

1SDH000635R0002 B2342

## Emax DC



Drwg.			Comp. Office		Title  Instructions for installation, service and maintenance of low voltage air circuit-breakers	Language		
App.			User Office			en		
Mod.	B2342			Apparatus	Emax DC	Scale		
ABB				ABB SACE		Doc N°	1SDH000635R0002	



## WARNING



**HAZARDOUS VOLTAGE  
CAN SHOCK, BURN  
OR CAUSE DEATH.**

Do not attempt to handle, install, use or service  
this product before reading instruction book

- **READ THIS MANUAL CAREFULLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE THIS CIRCUIT BREAKER.**
- File these instructions with other instruction books, drawings and descriptive data of the circuit breaker. Keep this manual available for the installation, operation and maintenance about this equipment. Use of these instructions will facilitate proper maintenance of the equipment and prolong its useful life.
- Install the Emax circuit breaker within the design limitations as described in the Installation and service instructions shipped with the circuit breaker. These circuit breakers are designed to operate within the current and voltage limitations on the switch nameplate. Do not apply these switches to systems with current and/or voltages that exceed these limits.
- Follow your company's safety procedures.
- Do not remove covers, open doors or work on equipment unless power has been turned off and all circuits de-energized.



## WARNING

- Detailed descriptions of standard repair procedures, safety principles and service operations are not included. It is important to note that this document contains warnings and cautions against certain specific service methods that could cause personal injury to service personnel, damage equipment, or render it unsafe. These warnings do not cover all conceivable ways in which service, whether or not recommended by ABB, might be performed, or the possible hazardous consequences of each conceivable way, nor could ABB investigate all such ways. Anyone using service procedures or tools, whether or not recommended by ABB, must satisfy himself thoroughly that neither personal safety, nor equipment safety, will be jeopardized by the service method or tools selected. Should further information be required or specific problems arise that are not sufficiently covered, refer the matter to an ABB service representative.
- This publication is written only for qualified persons and is not intended to be a substitute for adequate training and experience in the safety procedures for this device.
- The purchaser, installer or ultimate user is responsible for ensuring that warning signs are attached and all access doors and operating handles are securely locked when the gear is left unattended, even momentarily.
- All information contained in this manual is based on the latest product information available at the time of printing. We reserve the right to make changes at any time and without prior notice

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# 1. Description

## 1.1. General characteristics

SACE Emax DC circuit-breakers consist of a sheet steel structure which houses the operating mechanism, the poles and the auxiliary parts. Each pole is insulated from the others and contains the breaking parts, the shunt and the override protection. The fixed version circuit-breaker has its own terminals for connection to the power circuit. In the withdrawable version, the circuit-breaker is the moving part of the apparatus, which is completed with a fixed part fitted with terminals for connection to the power circuit of the installation. The moving and fixed parts are coupled together by special clamps installed in the fixed part. Consult the Technical Application Handbook “ABB circuit-breakers for direct current applications” (1SDC007104G0901) for details concerning the application of SACE Emax DC circuit-breakers in installations.

## 1.2. External front view of circuit-breaker

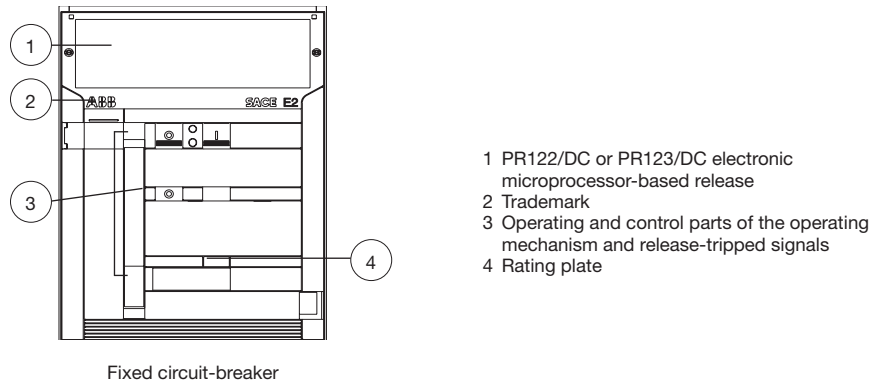


Fig. 1

## 1.3. Rating plate data

### 1.3.1. Three-pole circuit-breaker rating plate data

Example with supply from above





SACE E2B/E 800		u=800A    Ue=750V		Upper supply	
Ue (V)	500	750			EC 60947 2 Made in Italy by ABB SACE 
cu= cs (kA)	35	25			
cw(0.5s) (kA)	35	25			
cat B 	3P 				

Fig. 2a.

### 1.3.2. Four-pole circuit-breaker rating plate data

Example with supply from below





SACE E2B/E 800		u=800A Ue=1000V			Lower supply	
Ue (V)	500	750	1000		<div>EC 60947 2 Made in Italy by ABB SACE</div> 	
cu=cs(kA)	35	25	25			
cw(0.5s) (kA)	35	25	25			
cat B 	4P 					

Fig. 2b

### 1.3.3. Rating plate data of three-pole circuit-breaker UL

Example with supply from below



SACE E3N-A/DC	800A	Frame Size	
Rated Maximum Voltage (V)	635		ANSI C37.13  Low-Voltage DC General Purpose Power Circuit-Breaker 63FA
Rated Short-Circuit Current (kA)	60		
Rated Short Time Current (kA)	60		
Rated Peak Current (kA)	99		

Fig. 2c

### 1.3.4. Rating plate data of four-pole circuit-breaker UL

Example with supply from below



SACE E3N-A/DC	800A	Frame Size	
Rated Maximum Voltage (V)	635		ANSI C37.13  Low-Voltage DC General Purpose Power Circuit-Breaker 63FA
Rated Short-Circuit Current (kA)	60		
Rated Short Time Current (kA)	60		
Rated Peak Current (kA)	99		

Fig. 2d

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1.4. Construction characteristics of moving part

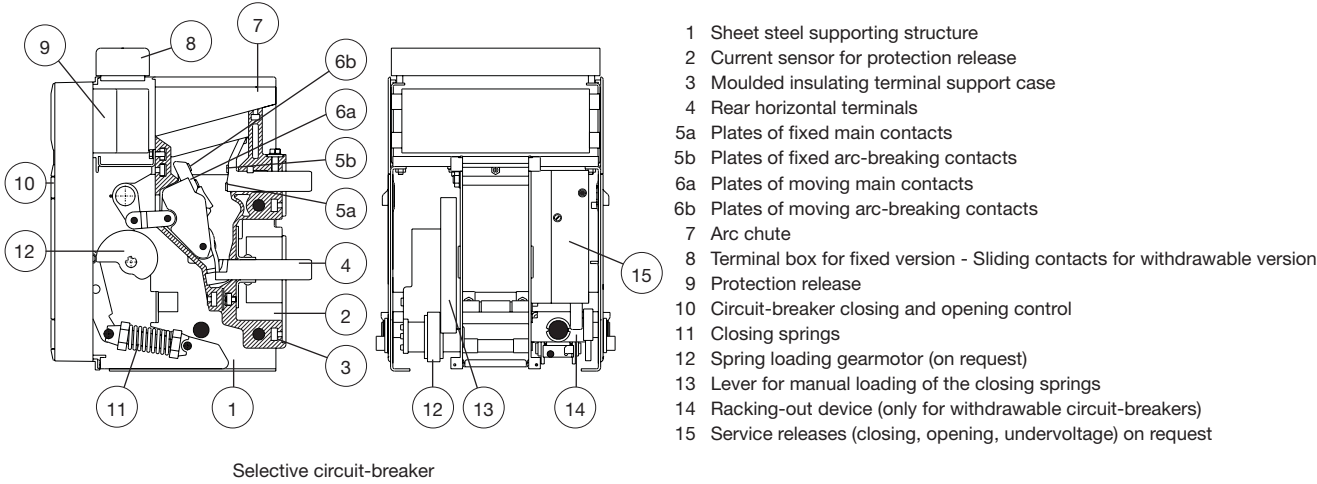


Fig. 3

1.5. Construction characteristics of moving part

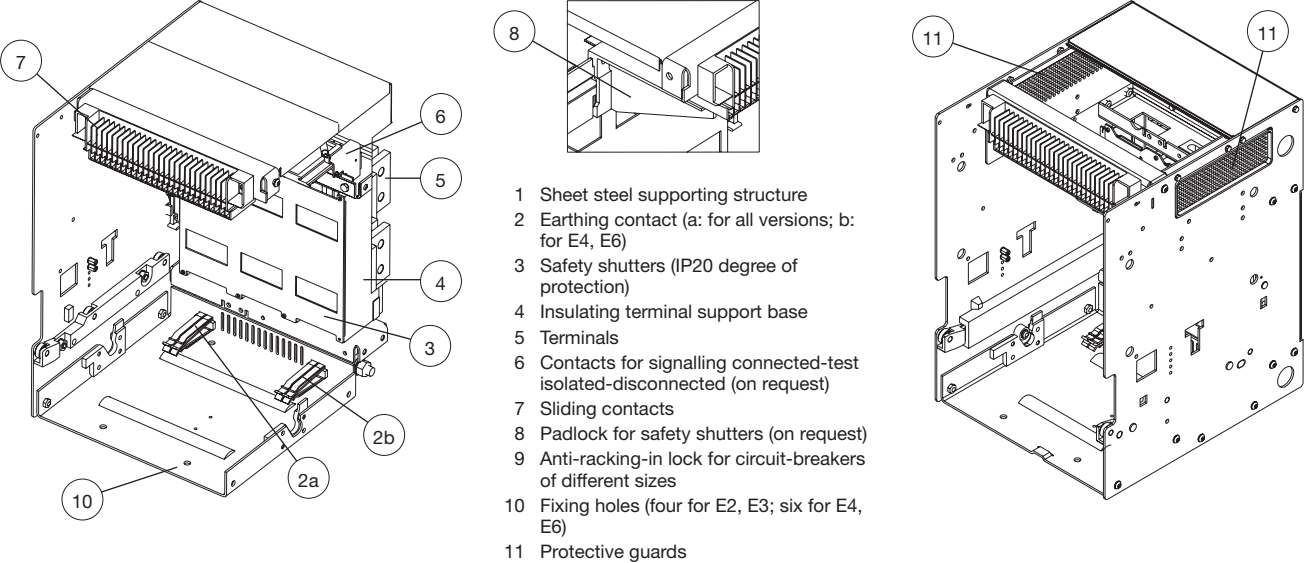


Fig. 4

2. Checking on receipt

Examine the condition of the material received and make sure that it corresponds to what was ordered. Any damage or non-compliance found when the material has been unpacked, which must be carried out with due care, must be notified within 5 days of receipt and the number of the shipping notice must be indicated on the notification.

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### 3. Storage, lifting and weights

Protected by an external wooden crate, the circuit-breaker is fastened with screws to the pallet used for transport or to the bottom of the packing crate.

If the circuit-breaker must be stored for even a short period of time before being put into service, after having been checked on receipt it must be its back into its container and covered with a waterproof tarpaulin.



**WARNING:**

- Store the circuit-breaker in a dry, dust-free ambient well away from aggressive chemicals.
- Place the circuit-breaker and any fixed part on a horizontal surface, not in direct contact with the floor but on a suitable support (Fig. 5).
- The maximum number of circuit-breakers that can be stacked on top of each other is shown in figure 6.
- Keep the circuit-breaker in the open position with the closing springs unloaded to prevent unwarranted stress and the risk of accidents to the personnel.

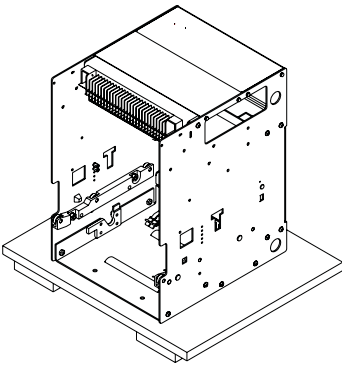


Fig. 5

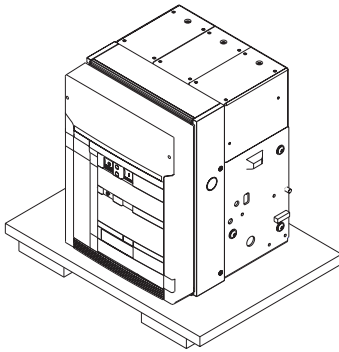
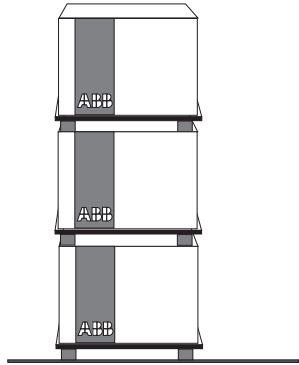


Fig. 6



Comply with the following instructions when lifting the circuit-breaker: the circuit-breakers must be placed on a sturdy surface and preferably lifted with an appropriate fork-lift truck. The use of ropes is, however, permitted: in this case, the lifting ropes must be secured as shown in the figure (the lifting plates are always supplied with the circuit-breaker).

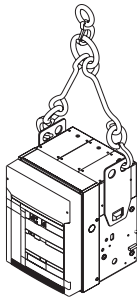
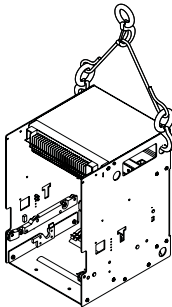


Fig. 7

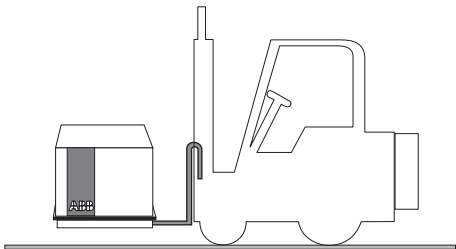


Table of circuit-breaker weights (kg)

Selective circuit-breaker	Fixed version				Withdrawable version			
	3 poles		4 poles		3 poles		4 poles	
	kg	lb	kg	lb	kg	lb	kg	lb
E2	50		61		78		93	
E3/E3-A	66	145	80	176	104	230	125	275
E4	97		120		147		170	
E6/ E6-A	140	309	165	364	210	463	250	551

**Note:**

- The weights given in the table refer to a circuit-breaker complete with PR122/DC or PR123/DC and relative current sensors, excluding the accessories.
- The withdrawable version includes the moving part with the aforementioned conditions and the fixed part with its terminals.

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4. Installation

4.1. Installation conditions

Install the circuit-breaker in a dry, dust-free, non-corrosive place where it will not be subjected to shocks or vibrations. When this is not possible, assemble it inside a switchboard with a suitable degree of protection.

For preparation of the installation ambient, refer to the “Overall dimensions” chapter, which provides information about the following points:

- minimum installation volumes of the circuit-breakers and derived versions
- clearances to be respected for circuit-breakers in compartments
- overall dimensions of the circuit-breakers
- drilling holes for fixing purposes
- drilling holes in the compartment door

The operations required for installation, putting into service, routine and supplementary maintenance must be performed by skilled personnel with detailed knowledge of the equipment.

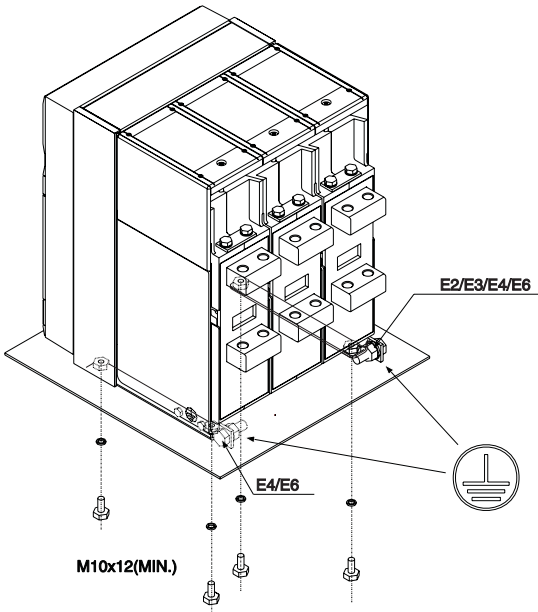


Fig. 8



**WARNING: The operations required for installation, putting into service, routine and supplementary maintenance must be performed by skilled personnel with detailed knowledge of the equipment.**



**WARNING RISK OF ELECTRIC SHOCK**  
Detach or disconnect all electric power supplies to prevent all potential risks of electric shocks during the assembly, installation and maintenance operations or when the circuit-breaker is removed from service. Some operations must be performed with the circuit-breaker is energized. Compliance with all the safety regulations is essential in this case.

4.2. Installation of fixed circuit-breakers

Fix the circuit-breaker to a horizontal surface with the screws (at least M10 x 12).

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

4.3.1. Preparation of the fixed part

**Assembly of the anti-racking-in lock**

Before installing the fixed part, make sure that the anti-racking-in lock is present for circuit-breakers with electrical characteristics differing from those of the fixed part itself. If the anti-racking-in lock has been supplied separately, it must be assembled in accordance with the following instructions.

- Find the assembly position of the stop bolts in relation to the circuit-breaker to be housed in the fixed part on the self-adhesive plate (4)
- Insert the hex screws (1) as shown in the figure, into the holes found in the previous point
- Fasten the screws with the washers (2) and the hexagonal stops (3).

Check that the circuit-breaker (moving part) is fitted with the anti-racking-in lock corresponding to the one installed on the fixed part.

- Anti-racking-in plate on moving part (5).

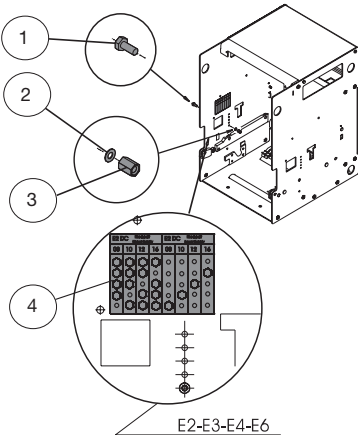


Fig. 9

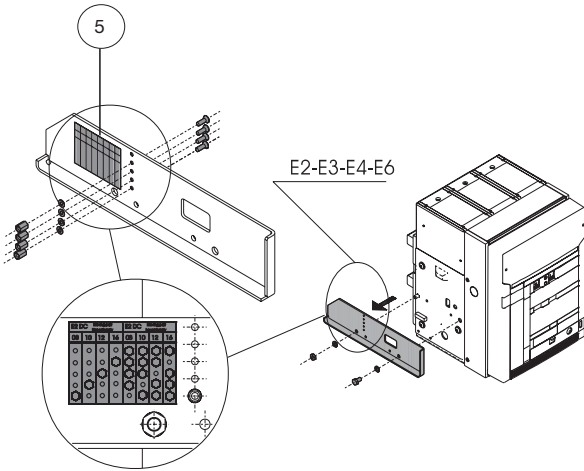


Fig. 10

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4.3.2. Installation of the fixed part (Fig. 12)

Fix the fixed part with the screws (1), washers (2) and nuts (3) (M8 x 16) supplied by ABB SACE. If different screws are used, make sure that their heads do not project 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 (Fig. 11)

With regard to the fixing points of the withdrawable versions of SACE Emax air circuit-breakers, additional fixing on the sides of the fixed part is advisable for applications on board ships (the M12 1/2" screws and spacers are not included in the supply).

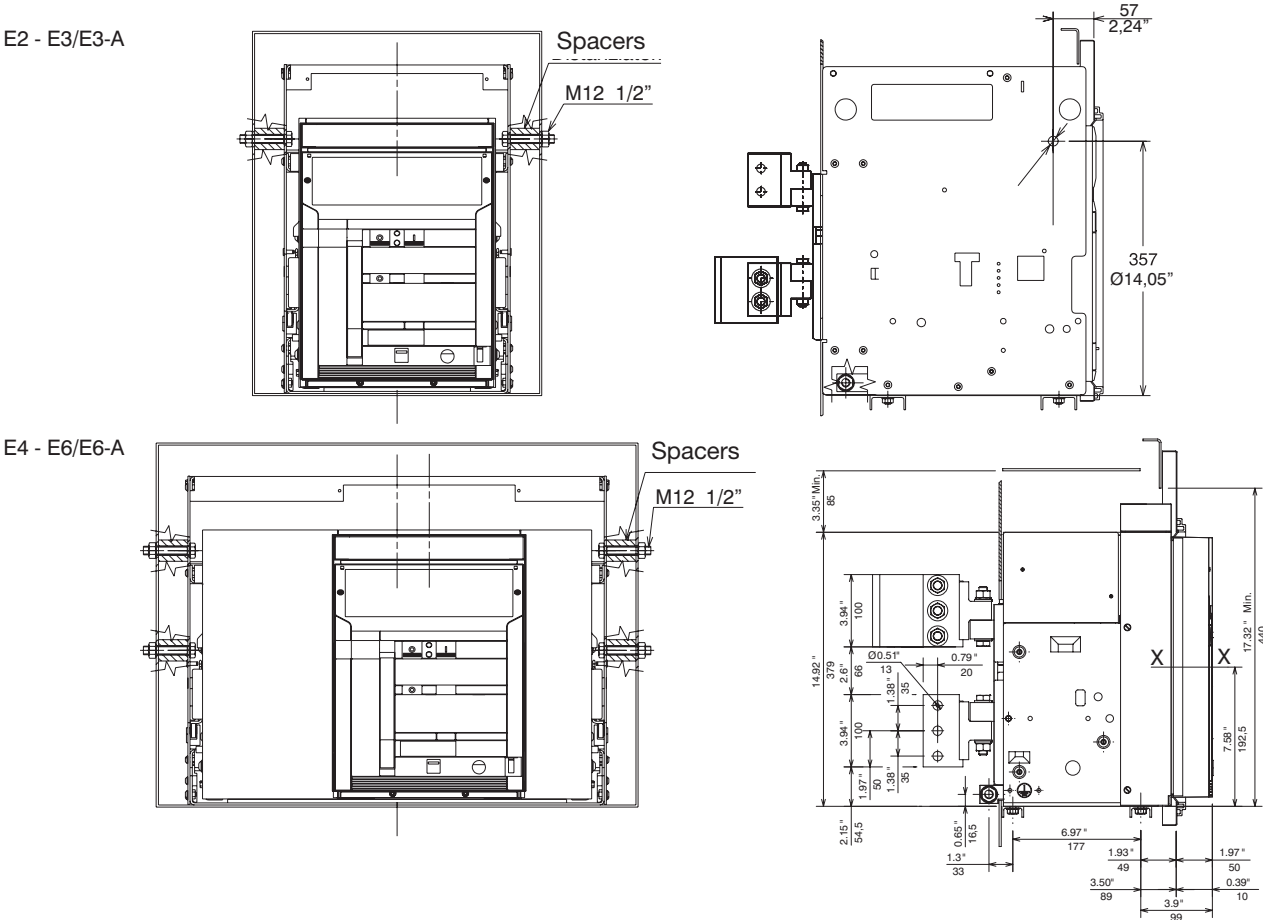
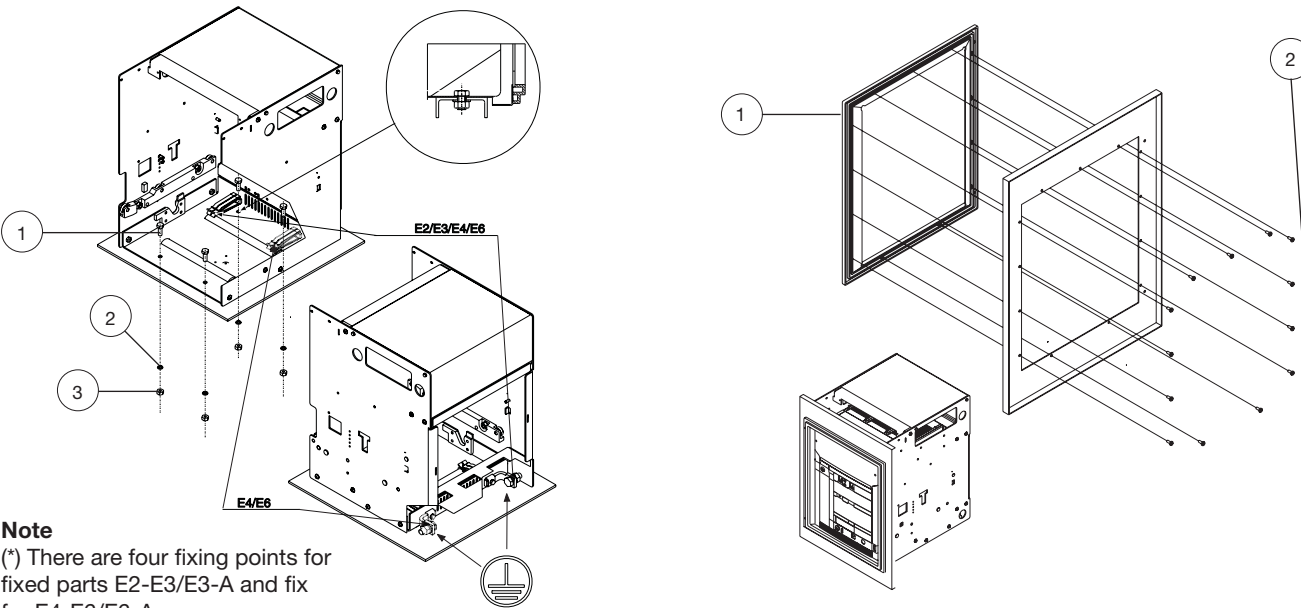


Fig. 11

4.4. Installation of the flange on the compartment door (Fig. 13)

- Drill the holes in the compartment door indicated in the section entitled "Overall dimensions".
- Apply the flange (1) to the front of the compartment door and fix it from the inside with the self-tapping screws (2).



Note

(\*) There are four fixing points for fixed parts E2-E3/E3-A and fix for E4-E6/E6-A.

Fig. 12

Fig. 13

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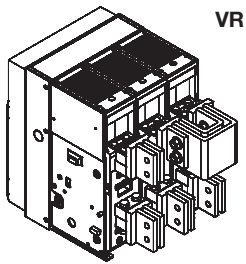
5. Electrical connections

5.1. Connections to the power circuit (for IEC60947-2 circuit-breakers)

Emax DC circuit-breakers are wired (default solution) for powering by the lower terminals (power supply from below). Using an extracode, the circuit-breaker can be ordered ready wired for powering by the upper terminals (power supply from above).

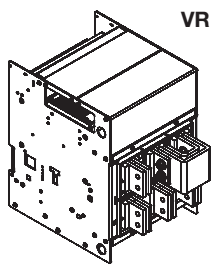
Fixed circuit-breaker

Fixed part for withdrawable circuit-breakers



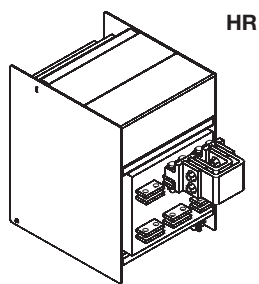
Vertical rear terminals  
Supply from below

Fig. 14 \_\_\_\_\_



Vertical rear terminals  
Supply from below

Fig. 15 \_\_\_\_\_

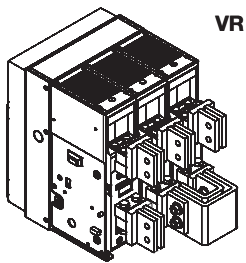


Rear horizontal terminals  
Supply from below

Fig. 15 b \_\_\_\_\_

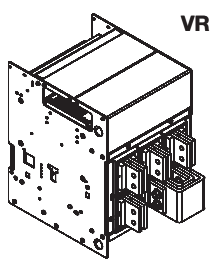
Fixed circuit-breaker

Fixed part for withdrawable circuit-breakers



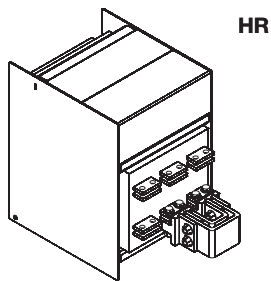
Vertical rear terminals  
Supply from above

Fig. 14 a \_\_\_\_\_



Vertical rear terminals  
Supply from above

Fig. 15 a \_\_\_\_\_



Rear horizontal terminals  
Supply from above

Fig. 15 c \_\_\_\_\_

Note

The drawings provide a schematic illustration of the type of terminal. The exact shape of the terminals is given in the chapter entitled "Overall dimensions".

5.1.1. 5Examples of connection busbar layouts depending on the types of terminals (for IEC 60947 circuit-breakers)

The busbars allow connections to be made between the terminals of the circuit-breaker and the busbars of the switchboard. They must

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be accurately sized by the switchboard design engineer.  
This section gives examples of constructions that can be created: it is normally advisable to use the entire contact surface of the terminal, thus the width of the busbar should be the same as that of the terminal.  
In certain cases, the width of the connection can be less than that of the terminal, as shown in the examples below.

Circuit-breaker	I <sub>u</sub> [A]	Vertical terminals			Horizontal and front terminals		
		Continuous capacity		Busbar cross-section [mm <sup>2</sup> ]	Continuous capacity		Busbar cross-section [mm <sup>2</sup> ]
		[A]	[A]		[A]	[A]	
		45°C	55°C		45°C	55°C	
E2B 800	800	800	800	1x(60x10)	800	800	1x(60x10)
E2B 1000	1000	1000	1000	1x(80x10)	1000	1000	1x(60x10)
E2B 1250	1250	1250	1250	1x(80x10)	1250	1250	1x(60x10)
E2B/N 1600	1600	1600	1600	2x(60x10)	1600	1600	2x(60x10)
E3N 800	800	800	800	1x(60x10)	800	800	1x(60x10)
E3N 1000	1000	1000	1000	1x(80x10)	1000	1000	1x(60x10)
E3N 1250	1250	1250	1250	1x(80x10)	1250	1250	1x(60x10)
E3N/H 1600	1600	1600	1600	2x(60x10)	1600	1600	1x(100x10)
E3N/H 2000	2000	2000	2000	3x(60x10)	2000	2000	2x(100x10)
E3N/H 2500	2500	2500	2500	2x(100x10)	2450	2400	2x(100x10)
E4S 1600	1600	1600	1600	2x(60x10)	1600	1600	1x(100x10)
E4S 2000	2000	2000	2000	3x(60x10)	2000	2000	2x(100x10)
E4S 2500	2500	2500	2500	3x(60x10)	2500	2500	2x(100x10)
E4S/H 3200	3200	3200	3200	3x(100x10)	3150	3000	3x(100x10)
E6H 3200	3200	3200	3200	3x(100x10)	3200	3200	3x(100x10)
E6H 4000	4000	4000	4000	4x(100x10)	4000	4000	4x(100x10)
E6H 5000	5000	5000	4600	6x(100x10)	4510	4250	6x(100x10)
Call ABB SACE for UL 1066 circuit-breakers							

Fig. 16

Position of the first anchoring plate of the busbars depending on the short-circuit current

Ancoraggio al quadro

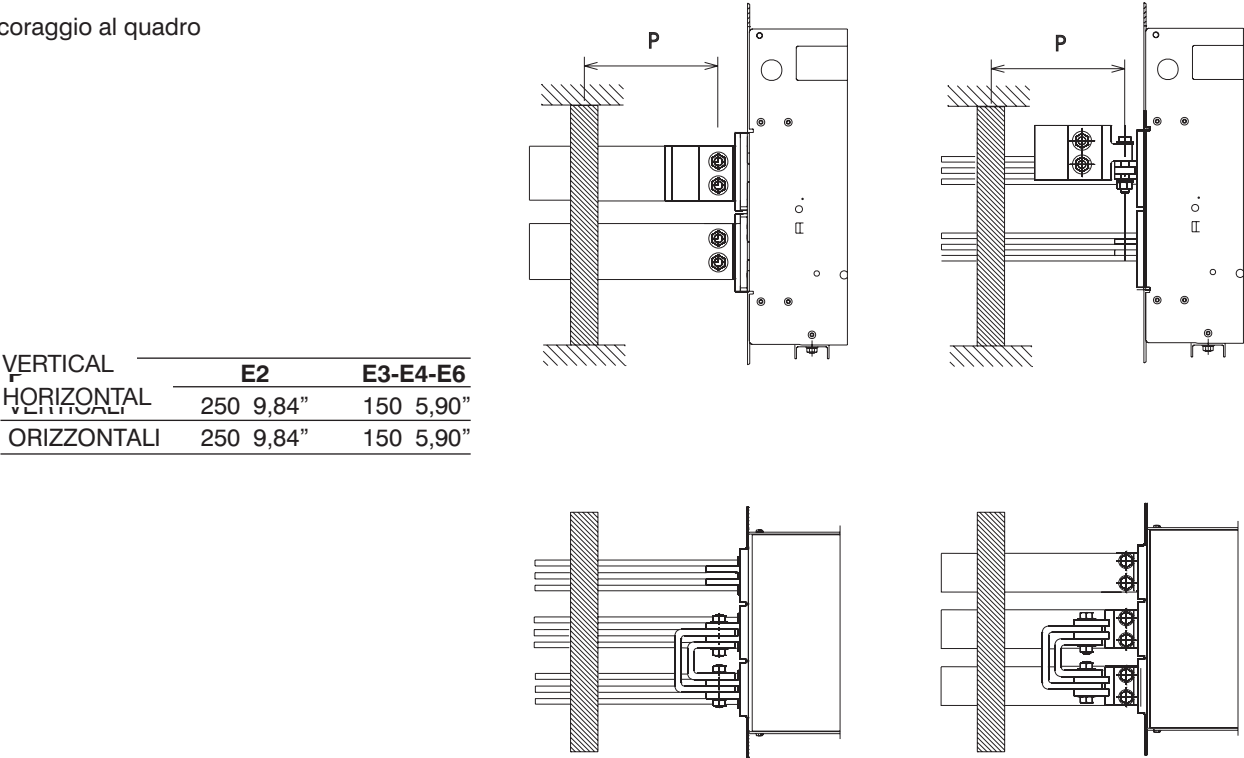


Fig. 17

5.2. Connections to the power circuit (for UL1066-ANSI C37.14 circuit-breakers)

Emax DC-ANSI circuit-breakers are wired for powering by the lower terminals (power supply from below).

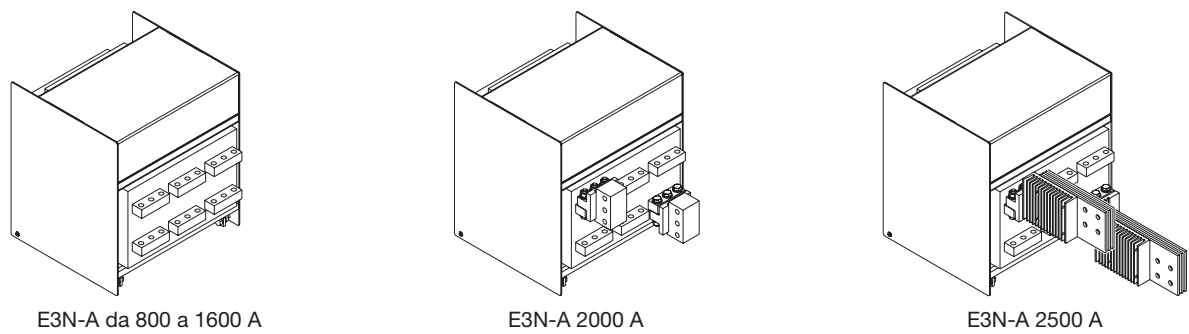


Fig. 18

**Note**  
The drawings provide a schematic illustration of the type of terminal. The exact shape of the terminals is given in the chapter entitled “Overall dimensions.”

**5.2.1. Examples of connection busbar applications depending on the types of terminals (for UL 1066 circuit-breakers)**

The busbars allow connections to be made between the terminals of the circuit-breaker and the busbars of the switchboard. They must be accurately sized by the switchboard design engineer. The following table lists a few examples in accordance with standard ANSI C37.14. Busbars with larger sections may be required for installations in switchboards.

Busbars for terminals						
Circuit-breaker frame size	Quantity	Size		Minimum length	Bar spacing	
A		in	mm	cm	in	mm
600/800	1	1/4 x 2	6.4 x 50.8	120	-	-
1200	1	1/4 x 4	6.4 x 102	120	-	-
1600	2	1/4 x 3	6.4 x 76.2	120	1/4	6,4
2000	2	1/4 x 4	6.4 x 102	120	1/4	6,4
2500	2	1/4 x 5	6.4 x 127	120	1/4	6,4
3000	3	1/4 x 4	6.4 x 102	120	1/4	6,4
4000	4	1/4 x 4	6.4 x 102	120	1/4	6,4
5000	4	1/4 x 5	6.4 x 127	120	1/4	6,4
6000	4	1/4 x 6	6.4 x 152	120	1/4	6,4

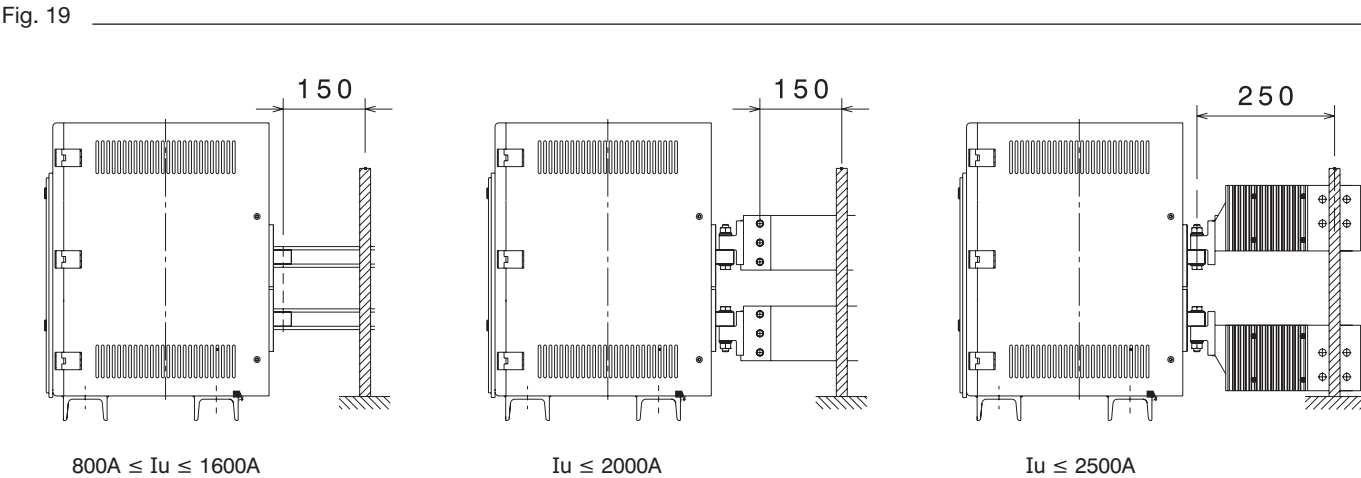


Fig. 20



5.2.2. Assembly procedure for the connection busbars

Check the state of the contact surfaces of the connections very carefully: they must be very clean and free from burrs, dents and traces of rust - which must be removed with a fine file or emery cloth to prevent localized increases in temperature. On completion of the operation, remove any traces of grease or dust with a cloth soaked in a suitable solvent.  
When aluminium connections are used, the contact surfaces must be tin-plated.  
Make sure that the connections are unable to exert any strain on the terminals in any direction.  
Always insert a flat washer with a large diameter (to distribute the tightening pressure over the widest possible area) and a spring washer.  
Establish contact between the connection and terminal and fully tighten the fixing screws.  
Always use two wrenches (to prevent the insulating parts from being unduly stressed) and apply the tightening torque indicated in Fig. 21. Check tightness after 24 hours.

High strength M12 1/2" screws  
Tightening torque of the main terminals 70 Nm/620Lb in.

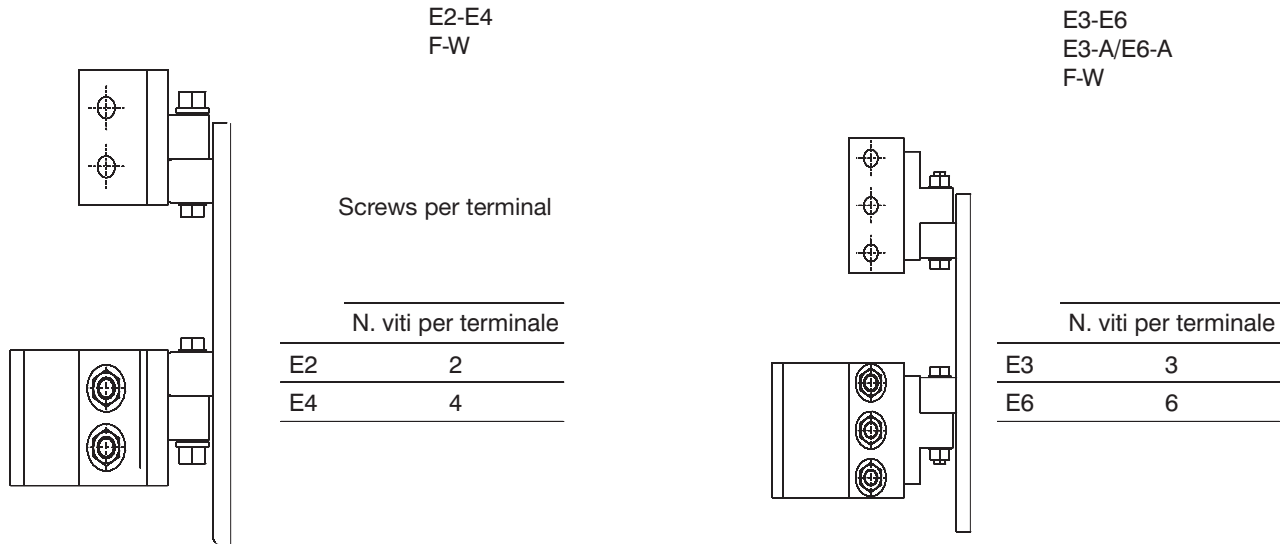


Fig. 21

5.3. Earthing

The fixed version circuit-breaker and the fixed part of the withdrawable circuit-breaker have one or two terminals on the rear, marked with the relative symbol, for the earth connection (Fig. 9 and Fig. 12b).  
Each terminals is complete with a bolt for fixing the connection.  
A conductor with a cross-section that complies with the Standards in force must be used for the connection.  
Clean and grease the area around the screw before making the connection.  
After assembly, tighten the bolt to a 70 Nm/620 lb in torque value.

5.4. Wiring of the auxiliary circuits of the circuit-breaker

5.4.1. Interface elements for fixed circuit-breakers

There is a special terminal board fitted with screw terminals for connecting the auxiliary circuits.  
The terminals are marked with alphanumerical identification codes as indicated in the electrical circuit diagram.  
The terminal board is identified by the letters XV on the electrical circuit diagram.  
The terminal board is accessed immediately when the compartment door is opened.

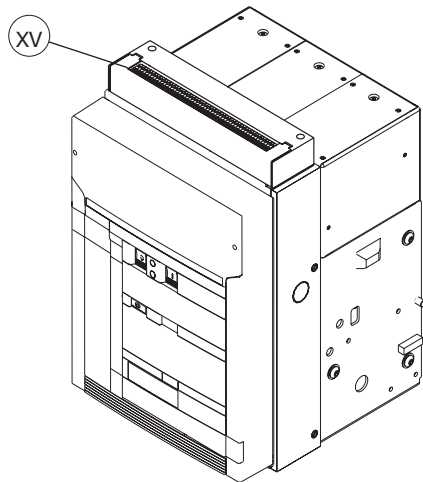


Fig. 22

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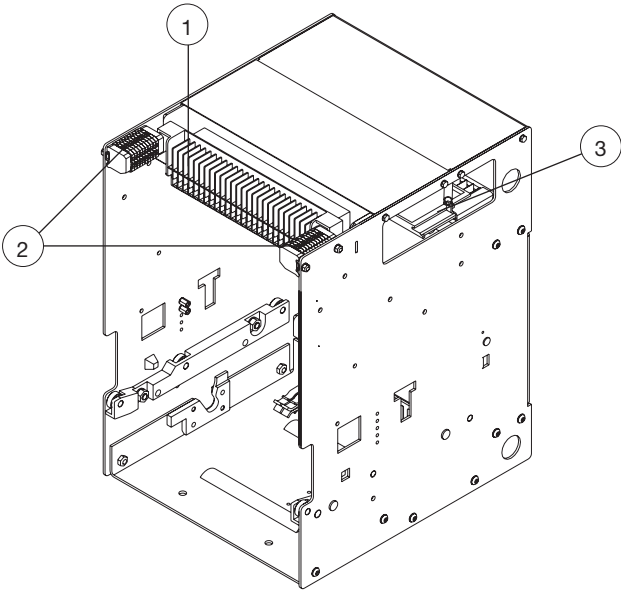
5.4.2. Withdrawable circuit-breaker

A connector with sliding contacts (see figure), identified by the letter X on the electrical circuit diagram, is available for connection of the moving part to the auxiliary circuits.

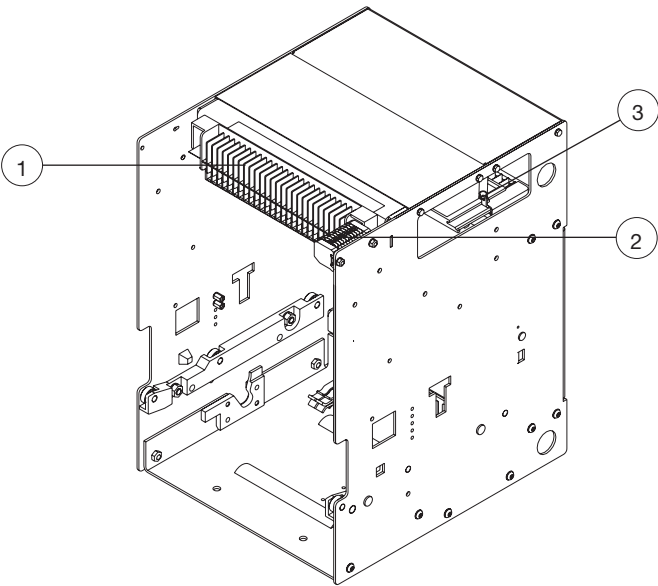
The connector terminals are accessed immediately when the compartment door is opened.

Moreover, a terminal , identified by the letters XF, is available for connection of the position contacts of the moving part in relation to the fixed part.

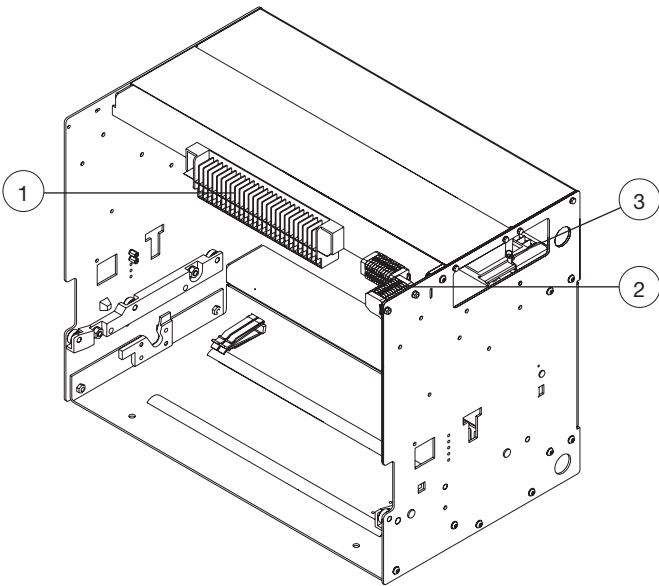
Both the connector and terminal box have screw terminals.



E2 - E3/E3-A  
10 contacts in position



E2 - E3/E3-A - E4 - E6/E6-A  
5 contacts in position



E4 - E6/E6-A  
10 contacts in position

- Key**
- 1 Sliding contacts (X)
  - 2 Terminal box for position contacts (XF)
  - 3 Position contacts

Fig. 23

Mod.	B2342			Apparatus	Emax DC	Scale
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5.5. Conversion of the auxiliary contacts or signalling contacts (disconnected - test isolated - connected) from normally closed (opening) to normally open (closing) or vice versa

The contacts are wired in the factory, as shown on the electric circuit diagram. If their state must be modified owing to installation requirements, proceed as follows.

**a) Auxiliary contacts**

Access the auxiliary contacts in the following way:

- remove the front protection (3) of the release by operating the locks (1) as shown in the figure
- remove the protection release (4) by removing the side nuts (2) and sliding it out from the front of the circuit-breaker.

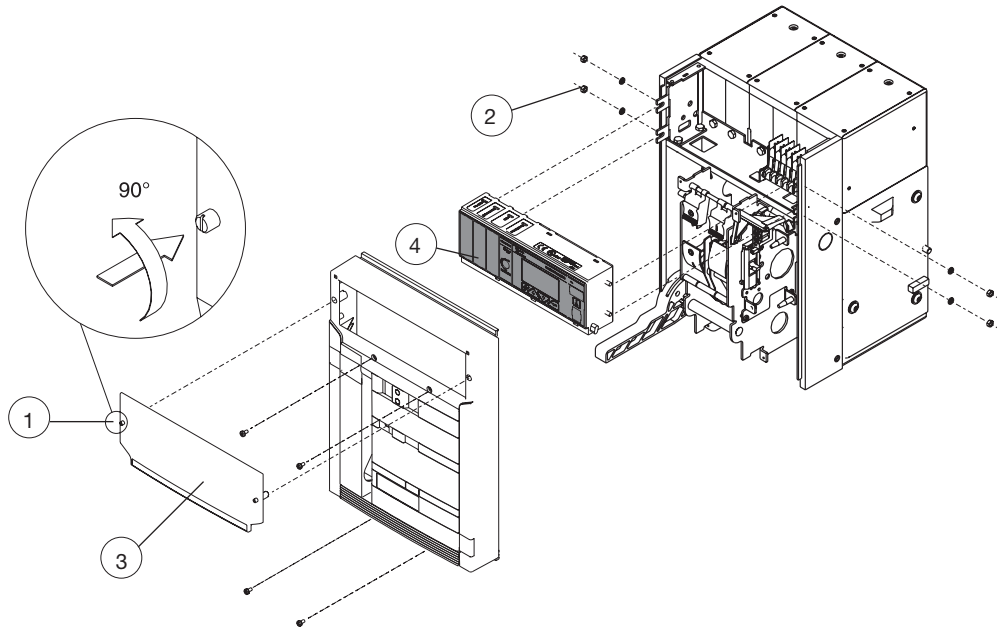


Fig. 24

Since they are the two-way type (change-over contacts), the auxiliary contacts can be changed 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 (example for PR122).

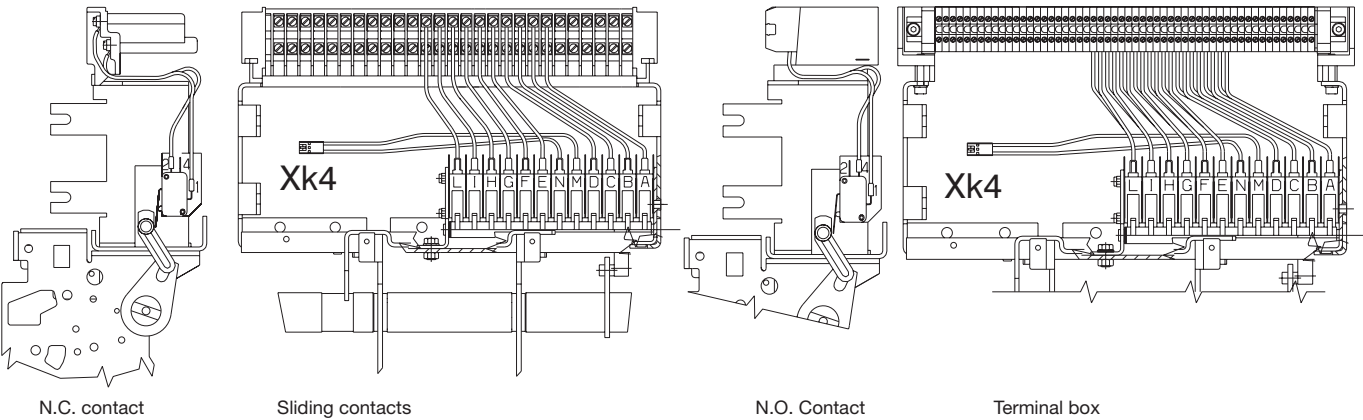
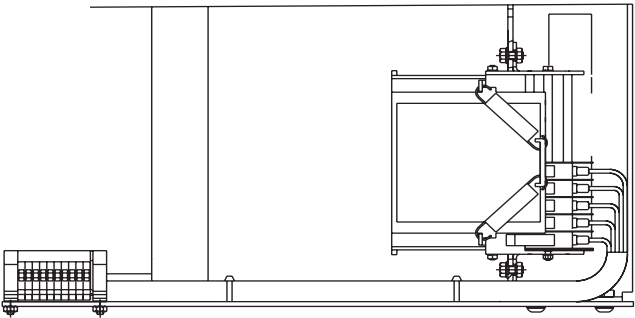


Fig. 25

**b) Disconnected - test isolated - connected signalling contacts**

Proceed as indicated for the auxiliary contacts to change the state of the position contact.



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## 6. Putting into service

### 6.1. General procedures

- Make sure that the power connections to the circuit-breaker terminals are tight
- Perform all the preparatory operations on the release
- Make sure that the power supply voltage of the auxiliary circuits is between 85% and 110% of the rated voltage of the electrical applications
- To avoid temperature rises, make sure that there is sufficient air exchange in the installation area
- Also perform the inspections indicated in the following table.

Item inspected	Procedure	Successful check
1 Manual operating mechanism	Perform a few opening and closing operations (see chap. 7.2). <b>WARNING</b> <b>When there is an undervoltage release, the circuit-breaker can only be closed after the release itself has been electrically energized.</b>	The spring loading lever moves normally.
2 Gearmotor (if provided)	Supply the spring loading gearmotor at the relative rated voltage.  Perform a few closing and opening operations. Note. Supply the undervoltage release at the relative rated voltage (if provided).	The springs are loaded normally. The signals are normal. The gearmotor stops when the springs have been loaded.  The gearmotor reloads the springs after each closing operation.
3 Undervoltage release (if provided)	Supply the undervoltage release at the relative rated voltage and perform the circuit-breaker closing operation.  Turn off the voltage supply to the release. Supply the undervoltage release at the relative rated voltage and perform the circuit-breaker closing operation.	The circuit-breaker closes normally. The signals are normal.  The circuit-breaker opens. The signal changes over.
4 Shunt opening release (if provided)	Close the circuit-breaker. Supply the shunt opening release at the relative rated voltage.	The circuit-breaker opens normally. The signals are normal.
5 Shunt closing release (if provided).	Open the circuit-breaker. Load the springs. Power the shunt closing release at its rated voltage.	The circuit-breaker closes normally. The signals are normal.
6 Lock for circuit-breaker in open position (key or padlock)	Open the circuit-breaker, turn the key and remove it. Attempt the circuit-breaker closing operation.	Both manual and electrical closing are prevented.
7 Auxiliary circuit-breaker contacts	Insert the auxiliary contacts into appropriate signalling circuits. Perform a few circuit-breaker closing and opening operations.	Signalling occurs normally.
8 Circuit-breaker connected, isolated for test, disconnected auxiliary contacts	Insert the auxiliary contacts into appropriate signalling circuits, then put the circuit-breaker in the connected, isolated for test, disconnected position.	The signals for the relative operations are normal.
9 Locking devices for circuit-breaker connected and disconnected; interlocking devices between circuit-breakers side by side and on top of each other (if applicable)	Perform operating tests.	The locks function correctly.
10 For withdrawable circuit-breakers: racking-in and racking-out device	Perform a few racking-in and racking-out operations.	Racking-in operation: the circuit-breaker is racked-in normally. There is no particular resistance during the first turns of the handle.



**WARNING:** When the undervoltage release trips owing to an event, the circuit-breaker can only be closed after the relay has been powered. Make sure that low voltage is present. If this is not the case, check that the circuit-breaker and relative accessories are functioning properly. If the application is in a critical condition, investigate immediately to identify the causes.

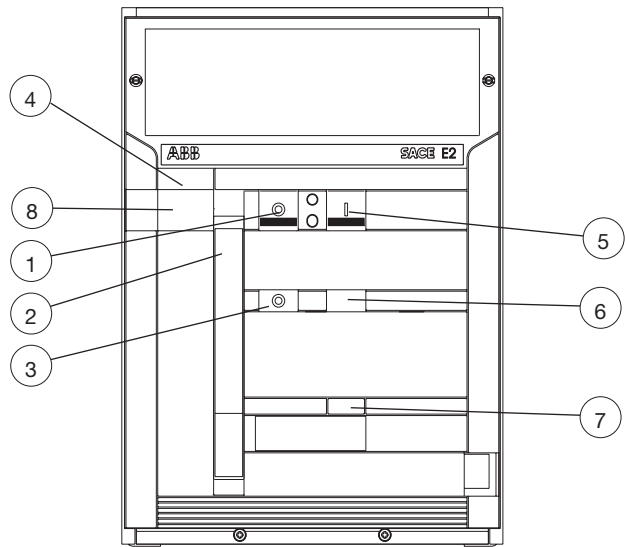
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7. Instructions for use

7.1. Operating and signalling parts

- 1 Push-button 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 (to order)
- 5 Pushbutton for the manual closing operation
- 6 Indicator for springs loaded - unloaded
- 7 Operation counter (to order)
- 8 Key lock on the closing operation
- 9 Mechanical indicator for circuit-breaker connected, isolated - test connected, disconnected
- 10 Seat for the racking-in - racking-out lever
- 11 Racking-in/racking-out operation release lever
- 12 Key lock on the racking-in/racking-out operation (to order)
- 13 Padlock on the manual closing operation (to order)
- 14 Padlock on the racking-in/racking-out operation (to order)

Fixed circuit-breaker



Withdrawable circuit-breaker

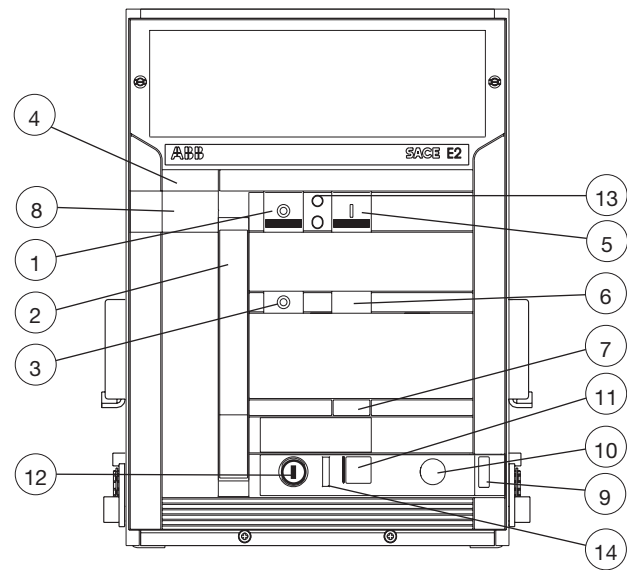


Fig. 26

**Note**

On request, a transparent cover that increases the degree of protection to IP54 can be installed on the front of the circuit-breaker. The cover is equipped with a key lock.  
As an alternative to the transparent cover, a protection can be installed on the manual opening and closing controls so that the push-buttons can only be operated with a tool.

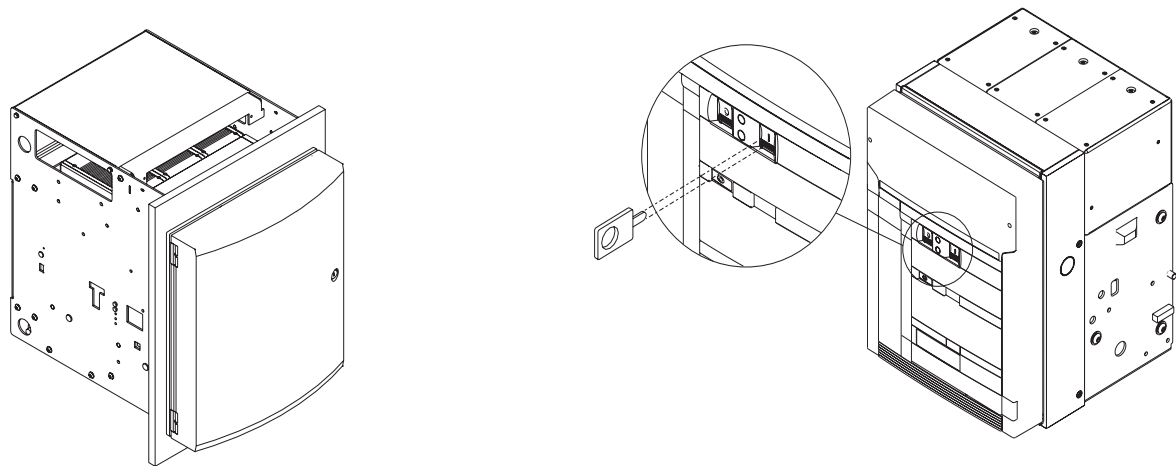


Fig. 27

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7.2. Circuit-breaker closing and opening operations

Circuit-breaker operation can be either manual or electrical.

a) Manual operation for loading the closing springs

- Make sure that “O” (circuit-breaker open) is displayed by the indicator
- Make sure that the indicator (6) is WHITE (springs unloaded)
- Repeatedly operate the lever (2) until the colour of the indicator (6) changes to YELLOW

b) Electrical operation for loading the closing springs

Electrica operation of the circuit-breaker is possible when the following accessories are present (supplied to order):

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

The gearmotor automatically reloads the springs after each closing operation until the yellow indicator appears (6, Fig. 28). If there is a power failure during the loading operation, the gearmotor stops and automatically continues with the spring loading operation once the power returns. However, it is always possible to complete the reloading operation in the manual mode.

c) Circuit-breaker closing

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

Press the push-button (5) marked with the letter “I” for closing in the manual mode. When there is a shunt closing release, the operation can also be carried out in the remote mode by means of the special control circuit. Closing is signalled by the relative indicator (3), which moves to the “I” position. Moreover, the indicator of the state of the springs (6) moves to the WHITE position. The control has enough energy for the opening operation even when the closing springs are unloaded. If present, the gearmotor immediately begins the automatic spring loading operation.

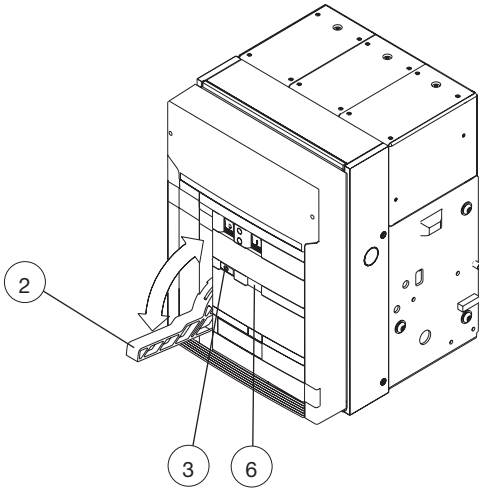


Fig. 28

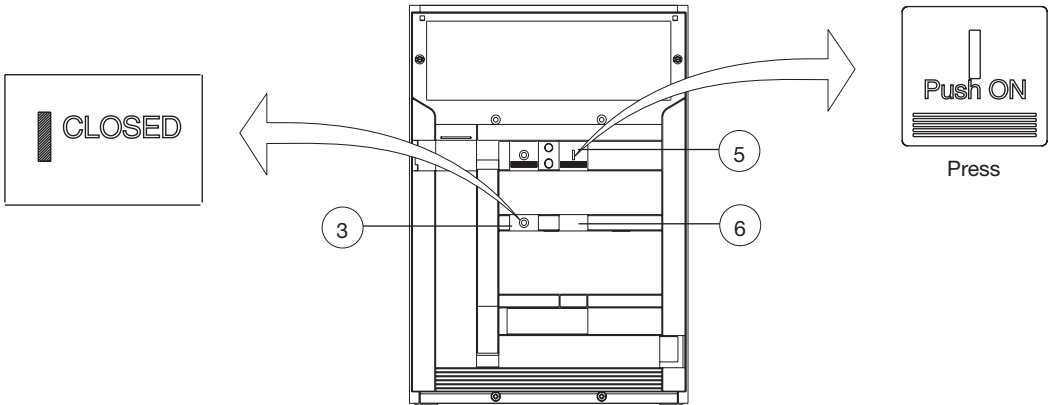


Fig. 29

d) Circuit-breaker opening

Press the push-button “O” (1) to open the circuit-breaker in the manual mode. When there is a shunt opening release, the operation can also be carried out in the remote mode by means of the special control circuit. The open state is signalled by the appearance of the letter “O” in the indicator (3).

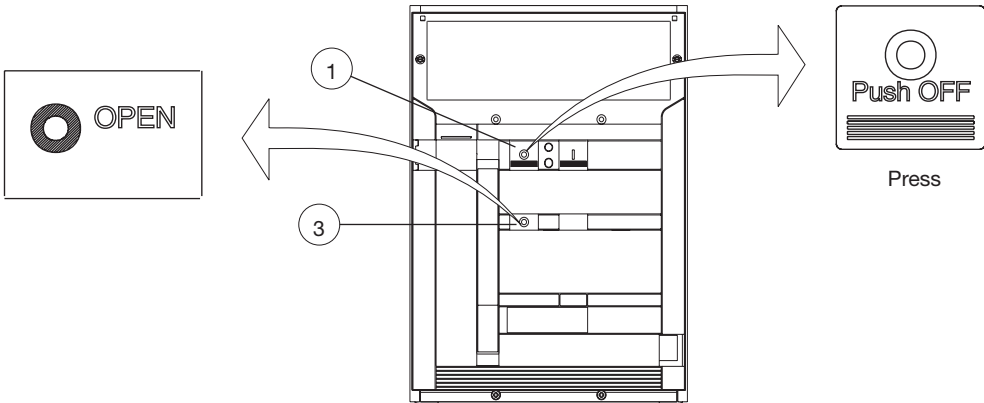



Fig. 30

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7.3. Racking-in/out operations

CAUTION

- A) Open the circuit-breaker before performing any racking-in or racking-out operation.
- B) The circuit-breaker (moving part) and fixed part are equipped with a lock which prevents insertion into the fixed part of circuit-breakers with different rated current values: to avoid unnecessary stress, the operator must check to make sure that the anti-racking-in lock is compatible before performing the racking-in operation.
- C) Remove any padlocks from the segregation shutters of the isolating terminals on the fixed part before proceeding with the racking-in operation.

 **WARNING RISK OF ELECTRIC SHOCK: Make sure that the circuit-breaker has been disconnected from all the power sources before performing any racking-in or racking-out operation.**

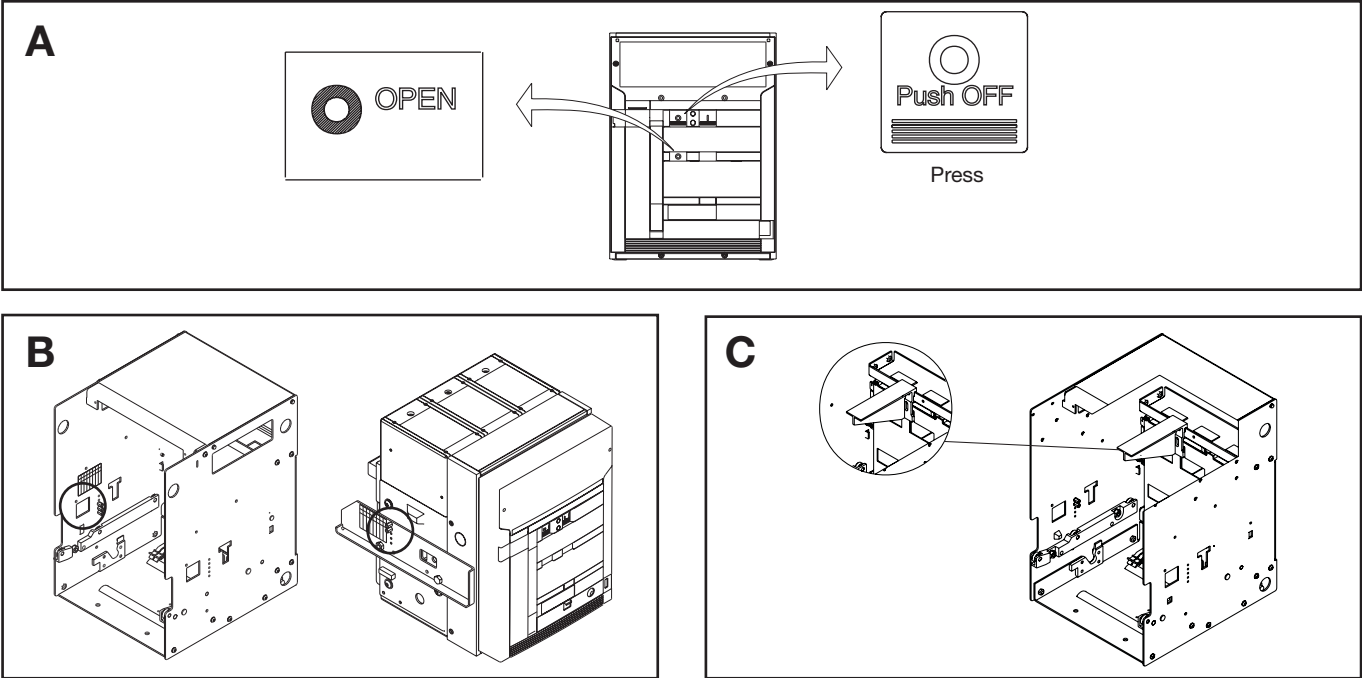


Fig. 31

NOTE

As indicated below, the circuit-breaker (moving part) can set to different positions in relation to the fixed part:

- **DISCONNECTED:** the moving part is connected in the fixed part **WITHOUT** any connection between the power terminals and **WITHOUT** coupling the sliding contacts for the auxiliary circuits: all circuit-breaker electrical operations are prevented in this position. On the front, the indicator (9, Fig. 26) indicates **DISCONNECTED**; the switchboard compartment door can be closed.
- **TEST ISOLATED:** the moving part is racked into the fixed part **WITHOUT** 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 no-load tests. The indicator (9, Fig. 26) indicates **TEST ISOLATED**.
- **CONNECTED:** the moving part is completely racked into the fixed part **WITH** connection of both the power terminals and the sliding contacts for the auxiliary circuits. The circuit-breaker is in operating conditions. The indicator (9, Fig. 23) indicates **CONNECTED**.

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

Lift the moving part as shown in section (3) and fit it into the guides of the fixed part, tilting it as shown in figure 32.

The manual connection operation must allow the edge (E) of the circuit-breaker guides to slide under the small blocks (D) of the fixed part. Remove the lifting devices.

Push the moving part as far as it will go until it comes to a stop in the fixed part.

Close the compartment door.

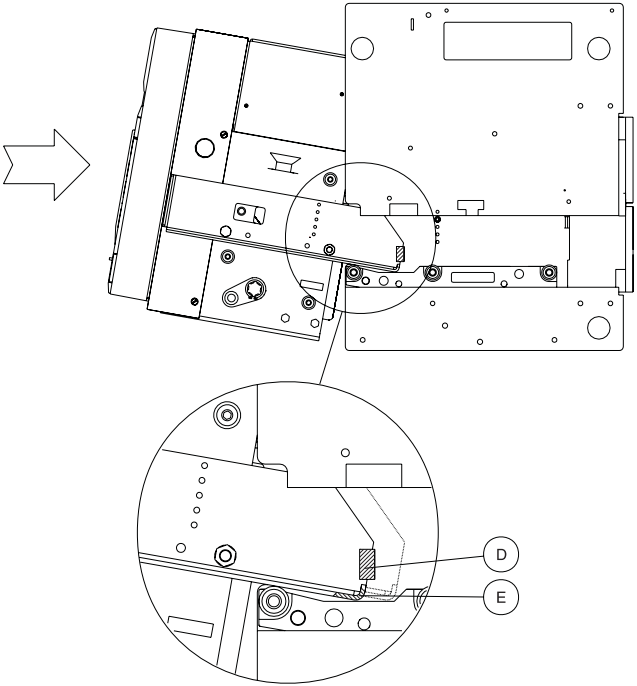


Fig. 32

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**b) Passing from the DISCONNECTED position 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 lock (12) is in the correct position and/or that the padlock (14) has been removed (if applicable).
- Make sure that the circuit-breaker is open.
- Push the moving part as far as it will go into the fixed part.
- Lower the release lever (11).
- Insert the handle into its coupling (10).
- Turn the handle clockwise until the TEST ISOLATED indication appears on the indicator (9). The handle must not encounter any particular resistance to rotation during the first few turns.
- The handle must be removed if no-load operations must be performed with the circuit-breaker.

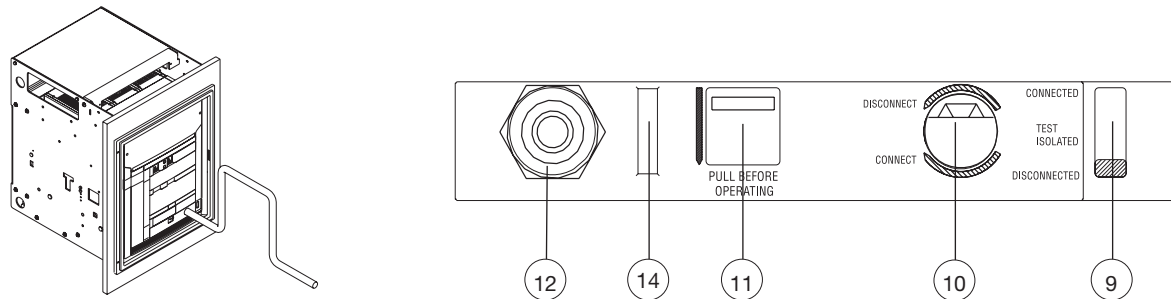


Fig. 33

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

- Make sure that the circuit-breaker is open.
- Lower the release lever (11).
- Insert the handle into its coupling (10).
- Turn the handle clockwise until the CONNECTED indication appears on the indicator (9).
- Remove the handle in order to close the circuit-breaker.

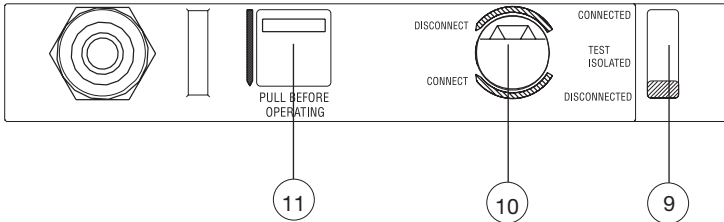


Fig. 34

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

- Repeat the connection procedures, but turn the handle in the anti-clockwise direction. Open the door in the disconnected position.

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## 8. Maintenance

### 8.1. Recommendations



**WARNING:** before proceeding with any maintenance operation, it is obligatory to:

- open the circuit-breaker and make sure that the springs of the operating mechanism are unloaded;
- if the circuit-breaker is the plug-in type, work with it withdrawn from the fixed part (Fig. 41);
- if work must be performed on fixed circuit-breakers or on fixed parts, disconnect the power supply to the power circuit and auxiliary circuits and visibly earth the terminals on both the supply side and load side;
- Set the equipment to safe conditions as established by the standards and laws in force.



**WARNING RISK OF ELECTRIC SHOCK:** Risk of electric shock or accident.

ABB declines all liability for damage to persons or property caused by failure to comply with the instructions in this document. The maintenance operations must be performed by skilled personnel with detailed knowledge of the equipment.

### 8.2. Maintenance program

#### 8.2.1. Circuit-breaker life (IEC 60947)

When regular maintenance is performed, SACE Emax circuit-breakers - with or without shunt opening or shunt closing devices - can withstand the following operating cycles without replacement of parts. <sup>(1)</sup>

Rated uninterrupted current		Mechanical life <sup>(2)</sup>		Electrical life <sup>(2)</sup>			
I <sub>u</sub> (40 °C) [A]		N° of operations x 1000	Frequency operations/ hour	500 V ~ N° of operations x 1000	750 V ~ N° of operations x 1000	1000 V ~ N° of operations x 1000	Frequency operations/ hour
E2 B	800	25	60	15	15	15	30
E2 B	1000-1250	25	60	15	15	15	30
E2 B-N	1600	25	60	10	10	10	30
E3 N	800	20	60	12	12	12	20
E3 N	1000-1250	20	60	12	12	12	20
E3 N-H	1600	20	60	10	10	10	20
E3 N-H	2000	20	60	9	9	9	20
E3 N-H	2500	20	60	7	7	7	20
E4 S	1600	15	60	7	7	7	20
E4 S	2000	15	60	7	7	7	20
E4 S	2500	15	60	7	7	7	20
E4 S-H	3200	15	60	7	7	7	20
E6 H	3200	12	60	5	5	5	10
E6 H	4000	12	60	4	4	4	10
E6 H	5000	12	60	2	2	2	10

<sup>(1)</sup> These data refer to the standard installation in accordance with the product standards. Ask ABB Sace if different applications are involved.

<sup>(2)</sup> Extreme weather conditions, polluted atmosphere or vibrations can reduce the life of the application. Ask ABB Sace.

#### 8.2.2. Circuit-breaker life (UL1066)

When regular maintenance is performed, SACE Emax circuit-breakers - with or without shunt opening or shunt closing devices - can withstand the following operating cycles without replacement of parts. <sup>(1)</sup>

Rated uninterrupted current		Mechanical life <sup>(2)</sup>		Electrical life <sup>(2)</sup>	
I <sub>u</sub> (40 °C) [A]		N° of operations x 1000	Frequency operations/hour	600 V ~ N° of operations x 1000	Frequency operations/hour
E3 N-A	800	20	60	12	20
E3 N-A	1000-1200	20	60	12	20
E3 N-A	1600	20	60	10	20
E3 N-A	2000	20	60	9	20
E3 N-A	2500	20	60	7	20
E6 H-A	4000	12	60	4	10
E6 H-A	5000	12	60	2	10

<sup>(1)</sup> These data refer to the standard installation in accordance with the product standards. Ask ABB Sace if different applications are involved.

<sup>(2)</sup> Extreme weather conditions, polluted atmosphere or vibrations can reduce the life of the application. Ask ABB Sace.

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### 8.2.3. Maintenance program

We hereby include the table indicating the frequency with which maintenance should be carried out and the relative routine maintenance operations required.

Compliance with the following rules is also recommended:

- Even circuit-breakers that are operated infrequently or that remain closed or open for long periods of time must be subjected to programmed maintenance.
- SACE PR122/DC and SACE PR123/DC releases with Vaux allow the number of operations performed by the circuit-breaker to be shown on the relative display.
- During service, visually inspect the circuit-breaker from the outside to make sure there is no dust, dirt or damage of any kind.

Maintenance operations	Intervals	
	Installations in normal places	Installations in dusty or polluted places <sup>(1)</sup> / <sup>(2)</sup> [ (1) = level of dust measured > 1 mg/m <sup>3</sup> ]
First Level	One year, or 20% of mechanical life, or 20% of electrical life	6 months, or 10% of mechanical life, or 10% of electrical life
Second Level	Three years, or 50% of mechanical life, or 50% of electrical life, or after a trip under short-circuit	18 months, or 25% of mechanical life, or 25% of electrical life, or after a trip under short-circuit

<sup>(1)</sup> These data refer to the standard installation in accordance with the product standards. Ask ABB Sace if different applications are involved.

<sup>(2)</sup> Extreme weather conditions, polluted atmosphere or vibrations can reduce the life of the application. Ask ABB Sace.

### 8.3. First Level maintenance operations

#### 8.3.1. Preliminary operations:

- open the circuit-breaker and make sure that the springs of the operating mechanism are unloaded.
- if the circuit-breaker is the plug-in type, work with it withdrawn from the fixed part (Fig. 41).



**WARNING: if work must be performed on fixed circuit-breakers or on fixed parts, disconnect the power supply to the power circuit and auxiliary circuits and visibly earth the terminals on both the supply side and load side.**

#### 8.3.2. Inspections and general cleaning:

- Remove any excess oil or grease with a clean, dry cloth (use a mild detergent if necessary - A cleaning product such as Henkel's 273471 or equivalent can be used if there is a heavy coating of dirt).
- Make sure that the rating plates with the technical specifications of the apparatus are affixed.
- The rating plates must be cleaned with a clean, dry cloth.
- Remove all traces of dust, mould, condensation and tarnish from both the outside and inside of the fixed part of the apparatus, if the circuit-breaker is the withdrawable type.
- Make sure that there are no foreign bodies in the circuit-breaker compartment.

#### 8.3.3. Circuit-breaker connections and connections between circuit-breaker and switchboard

- Remove any dust and dirt with a brush and dry cloth - use a mild cleaning product if necessary. A cleaning products such as Henkel's 273471 or equivalent can be used if there is a heavy coating of dirt.
- Make sure that there are no traces of localized overheating on the terminals. This problem is denoted by the change in the colour of the parts in contact. These parts are usually silvery in colour.
- Make sure that the bolts of the terminal connections are well tightened (M12 - 70 Nm / 620 lb in.).



**WARNING: if work must be performed on fixed circuit-breakers or on fixed parts, disconnect the power supply to the power circuit and auxiliary circuits and visibly earth the terminals on both the supply side and load side.**

- Make sure that the cable connecting screws are well tightened in the terminal boxes (0.7 Nm / 6.2 lb in.).

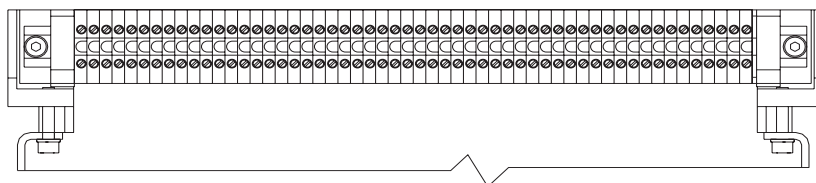


Fig. 35

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8.3.4. Flange and escutcheon plate disassembly operations

- Remove the flange (1) of the release by turning the screws (2) as shown in figure 33.
- Remove the front escutcheon plate (3) by removing the four screws (4).

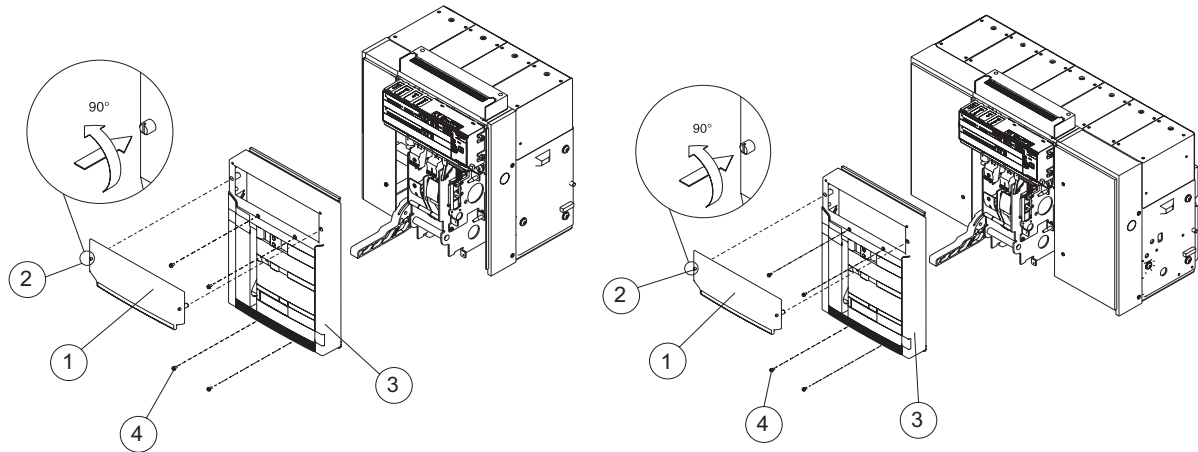


Fig. 36

- If the undervoltage release is installed, disassemble the coil support and unload the springs of the operating mechanism by closing and opening the circuit-breaker.

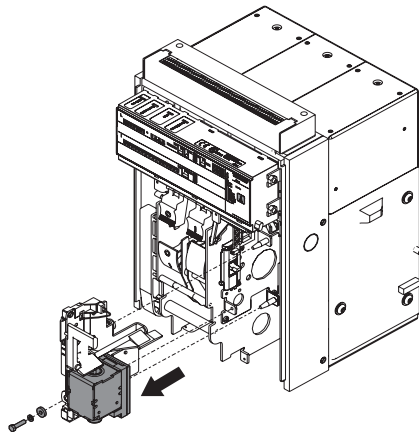


Fig. 37

8.3.5. Mechanical operating mechanism

- Clean the points indicated in figure 38. Use a cleaning product such as Henkel's 273471 or equivalent if there is a heavy coating of dirt.
- Lubricate the opening and closing latches and the shafts in the points indicated in figure 38 with MOBILGREASE 28 (EXXON MOBIL).
- Make sure that the opening and closing shafts are free to turn.

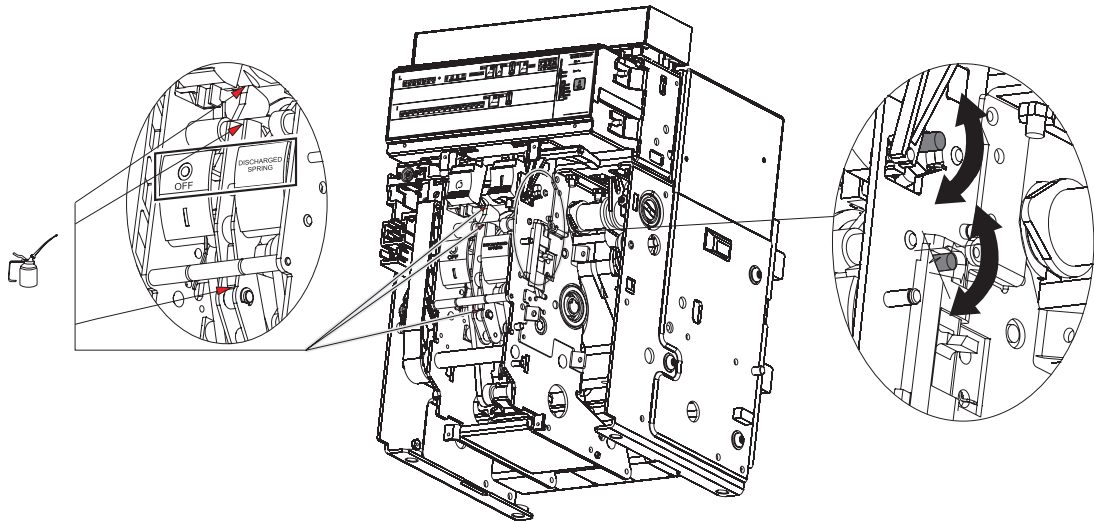


Fig. 38

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8.3.6. Electrical and mechanical accessories

- Make sure that the accessories are securely fixed to the circuit-breaker.
- Make sure that the electrical accessories are correctly connected to the circuit-breaker.
- Gearmotor: after every 10000 operations, check the brushes for wear and replace the gearmotor if necessary.
- Make sure that the releases (SOR-UVR-SRC) are in good conditions (absence of excessive wear, overheating, breakages) Fig. 39.
- Make sure that the mechanical operation counter functions correctly (if applicable) by operating the circuit-breaker.

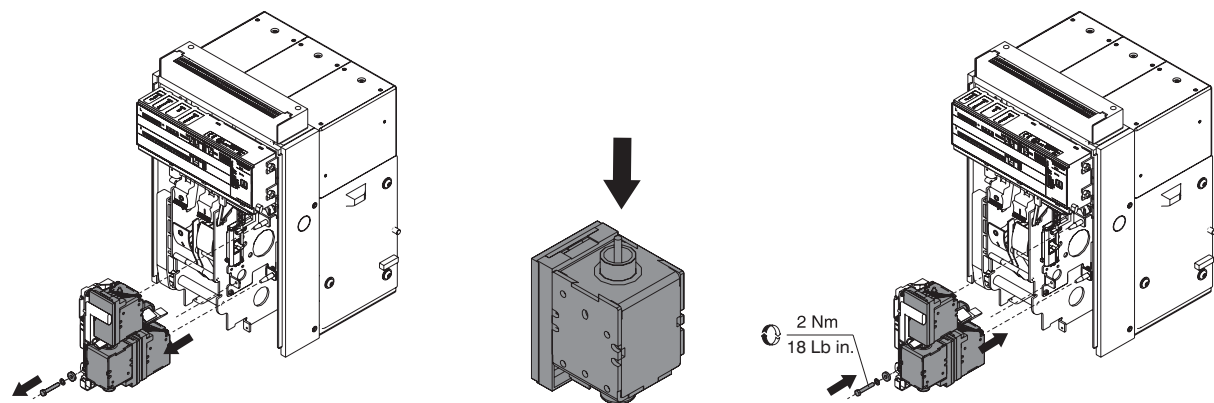


Fig. 39

8.3.7. Protection releases

- Power the protection release with a PR030/B Ultra battery unit.
- Make sure that the protection release functions correctly: release test with the “Trip Test” and “Autotest”
- Make sure that the front leds or display do not indicate the presence of alarms.
- Make sure that the cables are correctly connected to the release modules and to the release itself (if applicable).
- Check the percentage of wear on the circuit-breaker contacts.
- Remove the PR030/B Ultra battery unit from the relay upon termination.

8.3.8. Test with EKIP CONNECT (optional)

- Connect unit BT030 USB or BT030 USB Flash Drive to the relay that needs to be tested.
- Run the EKIP CONNECT program in a PC equipped with Bluetooth or Flash Drive connection, depending on the version of the BT030 USB used.
- Once the connection between the relay and PC has been established, make sure that there are no alarm signals from the relay. If this is the case, consult the ‘error messages’ and/or ‘troubleshooting’ sections of this manual.
- In normal operating conditions, proceed with the trip test and autotest (depending on the type of relay). For future check-outs, you are advised to enter the current information in the area called User Data and/or Tag Name. These data will remain stored in the relay itself.
- Remove the BT030 USB or BT030 USB flash drive from the relay.

8.3.9. Maintenance operations; final inspections

- Fit all the parts back in place and re-connect the auxiliary power supply if necessary.
- Re-assemble the escutcheon plate as shown in figure 37.

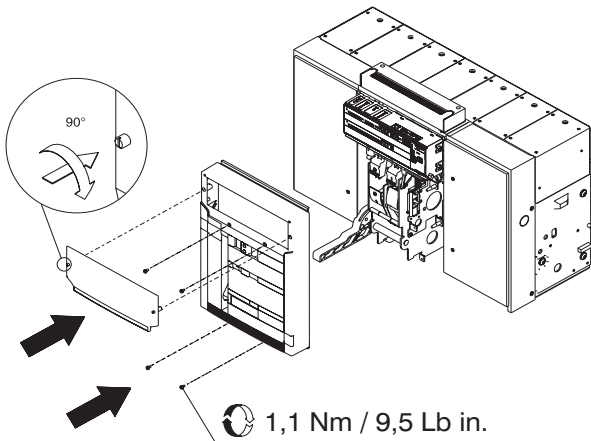


Fig. 40

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- Set the moving part back to the TEST-ISOLATED position.
- Using the different auxiliaries in succession, perform the operations 10 times:
  - Opening (in both the local and remote modes, if applicable)
  - Closing (in both the local and remote modes, if applicable)
  - Release by means of the trip test via relay
- Check the operations in accordance with the following sequence:
  - Open - Springs unloaded
  - Open - Springs loaded
  - Closed - Springs unloaded
  - Closed - Springs loaded
- Make sure that the accessories (if installed) function correctly
- Make sure that the gearmotor (if installed) functions correctly
- Make sure that the undervoltage release functions correctly (if installed)
- Make sure that the shunt opening release functions correctly (if installed)
- Make sure that the shunt closing release functions correctly (if installed)
- Make sure that the circuit-breaker's auxiliary contacts function correctly (if installed)
- Make sure that the lock for circuit-breaker in open position (key or padlock) functions correctly (if installed)

### 8.3.10. Interlocks

- Make sure that the interlocks between circuit-breakers side by side and on top of each other (if applicable) have been correctly installed and function correctly. The functionality test cannot be performed in the Test or Disconnected positions.

## 8.4. Second Level maintenance operations

### 8.4.1. Preliminary operations:

- open the circuit-breaker and make sure that the springs of the operating mechanism are discharged.
- if the circuit-breaker is the plug-in type, work with it withdrawn from the fixed part (Fig. 41)



**WARNING: if work must be performed on fixed circuit-breakers or on fixed parts, disconnect the power supply to the power circuit and auxiliary circuits and visibly earth the terminals on both the supply side and load side.**

### 8.4.2. Inspections and general cleaning:

- Check to make sure that the device (interrupting part) is clean. Remove any dust and traces of oil or grease with a clean, dry cloth (use a mild detergent if necessary - A cleaning product such as Henkel's 273471 or equivalent can be used if there is a heavy coating of dirt).
- Make sure that the rating plates with the technical specifications of the apparatus are affixed
- The data plates can be cleaned with a clean, dry cloth.
- Remove all traces of dust, mould, condensation and tarnish from both the outside and inside of the fixed part of the apparatus, if the circuit-breaker is the withdrawable type
- Make sure that there are no traces of overheating or cracks, which could impair the isolating parts of the circuit-breaker
- Make sure that the isolating jaw contacts are in a good condition (for withdrawable circuit-breakers, see det. A, fig 42).
- The jaw contacts must be silvery in colour with no traces of erosion or discoloration
- Make sure that there are no foreign bodies in the circuit-breaker compartment
- Make sure that the screws that fasten the fixed part to the switch-board are well tightened (M8 - 25 Nm / 221 lb in.)

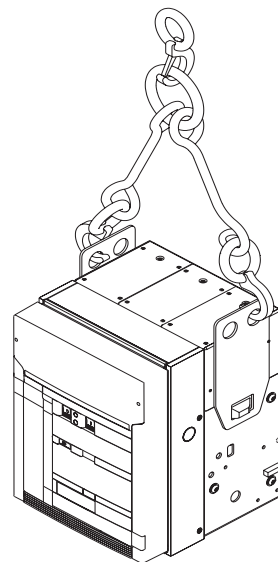


Fig. 41

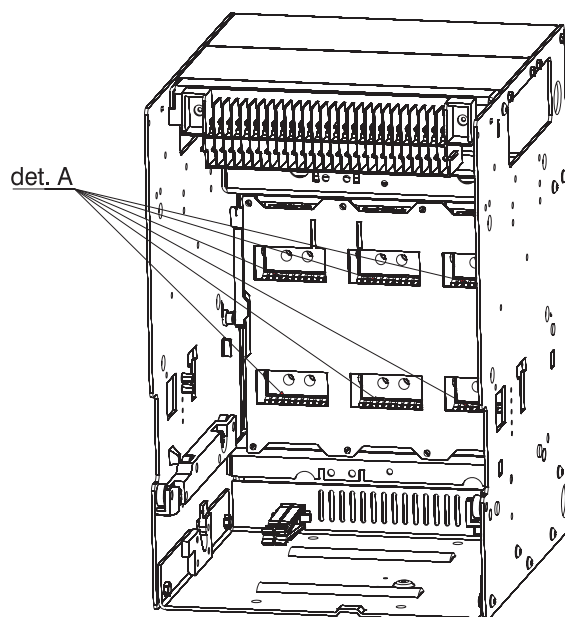



Fig. 42

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8.4.3. Circuit-breaker connections and connections between circuit-breaker and switchboard

- Remove any dust and dirt from the isolating parts with a brush and dry cloth (use a mild cleaning product if necessary - A cleaning products such as Henkel's 273471 or equivalent can be used if there is a heavy coating of dirt).
- Make sure that there are no traces of localized overheating on the terminals. This problem is denoted by the change in the colour of the parts in contact. These parts are usually silvery in colour.
- Make sure that the bolts of the terminal connections are well tightened (M12 - 70Nm / 620 lb in.).

 **WARNING:**  
if work must be performed on fixed circuit-breakers or on fixed parts, disconnect the power supply to the power circuit and auxiliary circuits and visibly earth the terminals on both the supply side and load side.

- Make sure that the cable connecting screws are well tightened in the terminal boxes (0.7 Nm / 6.2 lb in.).

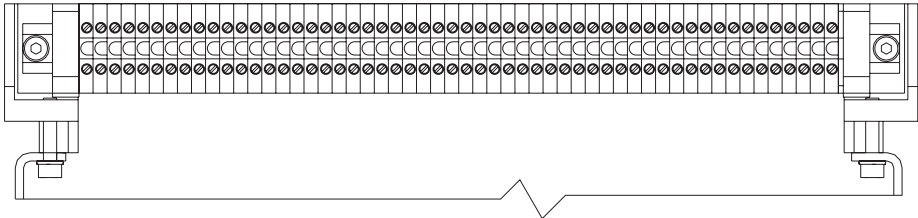


Fig. 43

8.4.4. Flange, escutcheon plate and arc chute disassembly operations

- Remove the flange (1) of the release by turning the screws (2) as shown in figure 41.
- Remove the front escutcheon plate (3) by removing the four screws (4).
- Remove one or both of the side guards (5) (if installed) by removing the front (6) and side (7) screws.
- Remove the arc chutes (8) by taking out the screws (9).

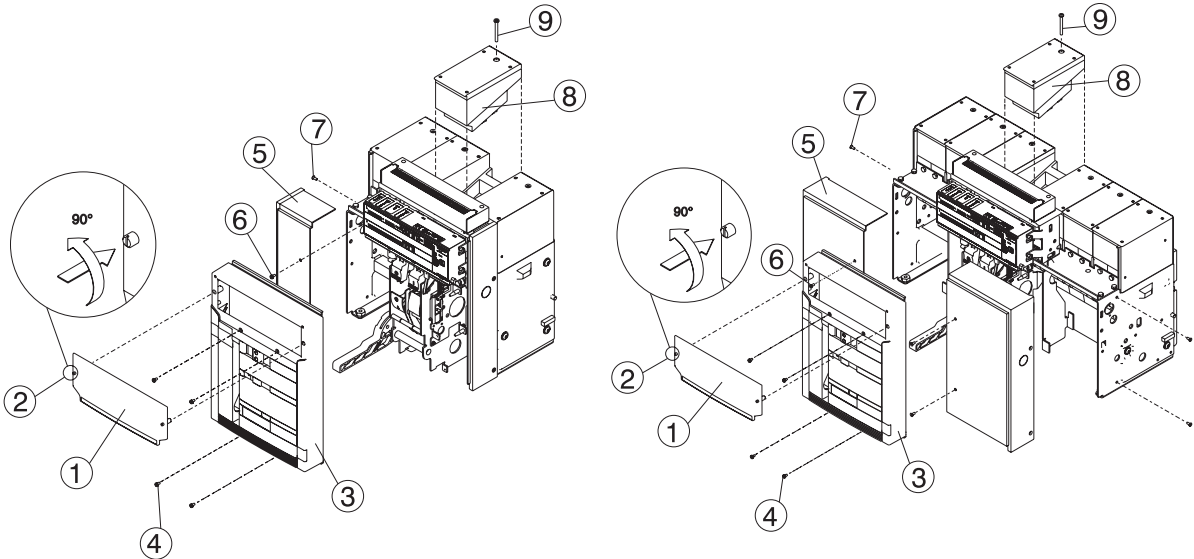


Fig. 44

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- If the undervoltage release is installed, disassemble the coil support and unload the springs of the operating mechanism by closing and opening the circuit-breaker.

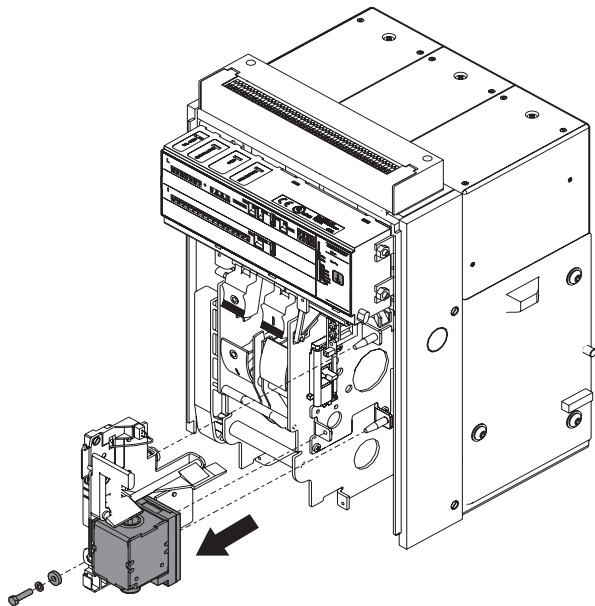


Fig. 45

**8.4.5. Mechanical operating mechanism**

- Clean (use a cleaning product such as Henkel's 273471 or equivalent if there is a heavy coating of dirt) and lubricate (in the points indicated in figure 46, det. A, as per the First Level) the shafts and opening closing latches with MOBILGREASE 28 (EXXON MOBIL).
- Clean (use a cleaning product such as Henkel's 273471 or equivalent if there is a heavy coating of dirt) and lubricate the operating shaft supports, including those on the sides of the circuit-breaker (see figure 46, det. B) with MOBILGREASE 28 (EXXON MOBIL).
- Make sure that the opening and closing shafts are free to turn.

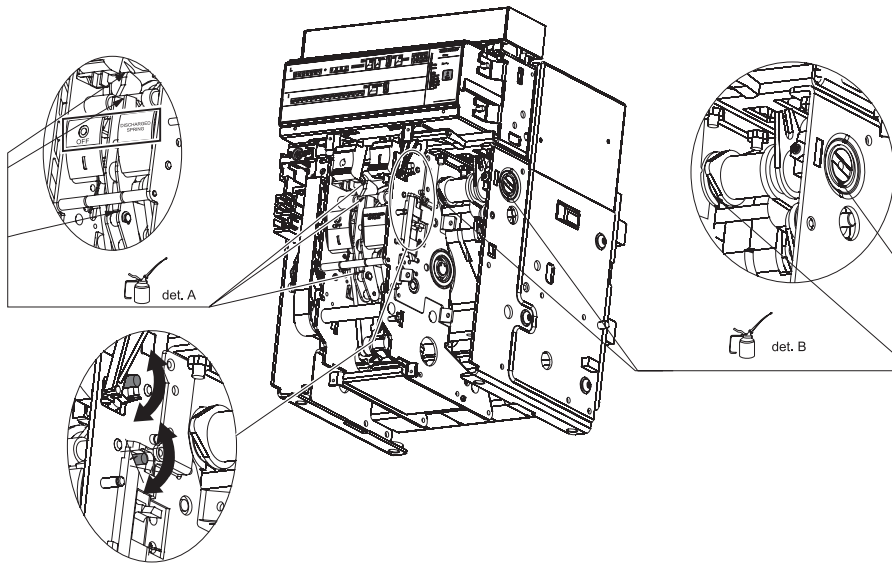


Fig. 46

- Contact ABB Sace (\*) if the springs are deformed or tarnished, if rings are missing or if the control is excessively worn.

(\*) ABB may replace spare parts type "A" after having obtained the customer's approval.

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#### 8.4.6. Electrical and mechanical accessories

- Make sure that the accessories are securely fixed to the circuit-breaker.
- Make sure that the electrical accessories are correctly connected to the circuit-breaker.
- Gearmotor: after every 10000 operations, check the brushes for wear and replace the gearmotor if necessary.
- Make sure that the releases (YO, YU, YC) are in good conditions (absence of excessive wear, overheating, breakages) Fig. 44.
- Make sure that the mechanical operation counter functions correctly (if applicable) by operating the circuit-breaker.

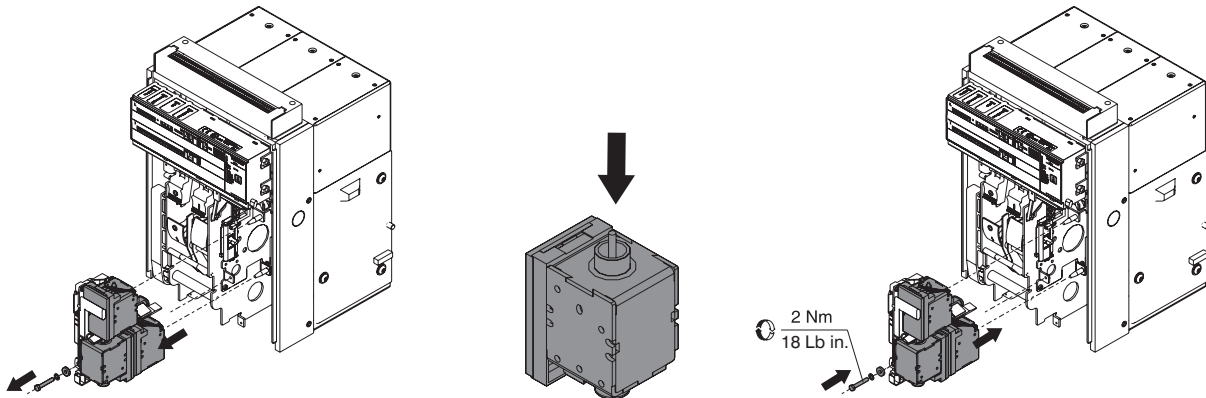
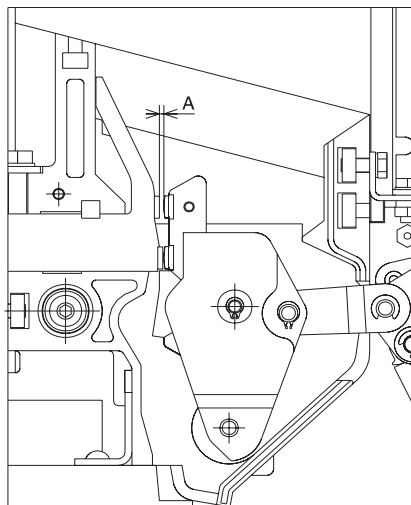


Fig. 47

#### 8.4.7. Inspection of contacts for wear

With the circuit-breaker open and the arc chutes removed:

- 1) Check the condition of the arc-breaking chutes: the body of the chute must be undamaged and the plates must be neither corroded nor indented.
- 2) Remove the dust with compressed air, then clean off all traces of fumes and slag with a brush.
- 3) Make sure that the contacts are in a good condition.
- 4) Visually check to make sure that the main and arc-breaking plates are in place.
- 5) Check for tarnishing or beading. If such defects are discovered, ask for assistance from a qualified ABB technician (\*).
- 6.1) Check the arc-breaking gaps (distance A fig 45).



Interruttore	A
E1 - E2 - E3	$\geq 1\text{mm} \rightarrow \text{OK}$
E4 - E6	$\geq 0,8\text{mm} \rightarrow \text{OK}$
E3-A	$\geq 0,039\text{in} \rightarrow \text{OK}$
E6-A	$\geq 0,032\text{in} \rightarrow \text{OK}$

Fig. 48

6.2) Close the circuit-breaker and check dimension A

- Call ABB Sace (\*) if dimension A is incorrect
- If dimension A is correct, open the circuit-breaker again and re-assemble the arc chutes.

(\*) ABB may replace spare parts type "A" after having obtained the customer's approval.

#### 8.4.8. Protection releases

- Power the protection release with a PR030/B Ultra battery unit.
- Make sure that the protection release functions correctly: release test with the "Trip Test" and "Autotest"
- Make sure that the front leds or display do not indicate the presence of alarms.
- Make sure that the cables are correctly connected to the release modules and to the release itself (if applicable).
- Check the percentage of wear on the circuit-breaker contacts.
- Remove the PR030/B Ultra battery unit from the relay upon termination.

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#### 8.4.9. Test with EKIP CONNECT (optional)

- Connect unit BT030 USB or BT030 USB Flash Drive to the relay that needs to be tested.
- Run the EKIP CONNECT program in a PC equipped with Bluetooth or Flash Drive connection, depending on the version of the BT030 USB used.
- Once the connection between the relay and PC has been established, make sure that there are no alarm signals from the relay. If this is the case, consult the 'error messages' and/or 'troubleshooting' sections of this manual.
- The trip test and autotest can be used (depending on the type of relay) in normal operating conditions.
- For future tests, it is advisable to enter the current information in the area called User Data and/or Tag Name. These data will remain stored in the relay itself.
- Remove the BT030 USB or BT030 USB flash drive from the relay.

#### 8.4.10. Maintenance operations; final inspections:

- Fit all the parts back in place and re-connect the auxiliary power supply if necessary.
- Re-assemble the escutcheon plate as shown in figure 46.

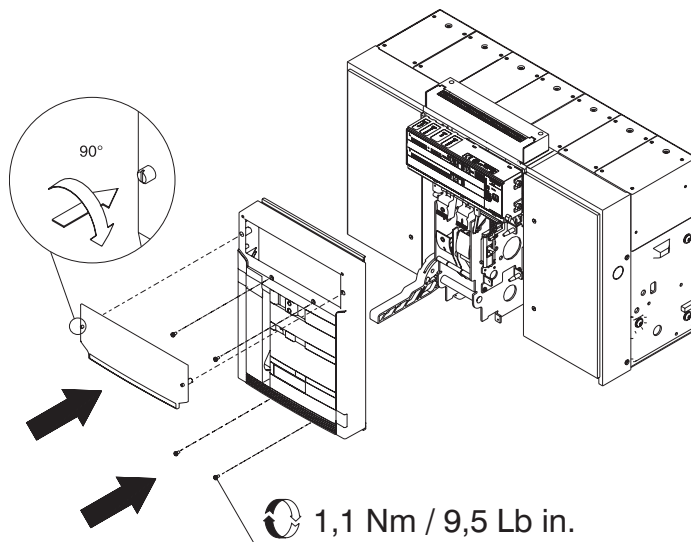


Fig. 49

- Set the moving part back to the TEST-ISOLATED position.
- Using the different auxiliaries in succession, perform the operations 10 times:
  - Opening (in both the local and remote modes, if applicable)
  - Closing (in both the local and remote modes, if applicable)
  - Release by means of the trip test via relay
- Check the operations in accordance with the following sequence:
  - Open - Springs unloaded
  - Open - Springs loaded
  - Closed - Springs unloaded
  - Closed - Springs loaded
- Make sure that the accessories (if installed) function correctly
- Make sure that the gearmotor (if installed) functions correctly
- Make sure that the undervoltage release functions correctly (if installed)
- Make sure that the shunt opening release functions correctly (if installed)
- Make sure that the shunt closing release functions correctly (if installed)
- Make sure that the circuit-breaker's auxiliary contacts function correctly (if installed)
- Make sure that the lock for circuit-breaker in open position (key or padlock) functions correctly (if installed)

#### 8.4.11. Interlocks

Make sure that the interlocks between circuit-breakers side by side and on top of each other (if applicable) have been correctly installed and function correctly. The functionality test cannot be performed in the Test or Disconnected positions.

#### 8.4.12. Withdrawable versions

If the version is the withdrawable type, make sure that the mechanical components that rack the circuit-breaker in and out of the fixed part function correctly. Do this by using the supplied operating lever and check to make sure that the shutters that segregate the live parts are closed once the circuit-breaker has been withdrawn.

Make sure that the lock for circuit-breaker racked-in and racked-out functions correctly (if installed).

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## 9. Measures to be taken for operating faults

The circuit-breaker fails to open when the opening pushbutton is pressed											Faults	
The circuit-breaker fails to open because service release YO has tripped												
The circuit-breaker fails to open because undervoltage release YU has tripped												
The circuit-breaker fails to open when the protection relay release test is performed												
The circuit-breaker fails to close when the closing pushbutton is pressed												
The circuit-breaker fails to close because closing coil YC has tripped												
The closing springs cannot be loaded with the manual loading lever												
The closing springs cannot be loaded with the spring-loading motor												
The racking-out crank handle fails to fit into the moving part												
The moving part cannot be fitted into the fixed part												
The circuit-breaker cannot be locked in the open position												
											Possible causes	Checks and solutions
			•								The opening solenoid of the relay is not connected properly	Make sure that the opening solenoid is connected correctly
			•	•	•						Relay tripping signal not reset	Press the mechanical pushbutton to reset the relay tripping signal
	•				•						Supply voltage of the auxiliary circuits too low	Measure the voltage: it must not be less than 85% of the rated voltage of the coil
	•				•						Supply voltage different from the value indicated on the nameplate of these releases	Check the voltage indicated on the nameplate of the releases
					•						Faulty switching circuit	Check the connections, fuses, interlocks, protection switches and accept contacts
	•				•		•				Loose clamping screws of the wires and auxiliary circuits	Make sure that the wire clamping screws are tight
	•				•		•				Incorrect electrical connections in the power supply circuit	Check the connections with the relative functional diagram
	•				•						Coil damaged	Replace the coil
		•			•						Operating mechanism locked	Operate in the manual mode. Contact ABB SACE if the fault persists
				•	•						Open position key lock activated	Unlock by inserting the key
				•	•						Circuit-breaker in intermediate position between connected and test	Complete the racking-in operation
				•	•						Undervoltage release not energized	Check the relative supply circuit and the supply voltage
				•	•						Shunt opening release remains permanently energized	Check the supply circuit
										•	The racking-in or racking-out operation has not been performed correctly	See section 7.3
•		•				•					Operating mechanism locked	Call ABB SACE
				•	•						Racking-out crank handle inserted	Remove crank handle
								•			Circuit-breaker in withdrawn position	Move the circuit-breaker to the test or racked-in position
								•			The fuse that protects the spring loading motor protection has tripped	Replace the fuse
								•			Faulty gearmotor for automatic spring loading	Replace the gearmotor
										•	Moving part incompatible with fixed part	Make sure that the moving part is compatible with the fixed part
									•	•	Circuit-breaker closed	Press the opening pushbutton and activate the lock
										•	Lock in open position defective	Call ABB SACE

## 10. Accessories

### 10.1. Electrical Accessories

#### Shunt opening / closing release (YO/YC) and second shunt opening release (Y02)

Allows the device to be opened or closed by remote control. 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 both direct and alternate current.

This release provides an instantaneous service (\*), but can be supplied permanently (\*\*).

In uses where the shunt closing release is supplied permanently, the shunt closing release must be momentarily de-energized in order to reclose the circuit-breaker after opening (the circuit-breaker operating mechanism is, in fact, fitted with an anti-pumping device).

Some applications require a very high degree of safety for the remote opening control of the circuit-breaker. Duplication of the control circuit of the shunt opening release is required in particular. SACE Emax circuit-breakers can be fitted with a second shunt opening release in order to achieve this. The second shunt opening release is located in the same seat as the undervoltage release and its technical characteristics are the same as the standard shunt opening release.

(\*) In the case of instantaneous service, the current impulse must last at least 100 ms.

(\*\*) In the case of permanent power supply to the shunt opening release, wait for at least 30 ms before transmitting the control to the shunt closing release.

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

Power supply (Un)	24 V DC	Operating limits	(YO-YO2) : 70...110% Un
	30 V AC/DC		(YC) : 85...110% Un
	48 V AC/DC		Inrush power consumption (Ps)
	60 V AC/DC		DC = 200 W
	110-120 V AC/DC		Inrush power time ~100 ms
	120-127 V AC/DC		AC = 200 VA
	220-240 V AC/DC		Continuous power (Pc)
	240-250 V AC/DC		DC = 5 W
	380-400 V AC		AC = 5 VA
	440 V AC		Opening time (YO - YO2)
		(max) 60 ms	
		Closing time (YC)	
		(max) 70 ms	
		Insulation voltage	
		2500V 50 Hz (for 1 min)	

#### Undervoltage release (YU)

The undervoltage release opens the circuit-breaker when there is a sensible reduction or lack of the voltage that powers it. It can be used for remote tripping (by means of normally closed pushbuttons), as a lock on closing or to control the voltage in primary or secondary circuits. The release power supply is therefore branched on the supply side of the circuit-breaker or from an independent source. Circuit-breaker closing is only allowed with the release powered (the closing lock is obtained mechanically). The release can operate with both direct and alternate current.

Power supply [Un]	24 V DC
	30 V AC/DC
	48 V AC/DC
	60 V AC/DC
	110-120 V AC/DC
	120-127 V AC/DC
	220-240 V AC/DC
	240-250 V AC/DC
	380-400 V AC
	440...480 V AC

Circuit-breaker opening takes place with power supply voltage values of the release equivalent to 35 - 70% Un.

Circuit-breaker closing can take place with power supply voltage values of the release equivalent to 85 - 110% Un.

IT can be fitted with a signalling contact for undervoltage release energized (C. aux YU).

Reference figure in the electrical circuit diagrams: 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)



#### CAUTION:

The undervoltage release (YU) is not compatible with the Fail Safe device (prevents withdrawal when the springs are loaded).

If the Fail Safe device is installed, remove it as indicated in figures 50, 51, 52 and 53.

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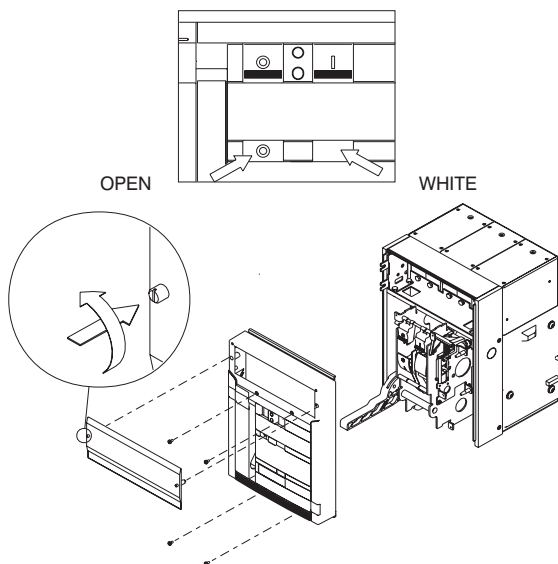


Fig. 50

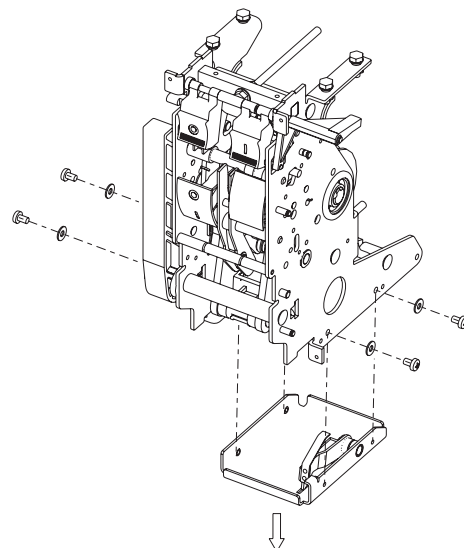


Fig. 51

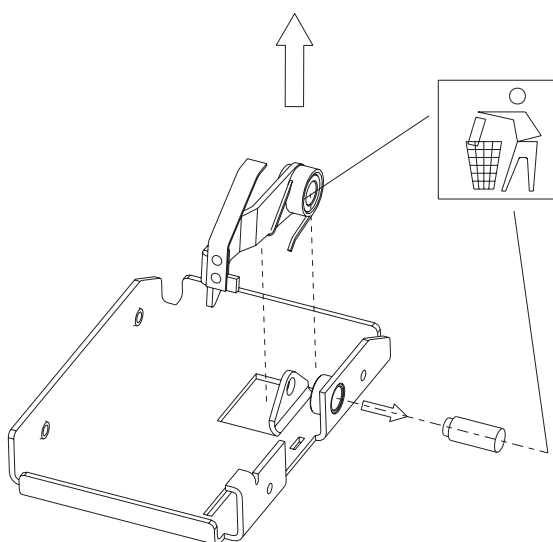


Fig. 52

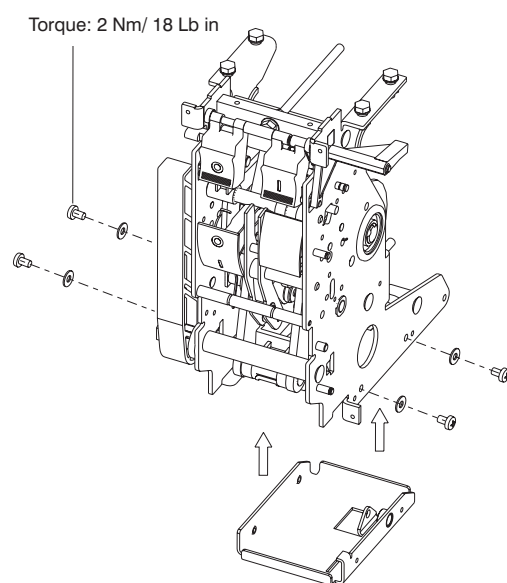


Fig. 53

#### Time delay device for undervoltage release (D)

The undervoltage release can be used in conjunction with an electronic time-delay device, which must be installed outside the circuit-breaker and which delays release tripping with preset, adjustable times. Use of the delayed undervoltage release is useful for preventing trips when the power supply network of the release may be subject to power cuts or brief voltage dips.

When it is not powered, circuit-breaker closing is prevented.

The time-delay device must be used with an undervoltage release with the same voltage.

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

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

#### Gearmotor for automatic loading of the closing springs (M)

Automatically loads the closing springs of the circuit-breaker's operating mechanism. Once the circuit-breaker has closed, the gearmotor immediately begins to reload the closing springs.

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The closing springs can still be loaded in the manual mode (using the relative lever of the operating mechanism) in a power failure or during maintenance work.

Power supply	24-30 V AC/DC
	48-60 V AC/DC
	100-130 V AC/DC
	220-250 V AC/DC
Operating 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 (for 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 after the overcurrent release has tripped:

##### a) Mechanical trip signalling for overcurrent releases

Enables visual signalling on the operating mechanism by pushing the trip button in when the circuit-breaker has been opened after the overcurrent releases have tripped. The circuit-breaker can only be closed again by putting the pushbutton back in its normal position in the standard configuration.

Reference figure in the electrical circuit diagrams: S51 (13).

##### b) Electrical trip signalling for overcurrent releases

Enables visual signalling on the operating mechanism (mechanical) and remotely (electrically, by means of a change-over switch) of the circuit-breaker having opened after tripping of the overcurrent releases. The mechanical indicator pushbutton must be reset before the circuit-breaker can be reset. Reference figure in the electrical circuit diagrams: S51 (13).

##### c) Coil for resetting the mechanical release trip indicator

Enables visual signalling on the operating mechanism (mechanical) and remotely (electrically, by means of a change-over switch) of the circuit-breaker having opened after tripping of the overcurrent releases. Using this accessory, you can reset the mechanical indicator with an electrical relay via remote control and this allows 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 and allow an indication of the circuit-breaker's state to be obtained. A special version of the auxiliary contacts is also available (gold plated contacts) for use at less than 24 V rated voltage (digital signals).

Un	In max	T	Un	In max	cosφ
125 V DC	0,3 A	10 ms	250 V AC	5 A	0,3
250 V DC	0,15 A	10 ms			

The following versions are available:

##### a) Electrical signalling of circuit-breaker open/closed

ELECTRICAL signalling of the circuit-breaker state (open/closed) can be obtained, 4, 10 or 15 auxiliary contacts.

The auxiliary circuits can have the following configurations:

- 4+2 break/make contacts for PR122/DC- PR123/DC(2 normally open + 2 normally closed + 2 for the release)
- 10+2 make/break contacts for PR122/DC- PR123/DC(5 normally open + 5 normally closed + 2 for the release)
- 15 supplementary make/break contacts, which can be assembled 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 faston connector on the microswitch. When 10 contacts for PR122/ PR123 are required, zone selectivity and the PR120/K module are not available.

Reference figure 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, electrical signalling can be provided by means of 5 or 10 auxiliary contacts installed on the fixed part.

Signalling is only available for withdrawable circuit-breakers for installation on the fixed part.

The auxiliary circuits can have the following configurations:

- contacts: group consisting of 2 connected signalling contacts, 2 disconnected signalling contacts and 1 test position signalling contact

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(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/unloaded**

This consists of a microswitch, which allows remote signalling of the state of the closing springs of the circuit-breaker operating mechanism. The contact is always supplied with the spring loading gearmotor.

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 equipped with an undervoltage energized signalling contact (normally closed or open, as required) 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 mechanical operations of the circuit-breaker. The indication is visible on the outside front of the circuit-breaker.

**10.2. Mechanical locks**

**a-b) Lock in open position**

Different mechanisms allowing the circuit-breaker to be locked in the open position are available.

These devices can be controlled by:

- A key a): a special circular lock with different keys (for one single circuit-breaker) or with the same keys (for several circuit-breakers). In this latter case, up to four different key code numbers are available.
- Padlocks b): up to 3 padlocks (not supplied): Ø 4 mm / 0.15 inch and Ø 8 mm / 0.31 inch.

**c) 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, with up to four different key code numbers available) and by padlocks (up to 3 padlocks, not supplied - Ø 4 mm / 0.15 inch and Ø 8 mm / 0.31 inch).

Only available for withdrawable circuit-breakers for installation on the moving part.

**d) 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 withdrawable circuit-breakers for installation on the moving part.

**e) Accessories for shutter padlocks**

They enable the shutters to be padlocked (installed on the fixed part) in the closed position.

Only available for withdrawable circuit-breakers for installation on the fixed part.

**f) 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 the circuit-breaker from closing when the compartment door is open.

**g) Fail safe device (to prevent withdrawal when the springs are loaded)**

This prevents the moving part of the circuit-breaker from being withdrawn if the closing springs are loaded. It is supplied as part of the standard equipment for all withdrawable circuit-breakers.

It is also available for withdrawable versions for installation on the moving part.



**WARNING:**

**The Fail Safe device is not compatible with the undervoltage release (YU).**

**Transparent protection covers**

**a) Protection covers for opening and closing pushbuttons**

Applied over the opening and closing pushbuttons, these protection covers prevent the corresponding circuit-breaker operations unless a special tool is used.

**b) IP54 door protection**

This is provided by means of a transparent plastic escutcheon plate which fully protects the front of the circuit-breaker and allows the IP54 degree of protection to be obtained. It is assembled on hinges and equipped with a key lock.

**Interlock between circuit-breakers**

This mechanism achieves a 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 mechanical interlock is supplied with the electrical circuit diagram for electrical changeover by means of a relay (at the customer's charge). The circuit-breakers can be installed either vertically or horizontally.

4 types of interlocks 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, other than safety services.

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Changeover from normal supply to emergency supply can be performed manually (with a local or remote control) or automatically. For changeover, the circuit-breakers must be equipped with the accessories required for electrical remote control and for the electrical and mechanical interlocks required by the changeover logic.

For example, these accessories can be:

- the shunt opening release
- the shunt closing release
- the motor operator
- the auxiliary contacts

For the changeover, the customer can use a dedicated electronically controlled relay circuit, the diagram of which is supplied by ABB SACE. The mechanical interlocks between two or three circuit-breakers are obtained by means of cables that can be used for circuit-breakers installed either side by side or stacked.

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

Type of interlock	Number of interlocks	Type of circuit-breaker	Possible interlock
A	TWO	A normal power supply unit and an emergency power supply unit	The first circuit-breaker can only be closed if the second (emergency) breaker is open
B	THREE	Two normal power supply units and one emergency power supply unit.	The first and third circuit-breakers can only be closed if the second (emergency) breaker is open. This latter can only be closed if the first and third are open.
C	THREE	A unit of 2 power 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 three power supplies / one single circuit-breaker closed. Three power 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.

### 10.3. Spare parts and retrofitting

#### Spare parts

The following spare parts are available:

- Mechanical operating mechanism (\*) (Type "A")
- Set of closing springs (\*) (Type "A")
- Set of clamp-type isolating contacts for the fixed part of the withdrawable circuit-breaker
- Sliding earth contact (for withdrawable version)
- Front guard kit complete with escutcheon plates and side guards
- Safety shutters for the fixed part
- Transparent protection for PR122DC and PR123DC releases
- Opening solenoid for the PR122DC / PR123DC overcurrent release
- Plug of front relay test connector
- Lubricating grease for the operating mechanism
- Tool case
- Terminal box for fixed version
- Sliding contacts for fixed part
- Sliding contacts for moving part
- Dust-guard flange for compartment door.
- Racking-out crank handle
- Pair of lifting plates
- Front escutcheon plate for Ronis-type key lock

Ask for the ABB SACE spare parts catalogue for further details.

(\*) ABB may replace spare parts type "A" after having obtained the customer's approval.

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## 11. Protection releases - General characteristics

The Emax series of ABB air circuit-breakers now has a new range of electronic relays for DC applications, called PR122/DC and PR123/DC.

The new protection releases possess all the functions of their predecessors and include new and interesting technical characteristics able to meet current and future installation needs.

Every operational requirement is now available thanks to the different performance levels of the new relays and of the additional modules that can be fitted inside them (PR120/V, PR120/LV, PR120/K, PR120/D-M, PR120/DC).

The following table clearly illustrates the technical characteristics and the mix-and-matchability of the relays.

Function/Unit	PR122/DC	PR123/DC
<b>Current protections</b> (L, S, I)	<b>S</b>	<b>S</b>
<b>Current protections G)</b>	-	<b>S</b>
<b>Additional protections</b> (U)	-	<b>S</b>
<b>Voltage protections</b> (UV, OV, RP)	-	<b>S</b>
<b>Further protections</b> (S2)	-	<b>S</b>
<b>Temperature protection</b> (OT)	<b>S</b>	<b>S</b>
<b>MCR protection</b>	<b>S</b>	<b>S</b>
<b>Thermal memory</b>	<b>S</b>	<b>S</b>
<b>Local bus for external accessory units</b>	<b>S</b>	<b>S</b>
<b>Wired communication</b> (RS485)	<b>S</b> <sup>(1)</sup>	<b>S</b> <sup>(1)</sup>
<b>Data Logger</b>	<b>S</b>	<b>S</b>
<b>Compatibility with Ekip CONNECT</b>	<b>S</b>	<b>S</b>
<b>Compatibility with PR010/T</b>	<b>S</b>	<b>S</b>
<b>Dual setting</b>	-	<b>S</b>
<b>PR120/V Measuring</b> (Internal voltage module)	<b>S</b> <sup>(2)</sup>	<b>S</b> <sup>(2)</sup>
<b>PR120/LV Measuring</b> (Internal voltage module)	<b>S</b> <sup>(2)</sup>	<b>S</b> <sup>(2)</sup>
<b>PR120/K Signalling</b> (Internal signalling module)	<b>O</b>	<b>O</b>
<b>PR120/D-M Com</b> (Internal communication module)	<b>O</b>	<b>O</b>
<b>PR120/DC</b> (Override protection module)	<b>S</b>	<b>S</b>
<b>PR021/K</b> (External signalling unit)	<b>O</b>	<b>O</b>
<b>HMI030</b> (External graphic interface)	<b>O</b>	<b>O</b>
<b>PR030/B Ultra</b> (External power supply unit)	<b>S</b>	<b>S</b>
<b>BT030 USB</b> (External Bluetooth communication unit)	<b>O</b>	<b>O</b>
<b>Key:</b> <b>S</b> : standard function/unit, <b>O</b> : optional function/unit, <b>-</b> : function/unit unavailable.		<b>Notes:</b> 1. : with PR120/D-M module, 2. : PR120/V or PR120/LV as alternatives (see sect. 14.1)

### 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.

This device must only be used by qualified and expert personnel.

**You must assume that the device is not safe to use if:**

1. The unit shows visible signs of damage.
2. The unit does not function (e.g. with autotest or with the trip test unit).
3. The unit has been damaged during transport.

 **WARNING: The circuit-breaker must be open before any servicing or replacements are made. Also remember to disconnect any power supplies connected.**

#### 11.1.1. Notes for dielectric strength tests

 **WARNING: it is forbidden to perform dielectric strength tests on the inputs and outputs of the releases.**

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## 11.2. Abbreviations and miscellaneous notes

### 11.2.1. Abbreviations

Abbreviation	Meaning
BA	Opening coil
BC	Closing coil
BT030 USB	ABB SACE power supply and wireless communication unit
CB	Circuit Breaker (e.g. Emax)
PDA	Pocket Pc with Bluetooth
Emax	Series of ABB SACE air circuit-breakers
HMI 030	Human Machine Interface (Display unit on front of switchboard)
HW	Hardware
In	Rated current of the Rating Plug installed in the circuit-breaker
MT	Thermal memory
Pn	Rated power of the circuit-breaker
PR120/K	Internal unit for signalling alarms and trips of the circuit-breaker
PR120/V-PR120/LV	Measuring module
PR021/K	Signalling unit
PR120/D-M	Communication module
PR120/DC	Instantaneous override protection
PR010/T	ABB SACE test unit
PR122/DC	Protection relay for Emax CB
PR123/DC	Protection relay for Emax CB
PR030/B Ultra	ABB SACE power supply unit
Relay	Also known as "Protection Unit" or "Protection Release"
RMS	Root Mean Square value
TC	Trip Coil (opening solenoid)
SdZ	Zone selectivity
SW	Software
i-Test	Info/test pushbutton on front of relay
Trip	CB opening, generated by the release
Un	Rated voltage
Vaux	Auxiliary power supply

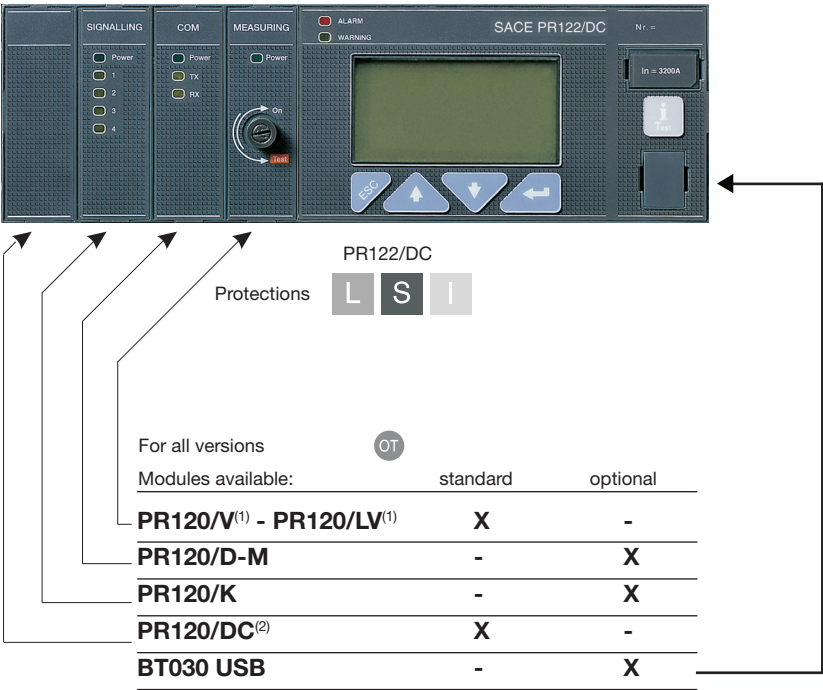
### 11.2.2. Miscellaneous notes:

- A. Use the BELDEN 3105A type two-wire cable (not supplied by ABB SACE) for example.
- B. Use the BELDEN 3106A type three-wire cable (not supplied by ABB SACE) for example.
- C. The unit has a "backup-protection" function. If the first command to the opening solenoid fails to open the circuit-breaker immediately (TC partially faulty), TRIP commands are repeatedly transmitted until the circuit-breaker opens.  
The "backup" condition can be signalled by configuring the relays of the unit. Using the "YO back" option, the "opening coil (YO)" accessory can be controlled like another opening device if the TC fails to function.

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12. SACE PR122/DC release – Identification

In accordance with IEC and UL standards, PR122/DC units are available with the various protections, default modules and options. They are illustrated in the figure below:



<sup>(1)</sup> Standard equipment: PR120/V or alternatively, PR120/LV

<sup>(2)</sup> Slot inside occupied by PR120/DC

12.1. Standard

II PR122/DC has been designed to operate in accordance with the following international standards:

**IEC 60947-2 Low voltage apparatus. Circuit-breakers.**

**UL 1066 Low voltage AC and DC Power Circuit Breakers Used in Enclosures.**

**ANSI C37.14 Low voltage DC Power Circuit Breakers Used in Enclosures.**

12.2. Specifications

12.2.1. General information

PR122/DC is a high-performance protection unit with **Protection, Measurement, Data Storage, Communication (optional), Self-test, Load control and Zone Selectivity** functions for the ABB SACE "Emax" series of three- and four-pole Low Voltage air circuit-breakers. The user interface of the unit also enables parameter setup and complete prealarm and alarm management for the protection and watchdog functions.

It is equipped with an instantaneous override protection that trips when the electronic relay is not powered.

The basic protections available are:

Symbol	Protection against
L	overload with inverse long-time delay
S	short-circuits with adjustable delay
I	instantaneous short-circuit
OT	temperature out of range
MCR	closing on short-circuit

PR122/DC can be installed on both three-pole and four-pole circuit-breakers.

The unit opens the circuit-breaker in which it is installed by means of the TC, which acts directly on the mechanical lever mechanisms of the device.

The protection unit is self-supplied by primary voltages (PR120/V or PR120/LV module).

The unit features digital microprocessor technology and interfaces with the user by means of a graphic display and keyboard.

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### 12.2.2. Auxiliary power supply

The external auxiliary power supply is provided using a galvanically-separated power supplier.



**WARNING:** Since the auxiliary voltage must be isolated from the earth, “galvanically separated converters” conforming to standard IEC 60950 (UL 1950) or the equivalent IEC 60364-41 and CEI 64-8 must be used to guarantee current in the common mode or leakage current (as defined in IEC 478/1 and CEI 22/3) that is no more than 3.5mA.

The presence of the auxiliary power supply allows the relay unit to be used even with the circuit-breaker open as well as powering all the modules.

The characteristics of the power supplier are given in the table below:

Characteristics	Version PR122/DC
Auxiliary voltage (galvanically separated)	24 V DC $\pm 20\%$
Maximum ripple	5%
Inrush current @ 24 V	$\sim 10$ A for 5ms
Rated power @ 24 V	$\sim 5$ W

#### 12.2.2.1. Powered by the PR120/V- PR120/LV module

For a full explanation of the features of the PR120/V-PR120/LV module, see sect. 14.1.

### 12.2.3. Environmental characteristics

Operating temperature	-25°C ... +70°C
Storage temperature	-40°C ... +90°C
Relative humidity	0% ... 98% with condensation
Degree of protection (with PR122/DC installed in the CB)	IP 30

### 12.2.4. Description of the inputs/outputs

#### 12.2.4.1. Binary inputs

– **K51/SZin:** Zone selectivity: input for protection S (only with Vaux)

#### 12.2.4.2. Binary outputs:

– **K51/SZout:** Zone selectivity: output for protection S (only with Vaux)

Note: These inputs/outputs should only be used between devices of the PR122/PR123 series.

### 12.2.5. Communication bus

Local bus, on rear connector; RS485 physical interface, Modbus protocol.

External system bus, RS485 physical interface, Modbus RTU protocol, baud rate 9600 - 19200 bps.

Test bus, on front test connector.

### 12.2.6. Protection functions

The PR122/DC protection unit provides 6 independent protection functions. In detail:

1. Protection against overload with inverse time “**L**”;
2. Protection against short-circuits with adjustable delay “**S**”;
3. Protection against instantaneous short-circuit “**I**”;
4. Protection against closing on short-circuit “**MCR**”;
5. Override protection with relay not powered;
6. Protection against temperature rise “**OT**”.

A timing indication (message + “alarm” Led) is provided on the unit's display and is activated during a protection alarm. It is dis-activated when the alarm condition ceases or when the protection has tripped. The page with the “Trip” data is displayed when the circuit-breaker opens (when “i Test” is pressed or automatically, in the presence of Vaux).

#### 12.2.6.1. Circuit-breaker state

The PR122/DC unit detects the state of the circuit-breaker by means of specific wiring in the CB itself. When the presence of current is detected with the circuit-breaker “OPEN”, a warning message is displayed (see sect. 12.6) and the “warning” led comes on to signal a state error

The signal can be combined with a relay of the PR120/K module or with those of the PR021/K unit.

### 12.2.7. Measuring functions

The current measuring (ammeter) function is available in all versions of the SACE PR122/DC unit.

The display shows histograms with the current of the polarity on the main page and in the numerical format.

- Current;
- Instantaneous current values over a given time interval (Data Logger);
- Maintenance: number of operations, percentage of contact wear, opening data storage (last 20 trips and 80 events);
- The protection records the historical data of the maximum current reading.

### 12.2.8. Watchdog

The PR122/P unit provides some watchdog functions able to ensure that relay faults are managed properly. These functions are as follows:

- ☐ Watchdog for the presence of Auxiliary Power Supply with the “plug” icon displayed.
- ☐ Rating PLUG validity.
- ☐ Watchdog for proper connection of the Trip Coil (TC). If enabled, any faults are signalled by a special alarm message and by the “Alarm” led coming on. If the PR120/D-M module is installed, it activates the coil opening command (Y0), thus opening the CB.
- ☐ Watchdog for protection of Hw Trip. If enabled, in the event of CB undefined or Rating Plug error, or Installation error, a CB command is given, by activation of the TC.

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12.2.9. Description of the protection functions

12.2.9.1. Protection “L”

Protection “L” is the only one that cannot be disabled since it is for self-protection against overloading of the relay itself. Only one type of curve can be set and it is defined by standard IEC 60255-8. The protection trip time, inverse time, is given by the expression:

$$\tau \ln \left( \frac{I_f}{I_f^2 - I_p^2} \right) \text{ for } I_f \leq 12I_n \text{ and } 1s \text{ for } I_f > 12I_n$$
 where  $I_f$  is the fault current and  $I_p$  the protection threshold and with  $\tau = t1/ (\ln 9/8)$

NOTE: Time expressed in seconds.

12.2.9.1.1. Thermal memory “L”

The thermal memory can be enabled to protect the cables on the basis of the "hot state" curve of the IEC 60255-8.

$$\tau \ln \left( \frac{I_f^2 - I_p^2}{I_f^2 - I_i^2} \right) \text{ for } I_f \leq 12I_n \text{ and } 1s \text{ for } I_f > 12I_n$$

where  $I_p$  is calculated on the basis of the evolution of the current over time, when there is no overload condition

The PR122/DC is fitted with two instruments for creating this thermal memory. The first is only effective when the release is powered (it also records overloads that have not lasted long enough to trip the release), while the second even works when the release is not powered, reducing any trip times in the case of an immediate reclosing and until the moment the circuit-breaker trips. It is the PR122/DC release that automatically decides which of the two to use, depending on the various different situations.

12.2.9.2. Protection “S”

This protection, which can be disabled, can be the fixed time (t=k) or inverse time (t=k/i²) type. In the latter case, the trip time is given by the expression

$$\max \left[ \frac{100 \cdot t_2}{(I_f)^2}, t_2 \right] \text{ for } I_f > I_2$$
 where  $I_f$  is the fault current and  $I_2$  the protection threshold

NOTE: Time expressed in seconds.

12.2.9.2.1. Thermal memory “S”

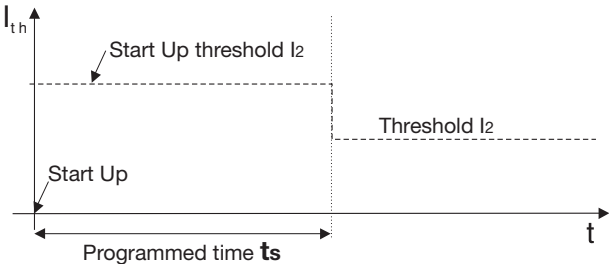
The thermal memory function can be enabled for cable protection when the curve with inverse time is selected. This is based on the “tS” parameter defined as the trip time of the curve (t2) selected at 1.5xI2. The other characteristics are the same as those for thermal memory “L” (see sect.12.2.9.1.1).

12.2.9.2.2. Start-up threshold “S”

The start-up function can be selected when the curve with fixed time is selected. The function can be disabled and is a setting characteristic of the individual protection units.

The start-up function allows the protection threshold (S and I) to be changed during a time interval lasting “ts” starting from “start-up”. This latter must be understood to be as follows:

- Passage of the overcurrent value over one single adjustable threshold (0.1...10In, in 0.1In steps). There can be a new start after the current has dropped below that threshold.

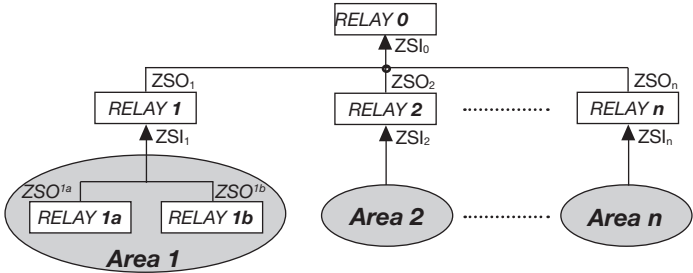


• Start-up time

There is a different start-up time for all the protections concerned. Range: 0.1 s ... 30 s, with 0.01 s steps.

12.2.9.2.3. Zone selectivity “S”

The zone selectivity function, guaranteed only if an auxiliary voltage is provided, allows the fault area to be isolated by only isolating the part of the installation nearest to the fault itself, while the rest of the installation remains operative. This is achieved by connecting all the zone selectivity outputs (ZSO=K51/SZout) of the releases belonging to the same zone to each other and by conveying this signal to the zone selectivity input (ZSI=K51/SZin) of the next release on the supply side. If the wiring has been made correctly, all the zone selectivity inputs of the last circuit-breaker in the chain and all the outputs of the circuit-breakers at the head of each chain must be empty.



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As a practical example, the figure above shows a fault in the load side of “Relay 1a”, isolated by this latter without “Relay 1” or “Relay 0” being tripped. A fault immediately downstream of “Relay 1” will be isolated by this latter without “Relay 0” being tripped, thus ensuring that Areas 2...n remain operative.

Output ZSO can be connected to up to 20 ZSI of relays on the supply side in the selectivity chain.



**WARNING: The maximum length of cable for zone selectivity between two units, is 300 meters.**  
**Use shielded stranded two-wire cable (see note A in sect. 11.2.2).**  
**The shield must only be earthed on the circuit-breaker of the supply-side relay (ZSI side).**

Operation is only guaranteed when there is auxiliary voltage.

The following logical table is used to manage the Zone Selectivity Input (ZSI) and Zone Selectivity Output (ZSO).

Zone selectivity	$I_{max} > I_2$	ZSI signal	ZSO signal	Trip T
Excluded	NO	0	0	No trip
Excluded	NO	1	0	No trip
Excluded	YES	0	0	$t_2$ programmed
Excluded	YES	1	0	$t_2$ programmed
Inserted	NO	0	0	No trip
Inserted	NO	1	1	No trip
Inserted	YES	0	1	$t_{selectivity}$
Inserted	YES	1	1	$t_2$ programmed

The value setting for time  $t_2$  must be equal to or higher than  $t_{selectivity} + 50$  ms on the circuit-breaker on the supply side, not required on the first one in the chain.

#### 12.2.9.3. Protection “I”

The protection can be enabled/disabled from the menu.

Where zone selectivity “S” is active, output signal ZSO is activated during the relay trip for “I” in any case, so as to ensure that the relay on the supply side functions correctly.

##### 12.2.9.3.1. Start-up threshold “I”

The start-up function can be selected.

The function can be enabled from the menu on the protection “I” page.

The function behaves in exactly the same way as the one described for protection “S” (see sect. 12.2.9.2.2).

##### 12.2.9.4. “MCR” protection against closing on short-circuit

The MCR function is used to protect the installation against closing on short-circuit.

This protection is activated when the circuit-breaker is closed, within a time slot ranging from 40 and 500ms and with a threshold established by the customer using the same algorithm as protection I. This protection can be disabled and is an alternative to protection “I”.

The function can be activated with a PR010/T hand-held unit via EKIP CONNECT software or through a remote system via a system bus.

This function has one fixed time protection curve only.

##### 12.2.9.5. “OT” protection against temperature rise inside relay

There is a sensor in the PR122/DC unit that monitors the temperature of the unit itself.

This allows abnormal temperature conditions to be signalled, conditions which could lead to temporary or continuous malfunctioning in the electronic components of the unit.

The protection has two operating states:

State of “**WARNING TEMPERATURE**” with  $-25^{\circ}\text{C} < \text{temp.} < -20^{\circ}\text{C}$  or  $70^{\circ}\text{C} < \text{temp.} < 85^{\circ}\text{C}$  :

the display is turned off and the “WARNING” led flashes at 0.5Hz

State of “**ALARM TEMPERATURE**” with  $\text{temp.} < -25^{\circ}\text{C}$  or  $\text{temp.} > 85^{\circ}\text{C}$  :

the display is turned off, the “WARNING” and “ALARM” leds flash at 2Hz and the Trip is activated (if enabled, by means of the “Over Temper. Trip = On” parameter).

NOTE.

- the display is turned off to preserve its functionality in the case of Warning and Alarm;
- the monitored temperature is not visible on the display.

The protection is always active, with both auxiliary and self-supply.



**WARNING: Disabling the Trip control of the protection means that the PR122/DC unit could work, with the circuit-breaker closed, within a temperature range where correct operation of the electronics is not guaranteed.**

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#### 12.2.9.6. Load control function

Single loads can be enabled/disabled on the load side before overload protection L trips the circuit-breaker on the supply side. This is done by contactors or switch-disconnectors (wired outside the release) controlled by the PR122/DC by means of contacts of the PR120/K module or of the PR021/K external unit.

The current thresholds are lower than those available with protection L, so that the load control can be used to prevent tripping due to overloads.

The function is active when an auxiliary power supply, or supply from PR120/V or PR120/LV are present (see sect. 14.1.3).

The operating logic requires the activation of three contacts when preset thresholds LC1, LC2 and  $I_w$  are exceeded.

Thresholds LC1 and LC2 are expressed as a percentage of  $I_n$  (current threshold specified for protection L), while "warning current"  $I_w$  is expressed as an absolute value. The setting values permitted are given in the following table:

Warning current $I_w$	0.30 to 10.0 steps of 0.05 $I_n$
Threshold LC1	50% to 100% steps of 1% $x I_n$
Threshold LC2	50% to 100% steps of 1% $x I_n$

From PR122/DC, each of the PR120/K or PR021/K contacts can be associated with a configuration (NO or NC), a delay and a latch (if applicable).

#### 12.2.9.7. Summary table of the protection function settings for PR122/DC

Protection	Disabling	Disabling of TRIP only	Zone selectivity	Start-up threshold	Thermal memory	Trip threshold	Tripp time	Trip threshold tolerance <sup>(2)</sup>	Trip time tolerance <sup>(2)</sup>
<b>L</b> curves IEC 60255-8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	$0.4xI_n \leq I_1 \leq 1xI_n$ 0.01 $xI_n$ step	$3s \leq t_1 \leq 102s^{(1)}$ , 3 s step $t_1 @ 3I_1$	Release between 1.05 and 1.3 $x I_1$	$\pm 10\%$ , $I_g \leq 4I_n$ $\pm 20\%$ , $I_g > 4I_n$
<b>S</b> ( $t=k$ )  see note (4)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	$0.6xI_n \leq I_2 \leq 10xI_n$ 0.1 $xI_n$ step $0.6xI_n \leq I_{2 \text{ start-up}} \leq 10xI_n$ 0.1 $xI_n$ step	$0.05s \leq t_2 \leq 0.35s$ , 0.01s step $0.10s \leq t_{2 \text{ start-up}} \leq 30s$ , 0.01s step $0.04s \leq t_{2 \text{ sel}} \leq 0.20s$ , 0.01s step	$\pm 7\%$ , $I_g \leq 6I_n$ $\pm 10\%$ , $I_g > 6I_n$	The best of the two values $\pm 10\%$ or 40 ms
<b>S</b> ( $t=k/i^2$ ) see note (4)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	$0.6xI_n \leq I_2 \leq 10xI_n$ 0.1 $xI_n$ step	$0.05s \leq t_2 \leq 0.35s$ , 0.01 s step at 10 $xI_n$	$\pm 7\%$ , $I_g \leq 6I_n$ $\pm 10\%$ , $I_g > 6I_n$	$\pm 15\%$ , $I_g \leq 4I_n$ $\pm 20\%$ , $I_g > 4I_n$
<b>I</b> ( $t=k$ )	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	$1.5xI_n \leq I_3 \leq 10xI_n$ 0.1 $xI_n$ step	$\leq 30ms$ $0.10s \leq t_{2 \text{ start-up}} \leq 30s$ , 0.01 s step where $I > I_4$	$\pm 10\%$	
<b>MCR</b> ( $t=k$ )	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	$6.0xI_n \leq I_5 \leq 10xI_n$ 0.1 $xI_n$ step	$\leq 30ms^{(3)}$	$\pm 10\%$	
<b>OT</b> (temp=k)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	fixed, defined by SACE	Instantaneous	$\pm 5^\circ C$	- - -
<b>Load control LC1/LC2</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	50%÷100% step of 0.05 $xI_n$			
<b>Warning <math>I_w</math></b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	$0.3 \div 10I_n$ step of 0.05 $xI_n$		$\pm 10\%$	10÷40 ms

<sup>(1)</sup> The minimum value of this trip is 0.5s, regardless of the type of curve set (self-protection).

<sup>(2)</sup> These tolerances are based on the following assumptions:

- relay at full power (without start-up);
- preset trip time of  $\geq 100ms$ .

<sup>(3)</sup> No trip time

<sup>(4)</sup> For special version E3H  $I_{cu}=85ka$ , S always ON and  $t_2=0.05...0.25s$

The following tolerance values apply to all cases not covered by the above hypotheses:

Protections	Trip threshold	Trip time
L	Release between 1.05 and 1.3 $x I_1$	$\pm 20\%$
S	$\pm 10\%$	$\pm 20\%$
I	$\pm 15\%$	$\leq 60ms$
Others		$\pm 20\%$

#### 12.2.9.7.1. Table of measurements

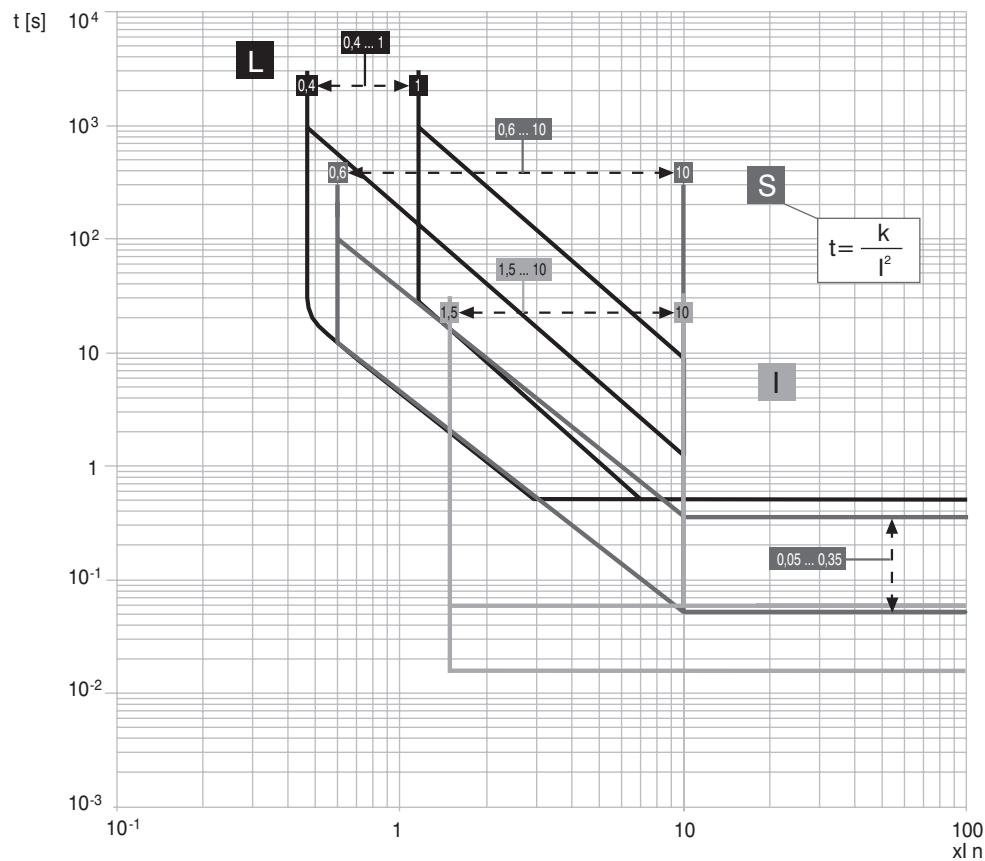
Type of measurement	Range of values measured by the relay	Standard operation range	
		Range	Tolerance %
Current 0.05...10 $I_n$	0.05...10 $I_n$	0.3...4 $I_n$	$\pm 5$

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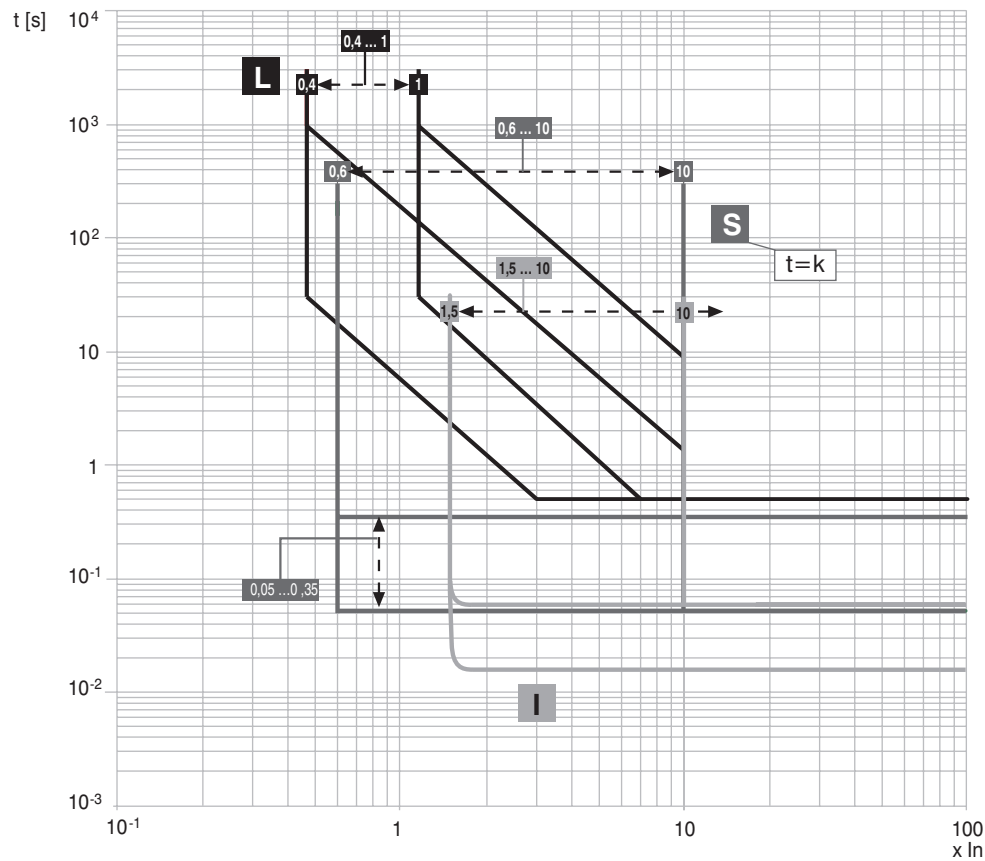
12.2.10. Trip curves

The trip curves given are indicative and are only a sub-group of the ones that can be selected (see sect. 12.2.9.7).

12.2.10.1. Trip curves for functions  $L-S(t=k/i^2)-I$



12.2.10.2. Trip curves for functions  $L-S(t=k)-I$



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## 12.3. Putting into service

### 12.3.1. TC connection test



**WARNING:** If the PR122/DC has been installed by the user, it is important, before closing the CB, to check the last line on the display when the relay is turned on for the first time via a PR030/B Ultra battery module. No TC disconnected messages must appear. If they do, do not close the CB and make the correct connections.

### 12.3.2. Test

Before putting into service, a test can be performed by means of the specific "Auto test" function, which can be activated on the PR122/DC. A positive result is shown on the display.

After this, a test can be performed on the whole TC chain, again using the specific function (Trip Test). A positive result is shown by the circuit-breaker opening. To run a Trip Test, press the "i Test" button and the "ENTER" key at the same time.

Check the open or closed state of the circuit-breaker on the same "PR122/DC Test" page by making sure that the CB is closed and de-energized.

Test	1/6
CB status	
Auto Test	
Trip Test (disabled)	
CB open	

### 12.3.3. Connection check-out



**WARNING:** After the initial settings have been made, to ensure that the voltage sockets are properly connected on the power busbars, check whether the relay comes on when there is voltage on the power input terminals and that the CB is open and without Vaux. If this is not the case, there is no guarantee that the unit will function when powered by the busbar voltages without any Vaux. Call ABB SACE.

### 12.3.4. Initial settings

If the PR122/DC is supplied ready installed in the circuit-breaker, it is up to ABB SACE to set all the variables involving the CB or the specific application correctly (e.g. type of CB, Rating Plug size, ...).

Note that ABB SACE defines each possible setting as indicated in the section about default parameters (see sect. 12.4.4).



**WARNING:** Apart from this, it is absolutely essential for the user to change the password and carefully define each modifiable parameter before putting the PR122/DC into service.

### 12.3.5. Password management

#### Specify a password? [0\*\*\*]

To access the "EDIT" mode, you must first enter a four-figure numerical password. The values that can be used in the password range from 0000 to 9999. The default password is given in sect. 12.4.4.

Select the value of the first figure (between '0'...'9') with the ↑ and ↓ keys and press ↵ to confirm the figure and proceed on to the next one.

Check the password after the fourth figure has been entered. The procedure will change from the "READ" state to the "EDIT" state if the password is correct.

The following message will appear if the password is wrong **Wrong password**

This message will remain until the **ESC** key is pressed (or after 5 seconds have elapsed).

The password entry procedure can be interrupted by pressing **ESC**.

The password is valid for up to two minutes from the last time a key was pressed.

#### Password disabling



The password prompt is disabled by setting the value of the password to [0000] (in the "System Configuration" menu). It is therefore always possible to switch from "READ" to "EDIT".

Select the "New Password" item from the "Settings/System" menu to enter a new password.

### 12.3.6. Replacement of an electronic release

#### 12.3.6.1. Installation

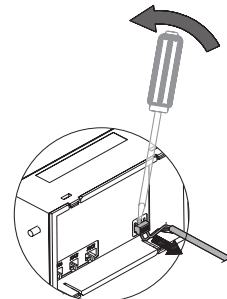
Comply with the following instructions to complete the installation procedure for a PR122/DC:

1. With the circuit-breaker open and possibly isolated, install the protection unit on the circuit-breaker
2. Power the unit ONLY from the PR030/B Ultra
3. If there are no other errors, the message  Configuration (configuration error) will appear on the display and the fixed yellow led (warning) will come on
4. Access the "Settings" menu of the unit
5. Select "Circuit-breaker"
6. Select "Unit installation"
7. Enter the password
8. Select "Install" and press "ENTER"
9. When the red led flashes and the message  Installation (installation error) appears, remove the PR030/B Ultra
10. Power the relay from any other source
11. Check for the absence of configuration errors.

#### 12.3.6.2. Uninstalling

Comply with the following instructions to uninstall a PR122/DC:

1. With the circuit-breaker open and/or isolated, power the unit from the PR030/B Ultra
2. Access the "Settings" menu of the unit
3. Select "Circuit-breaker"
4. Select "Unit installation"
5. Enter the password
6. Select "Uninstall" and press "ENTER"
7. Remove the PR030/B Ultra module
8. Remove the PR122/DC unit from the circuit-breaker
9. Proceed as indicated in the figure alongside to remove the TC connector.



The uninstalling procedure is not strictly necessary, but it allows the circuit-breaker parameters, such as contact wear and others that would otherwise be lost, to be stored. The data in question are then transmitted to the new PR122/DC unit, which will be installed on the same circuit-breaker.

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## 12.4. User interface



Ref.	Description
1	Voltage takeoff isolator
2	Busbar voltage LED
3	Prealarm signalling LED
4	Alarm signalling LED
5	Graphic display (the word ABB at the bottom left indicates normal operation)
6	Serial number of the PR122/DC
7	Rating Plug
8	Pushbutton for quitting the sub-menus or for canceling (ESC)
9	Button for the cursor (UP)
10	Button for the cursor (DOWN)
11	ENTER button for confirming the data or changing the page
12	TEST connector for connecting or testing the release by means of an external device (PR030/B battery unit, BT030 wireless communication unit and PR010/T test unit)
13	"iTest" and info button

### Description of the icons displayed

Symbol	Description
	remote control
	dual setting active. Setting A set
	fixed icon: datalogger activated flashing icon: triggered
	Vaux present
	parameter change stage

#### 12.4.1. Use of the pushbuttons

The modifiable fields can be filled in using the  $\uparrow$  or  $\downarrow$  keys and by confirming with the  $\rightarrow$  key. Once you have accessed the required page, you can move from one value to another by using the  $\uparrow$  or  $\downarrow$  keys. To change a value, position the cursor over the value itself (the modifiable field will appear in reverse, i.e. white on a black background), and use the  $\rightarrow$  key.

To confirm the settings programmed for the newly configured parameters, press the **ESC** key to scroll up the menus until the programming confirmation page is displayed, select the confirmation item and press **ENTER** to program the data.

The "i Test" button must be used to perform the Trip Test, to display the info page and the last trip, if this has caused it to switch off.

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12.4.2. Read and Edit modes

The menus map (see sect. 12.5. 1) shows all the pages that can be obtained and how to operate with the keyboard in the “READ” state (data reading only) or “EDIT” state (to set the parameters).

Whatever page is displayed, the default page will appear after about 120 seconds of inactivity (see sect. 12.5.1).

Depending on the state, the functions permitted are:

“READ”:





- ✓ Consultation of the measurements and historical data
- ✓ Consultation of the configuration parameters of the unit
- ✓ Consultation of the protection parameters

“EDIT”:

- ✓ Everything allowed in the READ mode
- ✓ Configuration of the unit
- ✓ Programming of the parameters relating to the protections
- ✓ TEST functions of the unit

To access the “EDIT” state, press the ↵ key in a page with fields that can be edited. You will then be asked to enter the password before being enabled to switch to the editing state.

Use of the pushbuttons is outlined in the table below:

Key	Function
	Move amongst the pages Move within the menus Change the parameter values
	End the setting phase and confirm the result Choose the menu item
	Access to surfing menus from the default pages Return to previous level when surfing within the menus, until you return to the default pages Quit the parameter editing phase and abort the changes
	This key is used to re-enable the display after it has been turned off within 48 hours from opening of the circuit-breaker in the self-supply mode.

12.4.3. Changing parameters

Moving within the Main Menu, you can access all the pages relating to the configurations and parameter settings, and can also edit the values of the parameters.

After certain programming procedures, you need to Confirm / Cancel / Change the changes made. This procedure does not apply to all the programming procedures.

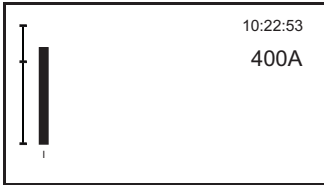
Two examples are provided below: one concerns the case in which no confirmation is needed for the changes made while in the other, a confirmation window appears.

Procedure where confirmation is not required

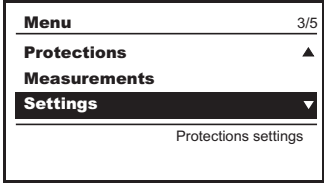
For instance, to set the System Date, the correct sequence is:

Press ESC from the default page  
to access the Main Menu  
Select SETTINGS item from the Main Menu  
press the ↵ key (enter)

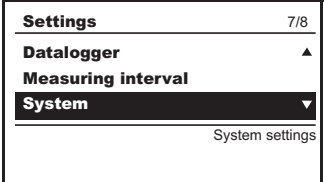
Select SYSTEM



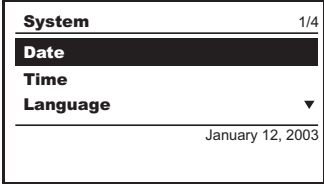
press the ↵ key (enter)



Select the DATE menu item to be changed



press the ↵ key (enter)



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press the ↵ key (enter)  
Change the date using the ↓ (arrow down) and

**Procedure where confirmation is required**  
For instance, to change the threshold of protection  $L$ , the correct

to access the Main Menu

Select the PROTECTION L item from the Main Menu  
press the ↵ key (enter)

You will be asked to enter the Password (sect. 12.3.5)  
comply with the password entry procedure  
press the ↵ key (enter)

The following mask will appear before the Main Menu is accessed:

Use the ↓ (arrow down) and ↑ (arrow up) keys to select the required option and press the ↵ (enter) key to confirm.

<b>Password</b>
0***
Enter password

Date
June 12, 2007

Category	Value
1	400A

Protections	1/6
<b>L Protection</b>	
<b>S Protection</b>	
<b>I Protection</b>	▼

<b>L Protection</b>	1/3
<b>Threshold I1</b>	
<b>Time t1</b>	
<b>Thermal memory</b>	

Password	
0***	
Enter password	

**Threshold I1**

---

**0,4 In (320A)**

---

<b>Programming</b>	1/3
<b>Confirm</b>	
<b>Abort</b>	
<b>Modify</b>	
	Confirm

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12.4.3.1. Modification of the basic configuration  
**No parameter settings can be made** if the PR122/DC unit is in an alarm condition.

The unit must be configured in the edit mode.  
Follow the instructions given in section 12.4.3 to display the following items:

Change System Date  
Change System Time  
Select System Language

System1/4

Date

Time

Language

New Password

\*\*\*\*

System1/4

Date

Time

Language

January 12, 2003

Password

0\*\*\*

Enter password

To change the System Password, select the relative menu item and press ↵ (enter). You will now be asked to enter the OLD password, after which you will be able to enter the new one twice.  
Press ESC twice to go back to the Main Menu.

The following mask will appear before the Main Menu is accessed:

Accept the new configuration  
Reject the new configuration (the previous configuration remains)  
Change the previously entered values

Programming1/3

Confirm

Abort

Modify

Confirm

Use the ↓ (arrow down) and ↑ (arrow up) keys to select the required option and press the ↵ (enter) key to confirm.  
Note: when selecting the system language, make sure that:  
- the relay is set to the local mode (if PR120/D-M is installed);  
- the CB is open.

The relay will not allow the language to be changed in the absence of one of the above conditions.

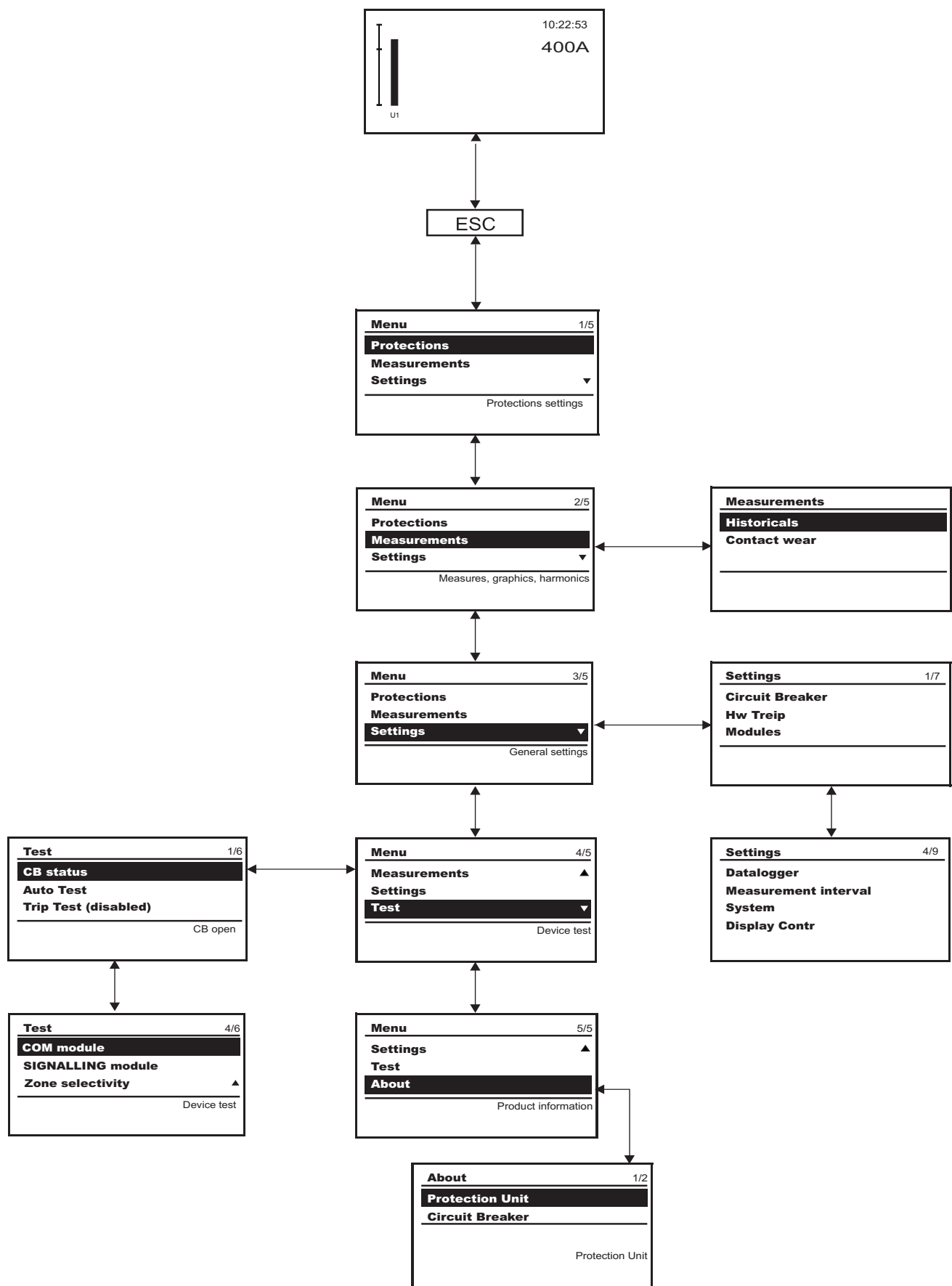
12.4.4. Default settings

The PR122/DC is supplied by ABB SACE with the following default parameters:

#	Protection	On/Off	Thresholds	Time	Curve	T.M.	ZS	Trip
1	L	--	1 In	102 s	-	Off	--	--
2	S	Off	6 In	50 ms	K	--	Off: 0.04 s	--
3	I	On	4 In	--	--	--	--	--
4	OT	--						Off
5	K LC1	Off	50 % I1					
6	K LC2	Off	75 % I1					
7	Language	--	Engl					
8	PR021/K	Off						
9	S startup	Off	6 In	100 ms				
10	I startup	Off	4 In	100 ms				
11	Password	--	0001					
12	Measuring interval	--	60 min					
13	Iw	Off	3 In					
14	MCR	Off	6 In	40 ms	--	--	--	--

12.5.1. Menu

As explained previously, the PR122/DC uses the display to show messages, diagrams and menus. All this information is organized in a logical, user-friendly way. The general layout showing how to access the main menu pages is given below.



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The following default page will appear on the display whenever the unit is turned on, or after more than 2 minutes of keyboard inactivity:

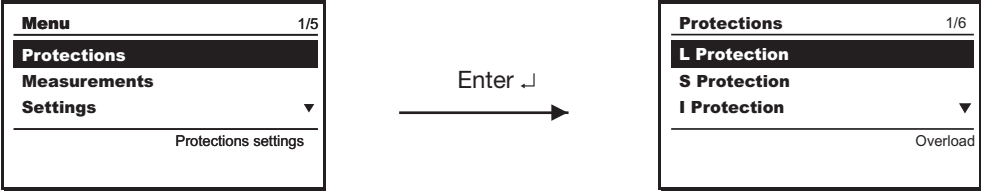
Percentage of the actual line currents and voltages in relation to the rated values (100%)



Current of the polarity under the greatest load

12.5.2. Protections Menu

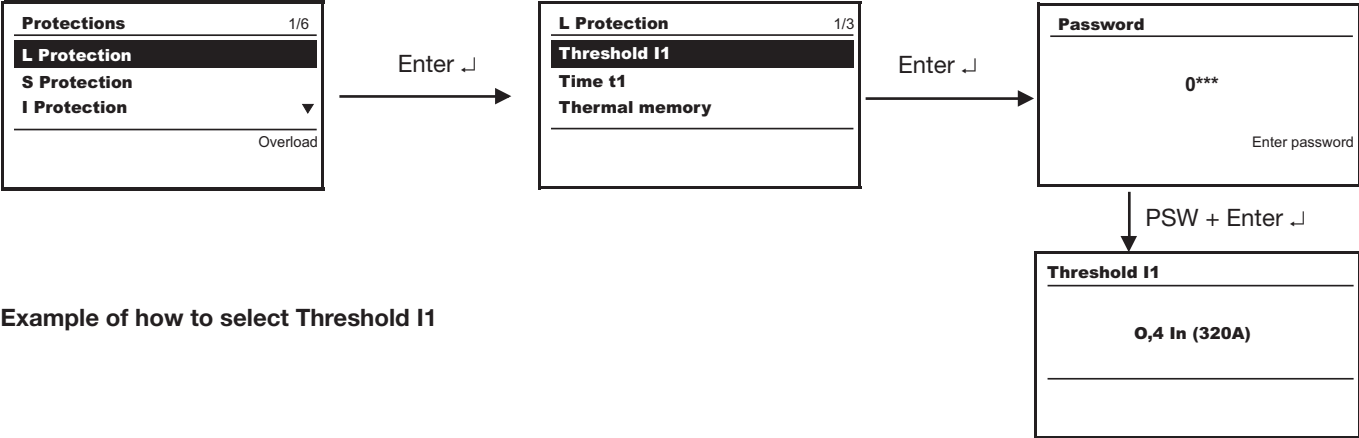
Press ENTER from the interface to access the menu with the various different protections available on the display



Use the "arrow UP" and "arrow DOWN" to display the various protections. As a whole, the data displayed concern the following protections: L, S, I, OT, LOAD PROTECTION.

Example of surfing in the Protection Menu

Press ENTER to access the Protection L menu from the Protections main page. You can now select the items in the menu with the "arrow UP" and "arrow DOWN", and confirm them by pressing ENTER. A Password prompt is triggered when ENTER is pressed. Entry of the Password allows you to select the functions associated with protection L (as shown in the example).



Example of how to select Threshold I1

Similarly, to access the menus of the other protections, consult the Protections Menu table below.

12.5.2.1. Protections Menu table

Protection	Parameter / Function		
L	Threshold I1		
	Time t1		
	Thermal memory		
	ON / OFF		
S	Enabling		
	ON / OFF		
	Curve		
	Threshold I2		
	Time t2		
	Zone selectivity		
	ON / OFF		
	Selectivity time		
I	Enable StartUp		
	ON / OFF		
	StartUp threshold		
	StartUp time		
OT	Enable Trip		
	ON / OFF		
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Protection	Parameter / Function	Enable Trip	ON / OFF
Load Control	Threshold 1 Enable Threshold	ON / OFF	
	Threshold 2 Enable Threshold		
	Threshold Iw Enable Threshold		

Note: for an explanation of the characteristics of the individual protections, their settings and relative curves, see sect. 12.2.9.

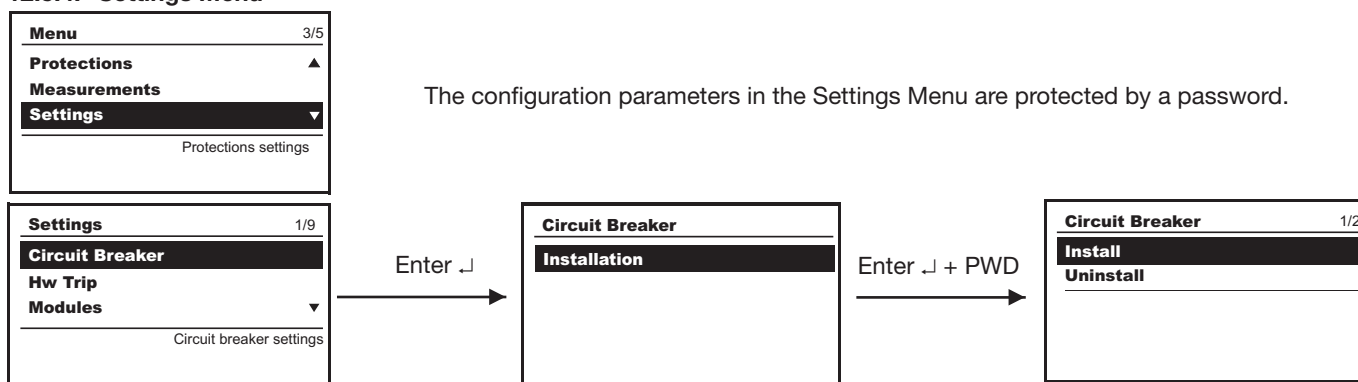
### 12.5.3. Measurements Menu

The following is a summary of the parameters that can be accessed from the menu of the PR122/DC unit.

#### 12.5.3.1. Measurements Menu table

Setting	Parameter / Function	Values	Notes
Historicals	Trips	Events	Last trips (20) Events log (max. 80 events)
	Measurements I Max Reset measurements	Current	
	Contact wear	Percentage of wear on CB contacts	

### 12.5.4. Settings Menu



#### 12.5.4.1. Settings Menu table

	Parameter / Function	Values	Notes
Circuit-breaker	Installation	Install/Uninstall	
	Hw Trip	Enable/Disable	
Modules	Module	(always present) if present if present Absent - Present	see sect. 12.5.5.1 see sect. 12.5.5.2 see sect. 15.5.5.3
	Data logger	Enable	ON/OFF Sampling frequency Stop event Stopping delay Restart Stop
Measurement interval		from 5 to 120 min, 5 min step	
System	Date		
	Time		
	Language	English/Italiano/Francais/Deutsch/Español	
Display	New password		
	Contrast		

For the summary table regarding surfing of the pages dedicated to Module PR120/K, see sect. 14.3, while for the PR021/K unit, see sect. 15.1.

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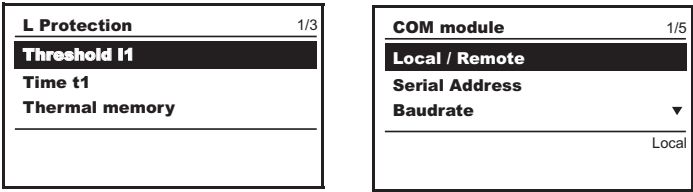
12.5.5. Modules

Access the Settings menu for the set of menus relating to the modules.

12.5.5.1. Module PR120/V - PR120/LV

The primary voltage values can be selected. See sect. 14.1

12.5.5.2. Module PR120/D-M - COM



The local and remote modes can be selected after a password has been entered. The serial address can be displayed after entry of the password. The BaudRate can be set at values 9600 and 19200 bits/s. The physical protocol provides for the following options: (8,E,1), (8,O,1), (8,N,2), (8,N,1). Standard Modbus or ABB addressing can be selected. See section 14.2 of this manual for further information about Communication Module PR120/D-M.

12.5.5.3. Module PR120/K - SIGNALLING

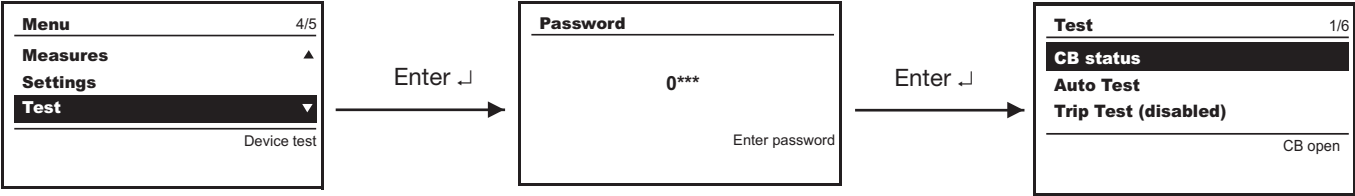
Refer to the relative section 14.3 for a detailed description of the signalling module.

12.5.5.4. Settings for the Local Bus unit

If the PR021/K unit is connected, the local bus must be activated by selecting present.

12.5.6. Test Menu

Access to the Test Menu is protected by a password.



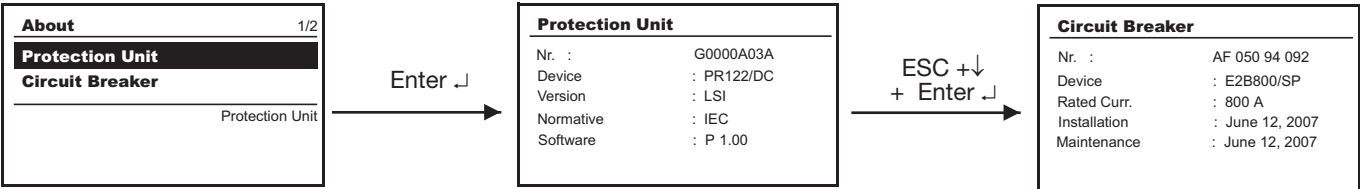
The menu shows the state of the CB, the state of the springs and the position of the CB in the dialog module (COM Module), while the CB can be opened or closed in this sub-menu. Trip disabling/enabling is displayed with the “Trip Test” function. If it is enabled, the circuit-breaker is opened. The function is only available with nil busbar current (use VauxPR030/B Ultra or PR010/T). The page (only with Vaux) also displays the state of the circuit-breaker (“STATE”), allowing you to make sure that the input has been wired correctly. The surfing path is outlined in the following table:

12.5.6.1. Test Menu table

Parameter / Function		Values	Notes
CB state		Open / Closed / Indefinite	Indefinite only in the case of a fault
Auto Test			
Trip Test		Enabled / Disabled	
Module PR120/D-M	State of springs CB position	Unloaded/Loaded Isolated/Withdrawn Open CB Close CB	
Module PR120/K	Input Auto Test	ON - - -	
Zone selectivity	Protection S (state) Input	ON/OFF Force Output Release Output	

12.5.7. Information Menu

The Information Menu displays data relating to the protection unit and the type of circuit-breaker.



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#### 12.5.7.1. Information about the trip and opening data

The PR122/DC stores all the information about the type of protection that has tripped, the opening data, the date and time. The release shows all these data on the display by means of the "i Test" button. There is no need for an auxiliary power supply for this function. With an auxiliary power supply, the information is shown immediately on the display without the need to press the "i Test" key and remains displayed indefinitely until the key is pressed.

The information remains available for 48 hours with the relay de-energized. The data relating to the last 20 trips are stored in the memory. You can retrieve the information about the last 20 trips recorded by connecting a PR030/B Ultra and PR010/T battery unit or a BT030 USB wireless communication unit.

The opening data display is accessed via the Historicals sub-menu of the Measurements menu. An example of the information provided data plate is given below:

<div> <div>Last Trip</div> <div>N.02</div> <div>June 12, 2007</div> <div>8:52:11:733</div> <div>L Protection</div> <div>I1: 625A</div> </div>	<div>← Number of openings due to tripped protections.</div> <div>← Protection tripped indication</div> <div>← Value of the current measured</div>
---	---

The Measurements Menu also displays the percentage of contact wear, which is an indication of the electrical life of the electrical contacts in the circuit-breaker.

The functionality of the relay is not changed in any way by the presence of wear messages.

The prealarm message (wear > 80%, "warning" led on) indicates that wear has reached a high value. The alarm message (100% wear, "alarm" led on) indicates that the state of contact wear must be checked.

The percentage of wear depends on the number of openings made by the circuit-breaker and by the absolute current interrupted in each.

### 12.6. Definition of alarms and signals in the PR122/DC unit

#### 12.6.1. Optical signals

Signalling	Description
<b>Warning</b> led (fixed yellow light)	<ul style="list-style-type: none"> <li>• The prealarm threshold has been exceeded; current value within the <math>0.9 \times I_1 &lt; I &lt; 1.05 \times I_1</math> range;</li> <li>• Contact wear over 80% (and less than 100%);</li> <li>• WARNING threshold <math>I_w</math> exceeded;</li> <li>• Circuit-breaker state error;</li> <li>• Configuration error;</li> <li>• Inconsistent settings.</li> </ul>
<b>Warning</b> led (yellow 0.5Hz)	• Internal temperature of relay exceeds WARNING threshold.
<b>Warning</b> led (yellow 2Hz)	• Internal temperature of relay exceeds ALARM threshold.
<b>Alarm</b> led (red)	<ul style="list-style-type: none"> <li>• Current values <math>I &gt; 1.3 I_1</math> present (timing of protection "L")*;</li> <li>• Timing in progress for protection S function;</li> <li>• Rating Plug disconnected;</li> <li>• 100% contact wear;</li> <li>• Trip Coil (TC) disconnected;</li> <li>• CB/relay inconsistency;</li> <li>• Installation error.</li> </ul>

\* Standard IEC 60947-2 defines the timing threshold L for current:  $1.05 < I < 1.3 I_1$ .

#### 12.6.2. Electrical signals

**K51/p1...p4** Electrical signals that can be programmed if the PR120/K module and auxiliary power supply are present.

**K51/p1...p8** Electrical signals that can be programmed if the PR121/K unit and auxiliary power supply are present.

The activated contacts can be reset by pressing the "i Test" button.


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### 12.6.3. Table of error and warning messages























All messages displayed concerning incorrect configurations, generic alarms or deriving from the protection functions and linked to useful information are described below.

The following symbols in the warning signals possess the meanings described below:

 = Warning signal / Protection in alarm state, without trip (trip=off).













 = Protection in alarm state, with trip at end of delay (trip=on).

 = Information, no action, except for display by the relay.

Alarm message	Description	Notes
 Contact wear	Alarm for contact wear	Contact wear = 100%
 T alarm	Alarm for protection T	Temperature outside range
 T (TRIP OFF)	Alarm for protection T	
 LC1 load	Alarm for load control LC1	
 Load LC2	Alarm for load control LC2	
 Sensor	Current sensor alarm	Sensor disconnected or faulty
 Warning signal	Protection in alarm state, without trip (trip=off).	
 TC disconnected	Trip Coil disconnected or faulty	
 Rating Plug	Error for Rating Plug absent or faulty	
 Invalid date	Clock information lost	
 CB state	CB state error	Probable error in Q26 and/or Q27
 Installation	Key plug error	
 CB not defined	Circuit-breaker state inconsistent (Open/Closed)	Probable error in Q26 and/or Q27
 Local bus	Local bus error	See sect. 12.7
 Contact wear	Contact wear prealarm	Contact wear $\geq 80\%$
 L prealarm	Protection L prealarm	
 T prealarm	Protection T prealarm	
 Warning lw	lw threshold exceeded	
 Timing L	Protection L timing	
 Timing S	Protection S timing	
 Configuration	Parameters inconsistent	
 Configuration	Relay key plug data inconsistent	

### 12.6.4. Error messages displayed in pop-up window

All the messages that appear on the display in a pop-up window are described below.

Error message	Description
 Password error	
 Session impossible	A programming session cannot be started due to a contingency (e.g. timing still in progress)
 Value outside range	Value beyond the established limits
 Exception 6	Command temporarily unavailable
 Unavailable	Function temporarily unavailable
 Invalid date	Date has not been set
 Parameters revised	Programming session concluded correctly
 Cancelled	Programming session cancelled
 Failed	Programming session rejected
 Failed 1001	Inconsistency between thresholds of protections L and S
 Failed 1002	Inconsistency between thresholds of protections I and S
 Failed 3001	Inconsistency as to language change




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## 12.7. PR122/DC troubleshooting

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

### NOTE.

- Before consulting the following table, check for any error messages that may appear on the display.
- FN indicates that the PR122/DC is operating normally.
- Please call the ABB SACE assistance service if the suggestions proposed are unable to solve the problem.

N°	Situation	Possible causes	Suggestions
1	The trip test cannot be run	1. The busbar current is > 0. 2. The TC is not connected 3. Circuit-breaker open.	1. FN 2. Check the messages on the display
2	Trip times lower than expected	1. Threshold too low 2. Curve too low 3. Thermal memory enabled 4. The SdZ is inserted	1. Correct threshold 2. Correct curve 3. Exclude if not necessary 4. Exclude if not necessary
3	Trip times higher than expected	1. Threshold too high 2. Curve too high 3. Curve I2t inserted	1. Correct threshold 2. Correct curve 3. Exclude if not necessary
4	Rapid trip, with I3=Off	Inst tripped	FN with short-circuit with high I
5	Display off	1. Incorrect voltage socket connection 2. Vaux missing and voltage below minimum value 3. Temperature outside range	1. Warning: see 12.3.4 2. FN, see 12.2.2.1 3. FN, see 12.2.9.5
6	The display is not backlit	Voltage below the limit for lighting the display	FN
7	Reading of I incorrect	Current below the minimum threshold that can be displayed	FN
8	"  Local Bus" message on display	No communication between PR122/DC and PR021/K	1. If not present, disable PR021/K, see 12.5.4.2.3 2. Check bus connection 3. Check PR021/K
9	Message "" instead of the expected data	Function disabled or data outside range	FN
10	The expected trip does not occur	Trip function excluded	FN enable trip if necessary
11	Opening data not displayed	Vaux missing, buffer capacitor discharged	FN, see 12.5.6.1
12	The password is not requested	The password has been disabled	FN, enter the password again with a value other than 0000.
13	Impossible to change any of the parameters	PR122/DC in alarm state	FN
14	"  Temp sensor" or "  Start-up" message	Possible fault inside relay	Call ABB SACE
15	Invalid date	1. First installation 2. Information lost due to power failure	FN see 12.4.3.1
16	Untimely trip		see 12.6.3
17	LED light on		see 12.6.1
18	The language cannot be changed	1. Relay set to the remote mode 2. The CB is not open	1. Set to local mode 2. Open the CB

### 12.7.1. If faults occur



**WARNING:** If you suspect that the PR122/DC is faulty, functions incorrectly or has generated an unwanted trip, you are strongly advised to strictly comply with the following recommendations from the Measurements Menu → Historicals → Trip:

- Make a note of the type of protection that has tripped by accessing the LAST TRIP page if there is an external power supply (Vaux or battery).
- Note down the type of circuit-breaker, the number of poles, any accessories connected, In, Serial Number (see sect. 12.4) and the sw version.
- Prepare a brief description of the opening (which leds and/or signals were displayed? When did it happen? How many times? Was it always under the same conditions? With what type of load? What voltage? What current? Is the event reproducible?)
- Send/notify all the information collected, together with the circuit diagram of 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 a technical analysis of the problem and will allow us to resolve it as soon as possible.

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## 12.8. Accessories

### 12.8.1. ABB SACE PR010/T test and configuration unit

Testing performed with the SACE PR010/T unit allows the user to make sure that the thresholds and trip times of protection functions “L”, “S”, “I” operate correctly. The test unit is connected to the relay with a dedicated connector (see sect. 12.4).

### 12.8.2. BT030 USB communication unit

Using a BT030 USB wireless communication unit, the PR122/DC can be connected via radio to a Pocket PC (PDA) or a normal PC, thereby extending the range of information available to the user. The values of the currents flowing through the circuit-breaker, the value of the last 20 interrupted currents and the protection settings can be read by means of ABB SACE Ekip T&P communication software.

### 12.8.3. PR021/K and HMI030 units

The PR122/DC can also be connected to the optional PR021/K external signalling unit (see sect. 15.1) so as to indicate alarms and protection trips by means of potential-free power contacts, and to the HMI030 switchboard front so as to display a wide variety of information.

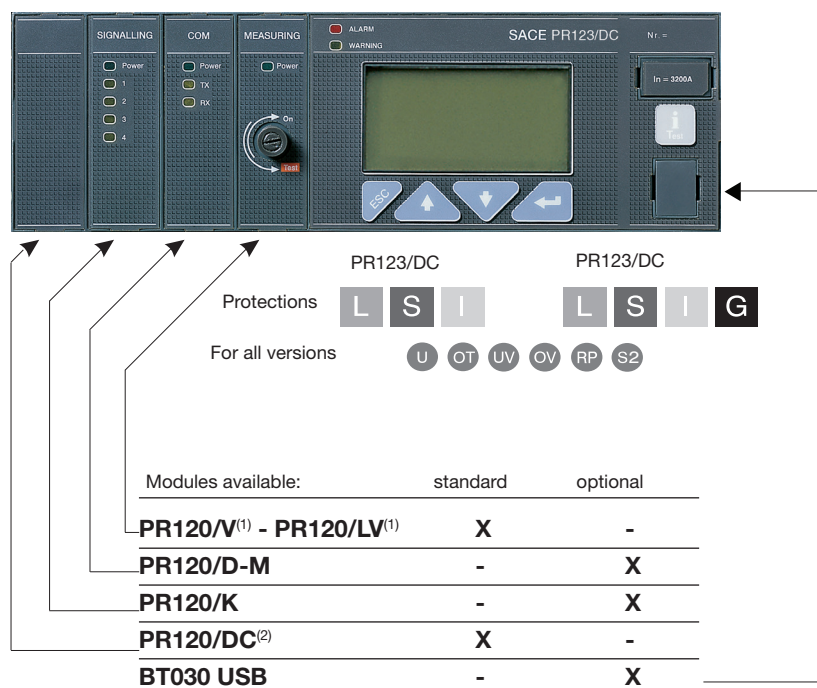
### 12.8.4. PR030/B Ultra power supply unit

The PR030/B Ultra power supply unit is an external unit that allows the Relay, Autotest and Trip Test to be powered, as well as CB open checks and the installation of new replacement units.

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### 13. SACE PR123/DC release – Identification

In accordance with IEC and UL standards, PR123/DC units are available with the various protections, default modules and options, as illustrated in the figure below:



<sup>(1)</sup> Standard equipment: PR120/V or alternatively, PR120/LV

<sup>(2)</sup> Slot inside occupied by PR120/DC

#### 13.1. Standards

PR123/DC has been designed to operate in accordance with the following international standards:

**IEC 60947-2 Low voltage apparatus. Circuit-breakers.**

**UL 1066 Low Voltage AC and DC Power Circuit Breakers Used in Enclosures.**

**ANSI C37.14 Low voltage DC Power Circuit Breakers Used in Enclosures.**

#### 13.2. Specifications

##### 13.2.1. General information

PR123/DC is a high-performance protection unit with **Protection, Measurement, Data Storage, Communication** (optional), **Self-test, Load Control and Zone Selectivity** functions for the ABB SACE 'Emax' series of three- and four-pole air circuit-breakers. The user interface of the unit also enables parameter setup and complete prealarm and alarm management for the protection and watchdog functions. It is equipped with an instantaneous override protection that trips when the electronic relay is not powered. The basic protections available are:

Symbol	Protection against
<b>L</b>	overload with inverse long-time delay
<b>S, S2</b>	short-circuit with adjustable delay
<b>I</b>	instantaneous short-circuit
<b>G</b>	earth fault with adjustable delay
<b>U</b>	currents unbalance
<b>OT</b>	temperature out of range
<b>UV</b>	undervoltage
<b>OV</b>	overvoltage
<b>RP</b>	reverse active power
<b>MCR</b>	closing on short-circuit

PR123/DC can be installed on both three-pole and four-pole circuit-breakers.

The unit opens the circuit-breaker in which it is installed by means of the TC, which acts directly on the mechanical lever mechanisms of the device.

The protection unit is self-supplied by primary voltages (PR120/V or PR120/LV module).

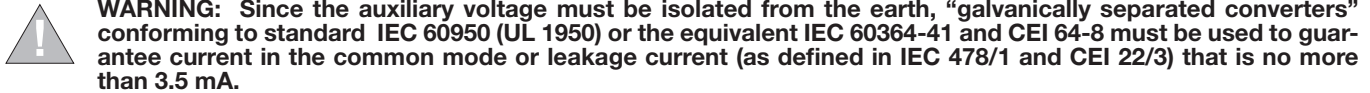
The unit features digital microprocessor technology and interfaces with the user by means of a graphic display and keyboard.

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### 13.2.2. Auxiliary power supply

The external auxiliary power supply is provided using a galvanically-separated power supplier.



The presence of the auxiliary power supply allows the relay unit to be used even with the circuit-breaker open as well as powering all the modules, with the exclusion of the PR120/V Module, which is powered by means of a connection to the busbars. The characteristics of the power supplier are given in the table below:

Characteristics	Version PR123/DC
Auxiliary voltage (galvanically separated)	24 V DC $\pm 20\%$
Maximum ripple	5%
Inrush current @ 24 V	$\sim 10$ A for 5 ms
Rated power @ 24 V	$\sim 5$ W

#### 13.2.2.1. Powered by the PR120/V- PR120/LV module

For a full explanation of the features of the PR120/V - PR120/LV module, see sect. 14.1.

### 13.2.3. Environmental characteristics

Operating temperature	-25 °C ... +70 °C
Storage temperature	-40 °C ... +90 °C
Relative humidity	0% ... 98% with condensation
Degree of protection (with PR123/DC installed in the CB)	IP 30

### 13.2.4. Description of the inputs/outputs

#### 13.2.4.1. Binary inputs

- **K51/SZin (K51/DFin):** Zone selectivity: input for protection S (only with Vaux)
- **K51/Gzin (K51/DBin):** Zone selectivity: input for protection G (only with Vaux)

#### 13.2.4.2. Binary outputs:

- **K51/SZout (K51/DFout):** Zone selectivity: output for protection S (only with Vaux)
- **K51/GZout (K51/DBout):** Zone selectivity: output for protection G (only with Vaux)

Note: These inputs/outputs should only be used between devices of the PR122/PR123 series.

### 13.2.5. Communication bus

Internal bus, on rear connector; RS485 physical interface, Modbus protocol.

External system bus, RS485 physical interface, Modbus RTU protocol, baud rate 9600 - 19200 bps.

Test bus, on front test connector.

### 13.2.6. Protection functions

The PR123/DC protection unit provides 11 independent protection functions. In detail:

1. Protection against overload with inverse time “**L**”;
2. Protection against short-circuits with adjustable delay “**S**” and “**S2**”;
3. Protection against instantaneous short-circuit “**I**”;
4. Protection against closing on short-circuit “**MCR**”;
5. Protection against earth fault with adjustable delay “**G**”;
6. Protection against polarity unbalance “**U**”;
7. Protection against temperature rise “**OT**”;
8. Protection against undervoltage “**UV**”;
9. Protection against overvoltage “**OV**”;
10. Protection against reverse active power “**RP**”;
11. Override protection with relay not powered.

A timing indication (message + “alarm” Led) is provided on the unit's display and is activated during a protection alarm. It is deactivated when the alarm condition ceases or when the protection has tripped. The page with the “Trip” data is displayed when the circuit-breaker opens (when “i Test” is pressed or automatically, in the presence of Vaux).

#### 13.2.6.1. Circuit-breaker state

The PR123/DC unit detects the state of the circuit-breaker by means of specific wiring in the CB itself. When the presence of current is detected with the circuit-breaker “OPEN”, state error is signalled by means of a warning message (see sect. 13.6) and the “warning” led comes on.

The signal can be combined with a relay of the PR120/K module or with those of the PR021/K unit.

### 13.2.7. Measurement functions

The current measuring (ammeter) function is available in all versions of the SACE PR123/DC unit.

The display shows histograms of the polarity on the main page. In addition, the current of the polarity under the greatest load is given in numerical form. Where applicable, the earth fault current is displayed in a dedicated page.

The PR123/DC release provides a complete set of measurements:

- Current
- Voltage
- Instantaneous voltage values over a given time interval (Data Logger);
- Active power
- Energy
- Maintenance: number of operations, percentage of contact wear, opening data storage.
- Data Logger see sect. 15.2.

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The PR123/DC can provide the trend of the measurements of certain quantities over an interval P established by the user these include: mean active power, maximum active power, overcurrent, overvoltage and undervoltage. The last 24 P intervals (adjustable from 5 to 120 min.) are stored in a non-volatile memory and displayed in a histogram. See the relevant sections (sect. 14.1 and sect. 13.5.3) of the PR120/V module to examine the Measurement functions.

### 13.2.8. Watchdog

The PR123/P unit provides some watchdog functions able to ensure that relay faults are managed properly. These functions are as follows:

- ☐ Watchdog for the presence of Auxiliary Power Supply with the "plug" icon displayed.
- ☐ Rating PLUG validity.
- ☐ Watchdog for proper connection of the Trip Coil (TC). If enabled, any faults are signalled by a special alarm message and by the "Alarm" led coming on. If the PR120/D-M module is installed, it activates the coil opening command (Y0), thus opening the CB.
- ☐ Watchdog for protection of Hw Trip. If enabled, in the event of CB undefined or Rating Plug error, or Installation error, a CB command is given, by activation of the TC.

### 13.2.9. Description of the protection functions

#### 13.2.9.1. Protection "L"

Protection "L" is the only one that cannot be disabled since it is for self-protection against overloading of the relay itself.

Only one type of curve can be set and it is defined by standard IEC 60255-8.

The protection trip time, inverse time, is given by the expression:

$$\tau \ln \left( \frac{I_f}{I_f^2 - I_p^2} \right) \text{ for } I_f \leq 12I_n \text{ and } 1s \text{ for } I_f > 12I_n \quad \text{where } I_f \text{ is the fault current and } I_p \text{ the protection threshold and with } \tau = t1 / (\ln 9/8)$$

NOTE: Time expressed in seconds.

##### 13.2.9.1.1. Thermal memory "L"

The thermal memory can be enabled to protect the cables on the basis of the "hot state" curve of the IEC 60255-8.

$$\tau \ln \left( \frac{I_f^2 - I_p^2}{I_f^2 - I_1^2} \right) \text{ for } I_f \leq 12I_n \text{ and } 1s \text{ for } I_f > 12I_n \quad \text{where } I_p \text{ is calculated on the basis of the evolution of the current over time, providing there is no overload condition.}$$

The PR123/DC is fitted with two instruments for creating this thermal memory. The first is only effective when the release is powered (it also records overloads that have not lasted long enough to trip the release), while the second even works when the release is not powered, reducing any trip times in the case of an immediate reclosing and until the moment the circuit-breaker trips. It is the PR123/DC release that automatically decides which of the two to use, depending on the various different situations.

#### 13.2.9.2. Protection "S"

This protection, which can be disabled, can be the fixed time ( $t=k$ ) or inverse time ( $t=k/i^2$ ) type. In the latter case, the trip time is given by the expression

$$\max \left[ \frac{100 \cdot t_2}{(I_f)^2}, t_2 \right] \text{ per } I_f > I_2 \quad \text{where } I_f \text{ is the fault current and } I_2 \text{ the protection threshold.}$$

##### 13.2.9.2.1. Thermal memory "S"

The thermal memory function can be enabled for cable protection when the curve with inverse time is selected. This is based on the "tS" parameter defined as the trip time of the curve (t2) selected at  $1.5 \times I_2$ . The other characteristics are the same as those for thermal memory "L" (see sect. 13.2.9.1.1).

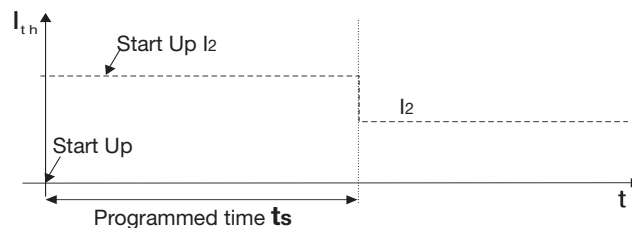
##### 13.2.9.2.2. Start-up threshold "S"

The start-up function can be selected when the curve with fixed time is selected.

The function can be disabled and is a setting characteristic of the individual protection units.

The start-up function allows the protection threshold (S, I and G) to be changed during a time interval lasting "ts" starting from "start-up". This latter must be understood to be as follows:

– Passage of the RMS value of the overcurrent over one single adjustable threshold (0.1...10In, in 0.1In steps). There can be a new start after the current has dropped below that threshold.



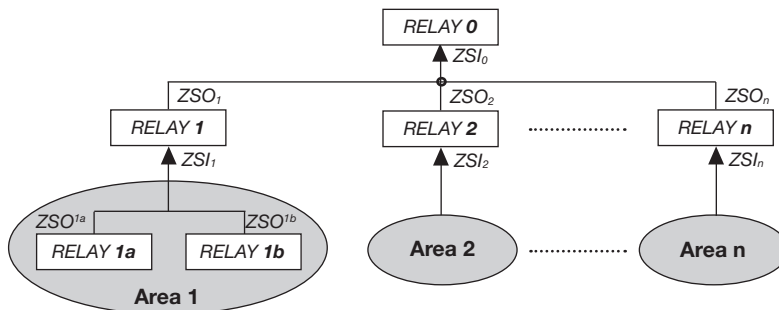
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#### • Start-up time

There is a different start-up time for all the protections concerned.  
Range: 0.1 s ... 30 s, with 0.01 s steps.

#### 13.2.9.2.3. Zone selectivity "S"

The zone selectivity function, guaranteed only if an auxiliary voltage is provided, allows the fault area to be isolated by only isolating the part of the installation nearest to the fault itself, while the rest of the installation remains operative. This is achieved by connecting all the zone selectivity outputs (ZSO=K51/SZout) of the releases belonging to the same zone to each other and by conveying this signal to the zone selectivity input (ZSI=K51/SZin) of the next release on the supply side. If the wiring has been made correctly, all the zone selectivity inputs of the last circuit-breaker in the chain and all the outputs of the circuit-breakers at the head of each chain must be empty.



As a practical example, the figure above shows a fault in the load side of "Relay 1a", isolated by this latter without "Relay 1" or "Relay 0" being tripped. A fault immediately downstream of "Relay 1" will be isolated by this latter without "Relay 0" being tripped, thus ensuring that Areas 2...n remain operative.

Output ZSO can be connected to up to 20 ZSI of relays on the supply side in the selectivity chain.

**WARNING:** The maximum length of cable for zone selectivity between two units, is 300 meters. Use shielded stranded two-wire cable (see note A in sect. 11.2.2). The shield must only be earthed on the circuit-breaker of the supply-side relay (ZSI side). Operation is only guaranteed when there is auxiliary voltage.  
The following logical table is used to manage the Zone Selectivity Input (ZSI) and Zone Selectivity Output (ZSO).

Zone selectivity	$I_{max} > I_2$	ZSI signal	ZSO signal	Trip T
Excluded	NO	0	0	No trip
Excluded	NO	1	0	No trip
Excluded	YES	0	0	$t_2$ programmed
Excluded	YES	1	0	$t_2$ programmed
Inserted	NO	0	0	No trip
Inserted	NO	1	1	No trip
Inserted	YES	0	1	$t_{selectivity}$
Inserted	YES	1	1	$t_2$ programmed

The value setting for time  $t_2$  must be equal to or higher than  $t_{selectivity} + 50$  ms on the circuit-breaker on the supply side, not required on the first one in the chain.

#### 13.2.9.3. Double S

Thanks to the new PR123/DC release that allows two independent and simultaneously active protection S thresholds to be specified, selectivity can be ensured even in critical conditions. This function allows a better selectivity level to be obtained than by using a release without a "double S". This function is valid for t=K only.

#### 13.2.9.4. Protection "I"

The protection can be enabled/disabled from the menu. Where zone selectivity "S" is active, output signal ZSO is activated during the relay trip for "I" in any case, so as to ensure that the relays on the supply side (and load side) function correctly.

##### 13.2.9.4.1. Start-up threshold "I"

The start-up function can be selected. The function can be enabled from the menu on the protection "I" page. The function behaves in exactly the same way as the one described for protection "S" (see sect. 13.2.9.2.2).

#### 13.2.9.5. "MCR" protection against closing on short-circuit

The MCR function is used to protect the installation against closing on short-circuit. This protection is activated when the circuit-breaker is closed, within a time slot ranging from 40 and 500ms and with a threshold established by the customer using the same algorithm as protection I. This protection can be disabled and is an alternative to protection "I". The function can be activated with a PR010/T hand-held unit via Ekip Connect software or through a remote system via a system bus. This function has one fixed time protection curve only.

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#### 13.2.9.6. Protection "G"

This protection, which can be disabled, can be the fixed time ( $t=k$ ) or inverse time ( $t=k/i^2$ ) type. In the latter case, the trip time is given by the expression

$$\max \left( \frac{2}{I^2}, t_4 \right) \text{ where } I=I_f/I_4, I_f \text{ is the fault current and } I_4 \text{ the protection threshold.}$$

NOTE: Time expressed in seconds.



**WARNING: The trip control of the protection can be disabled ("Enable Trip: Off"). Circuit-breaker opening does not take place for the entire duration of the earth fault, but only the alarm condition is signalled ("Alarm" led on and alarm message).**

This is provided inside the relay by calculating the vectorial sum of the currents of the 2 polarities. The fault current is defined by the following formula:

$$\vec{I}_G = \vec{I}_A + \vec{I}_B$$

When the circuit does not show any fault, the modulus of the sum of these currents is always nil. On the other hand, the value of the fault current will become increasingly higher depending on the size of the fault. This operating mode is enabled by default.

##### 13.2.9.6.1. Start-up threshold "G"

The start-up function can be selected when the curve with fixed time is selected.

The function can be enabled and disabled from the protection "G" page.

The function behaves in exactly the same way as the one described for protection "S" (see sect. 13.2.9.2.2).

##### 13.2.9.6.2. Zone selectivity "G"

The zone selectivity function can be enabled providing the fixed time curve has been selected, and the function is only assured if auxiliary voltage is provided.

Zone selectivity "G" can be active at the same time as zone selectivity "S".

The behaviour and wiring of the function are exactly the same as the those described for zone selectivity "S" (see sect. 13.2.9.2.3).

##### 13.2.9.7. Protection against unbalance "U"

This protection with fixed time, which can be excluded, trips when, for the **t6** time setting or longer, an unbalance occurs between two polarities higher than the **I6** threshold setting. Range: 2 ... 90%, with 1% steps.

The percentage of unbalance is calculated in the following way

$$\%Sbil. = \frac{I_{\max} - I_{\min}}{I_{\max}} \cdot 100 \text{ where } I_{\max} \text{ is the maximum and } I_{\min} \text{ the minimum polarity current.}$$



**WARNING: WARNING: The trip control of the protection can be disabled ("Enable Trip: Off"). In this case, circuit-breaker opening does not take place for the entire duration of the unbalance, but the condition is only by the "warning" led, which comes on, and by a warning message. When the value of the polarity current is above  $6xI_n$ , function "U" excludes itself because, in this case, the other protections trip. The protection is not enabled for maximum polarity current values of less than  $0.3xI_n$ .**

##### 13.2.9.8. "OT" protection against temperature rise inside relay

There is a sensor in the PR123/DC unit that monitors the temperature of the unit itself.

This allows abnormal temperature conditions to be signalled, conditions which could lead to temporary or continuous malfunctioning in the electronic components of the unit.

The protection has two operating states:

State of **"WARNING TEMPERATURE"** with  $-25^{\circ}\text{C} < \text{temp.} < -20^{\circ}\text{C}$  or  $70^{\circ}\text{C} < \text{temp.} < 85^{\circ}\text{C}$  :

the display is turned off and the "WARNING" led flashes at 0.5 Hz

State of **"ALARM TEMPERATURE"** with  $\text{temp.} < -25^{\circ}\text{C}$  or  $\text{temp.} > 85^{\circ}\text{C}$  :

the display is turned off, the "WARNING" and "ALARM" leds flash at 2 Hz and the Trip is activated (if enabled, by means of the "Over Temper. Trip = On" parameter).

Note:

- The display is turned off to preserve its functionality in the case of Warning and Alarm.
- The monitored temperature is not visible on the display.

The protection is always active, with both auxiliary and self-supply.



**WARNING: Disabling the Trip control of the protection means that the PR123/DC unit could work, with the circuit-breaker closed, within a temperature range where correct operation of the electronics is not guaranteed.**

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### 13.2.9.9. Load control function

Single loads can be enabled/disabled on the load side before overload protection L trips the circuit-breaker on the supply side. This is done by contactors or switch-disconnectors (wired outside the release) controlled by the PR123/DC by means of contacts of the PR120/K module or of the PR021/K external unit.

The current thresholds are lower than those available with protection L, so that the load control can be used to prevent tripping due to overloads. The function is active when an auxiliary power supply, or supply from PR120/V are present (see sect. 14.1.3). The operating logic requires the activation of three contacts when preset thresholds LC1, LC2 and  $I_w$  are exceeded. Thresholds LC1 and LC2 are expressed as a percentage of  $I_l$  (current threshold specified for protection L), while "warning current"  $I_w$  is expressed as an absolute value. The setting values permitted are given in the following table:

Warning current $I_w$	0.30 to 10.00 steps of $0.05 \times I_n$
Threshold LC1	50% to 100% steps of $1\% \times I_l$
Threshold LC2	50% to 100% steps of $1\% \times I_l$

From PR123/DC, each of the PR120/K or PR021/K contacts can be associated with a configuration (NO or NC), a delay and a latch (if applicable).

### 13.2.9.10. Voltage protections "U", "OV"

The PR123/DC provides 2 voltage protections, which can be disabled, with adjustable fixed time ( $t=k$ ), active with both self-powering and with auxiliary power:

- Undervoltage "UV";
- Overvoltage "OV";

Apart from the normal timing and "TRIP" operation, the voltage protections can be in a state defined as "alarm" (with the "emergency" led on and an alarm message displayed), providing there is an auxiliary or PR120/V or PR120/LV power supply. In fact, when the circuit-breaker is open and current is not detected, the timing leads to the "alarm" state and not to the "TRIP" state. This is because the fault linked to the voltages can persist even with the circuit-breaker open and the unit would therefore always be under "timing". When the circuit-breaker is closed or the passage of a current is detected, the apparatus immediately passes to the "TRIP" state without timing.

#### 13.2.9.10.1. Protection "UV"

When the undervoltage drops below the  $U_g$  threshold setting, the protection counts down the set time interval  $t_g$  and then opens.

#### 13.2.9.10.2. Protection "OV"

When the overvoltage exceeds the  $U_g$  threshold setting, the protection counts down the preset time interval  $t_g$  and then opens.

### 13.2.9.11. Protection against Reverse Active Power "RP"

The PR123/DC provides protection against reverse active power, which can be disabled, with adjustable fixed time ( $t=k$ ), active with both self-powering and with auxiliary power:

When the total reverse active power (sum of the power of the 2 polarities) exceeds the reverse active power threshold setting  $P_{11}$ , the protection counts down the preset time interval  $t_{11}$  and then opens.

The minus sign ('-') in front of the threshold and power indicates reverse power. The threshold is indicated as a percentage of "Pn", where "Pn" is the rated power of the circuit-breaker.

### 13.2.9.12. Double protection setting

Using the double protection setting, the PR123/DC can save a set of alternative parameters for all the protections. The second set of parameters (set B) can replace the default set (set A) by means of an external command. The passage from set A to set B can be made when there is a change in the network configuration or when there is an emergency capable of changing the load capacity and short-circuit levels.

The second set of parameters (set B) can be enabled by:

- Digital input provided with the PR120/K module. For instance, it can be connected to an auxiliary contact of a bus-tie;
- Communication network, by means of the PR120/D-M (e.g. when the switch is scheduled);
- Directly from the user interface of the PR123/DC (see settings menu, sect. 13.5.4);
- With a time that can be specified by set A and set B after the circuit-breaker has closed;
- Depending on a Vaux being installed.

The state (set A and set B) is indicated on the display during operation.

The double setting is disabled by default. To enable it, see sect. 13.5.4.1.

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## 13.2.9.13. Summary table of the protection function settings for PR123/DC

Protection	Disabling	Disabling TRIP only	Zone selectivity	Start-up threshold	Thermal memory	Threshold range	Time Range	Threshold tolerance <sup>(2)</sup>	Time tolerance <sup>(2)</sup>
<b>L</b> curve IEC60255-8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	$0.4xI_n \leq I_{t1} \leq 1xI_n$ 0.01xIn step	$3s \leq t_{t1} \leq 102s^{(1)}$ , 3s step $t_{t1} @ 3I_{t1}$	Release between 1.05 and 1.3xI1	$\pm 10\%$ , $I_{t1} \leq 4 I_n$ $\pm 20\%$ , $I_{t1} > 4 I_n$
<b>S<sub>1</sub></b> (t=k) see *	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	$0.6xI_n \leq I_{t2} \leq 10xI_n$ 0.1xIn step $0.6xI_n \leq I_{t2 \text{ start-up}} \leq 10xI_n$ 0.1xIn step	$0.05s \leq t_{t2} \leq 0.35s$ , 0.01s step $0.10s \leq t_{t2 \text{ start-up}} \leq 30s$ , 0.01s step $0.04s \leq t_{t2 \text{ sel}} \leq 0.20s$ , 0.01s step	$\pm 7\%$ , $I_{t2} \leq 6 I_n$ $\pm 10\%$ , $I_{t2} > 6 I_n$	The best of the two values $\pm 10\%$ o 40 ms
<b>S<sub>1</sub></b> (t=k/I <sup>2</sup> ) see *	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	$0.6xI_n \leq I_{t2} \leq 10xI_n$ 0.1xIn step	$0.05s \leq t_{t2} \leq 0.35s$ , 0.01 step at 10xIn	$\pm 7\%$ , $I_{t2} \leq 6 I_n$ $\pm 10\%$ , $I_{t2} > 6 I_n$	$\pm 15\%$ , $I_{t2} \leq 6 I_n$ $\pm 20\%$ , $I_{t2} > 6 I_n$
<b>S<sub>2</sub></b> (t=k) see *	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	$0.6xI_n \leq I_{t2} \leq 10xI_n$ 0.1xIn step	$0.05s \leq t_{t2} \leq 0.35s$ , 0.01s step $0.10s \leq t_{t2 \text{ start-up}} \leq 30s$ , 0.01s step $0.04s \leq t_{t2 \text{ sel}} \leq 0.20s$ , 0.005s step	$\pm 7\%$ , $I_{t2} \leq 6 I_n$ $\pm 10\%$ , $I_{t2} > 6 I_n$	The best of the two values $\pm 10\%$ o 40 ms
<b>I</b> (t=k)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	$1.5xI_n \leq I_{t3} \leq 10xI_n$ 0.1xIn step	$\leq 30 \text{ ms}$ $0.10s \leq t_{t3 \text{ start-up}} \leq 30s$ , 0.01s step where $I > I_4$	$\pm 10\%$	
<b>MCR</b> (t=k)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	$6.0xI_n \leq I_{t5} \leq 10xI_n$ 0.1xIn step	$\leq 30 \text{ ms}^{(3)}$		$\pm 10\%$
<b>G<sup>(4)</sup></b> (t=k)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	$0.20xI_n \leq I_{t4} \leq 1xI_n$ 0.02xIn step	$0.1s \leq t_{t4} \leq 1s$ , 0.05s step $0.1s \leq t_{t4 \text{ start-up}} \leq 1s$ , 0.02s step $0.04s \leq t_{t4 \text{ sel}} \leq 0.2s$ , 0.01s step where $I > I_4$	$\pm 7\%$	The best of the two values $\pm 10\%$ or 40 ms
<b>G<sup>(4)</sup></b> (t=k/I <sup>2</sup> )	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	$0.20xI_n \leq I_{t4} \leq 1xI_n$ step 0.02xIn	$0.1s \leq t_{t4} \leq 1s$ , 0.05s step @ $I_{t4} > 4I_n$	$\pm 7\%$	$\pm 15\%$
<b>U</b> <b>SFib</b> (t=k)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	$2\% \leq I_{t6} \leq 90\%$ 1% step	$0.5s \leq t_{t6} \leq 60s$ , 0.5s step	$\pm 10\%$	The best of the two values $\pm 10\%$ or 40 ms
<b>OT</b> (temp=k)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	fixed, defined by SACE	Instantaneous	$\pm 5^\circ\text{C}$	—
<b>Iinst</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Automatic, defined by SACE	Instantaneous		
<b>UV</b> (t=k)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	$0.5xU_n \leq U_{t8} \leq 0.95xU_n$ step 0.01xUn	$0.1s \leq t_{t8} \leq 5s$ , 0.1s step	$\pm 5\%$	The best of the two values $\pm 10\%$ or 40 ms
<b>OV</b> (t=k) ms	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	$1.05xU_n \leq U_{t9} \leq 1.2xU_n$ step 0.01xUn	$0.1s \leq t_{t9} \leq 5s$ , 0.1s step	$\pm 5\%$	The best of the two values $\pm 10\%$ or 40
<b>RP</b> (t=k)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	$-0.3xP_n \leq P_{t11} \leq -0.1xP_n$ step 0.02 Pn	$0.5s \leq t_{t11} \leq 25s$ , 0.1s step	$\pm 10\%$	The best of the two values $\pm 10\%$ or 40 ms
<b>Load control</b> <b>LC1/LC2</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	50% to 100% step 0.05xI <sub>1</sub>			
<b>Warning Iw</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0.3 to 10I <sub>n</sub> step 0.05xI <sub>n</sub>		$\pm 10\%$	10 to 40 ms

<sup>(1)</sup> The minimum value of this trip is 0.5s, regardless of the type of curve set (self-protection)

<sup>(2)</sup> These tolerances are based on the following assumptions:

- relay at full power (without start-up);
- preset trip time of  $\geq 100 \text{ ms}$ .

<sup>(3)</sup> No trip time

<sup>(4)</sup> Protection G is disabled for current values higher than 4In, where  $I_4 < 0.5 I_n$ , higher than 6 In, where  $0.5 I_n \leq I_4 < 0.8 I_n$  and higher than 8 In where  $I_4 \geq 0.8 I_n$ .

<sup>(5)</sup> For special version E3H Icu=85ka, S always ON and  $t_{t2} = 0.05 \dots 0.25s$

The following tolerance values apply to all cases not covered by the above hypotheses:

Protections	Trip threshold	Trip time
L	Release between 1.05 and 1.3 x I1	$\pm 20\%$
S	$\pm 10\%$	$\pm 20\%$
I	$\pm 15\%$	$\leq 60\text{ms}$
G	$\pm 10\%$	$\pm 20\%$
Others		$\pm 20\%$

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13.2.9.14. Table of measurements

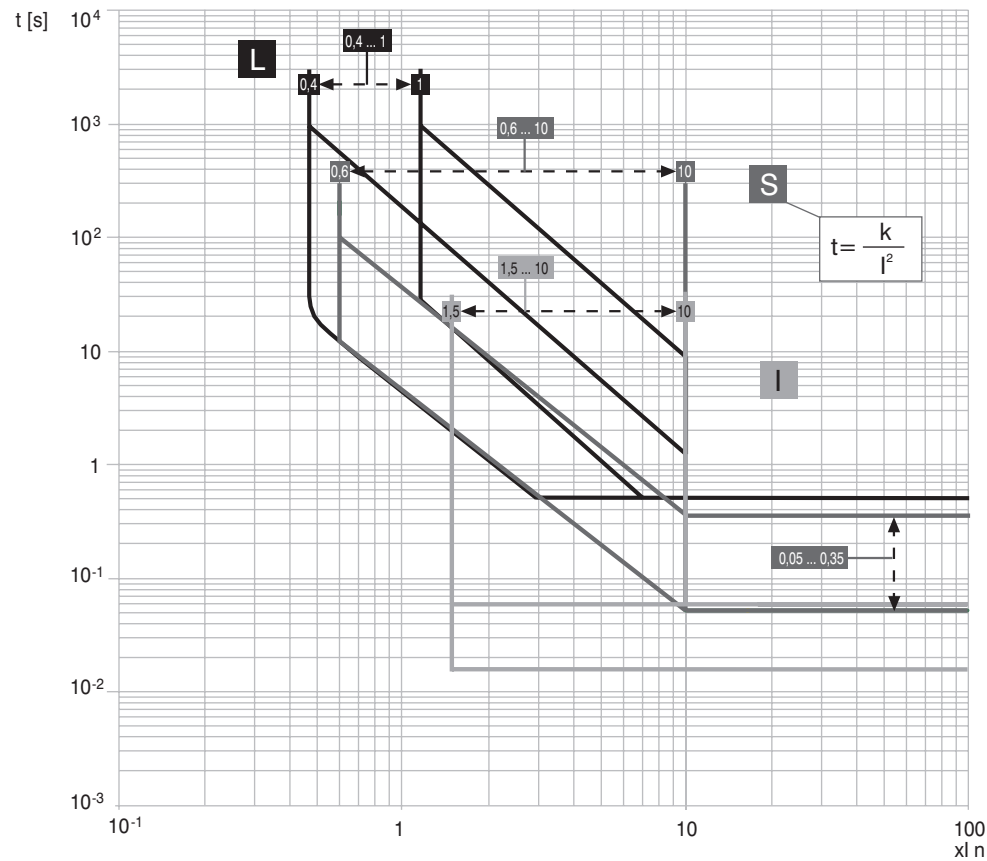
Type of measurement	Range of values measured by the relay	Standard operation range	
		Range	Tolerance %
Currents	0,05 ... 10 In	0,3 ... 4 In	± 5
Earth fault current	0,05 ... 4 In	0,3 ... 4 In	± 5
Voltage	(PR120/V) 10 V ... 1000 V	70V ... 1000 V	± 1
	(PR120/LV) 10 V ... 48 V	24 V ... 48V	± 1
Active energy	0,02 ... 16 Pn	0,3 ... 6 Pn	± 2,5



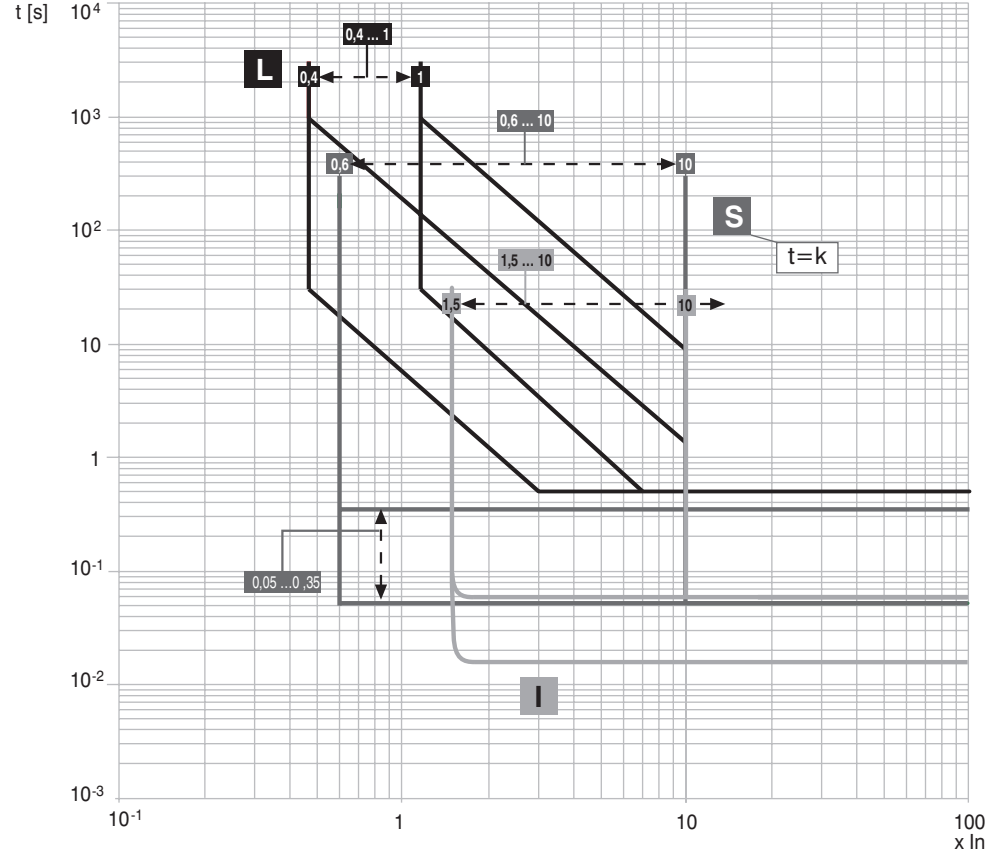
13.2.10. Trip curves

The trip curves given are indicative and are only a sub-group of the ones that can be selected (see sect. 13.5.2).

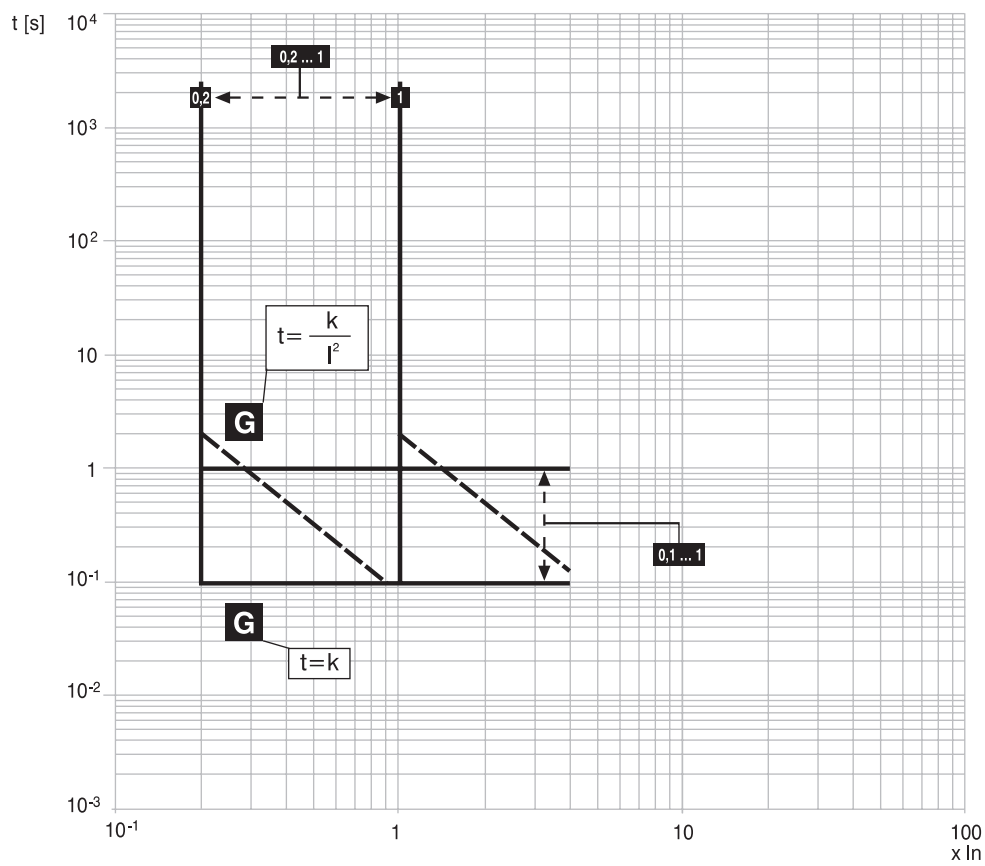
13.2.10.1. Trip curves for functions L-S(t=k/l2)-I



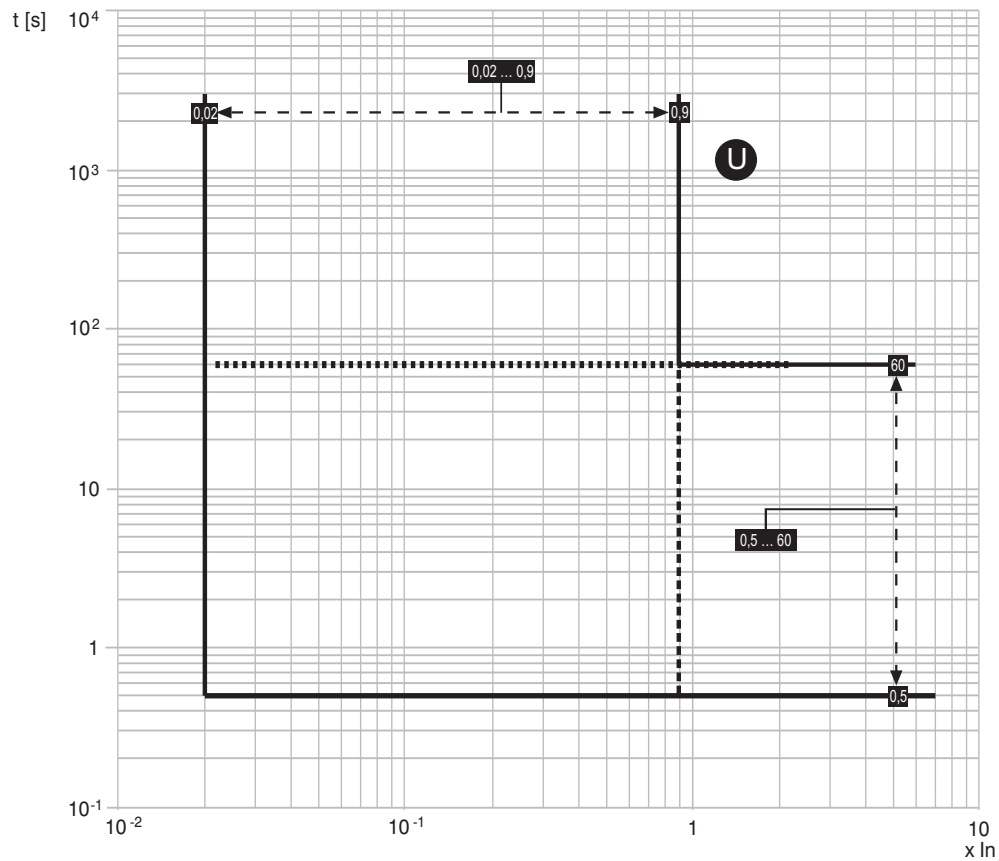
13.2.10.2. Trip curves for functions L-S(t=k)-I



13.2.10.3. Trip curves for function G

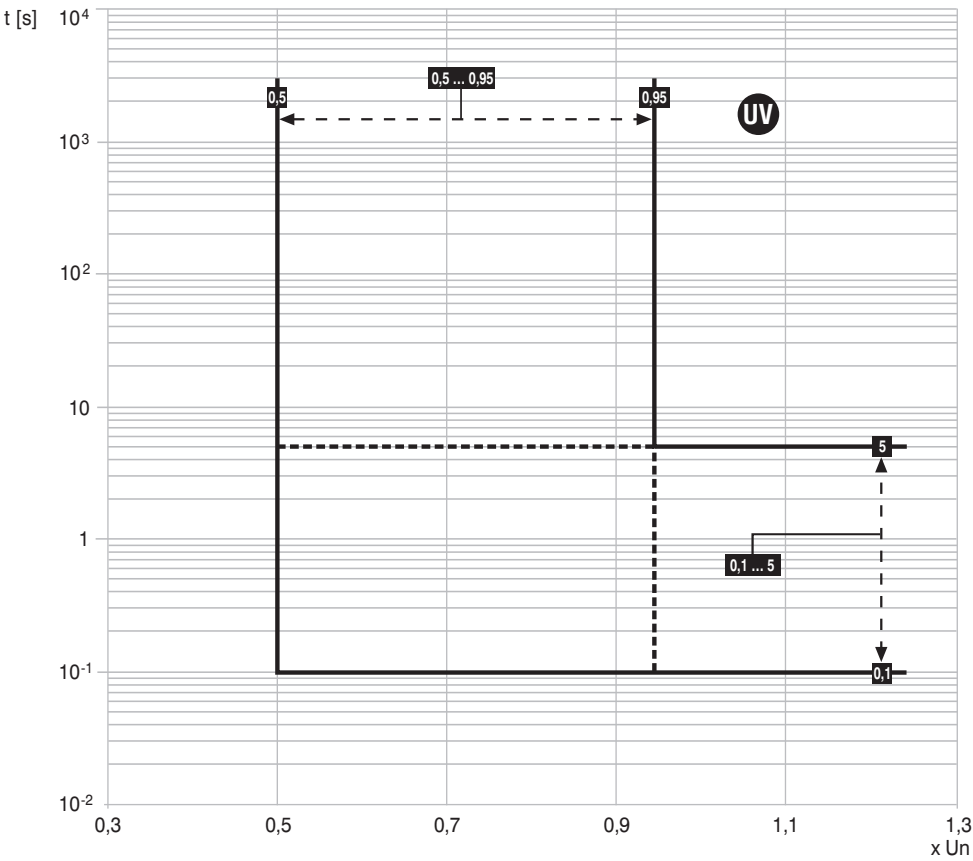


13.2.10.4. Trip curves for function U

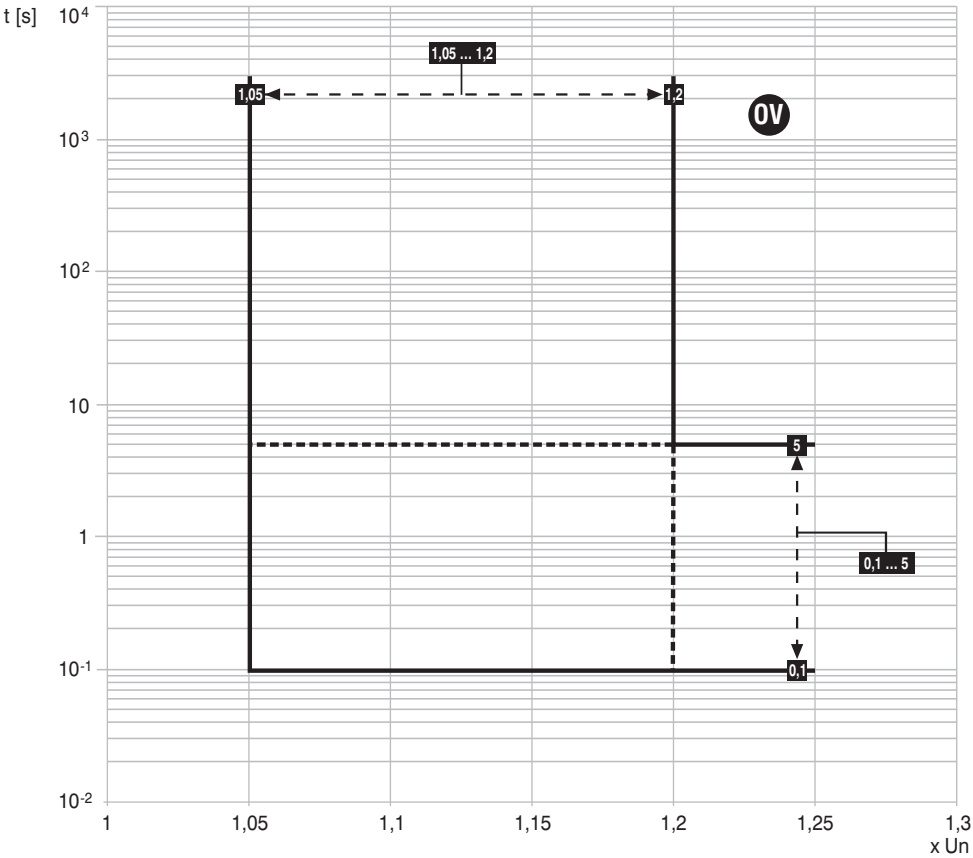


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13.2.10.5. Trip curves for function UV

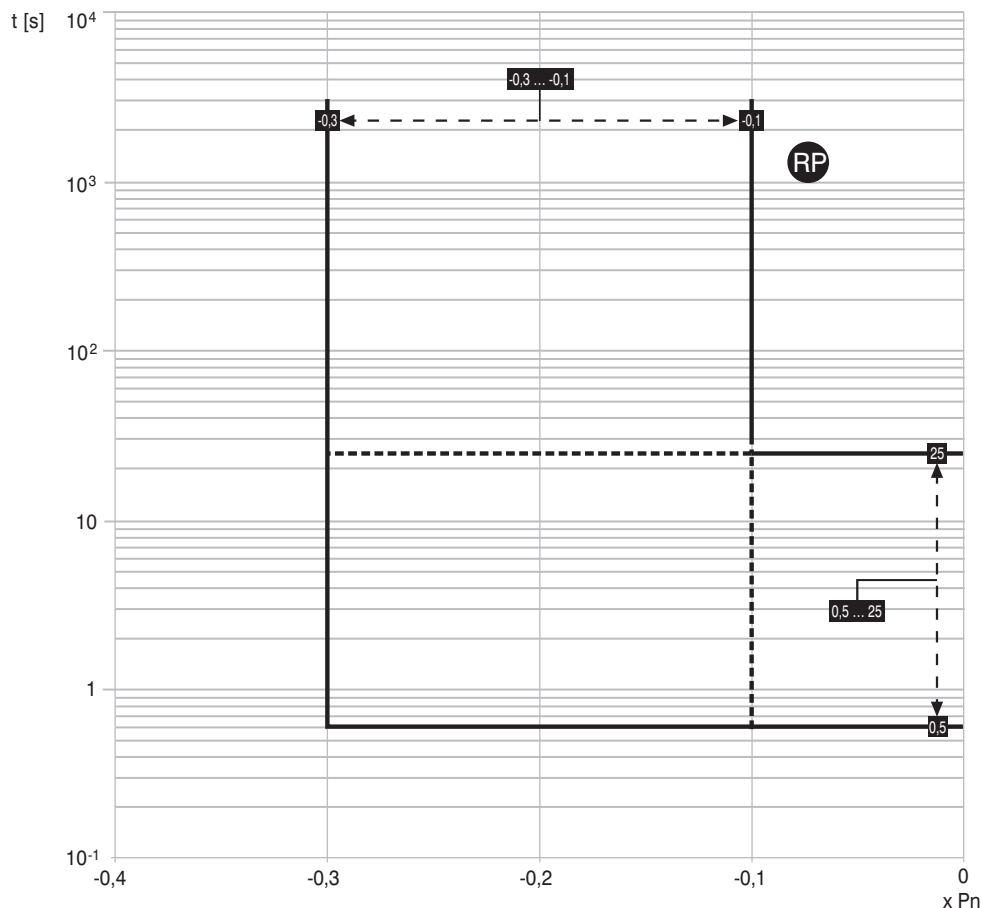


13.2.10.6. Trip curves for function OV




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13.2.10.7. Trip curves for function RP




13.3. Putting into service

13.3.1. Connections

 **WARNING:** Strictly comply with the recommendations in this document for the connections provided by the user. This will enable us to comply with all the pertinent international standards and to ensure that the relay operates perfectly even under severe environmental and electromagnetic conditions. Pay particular attention to the types of cable, the earth connections and the recommended maximum distances.

13.3.2. TC connection test


 **WARNING:** If the PR123/DC has been installed by the user, it is important, before closing the CB, to check the last line on the display when the relay is turned on for the first time via a PR030/B Ultra battery unit. No TC disconnected messages must appear. If they do, do not close the CB and make the correct connections.

13.3.3. Test

Before putting into service, a test can be performed by means of the specific “Auto test”function, which can be activated on the PR123/DC. A positive result is shown on the display. After this, a test can be performed on the whole TC chain, again using the specific function (Trip Test). A positive result is shown by the circuit-breaker opening. To run a Trip Test, press the “i Test” button and the “enter” key at the same time. Check the open or closed state of the circuit-breaker on the same “PR123/DC Test” page by making sure that the CB is closed and de-energized.

Test	1/6
CB status	
Auto Test	
Trip Test (disabled)	
	CB open

13.3.4. Connection check-out

 **WARNING:** After the initial settings have been made, to ensure that the voltage sockets are properly connected on the power busbars, check whether the relay comes on when there is voltage on the power input terminals and that the CB is open and without Vaux. If this is not the case, there is no guarantee that the unit will function when powered by the busbar voltages without any Vaux. Call ABB SACE.

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### 13.3.5. Initial settings

If the PR123/DC is supplied ready installed in the circuit-breaker, it is up to ABB SACE to set all the variables involving the CB or the specific application correctly (e.g. type of CB, Rating Plug size, ...). When the PR120/V module is installed, the user must set the rated voltage properly.

On the other hand, if the PR123/DC is supplied separately, it will be up to the user to set all the necessary parameters correctly. Note that ABB SACE defines each possible setting as indicated in the section about default parameters (see sect. 13.4.4).



**WARNING:** Apart from this, it is absolutely essential for the user to change the password and carefully define each modifiable parameter before putting the PR123/DC into service.

### 13.3.6. Password management

#### Specify a password? [0\*\*\*]

To access the "EDIT" mode, you must first enter a four-figure numerical password. The values that can be used in the password range from 0000 to 9999. The default password is given in sect. 13.4.4.

Select the value of the first figure (between '0'...'9') with the ↑ and ↓ keys and press ☐ to confirm the figure and proceed on to the next one.

Check the password after the fourth figure has been entered. The procedure will change from the "READ" state to the "EDIT" state if the password is correct.

The following message will appear if the password is wrong

#### Password error

This message will remain until the **ESC** key is pressed (or after 5 seconds have elapsed).

The password entry procedure can be interrupted by pressing **ESC**.

#### Password disabling

The password prompt is disabled by setting the value of the password to [0000] (in the "System Configuration" menu). It is therefore always possible to switch from "READ" to "EDIT".

Select the "New Password" item from the "Settings/System" menu to enter a new password.

### 13.3.7. Power direction test





**WARNING:** To make sure that the power direction setting is correct, disable protection RP (or enable the trip lock) and with the circuit-breaker closed and the minimum loads powered, check that the power measurement on the relay's display is consistent with the configuration of the system. If this is not the case, change the "Power flow" parameter (see sect. 14.1.4.2)

### 13.3.8. Replacement of an electronic release

#### 13.3.8.1. Installation

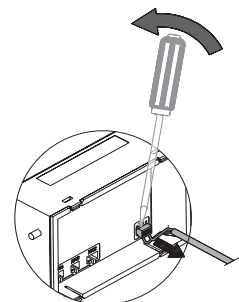
Comply with the following instructions to complete the installation procedure for a PR123/DC:

1. With the circuit-breaker open and possibly isolated, install the protection unit on the circuit-breaker
2. Power the unit ONLY from the PR030/B Ultra
3. If there are no other errors, the message  Configuration (configuration error) will appear on the display and the fixed yellow led (warning) will come on
4. Access the "Settings" menu of the unit
5. Select "Circuit-breaker"
6. Select "Unit installation"
7. Enter the password
8. Select "Install" and press "ENTER"
9. When the red led flashes and the message  Installation (installation error) appears, remove the PR030/B Ultra
10. Power the relay from any other source
11. Check for the absence of configuration errors.

#### 13.3.8.2. Uninstalling

Comply with the following instructions to uninstall a PR123/DC:

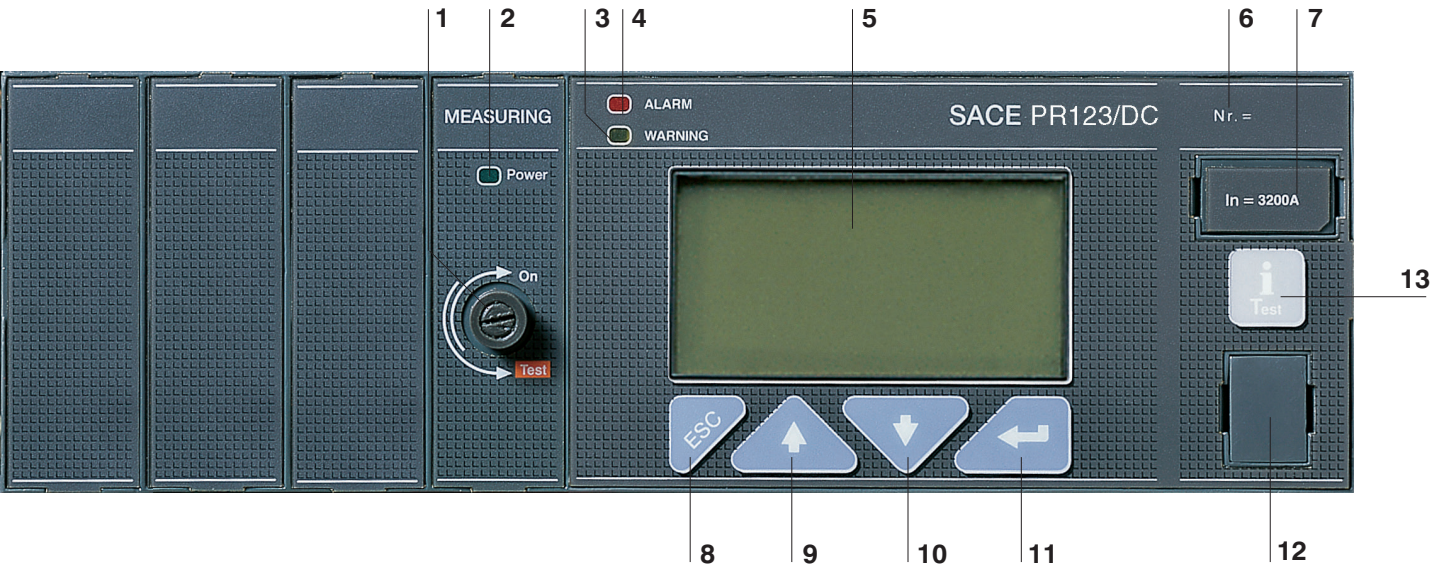
1. With the circuit-breaker open and/or isolated, power the unit from the PR030/B Ultra
2. Access the "Settings" menu of the unit
3. Select "Circuit-breaker"
4. Select "Unit installation"
5. Enter the password
6. Select "Uninstall" and press "ENTER"
7. Remove the PR030/B Ultra module
8. Remove the PR123/DC unit from the circuit-breaker
9. Proceed as indicated in the figure alongside to remove the TC connector.



The uninstalling procedure is not strictly necessary, but it allows the circuit-breaker parameters, such as contact wear and others that would otherwise be lost, to be stored. The data in question are then transmitted to the new PR123/DC unit to be installed in the same circuit-breaker.

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13.4. User interface



Ref.	Description
1	Voltage takeoff isolator
2	Busbar voltage LED
3	Prealarm signalling LED
4	Alarm signalling LED
5	Graphic display (the word ABB at the bottom left indicates normal operation)
6	Serial number of the PR123/DC
7	Rating Plug
8	Pushbutton for quitting the sub-menus or for canceling (ESC)
9	Button for the cursor (UP)
10	Button for the cursor (DOWN)
11	ENTER button for confirming the data or changing the page
12	TEST connector for connecting or testing the release by means of an external device (PR030/B battery unit, BT030 wireless communication unit and PR010/T test unit)
13	"iTest" and info button

Description of the icons displayed

Symbol	Description
	remote control
	dual setting active. Setting A set
	fixed icon: datalogger active flashing icon: triggered
	Vaux present
	parameter change stage

13.3.9. Use of the pushbuttons

The modifiable fields can be filled in using the ↑ or ↓ keys and by confirming with the ↵ key. Once you have accessed the required page, you can move from one value to another by using the ↑ or ↓ keys. To change a value, position the cursor over the value itself (the modifiable field will appear in reverse, i.e. white on a black background), and use the ↵ key.

To confirm the settings programmed for the newly configured parameters, press the **ESC** key to scroll up the menus until the programming confirmation page is displayed, select the confirmation item and press **ENTER** to program the data.

The "**i Test**" button must be used to perform the Trip Test, to display the info page and the last trip, if this has caused it to switch off.

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### 13.4.1. Read and Edit modes

The menu map (see sect. 13.5.1) shows all the pages that can be obtained and how to operate with the keyboard in the “READ” state (data reading only) or “EDIT” state (to set the parameters).

Whatever page is displayed, the default page will automatically appear after about 120 seconds of inactivity (see sect. 13.5.1).





Depending on the state, the functions permitted are:

“READ”:

- ✓ Consultation of the measurements and historical data
- ✓ Consultation of the configuration parameters of the unit
- ✓ Consultation of the protection parameters “EDIT”:
- ✓ Everything allowed in the READ mode
- ✓ Configuration of the unit
- ✓ Programming of the parameters relating to the protections
- ✓ TEST functions of the unit

To access the “EDIT” state, press the  $\downarrow$  key in a page with fields that can be edited. You will then be asked to enter the password before being enabled to switch to the editing state.

Use of the pushbuttons is outlined in the table below:

Key	Function
	Move amongst the pages Move within the menus Change the parameter values
	End the setting phase and confirm the result Choose the menu item
	Access to surfing menus from the default pages Return to previous level when surfing within the menus, until you return to the default pages Quit the parameter editing phase and abort the changes
	This key is used to re-enable the display after it has been turned off within 48 hours from opening of the circuit-breaker in the self-supply mode.

### 13.4.2. Changing parameters

Moving within the Main Menu, you can access all the pages relating to the configurations and parameter settings, and can also edit the values of the parameters.

After certain programming procedures, you need to Confirm / Cancel / Change the changes made. This procedure does not apply to all the programming procedures.

Two examples are provided below: one concerns the case in which no confirmation is needed for the changes made while in the other, a confirmation window appears.

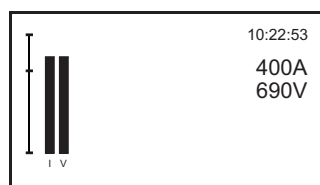
#### **Procedure where confirmation is not required**

For instance, to set the System Date, the correct sequence is:

Press ESC to access the Main Menu.

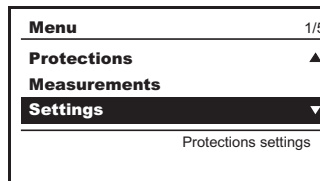
Select SETTINGS item from the Main Menu

press the  $\downarrow$  key (enter)



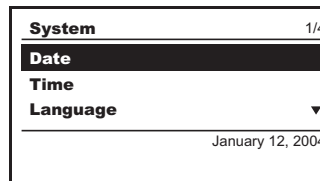
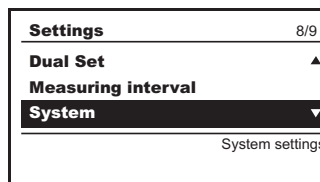
Select SYSTEM

press the  $\downarrow$  key (enter)



Select the DATE menu item to be changed

press the  $\downarrow$  key (enter)

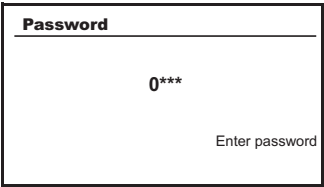


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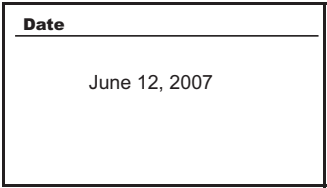


You will be asked to enter the Password  
comply with the password entry procedure (sect. 13.3.6)

press the ↵ key (enter)



Change the date using the ↓ (arrow down) and  
↑ (arrow up) keys and confirm by pressing the ↵ key (enter).

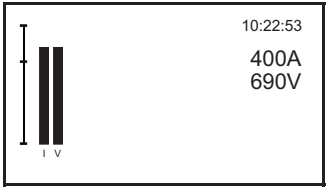


Press ESC twice to go back to the Main Menu.

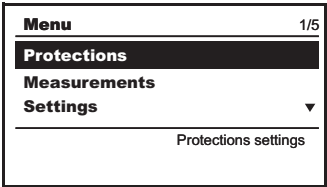
**Procedure where confirmation is required**

For instance, to change the threshold of protection L, the correct sequence is:

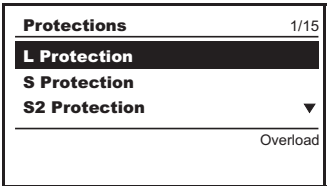
Press ESC to access the Main Menu.



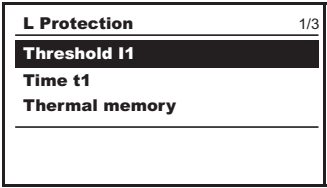
Select the PROTECTIONS item from the Main Menu  
press the ↵ key (enter)



Select the PROTECTION L item from the Main Menu  
press the ↵ key (enter)  
Select the THRESHOLD item from the Protection L Menu

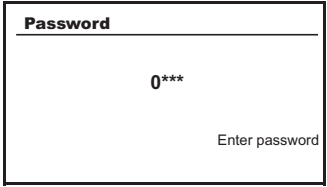


press the ↵ key (enter)  
You will be asked to enter the Password



comply with the password entry procedure (sect. 13.3.6)

press the ↵ key (enter)



Mod.	B2342			Apparatus	<b>Emax DC</b>	Scale
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Select the required value from the list  
Press the ↵ key (enter) to confirm.

press the ESC key twice

<b>Threshold I1</b>
<b>0,4 In (320A)</b>

The following mask will appear before the Main Menu is accessed:

Accept the new configuration  
Reject the new configuration (the previous configuration remains)  
Change the previously entered values

<b>Programming</b>	1/3
<b>Confirm</b>	
<b>Abort</b>	
<b>Modify</b>	
	Confirm

Use the ↓ (arrow down) and ↑ (arrow up) keys to select the required option and press the ↵ (enter) key to confirm.

#### 13.4.2.1. Modification of the basic configuration

**No parameter settings can be made** if the PR123/DC unit is in an alarm condition.

The unit must be configured in the edit mode.

Follow the instructions given in section 13.4.3 to display the following items:

Change System Date  
Change System Time  
Select System Language

<b>System</b>	1/4
<b>Date</b>	
<b>Time</b>	
<b>Language</b>	▼
	January 12, 2004

<b>System</b>	4/4
<b>Time</b>	▲
<b>Language</b>	
<b>New Password</b>	
	**** ⓘ

<b>Password</b>
0***
Enter password

To change the System Password, select the relative menu item and press ↵ (enter). You will now be asked to enter the OLD password, after which you will be able to enter the new one twice.  
Press ESC twice to go back to the Main Menu.

The following mask will appear before the Main Menu is accessed:

Accept the new configuration  
Reject the new configuration (the previous configuration remains)  
Change the previously entered values

<b>Programming</b>	1/3
<b>Confirm</b>	
<b>Abort</b>	
<b>Modify</b>	
	Confirm

Note: when selecting the system language, make sure that:

- the relay is set to the local mode (if PR120/D-M is installed);
- the CB is open.

The relay will not allow the language to be changed in the absence of one of the above conditions.

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### 13.4.3. Default settings

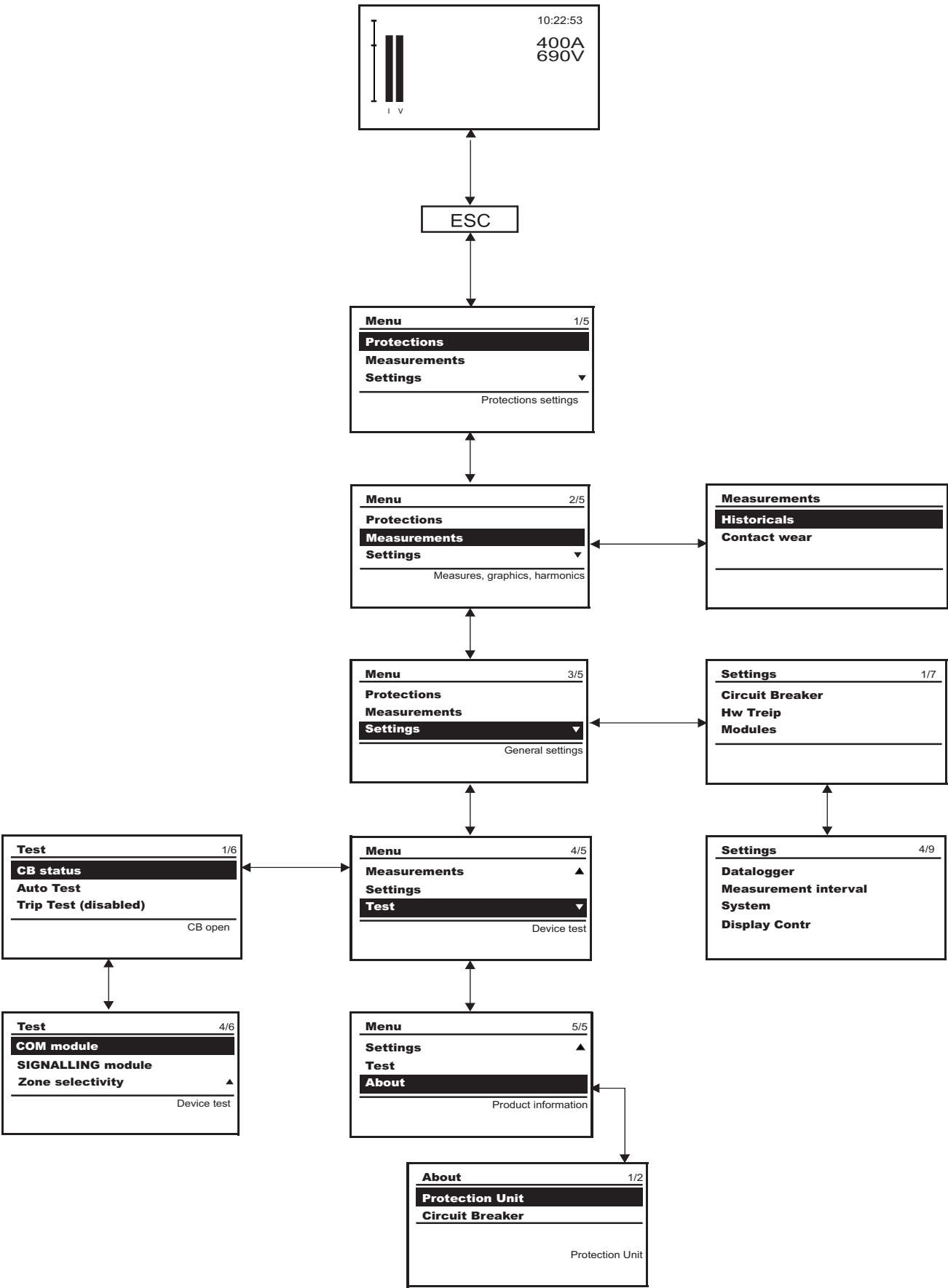
The PR123/DC is supplied by ABB SACE with the following predefined parameters (Set A and Set B):

#	Protection	On/Off	Thresholds	Time	Curve	T.M.	ZS	Trip
1	L	--	1 In	102 s	I <sup>2</sup> t	Off	--	--
2	S	Off	6 In	50 ms	K	--	Off: 0.04s	--
3	I	On	4 In	--	--	--	--	--
4	G	Off	0.2 In	0.4 s	K	--	Off: 0.04s	On
5	U	Off	50 %	5 s				Off
6	OT	--						Off
7	K LC1	Off	50 % I <sub>l</sub>					
8	<b>K LC2</b>	Off	75 % I <sub>l</sub>					
9	UV	Off	0.9 Un	5 s				Off
10	OV	Off	1.05 Un	5 s				Off
11	RP	Off	- 0.1 Pn	10 s				Off
12	Language	--	Engl					
13	PR021/K	Off						
14	Measuring module type	--	HIGH VOLTAGE					
15	Rated Voltage	--	500V					
16	S startup	Off	6 In	100 ms				
17	I startup	Off	4 In	100 ms				
18	G startup	Off	1 In	100 ms				
19	Password	--	0001					
20	Measuring interval	--	60 min					
21	Iw	Off	3 In					
22	MCR	Off	6In	40 ms	--	--	--	--

Mod.	B2342			Apparatus	<b>Emax DC</b>	Scale
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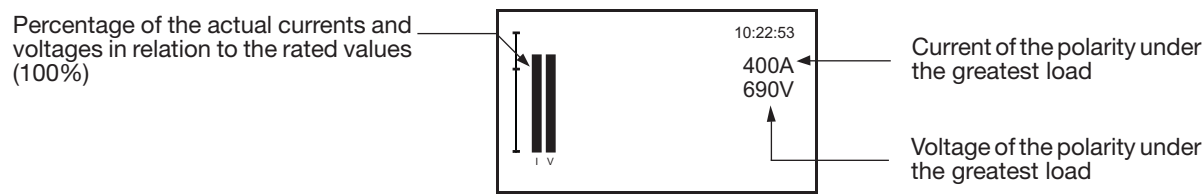
13.5.1. Menu

As explained previously, the PR123/DC uses the display to show messages, diagrams and menus. All this information is organized in a logical, user-friendly way. The general layout showing how to access the main menu pages is given below.



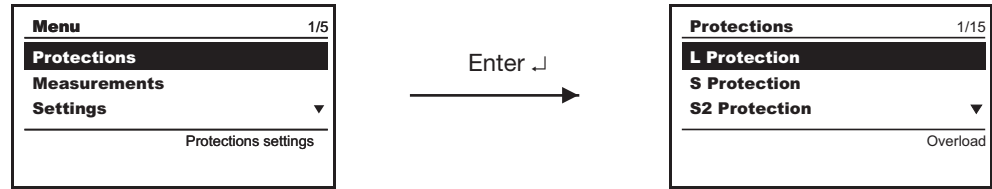
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The following default page will appear on the display whenever the unit is turned on, or after more than 2 minutes of keyboard inactivity:



13.5.2. Protections Menu

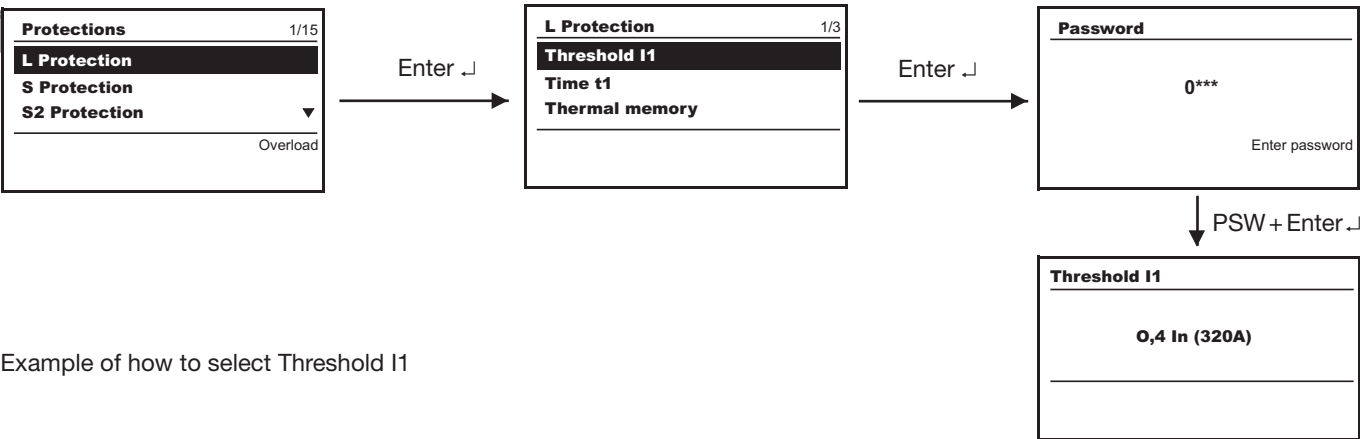
Press ENTER from the interface to access the menu with the various different protections available on the display



Use the "arrow UP" and "arrow DOWN" to display the various protections. As a whole, the data displayed concern the following protections: L, S, S2, I, G, U, UV, OV, RP, OT, LOAD PROTECTION.

Example of surfing in the Protection Menu

Press ENTER to access the Protection L menu from the Protections main page. You can now select the items in the menu with the "arrow UP" and "arrow DOWN", and confirm them by pressing ENTER. A Password prompt is triggered when ENTER is pressed. Entry of the Password allows you to select the functions associated with protection L (as shown in the example).



Example of how to select Threshold I1

Similarly, to access the menus of the other protections, consult the Protections Menu table below.

13.5.2.1. Protections Menu table

Protection	Parameter / Function	
L	Threshold I1	
	Time t1	
	Thermal memory	ON / OFF
S	Enabling	ON / OFF
	Curve	
	Threshold I2	
	Time t2	
	Zone selectivity	ON / OFF
	Selectivity time	

Protection	Parameter / Function	
	Enable StartUp	ON / OFF
	StartUp threshold	
	StartUp time	
<b>S2</b>	Enabling	ON / OFF
	Threshold I2	
	Time t2	
	Zone selectivity	ON / OFF
	Selectivity time	
	Enable StartUp	ON / OFF
	StartUp threshold	
	StartUp time	
<b>I</b>	Enabling	ON / OFF
	Threshold I3	
	Enable StartUp	ON / OFF
	StartUp threshold	
	StartUp time	
<b>G</b>	Enabling	ON / OFF
	Curve	
	Threshold I4	
	Time t4	
	Enable Trip	ON / OFF
	Zone selectivity	ON / OFF
	Selectivity time	
	Enable StartUp	ON / OFF
	StartUp threshold	
	StartUp time	
<b>U</b>	Enable	ON / OFF
	Function	Currents/Voltages
	Threshold I6	
	Time t6	
	Enable Trip	ON / OFF
<b>UV</b>	Enabling	ON / OFF
	Threshold U8	
	Time t8	
	Enable Trip	ON / OFF
<b>OV</b>	Enabling	ON / OFF
	Threshold U9	
	Time t9	
	Enable Trip	ON / OFF

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Protection	Parameter / Function	
<b>RP</b>	Enable	ON / OFF
	Threshold P11	
	Time t11	
	Enable Trip	ON / OFF
<b>OT</b>	Enable Trip	ON / OFF
<b>Load control</b>		
	Threshold 1 Enable Threshold	ON / OFF
	Threshold 2 Enable Threshold	ON / OFF
	Threshold lw Enable Threshold	ON / OFF

Note: for an explanation of the characteristics of the individual protections, their settings and relative curves, see sect.

### 13.5.3. Measurements Menu

For a full explanation of the features of the PR120/V module, see sect. 14.1.

The following is a summary of the parameters that can be accessed from the menu of the PR123/DC unit.

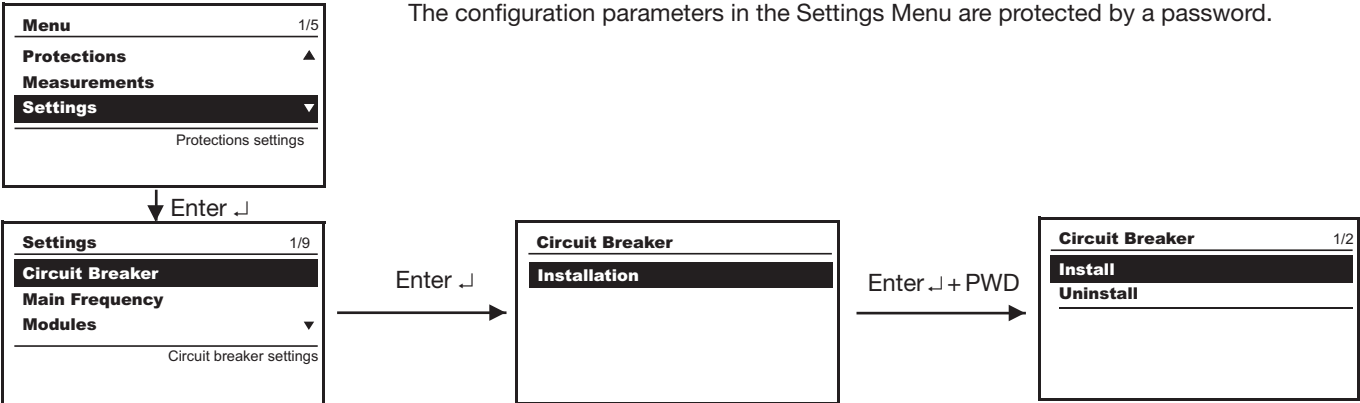
#### 13.5.3.1. Measurements Menu table

Setting	Parameter / Function	Values	Notes
<b>Historicals</b>			
	Trips		Last trip (20)
	Measurements		Events Events log (max. 80 events)
	I Max		Maximum active current
	P Max		Maximum active power
	P Mean		Mean active power
	U Max		Overvoltage
	U Min		Undervoltage
	Reset measurements		
<b>Energy</b>	Energy meters		
	Reset meters		
<b>Contact wear</b>			Percentage of wear on CB contacts

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13.5.4. Settings Menu



13.5.4.1. Settings Menu table

	Parameter / Function	Values	Notes
Circuit-breaker	Installation	Install/Uninstall	
Modules	Module PR120/V - PR120/LV PR120/D-M - COM PR120/K - Signalling Local Bus unit	if present if present if present Absent - Present	see sect. 13.5.5.1 see sect. 13.5.5.2 see sect. 13.5.5.3
Data Logger	Enable	ON/OFF Sampling frequency Stop event Stopping delay Restart Stop	See Annex sect. 15.2
Dual setting	Enable Default setting Dual Set CB closure Dual Set with Vaux	ON/OFF SET A / SET B	
Measurement interval		from 5 to 120 min, 5 min step	
System	Date Time Language New password	English/Italiano/Francais/Deutsch/Espa�ol	
Display	Contrast		

For the summary table regarding surfing of the pages dedicated to Module PR120/K, see sect. 14.3, while for the PR021/K unit, see sect.

13.5.5. Modules

Access the Settings menu for the set of menus relating to the modules.

13.5.5.1. Module PR120/V - PR120/LV

13.5.5.2. The primary voltage values can be selected. See sect. 14.1 Module PR120/D-M - COM

Modules2/4

MEASURING module

COM module

SIGNALLING module

Communication parameters

COM module1/5

Local / Remote

Serial Address

Baudrate

Local

The local and remote modes can be selected after a password has been entered. The serial address can be displayed after entry of the password. The BaudRate can be set at values 9600 and 19200 bits/s. The physical protocol provides for the following options: (8,E,1), (8,O,1), (8,N,2), (8,N,1). Standard Modbus or ABB addressing can be selected. See section 14.2 of this manual for further information about Communication Module PR120/D/M.

13.5.5.3. Module PR120/K - SIGNALLING

Refer to the relative section 14.3 for a detailed description of the signalling module.

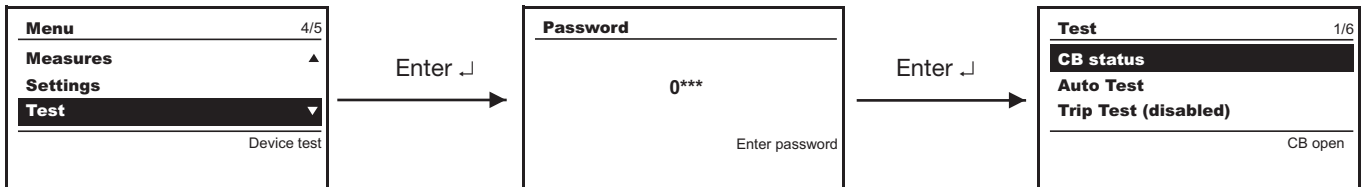
13.5.5.4. Settings for the Local Bus unit

If the PR021/K unit is connected, the local bus must be activated by selecting present.

### 13.5.6. Test Menu

Access to the Test Menu is protected by a password.

The menu shows the state of the CB, the state of the springs and the position of the CB in the dialog module (COM Module), while the CB can be opened or closed in this sub-menu.



Trip disabling/enabling is displayed with the “Trip Test” function. If it is enabled, the circuit-breaker is opened. The function is only available with nil busbar current (use Vaux PR030/B Ultra or PR010/T).

The page (only with Vaux) also displays the state of the circuit-breaker (“STATE”), allowing you to make sure that the input has been wired correctly.

The surfing path is outlined in the following table:

#### 13.5.6.1. Test Menu table

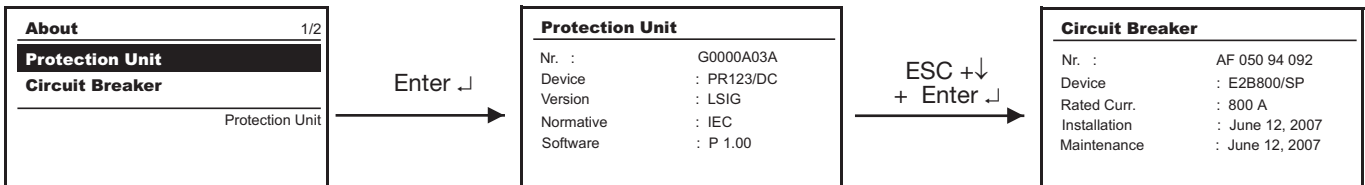
	Parameter / Function	Values	Notes
<b>CB state</b>	Open / Closed / Indefinite	Indefinite only in the case of a fault	
<b>Auto Test</b>	Display test		
<b>Trip Test</b>	Enabled / Disabled		
<b>Module PR120/D-M</b>	State of springs CB position Open CB Close CB	Unloaded/Loaded Isolated/Withdrawn	
<b>Module PR120/K</b>	Input Auto Test	ON - - -	
Zone selectivity	Protection S  Force Output Release Output Protection G (state) Input Force Output Release Output	(state) Input    ON/OFF   ON/OFF	ON/OFF

### 13.5.7. Information Menu

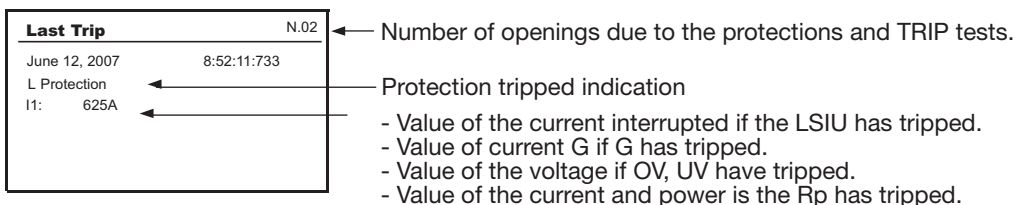
The Information Menu displays data relating to the protection unit and the type of circuit-breaker.

#### 13.5.7.1. Information about the trip and opening data

The PR123/DC stores all the information about the type of protection that has tripped, the opening data, the date and time. The release shows all these data on the display by means of the “i Test” button. There is no need for an auxiliary power supply for this function. With an auxiliary power supply, the information is shown immediately on the display without the need to press the “i Test” key and remains displayed indefinitely until the key is pressed.



The information remains available for 48 hours with the relay de-energized. The data relating to the last 20 trips are stored in the memory. You can retrieve the information about the last 20 trips recorded by connecting a PR030/B Ultra and PR010/T battery unit or a BT030 USB wireless communication unit. The opening data display is accessed via the Historicals sub-menu of the Measurements menu. An example of the information provided data plate is given below:



The Measurements Menu also displays the percentage of contact wear, which is an indication of the electrical life of the electrical contacts in the circuit-breaker.

The functionality of the relay is not changed in any way by the presence of wear messages.

The prealarm message (wear > 80%, “warning” led on) indicates that wear has reached a high value. The alarm message (100% wear, “alarm” led on) indicates that the state of contact wear must be checked.

The percentage of wear depends on the number of openings made by the circuit-breaker and by the absolute current interrupted in each.

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## 13.6. Definition of alarms and signals in the PR123/DC unit

### 13.6.1. Optical signals

Signalling	Description
<b>Warning</b> led (fixed yellow light)	<ul style="list-style-type: none"> <li>The prealarm threshold has been exceeded; current value within the <math>0.9xI_1 &lt; I &lt; 1.05xI_1</math> range;</li> <li>Presence, between two polarities, of unbalance above the value programmed for protection "U", with protection trip disabled</li> <li>Contact wear over 80% (and less than 100%);</li> <li>WARNING threshold <math>I_w</math> exceeded;</li> <li>Circuit-breaker state error;</li> <li>Configuration error;</li> <li>Inconsistent settings.</li> </ul>
<b>Warning</b> led (yellow 0.5Hz)	Internal temperature of relay exceeds WARNING threshold.
<b>Warning</b> led (yellow 2Hz)	Internal temperature of relay exceeds ALARM threshold.
<b>Alarm</b> led (red)	<ul style="list-style-type: none"> <li>Current values <math>I &gt; 1.3 I_1</math> present (timing of protection "L")*;</li> <li>Timing in progress for protection S function;</li> <li>Timing in progress for protection G function;</li> <li>Timing in progress for the protection functions (UV, OV);</li> <li>Timing in progress for the reverse active power protection function (RP);</li> <li>Timing in the case of unbalance between the polarities (protection U) above the value set in the configuration with protection trip set to on;</li> <li>100% contact wear;</li> <li>Rating Plug disconnected;</li> <li>Trip Coil (TC) disconnected;</li> <li>CB/relay inconsistency;</li> <li>Current sensors disconnected;</li> <li>Installation error.</li> </ul>

\* Standard IEC 60947-2 defines the timing threshold L for current:  $1.05 < I < 1.3 I_1$ .

### 13.6.2. Electrical signals


**K51/p1...p4** Electrical signals that can be programmed if the PR120/K module or PR021/K unit and auxiliary power supply are present.


**K51/p1...p8** Electrical signals that can be programmed if the PR021/K unit and auxiliary power supply are present. The activated contacts can be reset by pressing the "i Test" button.


### 13.6.3. Table of error and warning messages

















All messages displayed concerning incorrect configurations, generic alarms or deriving from the protection functions and linked to useful information are described below.

The following symbols in the warning signals possess the meanings described below:
















 = Warning signal / Protection in alarm state, without trip (trip=off).

 = Protection in alarm state, with trip at end of delay (trip=on).

 = Information, no action, except for display by the relay.















Alarm message	Description	Notes
 Contact wear	Alarm for contact wear	Contact wear = 100%
 G (TRIP OFF)	Alarm for protection G	
 T alarm	Alarm for protection T	Temperature outside range
 T (TRIP OFF)	Alarm for protection T	
 U Alarm	Alarm for protection U	Protection U counting down
 UV Alarm	Alarm for protection UV	
 OV Alarm	Alarm for protection OV	
 RP Alarm	Alarm for protection RP	
 Load LC1	Alarm for load control LC1	
 Load LC2	Alarm for load control LC2	
 Sensor $I_A$	Alarm for $I_A$	$I_A$ polarity sensor disconnected or faulty
 Sensor $I_B$	Alarm for $I_B$	$I_B$ polarity sensor disconnected or faulty
 TC disconnected	Trip Coil disconnected or faulty	
 Rating Plug	Error for Rating Plug absent or faulty	
 Invalid date	Clock information lost	
 CB state	CB state error	Probable error in Q26 and/or Q27

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Alarm message	Description	Notes
 Installation	Key plug error	
 CB not defined	Circuit-breaker state inconsistent (Open/Closed)	Probable error in Q26 and/or Q27
 Local bus	Local bus error	See sect. 13.7
 Contact wear	Contact wear prealarm	Contact wear $\geq 80\%$
 L prealarm	Protection L prealarm	
 T prealarm	Protection T prealarm	
 Warning lw	lw threshold exceeded	
 Timing L	Protection L timing	
 Timing S	Protection S timing	
 Timing S2	Protection S2 timing	
 Timing G	Protection G timing	
 Timing U	Protection U timing	
 Timing UV	Protection UV timing	
 Timing OV	Protection OV timing	
 Timing RP	Protection RP timing	

#### 13.6.4. Error messages displayed in pop-up window

All the messages that appear on the display in a pop-up window are described below.

Error message	Description
 Password error	
 Session impossible	A programming session cannot be started due to a contingency (e.g. timing in progress)
 Value outside range	Value beyond the established limits
 Failed 1001/2001	Inconsistency between thresholds of protections L and S (SET1/SET2)
 Failed 1002/2002	Inconsistency between thresholds of protections I and S (SET1/SET2)
 Failed 1003/2003	Inconsistency between thresholds of protections L and S2 (SET1/SET2)
 Failed 1004/2004	Inconsistency between thresholds of protections I and S2 (SET1/SET2)
 Failed 3001	Inconsistency as to language change
 Exception 6	Command temporarily unavailable
 Unavailable	Function temporarily unavailable
 Invalid date	Date has not been set
 Parameters revised	Programming session concluded correctly
 Cancelled	Programming session cancelled
 Failed	Programming session rejected

#### 13.7. PR123/DC troubleshooting

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

##### NOTE.

- Before consulting the following table, check for any error messages that may appear on the display.
- FN indicates that the PR123/DC is operating normally.
- Please call the ABB SACE assistance service if the suggestions proposed are unable to solve the problem.

N°	Situation	Possible causes	Suggestions
1	The trip test cannot be run	1. The busbar current is $> 0$ 2. The TC is not connected	1. FN 2. Check the messages on the display
2	Trip times lower than expected	1. Threshold too low 2. Curve too low 3. Thermal memory enabled 4. The SdZ is inserted	1. Correct threshold 2. Correct curve 3. Exclude if not necessary 4. Exclude if not necessary
3	Trip times higher than expected	1. Threshold too high 2. Curve too high 3. Curve I <sup>2</sup> t inserted	1. Correct threshold 2. Correct curve 3. Exclude if not necessary

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N°	Situation	Possible causes	Suggestions
4	Rapid trip, with I3=Off	Inst tripped	FN with short-circuit with high I
5	high earth I, but no trip occurs	Function G inhibited with I>4In	FN
6	Display off	1. Incorrect voltage socket connection 2. Vaux missing and voltage below minimum value 3. Temperature outside range	1. Warning: see 13.3.4 2. FN, see 13.2.2 3. FN, see 12.2.9.8
7	The display is not backlit	Voltage below the limit for lighting the display	FN
8	Reading of I incorrect	Current below the minimum threshold that can be displayed	FN
9	Reading of V or W incorrect	Voltage parameter setting error	Set correct parameters
10	"▲ Local Bus" message on display	No communication between PR123/DC and PR021/K	1. If not present, disable PR021/K, see 13.5.4.2.4 2. Check bus connection 3. Check PR021/K
11	Message "" instead of the expected data	Function disabled or data outside range	FN
12	The expected trip does not occur	Trip function excluded	FN enable trip if necessary
13	No activation of the Unbalance protection U	Values of I outside range	FN, see 13.2.9.4
14	Opening data not displayed	Vaux missing, buffer capacitor discharged	FN, see 13.5.6.1
15	The password is not requested	The password has been disabled	FN, enter the password again with a value other than 0000.
16	Impossible to change any of the parameters	PR123/DC in alarm state	FN
17	"▲ Temp sensor" or "▲ Start-up" message	Possible fault inside relay	Call ABB Sace
18	Invalid date	1. First installation 2. Information lost due to power failure	FN see 13.4.3.1
19	Untimely trip		see 13.6.3
20	LED light on		see 13.6.1
21	The language cannot be changed	1. Relay set to the remote mode 2. The CB is not open	1. Set to local mode 2. Open the CB

### 13.7.1. If faults occur



**WARNING: If you suspect that the PR123/DC is faulty, functions incorrectly or has generated an unwanted trip, you are strongly advised to strictly comply with the following recommendations from the Measurements Menu → Historicals → Trip:**

1. Make a note of the type of protection that has tripped by accessing the LAST TRIP page if there is an external power supply (Vaux or battery) or by pressing "i Test" if in the self-powering mode.
2. Note down the type of circuit-breaker, the number of poles, any accessories connected, In, Serial Number (see sect. 13.4) and the sw version.
3. Prepare a brief description of the opening (which leds and/or signals were displayed? When did it happen? How many times? Was it always under the same conditions? With what type of load? What voltage? What current? Is the event reproducible?)
4. Send/notify all the information collected, together with the circuit diagram of 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 a technical analysis of the problem and will allow us to resolve it as soon as possible.

### 13.8. Accessories

#### 13.8.1. ABB SACE PR010/T test and configuration unit

Testing performed with the SACE PR010/T unit allows the user to make sure that the thresholds and trip times of protection functions L, S, I, G, OV, UV, U operate correctly. The test unit is connected to the relay by means of the dedicated connector (see sect. 13.4).

#### 13.8.2. BT030 USB communication unit

Using a BT030 USB wireless communication unit, the PR123/DC can be connected via radio to a Pocket PC (PDA) or a normal PC, thereby extending the range of information available to the user. The values of the currents flowing through the circuit-breaker, the value of the last 20 interrupted currents and the protection settings can be read by means of ABB SACE Ekip Connect communication software.

#### 13.8.3. PR021/K and HMI030 units

The PR123/DC can also be connected to the optional PR021/K external signalling unit (see sect. 15.1) so as to indicate alarms and protection trips by means of potential-free power contacts, and to the HMI030 switchboard front so as to display a wide variety of information.

#### 13.8.4. PR030/B Ultra power supply unit

The PR030/B Ultra power supply unit is an external unit that allows the Relay, Autotest and Trip Test to be powered, as well as CB open checks and the installation of new replacement units.

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# 14. Modules

## 14.1. PR120/V-PR120/LV -- MEASURING module

### 14.1.1. General characteristics



**WARNING:** The MEASURING module records and processes the voltages. The measurements are sent by the module to the protection release, thereby enabling a set of protection and measuring functions to be implemented. The module comes with a “Power” LED and a sealable isolator for dielectric strength tests. The module also enables the relay to be powered. The PR120/V is used for voltages from 250V to 1000V, while the PR120/LV is used for voltages from 100 to 250V.

The following table shows when the measuring modules (PR120/V and PR120/LV) can be used:

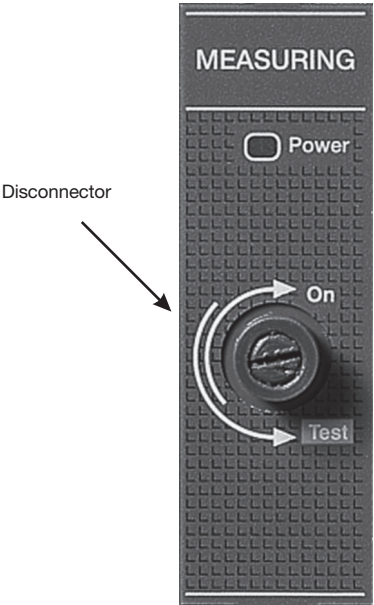
Ue (V)	12	100	250	1000
PR120/LV	PR120/LV + Vaux		PR120/LV	NO
PR120/V	PR120/V + Vaux	PR120/V + Vaux		PR120/V

### 14.1.2. Front view

- “Power line” LED (on when the busbar is powered, see 14.1.3)
- Disconnecter



**WARNING:** Before the dielectric strength test is performed, the disconnecter must be set to the Test mode by turning the screw anti-clockwise until it reaches end of travel.



**WARNING:** After having performed the dielectric strength test, set the disconnecter back to its initial position by turning it clockwise until it reaches the opposite end of travel position since all the voltage protections are disabled when the disconnecter is in the Test position.

Make sure that the Power line LED is on at the end of the procedure.

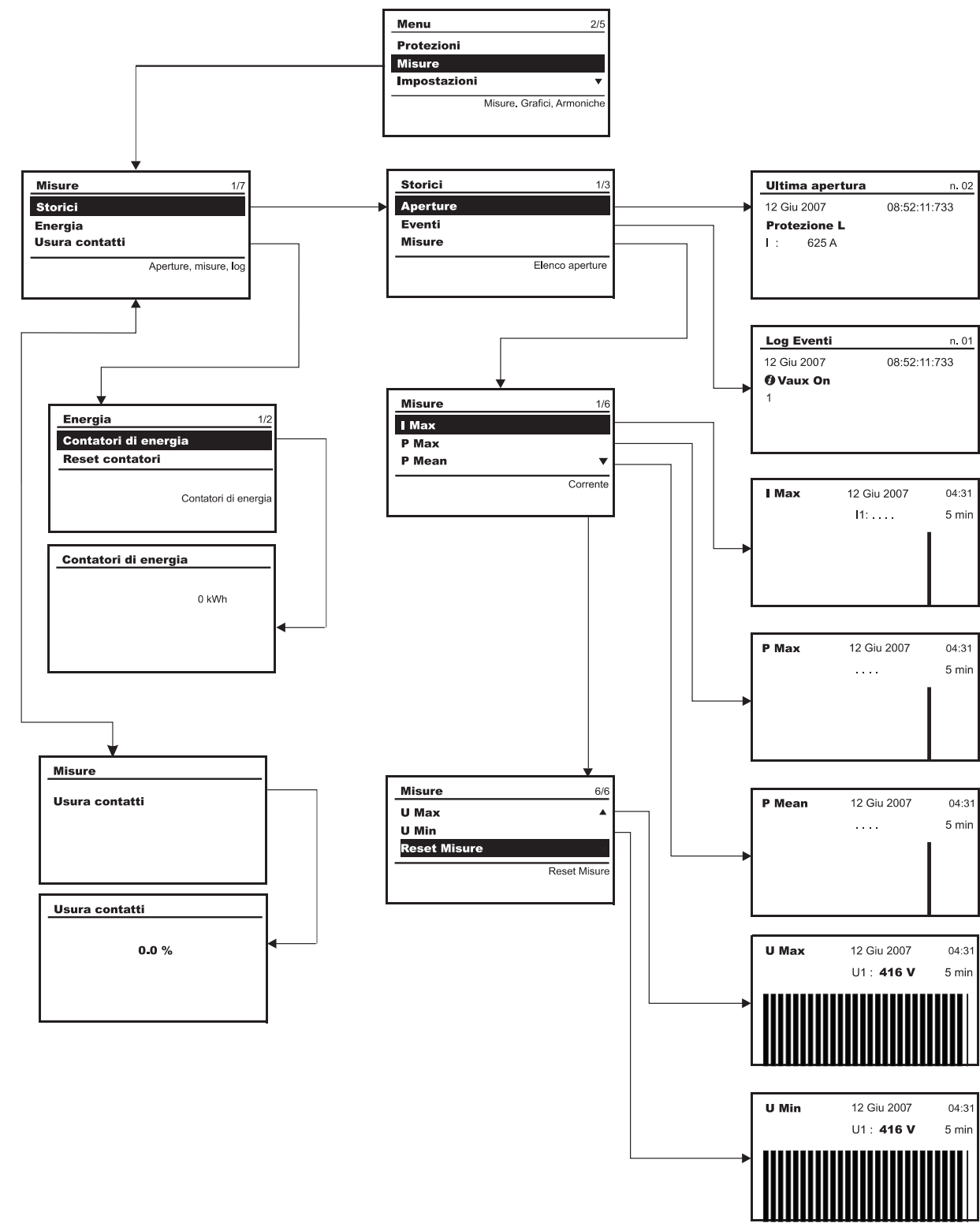
NOTE. The PR120/V-PR120/LV needs no connections to be made at the Customer's charge.

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14.1.3. Operating instructions / operation in service

14.1.3.1. Using the Measurement sub-menus with PR120/V- PR120/LV  
The menu for accessing the functions of the menu is given below:



14.1.3.2. Table of sub-menus for the PR120/V-PR120/LV module

This Menu is accessed by following the "Settings/Modules/PR120/V module" path

Parameter / Function	Values	Notes
Rated voltage	100V...1000V step 10	

Power flow *	Normal Reverse	This setting is used to determine the sign of the power value measured. To make sure that it is consistent with the system, perform the test described in sect. 13.3.7
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\* Only available for PR123/DC

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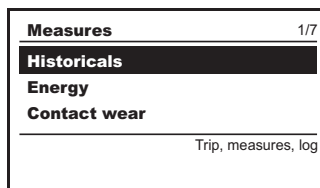
#### 14.1.3.3. Measurements Menu table

The table with the Measurements Menu is given below for your convenience.

	Parameter / Function	Values	Notes
<b>Historicals</b>	Trips		List of trips
	Events		Events log
	Measurements		
	Overcurrent		
	Maximum active power		
	Mean active power		
	Overvoltage		
	Undervoltage		
	Reset measurements		
	Mean power		
<b>Energy</b>	Energy meters		
	Reset meters		
<b>Contact wear</b>			Percentage of contact wear

#### 14.1.3.4. Measurements Menu

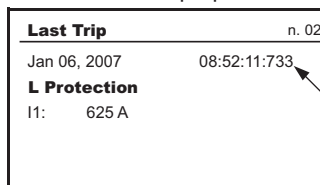
##### 14.1.3.4.1. Historicals



A whole set of measurements can be accessed from the "Measurements / Historical" menu.

##### 14.1.3.4.2. Trips

The following is an example of a page showing the latest trip. You can access this page by selecting Trips via the Measurements / Historicals / Trips path. The page shows the values for the type of protection that has tripped (L in the example).

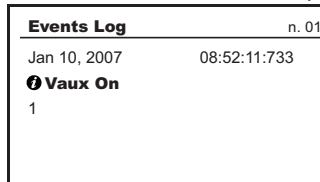


Meter: counts progressively (0 ... 65535) from the date of the last trip reset. Displays the latest 20 trips, which can still be selected.

Time (in hours and minutes) when the CB opened.

##### 14.1.3.4.3. Events

The following is a typical page showing the latest Events log. This page can be accessed by selecting Events via the Measurements / Historicals / Events path.



Meter: indicates "Last" and measures the previous ones from -1, -2 until -80 (e.g. second from last -1)

##### 14.1.3.4.4. Measurements

The following measurements are displayed in this sub-menu:

- I Max** - Overcurrent
- P Max** - Maximum active power
- P Mean** - Mean active power
- U Max** - Overvoltage
- U Min** - Undervoltage
- Reset** - Reset measurements

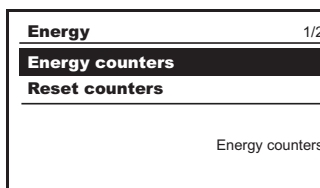
##### 14.1.3.4.5. Energy

The unit provides meter readings of the total active energy of the system. The minimum value displayed is 0.001 MWh.

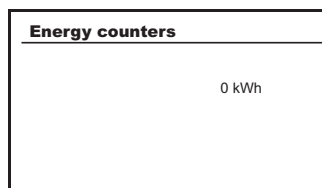
The full scale of the energy meters is about 2.15 billion kWh.

The meter can be reset by confirming the "Reset meters" menu item in the page.

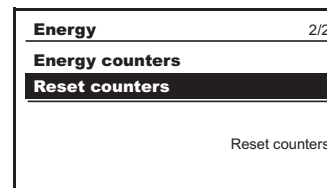
For the ranges and precisions, see sect. 13.2.9.14.



Enter ↵



ESC + ↵  
+ Enter ↵



##### 14.1.3.4.6. Contact wear

This sub-menu shows the percentage of wear on the CB contacts.

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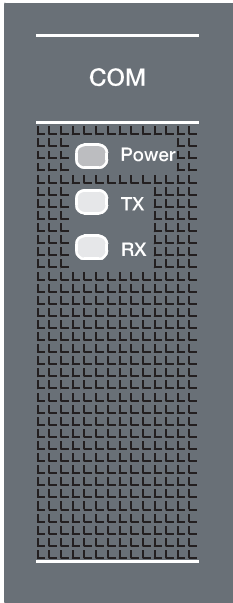
14.2. PR120/D-M - COM communication module

14.2.1. General characteristics

Dedicated communication module for connecting the relay to a Modbus network for remote supervisory and control activities on the circuit-breakers.

14.2.2. Front view

- "Power" LED (on when Vaux is installed)
- RX/TX LED (data send/receive signal)



14.2.3. Releases equipped with the module

- optional for PR122/DC
- optional for PR123/DC

14.2.4. Power supply

The PR120/D-M - COM communication module is only powered by the relay if there is a 24 V auxiliary voltage supply available.

14.2.5. Connection

Refer to **fig.45** in the wiring diagram provided in this manual.

14.2.6. Communication functions available

The communication function in the PR122/DC, PR123/DC releases with PR120/D-M - COM if given in the table:

PR122/DC or PR123/DC + PR120/D-M - COM

Protocol	Modbus RTU
Physical interface	RS-485
Baud rate	9600 - 19200 bit/s

14.2.7. PR120/D-M - COM module Menu

Parameter / Function	Values	Notes
Local/Remote	Local/Remote	
Serial address	1 ... 247	247 default address
Baudrate	9600 bit/s 19200 bit/s	
Physical protocol	8,E,1 - 8,O,1 - 8,N,2 - 8,N,1	
Addressing	Modbus standard ABB	

Mod.	B2342			Apparatus	Emax DC	Scale
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### 14.3. PR120/K signalling module

#### 14.3.1. General characteristics

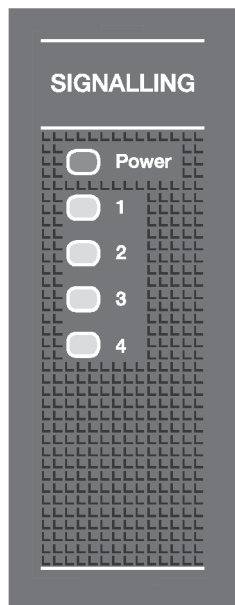
The module enables alarms and circuit-breaker trips to be signalled in the local mode.

There are two possible configurations for the SIGNALLING module:

- default configuration: 1 digital input, 3 contacts with pole in common, 1 independent contact;
  - alternative configuration: 4 independent contacts. In this case, the digital input is wired but is not routed to the terminal box.
- The two configurations are alternative to each other. You can switch from one configuration to the other without changing the module but by using different wiring, as shown in electric circuit diagrams 46 or 47.

#### 14.3.2. Front view

- "Power" LED (on when Vaux or PR120/V-PR120/LV are installed)
- 4 (four) LEDs: associated with the signalling contacts



#### 14.3.3. Releases equipped with the module

- optional for PR122/DC
- optional for PR123/DC

#### 14.3.4. Characteristics of the digital input

The unit allows the digital input to be associated with the following functions:

- enabling of an alternative set of parameters, set B (only PR123/DC);
- external trip control;
- zeroing release trips;
- resetting PR120/K contacts;
- local/remote enabling;
- resetting energy meters.

The digital input is activated by a 24 VDC  $\pm$  20% voltage.

The module can be used as an actuator for the load control function.

#### 14.3.5. Characteristics of the signalling contacts

The following data are defined for resistive loads

Type of contact	SPST	
Maximum change-over voltage	130 VDC	380 VAC
Maximum change-over current	5 A	8 A
Maximum change-over power	175 W	2000 VA
Breaking capacity @ 35 VDC	5 A	----
Breaking capacity @ 120 VDC	0.2 A	----
Breaking capacity @ 250 VAC	----	8 A
Breaking capacity @ 380 VAC	----	5.2 A
Contact/coil insulation		4000 Veff /Vrms
Contact/contact insulation		1000 Veff/Vrms

#### 14.3.6. Power supply

The PR120/K signalling module is powered in the auxiliary mode by the relay and/or by PR120/V-PR120/LV, as specified in chapter 14.1.

Mod.	B2342			Apparatus	<b>Emax</b>	Scale
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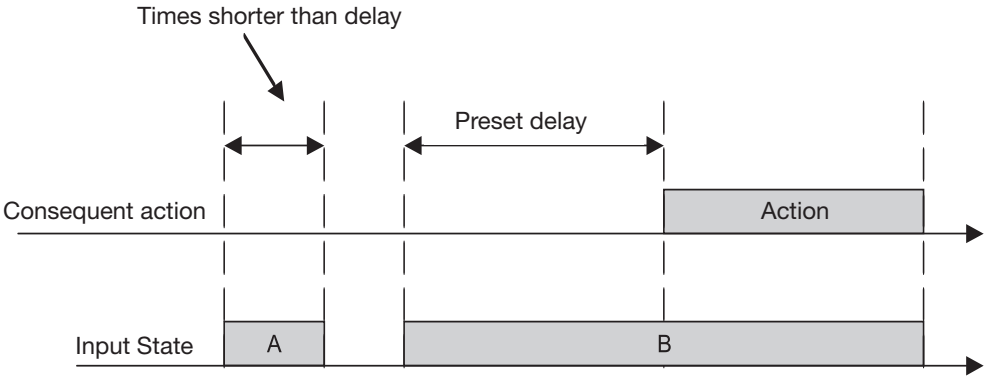
14.3.7. PR120/K Module menu

The PR120/K is equipped with four relays, the contacts of which are called K51/p1, K51/p2, K51/p3 and K51/p4. They can signal different situations selectable by the user from amongst the ones in the standard list, while customizations can be programmed by selecting "custom" from the menu and setting the required signal by means of the PDA, Ekip Connect or PR010/T. See Appendix 15.3

Parameter / Function		Values	Notes
<b>Relay N° 1...4</b>			
(K51/p1...p4)	Signal source	Standard or custom	- see sect. 15.3
	Delay	0...100s step 0.01s	- Intentional delay prior to activation of the contact
	NO/NC	NO/NC	- Contact normally open (NO) or normally closed (NC)
	Latch	ON/OFF	- With the contact "ON", once it has been activated it stays switched.
			A specific reset action is required to reset it.
<b>Input</b>			
	Polarity	Active low Active high	
	Function	Generic Outside trip Trip reset Set B Local Signal reset Energy reset	- No associated action - Releases the circuit-breaker - resets the data after a trip - Switches from set A to set B (only for PR123/DC) - Forces the local state of the protection (local/remote) - Programmable contact reset - Energy meter reset
	Delay	0...100s step 0.01s	- Performs the action after the set t

14.3.8. Configurable input

There is an input with a configurable function in the Signalling module. The figure shows two cases, A and B, in which the state of the input is active. In case A, the input does not remain valid for longer than the enabling delay, thus the associated action does not occur whereas in case B, the action takes place after the preset delay.



14.3.8.1. Input configuration settings

You can select the level at which the input is considered enabled:

- 1. Low input enabling level
- 2. High input enabling level

14.3.8.2. Input function (ACTION) settings

You can select the action associated with the input, i.e. the action that takes place after the programmed delay, when the input is enabled (on the high or low level).

You can select one of the following actions:

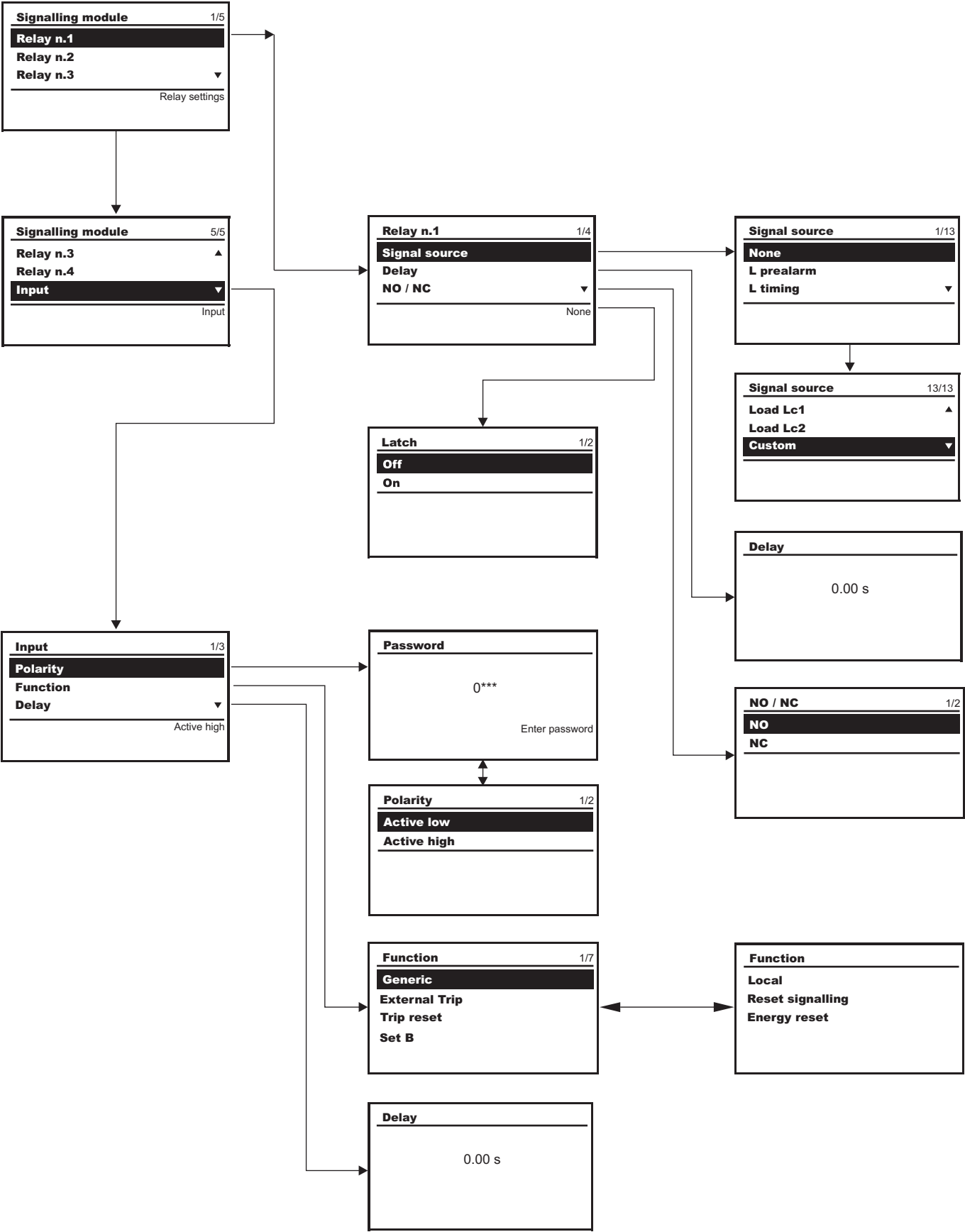
- 1. Generic: no specific action is associated with the input. The state of the input is shown on the available display and remotely via the bus
- 2. Trip test: when the input is enabled for the specific delay, a trip test is performed
- 3. Trip reset: when the input is enabled for the specific delay, a trip reset is performed
- 4. Set B: when the input is enabled for the specific delay, the Set B is enabled
- 5. Dial Local: when the input is enabled for the specific delay, the local dialog mode is forced
- 6. Signalling module reset: when the input is enabled for the specific delay, the state of the relays in the PR120/K module is reset
- 7. Energy reset: when the input is enabled for the specific delay, the energy meters are reset.

14.3.8.3. Setting the input enabling delay

Using the "Delay" parameter, you can specify the time that elapses before the input is enabled within the range of 0.00 [s] to 100.00 [s] with 0.01[s] steps.

14.3.9. PR120/K module menu layout

The menu layout of relay N° 1 (K51/p1) is illustrated below by way of example. The same applies to the menus of the other relays.



14.4. PR120/DC override protection module



14.4.1. General characteristics

This module is always installed in releases PR122/DC and PR123/DC and serves as an override protection when the relay is not powered.

The threshold value depends on the circuit-breaker, as shown in the table below:

CB	Threshold (kA)
E2 800	2,5
E2 1000	2,5
E2 1250	5
E2 1600	5
E3 E3-A 800	2,5
E3 E3-A 1000	2,5
E3-A 1200	5
E3 1250	5
E3 E3-A 1600	5
E3 E3-A 2000	7,5
E3 E3-A 2500	7,5
E4 1600	5
E4 2000	5
E4 2500	10
E4 3200	10
E6 3200	10
E6 E6-A 4000	15
E6 E6-A 5000	15

NOTE. There is no need for the Customer to make any connections or settings.

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## 15. Appendices

### 15.1. PR021/K external signalling module

#### 15.1.1. General information

The signalling unit converts the digital signals provided by the protection units into electrical signals by means of normally-open electric contacts.

Information about the state of the protection functions transits on a dedicated serial line connected to the release.

The following signals/contacts are available:

- L overload prealarm (the alarm signal remains enabled throughout the overload, until the release has been tripped);
- protection timing and trip (the trip signal of the protections remains active during the timing-controlled phase and after the release has been tripped);
- I protection trip;
- temperature rise threshold timing and overrun;
- two contacts for load control;
- release trip;
- communication fault on the serial line (connections between protection and signalling units);
- polarity unbalance.

The signals of 7 programmable contacts can be configured by means of a dip switch. This can be done by selecting them directly in the PR122/DC or PR123/DC relay via PR010/T, Ekip Connect, choosing them from a long list.

Two contacts available in the SACE PR021/K unit (load control), allow you to control a release for opening and closing the circuit-breaker. These contacts enable various applications, including load control, alarms, signals and electric locks.

A Reset button allows you to reset the state of all the front optical signals and to return the contacts of the relay to the position of reset.

The unit also has two LEDs for displaying the following information:

- Power ON: auxiliary power supply on;
- Tx(int Bus): flashing synchronized with dialog with the internal Bus;
- Eight LEDs associated with the signalling contacts.

#### 15.1.2. Power supply

Auxiliary power supply	24 V DC +/-20%
Maximum ripple	5%
Rated power @ 24 V	4.4 W

#### 15.1.3. General characteristics of the signalling relays

The following data are defined for resistive loads

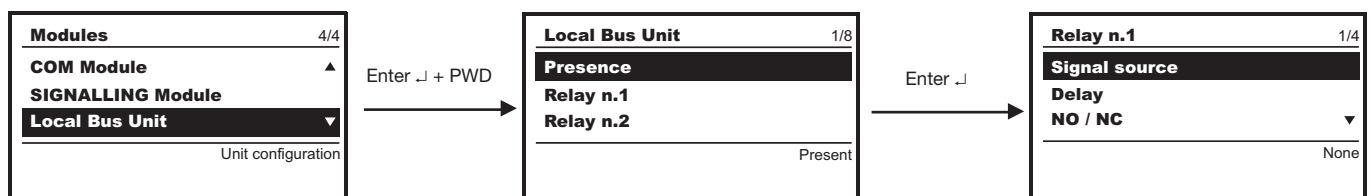
Type of contact		SPST
Maximum change-over voltage	130 VDC	380 VAC
Maximum change-over current	5 A	8 A
Maximum change-over power	175 W	2000 VA
Breaking capacity @ 35 VDC	5 A	----
Breaking capacity @ 120 VDC	0.2 A	----
Breaking capacity @ 250 VAC	----	8 A
Breaking capacity @ 380 VAC	----	5.2 A
Contact/coil insulation		4000 Veff Vrms
Contact/contact insulation		1000 Veff Vrms

#### 15.1.4. Relay functions

The available contacts can be used to manage the relative relays indicating an event (a given situation in the state of the device) that prompts the required relays to be independently enabled after the delay specified by the user. The function is entirely similar to the one described in the PR120/K signalling module in sect. 14.3 and 15.3 of this manual.

#### 15.1.5. PR021/K signalling unit menu

The functions of the unit can be accessed from the operator panel (PR123/DC and PR122/DC where applicable)



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### 15.1.5.1. PR021/K unit menu table

Protection	Parameter / Function	Values	Notes
PR021K unit		Present Absent	Leave as Absent if there is no PR021/K
	Relay N° 1 / 2 / 3 / 4 / 6 / 7 / 8 Signal source	None L prealarm L Timing S Timing L Trip S Trip G Trip I Trip Every trip Custom	- Only for PR123/DC
	Delay NO/NC	0...100 s step 0.01s NO/NC	- See sect. 15.3 - Intentional delay prior to activation of the contact - Contact normally open (NO) or normally closed (NC)
	Latch	ON/OFF	- With the contact "ON", once it has been activated, it stays switched. A specific reset action is required to reset it.

### 15.1.5.2. Important note



**WARNING:** The unit must be connected to the PR122/DC or PR123/DC by means of an internal busbar with a shielded, stranded two-wire cable (see note A, sect. 11.2) no more than 15 m long. The shield must be earthed both on the circuit-breaker side and on the PR021/K side. Refer to the specific user manual for instructions about how to install and operate the PR021/K accessory.

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## 15.2. Data Logger (recorder)

The Data Logger (recorder) function is available in the PR122/DC and PR123/DC units and can be used to automatically memorize the instantaneous values of certain analog and digital measurements in a large-sized memory buffer. The data can be easily downloaded from the unit using the Ekip T&P applications with a Bluetooth or Ekip Connect port via a Modbus bus, and transferred to any personal computer for processing. The function stops the recording every time a trip occurs in order to facilitate failure analysis.

### 15.2.1. General characteristics:

Number of analog channels:	7
Number of digital events:	64
Maximum sampling frequency:	4800 Hz
Maximum sampling time:	27 s ( - sampling frequency 600 Hz)

### 15.2.2. Description of the Data Logger menu

You can access the Data Logger menu from the Settings menu in the PR122/DC and PR123/DC units:

Settings 4/9  
Main Frequency ▲  
Modules  
Data logger ▼  
Data logger

#### 15.2.2.1. Data Logger enabling

The Data Logger is enabled following entry of the password.

Data logger 1/1  
Enable  
Off

Enter ↵

Password  
0\*\*\*  
Enter password

PWD + Enter ↵

Enable 2/2  
Off  
On

#### 15.2.2.2. Sampling frequency setting

The frequency with which the measurements are saved can be selected in the menu from amongst 4 fixed frequency values: 600 Hz, 1200 Hz, 2400 Hz or 4800 Hz.

Data logger 1/6  
Enable ▲  
Sampling freq. ▼  
Stop event ▼  
On

Enter ↵

Sampling freq. 1/4  
600 Hz  
1200 Hz  
2400 Hz ▼

The maximum data recording times (also see sect. 15.2.3) depend on the selected frequency and are given in the following table:

Frequency	RECORDING TIME
600 Hz	27.3 s
1200 Hz	13.6 s
2400 Hz	6.8 s
4800 Hz	3.4 s

Note: selecting the sampling frequency is an important step. The presence of high-order harmonic waves may cause aliasing on processing of collected data. It is advisable to use the maximum frequency when harmonic distortion is present, otherwise data processing may give results that do not match the real conditions of the installation.

#### 15.2.2.3. Setting the standard Stop Events (trigger)

You can select one of the following Stop Events (trigger), also see sect. 15.3.2:

1. None
2. Every alarm
3. L Timing
4. Every trip

Data logger 3/4  
Enable  
Sampling freq. ▼  
Stop event ▼  
None

Enter ↵

Stop event 1/5  
None  
Any Alarm  
L Prealarm  
Any Trip  
Custom

If you select "none" for the Stop Event, the Data Logger can only be stopped by a stop command from the operator, from the system or following a trip generated by the relay.

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15.2.2.4. Setting and viewing customized Stop Events (trigger)

You can set customized Stop Events (triggers) from the system, to coincide with the events described in section 15.3. The following page will appear if a customized trigger occurs:

Stop event5/5

L Prealarm

Any Trip

Custom

15.2.2.5. Stopping delay setting

The stopping delay can be set between 0.00 [s] to 10.00 [s] with 0.01 [s] steps

Data logger4/6

Sampling freq.

Stop event

Stop delay

0.00 s

Enter ↵

Stop delay

0.00 s

**WARNING:** If a trip occurs, this data storage process will be stopped after 10 ms, even if a longer stopping delay has been selected.

15.2.2.6. Data Logger Restart/Stop

Data Logger recording can be restarted/stopped with the Restart/Stop options.

Data logger5/6

Stop event

Stop delay

Restart

Restart

Data logger6/6

Stop delay

Restart

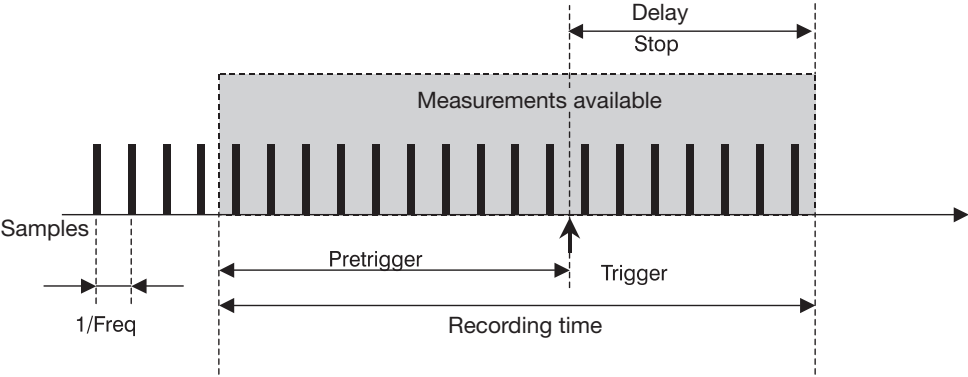
Stop

Stop

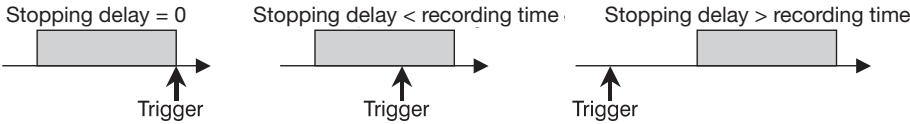
15.2.3. Recording time slots

The Data Logger's measurements are recorded in a time slot, the duration of which is defined and synchronized by an event (Trigger/Stop Event).

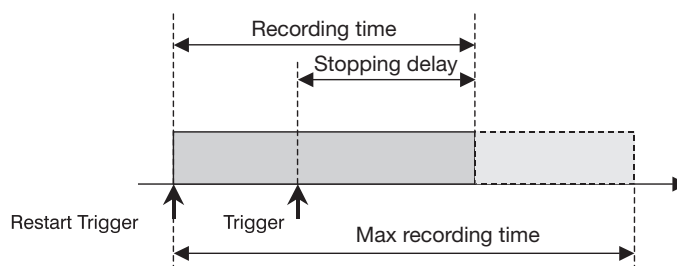
The following figure displays the time slot, the trigger and samples available in grey:



The user can select the sampling frequency (see sect. 15.2.2.2), the type of Stop Event (trigger) (see sect. 15.2.2.3) and the stop delay (see sect. 15.2.2.4) so as to obtain the desired pre-trigger with respect to the selected event. Depending on the selection made, the stopping delay may be nil or it may be lower or higher than the recording time, as illustrated in the next figure:



Maximum recording time is established solely by the sampling frequency set as described in sect. 15.2.2.2. The recording time may be than the maximum time obtainable when the sum of the stopping delay and the time that elapses between a restart trigger and a trigger is less than the maximum value, as shown in the figure below:



**WARNING:** If the data logger parameters are changed while the data logger is operating, the recording in progress is terminated and a new recording begins (after a restart trigger command) on the basis of the new parameters.

#### 15.2.4. Description of the information given by the Data Logger system

##### 15.2.4.1. Combination of devices for reading / setting data from the Data Logger system

By connecting to the outside bus of the release, you can set certain data logger parameters, triggers or commands, or read certain types and sequences of data in its memory.

The combinations of devices and the consequent software combinations that enable these functions are as follows:

- 1) PR122/DC + BT030 USB+EKIP CONNECT
- 2) PR122/DC + PR120/D-M + EKIP CONNECT or remote system
- 3) PR123/DC + PR120/D-M + EKIP CONNECT or remote system
- 4) PR122/DC + PR010/T \*
- 5) PR123/DC + PR010/T \*

\* It is impossible to download sequences of stored data with these combinations

In this manual, the term "from the system" is used to define both the operations that are carried out using one of the combinations equipped with Ekip T&P or Ekip Connect, and the operations that require connection to the remote system.

##### 15.2.4.2. Access to the data saved from the system

When the event associated with the Stop Event occurs or a stop command is received, the following data are saved in the recording block:

- Data Logger Trigger, which indicates the type of Stop Event (trigger) that prompted datalogger stopping;
- Time-stamp of the Stop Event (trigger) (day/time+minutes/seconds/milliseconds) (4 words);
- Datalogger max file, which indicates which is the max file with consistent data;
- Datalogger max address, which indicates the max address number of a block with consistent data.

The following information is recorded in the block for each sampling period:

1. current sample  $I_A$
2. current sample  $I_{A_2}$  (available only with E4/E6/E6-A)
3. current sample  $I_B$  (available only with PR123/DC)
4. current sample  $I_{B_2}$  (available only with PR123/DC and E4/E6/E6-A)
5. unavailable
6. unavailable
7. unavailable
8. voltage sample  $U$
9. digital inputs / outputs (among 16 possible options. E.g.: inputs/outputs for Zone Selectivity, PR120/K contact state, ...)
10. alarms1 (among 16 possible options. E.g.: L timing, G alarm, Prealarm)
11. alarms2 (among 16 possible options. E.g.: OV timing, RP timing)
12. trips (among 16 possible options. E.g.: tripping of L, S, I, G, UV, ...)

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15.2.4.3. Information from the system about the configuration and state of the Data Logger

The following information is given about the state of the Data Logger:

STATE	
Waiting trigger:	this means that the Data Logger is enabled and waiting for the occurrence of the event selected as the trigger
Data Logger triggered:	this indicates that the trigger event has occurred and the Data Logger is still recording
Data Logger stopped:	this means that the recording has been terminated either because it has been completed or because a Data Logger stop command has been received, or because a trip has occurred

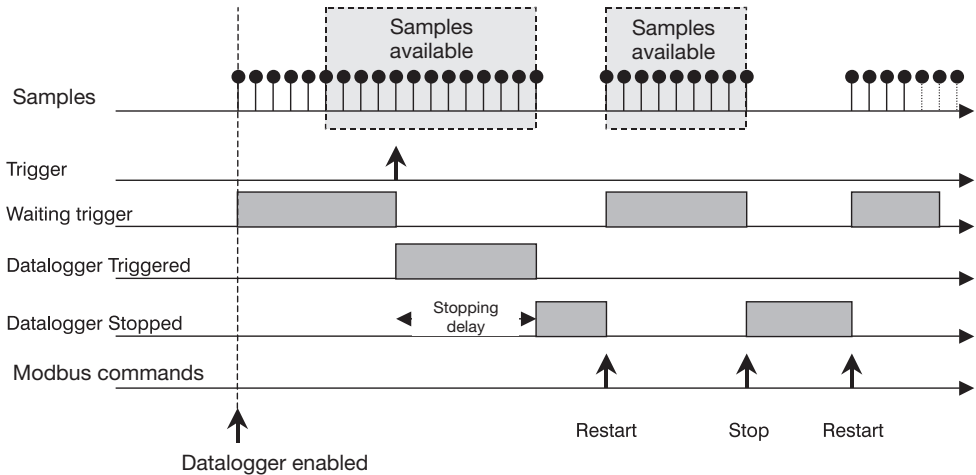
CONFIGURATION	
Data Logger Config:	Indicates whether or not the Data Logger is active
Data Logger Trigger Type:	indicates the Stop event setting (trigger)
Data Logger stopping delay:	indicates the delay for stopping

15.2.5. Data Logger controls from system

When a Datalogger Stop command is given, the recording is stopped by the system. The subsequent recording is enabled by a Restart trigger command. The same operations can be performed from the operator panel, as described in sect. 15.2.2.6

Example of Data Logger operation

The following figure shows an example of how the trigger works, the Data Logger's function, the effect of the stopping delay, and the restart and successive end (stop) of the data saving procedure.



### 15.3. Table showing lists of events

#### 15.3.1. "Standard" events for PR120/K and for PR021/K selectable from the relay

Event N°	Description	
0.	None	(none enabled)
1.	L prealarm	(L protection prealarm)
2.	L timing	(L protection timing)
3.	S timing	(S protection timing)
4.	L trip	(L protection trip)
5.	S trip	(S protection trip)
6.	I trip	(I protection trip)
7.	G trip	(G protection trip)
8.	Any trip	(tripping of any protection)
9.	Any alarm	(timing of any protection)
10.	Load LC1	(load control 1 alarm)
11.	Load LC2	(load control 2 alarm)

#### 15.3.2. Examples of "customized" events for the Data Logger function for PR120/K and for PR021/K:

(decimal)	Event	PR122	PR123
1920	G timing	-	x
2910	IA, IA2, IB, IB2, Sensor error or Trip Coil error	x	x
2688	LC1 alarm	x	x
2049	G alarm	-	x
2306	G timing	x	x
4124	UV or OV tripped	x	x
33672	CB connected and springs charged	x	x

You can combine the status bits with logical functions "and" or "or" within the same group of events (byte). Consult the Modbus Interface document for further details.

#### 15.3.3. "Standard" events for the Data Logger function selectable from the relay

Event N°	Description	
0.	None	(free running)
1.	Any alarm	(any alarm)
2.	L timing	(L protection timing)
3.	Any trip	(tripping of any protection)

#### 15.3.4. Combination of devices required for customized settings

The "custom" events can be selected using a remote control system, Ekip T&P, Ekip Connect. The devices you need to allow you to do so can be selected from among the following:

- 1) PR122/DC + BT030 USB + EKIP CONNECT
- 2) PR122/DC + PR120/D-M + EKIP CONNECT or remote system
- 3) PR122/DC + PR010/T
- 4) PR123/DC + BT030 USB + EKIP CONNECT
- 5) PR123/DC + PR120/D-M + EKIP CONNECT or remote system
- 6) PR123/DC + PR010/T

Mod.	B2342			Apparatus	<b>Emax</b>	Scale
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16. Overall dimensions

16.1. Fixed circuit-breaker (IEC 60947)

Basic version with rear terminals

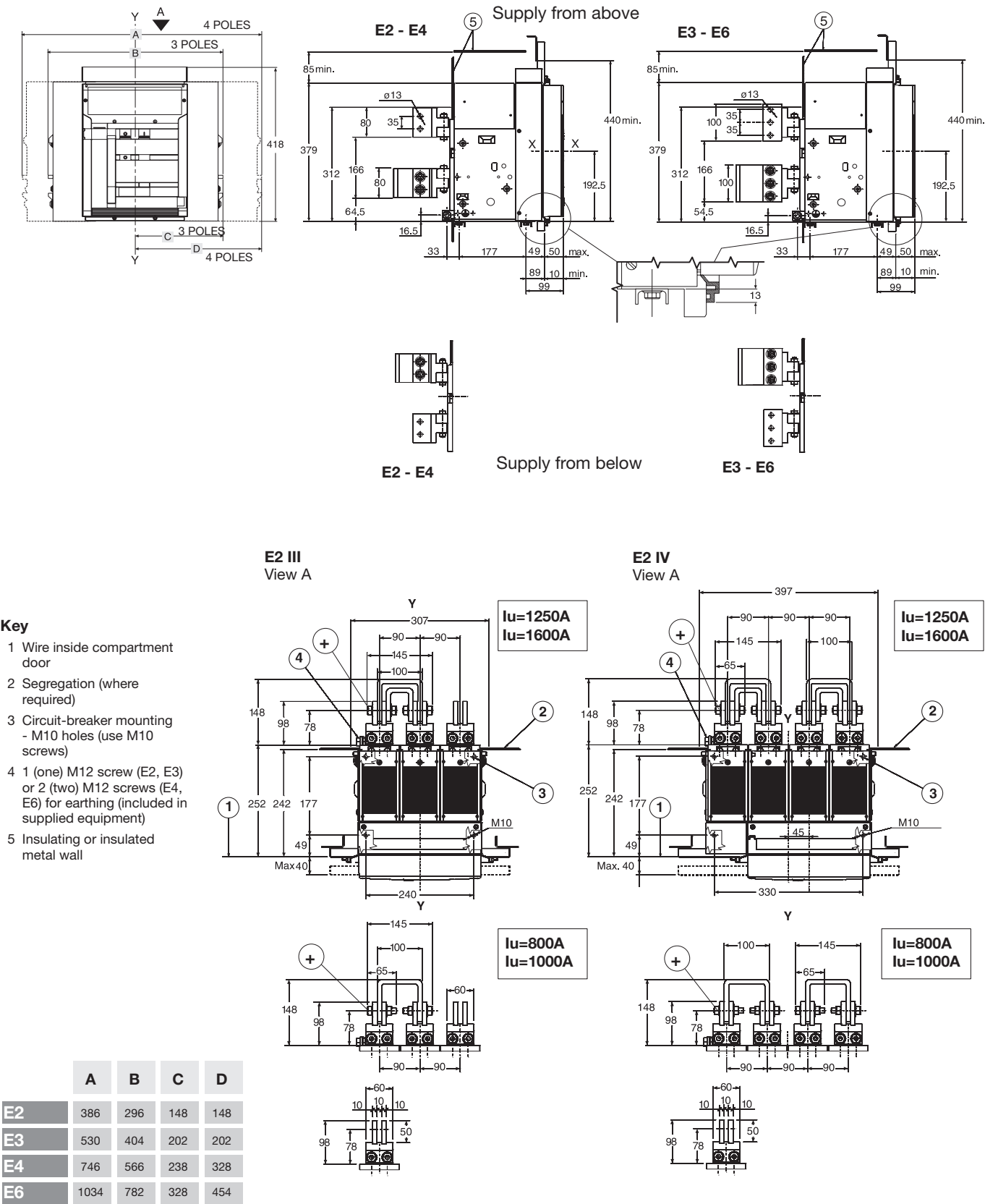


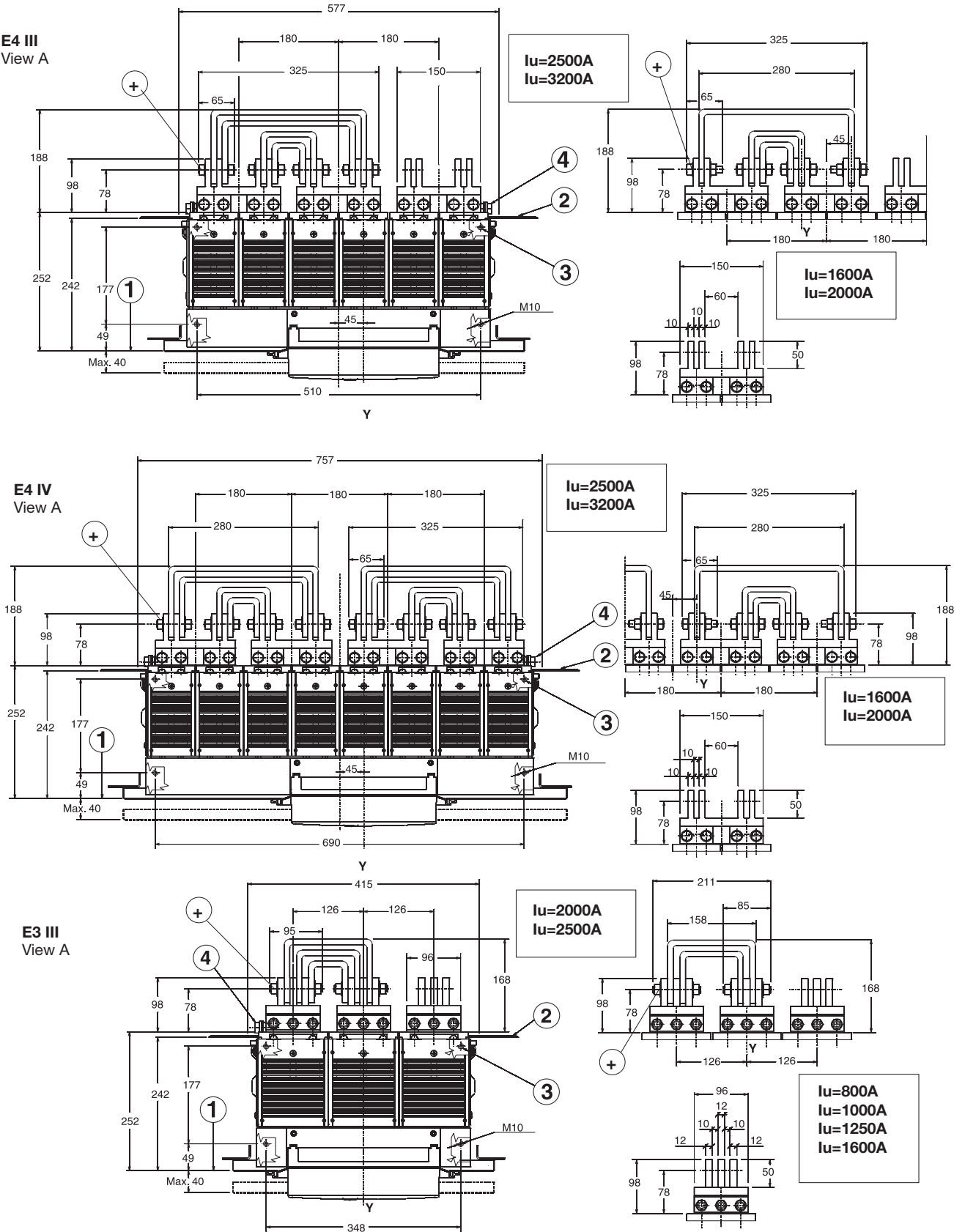
Fig. 54

Tightening torque of the main terminals 70 Nm  
Tightening torque of the earthing screw 70 Nm

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Fixed circuit-breaker (IEC 60947)

Basic version with rear terminals



Tightening torque of the main terminals 70 Nm  
Tightening torque of the earthing screw 70 Nm

Fig. 55

Mod.	B2342	Apparatus	Emax	Scale
		Doc N°	1SDH000635R0002	Page N° 103/131

Fixed circuit-breaker (IEC 60947)

Basic version with rear terminals

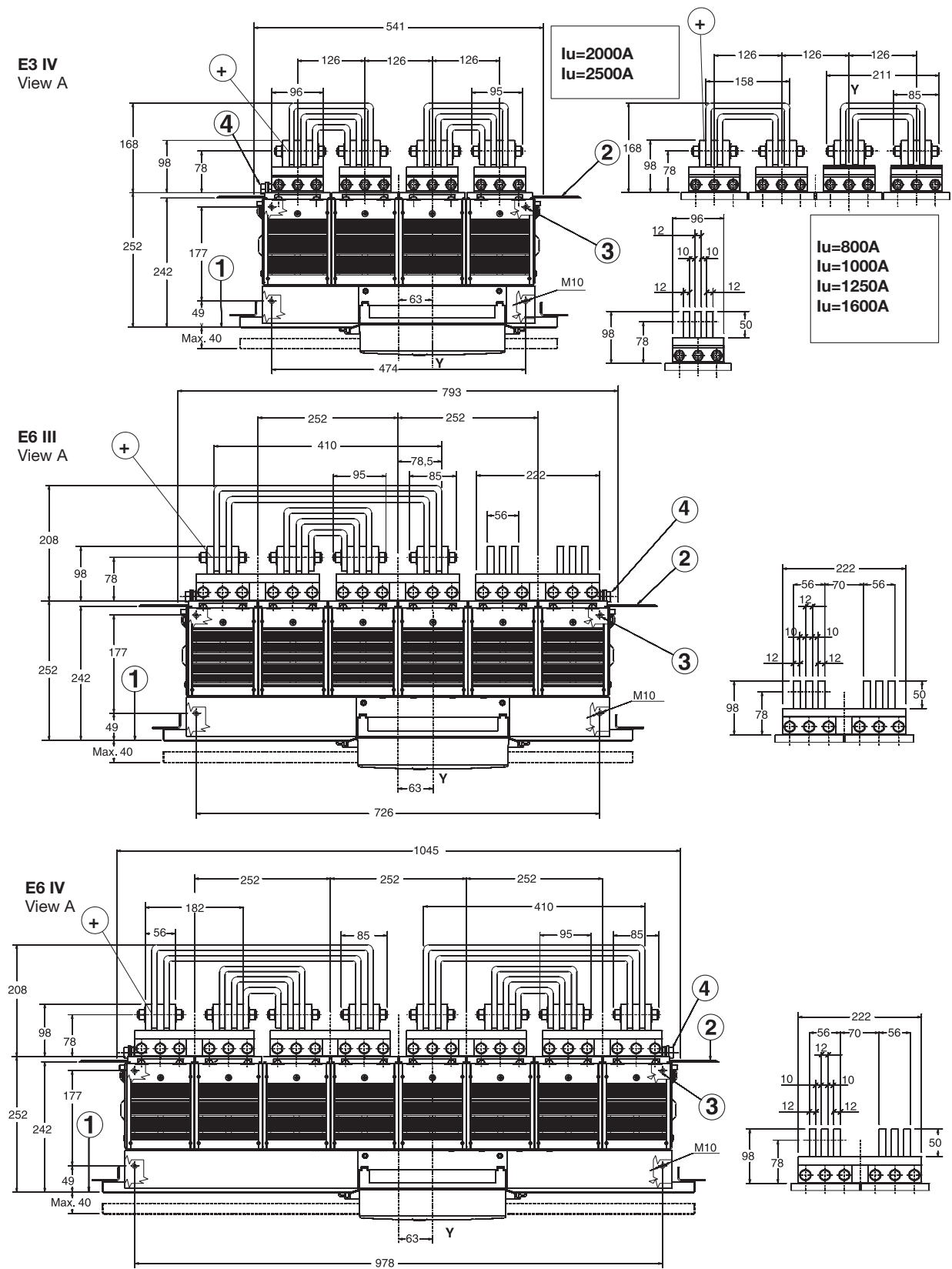


Fig. 56 Tightening torque of the main terminals 70 Nm  
Tightening torque of the earthing screw 70 Nm

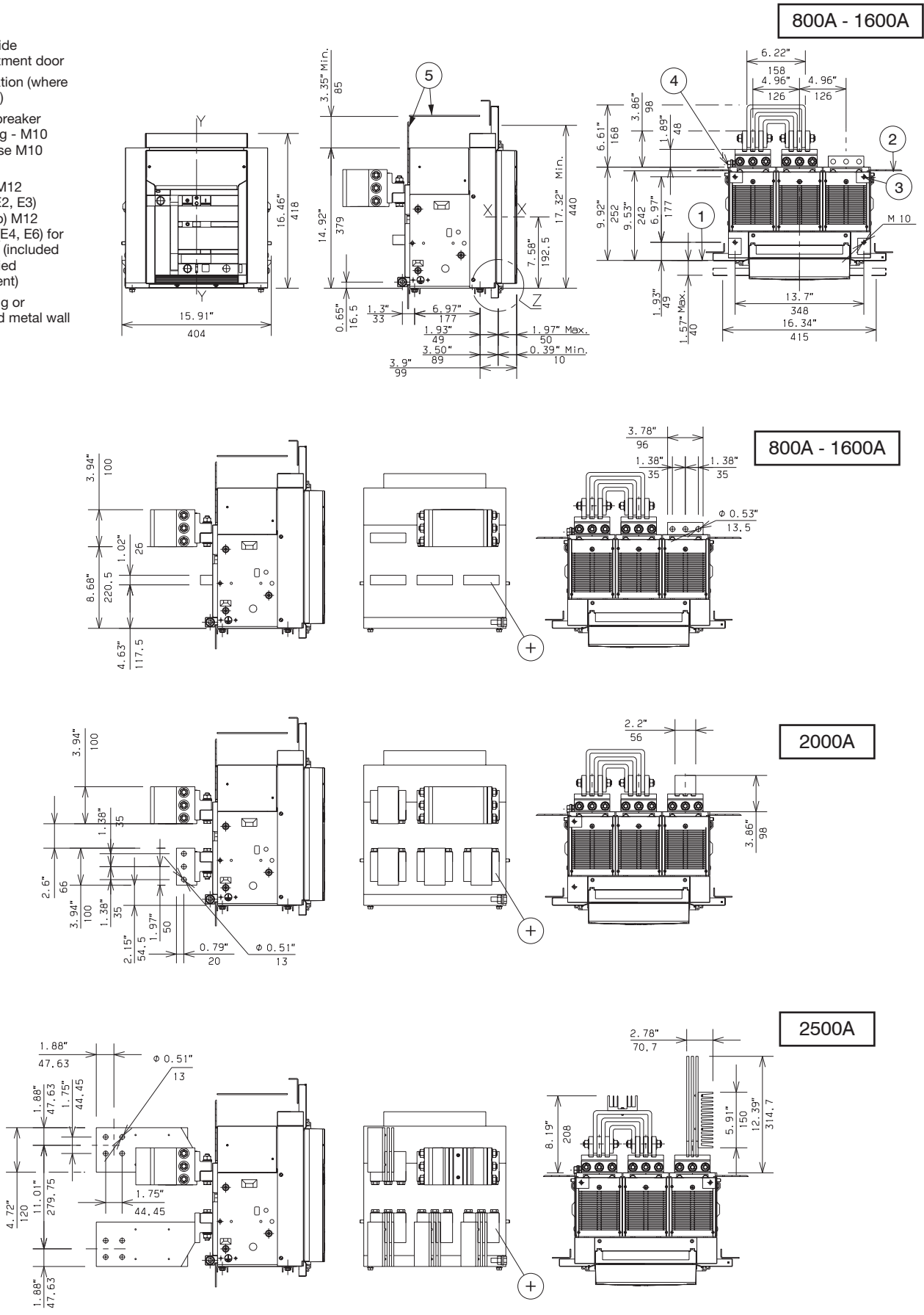
Mod.	B2342		Apparatus	Emax DC	Scale
			Doc N°	1SDH000635R0002	Page N° 104/131

16.2. Fixed circuit-breaker (UL 1066)

Emax DC UL III in the fixed version with 2PS+1 connection

Key

- 1 Wire inside compartment door
- 2 Segregation (where required)
- 3 Circuit-breaker mounting - M10 holes (use M10 screws)
- 4 1 (one) M12 screw (E2, E3) or 2 (two) M12 screws (E4, E6) for earthing (included in supplied equipment)
- 5 Insulating or insulated metal wall



Tightening torque of the main terminals 70 Nm  
Tightening torque of the earthing screw 70 Nm

Fig. 57

Mod.	B2342		Apparatus	Emax	Scale
			Doc N°	1SDH000635R0002	Page N° 105/131

Fixed circuit-breaker (UL 1066)  
Emax DC UL III in the fixed version with 3PS+0 connection

- Key**
- 1 Wire inside compartment door
  - 2 Segregation (where required)
  - 3 Circuit-breaker mounting - M10 holes (use M10 screws)
  - 4 1 (one) M12 screw (E2, E3) or 2 (two) M12 screws (E4, E6) for earthing (included in supplied equipment)
  - 5 Insulating or insulated metal wall

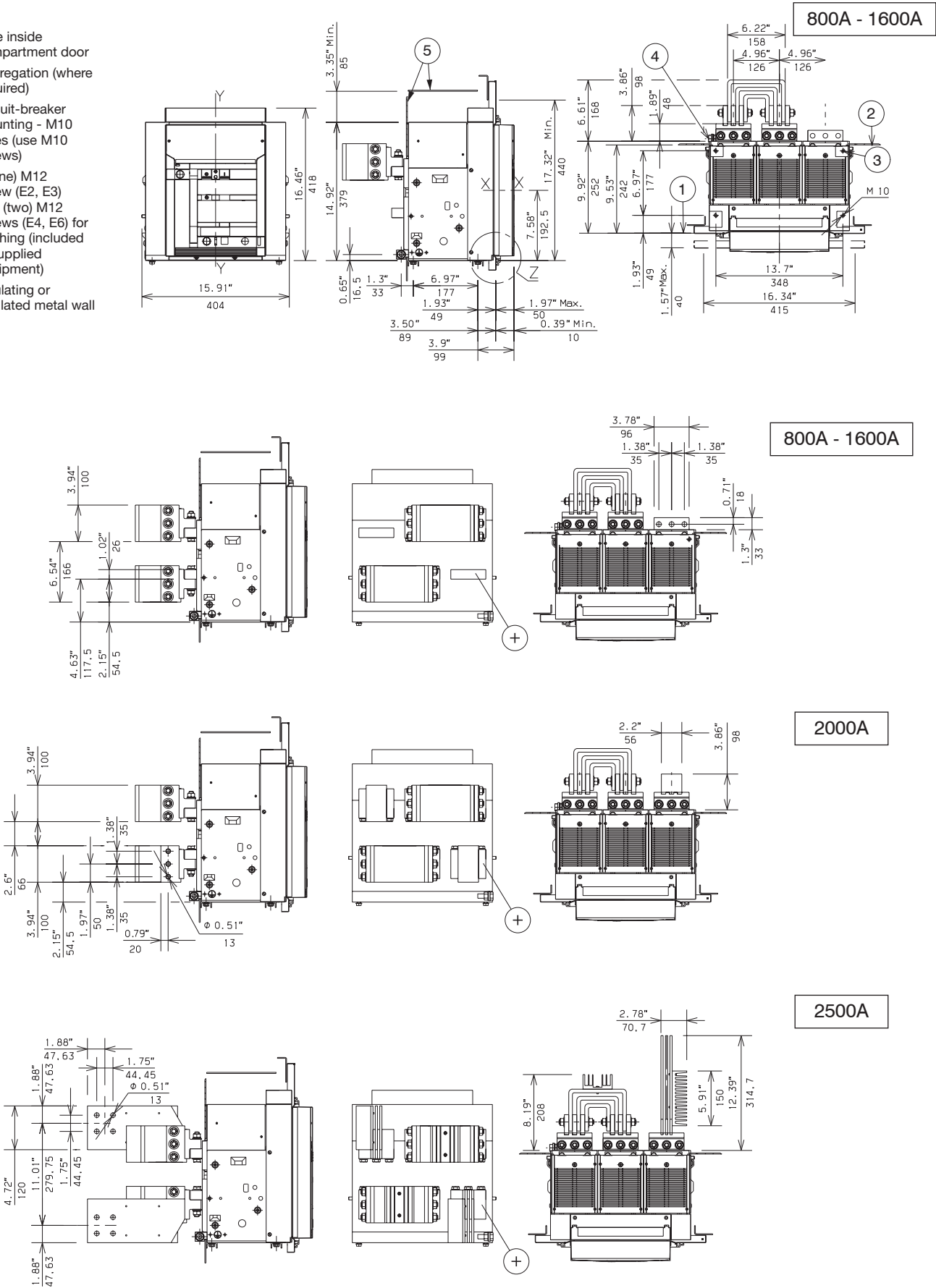


Fig. 58

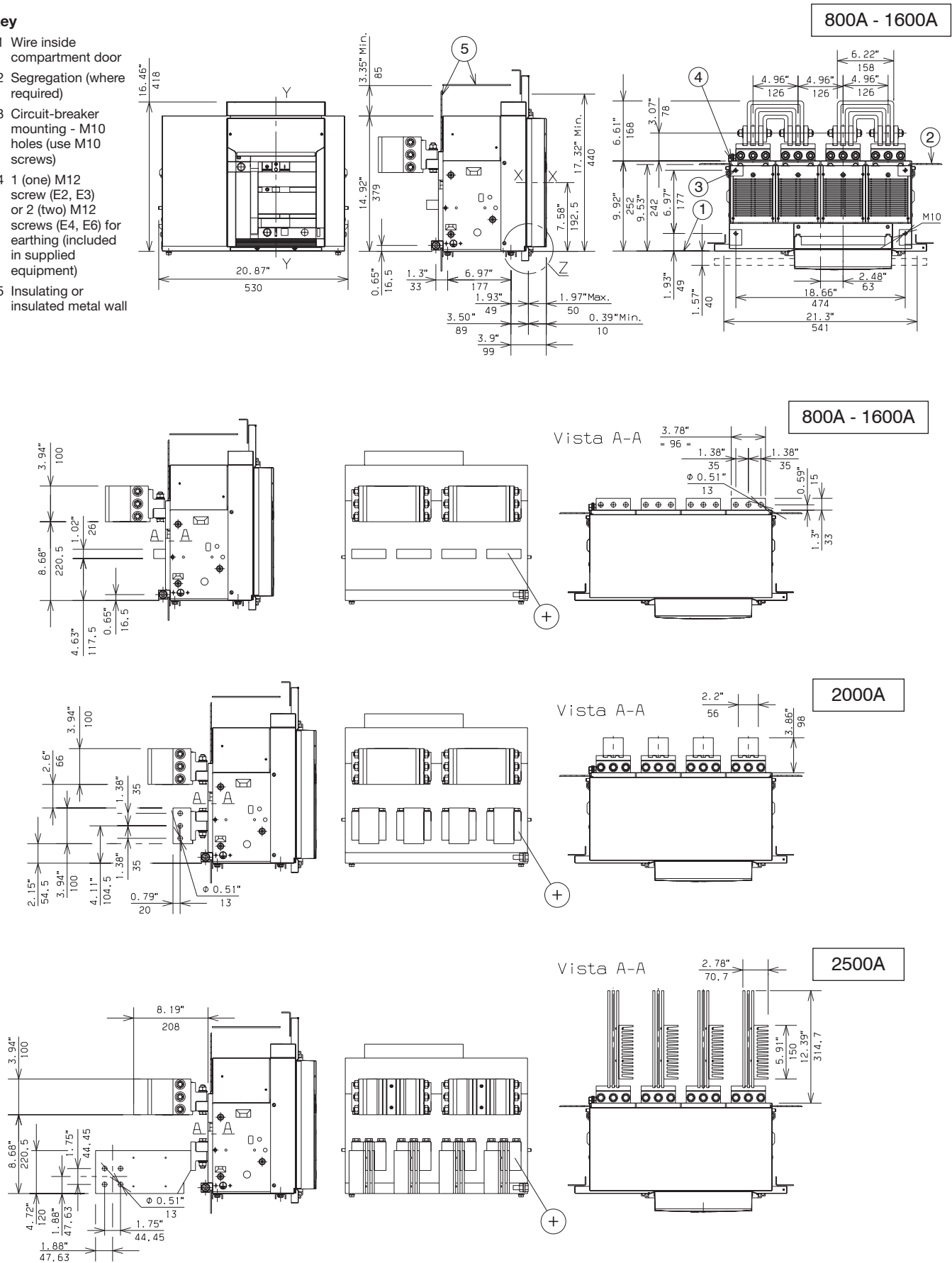
Tightening torque of the main terminals 70 Nm  
Tightening torque of the earthing screw 70 Nm

Mod.	B2342		Apparatus	Emax DC	Scale
			Doc N°	1SDH000635R0002	Page N° 106/131

Fixed circuit-breaker (UL 1066)  
Emax DC UL IV in the fixed version with 2PS+2PS connection

Key

- 1 Wire inside compartment door
- 2 Segregation (where required)
- 3 Circuit-breaker mounting - M10 holes (use M10 screws)
- 4 1 (one) M12 screw (E2, E3) or 2 (two) M12 screws (E4, E6) for earthing (included in supplied equipment)
- 5 Insulating or insulated metal wall



Tightening torque of the main terminals 70 Nm  
Tightening torque of the earthing screw 70 Nm

Fig. 59

Mod.	B2342		Apparatus	Emax	Scale
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Fixed circuit-breaker (UL 1066)  
Emax DC UL IV in the fixed version with 3PS+1 connection

- Key**
- 1 Wire inside compartment door
  - 2 Segregation (where required)
  - 3 Circuit-breaker mounting - M10 holes (use M10 screws)
  - 4 1 (one) M12 screw (E2, E3) or 2 (two) M12 screws (E4, E6) for earthing (included in supplied equipment)
  - 5 Insulating or insulated metal wall

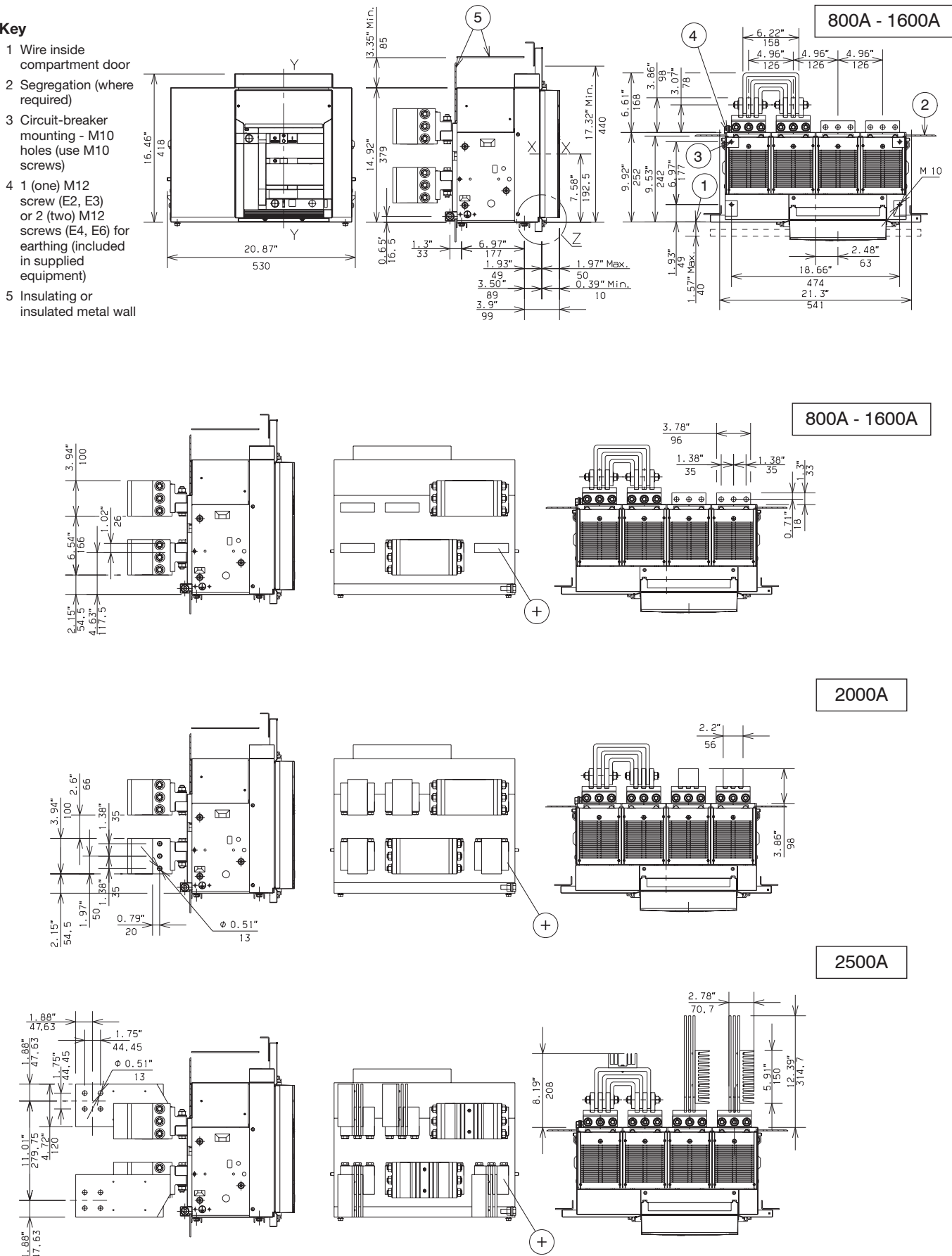


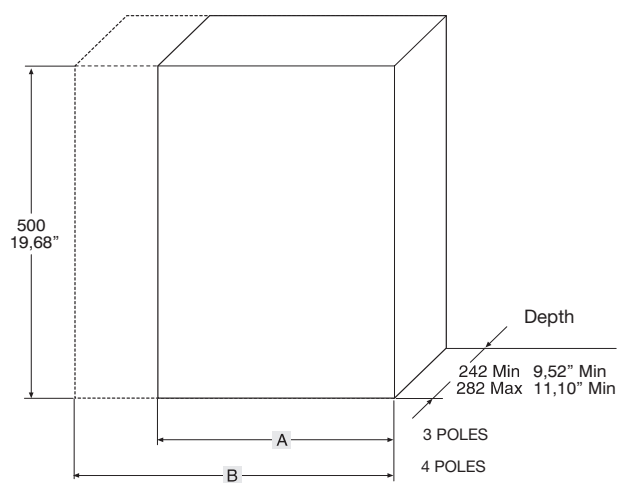
Fig. 60

Tightening torque of the main terminals 70 Nm  
Tightening torque of the earthing screw 70 Nm

Mod.	B2342		Apparatus	Emax DC	Scale
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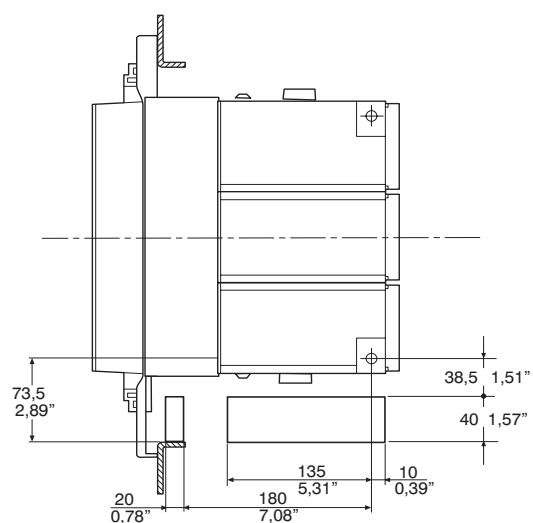


### Compartment dimensions (IEC)



	A	B
E2	400 15,74"	490 19,29"
E3	500 19,68"	630 24,80"
E4	700 27,56"	880 34,64"
E6	1000 39,37"	1260 49,60"

**Holes for routing flexible cables  
for mechanical interlocks**



### Holes drilled in compartment door

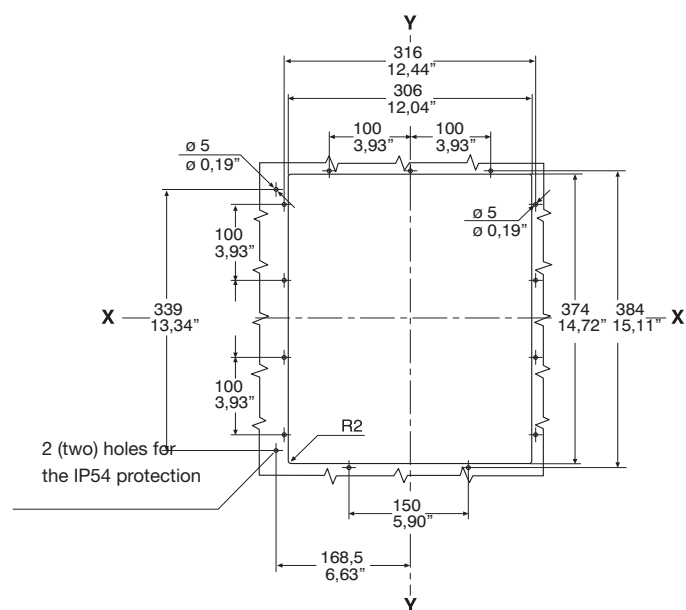


Fig. 61

Mod.	B2342			Apparatus	<b>E</b> max	Scale
				Doc N°	<b>1SDH000635R0002</b>	Page N° <b>109/131</b>

16.4. Withdrawable circuit-breaker (IEC 60947)  
Basic version with vertical rear terminals

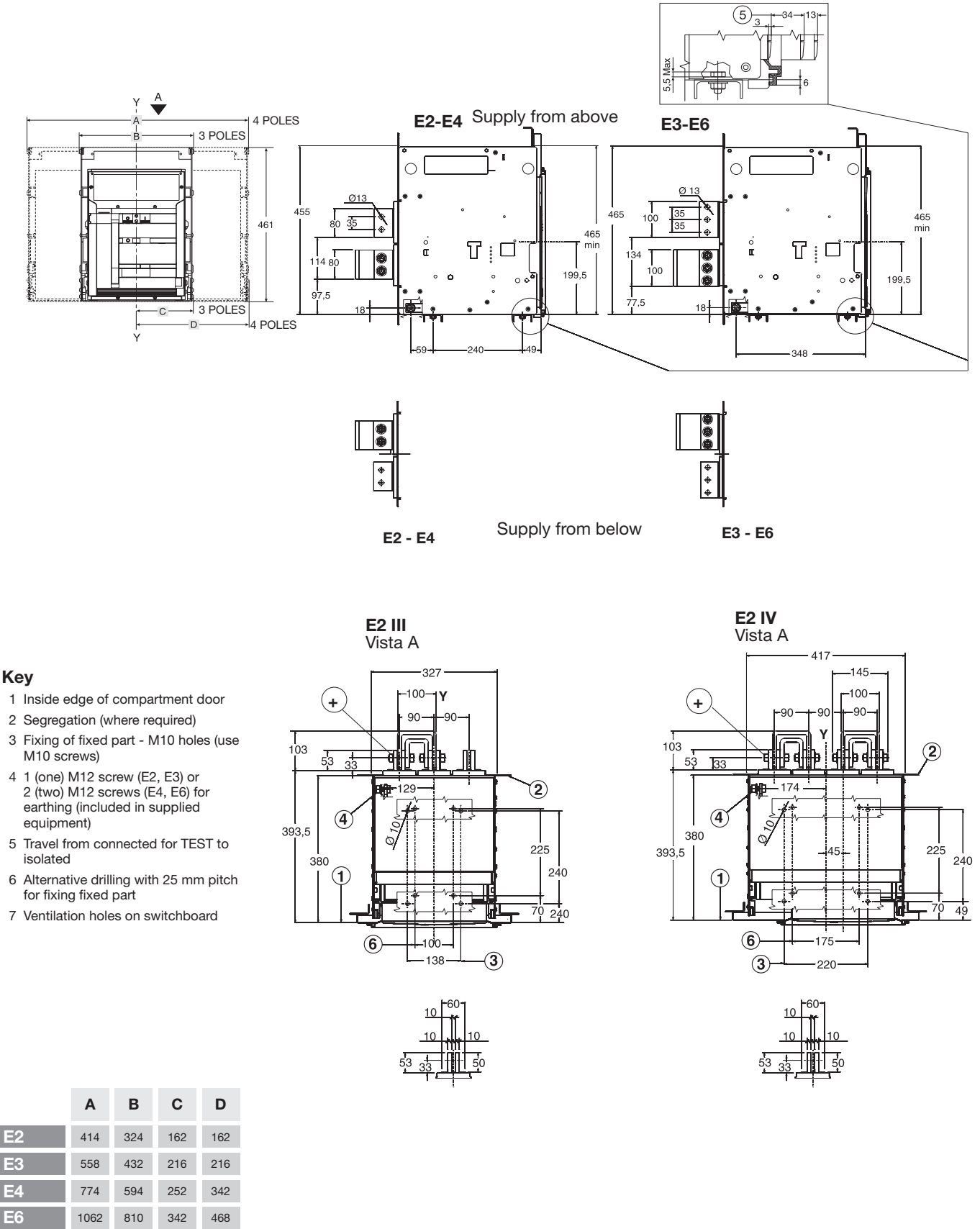


Fig. 62

Mod.	B2342			Apparatus	Emax DC	Scale
				Doc N°	1SDH000635R0002	Page N° 110/131

Tightening torque of the fixing screws 20 Nm  
Tightening torque of the main terminals 70 Nm  
Tightening torque of the earthing screw 70 Nm

Tightening torque of the fixing screws 20 Nm  
 Tightening torque of the main terminals 70 Nm  
 Tightening torque of the earthing screw 70 Nm

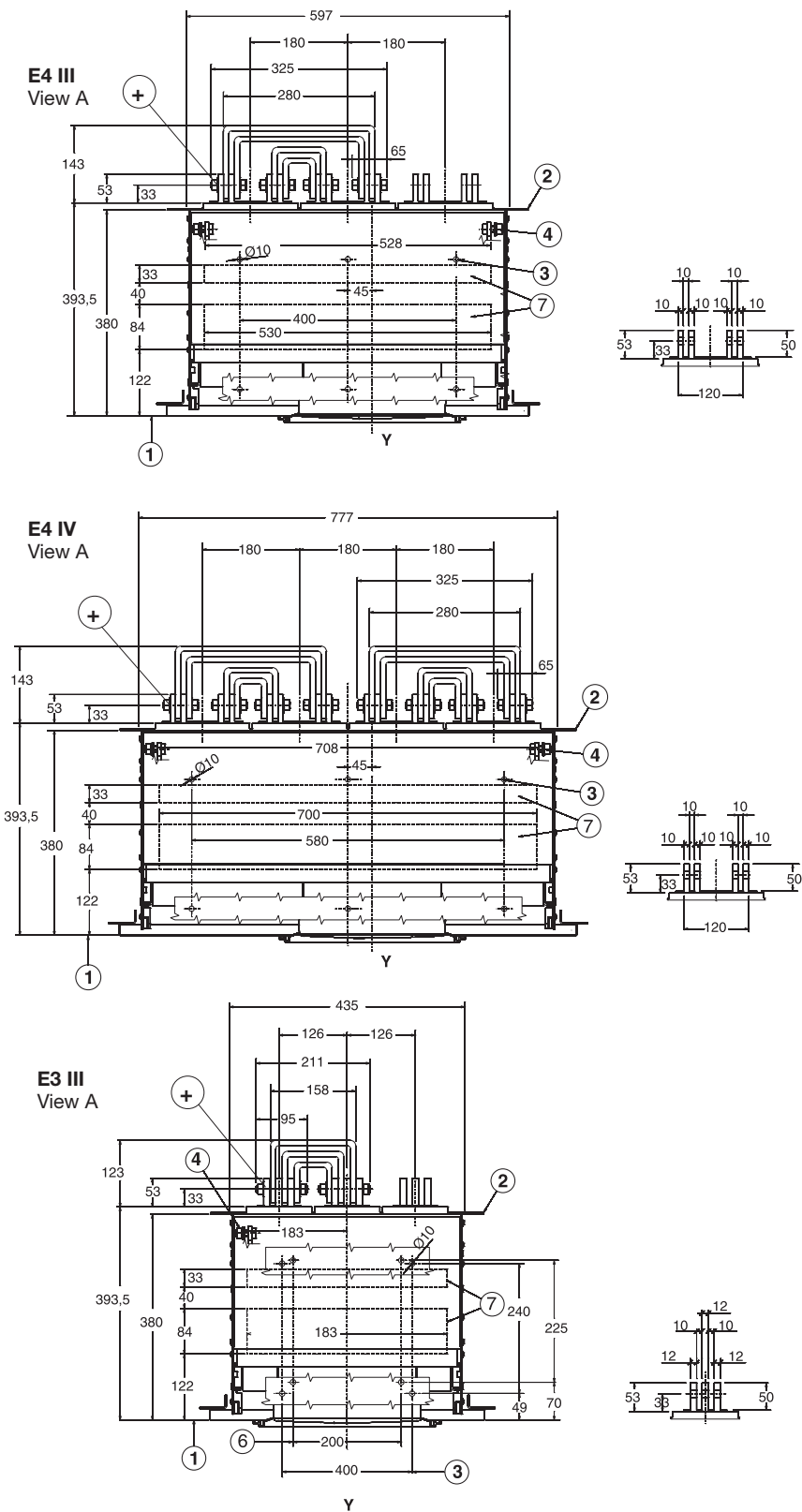


Fig. 63

Mod.	B2342		Apparatus	Emax	Scale
			Doc N°	1SDH000635R0002	Page N° 111/131

Tightening torque of the fixing screws 20 Nm  
 Tightening torque of the main terminals 70 Nm  
 Tightening torque of the earthing screw 70 Nm

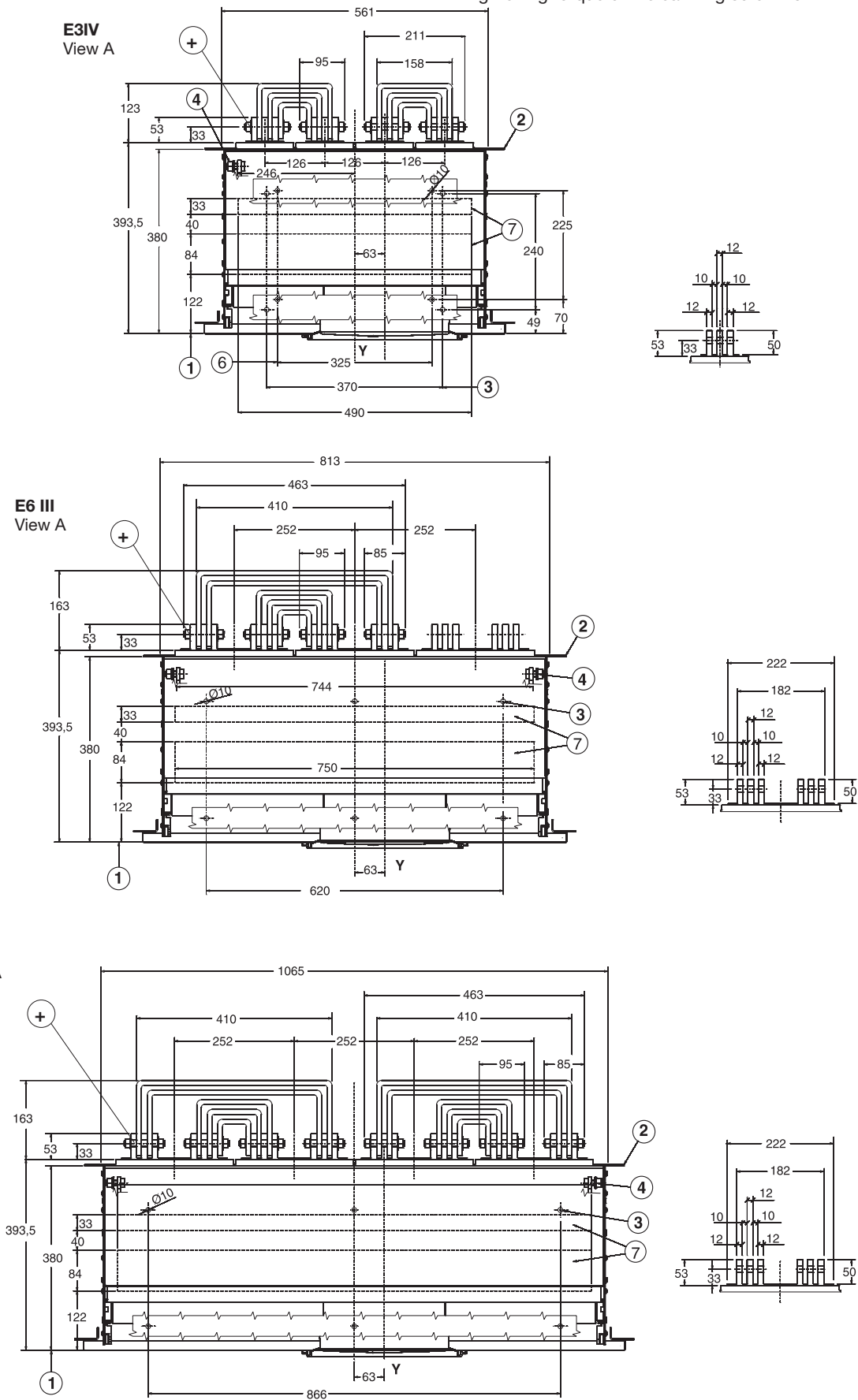


Fig. 64

Mod.	B2342		Apparatus	Emax DC	Scale
			Doc N°	1SDH000635R0002	Page N° 112/131

Withdrawable circuit-breaker (IEC 60947)  
 Basic version with horizontal rear terminals

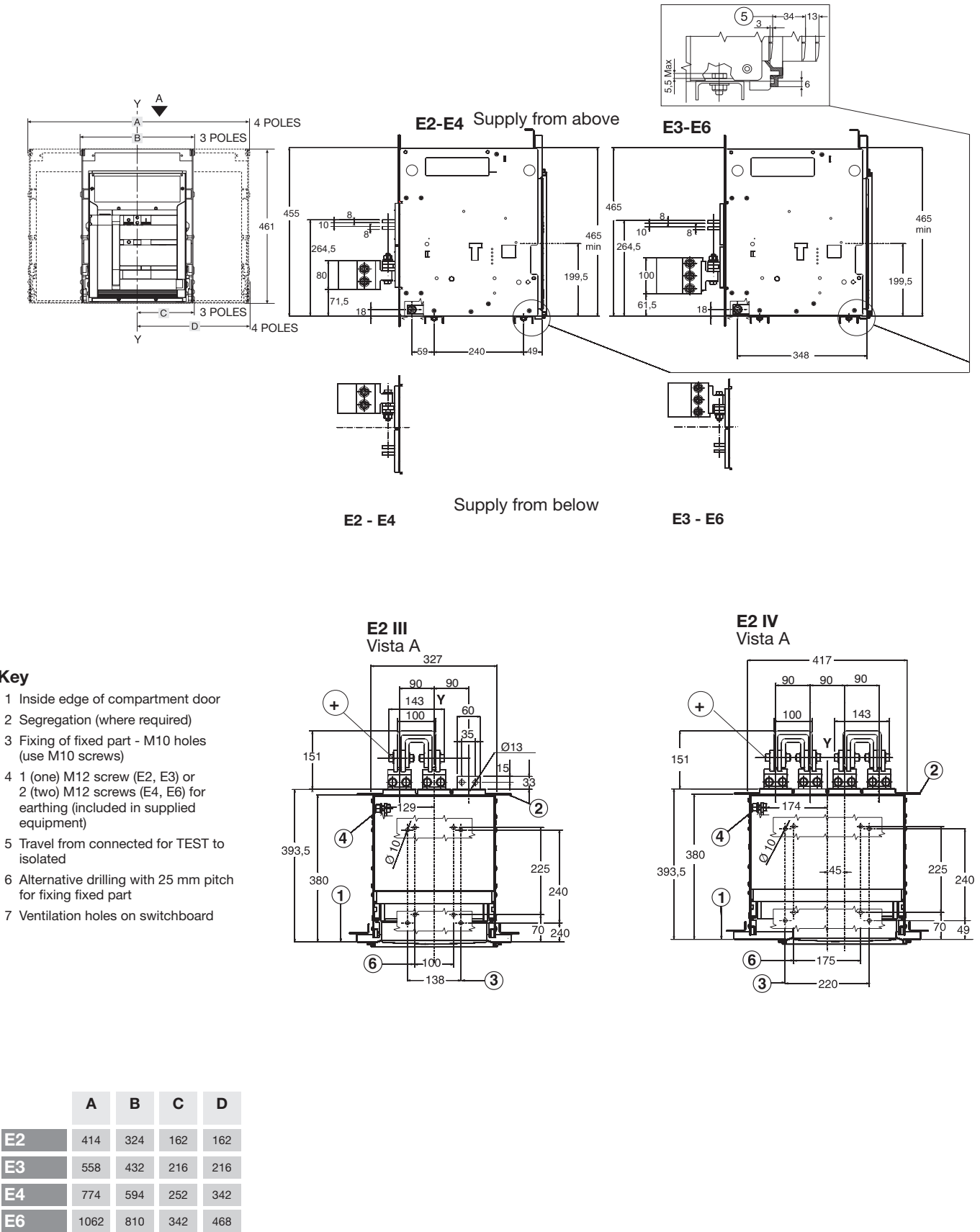


Fig. 65

Tightening torque of the fixing screws 20 Nm  
 Tightening torque of the main terminals 70 Nm  
 Tightening torque of the earthing screw 70 Nm

Mod.	B2342		Apparatus	Emax	Scale
			Doc N°	1SDH000635R0002	Page N° 113/131

Tightening torque of the fixing screws 20 Nm  
 Tightening torque of the main terminals 70 Nm  
 Tightening torque of the earthing screw 70 Nm

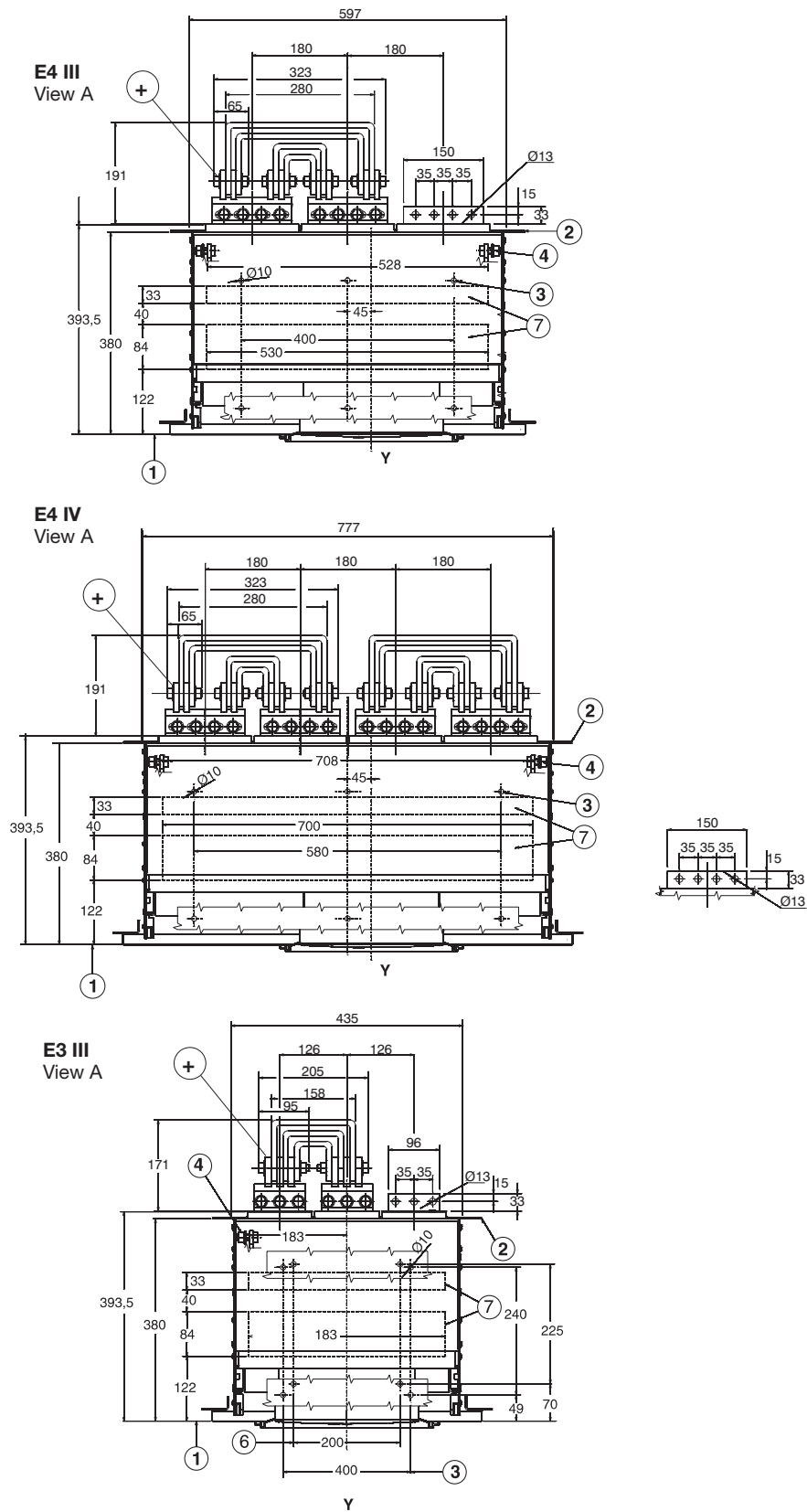


Fig. 66

Mod.	B2342		Apparatus	Emax DC	Scale
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Tightening torque of the fixing screws 20 Nm  
 Tightening torque of the main terminals 70 Nm  
 Tightening torque of the earthing screw 70 Nm

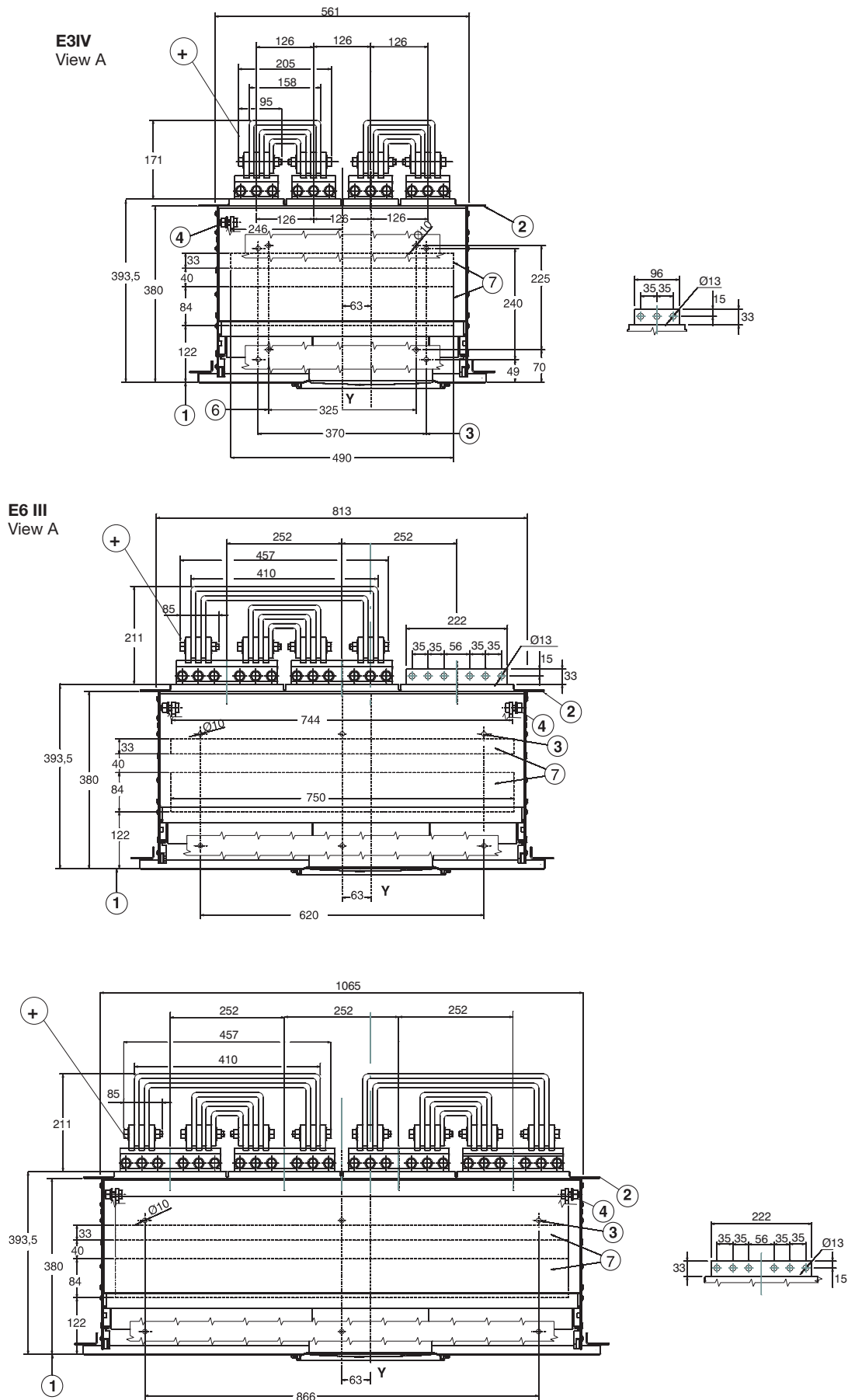


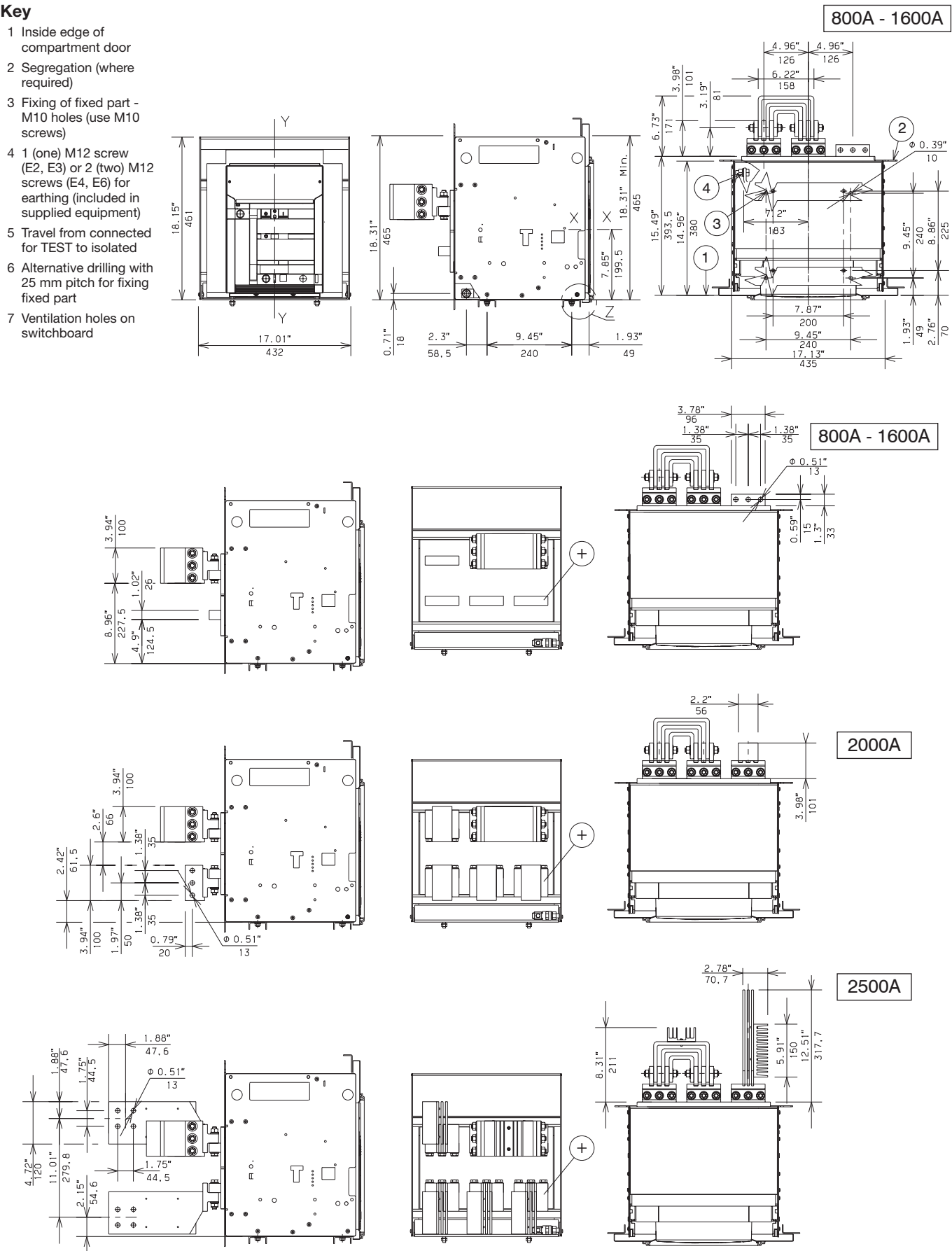
Fig. 67

Mod.	B2342		Apparatus	<b>Emax</b>	Scale
			Doc N°	<b>1SDH000635R0002</b>	Page N° 115/131

16.5. Withdrawable circuit-breaker (UL 1066)  
Emax DC UL III in the withdrawable version with 2PS+1 connection

Key

- 1 Inside edge of compartment door
- 2 Segregation (where required)
- 3 Fixing of fixed part - M10 holes (use M10 screws)
- 4 1 (one) M12 screw (E2, E3) or 2 (two) M12 screws (E4, E6) for earthing (included in supplied equipment)
- 5 Travel from connected for TEST to isolated
- 6 Alternative drilling with 25 mm pitch for fixing fixed part
- 7 Ventilation holes on switchboard



Tightening torque of the fixing screws 20 Nm  
Tightening torque of the main terminals 70 Nm  
Tightening torque of the earthing screw 70 Nm

Mod.	B2342		Apparatus	Emax DC	Scale
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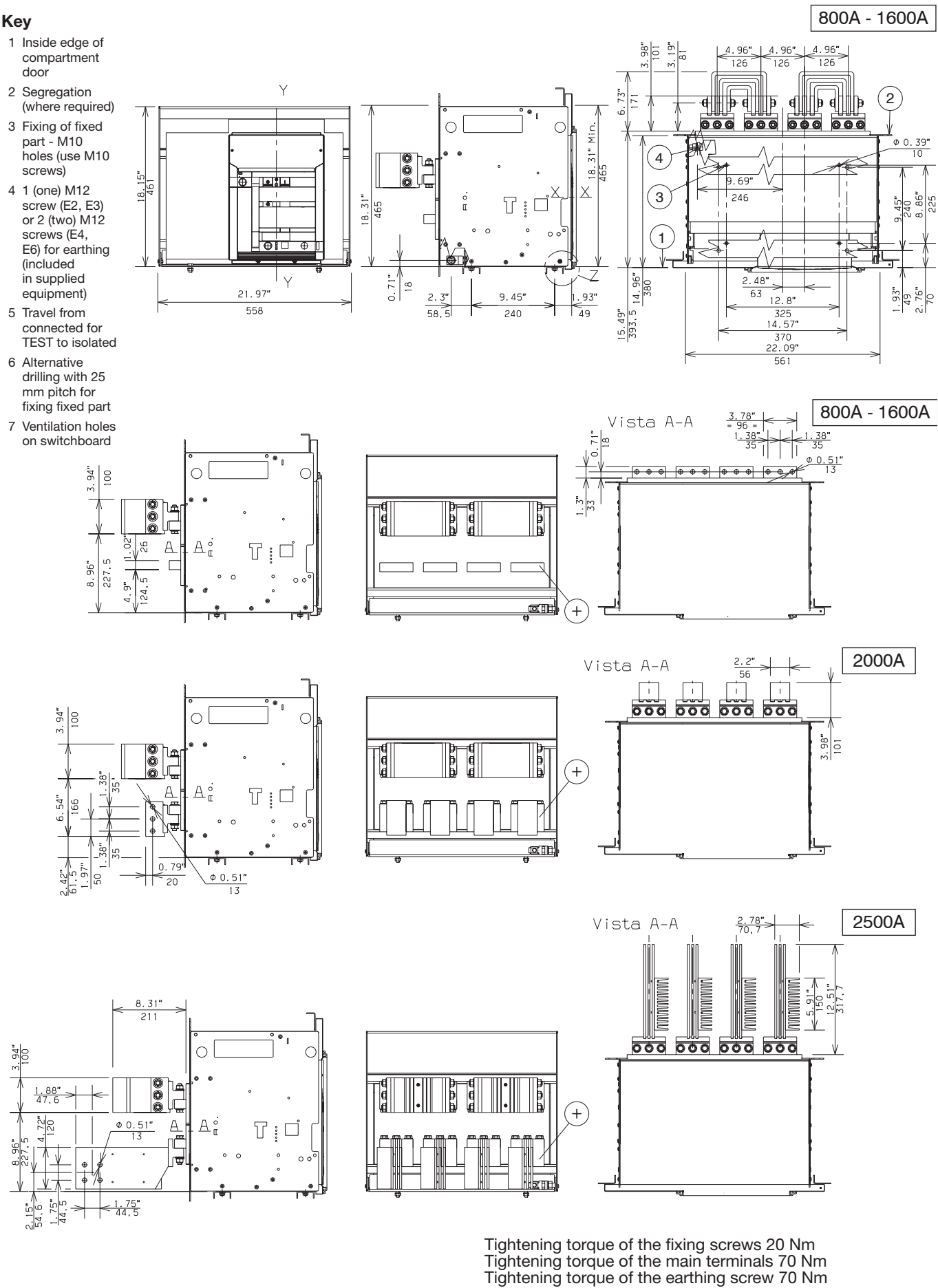


Mod.	B2342			Apparatus	<b>Emax</b>	Scale
				Doc N°	<b>1SDH000635R0002</b>	Page N° 117/131

Withdrawable circuit-breaker (UL 1066)  
 Emax DC UL IV in the withdrawable version with 2PS+2PS connection

Key

- Inside edge of compartment door
- Segregation (where required)
- Fixing of fixed part - M10 holes (use M10 screws)
- 1 (one) M12 screw (E2, E3) or 2 (two) M12 screws (E4, E6) for earthing (included in supplied equipment)
- Travel from connected for TEST to isolated
- Alternative drilling with 25 mm pitch for fixing fixed part
- Ventilation holes on switchboard



Mod.	B2342			Apparatus	Emax DC	Scale
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Emax DC UL IV in the withdrawable version with 3PS+1 connection

800A - 1600A

- 
- Technical drawings of the 18.31 inch wide unit, showing front and top views with dimensions.
- Front View Dimensions:**
- Overall Height: 18.15" / 461
  - Overall Width: 21.97" / 558
  - Internal Width: 18.31" / 465
- Top View Dimensions:**
- Overall Height: 18.31" / 465
  - Overall Width: 21.97" / 558
  - Internal Width: 18.31" Min. / 465
  - Internal Height: 18.31" / 465
  - Internal Width (Right): 1.93" / 49
  - Internal Width (Left): 2.3" / 58.5
  - Internal Width (Bottom): 9.45" / 240
  - Internal Width (Top): 0.71" / 18

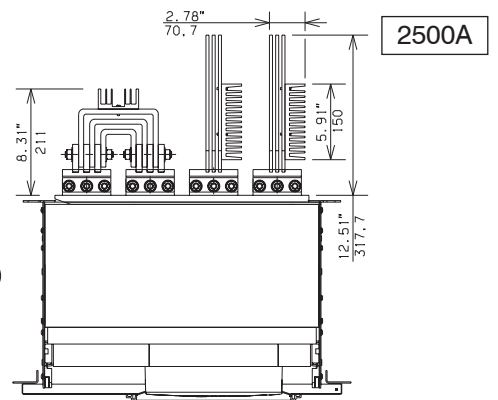
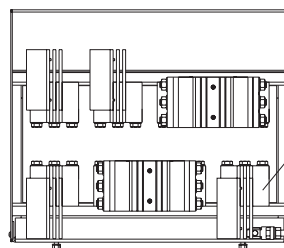
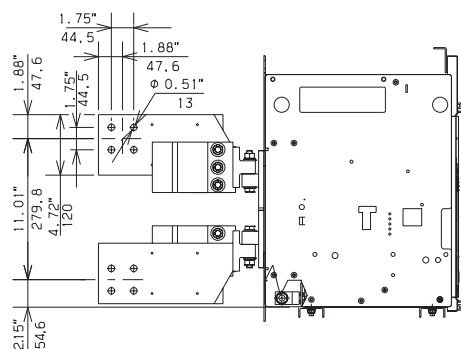
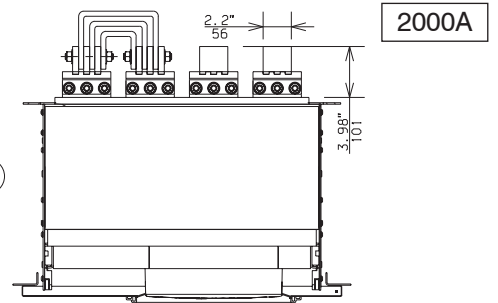
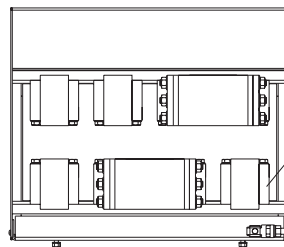
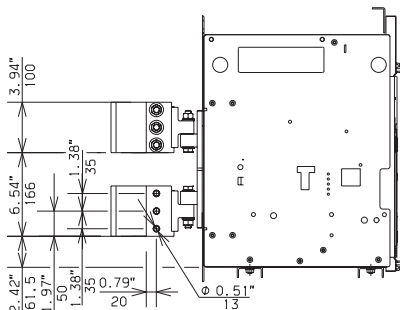
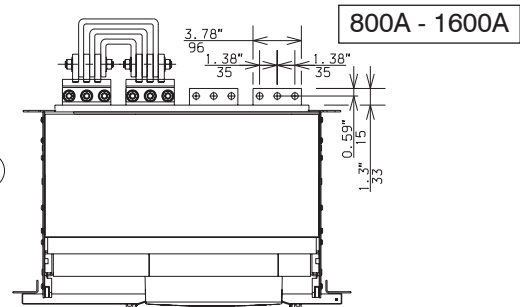
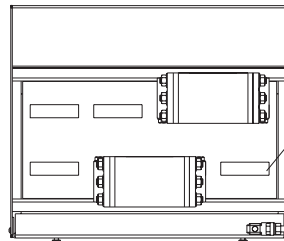
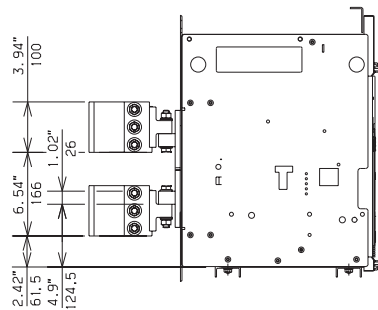
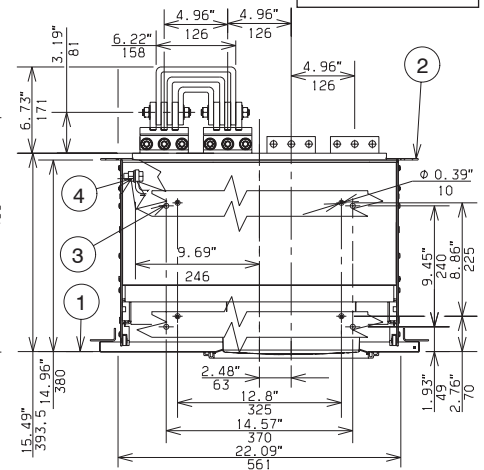
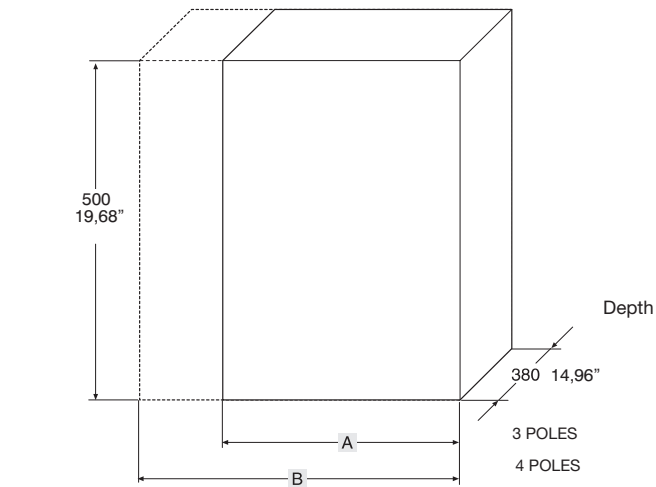


Fig. 71

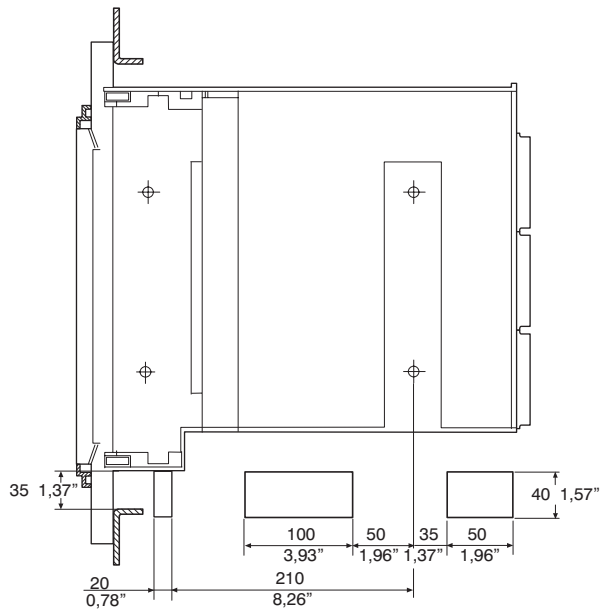
Mod.	B2342			Apparatus	<b>Emax</b>	Scale
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Compartment dimensions (IEC)



	A	B
E2	400 15,74"	490 19,29"
E3	500 19,68"	630 24,80"
E4	700 27,56"	880 34,64"
E6	1000 39,37"	1260 49,60"

Holes for routing flexible cables for mechanical interlocks



Holes drilled in compartment door

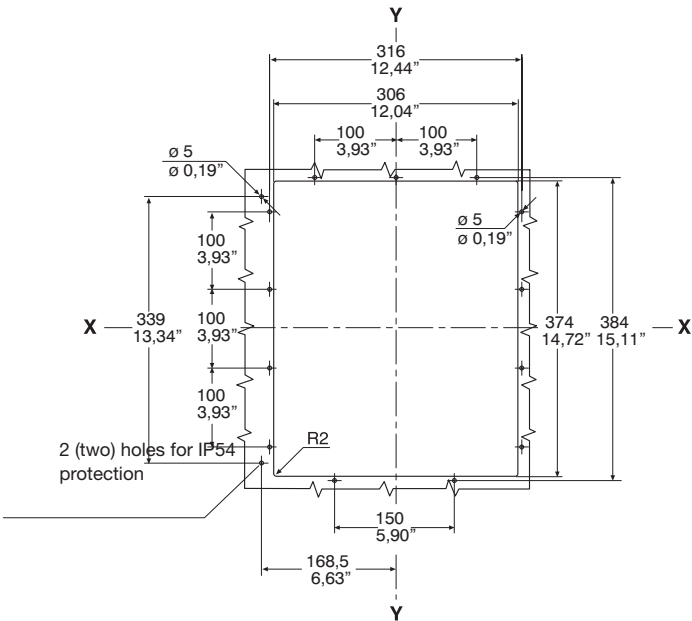


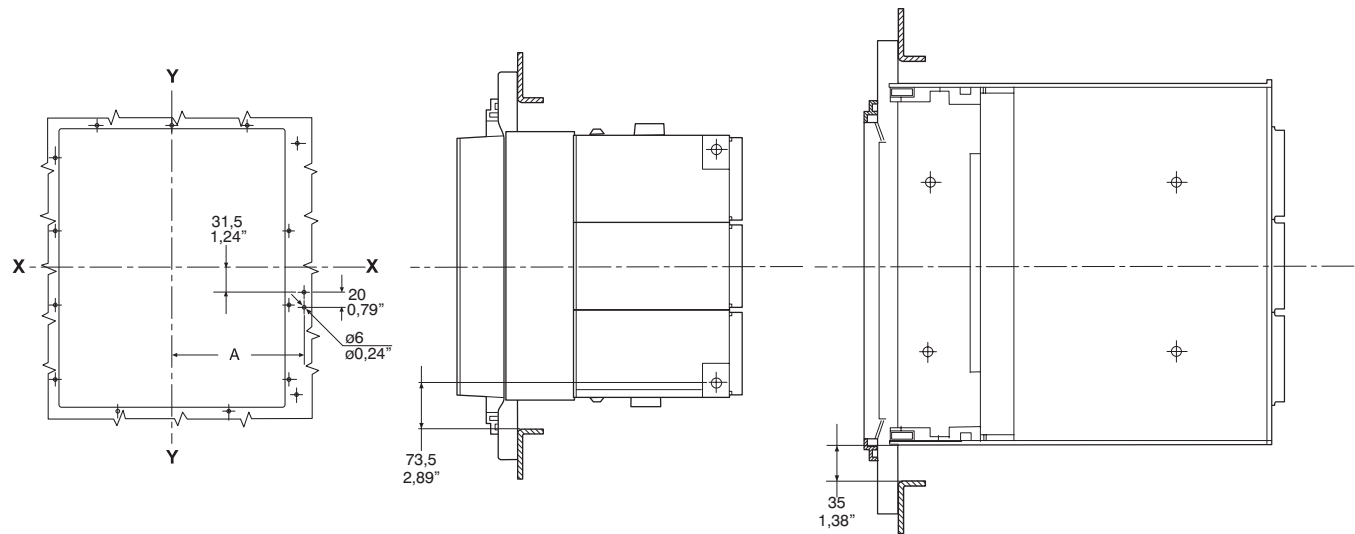
Fig. 72

16.7. Mechanical lock on compartment door

Holes drilled in compartment door. Minimum distance between the circuit-breaker and wall to switchboard

Fixed version

Withdrawable version



	A	
	3 POLES	4 POLES
E2	180 7.09"	180 7.09"
E3	234 9.21"	234 9.21"
E4	270 10.63"	360 14.17"
E6	360 14.17"	486 33.31"

Fig. 73

## 17. Circuit diagrams



**WARNING: Carefully read note F on the circuit diagrams before installing the circuit-breaker.**

### Operating state shown

The diagram illustrates the components in the following conditions:

- withdrawable circuit-breaker, open and racked-in
- circuits de-energized
- releases not tripped
- motor operator with unloaded springs.

### Versions

The diagram shows a circuit-breaker in the withdrawable version but also applies to fixed-version circuit-breakers.

#### Fixed version

The control circuits are installed between terminals XV (connector X is not supplied).

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

#### Withdrawable version

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

#### Version with PR122/DC electronic release

#### Version with PR123/DC electronic release

### Key

- = Circuit diagram figure number
- \* = See note indicated by the letter
- A1 = Circuit-breaker applications
- A3 = Applications applied to the fixed part of the circuit-breaker (for withdrawable versions only)
- A4 = Example switchgear and connections, outside the circuit-breaker
- A13 = PR021/K signalling unit (outside the circuit-breaker)
- D = Electronic time delay device of the undervoltage release, outside the circuit-breaker
- F1 = Delayed-trip fuse
- K51 = PR122/DC, PR123/DC electronic release with the following protection functions:
  - L overload protection with inverse long-time delay trip setting I1
  - S short-circuit protection with inverse or definite short time-delay trip setting I2
  - I short-circuit protection with instantaneous time-delay trip-setting I3
  - G earth fault protection with inverse short time-delay trip-setting I4 (only PR123/DC)
- K51/1...8 = Contacts for the PR021/K signalling unit
- K51/GZin(DBin) = Zone selectivity: for protection G (only with Vaux and PR123/DC release)
- K51/GZout(DBout) = Zone selectivity: for protection G (only with Vaux and PR123/DC release)
- K51/IN1 = Digital programmable input (available only with Vaux. and release PR122/DC or PR123/DC with signalling module PR120/K)
- K51/P1...P4 = Programmable electrical signalling (available only with Vaux. and release PR122/DC or PR123/DC with signalling module PR120/K)
- K51/SZin(DFin) = Zone selectivity: input for protection S (only with Vaux and release PR122/DC or PR123/DC)
- K51/SZout(DFout) = Zone selectivity: input for protection S (only with Vaux. and release PR122/DC or PR123/DC)
- K51/YC = Closing control from electronic release PR122/DC or PR123/DC with communication module PR120/D-M
- K51/YO = Opening control from electronic release PR122/DC or PR123/DC with communication module PR120/D-M
- M = Motor for loading the closing springs
- Q = Circuit-breaker
- Q/1...27 = Auxiliary contacts of the circuit-breaker
- S33M/1...3 = Limit contacts for spring loading motor
- S43 = Switch for setting remote/local control
- S51 = Contact for electrical signalling of circuit-breaker open due to tripping of the overcurrent release. The circuit-breaker may only be closed after the reset pushbutton has been pressed or after energizing the coil for electrical resetting (if installed).
- S75E/1..4 = Contacts for electrical signalling of circuit-breaker in disconnected position (only with withdrawable circuit-breakers)
- S75I/1..5 = Contacts for electrical signalling of circuit-breaker in connected position (only with withdrawable circuit-breakers)
- S75T/1..4 = Contacts for electrical signalling of circuit-breaker in test position (only with withdrawable circuit-breakers)
- CS = Pushbutton or contact for closing the circuit-breaker
- SO = Pushbutton or contact for opening the circuit-breaker
- SO1 = Pushbutton or contact for opening the circuit-breaker with delayed trip
- SO2 = Pushbutton or contact for opening the circuit-breaker with instantaneous trip
- SR = Pushbutton or contact for electrical resetting of the circuit-breaker
- Vaux = Auxiliary power supply voltage (see note F)
- W1 = Serial interface with control system (external bus): EIA RS485 interface (see note E)
- W2 = Serial interface with the accessories of releases PR122/DC and PR123/DC (internal bus)
- X = Delivery connector for the auxiliary circuits of the withdrawable circuit-breaker
- X1...X7 = Connectors for the circuit-breaker applications
- XF = Delivery terminal box for the position contacts of the withdrawable circuit-breaker (located on the fixed part of the circuit-breaker)
- XK1 = Connector for the power circuits of releases PR122/DC and PR123/DC

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XK2 - XK3 = Connectors for the auxiliary circuits of releases PR122/DC and PR123/DC  
 XK4 = Connector for signalling open/close  
 XO = Connector for YO1 release  
 PR120/DC = ??  
 XV = Delivery terminal box for the auxiliary circuits of the fixed 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 to electrically reset the circuit-breaker  
 YU = Undervoltage release (see notes B and Q)

### Description of the figures

Fig. 1 = Circuit of the motor for loading the closing springs.  
 Fig. 2 = Circuit of shunt closing release.  
 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 signalling of springs loaded.  
 Fig. 12 = Contact for electrical signalling of undervoltage release energized (see notes B and S).  
 Fig. 13 = Contact for electrical signalling of circuit-breaker open due to tripping of the overcurrent release. The circuit-breaker can only be closed after the reset pushbutton has been pressed.  
 Fig. 14 = Contact for electrical signalling of circuit-breaker open due to tripping of the overcurrent release and electrical reset coil. The circuit-breaker can only be closed after the reset pushbutton has been pressed or after the coil has been energized.  
 Fig. 21 = First set of auxiliary contacts of the circuit-breaker.  
 Fig. 22 = Second set of auxiliary contacts of the circuit-breaker (see note V).  
 Fig. 23 = Third set of supplementary auxiliary contacts of the circuit-breaker.  
 Fig. 31 = First set of contacts for electrical signalling of circuit-breaker connected, test isolated, disconnected position.  
 Fig. 32 = Second set of contacts for electrical signalling of circuit-breaker connected, test isolated, disconnected position.  
 Fig. 42 = Auxiliary circuits of release PR122/DC and PR123/DC (see notes F, M and V).  
 Fig. 45 = Circuits of communication module PR120/D-M of releases PR122/DC and PR123/DC (optional; see note E).  
 Fig. 46 = Circuits of signalling module PR120/K of releases PR122/DC and PR123/DC - connection 1 (optional; see note V).  
 Fig. 47 = Circuits of signalling module PR120/K of releases PR122/DC and PR123/DC - connection 2 (optional; see note V).  
 Fig. 62 = Circuits of signalling unit PR021/K (outside the circuit-breaker)

### Incompatibility

The circuits indicated in the following figures cannot be supplied at the same time in the same circuit-breaker:

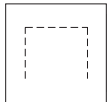
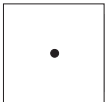
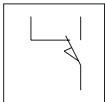
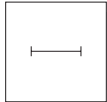
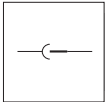
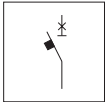

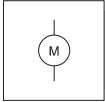
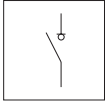
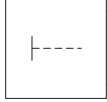
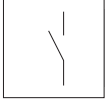
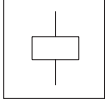
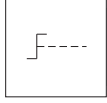
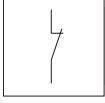
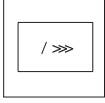

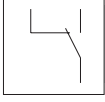
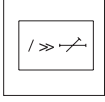
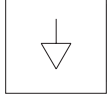
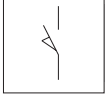
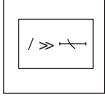
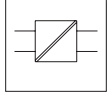
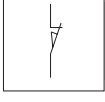
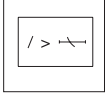
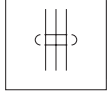
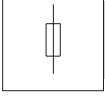
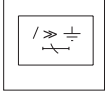
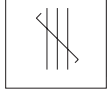
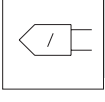
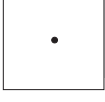
6 - 7 - 8  
 13 - 14  
 25 - 49 - 47

### Notes

- A) The circuit-breaker is only fitted with the accessories specified in the ABB SACE order acknowledgement. Consult the catalogue of the device for instructions about how to make out the order.
- B) The undervoltage release is supplied for operation using a power supply branched on the supply side of the circuit-breaker or from an independent source. The circuit-breaker can only close when the release is energized (there is a mechanical lock on closing).  
 If there is the same power supply for the closing and undervoltage releases and the circuit-breaker must close automatically when the auxiliary voltage returns, a 30 ms delay must be introduced between the accept instant of the undervoltage release and energizing of the closing release. This can be achieved by means of a circuit outside the circuit-breaker comprising a permanent closing contact, the contact indicated in fig. 12 and a time-delay relay.
- E) Consult "Technical Application Handbook - vol. 9" communication via BUS with ABB circuit-breakers for connection of the EIA RS485 serial link.
- F) The auxiliary voltage Vaux allows all the functions of PR122/DC and PR123/DC releases to be activated.  
 "Galvanically separated converters" conforming to standard IEC 60950 (UL 1950) or the equivalent standards, able to guarantee current in the common mode or leakage current (see IEC 478/1, CEI 22/3) that is no more than 3.5 mA (IEC 60364-41 and CEI 64-8) must be used since the Vaux must be isolated from the earth.
- N) With releases PR122/DC and PR123/DC, connections to the zone selectivity inputs and outputs must be made with a two-pole shielded and stranded cable (such as BELDEN 8762/8772) no more than 300 m long. The shield must be earthed on the selectivity input side.
- P) With releases PR122/DC - PR123/DC with communication module PR120/D-M, coils YO and YC can be controlled directly by contacts K51/YO and K51/YC with maximum voltage of 110-120 VDC and 240-250 VAC.
- Q) The second shunt opening release may be installed as an alternative to the undervoltage release.
- S) Also available in the version with normally closed contact.
- V) If fig. 22 is present (second set of auxiliary contacts) as well as relay PR112/DC - PR123/DC, the contacts for the zone selectivity of fig. 42 (K51/SZin, K51/SOut, K51/GZin, K51/GOut) are not wired. In addition, the signalling module PR120/K of figures 46 and 47 cannot be supplied.

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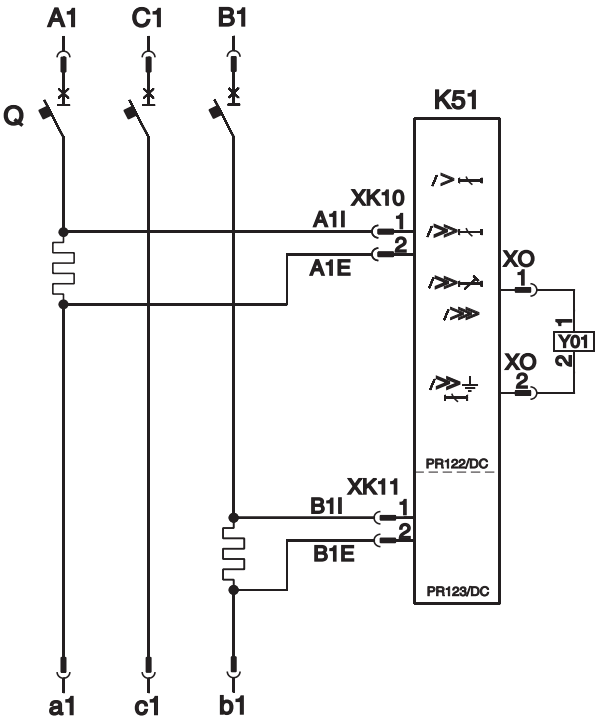
Circuit diagram symbols (Standards IEC 60617 e CEI 3-14...3-26)

	Shield (may be drawn in any shape)		Terminal or clamp		Change-over position contact with momentary circuit breaking (limit contact)
	Time delay		Socket and plug (female and male)		Power isolator with automatic opening action
	Mechanical or electrical connection		Motor (general symbol)		Switch-disconnector
	Manual mechanical control (general case)		Make contact		Control coil (general symbol)
	Rotating control		Break contact with automatic breaking		Instantaneous overcurrent relay
	Pushbutton control		Change-over contact		Overcurrent relay with adjustable short time-delay trip
	Equipotentiality		Make position contact (limit contact)		Overcurrent relay with inverse short time-delay trip
	Galvanically separated converter		Break position contact (limit contact)		Overcurrent relay with inverse long time-delay trip
	Shielded cable conductors (e.g. three conductors)		Fuse (general symbol)		Earth fault overcurrent relay with inverse short time-delay
	Conductors or stranded cables (e.g. 3 conductors)		Current sensor		Conductor connections

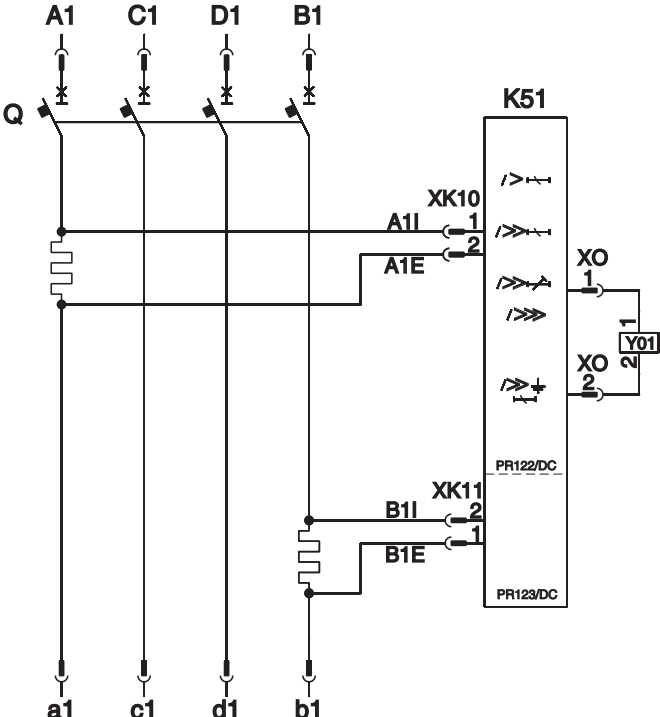


Circuit diagram - Operating state

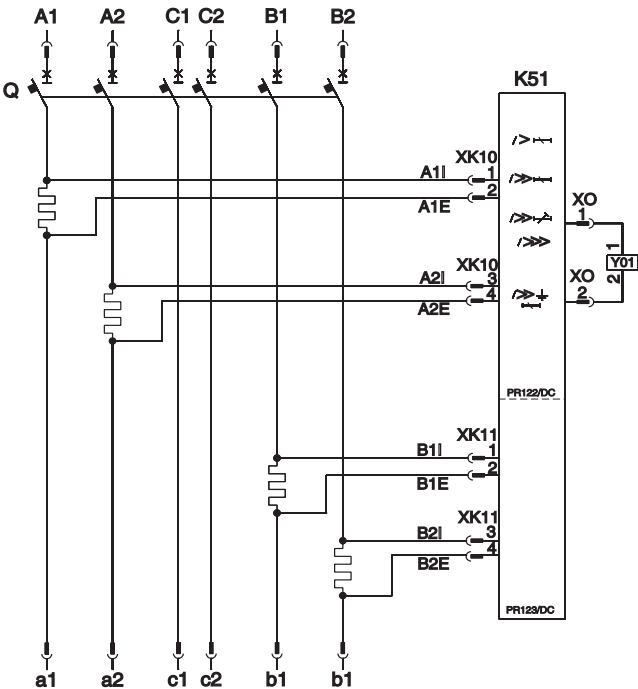
Three-pole circuit-breaker E2-E3\E3-A with PR122/DC or PR123/DC electronic release.



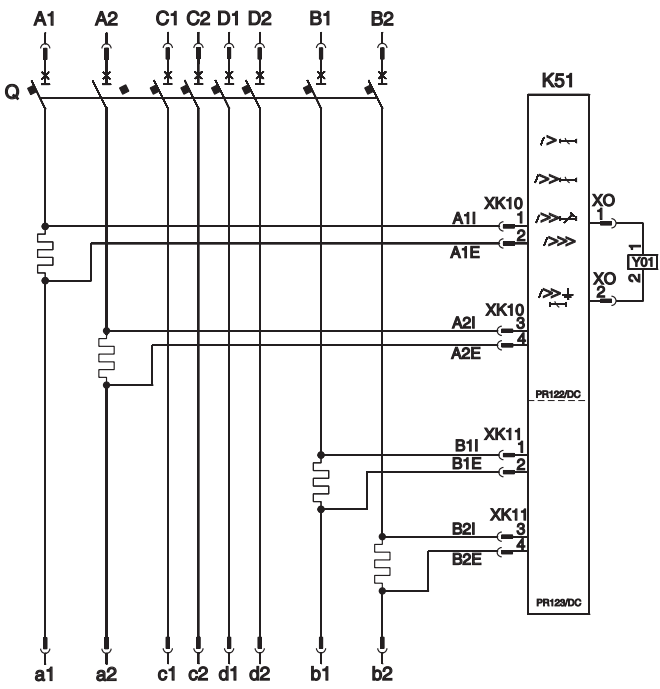
Four-pole circuit-breaker E2-E3\E3-A with PR122/DC or PR123/DC electronic release.



Three-pole circuit-breaker E4-E6\E6-A with PR122/DC or PR123/DC electronic release

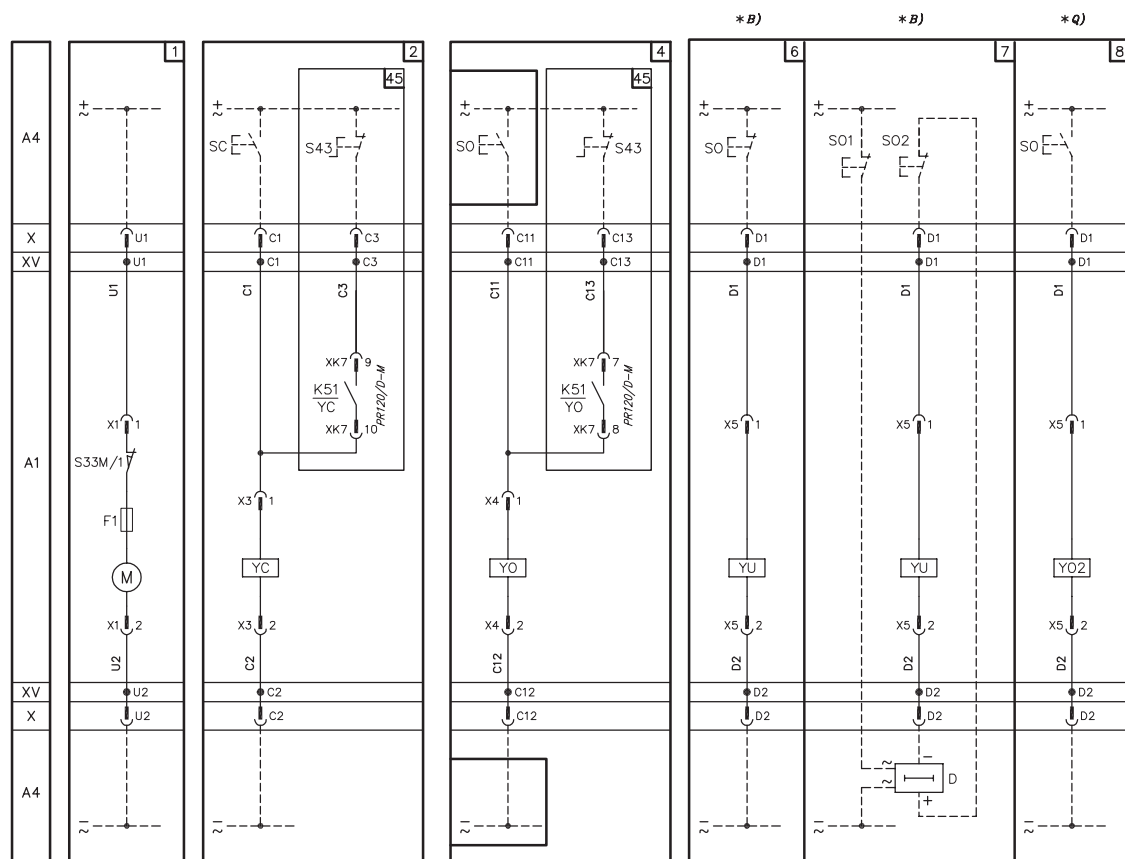


Four-pole circuit-breaker E4-E6\E6-A with PR122/DC or PR123/DC electronic release

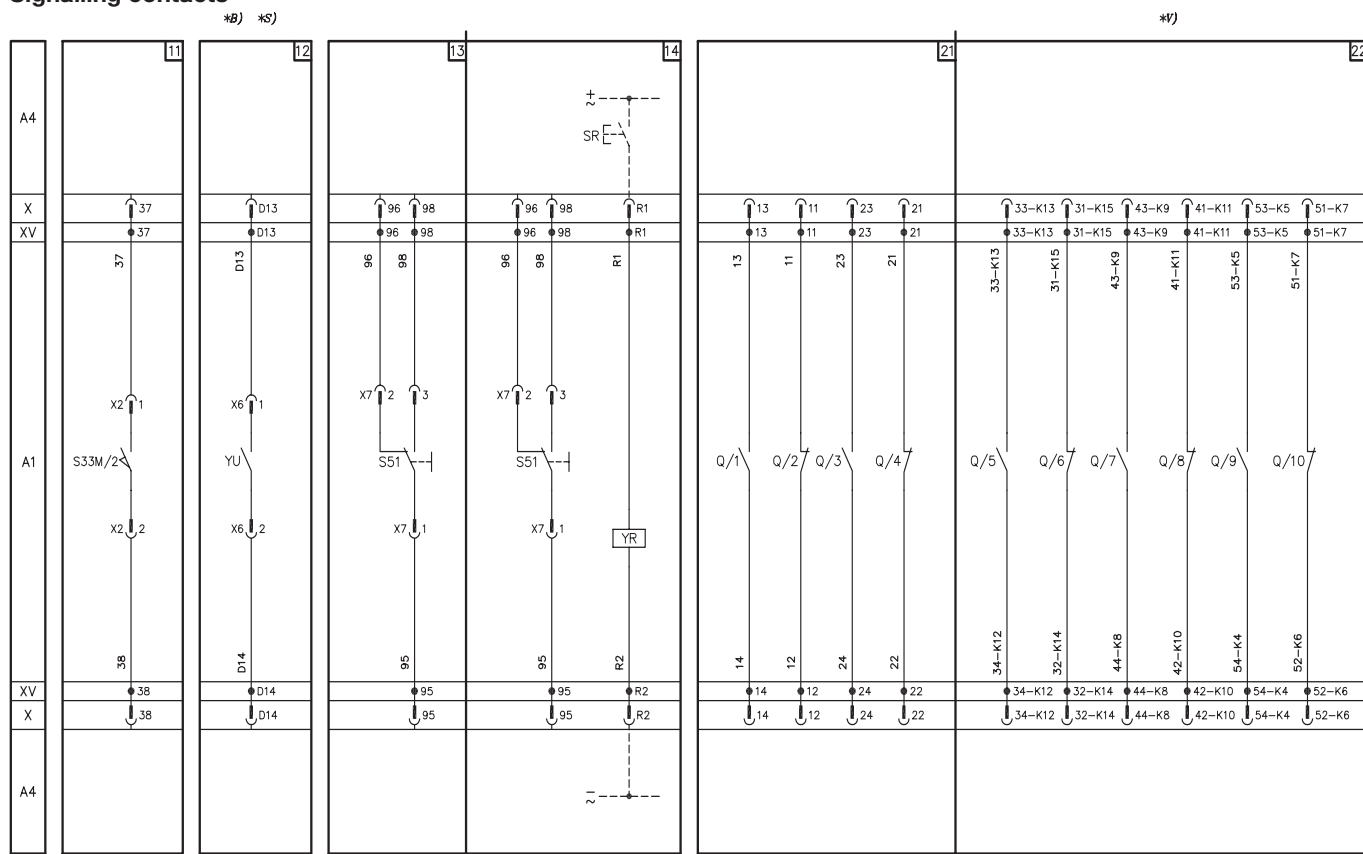


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### Motor operator, opening, closing and undervoltage releases



## Signalling contacts



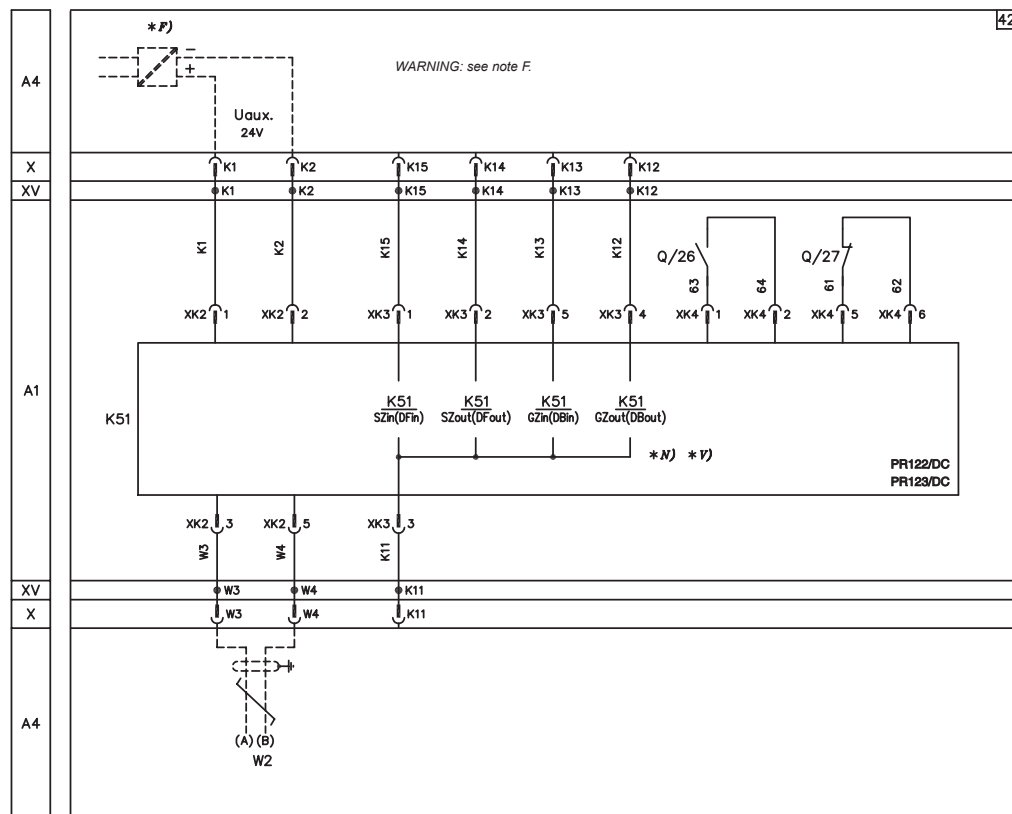
Mod.	B2342			Apparatus	<b>Emax DC</b>	Scale
				Doc N°	<b>1SDH000635R0002</b>	Page N° <b>126/131</b>

## Signalling contacts

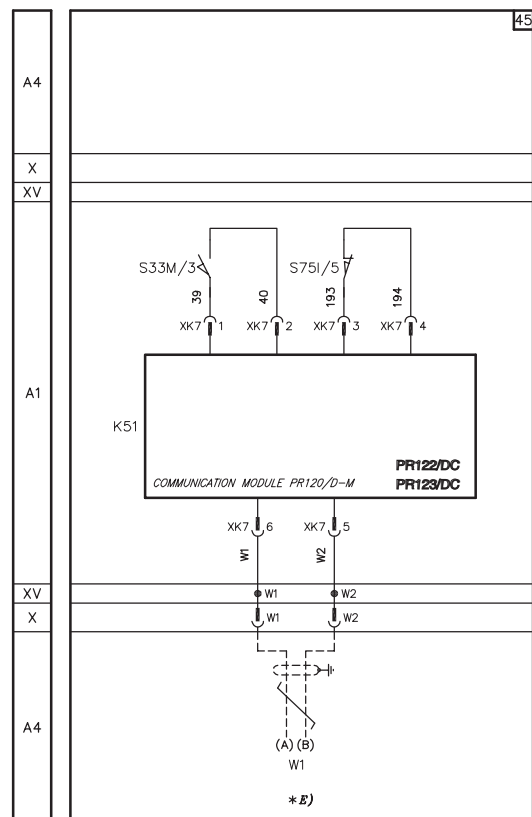


Mod.	B2342			Apparatus	Emax	Scale
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### Auxiliary circuits of releases PR122/DC and PR123/DC

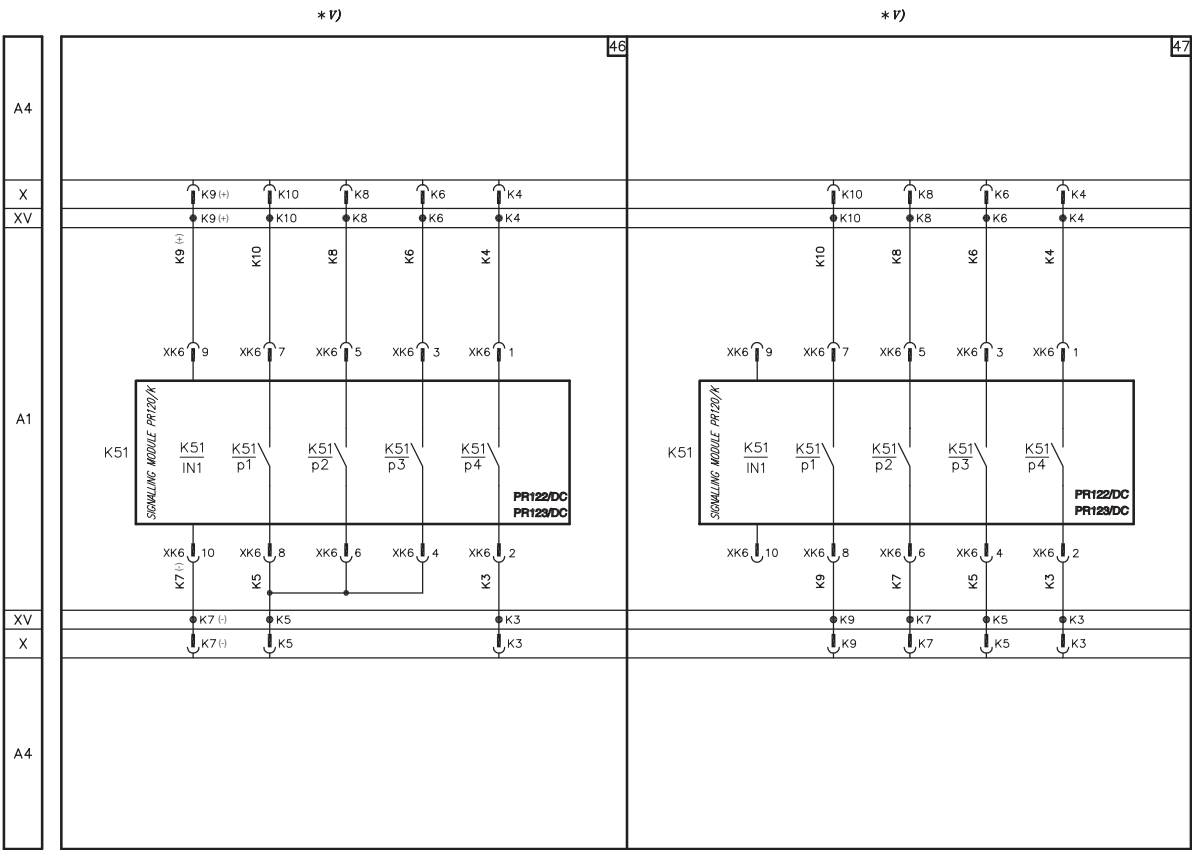


## PR120/D-M communication module

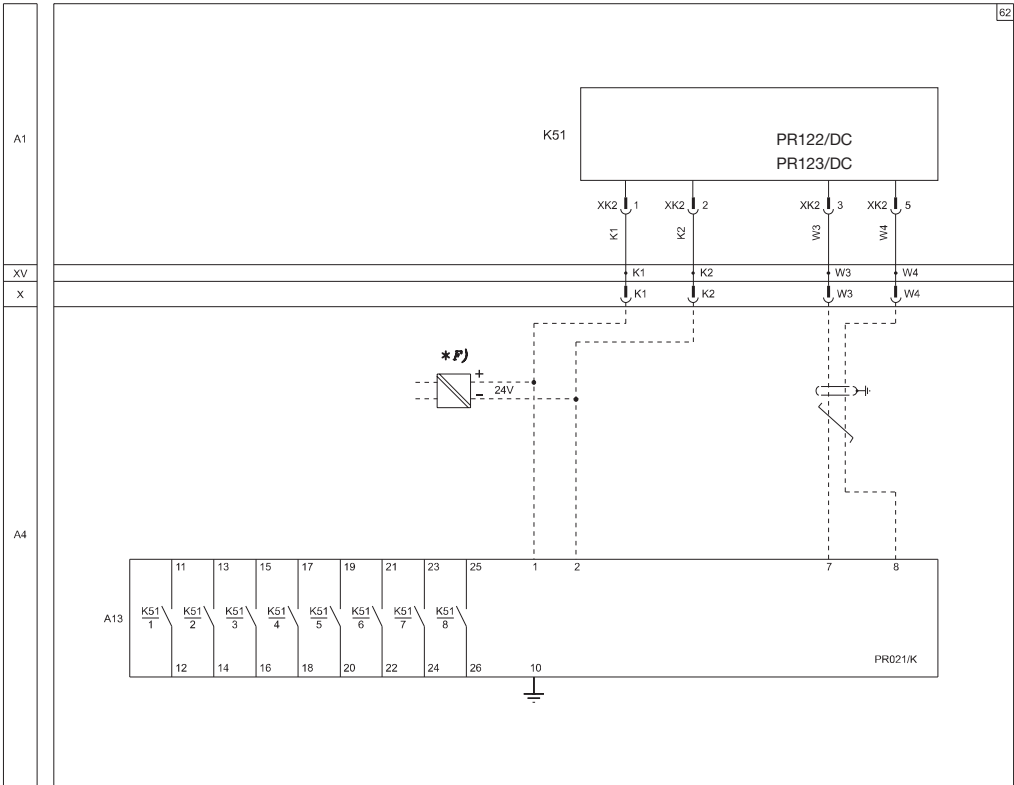


Mod.	B2342			Apparatus	<b>Emax DC</b>	Scale
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PR120/K signalling module



PR021/K signalling module



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<http://www.abb.com>

Since both the Standards and materials used are subject to continual developments, the characteristics and overall dimensions given in this catalogue may only be considered binding after they have been confirmed by ABB SACE.