ABB wind turbine converters

Hardware manual
ICU800-67LC incoming units (+C108/+C109)

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List of related manuals

Standard manuals	Code (English)
ACS800-67LC wind turbine converters hardware manual	*3AUA0000058400*
ACS800-67LC wind turbine converters system description and start-up guide	*3AUA0000059432*
ACS800 grid-side control program firmware manual	*3AUA0000075077*
ACS800-67(LC) doubly-fed induction generator control program firmware manual	*3AUA0000071689*

Option manuals	
ICU800-67LC incoming units (+C108/+C109) hardware manual	*3AUA0000071553*
ABRU-0x DC choppers (+D150) and resistors (+D151) for ACS800-67LC/-77LC/-87LC wind turbine converters hardware manual	*3AUA0000076494*
Manuals for fieldbus adapters, etc.	

You can find manuals and other product documents in PDF format on the Internet. See section *Document library on the Internet* on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.

Hardware manual

ICU800-67LC incoming units (+C108/+C109)

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1

Safety instructions

What this chapter contains

This chapter contains safety instructions that you must follow when installing, operating and servicing the ICU800-67LC incoming unit. If ignored, physical injury or death may follow, or damage may occur to the incoming unit, converter, generator or driven equipment. Read the safety instructions before you work on the incoming unit.

Use of warnings

There are two types of safety instructions throughout this manual: warnings and notes. Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment, and advise on how to avoid the danger. Notes draw attention to a particular condition or fact, or give information on a subject. The warning symbols are used as follows:

Electricity warning warns of hazards from electricity which can cause physical injury and/or damage to the equipment.

General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.

Electrostatic sensitive devices warning warns of electrostatic discharge which can damage the equipment.

Hot surface warning warns about hot surfaces. Some parts inside the cabinet remain hot for a while after the disconnection of input power.

Safety in installation and maintenance

Electrical safety

These warnings are intended for all who work on the incoming unit, converter or generator. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

WARNING!

- Only qualified electricians are allowed to install and maintain the incoming unit or converter!
- Before working in the incoming unit:
  - Stop the turbine, generator and the converter and run the system down
  - Run the turbine/generator shaft to standstill. Lock the shaft.
  - Switch off the main breaker, breaker of the stator circuit and the breaker of the main transformer.
  - Disconnect (withdraw) the main breaker and the disconnecting device of the grid transformer and lock the disconnectors to open position.
  - Ensure by measuring that the main circuit of the converter has been discharged (it takes 10 minutes after the power switch off) and that the incoming unit is dead.
  - Temporary ground the incoming unit main circuit.
- Never work on the incoming unit, converter or generator when grid or generator is connected. After disconnecting the input power, always wait for 10 minutes to let the intermediate circuit capacitors discharge before you start working on the incoming unit, converter or generator. By measuring the voltage between power terminals and earth and DC link and earth with a multimeter ensure that there is no live parts before beginning work.
- Apply temporary grounding before working on the unit. The incoming unit does not have internal grounding device, therefore external equipment is required.
- Do not work on the control cables when power is applied to the incoming unit or converter or to the external control circuits. Externally supplied control circuits (eg, UPS) may carry dangerous voltage even when the main power is switched off.
- Live parts inside the cubicle are protected against direct contact. However, pay special attention when handling metallic shrouds.
- Do not make any withstand voltage tests on the incoming unit.
- Isolate the transformer input power cables, the stator power cables or the grid-side converter power cables (option +C109) from the incoming unit when testing the insulation resistance or withstand voltage of the power cables, generator or the incoming unit.
- When reconnecting the power cable, always check that the phase order is correct.

Note:

- The generator cable terminals on the incoming unit or converter may contain a dangerously high voltage even when the input power is OFF, regardless of whether the generator is running or not.
- The converter DC link may contain a dangerously high voltage, regardless of whether the converter is running or not.

WARNING!

- Use extreme caution when manoeuvring heavy circuit breaker or contactor(s).
- Beware of hot surfaces. Some parts inside the incoming unit or converter remain hot for a while after the disconnection of input power.
- Pay attention to rotating cooling fans. The cooling fans may continue to rotate for a while after the disconnection of the electrical supply.
- Make sure that dust from drilling does not enter the incoming unit or converter when installing. Electrically conductive dust inside the cabinet may cause damage or lead to malfunction.
- *Recommendation:* Do not fasten the cabinet by riveting or welding. However, if welding is necessary, ensure that the return wire is properly connected close to the weld in order not to cause damage to the electronic equipment in the cabinet. Also ensure that welding fumes are not inhaled.

Grounding

These instructions are intended for all who are responsible for the grounding of the incoming unit. Incorrect grounding can cause physical injury, death or equipment malfunction and increase electromagnetic interference.

WARNING!

- Ground the incoming unit and adjoining equipment to ensure personnel safety in all circumstances, and to reduce electromagnetic emission and interference.
- Make sure that grounding conductors are adequately sized as required by safety regulations.

Note:

- Power cable shields are suitable for equipment grounding conductors only when adequately sized to meet safety regulations.

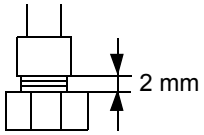
General safety

Work on the liquid cooling system

These instructions are intended for all who are responsible for installation and maintenance work of the liquid cooling system of the converter. Ignoring these instructions can cause physical injury or damage to the equipment.

WARNING!

- Beware of hot liquid. Do not work on the liquid cooling system until the pressure is lowered down by stopping the pumps. High-pressure warm coolant (6 bar (600 kPa), over 50 °C (122 °F)) is present in the internal cooling circuit when it is in operation.
- Before power switch-on, make sure that the internal cooling circuit is filled up with appropriate coolant. Running the pump dry will damage it. Also the incoming unit will not cool down.
- Avoid skin contact with coolant, especially antifreeze. Do not syphon them by mouth. If such substance is swallowed or gets into the eyes, seek medical advice.
- Do not overtighten the outer union of the nuts of the liquid hoses - leave 2 to 3 mm (0.08…0.1 in.) of thread visible. Overtightening will break the hose.



- Drain the unit before storing in temperatures below 0 °C (32 °F). Freezing of the liquid cooling system is not allowed. Add antifreeze and corrosion inhibitors to the cooling liquid. Operation at temperatures below 5 °C (41 °F) is not permitted, not even with antifreeze.

Safe start-up and operation

General safety

These warnings are intended for all who plan the operation of the incoming unit and converter or operate them. Ignoring the instructions can cause physical injury or death or damage to the equipment.

WARNING!

- The door of the incoming unit and converter must be kept locked when the input power is connected.
- Do not control the incoming unit or any its disconnecting device (means) manually; instead, use the commands via the I/O board of the converter or via fieldbus.

WARNING! Do not work on the incoming unit or converter when the generator is rotating. Also, when the power supply is switched off and the inverter is stopped, generator may feed power to the intermediate circuit of the converter and the grid-side connections become live.

Before installation and maintenance work on the incoming unit or converter:

- Stop the converter and the generator.
- Ensure that the generator cannot rotate during work. Lock the shaft mechanically (eg, by using a brake). Make sure that wind or other systems, like hydraulic crawling drives, are not able to rotate the generator directly or through any mechanical connection like felt, nip, rope, etc.

Ensure that there is no voltage on the incoming unit or converter power terminals:
Alternative 1) Disconnect the power supply and generator stator from the incoming unit with a safety switch or by other means. Measure that there is no voltage present on the incoming unit grid-side or stator terminals (L1, L2, L3, U, V, W).
Alternative 2) Measure that there is no voltage present on the power supply side, converter grid-side, DC link, stator-side or rotor-side terminals of the converter (L1, L2, L3, U2, V2, W2, U, V, W, UDC+, UDC-). Ground the incoming unit power supply side (coupled from the turbine main transformer) terminals temporarily by connecting them together as well as to the PE.
Alternative 3) If possible, both of the above.

2

Introduction to the manual

What this chapter contains

This chapter describes the intended audience and contents of the manual.

Applicability

The manual is compatible with optional (option code +C108 or +C109) incoming unit (type ICU800-67LC) of ACS800-67LC wind turbine converter. ICU800-67LC incoming unit is also referred as power cabinet. For the converter data, see *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

Target audience

This manual is intended for people who plan the installation, install and service the power cabinet. Read the manual before working on the power cabinet. The reader of the manual is expected to know the standard electrical wiring practices, electronic components, and electrical schematic symbols. The manual is written for readers worldwide.

Purpose of the manual

This manual helps in planning the installation, installing and maintaining the power cabinet.

Contents of the manual

The chapters of this manual are briefly described below.

Safety instructions gives safety instructions for the installation, commissioning, operation and maintenance of the power cabinet.

Operation principle and hardware description describes the construction of power cabinet.

Mechanical installation instructs how to move, place and mount the power cabinet.

Planning the electrical installation instructs in generator and cable selection, protective functions of the power cabinet and cable routing.

Electrical installation instructs in cabling and wiring of the power cabinet.

Installation checklist contains a list for checking the mechanical and electrical installation of the power cabinet.

Maintenance contains preventive maintenance instructions.

Technical data contains the technical specifications of the power cabinet, eg, ratings.

Dimension drawings contains dimension drawings of the power cabinet.

Related documents

See *List of related manuals* inside of the front cover.

Categorization by option code

The instructions, technical data and dimensional drawings which concern only certain optional selections are marked with + codes (eg, +F281). The options included in the converter or power cabinet can be identified from the + codes visible on the type designation label. The power cabinet option code selections are listed in chapter *Operation principle and hardware description* under *Type designation key*.

Terms and abbreviations

For complete list of terms and abbreviations, see *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

Term/Abbreviation	Explanation
ICU800	800 mm wide incoming unit. Power cabinet.
MCB	Main circuit breaker

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Operation principle and hardware description

What this chapter contains

This chapter describes the construction of the power cabinet. The converter is described in *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

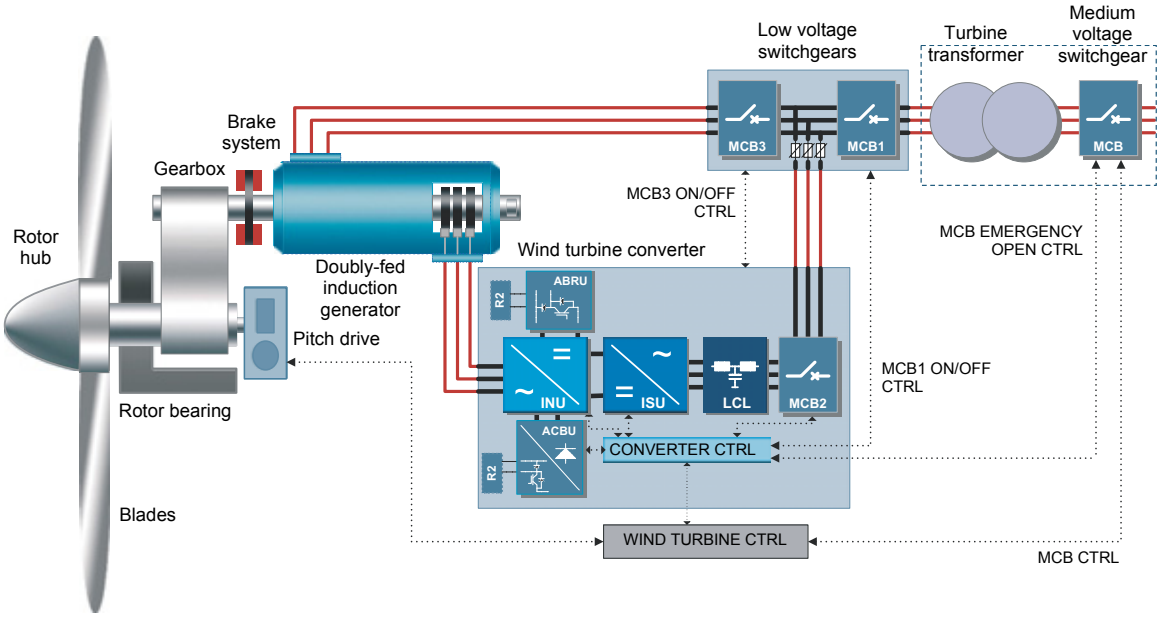
Operation principle

The power cabinet is 800 mm wide incoming unit for ACS800-67LC wind turbine converter. It contains main switching and disconnecting devices such as main circuit breaker and stator circuit contactor(s) and connection terminals to the power supply network, generator stator, and grid-side converter if option +C109 is selected. Cable entry plate is blank plate as standard and it is located at the bottom of the cabinet. Power cabinet also contains AC fuses for the grid-side converter as a standard. I/O interfaces are supported as fast plug-in type of connectors if option +C109 is selected.

The power cabinet can be an integral part of the converter line-up (option +C108), or it can be separated unit that can be installed elsewhere than the converter (option +C109). In this case the power cabinet needs to be connected to the converter with cables. The converter with power cabinet can be installed either in the tower bottom end or in the nacelle.

Block diagram of the system with power cabinet

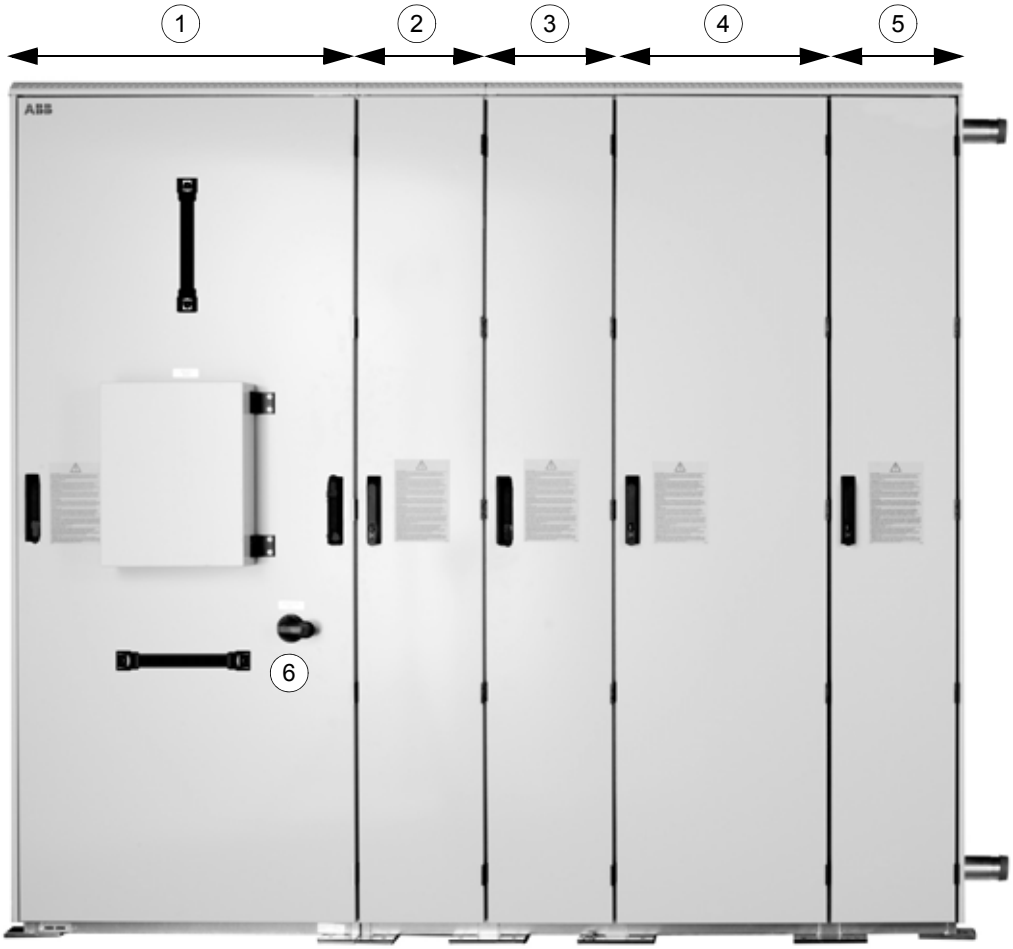
Diagram of a wind turbine system containing a power cabinet is presented in the figure below.



Layout drawings

Example layouts of the converter and power cabinet are shown below.

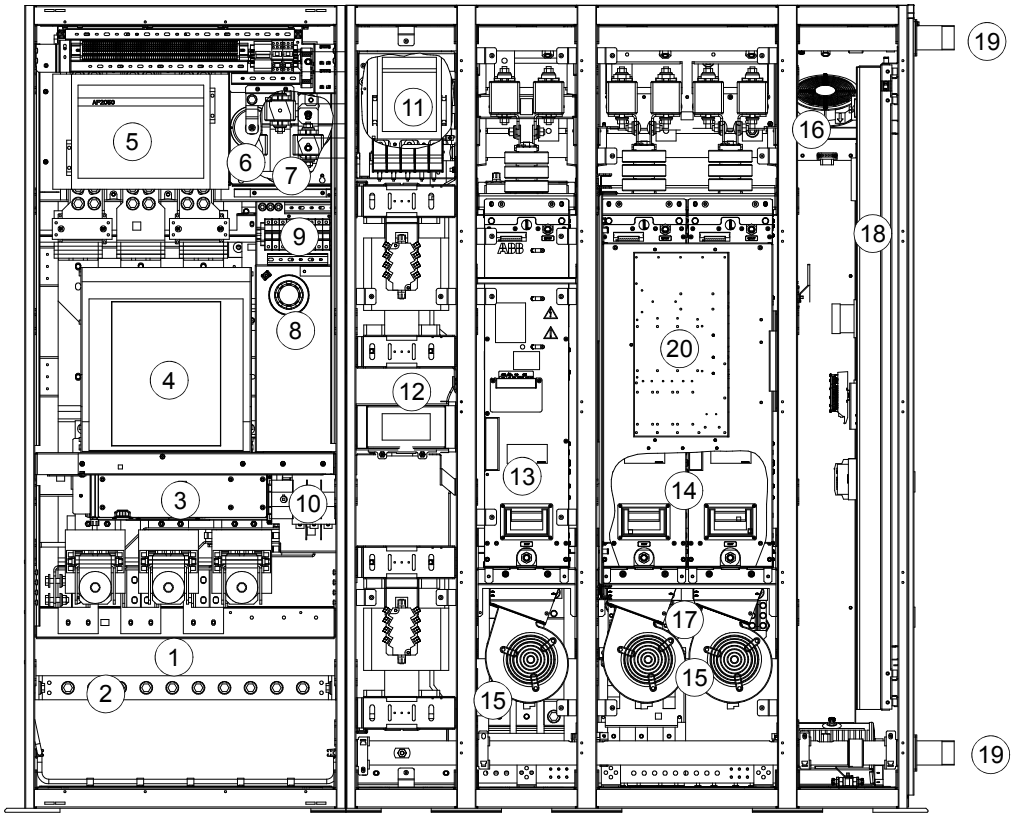
Doors closed



No.	Description
1	Incoming unit (power cabinet)
2	LCL filter cubicle (FIU)
3	IGBT supply module cubicle (ISU)
4	Inverter module cubicle (INU)
5	Auxiliary control cubicle (ACU)
6	Auxiliary voltage supply (optional)

Integrated power cabinet (option +C108)

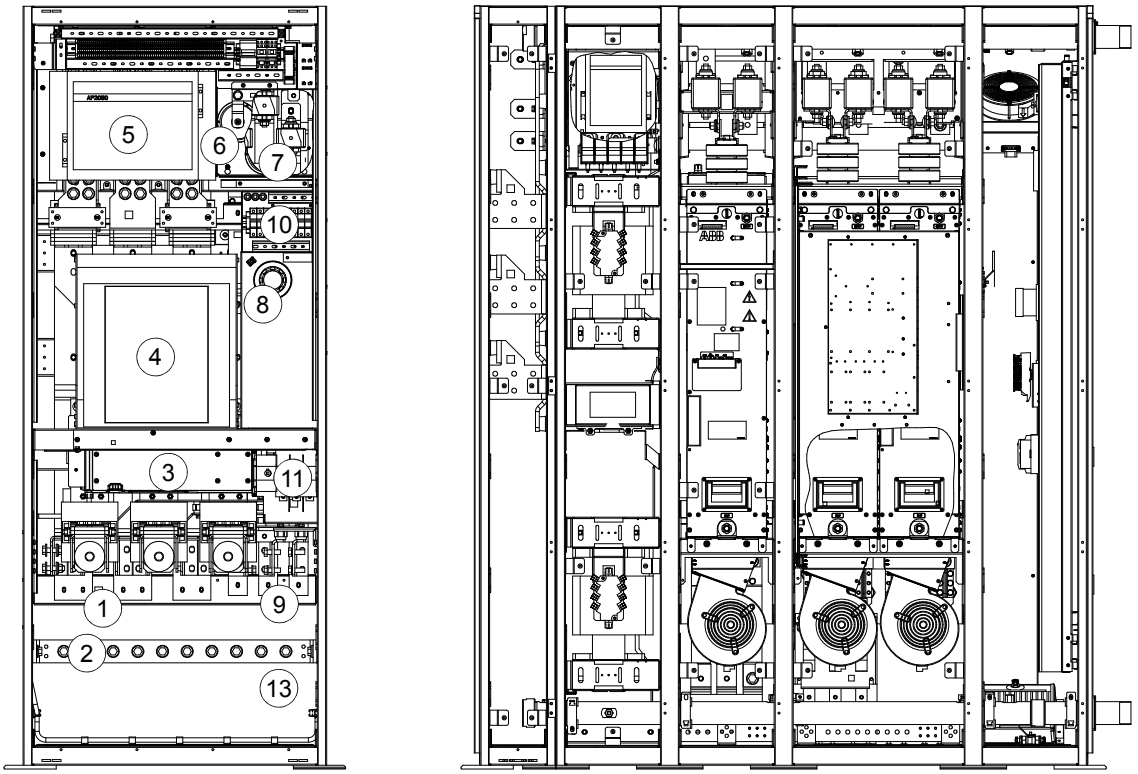
Doors open, shrouds removed



No.	Description
1	Power cable terminals (busbars) of the power cabinet (stator cable terminals behind the grid cable terminals)
2	PE terminal
3	Cooling fan of the power cabinet
4	Main circuit breaker (MCB1)
5	Stator contactor (s) (MCB3). If the delivery contains 2 pcs, they are installed back-to-back.
6	Overvoltage protection devices (option +F281)
7	AC fuses and indicators (behind the overvoltage protection devices, if any)
8	Smoke detector
9	Auxiliary circuit breakers
10	Auxiliary voltage supply (optional)
11	Grid-side converter contactor K1 behind the charging circuit (MCB2)
12	LCL filter
13	IGBT supply module
14	Inverter modules (behind the swing-out frame of the crowbar)
15	Module cooling fans
16	Auxiliary control unit cooling fan
17	Rotor-side power cable terminals (behind removable fans)
18	Sliding frame with control electronics
19	Coolant pipes
20	Crowbar (in the swing-out frame)

Stand-alone power cabinet (option +C109)

Doors open, shrouds removed



No.	Description
1	Power cable terminals (busbars) of the power cabinet (stator cable terminals behind the grid cable terminals)
2	PE terminal
3	Cooling fan of the power cabinet
4	Main circuit breaker (MCB1)
5	Stator contactor(s) (MCB3). If the delivery contains 2 pcs, they are installed back-to-back.
6	Overvoltage protection devices (option +F281)
7	AC fuses and indicators (behind the overvoltage protection devices, if any)
8	Smoke detector
9	Grid-side converter cable terminals
10	Auxiliary circuit breakers
11	Auxiliary voltage supply (optional)

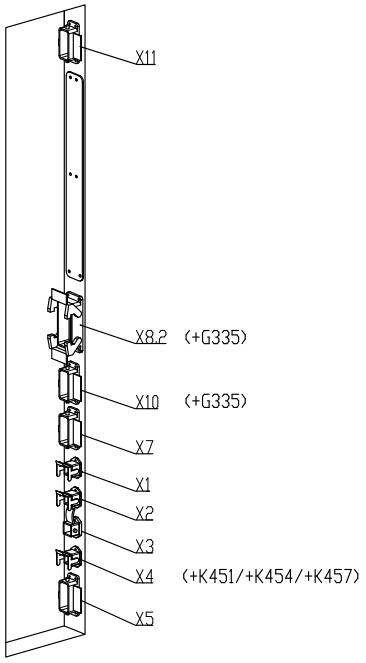
Overview of power and control connections

Power connections are located at the bottom of the power cabinet. There are three possible lead-through types for power cables: the blank plate (as default), sealing modules (optional) and cable glands (on request). Cable lugs can be connected to both sides of the connection busbar. The busbar size and number of holes varies according to cabinet size. For illustration and dimensions, see chapter *Dimension drawings*. For options available, see section *Option codes (+ codes)* on page *26*. For number and sizes of the power cables, see section *Typical power cable sizes* on page *30*.

Control connections are located at the right-hand side wall of the power cabinet (option +C109) or at the right-hand side wall of the converter cabinet (option +C108, see *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English]). Control connections are described below.

Control interfaces at the side of the cabinet	
Terminal	**Description**
X1	230 V AC supply (non-UPS)
X2	230 V AC supply (UPS)
X3	Ethernet
X4	Fieldbus
X5	Safety circuit and control signals
X6.1	External grid main circuit breaker control
X6.2	External stator main circuit breaker control
X7	Pulse encoder
X8.1	Grid voltage measurement
X8.2	Stator voltage measurement. Marked with X80 when option +G335 is selected.
X9	Stator current measurement
X10	ICU auxiliaries. Marked with X90 when option +G335 is selected.
X11	Grid MCB trip and on/off status (and Interbus option +K453)

Option +C108



Control interfaces at the side of the cabinet. ***Note:*** *Connectors vary depending on the selected options.*

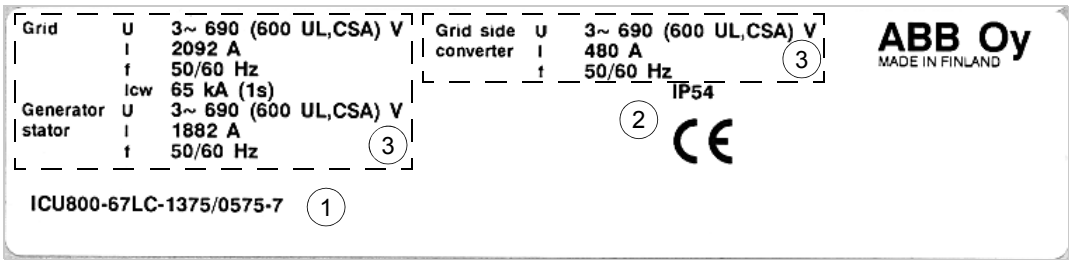
Circuit boards

Circuit boards controlling the converter and power cabinet are located in the auxiliary control unit of the converter cabinet. See *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

Type designation label

The type designation label includes the ratings, valid markings and type code of the unit. An example label of the power cabinet is shown below.

No.	Description
1	Type code. See section *Type designation key*.
2	Valid markings
3	Ratings of the unit



Type designation key

The type code contains information on the specifications and configuration of the unit.

- The first 23 digits form the basic code. It describes the basic construction of the unit. The fields in the basic code are separated with hyphens.
- The option codes follow the basic code. Each option code starts with an identifying letter (common for the whole product series), followed by descriptive digits. The option codes are separated by plus signs.

The option codes related to power cabinet are described below. For more information, contact your local ABB representative.

Option codes (+ codes)

Code	Description
As standard, the power cabinet includes stator circuit breaker, stator contactor(s), stator current measurement (L1 and L3), bottom entry and exit of cables, blank cable entry plate and AC fuses for grid-side converter. IP54 degree of protection.	
C108	Power cabinet attached to the converter cabinet (single delivery length)
C109	Power cabinet as a stand-alone cabinet. **Note:** Cooling connectors (G2” thread) are always on the right side of the cabinet.
G409	Auxiliary voltage supply 690 V IEC 160 A
G396	Auxiliary voltage supply 690 V IEC 125 A
G397	Auxiliary voltage supply 690 V IEC/UL 100 A
G398	Auxiliary voltage supply 690 V IEC/UL 80 A
G399	Auxiliary voltage supply 690 V IEC/UL 63 A
F281	Overvoltage protection for the grid supply (Class I SPD products, according to IEC 61643-1:2005)
G335	Grid power measurement (3 pcs class 0.5 current transformers with 1 A rated secondary current, and voltage measurement terminals)
nH374	IEC: Cabling: sealing module entry for 9.5…32.5 mm diameter single phase cables
1H374	64 cables
2H374	80 cables
3H374	112 cables
H379	IEC: Cabling: sealing module entry for 28…54 mm diameter single phase cables
nH380	IEC: Cabling: sealing module entry for 48…71 mm diameter three phase cables
1H380	16 cables
2H380	20 cables
3H380	28 cables

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4

Mechanical installation

What this chapter contains

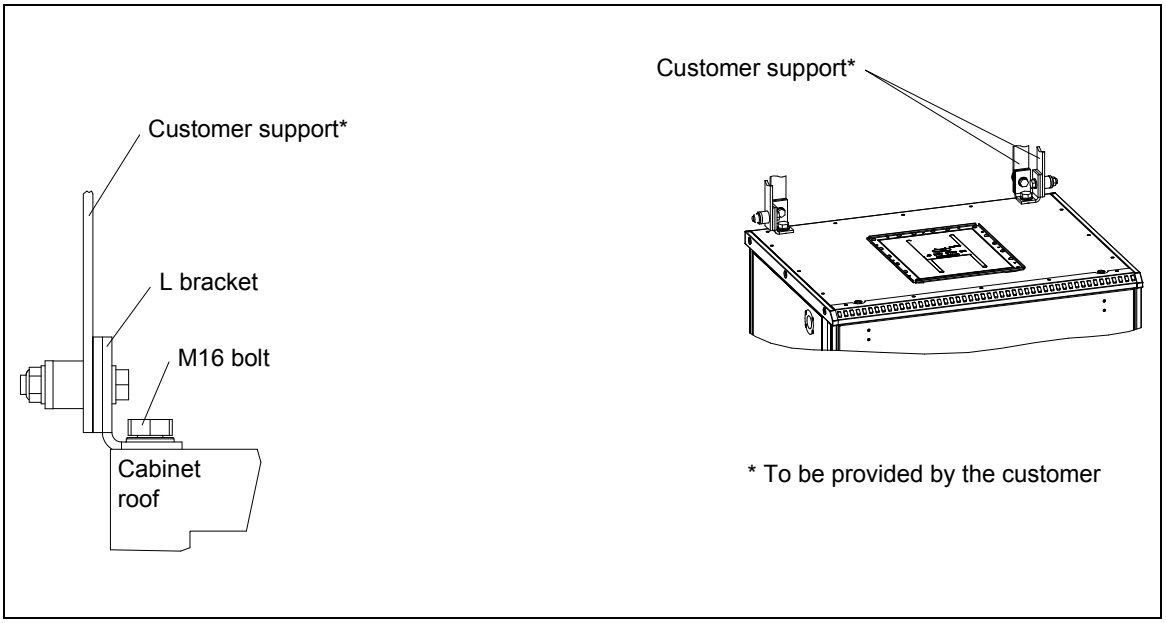
This chapter instructs in fastening the power cabinet at the top. For the complete mechanical installation instructions, see *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

Safety

See chapter *Safety instructions*.

Fastening the cabinet at the top

The power cabinet must be fastened at the top as follows:



Joining the liquid cooling unit to the stand-alone power cabinet (option +C109)

Stand-alone power cabinet is joined to the liquid cooling system in the same way as the converter. Connectors are similar. See *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

5

Planning the electrical installation

What this chapter contains

This chapter contains the instructions that you must follow when selecting the cables, protections, cable routing and way of operation for the power cabinet of the converter system. For the converter data, see *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

Note: The installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations. Furthermore, if the recommendations given by ABB are not followed, the converter may experience problems that the warranty does not cover.

Selecting the grid-side disconnecting device (disconnecting means)

The power cabinet is equipped with a withdrawable main breaker as standard. When withdrawn and locked to the withdrawn position, the breaker operates as the grid-side main disconnecting device both for the wind turbine converter and the generator.

Note however, that the withdrawn main breaker does not isolate the grid-side busbars (L1, L2 and L3) of the power cabinet from the grid. For that reason you must equip the distribution switchgear or the power grid transformer of the wind turbine converter with a disconnecting device. Lock the disconnecting device to open position during any installation and maintenance work in the power cabinet. The power cabinet or converter does not have internal grounding device, therefore external equipment is required.

Checking the compatibility of the generator

See the chapter *Technical data* for the power cabinet ratings and the generator connection data.

Selecting the power cables

Typical power cable sizes

IEC

The maximum number of cables to be connected are shown below.

Cables from the grid-side converter to the power cabinet (option +C109)

Type name	Grid-side converter current rating [A]	240mm²	185mm²	120mm²	3×240mm²+ 120mm²	3×185mm²+ 95mm²	3×120mm²+ 70mm²
		nr of cables / phase			nr of cables		
ACS800-67LC-1075/0575-7	480	1	2	2	2	2	2
ACS800-67LC-1375/0575-7	480	1	2	2	2	2	2
ACS800-67LC-1375/1125-7	941	3	3	4	3	3	4
ACS800-67LC-1595/0865-7	720	2	2	3	2	3	3

Cables from the generator stator to the power cabinet

Type name	Generator stator current rating [A]	240mm²	185mm²	120mm²	3×240mm²+ 120mm²	3×185mm²+ 95mm²	3×120mm²+ 70mm²
		nr of cables / phase			nr of cables		
ACS800-67LC-1075/0575-7	1395	4	5	6	4	5	7
ACS800-67LC-1375/0575-7	2092	6	7	9	7	8	10
ACS800-67LC-1375/1125-7	2417	7	8	10	7	9	11
ACS800-67LC-1595/0865-7	2789	8	9	12	9	10	13

Cables from the power supply transformer to the power cabinet

Type name	Power supply transformer current rating [A]	240mm²	185mm²	120mm²	3×240mm²+ 120mm²	3×185mm²+ 95mm²	3×120mm²+ 70mm²
		nr of cables / phase			nr of cables		
ACS800-67LC-1075/0575-7	1550	4	5	7	5	6	7
ACS800-67LC-1375/0575-7	2324	6	8	10	7	8	11
ACS800-67LC-1375/1125-7	2686	7	9	11	8	10	13
ACS800-67LC-1595/0865-7	3099	8	10	13	10	11	15

UL

The maximum number of cables to be connected are shown below. The cable ratings are based on UL508C and National Electric Code 2008 (US).

Cables from the grid-side converter to the power cabinet (option +C109)

Type name	Grid-side converter current rating [A]	500 kcmil (253 mm^2)	350 kcmil (177 mm^2)
		nr of cables / phase	
ACS800-67LC-1075/0575-7	480	2	3
ACS800-67LC-1375/0575-7	480	2	3
ACS800-67LC-1375/1125-7	941	5	6
ACS800-67LC-1595/0865-7	720	3	4

Cables from the generator stator to the power cabinet

Type name	Generator stator current rating [A]	500 kcmil (253 mm^2)	350 kcmil (177 mm^2)
		nr of cables / phase	
ACS800-67LC-1075/0575-7	1395	5	6
ACS800-67LC-1375/0575-7	2092	8	10
ACS800-67LC-1375/1125-7	2417	10	12
ACS800-67LC-1595/0865-7	2789	11	13

Cables from the power supply transformer to the power cabinet

Type name	Power supply transformer current rating [A]	500 kcmil (253 mm^2)	350 kcmil (177 mm^2)
		nr of cables / phase	
ACS800-67LC-1075/0575-7	1550	8	10
ACS800-67LC-1375/0575-7	2324	12	15
ACS800-67LC-1375/1125-7	2686	14	17
ACS800-67LC-1595/0865-7	3099	16	20

Selecting the control cables

External control cables are described in *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

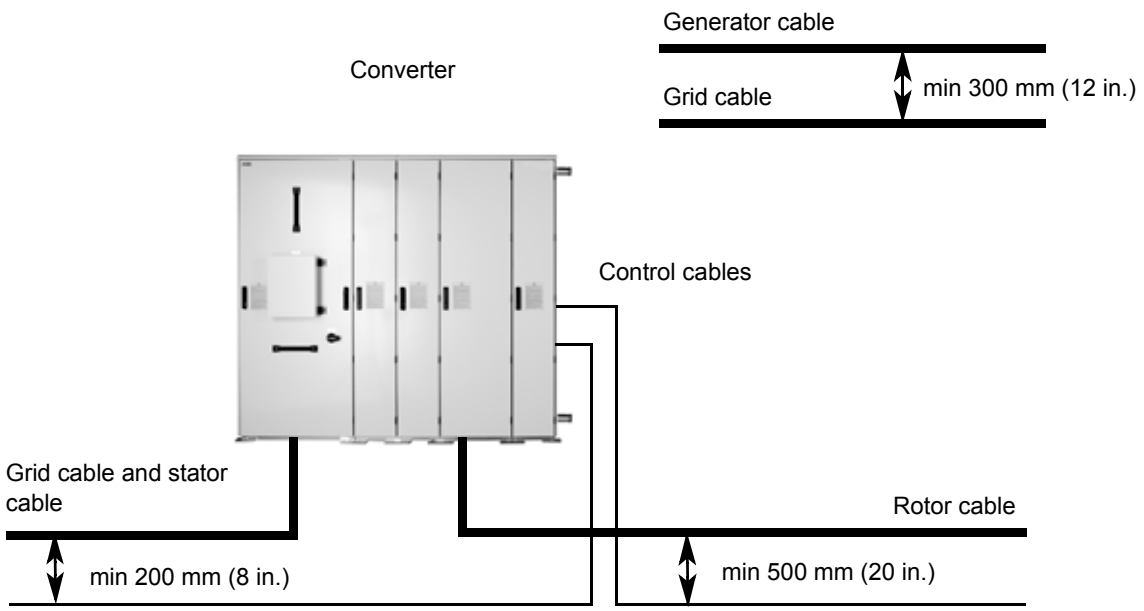
Routing the cables

Route the rotor cable away from other cable routes. It is recommended that the stator cable, rotor cable, grid cable and control cables be installed on separate trays. Avoid long parallel runs of cables in order to decrease electromagnetic interference caused by the rapid changes in the rotor voltage.

Where control cables must cross grid cables and stator cables, make sure they are arranged at an angle as near to 90 degrees as possible. Do not run extra cables through the power cabinet.

The cable trays must have good electrical bonding to each other and to the grounding electrodes. Aluminium tray systems can be used to improve local equalizing of potential.

A diagram of the cable routing is shown below.



Protecting the power cabinet, grid cable, generator and generator cable in short-circuit situation and against thermal overload

Protecting the power cabinet and grid cable in short-circuit situations

The main breaker protects the power cabinet in short-circuit. However, the power cabinet is not protected against short-circuit in the input power cable (the cable connected between the power cabinet and line-coupling transformer). To protect the grid cable, equip it with a short-circuit protection device. **Note:** No protection device solely for the cable will be needed if there is a circuit breaker for the grid transformer and its short-circuit current trip limit has been tuned below the short-circuit withstand current of the grid cable. See also section *Selecting the grid-side disconnecting device (disconnecting means)*.

Protecting the power cabinet, generator and generator cable in short-circuit situations

The main breaker of the power cabinet protects the generator stator and the stator cable in short-circuit when the stator cable is dimensioned according to the section *Selecting the power cables*. Note however, that you must tune the short-circuit current trip limit of the breaker below the short-circuit withstand current of the stator and the stator cable.

Protecting the power cabinet, generator cable and grid cable against thermal overload

The main breaker of the power cabinet protects the grid cable, power cabinet, generator stator and stator cable against thermal overload when the stator cable is dimensioned according to the section *Selecting the power cables*. Note however, that you must tune the thermal current trip limit of the breaker below the overload current of the grid cable, stator and the stator cable.

Protecting the power cabinet against ground faults in the converter or power cables

All units are equipped with an internal earth fault protective function to protect the converter against earth faults in the converter, generator rotor and generator cable. (This is not a personal safety or a fire protection feature.) Earth fault protection is achieved via earth fault protection function in the grid-side converter. However, the power cabinet is not protected against ground fault in the input power cable (the cable connected between the power cabinet and line-coupling transformer). See the hardware and firmware manuals delivered with the converter.

Implementing the emergency stop function

The converter is equipped with emergency stop function of Category 0 (immediate removal of power) as standard.

For safety reasons, install the emergency stop devices at each operator control station and at other operating stations where emergency stop may be needed.

6

Electrical installation

What this chapter contains

This chapter describes the electrical installation procedure of the power cabinet of the ACS800-67LC. For the converter data, see *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

WARNING! Only qualified electricians are allowed to carry out the work described in this chapter. Follow the *Safety instructions* on the first pages of this manual. Ignoring the safety instructions can cause injury or death.

Checking the insulation of the assembly

WARNING! Before start, read and follow the instructions given in chapter *Safety instructions*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

Power cabinet

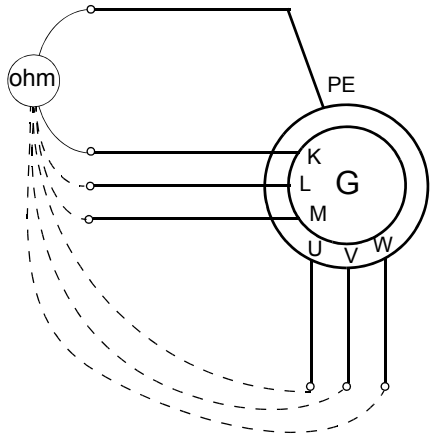
Every power cabinet has been tested for insulation between the main circuit and the chassis at the factory (2700 V rms 50 Hz for 1 second). Do not make any voltage tolerance or insulation resistance tests eg, hi-pot or megger, on any part of the power cabinet as testing can damage the power cabinet or converter. Also, there are voltage-limiting circuits inside the converter which cut down the testing voltage automatically.

Grid cable

Check the insulation of the grid cable according to local regulations before connecting it to the converter.

Generator and generator cable

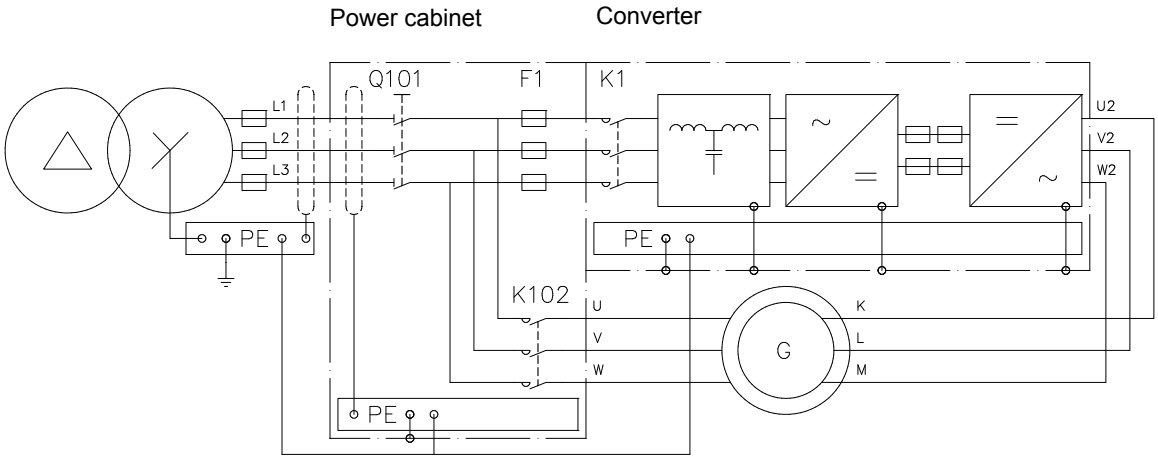
1. Check that the generator rotor cable is connected to the generator (terminals K, L and M), and the stator cable is connected to the generator (terminals U, V and W).
2. Ensure that the other ends of the cables are unconnected.
3. Measure the insulation resistance between each phase conductor and the protective earth conductor using a measuring voltage of 1 kV DC. Measure both rotor and stator cables. The insulation resistance of an ABB generator must exceed 100 Mohm (reference value at 25 °C (77 °F)). For the insulation resistance of other generators, consult the manufacturer's instructions. **Note:** Moisture inside the generator casing will reduce the insulation resistance. If moisture is suspected, dry the generator and repeat the measurement.



Connecting the power cables

Connection diagram

The diagram presents power cable connection diagram of the converter system with power cabinet.



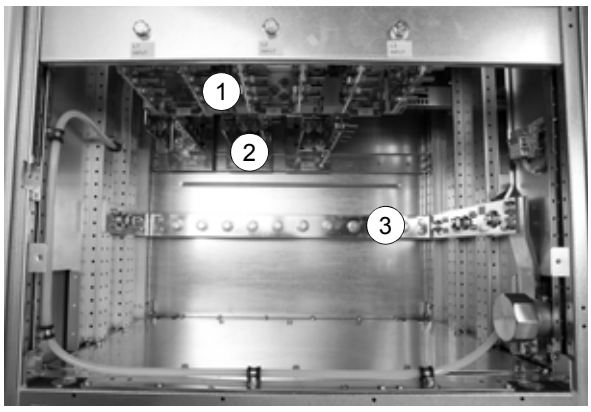
Connection procedure with integrated power cabinet (option +C108) – a blank plate at the cable lead-through

The recommended cable types are given in the chapter *Planning the electrical installation*.

WARNING! Only qualified electricians are allowed to carry out the work described in this chapter. Follow the *Safety instructions* on the first pages of this manual. Ignoring the safety instructions can cause injury or death.

1. Remove the door of the power cabinet. Unlock the handles, detach the upper part of the door and lift the door upwards.
2. The grid and the stator connections are located in the bottom of the power cabinet. Remove the shroud that protects the cable connection busbars and cable entries.
3. Cut/drill suitable holes for the cables. Smooth the hole edges.
4. Lead the cables inside the cabinet through the lead-through plate holes. Mind the edges.
5. Seal the cable lead-throughs to retain the degree of protection of the enclosure (to keep the dust and humidity out of the cabinet).
6. Connect the cables to the appropriate busbars. See section *Connection diagram*. For the tightening torques, see chapter *Technical data*.

Note: Only use lead-through components that fulfil the requirements of degree of protection IP54 or higher.



Cable connection terminals and cable entry plate (blank plate)

No.	Description
1	Grid connection terminals
2	Stator connection terminals
3	PE terminal

Connection procedure with integrated power cabinet (option +C108) – sealing modules at the cable lead-through

Sealing modules are supplied loose inside the power cabinet. Install them on site.

WARNING! Only qualified electricians are allowed to carry out the work described in this chapter. Follow the *Safety instructions* on the first pages of this manual. Ignoring the safety instructions can cause injury or death.

1. Remove the door of the power cabinet. Unlock the handles, detach the upper part of the door and lift the door upwards.
2. The grid and the stator connections are located in the bottom of the power cabinet. Remove the shroud that protects the cable connection busbars and cable entries.
3. Remove the blank plate and the gasket under it.
4. Install the sealing modules and lead the cables in. See *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].
5. Connect the cables to the appropriate busbars. See section *Connection diagram*. For tightening torques, see chapter *Technical data*.

Connection procedure with integrated power cabinet (option +C108) – cable glands at the cable lead-through

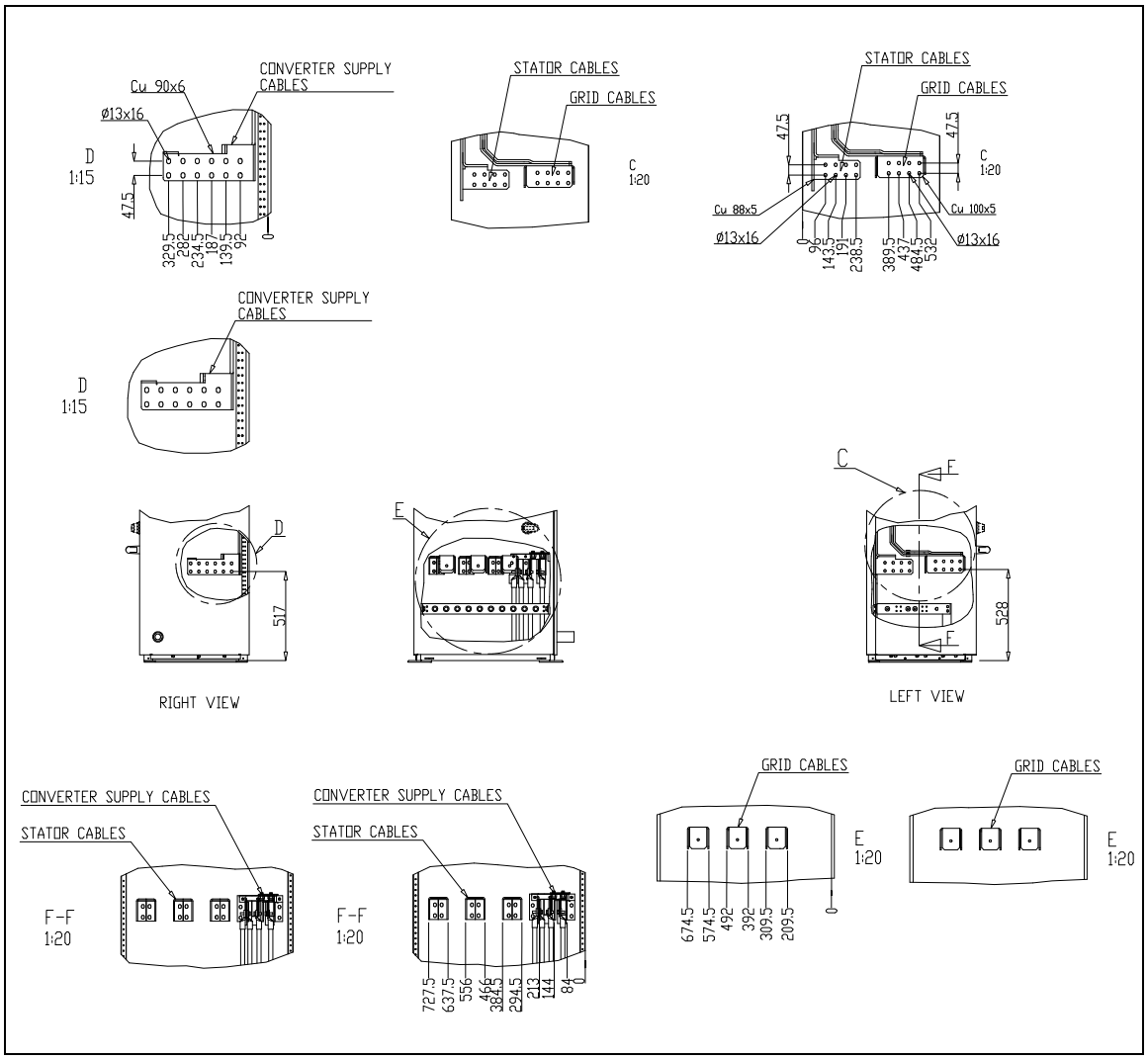
WARNING! Only qualified electricians are allowed to carry out the work described in this chapter. Follow the *Safety instructions* on the first pages of this manual. Ignoring the safety instructions can cause injury or death.

1. Remove the door of the power cabinet. Unlock the handles, detach the upper part of the door and lift the door upwards.
2. The grid and the stator connections are located in the bottom of the power cabinet. Remove the shroud that protects the cable connection busbars and cable entries.
3. When shielded cable is used:
   Lead the cables into the inside of the cubicle through the IP sealing glands. Ground a shielded cable 360° at cabinet PE busbar lead-through with an EMC cable gland (to be supplied by the customer).
   Connect the cables as follows:
   - Twist the cable shields into bundles and connect to cabinet PE (ground) busbar. Connect any separate ground conductors or cables to cabinet PE (ground) busbar.
   - Connect the cables to the appropriate busbars. See section *Connection diagram*. For tightening torques, see chapter *Technical data*.

   When single-core cables without metal shield are used:
   - Lead the cables into the inside of the cubicle through the IP sealing glands.
   - Connect the cables to the appropriate busbars. See section *Connection diagram*. For tightening torques, see chapter *Technical data*.
4. Provide support for the cables whenever necessary.
5. Refit all shrouds removed earlier and close the door.

Connection procedure with stand-alone power cabinet (option +C109)

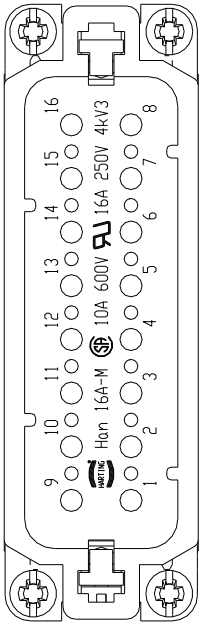
Only the grid-side converter cabling differs from the instructions given on pages *37*–*38*. Illustrations of connection terminals are shown below.



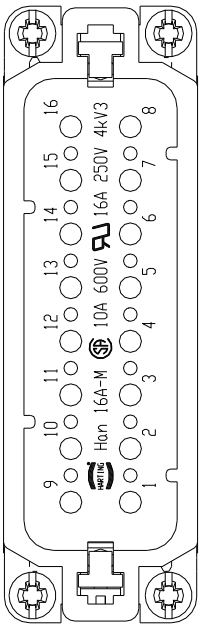
Control connections

The converter is controlled using the local control devices mounted in the sliding frame in the auxiliary control unit of the converter. For location and description of the connectors, see section *Overview of power and control connections* on page *24*. Control cable connections are described below.

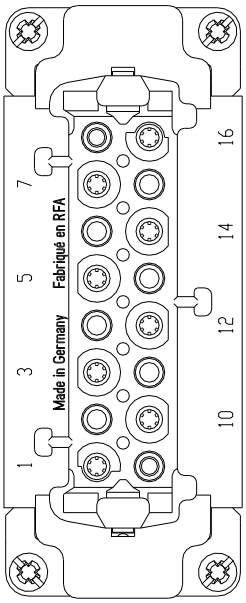
WARNING! Check the actual control connection of your delivery of the power cabinet from the circuit diagrams included in the delivery.



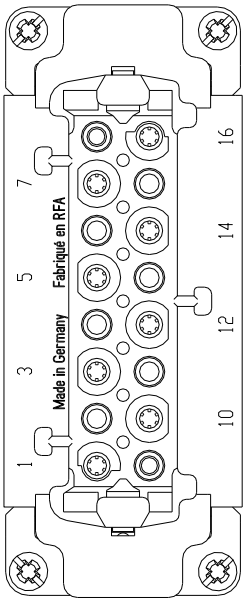
Connector X106.1: Grid main circuit breaker (MCB1) control	
Pin	**Description**
1	24 V DC
2	Status indication, 1=MCB is closed
3	Tripped state indication, 1=MCB is not tripped
4	Open relay control
5	Undervoltage relay control
6	Close relay control
7	Springs charging
8	0 V
9	Not used
10	Not used
11	Not used
12	Not used
13	Not used
14	Not used
15	Not used
16	Not used



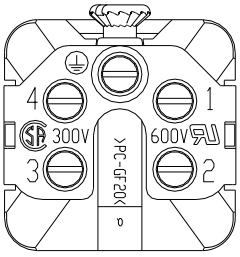
Connector X106.2: Stator main circuit breaker (MCB3) control	
Pin	**Description**
1	0 V DC
2	Not used
3	Not used
4	UPS supply voltage
5	Not used
6	Not used
7	Not used
8	Not used
9	0 V AC UPS voltage
10	Not used
11	Control 230 V AC
12	Not used
13	Not used
14	Not used
15	ON/OFF status
16	24 V DC supply voltage



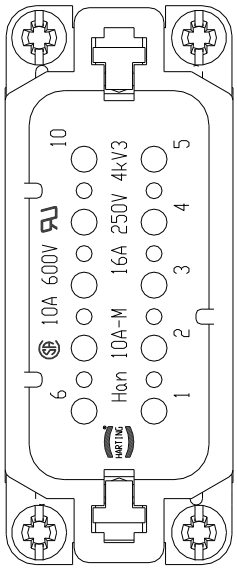
Connector X108.1: Grid voltage measurement	
Pin	**Description**
3	Phase U
5	Phase V
7	Phase W
10	Not used
12	Not used
14	Not used



Connector X108.2: Stator voltage measurement	
Pin	**Description**
3	Not used
5	Not used
7	Not used
10	Phase U
12	Phase V
14	Phase W



Connector X109: Stator current measurement	
Pin	**Description**
1	Phase U, S1
2	Phase U, S2
3	Phase W, S1
4	Phase W, S2



Connector X110: ICU auxiliaries	
Pin	**Description**
1	Smoke detector, sensor's alarm contact
2	Smoke detector, sensor's alarm contact
3	High temperature sensor
4	High temperature sensor
5	Low temperature sensor
6	Low temperature sensor
7	Main fuses' status contact
8	Main fuses' status contact
9	230 V AC fan supply voltage
10	0 V AC fan supply voltage

Connection procedure

For description and location of the control cable connectors, see chapter *Overview of power and control connections*, page *24*. To access the auxiliary control unit, see *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

Plug in the connectors and lock them into their positions.

Note: Always use the locking mechanism of the connector.

7

Installation checklist

Check the mechanical and electrical installation of the power cabinet before start-up. For the converter data, see the installation checklist in the *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)]. Go through the checklist below together with another person.

WARNING! Read and follow the instructions given in *Safety instructions*. Ignoring the instructions can cause physical injury or death, or damage to the equipment. Open the breakers and contactors of the power cabinet and lock them to open position. Ensure by measuring that the power cabinet is not powered.

Mechanical installation

The power cabinet has been fixed properly to floor, and if necessary (due to vibration etc.), also from top to the wall or roof.	☐
The ambient operating conditions are within the allowed limits. See chapter *Technical data.*	☐
If the lifting bars have been removed, ensure that the bolts are re-fastened to retain the cabinet degree of protection.	☐

Electrical installation

See chapters *Planning the electrical installation, Electrical installation.*

The power cabinet and converter are grounded properly and there is an adequately sized protective ground conductor between the power cabinet, converter and the power supply network (transformer).	☐
All protective ground conductors have been connected to the appropriate terminals and the terminals have been tightened (pull conductors to check).	☐

There is an adequately sized protective ground conductor between the generator and the power cabinet.	☐
The grid voltage matches the nominal input voltage of the converter.	☐
The grid cables have been connected to appropriate terminals (power cabinet terminals L1, L2 and L3), the phase order is correct, and the terminals have been tightened (pull conductors to check).	☐
The stator cables have been connected to appropriate terminals (power cabinet terminals U, V and W), the phase order is correct, and the terminals have been tightened (pull conductors to check).	☐
The stator cable has been routed away from other cables.	☐
The external control cables have been connected to appropriate plug-in terminals.	☐
There are no tools, foreign objects or dust from drilling inside the converter or power cabinet.	☐
Shrouds are fastened and doors are closed.	☐
Ensure that the lead-throughs fulfil the requirements of degree of protection IP54 or higher.	☐
The generator and the wind turbine are ready for start.	☐

Cooling circuit

See *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

The cooling circuit joints are tight (modules, liquid-cooling unit etc.).	☐
Bleed valves in all cubicles are closed (converter, liquid-cooling unit).	☐
The external control cabling (if any) has been connected to appropriate LCU terminals.	☐

8

Maintenance

What this chapter contains

This chapter contains maintenance intervals and maintenance instructions for power cabinet.

Maintenance intervals

The table below lists the main maintenance intervals recommended by ABB. Consult a local ABB Service representative for more details. See also *Service Plan* document (options +P910 and +P911). In the Internet, go to www.abb.com/drivesservices, select *Drive Services*, and *Maintenance and Field Services*.

Interval	Maintenance action	Instruction
Every year	Main circuit breaker maintenance	See *Main circuit breaker.*
Every 3 years	Checking the tightening torque of the power connections	See section *Power connections*.
Every 3 years	Cooling fan change in case of 60 Hz supply	See *Fans*.
Every 6 years	Cooling fan change	See section *Fans*.
Every 6 years	Checking the main contacts of the stator contactor/breaker.	See section *Stator contactor*.

Power connections

Tightening

WARNING! Read and follow closely the instructions given in section *Safety in installation and maintenance* on page *12*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Run the system down and prepare the power cabinet for the work by following the steps in section *Safety in installation and maintenance* on page *12*.
2. Check the tightness of the cable connections. Use the tightening torques given in chapter *Technical data*.

Fans

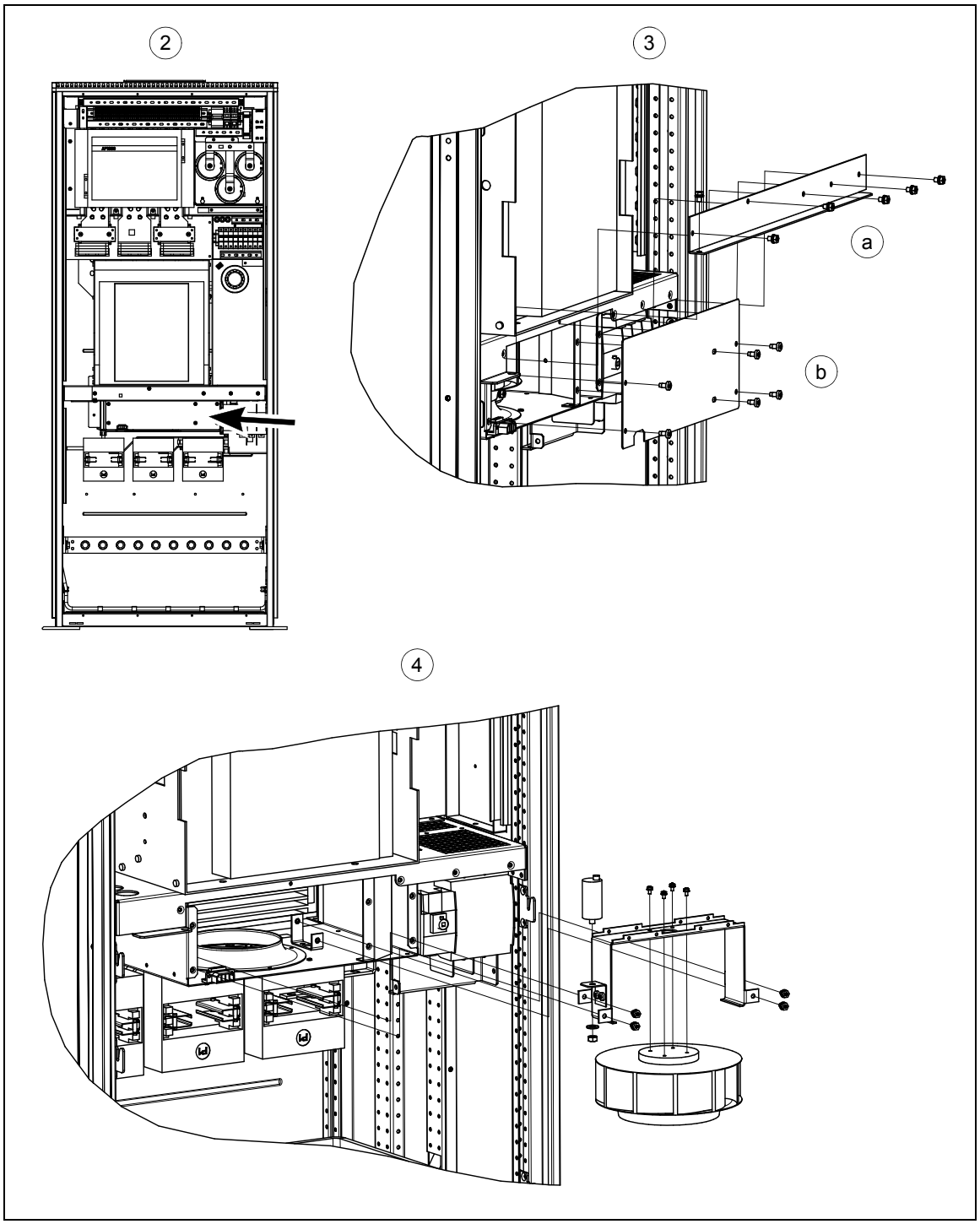
The cooling fan lifespan depends on the running time of the fan, ambient temperature and dust concentration. Replacements are available from ABB. Do not use other than ABB specified spare parts.

Fan failure can be predicted from increased noise from fan bearings and gradual rise in the temperature. Fan replacement is recommended once these symptoms appear.

Replacing the cooling fan of the power cabinet

WARNING! Read and follow closely the instructions given in section *Safety in installation and maintenance* on page *12*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Run the system down and prepare the power cabinet for the work by following the steps in section *Safety in installation and maintenance* on page *12*.
2. Remove the door and the shroud (metal grating) of the cubicle. The cooling fan is located in the middle part of the power cabinet.
3. Remove the six screws in the upper part of the fan assembly (a) and the six screws in front of the fan (b).
4. Pull the fan out and remove the eight screws and one nut.
5. Install a new fan in reverse order.

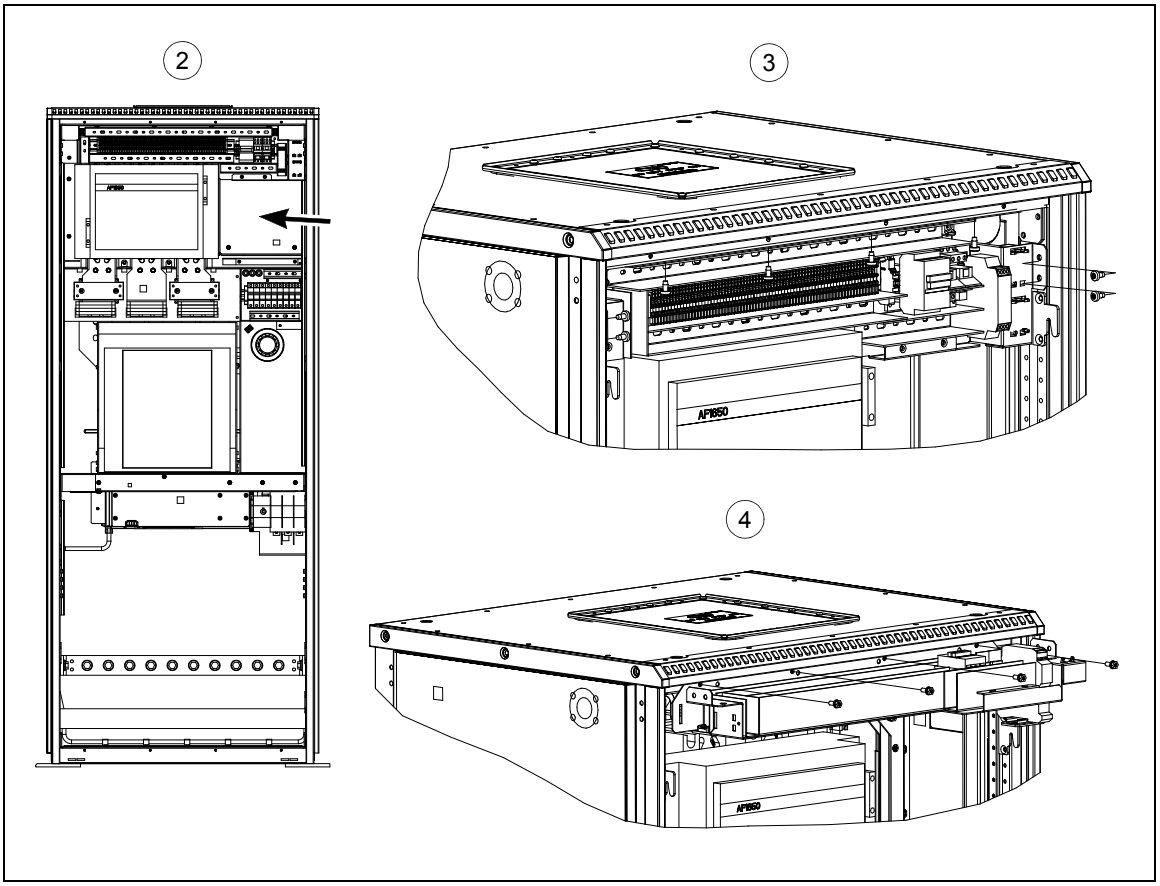

2
3
a
b
4

Replacing AC fuses – no option +F281

WARNING! Read and follow closely the instructions given in section *Safety in installation and maintenance* on page *12*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Run the system down and prepare the power cabinet for the work by following the steps in section *Safety in installation and maintenance* on page *12*.
2. AC fuses are located in the upper part of the power cabinet. Remove the shroud in front of the fuses.
3. Remove the 8 screws in the upper part of the power cabinet.
4. Remove the four screws.
5. Remove the four screws and pull out the plate in front of the fuses.
6. Open the nuts and remove the fuses.
   - **Mersen fuses:** M8 nuts, tightening torque 20 N·m (15 lbf·ft).
   - **Bussmann fuses:** M12 nuts, tightening torque 50 N·m (37 lbf·ft).
7. Insert new fuses.

Re-assemble the parts in reverse order.



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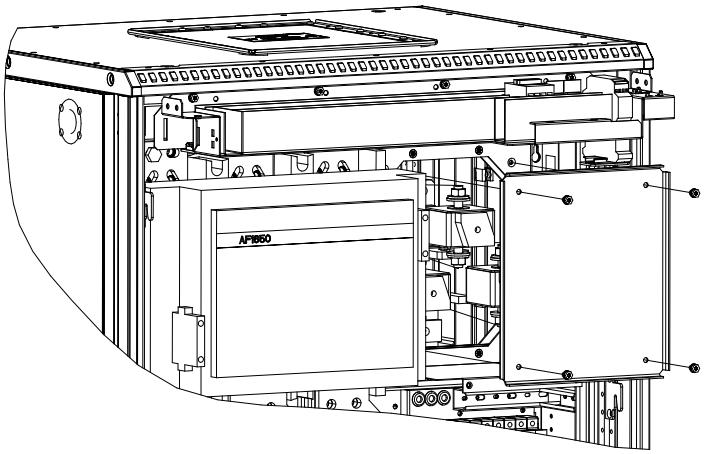

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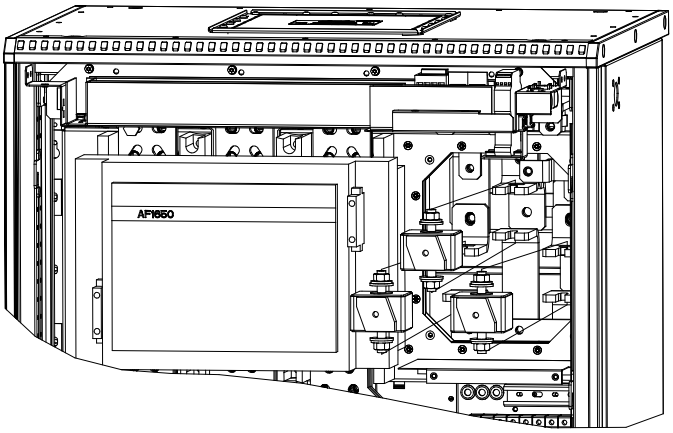
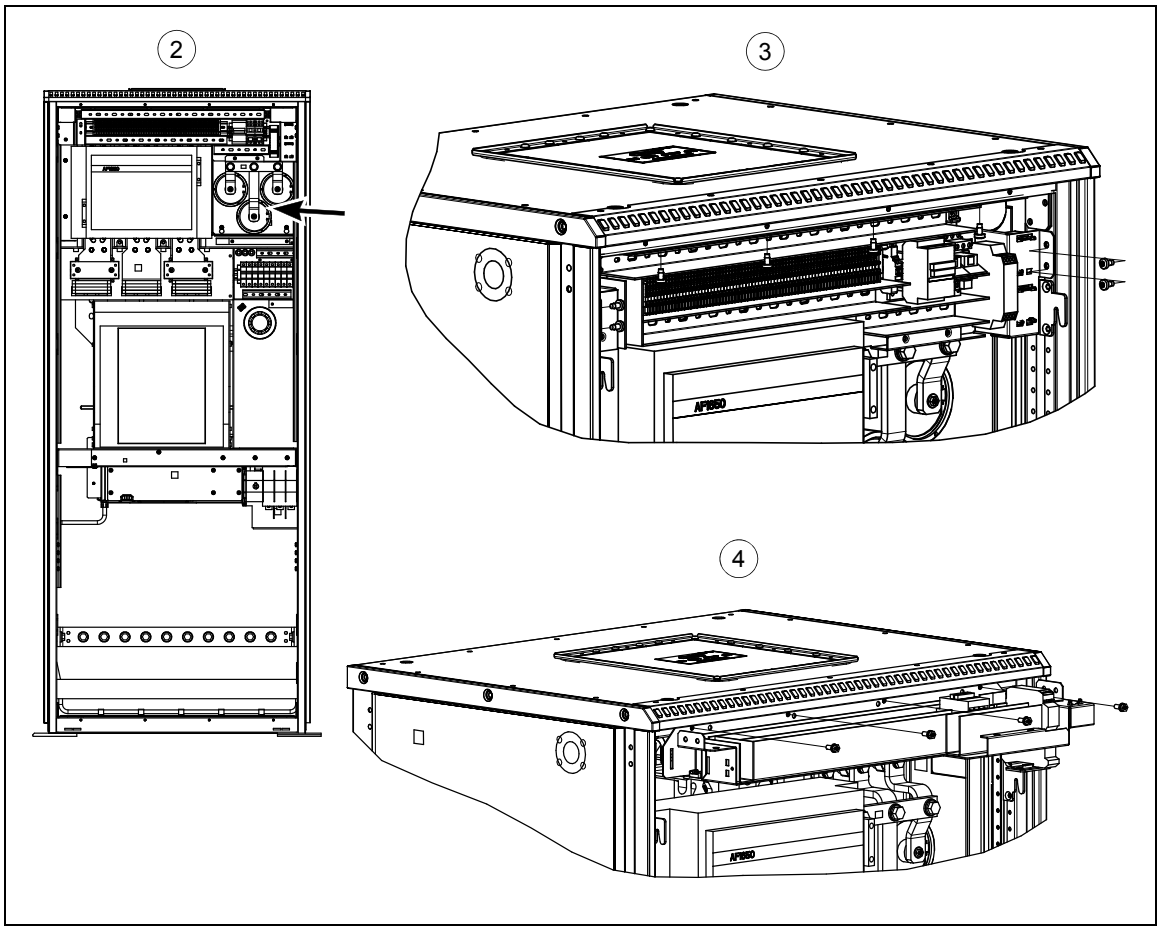


Replacing AC fuses – with option +F281

When option +F281 (overvoltage protection device) is selected, the AC fuses are replaced as follows.

WARNING! Read and follow closely the instructions given in section *Safety in installation and maintenance* on page *12*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Run the system down and prepare the power cabinet for the work by following the steps in section *Safety in installation and maintenance* on page *12*.
2. AC fuses are located in the upper part of the power cabinet behind the overvoltage protection devices. Remove the shroud in front of the fuses.
3. Remove the 8 screws in the upper part of the power cabinet.
4. Remove the four screws.
5. Remove the eight screws and pull out the overvoltage protection devices.
6. Open the nuts and remove the fuses.
   - **Mersen fuses:** M8 nuts, tightening torque 20 N·m (15 lbf·ft).
   - **Bussmann fuses:** M12 nuts, tightening torque 50 N·m (37 lbf·ft).
7. Insert new fuses.
8. Re-assemble the parts in reverse order.



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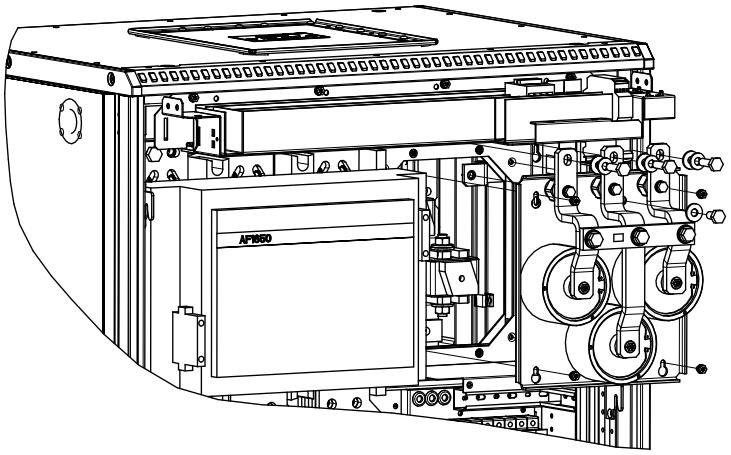

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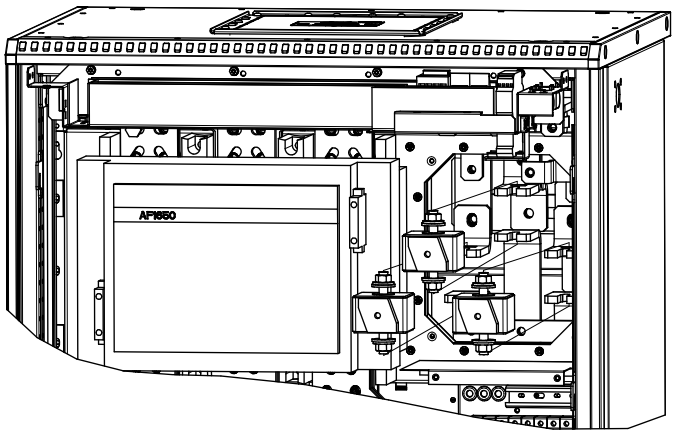
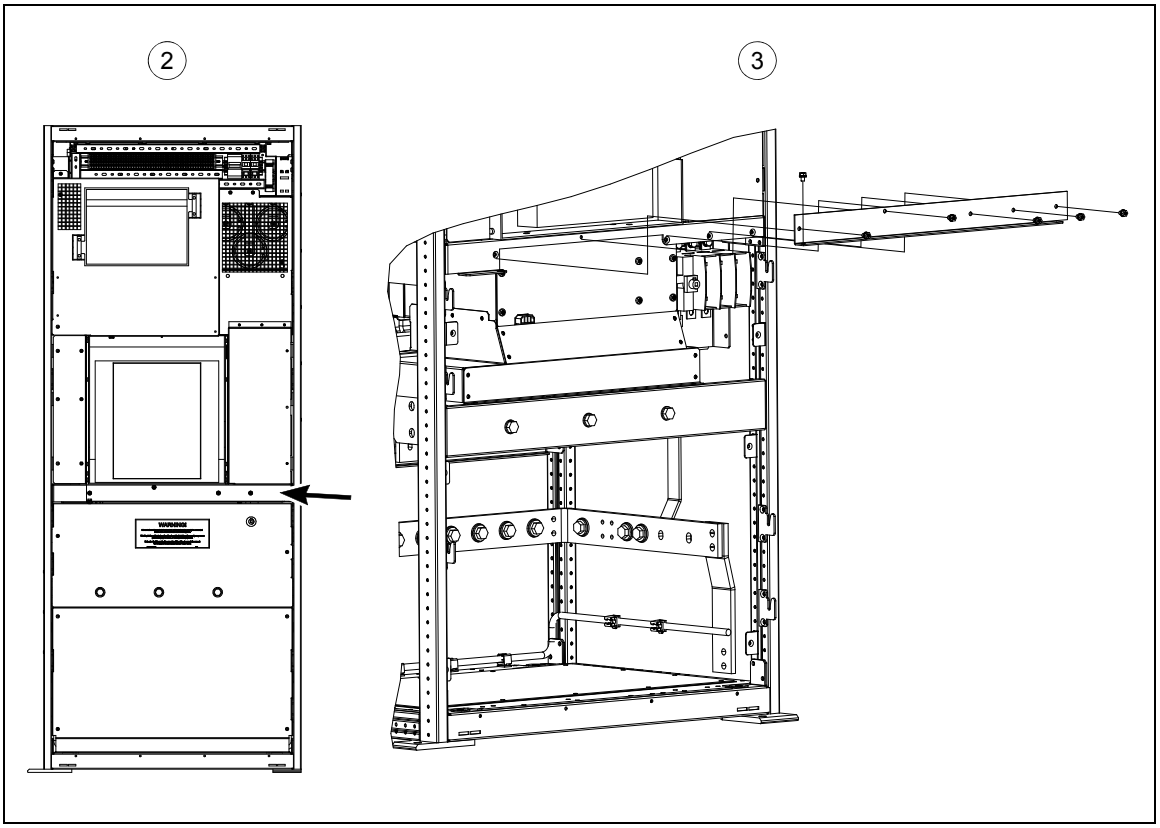


Replacing AC fuses of optional auxiliary voltage supply

WARNING! Read and follow closely the instructions given in section *Safety in installation and maintenance* on page *12*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

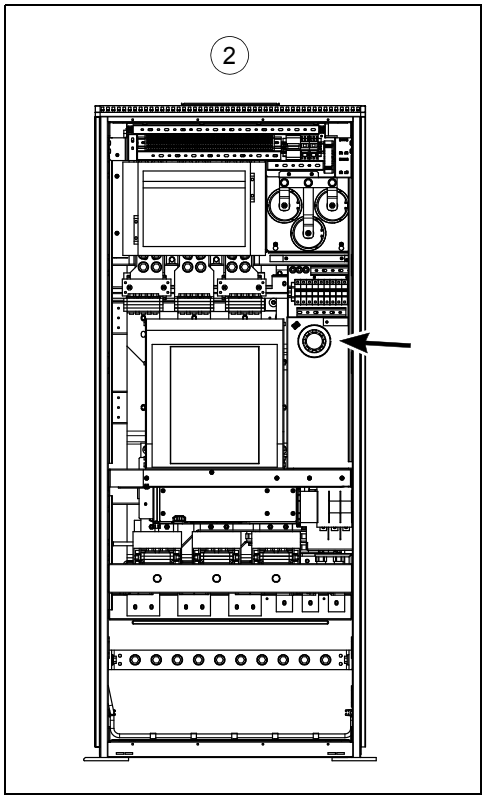
1. Run the system down and prepare the power cabinet for the work by following the steps in section *Safety in installation and maintenance* on page *12*.
2. AC fuses of auxiliary voltage supply are located in the middle part of the power cabinet. Remove the shroud in front of the fuses.
3. Remove the six screws and pull out the plate.
4. Open the nuts and remove the fuses.
5. Insert new fuses.
6. Re-assemble the parts in reverse order.



Replacing smoke detector or temperature measurement sensor

WARNING! Read and follow closely the instructions given in section *Safety in installation and maintenance* on page *12*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

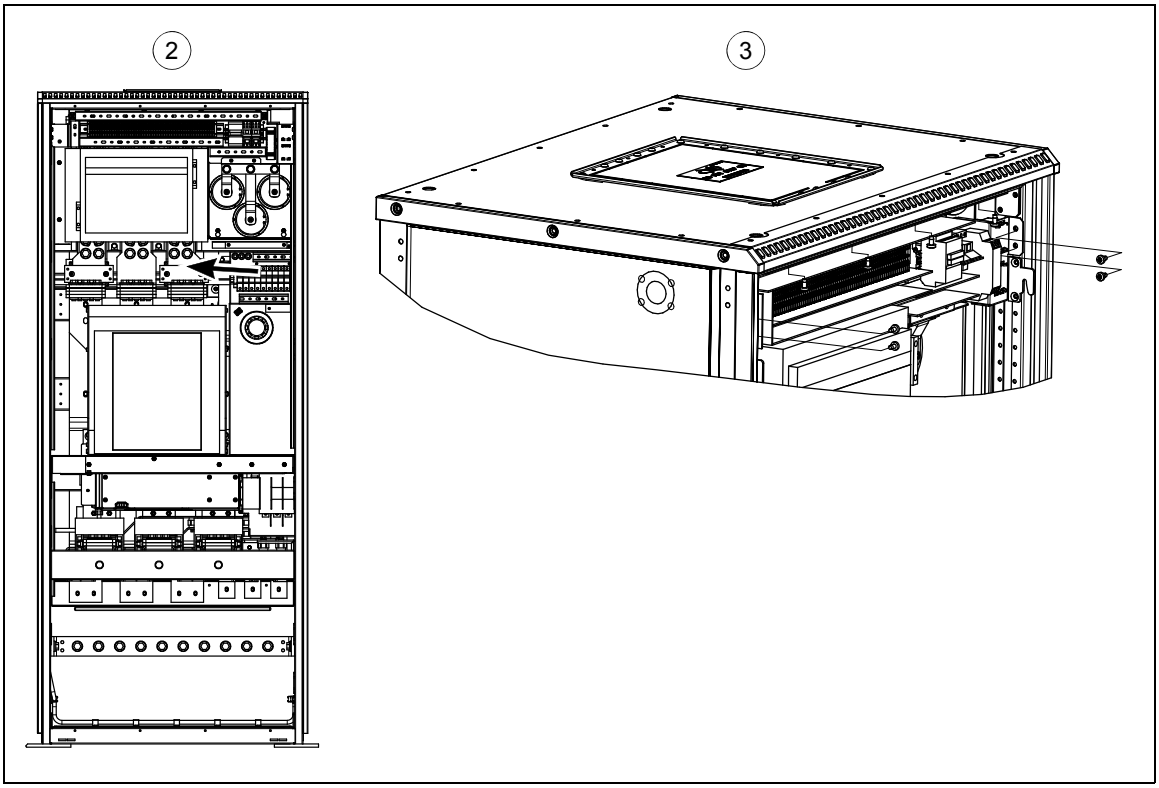
1. Run the system down and prepare the power cabinet for the work by following the steps in section *Safety in installation and maintenance* on page *12*.
2. Smoke detector is located in the upper part of the power cabinet. Remove the shroud in front of the smoke detector.
3. Follow the instructions given in *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

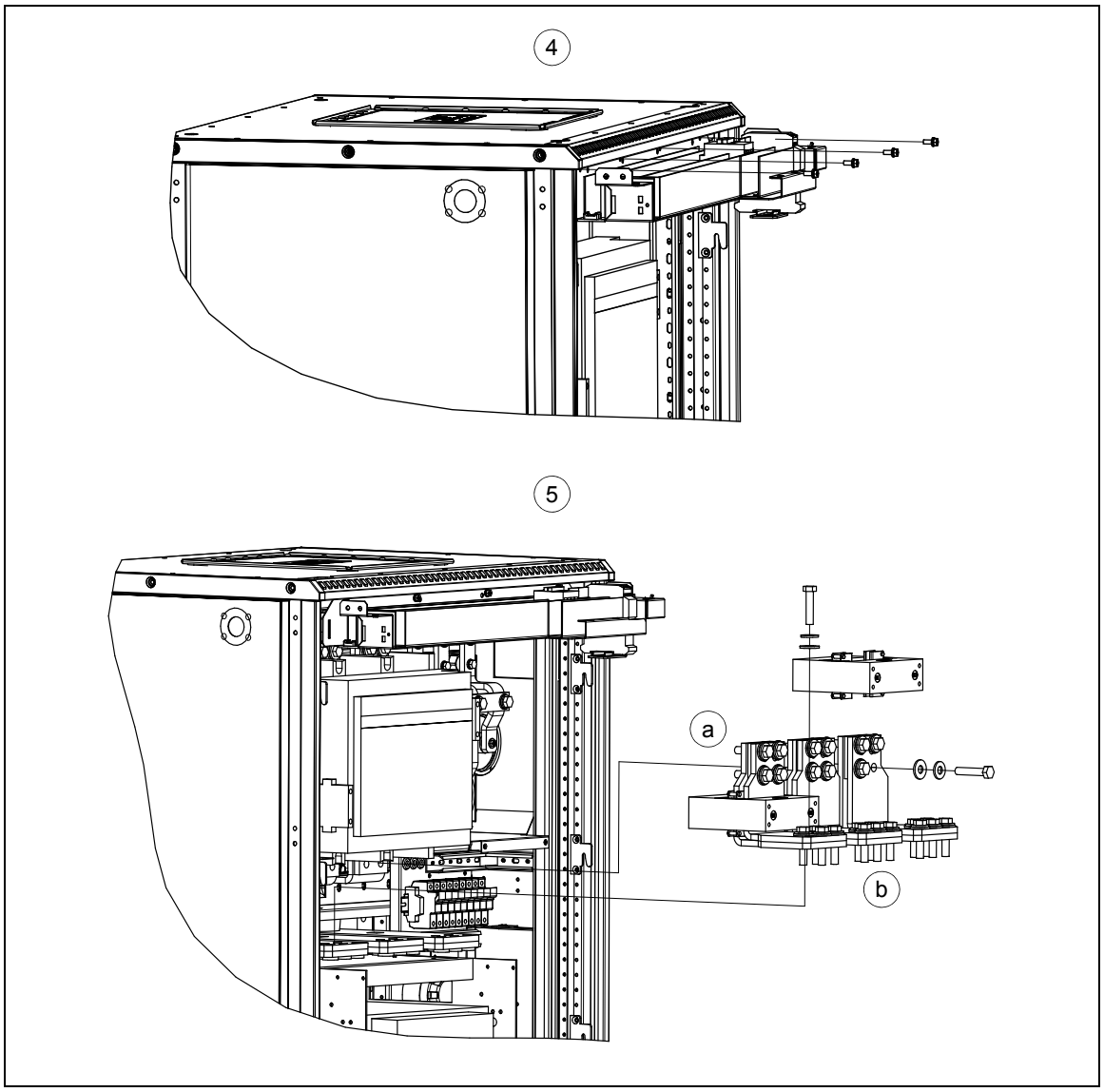


Replacing current transformers (stator current measurement)

WARNING! Read and follow closely the instructions given in section *Safety in installation and maintenance* on page *12*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Run the system down and prepare the power cabinet for the work by following the steps in section *Safety in installation and maintenance* on page *12*.
2. Current transformers of the stator current measurement are located in the upper part of the power cabinet. Remove the shroud in front of the current transformers.
3. Remove the 8 screws in the upper part of the power cabinet.
4. Remove the four screws.
5. Remove the 3×4 screws (a) and 2×5 screws (b) pull out the current transformers.
6. Insert new parts.
7. Re-assemble the parts in reverse order.

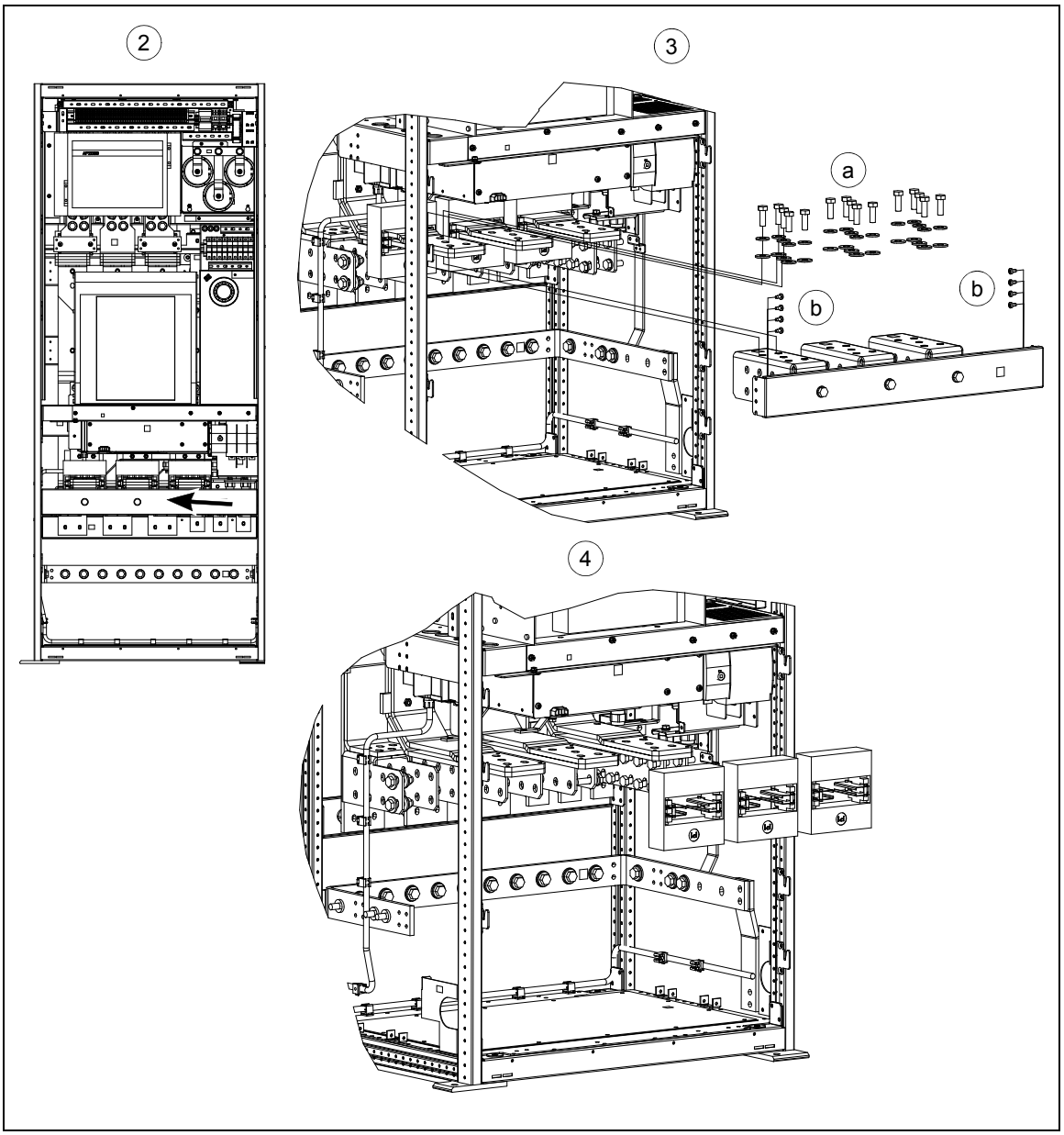



4
5
a
b

Replacing current transformers (option +G335)

WARNING! Read and follow closely the instructions given in section *Safety in installation and maintenance* on page *12*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Run the system down and prepare the power cabinet for the work by following the steps in section *Safety in installation and maintenance* on page *12*.
2. Current transformers are located in the lower part of the power cabinet. Remove the shroud in front of the fuses.
3. Remove the grid cables from the terminals L1, L2 and L3.
4. Remove the 3×5 screws (a) and the eight screws at the sides (b). Pull out the busbars.
5. Pull out the current transformers.
6. Insert new current transformers.
7. Re-assemble the parts in reverse order.



Replacing the overvoltage protection devices (option +F281)

1. Follow the steps 1…5 on page *50*.

Stator contactor

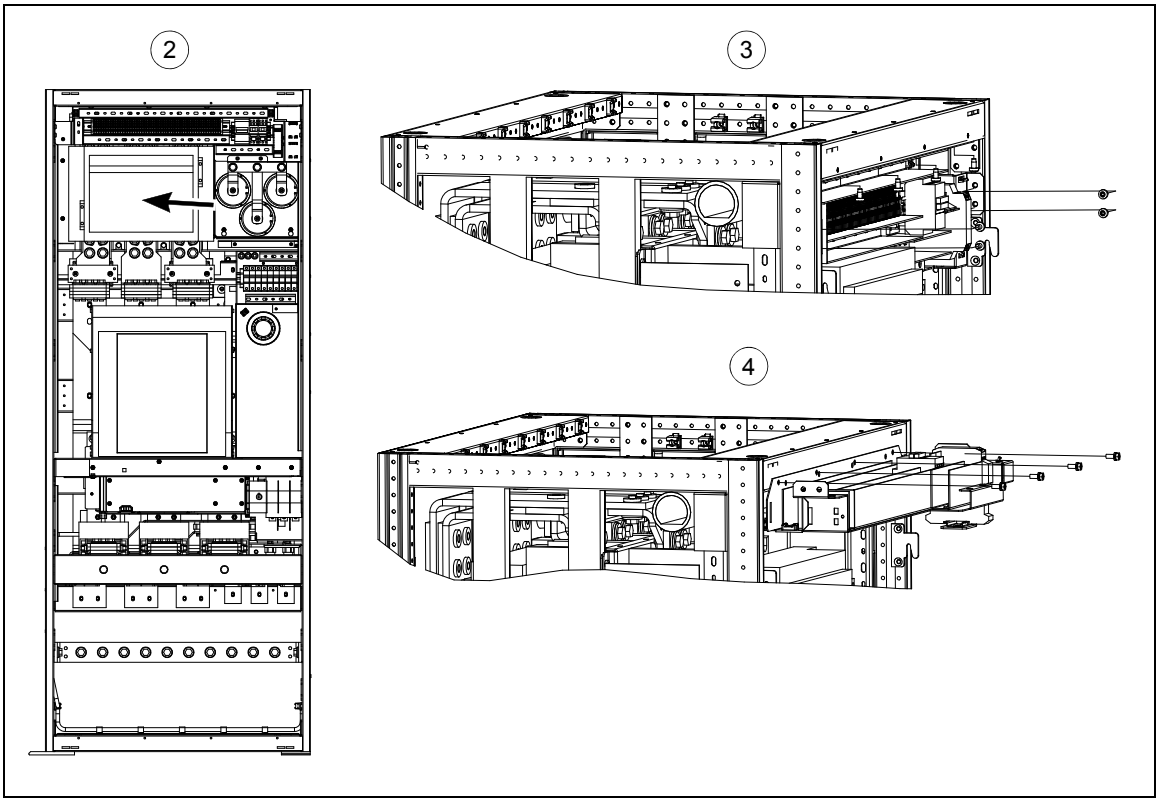
The type of the stator contactor is AF2050-30-11 by ABB Cewe control.

Replacing stator contactor(s)

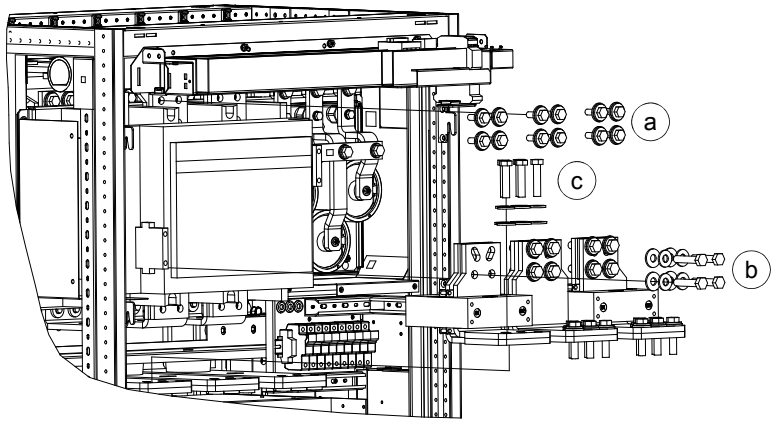
WARNING! Read and follow closely the instructions given in section *Safety in installation and maintenance* on page *12*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Run the system down and prepare the power cabinet for the work by following the steps in section *Safety in installation and maintenance* on page *12*.
2. Stator contactor is located in the upper part of the power cabinet. Remove the shroud in front of the contactor.
3. Remove the 8 screws in the upper part of the power cabinet.
4. Remove the four screws.
5. Remove the 3×4 screws (a), 3×4 screws (b) and 3×5 screws (c).
6. Remove the four screws in the contactor (a), two screws (b) and two screws (c) in the plates. Pull the parts out.
7. Remove the 3×3 screws in the busbars.
8. Remove the four screws (a), six screws in the plate (b) and four screws (c).
9. Remove the two screws above the contactor (a) and 14 screws below it (b).
10. Insert new contactor.

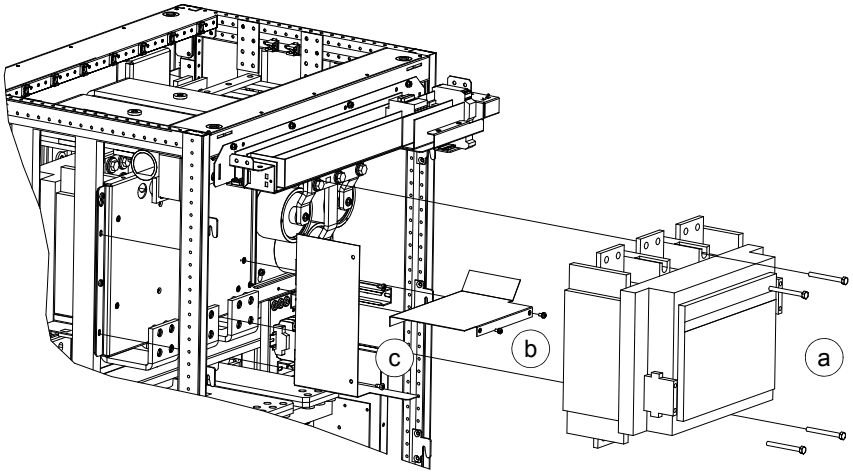
11. Re-assemble the parts in reverse order.



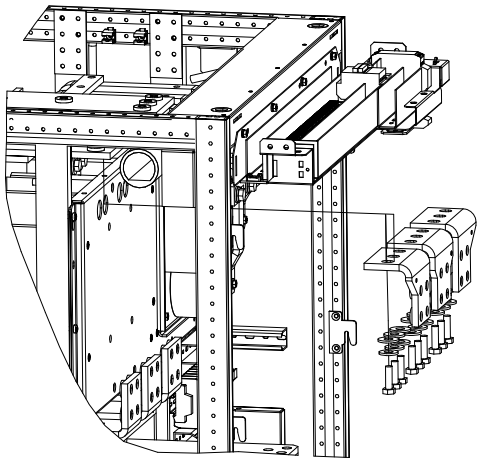
5

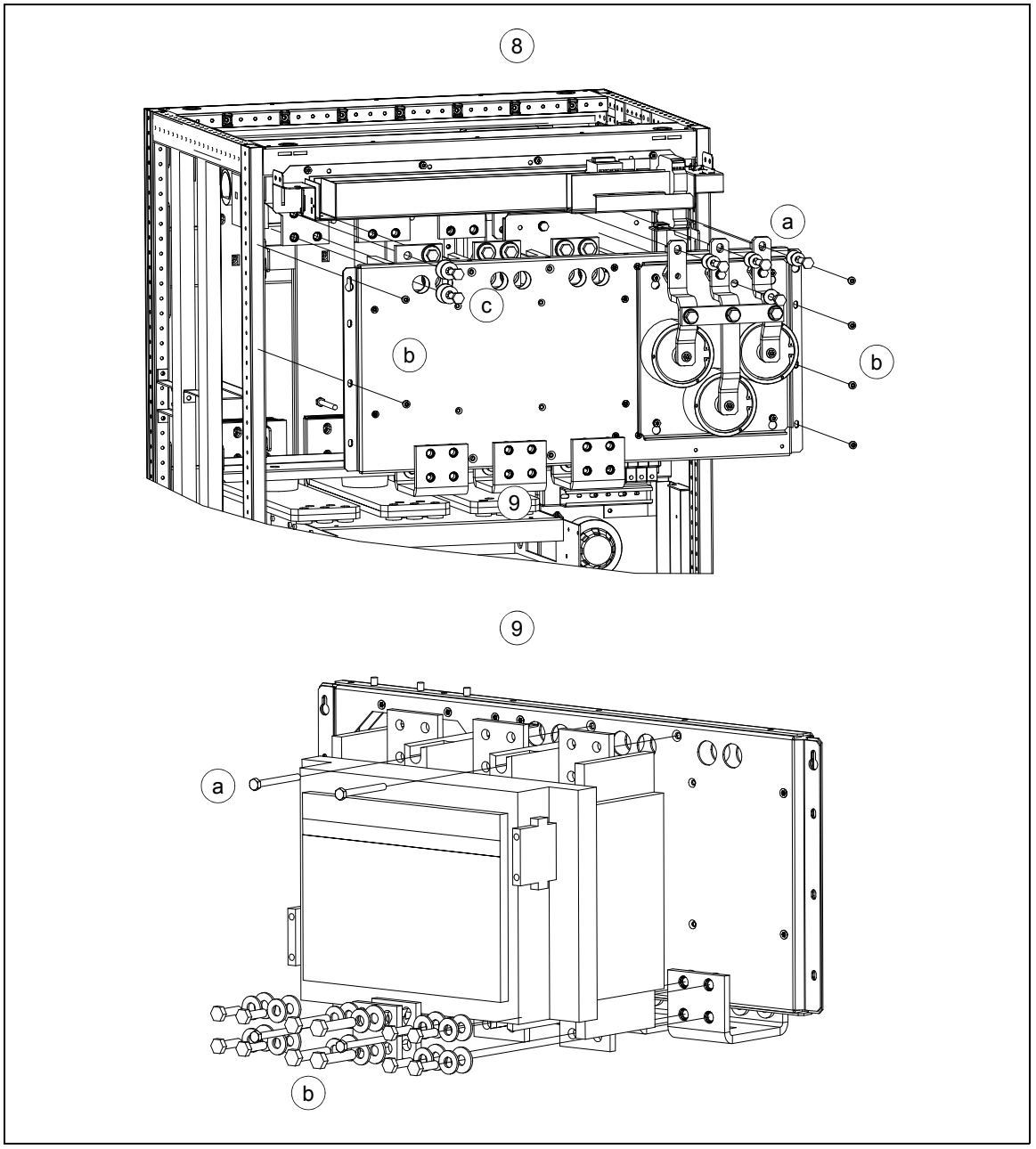


6



7




8
a
c
b
b
9
9
a
b

Maintenance of contacts

A contact is not necessarily damaged or worn out just because the surface is rough and discolored. The contacts in the figure below may look like a bad contact, but in fact they are better than a new set of contacts. This is because they are electrically seated and make a good contact over a larger surface. Based on this there is no need to change a contact only by judging it by the appearance of the surface. Typically the contacts in the three phases are not evenly worn, and all the contacts need to be changed at the same time. It is recommended to change the arc chutes at the same time too.

Filing of contacts

Avoid filing, grinding, and other means of restoring contacts or contact surfaces. Filing and grinding increase the risk of causing other problems, eg, the contact resistance may rise.

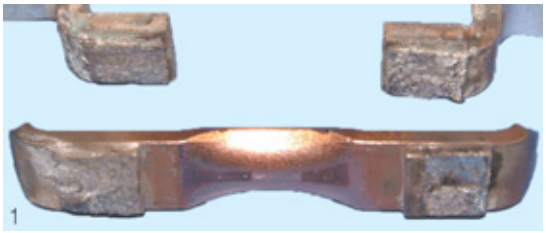
Limit the maintenance to inspection of the contacts for the level of contact wear. This is to ensure a trouble free operation of the contactor until the next service is required (see section *Interpreting levels of electrical contact wear*). At the same time you can observe if the contactor operates well in the application and that no signs of abnormal wear or damages are present on the contacts.

1. The appearance of contacts after a very low number of operations

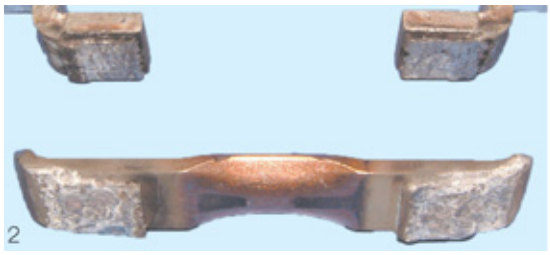
2. A contact just having reached a good worn in level

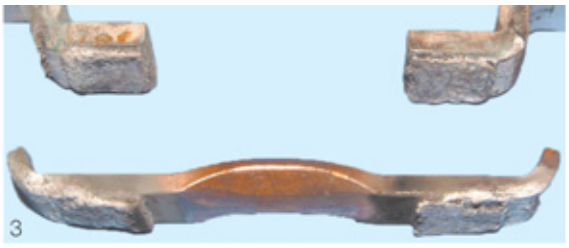
Interpreting levels of electrical contact wear

Basically the contactors used are considered maintenance free. Depending on the severity of the application contact inspection may be required. Premature service on contactors will increase the overall cost, while delayed service can cause costly interruptions or breakdowns. Service at the right time will avoid these kinds of problems. The pictures below help to interpret the main contact wear level.



1. Early stage of fixed and movable contacts





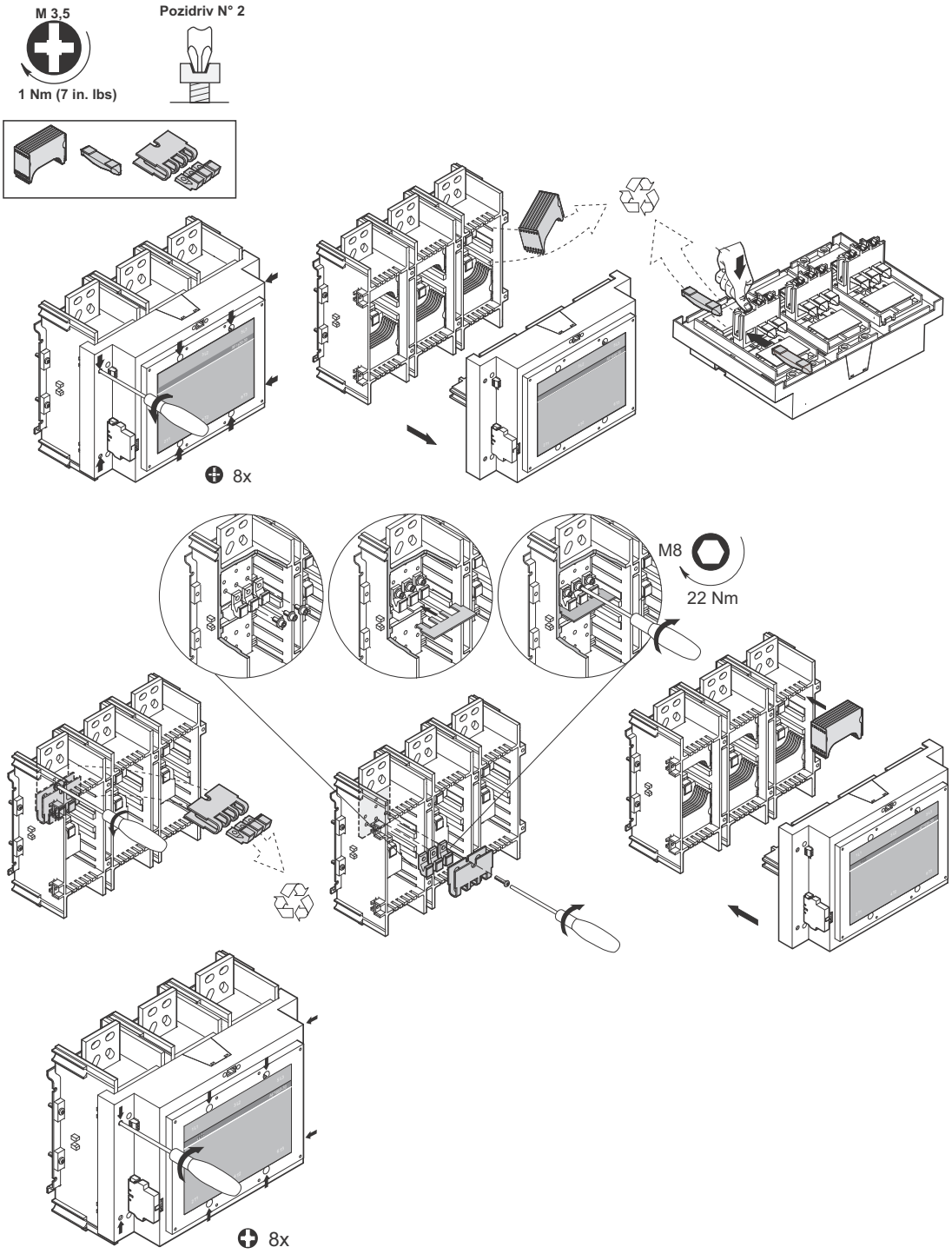
2. Mid-life stage of fixed and movable contact

3. End of life of fixed and movable contacts

Changing the main contacts and arc chutes

WARNING! Read and follow the instructions given in section *Safety in installation and maintenance* on page *12*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Run the system down and prepare the power cabinet for the work by following the steps in section *Safety in installation and maintenance* on page *12*.



Make sure that recommended torque values given in the instructions are followed.

Main circuit breaker

WARNING! Before taking any action to service this equipment it is compulsory to:

- open the circuit breaker and make sure that the control springs are not loaded,
- in the event of a withdrawable circuit breaker, take action with the circuit breaker withdrawn (DISCONNECTED) from the fixed part,
- when taking action on circuit breakers with a fixed design, or on the fixed parts of a withdrawable breaker, disconnect the supply to the power circuit and to the auxiliary circuits, and earth the terminals in a clearly visible manner, both on the power side and on the load side,
- make the equipment safe in accordance with current laws and standards.

ABB accepts no liability for damage to property or personal injury due to failure to comply with the instructions contained in this document.

These servicing procedures shall be handled only by qualified personnel with a thorough understanding of the equipment.

Routine maintenance frequency

See the table below for the frequency of servicing to be carried out and the relative routine maintenance operations required. It is also recommended to comply with the following rules:

- even circuit breakers that are operated only rarely, or that remain closed or open for lengthy periods of time, need routine servicing,
- for circuit breakers fitted with ABB SACE PR121 releases, installation of the mechanical operation counter (supplied on request) is recommended,
- during service, routinely inspect the circuit breaker from the outside to check for any dust, dirt or damage of any kind.

	Servicing intervals	
Servicing procedures	**Installations in normal environments**	**Installations in dusty environments** (1) / (2) [(1) = measured dust level > 1 mg/m³]
Level one	Yearly or 20% of mechanical life or 20% of electrical life	Six-monthly or 10% of mechanical life or 10% of electrical life
Level two	Three years or 50% of mechanical life or 50% of electrical life or after a short circuit has tripped the breaker.	18 months or 25% of mechanical life or 25% of electrical life or after a short circuit has tripped the breaker.

(1) These data refer to the standard installation in accordance with the product standards. Contact ABB SACE for assistance if different applications are involved.

(2) Extreme weather conditions, polluted atmosphere or vibrations may require specific maintenance schedules. Contact ABB SACE for assistance.

Servicing procedures - Level one

Preliminary operations

WARNING! When taking action on circuit breakers with a fixed design, or on the fixed parts of a withdrawable breaker, disconnect the supply to the power circuit and to the auxiliary circuits, and earth the terminals in a clearly visible manner, both on the power side and on the load side.

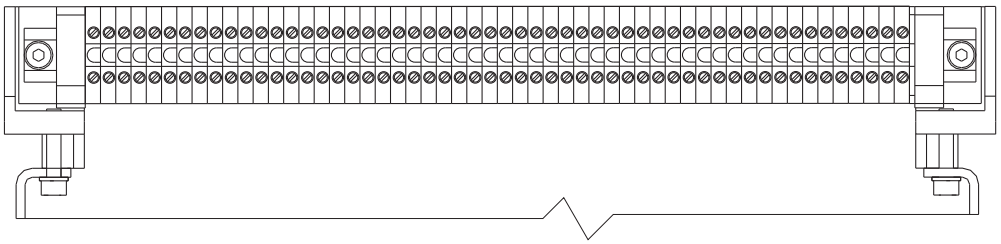
- Open the circuit breaker and make sure that the control springs are not loaded.
- In the event of a withdrawable circuit breaker, take action with the circuit breaker withdrawn (DISCONNECTED) from the fixed part.

Inspection and general cleaning

- Check the cleanliness of the equipment (the circuit-breaking part), remove any dust or traces of excess oil or grease with a clean dry cloth, by using mild detergent if necessary. Use a cleaning product such as Henkel 273471 or equivalent if there is a heavy coating of dirt.
- Check for the presence of the labels indicating technical characteristics of the device. Clean these labels with a clean dry cloth.
- Remove any traces of dust, mould, condensation or rust, also on the inside of the fixed part of withdrawable circuit breakers.
- Make sure there are no foreign objects inside the circuit breaker compartment.

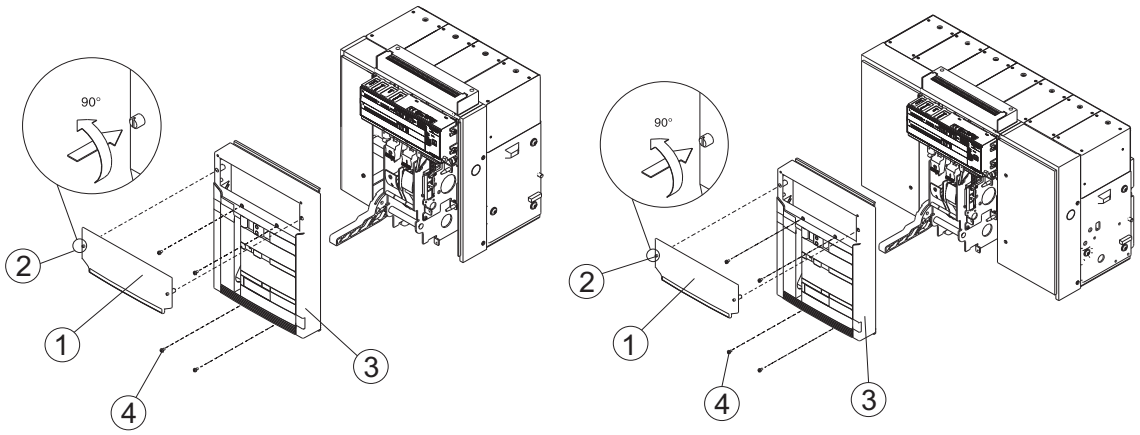
Power connections between the circuit breaker and the switchboard

- Remove any dust or dirt, if any, with a brush and clean cloth, by using mild detergent if necessary. Use a cleaning product such as Henkel 273471 or equivalent if there is a heavy coating of dirt.
- Make sure there are no signs of localized overheating on the terminals. Identify if there is any change in the coloring of the parts coming into contact; the parts in contact are usually silver in color.
- Make sure that the bolts of the terminal connections are tightened properly (M12 - 70 N·m).
- Check the tightness of the fixing cable screws on sliding contacts or terminal block (0.7 N·m).

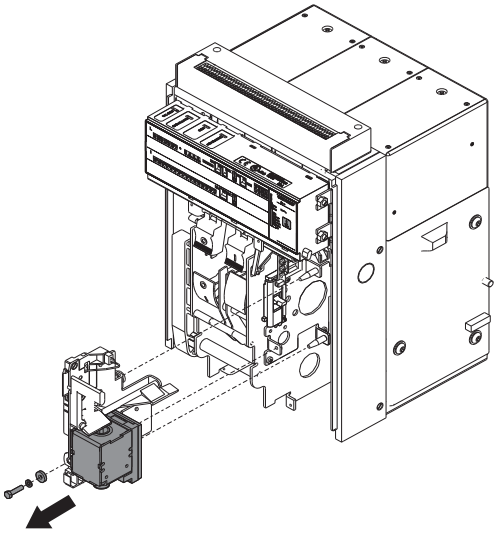


Flange and escutcheon plate disassembly operations

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

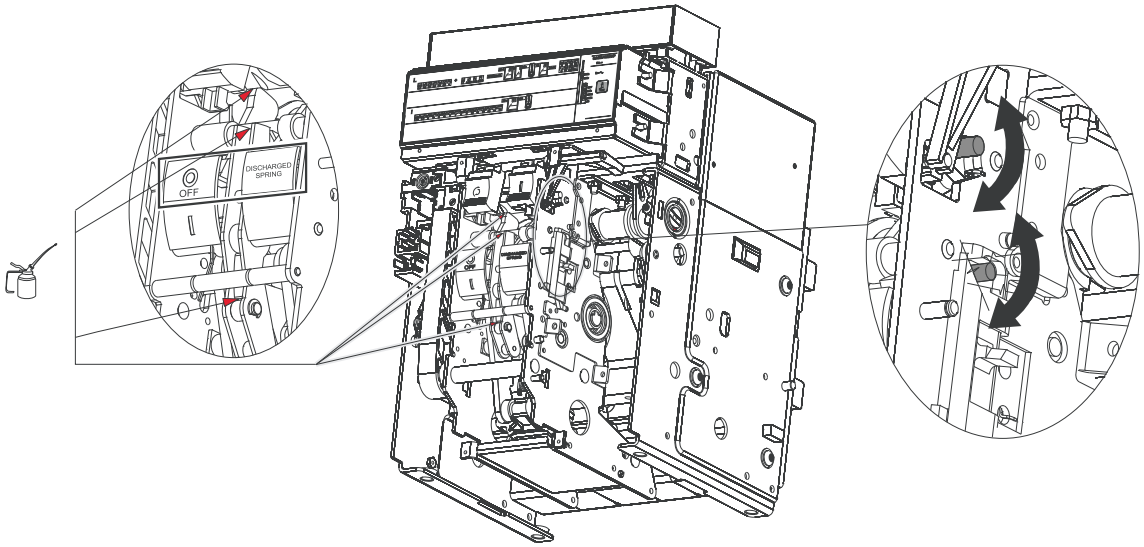


- If the undervoltage coil is installed, disassemble the coil support and relieve the springs of the operating mechanism by closing and opening the circuit breaker.



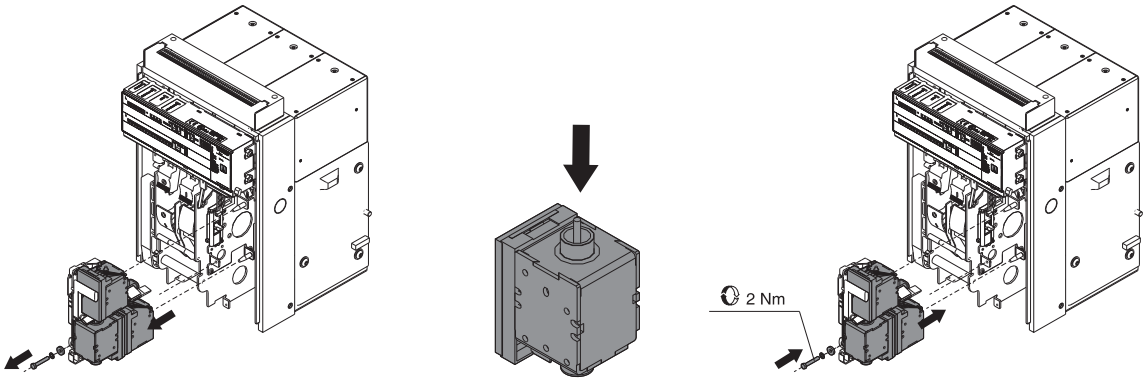
Mechanical control

- Clean the points shown in figure below. Use a cleaning product such as Henkel 273471 or equivalent if there is a heavy coating of dirt.
- Lubricate the shafts and the opening and closing latches on the points shown in the figure, by using grease type MOBILGREASE 28 (EXXON MOBIL).
- Check that opening and closing shafts are free to rotate.



Mechanical and electrical accessories

- Make sure that the accessories are securely fixed to the circuit breaker.
- Make sure that the electrical accessories are correctly connected to the circuit breaker.
- Gear motor: after every 10 000 operations, check the brushes for wear and replace the gear motor if necessary.
- Make sure that the releases (SOR-UVR-SRC) are in good condition (absence of excessive wear, overheating, breakages), see the figure below.
- Make sure that the mechanical operation counter functions correctly (if applicable) by operating the circuit breaker.



Protection release

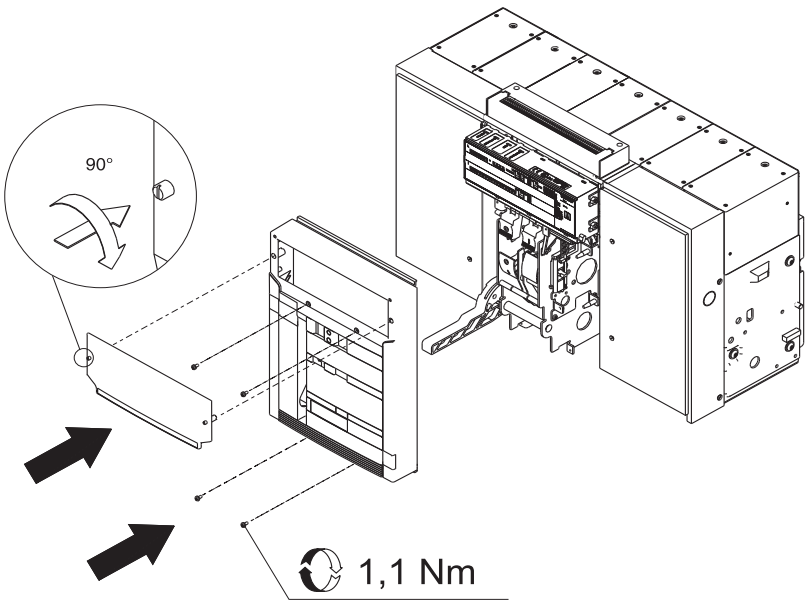
- Connect the BT030/B temporary power supply unit with the release.
- Check the efficient operation of the protection release: test the release using the **Trip Test** (PR121, PR122, PR123) and **Autotest** (PR122, PR123).
- With release PR121, make sure that the LEDs do not flash to indicate the presence of alarms.
- Make sure that the cables are correctly connected to the release modules and to the release itself (if applicable).
- At the end, remove the BT030/B temporary power supply unit from the release.

Test with SD Testbus2 (optional)

- Connect the BT030/B or BT030/Usb with the release.
- Launch the SD.TestBus2 program on a PC with Bluetooth connection (BT030/B) or USB connection (BT030/Usb).
- After establishing the communication between the release and PC, check that no alarms or warnings are present on the release. If present, see *ACS800-67(LC) doubly-fed induction generator control program firmware manual* [3AUA0000071689 (English)].
- In normal functioning conditions it is possible to perform the Trip test or Autotest, according to the release.
- For further investigations, insert the actual date to the **user Data/Tag name** area. The dates are stored in the release.
- At the end, remove the BT030/B or BT030/Usb unit from the release.

Servicing procedures, final checks

- Reinstall all parts and, if necessary, reconnect the auxiliary power supply.
- Re-assemble the escutcheon plate as shown in the figure below.



Move the mobile part back to the TEST-ISOLATED position.

Using the various auxiliaries in succession, perform ten of the following operations:

- Opening (both locally and remotely, where applicable)
- Closing (both locally and remotely, where applicable)
- Releasing by means of a trip test from the relay.

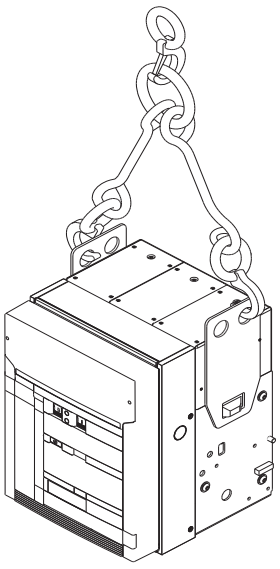
Check the procedures in the following sequence:

- Open - springs unloaded
- Open - springs loaded
- Closed - springs unloaded
- Closed - springs loaded
- Check the efficient operation of any accessories.
- Check the efficient operation of the geared motor.
- Check the proper operation of the undervoltage release.
- Check the efficient operation of the shunt opening release.
- Check the efficient operation of the shunt closing release.
- Check the efficient operation of the auxiliary contacts of the circuit breaker.
- Check the efficient operation of the device by locking the circuit breaker in its open position (with a key or padlock).

Servicing procedures - Level two

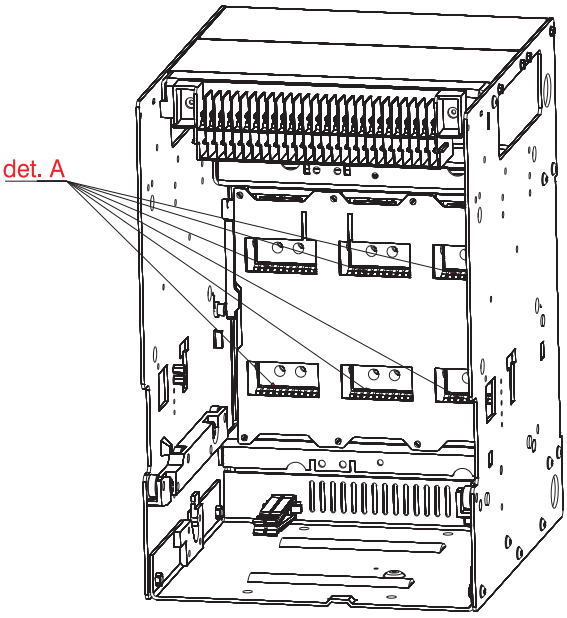
Preliminary operations

- Open the circuit breaker and make sure that the control springs are not loaded.
- In the event of a withdrawable circuit breaker, take action with the circuit breaker removed from the fixed part.
- When taking action on circuit breakers with a fixed design, or on the fixed parts of a withdrawable breaker, disconnect the supply to the power circuit and to the auxiliary circuits, and earth the terminals in a clearly visible manner, both on the power side and on the load side.



Inspection and general clearing

- Check the cleanliness of the equipment (the circuit-breaking part), remove any dust or traces of excess oil or grease with a clean dry cloth, by using mild detergent where necessary. Use a cleaning product such as Henkel 273471 or equivalent if there is a heavy coating of dirt.
- Check for the presence of labels indicating the technical characteristics of the device. Clean the labels with a clean dry cloth.
- Remove any traces of dust, mould, condensation or rust, also on the inside of the fixed part for withdrawable circuit breakers.
- Check for any signs of overheating or cracks that may interfere with the efficient insulation of the circuit breaker.
- Make sure that the isolating contacts are intact (for withdrawable circuit breakers). See the figure below (det. A). These contacts should be silver in color, with no traces of erosion or smoke.
- Make sure there are no foreign objects inside the circuit breaker compartment.
- Make sure that the screws that fasten the fixed part to the switchboard are tightened properly (M8 - 25 N·m).

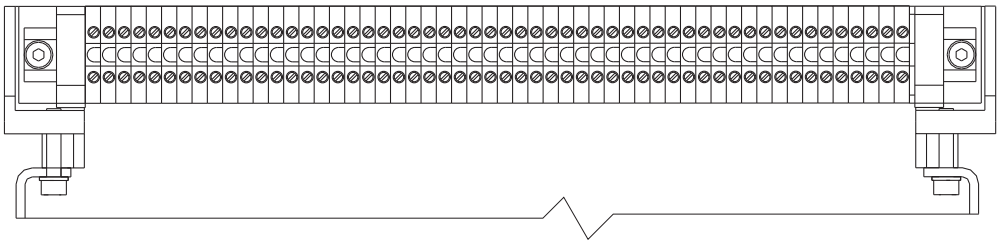


Power connections between the circuit breaker and the switchboard

- Remove dust or dirt, if any, with a brush and clean cloth, using mild detergent if necessary. Use a cleaning product such as Henkel 273471 or equivalent if there is a heavy coating of dirt.
- Make sure there are no signs of localized overheating on the terminals. Identify if there is any change in the coloring of the parts coming into contact; the parts in contact are usually silver in color.
- Make sure that the bolts of the terminal connections are tightened properly (M12 - 70 N·m).

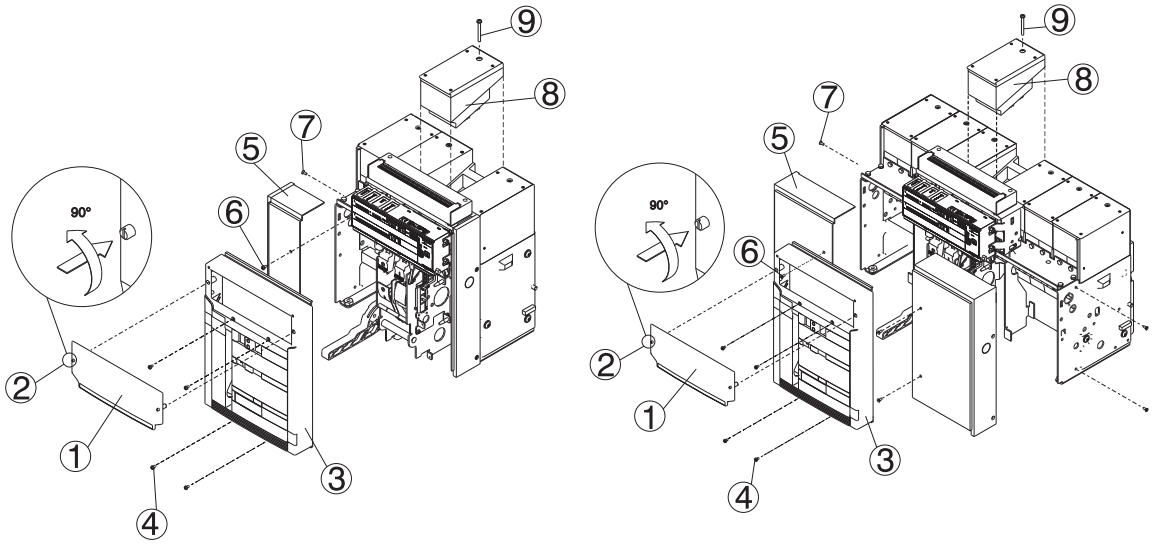
WARNING! When taking action on circuit breakers with a fixed design, or on the fixed parts of a withdrawable breaker, disconnect the supply to the power circuit and to the auxiliary circuits, and earth the terminals in a clearly visible manner, both on the power side and on the load side.

- Check the tightness of the fixing cable screws on sliding contacts or terminal block (0.7 N·m).

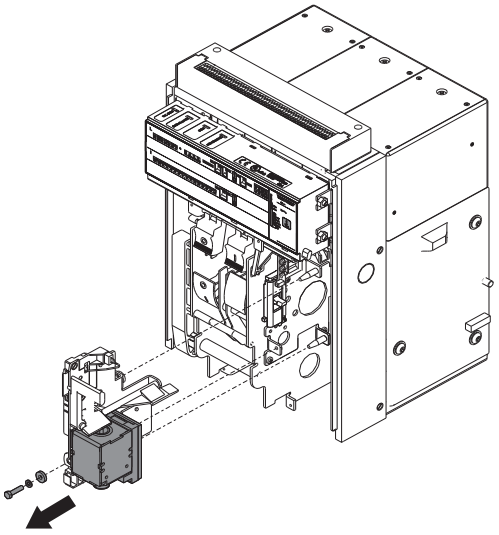


Flange, escutcheon plate and arcing chamber disassembly operations

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



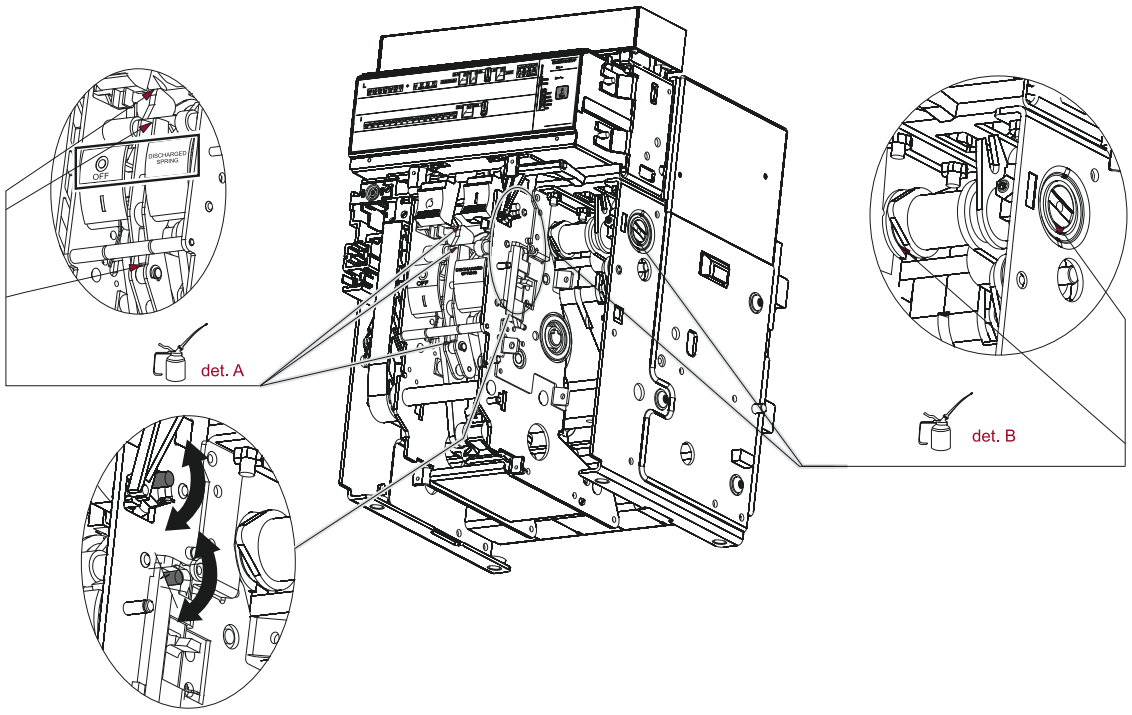
- If the undervoltage coil is installed, disassemble the coil support and relieve the springs of the operating mechanism by closing and opening the circuit breaker.



Mechanical control

- Clean (use a cleaning product such as Henkel 273471 or equivalent if there is a heavy coating of dirt) and lubricate the shafts and the opening and closing latches on the points shown in the figure below (det. A), by using grease type MOBILGREASE 28 (EXXON MOBIL).
- Clean (use a cleaning product such as Henkel 273471 or equivalent if there is a heavy coating of dirt) and lubricate the bearings of the drive shaft with MOBILGREASE 28 (EXXON MOBIL) grease, including those on the sides of the circuit breaker (see figure below, det. B).

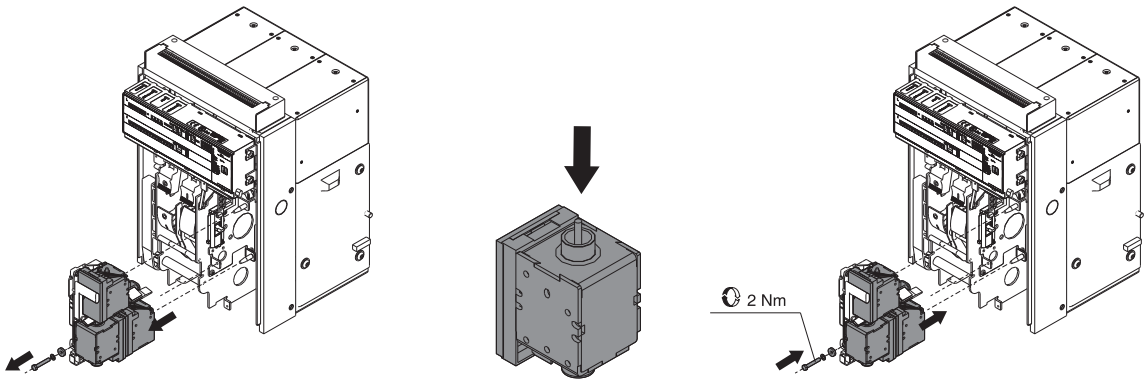
- Check that opening and closing shafts are free to rotate.



- In case of deformed or oxidized springs, safety rings out of place, or hard wear of operating mechanism, contact ABB SACE. ABB may replace spare parts type A after having obtained the customer's approval.

Mechanical and electrical accessories

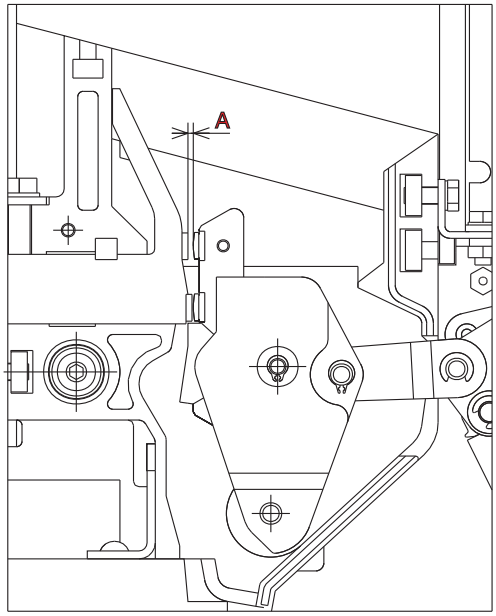
- Make sure that the accessories are securely fixed to the circuit breaker.
- Make sure that the electrical accessories are correctly connected to the circuit breaker.
- Gear motor: after every 10 000 operations, check the brushes for wear and replace the gear motor if necessary.
- Make sure that the releases (SOR-UVR-SRC) are in good condition (absence of excessive wear, overheating, breakages), see the figure below.
- Make sure that the mechanical operation counter functions correctly (if applicable) by operating the circuit breaker.



Checking contact wear

With the circuit breaker opened and the arcing chambers removed:

1. Check the condition of the arc-quenching chambers: the body of the chamber must be undamaged and the plates must be neither corroded nor indented.
2. Remove the dust with compressed air and clean all traces of fumes and slag with a brush.
3. Make sure that the contacts are in good condition.
4. Check visually that the main and arc-quenching plates are in place.
5. Check for tarnishing or beading. If discovered, contact ABB for assistance.
6. Check the arc-quenching distance (distance A in the figure below).



	A
E1 - E2 - E3	$\geq$ 1 mm -> OK
E4 - E6	$\geq$ 0.8 mm -> OK

7. Close the circuit breaker and check the dimension A.
   - Contact ABB SACE if the dimension A is incorrect. ABB may replace spare parts type A after having obtained the customer's approval.
   - If dimension A is correct, open the circuit breaker and re-assemble the arcing chambers.

Protection release

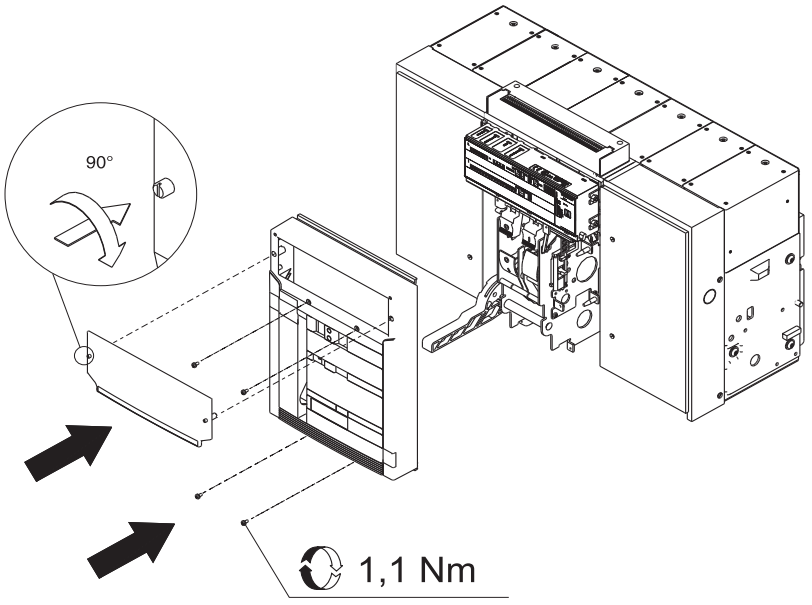
- Connect the BT030/B temporary power supply unit with the release.
- Check the efficient operation of the protection release: test the release using the **Trip Test** (PR121, PR122, PR123).
- With release PR121, make sure that the LEDs do not flash to indicate the presence of alarms.
- Make sure that the cables are correctly connected to the release modules and to the release itself (if applicable).
- At the end, remove the BT030/B temporary power supply unit from the release.

Test with SD Testbus2 (optional)

- Connect the BT030/B or BT030/Usb with the release.
- Launch the SD.TestBus2 program on a pc with Bluetooth connection (BT030/B) or USB connection (BT030/Usb).
- After establishing the communication between the release and PC, check that no alarms or warnings are present on the release. If present, see *ACS800-67(LC) doubly-fed induction generator control program firmware manual* [3AUA0000071689 (English)].
- In normal functioning conditions it is possible to perform the Trip test or Autotest, according to the release.
- For further investigations, insert the actual date to the **user Data/Tag name** area. The dates are stored in the release.
- At the end, remove the BT030/B or BT030/Usb unit from the release.

Servicing procedures, final checks

- Reinstall all parts and, if necessary, reconnect the auxiliary power supply.
- Re-assemble the escutcheon plate as shown in the figure below.



Move the mobile part back to the TEST-ISOLATED position.

Using the various auxiliaries in succession, perform ten of the following operations:

- Opening (both locally and remotely, where applicable)
- Closing (both locally and remotely, where applicable)
- Releasing by means of a trip test from the relay.

Check the procedures in the following sequence:

- Open - springs unloaded
- Open - springs loaded
- Closed - springs unloaded
- Closed - springs loaded
- Check the efficient operation of the geared motor.
- Check the proper operation of the undervoltage release.
- Check the efficient operation of the shunt opening release.
- Check the efficient operation of the shunt closing release.
- Check the efficient operation of the circuit breaker's auxiliary contacts.
- Check the efficient operation of the device for locking the circuit breaker in its open position (with a key or padlock).

Withdrawable versions

In the withdrawable versions, check the efficiency of the mechanics by inserting and withdrawing the circuit breaker from the fixed part of the device, completing the movement by means of the lever provided and making sure that the shutters for segregating the live parts close when the breaker has been withdrawn.

Check the efficient operation of the device for locking the circuit breaker in its open position (with a key or padlock).

Measures to be taken for any operating anomalies

The circuit breaker does not open by pressing the opening pushbutton.											**Anomalies**
	The circuit breaker does not open by shunt opening release YO tripping.										
		The circuit breaker does not open by undervoltage release YU tripping.									
			The circuit breaker does not open by pressing the i-Test push button on the protection release.								
				The circuit breaker does not close by pressing the closing push button.							
					The circuit breaker does not close by shunt closing release YC tripping.						
						The closing springs can not be loaded by manual lever charge.					
							The closing springs can not be loaded by gear motor.				
								The crank handle does not fit in the moving part.			
									The moving part does not rack into the fixed part.		
										The circuit breaker can not be locked in open position.	
										Possible causes	**Checks and remedies**
			▪							Overcurrent shunt opening release is not inserted correctly.	Check the correct connection of the overcurrent shunt opening release.
			▪	▪	▪					Signalling protections are not reset.	Press the mechanical push button for signalling protection tripping.
	▪				▪					Auxiliary circuit supply voltage is too low.	Measure the voltage: it must not be less than 85% of the rated voltage.
	▪				▪					The supply voltage differs from the one indicated on the rating plate of the releases.	Check the rating plate voltage of the releases.
					▪					Operating circuit faulty.	Check connections, fuses, interlocks, protection circuit breakers and consent contacts.
	▪				▪		▪			Wire tightening screws are loose.	Check the tightness of the screws connecting the wires.
	▪				▪		▪			Incorrect electrical connections in the power supply circuit.	Check the connections with the corresponding circuit diagram.
	▪				▪					Release coils interrupted.	Replace the coils.
		▪			▪					Operating mechanism blocked.	Operate by hand. If the fault persists, contact ABB SACE.
				▪	▪					Key lock in open position activated.	Unlock by inserting the key.
				▪	▪					Circuit breaker in intermediate position between connected and test.	Complete the operation.
				▪	▪					Undervoltage release not energized.	Check the corresponding power supply circuit and the supply voltage.
				▪	▪					Shunt opening release remains energized.	Check the power supply circuit.
								▪		Racking-in or out operation is not carried out correctly.	Contact ABB SACE.
▪		▪				▪				Operating mechanism blocked.	Contact ABB SACE.
				▪	▪					Crank handle inserted.	Extract crank handle.
							▪			Circuit breaker in disconnected position.	Rack-in the circuit breaker to connected or test position.
							▪			Fuse intervention to protect the gear motor.	Replace the fuse.
							▪			Failure of the gear motor.	Replace the gear motor.
								▪		Moving part incompatible with the fixed part.	Verify that the mobile part is compatible with the fixed part.
								▪	▪	Circuit breaker in closing position.	Press the opening push button and activate the lock.
									▪	Open-position key lock malfunctioning.	Contact ABB SACE.

Additional instructions for main circuit breaker troubleshooting

Required instruments

Digital multimeter and insulated screwdrivers are needed to perform tasks described in this section.

Downloading fault logger and dataloggers

Before power shut-down, download these data files:

- rotor-side converter fault logger as .txt file,
- rotor-side converter dataloggers.

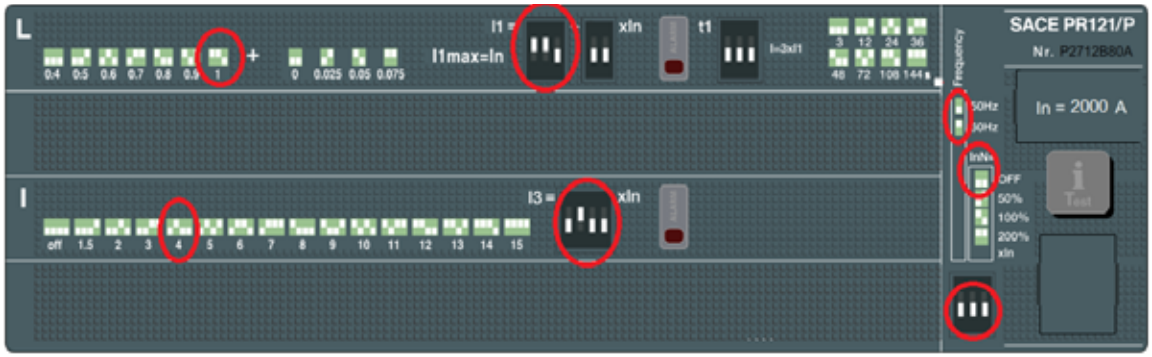
Acquire the SCADA data from turbine control system and fill the ABB warranty report if applicable.

Analysing converter fault loggers

Checking the breaker trip unit settings

Note that the default settings of a spare part breaker may differ from the ones required by the converter operation. Adjust the settings to the converter operation as follows.

Trip Unit	PR121/P LI	Unit	Absolute value
Nominal current In	2000	A	
L Protection I1	1	In	2000
L Protection t1	3	s	
I Protection I3	4	In	8000
Frequency	50	Hz	60 Hz in USA
Neutral configuration	OFF		



Overcurrent trip indication of the circuit breaker

If the circuit breaker overcurrent trip has occurred, blue button TU-TRIP on the breaker panel has popped out mechanically. Trip signal stays active and it is not possible to reset the converter control until TU-TRIP button has been manually reset. Push it back to its normal position on the breaker panel.

The normal position of the trip reset button is as shown in the picture below, otherwise the breaker has tripped.

Emax V2 - PR121/P - The normal position of the trip reset button

When MCB TRIP appears for the first time, there is a speed warning following MCB TRIP fault in the fault logger of the rotor-side converter. If the PLC continues making automatic reset trials after MCB TRIP and TU-TRIP button is out, the fault logger will fill up with MCB TRIP indications and speed warning is not shown anymore.

Example:

2. LAST WARNING +EM STOP (DI1 INU) 2010.09.30 11:20:04
3. LAST WARNING +TRIPPED at 1036 rpm 2010.09.30 11:20:04
4. LAST FAULT +MCB TRIP (DI4 INU) 2010.09.30 11:20:04
5. LAST FAULT -RESET FAULT 2010.09.30 11:18:34

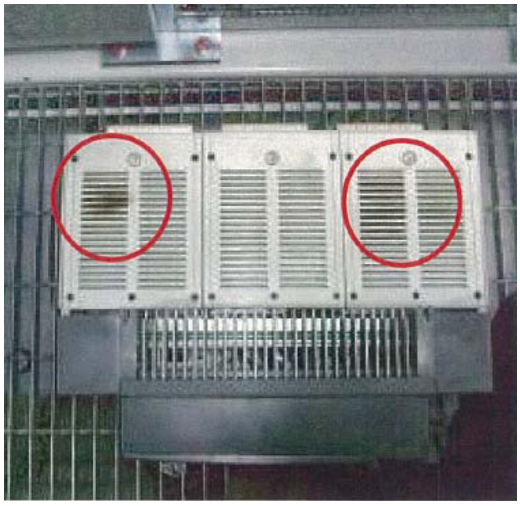
Possible causes of TU trip

Possible causes are:

- Breaker thermal limit (long-term overcurrent) has been exceeded due to control issues or high wind season.
- Instantaneous trip limit of the breaker has been exceeded:
  - short circuit in stator or at the supply transformer secondary,
  - wrong synchronization at breaker closing is causing high current,
  - short circuit at the MV supply.
- Current sensing system of the breaker or the trip unit has been damaged causing nuisance trip. This can happen at low power/speed operation.

What to do:

- Check that the breaker settings are correct according to the application.
- Check breaker visually to see signs of arc or black soot due to possible short circuit. If the breaker body is covered with black soot, there has been really high current at the breaker opening. If there are clear brown or black marks on the top grids of arcing chambers, it is a sign of high current too. If these marks are not fully spread on the arcing chambers top area, the actual breaking current has not been so big. In this case, reset the breaker manually and try again without breaker removal. In the figures below there are examples of arc chambers that contain only light signs of arcing. With these kinds of marks the replacement of the breaker is not necessary.



Light signs of high current in arcing chambers - No need to replace the circuit breaker

Medium signs of high current in arcing chambers - No need to replace the circuit breaker

If any of the top grid area of the arching chambers is fully covered with brown/black marks or if there is any sign of black soot on the breakers body or rear terminals, the breaker must be replaced at once and sent for workshop checking. See the example in the figure below.

Heavy signs of short circuit current - The circuit breaker must be replaced

Before actual next trial, check the power cabinet and the converter visually that there are no signs of short circuit or arc. Check especially the following locations:

- breaker cradle status: are there any signs of arc or short circuit in the internal parts or on the cradles rear terminals,

- stator connections in the bottom of the cabinet,
- power cabinet: AC fuses to the grid-side converter,
- converter power section status (top part of converter modules, DC fuses).

In insulation test with multimeter (1000 V DC) between the main circuit and ground the actual insulation level in the stator and rotor can be seen.

Measurement points are:
- stator phases after the breaker to ground,
- from rotor phases to ground,
- from DC link + and - bars to ground.

Check also if there are indications in the fault logger to see if TU TRIP is included in some other related indications. Typical cause for high breaker current is crowbar operation. Examples of the fault logger indications are:
- CROWBAR TRIP (DI5 INU)
- OVERCURRENT/ROTOR
- EARTH FAULT/INU

Check the behavior of external relays K4, K5 and KA1. Malfunction of these relays can stop the converter operation.

Read the breaker fault logger with a special test adapter BT030 and PC (application software is available in ABB web site) to see if there is a clear high current level in each of three phases. This is a sign that there has been really high current. If only one of the phases indicates high current and the other two phases indicate low or no current, the current measurement chain of one phase is reading erroneously more current than it really is. In this case, replace the breaker.

MCB READY FAULT (DI2 INU)

Breaker version only:

Meaning: UVR coil feedback differs from the converter control command. This fault occurs if there is still difference within 1 s (supervision delay of 1 s).

Turbine starting or running: UVR coil feedback indicates that the coil is de-energized.
- Check UVR microswitch contact and its washer.
- Check the control relay K4.

Turbine stopped: UVR coil feedback indicates that the coil is still energized.
- Check UVR microswitch contact and its washer.
- Check the control relay K4.

If possible, check the UVR coil status by energizing the terminals D1 and D2, and verify that D13-D14 contact status changes (according to Emax documentations). Otherwise install a new UVR+ signalization contact and try to restart the turbine. If MCB READY FAULT persists, replace the breaker.

Breaker and contactor version, firmware version AJXC2300:

Meaning: Breaker status differs from the converter command.
- DI2 INU follows FG008 status when KM052 is closed.
- DI2 INU does not follow FG008 status if KM052 is open.

Turbine starting in case FG008 was originally open: after KM052 closing, FG008 feedback does not indicate it is closed.
- Verify (if possible) that the power was present and UVR is properly energized.

- Check that the control relays K3, K4, K14 and the contact of NCBC board of the crowbar are energized.

Turbine stopped:
- No FG008 related alarms at stopping because it stays closed in normal condition.

MCB1 ACK FLT (DI2 INU)

This indication appears only in breaker and contactor version, firmware version AJXC2320 or later.

Meaning: Breaker status differs from the converter command.
- DI2 INU follows FG008 status when KM052 is closed.
- DI2 INU does not follow FG008 status if KM052 is open.

Turbine starting in case FG008 was originally open: after KM052 closing, FG008 feedback does not indicate it is closed.
- Verify that the breaker has spring charged flag on charged position (yellow).
- Check that the control relays K3 ON, K4 OFF, K14 ON, and the crowbar contact are energized (DC link charged).
- Try to reset and restart the system (PLC etc.) to see if the alarm persists.
- Verify (if possible) that the power was present and UVR is properly energized.
- Replace FG008.

Turbine stopped:
- No FG008 related alarms at stopping because it stays closed in normal condition.

In case the breaker has received an opening command:
- Medium voltage breaker should be open.
- Verify that FG008 is in open position, otherwise FG008 must be replaced.

MCB ACK FAULT (DI3 INU)

This indication appears only in breaker version.
- Check the behavior of the external relays K4, K5 and KA1. They often cause the turbine stop.
- Check that PLC is working properly and that it tries to reset the system at least three times. The three attempts should be delayed for five minutes after each other.
- UPS fail: If the relay controlling the UVR drops due to low voltage, the UVR becomes de-energized and the breaker opens. When the power comes back, the UVR is energized again. Converter has no UPS failure indication. The converter log will show various faults in case of auxiliary power break.
- Check the UPS output voltage and any drops recorded by SCADA system.
- Check that the UPS fault alarm is enabled.

MCB3 ACK FAULT (DI3 INU)

KM052 status differs from the software command. Supervision delay is 0.7 s. This indication is related to the contactor KM052. Do not mix this with breaker FG008.
- MCB1 = FG008
- MCB3 = KM052.

Fault codes summary

Breaker and contactor configuration. Rotor-side converter parameter 16.20 GRID CONNECT MODE set to MCB1+MCB3/C.

FW **NDCU DI**	**AJXC2330**	**Meaning**
DI2 INU	MCB1 ACK FLT (DI2)	FG008 status differs from expected in the software. DI2 INU follows FG008 status when KM052 is closed. DI2 INU does not follow FG008 status if KM052 is open. **Note:** In firmware version AJXC2320 there is a bug causing this trip in case EMERGENCY STOP occurs when the converter is running.
DI3 INU	MCB3 ACK FLT (DI3)	KM052 status differs from the software command, supervision delay is 0.7 s.
DI4 INU	MCB1 TRIP FLT (DI4 INU)	FG008 has tripped. (TU Trip, blue button popped out. Manual reset and inspection required.)
	MCB1 TRIP (IS>LIM)	Converter issues a breaker trip when stator current is too high for KM052 opening (no breaker nor contactor failure). Standard operation. FG008 shall not be replaced. OR In joint with MCB3 ACK FLT (DI3 INU) KM052 does not open when requested to within supervision delay of 0.7 s. Breaker FG008 will be opened due to safety reasons.

Cradle checks

Breaker must be checked without medium voltage connected, and by fully satisfying all safety procedures.

Visual inspection

On the terminal strip of ABB SACE breaker cradle:

- Note if there are any damages.
- Check if the screws of the cradle terminal board are fixed properly.

Check that these cables are wired to the cradle:

- motor (U1-U2),
- contact for spring charged S33M/2 (37-38),
- contact for trip signaling S51 (95-96-98),

- closing coil YC (C1-C2),
- opening coil YO (C11-C12),
- undervoltage YU (D1-D2),
- contact YU de-energized (D13-D14).

Cradle inspection

Version 2: new Emax

U2	38	96	R1	T1	T3	T5	T7	W3	K1	K3	53-K5	51-K7	43-K9
U1	37	95	98	R2	T2	T4	T6	T8	W4	K2	54-K4	52-K6	44-K8

41-K11	33-K13	31-K15	23	21	13	11	W1	C13	C2	C12	D2	D14
42-K10	34-K12	32-K14	24	22	14	12	W2	C3	C1	C11	D1	D13

Short description of the terminals (PR 121/P):

Charge spring motor (+)	U1		U2	Charge spring motor (-)
Contact for spring charged	37		38	Contact for spring charged
Trip contact S51 (com)	95		96	Trip contact S51 (NC)
Trip contact S51 (NA)	98		R1	Reset trip
Reset trip	R2		T1	
	T2		T3	
	T4		T5	
	T6		T7	
	T8		W3	Local bus (A)+
Local bus (B)-	W4		K1	Vaux(+)
Vaux(-)	K2		K3	
Aux Q/9	54-K4		53-K5	Aux Q/9
Aux Q/10	52-K6		51-K7	Aux Q/10
Aux Q/7	44-K8		43-K9	Aux Q/7
Aux Q/8	42-K10		41-K11	Aux Q/8
Aux Q/5	34-K12		33-K13	Aux Q/5
Aux Q/6	32-K14		31-K15	Aux Q/6
Aux Q/3	24		23	Aux Q/3
Aux Q/4	22		21	Aux Q/4
Aux Q/1	14		13	Aux Q/1
Aux Q/2	12		11	Aux Q/2
	W2		W1	
	C3		C13	
Closing coil YC (+)	C1		C2	Closing coil YC (-)
Opening coil YO (+)	C11		C12	Opening coil YO (-)
Undervoltage YU- sec. op. coil YO2(+)	D1		D2	Undervoltage YU- sec. op. coil YO2(-)
YU de-energized	D13		D14	YU de-energized

Terminals wired over the cradle:

U1, U2, 95, 98, 23, 24, 31, 32, 33, 34, 43, 44, C1, C2, C11, C12, D1, D2, D13, D14, 101, 104.

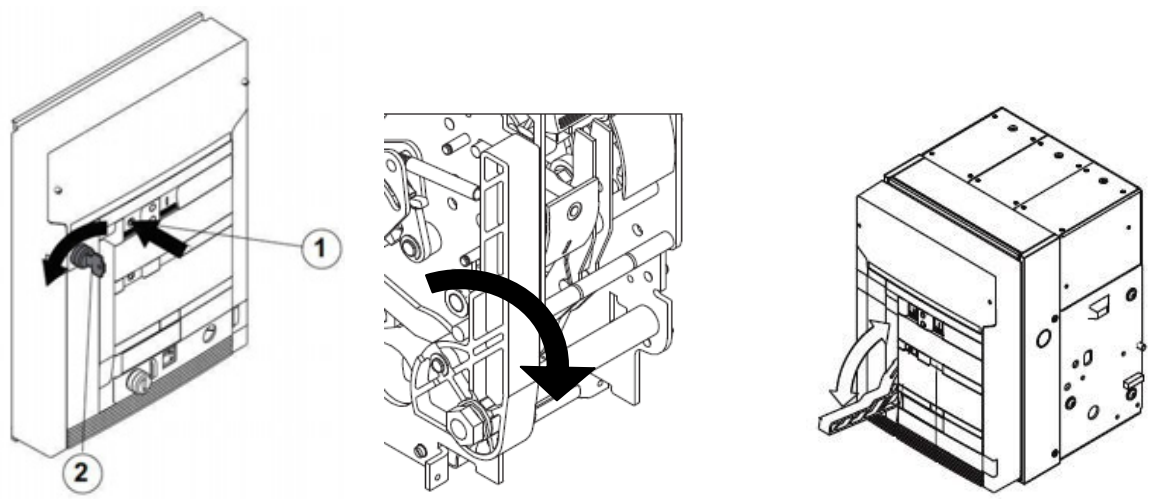
Checks when the breaker is not installed in its cradle

Check the breaker when it is out of the cradle, without medium voltage connected. These operations can be done in windfarm warehouse but not in the wind turbine.

Breaker inspection

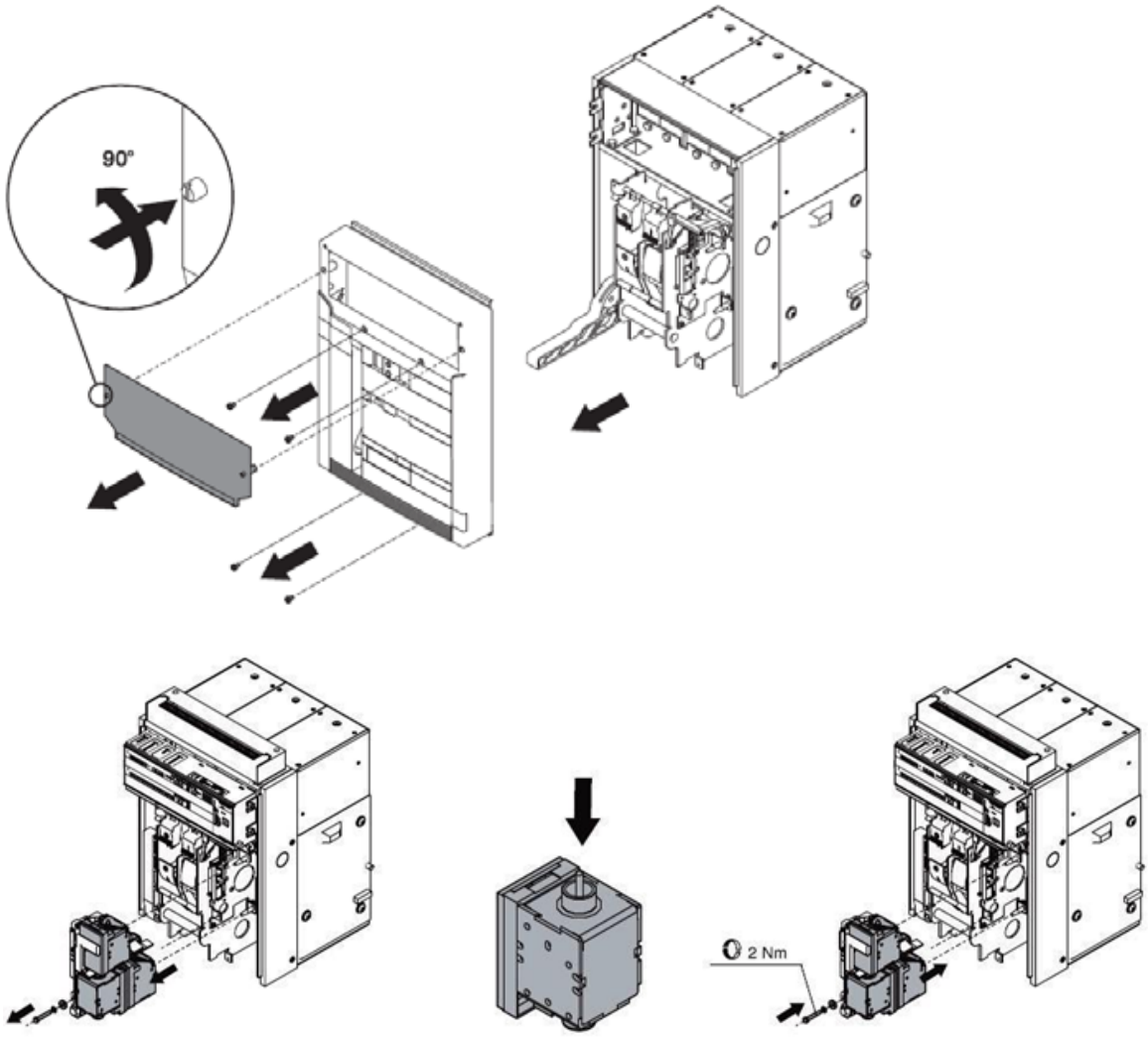
Note: Check that the breaker is in open position, springs charged; otherwise it must be replaced.

- Check manually the operation of the ON-OFF pushbuttons with a proper tool, through tamper-proof protective cover. The opening and closing buttons must not be stuck.
- Check manually the operation of the key-locks in open position by pushing the opening button and turning the key.
- Check manually the operation of the key-locks in connected/insulated/test position by turning the key and pushing the metal lever.
- Check the operation of the main charging handle in both of these conditions:
  - SPRINGS CHARGED: the manual charge of the handle is made void and nothing happens,
  - SPRINGS DISCHARGED: the manual operation of the handle should charge the springs. Circuit breaker must be replaced.



Electrical and mechanical accessories check

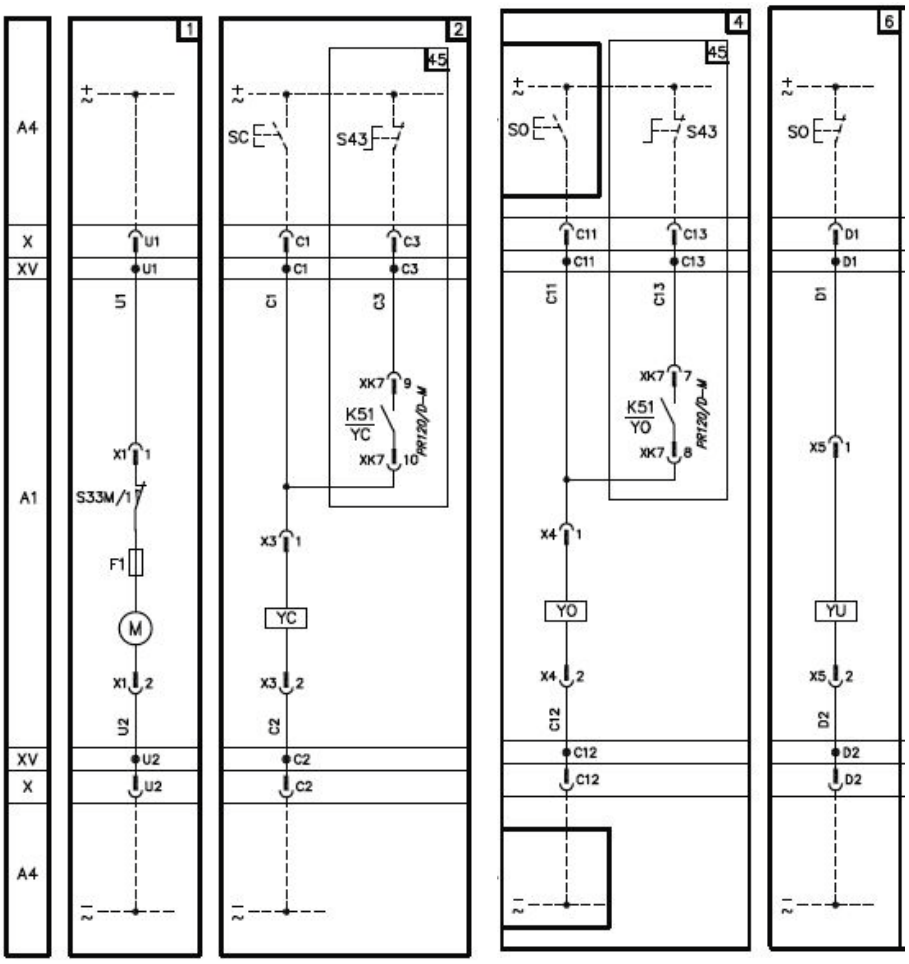
Remove the frontal cover and coils set:



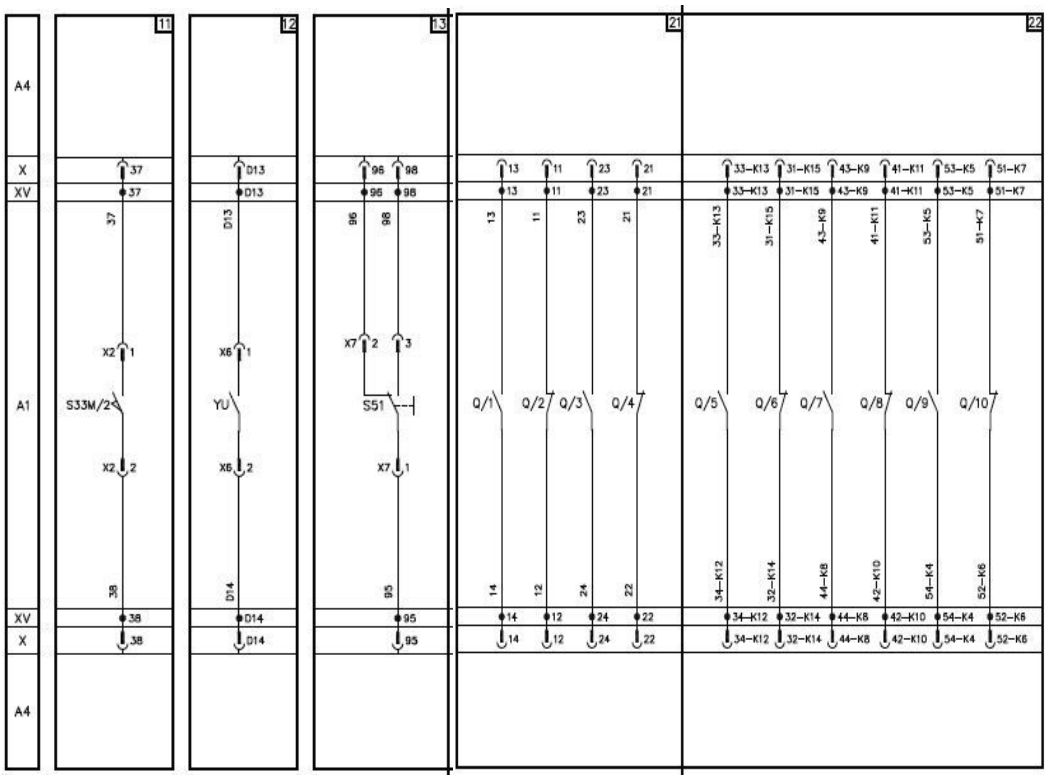
- Check that the accessories are tightly fixed to the breaker.
- Check that the electrical accessories are wired correctly to the switch.
- Check that the releases (YO, YU, YC) are in good condition (no excessive wear, overheating, breakages).
- Check that the mechanical operation counter is operating correctly (if applicable) by running five operations on the switch.

FG008 cradle terminal board schematic

Circuit breaker status is shown in OPEN POSITION, CONNECTED into the cradle, springs discharged.



Circuit breaker status is shown in OPEN POSITION, CONNECTED into the cradle, springs discharged.

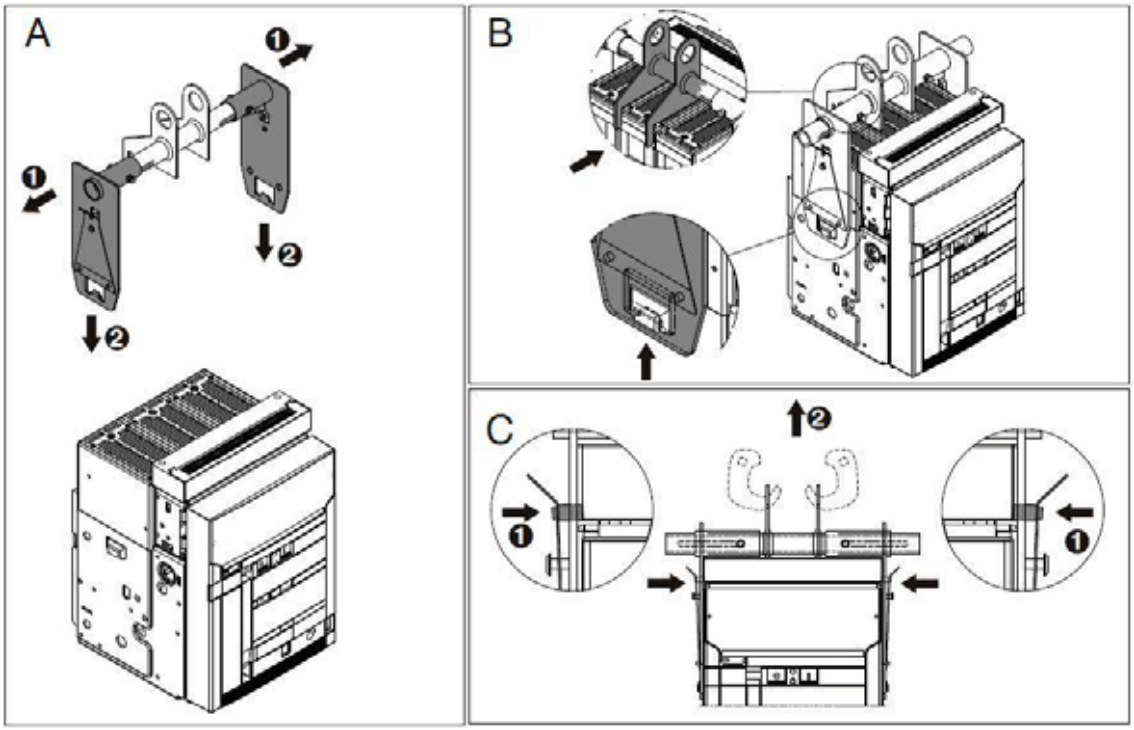


Greasing operations and controls

Perform the greasing procedure according to the ABB document 1SDH000460R0012. The document includes all the actions and skills needed for re-lubricating the main operating mechanism, shafts and pushbuttons.

Lifting

It is recommended to lift the breaker by using ABB SACE Emax lifting device.



Check list

Execute each step and fill in the blanks with results.

WINDFARM	
WIND TURBINE #	
CONVERTER firmware, rotor-side (INU)	
BREAKER s.n.	
BREAKER version (OLD=V1, NEW=V2)	
Number of operations	COUNTER: STICKERS:

#	Actions	Result	
		YES/ Complied	NO/Failed
1	Check that you have required instruments/tools.		
2	Download the converter fault logger, dataloggers and SCADA data.		
3	Troubleshoot the turbine by using this instruction.		
4	Take photos of the cradle, circuit breaker and wirings.		
5	Note if there are any damages.		
6	Check if the trip reset blue button is popped out.		
7	Check that the trip unit settings match the standard configuration.		
8	Check manually the operation of the ON-OFF pushbuttons.		
9	Check manually the operation of the key-locks.		
10	Check manually the operation of the charging springs handle.		

If all the above steps are complied, do the following steps; the circuit breaker must be connected position into the cradle, and OPEN, springs charged.

#	Actions	Result	
		YES/ Complied	NO/Failed
11	Use the troubleshooting matrix, if needed, to identify the fault condition.		
12	Execute the continuity test between terminals C1 and 31: Low impedance.		
13	Execute the continuity test between terminals 43 and 44: Open circuit.		
14	Execute the continuity test between terminals 31 and 32: Low impedance.		
15	Execute the continuity test between terminals 101 and 104: Low impedance.		
16	Execute the continuity test between terminals D14 and 44 and 95: Low impedance.		
17	Execute the continuity test between terminals 95 and 96: Low impedance.		
18	Execute the continuity test between terminals 23 and 24: Open circuit.		
19	Execute the continuity test between terminals 33 and 34: Open circuit.		
20	Execute the continuity test between terminals C11 and 23: Low impedance.		
21	Execute the continuity test between terminals 21 and 22: Low impedance.		
22	Execute the continuity test between terminals D13 and D14: Open circuit.		
23	Print this page and attach it to each breaker to be sent to ABB.		

9

Technical data

What this chapter contains

This chapter contains technical data of the ICU800-67LC, eg, ratings and component information. For other technical data, see *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

Ratings

ACS800-67LC converter types and corresponding ICU800-67LC types with ratings are given below.

Converter type	Power cabinet type	Approx. generator rating *P* [kW]	Stator connection *I* [A AC]	Grid connection *I* [A AC]	Grid-side converter connection *I* [A AC]
ACS800-67LC-1075/0575-7	ICU800-67LC-1075/0575-7	1500	1255	1395	480
ACS800-67LC-1375/0575-7	ICU800-67LC-1375/0575-7	2250	1882	2092	480
ACS800-67LC-1375/1125-7	ICU800-67LC-1375/1125-7	2600	2176	2417	941
ACS800-67LC-1595/0865-7	ICU800-67LC-1595/0865-7	3000	2510	2789	720

Derating

See *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

Main circuit breakers and stator contactors

Converter type	Main circuit breaker			Stator contactor	
	IEC	UL	Order code	Type	Order code
ACS800-67LC-1075/0575-7	E3S20	E3S20	3AUA0000082902	1 × AF1650	64731378
ACS800-67LC-1375/0575-7	E3S25	E3S25	3AUA0000071904	2 × AF1650	64731378
ACS800-67LC-1375/1125-7	E3S32	E4S32	3AUA0000081255	2 × AF2050	3AUA0000051805
ACS800-67LC-1595/0865-7	E4S40	E4S36	3AUA0000054928	2 × AF2050	3AUA0000051805

Fuses

Voltage measurement fuses

Converter type	Fuse type	MRP code	Fuse holder MRP code
All	A070GRB06T13	3AUA0000054244	64674978

Dimensions, weights and free space requirements

Converter type	Height (mm) 1)	Depth (mm)	Width (mm)	
			option +C108	option +C109
ACS800-67LC-1075/0575-7	2000	644	2200	800
ACS800-67LC-1375/0575-7	2000	644	2200	800
ACS800-67LC-1375/1125-7	2000	644	2400	800
ACS800-67LC-1595/0865-7	2000	644	2600	800

400 mm free space is needed above to allow opening of pressure relief lids (that open automatically upon arc fault). Lids need at least 200 mm space to open.

150 mm free space is needed at the right-hand side for the control cable plug-in connectors.

115 mm free space is needed at the right or left hand side of the power cabinet for the cooling pipe connections (depending on which side the cooling connections are).

Losses and cooling data

The power cabinet is liquid cooled without any external air flow. Heat losses are removed with air-to-liquid heat exchanger utilizing forced air cooling. Cooling air is circulated with fixed speed fan.

If option +C109 is selected, the liquid pipe connection(s) are equipped with G2" external spiral. Length of external spiral is 30 mm.

For further information, see *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

Internal cooling circuit data

See *ACS800-67LC wind turbine converters hardware manual* [3AUA0000058400 (English)].

Terminal and lead-through data for the power cables

For description of lead-through types, see chapter *Operation principle and hardware description*, page *24*.

Cable terminals	Screw size	Tightening torque
Grid busbars (L1, L2, L3)	M12	70 N·m (52 lbf·ft)
Stator busbars (U, V, W)	M12	70 N·m (52 lbf·ft)
PE terminals	M12	70 N·m (52 lbf·ft)

Note: In the USA and Canada, all lead-through components with UL Type 12 to fulfil the requirements of degree of protection UL Type 12. This includes power cables, control cables, user connections and 230 V AC supply cable.

Terminal and lead-through data for the control cables

The control cables are internally wired. The counterpart connector data is given in the table below.

Terminal	Identification	Type	Part number	Qty
X106.1	Han 16A Crimp terminal	Female insert (F)	09 20 016 3101	1
	Han 1.0 mm^2	Crimp contact female	09 33 000 6205	16
	Han 16A	Hood	19 20 016 1440	1
		Cable gland M20		1
X106.2	Han 16A Crimp terminal	Female insert (F)	09 20 016 3101	1
	Han 1.0 mm^2	Crimp contact female	09 33 000 6205	16
	Han 16A	Hood	19 20 016 1440	1
		Cable gland M20		1
X109	Han 4A Screw terminal	Male insert (M)	09 20 004 2611	1
	Han 3A	Hood	19 20 003 1440	1
		Cable gland M25		1
X108.1	Han Hv E Screw terminal	Male insert (M)	09 34 006 2601	1
	Han 16B	Hood	19 34 006 0421	1
		Cable gland M25		1
X108.2	Han Hv E Screw terminal	Male insert (M)	09 34 006 2601	1
	Han 16B	Hood	19 34 006 0421	1
		Cable gland M25		1
X110	Han 10A Crimp terminal	Female insert (F)	09 20 010 3101	1
	Han 2.5 mm^2	Crimp contact female	09 33 000 6202	10
	Han 10A	Hood	19 20 010 1440	1
		Cable gland M20		1
X180	Han Hv E Screw terminal	Male insert (M)	09 34 006 2601	1
	Han 16B	Hood	19 34 006 0421	1
		Cable gland M25		1
X190	Han 10A Crimp terminal	Male insert (M)	09 20 010 3001	1
	Han 1.0 mm^2	Crimp contact male	09 33 000 6104	10
	Han 10A	Hood	19 20 010 1440	1
		Cable gland M20		1

Stator circuit current transformers (phases L1 and L3)

Converter type	Transformer type (IEC)	Order code	Transformer type (UL)	Order code	Qty
ACS800-67LC-1075/0575-7	HF6, 2000 A	3AUA0000077334	HF6, 2000 A	3AUA0000077334	2
ACS800-67LC-1375/0575-7	HF6, 2500 A	3AUA0000071867	HF6, 2500 A	3AUA0000071867	2
ACS800-67LC-1375/1125-7	HF6, 3000 A	35079025	HF8A, 3000 A	3AUA0000091731	2
ACS800-67LC-1595/0865-7	HF8A, 4000 A	3AUA0000060209	HF8A, 4000 A	3AUA0000060209	2

Degree of protection

IP54 as standard. UL Type 12 is available as an option (+C129).

Auxiliary circuit current consumption

Cooling fans

Unit	Type
ICU800	R2E225-BD92-12

UPS supply

Voltage 230 V AC ± 5%, frequency 50 Hz or 60 Hz, typical power consumption < 500 W, maximum power and current consumption 5000 W / RMS 20 ms and 25 A / RMS 20 ms at start-up.

Non-UPS supply

Voltage 230 V AC ± 5%, frequency 50 Hz or 60 Hz, typical continuous power consumption < 2000 W, maximum peak power and current consumption < 4000 W / RMS 20 ms, maximum I_{peak} = 20 A. **Note:** These are maximum values when the delivery contains power cabinet.

Overvoltage protection (option +F281)

Overvoltage protection (Type 2) is connected to the main circuit terminals after the main circuit breaker.

Converter type	Device type	MRP code	Qty
All	Strikesorb 80-D	3AUA0000061420	3

Grid power measurement (option +G335)

Converter type	Transformer type (IEC)	Order code	Transformer type (UL)	Order code	Qty
ACS800-67LC-1075/0575-7	HF6, 2000 A	3AUA0000077334	HF6, 2000 A	3AUA0000077334	3
ACS800-67LC-1375/0575-7	HF6, 2500 A	3AUA0000071867	HF6, 2500 A	3AUA0000071867	3
ACS800-67LC-1375/1125-7	HF6, 3000 A	35079025	HF8A, 3000 A	3AUA0000091731	3
ACS800-67LC-1595/0865-7	HF8A, 4000 A	3AUA0000060209	HF8A, 4000 A	3AUA0000060209	3

Auxiliary power supply 63 A (option +G399)

IEC

Switch fuse	MRP code	Fuse type	MRP code
OS160D03W-71	64745123	63NH00GG	68298962

UL

Switch fuse	MRP code	Fuse type	MRP code
OS100J03	68371601	LPJ-70SP	68369517

Auxiliary power supply 80 A (option +G398)

IEC

Switch fuse	MRP code	Fuse type	MRP code
OS160D03W-71	64745123	80NH00GG	68286697

UL

Switch fuse	MRP code	Fuse type	MRP code
OS100J03	68371601	LPJ-80SP	68406331

Auxiliary power supply 100 A (option +G397)

IEC

Switch fuse	MRP code	Fuse type	MRP code
OS160D03W-71	64745123	100NH00GG	68298962

UL

Switch fuse	MRP code	Fuse type	MRP code
OS100J03	68371601	LPJ-100SP	68369550

Auxiliary power supply 125 A (option +G396)

IEC

Switch fuse	MRP code	Fuse type	MRP code
OS160D03W-71	64745123	125NH00GG	68882486

Auxiliary power supply 160 A (option +G409)

IEC

Switch fuse	MRP code	Fuse type	MRP code
OS160D03W-71	64745123	6,9URD000PV160	10003521

10

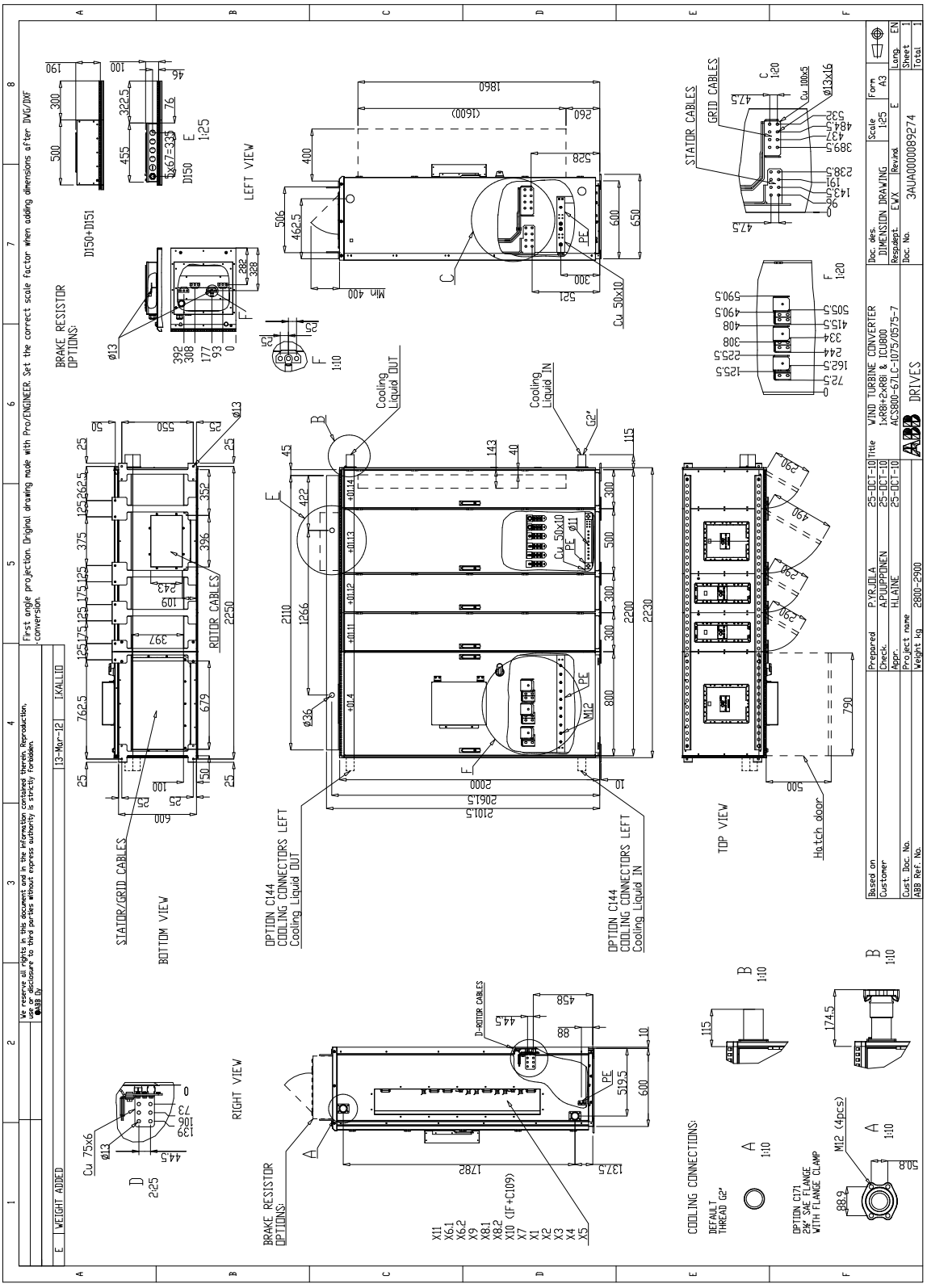
Dimension drawings

What this chapter contains

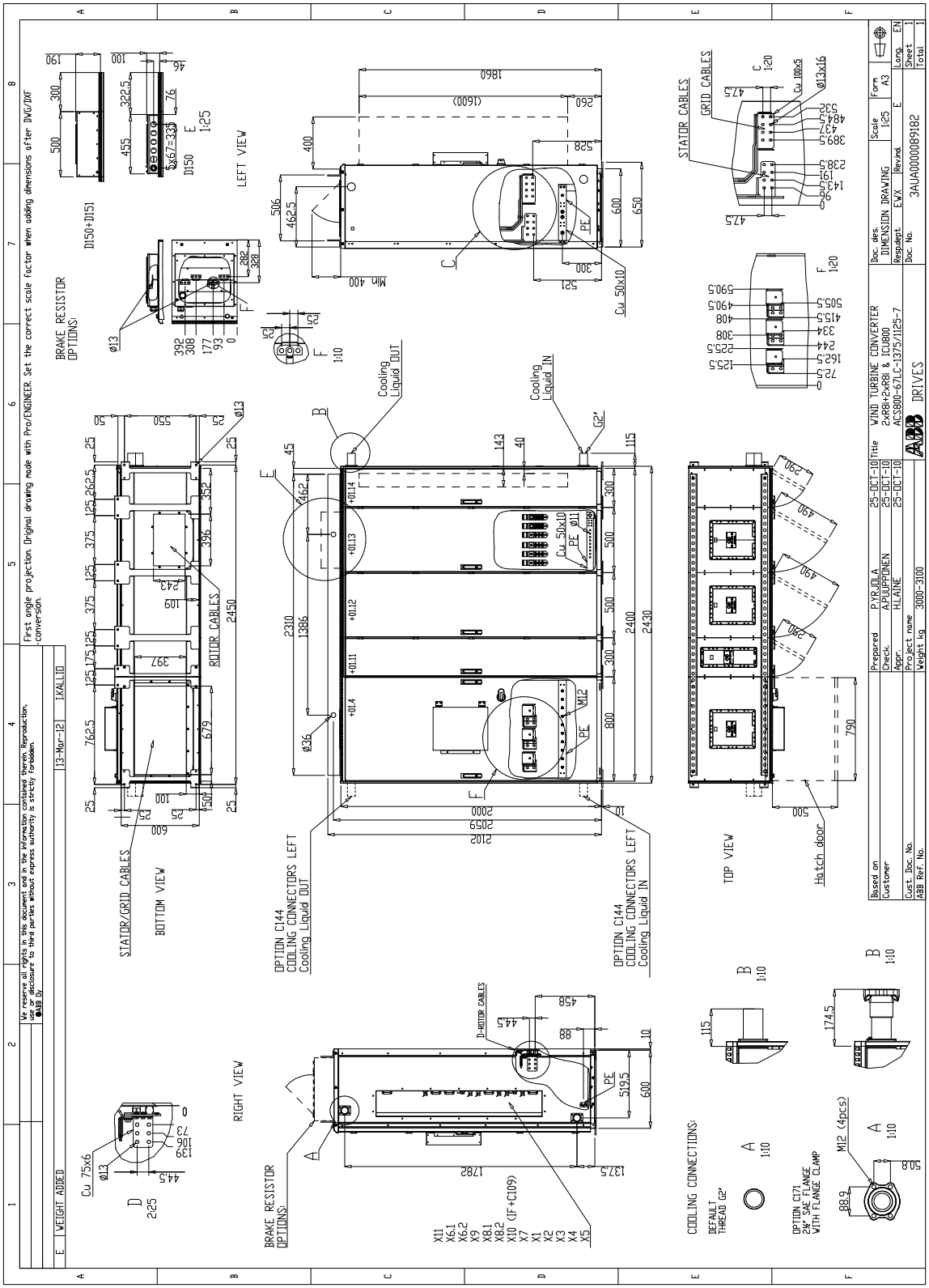
This chapter contains example dimensional drawings. Example lead-through drawings are included. The example drawing set helps in understanding the structure of the converter.

WARNING! These drawings are not intended for mechanical installation and cable lead-through purposes as they most probably differ from a customized unit. The customer-specific drawings are included in the delivery.

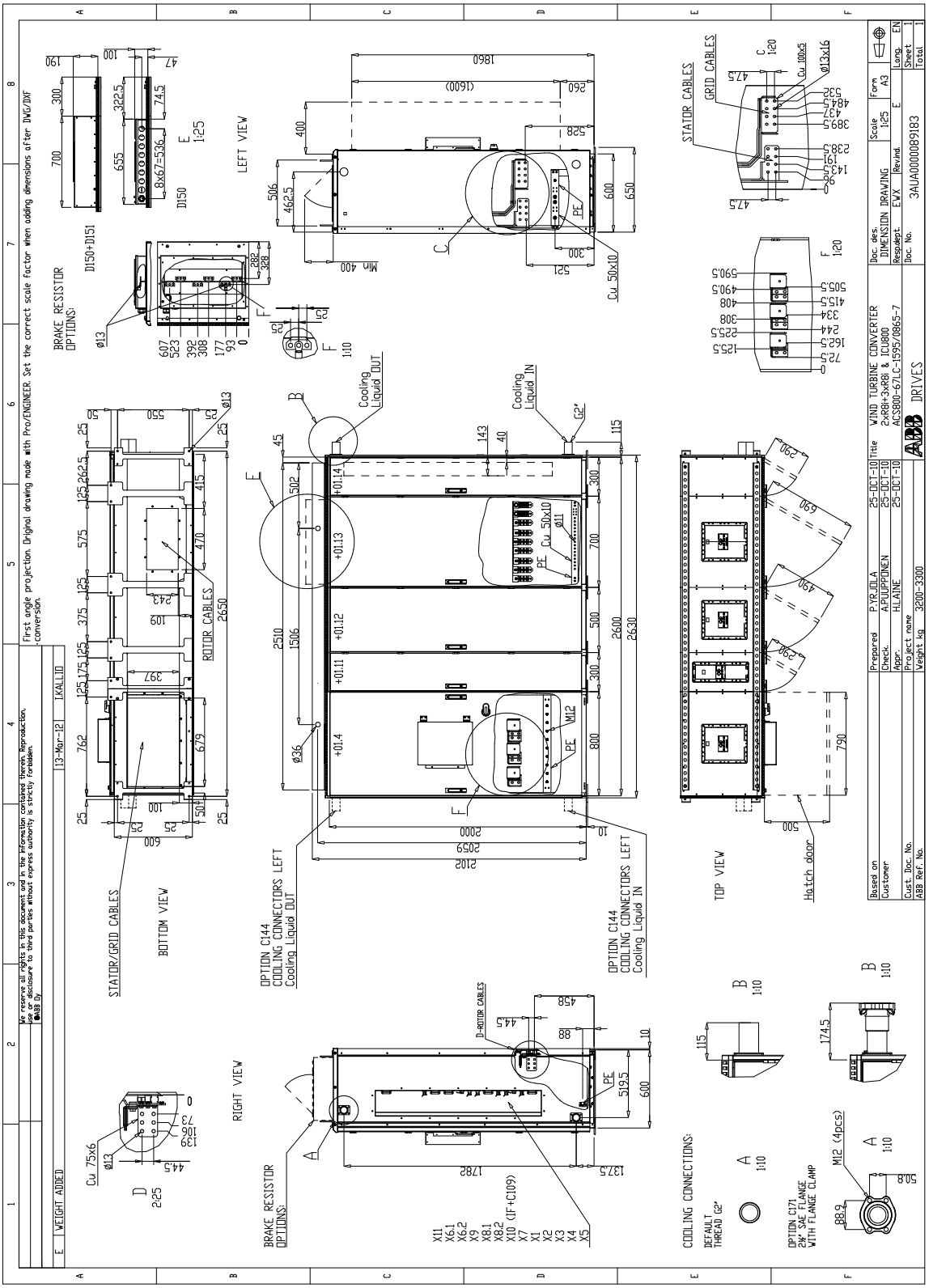
ACS800-67LC-1075/0575-7 and -1375/0575-7 with option +C108



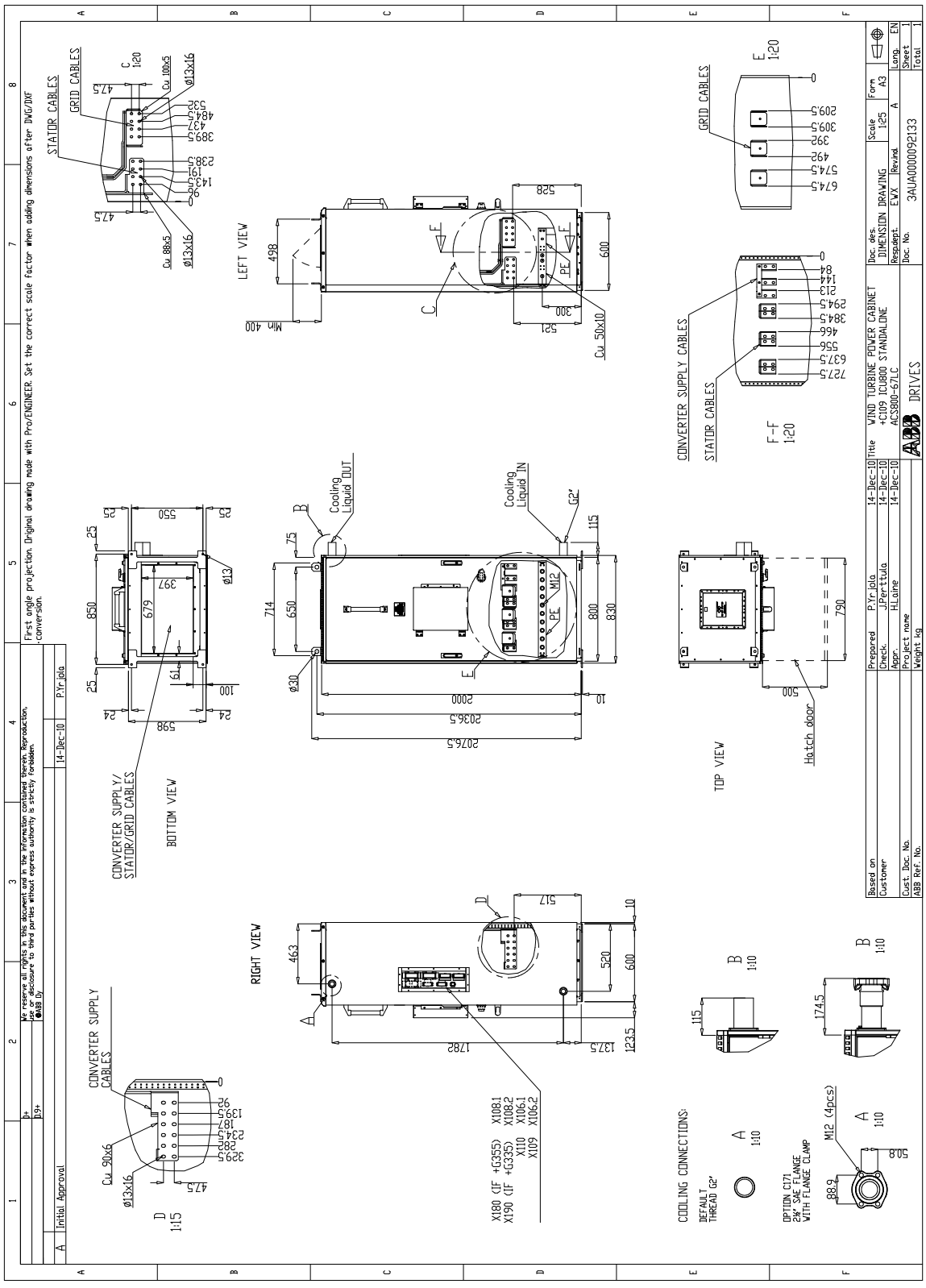
ACS800-67LC-1375/1125-7 with option +C108



ACS800-67LC-1595/0865-7 with option +C108



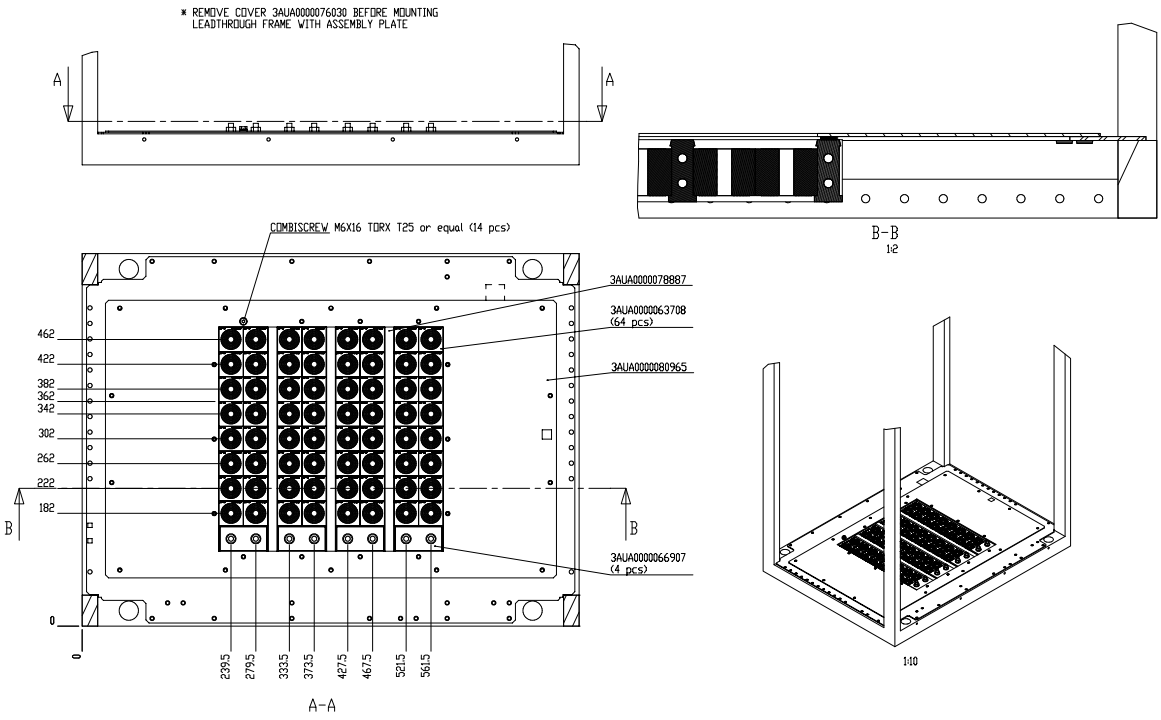
Stand-alone power cabinet (option +C109)



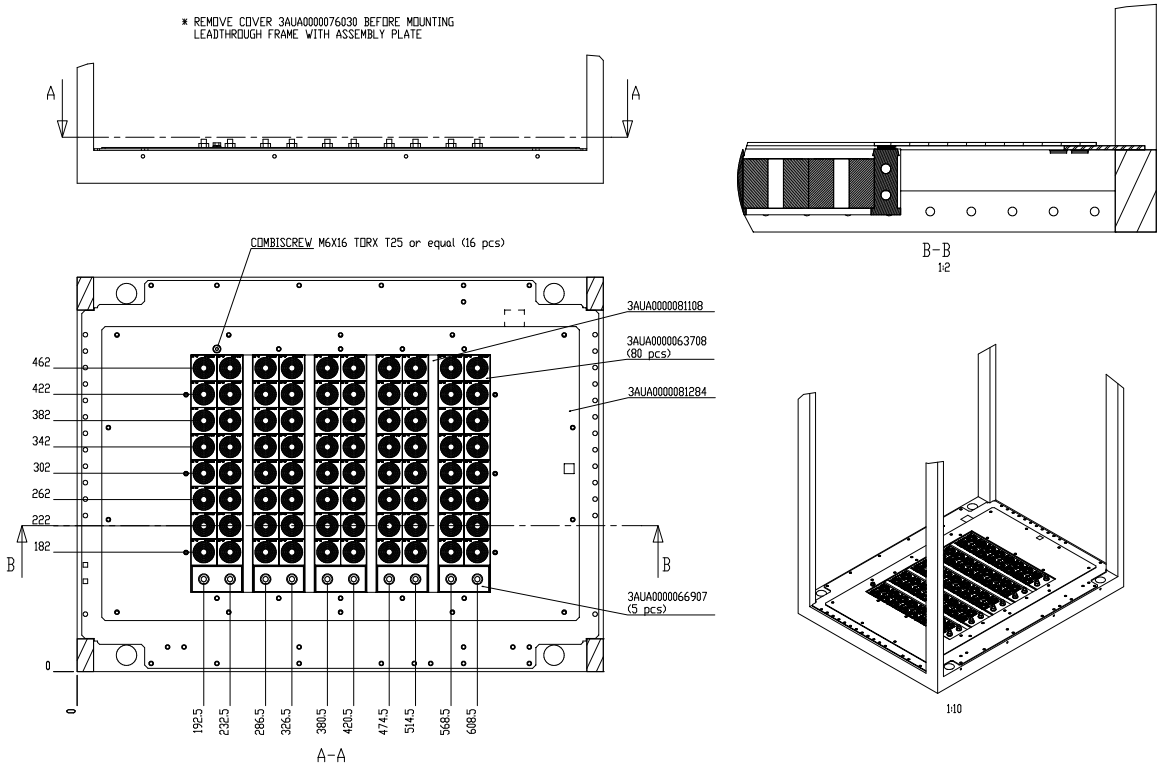
Sealing modules

Dimensions and illustrations for optional sealing modules in power cabinet are presented below.

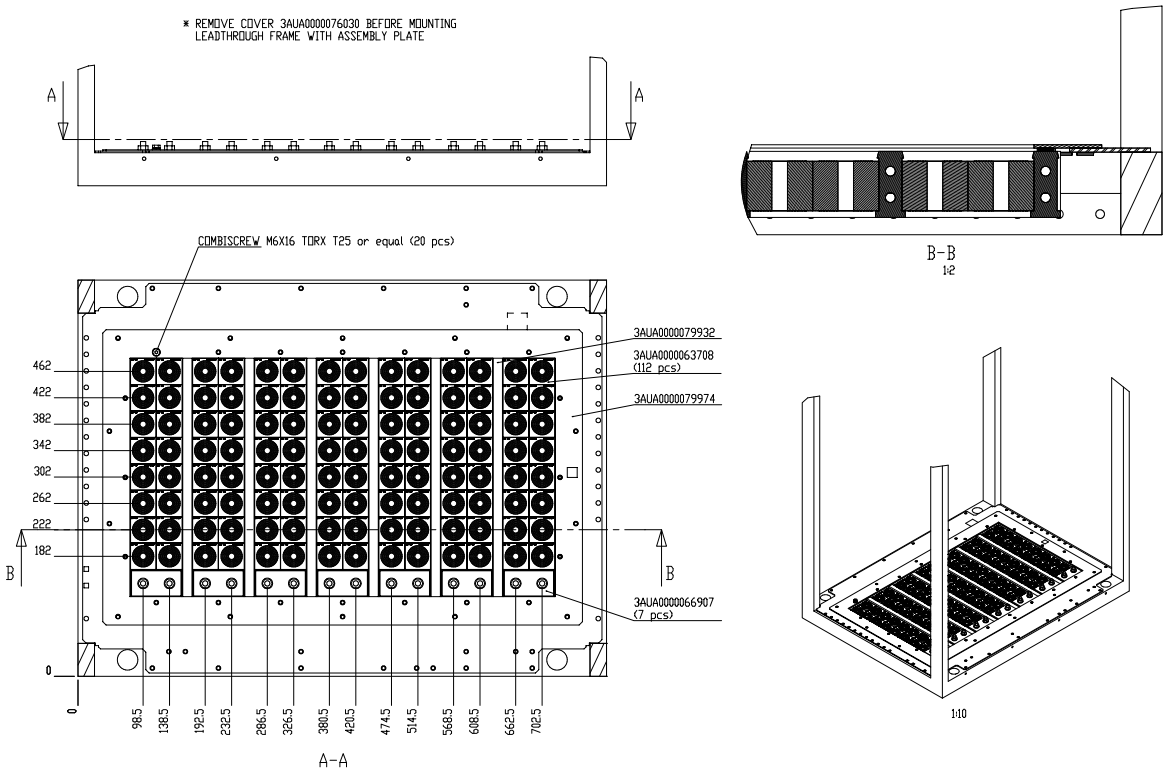
Option +1H374



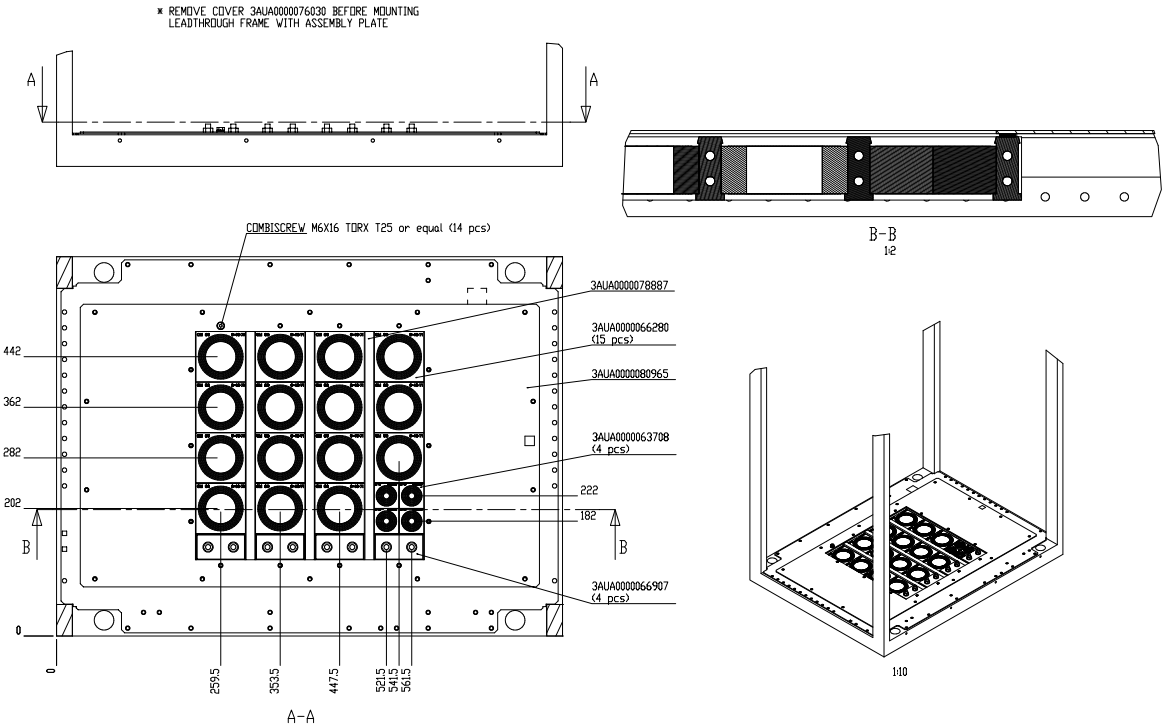
Option +2H374



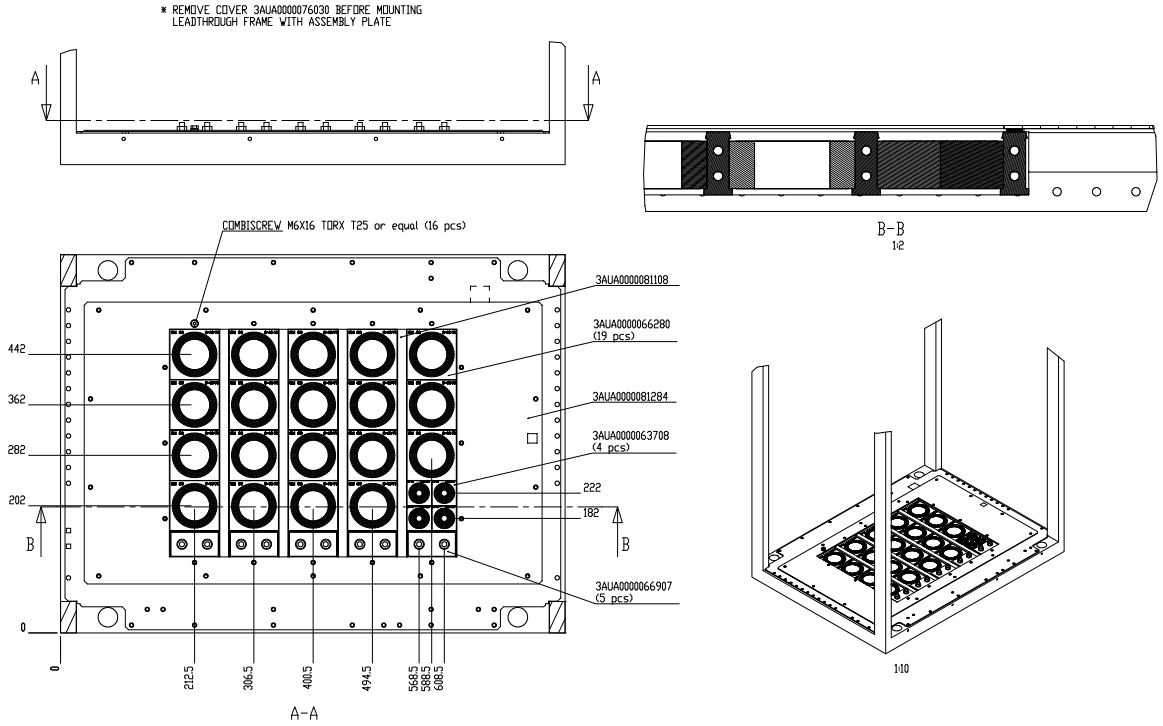
Option +3H374



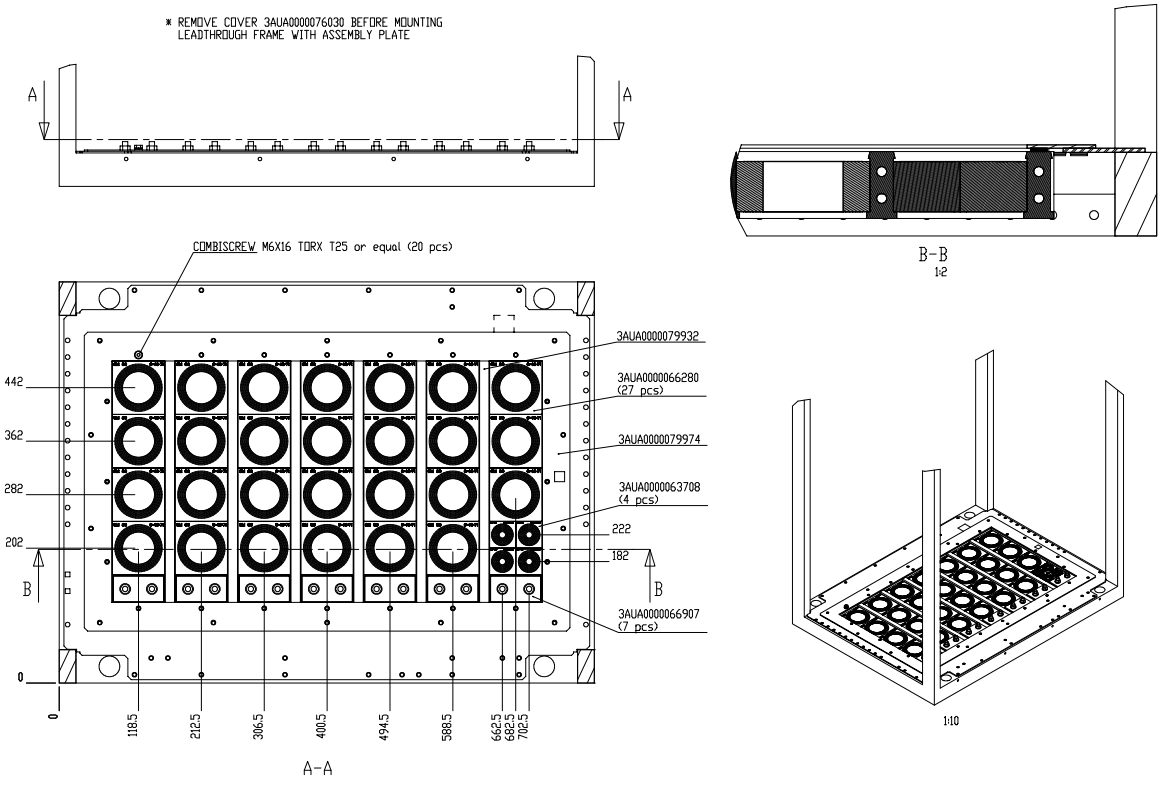
Option +1H380



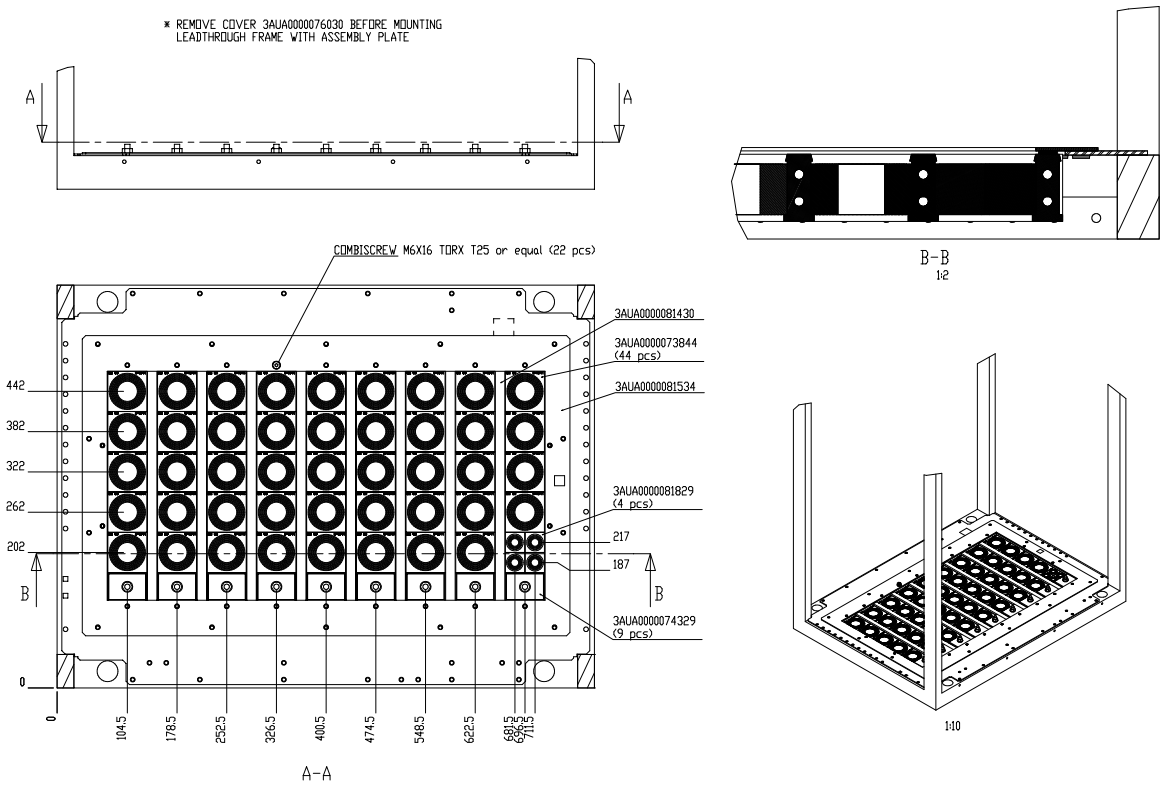
Option +2H380



Option +3H380



Option +H379


* REMOVE COVER 3AUA0000076030 BEFORE MOUNTING
LEADTHROUGH FRAME WITH ASSEMBLY PLATE
A
A
COMBISCREW M6X16 TORX T25 or equal (22 pcs)
3AUA0000081430
3AUA0000073844
(44 pcs)
3AUA0000081534
3AUA0000081829
(4 pcs)
217
187
3AUA0000074329
(9 pcs)
442
382
322
262
202
B
B
0
0
104.5
178.5
252.5
326.5
400.5
474.5
548.5
622.5
681.5
696.5
711.5
A-A
B-B
1:2
1:10

Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/drives and selecting *Sales, Support and Service network*.

Product training

For information on ABB product training, navigate to www.abb.com/drives and select *Training courses*.

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Your comments on our manuals are welcome. Go to www.abb.com/drives and select *Document Library – Manuals feedback form (LV AC drives)*.

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