Installation and
service instructions

Installation, service and maintenance instructions for low voltage air circuit-breakers

1SDH000910R0001 L6567

Emax VF UL listed

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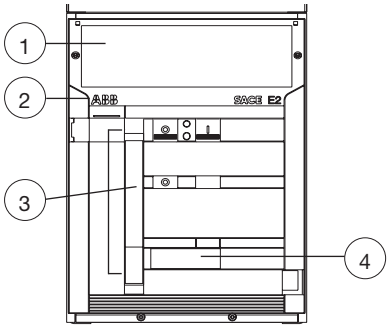
1. Description

1.1. General characteristics

The SACE Emax series of circuit-breakers consists of a steel sheet structure, which houses the operating mechanism, the poles and the auxiliary parts. Each pole, insulated from the others, contains the circuit-breaking parts and the current sensor of the corresponding phase. The fixed version circuit-breaker has its own terminals for connection to the power circuit; in the withdrawable version the circuit-breaker comprises the moving part of the apparatus, which is completed with a fixed part fitted with the terminals for connection to the power circuit of the installation. The moving part and the fixed part are coupled by means of special contacts installed in the fixed part.

1.2. External front view of the circuit-breaker



1 PR111/VF electronic microprocessor-based release
2 Trade mark
3 Operating and control parts of the operating mechanism and release tripped signals
4 Rating plate

Fixed circuit-breaker

Figure 1.

1.3. Circuit-breaker rating plate

SACE E2N/VF12		1200A			Frame Size	
Rated Maximum Voltage	(V)	240	480	600	ANSI C37.13	UL LISTED Low-Voltage AC Power Circuit-Breaker 63FA
Rated Short-Circuit Current	(kA)	15	15	15		
Rated Short Time Current	(kA)	15	15	15		
Rated Frequency	(Hz)	50-60				

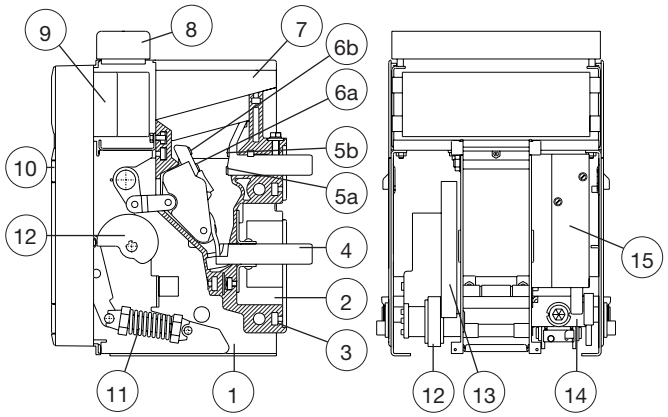
SACE E2N/VF12	Iu=1200A Ue=1000V		IEC 60947-2
Ue (V)	690	1000	Icw(1s)=15kA
Icu (kA)	15	10	Uimp=12kV
Ics (kA)	15	10	ABB SACE Italy CE
cat.A	50-60Hz		

Figure 2.

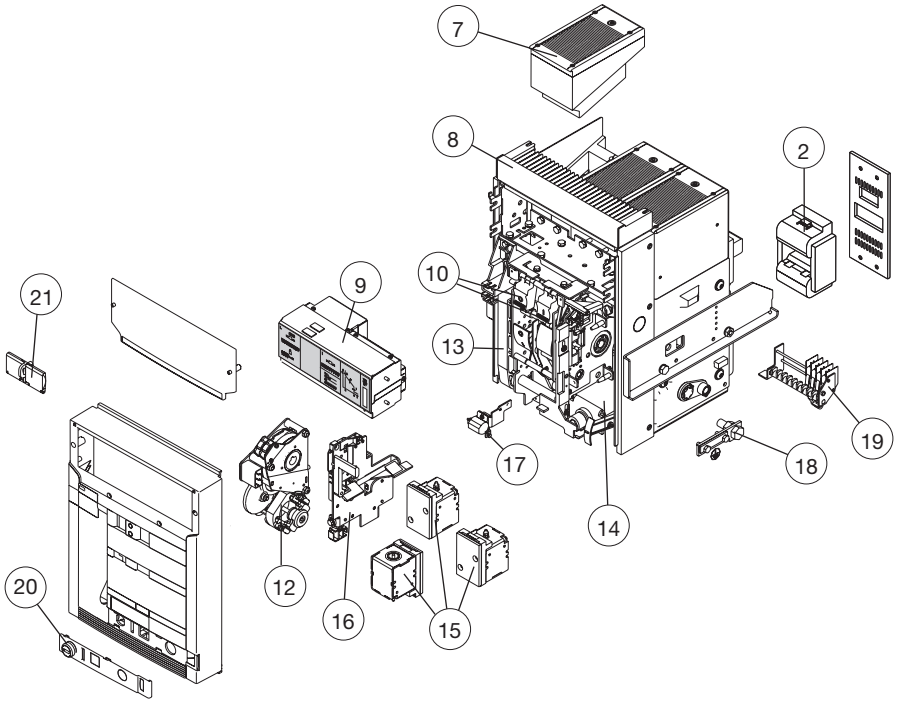
The SACE Emax VF circuit breakers can be used in applications with variable frequency from 20Hz to 200Hz, with rated voltage up to 1000V. The SACE Emax VF switch disconnectors can be used in applications with variable frequency from 1Hz to 200Hz with rated voltage up to 1000V.
The rated impulse withstand voltage of the circuit breakers is 12kV.

The SACE Emax VF circuit breakers and switch disconnectors up to 2500A are available also in LTT version; this special version, designed for low temperature environment, permits to extend the operating temperature range from -40°C to +70°C.

1.4. Moving part construction characteristics



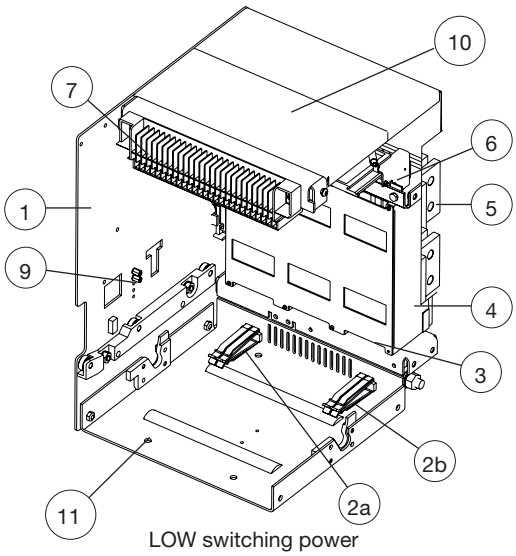
Selective circuit-breaker

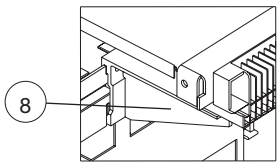


1 Supporting structure made of steel sheet
2 Current sensor for protection release
3 Terminal supporting insulating box
4 Horizontal rear terminals
5a Main fixed contact plates
5b Fixed arcing contact plates
6a Main moving contact plates
6b Moving arcing contact plates
7 Arcing chamber
8 Terminal box for the fixed version-Sliding contacts for the withdrawable version
9 Protection release
10 Circuit-breaker closing and opening mechanism
11 Closing springs
12 Spring loading geared motor (on request)
13 Lever for manually loading the closing springs
14 Racking-out device (only for withdrawable circuit-breakers)
15 Service releases (shunt closing release, shunt opening release, undervoltage release)(on request)
16 Support for releases
17 Operation counter
18 Earthing
19 Auxiliary contacts
20 Key lock and padlocks in the open position – extracted test – extracted
21 Key lock in the open position

Figure 3.

1.5. Fixed part construction characteristics





1 Steel sheet supporting structure
2 Earthing contacts (a: for all versions; b: for E4, E6)
3 Safety shutters (IP20 degree of protection)
4 Insulating terminal support base
5 Terminals
6 Contacts for signalling connected/test isolated/ disconnected (on request)
7 Sliding contacts
8 Padlock for safety shutters (on request)
9 Anti-racking-in lock for circuit-breakers of different size
10 Casing
11 Fixing holes (qty 4 for E2, E3, 6 for E4, E6)

Figure 4.

2. Checking on receipt

Examine the state of the material received and its consistency with the content of the order. Should any damage or errors be found on unpacking, which must be carried out carefully, make the relative notification within and not over 5 days from the receipt of the material. The notification must indicate the number of the shipping note.

3. Storage, lifting and weights

The circuit-breaker, protected by an external wooden crate, is fixed by means of screws to the transport pallet or to the bottom of the packing case. If the circuit-breaker has to remain in the warehouse even for a short time before being put into service, after checking it on receipt, it must be put back in its container and covered with a waterproof sheet.

CAUTION:
- **Use a dry, dust-free room free of aggressive chemical agents as a storage room**
- **Position the circuit-breaker and any fixed part on a horizontal surface, not in direct contact with the floor, but on a suitable support surface (Figure 5)**
- **The maximum number of stackable circuit-breakers is indicated in Figure 6.**
- **Keep the circuit-breaker in the open position and with the closing springs unloaded to avoid unnecessary stress and the risk of accident to the personnel.**
- **Storage temperature: -40°C … + 70°C.**

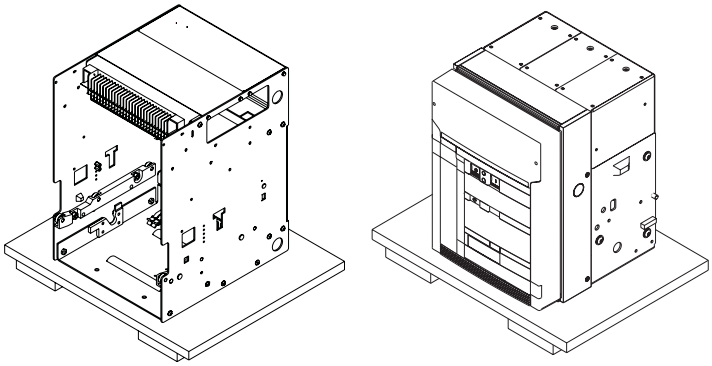


Figure 5.

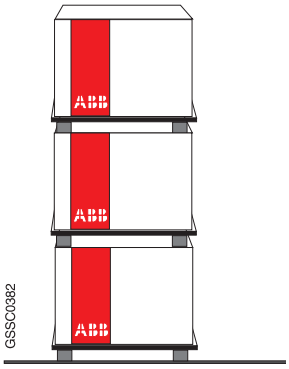


Figure 6.

With regard to lifting, follow the instructions: the circuit-breakers must be placed on a sturdy supporting surface and lifted, preferably by means of a special fork-lift truck. However, the use of ropes is allowed. In this case, the lifting ropes must be hooked up as shown in the figures (the lifting plates are always supplied with the circuit-breaker).

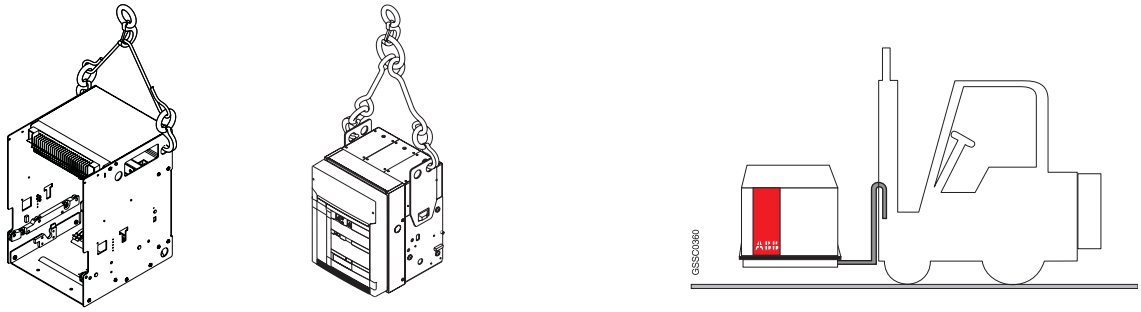


Figure 7.

Table of the circuit-breaker weights

Selective circuit-breaker	Fixed version		Withdrawable version	
	3 poles		3 poles	
	Kg	Lbs	Kg	Lbs
E2/VF	50	110	78	172
E3/VF	66	145	104	229
E4/VF	97	213	147	324
E6/VF	140	308	210	463

Notes:
The weights indicated in the table are intended for circuit-breakers complete with PR111/VF releases and relative current sensors, excluding the accessories. The withdrawable version includes the moving part in the same conditions as above, and the fixed part with horizontal rear terminals.

4. Installation

4.1. Installation room

Install the circuit-breaker in a dry, dust-free, non-corrosive room, and in such a way that it is not subject to shocks or vibrations. Where this is not possible, install it inside a switchboard with a suitable degree of protection. For the preparation of the installation room, please refer to the “Overall dimensions” paragraph, which gives information on the following points:
- minimum installation volumes of the circuit-breakers and derived versions
- distances to be respected for circuit-breakers in compartments
- overall dimensions of the circuit-breakers
- fixing drillings
- compartment door drillings.

The installation, commissioning and any ordinary and extraordinary maintenance have to be done by skilled personnel, with a detailed knowledge of the apparatus.

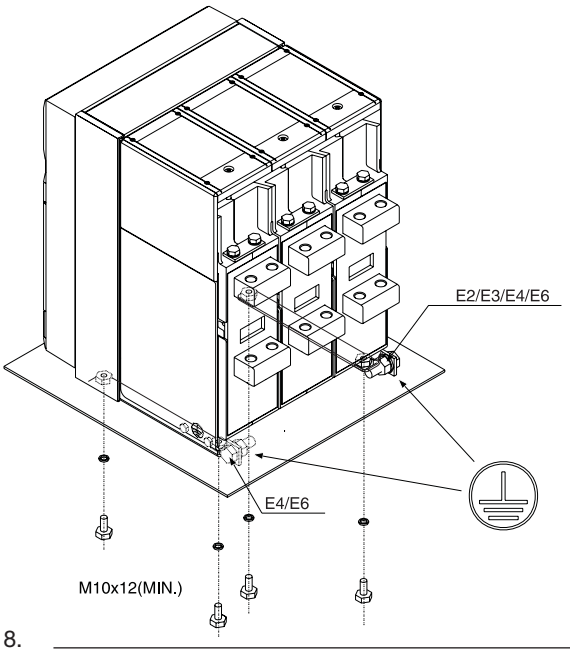


Figure 8.

WARNING: The installation, commissioning and any ordinary and extraordinary maintenance of the circuit-breaker and accessories must be performed by skilled personnel, with a detailed knowledge of the equipment.

WARNING ELECTRICAL SHOCK HAZARD:
Disconnect and lock and tag out all electrical power feeds to avoid any potential shock hazard when you are assembling, installing maintaining or removing the circuit breaker from service. Some operations must be performed when the circuit-breaker is energized. In this case, reasonable care and compliance with all safe working practices is required.

4.2. Installation of the fixed circuit-breaker

Fix the circuit-breaker to a horizontal surface using the screws (M10 x 12 min.) (Figure 8).

4.3. Installation of the fixed part of the withdrawable circuit-breaker

4.3.1. Preparation of the fixed part

Assembly of the anti-racking-in lock

Before installing the fixed part, it is necessary to check the presence of the anti-racking-in lock for circuit-breakers with different electrical characteristics from those of the fixed part. If the anti-racking-in lock has been supplied separately, proceed to assemble it as follows:
- On the self-adhesive plate (4), find the assembly position of the stop bolts in relation to the circuit-breaker which has to be housed in the fixed part
- Insert the two hexagon-head screws (1) into the holes found in the previous item as shown in the figure
- Fix the two screws with the washers (2) and the hexagonal stops (3).

Make sure that the anti-racking-in lock corresponding to the one installed on the fixed part is present on the circuit-breaker (moving part).
- Anti-racking-in plate on the moving part (5).

Example for E2N-VF according to the nameplate diagram:

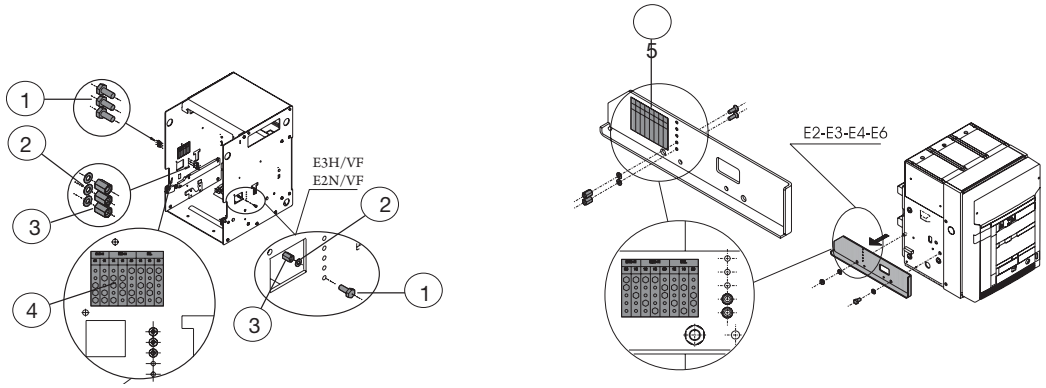


Figure 9.

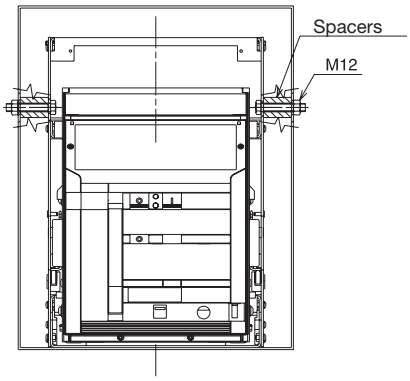
4.3.2. Installation of the fixed part (Figure 10)

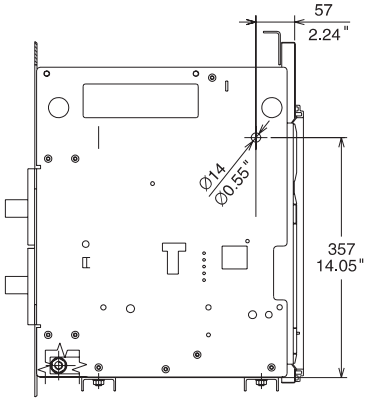
Attach the fixed part by means of the screws (1), washers (2) and nuts (3) (M8x 16), supplied by ABB SACE. If other screws are used, make sure that the head of the screws does not extend more than 5.5 mm (0.22 inches) from the base of the fixed part.

4.3.3. Installation of the fixed part on board a ship (Figure 11)

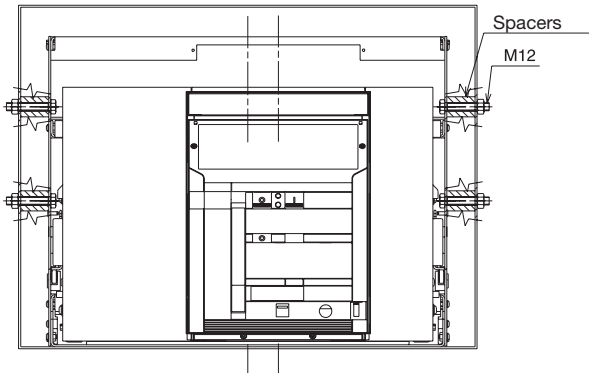
Regarding the fixing points of the SACE Emax withdrawable version air circuit-breakers, for applications on board a ship, additional fixing on the sides of the fixed part itself is recommended (the M12 screws and the spacers are not provided in the supply).

E2 - E3





E4 - E6



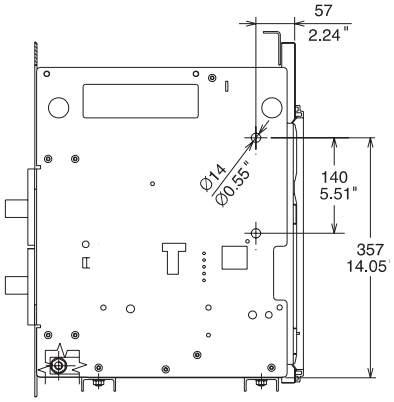
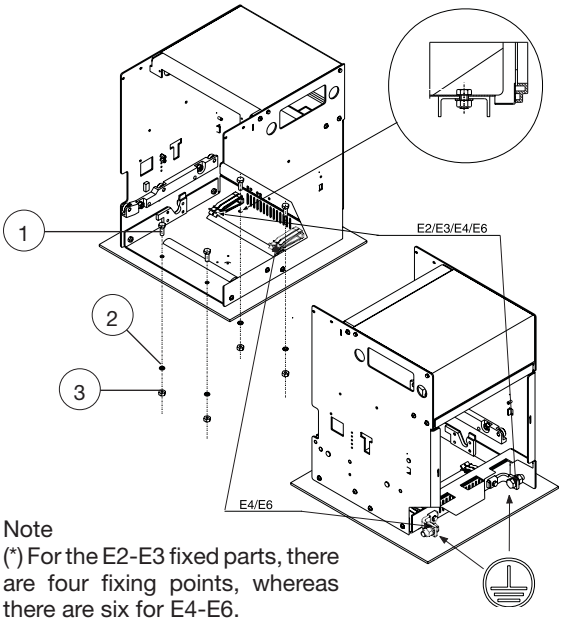


Figure 10.

4.4. Installation of the flange on the compartment door (Figure 12)

- Make the compartment door drillings specified in the “Overall dimensions” paragraph.
- Attach the flange (1) on the front of the compartment door, fixing it from the inside by means of the self-tapping screws (2).



Note
(*) For the E2-E3 fixed parts, there are four fixing points, whereas there are six for E4-E6.

Figure 11.

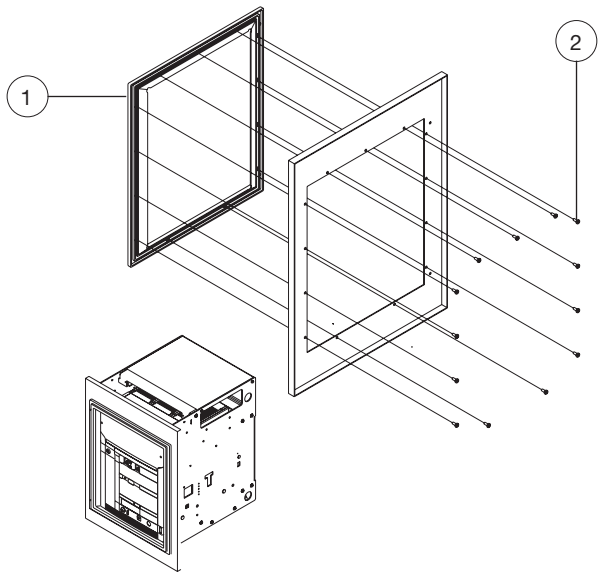


Figure 12.

5. Electrical connections

5.1. Connections to the power circuit

5.1.1. Shapes of the terminals

Fixed circuit-breaker

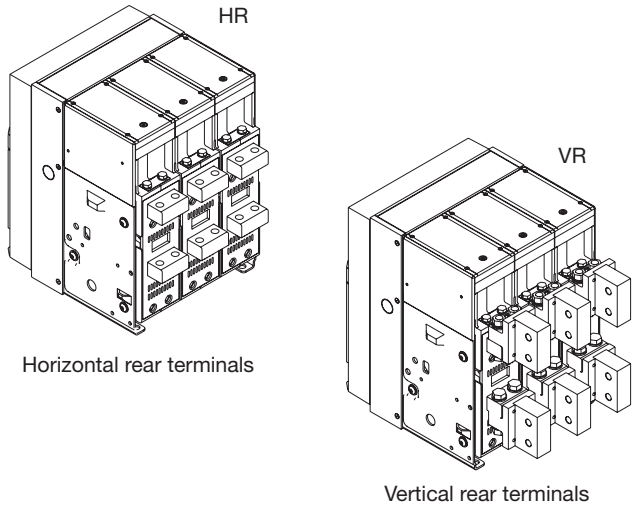


Figure 13.

Fixed part for withdrawable circuit-breaker

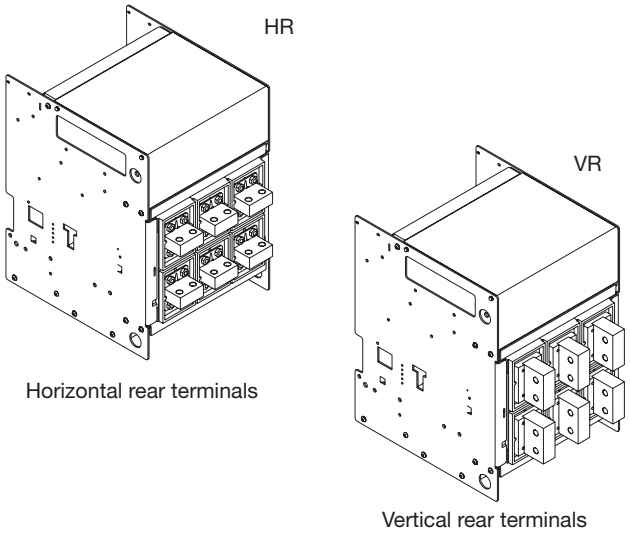


Figure 14.

Note
The drawings are provided to show the type of terminal in graphic form. The exact shape of the terminals is given in the “Overall dimensions” chapter.

5.1.2. Examples of positioning the connection busbars according to the types of terminal

The connection busbars enable the connection between the terminals of the circuit-breakers and the busbars of the switchgear. Their sizing must be carefully studied by the switchgear designer. Some examples of possible constructions in relation to the shape and size of the circuit-breaker terminals are given in this paragraph. The various types of terminals are of constant dimensions for each size of circuit-breaker: it is normally advisable to exploit the whole contact surface of the terminal, so the width of the connection busbars should be the same as that of the terminal. Different connection capacities can be obtained by adjusting the thickness and number of busbars in parallel. In some cases, reductions in the width of the connection in relation to that of the terminal are allowable, as shown in the following examples.

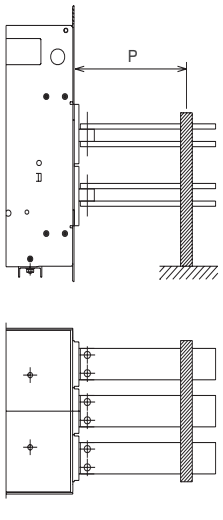
Possible length of connection busbars				
	Connection busbars			
	Nominal current	Number	Dimensions mm/inches	Dimensions mm/inches
E2	1200 A	2	50.8/2”	6.35/0.26”
E2	1600 A	2	76.2/3”	6.35/0.26”
E3	2000 A	2	101.6/4”	6.35/0.26”
E3	2500 A	3	101.6/4”	6.35/0.26”
E4	3600 A	6	76.2/3”	6.35/0.26”
E6	5000 A	8	101.6/4”	6.35/0.26”

Figure 15.

Positioning the first anchoring baffle of the busbars according to the short-circuit current

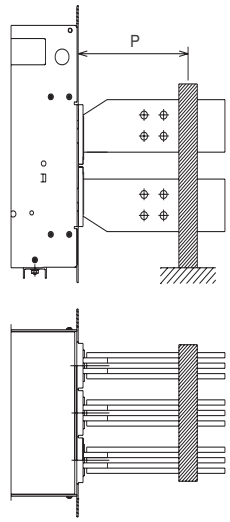
Anchoring to the switchgear

HORIZONTAL TERMINALS



P	E2	E3-E4-E6
mm	250	150
inch	9.84”	5.91”

VERTICAL TERMINALS



P	E2	E3-E4-E6
mm	250	150
inch	9.84”	5.91”

Figure 16.

5.1.3. Assembly procedure for the connection busbars

Check the state of the contact surfaces of the connections very carefully: they must be very clean with no burrs, dents or traces of rust, which must be eliminated using a fine file or an emery cloth to prevent localized increases in temperature. On completion of the operation, remove all traces of grease or dust with a cloth soaked in a suitable solvent.
When alluminium connections are used the contact surfaces must be tinned.
The connections must not exert any strain on the terminals in any direction.
Always insert a large-diameter flat washer and a spring washer between them (to spread the tightening pressure over a greater area).
Make the contact between connection and terminal and tighten the fixing screws completely.
Always use two wrenches (so as not to strain the insulating parts excessively), applying the tightening torque indicated in Figure 17.
Check tightness after 24 hours.

M12/ ½” high-strength screws
Tightening torque of the main terminals: 70 Nm / 620 Lb in.

Fixed part terminals

	No. of screws for phase	No. of screws for neutral
E2	2	2
E3	3	3
E4	4	2
E6	6	3

Fixed circuit-breaker terminals

	No. of screws for phase	No. of screws for neutral
E2	2	2
E3	3	3
E4	4	2
E6	6	3

Figure 17.

5.2. Earthing

The fixed circuit-breaker and the fixed part of the withdrawable circuit-breaker have one or two terminals on the rear, marked with the special symbol, for connection to earth (Figure 8 and Figure 11).
Each terminal is complete with a bolt for fixing the connection.
A conductor with a cross-section conforming to current standards must be used for the connection.
Before assembling the connection, clean and degrease the area around the screw.
After the assembly, tighten the bolt with a torque of 70 Nm / 620 Lb in.

5.3. Wiring the circuit-breaker auxiliary circuits

5.3.1. Interfacing elements for fixed circuit-breakers

A special terminal box is provided, fitted with screw terminals for connecting the auxiliary circuits.
The terminals are marked with alphanumerical identification codes as for the electrical circuit diagram. The terminal box is identified by code XV on the electrical circuit diagram. The terminal box is immediately accessible when the compartment door is open.

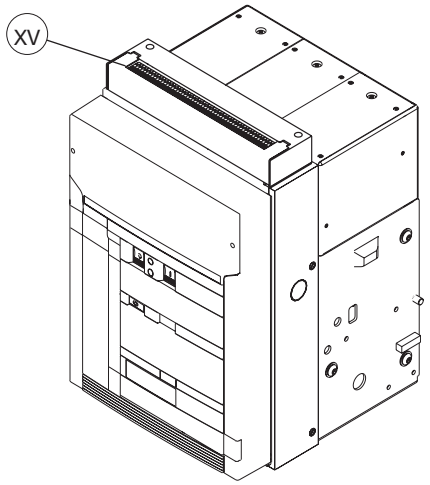
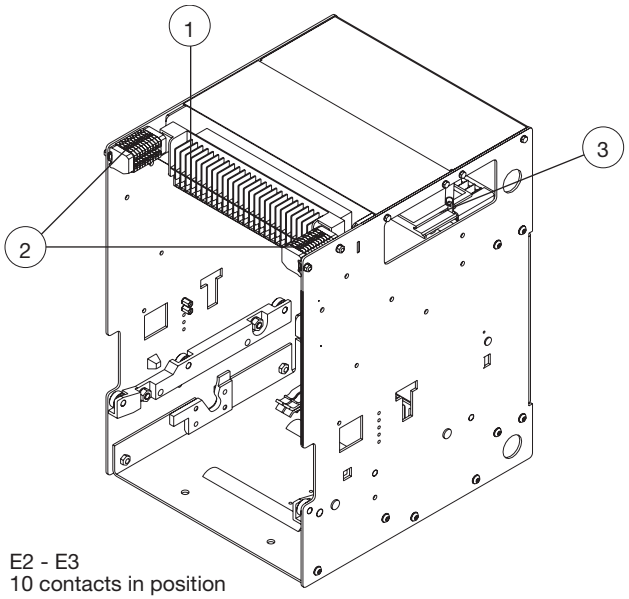


Figure 18.

5.3.2. Withdrawable circuit-breaker

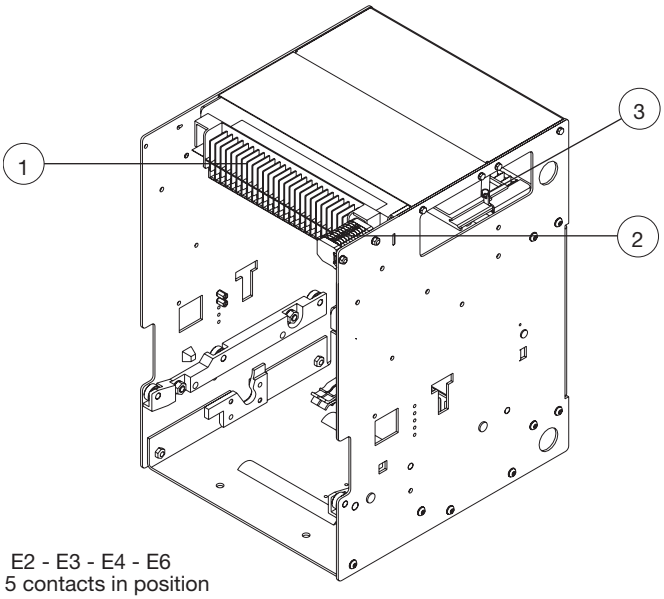
For connection of the moving part to the auxiliary circuits, a connection with sliding contacts is available on the fixed part (see figure), identified by code X on the electrical circuit diagram.
The terminals of the fixed connector are immediately accessible when the compartment door is open.
Furthermore, a terminal box identified by code XF is available for connecting the position contacts of the moving part in relation to the fixed part.

The connector and terminal box have screw terminals.

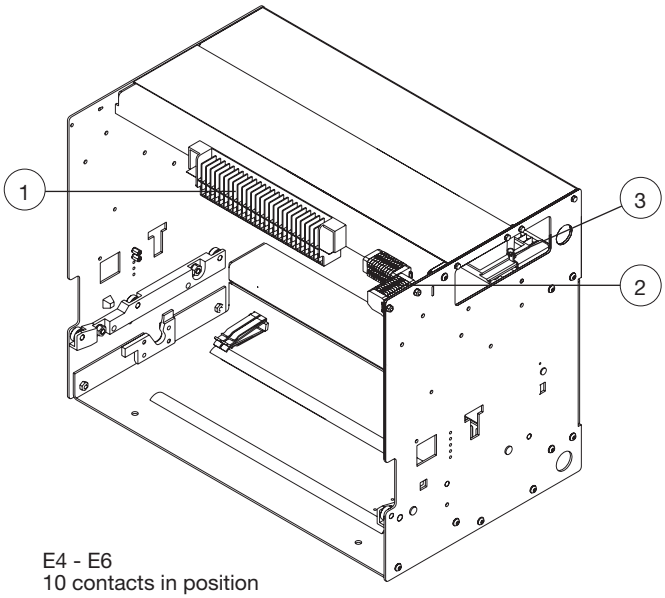


Caption
1 Sliding contacts (X)
2 Terminal box for position contacts (XF)
3 Position contacts

E2 - E3
10 contacts in position



E2 - E3 - E4 - E6
5 contacts in position



E4 - E6
10 contacts in position

Figure 19.

5.4. Conversion of the auxiliary contacts or of the position contacts from normally closed (opening) to normally open (closing) or vice versa

The contacts are wired at the factory as shown on the electrical circuit diagram. If it is necessary to change their state for installation requirements, proceed as followss.

a) Auxiliary contacts

To access the auxiliary contacts, carry out the following operations:

- remove the front protection (3) of the release by taking action on the blocks (1) as shown in the figure
- remove the protection release (4) removing the side nuts (2) and then sliding the release out from the front of the circuit-breaker.

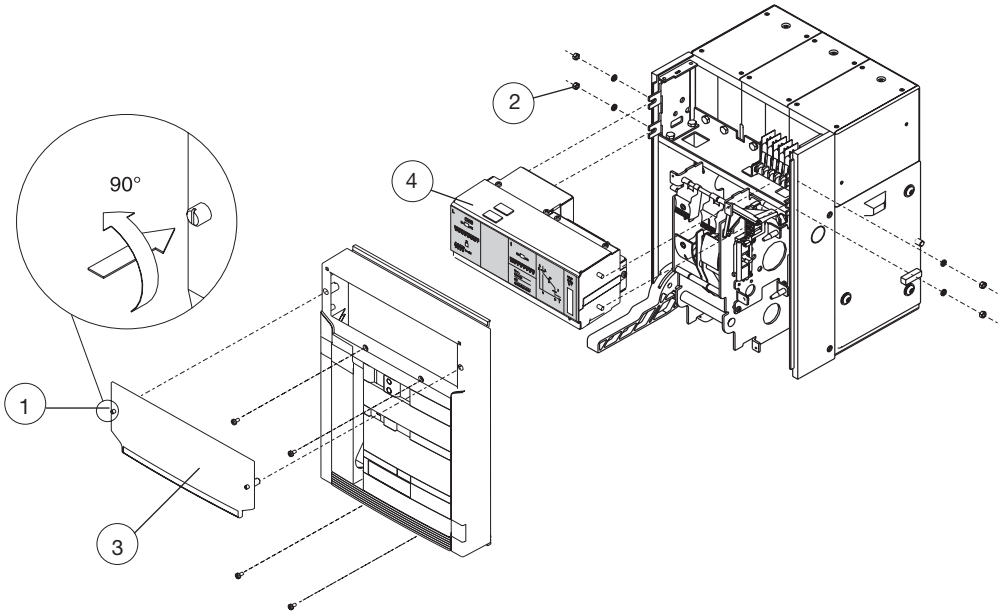


Figure 20.

Being of the two-way type (changeover contacts), the auxiliary contacts can be modified from break contacts to make contacts and vice versa simply by moving the output conductor from one position to the other, as shown in the figure.

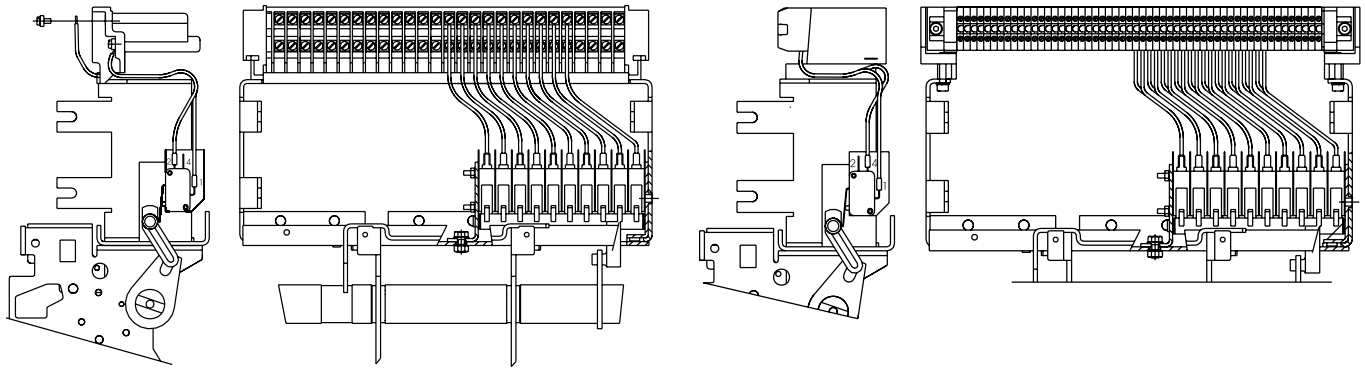


Figure 21.

b) Position contacts

To change the state of the position contact, proceed in the same way as explained for the auxiliary contacts (see Figure 20 and Figure 21).

6. Putting into service

6.1. General procedures

- Check tightness of the power connections at the circuit-breaker terminals
- Carry out all the preparatory operations on the release
- Make sure that the value of the auxiliary circuit power supply voltage is between 85 and 110% of the rated voltage of the electrical applications
- Make sure that there is an adequate air circulation in the place of installation to avoid overheating.

	Item inspected	Procedure	Positive check
1	Manual operating mechanism	Carry out some opening and closing operations (see the chapter 7.2). **CAUTION** **When there is an undervoltage release, the circuit-breaker can only be closed after the release has been electrically energized.**	The spring loading lever moves correctly
2	Geared motor (if any)	Supply the spring-loading geared motor at the corresponding rated voltage. Carry out some closing and opening operations. Note. Supply the undervoltage release at the corresponding rated voltage (if any).	The springs are loaded correctly. The signals are correct. The geared motor stops with the springs loaded. The geared motor recharges the springs after each closing operation.
3	Undervoltage release (if any)	Supply the undervoltage release at the corresponding rated voltage and carry out the circuit-breaker closing operation. Disconnect the release. Supply the undervoltage release at the corresponding rated voltage and carry out the circuit-breaker closing operation.	The circuit-breaker closes correctly. The signals are correct. The circuit-breaker opens. The signal changes over.
4	Shunt opening release (if any)	Close the circuit-breaker. Supply the shunt opening release at the corresponding rated voltage.	The circuit-breaker opens correctly. The signals are correct.
5	Shunt closing release (if any)	Open the circuit-breaker. Supply the shunt closing release at its rated voltage.	The circuit-breaker closes correctly. The signals are correct.
6	Circuit-breaker lock in the open position (with key or padlocks)	Open the circuit-breaker, turn the key and remove it from its seat. Attempt the circuit-breaker closing operation.	Both manual and electrical closing are prevented.
7	Auxiliary contacts of the circuit-breaker	Insert the auxiliary contacts in suitable signalling circuits. Carry out some circuit-breaker closing and opening operations.	The signals are given correctly.
8	Auxiliary contacts for signalling circuit-breaker connected, test isolated and disconnected	Insert the auxiliary contacts in suitable signalling circuits. Then put the circuit-breaker in the connected, test isolated and disconnected position.	The signals due to the relative operations are given correctly.
9	Lock devices for circuit-breakers connected and disconnected. Interlocking devices between circuit-breakers side by side and one on top of another (if any)	Carry out the operating tests.	The locks function correctly.
10	For withdrawable circuit-breakers: racking -in/out device	Carry out some racking-in and out operations.	Racking-in operation: the circuit-breaker racks in correctly. The first turns of the crank handle do not meet with any particular resistance.

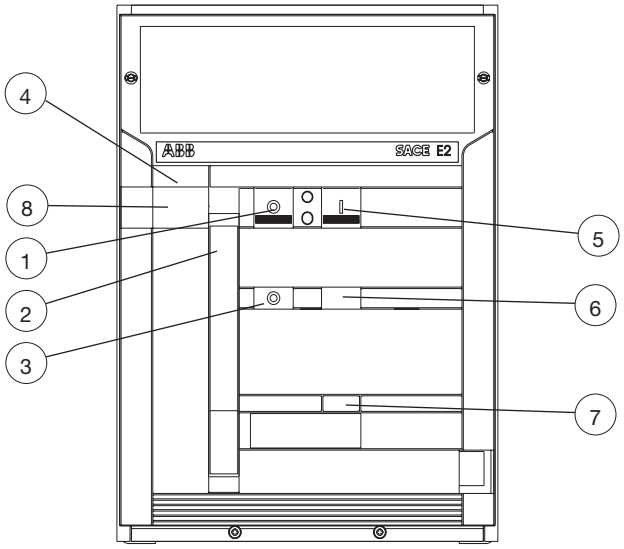
WARNING: When undervoltage release has been activated by an undervoltage event, the circuit-breaker can only be closed after the release has been electrically energized. Ensure that an undervoltage condition existed at the time the release was activated. If not, investigate circuit-breaker and associated equipment to ensure they are in proper working order. If application is critical, investigate immediately.

7. Instructions for use

7.1. Operating and signalling parts

1 Pushbutton for the manual opening operation
2 Lever for manual loading of the closing springs
3 Mechanical indicator for circuit-breaker open “O” and closed “I”
4 Mechanical indicator for protection release tripped (on request)
5 Pushbutton for the manual closing operation
6 Signalling device for springs loaded- unloaded
7 Operation counter (on request)
8 Key lock on the closing operation (on request)
9 Mechanical indicator for circuit-breaker connected, test isolated and disconnected
10 Seat for the racking-in/out lever
11 Lever releasing the racking-in/out operation
12 Key lock on the racking-in/out operation (on request)
13 Padlock on the manual closing operation (on request)
14 Padlock on the racking-in/out operation (on request)

Fixed circuit-breaker



Withdrawable circuit-breaker

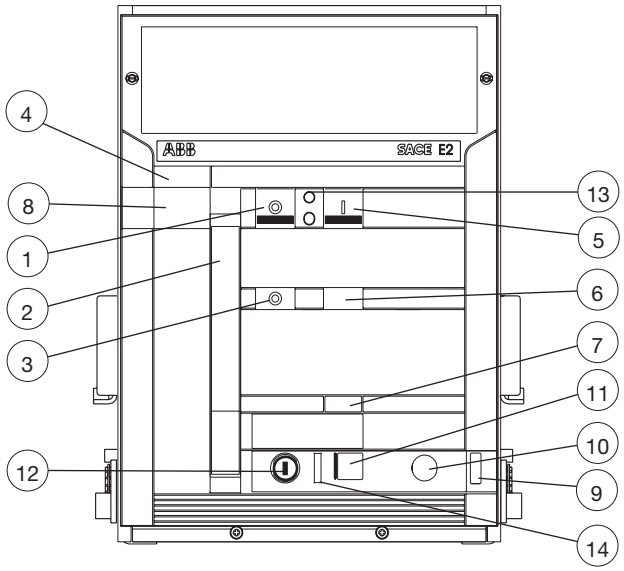


Figure 22.

Note On request, a transparent cover can be installed on the front of the circuit-breaker to increase the degree of protection to IP54. The cover has a locking key. As an alternative to the transparent cover, a protection can be mounted on the manual closing and opening controls, which only allows operation of the pushbuttons by means of a special tool.

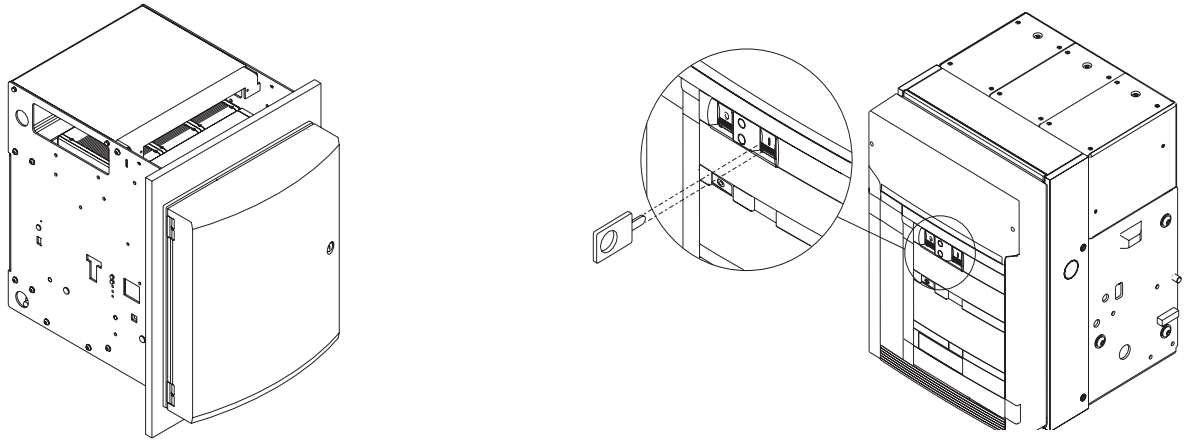


Figure 23.

7.2. Circuit-breaker closing and opening procedures

The operation of the circuit-breaker can be either manual or electrical.

a) Manual loading of the closing springs

- Make sure that the indicator (3) shows “O” (circuit-breaker open)
- Make sure that the indicator (6) is WHITE (springs unloaded)
- Repeatedly activate the lever (2) until the indicator (6) changes its color to YELLOW

b) Electrical loading of the closing springs

The electrical loading of the circuit-breaker is possible when the following accessories (supplied on request) are present:
– geared motor for automatic loading of the closing springs
– shunt closing release
– shunt opening release.
The geared motor automatically reloads the springs after each closing operation until the yellow indicator appears (6, Figure 24). When the power is cut off during loading, the geared motor stops and automatically starts reloading the springs again when the power returns. It is, in any case, always possible to complete the reloading operation manually.

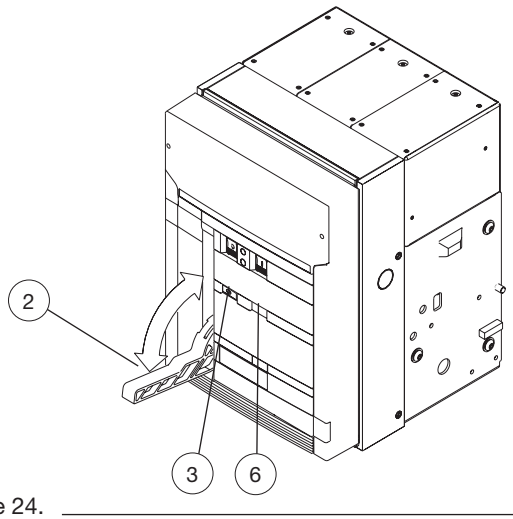


Figure 24.

c) Closing the circuit-breaker

The operation can only be carried out with the closing springs fully loaded. For manual closing, press the pushbutton (5) marked with the letter “I”. When there is a shunt closing release, the operation can be carried out remotely by means of the special control circuit. The special indicator (3) changes to indicate “I” to signal that the circuit-breaker has closed. Furthermore, the indicator of the state of the springs (6) goes to the WHITE position. Even with the closing springs unloaded, the operating mechanism retains enough energy for the opening operation. The geared motor, if any, immediately starts the automatic spring reloading operation.

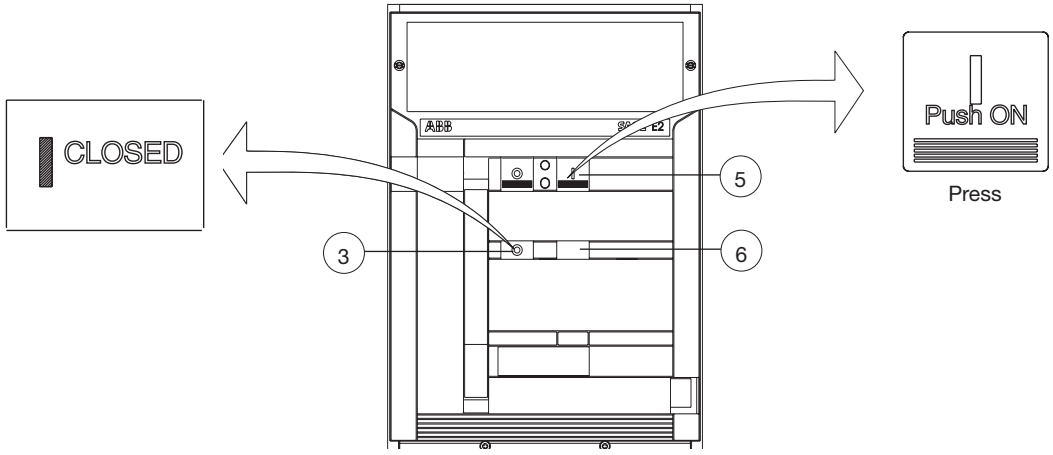


Figure 25.

d) Opening the circuit-breaker

For manual opening of the circuit-breaker, press pushbutton “O” (1). When there is a shunt opening release, the operation can also be carried out remotely by means of the special control circuit. Opening having taken place is signaled by the letter “O” appearing in the indicator (3).

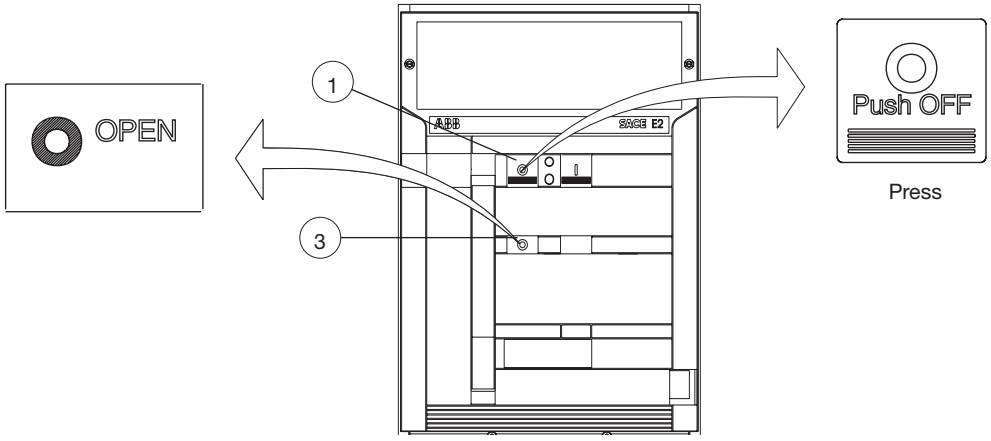


Figure 26.

7.3. Racking-in/out operation

WARNING

A) Open the circuit-breaker before carrying out any racking-in/out operation.
B) The circuit-breaker (moving part) and fixed part are fitted with a lock which prevents the fixed part from being racked into the circuit-breakers with a different rated current: the congruence of the anti-racking-in lock must be checked by the operator before carrying out the racking-in operation to avoid any unnecessary stress.
C) Before the racking-in operation, remove any padlock on the segregation shutter of the isolation terminals on the fixed part.

WARNING ELECTRICAL SHOCK HAZARD: Ensure that the circuit-breaker is either disconnected from all power sources and that the circuit breaker is open before performing any racking-in/out operation.

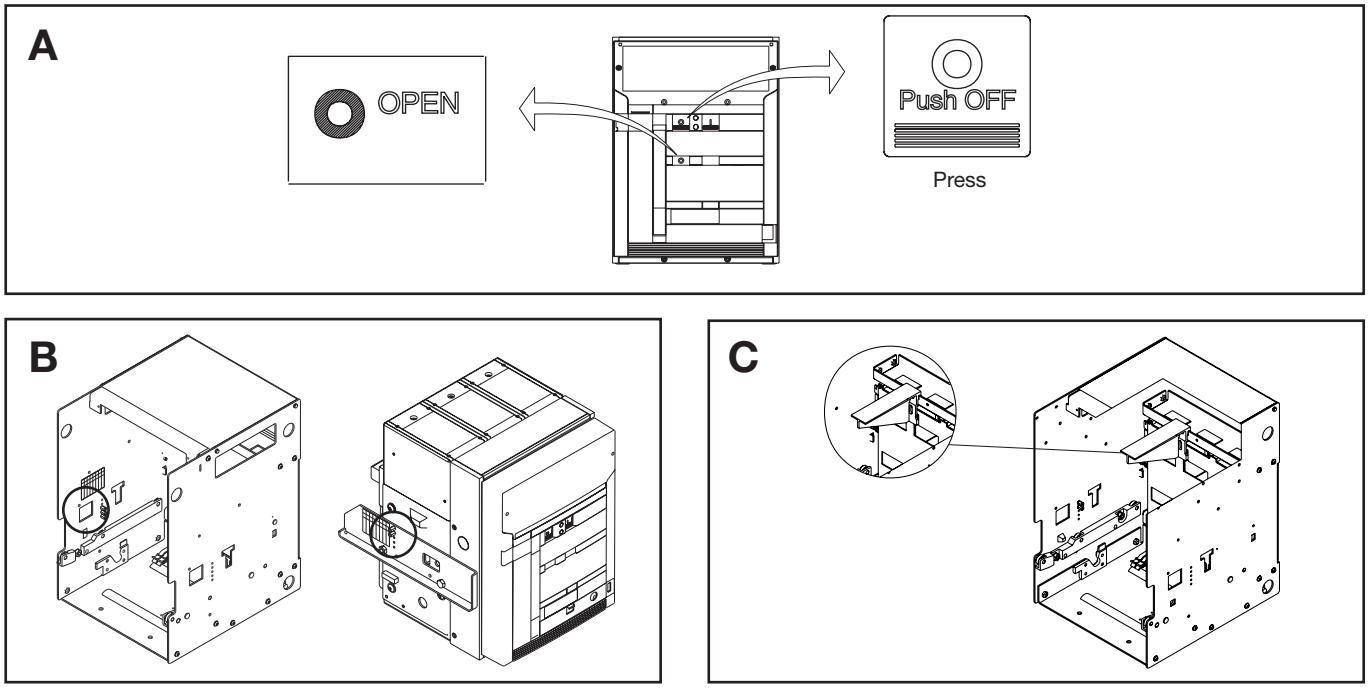


Figure 27.

NOTE

In relation to the fixed part, the circuit-breaker (moving part) can take up different positions, identified as follows:

- DISCONNECTED: the moving part is inserted in the fixed part WITHOUT any connection between the terminals and WITHOUT coupling the sliding contacts for the auxiliary circuits: in this position all electrical operation of the circuit-breaker is prevented. On the front the indicator (9, Figure 22) indicates DISCONNECTED. The switchgear compartment door can be closed.
- TEST ISOLATED: the moving part is inserted in the fixed part WITHOUT any connection between the power terminals, but WITH the sliding contacts coupled for the auxiliary circuits. In this position, the circuit-breaker can be operated for the offline tests. The indicator (9, Figure 22) indicates TEST ISOLATED.
- CONNECTED: the moving part is fully inserted in the fixed part WITH the connection of both the power terminals and the sliding contacts for the auxiliary circuits. The circuit-breaker is operational. The indicator (9, Figure 22) indicates CONNECTED.

a) Positioning the moving part in the fixed part in the DISCONNECTED position

Lift the moving part as shown in the paragraph (3) and insert it in the fixed part guide, tilting it as shown in Figure 28.
The manual connection must allow the edge (E) of the circuit-breaker guide to slide under the blocks (D) of the fixed part. Remove the lifting devices.
The position reached is stable and allows for any inspections of the circuit-breaker.
Push the moving part as far as the stop in the fixed part.
Close the compartment doo.

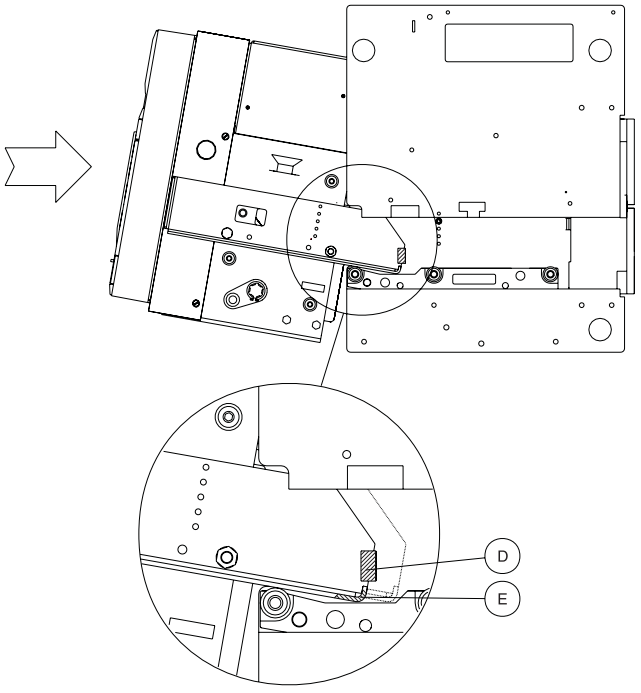


Figure 28.

b) Passing from the DISCONNECTED to the TEST ISOLATED position

- Make sure that the indicator (9) is in the DISCONNECTED position.
- For the connection procedure, make sure that the key (12) is in the correct position and/or the padlock (14), if any, has been removed.
- Make sure that the circuit-breaker is open.
- Push the moving part right into the fixed part.
- Lower the releasing lever (11).
- Insert the crank handle in the corresponding coupling (10).
- Proceed to turn the crank handle clockwise until the TEST ISOLATED indication appears on the indicator (9). During the initial turns, the crank
- handle must oppose no particular resistance to rotation.
- Should it be necessary to carry out offline circuit-breaker operations, the crank handle must be removed.

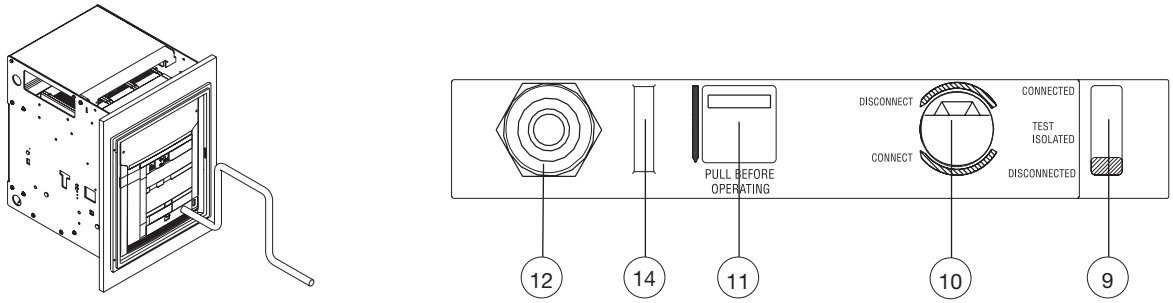


Figure 29.

c) Passing from the TEST ISOLATED position to the CONNECTED position

- Make sure that the circuit-breaker is open.
- Lower the releasing lever (11).
- Insert the crank handle in the corresponding coupling (10).
- Proceed to turn the crank handle clockwise until the CONNECTED indication appears on the indicator (9).
- Remove the crank handle to enable the circuit-breaker to close.

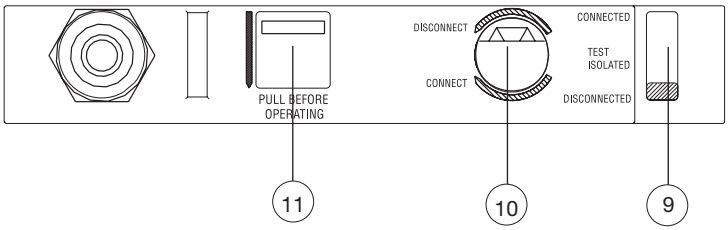


Figure 30.

d) Passing from the CONNECTED position to the TEST ISOLATED position, to the DISCONNECTED position

- Repeat the connection procedures changing the direction for turning the crank handle to anti-clockwise. Open the door in the disconnected position.

8. Maintenance

8.1. Warning

WARNING: Before carrying out any maintenance task, you must:
- **Open the circuit-breaker and check that the operating mechanism springs are unloaded;**
- **In the case of withdrawable circuit-breakers, work with the circuit-breaker racked-out (DISCONNECTED) of the fixed part;**
- **For action on fixed version circuit-breakers or on fixed parts disconnect the power circuit and the auxiliary circuits and visibly earth the terminals both on the power supply side and on the load side;**
- **Make safe in compliance with current laws.**

WARNING ELECTRICAL SHOCK HAZARD: Shock Hazard or Injury.

ABB declines all responsibility for damage to things and injury to people due to failure to comply with the instructions contained in this document. Maintenance tasks must be performed by qualified staff who are thoroughly familiar with the equipment.

During normal service, the circuit-breakers require limited maintenance.

The table of the maintenance program is given in the following paragraph, indicating the corresponding periodic intervals for action. In particular, with regard to the time intervals, it is advisable to follow the recommendations in the table, at least for the first year of service. On the basis of the results obtained during the routine checks, establish the best time intervals for the maintenance operations.

It is also advisable to refer to the following rules:
- circuit-breakers which rarely operate, or which remain closed for long periods, must be operated from time to time to avoid any tendency to stick
- during service, routinely inspect the circuit-breaker from the outside to check for any dust, dirt or damage of any kind.
- For circuit-breakers fitted with SACE PR111/VF release, installation of the mechanical operation counter (supplied on request) is recommended.

With regular maintenance, SACE Emax circuit-breakers, either with or without opening or closing releases, can withstand the following operation without replacement of parts.(1)

Circuit-breaker		**Mechanical life (2)**		**Electrical life (50/60 Hz) (2) (3)**	
		N° of operations (operations)	**Frequency (operations/hour)**	**N° of operations (operations)**	**Frequency (operations/hour)**
E2	1200	12000	30	10000	30
	1600	12000	30	10000	30
E3	2000	10000	30	7000	20
	2500	10000	30	7000	20
E4	3600	8000	30	4000	10
E6	5000	8000	30	2000	10
LTT Low termperature version					
E2 LTT	1200 - 1600	8000	30	8000	30
E3 LTT	2000 - 2500	8000	30	7000	30

(1) Data referring to standard installation conforming to product standards. For other applications please consult ABB Sace.
(2) Extreme atmospheric conditions, polluted atmosphere or vibrations may shorten the application's life. Please consult ABB Sace.
(3) For different frequency please consult ABB Sace.

8.2. Maintenance program

Maintenance operations	**Interval**	
	Installation in normal environments	Installation in dusty environments (1)/(2) and low temperature environment(3) [(1) = level of measured dust > 1 mg/m³]
First level	One year or 20% mechanical life or 20% electric life	6 months or 10% mechanical life or 10% electric life
Second level	Three years or 50% mechanical life or 50% electric life or after intervention on short circuit	18 months or 25% mechanical life or 25% electric life or after intervention on short circuit

(1) Data referring to standard installation in accordance with product standards. For other applications, please consult ABB Sace.
(2) Extreme atmospheric conditions, polluted atmosphere or vibrations may shorten the life of the application. Please consult ABB Sace.
(3) Emax LTT Low temperature environment application.

8.3.1. Preliminary operations:

- open the switch and check that the control springs are unloaded
- in the case of a circuit-breaker, work on the circuit breaker after it has been extracted (disconnected) from the fixed part

WARNING: before working on fixed circuit-breakers or on fixed parts, disconnect the supply to the power circuit and to the auxiliary circuits and earth the terminals in a visible manner both on the supply and on the load side.

8.3.2. Checks and general cleaning:

- Check that the apparatus (switching part) is clean, removing dust and any traces of excess oil or grease using dry and clean rags (possibly using non-corrosive detergent.
- For excessive deposits, a dilutant such as Henkel 273471 or the equivalent can be used.
- Check that the rating plates of the apparatus are in place.
- Clean the rating plates with dry and clean cloths.
- Eliminate any dust, mould, traces of condensation or oxidation also inside the fixed part of the apparatus if the switch is extractable.
- Check that there are no foreign bodies in the switch cabinet.

8.3.3. Switch connections and connections between the switch and the control panel

- Use brushes and dry cloths to remove any dust or dirt (if necessary, use non-corrosive detergent.
- For excessive deposits, a dilutant such as Henkel 273471 or the equivalent can be used.
- Check that there are no traces of overheating on the terminals. This problem is due to discolouring of the contact parts; the contact parts are normally silver in colour.
- Check that the bolts fixing the connections to the terminals are tight (M12 - 70 Nm / 620 Lb in).

WARNING: before working on fixed circuit-breakers or on fixed parts, disconnect the supply to the power circuit and to the auxiliary circuits and earth the terminals in a visible manner both on the supply and on the load side.

- Check that the connecting screws of the cables of the terminal boards are tight (0,7 Nm / 6,2 Lb in).

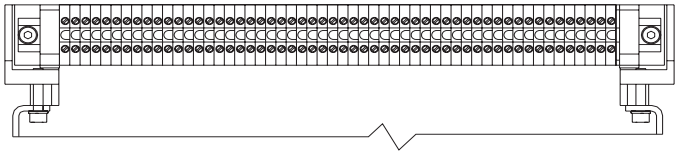


Figure 31.

8.3.4. Dismantling tab and cap

- The tab (1) of the release by rotating the screws (2) as shown in Figure 32.
- Remove the front cap (3) by loosening the four screws (4).

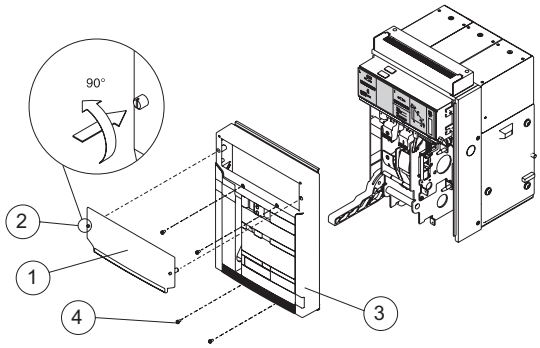


Figure 32.

- If there is an undervoltage release, remove the coils support and release the control springs, closing and opening the switch.

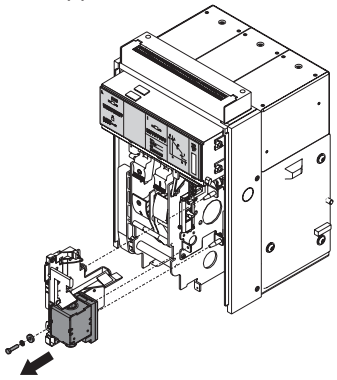


Figure 33.

8.3.5. Mechanical control

- Clean at the points indicated in Figure 34. For excessive deposits, a dilutant such as Henkel 273471 or the equivalent can be used.
- Lubricate, at the points indicated in Figure 34, the opening-closing shafts and hooks with MOBILGREASE 28 (EXXON MOBIL).
- Check that the opening and closing shafts are free to rotate.

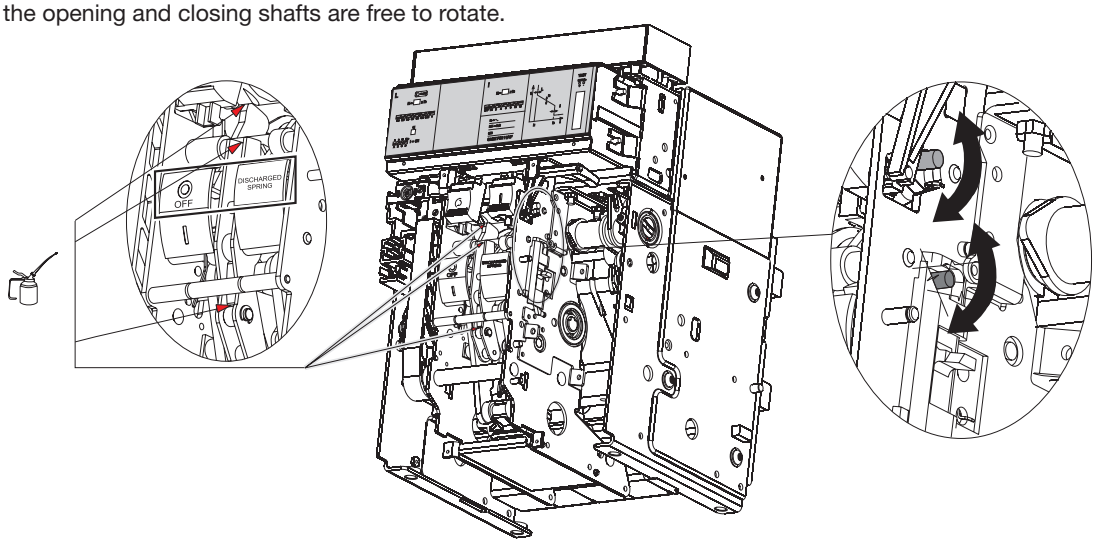


Figure 34.

8.3.6. Electrical and mechanical accessories

- Check that the accessories are fixed to the switch
- Check that the electrical accessories are connected to the switch
- Reduction gear: after 10000 operations check brushes for wear and replace the reduction gear if necessary.
- Check that the releases (YO-YU-YC) are in good condition (no excessive wear, overheating, breakages) Figure 35.
- Check that the mechanical operation counter is operating correctly (if applicable) by running an operation on the switch.

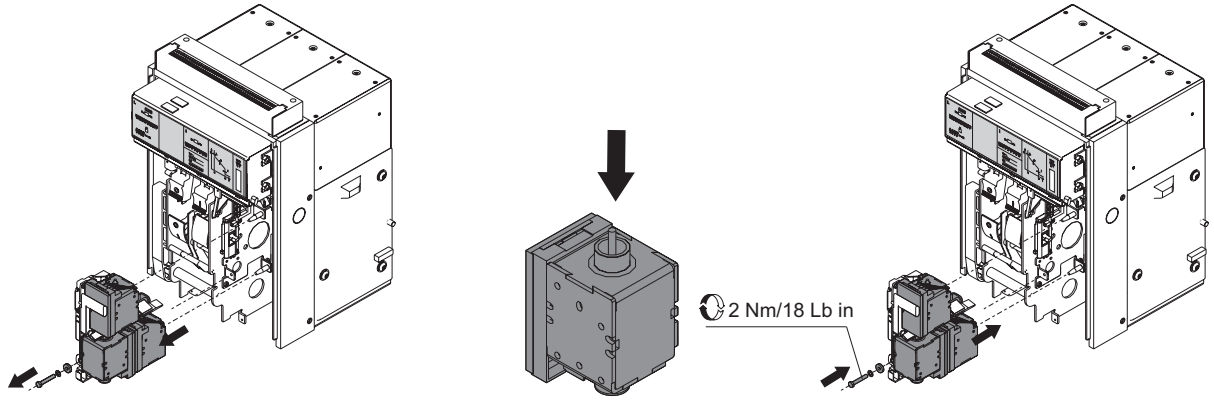


Figure 35.

8.3.7. Protection releases

Check that the protection release is working correctly: carry out a test (“Trip test”) of the whole SA chain by using the Ekip TT accessory. Positive outcome is shown by the power circuit breaker opening. At the end remove the Ekip TT unit from the relay.

8.3.8. Maintenance operations; final checks

- Refit all parts and if necessary reconnect the auxiliary supply.
- Refit the cap as indicated in Figure 36.

With CB open and springs discharged:

- Return the movable part to the TEST-ISOLATED position.
- Use the different auxiliaries in turn to run the following 14 operations:
  - Opening (both local and remote as applicable)
  - Closing (both local and remote as applicable)
  - Release by trip test from the relay

- Check the operations according to this sequence:
  - Open - Springs unloaded
  - Open - Springs loaded
  - Closed - Springs unloaded
  - Closed - Springs loaded

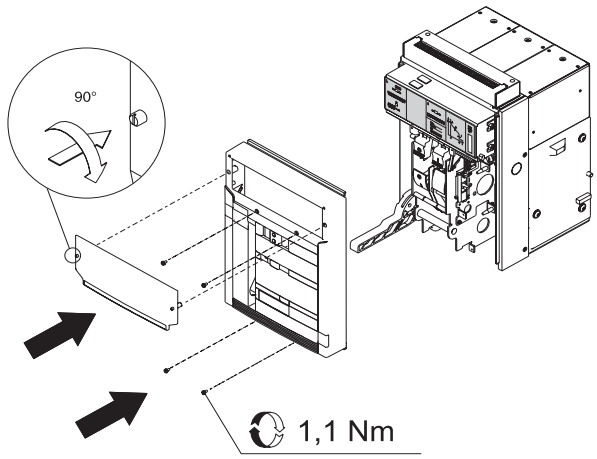


Figure 36.

- Check operation of the accessories, if present
- Check operation of reduction gear (if present)
- Check operation of undervoltage release (if present) (incompatible with fail safe device)
- Check operation of opening release (if present)
- Check operation of closing release (if present)
- Check operation of auxiliary contacts of switch (if present)
- Check operation of lock of switch in open position (with key or padlocks) (if present)

8.3.9. Interlock

- Check that the interlock devices have been correctly installed and operate correctly between adjacent and superimposed circuit-breakers (if present). The operating test cannot be run in the Test or Extracted positions.

8.4. Second level maintenance operations

8.4.1. Preliminary operations:

- open the switch and check that the control springs are unloaded
- in the case of a circuit breaker, remove the circuit breaker from the fixed part before working on it

WARNING: before working on fixed circuit-breakers or on fixed parts, disconnect the supply to the power circuit and to the auxiliary circuits and earth the terminals in a visible manner both on the supply and on the load side.

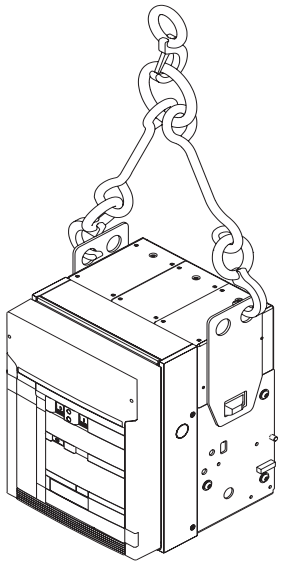


Figure 37.

8.4.2. General checks and cleaning:

- Check the cleanliness of the apparatus (switch part), removing dust and any traces of excess oil or grease with dry cloths (if necessary, use non-corrosive detergent)
- For excessive deposits, a dilutant such as Henkel 273471 or the equivalent can be used.
- Check that the rating plates of the apparatus are in place
- Clean the rating plates with dry and clean cloths
- Eliminate any dust, mould, traces of condensation or oxidation also inside the fixed part of the apparatus if the switch is extractable
- Check that there are no factors such as overheating or cracks that may compromise switch insulation
- Check the circuit-breaking couple for damage (for the extractable switch, see feature A, Figure 38).
- The couple must be silver in colour without trace of erosion or smoke
- Check that there are no foreign bodies in the switch cabinet
- Check that the fixing screws are tightened on the fixed side to the control panel (M8 - 25 Nm / 221 Lb in).

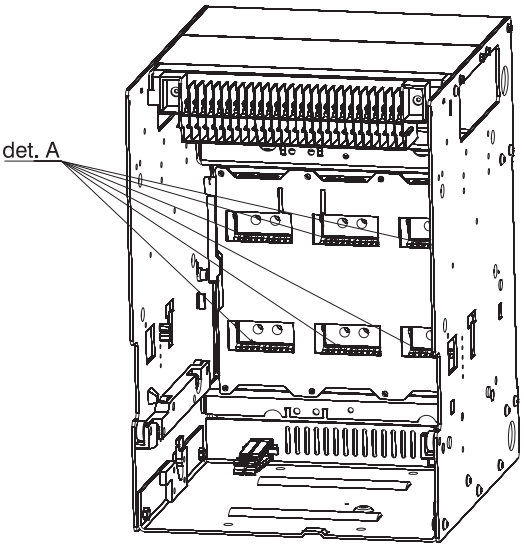


Figure 38.

8.4.3. Connections between the switch and the control panel

- Use brushes and try cloths to remove dust or dirt on the insulating parts (if necessary, use non-corrosive detergent
- For excessive deposits, a dilutant such as Henkel 273471 or the equivalent can be used).
- Check that there are no traces of overheating on the terminals. The problem is detected by discoloration of the parts in contact; the contact points are normally silver in colour.
- Check the tightness of the bolts fixing the connections to the terminals (M12 - 70Nm / 620 Lb in).

WARNING:
Before working on fixed circuit-breakers or on fixed parts, disconnect the supply to the power circuit and to the auxiliary circuits and earth the terminals in a visible manner both on the supply and on the load side.

- Check that the connecting screws of the cables of the terminal boards are tight (0.7 Nm / 6,2 Lb in).

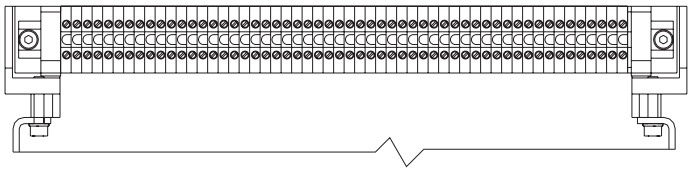


Figure 39.

8.4.4. Dismantling the tab, cap and arcing chambers

- Remove the flange (1) of the release, turning the screws (2) as shown in the figures
- Remove the front escutcheon plate (3) by removing the four screws (4)
- Remove, if present, one or both side guards (5) by removing the front (6) screws
- Remove the arcing chambers (8) by removing the screws (9).

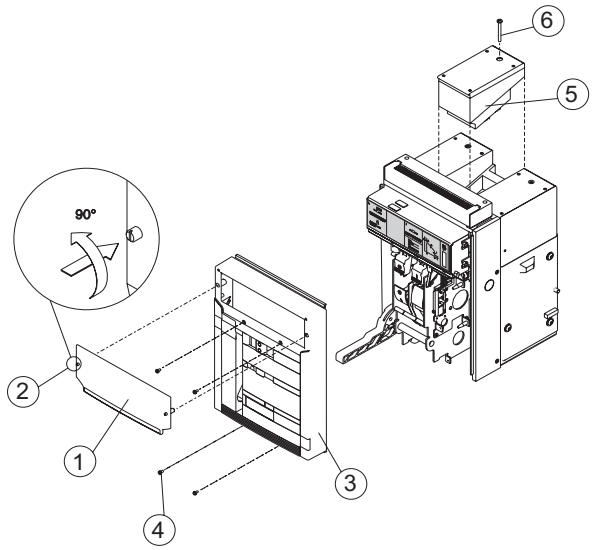


Figure 40.

- If there is an undervoltage release, dismantle the coil support and unload the control springs by opening and closing the switch.

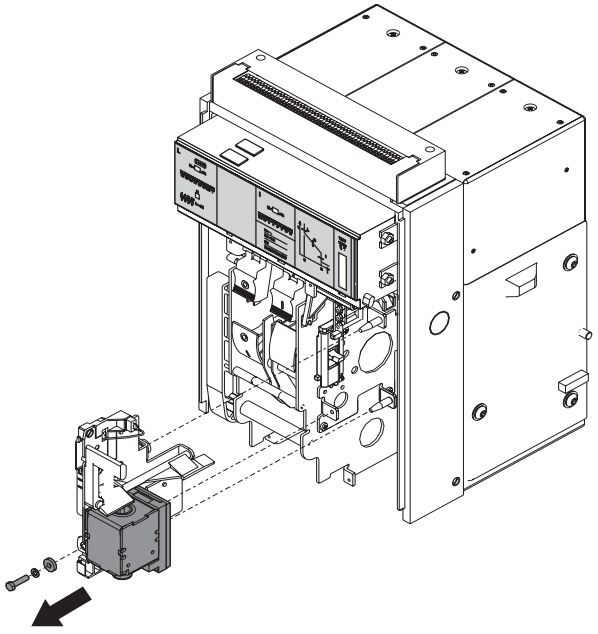


Figure 41.

8.4.5. Mechanical control

- Cleaning (for excessive deposits, a dilutant such as Henkel 273471 or the equivalent can be used) and lubricate, at the points indicated in Figure 42, part A, as for First Level, the opening and closing shafts and hooks with MOBILGREASE 28 (EXXON MOBIL).
- Cleaning (for excessive deposits, a dilutant such as Henkel 273471 or the equivalent can be used) and lubricate with MOBILGREASE 28 (EXXON MOBIL) the supports of the operating shaft, including those on the sides of the circuit-breaker (see Figure 42 part B).
- Check that the opening and closing shafts are free to rotate.

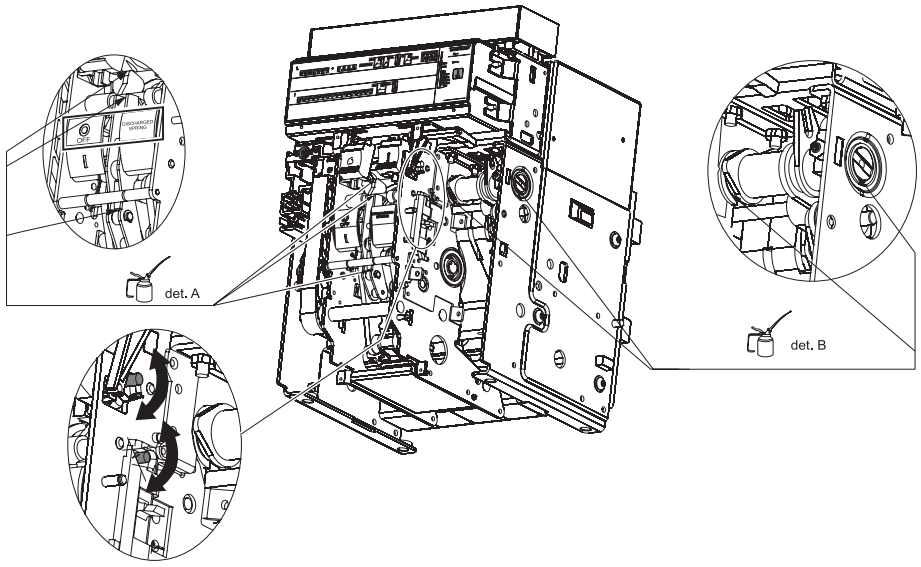


Figure 42.

- In the case of deformed or oxidated springs, missing rings or serious wear to the controls contact ABB Sace (*).

(*) Subject to the customer's approval, ABB can replace "A" type parts.

8.4.6. Electrical and mechanical accessories

- Check that the accessories are tightly fixed to the circuit-breaker.
- Check that the electrical accessories are wired correctly to the circuit-breaker.
- Reduction gear: after 10000 operations check brushes for wear and replace the reduction gear if necessary.
- Check that the releases (YO, YU, YC)) are in good condition (no excessive wear, overheating, breakages) Figure 43.
- Check that the mechanical operation counter is operating correctly (if applicable) by running an operation on the circuit-breaker.

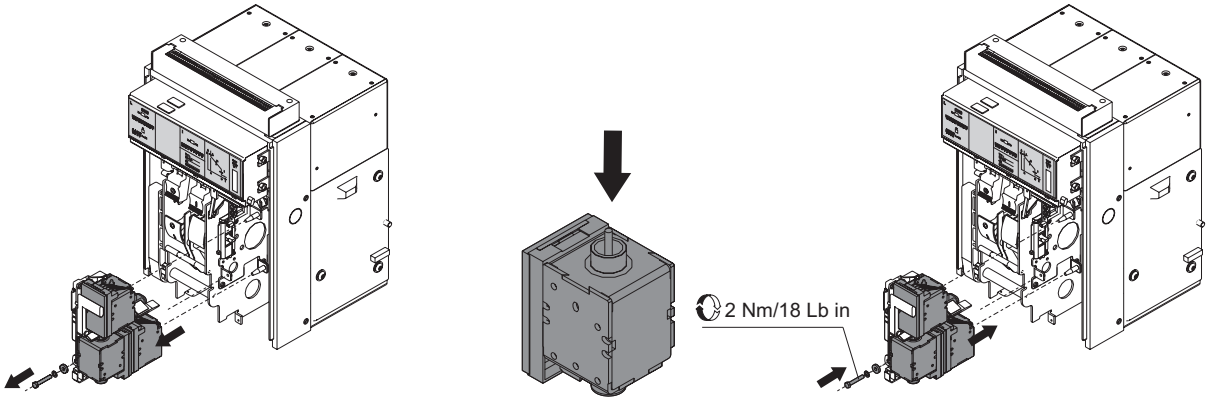


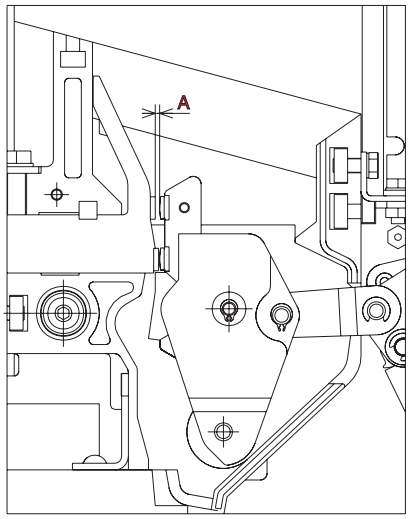
Figure 43.

8.4.7. Checking contact wear

With the circuit-breaker open and arcing chambers removed:

1) Check the state of the blowout magnet chambers: the body of the chamber must be undamaged and the plates must not be corroded or damaged.
2) Remove the dust with compressed air and remove traces of smoke and any waste with a brush of appropriate type.
3) Check the state of the contacts.
4) Visually check that the main plates and the blowout magnets are in place.

5) Check for oxidation or beads and if they are detected, request help from the qualified ABB technician (*).
6.1) Check the blowout magnets distances (distance A Figure 44).



Circuit Breaker	A
E2 - E3	≥ 1 mm → OK ≥ 0,039 inch → OK
E4 - E6	≥ 0,8 mm → OK ≥ 0,032 inch → OK

Figure 44.

6.2) close the circuit-breaker and check the gap A
- If the gap A is not correct, contact ABB Sace (*)
- If the gap A is correct, open the circuit breaker and refit the arc chambers.

(*) Subject to the customer's approval, ABB can replace "A" type parts.

8.4.8. Protection releases

Check that the protection release is working correctly: carry out a test ("Trip test") of the whole SA chain by using the Ekip TT accessory. Positive outcome is shown by the power circuit breaker opening .At the end remove the Ekip TT unit from the relay.

8.4.9. Maintenance operations; final checks:

- Refit each part and if necessary reconnect the auxiliary supply.
- Refit the cap as indicated in Figure 45.
- Return the movable part to the position TEST-ISOLATED.

- Use the different auxiliaries in turn to run the following 14 operations:
  - opening (both local and remote as applicable)
  - closing (both local and remote as applicable)
  - release by trip test from the relay
- Check the operations according to this sequence:
  - Open - Springs unloaded
  - Open - Springs loaded
  - Closed - Springs unloaded
  - Closed - Springs loaded

  - Check operation of the accessories, if present
  - Check operation of reduction gear (if present)
  - Check operation of undervoltage release (if present)
  - Check operation of opening release (if present)
  - Check operation of closing release (if present)
  - Check operation of auxiliary contacts of circuit-breaker (if present)
  - Check operation of lock of circuit-breaker in open position (with key or padlocks) (if present)

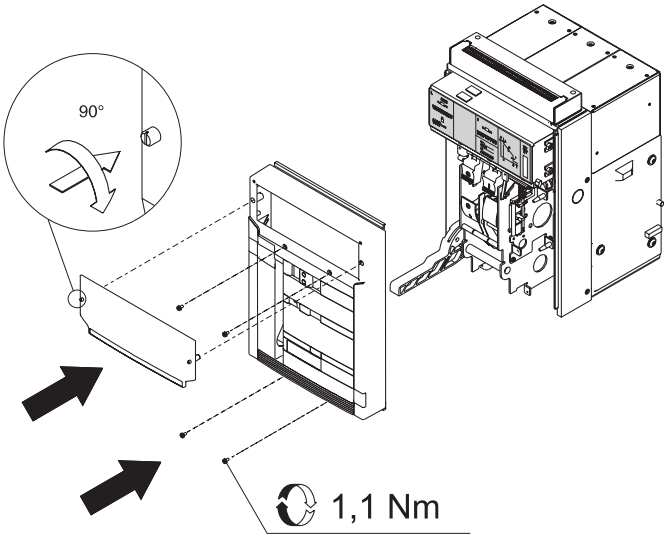


Figure 45.

8.4.10. Interlock

Check that the interlock devices have been correctly installed and operate correctly between adjacent and superimposed circuit-breakers (if present). The operating test cannot be run in the Test or Extracted positions.

8.4.11. Withdrawable versions

In the withdrawable versions, check the operational efficiency of the insertion and extraction of the circuit-breakers from the fixed part, performing the movement by means of the operating lever supplied and checking that the shutters for segregating the parts carrying live voltage are closed after extraction. Check correct operation of the inserted and extracted circuit-breaker lock devices (if present).

9. Measures to be taken for any operating anomalies

The circuit-breaker does not open when the opening button is pressed	The circuit-breaker does not open when the YO operating release is tripped	The circuit-breaker does not open when the YU undervoltage release is tripped	The circuit-breaker does not open when the protection relay test is run	The circuit-breaker does not shut when the close button is pressed	The circuit-breaker does not shut when the YC closing coil is tripped	The closing springs cannot be loaded by the manual loading lever	The closing springs cannot be loaded by the spring loading motor	The crank does not fit in the moving part	The moving part does not rack into the fixed part	The circuit-breaker cannot be locked in the open position	Possible causes	Checks and remedies
			●								The opening solenoid of the relay is not inserted correctly	Check that opening solenoid is connected correctly
			●	●	●						Warning that tripped relay has not been reset	Press the mechanical pushbutton to reset signal relay tripped
	●				●						Auxiliary circuit power supply voltage too low	Measure the voltage: it must not be less than 85% of the rated nominal coil voltage
	●				●						Different power supply voltage from the one indicated on the rating plate of the releases	Check the rating plate voltage of the releases
					●						Operating circuit faulty	Check connections, fuses, interlocks, protection circuit-breakers and consent contacts
	●				●		●				Screws for clamping loose wires and auxiliary circuits	Check tightness of the screws connecting the wires
	●				●		●				Incorrect electrical connections in the power supply circuit	Check the connections with the corresponding circuit diagram
	●				●						Damaged coil	Replace the coil
		●			●						Operating mechanism blocked	Operate by hand. If the fault persists please contact ABB SACE
				●	●						Key locked in open position	Unlock by inserting the key
				●	●						Circuit-breaker in intermediate position between connected and test	Complete the insertion operation
				●	●						Undervoltage release not energized	Check the corresponding power supply circuit and the power supply voltage
				●	●						Shunt opening release permanently energized	Check the power supply circuit
									●		Racking-in or out operation not carried out correctly	See paragraph 7.3
●		●				●					Locked control	Contact ABB SACE
				●	●						Extraction crank inserted	Extract crank
							●				Circuit-breaker in extracted position	Turn switch to test or inserted position
							●				Protection fuse tripped, spring-loading motor	Replace fuse
							●				Reduction gear fault due to automatic loading of springs	Replace reduction gear
									●		Movable part incompatible with the fixed part	Check that the movable part is compatible with the fixed part
								●		●	Circuit-breaker closed	Press the opening button and activate the lock
										●	Faulty open lock	Contact ABB SACE

Anomalies

WARNING: Persistent malfunction or non-operation of the circuit-breaker could cause injury to personnel or damage to property, remove the circuit-breaker immediately until it can be inspected or repaired.

10. Accessories

10.1. Electrical accessories

Opening/closing release (YO - Y02 - YC)
This allows remote opening or closing control of the apparatus. Given the characteristics of the circuit-breaker operating mechanism, opening (with the circuit-breaker closed) is always possible, whereas closing is only possible when the closing springs are loaded. Most of the releases can operate with either direct or alternating current. This release carries out an instantaneous service (*), but can be supplied permanently (**).
In uses where the shunt closing release is supplied permanently, to carry out the circuit-breaker reclosing operation after opening, it is necessary to momentarily de-energize the shunt closing release (the circuit-breaker operating mechanism reclosing is, in fact, fitted with an antipumping device).
(*) In the case of instantaneous service, the minimum duration of the current impulse must be 100 ms.
(**) In the case of permanent power supply to the shunt opening release, you must wait for at least 30 ms before giving the opening control to the shunt closing release.

Reference figures in the electrical circuit diagrams: YO (4) - YC (2) - YO2 (8)

Power supply (Un)	24 V DC
	30 V AC/DC
	48 V AC/DC
	60 V AC/DC
	110-120 V AC/DC
	125-127 V AC/DC
	220-240 V AC/DC
	240-250 V AC/DC
	380-400 V AC
	440 V AC

Operating limits	(YO-YO2) : 70…110% Un
	(YC) : 85…110% Un
Inrush power consumption (Ps)	DC = 200 W
Inrush power time ~100 ms	AC = 200 VA
Continuous power (Pc)	DC = 5 W
	AC = 5 VA
Opening time (YO - YO2)	(max) 60 ms
Closing time (YC)	80±10 ms
Insulation voltage	2500V 50 Hz (for 1 min.)

Undervoltage release (YU)
The undervoltage release opens the circuit-breaker in the case of a considerable drop or lack of its power supply voltage. It can be used for remote tripping (by means of normally closed type pushbuttons), as a lock on closing or to control the voltage in the primary and secondary circuits. The release power supply is therefore branched on the supply side of the circuit-breaker from an independent source. Circuit-breaker closing is only allowed with the release powered (the closing lock is carried out mechanically). Most of the releases can operate with either direct or alternating current.

Power supply (Un)	24 V DC
	30 V AC/DC
	48 V AC/DC
	60 V AC/DC
	110-120 V AC/DC

Power supply (Un)	120-127 V AC/DC
	220-240 V AC/DC
	240-250 V AC/DC
	380-400 V AC
	440 V AC

WARNING: The undervoltage release (YU) is incompatible with the Fail Safe device (preventing withdrawal when the spring is loaded).
If a Fail Safe device is present, remove it as indicated in Figure 46, Figure 47, Figure 48 and Figure 49.

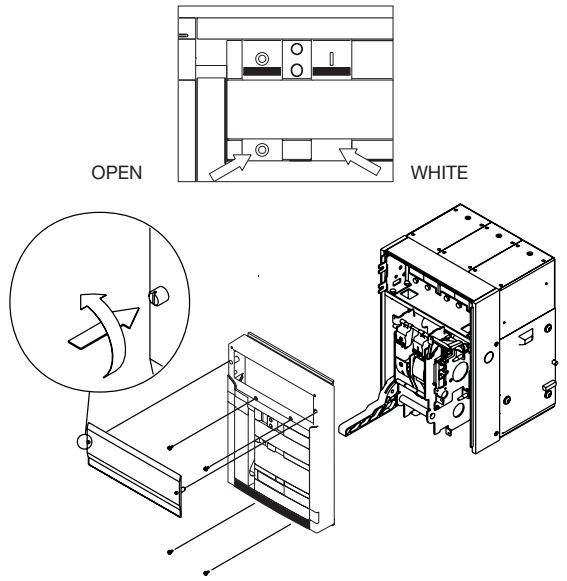


Figure 46.

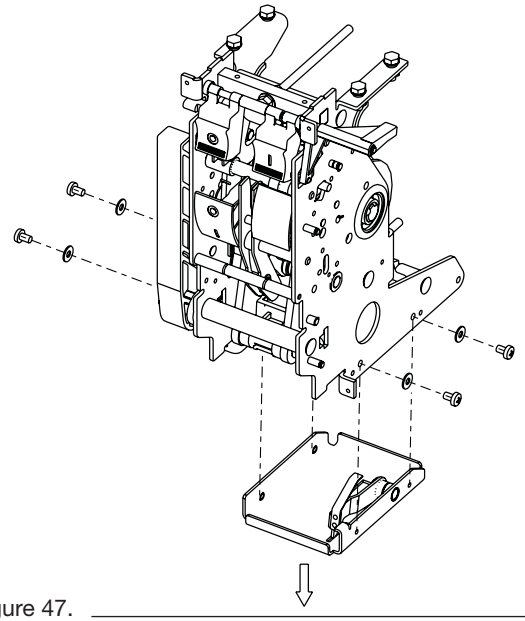


Figure 47.

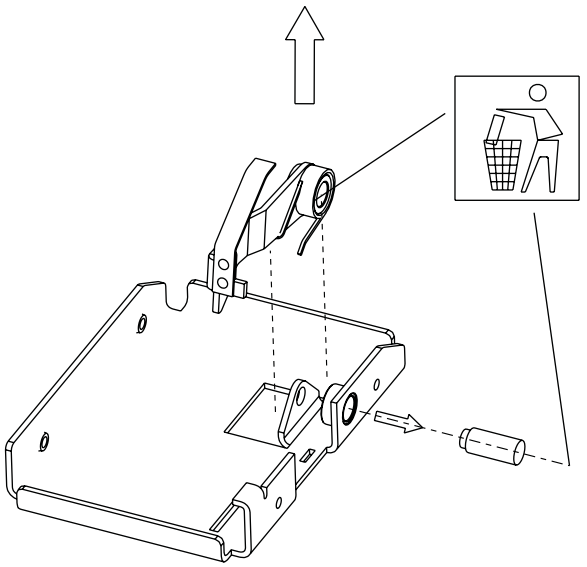


Figure 48.

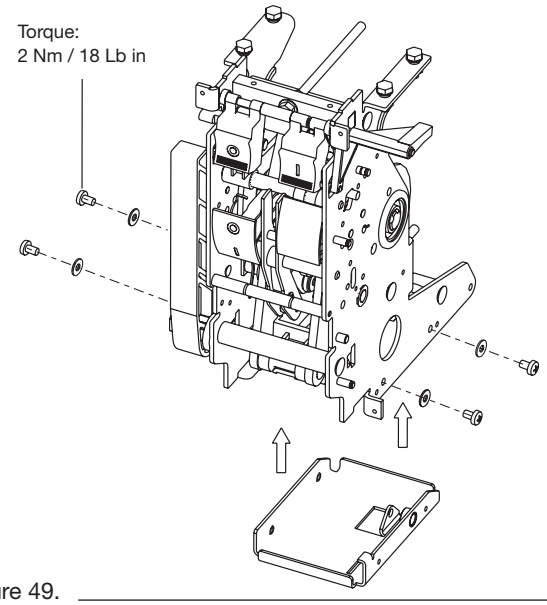


Figure 49.

Circuit-breaker opening takes place with power supply voltage values of the release equivalent to 30 - 60% Un.
Circuit-breaker closing is possible with power supply voltage of the release equivalent to 85-110% Un.
It can be fitted with a signalling contact for undervoltage release energized (C. aux YU).
Reference figures in the electrical circuit diagram: YU 6

Inrush power consumption (Ps):	DC = 200 W
	AC = 200 VA
Continuous power (Pc):	DC = 5 W
	AC = 5 VA
Opening time (YU):	≤80 ms
Insulation voltage	2500V 50 Hz (for 1 min.)

Time delay device for undervoltage release (D)
The undervoltage release can be combined with an electronic time-delay device for installing outside the circuit-breaker, which enables a delay in the tripping of the release with preset, adjustable times. The use of the delayed undervoltage release is recommended when the power supply network of the release can be subject to power cuts or short-lived voltage drops, in order to avoid trips.
When it is not supplied, circuit-breaker closing is prevented.
The time-delay device has to be combined with an undervoltage release with the same voltage as the time-delay device.

The characteristics of the time-delay device are:

Power supply (D):	24 - 30 V AC/DC
	48 V AC/DC
	60 V AC/DC
	110 - 127 V AC/DC
	220 - 250 V AC/DC
Adjustable opening time (YU+D):	0,5 - 1 - 1,5 - 2 - 3 s

Reference figures in the electrical circuit diagrams: YU + D; (7).

Geared motor for automatic closing spring loading (M)
This automatically loads the circuit-breaker operating mechanism closing springs. After circuit-breaker closing, the geared motor immediately sees to reloading the closing springs.
When there is no power supply or during maintenance work, the closing springs can still be loaded manually (by means of the special lever on the operating mechanism).

Power supply	24 - 30 V AC/DC
	48 - 60 V AC/DC
	100 - 130 V AC/DC
	220 - 250 V AC/DC
Operation limits:	85 ... 110% Un
Inrush power consumption (Ps):	DC = 500 W
	AC = 500 VA

Rated power (Pn):	DC = 200 W
	AC = 200 VA
Inrush time	0,2 s
Loading time:	4 - 5 s
Insulation voltage	2500 V 50 Hz (per 1 min.)

It is always supplied with limit contacts and microswitch for signalling closing springs loaded.

Reference figure in the electrical circuit diagrams: M (1).

Mechanical and electrical trip signalling for overcurrent releases
The following signals are available following tripping of the overcurrent release:

a) Mechanical trip signalling for overcurrent releases
This enables a visual signalling on the operating mechanism by pushing the trip pushbutton in when the circuit-breaker has been opened following tripping of an overcurrent release. The circuit-breaker can only be closed again by putting the pushbutton back into its normal position.
Reference figure in the electrical circuit diagrams: S51 (13).

b) Electrical and mechanical trip signalling for overcurrent releases
This enables a visual signalling on the operating mechanism (mechanical) and remotely (electrically by means of a changeover switch) of the circuit-breaker being opened following a trip of the overcurrent releases. To reset the circuit-breaker, it is necessary to reset the mechanical indicator pushbutton.
Reference figure in the electrical circuit diagrams: S51 (13).

c) Coil for resetting the mechanical release trip indicator
This enables a visual signalling on the operating mechanism (mechanical) and remotely (electrically by means of a changeover switch) of the circuit- breaker being opened following a trip of the overcurrent releases. With this accessory, you can reset the mechanical indicator with an electronic relay using a remote control and this enables the circuit-breaker to be reset.

Power supply:	24 - 30 V AC/DC
	220 - 240 V AC/DC
	110 - 130 V AC/DC

Reference figure in the electrical circuit diagrams: S51 (14)

Auxiliary contacts
Auxiliary contacts installed on the circuit-breaker are available to enable an indication of the circuit-breaker's status (a version with gold plated contacts is also available for digital signals).

Un	In max	T
125 V DC	0,3 A	10 ms
250 V DC	0,15 A	10 ms

Un	In max	cosφ
250 V AC	5 A	0,3

The versions available are:

a) Electrical signalling for circuit-breaker open/closed
It is possible to have electrical signalling of the circuit-breaker status (open/closed) 4,10 or 15 auxiliary contacts. The auxiliary contacts can have the following configurations:
- 4 break/make contacts for PR111/VF (2 normally open + 2 normally closed)
- 10 break/make contacts for PR111/VF (5 normally open + 5 normally closed)
- 15 supplementary break/make contacts which can be mounted outside the circuit-breaker.

The basic configuration described above can be modified by the user to indicate normally open or normally closed by repositioning the rapid connector on the microswitch. Reference
Fig. in the electrical circuit diagrams: Q/1÷10 (21-22)

b) Electrical signalling for circuit-breaker connected/test isolated/disconnected
In addition to mechanical signalling of the position of the circuit-breaker, it is possible to have electrical signalling by means of 5 or 10 auxiliary contacts which are installed on the fixed part.
Only available for circuit-breakers in withdrawable versions for installing on the fixed part.
The auxiliary contacts can have the following configurations:
- 5 contacts; group consisting of 2 connected signalling contacts, 2 disconnected signalling contacts and 1 test position signalling contact (main contacts isolated, but sliding contacts connected)
- 10 contacts; group consisting of 4 connected signalling contacts, 4 disconnected signalling contacts and 2 test position signalling contacts (main contacts isolated, but sliding contacts connected).

Reference figure in the electrical circuit diagrams: S75I (31-32) - S75T (31-32) - S75E (31-32)

c) Contact for signalling closing springs loaded
This consists of a microswitch which allows remote signalling of the state of the circuit-breaker operating mechanism closing springs. (The contact is always supplied with the spring loading geared motor).
Reference figure in the electrical circuit diagrams: S33 M/2 (11)

d) Contact for signalling undervoltage release energized (C.aux YU)
The undervoltage releases can be fitted with a contact (preferably, normally closed or open) for signalling undervoltage energized for remote signalling of the state of the undervoltage release.
Reference figure in the electrical circuit diagrams: (12)

Mechanical operations counter
This is connected to the operating mechanism by means of a simple lever mechanism. It indicates the number of circuit-breaker mechanical operations. The indication is visible on the front of the circuit-breaker from the outside.

Mechanical locks

a) Lock in open position
Different mechanisms are available which enable the circuit-breaker to be locked in the open position.
These devices can be controlled by:
- a key: a special circular lock with different keys (for a single circuit-breaker) or with the same keys (for several circuit-breakers). In the latter case, up to four different key code numbers are available.
- padlocks: up to 3 padlocks (not supplied): Ø 4 mm and Ø 8 mm /Ø 0,15 inch and Ø 0,31 inch.

b) Circuit-breaker lock in connected - test isolated - disconnected position
This device can be controlled by a special circular lock with different keys (for a single circuit-breaker) or with the same keys (for several circuit-breakers available up to four different key code numbers) and by padlocks (up to 3 padlocks, not supplied - Ø 4 mm / Ø 0,15 inch). Only available for circuit-breakers in withdrawable versions for installing on the moving part.

c) Accessories for lock in test isolated - disconnected position
In addition to the circuit-breaker lock in the connected - test isolated - disconnected position, this allows locking only in the disconnected or test isolated positions. Only available for circuit-breakers in withdrawable versions for installing on the moving part.

d) Accessories for shutter padlocks
They enable the shutters to be padlocked (installed on the fixed part) in the closed position. Only available for circuit-breakers in withdrawable versions for installing on the fixed part.

e) Mechanical lock on compartment door
This prevents the compartment door from being opened when the circuit-breaker is closed (and connected in the case of withdrawable circuit-breakers) and prevents circuit-breaker closing with the compartment door open.

f) Lock in open position with Kirk lock (internal or on front door)
This makes it possible to lock the circuit breaker in the open position using a Kirk key lock (not supplied).
For use on fixed circuit breakers, the accessory must be ordered together with the interlock plate for fixed circuit breakers.

g) Fail Safe device (to prevent extraction while the spring is loaded)
This makes it impossible to draw out the mobile part of the circuit breaker from it's cradle if the closing springs are loaded.
The accessory is supplied as standard for all withdrawable circuit breakers.
It is also available for withdrawable versions to be installed on the mobile part.

WARNING:
This is incompatible with undervoltage releases (YU).

Transparent protection covers

a) Protection covers for opening and closing pushbuttons
These protection covers, applied over the opening and closing pushbuttons, prevent the corresponding circuit-breaker operations except by using a special tool.

b) IP54 door protection (NEMA 3/3S/13)
This is provided by means of a transparent plastic escutcheon plate which fully protects the front of the circuit-breaker and ensures a degree of protection to IP54. Mounted on hinges, it is fitted with a key lock.

Interlock between circuit-breakers
This mechanism makes the mechanical interlock between two or three circuit-breakers (even of different sizes and in any fixed/withdrawable version) by means of a flexible cable. The electrical circuit diagram for the electrical changeover by means of a relay (to be provided by the customer)
is supplied with the mechanical interlock. The circuit-breakers can be installed vertically or horizontally.
4 types of interlock are available:
type A: between 2 circuit-breakers (power supply + emergency)
type B: between 3 circuit-breakers (2 power supplies + emergency)
type C: between 3 circuit-breakers (2 power supplies + bus-tie)
type D: between 3 circuit-breakers (3 power supplies / a single closed circuit-breaker)
The emergency power supply is generally supplied in order to substitute the normal power supply in two cases:
- to supply safety services for people.
- to supply essential parts of the installation for other than the safety services.

The change over from the normal supply to the emergency supply, can be done manually (with a local or remote control) or automatically. For the change over, the circuit-breakers must be supplied with the necessary accessories for the electrical remote control and

for electrical and mechanical interlocks provided for the changing over.
The accessories can be for example:
- the shunt opening release
- the shunt closing release
- the motor operator
- the auxiliary contacts

For the change over, the customer can use a suitable electronic relay, whose diagram is supplied by ABB SACE. The mechanical interlocks between two or three circuit-breakers are made by means of cables that can be used for circuit-breakers installed, either side-by-side or one over the other.

Table of feasible mechanical interlocks between two or three circuit-breakers

Type of interlock	Number of circuit-breakers	Type of circuit-breaker	Possible interlocks
A	TWO	A normal power supply unit and an emergency unit.	The first circuit-breaker can be closed only if the second (emergency) breaker is open.
B	THREE	Two normal power supply units and an emergency unit.	The first and third circuit-breakers can be closed only if the second (emergency) breaker is open. The latter can be closed only if the first and third are open.
C	THREE	A unit of 2 supplies and a bus-tie. The two half-busbars can be supplied by a single transformer (bus-tie closed) or simultaneously by both (bus-tie open).	One or two circuit-breakers out of three can be closed at the same time.
D	THREE	A unit of 3 supplies / a single closed circuit-breaker. Three supplies (generators or transformers) on the same busbar for which parallel operation is not allowed.	Only one of the three circuit-breakers can be closed.

Even interlock with exteded cables are available.

10.3. Notes for Emax LTT Low Temperature accessories

The SACE Emax VF LTT, circuit breaker designed for low temperature environment, is accessoriable only with the standard opening, closing and undervltage releases at 220V AC/DC.
The geared motor for the automatic charging of the spring is available with a special version for low temperature at 220V AC/DC.
Mechanical and electrical signalling for overcurrent releases accessories, auxiliary contacs, terminals and fixed parts are in common to the Emax VF product.
Transparent pushbuttons protection covers, IP54 door protection, interlocks, homoploar toroid, time delay device for undervoltage release and external neutral current sensors are not available.

10.4. Spare parts

The spare parts available are:
- Complete single pole (*) (Type “A”)
- Arcing chamber
- Stored energy operating mechanism (*) (Type “A”)
- Closing springs kit (*) (Type “A”)
- Current sensors and release connecting cables
- Contact kits for clamp disconnection for a fixed part of the removable circuit breaker
- Creeping earth contacts (for withdrawable version)
- Frontal shield kit complete with caps and side shields
- Safety shutters fixed part shutters
- Transparent protection for PR111/VF release
- Opening solenoid for maximum current release PR111/VF
- Lubricating grease for stored energy operating mechanism
- Terminal board for fixed
- Creeping contacts, fixed part
- Creeping contacts, movable part
- Dust tab for door of cell
- Extraction crank
- Lifting plates pair
- Front escutcheon plate for Ronis-type key lock

For further details, ask for the ABB SACE spare parts catalogue.
(*) Subject to the customer’s approval, ABB can replace “A” type parts.

11. Protection releases - General notes

Emax, the range of ABB air circuit-breakers, now has a new range of electronic relays.

A table can best illustrate the technical features of the relay.

Function/Unit	PR111/VF
Current protections (L, I)	S
Compatibility with PR010/T	O
Ekip TT (separate trip trest unit)	O

Key:
S : standard function/unit,
O : optional function/unit,

11.1. Safety notes

WARNING: this symbol gives information about operations, actions or circumstances that can cause injuries to the personnel, damage to the unit or economic losses.

Read this manual carefully and completely .
The use of this device should be reserved for qualified and expert personnel only.
If in doubt about its safe usage, the unit must be put out of service to prevent any accidental use.

You must assume that safe usage is impossible if:
1. the unit shows visible signs of damage
2. the unit does not function (for example with autotest or with the trip test unit)
3. the unit has been damaged in transit.

WARNING: Prior to servicing and/or replacing, the circuit-breaker must be open.
Also remember to disconnect all power supplies connected.

11.1.1. Notes for dielectric stiffness tests

WARNING: Dielectric stiffness tests on the releases' inputs and outputs, are not permitted.

11.2. Abbreviations and notes

11.2.1. Abbrevations

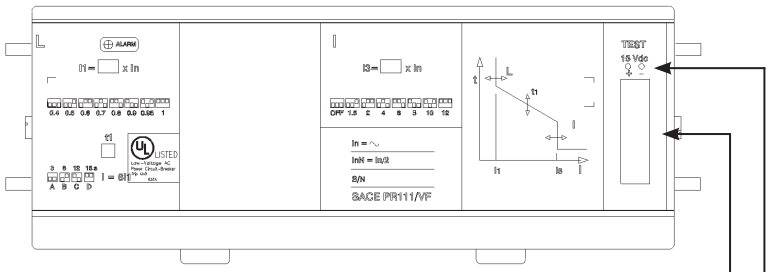
Abbreviations	Meaning
YO	Opening coil
YC	Closing coil
CB	Circuit-Breaker (for example Emax)
CS	Current Sensor (current transformer)
Emax	Series of ABB SACE air circuit-breakers
HW	Hardware
In	Rated current of the Rating Plug installed in the circuit-breaker
Pn	Circuit-breaker rated power
Relay	Also called “protection unit” or “protection release”
RMS	Root mean square value
TC	Trip Coil (opening solenoid)
Trip	CB opening, generated by the release

11.2.2. Notes

The unit has a “backup-protection” function; if the first command to the opening solenoid does not open immediately the circuitbreaker (TC partially fault), TRIP commands are repeatedly sent until the circuit-breaker opens or the current disappears.

12. SACE PR111/VF Release - Identification

The PR111/VF units available, in accordance with the IEC and ANSI/UL standards, together with the various protections and the various standard, are illustrated in the following figure:



Protections L I

Optional modules available

PR010/T

Ekip TT

12.1. General

12.1.1. Main Features

The PR111/VF is a high-performance protection unit with Protection, Watchdog and Test functions for ABB SACE 'Emax' low-voltage air circuit-breakers, for application with variable frequency.

The unit PR111/VF installed on CB, is connected to current sensors for the reading of primary current signals and for power supply, and to the Trip Coil for the management of CB Opening commands.
Depending on the protections settings, the unit manages timing and commands to open the circuit-breaker.

All the protections settings are available to the user through frontal dip switches.
The protections available with PR111/VF are:

Symbol	Protection against
L	overload with inverse long time delay
I	Instantaneous short-circuit

The unit is fitted with "backup protection" function. Should the first strike on the opening solenoid not immediately open the CB (Trip Coil partially faulty), TRIP commands are sent repeatedly until the CB opens or until disappearance of the current.

Using Accessory unit, it is possible to execute the testing procedure:
- with external unit PR010/T, it is possible to simulate current for check trip unit performances.
- with external unit Ekip TT it is possible to execute the Trip Coil function test.

12.1.2. Standard Reference

The PR111/VF has been designed to work in accordance with the international standard: ***Low voltage AC and DC power circuit breakers used in enclosures ANSI/UL 1066*** and with: ***IEC 60947-2 Low voltage apparatus. Circuit-breakers***.

12.1.3. Functioning condition

For a correct functioning of unit, the following conditions must be fulfilled:

12.1.3.1. Environmental condition

Operating temperature (Standard version)	-25 °C ... +70 °C
Operatin temperature (LTT Low temperature version)	-40°C ... +70°C
Storage temperature	-40 °C ... +90 °C
Relative humidity	0% ... 98% with condensation
Degree of protection (with PR111/VF installed in the CB)	IP 30

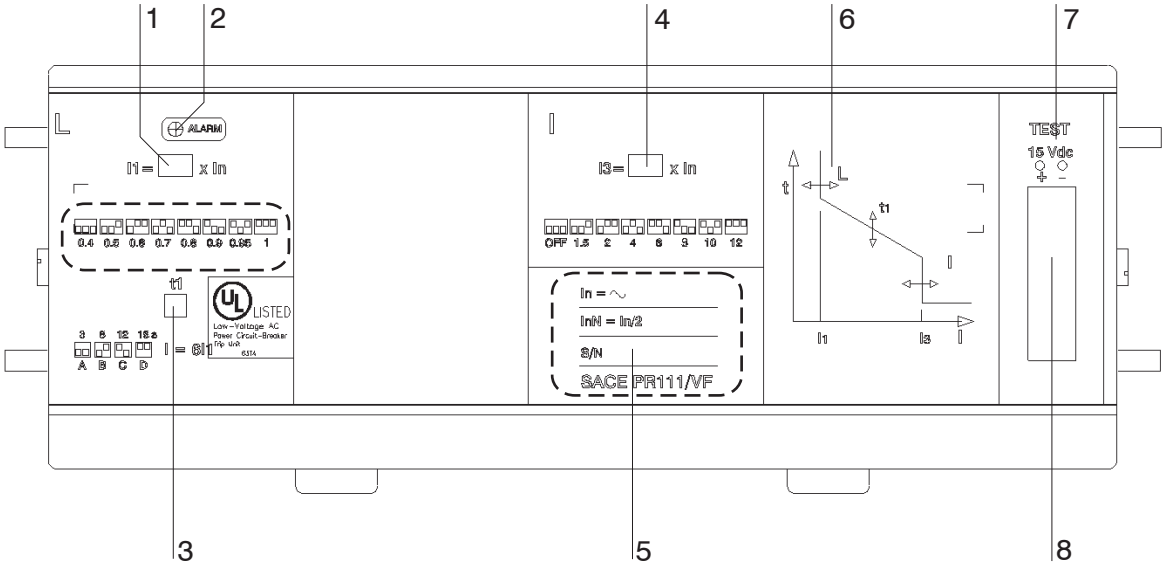
12.1.3.2. Power Supply condition

All the Protection functions are operative without any external auxiliary power supply. In fact, self-supply is guaranteed from the CTs installed in the power circuit breaker.

Minimum busbar current for turning the trip unit ON	0.2 In (three-phase current)
Nominal service frequency	20...200 Hz
Pass band	600 Hz max
Peak factor	2.1 max @ 2.8 In

12.2. User interface

On PR111/VF, all settings and information are available to user on the front.



Ref.	Description
1	Dip switches for L protection threshold setting
2	LED for L protection timing
3	Dip switches for L protection time setting
4	Dip switches for I protection threshold setting
5	CB Information and trip unit serial number
6	Graphic protection curve
7	Connector for Ekip TT unit
8	Connector for PR010/T unit

The following are the main charateristics of each part of user interface.
Descriptions of the optional unit are reported starting from para.12.4.

12.2.1. LED

There is one LED on the front of PR111/VF: it is ON, only with trip unit turned on, and in presence of one or more overloaded phases with current values over the L protection threshold.

12.2.2. Dip Switches

On the front label, it is possible to view the indication for threshold and timing settings of the protections

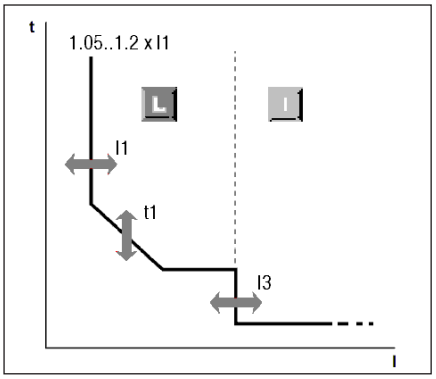
WARNING: Warning: It is not allowed to change protection settings while an alarm/timing condition is present.
The setting is indicated by the position of the white switch.
The dip switches on the top of the trip unit must always be set to OFF.

12.2.3. External Module

The unit PR111/VF can be connected to temporary external module, used for testing.
More details starting from para.12.4 on page 37

12.3. Protections

The following is a description of all the protections available to user into the Protections area:
- Protection against Overload (L protection).
- Protection from instantaneous short-circuit (I Protection).



Unit PR111/VF provides 3 states depending on the main protection thresholds (I_1, I_3), and level of primary current (I_f):

No Alarm: $I_f < (1.05...1.2)\ I_1$	The CB remains closed
L Alarm: $(1.05...1.2)\ I_1 < I_f < I_3$	The CB will open for L protection
I Alarm: $I_f > I_3$	The CB will open for I protection

The protection manages the current signal as follows:
- rms value for currents up to 2 In and with a peak factor ≤ 3, for the function L
- peak value for currents ≥ 2 In, and for the function I.

12.3.1. L Protection

The L protection is always active.
On unit PR111/VF it is possible to select the current threshold (I_1) and time (t_1), to determinate the tripping time (t_{trip}).

Setting	Value selectable	Description
Threshold I_1	0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 0.95, 1 (In)	Determinate the fault threshold of the primary current
Time t_1	A (3s), B (6s), C (12s), D (18s)	Determinate the t_{trip} of L protection

The unit applies an inversion time expression to calculate trip.
The expression considers the primary fault current (I_f), and the protection parameters (I_1 and t_1):

Condition	t_{trip} (s)	Example
$I_f \leq 12In$	$36 \times \frac{t_1}{(I_f/I_1)^2}$	I_1 = 0.8 x In; t_1 = 12s I_f = 1.5 x I_1 (1.2 x In) $t_{trip} = 36 \times \left(\frac{12}{(1.2/0.8)^2}\right) = 192s$
$I_f > 12In$	0.75	I_1 = 0.8 x In; t_1 = 12s I_f = 17 x I_1 (13.6 x In) t_{trip} = 0.75 s

WARNING: The minimum trip time is 0.75s. See trip curves for further details.

12.3.2. I Protection

The I protection is enabled/disabled on the protection menu.
On unit PR111/VF it is possible to select the current threshold (I_3), and it is possible to set Start-up parameters.

Setting	Value selectable	Description
Enable	ENABLE/DISABLE	Determinate the presence or absence of the protection.
Threshold I_3	OFF, 1.5, 2, 4, 6, 8, 10, 12 (In)	Determinate the fault threshold of the primary current

With I protection turned OFF, the only L protection will function, within all the fault current range.
With I protection turned ON, the unit will trip by I protection with $I_f > I_3$. The t_{trip} for I protection is ≤ 60ms.

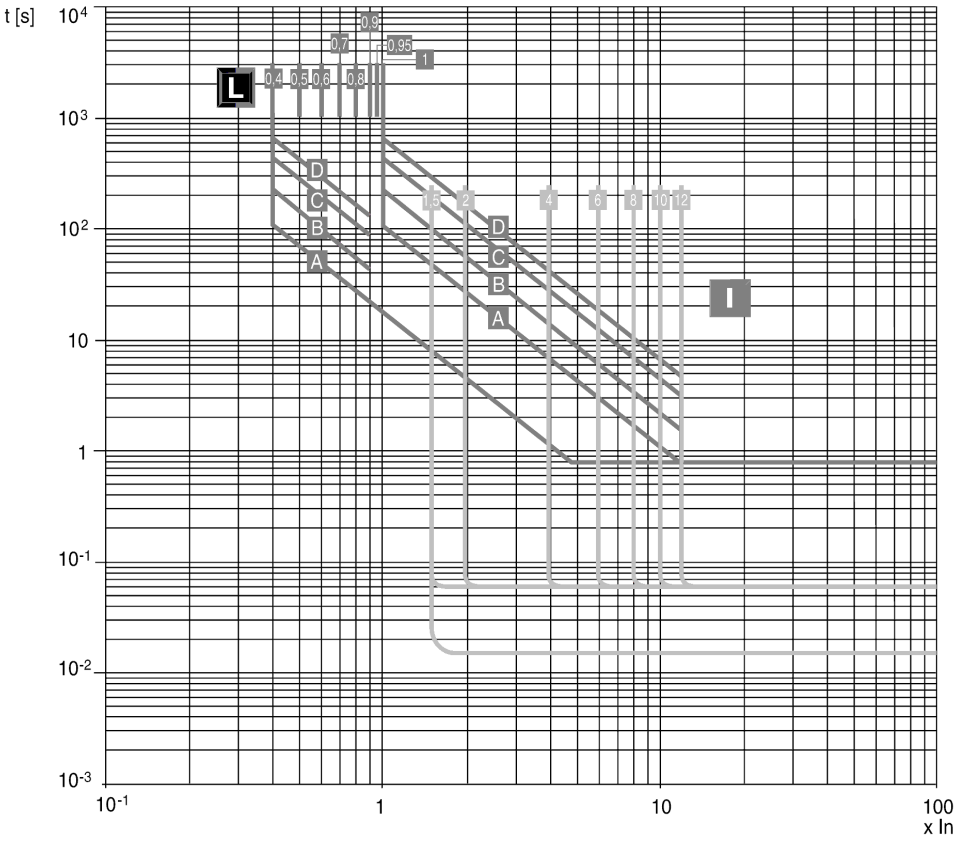
12.3.3. Trip performances and activation time

The following is a summary of Trip performances and tolerance, for all protections.

Protections	Threshold		Time Setting	Trip	
	Setting	Tolerance		Time	Tolerance
L	0.4In...1In	Activation within range 1.05...1.2 of I1	3s...18s	min: 0.75s. max: depends by expression	± 20%
I	1.5In...12In	± 20%	Fixed by unit	≤ 60ms	--

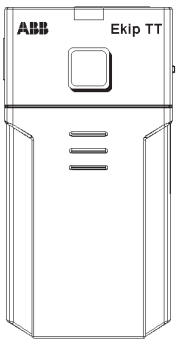
WARNING: L threshold tolerance according to ANSI37.17 and IEC 60947-2.
Tolerances are valid with the following hypotheses: trip unit not in startup and two-phases or three-phases power supply.

12.3.4. Curve



12.4. Modules

12.4.1. Ekip TT

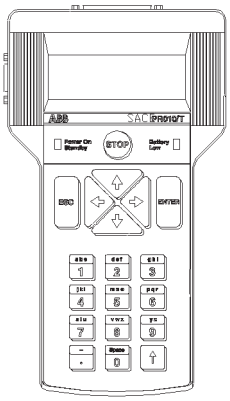


With SACE EKIP TT accessory, it is possible carry out the opening test of the CB.
EKIP TT connection to front test connector of PR, is possible using proper cable and adapter, provided on Ekip TT Set.

The unit is fitted with a set of 3 battery model AAA and does not therefore require any external power supply. Unit has one switch (to turn ON unit), one push button (to start Test) and one LED (for Battery status reading).

WARNING: For Ekip TT functionality details please see doc. n. 1SDH000721R0620. Ekip TT must be used with PR turned OFF (without primary current present).

12.4.2. PR010/T



By means of a cable connected to the front TEST connector of the PR111/VF, the test with the SACE PR010/T unit allows correct operation of the inputs, outputs, thresholds and trip times of protection functions L and I to be checked manually or automatically. It is also possible to obtain a test report which can be downloaded to a PC.
For operation of the PR010/T accessory, please consult the special instruction manual.

12.5. Default settings

The PR111/VF is supplied by ABB SACE with the following predefined parameters:

#	Protection/function	Status	Default Settings
1	L	ON (not disabled)	1 In; D (18s)
2	I	ON	4 In

12.6. Put into service

12.6.1. Connections

For the connections to be carried out by the user, it is advisable to strictly follow what is indicated in this document.
This means that we shall be able to satisfy all the international reference Standards and guarantee perfect operation of the trip unit even under severe environmental and electromagnetic conditions. Take particular care with the grounding connections.

12.6.2. PR111/VF test

WARNING: Before putting into service it is advisable carry out a test ("Trip test") of the whole SA chain by using the Ekip TT accessory.
Positive outcome is shown by the power circuit breaker opening. It is absolutely indispensable for the user to carefully define each modifiable parameter, before putting the PR111/VF into service.

12.7. Troubleshooting

The following table lists a series of typical service conditions, to help you understand and solve hypothetical faults or malfunctions.

WARNING: Before consulting the following table, check any lighting of the LEDs located on the front of the unit for some seconds.
The following, for FN the correct functioning of the PR111/VF is indicated.
If the suggested action does not lead to a solution of the problem, please contact the ABB SACE assistance service.

#	Situation	Possible cause	Suggestion
1	The trip test cannot be run	1. The busbar current is > 0 2. The TC is not connected 3. Ekip TT device battery flat	1. FN 2. Check the SA cabling 3. Replace the battery inside the Ekip TT
2	Trip times lower than expected	1. Threshold too low 2. Curve too low	1. Correct threshold 2. Correct curve
3	Trip times higher than expected	1. Threshold too high 2. Curve too high	1. Correct threshold 2. Correct curve
4	Rapid trip, with I3=OFF	Incorrect settings of DIPs located on the top of trip unit	Set DIPs to OFF position
5	The expected trip does not occur	Trip function disabled	FN. Enable trip if necessary
6	Impossible to change any parameter from display menu	PR111/VF in alarm situation	FN

In case of fault, follow the indication below:
- Make a note of the settings.
- Note down the type of CB, the nominal current, trip unit Serial Number.
- Prepare a brief description of the opening (when did it happen?, how many times ?, was it always under the same conditions? what type of load? what current? is the event reproducible?)
- Send/communicate all the information collected, together with the circuit diagram for the circuit-breaker, to your nearest ABB Customer Support service.

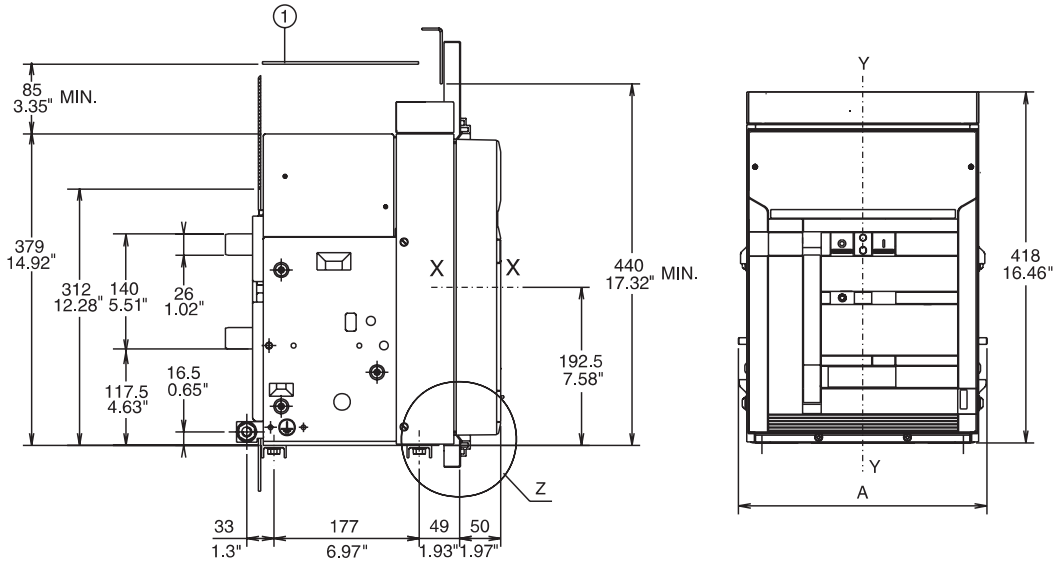
The completeness and accuracy of the information given to the ABB Assistance service will facilitate technical analysis of the problem encountered, and will allow us to rapidly carry out all actions to help the user.

13. Overall dimensions

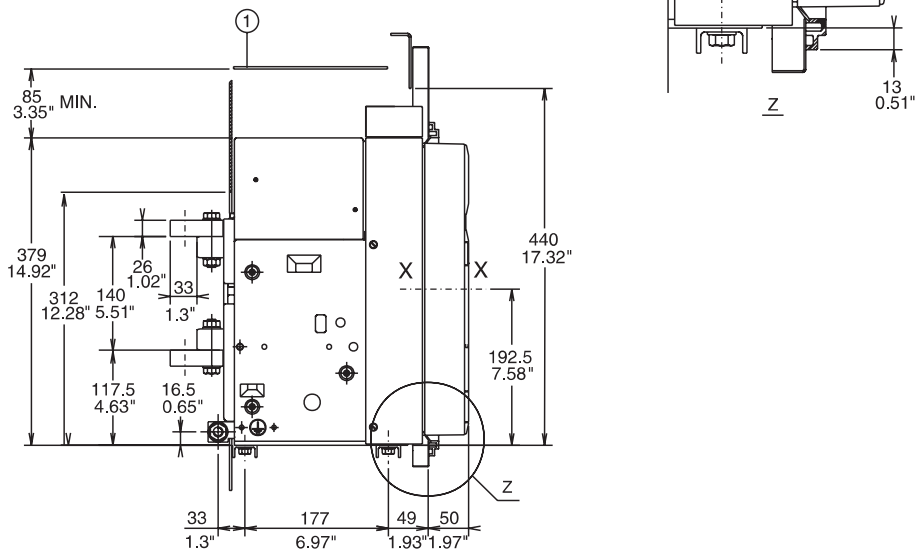
Fixed circuit-breaker

Basic version with horizontal rear terminals

E2-E3



E4-E6



	A 3 Poles
E2-VF	296/11.65''
E3-VF	404/15.91''
E4-VF	566/22.28''
E6-VF	782/30.79''

Legend

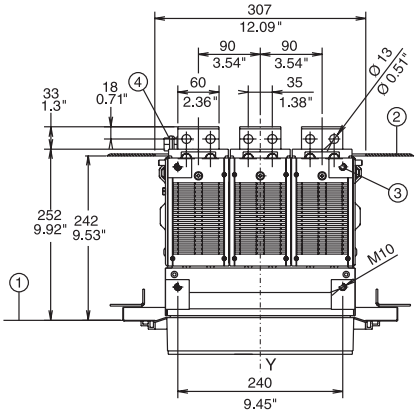
① Insulating or metal-insulated wall

Figure 50.

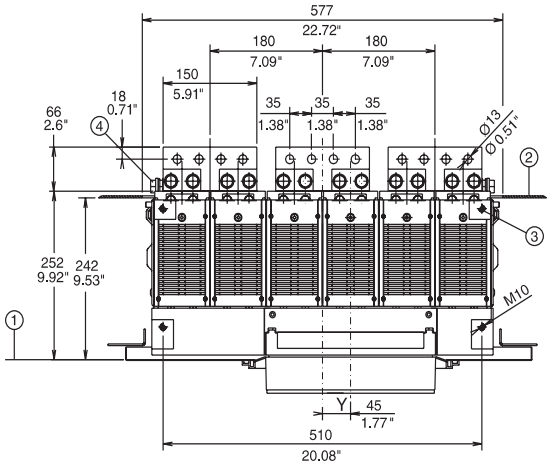
Fixed circuit-breaker

Basic version with horizontal rear terminals

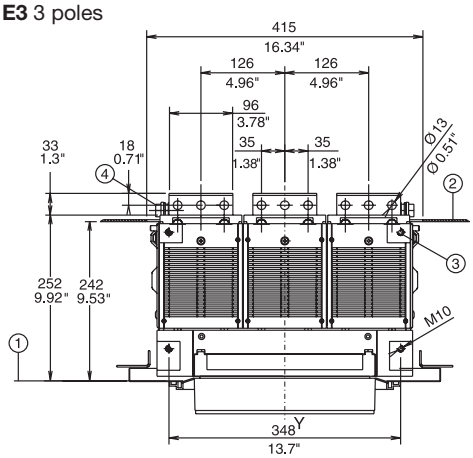
E2 3 poles



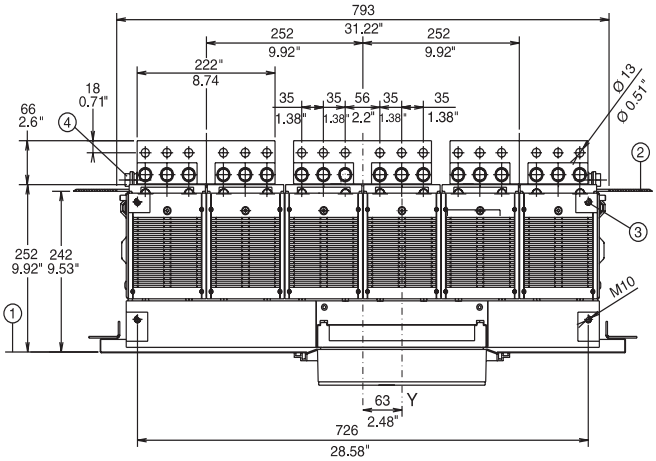
E4 3 poles



E3 3 poles



E6 3 poles



Legend

(1) Inside edge of compartment door

(2) Segregation (where foreseen)

3 M10 mounting holes for circuit breaker (included in the supply)

4 No 1 M12 screw for earthing (included in the supply)

Figure 51.

Fixed circuit-breaker

Basic version with vertical rear terminals

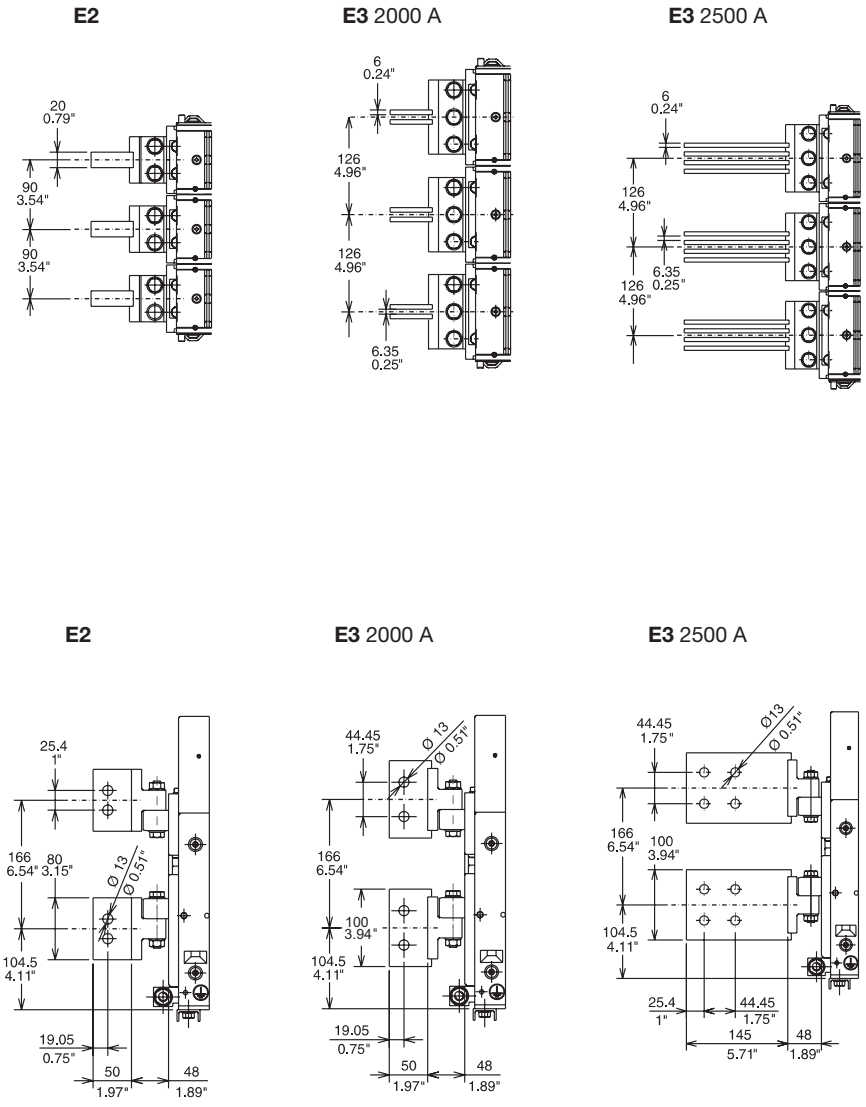


Figure 52.

Model	L5272	L6567		Apparatus	**Emax VF**	Scale
	L5712					
				Doc. No	**1SDH000910R0001**	Page No **41/60**

Fixed circuit-breaker

Basic version with vertical rear terminals

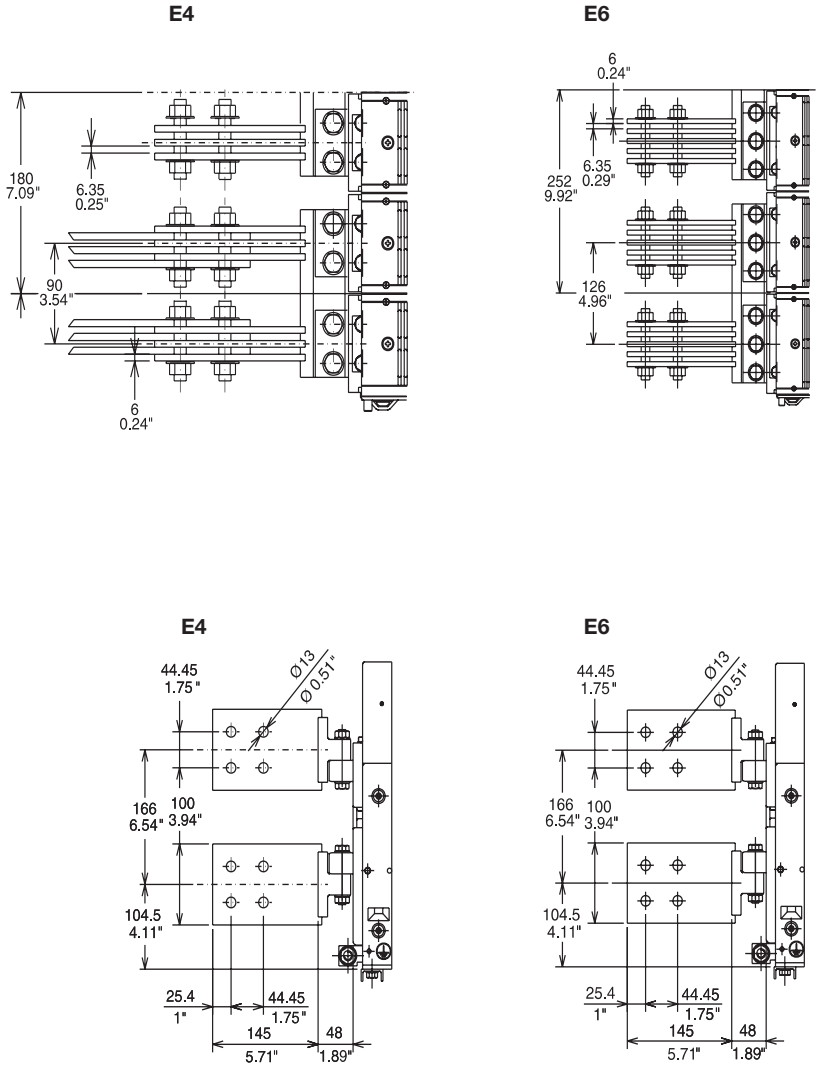


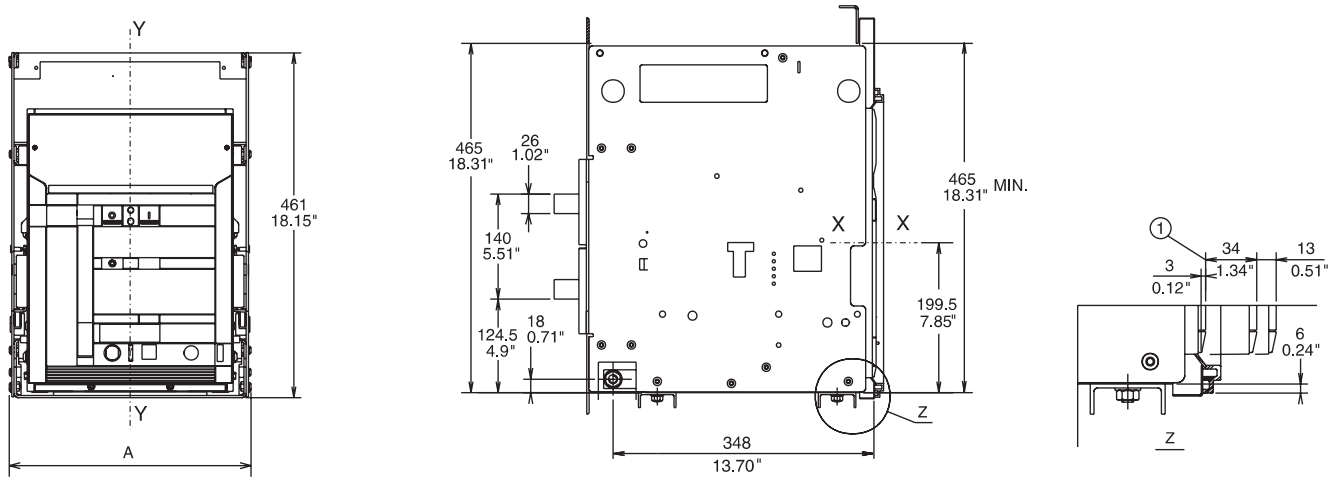
Figure 53.

Model	L5272	L6567		Apparatus	**Emax VF**	Scale
	L5712					
				Doc. no.	**1SDH000910R0001**	Page No **42/60**

Withdrawable circuit breaker

Basic version with horizontal rear terminals

E2-E3-E4-E6



	A 3 Poles
E2/VF	324/12.76''
E3/VF	432/17.01''
E4/VF	594/23.39''
E6/VF	810/31.89''

Legend

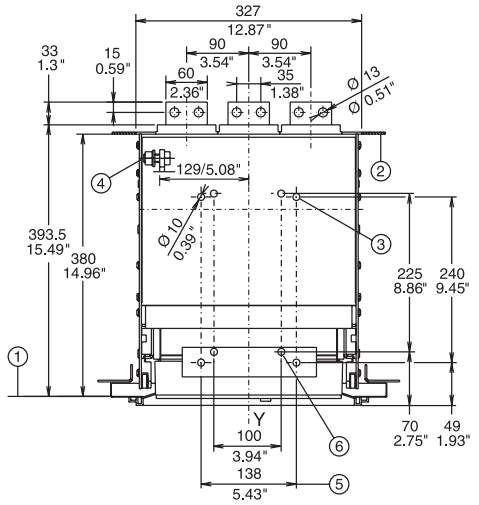
① Run from connected for a TEST to isolated

Figure 54.

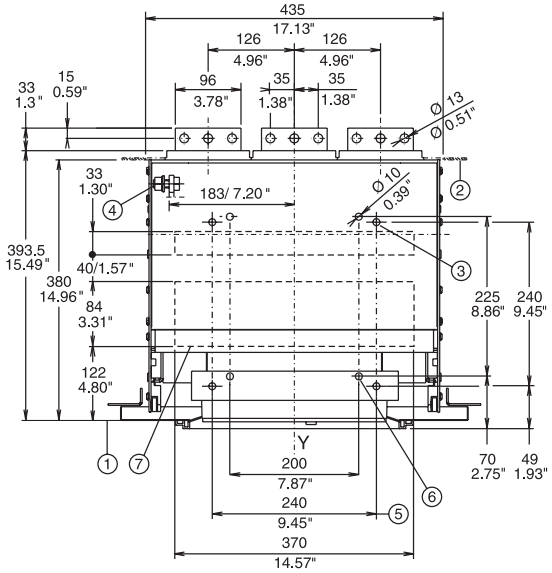
Withdrawable circuit breaker

Basic version with horizontal rear terminals

E2 3 poles



E3 3 poles



Legend

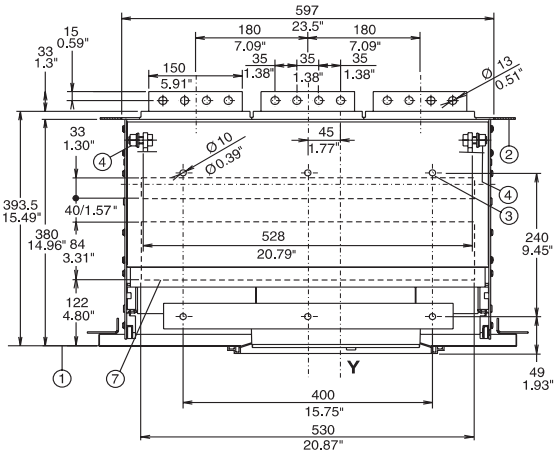
(1) *Inside edge of compartment door*
(2) Segregation (where foreseen)
(3) M8 mounting holes for circuit breaker (included in the supply)
(4) No. 1 M12 screw for earthing (included in the supply)
(5) No. 4 fixed part mounting holes (standard)
(6) Alternative drilling with 25 mm / 0.98 inch. pitch for fixing fixed part
(7) Ventilation drilling on the switchboard

Figure 55.

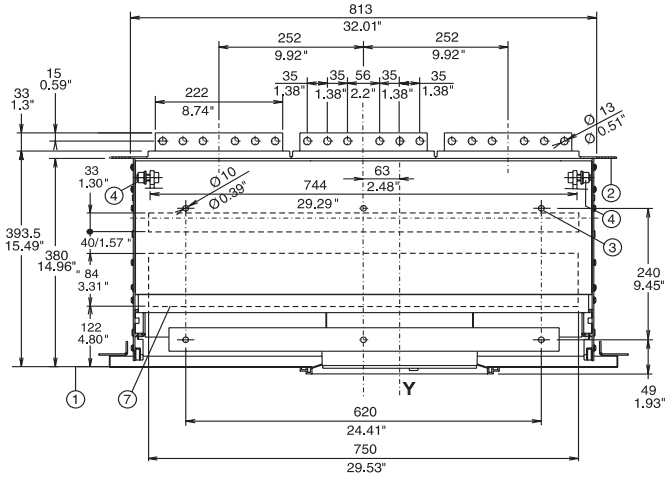
Withdrawable circuit breaker

Basic version with horizontal rear terminals

E4 3 poles



E6 3 poles



Legend

(1) Inside edge of compartment door

(2) Segregation (where foreseen)

(3) M8 mounting holes for circuit breaker (included in the supply)

(4) No. 1 M12 screw for earthing (included in the supply)

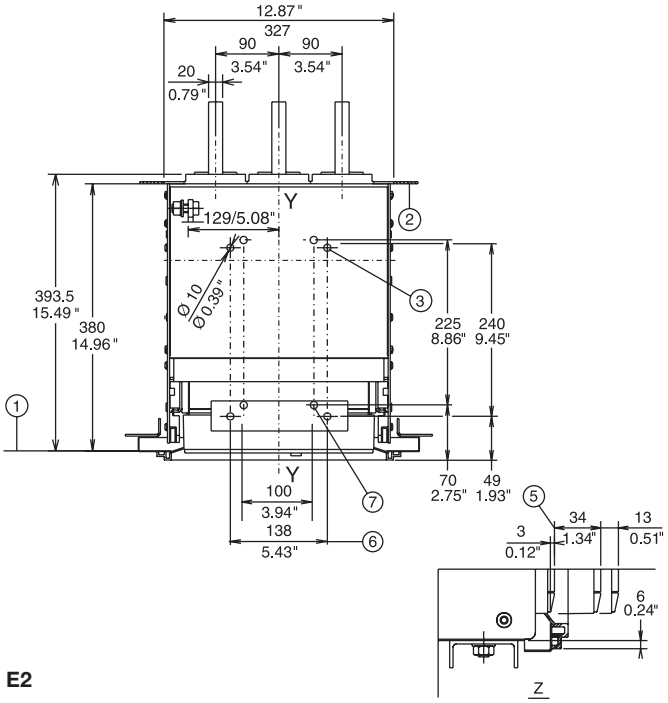
(7) Ventilation drilling on the switchboard

Figure 56.

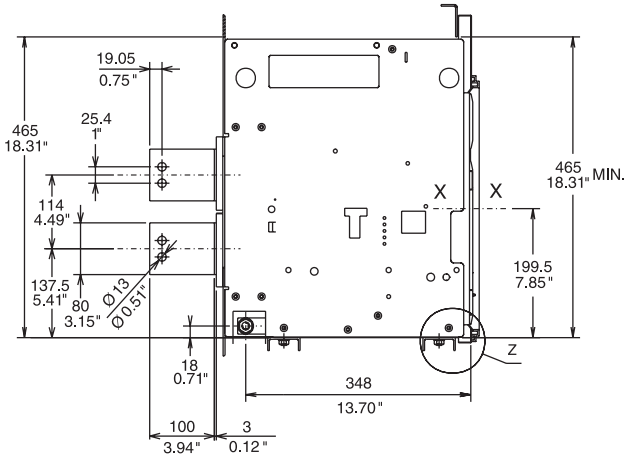
Withdrawable circuit breaker

Version with vertical rear terminals

E2 3 poles



E2



Legend

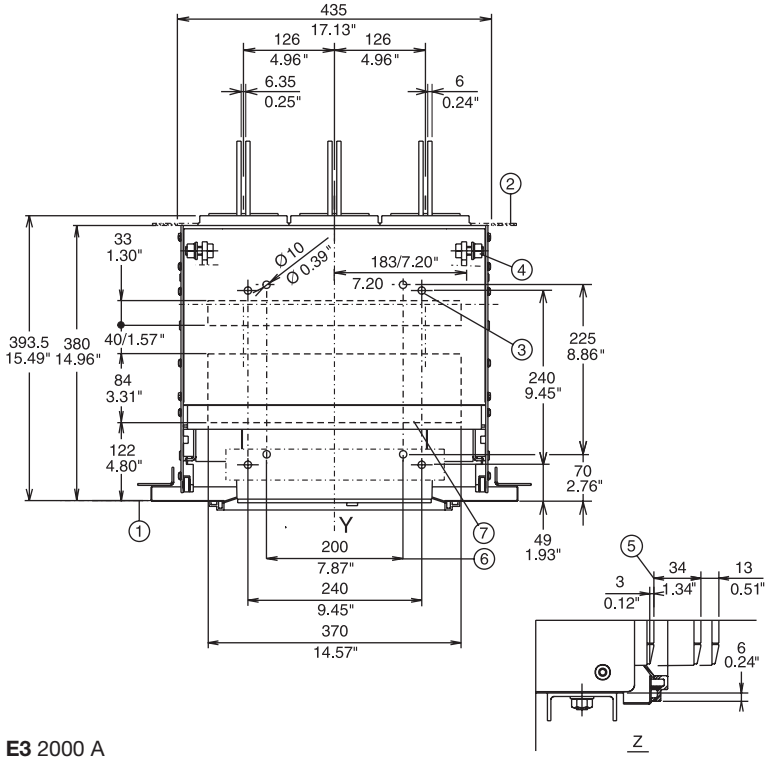
1. Inside edge of compartment door
2. Segregation (where foreseen)
3. M8 mounting holes for circuit breaker (included in the supply)
5. Run from connected for a TEST to isolated
6. No. 4 fixed part mounting holes (standard)
7. Alternative drilling with 25 mm / 0.98 inch. pitch for fixing fixed part

Figure 57.

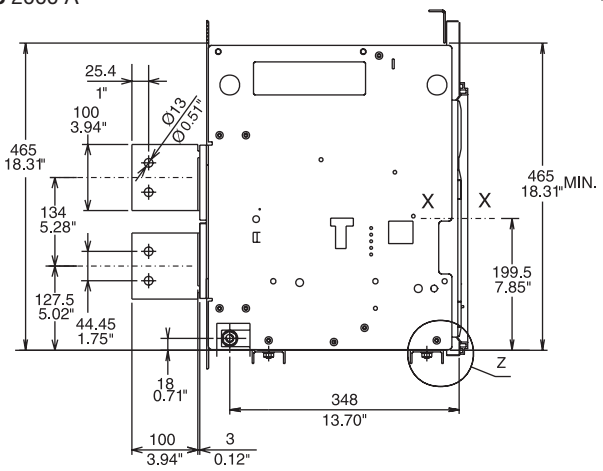
Withdrawable circuit breaker

Version with vertical rear terminals

E3 3 poles 2000 A



E3 2000 A



Legend

(1) *Inside edge of compartment door*

(2) Segregation (where foreseen)

(3) M8 mounting holes for circuit breaker (included in the supply)

(4) No. 2 M12 screws for earthing (included in the supply)

(5) Run from connected for a TEST to isolated

(6) Alternative drilling with 25 mm / 0.98 inch. pitch for fixing fixed part

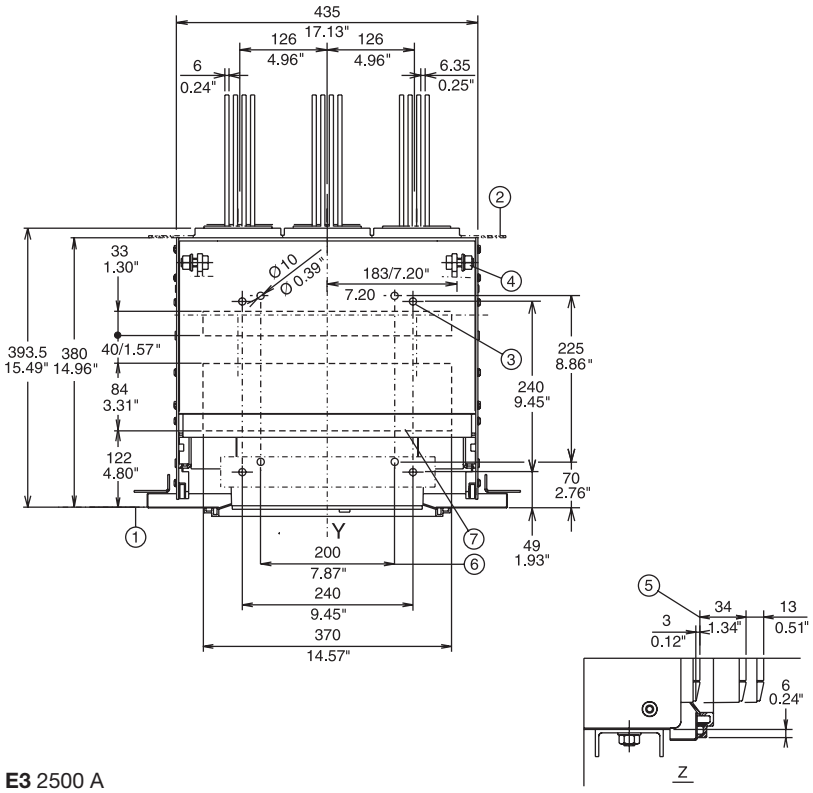
(7) Ventilation drilling on the switchboard

Figure 58.

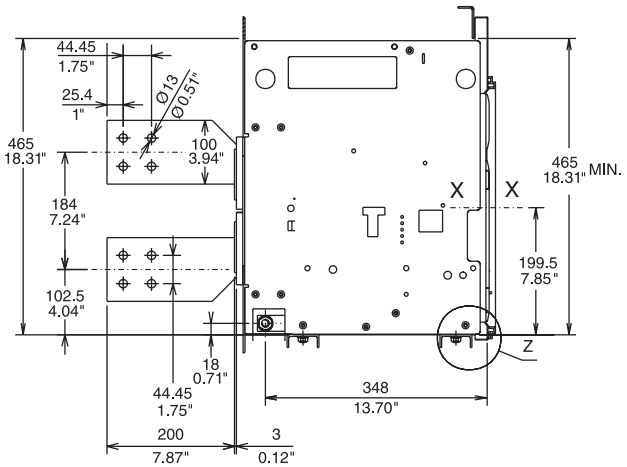
Withdrawable circuit breaker

Version with vertical rear terminals

E3 3 poles 2500 A



E3 2500 A



Legend

(1) *Inside edge of compartment door*

(2) Segregation (where foreseen)

(3) M8 mounting holes for circuit breaker (included in the supply)

(4) No. 2 M12 screws for earthing (included in the supply)

(5) Run from connected for a TEST to isolated

(6) Alternative drilling with 25 mm / 0.98 inch. pitch for fixing fixed part

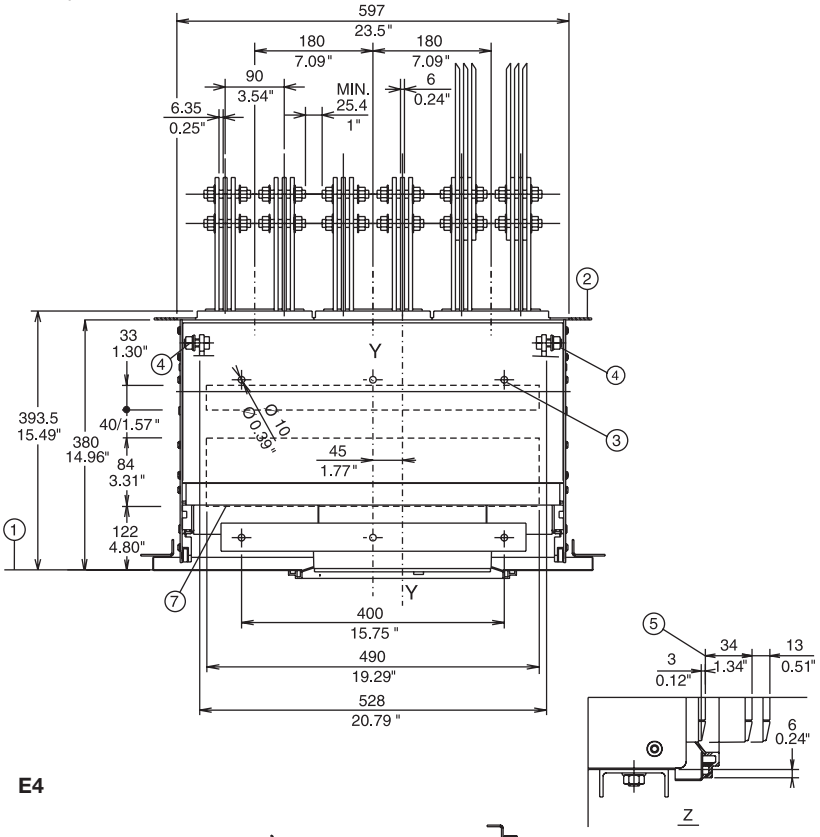
(7) Ventilation drilling on the switchboard

Figure 59.

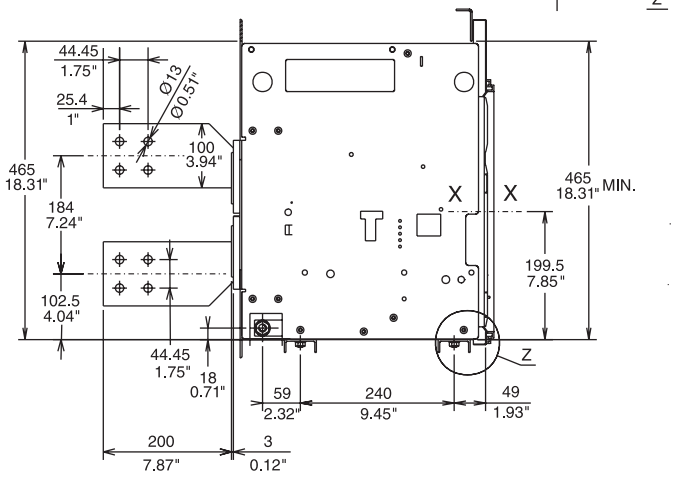
Withdrawable circuit breaker

Version with vertical rear terminals

E4 3 poles



E4



Legend

(1) *Inside edge of compartment door*

(2) Segregation (where foreseen)

(3) M8 mounting holes for circuit breaker (included in the supply)

(4) No. 2 M12 screws for earthing (included in the supply)

(5) Run from connected for a TEST to isolated

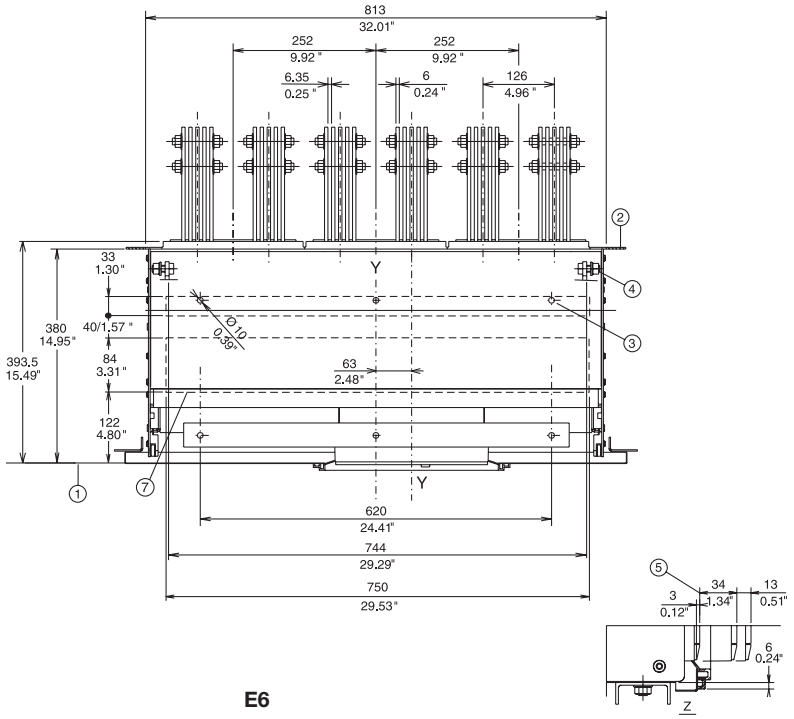
(7) Ventilation drilling on the switchboard

Figure 60.

Withdrawable circuit breaker

Version with vertical rear terminals

E6 3 poles



Legend

① Inside edge of compartment door

② Segregation (where foreseen)

③ M8 mounting holes for circuit breaker (included in the supply)

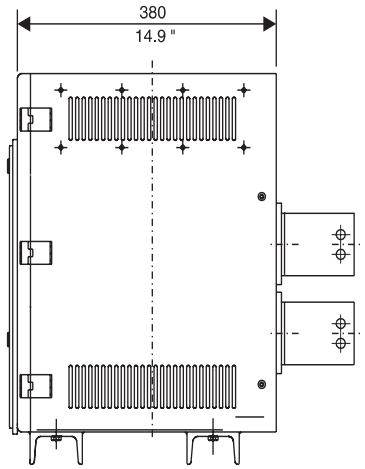
④ No. 2 M12 screws for earthing (included in the supply)

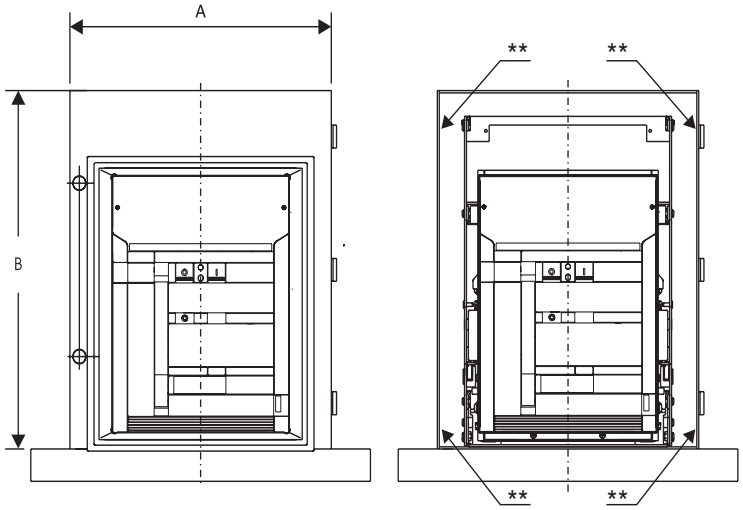
⑤ Run from connected for a TEST to isolated

⑦ Ventilation drilling on the switchboard

Figure 61.

Compartment dimensions





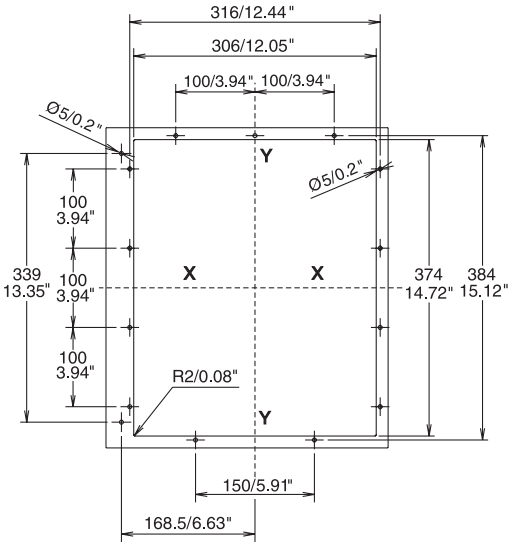
	A 3 Poles	B
E2/VF	400/15.7''	500/19.7''
E3/VF	500/19.7''	500/19.7''
E4/VF	700/25.7''	500/19.7''
E6/VF	1000/39.3''	500/19.7''

** Suitable to operate at 100% RATING in a minimun cubicle space (see the table), with a ventilation of 48 (12x4) sq. in. side botton and side top.

Check cubicle drawing.

Figure 62.

Drilling of compartment door



Tightening torque for fastening screws 20 Nm - 177 Lb in.
Tightening torque for main terminals 70 Nm - 620 Lb in.
Tightening torque of the earthing screw 70 Nm - 620 Lb in.

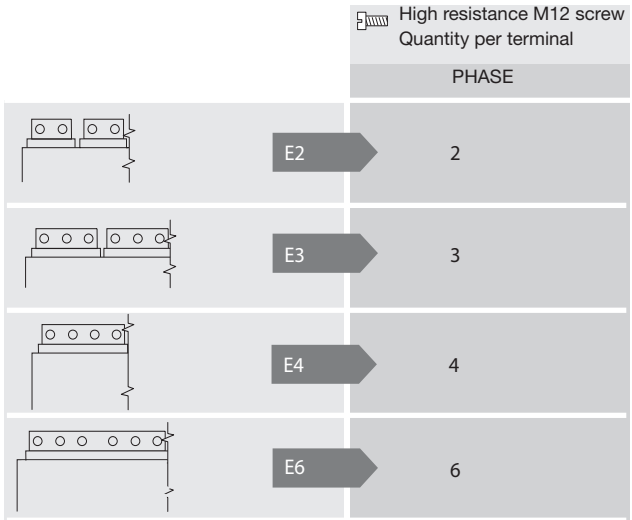


Figure 63.

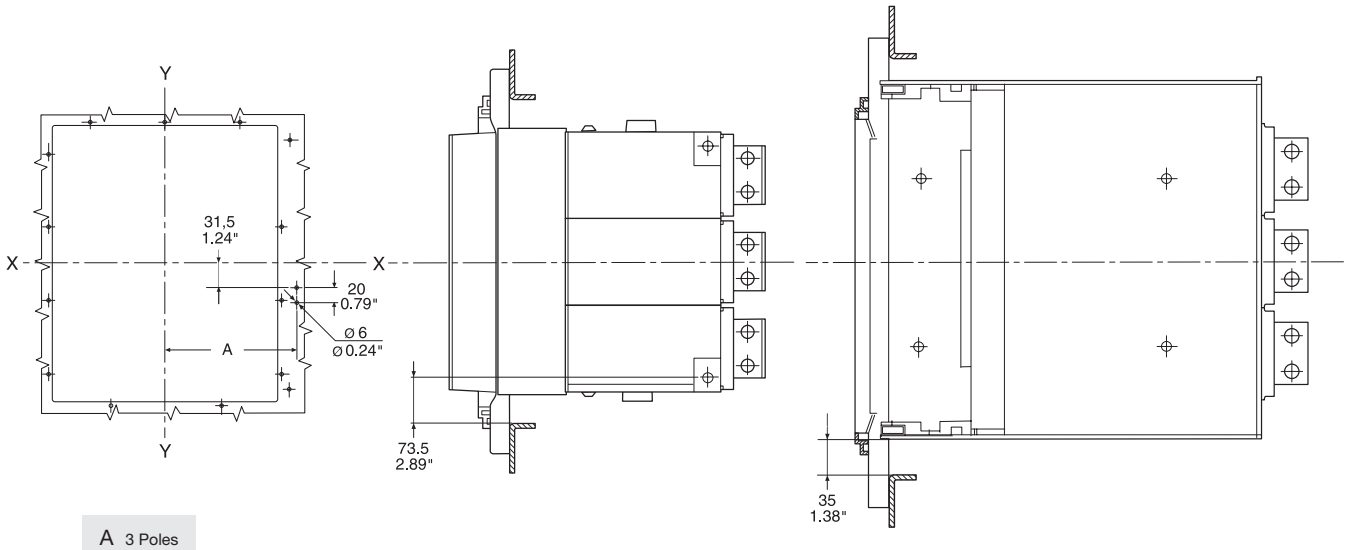
Compartment door mechanical lock

Drilling of compartment door

Minimum distance between circuit breaker and switchboard wall

Fixed version

Withdrawable version



	A 3 Poles
E2/VF	180/7.09''
E3/VF	234/9.21''
E4/VF	270/10.63''
E6/VF	360/14.17''

Figure 64.

14. Electrical circuit diagrams

Operating state shown
The diagram is shown under the following conditions:
- withdrawable circuit breaker, open and racked-in
- circuits de-energized
- releases not tripped
- motor operating mechanism with springs discharged.

14.1. Versions

The diagram shows a withdrawable circuit breaker but is also valid for fixed circuit breakers.

Fixed version
The control circuits are included between the XV terminals (the X connector is not supplied).

The applications indicated in figures 31, 32 cannot be supplied with this version.

Withdrawable version
The control circuits are included between the poles of the X connector (the XV terminal box is not supplied).

Version without overcurrent releases
The applications indicated in figures 13 and 14 cannot be supplied with this version.

14.2. Caption

Captions

☐	= Circuit diagram figure number
*	= See note indicated by the letter
A1	= Circuit breaker applications
A3	= Applications located on the fixed part of the circuit breaker (only provided with withdrawable circuit breakers)
A4	= Indicative apparatus and connections for control and signaling, outside the circuit breaker
AY	= SACE SOR TEST UNIT control/monitoring unit (see note R)
D	= Electronic time-delay device of the undervoltage release, outside the circuit breaker
F1	= Delayed-trip fuse
K51	= PR111/VF type electronic release with the following protection functions: - L against overload with inverse long delay trip - adjustment I1 - I against short circuit with instantaneous trip - adjustment I3
M	= Motor for closing spring charging
Q	= Circuit breaker
Q/1...25	= Circuit breaker auxiliary contacts
S33M/1...3	= Limit contacts of spring charging motor
S51	= Contact for electric signal indicating circuit breaker opened by overcurrent release. The circuit breaker can only be closed again after the reset button is pressed or after the electric reset coil YR has been powered (if present).
S75E/1.4	= Contacts for electric signal indicating circuit breaker in open position (only for withdrawable version circuit breakers)
S75I/1..5	= Contacts for electric signal indicating circuit breaker racked-in (only for withdrawable version circuit breakers)
S75T/1..4	= Contact for electric signal indicating circuit breaker in test position (only for withdrawable version circuit breakers)
CS	= Button or contact to close the circuit breaker
SO	= Button or contact to open the circuit breaker
SO1	= Button or contact to open the circuit breaker with delayed trip
SO2	= Button or contact to open the circuit breaker with instantaneous trip
SR	= Button or contact to reset the circuit breaker
TI/L1	= Current transformer located on phase L1
TI/L2	= Current transformer located on phase L2
TI/L3	= Current transformer located on phase L3
UI/L1	= Current sensor (Rogowski coil) located on phase L1
UI/L2	= Current sensor (Rogowski coil) located on phase L2
UI/L3	= Current sensor (Rogowski coil) located on phase L3
X	= Delivery connector for auxiliary circuits of withdrawable circuit breaker
X1...X7	= Connectors for the circuit breaker applications
XF	= Delivery terminal box for position contacts of the withdrawable circuit breaker (located on the fixed part of the circuit breaker)
XK1	= Connector for the power circuits of the PR111/VF releases
XO	= Connector for the YO1 release
XV	= Delivery terminal box for auxiliary circuits of fixed version circuit breaker
YC	= Shunt closing release
YO	= Shunt opening release

YO1 = Overcurrent shunt opening release (trip coil)
YO2 = Second shunt opening release (see note Q)
YR = Coil for electric circuit breaker reset
YU = Undervoltage release (see notes B and Q)

14.3. Description of figures

Fig. 1 = Closing spring charging motor circuit.
Fig. 2 = Shunt closing release circuit.
Fig. 4 = Shunt opening release.
Fig. 6 = Instantaneous undervoltage release (see notes B and Q).
Fig. 7 = Undervoltage release with electronic time-delay device, outside the circuit breaker (see notes B and Q).
Fig. 8 = Second shunt opening release (see note Q).
Fig. 11 = Contact for electrical signaling of springs charged.
Fig. 12 = Contact for electrical signaling of undervoltage release energized (see notes B and S).
Fig. 13 = Contact for electrical signaling that the circuit breaker is open because the overcurrent release has tripped. The circuit breaker can only be closed after the reset pushbutton has been pressed.
Fig. 14 = Contact for electrical signaling that the circuit breaker is open because the overcurrent release and electric reset coil have tripped. The circuit breaker can only be closed after the reset pushbutton has been pressed or after the coil has been powered.
Fig. 21 = First pack of auxiliary contacts for circuit breaker.
Fig. 22 = Second pack of auxiliary contacts for circuit breaker (see note V).
Fig. 23 = Third pack of additional auxiliary contacts outside the circuit breaker.
Fig. 31 = First pack of contacts for electrical signaling that the circuit breaker is in the racked-in, test or racked-out position.
Fig. 32 = Second pack of contacts for electrical signaling that the circuit breaker is in the racked-in, test or rackedout position.
Fig. 61 = SACE SOR TEST UNIT control/monitoring unit (see note R).

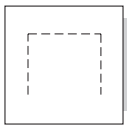
14.4. Incompatibilities

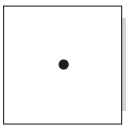
The circuits shown in the following figures cannot be powered on the same circuit breaker at the same time:
6 - 7 - 8
13 - 14

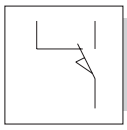
14.5. Notes

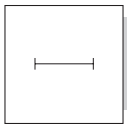
A) The circuit breaker is only fitted with the applications specified in the ABB order confirmation. To make out the order, please consult the apparatus catalogue.
B) The undervoltage release is provided for power supply branched on the supply side of the circuit breaker or from an independent source: circuit breaker closing is only allowed with the release energized (the lock on closing is made mechanically).
In the case where there is the same power supply for the closing and undervoltage releases and automatic circuit breaker closing is required, on return of the auxiliary voltage, a 30 millisecond delay must be introduced between the instant of consent of the undervoltage release and powering of the closing coil. This can be carried out by means of a circuit outside the circuit breaker including a permanent closing contact, the contact indicated in Figure 12 and a time-delay relay.
Q) The second shunt opening release must be installed as an alternative to the undervoltage release.
R) Operation of the SACE SOR TEST UNIT + shunt opening release (YO) system is guaranteed starting from 75% of the Vaux of the shunt opening release itself.
When the YO power supply contact is closing (short circuit of terminals 4 and 5), the SACE SOR TEST UNIT cannot determine the state of the opening coil. For this reason:
- If the opening coil has a continuous power supply, the TEST FAILED and ALARM signals will be activated.
- If the control of the opening coil is carried out impulsively, the TEST FAILED signal may be activated at the same moment. In this case, the TEST FAILED signal should only be considered an actual alarm signal if it remains on for longer than 20s.
S) Also available in the normally closed contact version.

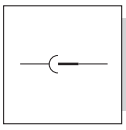
Graphic signs for circuit diagrams (IEC 60617 and CEI 3-14...3-26 Standards)

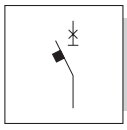

Shield
(may be drawn
in any shape)

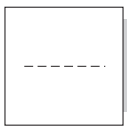

Terminal

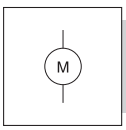

Change-over position contact with momentary circuit breaking (limit contact)


Time delay

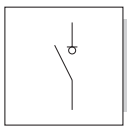

Plug and socket
(male and female)

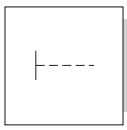

Power isolator with automatic breaking action

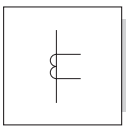

Mechanical or electrical connection

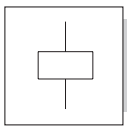


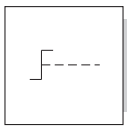
Motor
(general symbol)

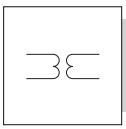

Switch-disconnector

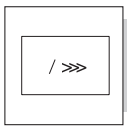

Manual mechanical control (general case)

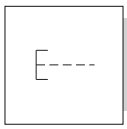

Current transformer

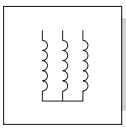

Control coil
(general symbol)

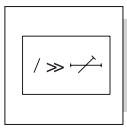

Rotating control

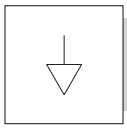

Voltage transformer

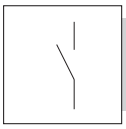

Instantaneous overcurrent relay

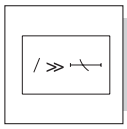

Pushbutton control

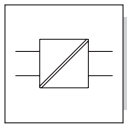

Winding of three-phase transformer, Star connection

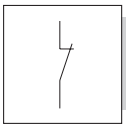

Overcurrent relay with adjustable short time-delay trip

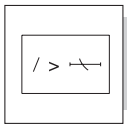

Equipotentiality

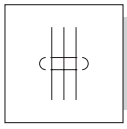

Make contact

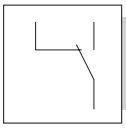

Overcurrent relay with inverse short time-delay tripa tempo breve inverso

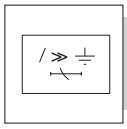

Galvanically separated converter

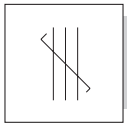

Break contact with automatic circuit breaking

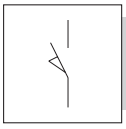

Overcurrent relay with inverse long time-delay trip

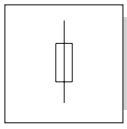

Shielded cable conductors (i.e., 3 conductors shown)

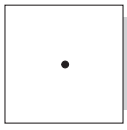

Change-over contact

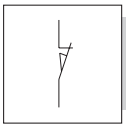

Earth fault overcurrent relay with inverse short time delay

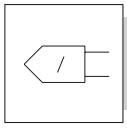

Conductors or stranded cables (i.e., 3 conductors shown)


Make position contact (limit contact)


Fuse (general symbol)

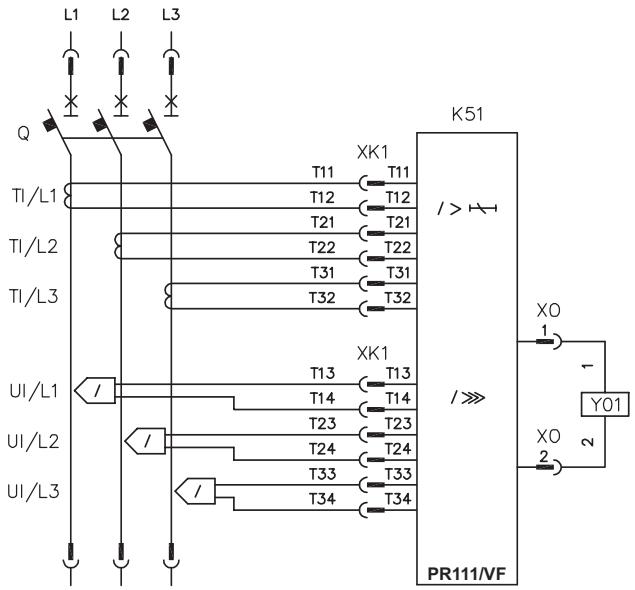

Connection of conductors


Break position contact (limit contact)

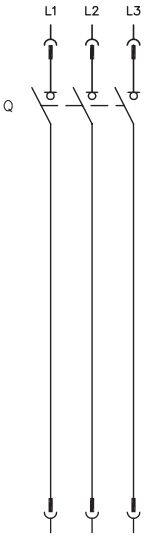

Current sensor

Circuit diagrams – operating status

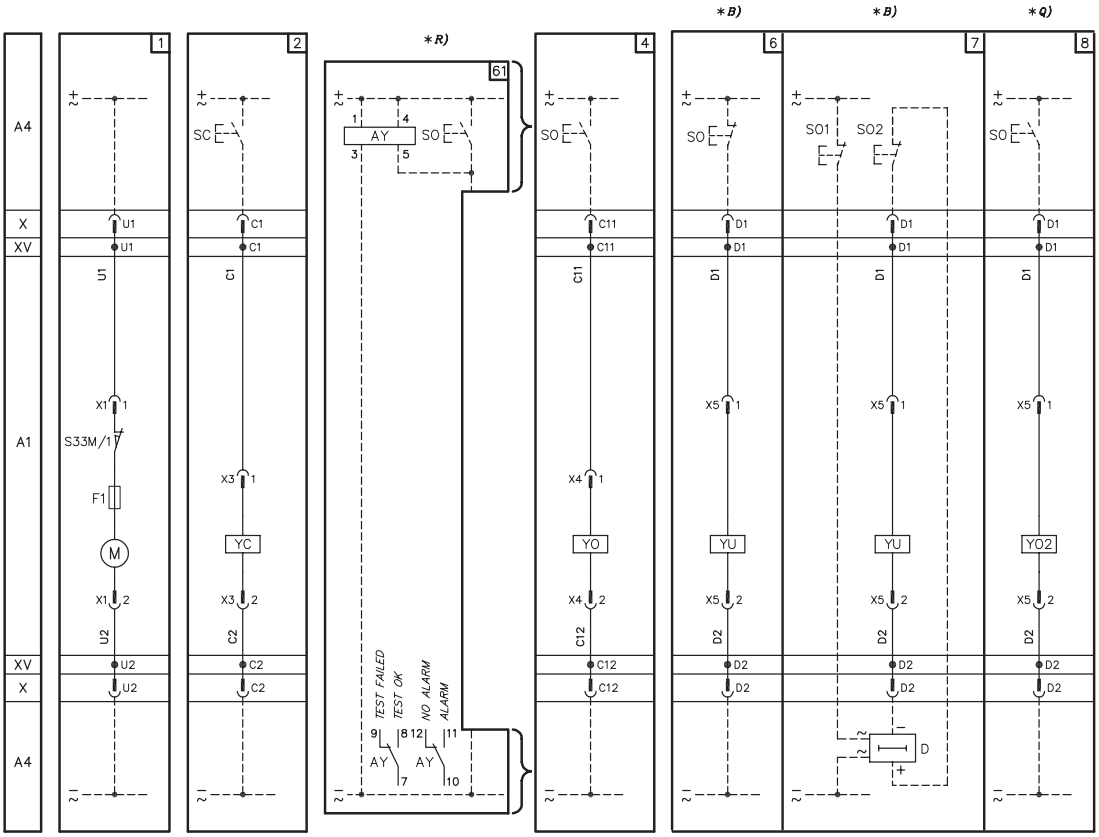
Three-pole circuit breaker with electronic release PR111/VF



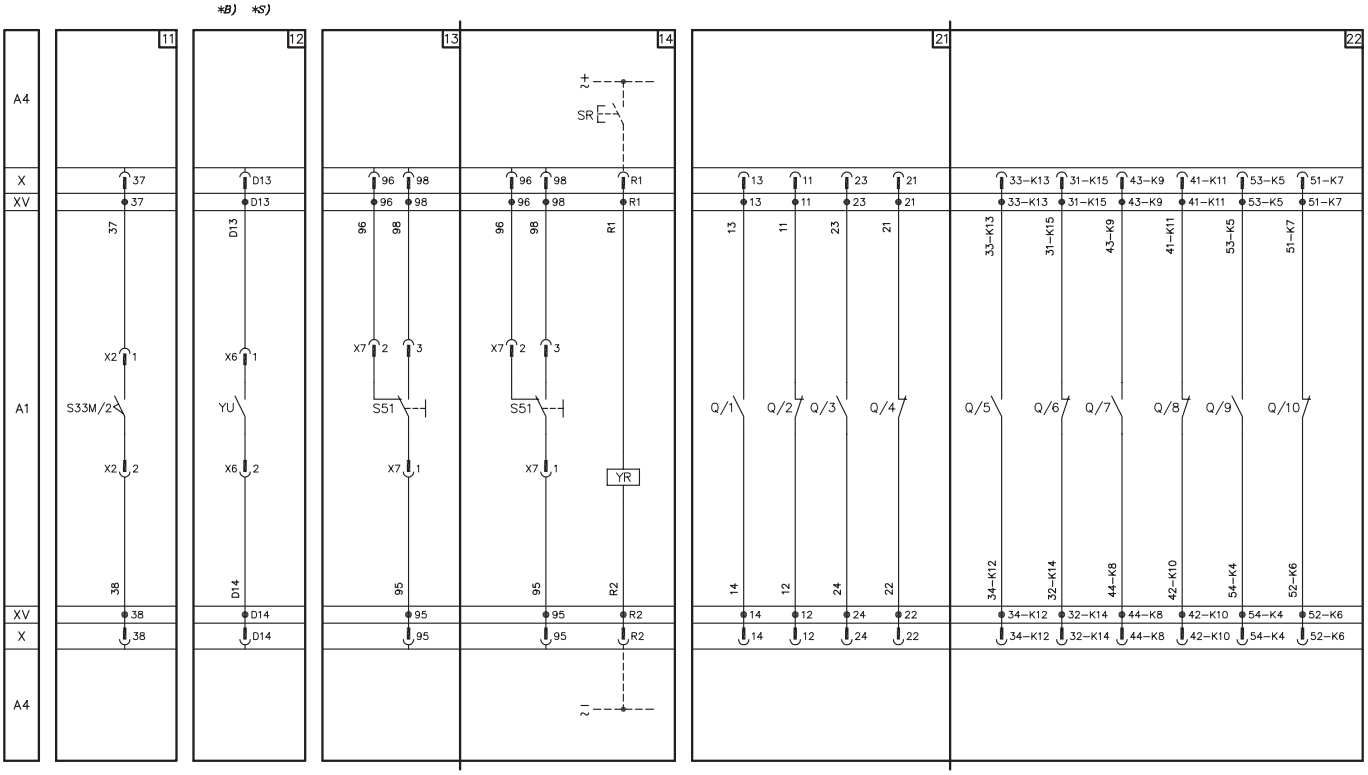
Three-pole switch-disconnector



Motor operating mechanism, opening, closing and undervoltage releases



Signaling contacts



Model	L5272	L6567		Apparatus	**Emax VF**	Scale
	L5712					
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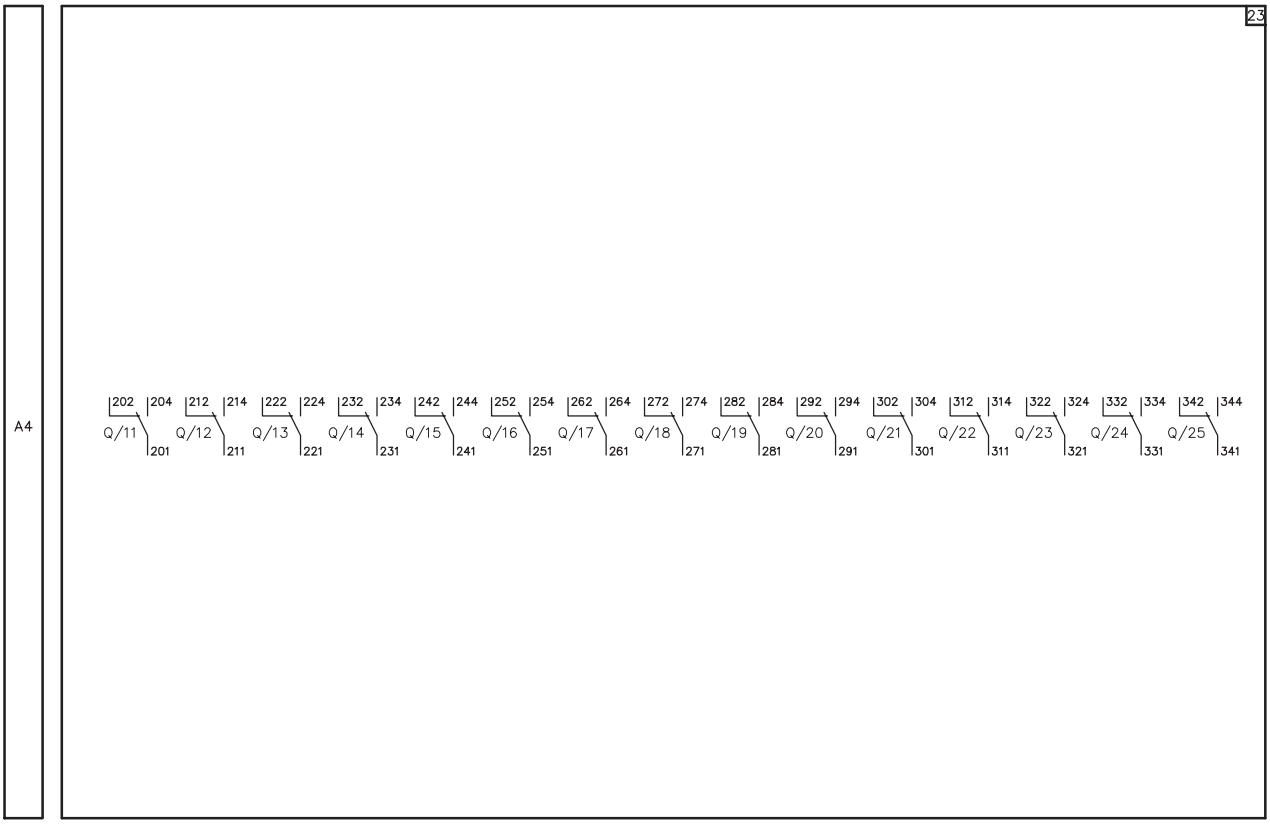
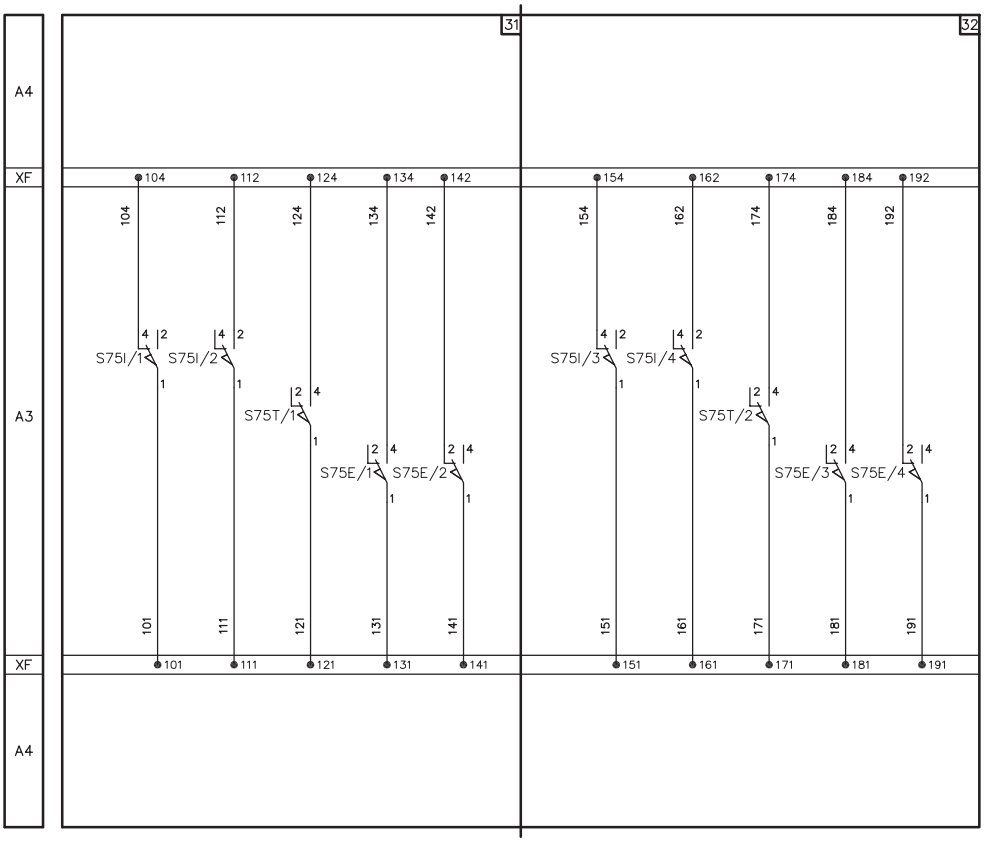
Signaling contacts





Model	L5272	L6567		Apparatus	**Emax VF**	Scale
	L5712					
				Doc. no.	**1SDH000910R0001**	Page No **58/60**

Due to possible developments of standards as well as of materials, the characteristics and dimensions specified in the present catalogue may only be considered binding after confirmation by ABB SACE.

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