Installation and service instructions

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

RH0109002 L2275

Emax UL Listed

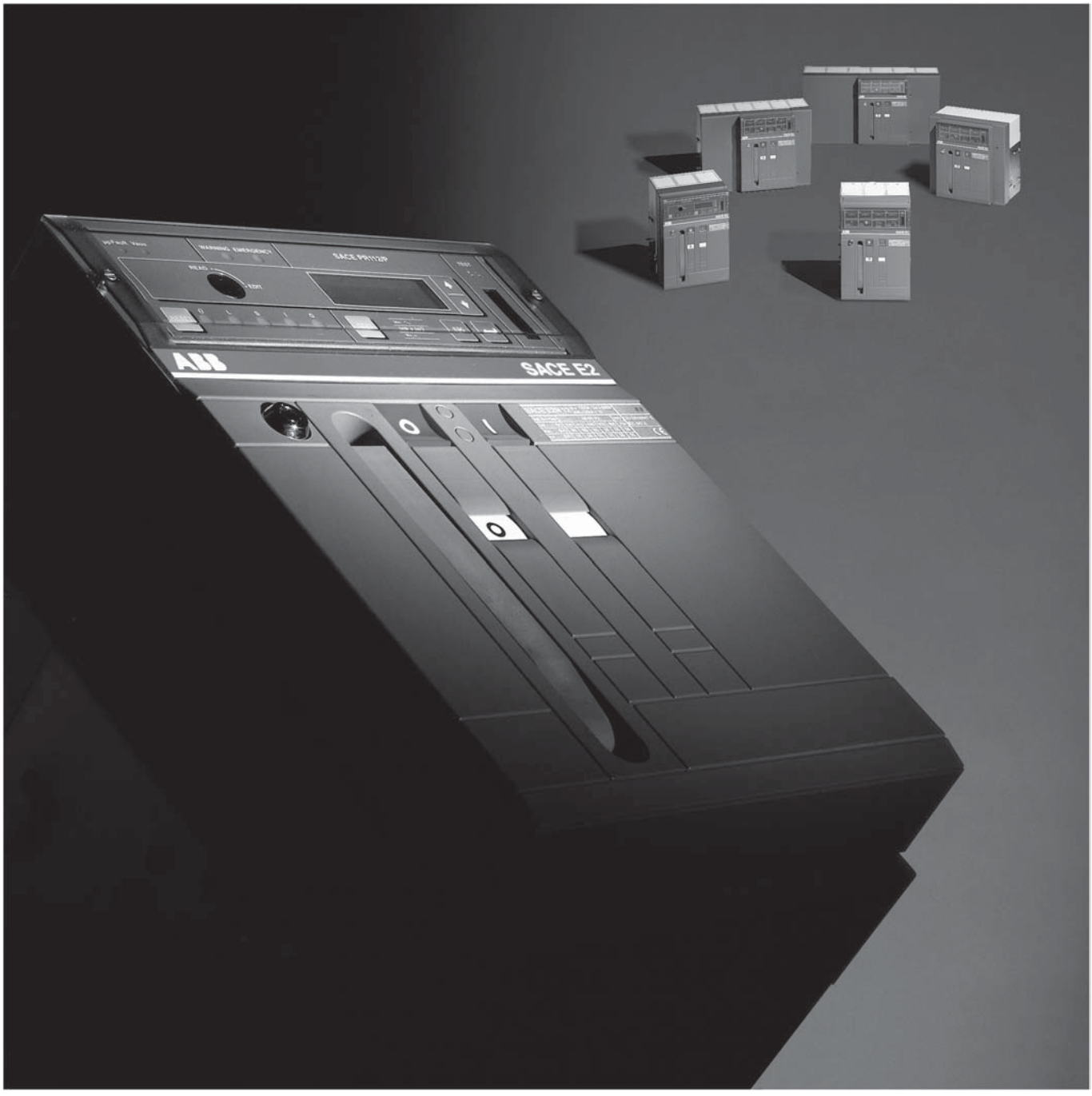

ABB SACE

Dis.		Uff. Resp.		Title **Installation, service and maintenance instructions for low voltage air power circuit breakers**	Lingua **en**
App.		Uff. Utilizz.			
Model	L2275			Apparatus **Emax UL**	Scale
ABB	**ABB SACE**			N° Doc. **RH0109002**	

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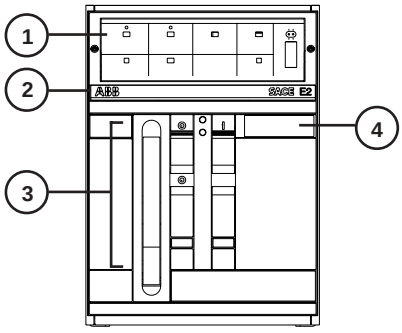
1. Description

1.1 General characteristics

The SACE Emax series of power circuit breakers are made up of a steel sheet structure which houses the operating mechanism, the poles and the auxiliary parts. Each pole, insulated from the others, contains the interrupting parts and the current transformer of the corresponding phase. The structure of the poles differs according to whether the power circuit breaker is selective or current limiting.
The fixed version power circuit breaker has its own terminals for connection to the power circuit. In the draw out version, the power circuit breaker makes up the moving part of the apparatus which is completed with a cradle fitted with the terminals for connection to the power circuit of the installation. Coupling between moving part and cradle takes place by means of special pliers mounted in the cradle.

1.2 External front view of the power circuit breaker



1 PR111-A, PR112-A or PR113-A electronic trip unit
2 Marchio di fabbrica
3 Operating and control parts of the operating mechanism and trip unit tripped signals
4 Rating plate

Fixed power circuit breaker

Fig. 1

1.3 Power circuit breaker rating plate data

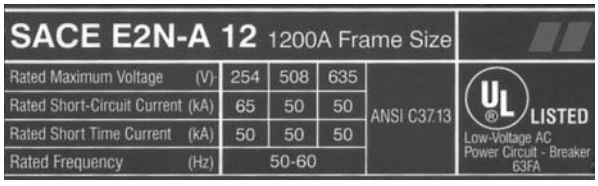
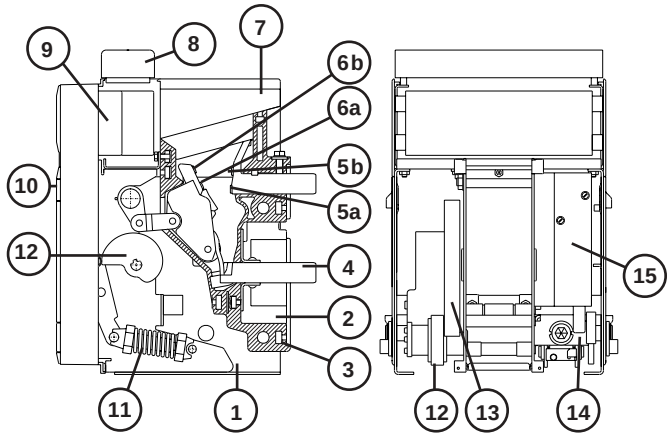


Fig. 2

1.4 Moving part construction characteristics

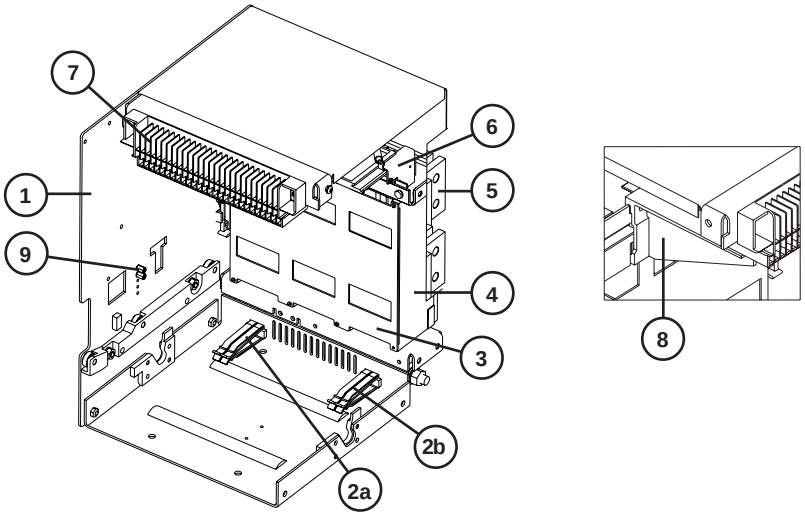


Selective power circuit breaker

1 Supporting structure made of steel sheet
2 Current transformer for trip unit
3 Terminal support insulating box
4 Horizontal rear terminals
5a Main fixed contact plates
5b Fixed arcing contact plates
6a Main moving contact plates
6b Moving arcing contact plates
7 Arcing chamber
8 Terminal box for the fixed version – Sliding contacts for the draw out version
9 Trip unit
10 Power circuit breaker closing and opening operating mechanism
11 Closing springs
12 Spring charging geared motor (on request)
13 Lever for manually charging the closing springs
14 Racking-out device (only for draw out power circuit breaker)
15 Service trip units (closing coil, shunt trip, undervoltage), on request

Fig. 3

1.5 Cradle construction characteristics



1 Supporting structure made of steel sheet
2 Grounding pliers (a: for all versions; b: for E4 and E6)
3 Safety shutters (IP20 degree of protection)
4 Insulating terminal support base
5 Terminals
6 Contacts for signaling connected/test connected/disconnected (on request)
7 Sliding contacts
8 Padlock for safety shutters (on request)
9 Anti-racking-in lock for power circuit breakers of different size

Fig. 4

2. Checking on receipt

Examine the state of the material received and its correspondence with what was foreseen at the time of ordering. Should any damage or irregularity be found on unpacking, which must be carried carefully, make the relative notification within and not over 5 days from receipt of the material. The notification must indicated the number of the shipping note.

3. Storage, lifting and weights

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

Caution
– Use a dry, dust-free room free of aggressive chemical agents as the storage room
– Position the power circuit breaker on a horizontal surface, not in direct contact with the floor, but on a suitable support surface (Fig. 6)
– The maximum number of stackable power circuit breakers is indicated in figure 7.
– Keep the power circuit breaker in the open position and with the closing springs discharged to avoid unnecessary stresses and risk of accidents to the personnel.

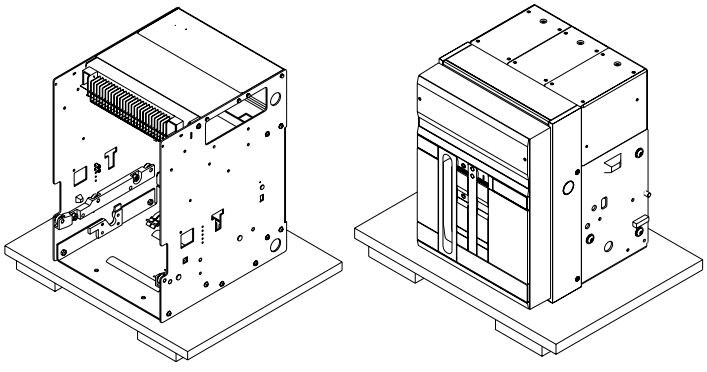


Fig. 6

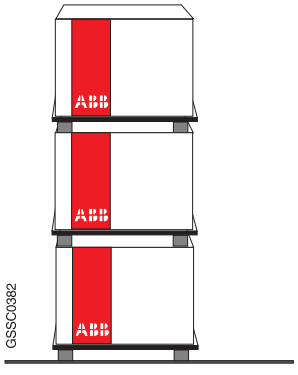


Fig. 7

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

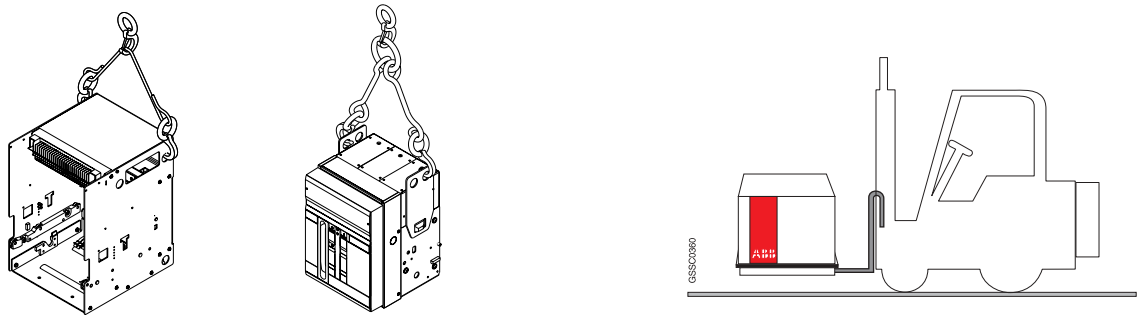


Fig. 8

Table of the power circuit breaker weights

Selective power circuit breaker	fixed 3 poles kg	Lbs	fixed 4 poles kg	Lbs	draw out 3 poles kg	Lbs	draw out 4 poles kg	Lbs
E1	45	99	54	119	70	154	82	181
E2	50	110	61	135	78	172	93	205
E3	66	145	80	176	104	229	125	275
E4	97	213	117	258	147	324	165	363
E6	140	308	160	353	210	463	240	529

Notes

The weights indicated in the table are intended for power circuit breakers complete with PR111-A, PR112-A or PR113-A trip units and relative current transformers, with exclusion of the accessories.

The draw out version includes the moving part in the same conditions as above, and the cradle with horizontal rear terminals.

4. Installation

4.1 Installation room

Install the power circuit breaker in a dry, dust-free, non-corrosive room, and in such a way that it is not subject to shocks or vibrations. Where this is not possible, use assembly in switchgear with a suitable degree of protection.

For preparation of the installation room, please refer to the “Overall dimensions” paragraph, which gives information on the following points:

– minimum installation volumes of the power circuit breakers and derived versions
– distances to be respected for power circuit breakers in compartments
– overall dimensions of the power circuit breakers
– fixing mounting holes
– compartment door mounting holes.

The operation of installation, put in service and eventually ordinary and straordinary maintenance have to be done by skilled personel, that has the detailed knowledge of the apparatus.

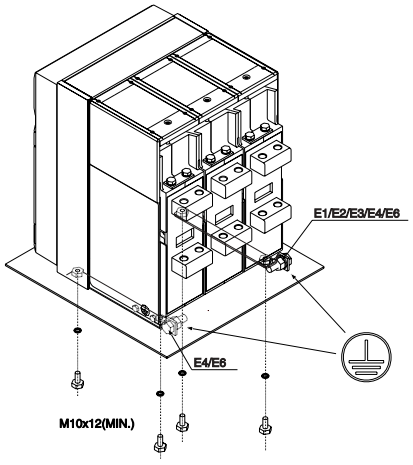


Fig. 9

4.2 Installation of the fixed power circuit breaker

Fix the power circuit breaker to a horizontal surface using the screws (M10 x 12 min.) (fig. 9).

4.3 Installation of the draw out power circuit breaker cradle

4.3.1 Preparation of the cradle

Assembly of the anti-racking-in lock

Before installing the cradle, it is necessary to check the presence of the anti-racking-in lock of power circuit breakers with different electrical characteristics from those of the cradle itself. Should the anti-racking-in lock have been supplied separately, proceed to assemble it as follows:

– On the self-adhesive plate (4), find the assembly position of the stop bolts in relation to the power circuit breaker which has to be housed in the cradle
– Insert the two hexagonal-head screws (1) in the holes found in the previous point as shown in the figure
– Fix the two screws with the washers (2) and the hexagonal stops (3).

Check that the anti-racking-in lock corresponding to the one installed on the cradle is present on the power circuit breaker (moving part).

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

Example for E1B 08 according to the plate diagram

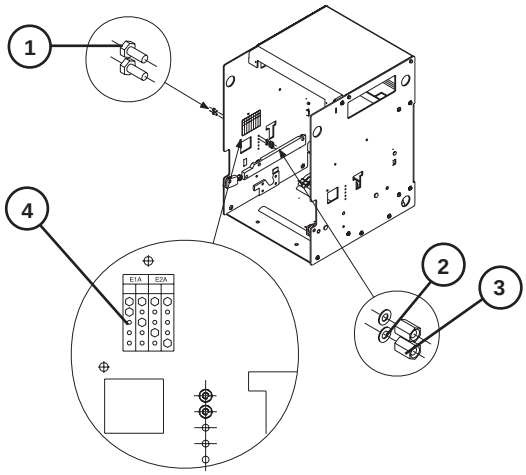


Fig. 10

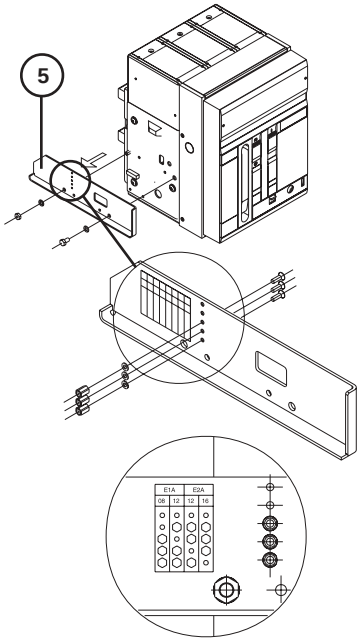


Fig. 11

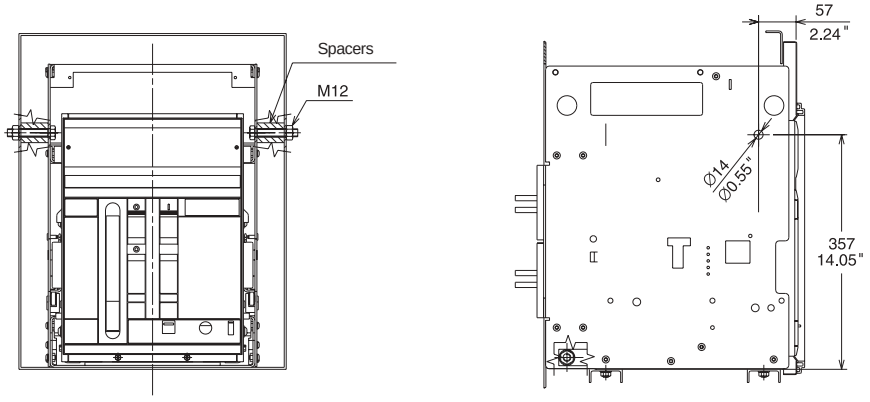
4.3.2 Installation of the cradle (Fig. 12b)

Fix the cradle by means of the screws (1), washers (2) and nuts (3) (M8 x 16), supplied by ABB SACE. If other screws are used, check that the head of the screws does not extend more than 5.5 mm (0.22 inches) from the base of the cradle.

4.3.3 Installation of the cradle on board a ship (Fig. 12a)

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

E1 - E2 - E3



E4 - E6

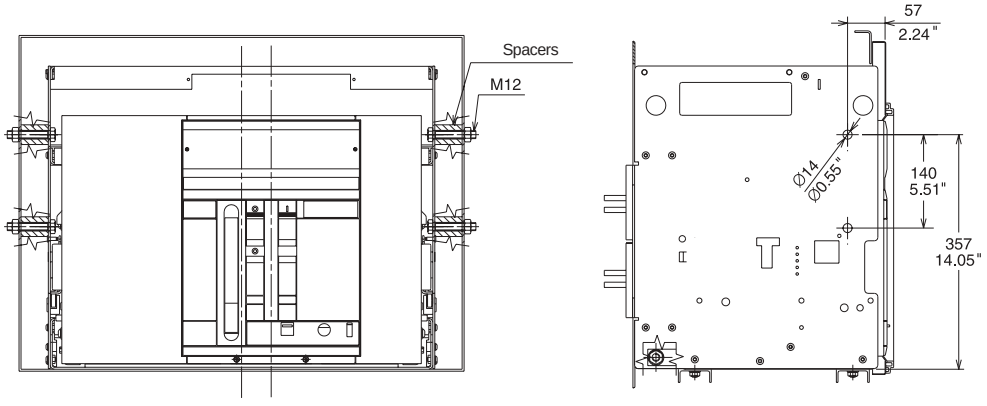
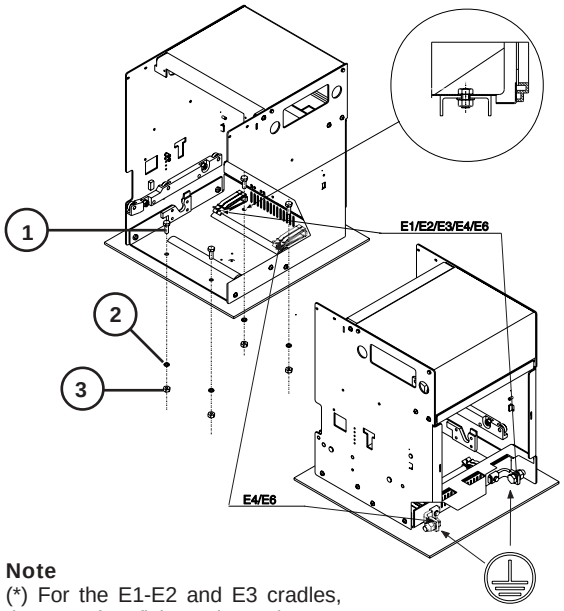


Fig. 12a

4.4 Installation of the flange on the compartment door (Fig. 9)

– Make the compartment door mounting holes foreseen in the “Overall dimensions” paragraph.
– Apply the flange (1) onto the front of the compartment door, fixing it from the inside by means of the self-threading screws (2).



Note
(*) For the E1-E2 and E3 cradles, there are four fixing points, whereas there are six for E4 and E6.

Fig. 12b

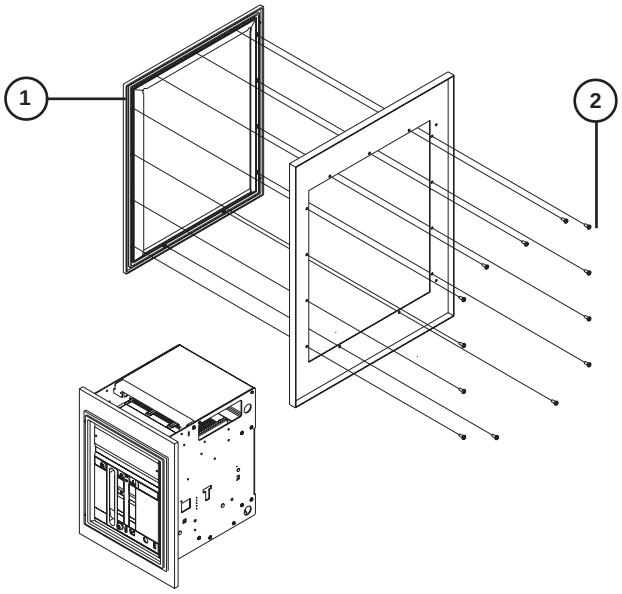


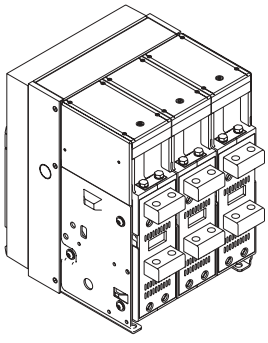
Fig. 13

5. Electrical connections

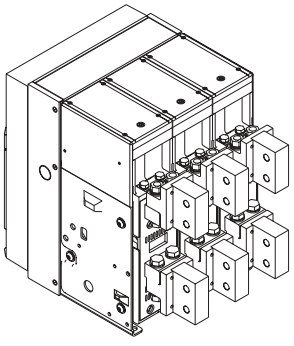
5.1 Connections to the power circuit

5.1.1 Shapes of the terminals

Fixed power circuit breaker



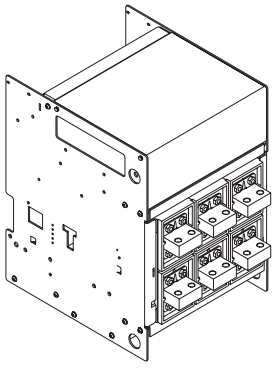
Horizontal rear terminals



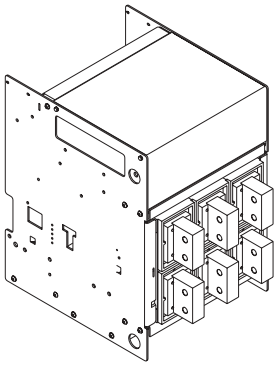
Vertical rear terminals

Fig. 14

Cradle for draw out power circuit breaker



Terminali posteriori orizzontali



Vertical rear terminals

Fig. 15

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

5.1.2 Examples of positioning the connection busbars according to the types of terminals

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

Possible widths of the connection busbars

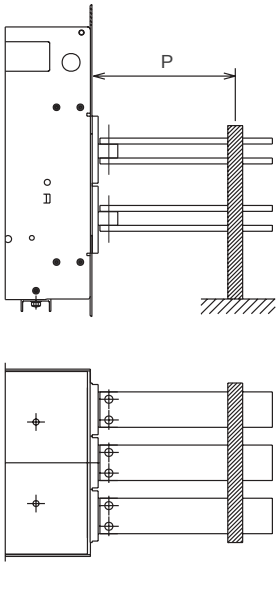
	Connection busbars			
	Continuous current rating	***Number***	***Size mm / inches***	
E1	800 A	1	76,2/3"	6,35/0,26"
E1	1200 A	2	50,8/2"	6,35/0,26"
E2	1200 A	2	50,8/2"	6,35/0,26"
E2	1600 A	2	76,2/3"	6,35/0,26"
E3	1200 A	2	50,8/2"	6,35/0,26"
E3	1600 A	2	76,2/3"	6,35/0,26"
E3	2000 A	2	101,6/4"	6,35/0,26"
E3	2500 A	3	101,6/4"	6,35/0,26"
E4	3200 A	5	76,2/3"	6,35/0,26"
E4	3600 A	6	76,2/3"	6,35/0,26"
E6	4000 A	7	76,2/3"	6,35/0,26"
E6	5000 A	8	101,6/4"	6,35/0,26"

Fig. 16

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

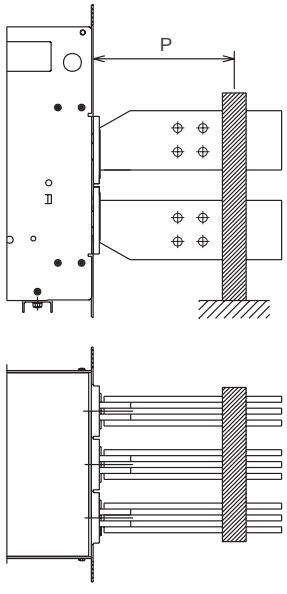
Anchoring to the switchgear

HORIZONTAL TERMINALS



P	E1-E2	E3-E4-E6
(mm)	250	150
(inch)	9.84"	5.91"

VERTICAL TERMINALS



P	E1-E2	E3-E4-E6
(mm)	250	250
(inch)	9.84"	9.84"

Fig. 17

5.1.3 Assembly procedures for the connection busbars

Check the state of the contact surfaces of the connections very carefully: these must be very clean and free of burrs, dents or traces of oxidation, which must be eliminated using a fine file or an emery cloth to prevent localized increases in temperature. On completion of the operation, remove all traces of grease or dust with a cloth soaked in a suitable solvent.
When copper connections are used, it is advisable to tin-plate the contact surfaces. When aluminium connections are used, it is advisable to apply a thin layer of Vaseline over the contact surfaces.
The connections must not exert any force on the terminals in any direction.
Always interpose a flat washer of good diameter and a spring washer between them (to spread the tightening pressure over a greater area).
Make the contact between connection and terminal and fully tighten the fixing screws.
Always use two wrenches (so as not to stress the insulating parts excessively), applying the tightening torque indicated in figure 11. Check the tightening after 24 hours. Fig. 18. Check tightening after 24 hours.

M12 / 1/2" high resistance screws
Tightening torque of the main terminals: 70 Nm / 584 lb. ft.

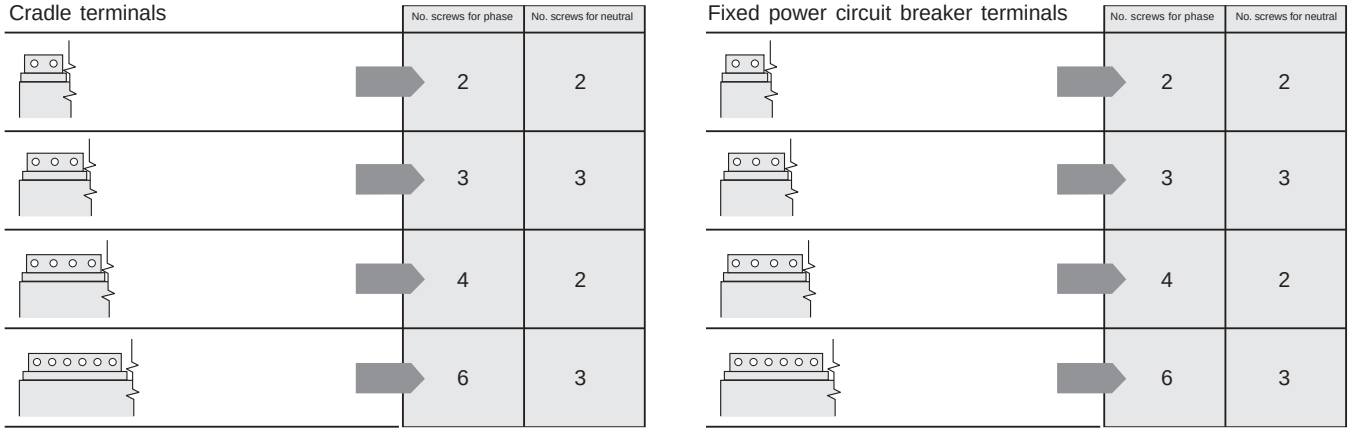


Fig. 18

5.2 Grounding

The fixed version power circuit breaker and the cradle of the draw out power circuit breaker have one or two terminals on the rear, marked with the special symbol, for connection to ground (Fig. 9 and Fig. 12).
Each terminal is complete with a bolt for fixing the connection.
A conductor with cross-section conforming to the Standards in force must be used for the connection.
Before assembling the connection, clean and degrease the area around the screw.
After assembly, tighten the bolt with a torque of 70 Nm / 584 lb. ft.

5.3 Cabling the power circuit breaker auxiliary circuits

5.3.1 Interfacing elements for fixed power circuit breaker

A special terminal box is provided fitted with screw terminals for connection of the auxiliary circuits.
The terminals are marked with alphanumerical identification codes as per the electrical circuit diagram.
The terminal box is identified by the code XV on the electrical circuit diagram.
There is immediate access to the terminal box when the compartment door is open.

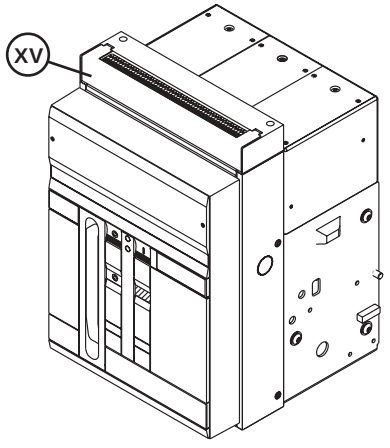
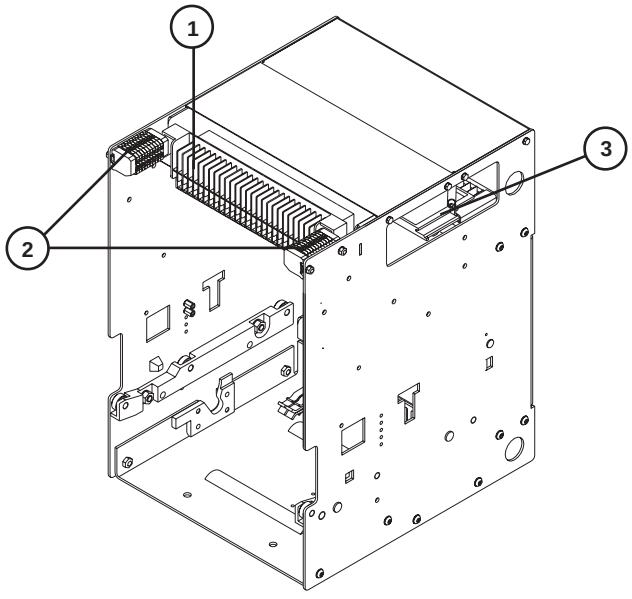


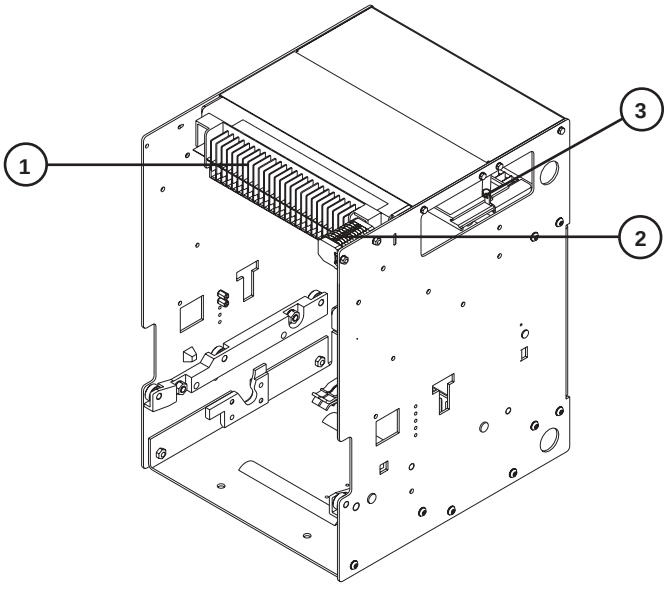
Fig. 19

5.3.2 Draw out power circuit breaker

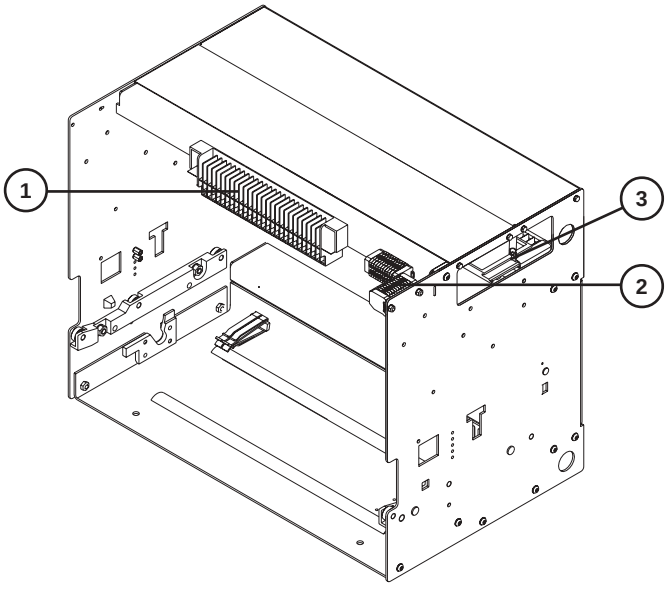
For connection of the moving part to the auxiliary circuits, a connector with sliding contacts is available on the cradle (see figure), identified by code X on the electrical circuit diagram.
There is immediate access to the terminals of the fixed connector when the compartment door is open.
Furthermore,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



E1 - E2 - E3
10 contacts in position



E1 - E2 - E3 - E4 - E6
5 contacts in position



E4 - E6
10 contacts in position

Caption

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

Fig. 20

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

The contacts are cabled in the factory as is shown on the electrical circuit diagram. Should it be necessary to modify the state for installation requirements, proceed as follows.

a) Auxiliary contacts

To access the auxiliary contacts, carry out the following operations:
– remove the front protection (3) of the trip unit by working on the blocks (1) as shown in the figure
– remove the trip unit (4) by removing the side nuts (2) and sliding it out from the front of the power circuit breaker.

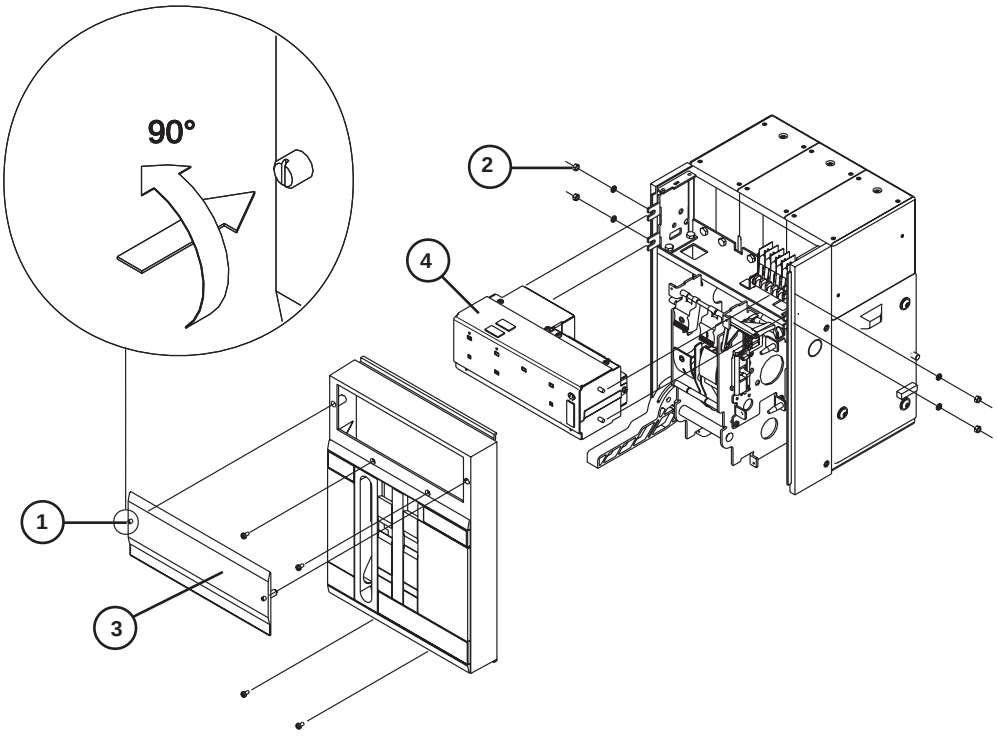
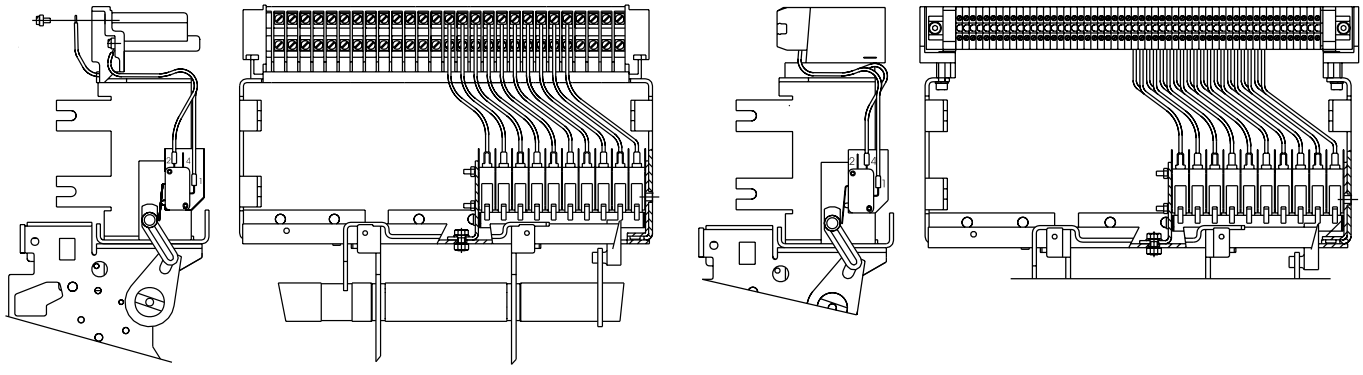


Fig. 21

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



N.C. contact Sliding contacts N.O. contact Terminal box

Fig. 22

b) Position contacts

To change the state of the position contact, proceed in the same way as the one indicated for the auxiliary contacts (see Fig. 21-22).

6. Putting into service

6.1 General procedures

– Check tightening of the power connections at the power circuit breaker terminals
– Carry out all the preparation operations of the trip unit
– Check that the value of the auxiliary circuit power supply voltage is between 85 and 110% of the rated voltage of the electrical applications
– Check that there is sufficient air exchange in the place of installation to avoid overtemperatures
– Also carry out the checks indicated in the following table.

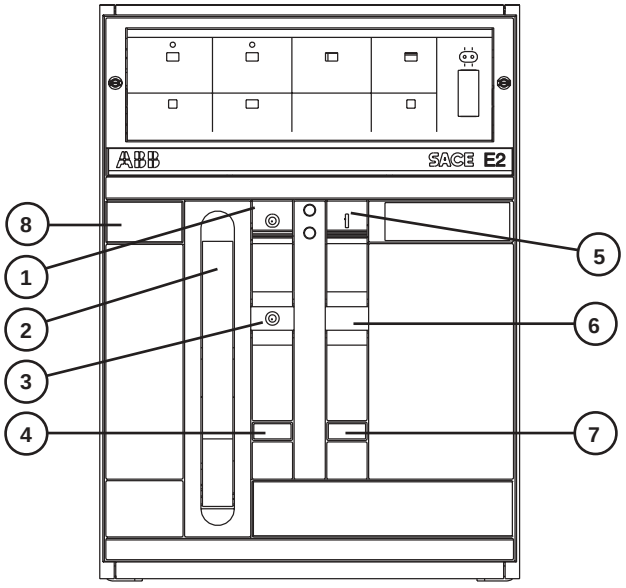
Item inspected	Procedure	Positive check
1 Manual operating mechanism	Carry out some opening and closing operations (see the cap. 7.2). CAUTION When there is an undervoltage release, the power circuit breaker can only be closed after having electrically energized the trip unit itself.	The spring charging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

7. Instructions for use

7.1 Operating and signaling parts

1 Pushbutton for the manual opening operation
2 Lever for manual charging of the closing springs
3 Mechanical indicator for power circuit breaker open “O” and closed “I”
4 Mechanical indicator for trip unit tripped (on request)
5 Pushbutton for the manual closing operation
6 Signaling device for springs charged - discharged
7 Operation counter (on request)
8 Key lock on the closing operation (on request)
9 Mechanical indicator for power circuit breaker connected, test connected, and disconnected.
10 Seat for the racking-in/out lever
11 Lever releasing the racking-in/out operation
12 Key lock on the racking-in/out operation (on request)
13 Padlock on the manual closing operation (on request)
14 Padlock on the racking-in/out operation (on request)

Fixed power circuit breaker



Draw out power circuit breaker

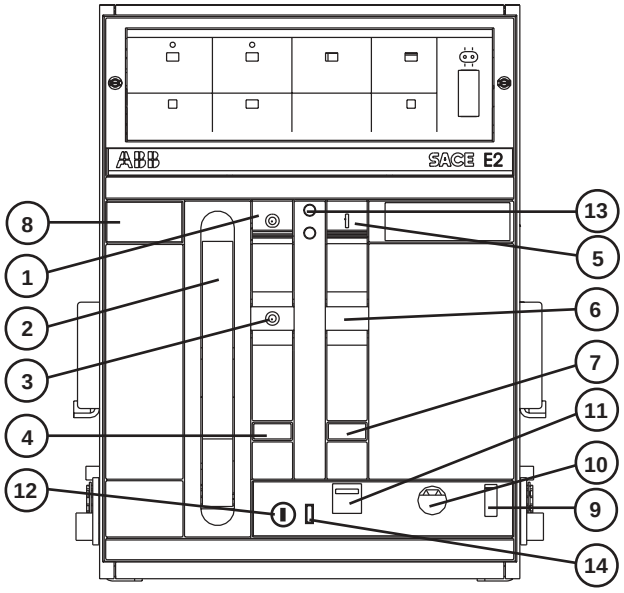


Fig. 23

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

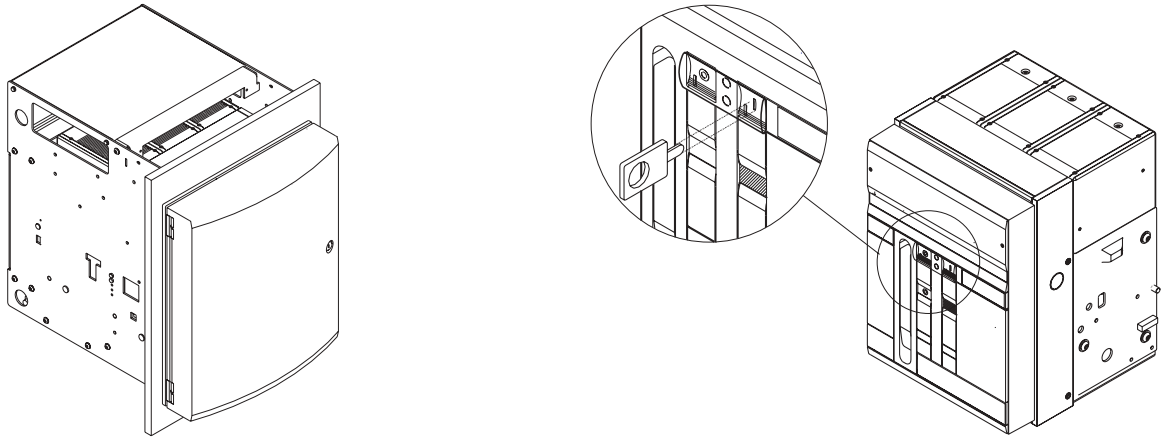


Fig. 24

7.2 Closing and opening operations of the power circuit breaker

Operation of the power circuit breaker can be either manual or electrical.

a) Manual charging operation of the closing springs

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

b) Electrical charging operation of the closing springs

The electrical operation of the power circuit breaker is possible when the following accessories (supplied on request) are present:
– geared motor for automatic charging of the closing springs
– closing coil
– shunt trip.

The geared motor automatically recharges the springs after each closing operation until the yellow indicator appears (6, Fig. 25). When the power is cut off during charging, the geared motor stops and automatically starts recharging the springs again when the power returns. It is, in any case, always possible to complete the recharging operation manually.

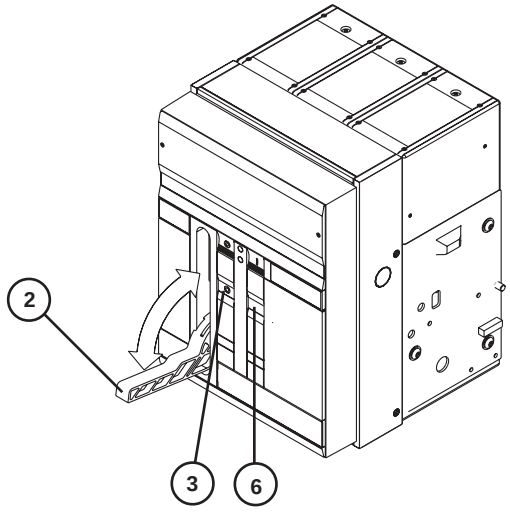


Fig. 25

c) Closing the power circuit breaker

The operation can only be carried out with the closing springs fully charged.
For manual closing, press the pushbutton (5) marked with the letter “I”. When there is a closing coil, the operation can be carried out remotely by means of the special control circuit. Closing having taken place is signaled by the special indicator (3) which goes to indication “I”. Furthermore, the indicator of the state of the springs (6) goes to the WHITE position. Even with the closing springs discharged, the operating mechanism conserves enough energy for the opening operation. The geared motor, if present, immediately starts the automatic spring recharging operation.

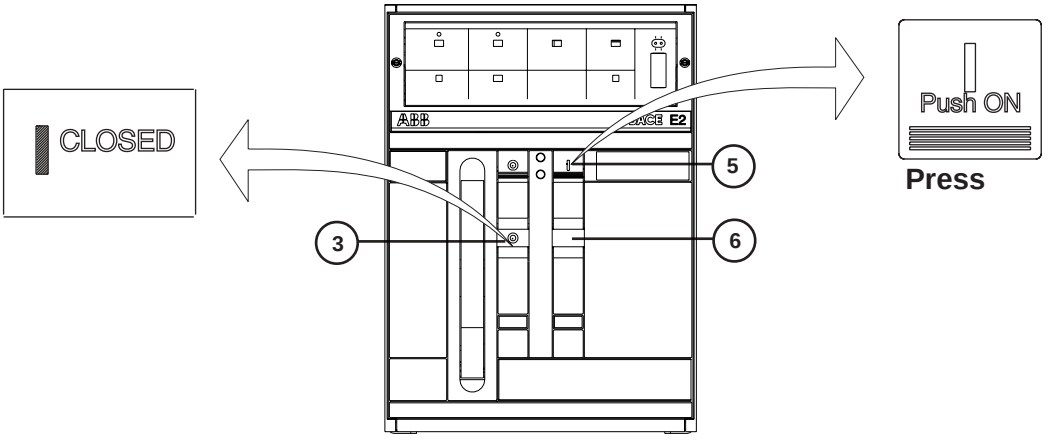


Fig. 26

d) Opening the power circuit breaker

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

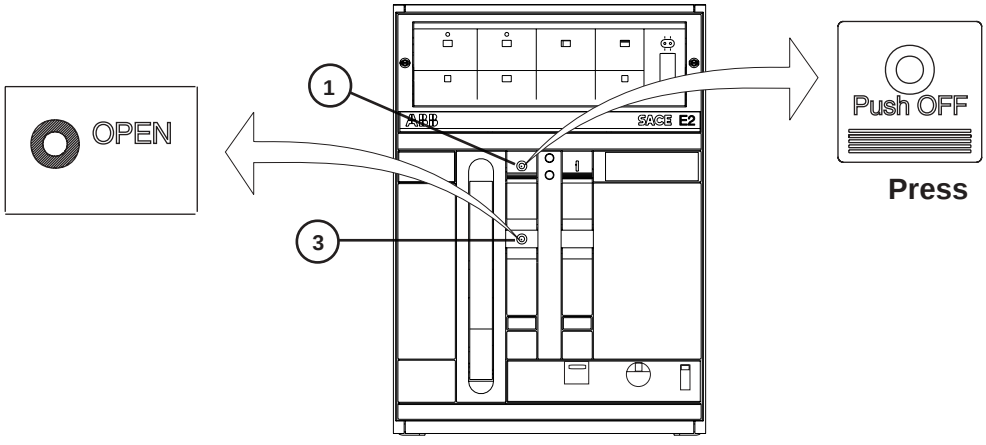


Fig. 27

7.3 Racking-in/out operation

WARNINGS

A) Open the power circuit breaker before carrying out any racking-in/out operation.

B) The power circuit breaker (moving part) and cradle are fitted with a lock which prevents the cradle being racked into power circuit breakers with a different continuous current rating: congruence of the anti-racking-in lock must be checked by the operator before carrying out the racking-in operation to avoid any unnecessary stress.

C) Before the racking-in operation, remove any padlock on the segregation shutters of the isolation terminals on the cradle.

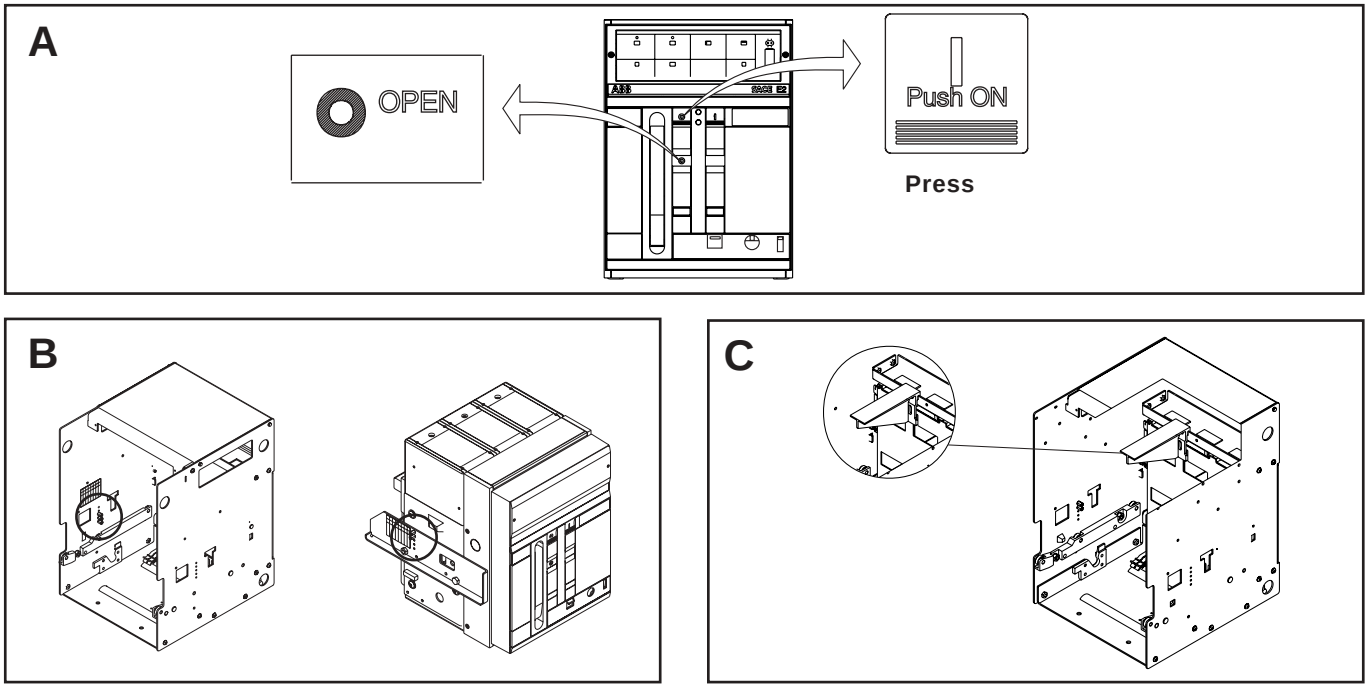


Fig. 28

NOTES

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

– DISCONNECTED: the moving part is inserted in the cradle WITHOUT connection between the power terminals and WITHOUT coupling of the sliding contacts for the auxiliary circuits: in this position all electrical operation of the power circuit breaker is prevented. On the front the indicator (9, Fig. 23) indicates DISCONNECTED. The switchgear compartment door can be closed.

– TEST CONNECTED: the moving part is inserted in the cradle WITHOUT the connection between the power terminals, but WITH coupling of the sliding contacts for the auxiliary circuits. In this position, the power circuit breaker can be operated for the blank tests. The indicator (9, Fig. 23) indicates TEST ISOLATED.

– CONNECTED: the moving part is fully inserted in the cradle WITH connection of both the power terminals and the sliding contacts for the auxiliary circuits. The power circuit breaker is operative. The indicator (9, Fig. 23) indicates CONNECTED.

a) Positioning of the moving part in the cradle in the DISCONNECTED position

Lift the moving part as shown in paragraph (3) and insert it into the cradle guide, inclining it as shown in figure 29.

The manual connection operation must allow edge (E) of the power circuit breaker guide to slide under blocks (D) of the cradle. Remove the lifting devices.

The position reached is stable and allows any inspections of the power circuit breaker.

Fully push in the moving part as far as the stop in the cradle.

Close the compartment door.

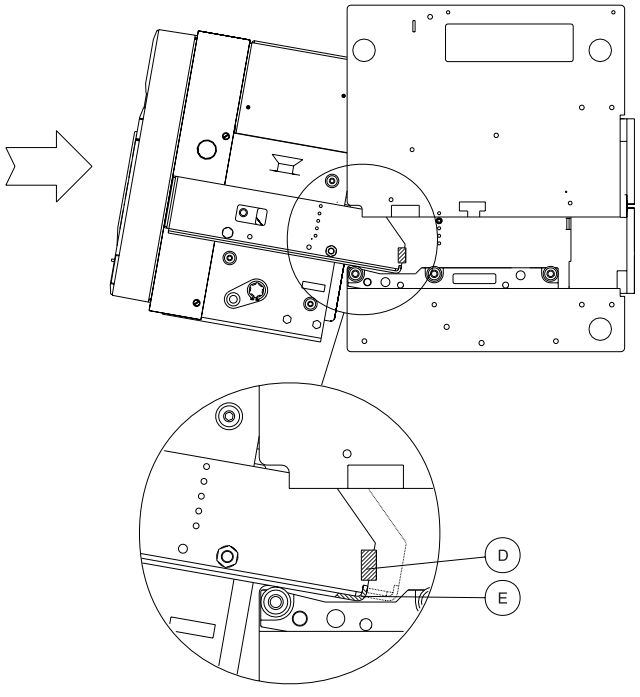


Fig. 29

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 operation, make sure that the key (12) is in the correct position and/or the padlock (14) has been removed (if present).
Make sure that the power circuit breaker is open.
Fully push the moving part into the cradle.
Lower the releasing lever (11).
Insert the crank handle in the relative coupling (10).
Proceed to rotate the crank handle clockwise until the TEST ISOLATED indication appears on the indicator (9). During the initial turns, the crank handle must not show any particular resistance to rotation.
Should it be necessary to carry out blank operations of the power circuit breaker, the crank handle must be removed.

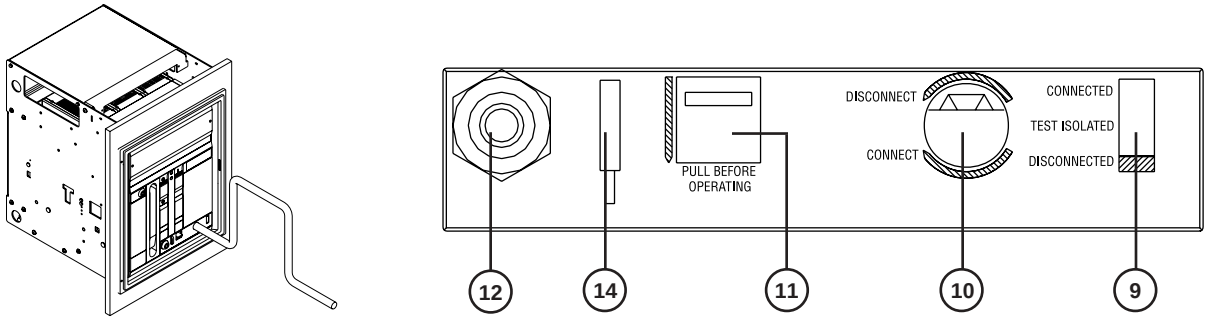


Fig. 30

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

Make sure that the power circuit breaker is open.
Lower the releasing lever (11).
Insert the crank handle in the relative coupling (10).
Proceed to rotate the crank handle clockwise until the CONNECTED indication appears on the indicator (9).
Remove the crank handle to be able to close the power circuit breaker.

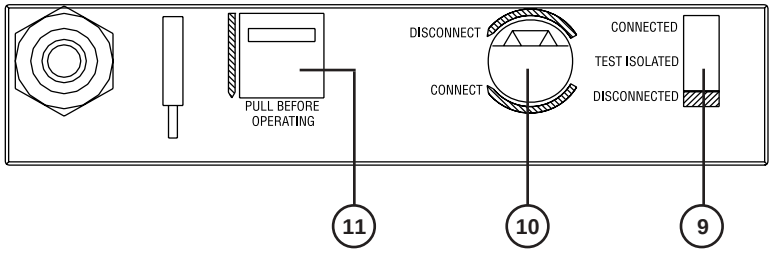


Fig. 31

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

Repeat the connection operations with the variation of rotating the crank handle anticlockwise. Open the door in the disconnected position.

8. Maintenance

8.1 Warnings

Before carrying out any maintenance work, it is necessary to complete the following procedure:
– open the power circuit breaker and check that the operating mechanism springs are discharged.
– in the case of draw out power circuit breakers, work with the power circuit breaker racked-out of the cradle
– for interventions on fixed version power circuit breakers or on cradles of draw out power circuit breakers, remove the supply to the power circuit and to the auxiliary circuits. Furthermore, visibly ground the terminals both on the power supply side and on the load side.
During normal service, the power circuit breakers require limited maintenance.

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

It is also advisable to refer to the following rules:
– power circuit breakers which rarely operate, or which in any case remain closed for long periods, must be operated from time to time to avoid any tendency to stick.
– during service, visually inspect the power circuit breaker from the outside to find any dust, dirt or damage of any kind.
For power circuit breakers with SACE PR112-A and SACE PR113-A trip units, check the percentage of wear of the contacts.
– For the power circuit breakers fitted with SACE PR111-A trip units, installation of the mechanical operation counter (supplied on request) is recommended. The SACE PR112-A and SACE PR113-A trip unit allows the number of operations carried out by the power circuit breaker in service to be displayed at all times on the special display. This latter trip unit also makes various useful pieces of information available for controlling the status of the power circuit breaker.

With regular maintenance, SACE Emax power circuit breakers, either with or without geared motor, can sustain the following operation cycles without replacement of parts.

Power circuit breaker		Mechanical life (*)		Electrical life (*)	
		N° of operations (operations)	Frequency (operations/hour)	N° of operations (operations)	Frequency (operations/hour)
E1	800	20000	30	10000	30
	1200	20000	30	10000	30
E2	1200	20000	30	10000	30
	1600	20000	30	10000	30
E3	1200	15000	30	10000	30
	1600	15000	30	10000	30
	2000	15000	30	8000	30
	2500	15000	30	8000	30
E4	3200	8000	30	5000	30
	3600	8000	30	5000	30
E6	3200	8000	30	5000	30
	4000	8000	30	5000	30
	5000	8000	30	3000	30

(*) With ordinary maintenance

8.2 Maintenance program

Maintenance operations	Interval	
	Installations in normal rooms	Installations in dusty or polluted rooms
General inspection (see par. 8.3.2)	One year or after a short circuit trip	Six months or after a short circuit trip
External visual check and inspection of the power section	One year	Six months
Operating mechanism maintenance (par. 8.3.4)	One year or 10000 operations for E1, E2 and E3 One year or 5000 operations for E4 and E6	Six months or 10000 operations for E1, E2 and E3 Six months or 5000 operations for E4 andE6
Checking intervention of the trip unit	One year	Six months
Power circuit breaker maintenance (par. 8.3.5)	Every 10000 operations for E1, E2 and E3 Every 5000 operations for E4 and E6	

8.3 Maintenance operations

8.3.1 Preliminary operations

– Remove the flange (1) of the trip unit, turning the screws (2) as shown in the figures
– Remove the front escutcheon plate (3) by removing the four screws (4)
– Remove, if present, one or both side guards (5) by removing the front (6) and lateral (7) screws
– Remove the arcing chambers (8) by removing the screws (9).

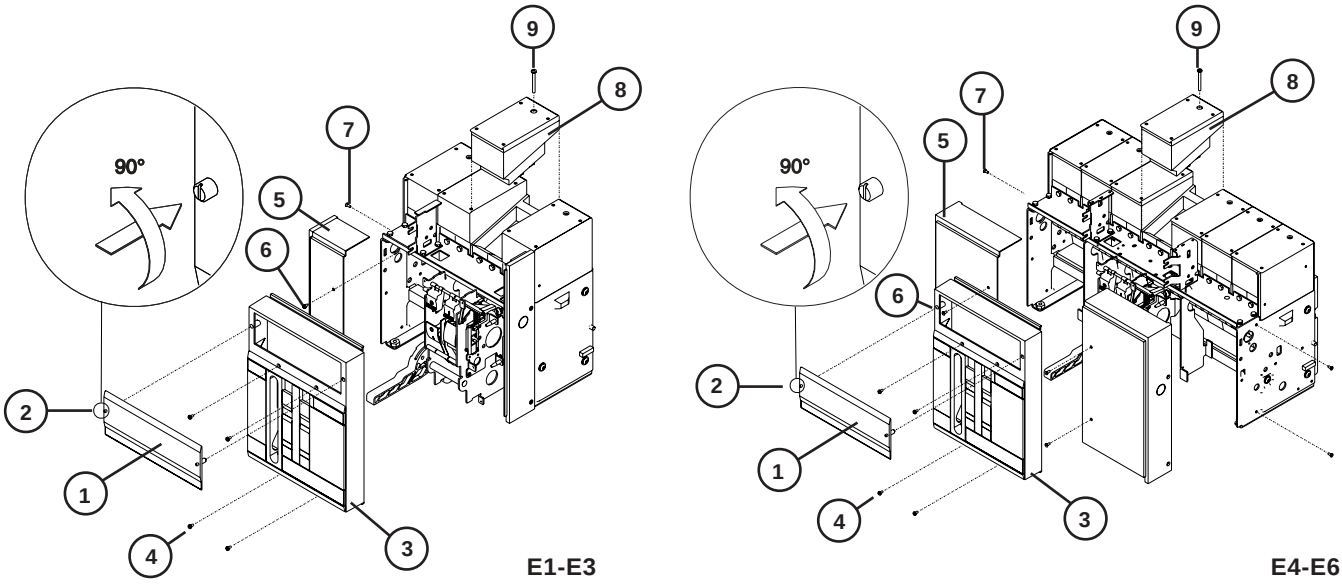


Fig. 32

8.3.2 General inspection of the power circuit breaker

Item to be inspected	Problem found	Remedy
1 Operating mechanism/Electrical accessories	– Presence of dust on the internal parts – Springs deformed or oxidized – Safety rings out of place, nuts or screws loose – Wires and straps detached	– Clean with brushes or dry cloths – Replace damaged springs – Put the rings back in place and tighten screws and nuts appropriately – Replace the straps and connect the detached wires correctly
2 Arcing and main contacts	– Traces of wear – Incorrect adjustments: distance A (Fig. 33) is less than 1mm for E1-E2-E3 or less than 0.8 mm for E4-E6	– Smooth the contacts with emery cloth – Adjust according to the paragraph 8.3.3
3 Arcing chambers	– Presence of fumes or dusts – Presence of cracks on the external plastic structure – Excessive difference in wear between the first and last arc extinguishing plate – Remove with compressed air and remove the fumes and any slag with a brush	– Replace the arcing chamber – Replace the arcing chamber – Replace the arcing chamber
4 Main circuit - Busbars - Isolating contacts	– Presence of dust or dirt on the insulating parts – Safety rings out of place, screws or nuts loose – Deformation or cracks of the insulating parts – Isolating contacts oxidized (only for draw out power circuit breaker) – Signs of wear or overheating or screws loose on the connections to the terminals of the power circuit breaker (only for fixed power circuit breaker)	– Clean with a brush or dry cloths – Put the rings back in place and tighten screws and nuts appropriately – Ask ABB SACE for replacement of the damaged parts – Remove the shutters and clean with a rough clothsoaked in a suitable solvent and lubricate moderately with neutral grease – Tighten the screws suitably
5 Grounding pliers (only for draw out power circuit breaker)	Presence of oxidation or loose nuts	Clean with a rough cloth soaked in a suitable solvent and lubricate moderately with neutral grease. Tighten the nuts fully
6 Grounding connection (only for fixied power circuit breaker)	Presence of oxidation and / orloose nut	Clean with a rough cloth soaked in a suitable solvent, fully tighten withthe ground connection and coverwith neutral grease again.
7 Auxiliary circuit power supply voltage	Check the power supply voltage of the electrical accessories of the operating mechanism	The trip units and locking devices must operate normally for values between 85% and 110% of the relative rated voltage
8 Operating and control parts	The operating tests, which must be carried outas shown in paragraph 6.1 have shown defects in the components	Replace the defective parts or those with defective operation (if necessary, ask ABB SACE)

8.3.3 Checking contact wear

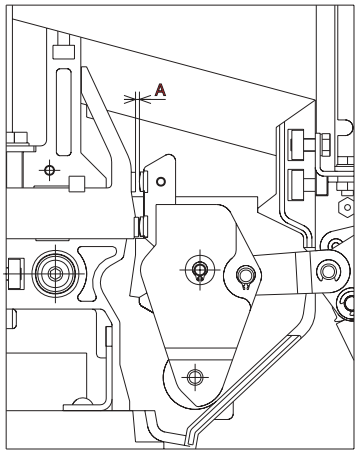
In order to obtain distance A indicated in the table, it is possible to ad just the position of the shaft and of the operating mechanism comando.

1) Open the circuit-breaker
2) Remove the arcing chamber

3a) Adjustment of moving contact detachment for E1-E2-E3:
- loosen the screws in pos.1 and the nuts in pos. 3 (FIG 33 a)
- work in a similar way on the screws in pos. 2
- take the bushes of the operating mechanism (pos. 5) to rest on the shaft, working on the nuts in pos. 4
- tighten the screws in pos.1 and the nuts in pos. 3 and 4
- close the circuit-breaker and check distance A

3b) Adjustment of moving contact detachment for E4-E6:
- loosen the screws in pos.1 and 6, and the nuts in pos. 3 and 8 (FIG 33 a and 33 b)
- work in a similar way on the screws pos. 2
- take the bushes of the operating mechanism (pos. 5) and the bushes of the intermediate shoulders (pos. 9) to rest on the shaft, working on the nuts in pos. 4 and the screws in position 7
- tighten the screws in pos.1 and 6, and the nuts in pos. 3, 4 and 8
- close the circuit-breaker and check distance A

4) If the distance is not correct, open the circuit-breaker again and repeat the operation indicated under point 3a or 3b
5) If distance A is correct, open the circuit-breaker again, seal with a yellow paint and remount the arcing chambers.



Power circuit breaker	A
E1 - E2 - E3	1 ÷ 1.9 mm 0.039 ÷ 0.075 inch
E4 - E6	0.8 ÷ 1.5 mm 0.031 ÷ 0.059 inch

Fig. 33

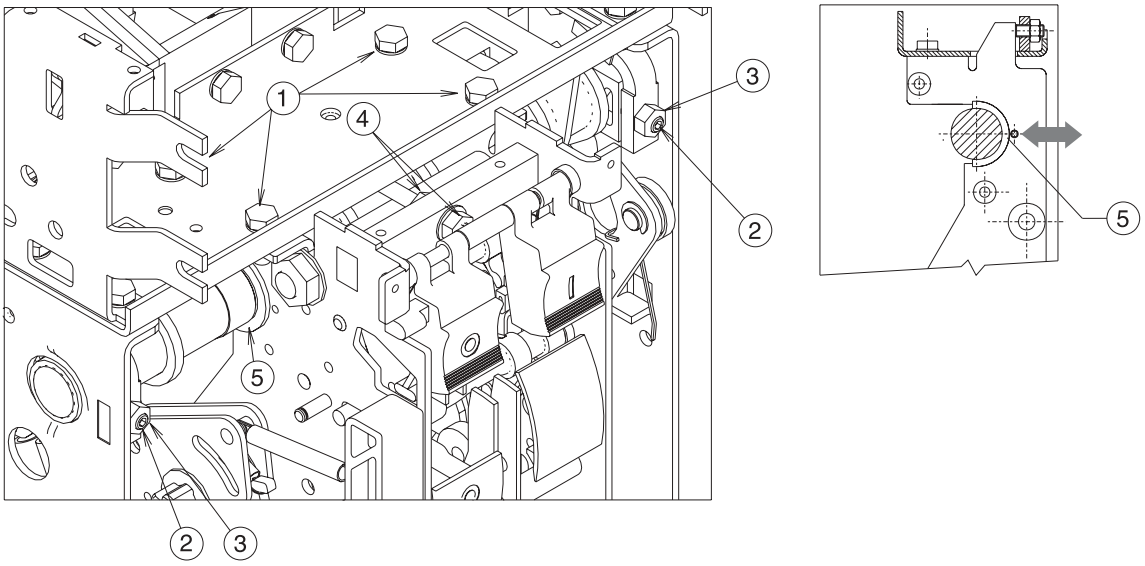


Fig. 33a

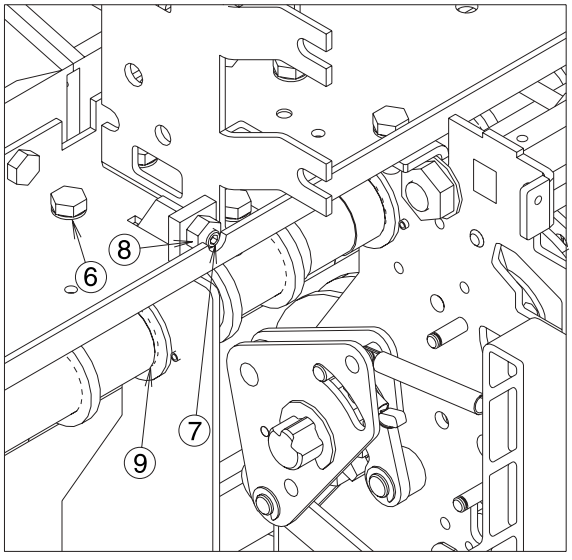


Fig. 33b

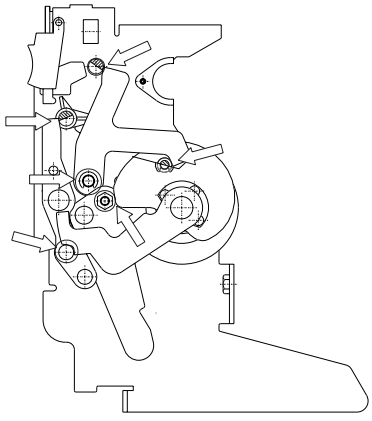


Fig. 33c

8.3.4 Operating mechanism maintenance

– Carry out the checks and interventions listed under point 1 of the table in paragraph 8.3.2.
– Lubricate the supports of the drive shaft with MU-EP1 (AGIP) grease, including those on the sides of the power circuit breaker. Equivalent greases: ESSO Beacon EP1 - BP LTX1 - SHELL AVANIA GREASE R1 - KLUBER LUBRIFICATION CENTO PLEX 2P
– Lubricate the small opening and closing shafts and the hooks with 5 RX MOLY (OLEOTECNICA) grease (Fig. 33c). Equivalent grease: KLUBER LUBRIFICATION GRAFLOSCON A-G 1 ULTRA
– Replace the operating mechanism springs after 10,000 operations for E1, E2 and E3 and after 5,000 operations for E4 and E6.

8.3.5 Power circuit breaker maintenance

Replace the following components after 10,000 operations for E1, E2 and E3 or 5,000 operations for E4 and E6:
– arcing chambers
– protection
– geared motor
– operating mechanism springs.

9. Measures to be taken for any operating anomalies

Anomalies	Possible causes	Checks and remedies
The power supply to the TEST (15 V DC) connection bosses of the PR111-A trip unit does not open the power circuit breaker Pressing the TEST pushbutton on the PR112-A/PR113-A does not cause power circuit breaker opening Intervention of the µP Fault signal on the PR112-A/PR113-A trip unit The WARNING or EMERGENCY LEDs on the PR112-A/PR113-A trip unit light up Trip unit coils interrupted or burnt out, geared motor winding interrupted The shunt trip or closing coil does not energize sufficiently The shunt trip or closing coil remains energized The moving part does not rack into in the cradle The moving part does not rack out of the cradle The power circuit breaker does not close The power circuit breaker does not open		
● ●	Connector XO not inserted correctly	Check and insert connector XO correctly
● ●	Coil of shunt trip YO1 interrupted	Replace the YO1shunt trip
● ● ●	Defect in the electronic circuits of the electronic trip unit	Put the power circuit breaker out of service and check the trip unit with the test apparatus
●	The possible causes of tripping are listed in the part of the manual relative to the trip units	Intervene according to the cause: in particular, if contact wear is higher than 80% (WARNING LED lit up) the power circuit breaker can remain in service, but replacement of the interrupting parts must be programmed within a short time. If contact wear reaches 100%, the power circuit breaker must be put out of service immediately. Ask ABB SACE about replacement operations of the interrupting parts.
●	Protections not reset	Press the mechanical pushbutton for signaling protection intervention
●	Operating mechanism or consent contacts blocked in closing position	Check the state of the contacts in series with the trip unit circuit
● ● ●	Auxiliary circuit power supply voltage too low	Measure the voltage: it must not be less than 85% of the rated voltage
● ● ●	Different power supply voltage than the one indicated on the rating plate of these trip units	Check the rating plate voltage of the trip units
● ●	Operating circuit faulty	Check connections, fuses, interlock, protection power circuit breakers and consent contacts
● ●	Wire tightening screws loose	Check tightening of the screws connecting the wires
● ●	Incorrect electrical connections in the power supply circuit	Check the connections with the relative circuit diagram
● ●	Trip unit coils interr upted	Replace the coils
● ●	Operating mechanism blocked	Operate by hand. If the fault persists, consult ABB SACE
●	Key not inserted in the operating mechanism key lock	Insert and turn the key
●	Power circuit breaker in intermediate position between racked-in and racked-out	Complete the operation
●	Undervoltage release not energized	Check the relative power supply circuit
●	Shunt trip remains energized	Check the power supply circuit
● ●	Racking-in or out operation not carried out correctly	See paragraph 7.3

10. Accessories

10.1 Electrical accessories

Shunt trip /closing coil (YO - YO2 - YC)

This allows remote opening or closing control of the apparatus. Given the power circuit breaker operating mechanism characteristics, opening (with the power circuit breaker closed) is always possible, whereas closing is only possible when the closing springs are charged. Most of the trip units can operate with either direct or alternating current.
This trip unit carries out an instantaneous service (*), but can be supplied permanently (**).
In the use where the closing coil is supplied permanently, to carry out the power circuit breaker reclosing operation after opening, it is necessary to momentarily de-energize the closing coil (the power circuit breaker operating mechanism is, in fact, fitted with an antipumping device).
(*) In the case of instantaneous service, the minimum duration of the current impulse must be 100 ms.
(**) In the case of permanent power supply to the shunt trip, you must wait for a time of at least 30 ms before giving the opening control to the closing coil.
Reference figures in the electrical circuit diagrams: YO 4 - 5 - YC 2 3; YO2 8

Power supply (A)	24 V DC
	30 V AC/DC
	48 V AC/DC
	60 V AC/DC
	110-120 V AC/DC
	125-127 V AC/DC
	220-240 V AC/DC
	250 V AC/DC
	380-400 V AC
	440-480 V AC

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

Undervoltage release (YU)

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

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

Power supply (Un)	125-127 V AC/DC
	220-240 V AC/DC
	250 V AC/DC
	380-400 V AC
	440-480 V AC

CAUTION:

The undervoltage release (YU) is incompatible with the Fail Safe device (against racking-out with the springs charged).
When the Fail Safe device is present, remove it as shown in Figs. 34a-b-c-d.

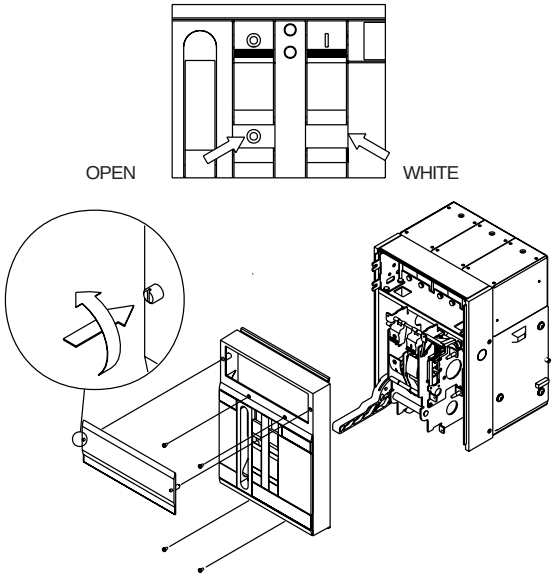


Fig. 34a

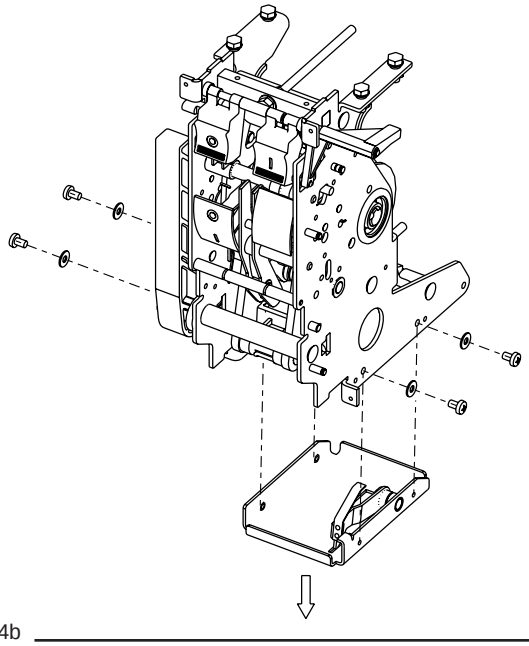


Fig. 34b

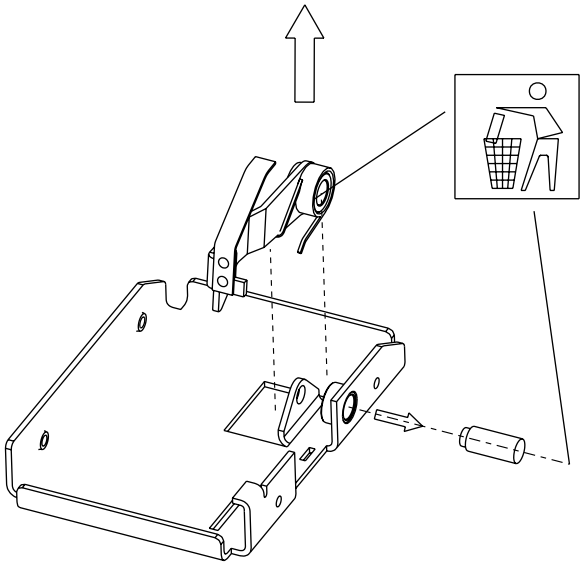


Fig. 34c

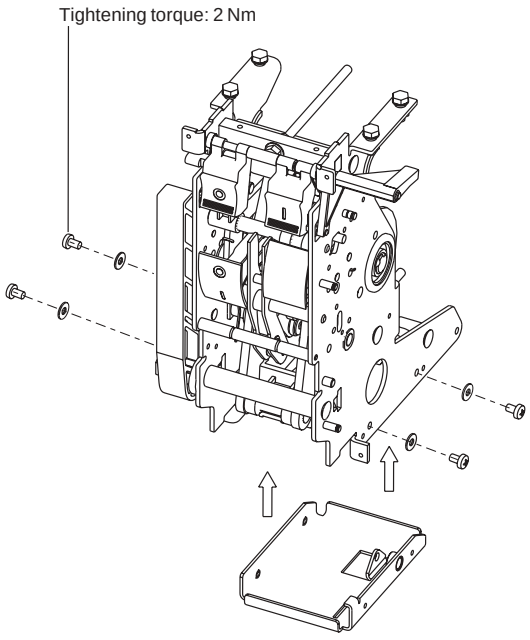


Fig. 34d

Power circuit breaker opening takes place with power supply voltage values of the trip unit equivalent to 30 - 60% A.
Power circuit breaker closing is possible with power supply voltage of the trip unit equivalent to 85-110% A.

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

Reference figures in the electrical circuit diagrams: YU 6

Time delay device for undervoltage release (D)

The undervoltage release can be combined with an electronic time-delay device to be mounted outside in relation to the power circuit breaker, which allows a delay in intervention of the trip unit with established and adjustable times. The use of the delayed undervoltage release is recommended when the power supply network of the trip unit can be subject to interruptions or short time drops in voltage, in order to avoid trips.
When it is not supplied, power circuit breaker closing is prevented.
The time-delay device is to be combined with an undervoltage release with the same voltage as the time-delay device.

Reference figures in the electrical circuit diagrams: YU + D 7

Inrush power consumption (Ps):	DC = 200 W
	AC = 200 VA
Continuous power (Pc):	DC = 5 W
	AC = 5 VA
Opening time (YU):	30 ms
Insulation voltage	2500V 50 Hz (for 1 min.)

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

Geared motor for automatic closing spring charging (M)

This carries out automatic closing spring charging of the power circuit breaker operating mechanism. After power circuit breaker closing, the geared motor immediately sees to recharging the closing springs.
When there is no power supply voltage or during maintenance work, the closing springs can, in any case, be charged manually (by means of the special lever of the operating mechanism).

Power supply	24-30 V AC/DC
	48-60 V AC/DC
	100-130 V AC/DC
	220-250 V AC/DC
Operating limits:	85…110% Un

Inrush power consumption(Ps):	DC = 500 W
	AC = 500 VA
Nominal power (Pn):	DC = 200 W
	AC = 200 VA
Inrush time	0.2 s
Charging time:	4-5 s
Insulation voltage	2500V 50 Hz (for 1 min.)

It is always supplied with limit contacts and microswitch for signaling closing springs charged.

Reference figures in the electrical circuit diagrams: M

Mechanical and electrical trip signaling for trip units
The following signals are available following tripping of the trip unit:

a) Mechanical trip signaling for trip units
This allows visual signaling on the operating mechanism by means of pushing the trip pushbutton in when the power circuit breaker has been opened following tripping of a trip unit. The power circuit breaker can only be closed again by putting the pushbutton back into its normal position.

b) Electrical and mechanical trip signaling for trip units
This allows visual signaling on the operating mechanism (mechanical) and remotely (electrical by means of a changeover switch) of the power circuit breaker being open following a trip of the trip units. To reset the power circuit breaker, it is necessary to reset the pushbutton for mechanical indication. The SACE PR112-A and SACE PR113-A trip units are already provided with an internal overcurrent signaling contact.

Reference figures in the electrical circuit diagrams: S51 12

Auxiliary contacts

Auxiliary contacts installed on the power circuit breaker are available which allow signaling of the power circuit breaker status (are also available in gold plated contact version for digital signal).

Un	In max	T
125 V DC	0.3 A	10 ms
250 V DC	0.15 A	10 ms

Un	In max	cosφ
250 V AC	5 A	0.3

The versions available are:

a) Electrical signaling for power circuit breaker open/closed

It is possible to have electrical signaling of the power circuit breaker status (open/closed) - 4 or 10 auxiliary contacts.
The auxiliary contacts take up the following configurations:
– 4 open/closed contacts (2 normally open + 2 normally closed)
– 10 open/closed contacts (5 normally open + 5 normally closed) - not available when the SACE PR112-A and SACE PR113-A trip units are required.
A group of 15 supplementary open/closed contacts is also available, which can be mounted outside the power circuit breaker. The basic configuration described above can be modified by the user for indication of normally open or normally closed by repositioning the faston connector on the microswitch.
Reference figures in the electrical circuit diagrams: Q/1÷10 21 22; Q/11÷25 23

b) Electrical signaling for power circuit breaker connected/TEST ISOLATED/disconnected

In addition to mechanical signaling of the position of the power circuit breaker, it is possible to have electrical signaling by means of 5 or 10 auxiliary contacts which are installed on the cradle.
Only available for power circuit breaker in draw out version - to be installed on the cradle.
The auxiliary contacts take up the following configurations:
– 5 contacts: group consisting of 2 connected signaling contacts, 2 disconnected signaling contacts and 1 test position signaling contact (main pliers isolated, but sliding contacts connected)
– 10 contacts: group consisting of 4 connected signaling contacts, 4 disconnected signaling contacts and 2 test isolated signaling contacts (main pliers isolated, but sliding contacts connected).
Reference figures in the electrical circuit diagrams:S75I 31-32 – S75T 31-32 – S75E 31-32

c) Contact for signaling closing springs charged

This consists of a microswitch which allows remote signaling of the state of the power circuit breaker operating mechanism closing springs. (It is always supplied with the spring charging geared motor).
Reference figures in the electrical circuit diagrams: S33 M/2 - 11

d) Contact for signaling undervoltage release energized (aux C. YU)

The undervoltage releases can be fitted with a contact (by choice, normally closed or open) for signaling undervoltage energized for remote signaling of the state of the undervoltage release.
Reference figures in the electrical circuit diagrams: 12

Current transformer for the neutral conductor outside the power circuit breaker

Only for three-pole power circuit breakers. Allows neutral protection to be carried out by means of connection to the trip unit. (It is supplied on request).
Reference figures in the electrical circuit diagrams: TI/N 51-52 – UI/N 51-52

Homopolar toroid for the main power supply earthing conductor (star center of the transformer)

SACE PR112 and PR113 microprocessor-based electronic releases may be used in combination with an external toroid located on the conductor, which connects the star center of the MV/LV transformer (homopolar transformer) to earth. In this case, the earth protection is defined as Source Ground Return.
The homopolar transformer is available in four different versions in terms of rated current (but keeping the same overall dimensions in any case).
Reference figure in the electrical circuit diagrams: TI/O (51-52)

Characteristics				
Rated current	100 A	250 A	400 A	800 A

10.2 Mechanical accessories

Mechanical operation counter

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

Mechanical locks

a) Lock in open position

Different mechanisms are available which allow the power circuit breaker to be locked in the open position.
These devices can be controlled by:
– A key: a special circular lock with different keys (for a single power circuit breaker) or with the same keys (for several power circuit breakers). In the latter case, up to four different key numberings are available.
– Padlocks: up to 3 padlocks (not supplied): Ø 4 mm.

b) Power 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 power circuit breaker) or with the same keys (for several power circuit breakers (up to four different key numberings are available) and by padlocks (up to 3 padlocks, not supplied - Ø 4 mm). Only available for power circuit breaker in draw out version to be installed on the moving part.

c) Accessories for lock in TEST ISOLATED - disconnected position

In addition to the power circuit breaker lock in the connected - TEST ISOLATED – disconnected position, this allows locking only in the disconnected or TEST ISOLATED positions. Only available for power circuit breaker in draw out version to be installed on the moving part.

d) Accessories for shutter padlocks

Allow the shutters to be padlocked (installed on the cradle) in the closed position. Only available for power circuit breaker in draw out version to be installed on the cradle.

e) Mechanical lock on compartment door

Does not allow the compartment door to be opened with the power circuit breaker closed (and power circuit breaker connected for draw out power circuit breakers) and locks power circuit breaker closing with the compartment door open.

f) Key lock in open position with Kirk lock (internal or front door)

Allows the power circuit breaker to be locked in the open position by means of a lock with Kirk key (not supplied). For uses on fixed power circuit breakers, the accessory must be requested in combination with the interlock plate for fixed power circuit breaker.

g) Fail Safe device (against racking-out with the springs charged)

Prevents the moving part of the power circuit breaker in the draw out version being racked out of the cradle if the closing springs are charged. The accessory is supplied as standard for each draw out version power circuit breaker. Only available for draw out version power circuit breaker to be installed on the moving part.

CAUTION:
Incompatible with the undervoltage release (YU)

Transparent protection covers

a) Protection covers for opening and closing pushbuttons

These protection covers, applied over the opening and closing pushbuttons, prevent the relative power circuit breaker operations except by using a special tool.

b) IP54 door protection (NEMA 3/3S/13)

This is carried out by means of a transparent plastic escutcheon plate which fully protects the front of the power circuit breaker and allows IP54 degree of protection to be obtained. Mounted on hinges, it is fitted with a key lock.

Interlock between power circuit breakers

This mechanism makes the mechanical interlock between two or three power circuit breakers (even of different sizes and in any fixed/draw out version) by means of a flexible cable. The electrical circuit diagram for the electrical changeover by means of a trip unit (to be provided by the customer) is supplied with the mechanical interlock. The power circuit breakers can be installed vertically or horizontally.
4 types of interlocks are available:
type A: between 2 power circuit breakers (power supply + emergency group)
type B: between 3 power circuit breakers (of 2 power supplies + emergency group)
type C: between 3 power circuit breakers (2 power supplies + bus-tie group)
type D: between 3 power circuit breakers (3 power supplies / a single closed power circuit breaker group)

10.3 Spare parts

– Shields and front escutcheon plate
– Opening solenoid for the PR111-A / PR112-A / PR113-A trip unit
– Arcing chamber
– Closing springs
– Jaw-type isolating contact for cradle of the draw out power circuit breaker
– Sliding ground contact
– Cradle shutters
– Complete pole
– Operating mechanism
– Connection cables between trip units and current transformers

11. Trip units – General notes

The SACE Emax series power circuit breakers can be equipped with SACE PR111, PR112 or PR113 electronic trip units.
The SACE PR111 trip units carry out the protection function and local and test signaling.
Apart from the functions of the PR111 which can be carried out with a wider range of possibilities, the SACE PR112 and PR113 trip units in the configuration fitted with the protection unit only (PR112/P-A, PR113/P-A), also carry out the functions of remote Watchdog signals and measurement.
Both the trip units normally receive their power supply from the current transformers mounted in each pole. All the adjustment and control parts available to the user are arranged on the front of the trip unit.
Their installation in the power circuit breaker is simple: the mechanical fixing is carried out by means of four nuts, whereas some connectors are available for the electrical connections, whose references are indicated on the electrical circuit diagram.

XK1: connector for connection of the PR111, PR112/P and PR113/P trip units to the current sensors
XK2 e XK3: connectors for the auxiliary circuits of the PR112/P and PR113/P trip units (for functions such as remote signals and circuits for zone selectivity)
X0: connector for the Y01 shunt trip which makes the power circuit breaker open following intervention of the trip unit.

Accessory units normally provided, and others supplied on request, allow the auxiliary power supply and tests to check functionality of the trip unit.

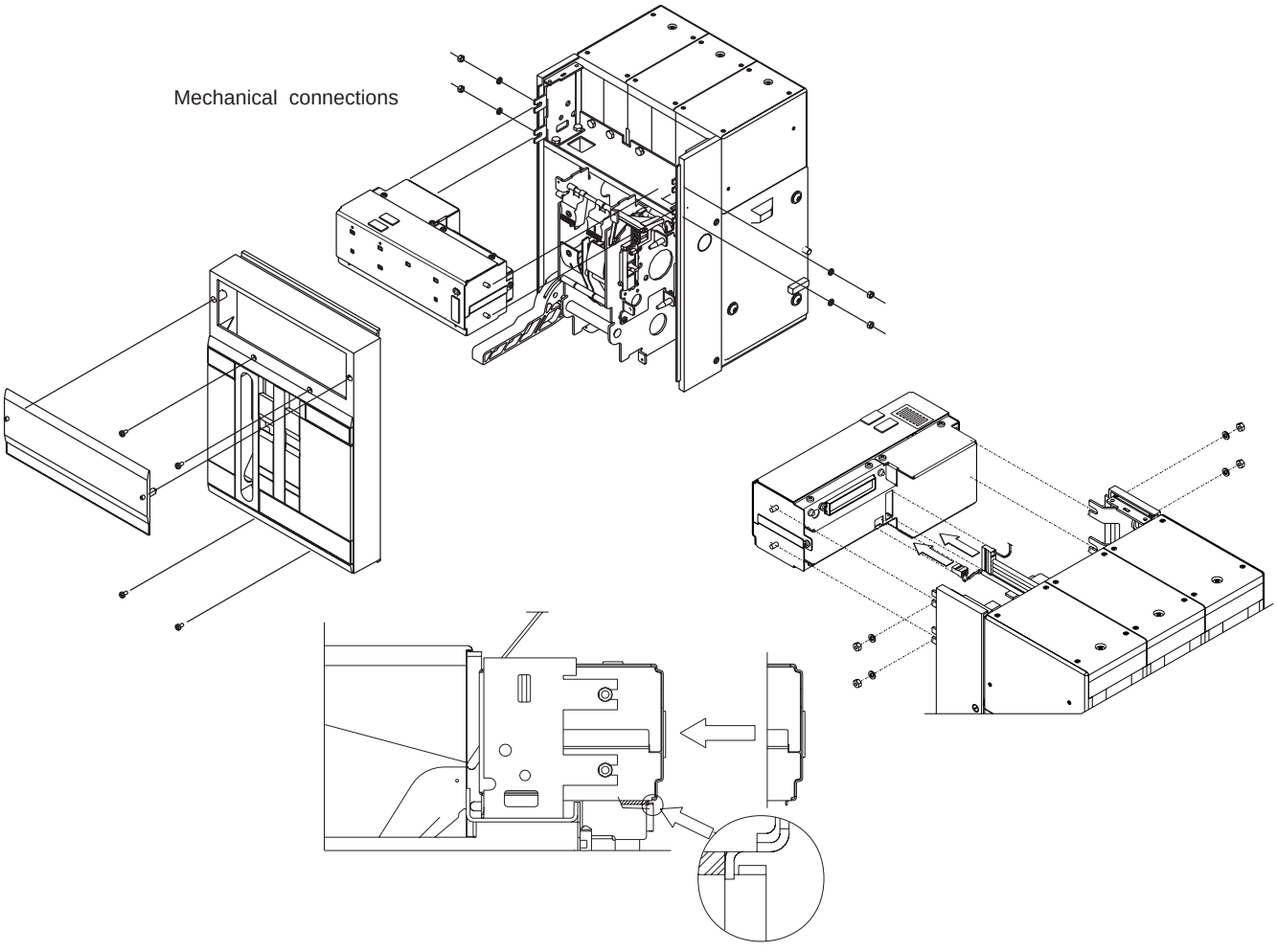


Fig. 34e

11.1 Safety notes

CAUTION: this symbol identifies information on the procedures, actions or circumstances which can lead to wounds or injuries of the personnel, damage to the unit or economic losses.

Read right through this manual carefully.
This device should only be used by qualified and competent personnel.

In case of any doubts regarding its safe use, the unit must be put out of service, ensuring that it is not used unintentionally.

It must be presumed that safe use is not possible if:
1. the unit shows visible damage.
2. the unit does not work (for example, with the auto-test or by means of the TT1 trip test unit).
3. the unit has undergone damage during transport.

11.1.1 Notes for dielectric strength tests

Dielectric strength tests are not allowed on the inputs and outputs of the trip units and on the VT eventually connected.

11.2 Abbreviations and various notes

11.2.1 Abbreviations

Abbreviation	Meaning
BA	Opening coil
BC	Closing coil
CB	Power circuit breaker (Power circuit breaker. For example, Emax)
CS	Current Sensor (also see CT)
CT	Current Transformer (also see CT)
Emax	ABB SACE Emax Series of air power circuit breakers
HMI	Human Machine Interface
HW	Hardware
In	Current transformer continuous current rating (CT) installed in the power circuit breaker
MT	Thermal memory
Pn	Power circuit breaker nominal power (3 * Vn * In)
Pn_{fase}	Nominal power of phase (Vn * In)
PR020/K	ABB SACE signaling unit
PR010/T	ABB SACE test unit
PR111/P-A	Protection trip unit for Emax power circuit breaker, UL version
PR112/P-A	Protection trip unit for Emax power circuit breaker, UL version
PR112/PDM-A	Protection trip unit for Emax power circuit breaker, UL version
PR113/P-A	Protection trip unit for Emax power circuit breaker, UL version
PR113/PDM-A	Protection trip unit for Emax power circuit breaker, UL version
PR120/B	ABB SACE power supply unit
Relè	Release Also called “Protection unit” or “Trip unit”
RMS	value
SA	Opening Solenoid
SdZ	Zone selectivity
SRE	Contact protection tripped (Trip unit tripped)
SW	Software
TA	Current transformer (also see CS)
Trip	Action of opening of the power circuit breaker, generated by trip unit
TV	Voltage transformer (also see VS)
Un	Rated voltage of voltage transformers installed (phase voltage)
Vaux	Auxiliary power supply
VS	Voltage Sensor (also see VT)

11.2.2 Various notes

A. For example, use two-wire “Belden” type cable (not supplied by ABB SACE) as described in ABB SACE RU4602.001 drawing.

B. For example, use three-wire “Belden” type cable (not supplied by ABB SACE) as described in ABB SACE RU4602.002 drawing.

C. The unit is fitted with “backup protection” function. Should the first command on the opening solenoid not immediately open the power circuit breaker (SA partially faulty), TRIP commands are sent repeatedly until the power circuit breaker opens (when Vaux is present) or until disappearance of the current (if under in self-supply). With Vaux present, in the “backup protection” condition, the “emergency LED flashes with the “Last Trips” page displayed, and the keyboard is disabled. The “backup” condition can be signaled by configuring the trip unit. By using the “YO back” selection, it is possible to control the accessory “opening coil (YO)” as a further opening device when the SA does not work.

12. SACE PR111/P-A trip unit – Identification

The PR111 units available according to the ANSI/UL Standards are:
- PR111/P-A (LI)
- PR111/P-A (LSI)
- PR111/P-A (LSIG)

12.1 Standard

PR111/P-A has been designed to work in accordance with the international standard:
Low voltage AC and DC power circuit breakers used in enclosures ANSI/UL 1066.

12.2 Specifications

12.2.1 General

The PR111 unit is a high performing self-supplied protection unit with **Protection, Watchdog and Test functions.**

The protections available are:

Protections available

Symbol	Protection against...
L	overload with inverse long time-delay
S	short circuit with adjustable delay
I	instantaneous short circuit
G	ground fault with adjustable delay
Iinst	ultrarapid instantaneous short circuit (for high currents)

The PR111 can be installed on three-pole, three-pole with external neutral or four-pole power circuit breakers.

It should be noted that the reference current, for the PR111, is the In (continuous current rating of the CTs mounted in the power circuit breaker) and not the Iu (uninterrupted continuous current rating of the power circuit breaker itself). Example: the E1B-A 800 power circuit breaker with 250 A CT, has an Iu of 800A and an In of 250 A.

The unit carries out opening of the power circuit breaker, in which it is integrated, by means of the SA which acts directly on the mechanical lever device of the apparatus.

The CTs supply both the energy for self-supply and the signal to calculate the current circulating in the power circuit breaker busbars to the trip unit. Operation with self-supply is guaranteed for any protection function and setting which can be defined by the user.

The unit is made using digital microprocessor technology and interfaces with the user by means of dipswitches. The protection parameters and in general the mode of operation of the unit can be completely set by the user.

12.2.2 Electrical characteristics

Nominal service frequency	50/60 Hz ±10%
Pass band	600 Hz max
Peak factor	2.1 max @ 2.8 In
MTBF	15 years @ 45°C

12.2.3 Self-supply

All the Protection functions (see par. 12.2.1) are operative without any external auxiliary power supply. In fact, self-supply is guaranteed from the CTs installed in the power circuit breaker.
Minimum busbar current for turning the trip unit on:
– 0.30xIn with single-phase current
– 0.20xIn with two-phase current
– 0.15xIn with three-phase current

12.3 Environmental characteristics

Operating temperature	-25°C ... +70°C
Storage temperature	-40°C ... +90°C
Relative Humidity	0% ... 98%
Degree of protection (with PR111 installed in the power circuit breaker)	IP 30

12.4 Protection functions

The PR111 protection unit carries out 5 independent protection functions. In particular:
1. Protection against overload with inverse long time-delay **"L"**;
2. Protection against short circuit with adjustable delay **"S"**;
3. Protection against instantaneous short circuit **"I"**;
4. Protection against ground fault with adjustable delay **"G"**;
5. Protection a fixed threshold against instantaneous short circuit **"Iinst"**;

The unit is fitted with "backup protection" function. Should the first strike on the opening solenoid not immediately open the power circuit breaker (SA partially faulty), TRIP commands are sent repeatedly until the power circuit breaker opens or until disappearance of the current.
The PR111 unit allows the neutral pole current signal to be processed with different relationships with regard to the value of the phases (see 12.9.1).

Two luminous indicators (LEDs) are provided on the front of the unit, which are activated during an alarm for protection "L" or "S". They are de-activated on ending of the alarm or when a protection has tripped.
For the protections with fixed time with adjustable delay, the relationship implemented is the following: t = k.
For the protections with inverse time, the relationship between trip time and overcurrent is given by the formula: t = k / I2.

RMS and Peak calculation
The protection allows the current signal to be processed in the following way:
- with rms value up to a current of 2xIn and with a peak factor ≤ 3 for protection function “L”
- with peak value for currents ≥ 2xIn and for protection functions “S”,”I” and “Iinst” (*).
- with mean value for ground fault protection function “G”.

If the waveform has a deformation above the declared limit (2.1 @ 2.8 In), the calculation tolerance of the true rms value will increase.

(*) Processing is carried out taking into account the peak value divided $\sqrt{2}$ (the sinusoidal wave form is therefore considered). This is because of incompatibility between the trip time and the rms value calculation time.

12.4.1 Protection “L”
Protection “L” is the only one which cannot be disabled since it carries out self-protection against overloads of the trip unit itself.

The type of curve settable is t=k/I² .
The trip time of the protection, inverse time, is given by the following expression:

$$\max\left[\ \frac{36\cdot t_1}{(I_f/I_1)^2}, 0.75\ \right] per\ I_f \le 12In\ ,\ 0.75\ \ per\ I_f > 12In$$

I_f is the fault current and I_1 is the protection threshold, set by the user.

NB: Time expressed in seconds.

12.4.2 Protection “S”
The protection, which can be disabled, can either be with fixed time (t=k) or inverse time (t=k/I2). In the latter case the trip time is given by the expression $\max\left[\frac{64\cdot t_2}{(I_f)^2},\ t_2\right]\ per\ I_f > I_2$ I_f is the fault current and I_2 the protection threshold, set by the user.

NB: Time expressed in seconds.

12.4.3 Protection “I”
The protection, which can be disabled, with fixed time (t=k) is carried out with nil intentional delay.

12.4.4 Protection “G”
The protection, which can be disabled, is of the inverse time type (t=k/I²).

The trip time is given by the expression $\max\left(\frac{0{,}6}{(I_f/I_4)^2},\ t_4\right)$ I_f is the fault current and I_4 the protection threshold, set by the user.

NB: Time expressed in seconds.

The PR111 unit is able to provide ground fault protection, carried out inside the trip unit, vectorially summing the phase and neutral currents. The fault current is defined by the following formula $\dot{I}_G = \dot{I}_1 + \dot{I}_2 + \dot{I}_3 + \dot{I}_{NE}$.

In the case when there is no fault in the circuit, the module of the sum of these currents is always nil. Vice versa, the value of the fault current will always take on a higher value depending on the size of the fault.

When the value of the phase current is above 4xIn, function “G” excludes itself since, in this case, there are other protections which intervene as the fault is considered to be a phase fault.

12.4.5 Protection against “Iinst” instantaneous short circuit
This function has a single protection curve with fixed time.
When the protection trips, the power circuit breaker opens by means of the opening solenoid (SA).

12.4.5.1 Selection of the threshold value

For correct setting of protection Iinst, linked to the size of the power circuit breaker, work on the 10 relative dipswitches located on the top part of the trip unit (see Figure 35), consulting the label placed to their side.

The protection, which can only be set by ABB personnel, cannot be excluded.

In the diagrams of the label relative to the settings, the position of the dipswitch is indicated by the white part.

In the diagram at the side, the dipswitch is set to the top position **(Off)**

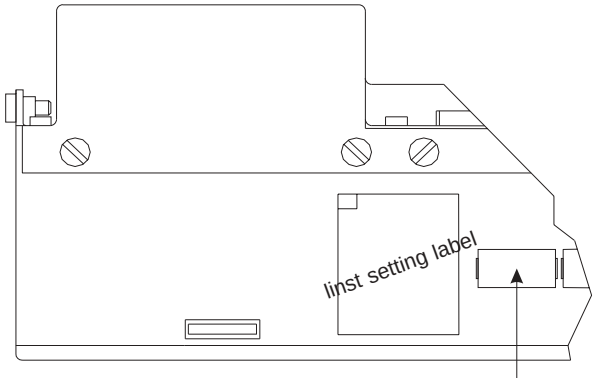


Fig. 35

Modification of the set threshold can lead to permanent damage of the power circuit breaker and of the installation itself, with consequent damage to the operator.

12.5 Other functions

12.5.1 Watchdog

Operation of the management circuits of the PR111/P-A, and the relative SW, are constantly monitored from a special control circuit (inside the microcontroller) in order to prevent it blocking during operation.

12.5.2 Simple test of the trip unit

Using the TT1 test unit (see par. 12.11.1) connected to the special dedicated test connector (see ref. G Fig. 36), it is possible to check correct operation of the activation chain (microprocessor, cabling and SA). In the case of a positive outcome, the power circuit breaker is opened. The function is only available with nil busbar current.

12.5.3 Complex test of the trip unit

Using the PR010/T test unit (see par. 12.11.2) connected to the trip unit by means of the front TEST connector (see ref. H Fig. 36), it is possible to carry out a complete series of tests, with reports which can be downloaded to a PC.

12.6 User interface

Caption for the front of the PR111unit:

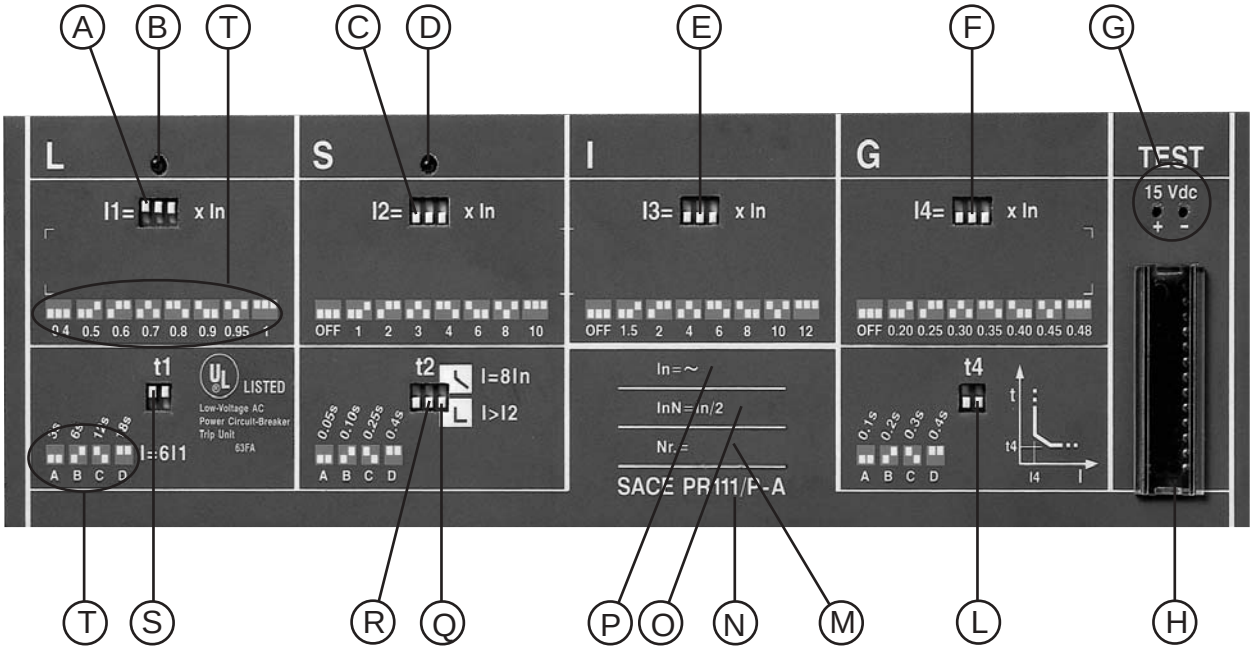


Fig. 36

Ref. Fig. 36	Description
A	Dipswitch for setting protection function “L” threshold
B	LED for signaling protection function “L” under timing.
C	Dipswitch for setting protection function “S” threshold
D	LED for signaling protection function “S” under timing.
E	Dipswitch for setting protection function “I” threshold
F	Dipswitch for setting protection function “G” threshold
G	TEST connection for application of the TT1 accessory.
H	TEST connector for application of the PR010/T accessory.
L	Dipswitch for setting the protection curve function “G”
M	Serial number of the unit.
N	SACE Logo identifying the product.
O	Setting the Neutral protection
P	In (Continuous current rating of the CTs installed).
Q	Dipswitch for setting the type of protection curve function “S”
R	Dipswitch for setting the protection curve function “S”
S	Dipswitch for setting the protection curve function “L”
T	Dipswitch setting diagram for setting the required value.

12.7 Default settings

The PR111/P-A is supplied by ABB SACE with the following preset parameters:

Default settings (preset by ABB SACE)

#	Protection	Threshold	Time	Curves
1	**L**	0.4 In	A (3s)	k/I^2
2	**S**	Off	A (0.05s)	k
3	**I**	2 In	—	—
4	**G**	Off	A (0.1s)	k
5	**Iinst**	E1 (*)	—	—
6	**Neutral sel.**	50% (°)	—	—

- (*) Parameters set with these values only for PR111 sold as a loose piece.
- (°) Setting can only be modified by ABB SACE

12.8 Putting into service

12.8.1 Connections

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

12.8.2 CT and SA connection check

If installation of the PR111 has been carried out by the user, before putting the power circuit breaker into service, it is advisable to check correct connection of the CT and/or SA cables, and if this has not been done, immediately open the power circuit breaker and make the connections.

12.8.3 Test

Before putting into service it is advisable carry out a test (“Trip test”) of the whole SA chain by using the TT1 accessory.
Positive outcome is shown by the power circuit breaker opening (see 12.5.2).

12.8.4 Initial settings

If the PR111 is supplied directly installed in the power circuit breaker, ABB SACE will see to applying the adhesive labels for all the variables relative to the power circuit breaker (e.g. Type of power circuit breaker, CT size, etc.). Vice versa, if the PR111 is supplied as a loose piece, it will be up to the user to apply the adhesive labels relative to all the necessary parameters.
It should be noted that ABB SACE defines each possible setting in a sensible way (see default parameters).

Apart from this, it is absolutely indispensable for the user to carefully define each modifiable parameter, before putting the PR111 into service.

12.9 Operating instructions/Service operation

12.9.1 Modification of basic configuration

It is possible to select the setting value relative to protection of the neutral conductor (percentage expressed according to the phase current). The selectable values are 50% and 100%. Modification must only be carried out by ABB SACE.

12.9.2 Modification of protection functions

This paragraph allows the user to set of the protection functions implemented in the PR111 unit. Here only the setting methods and which values are selectable are given. For all the other information regarding the technical characteristics of these protection functions, please see par.12.4.

No parameterization is allowed if the PR111 unit is in an alarm situation.

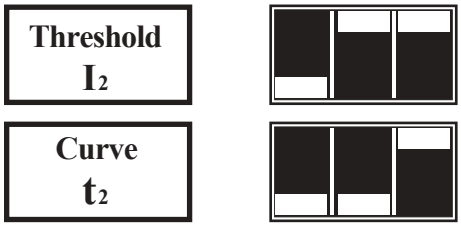
In the diagrams on the front plate (see ref. T Fig. 36), **relative to the settings, the position of the dipswitch is indicated by the white part.**

In the diagram at the side, the dipswitch is set in the top position

12.9.2.1 Example of setting

An example of setting the dip-switch of protection function S is given below, with:

- Trip threshold (I_2) ⇒ 2 x In
- Curve (t_2) ⇒ 0,05s (A) of type $t=k/I^2$



Protection	Disabling	Threshold		Time		Tolerance threshold (5)	Time Tolerance (5)
		Range	Values Selectable	Range	Values Selectable		
L (t=k/I²)	☐	0.4xIn ≤ I_1 ≤ 1xIn	0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 0.95,1	3s ≤ t_1 ≤ 18s (1) (2)	3 (A), 6 (B), 12 (C), 18 (D)	± 10% in accordance with ANSI37.17	± 10%, I_f ≤ 3xIn ± 20%, I_f > 3xIn
S (t=k)	☒	1xIn ≤ I_2 ≤10xIn	1, 2, 3, 4, 6, 8, 10 + Off	0.05s ≤ t_2 ≤ 0.4s (3)	0.05 (A), 0.1 (B), 0.25 (C), 0.4 (D)	± 10%	the best of the two data ± 20% o ± 50ms
S (t=k/I²)	☒					± 10%	± 20%
I (t=k)	☒	1.5xIn ≤ I_3 ≤ 12xIn	1.5, 2, 4, 6, 8, 10, 12 + Off	Instantaneous	--	± 20%	≤ 35ms I_f ≤ 3xIn ≤ 30ms I_f > 3xIn
G (t=k/I²)	☒	0.2xIn ≤ I_4 ≤ 0.48xIn	0.2, 0.25, 0.3, 0.35, 0.4, 0.45, 0.48 + Off	0.1s ≤ t_4 ≤ 0.4s (4)	0.1 (A), 0.2 (B), 0.3 (C), 0.4 (D)	± 10%	± 20%
Iinst	☐	Only settable by ABB		Instantaneous	--	± 5%	--

(1) The minimum value of this trip is 750ms regardless of the type of curve set (self-protection).
(2) The trip time t_1 is defined for $I_f=6I_1$
(3) The trip time t_2 is defined for $I_f=8$ In with $t=k/I^2$ or for $I_f > I_2$ with t=k
(4) The trip time t_4 is defined for If =4 In
(5) These tolerances are valid with the following hypotheses:
- trip unit self-supplied during service (without start-up)
- two-phase or three-phase power supply

For all cases not considered in the above hypotheses, the following tolerance values are valid:

	Trip threshold	Trip time
L	± 10% (according to ANSI 37.17 Standard)	± 20%
S	± 10%	± 20%
I	± 20%	≤ 60ms
G	± 15%	± 20%

12.9.3 Signals

12.9.3.1 Optical signals

Signal	Description
Led **Emergency** (red)	• Presence of one or more overloaded phases with current values of I>1.05xI1 (protection "L" timing) (on the NE, it depends on the selection made. For example, at 50% the values are halved); • Timing in progress for protection function "S"

12.10 Troubleshooting

The following table collects up a series of typical service situations, which are useful in order to understand and solve hypothetical faults or malfunctions.

N.B.:
1. Before consulting the following table, check any lighting up of the LEDs located on the front of the unit for some seconds.
2. FN indicates normal operation of the PR111.
3. In the case where the suggestions proposed do not lead to a solution of the problem, please contact the ABB SACE service assistance.

N°	Situation	Possible causes	Suggestions
1	It is not possible to carry out the trip test	1. The busbar current is > 0. 2. The SA is not connected 3. TT1 device battery flat	1. FN 2. Check the SA cabling 3. Replace the battery inside the TT1
2	Trip times lower than those expected	1. Threshold too low 2. Curve too low 3. Incorrect Neutral selection	1. Correct the threshold 2. Correct the curve 4. Correct the Neutral Selection
3	Trip times higher than those expected	1. Threshold too high 2. Curve too high 3. Curve I^2t inserted 4. Incorrect Neutral selection	1. Correct the threshold 2. Correct the curve 3. Exclude if not necessary 4. Correct the Neutral Selection
4	Rapid trip, with I3=Off	Iinst trip	FN with short circuit with high I
5	Earth I high, but there is no trip	Function G prevented with I>4 In	FN
6	It is not possible to modify any parameter	PR111 in alarm situation	FN

12.10.1 In the case of a fault

If it is suspected that the PR111 is faulty, shows malfunctions or has generated an unexpected trip, we recommend you strictly follow the indications below:
1. Note all the protection function settings.
2. Mark the type of power circuit breaker, number of poles, In and Serial Number (see Fig. 36)
3. Prepare a brief description of the opening (when did it happen? how many times? always under the same conditions? with what type of load? with what current? can the event be reproduced?)
4. Send/communicate all the information collected, together with the applicative circuit diagram of the power circuit breaker, to your nearest ABB Assistance.

The completeness and the accuracy of the information supplied to ABB Assistance will facilitate the technical analysis of the problem encountered, and will allow us to rapidly take all the useful measures to help the user.

12.11 Accessories

12.11.1 ABB SACE TT1 simple test unit

The SACE TT1 device is a test unit to be inserted in the special front TEST connector of the PR111 (see ref. G Figure 36). With this accessory, supplied as standard, it is possible carry out the opening test of the power circuit breaker (“Trip test”) (see 12.8.3).
The unit is fitted with a 12V battery and does not therefore require any external power supply.
The item has two pushbuttons (one for PRESET and the other for TRIP) and an LED (READY) indication.

The accessory operates in the following way:
- Press the PRESET pushbutton and wait for the READY LED to light up
- Position the TT1 in the protection unit
- Within 30s from the PRESET operation press the TRIP pushbutton.
- Check the opening of the power circuit breaker.

When the READY LED does not light up it means that either the battery is flat or that the TT1 is faulty.

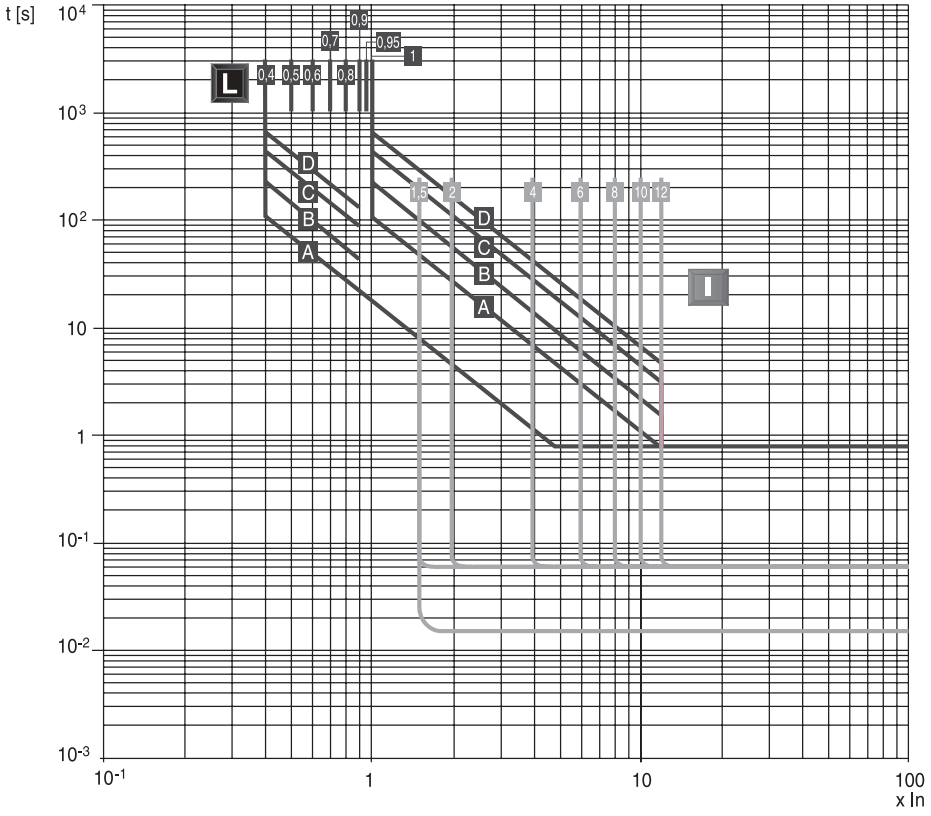
12.11.2 ABB SACE PR010/T complex test unit

By means of a cable connected to the front TEST connector of the PR111 (see ref. H Figure 36), the test with the SACE PR010/T unit allows correct operation of the inputs, outputs, thresholds and trip times of protection functions “L”, “S”, “I”, “G” and “Iinst” to be checked manually or automatically.
It is also possible to obtain a test report which can be downloaded to a PC.
For operation of the PR010/T accessory, please consult the special instruction manual.

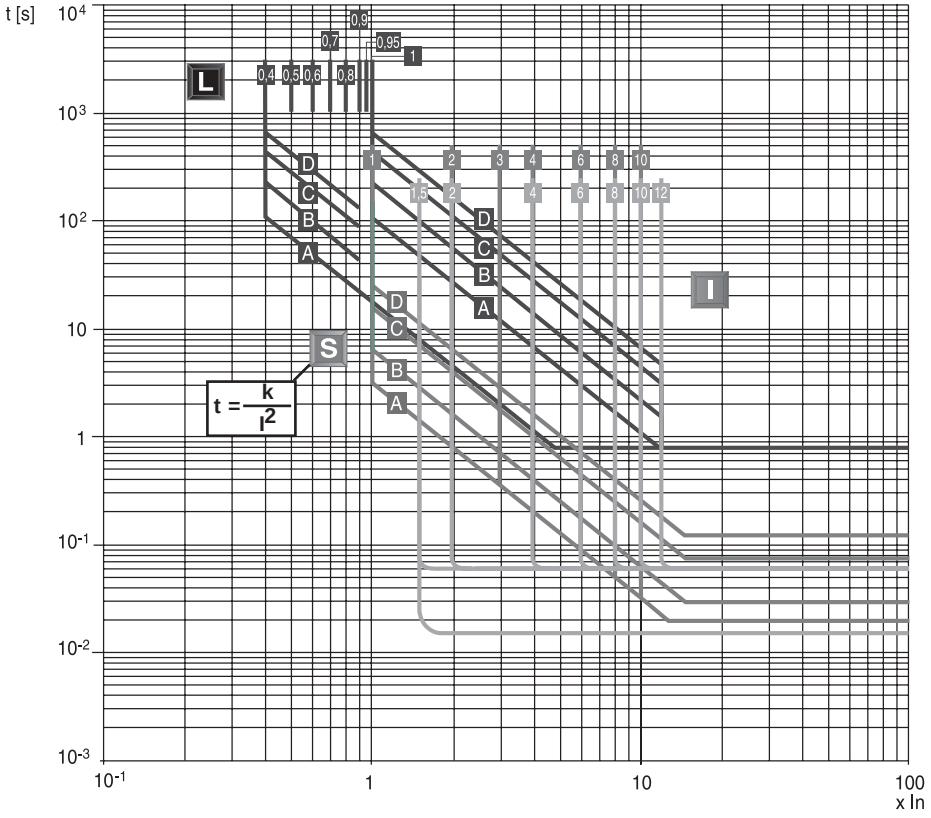
12.12 Trip curves

The trip curves given are indicative and only show a sub-group of the possible selections (see par. 12.9.2.1).

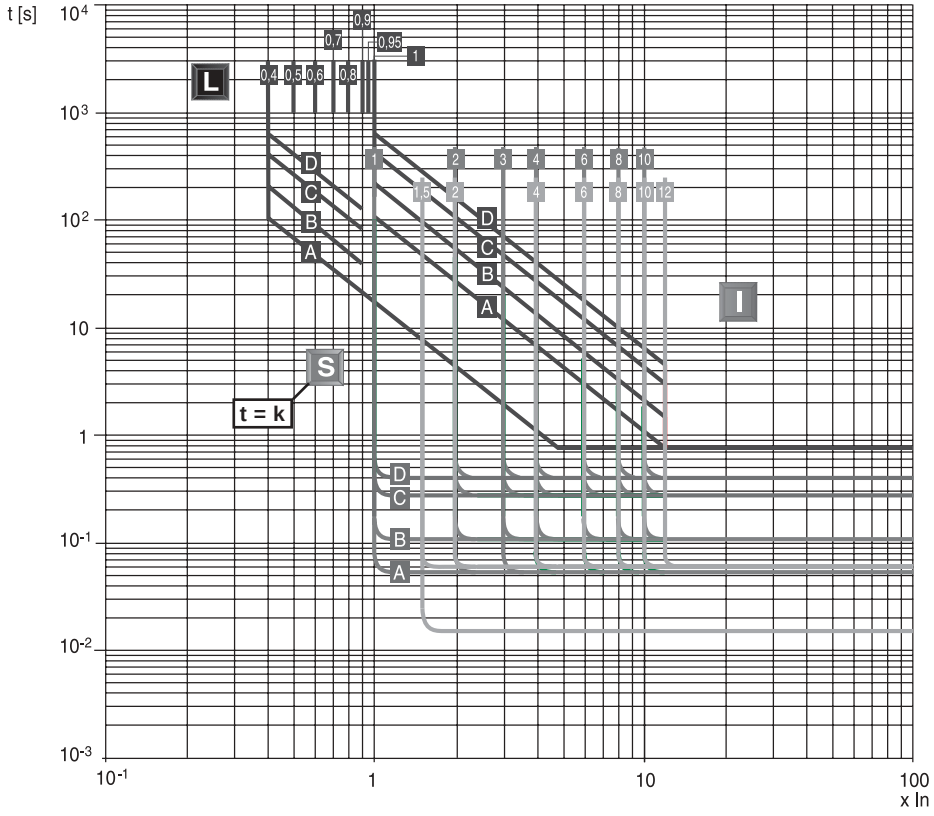
12.12.1 Trip curves of functions L-I



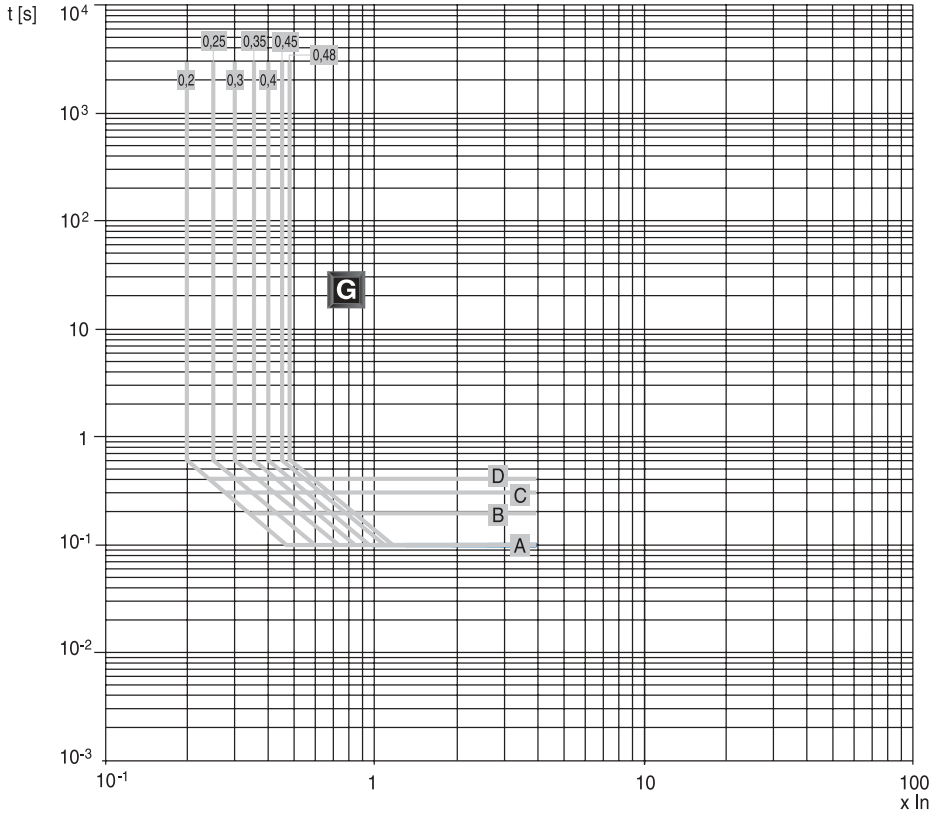
12.12.2 Trip curves of functions L-S-I



12.12.3 Trip curves of functions L-S-I



12.12.4 Trip curves of function G



13. SACE PR112/P-A trip unit – Identification

The PR112 units available according to the ANSI/UL Standards are:

- PR112/P-A (LSI)
- PR112/P-A (LSIG)
- PR112/PD-A (LSI fitted with communication card).
- PR112/PD-A (LSIG fitted with communication card).

13.1 Standard

The PR112 /P-A has been designed to work in accordance with the following international standard:
Low voltage AC and DC power circuit breakers used in enclosures ANSI/UL 1066.

13.2 Specifications

13.2.1 General

The PR112 unit carries out the **Protection, Measurement, Watchdog, Signaling, Test, Power circuit breaker Control, Communication** and Storage functions for low voltage 'EMAX' series air three-pole and four-pole power circuit breakers. The protections available are:

Table 1 Protections available

Symbol	Protection against ...
L	overload with inverse long time-delay
S	short circuit with adjustable delay
I	instantaneous short circuit
G	ground fault with adjustable delay
U	phase unbalance (signalling only)
OT	temperature out of range
K	load control
Iinst	ultra rapid instantaneous short circuit (for high currents)

The protections can be made in three-phase or three-phase with neutral mode according to of the type of power circuit breaker used (three-pole, three-pole with external neutral or four-pole). The unit is made using electronic digital technology and interfaces with the user with an alphanumerical display and membrane control keyboard. The protection parameters and in general the operating method of the unit are completely programmable by the user in 5 different languages.
The unit carries out opening of the power circuit breaker in which it is integrated by means of the SA, which acts directly on the mechanical operating mechanism of the apparatus.

13.3 Electrical characteristics

Nominal operating frequency	50/60 Hz ±10%
Pass band	600 Hz max
Peak factor	2.1 max @ 4 In
MTBF	15 years @ 45°C

13.3.1 Self-supply

All the protection functions are operational without an external auxiliary power supply. In fact, self-supply is guaranteed by the CT installed in the power circuit breaker.
Minimum busbar current for turning the trip unit on:
– 0.35xIn with single-phase current (0.50xIn for turning the display on as well)
– 0.20xIn with two-phase current (0.30xIn for turning the display on as well)
– 0.15xIn with three-phase current (0.20xIn for turning the display on as well)

The display lighting up time is about 3 s.

13.3.2 Auxiliary power supply

The unit operates regularly under self-supply, i.e. guaranteeing the configuration and protection of the power circuit breaker controlled.
When there is an auxiliary power supply, supplied by a galvanically separate converter, it is also possible to use the unit with the power circuit breaker open or with the power circuit breaker closed but with insufficient current to supply the device. Furthermore, the display is rear-lit, allowing data readout even in the dark. The PR112 time for reaching service operation, from the moment of connection of the Vaux is about 3 s.

Since a round-insulated Vaux is required, it is necessary to **use "galvanically separate converters"** complying with the IEC 60950 (UL 1950) Standards or their equivalent [which guarantee a common mode current or leakage current (see IEC 478/1, CEI 22/3) not higher than 3.5mA], IEC 60364-41 and CEI 64-8.

Characteristics	PR112/P-A version
Power supply voltage	24V DC ±20%
Maximum ripple	5%
Inrush Current @ 24 V	~3A for 30ms
Start-up Current @ 24 V	~1.0A for 150ms
Continuous current rating @ 24 V	~125mA
Nominal Power @ 24 V	~3W

13.4 Environmental characteristics

Operating temperature	-25°C ... +70°C
Storage temperature	-40°C ... +90°C
Relative Humidity	0% ... 98% with condensation
Degree of protection (with PR112 inserted in the circuit breaker)	IP 30

13.5 Inputs/outputs

13.5.1 Binary opto-insulated inputs
– **K51/S or G Zin:** Input SdZ S or G

13.5.2 Binary opto-insulated outputs
– **K51/S or G Zout:** SdZ S output or G

13.5.3 Output contacts
– **K51/p1:** relay output programmable by the user
– **K51/μP:** relay output for signalling microprocessor faulty
- Monostable contacts, only active when there is Vaux;
- Maximum changeover current: 3A – 250V AC (0.2A – 100V DC).
- Contact-contact insulation voltage: 1000V AC

– **K51/Y01**: relay output for signalling “release tripped”
- Bistable contact, also active in self-supply;
- Maximum changeover current: 0.5A – 125V AC (0.3A – 110V DC)
- Contact-contact insulation voltage: 750V AC

13.6 Communication bus

RS485 internal bus, 19,200 bps baud rate, ABB SACE protocol.

13.7 Protection functions

In the most complete configuration, the PR112 protection unit carries out six independent protection functions. In particular:

- Protection against overload with inverse time **“L”**
- Protection against short-circuit with adjustable delay **“S”**
- Protection against instantaneous short-circuit **“I”**
- Protection against earth fault with adjustable delay **“G”**
- Protection a fixed threshold against instantaneous short-circuit **“linst”**
- Protection against overtemperature **“OT”**
- **“K”** load control protection

Two functions (“K”) are also carried out for distinct control of loads: these are two predefined curves with threshold currents and trip times lower than those selectable with protection “L”, which can be used for two different applications:
1. disconnection of two distinct loads;
2. connection and disconnection of a load

These protections allow single loads to be disconnected before the protection for overload “L” intervenes to definitively open the circuit-breaker. This function is only available when there is an auxiliary power supply and when there is the external PR020/K signalling unit.

The protection allows current signal processing of the neutral pole in the following way:
1. at 50% of the phase value
2. at 100% of the phase value

The threshold values of protection functions “L”, “S”, “I” and “G” are indicated by I_1, I_2, I_3 and I_4 respectively, whereas the relative trip time is indicated by t_1, t_2, t_3 and t_4.

There is an indication on the display of the unit which is activated during an overload. This is disabled when the overload is finished or a protection has tripped. Furthermore the circuit-breaker opens by means of the opening solenoid (SA), closes with the electrical protection tripped (K51/Y01) and the corresponding yellow magnetic flag.

For the protections with fixed time with adjustable delay, the relationship implemented is the following: t = k

For the protections with inverse time, the relationship between trip time and overcurrent is given by the formula: t = k/I2

Rms and peak calculation
Protection functions “L, S and G” carry out the relative processing on the base of the true rms value of the secondary currents of the CT up to 6 In (protection G is disabled for currents higher than 4 In). For currents higher than 6 In, and for function “I”, the processing is carried out taking into account the peak value divided by $\sqrt{2}$, then the sinusoidal wave form is considered. This is because of incompatibility between the trip time and the calculation time of the rms value.

13.7.1 Protection “L”

Protection “L” is the only one which cannot be disabled since it carries out self-protection against overloads of the release itself.
The trip time, inverse time, of the protection is given by the expression

$\max\left[\frac{9 \cdot t_1}{(I_f / I_1)^2}, 0.75 \right]$ for $I_f \leq 12 In$, $0.75 s$ for $I_f > 12 In$ where I_f is the fault current and I_1 is the protection threshold.

NB: Time expressed in seconds.

13.7.1.1 Thermal memory "L"

It is possible to enable the thermal memory function for cable protection. This is based on the "tL" parameter defined as the trip time of the curve (t1) at 1.25xI1.
The trip time of the release is certainly 100% of the one selected after which a time of tL has passed from the last overload or from the last trip. Otherwise the trip time will be reduced depending on the overload which has take place and on the time which has passed.

The PR112 is fitted with two instruments to make this thermal memory. The first only works when the release is supplied (it remembers overloads which did not last long enough to cause intervention of the release), whereas the second works even when the release is not supplied (it reduces any trip times when there is immediate reclosing).
It is the PR112 release which automatically decides which of the two to use according to the various different situations.

13.7.2 Protection "S"

The protection, which can be disabled, can be either with fixed time (t = k) or with inverse time. In the latter case, the trip time is given by the expression

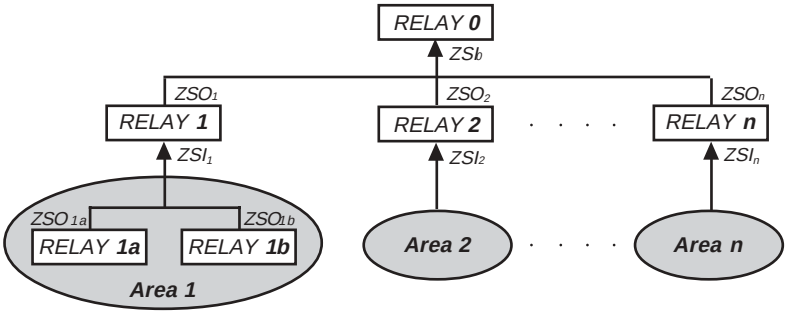
$\max\left[\frac{100 \cdot t_2}{(I_f)^2},\ t_2\right]$ for $I_f > I_2$ where I_f is the fault current and I_2 the protection threshold. NB: Time expressed in seconds.

13.7.2.1 Thermal memory "S"

It is possible to enable the thermal memory function for cable protection when the inverse time curve is selected. This is based on the parameter "tS" defined as the trip time of the curve (t2) selected at 1.5xIn. The other characteristics are the same as those for thermal memory "L".

13.7.2.2 Zone selectivity "S"

By means of the keyboard, it is possible to enable or disable the zone selectivity function "S".
This is done by connecting together all the zone selectivity outputs (ZSO) of the releases belonging to the same zone and taking this signal to the zone selectivity input (ZSI) of the release immediately to the supply side.
If the cabling operation has been done correctly, all the zone selectivity inputs of the last circuit-breakers in the chain and all the outputs of the circuit-breakers at the head of each chain must be empty.



The zone selectivity function allows the fault area to be isolated, only isolating the installation at the level closet to the fault, keeping the rest of the installation operative.
This means that a fault on the load side of "Relay 1a" will be isolated by the latter without "Relay 1" and "Relay 0" intervening. A fault just to the load side of "Relay 1" will be isolated by the latter without "Relay 0" intervening, guaranteeing that Areas 2…n remain active.

Cabling of zone selectivity "S" is alternative to the one for "G" and operation is only guaranteed when there is an auxiliary voltage.
The ZSI signal can be connected up to 20 units in parallel (to the relative ZSO signal).
The ZSO unit can be connected to a maximum of 3 ZSI relays on the supply side in the selectivity chain.

The maximum length of the cabling for zone selectivity, between two units, is 300 meters.
Use corded shielded two-wire cable (see note A to par. 11.2.2).
The shield must only be earthed on the circuit-breaker of the supply side relay (ZSI side).

13.7.3 Protection "I"

The protection, which can be disabled, is made with intentional delay nil.

13.7.4 Protection G

It is possible to disable the trip control of function G (Trip: Off).
For the whole duration of the earth fault, circuit-breaker opening does not take place, but only the alarm conditions is signalled (Emergency LED lit and alarm message).

The PR112 unit is able to provide two different types of protection against earth fault.

13.7.4.1 Protection G with internal toroidal transformer

The first is carried out by means of passage of all the secondary currents (coming from the CTs) to the inside of a toroidal transformer (contained in the unit itself) which induces a current proportional to the fault current of the primary circuit on its secondary winding.
The fault current is defined by the following formula:

$\overline{Ig} = \overline{I1} + \overline{I2} + \overline{I3} + \overline{In}$ (Vectorial sum of all the phase currents and neutral)

In the case when the circuit does not have any fault, the module of the sum of these currents is always 0, vice versa the value of the fault current will always take on a larger value depending on the size of the fault.
To work in this mode, it is necessary set Tor.selec.:Int.

13.7.4.2 Protection G with external toroidal transformer "Source Ground Return"

The second, also called "Source Ground return", can be carried out when there is the need to check operation of a machine (transformer or generator or motor etc.) which has star configuration of the windings.
The protection is carried out by physically positioning an external toroidal transformer on the cable connected from the star centre of the machine to the earthing connection point.
The induced current on the winding of the toroid is proportional to the fault current which in this case transits exclusively in the above-mentioned toroid.
To work with this mode it is necessary to set Tor. selec.:Ext.

The external toroid must be connected to the PR112 by means of a corded shielded two-wire cable (see note A to par. 11.2.2) with a length not exceeding 15m . The shield must be earthed both on the circuit-breaker side and on the toroid side.

It is indispensable for the star centre to be connected openly to earth and that this is not also used as a neutral conductor (as in the TNC system), making a protection according to the TT system.

The nominal values of the current sensors available are given in the table on page 48.

In single-phase self-supply, protection G is only active if the primary current is higher than 0.4 x In. When the phase current value is above 4 x In , function "G" excludes itself since in this case there are the other protections which intervene as the fault is considered a phase fault.

13.7.4.3 Zone selectivity "G"

By means of the keyboard, it is possible to enable or disable the zone selectivity function "G".
Cabling of zone selectivity "G" is alternative to the one for "S" and operation is only guaranteed when there is an auxiliary voltage.
The other characteristics are the same as those for zone selectivity "S".

13.7.5 Signal of phase unbalance "U"

The signal, which can be excluded, generates a warning message in the case when unbalance between two or more phases higher than the set threshold **I6** is determined.

The percentage of unbalance is calculated as follows $\%Sbil. = \frac{I_{max} - I_{min}}{I_{max}} \cdot 100$, where I_{max} is the maximum and I_{min} min the minimum phase current.

13.7.6 Protection against overtemperature inside the "OT" release

A sensor which monitors the temperature inside the unit is placed inside the PR112 unit.
This allows signalling of the presence of abnormal temperatures, which could cause temporary or continuous malfunctions of the microprocessor.

This protection has two alarm levels:

– On exceeding the first fixed threshold at 70°C, there is a prealarm signal, when there is auxiliary voltage the rear illumination of the display is disabled.
– On exceeding the second fixed threshold at 85°C, there is an alarm signal and circuit-breaker opening if the "OverTemper Trip" function is enabled.

13.7.7 Load control "K"

This function is carried out in combination with the accessory PR020/K signalling unit and the PR112 release is operating with Auxiliary Power Supply.

There are two distinct protection curves with threshold currents and trip times lower than those selectable with protection L, which can be used for the following two applications:

1. <u>disconnection of two distinct loads</u> (2 curves with inverse time t=k/I²);

2. <u>connection and disconnection of a load</u> (curve with adjustable delay t=k for connection and with inverse time t=k/I² for disconnection)

These protections allow single loads to be connected/disconnected before the protection for overload L intervenes to definitively open the circuit-breaker.

13.7.7.1 Disconnection of two loads

Ic1 = load n°1 disconnection threshold
Ic2 = load n°2 disconnection threshold

t (Ic1) = load n°1 disconnection time (minimum trip time:190ms)
t (Ic2) = load n°2 disconnection time (minimum trip time: 375ms)

The protection is **excludable,** for both the loads individually, by selecting the [Off] value for the threshold.

***<u>Functionality</u>*:**
The two protections use trip curves similar to those used by protection "L", but with lower thresholds and shorter times.
The trip curves to be used are those of protection "L". No thermal memory is foreseen.

The opening command to load n°1 is sent when I > Ic1 (for the time curve).
At this point the protection is disabled and a message appears for “load 1 open”.

The opening command to load n°2 is sent when I > Ic2 (for the time curve).
At this point the protection is disabled and a message appears for “load 2 open”.

To re-enable the protections on load n°1 (or n°2) to operate, it is necessary to press the “reset” key on the current page.

13.7.7.2 Connection - Disconnection of a load

Ic1= load n°1 connection threshold
Ic2= load n°1 disconnection threshold

t (Ic1) = waiting time for reconnection of the load
t (Ic2) = waiting time for disconnection of the load

The protection is **excludable,** for both the checks, by selecting the [Off] value for the threshold.

Functionality:

The disconnection protection uses trip curves similar to those used by protection “L”, but with lower thresholds and shorter times.
The trip curves to be used are those of protection “L”.
No thermal memory is foreseen. Operation with thermal memory “L” connected could cause abnormal behaviour.

For reclosing, adjustable tc1 fixed time timing is applied.

The closing control for load n°1 is sent when I < Ic1 (for the fixed time set with tc1).

The opening control for load n°1 is sent when I > Ic2 (for the time curve). At this point the protection is disabled and a message appears for “load 2 open”.

To re-enable operation of the protection on load n°1, it is necessary to press the “reset” key on the current page.

“Num.AR” indicates the number of load reclosing operations carried out.

“MaxAR” indicates the maximum number of reclosing operations which can be carried out (settable values: 1...9 reclosing operations, step 1 reclosing)
When “Num.AR = MaxAR”, reclosing is disabled (a message appears for “auto-reclosing disabled”).
To re-enable it, it is necessary to reset the **“Num. AR”** (entering “edit” mode on the protection setting page).

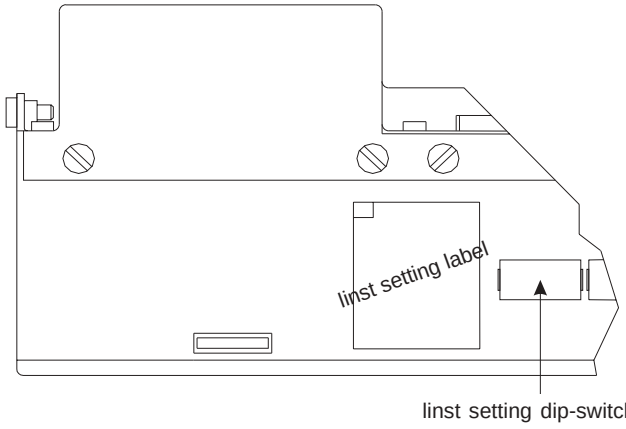
13.7.8 Protection against instantaneous short-circuit “Iinst”

This function has a single protection curve with fixed time.
When the protection trips, the circuit-breaker opens by means of the opening solenoid (SA).

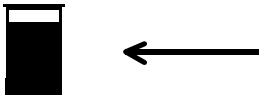
13.7.8.1 Selection of the threshold value

To set the Iinst protection correctly, linked to the size of the circuit-breaker, work on the relative 10 dip-switches located on the part above the release (see figure), consulting the label placed at its side.

The protection, which can only be set by personnel ABB, cannot be excluded.



In the label diagrams relative to the settings, the position of the dip-switch is indicated by the white part.



In the diagram,
the dip-switch is set in the
top position (**Off**)

The modification of the setted threshold may cause permanent damages to the circuit breaker itself and the plant with conseguent harms to the operator

13.8 Warning functions

13.8.1 Warning Threshold

When the maximum current (phase or neutral) exceeds the 0.9*I1 threshold (where I1 is the set threshold of function L) the “warning” LED is lit and the warning message is displayed (see par. 13.17).

13.8.2 Harmonic distortion

The PR112 unit signals that a peak factor above 2.1 has been exceeded (see par.13.7.1) with a warning message (see par. 13.17) and the “warning” LED lighting up (remember that the IEC 60947-2 annex “F” foresees that the protection unit functions regularly with a peak factor of ≤ 2.1, up to 2x In).

13.9 Measurement functions

13.9.1 Current measurements

The PR112 unit is always able to provide measurement of the currents in the three phases, in the neutral and for ground fault (ammeter function), both with self-supply and with auxiliary power supply.

The "……A" indication corresponds to a current reading under the measurable minimum.
The "—— A" indication corresponds to disabling of current measurement (greater than 4 In for ground fault).

The ground fault current takes on two different meanings according to whether the internal "Ground Fault" toroid or the external "Ground Source Return" one is selected.

The minimum value of current measurable is 0.1 In (10% of the nominal).

The maximum value of current measurable is 16 In.

In Range	0.3....6.0In
Measurement precision	5%

13.10 Information functions

13.10.1 Software version

Whenever it is necessary to notify ABB SACE of operating problems with the unit, it is advisable to indicate the **SW** version of the PR 112 unit.

ABB SACE	Heading
PR112/P-A Sw : x.xx	Software version of the PR112 unit/P-A

13.10.2 Opening data storage

The function of opening data storage ("TRIP" = opening for protection) is only active when there is an Auxiliary power supply before, during and after (for at least 1 sec.) any opening of the power circuit breaker due to trip for protection by the trip unit.

The function and also consultation of the page which shows the last data stored are therefore only **available when there is an auxiliary power supply.** In self-supply, the attempt to access the page makes a "function not available" message appear.

The percentage of contact wear is indicative of the electrical life of the EMAX power circuit breaker electrical contacts.

The functionality of the trip unit is not in any way modified by the presence of the wear messages. The alarm message indicates that it is necessary to check the state of contact wear.

The percentage of wear depends on the number of openings carried out by the power circuit breaker and on the absolute current interrupted during each of these.

13.10.2.1 Display of opening data

N°Open:xxxxx x PROT	Number of openings due to protections L, S, I and G and T for the PR112/P-A versions.
L1:xxxxxA L2:xxxxxA	Value of the currents interrupted during the last TRIP on L1 and L2
L3:xxxxxA Ne:xxxxxA	Value of the currents interrupted during the last TRIP on L3 and Ne
Wear:xxx% Gr:xxxxxA	Contact wear and ground fault current (only for versions LSIG)

In the case of trip for Iinst, the following page is displayed (without the values of the interrupted currents):

N°Open:xxxxx I PROT	Total number of openings carried out up to now by the power circuit breaker
Short circuit	Indication of trip against short circuit
Current > Icw	
Wear:xxx%	Contact wear

13.11 Other functions

13.11.1 Contact programming K51/p1

The PR112 is fitted with a trip unit, whose contact is called K51/p1.
This can signal different situations, selectable by the user among those listed in the following table.

Table 4. Values selectable for K51/p1 trip unit

Event	Description
“ L preal. ”	Prealarm + timing protection “L”
“ L timing ”	Timing protection “L”
“ S timing ”	Timing protection “S”
“ G timing ”	Timing protection “G”
“ G alarm ”	Alarm protection “G”
“ L trip ”	Opening by protection “L”
“ S trip ”	Opening by protection “S”
“ I trip ”	Opening by protection “I”
“ G trip ”	Opening by protection “G”
“ T trip ”	Opening by protection “T”
“ T >70°C ”	Internal temperature higher than 70°C
“ T >85°C ”	Internal temperature higher than 85°C

13.11.2 Watchdog

The PR112 unit provides some Watchdog functions able to guarantee correct management of any trip unit malfunctions.
In particular, the watchdog signal of the microprocessor is constantly monitored, generating an alarm signal when there is an operating anomaly (LED lighting up and µP Fault contact closure).

13.11.3 Self-test

The PR112 unit is able to monitor correct operation of:

- Microprocessor and SA with the **Trip Test** function.

This is carried out by means of the TEST pushbutton on the front panel following enabling from the Test Menu: in the case of a positive result, the power circuit breaker is opened.
This function is always guaranteed when there is self-supply (I>0.35 In single-phase) or auxiliary power supply.

- User interfacing devices with the **Self-test** function.

This is carried out by means of selection from the Test Menu: in the case of a positive result, correct operation of the following is verified:
- Display (all the pixel of the matrix light up)
- LEDs (4)
- Magnetic Flags (4 or 5 for LSIG version)
- Prealarm, Relay tripped and µPfault contacts

This function is guaranteed when there is an auxiliary power supply or in self-supply with at least 0.5 In single-phase: in the case of Warning or Emergency, the test is immediately abandoned, always guaranteeing all the protection function.
By pressing the “RESET” key the test is interrupted.

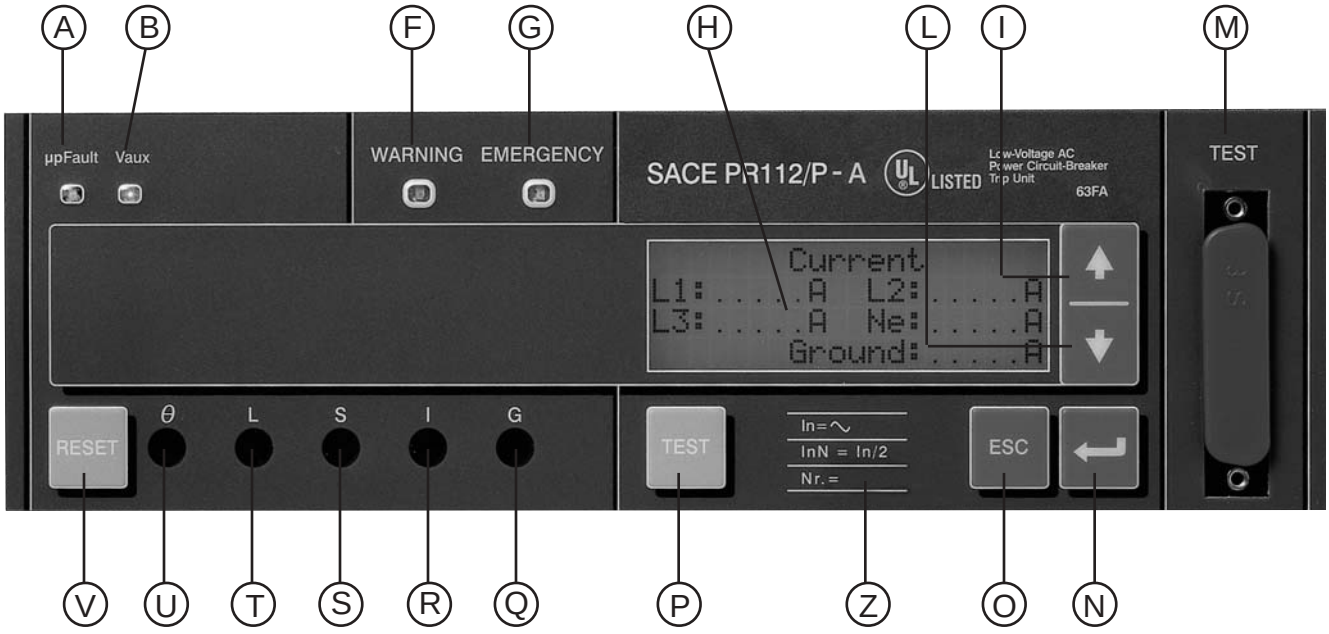
In all cases where there is no self-supply and/or auxiliary power supply, the energy can be supplied from the accessory PR120/B power supply unit (connected to the front test connector).

Following the instructions given under the “User interface” chapter, show on the display:

PR112 Tests	Heading
Trip Test : xxx	Select whether to enable the Trip Test function
Auto Test : xxx	Select whether to enable the Self-test function

13.11.4 Complex test of the trip unit

Using the PR010/T test unit (see par. 13.18.1) connected to the trip unit by means of the front multipin TEST connector, it is possible carry out a complete series of tests.



Caption to the front of the PR112 unit :

A	“µP Fault” LED
B	“Vaux” LED
F	“WARNING” LED
G	“EMERGENCY” LED
H	Rear-lit alphanumerical display
I	Pushbutton for moving the cursor (UP)
L	Pushbutton for moving the cursor (DOWN)
M	TEST connector for application of the PR120/B or PR010/T accessory
N	Pushbutton to allow data entry or page change (ENTER)
O	Pushbutton for exiting the sub-menus or for canceling (ESC)
P	Pushbutton to carry out release of the opening solenoid (TEST) + adjustment functions

Q	Magnetic signaling indicating ground fault “G” protection tripped
R	Magnetic signaling indicating instant. short circuit “I” protection tripped
S	Magnetic signaling indicating select. short circuit “S” protection tripped
T	Magnetic signaling indicating overload “L” protection tripped
U	Magnetic signaling indicating overtemperature “θ” protection tripped
V	Pushbutton to carry out reset of the magnetic and electrical signals (RESET) + end the Auto-Test + return to the currents page from the Trip page
Z	Serial Number of the unit

Alphanumerical display of the LCD type with 4 lines with 20 characters each, and which is rear-lit when auxiliary voltage is present. It is possible to adjust the contrast.

Each time the unit is activated, the display indicates the following page:

CURRENT	
L1:xxxxxA	L2:xxxxxA
L3:xxxxxA	Ne:xxxxxA
(*) Ground:xxxxxA	

(*) Indication only displayed in the case of PR112 unit/LSIG trip.
The “……A” indication corresponds to a current reading under the measurable minimum (0.1In).
The “—— A” indication corresponds to disabling of current measurement (ground fault).

Any “alarm” or “error” messages are displayed on the first line of this page. When there are more than one of these, they are displayed cyclically, one each second, on the first line. By pressing the ↵ key, it is possible to block message scrolling at the one currently displayed (the symbol “←” appears in the right-hand corner of the line). The various messages can therefore be scrolled through one at a time by using the “↓” key. To reset automatic updating, press the ↵ key again (the symbol “←” disappears).

13.12.1 Use of pushbuttons

The variables described by the letters xxx, can be compiled using the ↑ or ↓ keys and confirming them with the ↵ key.
Basically, once you have entered the page you are interested in, moving from one size to the other can be done by using the ↑ or ↓ keys. On the other hand, to change a size, once the cursor is placed over the size itself, the ↵ key must be pressed and then it becomes possible to modify the parameters (the '→' symbol appears on the left of the parameter) by means of the ↑ or ↓ keys. Confirmation of the parameter is carried out by means of the ↵ key.

In the case where repeating programming of a parameter which has just been configured is necessary, it is sufficient to press the **ESC** key just once and the display cursor will go back to the same line of the page selected, otherwise to return to the main menu it is necessary to press the **ESC** key twice.

The **RESET** pushbutton must be used to reset the yellow magnetic flags and the contacts of the signaling trip unit.

The **TEST** pushbutton must be used to carry out the Trip test (see par. 13.11.3)

13.12.2 Read and Edit modes

The map relative to the menus displays all the pages obtainable and the movements to be carried out with the keyboard, in the "READ" mode (just for data readout) or in the "EDIT" mode (for setting the protection parameters).

In the case when the page displayed is the one of the main menu or of other sub-menus, two different operating ways can be obtained, depending on the state of the unit:

1. "READ":
the page relative to the currents will be displayed automatically after about 120 seconds
2. "EDIT":
the page relative to the currents will be displayed automatically after about 240 seconds

The functions allowed according to the state are :

"READ":
- ✓ Consultation of the current measurements
- ✓ Consultation of the unit configuration parameters
- ✓ Consultation of the protection parameters
- ✓ Consultation of the protection unit information

"EDIT":
- ✓ Everything allowed in READ mode
- ✓ Configuration of the unit
- ✓ Programming the parameters relative to the protections
- ✓ "TEST" pushbutton enablement

13.13 Default settings

The ABB SACE PR112 is supplied with the following predefined paqrameters:

#	Protection	On/Off	Threshold	Time	Curve	T.M.	ZS
1	**L**	—	1 In	144 s	I^2t	Off	—
2	**S**	Off	6 In	min	K	—	Off: 0.04s
3	**I**	On	4 In	—	—	—	—
4	**G**	Off	0.2 In	0.4 s	K	—	Off: 0.04s
5	**U**	Off					
6	**OT**	Off					
7	**Iinst**	On	E1 (*)	—			
8	**Language**	—	Eng				
9	**Net Frequency**	—	60 Hz				
10	**PR020/K unit**	Off					
11	**Neutral sel.**	—	50 %				
12	**Toroid Selec.**	—	Int.				
13	**CB**	—	E1B-A800 (*)				
14	**CS In**	—	250 A (*)				
15	**Password**	—	0001				

- (*) Parameters set with these values only for PR112 sold as a loose piece.

13.14 Putting into service

13.14.1 Connections

For the Connections to be provided by the user, strictly follow what is indicated in this document.
This will mean that we can satisfy all the international reference Standards and guarantee perfect operation of the trip unit even under severe environmental and electromagnetic conditions.
Give special consideration to the types of cable, the ground connections and the maximum recommended distances.

13.14.2 Test

Before putting into service, a test can be carried out using the specific “Self-test” function which can be activated on the PR112. A positive outcome is visible and is shown on the display.
Still with the specific function (Trip test), following this it is possible carry out the test of the whole SA chain. A positive result is given by the power circuit breaker opening.

13.14.3 Initial settings

If the PR112 is supplied directly installed in the power circuit breaker, it will be up to ABB SACE to set all the variables relative to the power circuit breaker or to the specific application correctly (e.g. Type of power circuit breaker, CT size, …).

Vice versa, if the PR112 is supplied as a loose piece, it will be up to the user to set all the necessary parameters correctly. It should be noted that ABB SACE defines each possible setting in a sensible way (see default parameters in par. 13.13).
Apart from this, it is absolutely indispensable for the user to modify the password and define each modifiable parameter carefully before putting the PR112 into service.

13.14.4 Password management

Password? [0***]

To enter “edit” mode it is necessary to enter a numerical password with four figures (the default password is “0001”).
Select the value of the first figure (between ‘0’ and ’9’) by means of the “up” and “down” keys and press “↵” to confirm the figure and pass on to enter the next. After entering the fourth figure, checking the password entered is carried out. If the password is correct, passing from the “read” mode to the “edit” mode takes place (the flashing cursor appears on the parameter which can be modified).

In the case of a wrong password, the following message appears

Wrong password

which lasts until the “ESC” key is pressed (or after 2 minutes).

It is possible to interrupt the operation by pressing the “ESC” key even during entry of the password.

The password is valid for a maximum of two minutes from the last key being pressed. It is immediately reset in the case of a high priority alarm or in the case when the unit is reset.

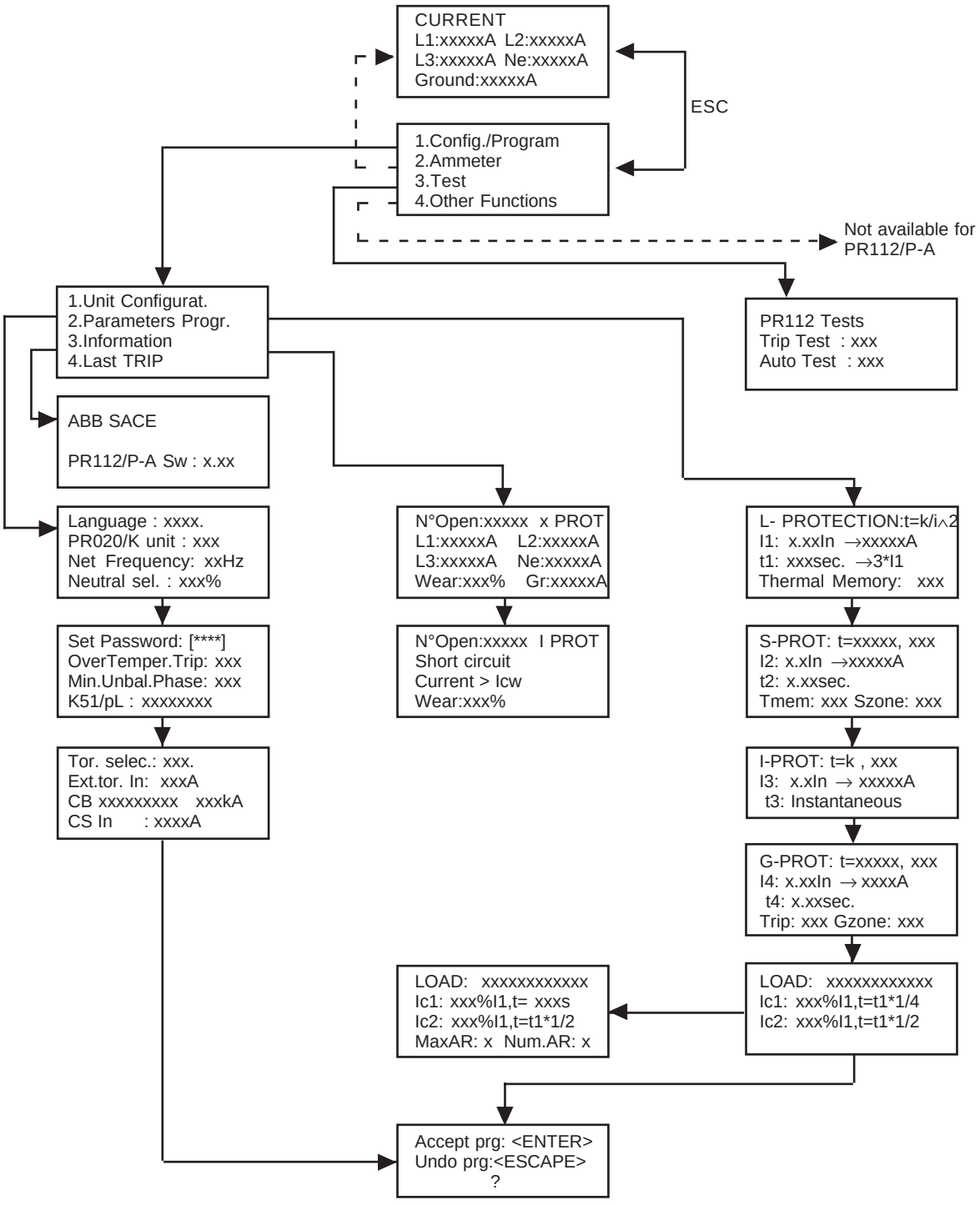
Entering a page without modifiable parameters, the state of the protection is put on “read”. If the password is still valid, to enter “edit” mode (in a page with modifiable parameters) simply press the “↵” key.

Disabling the Password
By setting the value of the password to “0000” (in the menu “Unit configuration”) the password request is disabled. Passing from “read” to “edit” is therefore always possible.

To enter a new password, select the **”Set Password”** item from the **“Unit Configuration”** menu

13.15 Operative/operating instructions during service

13.15.1 Menus



13.15.2 Modification of parameters

In the case when the operator wants to carry out data readout or configuration operations, simply press the **ESC** key and the page relative to the main menu will automatically be displayed:

1. Config./Program
2. Ammeter
3. Test
4. Other functions

Now, with the ↑ (up arrow) or ↓ (down arrow), ↵ and **ESC** keys it is possible to move around inside the main menu and reach all the pages relative to the configurations and parameterizations to display or modify the parameters set.
On completion of a programming operation, press the ↵ key to accept the new configuration **(Accept prg)** or press the ESC key to refuse it and therefore keep the old configuration (**Undo prg**).
The following will therefore appear:

Accept prg: **<ENTER>**
Undo prg: <ESCAPE>
?
Stored

Or

Accept prg: <ENTER>
Undo prg: <**ESCAPE**>
?
NOT stored

These pages indicate whether data storage has been successful or Not.
In the latter case, the PR112 unit will use the last valid configuration set.

13.15.2.1 Modification of basic configuration

If the PR112 unit is in an alarm situation **no parameterization is allowed**.

The basic configuration of the unit must be carried out in EDIT mode.
Following what is given under the chapter. 13.12 show the following on the display:

Language : xxxx. PR020/K unit : xxx Net Frequency: xxHz Neutral sel. : xxx%	Select the language to be used to display the messages Indicate whether the accessory PR020/K unit is present Select the Nominal Frequency value for operation of the installation Select the setting value relative to protection of the neutral conductor (percentage expressed according to the phase current).
Set Password: [****] OverTemper.Trip: xxx Min.Unbal.Phase: xxx K51/pL : xxxxxxxx	Programming a new password in EDIT mode. The successive messages are : **New Password:**→**[****]** e **Confirm PSW :**→**[****]** for confirmation Select enabling or disabling of power circuit breaker opening in the case of the second temperature (85°C) threshold being exceeded. Select the minimum unbalance value of the currents between phases Select which information to combine with signaling by means of the K51/pL relay. The possible selections are given in the table of par. 13.11.1.
Tor. Selec.: xxx. Ext.Tor. In: xxxxA CB Exx-Axxxx xxxkA CS In : xxxxA	Select the type of protection against ground fault: select [Int] if you want to protect the installation with the help of the internal toroid, otherwise [Ext] if you want to protect it with the help of the external toroid by carrying out the “Source Ground Return” protection function. (This selection is only displayed in the LSIG version) Select the value of the continuous current rating of the external toroidal transformer for the “Source Ground Return” function. Select the type of EMAX power circuit breaker (code and continuous current rating) which the PR112 unit is mounted on The possible selections are available in the technical catalogue. Select the value of the continuous current rating of the current sensors (CS) mounted on the power circuit breaker.

N.B.:
Incorrect configuration of “In” does not in any way jeopardize perfect functionality of the protections.
The only problem will be incorrect display of the absolute value of the Currents.

Properties / function	Values selectable
Language	Engl. (English), Ital. (Italian), Fran. (French), Deut. (German) Espa. (Spanish)
PR020/K unit	On , Off
Net Frequency	50Hz, 60Hz
Neutral sel.	50%, 100%
Set Password	0000…9999
OverTemper.trip	On, Off
Min.Unbal.Phase	Off, 10% …90%
K51/p1	See par. 13.11.1
Tor. Selec.	Int (internal), Ext (external)
Ext.tor. In	100A, 250A, 400A, 800A
C.B. Type	Versions allowed in the catalogue
CS In	250A, 400A, 800A, 1000A, 1200A, 1600A, 2000A, 2500A, 3200A, 3600A, 4000A, 5000A

13.15.2.2 Modification of protection functions

The basic configuration of the unit must be made in EDIT mode.

This paragraph allows the user to program the protection functions implemented with the PR112 unit. Only the data programming methods and which values can be set are given. For all the other information relative to the technical characteristics of these protection functions, please refer to the “Protection functions” par..

Following the instructions given under chapter. 13.12, show the following on the display to set protection functions L, S, I and G:

L-PROTECTION:t=k/i∧2	Heading. For protections S, I and G it is possible to select disablement of the function. For protections S and G it is also possible to select the type of curve.
I1: x.xxIn →xxxxxA	Select which threshold value **I1** to set. At the side of selection of threshold I1, its value expressed in Amperes will also be displayed automatically.
t1: xxxsec.→3*I1	Select which trip curve **t1** to set.
Thermal Memory: xxx	Select whether to enable or disable operation of protection L with thermal memory.
S-PROT: t=xxxxx, xxx I	Heading. For protections S, I and G it is possible to select disablement of the function. For protections S and G it is also possible select the type of curve.
I2: x.xIn →xxxxxA	Select which threshold value to set. At the side of selection of the threshold, its value expressed in Amperes will also be displayed automatically.
t2: x.xxsec.	Select which trip curve to set (this is not possible for I).
Tmem: xxx Szone: xxx	For protection S it is possible to decide whether to enable or disable the thermal memory. For protections S and G it is possible to decide whether to enable or disable the zone selectivity. For protection G it is possible to decide whether to enable or disable the trip control at the end of timing.

Depending on the method used on the first line, the following pages will be displayed if PR020/K=ON:

1st	LOAD: Open1-Open2	Method: “Disconnection of two loads”
	Ic1: xxx%I1,t=t1*1/4	Selection of the threshold value of disconnection of the first load
	Ic2: xxx%I1,t=t1*1/2	Selection of the threshold value of disconnection of the second load

2st	LOAD: Close1-Open1	Method: “Connection - disconnection of a load”
	Ic1: xxx%I1,t= xxxs	Selection of the threshold of connection of the load and relative waiting time
	Ic2: xxx%I1,t=t1*1/2	Selection of the threshold of disconnection of the load
	MaxAR: x Num.AR: x	Maximum number of reclosing operations which can be carried out and number of reclosing operations carried out

Protection	Disabling	Disabling only TRIP	Zone Selectivity	Thermal Memory	Threshold range	Time range	Threshold tolerance (4)	Time tolerance (4)
L ($t=k/I^2$)	☐	☐	☐	☒	$0.4xIn \le I_1 \le 1xIn$ step 0.01xIn	$3s \le t_1 \le 144s$, step 3s (1)	± 10% ANSI 37.17	± 10%, $I_f \le 4xIn$ ± 20%, $I_f > 4xIn$
S ($t=k$)	☒	☐	☒	☐	$0.6xIn \le I_2 \le 10xIn$ step 0.1xIn	Min(2), $0.05s \le t_2 \le 0.4s$, step 0.01s	± 7%, $I_f \le 4xIn$ ± 10%, $I_f > 4xIn$	The best of the two data ±10% or ±50ms, $I_f \le 4xIn$ ±15% or ±50ms, $I_f > 4xIn$
S ($t=k/I^2$)	☒	☐	☐	☒	$0.6xIn \le I_2 \le 10xIn$ step 0.1xIn	$0.05s \le t_2 \le 0.4s$, step 0.01s	± 7%, $I_f \le 4xIn$ ± 10%, $I_f > 4xIn$	± 15%, $I_f \le 4xIn$ ± 20%, $I_f > 4xIn$
I ($t=k$)	☒	☐	☐	☐	$1.5xIn \le I_3 \le 15xIn$ step 0.1xIn	Instantaneous	± 10%, $I_f \le 4xIn$ ± 15%, $I_f > 4xIn$	≤ 25ms
G ($t=k$)	☒	☒	☒	☐	$0.2xIn \le I_4 \le 1xIn$ **(3)** step 0.02xIn	$0.1s \le t_4 \le 0.4s$, step 0.05s	± 10%	The best of the two data ±10% or ±50ms, $I_f \le 4xIn$
G ($t=k/I^2$)	☒	☒	☐	☐	$0.2xIn \le I_4 \le 1xIn$ **(3)** step 0.02xIn	$0.1s \le t_4 \le 0.4s$, step 0.05s	± 10%	± 20%
U ($t=k$)	☒	☐	☐	☐	$10\% \le I_6 \le 90\%$ step 10%	$0.5s \le t_6 \le 60s$, step 0.5s	± 10%	± 20%
OT (temp=k)	☐	☒	☐	☐	Can only be set by ABB	Instantaneous	± 1°C	—-
K (Open1-Open2)	☒	☐	☐	☐	$0.5xI1 \le (I_{c1}, I_{c2}) \le 1.0xI1$ step 0.01xI1	$t_{c1} \le t_1 / 4$ $t_{c2} \le t_1 / 2$	± 10%	± 20%
K (Closed1-Open1)	☒	☐	☐	☐	$0.5xI1 \le (I_{c1}, I_{c2}) \le 1.0xI1$ step 0.01xI1	$10s \le t_{c1} \le 120s$ step 5s $t_{c2} \le t_1 / 2$	± 10%	± 20%
Iinst	☐	☐	☐	☐	Can only be set by ABB	Instantaneous	± 5%	—-

(1) The minimum value of this trip is 750ms regardless of the type of curve set (self-protection)

(2) In the case when the trip curve with fixed time (t=k) is selected, apart from those indicated, it is also possible to set the trip time t2=min.

(3) ABB SACE respects the NEC standard guaranteeing that the maximum value of ground fault current (I4) selectable does not exceed the value of 1200A. The range of adjustment the threshold I4 is allowed is automatically decreased, according to the type of power circuit breaker selected, so that the following condition is respected: [(I4 x In) ≤ 1200A].

(4) These tolerances are valid with the following hypothesis:
- trip unit self-supplied when running (without start-up)
- two-phase or three-phase power supply

For all cases not covered by the above hypothesis, the following tolerance values are valid:

	Trip threshold	Trip time
L	± 10% (according to ANSI 37.17 standard)	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60ms
G	± 15%	± 20%

13.15.3 Signals

13.15.3.1 Optic signals

Signaling	Description
Led **Vaux** (green)	Presence of Auxiliary power supply
Led **µP Fault** (red)	Microprocessor with temporary or permanent fault
Led **Warning** (yellow)	• Presence of one or more phases with current values in the 0.83*I1<I<1.05*I1 range (on the NE at 50% the values are halved); • Presence, between two or three phases, of unbalance above the value programmed during configuration; • First temperature threshold T=70°C exceeded; • Contact wear higher than 80 %
Led **Emergency** (red)	• Presence of one or more phases under overload with current values of >1.05*I1 (protection L timing) (on the NE at 50% the values are halved); • Timing in progress for protection function S; • Timing in progress for protection function G; • Second temperature threshold T=85°C exceeded; • Contact wear at 100 %.

Signaling	Description
Yellow magnetic flag "θ"	Trip of protection "T" for overtemperature (second threshold: T=85°);
Yellow magnetic flag **"L"**	Trip of protection "L";
Yellow magnetic flag **"S"**	Trip of protection "S";
Yellow magnetic flag **"I"**	Trip of protection "I" or "Iinst"
Yellow magnetic flag **"G"**	Trip of protection "G";

13.15.3.2 Electrical signals

Electrical signals (see par. on Inputs/Outputs)

Signaling	Description
Contact **K51/p1**	The signaling to which it is connected (see Table par.13.11.1) is active;
Contact **K51/Y01**	Any one of protections " L, S, I, G and θ " has tripped;
Contact **K51/uP**	Microprocessor with temporary or permanent fault. (closes with delay of 1...2 s). Only operational with Auxiliary power supply.

By pressing the "Reset" pushbutton, it is possible to reset the state of the magnetic flags and of the contacts.
This pushbutton is effective when there is self-supply or an auxiliary power supply.
Otherwise the energy accumulated by a special 'buffer'' RESET capacitor is used, which is charged in 12s under self-supply running. This guarantees, in the case of no self-supply and auxiliary power supply, at least one RESET operation for 6 hours at 25°C.
In the case where the 'buffer' capacitor is also discharged, it can be used to RESET the PR120/B supplementary power supply unit.
In this situation, power circuit breaker closing is always possible, both by means of Closing Coils (BC) and by means of a mechanical pushbutton.
Operation of the trip unit is ensured immediately after closing, whereas signal resetting can only be carried out after 12 seconds.

13.16 Troubleshooting

The following table gathers together a series of typical service situations, which are useful to understand and solve hypothetical faults or malfunctions.
N.B.:
1. Before consulting the following table, check any signaling of error messages on the first line of the display for a few seconds.
2. **FN** indicates normal operation of the PR112.
3. In the case when the suggestions proposed do not lead to a solution of the problem, please contact the ABB SACE Assistance service.

N°	Situation	Possible causes	Suggestions
1	It is not possible to reset the magnetic signals	The buffer capacitor is discharged	**FN**, connect the Vaux, the PR010/T or the PR120/B, to reset
2	It is not possible to carry out the trip test	1. The busbar current is > 0. 2. The SA is not connected	1. FN 2. Connect the SA
3	Trip times lower than those expected	1. Threshold too low 2. Curve too low 3. Thermal memory inserted 4. Incorrect Neutral Selection 5. The SdZ is inserted	1. Correct threshold 2. Correct curve 3. Exclude if not necessary 4. Correct Neutral Selection 5. Exclude if not necessary
4	Trip times higher than those expected	1. Threshold too high 2. Curve too high 3. Curve I^2t inserted 4. Incorrect Neutral Selection	1. Correct threshold 2. Correct curve 3. Exclude if not necessary 4. Correct Neutral Selection
5	Rapid trip, with I3=Off	Iinst trip	FN with short circuit with high I
6	I of ground high, but there is no trip	1. Incorrect selection of the sensor 2. Function G prevented with I>4 In	1. Set int. or ext. sensor 2. FN
7	Display off	1. Vaux missing and the I of busbar 2. Temperature out of rangeis less than the minimum value	1. FN, see 13.3.1 2. FN, see 13.7.6
8	The display is not rear-lit	Vaux missing	FN
9	Reading of I incorrect	Incorrect setting of In	Change parameters, see 13.15.2.1

N°	Situation	Possible causes	Suggestions
10	“No Int Bus Comm” Message	There is no communication between PR112 and PR020/K	1. If not present, exclude PR020/K 2. Check bus connection 3. Check PR020/K
11	Display indicates “….” or “——” , instead of the data expected	Function excluded or data out of range	FN, see 13.9
12	The expected trip does not occur	Trip function excluded	FN enable trip if necessary
13	No activation of the Unbalance U protection	Values of I out of range	FN, see 13.7.5
14	Anomalous behavior of Load control K protection	The MT of L is inserted.	FN, exclude the MT of L
15	No display of the of opening data	Vaux missing	FN, see 13.10.2
16	The password is not requested	The password has been disabled	FN, re-enter the password with a value other than 0000.
17	It is not possible to change any parameter	PR112 in alarm situation	FN

13.17 Warning and error messages

All the messages which can be shown on the display relating to incorrect configurations, generic alarms or deriving from the protection functions and linked to useful information are described below.

INCORRECT CONFIGURATIONS

MESSAGE	DESCRIPTION
WRONG CS FOR THIS CB	A CS size which cannot be installed on the power circuit breaker has been selected (e.g. E1 with 5000A)
ERROR I2 <= I1	The trip threshold of function L is higher than threshold of function S
ERROR I3 <= I2	The trip threshold of function S is higher than threshold of function I
ERROR: S ZONE SEL.	Zone selectivity for function G has been activated but zone selectivity is already active for function S.
ERROR: G ZONE SEL.	Zone selectivity for function S has been activated but zone selectivity is already active for function G.
ERROR: V_AUX OFF	The auxiliary power supply is not present - function not available.
V_AUX OFF: Comm. OFF	The communication bus is not operating because the auxiliary voltage is missing.
NO Int. Bus Comm.	The presence of the PR020/K unit is set, but there is no communication on the internal bus.
NOT available	The function required is not available
V_AUX Off: S Sel. Off	The unit is configured to operate with zone selectivity S but the auxiliary power supply has been removed.
V_AUX Off: G Sel. Off	The unit is configured to operate with zone selectivity G but the auxiliary power supply has been removed.

GENERAL ALARMS

MESSAGE	DESCRIPTION
CONTACTS WEAR >80%	The wear on the power circuit breaker electrical contacts has reached 80%
CONTACTS WEAR 100%	The wear on the power circuit breaker electrical contacts has reached 100%
HARMONIC DISTORSION	The current circulating in the power circuit breaker is distorted (peak factor >2.1).

PROTECTION FUNCTIONS

MESSAGE	DESCRIPTION
PREALARM L	The current circulating on at least one phase is above the set prealarm threshold value for protection L - see par.13.8.1
L PROTECTION TIMING	The current circulating on at least one phase is above the set current threshold value for protection L and the unit is under timing.
S PROTECTION TIMING	The current circulating on at least one phase is above the set current threshold value for protection S and the unit is under timing.
G PROTECTION TIMING	The current circulating on at least one phase is above the set current threshold value for protection S and the unit is under timing.
G ALARM, TRIP OFF	Timing of function G is in progress, but the trip control which is given at the end of the timing has been disabled.

PR020/K

MESSAGE	DESCRIPTION
ERROR Ic2 < Ic1	The current threshold set for load n°1 is higher than that of load n°2 or the current threshold set for reclosing is higher than that of load opening.
K: LOAD 1 TIMING	The current circulating has exceeded the threshold of lad n°1 connected to PR112/K and the unit is under timing for load opening.
K: LOAD 2 TIMING	The current circulating has exceeded the threshold of lad n°2 connected to PR020/K and the unit is under timing for load opening.
K: LOAD 1 CLOSING	Load n°1 connected to PR020/K is about to be reconnected
K: LOAD 1 OPEN	Load n°1 connected to PR020/K has been isolated
K: LOAD 2 OPEN	Load n°2 connected to PR020/K has been isolated
K: AR DISABLED	The auto-reset of load n°1 connected to PR020/K has been disabled

PASSWORD MANAGEMENT

MESSAGE	DESCRIPTION
Password ? [****]	Enter the access password in EDIT mode
Wrong Password	The password entered is wrong
New Password : →[****]	Enter the new password
Confirm Password:→[****]	Confirm the new password entered

13.17.1 In the case of a fault

If it is suspected that the PR112 is faulty, has malfunctions or has generated an unexpected trip, we advise you to strictly following the indications below:

1. Do not reset the trip unit.
2. Note down which small magnetic signal is activated (yellow area).
3. If there is Vaux, the trip unit has memorized the trip data, so take these from the Last Trip page.
4. If there is no Vaux, use PR120/B and note down all the settings of the protection functions.
5. Note down the type of power circuit breaker, number of poles, any accessories connected, In, Serial Number (see par. 13.12) and the SW version.
6. Prepare a brief description of opening (when did it take place? how many times? always under the same conditions? with what type of load? with what voltage? with what current? can the event be reproduced?)
7. Send/communicate all the information collected, together with the application circuit diagram of the power circuit breaker, to the ABB Assistance closest to you.

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

13.18 Accessories

13.18.1 ABB SACE PR010/T complex test unit

The test with the SACE PR010/T unit allows correct operation of the inputs, outputs, thresholds and trip times of protection functions “L”, “S”, “I”, “G” and “Iinst” to be checked either manually or automatically.
Furthermore it is possible to obtain a test report and modify the settings.

For operation of the PR010/T accessory, please consult the special instruction manual.

13.18.2 ABB SACE PR020/K signaling unit

The PR020/K signaling unit, when connected to the internal bus of the PR112/P-A, allows the state of the protection functions and of the PR112/P-A trip itself to be signaled by means of clean power contacts.
The PR020/K must be supplied with 24Vdc ±20%.

For operation/installation of the PR020/K accessory, please consult the special instruction manual.

The unit must be connected to the PR112 by means of an internal bus with a corded shielded cable with two conductors (see note A of par. 11.2.2) with a maximum length of 15m.

The shield must be grounded both on the power circuit breaker side and on the PR020/K side.

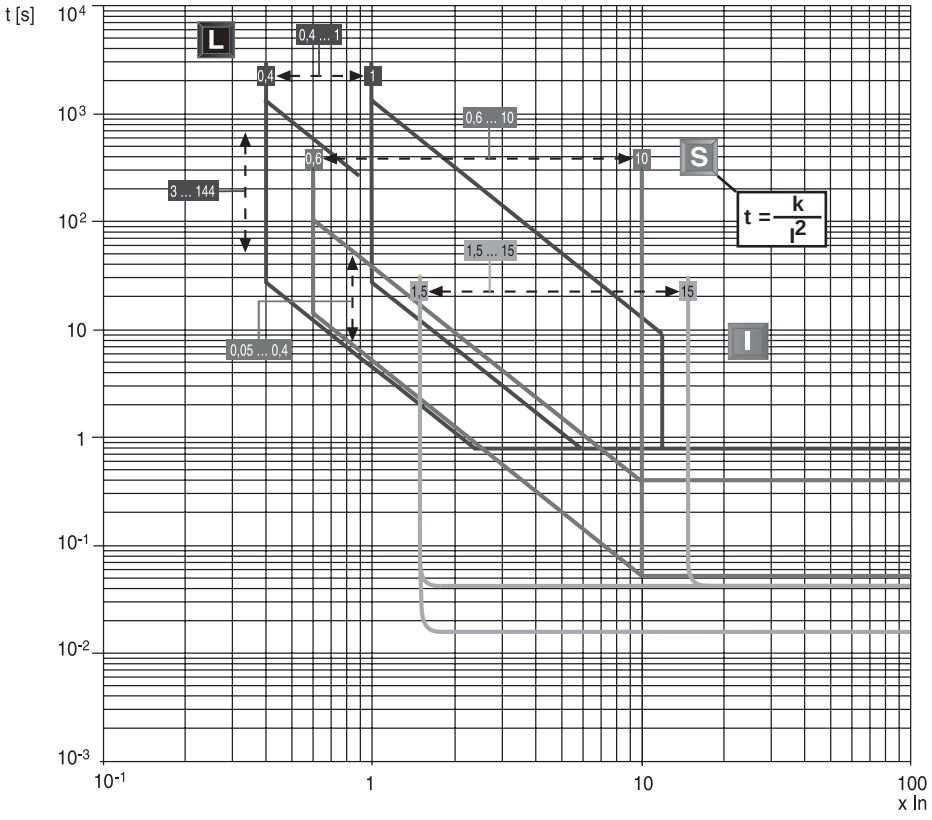
13.18.3 ABB SACE PR120/B power supply unit

The PR120/B is a supplementary power supply unit with front connection (by means of the test connector).
It is possible to read and configure the parameters of the PR112 unit whatever the status of the power circuit breaker (open, closed, in the test position or racked-in, and with/without auxiliary power supply) with this accessory, which is always supplied,
Inside it there is an electronic circuit which allows power supply to the unit for about 3h continuously, just to carry out the sole operations of reading, configurations and testing.
Its autonomy decreases, proportionally to its use, if the PR120/B accessory is also used to carry out the functions of the “Test” menu (Trip test, Self-test).

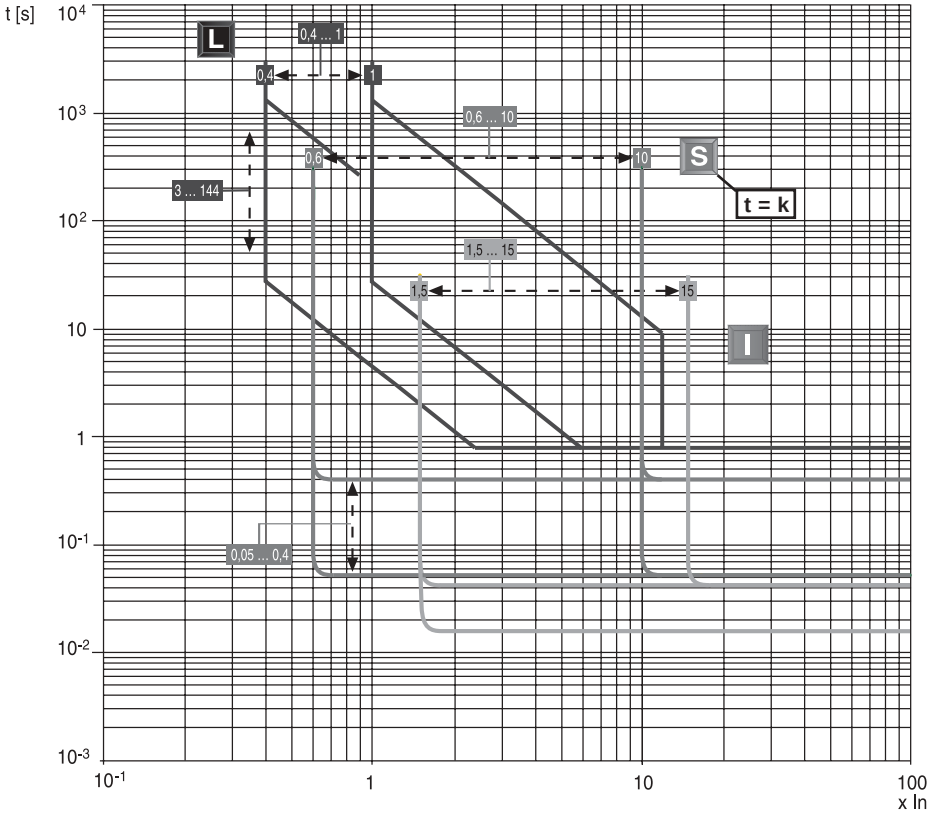
13.19 Trip curves

The trip curves given are indicative and only represent a sub-group of the possibilities selectable (par.13.15.2.2).

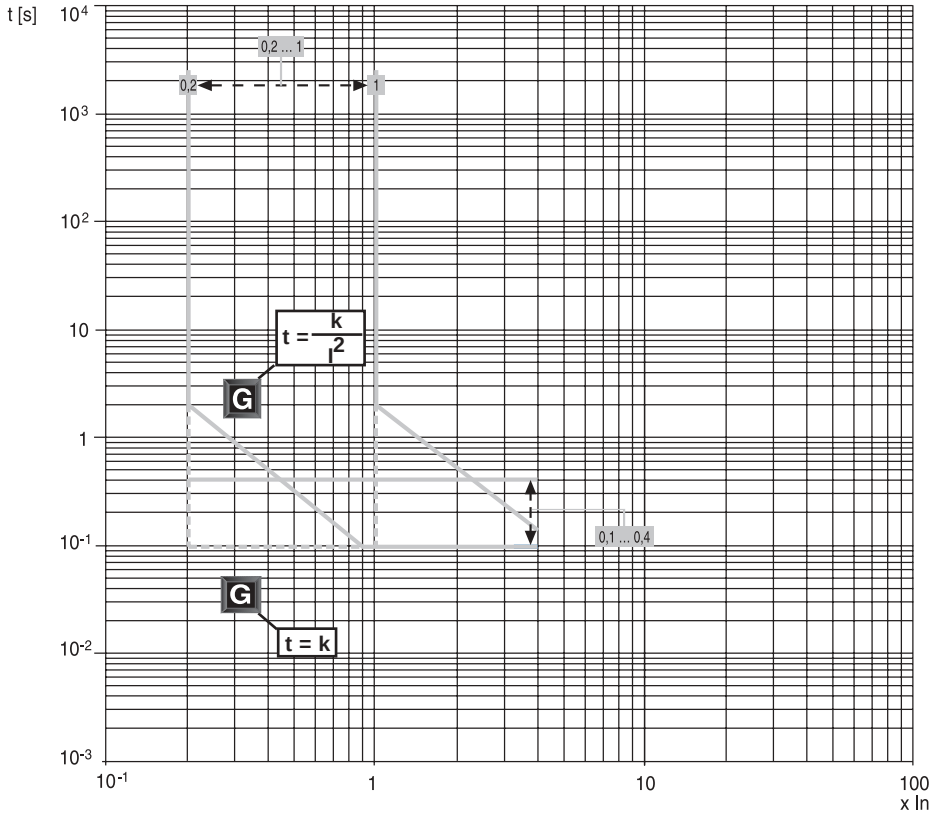
13.19.1 Trip curves of functions L-S-I



13.19.2 Trip curves of functions L-S-I



13.19.3 Trip curves of function G



14. SACE PR112/PD-A Trip unit – Identification

The PR112 units available fitted with a dialogue unit, with Modbus™ protocol , are:
- PR112/PD-A (in accordance with ANSI/UL Standards)

14.1 Standard

The PR112 /PD-A has been designed to work in accordance with the following international standard:

Low voltage AC and DC power circuit breakers used in enclosures ANSI/UL 1066.

14.2 Safety notes

For correct use and management of the PR112 protection unit fitted with a dialogue unit with Modbus™ protocol [PR112/PD-A], it is also necessary to consider what is given in the following documents:

- "PR112/P-A Instruction manuals " (par.13)
- "PR112/PD Modbus™ System Interface" - see par.14.3 (doc. n° RH0295)
- "Modbus™ installation guideline" - see par. 14.3 (doc. n° RH0298)

14.3 Various notes

A. All the detailed information on the communication interface (necessary for development of the supervision and control system by the System integrator) is given in document RH0295.

B. All the detailed information necessary to make the physical external connections to the protection trip unit, as well as the maximum distances of the cabling, the type of conductor to be used, etc. are given in document RH0298.

C. The following are trademarks of Modicon, Inc.:

Modbus	984	P190	SM85
ModConnect	BM85	RR85	SQ85
Modcom	BP85	SA85	

14.4 Specifications

14.4.1 General

When there are no auxiliary power supplies, the communication functions are not active.

The PR112 units fitted with dialogue allow a supervision system to acquire information.

The information available is:

	Data transmitted from the PR112/PD-A to the supervision system
1	Protection parameters set
2	Configuration parameters set
3	Phase, neutral and ground currents
4	Status of the power circuit breaker (open-closed)
5	Position of the power circuit breaker (connected-isolated)
6	State of the springs (charged-discharged)
7	Number of mechanical power circuit breaker operations, overall number of trips and for each protection
8	Last current interrupted
9	Contact wear
10	State of the protection functions (prealarm funct.L, timing funct. L, S, G…)
11	Overtemperature protection function
12	State of internal bus communication
13	****

*** See par. 14.3 note **A***

14.4.1.1 Auxiliary power supply

When there is a PR112 equipped with a dialogue unit, the consumptions of the unit are different from those indicated just for the protection unit. The values to be considered are given in the following table.

Characteristics	PR112/PD-A version
Power supply voltage	24V DC ±20%
Maximum ripple	5%
Inrush Current @ 24 V	~5A for 30ms
Start-up Current @ 24 V	~1.0A for 150ms
Continuous current rating@ 24 V	~250mA
Nominal Power@ 24 V	~6W

14.4.2 Inputs/outputs

14.4.2.1 Binary opto-insulated inputs

– **CB-Closed:** Status of power circuit breaker
– **CB-Open:** Status of power circuit breaker (for congruency control with power CB-Closed)
– **CB-Springs:** State of springs
– **CB-Position:** Position of power circuit breaker

14.4.2.2 Output contacts

– **K51/YC:** relay output which can be activated by the user to close the power circuit breaker
– **K51/YO:** relay output which can be activated by the user to open the power circuit breaker

- Monostable contacts, only active when there is Vaux
- Maximum changeover current: 3A – 250V AC (0.2A – 100V DC)
- Insulation contact-contact voltage: 1000 V AC

14.4.3 Communication bus

– External bus Modbus™ protocol RS485 2-Wire Twisted Pair, 19.2kbit/s max., connection to differential bus (*See par.14.3 note **B***).

14.4.4 Information functions

To access the following pages, see par.14.6.1.

14.4.4.1 Software version

ABB SACE PR112/D-M Sw: x.xx	This page shows which Software version there is of the dialogue unit of the above PR112 /PD trip unit. Each time it is necessary to communicate any operating problems with the dialogue unit to ABB SACE, it is a good idea to indicate the **Sw** version of the unit (“x.xx”).

14.4.4.2 Opening data storage

Manual Opens: xxxxx Prot. Trips: xxxxx Other Trips: xxxxx Trip Fails: xxxxx	Sum of openings due to manual openings by means of pushbuttons on the front of the power circuit breaker, controls coming from opening coil (YO) and undervoltage (MT). Sum of openings due to protections (L, S, I, G,…). Sum of openings due to the trip test. Sum of any missed trips in relation to a fault.
L: xxxxx S: xxxxx I: xxxxx G: xxxxx T: xxxxx	Number of trips due to protections L, S, I, G and T (temperature) respectively.

14.4.4.3 State of power circuit breaker auxiliary inputs

CB StatuS: xxxxx	Status of the power circuit breaker. The possible states are: Open - Closed – Error*
CB Springs: yyyyy	State of spring charging. The possible states are: Charged – Discharged
CB Pos.: zzzzz	Position of the power circuit breaker. The possible states are: Conn. – Isol.
Test YO/YC: kkk	See par. 14.4.5

* The display of "Error" indicates a condition of incongruence (both the CB-Open and CB-Closed inputs are in the same logical state)

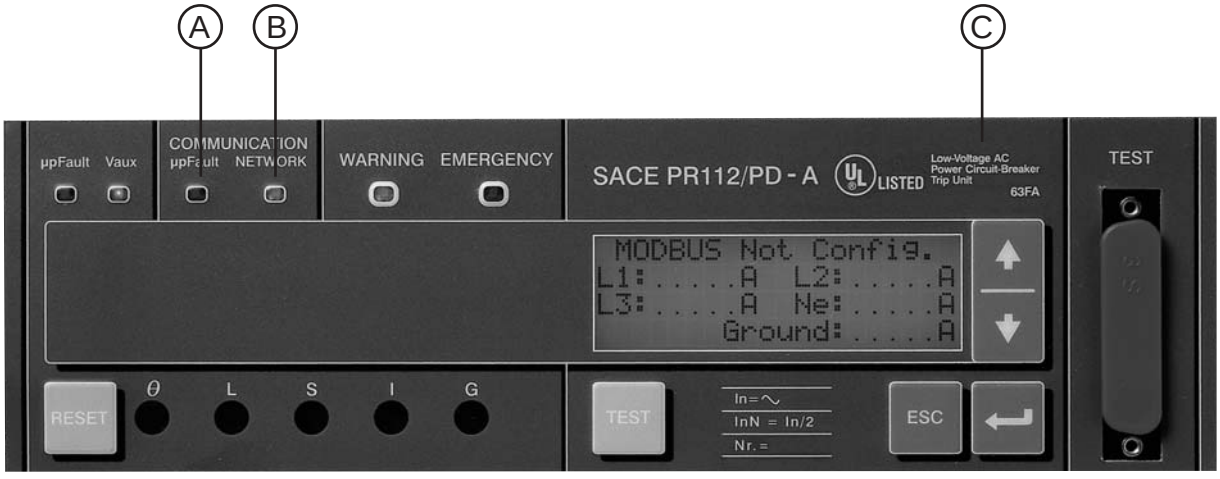
14.4.5 Control functions

CB Status : xxxxx	See par. 14.4.4.3
CB Springs: yyyyy	See par. 14.4.4.3
CB Pos. : zzzzz	See par. 14.4.4.3
Test YO/YC: kkk	Control function for opening and closing the power circuit breaker by means of coils YC and YO.

- To open the power circuit breaker, select YO and then press the TEST pushbutton on the front of the PR112/PD-A
- To close the power circuit breaker select YC and then press the TEST pushbutton on the front of the PR112/PD-A

14.4.6 User interface

Caption of the front of the PR112/PD-A unit (integration of the caption relative to the PR112/P-A version):



Ref.	Description
A	"µP fault" LED relative to operation of the µProcessor dialogue unit.
B	"NETWORK" LED linked to the state of communication activities (Tx) on external bus.
C	Identification label for trip unit according to ANSI/UL Standards

14.4.7 Default settings

The PR112/PD is supplied by ABB SACE with the following pre-defined communication parameters:

Slave Addr.	Baudrate	Parity	Addressing
255 (UNCONFIGURED)	19.200 bit/s	Even	Standard

Operating mode
Local

14.5 Putting into service

14.5.1 Connections

For the Connections to be made by the user, it is advisable to check what is indicated in par.14.3.
This means that we shall be able to satisfy all the international reference Standards and guarantee perfect operation of the trip unit even under severe environmental and electromagnetic conditions.

Pay particular attention to the types of cable, the connections to ground and the maximum distances recommended.

In case of replacement of a PR112/P-A with a PR112/PD-A it is necessary to complete the missing cabling on the terminal box (or sliding contacts of the power circuit breaker) with those required for the dialogue function as well as to replace the connectors which are coupled with the PR112 trip unit from the terminal box.

14.5.2 Test

Before putting into service, it is advisable to carry out some opening, closing and resetting controls of the power circuit breaker, also checking correct indication of the status of the power circuit breaker on the display (open-closed).
It is also advisable to check the correct state of the springs (charged-discharged) as well as the position of the power circuit breaker (connected-isolated). For further details see par. 14.4.4.3.

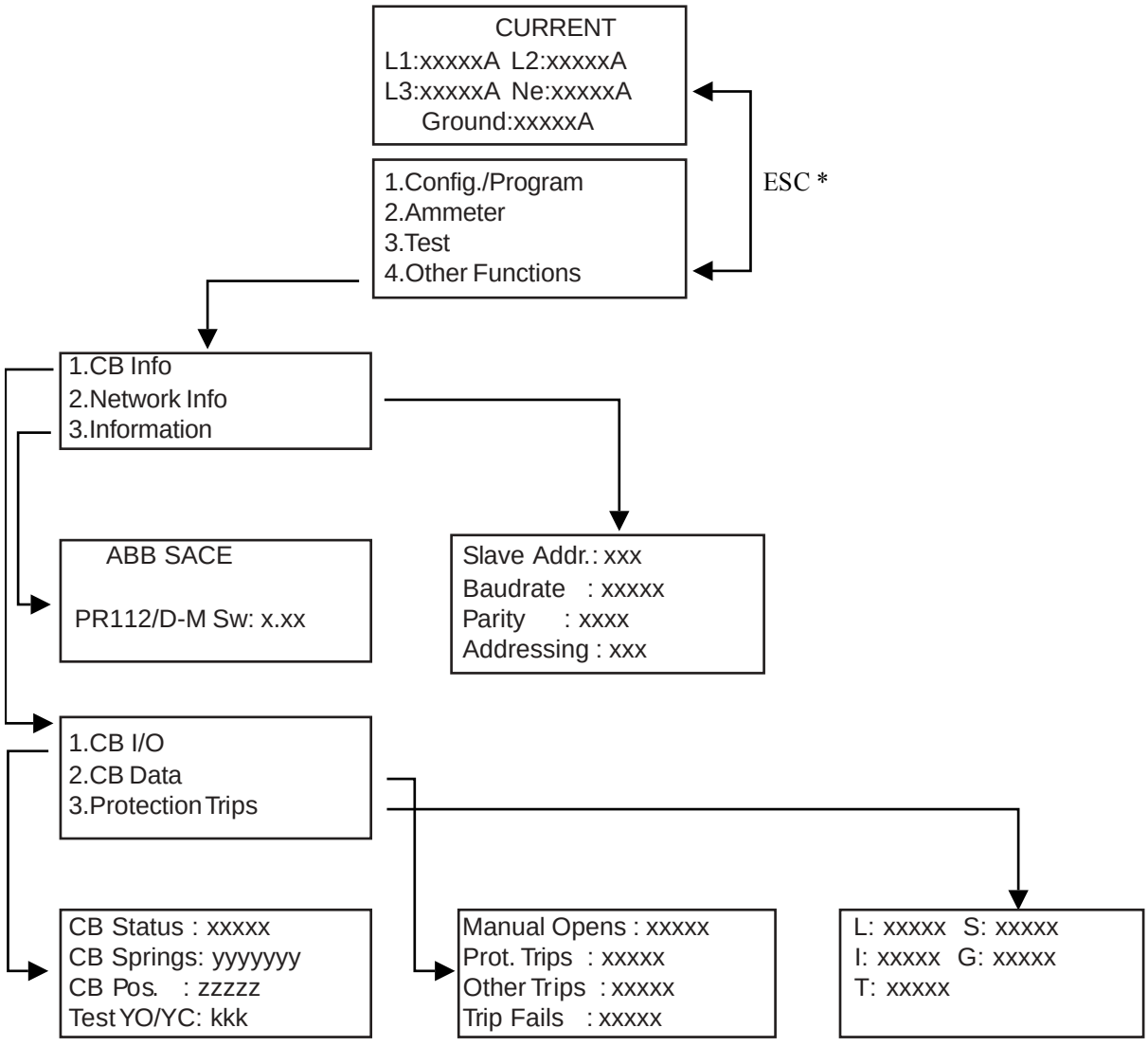
14.5.3 Initial settings

ABB SACE defines each setting of the communication parameters (see default parameters in par. 14.4.7). Apart from this, before putting the PR112 into service, it is absolutely indispensable for the user to carefully define each modifiable parameter (see par.14.6.2).

14.6 Operative/operating instructions during service

14.6.1 Menus

As already seen previously, the PR112 uses the display to show messages, data and menus. These are organized in a logical and intuitive way. For user convenience, all the additional screens which can be seen with PR112/PD-A are given below.



* Press ESC to return to the previous page

14.6.2 Modification of parameters

The information for modification of the various parameters is given in the PR112/P part of the instruction manual.

14.6.2.1 Modification of communication parameters

Slave Addr.:	xxx
Baudrate :	xxxxx
Parity :	xxxx
Addressing :	xxx

Properties / function	Selectable values	Description
Slave Addr.	1...247 and 255*	Logical address of the device.
Baudrate	9600-19200 bit/s	Data transmission speed.
Parity	Even-Odd	Control mode of data transmitted.
Addressing	Standard-ABB SACE	Type of addressing of the Modbus™ data.

* Slave Addr. = 255 means unit not configured.

14.6.3 Signals

14.6.3.1 Optical signals

Signaling		Description
Led **μP Fault** [COMMUNICATION]	(red)	Microprocessor of the dialogue unit with temporary or permanent fault.
Led **Network** [COMMUNICATION]	(yellow)	The communication (Tx) activity between the PR112 trip unit and the remote supervision system is active (rapid flashing).

14.7 Troubleshooting

The following table collects up a series of typical service situations, which are useful in order to understand and solve hypothetical faults or malfunctions.

N.B.:

1. Before consulting the following table, check any signaling of error messages on the first line of the display for a few seconds.
2. **FN** indicates normal operation of the PR112.
3. In the case when the suggestions proposed do not lead to a solution of the problem, please contact the ABB SACE Assistance service.

N°	Situation	Possible causes	Suggestions
1	There is no serial communication activity with the remote supervision system	1. Incorrect cabling of the connections 2. There is no auxiliary voltage 3. Incorrect communication parameters	1. Check the connections 2. Recover the auxiliary voltage 3. Set the correct parameters
2	Incorrect indication of the power circuit breaker status, power circuit breaker position and state of the springs	Incorrect cabling of the connections	Check the connections
3	Impossible to send power circuit breaker opening and/or closing controls	1. Incorrect cabling of the connections 2. No power supply to the opening and/or closing coils	1. Check the connections 2. Recover the power supply voltage
4	Impossible to change the PR112 parameters and/or send remote controls from the front keyboard	The unit is set to Remote	Set the unit to Local
5	Impossible to change the PR112 parameters and/or send remote opening/closing controls	1. The unit is set to Local 2. The device is a PR112/PD-A	1. Set the unit to Remote 2. FN
6	“No Int. Bus Comm” message on the display	No communication activity between protection unit and communication unit inside the PR112	Contact ABB SACE
7	No updating of the opening data	Vaux not present during the trip	FN

14.8 Warning and error messages

All the messages which can be shown on the display relating to incorrect configurations, generic alarms or linked to useful information are described below.

Incorrect configurations	
MESSAGE	**DESCRIPTION**
MODBUS not config.	The dialogue unit does not have the address set (ABB default setting)
V_AUX OFF: Comm. OFF	The communication bus is not operating because there is no auxiliary voltage.
NO Int. Bus Comm.	No communication between the protection unit and the dialogue unit inside the PR112/PD-A.
NOT available	The function required is not available.
CB Status Unknown	See par.14.4.4.3
MODBUS Wink	The Wink mode has been activated. In this condition, rear illumination of the display is intermittent.

14.9 Accessories

See paragraph 13.18.

15. SACE PR113/P-A Trip unit – Identification

The PR113 units available according to the ANSI/UL Standards are:
- PR113/P-A (LSIG)
- PR113/PD-A (LSIG fitted with communication card).

15.1 Standard

The PR113 /P-A has been designed to work in accordance with the following international standard :
Low voltage AC and DC power circuit breakers used in enclosures ANSI/UL 1066.

15.2 Specifications

15.2.1 General

The PR113 unit is a self-supplied protection unit with high performance with **Protection, Measurement, Watchdog, Signaling, Test, Control of the Power circuit breaker, Communication and Storage functions** for ABB SACE 'EMAX' series of air three-pole and four-pole Low Voltage power circuit breakers

The protections available are:

Symbol	Protection against …
L	overload with inverse long time-delay
S	short circuit with adjustable delay
D	directional short circuit with adjustable delay
I	instantaneous short circuit
G	ground fault with adjustable delay
U	phase unbalance
OT	temperature out of range
K	load control
UV	undervoltage
OV	overvoltage
RV	residual voltage
RP	reverse active power
Iinst	ultra rapid instantaneous short circuit (for high currents)

The PR113 can be installed both on three-pole, three-pole with external neutral or four-pole power circuit breakers.

It should be noted that the reference current, for the PR113, is the In (continuous current rating of the CTs mounted in the power circuit breaker) and not the Iu (uninterrupted continuous current rating of the power circuit breaker itself).
Example: the E1B-A800 power circuit breaker with 250 A CT, has an Iu of 800A and an In of 250 A.

The unit carries out opening of the power circuit breaker, in which it is integrated, by means of the SA, which acts directly on the mechanical lever mechanism of the apparatus.

The CTs supply the trip unit with both the energy for self-supply, and the signal to calculate the current circulating in the busbars of the power circuit breaker. Operation in self-supply is guaranteed for any protection function and for setting which can be defined by the user. Some supplementary functions, for example the SdZ, require an external auxiliary power supply.
For further information regarding self-supply and the auxiliary power supply, see par. 15.2.2.

The VTs provide the signals used for the protection functions and for the measurements of voltage and power (see par. 15.3.2).

The maximum length of the VT - PR113 cabling must not exceed 15 meters.
Use corded shielded two-wire cable (see note A to par. 11.2.2).
The shield must be connected to ground on both sides.

Use VTs with a shield, connected to ground (see note A to par. 15.3.2.1).

The unit is made with electronic digital technology and interfaces with the user with a graphic display and a membrane control keyboard.
The protection parameters and in general the mode of operation of the unit are fully programmable by the user, in different languages.

15.2.2 Electrical characteristics

Nominal operating frequency	50/60 Hz ±10%
Pass band	1200 Hz max
Peak factor	2.1 max @ 4 In
MTBF (MIL-HDBK-217E)	15 years @ 45°C

15.2.2.1 Self-supply

All the protection functions are operational without an external auxiliary power supply. In fact, self-supply is guaranteed by the CTs installed in the power circuit breaker.

Minimum busbar current for turning the trip unit on:
– 0.35xIn with single-phase current
– 0.20xIn with two-phase current
– 0.15xIn with three-phase current

Minimum busbar current for turning the display on (not rear-lit):
– 0.50xIn with single-phase current
– 0.30xIn with two-phase current
– 0.20xIn with three-phase current

The display lighting up time is about 3 seconds.

15.2.2.2 Auxiliary power supply

The Auxiliary power supply guarantees operation of the PR113 in any condition, even with the power circuit breaker open or with circulating current lower than the values mentioned in the previous paragraph.

A sudden drop or loss of the Vaux does not have any effect on the protection functions, since, if involved in a fault current, this guarantees self-supply.

The Vaux is necessary for some special functions/performances (e.g. SdZ, communication, rear illumination of the display …).

The time for reaching normal running of the PR113, from the moment of connection of the Vaux is about 5 s.

Since a Vaux insulated from ground is required, it is necessary to use “galvanically separate converters” conforming to the IEC 60950 (UL 1950) Standards or their equivalent [which guarantee a common mode current or leakage current (see IEC 478/1, CEI 22/3) not higher than 3.5mA], IEC 60364-41 and CEI 64-8.

Characteristics	PR113/P-A Version
Power supply voltage	24V DC ±20%
Maximum ripple	5%
Inrush Current @ 24 V	~3A for 30 ms
Start-up Current @ 24 V	~1.0A for 150 ms
Continuous current rating @ 24 V	~200mA
Nominal Power @ 24 V	~5W

15.2.3 Environmental characteristics

Operating temperature	-25°C ... +70°C
Storage temperature	-40°C ... +90°C
Relative Humidity	0% ... 98% with condensation
Degree of protection (with PR113 installed in the power circuit breaker)	IP 30

15.2.4 Inputs/outputs

15.2.4.1 Binary opto-insulated inputs

– **CB-Closed:** power circuit breaker status
– **K51/SZin (K51/DFin):** SdZ S input (or FW in, for SdZ Directional function)
– **K51/Gzin (K51/DBin):** SdZ G input (or BW in, for SdZ Directional function)

15.2.4.2 Binary opto-insulated outputs

– **K51/SZout (K51/DFout):** SdZ S output (or FW out, for SdZ Directional function)
– **K51/GZout (K51/DBout):** SdZ G output (or BW out, for SdZ Directional function)

15.2.4.3 Output contacts

– **K51/p1:** relay output programmable by the user
– **K51/p2:** relay output programmable by the user
– **K51/μP:** relay output for signaling microprocessor faulty

- Monostable contacts, only active when there is Vaux;
- Maximum changeover current: 3A – 250V AC (0.6A – 100V DC).
- Contact-contact insulation voltage : 1000 V AC

– **K51/Y01**: relay output for signaling “trip unit tripped”

- Bistable contact, also active in self-supply;
- Maximum changeover current: 0.5A – 125V AC (0.3A – 110V DC).
- Contact-contact insulation voltage : 750 V AC

15.2.5 Communication bus

Internal RS485 bus, 38,400 bps baud rate, ABB SACE protocol.

15.2.6 Protection functions

The PR113 protection unit carries out 13 independent protection functions. In particular:

1. Protection against overload with inverse time “**L**”;
2. Protection against short circuit with adjustable delay “**S**”;
3. Protection against directional short circuit with adjustable delay “**D**”;
4. Protection against instantaneous short circuit “**I**”;
5. Protection against ground fault with adjustable delay “**G**”;
6. Protection against phase unbalance “**U**”;
7. Protection against overtemperature “**OT**”;
8. Load control protection “**K**” (#)
9. Protection against undervoltage “**UV**”;
10. Protection against overvoltage “**OV**”;
11. Protection against residual voltage “**RV**”;
12. Protection against reverse active power “**RP**”.
13. Protection with fixed threshold against instantaneous short circuit “**Iinst**”;

(#) :The K protection, used for load control, is made up of two predefined curves with threshold currents and trip times lower than those selectable with protection “L”, which can be used for two different applications:
1. disconnection of two distinct loads;
2. connection and disconnection of a load

This protection allows single loads to be disconnected before protection for overload “L” intervenes to definitively open the power circuit breaker. It is a function which is only available when there is an auxiliary power supply.

The PR113 unit allows current signal processing of the neutral pole with different relationships relative to the value of the phase.
N.B.: Over 15.5xIn of current on the Ne, the protection itself is considered as set to 100%.

An indication (message + “emergency” LED) is provided on the unit display which is activated during a protection alarm. This is de-activated when the alarm stops or with a protection tripped. On opening of the power circuit breaker by means of the SA (see note C to par. 11.2.2), the electrical contact of protection tripped (K51/Y01) is closed and the corresponding yellow magnetic flag turned. When there is an auxiliary power supply, the openings page with the data of the “trip” which has just occurred is also displayed (see par. 15.2.9.2) and the “Trip” LED is lit.
The signals (K51/Y01, flag and Trip LED) are reset by pressing the RESET key (the Trip LED is also turned off by switching the unit off).

For the protections with fixed time with adjustable delay, the relationship implemented is the following: $t = k$.
For the protections with inverse time, the relationship between trip time and overcurrent is given by the formula: $t = k / I^2$.

Calculation of RMS and Peak
The “L, S, D, U, G and RP” protection functions carry out the relative processing on the basis of the true rms value of the secondary currents of the CTs up to 6 In (protection G is disabled for phase currents higher than 4xIn). For currents higher than 6xIn, and for function “I”, the processing is carried out taking into account the peak value divided by $\sqrt{2}$ (the sinusoidal wave form is then considered). This is because of incompatibility between the trip time and the rms value calculation time.
If the waveform has a deformation above the declared limit (2.1@4In), the calculation tolerance of the true rms value will increase. The UV, OV, RV voltage protections always work on the basis of the true rms value of the secondary voltages supplied by the VTs.

15.2.6.1 Protection “L”

Protection “L” is the only one which cannot be disabled since it carries out self-protection against overloads of the trip unit itself.
The protection trip time - inverse time - is given by the expression

$$\max\left[\ \frac{9\cdot t_1}{(I_f/I_1)^2}, 0.75\ \right] \text{per } I_f \le 12In\ ,\ 0.75\,s \text{ per } I_f > 12In$$

where I_f is the fault current and I_1 the protection threshold.

NB: Time expressed in seconds.

15.2.6.1.1 Thermal memory “L”

It is possible to enable the function of thermal memory for cable protection. This is based on the “τL” parameter defined as the trip time of curve (t1) selected at 1.25xI1.
The trip unit trip time is certainly 100% of the one selected after which a time of 3xτL has passed since the last overload or since the last trip. Otherwise the trip time will be reduced depending on the overload which has occurred and on the time passed.

The PR113 is fitted with two instruments to make up this thermal memory. The first only works when the trip unit is supplied (it remembers overloads which did not last long enough to make the trip unit trip), whereas the second only works when the trip unit is not supplied (it reduces any trip times in the case of immediate reclosing).
The PR113 trip unit automatically decides which of the two to use according to the various situations.

15.2.6.2 Protection “S”

This protection, which can be disabled, can be with fixed time (t = k) or inverse time. 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.

NB: Time expressed in seconds.

15.2.6.2.1 Thermal memory “S”

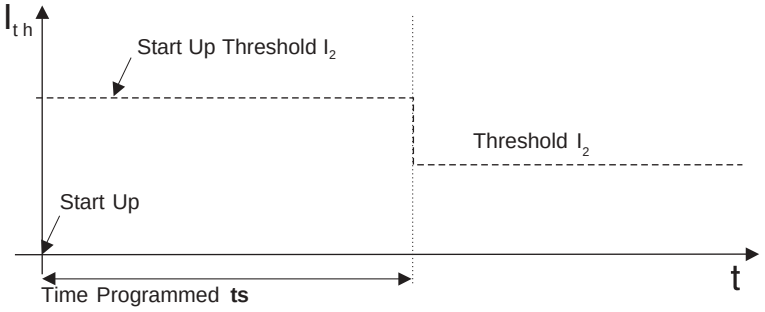
It is possible to enable the thermal memory function for cable protection in the case where the curve with inverse time is selected: This is based on the “tS” parameter defined as the trip time of the curve (t2) selected at 1.5xI2. The other characteristics are the same as those for thermal memory “L” (see par.15.2.6.1.1).

15.2.6.2.2 Start-up threshold “S”

It is possible to select the start-up function in the case where the curve with fixed time is selected.
The function is disabled by selecting [-----] at the “StartUp” parameter on the protection “S” page.

The time the start-up threshold is valid for depends on what is set for the “ts” parameter on the page for general enabling of the START-UP function (see par.15.4.2.2). If the function is placed on [Off] here, the start-up threshold is disabled for all the protections.

The start-up function allows modification of the protection threshold (S, D, I and G) during a time interval lasting “ts”, starting from “start-up”. The latter must be intended as follows:
– Turning on of the trip unit, under self-supply;
– Passage of the peak value of the maximum current over 0.1xIn. A new start-up is possible after the current has gone down below 0.1xIn.

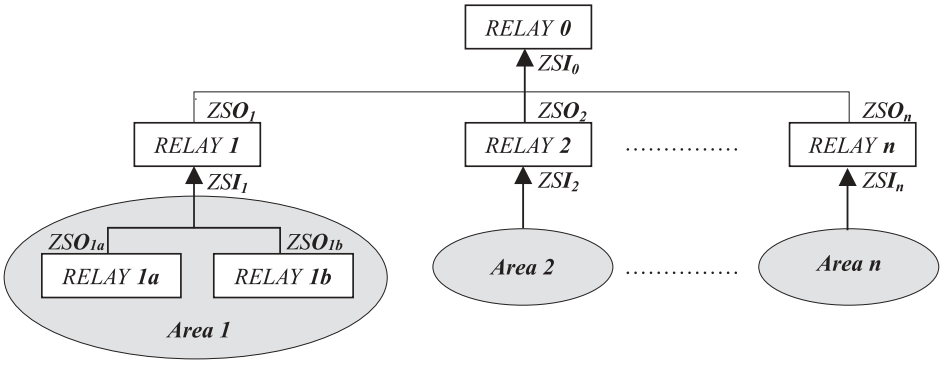


- **Start-up time**

The start-up time is common to all the protections involved.
Range: 0.1 s … 1.5 s, with steps of 0.05 s. Tolerance : ± 20%.

15.2.6.2.3 Zone selectivity “S”

It is possible to enable the zone selectivity function in the case where the curve with fixed time is selected and there is an auxiliary power supply. This carried out by connecting all the zone selectivity outputs to one another (ZSO=K51/SZout) of the trip units belonging to the same zone and taking this signal to the zone selectivity input (ZSI=K51/SZin) of the trip unit immediately on the supply side. If the cabling operation has been carried out correctly, all the zone selectivity inputs of the last power circuit breakers in the chain and all the outputs of the power circuit breakers at the head of each chain must be empty.



The zone selectivity function allows the fault area to be isolated, only isolating the installation to the level nearest the fault and keeping the rest of the installation operational.
This means that a load side fault of “Relay 1a” will be isolated from the latter without “Relay 1” and “Relay 0” intervening. A fault just on the load side of “Relay 1” will be isolated from the latter without “Relay 0” intervening, guaranteeing that the Areas 2…n remain active.

The ZSI signal can be connected up to 20 units in parallel (to the relative ZSO signal).
The ZSO output can be connected to a maximum of 3 ZSI relays on the supply side in the selectivity chain.

The maximum length of cabling for zone selectivity, between two units, is 300 meters.
Use corded shielded two-wire cable (see note A to par. 11.2.2).
The shield must only be grounded on the power circuit breaker of supply side relay (ZSI side).

Cabling and enabling zone selectivity “S” is an alternative to that of protection “D” and operation is only guaranteed when there is auxiliary voltage.
The following logical table is implemented to manage the Zone Selectivity Input (ZSI) and Zone Selectivity Output (ZSO) signals:

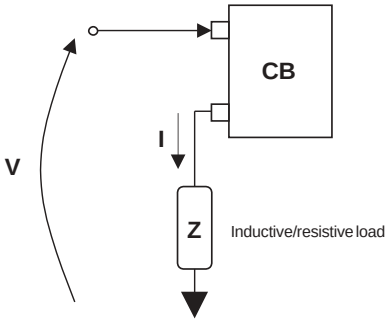
Zone selectivity	Imax > I2	ZSI Signal	ZSO signal	Trip t2 T
Excluded	NO	0	0	No trip
Excluded	NO	1	0	No trip
Excluded	YES	0	0	t2 programmed
Excluded	YES	1	0	t2 programmed
Inserted	NO	0	0	No trip
Inserted	NO	1	1	No trip
Inserted	YES	0	1	$t_{selectivity}$
Inserted	YES	1	1	t2 programmed

As seen in par.15.4.2.2, it is possible to set the time $t_{selectivity}$ (40... 200ms). The [tpgr] setting for the parameter makes $t_{selectivity} = t_2$ (useful for the relays at the base of the selectivity chain).

15.2.6.3 Directional Protection “D”

The PR113 unit carries out excludable directional protection against short circuit with adjustable fixed time (t = k) active both with self-supply and with auxiliary supply.

The protection functionality is very similar to protection “S” with fixed time, with the capacity to recognize the current direction during the fault period as well. However, it is a phase and not neutral protection.
The direction of the current allows determination of whether the fault is on the supply side or load side of the power circuit breaker. Especially in ring distribution systems, this allows the distribution stretch where the fault occurred to be identified and to isolate it without interfering with the rest of the installation (using zone selectivity).



The direction is only determined in the case where the maximum value of the phase reactive powers is higher than 2% of the nominal phase power ($P_Q \geq 2\% \cdot P_{nfase}$).

Once these conditions are fulfilled, the direction is defined in the following way:
- positive reactive power in → *“forward”* direction;
- negative reactive power in → *“backward”* direction.

In the drawing at the side, the direction of the current is *“forward”* (PQ>0).

With regard to the trip times, it is possible to set two different ones **[Bw, Fw]** according to whether the direction of the current trip selected is *“backward” or “forward”.*

Operation, with zone selectivity disabled, is the following:
- ❑ If Imax > I7 and current direction determined ≠ direction set → no alarm;
- ❑ If Imax > I7 and current direction determined = direction set → times and opens;
- ❑ If Imax > I7 and current direction cannot be determined → times and opens considering as the direction the one selected with the “Direction” parameter.

N.B.:
- **Protection D always considers I neutral (Neutral sel.) = 100%.**
- **Protection D is not available with 250 and 400 A CT.**
- **See Warnings par. 15.3.2.**

15.2.6.3.1 Start-up threshold “D”

The function is disabled by selecting [-----] at the “StartUp” parameter on the protection “D” page.
The behavior of the function is identical to the one described for protection “S” (see par. 15.2.6.2.2).

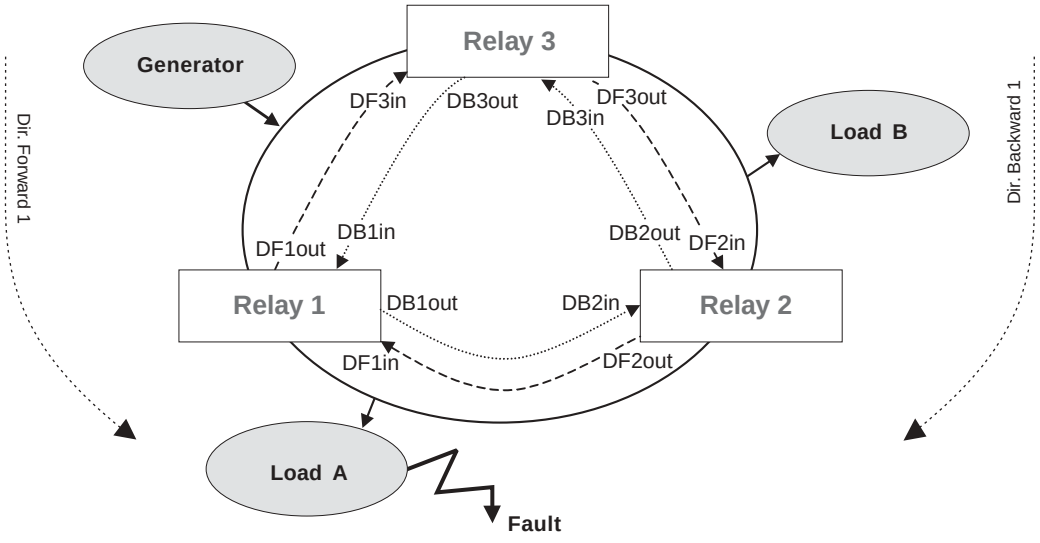
15.2.6.3.2 Zone selectivity “D”

Zone selectivity “D” can only be set [On] in the case where zone selectivity “S” and “G” are set on [Off] and there is an auxiliary power supply. It uses 4 signals, two outputs two inputs:
- ☒ DFin (K51/DFin), DFout (K51/DFout) for signaling in the case of “forward” direction of the fault current;
- ☒ DBin (K51/DBin), DBout (K51/DBout) for the signaling in the case of “backward” direction of the fault current.

With zone selectivity activated, if the direction is not determined, the protection trips considering the shorter time programmed of forward and backward and without activating any output (DFout or DBout).

Setting the “Direction” parameter for operation with zone selectivity has no influence.

The typical configuration of the power circuit breaker system for which the use of zone selectivity “D” is foreseen is the ring one, as shown as an example in the following figure.



In the case when a fault is determined on one of the sections of the system (Load A), the end power circuit breakers of the section itself (Relay1 and Relay2) communicate the presence of the fault to the power circuit breakers connected (Relay3) setting the DFout or DBout output signals on the basis of the direction of the current (DFout1=On, DB2out=On). In particular, the power circuit breakers which limit the section of the fault see the direction of the fault current in different ways (Relay 1 “forward” and Relay 2 “backward”).

The power circuit breakers which limit the section involved by the fault intervene with selectivity time **ts** (130...500 ms) whereas the power circuit breakers connected time with time t7 (Relay3). In this way the system is isolated by excluding the fault area.

15.2.6.4 Protection “I”

The protection, which can be disabled, is made with intentional delay nil.

In the case where zone selectivity “S” (or “D”) is active, during the trip of the relay for “I”, the ZSO (or DFW and BFW) output signal is activated in any case to guarantee correct operation of the supply side (and load side) relay.

15.2.6.4.1 Start-up threshold “I”

The start-up function can be selected.
The function is disabled by selecting ‘-----’ at the “StartUp” parameter on the protection “I” page.
The behavior of the function is identical to the one described for protection “S” (see par. 15.2.6.2.2).

15.2.6.5 Protection "G"

The protection, which can be disabled, can be with fixed time (t = k) or inverse time. In the latter case, the trip time is given by the expression $\max\left(\frac{2}{(I_f/I_4)^2}, t_4\right)$ where I_f is the fault current and I_4 the protection threshold.

NB: Time expressed in seconds.

It is possible to disable the trip control of the protection ("Trip: Off").
For the whole duration of the ground fault the power circuit breaker will not be opened, but only the alarm condition will be signaled ("emergency" LED lit and alarm message).

The PR113 unit is able to provide two different types of ground fault protection:

× ***Internal protection G***

This is carried out inside the trip unit by vectorially summing the phase and neutral currents. The fault current is defined by the following formula

$$\vec{I}_G = \vec{I}_1 + \vec{I}_2 + \vec{I}_3 + \vec{I}_{NE}$$

In the case when the circuit does not show any fault, the module of the sum of these currents is always nil, vice versa the value of the fault current will take on an increasingly large value depending on the size of the fault.
It is necessary to set "Tor.selec.: Int." to work in this mode.

× ***Protection G with external toroidal transformer "Source Ground Return"***

Also called "Source Ground return", this can be carried out when there is the need to check operation of a machine (transformerù or generator or motor etc.) which has star configured windings.
The protection is carried out by physically positioning an external toroidal transformer on the cable connected from the star center of the machine to the earthing connection point.
The induced current on to the winding of the toroid is proportional to the fault current which, in this case, only transits in the above-mentioned toroid.
It is necessary to set "Tor.selec.Ext." to work in this mode.

The external toroid must be connected to the PR113 by means of a corded shielded two-wire cable (see note A to par. 11.2.2) with a length not exceeding 15m.
The shield must be grounded both on the power circuit breaker side and on the toroid side.

It is indispensable for the star center to be connected openly to earth and for the same not to be used as a neutral conductor as well (as in the TNC system), making a protection according to the TT system. The nominal values of the current sensors available are given in par. 15.4.2.1.

In single-phase self-supply, protection "G" is only active if the primary current is higher than 0.4xIn. When the value of the phase current is above 4xIn , function "G" excludes itself since, in this case, it is the other protections which intervene as the fault is considered a phase fault.

In accordance with the Nec standard, the maximum settable threshold is limited.

15.2.6.5.1 Start-up threshold "G"

It is possible to select the start-up function in the case where the curve with fixed time is selected.
The function is disabled by selecting '——-' at the "Startup" parameter on the protection "G" page.
The behavior of the function is identical to the one described for protection "S" (see par.15.2.6.2.2).

15.2.6.5.2 Zone selectivity "G"

It is possible to enable the function of zone selectivity in the case when the curve with fixed time is selected and there is an auxiliary power supply.
The cabling and enabling of zone selectivity "G" is an alternative to the "D" one and operation is only guaranteed when there is auxiliary voltage.

Zone selectivity "G" can be active at the same time as zone selectivity "S" since the inputs and the outputs are independent (ZSI=K51/GZin and ZSO=K51/Gzout).

The behavior and cabling of the function are identical to those indicated for zone selectivity "S" (see par.15.2.6.2.3).

15.2.6.6 Protection against phase unbalance "U"

The protection with fixed time, which can be excluded, trips in the case when, for a time greater than or the same as the time **t6** set, an unbalance is determined between two or more phases higher than the set threshold **I6**.

The percentage of unbalance is therefore calculated $\%Sbil. = \frac{I_{max} - I_{min}}{I_{max}} \cdot 100$ where I_{max} is the maximum and I_{min} the minimum phase current.

It is possible to disable the trip control of the protection ("Protection Trip: Off").
In that case, for the whole duration of the unbalance the power circuit breaker will not be opened, but only the condition will be signaled by means of the "warning" LED lit up and a warning message.
When the value of the phase current is above a 6xIn , function "U" excludes itself since in this case it is the other protections which intervene since the fault is considered a phase fault.
The protection is not enabled for maximum phase current values lower than 0.3xIn.

15.2.6.7 Protection against overtemperature inside the "OT" trip unit

A sensor is placed inside the PR113 unit which monitors the temperature of the unit.
This allows the presence of abnormal temperatures which could cause temporary or continuous malfunctions of the electronic components of the unit to be signaled.

This protection has two states of operation:

× State of **"WARNING TEMPERATURE"** with ***–25°C < temp. < -20°C*** or ***70°C < temp. < 85°C***; the display is turned off and the "TEMP" LED flashes.

× State of **"ALARM TEMPERATURE"** with ***temp. < –25°C*** or ***temp. > 85°C;*** the display is turned off,

the "TEMP" LED remains lit and the Trip is activated (if enabled, by means of the "Over Temper. Trip" = On parameter).

The precision of temperature measurement is ±1°C ("range" of measurement –40°C…+125°C).
N.B.:

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

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

Disabling the Trip control of the protection means that the PR113 unit could work, with the power circuit breaker closed, in a range of temperatures where correct operation of the electronics is not guaranteed.

15.2.6.8 "K" Load control function

There are two distinct protection curves with threshold currents and trip times lower than those selectable with protection L, which can be used for the following two applications:

1. *disconnection of two distinct loads (2 curves with inverse time $t = k/I^{2)}$;*
2. *connection and disconnection of one load (curve with adjustable delay t= k for connection and with inverse time $t= k/I^2$ for disconnection)*

These protections allow single loads to be connected/disconnected before protection L against overload intervenes to definitively open the power circuit breaker.

The disconnection protections use trip curves similar to those used by protection "L", but with lower thresholds and shorter times. The reference curves are those of protection "L".
Presence of a thermal memory is not foreseen. Operation with "L" thermal memory inserted could cause abnormal behavior.

The "Load control" protection is carried out by means of the relay contacts on board the PR113 unit (K51/p1 and K51/p2 to be configured) or by means of the contacts supplied by the PR020/K accessory signaling unit (par. 15.7.2). The function is only active when there is an auxiliary power supply.

The protection can be totally disabled by selecting the value [Off] beside the indication of the type of control activated (see par.15.4.2.2). Each single protection is excludable by selecting "Off" for the threshold.
The trip thresholds are expressed in percentages of the "L" (I_1) threshold. The trip times for load disconnection are fractions of the time selected for protection "L" (t_1).

15.2.6.8.1 Disconnection of two loads

The opening control for load n°1 is sent when I_{max} > Ic1 (for the time curve = t1/4). At this point the protection is disabled and a message appears for "load 1 open".

The opening control for load n°2 is sent when I_{max} > Ic2 (for the time curve = t1/2). At this point the protection is disabled and a message appears for "load 2 open".

To re-enable operation of the protections on load n°1 (or n°2), it is necessary to press the "RESET" key, on the current page, on the "default" page or on the one for configuration of protection "K".

15.2.6.8.2 Connection - Disconnection of a load

For reclosing timing with fixed adjustable time tc1 is applied. The closing control for load n°1 is sent when I_{max} < Ic1 (for the time set with tc1). On start-up of the unit, if self-reclosing is not locked, reclosing is always carried out if I_{max} < Ic1.
The opening control for load n°1 is sent when I_{max} > Ic1 (for the time curve = t1/2). At this point the protection is disabled and a message appears for "load 1 open".
It is re-enabled by the automatic reclosing or by pressing the "RESET" key on the currents page, on the "default" page or on the one for configuration of the protection (the opening protection is released voluntarily without a reclosing operation having taken place).

When the number of self-reclosing operations reaches the maximum number of self-reclosing operations which can be carried out ("Nr. AR = MaxAR"), reclosing is disabled (a message appears for "self-reclosing operation disabled"). To re-enable it, it is necessary to reset the **"Nr. AR"** (by entering the protection setting page in "edit" mode).

15.2.6.9 Voltage protections "UV", "OV", "RV"

The PR113 unit carries out 3 voltage protections, which are excludable, with fixed adjustable time (t = k), active both with self-supply and with auxiliary supply:
– Undervoltage "UV"
– Overvoltage "OV"
– Residual voltage "RV"

The protections work on the phase voltages. The threshold voltages indicated refer to the phase voltage.

Apart from normal timing and “Trip” operation, the voltage protections canbe in a state defined as “alarm” (“emergency” LED lit and display of alarm message), only with an auxiliary power supply. In fact, in the case where the power circuit breaker is open and no current is determined, the timing leads to the “alarm” state and not to “TRIP”. This is because the fault linked to the voltages can persist even with the power circuit breaker open (VT always connected) and the unit would therefore always be under “timing”. When closing of the power circuit breaker or the passage of current is determined, you pass immediately from the state of “alarm” to “TRIP” without timing (for warning see par. 15.3.2).

15.2.6.9.1 Protection “UV”

When the minimum phase voltage drops below the set threshold V_8 , the protection times for the time set t_8 and then opens.

15.2.6.9.2 Protection “OV”

When the voltage phase maximum exceeds the set threshold V_9 , the protection times for the time set t_9 and then opens.

15.2.6.9.3 Protection “RV”

When the residual voltage exceeds the set threshold V_{10} , the protection times for the time set t_{10} and then opens.

The residual voltage V_0 is calculated by vectorially summing the phase voltages. It is therefore defined by the following formula

$$\overrightarrow{V_0} = \overrightarrow{V_1} + \overrightarrow{V_2} + \overrightarrow{V_3}.$$

The protection allows determination of voltage unbalances in the case of star systems with neutral grounded.

15.2.6.10 Protection against Reverse active power “RP”

The PR113 unit carries out excludable, with fixed adjustable time (t = k) protection against reverse active power, active both with self-supply and with auxiliary supply.

When the total reverse active power (sum of the power of the 3 phases) exceeds the set threshold of reverse active power P_{11} , the protection times for the time set t_{11} and then opens.
The minus sign (‘-’) in front of the threshold and the power indicates reverse power. The threshold is indicated in a percentage of “Pn”, where “Pn” is the nominal power of the power circuit breaker (3 Vn*In).

15.2.6.11 Protection against instantaneous short circuit “linst”

This function has a single protection curve with fixed time.
When the protection trips, the power circuit breaker opens by means of the opening solenoid (SA).

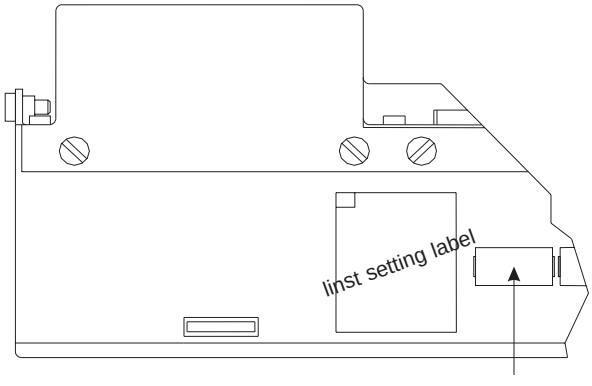
15.2.6.11.1 Selection of the threshold value

For correct setting of protection linst, linked to the size of the power circuit breaker, work on the relative 10 dipswitches placed on the part above the trip unit (see figure), consulting the label at the side of them.

The protection, which can only be set by ABB personnel, cannot be excluded.

In the diagrams of the label, relative to the settings, the position of the dipswitch is indicated by the white part.

In the diagram at the side, the dipswitch is set in the high position (Off)



Modification of the threshold set can lead to permanent damage of the power circuit breaker and of the installation itself with consequent damage to the operator.

15.2.7 Warning functions

15.2.7.1 Warning Threshold

This function allows monitoring of a current threshold Iw which can be set inside the configuration menu (see par.15.4.2.1). The function can be disabled by selecting [----] (value on “Off”).

When the maximum current (of phase or neutral) exceeds the set threshold, the “warning” LED is lit and the warning message is displayed. The signaling can be combined with one of the internal relays or with those of the PR020/K unit.

The precision of the threshold is ±10%.

15.2.7.2 Network frequency

The PR113 unit constantly measures the frequency of the network voltages it is connected to. When there are no voltages (Umax < 0.1Un), determination is carried out on the currents (if Imax >0.1In).

If the frequency goes out of the permitted range by ±10% in relation to the nominal frequency selected (50 or 60Hz), the "warning" LED is lit and the warning message is displayed (see par. 15.6).
Signaling can be combined with one of the internal relays or with those of the PR020/K unit.

Precision of frequency determination is ± 0.1Hz.

15.2.7.3 Harmonic distortion

The PR113 unit signals that a peak factor above a 2.1 has been exceeded with a warning message and the "warning" LED lighting up (see par. 15.2.8.4.2) (remember that the IEC 60947-2 annex "F" Standard foresees that the protection unit must function regularly with a peak factor ≤ 2.1, up to 2xIn).

Signaling can be combined with one of the internal relays or with those of the PR020/K unit.

15.2.7.4 Stato interruttore

When there is an auxiliary power supply, the PR113 unit determines the status of the power circuit breaker by means of special cabling on the power circuit breaker. In the case where the presence of current is determined with the power circuit breaker in the "OPEN" status, a status error is signaled by means of display of a warning message (see par. 15.6) and the "warning" LED lighting up.

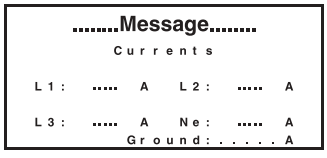
Signaling can be combined with one of the internal relays or with those of the PR020/K unit.

15.2.8 Measurement functions

The measurements are always available when there is an auxiliary power supply. In the case of self-supply, the sum of the entering currents must exceed a certain value (see par. 15.2.2.1) for the display to be activated. Both with Vaux and self-supply, the display is lit after a few seconds (see par. 15.2.2) from when the PR113 itself is turned on.

The indication "**……**" corresponds to a value under the minimum measurable.
The indication "**> xxxx**" corresponds to a value over the maximum measurable.
The indication "**-----**" corresponds to disabling of the calculation of the value.

15.2.8.1 Current measurements



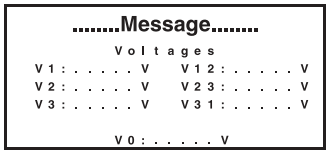
The PR113 unit is able to provide current measurement of the three phases, of the neutral and of the ground fault, both with self-supply and with an auxiliary power supply. The ground fault current takes on two different meanings according to whether the internal "Ground Fault" toroid is selected or the external "Source Ground Return" one.
You access the page from the default one by using the ↓ key (↑ to go back).

The minimum value of current measurable is 0.1xIn (10% of the nominal).
The maximum value of current measurable is 16xIn.

The measurement of current for the ground fault is disabled when the current of one of the phases exceeds a defined value (see par. 15.2.6.5).

Range	0.4….2xIn
Measurement precision	2 %

15.2.8.2 Voltage measurements



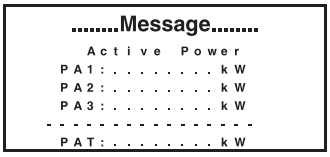
The PR113 unit is able to provide voltage measurement of the three phases, of the relative line-to-line voltages and of the residual voltage both with self-supply and with an auxiliary power supply.
You access the page from the current measurement one using the ↓ key (↑ to go back).

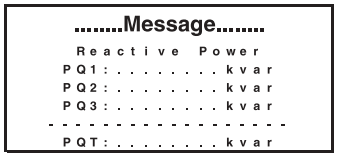
The minimum value of voltage measurable is 0.05xUn (5% of the nominal).
The maximum value of current measurable is 1.2xUn.

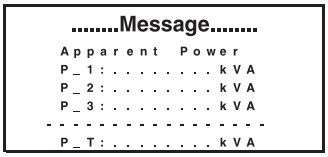
Measurement precision	1 %

Values obtained with class 0.5. voltage sensors (see note A al par.15.3.2.1)

15.2.8.3 Power measurements







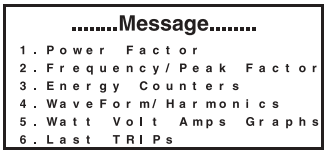
The PR113 unit is able to provide measurement of the active, reactive and apparent powers of the three phases and of the relative total powers (of the system), both with self-supply and with an auxiliary power supply.
You access the “Active power” page from the one of voltage measurements using the key (↑ to go back). Still with ↓ in succession, you access the other two “Reactive power” and “Apparent Power” pages. From the latter, by pressing ↓ again, you return to the default page.

The minimum value of power measurable is 0.02xPn_{phase} (2% of the nominal of phase A x In).
The maximum value of power measurable is 19.2x$Pn_{phase.}$

Range	0.4 … 2xPn_{fase}
Measurement precision	3 % *

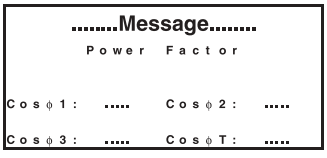
*: With cos}v > 0.5.

15.2.8.4 Other Measurements



From the “Measurements/Trips” menu it is possible to access a whole series of other measurements. Only the “Power factor” and “Frequency/peak factor” pages are also available with self-supply. Position the cursor arrow over the required position and press the ↵ key to access the measurement desired.

15.2.8.4.1 Power factor Measurements

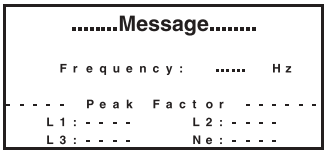


The PR113 unit provides measurement of the power factor of each phase and of the system (calculated as a weighted average of the phase factors). For phase power under 2% (0.02xPnfase), the value is not displayed and is replaced by ‘.....’.

The measurement precision is class 2 in the interval [0.5…1].

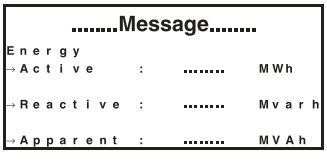
15.2.8.4.2 Frequency and Peak factor Measurements

This page allows display of the network frequency. This is calculated on the voltages (if Umax > 0.1Un) and, if these are lacking, on the currents (if Imax > 0.1In). The calculation of the frequency allows a precision of ± 0.1Hz (after a maximum of 5s from the variation of the frequency).



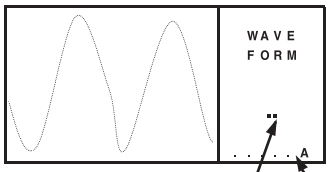
Measurement of the peak factor - relationship between I_{peak} / I_{rms} - for each of the phases is also present. The measurement is not displayed for phase current less than 0.3xIn and is not available for phase current above 6xIn. The accuracy of the calculation follows what is indicated for measurement of the currents (see par. 15.2.8.1).

15.2.8.4.3 Energy Measurements



The unit carries out counter measurements of active, reactive, and total apparent energy of the system. The minimum value which can be displayed is 0.001MWh or 0.001Mvarh or 0.001MVAh. The counter resets itself when the apparent energy accumulated reaches a value equivalent to 200 days at the nominal three-phase power of the power circuit breaker (continuous).
By pressing the “RESET” key inside the page the counter is reset.
The accuracy of the calculation follows what is indicated for measurement of the powers (see par. 15.2.8.3).

15.2.8.4.4 Display of Wave form and harmonic calculation



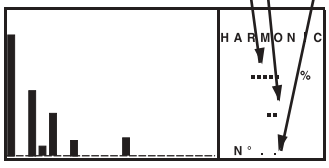
By entering the page, 120 samples of the wave form of phase L1 are acquired and then displayed. By pressing the ↵ key, a new acquirement and re-display of the waveform is carried out. By means of the → or ← keys, it is possible to display the waveforms on the other measurement channels (L2, L3, Ne, V1, V2, V3, Gt).

Channel displayed

RMS of the signal displayed

Value of harmonic N°

N° of harmonic currently selected



Using either the ↑ or ↓ keys, it is possible to carry out a harmonic analysis of the samples acquired and displayed on the "Wave Form" page.
This means the page indicated here at the side is displayed, containing the module of the harmonics from the 2nd to the 20th (up to the 19th for network frequency set to 60Hz) referred as a percentage of the fundamental (harmonic n°1) and therefore always indicated at100%.

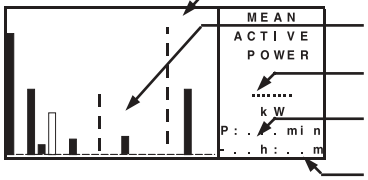
Using the → and ← keys, it is possible to position yourself over the desired bar (at the "N° " of harmonic desired, the bar starts to flash) and read the corresponding percentage value.

Measurement precision	5%

15.2.8.4.5 Historic Measurements

The PR113 unit is able to provide the trend of the measurements of some values over a settable period of time "P" (see "Store Meas. T", par. 6.2.1 for setting the periods).

Memory (not volatile) is kept of the last 24 "P" periods which are displayed in a histogram (see figure) with the least recent period positioned on the right side of the page whereas on the left side there is another bar (the 25th) representing the progressive value of the period in progress of storage.



Progressive value of present period

Indication of variation of the "P" period

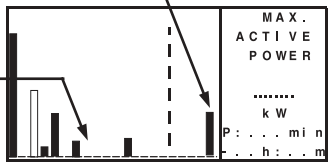
Value of the bar currently selected.

Period of storage of the bar selected.

Hour and minute of starting the period the bar refers to, in relation to the present instant

Indication of Vaux being turned on

The "empty" bars indicate a negative value.

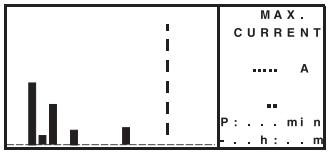


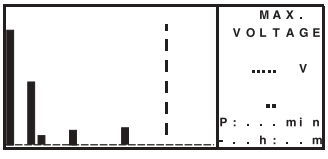
Using the → and ← keys, it is possible to position yourself over the bar desired (which starts to flash) and read the corresponding value of the that period (for example, the maximum power determined in the "P" interval) as well as the time that period of measurement was started with reference to the present instant.

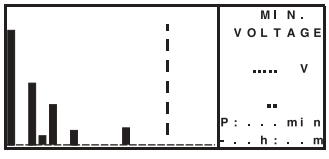
The measurements can only be acquired with Vaux present for the whole period of storage, otherwise the data is not recorded. The "turning on auxiliary" symbol indicates that there has been a period (without Vaux) of no storage during which the data were lost and the time counter was blocked.

The full-scale of the histograms is fixed by the graduated scale present on the diagram (on the left side). In any case, the higher values are correctly displayed in the "Value of the present bar" field.

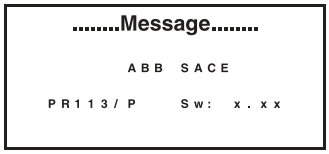
Apart from "Average active power" and "Maximum Active power", the "Maximum Current", "Maximum Voltage" and "Minimum Voltage" historical values are available.







15.2.9 Information functions
15.2.9.1 Software version



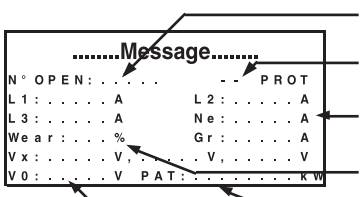
This page shows what the software version of the relative PR113 trip unit is.

Each time it is necessary to communicate any unit operating problems to ABB SACE, it is advisable to indicate the **Sw** version of the unit ("x.xx")

15.2.9.2 Opening data storage

The storage function of the opening data ("TRIP" = opening for protection) is only active if there is an Auxiliary power supply before, during and after (for at least 1sec.) any power circuit breaker opening due to a trip for protection by the trip unit.

The function and also consultation of the page which shows the last data stored are therefore only **available when there is an auxiliary power supply**. In self-supply, the attempt to access the page makes a "function not available" message appear.



Number of openings due to the protections and to the TRIP tests

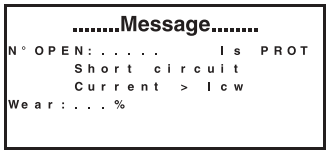
Indication for protection tripped

Value of the currents interrupted on phases (L1, L2, L3), neutral (Ne) and Ground (Gr) not available in the case of a trip with phase current > 4xIn or I or S with "minimum" time).

Contact wear accumulated.

Value of total interrupted Active power (not available in the case of S, I, D and G trip)

Value of phase voltages (V1, V2 and V3; not available in the case of I trip) and residual voltage (V0; not available in the case of I or S with "minimum" time trip) at the moment of interruption



In the case of trip for "Iinst", the page at the side is displayed.

Entering the page from the "Measurements/Trips" menu by selecting "Last Trip", the last opening carried out is always presented. Using the ↑ and ↓ keys it is possible to scroll through the last 10 Trips stored by the unit.

The percentage of contact wear is indicative of the electrical life of the electrical contacts of the EMAX power circuit breaker.
In any case, functionality of the trip unit is in no way modified by the presence of the wear messages.
The prealarm message (wear > 80%, "warning" LED lighting up) indicates that the wear has reached a high value. The alarm message (100% wear, "emergency" LED lighting up) indicates that it is necessary to check the state of contact wear. The signals are only active with Vaux.
The percentage of wear depends on the number of openings carried out by the power circuit breaker and by the absolute interrupted current during each of them.

Protection	Symbol	Protection	Symbol	Protection	Symbol
Prot. L	L	Prot. I	I	Overvoltage	OV
Prot. S	S	Ground fault	G	Undervoltage	UV
Directional (direction not determined)	D	Phase unbalance	U	Residual voltage	RV
Directional (forward direction)	Df	Temperature	OT	Reverse active power	RP
Directional (backward direction)	Db			Prot. Inst	Is

15.2.10 Other functions
15.2.10.1 Programming contacts K51/p1 and K51/p2

The PR113 is fitted with two relays, whose contacts are called K51/p1 and K51/p2.
These can signal different situations, selectable by the user among those listed in the following table.

N°	Value	Description	Notes
1.	" L preal. "	Prealarm of "L"	*Active with I > Prealarm Threshold, see par.15.4.3.1*
2.	" L timing "	Timing protection "L"	
3.	" S timing "	Timing protection "S"	
4.	" D timing "	Timing protection "D"	

N°	Value	Description	Notes
5.	" G timing "	Protection "G" timing	
6.	" G alarm "	Protection "G" Alarm	*Active in the case when "G" trip is disabled*
7.	" UV tim. "	"Undervoltage" protection Timing	
8.	" UV alarm. "	"Undervoltage" protection Alarm	*Active in the case of power circuit breaker open state*
9.	" V<TH.UV. "	Undervoltage" protection at threshold	*Equivalent to the logical OR of " UV tim. "and " UV alarm."*
10.	" OV tim. "	"Overvoltage" protection Timing	
11.	" OV alarm. "	"Overvoltage" protection Alarm	*Active in the case of power circuit breaker open state*
12.	" V>TH.OV. "	"Overvoltage" protection at threshold	*Equivalent to the logical OR of " OV tim. "and " OV alarm "*
13.	" RV tim. "	"Residual Voltage" protection Timing	
14.	" RV alarm. "	"Residual Voltage" protection Alarm	*Active in the case of power circuit breaker open state*
15.	" V0>TH.RV "	"Residual Voltage" protection at threshold	*Equivalent to the logical OR of " RV tim. "and " RV alarm*
16.	" RP tim. "	"Reverse Power" protection Timing	
17.	"U tim. "	"Unbalanced Phases" protection Timing "	
18.	"U alarm. "	"Unbalanced Phases" protection Alarm	*Active in the case "U" trip is disabled*
19.	" L trip "	Opening by protection "L"	*Reset signaling by means of "RESET" key*
20.	" S trip "	Opening by protection "S"	*Reset signaling by means of "RESET" key*
21.	" D trip "	Opening by protection "D"	*Reset signaling by means of "RESET" key*
22.	" I trip "	Opening by protection "I"	*Reset signaling by means of "RESET" key*
23.	" G trip "	Opening by protection "G"	*Reset signaling by means of "RESET" key*
24.	" T trip "	Opening by protection "T"	*Reset signaling by means of "RESET" key*
25.	"UV trip "	Opening by protection "UV"	*Reset signaling by means of "RESET" key*
26.	"OV trip "	Opening by protection "OV"	*Reset signaling by means of "RESET" key*
27.	"RV trip "	Opening by protection "RV"	*Reset signaling by means of "RESET" key*
28.	"RP trip "	Opening by protection "RP"	*Reset signaling by means of "RESET" key*
29.	"U trip "	Opening by protection "U"	*Reset signaling by means of "RESET" key*
30.	"Any trip "	Opening of one of the protections listed	*Reset signaling by means of "RESET" key*
31.	"Warn. T "	Thresholds exceeded: temp <-20°C and temp > +70°C	
32.	"Alarm T "	Thresholds exceeded: temp <-25°C and temp > +85°C	
33.	"Sz: IN "	Zone selectivity S (or DFW) on input ON	
34.	"Sz: OUT"	Zone selectivity S (or DFW) on output ON	
35.	"Gz: IN"	Zone selectivity G (or DBW) on input ON	
36.	"Gz: OUT"	Zone selectivity G (DBW) on output ON	
37.	"LC1 set"	Load control n°1 contact	Relative to threshold Ic1
38.	"LC2 set"	Load control n°2 contact	Relative to threshold Ic2
39.	"Harmonic"	Peak factor >2.1	Harmonic distortion
40.	"Out fre."	Frequency out of 50Hz 10% or 60Hz 10% range	
41.	"Iw thre."	Current above the set threshold Iw	
42.	"RCC Al."	" Signaling CT disconnection	At least one
43.	"CCC Al."	" Signaling SA disconnection	
44.	"CCC,RCC"	Logical OR between "RCC Al." and "CCC Al."	
45.	"Trip ba."	Backup protection tripped (TRIP fail)	See "note C" to par.11.2.2
46.	"YO back."	Backup protection control for YO	See "note C" to par.11.2.2
47.	"CB close"	Signaling power circuit breaker closed status	
48.	"CB error"	Presence of current with power power circuit breaker open	See paragraph 15.2.7.4
49.	"No I. bus"	No communication on the internal bus	With PR020/K active

15.2.10.2 Programming contacts K51/1 …. K51/8 of the PR020/K

Using a PR020/K, connected to the PR113, the user has the possibility of combining up to 7 different situations, selectable from the previous table (Table 9), with the relays available in the PR020/K itself.
It is also possible to connect two or three PR020/Ks with the PR113.
The only points to note are that the Vaux must be common to all the PR020/Ks, and that one must be configured as master, whereas another as slave.
In this way it is possible to activate up to (7 + 8 + 3 =) 18 contacts without potential (relay), plus 6 replicated, (see par. 15.7.2).

15.2.10.3 Watchdog

The PR113 unit provides some watchdog functions able to guarantee correct management of the trip unit malfunctions. These functions are as follows:

❑ Watchdog of correct operation of the microprocessor (by means of a Watchdog signal generated by the microprocessor). In the case of a fault, signaling takes place by means of the front "µP Fault" LED lighting up (also operational in self-supply) and closing of the monostable contact k51/µP (only with Vaux).

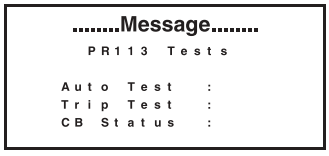
❑ Watchdog for presence of Auxiliary power supply.

Signaling by means of front 'Vaux ' LED.

❑ Watchdog for correct connection of the current sensors (CT). In the case of a fault, signaling takes place by means of a special alarm message and the "emergency" LED lighting up.

❑ Watchdog for correct connection of the opening solenoid (SA). In the case of a fault, signaling takes place by means of a special alarm message and the "emergency" LED lighting up.

15.2.10.4 Self-Test



The page shown at the side will be displayed by selecting the sub-menu "4. Test" from the main menu screen.

At this point it is possible to check correct operation of:

❑ Actuation chain (microprocessor, cabling and SA) with the "Trip Test" function. Select [On] and press the TEST pushbutton. In the case of a positive result the power circuit breaker is opened. The function is only available with busbar current nil (use Vaux, PR120/B or PR010/T).

❑ User interface devices with the "Self-test" function. Select [On] and press ¿ to check correct operation of:
- Display (all the pixel of the matrix light up)
- Contrast (this is decreased, increased and then reset)
- Led (n°6)
- Magnetic Flags (n°5)
- Relay tripped contact (k51/Y01)
- mPfault, k51/p1 and k51/p2 contacts (only with Vaux)

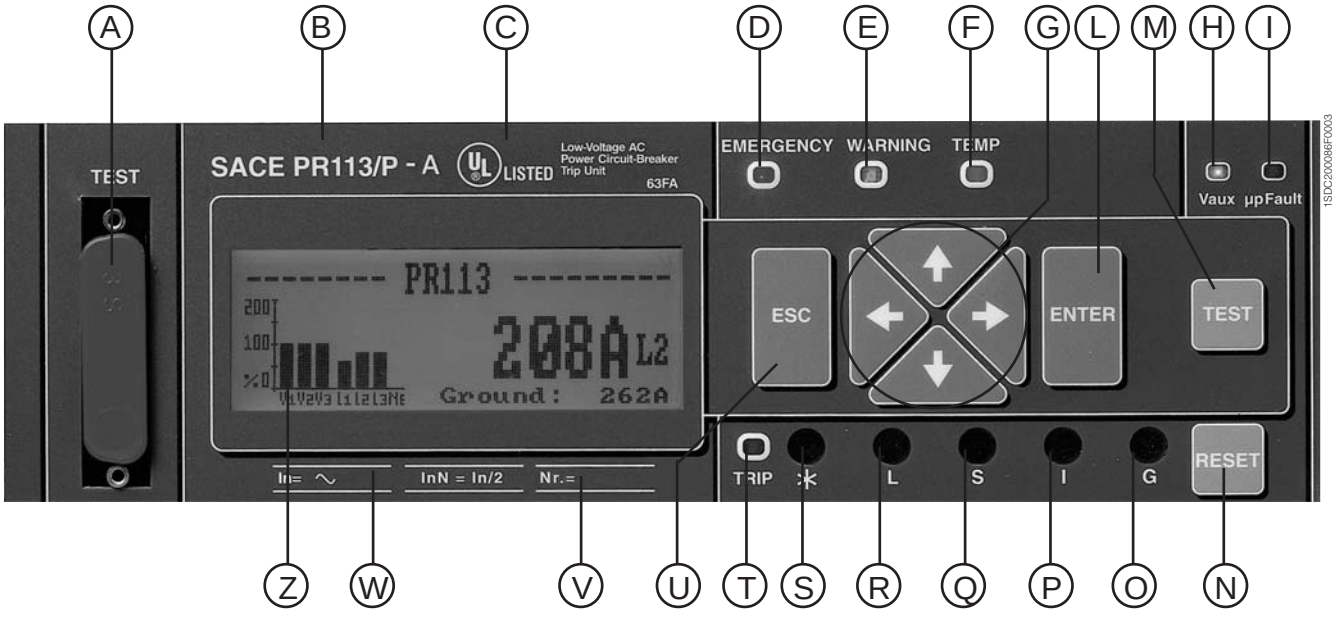
In the case of Warning or Emergency, the test is immediately abandoned, still guaranteeing all the protection functions. The test is interrupted by pressing the "RESET" key.

The functions are guaranteed when there is Vaux or in self-supply with at least single-phase 0.5xIn.
In the absence of both, the energy can be supplied by the PR120/B accessory power supply unit.

On this page - only with Vaux - it is also possible to see the status of the power circuit breaker ("CB STATUS"), thereby checking correct cabling of the input.

15.2.10.5 Complex test of the trip unit

It is possible to carry out a complete series of tests, with a report which can be downloaded to a PC by using the PR010/T test unit (see par. 15.7.1) connected to the trip unit by means of the front TEST connector.



Ref.	Description
A	TEST connector for application of the PR120/B or PR010/T accessories.
B	SACE Logo identifying the product.
C	Position of UL certification label.
D	“EMERGENCY” LED.
E	“WARNING” LED.
F	“TEMP” LED.
G	Pushbuttons for moving the cursor and setting the parameters: UP, DOWN, LEFT, RIGHT.
H	“Vaux” LED.
I	“µP Fault” LED.
L	Consent pushbutton for entering data or for confirmation (ENTER).
M	Pushbutton to make the opening solenoid trip (TEST) + adjustment functions.
N	Pushbutton for resetting the magnetic and electrical signals (RESET), to end the Self-Test or to return to the current page from the Trip page.
O	Magnetic signaling indicating ground fault “G” protection tripped.
P	Magnetic signaling indicating instantaneous short circuit “I” protection tripped.
Q	Magnetic signaling indicating trip of protection functions “S” or “D”.
R	Magnetic signaling indicating overload “L” protection tripped.
S	Magnetic signaling indicating trip of one of the following protections: undervoltage, overvoltage, residual voltage, and reversal of active power, phase unbalance or overtemperature.
T	“TRIP” LED.
U	Pushbutton for exiting the sub-menus or for cancellation (ESC).
V	Serial number of the unit
Z	Rear-lit graphic display
W	In (Continuous current rating of the CTs installed)

The Graphic Display is of the LCD type with 192x64 pixel and is rear-lit when there is an auxiliary voltage.
The display is always lit, when there is Vaux, or, in self-supply with a minimum busbar current, as defined in par. 15.2.2.1
It is possible to adjust the contrast by pressing over the TEST key on the current page (the one which shows the four busbar and the ground currents), using the ↑ and ↓ keys to increase and decrease it, and ↵ for the ABB SACE default value.
N.B.: In the case of “TEMP” LED lit or flashing, the display turns off (see par.15.2.6.7).

Fig. 7 - Some screens of the unit.

15.2.11.1 Use of pushbuttons

The modifiable fields can be filled in using the → or ← keys and confirming with the ↑and ↓or ↵keys. Once entered on the relative page, movement from one value to another can be carried out by using the ↑ and ↓ keys. To change a value, on the other hand, once the cursor is positioned over the value itself (the modifiable field will be put in reverse, i.e. white on a black background), use the →or ← keys.

To confirm the programming operation of the parameters just configured, press the **ESC** key once only. A check will be carried out for parameters entered and then the page for programming confirmation will be displayed. To return to the main menu, it is necessary to press the **ESC** key twice.

The **RESET** pushbutton must be used to reset the yellow magnetic flags, the contacts of the signaling relay unit and to interrupt the self-test.

The **TEST** pushbutton must be used to carry out the Trip test and to activate adjustment of the contrast on the display.

15.2.11.2 Read and Edit mode

The map relative to the menus (see par. 15.4.1) displays all the pages which can obtained and the movements to be carried out with the keyboard, in the“READ” (just for data readout)or in the “EDIT” mode (for the setting the parameters).

Starting from any page displayed, two different operations can be obtained according to the state of the unit:
1. “READ”:
   the default page will be displayed automatically after about 120 seconds.

2. “EDIT”:
   the default page will be displayed automatically after about 240 seconds.

The functions allowed according to the state are :
“READ”:
- ✓ Consultation of the measurements and of the historical data
- ✓ Consultation of the unit configuration parameters
- ✓ Consultation of the protection parameters

“EDIT”:
- ✓ Everything allowed in READ mode
- ✓ Configuration of the unit
- ✓ Programming of the parameters relative to the protections
- ✓ TEST Functions of the unit

To access to the “EDIT” mode, it is necessary to press the ↵ key on of a page with fields which can be edited. A password will therefore be required to enable passing into the editing mode.

15.2.12 Default settings

The PR113/P-A is supplied by ABB SACE with the following predefined parameters:

#	Protection	On/Off	Threshold	Time	Curves	T.M.	ZS	Trip
1	**L**	--	1 In	144 s	I^2t	Off	--	--
2	**S**	Off	6 In	min	K	--	Off: 0.04s	--
3	**D**	Off	6 In	0.2s-0.2s			Off: 0.13s	
4	**I**	On	4 In	--	--	--	--	--
5	**G**	Off	0.2 In	0.4 s	K	--	Off: 0.04s	On
6	**U**	Off	50 %	5 s				Off
7	**OT**	--	See par.15.2.6.7				Off	
8	**K**	Off						
9	**UV**	Off	0.9 Un	5 s				Off
10	**OV**	Off	1.05 Un	5 s				
11	**RV**	Off	0.15 Un	15 s				
12	**RP**	Off	- 0.1 Pn	10 s				
13	**Iinst**	On	E1 (*)	--				
14	**Language**	--	Engl					
15	**Net Frequency**	--	60 Hz					
16	**PR020/K**	Off						
17	**PR020/K relays**	--- (Off)						
18	**Neutral sel.**	--	50 %					
19	**Toroid Selec.**	--	Int.					
20	**CB**	--	E1B-A800 (*)					
21	**CS In**	--	250 A (*)					
22	**Ext. tor. In**	---- (Off)	100 A					
23	**Vs Un**	--	380/$\sqrt{3}$ V					
24	**Startup Thresholds**	Off	--	0.10 s				
25	**S startup (threshold)**	---- (Off)	---- In					
26	**D startup (threshold)**	---- (Off)	---- In					
27	**I startup (threshold)**	---- (Off)	---- In					
28	**G startup (threshold)**	---- (Off)	---- In					
29	**Password**	--	0001					
30	**Store Meas. T.**	--	60 min.					
31	**Warning Current Thre.**	-- (Off)	--					
32	**PR113 Relay 1**		PL					
33	**PR113 Relay 2**	Off						

(*) Parameters set with these values only for PR113 sold as a loose piece.

15.3 Putting into service

15.3.1 Connections

For the connections to be provided by the user, it is recommended to strictly follow what is indicated in this document.
This means that we shall be able to satisfy all the international reference Standards and guarantee perfect operation of the trip unit even under severe environmental and electromagnetic conditions.
Pay particular attention to the types of cable, the connections to ground and the maximum distances recommended.

15.3.2 VT Connections

15.3.2.1 Summarized Table for VT connections

Types of transformers:
TV ABB SACE: ABB SACE model TV055 transformers (with nominal secondary voltage =100$\sqrt{3}$ V).
TV Custom (A): single custom-made “ad hoc” transformers with the same electrical characteristics as the ABB SACE VT (ABB SACE RE0382 drawing)
TV Standard (A): single standard transformers “compatible” with ABB SACE VT (the same electrical characteristics except for the output voltage: Us=100Vrms).

(A): The VTs must have a performance of between 1 VA and 5 VA max., 4 kV insulation between primary and secondary and towards the shield, primary impedance of 600 ohm; class 0.5. They must be of the insulation type (fitted with metal shield between the two windings) with the shield grounded.

Installation System	ABB SACE VT type transformer (Star/Star)		“VT Custom” type transformer (Star/Star)		“VT Standard” type transformer (Delta/Delta)	
	Application diagram	Functionality	Application diagram	Functionality	Application diagram	Functionality
TN-C	**A**	**Total**	**D**	**Total**	**C**	**Note 5**
TN-S	**A/B**	**Total**	**D**	**Total**	**C**	**Note 5**
IT with neutral	**A**	**Total**	**D**	**Total**	**C**	**Note 5**
IT	**B**	**Note 1 and 4**	**n.c**	**—**	**C**	**Note 5**
TT with neutral	**A**	**Total**	**D**	**Total**	**C**	**Note 5**
TT without neutral	**B**	**Note 1 and 4**	**n.c**	**—**	**C**	**Note 5**

Caption:
UV: Undervoltage protection; **OV:** Overvoltage protection; **D:** directional protection; **n.c.:** not allowed.

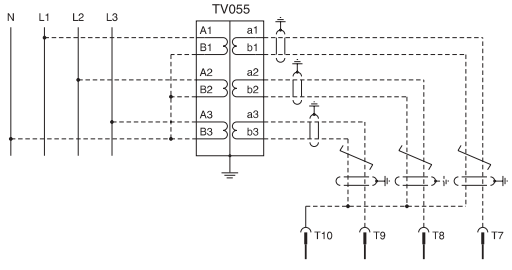
Note 1: - In application diagram B, the RV (residual voltage) protection is not correctly operative
Note 2: - for TN-C systems the connection must be carried out on PEN
- for TN-S systems the connection must be carried out on N for configurations with neutral or on PE for configurations without neutral as shown in application diagram A; in the case where the PE is used, the current on this could be around a dozen mA. If the customer considers this value too high or has a residual current protection which risks intervening, application diagram B must be used (see notes 1 and 3)
- for IT and TT systems with neutral, the connection must be carried out on N

Note 3: - For the TV054 transformer, the Up (primary voltage) and Us (secondary voltage) voltages are starred voltages (phase-neutral).
- For the VT_ADAPTER adapter, the line voltage is intended as line-to-line (phase-phase).

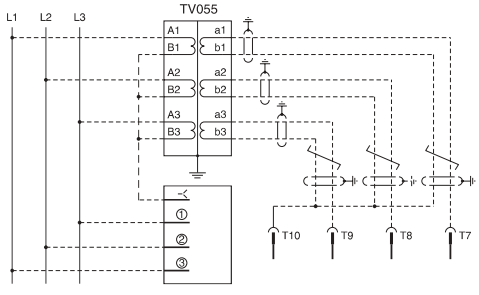
Note 4: - For voltages lower than 230V or higher than 690V, the protection functions which make reference to the voltage measurements cannot be used.
Note 5: - Exclude functions UV, OV, RV and D. The voltage and power measurements are calculated using a reconstructed star center.

15.3.2.2 Connection application diagrams

Application diagram A (see Note 3)

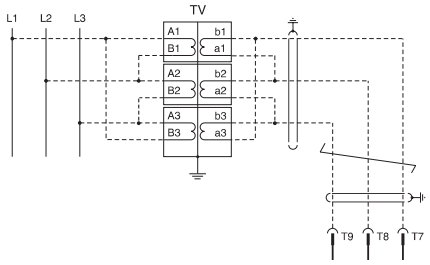


Application diagram B (see Note 1 and Note 3)

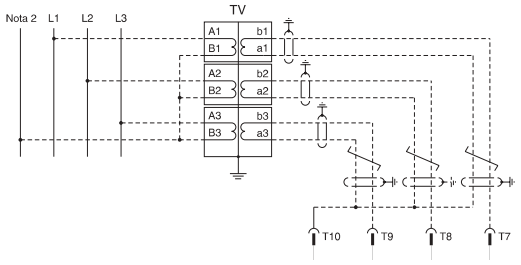


VT_Adapter	Input connections		
Up	①	②	③
Up < 230 V	See note 4		
230…277 V	A1	A2	A3
347…480 V	B1	B2	B3
500…690 V	C1	C2	C3
Up > 690 V	See note 4		

Application diagram C



Application diagram D



15.3.3 CT and SA connection check

If installation of the PR113 was carried out by the user, at the time the trip unit is turned on for the first time, it is advisable to check the first line of the display. No messages of CTs and/or SA disconnected must appear, otherwise immediately open the power circuit breaker and make the correct connections.

15.3.4 Test

Before putting into service, it is possible carry out a test by means of the specific “Self-test” function which can be activated on the PR113. A positive result is visible and shown on the display.
Following this, it is possible carry out, still using the specific function (Trip test), testing of the whole SA chain. A positive result is given by the power circuit breaker opening.Check, on the same “PR113 Tests” screen the open or closed status of the power circuit breaker, checking “CB Status”.

.....Message.....

PR113 Tests

Auto Test :
Trip Test :
CB Status :

15.3.5 Initial settings

If the PR113 is supplied directly installed in the power circuit breaker it is up to ABB SACE to set all the variables referring to the power circuit breaker or to the specific application correctly (e.g. Type of power circuit breaker, CT size, network frequency …). Vice versa, if the PR113 is supplied as a loose piece, it will be up to the user to set all the necessary parameters correctly.
It should be noted that ABB SACE defines each possible setting in a sensible way (see default parameters).

Apart from this, it is absolutely indispensable for the user to modify the password and carefully define each modifiable parameter, before putting the PR113 into service.

15.3.6 Password management

Password? [0*]**

To enter “edit” mode it is necessary to enter a four-figure numerical password.
Select the value of the first figure (between ‘0’…’9’) by means of the ↑ and ↓ keys and press ↵ to confirm the figure and pass on to entering the next one.
After entering the fourth figure, check the password entered. If the password is correct, you pass from the “READ” mode to the “EDIT” mode (at this point the first field which can be edited on the page is displayed in reverse).

In the case of an wrong password, the message following message appears

Wrong password

which remains until the **ESC** key is pressed (or after 2 minutes).

It is also possible to interrupt the operation during entry of the password by pressing the **ESC** key.

The password is valid for a maximum of two minutes from the last time a key was pressed. It is immediately reset in the case of a high priority alarm or when the unit is reset.

On entering a page without modifiable parameters, the state of the protection is put on “READ”. If the password is still valid, to enter “edit” mode (on a page with modifiable parameters) simply press the key ↵.

Disabling the Password.

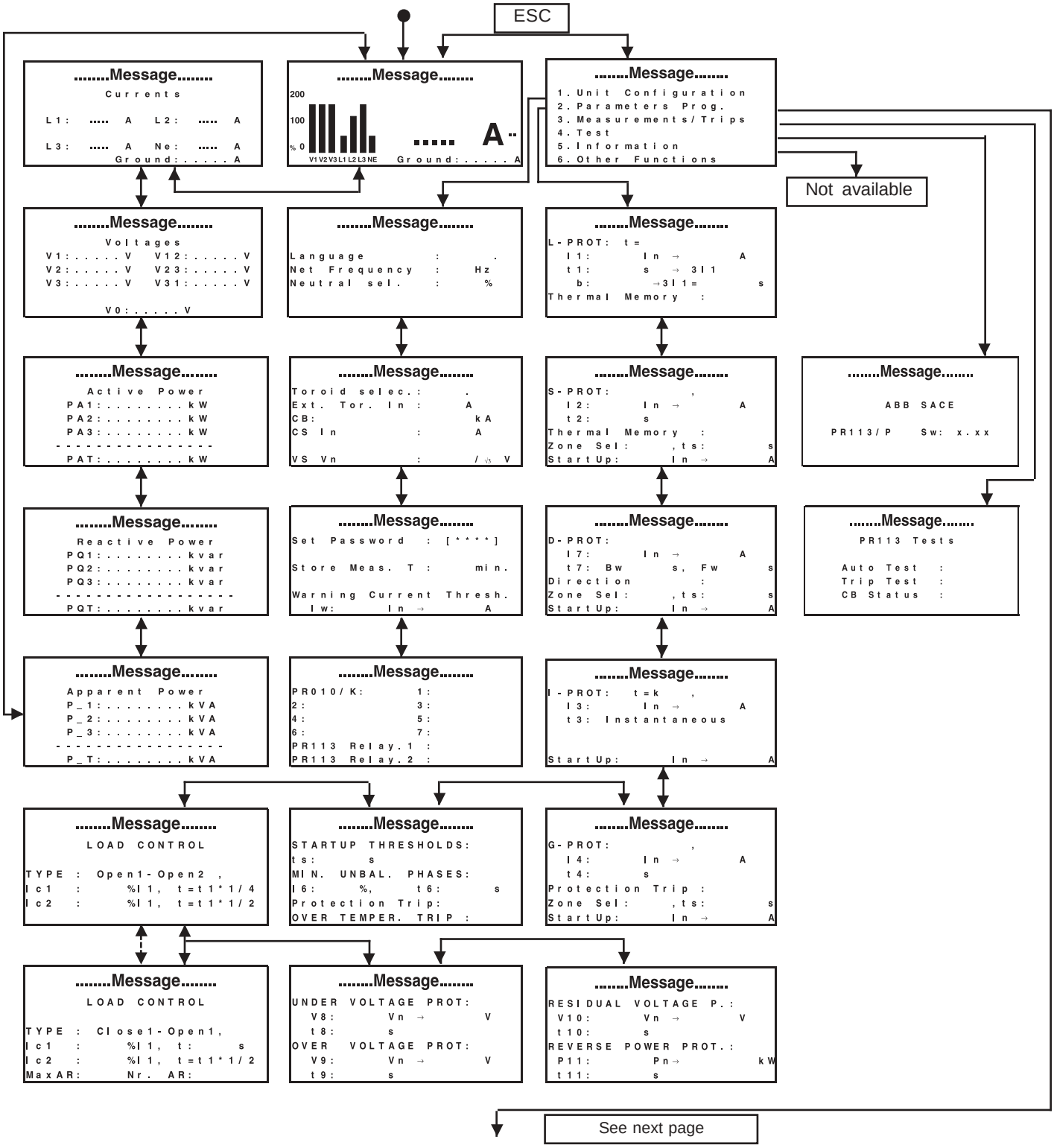
By setting the value of the password to [0000] (in the “Unit configuration” menu) the request for password is disabled. Passing from “READ” to “EDIT” is therefore always possible.

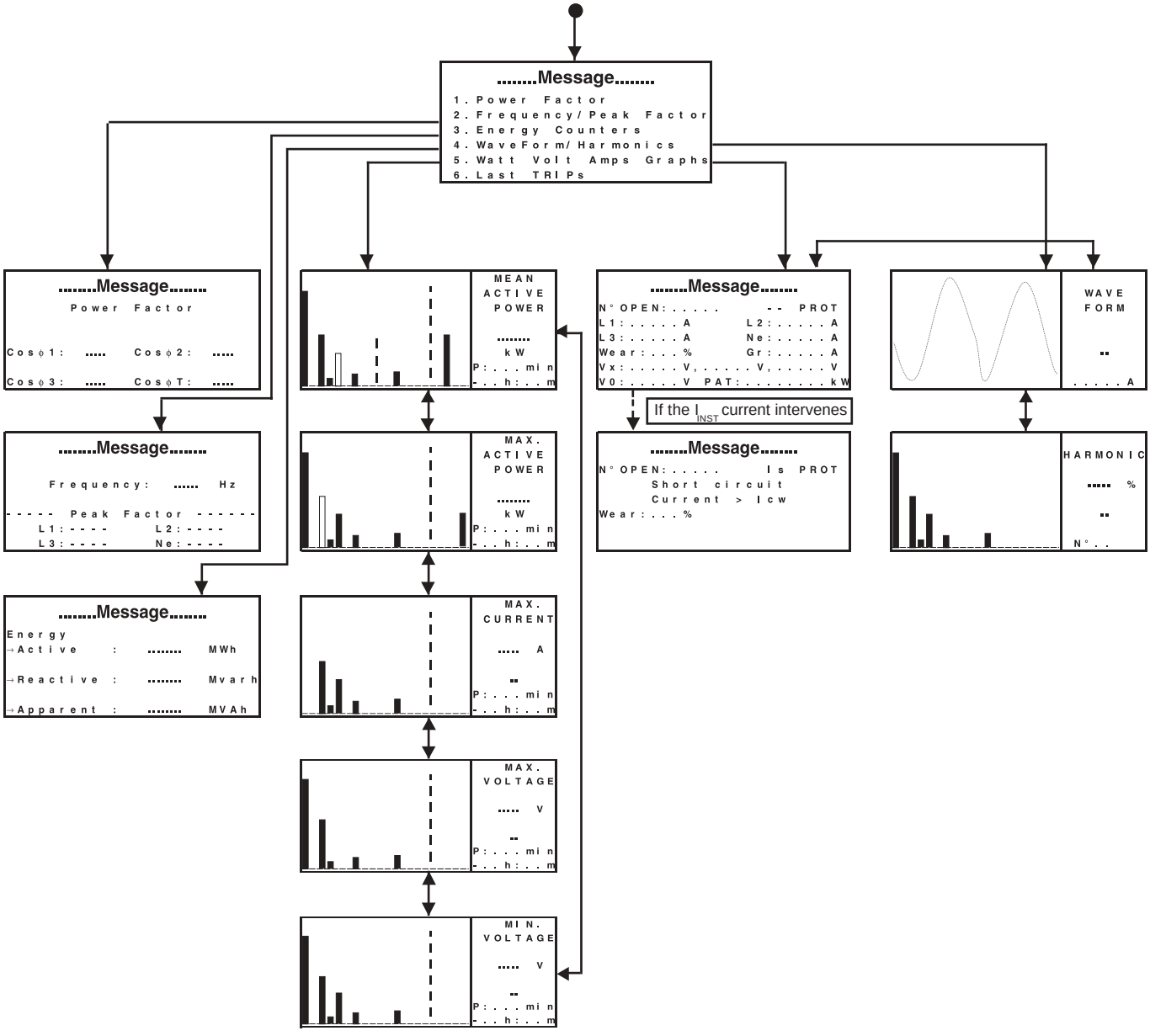
To enter a new password, select “Set Password” from the “Unit Configuration” menu.

15.4 Operative/operating instructions during service

15.4.1 Menus

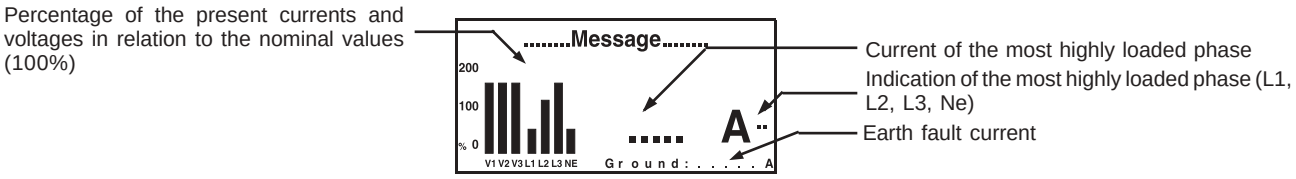
As already seen previously, the PR113 uses the display to show messages, diagrams and menus. These are organized in a logical and intuitive way. For user convenience, all the screens visible are given below.





Mod.	L2275			Apparatus	**Emax UL**	Scale
				Doc. N°	**RH0109002**	Page N° **84/132**

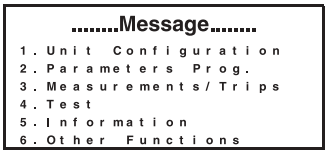
Each time the unit is activated, or after more than 2 minutes of inactivity on the keyboard, the display indicates the following page (default):



On most pages, in the space indicated by "….Message…", any "warning" or "error" messages are displayed (see par.15.6). In the case where there is more than one, they are displayed cyclically, one each second. By pressing the ↵ key, it is possible to block scrolling of the messages on the one currently displayed (the "←"symbol appears in the right-hand corner of the line). This means the various messages can be scrolled one at a time using the ↵ key. To reset automatic updating, simply press the ↵ key again. (the "←"symbol disappears). In the case when there are no messages, the name of the unit is displayed.

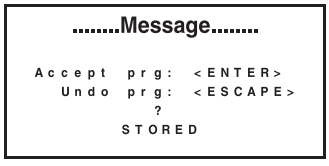
15.4.2 Modification of parameters

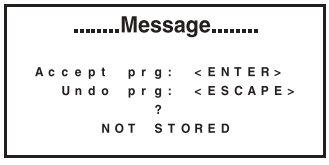
In the case where the operator wants carry out reading or data configuration operations, it is sufficient to press the **ESC** (escape) key and the page relative to the main menu will automatically be displayed:



Now, with the ↑ (up arrow), ↓ (down arrow), ↵ (enter) and **ESC** (escape) keys, it is possible to move around inside the main menu and reach all the pages relative to the configurations and parameterizations to display or modify the parameters set..

On completion of a programming operation, to accept the new configuration (**Accept prg**) press the ↵ key or press the ESC key to refuse it and therefore keep the old configuration (**Undo prg**).
The following will therefore appear:



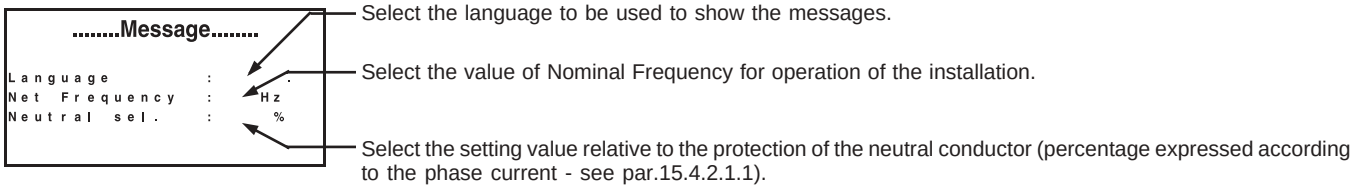


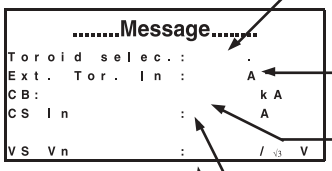
These pages indicate whether data storage has been successful or not.
In the latter case, the PR113 unit will use the last valid configuration set.

15.4.2.1 Modification of basic configuration

If the PR113 unit is in an alarm **situation no parameterization is allowed.**

The configuration of the unit must be carried out in EDIT mode.
Following what is indicated in par.15.2.11, show the following on the display:





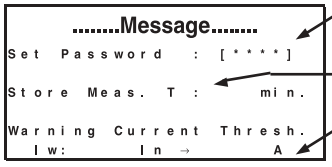
Select the type of protection against ground fault: select [Int] if you want to protect the installation with the help of the internal toroid, otherwise [Ext] if you want to protect with the help of the external toroid by making the “Source Ground Return” protection function.

Select the value of the continuous current rating of the external toroidal transformer for the “Source Ground Return” function.

Select the type of EMAX power circuit breaker (code and continuous current rating) on which the PR113 unit is mounted. The selections possible are available in the technical catalogue.

Select the value of the continuous current rating of the current sensors (CS) mounted on the power circuit breaker.

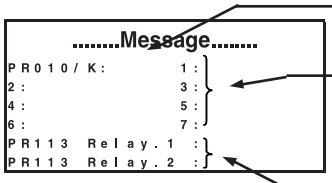
Select the rated voltage of the voltage sensors (VT) installed for the power circuit breaker.



Programming new password in EDIT mode. The successive messages are:
New Password:→[****] **e** Confirm PSW :→[****] **for confirmation.**

Select the time interval for data acquisition in the Historical Measurements.

Select the Warning current threshold value (Iw) (the absolute value of the threshold is also displayed).



Indicate whether there is an PR020/K accessory unit (can only be set with Vaux).

Select what information to combine with the 7 clean contacts present on the PR020/K. Selection is only possible if the accessory unit is configured as present on the PR113. The selections possible are given in par. 15.2.10.1. The PR020/K must be set to operate in “Configurable from PR113” mode by means of special dip-switches (only with Vaux).

Select what information to combine with the 2 clean contacts (K51/p1 and K51/p2) present on the PR113/P-A (see par. 15.2.10.1).

N.B.
Incorrect configuration of In and Un does not jeopardize perfect functionality of the protections in any way, (except, possibly, selection of threshold G).
The only problem will be display of an incorrect absolute value of Currents, Voltages and Powers.

Properties/function	**Values selectable**
Language	Engl. (English), Ital. (Italian), Fran. (French), Deut. (German) Espa. (Spanish)
Net Frequency	50Hz, 60Hz
Neutral sel.	50%, 100%, 150%, 200%
Toroid Selec.	Int (internal, Ext (external)
Ext. tor. In	100A, 250A, 400A, 800A
C.B.	Versions allowed in the catalogue
CS In	250A, 400A, 800A, 1000A, 1200A, 1600A, 2000A, 2500A, 3200A, 3600A, 4000A, 5000A
VS Un	[100, 115, 120, 190, 208, 220, 230, 240, 277, 347, 380, 400, 415, 440, 480, 500, 550, 600, 660, 690, 910, 950, 1000] / √3 V
Password	0000…9999
Store Meas. T.	[5, 15, 30, 60, 120] minutes
Warning current Th.	‘——’(off), 0.3 …. 3.0 x In step 0.05 x In
PR020/K	On , Off
PR020/K relays, PR113 relays 1 e 2	See par. 15.2.10.1

15.4.2.1.1 Adjustment of the neutral

The Neutral protection is normally set to a current value at 50% of the adjustment carried out on the phases.
In some installations, where particularly high harmonics occur, the current circulating on the neutral can be higher than that of the phases.
In the SACE PR113 trip unit, it is possible to set this protection for the following values : I1N = 50% - 100% - 150% - 200% * I1.
In the table below the settable values for adjustment of the neutral are indicated, for the various possible combinations between types of power circuit breakers and adjustment of threshold I1.

Adjustments which can be set for the Neutral protection

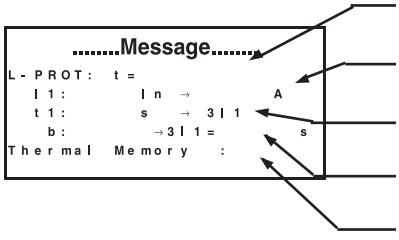
Adjustments of the threshold I1 (protection against overload)			
Size power circuit breaker	**0,4 ≤ I1 ≤ 0,5**	**0,5 < I1 ≤ 0,66**	**0,66 < I1 ≤ 1**
E1B-A	50-100-150-200%	50-100-150%	50-100%
E2B-A	50-100-150-200%	50-100-150%	50-100%
E2N-A	50-100-150-200%	50-100-150%	50-100%
E3N-A	50-100-150-200%	50-100-150%	50-100%
E3S-A	50-100-150-200%	50-100-150%	50-100%
E3H-A	50-100-150-200%	50-100-150%	50-100%
E3V-A	50-100-150-200%	50-100-150%	50-100%
E4S-A	50-100%	50%	50%
E4H-A	50-100%	50%	50%
E4V-A	50-100%	50%	50%
E6H-A	50-100%	50%	50%
E6V-A	50-100%	50%	50%

Not respecting the limits at settings of "I_1" and "Neutral sel." can damage the power circuit breaker with consequent risks for the operator as well.

15.4.2.2 Modification of protection functions

The basic configuration of the unit must be carried out in EDIT mode.

This paragraph allows the user to program the PR113 unit protection functions implemented. Here only the methods for data programming and which values can be set are given. For all the other information relative to the technical characteristics of these protection functions, see par.15.2.6. Following the instructions given in par. 15.2.11.2 and 15.4.1, show the pages for setting the protection functions on the display:



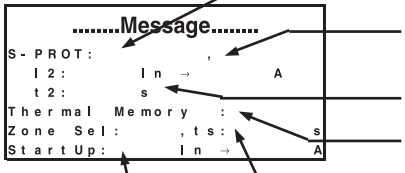
Heading: all the protections, excluding L, T and Iinst, are disabled. For protections S and G, it is also possible to select the type of curve (t=k or t=k/ti^2).

Select which threshold value to set. The value of this, expressed in Amperes, will also be displayed automatically at the side of the threshold selection.

Select which trip curve t1 (trip time at 3 x I1) to set.

Select the value of the desired curve, according to IEC60255-3 (trip time at 3 x I1)
NB: as alternative to curve t=k/I^2.

Select whether to enable or disable operation of protection L with thermal memory.



Set the type of curve (t=k or t=k/I^2) and the state of the protection (On, Off).

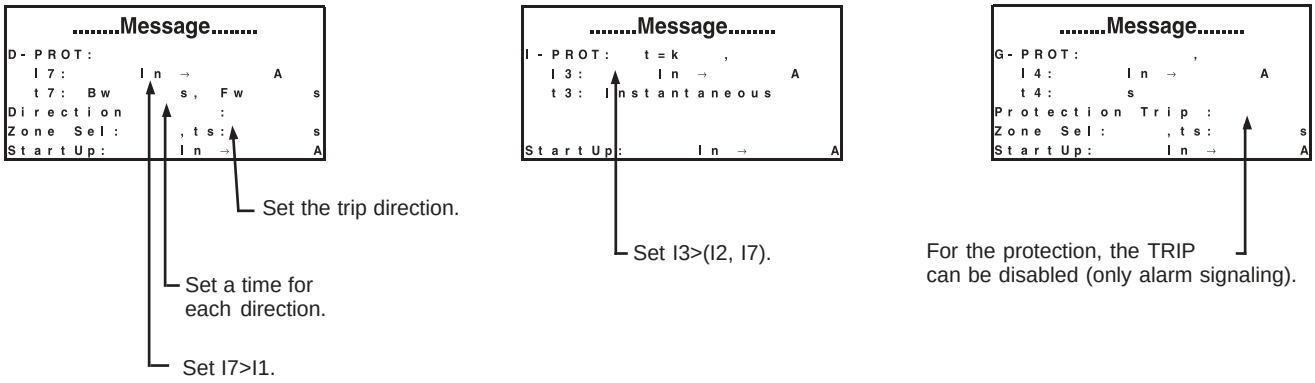
Select which threshold value to set (with I2>I1). The value of this, expressed in Amperes, will also be displayed automatically at the side of the threshold selection.

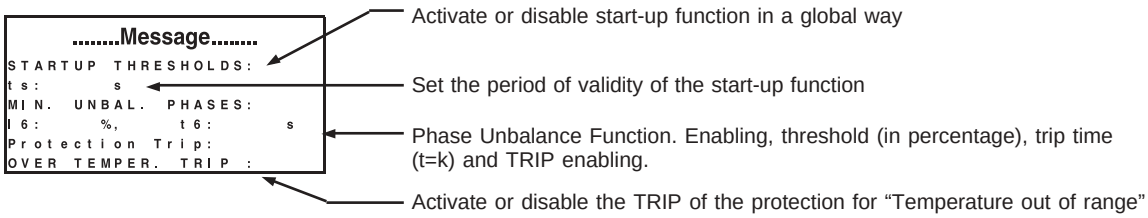
Select which trip curve to set.

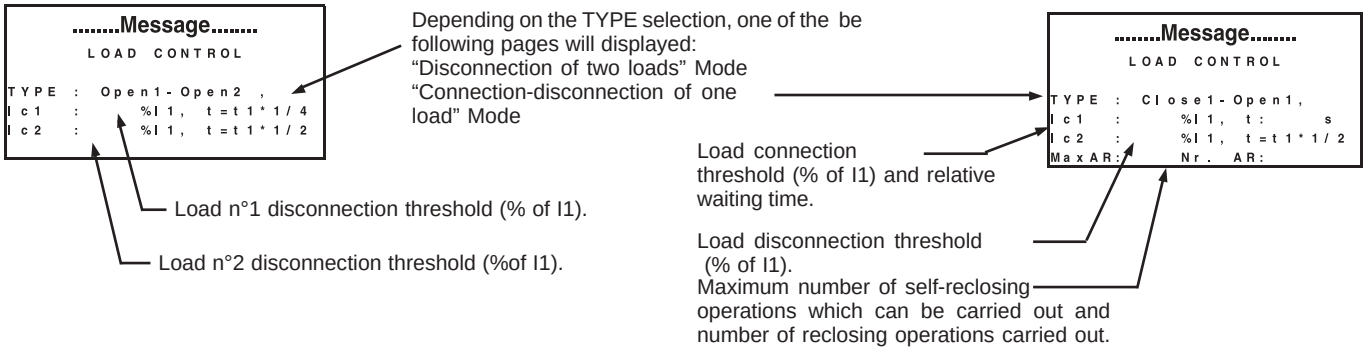
Select whether to enable or disable operation of protection S with thermal memory (only with curve type t = k/I^2).

For protections S, D and G, it is possible to enable or disable operation of the protection with zone selectivity (only with curve type t = k). At the side, it is also possible to set the selectivity trip time for the protection.

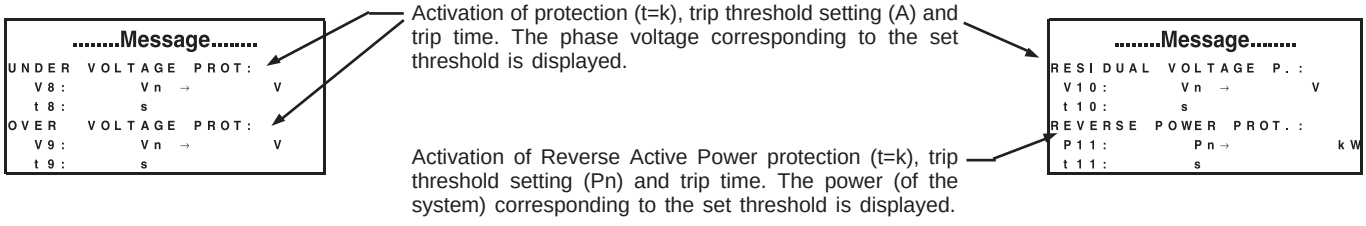
For protections S, D, I and G, it is possible to select which threshold value of start-up to set (only with curve type t=k and locally at the protection considered). The value of this, expressed in Amperes, will also be displayed automatically at the side of the threshold selection.







Voltage Protections:



Protection	Disabling	Disabling of TRIP only	Zone selectivity	Start-up threshold	Thermal memory	Threshold Range	Time Range	Tolerance threshold (4)	Time Tolerance (4)
L ($t=k/I^2$)	☐	☐	☐	☐	☒	0.4xIn $\leq I_1 \leq$ 1xIn step 0.01xIn	3s $\leq t_1 \leq$ 144s, step 3s (1)	± 10% in accordace with ANSI 37.17	± 10%, $I_f \leq$ 4xIn ± 20%, $I_f >$ 4xIn
S ($t=k$)	☒	☐	☒	☒	☐	0.6xIn $\leq I_2 \leq$ 10xIn step 0.1xIn	Min(2), 0.05s $\leq t_2 \leq$ 0.40s, step 0.01s tpgr, 0.04s $\leq t_{2sel} \leq$ 0.40s, step 0.005s	± 7%, $I_f \leq$ 4xIn ± 10%, $I_f >$ 4xIn	The best of the two data: ± 10% o ± 50ms, $I_f \leq$ 4xIn ± 15% o ± 50ms, $I_f >$ 4xIn
S ($t=k/I^2$)	☒	☐	☐	☐	☒	0.6xIn $\leq I_2 \leq$ 10xIn step 0.1xIn	0.05s $\leq t_2 \leq$ 0.40s, step 0.01 In	± 7%, $I_f \leq$ 4xIn ± 10%, $I_f >$ 4xIn	± 15%, $I_f \leq$ 4xIn ± 20%, $I_f >$ 4xIn
I ($t=k$)	☒	☐	☐	☒	☐	1.5xIn $\leq I_3 \leq$ 15xIn step 0.1xIn	Instantaneous	± 10%, $I_f \leq$ 4xIn ± 15%, $I_f >$ 4xIn	$\leq$ 25ms
G ($t=k$)	☒	☒	☒	☒	☐	0.2xIn $\leq I_4 \leq$ 1xIn (3) step 0.02xIn	0.1s $\leq t_4 \leq$ 0.4s, step 0.05s tpgr, 0.04s $\leq t_{4sel} \leq$ 0.40s, step 0.005s	± 7%, $I_f \leq$ 4xIn	The best of the two data: ± 10% o ± 50ms, $I_f \leq$ 4xIn
G ($t=k/I^2$)	☒	☒	☐	☐	☐	0.2xIn $\leq I_4 \leq$ 1xIn (3) step 0.02xIn	0.1s $\leq t_4 \leq$ 0.4s, step 0.05s	± 7%, $I_f \leq$ 4xIn	± 15%
D ($t=k$)	☒	☐	☒	☒	☐	0.6xIn $\leq I_7 \leq$ 10xIn step 0.1xIn	0.20s $\leq t_7 \leq$ 0.75s, step 0.01s tpgr, 0.13s $\leq t_{2sel} \leq$ 0.50s, step 0.01s	± 10%	± 20%
U ($t=k$)	☒	☒	☐	☐	☐	10% $\leq I_6 \leq$ 90% step 10%	0.5s $\leq t_6 \leq$ 60s, step 0.5s	± 10%	± 20%
OT (temp=k)	☐	☒	☐	☐	☐	Only settable by ABB	Instantaneous	± 1°C	—-
K (Open1-Open2)	☒	☐	☐	☐	☐	0.5xI1 $\leq (I_{c1}, I_{c2}) \leq$ 1.0xI1 step 0.01xI1	$t_{c1} \leq t_1 / 4$ $t_{c2} = t_1 / 2$	± 10%	± 20%
K (Closed1-Open1)	☒	☐	☐	☐	☐	0.5xI1 $\leq (I_{c1}, I_{c2}) \leq$ 1.0xI1 step 0.01xI1	10s $\leq t_{c1} \leq$ 120s step 5s, $t_{c2} \leq t_1 / 2$	± 10%	± 20%
UV ($t=k$)	☒	☐	☐	☐	☐	0.6xUn $\leq V_8 \leq$ 0.95xUn step 0.01xUn	0.1s $\leq t_8 \leq$ 5s, step 0.1s	± 5%	± 20%
OV ($t=k$)	☒	☐	☐	☐	☐	1.05xUn $\leq V_9 \leq$ 1.2xUn step 0.01xUn	0.1s $\leq t_9 \leq$ 5s, step 0.1s	± 5%	± 20%
RV ($t=k$)	☒	☐	☐	☐	☐	0.1xUn $\leq V_{10} \leq$ 0.4xUn step 0.05 Un	0.5s $\leq t_{10} \leq$ 30s, step 0.5s	± 5%	± 20%
RP ($t=k$)	☒	☐	☐	☐	☐	-0.3xPn $\leq P_{11} \leq$ -0.1xPn step 0.02 Pn	0.5s $\leq t_{11} \leq$ 25s, step 0.1s	± 10%	± 20%
Iinst	☐	☐	☐	☐	☐	Only settable by ABB	Instantaneous	± 5%	—-

(1) The minimum value of this trip is 750ms regardless of the type of curve set (self-protection).

(2) "Minimum time": minimum time which can be taken by the protection (see par. 11.1.2)

(3) ABB SACE respects the NEC standard, guaranteeing that the maximum selectable value of ground fault current (I4) does not exceed the value of 1200A. The range of threshold I4 adjustment allowed is automatically decreased, according to the type of power circuit breaker selected, so that the following condition is respected: [(I4 x In) ??1200A].

(4) These tolerances are valid in the following hypotheses:
- trip unit self-supplied during running (without start-up)
- two-phase or three-phase power supply

For all cases not considered in the above hypotheses, the following tolerance values are valid:

	Trip threshold	Trip time
L	± 10% (according to ANSI 37.17 Standard)	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60ms
G	± 10%	± 20%

15.4.3 Signals
15.4.3.1 Optical signals

Signaling	Description
Led **Vaux** (green)	Presence of Auxiliary power supply
Led **µP Fault** (red)	Microprocessor with temporary or permanent fault
Led **Temp** (orange)	• *Flashing* with values of "Warning temperature", see par. 15.2.6.7 • *Lit permanently* with values of "Alarm temperature", see par. 15.2.6.7
Led **Trip** (red)	Lights up (only with Vaux) following an opening due to a protection.
Led **Warning** (yellow)	• The **prealarm threshold** has been exceeded; one or more phases with current values in the 0.83xI1< I < 1.05xI1 range. (the selection carried out depends on the Ne. For example, at 50% the values are halved) • Presence, between two or three phases, of unbalance above the value programmed for the "Unbalanced Phases" protection, with protection trip disabled. Presence of Distorted Wave form with Shape Factor > 2.1; • Contact wear higher than 80% (and less than 100%; only with Vaux); • WARNING THRESHOLD exceeded, see par.15.2.7.1; • Power circuit breaker status error (only with Vaux); • Frequency out of range.
Led **Emergency** (red)	• Presence of one or more phases under overload with current values I >1.05*I1 (protection "L timing") (the selection carried out depends on the Ne. For example, at 200% the values are doubled); • Timing in progress for protection function S; • Timing in progress for protection function I; • Timing in progress for protection function G; • Timing in progress for protection function D; • Timing in progress for the voltage protection functions (UV, OV, RV); • Timing in progress for the reverse active power protection function (RP); • Timing in the case of unbalance between the phases above the value set in the configuration with protection trip set to on; • Wear at 100 %; • CTs disconnected; • Opening solenoid (SA) disconnected. NB. *Flashes* in the case of trip of the backup protection.

Signaling	Description
Yellow magnetic flag	"*****" Trip of one of the following protections: undervoltage, overvoltage, residual voltage, reverse active power, phase unbalance, overtemperature;
Yellow magnetic flag	"**L**" Trip of protection "L";
Yellow magnetic flag	"**S**" Trip of protection "S" or "D";
Yellow magnetic flag	"**I**" Trip of protection "I" or "Iinst"
Yellow magnetic flag	"**G**" Trip of protection "G".

15.4.3.2 Electrical signals

Signaling	Description
Contact **K51/p1**	The signaling to which it is connected (see par. 15.2.10.1) is active (only with Vaux);
Contact **K51/p2**	The signaling to which it is connected (see par. 15.2.10.1) is active (only with Vaux);
Contact **k51/YO1**	Trip of one of the following protections: L, S, D, I, G, U, OT, UV, OV, RV, RP, Iinst;
Contact **K51/µP**	Microprocessor with temporary or permanent fault.(closes with a delay of 1...2 s, only with Vaux).

By pressing the "Reset" pushbutton, it is possible to reset the normal state of both the magnetic flags (black) and of the contacts (normally open).

This pushbutton is also active without an auxiliary power supply.
With the relay not supplied, the energy accumulated by a special 'buffer' Reset capacitor is used, which is charged when turned on (in ~12s). This means that, @ 25°C, at least one Reset operation is guaranteed in the case of no of self-supply or auxiliary power supply, within 2 hours from power circuit breaker opening, for the flags, and 12 hours for the SRE contact.

Should the capacitor 'buffer' also be discharged, the PR113 can be supplied momentarily by means of the PR120/B or PR010/T (see par. 15.7).

Regardless of the state of the signals and of the relay power supply, it is always possible to close the power circuit breaker, both by means of Closing Coils (BC) and by means of a mechanical pushbutton.

15.5 Troubleshooting

The following table collects up a series of typical service situations, which are useful in order to understand and solve hypothetical faults or malfunctions.

N.B.:

1. Before consulting the following table, check any lighting up of the LEDs located on the front of the unit for some seconds.
2. **FN** indicates normal operation of the PR113.
3. In the case where the suggestions proposed do not lead to a solution of the problem, please contact the ABB SACE service assistance.

N°	Situation	Possible causes	Suggestions
1	It is not possible to reset the	The buffer capacitor is discharged	**FN**, connect the Vaux, the PR010/T or signals the PR120/B, to reset.
2	It is not possible to carry out the trip test	1. The busbar current is > 0 2. The SA is not connected	1. FN 2. Check the messages on the display
3	Trip times lower than those expected	1. Threshold too low 2. Curve too low 3. Thermal memory inserted 4. Incorrect Neutral Selection 5. The SdZ is inserted	1. Correct threshold 2. Correct curve 3. Exclude if not necessary 4. Correct Neutral Selection 5. Exclude if not necessary
4	Trip times higher than those expected	1. Threshold too high 2. Curve too high 3. Curve I^2t inserted 4. Incorrect Neutral Selection	1. Correct threshold 2. Correct curve 3. Exclude if not necessary 4. Correct Neutral Selection
5	Rapid trip, with I3=Off	Iinst trip	FN with short circuit with high I
6	I of ground high, but there is no trip	1. Incorrect selection of the sensor 2. Function G prevented with I>4 In	1. Set int. or ext. sensor 2. FN
7	Display off	1. Vaux missing and the busbar I is less than the minimum value. 2. Temperature out of range	1. FN, see 15.2.2.1 2. FN, see 15.2.6.7
8	The display is not rear-lit	Vaux missing	FN
9	Reading of I and/or V incorrect	Incorrect setting of In and Un	Change parameters, see 15.4.2.1
10	Reading of V, W and power factor incorrect	Incorrect connection of the VT	Check VT-PR113 connections
11	No Int Bus Comm" Message	There is no communication between PR113 and PR020/K	1. If not present, exclude PR020/K, see 15.4.2.1 2. Check bus connection 3. Check PR020/K
12	Display indicates "…." or ">xxxx", inistead of the data expected	Function excluded or data out of range	FN, see 15.2.8
13	The expected trip does not occur	Trip function excluded	FN enable trip if necessary
14	No activation of the Unbalance U protection	Values of I out of range	FN, see 15.2.6.6
15	Anomalous behavior of Load control K protection	The MT of L is inserted.	FN, exclude the MT of L
16	No display of the opening data	Vaux missing	FN, see 15.2.9.2
17	The password is not requested	The password has been disabled	FN, re-enter the password with a value other than 0000.
18	It is not possible to change any parameter	PR113 in alarm situation	FN
19	The display shows "ABB SACE psw ? [****] "	You are trying to access an ABB reserved area	FN, press "ESC" to exit.

15.6 Warning and error messages

All the messages which can be shown on the display relating to incorrect configurations, generic alarms or deriving from the protection functions and linked to useful information are described below.

	INCORRECT CONFIGURATIONS
MESSAGE	DESCRIPTION
WRONG CS FOR THIS CB	A CS size which cannot be installed on the power circuit breaker has been selected (e.g. E1 with 5000A)
ERROR I2 <= I1	The trip threshold of function L is higher than threshold of function S
ERROR I5 <= I1	The trip threshold of function L is higher than threshold of function D
ERROR I3 <= I2	The trip threshold of function S is higher than threshold of function I
ERROR I3 <= I5	The trip threshold of function D is higher than threshold of function I
ERROR: S ZONE SEL.	Zone selectivity for function D has been activated but zone selectivity is already active for function S
ERROR: D ZONE SEL.	Zone selectivity for function G has been activated but zone selectivity is already active for function D
ERROR: V_AUX OFF	The auxiliary power supply is not present - function not available
V_AUX OFF: Comm. OFF	The communication bus is not operating because there is no auxiliary voltage
NO Int. Bus Comm.	The presence of the PR020/K unit is set, but there is no communication on the internal bus
WRONG NE% SELECTION	A Neutral protection incompatible with the present CT and power circuit breaker has been selected, or a CT incompatible with the current Neutral protection and power circuit breaker has been selected. The condition CT * %Ne (0.5, 1, 1.5 or 2) ≤ “Power circuit breaker continuous current rating” must be valid
NOT available	The function required is not available
CB STATUS ERROR	Current is determined with power circuit breaker status “OPEN”. The status input of the power circuit breaker has not been cabled correctly (check only carried out with Vaux)
V_AUX Off: S Sel. Off	The unit is configured to operate with zone selectivity S but the auxiliary power supply has been removed
V_AUX Off: G Sel. Off	The unit is configured to operate with zone selectivity G but the auxiliary power supply has been removed
V_AUX Off: D Sel. Off	The unit is configured to operate with zone selectivity D but the auxiliary power supply has been removed

	GENERAL ALARMS
MESSAGE	DESCRIPTION
CONTACTS WEAR >80%	The wear on the power circuit breaker electrical contacts has reached 80%
CONTACTS WEAR 100%	The wear on the power circuit breaker electrical contacts has reached 100%
HARMONIC DISTORTION	The current circulating in the power circuit breaker is distorted (peak factor >2.1)
CS-L1 DISCONNECTED	Current sensor relative to phase L1 not connected
CS-L2 DISCONNECTED	Current sensor relative to phase L2 not connected
CS-L3 DISCONNECTED	Current sensor relative to phase L3 not connected
CS-NE DISCONNECTED	Current sensor relative to neutral NE not connected
SA DISCONNECTED	Shunt trip not connected
FREQUENCY OUT OF RANGE	Frequency of the measured current/voltage out of limits
CURRENT > Iw THRESHOLD	Presence of current higher than the free threshold set by user (Iw)

	PROTECTION FUNCTIONS
MESSAGE	DESCRIPTION
PREALARM L	The current circulating on at least one phase is above the set prealarm threshold value for protection L see par. 15.4.3.1
L PROTECTION TIMING	The current circulating on at least one phase is above the set current threshold value for protection L and the unit is under timing
S PROTECTION TIMING	The current circulating on at least one phase is above the set current threshold value for protection S and the unit is under timing
G PROTECTION TIMING	The current circulating on at least one phase is above the set current threshold value for protection S and the unit is under timing

	PROTECTION FUNCTIONS
MESSAGE	DESCRIPTION
G ALARM, TRIP OFF	Timing of function G is in progress, but the trip control which is given at the end of the timing has been disabled.
OVERVOLTAGE TIMING	The voltage on at least one phase is above the voltage value of the OV protection threshold and the unit is under timing
OVERVOLTAGE ALARM	The voltage on at least one phase is above the voltage value of the OV protection threshold, timing is completed and the protection is in the “ALARM” state
UNDERVOLTAGE TIMING	The voltage on at least one phase is less than the voltage value of the UV protection threshold and the unit is under timing
UNDERVOLTAGE ALARM	The voltage on at least one phase is less than the voltage value of the UV protection threshold, is completed and the protection is in the “ALARM” state
RESIDUAL VOLTAGE TIMING	The residual voltage calculated is above the voltage value of the threshold of protection RV protection threshold and the unit is under timing
RESIDUAL VOLTAGE ALARM	The residual voltage calculated is above the voltage value of the threshold of protection RV protection threshold, is completed and the protection is in the “ALARM” state
REVERSE A.POWER TIMING	The active power total is less than value of the threshold of protection RP protection threshold and the is under timing.
UNBALANC. PHASES TIMING	Presence of an unbalance between at least two phases above the value set and the unit is under timing.
UNBALANC. PHASES ALARM	Presence of an unbalance between at least two phases above the value set, but the trip control which is given at the end of the timing has been disabled

	PR020/K
MESSAGE	DESCRIPTION
ERROR Ic2 < Ic1	The current threshold set for load n°1 is higher than that of load n°2 or the current threshold set for reclosing is higher than that of load opening
K: LOAD 1 TIMING	The current circulating has exceeded the threshold of load n°1 connected to PR020/K and the unit is under timing for load opening
K: LOAD 2 TIMING	The current circulating has exceeded the threshold of load n°2 connected to PR020/K and the unit is under timing for load opening
K: LOAD 1 CLOSING	Load n°1 connected to PR020/K is about to be reconnected
K: LOAD 1 OPEN	Load n°1 connected to PR020/K has been isolated
K: LOAD 2 OPEN	Load n°2 connected to PR020/K has been isolated
K: AR DISABLED	The auto-reset of load n°1 connected to PR020/K has been disabled

	PASSWORD MANAGEMENT
MESSAGE	DESCRIPTION
Password ? [****]	Enter the access password in EDIT mode
Wrong Password	The password entered is wrong
New Password:→[****]	Enter the new password
Confirm Password:→[****]	Confirm the new password entered

15.6.1 In the case of a fault

If it is suspected that the PR113 is faulty, has malfunctions or has generated an unexpected trip, we advise you to strictly following the indications below:

1. Do not reset the trip unit.
2. Note down which small magnetic signal is activated (yellow area).
3. If there is Vaux, the trip unit has memorized the trip data, so take these from the Last Trip page.
4. If there is no Vaux, use PR120/B and note down all the settings of the protection functions.
5. Note down the type of power circuit breaker, number of poles, any accessories connected, In, Serial Number (see par. 15.2.11) and the SW version.
6. Prepare a brief description of opening (when did it take place? how many times? always under the same conditions? with what type of load? with what voltage? with what current? can the event be reproduced?)
7. Send/communicate all the information collected, together with the application circuit diagram of the power circuit breaker, to the ABB Assistance closest to you.

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

15.7 Accessories

15.7.1 ABB SACE PR010/T complex test unit

The test with the SACE PR010/T unit allows correct operation of the inputs, outputs, thresholds and trip times of protection functions “L”, “S”, “I”, “G”, “U”, “Iinst”, “UV”, OV” and “RV” to be checked either manually or automatically.
Furthermore it is possible to obtain a test report and modify the settings of the PR113 unit.

For operation of the PR010/T accessory, please consult the special instruction manual.

15.7.2 ABB SACE PR020/K signaling unit

The PR020/K signaling unit, when connected to the internal bus of the PR113/P, allows the state of the protection functions and of the PR113/P trip itself to be signaled by means of clean power contacts (250V AC, 5A).
The user has the possibility of individually “combining” one of the signals defined to par. 15.2.10.with each of the 7 K51 power relays, inside the PR020/K.
In this way, the user can obtain indication of the signals considered most important by means of clean power contacts.
If the signaling requirements are the classic ones (Alarm L, S, I ... Trip), these are preconfigured in the PR020/K, making putting into service immediate.

The PR020/K must be supplied with 24V DC ±20% Vaux.

For installation and operation of the PR020/K accessory, please consult the special instruction manual .

The unit must be connected to the PR113 by means of an internal bus with a corded shielded cable with two conductors (see note A of par. 11.2.2) with a maximum length of 15m .
The shield must be grounded both on the power circuit breaker side and on the PR020/K side.

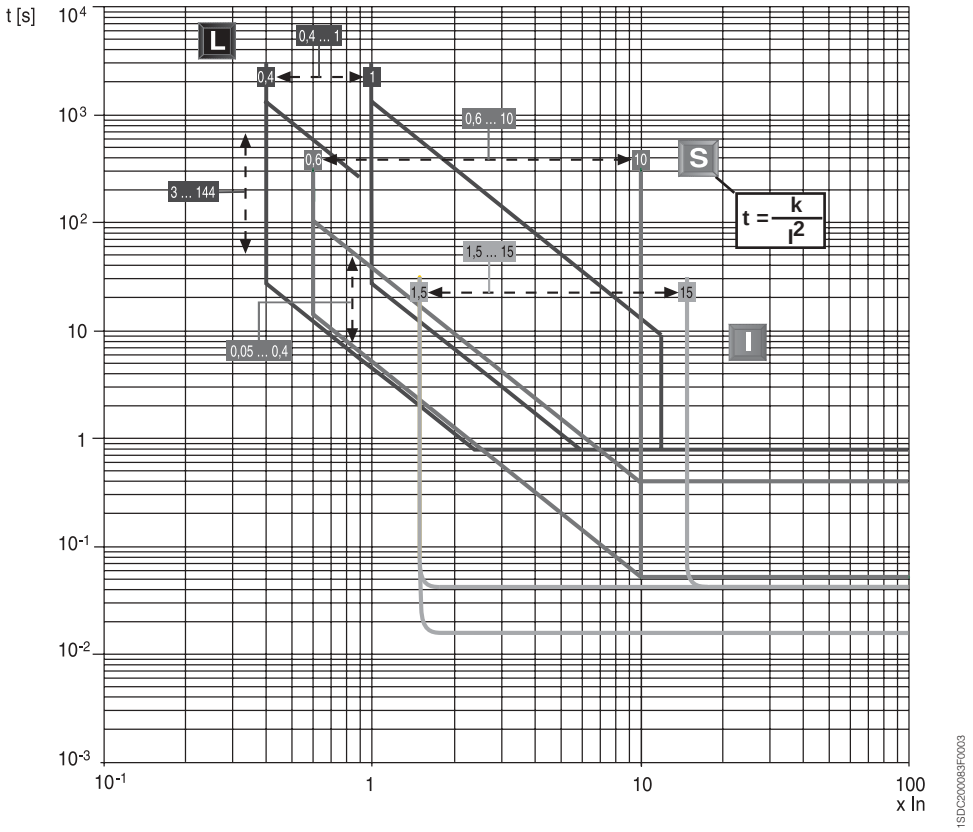
15.7.3 ABB SACE PR120/B power supply unit

The PR120/B is a momentary power supply unit to be inserted in the front TEST connector of the PR113.
With this accessory, supplied as standard, it is possible carry out the test, read and configure the parameters of the PR113 unit whatever the status of the power circuit breaker (open, closed, in the test position or racked-in, and with/without auxiliary power supply).
Testing the PR113 with the power supply supplied by the PR120/B, it is normal for the display to turn off for a few seconds after a trip test.
The battery inside the PR120/B guarantees power supply to the unit for about 3h continuously (depending on the operations carried out on the PR113)

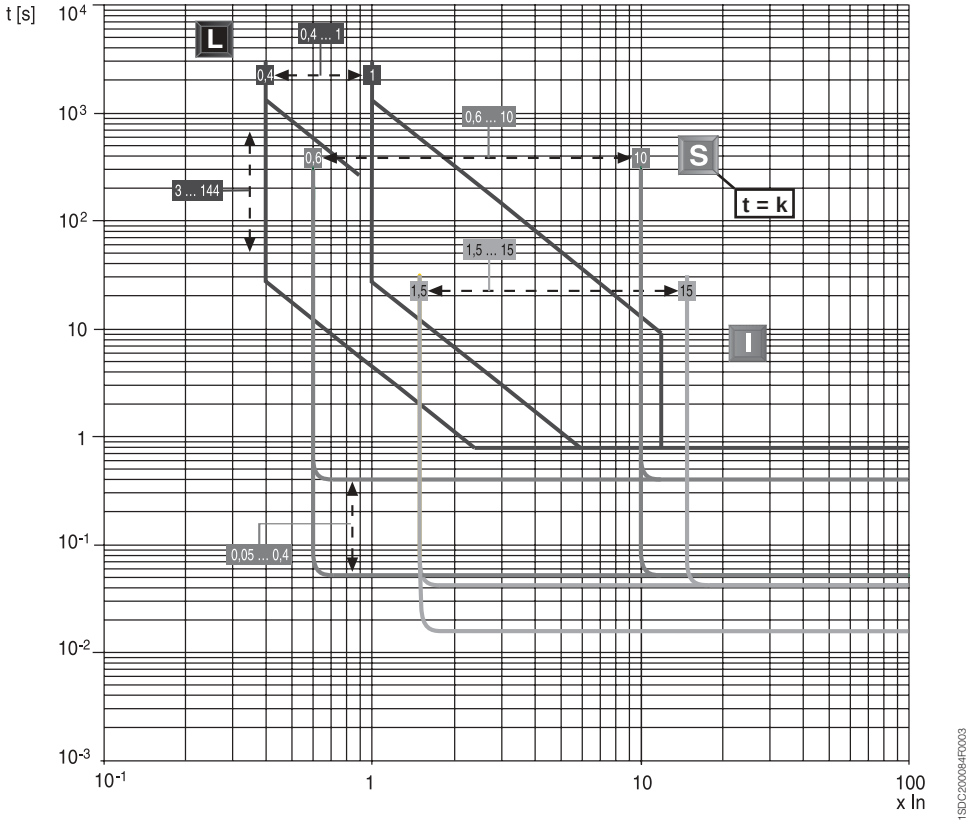
15.8 Trip curves

The trip curves given are indicative and only show a sub-group of the possible selections (see par. 15.4.2.2).

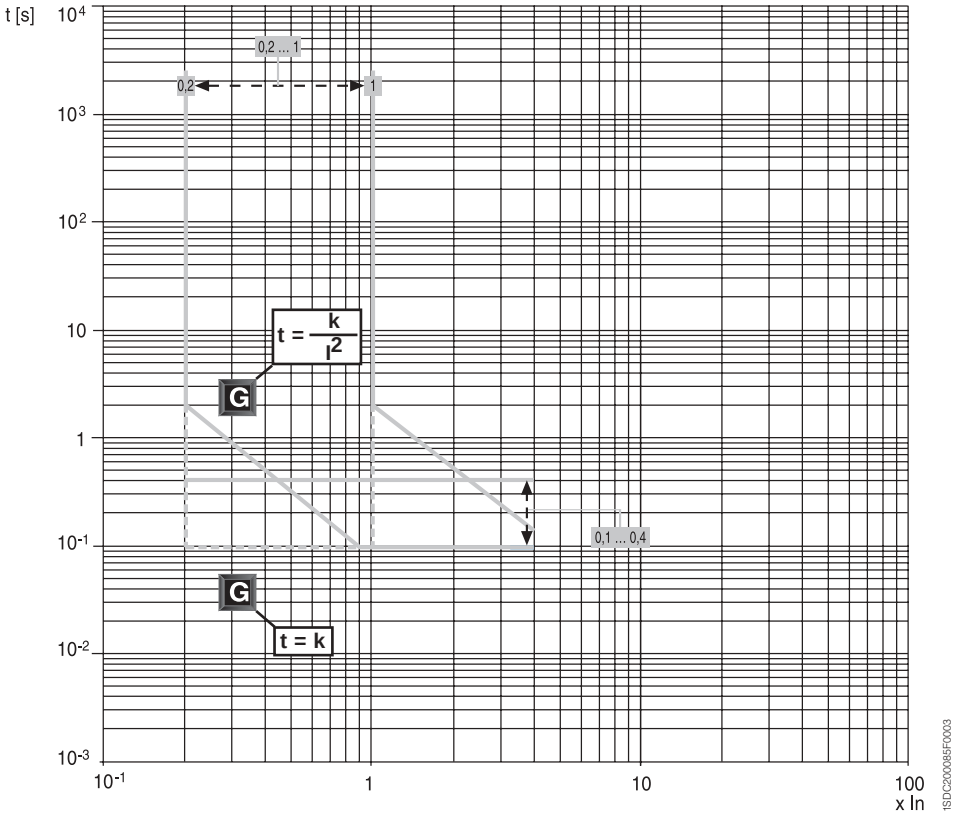
15.8.1 Trip curves of functions L-S-I



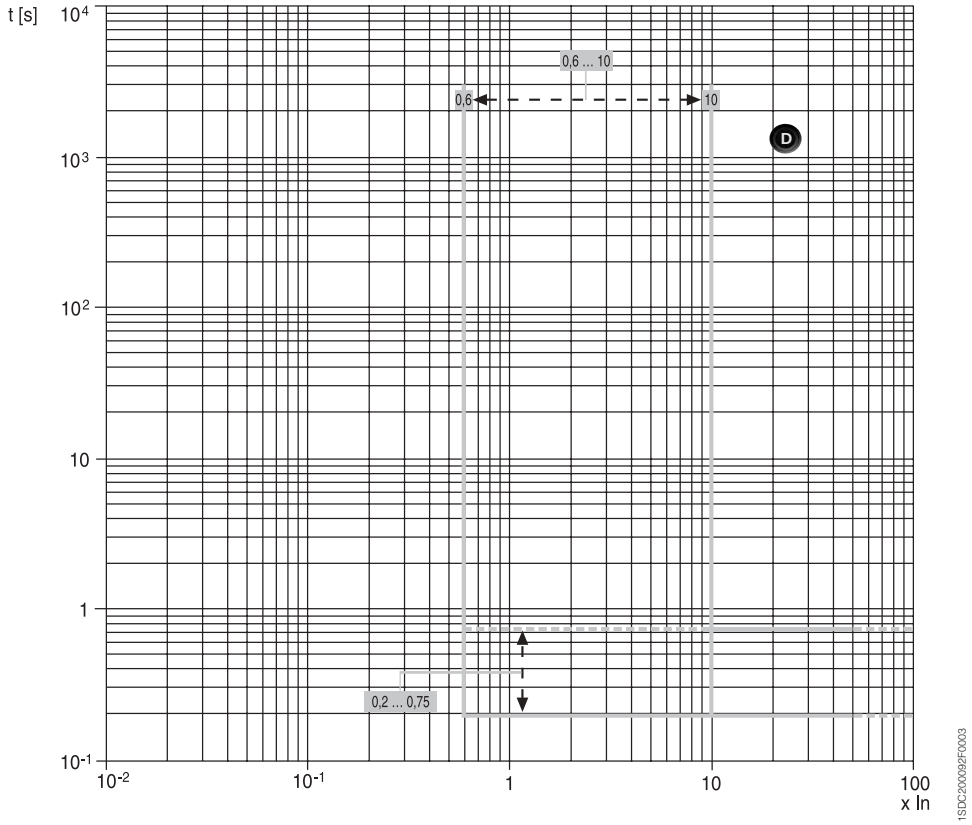
15.8.2 Trip curves of functions L-S-I



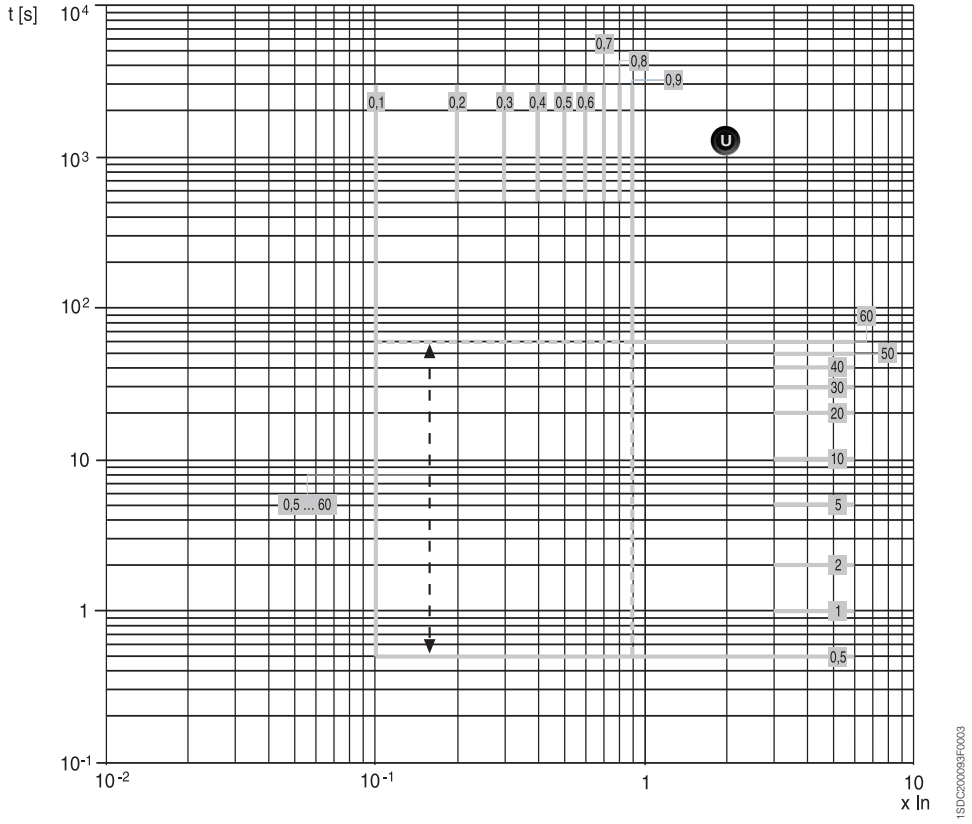
15.8.3 Trip curves of function G



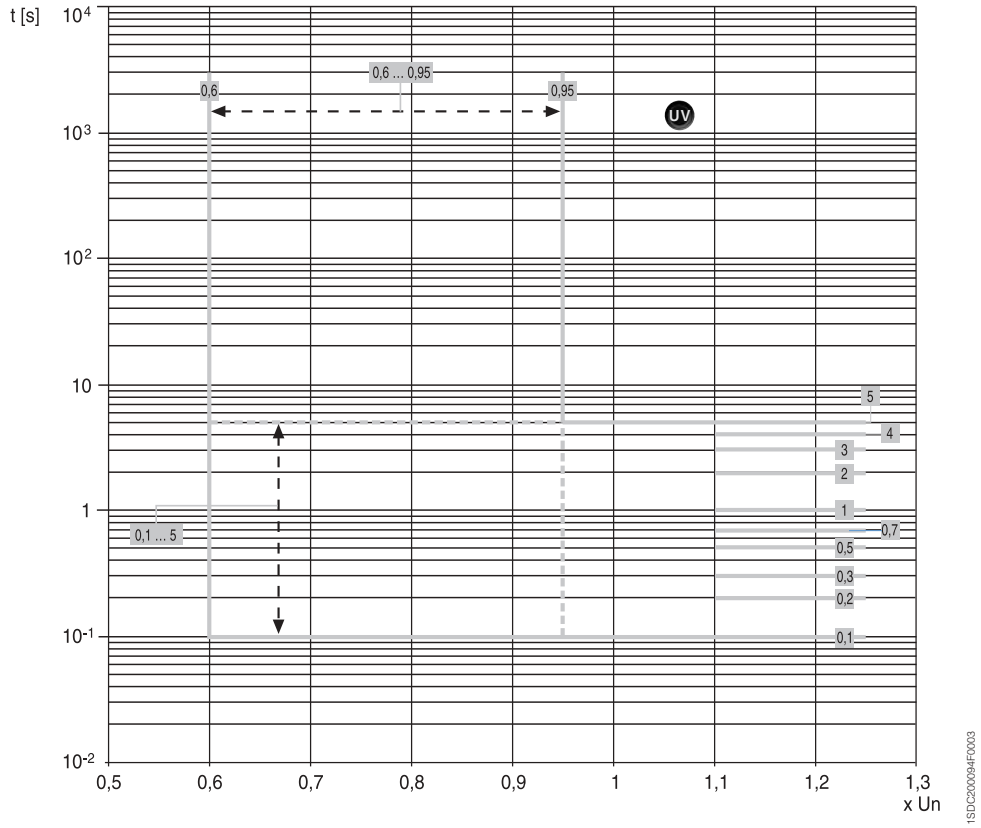
15.8.4 Trip curves of function D



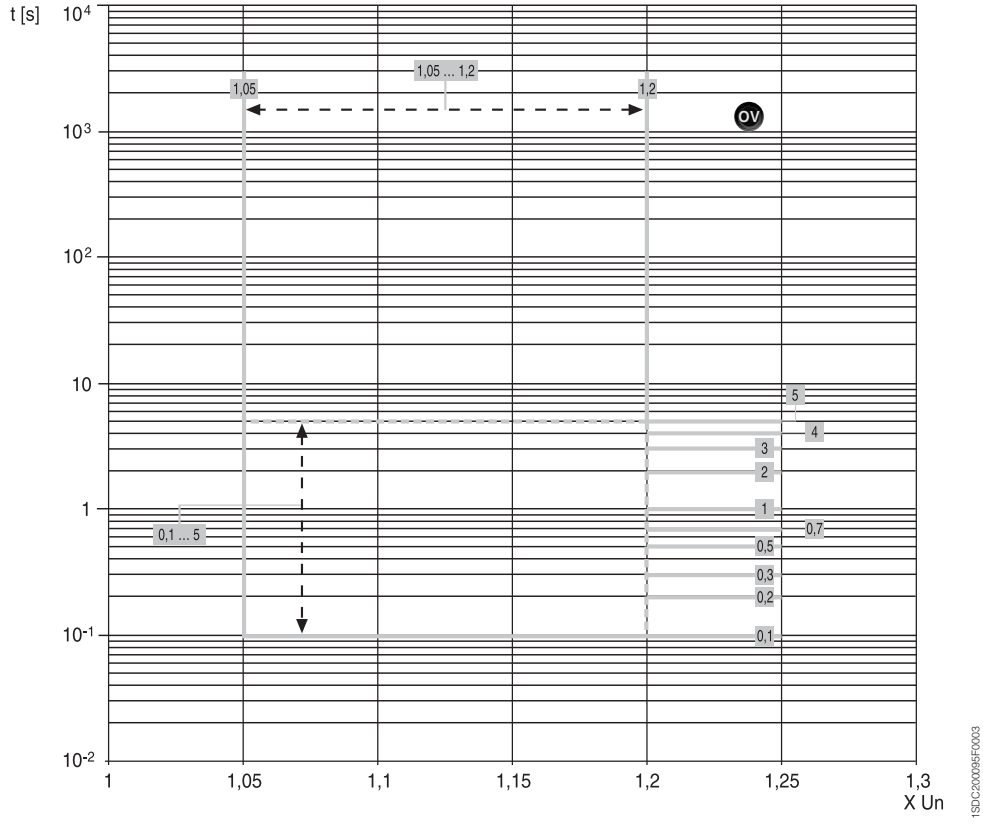
15.8.5 Trip curves of function U



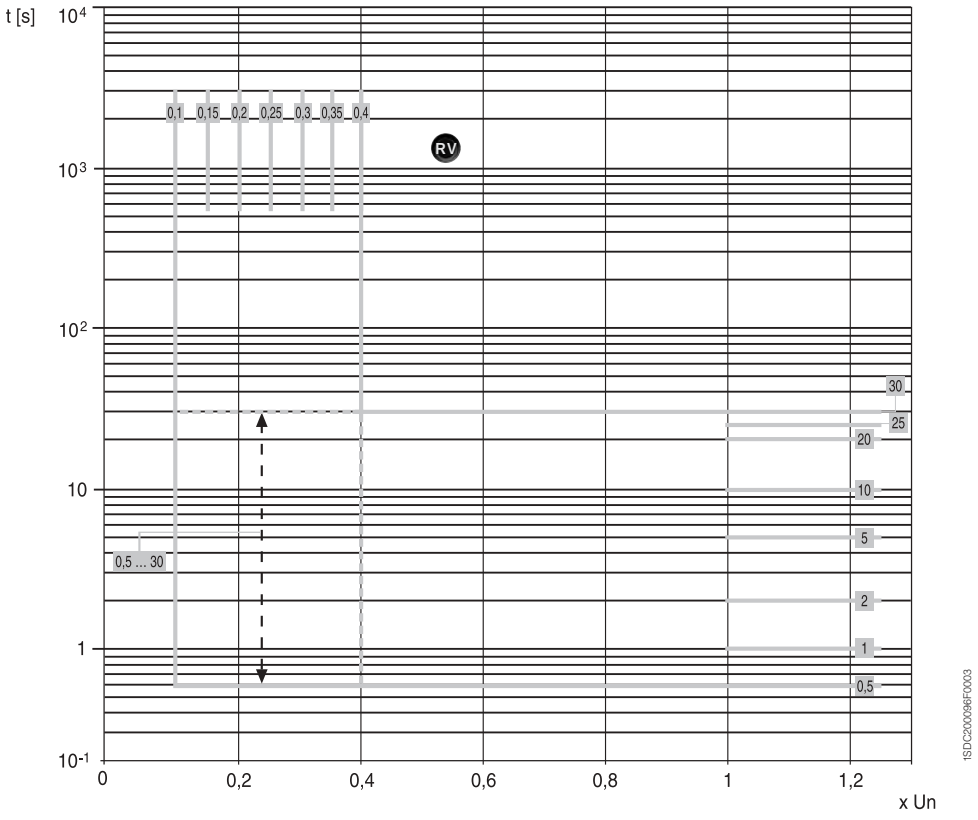
15.8.6 Trip curves of function UV



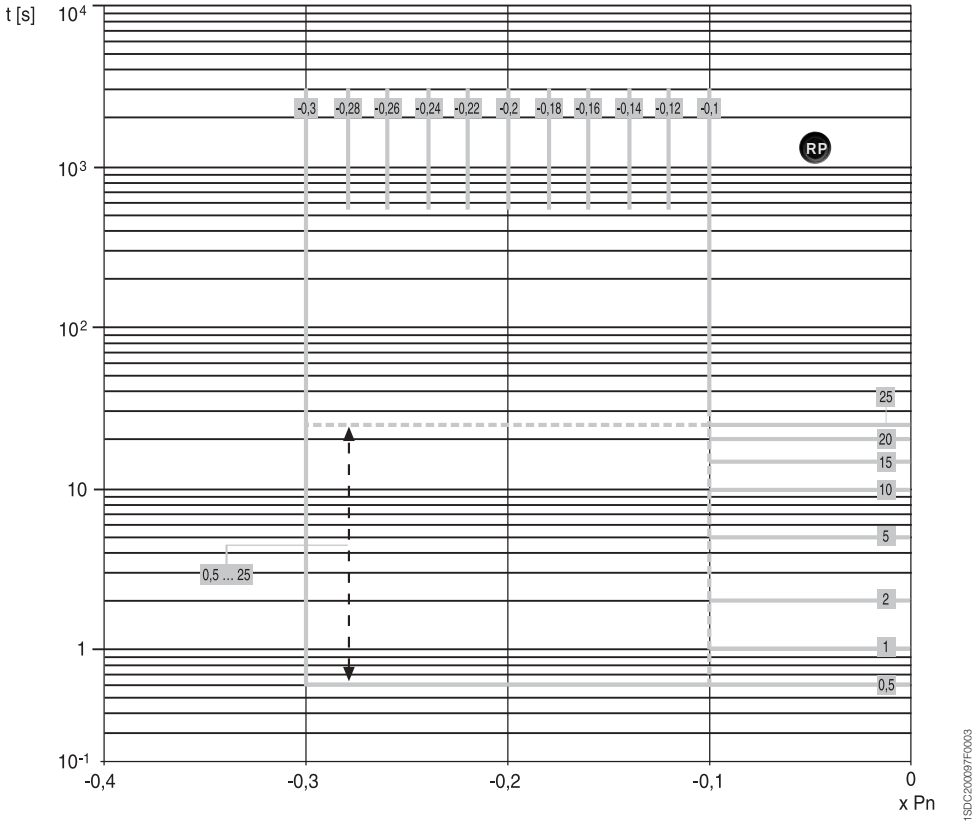
15.8.7 Trip curves of function OV



15.8.8 Trip curves of function RV



15.8.9 Trip curves of function RP



16 SACE PR113/PD-A Trip unit – Identification

The PR113 units available fitted with a dialogue unit, with Modbus™ protocol , are:
- PR113/PD (in accordance with IEC Standards)
- PR113/PD-A (in accordance with ANSI/UL Standards)

16.1 Standard

The PR113 /PD-A has been designed to work in accordance with the following international standard:
Low voltage AC and DC power circuit breakers used in enclosures ANSI/UL 1066.

16.2 Safety notes

This symbol identifies information on the procedures, actions or circumstances which can lead to wounds or injury of personnel, damage to the unit or economic losses.

Read this manual carefully and all the way through.
This appendix is intended as an integration of the PR113/P instruction manual.
For correct use and management of the PR112 protection unit fitted with a dialogue unit with Modbus™ protocol [PR112/PD-A], it is also necessary to consider what is given in the following documents:

- " PR113/P-A Instruction manuals " (par.15)
- "PR113/PD Modbus™ System Interface" - see par.16.3 (doc. n° RH0296)
- "Modbus™ installation guide line" - see par.16.3 (doc. n° RH0298)

16.3 Various notes

A. All the detailed information on the communication interface (necessary for development of the supervision and control system by the System integrator) is given in document RH0296.

B. All the detailed information necessary to make the physical external connections to the protection trip unit, as well as the maximum distances of the cabling, the type of conductor to be used, etc. are given in document RH0298.

C. The following are trademarks of Modicon, Inc.:

Modbus		984	P190	SM85
ModConnect	BM85	RR85	SQ85	
Modcom		BP85	SA85	

16.4 Specifications

16.4.1 General

When there is no auxiliary power supply, the communication functions are not active.

The PR113-A unit fitted with dialogue allows a supervision system to acquire information. The information available is:

Data transmitted from the PR113/PD-A to the supervision system	
1	Protection parameters set
2	Configuration parameters set
3	Phase, neutral and ground currents
4	Line-to-line and starred voltages
5	Power factor for each phase and total
6	Active, reactive and apparent power
7	Line frequency
8	Status of the power circuit breaker (open-closed)
9	Position of the power circuit breaker (connected-isolated)
10	State of the springs (charged-discharged)
11	Number of mechanical power circuit breaker operations, overall number of trips and for each protection
12	Last current , voltage and power interrupted
13	Historical variations in current, voltage and energy
14	Contact wear
15	State of the protection functions (prealarm funct.L, timing funct. L, S, G, UV, OV, RV,...)
16	Overtemperature protection function
17	State of internal bus communication
18	State of SA and current sensor connection
19	**

** *See par.16.3 note **A***

16.4.1.1 Auxiliary power supply

When there is a PR113 equipped with a dialogue unit, the consumptions of the unit are different from those indicated just for the protection unit. The values to be considered are given in the following table.

Characteristics	PR113/PD-A Version
Power supply voltage	24V DC ±20%
Maximum ripple	5%
Inrush Current @ 24 V	~5A for 30ms
Start-up Current@ 24 V	~1.0A for 150ms
Continuous current rating @ 24 V	~310mA
Nominal Power @ 24 V	~8W

16.4.2 Inputs/outputs

16.4.2.1 Binary opto-insulated inputs

– **CB-Closed:** Status of power circuit breaker
– **CB-Open:** Status of power circuit breaker (for congruency control with power CB-Closed)
– **CB-Springs:** State of springs
– **CB-Position:** Position of power circuit breaker

16.4.2.2 Output contacts

– **K51/YC:** relay output which can be activated by the user to close the power circuit breaker
– **K51/YO:** relay output which can be activated by the user to open the power circuit breaker

- Monostable contacts, only active when there is Vaux
- Maximum changeover current: 3A – 250V AC (0.2A – 100V DC)
- Insulation contact-contact voltage: 1000 V AC

16.4.3 Communication bus

– External bus Modbus™ protocol RS485 2-Wire Twisted Pair, 19.2kbit/s max., connection to differential bus (See par.16.3 note B).

16.4.4 Information functions

To access the following pages, see par. 16.6.1.

16.4.4.1 Software version

ABB SACE PR113/D-M Sw: x.xx

This page shows which Software version there is of the dialogue unit of the above PR113/PD unit.

Each time it is necessary to communicate any operating problems with the dialogue unit to ABB SACE, it is a good idea to indicate the **Sw** version of the unit (“x.xx”).

16.4.4.2 Opening data storage

Manual Opens: xxxxx	Sum of openings due to manual openings by means of pushbuttons on the front of the power circuit breaker, controls coming from opening coil (YO) and undervoltage (MT).
Prot. Trips: xxxxx	Sum of openings due to protections (L, S, I, G, T temperature, D, A, UV, OV, RV,…).
Other Trips: xxxxx	Sum of openings due to the trip test.
Trip Fails: xxxxx	Sum of any missed trips in relation to a fault.

L: xxxxx	UN: xxxxx	Number of trips due to protections L, S, I, G and T (temperature), D, A, UV, OV, RV, RP.
I: xxxxx	OV: xxxxx	
G: xxxxx	RV: xxxxx	
T: xxxxx	RP: xxxxx	
D: xxxxx		

16.4.4.3 State of power circuit breaker auxiliary inputs

CB StatuS: xxxxx	Status of the power circuit breaker. The possible states are: Open - Closed – Error*
CB Springs: yyyyy	State of spring charging. The possible states are: Charged – Discharged
CB Pos.: zzzzz	Position of the power circuit breaker. The possible states are: Conn. – Isol.
Test YO/YC: kkk	See par. 16.4.5

* The display of "Error" indicates a condition of incongruence (both the CB-Open and CB-Closed inputs are in the same logical state)

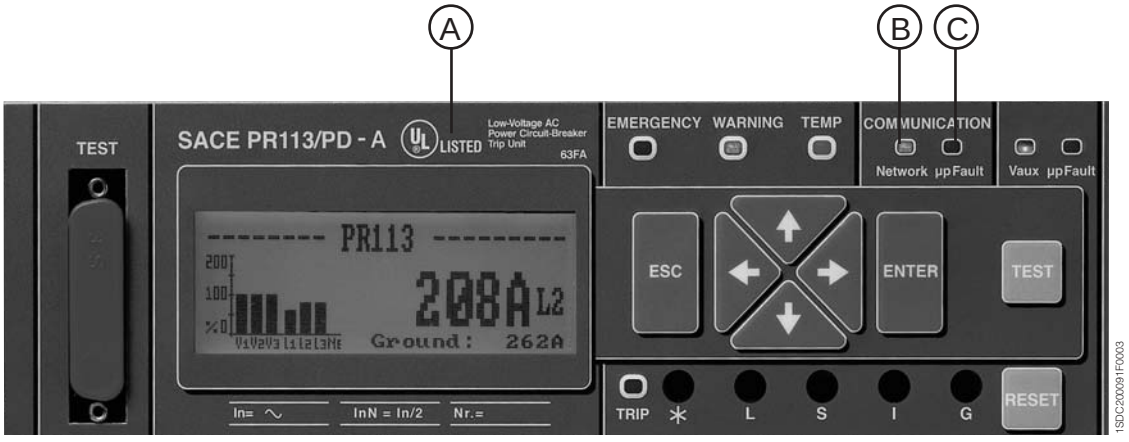
16.4.5 Control functions

CB Status : xxxxx	See par.16.4.4.3
CB Springs: yyyyy	See par. 16.4.4.3
CB Pos. : zzzzz	See par. 16.4.4.3
Test YO/YC: kkk	Control function for opening and closing the power circuit breaker by means of coils YC and YO.

- To open the power circuit breaker, select YO and then press the TEST pushbutton on the front of the PR113/PD-A
- To close the power circuit breaker, select YC and then press the TEST pushbutton on the front of the PR113/PD-A

16.4.6 User interface

Caption of the front of the PR113/PD-A unit (integration of the caption relative to the PR113/P-A version):



Ref.	Description
A	Identification label for trip unit according to ANSI/UL Standards.
B	"NETWORK" LED linked to the state of communication activities (Tx) on external bus.
C	"µP fault" LED relative to operation of the µProcessor dialogue unit.

16.4.6.1.1 Local operating mode

In local mode :
- Remote parameterization (i.e. from supervision and control system) not allowed (e.g. modification of protection function settings …)
- Remote controls which cannot be carried out (e.g. power circuit breaker opening, closing …)

The following actions are allowed:
- Reading current voltage, frequency and power measurements
- Reading configuration parameters
- Reading protection parameters
- Reading parameters set for Load control
- Reading the information relative to the protection unit

16.4.7 Default settings

The PR113/PD is supplied by ABB SACE with the following pre-defined communication parameters:

Slave Addr.	Baudrate	Parity	Addressing
255 (UNCONFIGURED)	19.200 bit/s	Even	Standard

Operating mode
Local

16.5 Putting into service

16.5.1 Connections

For the Connections to be made by the user, it is advisable to check what is indicated in par.16.3 note B. This means that we shall be able to satisfy all the international reference Standards and guarantee perfect operation of the trip unit even under severe environmental and electromagnetic conditions.

Pay particular attention to the types of cable, the connections to ground and the maximum distances recommended.

In case of replacement of a PR113/P-A with a PR113/PD-A it is necessary to complete the missing cabling on the terminal box (or sliding contacts of the power circuit breaker) with those required for the dialogue function, as well as to replace the connectors which are coupled with the PR113 trip unit from the terminal box.

16.5.2 Test

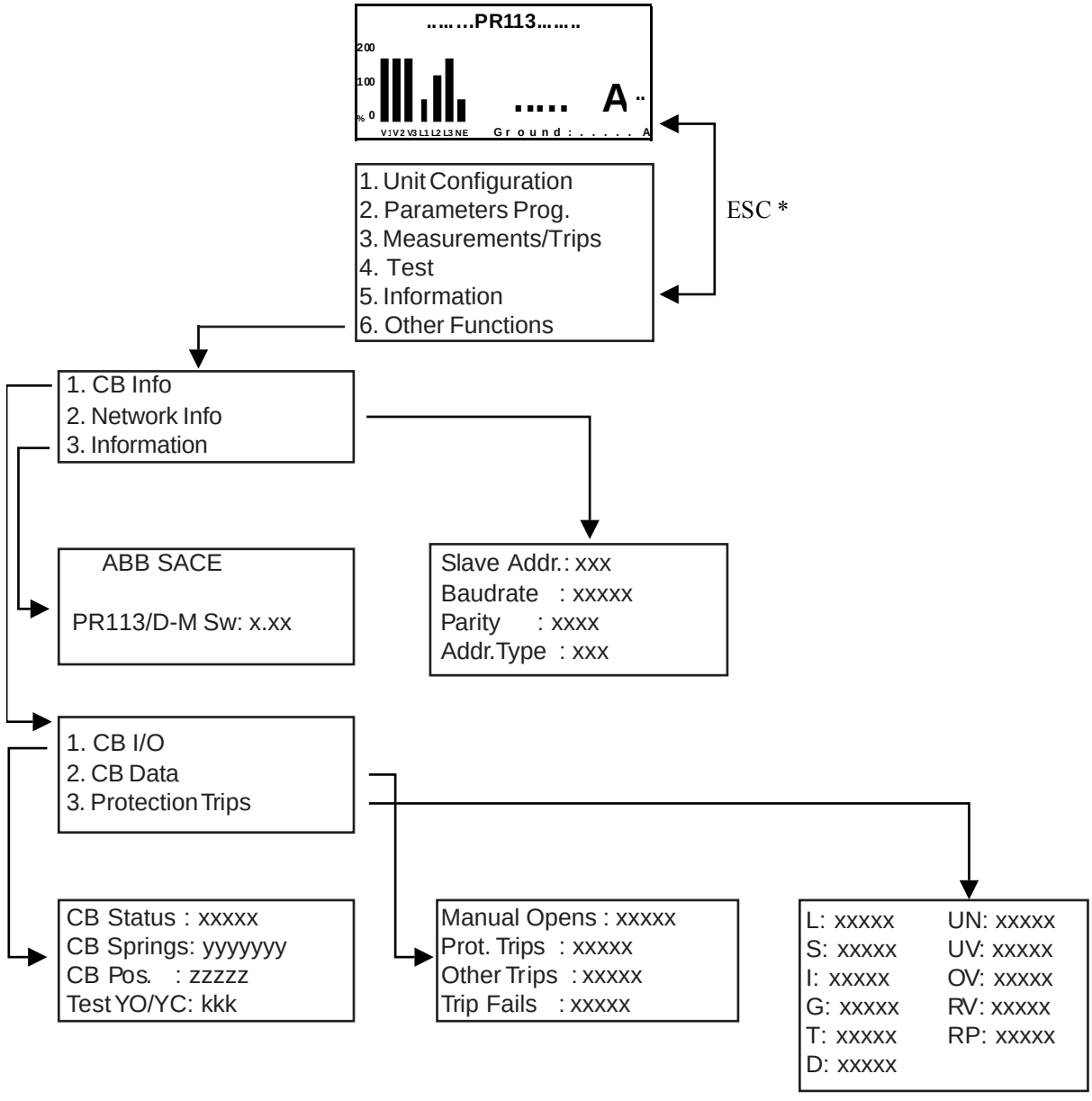
Before putting into service, it is advisable to carry out some opening, closing and resetting controls of the power circuit breaker, also checking correct indication of the status of the power circuit breaker on the display (open-closed).
It is also advisable to check the correct state of the springs (charged-discharged) as well as the position of the power circuit breaker (connected-isolated). For further details see par. 16.4.4.3.

16.5.3 Initial settings

ABB SACE defines each setting of the communication parameters (see default parameters). Apart from this, before putting the PR113 into service, it is absolutely indispensable for the user to carefully define each modifiable parameter (see par.16.6.2).

16.6.1 Menus

As already seen previously, the PR113 uses the display to show messages, data and menus. These are organized in a logical and intuitive way. For user convenience, all the additional screens which can be seen with PR113/PD-A are given below.



* Press ESC to return to the previous page

16.6.2 Modification of parameters

The information for modification of the various parameters is given in the PR113/P-A part of the instruction manual.

16.6.2.1 Modification of communication parameters

Slave Addr.:	xxx
Baudrate:	xxxxx
Parity:	xxxx
Addr.Type:	xxx

Properties / function	Selectable values	Description
Slave Addr.	1…247 and 255*	Logical address of the device.
Baudrate	9600-19200 bit/s	Data transmission speed.
Parity	Even-Odd	Control mode of data transmitted.
Addr. Type	Standard-ABB SACE	Type of addressing of the Modbus™ data.

* Slave Addr. = 255 means unit not configured.

16.6.3 Signals

16.6.3.1 Optical signals

Signaling	Description
Led µ**P Fault** [COMMUNICATION] (red)	Microprocessor of the dialogue unit with temporary or permanent fault.
Led **Network** [COMMUNICATION] (yellow)	The communication (Tx) activity between the PR113 trip unit and the remote supervision system is active (rapid flashing).

16.7 Troubleshooting

The following table collects up a series of typical service situations, which are useful in order to understand and solve hypothetical faults or malfunctions.

N.B.:
1. Before consulting the following table, check any lighting up of the LEDs located on the front of the unit for some seconds.
2. **FN** Indicates normal operation of the PR 113.
3. In the case where the suggestions proposed do not lead to a solution of the problem, please contact the ABB SACE service assistance.

N°	Situation	Possible causes	Suggestions
1	There is no serial communication activity with the remote supervision system	1. Incorrect cabling of the connections. 2. There is no auxiliary voltage 3. Incorrect communication parameters	1. Check the connections 2. Recover the auxiliary voltage 3. Set the correct parameters
2	Incorrect indication of the power circuit breaker status, power circuit breaker position and state of the springs	Incorrect cabling of the connections	Check the connections
3	Impossible to send power circuit breaker opening and/or closing controls	1. Incorrect cabling of the connections 2. No power supply to the opening and/or closing coils	1. Check the connections 2. Recover the power supply voltage
4	Impossible to change the PR113 parameters and/or carry out opening/closing controls from the front keyboard	The unit is set to Remote	Set the unit to Local
5	Impossible to change the PR113 parameters and/or send remote opening/closing controls	1. The unit is set to Local 2. The device is a PR113/PD-A	1. Set the unit to Remote 2. FN
6	“No Int. Bus Comm” message on the display	No communication activity between protection unit and communication unit inside the PR113	Contact ABB SACE
7	No updating of the opening data	Vaux not present during the trip	FN

16.8 Warning and error messages

All the messages which can be shown on the display relating to incorrect configurations, generic alarms or linked to useful information are described below.

Incorrect configurations	
MESSAGE	**DESCRIPTION**
MODBUS not config.	The dialogue unit does not have the address set (ABB default setting)
V_AUX OFF: Comm. OFF	The communication bus is not operating because there is no auxiliary voltage.
NO Int. Bus Comm.	No communication between the protection unit and the dialogue unit inside the PR112/PD.
NOT available	The function required is not available.
CB Status Unknown	See par.16.4.4.3
MODBUS Wink	The Wink mode has been activated. In this condition, rear illumination of the display is intermittent.

16.9 Accessories

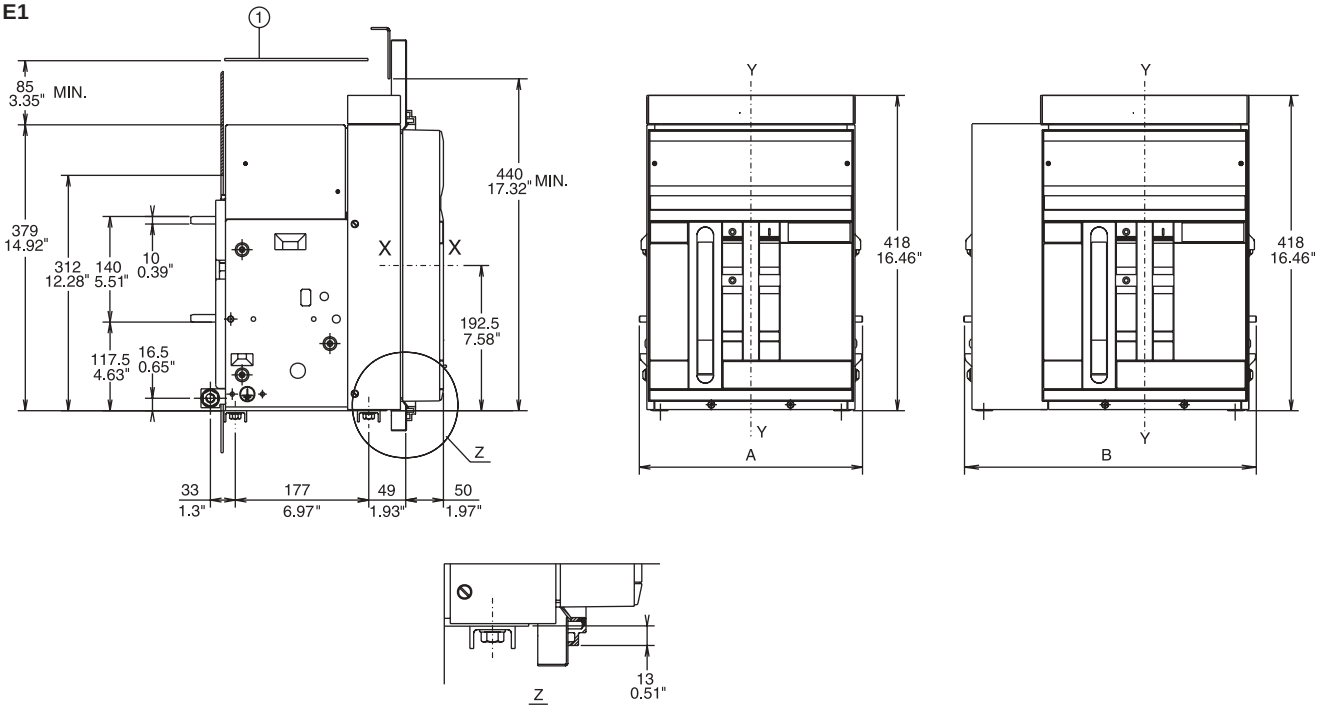
See paragraph 15.7.

17. Overall dimensions

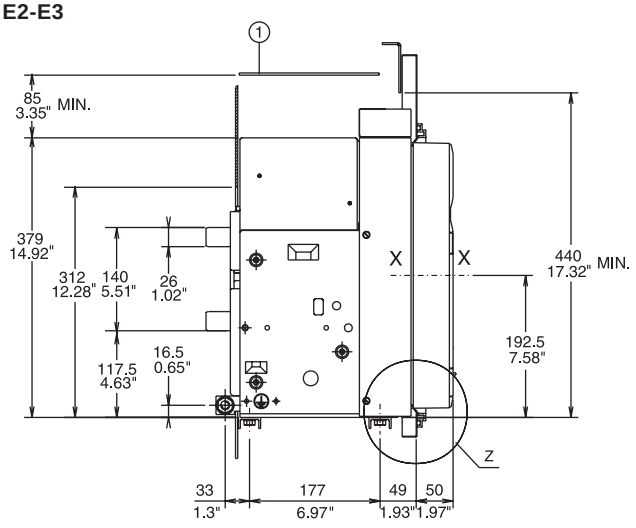
Fixed power circuit breaker

Basic version with horizontal rear terminals

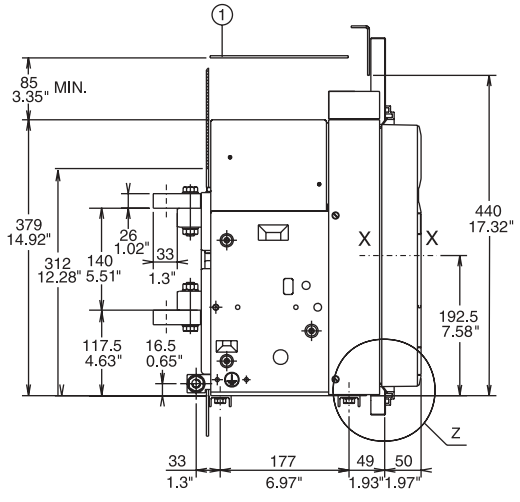
E1



E2-E3



E4-E6



Caption

① Insulating or metal-insulated wall

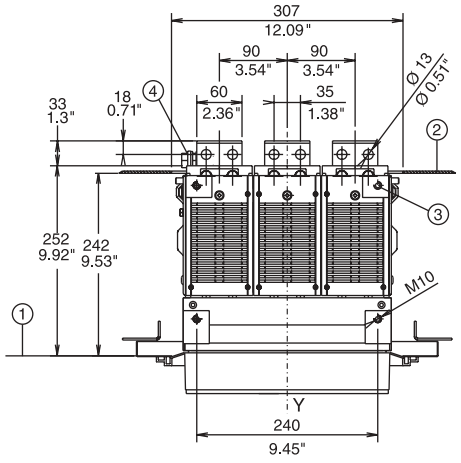
	A 3 Poles	B 4 Poles
E1-A	296/11.65"	386/15.2"
E2-A	296/11.65"	386/15.2"
E3-A	404/15.91"	530/20.87"
E4-A	566/22.28"	656/25.83"
E6-A	782/30.79"	908/35.75"

Fig. 35

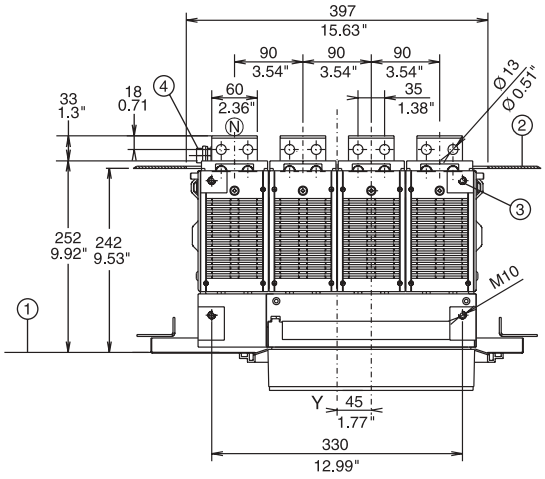
Fixed power circuit breaker

Basic version with horizontal rear terminals

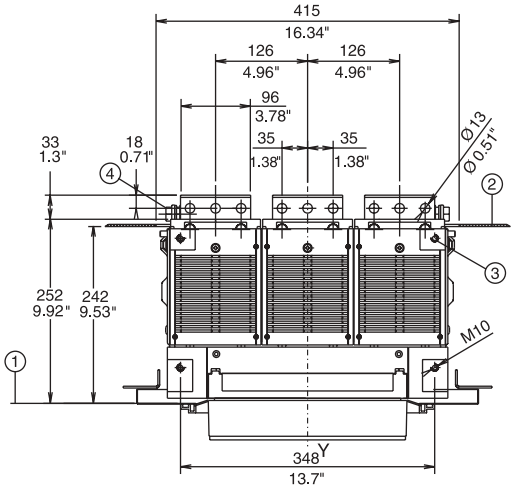
E1 3 poles / **E2** 3 poles



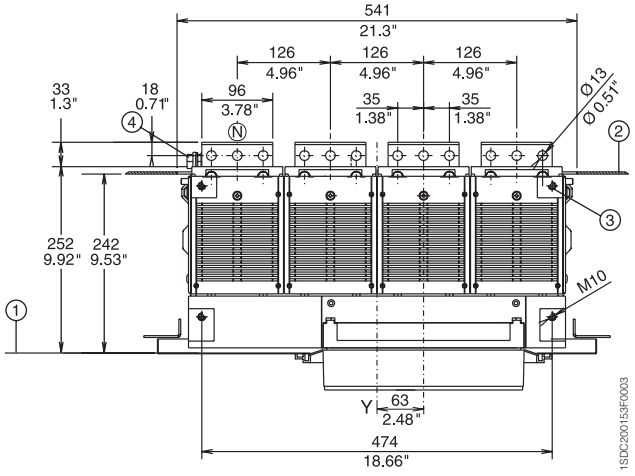
E1 4 poles / **E2** 4 poles



E3 3 poes



E3 4 poles



Caption

① Inside edge of compartment door

② Segregation (where foreseen)

③ Power circuit breaker M10 fixing mounting hole (included in the supply)

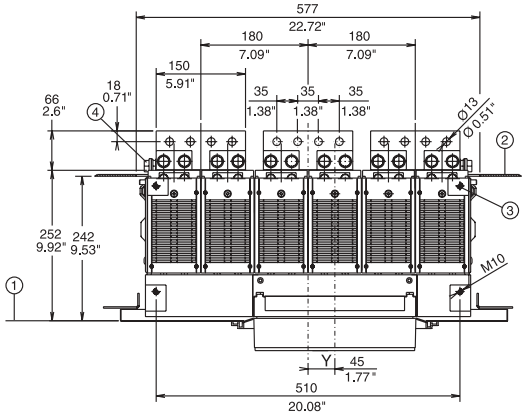
④ No. 1 M12 screw for grounding (included in the supply)

Fig. 36

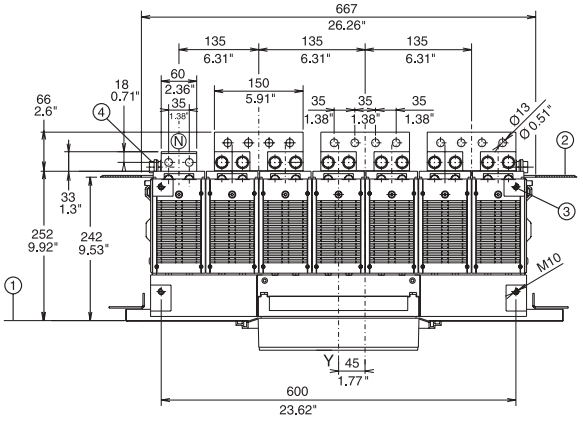
Fixed power circuit breaker

Basic version with horizontal rear terminals

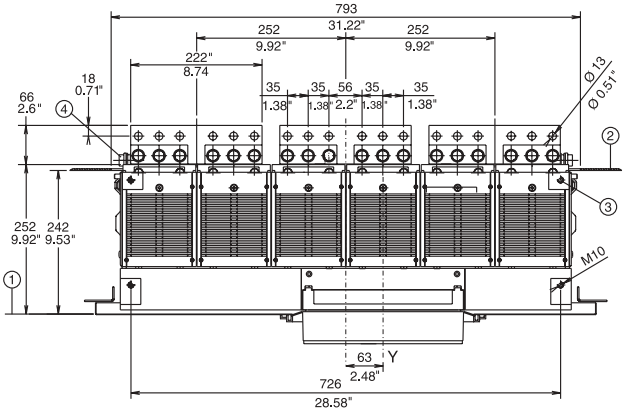
E4 3 poles



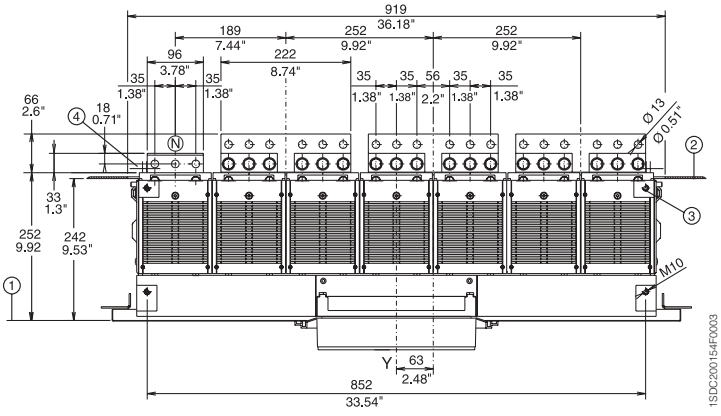
E4 4 poles



E6 3 poles



E6 4 poles



Caption

① Inside edge of compartment door

② Segregation (where foreseen)

③ Power circuit breaker M10 fixing mounting hole (included in the supply)

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

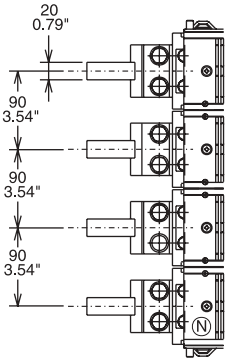
Fig. 36a

Mod.	L2275			Apparatus	**Emax**	Scale
				Doc. N°	**RH0109002**	Page N° **109/132**

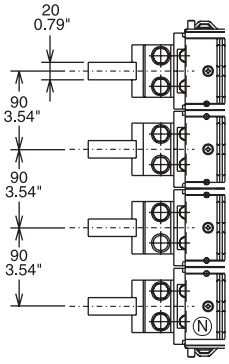
Fixed power circuit breaker

Basic version with vertical rear terminals

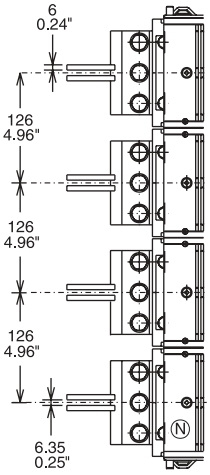
E1



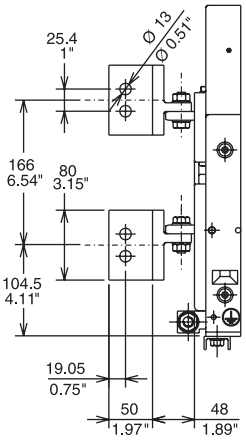
E2



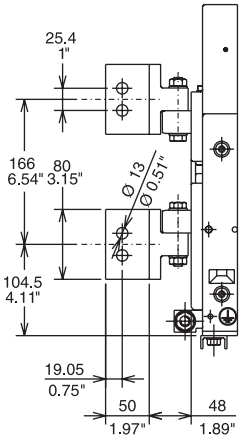
E3 1200÷2000 A



E1



E2



E3 1200÷2000 A

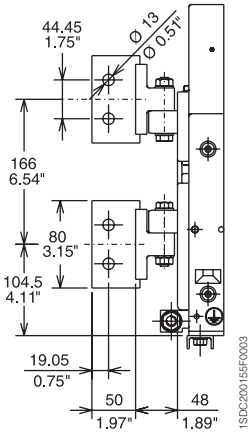


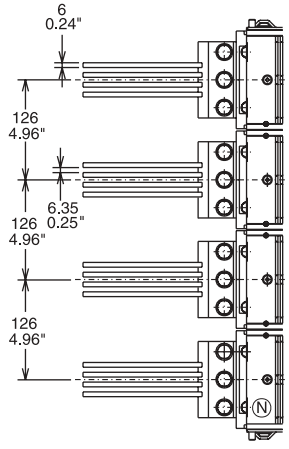
Fig. 37

Mod.	L2275			Apparatus	**Emax**	Scale
				Doc. N°	**RH0109002**	Page N° **110/132**

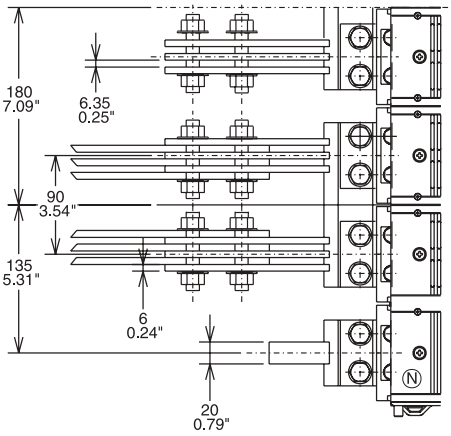
Fixed power circuit breaker

Basic version with vertical rear terminals

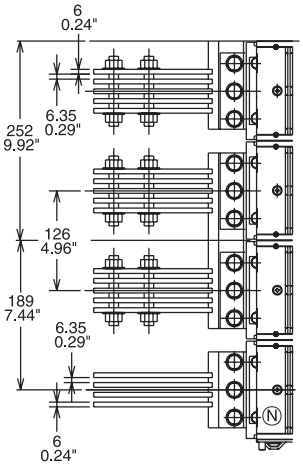
E3 2500 A



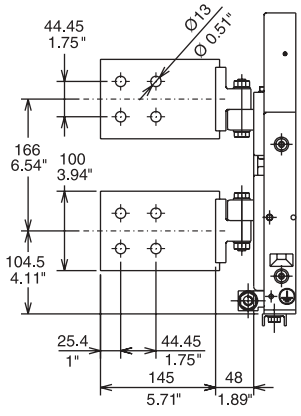
E4



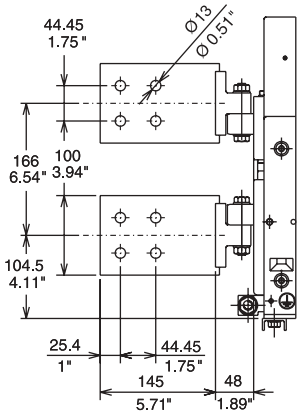
E6



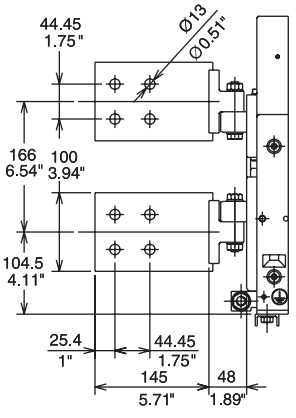
E3 2500 A



E4



E6



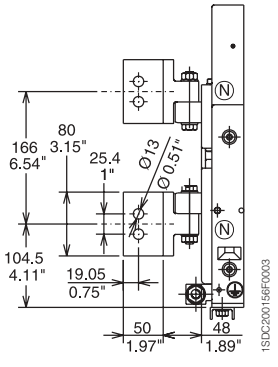


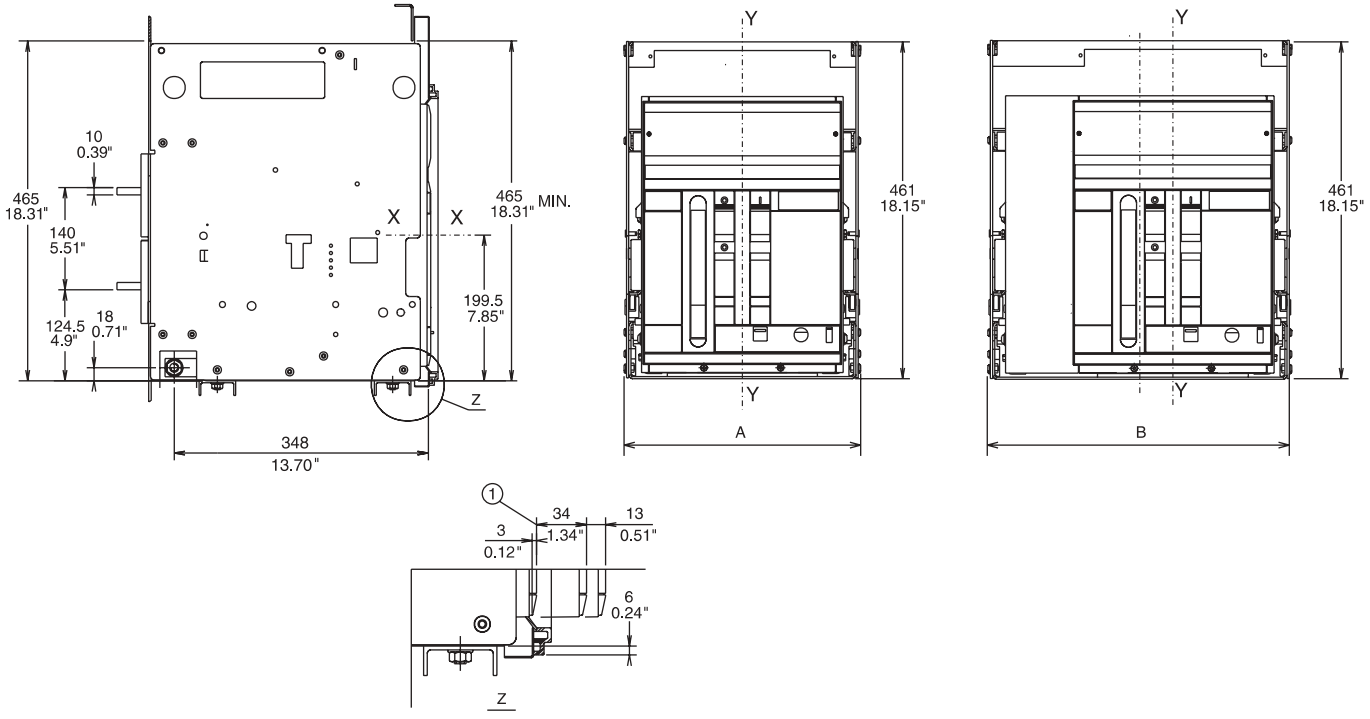
Fig. 38

Mod.	L2275			Apparatus	**Emax**	Scale
				Doc. N°	**RH0109002**	Page N° **111/132**

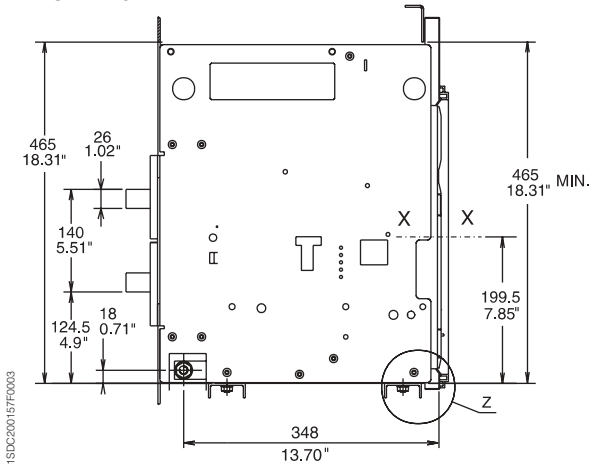
Draw out power circuit breaker

Basic version with horizontal rear terminals

E1



E2-E3-E4-E6



	A 3 Poles	B 4 Poles
E1-A	324/12.76"	414/16.3"
E2-A	324/12.76"	414/16.3"
E3-A	432/17.01"	558/21.97"
E4-A	594/23.39"	684/26.93"
E6-A	810/31.89"	936/36.85"

Caption

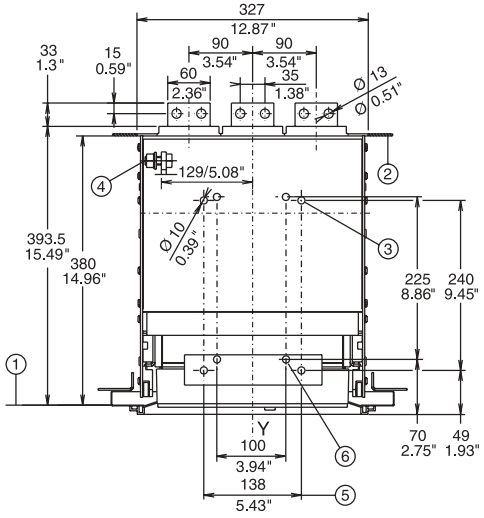
① Run from racked-in to test to isolated

Fig. 39

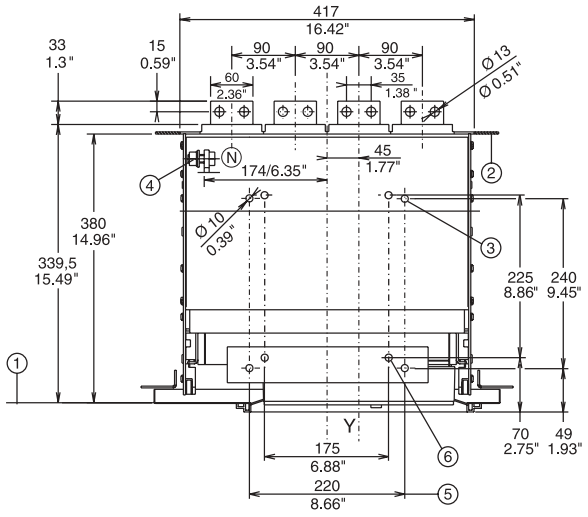
Draw out power circuit breaker

Basic version with horizontal rear terminals

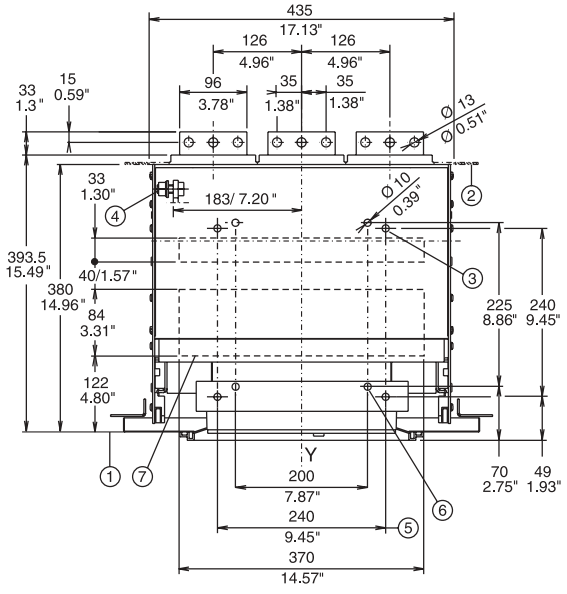
E1 3 poles / **E2** 3 poles



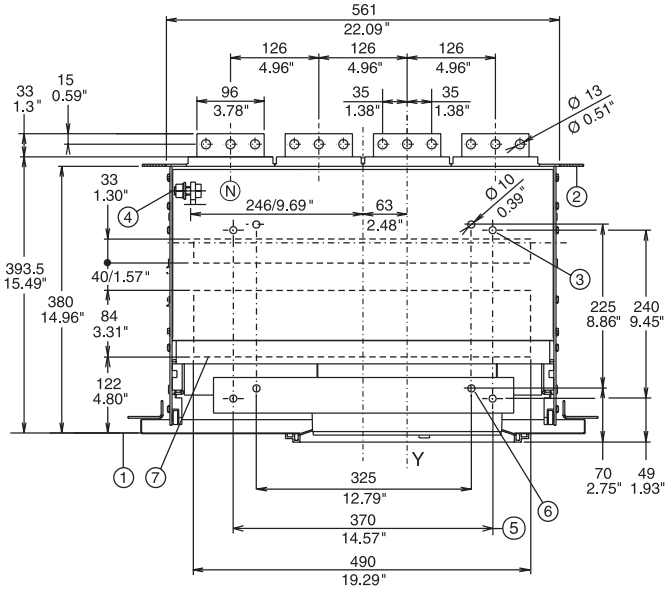
E1 4 poles / **E2** 4 poles



E3 3 poles



E3 4 poles



1SDC200158F0003

Caption

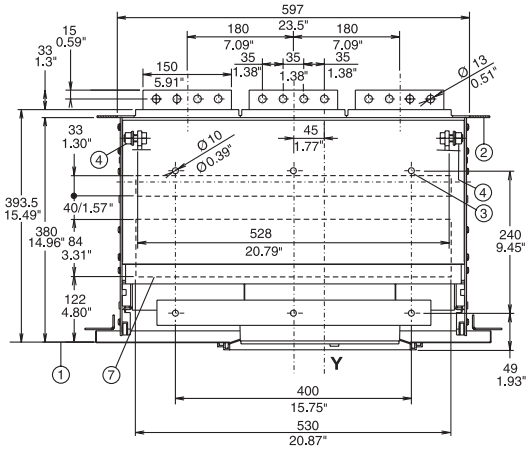
1. Inside edge of compartment door
2. Segregation (where foreseen)
3. Power circuit breaker M8 fixing mounting hole (included in the supply)
4. No. 1 M12 screw for grounding (included in the supply)
5. No. 4 fixed part mounting holes (standard)
6. Alternative drilling with 25 mm pitch for fixing fixed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

Fig. 40

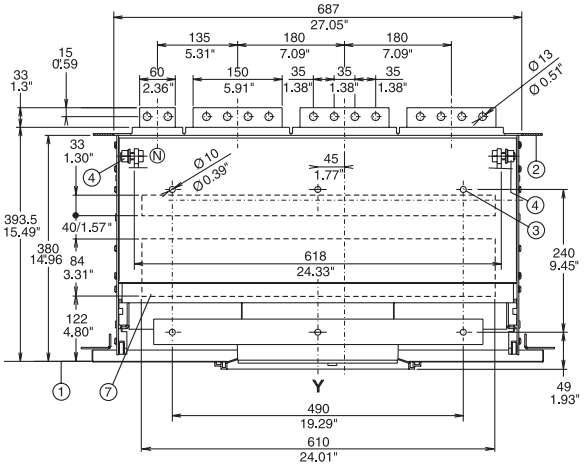
Draw out power circuit breaker

Basic version with horizontal rear terminals

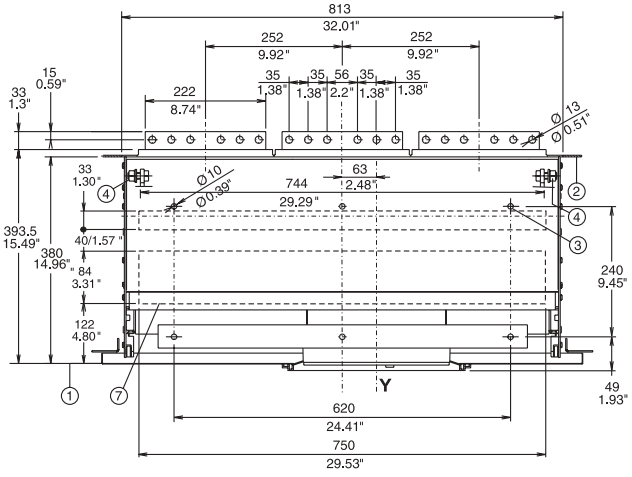
E4 3 poleas



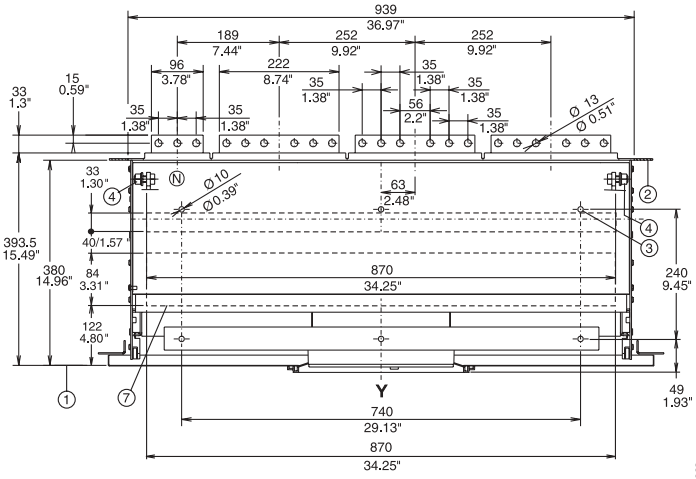
E4 4 poles



E6 3 poles



E6 4 poles



1SDC200159F0003

Caption

① Inside edge of compartment door

② Segregation (where foreseen)

③ Power circuit breaker M8 fixing mounting hole (included in the supply)

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

⑦ Ventilation drilling on the switchgear

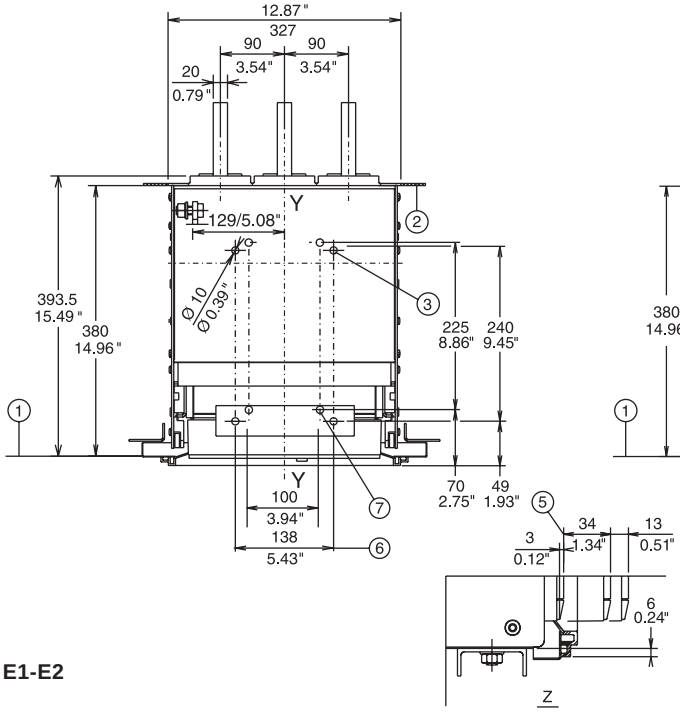
Fig. 40a

Mod.	L2275			Apparatus	**Emax**	Scale
				Doc. N°	**RH0109002**	Page N° **114/132**

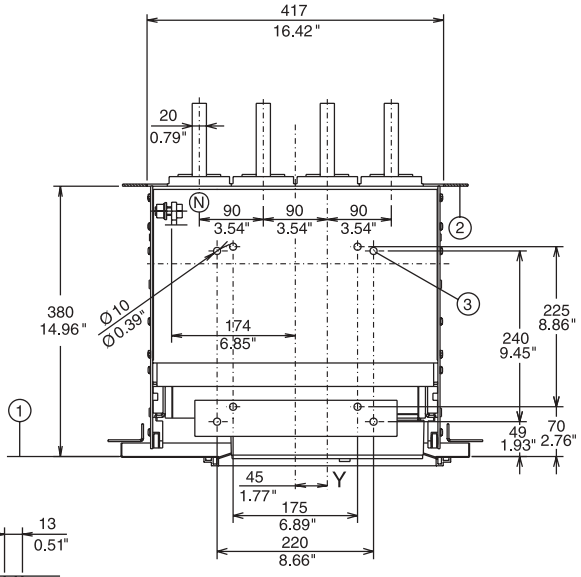
Draw out power circuit breaker

Version with vertical rear terminals

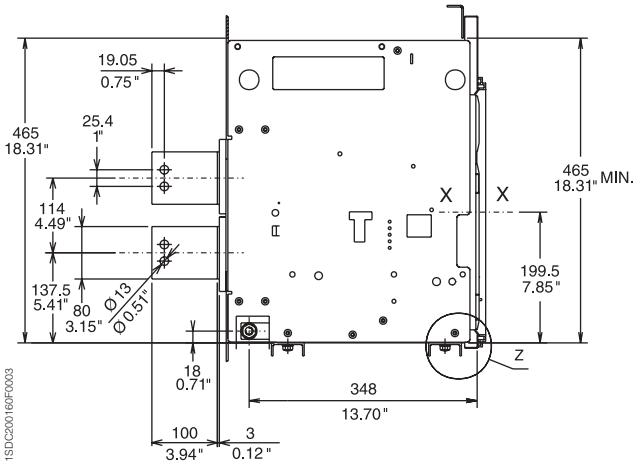
E1 3 poles / **E2** 3 poles



E1 4 poles / **E2** 4 poles



E1-E2



Caption

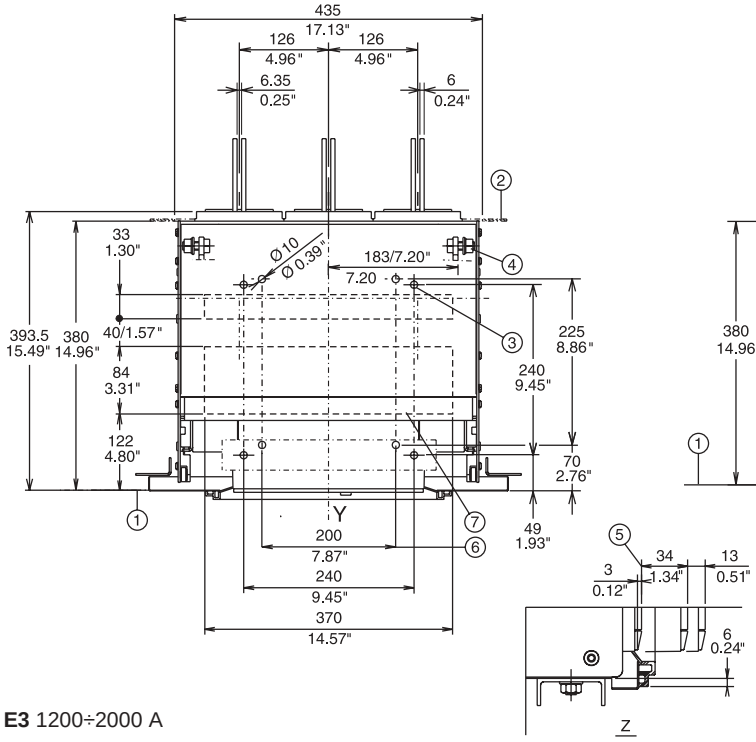
1. Inside edge of compartment door
2. Segregation (where foreseen)
3. Power circuit breaker M8 fixing mounting hole (included in the supply)
5. Run from racked-in to test to isolated
6. No. 4 fixed part mounting holes (standard)
7. Alternative drilling with 25 mm pitch for fixing fixed part

Fig. 41

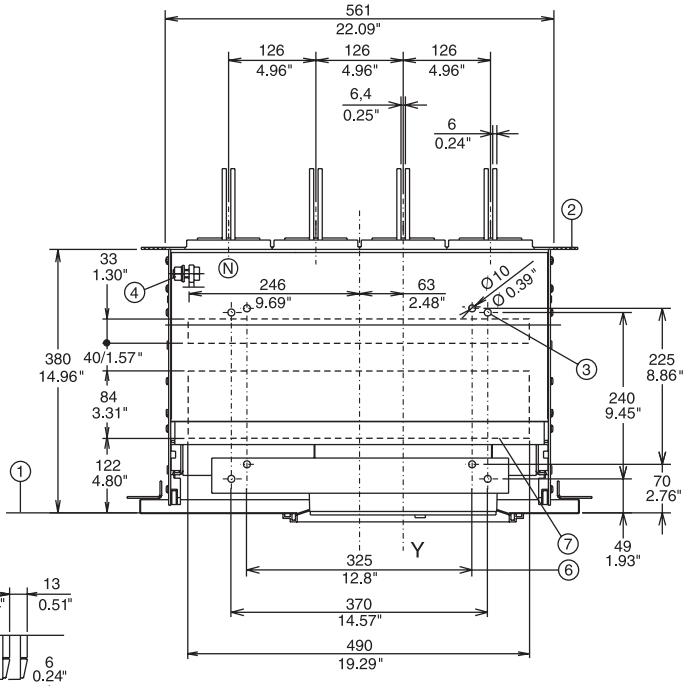
Draw out power circuit breaker

Version with vertical rear terminals

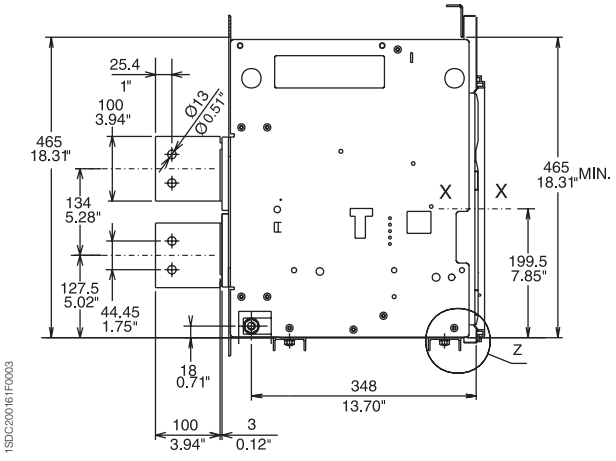
E3 3 poles 1200÷2000 A



E3 4 poles 1200÷2000 A



E3 1200÷2000 A



Caption

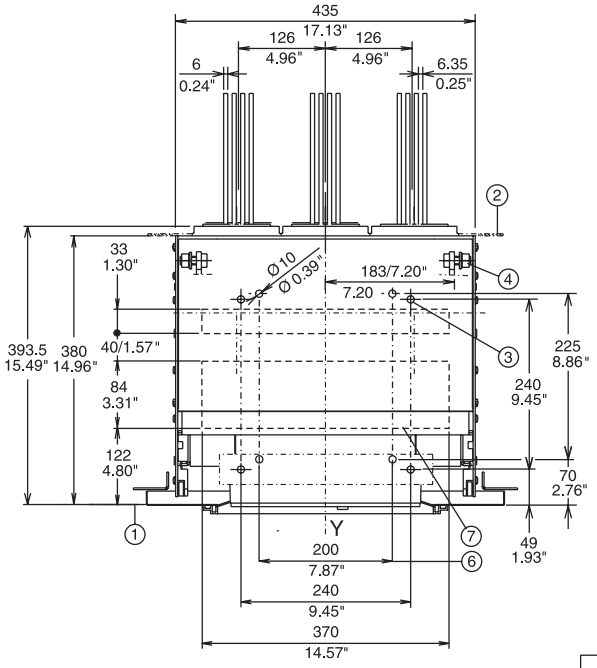
1. Inside edge of compartment door
2. Segregation (where foreseen)
3. Power circuit breaker M8 fixing mounting hole (included in the supply)
4. No. 2 M12 screws for grounding (included in the supply)
5. Run from racked-in to test to isolated
6. Alternative drilling with 25 mm pitch for fixing fixed part
7. Ventilation drilling on the switchgear

Fig. 41a

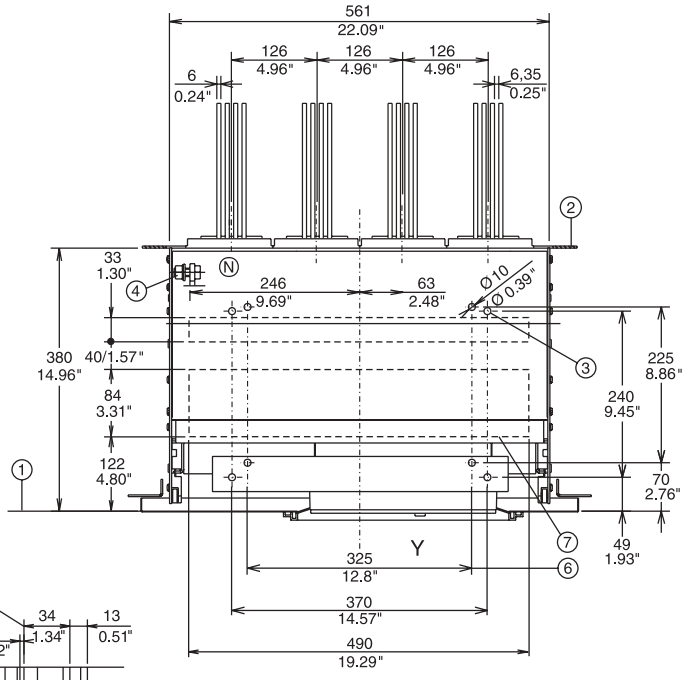
Draw out power circuit breaker

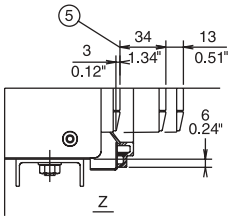
Version with vertical rear terminals

E3 3 poles 2500 A

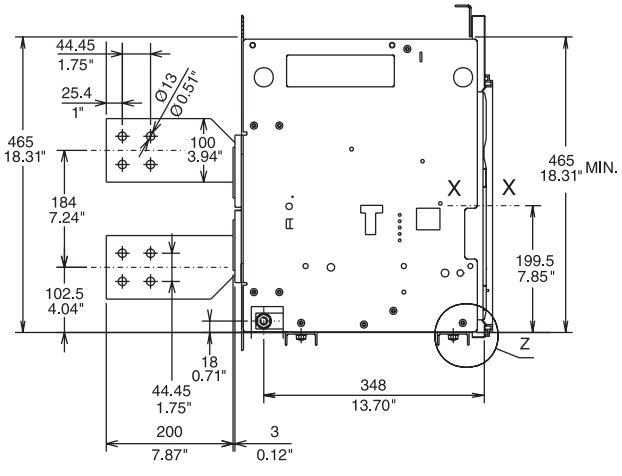


E3 4 poles 2500 A





E3 2500 A



1SDC200162F0003

Caption

1. Inside edge of compartment door
2. Segregation (where foreseen)
3. Power circuit breaker M8 fixing mounting hole (included in the supply)
4. No. 2 M12 screws for grounding (included in the supply)
5. Run from racked-in to test to isolated
6. Alternative drilling with 25 mm pitch for fixing fixed part
7. Ventilation drilling on the switchgear

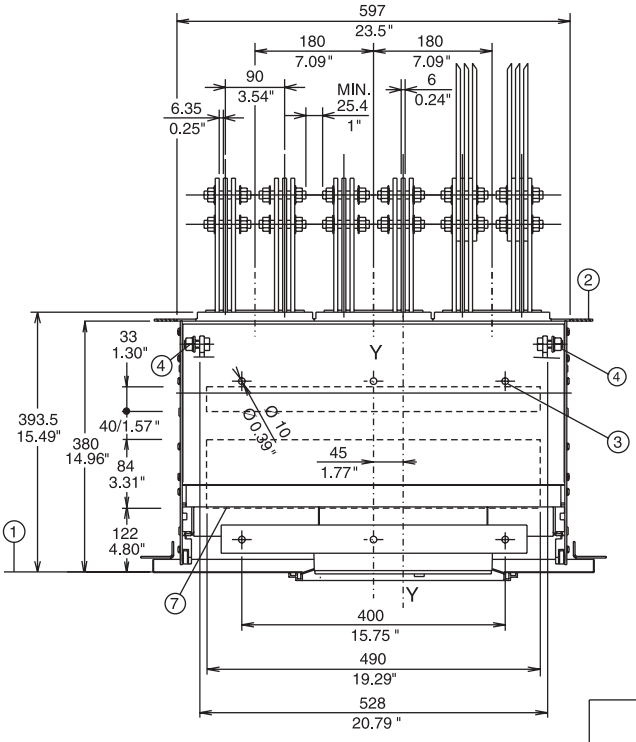
Fig. 42

Mod.	L2275			Apparatus	**Emax**	Scale
				Doc. N°	**RH0109002**	Page N° **117/132**

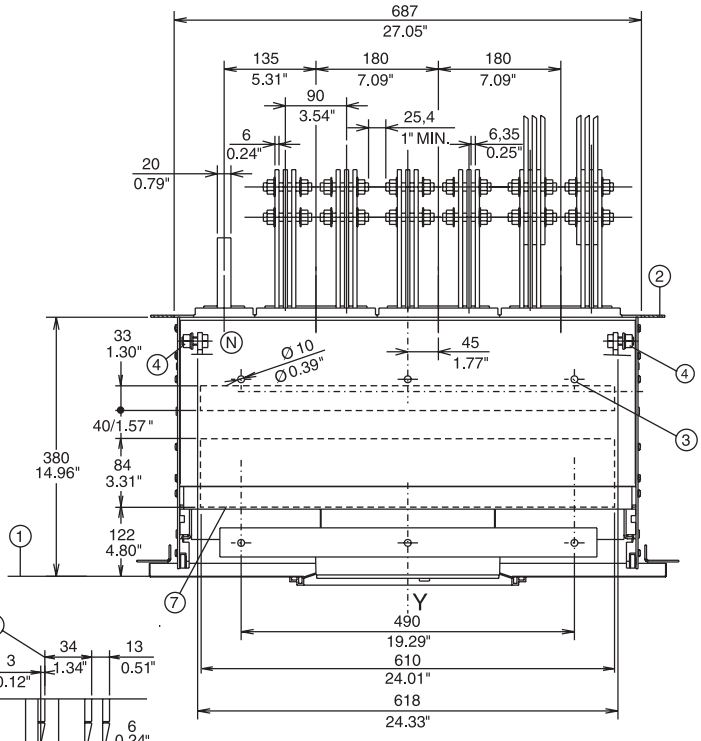
Draw out power circuit breaker

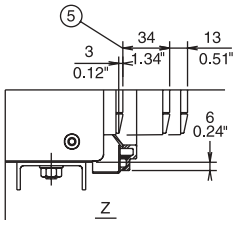
Version with vertical rear terminals

E4 3 poles

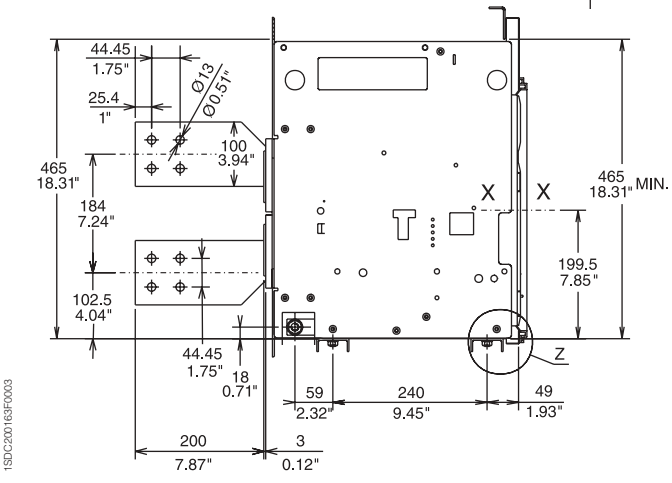


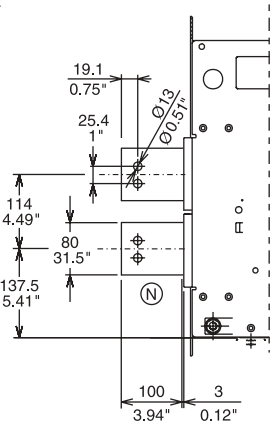
E4 4 poles





E4





1SDC200163F0003

Caption

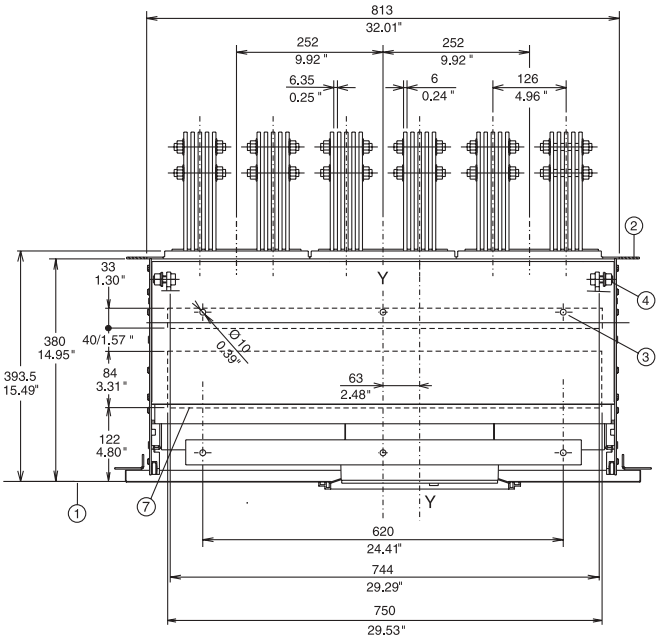
1. Inside edge of compartment door
2. Segregation (where foreseen)
3. Power circuit breaker M8 fixing mounting hole (included in the supply)
4. No. 2 M12 screws for grounding (included in the supply)
5. Run from racked-in to test to isolated
7. Ventilation drilling on the switchgear

Fig. 42a

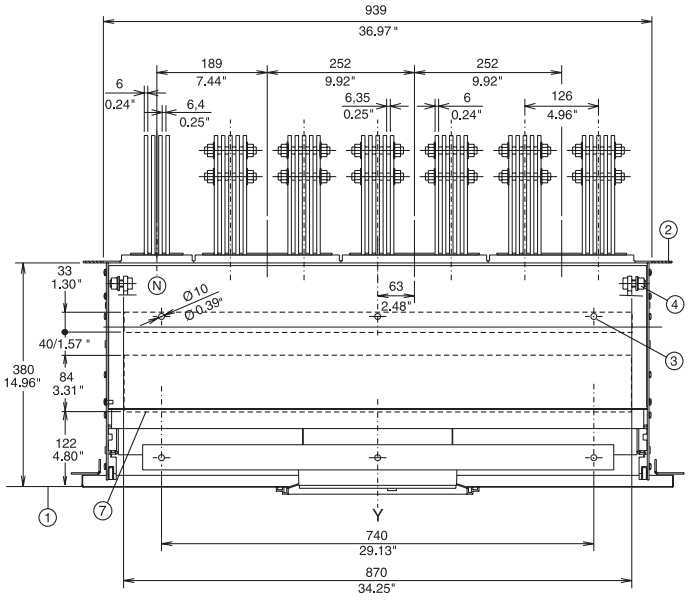
Draw out power circuit breaker

Version with vertical rear terminals

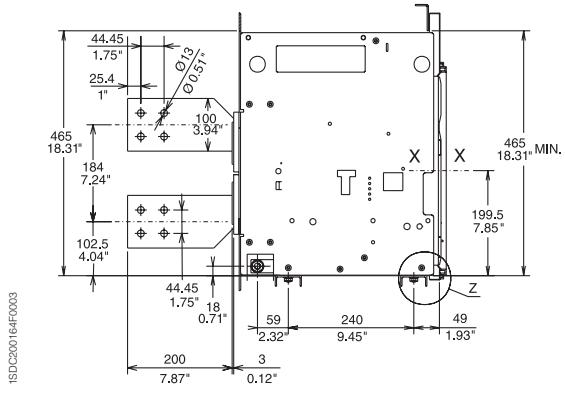
E6 3 poles

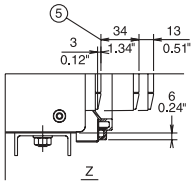


E6 4 poles



E6



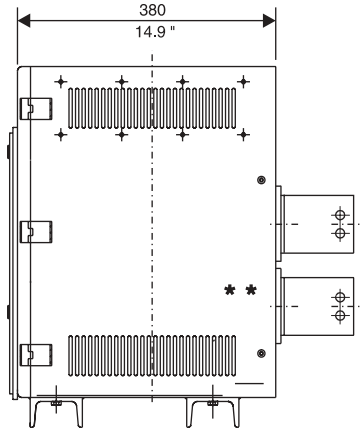


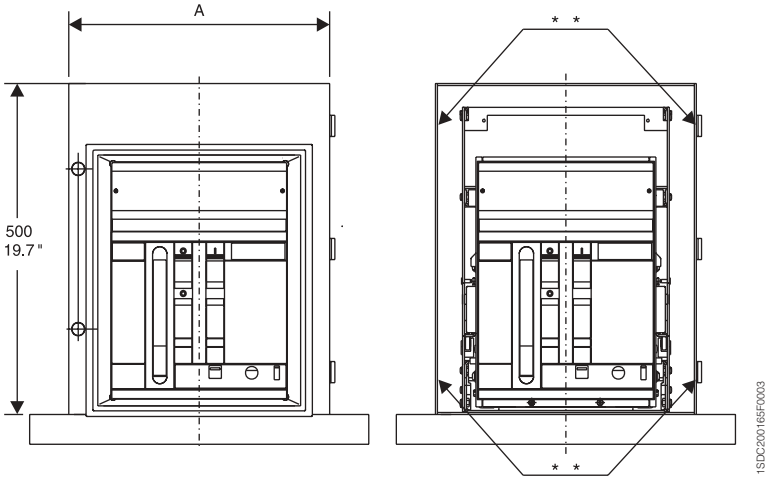
Caption

1. Inside edge of compartment door
2. Segregation (where foreseen)
3. Power circuit breaker M8 fixing mounting hole (included in the supply)
4. No. 2 M12 screws for grounding (included in the supply)
5. Run from racked-in to test to isolated
7. Ventilation drilling on the switchgear

Fig. 43

Compartment dimensions





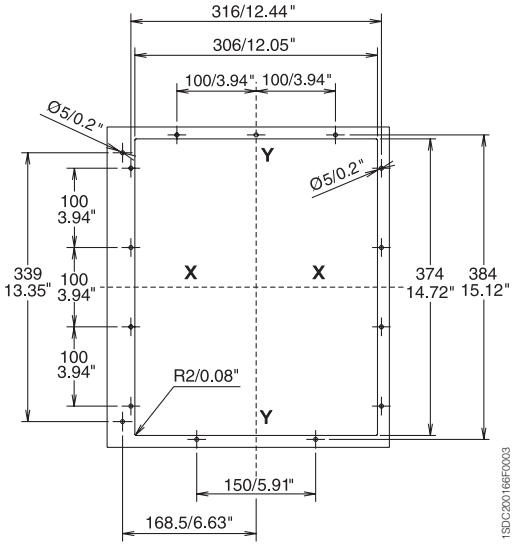
	A 3 Poles	A 4 Poles
E1-A	400/11.65''	490/19.30''
E2-A	400/15.7''	490/19.30''
E3-A	500/19.7''	630/24.82''
E4-A	700/25.7''	790/30.62''
E6-A	1000/39.3''	1130/44.52''

Suitable for operating at 100% rating in a compartment of the dimensions shown in the figure, with a ventilation of 48 square inches (12x4) in the bottom part and in the top part.

Refer to the compartment drawings for verification.

Fig. 44

Compartment door mounting holes



Tightening torque of the fixing screws: Nm 20 - 177 lb/in
Tightening torque of the main terminals: Nm 70 - 620 lb/in
Tightening torque of the grounding screw: Nm 70 - 620 lb/in

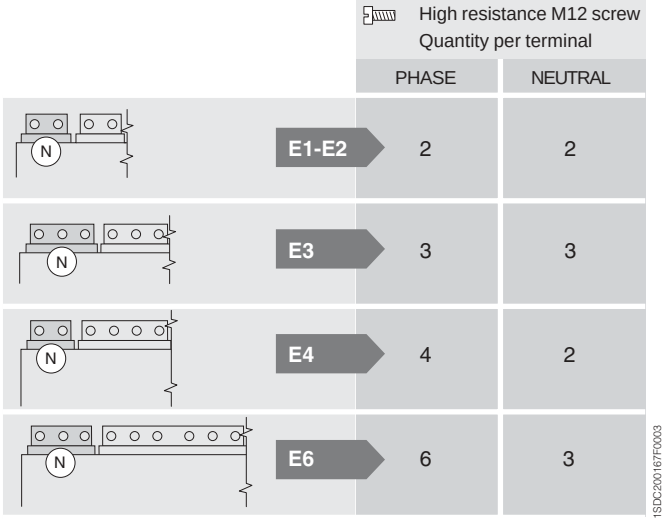


Fig. 45

Mod.	L2275			Apparatus	Emax	Scale
				Doc. N°	RH0109002	Page N° 120/132

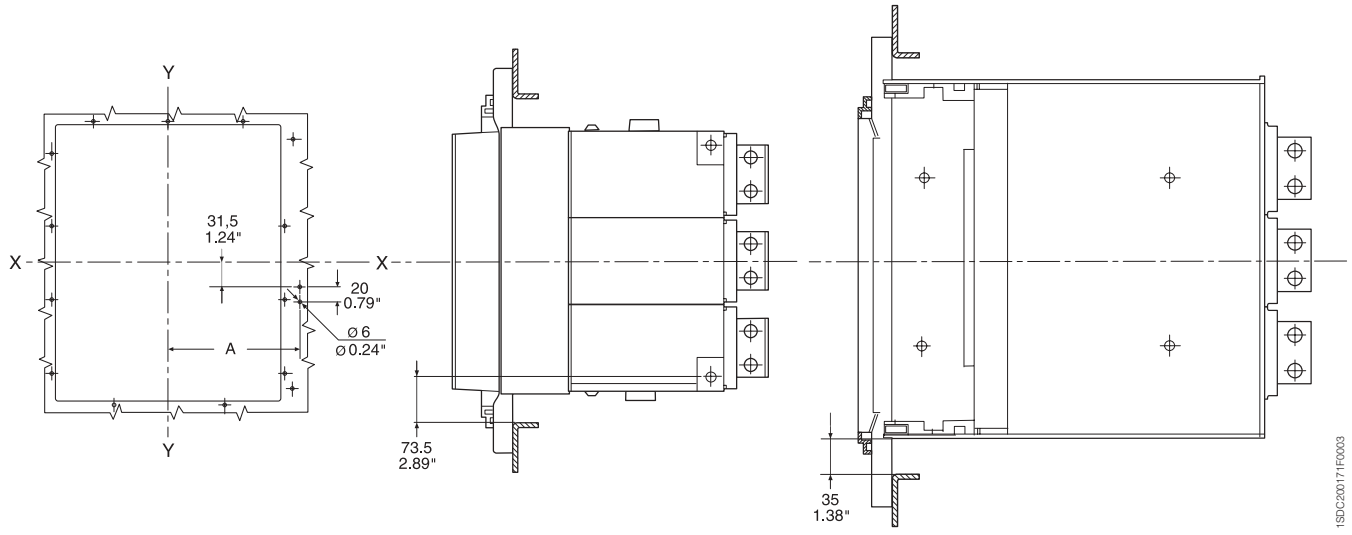
Compartment door mechanical lock

Door mounting holes

Minimum distance between the power circuit breaker and the side of the switchgear

Fixed version

Draw out version



	A 3 Poles	A 4 Poles
E1-A	180/7.09''	180/7.09''
E2-A	180/7.09''	180/7.09''
E3-A	234/9.21''	234/9.21''
E4-A	270/10.63''	360/14.17''
E6-A	360/14.17''	486/19.13''

Fig. 48

18. Electrical circuit diagrams

State of operation shown

The diagram is shown in the following conditions:
– draw out version power circuit breaker, open and racked-in
– circuits de-energized
– trip units not tripped
– motor operator with springs discharged.

Versions

The diagram shows a draw out version power circuit breaker, but is also valid for fixed version power circuit breakers.
Fixed version
The control circuits are included between the XV terminals (the X connector is not supplied).
The applications indicated in figures 31, 32 and 51 cannot be supplied with this version.
Draw out version
The control circuits are included between the poles of the X connector (the XV terminal box is not supplied).
The application indicated in figure 52 cannot be supplied with this version.
Version without trip unit
The applications indicated in figures 3, 5, 13, 41, 42, 43, 44, 51, 52, 53 and 62 cannot be supplied with this version.
Version with PR111-A
The PR111-A trip unit is only fitted with the protection unit.
The applications indicated in the figures 3, 5, 41, 42, 43, 44, 53 and 62 cannot be supplied with this version.
Version with electronic PR112/P-A trip unit
The PR112/P-A trip unit is only fitted with the protection unit.
The applications indicated in the figures 3, 5, 22, 42, 43, 44 and 53 cannot be supplied with this version.
Version with electronic PR112/PD-A trip unit
The PR112/PD-A trip unit is fitted with the protection and dialogue unit.
The applications indicated in the figures 22, 41, 43, 44 and 53 cannot be supplied with this version.
Version with electronic PR113/P-A trip unit
The PR113/P-A trip unit is only fitted with the protection unit.
The applications indicated in the figures 3, 5, 22, 41, 42 and 44 cannot be supplied with this version.
Version with electronic PR113/PD-A trip unit
The PR113/PD-A trip unit is fitted with the protection and dialogue unit.
The applications indicated in the figures 22, 41, 42 and 43 cannot be supplied with this version.

Caption

□	=	Number of figure of the diagram
*	=	See the note indicated by the letter
A1	=	Applications of the power circuit breaker
A13	=	PR020/K signaling unit (only provided with PR112/P-A, PR112/PD-A, PR113/P-A or PR113/PD-A trip unit)
A3	=	Applications located on the cradle of the power circuit breaker (only provided with draw out version power circuit breakers)
A4	=	Indicative apparatus and connections for control and signaling, outside the power circuit breaker
AY	=	SACE SOR TEST UNIT: control/monitoring unit (see note R)
D	=	Electronic time-delay device of the undervoltage release, outside the power circuit breaker
F1	=	Fuse with delayed intervention
K51	=	PR111-A, PR112/P-A, PR112/PD-A, PR113/P-A or PR113/PD-A type electronic trip unit with the following protection functions (see note G): - L against overload with inverse long delay trip - adjustment I1 - S against short circuit with inverse or definite short delay trip - adjustment I2 - I against short circuit with instantaneous trip - adjustment I3 - G against ground fault with inverse short delay trip - adjustment I4
K51/µP	=	Electrical alarm bell for operating anomalies of the microprocessor (only provided with Uaux. and PR112/P-A, PR112/PD-A, PR113/P-A or PR113/PD-A trip unit)
K51/1…8	=	PR020/K signaling unit contacts
K51/GZin (DBin)	=	Zone selectivity: input for protection G or input in “backward” direction for protection (only provided with Uaux. and PR113/P-A or PR113/PD-A trip unit)
K51/GZout (DBout)	=	Zone selectivity: output for protection G or output in “backward” direction for protection D (only provided with Uaux. and PR113/P-A or PR113/PD-A trip unit)
K51/P1	=	Programmable electrical signaling (only provided with Uaux. and PR112/P-A,PR112/PD-A, PR113/P-A or PR113/PD-A trip unit)
K51/P2	=	Programmable electrical signaling (only provided with Uaux. and PR113/P-A trip unit)
K51/SZin (DFin)	=	Zone selectivity: input for protection S or input in “forward” direction for protection D (only provided with Uaux. and PR113/P-A or PR113/PD-A trip unit)
K51/SZout (DFout)	=	Zone selectivity: output for protection S or output in “forward” direction for protection D (only provided with Uaux. and PR113/P-A or PR113/PD-A trip unit)
K51/YC	=	Closing control from PR112/PD-A or PR113/PD-A electronic trip unit
K51/Y0	=	Opening control from PR112/PD-A or PR113/PD-A electronic trip unit
K51/Y01	=	Electrical bell alarm for shunt trip Y01 TRIPPED (only provided with PR112/P-A, PR112/PD-A, PR113/P-A or PR113/PD-A trip unit)
K51/Zin	=	Zone selectivity: input (only provided with Uaux. and PR112/P-A or PR112/PD-A trip unit)
K51/Zout	=	Zone selectivity: output (only provided with Uaux. and PR112/P-A or PR112/PD-A trip unit)
M	=	Motor for closing spring charging
Q	=	Power circuit breaker
Q/1…25	=	Power circuit breaker auxiliary contacts
S33M/1	=	Limit contact of spring charging motor
S33M/2	=	Contact for electrical signaling of springs charged
S43	=	Changeover switch for setting remote/local control

S51 = Contact for bell alarm of power circuit breaker open due to trip of the trip unit. Power circuit breaker closing can only take place after having pressed the reset pushbutton
S75E/14 = Contacts for electrical signaling of power circuit breaker in racked-out position (only provided with draw out version power circuit breakers)
S75I/14 = Contacts for electrical signaling of power circuit breaker in racked-in position (only provided with draw out version power circuit breakers)
S75T/14 = Contacts for the electrical signaling of power circuit breaker in test position (only provided with draw out version power circuit breakers)
SC = Pushbutton or contact for power circuit breaker closing
SO = Pushbutton or contact for power circuit breaker opening
SO1 = Pushbutton or contact for power circuit breaker opening with delayed trip
SO2 = Pushbutton or contact for power circuit breaker opening with instantaneous trip
TI/L1 = Current transformer located on phase L1
TI/L2 = Current transformer located on phase L2
TI/L3 = Current transformer located on phase L3
TI/N = Current transformer located on the neutral
TI/O = Homopolar current transformer located on the conductor which connects the MV/LV transformer star center to ground (see note G)
TU = Insulation transformer
Uaux. = Auxiliary power supply voltage (see note F)
UI/L1 = Current sensor (Rogowski coil) located on phase L1
UI/L2 = Current sensor (Rogowski coil) located on phase L2
UI/L3 = Current sensor (Rogowski coil) located on phase L3
UI/N = Current sensor (Rogowski coil) located on the neutral
W1 = Serial interface with the control system (external bus): EIA RS485 interface (see note E)
W2 = Serial interface with the accessories of the PR112/P-A, PR112/PD-A, PR113/P-A and PR113/PD-A (internal bus) trip units
X = Delivery connector for draw out version power circuit breaker auxiliary circuits
X1…X7 = Connectors for the power circuit breaker applications
XF = Delivery terminal box for the draw out version power circuit breaker position contacts (located on the cradle of the power circuit breaker)
XK1 = Connector for the power circuits of the PR111-A, PR112/P-A, PR112/PD-A, PR113/P-A and PR113/PD-A trip units
XK2 - XK3 = Connectors for the auxiliary circuits of the PR112/P-A, PR112/PD-A, PR113/P-A and PR113/PD-A trip units
XO = Connector for the YO1release
XV = Delivery terminal box for fixed version power circuit breaker auxiliary circuits
YC = Closing coil
YO = Shunt trip
YO1 = Shunt trip for overcurrent
YO2 = Second shunt trip (see note Q)
YU = Undervoltage release (see notes B and Q)

Description of figures

Fig. 1 = Closing spring charging motor circuit
Fig. 2 = Closing coil circuit
Fig. 3 = Closing coil circuit with control from the dialogue unit of the PR112/PD-A or PR113/PD-A trip unit
Fig. 4 = Shunt trip
Fig. 5 = Shunt trip circuit with control from the dialogue unit of the PR112/PD-A or PR113/PD-A trip unit
Fig. 6 = Instantaneous undervoltage release (see notes B and Q)
Fig. 7 = Undervoltage release with electronic time-delay device, outside the power circuit breaker (see notes B and Q)
Fig. 8 = Second shunt trip (see note Q)
Fig.11 = Contact for electrical signaling of springs charged.
Fig.12 = Contact for electrical signaling of undervoltage release energized (see notes B, L and S)
Fig.13 = Contact for bell alarm of power circuit breaker open due to trip of the trip unit. Power circuit breaker closing can only take place after the reset pushbutton has been pressed.
Fig.21 = First pack of power circuit breaker auxiliary contacts
Fig.22 = Second pack of power circuit breaker auxiliary contacts (not available with the PR112/P-A, PR112/PD-A, PR113/P-A and PR113/PDA trip units).
Fig.23 = Third pack of additional power circuit breaker auxiliary contacts outside the power circuit breaker
Fig.31 = First pack of contacts for electrical signaling of power circuit breaker in racked-in, test or racked-out position
Fig.32 = Second pack of contacts for electrical signaling of power circuit breaker in racked-in, test or racked-out position
Fig.41 = Auxiliary circuits of the PR112/P-A trip unit (see note F)
Fig.42 = Auxiliary circuits of the PR112/PD-A trip unit (see note D, F and M)
Fig.43 = Auxiliary circuits of the PR113/P-A trip unit (see note F)
Fig.44 = Auxiliary circuits of the PR113/PD-A trip unit (see notes F and M)
Fig.51 = Circuit of the current transformer on the neutral conductor outside the power circuit breaker, for draw out version power circuit breaker
Fig.52 = Circuit of the current transformer on the neutral conductor outside the power circuit breaker, for fixed version power circuit breaker (see note C)
Fig.53 = Circuit valid in the case of three-pole power circuit breaker with PR113/P-A or PR113/PD-A trip unit without current transformer on the neutral conductor outside the power circuit breaker (see note H)
Fig.61 = SACE SOR TEST UNIT: control/monitoring unit (see note R)
Fig.62 = PR020/K signaling unit (only provided with PR112/P-A, PR112/PD-A, PR113/P-A or PR113/PD-A trip unit)

Incompatibility

The circuits shown in the following figures cannot be provided on the same power circuit breaker at the same time:
2 - 3
4 - 5
6 - 7 - 8
22 - 41 - 42 - 43 - 44
31 - 51
51 - 52 - 53

Notes

A) The power circuit breaker is only fitted with the applications specified in the ABB order confirmation. To make out the order, please consult the apparatus catalogue.

B) The undervoltage release is provided for power supply branched on the supply side of the power circuit breaker or from an independent source: power circuit breaker closing is only allowed with the trip energized (the lock on closing is made mechanically).
In the case where there is the same power supply for the closing coils and undervoltage releases and automatic power circuit breaker closing is required, on return of the auxiliary voltage, it is necessary to introduce a delay of 30 milliseconds between the instant of consent of the undervoltage release and energisation of the closing coil. This can be carried out by means of a circuit outside the power circuit breaker including a permanent closing contact, the contact indicated in figure 12 and a time-delay relay.

C) In the case of a fixed version power circuit breaker with current transformer on the neutral conductor outside the power circuit breaker, when the power circuit breaker is to be removed, it is necessary to short circuit the terminals of the TI/N transformer.

D) Connect the S33M/2 contact indicated in fig. 11, one of the closing contacts and one of the opening contacts of the power circuit breaker indicated in fig. 21 in the way shown in fig. 42.

E) For connection of the EIA RS485 serial line, see the following documentation:
- RH0298.002 for MODBUS communication

F) The Uaux. auxiliary voltage allows activation of all the functions of the PR112/P-A, PR112/PD-A, PR113/P-A and PR113/PD-A trip units. With regard to this, please refer to the relative instruction manuals.

G) Protection against ground fault is available with the PR112/P-A, PR112/PD-A, PR113/P-A and PR113/PD-A trip units by means of a current transformer located on the conductor which connects the MV/LV transformer star center to ground. The connection between terminals 1 and 2 of the TI/O current transformer and the T5 and T6 poles of the X (or XV) connector, must be made using a shielded and corded two-pole cable (see instruction manual) not longer than 15 m. The shield must be grounded on the power circuit breaker side and on the current transformer side.

H) In the case of PR113/P-A or PR113/PD-A trip units mounted on a three-pole power circuit breaker without connection to the neutral outside, the T3 and T4 poles of the X (or XV) connector must be short circuited (by the customer).

I) The contact cannot be used if the PR112/PD-A and PR113/PD-A unit is present.

L) The contact cannot be used if the PR113/P-A or PR113/PD-A unit is present.

M) Connect one of the S75I contacts indicated in fig. 31 or 51 in the way shown in figs. 42-44.
In the case of fixed version power circuit breakers, connect the XV-K14 terminal directly to the XV-K16 terminal (contact S75I does not exist).

N) With PR112/P-A, PR112/PD-A, PR113/P-A and PR113/PD-A trip units, the connections to the zone selectivity inputs and outputs must be made using a shielded and corded two-pole (see instruction manual) not longer than 300m. The shield must be grounded on the selectivity input side.

O) With PR113/P-A and PR113/PD-A trip units, the connection between the voltage sensors (TV) and the power circuit breaker must be made using a shielded and corded two-pole cable (see instruction manual) not longer than 15 m.
The shield must be grounded on both sides (sensor and power circuit breaker).

P) With PR112/PD-A and PR113/PD-A trip units, the power supply of the YO and YC coils must not be branched from the main one.
The coils can be controlled directly from the K51/YO and K51/YC contacts with maximum voltage values of 60VDC and 240-250VAC for PR112/PD-A, 240-250VDC and 240-250VAC for PR113/PD-A.

Q) The second shunt trip must be installed as an alternative to the undervoltage trip.

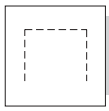
R) The operation of the SACE SOR TEST UNIT system + shunt trip (YO) is guaranteed starting from 75% of the Uaux of the shunt trip.
During closing of the power supply contact to YO (short circuit of terminals 4 and 5), the SACE SOR TEST UNIT is not able to determine the state of the opening coil.
For this reason:
- In the case of an opening coil supplied continuously, the TEST FAILED and ALARM signals will be activated.
- If the control of the opening coil is carried out impulsively, the TEST FAILED signal may be activated at the same moment. In this case, the TEST FAILED signal should only be considered an actual alarm signal if it remains for longer than 20s.

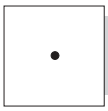
S) Also available in the normally closed contact version.

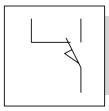
T) Configuration valid for four-pole or three-pole power circuit breaker with external neutral. For other installation configurations, please consult the manual.

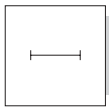
Instructions to follow for replacement of the PR111-A, PR112/P-A, PR112/PD-A, PR113/P-A or PR113/PD-A trip units:
– Take special notice of the notes indicated on the electrical circuit diagrams provided
– The contact for electrical signaling of undervoltage release energized (Fig. 12 of the enclosed diagrams) must be removed from the terminal box.

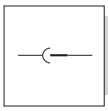
Graphic symbols for electrical circuit diagrams (IEC 60617 and CEI 3-14...3-26 Standards)

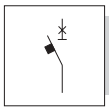

Shield (can be drawn in any shape)

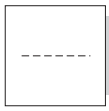

Terminal or clamp

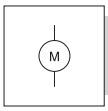

Changeover position contact with momentary trip (limit switch)


Timing

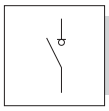

Socket and plug (female and male)

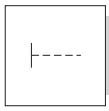

Power molded case switch with automatic opening

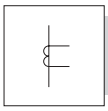

Mechanical connection

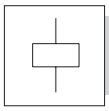


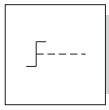
Motor (general symbol)

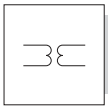

Molded case switch

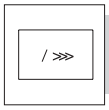

Manual mechanical operating mechanism (general case)

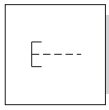

Current transformer

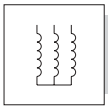

Control coil (general symbol)

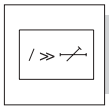

Rotary handle operating mechanism

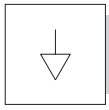

Voltage transformer

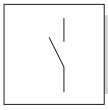

Instantaneous trip unit

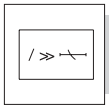

Pushbutton operating mechanism

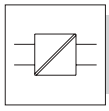

Three-phase transformer winding, star connection

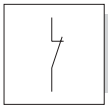

Trip unit with short adjustable time-delay characteristic

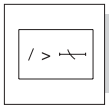

Equipotentiality

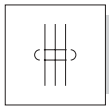

Make contact

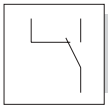

Trip unit with inverse short time-delay characteristic


Converter separated galvanically


Break contact with with automatic trip

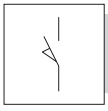

Trip unit with inverse long time-delay characteristic

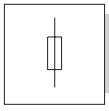

Conductors in shielded cable (e.g. three conductors)

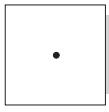

Changeover contact


Trip unit for ground fault with inverse short time-delay characteristic

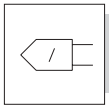

Conductors or corded cables (e.g. 3 conductors)

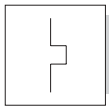

Closing position contact (limit switch)

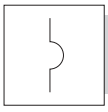

Fuse (general symbol)

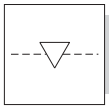

Connection of conductors


Opening position contact (limit switch)


Current sensor

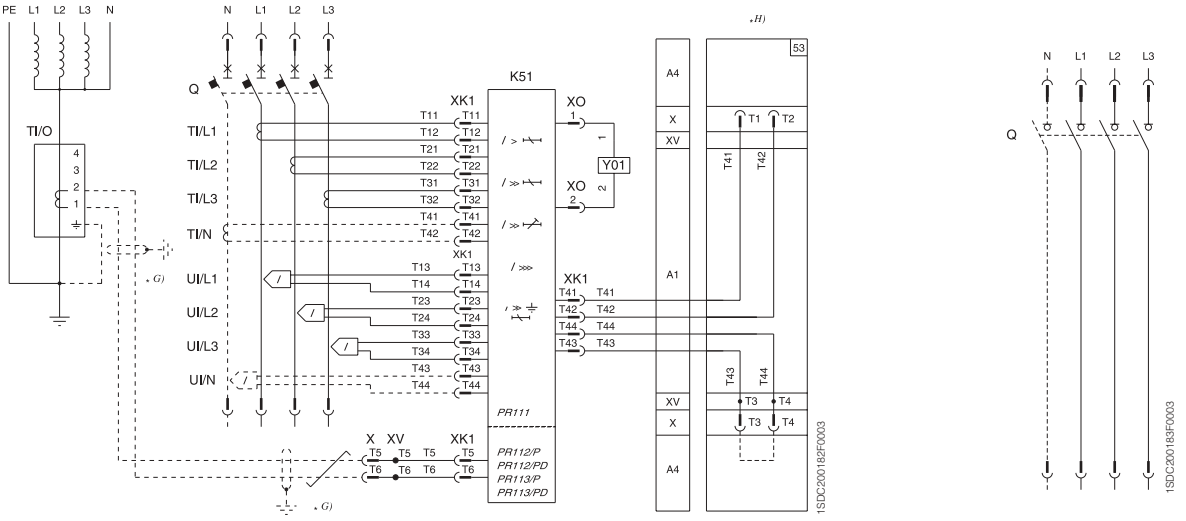

Thermal effect


Electromagnetic effect

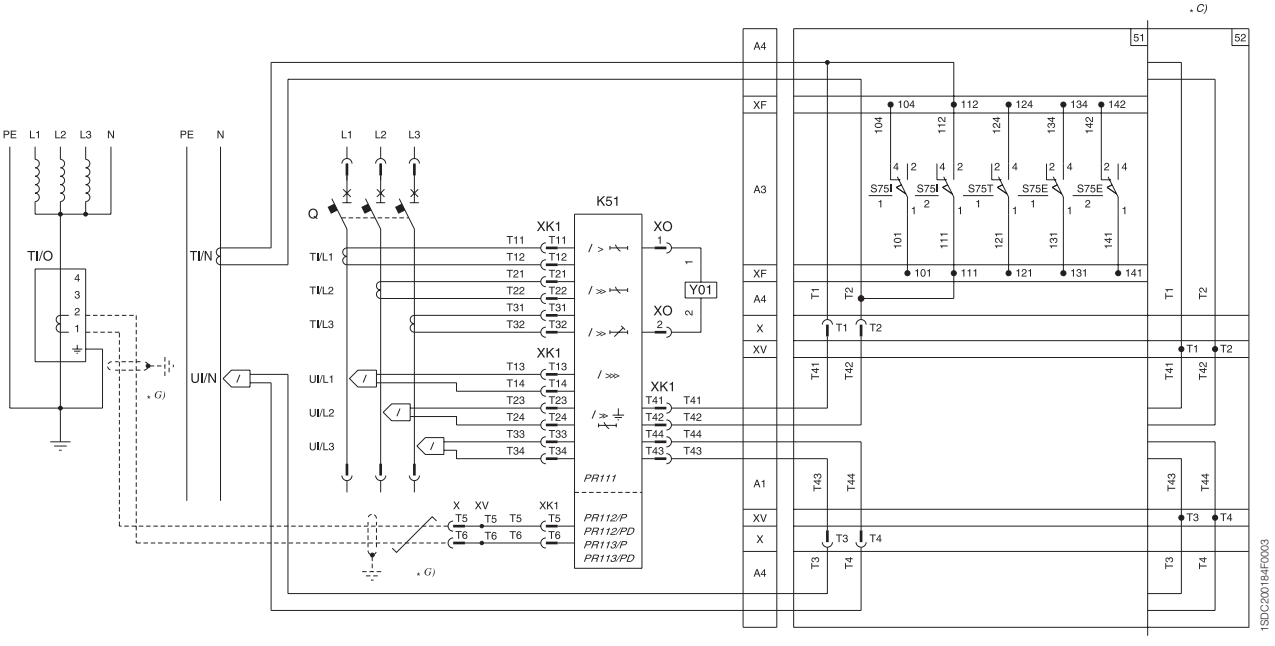

Mechanical interlock between two power circuit breakers

State of operation

Three-pole or four-pole power circuit breaker with PR111-A, PR112/P-A, PR112/PD-A, PR113P-A and PR113/PD-A electronic trip unit



Three-pole power circuit breaker with electronic PR111-A, PR112/P-A, PR112/PD-A, PR113P-A and PR113/PD-A trip units and current transformer on neutral conductor outside the power circuit breaker



Mod.	L2275			Apparatus	**Emax**	Scale
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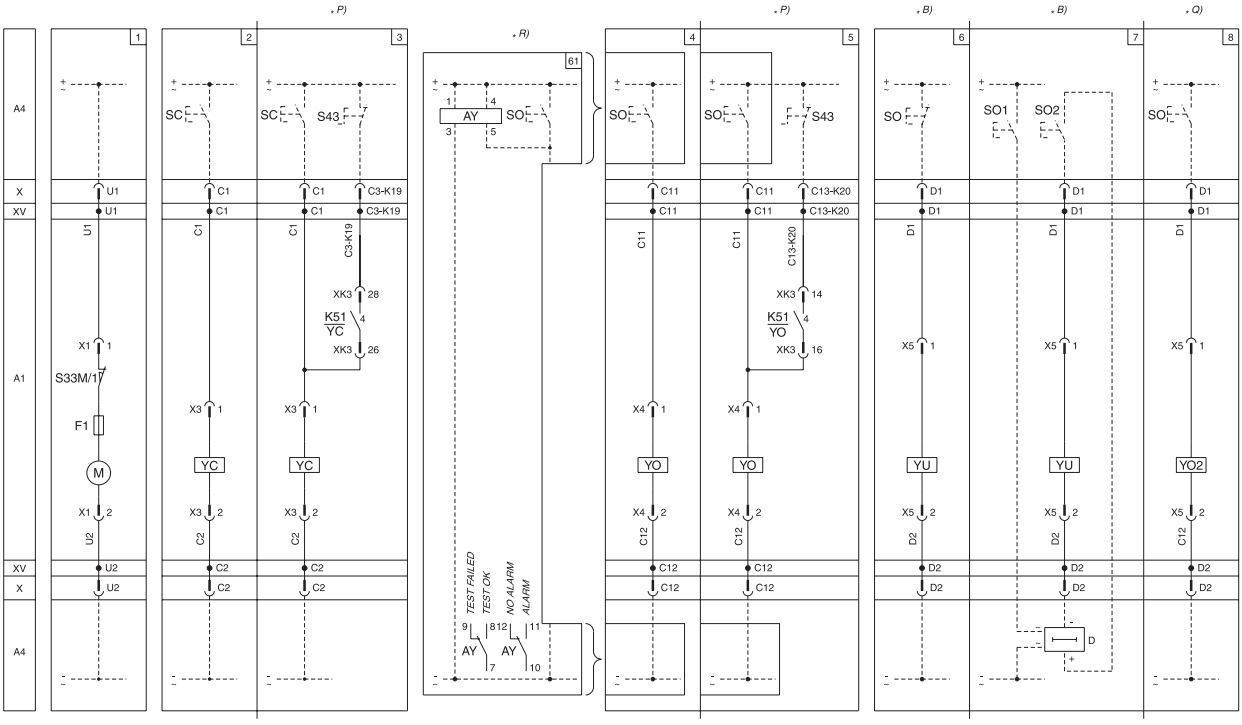
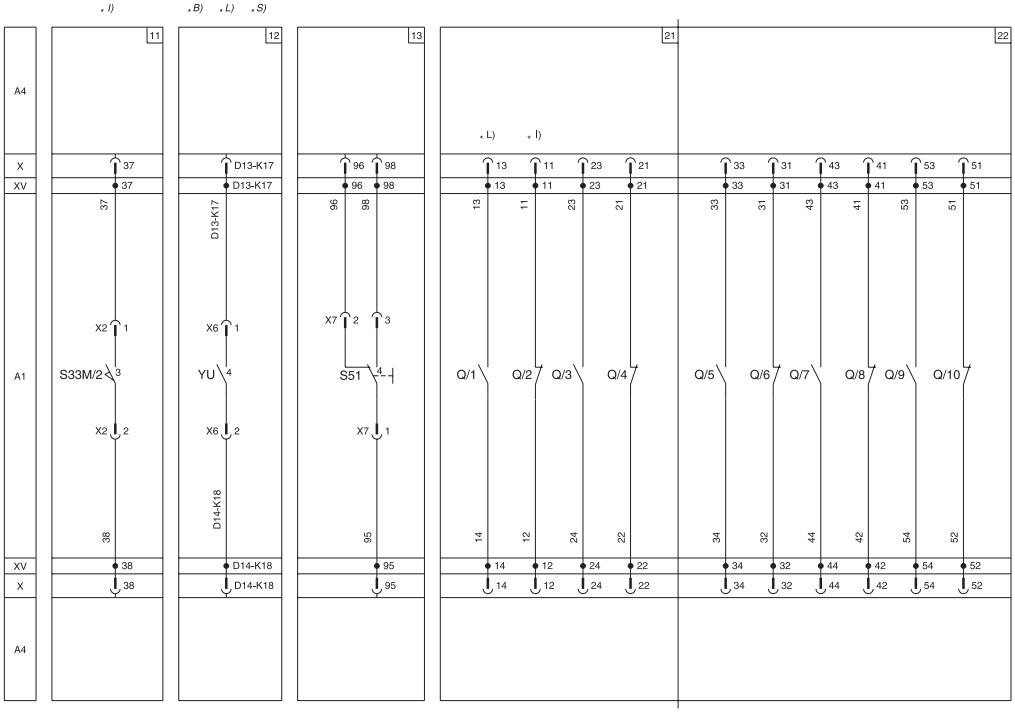
Motor operator, shunt trips, closing coils and undervoltage releases

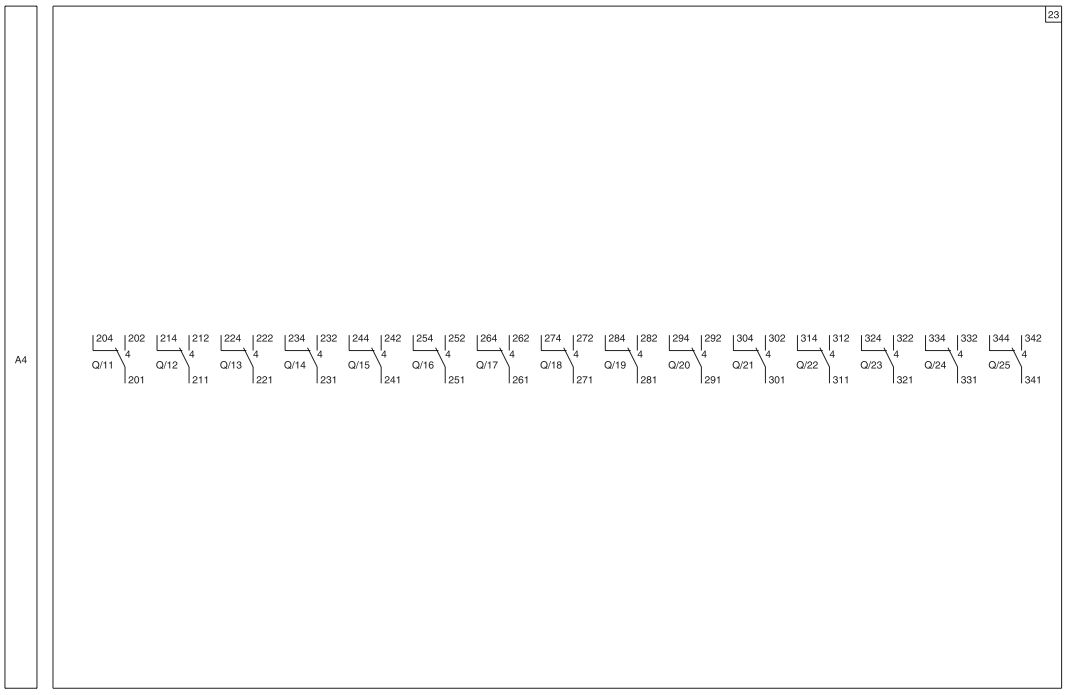


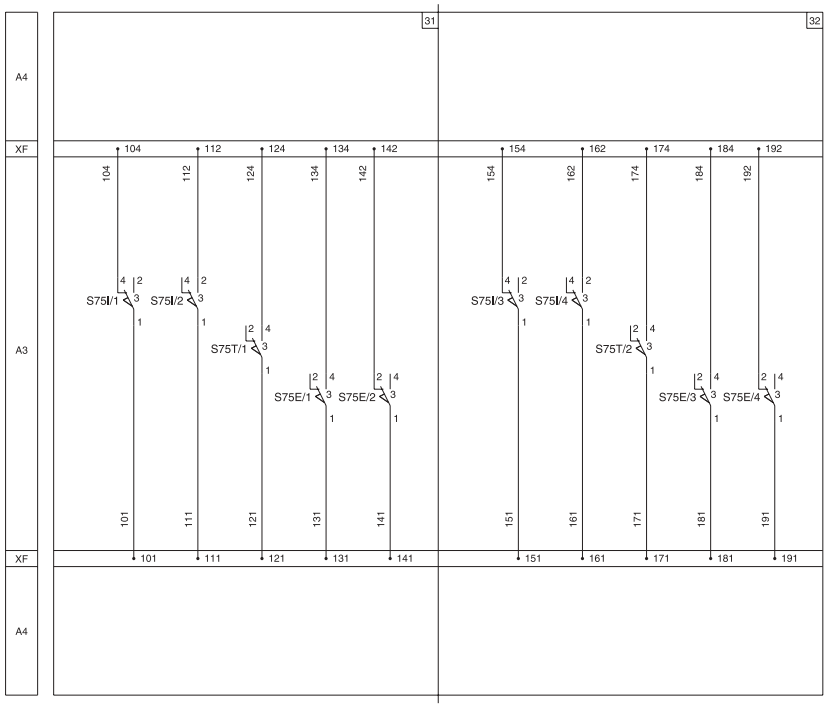
Signaling contacts



Mod.	L2275			Apparatus	Emax	Scale
				Doc. N°	RH0109002	Page N° 127/132

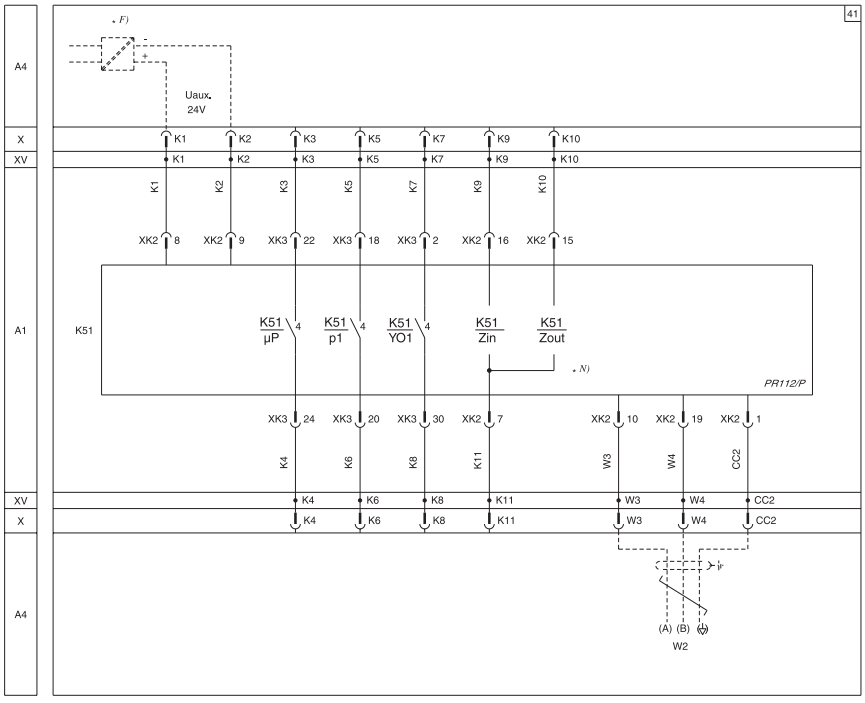
Signaling contacts



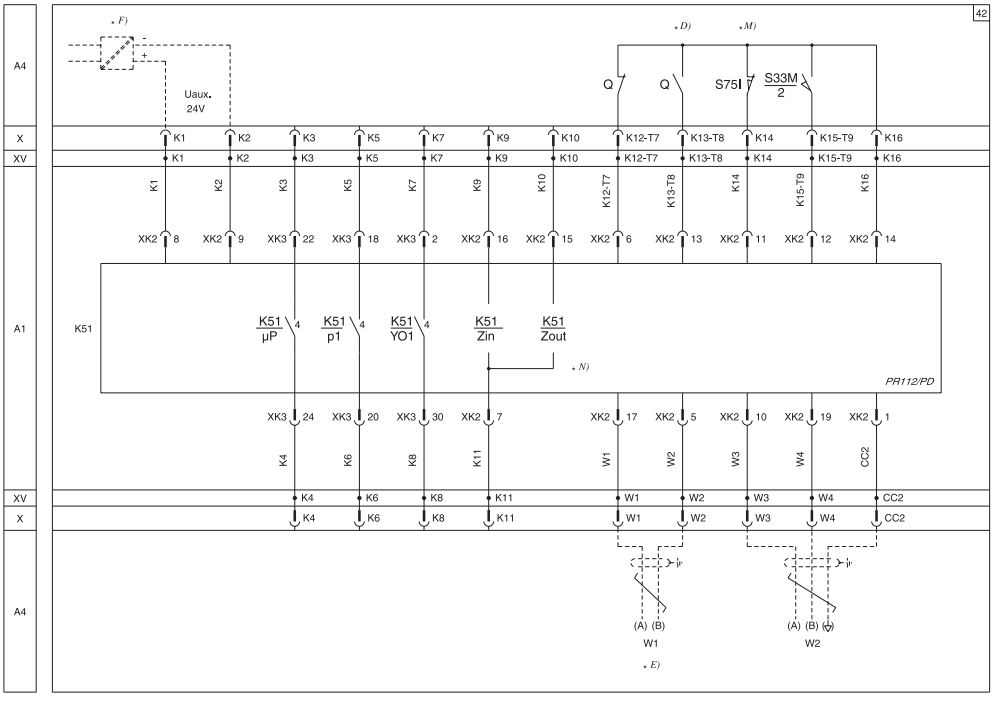


Mod.	L2275			Apparatus	**Emax**	Scale
				Doc. N°	**RH0109002**	Page N° **128/132**

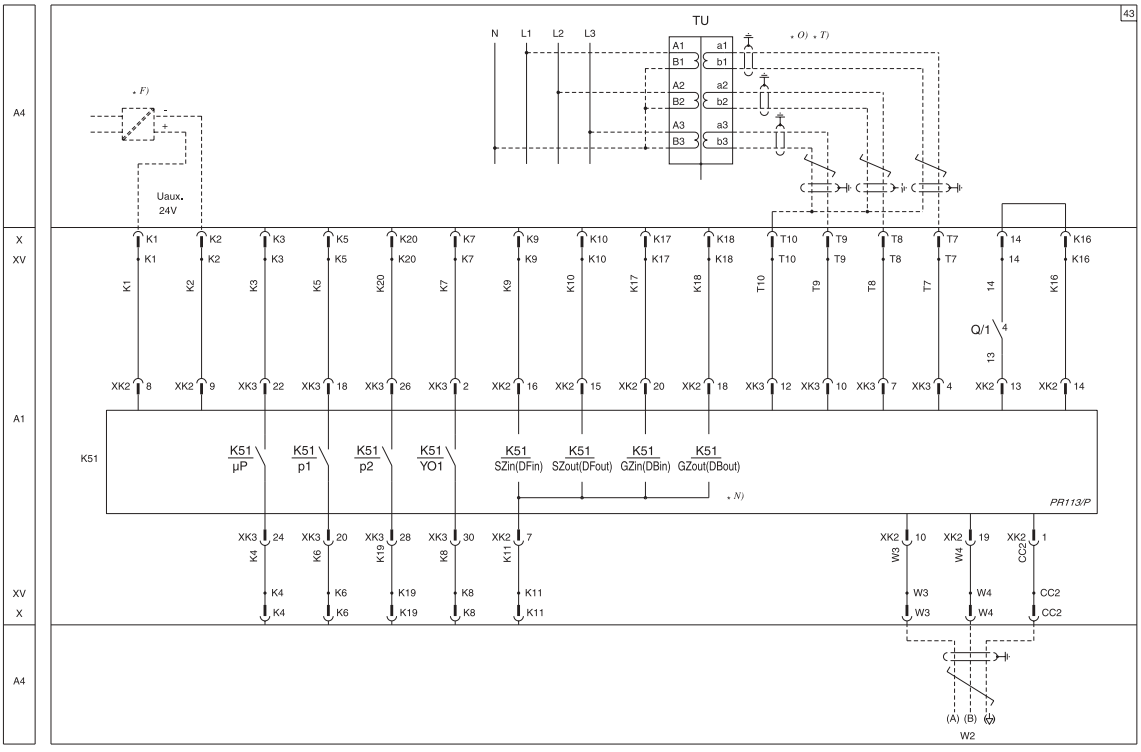
Auxiliary circuits of the PR112/P-A trip unit



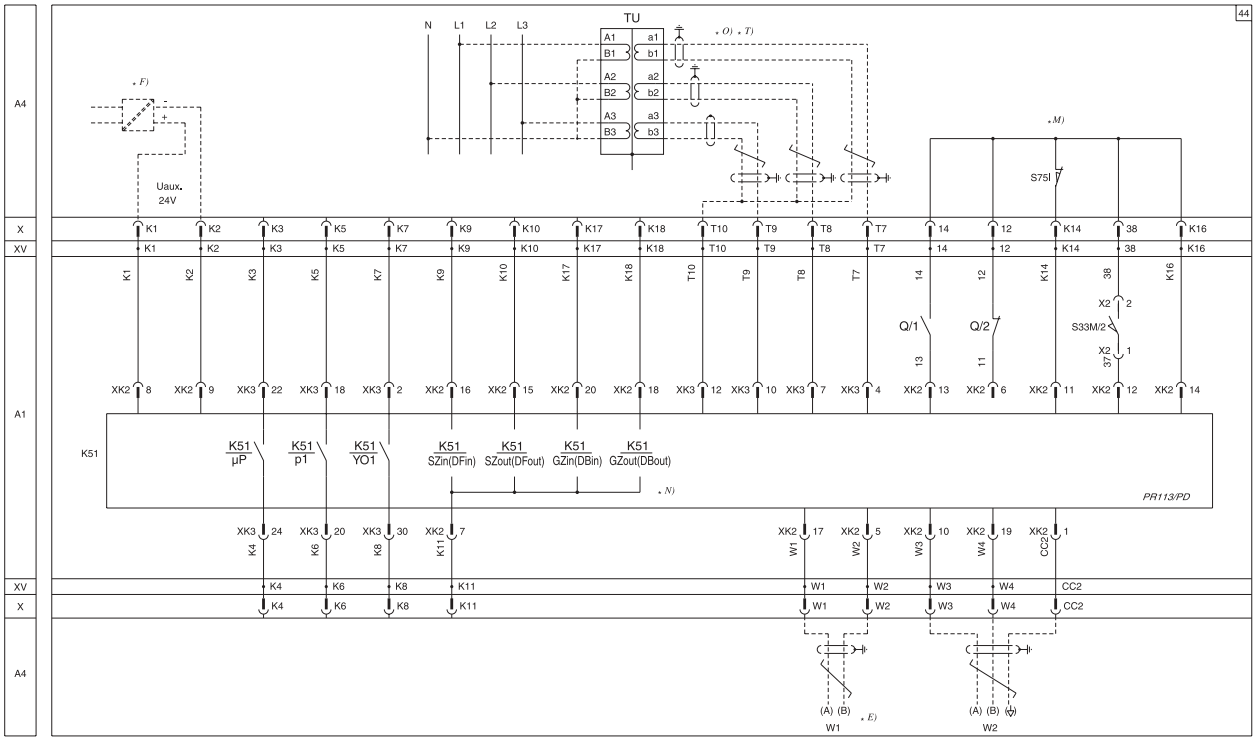
Auxiliary circuits of the PR112/PD-A trip unit



Auxiliary circuits of the PR113/P-A trip unit



Auxiliary circuits of the PR113/PD-A trip unit



Mod.	L2275			Apparatus	**Emax**	Scale
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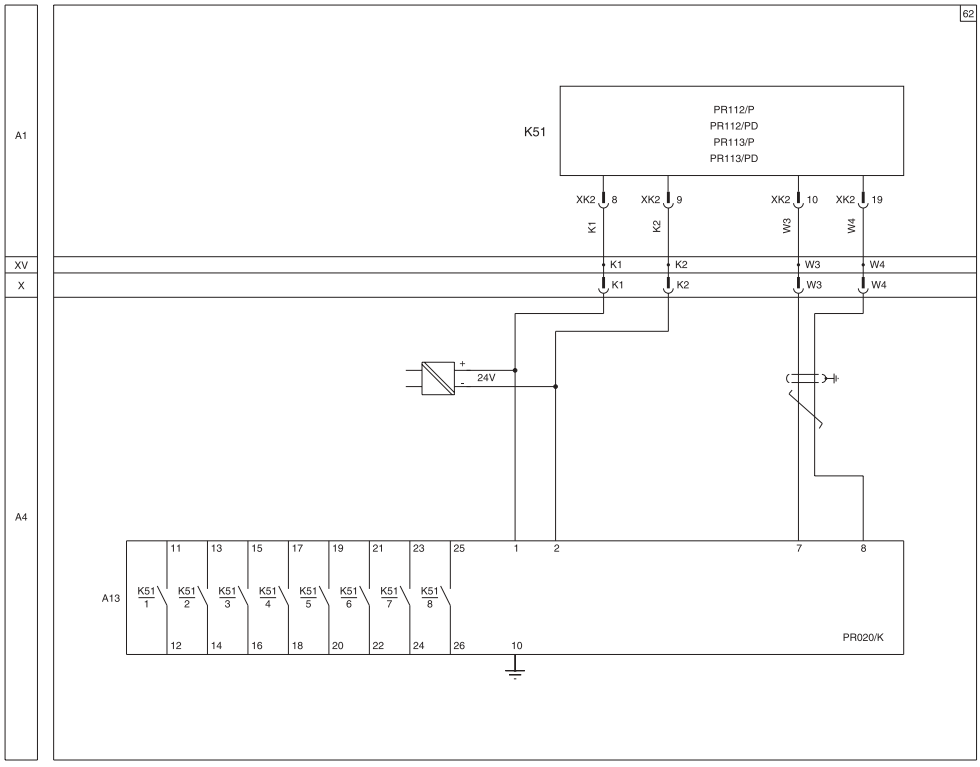
PR020/K signaling unit



Mod.	L2275			Apparatus	**Emax**	Scale
				Doc. N°	**RH0109002**	Page N° **131/132**

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

RH0109002 L2275

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