

SYSTEM DRIVES

ACS5000 water-cooled (generation 3)

User manual



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1. About this manual

1.1. Equipment covered by this manual

This manual covers standard drive and provides generic information on the drive. The manual does not claim to cover all variations and details of the drive, nor to consider all eventualities that may arise during installation, commissioning, operation and maintenance of the drive.

If the drive is adapted to specific customer needs or applications, and handling, installation, and operation of the drive are affected by these modifications, information on these modifications is provided in the appropriate documentation (such as layout drawings, wiring diagrams, project-specific data, engineering notes).

If information is required beyond the instructions in this manual, refer the matter to ABB.

1.2. Structure of the user documentation

The documentation for a standard drive consists of this document and the following project-specific appendices.

NOTE – These appendices are NOT included in this document.

- **Appendix A – Additional manuals** provides manuals about additional equipment delivered with the drive (such as project-specific options like pulse encoder or fieldbus interfaces), or information on modifications of the standard drive.
- **Appendix B – Technical data** contains the technical data sheets of the drive.
- **Appendix C – Mechanical drawings** provides the outline drawings of the drive. The drawings are generated according to the customer-specific project.
- **Appendix D – Wiring diagrams** contains the circuit diagrams with information on device identification, cross-reference and device identification conventions. The diagrams are generated according to the customer-specific project. “Setting of protective devices” is generated according to the customer-specific project.
- **Appendix E – Parts list** produced for each project and contains all information to identify a component.
- **Appendix F – Test reports and certificates** provides the test reports of the drive. Quality certificates, and codes and standards the drive complies with are added if necessary for the project.
- **Appendix G – Signal and parameter table** includes descriptions of actual signals, control and status words, and control parameters and their default settings.

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1.3. Related documents

The following ABB documents are available for supplementary information:

1.3.1. Maintenance

Title	Document ID.
ACS5000 preventive maintenance schedule	3BHS855274 E01

1.3.2. Technical data

Title	Document ID.
Technical data from DriveSmart Configuration software for medium voltage drives	

1.3.3. Schematics

Title	Document ID.
Layout drawing	Project-specific

1.3.4. Specifications and guidelines

Title	Document ID.
Generic transformer specification	3BHS356582 E01
Generic motor specification	3BHS824803 E01
Main circuit breaker engineering guideline	3BHS125149 E50
Power cable specification	3BHS215798 E01
Power cables engineering guideline	3BHS542290 E01
Auxiliary power and control cables guideline	3BHS813742 E01
Field wiring terminals	3BHS500316 E01

1.3.5. Manuals

Title	Document ID.
ACS5000, ACS6000 and ACS6080 water cooling unit WCU800 user manual	3BHS821937 E01
ACS5000, ACS6000 and ACS6080 water cooling unit WCU1400 user manual	3BHS835714 E01
ACS5000W Gen3 generic spare parts package	3BHS909701 E01

1.3.6. Service

Title	Document ID.
Service equipment	3BHS264270 E20

1.3.7. I/O interface

Title	Document ID.
UCU-26 control unit hardware manual	3BHS897436 E01

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1.3.8. Communication interfaces

Title	Document ID.
Absolute encoder interface FEN-11 user manual	3AFE68784841
ACX-AP-x Assistant control panels user's manual	3AUA0000085685
EGW-02 Connectivity Edge Gateway user's manual	3AXD50000929719
HTL Encoder interface FEN-31 user manual	3AUA0000031044
PLC Automation: PLCs, control panels, Engineering Suite AC500, CP600, Automation Builder	3ADR020077C0204
System assembly and device specifications for AC500 V2 Products	3ADR010121

1.4. Terms and definitions

The following table lists terms and abbreviations you should be familiar with when using this user manual. Some of the terms and abbreviations used in this user manual are unique to ABB and might differ from the normal usage.

Term	Definition
ACP	Assistant control panel (see Control panel)
Control panel	Serves as the basic user interface for operating and monitoring the drive when the local operating mode has been selected, also known as assistant control panel.
Converter	Short form for ACS5000 frequency converter
COU	The control unit (COU) consists of a control section, a customer interface section, and a terminal section. The control section incorporates the hardware for control, monitoring, and protection functions of the drive and the communication interface to the door-mounted control panel, including S500 I/O modules. The COU compartment also incorporates the grounding frame for cable screens and the ground cable, the grounding accessories and the motor terminal section.
CVMI	Current voltage measurement interface
DDCS	Distributed drive control system. DDCS is an acronym for a serial communications protocol designed for data transfer via optical fibers.
Drive	Synonym for ACS5000 frequency converter
Drive Composer	Windows application for commissioning and maintaining ABB drives.
EAF	Earth fault monitoring
EMC	Electromagnetic compatibility
EOI	Electrical-optical interface
Equipment	Frequency converter and related equipment
EXU	The excitation unit (EXU) is part of the drive when a synchronous motor has to be supplied with excitation power.
FS	Frame sizes 1 to 4 give the different power ranges. The higher the frame size, the greater the output power capability.
Gateway to ABB Ability™	Monitoring and diagnostics tool that allows access to the drive from any location in the world via a secure Internet connection.
Ground	Earth
To ground	To connect the electrical equipment to the earth, eg, by a grounding set or a grounding switch.
HVD	High voltage divider
I/O	Input/Output
I/O device	Term of ABB's S500 I/O process system. An I/O device consists of a module termination unit (MTU) and one I/O module.

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Term	Definition
I/O module	Term of ABB's S500 I/O process system. The I/O module is an active input or output device for digital or analog signals.
IGCT	Integrated gate-commutated thyristor
INT	Interface circuit board
IPS	Insulated power supply
LED	Light emitting diode
LSU	Line supply unit (rectifier phase module)
MCB	The main circuit breaker (MCB) is a major protection device of the drive system and connects and / or disconnects the main power supply to the drive.
Motor terminal section	This is the customer terminal for connecting motor cables. It is located behind the swing frame of the COU compartment.
NP	Neutral point
OEI	Optical-electrical interrupter
PCB	Printed circuit board
PCU	A primary phase converter unit (PCU) consists of a transformer terminal section, a rectifier stack, a DC-link and an inverter stack. A secondary phase converter unit consists of a DC-link and an inverter stack.
PE	Protective earth - ground busbar for ground cable and cable shield connections.
Phase module	The phase module is a compact assembly of wired components including power semiconductors and circuit boards that serves as a standardized building block for the inverter and rectifier stack.
PICW	Person in charge of work
PINT	Pulse interface
PPE	Personal protective equipment
PTW	Permit to work
SW	Software
S500 I/O	The S500 I/O is a distributed process input output system that can be connected to various process controllers from ABB and other companies.
Transformer terminal section	This is the customer terminal for connecting transformer cables. It is located in the back of the PCU compartment.
UCU-26	Control unit that controls converters via fiber optic links and electrical interfaces.
UNICOS	Operating system
UPS	Uninterruptible power supply
USB	Universal serial bus
VLSCD	Voltage limiting short circuit detection
WCU	The water cooling unit (WCU) dissipates heat losses of the power electronics.

1.5. Target groups and required qualification

The drive presented in this manual is part of an industrial environment where voltages are present that contain a potential hazard of electric shock and / or burn. For this reason, only personnel who have a thorough knowledge of the drive and the industrial environment and have obtained the required qualification should handle, install, operate, or maintain the drive.

The manual addresses personnel who are responsible for unpacking, transportation, installation, operation and maintenance of the drive. The personnel must carry out the below listed tasks in a manner that does not cause physical harm or danger, and ensures the safe and reliable functioning of the drive.

IMPORTANT! Commissioning of the drive must only be performed by qualified and certified ABB personnel

1.5.1. Handling

Personnel must be skilled and experienced in unpacking and transporting heavy equipment.

1.5.2. Mechanical installation

The personnel must be qualified to prepare the installation site according to the site and equipment requirements and to perform the installation accordingly.

1.5.3. Electrical installation

Personnel must have a sound knowledge of the relevant electrical codes and specifications covering low and medium voltage equipment, be experienced with electrical wiring principles and know the electrical symbols typically used in wiring diagrams.

1.5.4. Operation

The personnel include all persons who operate the drive from the local operator panel of the drive. The personnel must know the functions of the operator panel, be adequately trained for the drive, and know the driven process. Special knowledge of frequency converter technology is not required.

1.5.5. Maintenance

The personnel include all persons who

- Are qualified to carry out preventive and corrective maintenance on drive as described in this manual
- Are thoroughly familiar with the drive
- Have a sound knowledge of the relevant electrical codes and specifications covering low and medium voltage equipment
- Are able to assess the hazards associated with the energy sources of the drive and act correspondingly
- Know the safe shutdown and grounding procedures for the drive system

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1.6. User's responsibilities

It is the responsibility of those in charge of the drive to ensure that each person involved in the installation, operation or maintenance of the drive has received the appropriate training and has thoroughly read and clearly understood the instructions in this manual and the relevant safety instructions.

1.7. Intended use of equipment

Those in charge of the drive must ensure that the drive is only used as specified in the contractual documents, operated under the conditions stipulated in the technical specifications and on the rating plate of the drive, and serviced in the intervals specified by ABB.

Use of the drive outside the scope of the specifications is not permitted.

Intended equipment use also implies that only spare parts recommended and approved by ABB must be used.

Unauthorized modifications and constructional changes of the drive are not permitted.

1.8. Quality certificates and applicable standards

The following certificates and conformity declarations are available with ABB:

- ISO 9001 and ISO 14001 certificates stating that ABB Switzerland Ltd has implemented and maintains a management system which fulfills the requirements of the normative standards
- EC declaration of conformity
- List of standards the drive complies with (see "Appendix F – Test reports and certificates provides the test reports of the drive. Quality certificates, and codes and standards the drive complies with are added if necessary for the project.")

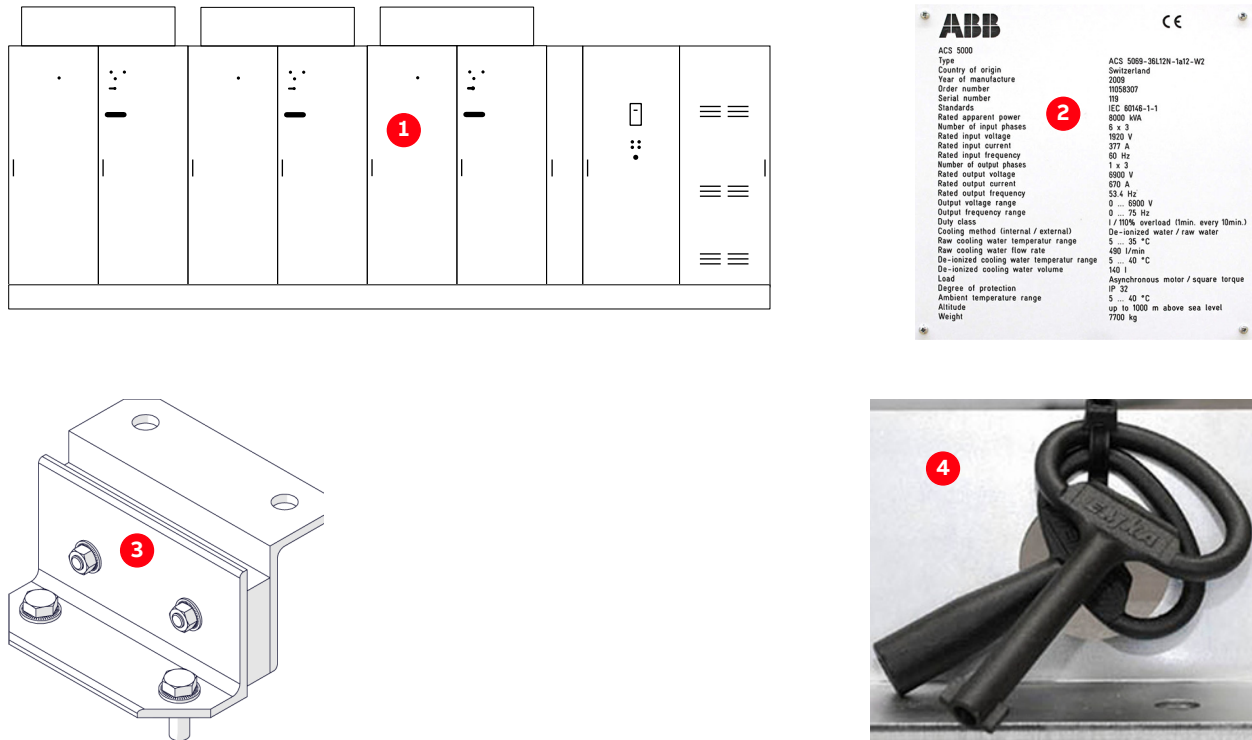
1.8.1. Standards

Standard	Title
ANSI Z535.6	American national standard for product safety information in product manuals, instructions, and other collateral materials
ISO 3864-2	2004 (E) - 'Graphical symbols – Safety colors and safety signs – Part 2: Design principles for product safety labels'
ISO 7010	2011 (E) - Graphical symbols - Safety colours and safety signs - Registered safety sign
EN 50110	European standard code for electrical work safety
ISO 13849-1	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design, section 6.2.6 Category 3
IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
IEC 60721-3-1	Classification of environmental conditions: Classification of groups of environmental parameters and their severities; Storage
IEC 60721-3-2	Classification of environmental conditions: Classification of groups of environmental parameters and their severities; Transportation
IEC 60721-3-3	Stationary use at weather-protected locations
IEC 61800-5-1	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
IEC 62477-2	Safety requirements for power electronic converter systems and equipment – Part 2: Power electronic converters from 1 000 V AC or 1 500 V DC up to 36 kV AC or 54 kV DC

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1.9. Items covered by delivery

The delivery includes the following items, whereas items 3 – 5 are shipped in a separate container.



Key	Explanation
1. Drive (frame size 1 shown)	Shipped in transport units – shipping splits are defined in the customer-specific layout drawing
2. Rating plate	On the first door from the left
3. Roof attachments	Only for marine drives
4. Door keys	

Figure 1 – Typical delivery

1.9.1. Identifying the delivery

The drive and accessories are identified by the type code printed on the rating label.

The rating label is located on the back of the control compartment door.

The label provides information on the type of drive, the rated voltage, the frequency and the current of the main and the auxiliary power supply.

1.10. Tools

ABB offers various tool sets containing all necessary tools and equipment for installation, commissioning and maintenance of the drive. The content of the tool sets is described in the manual Service equipment.

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1.11. Document conventions

The document uses the following font formats and symbols. See also [2.1 Safety messages and safety signs in this document on page 22](#).

1.11.1. Font formats

Convention	Description
✓	A condition that must be true, or an action you must do, before you start a task.
1.	A numbered list shows the order of steps in a task. Numbers also refer to items in a figure. For example: “Lift fan (1, Figure 2)” or “Remove cover (3, Figure 2) and...”.
→	A single action you must do, or a list of action you can do in any order.
↳	The result after you complete a step.
-	An item in a list.
□	An item in a checklist.
Monospace text	Software parameters, file names, or code text. For example: 16 .02 PARAMETER LOCK.
Bold text	A safety hazard, a value to enter, or the name of a button, or user interface element. For example, the Open command on a software menu.
Blue text	A link to another topic, figure, or table in this document. Blue text can also link to a web page or document on the Internet (for example, a PDF).

1.11.2. Symbols

Symbol	Description
	A callout identifies a specific item in a figure. It is close to the item or connected to it with a line. The legend below or beside the figure shows what each callout means.
	A pictogram shows the subject of the text.
	A safety symbol helps to explain a safety message. The symbol can also add to the message or replace part of all of it (see 2.1.2 Safety symbols on page 22).

2. Important safety information



Read this material carefully before working on or around the equipment. Failure to do so can result in serious Injury or DEATH! Keep for future reference.

2.1. Safety messages and safety signs in this document

This document uses [ANSI Z535.6](#) signal words, [ISO 7010](#) safety signs, and [ISO 3864-2](#) colors to highlight safety-related information.

2.1.1. Safety messages



This is the safety alert symbol. It is used to alert you to potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER

DANGER! indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

WARNING! indicates a hazardous situation which, if not avoided, could result in death or serious injury.









CAUTION

CAUTION! indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury, but which can result in equipment damage.

2.1.2. Safety symbols

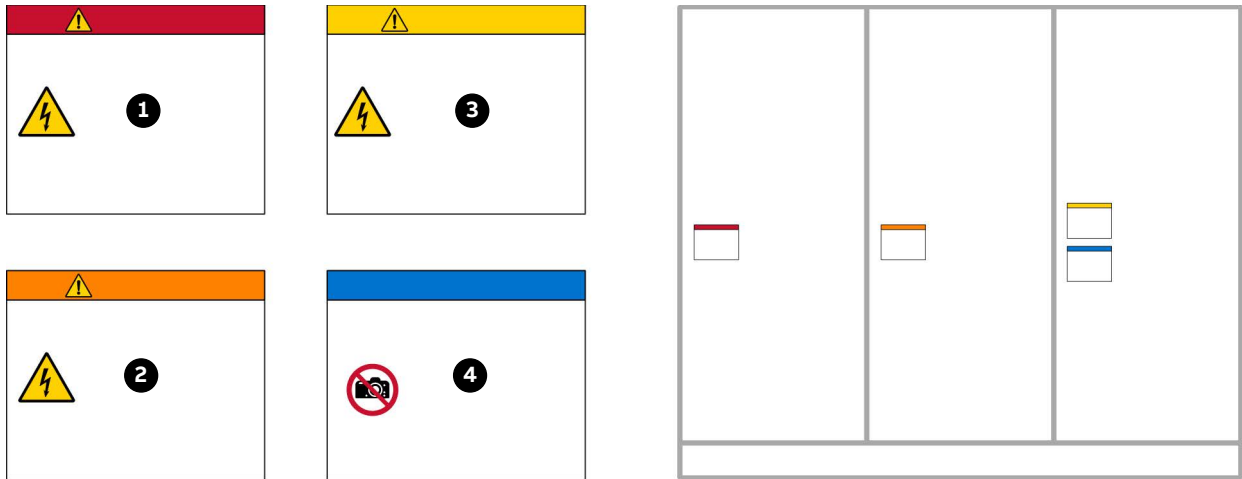
Sign	Description	Sign	Description
	Refer to the instruction manual.		Arc flash hazard
	Hazardous voltage warning		Automatic start-up
	Overhead load warning		Electrostatic discharge susceptible
	Tipping hazard		Emergency stop button

2.2. Product safety labels

Product safety labels on the equipment alert you to the hazards that can occur when you work on or operate the equipment.

- Always follow the instructions on the labels to avoid the hazard
- Keep the labels in a perfectly legible condition

For the location of the labels, see the label placement document for the drive.



Key

1. Danger label
2. Warning label
3. Caution label
4. Notice label

Figure 2 – Product warning label examples (label placement depends on the equipment)

2.3. Electrical safety

The following electrical safety instructions are based on [EN 50110](#).

2.3.1. General safety instructions

1. Minimize hazards

2. Before energizing the drive:

- Remove all foreign objects are from the drive
- Fasten all internal and external covers securely
- Close, lock, and/or bolt all doors
- Move the release dial of the door safety switches into the locked position

3. Before working on the drive:

- Turn off, lock out, and tag out the main and auxiliary power supplies to the drive
- De-energize the drive
- Ensure that the safety ground connections are in place
- Ensure that the appropriate personal protective equipment (PPE) is available and used when required
- Inform the involved personnel about the potential safety hazards
- Wear hearing protection when a drive is running.

4. Before working simultaneously on the drive and on other drive system equipment:

- Observe the relevant safety codes and standards
- Turn off all energy sources for the equipment
- Ensure that all lockout and tagout devices are in place
- Install barriers around and use appropriate covers on the equipment that is still energized
- Inform the involved personnel about the potential safety hazards

5. In case of fire in the drive room:

- Observe the established rules and regulations for fire safety
- Only allow firefighters with the appropriate PPE to enter the drive room

2.3.2. The 7 steps that save lives

ABB's 7 steps that save lives concept is a series of actions that must take place prior to commencing work on or near electrical installations.

1. Prepare for the work: do an on-site risk assessment or job hazard analysis that considers the limits of approach for shock and arc-flash.

- Be in possession of a clear work order to execute the work.
- When required, the access or work permit is to be obtained by a person who is authorized for the specific electrical system.
- Engage the person responsible for electrical equipment or system to review single-line diagrams, schematics, switching plans, etc.
- Ensure the competence of workers.
- Check for proper tools for the job.
- Determine and select the proper arc-rated Personal Protective Equipment (PPE).
- Decide of the appropriate work methods and initiate the Permit To Work (PTW) process.

2. Clearly identify the work location and equipment.

- Use your senses (sight, hearing and smell) to identify problem areas.
- Define the work area via barriers and barricading and label equipment.
- Avoid distractions such as talking or texting on the phone.

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3. Disconnect all sources of supply and secure against reconnection by applying Lockout/Tagout.

- If ABB is responsible for switching and it cannot be done remotely, then the person performing the switching must be properly trained and wearing the proper PPE identified in step 1.
- The Person in Charge of Work (PICW) must ensure that switching is performed in the proper manner by witnessing it from a safe distance if present on site or by engaging the person responsible for switching to identify all isolation points.
- Apply Lockout/Tagout (LOTO) to the energy isolation device and if multiple energy isolation devices are involved, then Group LOTO must be implemented with the PICW serving as the Group LOTO Leader.

4. Verify the absence of operating voltage: always test before you touch!

Only use properly rated and inspected voltage detection devices and wear proper PPE identified in step 1:

- Test voltage detection device
- Test for voltage
- Test voltage detection device

It is highly important that the voltage detection device is tested on a known voltage source such as a Proving Unit or by performing an internal self-test, according to the manufacturer's instructions, before and after testing for the absence of operating voltage.

5. Carry out earthing and short-circuiting.

- Close and lock the earthing switch if the electrical equipment is designed for this purpose or apply portable equipment for earthing and short-circuiting.

If this is carried out by the customer, then the PICW must ensure that this equipment is properly earthed as a part of the integration/verification and during step 7 when the PICW walks the PTW.

6. Protect against adjacent live parts and take special precautions when close to bare conductors.

- Determine minimum approach distances, apply screening or shrouding, and when applicable, padlock both cable and busbar shutters.
- If working within the restricted approach boundary or vicinity zone where inadvertent movement could cause contact with live parts, special precautions must be employed, such as the use of the properly rated insulated gloves and tools.

7. Complete the permit to work and "Walk the Permit".

- Check isolation points
- Verify that all circuits are isolated and secured
- Ensure all parties are integrated with the Lockout/Tagout
- Check the earths are properly applied
- Answer specific questions from the working group
- Ensure the work can proceed without danger
- Complete and verify the "Permit to Work"

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Approved	Public	3BHS904690 E01	E	en	25/159

2.3.3. Possible residual risks

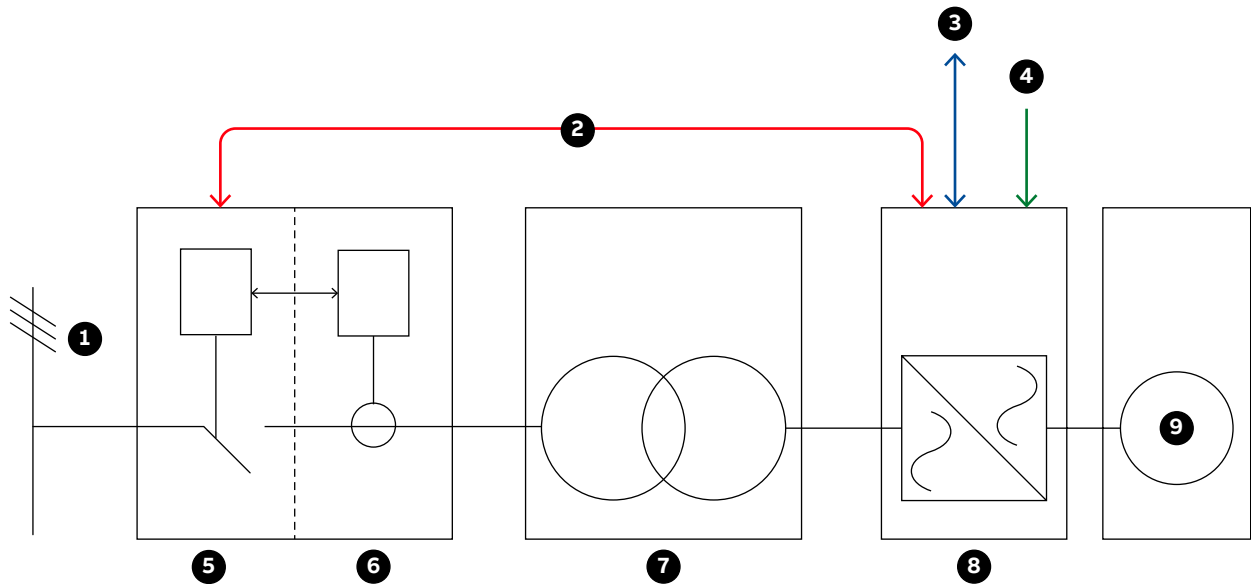
Residual risks must be considered by the drive system integrator and/or plant owner when assessing the hazards of the equipment to personnel. The following risks can pose a hazard to drive system personnel:

1. **Electric power equipment generates electro-magnetic fields which can cause a hazard to people with metal implants and / or a pacemaker.**
2. **Drive system components can move unintentionally when being commissioned, operated, or serviced due to:**
 - Operation of the equipment outside the scope of the specifications
 - Incorrectly assembled or installed equipment
 - Wrongly connected cables
 - External influence on, or damage of the equipment
 - Wrong parameter settings
 - Software errors
 - Faulty hardware
3. **Hazardous touch voltages can be present on drive system components, which can be caused by:**
 - Operation of the equipment outside the scope of the specifications
 - External influence on, or damage of the equipment
 - Induced voltages by external equipment
 - Condensation on equipment components, or pollution
 - Faulty hardware
4. **High temperatures, noise, particles, or gases can be emitted from drive system components caused by:**
 - Operation of the equipment outside the scope of the specifications
 - External influence on or damage of the equipment
 - Incorrect parameter settings
 - Software errors
 - Faulty hardware
5. **Hazardous substances can be emitted from drive system components due to incorrect disposal of components.**

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Approved	Public	3BHS904690 E01	E	en	26/159

2.4. Main circuit breaker protection device

The main circuit breaker (MCB) is a major protection device of the drive. If a serious fault occurs in the drive, the MCB must disconnect the main power supply to the drive immediately. The main power supply must be disconnected without delay on an open or trip command from the drive to prevent hazard to the personnel and further damage to the equipment. The MCB is located on the primary side of the converter transformer.



Key

1. Main power supply
2. MCB control interface
3. Higher-level control system
4. Local MCB control
5. MCB
6. Protection relay
7. Converter transformer
8. Drive
9. Motor

Figure 3 – Drive system overview

The MCB is defined as a switching device to disconnect the power supply whenever required by the process or when a fault occurs. Typical devices used as MCBs are:

- Vacuum circuit breakers
- SF6 circuit breakers
- Fused contactors or motor control centers

A dedicated protection relay is used for:

- Transformer primary cable protection
- Transformer protection (if applicable)
- Transformer secondary cable protection (if applicable)
- Backing up the drive protection

In general, these protective measures are not included in the drive as provided by ABB.

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Approved	Public	3BHS904690 E01	E	en	27/159

2.4.1. Safety and protection requirements

For safety and protection reasons, the MCB must meet the stipulated minimum requirements of the specifications of ABB MV Drives. It is the system integrator's responsibility to ensure that the minimum requirements are met. The minimum requirements for the MCB are stated in this note and in the respective MCB engineering guideline, which are available for each medium voltage drive from ABB.

The safety requirements for the drive are based on the following standards:

- [ISO 13849-1](#)
- [IEC 60204-1](#)

2.4.2. Minimum requirements for MCB and MCB control

- The MCB open and / or trip command has to be wired directly from the drive to the MCB. It is not permitted to wire the trip command through any PLC or DCS system if it is not certified to meet SIL three-level requirements and to fulfill the timing requirements outlined below. Opening of the MCB by the drive must be possible at any time. It is not permitted to interrupt the open and / or trip command, eg, by a local-remote switch in the MCB. When the MCB is in service position, the drive must have exclusive control of closing the MCB. Local closing of the MCB is not permitted.
- The maximum opening time of the MCB must never exceed the product- or project-specific maximum time defined in the MCB specifications. Typical maximum values for the drive are defined as follows:
 - **Maximum protection trip time:** 75 ms
The maximum protection trip time is the maximum allowed breaking time (open and arcing) of the breaking device after the open command has been initiated to prevent further damage to the drive, such as diode failures.
 - **Maximum safety trip time:** 500 ms
The maximum safety trip time is the maximum allowed time to ensure safe disconnection of the main power supply to prevent any hazard to personnel.

For more information on the MCB requirements, control interface and control philosophy, see "Main circuit breaker engineering guideline" (3BHS125149 E50).

2.4.3. Maintenance recommendation

The MCB trip circuits should be checked annually once per year.

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Approved	Public	3BHS904690 E01	E	en	28/159

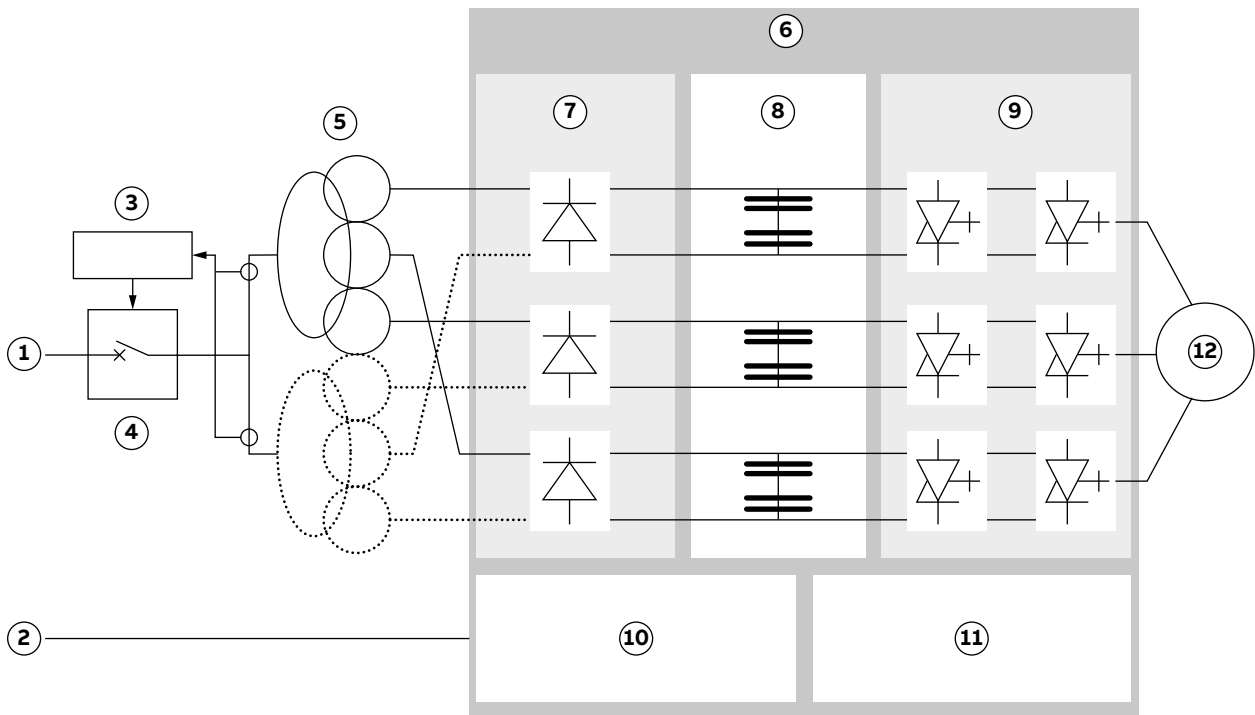
3. Power electronics and cabinet features

3.1. Main features of the drive

The water-cooled ACS5000 is a voltage source frequency converter of the ACS product range. It is available for up to 36 MVA and for standard motors with voltages up to 6.9 kV.

The drive features several proven ABB technologies including:

- Multilevel-fuseless voltage source inverter (VSI-MF) design
- Direct torque control (DTC) platform
- IGCT power semiconductors



Key

1. Main power supply
2. Auxiliary power supply
3. I >> Prot
4. MCB
5. Transformers: 18-pulse (solid line) and 36-pulse (solid line and dotted line)
6. ACS5000
7. 18-pulse or 36-pulse rectifier
8. DC-link
9. 9-level inverter
10. Control system
11. Cooling system
12. Motor

Figure 4 – Typical block diagram of the drive

VSI-MF

The VSI design employs DC-link capacitors and provides a switched voltage waveform. As a result of the multilevel topology, the drive produces an optimum number of switching levels, ie, 9 levels, phase to phase. The resulting output waveform permits the application of standard motors without decreasing the reliability and efficiency of the motor.

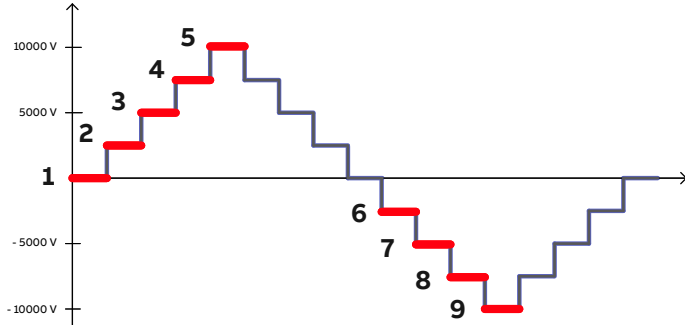


Figure 5 – Switching levels

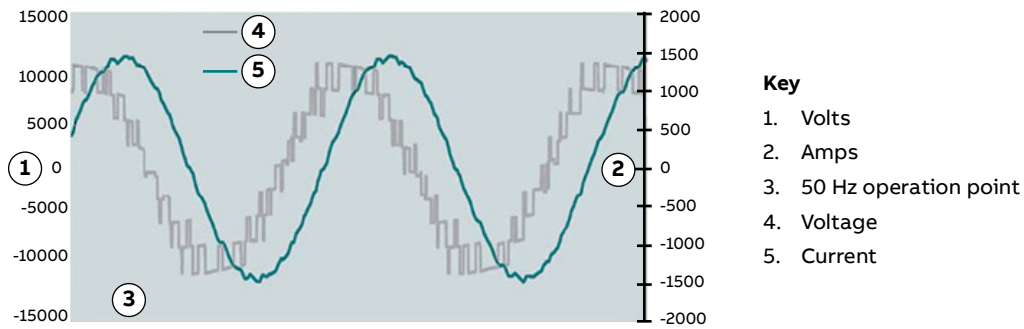


Figure 6 – Principle of 9-level topology

IGCT

Integrated gate-commutated thyristors (IGCT) are switching devices in the inverter section of phase converter units (PCU). IGCTs combine fast switching capabilities with low losses and enable a drive design with a low parts count.



Figure 7 – IGCT

Fuseless protection concept

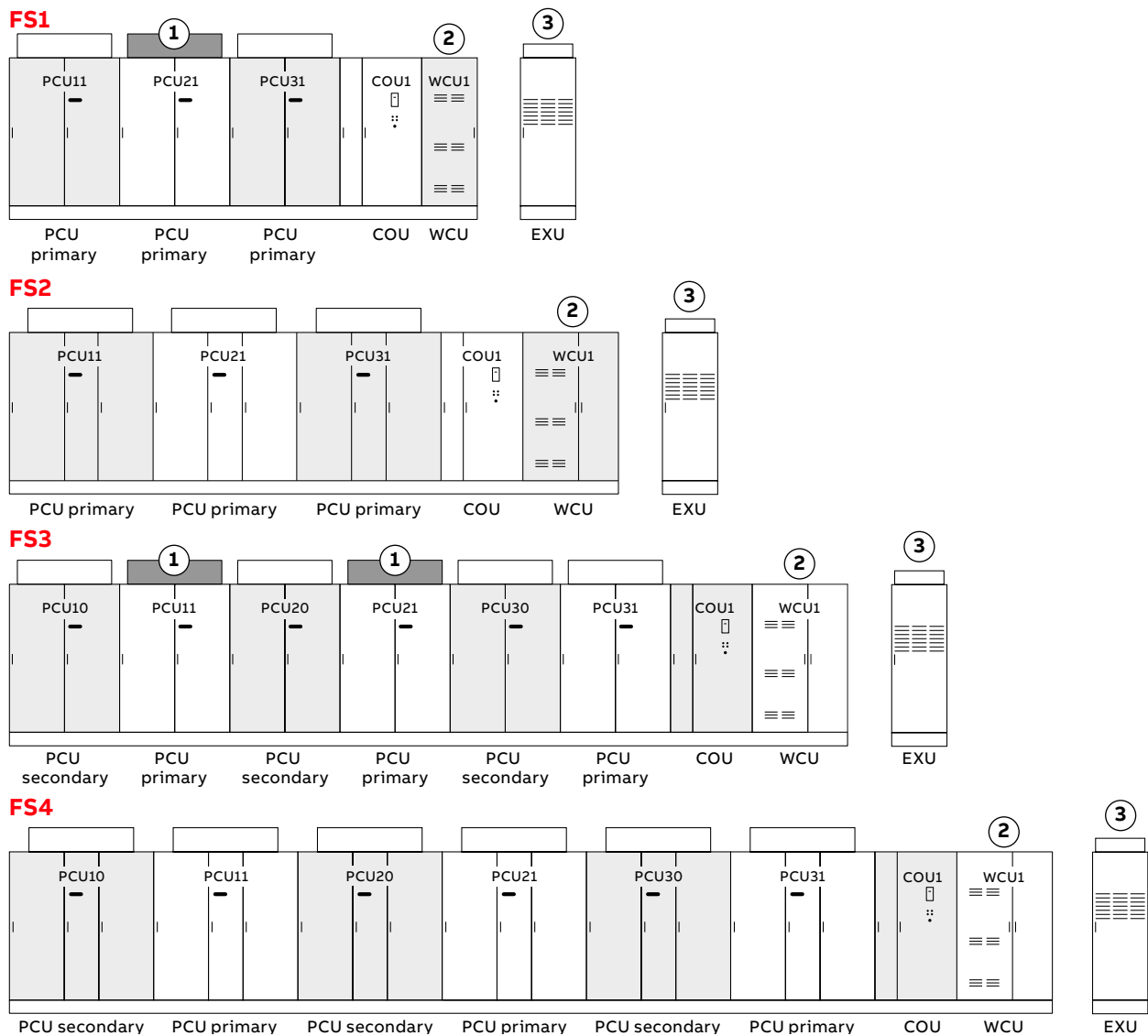
The drive does not require any power fuses. Instead, the IGCTs of the inverter are used for protection. If an overcurrent occurs, protection firing is triggered and fault clearing is initialized in less than 25 μs.

3.2. Drive frame sizes and configurations

The drive is available in four frame sizes (FS), ie, FS1 to FS4 (see Figure 8 for typical drive configurations). For information on a project-specific configuration, see the layout drawing in Appendix C – Mechanical drawings (see 1.2 Structure of the user documentation on page 14).

Table 1 – Lineup specifications by frame size

Frame size	Rating	COU	Primary PCU	Secondary PCUs	PCU width (mm)	WCU width (mm)	Total length (mm)
FS1	12 MVA	1	3	0	1700	800	7130
FS2	18 MVA	1	3	0	2100	1400	8930
FS3	24 MVA	1	3	3	1700	1400	12830
FS4	36 MVA	1	3	3	2100	1400	15230



Key

1. Presence of these fans depend on drive configuration
2. WCU can also be on the left side of the drive
3. EXU for synchronous motor application (optional)

Figure 8 – Typical drive configurations for FS1 to FS4

3.3. Phase converter unit (PCU)

PCUs are available as 6-pulse and 12-pulse rectifiers (Table 2). All drive configurations (FS1, FS2, FS3, and FS4, Figure 8) have three primary PCUs, where each PCU supplies a different motor phase.

A complete functional PCU assembly is:

- One primary PCU in FS1 and FS2 drives
- One primary and one secondary PCU (connected via DC link) in FS3 and FS4 drives

Table 2 – PCU rectifier types

Converter rectifier type ^a	Frame size	PCU type	No. of PCUs	Input phases/PCU
18-pulse ^b	FS1 FS2	PCU primary, 6-pulse	3 ×	3-phase system
36-pulse ^c	FS1 FS2	PCU primary, 12-pulse	3 ×	2 × 3-phase system
36-pulse ^c	FS3 FS4	PCU primary, 12-pulse PCU secondary, 12-pulse	3 × 3 ×	2 × 3-phase system no input phases

^a The rectifier type is determined by the number of input phases, which is on the rating plate on the door of the drive.

^b An 18-pulse rectifier has 3 × 3 input phases.

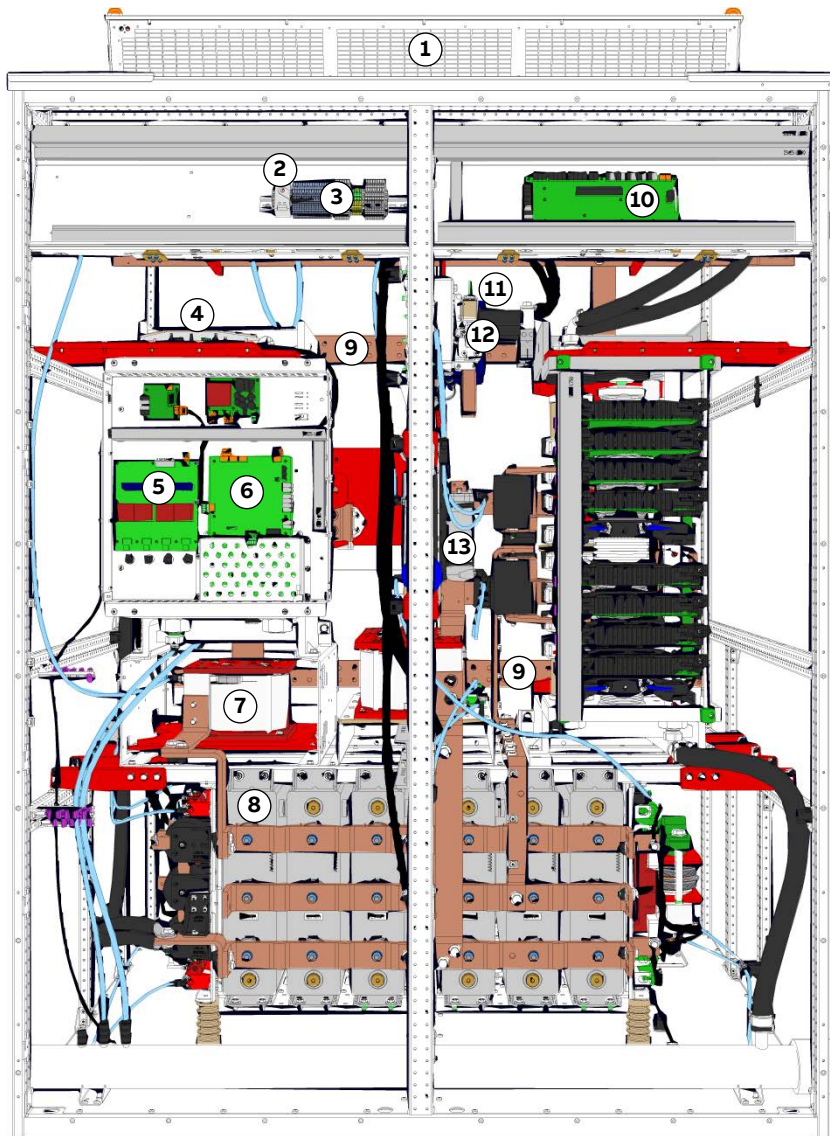
^c A 36-pulse rectifier has 6 × 3 input phases.

NOTE – Transformer cables are connected to terminals at the back of each primary PCU. For more information, see [6.7.2 Connecting the cables on page 97](#).

3.3.1. Primary phase converter unit (1700 mm and 2100 mm)

3.3.1.1. Primary PCU (1700 mm) - FS1 and FS3

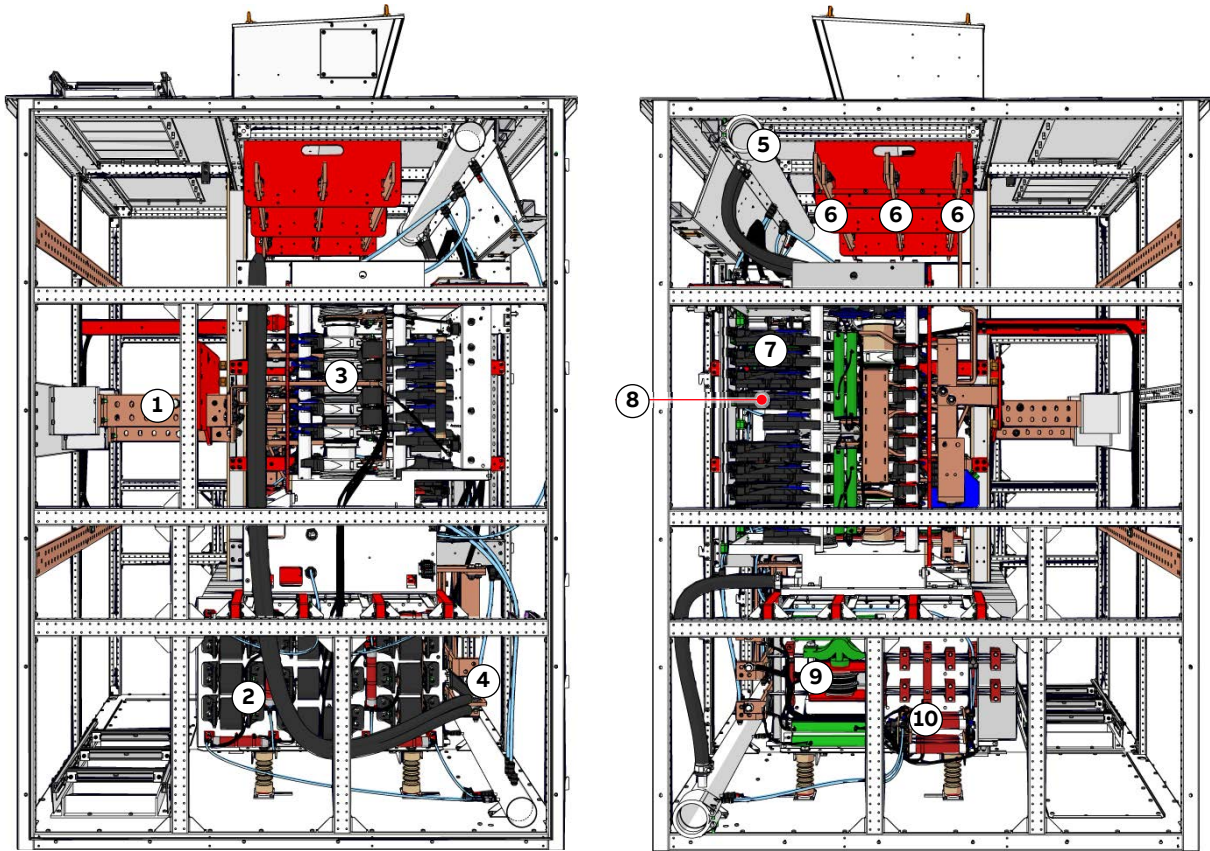
For the location of these PCUs in typical FS1 and FS3 drive configurations, see [Figure 8](#).



Key

- | | |
|---|--|
| 1. Roof-mounted cooling unit (presence depends on drive configuration) | 7. 2 di/dt chokes and 2 VLSCD circuit boards |
| 2. Thermostat for temperature supervision | 8. DC-link capacitors |
| 3. Low voltage terminals for signal and auxiliary power distribution (internal) | 9. PE ground busbar |
| 4. HVD circuit board | 10. INT interface circuit board |
| 5. Crowbar circuit board or PINT circuit board | 11. IPS (integrated power supply) |
| 6. CVMI circuit board for voltage and current measurement | 12. Grounding switch |
| | 13. Clamp resistor |

Figure 9 – Primary PCU, 1700 mm



a) Left side

b) Right side

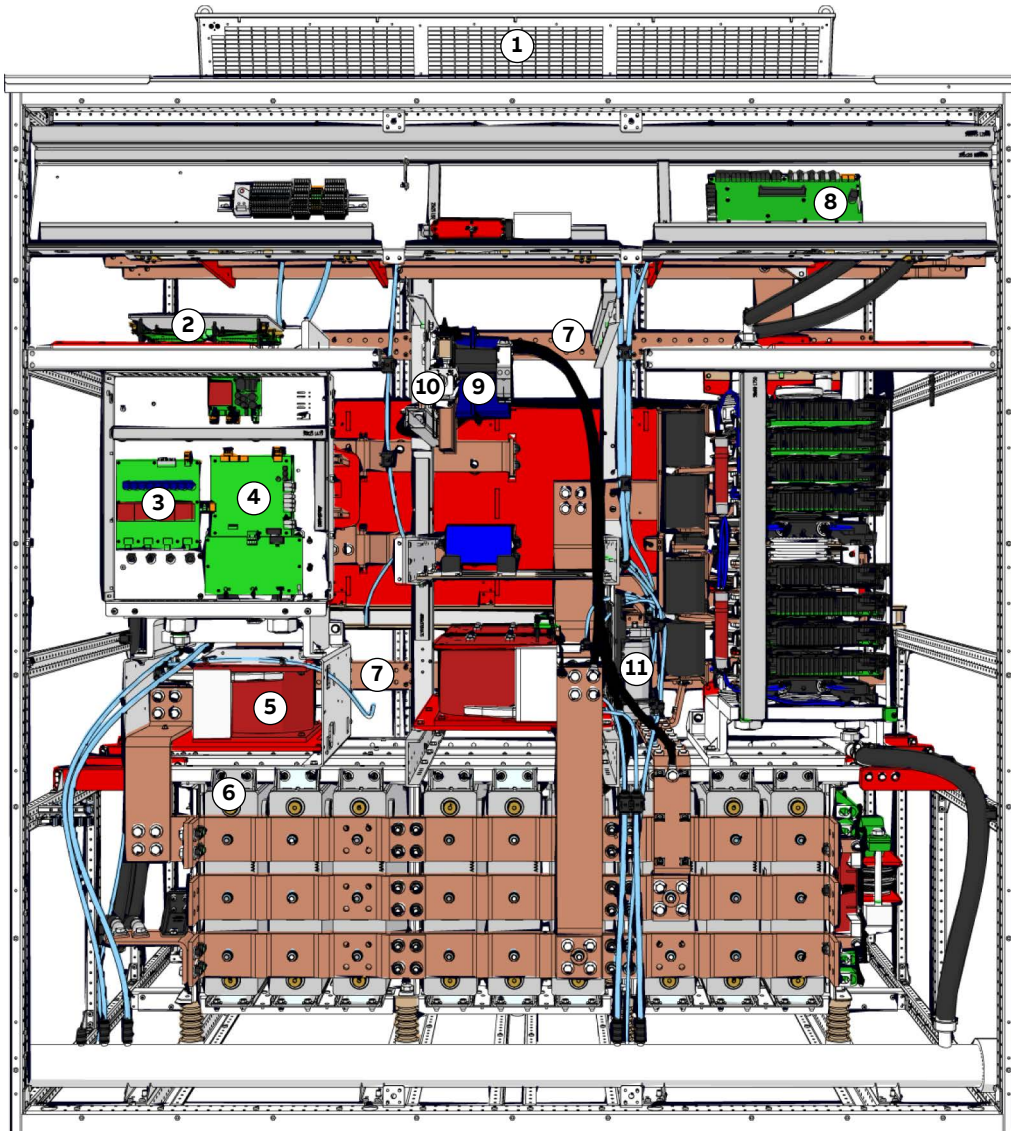
Key

- 1. Terminal compartment (PCU 6-pulse only) for transformer cables
- 2. LSU snubber plate (PCU 6-pulse only)
- 3. Rectifier stacks consisting of diodes and thyristors
- 4. DC-link connection
- 5. Water pipe
- 6. AC busbars for adjacent PCU and motor phase
- 7. Inverter stacks consisting of diodes and IGCTs
- 8. Gate unit
- 9. Back oscillation damping circuit
- 10. DC-link limiter (PCU 6-pulse only)

NOTE – PCU 6-pulse and 12-pulse terminal compartments (1, [Figure 10](#)) have different busbar configurations. For more information, see [6.7.2 Connecting the cables on page 97](#).

Figure 10 – Primary PCU, 1700 mm – side views

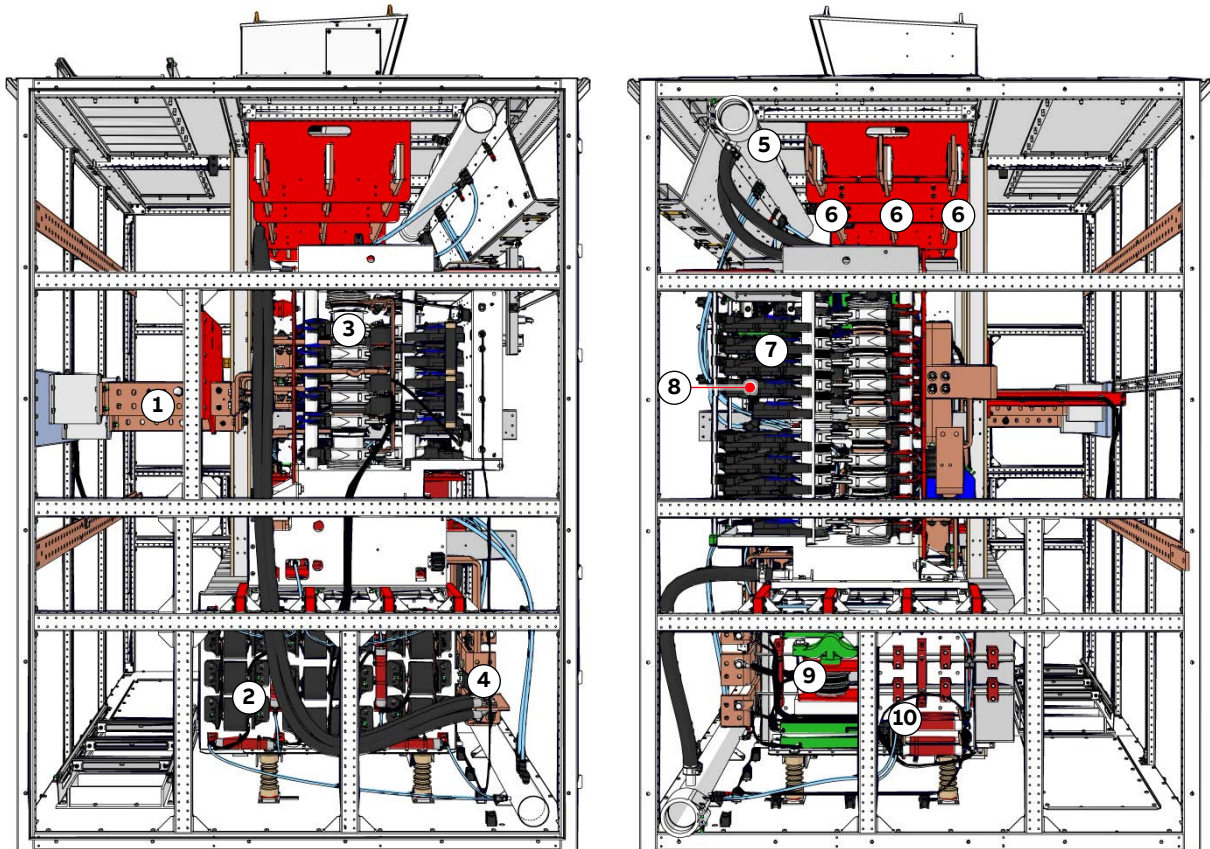
3.3.1.2. Primary PCU (2100 mm) - FS2 and FS4



Key

- 1. Roof-mounted cooling unit
- 2. HVD circuit board
- 3. Crowbar circuit board or PINT circuit board
- 4. CVM circuit board for voltage and current measurement
- 5. 2 di/dt chokes and 2 VLSCD circuit boards
- 6. DC-link capacitors
- 7. PE ground busbar
- 8. INT interface circuit board
- 9. IPS (Integrated Power Supply)
- 10. Grounding switch
- 11. Clamp resistor

Figure 11 – Primary PCU, 2100 mm



a) Left side

b) Right side

Key

1. Terminal compartment for transformer cables
2. LSU snubber plate (PCU 6-pulse only)
3. Rectifier stacks consisting of diodes and thyristors
4. DC-link connection
5. Water pipe
6. AC busbars for adjacent PCU and motor phase
7. Inverter stacks consisting of diodes and IGCTs
8. Gate unit
9. Back oscillation damping circuit
10. DC-link limiter (PCU 6-pulse only)

Figure 12 – Primary PCU, 2100 mm – side views

3.3.2. Secondary phase converter unit (1700 mm and 2100 mm) – FS3 and FS4

A secondary PCU has the same design as a primary PCU, but without the rectifier stack and the transformer terminal compartment. Drive FS3 uses 1700 mm secondary PCUs and FS4 uses 2100 mm secondary PCUs.

For the location of these PCUs in typical FS3 and FS4 drive configurations, see [Figure 8](#).

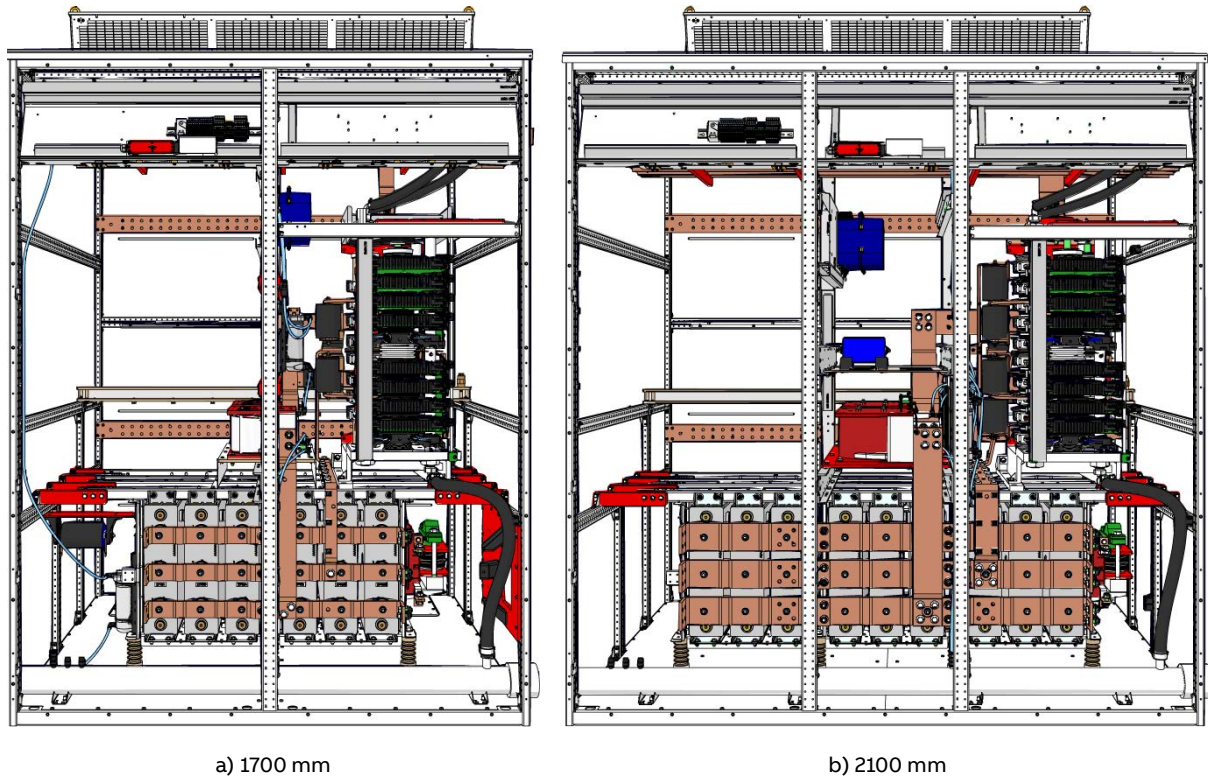


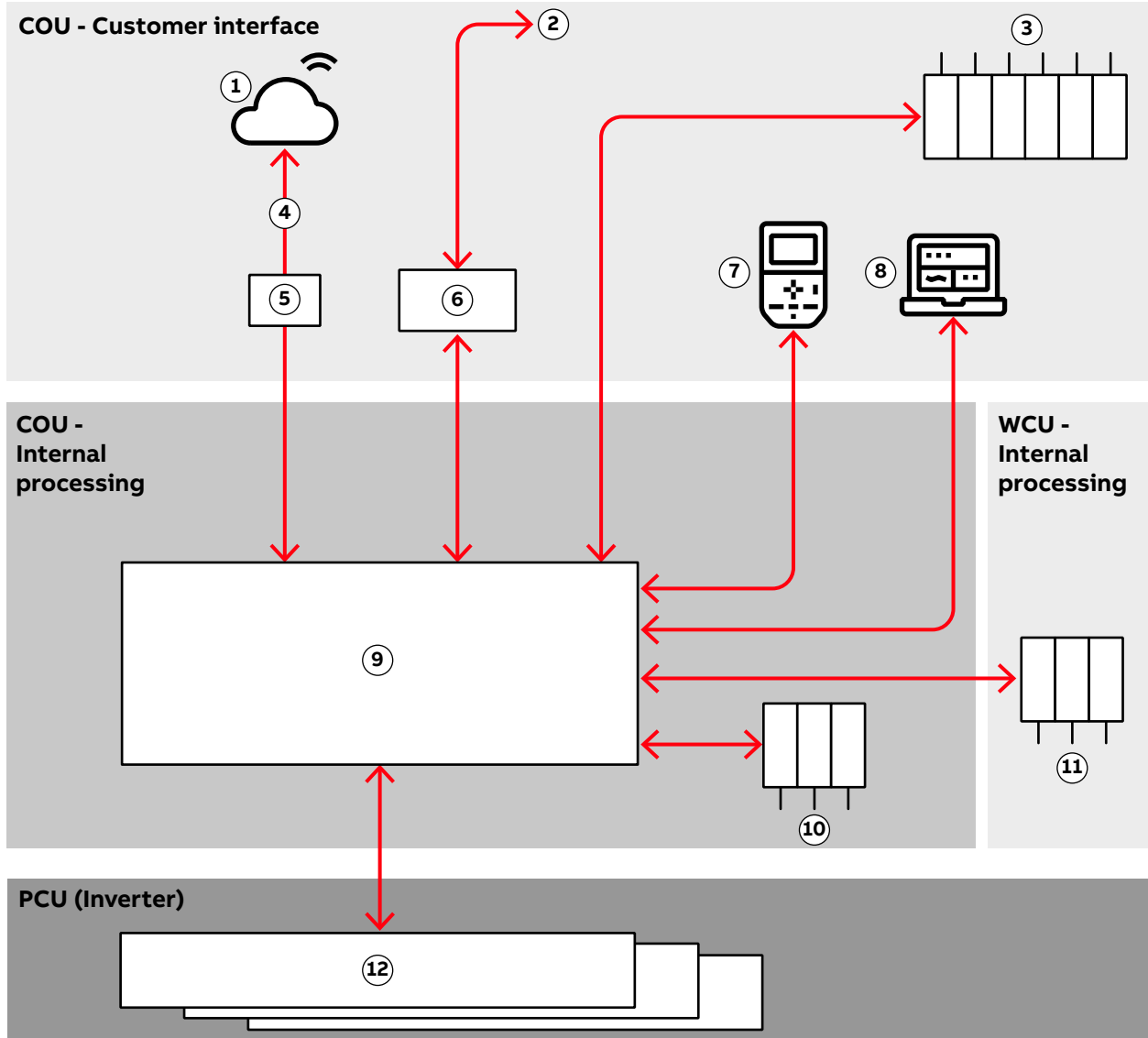
Figure 13 – Secondary PCU, 1700 mm and 2100 mm

NOTE – For an overview of the components in a secondary PCU, see [Figure 9](#), [10](#), [11](#), and [12](#).

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3.4. Control unit (COU)

The control unit incorporates the hardware for the control, monitoring and protection functions of the drive, and the communication interfaces to the local control panel and to the remote control devices. Depending on the control concept of the drive system, the remote control devices include a higher-level control system and / or remote operator stations.

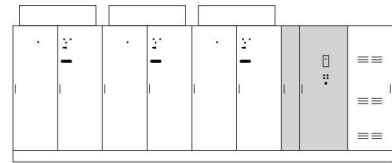
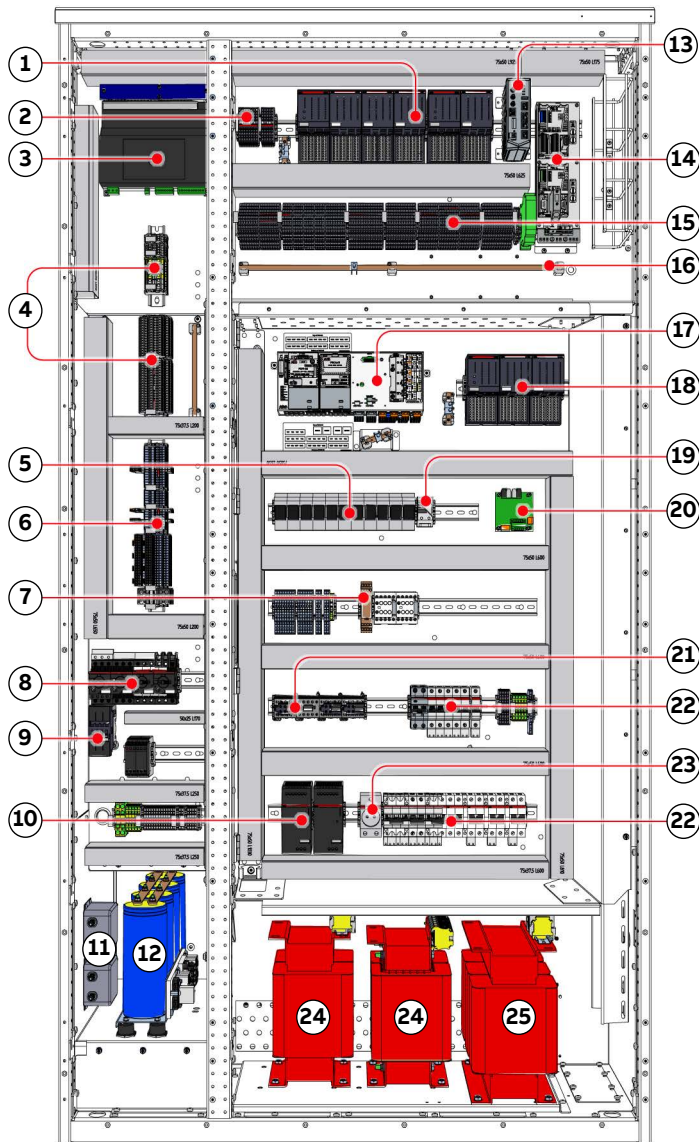


Key

- | | |
|------------------------------------|---------------------------------|
| 1. ABB Ability™ cloud connectivity | 7. Control panel on COU door |
| 2. Higher-level control system | 8. PC tool (Drive Composer) |
| 3. Customer terminals | 9. Main controller |
| 4. Ethernet TCP/IP | 10. Internal I/Os |
| 5. Gateway to ABB Ability™ | 11. WCU - internal processing |
| 6. Fieldbus | 12. INT interface circuit board |

Figure 14 – Block diagram of control system

3.4.1. Main components



Key

- | | |
|---|---|
| <ul style="list-style-type: none"> 1. S500 I/O extension modules (optional) 2. 24 V DC terminal block 3. Arc Guard System™ 4. Customer terminals - UPS and Process interface (eg, MCB, E-Off, and PreMag) 5. Auxiliary relay 6. Internal terminals 7. Safety relay 8. Circuit-breakers for auxiliary power distribution 9. Charging contactor 10. 24 V DC power supplies 11. EMC filter 12. DC buffer capacitors (optional) 13. Gateway to enable ABB Ability™ digital services (optional) | <ul style="list-style-type: none"> 14. Speed and/or position encoder interface (optional) 15. Customer terminals for control I/O extension (optional) 16. Shield grounding busbar (for process and encoder cabling) 17. Main control UCU-26 control unit and customer fieldbus interface 18. S500 I/O modules - internal 19. Thermostat to monitor cabinet temperature 20. EOI circuit board 21. Auxiliary contactors 22. Miniature circuit breakers 23. 230 V socket (optional) 24. 1-phase/ 3-phase auxiliary transformers (optional) 25. Transformer for unbuffered auxiliary power supply (T1111) |
|---|---|

Figure 15 – COU control section

3.4.2. Parameters

The control system is configured, customized, and tuned with a set of application parameters. The application parameters are organized in functional groups and have factory-set default values.

The default parameter values are adjusted during commissioning to the specific application of the drive in order to activate the specific control, monitoring and protection functions for the driven process, and to define the signals and data transferred between drive and external equipment.

For more information on the parameters for signal allocation, signal type selection, signal inversion, scaling, and filtering, see the firmware manual in Appendix G – Signal and parameter table (see [1.2 Structure of the user documentation on page 14](#)).

3.4.3. Main circuit breaker

The main circuit breaker (MCB) is an important switching and protection device of the drive system. Therefore it must only be controlled and monitored by the drive.

For more information, see:

- "Main circuit breaker engineering guideline" (3BHS125149 E50)
- [2.4 Main circuit breaker protection device on page 27](#)

3.4.4. Peripheral I/O devices

The peripheral input and output devices connected to the circuit board include:

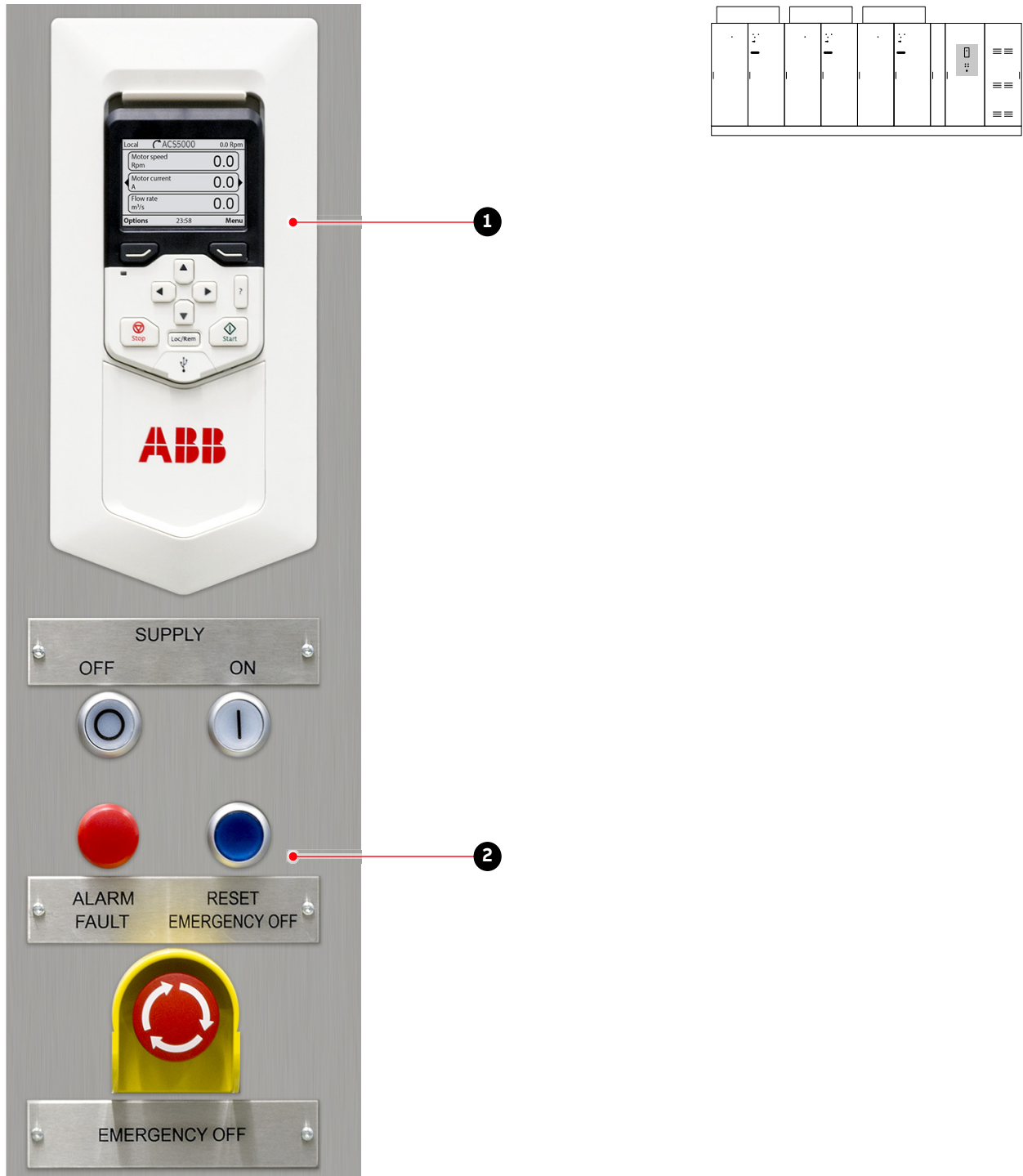
- Local control panels
- S500 I/O system for hardwired signal transfer to external devices
- Optional fieldbus adapters for serial data transfer to a higher-level control system
- EGW-02: monitoring and diagnostics tool that allows access to the drive from any location in the world via a secure Internet connection. For an overview of the control system, see [Figure 14](#).
- PC-based service tool (Drive Composer)

3.4.5. Local operator panel

The local operator panel serves as the basic user interface for monitoring, control and operation of the drive and setting of parameters.

For more information on local operation and the control panel, see [8 Operation on page 117](#).

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Key

- 1. Control panel
- 2. Control push buttons

Figure 16 – Local operator panel

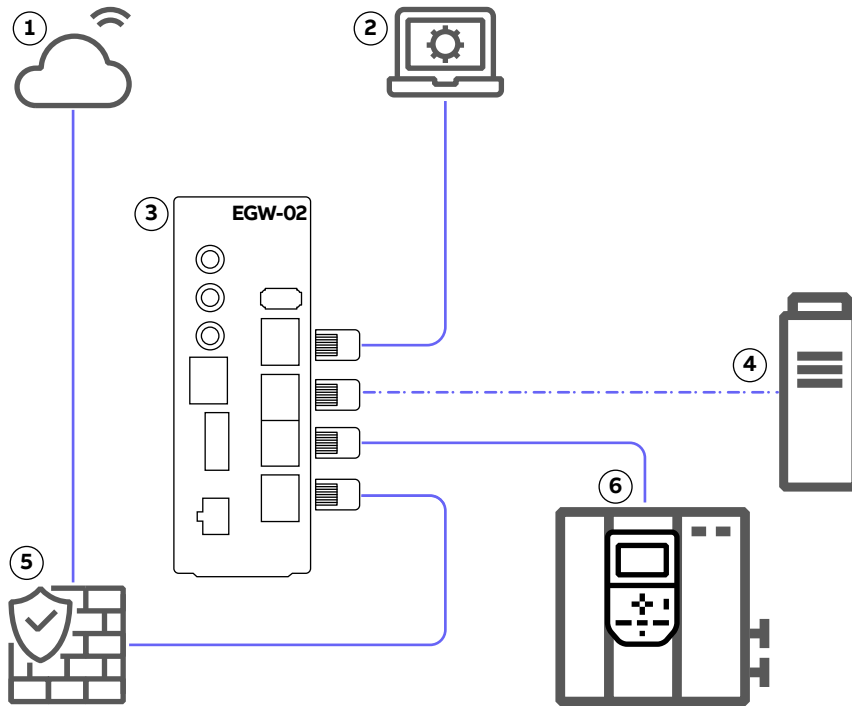
3.4.6. Remote connectivity

ABB offers cloud services for drives (for example, ABB Ability™ Remote Condition Monitoring for Drives). To use ABB cloud services, an Internet connection is necessary.

An EGW-02 gateway (4, [Figure 17](#)) provides Internet connectivity for ABB drives. The optional gateway is installed in the COU (13, [Figure 15](#)).

NOTE – Use of ABB Ability™ Remote Condition Monitoring for Drives requires an active subscription.

The EGW-02 gateway supports a wired Ethernet (connection through WAN port on EGW-02, 10/100 Mbps).



Key

1. ABB cloud service
2. PC tool customer interface
3. EGW-02 gateway
4. Optional EXU
5. Firewall
6. Drive

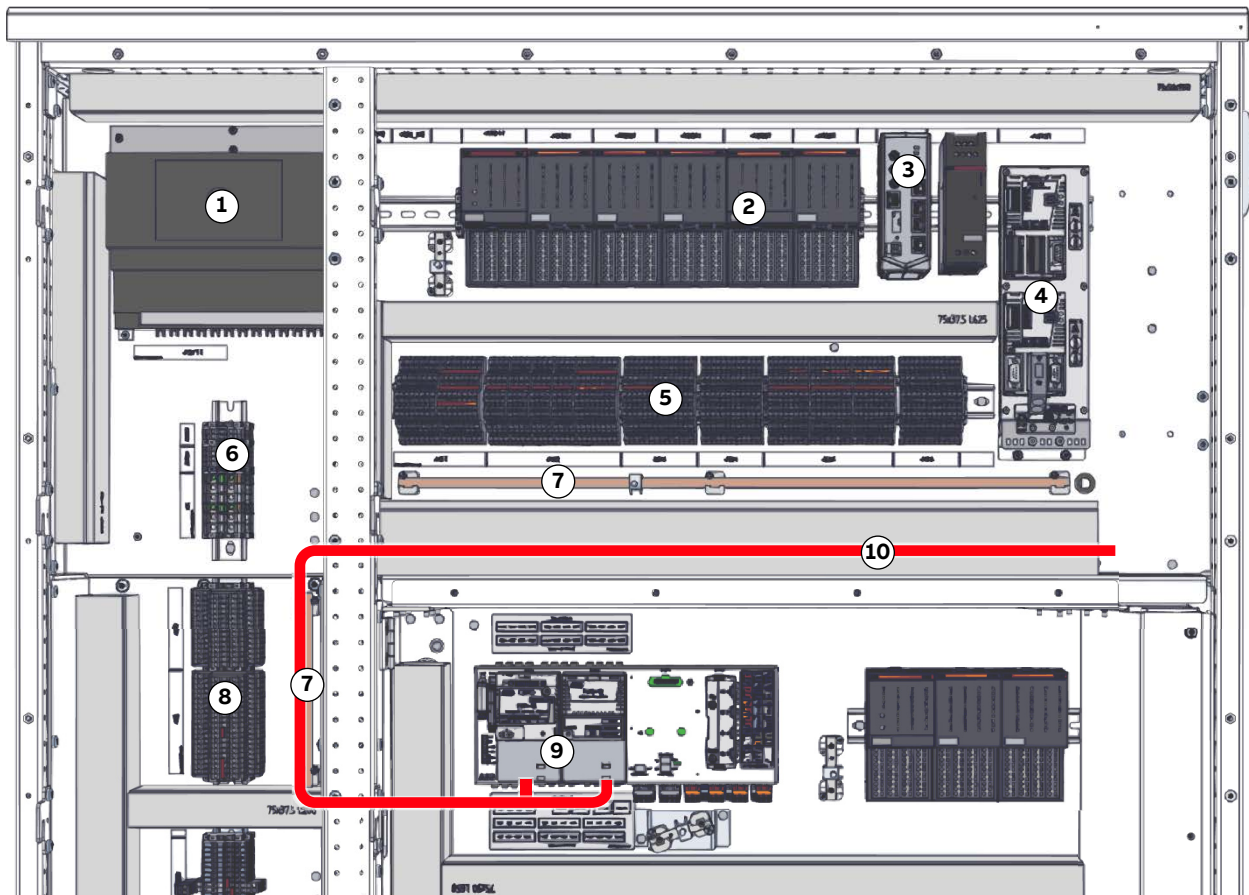
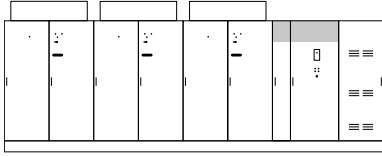
Figure 17 – Overview of the EGW-02 gateway connectivity

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Approved	Public	3BHS904690 E01	E	en	42/159

3.4.7. Customer interface

The devices present in the customer interface depend on the options ordered, such as:

- Serial communications interface to a higher-level control system
- Optional control I/O extension, eg, to monitor external equipment such a transformer or motor



Key

1. Arc Guard System™
2. S500 I/O process system (customer- specific configuration)
3. Gateway to ABB Ability™ services
4. Speed and position encoder interface
5. Customer terminals for control I/O extension (optional)
6. Customer terminal - UPS and space heater
7. Ground rail for cable shield
8. Customer terminals - process interface
9. Fieldbus adapter modules

Figure 18 – COU customer interface section

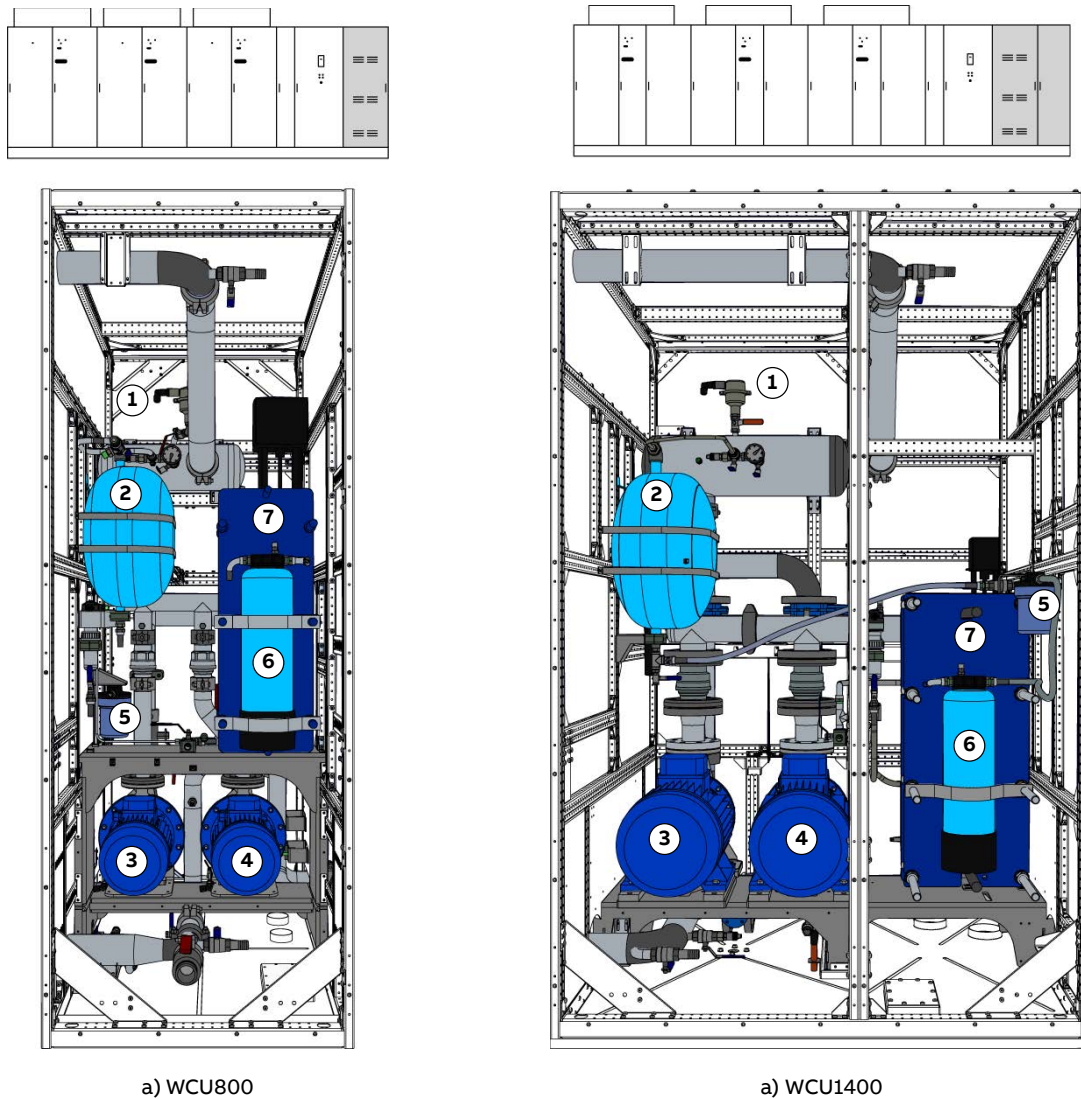
3.5. Water cooling unit (WCU)

The size of the WCU depends on the drive FS (see [3.2 Drive frame sizes and configurations on page 31](#)). Both sizes have the same components:

- WCU800 has a cabinet width of 800 mm
- WCU1400 has a cabinet width of 1400 mm

In addition to the cooling system components ([Figure 19](#)), a WCU has a low voltage compartment section for power distribution and cooling unit control. For more information, see the WCU user manual in Appendix A – Additional manuals (see [1.2 Structure of the user documentation on page 14](#)).

For information on the customer interface in the WCU, see [6.8.2.1 WCU - auxiliary power and space heater cable on page 104](#).



Key

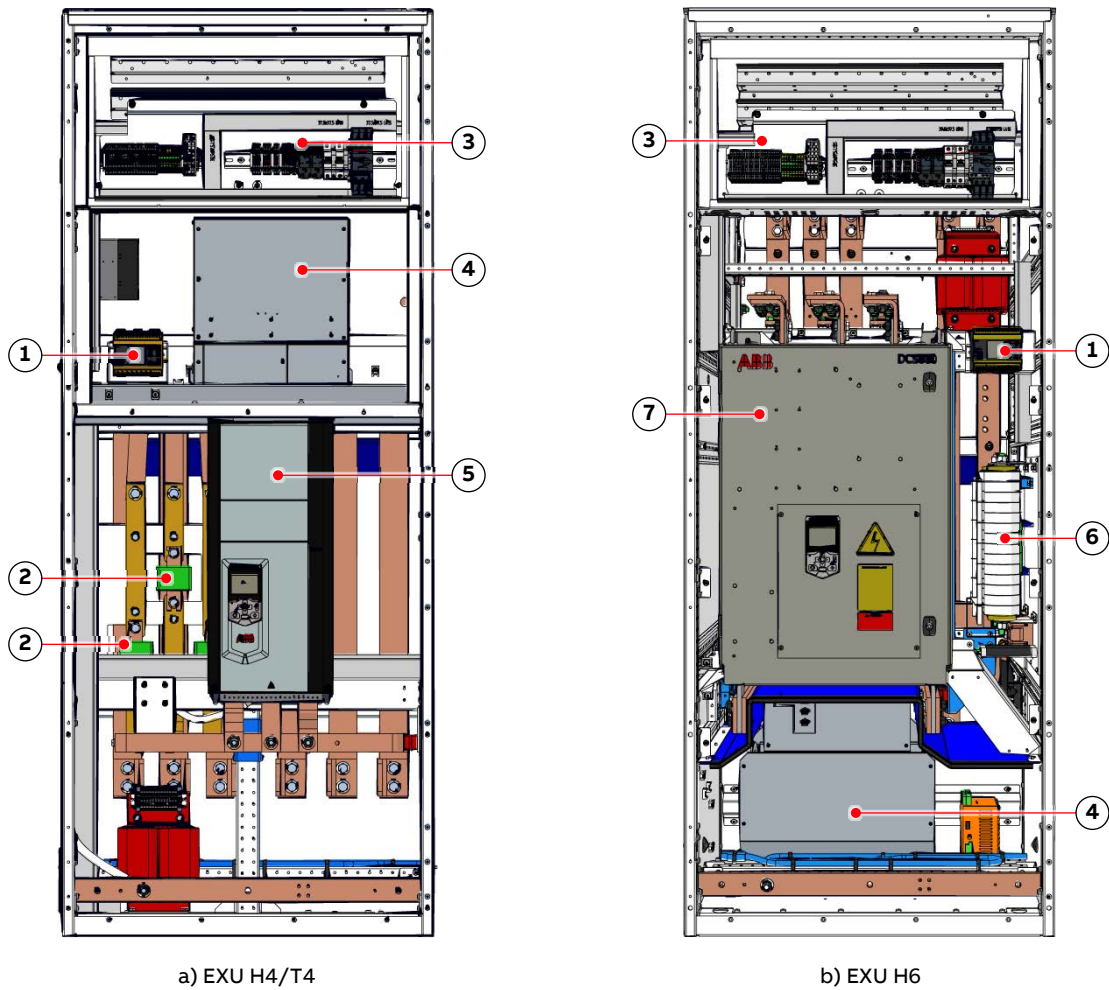
- | | |
|---------------------|----------------------------------|
| 1. Deaeration valve | 5. Filter |
| 2. Expansion vessel | 6. Ion exchange vessel |
| 3. Water pump 1 | 7. Water-to-water heat exchanger |
| 4. Water pump 2 | |

Figure 19 – WCU cooling system components (low voltage control compartment not visible)

3.6. Excitation unit (EXU - optional)

The EXU supplies a synchronous motor with excitation power and is available for the following excitation methods:

- **Brush excitation (DC excitation):** uses a DCS880 AC-to-DC converter which is supplied by the mains. The converter controls the direct current for generating the magnetic field. Brushes and slip-rings feed the DC current to the rotor.
- **Brushless excitation (AC excitation):** uses a three-phase DCT880 AC-power controller. The power controller feeds an exciter which is mounted on the shaft of the main motor. The rotating armature of the exciter supplies a rectifier which generates the DC current for producing the magnetic field in the synchronous motor.



Key

1. Ground fault detection device (optional)
2. Fuses
3. Control compartment
4. Fan units
5. DCS880/DCT880 H4 unit
6. Overvoltage protection (not shown in A)
7. DCS880 H6 unit

Figure 20 – EXU frame cabinets

3.6.1. DCS880/DCT880 control panel

The control panel of the DCS880/DCT880 unit enables the user to control, read the status messages and set the parameters of the DCS880/DCT880 unit. The panel can also be used to copy parameters from one DCS880/DCT880 unit to another DCS880/DCT880.



Figure 21 – DCS880/DCT880 control panel

For more information, see [8.3.3 EXU control panel on page 119](#).

3.6.2. Output disconnecter

The optional output disconnecter is used to disconnect the EXU from the motor for maintenance purposes.

3.7. Transformer and motor cable terminals

3.7.1. Transformer cable terminals



DANGER

Hazardous voltages!

- Complete the steps in [2.3.2 The 7 steps that save lives on page 24](#) before you remove the side and back walls from the drive to access the grounding studs in a PCU.

To access the transformer cable terminals (busbars), remove the back wall of the primary PCU (see [Figure 8](#) for PCU location).

For information on the dimensions and the motor busbar arrangement, see [6.7.2 Connecting the cables on page 97](#) and Appendix C – Mechanical drawings (see [1.2 Structure of the user documentation on page 14](#)).

3.7.2. Motor cable terminals

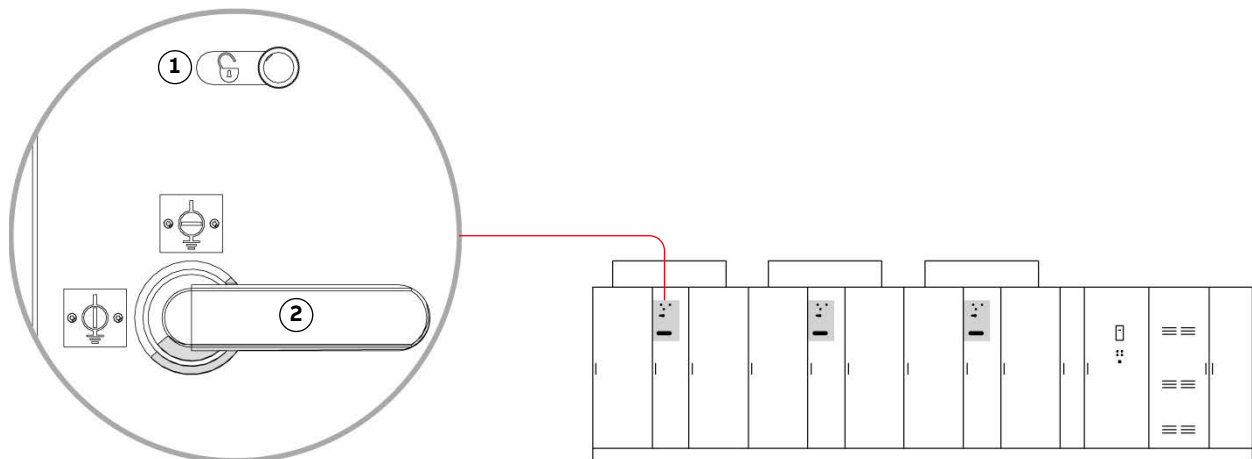
To access the motor cable terminals (busbars) at the back of the COU cabinet, open the COU swing frame or remove the back wall of the COU (see [Figure 8](#) for COU location).

The COU also contains the charging transformer for the DC-link, the EMC filter, and the common mode filter.

For information on the dimensions and the motor busbar arrangement, see [6.7.2 Connecting the cables on page 97](#) and Appendix C – Mechanical drawings (see [1.2 Structure of the user documentation on page 14](#)).

3.8. Door interlocking system

Each PCU has an electromechanical interlocking system to keep the PCU doors locked and secure during operation to prevent contact with hazardous voltages. The main protection features of the interlocking system are locking bars (1) and grounding switches (2).



Key

1. Locking bar
2. Grounding switch

Figure 22 – Location of protection features and lamps (FS2 drive example)

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You can only connect the main power supply to the drive when all of the locking bars are in the locked position and the grounding switches in the ungrounded position. Similarly, you can only open the PCU doors after the main power supply has been disconnected, the DC-link capacitors have been discharged, and the grounding switches are in grounded position.

The doors of the COU (control unit and motor terminal section) and the WCU are not integrated into the interlocking system and can be opened any time.

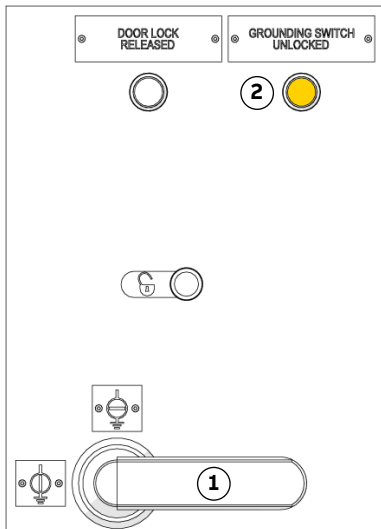
CAUTION! DO NOT open the swing frame of the control unit while the drive is in operation.

For instructions on how to open and close doors, see [9.4.3 Opening and closing the doors on page 138](#).

3.8.1. Grounding switches

Each primary PCU in the drive has a grounding switch on the door.

You can only turn the grounding switch (1) to the grounded position (horizontal) when the yellow lamp (2) is lit, ie, after the drive has been disconnected from the main power supply and the DC-link has been discharged. For a detailed grounding diagram, see Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)).



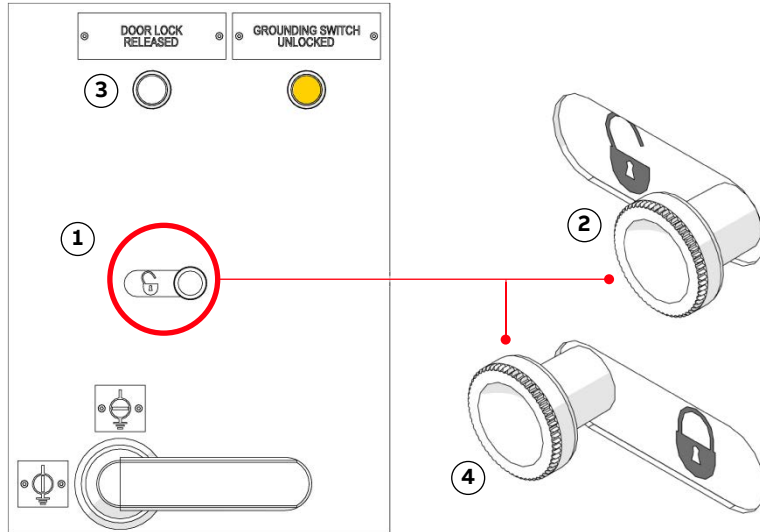
Key	Explanation
1. Grounding switch	<ul style="list-style-type: none"> - Horizontal position - drive is grounded - Vertical position - drive is ungrounded.
2. Yellow lamp (grounding switch unlocked)-	Lights up to indicate that you can turn the grounding switch to the grounded or ungrounded position.

Figure 23 – Grounding switch

3.8.2. Locking bars

A locking bar is a safety mechanism that locks the doors of the primary and secondary PCUs when the drive is ungrounded.

You can only slide the locking bar (1) to the unlocked position (2) and open the doors when the drive is grounded, ie, when the white lamp (3) is lit. In order to slide a locking bar to the locked position (4), you need to close all of the PCU doors (2 doors in 1700 mm PCUs, 3 doors in 2100 mm PCUs).



Key	Explanation
1. Locking bar	Location on local control panel
2. Locking bar	Unlocked position
3. White lamp	Lit when drive is grounded
4. Locking bar	Locked position

Figure 24 – Locking bar positions

3.9. Grounding studs

The COU and each PCU has grounding studs that are designed for use with the 4-way grounding set (Figure 26).

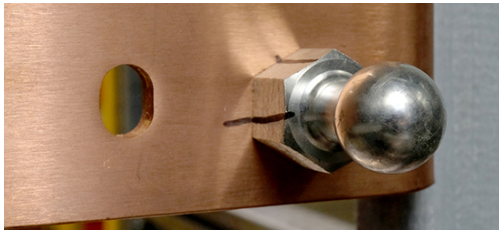


Figure 25 – Grounding stud

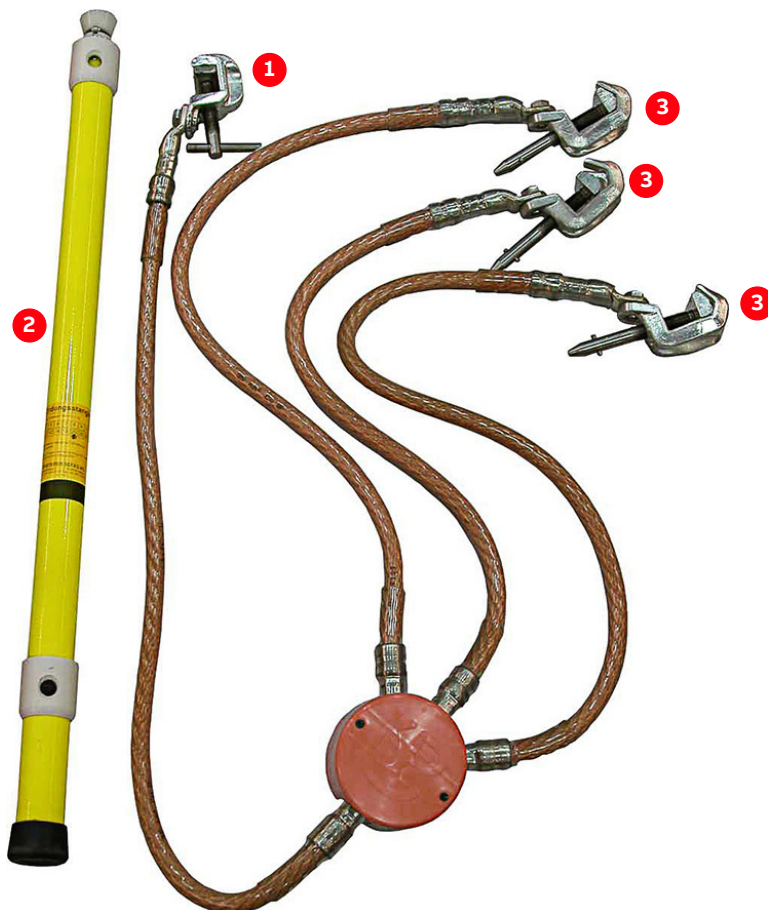
3.9.1. Grounding set



⚠ DANGER

Hazardous voltages!

→ Complete the steps in [2.3.2 The 7 steps that save lives on page 24](#) before you access the grounding studs in the PCU and COU.



Key

1. Enclosure ground clamp
2. Telescopic insulating pole
3. Busbar ground clamp

Figure 26 – 4-way grounding set

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Approved	Public	3BHS904690 E01	E	en	50/159

3.9.2. Output grounding studs in COU

The converter output grounding studs, ie, 1L1, 1L2, 1L3 and 2L1, 2L2, and 2L3, and the protective earth (PE) busbar are at the back of the COU.

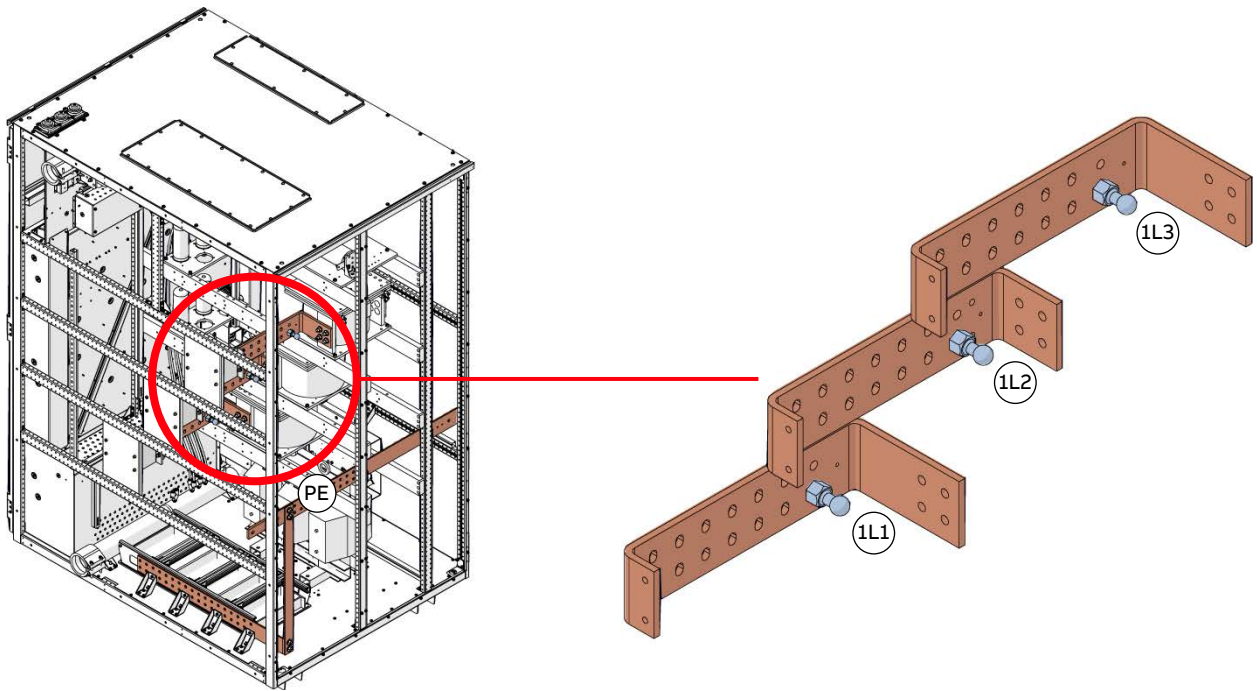


Figure 27 – Location of PE busbar and grounding studs (1L1, 1L2, and 1L3) in COU, FS1 and FS2

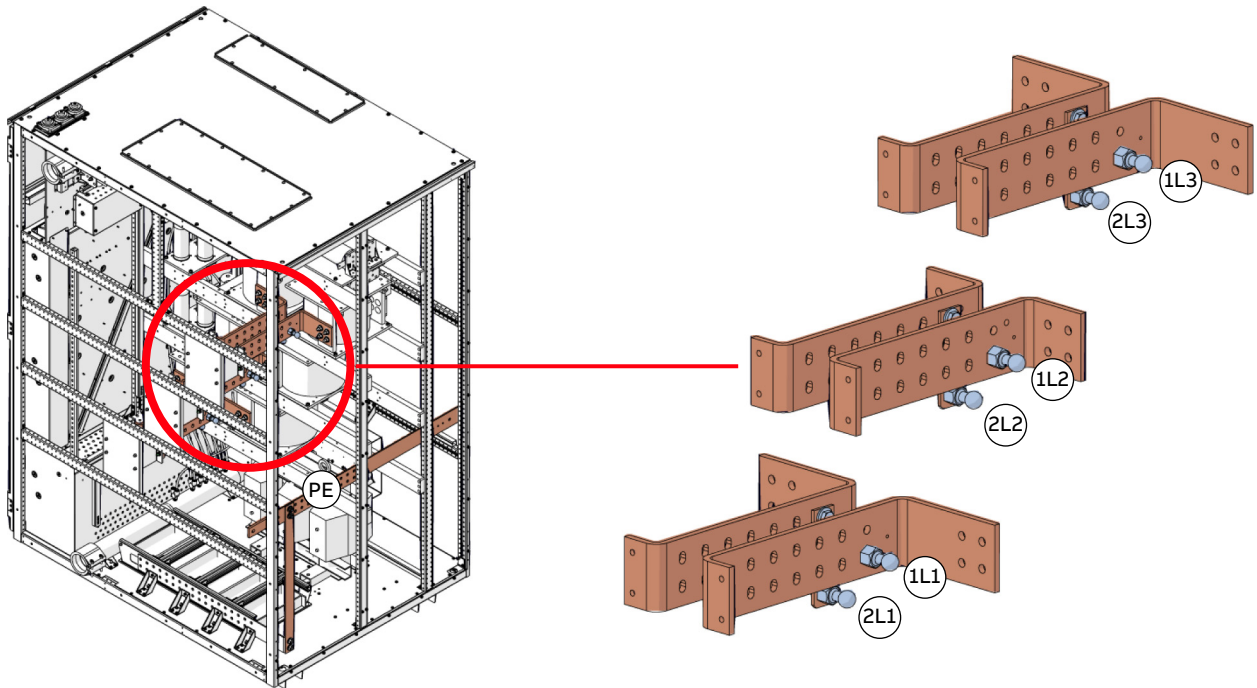


Figure 28 – Location of PE busbar and grounding studs (1L1, 1L2, 1L3, 2L1, 2L2, and 2L3) in COU, FS3 and FS4

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	3BHS904690 E01	E	en	51/159

3.9.3. Input grounding studs in a PCU



DANGER

Hazardous voltages!

→ Complete the steps in [2.3.2 The 7 steps that save lives on page 24](#) before you remove the side and back walls from the drive to access the grounding studs in a PCU.

The converter input grounding studs, ie, 1L1, 1L2, and 1L3 and 2L1, 2L2, and 2L3 and the protective earth busbar are at the back of each PCU.

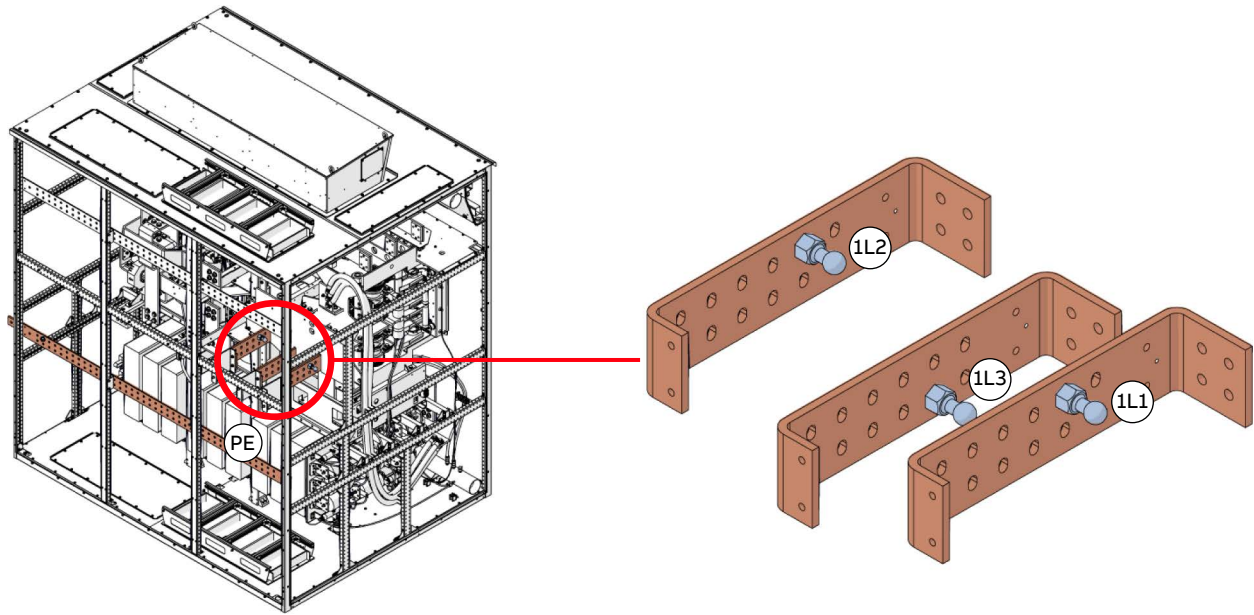


Figure 29 – Location of PE busbar and grounding studs (1L1, 1L2, and 1L3) in a 6-pulse PCU

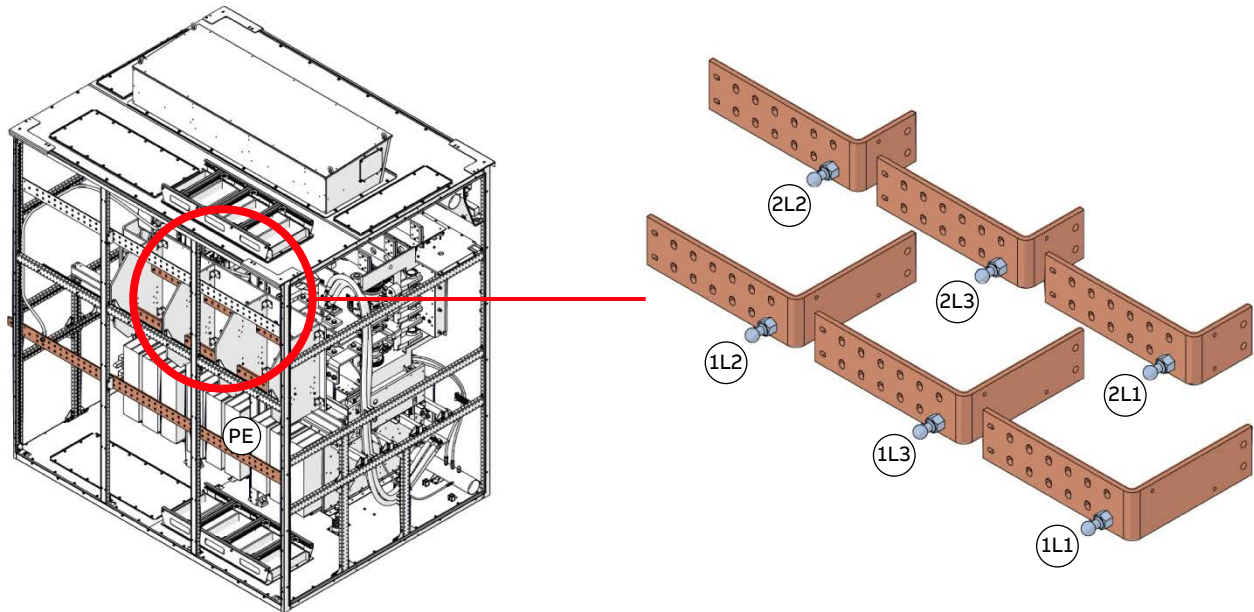


Figure 30 – Location of PE busbar and grounding studs (1L1, 1L2, 1L3, 2L1, 2L2, and 2L3) in a 12-pulse PCU

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Approved	Public	3BHS904690 E01	E	en	52/159

4. Transportation, storage, and disposal

4.1. Safety



The drive must only be handled by personnel who are skilled and experienced in unpacking and transporting heavy equipment.

4.2. Transport conditions

The transport conditions for the drive are based on [IEC 60721-3-2](#).

- **Classification:** 2K12 / 2B1 / 2C2 / 2S5 / 2M4

4.3. Unpacking and inspection

1. Carefully remove all packaging material.
2. Inspect the drive and accompanying equipment and make note of any damage.
 - Take a photograph of the damage and inform ABB and the shipping company immediately.
3. Compare the complete delivery with the purchase order and the packing list.
 - If parts are missing, contact the shipping company and ABB immediately

4.4. Identifying drive units

A delivery can consist of transport units for several drives. To identify the transport units and assign them to a particular drive, see the following accompanying papers for information:

- Packing list, attached to the packaging of each transport unit
- Packing label on the back wall of each drive unit (PCU, COU, WCU). The packing label is only visible after the packaging has been removed.

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4.4.1. Packing list

The “Commodity description” column of the packing list states the number of the drive that the transport unit belongs to.

ABB item Customer item	Qty.	Unit.	Identnumber	Commodity description
001201	1	PC		Converter 1 ^a : Transport Unit 1
ABB Switzerland Ltd Drives				
Mailing address: CH-5401 Baden/Switzerland	Phone: +41 58 589 27 95	Telex: 755749 abb ch	Facsimile: +41 58 580 20 84	Bank Credit Suisse CH-8070 Zurich/Switzerland

^a All of the transport units for a drive have the same converter number, in this case, “Converter **1**”.


The item number in the “ABB Item / Customer item” column of the packing list provides information about separately delivered crates with accessories such as tools and installation material.

ABB item Customer item	Qty.	Unit.	Identnumber	Commodity description
00 1 221 ^a	1	PC		cross wiring
00 1 222	1	PC		WCU accessory
00 1 223	1	PC		crank for isolator
00 1 500	1	PC	3BHB013202R0001	ACS6080 Max-SL LOOSE PARTS config.
ABB Switzerland Ltd Drives				
Mailing address: CH-5401 Baden/Switzerland	Phone: +41 58 589 27 95	Telex: 755749 abb ch	Facsimile: +41 58 580 20 84	Bank Credit Suisse CH-8070 Zurich/Switzerland

^a The third digit from the right identifies the drive that the accessories belong to, ie, drive **1**.

4.4.2. Packing label

The packing labels on the back wall of transport units can also be used for identification

ABB	Packing Label	0000
Material no	3BHB009964R1500	1 ST
Material	Cabinet ARU/INU LSU config.	
Order no/positions	11027727 00 1 241 ^a Project CBA	
Material Document	 004902892300012004	

^a The fourth digit from the right identifies the drive that the transport unit belongs to, ie, drive **1**.

4.5. Lifting and transportation

This following information is for crane lifting operations.



WARNING

Risk of serious injury! Incorrect securing and lifting of loads can cause serious injury and damage the equipment.

- Lift operations **MUST** be performed by qualified personnel in accordance with local lifting laws!
- **DO NOT** use a forklift for transport units or drives; for a stand-alone EXU, you can use a manual forklift
- Use suitable lifting gear for the load weight, eg, web slings, chain slings, round slings, and shackles
- Use a lift frame or spreader frame for large loads, eg transport unit or drive on a base frame.
- Only use the original lifting attachments with the original mounting bolts (and washers where applicable) to transport the equipment
- Before use, always check the lifting attachments for damage, eg, corrosion and cracks; **DO NOT** attempt to lift equipment with a damaged lifting attachment; contact ABB for a replacement before you proceed
- Always transport the load in an upright position
- Always observe the center of gravity
- **DO NOT** lift more than one load at a time



Refer to “Appendix C – Mechanical drawings” (see [1.2 Structure of the user documentation on page 14](#)) for the relevant dimensions and weight.

NOTICE

Risk of component damage. Dirt and metallic dust can cause failure when the drive is energized.

- Keep the cabinet doors closed during lift operations

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Approved	Public	3BHS904690 E01	E	en	55/159

4.5.1. Lifting attachment types

IMPORTANT! The lifting attachments, which are included with the delivery, are intended exclusively for use with ACS5000W equipment. Any use beyond this is strictly prohibited. Only use the original lifting attachments to transport the equipment.



Only use the lifting attachments that are included with the delivery, either factory-installed or in the loose parts box for the drive. These lifting attachments are intended exclusively for use with ACS5000W gen. 3 equipment. Any use beyond this is strictly prohibited.



Key	Explanation
1. Lifting plate	On base-frame for lifting the drive
2. M16 rotating eyebolt	For top-lifting EXU and WCU cabinets in lineup left
3. M8 rotating eyebolt	For top-lifting roof-mounted cooling units

Figure 31 – Lifting attachment types

4.5.2. Lifting with lifting plates

Lifting plates are factory-installed on the base frame of transport units.



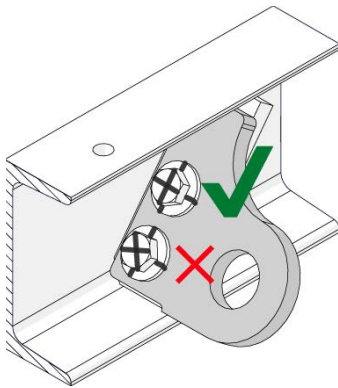
CAUTION

Risk of tipping! The following procedure requires a crane with a lift frame or a spreader frame. If you do not have this equipment:

→ Ensure that the slope angle of the slings DOES NOT exceed 15° (7, [Figure 33](#)).

1. Verify that the factory torque marks on the mounting bolts and washers of the lifting plates are aligned.

If the marks are not aligned or are not visible, tighten the mounting bolt to the torque that is specified in [Table 3](#).



2. Attach slings to the lifting plates (1) with load-appropriate shackles (2).

CAUTION! DO NOT run a sling through the hole of a lifting plate!



Referring to [Figure 33](#):

3. Wrap a sling horizontally around the upper $\frac{1}{3}$ of the load height and secure in place with vertical slings.
4. Protect the edges and other protrusions on the load from direct contact with the lifting gear, eg slings.
5. Lift the load slowly and steadily, with no abrupt stops, in an upright position to the required clearance height.

CAUTION! Keep an eye on the horizontal position of the load and reposition the slings when necessary.

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Approved	Public	3BHS904690 E01	E	en	57/159

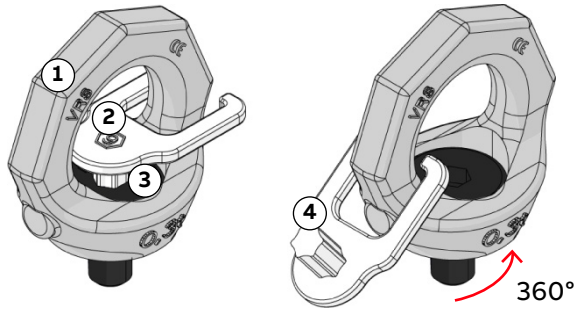
4.5.3. Lifting with rotating eyebolts

Rotating eyebolts are either installed in the factory or are in the loose parts box for the drive.

The following procedure requires a crane with a lift frame or a spreader frame.

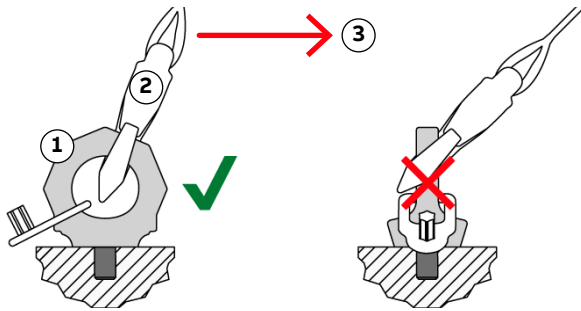
1. For rotating eyebolts (1) from the loose parts box, use the attached star key (2) to hand-tighten and properly seat the mounting bolt (3).

CAUTION! DO NOT use an extension with the star key tool. Remove the key (4) before you attach the lifting gear. The eyebolt must be able to rotate 360° when mounted.



2. Rotate the eyebolts (1) in the pull direction (3), ie, sling direction, and then attach slings to the eyebolts with safety hooks or shackles (2).

CAUTION! DO NOT run slings through the eyebolts!



Referring to [Figure 33](#):

3. Protect the edges and other protrusions on the load from direct contact with the lifting gear, eg slings.
4. Lift the load slowly and steadily, with no abrupt stops, in an upright position to the required clearance height.

CAUTION! Keep an eye on the horizontal position of the load and reposition the slings when necessary.

5. At the end of the lifting operation, remove the hand-tightened eyebolts that you installed in step 1.

NOTE – For a permanent installation, tighten the eyebolts to the correct torque (see [4.5.4 Reinstalling lifting attachments on page 59](#)) with a suitable torque wrench socket (not included in the scope of delivery).

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4.5.4. Reinstalling lifting attachments

If you need to reinstall factory-mounted lifting attachments, eg, when the drive is at end of life, tighten the mounting bolts to the torque that is specified in [Table 3](#).

NOTE – The torque wrench sockets for the rotating eyebolts are not included in the scope of delivery.

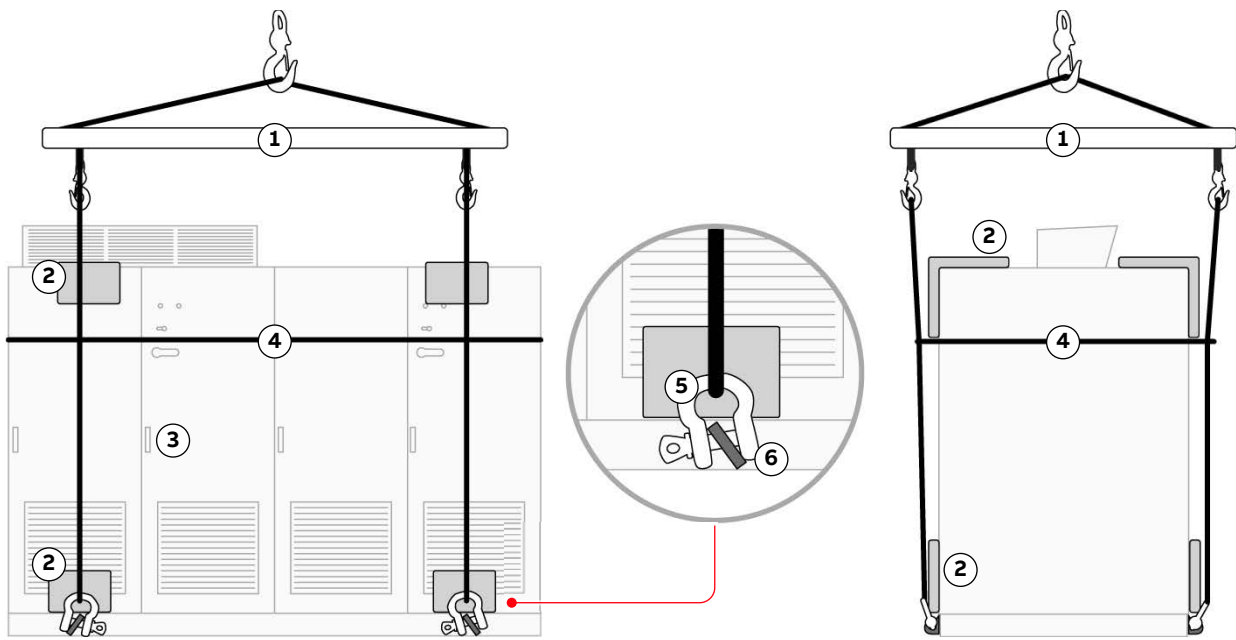
Table 3 – Lifting attachment specifications

Type	Mounting bolt	Torque (Nm)	Material No.
Lifting plate	2 × M16 × 40 (A2-70)	204	3BHB039841R0001
M16 rotating eyebolt	M16	60	3BHE015753P0016
M8 rotating eyebolt	M8	10	3BHE015753P0008

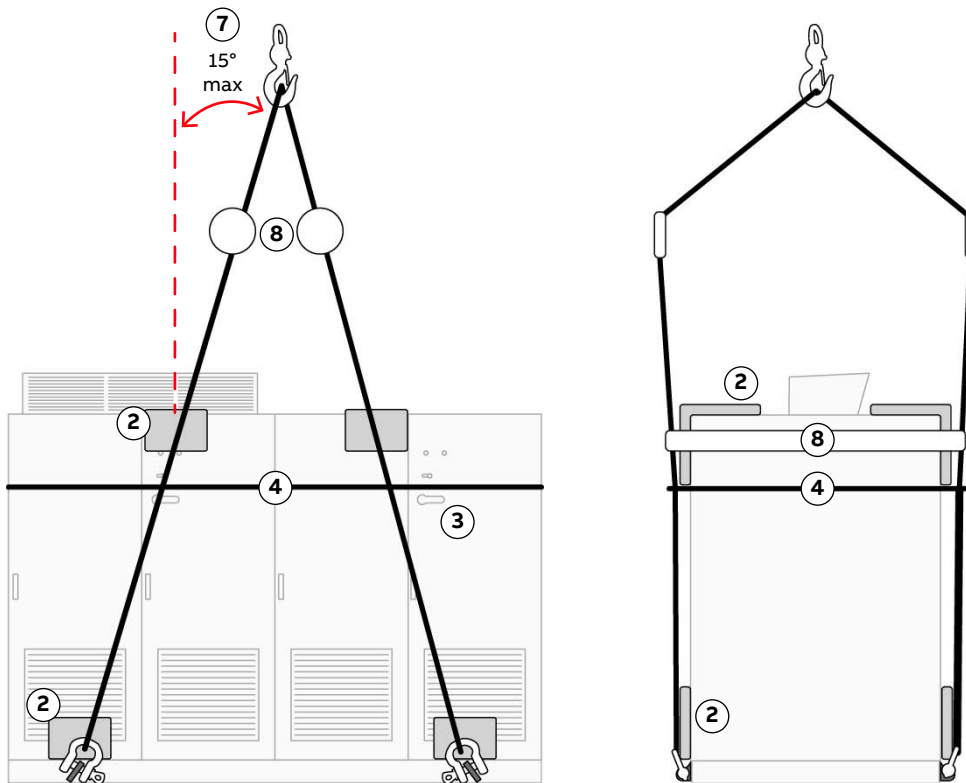


Figure 32 – Torque wrench socket for rotating eyebolt (not included in delivery)

4.5.5. Sling configurations for lift frames and spreader frames



a) Lift frame



b) Spreader frame

Key

- 1. Lift frame
- 2. Protect the edges
- 3. Protect door handles and levers
- 4. Extra horizontal sling
- 5. Safety hook or shackle
- 6. Lifting plate
- 7. Slope angle (maximum 15 °)
- 8. Lift spreader

Figure 33 – Sling configurations

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4.6. Storage

The drive can be stored for up to one year in the original packaging as long as it is not damaged or opened. For information on longer storage periods, contact the ABB service organization.

4.6.1. Storage conditions

The minimum requirements for storage are based on [IEC 60721-3-1](#).

- **Classification:** 1K22 / 1B1 / 1C2 / 1S11 / 1M11

4.6.2. Storing a drive

If the drive is taken out of service for a longer time proceed as follows:

1. Drain the cooling circuit completely or add the appropriate amount of glycol for frost proofing if the drive is to be stored in ambient temperatures below 0 °C.

For information about draining and frost proofing, see the manual of the water cooling unit in “Appendix A – Additional manuals” (see [1.2 Structure of the user documentation on page 14](#)).

2. Cover all cable inlets and ventilation slots with an impermeable plastic or aluminum foil and a wooden panel.
3. Add a desiccant of the appropriate quality:
 - One unit desiccant (30 g) absorbs 6 g water vapor
 - When using a polyethylene foil: 10 units/m² foil
4. Close and lock the doors of the drive.
5. Use polyethylene or equivalent for packaging:
 - 0.3 g/m²/24 h water vapor diffusion
6. Attach humidity indicators to the packaging.

NOTICE Check storage and packaging conditions regularly. Repair damage immediately.

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4.7. Storage and handling of spare parts



NOTICE

Risk of component damage. Static electricity can damage printed circuit boards.

→ Apply static-sensitive precautions when you handle spare parts.

4.7.1. Warranty information

IMPORTANT! Inspect all spare parts upon receipt and make note of any damage. Inform ABB and the shipping company of the damage.

To keep spare parts in good condition and to keep the warranty valid during the warranty period:

- Store spare parts in their original packaging.
- Store printed circuit boards in antistatic bags or boxes.
- Maintain a storage temperature range of -5 °C to + 55 °C
- Maintain the following storage place conditions:
 - Free of vibration and shock.
 - Protected against dust, sand, vermin and insects.
 - Free of corrosive gases, salt or other impurities that could damage electronic equipment.
 - Maintain a relative air humidity of: 5 to 95% (dry with no condensation)
 - If you cannot keep the relative air humidity in this range, protect spare parts with an external heater.
- DO NOT touch a component without wearing a wrist grounding strap.
 - Place a component on a grounded working surface that is protected against electrostatic discharges.
 - Hold a component only at the edge.

4.8. Disposal of packaging materials and components

Dispose of the packaging materials and components at the end of the life time of the drive according to local regulations.

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5. Mechanical installation

5.1. Safety



All installation work must be carried out by qualified personnel according to the site and equipment requirements and in compliance with local regulations.

5.2. Overview of installation work

The drive is delivered in transport units that must be joined and fixed to the floor at the installation site. The installation includes the following work:

- [5.5 Preparing the installation site on page 65](#)
- [5.6 Aligning transport units on page 65](#)
- [5.7 Joining transport units on page 67](#)
- [5.8 Applying silicone on page 68](#)
- [5.9 Installing roof joints on page 68](#)
- [5.10 Installing roof-mounted cooling units on page 69 \(option\)](#)
- [5.11 Installing roof attachments on marine drives on page 73 \(option\)](#)
- [5.12 Joining water pipes on page 75](#)
- [5.13 Joining busbars on page 76](#)
- [5.14 Connecting the heating cable on page 78 \(option\)](#)
- [5.15 Connecting raw water pipes on page 79](#)
- [5.16 Fixing the drive to the floor on page 79](#)

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5.3. General notes on installation

NOTICE

Risk of component damage. Incorrect transport, assembly, and post installation actions can damage the drive or transport units. Foreign objects, metallic dust, and dirt can cause an energized drive to fail

- DO NOT use a crane if the transport units are secured to the base frame; use heavy load hydraulics rollers or air cushions. If you are unsure, contact ABB for instructions.
- DO NOT damage or dislocate the EMC sealing strips when you join 2 transports units; The strips are glued to the outer surfaces of the cabinet frames.
- Close the doors and secure and fasten all covers of the drive when the work is complete

5.4. Dimensions and clearances

For information on dimensions, location and size of fixing holes and clearances, see “Appendix C – Mechanical drawings” (see [1.2 Structure of the user documentation on page 14](#)).

5.4.1. Rear and top access to the cabinet

Joining the transport units and DC busbars requires rear and top access.

5.4.2. Cabinet roof

The cabinet roof is not designed as a base for foreign devices or cable ducts. Therefore, do not install any foreign objects on the roof.

5.4.3. Fire protection

To prevent fire from spreading into the drive, apply suitable fire protection measures.

5.4.4. Cable duct material

Use cable ducts of non-flammable material with non-abrasive surface.

To prevent dust, humidity and animals from entering the drive, protect all cable entries and exits of cable ducts.

5.4.5. Installation material

Installation material is supplied with the drive in a separate box.

5.4.6. Tools

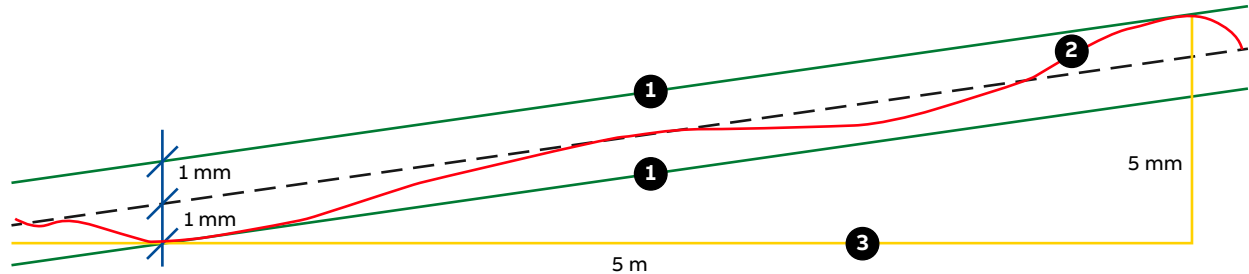
See [1.10 Tools on page 20](#).

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5.5. Preparing the installation site

To ensure proper alignment and installation of the drive, prepare the floor as follows:

- The floor must be able to support the weight of the drive (minimum 1500 kg/m²).
- The overall incline of the floor across 5 m must not exceed 5 mm.



Key

1. Tolerance from mean ground ± 1 mm
2. Surface or floor
3. Tolerance for incline: 5 mm incline on 5 m length

Figure 34 – Floor inclination

The floor must be even.

- Check the evenness and incline of the floor well in advance so that work for improving the surface is completed before the installation of the drive.
- Use a spirit level or flooring rule with a vial for checking.
Recommended length: 1 to 2 m.
- If the surface cannot be improved, place shims or leveling plates under the base frame at appropriate distances (every 1 m) for adjustment.
- Leveling plates of the following size are recommended: 100 mm × 100 mm
- Drill the fixing holes before moving the drive to the final location.

5.6. Aligning transport units

1. Remove the protective covers from the water pipe ends on both sides.



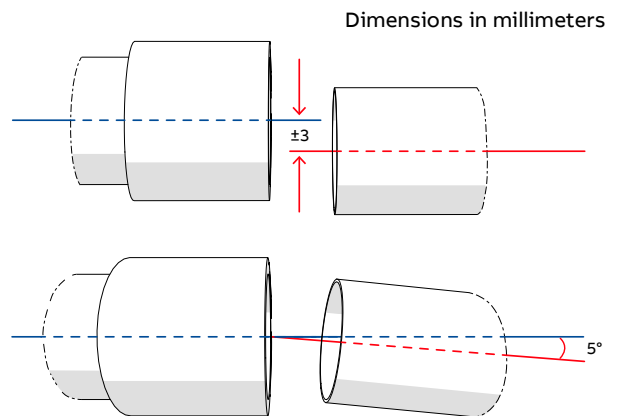
2. Check that a pipe joint has been slid on one pipe end of two adjoining water pipes.



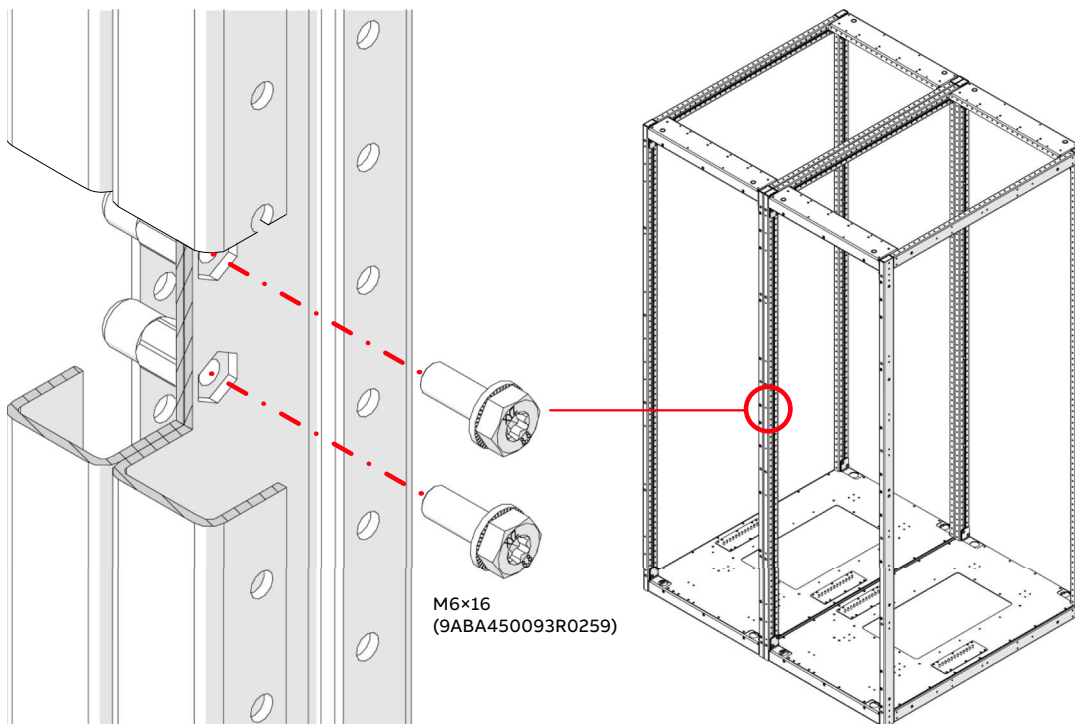
3. Line up the transport units as shown in “Appendix C – Mechanical drawings” (see [1.2 Structure of the user documentation on page 14](#)).

NOTE – The units can be lined up either beginning from the left or the right.

4. Align the transport units and verify the following:
 - Maximum values for the axial misalignment (± 3 mm) and the angular deflection (5°) of two adjoining water pipes are not exceeded



- Bolt holes are exactly aligned.



- Cabinet doors are not misaligned and that there are no gaps between cabinet walls and cabinet frame
- Adjoining surfaces of transport units meet perfectly all around

5.7. Joining transport units

Join the transport units with the supplied installation material. The installation material is attached to one of the transport units.

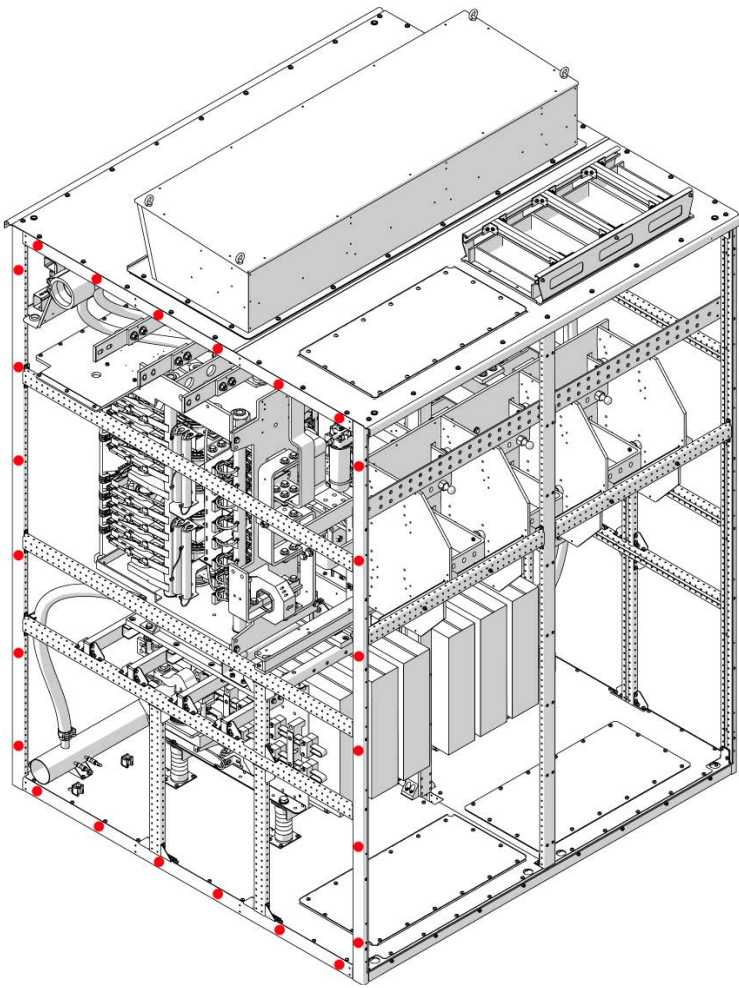


Figure 35 – Connection points on side of transport units (PCU example)

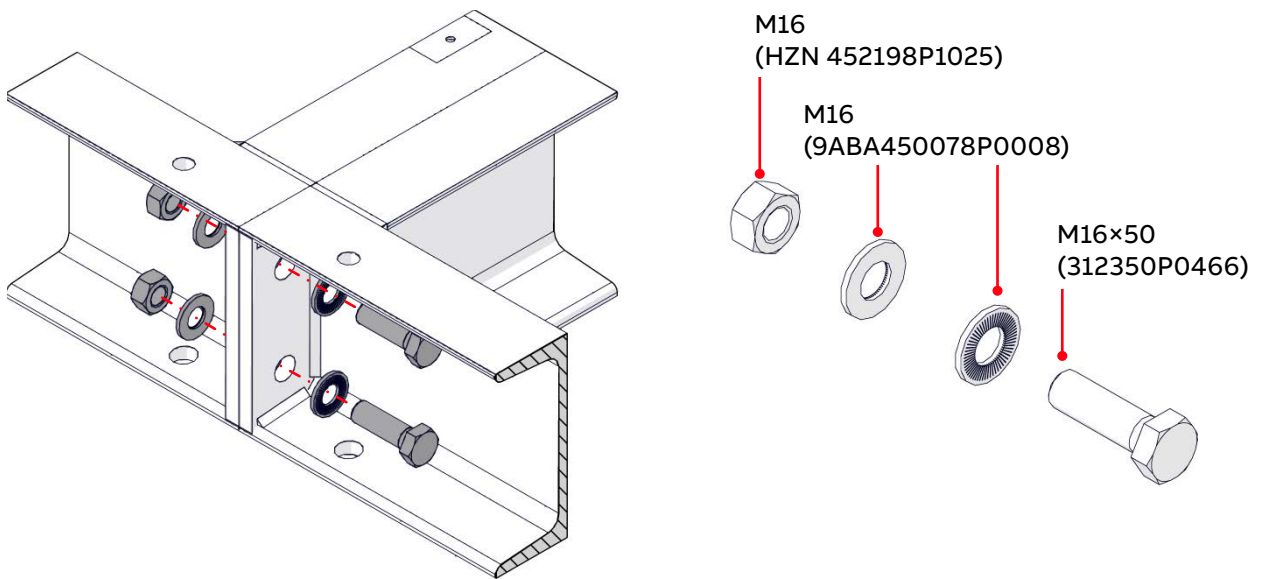


Figure 36 – Base frame connection points

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5.8. Applying silicone

Silicone prevents water from entering the gap between two joining roof plates. Apply silicone where two transport units have been joined ([Figure 37](#)). Gaps within a transport unit are factory-sealed.

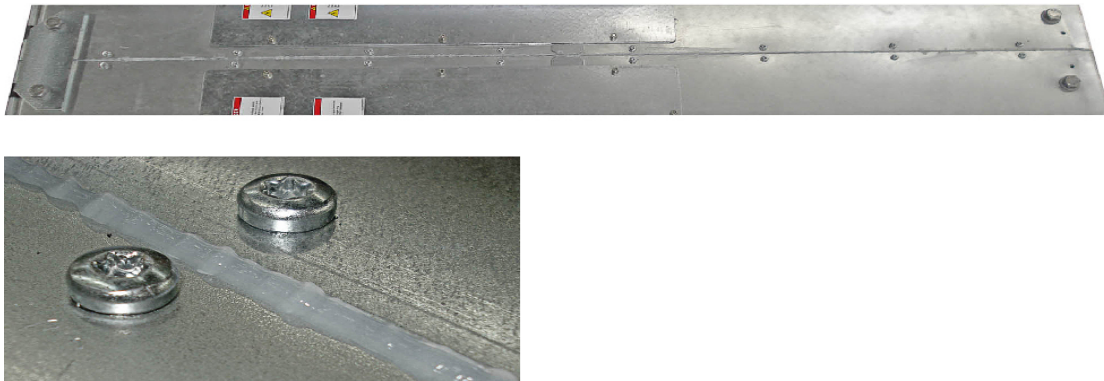


Figure 37 – Applying silicone

5.9. Installing roof joints

Install the roof joints, which were temporarily mounted on the roof for shipping, across the shipping splits at the following locations:

- Marine drives: at the front of the roof (the back is reserved for roof attachments, see [5.11 Installing roof attachments on marine drives on page 73.](#))
- Standard drives: at the front and the back of the roof

For the exact number and fitting location of roof joints, see “Appendix C – Mechanical drawings” (see [1.2 Structure of the user documentation on page 14.](#))

Table 4 – Installation material per roof joint

Items	Details	Material No.
Connecting piece	8 × 80 × 220 mm	3BHB011552R0001
Hex-head bolt	M16 × 40	NB 312350P0464
Washer	17 × 30 × 3	9ABA450078P0008



Figure 38 – Roof joint

5.10. Installing roof-mounted cooling units

You need a crane to install a roof-mounted cooling unit. Each PCU has a designated roof opening for a cooling unit. These instructions are only for PCU that were not delivered with pre-installed cooling units.

5.10.1. Installing IP42 roof-mounted cooling units



CAUTION

Heavy object! An IP42 cooling unit weighs **40 kg**.

- Use appropriate slings and shackles
- Before you begin, read [4.5.3 Lifting with rotating eyebolts on page 58](#)

Table 5 – Installation material per IP42 unit

Item	Quantity	Details	Material No.
Self-tapping Torx screws	18	M6 × 16	HAQN401050P0259
Washers with sealing	18	6.8 × 1 (4.8 × 2.8)	3BHB034338R0001
Cable binders			

1. Install rotating eyebolts (1, [Figure 39](#)) in the top corners of the IP42 cooling unit.

CAUTION! For a single lifting operation, tighten the eyebolts (1, [Figure 39](#)) firmly with the star key (2, [Figure 39](#)). DO NOT leave the star key in the bolt head. The eyebolt must be able to rotate 360° freely. For a permanent installation, tighten the eyebolts to the nominal torque that is specified in [4.5.1 Lifting attachment types on page 56](#) for the tightening torque.

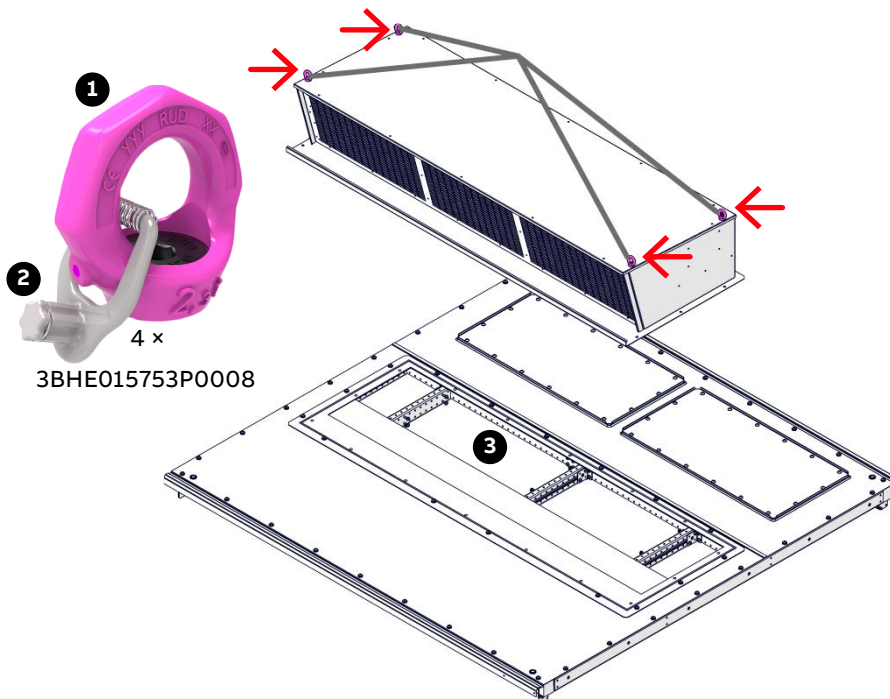


Figure 39 – Lifting an IP42 cooling unit

2. Attach the appropriate slings and shackles to the rotating eyebolts.
3. Orient the rotating eyebolts in the direction of force.

CAUTION! Rotation during transportation must be avoided.

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4. Lift the cooling unit above the PCU cabinet with a crane.
5. Align the cooling unit with the opening (3, [Figure 39](#)) in the cabinet roof and slowly lower the cooling unit onto the cabinet roof.
IMPORTANT! Ensure that the screw holes on the roof and the cooling unit match up.
6. Secure the cooling unit to the cabinet roof with the supplied screws.
7. Remove the rotating eyebolts that you installed in [step 1](#).
CAUTION! For a permanent installation, tighten the eyebolts to the torque that is specified in [Table 3](#).
8. Feed the cables from the cooling unit into the cabinet.
NOTE – You might need to remove the back wall of the cabinet to gain access to the cables.
9. Route the cables along the pre-installed white cable brackets and through the designated openings (1, [Figure 40](#)) into the front of the cable duct.
IMPORTANT! Use cable binders to fix the cables to the cable brackets.

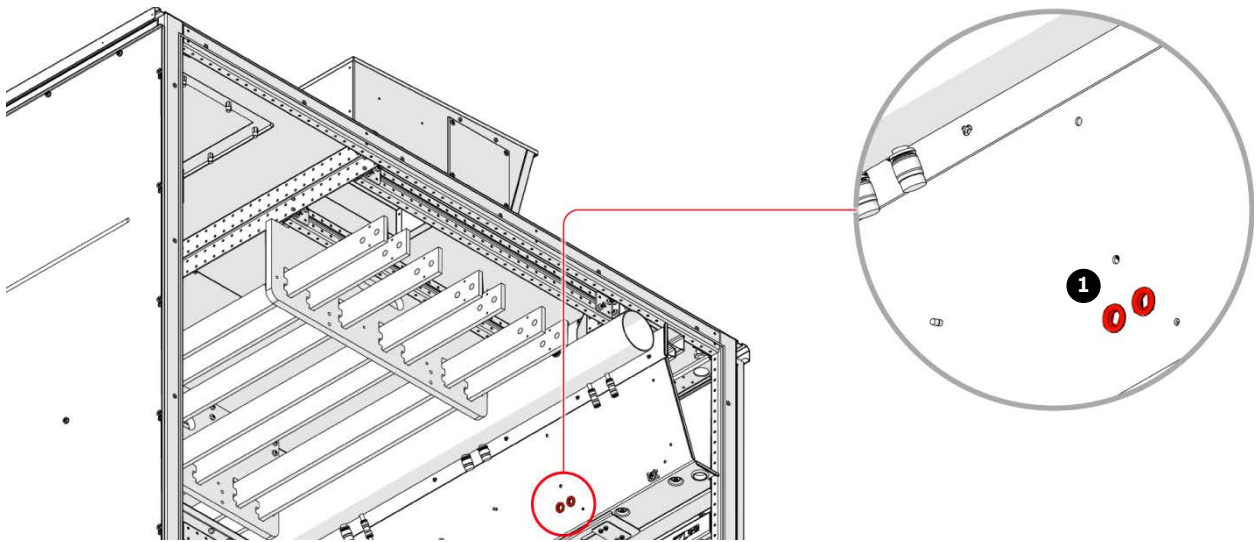


Figure 40 – Cable duct openings (example with 1700 mm PCU)

10. In the cable duct at the front of the cabinet, connect the cables according to “Appendix D – Wiring diagrams” (see [1.2 Structure of the user documentation on page 14](#)).

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5.10.2. Installing IP54 roof-mounted cooling units



CAUTION

Heavy object! An IP54 cooling unit weighs **98 kg**.

- Use appropriate slings and shackles
- Before you begin, read [4.5.3 Lifting with rotating eyebolts on page 58](#)

Table 6 – Installation material per IP54 unit

Item	Quantity	Details	Material No.
Self-tapping Torx screws	22	M6 × 16	HAQN401050P0259
Washers with sealing	22	6.8 × 1 (4.8 × 2.8)	3BHB034338R0001
Tube spacers	2		

1. Install rotating eyebolts (1, [Figure 41](#)) in the top corners of the IP54 cooling unit.

CAUTION! For a single lifting operation, tighten the eyebolts (1, [Figure 41](#)) firmly with the star key (2, [Figure 41](#)). DO NOT leave the star key in the bolt head. The eyebolt must be able to rotate 360° freely. For a permanent installation, tighten the eyebolts to the nominal torque that is specified in [4.5.1 Lifting attachment types on page 56](#) for the tightening torque.

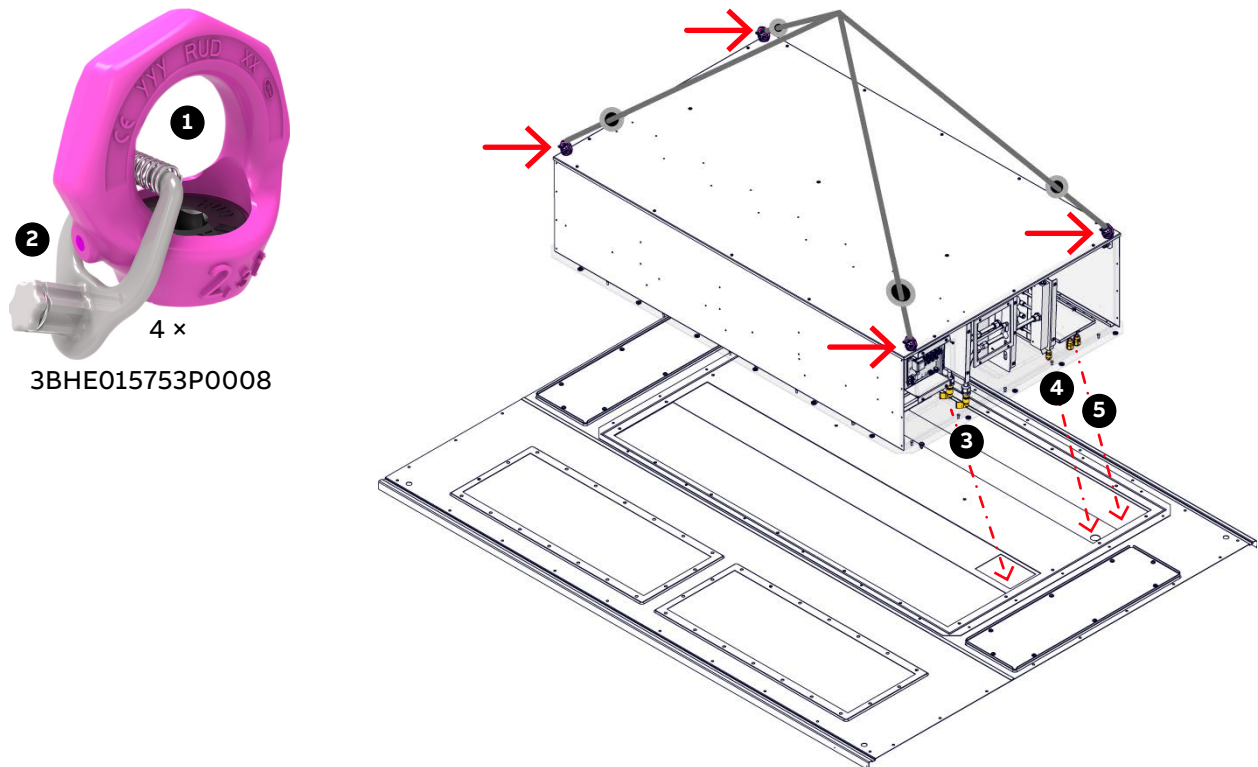


Figure 41 – Lifting an IP54 cooling unit

2. Attach the appropriate slings and shackles to the rotating eyebolts.
3. Orient the rotating eyebolts in the direction of force.
CAUTION! Rotation during transportation must be avoided.
4. Lift the cooling unit above the PCU cabinet with a crane.

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- Align the water inlet / outlet (3, [Figure 41](#)), drain outlet (4, [Figure 41](#)), and cables (5, [Figure 41](#)) of the cooling unit with the designated openings in the cabinet roof and then slowly lower the cooling unit onto the cabinet roof.

IMPORTANT! Ensure that the screw holes on the roof and the cooling unit match up.

- Secure the cooling unit to the cabinet roof with the supplied screws.
- Remove the rotating eyebolts that you installed in step.

CAUTION! For a permanent installation, tighten the eyebolts to the torque that is specified in [Table 3](#).

- Connect the tube from the return pipe (5, [Figure 42](#)) to the water outlet (1, [Figure 42](#)).

NOTE – If you cannot reach the water inlets and outlets from underneath the cable duct at the front of the cabinet, you might need to remove the back wall.

The tubes are transparent and the colors in [Figure 42](#) are for illustration only. From the back of the cabinet, the water outlet is on the left and from the front of the cabinet, the water outlet is on the right.

- Connect the tube from the feed pipe at the bottom of cabinet to the water inlet (2, [Figure 42](#)).
- From the back of the cabinet, the water inlet is on the right and from the front of the cabinet, the water inlet is on the left.
- Connect the drain tube to the drain outlet (3, [Figure 42](#)).

The drain tube guides water condensation to the cabinet floor.

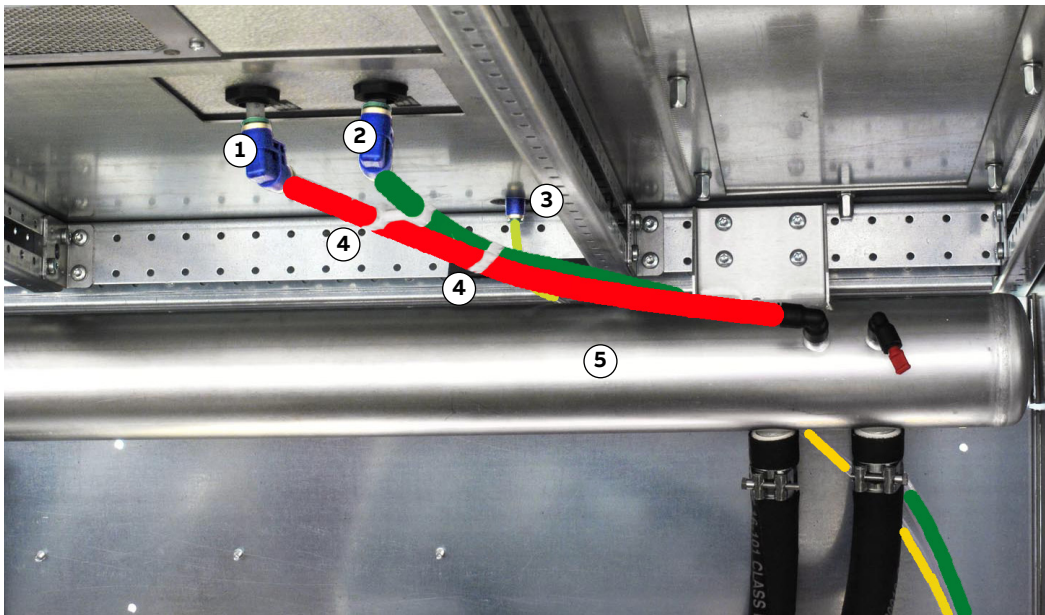


Figure 42 – Water tube connections (back view)

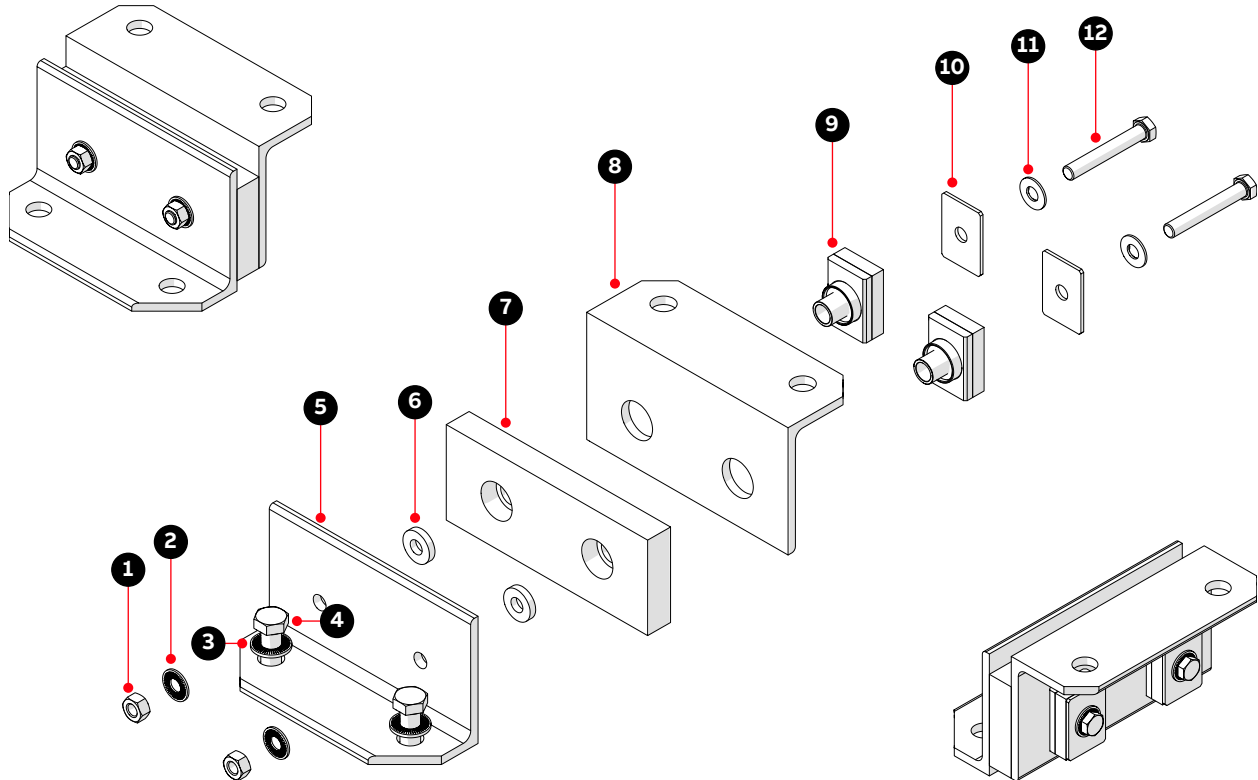
- Install the two white spacers (4, [Figure 42](#)) between the inlet and outlet tube.
- In the cable duct at the front of the cabinet, connect the cables according to “Appendix D – Wiring diagrams” (see [1.2 Structure of the user documentation on page 14](#)).

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5.11. Installing roof attachments on marine drives

Roof attachments are only available for marine drives.

To prevent tilting and dampen vibrations, attach the drive to the ceiling or the back wall of the drive room according to the instructions. For information on the fitting location, see “Appendix D – Wiring diagrams” (see [1.2 Structure of the user documentation on page 14](#)).



Key	Details	Material No.	
1.	2 × nuts	M12	HZN 452198P1022
2.	2 × washers	13 / 29 ST / ZN	9ABA450078P0007
3.	2 × washers	17×30×3	9ABA450078P0008
4.	2 × hex-head bolts	M16×40	NB 312350P0464
5.	1 × bracket		3BHB035997R0002
6.	2 × spacers		3BHB032466R0001
7.	1 × damping pad		3BHB035998R0001
8.	1 × bracket		3BHB035997R0001
9.	2 × damping connectors		3BHB033405R0001
10.	2 × plates		3BHB035999R0001
11.	2 × washers	13 / 29 ST / ZN	9ABA450078P0007
12.	2 × hex-head bolts	M12×80	NB 312450P8127

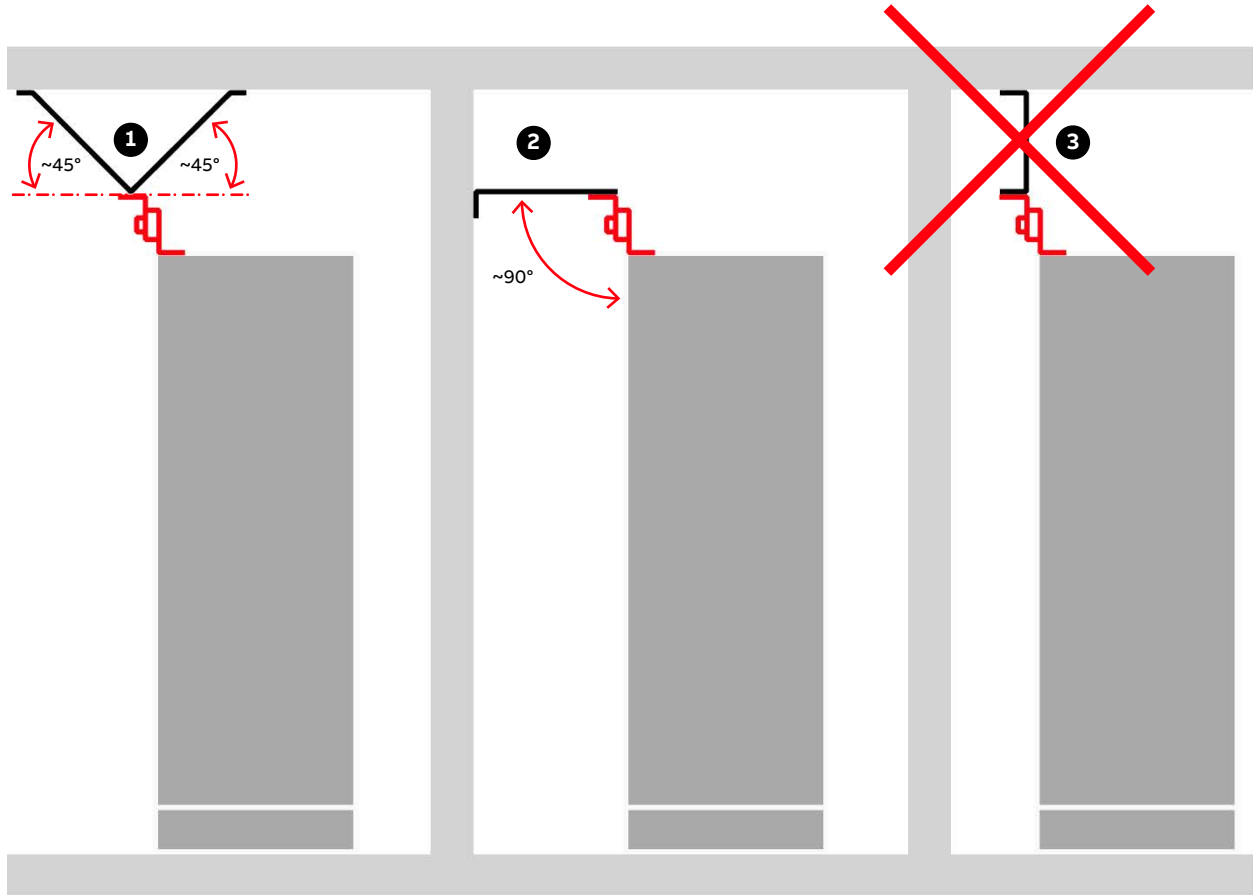
Figure 43 – Roof attachment

1. Assemble the roof attachment.
2. Tighten the bolts firmly.

3. To fix the drive to the ceiling or the back wall, use two suitable struts per roof attachment (the struts are not part of the scope of delivery).

WARNING! DO NOT install the struts at a 90° angle to the cabinet roof (3, [Figure 44](#)).

4. If you fix the drive to the ceiling, use two struts per roof attachment (1, [Figure 44](#)).
5. If you fix the drive to the back wall, install one strut at a 90° angle to the drive (2, [Figure 44](#)).



Key

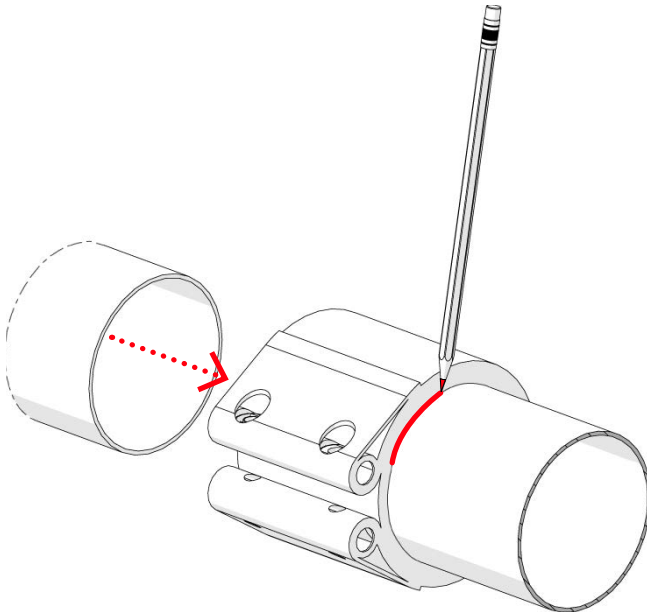
1. Two struts at 45° to ceiling
2. One strut at 90° to wall
3. DO NOT install the struts at a 90° angle to the cabinet roof

Figure 44 – Recommended ceiling and wall fixings

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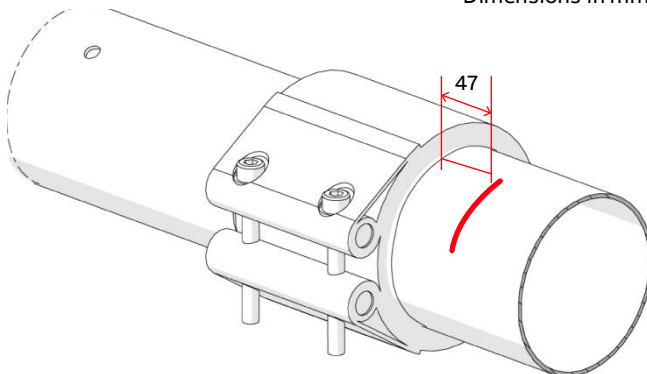
5.12. Joining water pipes

1. Mark the length of a pipe joint on one end of a water pipe as a fitting guide.



2. Slide the pipe joint over the two adjoining pipe ends.
3. Center the pipe joint.

Dimensions in mm



4. After adjusting a pipe joint, alternately tighten the bolts lightly.
5. Tighten the bolts to the torque indicated on the pipe joint.

5.12.1. Removing a pipe joint

If you need to remove a pipe joint, proceed as follows:

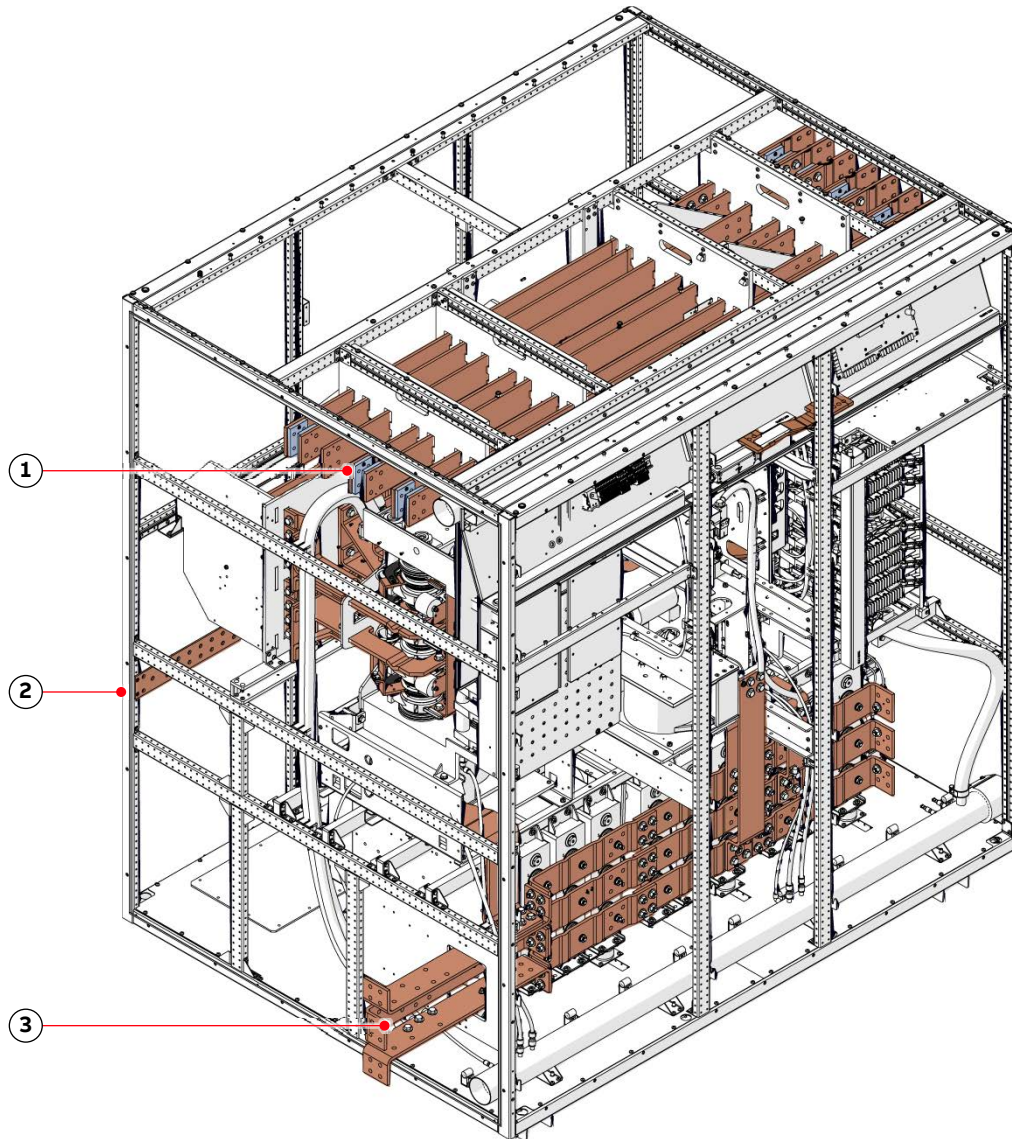
1. Loosen the bolts alternately but do not remove them completely.
2. Slide the pipe joint to the side.
3. The sealing lip may touch the pipe end.
4. Turn and move the pipe joint smoothly.
5. Clean the pipe joint and treat the bolts with an appropriate lubricant before refitting.

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5.13. Joining busbars

There are three types of busbars that need to be joined:

- AC busbars (1, [Figure 45](#))
- PE ground busbar (2, [Figure 45](#))
- DC busbars (3, [Figure 45](#))



Key

1. AC busbars
2. PE ground busbar
3. DC busbars

Figure 45 – Busbar connections

1. Before installing the joining pieces, grease the bolts to maintain the required contact pressure.
2. Join the busbars.
3. Tighten the bolts to the torque of 40 Nm.

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5.13.1. AC busbars

The joining pieces of the AC busbars and related installation material are mounted at one of the busbar ends in the transport units.

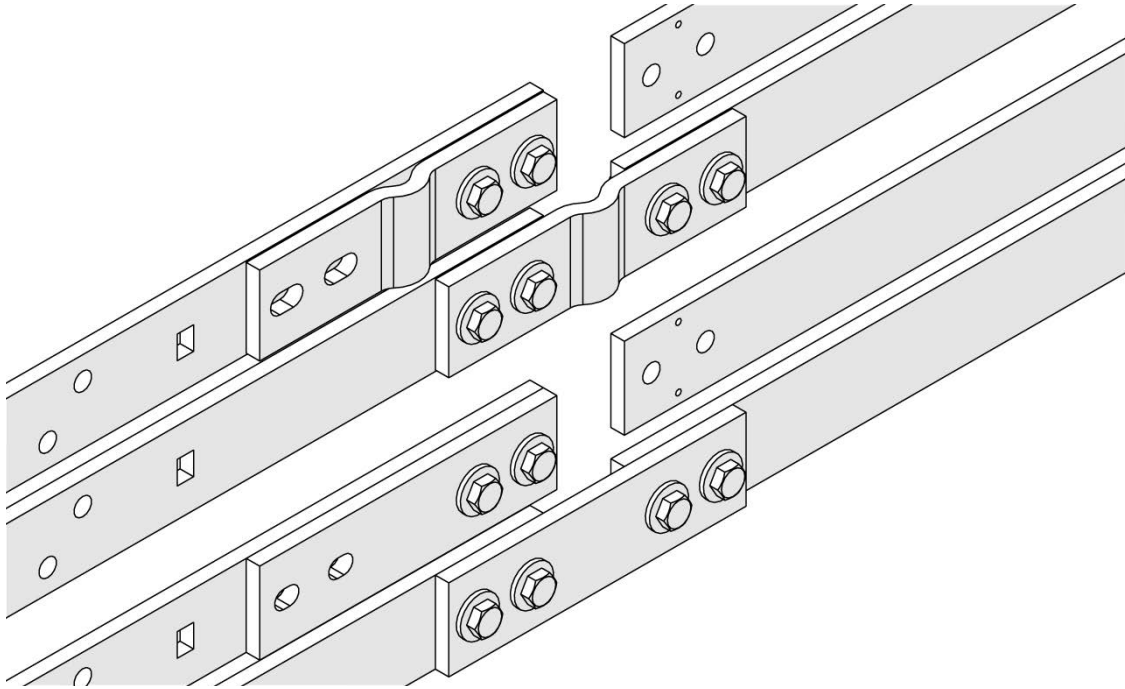


Figure 46 – AC busbar connection

5.13.2. PE ground busbar

The joining pieces of the PE ground busbar and related installation material are mounted at one of the busbar ends in the transport units.

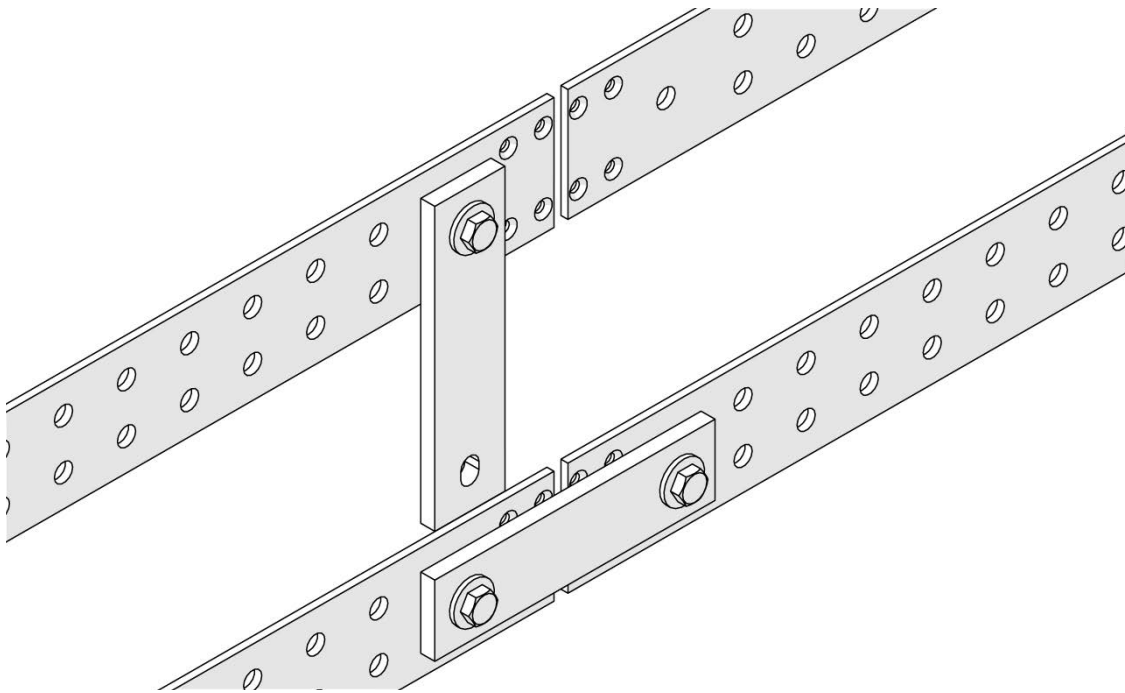


Figure 47 – PE ground busbar connection

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5.13.3. DC busbars

The joining pieces of the DC busbars are deposited inside the transport units. Related installation material is mounted at one of the busbar ends in the transport units.

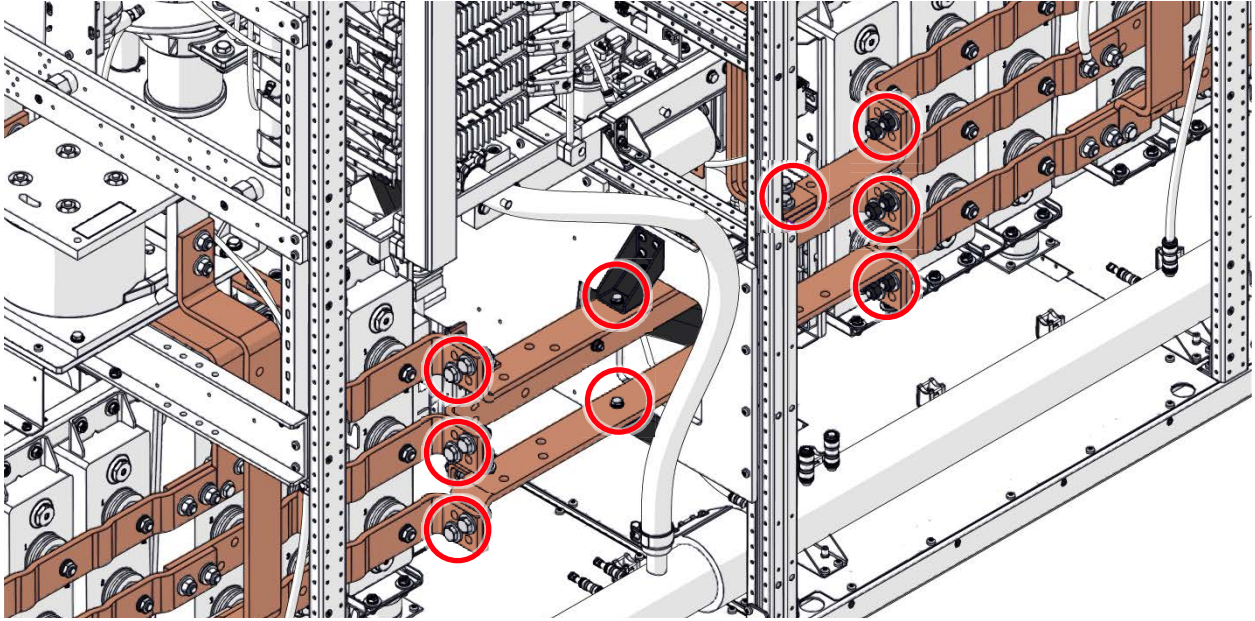


Figure 48 – DC busbar connection

5.14. Connecting the heating cable

Some drives have heating cables that you need to connect when you assemble the transport units.

1. Connect the heating cables (1, [Figure 49](#)) of two adjoining transport units.
2. Fasten the connectors with cable ties (2, [Figure 49](#)).

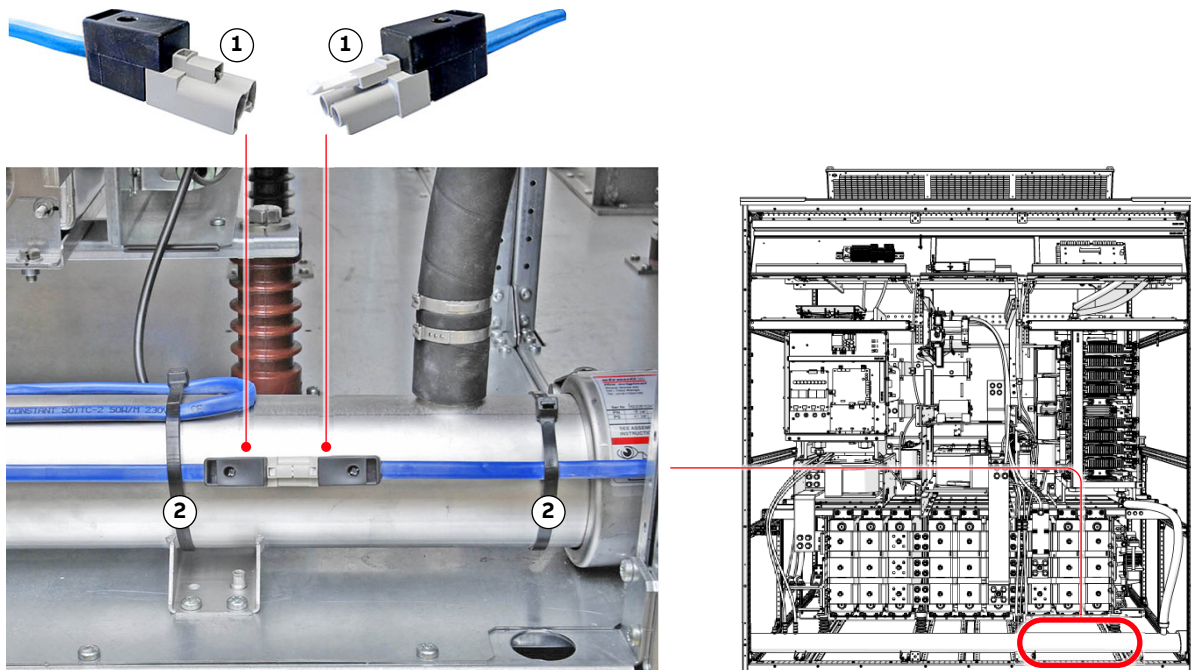


Figure 49 – Heating cable connection

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5.15. Connecting raw water pipes

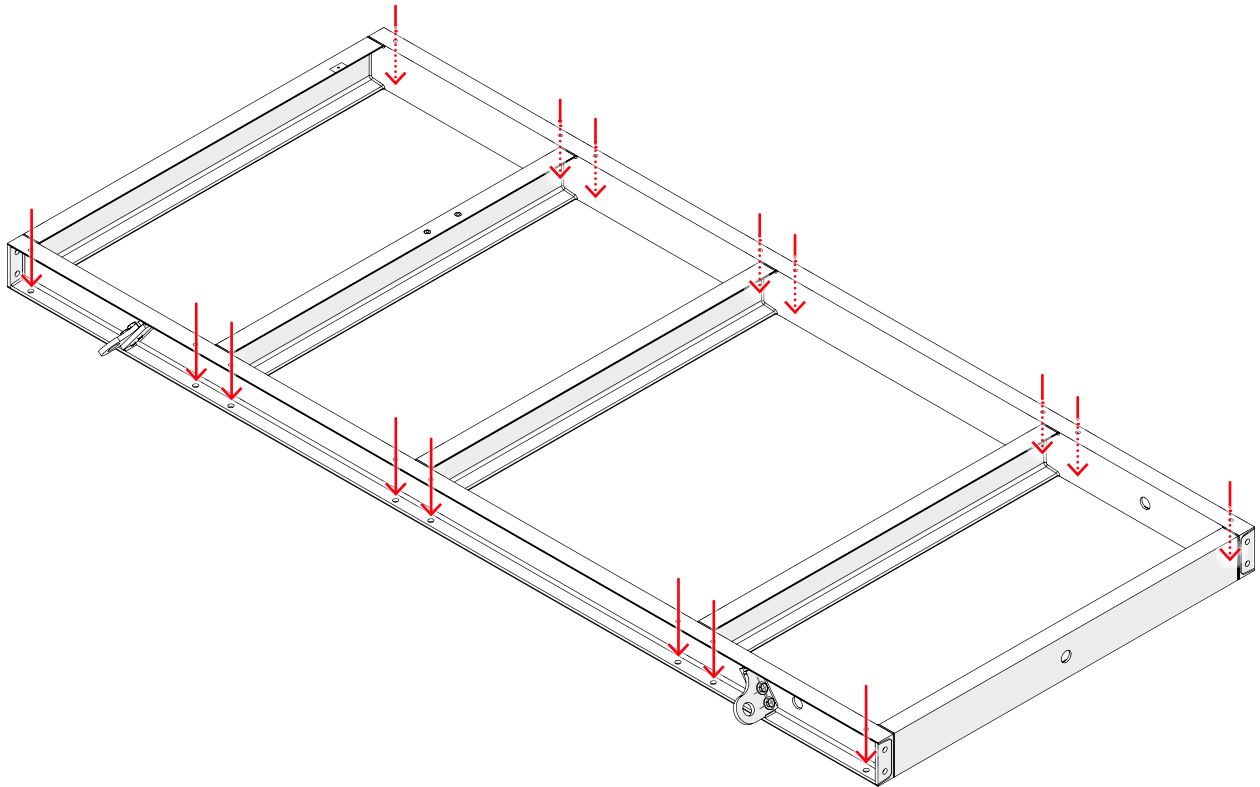
Connect the incoming and outgoing raw water pipes to the flanges of the water cooling unit.

NOTE – Installation material such as counter flanges, bolts, nuts and seals are in the loose parts box that was delivered with the drive.

For dimensions of the raw water entry and the flanges, see “Appendix C – Mechanical drawings” (see [1.2 Structure of the user documentation on page 14](#)).

5.16. Fixing the drive to the floor

The base frame provides holes (arrows) for fixing the drive to the floor. Floor fixings are not supplied. Bolts and nuts of size M16 are recommended.



For more information, see the fixing and lifting document in “Appendix C – Mechanical drawings” (see [1.2 Structure of the user documentation on page 14](#)).

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6. Electrical installation

6.1. Safety



⚠ DANGER

Hazardous voltage! Risk of DEATH or life-threatening injury!

- Qualified personnel only, who have a thorough knowledge of relevant electrical codes, site, and equipment requirements.
- DO NOT switch on main and auxiliary power supplies without ABB consent.
- Take preventive measures to ensure power remains off during the installation.
- Obtain consent from ABB commissioning personnel at end of the installation to switch on the power

6.2. Overview

Electrical installation includes the following tasks:

- Grounding
- Internal wiring
- Cable entries
- Power cables, ground cables, equipotential bonding conductor
- Auxiliary power cables and control cables

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Approved	Public	3BHS904690 E01	E	en	80/159

6.3. Cable requirements

6.3.1. Power cables

For information on the requirements for power cables, ground cable and equipotential bonding conductor, see:

- "Power cable specification" (3BHS215798 E01)
- "Power cables engineering guideline" (3BHS542290 E01)

6.3.2. Additional cable requirements for EXU power cable in a UL certified drive

The UL347A standard has additional requirements for field connection power cables below 1500 V; therefore, the EXU power input and output cabling in a UL certified drive must comply with the following additional requirements:

- Maximum diameter per core of 253 mm² (500 kcmil), which is determined by the ampacity that is required for a minimum temperature rating of 90 °C
- Maximum six cables per phase
- Three-core cables must be used when there are more than three cables per phase due to the limitation of cable entry
- Minimum tightening torque of 42.4 Nm (375 lbf-in) for the terminals

6.3.3. Auxiliary and control cables

NOTICE

Risk of false signals! Power supply cables can disrupt signals in control cables.

- DO NOT lay control cables in parallel to the power supply cables.
If this cannot be avoided, a minimum distance of 30 cm must be maintained between control and power supply cables.
- Cross control and power supply cables at an angle of 90°

For information on the requirements for the auxiliary power cable and the control cables, see "Auxiliary power and control cables guideline" (3BHS813742 E01).

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6.4. Grounding

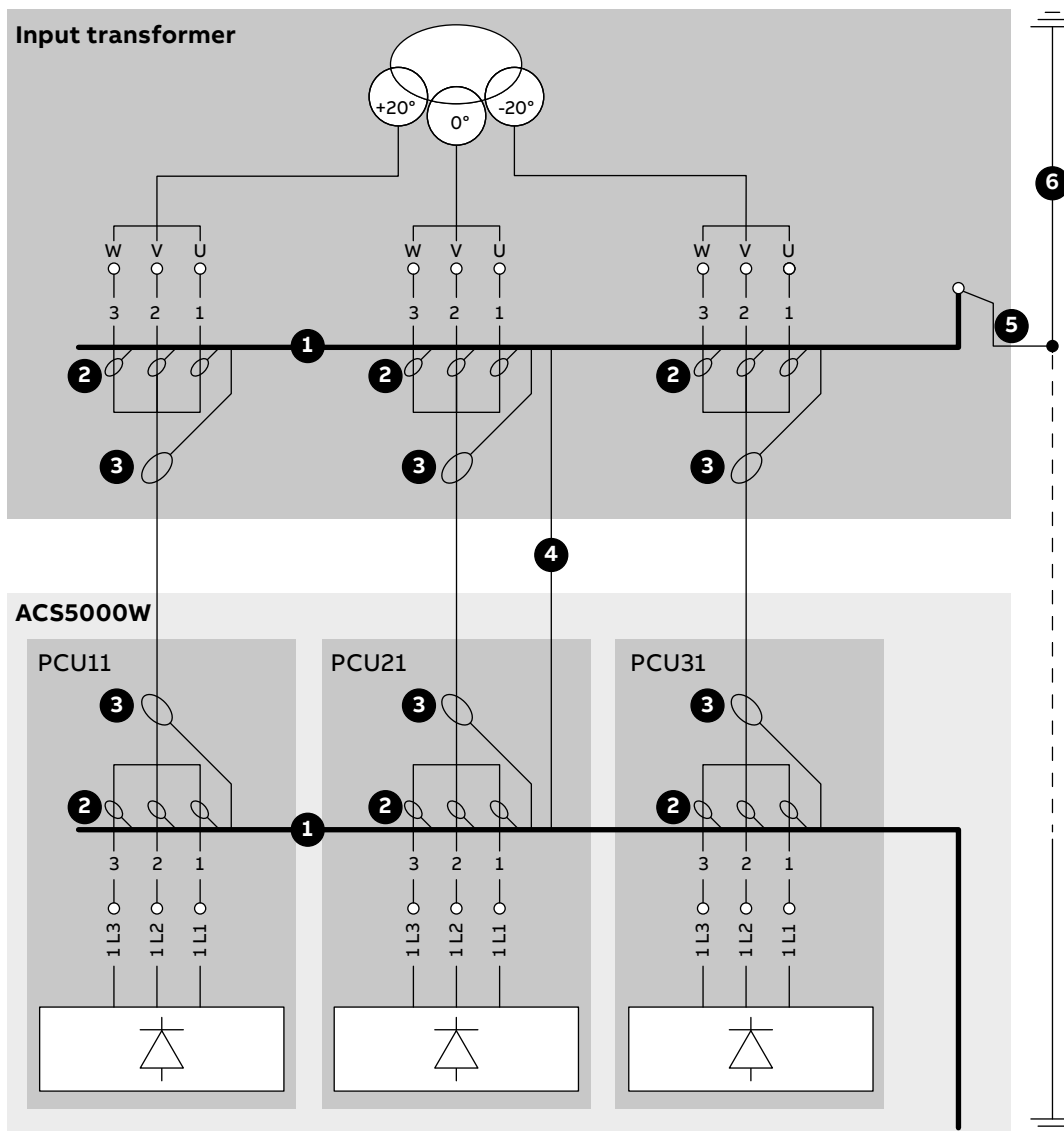
The cabinet is equipped with ground buses (marked PE, Protective Earth) for grounding the armor and shields of the cables, and for the connection of the ground cable.

To identify the ground buses, see Appendix C – Mechanical drawings (see [1.2 Structure of the user documentation on page 14](#)).

For more information see the "Power cable specification" (3BHS215798 E01) and "Power cables engineering guideline" (3BHS542290 E01).

6.4.1. Grounding the transformer and an 18-pulse drive

Figure 50 shows the grounding connections of an ACS5000W drive with an 18-pulse line supply and an input transformer.



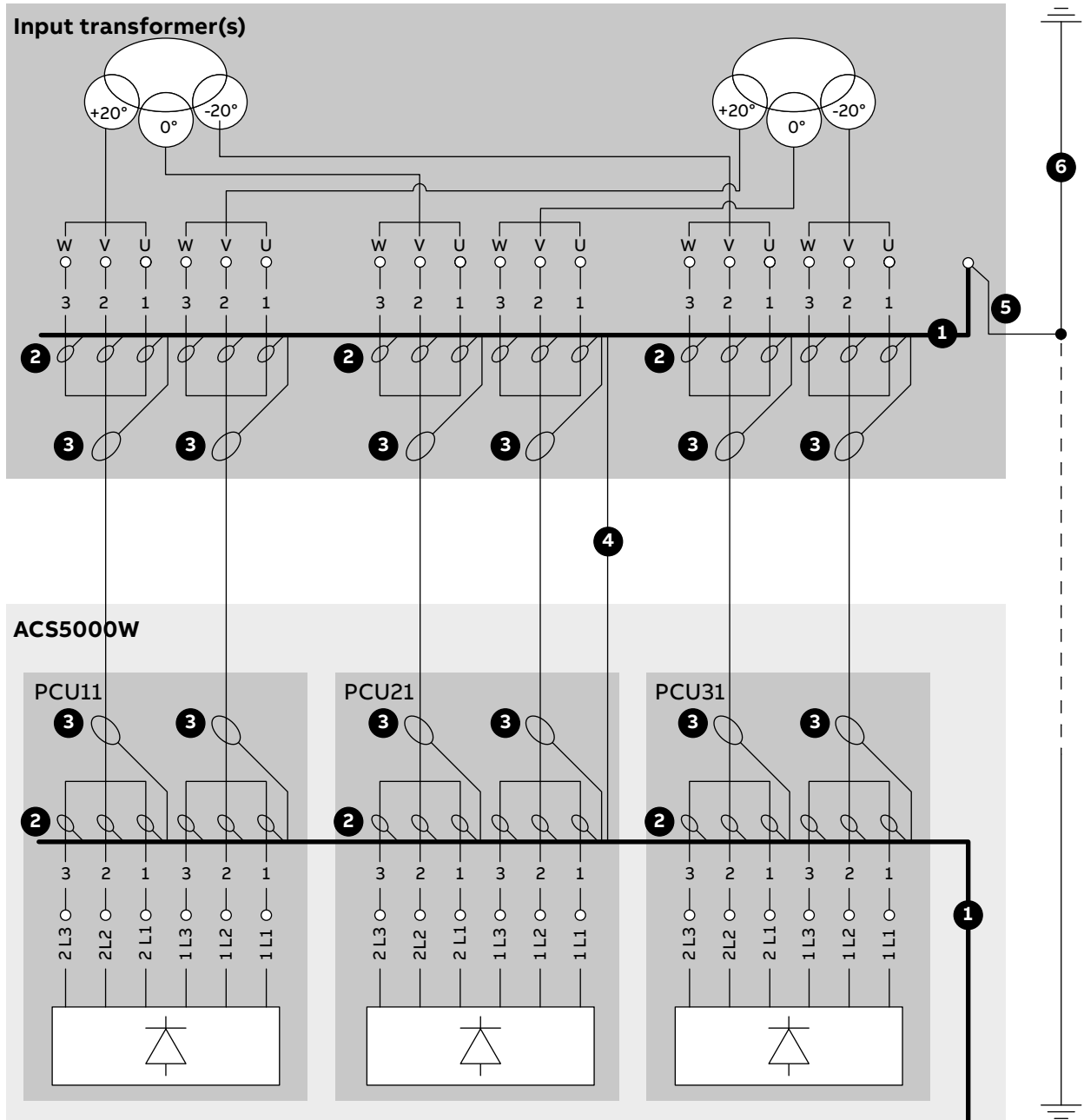
Key

- | | | |
|-----------------------|---|---|
| 1. PE busbar | 4. Equipotential bonding conductor (optional) | 6. System ground (grounding network of installation site) |
| 2. Cable screen | | |
| 3. Cable shield/armor | 5. Ground conductor | |

Figure 50 – Grounding the transformer and an 18-pulse drive (in PCU)

6.4.2. Grounding the transformer and a 36-pulse drive

Figure 51 shows the grounding connections of an ACS5000W drive with a 36-pulse line supply and an input transformer.



Key

1. PE busbar
2. Cable screen
3. Cable shield/armor
4. Equipotential bonding conductor (optional)
5. Ground conductor
6. System ground (grounding network of installation site)

Figure 51 – Grounding the transformer and a 36-pulse drive (in PCU)

6.4.3. Grounding the drive and the motor (multi-point bonding)

Multi-point bonding is the preferred method for voltage source converter applications.

NOTE – Multi-point bonding is not allowed for high-speed applications; use single-point bonding instead (see 6.4.3 Grounding the drive and the motor (multi-point bonding) on page 84).

For more information, see "Power cables engineering guideline" (3BHS542290 E01).

Figure 52 shows the multi-point connections for grounding a drive and a motor in the COU compartment.

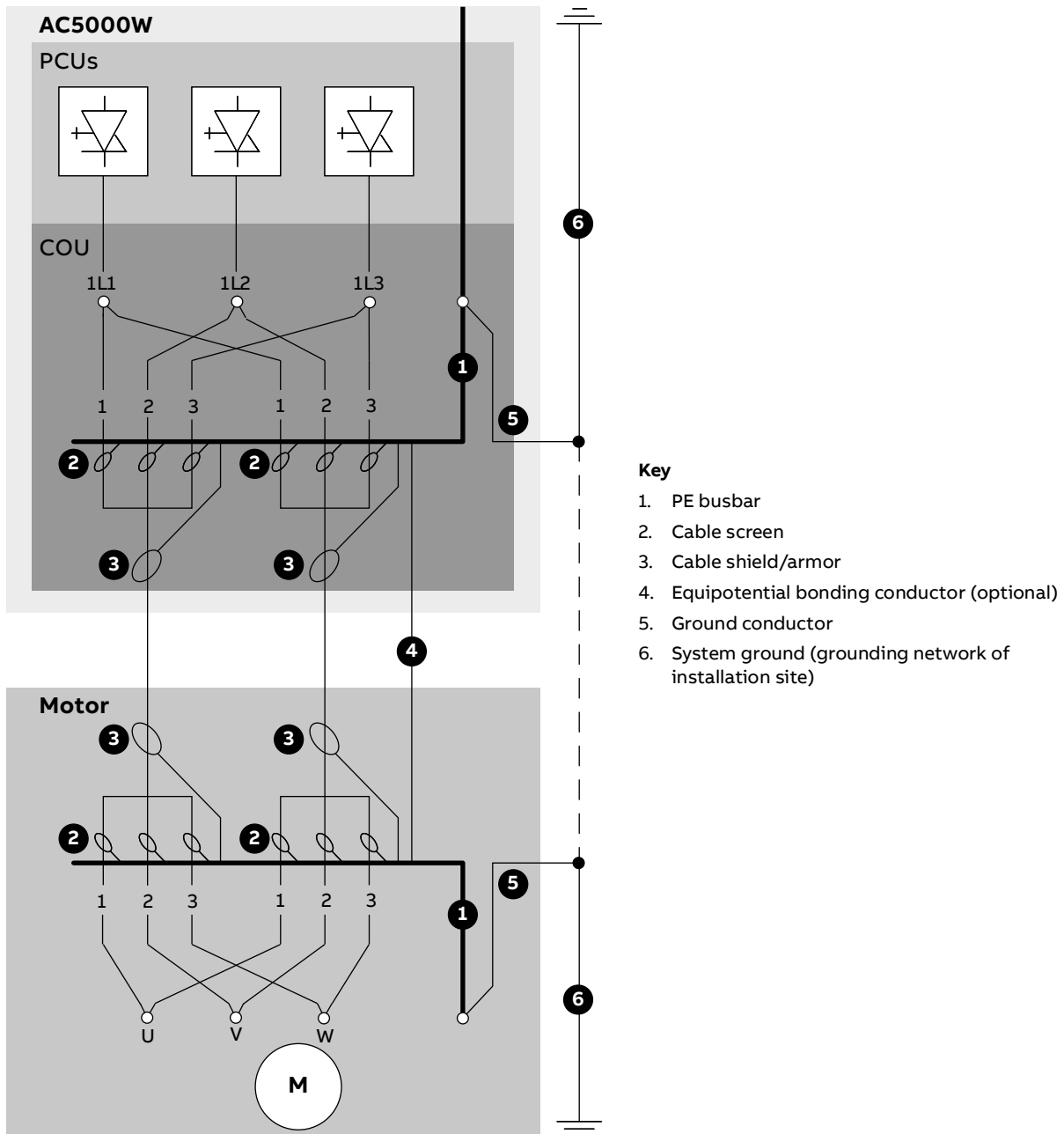


Figure 52 – Grounding the drive and the motor (multi-point bonding)

6.4.4. Grounding the drive and the motor (single-point bonding)

Single-point bonding is the preferred method for high-speed applications with fundamental frequencies above 120 Hz.

For more information see the "Power cables engineering guideline" (3BHS542290 E01).

Figure 53 shows the single-point bonding connections to ground a drive and a motor in the COU compartment.

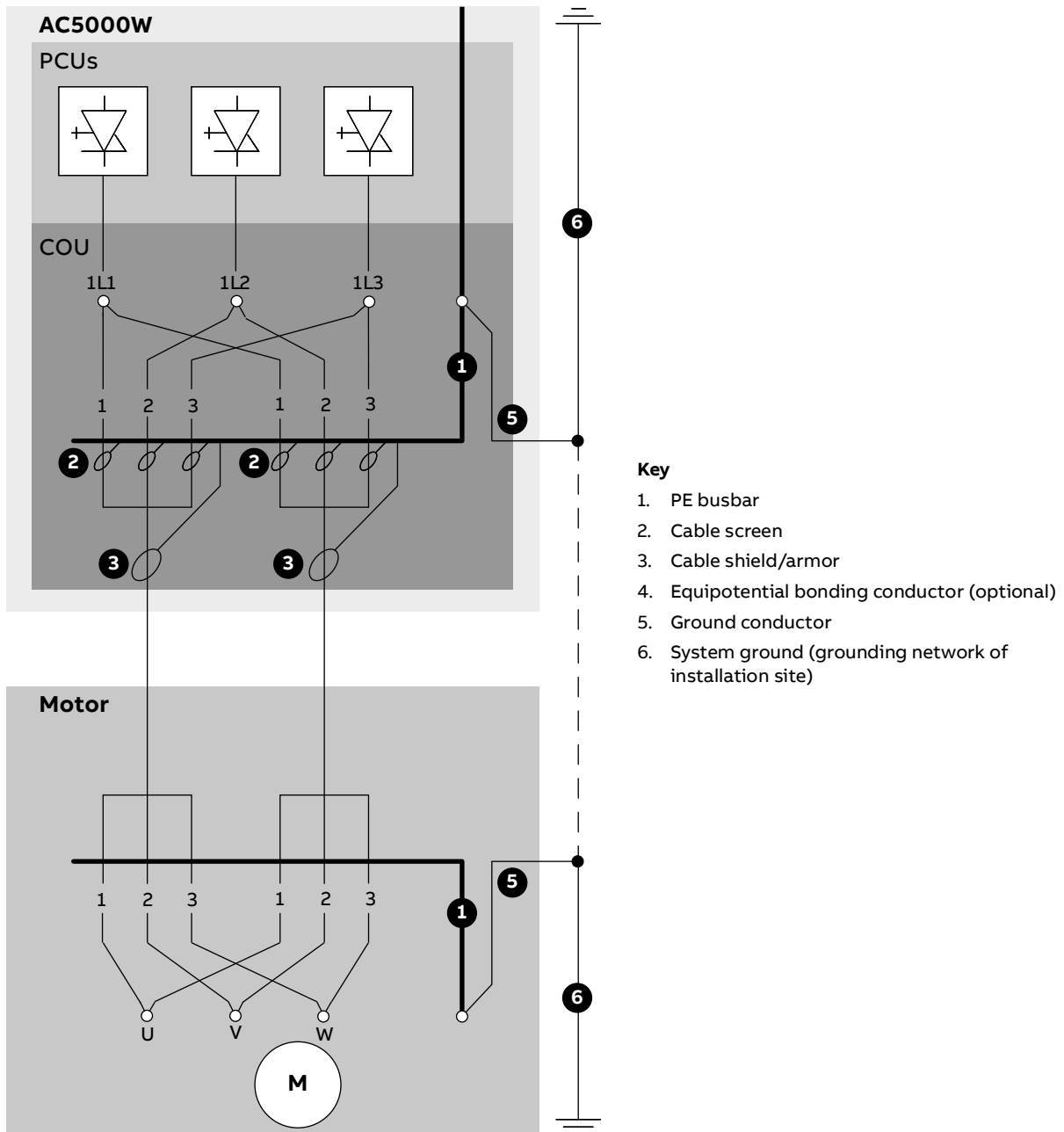
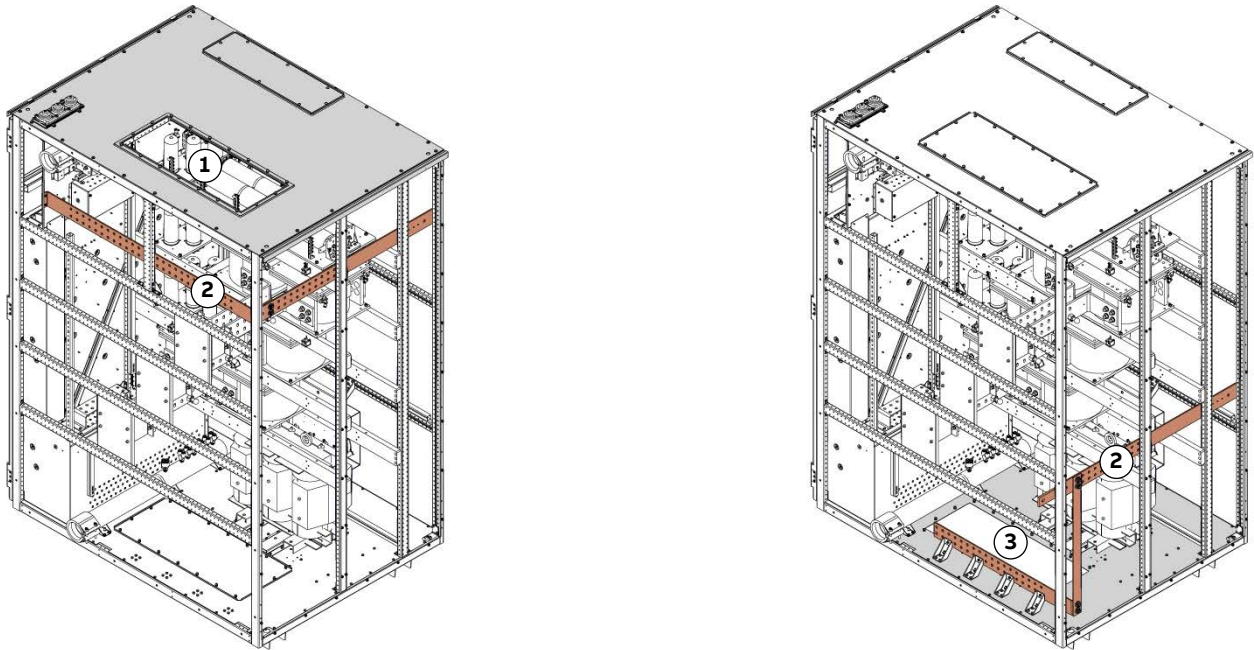


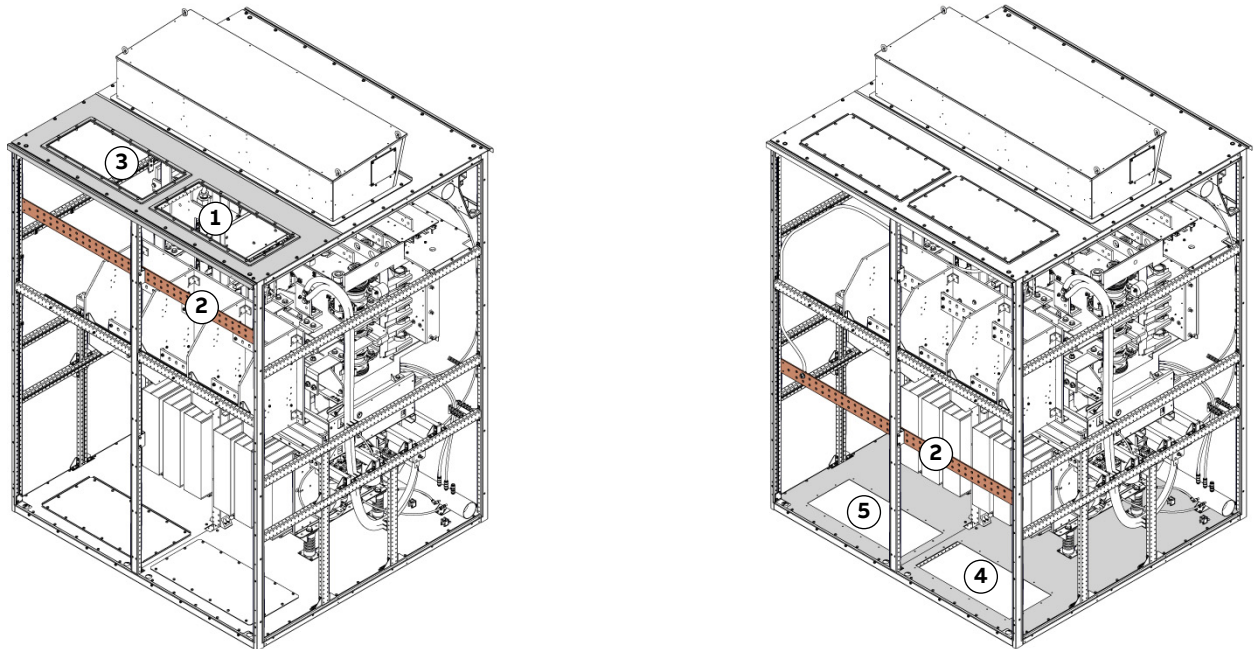
Figure 53 – Grounding the drive and the motor (single-point bonding)

6.4.5. Ground cable connection

The ground cable enters the COU compartment from the top or from the bottom. It connects to the PE ground busbar of the adjoining PCU compartment. The ground busbar spans across the entire length of the drive (Figure 54). The connection must be in compliance with local regulations. For project-specific illustrations, see Appendix D – Wiring diagrams (see 1.2 Structure of the user documentation on page 14).



a) COU



b) PCU

Key

- 1. Top cable entry
- 2. PE ground busbar
- 3. Top cable entry – second opening (FS3/FS4 only)
- 4. Bottom cable
- 5. Bottom cable entry – second opening (FS3/FS4 only)

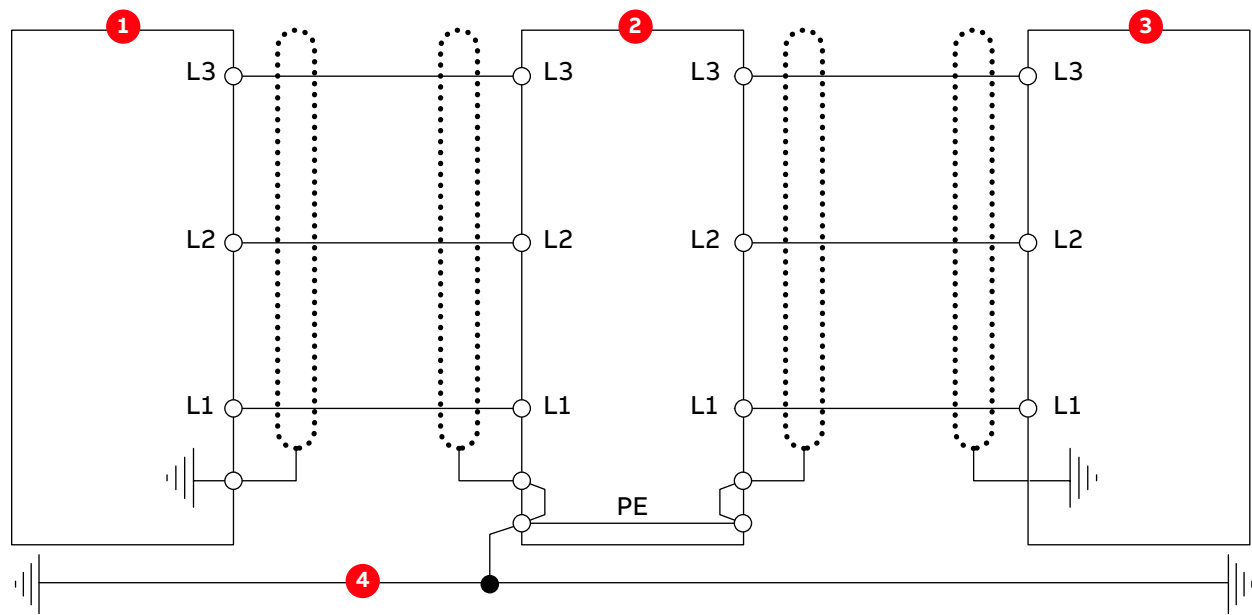
Figure 54 – PE ground busbar examples

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6.4.6. EXU cabinet ground connections

For safe operation, the EXU cabinet must be properly grounded:

- Connect the ground to the ground system of the installation site and to the ground busbar inside the EXU
- Minimum cross-sectional area of the ground conductor must be 16 mm^2 or $\frac{1}{2}$ of the phase conductor cross-sectional area (whichever area is stricter according to IEC 61800-5-1)
- Ground conductor must be the same material as the phase conductors
- Outer cable screens at both ends of a cable must be grounded
- At the EXU, ground the cable screen via the conductive sleeve of the entry plate



Key

1. Transformer
2. EXU
3. Motor
4. Ground cable

Figure 55 – Grounding the EXU

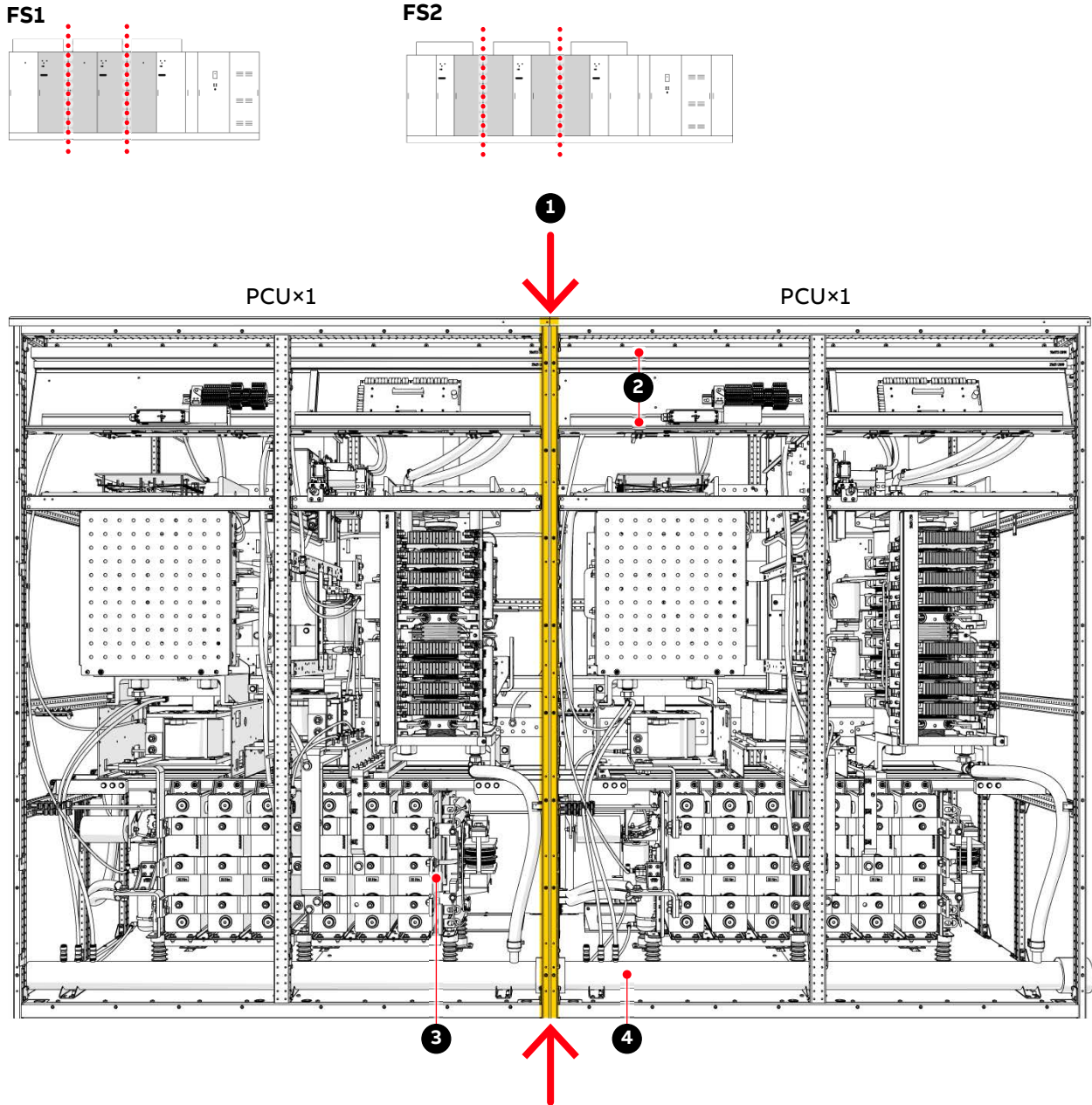
6.5. Internal wiring

For information on individual connections, see the converter hardware diagram in Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)). Internal wiring refers to all cabling and wiring across shipping splits, including:

- Signal cable connection
- Auxiliary power supply cable connection
- Optical fiber connections
- Arc Guard sensor cabling

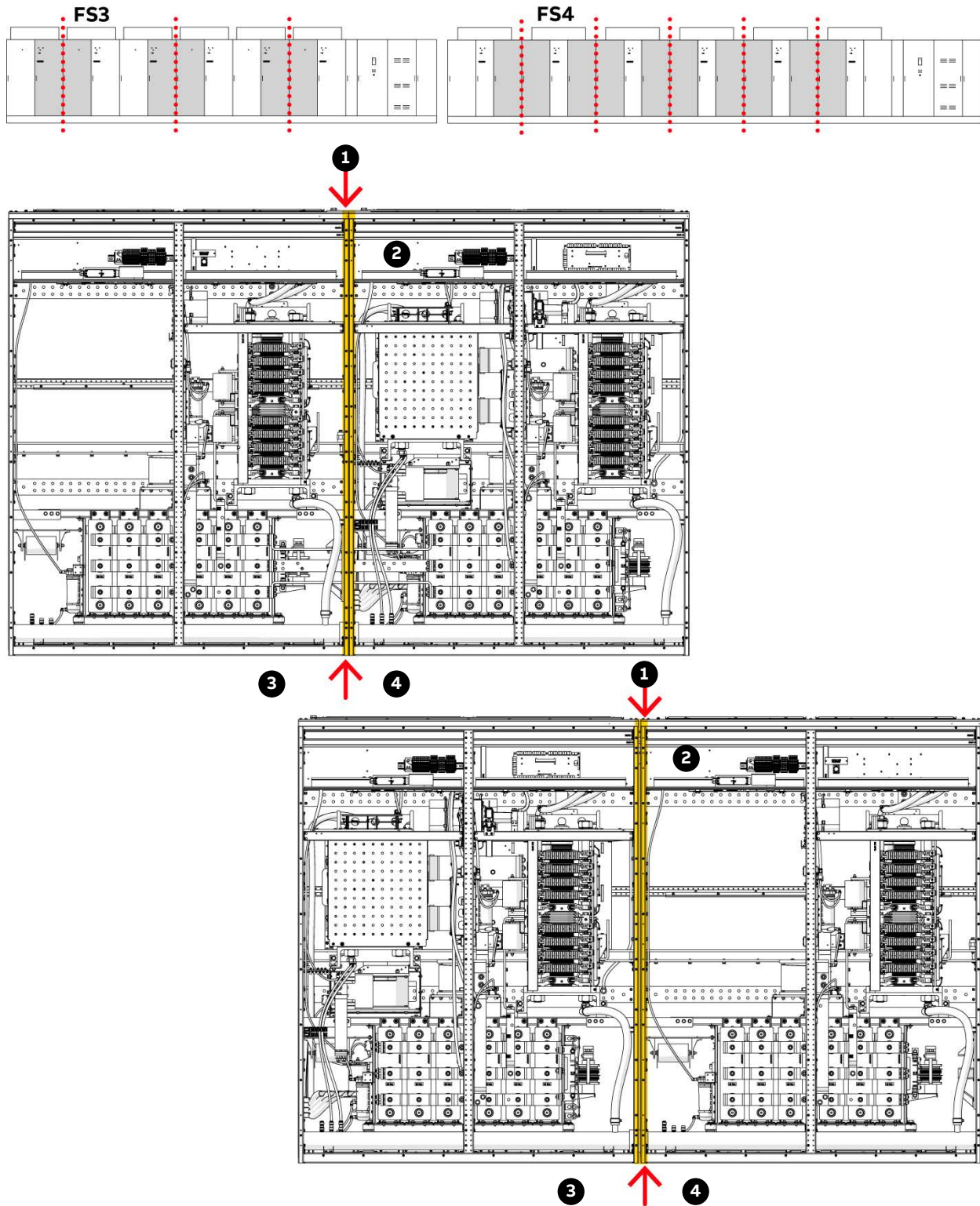
Each cable has a terminal designation and is ready for connection in the upper cable ducts of the cabinet (2, [Figure 56](#)), except for the charging cable, which is at the base of the cabinet behind the water pipe (4, [Figure 56](#)).

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Key	Explanation
1. Shipping split	PCUx1 – PCUx1
2. Cable ducts on each side of the shipping split	For auxiliary power supply cables, optical fibers, and signal cables
3. Connection point	For charging cable
4. Charging cable behind water pipe (not illustrated)	Laid on the brackets and connected to the busbar

Figure 56 – Wiring across shipping splits, FS1 and FS2



Key	Explanation
1. Shipping split	PCUx0 – PCUx1 and PCUx1 – PCUxo
2. Cable ducts on each side of the shipping split	For auxiliary power supply cables, optical fibers, and signal cables
3. Connection point	For charging cable
4. Charging cable behind water pipe (not illustrated)	Laid on the brackets and connected to the busbar

Figure 57 – Wiring across shipping splits, FS3 and FS4

6.5.1. Optical fibers

NOTICE

Risk of equipment failure! A damaged or incorrectly installed optical fiber cable can degrade data transmission and cause equipment failure.

- Handle optical fibers with care.
- Only use the designated encoder cable conduit that passes through the drive to the EXU; The conduit extends 10 to 20 mm from the entry plate of the drive.
- Cover the cable end with a cap BEFORE you pull the cable through the conduit.
- DO NOT exceed the maximum tensile load of 1.0 N and the minimum bend radius of 25 mm.
- DO NOT deform the optical fibers when you tighten the cable ties and DO NOT use a cable tie gun.
- Hold the connector when you connect or disconnect an optical fiber.

6.5.1.1. Optical fibers for internal arc protection

NOTICE

Risk of cable damage. Optical fiber cables are only available in standard lengths.

- DO NOT cut or extend the cables
- Wind up excess cable in coils with a minimum diameter of 100 mm.

Each unit with power cable entries and terminals is monitored for arc faults by the Arc Guard System™ with up to 4 detectors. See the project-specific “Converter hardware diagram” on page 392 for the exact number of detectors in each cubicle.

The Arc Guard unit and the HMI panel are in the COU ([Figure 74](#)) and the detectors are pre-installed in the relevant cabinets. The optical fibers, which are coiled up beside the detectors, must be routed from the detectors to the Arc Guard unit in the COU.

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6.6. Cable entries

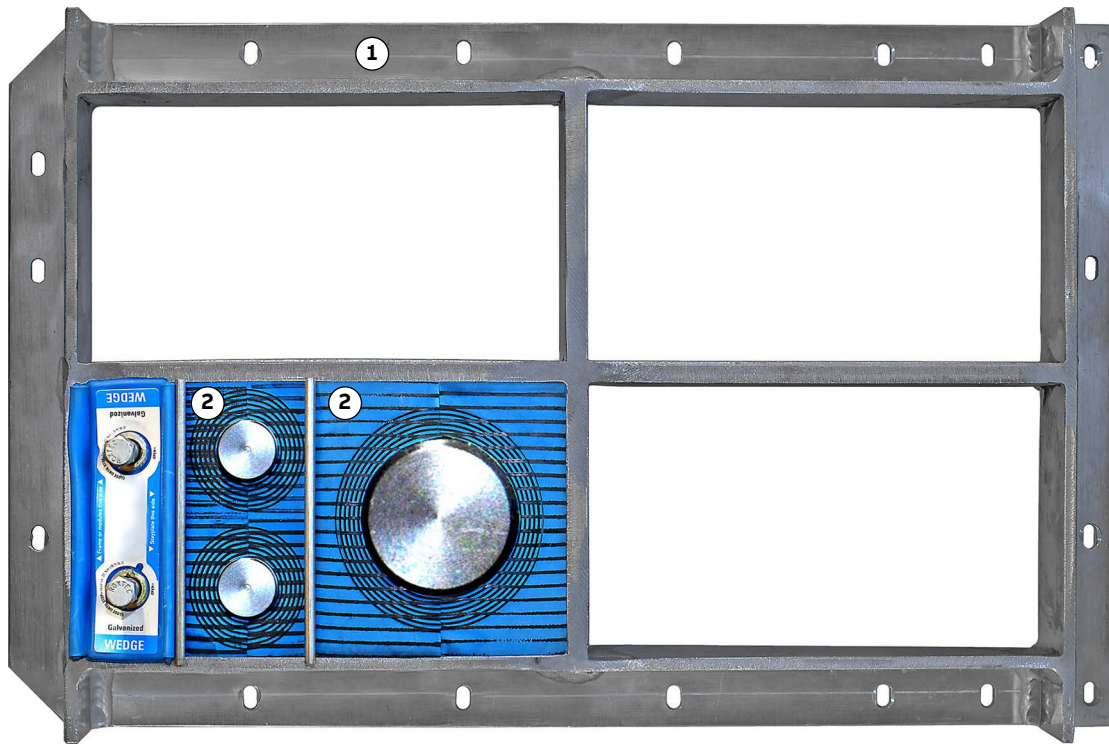
The drive is prepared for top or bottom cable entry with one or a combination of the following cable entries:

- Cable entry with sealing modules, type 1
- Cable entry with cable glands

For information on the location and the dimensions of the cable entry, see Appendix C – Mechanical drawings (see [1.2 Structure of the user documentation on page 14](#)).

6.6.1. Cable entry with sealing modules, type 1

Usage	Included in delivery	Not included in delivery
<ul style="list-style-type: none"> – Power cables – Ground cables – Bonding conductors 	<ul style="list-style-type: none"> – Cable entry frame (1, Figure 58) 	<ul style="list-style-type: none"> – Sealing modules (2, Figure 58) – Accessories, tools



Key

1. Compression wedge
2. Sealing module (RM120)
3. Cable entry frame

Figure 58 – Cable entry with sealing modules – type 1

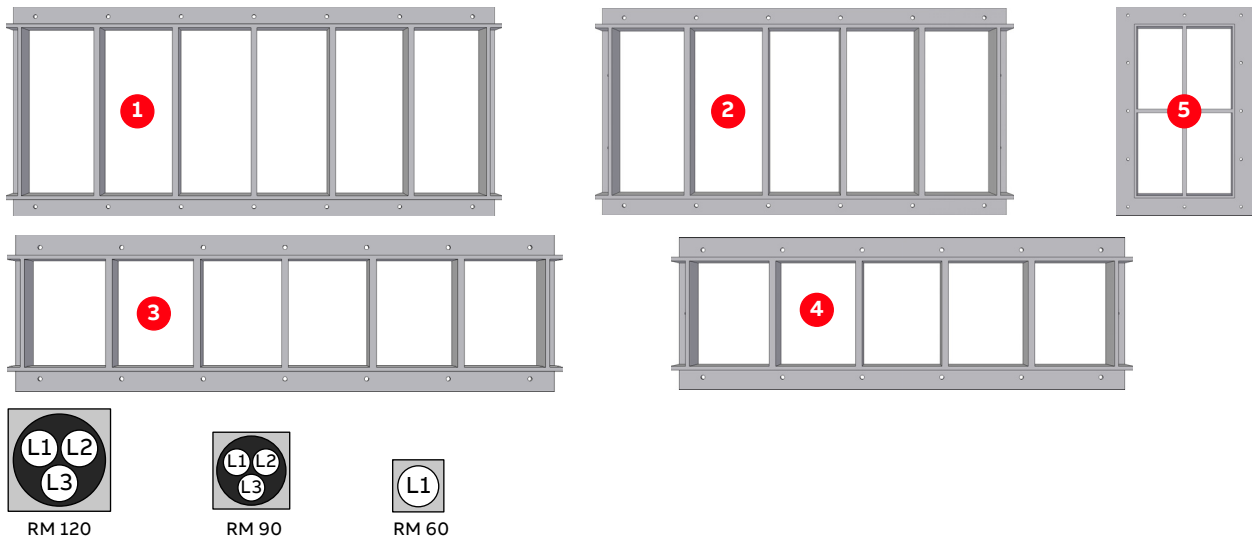


Figure 59 – Cable entry frame sizes (top) for type 1 sealing modules (bottom)

Table 7 – Type 1 sealing modules and cables per frame opening

Frame	1	1	2	3	4	5
Location	COU	PCU	PCU	PCU	PCU	EXU
Top entry	FS1 to FS6	FS2_6p ^a FS2_12p ^b FS4 FS6	FS1_6p FS1_12p FS3 FS5			✓
Bottom entry	FS1 to FS6	FS2_12p FS4	FS1_12p FS3	FS2_6p FS6	FS1_6p FS5	✓

^a 6p = 6-pulse

^b 12p = 12-pulse

Table 8 – Maximum number of type 1 sealing modules per frame opening

Frame	1	1	2	3	4	5
RM 120	2	2	2	1	1	1
RM 90						2
RM 60	8	8	8	4	4	6

Table 9 – Maximum number of cables per frame opening - 3 core

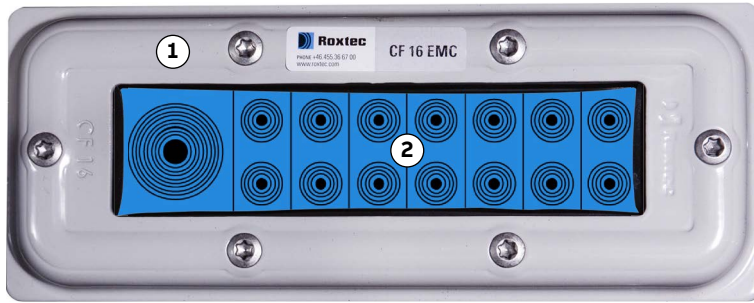
Frame	1	1	2	3	4	5
∅ 68-99 mm	2	2	2	1	1	1
∅ 48-71 mm						2

Table 10 – Maximum number of cables per frame opening - single core

Frame	1	1	2	3	4	5
∅ 28-50 mm	8	8	8	4	4	6

6.6.2. Cable entry with sealing modules, type 2

Usage	Included in delivery	Not included in delivery	Supplier
<ul style="list-style-type: none"> - Auxiliary power cables - Control cables 	Frame (1, Figure 60)	<ul style="list-style-type: none"> - Type 2 sealing modules (2, Figure 60) - Installation tools - Accessories 	Roxtec AB (www.roxtec.com)



Key

- 1. EMC cable entry frame
- 2. Type 2 sealing modules

Figure 60 – Cable entry with sealing modules – type 2

6.6.3. Cable entry with cable glands

Usage	Included in delivery	Not included in delivery
<ul style="list-style-type: none"> - Power cables - Ground cables - Bonding conductors - Auxiliary power cables - Control cables 	<ul style="list-style-type: none"> - Undrilled plate for cable glands - Cable strain reliefs (C-rails) (Figure 62) 	<ul style="list-style-type: none"> - Cable glands - Tools - Cable clamps - Accessories



Figure 61 – Cable entry with cable gland

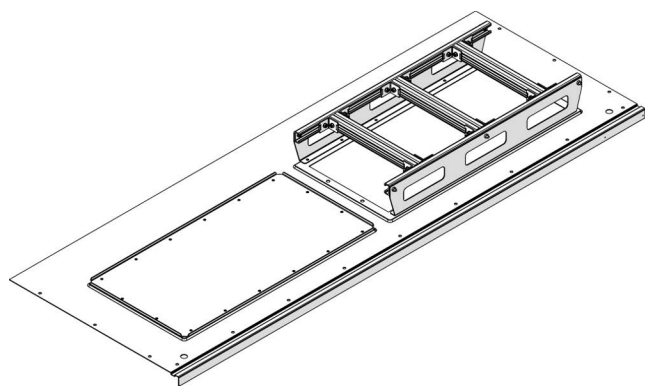
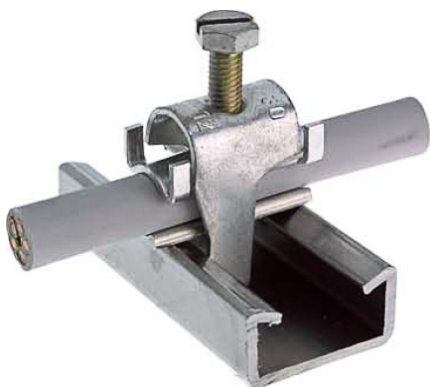


Figure 62 – Cable strain reliefs, C-rails

6.6.4. Cable entry with EMC plates

Usage	Included in delivery
– Power cables	– Galvanized plate with EMC mesh (1, Figure 63)
– Ground cables	– Sealing grommets (2, Figure 63)
– Bonding conductors	
– Auxiliary power cables	
– Control cables	



Figure 63 – Cable entry with EMC plates

6.7. Power cables, ground cables, equipotential bonding conductor

See Appendix A – Additional manuals (see [1.2 Structure of the user documentation on page 14](#)) for information on:

- Project-specific cable entry
- Distance between point of cable entry and terminals
- Busbar and fastening hole dimensions
- Installation instructions for sealing modules

See Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)) for information on:

- Designation, cross-reference and device identification conventions
- Transformer cables and motor cables and their corresponding connections

6.7.1. Preparing the cable entry and the cables

NOTICE

Risk of damage or malfunction! Waste inside the cabinet can cause damage or malfunction.

- Avoid cutting cables inside the terminal compartment
- Remove all waste from the cabinet when you are done

6.7.1.1. Determining the cable length

1. Determine the required length of a cable between the point of entry and the connection point inside the cabinet.
2. Cut the cable to the required length before connection.

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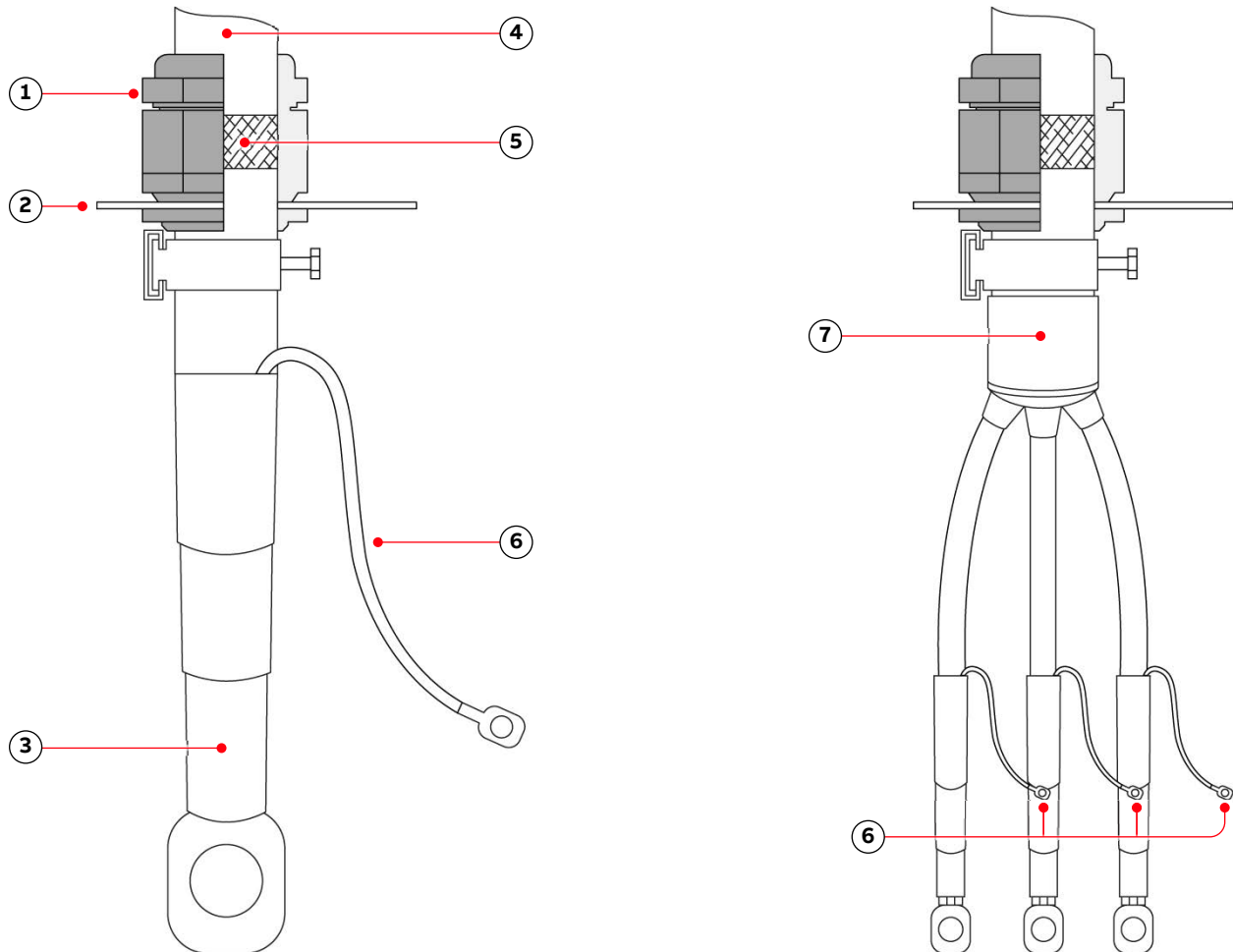
6.7.1.2. Preparing cables for cable entries with cable glands

Prepare cables with an outer cable screen or shield for EMC bonding with the metal enclosure of the cabinet as illustrated.

NOTICE

Risk of cable damage! Incorrectly connected pigtails (6, [Figure 64](#)) can create unwanted current loops that can damage the cables.

- Connect each pigtail directly to the PE busbar.
- DO NOT shorten or connect the pigtails to each other (see [6.4 Grounding on page 82](#))



Key

1. Cable gland
2. Plate
3. Heat-shrinkable termination
4. Outer cable sheath
5. Conductor insulation removed to expose cable shield/armor
6. Cable screen extension (pigtail) for PE ground busbar connection
7. Sheath seal

Figure 64 – Preparing power cables for cable glands

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Approved	Public	3BHS904690 E01	E	en	95/159

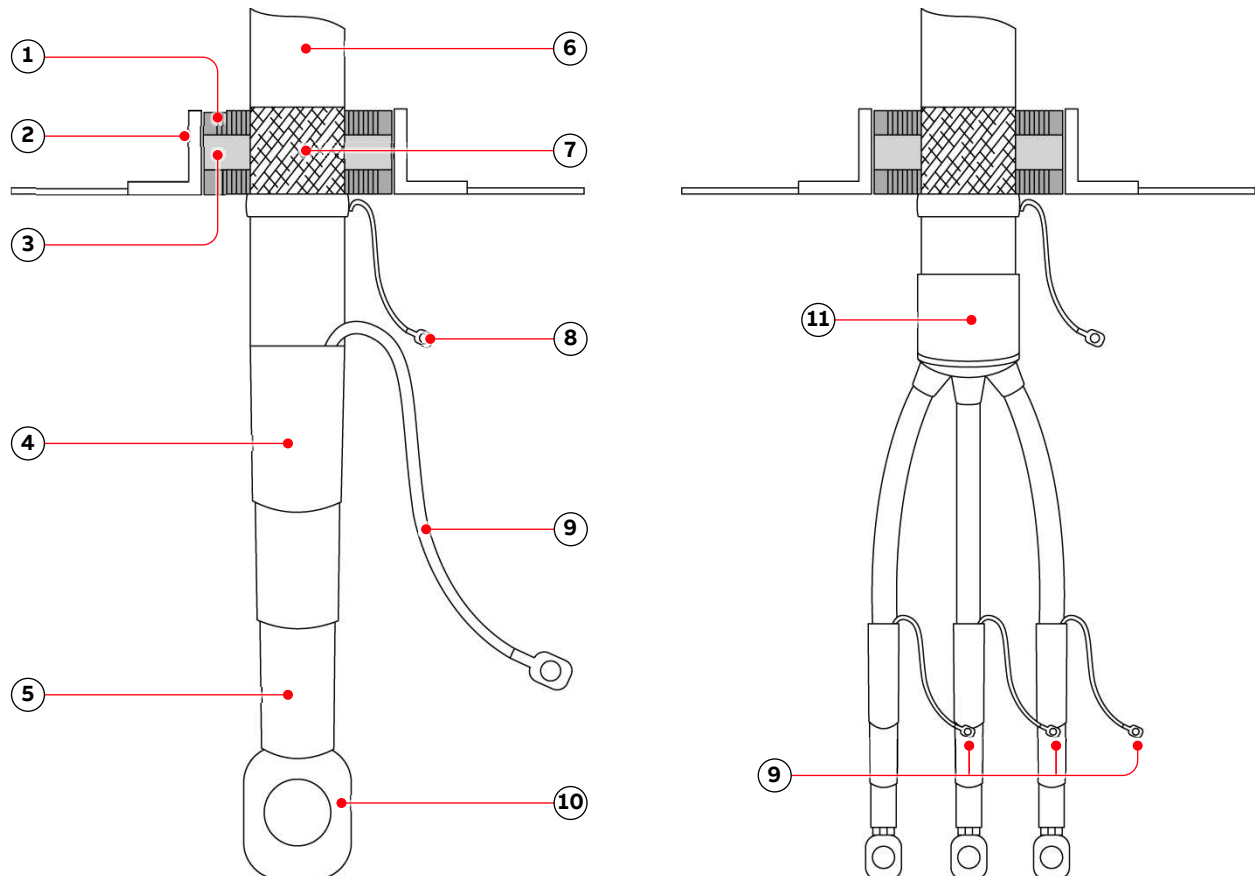
6.7.1.3. Preparing cables for cable entries with sealing modules

Prepare cables with an outer cable screen or shield for EMC bonding with the metal enclosure of the cabinet as illustrated. Install the sealing modules according to the instructions of the sealing module supplier.

NOTICE

Risk of cable damage! Incorrectly connected pigtails (6, Figure 64) can create unwanted current loops that can damage the cables.

- Connect each pigtail directly to the PE busbar.
- DO NOT shorten or connect the pigtails to each other (see 6.4 Grounding on page 82)



Key

1. Sealing module
2. Frame
3. Conductive foil of sealing module
4. Shrinkable sheath seal
5. Heat-shrinkable termination
6. Outer cable sheath
7. Cable sheath removed to expose cable shield/armor
8. Shield extension to be connected to PE busbar (not applicable if the cable only has armor)
9. Cable screen extension to be connected to the PE busbar
10. Cable lug as specified by the cable supplier and suitable for M12 bolt
11. Sheath seal

Figure 65 – Preparing power cables for sealing modules

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6.7.2. Connecting the cables

Connect the cables to their corresponding busbars:

- Transformer cables to the busbars inside the primary PCU ([Figure 66](#) and [Figure 67](#))
- Motor cables to the busbars inside the COU ([Figure 68](#))
- Ground cable to the PE ground busbar inside the COU (see [6.4.5 Ground cable connection on page 86](#), [Figure 54](#))

For information on the dimensions and the busbar arrangement, see Appendix C – Mechanical drawings (see [1.2 Structure of the user documentation on page 14](#)).



CAUTION

Risk of flashover! High voltages in the terminal unit can cause flashover between the electric potential of different conductors and the electric potential of a conductor and earth. When you route and connect the cables, maintain the following minimum clearances:

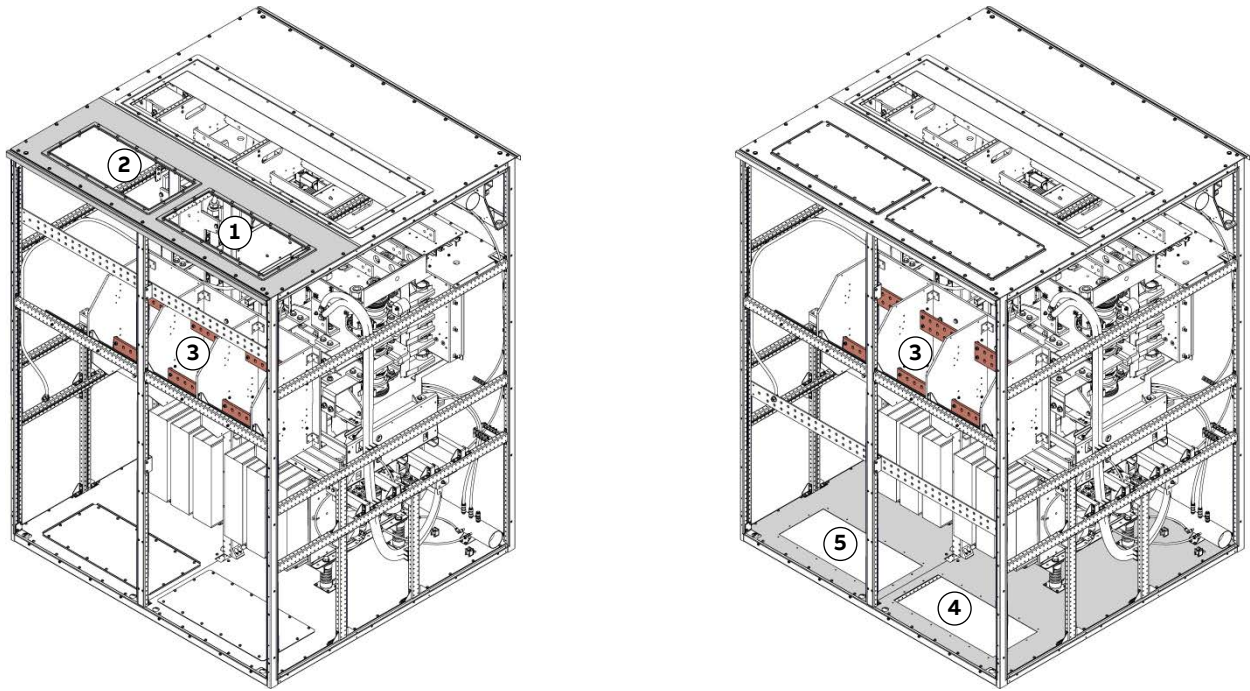
- 70 mm between cable lugs of conductors with a different potential
- 70 mm between the cable lug of a conductor and the parts with earth potential
- 30 mm between cables with a different potential

6.7.2.1. Checking the cable insulation

- Measure the insulation of each cable before connection and verify that the results are within the specification of the cable manufacturer.
- Leave the conductors unconnected at both ends until the commissioning personnel has given permission to connect them.

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6.7.2.2. Connecting transformer cables ACS5000W, 36-pulse

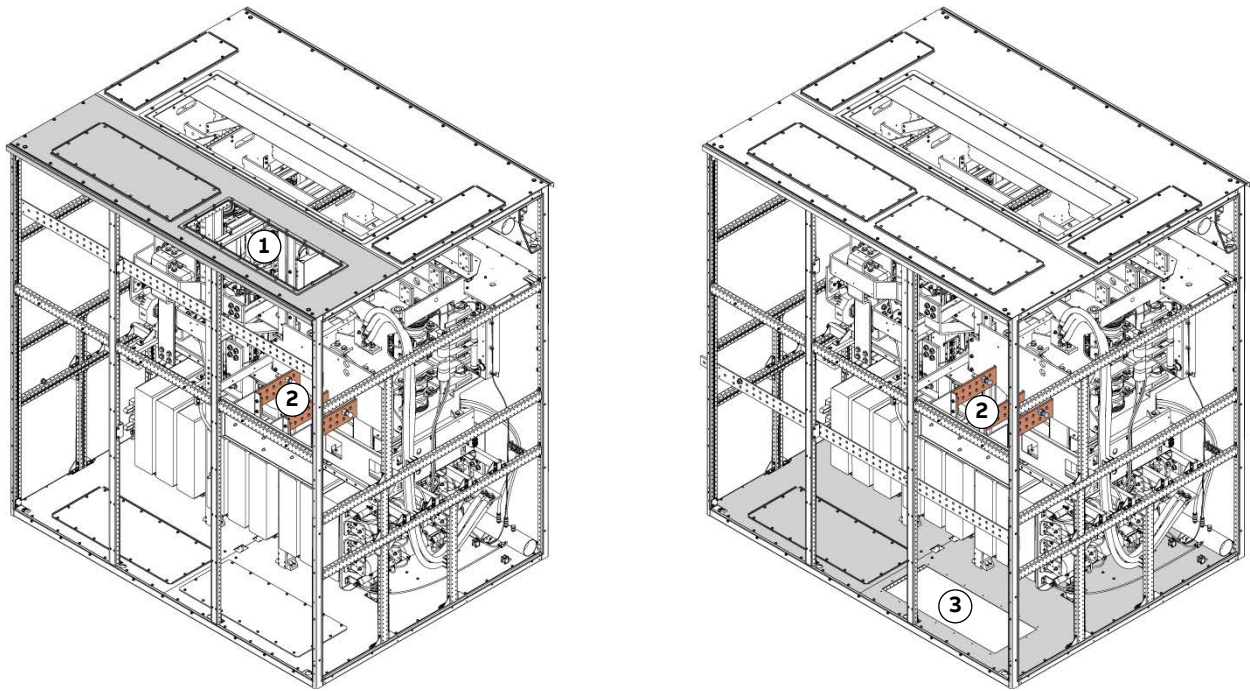


Key

- 1. Top cable entry
- 2. Top cable entry – second opening (FS3/FS4 only)
- 3. Busbars for transformer cables
- 4. Bottom cable entry
- 5. Bottom cable entry – second opening (FS3/FS4 only)

Figure 66 – PCU 12-pulse top and bottom cable entry (back view)

6.7.2.3. Connecting transformer cables ACS5000W, 18-pulse



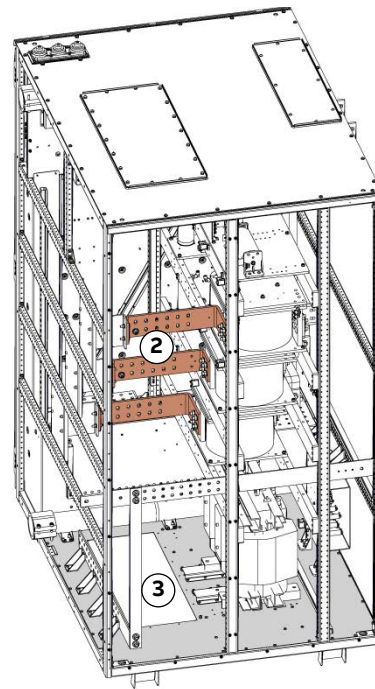
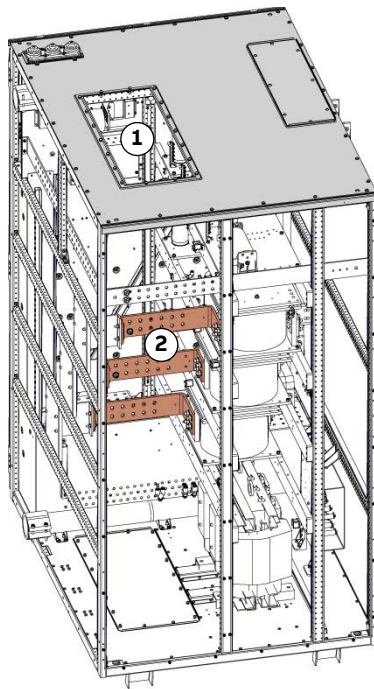
Key

- 1. Top cable entry
- 2. Busbars for transformer cables
- 3. Bottom cable entry

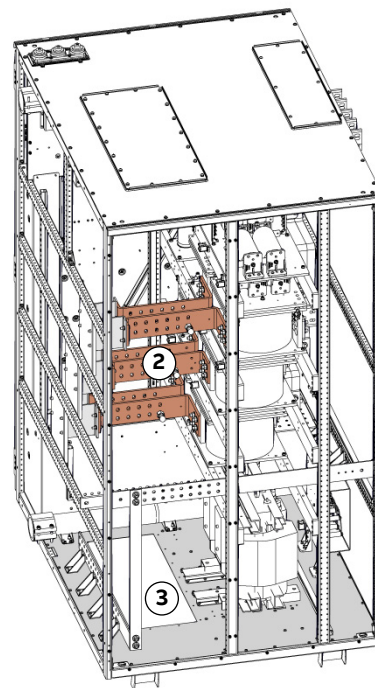
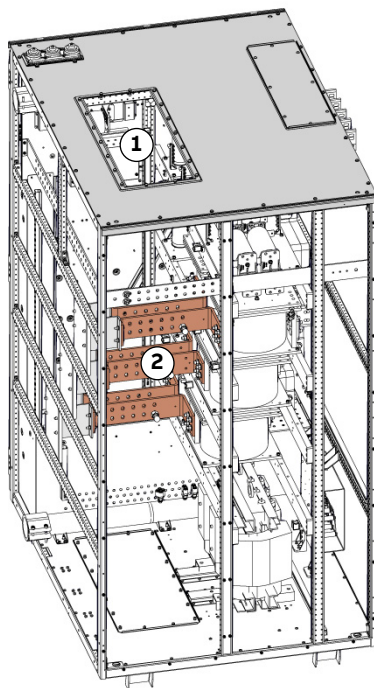
Figure 67 – PCU 6-pulse top and bottom cable entry (back view)

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6.7.2.4. Connecting motor cables



a) COU FS1/FS2



b) COU FS3/FS4

Key

- 1. Top cable entry
- 2. Busbars for motor cables (FS1 and FS2)
- 3. Bottom cable entry

Figure 68 – COU cable terminals

6.7.2.5. Bolted connections

Material requirements

Use stainless steel bolts and nuts with the appropriate steel grade and property class for the connection (recommended: A2-70 [designation according to ISO 3506]).

Nuts with bonded coating can be used as an alternative to uncoated stainless steel nuts.

Connection type

The following connection type is recommended when a cable lug (4, [Figure 69](#)) is connected to a busbar:

- Spring washer (2, [Figure 69](#)) and flat washer (3, [Figure 69](#)) on each side of the busbar (5, [Figure 69](#)).
Other washers can be used, provided they maintain the required contact pressure.
- Use cable lugs suitable for M12 bolts.

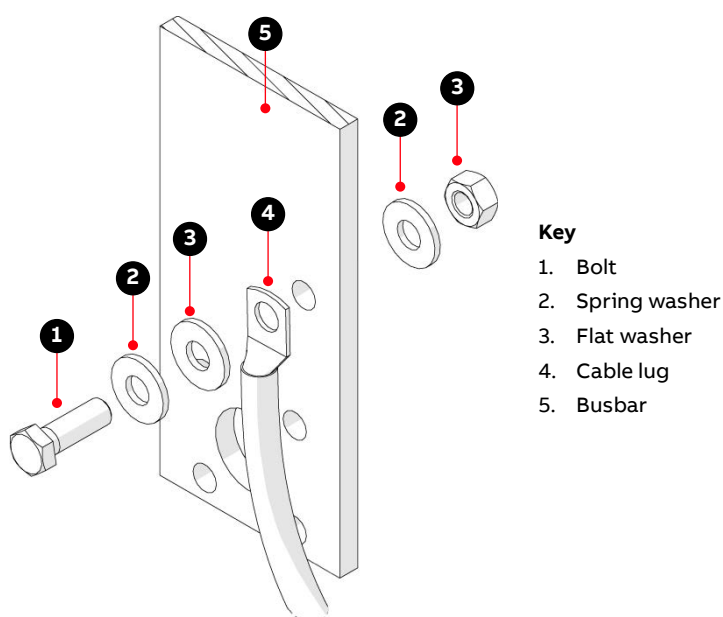


Figure 69 – Bolted busbar connection

Lubrication

- If stainless steel bolts and nuts are used, lubricate the thread and head contact surface of the bolt using recommended pasts, eg, Molykote D paste.
- If a coated nut (eg, with bonded molybdenum-disulfide [MoS_2] coating) is used, the connection does not have to be lubricated.

Tightening torque

ABB recommends a tightening torque of 40 Nm for M10 bolts. For other sizes, follow the manufacturer's recommendations.

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Approved	Public	3BHS904690 E01	E	en	100/159

6.8. Auxiliary power cables and control cables

See Appendix C – Mechanical drawings (see [1.2 Structure of the user documentation on page 14](#)) for information on:

- Project-specific cable entry
- Dimensions between point of cable entry and terminals

See Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)) for information on:

- Conventions for cross-references and device identification
- Terminal designations

6.8.1. Preparing the cable entry and the cables

6.8.1.1. Determining the cable length

1. Determine the required length of a cable between the point of entry and the connection point inside the cabinet.
2. Cut the cable to the required length before connection.

6.8.1.2. Routing the cables

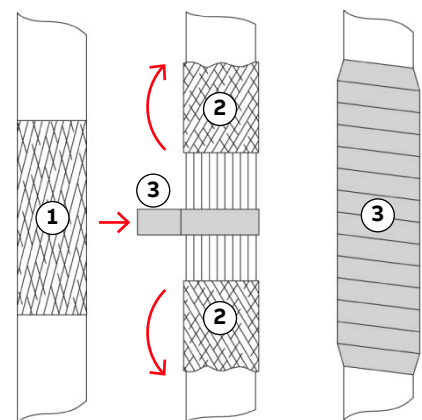
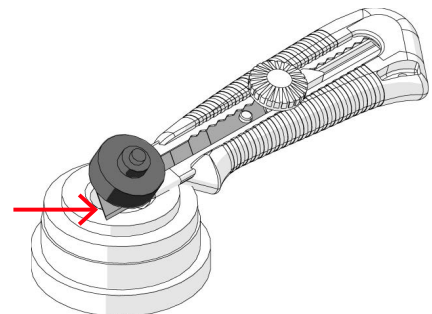
For information on routing low voltage cables to COU, WCU, and EXU cabinets, see [6.8.2 Routing and connecting low voltage cables on page 104](#).

6.8.1.3. Preparing cables for EMC plates - only top cable entry

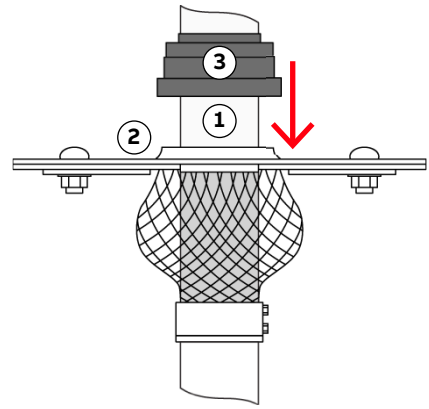
1. Remove the grommets from the entry plate.
2. To ensure proper sealing, cut along the marking that corresponds to the cable diameter (arrow).
3. Slide the grommet onto the cable and ensure that the grommet fits tightly to prevent water from entering the cabinet.
NOTE – If cables are routed through the cabinet floor, the grommets can be discarded.
4. If necessary, remove the entry plate and pull the cable through the entry holes.
5. Remove the cable insulation to expose the cable screen at the point of entry (1).

If the outer cable screen is non-conductive:

6. Cut open the cable screen in the middle of the stripped area (1).
7. Pull the cable screen ends over the cable insulation to turn the conductive side inside out (2).
8. Connect the screens ends with a continuous conducting foil (3).

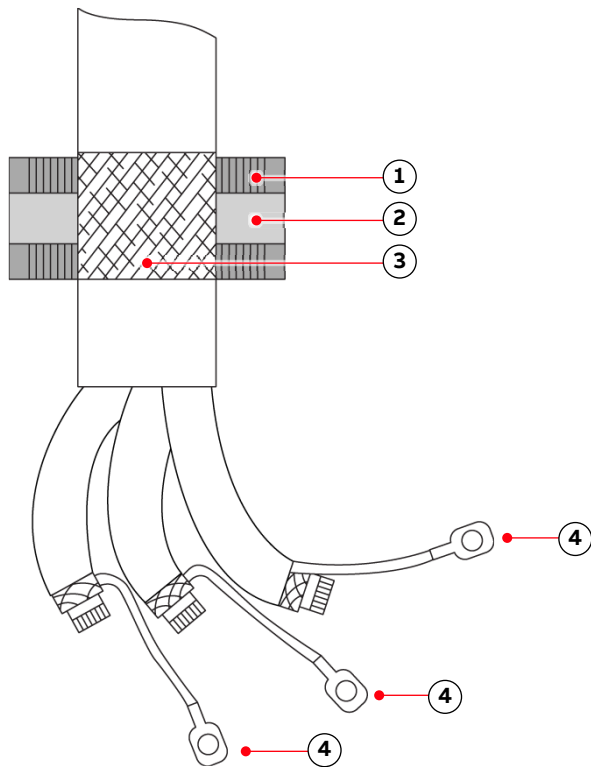


9. Pull the cable (1) through the entry plate (2).
10. To prevent water from entering the cabinet, fit the grommet (3) tightly and seal any gaps with silicone.
11. If you removed the entry plate, reinstall the plate, and fasten it properly.



6.8.1.4. Preparing cables for cable entries with sealing modules

1. Unscrew the frame and remove the sealing modules.
For information on removing and installing the sealing modules and using the compression wedge, see Appendix A – Additional manuals (see [1.2 Structure of the user documentation on page 14](#)).
2. Prepare the cables with an outer cable screen for EMC bonding with the metal enclosure of the cabinet as illustrated (Figure 70).



Key

1. Sealing module
2. Conductive foil
3. Cable sheath removed to expose cable shield
4. Conductor screen extension to be connected to PE terminal

Figure 70 – Preparing control cables for sealing modules

6.8.1.5. Preparing cables for cable entries with cable glands

Prepare the cables with an outer cable screen for EMC bonding with the metal enclosure of the cabinet as illustrated (Figure 71).

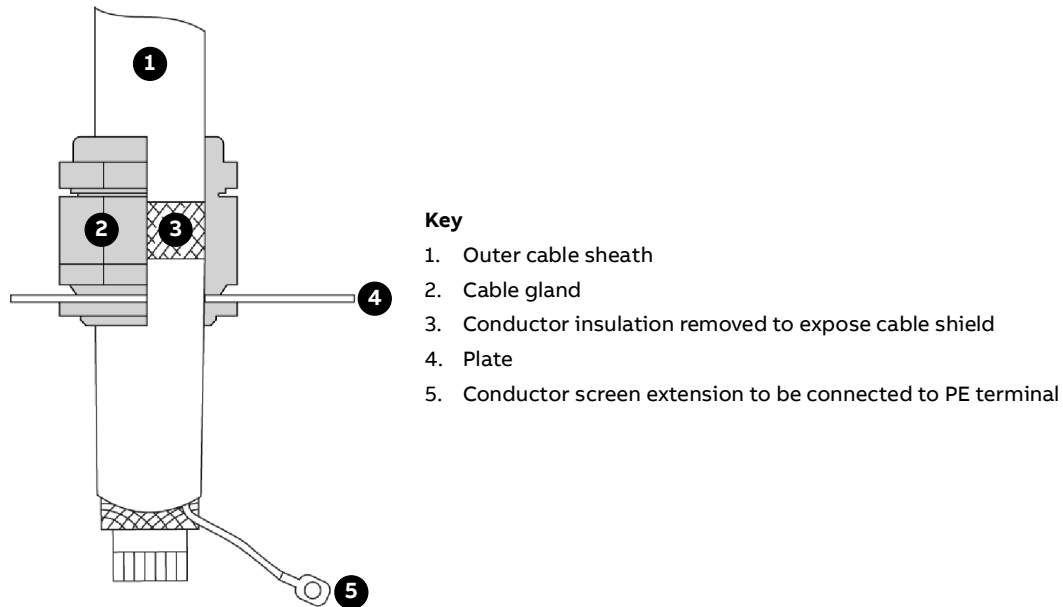


Figure 71 – Preparing control cables for cable glands

6.8.2. Routing and connecting low voltage cables

For the project-specific cable connections, see Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)). For a description of the different cable entry types, see [6.6 Cable entries on page 91](#).

6.8.2.1. WCU - auxiliary power and space heater cable

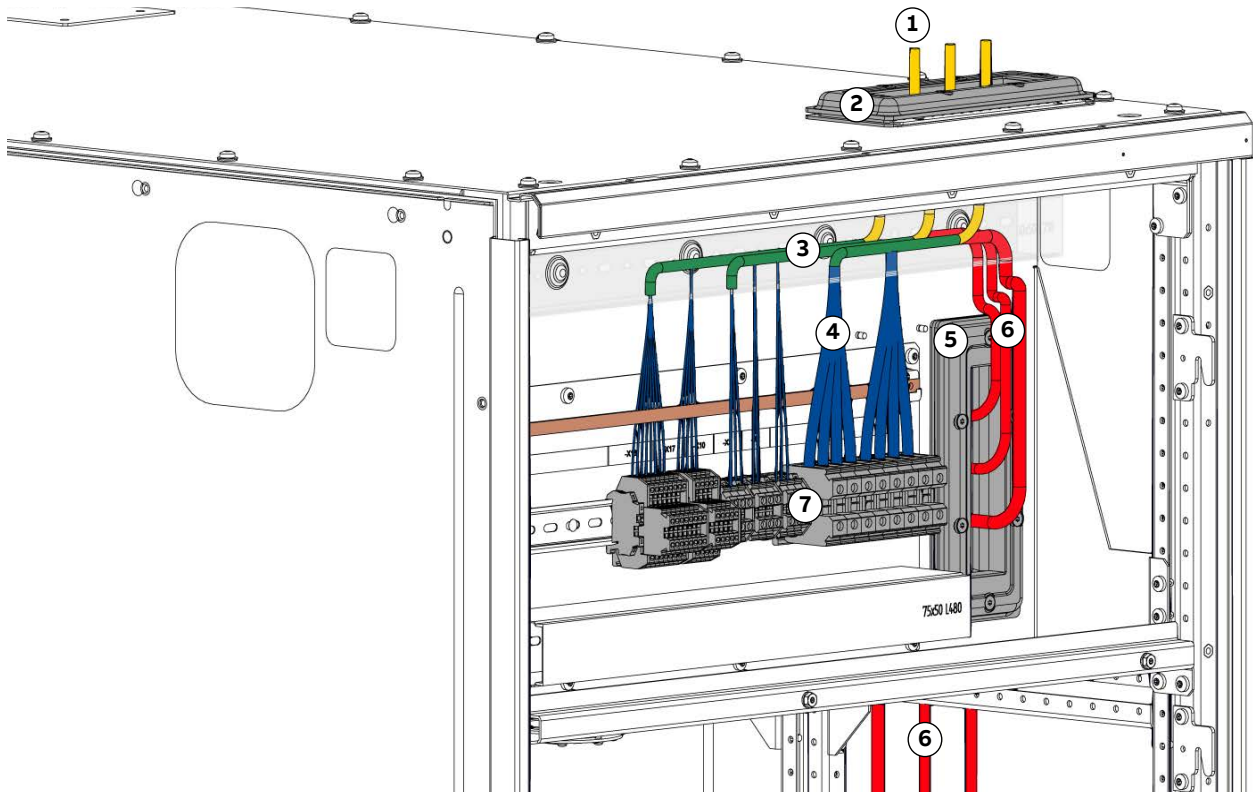
For an overview of the components in a WCU cabinet, see [3.5 Water cooling unit \(WCU\) on page 44](#).

The following cables are typically connected to the WCU.

- 3-phase power supply auxiliary cable (always)
- Space heater converter cable (optional)
- Space heater motor cable (optional)
- Aux power supply status cable (potential free contact)
- Process interface - External cooling control cables (optional)

For the project-specific cable connections, see Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)).

The cables are routed into the WCU cabinet either through a top cable entry or bottom cable entry. [Figure 72](#) shows both cable routing options in the WCU control compartment.



Key

- | | |
|---|---|
| 1. Top cable routing | 5. Bottom cable entry in control compartment (Roxtec frame) |
| 2. Top cable entry (Roxtec frame shown) | 6. Bottom cable routing |
| 3. Common cable routing | 7. Customer terminals |
| 4. Example cables | |

Figure 72 – Cable routing options to WCU800 control compartment

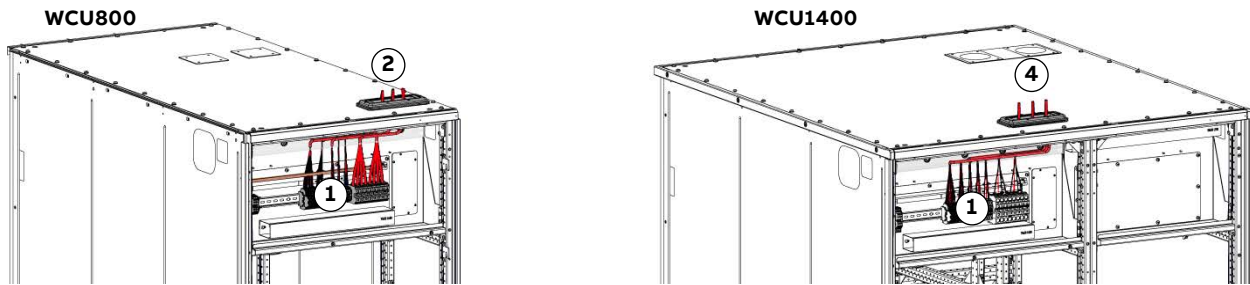
STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	3BHS904690 E01	E	en	104/159

6.8.2.1.1. Top and bottom cable entries

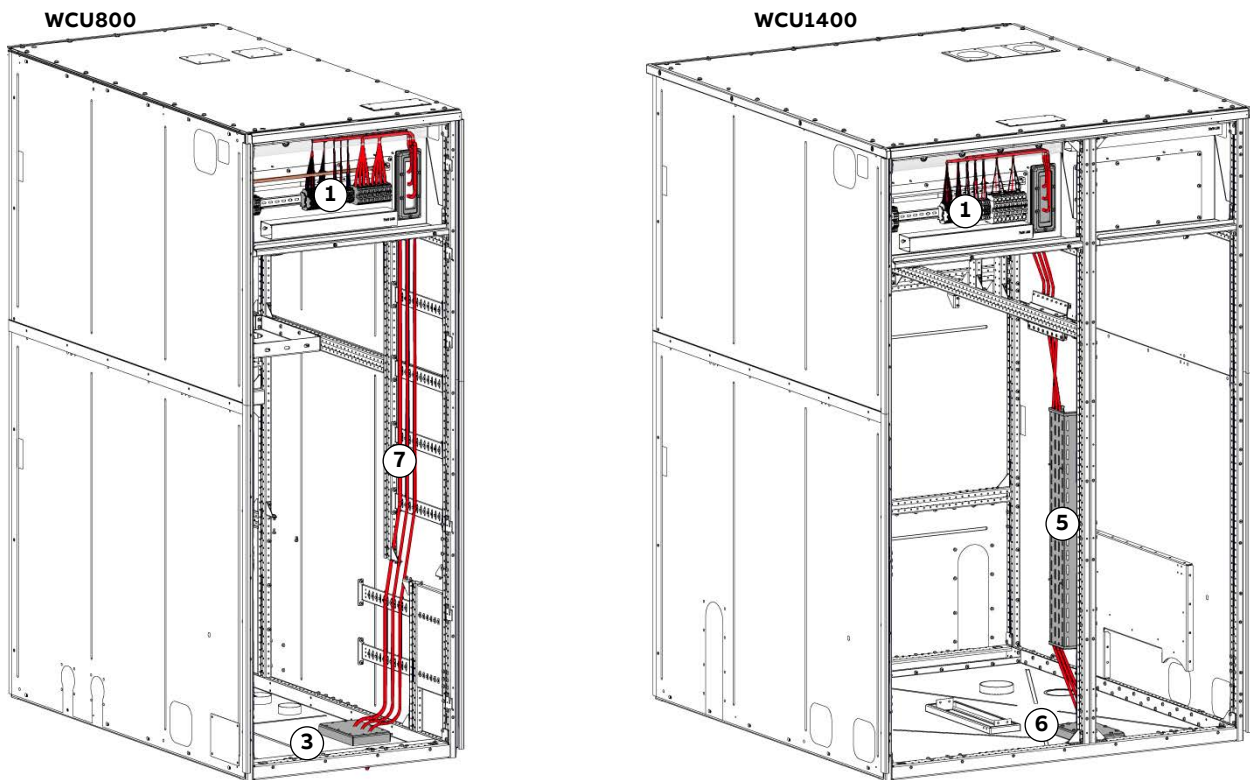
Referring to [Figure 73](#):

1. Route the cables to the terminal compartment (1).
 - Top cable entry: via (2) or (4)
 - Bottom cable entry: via (3) or (6)

NOTE – Use cable ties to attach the cables to the cable ladder (7) or cable duct (5).
2. Connect the cables to the relevant terminals (2) according to the project-specific wiring diagram.



a) Top cable entries



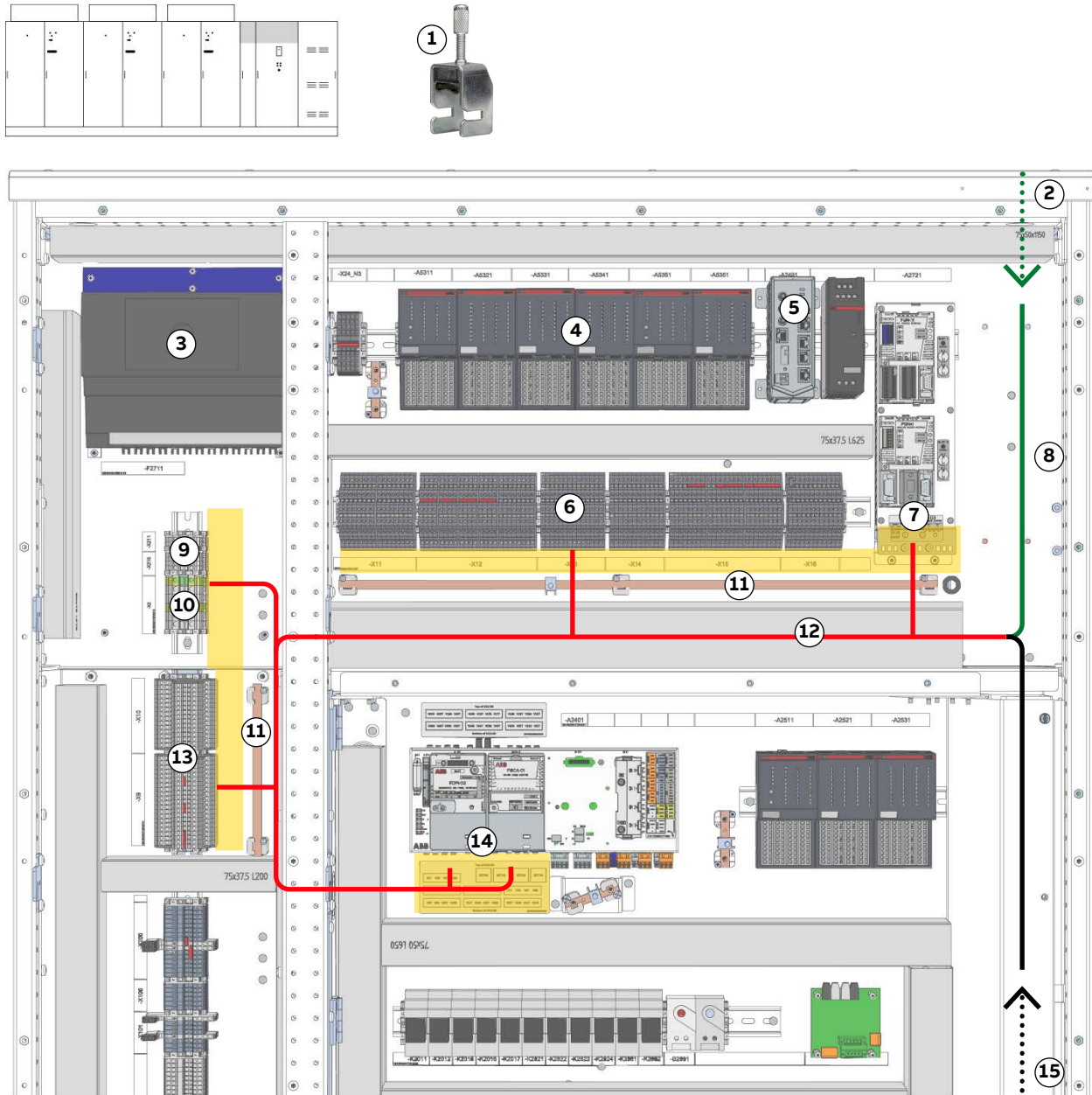
b) Bottom cable entries

Key

- | | |
|------------------------------|-------------------------------|
| 1. Control compartment | 5. Duct |
| 2. WCU800 cable entry top | 6. WCU1400 cable entry bottom |
| 3. WCU800 cable entry bottom | 7. Cable ladder |
| 4. WCU1400 cable entry top | |

Figure 73 – Top and bottom cable routing in WCU800 and WCU1400 cabinets

6.8.2.2. COU - UPS supply and control signal cable



Key

- | | |
|---|--|
| 1. Shield grounding clamp | 9. Excitation unit interface - supply and process I/O (optional) |
| 2. Top cable entry route | 10. Customer terminal - UPS supply |
| 3. Arc Guard System™ | 11. Shield grounding busbar (for process and encoder cabling) |
| 4. S500 I/O process system (customer- specific configuration) | 12. Cable route |
| 5. ABB Ability™ | 13. Customer terminal for standard process interface |
| 6. Customer terminals for control I/O extension (optional) | 14. Fieldbus |
| 7. Speed and position encoder interface | 15. Bottom cable entry route |
| 8. Cable fixation for top entry cables | |

Figure 74 – COU customer interface section

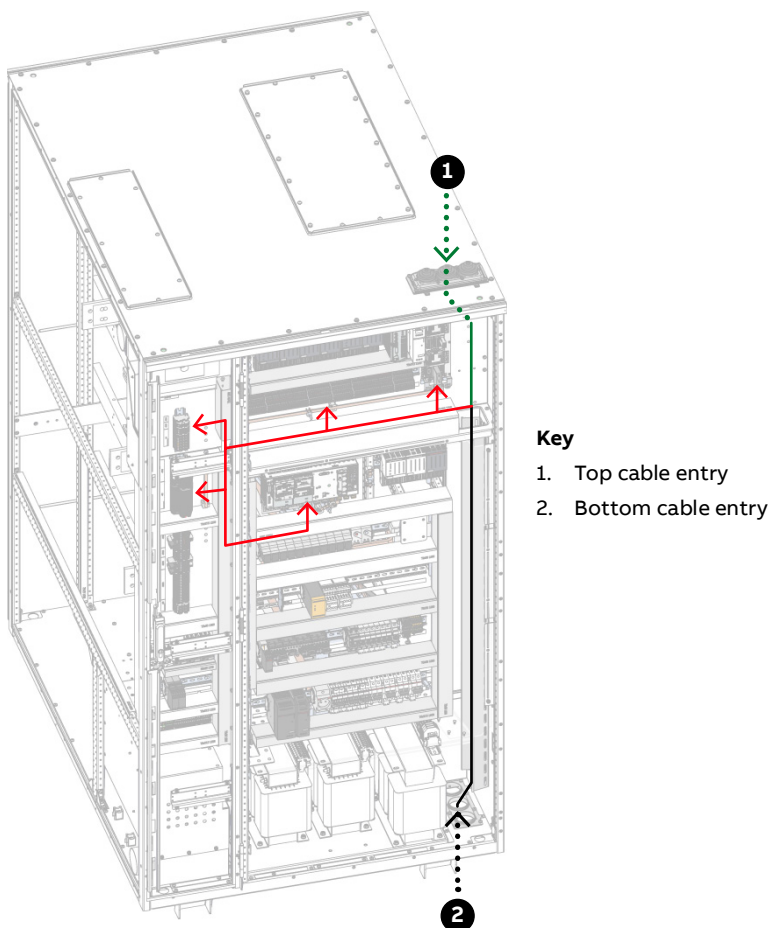


Figure 75 – Cable routing in COU cabinet

6.8.2.2.1. Shielded cables

- Keep the unshielded ends of twisted pair cables twisted until they reach the terminals.
- Keep unshielded conductor ends as short as possible.
- Use a shield grounding clamp (1, [Figure 74](#)) to fasten the overall shield and the individual shields to the ground busbar (10, [Figure 74](#)).

6.8.2.2.2. UPS control power supply

- Connect the cables to the terminals (9, [Figure 74](#)) according to the project-specific wiring diagram in Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)).

6.8.2.2.3. Control signals

- Connect the cables to the process interface according to project-specific wiring diagram.
 - X9; X10: Process interface (standard), (12, [Figure 74](#))
 - X11 to X17: Process interface (optional), (6, [Figure 74](#))

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Approved	Public	3BHS904690 E01	E	en	107/159

6.8.2.2.4. Speed and position encoder interface



Refer to the "Absolute encoder interface FEN-11 user manual" (3AFE68784841) and the "HTL Encoder interface FEN-31 user manual" (3AUA0000031044) for the following steps.

1. Connect the cable directly to the encoder adapter.
2. Connect the overall shield and the individual shield of the encoder cable to one of the following:
 - Chassis of the plug that is connected to the encoder module

NOTICE Verify that the fixing screw of the encoder is properly tightened (see the relevant user manual).

 - Shield grounding busbar (11, [Figure 74](#))

6.8.2.2.5. Fieldbus interface

1. Connect the fieldbus cable to the module (13, [Figure 74](#)).
2. Connect the shield of fieldbus cables to the fieldbus adapter.

6.8.2.2.6. ABB Ability™ gateway (EGW-02)

- Connect the Ethernet cable to the **ETH2** port.

For more information, see "EGW-02 Connectivity Edge Gateway user's manual" (3AXD50000929719).

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6.8.2.3. EXU - auxiliary and control cables

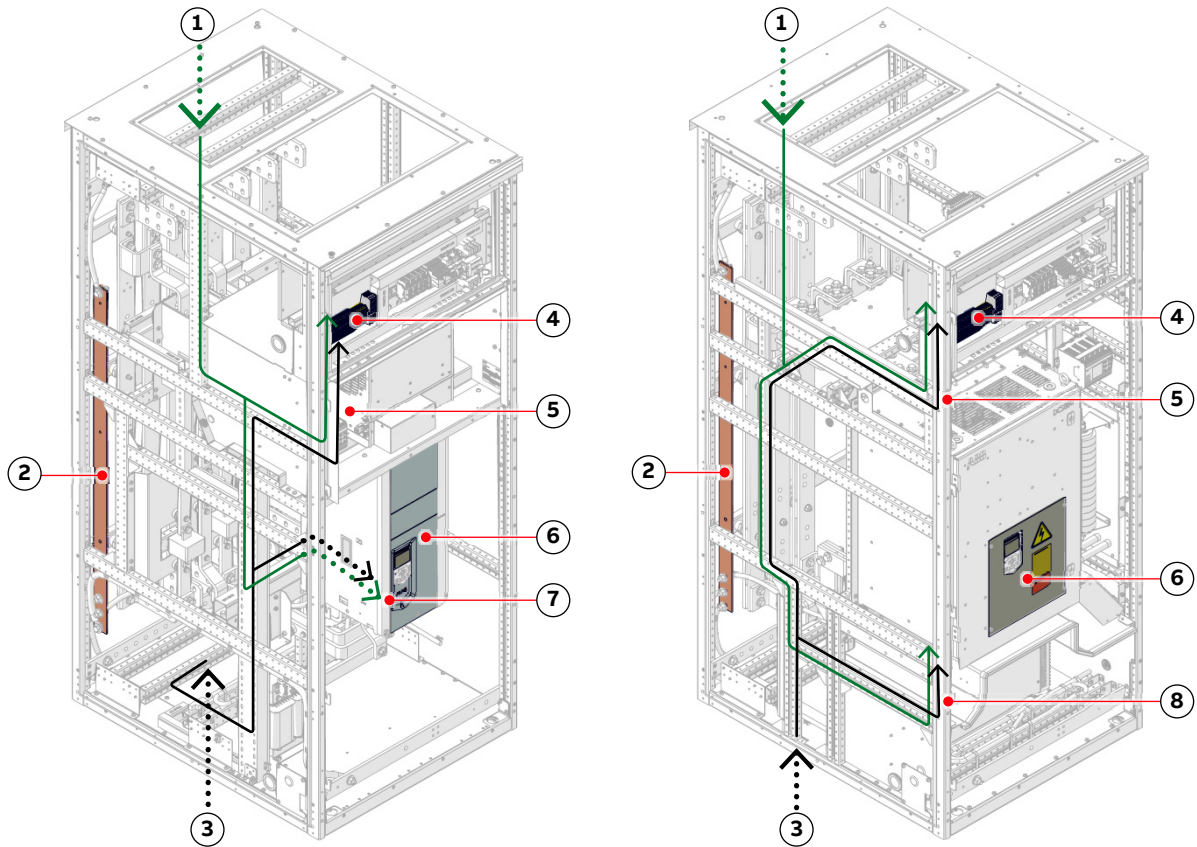
This section applies to a stand-alone EXU.

6.8.2.3.1. Auxiliary power and control cables

1. Enter the cables through the cable entry (1 or 3, [Figure 76](#)).
2. On the length of cable that passes through the cable transit, prepare the cable according to the following instructions:
 - Cable entries with EMC plates: see [6.8.1.3 Preparing cables for EMC plates - only top cable entry on page 101](#)
 - Cable entries with cable glands: see [6.8.1.5 Preparing cables for cable entries with cable glands on page 103](#).

NOTE – Materials for cable fitting, EMC requirements and sealing are not supplied for undrilled plates.

3. Route the cables through the designated cable ducts as illustrated in [Figure 76](#).



a) EXU cabinet with ED5V, EB5R, EB5S, EB7P or EB7Q type DCS880/DCT880 converter

b) EXU cabinet with an ED7Y type DCS880 converter

Key

- | | |
|--|---|
| 1. Cable enters through roof | 5. Auxiliary supply cable |
| 2. PE ground busbar | 6. Terminal for optical fibers behind cover |
| 3. Cable enters through the floor | 7. Optical fibers to DCS880 H4 converter |
| 4. Terminal strip for auxiliary power and control cables | 8. Optical fibers to DCS880 H6 converter |

Figure 76 – EXU cable routing examples

4. Connect the cables to the terminals inside the terminal compartment of the cabinet according to the project-specific wiring diagram in Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)).

6.8.2.3.2. Optical fiber cables

NOTICE

Risk of equipment failure! Handle optical fibers with care. A damaged or incorrectly installed optical fiber cable can degrade data transmission and cause equipment failure.

- Only use the designated encoder cable conduit that passes through the drive to the EXU.
- The conduit extends 10 to 20 mm from the entry plate of the drive.
- BEFORE you pull the cable through the conduit, cover the cable end with a cap.
- DO NOT exceed the maximum tensile load of 1.0 N and the minimum bend radius of 25 mm.
- When you tighten the cable ties DO NOT deform the optical fibers and DO NOT use a cable tie gun.
- Hold the connector when you connect or disconnect an optical fiber.

6.8.2.3.3. Routing optical fiber cables in an EXU cabinet with an ED5V, EB5R, EB5S, EB7P, and EB7Q type DCS880/DCT880 converter

1. Remove the acrylic protection cover in the cabinet.
2. Unplug the DCS880/DCT880 control panel.



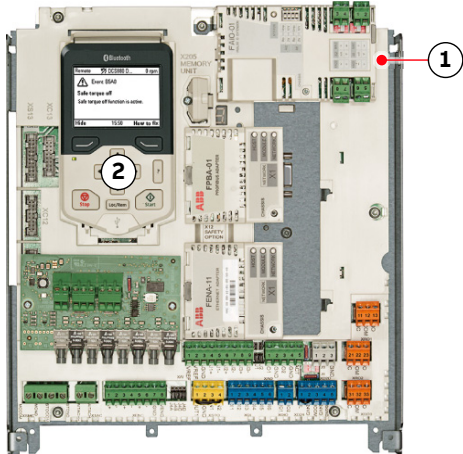
Key

1. DCS880/DCT880 control panel
2. Removable front cover
3. Indentation

Figure 77 – DCS880/DCT880 H4 converter (ED5V, EB5R, EB5S, EB7P and EB7Q types)

3. Insert a flat-blade screwdriver into one of the indentations at the bottom of the DCS880/DCT880 front cover.
4. Gently press down the latch tab with the tip of the screwdriver and pull the corner of the cover forward and repeat for the other side.
5. Slide the removable cover up and then remove the cover.

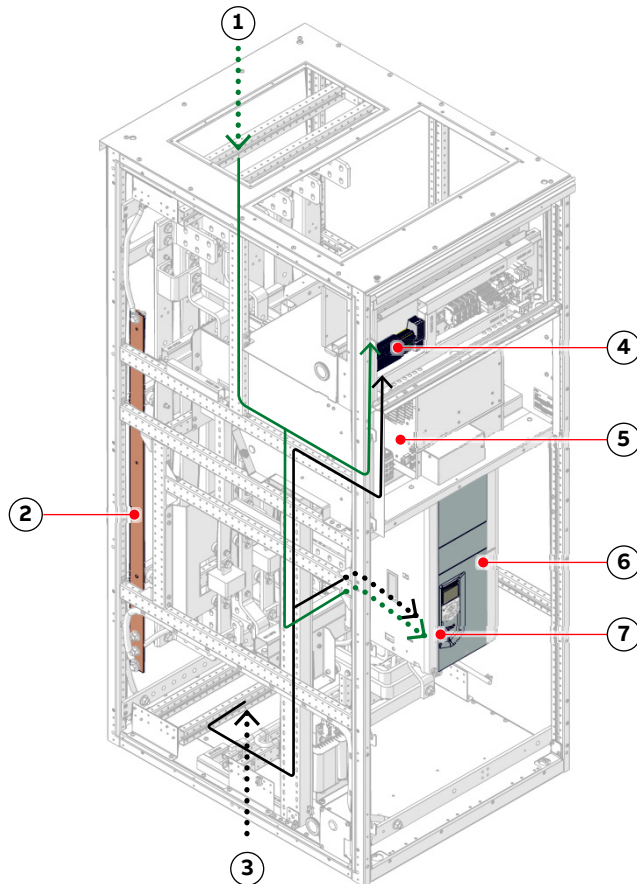
- Connect the two optical fibers to the receptacles of slot 1 according to the terminal numbers printed on the marker sleeves.



- Key**
- Slot 1 (FDCO-01 module)
 - Control panel

Figure 78 – 1 Control unit SDCS-CON-H01

- Route the cables through the designated cable ducts as illustrated in Figure 79.



- Key**
- Cable enters through roof
 - PE ground busbar
 - Cable enters through the floor
 - Terminal strip for auxiliary power and control cables
 - Auxiliary supply cable
 - Terminal for optical fibers behind cover
 - Optical fibers to DCS880/DCT880 converter

Figure 79 – Cable routing example in an EXU cabinet with an ED5V, EB5R, EB5S, EB7P and EB7Q type DCS880/DCT880 converter

- Reattach the front cover of the DCS880/DCT880.

6.8.2.3.4. Routing cables in an EXU cabinet with an ED7Y type DCS880/DCT880 converter

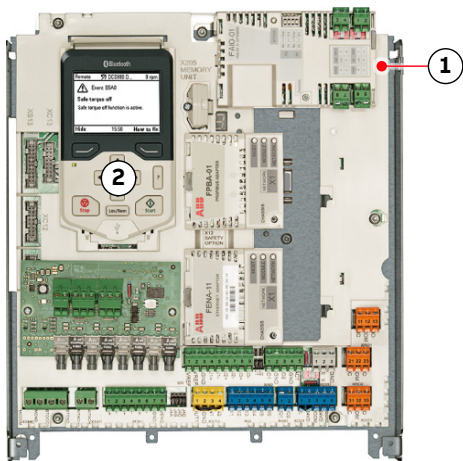
1. Unscrew the rectangular cover from the DCS880/DCT880 unit.



- Key**
1. Control panel
 2. Removable cover

Figure 80 – DCS880/DCT880 converter (ED7Y)

2. Connect the two optical fibers to the receptacles of slot 1 according to the terminal numbers printed on the marker sleeves.



- Key**
1. Slot 1 (FDCO-01 module)
 2. Control panel

Figure 81 – 1 Control unit SDCS-CON-H01

3. Route the cables through the designated cable ducts as illustrated in [Figure 82](#).

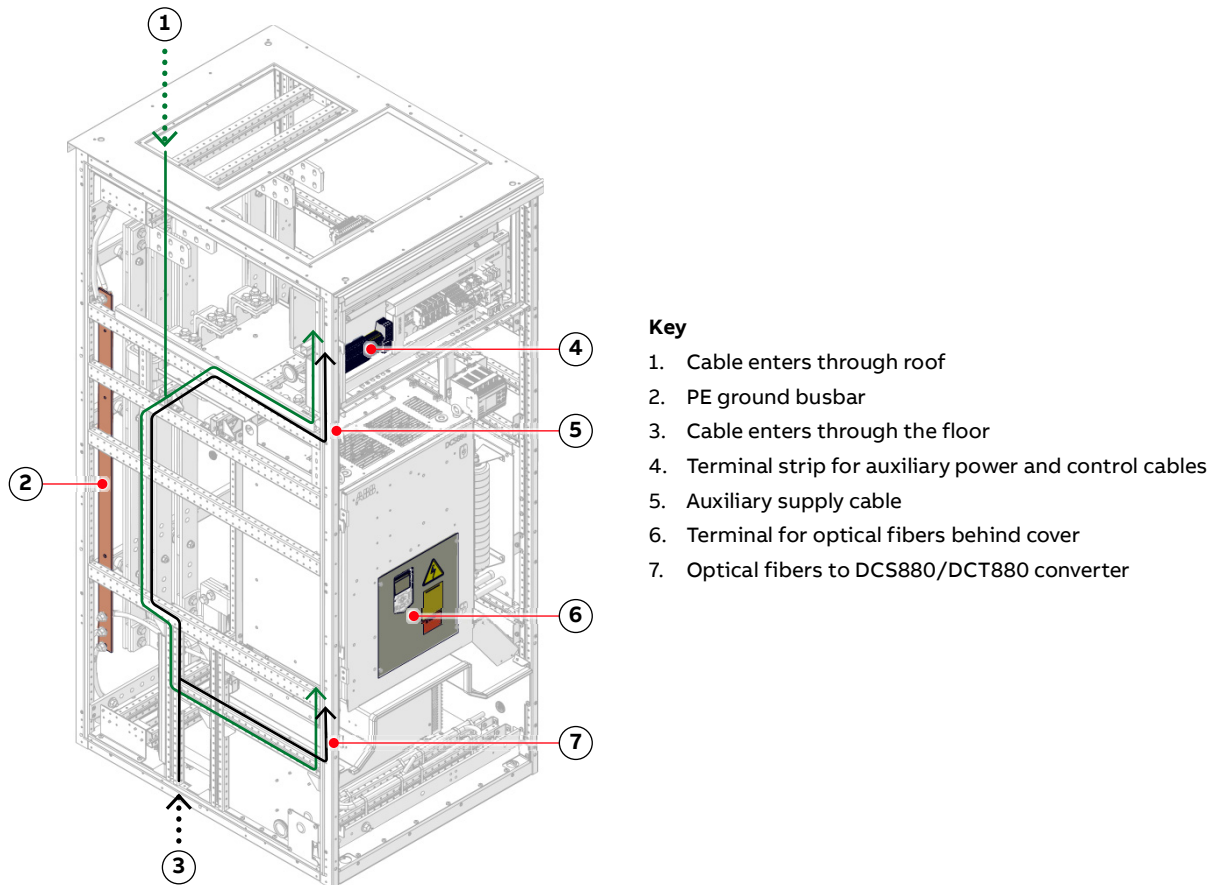


Figure 82 – Cable routing example in an EXU cabinet with an ED7Y type DCS880/DCT880 converter

4. Reattach the DCS880/DCT880 cover.

7. Commissioning

7.1. Required qualification

Commissioning, parameter adjustments and functional tests must be carried out only by qualified commissioning personnel that have been certified by ABB.

7.2. Commissioning procedure

Information on the commissioning procedure and the start conditions for commissioning can be obtained from ABB.

7.3. Commissioning checklist

In order to ensure uncomplicated and speedy commissioning, it is important that drive and associated equipment are ready for commissioning. Reviewing and completing the items in the commissioning checklist before the commissioning personnel arrive on site will help to achieve this.

7.4. Customer assistance

During the commissioning period, the customer is requested to provide qualified personnel for assistance, who are:

- Experienced with medium and low voltage equipment and with the local safety regulations,
- Familiar with the driven process
- Authorized to operate associated medium and low voltage equipment (eg, input circuit breaker, other low and medium voltage switchgear)
- Authorized to operate the driven process for functional tests

7.5. Customer acceptance

When commissioning has been completed, the commissioning report is signed by the responsible commissioning personnel and by the customer as a sign of acceptance. A copy of the report and a copy of the actual parameter settings are handed out to the customer.

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Approved	Public	3BHS904690 E01	E	en	114/159

7.6. Commissioning checklists

This checklist is designed to help you prepare the drive and associated equipment for commissioning.

7.6.1. Mechanical installation checklist

- Drive is aligned according to drive layout drawing (if delivered in several transport units) and installed according to the instructions in this user manual (3BHS904690 E01).
- Silicon sealant is applied across roof plate gaps.
- Roof joints are installed.
- Pipe joints are orientated and torqued correctly.
- Roof attachments are installed (if applicable).
- Busbars are installed and torqued correctly.
- Raw water piping is completed and pipes are flanged to the drive (if applicable).
- Raw water supply is ready.
- Visual inspection:
 - No badly affixed or damaged components
 - No foreign objects left in the cabinet
 - No dirt, dust or moisture in the cabinet

7.6.2. Electrical installation checklist

- Types and cross sections of control cables suitable for the signal type and signal level.
- Types and cross sections of power cables selected according to the ABB power cable specification.
- Pulse encoder cable shields are connected to the shield earthing point and not connected directly to the pulse encoder interface (applies only to drives with pulse encoder interface).
- Cable entries prepared according to the instructions in the user manual (3BHS904690 E01).
- Control cable screens and conductors are connected as instructed in the user manual, labeled appropriately, and the customer side connections are completed.
- Heating cables (if supplied) connected
- Wiring across shipping splits is completed according to the instructions in the user manual (3BHS904690 E01).
- Ground cable of the drive is securely connected at both ends.
- Cable armor and screens of power supply cables are connected to PE ground busbar.
- The transformer and motor cables are installed but the conductors not connected at both ends (cables and drive must be insulation resistance tested (Megger test) before connection).

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7.6.3. Main circuit breaker (MCB) checklist

- MCB selected as per “Main circuit breaker specification”
- Pay attention to MCB opening time and installation of undervoltage coil or second opening coil
- High-voltage power connections completed
- MCB is ready to be tested with drive
- MCB protection relay settings are tested
- Protection devices (eg, door locks) are tested and in operation.
- Local operation of MCB is disabled.
- Emergency-off loop is tested.

7.6.4. Input transformer checklist

- Grounding is completed
- Transformer auxiliaries (eg, dehydrating breathers, cooling, protection devices) are ready.
- Protection devices are tested and in operation.

7.6.5. Motor checklist

- Motor is installed, aligned and alignment protocol available.
- Motor is not coupled to driven load.
- Grounding is completed
- Motor auxiliaries (eg, bearing lubrication) are ready
- Control and monitoring signals are connected.

7.6.6. Insulation tests checklist

- Insulation of the cables to input transformer, from input transformer to drive and from drive to motor is tested, and measured values within required limits.
- Test report is available
- If the commissioning personnel carry out the test, an additional day per drive-motor combination must be reserved. After the test, the mains cables can be connected, except at the drive end. Test must comply with the specification.

7.6.7. Power checklist

- Medium voltage available for startup of drive.
- Low voltage is available for startup of drive.

7.6.8. Miscellaneous checklist

- Sufficient number and correct type of spare parts available
- Sufficient quantity of deionized water according is available. (see “Appendix C – Mechanical drawings”).
- Air conditioning of drive room ready for load run of drive
- Optional equipment (eg, chiller) ready

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Approved	Public	3BHS904690 E01	E	en	116/159

8. Operation

8.1. Overview

This chapter describes how to locally operate an ACS5000 drive or EXU from an assistant control panel (ACP). The COU and the EXU have separate control panels.

NOTE – Control of the drive via a PLC or higher-level control system is not described. If the drive is controlled remotely, see the applicable manuals for more information.

The panel messages and parameter settings that are used in this chapter are typical examples. They illustrate the related instructions and display functions, but can differ from the actual messages and parameter settings for the drive or EXU.

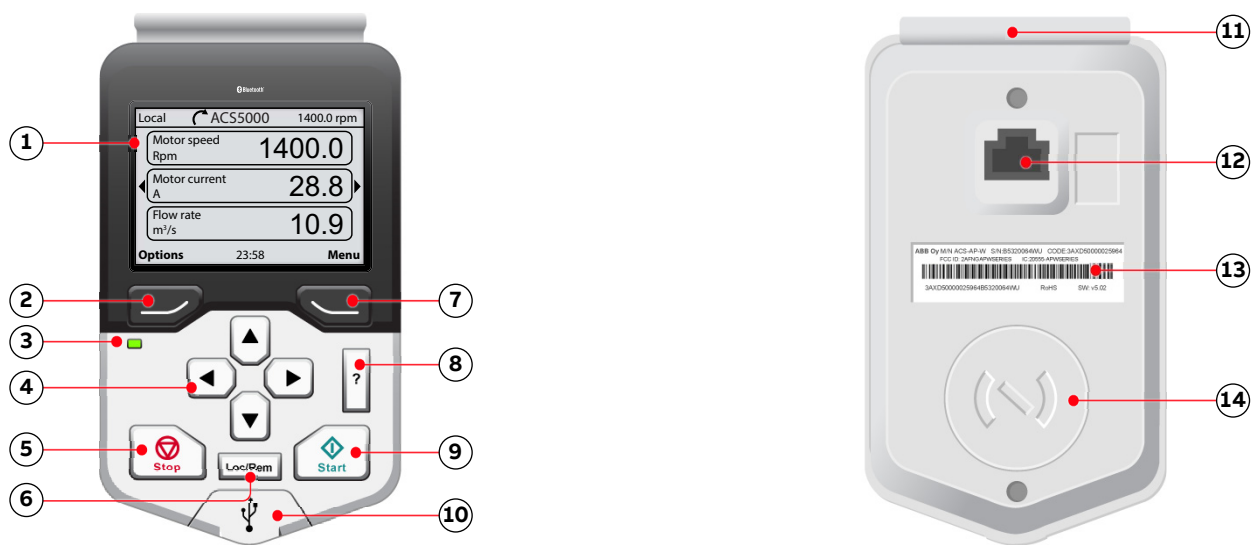
8.2. Operating conditions

The operating conditions for the drive are according to [IEC 60721-3-3](#).

- **Classification:** 3K22 / 3B1 / 3S6 / 3M11

8.3. Control panels

The drive has control panels on the COU and optional EXU cabinets. For instructions on how to use a control panel, see [8.3.1 Navigating the home view on page 118](#) and the "ACX-AP-x Assistant control panels user's manual" (3AUA0000085685).










Key

- | | |
|-------------------------------|---------------------|
| 1. Display | 8. Help |
| 2. Left soft key | 9. Start |
| 3. Status LED | 10. USB connector |
| 4. Arrow keys | 11. Clip |
| 5. Stop | 12. RJ-45 connector |
| 6. Local/Remote control modes | 13. Type code label |
| 7. Right soft key | 14. Battery cover |

Figure 83 – Display, keys, and parts of the assistant control panel

8.3.1. Navigating the home view

The main view in the control panel display is called **Home** view. In **Home** view you can monitor the status of the drive, such as drive speed, torque, or power. The **Home** view has one or more pages, each of which can display up to three signals.

- Use  and  to move between the different pages of **Home** view.
- Use  or  to adjust the reference (visible in the top right corner)
- Press  (**Menu**) to open the main **Menu**
- Press  (**Options**) to open the **Options** menu
- Press  (**Help**) for a context-sensitive help page

8.3.2. Drive control panel



Figure 84 – Drive control panel and local control push buttons

The drive control panel is on the COU door. The control panel allows you to organize parameters in different ways and to store essential parameters for different configurations for specialized applications. You can customize the menus and messages for specific terminology so that you can configure each application for optimum performance.

The panel text editor allows you to add information, customize text, and label the drive. Powerful backup and restore functions are supported. The help key provides context sensitive guidance.

You can connect the PC tool to the drive through the USB port on the control panel.

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Approved	Public	3BHS904690 E01	E	en	118/159

8.3.3. EXU control panel

The EXU control panel allows you to control the operation of the DCS880 or DCT880 unit in the EXU cabinet as well as set the parameters and view the status data of the EXU. For an overview of the control panel buttons and usage, see [8.3 Control panels on page 117](#).





Figure 85 – EXU control panel examples

8.3.3.1. Operational settings

At the end of commissioning, disable local control on the EXU control panel:

- **DCS880 unit:** set parameter 96.08 Local control to **1**
- **DCT880 unit:** set parameter 19.17 Local control to **1**

NOTE – When the EXU control panel is in remote control mode, **REM** is in the top left corner of the display, and the  (**Start**) and  (**Stop**) keys do not work.

NOTICE

Risk of component damage! Switching the EXU control panel from local to remote control during drive operation automatically shuts down the drive!

- DO NOT switch to local control during drive operation
- Only use the control panel to rectify alarms or fault conditions



8.3.3.1.1. Display values

You can select the values that are shown on the display. The following default values are visible when the panel is in local control mode:

- **Motor current** in A
- **Armature voltage** in V
- **Converter current** in A (rectified AC current value)

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Approved	Public	3BHS904690 E01	E	en	119/159

8.3.3.2. Resetting alarm and fault messages

- **Alarm messages:** reset automatically after the problem has been resolved. You cannot reset the messages manually with the  (**Reset**) key on the control panel.
- **Fault messages:** must be reset manually with the  (**Reset**) key on the control panel after the fault has been resolved.

8.3.3.3. Parameter settings

Parameters are set and verified during commissioning to ensure the EXU operates correctly.

NOTICE

Risk of component damage! Running the EXU with incorrect parameters can damage the equipment, cause faulty operation of the drive system, and reduce control accuracy.

- DO NOT change a parameter if you do not understand the parameter and the effects of the change
- Contact ABB if you want to modify a parameter

8.4. Lamp test

The illuminated push buttons on the COU and PCU doors can be tested.

8.4.1. Testing the lamps on the COU door

NOTE – This procedure might not work for customer-requested status indicator lamps.

Referring to [Figure 16 on page 16](#):

1. On the control panel, change the value of parameter 95 . 60 from **Not selected** to **Selected**.
 2. Verify that the following lamps on the COU door turn on.
 - **Supply OFF**
 - **Supply ON**
 - **Alarm Fault**
 - **Reset Emergency Off**
- ↳ The lamps turn off after a ten-second delay.

8.4.2. Testing the lamps on PCU doors

1. On the PCU door, press and hold the following pushbuttons:
 - **Door Lock Released**
 - **Grounding Switch Unlocked**
2. Verify that the lamps turn on.
3. Release the pushbuttons.



8.5. Status messages

The following section lists the status messages of the main operating states that the drive passes through when:

- Drive is put into operation (see [8.5.1 Start sequence of the drive on page 122](#))
- Drive is stopped (see [8.5.2 Stop sequence of the drive on page 123](#))
- Fault condition has occurred

The status messages are sent to the higher-level control system and are displayed on the control panel of the drive.

For information on other status messages (eg, fault status messages), see the status words in Appendix G – Signal and parameter table (see [1.2 Structure of the user documentation on page 14](#)).



NotReadyOn

The DC-link cannot be charged and the drive cannot be connected to the main power supply, ie, the main circuit breaker cannot be closed. The status message is displayed, eg, when the doors of medium voltage compartments are still open, the grounding switch of the drive is in the grounded position, or the motor starter of the fan unit is switched off.



ReadyOn

The drive is healthy and ready for the **ON** command. The **ON** command initiates charging of the DC-link capacitors and the closing of the main circuit breaker of the drive. Depending on the control location, the command can either be sent from the higher-level control system to the drive or be initiated by pressing the **Supply On** push button on the control compartment door.



Charging

The status message **ReadyOn** changes to **Charging** when the DC-link capacitors of the drive are being charged.



ReadyRun

The drive is energized and ready for operation. As soon as the start command is initiated, the motor is magnetized and the drive starts to modulate.



ReadyRef

The drive is running and operating according to the set speed or torque reference value. When in remote control mode, the reference value is set at the higher-level control system. When in local control mode, the value is entered into the control panel.



Stopping

The drive has received a stop command and that a ramp or coast stop has been initiated. The stopping mode depends on the parameter setting. The status message changes to **ReadyRun** when the zero speed threshold is reached. When a start command is given while the drive is stopping, the drive resumes operation and the status message changes to **ReadyRef** again.



Tripped

A fault condition has occurred that requires a shutdown of the drive. The status message always alternates with the specific fault message. The type of shutdown depends on the fault class the fault condition is assigned to in the drive software.

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	3BHS904690 E01	E	en	121/159

8.5.1. Start sequence of the drive



1. NotReadyOn



2. ReadyOn

- Auxiliary power supply on
- PCU doors closed and locked
- Drive not grounded
- No emergency-off
- No fault
- WCU ready



3. On command



4. Charging

- DC-link charges
- MCB closes
- Cooling system switches on



5. ReadyRun



6. Start Command

- Inverter starts to modulate











7. ReadyRef







8. Operation

8.5.2. Stop sequence of the drive

1. **Operation** 
2. **ReadyRef** 
3. **Stop command** 
4. **Stopping** 
 - Speed ramps down
 - Inverter stops modulating
5. **ReadyRun** 
6. **Off command** 
 - MCB opens
 - DC-link discharges
 - Cooling system switches off after a delay
7. **ReadyOn** 
 - Ground drive
 - PCU doors are released for opening
 - Switch off auxiliary power supply
8. **NotReadyOn** 

8.5.3. Emergency-off sequence

1. **Operation** 
2. **ReadyRef** 
3. **Emergency-off command** 
 - MCB opens
 - Inverter stop modulating
 - Speed coasts down
4. **NotReadyOn** 

8.6. Starting the drive



DANGER

Hazardous voltages! Accidental contact with energized components can cause serious injury or DEATH. Before operating the drive:

- Remove all foreign objects from the drive
- Secure and fasten all covers
- Close all doors and lock the doors of the medium voltage compartments
- Verify that the release dials of the safety switches are in the locked position



WARNING

Risk of electric shock! The IPXXB/IP20 rating of the low voltage compartment is not fulfilled by live parts with voltages > 50 V AC. If the compartment door is open during drive operation, contact with these accessible live parts can result in DEATH or serious injury!



- Drive system must **ONLY** be operated by qualified and authorized personnel who are familiar with the operation of the drive system and the hazards involved



CAUTION

Cooling fans start automatically. When the auxiliary voltage is switched on, cooling fans can start automatically.

- Avoid contact with the cooling fans

NOTICE

Preprogrammed startup limitation. Overloading the DC-link can damage the drive.

- Drive software automatically blocks the charging sequence after 3 consecutive attempts; during the cool down period, typically < 15 minutes, the control panel displays **Charging Transformer Cooldown alarm**.
- At the end of the cool down period, the software releases the charging sequence for the next startup sequence.



When you start the drive system locally for the first time after commissioning, have the following documents at hand:

- Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)) to identify the circuit breakers to be switched on
- Appendix A – Additional manuals (see [1.2 Structure of the user documentation on page 14](#)), manual of the water cooling unit to check that the water cooling unit is ready for operation
- "ACX-AP-x Assistant control panels user's manual" (3AUA0000085685) for information on the functions and features of the ACP

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	3BHS904690 E01	E	en	124/159

8.6.1. Checks before starting the drive

When the drive is put into service after it has been commissioned, or after it has been taken out of service for a longer period, use the following check list:




- Tools and foreign objects are not in the cabinet.
- All auxiliary power supplies from external sources are switched on.
- All internal circuit breakers of the drive have been closed.
- All covers have been fitted.
- All locking screws have been removed from the locking bars on the inside of the doors of medium voltage compartments.
- All doors have been closed and locked or bolted.
- Grounding switch is in the not grounded position.
- MCB is in operating position.
- Run interlock is not active.

8.6.2. Starting the drive remotely

When the drive system is operated from a higher-level control system or an operator control desk, follow the instructions in the applicable manuals.

8.6.3. Starting the drive locally

You can start the drive locally with the control panel on the COU.

1. Press the  key to switch local control mode if the text in the top left of the display is **Remote** instead of **Local**.
2. If the **Reset Emergency Off** push button is flashing, complete the steps in [8.7.3.1 Resetting the Emergency Off push button on page 127](#).
NOTE – The button flashes in the following situations:
 - When the emergency-off safety relay of the drive is actuated, ie, when the auxiliary voltage is switched off and on again
 - When the **Emergency Off** push button for the drive system is active.
3. If the display shows an alarm or fault message, reset the fault.
NOTICE If the reset does not work, the responsible personnel must rectify the fault.
4. Press the **Supply On** push button on the COU door.
The push button flashes while the DC-link charges. When the charging is complete:
 - Main circuit breaker closes automatically
 - **Supply On** push button remains lit
5. In the **Options** menu, select **Reference**, enter the reference value for the drive, and then press  (**Save**).
6. Press the  (**Start**) key.

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8.7. Stopping the drive

8.7.1. Stopping the drive remotely

When the drive system is operated from a higher-level control system or an operator control desk, follow the instructions in the applicable manuals.


8.7.2. Stopping the drive locally

You can stop the drive locally with the control panel on the COU.

1. Press the  key to switch local control mode if the text in the top left of the display is **Remote**.

2. Press the  (**Stop**) key.

The drive status changes to **Stopping** while the motor stops according to a preset function. When the motor speed is 0, the drive status changes to **ReadyRun**. If the MCB has not been opened, you can restart the motor at any time.

NOTE – If you need to restart the drive during the stop sequence, press the  (**Start**) key.

8.7.3. Stopping the drive in an emergency



CAUTION

Hazardous voltage. The **Emergency Off** push button DOES NOT disconnect the auxiliary power supply from the drive.

→ Avoid contact with live parts



The **Emergency Off** push button is a hardwired fail-safe control switch that immediately stops the drive by disconnecting the main power supply. When you activate the button:

- MCB opens
- Drive system coasts down
- DC-link of the drive discharges

Referring to [Figure 86](#):

1. Press the **Emergency Off** push button for the drive system:
 - On the local control panel of the COU door
 - At an external location that is linked to the emergency-off circuit

The emergency stop activates and the **Emergency Off** button locks in the open position. While the stop is active, the **Reset Emergency Off** and **Supply Off** buttons flash.

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**Key**

1. Supply Off push button
2. Reset Emergency Off push button
3. Emergency Off latching push button

Figure 86 – Detail of local control panel on the COU

8.7.3.1. Resetting the Emergency Off push button

You need to reset the **Emergency Off** button after each use, ie, when the **Reset Emergency Off** button is flashing. The button is either on the local control panel of the COU door or at an external location that is linked to the emergency-off circuit.

Referring to [Figure 86](#):

1. Verify that the reason for the emergency stop has been resolved.
2. Turn the red **Emergency Off** push button in the direction of the arrows until the button unlatches and returns to the up position.
3. Press the **Reset Emergency Off** push button.
The flashing light of the button goes off and the emergency-off safety relay of the drive is reset.
4. Connect the main power supply to the drive and start the drive according to [8.6 Starting the drive on page 124](#).

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8.8. Arc resistant design

The optional “Arc Resistant Design” provides the drive with arc fault protection in accordance with IEC 62477-2.

The ABB arc resistant classes in [Table 11](#) indicate the type of arc proofing that a drive uses. Depending on the drive configuration, classes I and IV are available for an ACS5000W gen. 3.

For information on the arc resistant design class of your drive, see the project-specific “Converter Data Sheet” (Appendix B – Technical data (see [1.2 Structure of the user documentation on page 14](#))).

Table 11 – ABB arc resistant classes

ABB class	Description
Class I	Protection based on arc prevention (NOT certified according to IEC 62477-2)
Class II	Protection based on arc resistant cabinet structure, IAC certified by 3rd body according to IEC 62477-2
Class III	Protection based on external arc fault limitation and elimination. HV fuses are applied externally to limit the arc fault current, IAC certified by 3rd body according to IEC 62477-2
Class IV	Fast arc detection and elimination, IAC certified by 3rd body according to IEC 62477-2

8.8.1. Internal arc classification (IAC)

The arc fault rating, which is based on arc fault tests, is on the label underneath the drive rating plate.

Internal Arc Classification (IAC)									
ABB Class IV									
IAC	F	L	R	T	B	I _A	t _A	APR	SC
IEC 62477-2	2b	2b	2b	1	1	19 kA	0.5 s	Yes	No
Distance [m]	0.3	0.3	0.3	-	-				

3BHB049908R5419

Figure 87 – IAC label example

IMPORTANT! The Main Circuit Breaker (MCB) for the drive fulfills the APR (Associated Protection Requirement) without the need for additional devices. The MCB requirements are described in [2.4 Main circuit breaker protection device on page 27](#).

Based on the ACS5000W gen. 3 IAC rating, the minimum approach distance is 0.3 m. Local rules may require additional distance. The user is responsible to determine the correct approach distance considering local rules.

8.8.2. Arc detection with the Arc Guard System™

The Arc Guard System™ detects fast arc faults in the terminal sections of the drive. When the Arc Guard System detects an arc fault the drive performs protection firing and immediately opens the main circuit breaker. The Arc Guard monitor and HMI panel are located in the COU ([Figure 15](#)).



Figure 88 – Arc Guard™ system with HMI panel

The Arc Guard System™ consists of the following:

- Arc Guard unit TVOC-2 with HMI panel
- Optical fiber detector

8.8.3. Action after the Arc Guard System™ has been triggered

1. De-energize and ground the drive according to [9.4.2 De-energizing the drive on page 136](#).
2. Search for the location where the arc has been detected.
3. Check the Arc Guard HMI panel messages and use the circuit diagrams.



Figure 89 – HMI panel

4. Open the power units and localize the defect.
5. Repair the defect or contact support line if needed.
6. Reset the fault on Arc Guard HMI panel.
7. Acknowledge the firing through with parameter 8.50 on the control panel (only when fault was understood and corrected).
8. Restart the drive.

8.9. De-energizing and grounding the drive

See [9.4.2 De-energizing the drive on page 136](#).

8.10. Opening the doors

See [9.4.3 Opening and closing the doors on page 138](#).

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9. Preventive and corrective maintenance

9.1. General information

During the warranty period of the drive, any maintenance must be carried out exclusively by ABB service personnel. After the warranty period, repair work may only be carried out by certified personnel.

9.1.1. Required qualification

To maintain safe and reliable operation of the drive, ABB recommends taking out a service contract with the ABB service organization.

9.1.2. Maintenance schedule

Carry out all maintenance tasks according to the maintenance schedule, on time and at the stated intervals in the "ACS5000 preventive maintenance schedule" (3BHS855274 E01).

9.1.3. Logbook

It is recommended to record all troubleshooting and maintenance work in a logbook including:

- Date and time
- Detailed description

9.1.4. Spare parts

To ensure safe and reliable operation, use only spare parts recommended and approved by ABB.

For information on types and identification codes, see Appendix E – Parts list (see [1.2 Structure of the user documentation on page 14](#)).

9.2. Identifying electrical equipment

9.2.1. Device designation

To facilitate the identification in wiring diagrams and parts lists, all devices are labeled in accordance with IEC 81346-1.

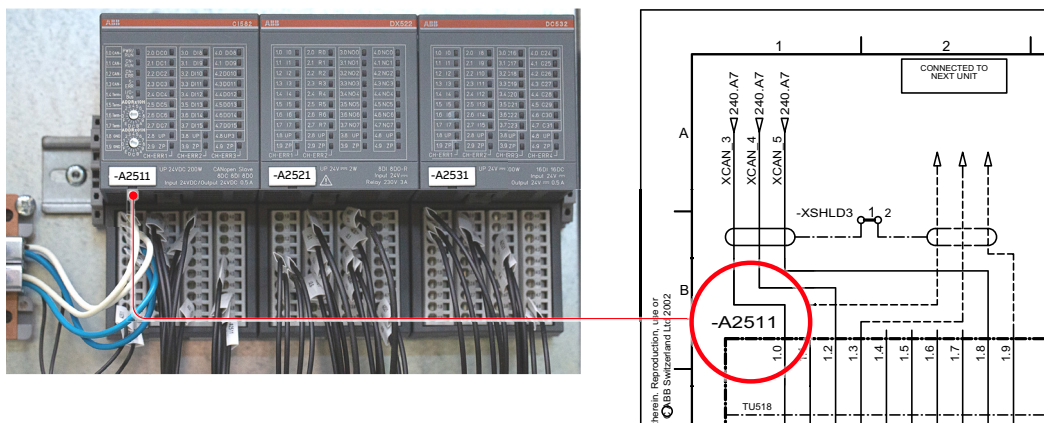


Figure 90 – Example of device identification number on S500 I/O module and wiring diagram

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9.2.2. Cables and wires

Cables and wires in the drive are equipped with marker sleeves that have the designation name of the terminal that the cable or wire is connected to. This name corresponds with the designation in the wiring diagram.

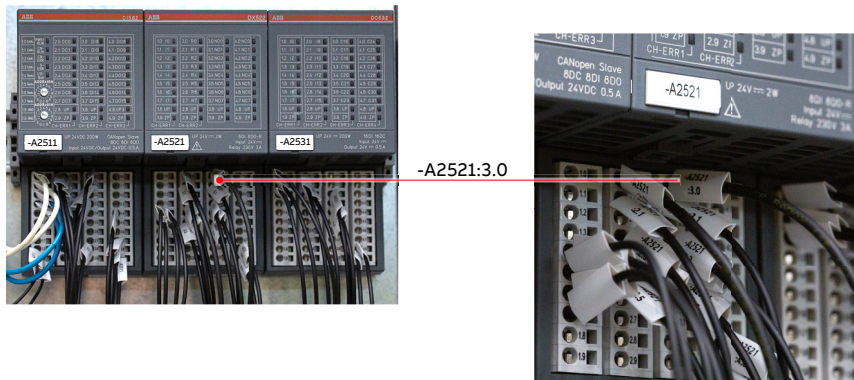


Figure 91 – Cable and wire designations

9.2.3. Understanding wiring diagrams

For information on item designation and cross-reference conventions, see Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)).

9.3. Drive status indicators

The drive has hardware and software indicators that show the status of the drive, drive component, or equipment that is monitored by the drive, eg, MCB, transformer, or cooling system.

9.3.1. Alarm and fault indicators

When a failure occurs in the drive or in the equipment monitored by the drive (eg, main circuit breaker, transformer, cooling system), the control panel displays a corresponding alarm or fault message and the alarm / fault lamp on the control compartment door lights up:

- **Alarm:** flashing light
- **Fault:** permanent light



The message can be saved and viewed in the fault logger of the drive when a PC with Drive Composer is connected to the drive. The fault history can also be called up on the control panel.

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9.3.2. Error message levels

Two error message levels are used in the drive:

- **Alarm:** does not shut down the drive. If the condition causing the alarm is not corrected, a persisting alarm can often lead to a fault. An alarm cannot be reset manually. The alarm message is deleted from the display as soon as the alarm condition has been corrected.
- **Fault:** shuts down the drive. The type of shutdown depends on the origin of the fault.

Depending on the type of fault, the drive opens the main circuit breaker (MCB) or keeps it closed:

- Class 1 faults (FC 1) with FT (firing through) and opening of the MCB
- Class 1 faults (FC 1) without FT (firing through) and opening of the MCB
- Class 2 faults (FC 2) without opening of the MCB

Since the MCB is controlled and monitored entirely by the drive, no opening command must be given to the MCB when a fault condition occurs.

A fault condition must be corrected and the fault be manually reset before the drive can be started again.

9.3.2.1. Alarm and fault messages

When an alarm or a fault occurs, a specific message is saved in the fault buffer of the drive. Information on the 64 most recent fault and alarm events are saved.

9.3.2.2. Fault handling

The faults are entered into the fault buffer as they occur and are numbered:

- The last fault entered has number 1.
- The first fault entered has the highest number.

Information of the fault classification (eg, FC 1 or FC 2) is also saved when the first fault of the fault class is active. Date and time stamps facilitate fault tracing, especially when a fault leads to several subsequent faults.

For more information on alarms and faults, see the firmware manual in Appendix G – Signal and parameter table (see [1.2 Structure of the user documentation on page 14](#)).

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9.3.2.2.1. Standard troubleshooting procedure

If a fault shuts down the drive, proceed as follows:

1. DO NOT switch off the auxiliary supply voltage or try to reset a fault message before all information at the time of the occurrence of the fault condition has been saved.
2. Select the fault history display on the control panel, but do not clear the buffer now!
3. See [8 Operation on page 117](#).
4. Identify the fault and make a logbook entry.
5. Save the content of the data logger when a PC is available which has the Drive Composer/Startup tool installed.

The data logger provides information (eg, waveforms of voltage, current, torque) for efficient troubleshooting.

6. Contact ABB service if a fault cannot be rectified.

When calling ABB service, it is recommended to have the following data available at the time when the fault occurred:

- Operating, ambient and load conditions
- Unusual events

7. After the fault has been rectified, start the drive as described in [8 Operation on page 117](#).

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9.3.3. LEDs and switches on circuit boards and I/O devices

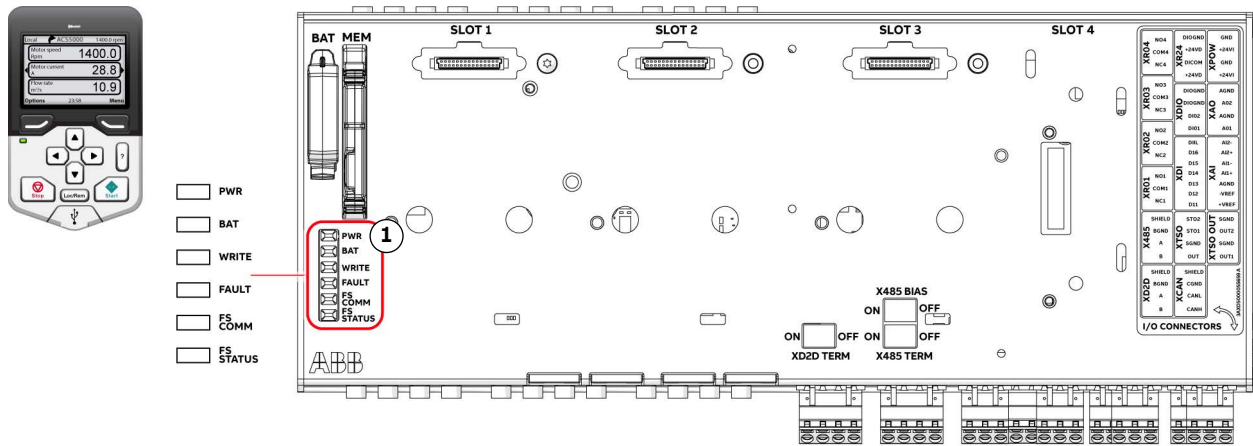
This section provides an overview of the meaning of LEDs and switches of the main circuit boards and I/O modules.

The LEDs can be checked easily while the auxiliary voltage is switched on without having to remove covers first. The LEDs provide information on the status of the devices and can be used for diagnostic purposes.

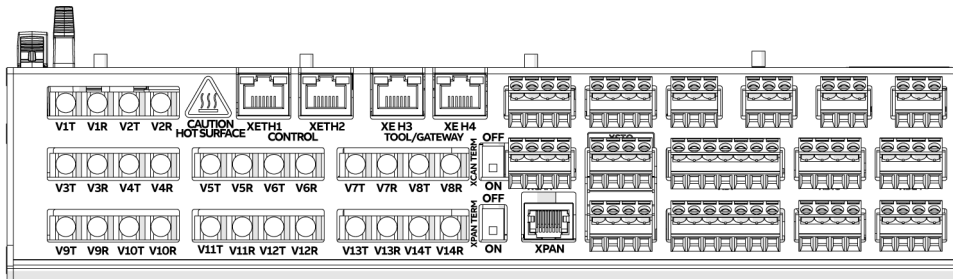
9.3.3.1. UCU-26 control unit

The UCU-26 control unit is connected to the control panel via an Ethernet cable.

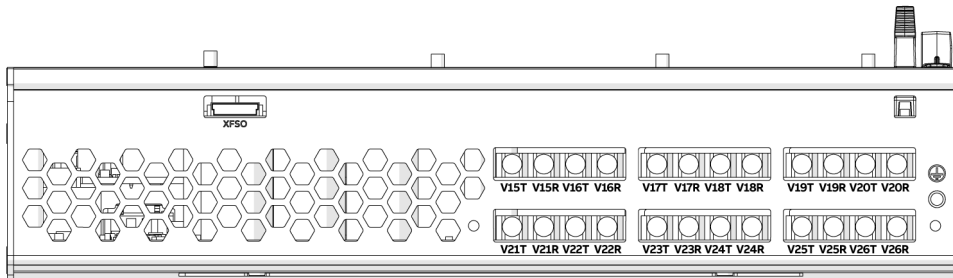
For more information, see the "UCU-26 control unit hardware manual" (3BHS897436 E01).



a) Control panel and top view of UCU-26



b) Front view



c) Rear view

Key

- 1. LEDs

Figure 92 – UCU-26 control unit

Table 12 – LED indications, UCU-26 control unit board

LED	Status	Indication
PWR	ON	Voltage supply is sufficient.
BAT	ON	Real-time clock battery voltage is higher than 2.5 V.S
	OFF	Replace the battery.
WRITE	ON	Writing to microSDHC memory card is in progress. Do not remove the microSDHC memory card.
FAULT	ON	Control program has generated a fault Refer to the firmware manual.
FS COMM	–	Reserved
FS STATUS	–	Reserved

For more information, see "UCU-26 control unit hardware manual" (3BHS897436 E01).

9.3.3.2. S500 I/O modules

The S500 modules have protected outputs and are used for comprehensive diagnosis that covers a wide range of signal types.

For more information about diagnostic and LED states, see "System assembly and device specifications for AC500 V2 Products" (3ADR010121).

9.3.3.3. Serial communication interfaces (optional)

To identify the serial communication interface in the drive, see Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)).

For more information on the serial communication options, see the “Optional communication interfaces” section in "Field wiring terminals" (3BHS500316 E01).

9.3.3.4. LEDs on roof-mounted cooling fans

LEDs on the front of the roof-mounted cooling units indicate the operational status of the unit, eg, an alarm.

Alarm signals are also shown on the control panel.

For more information, see [9.4.12.1 Replacing a fan in an IP42 roof-mounted cooling unit on page 152](#) and [9.4.12.2 Replacing a fan in an IP54 roof-mounted cooling unit on page 153](#)

9.4. Corrective maintenance

Overview on maintenance tasks:

- [9.4.6 Visual checks on the drive on page 143](#)
- [9.4.7 Cleaning on page 143](#)
- [9.4.8 Checking wire and cable connections on page 144](#)
- [9.4.9 Checking and replacing filter mats on page 144](#)
- [9.4.12 Replacing fans on page 152](#)

9.4.1. Safety



DANGER

Hazardous voltages! Risk of life-threatening injury or DEATH.

- Before you work on the drive, carry out the steps in [2.3.2 The 7 steps that save lives on page 24](#).

After the work is complete and before you energize the drive:

- Remove all foreign objects.
- Secure and fasten all covers.
- Close all doors.
- Lock the doors of the medium voltage compartments.
- Verify that the release dials of the safety switches are in the locked position.



WARNING

Hazardous voltage! Contact with a charged capacitor can cause serious injury or DEATH!



75 min

- After the drive has been de-energized, wait a MINIMUM of 75 minutes for the capacitors to fully discharge

- Verify that a capacitor is discharged before you touch it



The IPXXB/IP20 rating of the low voltage compartment is not fulfilled by live parts with voltages > 50 V AC. If the compartment door is open during drive operation, contact with these accessible live parts can result in DEATH or serious injury!

- Work must ONLY be performed by qualified personnel with electrotechnical expertise



NOTICE

Risk of component damage. Foreign objects, metallic dust, and dirt can cause an energized drive to fail.

- Remove all foreign objects
- Secure and fasten all covers
- Close all doors

9.4.2. De-energizing the drive

The following steps describes how to de-energize the drive with the control panel. If the drive is remotely controlled, follow the established shutdown procedures.

1. Press the  key to switch local control mode if the text in the top left of the display is **Remote** instead of **Local**.
2. Press the  (**Stop**) key to stop the motor.

The motor stops according to the preset stop function. When the motor speed reaches zero, the drive status changes to **ReadyRun**.

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3. Press the **Supply Off** push button to disconnect the drive from the main power supply.



- ↳ The following happens:

- MCB opens
- DC-link discharges
- **Supply Off** push button flashes and remains on after the DC-link has discharged
- Drive status changes to **ReadyOn**.

4. Rack-out, lock-out, ground, and tag-out the main power supply.
5. Wait for the **Grounding Switch Unlocked** buttons on the PCUs to turn yellow, and then continue with step 6.

CAUTION! Forcing the switch can short-circuit in DC-link capacitors (loud bang) if the DC-link is energized, damage the (unreleased) grounding switch, or damage the components inside the drive. If the button lamps remain off, investigate the cause, and correct the problem (see [9.3.1 Alarm and fault indicators on page 131](#)).

6. Turn the grounding switch to the grounded position.
7. Open the medium voltage doors according to [9.4.3 Opening and closing the doors on page 138](#).
NOTE – Auxiliary voltage is required to open the doors.

8. Switch off and lock out all auxiliary voltages from external sources.

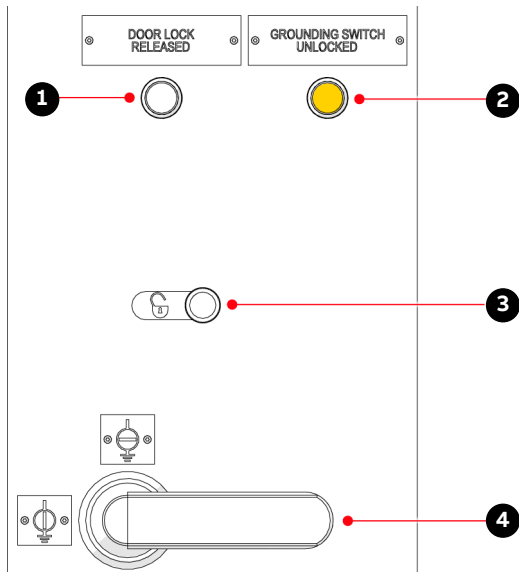
The drive is now de-energized, but not grounded.

DANGER! FATAL voltages can still be fed into an ungrounded drive from the main power supply or motor during maintenance work. Connect grounding equipment to the designated locations before you work on the drive (see [3.9 Grounding studs on page 50](#)).

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9.4.3. Opening and closing the doors

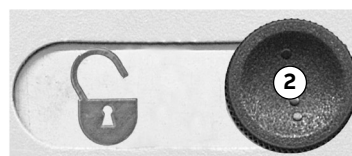
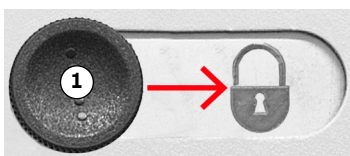
9.4.3.1. Releasing the doors



Key	Explanation
1. White lamp	Lights up to indicate that the drive is grounded and you can slide the locking bar to the unlocked / locked position.
2. Yellow lamp	Lights up when the grounding switch has been released. You can then turn the grounding switch to the grounded or ungrounded position.
3. Locking bar	Releases or blocks the door handles of a PCU compartment.
4. Grounding switch	In horizontal position, the drive is grounded. In vertical position, the drive is not grounded.

Figure 93 – Grounding switch grounded

- To test the yellow lamp, press its push button.
If the lamp does not turn on, see [9.4.4 Grounding the drive when the grounding switch is not released on page 140](#).
- If the drive is in operation, stop the drive according to [8.7 Stopping the drive on page 126](#).
- To discharge the DC-link of the drive, press the **Supply Off** push button on the local control panel.
The yellow lamp lights up when the DC-link is discharged. If the lamp does not turn on, see [9.4.4 Grounding the drive when the grounding switch is not released on page 140](#).
- Once the yellow lamp lights up, turn the grounding switch to the grounded position.
The white lamp lights up to indicate that the drive is grounded.
- Once the white lamp lights up, slide the locking bar from the locked (1) to the unlocked (2) position.

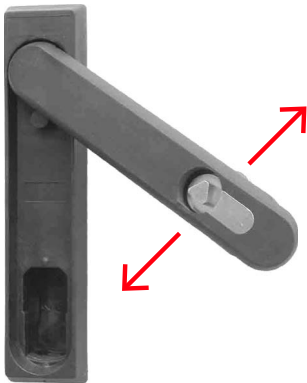


9.4.3.2. Opening the doors

1. To release the door handle, insert and turn the key to the right.
 - ↳ The door handle pops out.



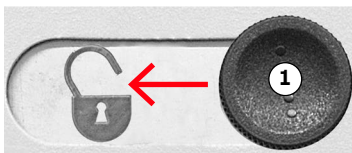
2. Turn the door handle:
 - Right if the door is hinged on the right
 - Left if the door is hinged on the left.



9.4.3.3. Closing and locking the doors

1. Align the door handle with its base and press the handle down until it snaps into place.
2. Verify that the drive is supplied with auxiliary voltage.
3. Slide the locking bar from the unlocked (1) to the locked (2) position.

IMPORTANT! A limit switch monitors the locked position of the locking bar; you cannot start the drive if the door is not properly locked.



9.4.4. Grounding the drive when the grounding switch is not released

When the DC link of the drive has been discharged, the lamp **Grounding Switch Unlocked** lights up to indicate that the grounding switch is released and can be turned to the grounded position. If the lamp does not turn on, take the following steps.

1. Check that the auxiliary and control voltage are switched on.
NOTICE DO NOT force the grounding switch in any direction.
2. Press the lamp cap to test the lamp.
 - **Lamp off:** lamp is defective or the lamp-test circuit is faulty
NOTE – Since the lamp-test circuit is independent of the grounding circuit, the lamp remaining off does not indicate a faulty grounding and/or discharging circuit.
 - **Lamp on:** malfunction in the discharging circuit and/or the grounding circuit
3. Verify that the MCB (main circuit breaker) is open.
 - Press the **Emergency Off** pushbutton on the COU door according to [8.7.3 Stopping the drive in an emergency on page 126](#)
 - If the MCB is open, secure the MCB against closing.
 - Check if the LED of digital input IO (input module A2531, input C1_P3_IO in COU1) is lit. If the LED is lit, the feedback signal **MCB is open** is present.
4. Verify that hazardous voltages from the motor cannot be fed into the drive.
5. Check if the LED of digital output R1 (output module A2521, C1_P1_R1 in COU1) is lit. If the LED is lit, the grounding switch is released.
6. Check the discharging level of the DC link.
If the value of the parameter 9.91 DC voltage max value is below 50 V, the DC link is discharged.
7. Carefully turn the grounding switch to the grounded position under the following conditions:
 - Hazardous voltages cannot be fed into the drive from the main power supply or the motor
 - DC link is discharged
 - Grounding switch is released
 - Drive status is “Emergency Off”

IMPORTANT! If you still cannot turn the grounding switch, continue with [9.4.5 Emergency release of a door safety switch on page 141](#).

For information on the wiring of the control circuit, see the project-specific wiring diagrams in Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)).

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9.4.5. Emergency release of a door safety switch



DANGER

Hazardous voltages! Risk of life-threatening injury or DEATH!

- Before you unlock a safety switch, de-energize and ground the drive according to [9.4.2 De-energizing the drive on page 136](#)
- DO NOT unlock the safety switches permanently

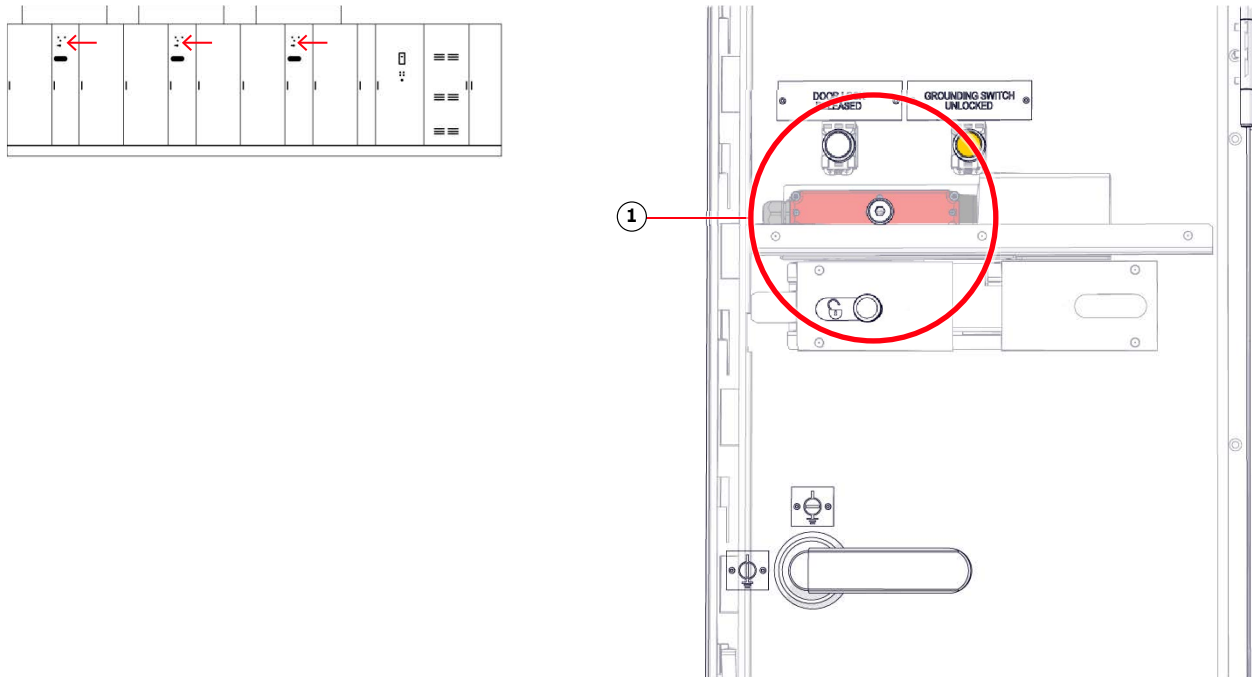
9.4.5.1. Location of safety switches

To prevent you from opening the medium voltage compartment doors during operation, each primary and secondary PCU has a safety switch. The switch blocks and releases the locking bar based on the drive being discharged and grounded. This prevents you from opening these doors unintentionally during operation.

In 1700 mm PCUs, the safety switches are on the back of the left door.

In 2100 mm PCUs, the safety switches are on the back of the middle door.

A screw cap on the front of the door marks the exact position.



Key

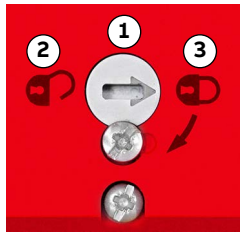
1. Safety switch behind door

Figure 94 – Location of safety switches

NOTE – For the safety switches to work and to be able to open the doors, auxiliary power supply is required. If the auxiliary power supply is unavailable and the doors are closed, you can only open them by unlocking the safety switch manually.

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9.4.5.2. Safety-switch settings



Key

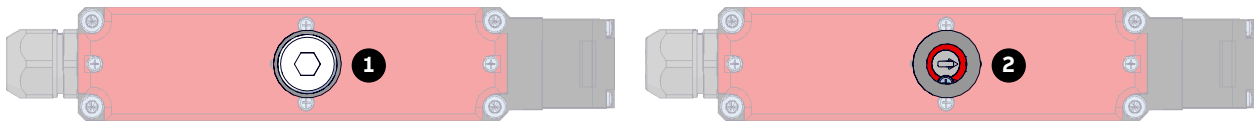
1. Release dial
2. Unlocked position: enables opening the door of a medium voltage unit whether the auxiliary voltage is switched on or off.
3. Locked position: Normal operating setting

Figure 95 – Safety switch

9.4.5.2.1. Unlocking a door

✓ DC link is discharged and the auxiliary voltage is switched on.

1. To access the release dial (2), remove the screw cap (1) from the door.



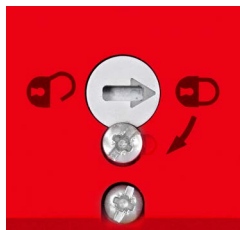
2. Turn out the locking screw (1) until the release dial can be turned.



3. Turn the release dial from the locked to the unlocked position.
You can now actuate the locking bar and open the doors.



4. When the door is open, turn the release dial to the locked position and screw in the locking screw.



5. Screw in the locking screw again.
6. Refit the screw cap.

9.4.6. Visual checks on the drive

Check the drive and its immediate vicinity visually at the intervals stated on the maintenance schedule and pay attention to the following items:

- Humidity inside the drive
- Permitted range of ambient air temperature and humidity of the drive
- Dust built-up inside the drive
- Appropriate fastening of cables and wires and connections of cable shields and screens
- Integrity of cable insulation
- Signs for overheated components, wires, cables or busbars
- Corrosion on electronic circuit boards, connectors or busbars
- Correct type of signal and power supply cables

For information, see the applicable cable specifications.

9.4.7. Cleaning

NOTICE

Risk of component damage. Dust and moisture on electrical components and wiring can result in failure, damaged components, and the loss of low-level signals in loose connections.

- Check the cabinet regularly for signs of dust and humidity and clean if necessary.
- Use appropriate and recommended cleansing agents.
- DO NOT use alcohol and solvents that can damage the components.

9.4.7.1. Cleaning the drive cabinet

When cleaning the drive cabinet, keep the following in mind:

- To prevent dirt falling into equipment, cover the equipment.
- The drive contains components which are sensitive to electrostatic discharge. Therefore, take electrostatic-sensitive precautions and use suitable tools.
- Clean circuit boards with special care. To prevent the components being damaged, use antistatic brushes and a vacuum cleaner with a soft nozzle.
- Remove dust on assemblies and busbars inside the cabinet with a vacuum cleaner and lint-free cleaning cloths.
- Remove water, oily or greasy deposits on assemblies, components and busbars with water- and oil-absorbing microfibers such as 3M Scotch-Brite™.
- Use a nylon brush or a vacuum cleaner for removing dust or deposits from recesses.
- Clean the outside of the cabinet with a vacuum cleaner and cleaning cloths.

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9.4.8. Checking wire and cable connections

NOTICE

Risk of component damage. Vibration can loosen electrical connections and cause equipment failure. Excessive force damages the capacitor bushings.

- Tighten to the torque value on the label attached to the capacitor; DO NOT exceed 20 Nm if the tightening torque value is not specified.
- Check all power and control cable connections and tighten them if necessary.
- Check that all plugs and connectors are tight.

9.4.9. Checking and replacing filter mats

You can replace EXU, PCU, and WCU filter mats.

Inspection intervals	See the "ACS5000 preventive maintenance schedule" (3BHS855274 E01).
Service during operation	Possible
Filter mat class	G3 (EN779)
Location	In IP 54 rated drives, the filter mats are behind the ventilation grids of the roof-mounted cooling units on COU and WCU cabinets. In IP 42-rated drives, the filter mats are behind the ventilation grids in the PCU and WCU cabinet doors.

Table 13 – Filter mat specifications

Location	IP class	Filter class	Width (mm)	Height (mm)	Depth (mm)	Material No.
WCU	IP 42/IP 54	G2 P15/150S	89	89	10	3BHB056111R0001
EXU	IP 42/IP 54	G3 P15/350S	283	283	12	3BHE042095R0001
PCU	IP 42	G3 T15/150	600	652	10	3BHB030369R0800
PCU (FS2/FS4 only)	IP 42	G3 T15/150	600	352	10	3BHB030369R0500



CAUTION

Cooling fans start automatically. Cooling fans start automatically in response to temperature levels.

- Switch off the protection switch for the cooling fan according to Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)).

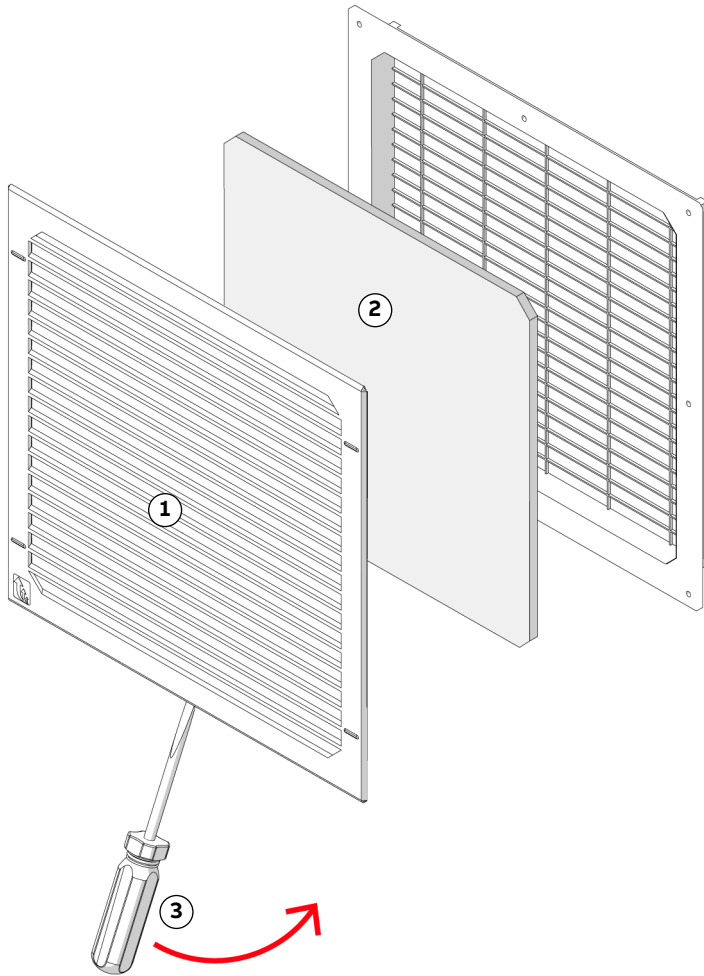
NOTICE

Risk of component damage. Dust inside the cabinet can damage components and cause failure.

- Always use a replacement filter mat with the same dimensions and filter class as the original filter mat (see [Table 13](#)).

9.4.9.1. Replacing an EXU filter mat

1. Insert a screwdriver (2, [Figure 96](#)) into the slot of the air outlet panel (1, [Figure 96](#)), and then gently pry the panel off.



Key

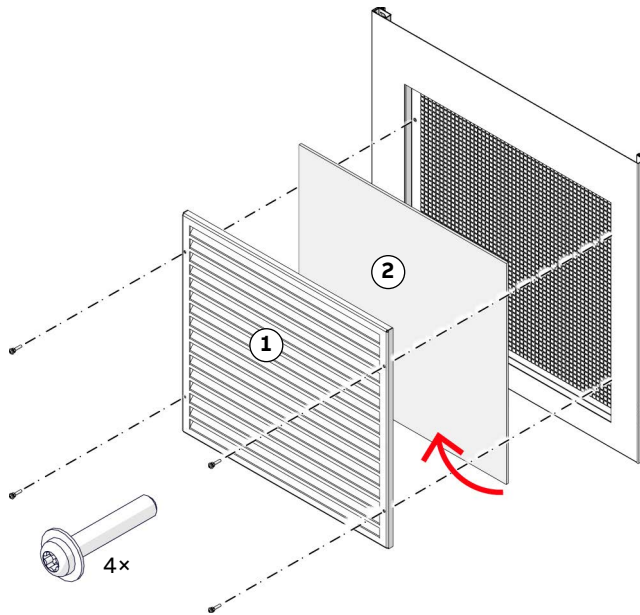
1. Air outlet panel
2. Filter mat
3. Screwdriver

Figure 96 – EXU filter mat

2. Remove the filter mat.
3. Insert the new filter mat and reinstall the air outlet panel.

9.4.9.2. Replacing a PCU filter mat

1. Remove the four screws from the air outlet panel (1, [Figure 97](#)) and then remove the panel.

**Key**

1. Air outlet panel
2. Filter mat

Figure 97 – PCU filter mat

2. Starting from the top, roll down the filter mat (2, [Figure 97](#)).
3. Insert the new filter mat.
NOTE – See [Table 13](#) for the filter mat specifications.
4. Reattach the air outlet panel with the 4 screws.

9.4.9.3. Replacing a WCU filter mat

1. Insert a screwdriver into the slot of the ventilation grid, and then gently pry the cover off of the fan.



2. Remove the filter mat.



3. Insert the new filter mat and reinstall the ventilation grid.

9.4.10. Battery inspection and replacement

The control panel is on the local operator panel (1, [Figure 98](#)) of the COU door.

9.4.10.1. Replacing the control panel battery

At an ambient temperature of 25 °C, the change interval of the CR2032 battery that powers the real-time clock of the control panel is approximately 10 years.

1. Push down the retaining clip at the top of the control panel and then pull the panel forward from the top edge.



Key

1. Local operator panel on COU

Figure 98 – Removing control panel

2. Turn the lid on the back of the control panel counter-clockwise until the lid opens.



3. Remove the battery carefully.
4. Replace the battery with a new CR2032 battery.
NOTE – The battery holder has grip nails.
5. First slide the battery and then press on the other side.
↳ The battery snaps in.
6. Make sure that the battery polarity shows positive on the upside.
7. Put the lid back and turn it clockwise to lock it.
8. Dispose of the old battery according to local disposal rules or applicable laws.
9. Replace the control panel in the reverse order of removal (step 1).

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9.4.10.2. Replacing the UCU-26 control unit battery

The UCU-26 control unit is in the COU (see 17, [Figure 16](#)).

Replace the real-time clock battery when the **BAT** LED of the UCU-26 control unit ([Figure 92a](#)) remains off during drive operation. Since the battery is not critical for drive operation, you can schedule the replacement at the next available opportunity.

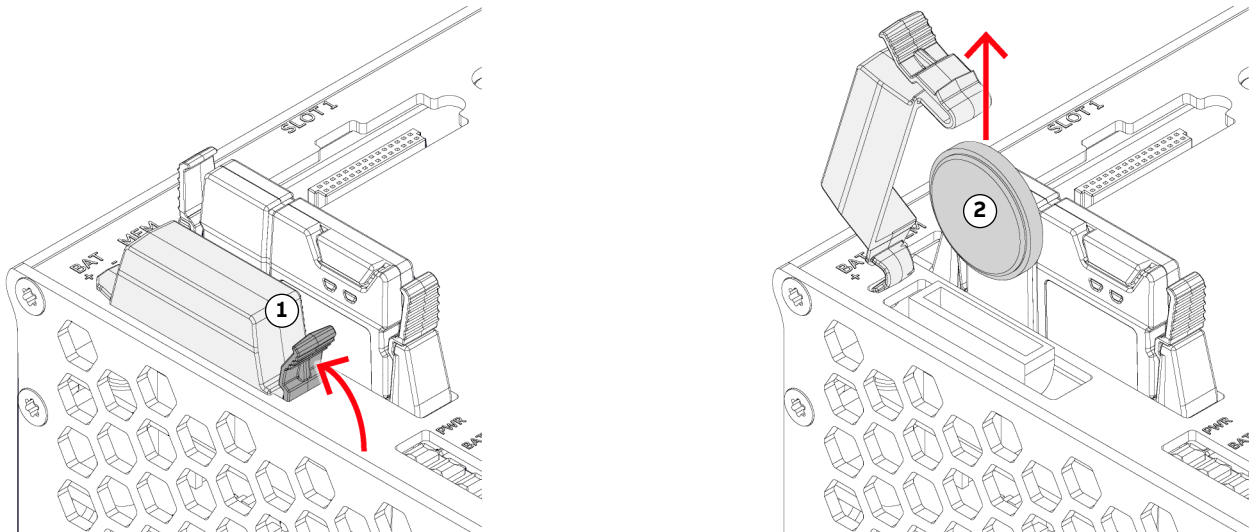


DANGER

Hazardous voltage. Risk of injury or DEATH and damage to the equipment.

- Follow the safety instructions in [2 Important safety information on page 22](#)
- All work must be done by a qualified electrical professional

1. Stop the drive according to [8.7 Stopping the drive on page 126](#).
2. Open the doors on the power unit.
3. Make sure that the control unit is de-energized.
4. Open the battery cover (1, [Figure 99](#)) and remove the battery (2, [Figure 99](#)).



Key

1. Battery cover
2. BR2032 battery

Figure 99 – Location of UCU-26 battery

5. Replace the battery with a new BR2032 battery.
NOTE – The real-time clock stays set for 2 minutes without a battery.
6. Close the battery cover.
7. If necessary, set the real-time clock – for instructions, refer to "ACX-AP-x Assistant control panels user's manual" (3AUA0000085685).
8. Discard the old battery according to applicable laws.

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9.4.11. UCU-26 control unit memory unit/card replacement



DANGER

Hazardous voltage. Risk of injury or DEATH and damage to the equipment.

- Follow the safety instructions in [2 Important safety information on page 22](#)
- All work must be done by a qualified electrical professional

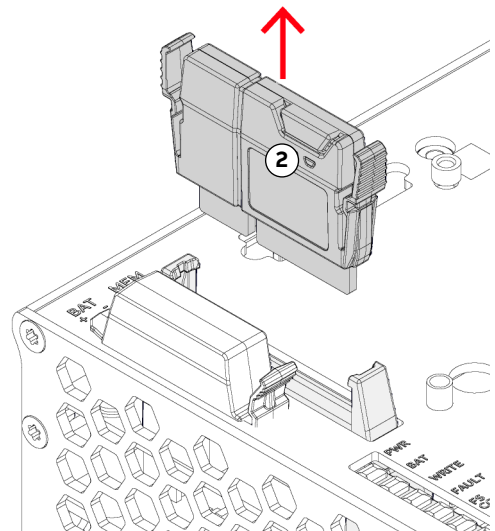
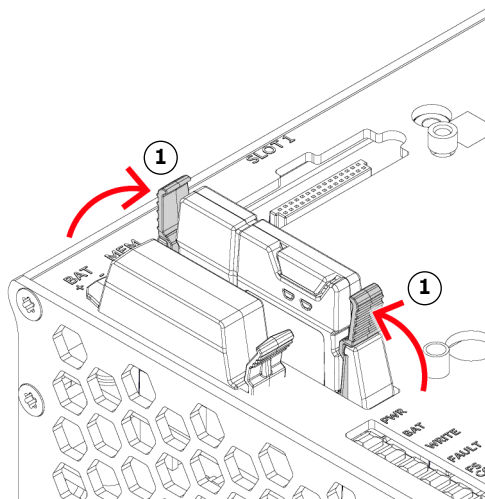
The UCU-26 control unit is in the COU (see 17, [Figure 16](#)).

9.4.11.1. Replacing the memory unit of the UCU-26 control unit

After replacing a control unit, you can keep the existing parameter settings by transferring the memory unit from the defective control unit to the new control unit.

Replace the memory unit as follows:

1. Stop the drive according to [8.7 Stopping the drive on page 126](#).
2. Open the doors on the power unit.
3. Verify sure that the control unit is de-energized.
4. Press and hold in the clips (1, [Figure 100](#)) on the memory unit (2, [Figure 100](#)), then gently pull the memory unit out.



Key

1. Clips
2. Memory unit

Figure 100 – Remove memory unit from UCU-26 control unit

5. Push the new memory unit in.

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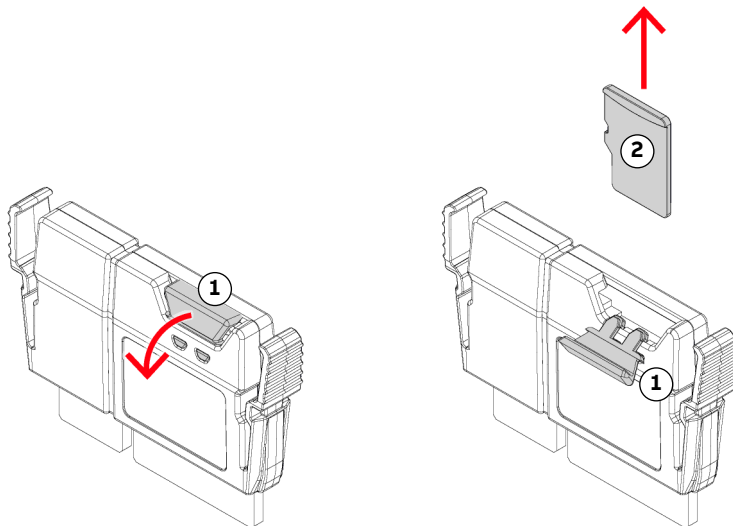
9.4.11.2. Replacing the memory card of the UCU-26 control unit

Table 14 – UCU-26 control unit memory card specifications

Type	microSDHC
Speed	Class 4 (minimum)
Size	4 to 32 GB

Replace the memory card as follows:

1. Stop the drive according to [8.7 Stopping the drive on page 126](#).
2. Open the doors on the power unit.
3. Verify that the control unit is de-energized.
4. Remove the memory unit from the control unit – for instructions, refer to [9.4.11.1 Replacing the memory unit of the UCU-26 control unit on page 150](#).
5. Open the memory card cover on the memory unit.
6. Push the memory card to remove it.



Key

1. Memory card cover
2. Memory card – microSDHC

Figure 101 – Remove memory card from UCU-26 memory unit

7. Push in the new memory card and verify that it is correctly installed.
8. Close the memory card cover.
9. Install the memory unit onto the control unit.

9.4.12. Replacing fans

The following instructions are for fans in IP42 and IP54 roof-mounted cooling units as well as DCS880 H4/DCT880 T4 and DCS880 H6 EXUs.

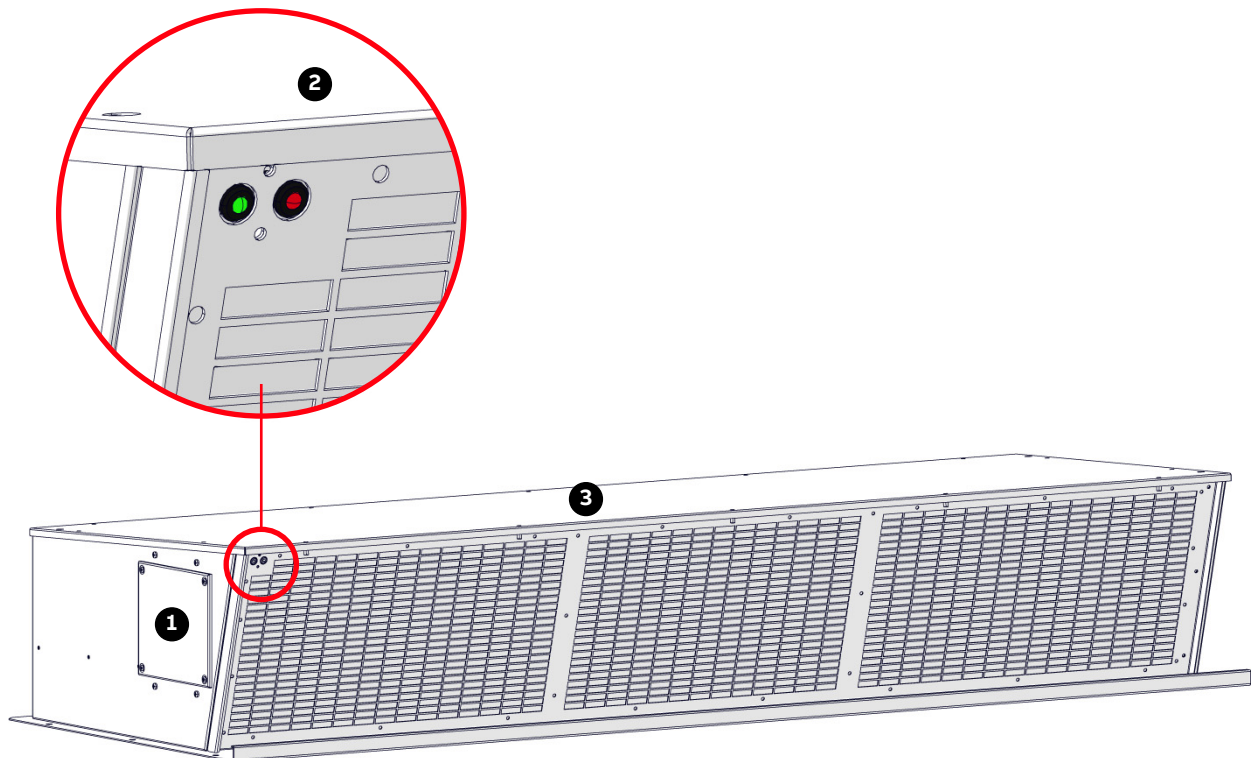
9.4.12.1. Replacing a fan in an IP42 roof-mounted cooling unit

The roof-mounted cooling unit on an IP42 cabinet has 2 working fans and 1 redundant fan.

In case of fan failure, the redundant fan begins operating and the red indicator light on the front of the cooling unit turns on.



If you need to replace a fan in a roof-mounted cooling unit, contact ABB. DO NOT attempt to replace the fan yourself.



Key

1. Control access panel
2. Indicator lights
3. Location of fans (below cover)

Dimensions (L × W × H): 1550 mm × 550 mm × 230 mm

Weight: 40 kg

Figure 102 – Roof-mounted cooling unit (IP42)

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Approved	Public	3BHS904690 E01	E	en	152/159

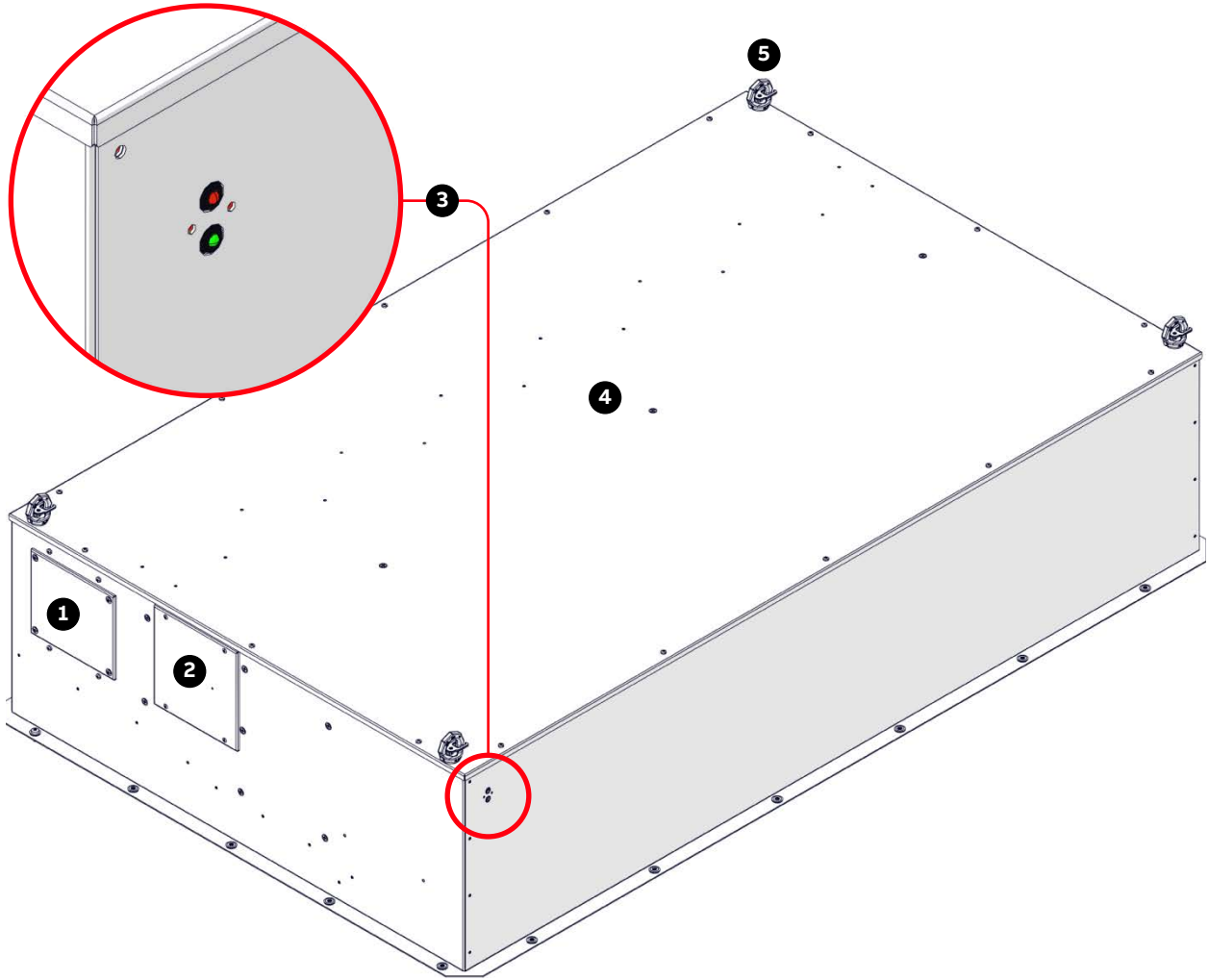
9.4.12.2. Replacing a fan in an IP54 roof-mounted cooling unit

The roof-mounted cooling unit on an IP54 cabinet has an air-to-water heat exchanger, 3 working fans, and 1 redundant fan.

In case of fan failure, the redundant fan begins operating and the red indicator light on the front of the cooling unit turns on.



If you need to replace a fan in a roof-mounted cooling unit, contact ABB. DO NOT attempt to replace the fan yourself.



Key

- 1. Control access panel
- 2. Air-bleed access plate
- 3. Indicator lights
- 4. Location of fans (below cover)
- 5. Lifting point (one in each corner)

Figure 103 – Roof-mounted cooling unit (IP54)

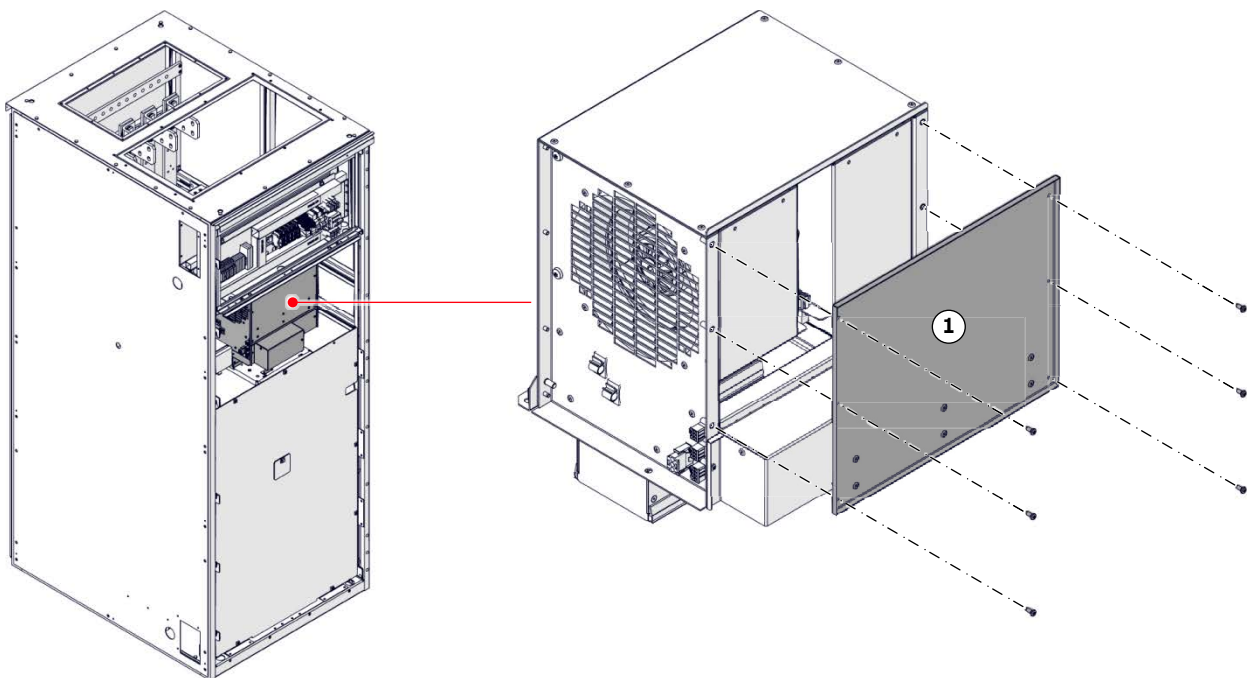
Dimensions (L × W × H)	Weight
1550 mm × 975 mm × 386 mm	98 kg

9.4.12.3. Replacing a fan in an EXU with a DCS880 H4/DCT880 T4 controller



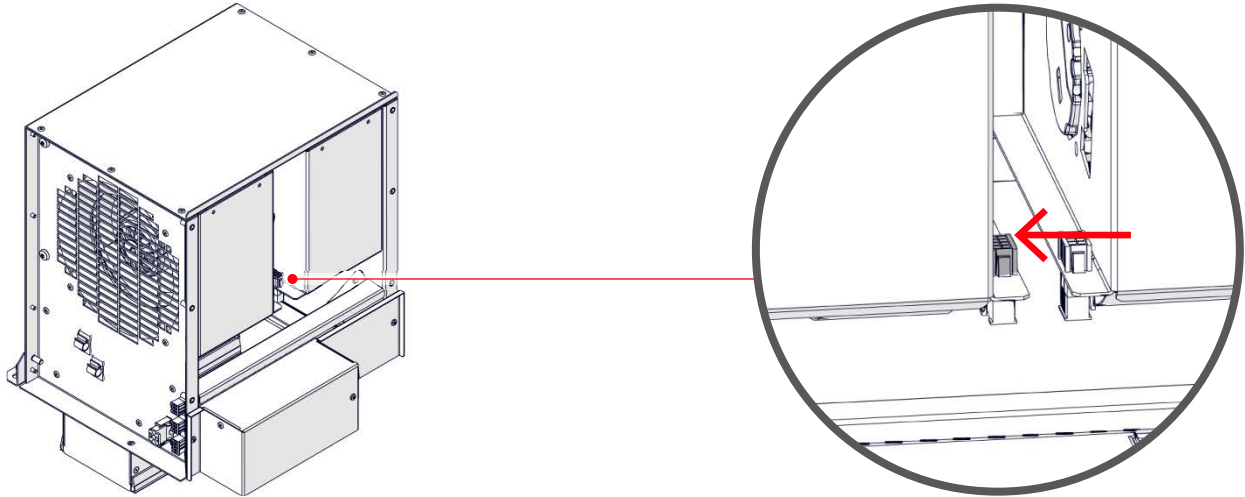
Figure 104 – DCS880 controller - size H4

1. Switch off the miniature circuit breaker of the fan unit.
NOTE – To identify the miniature circuit breaker, see Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)).
2. Remove the 6 screws from the fan cover (1) and then remove the fan cover.

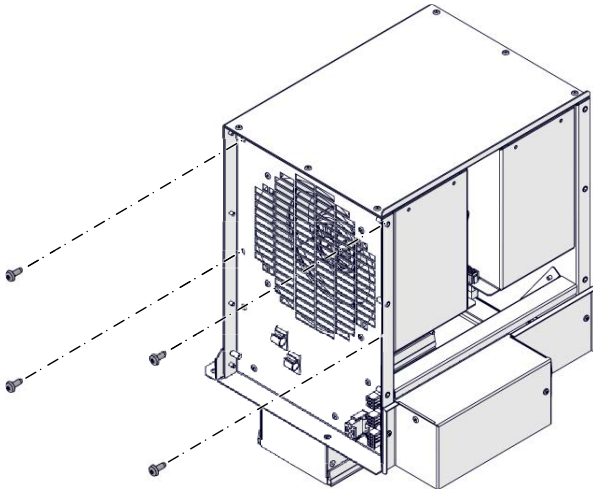


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Approved	Public	3BHS904690 E01	E	en	154/159

3. Unplug the fan cables.

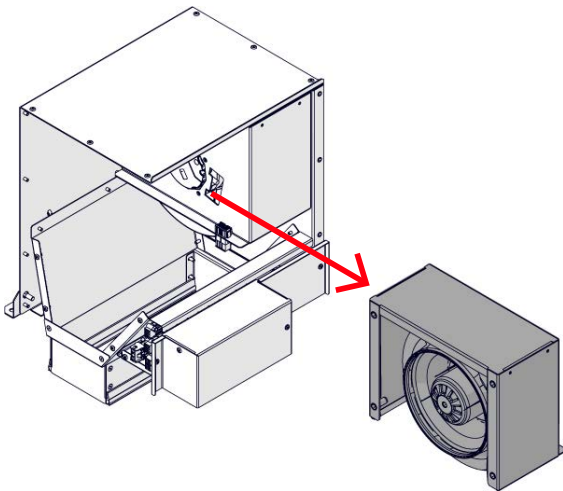


4. Remove the 4 fastening screws from the outside panel of the fan unit.



5. Pull the fan out of fan unit in the cabinet.

CAUTION! To prevent the fan from falling onto you, place a support (ie, a box) underneath.



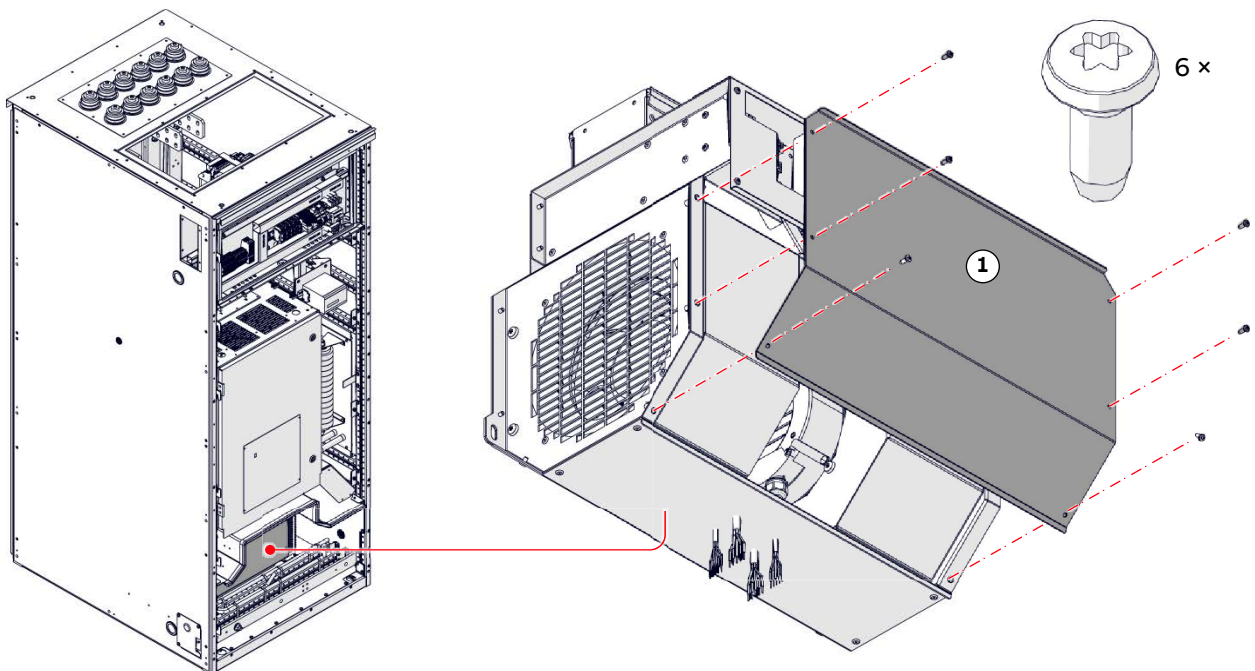
6. Install the new fan in reverse order of removal.

9.4.12.4. Replacing a fan in an EXU with a DCS880 H6 unit



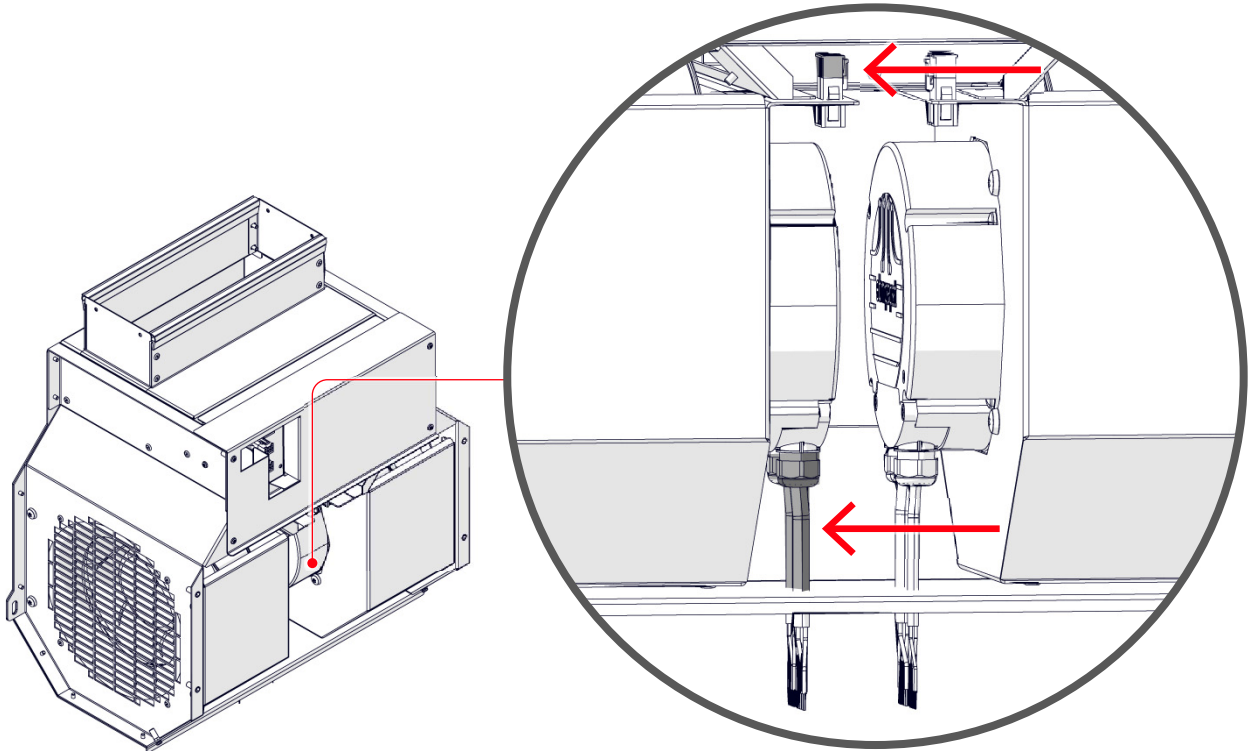
Figure 105 – DCS880 controller - size H6

1. Switch off the miniature circuit breaker of the fan unit.
To identify the miniature circuit breaker, see Appendix D – Wiring diagrams (see [1.2 Structure of the user documentation on page 14](#)).
2. Remove the 6 screws from the fan cover (1) and then remove the fan cover.

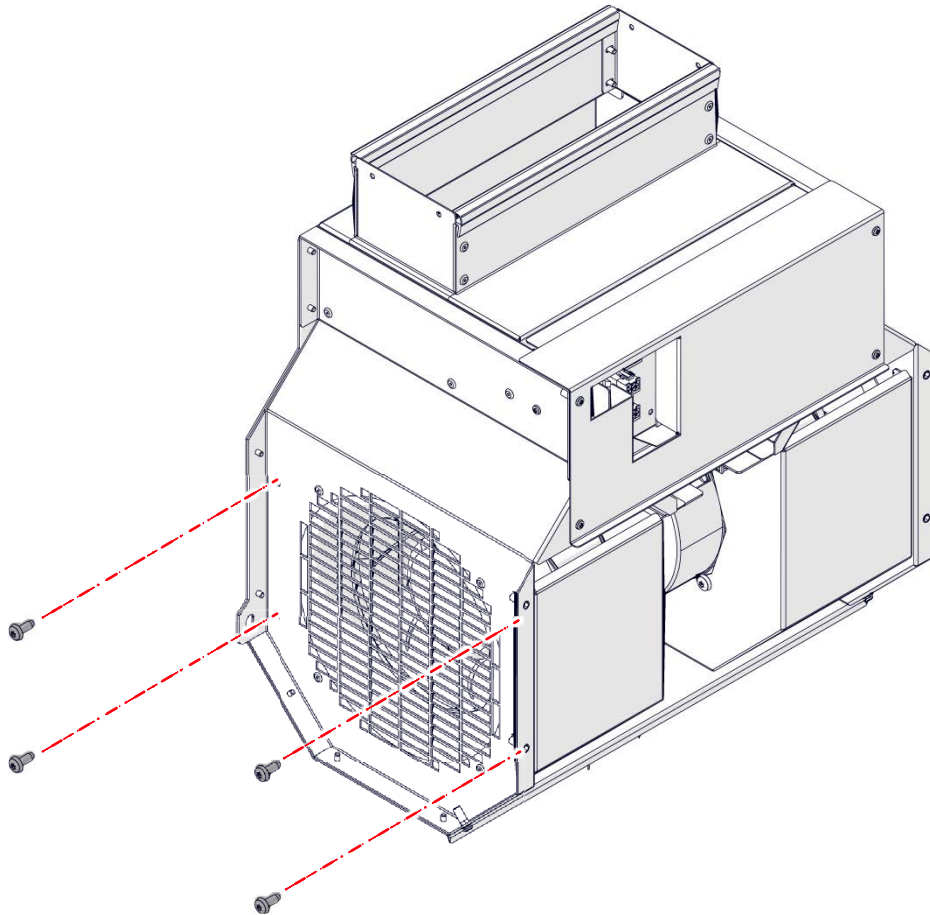


STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
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3. Unplug the fan cables.

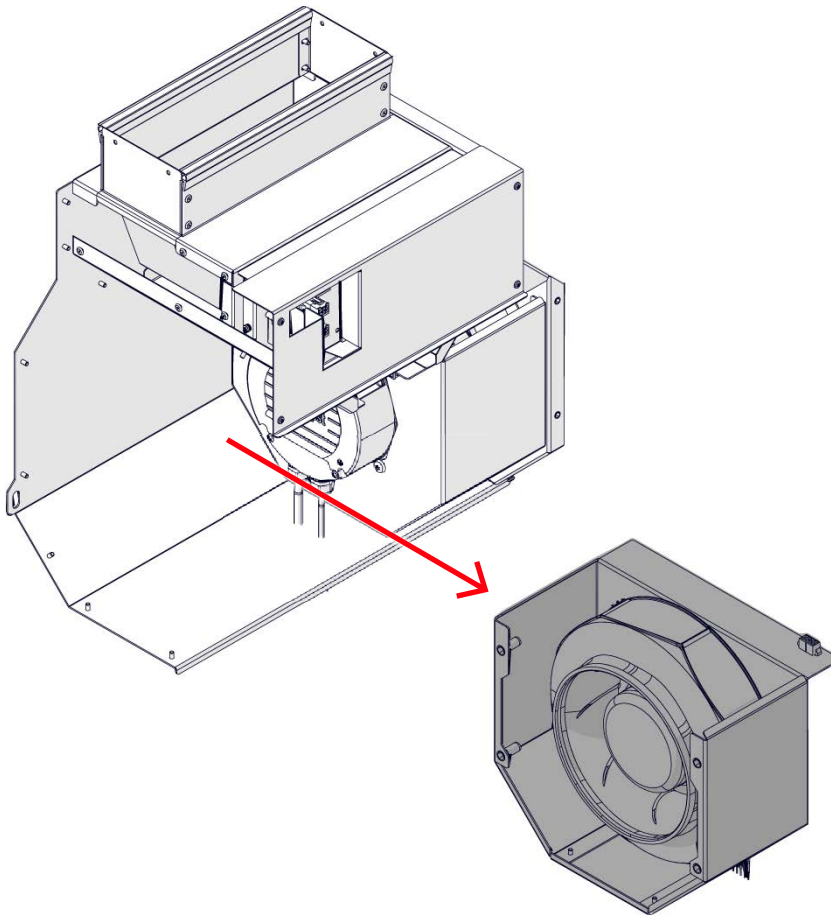


4. Remove the 4 fastening screws from the outside panel of the fan unit.



- Pull the fan out of the fan unit in the cabinet.

CAUTION! To prevent the fan from falling onto you, put a support (ie, a box) underneath.



- Install the new fan in reverse order of removal.



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