DOC. N° 1SDH000999R0002 - ECN000109166 - Rev. C

SACE Emax 2

Emax E1.2 low voltage air circuit-breakers

Installation, operation and maintenance instructions for the installer and the user

Glossary

Term	Description
SACE Emax 2	New series of ABB SACE air circuit-breakers
CB	Circuit-breaker
Trip unit	Electronic unit connected to the CB, which provides measuring, monitoring and protection functions for the CB if faulty operating conditions occur. In the event of an alarm, it commands a TRIP
Ekip Dip	Trip unit SACE Emax 2 CBs, equipped with dip-switch type interface
Trip coil	CB opening actuator controlled directly by Trip unit
TRIP	Concluding action of protection timing or a test command which, except in special configurations applicable to the trip unit, coincides with activation of the trip coil, which instantly opens the bars of each pole and interrupts the circulating current
Vaux	Auxiliary power supply
4P / 3P / 3P + N	CB configuration: four-pole (4P), three-pole (3P) and three-pole with external neutral (3P + N)
If	Fault current measured by Trip unit, useful for calculating the trip time t_t

Introduction

1 - Contents

Overview

This manual contains instructions on the operations to be performed on EMAX circuit-breakers E1.2 throughout their life cycle, from reception to installation, and from commissioning to subsequent maintenance during operation, with particular attention to the environment at the end of the life cycle of the product.

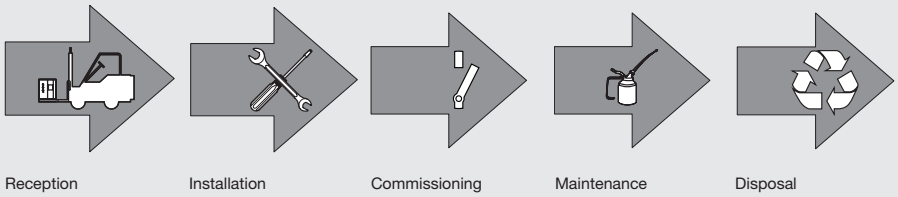


Figure 1

Integrated informations

A full description of Emax 2 circuit-breakers is available in document 1SDH001330R1002 (Emax 2 engineering manual) available on the website ABB library.

IMPORTANT: all codes and documents mentioned in this document refer to Emax 2 configured with Trip unit Firmware version= 3.xx.

If the Firmware version of the Trip unit on the Emax 2 circuit-breaker =2.xx, consult document 1SDH001330R0002 available on the website ABB library.

recipients

This manual refers to two user profiles, as defined by standard IEC 60050:

- Electrically Skilled Person (IEV 195-04-01): person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create.
- Trained Persons in the electrical field (IEV 195-04-02): person adequately advised or supervised by electrically skilled persons to enable him or her to perceive risks and to avoid danger which electricity can create.

IMPORTANT: This manual specifically indicates what operations can be performed by people trained in the field of electricity. All the remaining operations described in the handbook must be performed by skilled persons, in the electrical field. ABB declines all liability for damage to persons or property caused by failure to comply with the instructions in this document.

Specifications and supporting documents

To ensure that the Emax 2 circuit-breaker is installed and configured correctly, please read the information in this manual and in the technical documentation of the product, supplied with the circuit-breaker or available in the website ABB LIBRARY

Document	Description
1SDH001330R1002	Manual for design engineers with full information about the trip units and accessories for Emax 2
1SDH001316R1002	Manual of Ekip Touch trip units for Emax 2 circuit-breakers
1SDC200023D0906	Sace Emax 2 CBs General catalog
1SDM000091R0001	Sace Emax 2 CBs Circuit diagrams
1SDH001140R0001	Communication System Interface for Emax 2 CBs

Design notes

The information in this manual was written in Italian and then translated into other languages to conform to the laws and/or commercial requirements concerning the product.

2 - Safety

Warnings

Figure 2

The following warnings must be respected:

- **READ THE INSTRUCTIONS CAREFULLY BEFORE TRYING TO INSTALL, OPERATE OR REPAIR THE CIRCUIT BREAKER.**
- Store these instructions along with other documents for instruction, maintenance and installation, drawings and descriptive notes on the circuit-breaker.
- Keep these documents available during the installation, operation and maintenance of the appliance. The use of these instructions facilitates proper maintenance.
- Install the circuit-breaker within the limits of the project described in the instruction manual shipped with the unit. These circuit-breakers are designed to operate with values of voltage and current within the limits of plate ratings. Do not install this equipment in systems operating at nominal values exceeding these limits.
- Follow the safety procedures indicated by Your Company.
- Do not open any covers or doors, do not work on devices before removing power from all circuits, and after making sure of that with a measuring instrument.

WARNING!

- detailed descriptions of standard procedures for installation, use, maintenance and principles for safe operation are not included. It is important to note that this document contains safety and precaution instructions, against certain methods (of installation, use and maintenance) that could cause harm to personnel, damage devices, or make them unsafe.
- these warnings and alarms do not include all conceivable ways to make installation, use and maintenance recommended by ABB or not, that may be made, or possible consequences and complications of each conceivable way, nor shall ABB investigate all those ways.
- anyone using maintenance procedures or devices, recommended by ABB or not, must check thoroughly that neither personal safety nor the safety devices are endangered by mode of installation, use, maintenance or the instruments used. For more information, questions or specific problems contact your nearest ABB representative.
- This manual is written for qualified personnel only and is not intended as a substitute for a proper course, or experience about safety procedures for this device.
- for the products equipped with communication, the purchaser, the installer or the final customer is responsible for applying all the IT safety measures necessary in order to prevent risks deriving from connection to communication networks; such risks include, among other things, the use of the product by unauthorized persons, alteration of its normal functionality, accessing and modifying the information.
- the purchaser, installer or end user is responsible for ensuring that notices and safety signs are posted and that all access points and switching devices are locked securely when the switchgear is left unattended, even momentarily.
- all the information contained in this document reflects the latest product information available at the time of printing. We reserve the right to edit the document at any time and without notice

3 - Regulations

Standards

The SACE Emax 2 circuit-breakers and their accessories comply with the following international standards:

- IEC 60947
- EN 60947
- CEI EN 60947
- IEC 61000
- UL 1066

They comply with the following EC directives:

- "Low Voltage Directives" (LVD) no.. 2006/95/EC
- "Electromagnetic Compatibility Directive" (EMC) no. 2004/108/EC

The SACE Emax 2 circuit-breakers also feature a range certified according to these standards:

- Russian - GOST (Russia Certificate of Conformity)
- Chinese - China CCC (China Compulsory Certification)

Management operations

1 - Transport and checking on receipt

Introduction

The SACE Emax 2 circuit-breakers, on account of their weight, require special attention during transport and handling.

They are distributed with following packages:

- single package for fixed circuit-breaker
- two packages for withdrawable circuit-breakers (one package for the fixed part and one for the mobile part).

WARNING! comply with the following instructions during each transport phase:

- **The movable part of the circuit-breaker must be removed from the switchgear and/or from the relative fixed part even if this latter is not installed in the switchgear.**
- **The circuit-breaker must be in the open position.**
- **The circuit-breaker must be protected and fastened in its original packing.**
- **The closing springs of the circuit-breaker must be completely discharged.**

Weight of the circuit-breakers with packaging

The following table specifies the weights of the circuit-breakers with packaging:

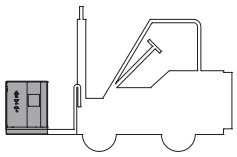
	Fixed		Moving part of withdrawable device		Fixed part of withdrawable device	
	III	IV	III	IV	III	IV
E1.2	16 Kg / 35 lbs	18 Kg / 39 lbs	20 Kg / 44 lbs	23 Kg / 51 lbs	23 Kg / 51 lbs	26 Kg / 57 lbs
E1.2-A	16 Kg / 35 lbs	18 Kg / 39 lbs	22 Kg / 48 lbs	25.5 Kg / 56 lbs	24 Kg / 52 lbs	27 Kg / 59 lbs

NOTE:

- *weights are indicated with reference to the basic circuit-breakers including protection trip unit and its sensors, without terminals and without accessories.*
- *the weights of the fixed part of withdrawable circuit-breakers refer to the version with horizontal rear terminals.*

Transport of the packaged circuit-breaker

Consult the table "Weight of the circuit-breakers with packaging" before proceeding with the transport.



WARNING! Improper lifting can result in death, serious injury to persons and damage to the equipment. Never lift a circuit-breaker and / or a fixed part above other people.

IMPORTANT: The trained personnel in charge of handling and lifting must use appropriate safety equipment.

Identification of packaging

Examine the state of the packaging and check that:

- The data on the packaging plate match the data of the order.
- The box is intact and perfectly closed.

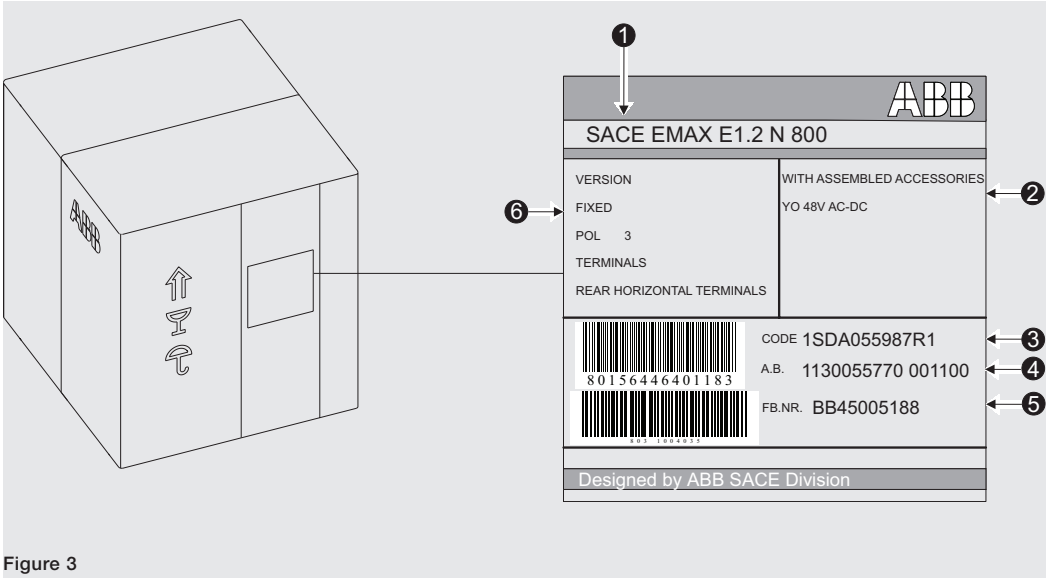


Figure 3

Pos.	Description
1	Short description of the circuit-breaker
2	Description of accessories
3	Commercial code
4	Confirmation number and location
5	Circuit-breaker serial number
6	Features of the circuit-breaker

Packaging checks

Examine the state of the material received and verify that:

- The circuit-breaker or the fixed part are consistent with the order.
- The circuit-breaker or the fixed part are completely intact.

IMPORTANT:

- **check the material before any storage. For opening the packaging, follow the procedures outlined in the section "Unpacking and handling - opening the packages" on page** 10
- **in the case of inconsistencies report it within five days of receipt. See the paragraph "Damage and Discrepancy Report" in this chapter.**

Damage and Discrepancy Report

If there is any damage to the packaging upon receipt and / or inconsistencies between order and product identification label or product please contact ABB. Damage to the packaging must be reported no later than seven days from receipt of the material.

NOTE: *The notification must indicate the Packing List number.*

Storage method

Place the packaging (circuit-breakers and / or fixed parts) on a horizontal plane, not in contact with the floor. If the circuit-breaker has been removed and reinserted in the package ensure, prior to storage that:

- the circuit-breaker is in the open position and springs discharged. See the chapter "Description - circuit-breaker opening/closing operations" on page 15
- the circuit-breaker is protected and locked in its original packaging

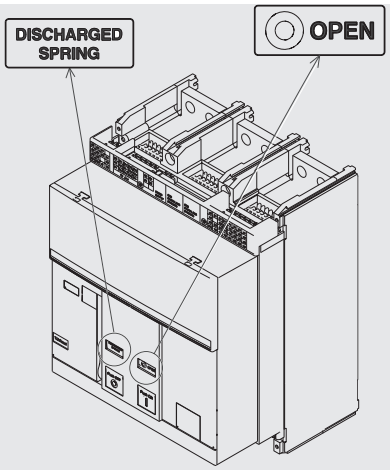


Figure 4

2 - Unpacking and handling

Opening the packaging

NOTE: *to unpack the circuit-breaker safely refer to the instruction sheet in the zipped packaging pouch.*

The following is the procedure for opening the packaging:

1. Cut the tape that seals the box. See Figure 5 and Figure 6.

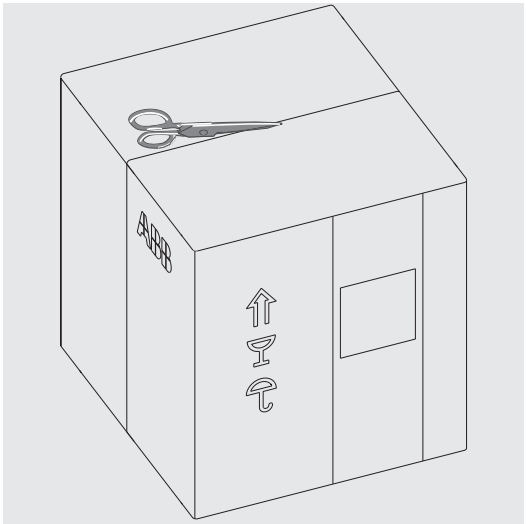


Figure 5

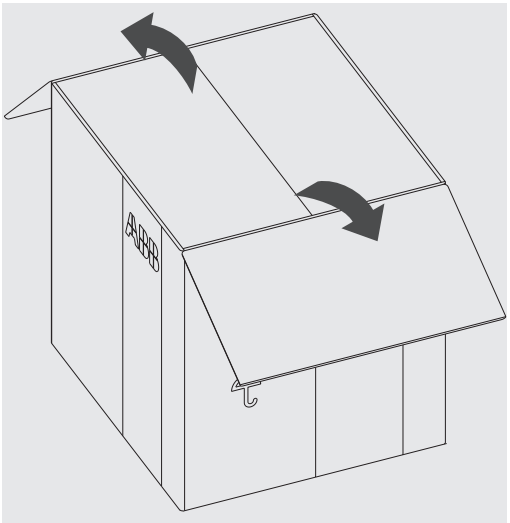


Figure 6

2. Open the upper part of the packing box and remove the upper containment protection. See Figure 7 and Figure 8.

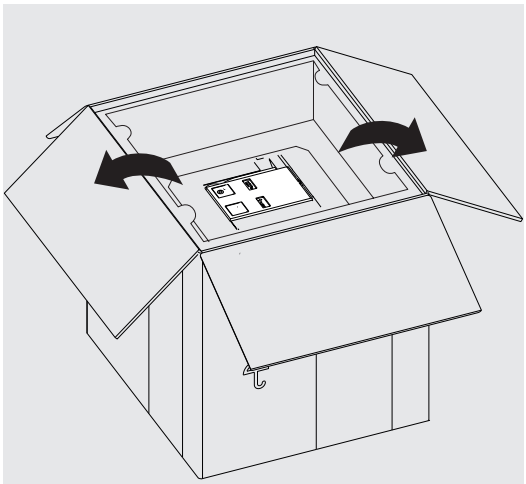


Figure 7

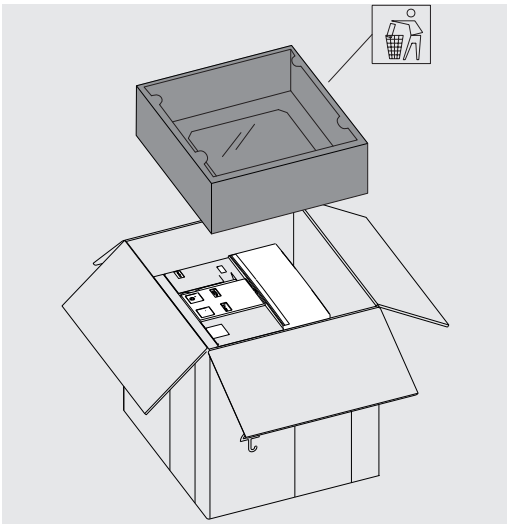


Figure 8

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3. Remove the side containment protections from the packing box. See Figure 9.

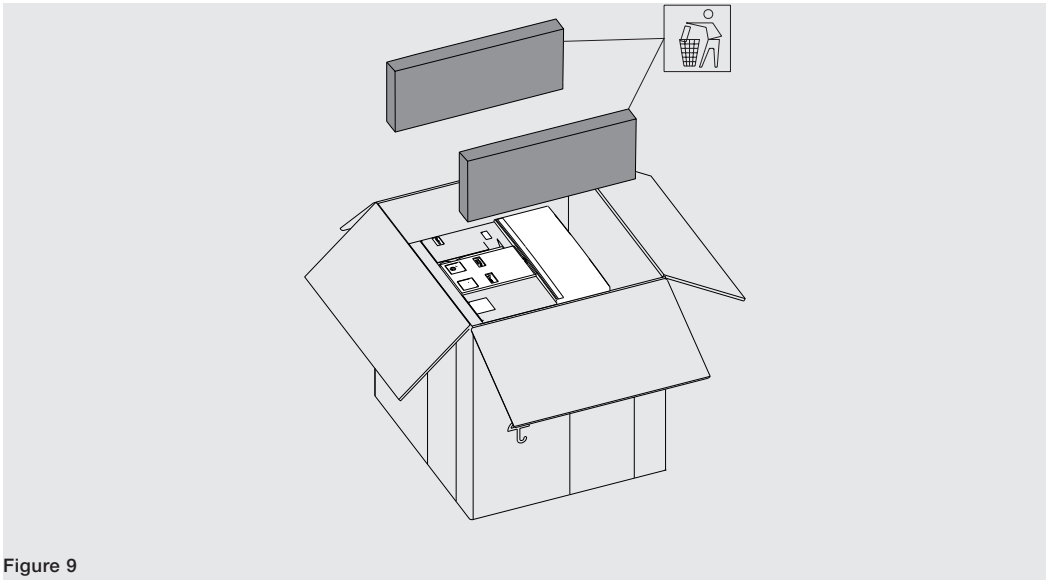

Figure 9

Weight of circuit-breakers without packaging

The following table specifies the weights of the circuit-breakers without packaging:

	Fixed		Moving part of withdrawable device		Fixed part of withdrawable device	
	III	IV	III	IV	III	IV
E1.2	14 Kg / 31 lbs	16 Kg / 35 lbs	18 Kg / 40 lbs	20 Kg / 44 lbs	20 Kg / 44 lbs	23 Kg / 51 lbs
E1.2-A	14 Kg / 31 lbs	16 Kg / 35 lbs	20 Kg / 44 lbs	22.5 Kg / 49 lbs	21 Kg / 46 lbs	24 Kg / 52 lbs

Disposal of packing materials

For disposal of the packaging materials see the chapter " 5 - Decommissioning and treatment at end of life " on page 61.

3 - Description

Description of circuit-breaker

Emax E1.2 circuit-breakers consist of a structure containing the poles, the operating mechanism and the auxiliary parts. Each pole, enclosed in a plastic box, consists of a breaking part and a current transformer.

The structure of the breaking part differs between selective or current-limiting circuit-breaker.

The circuit-breaker is available in two types:

- fixed version
- withdrawable

The circuit-breaker in fixed version (see Figure 10) has its own terminals for connection to the power circuit.

The withdrawable circuit breaker consists of a mobile part (see Figure 11 for IEC and Figure 12 for UL) and of a fixed part (see Figure 13 for IEC and Figure 14 for UL) for connection through its own terminals to the power circuit.

The coupling between the mobile part and the fixed part is via disconnection contacts mounted on the fixed part.

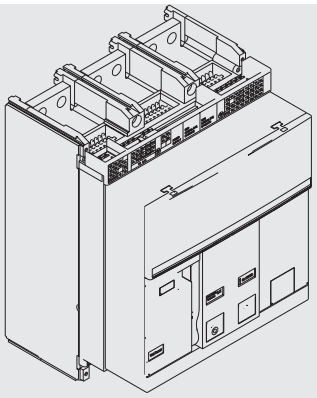

Figure 10

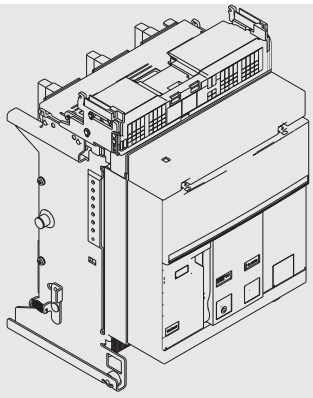

Figure 11

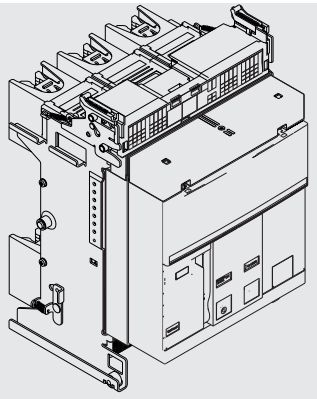

Figure 12

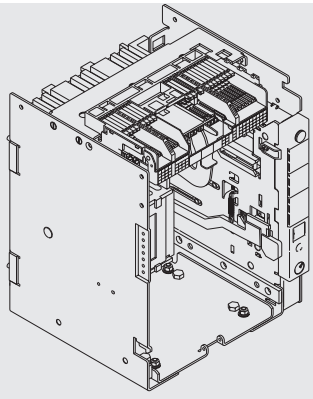

Figure 13

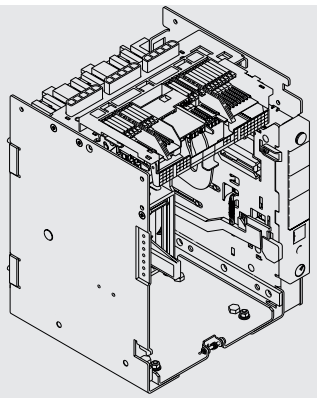

Figure 14

Description of the circuit-breaker front panel

The following are the main components of the circuit-breaker:

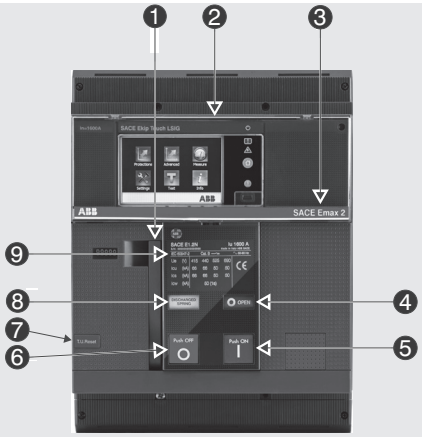

Figure 15

Pos.	Description
1	Lever for manually charging the closing springs
2	SACE Ekip protection trip unit
3	Name of the circuit-breaker
4	CB open (O) / closed (I) indicator
5	Closing pushbutton
6	Opening pushbutton
7	Mechanical signalling of tripped TU
8	Springs charged-discharged signalling device
9	Electrical data plate

Description of electrical data plate IEC

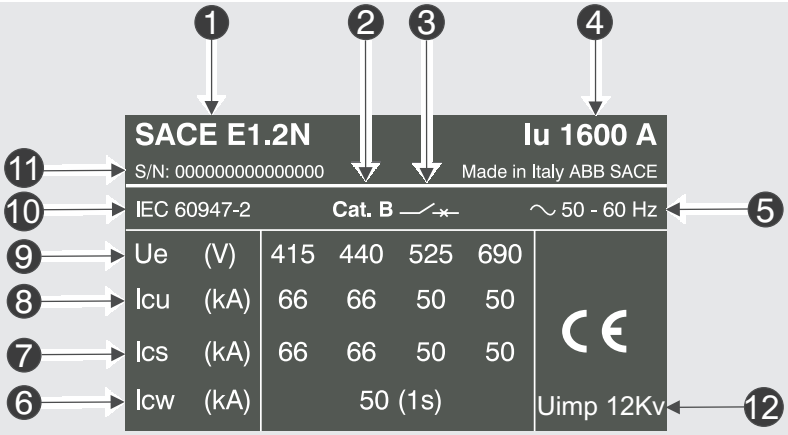

Figure 16

Pos.	Description
1	Type of circuit-breaker
2	Utilization category
3	Device type: Circuit-breaker or switch-disconnector
4	Rated current
5	Rated operating frequency
6	Admissible rated short-time current
7	Rated duty short-circuit breaking capacity
8	Rated ultimate short-circuit breaking capacity
9	Rated service voltage
10	Standards
11	Circuit-breaker serial number
12	Impulse voltage

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Description of electrical data plate UL

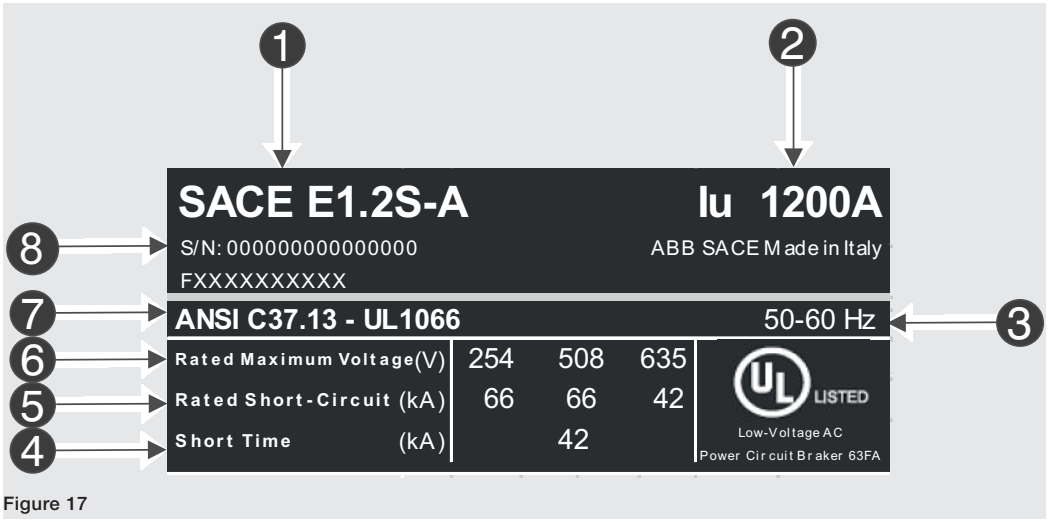

Figure 17

Pos.	Description
1	Type of circuit-breaker
2	Rated current
3	Rated operating frequency
4	Admissible rated short-time current
5	Rated short-circuit breaking capacity
6	Rated service voltage
7	Standards
8	Circuit-breaker serial number

Manual operations for opening and closing the circuit-breaker

The following is the sequence of steps for closing and opening the circuit-breaker:

1. Check that the circuit-breaker is open (open / closed indicator "O - OPEN"), and check that the springs are discharged (spring signalling device "white - DISCHARGED SPRING") as indicated in Figure 18.
2. Charging the springs - Pull the lever [A] downwards several times until the springs charged signalling device [B] is “yellow - CHARGED SPRING” as indicated in Figure 19.

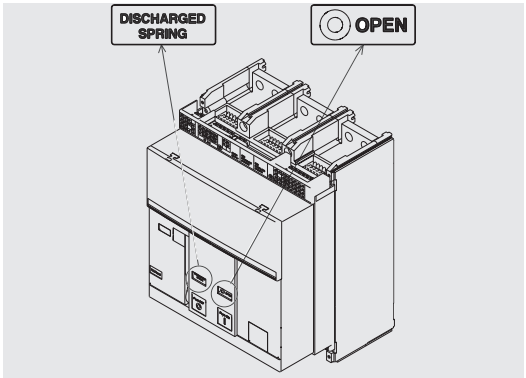

Figure 18

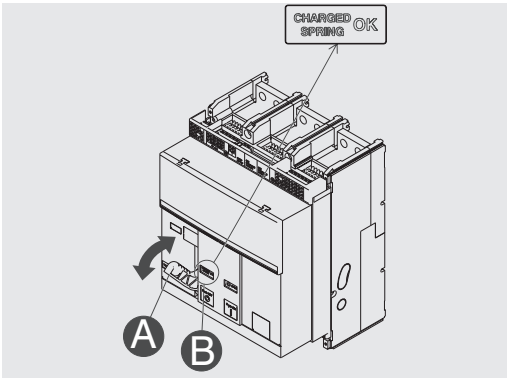

Figure 19

3. Check that the circuit-breaker is open (open/closed signalling device “O - OPEN”), and check that the springs are charged (springs signalling device “yellow - CHARGED SPRING”) as indicated in Figure 20.
4. Closing - Press the closing pushbutton “I - Push ON” as indicated in Figure 21.

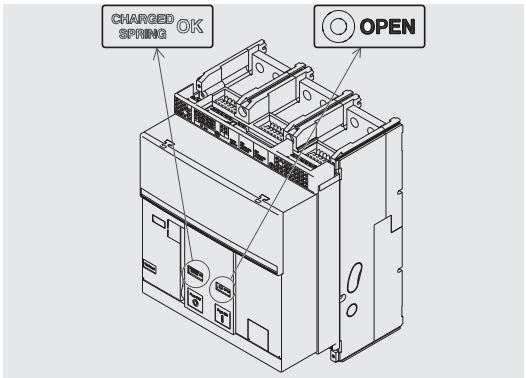

Figure 20

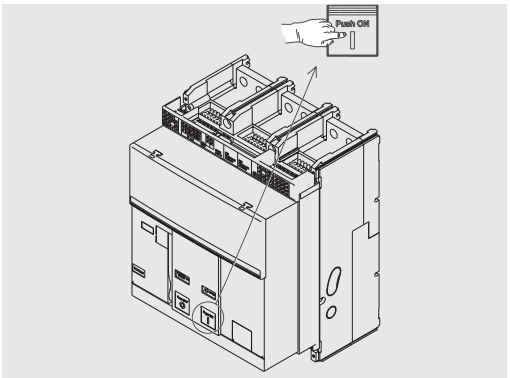

Figure 21

5. Check that the circuit-breaker is closed (open/closed indicator "I - CLOSED"), and check that the springs are discharged (spring signalling device "white - DISCHARGED SPRING" as indicated in Figure 22.
6. Opening - Press the opening pushbutton “O - Push OFF” as indicated in Figure 23.

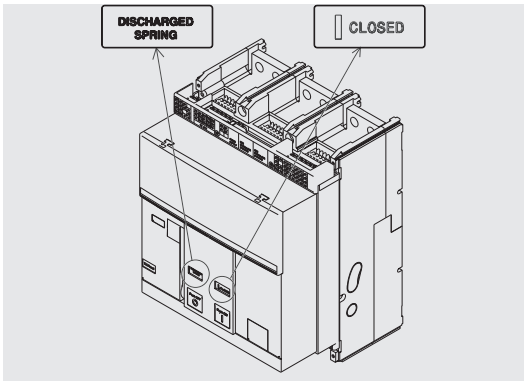

Figure 22

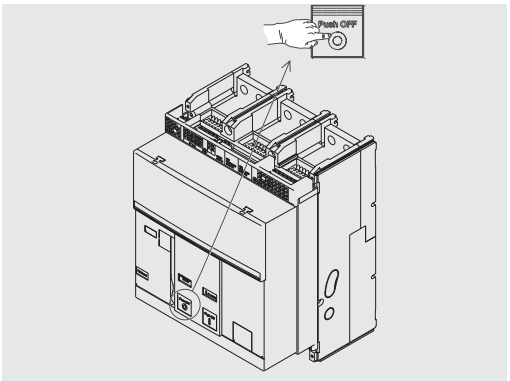

Figure 23

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7. Check that the circuit-breaker is open (open / closed indicator "O - OPEN"), and check that the springs are discharged (spring signalling device "white - DISCHARGED SPRING") as indicated in Figure 24.

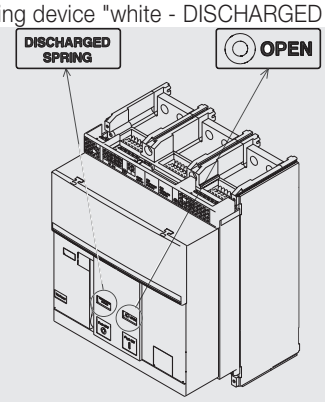


Figure 24

Mechanical status indicators

The following are the possible states in which you can find the circuit-breaker:

1. Circuit-breaker open with springs discharged (see Figure 25).
2. Circuit-breaker open with springs charged (see Figure 26).
3. Circuit-breaker closed with springs discharged (see Figure 27).
4. Circuit-breaker closed with springs charged (see Figure 28). This state occurs when after closing (see step 4 - Figure 28) the springs are recharged manually or automatically by the gearmotor (if provided).

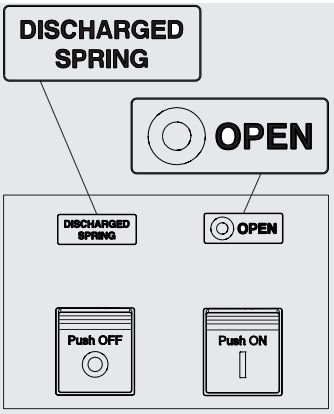


Figure 25

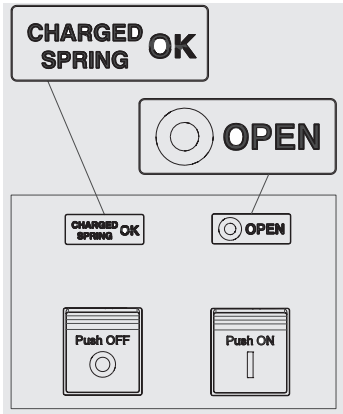


Figure 26

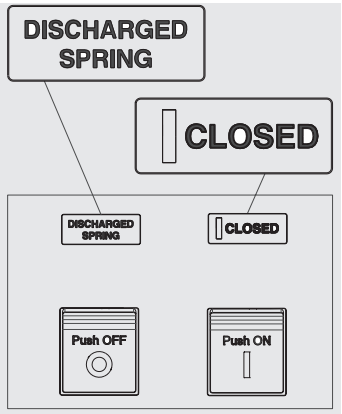


Figure 27

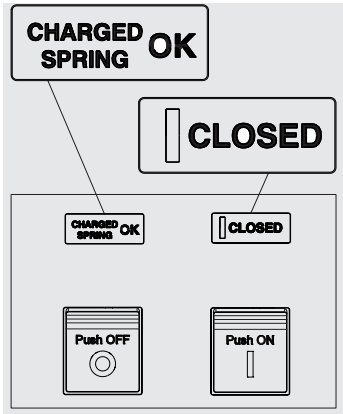


Figure 28

Circuit breaker racking-in/ racking-out operations

The following is the procedure for the insertion of the moving part in the fixed part:

WARNING!

- **Make sure the circuit-breaker is disconnected from all sources of energy.**
- **Switch the circuit-breaker to the open position with springs discharged.**

WARNING! Before proceeding, remove all equipment used during the work and remove processing waste and materials used.

1. Turn plate through 90° before inserting the moving part.

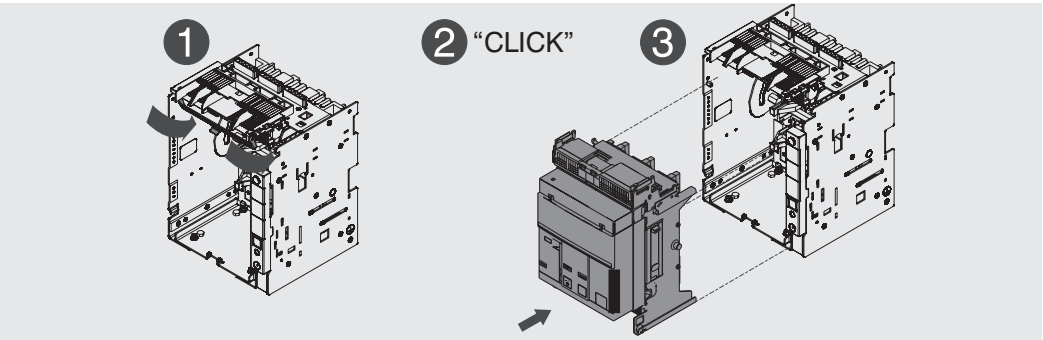


Figure 29

2. Make sure that signalling device on the fixed part indicates the **DISCONNECT** position. See Figure 30.

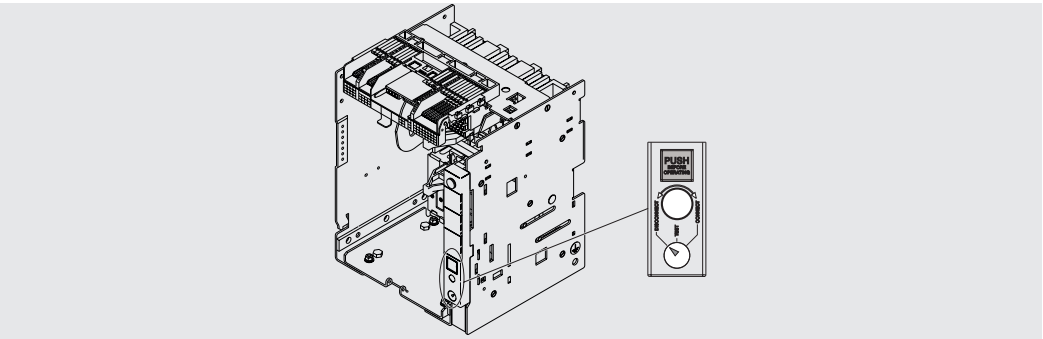


Figure 30

3. Position the moving part in the fixed part and push until it comes to a stop. See Figure 31 and Figure 32.

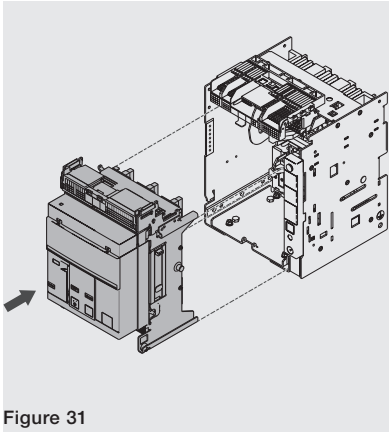


Figure 31

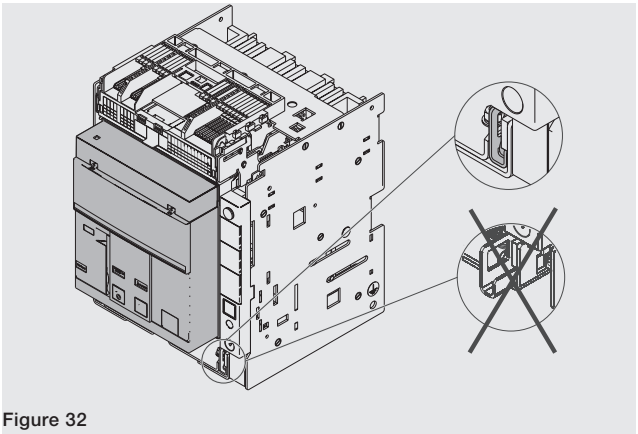


Figure 32

Continued on the next page

4. Extract the disconnection crank from its housing See Figure 33.
5. Press the lock pushbutton and insert the crank in the moving part. In this phase the moving part is still in **DISCONNECT** position. See Figure 34.

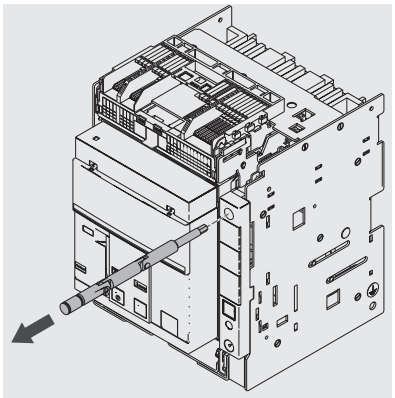


Figure 33

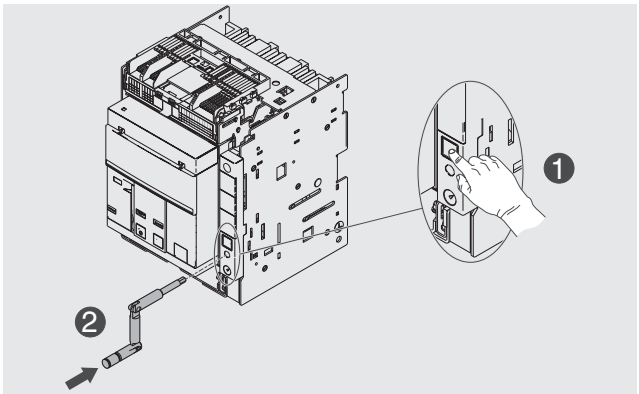


Figure 34

6. Turn the crank clockwise until the pushbutton comes out and the indicator shows that the circuit-breaker is in **TEST** position. See Figure 35.

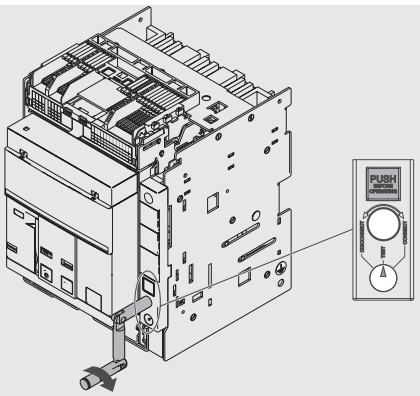


Figure 35

7. Press the lock button and then rotate the crank clockwise until the button comes out and the indicator shows that the circuit-breaker is in the **CONNECT** position. See Figure 36.

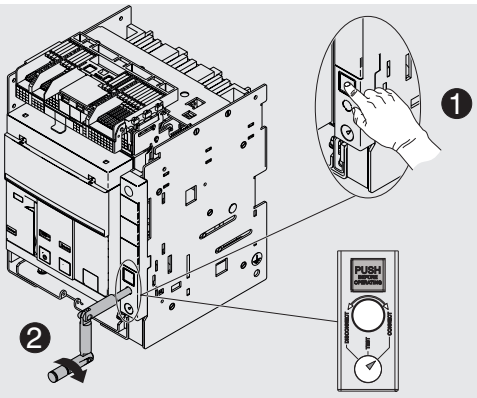


Figure 36

Continued on the next page

8. Extract the crank. See Figure 37.
9. Replace the crank in its housing See Figure 38.

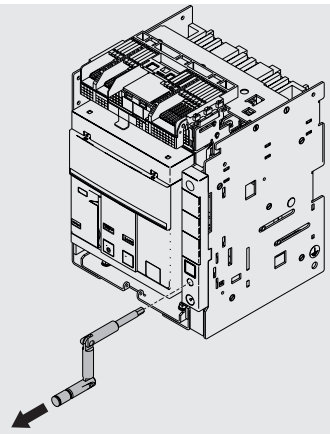


Figure 37

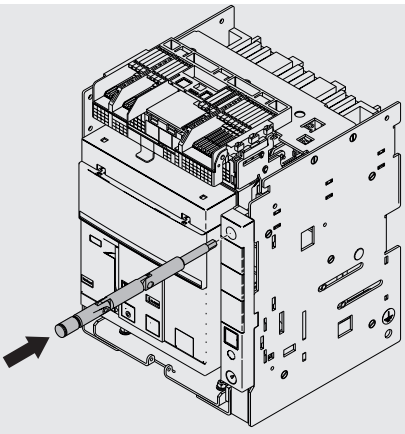


Figure 38

To extract the moving part from the fixed part, perform the same steps indicated for insertion in reverse order.

After extraction, in order to remove the moving part, unlock the safety lock. See Figure 39.

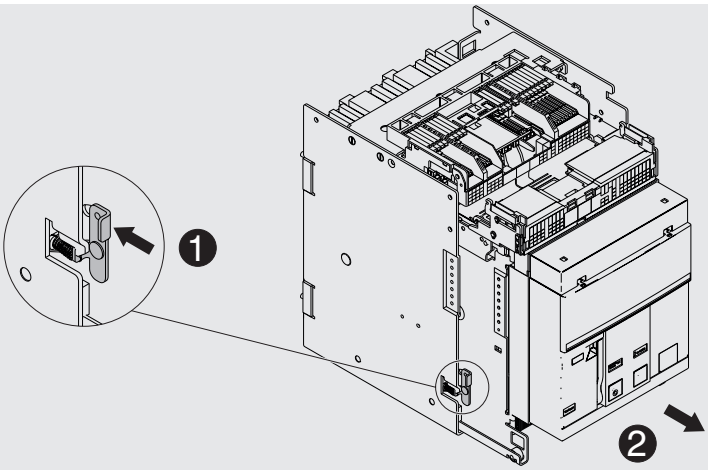


Figure 39

⚠ **WARNING! The inserted circuit-breaker must be opened in order to be able to reach the test position Discharge the springs before removing the circuit-breaker from the fixed part. On the UL version, the fail safe prevents the removal of the circuit-breaker from the fixed part with springs charged. For further details, consult the Mechanical safety accessories chapter in document 1SDH001330R1002.**

Mechanical position indicators

The following are the possible positions where you can find the mobile part of a withdrawable circuit-breaker during its use:

- circuit breaker in DISCONNECT position (see Figure 40).
- circuit-breaker in test position (see Figure 41).
- circuit-breaker in CONNECT position (see Figure 42).

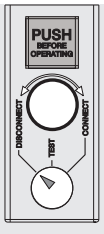


Figure 40

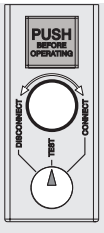


Figure 41

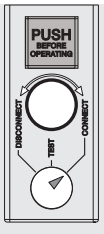


Figure 42

4 - Environmental conditions

Details related to this chapter are available in the manual 1SDH001330R1002 (Emax 2 engineering manual) available on the website ABB library.

5 - Installation

Warnings and precautions before the installation

The following warnings and precautions must be respected before installing the circuit-breaker in the switchgear

WARNING!

- **Disconnect the power from the circuit-breaker (power circuit and auxiliary circuits)**
- **Make sure the circuit-breaker is disconnected from all sources of energy**
- **Switch the circuit-breaker to the open position with springs discharged**

NOTE: *The trained personnel in charge of handling and lifting must use appropriate safety equipment.*

Mounting of the fixed circuit-breaker

Fix the circuit-breaker to a horizontal surface using four M5 x 25 screws (see Figure 43). Lock the screws with tightening torque 4 Nm - 35 lb in.

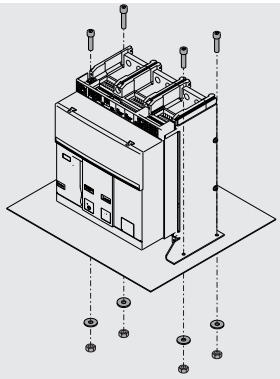


Figure 43

Mounting anti-insertion locks

Before installing the fixed part it is necessary to fit the lock that prevents the insertion of circuit-breakers into fixed parts with different electrical characteristics (see Figure 44).

Information on the assembly is available on the website http://www.abb.com/abblibrary/DownloadCenter/, in particular with the kit sheet 1SDH000999R0701.

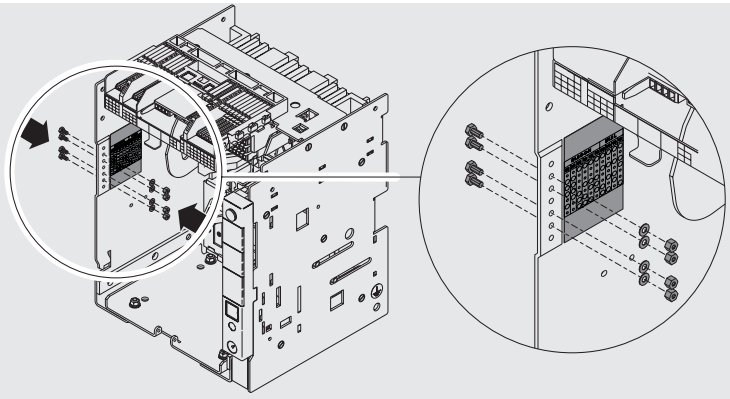


Figure 44

Mounting the fixed part of the withdrawable circuit-breaker

Fix the fixed part to a horizontal surface using four M8 x 25 screws (see Figure 45). Tighten the screws with tightening torque = 21 Nm - 186 lb.in.

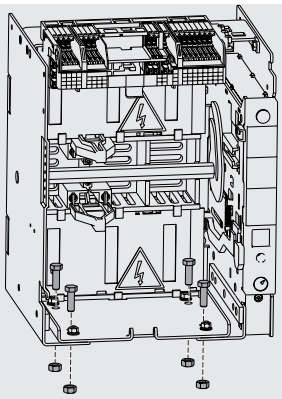


Figure 45

Types of terminal

The following are the different types of terminal:

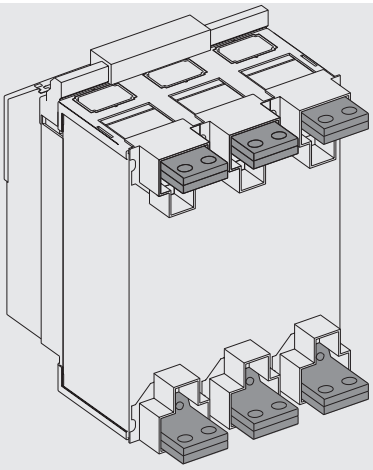


Figure 46 - F - HR - Horizontal rear IEC

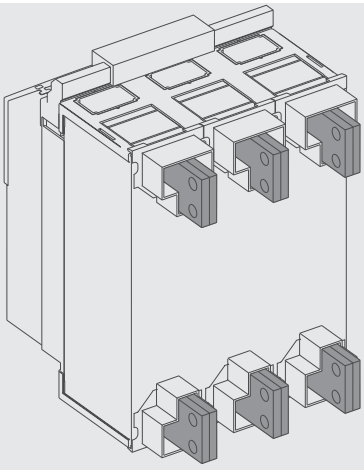


Figure 47 - F - VR - Vertical rear IEC

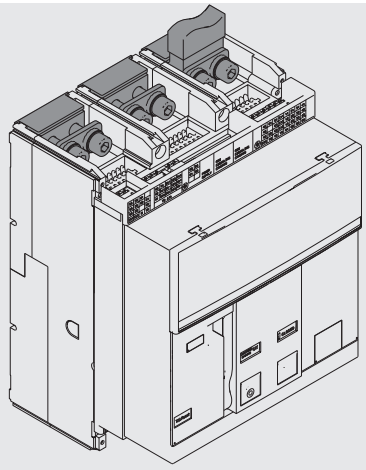


Figure 48 - F - F - Front IEC-UL

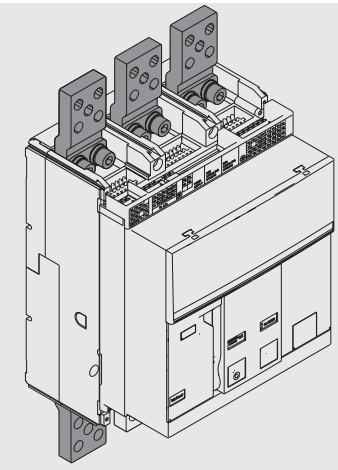


Figure 49 - F - EF - Extended front IEC-UL

Continued on the next page

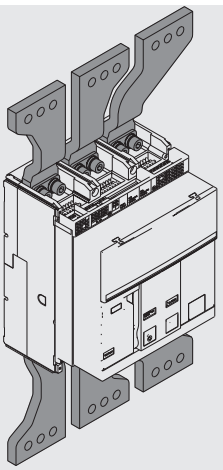


Figure 50 - F - ES - Spread front IEC-UL

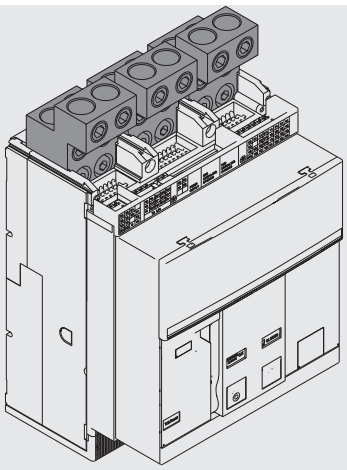


Figure 51 - F - FC - Terminals for cables IEC-UL

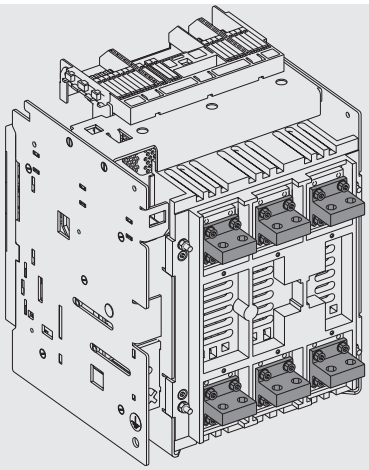


Figure 52 - W - HR - Horizontal rear IEC

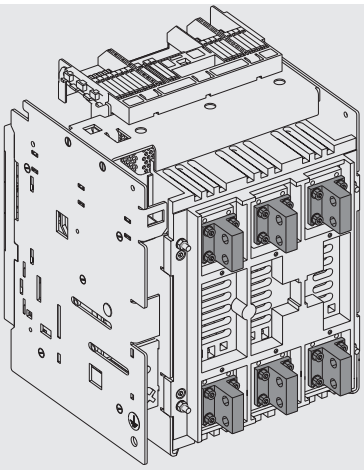


Figure 53 - W - VR - Vertical rear IEC

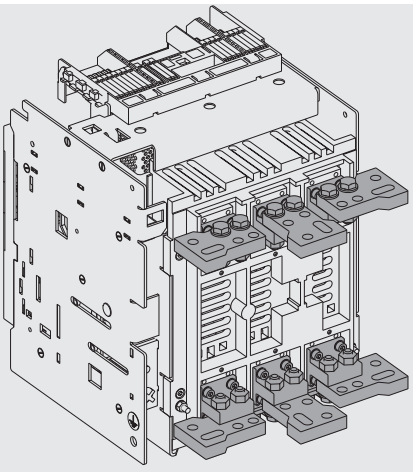


Figure 54 - W - SHR - Spread horizontal rear IEC

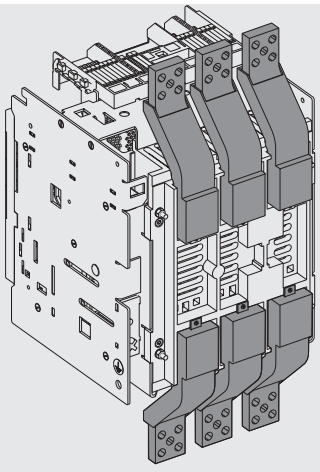


Figure 55 - W - EF - Extended front IEC-UL

Continued on the next page

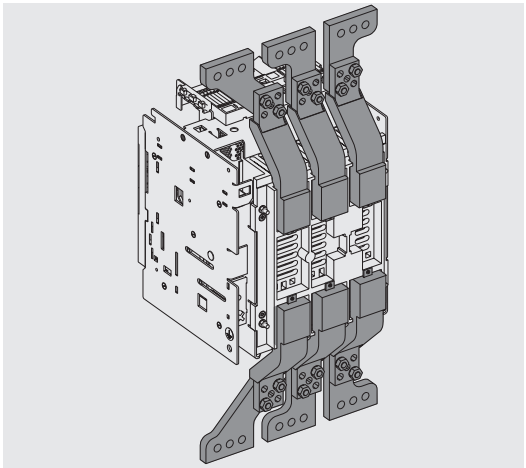


Figure 56 - W - ES - Spread front IEC-UL

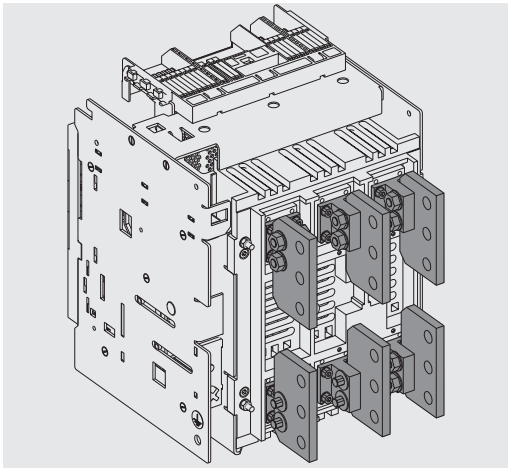


Figure 57 - F - FC - Terminals for cables IEC-UL

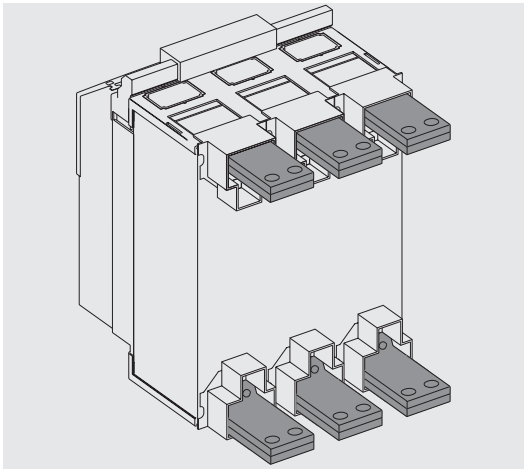


Figure 58 - F - HR - Horizontal rear UL Listed

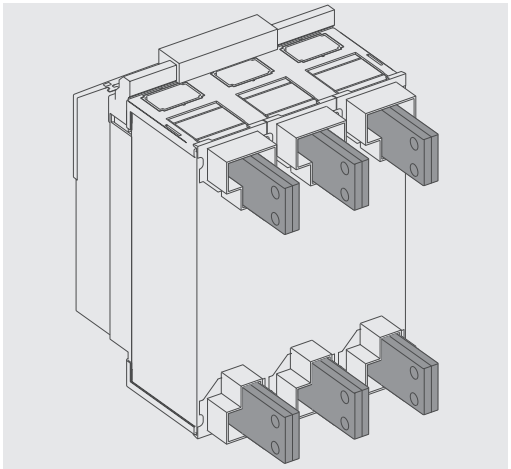


Figure 59 - F - VR - Vertical rear UL Listed

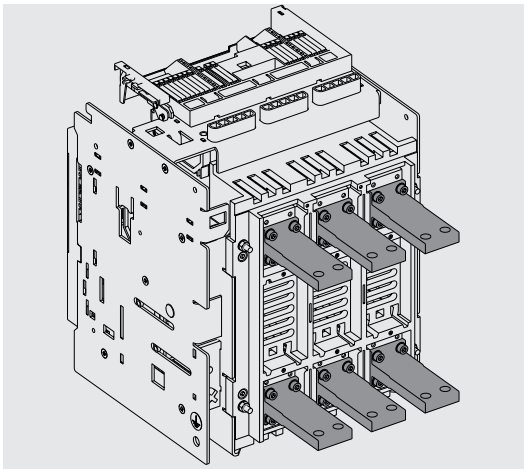


Figure 60 - W - HR - Horizontal rear UL Listed

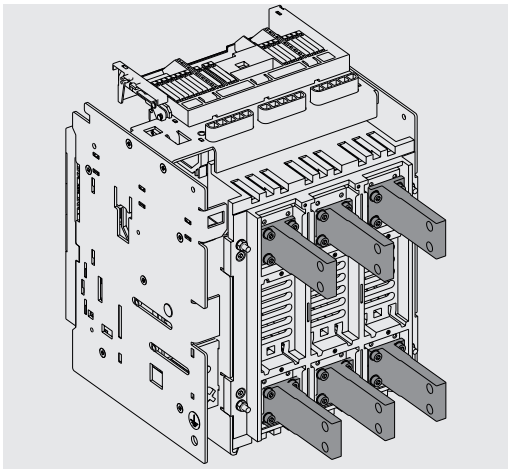


Figure 61 - W - VR - Vertical rear UL Listed

Change of position of the vertical/horizontal terminals

If the circuit-breaker is supplied equipped with terminals of the horizontal/rear type, it is possible at any moment to switch from horizontal to vertical and vice versa. (see Figure 62 and Figure 63). Lock the screws with tightening torque 20 Nm - 177 lb in.

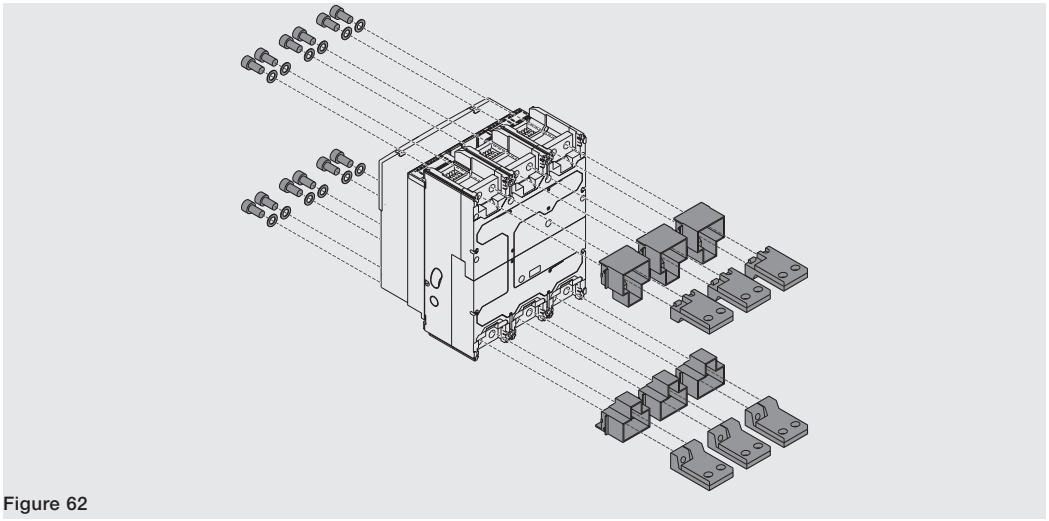


Figure 62

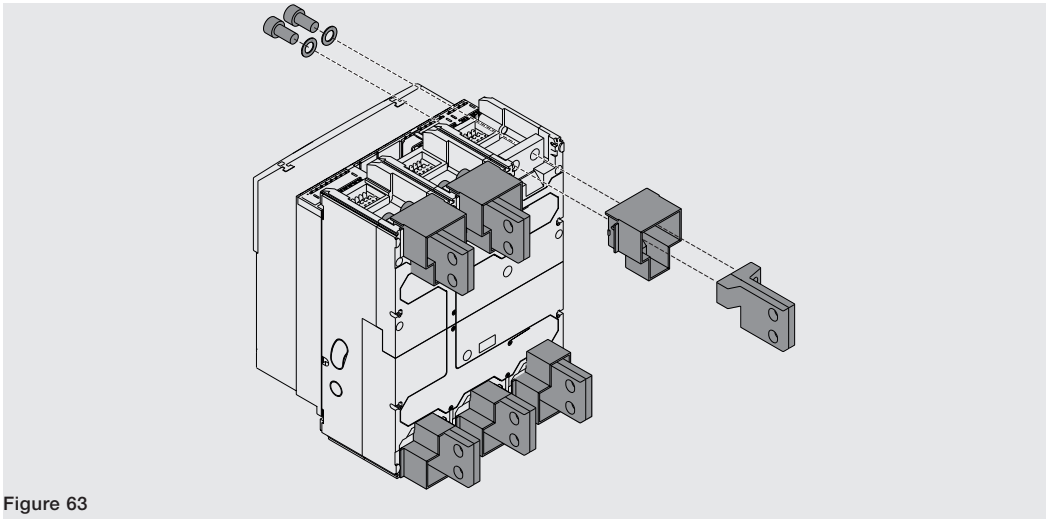


Figure 63

Connection to the power circuit

The connection of a circuit-breaker to the power circuit is performed using the connection busbars of the electric switchgear fixed to the terminals of the circuit-breaker. The sizing of the busbars is specified by the designer of the electrical switchgear.

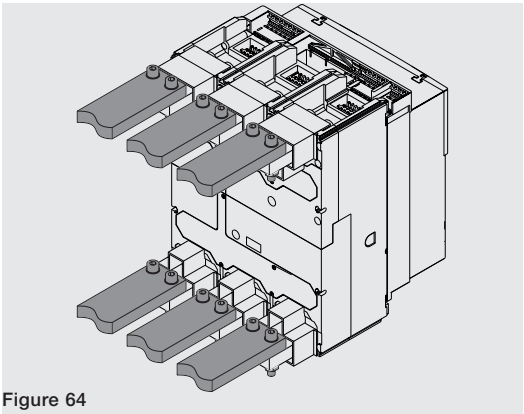


Figure 64

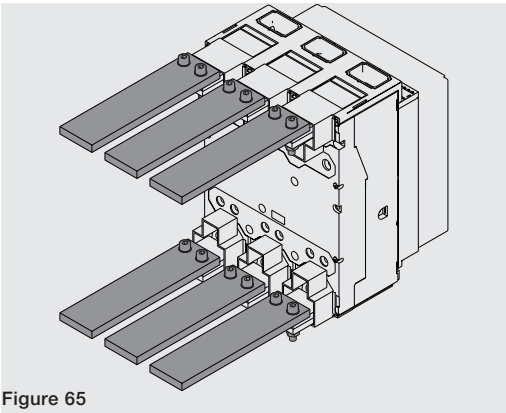


Figure 65

IMPORTANT: it is possible to obtain different capacities for the connections by altering the thickness and number of busbars in parallel.

The following tables provide some examples of the quantity and the sizes of the connections that can be used for each type of circuit-breaker:

circuit-breaker IEC 60947	Iu (A)	Dimension of busbars (mm)	Horizontal terminals	Vertical terminals
E1.2	630	2x40x5	yes	yes
E1.2	800	2x50x5	yes	yes
E1.2	1000	2x50x10	yes	-
		2x50x8	-	yes
E1.2	1250	2x50x10	yes	-
		2x50x8	-	yes
E1.2	1600	3x50x8	yes	-
		2x50x10	-	yes

circuit-breaker UL 1066	Iu (A)	Horizontal terminals		Vertical terminals	
		Q.ty	Dimension of busbars (in)	Q.ty	Dimension of busbars (in)
E1.2-A	800	2	1/4 x 2	1	1/4 x 3
E1.2-A	1200	4	1/4 x 2	2	1/4 x 3

Continued on the next page

IMPORTANT: Before proceeding with the connection between terminals and connection busbars:

- **make sure that the contact surfaces of the busbars are free of burrs, dents, traces of rusting, dust or traces of grease.**
- **make sure, if aluminium busbars are used, than these are tin plated in the contact areas.**
- **make sure that the busbars do not exert forces in any direction on the terminal.**
- **for tightening use M10 screws with resistance class 8.8 equipped with spring washers and lock them with a torque of 45 Nm - 400 lb in.**

Dimensions

Information on the overall dimensions is available on the website:

http://www.abb.com/abblibrary/DownloadCenter/.

The following drawings are also available in .dxf format:

- 1SDH000999R0101 - E1.2 III-IV Fixed F EF IEC-UL
- 1SDH000999R0102 - E1.2 III-IV Fixed FC IEC-UL
- 1SDH000999R0103 - E1.2 III-IV Withdrawable EF IEC-UL
- 1SDH000999R0104 - E1.2 III-IV Withdrawable ES IEC-UL
- 1SDH000999R0105 - E1.2 III-IV Withdrawable SHR IEC
- 1SDH000999R0106 - E1.2 III-IV Withdrawable FC IEC
- 1SDH000999R0107 - E1.2 III-IV Fixed HR-VR Positionable IEC
- 1SDH000999R0108 - E1.2 III-IV Fixed ES IEC-UL
- 1SDH000999R0109 - E1.2 III-IV Withdrawable HR-VR IEC
- 1SDH000999R0120 - E1.2 Flange Fixed Withdrawable IEC-UL
- 1SDH000999R0121 - E1.2 Floor mounting IEC-UL
- 1SDH000999R0303 - E1.2 III-IV Withdrawable Rear Terminals HR-VR UL
- 1SDH000999R0307 - E1.2 III-IV Fixed Rear Terminals HR-VR UL

Positioning anchor plates

The diagram below indicates the distance for positioning the first anchor plate according to the circuit-breaker type and the peak current:

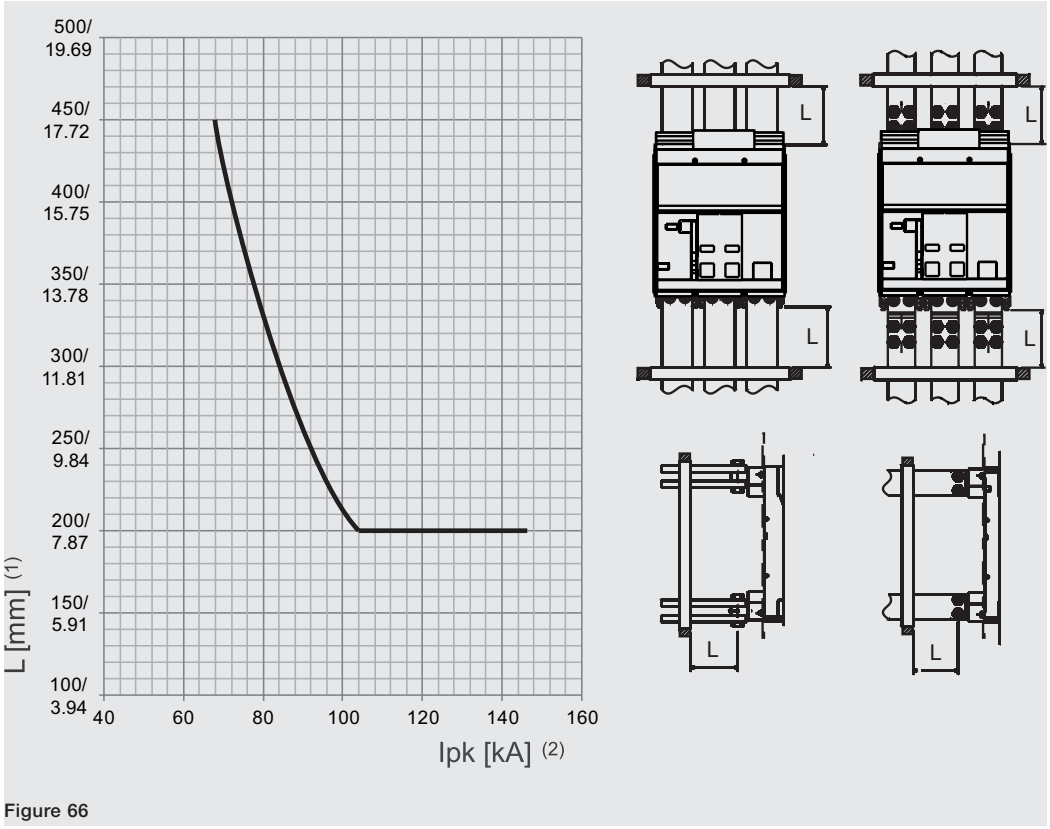


Figure 66

(1): distance of the first anchor plate from the circuit-breaker terminals
(2): peak current

Ekip Dip

1 - General characteristics

Families

SACE Emax 2 can be configured with two families of Trip units:

- Ekip Dip with interface via dip-switches
- Ekip Touch with touchscreen display

Both families provide protection and measuring functions related to signals from the installation and are available in different models and versions.

Details of Ekip Dip are given in this document; for a description of Ekip Touch, consult document 1SDH001316R1002.

Versions and main functions

Ekip Dip is available in three versions: Ekip Dip LI, Ekip Dip LSI, Ekip Dip LSIG.

All versions provide the following functionalities:

- *Measurement* of installation currents
- *Protection*: depending on the measurements made and the parameters configured by the user, the Trip unit checks for the presence of alarms and commands circuit-breaker opening if necessary
- *Signalling*: management of contacts and communication networks to optimize plant efficiency, communication among different CB and other functions

The Ekip Dip functions are provided both by means of transducers and actuators inside the circuit-breaker, and by means of a vast range of external accessories

Presentation

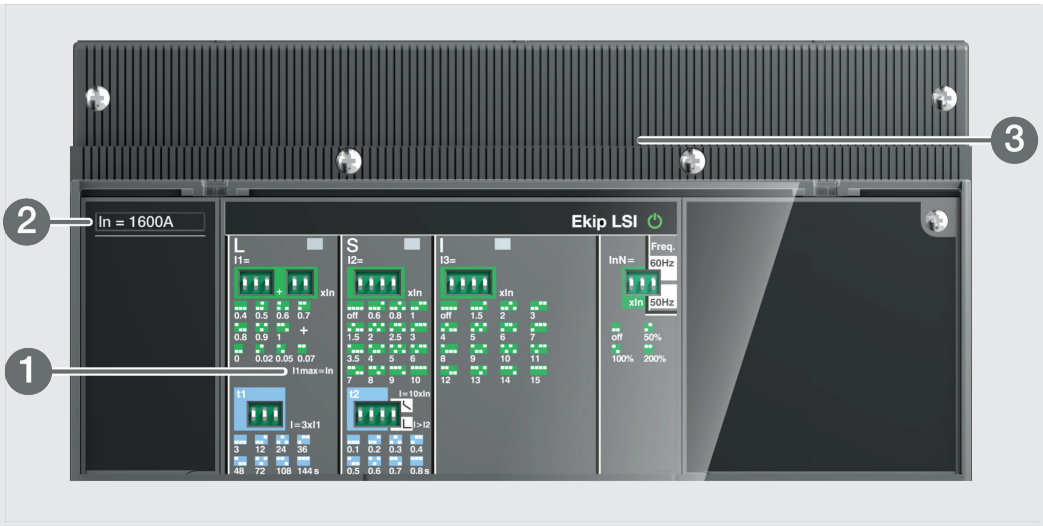


Figure 67

Ekip Dip has a dip-switch (**1**) interface for configuring and verifying the protections and main parameters (page 30).

The nominal size of the Rating plug (**2**) can be checked on the front (page 46).

All the external connections, including the supply and communication modules, the external sensors and mechanical accessories, are available in the upper terminal box (**3**) (page 45 for an overview of the electronic accessories).

2 - Operating features

Introduction

Ekip Dip has been developed and certified to function in specific environmental, electrical and mechanical conditions; full details are available in the *Technical catalog*.

The following sections describe the electrical and power supply characteristics that enable Ekip Dip and the relative electronic accessories to operate correctly.

Electrical characteristics

The Ekip Dip measurement and protection functions described in this document are guaranteed with current values within the following nominal ranges:

Parameter	Rated operating range
Primary current	0,004 ÷ 16 In [1]
Rated frequency	45 ... 55 Hz (with fn= 50 Hz) / 54 ... 66 Hz (with fn= 60 Hz)
Peak factor	Complying with standard IEC 60947-2

[1] range with reference to each phase; In refers to the rated size defined by the Rating plug installed on the Trip unit, available in models from 100 A to 6300 A

Self-supply

The internal current sensors are able to supply the Trip unit directly

Parameter	Operating limits
Minimum three-phase turn-on current	> 30 A (with Rating Plug < 400 A)
	> 80 A (with Rating Plug ≥ 400 A)

Auxiliary power supply

Ekip Dip can be connected to an external auxiliary supply source, which is useful when certain functions such as communication via Local Bus, recording manual operations, certain measurements and the datalogger must be activated.

The auxiliary supply can be provided by modules from the Ekip Supply range or via a direct connection to the terminal box; the direct connection must be made when the following operating conditions can be guaranteed:

Parameter	Operating limits
Voltage	24 VDC galvanically isolated
Tolerance	± 10%
Maximum ripple	± 5%
Maximum inrush current @ 24 V	10 A per 5 ms
Maximum rated power @ 24 V	4 W
Connection cable	Insulated with grounding cable (same characteristics as Belden 3105A/B or higher)

IMPORTANT: if connection is direct, the power supply must be galvanically insulated and provide the insulation characteristics established by standard IEC 60950 (UL 1950) or equivalent.

3 - Operator interface

Introduction

The operator interface of the Ekip Dip protection trip unit allows you to:

- Set the parameters relating to the available protections.
- View the status of the trip unit and alarms.
- Connect to the frontal connector to communicate and perform the opening test.

Components of the interface

The Ekip Dip operator interface appears as follows:

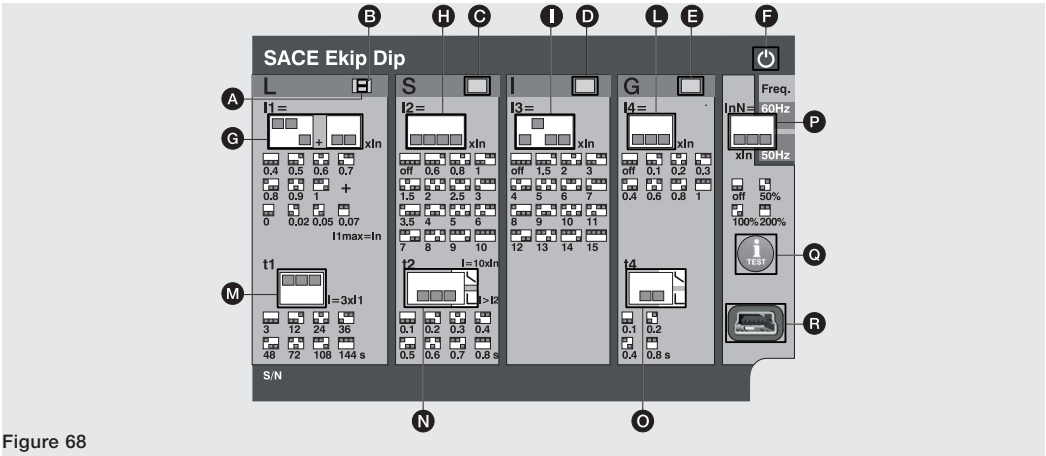


Figure 68

The following table provides a description of the components of the interface:

Position	Type	Description
A	**LED**	L Protection LED (alarm and trip)
B		L Protection LED (pre-alarm)
C		S Protection LED (alarm and trip)
D		I Protection LED (trip)
E		G Protection LED (alarm and trip)
F		Power-on LED (trip unit powered and on)
G	**Protections: thresholds**	L Protection dip-switch (threshold I1)
H		S Protection dip-switch (threshold I2)
I		I Protection dip-switch (threshold I3)
L		G Protection dip-switch (threshold I4)
M	**Protections: times**	L Protection dip-switch (time t1)
N		S Protection dip-switch (time t2 and type of curve)
O		G Protection dip-switch (time t4 and type of curve)
P	**Settings**	Neutral and frequency dip-switch
Q	**Test**	Test pushbutton
R		Test connector

IMPORTANT: the figure above refers to an Ekip Dip, LSIG version. In the case of Ekip Dip LI or LSI versions, LEDs and dip-switches related only to the protections present are available.

LEDs

The LEDs are useful on Ekip Dip in order to distinguish and identify various types of information on the protection trip unit, the circuit-breaker and state of the line currents.

Operational conditions

The operation of the LED is determined by the power supply conditions of the trip unit:

- With the trip unit energized (by current sensors or by auxiliary power supply or by Ekip TT or by Ekip T&P or by Ekip Bluetooth) the LEDs are operational for all the signals.
- With the trip unit de-energized, the LEDs are limited to the signalling of the last switch-off or trip event (combined with the check via iTest, described below).

NOTE: *with the trip unit off, the operation of the LEDs is guaranteed if the internal battery of the trip unit is working properly.*

About

The LEDs combined with the protections provide various information, through different combinations of lighting and blinking.

NOTE: *all the combinations related to protection LED signals are described in chapter* **Self-diagnosis and signalling** *, on page* **42.**

The power-on LED provides information about the power status of the protection trip unit:

- LED on (default configuration) fixed or blinking, signals trip unit energized.
- LED off signals trip unit de-energized.

NOTE: *with Ekip T&P and Ekip Bluetooth modules and Ekip Connect software, it is possible to configure how the power LED functions (LED fixed or blinking).*

Protections: thresholds

The thresholds of all the protections can be modified with various dip-switches, as specified on the serigraph of the interface.

The values of the protections make reference to the current In, a nominal value defined by the Rating Plug.

IMPORTANT:

- **Modification of the thresholds must be performed in the absence of protection alarms.**
- **Modifications carried out in alarm conditions are accepted by the trip unit when resting condition is restored (absence of protection alarms).**

Protections: times

The times and the curves of the protections can be modified with various dip-switches, as specified on the serigraph of the interface.

IMPORTANT:

- **Modification of the times must be performed in the absence of protection alarms.**
- **Modifications carried out in alarm conditions are accepted by the trip unit when resting condition is restored (absence of protection alarms).**

Settings

Two further settings are available:

- **Neutral** allows activation and adjustment of the protections on the neutral pole.
- **Frequency** allows the selection of the installation frequency.

iTest pushbutton

The iTest pushbutton is useful for three operations:

- Perform tests (circuit-breaker opening test and LED test). Consult chapter 6 - Test on page 41.
- Reset the signal of the tripped protection. This operation can be performed when the circuit-breaker is both open and closed and with currents present, by pressing the push-button for about 1 second (the signal disappears when the push-button is released).
- With the trip unit off, check the information relating to the switch-off or tripping event.

NOTE: *with the trip unit off, pressing of the iTest button switches on (for approximately 4 seconds):*

- the power-on LED, if the trip unit is off due to an energy drop (primary current less than the minimum level of operation, removal of auxiliary power supply with circuit-breaker open, etc…).
- the protection tripped LED if the trip unit is off due to a protection trip.

Test connector

The test connector allows the connection of Ekip TT, Ekip T&P and Ekip Bluetooth modules, in order to perform the following operations:

- Temporary energizing of the trip unit to check the status, and perform the trip test (option possible with all the front interface modules).
- Analysis, supervision and setting of additional parameters through external communication test units (Ekip T&P, Ekip Bluetooth).

4 - Protections

Operating principle

The protection functions are available with all Ekip Dip versions.

1. If the signal measured exceeds the set **threshold**, the specific protection activates (prealarm and/or **alarm**).
2. The **alarm** appears on the display and, after a period of time (timing t_1), depending on the protection parameters set, can convert into a **trip command (TRIP)** transmitted to the internal Trip coil of the CB.

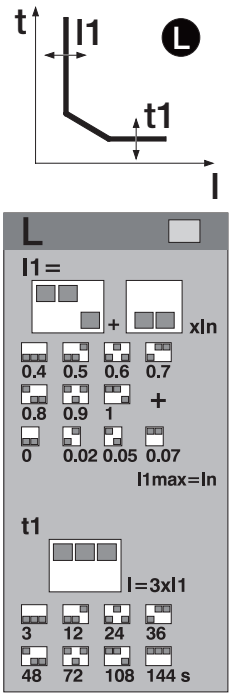
NOTE:

- if the signal measured drops below the set threshold before the trip time has elapsed, Ekip Dip quits the alarm and/or timing state and returns to the normal operating condition
- all protections have a default configuration: check the parameters and change to suit the installation requirements before putting into service
- to allow circuit-breaker tripping to be controlled by a specific protection, the protection itself must be enabled

L Protection

L protection protects against overloads

NOTE: *the protection is available and active for all the versions of the trip unit.*



When the activation threshold is exceeded, the protection trips in a time that decreases as the current read increases.

Parameters

All the parameters that can be modified by the user affect the response curve, and related tripping times.

Parameter	Description
Threshold I1	The value I1 contributes in calculating the tripping time, and also defines the current value that, if exceeded, activates the protection (with reference to the curve, it is the part parallel to the y-axis). **IMPORTANT:** **• The protection is activated and starts timing for currents between 1.05 and 1.2 of the threshold I1 set** [(1)]. **• The delay is interrupted if the current drops below the activation threshold.**
Time t1	The value t1 contributes in calculating the tripping time (with reference to the curve, T1 affects the entire curve by shifting it as a whole along the y-axis). **IMPORTANT:** **The protection limits the tripping time to 1 second in two cases:** **• if, according to the calculation, the time is less than 1 second.** **• If the fault current is greater than 12 In.**

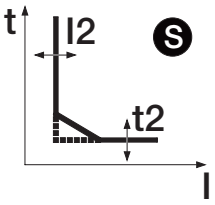
(1) *Example (with I1 set to 400 A): the protection is activated for currents between 420 A and 480 A.*

With the modules Ekip T&P or Ekip Bluetooth and with the Ekip Connect software, it is possible to activate the function **Thermal Memory**, and adjust the threshold of **Pre-alarm**.

S Protection

S protection protects against selective short circuit.

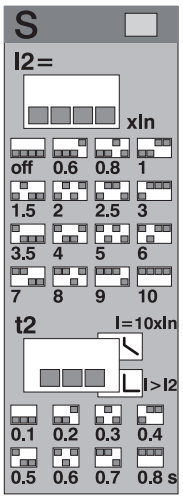
NOTE: *the protection is available for LSI and LSIG versions of the trip unit.*



When the activation threshold is exceeded, the protection trips within a fixed or dynamic time (the time decreases as the current reading increases).

Parameters

All the parameters that can be modified by the user affect the response curve, and related tripping times.



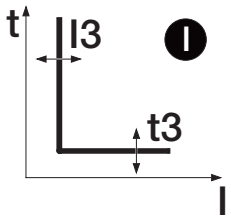
Parameter	Description
Enable	By setting the threshold dip-switches to the Off position, the protection is disabled.
Type of curve	It determines the dynamic of the curve and the tripping time, fixed or dynamic according to the selection: **NOTE:** calculation of the tripping time of the inverse time curve is based on a mathematical expression. The details are provided in the table on page 39.
Threshold I2	It defines the current value that activates the protection when exceeded (with reference to the curve, it is the part parallel to the y-axis). **IMPORTANT:** **• The I2 threshold set must be higher than the I1 threshold. An incorrect configuration returns an alarm signal.** **• The delay is interrupted if the current drops below the activation threshold.**
Time t2	The selected function determines the contribution of t2: • Fixed time: t2 is the delay time between exceeding the I2 threshold and sending the opening command. • Dynamic time: t2 contributes in calculating the tripping time (with reference to the curve, t2 affects the entire curve, shifting it as a whole along the vertical axis). **IMPORTANT:** **• The minimum tripping time of the protection is t2. If, according to the calculation, the tripping time is less, it is automatically limited to t2.** **• For all the UL versions, the maximum time allowed is 0.4 s. If a higher value is set, the trip unit signals the error and forces the parameter to 0.4 s.**

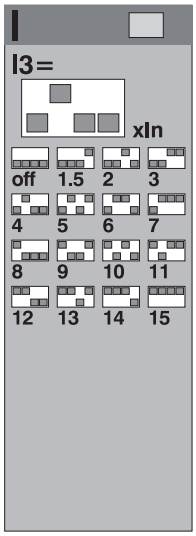
With the modules Ekip T&P or Ekip Bluetooth and with the Ekip Connect software, it is possible to activate the function **Thermal Memory**.

I Protection

I protection protects against instantaneous short circuit.

When the activation threshold is exceeded, the protection trips within a fixed non-adjustable time.





Parameters

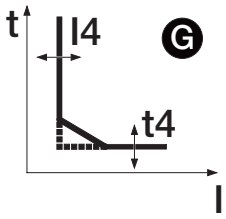
The user can set the intervention threshold.

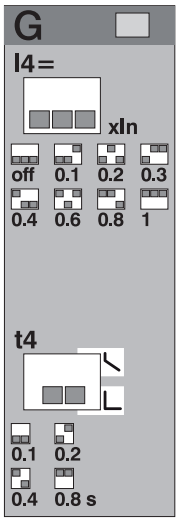
Parameter	Description
Enable	By setting the threshold dip-switches to the Off position, the protection is disabled.
Threshold I3	It defines the current value that activates the protection when exceeded (with reference to the curve, it is the part parallel to the y-axis). **IMPORTANT: The I3 threshold set must be higher than the I2 threshold. An incorrect configuration returns an alarm signal.**

G Protection

G protection protects against a ground fault.

NOTE: *the protection is available for the LSIG version of the trip unit.*





When the activation threshold is exceeded, the protection trips within a fixed or dynamic time (the time decreases as the current reading increases).

Parameters

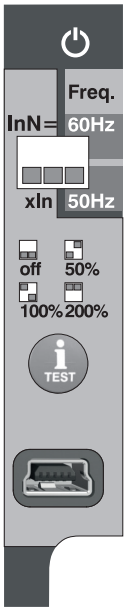
All the parameters that can be modified by the user affect the response curve, and related tripping times.

Parameter	Description
Enable	By setting the dip-switches of the threshold in one of the available combinations other than Off, the protection is enabled. If enabled, the protection is inhibited automatically by the trip unit under two conditions: • Disconnection of one or more current sensors. • Current measured on one of the phases higher than a maximum value. **IMPORTANT: the maximum current value that deactivates G protection varies according to the threshold set:** **• 8 In (with I4 ≥ 0.8 In)** **• 6 In (with 0.5 In ≤ I4 < 0.8 In)** **• 4 In (with 0.2 In ≤ I4 < 0.5 In)** **• 2 In (with I4 < 0.2 In)**
Type of curve	It determines the dynamic of the curve and the tripping time, fixed or dynamic according to the selection: **NOTE:** calculation of the tripping time of the inverse time curve is based on a mathematical expression. The details are provided in the table on page 39.
Threshold I4	It defines the current value that activates the protection when exceeded (with reference to the curve, it is the part parallel to the y-axis). **IMPORTANT:** **• The delay is interrupted if the current drops below the tripping threshold.** **• For all the UL versions the maximum threshold allowed by the trip unit is 1200 A. If a higher value is set, the trip unit signals the error and forces the parameter to 1200 A.**
Time t4	The selected function determines the contribution of t4: • Fixed time: t4 is the delay time between the exceeding of the I4 threshold and the sending of the opening command. • Dynamic time: t4 contributes in calculating the tripping time (with reference to the curve, t4 affects the entire curve, shifting it as a whole along the y-axis). **IMPORTANT:** **• The minimum tripping time of the protection is t4. If, according to the calculation, the tripping time is less, it is automatically limited to t4.** **• For all the UL versions, the maximum time allowed by the trip unit is 0.4s. If a higher value is set, the trip unit signals the error and forces the parameter to 0.4 s.**

With the Ekip T&P or Ekip Bluetooth modules and with the Ekip Connect software, it is possible to adjust the threshold of **Pre-alarm**.

Neutral and frequency

Adjusting of the neutral setting is used to customize the L, S and I protections on the Neutral pole with a control factor different from the other phases.



NOTE: *use the adjustment of the neutral setting only with four-pole or three-pole circuit-breakers with external neutral: with three-pole circuit-breakers and neutral protection active, the trip unit signals the absence of the current sensor.*

The adjustment of the frequency is used in order to set the installation frequency (between 50 and 60 Hz).

Neutral parameters

The user can activate the protection and set the percentage for calculation of the protection thresholds.

Parameter	Description
Enable	By setting the threshold dip-switches to the Off position, the protection on the Neutral is disabled.
Threshold InN	It establishes the multiplication factor applied to the trip thresholds of the protections: • 50%: trip threshold of the neutral current lower than other phases. • 100%: same trip thresholds for all poles. • 200%: trip threshold of the neutral current higher than other phases.

Limitations

The adjustment of the Neutral threshold to value of 200 % must be performed considering the following formula: (I1 * InN) ≤ Iu.

I1 indicates the threshold of L protection in Amperes (example: In = 1000 A; I1 = 0.45 In = 450 A), InN is the neutral threshold expressed as a multiplication factor (example: 2), Iu indicates the size of the circuit-breaker (example: 1000 A).

WARNING! With 200% threshold and measured neutral current exceeding 16In, the Trip unit resets the protection to 100% by itself

Additional protections

The Ekip T&P and Ekip Bluetooth modules, and the Ekip Connect software, allow you to set some protections not available via dip-switch:

- Thermal Memory
- T Protection
- Prealarm threshold
- Hardware Trip

Thermal Memory

This function, available for protections L and S, reduces the tripping time of the protection based on the time elapsed between multiple trips caused by heating of the cables.

IMPORTANT: for the S protection the function can be activated if the selected curve is time-dependent.

T Protection

T protection protects the circuit-breaker against abnormal temperatures recorded by the protection trip unit.

T protection is always active; via Ekip Connect it is possible to enable tripping, which takes place for temperatures t < -40 °C or t > 85 °C.

Pre-alarm

The purpose of the pre-alarm, available for L and G protections, is to signal that the measured current is near the activation threshold of the protection itself.

It is possible to set the pre-alarm threshold in order to establish the pre-alarm activation values; the pre-alarm threshold is expressed as a percentage in relation to the protection thresholds (I1 and I4) and is adjustable between 50% and 90% (default value).

Example: with I1 = 0.6 In and pre-alarm threshold L=50 %, the pre-alarm is activated for currents greater than 0.3 In

The pre-alarm condition is activated for currents higher than the threshold set, and is deactivated for:

- Current less than the pre-alarm threshold.
- Current greater than the activation threshold of protection.

Hardware Trip

If enabled, the protection activates if one or more disconnections of the current sensors, Rating plug, Trip coil or an alarm inside the unit are detected.

The protection activates with a TRIP if the disconnections persist for more than one second; in the case of Trip coil disconnection, the unit merely handles alarm signaling.

Summary table of protections

ABB	ANSI [5]	Threshold [1]	Threshold tolerance [3]	Time [1]	Calculation formula t_t [2]	Calculation example t_t [2]	Tolerance t_t [3]
L	49	I1 = 0.4…1 In	activation for If in the range (1.05...1.2) x I1	t1 = 3…144 s	$t_t = (9\ t1) / (If / I1)^2$	t_t = 6.75 s with: I1 = 0.4 In; t1 = 3 s; If = 0.8 In	± 10 % with If ≤ 6 In ± 20 % with If > 6 In
S (t = k)	50 TD	I2 = 0.6...10 In	± 7 % with If ≤ 6 In ± 10 % with If > 6 In	t2 = 0.1…0.8 s	t_t = t2	-	The better of the two values: ± 10 % or ± 40 ms
S ($t = k / I^2$)	51	I2 = 0.6...10 In	± 7 % with If ≤ 6 In ± 10 % with If > 6 In	t2 = 0.1…0.8 s	$t_t = (100\ t2) / (If)^2$	t_t = 5 s con: I2 = 1 In; t2 = 0.8 s; If = 4 In	± 15 % with If ≤ 6 In ± 20 % with If > 6 In
I	50	I3 = 1.5...15 In	± 10 %	Not adjustable	t_t ≤ 30 ms	-	-
G (t = k)	50N TD	I4 [4] = 0.1...1 In	± 7 %	t4 = 0.1…0.8 s	t_t = t4	-	The better of the two values: ± 10 % or ± 40 ms
G ($t = k / I^2$)	51N	I4 [4] = 0.1...1 In	± 7 %	t4 = 0.1…0.8 s	$t_t = 2 / (If / I4)^2$	t_t = 0.32 s with: I4 = 0.8 In; t4 = 0.2 s; If = 2 In	± 15 %
Iinst	-	Defined by ABB	-	Instantaneous	-	-	-

[1] See the serigraph for the available combinations.
[2] t_t calculation is valid for If values that have exceeded the trip threshold of the protection. Use fault current and threshold values expressed in In to calculate t_t, as shown in the example.
[3] Tolerances valid with trip unit energized in service conditions or with the auxiliary; tripping time ≥ 100 ms, temperature and currents within operating limits. If these conditions are not guaranteed, the tolerances in the table shown below apply.
[4] In the presence of auxiliary power supply, you can select all the thresholds. In self-supply mode the minimum threshold is limited to: 0.3 In (with In = 100 A), 0.25 In (with In = 400 A) or 0.2 In (for all other sizes).
[5] ANSI / IEEE C37-2 encoding.

Key

- (t=k) - Fixed time curve
- *($t=k/I^2$)* - Dynamic time curve
- t_t - Tripping time
- *If* - Primary fault current

Tolerances in particular cases

If the conditions defined in point [3] of the above table are not guaranteed, the following tolerances apply:

Protection	Tolerance threshold	Tolerance t_t
L	Activation for If in the range (1.05...1.2) x I1	± 20 %
S	± 10 %	± 20 %
I	± 15 %	≤ 60 ms
G	± 15 %	± 20 %

5 - Measurements

List Ekip Dip is able to take various measurements, all available via Ekip Connect::

Parameter	Description
Instantaneous currents	Phase current and earth fault measurements in real time
Trip	List of current protection trips (TRIP)
Min Max Measurements	History of minimum and maximum currents, recorded at a settable interval
Operation counters	Number of mechanical and electrical operations

All information is available via the Ekip T&P and Ekip Bluetooth modules and via Ekip Connect software; instantaneous measurements are also available via the Ekip Multimeter unit.

Instantaneous currents The instantaneous currents, available in the Measurements pages, are real time measurements of the phase and earth fault currents expressed in root mean square value; the measurement time and performance depend on the rated current defined by the *Rating plug* (In):

Measurement	Monitor time (min-max)	Normal operating range	Accuracy of value read [1]
Phase currents	0,004...64 In	0,2...1,2 In	1 %
Internal earth fault currents [2]	0,08...64 In	0,2...1,2 In	2 %

[1] the accuracies refer to normal operating ranges, as established by IEC 61557-12
[2] available with LSIG versions

6 - Test

Presentation

The Ekip TT, Ekip T&P and Ekip Bluetooth modules connected to the Ekip Dip allow you to perform various tests:

- Trip unit LED test
- Check on the presence of the internal battery
- Circuit-breaker opening test (trip test)
- Protection test.

LED test

The LED test can be performed directly on Ekip Dip:

Phase	Operation
1	Connect a module to the front test connector of frontal test.
2	Press the iTest pushbutton for at least 6 seconds, but less than 9 seconds.
3	When the protection LEDs light up, trip unit the iTest pushbutton.
4	Check the following switch-on sequence: • S, I, G LEDs on fixed • Led pre-alarm L and alarm L that alternate three times • All the protection LEDs off

Battery test

The battery check is integrated in the LED test procedure, except for the battery error signal:

- If the battery is absent or not working, after iTest is pressed the error is signalled by five flashes of the pre-alarm LED L.
- If the battery is present and working, the LED test proceeds as in the normal procedure.

Protection test

In order to perform the protection test, follow the instructions below:

Phase	Operation
1	Make sure that the circuit-breaker is closed and that there are no primary currents.
2	Connect Ekip T&P or Ekip Bluetooth to the front test connector.
3	Start the communication with Ekip Connect.
4	Open the Information page and select the Test command, which opens the protection test page.
5	Set up the test as required and verify that the trip unit functions properly.

Opening test

The opening test can be performed directly on the trip unit or from Ekip Connect.

To perform the test:

Phase	Operation
1	Make sure that the circuit-breaker is closed and that there are no primary currents.
2	Connect a module to the front test connector of frontal test.
3	Press the iTest pushbutton for at least 9 seconds.
4	Check that the circuit-breaker opens and that the TU Reset button comes out

To perform the test from Ekip Connect:

Phase	Operation
1	Make sure that the circuit-breaker is closed and that there are no primary currents.
2	Connect Ekip T&P or Ekip Bluetooth to the front test connector.
3	Start the communication with Ekip Connect.
4	Select the trip test command.
5	Check that the circuit-breaker opens and that the TU Reset button comes out

7 - List of alarms and signals

LED view

Ekip Dip continuously monitors its own operating condition and that of all the devices to which it is connected. All the signals are available with the front LEDs. The protection LEDs provide information with various combinations of lighting and flashing, while the power-on LED, as described on page 31, indicates the power-on conditions of the trip unit.

NOTE: *the number of LEDs depends on the version of Ekip Dip (LI, LSI, LSIG).*

Summary table of LED signals

The following table summarises the signals available with the protection LEDs and the operations to be carried out in response to alarms or fault conditions signalled.

Type of Information	Slow flashing (0.5Hz)			Fast flashing (2 Hz)				On and fixed			2 flashes every 2 s		3 flashes every 3 s	4 flashes every 4 s	HELP
Colour and LED	All R	G	All R+G	All R	R (single)	G	All R+G	All R	R (single)	G	All R	G	G	G	
Internal configuration error [5].			x				x	x							A
Trip coil disconnected or trip command failed				x											B
Current sensors disconnected	x														B
Rating Plug error											X				B+E
Protection delay					x										C
Temperature alarm [1]					x										C
Pre-alarm L										x					C
Trip [2]									x						C
Hardware Trip [3]									x	x					B
Installation error						x									E
Parameter error												x			D
Circuit-breaker state not defined or in error		x													B
Error on Local Bus														x	F
Maintenance alarm													x		F
Low battery (during self-test) [4]						x									G

[1] The temperature alarm is signalled by lighting of the protection L and I red LEDs.
[2] The last trip can also be displayed with trip unit off, by pressing the iTest key.
[3] The Hardware Trip is signalled by lighting of the pre-alarm L yellow LED and the protection I red led.
[4] Five flashes when self-test is started up
[5] Error present with one of the three flashing options displayed alongside.

Key to LED colours

The above table lists the colors of the LEDs, to be interpreted as follows:

- R = red LED (alarm LED L, S, I, G).
- G = yellow LED (pre-alarm LED L).

NOTE: *for further details refer to the table listing the components of the interface, available on page* **30.**

HELP

Some LED signals indicate connection errors or operational errors that require corrective or maintenance operations. The following are the suggestions for checking with reference to the preceding LED table:

HELP note	Operation
A	Contact ABB and give details about the state of the LEDs on the unit.
B	Check the connections between trip unit and accessories (Rating Plug, trip coil, sensors, etc).
C	Normal operation/signalling provided by the trip unit.
D	Error in setting of the dip-switches. Check and correct the following conditions: • All the dip-switches of L are in the ON position • I1 ≥ I2 or I2 ≥ I3. • Iu < (2 * In * I1) in the case where InN = 200 %. • I4 < 0.3 In (con In = 100 A), 0.25 In (con In = 400 A) or 0.2 In (for all other sizes), in the absence of auxiliary power supply. • t2 > 0.4s (in the case of UL circuit-breaker) • t4 > 0.4s (in the case of UL circuit-breaker) • I4 > 1200 A (in case of UL circuit-breaker)
E	Carry out installation.
F	Connect via Ekip Connect in order to set the Local Bus or to confirm maintenance.
G	Replace the battery.

8 - Additional functions

Additional functions

Ekip T&P, Ekip Programming and Ekip Bluetooth allow the Trip unit to be connected to Ekip Connect software and to access parameters and commands that are not directly available from the front interface; the main ones are:

Name	Description
Maintenance	Function allowing the user to be informed that more than a year has passed since the last maintenance or that contact wear has increased by more than 10%
Local Bus	Bus activation so as to communicate with Ekip Link, Ekip Multimeter or Ekip Signalling 10K modules
Programmable states	Programmable states for monitoring events, to associate with the Ekip Signalling 10K contacts
Programmable Functions	Commands which activate according to the state of signals or events programmable by the user
Led Alive	Configuration of the Power led of the Trip unit and of all modules connected

Details of these and other parameters are given in manual 1SDH001330R1002.

9 - Default parameters

Ekip Dip default parameters

The Ekip Dip trip units are supplied with the following default parameters, some adjustable with the front DIPs (protections, Frequency, Neutral), other via front bus.

Protection/Parameter	Value
L	1 In; 144 s
S (1)	Off; 0.1 s
I	4 In
G (1)	Off; 0.1 s
Frequency	50 Hz (IEC) / 60 Hz (UL)
Neutral	Off (for three-pole circuit breakers). 50 % (for four-pole circuit-breaker)
Hardware Trip	Disabled
Local Bus	Off
Alive LED	Disabled (Power-on LED fixed)
Maintenance	Off

(1) S Protection available with LSI and LSIG versions of the trip unit. G Protection available with LSIG version.

Accessories

1 - Overview

Overview and connection

Emax 2 circuit-breakers have a set of electronic, electrical and mechanical accessories, the availability of which depends on the CB model.

Consult manual 1SDH001330R1002 for details, circuit diagrams 1SDM000091R0001 and assembly instructions for the connection.

Electronic accessories

Electronic accessories for Ekip Dip:

Name	Mounting	Function
Rating Plug (1)	Front	Defines rated current In
Ekip Supply	Terminal box	Power supply of Trip unit and modules in terminal box
Ekip Link (2)	Terminal box	Communication between Trip units via an intranet with ABB proprietary protocol

Other external modules and accessories:

Name	Function
Ekip Signalling 10K	Programmable digital inputs/outputs
Ekip Multimeter	Panel front display
External neutral	Sensor for protecting the external neutral line with 3P circuit-breaker

In addition, the supervision, configuration and reporting functions are provided by further modules for temporary communication and supply:

Name	Function
Ekip TT	Supply and tests
Ekip T&P	Supply, communication, programming and tests
Ekip Programming	Supply, communication and programming
Ekip Bluetooth Key	Bluetooth communication and programming

(1) assembled by default at the time of order; can be replaced afterwards with a model of a different size
(2) always supplied for contacts Ekip AUP and Ekip RTC

Mechanical accessories

Electrical and mechanical accessories for E1.2:

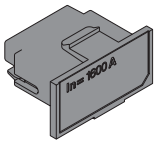
Type of accessory	Accessory	Circuit-breakers	Switch-disconnectors
Electrical signalling	AUX 4Q	S	R
	AUX 15Q	R	R
	Ekip AUP (1)	R	R
	Ekip RTC	R	R
	S51	S	-
	S33 M/2	R	R
Electrical control	YO (4) - YC	R	R
	YO2 (4)	R	R
	YU (2)(4)	R	R
	M	R	R
	YR	R	-
Security mechanical	KLC - PLC	R	R
	KLP - PLP (1)	R	R
	SL (1)	S	S
	DLC	R	R
	Anti-insertion lock	S	S
	MOC	R	R
	FAIL SAFE (3)	R	R
Protection mechanical	PBC	R	R
	IP54	R	R
	HTC-LTC	R	R
	PB	R	R
Interlocks	MI	R	R

S: Standard. R: on request.
(1) For withdrawable version only.
(2) Incompatible with FAIL SAFE. Can be ordered for UL on request
(3) Incompatible with YU; standard for UL version.
(4) A maximum of two accessories are available for YO and YU.

2 - Rating Plug

Description

The *Rating Plug*, supplied with Ekip Touch, establishes the rated current In required by the measuring range and sets the current protections (with reference to In).



It is installed on a dedicated front connector and is accessible to the user for inspections or replacement following a change of model/size.

For further details about the available models, operations and reference documents, consult document 1SDH001330R1002.

Putting into service and maintenance

1 - Putting into service

Introduction

The general check is necessary:

- when the circuit-breaker is put into service for the first time
- after prolonged inactivity of the circuit-breaker

HAZARD! RISK OF ELECTRIC SHOCK! Test the circuit-breaker with all switchgear apparatus de-energized.

IMPORTANT: The checks involve carrying out procedures that can be performed only by Skilled Persons in the electrical field (IEV 195-04-01: person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create).

General checks

Before putting it into service for the first time or after a prolonged period of inactivity, some checks must be carried out on the circuit-beaker and the environment in which it is installed:

Points to be checked	Checks
Switchgear	1. Sufficient change of air to avoid overtemperatures
	2. Clean location, free of all installation refuse (e.g.: cables, tools, metal splinters)
	3. Circuit-breaker mounted correctly (tightening torques, clearances respected)
	4. The installation environmental conditions must be consistent with the “Environmental conditions” specifications on page 20
Connections	1. Power connections tightened to the terminals of the circuit-breaker
	2. Cables and busbars with adequate cross-section
	3. Correct ground connections
	4. Maximum distances of separators respected
Operations	Perform some opening and closing operations (See chapter "Description of the product - circuit-breaker opening/closing operations on page 15). The spring loading lever must move with regularly
	WARNING! in the presence of an undervoltage coil the circuit-breaker can be closed only after the trip unit is energized
Trip unit alarm	Connect the protection device Ekip TT to the trip unit and verify that there are no alarms present
State of the circuit-breaker with Ekip Dip	With Ekip Dip, the circuit-breaker state must not be in error (see table on page 42). Perform a circuit-breaker closing/opening operation and make sure that there are no alarms (see table on page 42)
State of the circuit-breaker with Ekip Touch	With Ekip Touch, the circuit-breaker state must be read correctly (see table on page 42). Perform a circuit-breaker closing/opening operation and make sure that change of state is read correctly
Trip Test	With circuit-breaker closed and in conditions of rest (without circulating currents), carry out a Trip test, and verify the opening of the circuit-breaker
Ekip Dip parameters	Check and modify the protection dip switches, presence of external neutral and frequency to suit your installation requirements
Ekip Touch parameters	Connect the Ekip TT device. Check and make the necessary changes to: protection parameters, circuit-breaker configuration, frequency, password, date and language

NOTE: *for safety reasons, ABB strongly advises you to change the password right from the first access and to keep it with care.*

Wizard

When powered, the Ekip Touch shows the Wizard window, a user-friendly procedure for immediate adjustment of certain parameters: language, date, time, voltage of the installation (if Ekip Measuring is present) and password.

After the procedure has terminated, the window will no longer appear unless it is reset by Ekip Connect (Reset Wizard command): in this case, it will appear the first time the apparatus is powered after the command has been sent.

Check accessories

The following procedures for checking the accessories are to be performed before they are put into service:

Accessories (*) to be checked	Procedure
Gearmotor	1. Power the gearmotor to charge the springs at the relevant rated voltage.
	Result: The springs are charged correctly. The signals are normal. When the springs are charged the gearmotor stops.
	2. Perform some closing and opening operations.
	Result: The gearmotor recharges the springs after every closing operation.
	NOTE: *If present, power the undervoltage coil in advance.*
Undervoltage coil	1. Power the undervoltage coil at the relevant rated voltage and perform the closing operation on the circuit-breaker.
	Result: The circuit-breaker closes correctly; the signals are normal.
	2. Turn off the voltage supply to the trip unit. The circuit-breaker opens.
	3. Power the undervoltage coil at the relevant rated voltage and perform the closing operation on the circuit-breaker.
	Result: The circuit-breaker closes; the signal switches over.
	WARNING! If the undervoltage coil has been tripped by a power failure, the circuit-breaker can be closed only after the coil has been energized electrically. Make sure that the coil has effectively been tripped due to a power failure. Otherwise, examine the circuit-breaker and the associated equipment to make sure that they are in a good condition.
Opening coil	1. Close the circuit-breaker.
	2. Power the opening coil at the relevant rated voltage.
	Result: The circuit-breaker opens correctly; the signals are normal.
Closing coil	1. Open the circuit-breaker.
	2. Charge the springs manually or electrically.
	3. Power the closing coil at its rated voltage.
	Result: The circuit-breaker closes correctly; the signals are normal.
Opening coil with Ekip Com Actuator	1. Power the protection trip unit with the Vaux auxiliary power supply.
	2. Power the Ekip Com Actuator contacts.
	3. Close the circuit-breaker
	4. Select **“open CB”** from the Ekip Touch menu
	Result: The circuit-breaker opens correctly; the signals are normal.
	NOTE: *The test can be performed if the trip unit and the coils are energized.*

(*) if present.

(**) withdrawable versions only.

Continued on the next page

Accessories (*) **to be checked**	**Procedure**
Closing coil with Ekip Com Actuator	1. Power the protection trip unit with the Vaux auxiliary power supply.
	2. Power the Ekip Com Actuator contacts.
	3. Charge the springs.
	4. Select **"close CB"** from the Ekip Touch menu
	Result: The circuit-breaker closes correctly; the signals are normal.
	NOTE: *The test can be performed if the protection trip unit and the coils are energized.*
Lock for circuit-breaker in open position (key or padlock)	1. Open the circuit-breaker
	2. Keep the opening pushbutton pressed
	3. Turn the key and remove it
	4. Attempt the circuit-breaker closing operation.
	Result: Both manual and electrical closing is prevented.
Auxiliary open/ closed contacts of the circuit-breaker	1. Connect the auxiliary contacts to appropriate signalling circuits or to the multimeter.
	2. perform some closing and opening operations on the circuit-breaker.
	Result: signalling occurs normally.
Circuit-breaker connected, isolated for test, disconnected auxiliary contacts	1. Connect the auxiliary contacts to appropriate signalling circuits.
	2. bring the circuit-breaker to the connected, isolated for test and disconnected position.
	Result: the signals due to the relative operations are normal.
Locking devices for connected/ test/disconnected positions (**)	1. Perform operating tests.
	Result: the interlocks function correctly.
Interlocks between circuit breakers assembled side by side and stacked	1. Perform operating tests.
	Result: the interlocks function correctly.
Racking-in/out device (**)	1. Perform a few racking-in and racking-out operations.
	Result: in the rack-in operation the circuit-breaker is connected correctly. There is no particular resistance during the first turns of the handle.
Auxiliary accessories and auxiliary voltage	Verify the proper installation. The supply voltage of the auxiliary accessories must be between 85% and 110% of the rated voltage for the auxiliary accessories.
External modules	1. For all modules with terminal box: check connection to *Ekip Supply* in mechanical seat of terminal box For *Ekip Signalling 10K* and *Ekip Multimeter*: check connection of the bus of module (W3-W4) to the respective sockets of *Ekip supply* or terminal box
	2. Power up the Trip unit (and external modules if there is a separate supply) and make sure they are on
	3. Check on menu or via Ekip Connect that the local bus on the Trip unit is enabled
	4. Check that the Power LED on each module is on in the same way as the Power LED of Ekip Touch (steady or synchronous flash)
	5. Check on menu or via Ekip Connect to make sure that all installed modules are present and that there are no alarms
External neutral, single-pole sensor (SGR), residual current sensor (Rc)	1. Make sure that the sensor is connected to the terminal box
	2. Power up the Trip unit and make sure it is on
	3. For *External neutral*: check in the *Settings - Circuit-breaker* menu that *Configuration*= 3P + N; otherwise change the parameter For single-pole and residual current sensors: set presence and size in the *Settings - Circuit-breaker - Earth protection* menu; protection parameters in the *Protections* or *Advanced* menus
	4. Make sure there are no alarms

(*) if present.

(**) withdrawable versions only.

Accessories (*) to be checked	Procedure
Zone selectivity	1. Check selectivity connections (between Ekip Touch and the other units) as shown in circuit diagrams
	2. Provide Ekip Touch with auxiliary power and make sure that CB status is: Open
	3. Check that the protection of the selectivity concerned has been enabled (example: S protection)
	4. Select the *Test - Zone Selectivity* menu and the submenu of the protection concerned; repeat points 5, 6, 7 and 8 for each protection activated **NOTE**: *for selectivity D, consider submenu S for the Forward connections and G for the Backward connections*
	Check **Output**: 5. Select the *Force Output* command and check, on the unit connected to the Ekip Touch output, that the state of its *Input* = **ON** 6. Select *Release Output* and check on the unit that *Input* = **OFF**
	Check **Input**: 7. Select the *Force Output* command in the unit connected to the Ekip Touch input; check on Trip unit: *Input* = **ON** 8. Select *Release Output* and check on Trip unit: *Input* = **OFF**

Final check list

Perform the operations described below after having completed the general inspection procedures and checked the accessories. Print this sheet and use it to make an inspection report in the "Checks" column.

Operation		Description	Check
1	Circuit-breaker OFF	Open the circuit-breaker	
2	Circuit-breaker connected	Switch the circuit-breaker in withdrawable version to the connected position and reposition the crank in its seat	
3	Trip unit Parameters	Adjust the protection trip unit in accordance with the design specifications of the installation (drawn up by design engineer of the installation). If necessary, power the protection trip unit with an Ekip TT unit	
4	Removal of the Ekip TT	If present, remove the Ekip TT unit	
5	Connecting the voltage	Connect the auxiliary voltage	
6	Closing the switchgear	Close the switchgear door	
7	Charging the springs	Charge the closing springs	
8	Undervoltage coil	Make sure that undervoltage coil is energized	
9	Opening and closing coils	Make sure that opening and closing coils are NOT energized	
10	Mechanical interlock of the circuit-breaker	If present, make sure that the mechanical interlock of the circuit-breaker is not active	
11	Locking devices	If present, make sure that the locking devices of the circuit-breaker are not active	
12	Status signals	Make sure that the signalling devices on the front of the circuit-breaker indicate: circuit-breaker open - springs discharged O - OPEN and white spring signalling device DISCHARGED SPRING	

2 - Identification of alarms or failures

Introduction

The protection trip unit is able to identify some faults and to signal them through LEDs or display; you need to identify the cause and eliminate it before re-closing the circuit-breaker, both locally and remotely.

WARNING! detecting faults must only be managed by persons skilled in electrical matters (IEV 195-04-01): person with sufficient training and experience to enable him or her to perceive risks and to avoid the dangers potentially created by electricity) This is because it may be necessary to perform insulation and dielectric tests on part or all of the installation.

Some failures involve partial operation of the circuit-breaker. Consult the paragraphs “Faults, causes and remedies” where the possible causes of the main faults are listed.

Further information on the Ekip Touch and on the accessories mentioned in this chapter and which are not covered in this manual are available on the website http://www.abb.com/abblibrary/DownloadCenter/, with the Ekip Touch manual 1SDH001316R0002.

Faults, causes and remedies

The following is a list of possible fault situations, their possible causes and suggestions for resolving them.

NOTE: *with Ekip Touch, also make use of the suggestions given in document* **1SDH001316R1002**.

Faults	Possible causes	Suggestions
The circuit-breaker doesn't close when the closing pushbutton is pressed	The trip signal of the protection trip unit has not been reset	Press the TU mechanical reset pushbutton or operate the electrical reset remotely.
	The open-position key lock or padlock is activated	Unlock the lock in open position using the relevant key
	The circuit-breaker is in an intermediate position between connected and isolated for test or between isolated for test and disconnected	Complete the rack-in operation
	The undervoltage coil is not energized	Check the power supply circuit and the power supply voltage
	The opening coil is permanently energized	Correct operating condition.
	The trip unit pushbutton is pressed (withdrawable version)	Rotate the crank to complete
The circuit-breaker doesn't close when the closing coil is powered	The trip signal of the protection trip unit has not been reset	Press the TU Reset button
	The power supply voltage of the auxiliary circuits is too low	Measure the voltage: it should not be lower than 70% of the rated voltage of the coil
	The power supply voltage is different from that indicated on the rating plate	Check the voltage on the rating plate
	The cables of the coil are not inserted correctly in the terminals	Make sure there is continuity between cable and terminal and if necessary reconnect the cables of the coil to the terminals
	The connections in the power supply circuit are wrong	Check the connections using the relevant wiring diagram
	The closing coil is damaged	Replace the coil
	The operating mechanism is blocked	Perform the closing operation manually; if the fault persists contact ABB
	The open position key lock is activated	Unlock the lock in open position using the relevant key
	The circuit-breaker is in an intermediate position between connected and test or the trip unit pushbutton is pressed (withdrawable version)	Complete the rack-in operation
	The undervoltage coil is not energized	Make sure that undervoltage coil is energized properly
	The opening coil is permanently energized	Correct operating condition. If necessary, disconnect the power from the opening coil
	The racking out crank handle is inserted (withdrawable version)	Remove the crank
The circuit-breaker doesn't open when the opening pushbutton is pressed	The operating mechanism is blocked	Contact ABB

Continued on the next page

Faults	Possible causes	Suggestions
The circuit-breaker doesn't open when the opening coil is powered	The operating mechanism is blocked	Contact ABB
	The power supply voltage of the auxiliary circuits is too low	Measure the voltage: it should not be lower than 85 % of the rated voltage of the coil
	The power supply voltage is different from that indicated on the rating plate	Use the correct voltage
	The cables of the coil are not inserted correctly in the terminals	Make sure there is continuity between cable and terminal and if necessary reconnect the cables of the coil to the terminals
	The connections of the power supply circuit are wrong	Check the connections using the relevant wiring diagram
	The opening coil is damaged	Replace the coil
The circuit-breaker doesn't open despite the command of the undervoltage coil	The operating mechanism is blocked	Perform the opening operation manually; if the fault persists contact ABB
It is not possible to charge the closing springs by means of the manual charging lever	The operating mechanism is blocked	Contact ABB
It is not possible to charge the closing springs by means of the gearmotor	The cables of the gearmotor are not inserted correctly in the terminals	Make sure there is continuity between cable and terminal and if necessary reconnect the cables of the gearmotor to the terminals
	The connections of the power supply circuit are wrong	Check the connections using the relevant wiring diagram
	The circuit-breaker is in disconnected position	Switch the circuit-breaker to the test or connected position
	The gearmotor protection internal fuse has tripped	Replace the fuse
	The gearmotor is damaged	Replace the gearmotor
It is not possible to press the button in order to insert the racking out crank handle	The circuit-breaker is closed	Press the opening pushbutton in order to allow the insertion of the crank with the circuit-breaker open
It is not possible to insert the moving part in the fixed part	The racking-in/racking-out operation is not performed correctly	See chapters "Circuit breaker racking-in/racking-out operations" on pages 17
	The moving part is incompatible with the fixed part	Check the compatibility between the moving part and the fixed part
It is not possible to lock the circuit-breaker in the open position	The opening pushbutton is not being pressed	Press the opening pushbutton and activate the lock
	The lock in open position is defective	Contact ABB
It is not possible to perform the trip test	The opening solenoid is not inserted correctly	Check connection of opening solenoid and check leds
	The trip signal of the protection trip unit has not been reset	Press the reset pushbutton
	The busbar current is greater than zero	Correct operating condition.

Continued on the next page

Faults	Possible causes	Suggestions
It is not possible to remove the circuit-breaker from the disconnected position	Fail Safe lock active	Discharge the closing springs of the command
Tripping times shorter than expected	Selected threshold too low	Modify the threshold
	Wrong curve selected	Modify the curve
	Thermal memory enabled	Disable it if it is not necessary
	Incorrect neutral selection	Modify the neutral selection
	Zone Selectivity enabled	Disable it if it is not necessary
Tripping times longer than expected	Threshold too high	Modify the threshold
	Curve too high	Modify the curve
	Wrong curve selected	Modify the curve type
	Incorrect neutral selection	Modify the neutral selection
Rapid trip with I3 = Off	Iinst trip	Correct operating condition with short circuit at high current
High ground-fault current, but no trip occurs	Function G inhibited owing to high current	Correct operating condition (see use cases in the chapter that describes the protection)
Incorrect current reading	Current below the minimum threshold that can be displayed	Correct operating condition.
The expected trip does not occur	Trip excluded	Correct operating condition. Enable trip if necessary

3 - Maintenance

Safety standards

The following are the warnings to be respected during the maintenance operations

HAZARD! RISK OF ELECTRIC SHOCK! Risk of electric shock or accident.

WARNING! before proceeding with any maintenance operation, it is mandatory to:

- **Set the circuit-breaker to the open position and make sure that the springs of the operating mechanism are discharged.**
- **In the case of a withdrawable circuit-breaker, extract the circuit-breaker from the fixed part (see the indication DISCONNECTED)**
- **If work must be performed on fixed circuit-breakers or on fixed parts, disconnect the power supply to the power circuit and auxiliary circuits and visibly ground the terminals on both the supply side and load side.**
- **Use adequate personal protection equipment, ensure that the apparatus is in a safe condition and proceed in accordance with the Laws in force.**

Skilled personnel

The maintenance operations must be carried out by Skilled Personnel:

electrically skilled person (IEV 195-04-01): person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create.

ABB declines all liability for damage to persons or property caused by failure to comply with the instructions in this document.

Circuit-breaker life

The circuit-breakers SACE Emax 2, with or without opening or closing coils, can withstand the following operating cycles if regularly serviced. For further information see chapter 4 - Environmental conditions on page 20.

circuit-breaker IEC 60947	Interrupted rated current	Mechanical life with regular maintenance		Electrical life		
				440V AC	690V AC	Frequency of operations/ hour
	Iu (40°C) [A]	No. of operations (x 1000)	Frequency of operations/ hour	No. of operations (x 1000)	No. of operations (x 1000)	
E1.2	</= 1000	20	60	8	8	30
	1250	20	60	8	6.5	30
	1600	20	60	8	6.5	30
	1250 L	20	60	3	1	30

circuit-breaker UL 1066	Interrupted rated current	Mechanical life with regular maintenance		Electrical life		
				508V AC	635V AC	Frequency of operations/ hour
	Iu (40°C) [A]	No. of operations (x 1000)	Frequency of operations/ hour	No. of operations (x 1000)	No. of operations (x 1000)	
E1.2-A	</= 800	20	60	8	8	30
	1200	20	60	7	6.5	30

Maintenance schedule

Proper maintenance of the equipment allows good electromechanical operation to be maintained over time.

The maintenance plan for SACE Emax 2 circuit-breakers specifies the maintenance frequency for the different types of site conditions.

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

	Maintenance in standard environments [1]	Maintenance in dusty environments (dust level measured > 1mg/m3)
Frequency	One year or 2000 operations or after tripping due to short circuit	6 months or 1000 operations or after tripping due to short circuit

[1] Only for 900V and 1150V circuit-breakers Operating sequences/hour = 10.

Compliance with the following rules is also recommended:

- Even circuit-breakers that operate infrequently or that remain closed or open for long periods of time must be subjected to programmed maintenance.
- All the circuit-breakers provide information on the number of operations performed in the presence of auxiliary power supply of the Trip Unit. With Ekip Dip trip units, the information can be obtained with the aid of Ekip T&P and a PC on which the Ekip Connect software is installed. With Ekip Touch trip units, the information is available at any time on the appropriate display. With Ekip Dip trip units, installation of the mechanical operation counter is recommended (supplied on request).
- During the service, visually inspect the circuit-breaker from the outside to check for the presence of dust, dirt or damage.

4 - Maintenance operations

The maintenance operations must be carried out in accordance with the maintenance plan indicated on page 56.

Preliminary operations

WARNING! before proceeding with any maintenance operation, it is mandatory to:

- **Set the circuit-breaker to the open position and make sure that the springs of the operating mechanism are discharged.**
- **In the case of a withdrawable circuit-breaker, extract the circuit-breaker from the fixed part (see the indication DISCONNECTED)**
- **If work must be performed on fixed circuit-breakers or on fixed parts, disconnect the power supply to the power circuit and auxiliary circuits and visibly ground the terminals on both the supply side and load side.**

Inspections and general cleaning

Perform the following checks:

1. Make sure that the circuit-breaker is clean. Remove dust and oily substances or excess grease with a clean, dry cloth and mild detergent if necessary. If there is a thick build-up of dirt, use a thinner from the greasing kit or ask for assistance from the service staff.
2. Check that the rating plates with the technical specifications of the apparatus are present.
3. Clean the rating plates with clean, dry rags.
4. Make sure that there are no foreign bodies in the circuit-breaker compartment.

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

Perform the following checks on the connections:

1. With dry paint-brushes and rags remove dust or soil, if present (use a non- aggressive detergent if necessary. Use a cleaning product such as Henkel 273471 or Chemma 18 or equivalent if there is a heavy coating of dirt).
2. Make sure there there are no traces of overheating on the terminals. Overheating is detected by a different coloration of the parts in contact; the contact parts are usually silvery white in colour.
3. Check the tightness of fastening bolts for all connections to the terminals

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

Disassembly operations

To disassemble the parts of the circuit-breaker:

1. Remove the front cover (A) by removing the mounting screws (B and C).
2. With a four-pole circuit-breaker, remove the lateral shield (d) by removing the fixing screws (E).
3. With circuit-breaker in the withdrawable version, remove the protection (F) and the terminal-cover (G) by removing the screws (H)

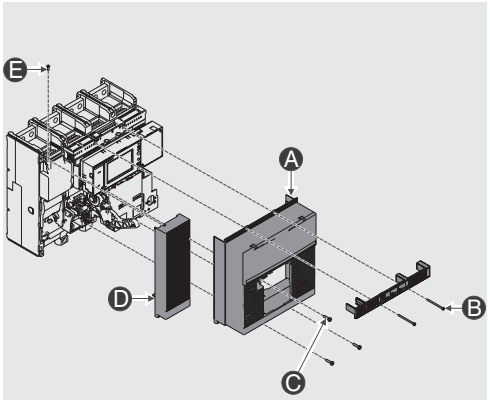


Figure 69 - Four-pole fixed circuit-breaker

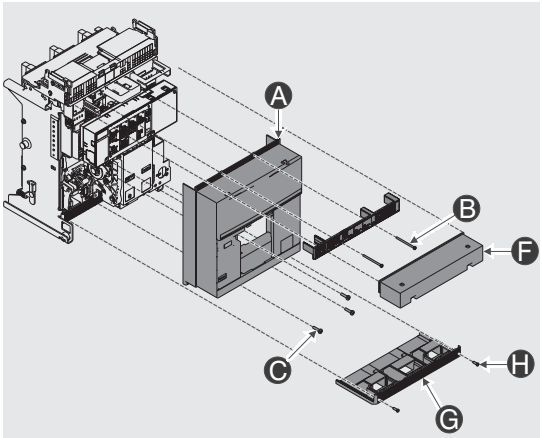


Figure 70 - Three-pole withdrawable circuit-breaker

4. Remove the gearmotor (E) by removing the screw (F).

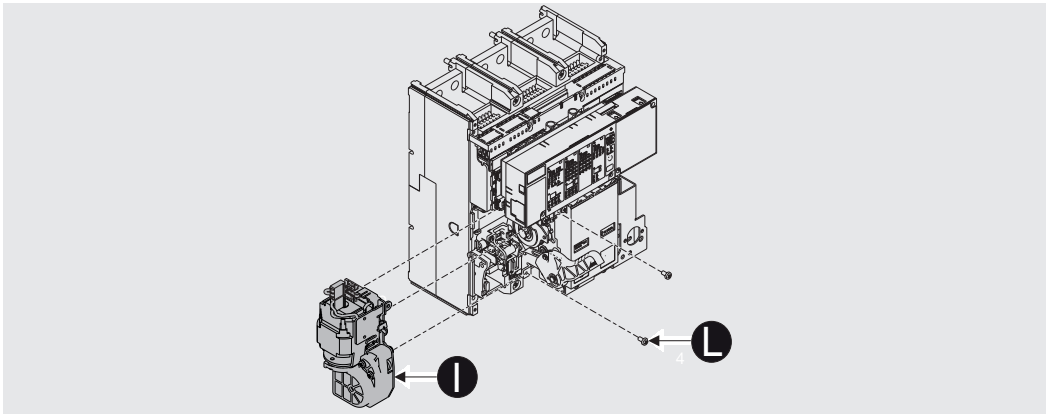


Figure 71 - Removing the gearmotor

5. If there is a undervoltage coil (M), remove it, and discharge the springs of the operating mechanism for closing and opening the circuit breaker.

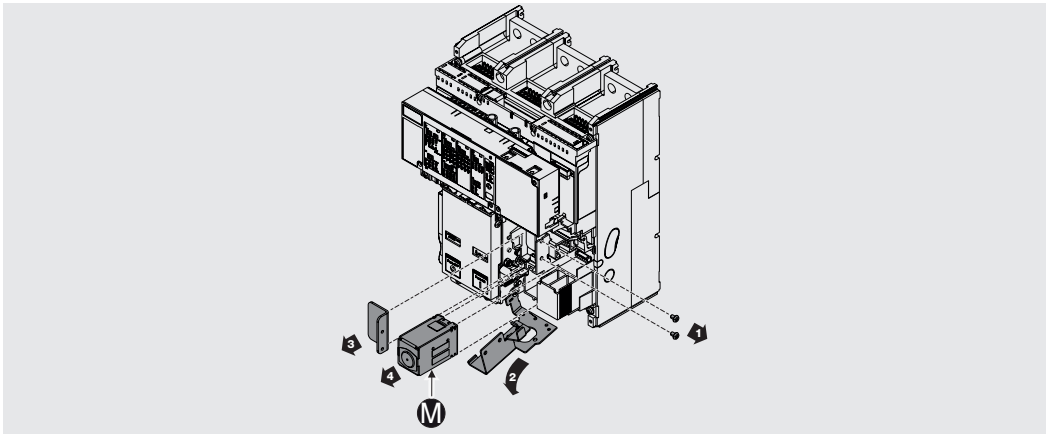


Figure 72 - Removing the undervoltage coil

Cleaning and lubrication of the operating mechanism

To clean and lubricate:

1. Clean in the points shown in the illustration. If there is a thick build-up of dirt, use a thinner from the greasing kit or ask for assistance from the service staff.
2. Lubricate the opening and closing latches and the shafts in the indicated points using Mobilgrease 28 (EXXON MOBIL).
3. Make sure that the opening and closing shafts are free to turn.

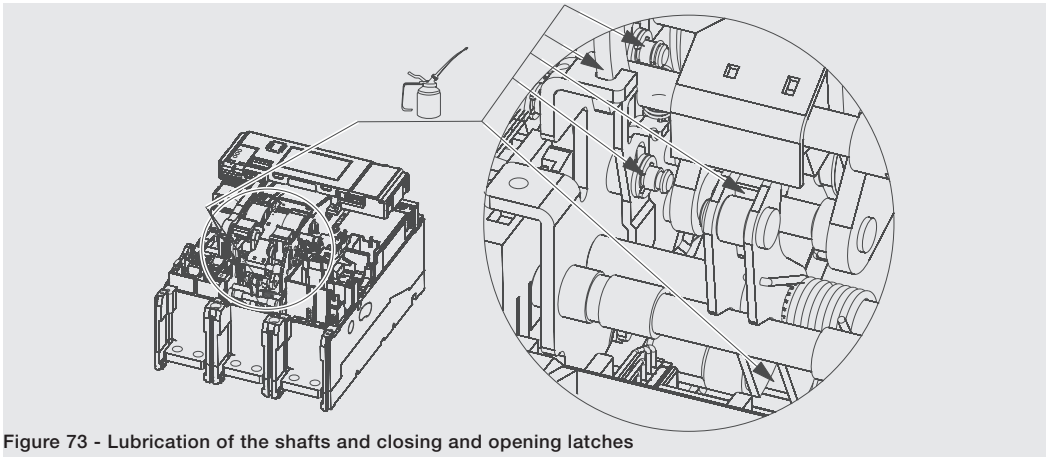


Figure 73 - Lubrication of the shafts and closing and opening latches

Inspection of electrical and mechanical accessories

Check the accessories:

1. Check that the accessories are securely fixed to the circuit-breaker.
2. Check that the accessories are connected correctly to the circuit-breaker.
3. Make sure that the coils (YU-YO-YC), if present, are in good condition (no excessive wear and tear, overheating, rupture).
4. Make sure that the mechanical operation counter functions correctly (if present) by operating the circuit-breaker.
5. Check the wear on the brushes of the gearmotor and if necessary replace them.

NOTE: *it is advisable to replace the gear motor if it has performed more than 10000 spring charging operations or reached 50% of the declared mechanical life of the circuit-breaker.*

Inspection of the protection trip unit

Check that the trip unit is in good condition:

1. Power the protection trip unit with an Ekip TT battery unit.
2. Check the correct operation of the protection trip unit: tripping test with "Trip Test" and "Autotest".
3. With a Ekip Dip verify the absence of alarms through frontal LEDs.
4. With a Ekip Touch, verify the absence of alarms via the display and the front LEDs.
5. Make sure that the cables are correctly connected to the modules and to the trip unit (if applicable).
6. On a Ekip Touch check the percentage of wear on the contacts of the circuit-breaker.
7. Finally, remove the Ekip TT battery unit.

Test with Ekip Connect

Test the trip unit:

1. Connect the Ekip Bluetooth or Ekip T & P unit to the trip unit.
2. Connect the computer where the program is installed by means of a Bluetooth or USB connection.
3. After connecting the computer and trip unit, check that there are no alarm signals. Otherwise, refer to the paragraph " 2 - Identification of alarms or failures" on page 51.
4. In the absence of alarms you can proceed to the trip test and self test (depending on the type of trip unit). For future checks it is recommended to insert the current date in the area called "Information". These data will be stored within the trip unit itself.
5. Remove the Ekip Bluetooth or Ekip T & P unit from the trip unit.

Final checks

Reassemble and check the circuit-breaker:

1. Reassemble all the parts by performing all the operations indicated in the paragraph “Disassembly Operations” in reverse order and, if necessary, reconnect the auxiliary power supply.
2. Put the movable part (breakers) in the test position (see indication TEST).
3. Perform the following operations 10 times:
   - *Opening (in both local and remote modes, if applicable)*
   - *Closing (in both local and remote modes, if applicable)*
   - *Tripping via Trip Test*
4. Perform the operations in the following sequence:
   - *Open - Springs discharged*
   - *Open - Springs charged*
   - *Closed - Springs discharged*
   - *Closed - Springs charged*
5. Check that the following operate correctly:
   - *accessories, if provided.*
   - *gearmotor, if provided.*
   - *undervoltage coil, if provided.*
   - *opening coil, if provided.*
   - *closing coil, if provided.*
   - *auxiliary contacts of the circuit-breaker, if provided.*
   - *lock for circuit-breaker in open position (key or padlock), if provided*

Interlock check

Check that the vertical or horizontal interlocking devices (if provided) are installed and that they operate correctly.

⚠ **WARNING! the interlocks cannot be tested in the Test or Disconnected positions.**

Perform maintenance periodically as indicated in the table below.

Activity	Frequency	Maintenance operations
Functionality	1 year or 20% of mechanical life or 20% of electrical life	See kit sheet
Check tightness		
Lubrication		As shown in the figure
Cables	Three years or 50% of the mechanical life or 50% of the electrical life of the largest circuit-breaker involved in the interlock. After a trip due to a short-circuit.	Replacement is advisable

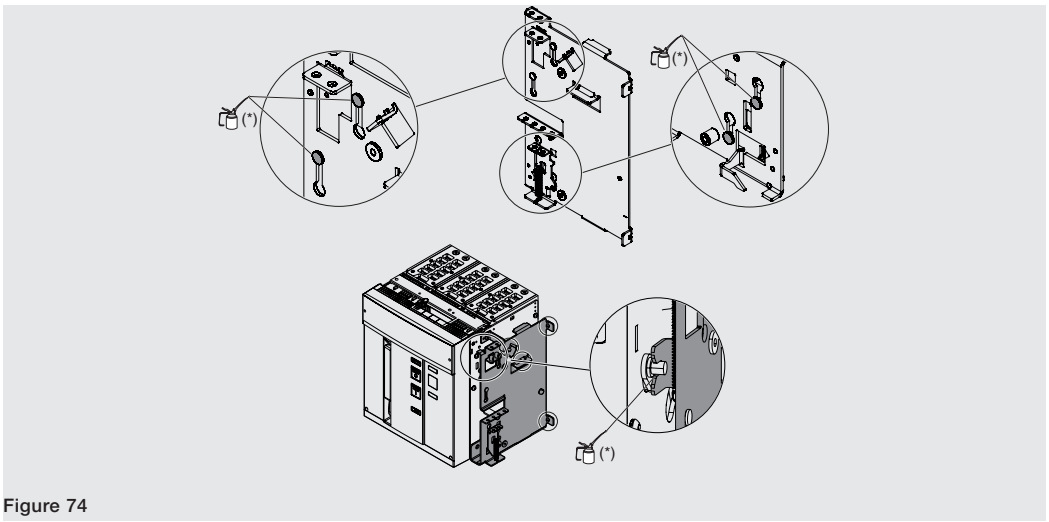


Figure 74

(*) Use Mobilgrease 28, also available in the ABB greasing kit.

5 - Decommissioning and treatment at end of life

Safety standards

During the early stages of the process of decommissioning and end of life treatment of SACE Emax 2 circuit-breakers, observe the following safety rules:

- the closing springs, even if discharged, must never to be taken apart
- for handling and lifting of the circuit-breakers refer to the section "Unpacking and handling" on page 10 .

HAZARD! RISK OF ELECTRIC SHOCK! Unplug or disconnect any power supply, to avoid any potential risk of shock during removal of the circuit-breaker from the service.

WARNING! After dismantling the switchgear, the circuit-breaker must be stored in the open position with the closing springs discharged and with the front cover mounted.

Trained personnel

The operations for decommissioning SACE Emax 2 circuit-breakers involve performing procedures that can be performed by Trained Persons in the electrical field (IEV 195-04-02: person adequately advised or supervised by electrically skilled persons to enable him or her to perceive risks and to avoid danger which electricity can create).

End of life treatment for circuit-breaker materials

The materials used in the production of SACE Emax 2 circuit-breakers are recyclable and should be treated separately as shown in the following table:

TYPE	MATERIAL
A	Plastic parts [1]
B	Metal parts
C	Printed circuits
D	Current sensors, cables, motors, electrical windings

[1] All the components of significant dimensions bear a mark specifying the type of material.

NOTE: *refer to the national legislation in force at the time of decommissioning of the product, in the case where it specifies end of life treatment procedures different from those indicated.*

Disposal of packing materials

The materials used for the packaging of SACE Emax 2 circuit-breakers are recyclable and should be treated separately as shown in the following table:

TYPE	MATERIAL
A	Plastic parts
B	Cardboard parts
C	Wooden parts

NOTE: *refer to the national legislation in force at the time of decommissioning of the product, in the case where it specifies end of life treatment procedures different from those indicated.*

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