

MEDIUM VOLTAGE PRODUCTS

# HD4/R - HD4/R-SEC - HD4/RE-SEC

## Installation and operating instructions



01



02

01 HD4/R series circuit breakers

02 HD4/RE series circuit breakers

### Table of Contents

I. Introduction	3
1. Packing and transport	4
2. Inspection on arrival	5
3. Storage	6
4. Handling	7
5. Description	8
6. Instructions for operating the circuit breaker	15
7. Installation	17
8. Putting into service	25
9. Routine inspections	26
10. Instructions for handling apparatus containing SF6 gas	28
11. Spare parts and accessories	29
12. Quality of the products and environmental protection	30

# For your safety!

- Make sure that the installation room (space, divisions and environment) is suitable for the electrical apparatus.
- Make sure that all the installation, putting into service and maintenance operations are carried out by skilled personnel with in-depth knowledge of the equipment.
- Make sure that all the installation, service and maintenance operations comply with the standards and laws so as to ensure that the installations are constructed in accordance with the rules of good workmanship and safety in the work place.
- Strictly comply with the instructions in this manual.
- Make sure that the rated performance of the apparatus is not exceeded during service.
- Make sure that the personnel are provided with this manual and are aware of all the relevant information while operating on the apparatus.
- Pay special attention to the information in the manual highlighted by the following symbol:



Responsible behaviour safeguards your own and others' safety!

Please contact the ABB Assistance Service for any further requirements.

# I. Introduction

This publication contains the information required for installing and putting the following medium voltage circuit breakers into service: HD4/R, HD4/RE, HD4/R-SEC, HD4/RE-SEC.

Please read the manual carefully to ensure that the product is used correctly.

Refer to the relative instructions in order to assemble the accessories and/or spare parts correctly.

Similarly to all the apparatus we manufacture, the HD4/R, HD4/RE, HD4/R-SEC, HD4/RE-SEC circuit breakers are also designed for different installation configurations.

However, these devices can be subjected to further technical construction modifications (at the customer's request) so as to adapt them to special installation requirements.

Consequently, the manual may not contain instructions concerning special customized configurations.

Besides 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 standard configurations.



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

Only use original spare parts for maintenance operations.

Please also consult the technical catalogue of the circuit breaker and the spare parts catalogue for further details.

# 1. Packing and transport

The circuit breaker is shipped in special packing in the open position, with the springs discharged and with the absolute pressure of the pole corresponding to the service value.

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.

Handling and transport must only be carried out by expert and properly trained personnel.

Do not remove or alter the switch identification contents and labels.

Switches subject to UN3164 standards for transportation by air and / or sea.

Safety data sheet: 1VCD850182

## 2. Inspection on arrival



**Before proceeding with any operation, always make sure that the springs of the operating mechanism are discharged and that the apparatus is in the open position.**

As soon as it arrives, check the condition of the apparatus, that the packing is undamaged and that the nameplate data (see fig. 1) correspond to the information in the order confirmation sent by ABB and in the shipping note.

Also make sure that the supply includes all the materials described in the shipping note and the lever for loading the springs of the operating mechanism in the manual mode.

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.

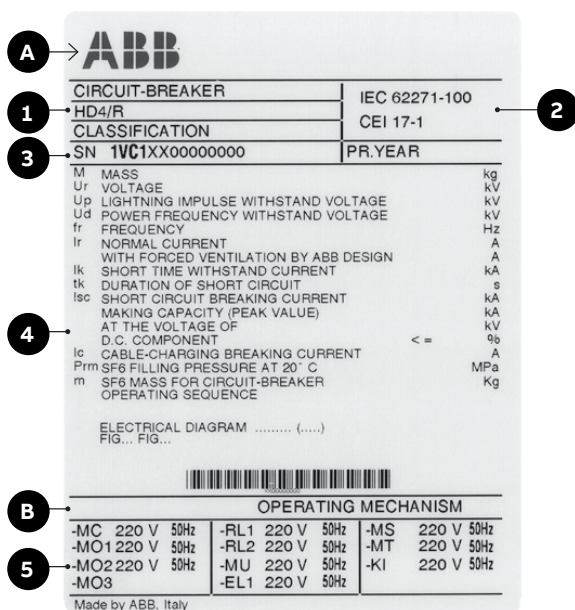
The apparatus is only supplied with the accessories specified at the time of ordering and validated in the order confirmation sent by ABB.

The following documents accompany the apparatus when it is shipped:

- Instruction manual (this document)
- Test certificate
- Identification label
- Fiscal copy of the shipping notification
- Wiring diagram.

Other documents, sent prior to shipment of the apparatus, are:

- Order confirmation
- Original shipping notification
- Any drawings or documents referring to special configurations/conditions.



### Key

- A Circuit breaker rating plate
- B Operating mechanism rating plate
- 1 Type of apparatus
- 2 Symbols indicating compliance with Standards
- 3 Serial number
- 4 Circuit breaker specifications
- 5 Characteristics of the operating mechanism auxiliaries

Figure 1

## 3. Storage

When the apparatus must be stored for a certain period of time, our workshops can (on request) provide suitable packing for the specified storage conditions.

On arrival, the apparatus must be carefully unpacked and checked as described in the Checking on arrival section (chap. 2).

If the apparatus cannot be installed immediately, it must be repacked in the original packing materials. Insert at least one standard packet of special hygroscopic substance per piece of apparatus inside the packing.

Should the original packing no longer be available and the apparatus cannot be installed immediately, it should be stored indoors in a well-ventilated, dry, dust-free, noncorrosive environment, well away from any easily flammable materials and at a temperature between -5 °C and +45 °C. Avoid any accidental impact or positions which stress the structure of the apparatus.

## 4. Handling

Before proceeding with any operation, always make sure that the springs of the operating mechanism spring are discharged and that the apparatus is in the open position. When handling the apparatus, take great care to prevent the insulating parts and the terminals of the circuit breaker from being stressed.



**The apparatus must not be handled by inserting lifting devices directly under the apparatus itself. If this technique is unavoidable, place the circuit breaker on a pallet or a sturdy supporting surface.**

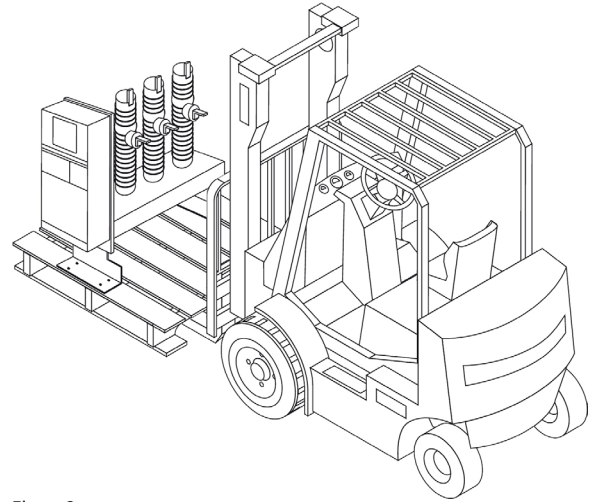


Figure 2

## 5. Description

### 5.1 General information

HD4/R circuit breakers made with the separate pole construction technique. They are sulphur hexafluoride insulated for indoor installation and are life-long sealed pressure devices (Standards IEC 62271-100 and CEI-EN 62271-100).

Refer to the technical catalogue for the electrical performance.

The following versions are available:

- Fixed, with rh lateral operating mechanism (up to 36 kV)
- Plug-in, for UniSec switchgear.

Depending on the version (excluding 36 kV), they can be equipped on request with two or three current sensors and with a REF601 series device for protection against overcurrents (only REF601 for HD4/R-SEC, HD4/RE-SEC).

The three poles, the operating mechanism and any optional accessories used are assembled on a sturdy bearing frame.

The metal frame is equipped with wheels for 36 kV circuit breakers and for circuit breakers for UniSec switchgear.

Each pole consists of an epoxy resin enclosure which houses all the active parts, the kinematics of the moving contacts, the medium voltage terminals and the arcing chambers, immersed in SF<sub>6</sub> gas.

#### Reference Standards

- IEC 62271-100
- CEI-EN 62271-100

### 5.2 Basic configuration

The basic coded versions of the circuit breakers are always three-pole and comprise the following equipment (fig. 3 and 4):

- 1 closing pushbutton
- 2 opening pushbutton
- 3 circuit breaker open/closed indicator
- 4 manual operating mechanism
- 5 mechanical indicator for closing springs
- 6 operation counter

moreover:

terminal board for fixed circuit breaker (connector for plugin circuit breaker), basic wiring for the connection of electrical accessories.

**NOTE.** The basic version is always equipped with shunt opening release, a set of 5 open/closed auxiliary contacts, key lock and spring loading lever (spring loading lever for HD4/R series only).



Figure 3 HD4/RE series circuit breakers

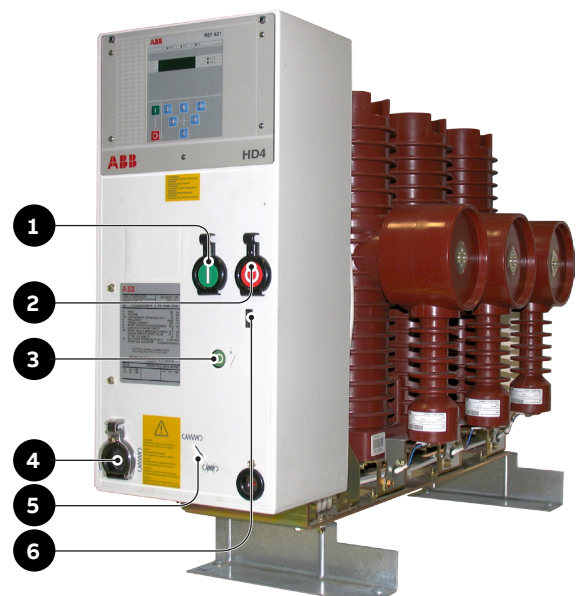


Figure 4 HD4/R series circuit breakers



## 5.3 Operating mechanism

### 5.3.1 Operating mechanism for HD4/R series circuit breakers

The ESH operating mechanism with energy stored by means of preloaded springs is used for fixed or plu-in HD4/R circuit breakers.

The closing springs of the ESN operating mechanism are loaded in the manual mode using the special removable lever.

The opening springs are automatically reloaded during the closing operation.

If a gearmotor is installed, the closing springs are automatically loaded after each closing operation. The shunt closing, shunt opening and undervoltage releases allow the operations to be carried out in the remote mode.

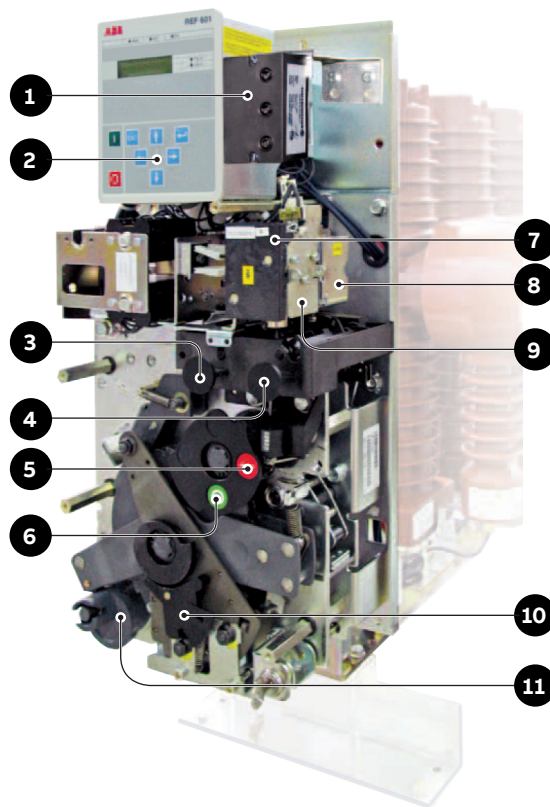
### 5.3.2 Operating mechanism for HD4/RE series circuit breakers

The EL operating mechanism with energy stored by means of preloaded springs is used for fixed or plu-in HD4/RE circuit breakers.

The closing springs of the EL operating mechanism are loaded in the manual mode using the special lever.

The opening springs are automatically reloaded during the closing operation.

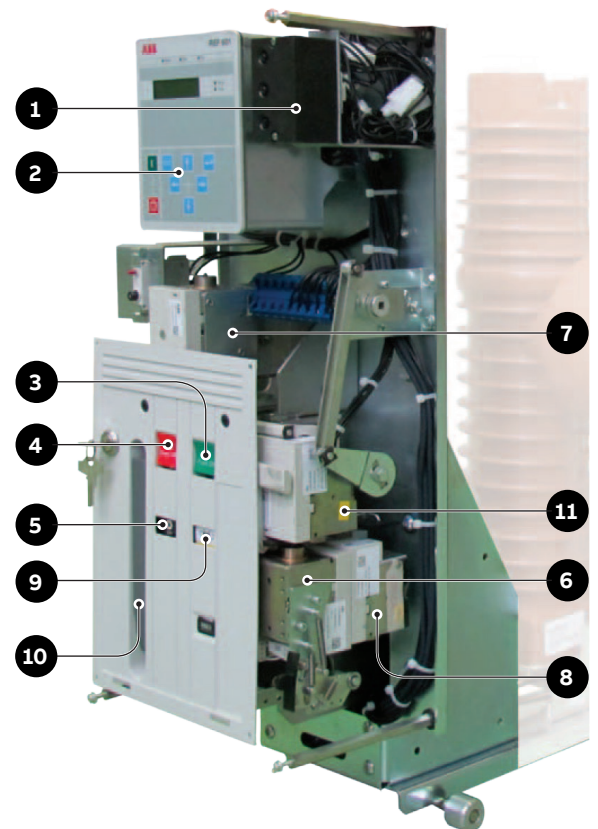
If a gearmotor is installed, the closing springs are automatically loaded after each closing operation. The shunt closing, shunt opening and undervoltage releases allow the operations to be carried out in the remote mode.



#### Key

- 1 SF6 gas pressure signalling device (on request - only for circuit breakers with pressure switch)
- 2 PR521 or REF 601 overcurrent relay (on request)
- 3 Closing pushbutton
- 4 Opening pushbutton
- 5 Circuit breaker closed indicator
- 6 Circuit breaker open indicator
- 7 Undervoltage release
- 8 Additional shunt opening release
- 9 Shunt opening release
- 10 Indicator for closing springs loaded (yellow) / discharged (white)
- 11 Lever for loading the closing springs in the manual mode

Figure 5



#### Key

- 1 SF6 gas pressure signalling device (on request - only for circuit breakers with pressure switch)
- 2 PR521 or REF 601 overcurrent relay (on request)
- 3 Closing pushbutton
- 4 Opening pushbutton
- 5 Signalling device for circuit breaker open / closed
- 6 Undervoltage release
- 7 Additional shunt opening release
- 8 Shunt opening release
- 9 Indicator for closing springs loaded (yellow) / discharged (white)
- 10 Lever for loading closing springs in manual mode
- 11 Shunt closing release

Figure 6

## 5. Description

### 5.4 Fixed circuit breakers

The fixed circuit breaker (fig. 7) is the basic version, previously described in sect. 5.2. There are two drilled supports in the lower part of the structure to allow the circuit breaker to be fixed.

The terminal box (7) is available for the electrical connections of the circuit breaker's auxiliary circuits, in the front protection.

The earthing screw is located at the side of the circuit breaker.

### 5.5 Withdrawable circuit breakers

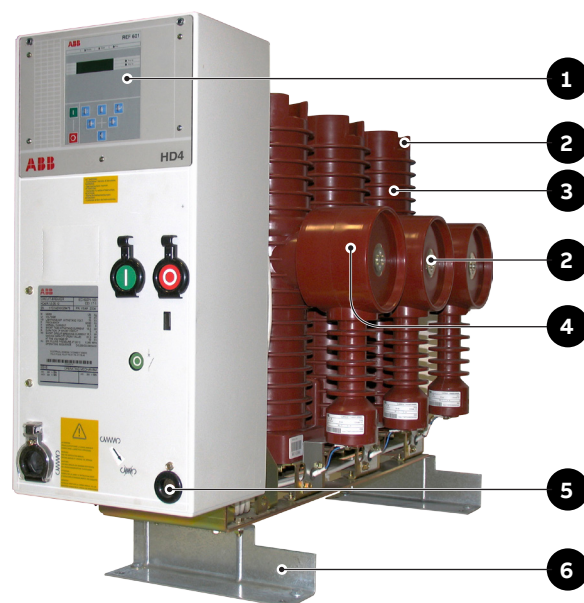
The withdrawable circuit breakers are available for UniSec switchgears. They are essentially derived from a fixed circuit breaker to which the wheels, the disconnecting contacts and the locking lever are applied. The HD4/R-Sec and HD4/RE-Sec circuit breakers are used in UniSec switchgears. The circuit breakers can only be extracted in safe conditions with open isolation switches open and earth switches closed. To facilitate the extraction of the circuit breaker, a special extraction truck is available.

### 5.6 Gas pressure monitoring device (on request)

The device for signalling the state of the SF6 gas is supplied on request and always has two intervention thresholds (low pressure and insufficient pressure).

The following configurations can be obtained:

- 1) with contacts for remote signalling (normal, low and insufficient pressure);
- 2) as in point 1, plus a lock on circuit breaker closure and a choice between automatic opening or lock on opening;
- 3) as in point 2 plus three lamps for local signalling of the state of the gas.



#### Legenda

- 1 REF 601 overcurrent relay (on request)
- 2 Medium voltage terminals
- 3 Circuit breaker pole
- 4 Current sensors (if provided)
- 5 Key lock
- 6 Fixing brackets
- 7 Circuit breaker control circuit supporting terminal box

Figure 7

## 5.7 Circuit breaker specifications

### 5.7.1 General specifications of HD4/R series fixed circuit breakers with rh lateral operating mechanisms (12 - 17.5 - 24 - 36 kV)

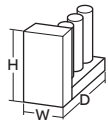
Circuit breaker		HD4/R 12			HD4/R 17			HD4/R 24			HD4/R 36		
Standards	IEC 62271-100	•			•			•			•		
	CEI EN 62271-100	•			•			•			•		
Rated voltage	Ur [kV]	12			17.5			24			36		
Rated insulation voltage	Us [kV]	12			17.5			24			36		
Withstand voltage at 50 Hz	Ud (1 min) [kV]	28			38			50			70		
Impulse withstand voltage	Up [kV]	75			95			125			170		
Rated frequency	fr [Hz]	50-60			50-60			50-60			50-60		
Rated thermal current (40 °C)	Ir [A]	630	800	1250	630	800	1250	630	800	1250	630	800	1250
Rated duty breaking capacity (symmetrical rated short-circuit current)	Isc [kA]	12.5	–	–	12.5	–	–	12.5	–	–	12.5	12.5	12.5
		16	16	16	16	16	16	16	16	16	16	16	16
		20	20	20	20	20	20	20	20	20	–	–	–
		25	25	25	–	–	25	–	–	–	–	–	–
Short-time withstand current (3 s)	Ik [kA]	12.5	–	–	12.5	–	–	12.5	–	–	12.5	12.5	12.5
		16	16	16	16	16	16	16	16	16	16	16	16
		20	20	20	20	20	20	20	20	20	–	–	–
		25	25	25	–	–	25	–	–	–	–	–	–
Making capacity	Ip [kA]	31.5	–	–	31.5	–	–	31.5	–	–	31.5	31.5	31.5
		40	40	40	40	40	40	40	40	40	40	40	40
		50	50	50	50	50	50	50	50	50	–	–	–
		63	63	63	–	–	63	–	–	–	–	–	–
Sequence of operations		[O - 3min - CO - 3 min - CO] [O - 3min - CO - 3 min - CO] [O - 3min - CO - 3 min - CO] [O - 0.3s - CO - 15s - CO]											
Opening time	[ms]	45			45			45			45		
Arcing time	[ms]	10...15			10...15			10...15			10...15		
Total break-time	[ms]	55...60			55...60			55...60			55...60		
Closing time	[ms]	80			80			80			80		
Overall dimensions (maximum)	H [mm]	764.5			764.5			764.5			810		
	W [mm]	321			321			321			409		
	D [mm]	1049 <sup>(1)</sup> / 1189 <sup>(2)</sup>			1049 <sup>(1)</sup> / 1189 <sup>(2)</sup>			1049 <sup>(1)</sup> / 1189 <sup>(2)</sup>			1348		
	Pole center-distance [mm]	230 / 300			230 / 300			230 / 300			350		
Weight <sup>3)</sup>	[kg]	103 <sup>(1)</sup> - 105 <sup>(2)</sup>			103 <sup>(1)</sup> - 105 <sup>(2)</sup>			103 <sup>(1)</sup> - 105 <sup>(2)</sup>			110		
Absolute gas pressure (nominal duty value)	[kPa]	380			380			380			380		
Application protection device	REF 601	• <sup>(4)</sup>			• <sup>(4)</sup>			• <sup>(4)</sup>			–		
Standardized dimensions table		TN 7237 <sup>(1)</sup>			TN 7237 <sup>(1)</sup>			TN 7237 <sup>(1)</sup>			TN 7238		
		TN 7234 <sup>(2)</sup>			TN 7234 <sup>(2)</sup>			TN 7234 <sup>(2)</sup>					
Wiring diagram	without protection device installed	1VCD400017			1VCD400017			1VCD400017			1VCD400017		
	with REF 601	1VCD400114			1VCD400114			1VCD400114			–		
Operating temperature	[°C]	-5 ... +40			-5 ... +40			-5 ... +40			-5 ... +40		
Tropicalization	IEC: 60068-2-30. 60721-2-1	•			•			•			•		
Electromagnetic compatibility	IEC 62271-1	•			•			•			•		

<sup>(1)</sup> 230 mm pole center-distance

<sup>(2)</sup> 300 mm pole center-distance

<sup>(3)</sup> increase the indicated weight by 20 kg for circuit breakers with REF 601 devices and 3 current sensors (15 kg only with 2 current sensors)

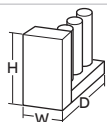
<sup>(4)</sup> the REF 601 device and the current sensors are available on request. The rated current of the REF 601 must be set in the relay and must be compatible with the rated current of the circuit breaker. The rated current that can be set with CEI 0-16 is 80 A or 250 A. With the CEI 0-16 version of REF 601, the circuit breaker is always supplied with 3 phase sensors (Rogowsky coils) on the circuit breaker itself, one 40/1 A closed-core toroidal TA and a -MU undervoltage release for relay-controlled opening



## 5. Description

### 5.7.2 General specifications of HD4/RE series fixed circuit breakers with rh lateral operating mechanisms (12 - 17.5 - 24 kV)

Circuit breaker		HD4/RE 12	HD4/RE 17	HD4/RE 24
Standards	IEC 62271-100	•	•	•
	CEI EN 62271-100	•	•	•
Rated voltage	Ur [kV]	12	12	12
Rated insulation voltage	Us [kV]	12	17.5	24
Withstand voltage at 50 Hz	Ud (1 min) [kV]	28	38	50
Impulse withstand voltage	Up [kV]	75	95	125
Rated frequency	fr [Hz]	50-60	50-60	50-60
Rated thermal current (40 °C)	Ir [A]	630	630	630
Rated duty breaking capacity (symmetrical rated short-circuit current)	Isc [kA]	12.5	12.5	12.5
		16	16	16
Short-time withstand current (1 s)	Ik [kA]	12.5	12.5	12.5
		16	16	16
Making capacity	Ip [kA]	31.5	31.5	31.5
		40	40	40
Sequence of operations	[O - 3 min - CO - 3 min - CO]	•	•	•
Opening time	[ms]	77	77	77
Arcing time	[ms]	10...15	10...15	10...15
Total break-time	[ms]	87...92	87...92	87...92
Closing time	[ms]	50	50	50
Overall dimensions (maximum)	H [mm]	764.5	764.5	764.5
	W [mm]	321	321	321
	D [mm]	1049 <sup>1)</sup>	1049 <sup>1)</sup>	1049 <sup>1)</sup>
	Pole center-distance [mm]	230	230	230
Weight <sup>2)</sup>	[kg]	74	74	74
Absolute gas pressure (nominal duty value)	[kPa]	380	380	380
Application protection device	REF 601	• <sup>3)</sup>	• <sup>3)</sup>	• <sup>3)</sup>
Standardized dimensions table			1VCD000207	
Wiring diagram	without protection device installed		1VCD400150	
	with REF 601		1VCD400150	
Operating temperature	[°C]	-5 ... +40	-5 ... +40	-5 ... +40
Tropicalization	IEC: 60068-2-30, 60721-2-1	•	•	•
Electromagnetic compatibility	IEC 62271-1	•	•	•



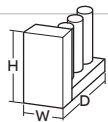
<sup>1)</sup> 230 mm pole center-distance

<sup>2)</sup> increase the indicated weight by 20 kg for circuit breakers with REF 601 devices and 3 current sensors (15 kg only with 2 current sensors)

<sup>3)</sup> the REF 601 device and the current sensors are available on request. The rated current of the REF 601 must be set in the relay and must be compatible with the rated current of the circuit breaker. The rated current that can be set with CEI 0-16 is 80 A or 250 A. With the CEI 0-16 version of REF 601, the circuit breaker is always supplied with 3 phase sensors (Rogowsky coils) on the circuit breaker itself, one 40/1 A closed-core toroidal TA and a -MU undervoltage release for relay-controlled opening

### 5.7.3 General specifications of fixed circuit breakers with rh lateral operating mechanisms for ABB UniSec switchgear (12 - 17.5 - 24 kV)

Circuit breaker		HD4/R SEC 12		HD4/R SEC 17		HD4/R SEC 24
Standards	IEC 62271-100	•		•		•
	CEI EN 62271-100	•		•		•
Rated voltage	Ur [kV]	12		17.5		24
Rated insulation voltage	Us [kV]	12		17.5		24
Withstand voltage at 50 Hz	Ud (1 min) [kV]	28		38		50
Impulse withstand voltage	Up [kV]	75		95		125
Rated frequency	fr [Hz]	50-60		50-60		50-60
Rated thermal current (40 °C)	Ir [A]	630	800	630	800	630
Rated duty breaking capacity (symmetrical rated short-circuit current)	Isc [kA]	12.5 <sup>(e)</sup>	12.5	12.5 <sup>(e)</sup>	12.5	12.5 <sup>(e)</sup>
		16 <sup>(e)</sup>	16	16 <sup>(e)</sup>	16	16 <sup>(e)</sup>
		20	20	20 <sup>(e)</sup>	20 <sup>(e)</sup>	20
		25	25	–	–	–
Short-time withstand current (3 s)	Ik [kA]	12.5	12.5	12.5	12.5	12.5
		16	16	16	16	16
		20	20	20 <sup>(e)</sup>	20 <sup>(e)</sup>	20
		25 <sup>(d)</sup>	25 <sup>(d)</sup>	–	–	–
Making capacity	Ip [kA]	31.5	31.5	31.5	31.5	31.5
		40	40	40	40	40
		50	50	50	50	50
		63	63	–	–	–
Sequence of operations		[O - 0.3 s - CO - 15 s - CO] [O - 0.3 s - CO - 3 min - CO]		[O - 0.3 s - CO - 15 s - CO] [O - 0.3 s - CO - 3 min - CO]		[O - 0.3 s - CO - 15 s - CO] [O - 0.3 s - CO - 3 min - CO]
Opening time	[ms]	45		45		45
Arcing time	[ms]	10...15		10...15		10...15
Total break-time	[ms]	55...60		55...60		55...60
Closing time	[ms]	80		80		80
Overall dimensions (maximum)	H [mm]	740		740		740
	W [mm]	315		315		315
	D [mm]	1049		1049		1049
	Pole center-distance [mm]	230		230		230
Weight <sup>(1)</sup>	[kg]	103		103		103
Absolute gas pressure (nominal duty value)	[kPa]	380		380		380
Application protection device	REF 601	• <sup>(2)</sup>		• <sup>(2)</sup>		• <sup>(2)</sup>
Standardized dimensions table		1VCD003536		1VCD003536		1VCD003536
Wiring diagram	with / without REF 601	1VCD400119		1VCD400119		1VCD400119
Operating temperature	[°C]	-5 ... +40		-5 ... +40		-5 ... +40
Tropicalization	IEC: 60068-2-30, 60721-2-1	•		•		•
Electromagnetic compatibility	IEC 62271-1	•		•		•



<sup>(1)</sup> increase the indicated weight by 20 kg for circuit breakers with REF 601 devices and 3 current sensors (15 kg only with 2 current sensors)

<sup>(2)</sup> the REF601 device and the current sensors are available on request. The rated current of the REF 601 must be set in the relay and must be compatible with the rated current of the circuit breaker. The rated current that can be set with CEI 0-16 is 80 A or 250 A. With the CEI 0-16 version of REF 601, the circuit breaker is always supplied with 3 phase sensors (Rogowsky coils) on the circuit breaker itself, one 40/1 A closed-core toroidal TA and a -MU undervoltage release for relay-controlled opening

<sup>(d)</sup> at 12, the rated short-time withstand current is 25 kA for 2 seconds

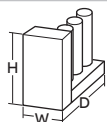
<sup>(e)</sup> at 17.5 kV, the breaking capacity is 21 kA and the rated short-time withstand current is 21 kA for 3 seconds

<sup>(e)</sup> at 12 kV, 17.5 kV and 24 kV and at rated current 630 A, the sequence of operations is O - 0.3 s - CO - 15 s - CO

## 5. Description

### 5.7.4 General specifications of fixed circuit breakers with rh lateral operating mechanisms for ABB UniSec switchgear (12 - 17.5 - 24 kV)

Circuit breaker		HD4/RE SEC 12	HD4/RE SEC 17	HD4/RE SEC 24
Standards	IEC 62271-100	•	•	•
	CEI EN 62271-100	•	•	•
Rated voltage	Ur [kV]	12	17.5	24
Rated insulation voltage	Us [kV]	12	17.5	24
Withstand voltage at 50 Hz	Ud (1 min) [kV]	28	38	50
Impulse withstand voltage	Up [kV]	75	95	125
Rated frequency	fr [Hz]	50-60	50-60	50-60
Rated thermal current (40 °C)	Ir [A]	630	630	630
Rated duty breaking capacity (symmetrical rated short-circuit current)	Isc [kA]	12.5	12.5	12.5
		16	16	16
Short-time withstand current (1 s)	Ik [kA]	12.5	12.5	12.5
		16	16	16
Making capacity	Ip [kA]	31.5	31.5	31.5
		40	40	40
Sequence of operations	[O- 3 min - CO - 3 min - CO]	•	•	•
Opening time	[ms]	77	77	77
Arcing time	[ms]	10...15	10...15	10...15
Total break-time	[ms]	87...92	87...92	87...92
Closing time	[ms]	50	50	50
Overall dimensions (maximum)	H [mm]	740	740	740
	W [mm]	315	315	315
	D [mm]	1049	1049	1049
	Pole center-distance [mm]	230	230	230
Weight <sup>(1)</sup>	[kg]	74	74	74
Absolute gas pressure (nominal duty value)	[kPa]	380	380	380
Application protection device	REF 601	• <sup>(2)</sup>	• <sup>(2)</sup>	• <sup>(2)</sup>
Standardized dimensions table		1VCD000196	1VCD000196	1VCD000196
Wiring diagram	with / without REF 601	1VCD400150	1VCD400150	1VCD400150
Operating temperature	[°C]	-5 ... +40	-5 ... +40	-5 ... +40
Tropicalization	IEC: 60068-2-30, 60721-2-1	•	•	•
Electromagnetic compatibility	IEC 62271-1	•	•	•



<sup>(1)</sup> increase the indicated weight by 20 kg for circuit breakers with REF 601 devices and 3 current sensors (15 kg only with 2 current sensors)

<sup>(2)</sup> the REF601 device and the current sensors are available on request. The rated current of the REF 601 must be set in the relay and must be compatible with the rated current of the circuit breaker. The rated current that can be set with CEI 0-16 is 80 A or 250 A. With the CEI 0-16 version of REF 601, the circuit breaker is always supplied with 3 phase sensors (Rogowsky coils) on the circuit breaker itself, one 40/1 A closed-core toroidal TA and a -MU undervoltage release for relay-controlled opening



## 6. Instructions for operating the circuit breaker

### 6.1 Safety indications



**HD4/... circuit breakers guarantee a minimum IP3X degree of protection when installed in the following conditions:**

- **fixed version, installed behind a protective metal net**

- **plug-in version, installed in switchgear.**

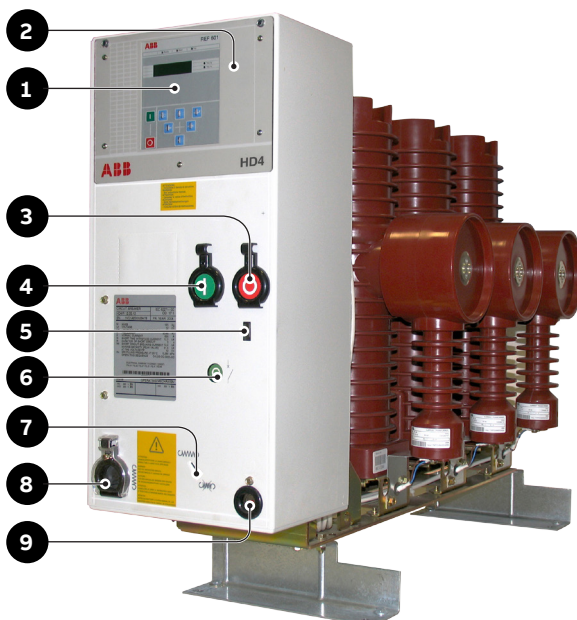
**In these conditions the operator is totally protected against accidental contact with moving parts.**

**Pay the greatest attention to moving parts if the circuit breaker is subjected to mechanical operations outside the switchgear or when the protective nets have been removed.**

**If the operations are obstructed, do not force the mechanical interlocks and check that the operating sequence is correct.**

**The circuit breaker must be gradually racked-in and out of the switchgear to avoid shocks that could deform the mechanical interlocks and the isolating contacts.**

### 6.2 HD4/R series operating and signalling mechanisms



#### Key

- 1 Release REF 601 (if provided)
- 2 Gas state indicator (if provided).
- 3 Opening pushbutton
- 4 Closing pushbutton
- 5 Operation counter (if provided)
- 6 Circuit breaker open/closed indicator
- 7 Signalling device for closing springs loaded/discharged
- 8 Shaft for loading the closing springs in the manual mode
- 9 Key lock

Figure 10

### 6.3 Instructions for HD4/R series circuit breaker operation

Circuit breaker operation can be either manual or electrical (see fig. 10).

#### 6.3.1 Loading the closing springs in manually loaded operating mechanisms

Match the coupling position of the handle (provided) with the hub (8) on the loading shaft, fully insert it on the shaft itself and turn in a clockwise direction until the springs loaded signal (yellow) appears in the window (7).

The force normally applied to the loading lever supplied is 130 N. In any case, the maximum force applied must not exceed 170 N.

#### 6.3.2 Closing spring loading lever

If connected to the electric power supply, the operating mechanism will automatically load the springs and will signal when the operation has been completed with a yellow indicator in the window (7).

It is advisable to load one mechanism at a time to prevent excessive current from being absorbed in installations with several motorized operating mechanisms.

The first time the equipment is put into service, it is advisable to load the closing springs in the manual mode to prevent several operating mechanisms from starting to load at the same time and overloading the auxiliary power supply.

#### 6.3.3 Manual loading in operating mechanisms with automatic loading devices

The automatic loading movement is released when the handle is inserted: loading can now proceed as described in sect. 6.3.1.

Remove the handle after loading.

**NOTE.** If the motor starts during the manual loading operation, continue regardless with the operation until it has been completed in the manual mode: the motor will stop as soon as loading terminates. Neither remove nor insert the handle if the motor is running. If the motor stops due to the protection circuit breaker having tripped, complete the loading operation in the manual mode before closing the circuit breaker itself.

## 6. Instructions for operating the circuit breaker

### 6.3.4 Closing operation

Make sure that the springs of the operating mechanism are loaded, as indicated by the yellow signal in the window (7).

Press the closing pushbutton (4). Closing is displayed by the letter "I" in the red part of the window (6).

If there is a shunt closing release, the closing operation can be obtained by remote control.

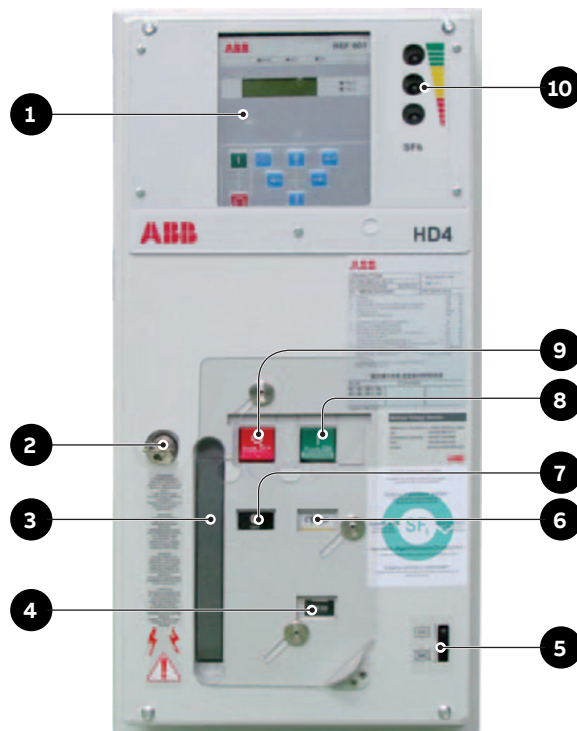
### 6.3.5 Opening operation

Press the opening pushbutton (3).

Opening is displayed by the letter "O" in the green part of the window (6).

If there is a shunt opening release, the closing operation can be obtained by remote control.

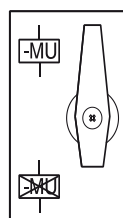
### 6.4 HD4/RE series operating and signalling mechanisms




#### Key


- 1 Relay REF601
- 2 Key lock
- 3 Closing spring loading lever
- 4 Operation counter
- 5 Housing of undervoltage release's mechanical override
- 6 Mechanical indicator for closing springs loaded/unloaded
- 7 Mechanical indicator for circuit breaker open/closed
- 8 Closing pushbutton
- 9 Opening pushbutton
- 10 Gas state indicator

Figure 11



#### Mechanical override of undervoltage release (on request)

 Undervoltage release enabled. The circuit breaker can only be closed if the undervoltage release is powered.

 Undervoltage release disabled. The circuit breaker can also be closed if the undervoltage release is not powered.

### 6.5 Instructions for HD4/RE series circuit breaker operation

Circuit breaker operation can be either manual or electrical.

#### a) Manual loading of the closing springs (fig. 11)

Repeatedly operate the loading lever (3) (the lever's maximum angle of rotation is about 90°) until the yellow indicator appears (6).

Maximum force that can normally be applied to the lever:  $\leq 150$  N.

#### b) Maximum force that can normally be applied to the lever

On request, the circuit breaker can be fitted with the following accessories for electrical operation:

- gearmotor for automatic loading of the closing springs
- shunt closing release.

When powered, the gearmotor automatically reloads the springs after every closing operation until the yellow indicator appears (8).

If a power cut occurs when loading is in progress, the gearmotor stops and automatically starts loading the springs again when the power returns. However, loading can always be completed in the manual mode.

To avoid excessive power consumption in installations with several circuit breakers controlled by a motor operator, it is advisable to load one operating mechanism at a time during the starting stage.

#### c) Circuit breaker closing

This operation can only be performed when the closing springs are fully loaded.

Press the pushbutton (8 - fig. 11) to close the circuit breaker in the manual mode.

When there is a shunt closing release, the operation can also be performed in the remote mode by means of the special control circuit. Effective closing is signalled by the indicator (7 - fig. 11).

#### d) Circuit breaker opening

Press the pushbutton (9 - fig. 11) to open the circuit breaker in the manual mode.

When there is a shunt opening release, the operation can also be carried out in the remote mode by means of the special control circuit. Effective opening is signalled by the indicator (7 - fig. 11).



## 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 components during installation.**  
**All the operations required for installation, putting into service, service and maintenance must be carried out by qualified personnel.**

### 7.2 Normal installation conditions

Maximum ambient air temperature	+ 40 °C
Minimum ambient air temperature	- 5 °C
Relative humidity	% ≤ 95
Altitude	≤ 1000 m

It must be possible to ventilate the installation room.

Comply with the indications in the product standards (IEC 62271-100) if other installation conditions are involved. Please contact ABB for special installation requirements.

The areas through which power conductors or auxiliary circuit conductors are routed must be protected against the access of animals which could lead to damage or disservice.

### 7.3 Preliminary operations

- Clean the insulating parts with clean dry rags.
- Make sure that the upper and lower 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 installed straight on the floor or on supporting frames provided by the customer (see fig. 8).

The areas on which the supporting frames or truck (if provided) rest must be on the same plane to avoid any risk of distortion in the breaker structure. A minimum degree of protection (IP2X) must be guaranteed from the front towards live parts.

The apparatus can be fixed in the following ways:

- by means of special expansion anchoring bolts with M8 threaded hole if the apparatus is fixed to a cement floor
- by means of M8 bolts if the apparatus is fixed to metal structures or to cement floors into which special steel sections
- have been embedded.

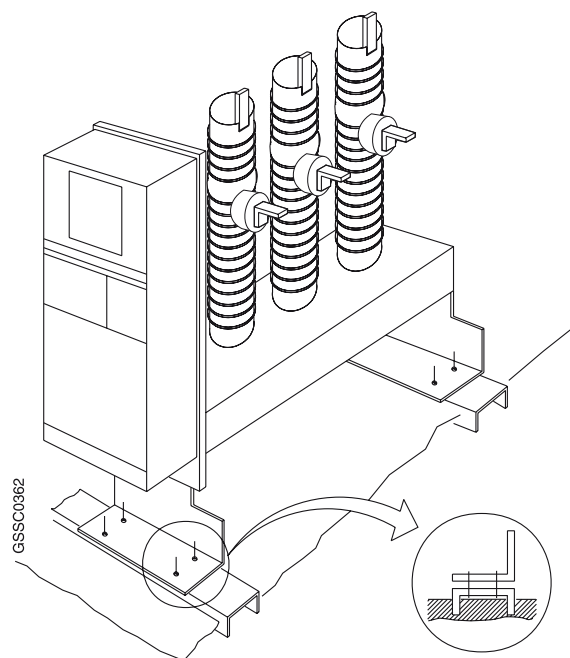


Figure 12

Whatever the method used, the fixing surface must be welllevelled and all the resting points must be on the same horizontal plane.

### 7.5 Installation of plug-in circuit breakers

Plug-in circuit breakers are designed for use in UniSec switchgear. Special assembly operations are not usually required.

However, consult the documentation of the switchgear in question.

### 7.6 Power circuit connections

#### 7.6.1 General recommendations

- Make sure that the circuit breaker terminals are clean and are free from any deformation caused by shocks received during transport or storage.
- Choose the conductor cross-sections to suit the service and short-circuit current of the installation.
- Provide suitable supporting insulators near the fixed circuitbreaker terminals or the monoblocs of the cubicles, sized according to the electrodynamic stress caused by the short-circuit current of the installation.



**The circuit breaker terminals are always silver-plated. To clean them, use only dry rags, soaked in a suitable solvent if necessary.**

**NOTE. Never use a file or emery cloth!**

## 7. Installation

### 7.6.2 Maximum dimensions of the connections

For fixed version HD4/R and HD4/RE circuit breakers, the connections must be shaped and installed in accordance with the indications given in figures 14, 15, 16 and 25, and the distances indicated.

### 7.6.3 Surface treatment of the connections

The connections can be made of bare copper or bare aluminium. However, it is always advisable to silver-plate the contact surfaces. The thickness of the surface treatment must be even and regular.

### 7.6.4 Assembly of the connections

- Make sure that the contact surfaces of the connections are perfectly flat and without burrs, traces of oxidation or deformities caused by drilling or impact sustained.
- Depending on the conductive material used and the surface treatment given, the operations indicated in the following table must be carried out on the surface contact of the conductor.

Bare copper	Clean with a fine file or emery cloth
	Smear 5RX Moly
Copper or silverplated aluminium	Clean with a rough dry cloth
	Only if there are traces of oxidation that are difficult to shift, clean with ultra-fine grain emery cloth and take care not to remove the surface layer
	Repeat the surface treatment if necessary
Bare aluminium	Clean with a metal brush or emery cloth
	Immediately smear neutral grease over the contact surfaces
	Insert a bi-metal copper-aluminium strip with beaded surfaces between the aluminium connection and the copper terminal (copper side touching the terminal, aluminium side touching the connection)

### Assembly procedures

- Place the connections in contact with the circuit breaker terminals.
- Insert a spring washer and a flat washer between the head of the bolt and the connection.
- The diameter of the flat washers must be able to distribute the torquing pressure over a wide area.
- Tighten the bolt, taking care to prevent the insulating parts from being stressed (consult the table with the rightening torque values).
- Make sure that the connections do not exert any force on the terminals.
- Carefully comply with the manufacturer's instructions for terminating the cables in cable connections.

Table of tightening torque values	
Screw	Tightening torque values
M6	10 Nm
M8	30 Nm
M10	40 Nm
M12	70 Nm

## 7.7 Earthing

- Earth fixed version circuit breakers by means of the special screw marked with the relative symbol. Clean and degrease the area around the screw corresponding to a diameter of about 30 mm. Use a conductor (busbar or cord) with a cross-section conforming to the Standards in force.
- When the assembly is completed, cover the joint with vaseline grease.



Figure 13

## 7.8 Connection of the auxiliary circuits

The minimum cross-section of the wires used for the auxiliary circuits must not be less than the one used for the internal cabling. They must also be insulated for 3 kV test voltage.

### 7.8.1 Fixed version circuit breakers

The auxiliary circuits of the circuit breaker must be connected by means of the terminal box installed in the circuit breaker's operating mechanism. The wires outside the circuit breaker must be routed inside appropriately earthed metal tubes or ducts.



**Make sure that the circuit breaker is open and the closing springs discharged before removing the operating mechanism cover to access the terminal box.**

### 7.8.2 Plug-in circuit breaker

The auxiliary circuits of the plug-in or removable circuit breaker are fully wired in the factory through to the connector. Please refer to the wiring diagram of the switchgear for the connections.

## 7.9 Overall dimensions

### 7.9.1 Fixed HD4/R, 12 ... 24 kV, 630 ... 1250 A

TN 7237

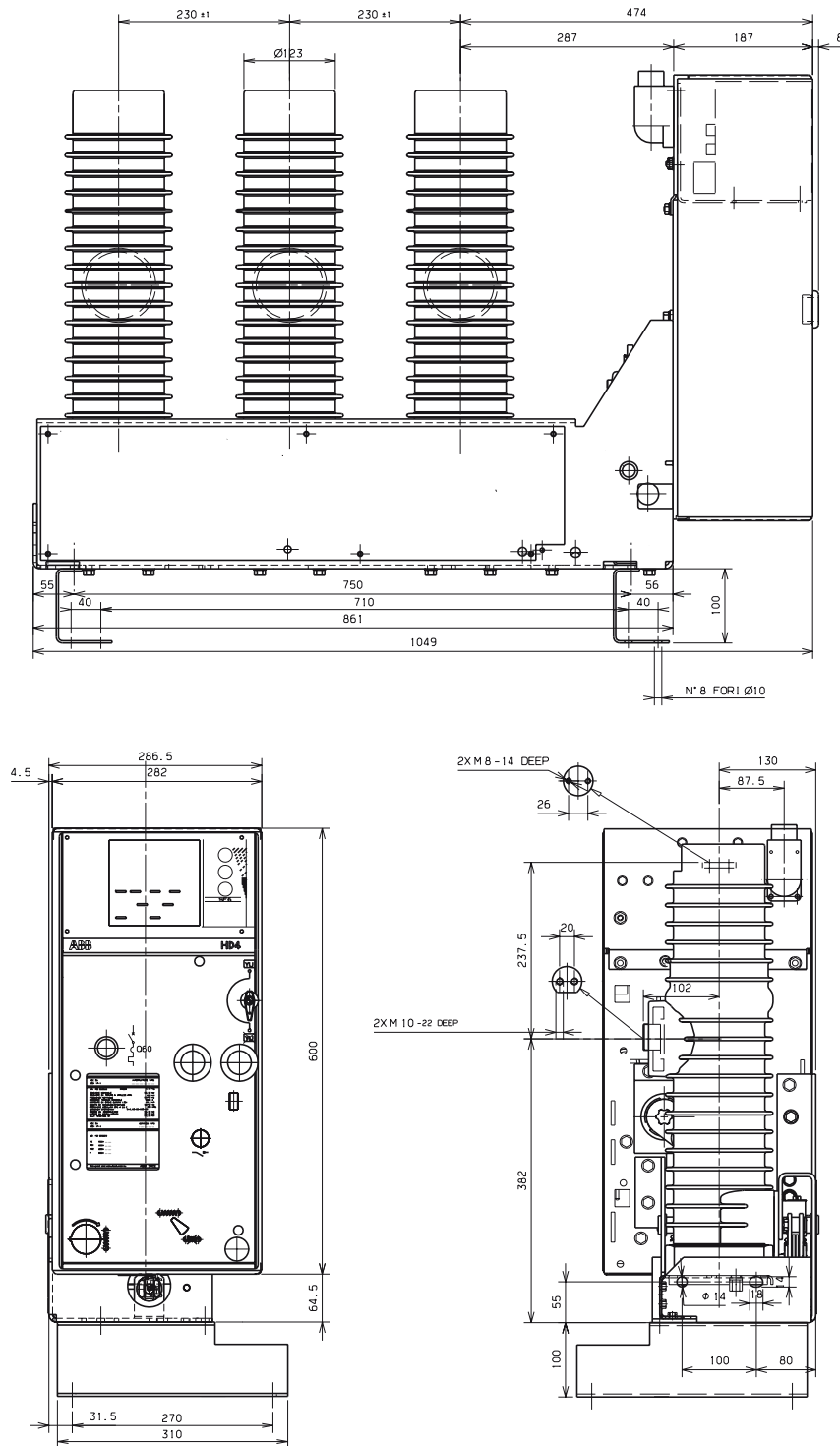


Figure 14

\_\_\_\_\_

TN 7234

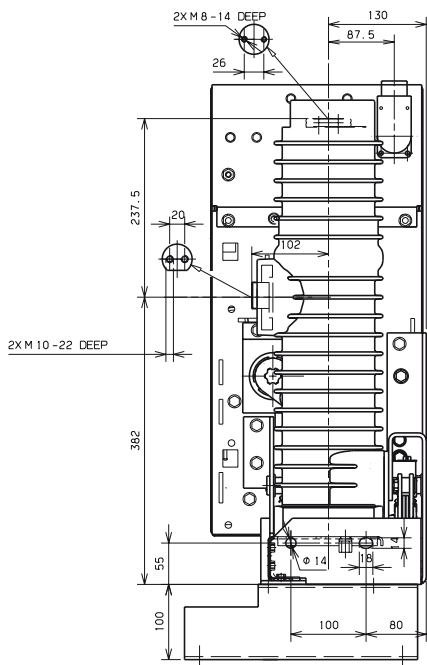


Figure 15

7.9.3 Fixed HD4/R, 36 kV, 630 ... 1250 A

TN 7238

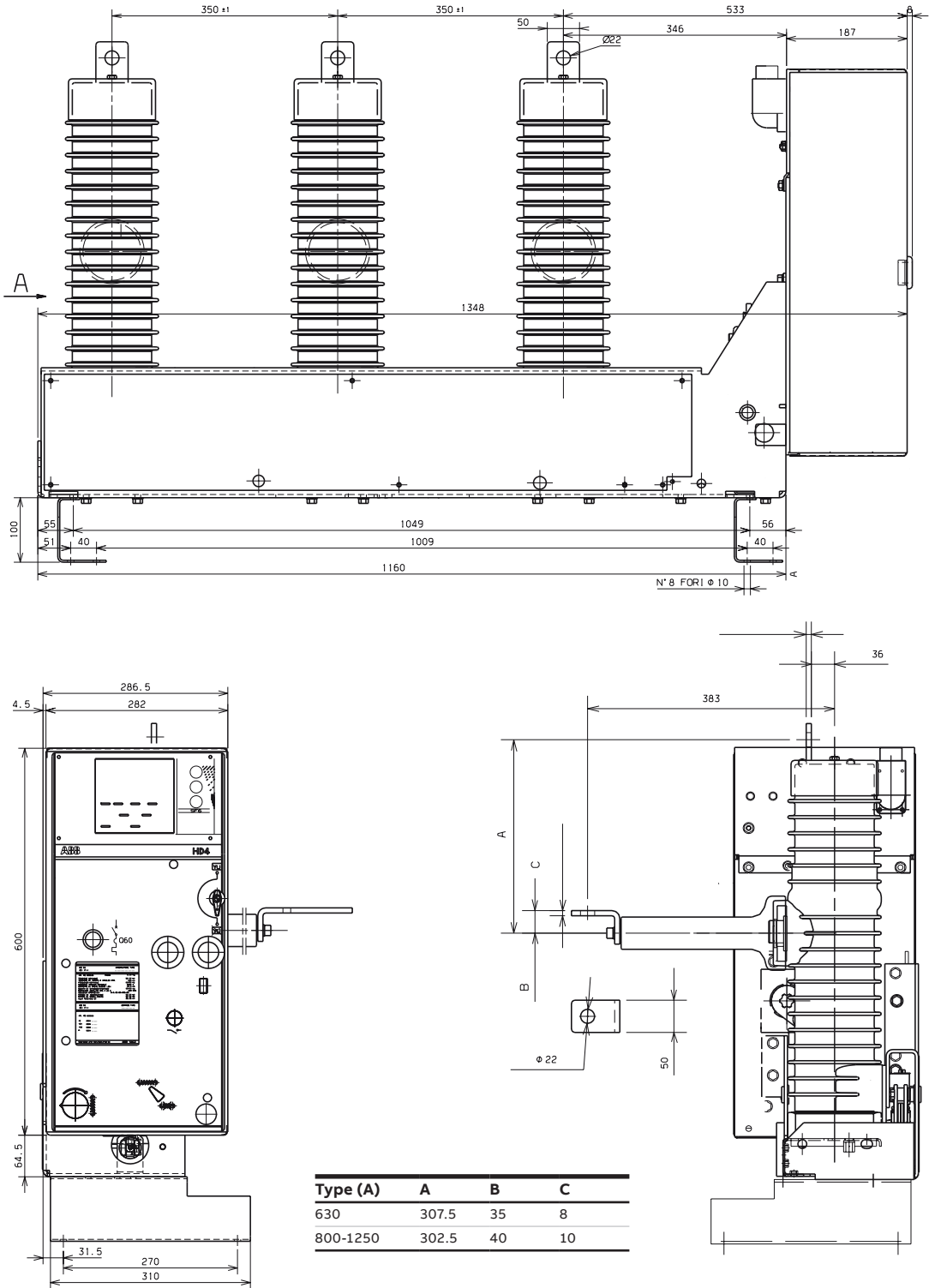


Figure 16

## 7. Installation

### 7.9.4 HD4/R-SEC, 12 ... 24 kV, 630 ... 800 A

1VCD003536

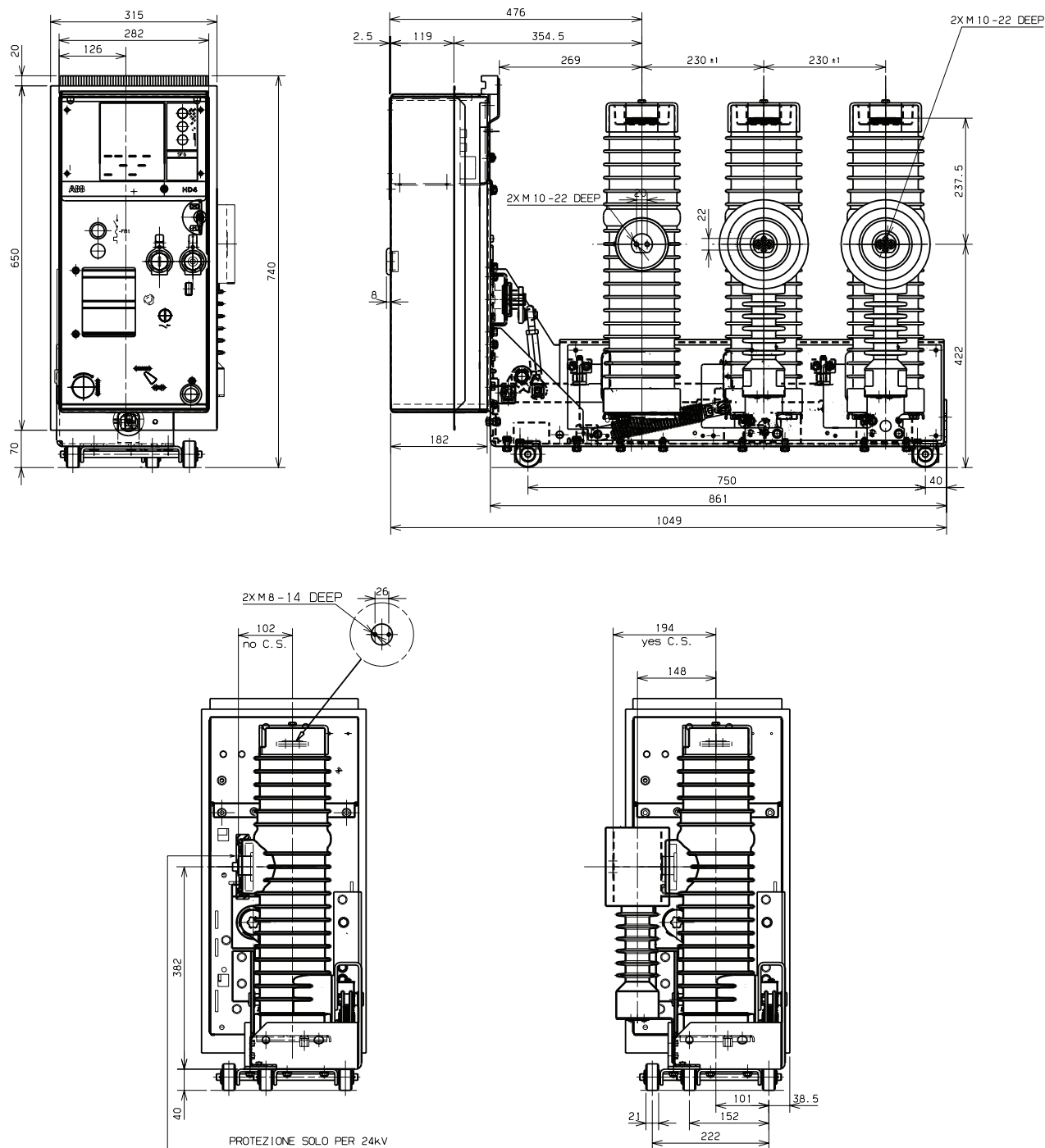


Figure 17

### 7.9.5 HD4/RE-SEC fisso, 12 ... 24 kV, 630 A

1VCD000196

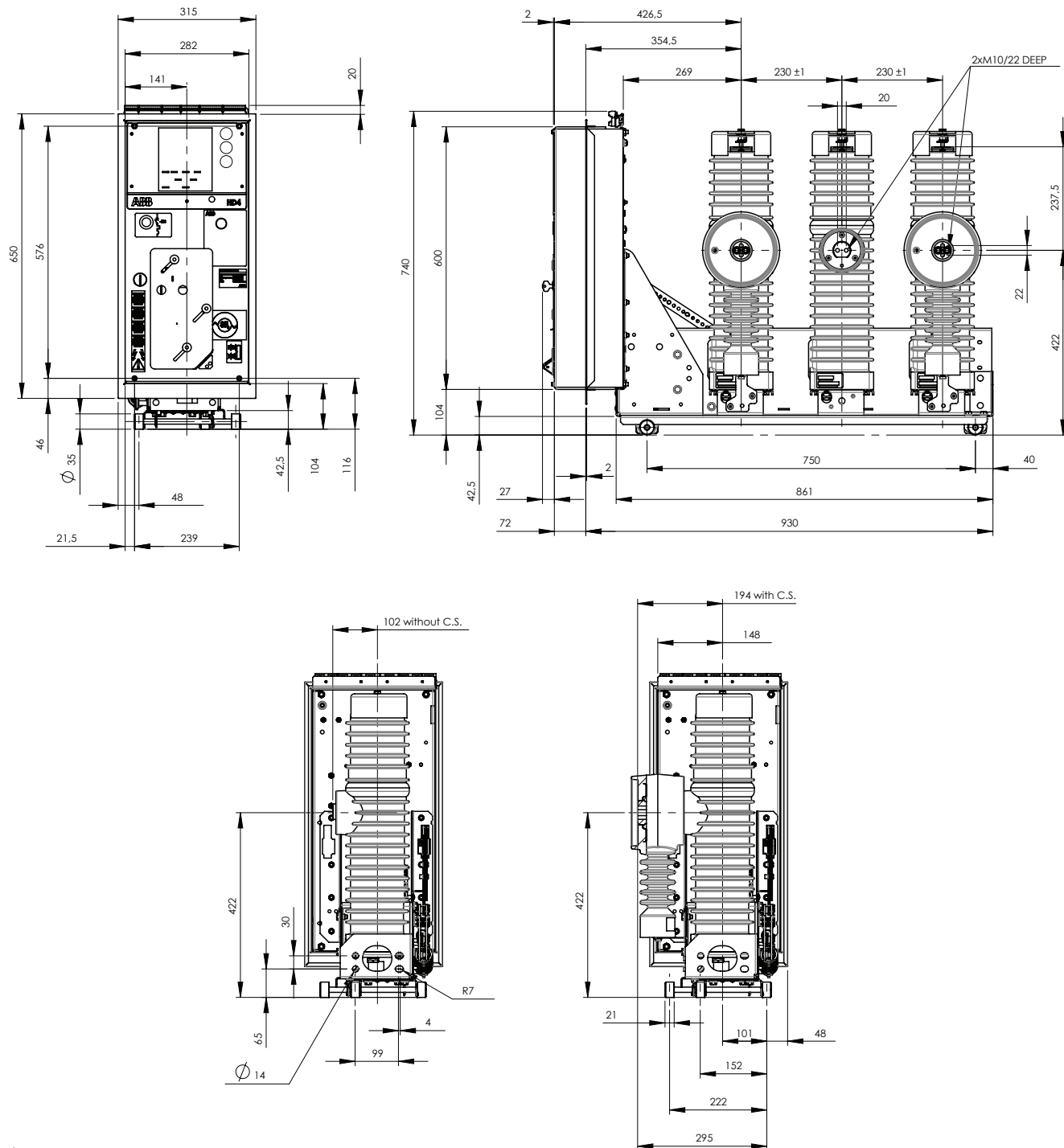


Figure 18

## 7. Installation

### 7.9.6 HD4/RE 12 ... 24 kV, 630 A

1VCD000207

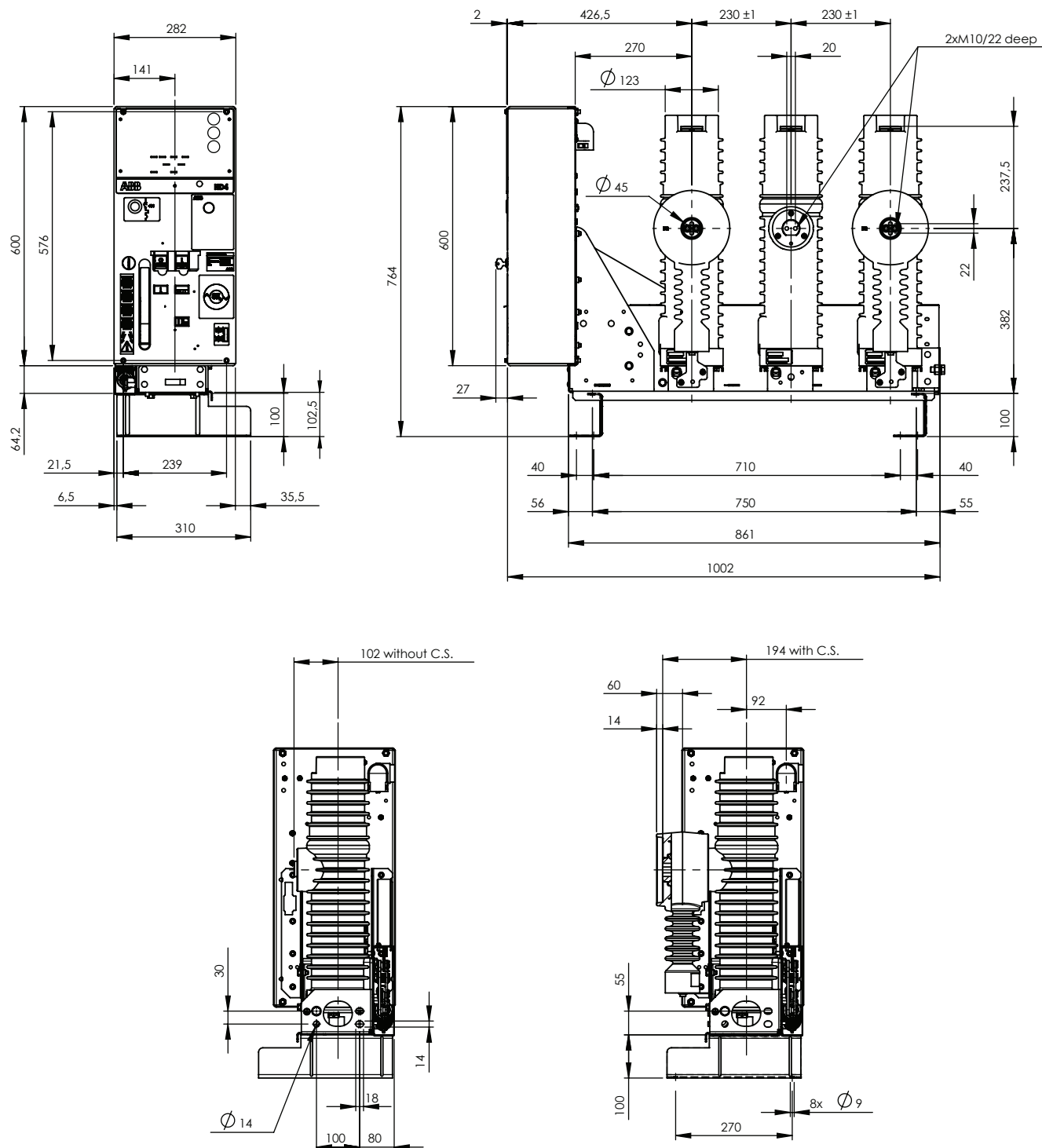


Figure 19



## 8. Putting into service

### 8.1 General procedures



**All the operations for putting into service must be carried out by ABB personnel or by the customer's qualified personnel. If the operations are obstructed in any way, do not force the mechanical interlocks and check that the operating sequence is correct.**

**The operating forces which can be applied are indicated in paragraph 6.3. Discharge the closing springs (close and open the circuit breaker) to access the inside of the operating mechanism. Disconnect the PR521 release (if provided) before conducting insulation tests on the circuit breaker.**

Carry out the following operations before putting the circuit breaker into service:

- make sure that the power connections to the circuit breaker terminals are tight;
- establish the setting of the primary electronic overcurrent release (if provided);
- make sure that the value of the power supply voltage of the auxiliary circuits is between 85% and 110% of the rated voltage of the electrical applications;
- make sure that there are no foreign bodies, such as bits of packing, in the moving parts;
- to avoid overtemperatures, make sure that there is a sufficient exchange of air in the place of installation;
- also perform the inspections indicated in the following table:

Subject of the inspection	Procedure	Positive check
1 Insulation resistance.	Medium voltage circuit Using a 2500 V Megger, measure the insulation resistance between the phases and between phases and earth the circuit.	The insulation resistance should be at least 50 MΩ and must remain constant over time.
	Auxiliary circuits Using a 500 V Megger (installed equipment permitting), measure the insulation resistance between the auxiliary circuits and the earth.	The insulation resistance should be several MΩ and must remain constant over time.
2 Auxiliary circuits.	Make sure that the connections to the control circuit are correct: proceed with the relative power supply..	Normal operations and signals.
3 Manual operating mechanism.	Perform a few closing and opening operations (see chap. 6). NOTE. Power the undervoltage release and the locking magnet on the operating mechanism at the relative rated voltage (if provided).	The operations and relative signals occur correctly.
4 Motor operator (if provided).	Power the spring loading gearmotor at the relative rated voltage.	The springs are loaded correctly. The signals are correct. The gearmotor stops when the springs have been loaded.
	Perform a few closing and opening operations. NOTE. Power the undervoltage release and the locking magnet on the operating mechanism at the relative rated voltage (if provided).	The gearmotor reloads the springs after each closing operation.
5 Undervoltage release (if provided).	Power the undervoltage release at the relative rated voltage and perform the circuit breaker closing operation.	The circuit breaker closes correctly. The signals are correct.
	Disconnect the power supply to the release.	The circuit breaker opens. The signal changes over.
6 Shunt opening release and supplementary opening release (if provided).	Close the circuit breaker. Power the shunt opening release at the relative rated voltage.	The circuit breaker opens correctly. The signals are correct.
7 Shunt closing release (if provided).	Open the circuit breaker. Power the shunt closing release at the relative rated voltage.	The circuit breaker closes correctly. The signals are correct.
8 Key lock.	Open the circuit breaker. Turn the key and remove it. Attempt the circuit breaker closing operation.	Neither manual nor electric closing takes place.
	Insert the key again and turn it through 90°. Perform the closing operation.	Both electric and manual closing take place correctly; in this position the key cannot be removed.
9 Auxiliary contacts in the operating mechanism.	Insert the auxiliary contacts into suitable signalling circuits. Perform a few closing and opening operations.	The signals occur correctly.

## 9. Routine inspections



**Before proceeding with any operation, always make sure that the springs of the operating mechanism are discharged and that the apparatus is in the open position.**

## 9.1 General information

During normal service, the circuit breakers are maintenance-free. Any interventions required basically depend on the severity of the service conditions, i.e. to various different factors such as the frequency of the operations, the interrupted current values, the relative power factor and the installation site.

For precautionary reasons, an inspection schedule is given in the table in the following section, along with the frequency with which the equipment must be checked.

As far as this latter is concerned, it is advisable to comply with the specifications in the table, at least during the first inspection.

Optimal time limits for carrying out successive operations can be established on the basis of the results obtained during the routine inspections.

## 9.2 Inspection schedule

	Inspection	Frequency	Criteria
1	Perform five mechanical closing and opening operations	Once a year	The circuit breaker must function normally, without stopping in intermediate positions
2	Visual inspection of the poles (resin parts)	Once a year or after every 1,500 operations	The resin parts must be free from any built-up dust, dirt, cracks, discharges or traces of surface discharges
3	3 Visual inspection of the operating mechanism and transmission	Once a year or after every 1,500 operations	The elements must not be deformed in any way. Screws, nuts, bolts, etc., must be tight
4	Measurement of the insulation resistance	Every 5 years or after every 1,500 operations	See sect. 8.1 point 1
5	Checking interlock operation	Every 5 years or after every 1,500 operations	The interlocks provided must function correctly

### Warning!

Contact the ABB Assistance Service and have the circuitbreaker completely overhauled after 10,000(\*) operations or after 10 years.

(\*) 2,000 operations for HD4/RE series.

## 9.3 Troubleshooting

The shunt opening and/or shunt closing release remains energized						
The shunt opening and/or shunt closing undervoltage releases are insufficiently energized						
Release coils interrupted or burnt, gearmotor winding interrupted						
The circuit breaker fails to open						
The circuit breaker fails to close						
Flashovers						



**Maintenance must only be carried out by ABB personnel or by the customer's suitably qualified personnel (IEC 60694, CEI EN 60694 sect. 10.4.2). If maintenance is 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" (sect. 11.1) must only be carried out by ABB personnel.**

**In particular:**

- complete pole with bushings/connections
- operating mechanism
- closing spring set
- opening spring.

#### Note

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

#### Functional test

- Perform a few opening and closing operations with the circuit breaker not connected to the load.
- If necessary, cut off the power supplied to the spring loading motor. Unload the springs by closing and opening the circuit breaker with the closing and opening pushbuttons.
- Visually inspect the jaw isolating contacts, sliding surfaces, etc., to make sure that they are properly lubricated.
- Check the electrical and mechanical operation of the various devices to make sure that everything is correct, particularly the interlocks.
- The screws and nuts are tightened in the factory and correct tightening is indicated by a coloured mark. No further tightening should be required during the operating life of the circuit breaker. However, if the screws or nuts must be retightened after maintenance work or other, always comply with the values indicated in fig. 25.

#### Screw inspection to check tightening torque

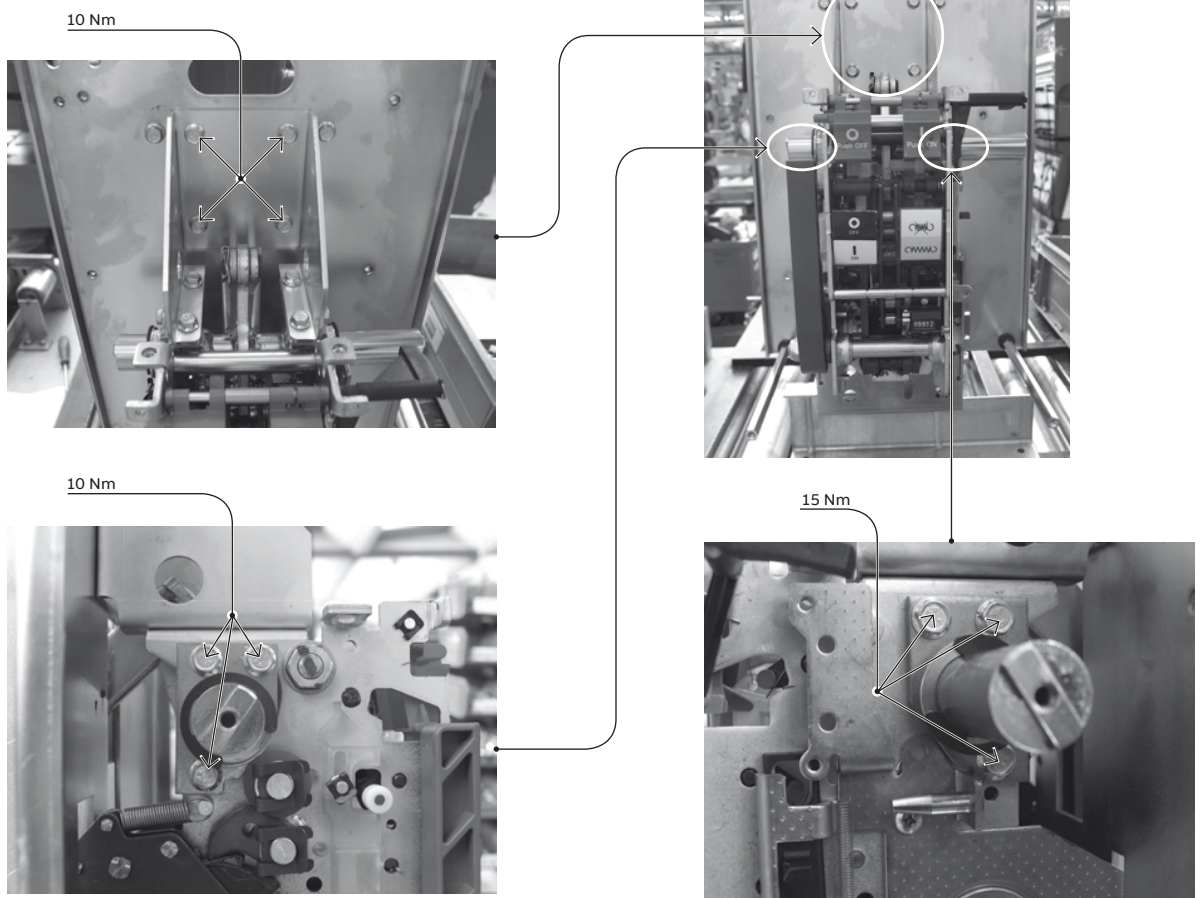


Figure 25

## 10. Instructions for handling apparatus containing SF<sub>6</sub> gas

In its pure state, SF<sub>6</sub> is an odourless, colourless, non-toxic gas with a density about six times higher than that of air. For this reason, although it does not lead to any specific physiological effects, it can produce effects caused by lack of oxygen in places saturated with SF<sub>6</sub>.

The electric arc produced during the interruption phase of the circuit breaker decomposes a very small amount of SF<sub>6</sub>. The products of this decomposition remain inside the poles and are absorbed by special substances which act as molecular sieves.

The probability of coming into contact with decomposed SF<sub>6</sub> is extremely remote, and its presence in small quantities (1-3 ppm) is immediately noticeable because of its sour and unpleasant smell. If this happens, the room must be aired before anyone enters it.

The strong infrared absorption of SF<sub>6</sub> and the fact that it remains in the environment for a long time are the reasons for its high Global Warming Potential (GWP), which is 22,200 higher than CO<sub>2</sub>, according to the Third Assessment Report.

The GWP (global warming potential) of 1 kg of SF<sub>6</sub>, with reference to 1 kg of CO<sub>2</sub>, is calculated over a time period of 100 years. Its overall contribution to the global greenhouse gas effect from all applications, amounts to approximately 0.2%.

However, the GWP of SF<sub>6</sub> gas alone is not sufficient for measuring the environmental impact of electric power equipment based on SF<sub>6</sub> technology.

The environmental impact of any specific application should be evaluated and/or compared using the Life Cycle Assessment - LCA approach, as established by ISO 14040 standards.

The Electric Industry uses SF<sub>6</sub> in a closed cycle, e.g. in the circuit breakers of gas insulated substations (GIS), in medium voltage and high-voltage gas insulated circuit breakers (GCB), in high-voltage gas insulated lines (GIL) and in gas insulated voltage transformers (GVT). In Asia, significant quantities of SF<sub>6</sub> are banked in gas insulated power transformers (GIT) as well.

The Electric Industry is reported to be the most important user of SF<sub>6</sub>, worldwide. In spite of being the most important user of SF<sub>6</sub>, the Electric Industry is a low contributor to the global emission of SF<sub>6</sub>, far below other industries or users with "open applications" of this gas.

However, the importance of SF<sub>6</sub> gas as a source of GWP varies substantially from region to region and from country to country, depending on the procedures used for handling it, the tightness of the electric power equipment and the amount of gas banked in electric equipment.

Consult document 1VCP000264 or 1VCP000266 for info about the Life Cycle Assessment of apparatus.

Please contact the ABB Assistance Service for information about how to dispose of SF<sub>6</sub> gas as this operation must only be carried out by trained and qualified personnel. The persons to contact are listed at <http://www.abb.com/ServiceGuide/alphabetical.aspx>.

Specific instructions about how to empty the SF<sub>6</sub> gas from the equipment are available on request (ask for internal document 650551 or 1VCP000617). The volume of SF<sub>6</sub> gas in each apparatus is indicated on the nameplate.

## 11. Spare parts and accessories



**All assembly operations of spare parts/ accessories must only be carried out by ABB personnel or by the customer's suitably qualified personnel, in compliance with the instructions enclosed with the spare parts and accessories themselves (IEC 60694, CEI EN 60694 sect. 10.4.2).**

**If maintenance is carried out by the customer's personnel, responsibility for the interventions remains with the customer.**

**Before proceeding with any operation, always make sure that the circuit breaker is open, the springs discharged and that it is not energised (medium voltage circuit and auxiliary circuits).**

### 11.1 List of spare parts/Accessories

- Opening release
- Undervoltage release
- Contact for signalling undervoltage release energised/deenergised
- Time delay device for undervoltage release
- Mechanical override for undervoltage release
- Closing release
- Spring loading geared motor with electrical signalling of springs loaded
- Gearmotor thermomagnetic protection circuit breaker
- Contact for signalling gearmotor protection circuit breaker open/closed
- Contact for signalling closing springs loaded/ discharged
- Auxiliary contacts of the circuit breaker
- Opening solenoid
- Open position key lock
- Opening pushbutton protection
- Closing pushbutton protection
- Opening/closing knob
- Gas refill kit
- 5-liter SF6 gas cylinder
- SF6 gas pressure monitoring device
- Current sensors
- Connector complete with sheath
- Wheel Kit
- Operation counter

## 12. Quality of the products and environmental protection

The apparatus is manufactured in accordance with the requirements established by the international standards concerning quality management and environmental management systems. The level of excellence in these fields is testified by the ISO 9001 and ISO 14001 certificates available.

### End of life of the products

ABB undertakes to comply with the environmental protection requirements established by law, in accordance with the matters established by the ISO 14001 Standards.

ABB provides its skills and assistance to facilitate the recycling and disposal process for products at the end of their life. It is always necessary to comply with the local regulations when disposing of products.

### Disposal methods

The products can be disposed of by means of heat treatments, in incineration systems or by storage in dedicated areas.

Material	Recommended disposal method
Metals (Fe, Cu, Al, Ag, Zn, W, altro)	Separation and recycling
Termoplastici	Recycling or disposal
Epoxy resin	Separation of the metal parts, disposal of the resin parts
Rubber	Disposal
SF6 gas	Recovery, recycling or disposal
Wood for packaging	Recycling or disposal
Aluminium foil for packaging	Recycling or disposal



# Notes

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**ABB S.p.A.**

Via Friuli, 4

24040 Dalmine

Tel: +39 695 2111

Fax : +39 035 6952 874

E-mail : [info.mv@it.abb.com](mailto:info.mv@it.abb.com)

**[abb.com/mediumvoltage](http://abb.com/mediumvoltage)**

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**ABB AG**

Calor Emag Medium Voltage Products

Oberhausener Strasse 33

D-40472 Ratingen

Phone: +49(0)2102/12-1230

Fax: +49(0)2102/12-1916

E-mail: [powertech@de.abb.com](mailto:powertech@de.abb.com)

**[www.abb.de/calor](http://www.abb.de/calor)**

More product information:

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Your contact center:

**[abb.com/contactcenters](http://abb.com/contactcenters)**

More service information:

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