ABB WIND TURBINE CONVERTERS

ACS800-67LC wind turbine converters

Hardware manual

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 and quick guides for I/O extension modules, fieldbus adapter, etc.	

For manuals, contact your local ABB representative.

Hardware manual

ACS800-67LC wind turbine converters

3AUA0000058400 Rev C
EN
EFFECTIVE: 2018-11-09

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4. Mechanical installation

5. Planning the electrical installation

6. Electrical installation

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1

Safety instructions

What this chapter contains

This chapter contains safety instructions which you must follow when installing, operating and servicing the wind turbine converter. If ignored, physical injury or death may follow, or damage may occur to the converter, the generator or driven equipment. Read the safety instructions before you work on the converter.

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 converter 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 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 converter!
- Before working in the incoming cubicle, isolate the whole converter from the electrical power supply network. The load switch disconnector (option +C111) or air circuit breaker (options +C108/+109) does not remove the voltage from the grid-side connection terminals of the converter.
- Never work on the converter or generator when input power is applied. After disconnecting the input power, always wait for 10 minutes to let the intermediate circuit capacitors discharge before you start working on the converter or generator. Always ensure by measuring with a multimeter the voltage between the power terminals and earth and DC link and earth that the converter does not have any live parts before beginning work.
- Apply temporary grounding before working on the unit. The converter does not have internal grounding device, therefore external equipment is required.
- Do not work on the control cables when input power is applied to the converter or to the external control circuits. Externally supplied control circuits (eg, UPS) may carry dangerous voltage even when the input power of the converter is switched off.
- Live parts inside the cubicle are protected against direct contact. However, pay special attention when handling metallic shrouds. The cabinet is protected to IP54 only when doors are closed.
- Do not make any withstand voltage tests on the converter.
- Isolate the cables from the converter when testing the insulation resistance or withstand voltage of the power cables or the generator.
- When reconnecting the cables, always check that the phase order is correct.

Note:

- The rotor cable terminals may contain a dangerously high voltage when the input power is on, 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.
- Depending on the external wiring, dangerous voltage (115 V or 230 V) may be present on the relay outputs of the converter system.

WARNING!

- Use extreme caution when manoeuvring heavy converter or filter modules.
- Beware of hot surfaces. Some parts inside the converter cabinet, such as power modules or crowbar(s), 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 converter when installing. Electrically conductive dust inside the converter 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 converter. Incorrect grounding can cause physical injury, death or equipment malfunction and increase electromagnetic interference.

WARNING!

- Ground the converter, the generator 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 local safety regulations.

Note:

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

General safety

Printed circuit boards

WARNING! The printed circuit boards contain components sensitive to electrostatic discharge. Wear a grounding wrist band when handling the boards. Do not touch the boards unnecessarily.

Fiber optic cables

WARNING! Handle the fiber optic cables with care. When unplugging optic cables, always grab the connector, not the cable itself. Do not touch the ends of the fibers with bare hands as the fiber is extremely sensitive to dirt. The minimum allowed bend radius is 35 mm (1.38 in.).

Work with an installation stand and lifting

Note: The installation stand is not included as standard in the delivery. Please contact local ABB representative for further inquires regarding installation stand.

WARNING!

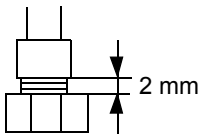
- Attach a lifting chain to the front of the module before pulling out the entire module from the cabinet.
- Ensure that the installation stand legs have been locked in position before moving a module onto it.
- Ensure that the lifting chains have been evenly adjusted before lifting the module.
- Do not go under a lifted module or lift a module over other people.

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 converter 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…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 liquid 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 converter or operate the converter. Ignoring the instructions can cause physical injury or death or damage to the equipment.

WARNING!

- Before adjusting the converter and putting it into service, make sure that the generator and all driven equipment are suitable for operation throughout the speed range provided by the converter.
- The doors of the converter must be kept locked when the converter is in operation.
- Before power switch-on, make sure that the liquid cooling circuit is filled up with coolant. Running the pump dry will damage it and the converter will not cool down.
- Do not control the generator with the disconnecting device (means); instead, use the commands via I/O board of the converter or via fieldbus.

Note:

- It is not allowed to start-up the converter more often than once in two minutes during commissioning. In normal use it is not allowed to do repetitive start-ups more often than once in 10 minutes. Avoid frequent start-ups.
- If an external source for start command is selected and it is ON, the converter will start immediately after fault reset unless the converter is configured for a pulse start/stop by a parameter.

WARNING! Do not work on the converter when the generator is rotating. Also, when the input power is switched off and the converter is stopped, a rotating generator may feed power to the intermediate circuit of the converter and the power connections become live.

- Before installation and maintenance work on the 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 converter power terminals:
Alternative 1) Disconnect the generator from the converter with a safety switch or by other means. Measure that there is no voltage present on the converter grid-side or rotor-side terminals (L1, L2, L3, U2, V2, W2, UDC+, UDC-).
Alternative 2) Measure that there is no voltage present on the grid-side or rotor-side terminals of the converter (L1, L2, L3, U2, V2, W2, UDC+, UDC-). Ground the converter grid-side and rotor-side 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. It contains a flowchart of steps in checking the delivery, installing and commissioning the converter. The flowchart refers to chapters/sections in this manual and other manuals.

Applicability

The manual is compatible with ACS800-67LC wind turbine converters.

Target audience

This manual is intended for people who plan the installation, install and service the converter. Read the manual before working on the converter. 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. Both SI and imperial units are shown where applicable.

Purpose of the manual

This manual instructs in planning the installation, installing and maintaining the converter.

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 converter.

Operation principle and hardware description describes the operation and construction of the converter.

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

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

Electrical installation instructs in cabling and wiring of the converter.

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

Maintenance contains preventive maintenance instructions.

The internal cooling circuit describes the cooling system of the converter.

Technical data contains the technical specifications of the converter, eg, ratings, frame sizes and technical requirements and provisions for fulfilling the requirements for CE and other markings.

Dimension drawings contains dimension drawings of the converter.

Related documents

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

Categorization by frame size and option code

This manual deals with the wind turbine converters made of the modules of the frame size R8i. The frame size of each converter type is indicated in section *Type equivalence table* on page *123*.

The instructions, technical data and dimensional drawings which concern only certain optional selections are marked with + codes (eg, +K454). The options included in the converter can be identified from the + codes visible on the type designation label. The + code selections are listed in chapter *Operation principle and hardware description* under *Type designation key*.

Quick installation, commissioning and operation flowchart

Task	See / Action
Plan the installation. Check: ambient conditions, ratings, required external cooling circuit arrangements, input power connection, compatibility of the generator, generator connection, etc. Select the cables.	*Technical data,* page *121* *Planning the electrical installation,* page *53* Option manuals (if optional equipment is included)
↓	
Unpack and check the units. Check the type code indicated on the type designation label against the original order. Check that all necessary optional modules and equipment are present and correct. If the converter has been non-operational for more than one year, reform the converter DC link capacitors. **Only intact units may be started up!**	*Checking the delivery,* page *44* Contact your local ABB representative.
↓	
Check the installation site.	*Checking the installation site*, page *43*
↓	
Route the cables.	*Routing the cables,* page *62*
↓	
Mount the cabinet line-up.	*Mechanical installation,* page *43*
↓	
Connect the liquid cooling connections.	*The internal cooling circuit,* page *113*
↓	
Check the insulation of the generator and the rotor cable.	*Checking the insulation of the assembly,* page *67*
↓	
Connect the power cables. Connect the control and the auxiliary control cables.	*Electrical installation,* page *67*
↓	
Check the installation.	*Installation checklist,* page *87*
↓	
Commission the converter.	*ACS800-67LC system description and start-up guide* [3AUA0000059432 (English)] and *ACS800-67(LC) doubly-fed induction generator control program firmware manual* [3AUA0000071689 (English)]

Terms and abbreviations

Term/Abbreviation	Explanation
AGDR	Gate driver control board (interface to IGBTs)
AINT	Main Circuit Interface Board
AMC	Application and Motor Controller Board. Part of the NDCU Drive Control Unit
APBU	Optical branching unit for fiber links that use the PPCS protocol. The unit is used for connecting parallel-connected inverter modules to the RDCU/NDCU.
APOW	Power Supply Board
Auxiliary control cubicle (ACU)	The cubicle with auxiliary devices such as auxiliary voltage circuit breakers, control electronics, measurement boards, etc.
DC (brake) chopper	Conducts the surplus energy from the intermediate circuit of the converter to the DC (brake) resistor when necessary. The chopper operates when the DC link voltage exceeds certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia generator. DC chopper type ABRU is used in ACS800-67LC.
DC (brake) resistor	Dissipates the converter surplus braking energy conducted by the DC chopper to heat. Essential part of the chopper circuit. See *DC (brake) chopper*.
Converter	Converts electric power from one form to another.
Cubicle	One section of a cabinet-installed wind turbine converter. A cubicle is typically behind a door of its own.
Crowbar	Conducts the surplus energy from the rotor circuit of the converter to the resistor when necessary. The crowbar operates when the DC link voltage or rotor circuit current exceeds certain maximum limit. The voltage rise is typically caused by grid failures like voltage dips (sags). Crowbar type ACBU is used in ACS800-67LC.
DC link	DC circuit between grid-side converter and rotor-side converter
DC link capacitors	Energy storage which stabilizes the intermediate circuit DC voltage.
DDCS	Distributed Drives Communication System. Communication protocol used with fiber optic link.
DTC	Direct Torque Control
EMC	Electromagnetic Compatibility
Frame (size)	Refers to power modules that share a similar mechanical construction, for example: • converter or converter/inverter modules of frame R8i • frame 2×R8i + 1×R8i includes two size R8i inverter modules and one size R8i supply module. To determine the frame size of a component, refer to the rating tables in chapter *Technical data*.
Grid-side converter	A converter that is connected to the power supply network (grid) and is capable of transferring energy from the converter DC link to the grid and vice versa. The grid-side converter is also called ISU.
IGBT	Insulated gate bipolar transistor
IGBT supply module	Bidirectional IGBT bridge and related components enclosed inside a metal frame or enclosure. Intended for cabinet installation. Used as the supply module in regenerative and low-harmonic converters.
IGBT supply unit (ISU)	Grid-side converter unit. Consists of the converter module and the related accessories (such as fuses, switches, control unit, etc.). See *IGBT supply module*.

Term/Abbreviation	Explanation
Incoming cubicle (ICU)	Cubicle with input power terminals, main switching and disconnecting devices, etc. See *Cubicle*.
Inverter	Converts direct current and voltage to alternating current and voltage.
Inverter module	Inverter bridge, related components and converter DC link capacitors enclosed inside a metal frame or enclosure. Intended for cabinet installation.
Inverter module cubicle	Cubicle which includes inverter module(s). See *Inverter module*, *Cubicle*.
Inverter unit (INU)	Rotor-side converter unit. Consists of the converter module and the related accessories (such as fuses, switches, control unit, etc.) See *Inverter module*.
Intermediate circuit	See *DC link*.
LCU	Liquid cooling unit
LCL	Grid-side filter that suppresses voltage distortion and current harmonics. Essential part of the grid-side converter.
Main circuit breaker (MCB)	Electrically-controlled main switching and protecting device. Also used as the main disconnector.
NAMU	Auxiliary Measuring Unit. Performs voltage measurement for IGBT supply unit RMIO board.
NCAN	CANopen® Adapter Module
NDCU	Drive Control Unit. Consists of a AMC board and NIOC board built into a metal housing. NDCU unit controls the rotor-side converter.
NDNA	DeviceNet™ Adapter Module
NETA	Ethernet Adapter Module
NIBA	Interbus-S® Adapter Module
NIOC	Input/Output Board. Part of the NDCU Drive Control unit
NPBA	PROFIBUS DP® Adapter Module
NTAC	Pulse Encoder Interface Module
NUIM	Voltage and Current Measurement Unit. Performs voltage and current measurement for AMC board.
PPCS	Power Plate Communication System. Communication protocol used with optic fiber link which controls the power stage of the converter modules.
RAIO	Analog I/O Extension Module
RDCO	DDCS Communication Option with optic fiber channels
RDCU	Drive Control Unit which contains an RMIO (Motor Control and I/O) board. An RDCU unit controls the grid-side converter.
RFI	Radio Frequency Interference
RMIO	Motor Control and I/O Board. Part of the RDCU Drive Control Unit
Rotor-side converter	A converter that is connected to the generator rotor and controls its operation. The rotor-side converter is also called the inverter unit or INU.
UPS	Uninterruptible power supply

3

Operation principle and hardware description

What this chapter contains

This chapter describes the operation principle and construction of the wind turbine converter.

Operation principle

ACS800-67LC liquid-cooled wind turbine converter is used with induction generators with wound rotor and slip rings, such as the ABB AMK series. The converter is connected between the generator rotor and the power supply network. The converter can be installed in a downtower cabinet, tower or in the nacelle.

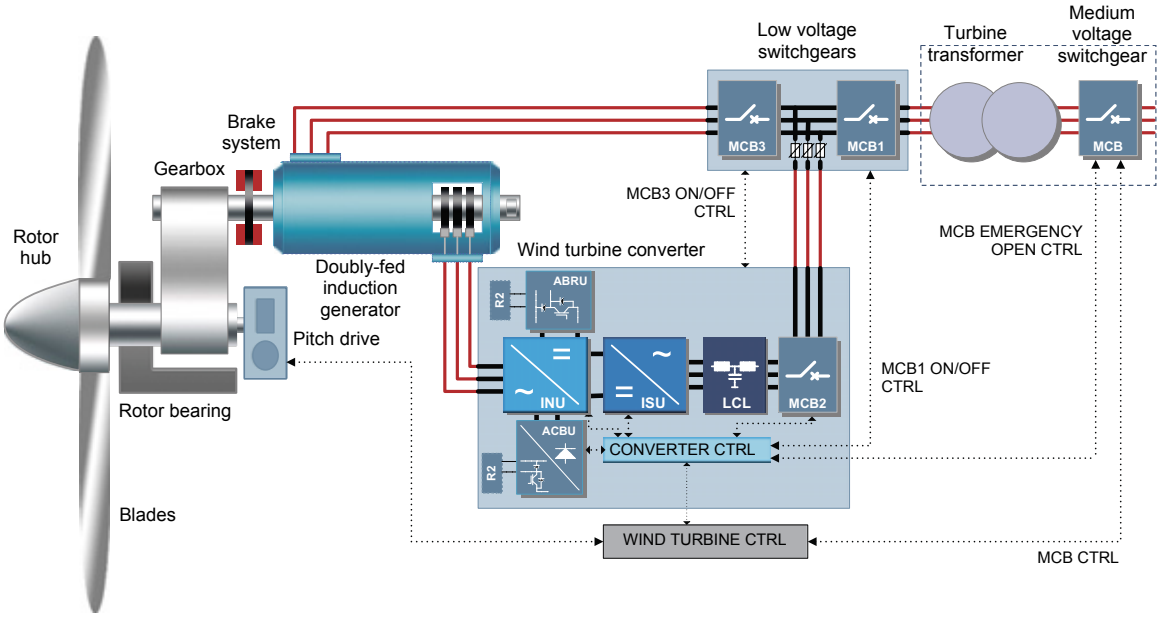
Doubly-fed asynchronous generators are essentially wound rotor induction generators with variable frequency excitation of the rotor circuit, incorporating rotor direct torque control (DTC) via power converter. The rotor control is four-quadrant, allowing independent control of real and reactive power flow in either direction (rotor to grid or grid to rotor), or confined to unidirectional (grid to rotor) active power flow.

Induction generators have a gearbox for coupling the generator shaft to turbine hub, active control of turbine blade pitch for maximizing production and controlling mechanical speed, and variable speed operation depending on the rating of power converter relative to turbine rating (typically ±30% of the generator synchronous speed).

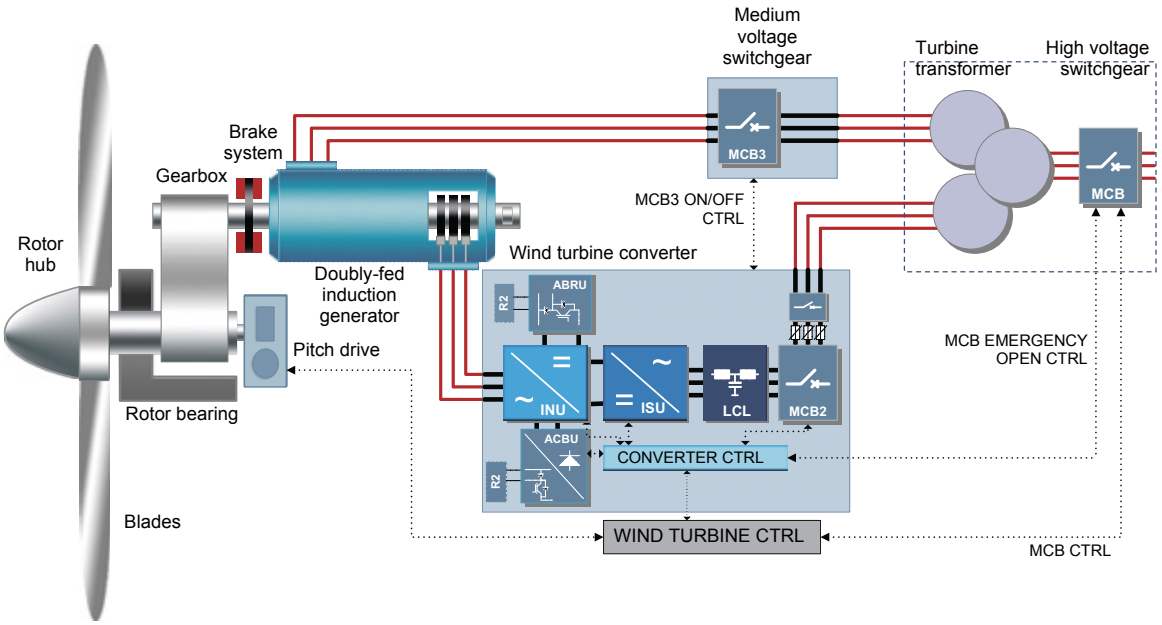
In doubly-fed systems the stator circuit of the generator is connected to the power supply network (grid) while the rotor circuit is connected to a converter via slip rings. In a doubly-fed concept the size of the power converter is significantly smaller than in eg, full-power concept because only one-third of the rated generator power is fed through the converter

and main part of the generator power is fed by the generator stator. Principle of the doubly-fed induction generator with a wind turbine converter can be seen in the figures below.

Wind turbine system with low voltage stator (690 V)



Wind turbine system with medium voltage stator (> 1000 V)



With the rotor-side converter (INU) it is possible to control the generator torque or speed and the power factor at the rotor/stator terminals, while the main task of the grid-side converter (ISU) is to keep the DC link voltage constant. While the rotor is accelerated by the wind and the speed is controlled by the pitch of the blades the converter can be started and controlled in DTC mode. After the grid-side converter has charged the intermediate DC link properly and the rotor-side converter has magnetized the generator properly (correct voltage magnitude and phase sequence), the circuit breaker of the stator (MCB3) can be closed. When the converter is synchronized to the power supply network it is ready to feed power to the grid. In order to stop the converter the breakers have to be opened and the rotor is braked to standstill by pitch control and mechanical brakes.

Grid-side and rotor-side converters

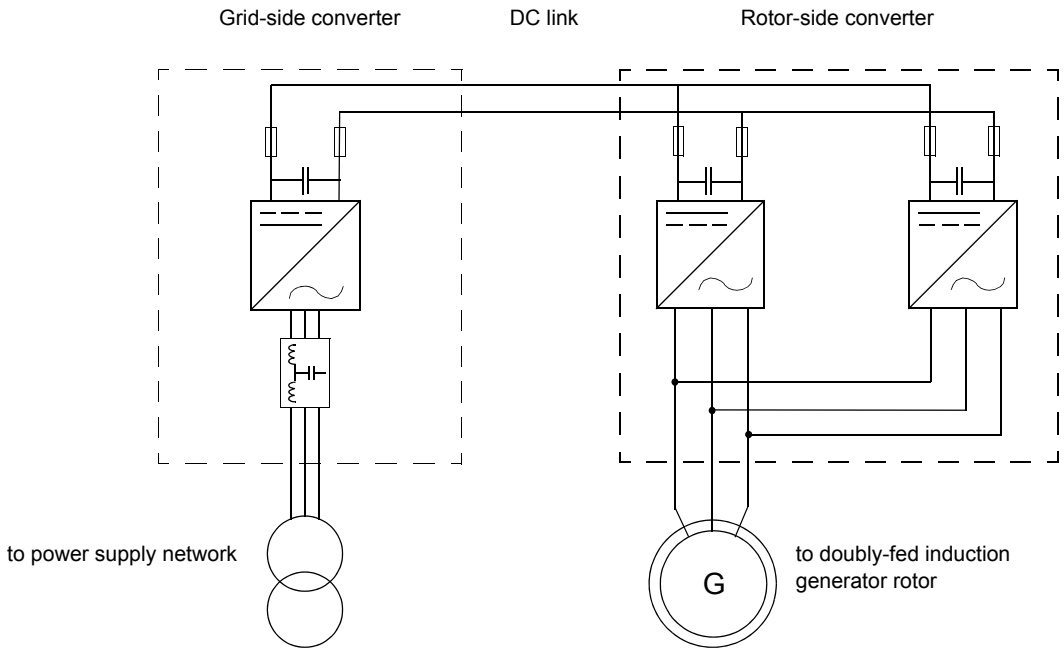
The grid-side converter is an IGBT based module equipped with a line filter (LCL), contactor, DC fuses and optional devices. It has RDCU-12 control unit with grid-side control program. The converter is controlled by the rotor-side converter control unit via a fiber optic link. RDCU-12C control unit contains RDCO DDCS communication option module containing fiber optic terminals.

The grid-side converter rectifies three phase AC current to direct current for the intermediate DC link of the converter. The intermediate DC link supplies the rotor-side converter. The line filter suppresses the AC voltage and current harmonics.

As default, the grid-side converter controls the DC link voltage to the peak value of the phase-to-phase voltage. The control of the IGBT power semiconductors is based on the Direct Torque Control (DTC) method typically used in motor control of the converter. Two line currents and DC link voltage are measured and used for the control.

The rotor-side converter consists of IGBT based inverter modules and employs the NDCU-33C control unit. The converter is equipped with the doubly-fed induction generator control program which also controls the grid-side converter module(s) via a fiber optic link. The rotor-side converter modules control the torque of the generator and the power factor at the stator/rotor terminals.

The diagram below shows an example of a common DC link converter system. In this example the converter consists of one grid-side converter module and two parallel connected rotor-side converter modules.



Product overview

Layout

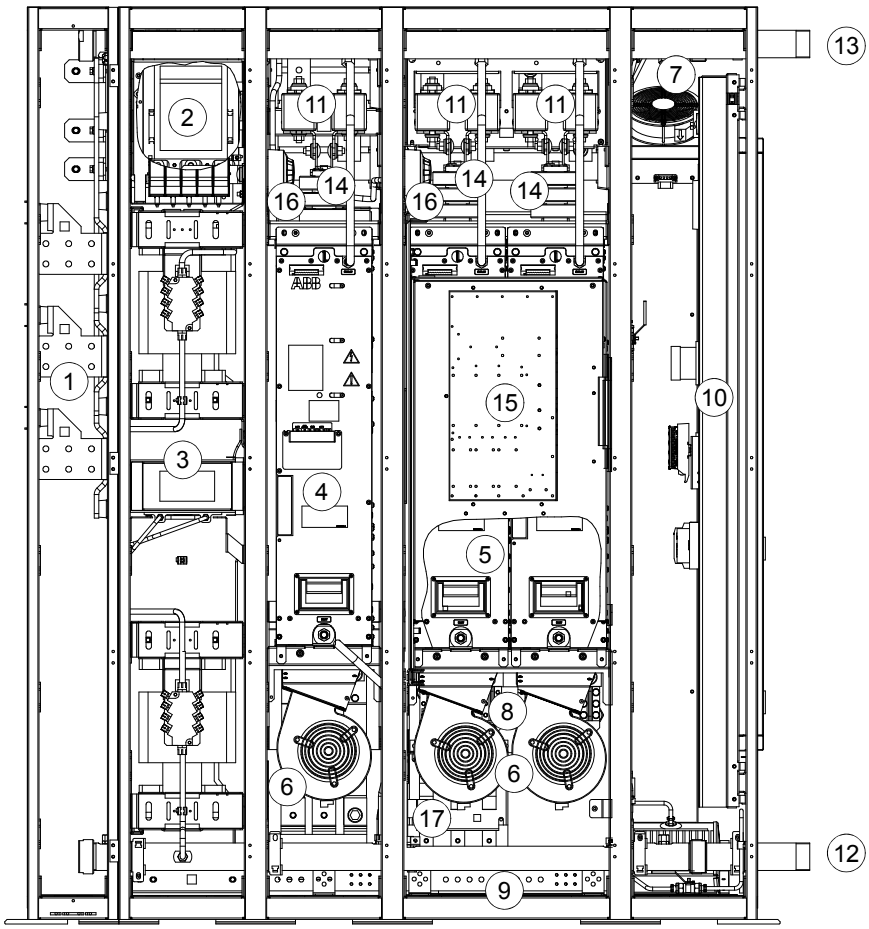
An example layout of the converter is presented in the following drawings. For power cabinet layout, see *ICU800-67LC incoming units (+C108/+C109) hardware manual* [3AUA0000071553 (English)].

Doors closed

No.	Description
1	Incoming cubicle (ICU)
2	LCL filter cubicle (FIU)
3	IGBT supply module cubicle (ISU)
4	Inverter module cubicle (INU)
5	Auxiliary control cubicle (ACU)

Converter with 200 mm wide incoming cubicle

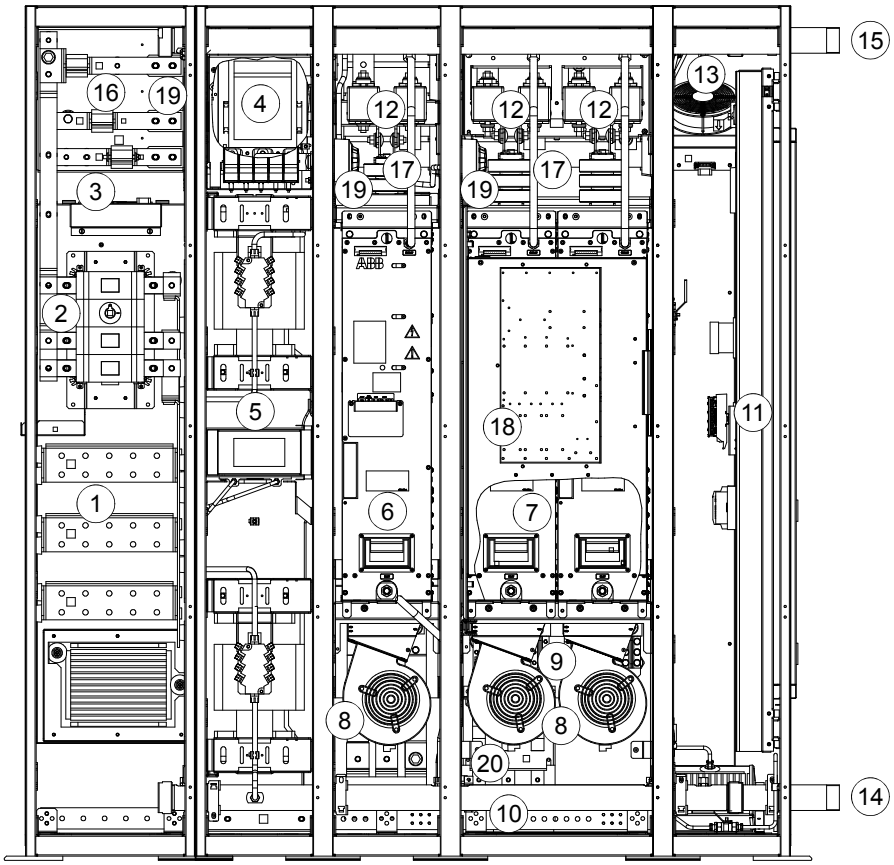
Doors open, shrouds removed



No.	Description
1	Grid-side power cable terminals (busbars)
2	Grid-side converter contactor K1 behind the charging circuit
3	LCL filter
4	IGBT supply module
5	Inverter modules (behind the swing-out frame of the crowbar)
6	Module cooling fans
7	Auxiliary control unit cooling fan
8	Rotor-side power cable terminals (behind removable fans)
9	PE terminal (cabinet grounding busbar behind the coolant pipe)
10	Sliding frame with control electronics
11	DC link fuses
12	Coolant inlet pipe
13	Coolant outlet pipe
14	Common mode filters
15	Crowbar (in the swing-out frame)
16	Smoke detectors
17	Common mode filter of crowbar

Converter with 400 mm wide incoming cubicle (option +C111)

Doors open, shrouds removed



No.	Description
1	Grid-side power cable terminals (busbars)
2	Load switch disconnector
3	Cooling fan of the incoming cubicle
4	Grid-side converter contactor K1 behind the charging circuit
5	LCL filter
6	IGBT supply module
7	Inverter modules (behind the swing-out frame of the crowbar)
8	Module cooling fans
9	Rotor-side power cable terminals (behind removable fans)
10	PE terminal (cabinet grounding busbar behind the coolant pipe)
11	Sliding frame with control electronics
12	DC link fuses
13	Auxiliary control unit cooling fan
14	Coolant inlet pipe
15	Coolant outlet pipe
16	AC fuses
17	Common mode filters
18	Crowbar (in the swing-out frame)
19	Smoke detectors
20	Common mode filter of crowbar

Power modules

Size R8i modules are used in single or parallel configurations in both grid-side converter and rotor-side converter. DC connection is located on the top front part of the module. The DC voltage is connected to the busbars through fuses. Common mode filtering is implemented by running the DC busbars through ferrite cores. Du/dt filtering is a standard feature.

The generator connection is via a quick connector at the back of the module that couples when the module is inserted into the cubicle. From the connector, the cables can be run directly through the floor of the cubicle. Each parallel module is connected to the inverter module cubicle internally by busbars.

The coolant enters the module at the bottom front and exits at the top. Inside the module, the coolant runs through the heatsink as well as an air-to-liquid heat exchanger. For more information on the liquid cooling system, see chapter *The internal cooling circuit*.

The cooling fan below the module forces air through the air-to-liquid heat exchanger and the module itself. The converter module is shown below.

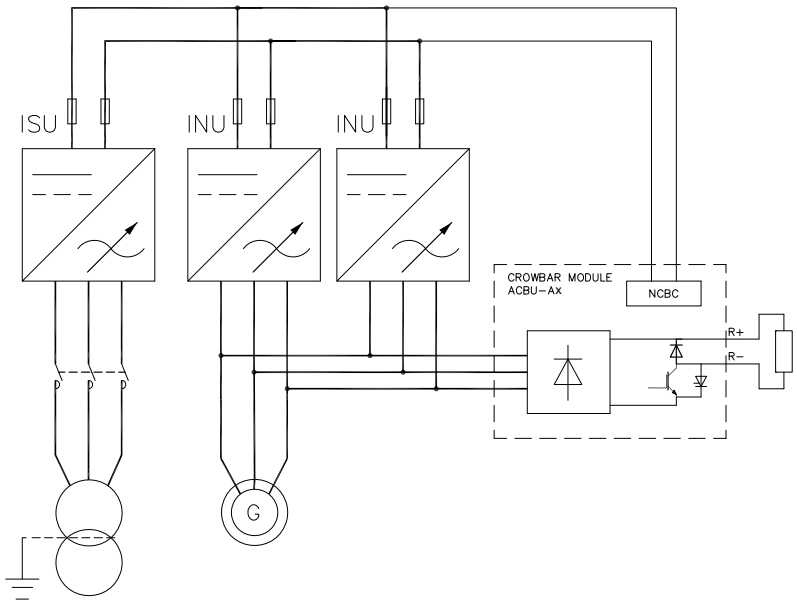
No.	Description
1	DC connections (UDC+ and UDC-)
2	Fiber optic connectors of the AINT board. Connected to the control units.
3	Terminal block X17 (not in use)
4	Handle
5	Coolant inlet connection
6	Coolant outlet connection
7	AC connections (U2,V2,W2). Quick connector for AC connection is located behind the module.

Crowbar

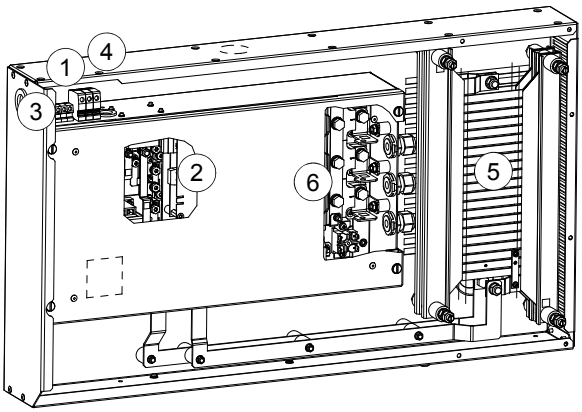
The converter is equipped with active crowbar(s) as standard. The crowbar consists of crowbar unit (type ACBU-Ax) and crowbar resistor (type ACBU-Rx).

The crowbar circuit is used for DC overvoltage protection in abnormal grid conditions, eg, short interruptions or voltage dip/sag events. Active crowbar is needed when the converter must stay connected to the grid during grid faults. The crowbar can be switched ON and OFF by the rotor-side converter. This allows the converter to be connected to the grid even during very severe grid faults.

Crowbar is triggered if the DC link voltage is too high or alternatively if the rotor current is too high. Active crowbar is controlled by the rotor-side converter control program but in case of internal failure it can protect the converter independently. Circuit diagram and layout of the crowbar is shown below.



Crowbar (ACBU-Ax)



No.	Description
1	DC connections (UDC+ and UDC-)
2	Fiber optic connectors of the AITF board (inside the cover). Connected to the control units.
3	Terminal block (klixon)
4	Terminal block (triggered)
5	Crowbar resistor
6	AC connections (U2, V2, W2). Connector for AC input connection is located under the cover.

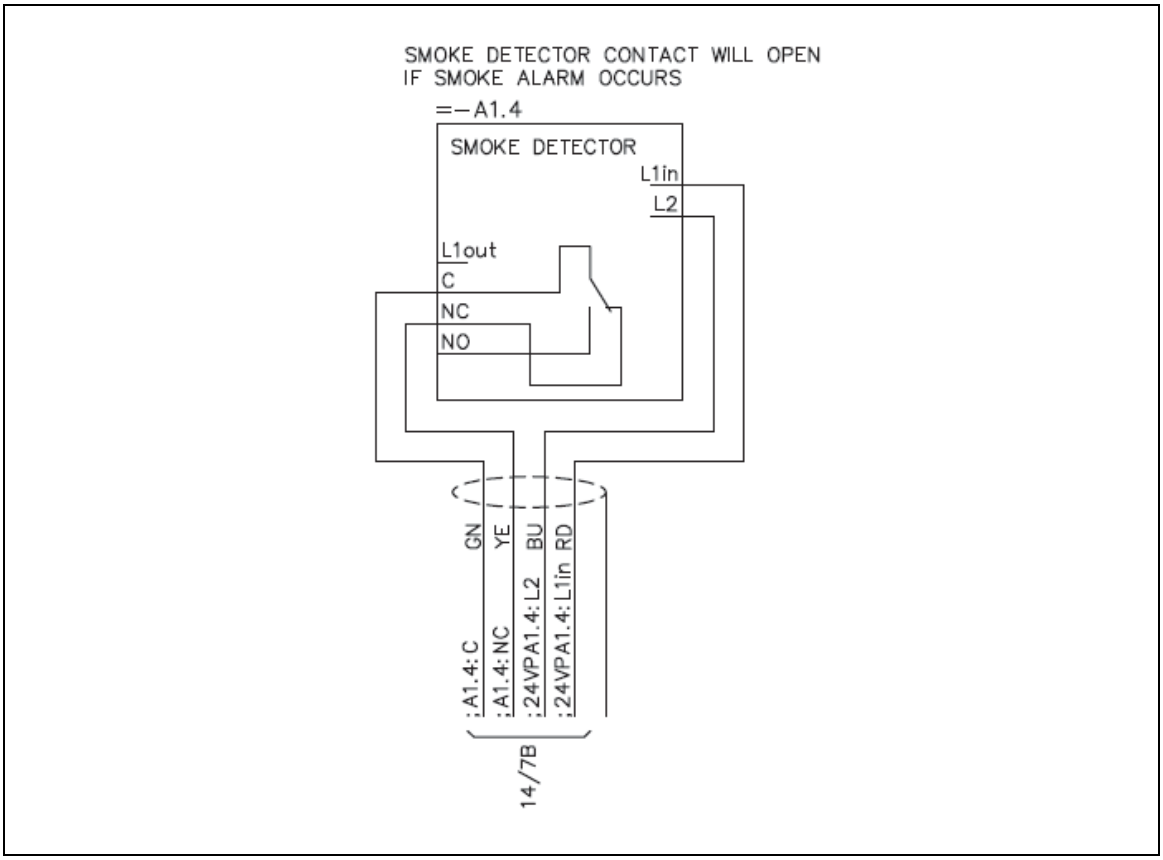
Smoke detector

The wind turbine converter is equipped with smoke detector to provide additional protection. The smoke detector is equipped with NC (normally closed) contact which opens if smoke is detected.

Contact is wired to the digital input 1 (DI1) on the grid-side converter control unit together with other hardwired faults, for example LCL filter temperature. Smoke detector alarm can be reset only with auxiliary power reboot. If the converter is started when the smoke detector alarm is ON, DI1 trip on the grid-side converter will occur after 2 seconds.

In case of smoke detector alarm it is mandatory to check the converter for possible hardware related issues. Especially LCL filter capacitor requires visual inspection and capacitance measurement between phases.

Example of wiring connection is shown below.



Power cable lead-throughs

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 *40*. For number and sizes of the power cables, see section *Selecting the power cables* on page *54*.

All external power cables used are unshielded.

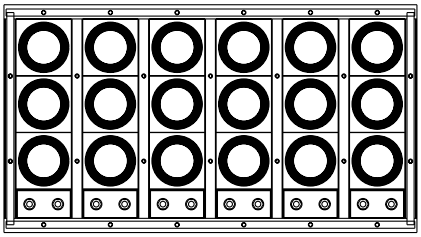
Note: In the USA and Canada, all lead-through components with UL Type 12 to fulfill the requirements of degree of protection UL Type 12. This includes power cables, control cables, user connections and 230 V AC supply cable.

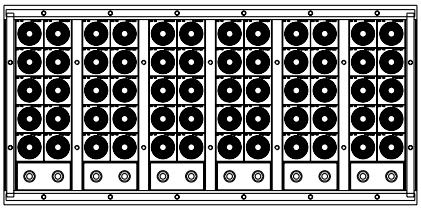
Blank plate

The blank plate has no openings for the cables when delivered. Ensure that all the lead-through components you use fulfill the requirements of degree of protection IP54 or higher.

Sealing modules

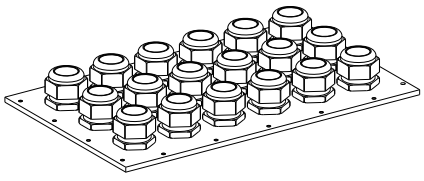
The cables enter the cabinet through the sealing modules. The number of sealing modules depends on the size of the incoming cubicle and whether 1-phase or 3-phase cabling is used. In cabling, the modules can be adjusted to accommodate any cable of 9.5…32.5 mm, 28…54 mm or 48…71 mm in diameter by removing layers. The modules are laid out in rows in a frame. Each row also has a wedge that is tightened to keep the modules in place.





Cable glands

The cables enter the cabinet through cable glands. Cable glands are only available through application engineering. Only cable glands can be grounded 360°.

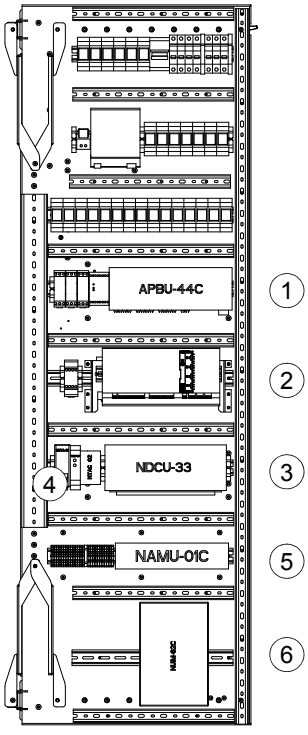


Control interfaces

Control interfaces of the converter are described below.

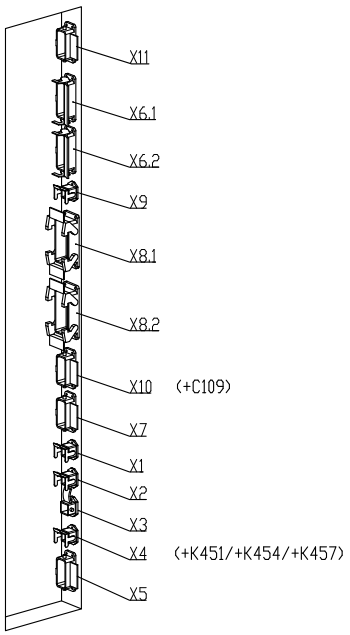
Sliding frame in the auxiliary control cubicle	
No.	**Description**
1	APBU branching unit
2	RDCU unit. (If parallel connected grid-side converter modules are used, another APBU unit is located behind RMIO board.)
3	NDCU unit
4	NTAC Pulse Encoder Interface module, optional fieldbus modules if ordered
5	NAMU measuring unit
6	NUIM voltage and current measuring unit

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 MCB control
X6.2	External stator MCB 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)

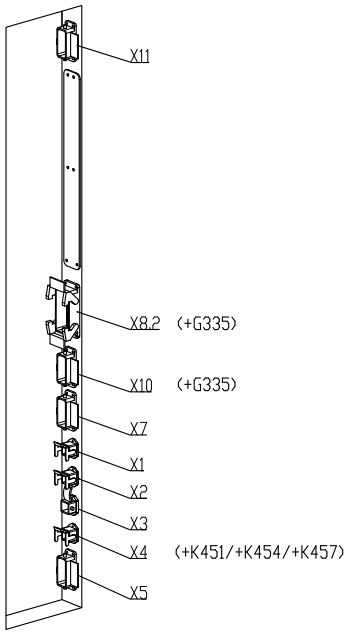


PC tool interface (sliding frame)

ICU200 or ICU400 (option +C111)



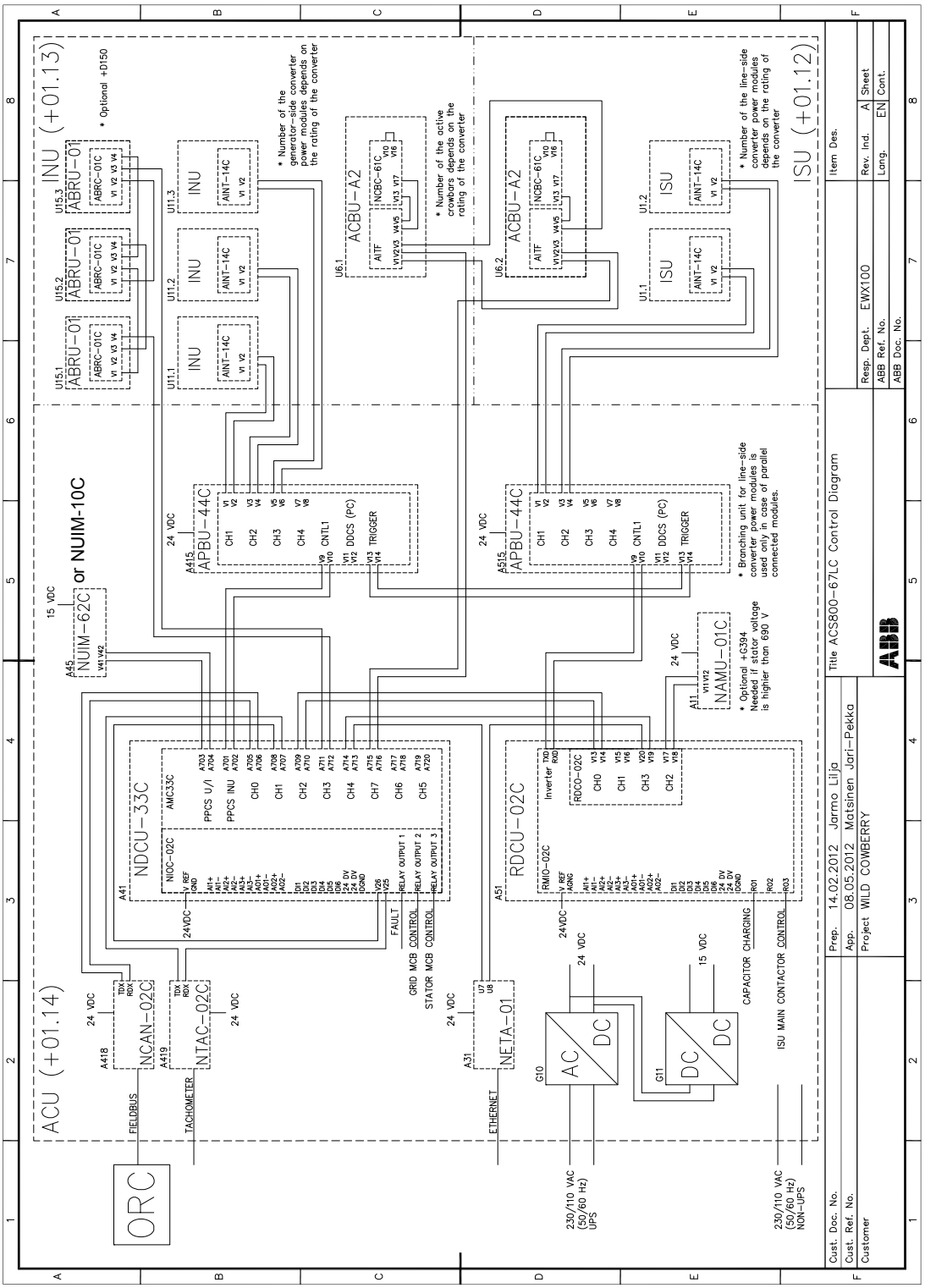
ICU800 (option +C108)



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

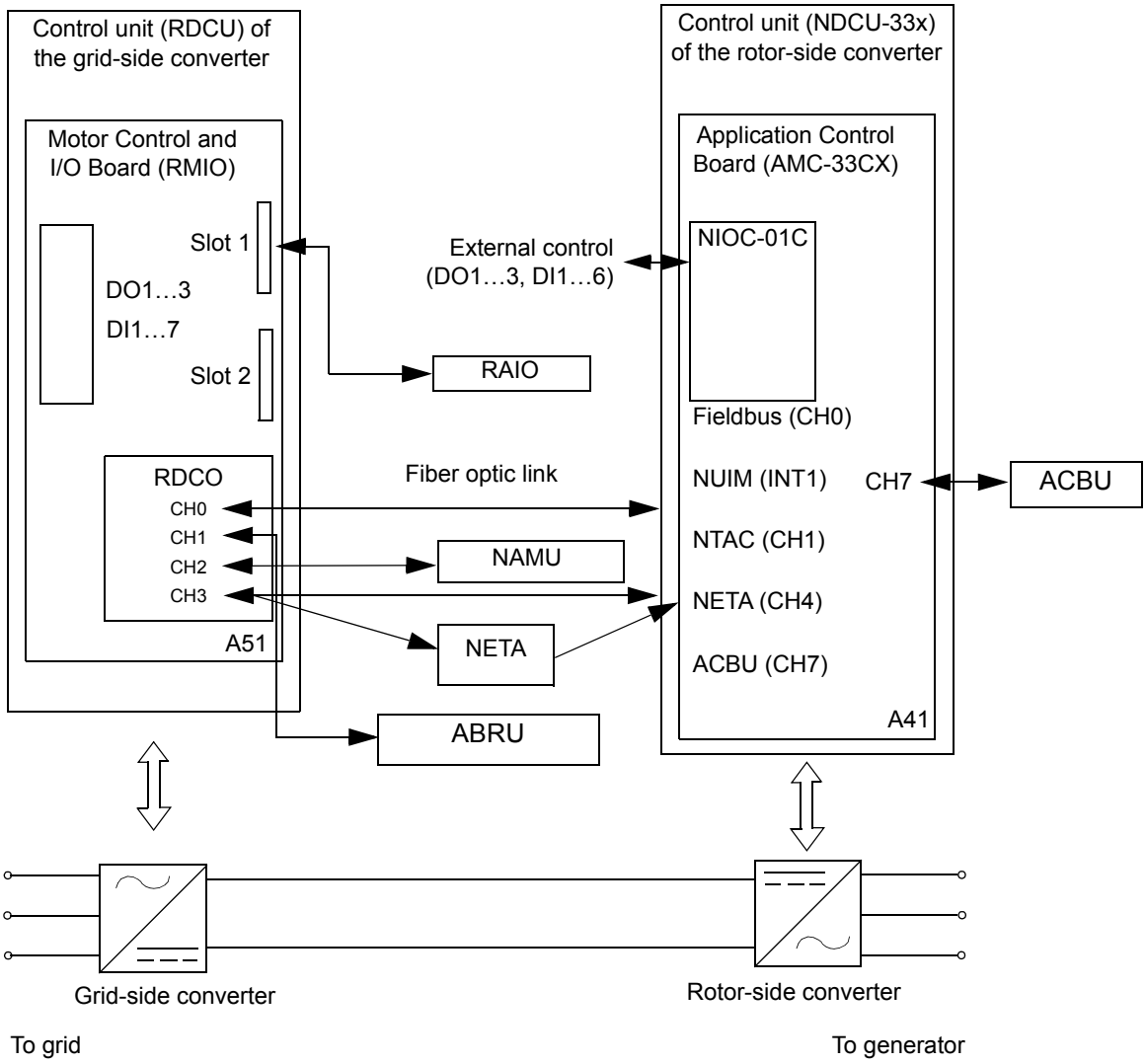
Circuit boards

The diagram below shows the interconnections between the circuit boards of the converter. For details, see the circuit diagrams delivered with the converter.



PC tool interfaces

The following diagram shows the control interfaces and option modules of the converter.



RDCU and NDCU control units encapsulate the RMIO/AMC boards which are used for controlling the converter. The units are located in the sliding frame of the auxiliary control cubicle. With control units a PC tool can be used for parameter change and check, local control of the converter during the commissioning and remote monitoring of the converter. It is also possible to read fault indications through a relay output and communicate with the unit through a serial communication interface. DriveWindow PC tool is used with the ACS800-67LC.

Control unit of the grid-side converter

The grid-side converter is controlled by its own RDCU control unit. The RDCU is connected to the grid-side converter power modules by a fiber optic link (distributed through an APBU optical branching unit in case of parallel connected power modules). In the grid-side converter module(s) the fiber optic link is connected to the AINT board.

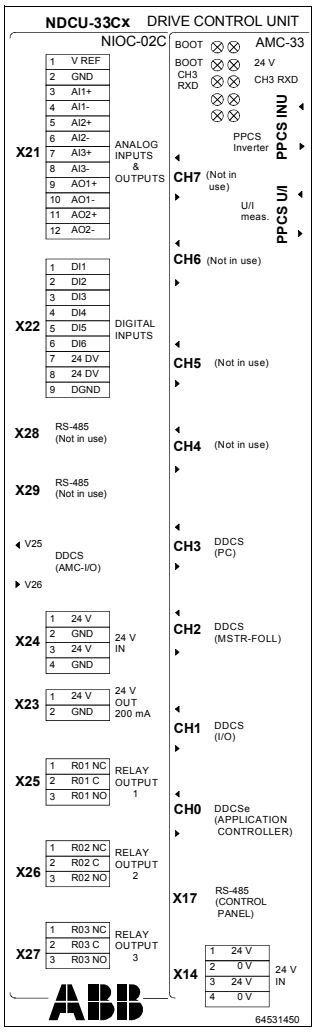
Control unit of the rotor-side converter

The rotor-side converter is controlled by its own NDCU control unit. The NDCU is connected to the rotor-side converter power modules by a fiber optic link, distributed through APBU optical branching unit. In the rotor-side converter modules the fiber optic link is connected to the AINT board.

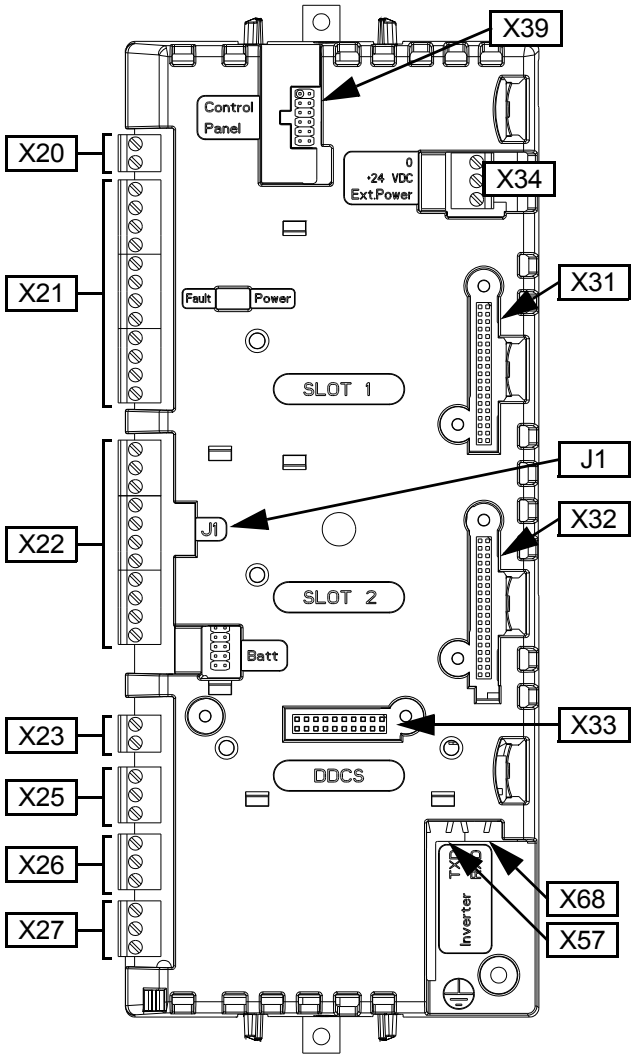
Control unit NDCU-33Cx/RDCU-12C

The connectors of the rotor-side converter control unit NDCU-33Cx (consisting of the NIOC-02C and AM33C boards) and the grid-side converter control unit RDCU-12C (containing the RMIO-12C board) are shown below. For further information on the RDCU control unit, see *RDCU drive control units hardware manual* [3AFE64636324 (English)].

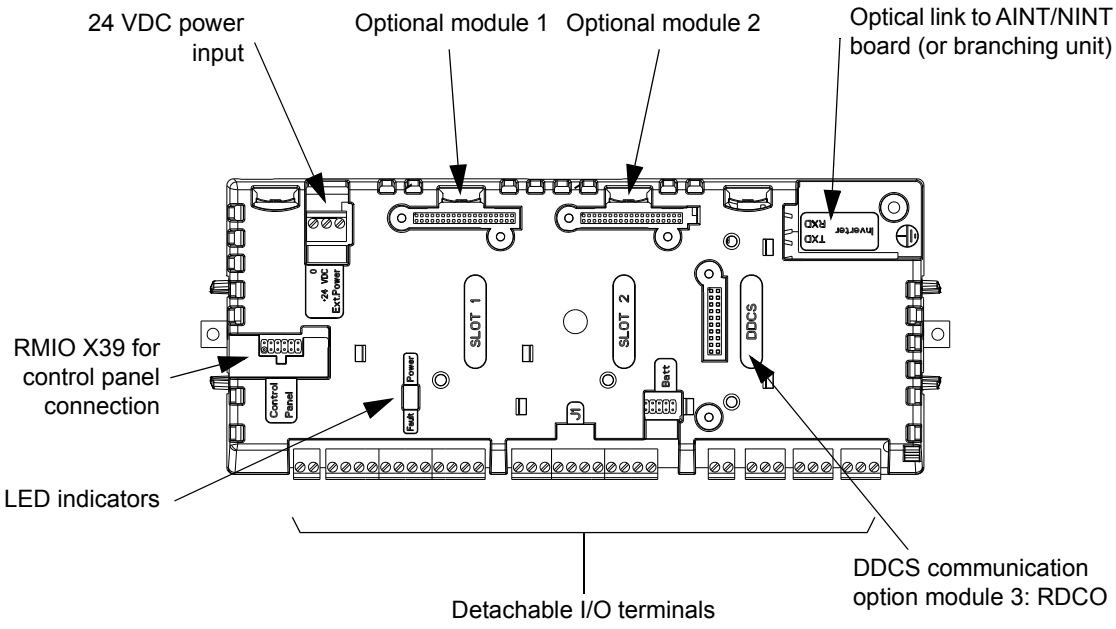
NDCU-33Cx *RDCU-12C*



X20	1	VREF
	2	GND
X21	1	VREF
	2	GND
	3	AI1+
	4	AI1-
	5	AI2+
	6	AI2-
	7	AI3+
	8	AI3-
	9	AO1+
	10	AO1-
	11	AO2+
	12	AO2-
X22	1	DI1
	2	DI2
	3	DI3
	4	DI4
	5	DI5
	6	DI6
	7	+24V
	8	+24V
	9	DGND
	10	DGND
	11	DIIL
X23	1	+24 V
	2	GND
X25	1	RO1
	2	RO1
	3	RO1
X26	1	RO2
	2	RO2
	3	RO2
X27	1	RO3
	2	RO3
	3	RO3

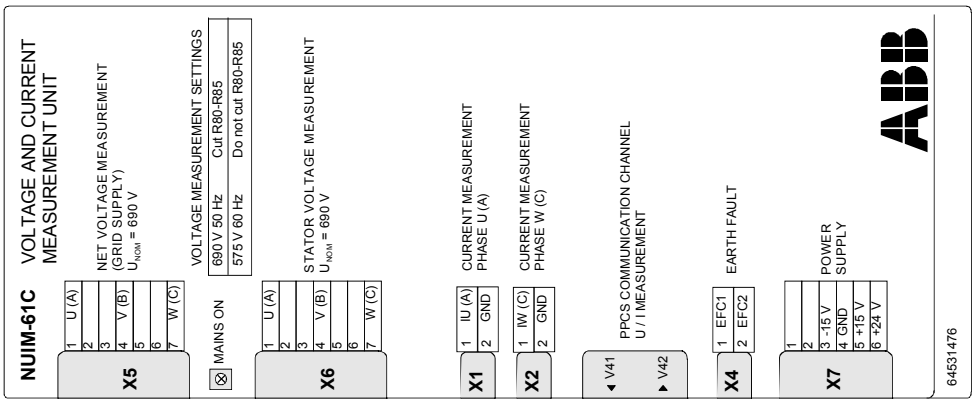


RDCU-12C



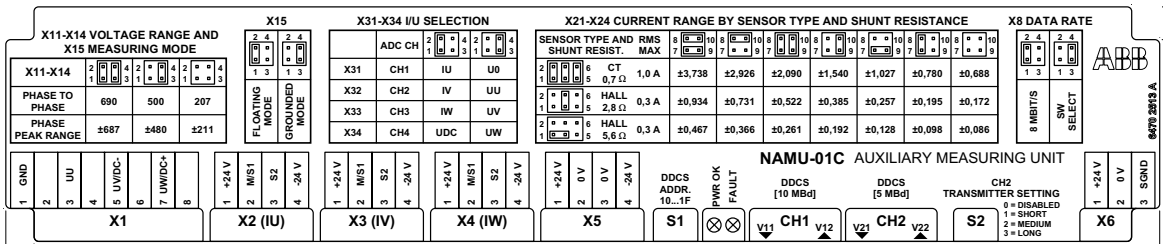
Voltage and Current Measurement Unit NUIM-61C/NUIM-10C

The connectors of the Voltage and Current Measurement Unit NUIM-61C are shown below.



Auxiliary Measuring Unit NAMU-01C

Auxiliary Measuring Unit NAMU-01C is connected to CH2 of the RDCO module. Connectors of the unit are shown below.



Fiber optic links

Grid-side converter: DDCS fiber optic links are provided by RDCO modules (installed on the RDCU control units) for PC tools, master/follower link, NDIO, NTAC, NAIO, AIMA I/O module adapter and fieldbus adapter modules of type Nxxx. For the connections, see *RDCO user's manual* [3AFE64492209 (English)].

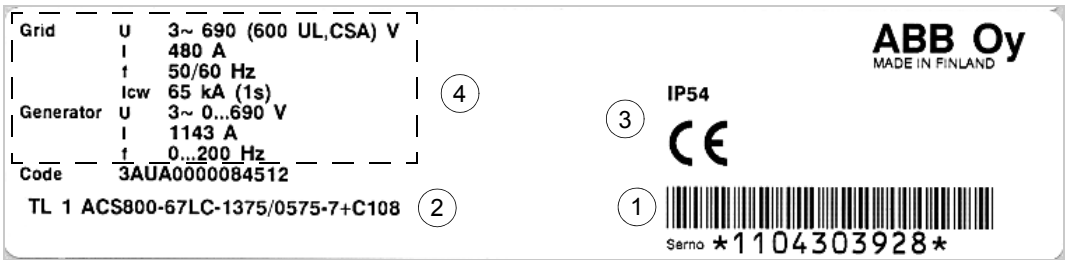
Rotor-side converter: DDCS fiber optic links are provided by NDCU control unit for PC tools, master/follower link, NDIO, NTAC, NAIO, AIMA I/O module adapter and fieldbus adapter modules of type Nxxx.

Type designation labels

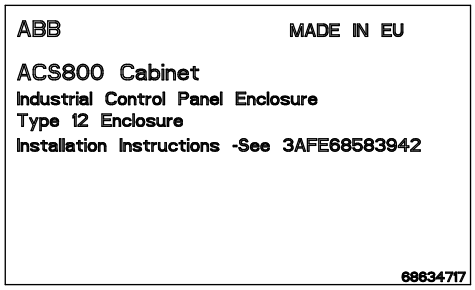
Type designation label is attached to the door of the ACU cubicle (inside and outside of the door). The type designation label includes ratings, valid markings, type code and serial number of the unit. Each power module is also individually labeled.

Example label is shown below.

No.	Description
1	Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number.
2	Type code. See section *Type designation key*.
3	Valid markings
4	Ratings of the unit



UL Type 12 label (USA and Canada only)



UL508A label

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 selections are listed below. For more information, contact your local ABB representative.

Basic code

Digit no.	Name/Description	Alternatives	Description
1…6	Product series	ACS800	
8…11	Construction	67LC	Cabinet mounted liquid-cooled wind turbine converter for the control of an induction generator
13…21	Size	1075/0575 1375/0575 1375/1125 1595/0865 2035/1125	Rotor-side converter kVA rating / Grid -side converter kVA rating
23	Voltage rating	7	7 – Voltage range 525…690 V

When no options are selected, the following features are included as standard: 1-phase 230 V connection for control electronics to be supplied by online UPS, auxiliary power connection 1-phase, 50/60 Hz supply 230 VAC control voltage, NTAC-02, NAMU-6x, doubly-fed induction generator control program. Control logic for cabinet liquid circuit heater, cooling connection with G2” thread, cooling connection on the right-hand side of the cabinet, EMC 2nd Environment filter, du/dt limitation by choke, common mode filter, Emergency stop cat. 0, ICU 200 mm with bottom entry cables, bottom exit of cables, cable entry plates (blank plates), coated boards, one set of default language documents.

Option codes (+ codes)

Code	Description
Construction	
C129	UL508A design. UL508A approved up to 600 V AC.
C144	Cooling connectors on the left-hand side when viewed from front
C171	Flange for cooling liquid connections of size DN64 with flange clamp, ISO 6162-1:2002
C111	400 mm wide incoming cubicle instead of standard 200 mm with AC fuses and load switch disconnector for grid-side converter
C161	Removable cabinet doors for 400 mm and wider cubicles
nH370	IEC: Converter supply cable: sealing module entry for 9.5…32.5 mm diameter single phase cables
1H370	12 cables
2H370	24 cables (not available for 200 mm wide incoming cubicle)
nH371	IEC: Converter supply cable: sealing module entry for 48…71 mm diameter three phase cables
1H371	3 cables
2H371	6 cables (not available for 200 mm wide incoming cubicle)
nH372	IEC: Rotor cable: sealing module entry for 9.5…32.5 mm diameter single phase cables
1H372	12 cables
2H372	24 cables
3H372	36 cables
nH373	IEC: Rotor cable: sealing module entry for 48…71 mm diameter three phase cables
1H373	3 cables
2H373	6 cables
3H373	9 cables
H375	IEC: Rotor cable: sealing module entry for 28…54 mm diameter single phase cables
H378	IEC: Converter supply cable: sealing module entry for 28…54 mm diameter single phase cables
Power Cabinet	
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. For detailed description of power cabinet options, see *ICU800-67LC incoming units (+C108/+C109) hardware manual* [3AUA0000071553 (English)].	
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
F280	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

Code	Description
2H380	20 cables
3H380	28 cables
Ride through options	
D150+D151	Zero voltage ride through option 1 (DC chopper + DC resistor 1500kJ / INU module)
D150	Zero voltage ride through option 2 (DC chopper)
Measurement for stator voltage	
G394	Standard NUIM replaced by NUIM-10 for MV measurement (stator voltage > 1kV)
Fieldbus options	
K451	DeviceNet adapter (NDNA-02)
K453	Interbus-S adapter (NIBA-01)
K454	PROFIBUS DP adapter (NPBA-12)
K457	CANopen adapter (NCAN-02)
Ethernet	
K464	Ethernet adapter EIP, MB/TCP (NETA)
Specialities	
P902	Customized according to Technical Appendix
P904	Extended warranty 24/30
P909	Extended warranty 36/42
P910	Service plan 48/54
P911	Service plan 60/66
P913	Special color according to Technical Appendix

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4

Mechanical installation

What this chapter contains

This chapter describes the mechanical installation procedure of the ACS800-67LC converter.

Safety

See chapter *Safety instructions*.

Checking the installation site

See page *128* for allowable operating conditions, and page *124* for requirements for free space around the converter cabinet.

The converter cabinet must be installed in an upright vertical position. (For tilted installations, contact your local ABB representative.)

The floor that the unit is installed on must be of non-flammable material, as smooth as possible and strong enough to support the weight of the unit. Anything located immediately next to the converter cabinet must be of non-flammable material. The floor flatness must be checked with a spirit level before installing the cabinet into its final position. The maximum allowed deviation from the surface level is 5 mm in every 3 metres. The installation site should be leveled, if necessary, as the cabinet is not equipped with adjustable feet.

Required tools

The tools required for moving the unit to its final position, fastening it to the floor and tightening the connections are listed below:

- crane, fork-lift or pallet truck (check load capacity!), iron bar and jack
- Pozidrive and Torx (2.5…6 mm) screwdrivers for the tightening the frame screws
- torque wrench
- set of wrenches or sockets.

Unpacking

Unpack and move the unit according to the instructions given in section *Moving the unit*.

Checking the delivery

The converter delivery contains:

- converter cabinet
- options (if ordered) installed at the factory
- installation stand for the converter module replacement (if ordered)
- lifting bars.

Following equipment are located in the floor of the inverter module cubicle:

- fastening equipment kit for fastening the cabinet to the roof
- appropriate manuals and guides
- optional module manuals
- delivery specific circuit diagrams
- delivery specific dimensional drawings
- delivery specific test reports
- delivery documents.

Lead-through frame and sealing modules (if ordered) are located in the cubicles they are to be installed in.

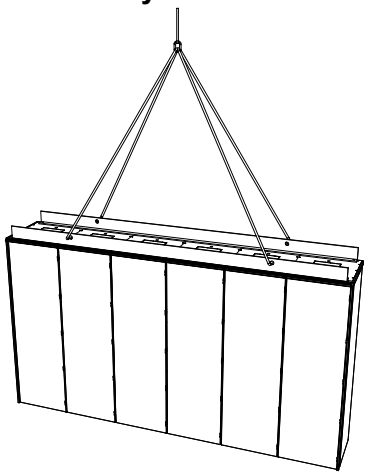
Check that there are no signs of damage. Before attempting installation and operation, check the information on the type designation label of the converter to verify that the unit is of correct type. The label includes IEC and UL rating, type code and serial number that allow the identification of each unit. For further information, see section *Type designation labels* on page *38*.

Moving the unit

Moving the unit by crane, fork-lift or pallet truck

Moving the unit

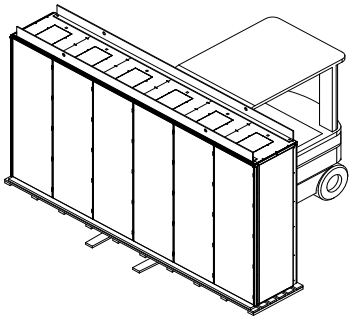
…by crane



Use the steel lifting bars attached to the top of the cabinet. Insert the lifting ropes or slings into the holes of the lifting bars.

The lifting bars must be removed once the cabinet is in its final position if the cabinet is to be fastened to the roof. Fastening brackets are to be mounted to the lifting bar fastening holes. Otherwise, it is not mandatory to remove the lifting bars. **If the lifting bars are removed, the bolts must be refastened to retain the degree of protection of the cabinet.**

…by fork-lift or pallet truck



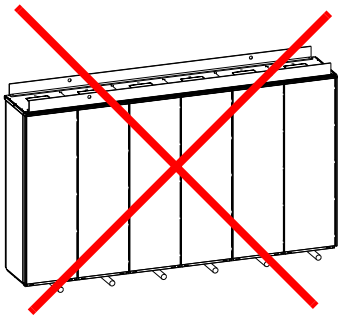
The centre of gravity is high. Be therefore careful when transporting the unit. Avoid tilting the cabinets.

The units are to be moved only in the upright position.

If using a pallet truck, check its load capacity before attempting to move the unit.

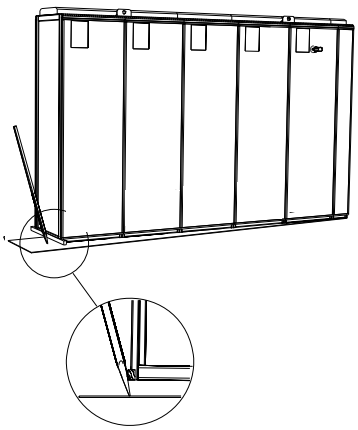
Do not move the unit without the pallet!

Note:



It is not allowed to move the unit on rollers.

Final placement of the unit



Move the cabinet into its final position with an iron bar and a wooden piece at the bottom edge of the cabinet. Place the wooden piece properly not to damage the cabinet frame!

Overview of the installation procedure

1. The cabinet can be installed with its back against a wall. Fasten the cabinet to the floor with fastening clamps. For the location of the fastening clamps, see the delivery specific dimensional drawings.

Note 1: Leave a minimum clearance of 400 mm above the basic roof level of the cabinet to allow the pressure release lids to open at an arc fault.

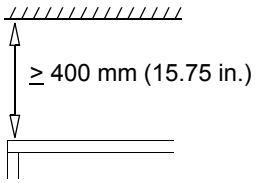
Note 2: Leave some space at the side where the cabinet outmost hinges are to allow the doors to open sufficiently. The doors must open 120° to allow converter module replacement. For more accurate space requirements for the door openings, see chapter *Dimension drawings*.

Note 3: Leave 115 mm free space at the right- or left-hand side of the converter for the cooling pipe connections (depending on which side the cooling connections are).

Note 4: Leave 150 mm free space at the right-hand side for the plug-in connectors.

Note 5: Height adjustment can be done by using metal shims between the bottom frame and floor.

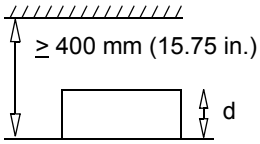
View from front



Note 1: Top clearance

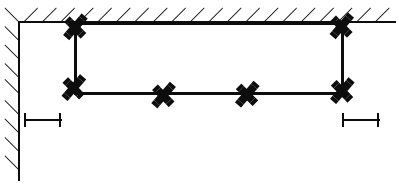
①

View from front (options +D150 and +D151)



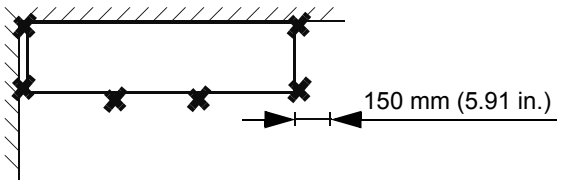
Note 1: Top clearance
d = 80 mm (2.8 in.) when option +D150 is selected.
d = 170 mm (5.9 in.) when option +D150+D151 is selected.

View from top



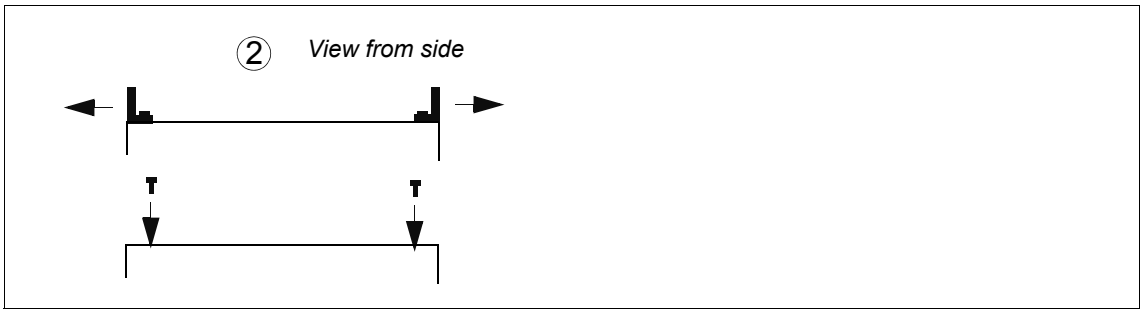
Note 2: Door opening clearance

View from top



Note 4: Right-hand clearance

2. Remove the lifting bars. Use the holes for fastening the cabinet from top. Use the original bolts to block any unused holes.

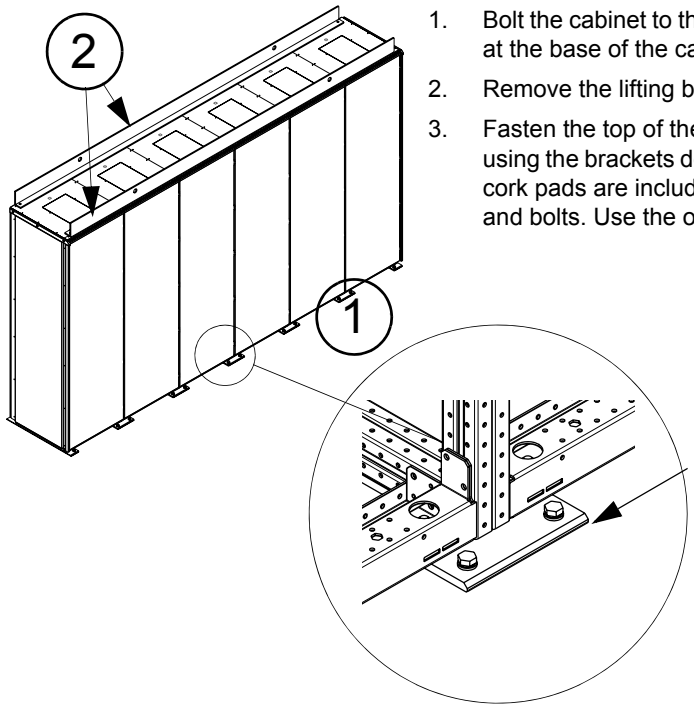


Fastening the cabinet to the roof

If the converter is installed in a nacelle, the cabinet roof must be fixed to the nacelle structure for roof support. Roof support kit is included in the delivery as standard.

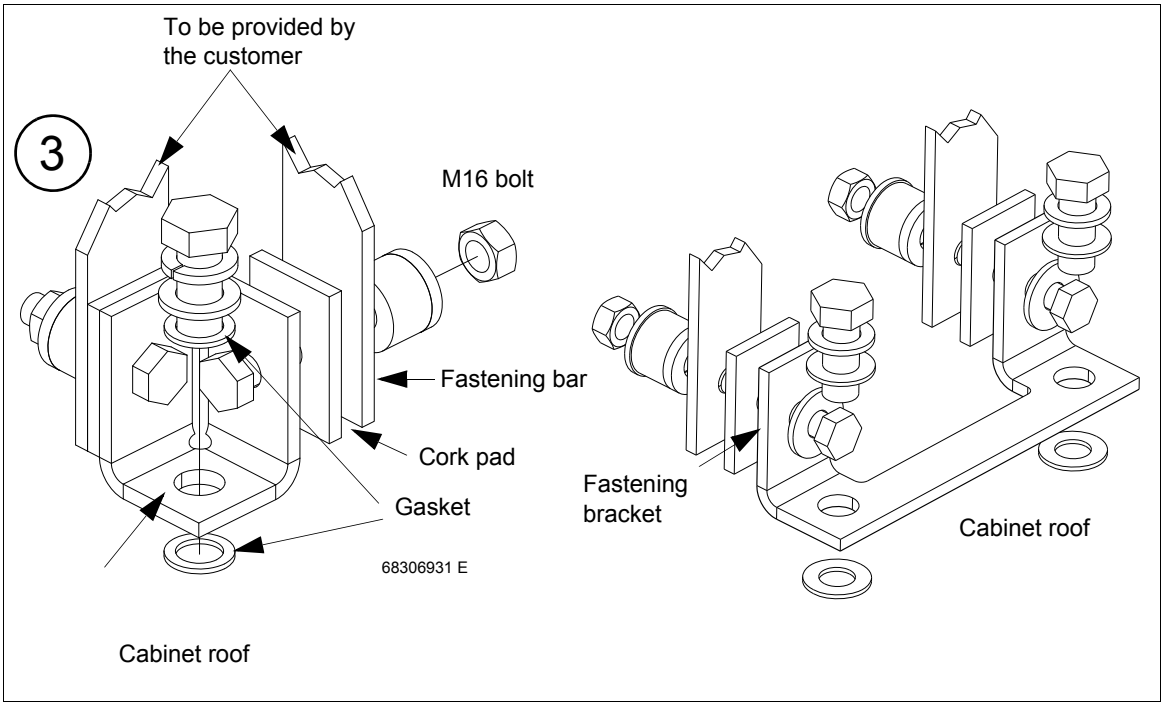
The lifting lugs on the top of the cabinet are replaced with the roof support. Support for both sides of the cabinet roof is required.

The unit must be fastened to the floor and roof (wall) as follows:

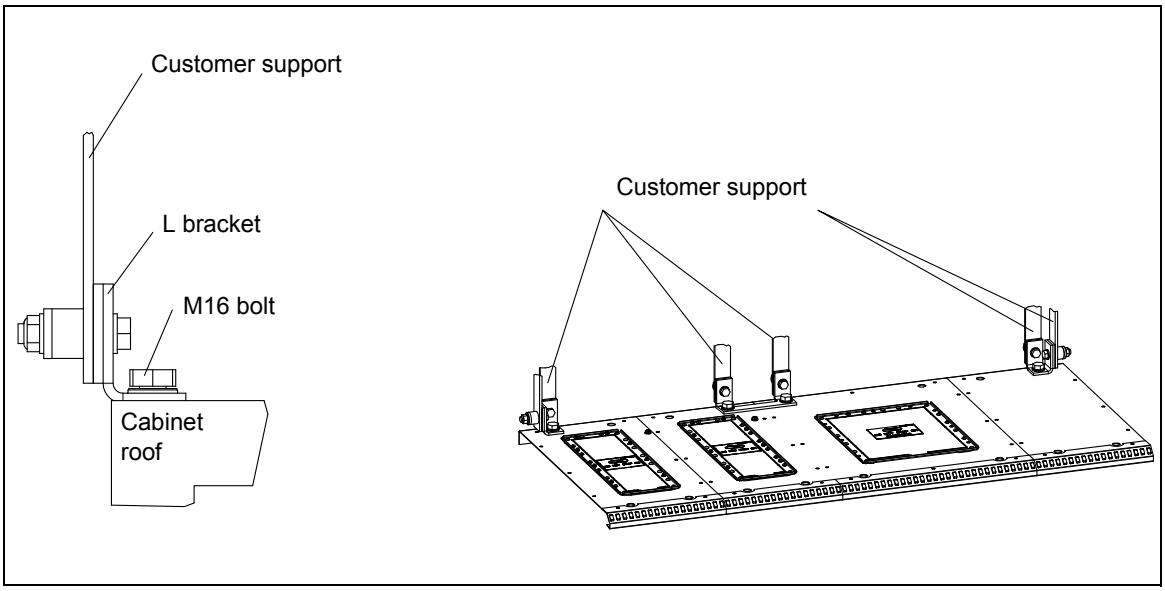


1. Bolt the cabinet to the floor through the holes in each flat bar at the base of the cabinet using M10 or M12 screws.
2. Remove the lifting bars.
3. Fasten the top of the cabinet to the rear wall and/or roof using the brackets delivered with the converter. Gaskets and cork pads are included. Use the lifting bar fastening holes and bolts. Use the original bolts to block any unused holes.

Use M10 or M12 screws; welding is not recommended (see *Electric welding* on page *51*).



Fastening the cabinet at the top with brackets



Joining the liquid cooling unit to the converter cabinet

Converter delivery does not include the liquid cooling unit (LCU) that is to be connected to the converter cabinet.

Connecting the liquid pipes

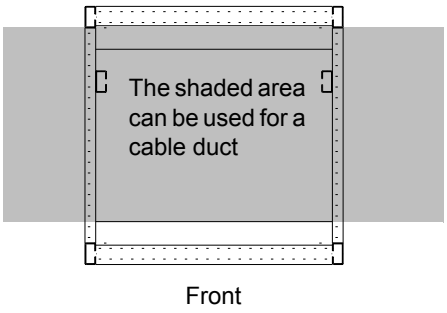
Note: It is recommended to use closing valves in the pipe connections of the cooling circuit.

1. Ensure that there is sufficient space and free access to make proper cooling pipe connections between the liquid cooling unit and the converter. It is not allowed to use inflexible and fixed cooling pipe connections between two separate units (eg, LCU and the converter connection). Always use a flexible connector that can reduce possible stress caused by eg, vibration.
2. Check visually that the converter liquid pipes are not damaged (threads and flange joint not damaged).
3. Connect the external cooling circuit pipes to the LCU. Secure the pipes mechanically. See chapter *Technical data* for the pipe materials.
4. Position the liquid pipe ends against each other.
5. Centre the connector onto the pipe ends.
6. Tighten the
   - threaded connector carefully and ensure that it is slid on pipe ends,
   - flange connector bolts to a torque of 70 N·m (52 lbf·ft).

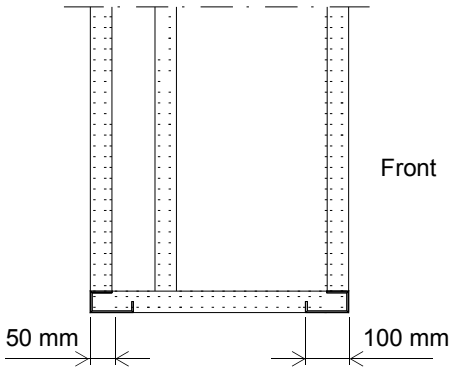
Miscellaneous

Cable duct in the floor below the cabinet

A cable duct can be constructed below the middle part of the cabinet. The duct width may not exceed 450 mm. The cabinet weight lies on the 100 mm wide section in front and 50 mm wide section on the back which the floor must carry.

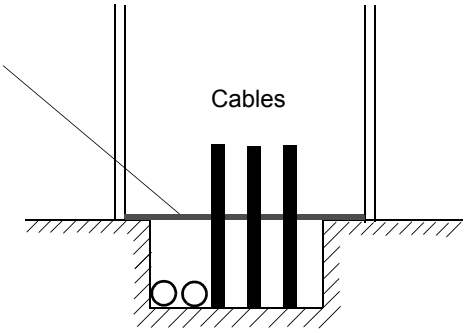


Allowed area for cable duct (view from above)



Minimum widths for the floor support (side view)

Prevent the cooling air flow from the cable duct to the cabinet by bottom plates. To ensure the degree of protection for the cabinet use the original bottom plates delivered with the unit. With user-defined cable entries, take care of the degree of protection, fire protection and EMC compliance.



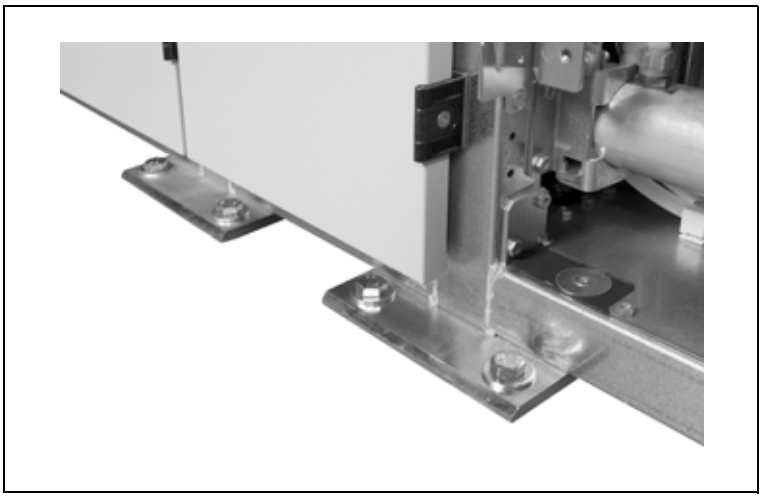
Preventing cooling air flow

Electric welding

It is not recommended to fasten the cabinet by welding.

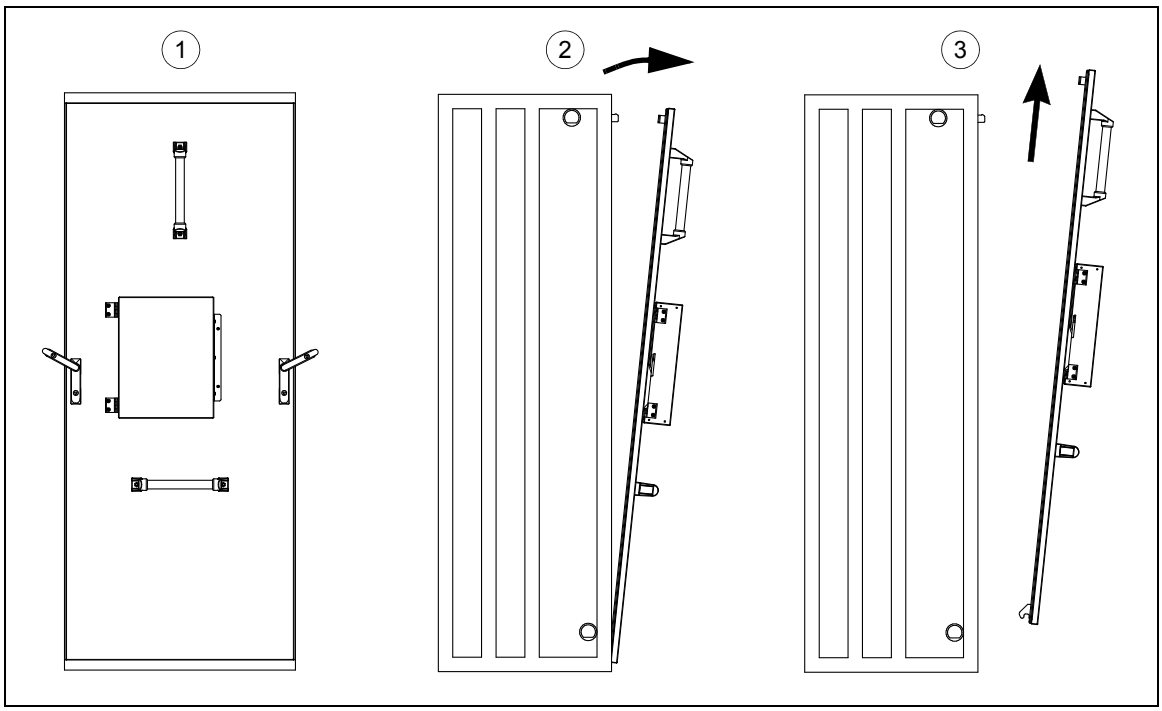
- Weld only the flat bar under the cabinet, never the cabinet frame itself.
- Clamp the welding electrode onto the flat bar that is to be welded or to the next flat bar of the cabinet (within 0.5 metres of the welding point).

WARNING! If the welding return wire is connected improperly, the welding circuit may damage electronic circuits in the cabinet. The thickness of the zinc coating of the cabinet frame is 100 to 200 micrometres; on the flat bars the coating is approximately 20 micrometres. Ensure that the welding fumes are not inhaled.



Lifting the door (option +C161)

1. Open the handles.
2. Detach the upper part of the door.
3. Lift the door upwards.



5

Planning the electrical installation

What this chapter contains

This chapter contains the instructions that you must follow when selecting the generator, cables, protections, cable routing and way of operation for the converter system.

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 converter must always be equipped with a grid-side disconnecting device which can be locked to the open position for installation and maintenance work. If the converter is equipped with the 400 mm wide incoming cubicle (option +C111), or power cabinet (option +C108 or +C109) it is equipped with the disconnecting device automatically. For the other units, the device must be selected, acquired and installed by the customer.

The disconnecting device does not, however, isolate the L1, L2 and L3 busbars from the power supply network. Therefore during installation and maintenance work on the converter, the converter must be isolated from the power supply network with a disconnector at the distribution board or at the line-coupling transformer. Apply temporary grounding before working on the unit.

Checking the compatibility of the generator and converter

For choosing the correct generator type, contact your local ABB representative.

Protecting the generator insulation and bearings

The rotor-side converter output consists of – regardless of output frequency – pulses of approximately the converter DC link voltage with a very short rise time. The voltage of the pulses can almost double at the generator terminals, depending on the attenuation and reflection properties of the generator cables and terminals. This can cause additional stress on the generator and generator cable insulation. Converters with fast rising voltage pulses and high switching frequencies can cause current pulses that flow through the generator bearings, and can gradually erode the bearing races and rolling elements.

The stress on generator insulation can be avoided by using ABB du/dt and common mode filters. The converter is equipped with the following output filters as standard:

- du/dt filter that protects the generator insulation system and reduces bearing currents
- common mode filter that reduces bearing currents.

To avoid damage to the generator bearings, the cables must be selected and installed according to the instructions given in this manual. In addition, insulated N-end (non-drive end) bearings must be used.

Selecting the power cables

General rules

Dimension the grid-side and rotor-side connection cables **according to local regulations**:

- The cable must be able to carry the converter load current and withstand the voltage stress of the converter. See chapter *Technical data* for the rated currents.
- The cable must be rated for at least maximum permissible temperature of conductor in continuous use. For US, see section *Additional US requirements*.
- The inductance and impedance of the PE conductor/cable (grounding wire) must be rated according to permissible touch voltage appearing under fault conditions (so that the fault point voltage will not rise excessively when a ground fault occurs).
- For 690 V AC rated equipment, the rated voltage between the conductors of the cable should be minimum 1 kV.

For generators, symmetrical shielded generator cable is recommended.

A four-conductor system is allowed for grid-side cabling, but shielded symmetrical cable is recommended.

To operate as a protective conductor, the shield conductivity requirements according to IEC 61800-5-1 are shown below when the protective conductor is made of the same metal as the phase conductors. The table applies also to four conductor systems.

Cross-sectional area of the phase conductors S (mm^2)	**Minimum cross-sectional area of the corresponding protective conductor S_p (mm^2)**
$S \leq 16$	S
$16 < S \leq 35$	16
$35 < S \leq 400$	S/2
$400 < S \leq 800$	200
$800 < S$	S/4

Compared to the four conductor system, the use of symmetrical shielded cable reduces electromagnetic emission of the whole converter system as well as generator bearing currents and wear.

Note: The cabinet configuration of the converter may require multiple supply and/or generator cabling. Refer to the connection diagrams in chapter *Electrical installation*.

The generator cable and its PE pigtail (twisted screen) should be kept as short as possible in order to reduce electromagnetic emission as well as capacitive current.

Typical power cable sizes

IEC

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

Rotor-side converter cables

Type name	Rotor-side converter current rating [A]	240mm^2	185mm^2	120mm^2	3×240mm^2 + 120mm^2	3×185mm^2 + 95mm^2	3×120mm^2+ 70mm^2
		nr of cables / phase			nr of cables		
ACS800-67LC-1075/0575-7	898	2	3	4	3	3	4
ACS800-67LC-1375/0575-7	1143	3	4	5	3	4	5
ACS800-67LC-1375/1125-7	1143	3	4	5	3	4	5
ACS800-67LC-1595/0865-7	1334	4	4	6	4	5	6
ACS800-67LC-2035/1125-7	1697	5	5	7	5	6	8

Grid-side converter cables (or cables to the power cabinet (option +C109))

Type name	Grid-side converter current rating [A]	240mm^2	185mm^2	120mm^2	3×240mm^2 + 120mm^2	3×185mm^2 + 95mm^2	3×120mm^2+ 70mm^2
		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
ACS800-67LC-2035/1125-7	941	3	3	4	3	3	4

UL

The maximum number of cables to be connected are shown below. The cable ratings are based on UL508A and National Electric Code 2008 (US).

Rotor-side converter cables

Type name	Rotor-side converter current rating [A]	500 kcmil (253 mm^2)	350 kcmil (177 mm^2)
		nr of cables / phase	
ACS800-67LC-1075/0575-7	898	4	5
ACS800-67LC-1375/0575-7	1143	6	8
ACS800-67LC-1375/1125-7	1143	6	8
ACS800-67LC-1595/0865-7	1334	6	9
ACS800-67LC-2035/1125-7	1697	9	11

Grid-side converter cables (or cables to the power cabinet (option +C109))

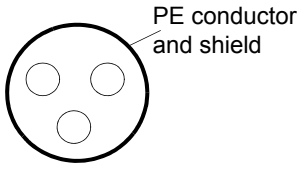
Type name	Grid-side converter current rating [A]	500 kcmil (253 mm^2)	350 kcmil (177 mm^2)
		nr of cables / phase	
ACS800-67LC-1075/0575-7	480	2	3
ACS800-67LC-1375/0575-7	480	2	3
ACS800-67LC-1375/1125-7	941	5	6
ACS800-67LC-1595/0865-7	720	3	4
ACS800-67LC-2035/1125-7	941	5	6

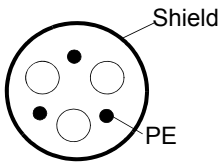
Alternative power cable types

Power cable types that can be used with the converter are represented below.

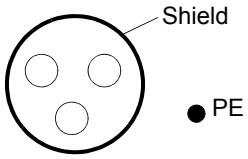
Recommended

Symmetrical shielded cable: three phase conductors and a concentric or otherwise symmetrically constructed PE conductor, and a shield





A separate PE conductor is required if the conductivity of the cable shield is <50% of the conductivity of the phase conductor.

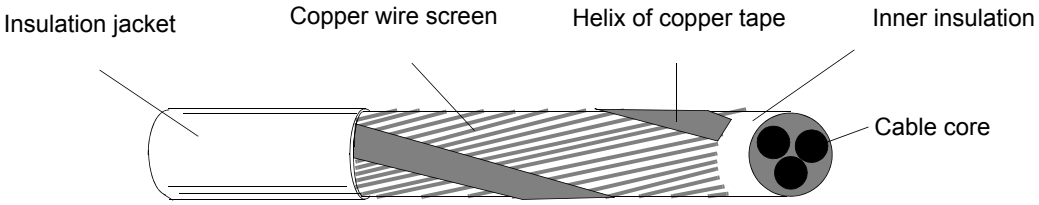


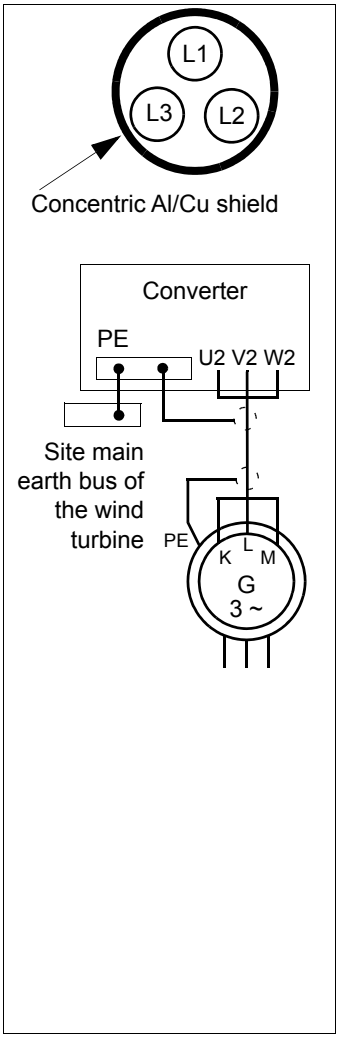
A four conductor system: three phase conductors and a protective conductor.

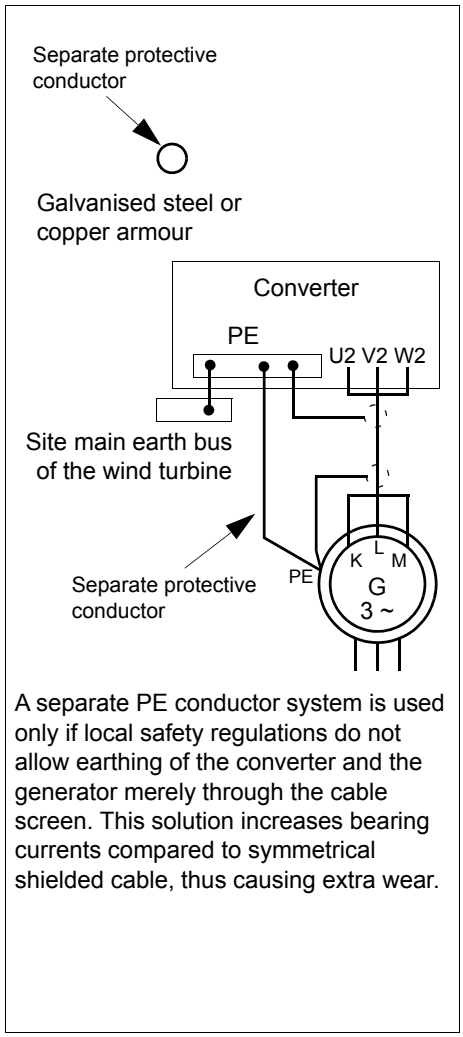
Can be used for rotor cables (not recommended)

Rotor cable shield

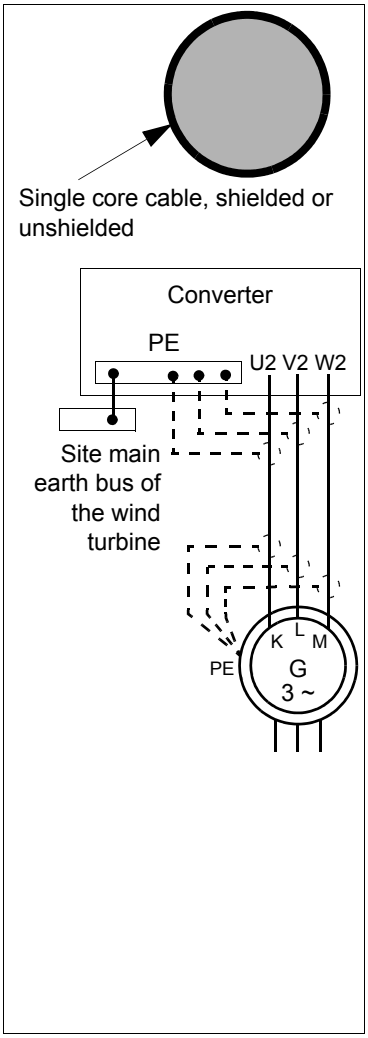
To effectively suppress radiated and conducted radio frequency emissions, the shield conductivity must be at least 1/10 of the phase conductor conductivity. The requirements are easily met with a copper or aluminium shield. The minimum requirement of the rotor cable shield of the converter is shown below. It consists of a concentric layer of copper wires with an open helix of copper tape. The better and tighter the shield, the lower the emission level and the bearing currents.







A separate PE conductor system is used only if local safety regulations do not allow earthing of the converter and the generator merely through the cable screen. This solution increases bearing currents compared to symmetrical shielded cable, thus causing extra wear.



Additional US requirements

Type MC continuous corrugated aluminum armor cable with symmetrical grounds or shielded power cable must be used for the generator cables if metallic conduit is not used. For North America, 600 V AC cable is accepted up to 500 V AC. 1000 V AC cable is required above 500 V AC (below 600 V AC). For converters rated over 100 A, the power cables must be rated for 75 °C (167 °F).

Sizes of grounding conductor terminals are listed below.

Maximum ampere rating of overcurrent protection for field wiring conductors supplying panel	Size of equipment grounding or bonding conductor, minimum			
	Copper		Aluminum	
	AWG or kcmil	mm^2	AWG or kcmil	mm^2
15	14	2.1	12	3.3
20	12	3.3	10	5.3
30	10	5.3	8	8.4
40	10	5.3	8	8.4
60	10	5.3	8	8.4
100	8	8.4	6	13.3
200	6	13.3	4	21.2
300	4	21.2	2	33.6
400	3	26.7	1	42.4
500	2	33.6	1/0	53.5
600	1	42.4	2/0	67.4
800	1/0	53.5	3/0	85.0
1000	2/0	67.4	4/0	107.2
1200	3/0	85.0	250 kcmil	127
1600	4/0	107.2	350	177
2000	250 kcmil	127	400	203
2500	350	177	600	304
3000	400	203	600	304
4000	500	253	800	405
5000	700	355	1200	608
6000	800	506	1200	608

Conduit

Bridge the joints of the conduits with a ground conductor bonded to the conduit on each side of the joint. Bond the conduits also to the converter enclosure and generator frame. Use separate conduits for input power, generator, DC resistors, and control wiring. When conduit is employed, type MC continuous corrugated aluminum armor cable or shielded cable is not required. A dedicated ground cable is always required.

Note: Do not run generator wiring from more than one converter in the same conduit.

Armored cable / shielded power cable

Six conductor (3 phases and 3 ground) type MC continuous corrugated aluminum armor cable with symmetrical grounds is available from the following suppliers (trade names in parentheses):

- Anixter Wire & Cable (Philsheath)
- BICC General Corp (Philsheath)
- Rockbestos Co. (Gardex)
- Oaknite (CLX).

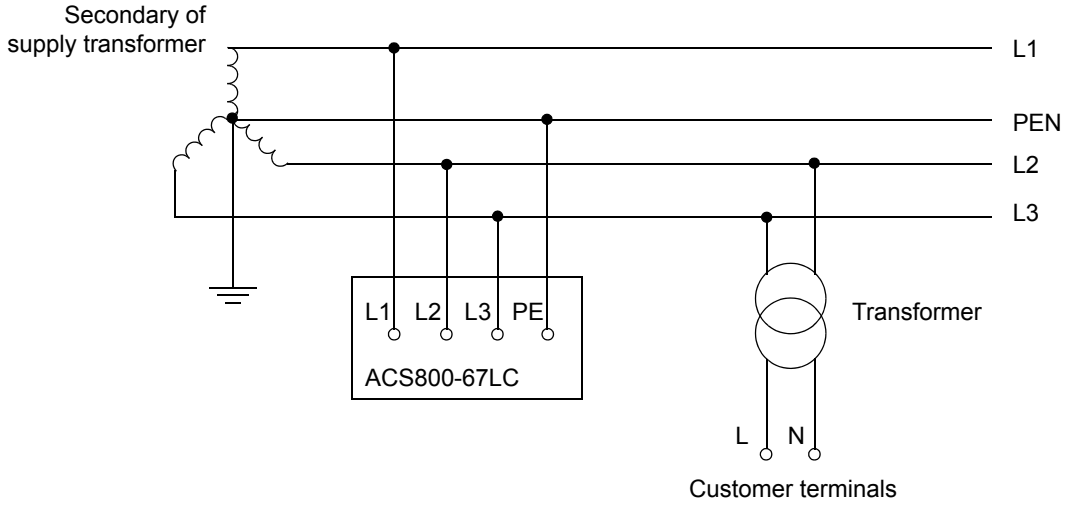
Shielded power cables are available from Belden, Lapp Kabel (ÖLFLEX) and Pirelli, among others.

Suitable power supply networks

Converter can be installed in TN-C-S and TN-S systems (most generally used in wind turbine installations).

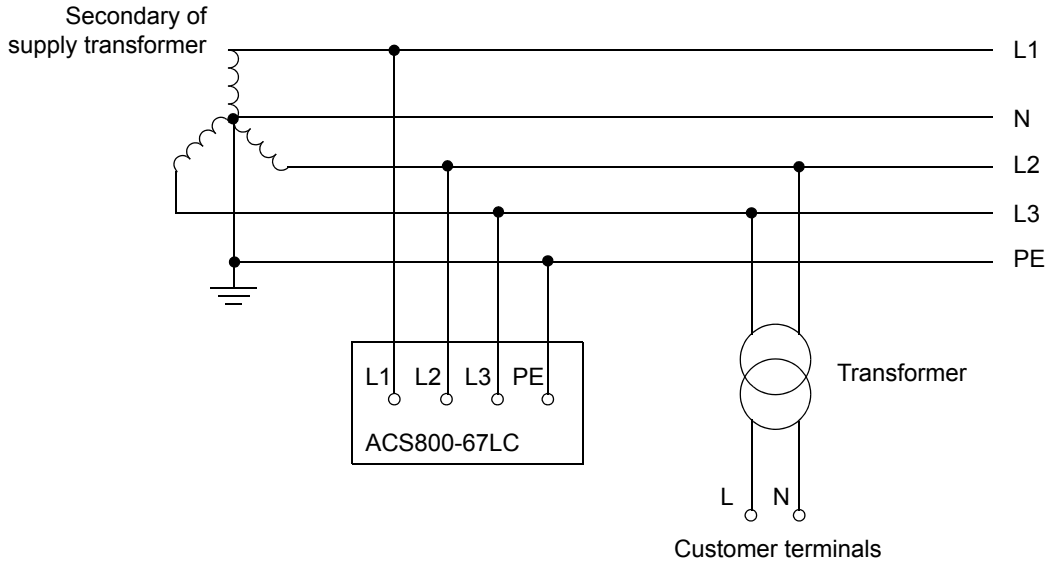
TN-C-S power supply network

In TN-C-S power supply network separate neutral and protective conductors are used. The supply, however, uses a common conductor for both the neutral and the earth. This combined earth and neutral system is called the protective and neutral conductor (PEN) or the combined neutral and earth conductor (CNE). A system shown below is usually called the protective multiple earth (PME) system.



TN-S power supply network

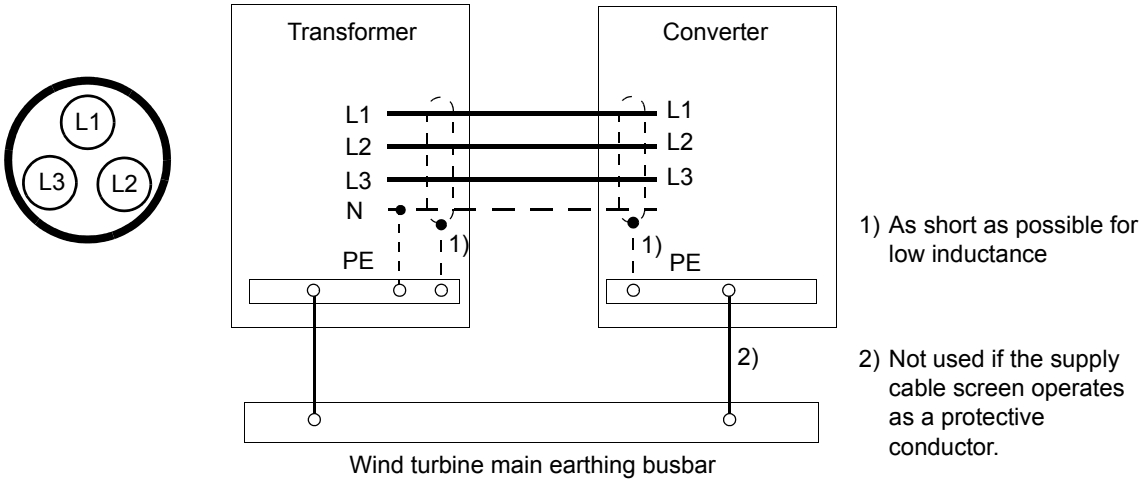
In TN-S power supply network earth terminal is connected by the supply protective conductor (PE) back to the star point (neutral) of the secondary winding of the supply transformer, which is also connected at that point to an earth electrode. The earth conductor usually takes the form of the armour and sheath (if applicable) of the underground supply cable. A system diagram is shown below.



Selecting the grid-side power cabling principle

This section presents three alternative principles for the grid-side power cabling.

Alternative 1: Symmetrical, shielded three-phase cable(s)

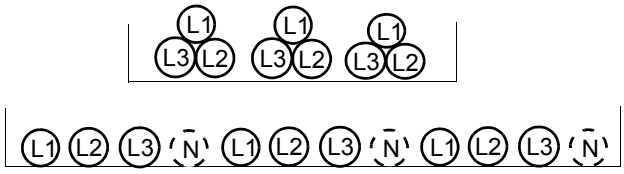


1) As short as possible for low inductance

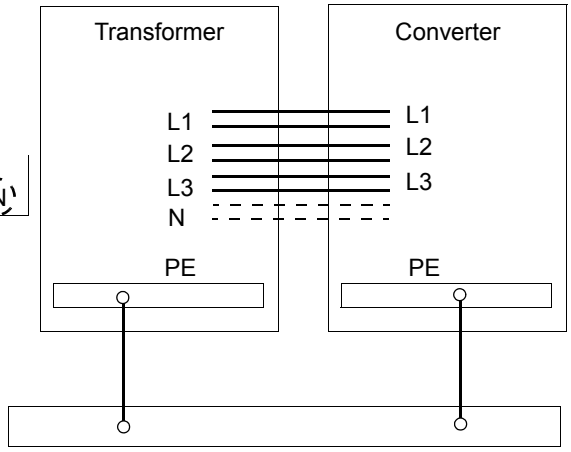
2) Not used if the supply cable screen operates as a protective conductor.

Alternative 2: Cable bus system

The connection of a high current (> 300 A) cable bus system that consists of several cables is shown below. In this system, less conductor material is needed due to better cooling of separate conductors.



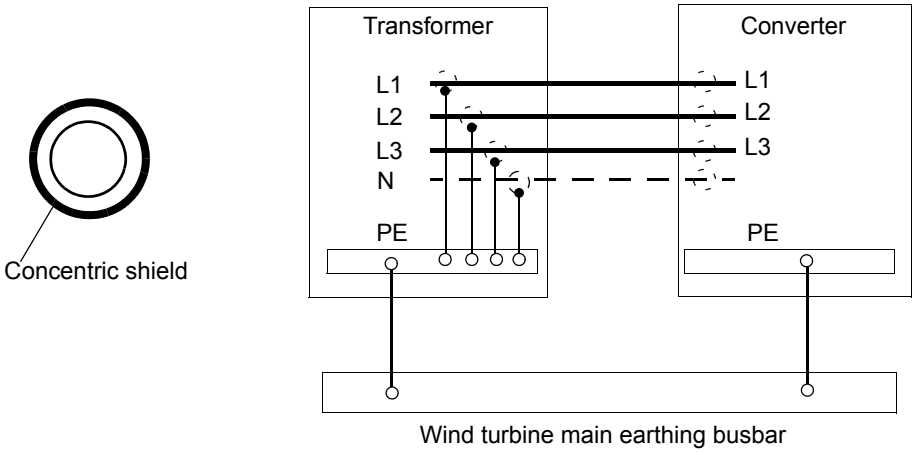
It is recommended to arrange the cables as shown – alongside each other – to achieve a current distribution as accurate as possible. Gaps between cables are required for cooling.



Note: Current derating of the cables is required when installing the cables in a cable tray. This derating factor must be taken into account as per the local electrical safety code.

Alternative 3: Single core cables with concentric protective shields

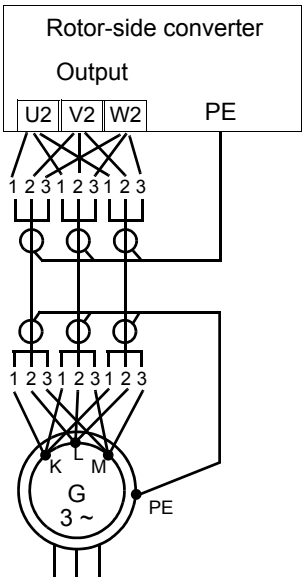
When single core cables equipped with concentric protective shields (metal) are used, the phase current will induce voltage to the cable shield. If the shields are connected to each other at both ends of the cable, current will flow in the cable shield. In order to prevent this and to ensure personal safety, the cable shield must be connected only to PE at the transformer side and insulated on the converter side. The connection is represented below.



Selecting the rotor cabling principle

Only use three-phase symmetrical cables between the converter and the rotor. For the possible rotor cable shield constructions, see section *Rotor cable shield* on page *57*.

Rotor cable connections with parallel symmetrical cables are shown below.



For information on how to change the rotation direction of the generator, see *ACS800-67LC system description and start-up guide* [3AUA0000059432 (English)].

Selecting the control cables

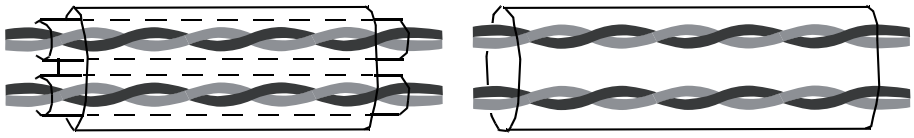
General rules

All control cables must be shielded.

The control cable shield should be earthed directly in the converter. The other end of the shield should be left unconnected or earthed indirectly via a high frequency, high voltage capacitor of a few nanofarads (eg, 3.3 nF / 3000 V). The screen can also be earthed directly at both ends if they are in the same earth line with no significant voltage drop between the end points.

Use a double shielded twisted pair cable (see figure a) for analog signals. This type of cable is recommended for the pulse encoder signals also. Employ one individually shielded pair for each signal. Do not use common return for different analog signals.

A double shielded cable is the best alternative for low voltage digital signals but single shielded twisted multipair cable (figure b) is also usable.



a
Double shielded twisted multipair cable

b
Single shielded twisted multipair cable

Run analog and digital signals in separate, shielded cables.

Relay controlled signals, providing their voltage does not exceed 48 V, can be run in the same cables as digital input signals. It is recommended that the relay controlled signals be run as twisted pairs.

Relay cable

The cable type with braided metallic screen (eg, ÖLFLEX LAPPKABEL, Germany) has been tested and approved by ABB.

Control panel cable

In remote use, the cable connecting the control panel (if any) to the converter must not exceed 3 metres (10 ft). The cable type tested and approved by ABB is used in control panel option kits. Control panel or cable is not included in the converter delivery. For control panel, contact local ABB representative.

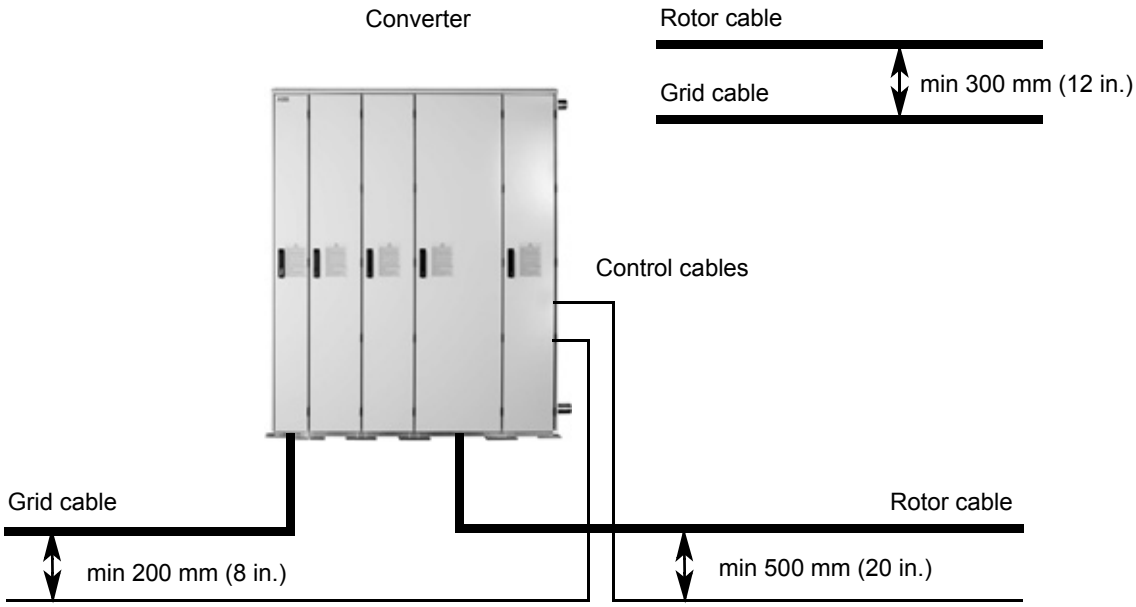
Routing the cables

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

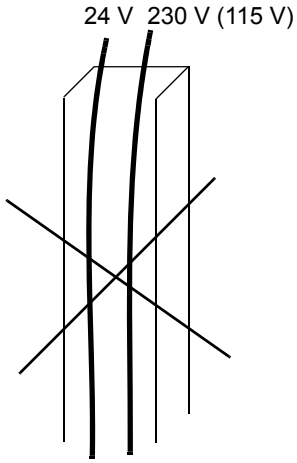
Where control cables must cross grid cables and rotor cables, make sure they are arranged at an angle as near to 90 degrees as possible. Do not run extra cables through the converter.

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.

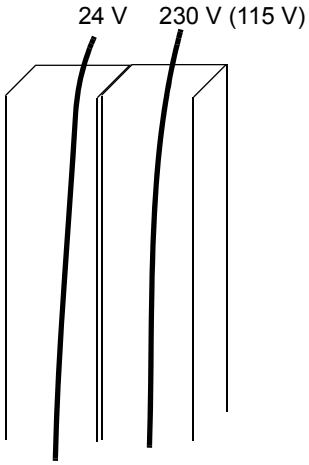
A diagram of the cable routing is shown below.



Control cable ducts



Not allowed unless the 24 V cable is insulated for 230 V (115 V) or insulated with an insulation sleeving for 230 V (115 V).



Lead 24 V and 230 V (115 V) control cables in separate ducts inside the cabinet.

Protecting the converter, grid cable, rotor and rotor cable in short-circuit situation and against thermal overload

Protecting the grid cable in short-circuit situations

Protect the grid cable with fuses.

Size the fuses according to local safety regulations, appropriate input voltage and rated current of the converter. Check that the operating time of the fuses is below 0.5 seconds.

WARNING! Circuit breakers are not capable of providing sufficient protection because they are inherently slower than fuses. Always use fuses with circuit breakers.

Protecting the converter in short-circuit situations

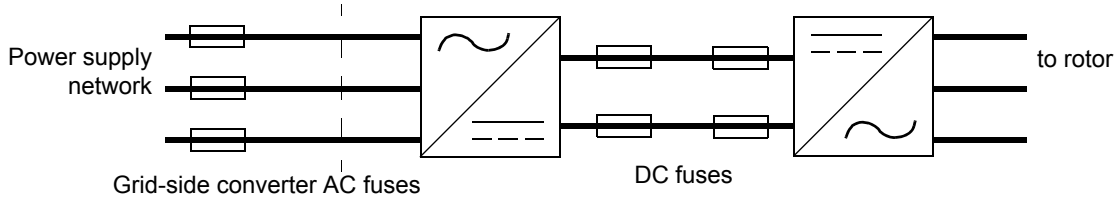
AC fuses

Always protect the converter with AC fuses listed in chapter *Technical data*. The fuses restrict the converter damage and prevent damage to adjoining equipment. The fuses are included in the delivery of the wind turbine converter automatically if it is equipped with 400 mm wide incoming cubicle (option +C111), or a power cabinet (option +C108 or +C109). For the other units, the fuses must be acquired and installed outside the converter cabinet by the user.

WARNING! Circuit breakers are not capable of providing sufficient protection because they are inherently slower than fuses. Always use appropriate fuses.

DC fuses

The converter employs fuses in the DC link between the grid-side and rotor-side converter modules. See chapter *Technical data* for fuse ratings.



Protecting the rotor and rotor cable in short-circuit situations

The converter is capable of detecting a short-circuit in generator rotor windings or in generator rotor cable. However, it does not protect the generator or generator cables.

Protecting the converter, grid cable and rotor cable against thermal overload

The converter protects itself, the grid cable and rotor cable against thermal overload when the cables are dimensioned according to the nominal current of the converter and the ambient conditions are within the limits specified in section *Ambient conditions* on page *128*.

Protecting the converter against ground faults in the converter, grid cable, rotor or rotor cable

The rotor-side converter is equipped with an internal ground fault protective function to protect the converter against ground faults in the generator and rotor cable. The grid-side converter is equipped with an internal ground fault protective function to protect the converter against ground faults in the converter or grid cable. This is not a personal safety or a fire protection feature.

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.

See also section *Control connections* on page *80*.

Supplying power for the auxiliary circuits

As standard the converter auxiliary circuit is to be supplied from the power supply network through an external auxiliary voltage transformer and UPS. The converter is equipped with terminals for connecting external control voltages (X1 and X2). The circuit breakers are located in the auxiliary control cubicle of the converter. For information on the power consumption of auxiliary devices, see section *Auxiliary circuit current consumption* on page *129*.

Uninterrupted auxiliary power supply for the converter (UPS)

The converter is equipped with a 1-phase 230 V AC (50/60 Hz) connection for control electronics to be supplied by UPS (UPS not included in the ABB delivery). It is recommended to use an on-line type of UPS the output voltage of which does not depend on the voltage and frequency of the power supply network. In case of UL and without option +C108 or +C109 also 1-phase 50/60 Hz is allowed.

Auxiliary power supply for converter (non-UPS)

The converter is equipped with a 1-phase 230 V AC (50/60 Hz) connection for heating control logic and cooling fan supply power. In case of UL and without option +C108 or +C109 also 1-phase 50/60 Hz is allowed.

Planning the installation of equipment connected to the rotor cable

Safety switches, contactors, connection boxes, etc.

To minimize the emission level when safety switches, contactors, connection boxes or similar equipment are installed in the rotor cable between the converter and the generator:

- EU: Install the equipment in a metal enclosure with 360° grounding for the shields of both the incoming and outgoing cables, or connect the shields of the cables otherwise together.
- US: Install the equipment in a metal enclosure in a way that the conduit or rotor cable shielding runs consistently without breaks from the converter to the generator.

Bypass connection

WARNING! Never connect the power supply to the converter rotor-side terminals U2, V2 and W2. Input voltage applied to the U2, V2 and W2 terminals can result in permanent damage to the unit.

6

Electrical installation

What this chapter contains

This chapter describes the electrical installation procedure of the converter.

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.

Converter

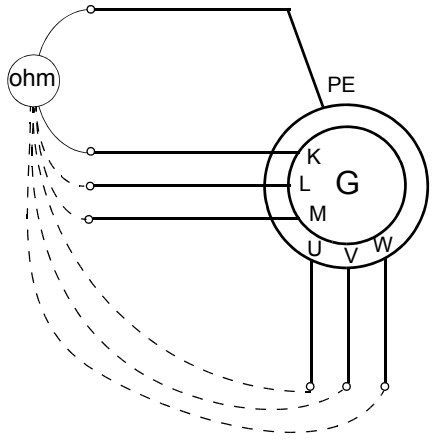
Every converter has been tested for insulation between the main circuit and the chassis at the factory (2700 V rms 50 Hz for 1 second). Do not make any voltage tolerance or insulation resistance tests eg, hi-pot or megger, on any part of the converter as testing can damage the converter. Also, there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

Rotor and rotor cable

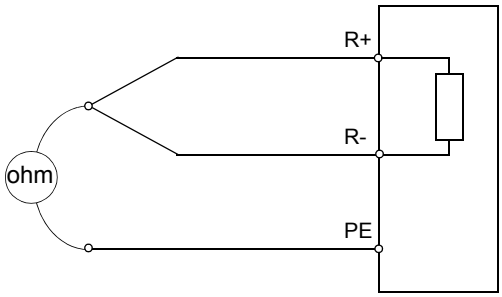
1. Check that the generator rotor cable is connected to the generator (terminals K, L and M), and the stator cable is connected to the generator (terminals U, V and W).
2. Ensure that the other ends of the cables are unconnected.
3. Measure the insulation resistance between each phase conductor and the 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, please 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.



DC resistor and resistor cable

Option +D150

- Check that the resistor cable is connected to the resistor and disconnected from the converter output terminals R+ and R-. At the converter end, connect the R+ and R- conductors of the resistor cable together.
- Measure the insulation resistance between the combined conductors and the PE conductor by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.



Option +D150+D151

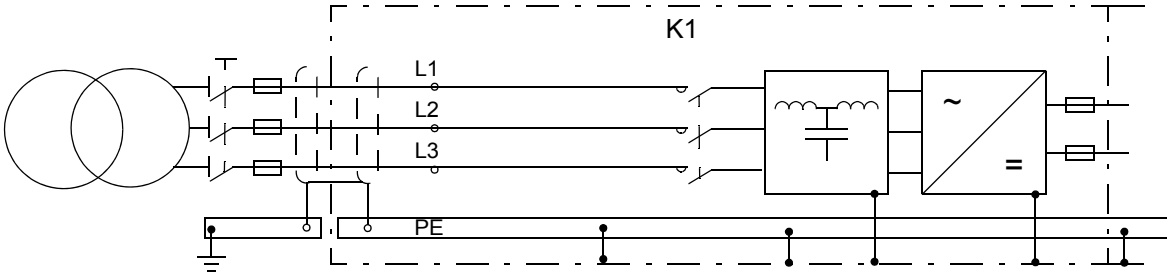
Every converter equipped with integrated DC resistor is tested for insulation between the main circuit and the chassis at the factory (2700 V rms 50 Hz for 1 second). Do not make any voltage tolerance or insulation resistance tests.

Connecting the grid cables – units with 200 mm wide incoming cubicle

Note: The cabling from all converter modules must be physically identical considering cable type, cross-sectional area and length.

Connection diagram

The diagram below shows the connection of the grid cable to the converter. The connection principle is the same also for the larger units.



Note: See chapter *Technical data* for:

- number and sizes of the cable lead-throughs
- number and sizes of the connection busbars
- tightening torques for the power connections.

Note: For the instructions on the possible construction and sizes of the grid-side cabling and PE conductor, see chapter *Planning the electrical installation*.

Connection procedure – a blank plate at the cable lead-through

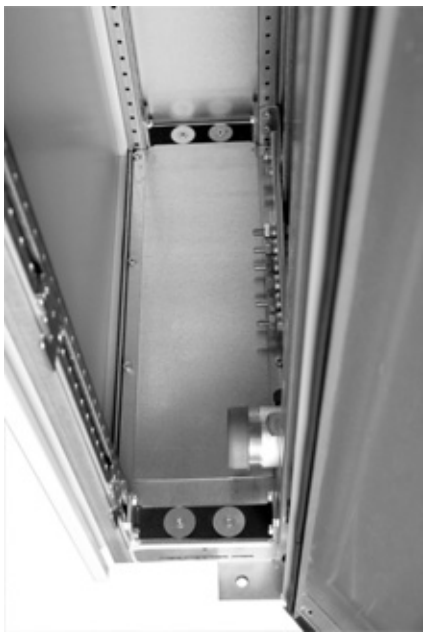
For description of the blank plate, see chapter *Operation principle and hardware description*, page *32*.

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

1. Open the door of the incoming cubicle. Unlock the handle, release it from the holder and turn upwards to release the door locking mechanism.
2. Remove the shroud that protects the grid 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 fulfill the requirements of degree of protection IP54 or higher.

Grid cable connection terminals L1, L2, L3



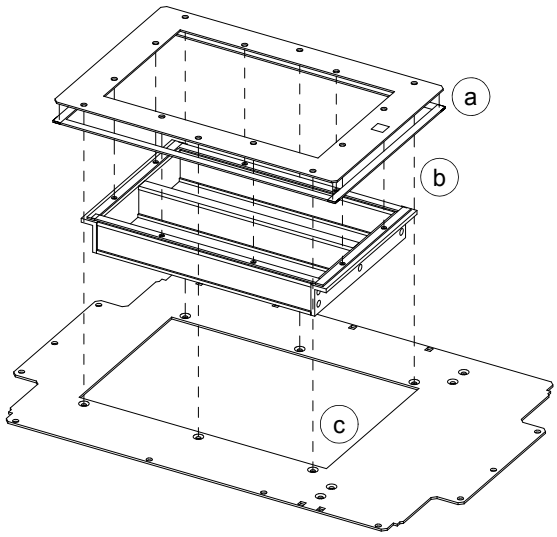
Grid cable entry plate (blank plate)

Connection procedure – sealing modules at the cable lead-through

For description of the sealing modules, see chapter *Operation principle and hardware description*, page *32*. Sealing modules are to be installed by the customer and they are located unfastened in the cubicles they are to be installed in.

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

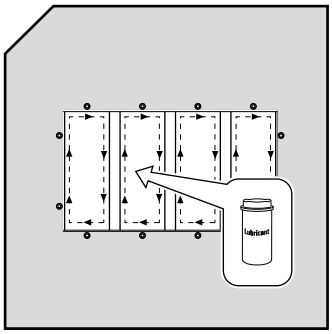
1. Open the door of the incoming cubicle. Unlock the handle, release it from the holder and turn upwards to release the door locking mechanism.
2. Remove the shroud that protects the cable connection busbars and cable entries.
3. Remove the blank plate and the gasket under it.
4. Follow the instructions below.



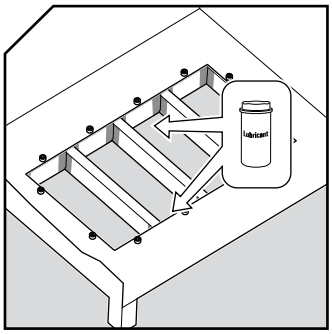
Fasten the gasket to the collar plate (a).

Fasten the sealing module frame to the collar plate (b).

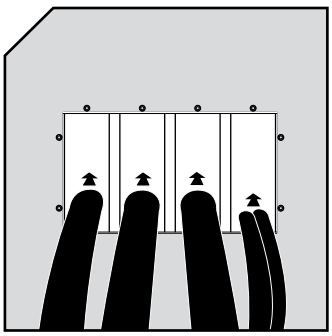
Fasten both parts onto the cabinet (c).



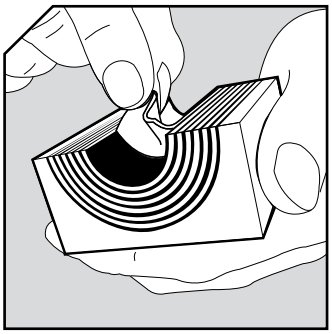
Lubricate the inside of all frame openings thoroughly with lubricant.



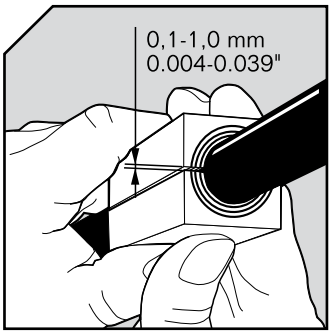
Put some extra lubricant in all corners of all frame openings.



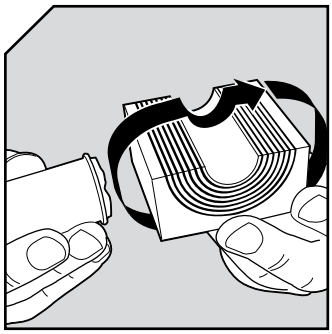
Route all cables. It is recommended to seal cables at the bottom of the frame and put spare modules on top.



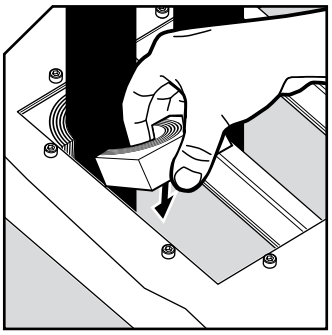
Adapt modules, which are to hold cables, by peeling off layers until you reach the gap seen in the next picture. Try to remove the same number of layers on both module halves.



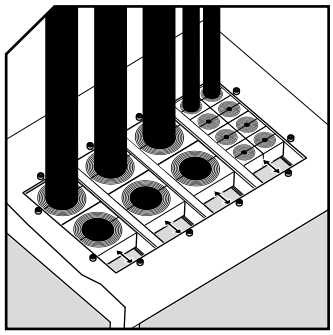
Achieve a 0.1…1.0 mm gap between the two halves when held against the cable.



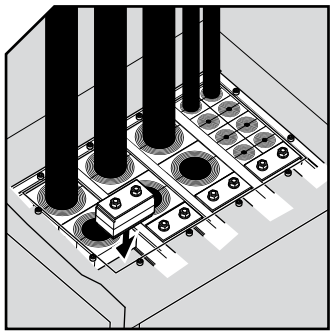
Lubricate all modules for the frame thoroughly on both the inside and the outside surfaces.



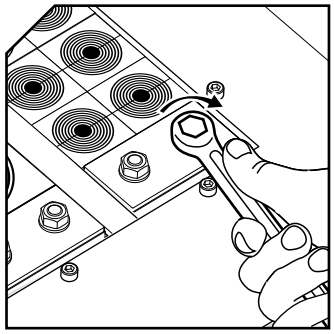
Mount the modules by sliding them in through the angled entry side of the frame.



Mount the modules row by row starting from the inside. Precompress the frame.



Lubricate the compression units. Insert one in the top of each opening.



Tighten all compression units alternately until full stop, approx. 10 N·m (7.4 lbf·ft).

Connection procedure – cable glands at the cable lead-through

For description of the cable glands, see chapter *Operation principle and hardware description*, page *32*.

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

---

1. Open the door of the incoming cubicle. Unlock the handle, release it from the holder and turn upwards to release the door locking mechanism.
2. Remove the shroud that protects the grid 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 phase conductors to terminals L1, L2 and L3. Tighten the phase conductors and PE to 70 N·m (50 lbf·ft) torque.

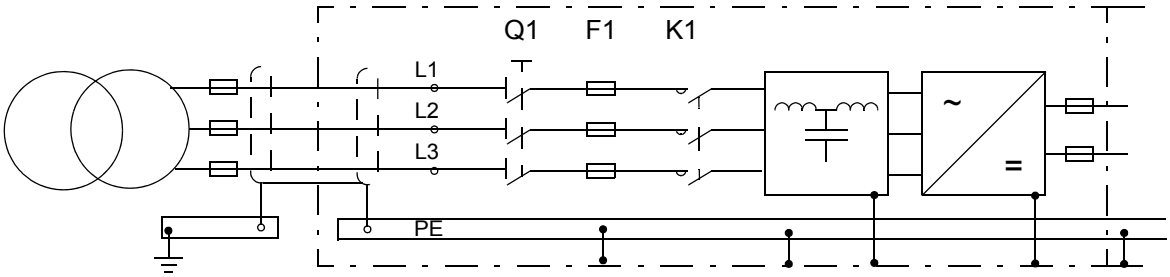
   When single-core cables without metal shield are used:
   - Lead the cables into the inside of the cubicle through the IP sealing glands.
   - Connect the phase conductors to terminals L1, L2 and L3, and the PE conductors to the PE terminal. Tighten the phase and PE conductors to 70 N·m (50 lbf·ft) torque.
4. Provide support for the cables whenever necessary.
5. Refit all shrouds removed earlier and close the door.

Connecting the grid cables – units with 400 mm wide incoming cubicle (option +C111)

Note: The cabling from all converter terminals must be physically identical considering cable type, cross-sectional area and length.

Connection diagram

The diagram below shows the connection of the grid cable to the converter. The connection principle is the same also for the larger units.



Connection procedure

See pages 70–73.

Grid cable connection terminals L1, L2, L3

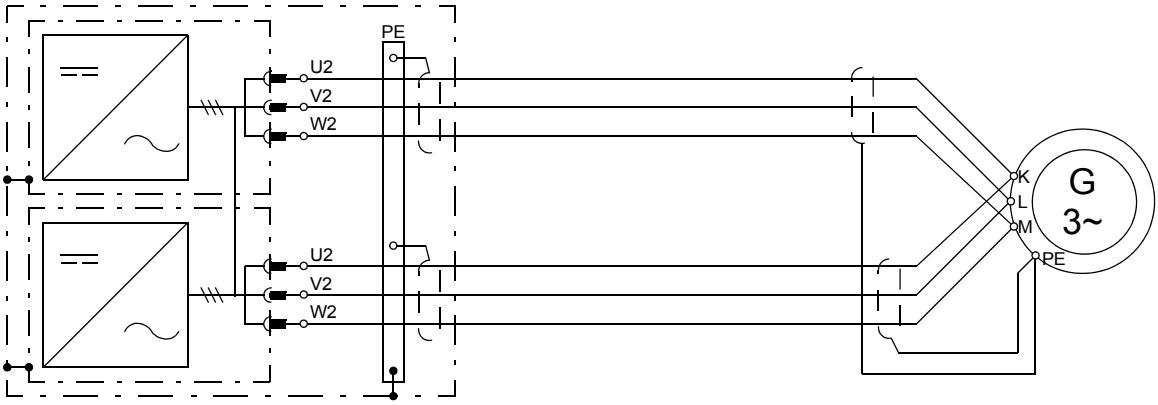
Grid cable entry plate (blank plate)

Connecting the rotor cables

Note: The cabling from all converter modules must be physically identical considering cable type, cross-sectional area and length. When connecting several cables per phase, it is recommended to divide the cables as evenly as possible among the modules.

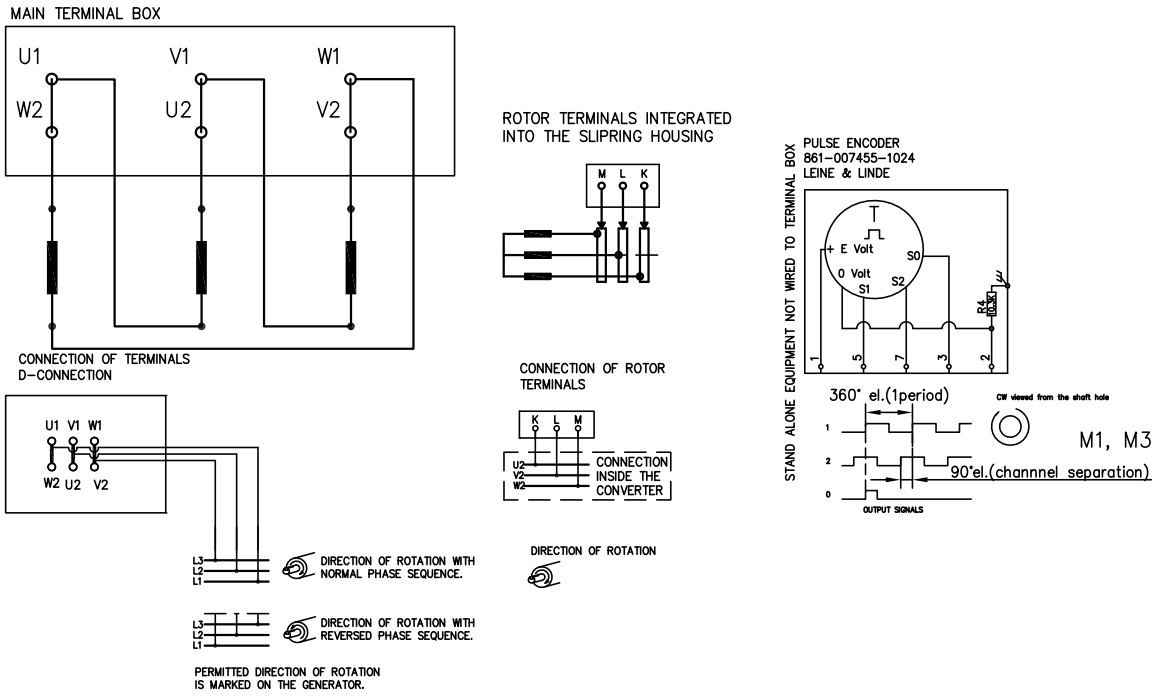
Connection diagram

A connection diagram of frame 2×R8i parallel connected power modules feeding one generator is shown below. The cable connection for frames 2×R8i and up is similar.



Note: Rotor-side cable connection terminals are U2, V2, W2 and PE. To be wired by the user. For selection of the cables, see chapter *Planning the electrical installation*. For the terminal sizes, tightening torques and lead-throughs, see chapter *Technical data*.

Note: Depending on the type of the generator used, the phase order may vary.



Connection procedure – a blank plate at the cable lead-through

For description of the blank plate, see chapter *Operation principle and hardware description*, page *32*.

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

1. Open the door of the inverter module cubicle.
2. Remove the shroud that protects the rotor cable connection busbars and cable entries.
3. Remove the fans (see the pictures below). Undo the two fastening screws of the fan collar, push the collar a bit inwards and pull the fan with collar out.
4. Cut/drill suitable holes for the cables. Smooth the hole edges.
5. Lead the cables inside the cabinet through the lead-through plate holes. Mind the edges.
6. Seal the cable lead-throughs to retain the degree of protection of the enclosure (to keep the dust and humidity out of the cabinet).
7. 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 fulfill the requirements of degree of protection IP54 or higher.

Connection procedure – sealing modules at the cable lead-through

For description of the sealing modules, see chapter *Operation principle and hardware description*, page *32*.

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

1. Open the door of the inverter module cubicle.
2. Remove the shroud that protects the rotor cable connection busbars and cable entries.
3. Remove the fans (see the pictures below). Undo the two fastening screws of the fan collar, push the collar a bit inwards and pull the fan with collar out.
4. Follow the instructions given on page *71*.

Connection procedure – cable glands at the cable lead-through

For description of the cable glands, see chapter *Operation principle and hardware description*, page *32*.

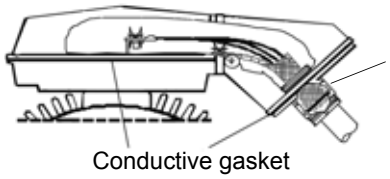
WARNING! Read and follow the instructions given in chapter *Safety instructions*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Open the door of the inverter module cubicle.
2. Remove the shroud that protects the rotor cable connection busbars and cable entries.
3. Remove the fans (see the pictures below). Undo the two fastening screws of the fan collar, push the collar a bit inwards and pull the fan with collar out.
4. When shielded cable is used:
   Lead the cables into the inside of the cubicle. Ground a shielded cable 360° at the lead-through with an EMC cable gland.
   - Connect the cables as follows:
   - Cut the cables to suitable length. Strip the cables and conductors. Fasten the cable lugs to the conductor ends.
   - 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 phase conductors to terminals U2, V2 and W2. See the appropriate connection diagram above. Tighten the phase conductors and PE to 70 N·m (50 lbf·ft) torque.

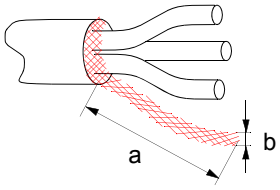
   When single-core cables without metal shield are used:
   - Lead the cables into the inside of the cubicle through the IP sealing glands.
   - Connect the phase conductors to terminals U2, V2 and W2, and the PE conductors to the PE terminal. See the appropriate connection diagram above. Tighten the phase and PE conductors to 70 N·m (50 lbf·ft) torque.
5. Provide support for the cables whenever necessary.
6. Install the fans removed earlier.
7. Refit the shroud removed earlier and close the door.
8. Connect the generator end of the cable. See the diagrams above and the drawings below. For minimum radio frequency interference and generator bearing current ground the cable shield 360° at the lead-through of the generator terminal box, or ground the cable by twisting the shield as follows: flattened width ≥ 1/5 × length. For the generator specific instructions, see the manufacturer's user manual.

Alternative cable shield grounding means at the generator end

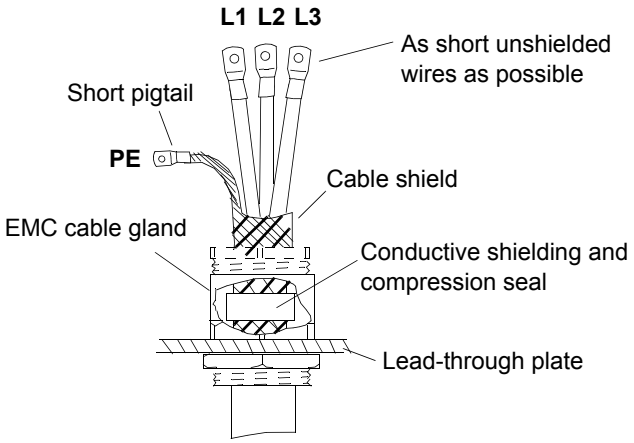
Alternative 1:
360° grounding of the shield



Alternative 2:
grounding the twisted shield

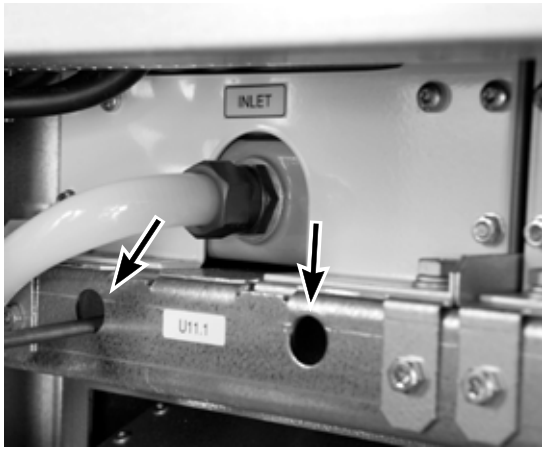


6 *Cable lead-through when shielded cable is used*

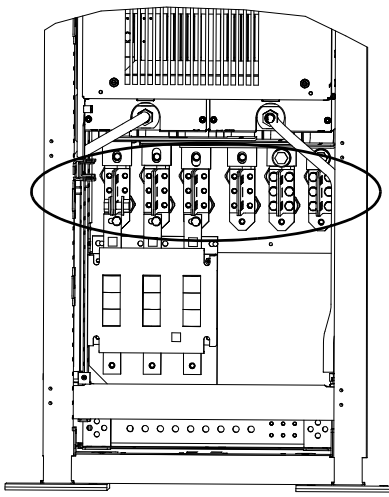


Note: EMC cable glands are not included in the delivery. They must be supplied by the customer.

③



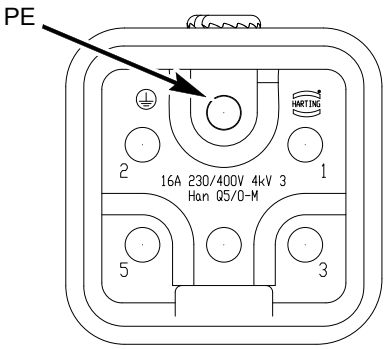
③



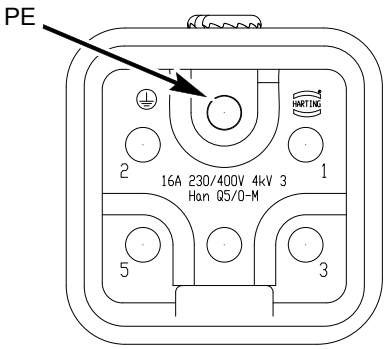
Rotor-side cable connection terminals U2, V2, W2

Control connections

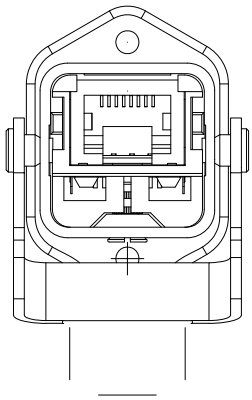
Control cable connections are described below. For location of the connectors, see page 33.



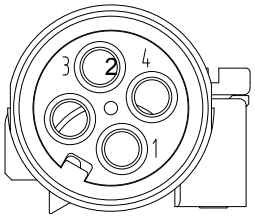
Connector X1: 230 V AC supply (non-UPS)	
Pin	**Description**
3	L
4	N
PE	PE



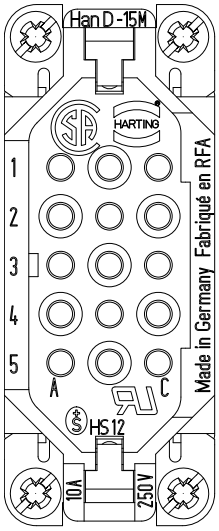
Connector X2: 230 V AC supply (UPS)	
Pin	**Description**
1	L
2	N
PE	PE



Connector X3: RJ45 cable with Ethernet	
1	TD+
2	TD-
3	RD+
4	NC
5	NC
6	RD-
7	NC
8	NC
Casing	PE

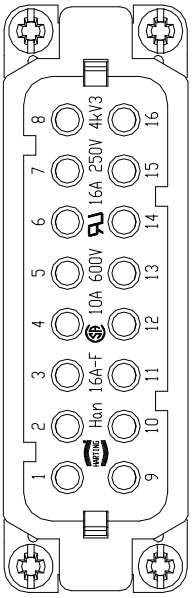


Connector X4: fieldbus		
Fieldbus	**Pin**	**Description**
CANopen	1	CAN_H
	2	CAN_L
	3	GND
PROFIBUS DP	1	D (N)
	2	D (P)
DeviceNet	1	CAN_H
	2	CAN_L
	3	GND



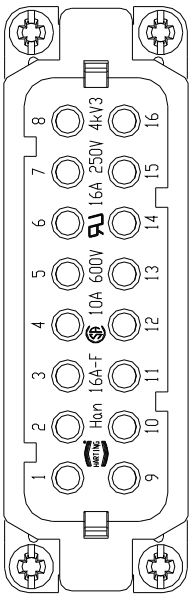
Connector X5: Safety circuit and control signals	
Pin	**Description**
A1	Common, heating request
A2	Normally open contact, heating request
A3	Normally closed contact, heating request
A4	Normally open contact, request for immediate grid MCB (outside of ABB converter) switching off
A5	Normally closed contact, request for immediate grid MCB (outside of ABB converter) switching off
B1	Common, converter's common fault
B2	Normally open contact, converter's common fault
B3	Normally closed contact, converter's common fault
B4	230 V AC, release blocking of grid MCB (inside ABB converter) switching on
B5	0 V AC, release blocking of grid MCB (inside ABB converter) switching on
C1	Common, request for immediate grid MCB (outside of ABB converter) switching off
C2	Emergency stop reset contact
C3	Emergency stop reset contact
C4	Emergency stop push button contact
C5	Emergency stop push button contact

WARNING! Either +24 V DC or +230 V AC can be supplied to connector X5. Example connections are shown above. Check the actual connections of your converter from the circuit diagrams delivered with the converter.

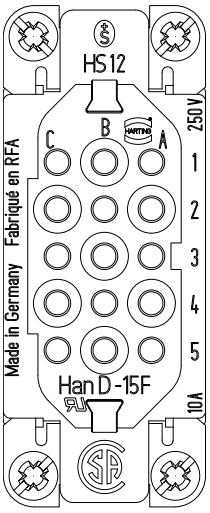


Connector X6.1: Grid MCB control	
Pin	**Description**
1	24 V DC
2	Status indication, 1=MCB is closed
3	Tripped state indication, 1=MCB is not tripped
4	Open relay control
5	Undervoltage relay control
6	Close relay control
7	Springs charging
8	0 V
9	Not used
10	Not used
11	Not used
12	Not used
13	Not used
14	Not used
15	Not used
16	Not used

WARNING! Either +24 V DC or +230 V AC can be supplied to connector X6.1. Example connections are shown above. Check the actual connections of your converter from the circuit diagrams delivered with the converter.

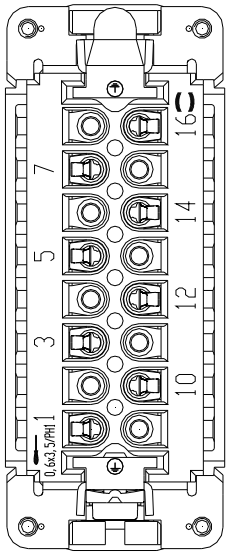


Connector X6.2: Stator MCB control	
Pin	**Description**
1	0 V DC
2	Not used
3	Not used
4	UPS supply voltage
5	Not used
6	Not used
7	Not used
8	Not used
9	0 V
10	Springs charging
11	Close relay control
12	Undervoltage relay control
13	Open relay control
14	Tripped state indication, 1=MCB is not tripped
15	Status indication, 1=MCB is closed
16	24 V DC

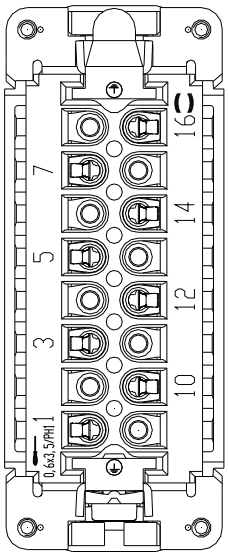


Connector X7: pulse encoder	
Pin	**Description**
A1	CHA+
B1	CHA-
C1	Shield
A2	CHB+
B2	CHB-
C2	Shield
A3	CHZ+
B3	CHZ-
C3	Shield
A4	0 V
B4	V out
C4	Shield
C5	Outer shield

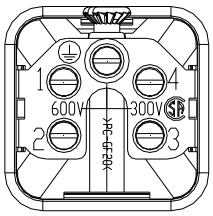
WARNING! Either +24 V DC or +230 V AC can be supplied to connector X6.2. Example connections are shown above. Check the actual connections of your converter from the circuit diagrams delivered with the converter.



Connector X8.1: Grid voltage measurement	
Pin	**Description**
3	Phase U
5	Phase V
7	Phase W
10	Not used
12	Not used
14	Not used

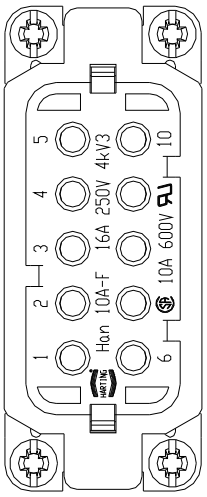


Connector X8.2: Stator voltage measurement	
Pin	**Description**
3	Not used
5	Not used
7	Not used
10	Phase U
12	Phase V
14	Phase W



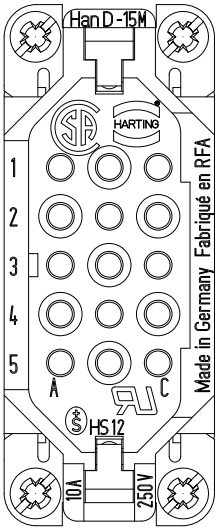
Connector X9: Stator current measurement	
Pin	**Description**
1	Phase U, S1
2	Phase U, S2
3	Phase W, S1
4	Phase W, S2

WARNING! +690 V AC is supplied to connectors X8.1 and X8.2. Example connections are shown above. Check the actual connections of your converter from the circuit diagrams delivered with the converter.



Connector X10: 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

WARNING! Either +24 V DC or +230 V AC can be supplied to connector X10. Example connections are shown above. Check the actual connections of your converter from the circuit diagrams delivered with the converter.



Connector X11: Grid MCB trip and on/off status (and Interbus option +K453)	
Pin	**Description**
A1	NOT DI1 (option +K453)
A2	DI2 (option +K453)
A3	NOT DO1 (option +K453)
A4	DO1 (option +K453)
A5	DG1 (option +K453)
B1	Common, grid MCB ON/OFF status
B2	Normally closed contact, grid MCB ON/OFF status
B3	Normally open contact grid ON/OFF status
B4	Common grid MCB TRIP status
B5	Normally closed contact grid MCB TRIP status
C1	Normally open contact grid MCB TRIP status
C2	Not in use.
C3	Not in use.
C4	Not in use.
C5	Not in use.

WARNING! Either +24 V DC or +230 V AC can be supplied to connector X11. When option +K453 is selected, use +24 V DC.

Connection procedure

Control cable connectors for all I/O control cables are located at the right-hand side wall of the converter cabinet. Plug in the connectors and lock them into their positions.

Note: Always use the locking mechanism of the connector.

Connecting a PC

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

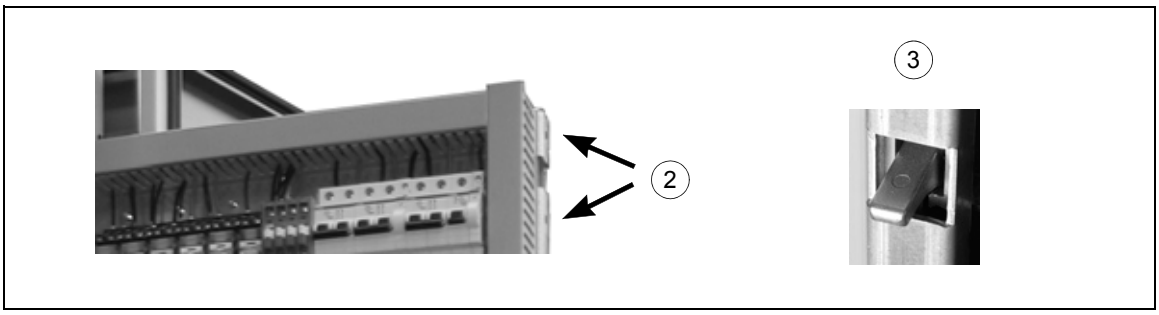
Connecting to the grid-side converter: Connect a PC to CH3 of the RDCO module via a fiber optic link. RDCO is attached to the option slot 3 of the RDCU unit. If NETA module (option +K464) is connected, remove its fiber optic link first.

Connecting to the rotor-side converter: Connect a PC to CH3 of the NDCU unit via a fiber optic link.

For the connection diagram, see *ACS800-67LC wind turbine converters system description and start-up guide* [3AUA0000059432 (English)].

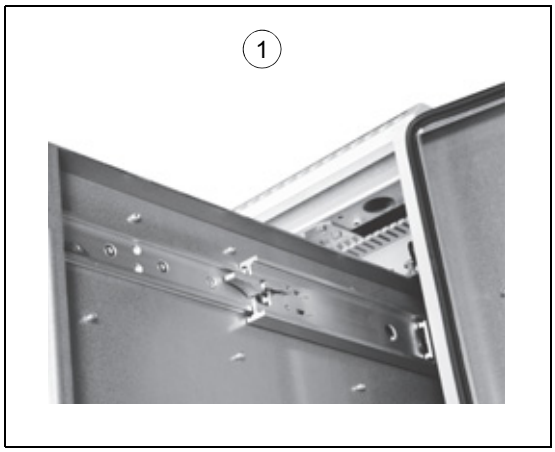
To access the auxiliary control unit:

1. Open the cubicle door.
2. Remove two fastening screws in the front part of the sliding frame.
3. Press down the knob between the fastening screws and pull the sliding frame out of the cubicle.
4. Connect the fiber optic cables from the PC to the converter controllers as follows:
   - Run the fiber optic cables to the inside of the auxiliary control cubicle.
   - Connect one wire to the RDCU unit channel CH3 and the other fiber optic cable to the NDCU unit of the converter cubicle. For the connectors of the RDCU and NDCU units, see section *Control unit NDCU-33Cx/RDCU-12C* on page *36*.



To push the sliding frame back into the cubicle:

1. Press down the knob on the back of the unit and push the control unit back into the cubicle. Fasten with two fastening screws.



2. Close the control unit cubicle door.

7

Installation checklist

Check the mechanical and electrical installation of the converter before start-up. 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 load switch disconnector of the converter and lock it to open position. Ensure by measuring that the converter is not powered.

Mechanical installation

The converter 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 converter is grounded properly and there is an adequately sized protective ground conductor between the 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).	☐

If the converter has been stored over one year: The electrolytic DC capacitors in the DC link of the converter have been reformed. See the reforming instructions (available from your local ABB representative).	☐
There is an adequately sized protective ground conductor between the generator and the converter.	☐
The grid voltage matches the nominal input voltage of the converter.	☐
The grid cables have been connected to appropriate terminals (incoming cubicle terminals L1, L2 and L3), the phase order is correct, and the terminals have been tightened (pull conductors to check).	☐
The rotor-side cables have been connected to appropriate terminals (inverter cubicle terminals U2, V2 and W2), the phase order is correct, and the terminals have been tightened (pull conductors to check).	☐
The DC resistors (option +D150+D151) have been connected to appropriate terminals (R+ and R), and the terminals have been tightened (pull conductors to check).	☐
The rotor cable is routed away from other cables.	☐
The generator cable (and DC resistor cable, if present) has been routed away from other cables.	☐
No power factor compensation capacitors are connected to the rotor terminals.	☐
The external control cables have been connected to appropriate plug-in terminals on the connection board on the right-hand side of the converter.	☐
There are no tools, foreign objects or dust from drilling inside the converter.	☐
Shrouds are fastened and doors are closed.	☐
The input voltage can not be connected to the U2, V2 and W2 terminals of the converter.	☐
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 chapter *The internal cooling circuit*.

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.

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 of storage	Capacitor reforming	See *Capacitors.*
Every year	Smoke detector inspection (visual inspection and maintenance action if needed)	Inspect the smoke detector with test gas.
Every 2 years	Addition of corrosion inhibitor to coolant	Add inhibitor according to instructions. For amount and type, see chapter *The internal cooling circuit.*
Every 3 years	Power connections check and cleaning	See *Power connections*.
Every 3 years	Cooling fan change in case of 60 Hz supply	See *Fans*.
Every 5 years	Cooling fan change	See *Fans*.

Interval	Maintenance action	Instruction
Every 6 years	APBU branching unit memory backup battery renewal (only with parallel connected modules)	See *PPCS branching unit (APBU-xx)*.
Every 6 years	Coolant change	Change the coolant according to instructions. See also chapter *The internal cooling circuit.*
Every 9 years	Capacitor renewal	See *Capacitors.*

Power connections

Tightening

WARNING! Read and follow the instructions on the first pages of this manual. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. Check the tightness of the cable connections. Use the tightening torques given in chapter *Technical data*.

Cleaning and greasing

WARNING! The modules are heavy and have a high centre of gravity. They topple over easily if handled carelessly.

1. Open the cabinet doors.
2. Use the tightening torques given in chapter *Technical data*.
3. Clean all contact surfaces of the quick connector and apply a layer of suitable joint compound (eg, Isoflex® Topas NB 52 from Klüber Lubrication) onto them.
4. Repeat steps 1 to 3 for all remaining modules.

Fans

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

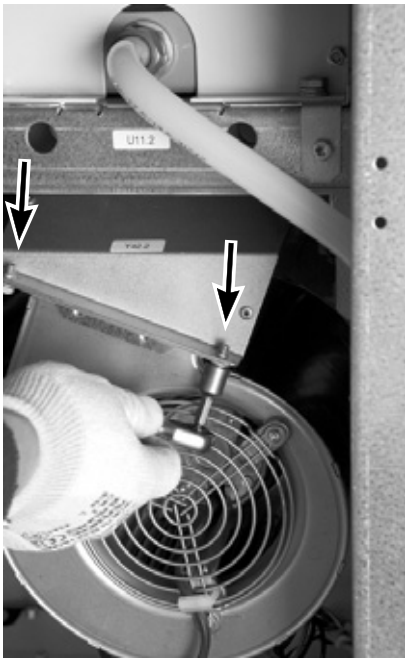
Replacing the cooling fan of the converter module

WARNING! Read and follow the instructions on the first pages of this manual. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. Disconnect the 230 V AC supply cables from connectors X1 and X2 at the right-hand side of the cabinet.
3. Open the door and remove the lower shroud (metal grating) of the cubicle.
4. Disconnect the plug.
5. Undo the two fastening screws of the fan.
6. Pull the fan out.
7. Install a new fan in reverse order.

4

5



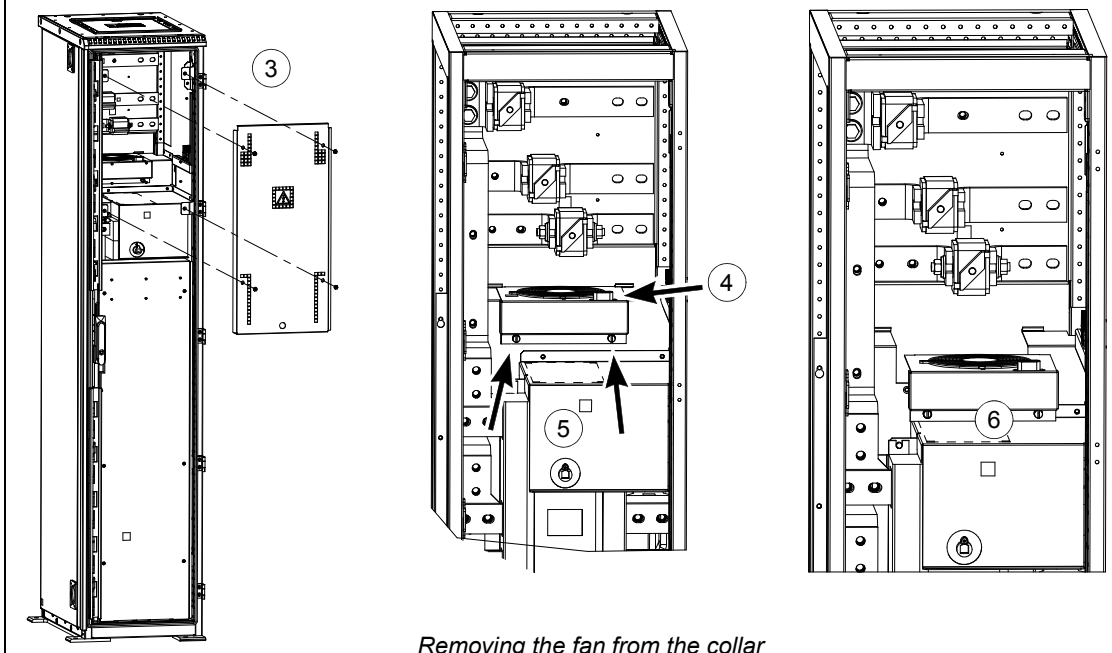
5

6

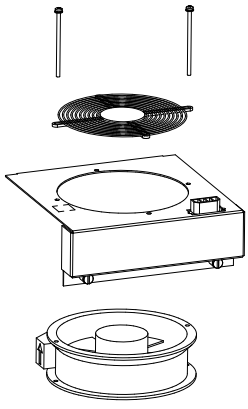
Replacing the fan in the 400 mm wide incoming cubicle (option +C111)

WARNING! Read and follow the instructions on the first pages of this manual. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. Disconnect the 230 V AC supply cables from connectors X1 and X2 at the right side of the cabinet.
3. Open the door and remove the upper shroud of the cubicle by removing four screws.
4. Disconnect the plug.
5. Loosen the two fastening screws of the fan.
6. Pull the fan out. Remove the two screws if you want to remove the fan from the collar.
7. Install a new fan in reverse order.



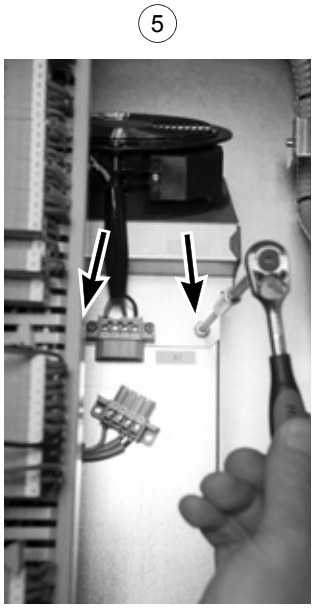
Removing the fan from the collar



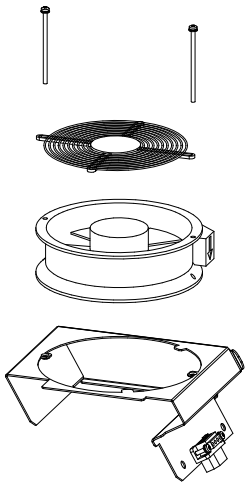
Replacing the fan in auxiliary control cubicle

WARNING! Read and follow the instructions on the first pages of this manual. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. Disconnect the 230 V AC supply cables from connectors X1 and X2 at the right side of the cabinet.
3. Open the door and pull the sliding frame out of the cubicle. For instructions, see page *86*.
4. Disconnect the plug.
5. Undo the two fastening screws of the fan.
6. Pull the fan out. Remove the two screws if you want to remove the fan from the collar.
7. Install a new fan in reverse order.



Removing the fan from the collar



Converter module

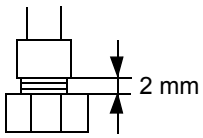
Replacing the converter module

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

Note: Performing this action requires following accessories that are not included in the delivery as standard: winch (not available from ABB) and installation stand (order code: 3AUA0000078146).

1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. Disconnect the external control cables from connectors X1 and X2 at the right-hand side of the cabinet.
3. Remove the shrouds of the cubicle.
4. The cubicles with swing-out frame: remove the screws on the shroud of the swing-out frame. Open the swing-out frame.
5. Close the inlet and outlet valves of the liquid cooling unit, and drain the cooling circuit (see *Draining the internal cooling circuit* on page *117*.) **Note:** Drain and bleed valves have locking handles. Release the mechanism before turning.
6. Decouple the cooling circuit inlet and outlet pipes from the module: Unscrew the locking nut until fully open and pull the pipe out.

WARNING! When re-attaching the coolant hoses, do not overtighten the outer nuts of the union - leave 2…3 mm (0.08…0.1 in.) of thread visible. Overtightening will break the hose.



7. Unplug the fiber optic cables from the module.
8. Disconnect the DC output busbars from the module. Beware not to drop the screws inside the module!
9. Remove the module mounting screws at top (two at top, two at bottom).
10. Fasten a module installation stand to the frame of the cubicle. For instructions, see page *98*.
11. Pull the module out enough to attach a lifting chain to the front of the module.
12. Pull the whole module onto the installation stand. Keep the pipes and wires away from the sharp edges and be careful not to damage the coolant inlet.
13. Attach a second lifting chain to the rear of the module. Ensure that the lifting chains are evenly adjusted.
14. Lift the module onto a pallet or other platform for transportation.

WARNING! The module is heavy and its centre of gravity is high. The module topples over easily. Never maneuver it in upright position untied. It is recommended to lay the module on its side before moving the pallet.

15. Before installing a new module, check and service the quick connector through which the AC output busbars of the cubicle connect to the module. Clean all contact surfaces

of the quick connector and apply a layer of suitable joint compound (eg, Isoflex® Topas NB 52 from Klüber Lubrication) onto them.

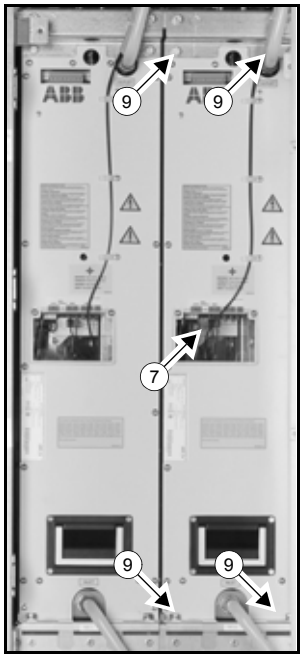
16. Install a new module in reverse order.

WARNING! Mind your fingers when pushing the module into the wind turbine converter. Do not place your fingers on the sides of the module when pushing.

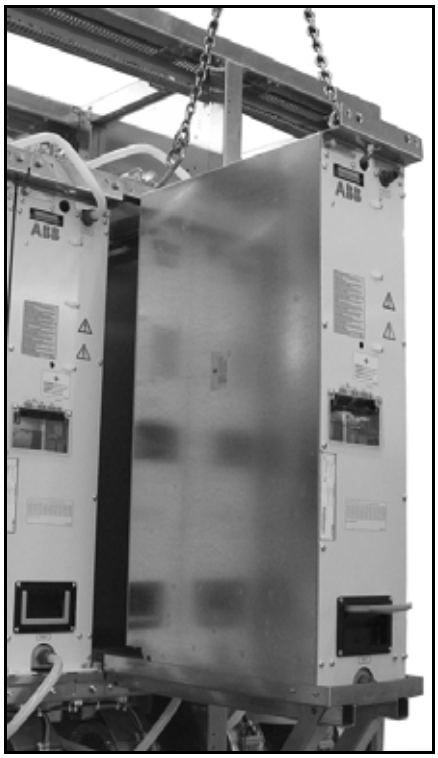
6 *Decoupling the pipes*

7 *Unplugging the fiber optic cables*

9 *Removing the mounting screws*



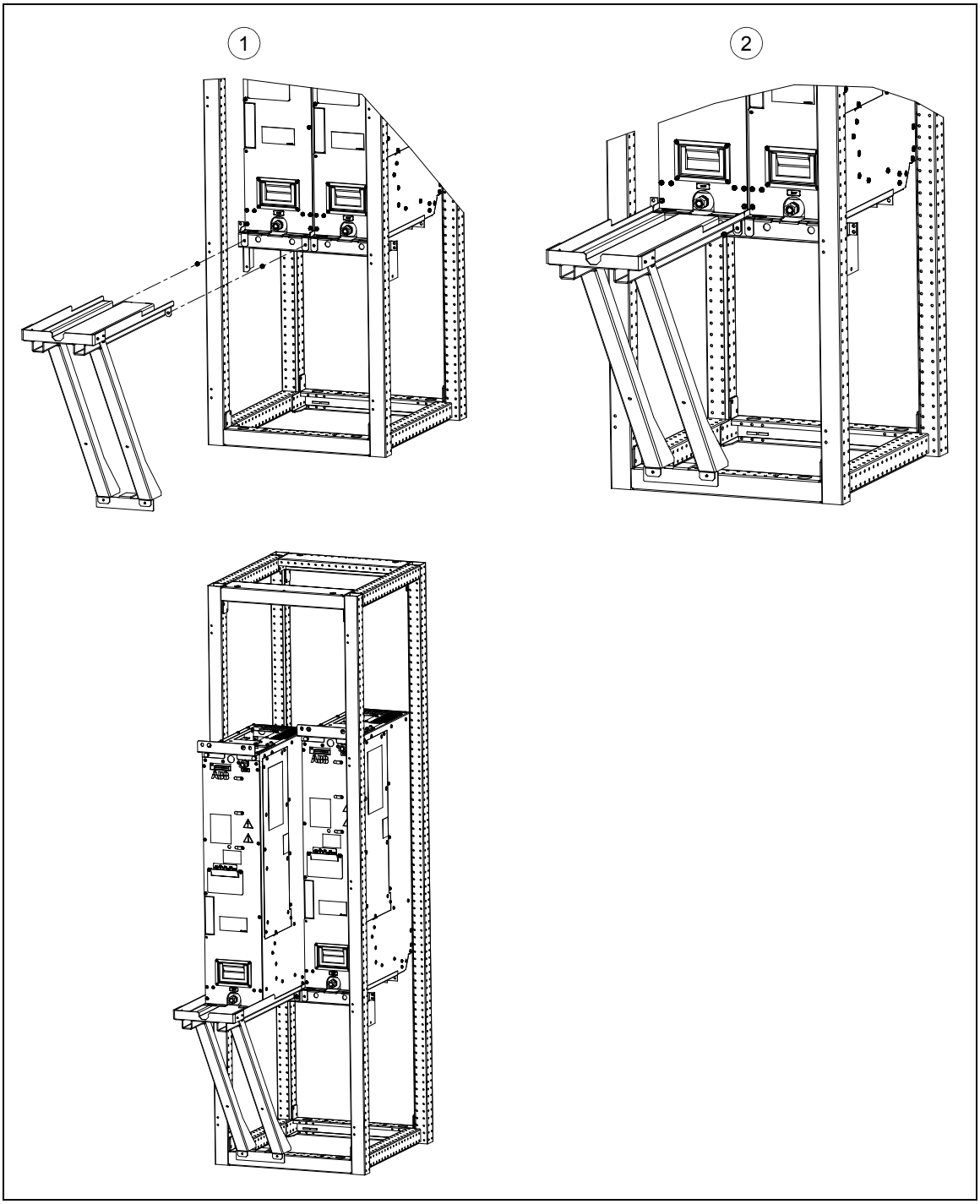
13 *Attaching the lifting chains*



Installing the installation stand

1. The installation stand is fastened to the module frame. Remove the two screws in the module frame.
2. Align the stand and the rails on which the module lies on. Fasten the two screws (removed in previous step) back to their original positions. Ensure that the legs lock into position.

WARNING! When replacing the module, note that the module is heavy and its center of gravity is high. The module topples over easily.



Capacitors

Reforming the capacitors

The converter modules employ several electrolytic capacitors. Their lifespan depends on the operating time of the converter, loading and the ambient temperature. Capacitor life can be prolonged by lowering the ambient temperature.

It is not possible to predict capacitor failure. Capacitor failure is usually followed by damage to the unit and an input cable fuse failure, or a fault trip. Contact ABB if capacitor failure is suspected.

Reform (re-age) spare part capacitors once a year according to *Converter modules with electrolytic DC capacitors in the DC link Capacitor reforming instructions* [3BFE64059629 (English)], available through your local ABB representative.

Replacing the capacitors

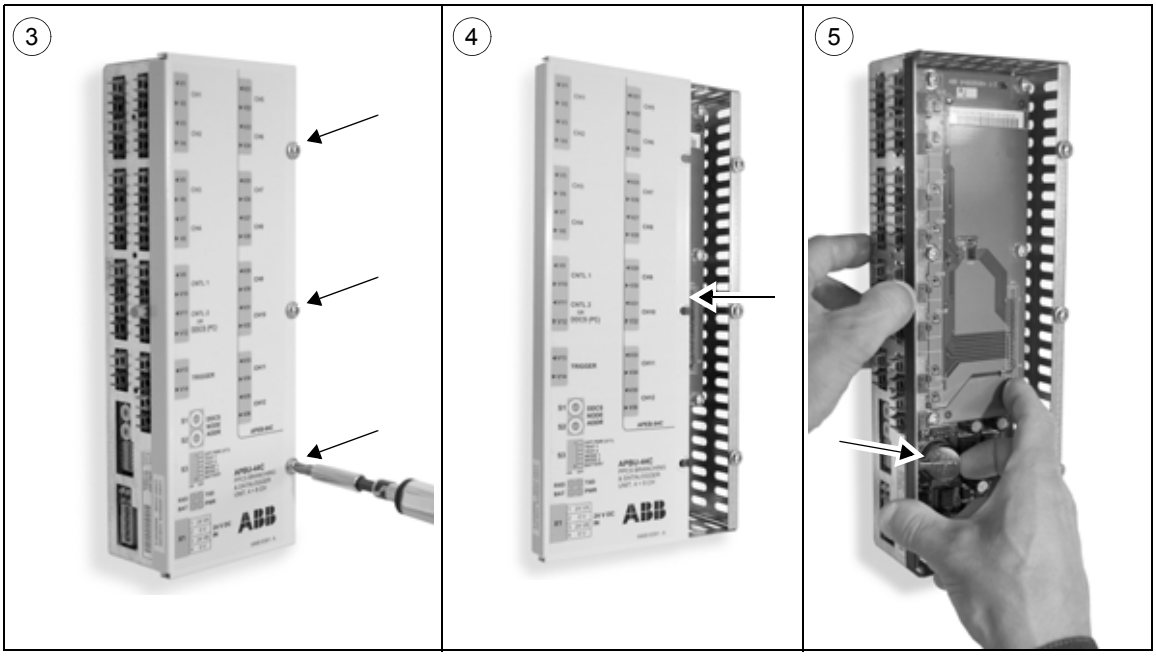
Contact an ABB Service representative.

PPCS branching unit (APBU-xx)

Replacing the memory backup battery

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

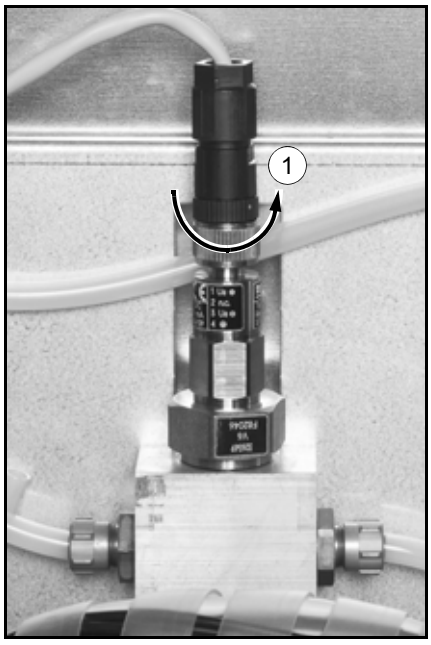
1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. Disconnect the 230 V AC (115 V AC) supply cables from connectors X1 and X2 at the right-hand side of the cabinet.
3. The APBU unit(s) are located in the auxiliary control cubicle (see page *33*). The grid-side converter APBU unit is located under the RDCU unit. Open the screws on the unit cover (3 pcs).
4. Slide off the cover.
5. Remove the battery.
6. Insert new CR 2032 battery and reattach the cover. Connect the cables in reverse order.

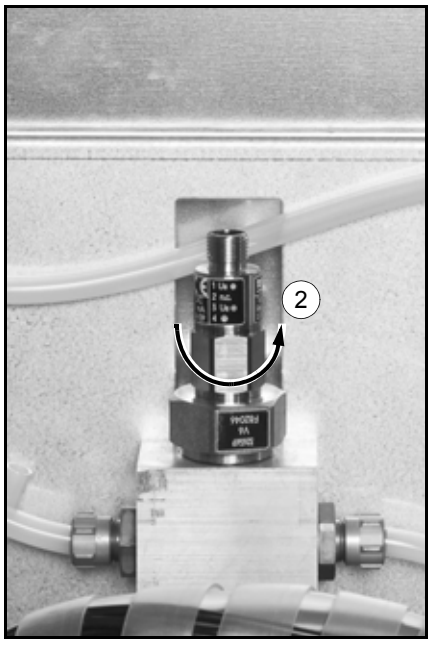


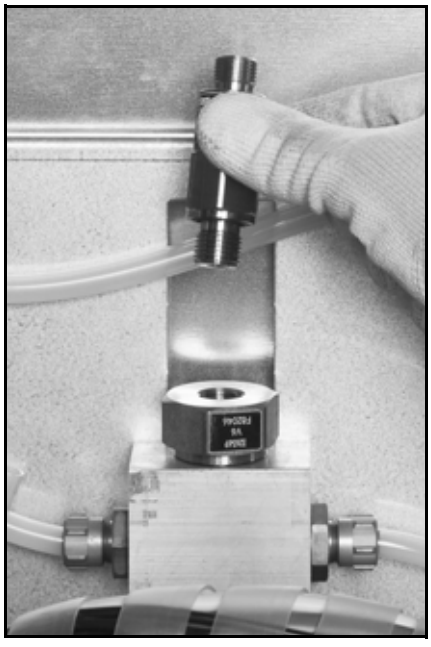
Replacing the pressure transmitter

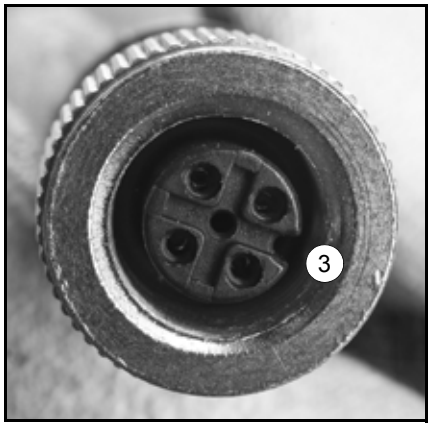
WARNING! Read and follow the instructions in chapter *Safety instructions*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Open the connector and disconnect it from the pressure transmitter.
2. Remove the pressure transmitter. The coolant circulation stops automatically.
3. Install a new pressure transmitter in reverse order.
   Note: When connecting the connector to the pressure transmitter, make sure that the notch in the connector meets its counterpart in the pressure transmitter.





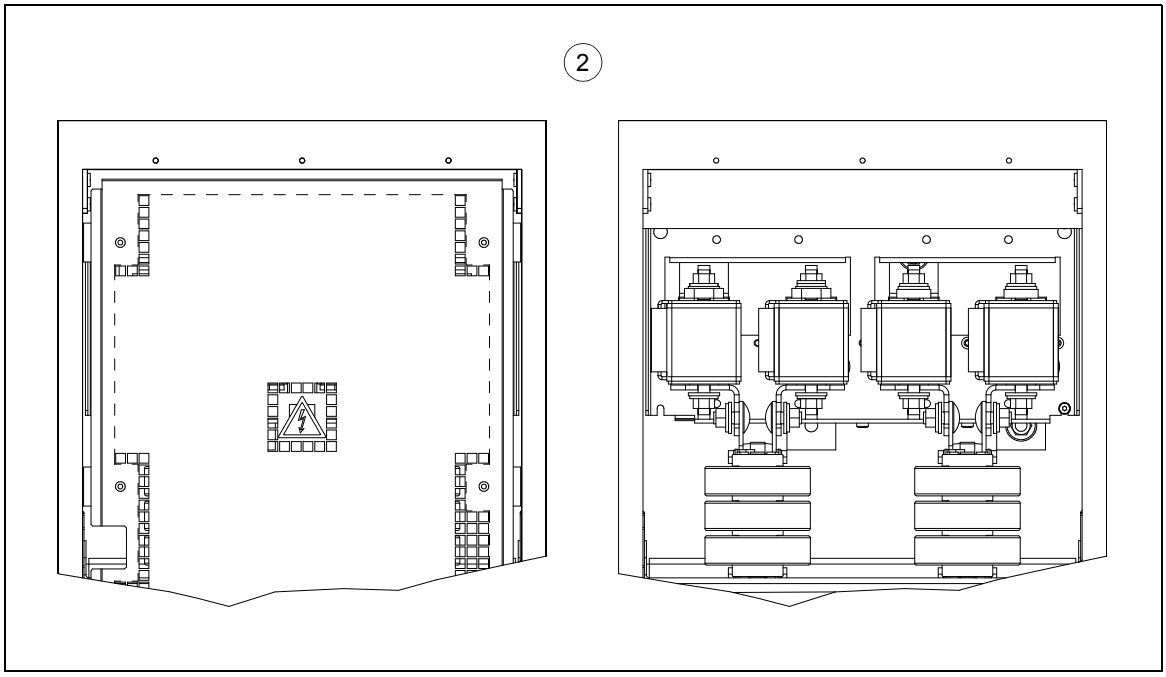




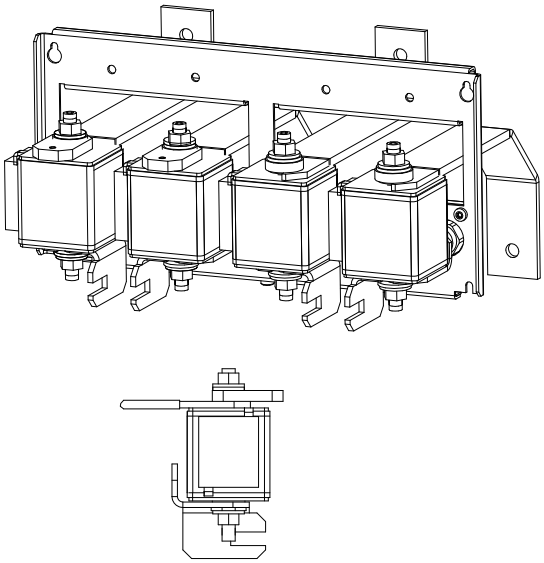
Replacing DC fuses

There are two types of DC fuses that can be used with the converter, Bussmann and Mersen fuses. If the replacement fuses are of the other type than the fuses previously used in the converter, you have to adjust assembly parts as instructed in *Bussmann fuses* and *Mersen fuses*.

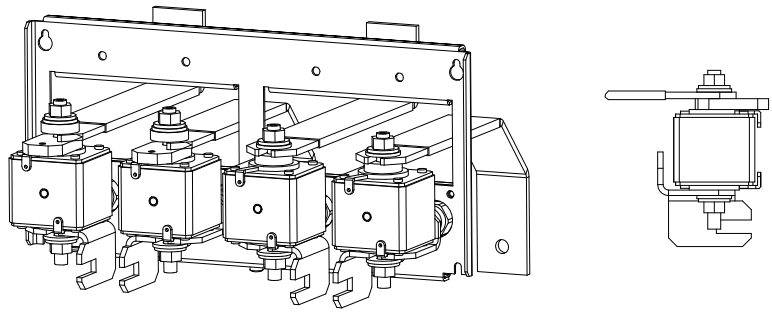
1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. Remove the shrouds in front of the fuses.
3. Open the M12 nuts and remove the fuses.
4. If necessary, adjust the assembly parts. See sections *Bussmann fuses* and *Mersen fuses*.
5. Insert new fuses.
6. Re-assemble the parts in reverse order.
   - The tightening torque for the M12 set screws is 5 N·m (3.7 lbf·ft).
   - The tightening torque for the M12 nuts is 50 N·m (37 lbf·ft).



Bussmann fuses

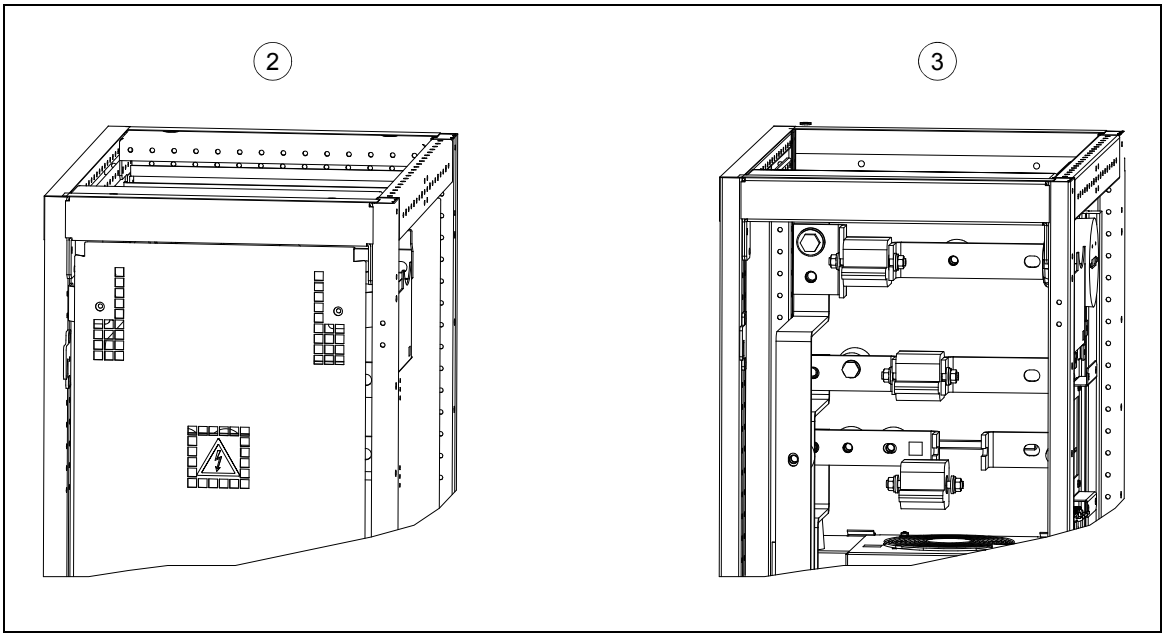


Mersen fuses



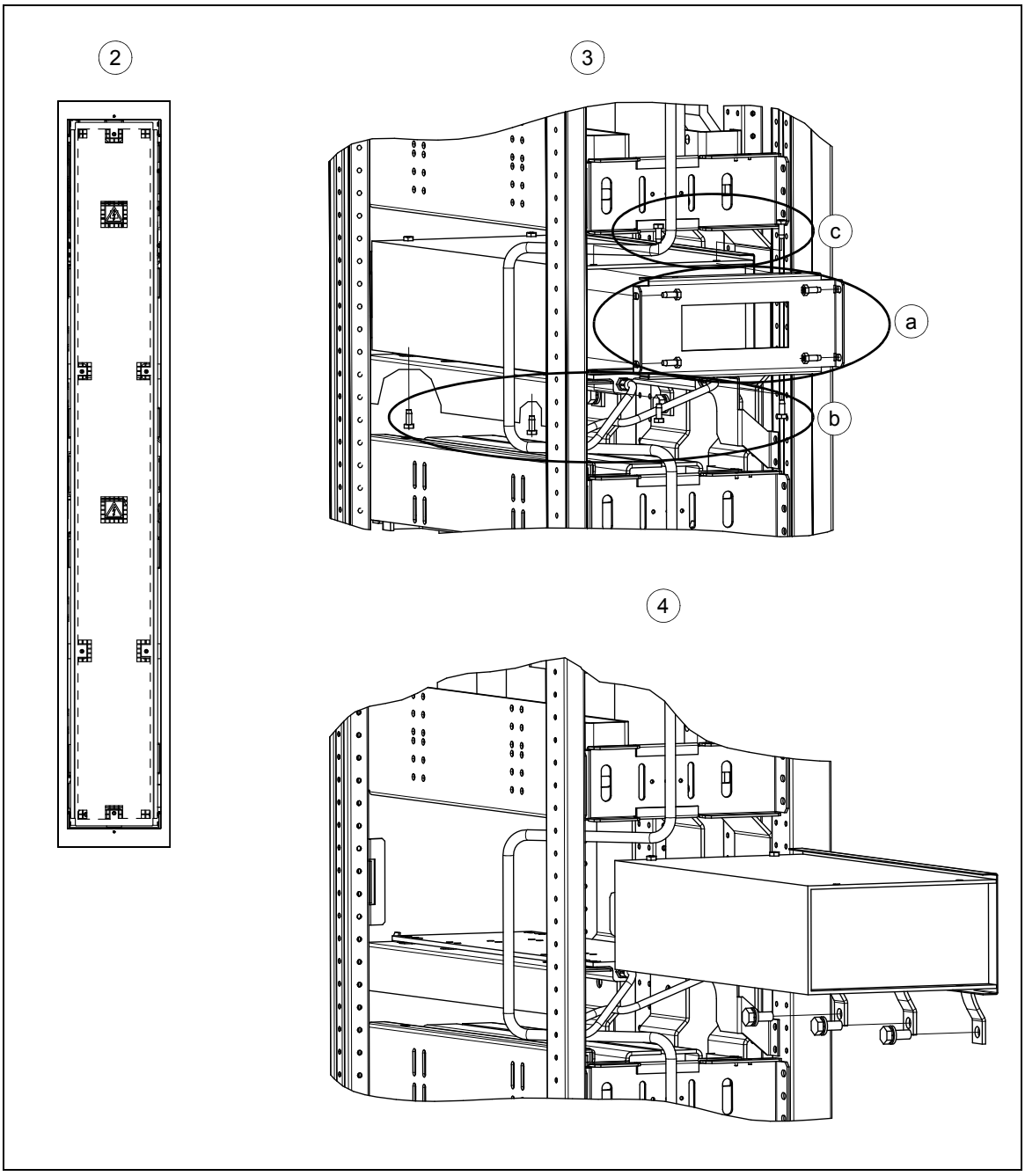
Replacing AC fuses (option +C111)

1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. Remove the shrouds in front of the fuses.
3. Open the nuts and disconnect the microswitches. Remove the fuses.
4. Insert new fuses and connect the microswitches.
5. Re-assemble the parts in reverse order.
   - The tightening torque for the M12 nuts is 50 N·m (37 lbf·ft).
   - The tightening torque for the M8 nuts is 20 N·m (15 lbf·ft).



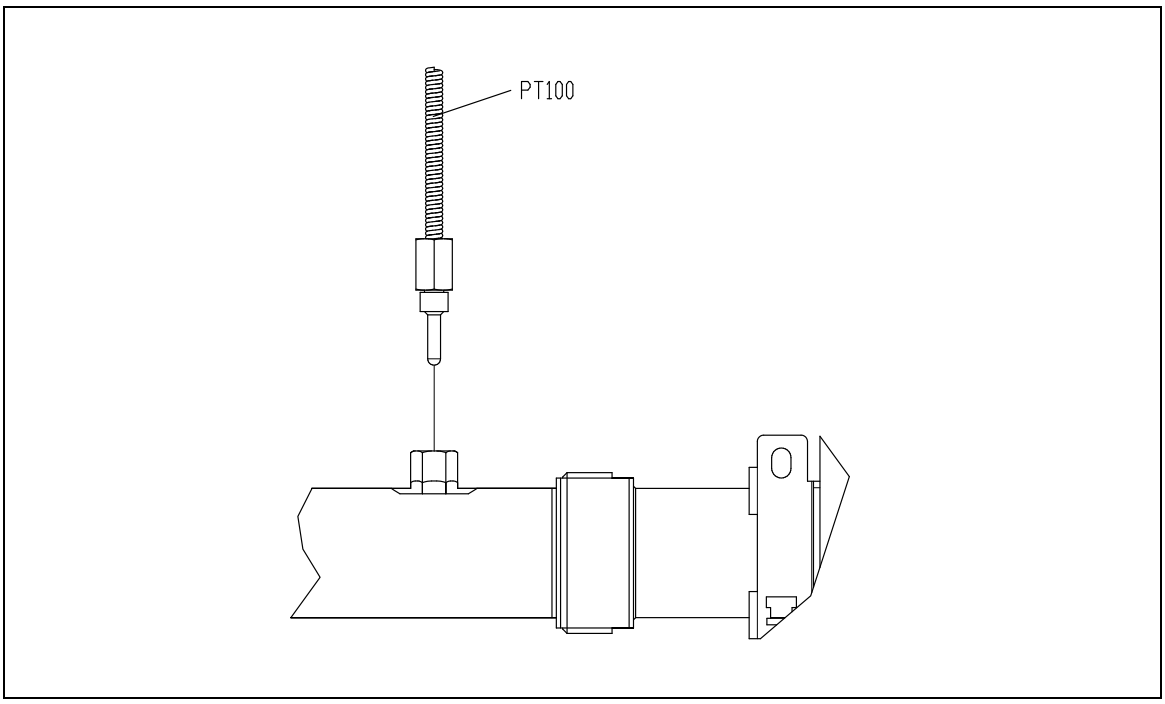
Replacing the capacitor of the LCL filter

1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. Remove the shroud of the LCL filter cubicle.
3. Remove the four screws in front (a), four screws below (b) and two screws on top (c) of the capacitor.
4. Remove the three busbar connection bolts and pull out the capacitor.
5. Insert new capacitor.
6. Re-assemble the parts in reverse order.
   - Tightening torque for busbar connection bolts is 18 N·m (13 lbf·ft).



Replacing the temperature measurement sensor

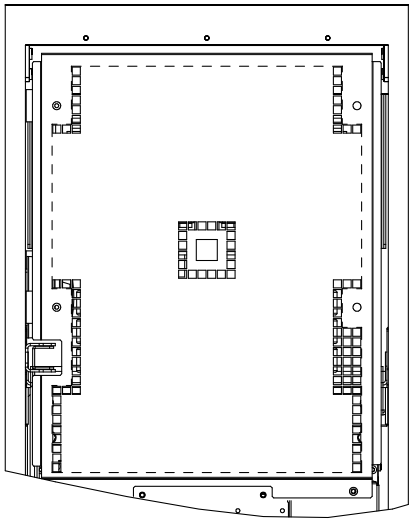
1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. The temperature measurement sensors are located on the coolant inlet and outlet pipes in the cubicle the pipes enter the converter cabinet. To detach the sensor, turn the sensor left.
3. To install a new sensor, turn the sensor right.



Replacing the smoke detector

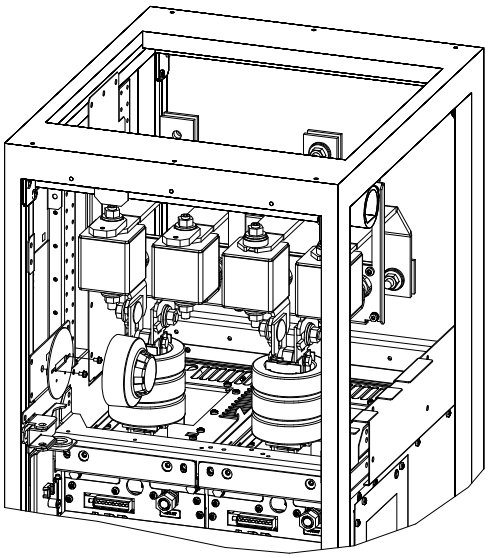
1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. Remove the shrouds in front of the fuses.
3. Turn the smoke detector to the left and remove the two fastening screws.
4. Insert new smoke detector.
5. Re-assemble the parts in reverse order.

2



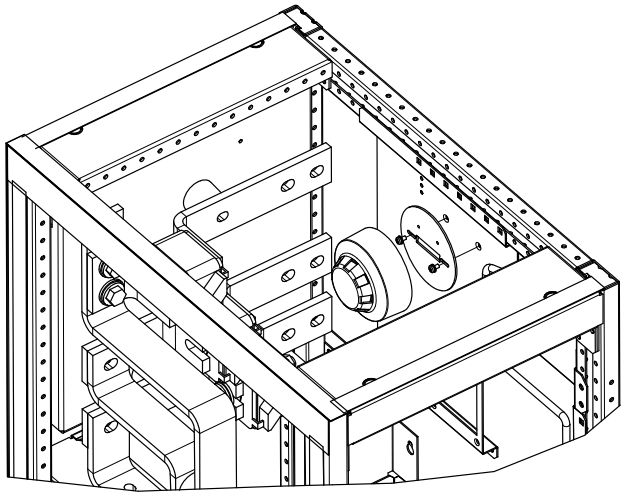
3

Inverter and supply module cubicles



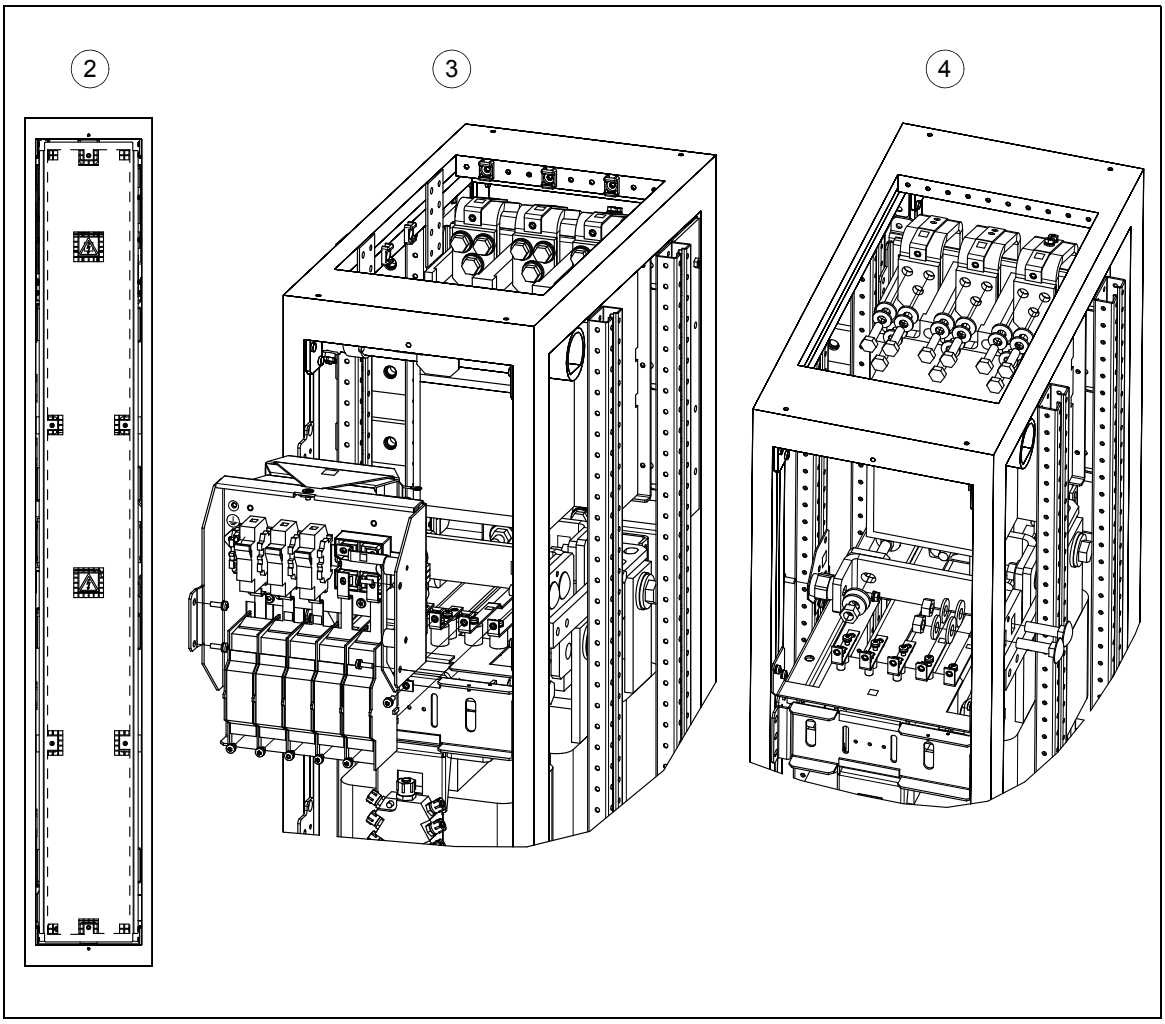
3

400 mm wide incoming cubicle (option +C111)



Replacing the main contactor

1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. Remove the shroud of the LCL filter cubicle.
3. Remove the ten fastening screws.
4. Remove the four fastening screws and nine screws in the upper part of the cubicle.
5. Remove the two nuts and one screw.
6. Remove the three fastening screws and five screws in the front part of the cubicle.
7. Remove the two screws in the main contactor.
8. Pull the main contactor out and turn it 90° upwards simultaneously.
9. Insert new main contactor.
10. Re-assemble the parts in reverse order.



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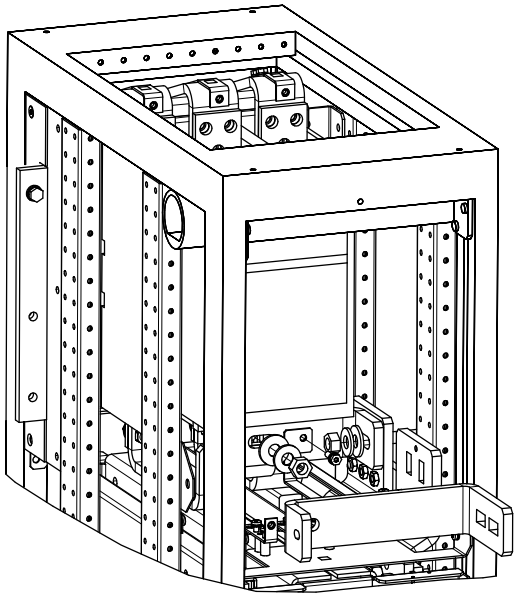

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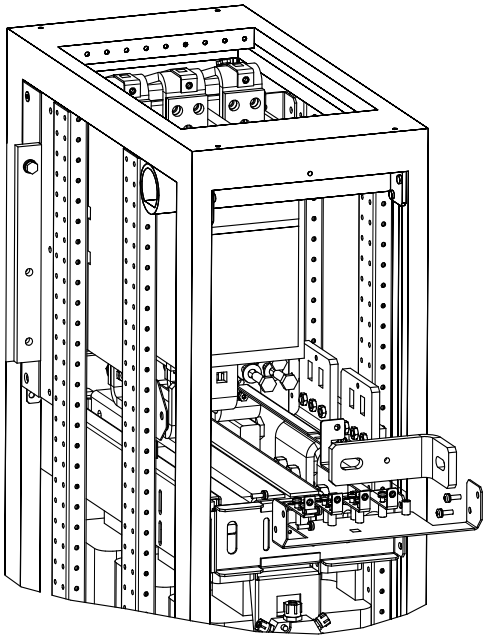
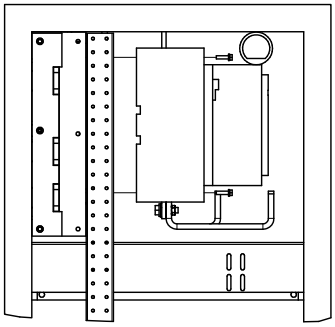
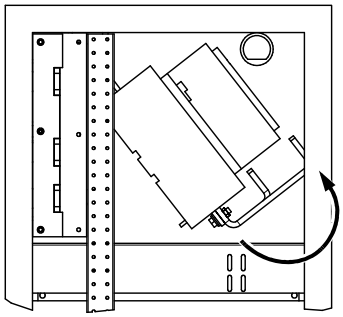
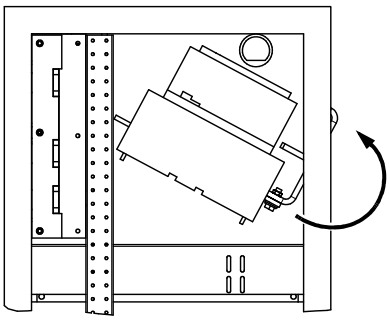
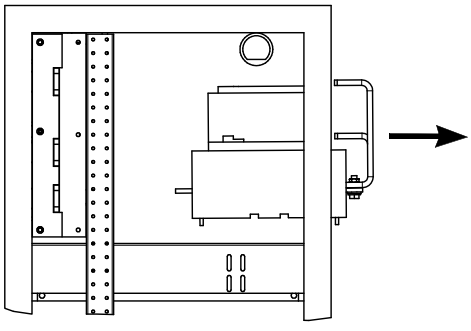


7



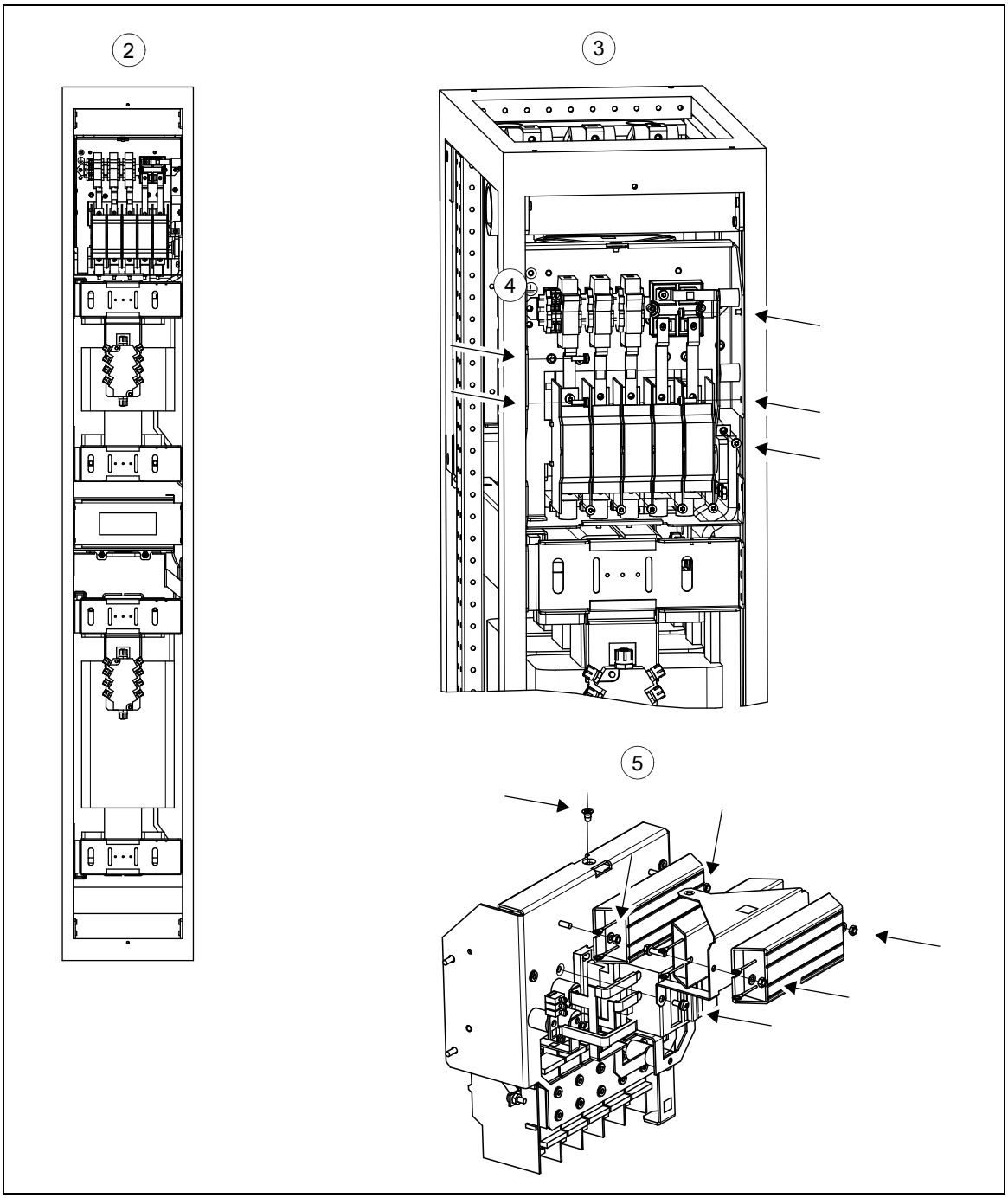






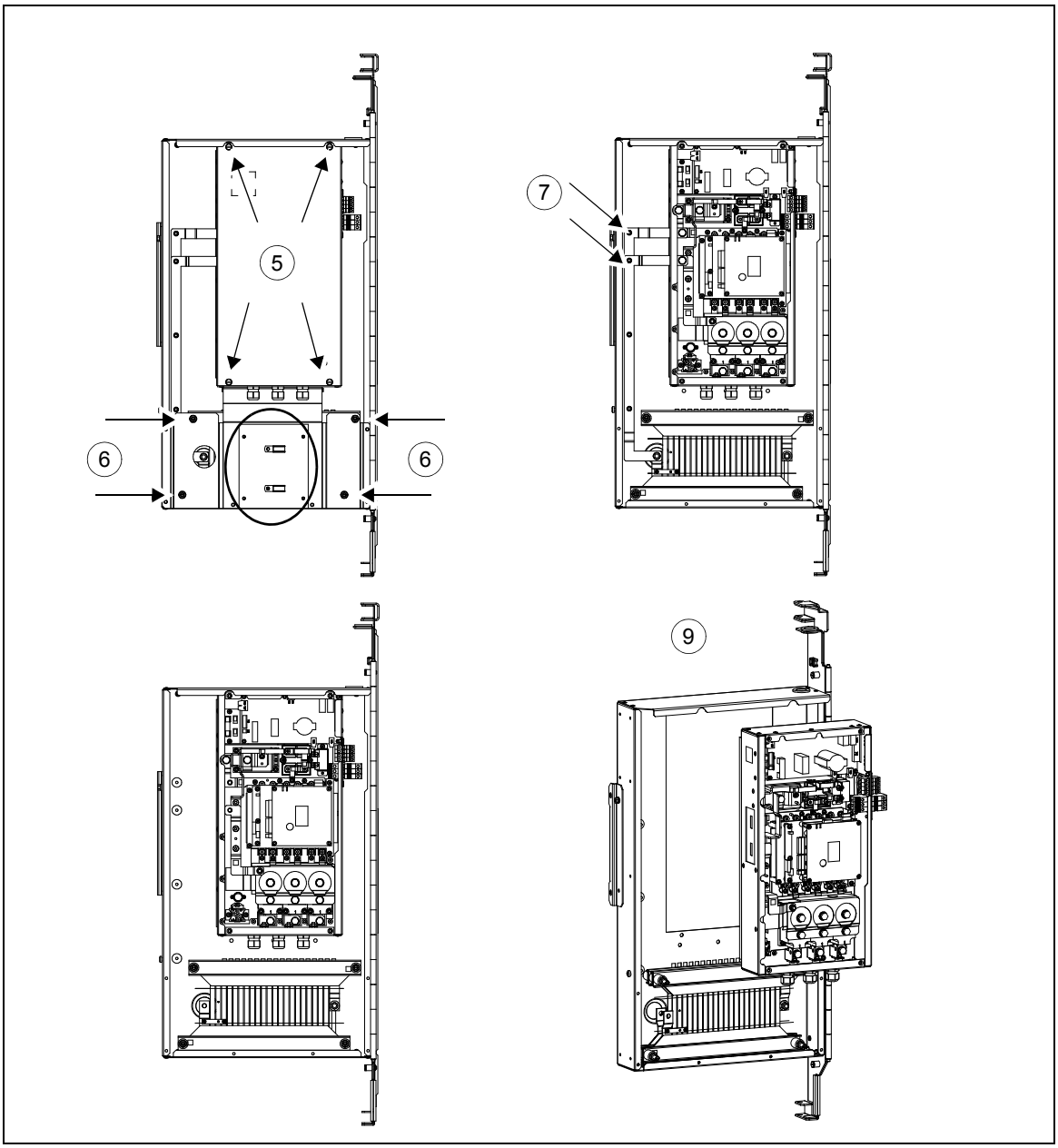
Replacing the charging circuit resistors

1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. Remove the shrouds in front of the resistors. The resistor are located in the upper part of the cubicle.
3. Remove the five fastening screws of the resistors.
4. Unplug the resistor cable.
5. Remove the six fastening screws.
6. Insert new resistors.
7. Re-assemble the parts in reverse order.



Replacing the crowbar

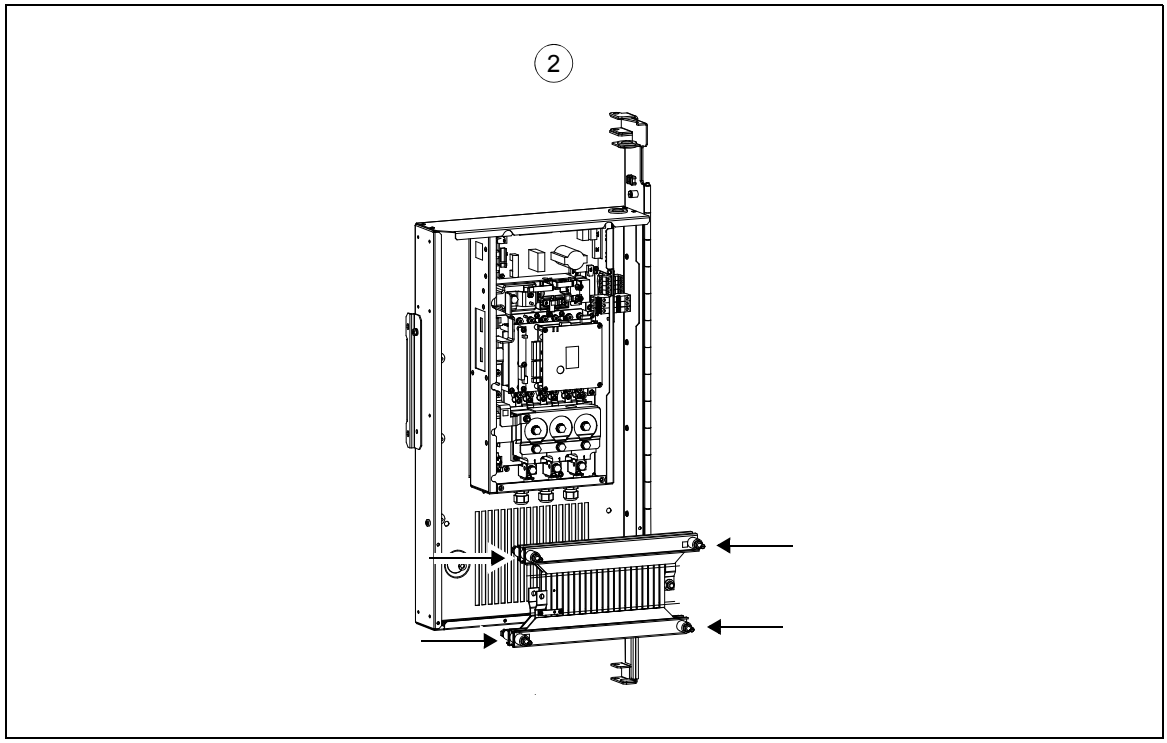
1. Ensure that the converter is disconnected from the power supply network and all other precautions described in section *Safety in installation and maintenance*, page *12* have been taken into consideration.
2. Remove the shrouds of the inverter module cubicle.
3. Remove the four screws that fasten the swing-out frame to the cabinet frame.
4. Loosen the two panel screws of the hinge and pull out the swing-out frame.
5. Remove the crowbar cover by removing four panel screws.
6. Remove the resistor cover by removing four M8 nuts and six M5 screws.
7. Remove the resistor busbars (2 pcs).
8. Remove AC and DC cables, fasteners and other wires.
9. Remove the crowbar from the swing-out frame by removing five M6 screws.
10. Insert new crowbar.
11. Re-assemble the parts in reverse order.



Replacing the crowbar resistor

WARNING! Beware of hot surfaces. Some parts remain hot for a while after the disconnection of input power.

1. Follow the steps 1…8 in section *Replacing the crowbar* on page *111*.
2. Remove the crowbar resistor from the swing-out frame by removing four M8 nuts.
3. Insert new resistor.
4. Re-assemble the parts in reverse order.



9

The internal cooling circuit

What this chapter contains

This chapter describes the internal cooling circuit.

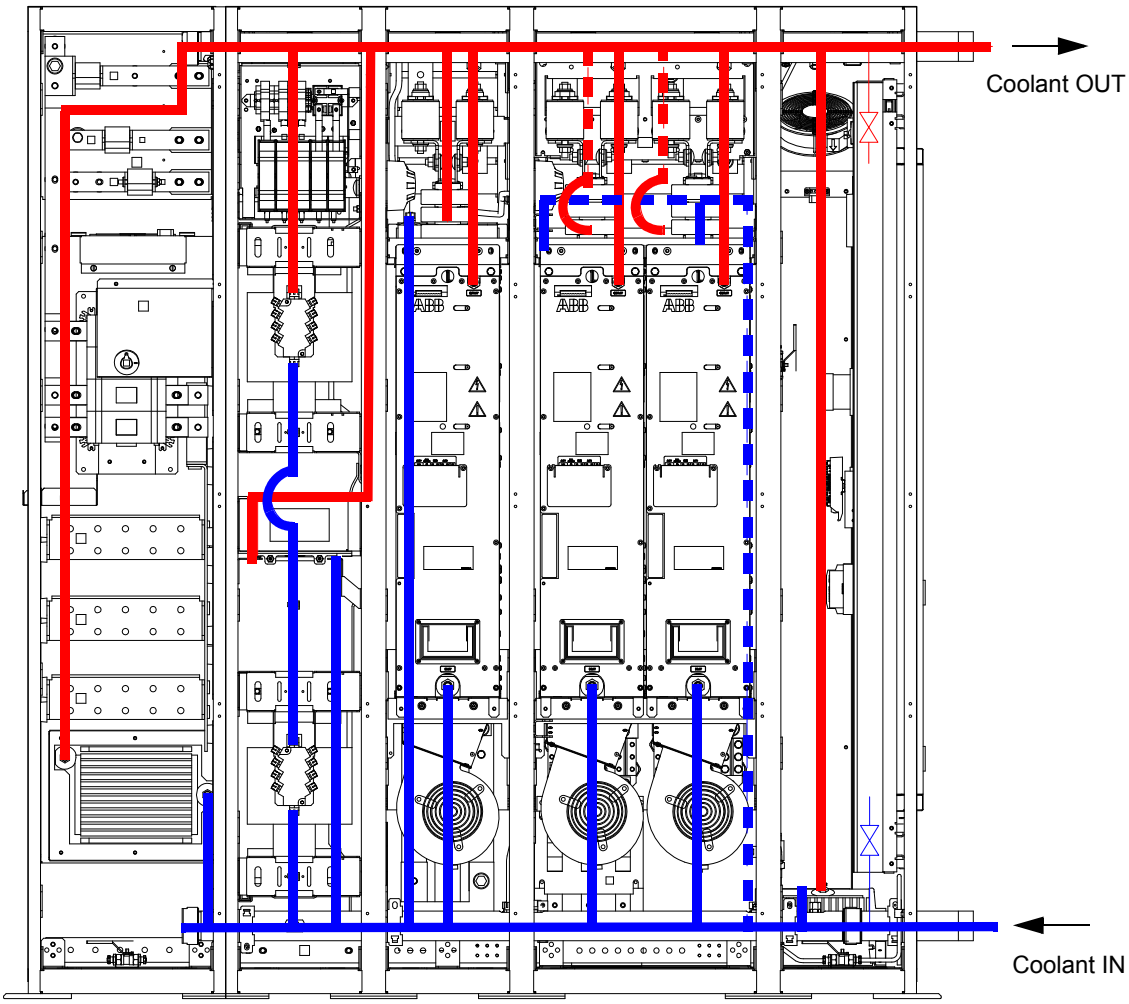
Hardware description

General

The cooling system of a liquid-cooled wind turbine converter consists of two circuits: firstly, the internal cooling circuit that covers the heat-generating electrical components and transfers the heat to the cooling unit, and the external cooling circuit that is usually part of a larger external cooling system. This chapter deals with the internal cooling circuit. Liquid cooling unit is not included in the ABB deliveries (the liquid cooling system of the converter does not include eg, pump, expansion tank etc.).

Diagram of the internal cooling circuit

The following diagram shows how the coolant circulates in the converter system.



The power modules in each cubicle can not be isolated from the main cooling circuit. The converter is equipped with a drain valve and a bleed valve.

Planning the cooling system

Connection to a customer cooling unit

General requirements

Equip the system with an expansion tank to damp pressure rise due to volume changes when the temperature varies. Keep the pressure within the limits specified in *Specifications* below. Install a pressure regulator to ensure that the maximum permissible operating pressure is not exceeded.

Install a bleed valve at the highest point of the cooling circuit. Install a drain valve below the lowest pipe in the cooling circuit.

The materials used in the cooling system are listed in *Specifications* on page *117*.

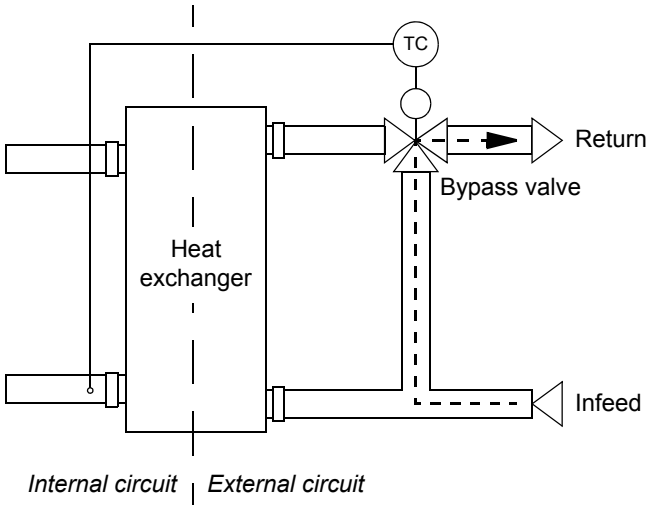
Additional US and Canada requirements

To comply with the requirements of UL508C, install a pressure relief valve in the liquid cooling unit. The recommended discharge rate of the valve is 8…10 bar (800…1000 kPa).

Coolant temperature control

The temperature of the coolant in the internal cooling circuit must be kept within the limits specified in *Specifications* on page *117*. Note that the minimum temperature is dependent on ambient temperature and relative humidity.

The following diagram shows an example of coolant temperature control using the three-way valve in the external cooling circuit. Part of the infeed coolant flow is directed into the return pipe through a three-way valve without letting it circulate in heat exchanger if the coolant in the internal circuit is too cold.



Mechanical installation

Coupling the internal cooling circuit to a customer cooling unit

Connect the external cooling circuit directly to the coupling pipes on the side of the converter. Lay liquid piping with extreme care. Secure the pipes properly mechanically and check for leaks.

Maintenance

Filling up and bleeding the internal cooling circuit

Converter line-ups with a customer cooling unit

Both the converter and coolant must be at room temperature before filling in the cooling circuit.

WARNING! Ensure that the maximum permissible operating pressure is not exceeded. When necessary regulate the pressure to appropriate level by draining excess coolant out of the system.

WARNING! Bleeding of the cooling circuit is very important and has to be done with great care. Air bubbles in the cooling circuit may reduce or completely block coolant flow and lead to overheating. Let the air out of the cooling system while filling in coolant and, eg, after any power module replacements.

Notes:

- The bleed valves in the line-up are used only to vent the air from the circuit so that it can be displaced by the coolant. The actual bleeding of the circuit must be done via an external bleed valve installed at the highest point of the cooling circuit. The most practical location for the valve is usually near or at the cooling unit.
- Observe the instructions given by the manufacturer of the cooling unit. Pay special attention to filling up and bleeding the pumps properly as they may be damaged if operated when dry.
- Draining liquid into the sewer system is not allowed (it may contain harmful substances like propylene glycol).

1. Open the main bleed valve at the cooling unit.
2. Open the inlet, outlet and bleed valves of one converter cubicle.
3. Lead the bleed hoses into buckets or other suitable containers. Extend the standard hoses if necessary.
4. Fill the circuit with coolant. For coolant specification, see below.
5. After the converter unit is filled up, coolant will start flowing from the bleed hose of the converter cubicle. Let some coolant flow out before closing the bleed valve.
6. Close the inlet, outlet and bleed valves of the converter cubicle.
7. Open the inlet and outlet valves in converter cubicle. Let any air remaining in the system out through the bleed valve at the cooling unit.
8. Close the bleed valve at the cooling unit.
9. Continue to fill in coolant until a base pressure of 100…150 kPa (1…1.5 bar) is achieved.
10. Open the bleed valve of the pump to allow any air out.
11. Re-check the pressure and add coolant if necessary.
12. Start the coolant pump. Let any air remaining in the system out through the bleed valve at the cooling unit.
13. After one to two minutes, stop the pump or block the coolant flow with a valve.
14. Re-check the pressure and add coolant if necessary.

15. Repeat steps 13 to 15 a few times until all air is let out of the cooling circuit. Listen for a humming sound and/or feel the piping for vibration to find out if there is still air left in the circuit.
16. Open the bleed valve in the cabinet. Check that coolant comes out, not air. Lead the bleed hose into a bucket or other suitable container.

Draining the internal cooling circuit

The internal cooling circuit can be drained through the drain valves in auxiliary control cubicle.

WARNING! High-pressure warm coolant may be present in the internal cooling circuit. No work on the cooling circuit is allowed until the pressure is lowered down by stopping the pumps and draining coolant.

1. Lead the bleed and drain hoses to buckets or other suitable containers. Extend the standard hoses if necessary.
   Note: Draining liquid that contains eg, propylene glycol into the sewer system is not allowed.
2. Open the bleed valves to let air displace the liquid.
3. If required, dry the piping with compressed oil-free air of less than 600 kPa (6 bar).
4. If the converter is to be stored in temperatures below 0 °C (32 °F),
   - dry the cooling circuit with air
   - fill the cooling circuit with a mixture of water, corrosion inhibitor and antifreeze according to *Freeze protection and corrosion inhibition* below
   - drain the cooling circuit again.

Adding inhibitor

Add inhibitor in the internal circuit every second year. The amount to be added is 0.5% of the total coolant quantity in the circuit. Use eg, Cortec VpCI-649 (by Cortec Corporation, www.cortecvci.com).

Specifications

Temperature limits

Ambient temperature: See chapter *Technical data*.

Minimum coolant inlet temperature for the converter: Condensation is not allowed. The minimum coolant temperature to avoid condensation (at an atmospheric pressure of 100 kPa (1 bar)) is shown below as a function of the relative humidity (ϕ) and the ambient temperature (T_{air}).

T_{air} (°C)	Min. $T_{coolant}$ (°C)				
	ϕ = 95%	ϕ = 80%	ϕ = 65%	ϕ = 50%	ϕ = 40%
5	5.0	5.0	5.0	5.0	5.0
10	9.2	6.7	5.0	5.0	5.0
15	14.2	11.5	8.4	5.0	5.0
20	19.2	16.5	13.2	9.4	6.0
25	24.1	21.4	17.9	13.8	10.5
30	29.1	26.2	22.7	18.4	15.0
35	34.1	31.1	27.4	23.0	19.4
40	39.0	35.9	32.2	27.6	23.8
45	44.0	40.8	36.8	32.1	28.2
50	49.0	45.6	41.6	36.7	32.8

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= Not allowed as standard but the coolant temperature must be 5 °C or above. Consult an ABB representative if operation below coolant temperature 5 °C is required.

Example: At an air temperature of 45 °C and relative humidity of 65% the coolant temperature may not be below +36.8 °C

Maximum coolant inlet temperature for the converter

Range	Converter output current derating
5 °C (41 °F)	minimum coolant inlet temperature
50 °C (122 °F)	maximum coolant inlet temperature with derating

Maximum inlet temperature variation: ±4°C

Maximum temperature rise: 13°C; depends on mass flow.

Pressure limits

Base pressure: 100…150 kPa (recommended); 200 kPa (maximum). “Base pressure” denotes the pressure of the system compared with the atmospheric pressure when the cooling circuit is filled with coolant.

Maximum design pressure: 600 kPa (6 bar)

Nominal pressure difference: 130 kPa (1.3 bar) / 140 kPa (1.4 bar) (hydrostatic)

Maximum pressure difference: 170 kPa (1.7 bar) / 180 kPa (1.8 bar) (hydrostatic)

Working pressure: min. 120 kPa (1.2 bar)

Pressure monitoring: Pressure at the measuring point must stay within the range of 120 kPa...380 kPa (1.2…3.8 bar) for the converter to operate.

Water quality

Tap water The use of tap water is allowed as follows. Tap water must fulfil the requirements of the Council Directive 98/83/EC of 3/11/98 on the quality of water intended for human consumption. Corrosion inhibition with 0.5% by volume Cortec VCI-649 is required.	
pH value	6…9
Chloride	< 50 mg/l
Sulphate	< 100 mg/l
Total dissolved solids	< 200 mg/l, no deposits are allowed at the temperature of +57 °C
Total hardness as $CaCO_3$	< 250 mg/l
Conductivity	< 400 µS/cm (this equals the resistance of > 2500 ohm/cm)
The water must be clean of solid matter.	

Freeze protection and corrosion inhibition

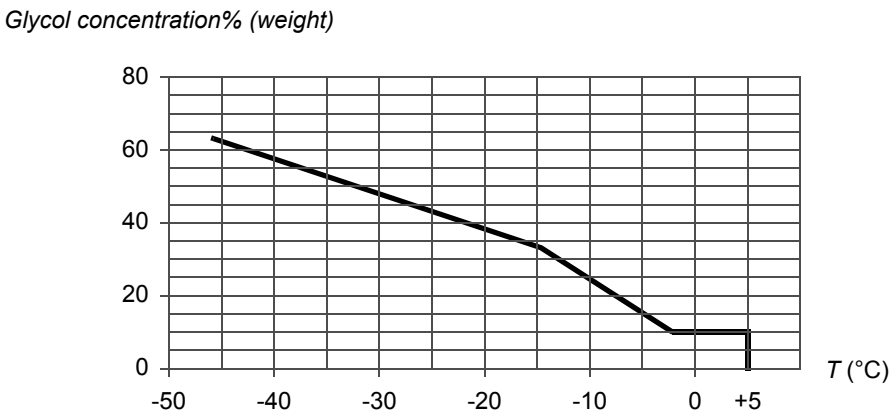
Depending on the ambient temperature, add antifreeze and corrosion inhibitor to the coolant (see *Glycol concentration* below). If you use one of the following types of antifreeze that contain both freeze protector and corrosion inhibitor, no additional corrosion inhibitor is needed:

- Clariant Antifrogen N
- Clariant Antifrogen L
- BASF Glysantin G30
- DOW company Dowcal 20

If you use DOW industrial grade propylene glycol (PGI), add an amount of Cortec VpCI-649 that makes up 0.5% of the total coolant quantity in the circuit.

Glycol concentration

The graph below shows the required glycol concentration in weight percentage according to ambient/storage temperature *T*.



WARNING! Operation at temperatures below 5 °C (41 °F) is not permitted even with antifreeze.

Note: If more than 25% is added, the pressure loss in the system increases. An operating pressure of more than 150 kPa is required for sufficient flow.

Approved coolants

- BASF Glysantin G30
- BASF Glythermin P44
- Clariant Antifrogen N
- Clariant Antifrogen L
- DOW company Dowcal 20
- DOW industrial grade propylene glycol (PGI) with Cortec VpCI-649 corrosion inhibitor that makes up 0.5% of the total coolant quantity in the circuit
- Nalco Varidos FSK
- Shell Freezeguard OAT -45 °C.

Materials

Materials used in the internal cooling circuit are listed below. **Note:** These are also the only materials that can be used in the external cooling circuit.

- stainless steel AISI 316L (UNS 31603)
- heavy gauge aluminum
- plastic materials such as PA, PEX and PTFE
  Note: PVC hoses are not suitable for use with antifreeze.
- rubber gasketing NBR (nitrile rubber).

WARNING! If connecting external piping to the internal cooling circuit, use only materials that are specified above. Copper and brass must not be used under any circumstances. Even minor dissolution of copper can cause copper precipitation on aluminum and subsequent galvanic corrosion. The liquid cooling system may not contain any zinc (eg, galvanized pipes) at all since zinc would react with the inhibitor.

If the system incorporates normal iron pipes or cast iron accessories, a liquid cooling unit with a heat exchanger must be used to separate the systems.

10

Technical data

What this chapter contains

This chapter contains technical data of the ACS800-67LC, eg, ratings, frame sizes, technical requirements and provisions for fulfilling the requirements for CE and other markings.

Ratings

The ratings for the converter with 50 Hz and 690 V AC power supply network are given below.

Grid-side converter ratings

ACS800-204LC	Frame size	Nominal ratings			
		$I_{cont.max}$ A (AC)	$S_{cont.max}$ kVA	$Q_{cont.max}$ kVAr	I_{max} A (AC)
Three-phase supply voltage: 525…690 V					
-0575-7+E205	R8i	480	574	470	718
-0865-7+E205	2×R8i	720	860	706	1077
-1125-7+E205	2×R8i	941	1124	922	1407

For information on reactive power capability, see *ACS800-67LC system description and start-up guide* [3AUA0000059432 (English)].

Rotor-side converter ratings

ACS800-104LC	Frame size	Nominal ratings			Light overload use	Heavy duty use
		$I_{cont.max}$ A (AC)	$S_{cont.max}$ kVA	I_{max} A (AC)	I_N A	I_{hd} A
Three-phase supply voltage: 690 V						
-1075-7	2×R8i	898	1074	1344	863	672
-1375-7	2×R8i	1143	1366	1710	1097	855
-1595-7	3×R8i	1334	1594	1996	1281	998
-2035-7	3×R8i	1697	2028	2539	1629	1269

Definitions

Nominal ratings

$I_{cont.max}$ Continuous rms input/output (AC) and input (DC) current. No overloadability at 45 °C (+113 °F).

$S_{cont.max}$ Nominal apparent power

$Q_{cont.max}$ Nominal reactive power

I_{max} Maximum input/output current. Allowable for 10 seconds at start, otherwise as long as allowed by the converter temperature.

Typical ratings for light overload use (10% overloadability)

I_N Continuous rms input/output current. 10% overload is allowed for 1 minute every 5 minutes.

Typical ratings for heavy duty use (50% overloadability)

I_{hd} Continuous rms input/output current. 50% overload is allowed for 1 minute every 5 minutes.

Derating

Temperature derating

Coolant inlet temperature: In the temperature range +45 °C (+113 °F) to +50 °C (+122 °F), the rated output current is decreased by 2% for every additional 1 °C (1.8 °F). The output current is calculated by multiplying the current given in the rating table by the derating factor.

Example: If the coolant inlet temperature is 47 °C (+117 °F), the derating factor is 100% - 2%/°C · 2 °C = 100% - 4% = 96% = 0.96. The output current is then 0.96 × I_N or 0.96 × $I_{cont.max}$.

Ambient temperature: In the ambient temperature range +50 °C (+122 °F) to +55 °C (+131 °F), the rated output current is decreased by 1% for every additional 1 °C (1.8 °F). The output current is calculated by multiplying the current given in the rating table by the derating factor.

Example: If the ambient temperature is 52 °C (+126 °F), the derating factor is 100% - 1%/°C · 2 °C = 100% - 2% = 98% = 0.98. The output current is then 0.98 × I_N or 0.98 × $I_{cont.max}$.

Altitude derating

At altitudes from 1000 to 4000 m (3281 to 13123 ft) above sea level, the derating is 1% for every 100 m (328 ft). If the installation site is higher than 2000 m (6600 ft) above sea level, contact the local ABB representative.

Type equivalence table

Type	Construction	Grid-side converter	Rotor-side converter
		Module type	Module type
ACS800-67LC-1075/0575-7	2xR8i+1xR8i+1xLCL	ACS800-104LC-0705-7+E205	ACS800-104LC-0705-7+E205
ACS800-67LC-1375/0575-7	2xR8i+1xR8i+1xLCL	ACS800-104LC-0705-7+E205	ACS800-104LC-0705-7+E205
ACS800-67LC-1375/1125-7	2xR8i+2xR8i+1xLCL	ACS800-104LC-0705-7+E205	ACS800-104LC-0705-7+E205
ACS800-67LC-1595/0865-7	3xR8i+2xR8i+1xLCL	ACS800-104LC-0555-7+E205	ACS800-104LC-0555-7+E205
ACS800-67LC-2035/1125-7	3xR8i+2xR8i+1xLCL	ACS800-104LC-0705-7+E205	ACS800-104LC-0705-7+E205

Fuses

Main circuit AC fuses

Type	I_n (A)	Bussmann type	MRP code	Microswitch for the fuse	MRP code
ACS800-67LC-1075/0575-7	700	170M4467	3AUA0000081489	170H0069	58063690
ACS800-67LC-1375/0575-7	700	170M4467	3AUA0000081489		
ACS800-67LC-1375/1125-7	1400	170M6467	3AUA0000062487		
ACS800-67LC-1595/0865-7	1250	170M6466	3AUA0000062488		
ACS800-67LC-2035/1125-7	1400	170M6467	3AUA0000062487		

Type	I_n (A)	Mersen type	MRP code	Microswitch for the fuse	MRP code
ACS800-67LC-1075/0575-7	700	PC31UD69V700TF	3AUA0000081747	MS3 V1-5	3AUA0000081746
ACS800-67LC-1375/0575-7	700	PC31UD69V700TF	3AUA0000081747		
ACS800-67LC-1375/1125-7	1400	PC33UD69V1400TF	3AUA0000081748		
ACS800-67LC-1595/0865-7	1250	PC33UD69V1250TF	3AUA0000081749		
ACS800-67LC-2035/1125-7	1400	PC33UD69V1400TF	3AUA0000081748		

All fuses are UL listed.

Type	AC fuse spare part kit
ACS800-67LC-1075/0575-7	3AUA0000081750
ACS800-67LC-1375/0575-7	3AUA0000081750
ACS800-67LC-1375/1125-7	3AUA0000081751
ACS800-67LC-1595/0865-7	3AUA0000081752
ACS800-67LC-2035/1125-7	3AUA0000081751

Main circuit DC fuses

Type	I_n (A)	Mersen type	Bussmann type	MRP code	pcs
ACS800-67LC-1075/0575-7	1100	PC73UD10C11CTF	170M6549	68736021	6
ACS800-67LC-1375/0575-7	1100	PC73UD10C11CTF	170M6549	68736021	6
ACS800-67LC-1375/1125-7	1100	PC73UD10C11CTF	170M6549	68736021	8
ACS800-67LC-1595/0865-7	800	PC73UD13C800TF	170M6546	68736005	10
ACS800-67LC-2035/1125-7	1100	PC73UD10C11CTF	170M6549	68736021	10

All fuses are UL listed.

Notes:

- Larger fuses must not be used.
- Use always the fuses that are specified by ABB.
- The recommended fuses are for branch circuit protection per NEC as required for UL approval.
- Make sure that fuses within a converter are made by the same manufacturer.

Dimensions and free space requirements

Type	Height (mm)	Depth (mm)	Width (mm)	
			ICU 200 mm	ICU 400 mm (+C111)
ACS800-67LC-1075/0575-7	2000	644	1600	1800
ACS800-67LC-1375/0575-7	2000	644	1600	1800
ACS800-67LC-1375/1125-7	2000	644	1800	2000
ACS800-67LC-1595/0865-7	2000	644	2000	2200
ACS800-67LC-2035/1125-7	2000	644	2000	2200

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 converter for the cooling pipe connections (depending on which side the cooling connections are).

Losses, cooling data and noise

ACS800-67LC-	Losses kW					
	Maximum total losses 1), 3), 4)	Maximum total losses 2), 5)	Maximum $P_{loss\ tot\ coolant}$ 1), 3), 4)	Maximum $P_{loss\ tot\ coolant}$ 2), 5)	Maximum $P_{loss\ tot\ air}$ 1), 3), 4)	Maximum $P_{loss\ tot\ air}$ 2), 5)
1075/0575-7	27	31	26	30	0.5	0.6
1375/0575-7	30	34	29	33	0.6	0.7
1375/1125-7	40	45	40	44	0.8	0.9
1595/0865-7	44	50	43	49	0.9	1.0
2035/1125-7	57	63	56	62	1.1	1.3

ACS800-67LC-	Pressure loss kPa (bar) 1), 2), 3), 4, 5)	Noise level dB 1), 2), 3), 4, 5)
All types	100 (1.0)	<70

1) With 200 mm or 400 mm (option +C111) wide incoming cubicle

2) With power cabinet (option +C108 or +C109)

3) With DC chopper (option +D150)

4) With 400 mm wide incoming cubicle (option +C111) and DC chopper (option +D150)

5) With power cabinet (option +C108 or +C109) and DC chopper (option +D150)

ACS800-67LC-	Liquid massflow l/min (m^3/h)					
	ICU200	With option +C111	With option +C108 or +C109	With option +D150	With options +D150 and +C111	With options +D150 and +C108 or +C109
1075/0575-7	75 (4.5)	85 (5.1)	100 (6.0)	93 (5.6)	103 (6.2)	118 (7.1)
1375/0575-7	75 (4.5)	85 (5.1)	100 (6.0)	93 (5.6)	103 (6.2)	118 (7.1)
1375/1125-7	100 (6.0)	110 (6.6)	125 (7.5)	118 (7.1)	128 (7.7)	143 (8.6)
1595/0865-7	115 (6.9)	125 (7.5)	140 (8.4)	142 (8.5)	152 (9.1)	167 (10.0)
2035/1125-7	115 (6.9)	125 (7.5)	140 (8.4)	142 (8.5)	152 (9.1)	167 (10.0)

ACS800-67LC-	Liquid quantity l					
	ICU200	With option +C111	With option +C108 or +C109	With option +D150	With options +D150 and +C111	With options +D150 and +C108 or +C109
1075/0575-7	11	12	13	11	12	13
1375/0575-7	11	12	13	11	12	13
1375/1125-7	14	15	16	14	15	16
1595/0865-7	16	17	19	16	18	19
2035/1125-7	16	17	19	16	18	19

Internal cooling circuit data

See chapter *The internal cooling circuit*.

LCL filter data

ACS800-67LC-	LCL filter		L1		L2		C	
	Type code	MRP code	Inductance uH	MRP code	Inductance uH	MRP code	Capacitance uF	MRP code
1075/0575-7	ALCL-15LC-7	68462193	106	68459559	190	68459656	64	68459737
1375/0575-7	ALCL-15LC-7	68462193	106	68459559	190	68459656	64	68459737
1375/1125-7	ALCL-25LC-7	68462258	54	68459681	97	68459699	125	68459753
1595/0865-7	ALCL-24LC-7	68462215	70	68459664	127	68459672	96	68459745
2035/1125-7	ALCL-25LC-7	68462258	54	68459681	97	68459699	125	68459753

Terminal and lead-through data for the power cables

For description of lead-through types, see chapter *Operation principle and hardware description*, page *32*.

Cable terminals	Screw size	Tightening torque
DC terminals	M12 Max. intrusion into module: 20 mm (0.8 in.)	50 N·m (37 lbf·ft)
Input busbars (L1, L2, L3)	M12	70 N·m (52 lbf·ft)
Output busbars (U2, V2, W2)	M12	70 N·m (52 lbf·ft)
PE terminals	M12	70 N·m (52 lbf·ft)

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
X1	Han Q 5/0 Crimp terminal	Female insert (F)	09 12 005 3101	1
	Han 2.5 mm^2	Crimp contact female	09 33 000 6202	5
	Han 3A	Hood	19 20 003 1440	1
		Cable gland M20		1
X2	Han Q 5/0 Crimp terminal	Female insert (F)	09 12 005 3101	1
	Han 2.5 mm^2	Crimp contact female	09 33 000 6202	5
	Han 3A	Hood	19 20 003 1440	1
		Cable gland M20		1
X3	RJ45 Han3A	Complete RJ45	09 45 115 1104	1
X4	Hanbrid Quintax	Female insert (F)	09 15 003 3101	1
	Hanbrid Quintax	Contact female (F)	09 15 004 3113	1
	Han 0.5 mm^2	Crimp contact female	09 15 000 6203	4
	Han Hanbrid	Hood	19 20 003 1440	1
		Cable gland M20		1
X5	Han 15D Crimp terminal	Female insert (F)	09 21 015 3101	1
	Han 1.0 mm^2	Crimp contact female	09 33 000 6205	15
	Han 10A	Hood	19 20 010 1440	1
		Cable gland M20		1
X7	Han 15D Crimp terminal	Male insert (M)	09 21 015 3001	1
	Han 0.5 mm^2	Crimp contact male	09 15 000 6103	15
	Han 10A	Hood	19 20 010 1440	1
		Cable gland M20		1
X10	Han 10A Crimp terminal	Male insert (M)	09 20 010 3001	1
	Han 1.0 mm^2	Crimp contact male	09 33 000 6105	8
	Han 2.5 mm^2	Crimp contact male	09 33 000 6102	2
	Han 10A	Hood	19 20 010 1440	1
		Cable gland M20		1
X11	Han 15D Crimp terminal	Female insert (F)	09 21 015 3101	1
	Han 1.0 mm^2	Crimp contact female	09 33 000 6205	11
	Han 10A	Hood	19 20 010 1440	1
		Cable gland M20		1
X8.2	Han Hv E Screw terminal	Female insert (F)	09 34 006 2701	1
	Han 16B	Hood	19 34 006 0421	1
		Cable gland M25		1
X8.1	Han Hv E Screw terminal	Female insert (F)	09 34 006 2701	1
	Han 16B	Hood	19 34 006 0421	1
		Cable gland M25		1
X9	Han 4A Screw terminal	Female insert (F)	09 20 004 2711	1
	Han 3A	Hood	19 20 003 1440	1
		Cable gland M20		1
X6.2	Han 16A Crimp terminal	Male insert (M)	09 20 016 3001	1
	Han 1.0 mm^2	Crimp contact male	09 33 000 6105	16
	Han 16A	Hood	19 20 016 1440	1
		Cable gland M20		1

Terminal	Identification	Type	Part number	Qty
X6.1	Han 16A Crimp terminal	Male insert (M)	09 20 016 3001	1
	Han 1.0 mm^2	Crimp contact male	09 33 000 6105	16
	Han 16A	Hood	19 20 016 1440	1
		Cable gland M20		1
X80	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
X90	Han 10A Crimp terminal	Male insert (M)	09 20 010 3001	1
	Han 1.5 mm^2	Crimp contact male	09 33 000 6104	10
	Han 10A	Hood	19 20 010 1440	1
		Cable gland M20		1

Electric power network specification

Voltage (U_1)
690 V AC 3-phase for 690 V AC units
600 V AC 3-phase for 690 V AC units (UL508A)
±10% variation from converter nominal voltage (U_1) is allowed as default.

Frequency
50 ± 2 Hz or 60 ± 3 Hz. Maximum rate of change 17%/s.

Imbalance
Max. ± 3% of nominal phase-to-phase input voltage

Current
See section *Ratings.*

Voltage dips
See section *Grid codes.*

Short-circuit withstand strength (IEC 60439-1)
Maximum allowable prospective short-circuit current is 65 kA when protected by fuses given under *Fuses*.

Short-circuit current protection (UL 508A)
US and Canada: The converter is suitable for use on a circuit capable of delivering not more than 65,000 rms symmetrical amperes at 600 V maximum when protected by fuses given under *Fuses*.

Power factor
1.00 (in normal use)

$$\frac{I_1}{I_{rms}} \cdot \text{cosphi} > 0.98$$

cosphi = 1.00 (fundamental at nominal load)
I_1 = input/output current rms value
I_{rms} = total input/output current rms value

Harmonic distortion
Harmonics below are the limits defined in IEEE519 for I_{sc}/I_L. Each individual harmonic current fulfils IEEE519 table 10-3 for $I_{sc}/I_L > 20$. Current THD and each individual current harmonic fulfil IEC 61000-3-4 table 5.2 for $R_{sce} > 33$. The values will be met if the supply network voltage is not distorted by other loads.

Switching frequency
3 kHz (typically, may vary in between 3 kHz…2 kHz based on temperature model

Generator connection data

Generator types: Asynchronous AC doubly-fed induction generators

Voltage (U_2)
0 to U_1, 3-phase symmetrical, U_{max} 750 V. U_{max} at the field weakening point.

Frequency
0 to 200 Hz (typically)

Current
See section *Ratings.*

Switching frequency
2 kHz (typically, may vary between 2 kHz…1.4 kHz based on temperature model)

DC resistor connection data

See *ABRU-0x DC choppers (+D150) and resistors (+D151) for ACS800-67LC/-77LC/-87LC wind turbine converters hardware manual* [3AUA0000076494 (English)].

DC connection data

Nominal voltage	976 V DC +20%
Maximum operating voltage	< 1211 V DC
DC voltage limits	Overvoltage: 136% x U_{DC} Undervoltage: 50% x U_{DC}
Current	See section *Ratings.*

Efficiency

System efficiency is at least 97% at rated current and nominal supply voltage (generator dependent).

Degree of protection

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

Ambient conditions

Environmental limits for the converter are given below. The converter must be used in a specified environment.

	Operation installed for stationary use	**Storage** in the protective package	**Transportation** in the protective package
Installation site altitude	0 to 2000 m (6562 ft) above sea level. Above 1000 m (3281 ft), see section *Derating* on page *122*.	-	-
Air temperature	-30 to +55 °C (-22 to 131 °F). Above +45 °C (+113 °F), see section *Derating* on page *122*. No frost allowed. **Note:** UL temperature requirement: max. +40 °C (+104 °F).	-40 to +70 °C (-40 to +158 °F)	-40 to +70 °C (-40 to +158 °F)
Water temperature	See section *Temperature limits* on page *117*.		
Relative humidity	5 to 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination levels (IEC 60721-3-3, IEC 60721-3-2, IEC 60721-3-1)	No conductive dust allowed.		
	Boards with coating: Chemical gases: Class 3C2 Solid particles: Class 3S2	**Boards with coating:** Chemical gases: Class 1C2 Solid particles: Class 1S3	**Boards with coating:** Chemical gases: Class 2C2 Solid particles: Class 2S2
Atmospheric pressure	70 to 106 kPa 0.7 to 1.05 atmospheres	70 to 106 kPa 0.7 to 1.05 atmospheres	60 to 106 kPa 0.6 to 1.05 atmospheres

Vibration (IEC 60068-2)	0.075 mm (0…58 Hz) 10 m/s^2 (58…150 Hz) Marine requirements: ±1 mm (0.04 in.) (peak value, 2…13.2 Hz) 0.7g (13.2…100 Hz) Max. amplification 10	1.5 mm (2…9 Hz) 5 m/s^2 (9…200 Hz) (1M2, IEC 60721-3-1)	3.5 mm (0.14 in.) (2…9 Hz) 10 m/s^2 (9…200 Hz) Random 10…200 Hz Acceleration spectral density 1 m^2/s^3 (2M2, IEC 60721-3-2)
Shock (IEC 60068-2-29)	Not allowed	Max. 100 m/s^2 (330 ft/s^2), 11 ms	Max. 100 m/s^2 (330 ft/s^2), 11 ms
Free fall	Not allowed	100 mm (4 in.)	100 mm (4 in.)

Materials

Cabinet	Hot-dip zinc-coated (thickness approx. 20 µm) steel sheet (thickness 1.5 mm) with polyester thermosetting powder coating (thickness approx. 80 µm) on visible surfaces except back panel. Colour: RAL 7035 (light beige, semigloss).
Busbars	Tin- or silver-plated copper
Internal cooling circuit piping	Aluminium, acid-fast stainless steel, PA pipes
Fire safety of materials (IEC 60332-1)	Insulating materials and non-metallic items: Mostly self-extinctive
Packaging	Frame: Wood or plywood. Plastic wrapping: PE-LD. Bands: PP or steel.
Disposal	The converter contains raw materials that should be recycled to preserve energy and natural resources. The package materials are environmentally compatible and recyclable. All metal parts can be recycled. The plastic parts can either be recycled or burned under controlled circumstances, according to local regulations. Most recyclable parts are marked with recycling marks. If recycling is not feasible, all parts excluding electrolytic capacitors and printed circuit boards can be landfilled. The DC capacitors (C1-1 to C1-x) contain electrolyte and the printed circuit boards contain lead, both of which are classified as hazardous waste within the EU. They must be removed and handled according to local regulations. For further information on environmental aspects and more detailed recycling instructions, please contact your local ABB distributor.

Auxiliary circuit current consumption

Cooling fans

Unit	Type
ISU and INU	D2E146-AP47-xx
ACU and ICU400	W2E 143-AA09-01

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 optional power cabinet is selected (option +C108 or +C109).

Applicable standards

	The converter complies with the standards below. The compliance with the European Low Voltage Directive is verified according to standards EN 61800-5-1 and EN 60204-1.
• IEC/EN 60204-1:2006	Safety of machinery. Electrical equipment of machines. Part 1: General requirements. *Provisions for compliance:* The final assembler of the machine is responsible for installing - an emergency-stop device.
• IEC/EN 60529:2001	Degrees of protection provided by enclosures (IP code).
• IEC/EN 60664-1:2007	Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.
• IEC/EN 61400-1:2005	Wind turbines. Part 1: design requirements.
• IEC/EN 61800-3:2004	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods.
• IEC/EN 61800-5-1:2007	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy.
• UL 50	Twelfth Edition. Enclosures for Electrical Equipment, Non-Environmental Considerations.
• UL 508A	First Edition. Industrial Control Panels.

Grid codes

See *ACS800-67LC wind turbine converters system description and start-up guide* [3AUA0000059432 (English)].

CE marking

A CE mark is attached to the converter to verify that the unit follows the provisions of the European Low Voltage and EMC Directives.

Compliance with the European Low Voltage Directive

The compliance with the European Low Voltage Directive has been verified according to standard EN 61800-5-1 and applicable parts of standard EN 60204-1.

Compliance with the European EMC Directive

See section *Compliance with the EN 61800-3*.

Compliance with the European Machinery Directive

The converter complies with the European Machinery Directive requirements for a partly completed machinery.

Declaration of incorporation

Declaration of Incorporation

(According to Machinery Directive 2006/42/EC)

Manufacturer: ABB Oy
Address: P.O Box 184, FIN-00381 Helsinki, Finland. Street address: Hiomotie 13,

herewith declare under our sole responsibility that the frequency converter series with type markings:

ACS800-67LC ACS800-77LC ACS800-87LC

are intended to be incorporated into machinery or to be assembled with other machinery to constitute machinery covered by Machinery Directive 2006/42/EC and relevant essential health and safety requirements of the Directive and its Annex I have been complied with.

The technical documentation is compiled in accordance with part B of Annex VII, the assembly instructions are prepared according Annex VI and the following harmonised European standard has been applied:

EN 60204-1:2006 + A1:2009
Safety of machinery - Electrical equipment of machines- Part 1: general requirements

The person authorised to compile the technical documentation:

Name: Kimmo Heinonen
Address: P.O Box 184, FIN-00381 Helsinki, Finland

The equipment referred in this Declaration is in conformity with Low voltage directive 2006/95/EC and EMC directive 2004/108/EC. The Declaration of Conformity according to these directives is available from the manufacturer.

ABB Oy furthermore declares that it is not allowed to put the equipment into service until the machinery into which it is to be incorporated or of which it is to be a component has been found and declared to be in conformity with the provisions of the Directive 2006/42/EC and with national implementing legislation, i.e. as a whole, including the equipment referred to in this Declaration.

ABB Oy gives an undertaking to the national authorities to transmit, in response to a reasoned request by the national authorities, relevant information on the partly completed machinery. The method of transmission can be either electrical or paper format and it shall be agreed with the national authority when the information is asked. This transmission of information shall be without prejudice to the intellectual property rights of the manufacturer.

Helsinki, 21.12.2009

Timo Salmela

Vice President
ABB Oy

Validating the operation of a safety function

IEC 61508 and EN IEC 62061 require that the final assembler of the machine validates the operation of the safety function with an acceptance test. The acceptance tests for the standard safety functions of the converter are described in chapter *Planning the electrical installation*. The tests for the optional safety functions are described in the appropriate option manuals.

The acceptance test must be performed:

- at initial start-up of the safety function
- after any changes related to the safety function (wiring, components, settings, etc.)
- after any maintenance work related to the safety function.

Authorized person

The acceptance test of the safety function must be carried out by an authorized person with expertise and knowledge of the safety function. The test must be documented and signed by the authorized person.

Acceptance test reports

Signed acceptance test reports must be stored in the logbook of the machine. The report shall include documentation of start-up activities and test results, references to failure reports and resolution of failures. Any new acceptance tests performed due to changes or maintenance shall be logged into the logbook.

Compliance with the EN 61800-3

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN 61800-3) covers requirements stated for converters.

Definitions

EMC stands for **E**lectro**m**agnetic **C**ompatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

First environment includes establishments connected to a low-voltage network which supplies buildings used for domestic purposes.

Second environment includes establishments connected to a network not supplying domestic premises.

Drive of category C3: drive of rated voltage less than 1000 V and intended for use in the second environment and not intended for use in the first environment.

Drive of category C4: drive of rated voltage equal to or above 1000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment.

Category C3

The converter complies with the standard with the following provisions:

1. The generator and control cables are selected as specified (recommended cable types) in the *Hardware Manual*.
2. The converter is installed according to the instructions given in the *Hardware Manual*.

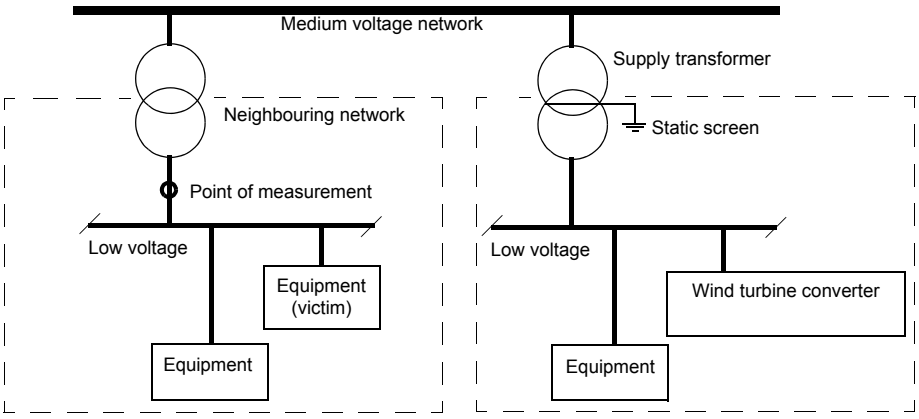
3. Maximum cable length is 100 metres.

WARNING! A drive of category C3 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

Category C4

If the provisions under *Category C3* cannot be met, the requirements of the standard can be met as follows:

1. It is ensured that no excessive emission is propagated to neighbouring low-voltage networks. In some cases, the natural suppression in transformers and cables is sufficient. If in doubt, the supply transformer with static screening between the primary and secondary windings can be used.



2. An EMC plan for preventing disturbances is drawn up for the installation. A template is available from the local ABB representative.
3. The generator and control cables are selected as specified in the *Hardware Manual*.
4. The converter is installed according to the instructions given in the *Hardware Manual*.

WARNING! A drive of category C4 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the converter is used on such a network.

UL marking

The converter is cULus listed industrial control panel. The approvals are valid with rated voltages up to 600 V AC. The markings are attached to the converter when option +C129 (cULus) is selected. ETL marking according to UL508C up to 690 V AC is pending. Contact the local ABB representative when ETL marking is required.

ACS800 multidrive modules: The module is cULus listed industrial control equipment. The approvals are valid with rated voltages up to 600 V.

UL checklist

Input power connection – Short-circuit current protection (UL 508A): The converter is suitable for use in a circuit capable of delivering not more than 65,000 symmetrical amperes (rms) at 600 V maximum when protected with the fuses given in section *Fuses*.

Disconnecting device (disconnecting means) – See chapter *Planning the electrical installation*.

Ambient conditions – The converter is to be used in a specified environment. For the specifications, see section *Ambient conditions*.

Input cable fuses – For installation in the United States, branch circuit protection must be provided in accordance with National Electrical Code (NEC) and any applicable local codes. To fulfil this requirement, use the US fuses given in section *Fuses*.

For installation in Canada, branch circuit protection must be provided in accordance with Canadian Electrical Code and any applicable provincial codes. To fulfil this requirement, use the UL classified fuses given in section *Fuses*.

Power cable selection – See chapter *Planning the electrical installation*.

Power cable connections – For the connection diagram and tightening torques, see chapter *Electrical installation*.

Control connections – For the connection diagram and tightening torques, see chapter *Electrical installation*.

Overload protection – The converter provides overload protection in accordance with the National Electrical Code (US). See the *Firmware manual* for setting. Default setting is off, must be activated at start-up.

DC chopper (brake) unit – The converter can be equipped with a chopper unit that will allow the converter to dissipate regenerative energy (normally associated with quickly decelerating a generator).

UL standards – See section *Applicable standards*.

CSA marking

ACS800 multidrive modules: The module is cCSAus certified. The approvals are valid with rated voltages up to 600 V. The ACS800-67LC is not CSA marked. Contact the local ABB representative when CSA approval is required.

C-Tick marking

C-Tick marking is required in Australia and New Zealand. A C-Tick mark is attached to each converter in order to verify the compliance with the relevant standard (IEC 61800-3:2004, *Adjustable speed electrical power drive systems – Part 3: EMC product standard including specific test methods*). For fulfilling the requirements of the standard, see section *Compliance with the EN 61800-3*.

Disclaimer

The manufacturer shall have no obligation with respect to any product which (i) has been improperly repaired or altered; (ii) has been subjected to misuse, negligence or accident; (iii) has been used in a manner contrary to the manufacturer's instructions; or (iv) has failed as a result of ordinary wear and tear.

11

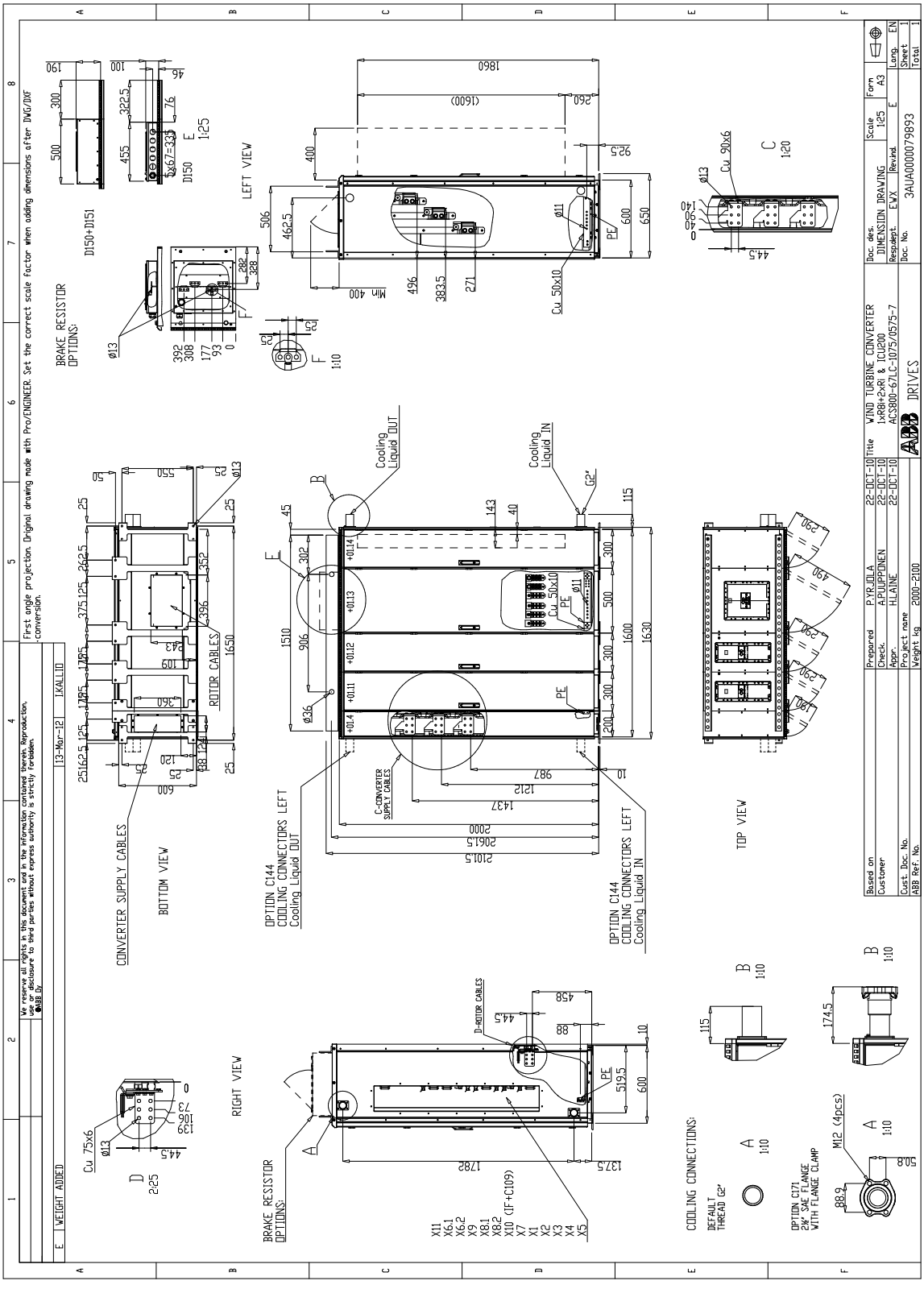
Dimension drawings

What this chapter contains

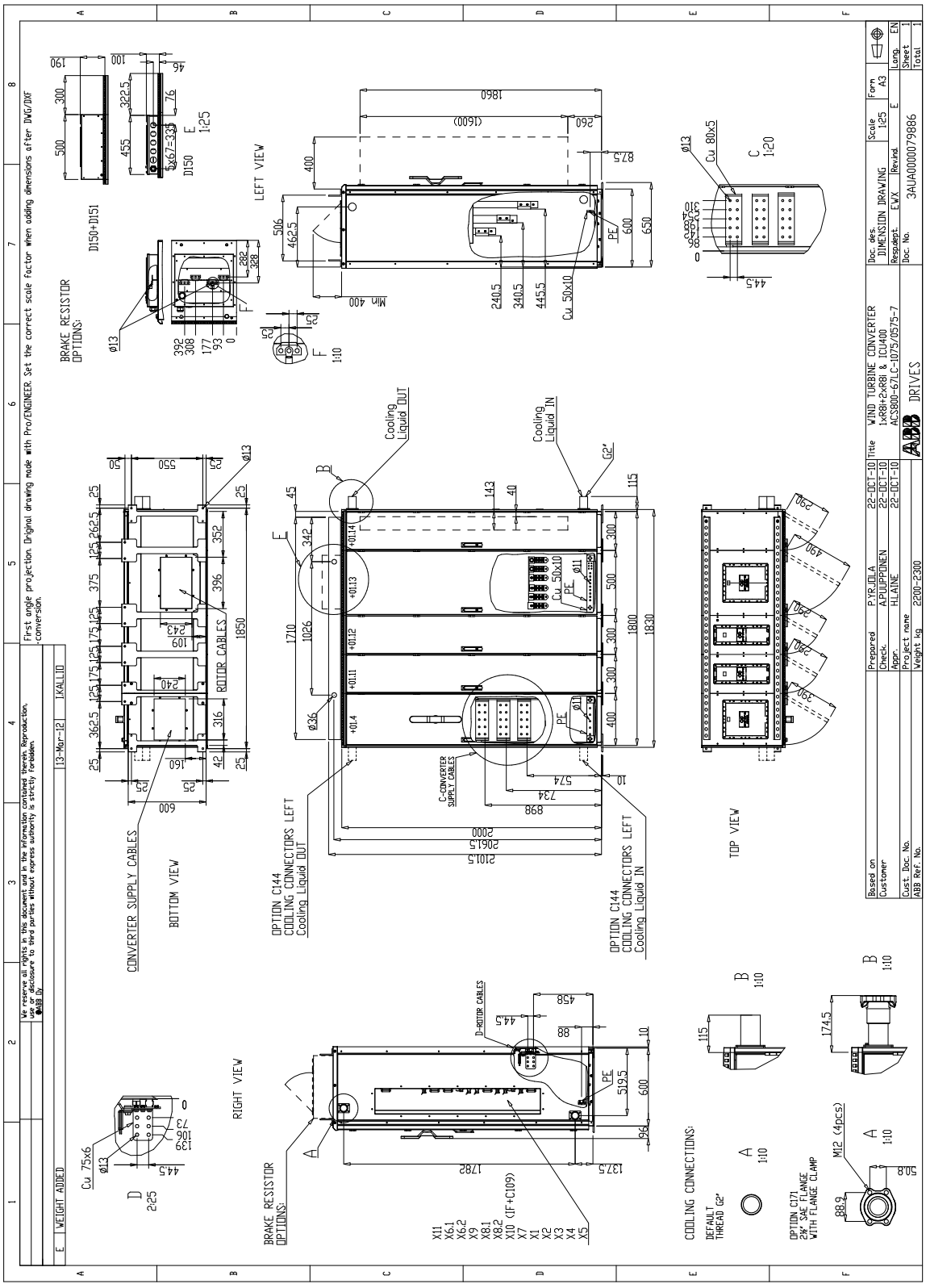
This chapter contains example dimension drawings. Example lead-through drawings are included. The example drawing set helps in understanding the structure of the converter.

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

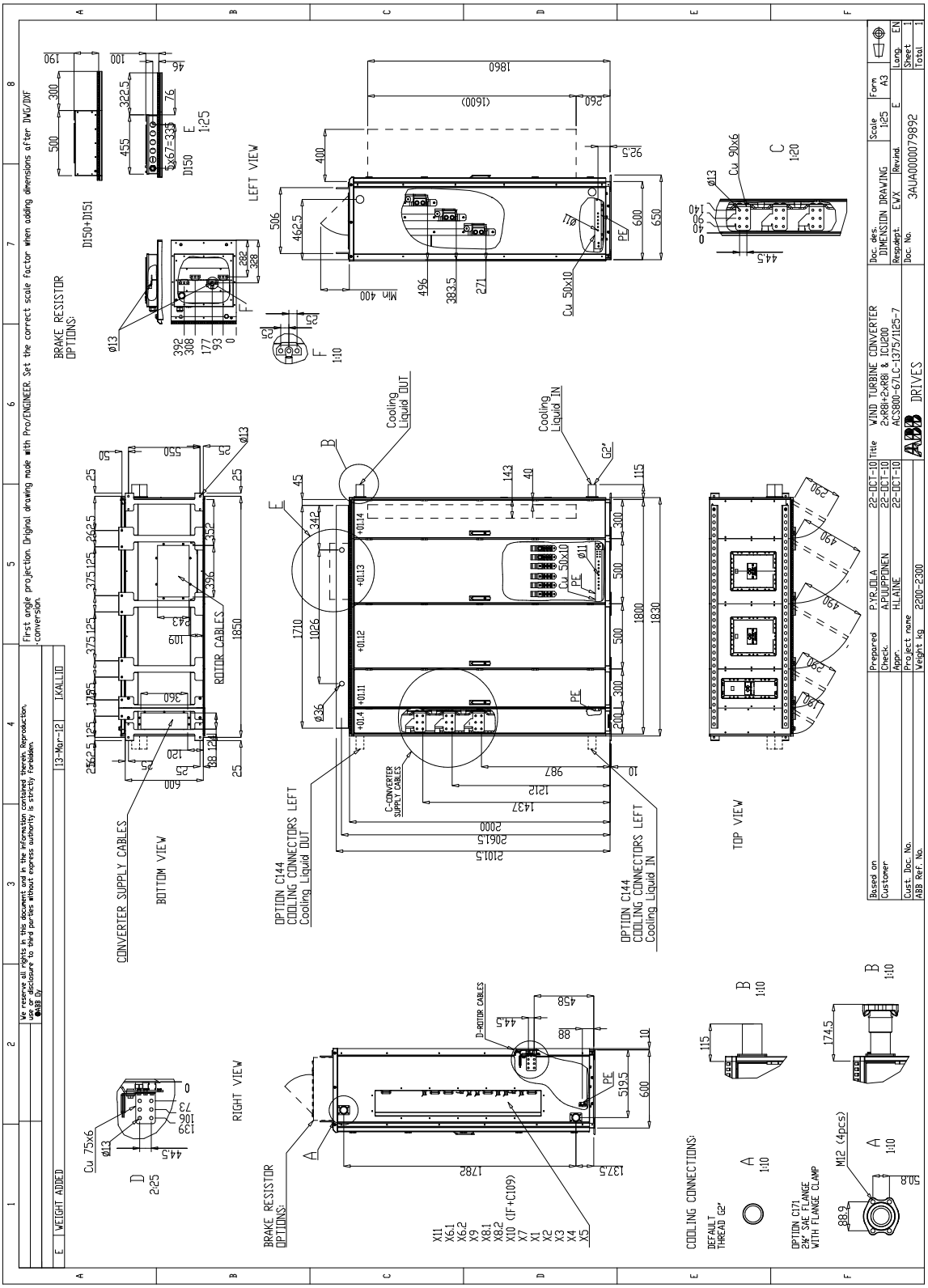
ACS800-67LC-1075/0575-7 and -1375/0575-7



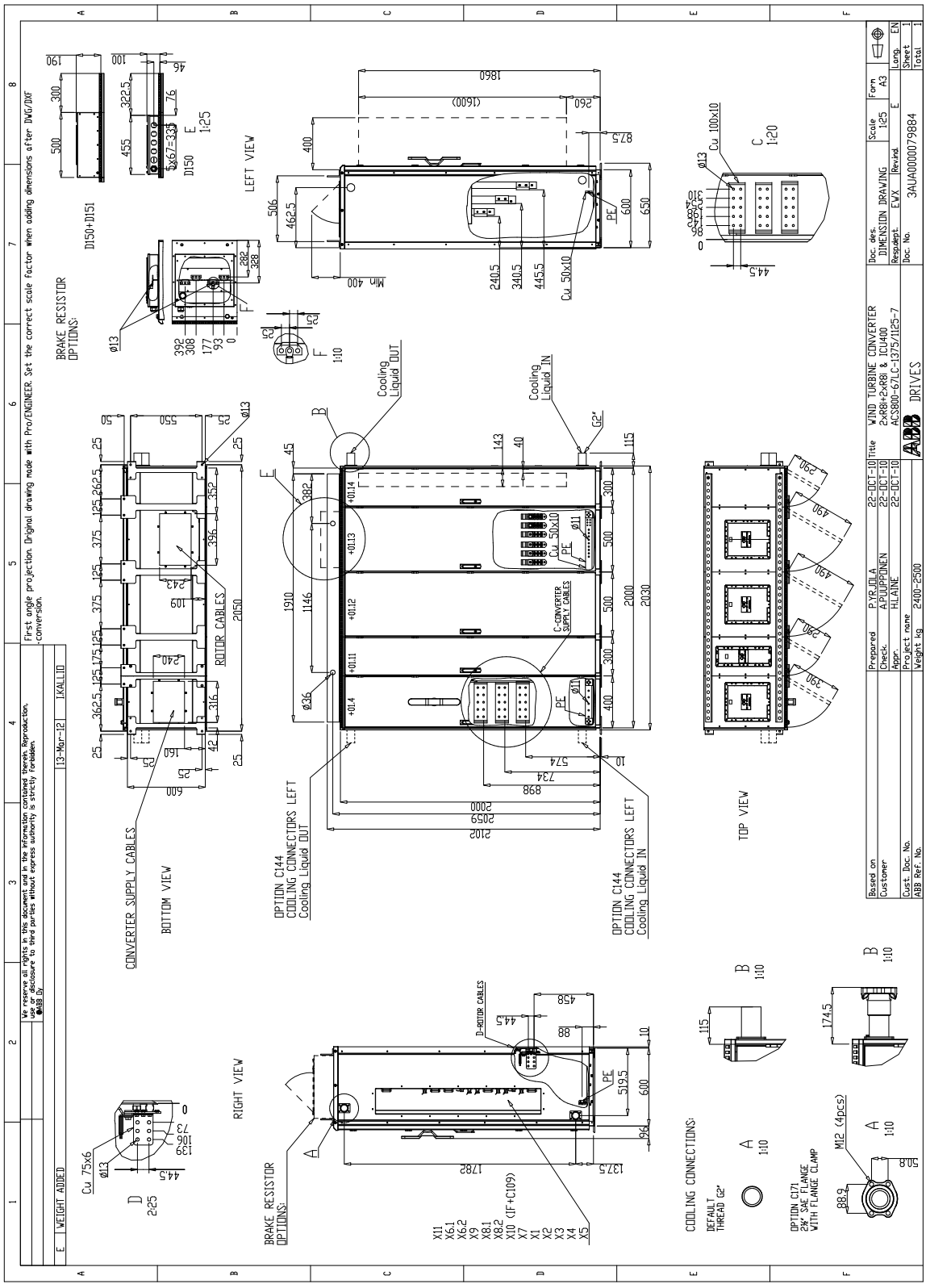
With 400 mm wide incoming cubicle (option +C111)



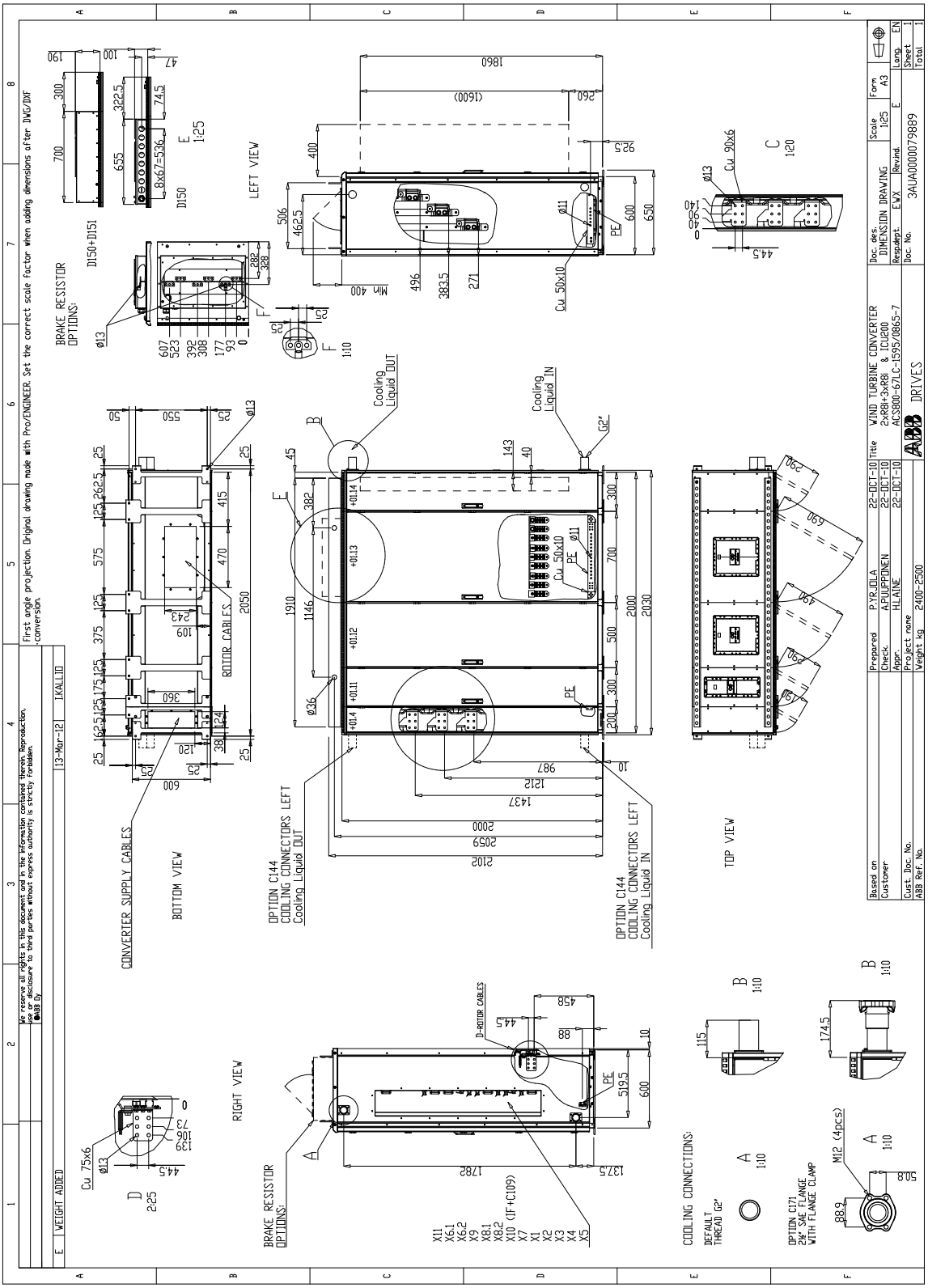
ACS800-67LC-1375/1125-7



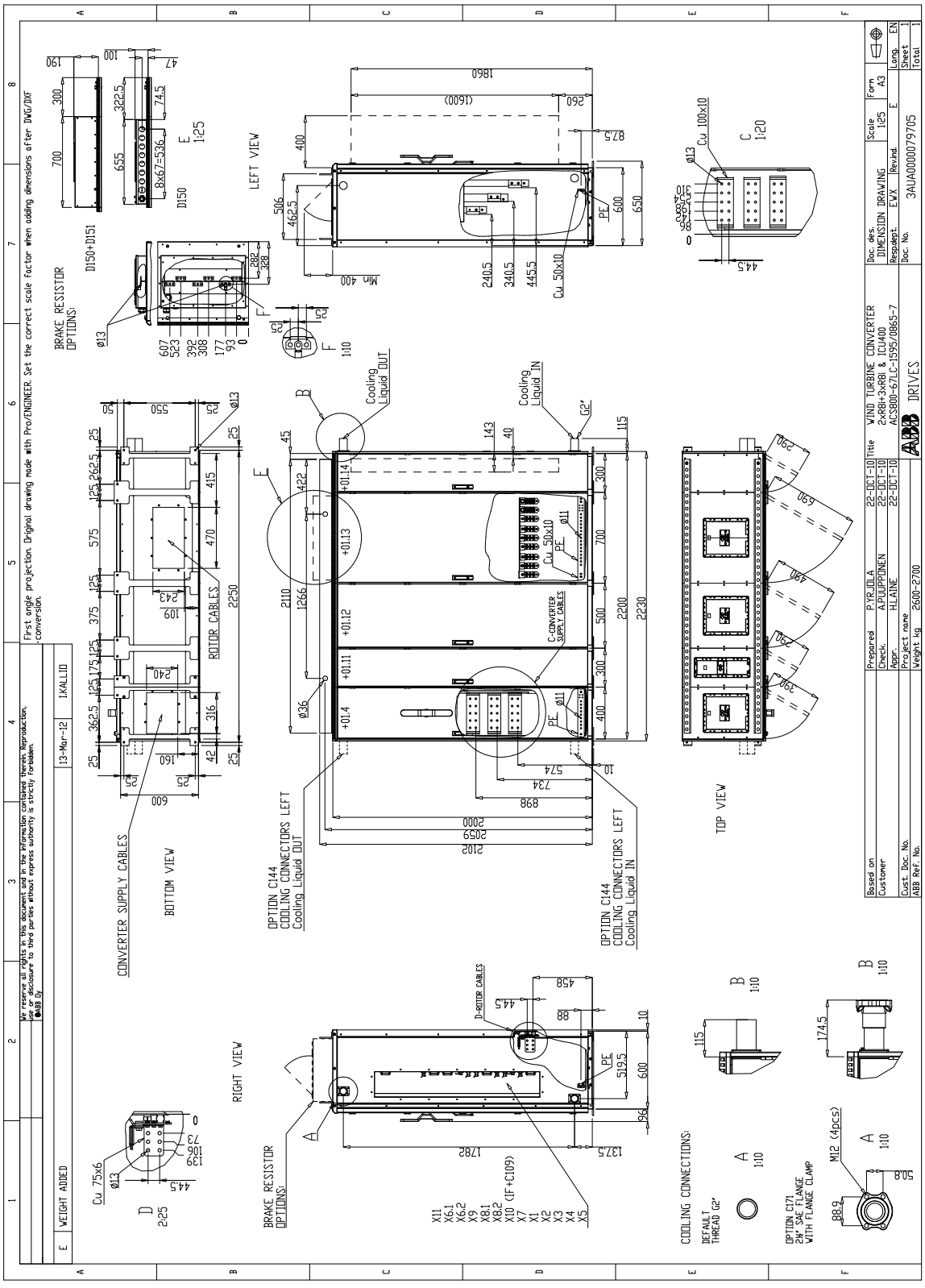
With 400 mm wide incoming cubicle (option +C111)



ACS800-67LC-1595/0865-7 and -2035/1125-7



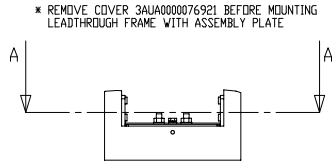
With 400 mm wide incoming cubicle (option +C111)

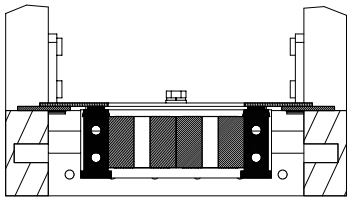


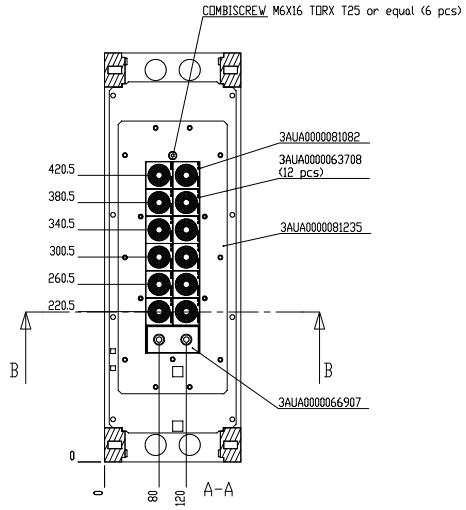
Sealing modules for grid cables

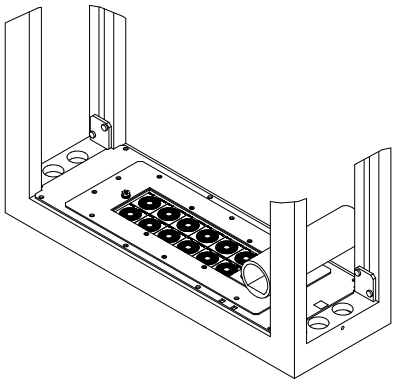
Dimensions and illustrations for optional sealing modules in incoming cubicles (widths 200 mm and 400 mm (option +C111)) are presented below.

Option +1H370

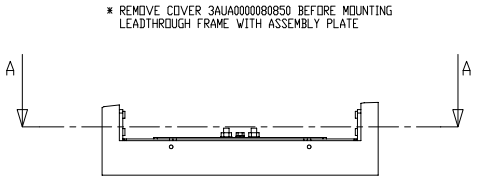


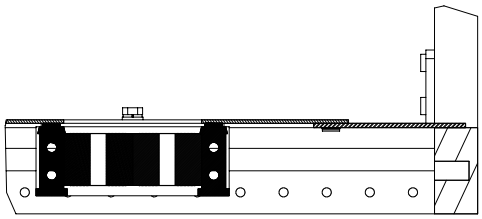


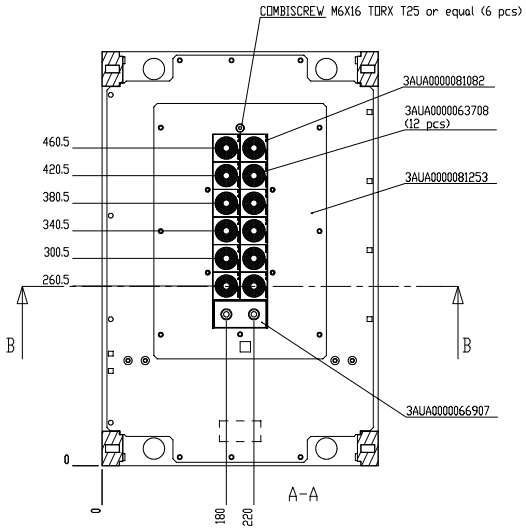


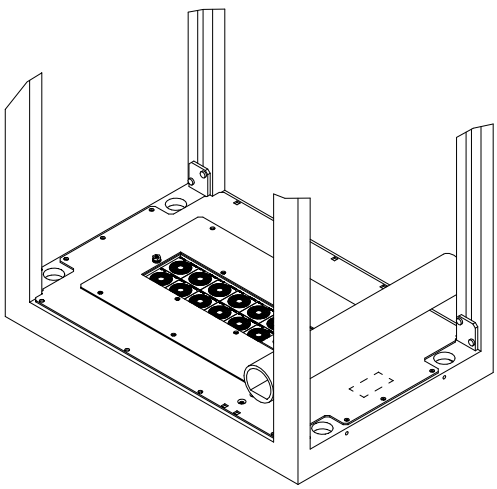


Options +1H370 and +C111

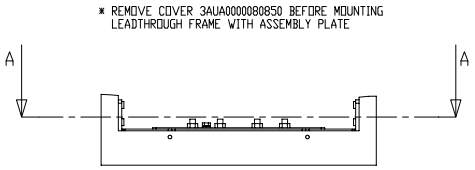


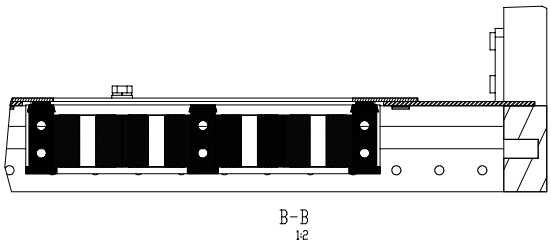


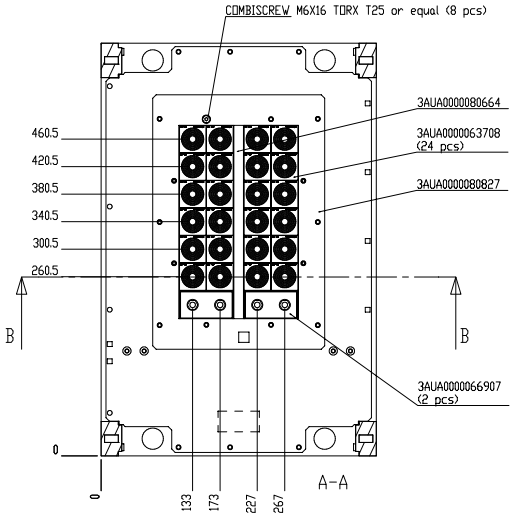


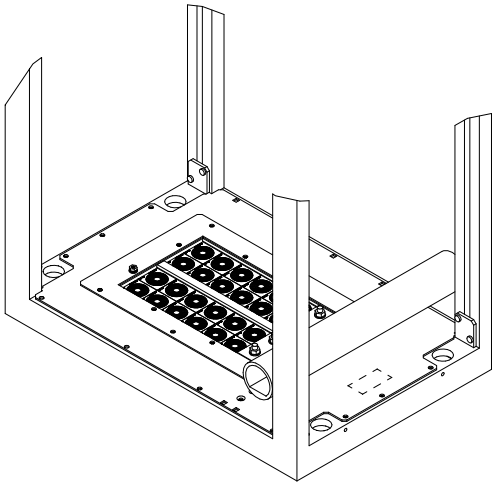


Options +2H370 and +C111

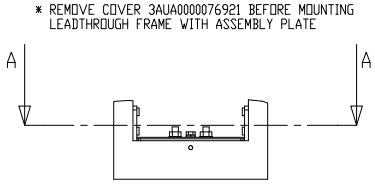


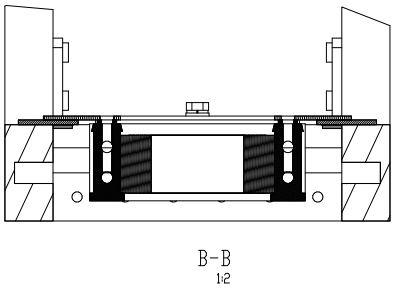


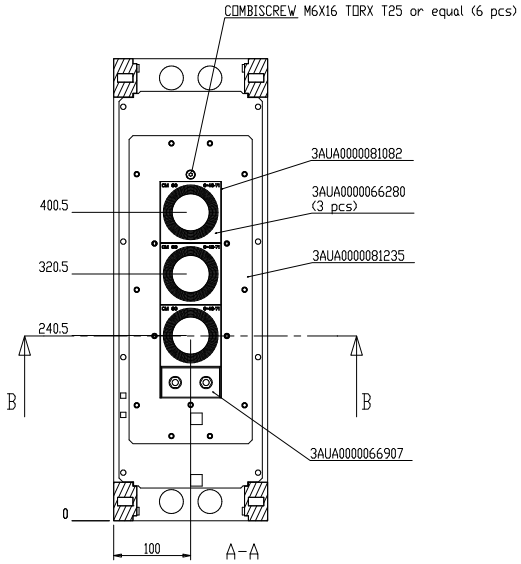


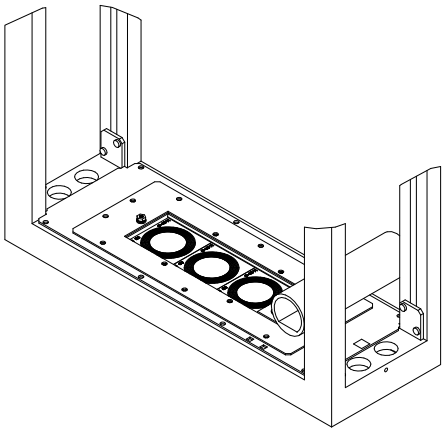


Option +1H371

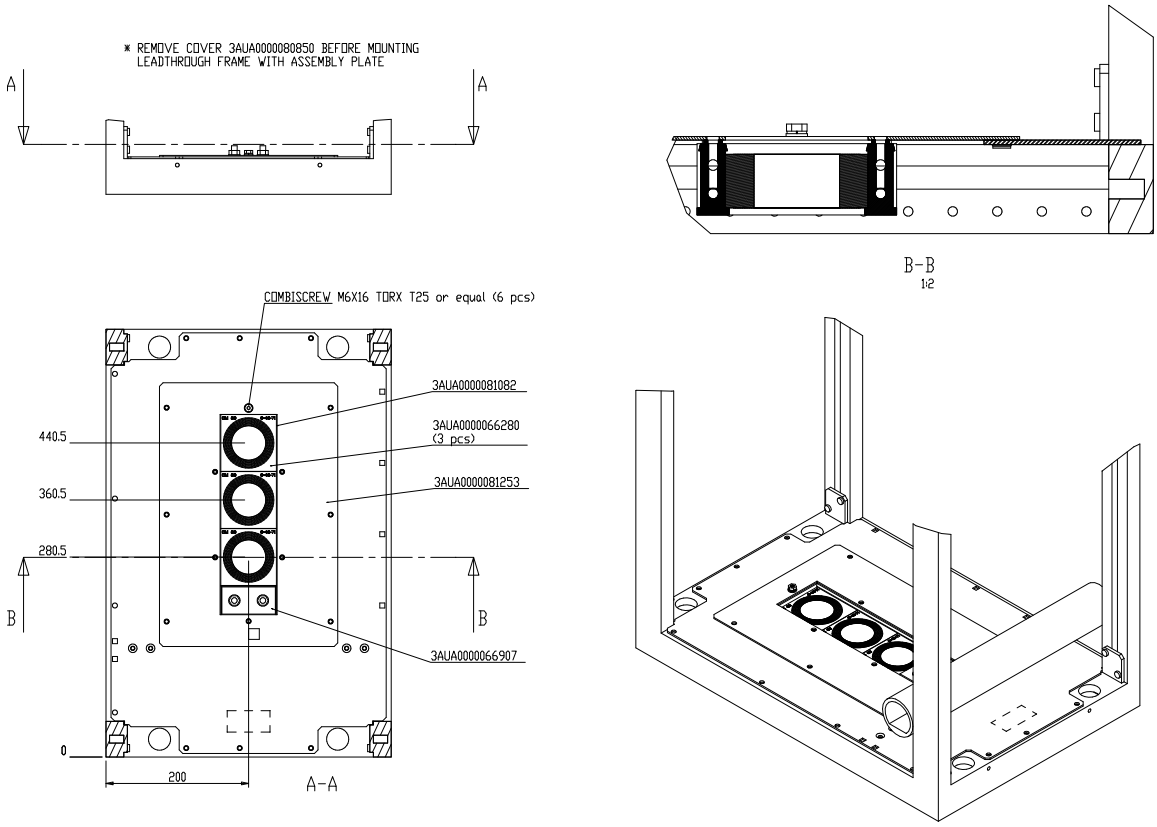




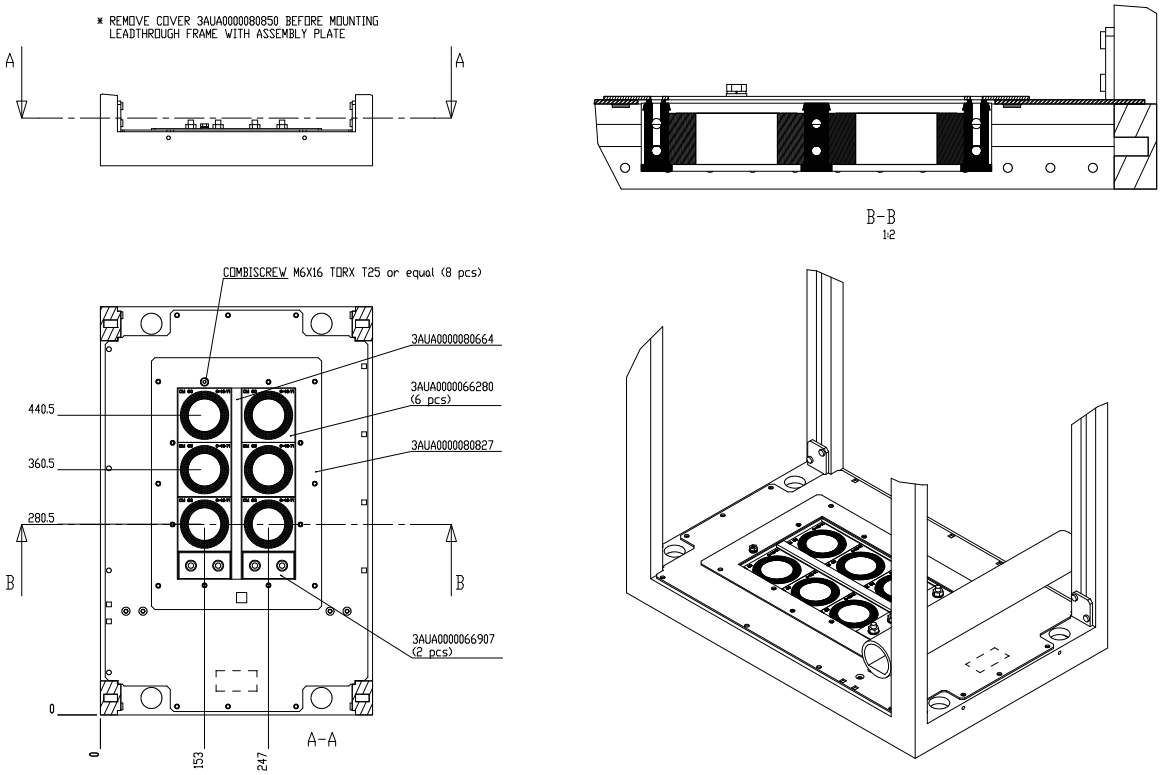




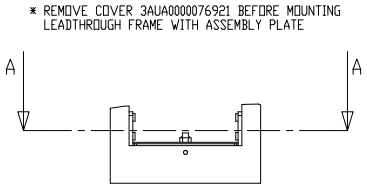
Options +1H371 and +C111

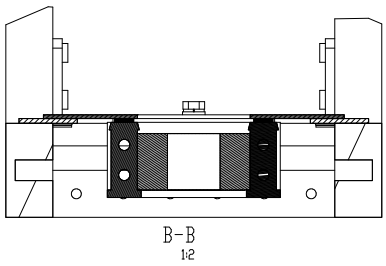


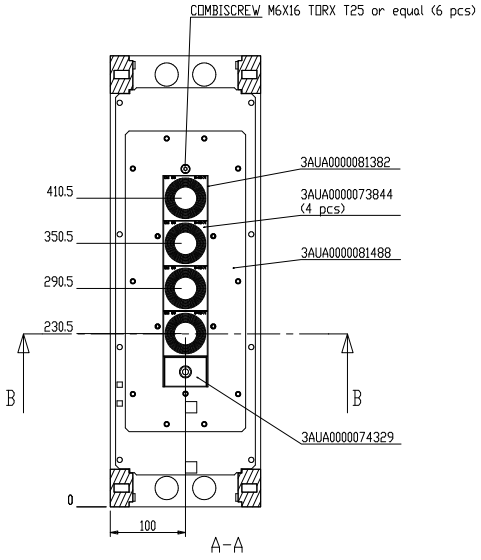
Options +2H371 and +C111

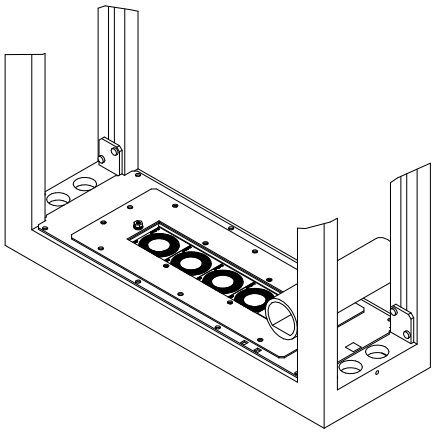


Option +H378

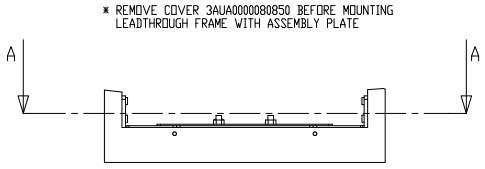


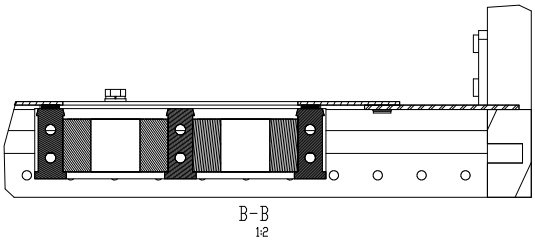


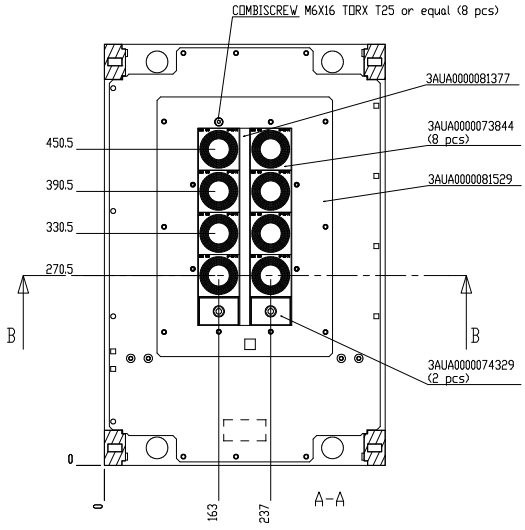


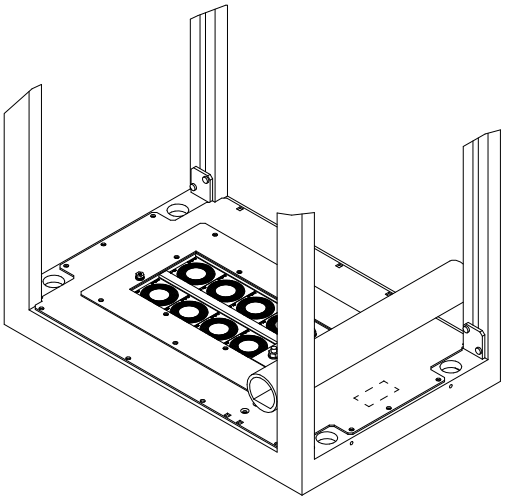


Options +H378 and +C111





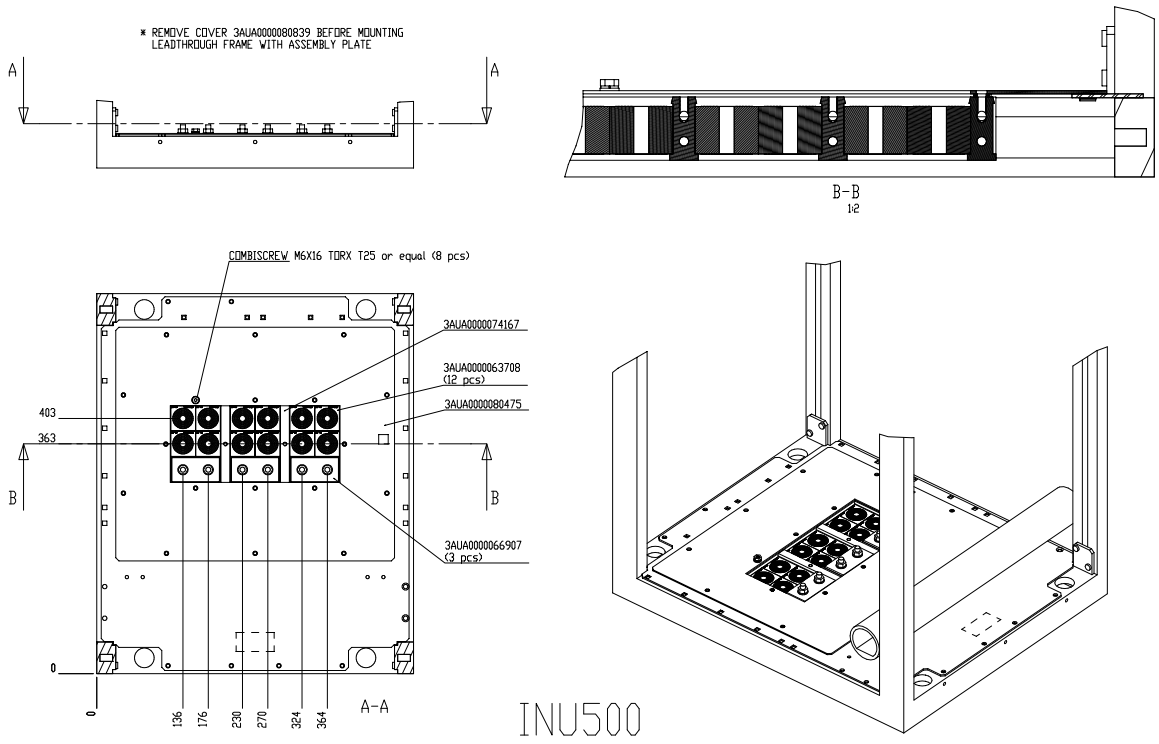


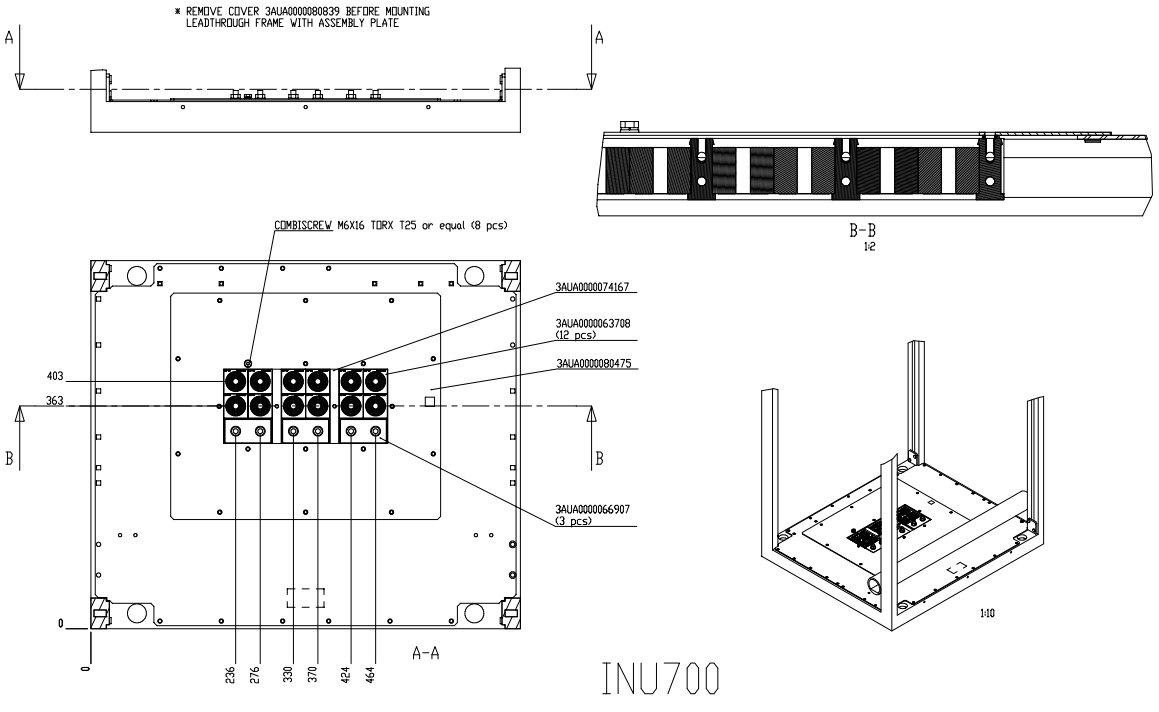


Sealing modules for rotor cables

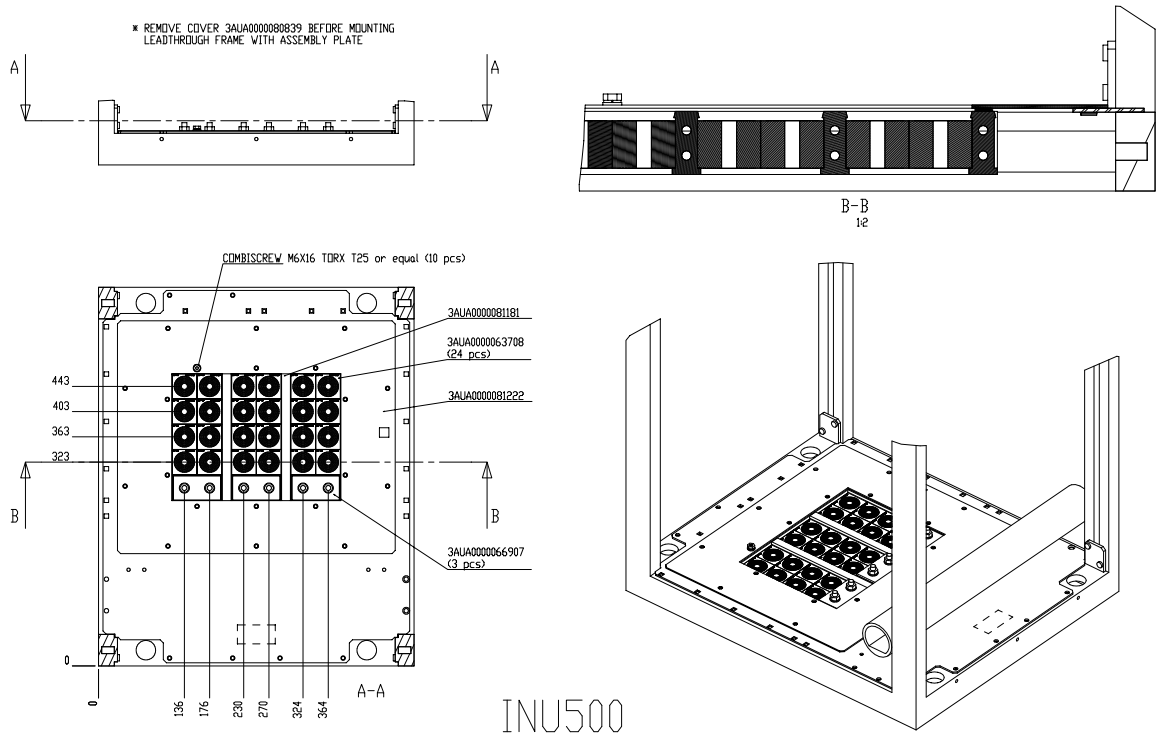
Dimensions and illustrations for optional sealing modules in inverter module cubicles (widths 500 mm and 700 mm) are presented below.

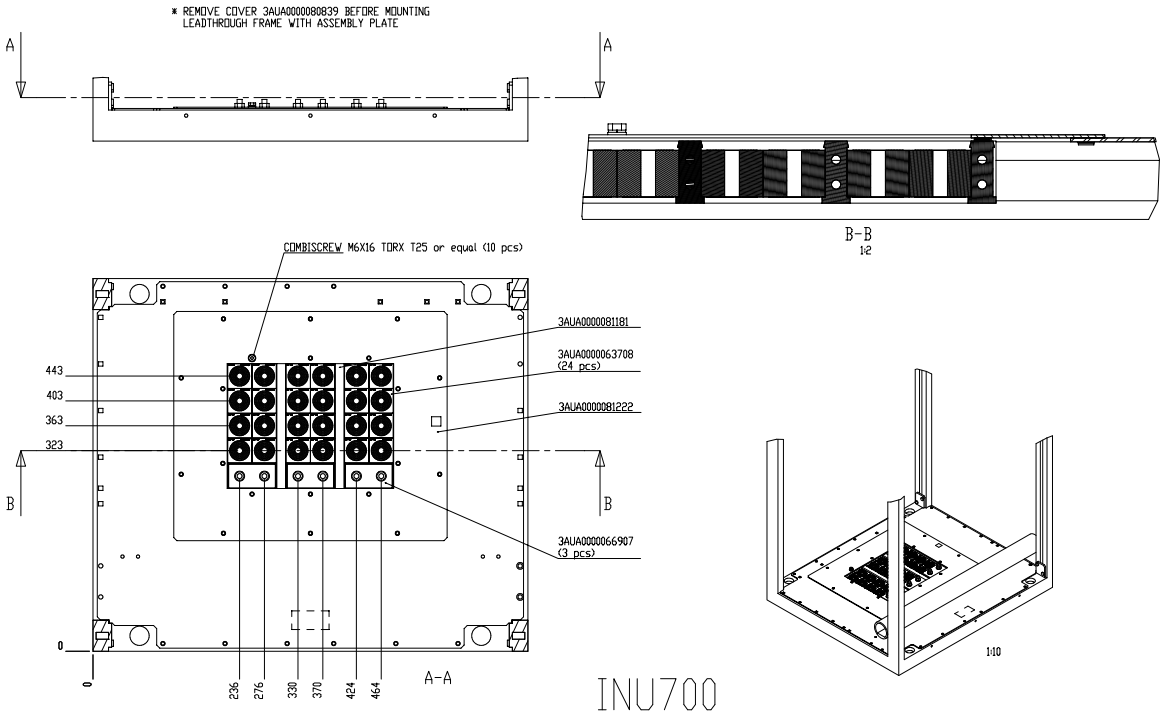
Option +1H372



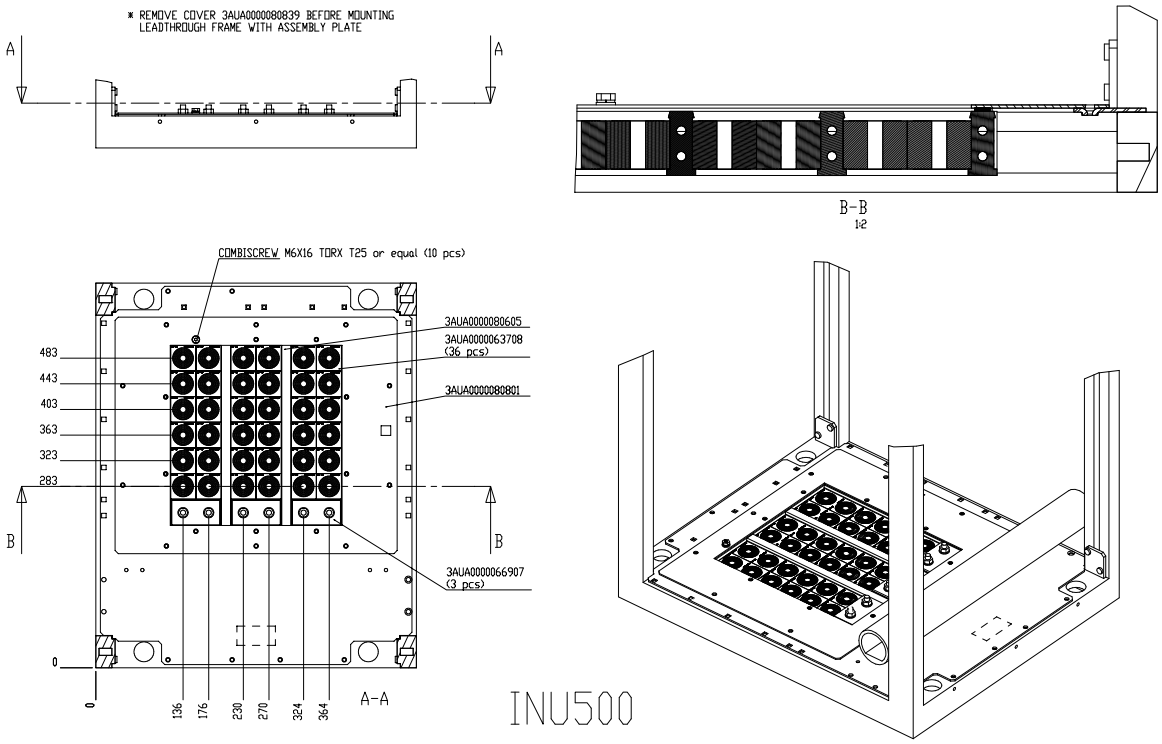


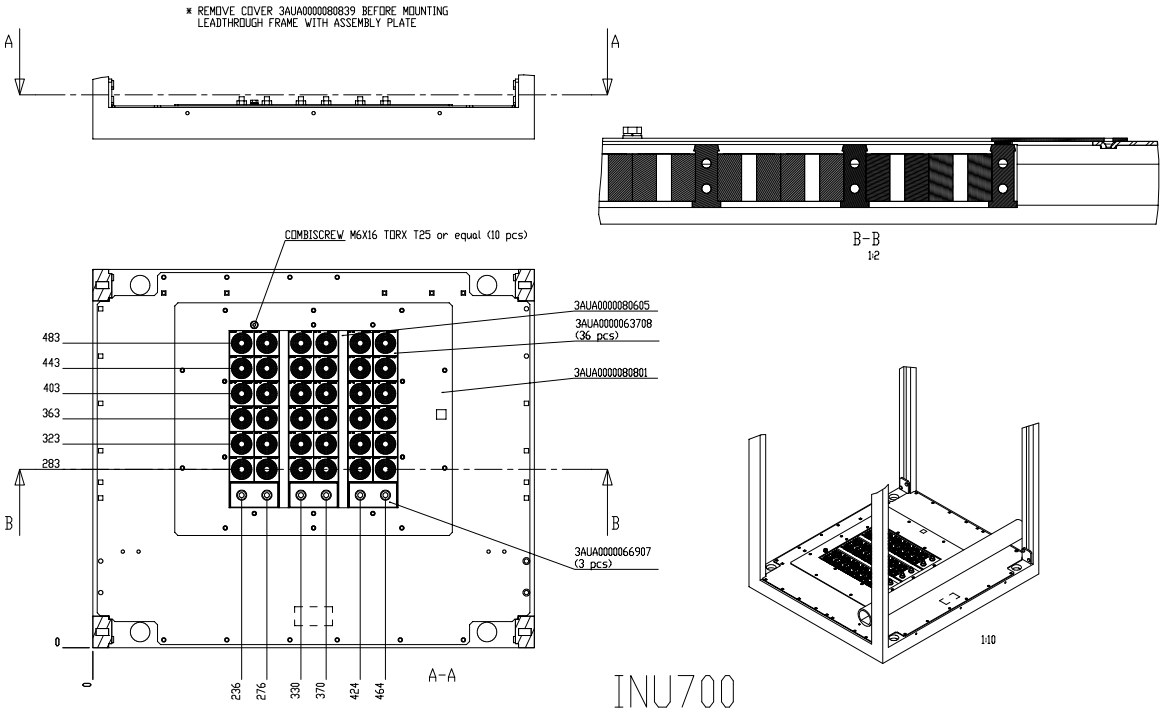
Option +2H372



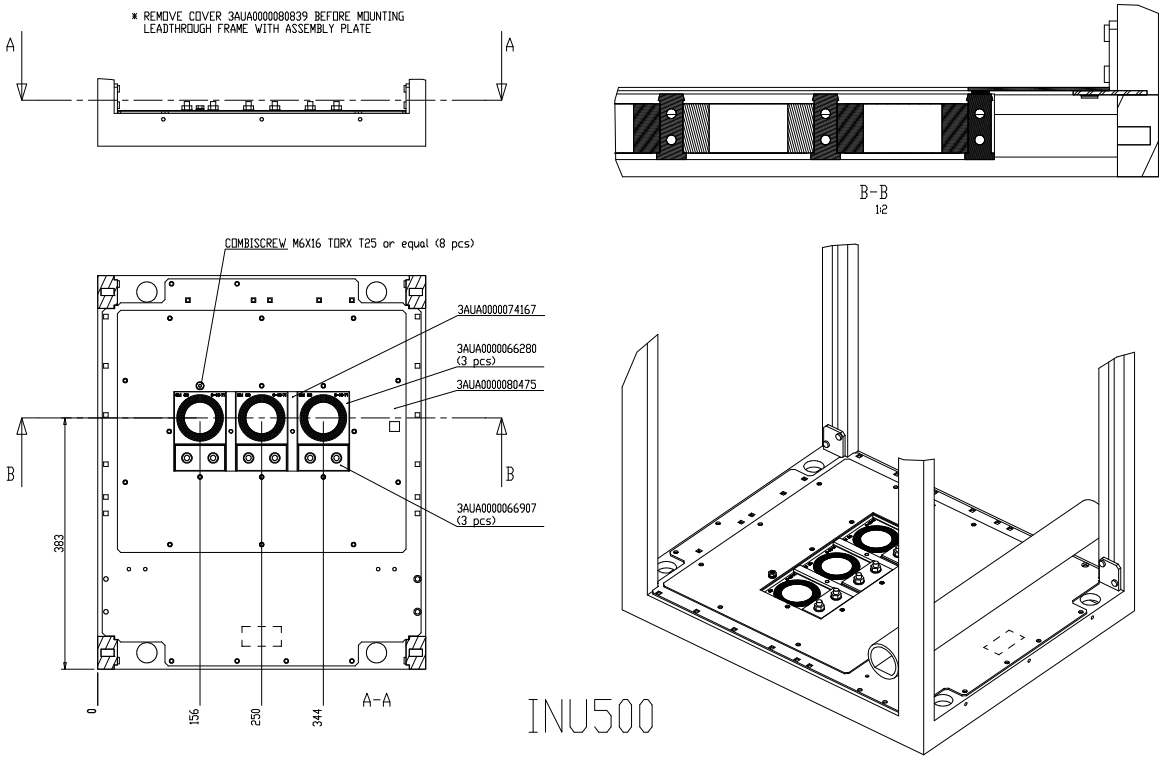


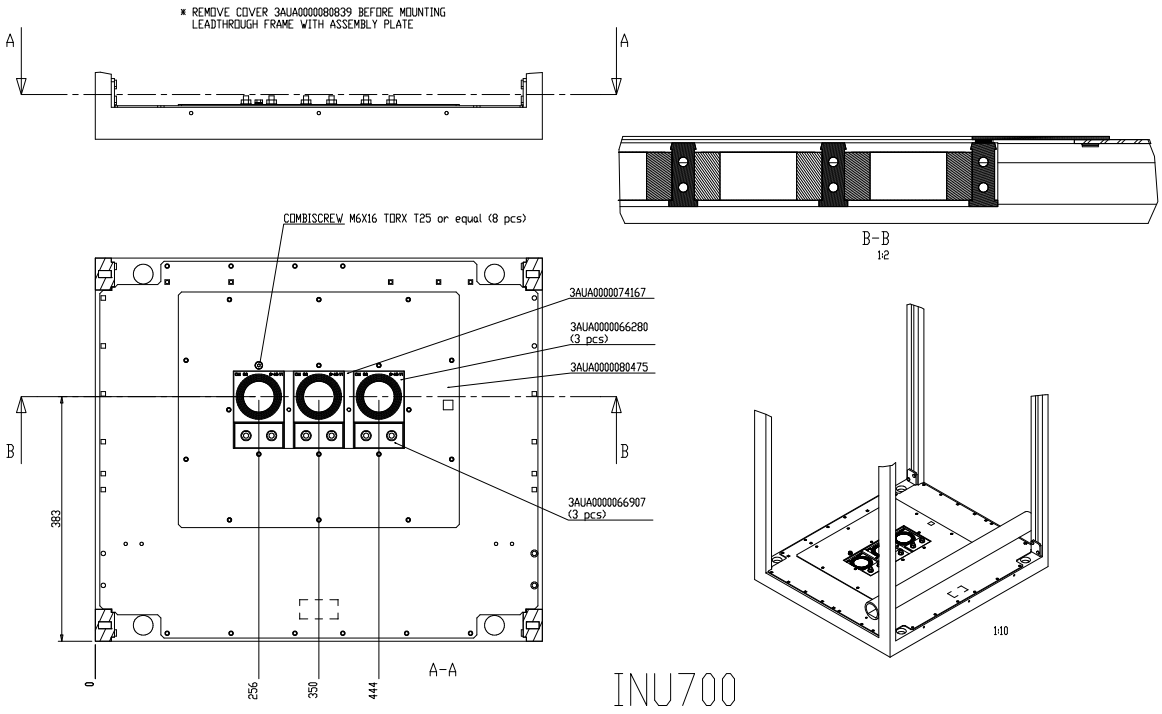
Option +3H372



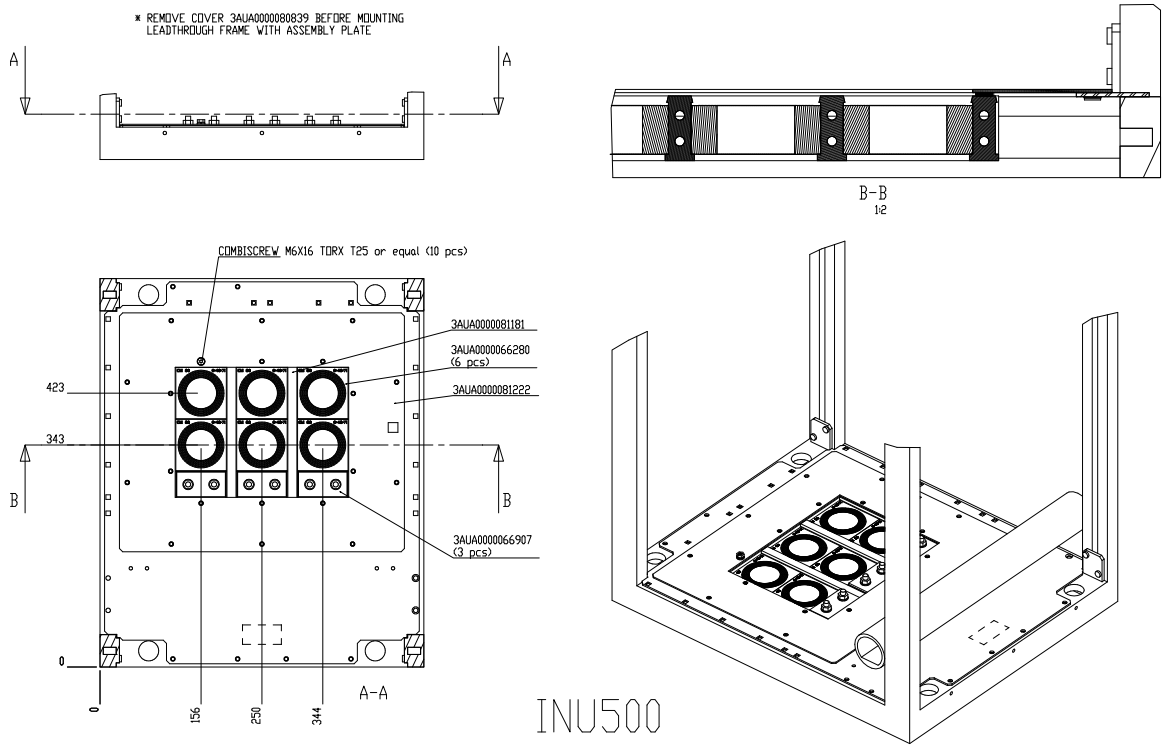


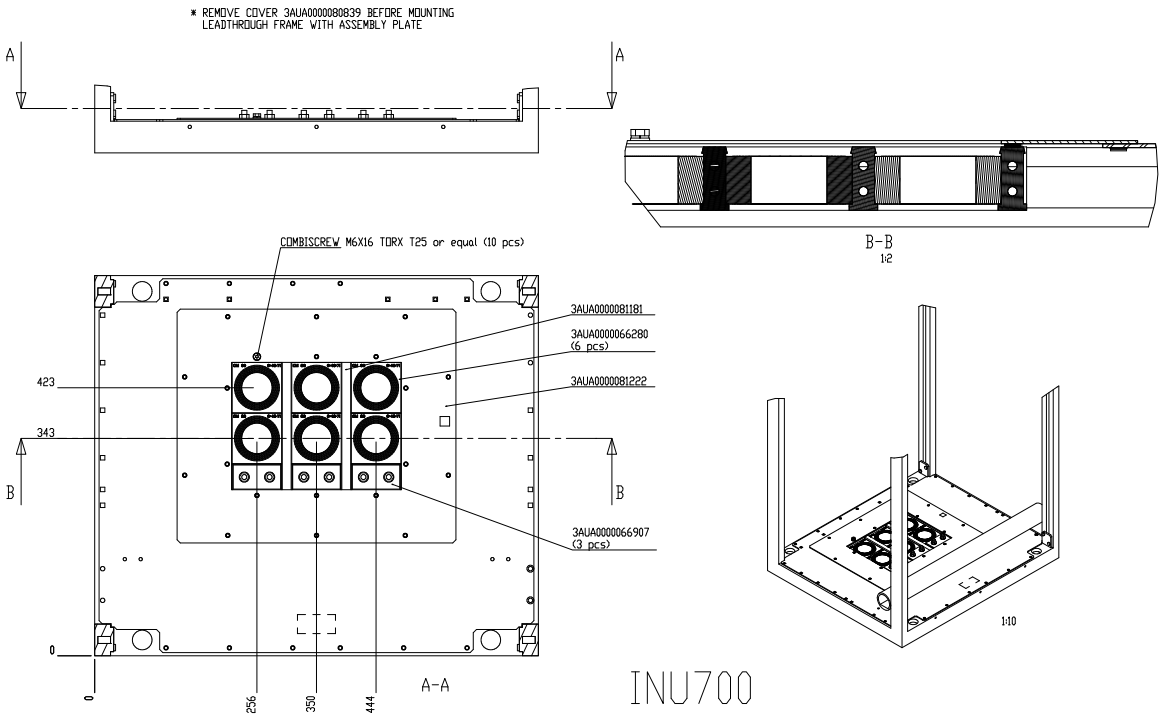
Option +1H373



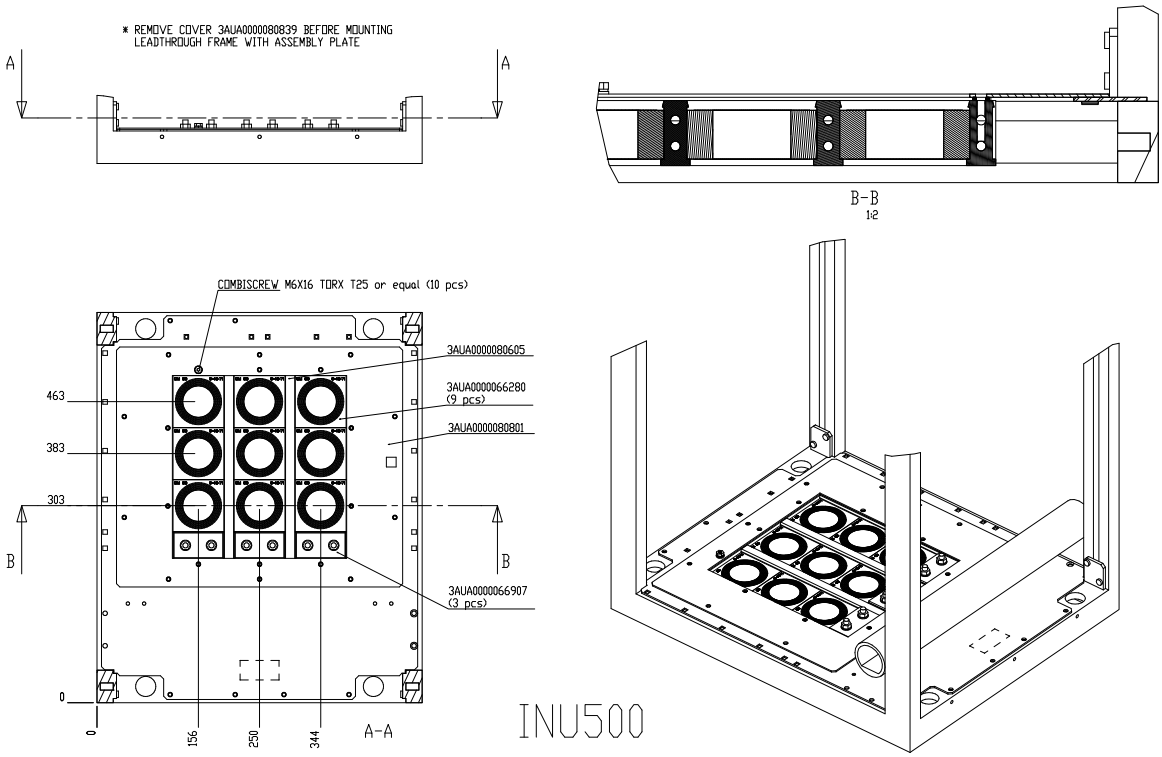


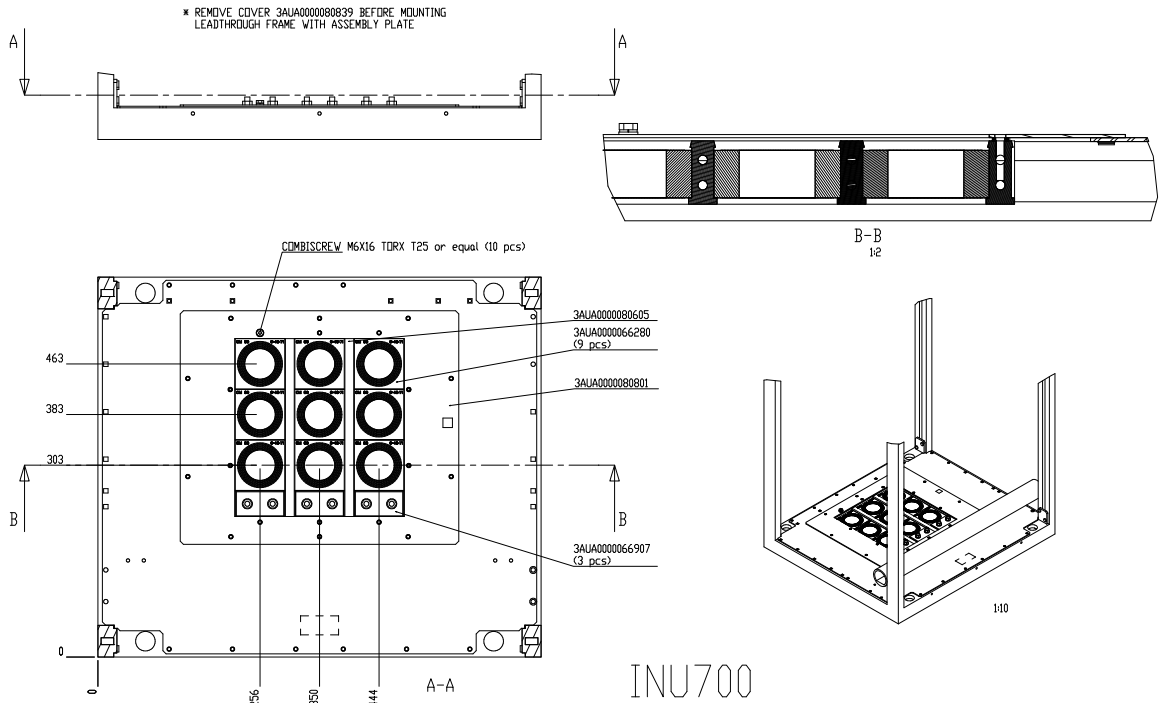
Option +2H373



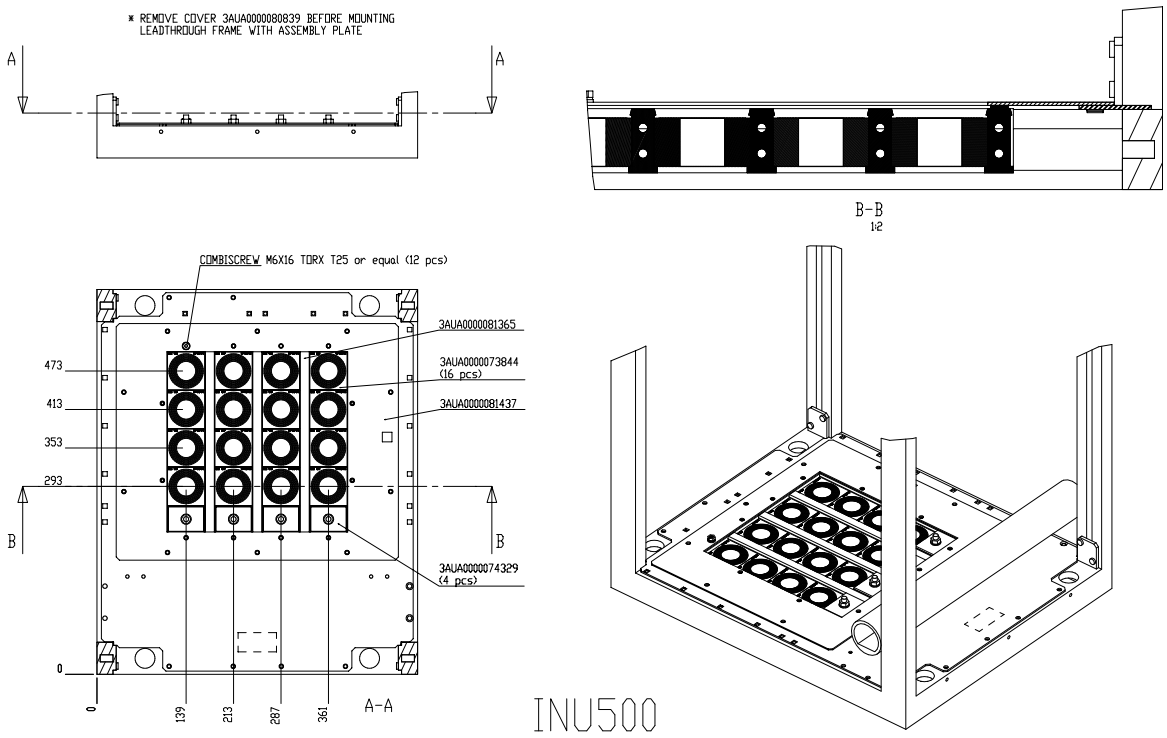


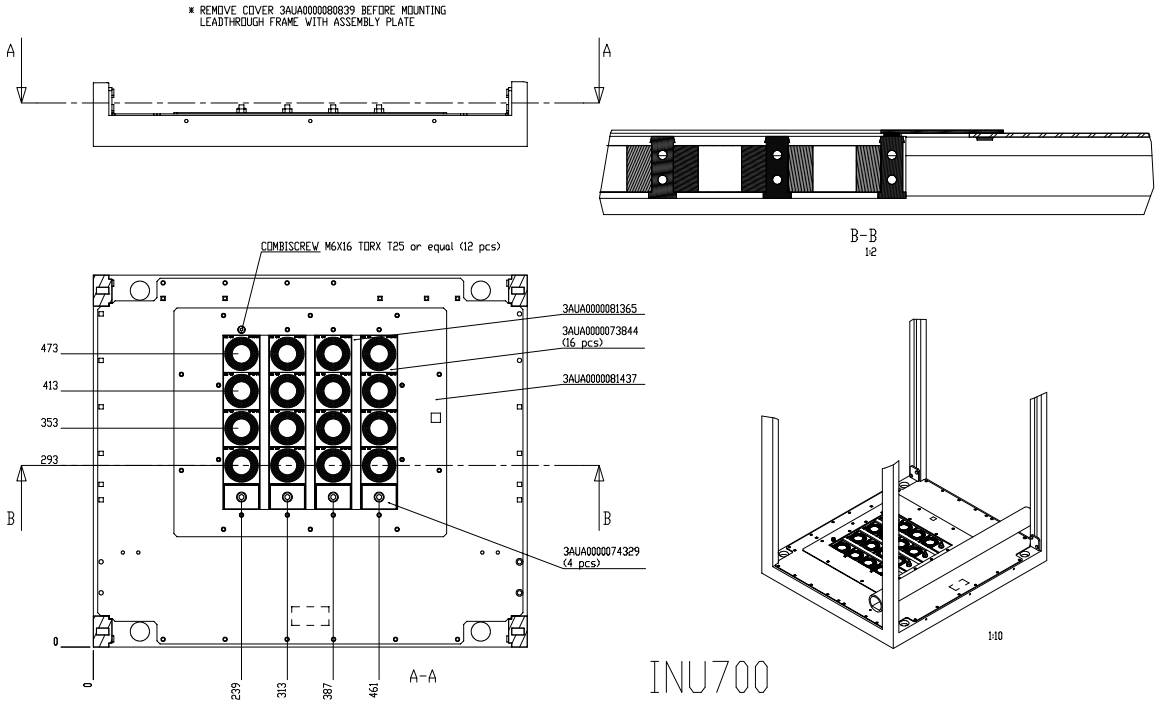
Option +3H373





Option +H375


* REMOVE COVER 3AUA0000080839 BEFORE MOUNTING
LEADTHROUGH FRAME WITH ASSEMBLY PLATE
A
A
B-B
1:2
COMBISCREW M6X16 TORX T25 or equal (12 pcs)
3AUA0000081365
3AUA0000073844
(16 pcs)
3AUA0000081437
3AUA0000074329
(4 pcs)
473
413
353
293
B
B
0
0
139
213
287
361
A-A
INU500


* REMOVE COVER 3AUA0000080839 BEFORE MOUNTING
LEADTHROUGH FRAME WITH ASSEMBLY PLATE
A
A
B-B
1:2
COMBISCREW M6X16 TORX T25 or equal (12 pcs)
3AUA0000081365
3AUA0000073844
(16 pcs)
3AUA0000081437
3AUA0000074329
(4 pcs)
473
413
353
293
B
B
0
0
239
313
387
461
A-A
1:10
INU700

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 abb.com/searchchannels.

Product training

For information on ABB product training, navigate to new.abb.com/service/training.

Providing feedback on ABB Drives manuals

Your comments on our manuals are welcome. Navigate to new.abb.com/drives/manuals-feedback-form.

abb.com/windconverters

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