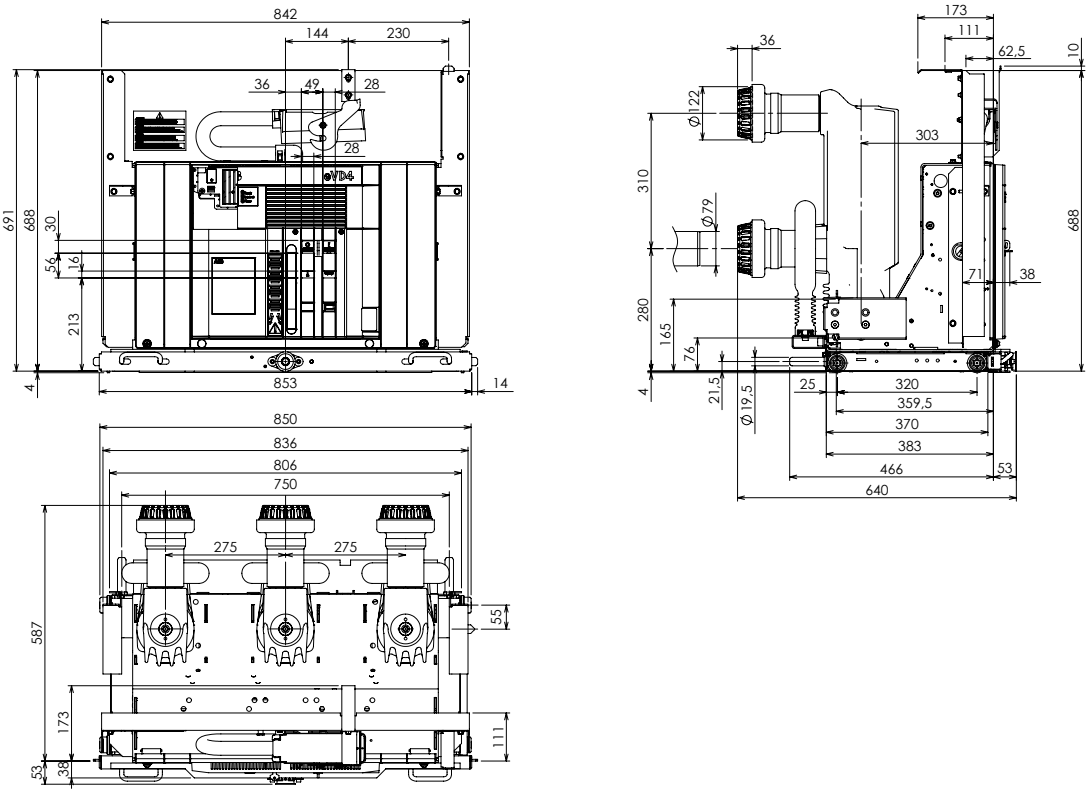
(*) only 2000 A



Withdrawable circuit-breakers for UniGear ZS1 switchgear

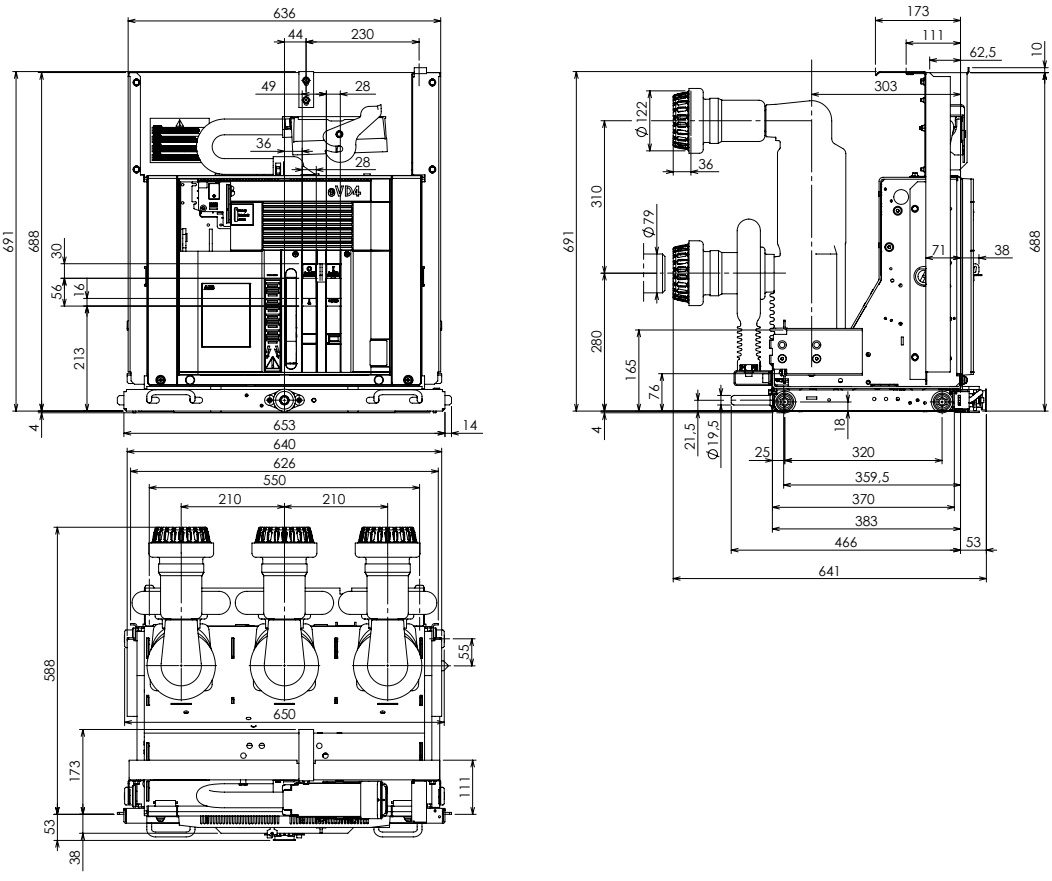
eVD4/P		
TN	1VCD000165	
Ur	12	kV
	17.5	kV
Ir	1600	A
	2000	A
Isc	20	kA
	25	kA
	31.5	kA
	40 (*)	kA

(*) only 2000 A



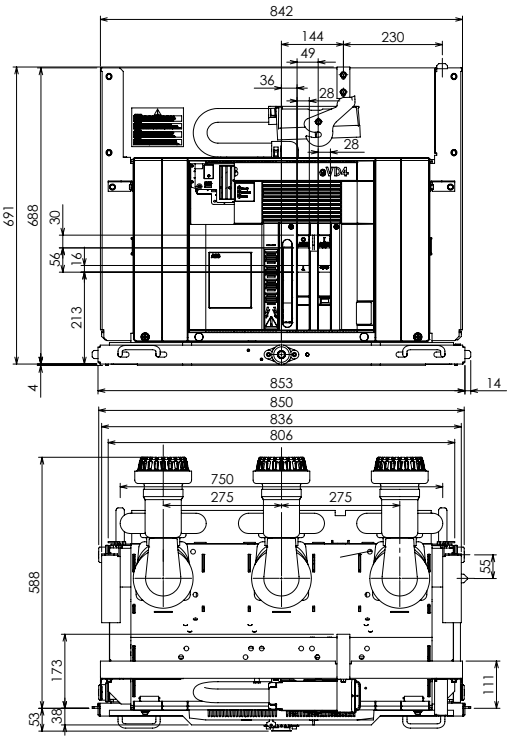
Withdrawable circuit-breakers for UniGear ZS1 switchgear and PowerCube units

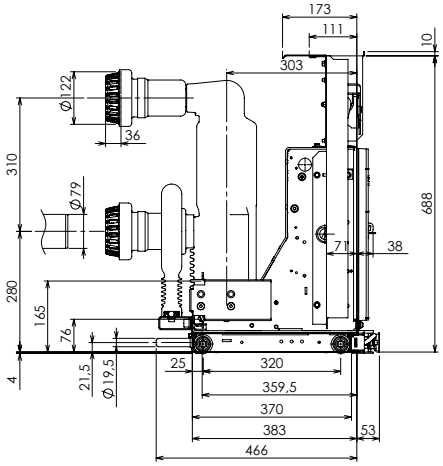
eVD4/P		
TN	1VCD000166	
Ur	12	kV
	17.5	kW
Ir	1250	A
	1600	A
Isc	40	kA



Withdrawable circuit-breakers for UniGear ZS1 switchgear

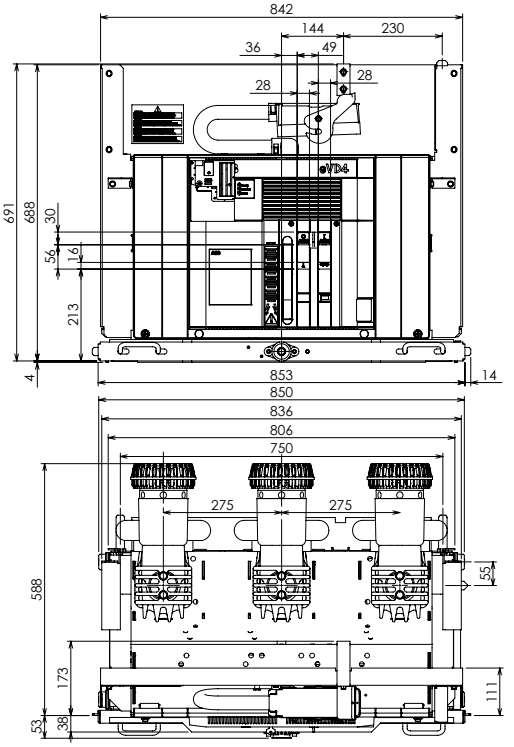
eVD4/P		
TN	1VCD000167	
Ur	12	kV
	17.5	kV
Ir	1250	A
	1600	A
Isc	40	kA

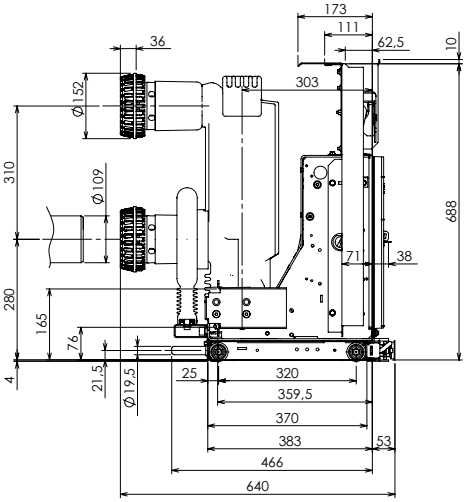




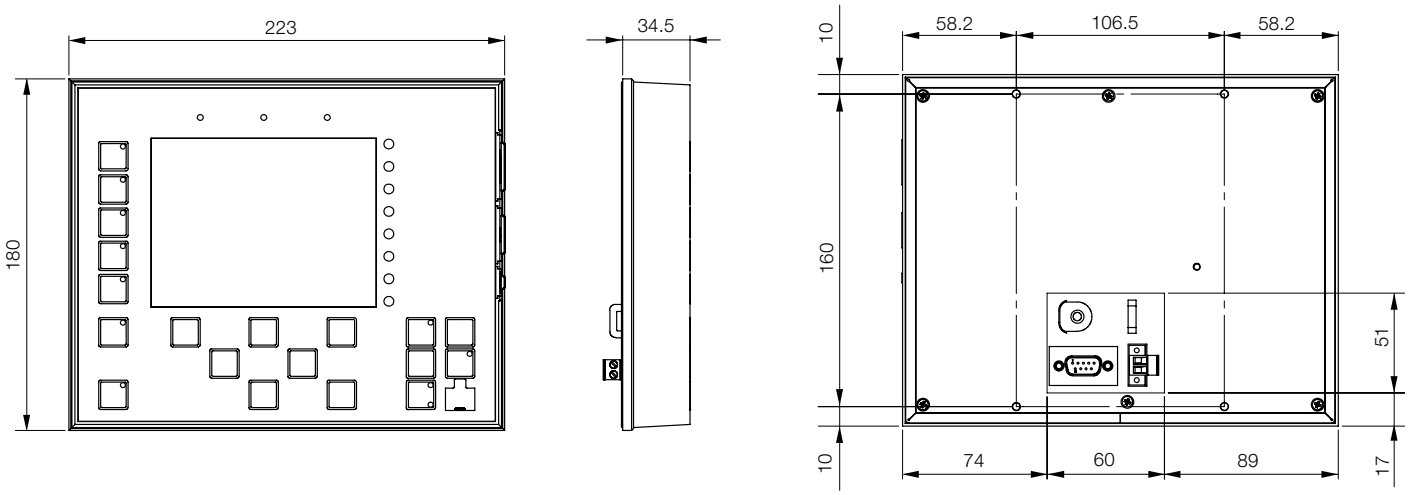
Withdrawable circuit-breakers for UniGear ZS1 switchgear

eVD4/P		
TN	1VCD000175	
Ur	12	kV
	17.5	kV
Ir	2500	A
Isc	20	kA
	25	kA
	31.5	kA
	40 (*)	kA





HM1



14. Product quality and protection of the environment

The apparatuses are produced in compliance with the requirements of the International Standards regarding quality management and environmental management systems. In these fields, the level of excellence is proven by the availability of ISO 9001 and ISO 14001 certificates.

End of product life

ABB is committed to complying with the relevant legal and other requirements for environment protection according to the ISO 14 001 Standard.
ABB offers its skills and help with re-cycling and disposal of the products at the end of their life.
For disposal of the products, it is always necessary to act in accordance with local legal requirements in force.

Methods of disposal

Disposal can be carried out with heat treatment, in incineration plants, or by means of storage in special waste sites.

Material	Recommended disposal method
Metal material (Fe, Cu, Al, Ag, Zn, W, others)	Separation and recycling
Thermoplastics	Recycling or disposal
Epoxy resin	Separation of metal material and disposal of resin parts
Rubber	Disposal
Dielectric oil (transformer oil)	Recovery and recycling or disposal
Wood packing material	Recycling or disposal
Aluminium sheet packing material	Recycling or disposal

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