

SYSTEM DRIVES

ACS5000 water-cooled (generation 2)

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	ABB ID
ACS5000 preventive maintenance schedule	3BHS855274 E01

1.3.2. Technical data

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

1.3.3. Schematics

Title	ABB ID
Layout drawing	Project-specific

1.3.4. Specifications and guidelines

Title	ABB ID
Generic transformer specification	3BHS356582 E01
Generic motor specification	3BHS824803 E01
Main circuit breaker engineering guideline	3BHS125149 E50
ACS5000 power cable specification	3BHS215798 E01
Synchronized bypass unit engineering guideline	3BHS400185 E01
Power cables engineering guideline	3BHS542290 E01
Auxiliary power and control cables guideline	3BHS813742 E01
Customer interface	3BHS347034 E03

1.3.5. Manuals

Title	ABB 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

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1.3.6. I/O interface

Title	ABB ID
S800 I/O Getting started Available: https://library.abb.com	3BSE020923
S800 I/O Modules and Termination Units Available: https://library.abb.com	3BSE020924

1.3.7. Serial communications interfaces

Title	ABB ID
ACX-AP-x Assistant control panels user manual	3AUA0000085685
Ethernet - NETA-21 remote monitoring tool user manual Available: https://library.abb.com	3AUA0000096939
Modbus - NMBA-01 installation and start-up guide Available: https://library.abb.com	3AFY58919772
Profibus - NPBA-12 installation and start-up guide Available: https://library.abb.com	3BFE64341588

1.4. Terms and abbreviations

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
AMC	The application and motor controller (AMC) is a digital signal processor and the heart of the drive control system.
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 CDP control panel. 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
DriveDebug	DriveDebug is part of ABB's DriveWare® software tools for devices using the DDCS communications protocol. DriveDebug runs on computers with Microsoft Windows® operating systems. DriveDebug is a specialist tool used to diagnose, tune and troubleshoot frequency converters.

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Term	Definition
DriveWindow	DriveWindow is a DriveWare® product. DriveWindow is a 32-bit Microsoft Windows® application for commissioning and maintaining ABB drives equipped with optical communication links.
DriveMonitor	DriveMonitor is a monitoring and diagnostics system that allows secure access to the frequency converter via the Internet from a remote location. DriveMonitor provides long-term monitoring functions that allow to infer equipment status and improve equipment performance.
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.
Ground	Earth
To ground	To connect the electrical equipment to the earth, eg, by a grounding set or a grounding switch.
I/O device	Term of ABB's S800 I/O process system. An I/O device consists of a module termination unit (MTU) and one I/O module.
I/O module	Term of ABB's S800 I/O process system. The I/O module is an active input or output device for digital or analog signals.
I/O station	Term of ABB's S800 I/O process system. The I/O station typically consists of a bus modem and several input and output devices.
IGCT	Integrated gate-commutated thyristor
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.
NETA-21	Monitoring and diagnostics tool that allows access to the drive from any location in the world via a secure Internet connection.
NP	Neutral point
OEI	Optical-electrical interrupter
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.
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.

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Term	Definition
PICW	Person in charge of work
PINT	Pulse interface
PPE	Personal protective equipment
PTW	Permit to work
S800 I/O	The S800 I/O is a distributed process input / output system that can be connected to various process controllers from ABB and other companies.
SBU	The synchronized bypass unit (SBU) is a control cabinet that provides control to the startup motor and then synchronizes the motor to the supply network to start direct-on-line operation (and vice versa)
SW	Software
Transformer terminal section	This is the customer terminal for connecting transformer cables. It is located in the back of the PCU compartment.
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.

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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

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.

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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”)

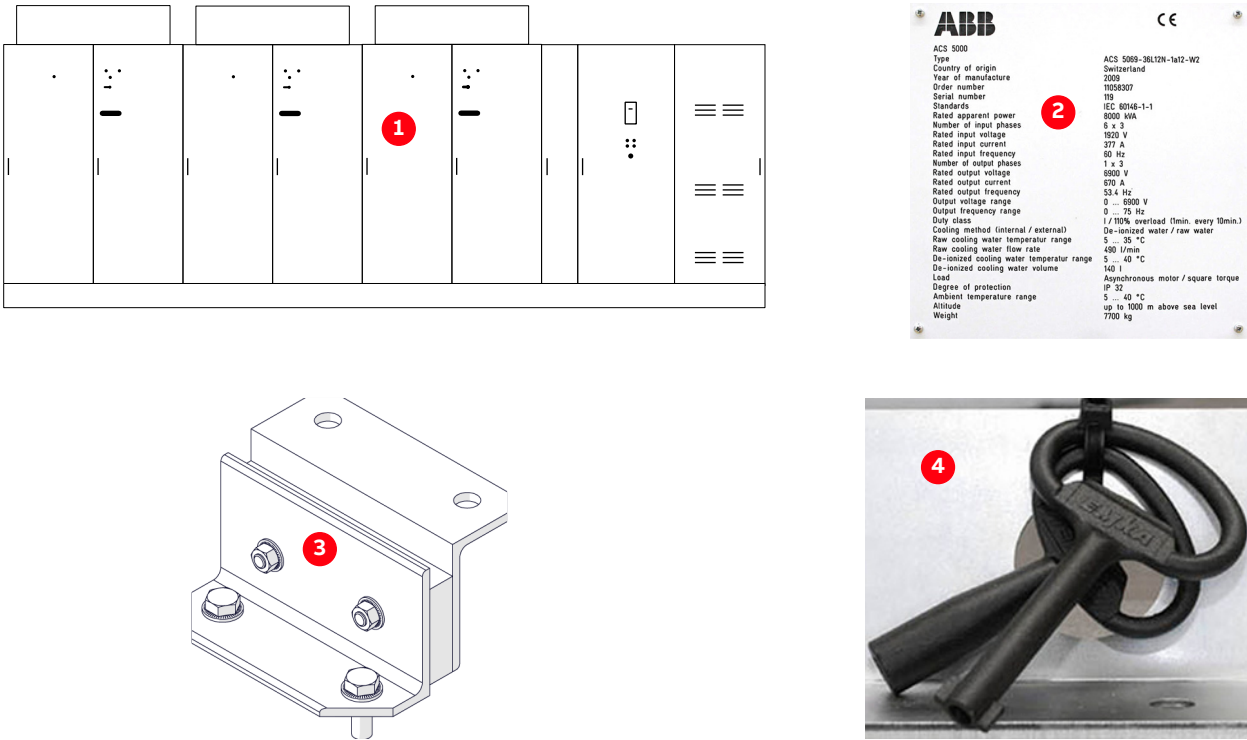
1.8.1. Standards

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 colors 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 60721-3-2	Classification of environmental conditions: Classification of groups of environmental parameters and their severities; Transportation
IEC 60721-3-1	Classification of environmental conditions: Classification of groups of environmental parameters and their severities; Storage
IEC 60721-3-3	Stationary use at weather-protected locations
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 to 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	

Fig. 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 Section 2.1, “Safety messages and safety signs in this document”, page 22.

Font formats

Convention	Description
✓	Prerequisite for a task
1.	Sequential procedural steps in a task
– •	Non-sequential procedural steps in a task or items in a list
→	Instructions on how to avoid a safety hazard
1)	Numbered list
(1)	Explanation for callout keys in legend under an illustration or refers to a callout key in the main text, eg, “Lift fan (1)” or “Remove cover (1, Fig. 2), and...”
<i>Italic text</i>	Identifies software parameters, eg, <i>16.02 PARAMETER LOCK</i> .
Bold text	Depending on the context, indicates a safety hazard, the text that you type, a software or physical button , or a link to another part of the document
<u>Underlined text</u>	Identifies a hyperlink
Courier font	Identifies software file names and file paths
Cursor	Represents blinking text on a screen

Symbols

Symbol	Description
① ② ③	Figure callout on an image
	These pictograms refer to the subject matter of the text.
	See Section 2.1.2, “Safety signs”, page 22.

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



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











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



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

2.1.2. Safety signs

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

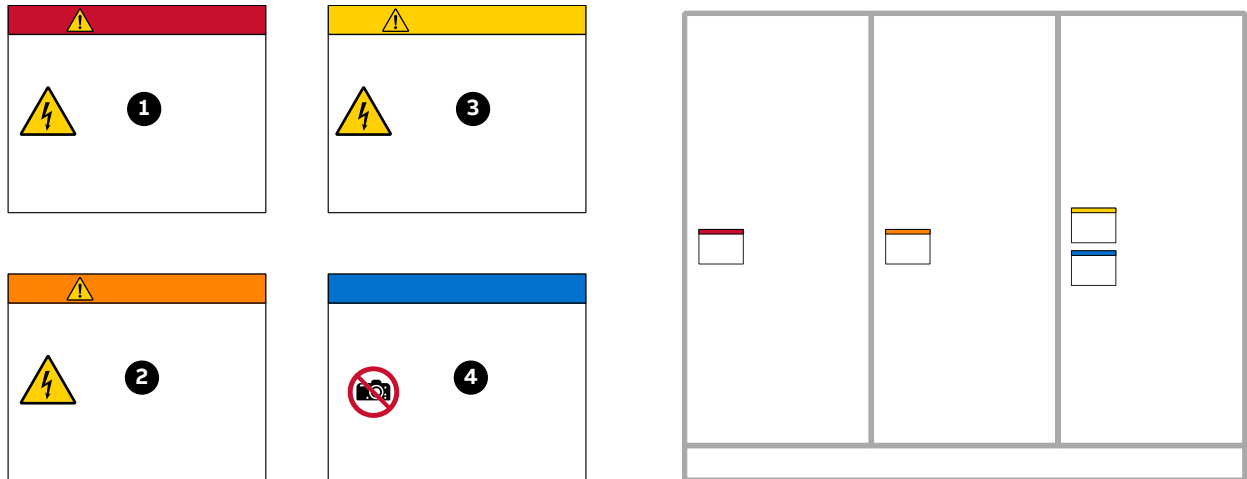
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2.2. Product safety labels

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 | (3) Caution label |
| (2) Warning label | (4) Notice label |

Fig. 2. Product warning label examples (label placement depends on the drive)

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

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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.

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.

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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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2.3.3. Possible residual risks

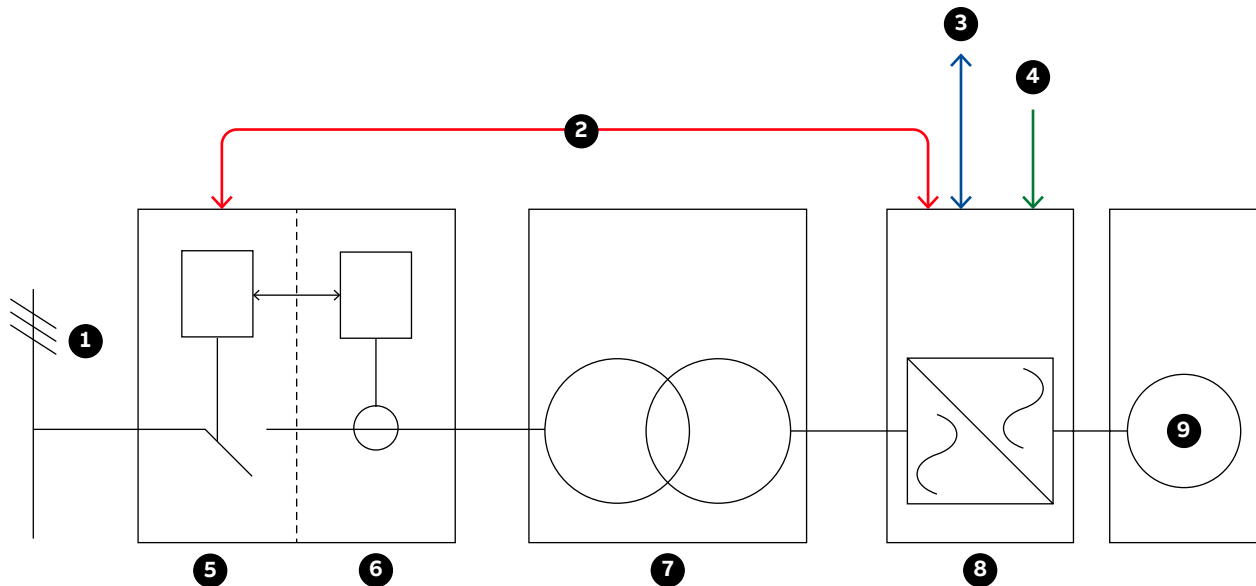
Residual risks must be considered by the drive system integrator and/or plant owner when assessing the hazards of the equipment to personnel. The following risks can pose a hazard to drive system personnel:

- 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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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 | (6) Protection relay |
| (2) MCB control interface | (7) Converter transformer |
| (3) Higher-level control system | (8) Drive |
| (4) Local MCB control | (9) Motor |
| (5) MCB | |

Fig. 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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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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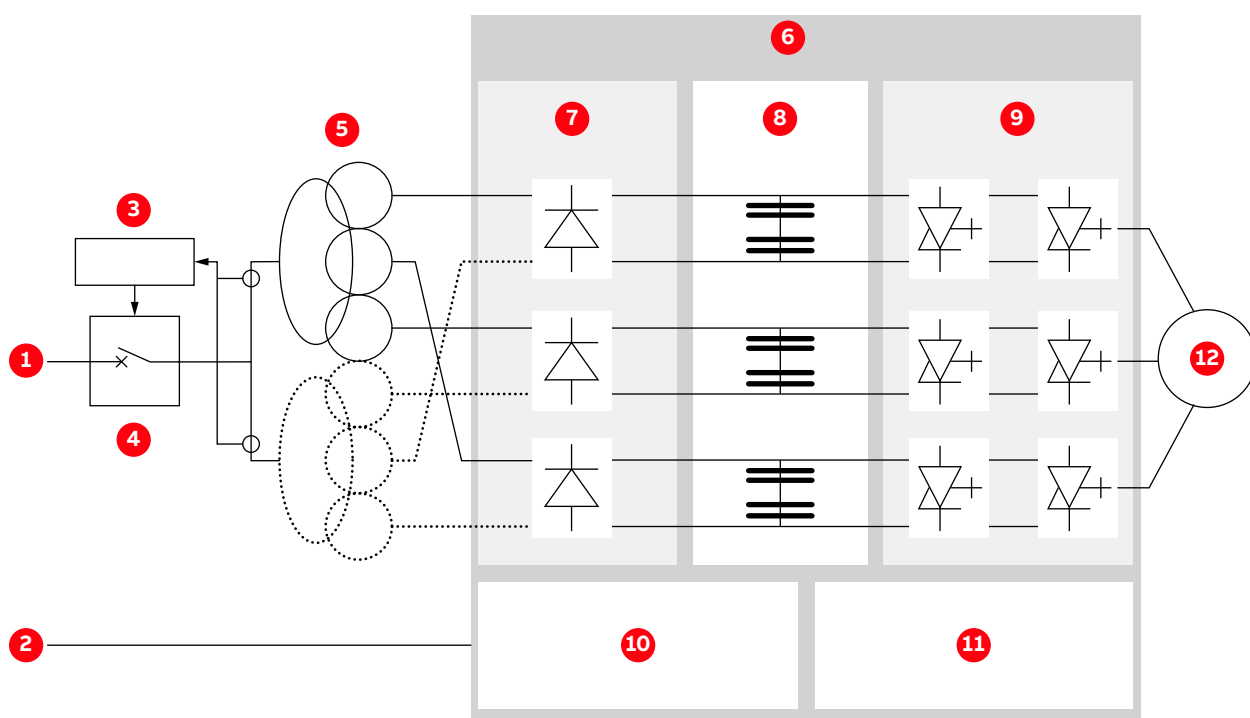
3. Power electronics and cabinet features

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

Fig. 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.

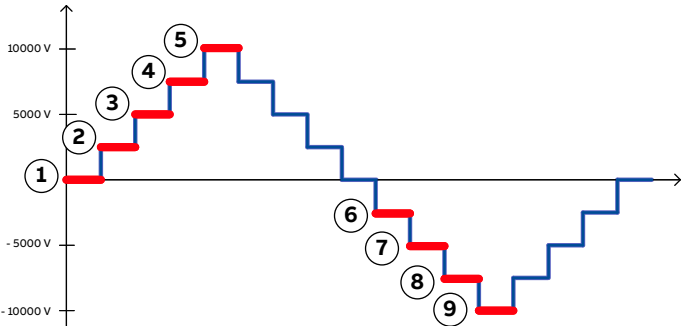
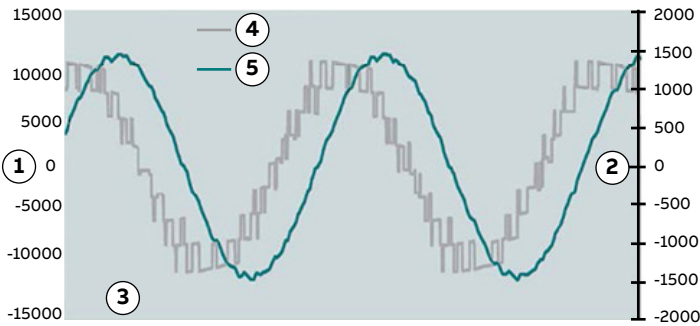


Fig. 5. Switching levels



Key:

- (1) Volts
- (2) Amps
- (3) 50 Hz operation point
- (4) Voltage
- (5) Current

Fig. 6. Principle of 9-level topology

IGCT

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

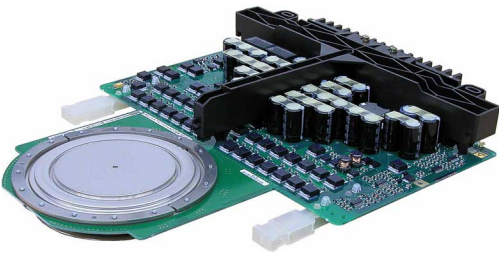


Fig. 7. IGCT

Fuseless protection concept

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

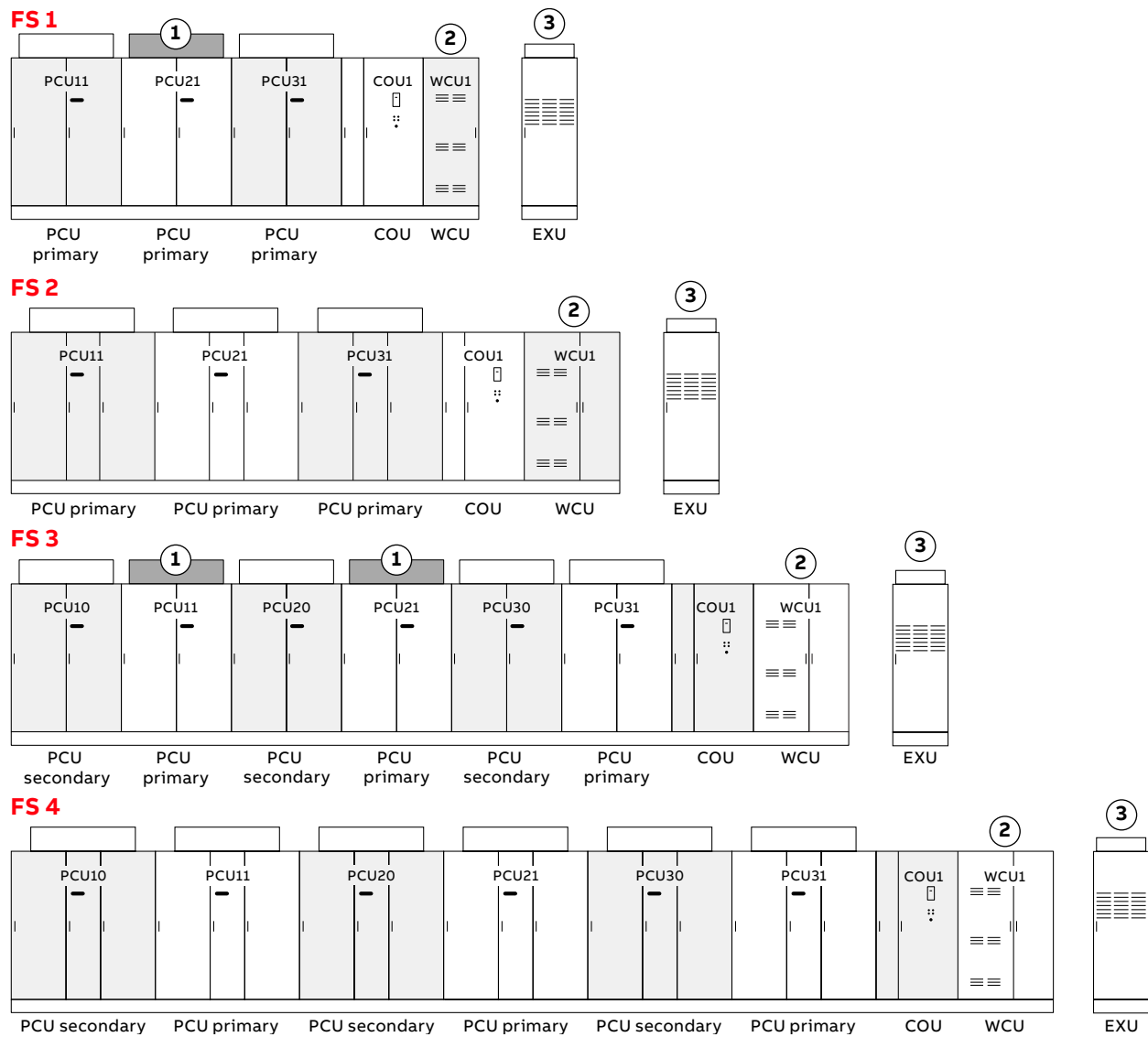
3.2. Drive frame sizes and configurations

The drive is available in four frame sizes (FS), ie, FS 1 to FS 4 (see Fig. 8 for typical drive configurations). For information on a project-specific configuration, see the layout drawing in “Appendix C – Mechanical drawings”.

TABLE 1 Line-up specifications by frame size

Frame size	Rating	COU	Primary PCU	Secondary PCUs	PCU width (mm)	WCU width (mm)	Total length (mm)
1	12 MVA	1	3	0	1700	800	7130
2	18 MVA	1	3	0	2100	1400	8930
3	24 MVA	1	3	3	1700	1400	12830
4	36 MVA	1	3	3	2100	1400	15230

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**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)

Fig. 8. Typical drive configurations for FS 1, FS 2, FS 3, and FS 4

3.3. Phase converter unit (PCU)

PCUs are available as 6-pulse and 12-pulse rectifiers (Table 2). All drive configurations (FS 1, FS 2, FS 3, and FS 4, Fig. 8) have three primary PCUs, where each PCU supplies a different motor phase.

A complete functional PCU assembly is:

- One primary PCU in FS 1 and FS 2 drives
- One primary and one secondary PCU (connected via DC link) in FS 3 and FS 4 drive

TABLE 2 PCU rectifier types

Converter rectifier type ¹	Frame size	PCU type	No. of PCUs	Input phases/PCU
18-pulse ²	FS 1 FS 2	PCU primary, 6-pulse	3 ×	3-phase system
36-pulse ³	FS 1 FS 2	PCU primary, 12-pulse	3 ×	2 × 3-phase system
36-pulse ³	FS 3 FS 4	PCU primary, 12-pulse PCU secondary, 12-pulse	3 × 3 ×	0

¹ The rectifier type is determined by the number of input phases, which is on the rating plate on the door of the drive.

² An 18-pulse rectifier has 3 × 3 input phases.

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

NOTE – Transformer cables are connected to terminals at the back of each primary PCU (see Section 6.7.2.2, “Connecting the cables”, page 102).

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

3.3.1.1. Primary PCU (1700 mm) – FS 1 and FS 3

For the location of these PCUs in typical FS 1 and FS 3 drive configurations, see Fig. 8.

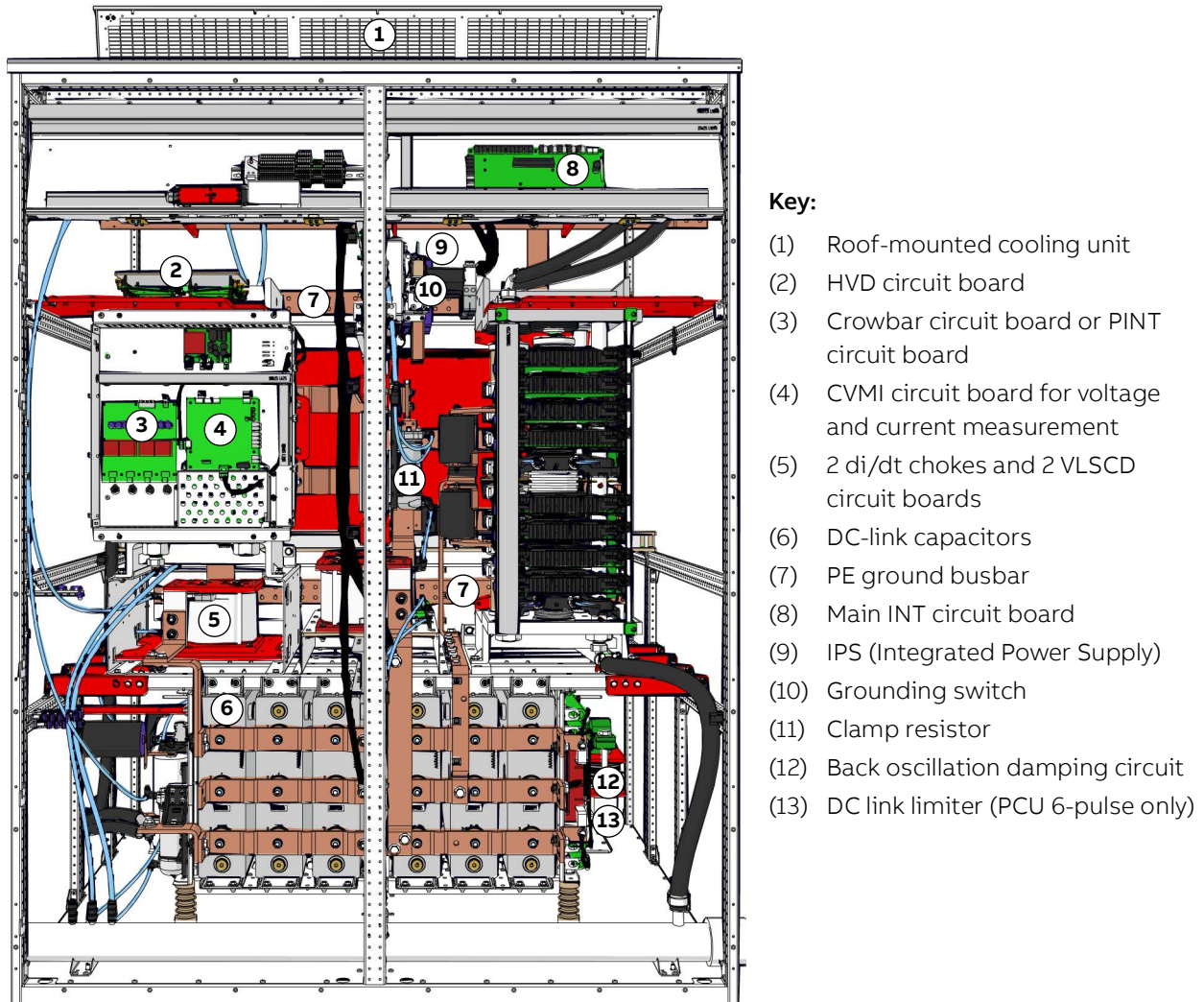
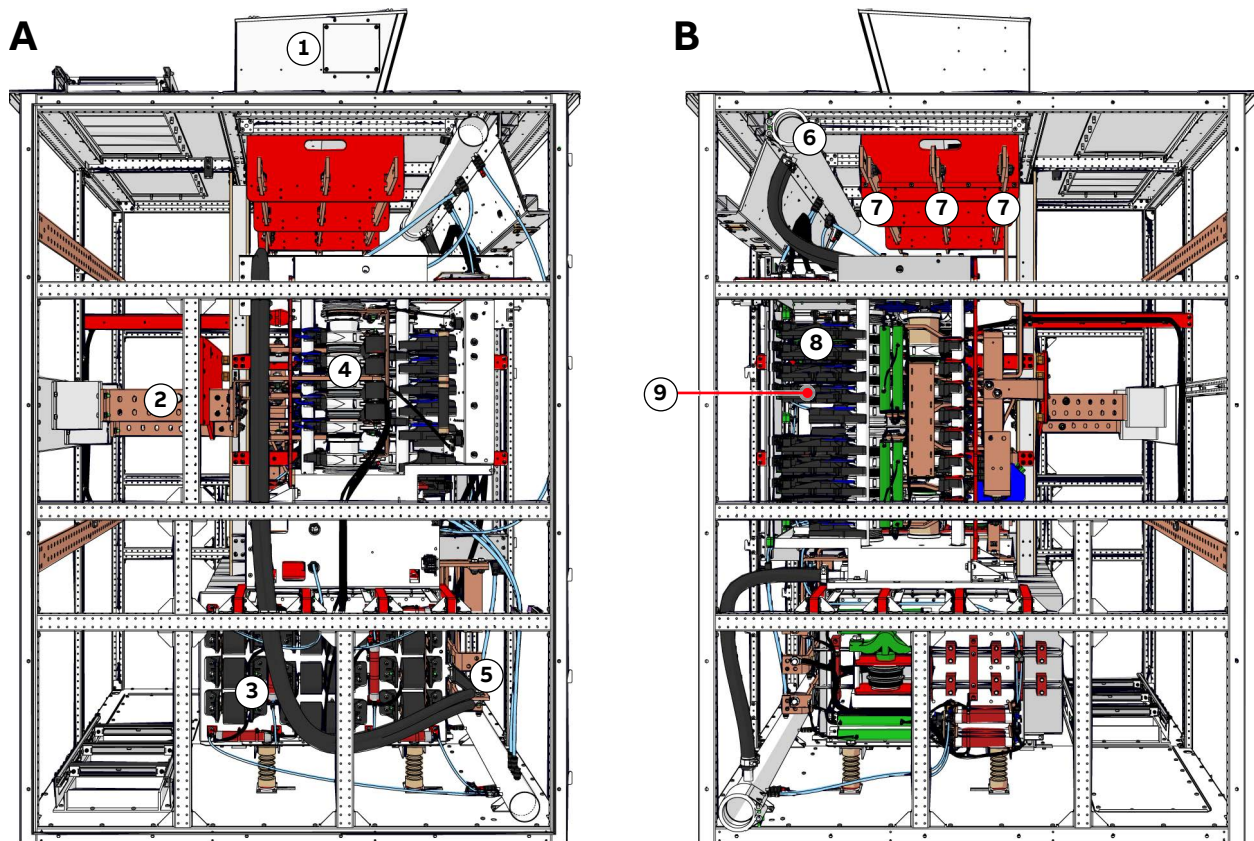


Fig. 9. Primary PCU, 1700 mm

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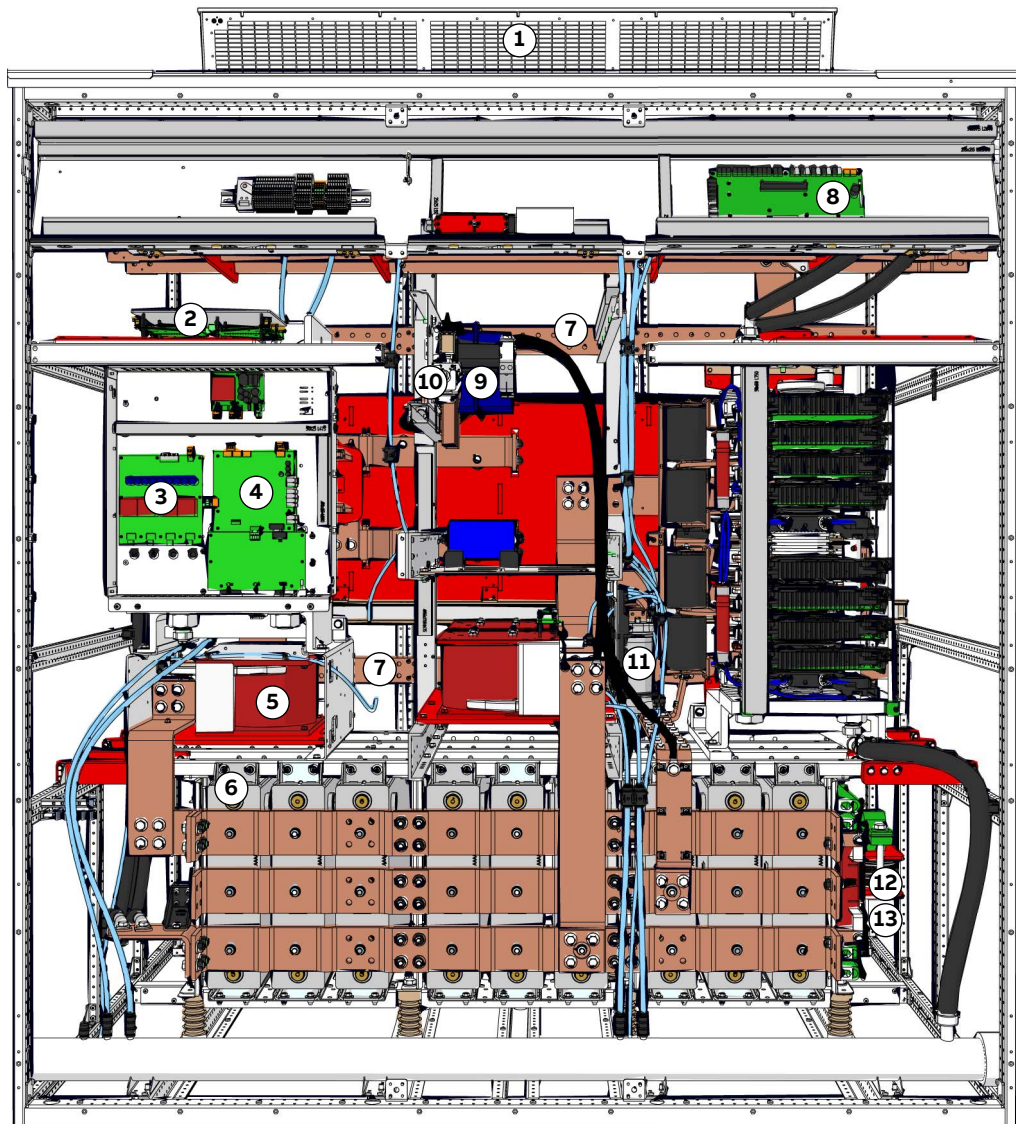
**Key:**

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

Fig. 10. Primary PCU, 1700 mm: (A) side view left and (B) side view right

3.3.1.2. Primary PCU (2100) – FS 2 and FS 4

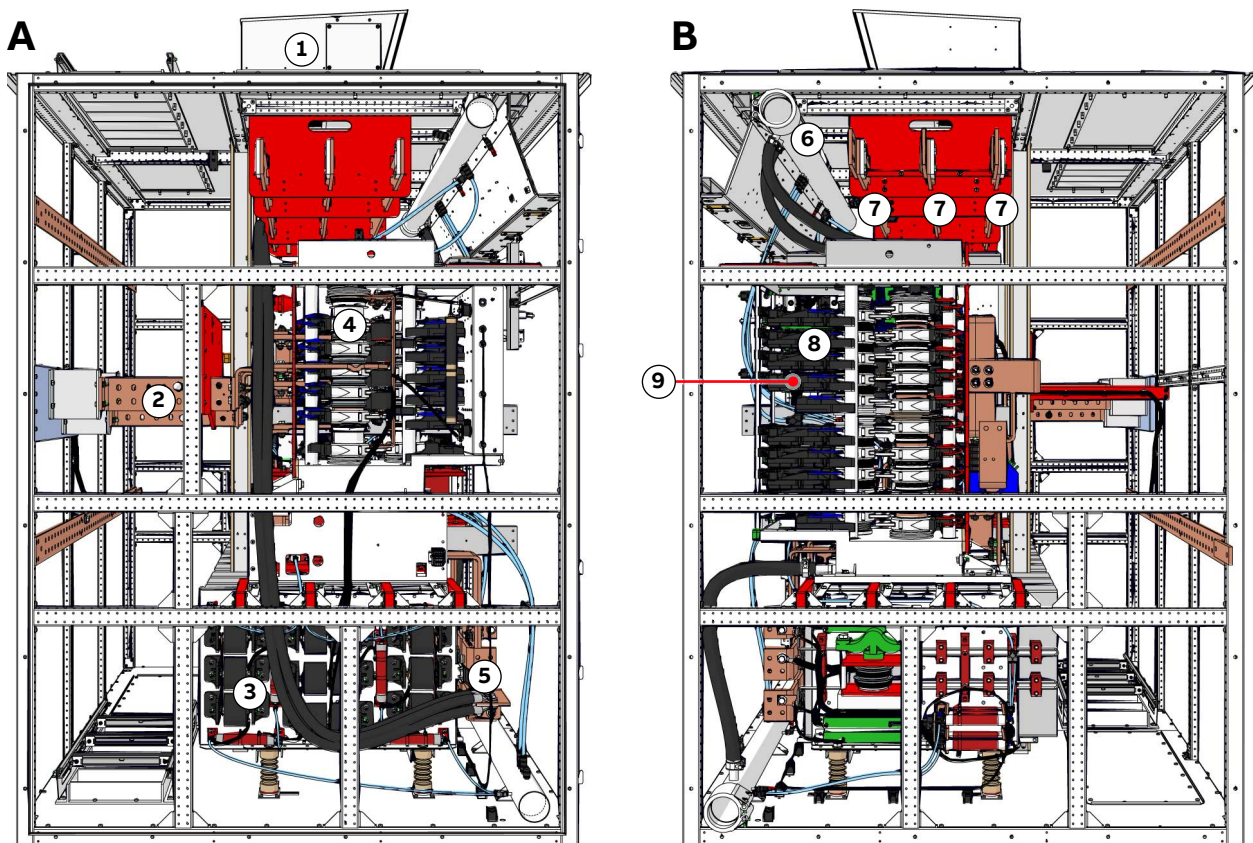
For the location of these PCUs in typical FS 2 and FS 4 drive configurations, see Fig. 8.



Key:

- | | |
|--|---|
| (1) Roof-mounted cooling unit | (7) PE ground busbar |
| (2) HVD circuit board | (8) Main INT circuit board |
| (3) Crowbar circuit board or PINT circuit board | (9) IPS (Integrated Power Supply) |
| (4) CVMI circuit board for voltage and current measurement | (10) Grounding switch |
| (5) 2 di/dt chokes and 2 VLSCD circuit boards | (11) Clamp resistor |
| (6) DC-link capacitors | (12) Back oscillation damping circuit |
| | (13) DC link limiter (PCU 6-pulse only) |

Fig. 11. Primary PCU, 2100 mm



Key:

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

Fig. 12. Primary PCU, 2100 mm: (A) side view left and (B) side view right

3.3.2. Secondary phase converter unit (1700 mm and 2100 mm) – FS 3 and FS 4

A secondary PCU has the same design as a primary PCU, but without the rectifier stack and the transformer terminal compartment. Drive FS 3 uses 1700 mm secondary PCUs and FS 4 uses 2100 mm secondary PCUs.

For the location of these PCUs in typical FS 3 and FS 4 drive configurations, see Fig. 8.

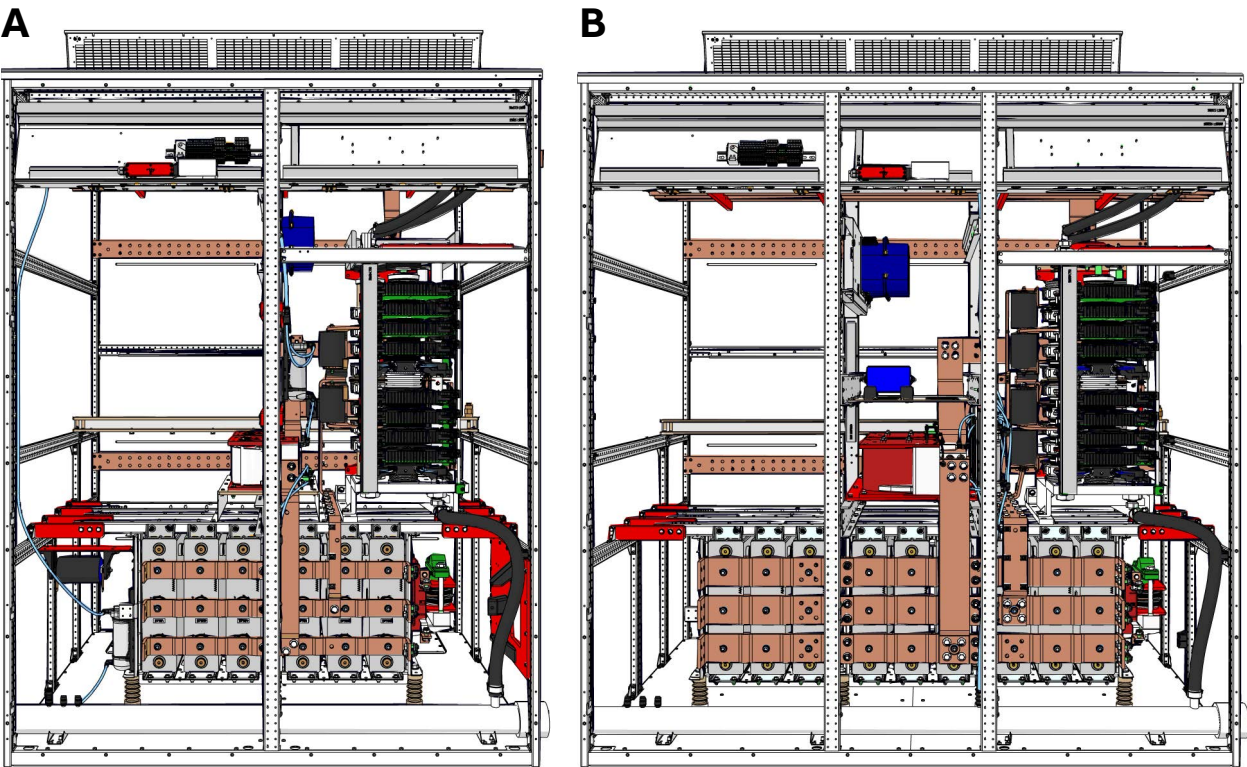
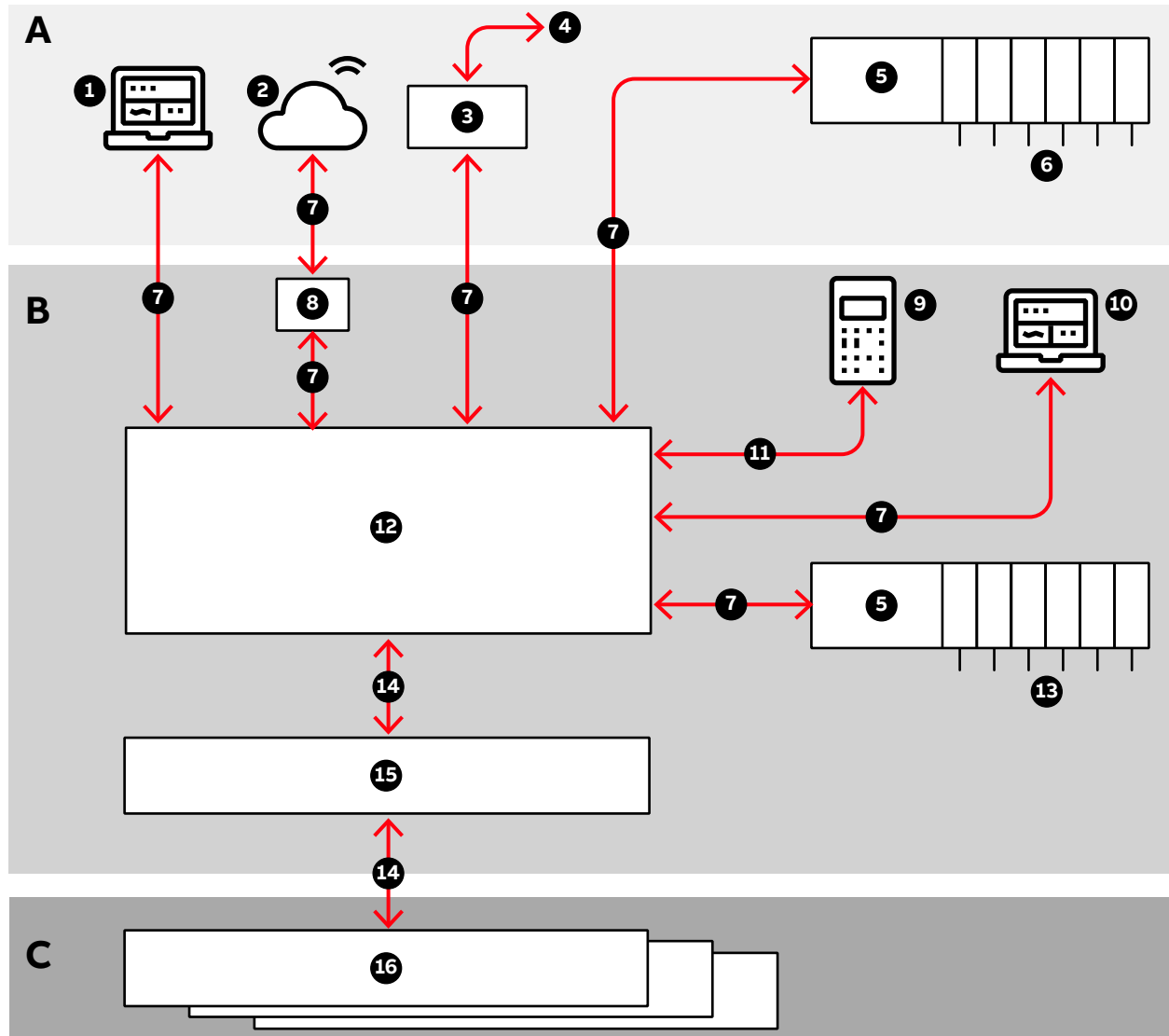


Fig. 13. (A) Secondary PCU, 1700 mm and (B) secondary PCU 2100 mm

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.

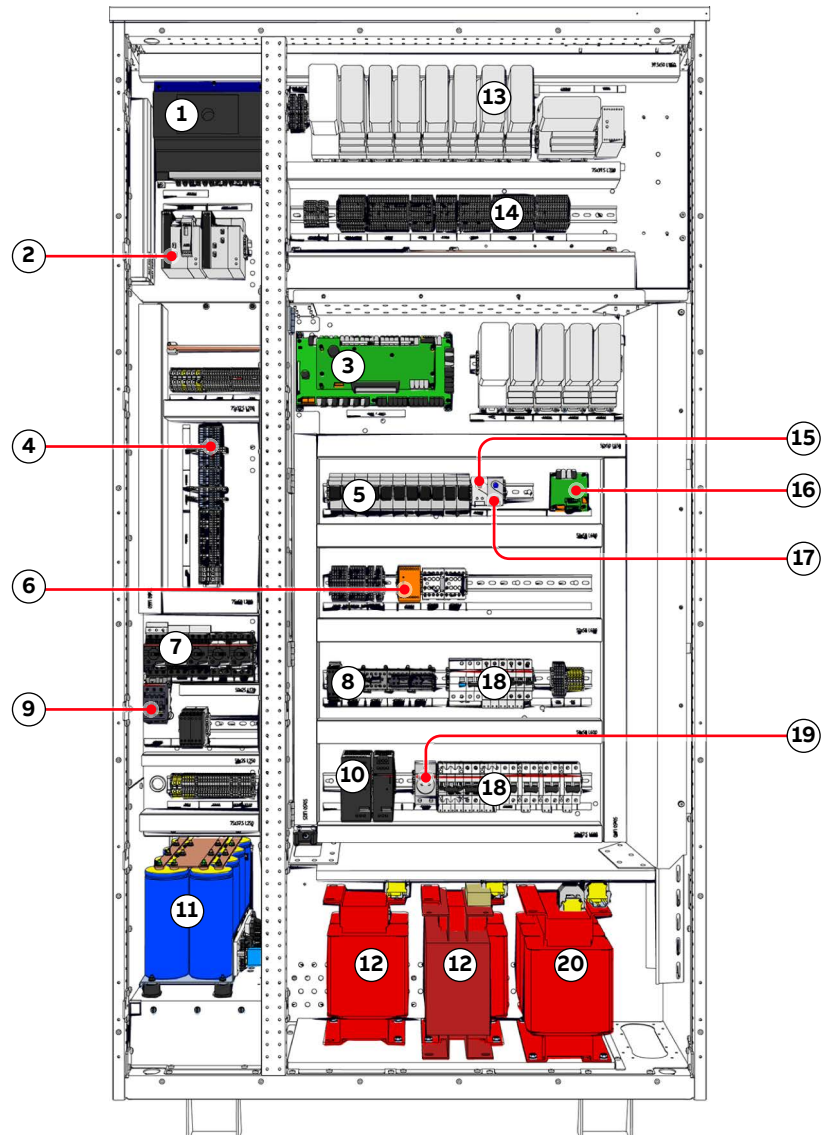
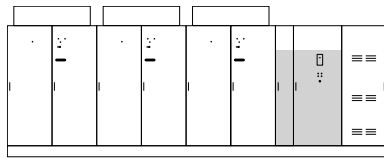


Key:

- | | |
|---------------------------------|--------------------------|
| A) Customer interface | (8) NETA-21 |
| B) Control unit | (9) CDP control panel |
| C) Inverter | (10) PC tools |
| (1) ABB Ability™ | (11) RS485 |
| (2) Cloud connectivity | (12) AMC circuit board |
| (3) Fieldbus | (13) Internal I/Os |
| (4) Higher-level control system | (14) Fiber-optic |
| (5) s800 I/O process system | (15) Main INT interface |
| (6) Process I/O | (16) Phase INT interface |
| (7) DDCS | |

Fig. 14. Block diagram of control system

3.4.1. Main components



Key:

- | | |
|---|---|
| (1) Arc Guard System™ | (12) Isolating transformers for customer UPS – T1011, T1012, and step-down transformer for internal buffer T1021 (optional) |
| (2) NETA-21 | (13) S800 I/O process system |
| (3) AMC and main INT circuit board | (14) Customer terminals |
| (4) Terminals for customer UPS and PCU auxiliary power supply – X200, X100, X101, X120, X3 (from top to bottom) | (15) Thermostat for internal temperature |
| (5) Auxiliary relay | (16) EOI circuit board |
| (6) Safety relay | (17) Thermostat for door-mounted cooling fan |
| (7) Motor circuit-breakers | (18) Miniature circuit breakers |
| (8) Auxiliary contactors | (19) 230 V socket |
| (9) Charging contactor | (20) Transformer for unbuffered auxiliary power supply (T1111) |
| (10) Switched-mode power supplies | |
| (11) Electrolytic capacitors (optional) | |

Fig. 15. COU control section

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3.4.2. AMC circuit board

The AMC circuit board is the major component of the drive's control system and performs general drive, motor control, and closed loop functions. The main internal control devices and the peripheral input and output interfaces to the customer communicate with the AMC circuit board via optical fibers.

The circuit board is fitted with a Motorola DSP processor and features two PPCS and eight DDCS communication channels. The communication channels are used for high speed data transfer via the INT circuit boards to the Phase-INT circuit boards inside the phase modules.

3.4.2.1. Control tasks

The AMC circuit board has specific control and closed-loop tasks assigned to it. It processes drive and status information, performs the speed and torque control tasks, and monitors the operation of the drive.

All relevant drive variables (eg, speed, torque, current, voltage) are continuously monitored by the control system. Pre-programmed protection functions ensure that these variables remain within certain limits in order to maintain safe operation of the drive. These internal functions are not programmable by the user.

Optionally, the drive can monitor signals from external equipment. These can be activated and adjusted with parameters (see Section 3.4.2.3, "Parameters", page 44).

Other general control, protection and monitoring tasks regarding the whole drive include control and monitoring of:

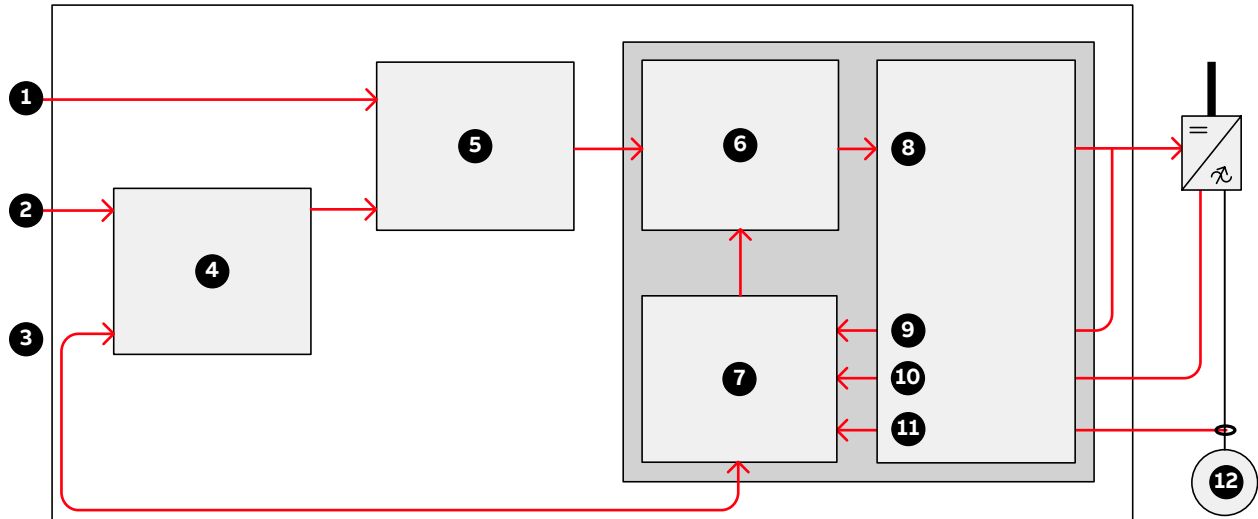
- Main circuit breaker (MCB)
- Grounding switches
- Door interlocking
- Cooling system

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3.4.2.2. Direct torque control

The speed and torque of the motor is controlled by DTC (Direct Torque Control). The DTC motor control platform is unique to ABB and has been proven in all variable speed drives of the ACS product range. DTC provides accurate speed and torque control, and high dynamic speed response. DTC is implemented on the AMC circuit board of the INU.

Fig. 16.



Key:

- | | |
|---------------------------------|----------------------|
| (1) Torque reference | (7) Motor model |
| (2) Speed reference | (8) Switching logic |
| (3) Actual reference | (9) Switch positions |
| (4) Speed controller | (10) Voltage |
| (5) Torque reference controller | (11) Current |
| (6) Torque-flux comparator | (12) Motor |

Fig. 17. DTC torque control

Switching of the semiconductors is directly controlled in accordance with the motor core variables flux and torque.

The measured motor currents and DC link voltages are inputs to an adaptive motor model. The model produces exact values of torque and flux every 25 μ s. Motor torque and flux comparators compare the actual values to reference values which are produced by the torque and flux reference controllers.

Depending on the outputs from the hysteresis controllers, the switching logic directly determines the optimum switch positions every 50 ms and initiates switching whenever required.

3.4.2.3. 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 “Appendix G – Signal and parameter table”.

3.4.2.4. 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
- Section 2.4, “Main circuit breaker protection device”, page 28

3.4.2.5. Peripheral I/O devices

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

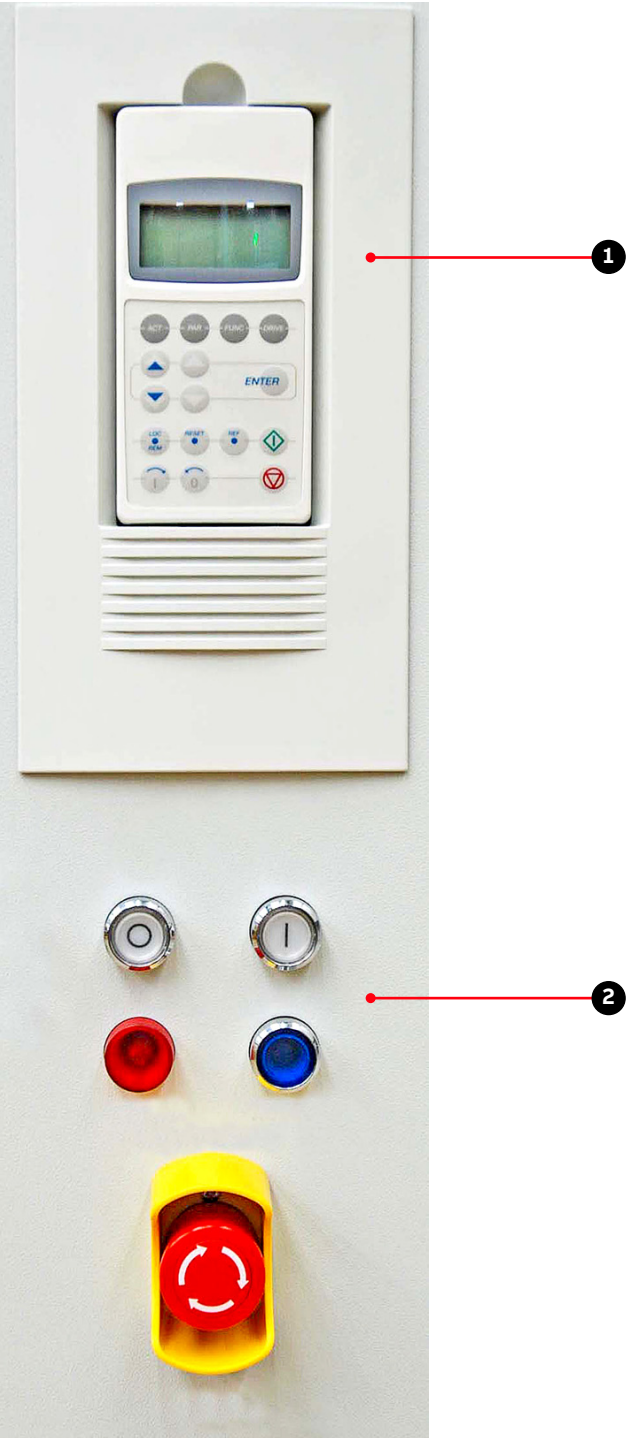
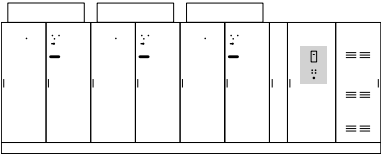
- Local control panel (see Section 3.4.2.6, “Local control panel”, page 45)
- Customer interface (see Section 3.4.2.7, “Customer interface”, page 46)
- S800 I/O system for parallel signal transfer to external devices (see Section 3.4.2.8, “S800 I/O system”, page 46)
- Fieldbus adapters for serial data transfer to a higher-level control system
- PC-based service tools comprising:
 - **DriveWare® software tools:** include the commissioning and maintenance tools DriveWindow and DriveDebug, and DriveOPC for data transfer between ABB drives and Windows®-based applications.
 - **DriveMonitor (option):** a monitoring and diagnostics tool that allows access to the drive from any location in the world via a secure Internet connection.
 - **NETA-21:** monitoring and diagnostics tool that allows access to the drive from any location in the world via a secure Internet connection.

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3.4.2.6. Local control panel

The control 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 CDP control panel, see Chapter 8, “Operation”, page 122 and Chapter 9, “CDP control panel”, page 138.



Key:

- (1) Local control panel
- (2) Push buttons

Fig. 18. Local control panel

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3.4.2.7. 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
- The modules of the S800 I/O system for monitoring of external equipment, such as transformer and motor
- DriveMonitor



Key:

- | | |
|--|--------------------------------------|
| (1) Arc Guard System™ | (5) Grey encoder (optional) |
| (2) Remote condition monitoring NETA-21 and fieldbus interface | (6) NTAC-02 pulse encoder (optional) |
| (3) Customer terminals | (7) Customer terminals |
| (4) S800 I/O process system (customer-specific configuration) | |

Fig. 19. COU customer interface section

3.4.2.8. S800 I/O system

The S800 I/O station with digital and analog I/O interfaces transfers drive-related hardwired signals to the AMC circuit board.

Standard ABB Advant S800 I/O modules interconnect internal and external digital and analog I/O signals with the control system of the drive. The I/O station consists of a bus modem serving as an interface to the AMC circuit board and the I/O modules. Each I/O module is plugged into a termination unit that is wired to separate terminals to which the external signals are connected.

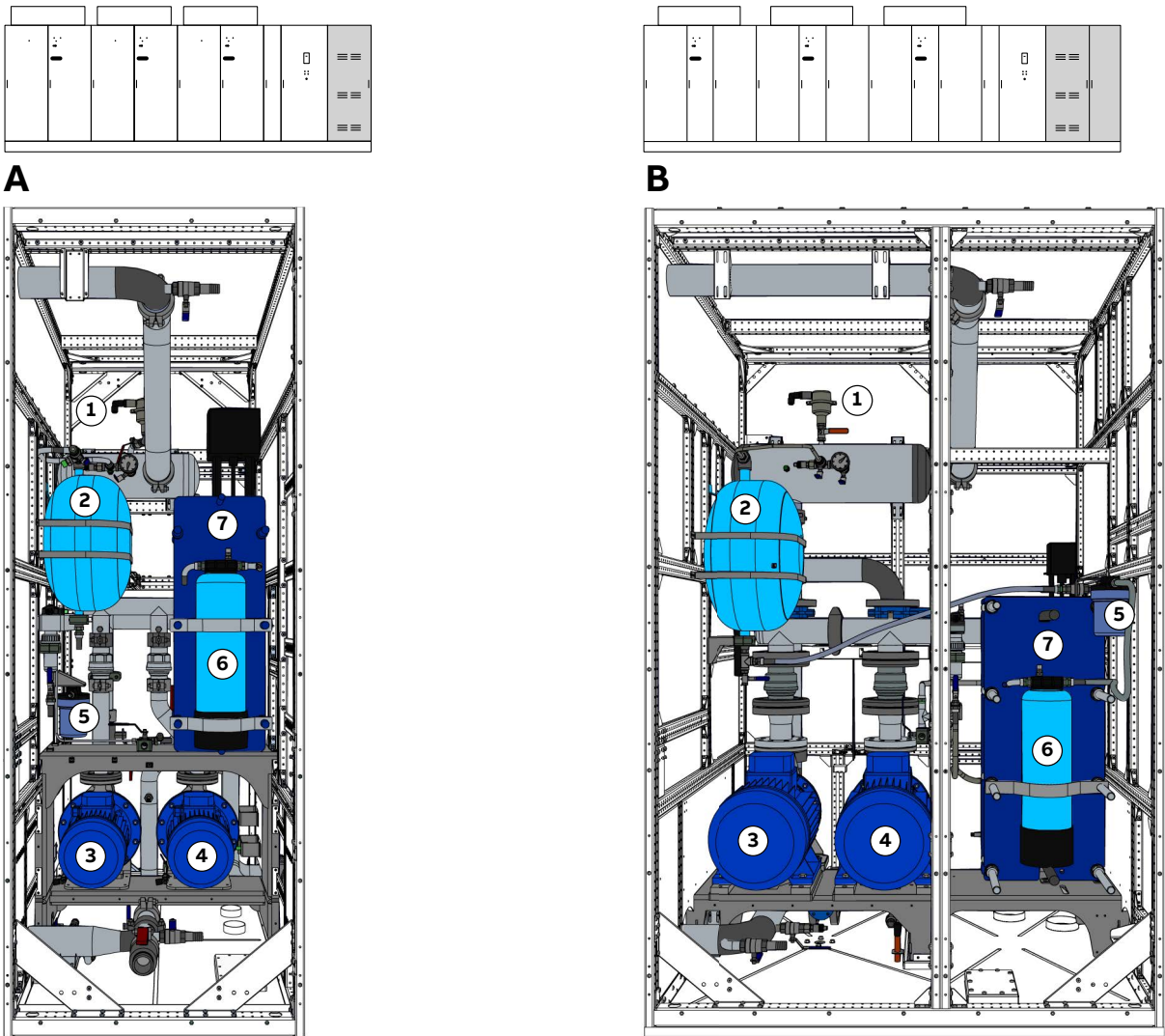
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3.5. Water cooling unit (WCU)

The size of the WCU depends on the drive FS (see Section 3.2, “Drive frame sizes and configurations”, page 32). 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 (Fig. 20), 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”; for information on the customer interface in the WCU, see Section 6.8.2.1, “WCU - auxiliary power and space heater cable”, page 109.



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 | |

Fig. 20. (A) WCU800 and (B) WCU1400 cooling system components (low voltage control compartment not visible)

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3.6. Transformer and motor cable terminals

3.6.1. Transformer cable terminals



Hazardous voltages!

- Complete the steps in Section 2.3.2, “The 7 steps that save lives”, page 25 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 Fig. 8 for PCU location).

For information on the dimensions and the motor busbar arrangement, see Section 6.7.2.2, “Connecting the cables”, page 102 and “Appendix C – Mechanical drawings”

3.6.2. 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 Fig. 8 for COU location).

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

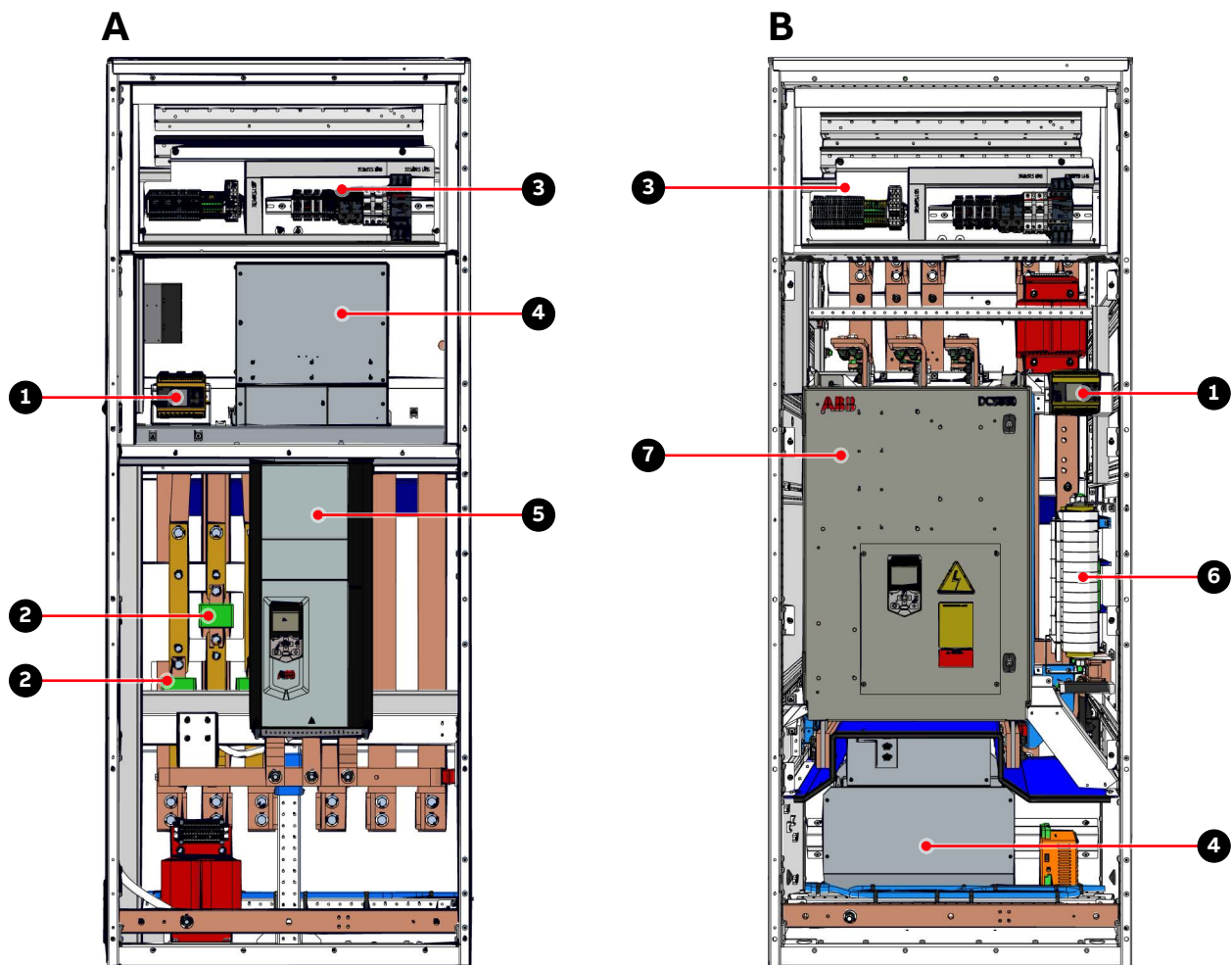
For information on the dimensions and the motor busbar arrangement, see Section 6.7.2.2, “Connecting the cables”, page 102 and “Appendix C – Mechanical drawings”.

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3.7. EXU – Excitation unit (optional)

The EXU supplies a synchronous motor with excitation power. The EXU 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) | (5) DCS880/DCT880 H4 unit |
| (2) Fuses | (6) Overvoltage protection (not shown in A) |
| (3) Control compartment | (7) DCS880 H6 unit |
| (4) Fan units | |

Fig. 21. (A) EXU H4/T4 frame cabinet and (B) EXU H6 frame cabinet

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3.7.1. 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.

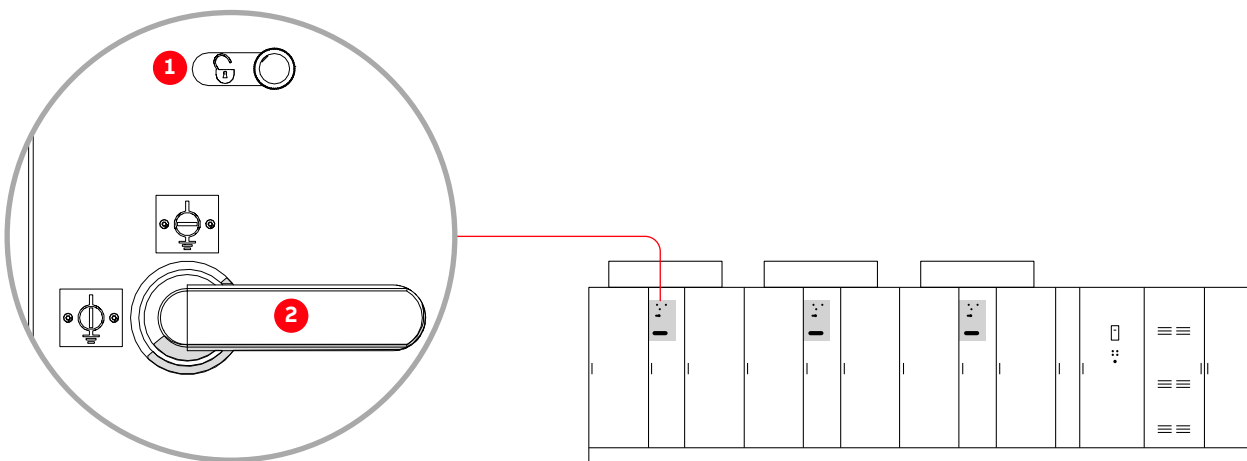
For more information, see Section 8.5, “EXU control panel”, page 124.

3.7.2. Output disconnect

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

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

Fig. 22. Location of protection features and lamps (FS 2 drive example)

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.

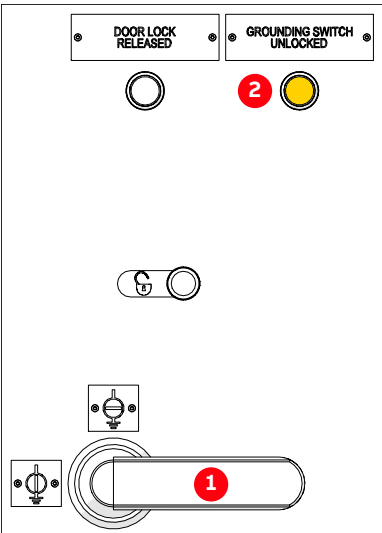
For instructions on how to open and close doors, see Section 10.6.3, “Opening and closing the doors”, page 171.

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, Fig. 23) to the grounded position (horizontal) when the yellow lamp (2, Fig. 23) 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”.



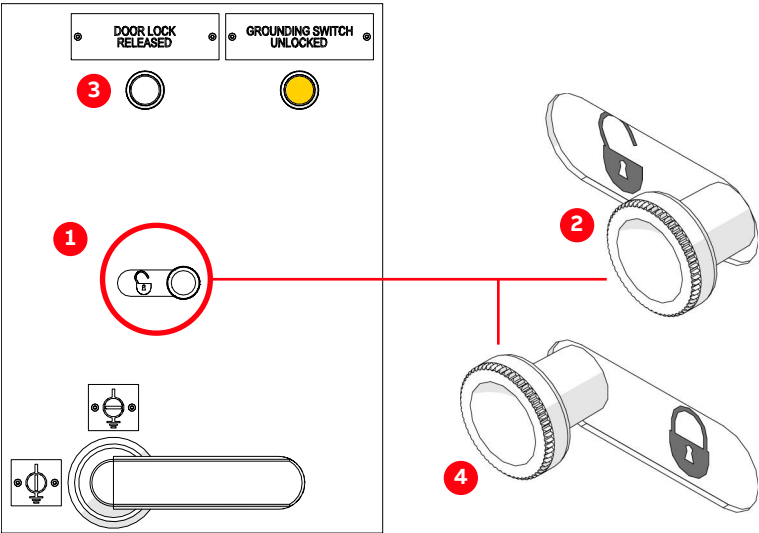
Key:	Explanation
(1) Grounding switch	<ul style="list-style-type: none">Horizontal position - drive is groundedVertical position - drive is ungrounded.
(2) Yellow lamp (grounding switch unlocked)	Lights up to indicate that you can turn the grounding switch to the grounded or ungrounded position.

Fig. 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, Fig. 24) to the unlocked position (2, Fig. 24) and open the doors when the drive is grounded, ie, when the white lamp (3, Fig. 24) is lit. In order to slide a locking bar to the locked position (4, Fig. 24), 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

Fig. 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 (Fig. 26).

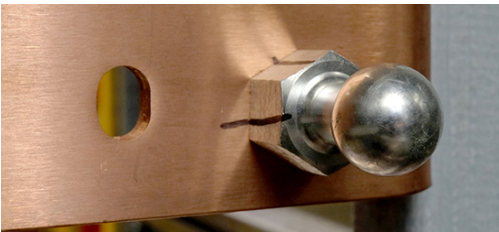


Fig. 25. Grounding stud

3.9.1. Grounding set



! DANGER

Hazardous voltages!

→ Complete the steps in Section 2.3.2, “The 7 steps that save lives”, page 25 before you access the grounding studs in the PCU and COU.

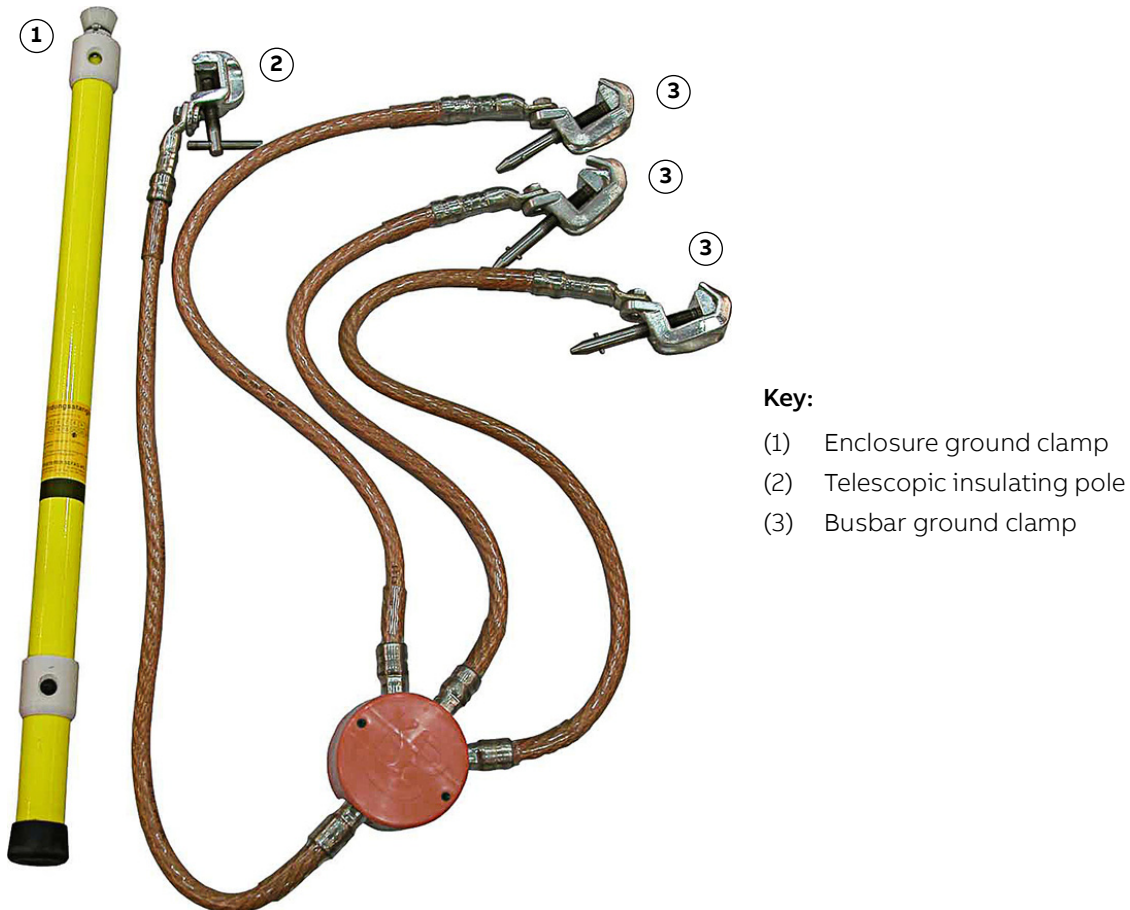


Fig. 26. 4-way grounding set

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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.

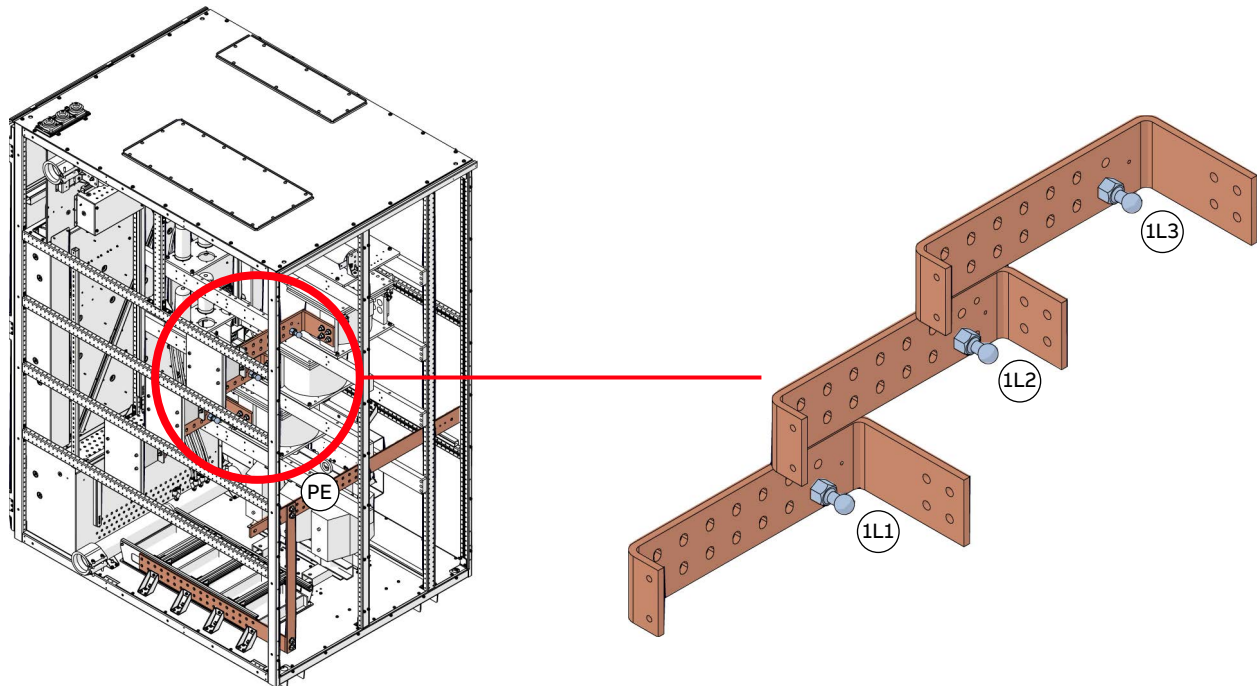


Fig. 27. Location of PE busbar and grounding studs (1L1, 1L2, and 1L3) in COU, FS 1 and FS 2

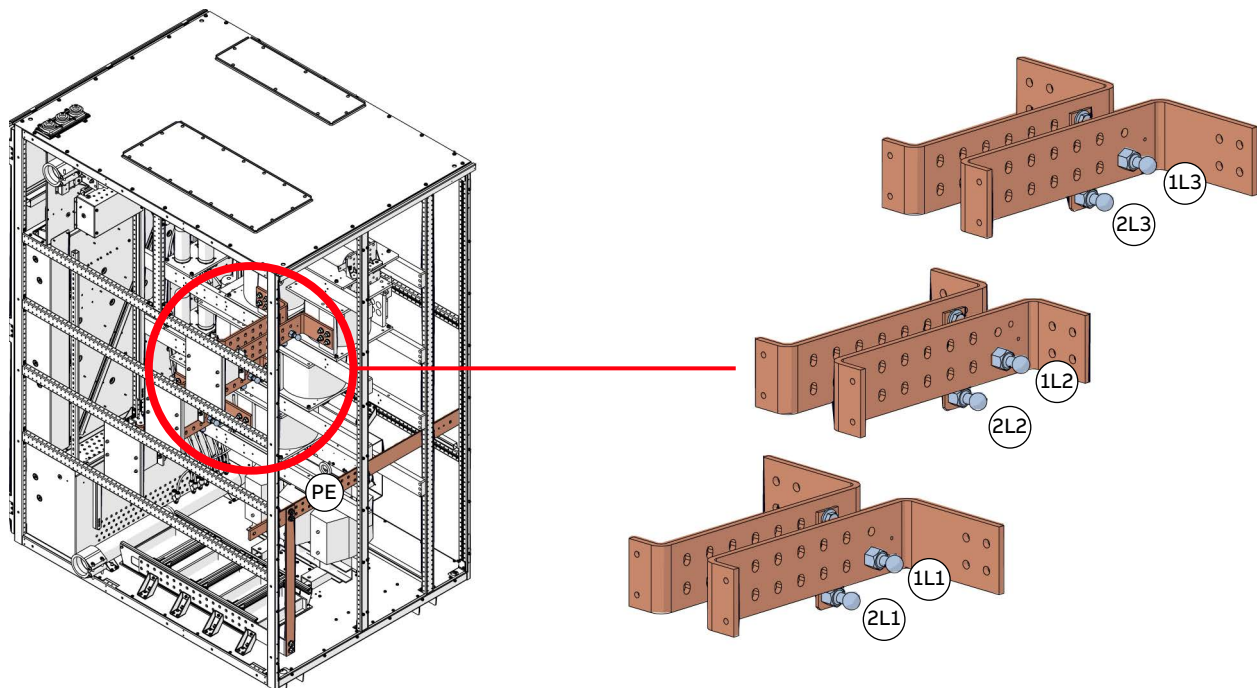


Fig. 28. Location of PE busbar and grounding studs (1L1, 1L2, 1L3, 2L1, 2L2, and 2L3) in COU, frame sizes 3 and 4

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3.9.3. Input grounding studs in a PCU



! DANGER

Hazardous voltages!

→ Complete the steps in Section 2.3.2, “The 7 steps that save lives”, page 25 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.

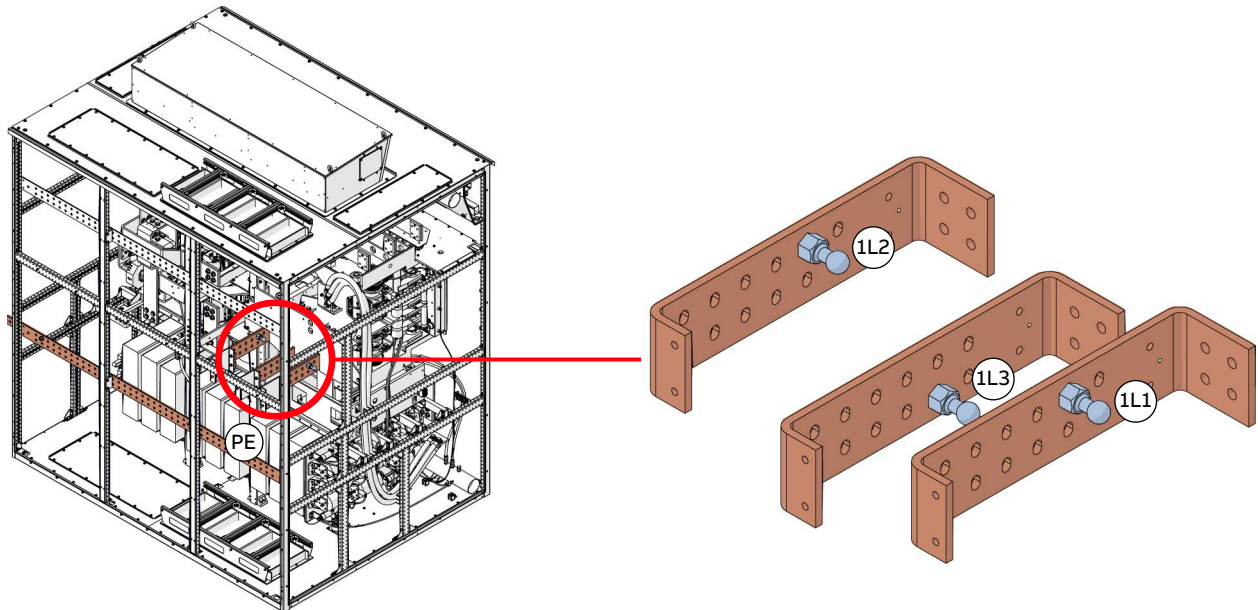


Fig. 29. Location of PE busbar and grounding studs (1L1, 1L2, and 1L3) in an 6-pulse PCU

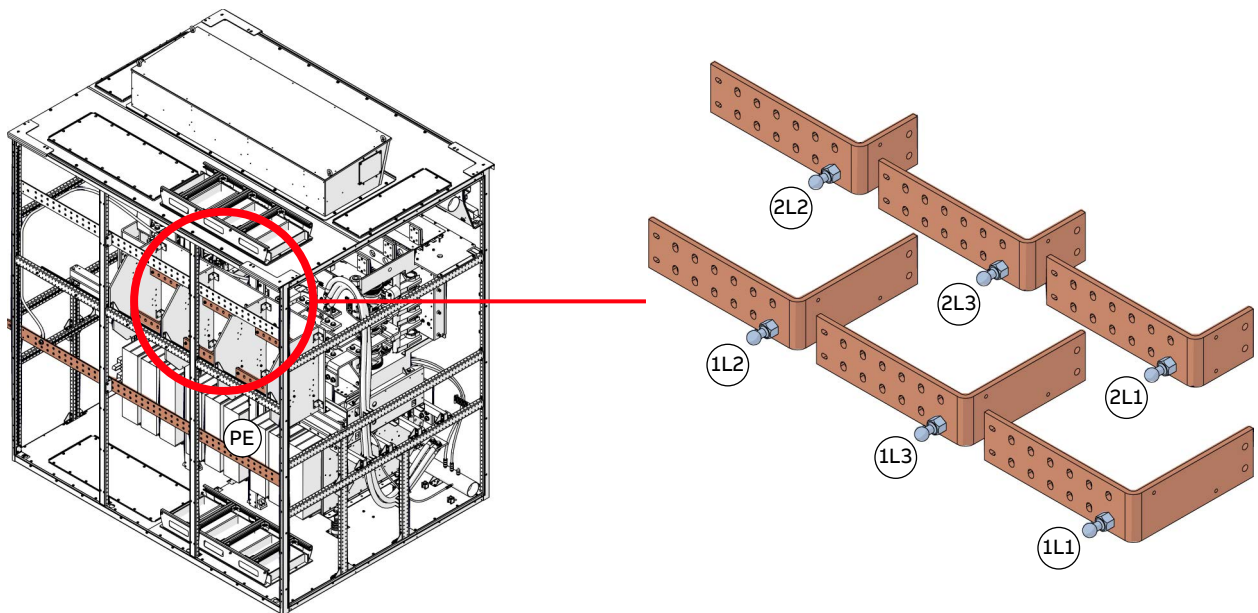


Fig. 30. Location of PE busbar and grounding studs (1L1, 1L2, 1L3, 2L1, 2L2, and 2L3) in a 12-pulse PCU

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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 ¹ : 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

¹ 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 ¹	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

¹ 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 ¹ Project CBA
Material Document	 004902892300012004	

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

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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, safety hooks, 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” for the relevant dimensions and weight

NOTICE

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

- Keep cabinet doors closed during lift operations

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4.5.1. Lifting attachment types



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. 2 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, SBU, and WCU cabinets in lineup left
(1)	M8 rotating eyebolt	For top-lifting roof-mounted cooling units

Fig. 31. Lifting attachment types

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4.5.2. Lifting with lifting plates

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



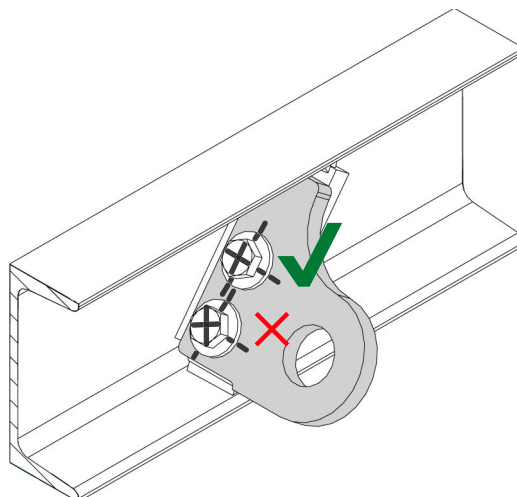
CAUTION

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, Fig. 4–2).

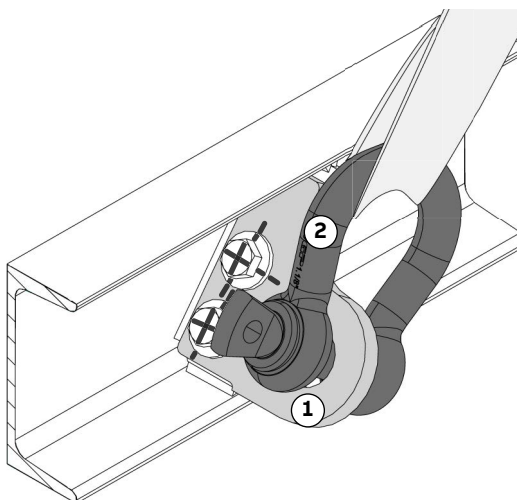
1. Verify that the factory torque marks on the mounting bolts and washers of the lifting plates are aligned.

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) or safety hooks.

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



Referring to Fig. 33, page 63:

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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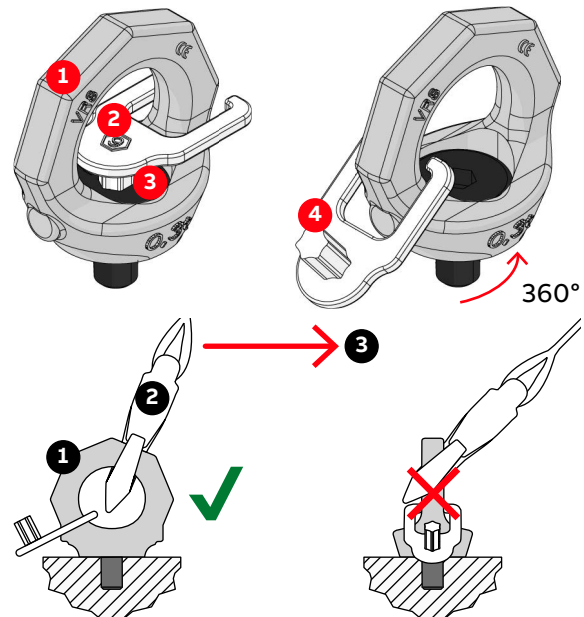
4.5.3. Lifting with rotating eyebolts

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 star 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 Fig. 33, page 63:

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 Section 4.5.4, “Reinstalling lifting attachments”, page 62) 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.

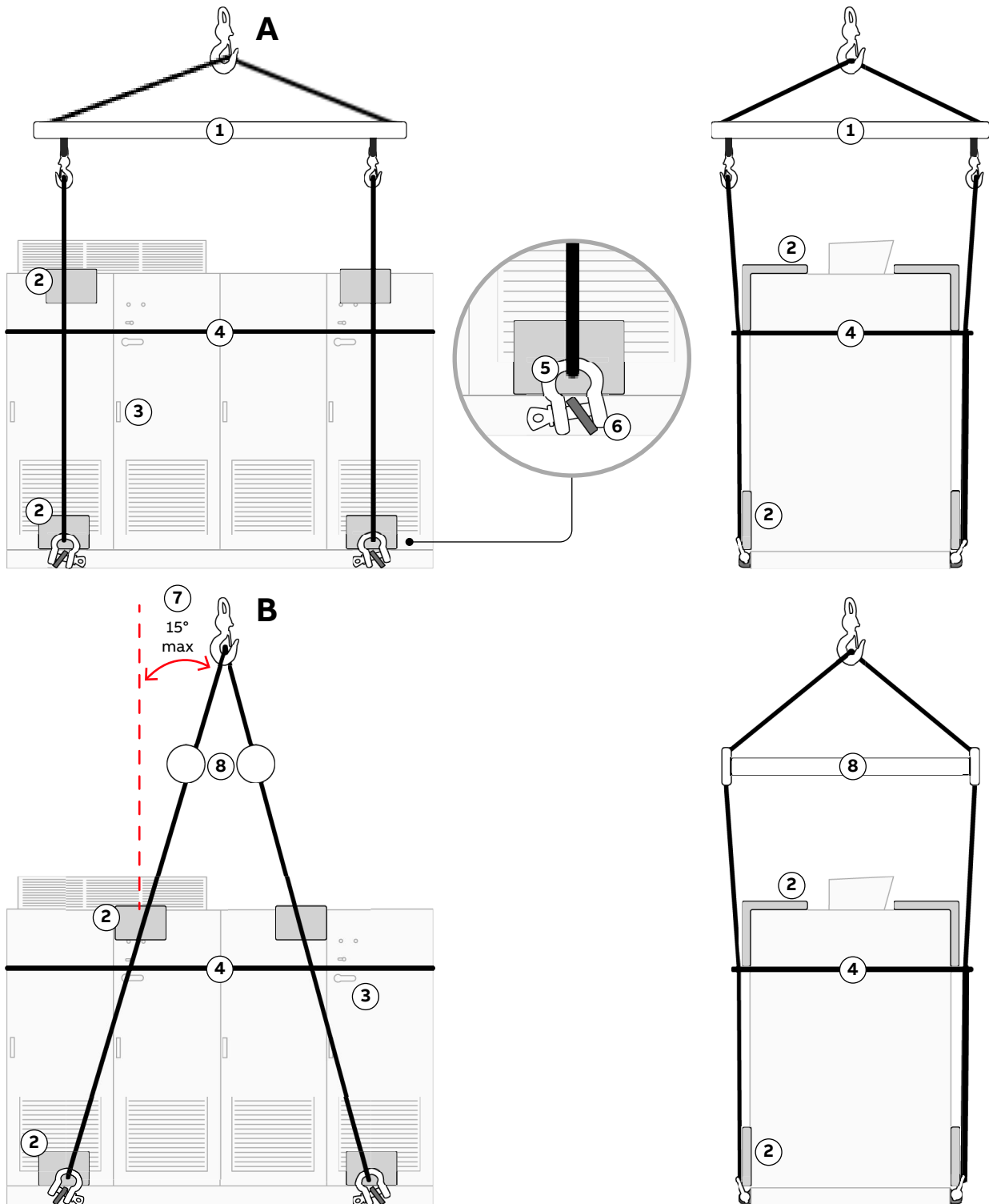
TABLE 3 Lifting attachment specifications

Type	Mounting bolt	Torque (Nm)	ABB ID
Lifting plate	2 × M16 × 40 (A2-70)	204	3BHB039841R0001
M16 rotating eyebolt	M16	60	3BHE015753P0016
M8 rotating eyebolt	M8	10	3BHE015753P0008



Fig. 32. Torque wrench socket for rotating eyebolt (not included in delivery)

4.5.5. Sling configurations for lift frames and spreader frames



Key:

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

Fig. 33. Sling configuration for (A) lift frame and (B) spreader frame

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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 ABB.

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”.
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:

- “Preparing the installation site”, page 68
- “Aligning transport units”, page 69
- “Joining transport units”, page 71
- “Applying silicone”, page 72
- “Installing roof joints”, page 72
- “Installing roof-mounted cooling units”, page 73 (option)
- “Installing roof attachments on marine drives”, page 78 (option)
- “Joining water pipes”, page 80
- “Joining busbars”, page 81
- “Connecting the heating cable”, page 83 (option)
- “Connecting raw water pipes”, page 84
- “Fixing the drive to the floor”, page 84

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

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5.4. Dimensions and clearances

For information on dimensions, location and size of fixing holes and clearances, see “Appendix C – Mechanical drawings”.

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

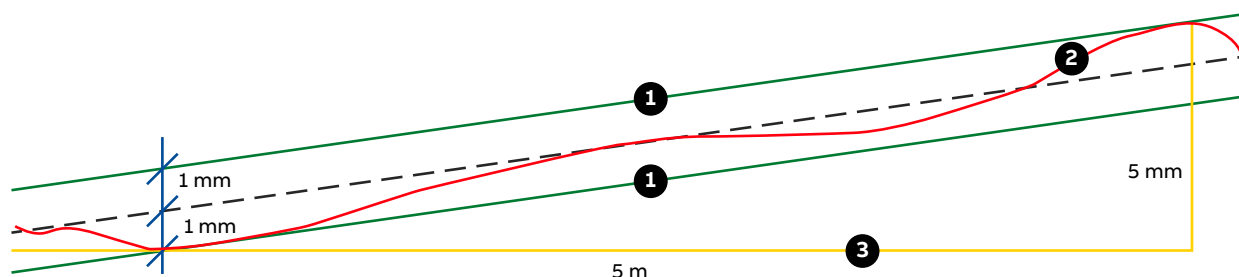
See Section 1.10, “Tools”, page 20.

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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 |

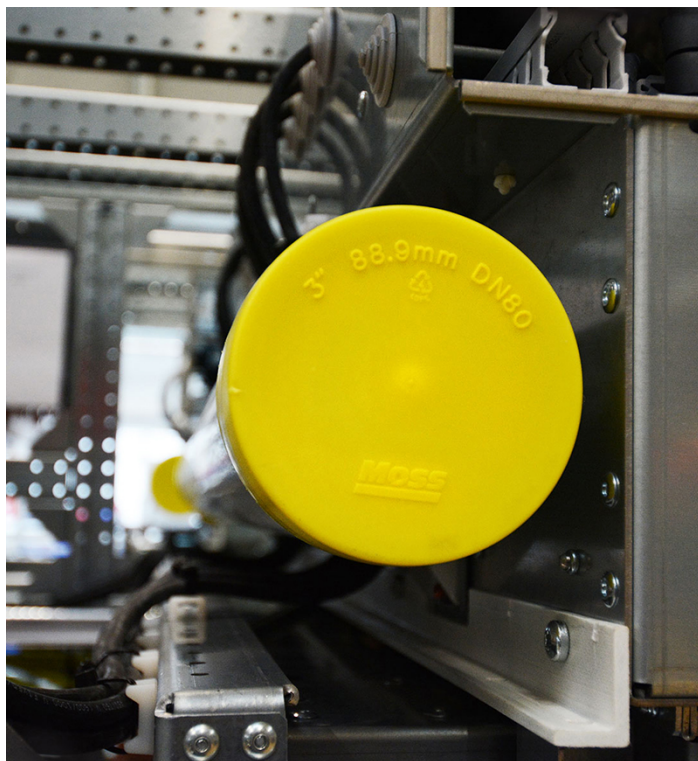
Fig. 34. Floor inclination

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.

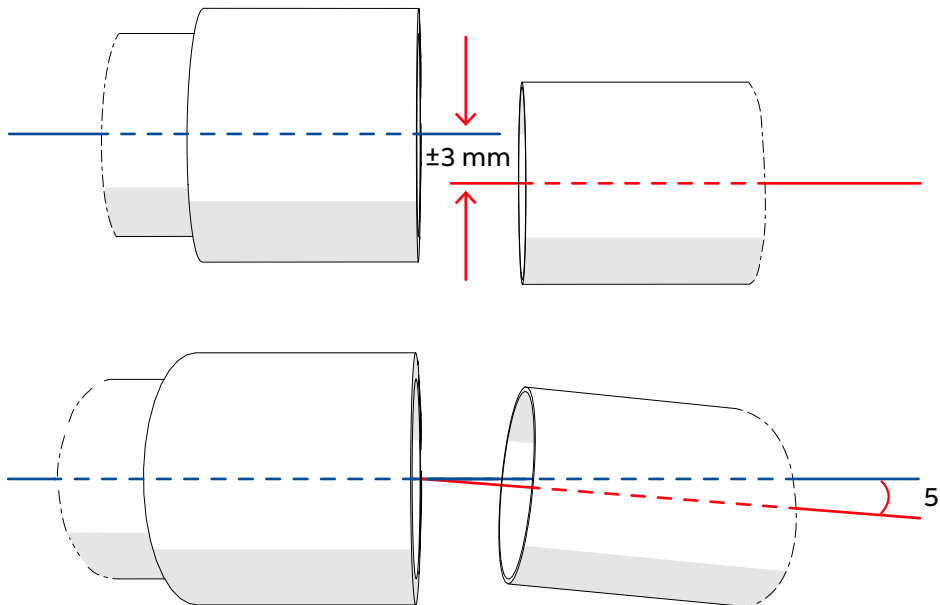


3. Line up the transport units as shown in “Appendix C – Mechanical drawings”.
The units can be lined up either beginning from the left or the right.
4. Align the transport units.

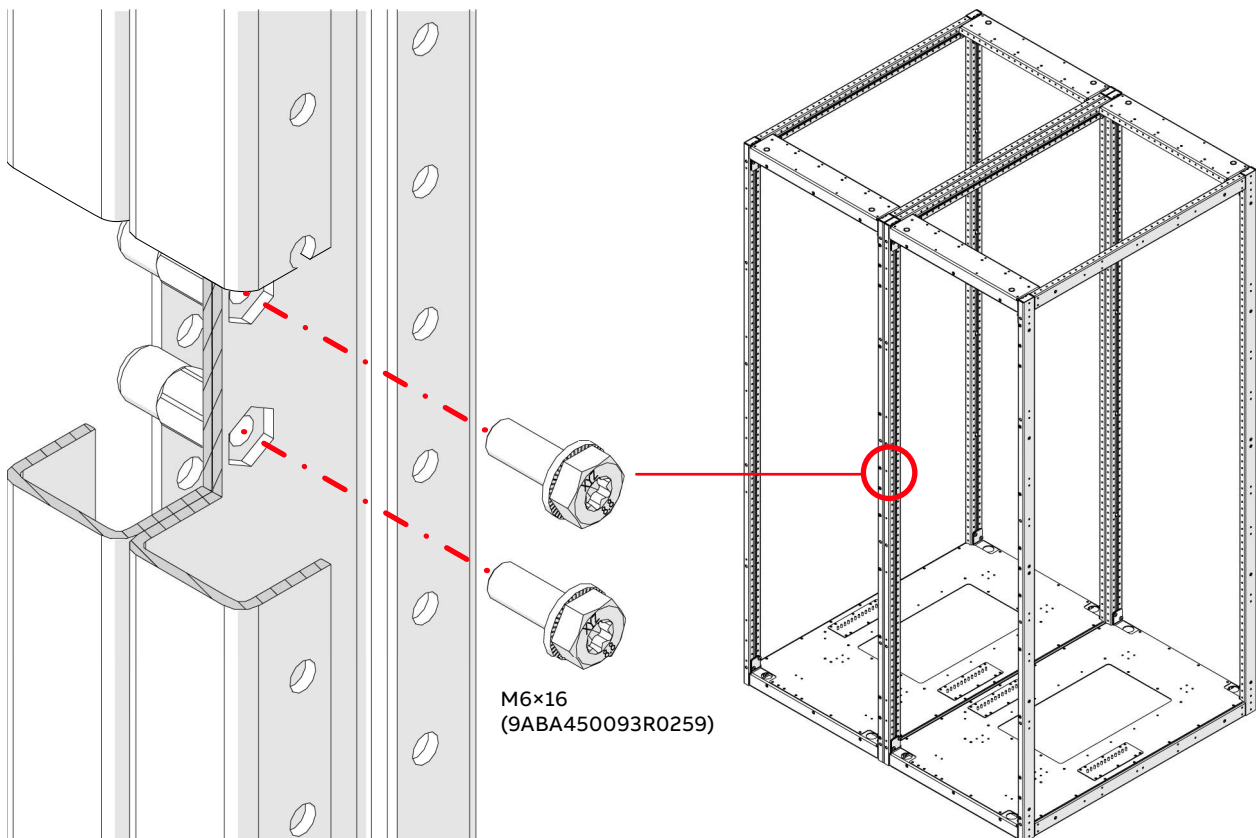
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5. Verify the following alignment parameters:

- 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

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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.

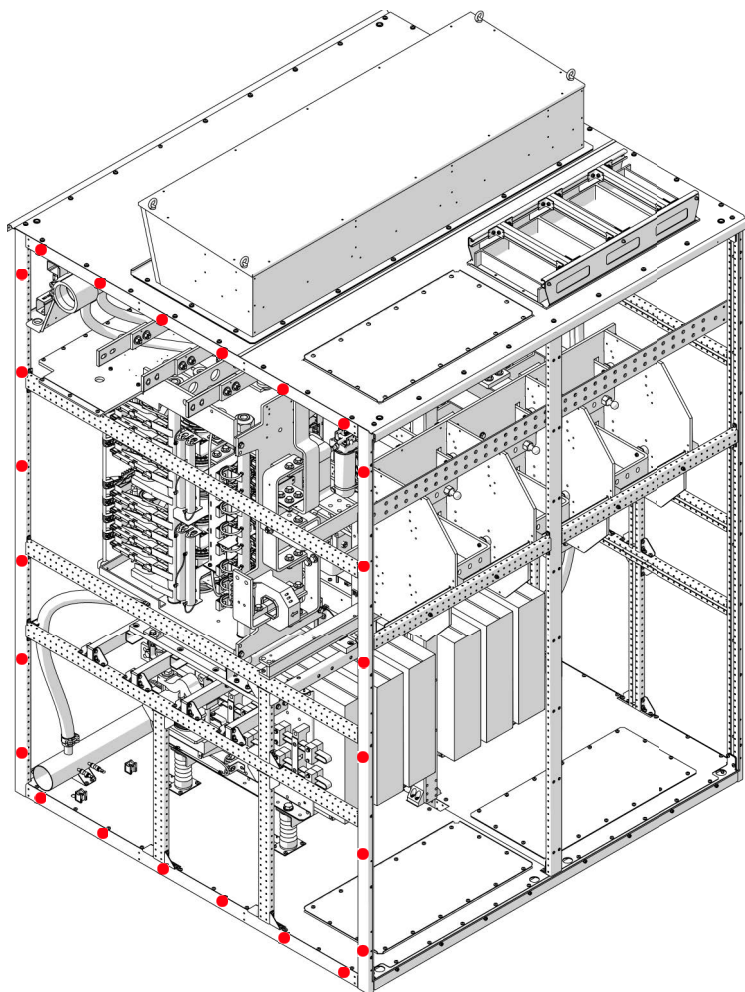


Fig. 35. Connection points on side of transport units (PCU example)

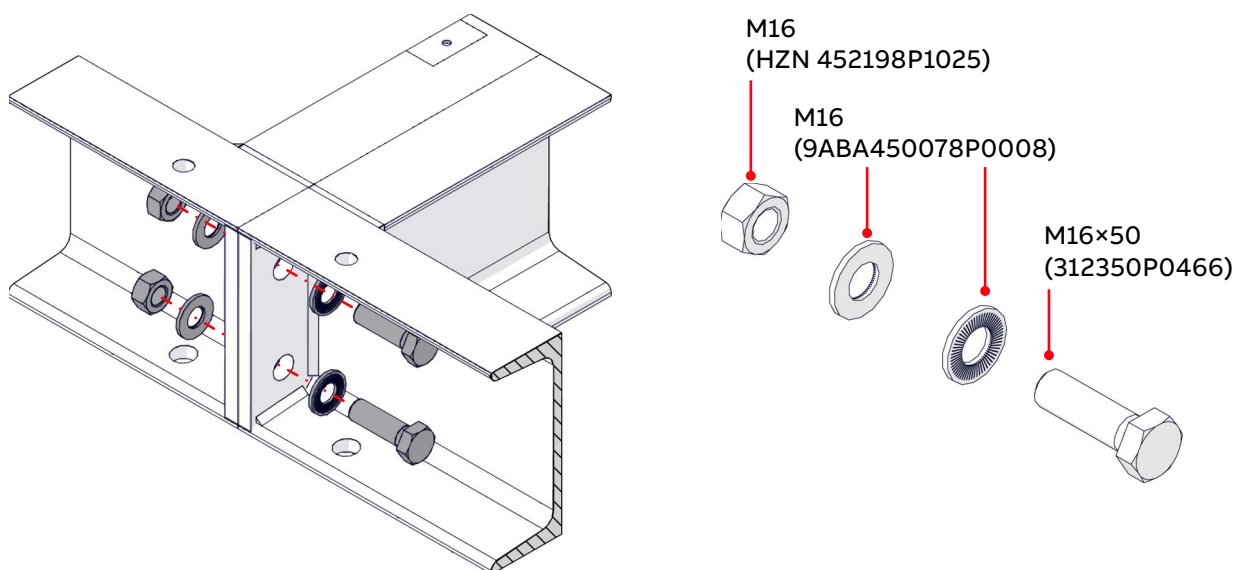


Fig. 36. Base frame connection points

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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 (Fig. 37). Gaps within a transport unit are factory-sealed.

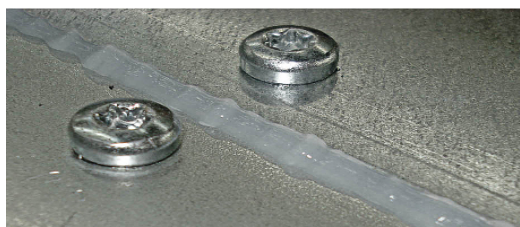


Fig. 37. Applying silicone

5.9. Installing roof joints

Install the roof joints across shipping splits at the following locations:

- Marine drives: at the front of the roof (the back is reserved for roof attachments, see Section 5.11, “Installing roof attachments on marine drives”, page 78.)
- 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”.

TABLE 4 Installation material per roof joint

Items	Details	ID Number
Connecting piece	8 × 80 × 220 mm	3BHB011552R0001
Hex-head bolt	M16 × 40	NB 312350P0464
Washer	17 × 30 × 3	9ABA450078P0008



Fig. 38. Roof joint

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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. Lifting a cooling unit with a crane



CAUTION

Heavy object! An IP42 cooling unit weighs **40 kg** and an IP54 cooling unit weighs **98 kg**.

→ Use appropriate slings and shackles

Referring to Fig. 39:

1. Install 4 RUD bolt-on lifting points (ABB ID: 3BHE015753P0008) in the 4 top corners of the cooling unit.

NOTE – The lifting points are in the loose parts that were delivered with the drive.

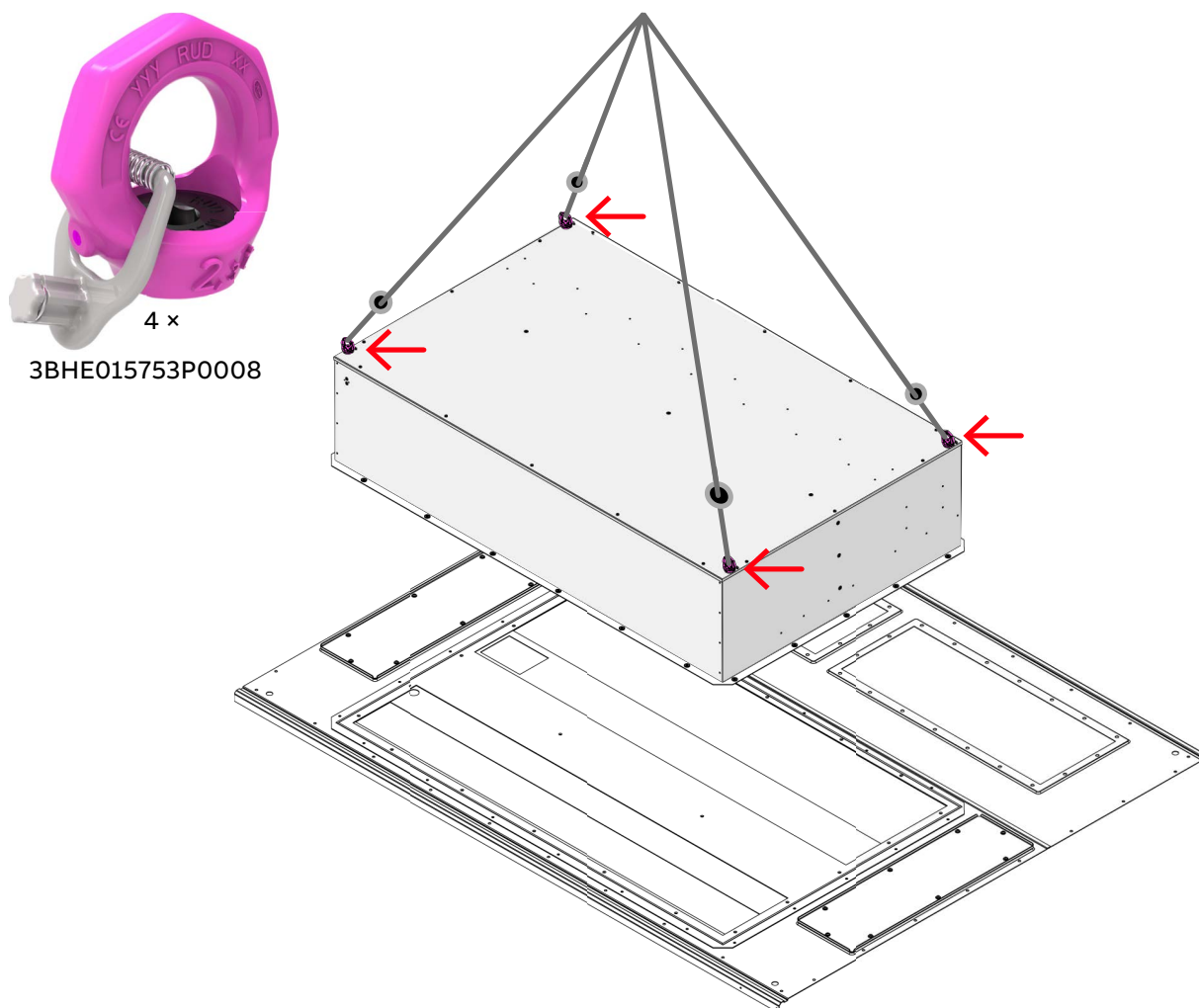


Fig. 39. Lifting a cooling unit (example with IP54 unit)

2. Attach appropriate slings and shackles to the lifting points.
3. Lift the cooling unit above the cabinet with the crane.

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5.10.2. Installing IP42 roof-mounted cooling units



CAUTION

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

40 kg

- Only use the rotating eyebolts (ABB ID: 3BHE015753P0008) that were delivered with the loose part of the drive
- Use appropriate slings and shackles with the eyebolts
- Before you begin, read Section 4.5.3, “Lifting with rotating eyebolts”, page 61

TABLE 5 Installation material per IP42 unit

Item	Quantity	Details	ID number
Self-tapping Torx screws	18	M6 × 16	HAQN401050P0259
Washers with sealing	18	6.8 × 1 (4.8 × 2.8)	3BHB034338R0001
Cable binders			

Referring to Fig. 40:

1. Install rotating eyebolts (1) in the top corners of the IP42 cooling unit.

CAUTION! For a single lifting operation, tighten the eyebolts (1) firmly with the star key (2). 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 Section 4.5.1, “Lifting attachment types”, page 59.

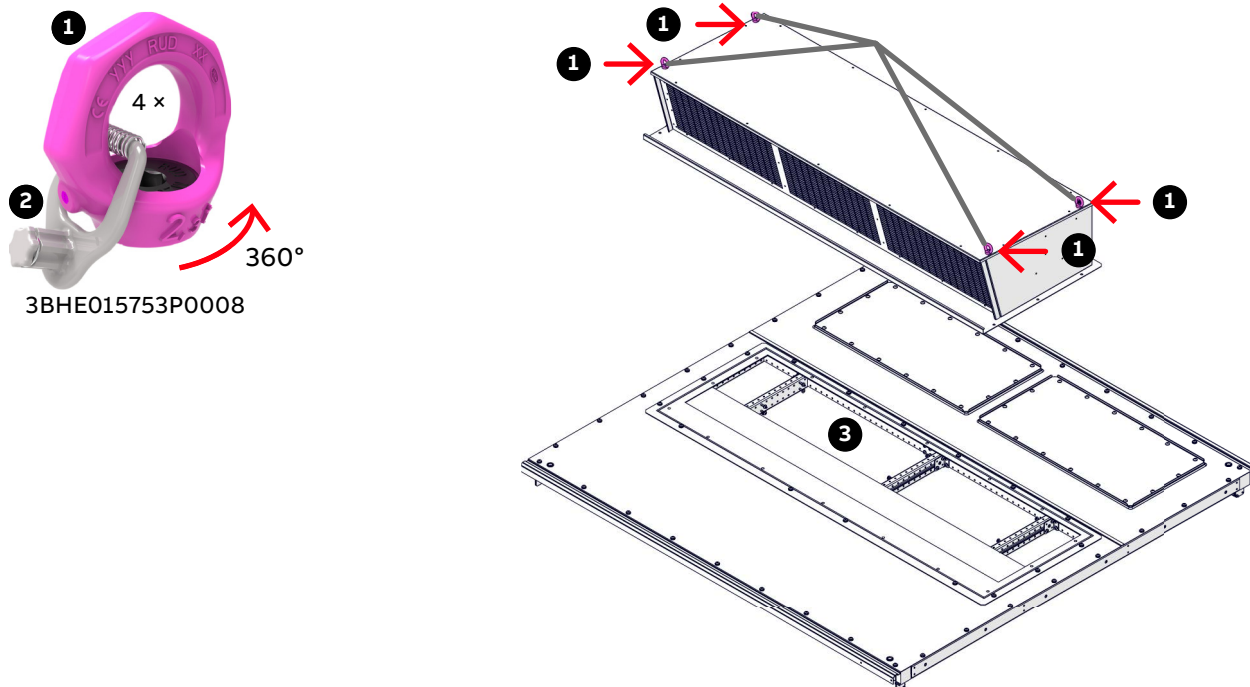


Fig. 40. Lifting an IP42 cooling unit

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 (2) 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.
 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.

Referring to Fig. 41, page 75:

9. Route the cables along the pre-installed white cable brackets and through the designated openings (1) into the front of the cable duct.

IMPORTANT! Use cable binders to fix the cables to the cable brackets.

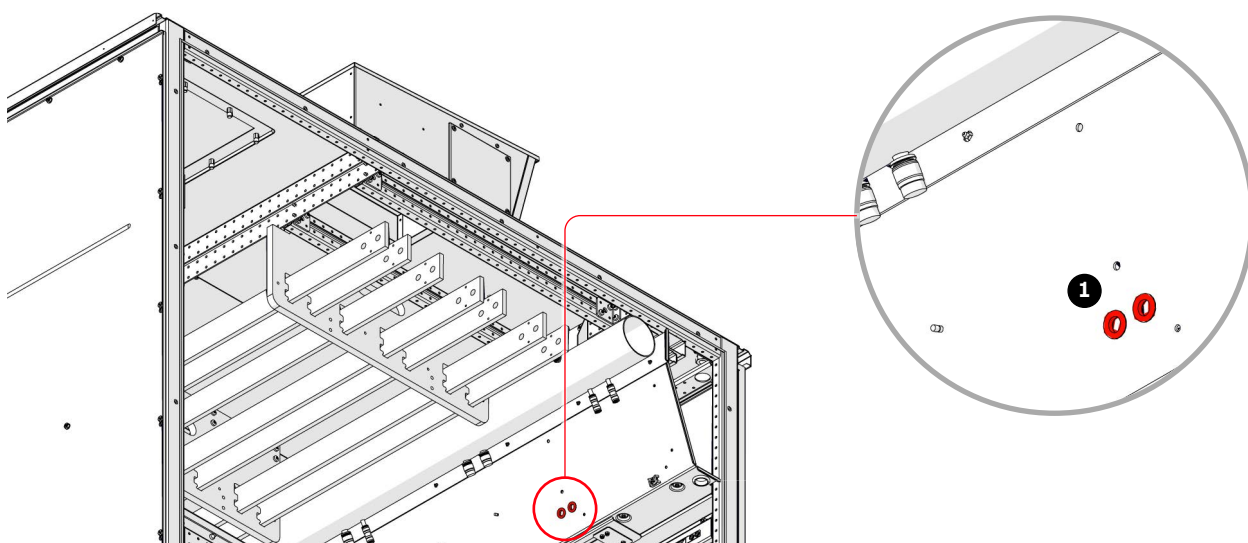


Fig. 41. Cable duct openings (example with 1700 mm PCU)



10. In the cable duct at the front of the cabinet, connect the cables according to “Appendix D – Wiring diagrams”.

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5.10.3. Installing IP54 roof-mounted cooling units



CAUTION

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

- 98 kg**
- Only use the rotating eyebolts (ABB ID: 3BHE015753P0008) that were delivered with the loose part of the drive
 - Use appropriate slings and shackles with the eyebolts
 - Before you begin, read Section 4.5.3, “Lifting with rotating eyebolts”, page 61

TABLE 6 Installation material per IP54 unit

Item	Quantity	Details	ID number
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 in the top corners of the IP54 cooling unit.

CAUTION! For a single lifting operation, tighten the eyebolts (1, Fig. 42) firmly with the star key (2, Fig. 42). 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 Section 4.5.1, “Lifting attachment types”, page 59.

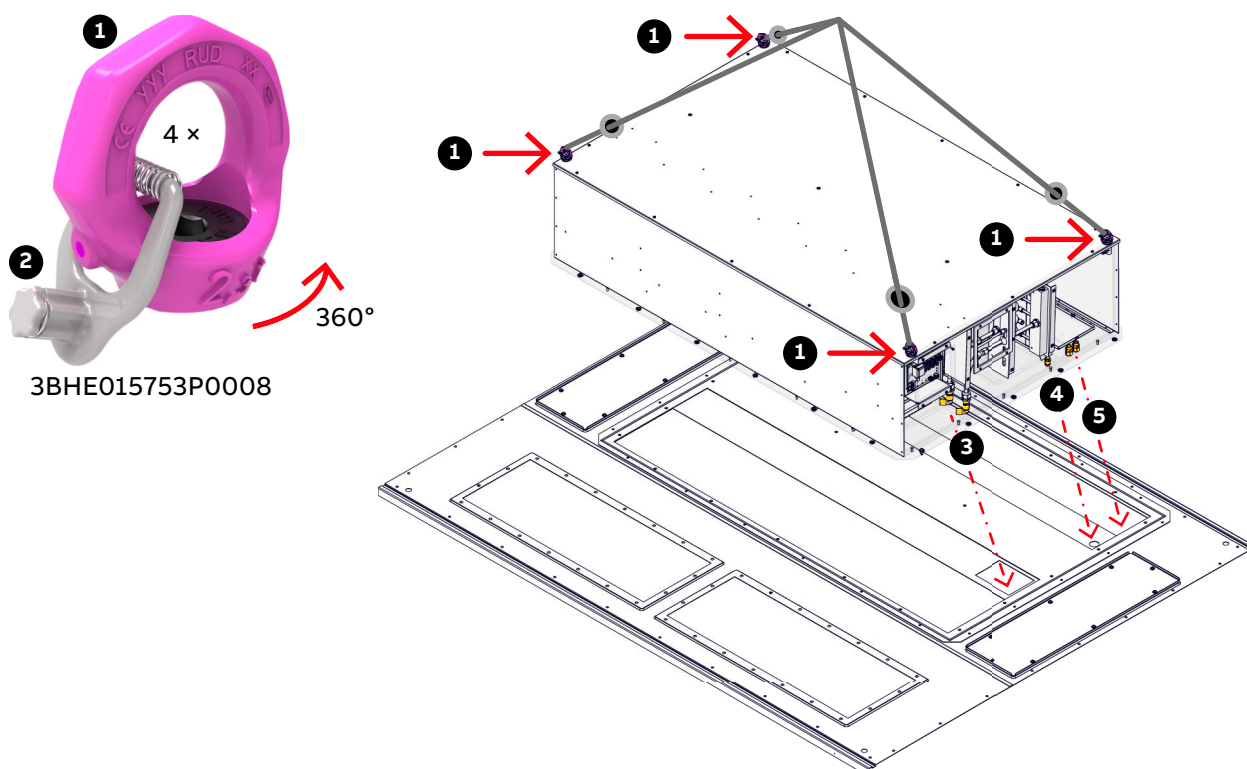


Fig. 42. Lifting an IP54 cooling unit

2. Attach the appropriate slings and shackles to the eyebolts.
3. Orient the 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 water inlet / outlet (2, Fig. 42), drain outlet (3, Fig. 42), and cables (4, Fig. 42) 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.

6. Secure the cooling unit to the cabinet roof with the supplied screws.
7. Remove the rotating eyebolts that you installed in step 1.
8. Connect the tube from the return pipe (5, Fig. 43) to the water outlet (1, Fig. 43).
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 Fig. 43 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.
9. Connect the tube from the feed pipe at the bottom of cabinet to the water inlet (2).
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.
10. Connect the drain tube to the drain outlet (3, Fig. 43).
The drain tube guides water condensation to the cabinet floor.

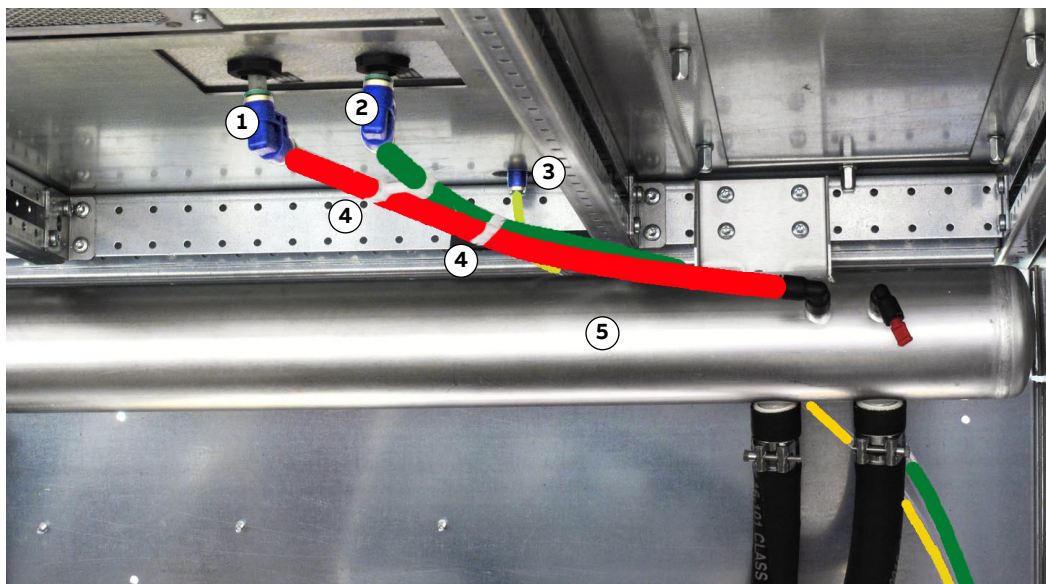


Fig. 43. Water tube connections (back view)

11. Install the two white spacers (4, Fig. 43) between the inlet and outlet tube.
12. In the cable duct at the front of the cabinet, connect the cables according to “Appendix D – Wiring diagrams”.

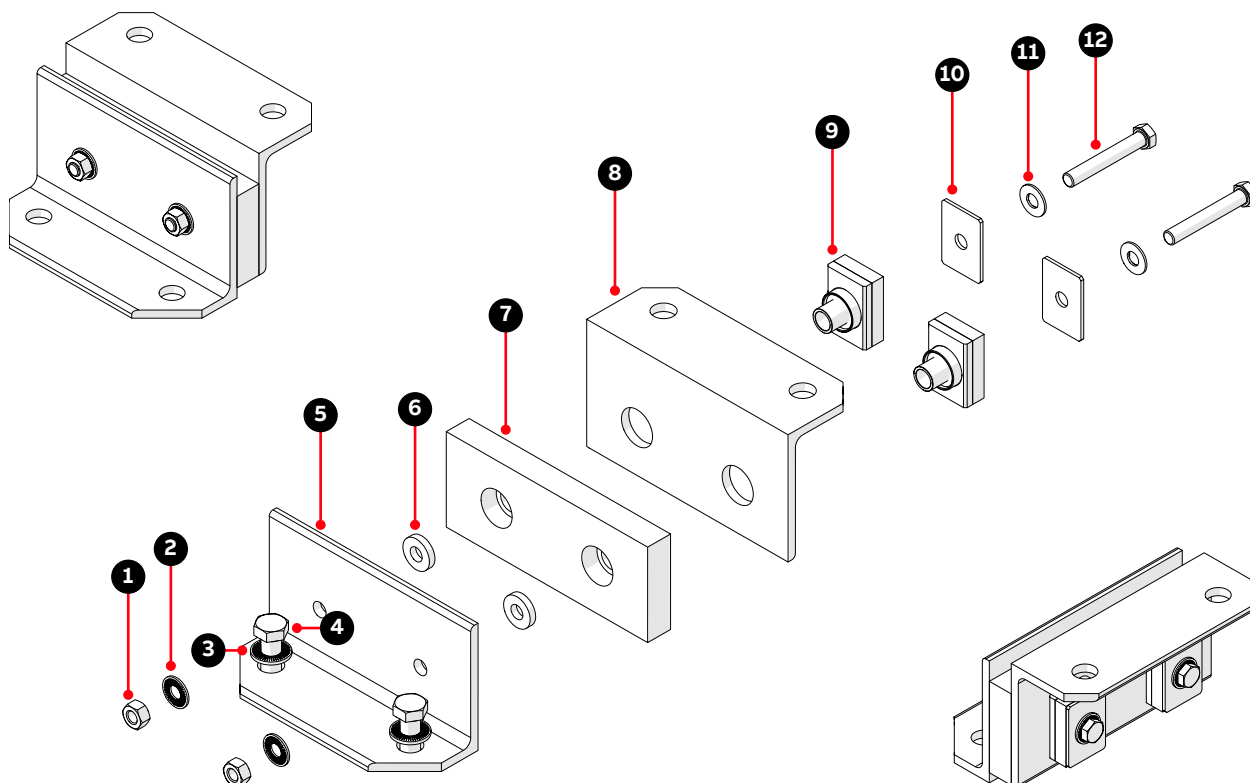


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5.11. Installing roof attachments on marine drives

Roof attachments are only available on 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”.



Key:	Details	ID number
(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

Fig. 44. Roof attachment

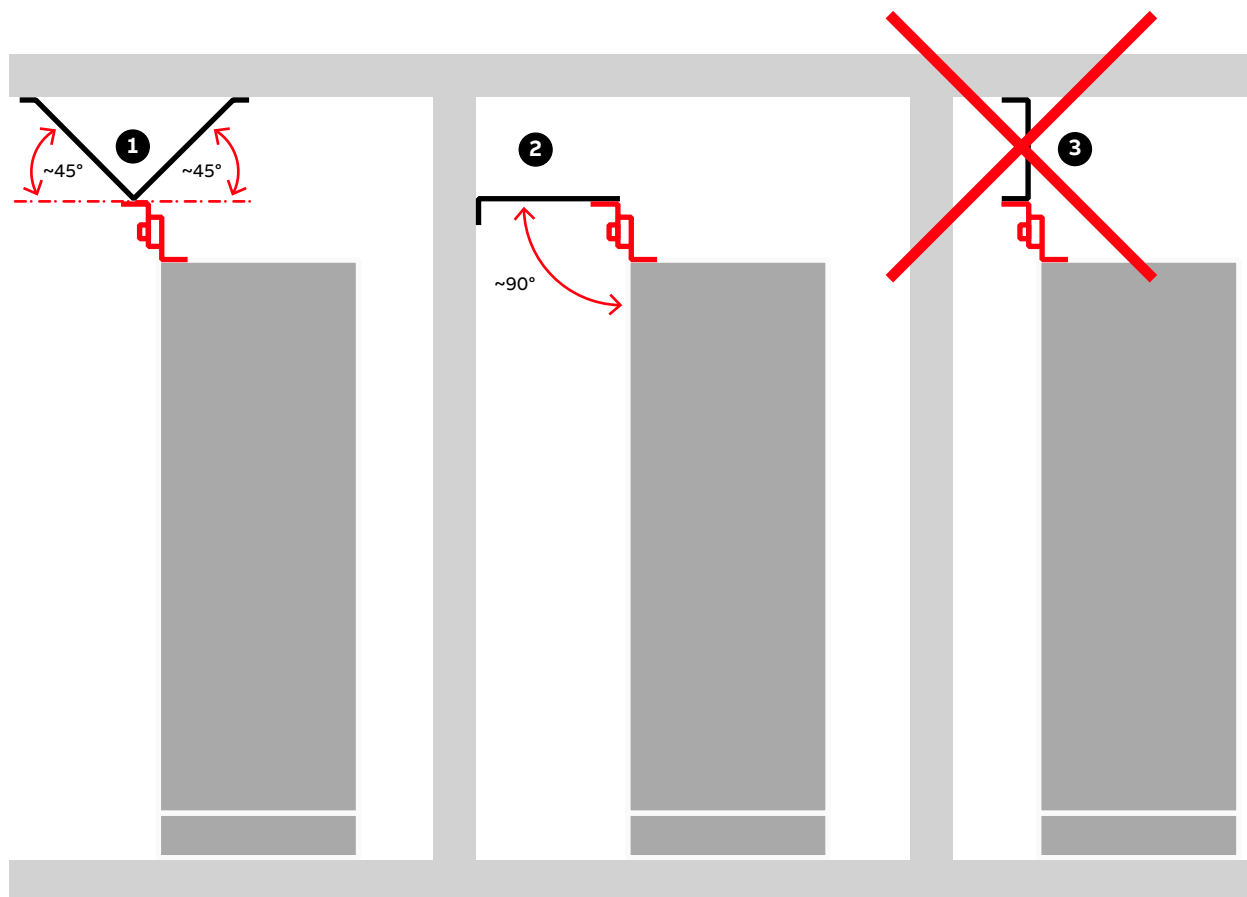
1. Assemble the roof attachment.
2. Tighten the bolts firmly.

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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, Fig. 45).

4. If you fix the drive to the ceiling, use two struts per roof attachment (1, Fig. 45).
5. If you fix the drive to the back wall, install one strut at a 90° angle to the drive (2, Fig. 45).



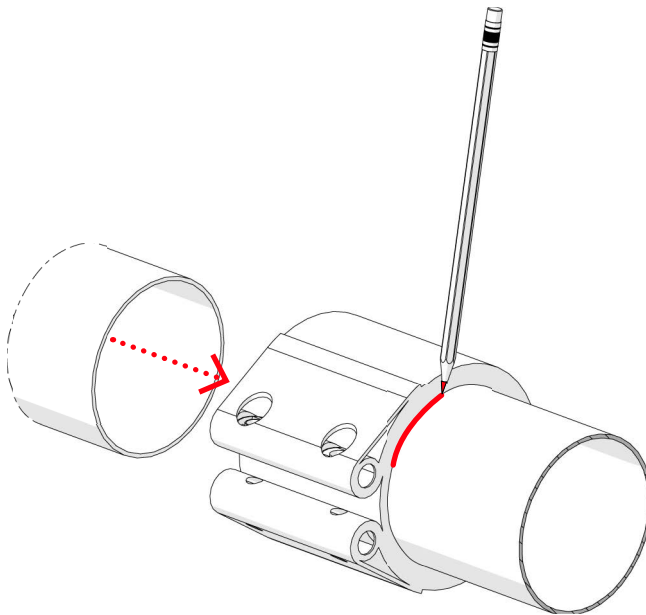
Key:

- | | |
|-----|--|
| (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 |

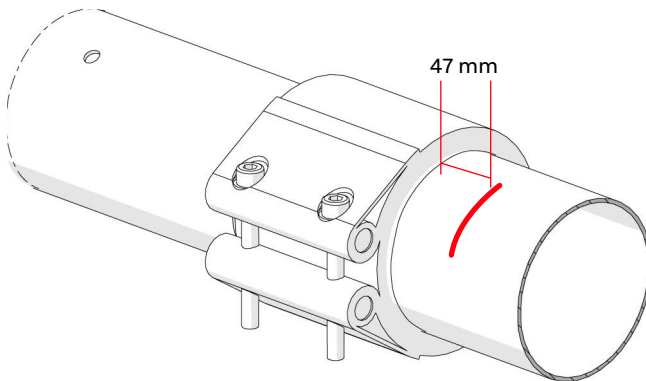
Fig. 45. Recommended ceiling and wall fixings

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.



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, Fig. 46)
- PE ground busbar (2, Fig. 46)
- DC busbars (3, Fig. 46)

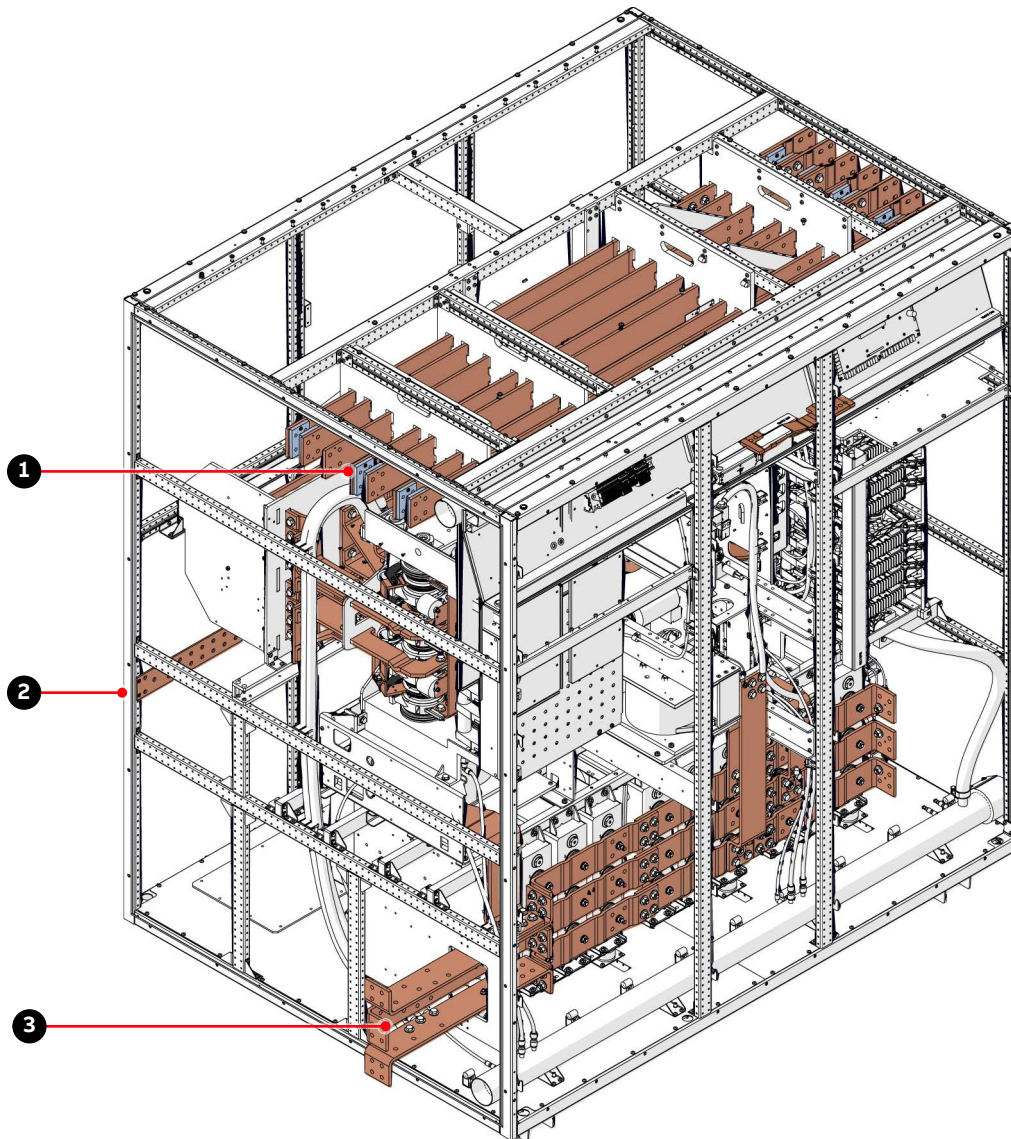


Fig. 46. Busbar connections

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.

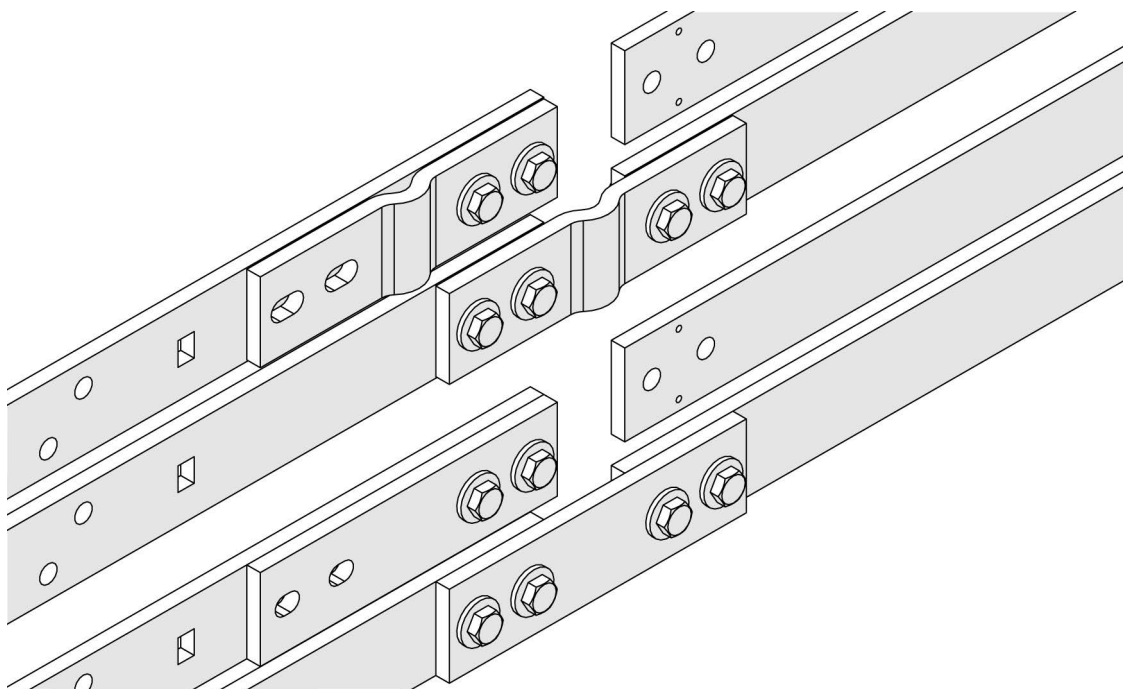


Fig. 47. AC busbar connection

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.

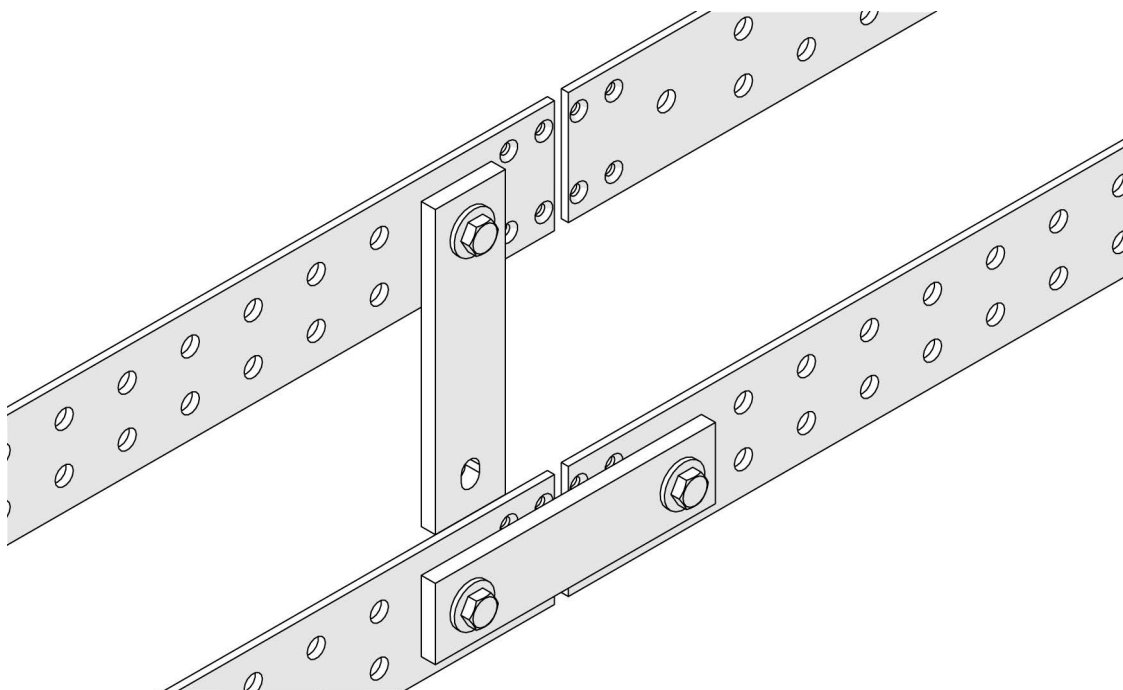


Fig. 48. PE ground busbar connection

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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.

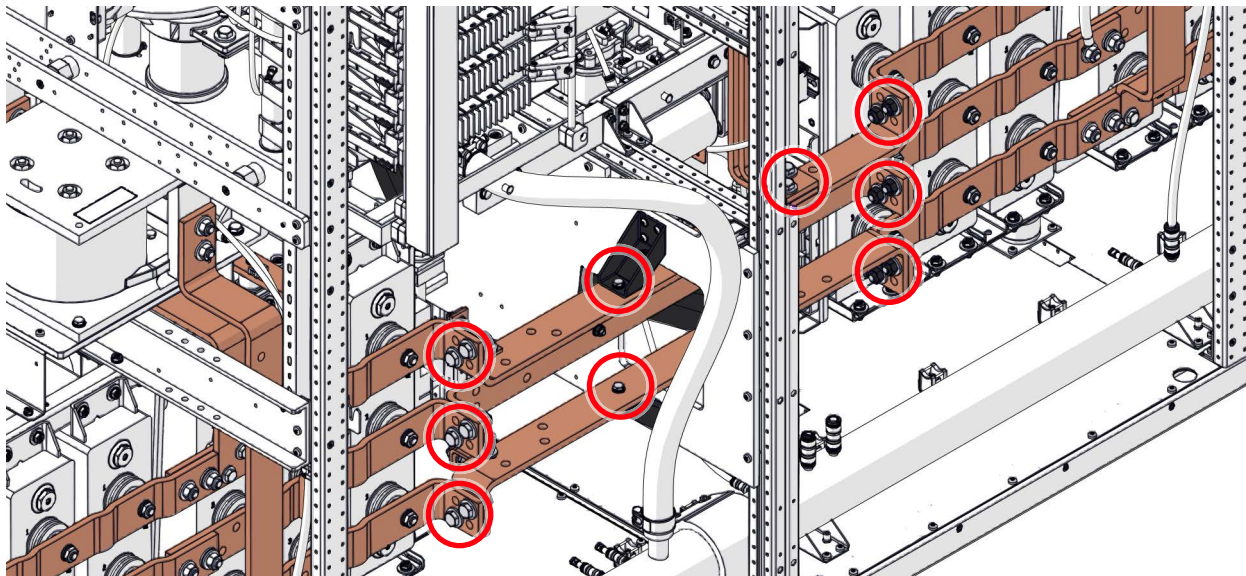


Fig. 49. DC busbar connection

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, Fig. 50) of two adjoining transport units.
2. Fasten the connectors with cable ties (2, Fig. 50).

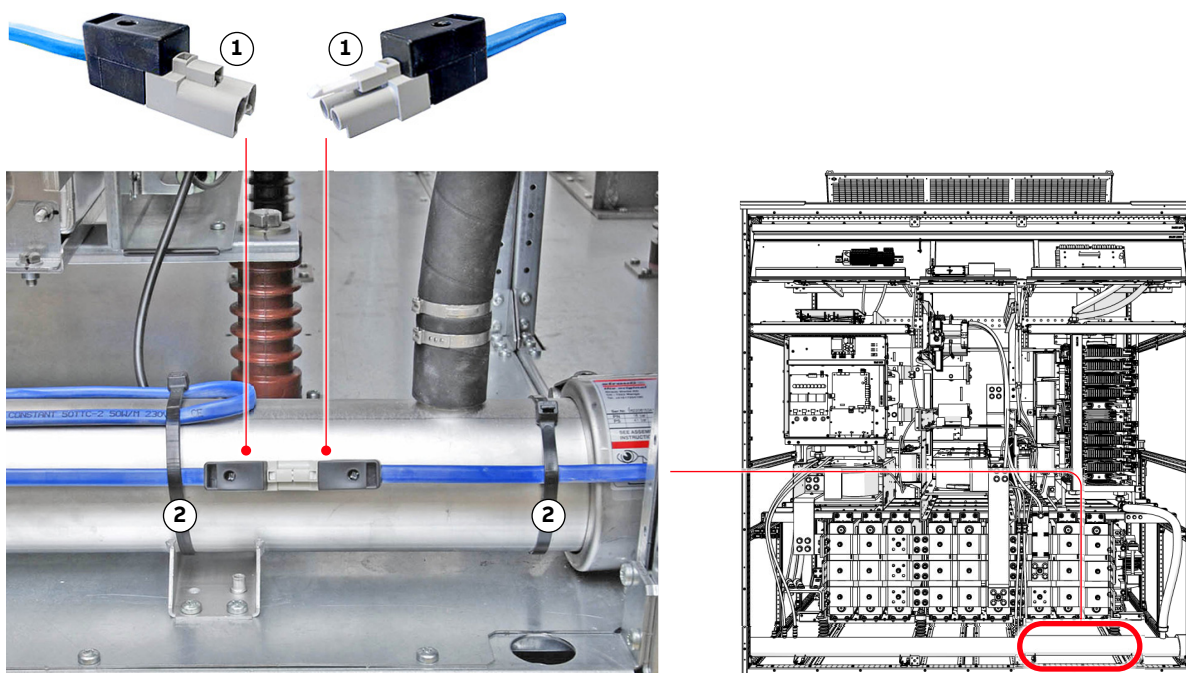


Fig. 50. Heating cable connection

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5.15. Connecting raw water pipes

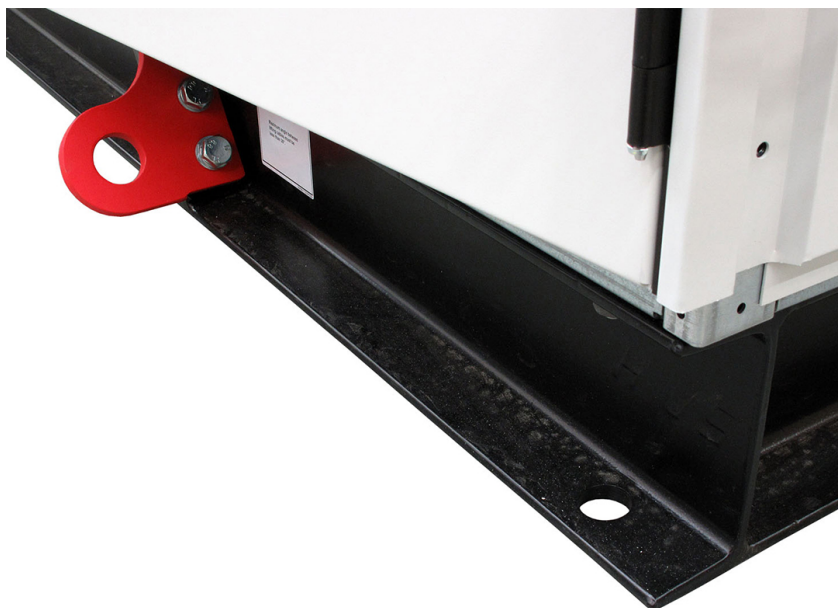
Connect the incoming and outgoing raw water pipes to the flanges of the water cooling unit.

Installation material such as counter flanges, bolts, nuts and seals are supplied.

For dimensions of the raw water entry and the flanges, see “Appendix C – Mechanical drawings”.

5.16. Fixing the drive to the floor

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



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6. Electrical installation

6.1. Safety



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

6.3. Cable requirements

6.3.1. Power cables

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

- “ACS5000 power cable specification”, 3BHS215798 E01
- “Power cables engineering guideline”, 3BHS542290 E01

6.3.2. 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.

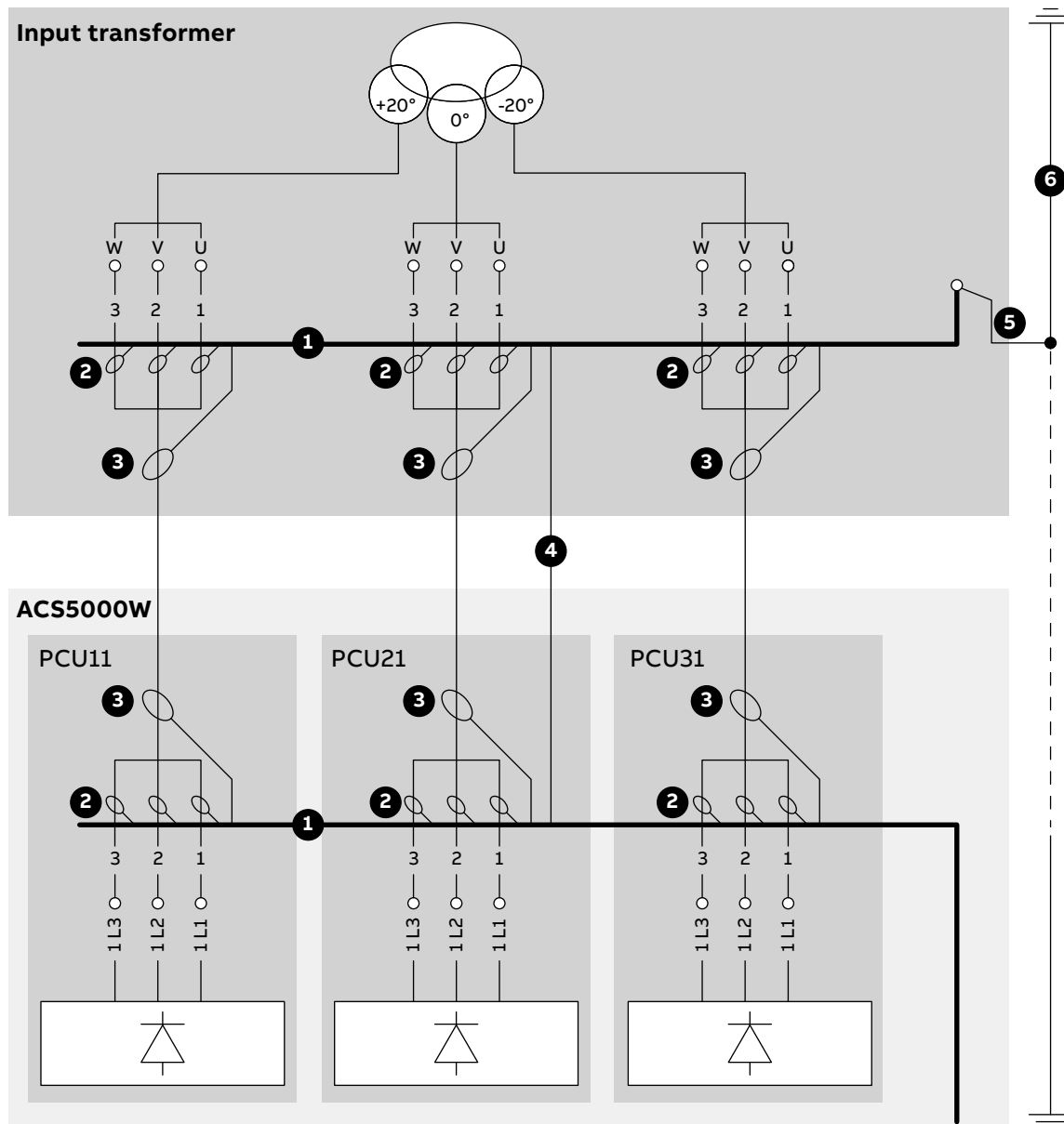
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6.4. Grounding

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”.

6.4.1. Grounding the transformer and an 18-pulse drive

Fig. 51 shows the grounding connections of an ACS5000W drive with an 18-pulse line supply and an input transformer.



Key:

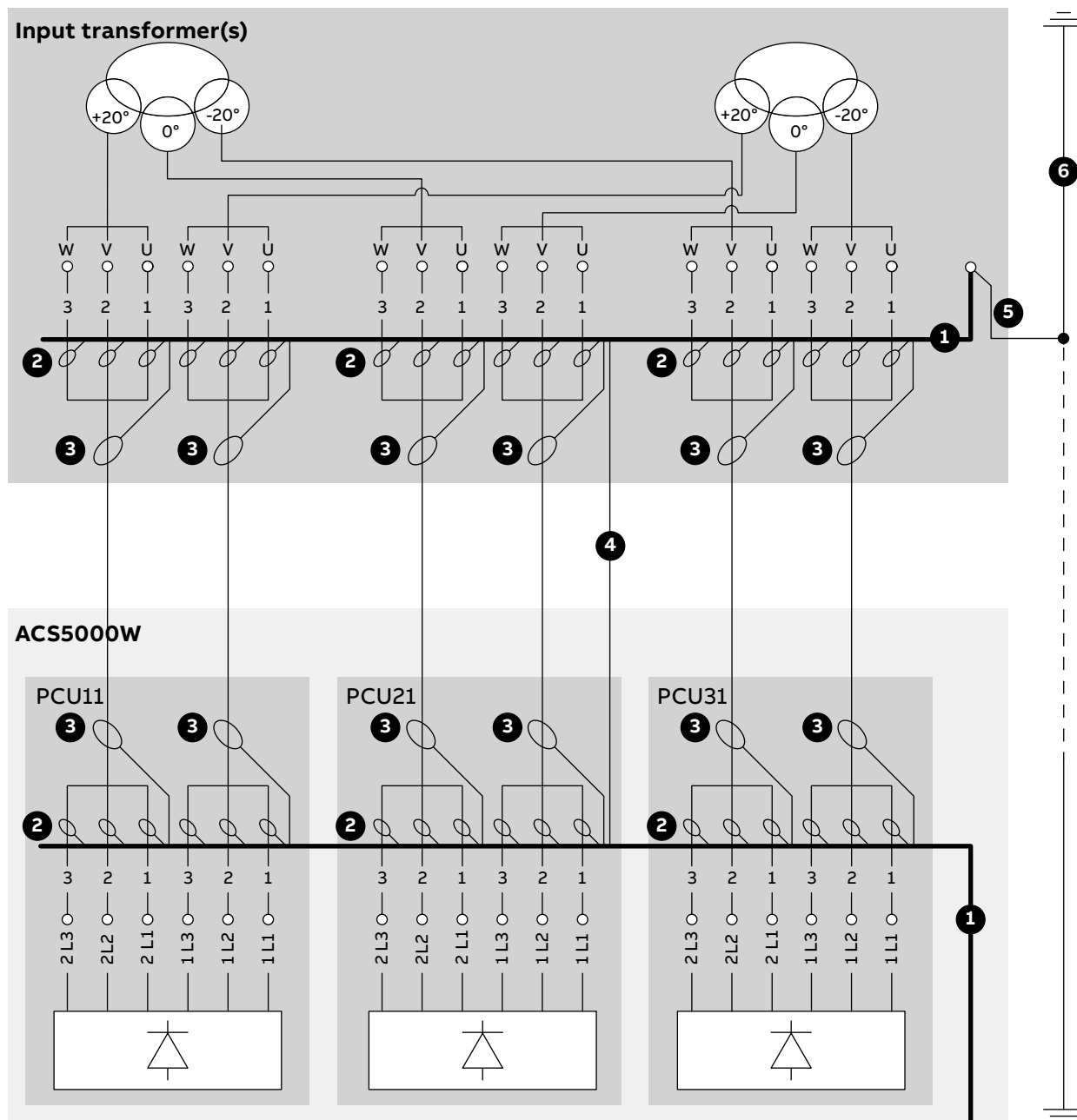
- | | |
|--|--|
| (1) PE busbar | (5) Ground conductor |
| (2) Cable screen | (6) System ground (grounding network of installation site) |
| (3) Cable shield/armor | |
| (4) Equipotential bonding conductor (optional) | |

Fig. 51. Grounding the transformer and an 18-pulse drive (in PCU)

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6.4.2. Grounding the transformer and a 36-pulse drive

Fig. 52 shows the grounding connections of an ACS5000W drive with an input transformer and an input transformer.



Key:

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

Fig. 52. 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 Section 6.4.4, “Grounding the drive and the motor (single-point bonding)”, page 89).

For more information, see “Power cables engineering guideline”, 3BHS542290 E01.

Fig. 53 shows the multi-point connections for grounding a drive and a motor in the COU compartment.

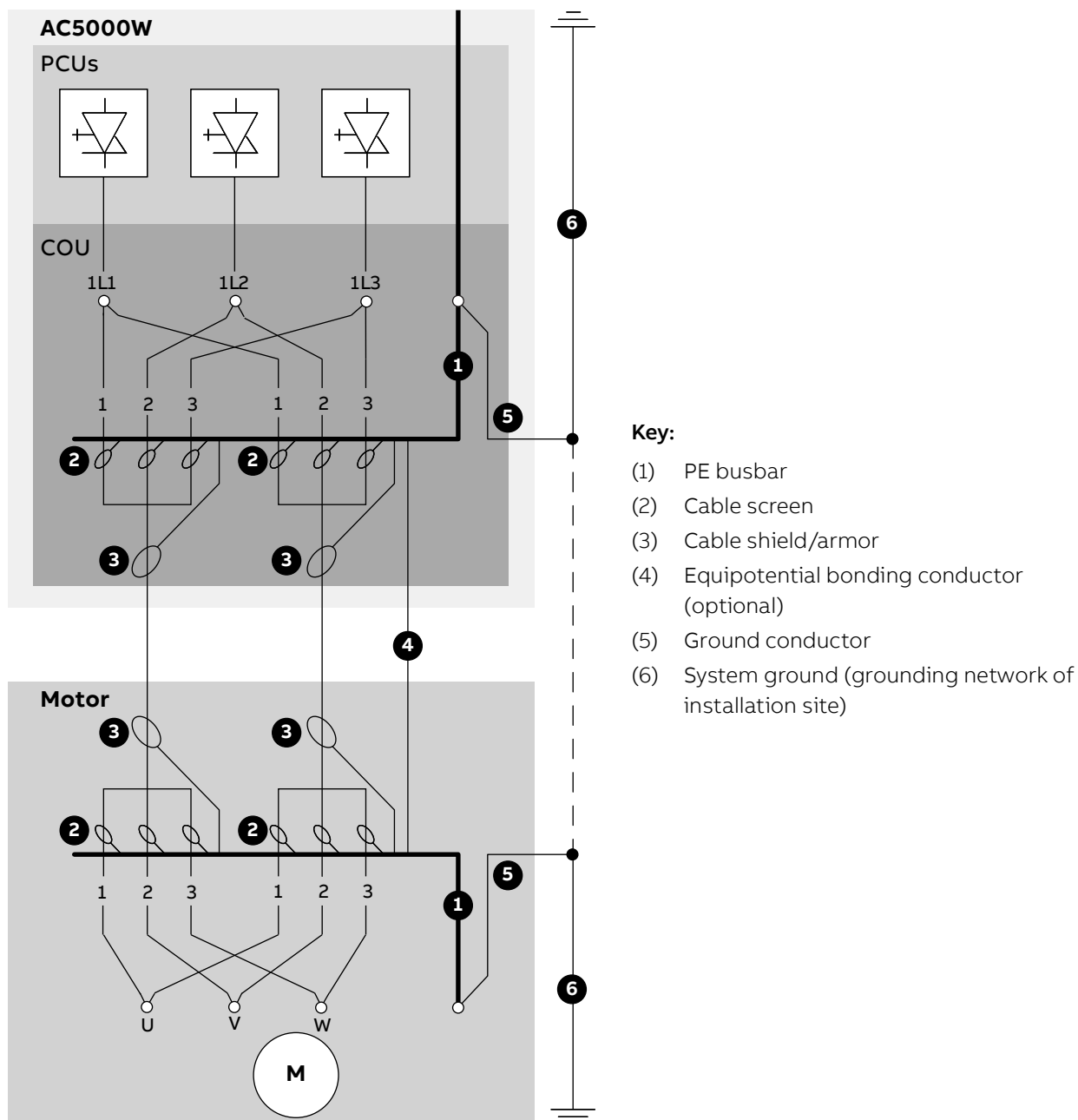


Fig. 53. Grounding the drive and the motor (multi-point bonding)

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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.

Fig. 54 shows the single-point bonding connections to ground a drive and a motor in the COU compartment.

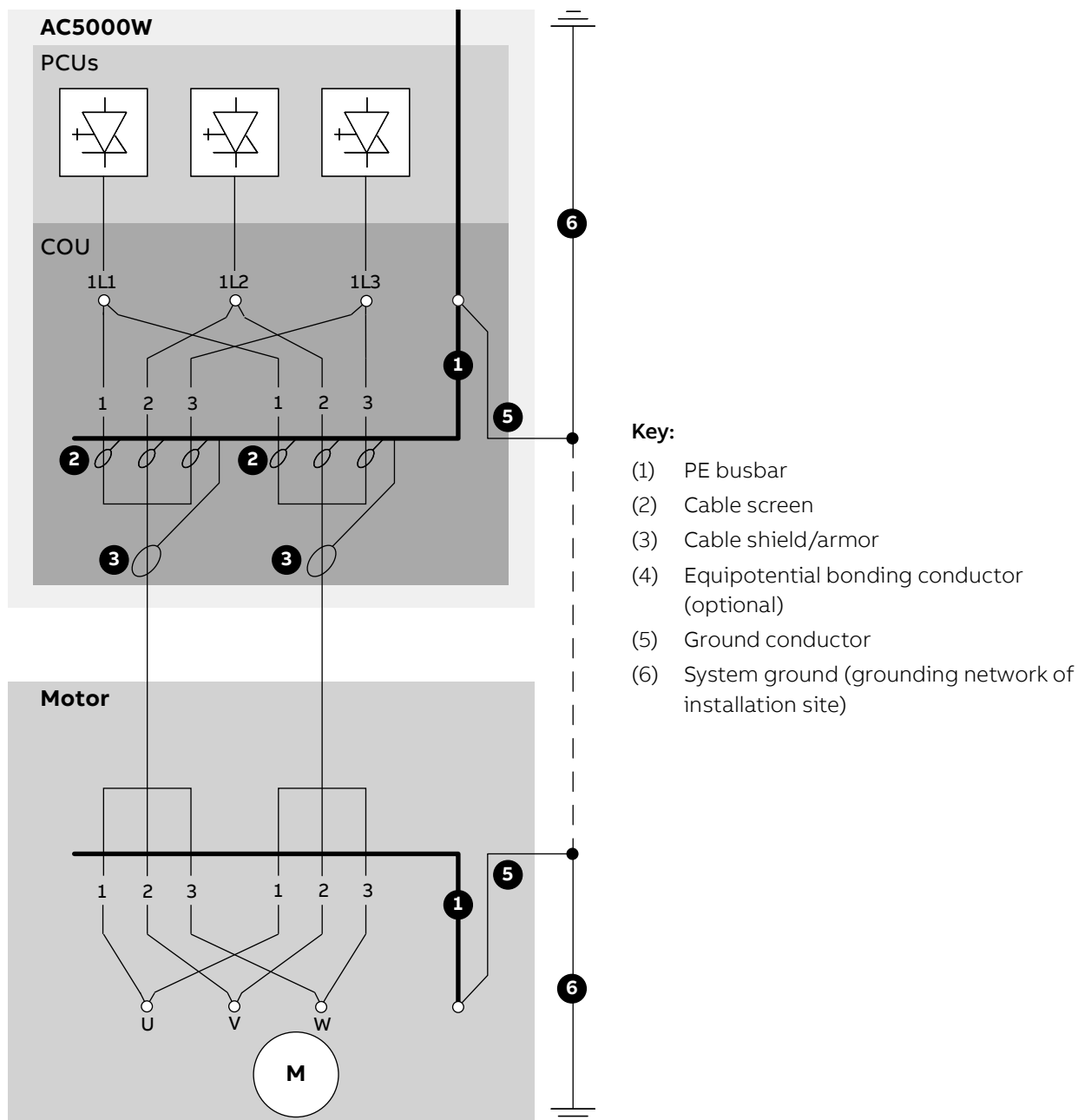
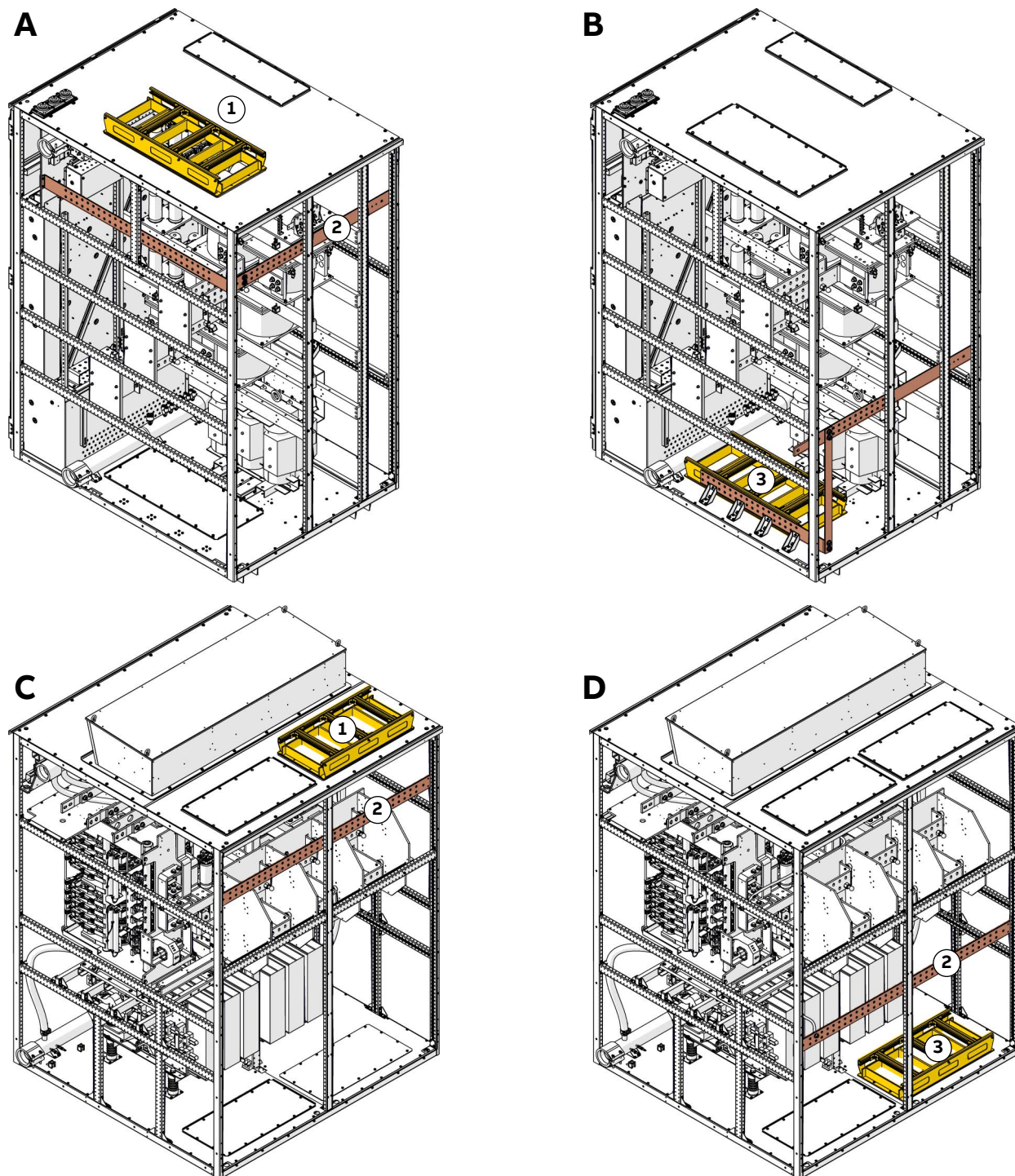


Fig. 54. Grounding the drive and the motor (single-point bonding)

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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 (Fig. 55). The connection must be in compliance with local regulations. For project-specific illustrations, see “Appendix D – Wiring diagrams”.



Key:

(1) Top entry

(2) PE ground busbar

(3) Bottom entry

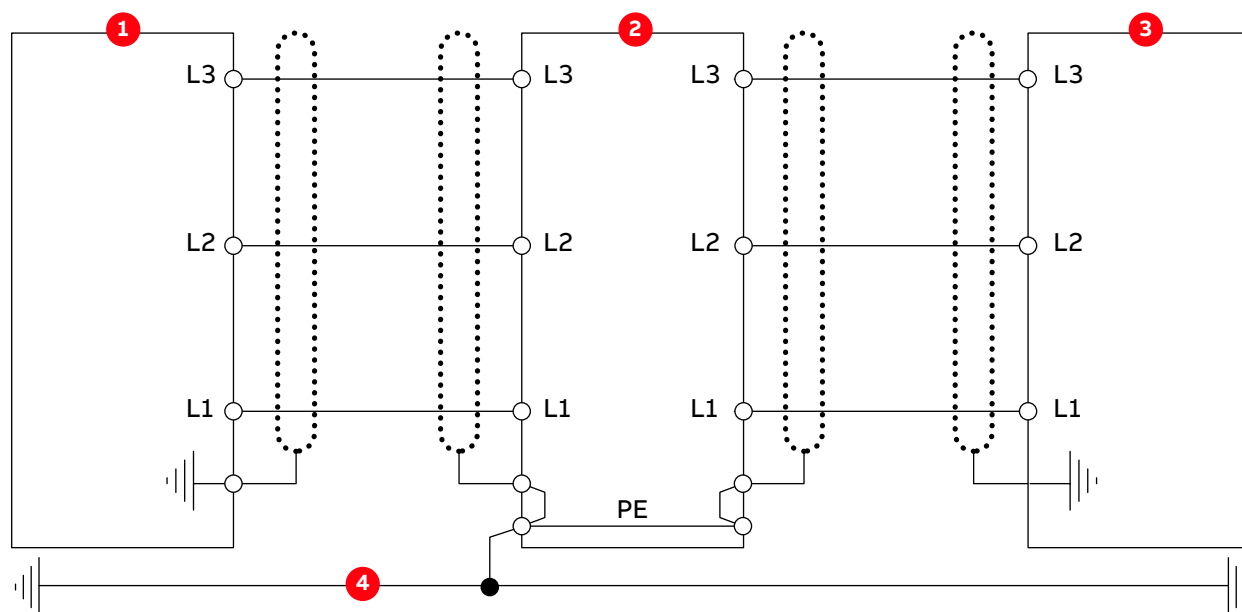
Fig. 55. PE ground busbars in a (A and B) COU, (C) PCU FS1, and (D) PCU FS 2

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6.4.6. EXU cabinet ground connections

It is important that the EXU is properly grounded to maintain safety and to ensure smooth functioning of the equipment.

- Connect the ground to the ground system of the installation site and to the ground busbar inside the EXU.
- Cross-section of the ground cable and the ground connection must be in compliance with local regulations.
- Ground the outer cable screen at both ends of a cable.
- 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

Fig. 56. Grounding the EXU

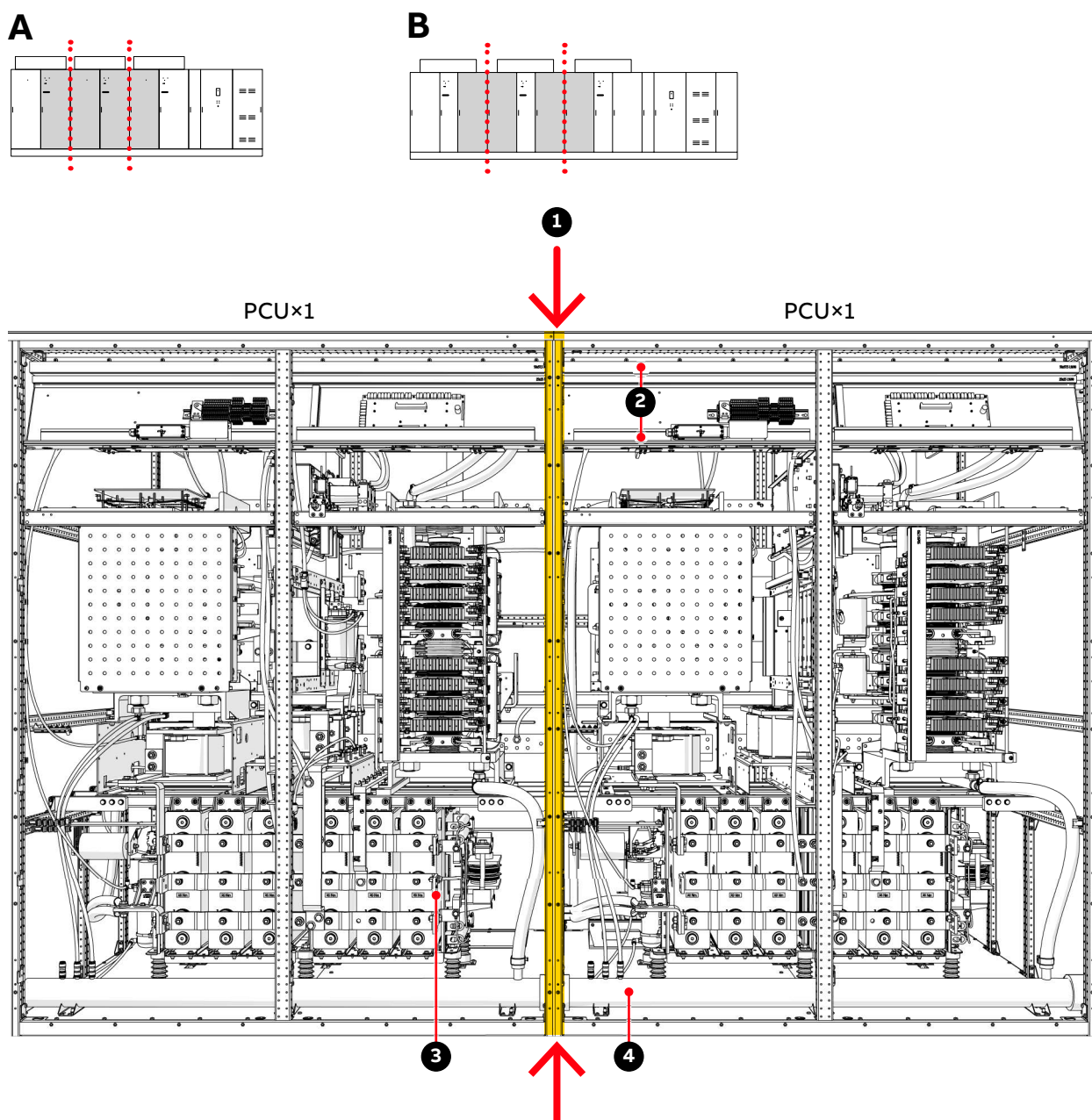
6.5. Internal wiring

For information on individual connections, see the converter hardware diagram in “Appendix D – Wiring diagrams”. 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, Fig. 57), except for the charging cable, which is at the base of the cabinet behind the water pipe (4, Fig. 57).

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**Key:**

(1) Shipping split

(2) Cable ducts on each side of the shipping split

(3) Connection point

(4) Charging cable behind water pipe (not illustrated)

Explanation

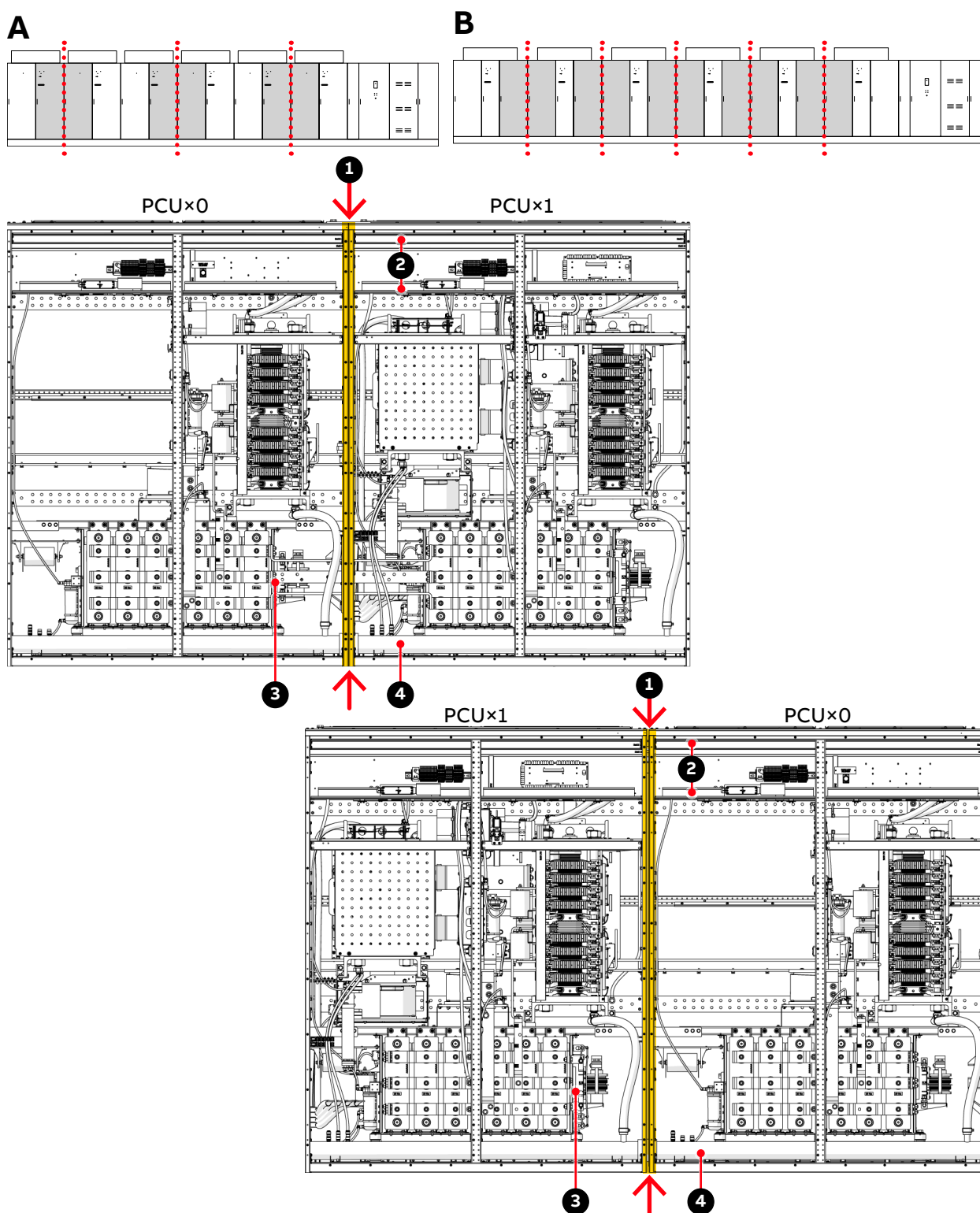
PCUx1 – PCUx1

For auxiliary power supply cables, optical fibers, and signal cables

For charging cable

Laid on the brackets and connected to the busbar

Fig. 57. Wiring across shipping splits, (A) FS 1 and (B) FS 2

**Key:**

(1) Shipping split

(2) Cable ducts on each side of the shipping split

(3) Connection point

(4) Charging cable behind water pipe (not illustrated)

Explanation

PCUx0 – PCUx1 and PCUx1 – PCUxo

For auxiliary power supply cables, optical fibers, and signal cables

For charging cable

Laid on the brackets and connected to the busbar

Fig. 58. Wiring across shipping splits, FS 3 and FS 4

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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 (Fig. 19) 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

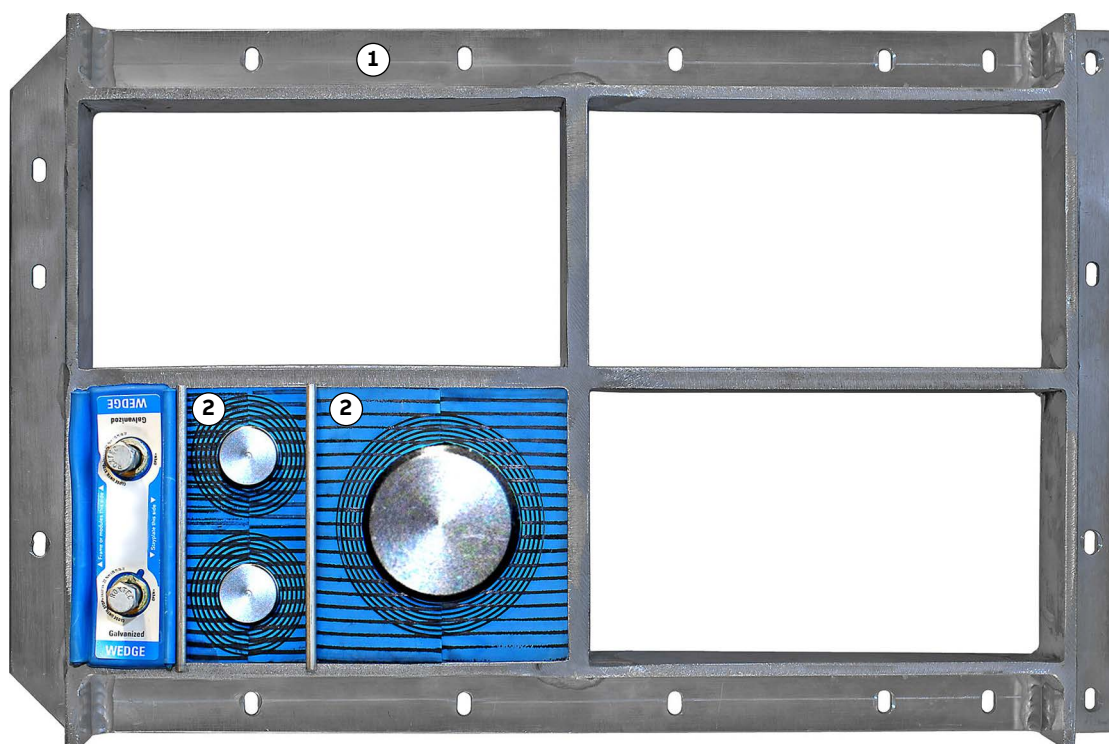
The drive is prepared for top or bottom cable entry with one or a combination of the following cable entries:

- 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”.

6.6.1. Cable entry with sealing modules, type 1

Usage	Include 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, Fig. 59) 	<ul style="list-style-type: none"> – Sealing modules (2, Fig. 59) – Accessories, tools



Key:

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

Fig. 59. Cable entry with sealing modules – type 1

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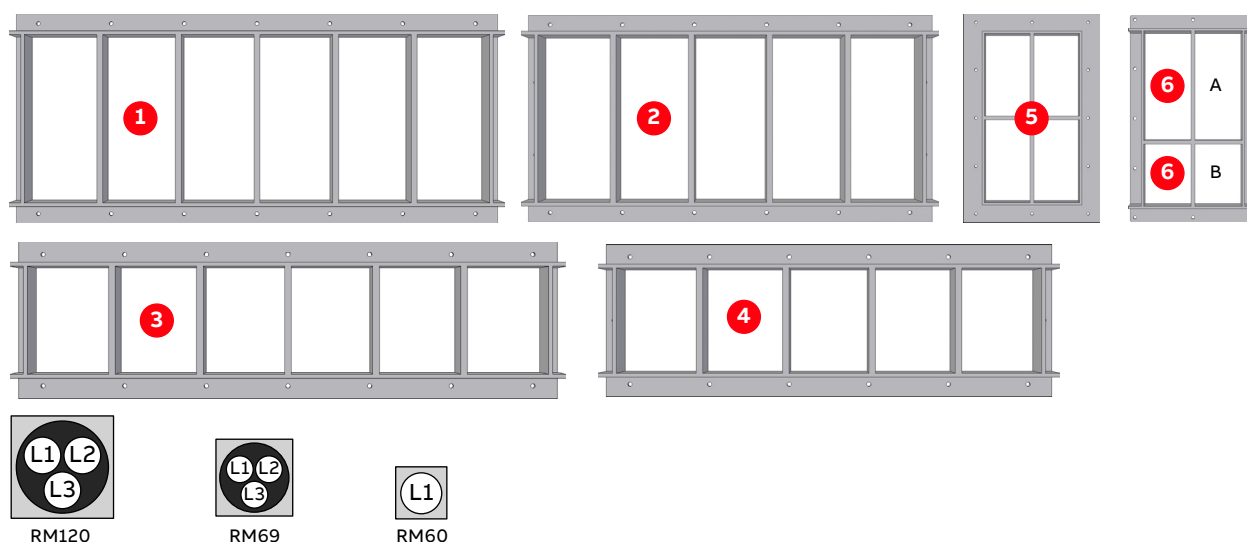


Fig. 60. Cable entry frame sizes (top) for type 1 sealing modules (bottom)

TABLE 7 Type 1 sealing modules and cables per frame opening

Frame	1	1	2	3	4	5	6A	6B
Location	COU	PCU	PCU	PCU	PCU	EXU	SBU	SBU
Top entry	FS1 to FS6	FS2_6p ¹ FS2_12p ² FS4 FS6	FS1_6p FS1_12p FS3 FS5	–	–	✓	✓	✓
Bottom entry	FS 1 to FS 6	FS2_12p FS4	FS1_12p FS3	FS2_6p FS6	FS1_6p FS5	✓	✓	✓

¹ 6p = 6-pulse

² 12p = 12-pulse

TABLE 8 Maximum number of type 1 sealing modules per frame opening

Frame	1	1	2	3	4	5	6A	6B
RM120	2	2	2	1	1	1	2	1
RM90	–	–	–	–	–	2	2	1
RM60	8	8	8	4	4	6	8	4

TABLE 9 Maximum number of cables per frame opening – 3 core

Frame	1	1	2	3	4	5	6A	6B
Ø 68-99 mm	2	2	2	1	1	1	2	1
Ø 48-71 mm	–	–	–	–	–	2	2	1

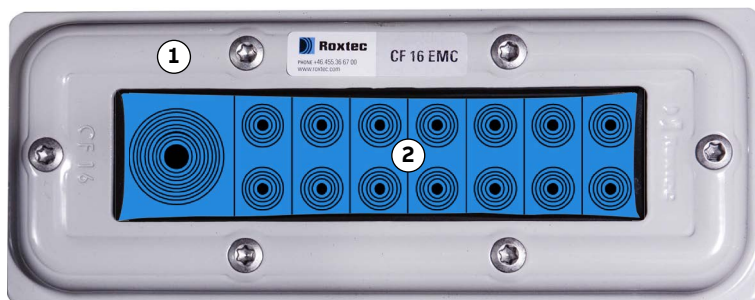
TABLE 10 Maximum number of cables per frame opening – single core

Frame	1	1	2	3	4	5	6A	6B
Ø 28-50 mm	8	8	8	4	4	6	8	4

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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, Fig. 61)	<ul style="list-style-type: none"> – Type 2 sealing modules (2, Fig. 61) – Installation tools – Accessories 	Roxtec AB (www.roxtec.com)



Key:

- (1) EMC cable entry frame
- (2) Type 2 sealing modules

Fig. 61. 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) (Fig. 63) 	<ul style="list-style-type: none"> – Cable glands – Tools – Cable clamps – Accessories



Fig. 62. Cable entry with cable gland

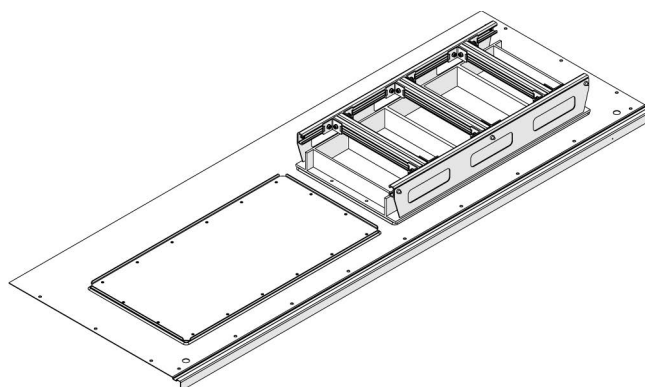
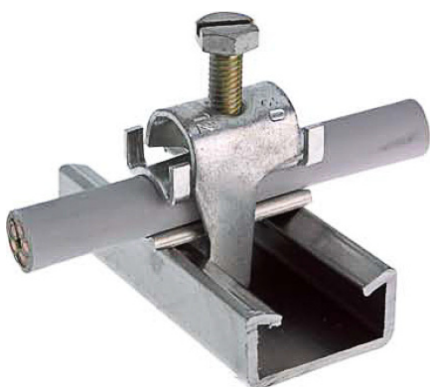


Fig. 63. Cable strain reliefs, C-rails

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6.6.4. Cable entry with EMC plates

Usage	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"> – Galvanized plate with EMC mesh (1, Fig. 64) – Sealing grommets (2, Fig. 64)



Fig. 64. Cable entry with EMC plates

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6.7. Power cables, ground cables, equipotential bonding conductor

See “Appendix A – Additional manuals” 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” 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.

6.7.1.2. Preparing cables for cable entries with cable glands

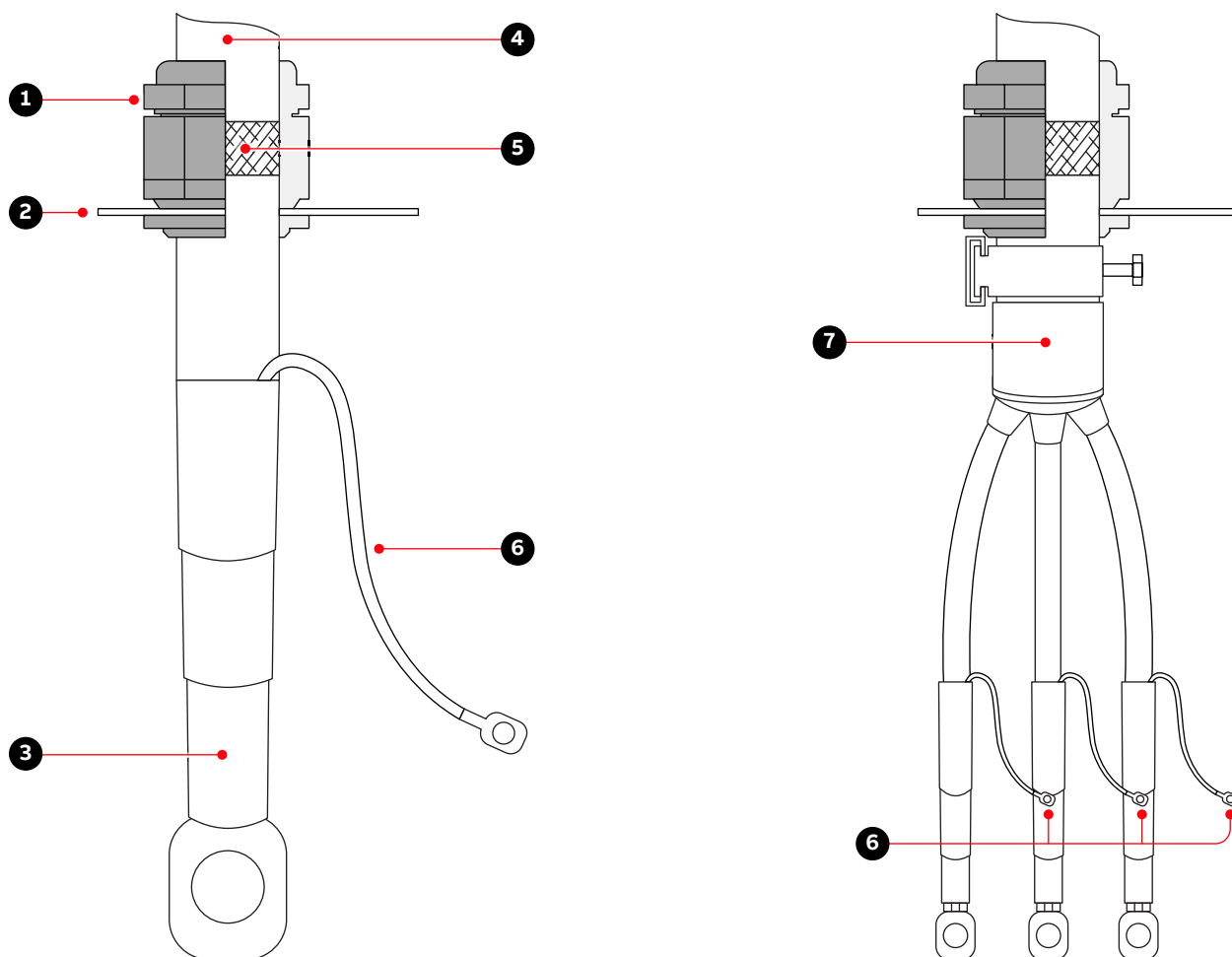
Prepare cables with an outer cable screen or shield for EMC bonding with the metal enclosure of the cabinet as illustrated.

NOTICE

Risk of cable damage! Incorrectly connected pigtails (6, Fig. 65) 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 Section 6.4, “Grounding”, page 86)

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**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

Fig. 65. Preparing power cables for cable glands

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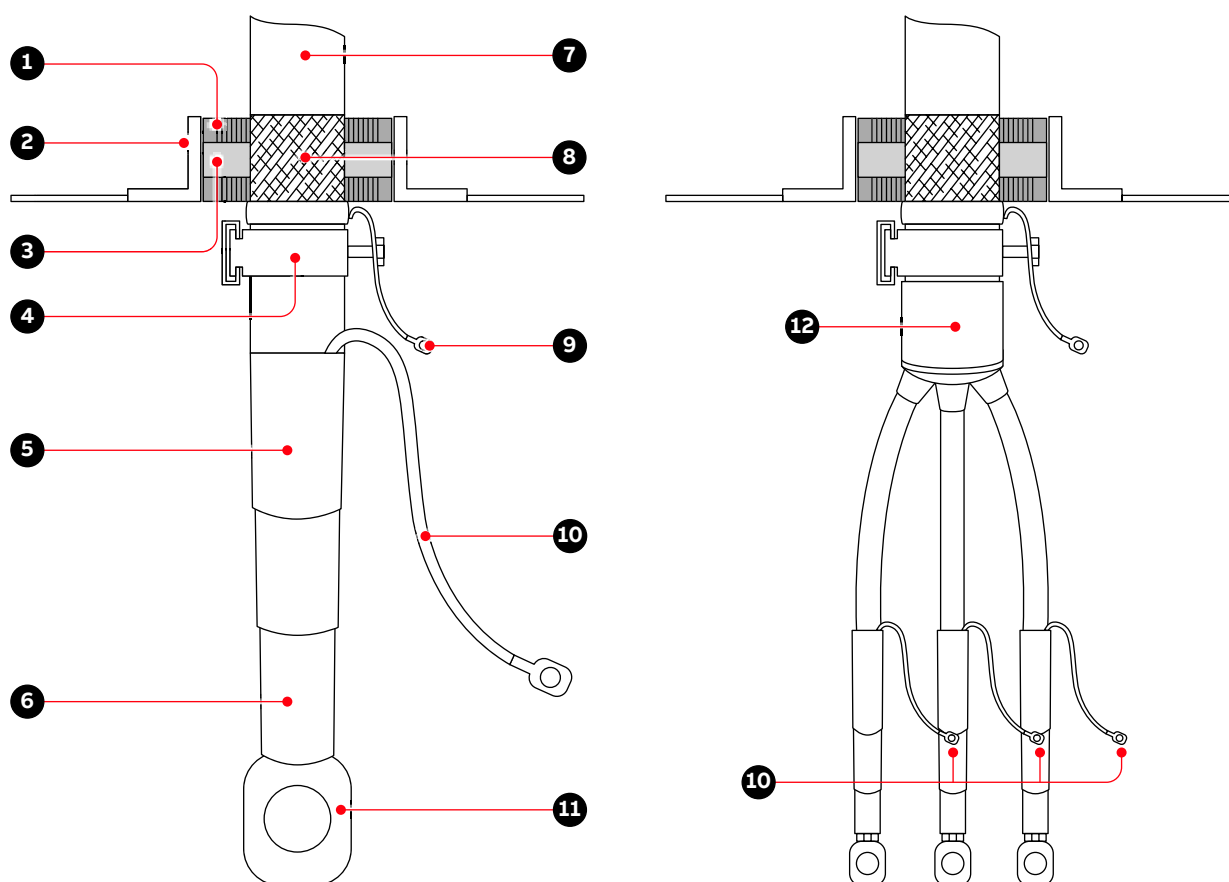
6.7.1.3. Preparing cables for cable entries with sealing modules

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 (10, Fig. 66) 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 Section 6.4, “Grounding”, page 86)



Key:

- | | |
|---|--|
| (1) Sealing module | (9) Shield extension to be connected to PE busbar (not applicable if the cable only has armor) |
| (2) Frame | (10) Cable screen extension to be connected to the PE busbar |
| (3) Conductive foil of sealing module | (11) Cable lug as specified by the cable supplier and suitable for M12 bolt |
| (4) Cable clamp | (12) Sheath seal |
| (5) Shrinkable sheath seal | |
| (6) Heat-shrinkable termination | |
| (7) Outer cable sheath | |
| (8) Cable sheath removed to expose cable shield/armor | |

Fig. 66. Preparing power cables for sealing modules

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6.7.2. Connecting the cables



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.

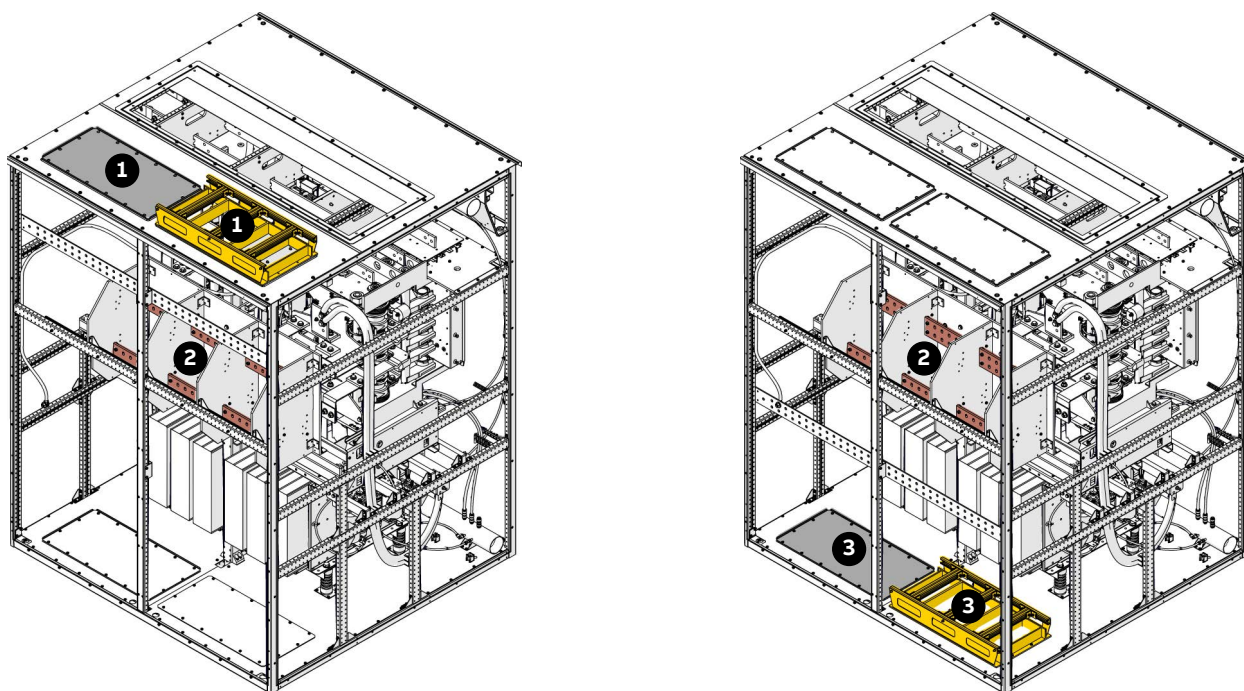
6.7.2.2. Connecting the cables

Connect the cables to their corresponding busbars:

- Transformer cables to the busbars inside the primary PCU (Fig. 67)
- Motor cables to the busbars inside the COU (Fig. 69)
- Ground cable to the PE ground busbar

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6.7.2.2.1. Transformer cables ACS5000W, 36-pulse



Key:

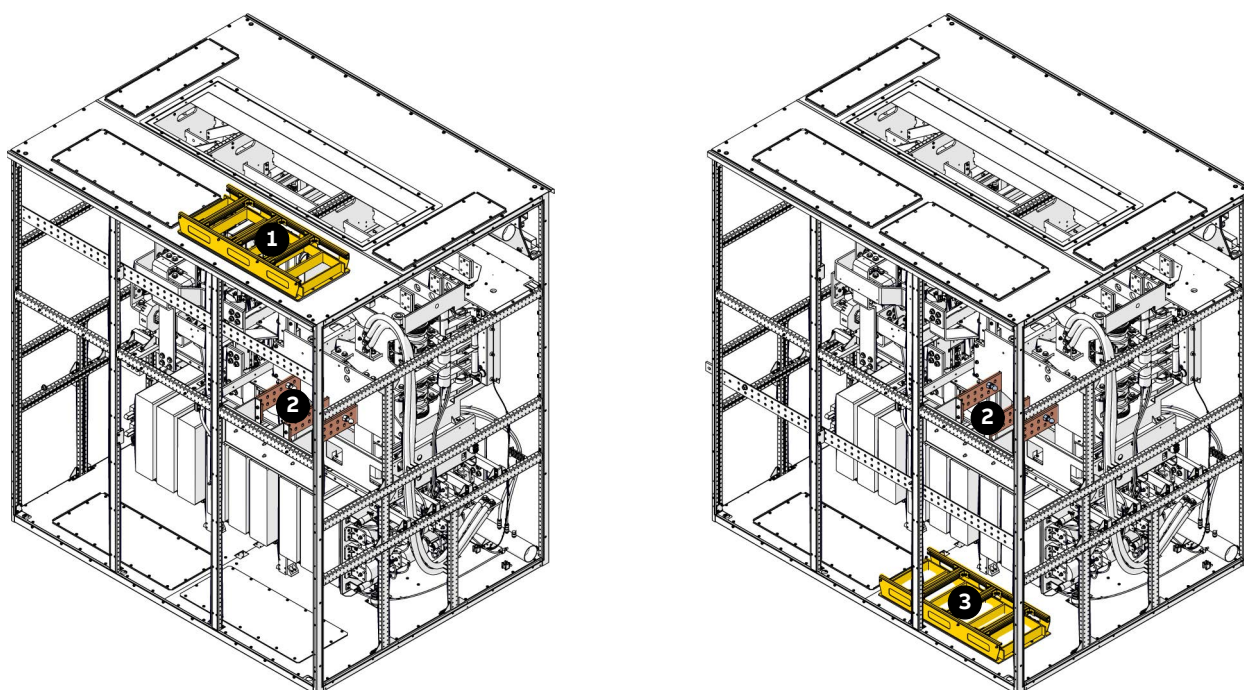
(1) Top cable entry

(3) Bottom cable entry

(2) Busbars for transformer cables

Fig. 67. PCU 12-pulse top and bottom entry (back view)

6.7.2.2.2. Transformer cables ACS5000W, 18-pulse



Key:

(1) Top cable entry

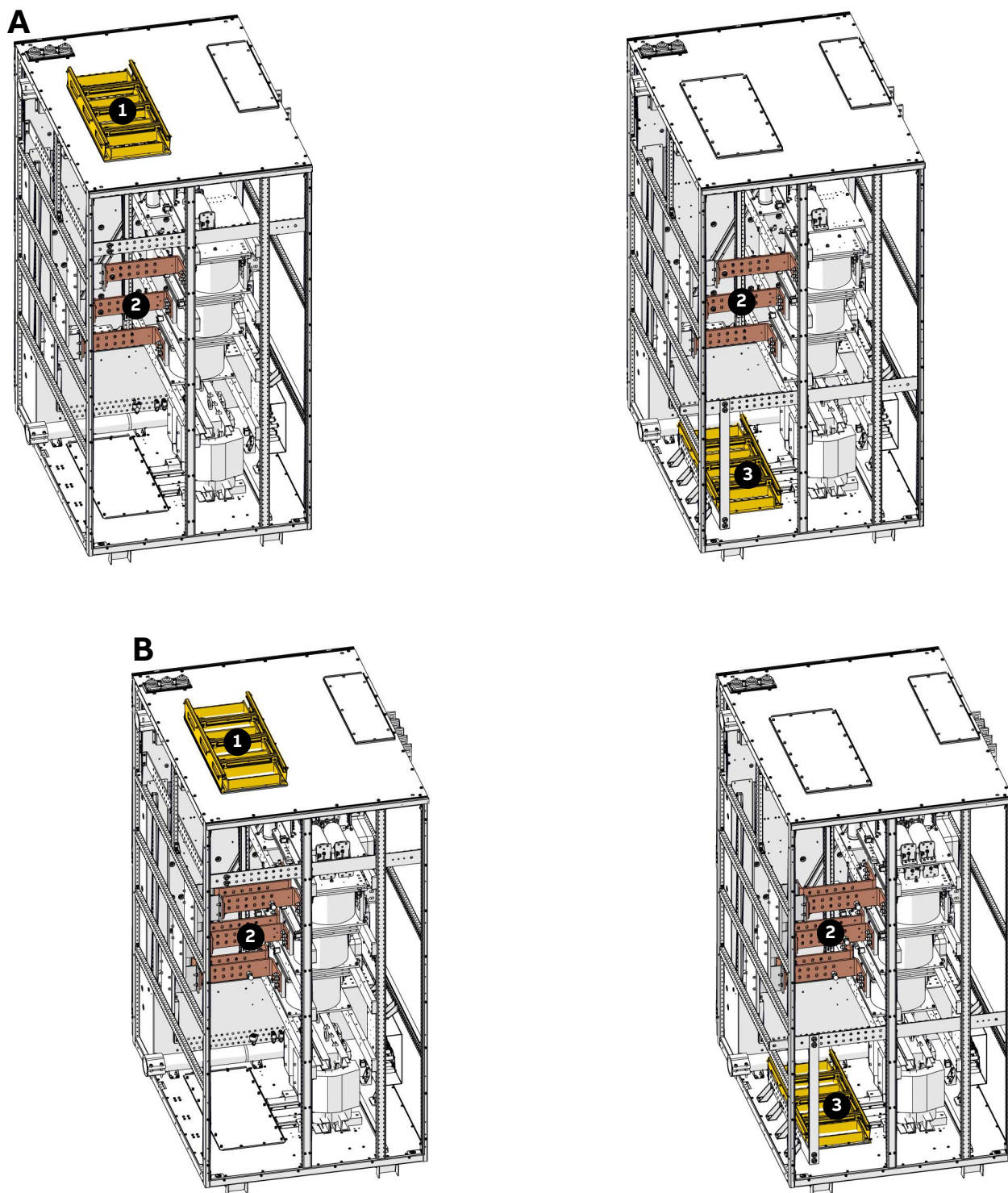
(3) Bottom cable entry

(2) Busbars for transformer cables

Fig. 68. PCU 6-pulse top and bottom entry (back view)

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6.7.2.2.3. Motor cables



Key:

- (1) Top cable entry
- (2) Busbars for motor cables (FS 1 and FS 2)
- (3) Bottom cable entry

Fig. 69. COU cable terminals, top and bottom entry (back view) - (A) FS 1 and FS 2, and (B) FS 3 and FS 4

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6.7.2.3. Bolted connections

6.7.2.3.1. 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.

6.7.2.3.2. Connection type

The following connection type recommended when a cable lug (4, Fig. 70) is connected to a busbar:

- Spring washer (1, Fig. 70) and flat washer (2, Fig. 70) on each side of the busbar (4, Fig. 70). Other washers can be used, provided they maintain the required contact pressure.
- Use cable lugs suitable for M12 bolts.

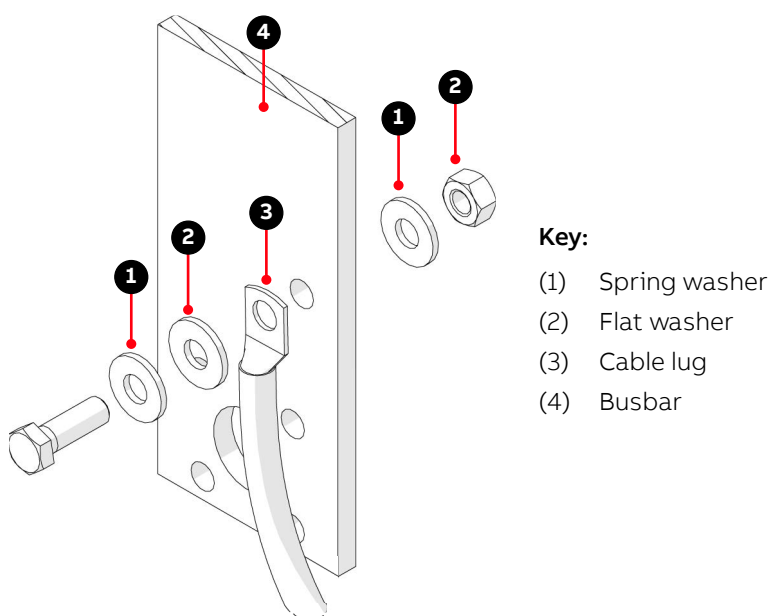


Fig. 70. Bolted busbar connection

6.7.2.3.3. Lubrication

- If stainless steel bolts and nuts are used, lubricate the thread and head contact surface of the bolt using recommended pastes, eg, Molykote D paste.
- If a coated nut (eg, with bonded molybdenum-disulfide [MoS₂] coating) is used, the connection does not have to be lubricated.

6.7.2.3.4. 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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6.8. Auxiliary power cables and control cables

See “Appendix C – Mechanical drawings” for information on:

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

See “Appendix D – Wiring diagrams” 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

- The auxiliary power supply cables enter the WCU compartment.
- The control cables enter the COU compartment.

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

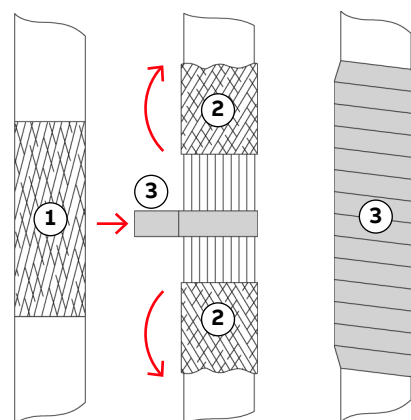
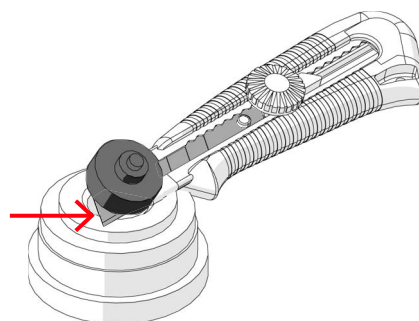
1. Remove the grommets from the entry plate.
2. To ensure proper sealing, cut along the marking that corresponds to the cable diameter (arrow).
3. Slide the grommet onto the cable and ensure that the grommet fits tightly to prevent water from entering the cabinet.

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).

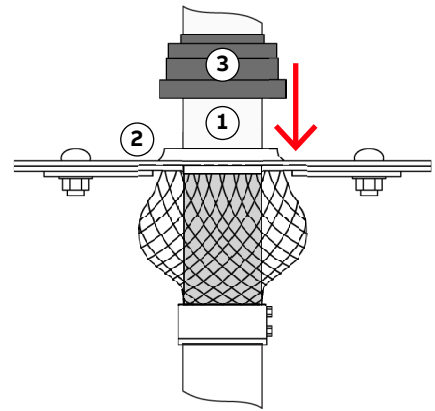
If the outer cable screen is non-conductive:

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).



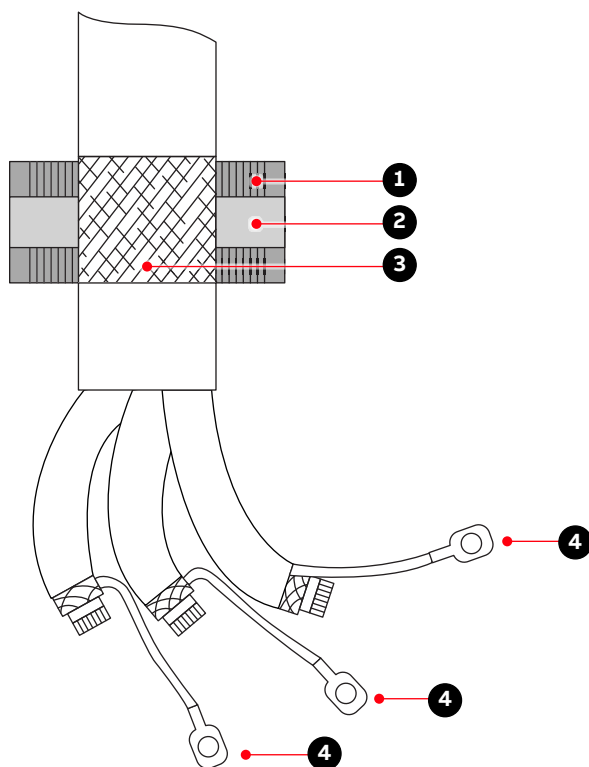
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9. Pull the cable (1) through the entry plate (2).
10. To prevent water from entering the cabinet, fit the grommet (3) tightly and seal any gaps with silicone.
11. If you removed the entry plate, reinstall the plate, and fasten it properly.



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



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

Fig. 71. Preparing control cables for sealing modules

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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 (Fig. 72).

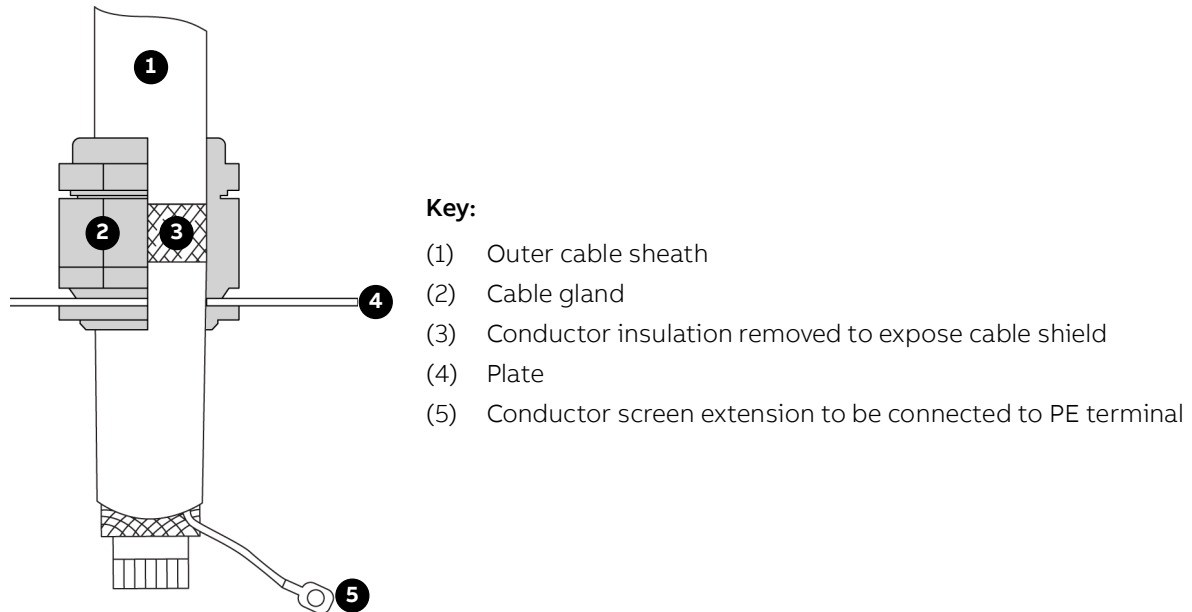


Fig. 72. Preparing control cables for cable glands

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6.8.2. Routing and connecting low voltage cables

For the project-specific cable connections, see “Appendix D – Wiring diagrams”. For a description of the different cable entry types, see Section 6.6, “Cable entries”, page 95.

6.8.2.1. WCU - auxiliary power and space heater cable

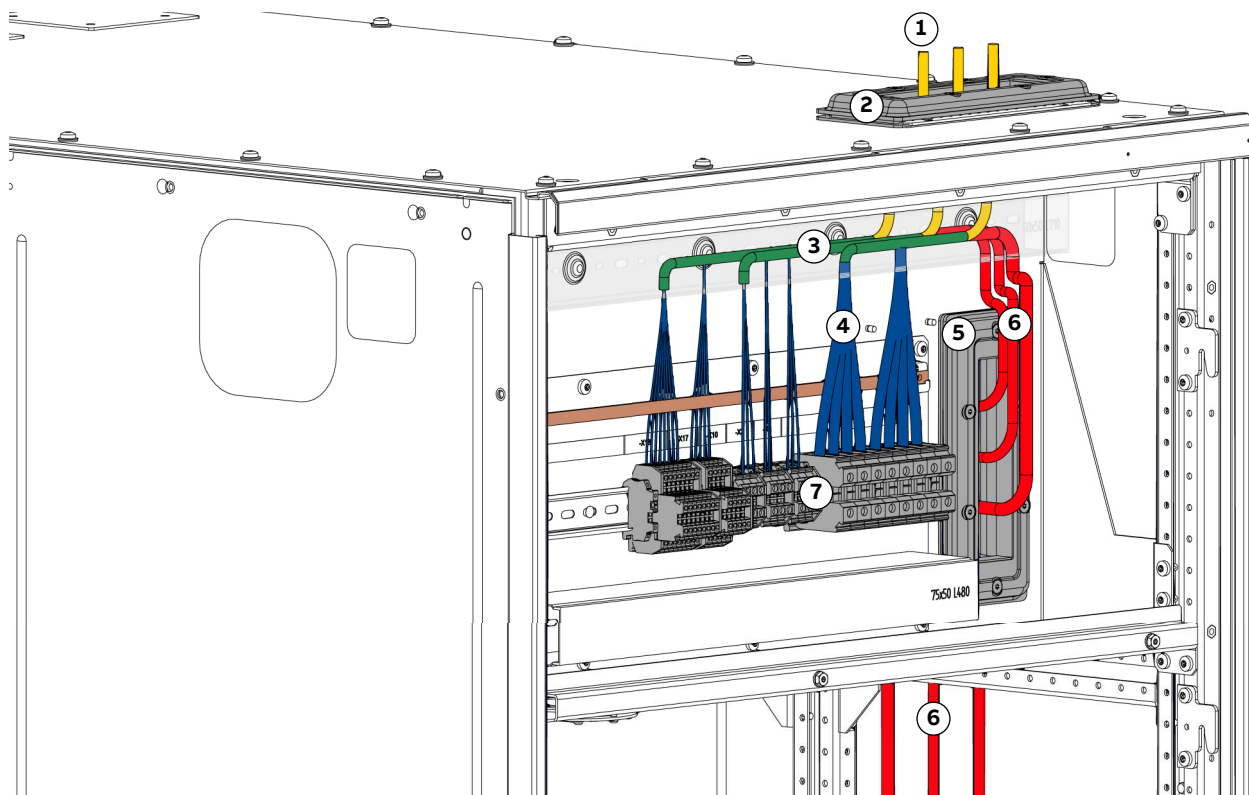
For an overview of the components in a WCU cabinet, see Section 3.5, “Water cooling unit (WCU)”, page 47.

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”.

The cables are routed into the WCU cabinet either through a top cable entry or bottom cable entry. Fig. 73 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 | |

Fig. 73. Cable routing options to WCU800 control compartment

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6.8.2.1.1. Top and bottom cable entries

Referring to Fig. 74:

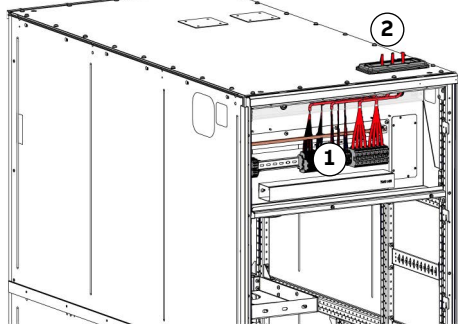
1. Route the cables to the terminal compartment (1).

- Top cable entry: via (2) or (4)
- Bottom cable entry: via (3) or (6)

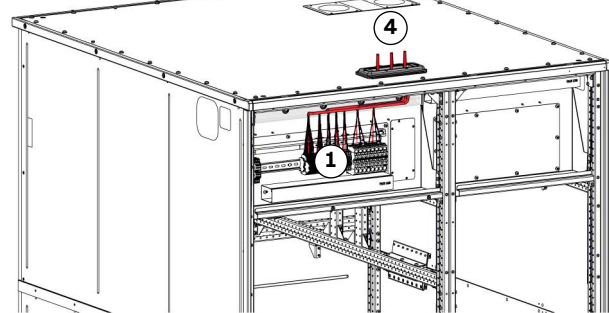
NOTE – Use cable ties to attach the cables to the cable ladder (7) or cable duct (5).

2. Connect the cables to the relevant terminals (2) according to the project-specific wiring diagram.

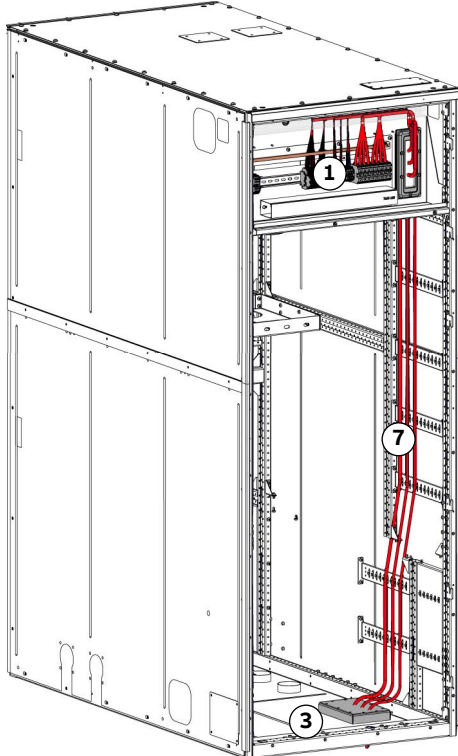
Top WCU800



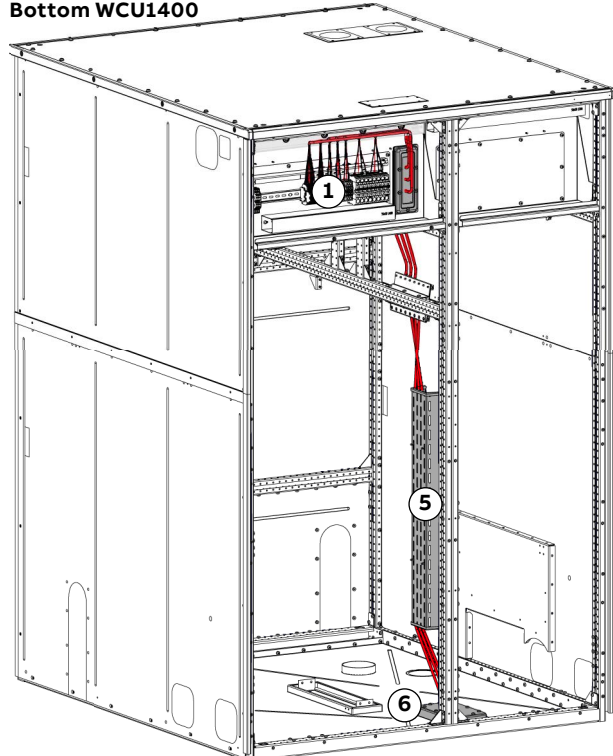
Top WCU1400



Bottom WCU800



Bottom WCU1400



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 | |

Fig. 74. Top and bottom cable routing in (A and B) WCU800 and (C and D) WCU1400 cabinets

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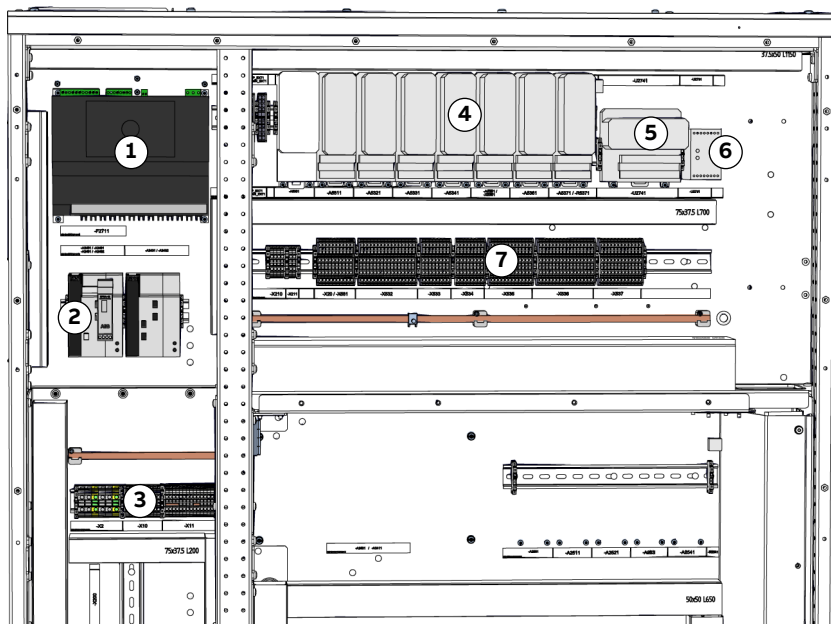
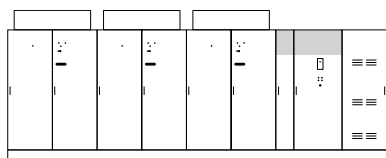
6.8.2.2. Connecting cables in COU

6.8.2.2.1. Shielded cables

- If you use twisted pair cables, leave the unshielded cable ends twisted until they reach the terminals.
- Leave unshielded conductor ends as short as possible.
- Use a shield grounding clamp (Fig. 75) to fasten the overall shield and the individual shields to the ground busbar (8, Fig. 75).



Fig. 75. Shield grounding clamp

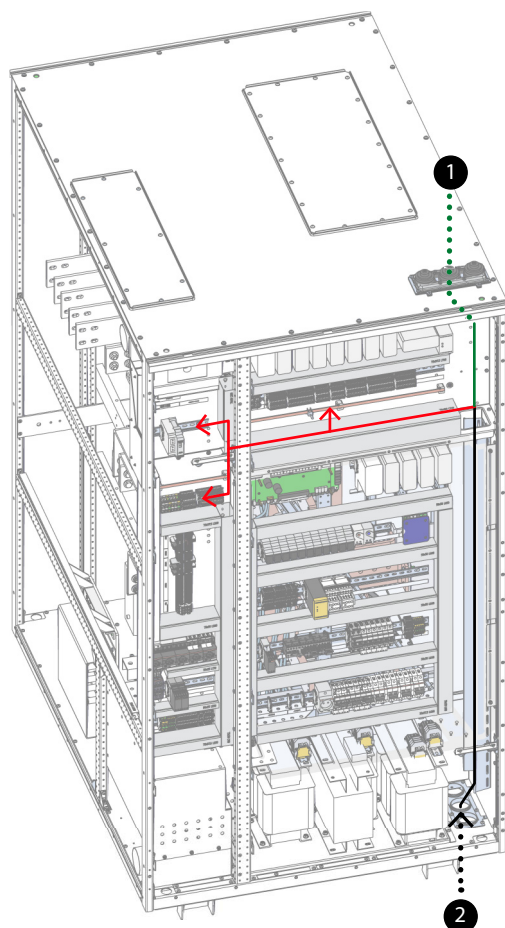


Key:

- (1) Arc Guard™
- (2) Remote condition monitoring NETA-21 and fieldbus interface
- (3) Customer terminals
- (4) S800 I/O process system (customer- specific configuration)
- (5) Grey encoder (optional)
- (6) NTAC-02 pulse encoder (optional)
- (7) Customer terminals

Fig. 76. COU customer interface section

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**Key:**

- (1) Top cable entry
- (2) Bottom cable entry

Fig. 77. Cable routing in COU cabinet**6.8.2.2.2. Control power supply**

- Connect the cable for the control power to terminal X2 (11, Fig. 76).

6.8.2.2.3. Control signals

- Connect the cables to the following terminals:
 - X10, X11 (10, Fig. 76) Main circuit breaker signals and emergency off signals
 - X20 to X27 (7, Fig. 76) Control signals of monitored equipment

6.8.2.2.4. Fieldbus interface

- Connect the cable directly to the fieldbus adapter.

6.8.2.2.5. Encoder interface

1. Connect the cable directly to the encoder adapter.
2. Connect the overall shield and the individual shields of the encoder cable to the copper busbar.

NOTICE DO NOT connect the shields directly to the encoder adapter.

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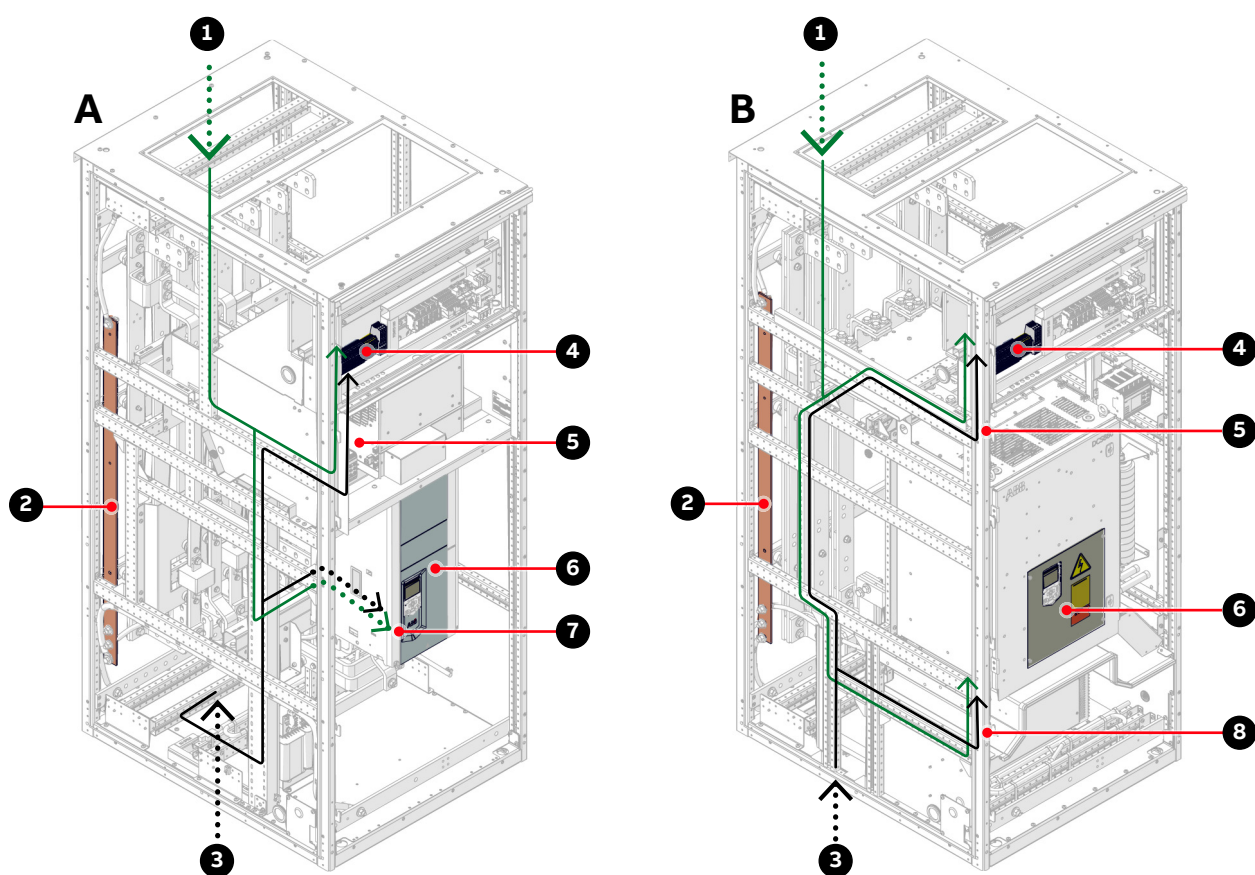
6.8.3. Routing cables in a stand-alone EXU cabinet

6.8.3.1. Auxiliary power and control cables

1. Enter the cables through a free hole of the EMC plate.
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 Section 6.8.1.3, “Preparing cables for EMC plates - only top cable entry”, page 106
 - Cable entries with cable glands: see Section 6.8.1.5, “Preparing cables for cable entries with cable glands”, page 108.

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.



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 |

Fig. 78. Cable routing examples in an (A) EXU cabinet with an ED5V, EB5R, EB5S, EB7P or EB7Q type DCS880/DCT880 converter and in an (B) EXU cabinet with an ED7Y type DCS880 converter

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”.

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6.8.3.2. 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.

6.8.3.3. 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.



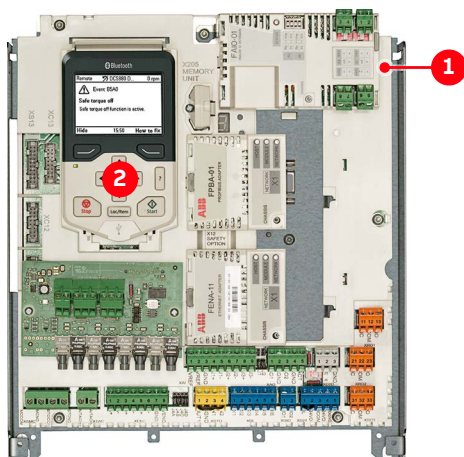
Key:

- (1) DCS880/DCT880 control panel
- (2) Removable front cover
- (3) Indentation

Fig. 79. 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.
6. Connect the two optical fibers to the receptacles of slot 1 according to the terminal numbers printed on the marker sleeves.

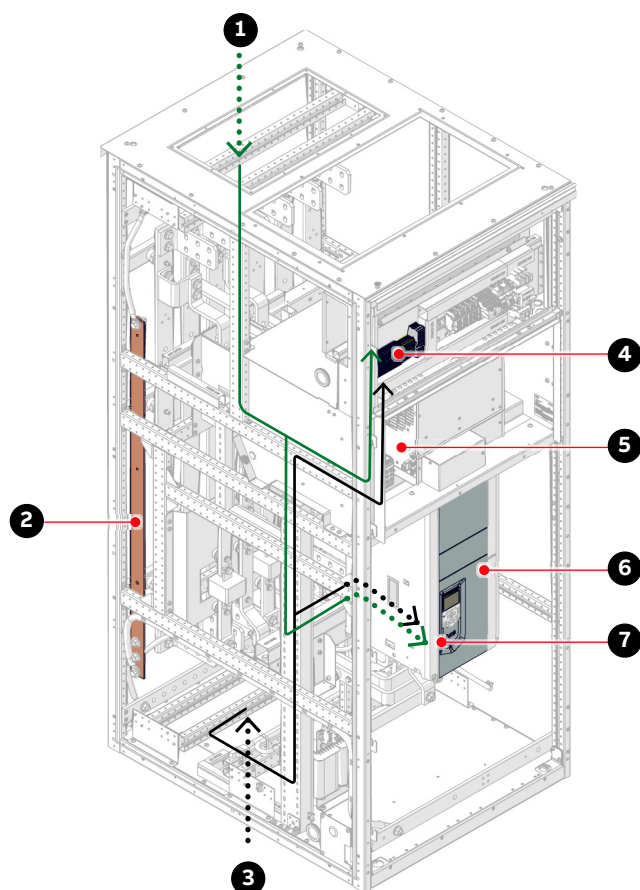
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**Key:**

- (1) Slot 1 (FDCO-01 module)
- (2) Control panel

Fig. 80. 1 Control unit SDCS-CON-H01

7. Route the cables through the designated cable ducts as illustrated in Fig. 81.

**Key:**

- (1) Cable enters through roof
- (2) PE ground busbar
- (3) Cable enters through the floor
- (4) Terminal strip for auxiliary power and control cables
- (5) Auxiliary supply cable
- (6) Terminal for optical fibers behind cover
- (7) Optical fibers to DCS880/DCT880 converter

Fig. 81. Cable routing example in an EXU cabinet with an ED5V, EB5R, EB5S, EB7P and EB7Q type DCS880/DCT880 converter

8. Reattach the front cover of the DCS880/DCT880.

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

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

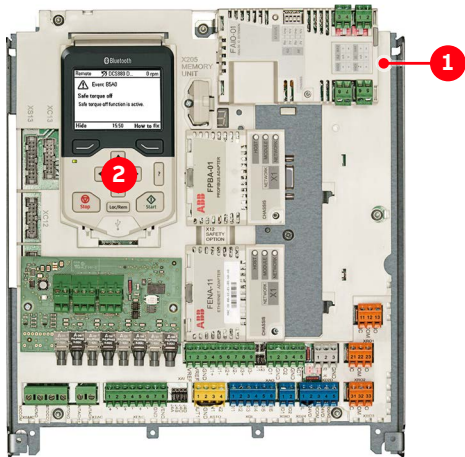


Key:

- (1) Control panel
- (2) Removable cover

Fig. 82. 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.



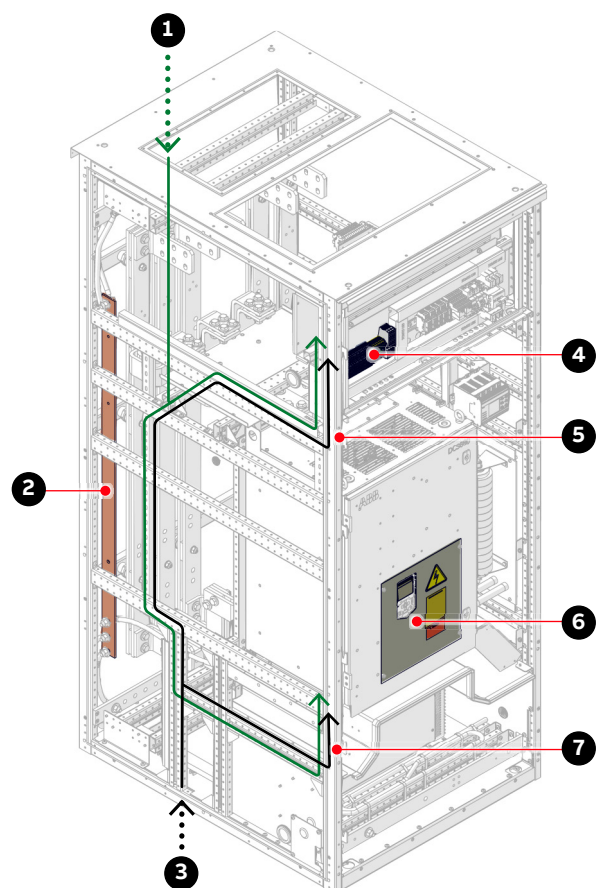
Key:

- (1) Slot 1 (FDCO-01 module)
- (2) Control panel

Fig. 83. 1 Control unit SDCS-CON-H01

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3. Route the cables through the designated cable ducts as illustrated in Fig. 84.



Key:

- (1) Cable enters through roof
- (2) PE ground busbar
- (3) Cable enters through the floor
- (4) Terminal strip for auxiliary power and control cables
- (5) Auxiliary supply cable
- (6) Terminal for optical fibers behind cover
- (7) Optical fibers to DCS880/DCT880 converter

Fig. 84. Cable routing example in an EXU cabinet with an ED7Y type DCS880/DCT880 converter

4. Reattach the DCS880/DCT880 cover.

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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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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		<input checked="" type="checkbox"/>
6) Drive is aligned according to drive layout drawing (if delivered in several transport units) and installed according to the instructions in this user manual (3BHS799208 E01).		<input type="checkbox"/>
7) Silicon sealant is applied across roof plate gaps.		<input type="checkbox"/>
8) Roof joints are installed.		<input type="checkbox"/>
9) Pipe joints are orientated and torqued correctly.		<input type="checkbox"/>
10) Roof attachments are installed (if applicable).		<input type="checkbox"/>
11) Busbars are installed and torqued correctly.		<input type="checkbox"/>
12) Raw water piping is completed and pipes are flanged to the drive (if applicable).		<input type="checkbox"/>
13) Raw water supply is ready.		<input type="checkbox"/>
14) Visual inspection:		<input type="checkbox"/>
<ul style="list-style-type: none"> • 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		<input checked="" type="checkbox"/>
1) Types and cross sections of control cables suitable for the signal type and signal level.		<input type="checkbox"/>
2) Types and cross sections of power cables selected according to the ABB power cable specification.		<input type="checkbox"/>
3) 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).		<input type="checkbox"/>
4) Cable entries prepared according to the instructions in the user manual (3BHS799208 E01).		<input type="checkbox"/>
5) Control cable screens and conductors are connected as instructed in the user manual, labeled appropriately, and the customer side connections are completed.		<input type="checkbox"/>
6) Heating cables (if supplied) connected		<input type="checkbox"/>
7) Wiring across shipping splits is completed according to the instructions in the user manual (3BHS799208 E01).		<input type="checkbox"/>
8) Ground cable of the drive is securely connected at both ends.		<input type="checkbox"/>
9) Cable armor and screens of power supply cables are connected to PE ground busbar.		<input type="checkbox"/>
10) 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).		<input type="checkbox"/>

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7.6.3. Door interlocking checklist ☒

- 1) The release dial of the safety switches in the locked position. ☐

7.6.4. Main circuit breaker (MCB) checklist ☒

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

7.6.5. Input transformer checklist ☒

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

7.6.6. Motor checklist ☒

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

7.6.7. Insulation tests checklist ☒

- 1) 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. ☐
- 2) 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.

7.6.8. Power checklist	<input checked="" type="checkbox"/>
-------------------------------	-------------------------------------

- | | |
|---|--------------------------|
| 1) Medium voltage available for startup of drive. | <input type="checkbox"/> |
| 2) Low voltage is available for startup of drive. | <input type="checkbox"/> |

7.6.9. Miscellaneous checklist	<input checked="" type="checkbox"/>
---------------------------------------	-------------------------------------

- | | |
|---|--------------------------|
| 1) Sufficient number and correct type of spare parts available | <input type="checkbox"/> |
| 2) Sufficient quantity of deionized water according is available. (see “Appendix C – Mechanical drawings”). | <input type="checkbox"/> |
| 3) Air conditioning of drive room ready for load run of drive | <input type="checkbox"/> |
| 4) Optional equipment (eg, chiller) ready | <input type="checkbox"/> |

8. Operation

8.1. Operating conditions

The operating conditions for the drive are according to IEC 60721-3-3.

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

8.2. Safety



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

8.3. Overview

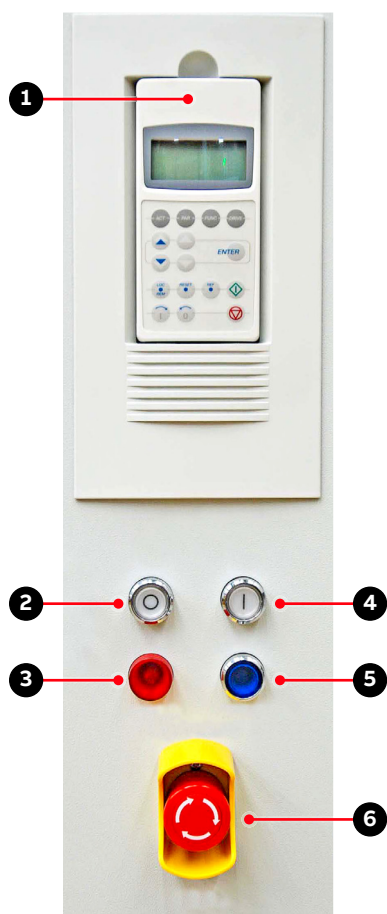
This chapter outlines the local operation of the drive.

Control of the drive via a PLC or higher-level control system is not described in this chapter. If the drive is controlled from remote, see the applicable manuals for information.

The status messages and parameter settings used in this chapter are typical examples to illustrate the related instructions and display functions and may therefore differ from the actual status messages and parameter settings in the drive.

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8.4. Local operator panel



The operator panel on the control compartment enables the operator to control the drive without restrictions, provided that all requirements for normal operation are met. The functions of the local operator panel include:

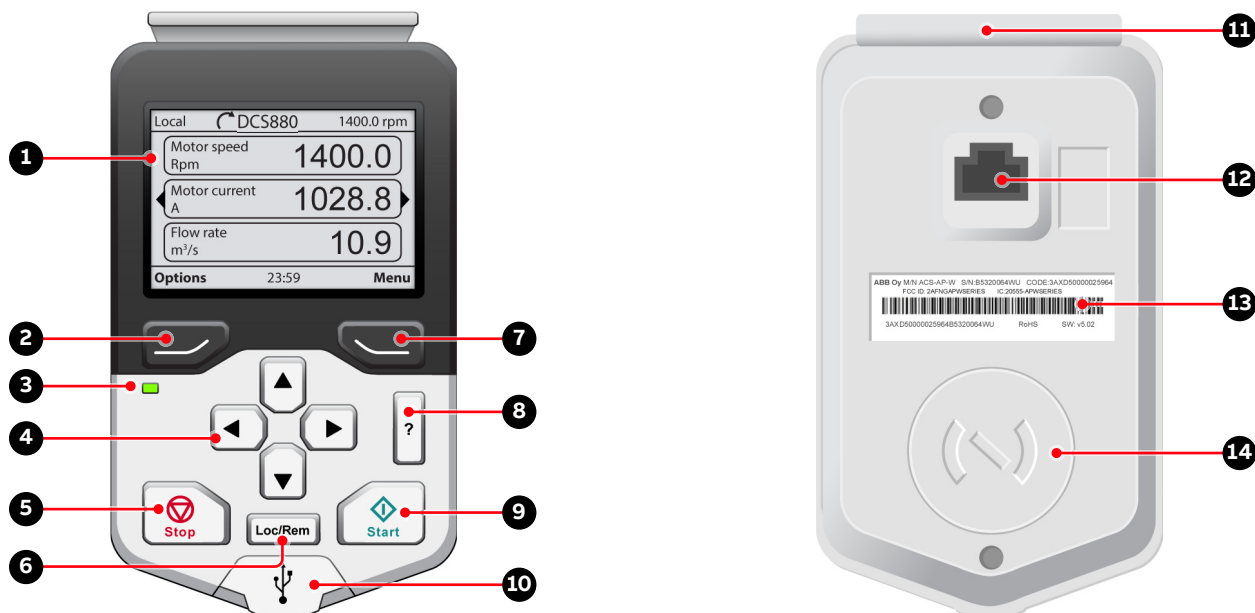
- Connecting and disconnecting the main power supply
- Setting the reference value
- Starting and stopping the drive system
- Displaying: Actual values, status messages and alarm and fault messages
- Viewing and setting parameters
- Resetting alarm and fault messages
- Activating the emergency-off
- Testing lights and illuminated push buttons

Fig. 85. Local operator panel

Key:	Explanation
(1) CDP control panel	<ul style="list-style-type: none"> – Starts / stops drive and motor – Displays status messages – Displays alarm and fault messages of the drive and monitored foreign equipment – Resets alarm and fault messages – For more information, see Chapter 9, “CDP control panel”, page 138.
(2) Main power supply off	Illuminated push button opens the main circuit breaker
(3) Main power supply on	Illuminated push button charges the DC link and closes the main circuit breaker
(4) Alarm fault lamp	<ul style="list-style-type: none"> – Flashing light: alarm – Permanent light: fault
(5) Emergency-off reset push button	<ul style="list-style-type: none"> – Resets the emergency-off relay in the drive control system – Flashes when the auxiliary voltage is switched on, or when an emergency-off switch is pressed
(6) Emergency-off latching push button	<ul style="list-style-type: none"> – Prevents starting when pressed at standstill of the drive – Main circuit breaker opens and DC link discharges when pressed during operation of the drive

8.5. EXU control panel

The EXU assistant control panel (ACP) 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 instructions on how to use the ACP, see the “ACX-AP-x Assistant control panels user manual”, 3AUA0000085685.



Key:

- | | |
|--------------------|----------------------|
| (1) Display | (8) Help |
| (2) Left soft key | (9) Start |
| (3) Status LED | (10) USB connector |
| (4) Arrow key | (11) Clip |
| (5) Stop | (12) RJ-45 connector |
| (6) Location key | (13) Type code label |
| (7) Right soft key | (14) Battery cover |

Fig. 86. EXU control panel front and back

8.5.1. 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 – After you set this parameter, you can only control the EXU remotely. When the control panel is controlled remotely, **REM** is in the top left corner of the display.

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 enable or switch to local control during drive operation
- Only use the control panel to rectify an alarm or a fault condition

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8.5.1.1. Display values

The actual values shown on the display can be freely selected. The following default values are shown on the display when the panel is in local control mode:

- Motor current in percent (%)
- Actual armature voltage in V
- Actual converter current in A (rectified AC current value)

NOTE – In remote control mode, the **START** and **STOP** keys do not work.

8.5.2. Resetting alarm and fault messages

- **Alarm messages:** cannot be reset by pressing the reset soft key. The alarm resets automatically as soon as the reason causing the alarm has been resolved.
- **Fault messages:** must be reset manually after the reason causing the fault has been resolved. The message on the display can be reset either by pressing the reset soft key on the EXU control panel, or by pressing the reset button on the control panel of the drive.

8.5.3. 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, result in 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

8.6. Lamp-test function

The lights and illuminated push buttons on the control compartment can be tested with the lamp-test function. The lamp test is activated via the CDP control panel by setting control parameter 16.7 to **LAMP TEST**. The lamp-test function resets itself after a set time.

8.7. 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 Section 8.7.1, “Start sequence of the drive”, page 127)
- Drive is stopped (see Section 8.7.2, “Stop sequence of the drive”, page 128)
- Fault condition has occurred

The status messages are sent to the higher-level control system and are displayed on the CDP 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”.

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**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 CDP 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.

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8.7.1. 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

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8.7.2. 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**

8.7.3. Emergency-off sequence



1) **Operation**



2) **ReadyRef**



3) **Emergency-off command**

- MCB opens
- Inverter stop modulating
- Speed coasts down



4) **NotReadyOn**

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8.8. Starting the drive



DANGER

Hazardous voltages! Accidental contact with energized components can cause serious injury or DEATH. All doors and openings must be secured before operation.

- Remove all foreign objects from the drive
- 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.



CAUTION

Cooling system starts automatically! The cooling system can start automatically after the auxiliary voltage has been switched on.



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

- “Appendix D – Wiring diagrams” to identify the circuit breakers to be switched on
- “Appendix A – Additional manuals”, manual of the water cooling unit to check that the water cooling unit is ready for operation
- Chapter 9, “CDP control panel”, page 138 for information on functions and features of the CDP control panel

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8.8.1. 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, check the drive according to the following 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.

8.8.2. 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.

8.8.3. Starting the drive locally

1. Set the CDP control panel to local control mode.



2. If the EMERGENCY-OFF RESET push button is flashing, press the push button to cancel flashing.

Each time the auxiliary voltage is switched off and on again, the emergency-off safety relay of the drive is actuated and lets the **EMERGENCY-OFF RESET** push button flash.

The push button also flashes if the **EMERGENCY-OFF** push button on the control compartment door, or any other emergency-off switch linked to the drive, is pressed. If the push button continuous flashing, verify that there is no emergency-off command active.

For more information, see Section 8.9.1, “Stopping the drive in an emergency”, page 133.

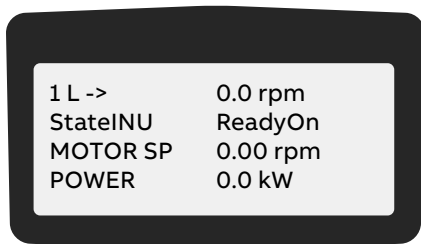
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3. Check that no alarm or fault messages are displayed on the CDP control panel.
When a fault message is displayed on the CDP control panel, reset the fault.

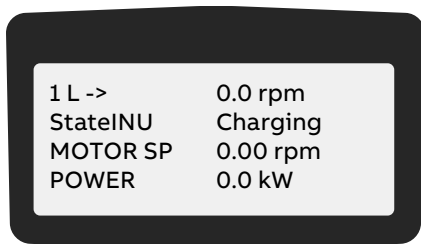


If a fault cannot be reset, it must be rectified by the responsible personnel.

When no alarms and faults are present and the drive is ready, the CDP control panel displays **ReadyOn**.



4. Press the **SUPPLY ON** push button on the control compartment door to charge the DC link.
The push button flashes during charging.
The status line of the CDP control panel alternates between Charging and **AuxiliaryOn**.

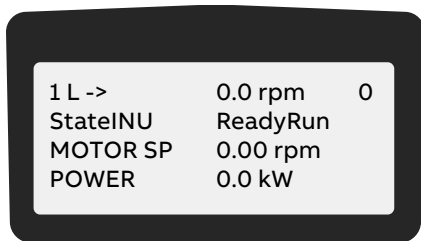


Alternating display message:

- Charging
- AuxiliaryOn

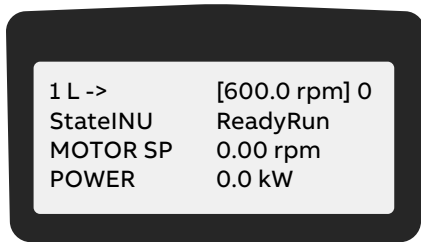
After charging has been finished, the following takes place:

- The main circuit breaker closes automatically.
- The SUPPLY ON push button lights up permanently.



5. Enter the reference value.

For more information, see Section 9.3.2, “Entering a reference value”, page 157.

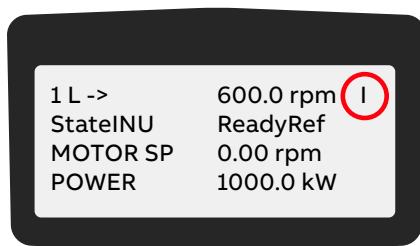


6. To start the motor, press the **START** key.



After the motor has been magnetized, the motor speed ramps up to the reference value. While the motor is accelerating, the run status message in the display blinks. When the motor speed has reached the reference value, the run status message lights up permanently.

The display shows **ReadyRef** to indicate that the drive system is operating.



8.9. Stopping the drive

- To stop the motor, press the STOP key.



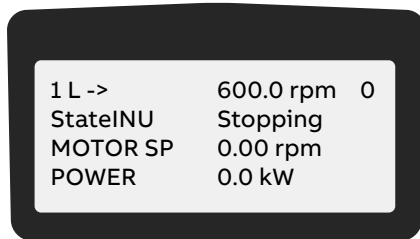
The motor stops according to the preset stop function. While the motor stops, the status line of the display shows **ReadyRef** and the run status message **blinks**.



As long as the stop sequence is in progress, you can always restart the drive by pressing the **START** key.



Just before the motor comes to a standstill, the status line shortly displays **Stopping**.



When the motor has reached zero speed, the status line displays **ReadyRun**.



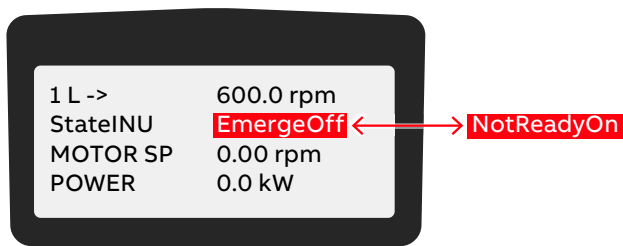
As long as the MCB has not been opened, you can restart the motor at any time.

8.9.1. Stopping the drive in an emergency



The **EMERGENCY OFF** push button (Fig. 87) on the local control panel (Fig. 85) is a hardwired fail-safe control switch that immediately disconnects the drive from the main power supply when pressed. When you activate an emergency off:

- MCB opens
- Drive system coasts down
- DC-link of the drive discharges
- Status line indication of the CDP control panel alternates between **EmergeOff** and **NotReadyOn**.



- Emergency-off reset push button flashes.
- Main power supply off push button flashes.



CAUTION

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

→ Avoid contact with live parts

Referring to Fig. 87:

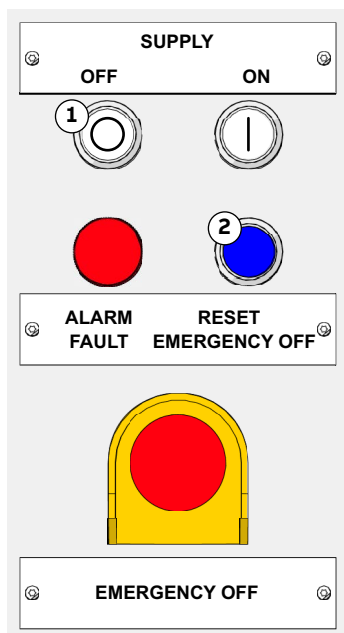
1. Press the **EMERGENCY OFF** push button for the drive system:

- 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.

NOTE – If the drive is at a standstill when you press the emergency off-push button, you will not be able to connect the drive to the main power supply or start the drive.

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**Key:**

- (1) **SUPPLY OFF** push button
- (2) **RESET EMERGENCY OFF** push button
- (3) **EMERGENCY OFF** latching push button

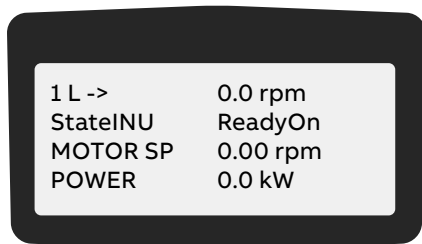
Fig. 87. Detail of local control panel

8.9.2. Starting the drive system after an emergency-off

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 Fig. 87:

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 turns off, the emergency-off safety relay of the drive is reset, and the drive status message changes to ReadyOn.



4. Connect the main power supply to the drive and start the drive according to Section 8.8, "Starting the drive", page 129.

8.10. 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. 2.

For information on the arc resistant design class of your drive, see the project-specific “Converter Data Sheet” (“Appendix B – Technical data” of the ACS5000W gen. 2 user manual).

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

8.10.1. 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

Fig. 88. 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 Section 2.4, “Main circuit breaker protection device”, page 28.

Based on the ACS5000W gen. 2 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.

8.10.2. 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 (Fig. 15).



Fig. 89. 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

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

1. De-energize and ground the drive according to Section 10.6.2, “De-energizing the drive”, page 169.
2. Search for the location where the arc has been detected.
3. Check the Arc Guard HMI panel messages and use the circuit diagrams.



Fig. 90. 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 16.26 on the CDP control panel (only when fault was understood and corrected).
8. Restart the drive.

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8.11. De-energizing and grounding the drive

See Section 10.6.2, “De-energizing the drive”, page 169.

8.12. Opening the doors

See Section 10.6.3, “Opening and closing the doors”, page 171.

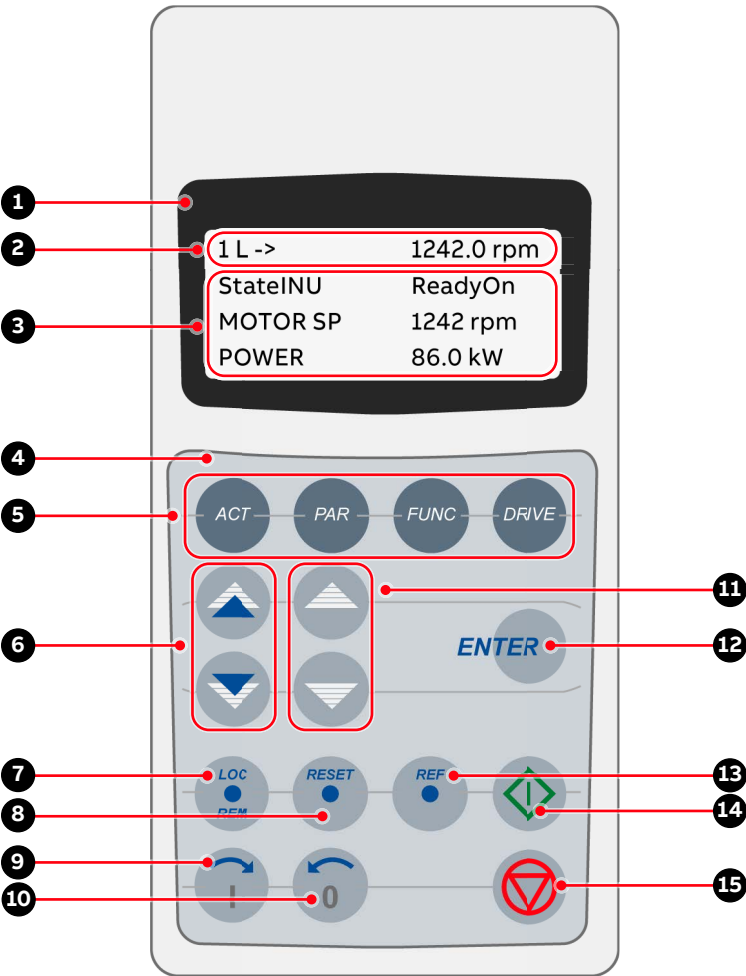
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9. CDP control panel

9.1. Overview

The panel messages and parameter settings in the following sections are typical examples and might differ from the actual ones.

9.1.1. Display and keypad



Key:

- (1) Display

(2) Status line

(3) Actual signal names and values

(4) Keypad

(5) Mode selection keys

(6) Fast navigation key for selecting the actual signals display or the fault memory display

(7) Local / remote selection key

(8) Reset key
- (9) Forward key

(10) Backward key

(11) Slow navigation key for selecting signals or fault messages

(12) Enter key, terminates a procedure

(13) Reference key

(14) Start key

(15) Stop key

Fig. 91. CDP control panel

9.1.2. Functions

The CDP control panel serves as the basic user interface for operating and monitoring the drive when the local operating mode has been selected.

The CDP control panel can be attached to or detached from the drive without having to switch off the auxiliary power supply first.

Using the CDP control panel, it is possible to:

- Enter startup data
- Enter reference values
- Enter start, stop and direction commands
- Display actual values (three values can be read simultaneously)
- Display and adjust parameters
- Display information on the most recent 64 fault events

9.2. Modes

The CDP control panel provides the following modes:

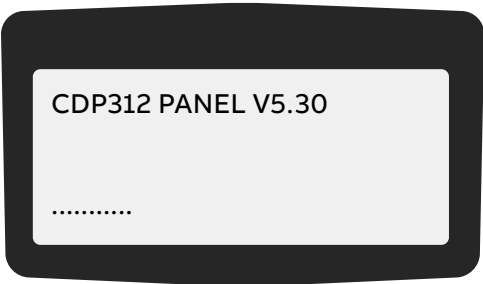
- Identification mode
- Actual signals mode
- Parameters mode
- Functions mode
- Drive mode (not used)

9.2.1. Identification mode

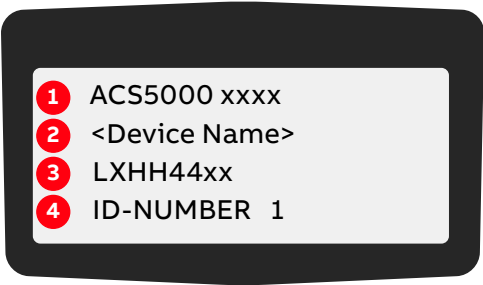
The identification mode informs the user about the CDP control panel version and the ID number of the drive. The information appears on the display

- when the power supply is switched on, or
- when the CDP control panel is connected to the drive and the auxiliary voltage has been switched on already.

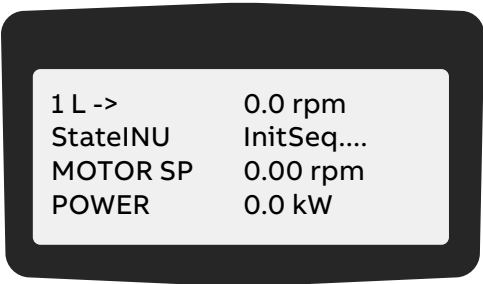
When the CDP control panel is initialized, the display changes as follows:



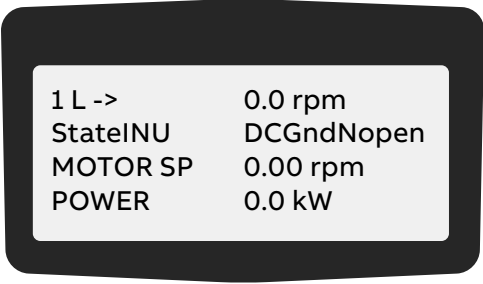
After 2 to 3 seconds the display shows the drive name (1 and 2), the application software in use (3), and the drive identification (4) is displayed.



After another few seconds.



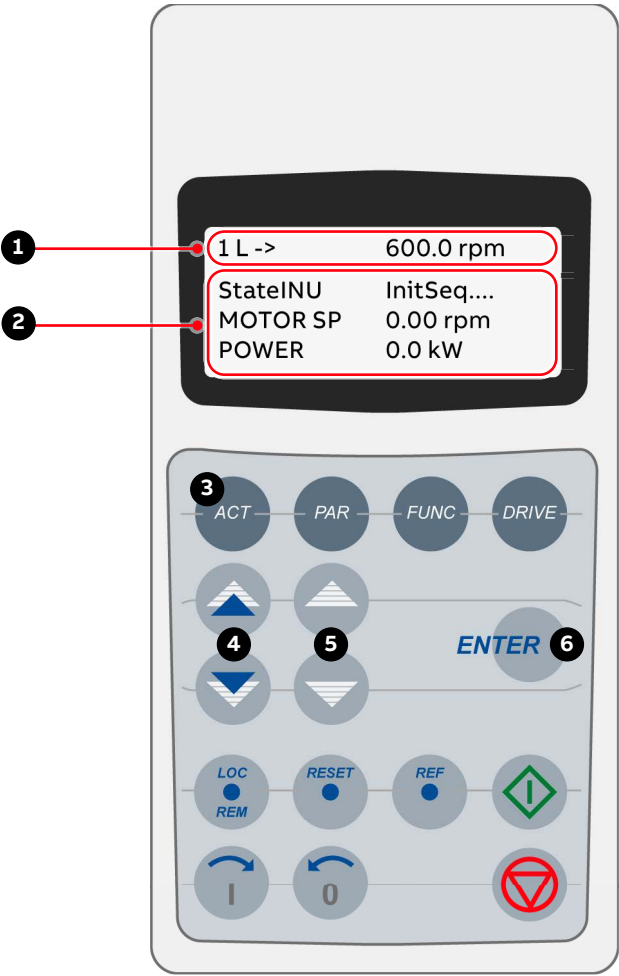
After another few seconds, the display changes to the actual signals display. The status line of the display alternates between DCGndNOpen and NotReadyOn.



Alternating display message:

- DCGndNopen
- NotReadyOn

9.2.2. Actual signals mode



Key:

- (1) Display

(2) Actual signal names and values

(3) Selection key for actual signals mode

(4) Fast navigation key for selecting the actual signals display or the fault memory display
- (5) Slow navigation key for selecting signals or fault messages

(6) Enter key for confirming the selection

Fig. 92. Control panel functions for Actual signals mode

9.2.2.1. Overview

Two displays can be selected in the actual signals mode:

- Actual signals display
- Fault memory display

The actual signals display appears first when entering the actual signals mode. However, when the drive is in a fault condition, the fault memory display appears instead.

The actual signals display is used to monitor the drive without interfering with its operation. It continuously displays three selectable actual values.

If a key is not actuated within one minute (an exception from this is the fault memory display), the CDP control panel automatically returns to the actual signals display from other modes.

9.2.2.1.1. Actual values

For the complete list of selectable actual signals, see “Appendix G – Signal and parameter table”.

The actual values are organized in groups.

Group	Description
Group 01	Measured or calculated motor values
Group 02	Measured or calculated drive values
Group 03	Reference values
Group 04	Status signals of S800 I/O system
Group 05	Communication link and MCB status signals
Group 06	Software version, drive and motor nominal values
Group 07	Control words
Group 08	Status words
Group 09	Fault and alarm words

9.2.2.1.2. Fault memory

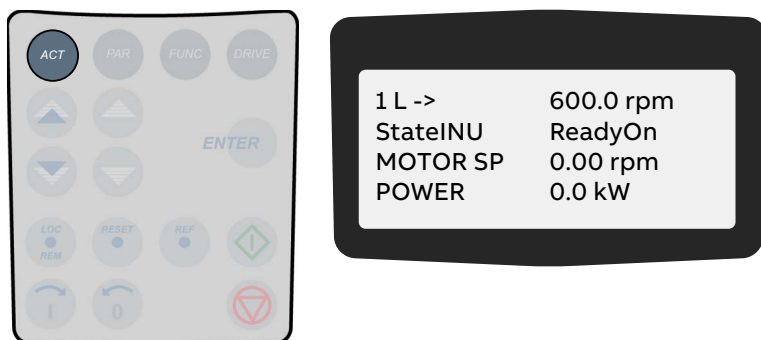
The fault memory display provides information on the 64 most recent fault events that occurred in the drive. It displays the name of the fault and the time it occurred. For instructions on how to display and reset the fault memory, see Section 9.2.2.7, “Displaying and resetting an active fault”, page 146.

When the drive generates a fault or alarm, the corresponding message displays immediately.

Changing from the fault memory display to other modes is possible without resetting the fault first. If no key is actuated, the fault or alarm message displays as long as the fault is active.

9.2.2.2. Selecting the actual signals display

To select the actual signals display, press the **ACT** key.



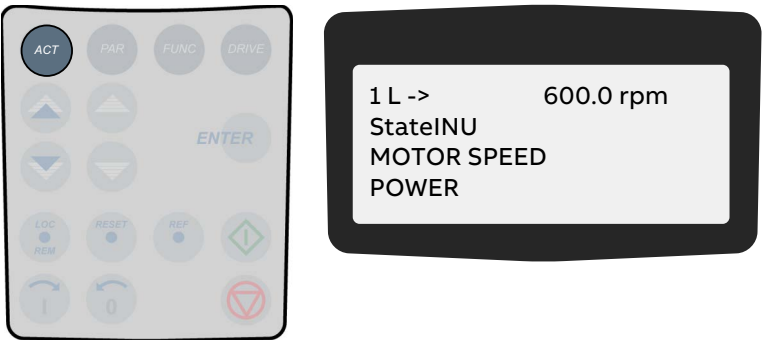
9.2.2.3. Toggling between actual signals display and fault memory

To toggle between actual signals display and fault history display, press a fast navigation key.



9.2.2.4. Displaying three actual signals

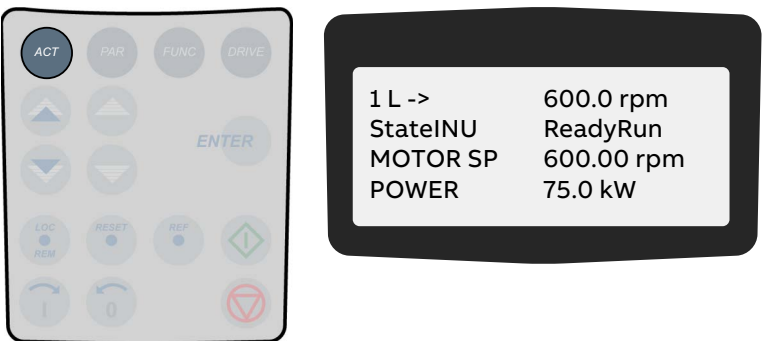
- 1. To display the full name of three actual signals, press and hold the **ACT** key.



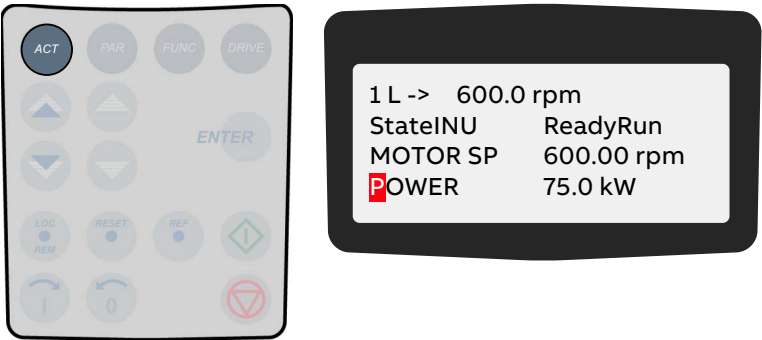
- 2. To return to the actual signals display, release the **ACT** key.

9.2.2.5. Selecting actual signals

- 1. To select the actual signals display, press the **ACT** key.



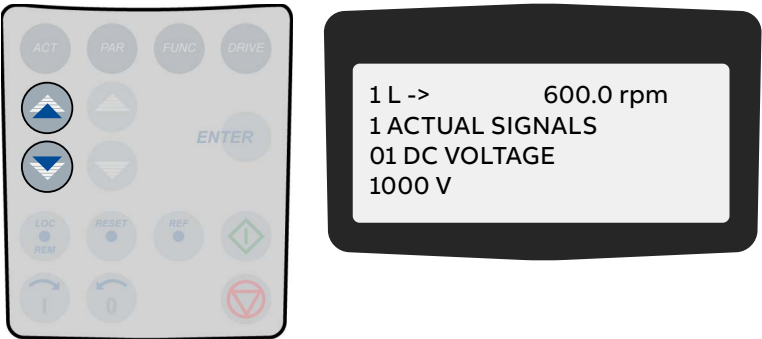
2. To select a line where the actual signal is to be displayed, press the slow navigation keys.
A **blinking** cursor indicates the selected line.



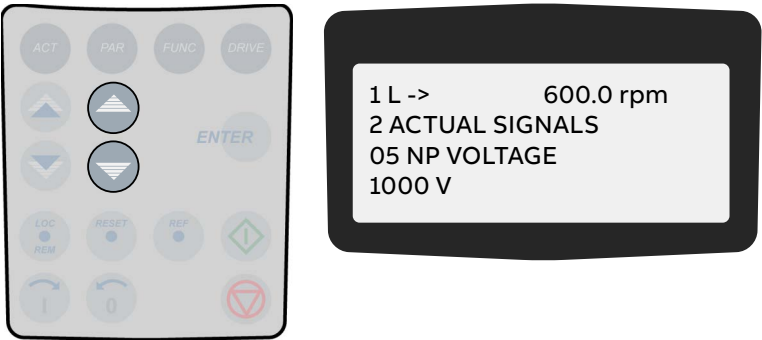
3. To enter the actual signals selection function, press the **ENTER** key.



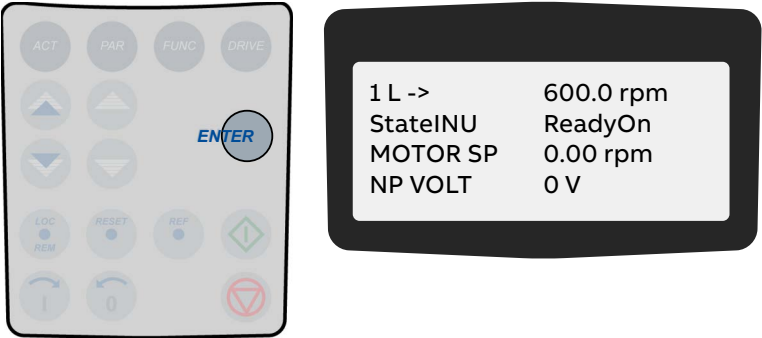
4. To select a parameter group, press a fast navigation keys.



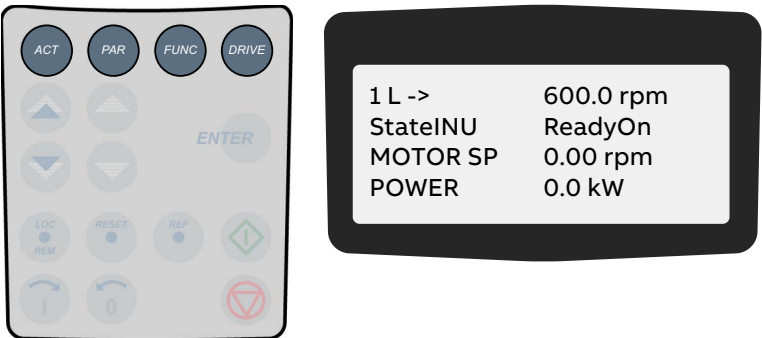
5. To select an actual signal, press a slow navigation keys.



6. To confirm the selection and to return to the actual signals display, press the **ENTER** key.

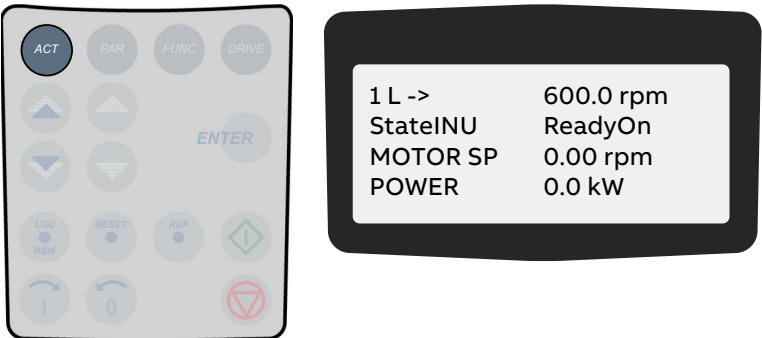


7. To cancel the selection and keep the original selection, press any of the mode selection keys.
The selected keypad mode is entered.



9.2.2.6. Displaying a fault and resetting the fault memory

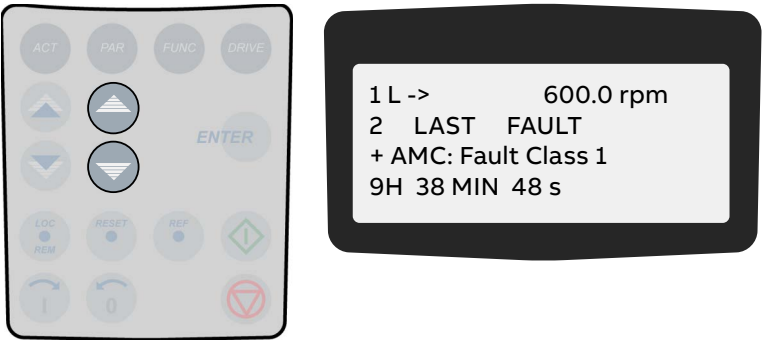
1. To open the actual signals display, press the **ACT** key.



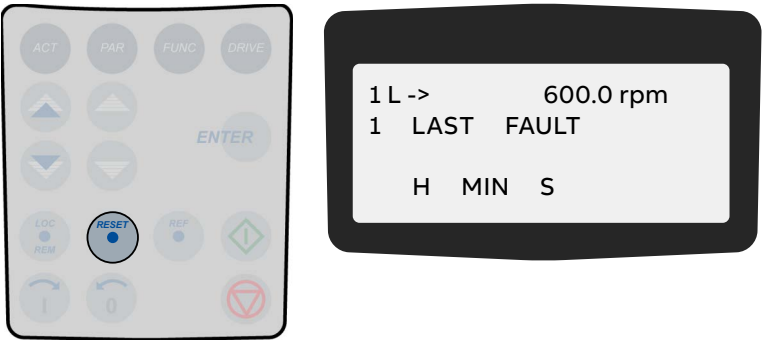
2. To change to the fault memory display, press a fast navigation key.



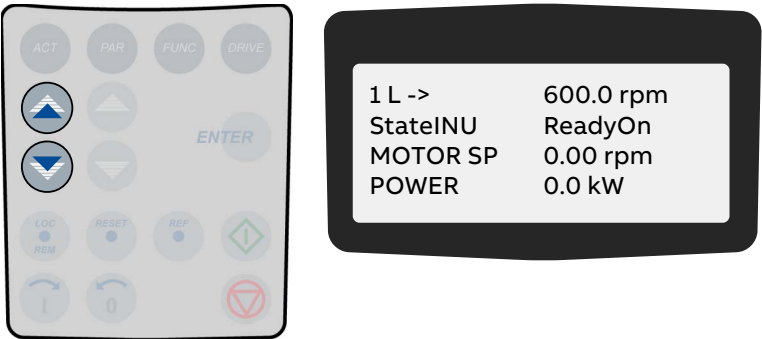
3. To display a specific fault, press the slow navigation keys.
The up key selects the previous, the down key the next fault.



4. To clear the fault memory, press the **RESET** key.

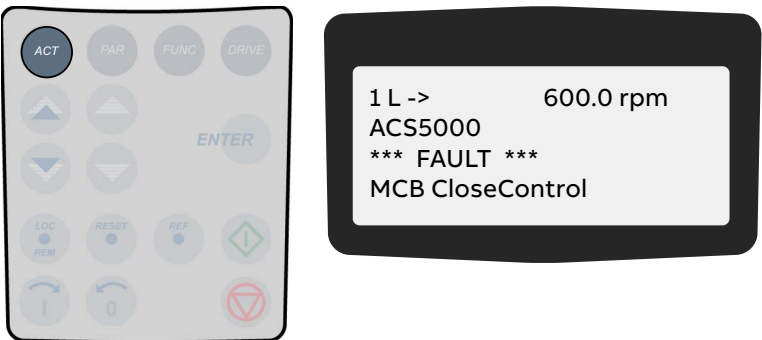


5. To return to the actual signals display, press a fast navigation key.

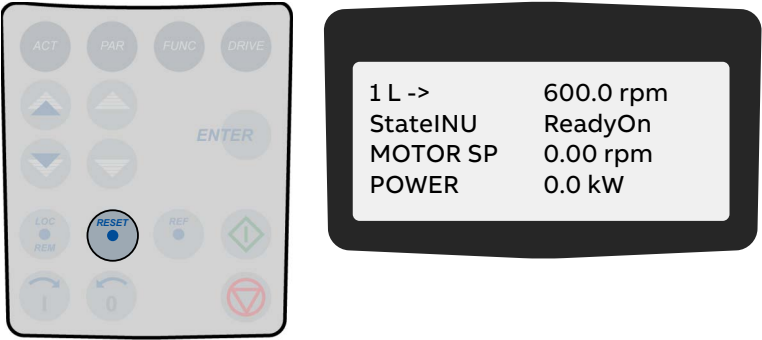


9.2.2.7. Displaying and resetting an active fault

1. To display an active fault, press the **ACT** key.



2. To reset the fault, press the **RESET** key.

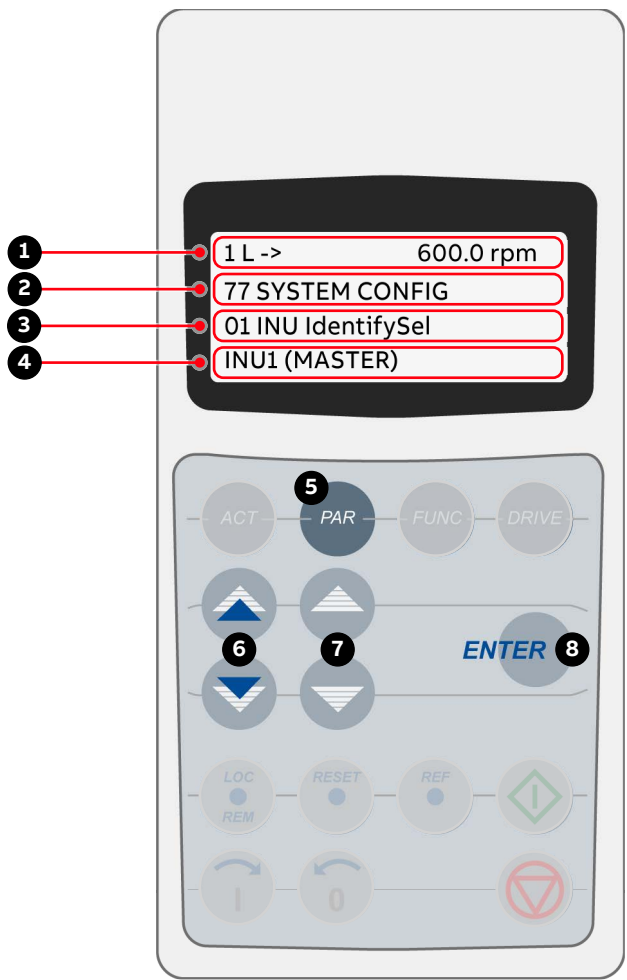


9.2.3. Parameters mode

NOTICE

Risk of component damage. Incorrect parameter data can reduce control accuracy, interfere with drive operation, and damage equipment.

- Qualified personnel only
- If you do not fully understand what a parameter controls, DO NOT change the value of the parameter.



Key:

- (1) Status line

(2) Group number and name

(3) Parameter number and name

(4) Parameter value

(5) Selection key for parameters mode
- (6) Fast navigation key for selecting a parameter group (and a parameter value)

(7) Slow navigation key for selecting a parameter (and a parameter value)

(8) Enter key for confirming the selection

Fig. 93. Control panel functions for Parameters mode

9.2.3.1. Overview

If the parameter lock is disabled or unlocked (see Section 9.2.3.3, “Enabling / unlocking a parameter lock”, page 152) the parameters mode allows entering the parameter settings for the required drive configuration depending on the application.

The parameters are organized in functional groups, so called parameter groups.

Group	Description	Parameter	Description
Group 07	Control words	21.01	Start function
Group 08	Status words	21.02	Start function
Group 09	Fault and alarm words	21.03	Off1 stop mode
Group 11	Start, stop, direction or MCB control	21.04	Process stop selection
Group 12	Reference selection	21.05	Process stop signal
Group 16	System control inputs	21.06	Process stop MCB control
Group 17	DC link control	21.07	Process stop mode
Group 18	Utility	.	
Group 19	Data storage	.	
Group 20	Limits	.	
Group 21	Start / stop / process stop	21.17	MCB closing time limit
Group 22	Ramp functions	.	
Group 23	Speed reference	21.19	MCB available signal

For details about the parameters, their settings and functions, see “Appendix G – Signal and parameter table”.

When entering the parameters mode for the first time after the auxiliary supply voltage of the drive has been switched on, the CDP control panel displays the first parameter of parameter group 11. The next time the parameters mode is entered, the previously selected parameter displays.

Some parameter settings cannot be changed while the drive is running. If tried, the following warning displays.

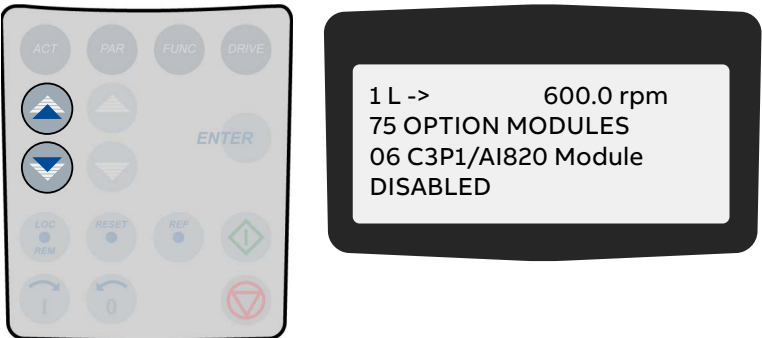
**** WARNING ****
WRITE ACCESS DENIED
PARAMETER SETTING
NOT POSSIBLE

9.2.3.2. Changing a parameter setting

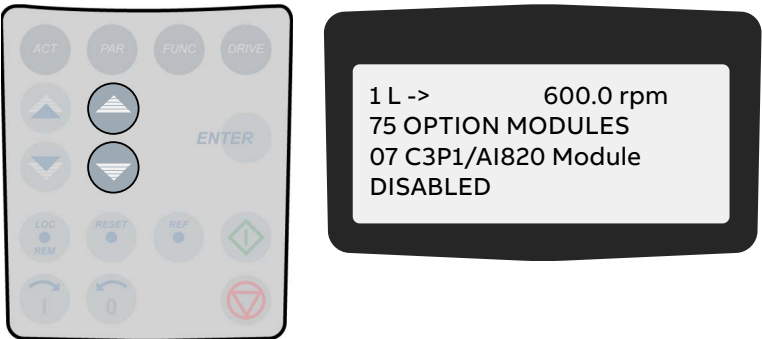
1. To enter the parameters mode, press the **PAR** key.



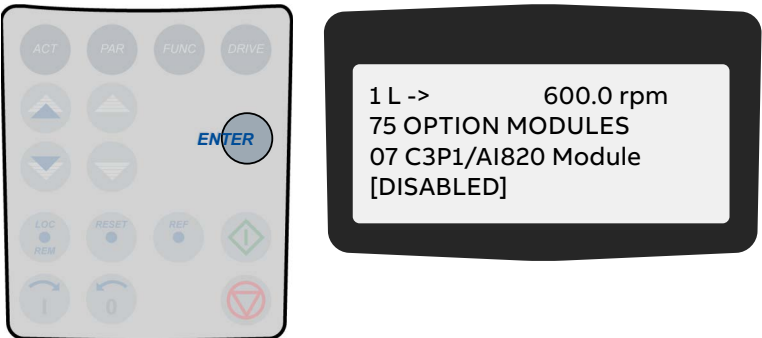
2. To select a different group, press a fast navigation key.



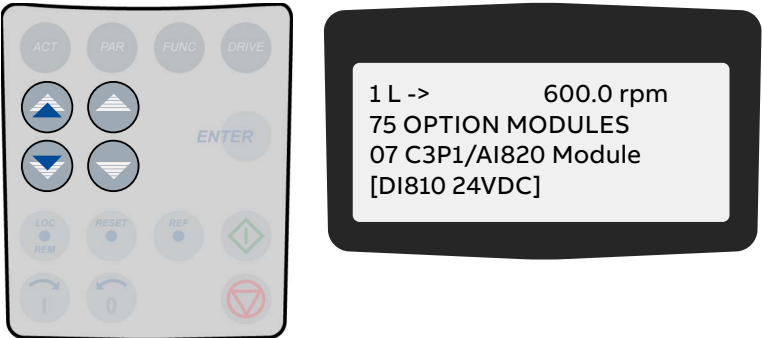
3. To select a parameter, press a slow navigation key.



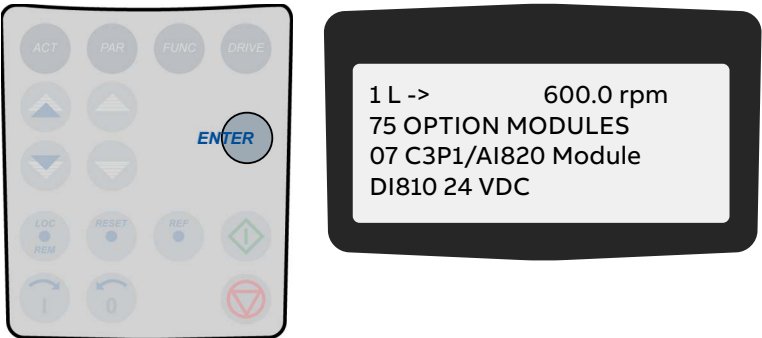
4. To enter the parameter setting function, press the **ENTER** key.



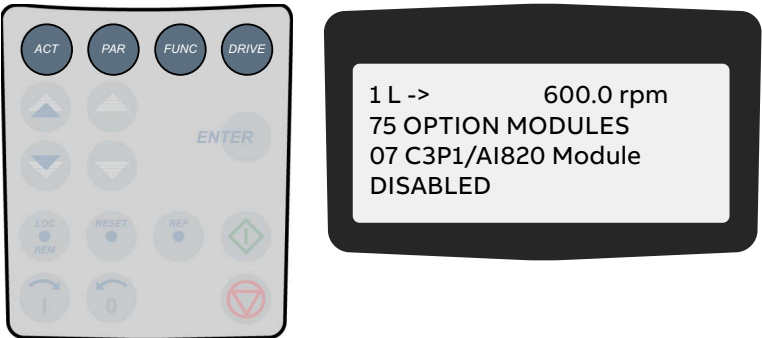
5. To change the parameter value, press:
- Slow navigation keys for numbers and text
 - Fast navigation keys for numbers only



6. To confirm the setting and to return to the actual signals display, press the **ENTER** key.



7. To cancel the setting and keep the original setting, press any of the mode selection keys.
The selected keypad mode is entered.



9.2.3.3. Enabling / unlocking a parameter lock

Unwanted parameter settings can be prevented by activating the parameter lock function.

The corresponding parameters are *16.02 PARAMETER LOCK* and *16.03 PASSCODE* and belong to parameter group *16 SYSTEM CTRL INPUTS*.

9.2.3.3.1. Enabling the parameter lock

1. Select parameter *16.02*.
2. Set parameter *16.02* to **1** (LOCKED).
3. Confirm the setting and exit the parameters mode.

9.2.3.3.2. Unlocking the parameter lock

1. Select parameter *16.03*.
2. Set the correct pass code.
3. Confirm the setting and exit the parameters mode.

For more information, see “Appendix G – Signal and parameter table”.

9.2.3.4. User lock

NOTICE

Risk of component damage. ABB is not liable for damages or losses that are caused by the failure to activate the user lock for the control panel or to change the default pass code for the user lock.

9.2.3.4.1. Setting the pass code to lock the control panel

ABB recommends that you set a pass code to lock the control panel to protect the parameter values.

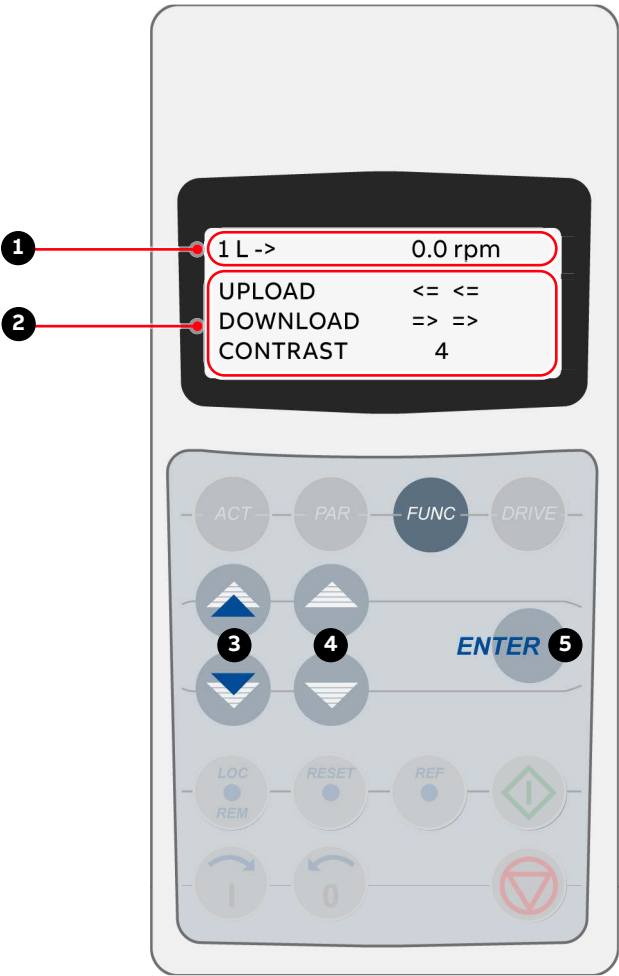
1. To activate the user lock for the first time, enter the default pass code, i.e., **358**, in *16.02 Passcode*.
You can now edit parameters *16.24...16.25*.
2. Enter the old pass code in *16.24 OldUserPasscode*.
3. Enter the new pass code in *16.25 NewUserPasscode*.
4. In *16.02 Parameter Lock*, enable the user lock functionality.

NOTE – To reopen the user lock, i.e., to edit parameters *16.24* and *16.25*, enter the new pass code in *16.03 Passcode*.

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9.2.4. Functions mode

The functions mode is used for adjusting the display contrast.



Key:

- | | |
|--------------------------------------|---|
| (1) Status line | (4) Slow navigation key for selecting a line (and adjusting the contrast) |
| (2) Selectable functions | |
| (3) Selection key for functions mode | (5) Enter key for confirming the selection |

Fig. 94. Control panel functions for Functions mode

9.2.4.1. Adjusting the display contrast

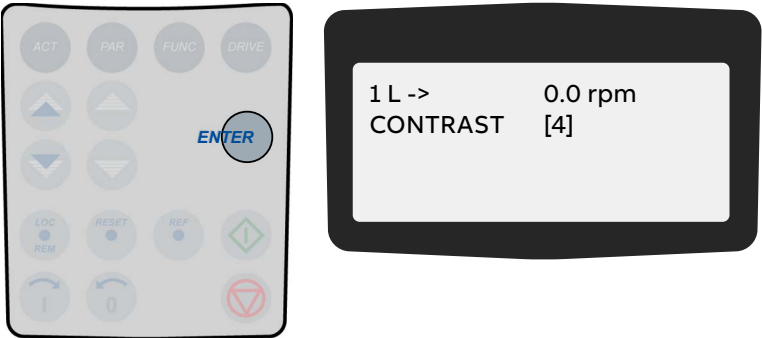
1. To enter the functions mode, press the **FUNC** key.



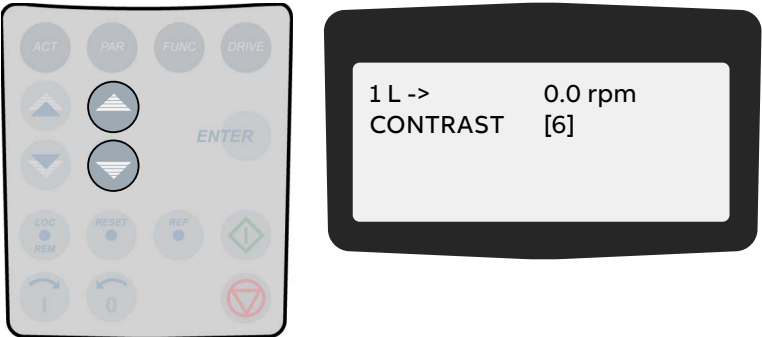
2. To select the contrast adjustment function, press the slow navigation keys until the **blinking** cursor reaches the CONTRAST line.



3. Press the **ENTER** key.



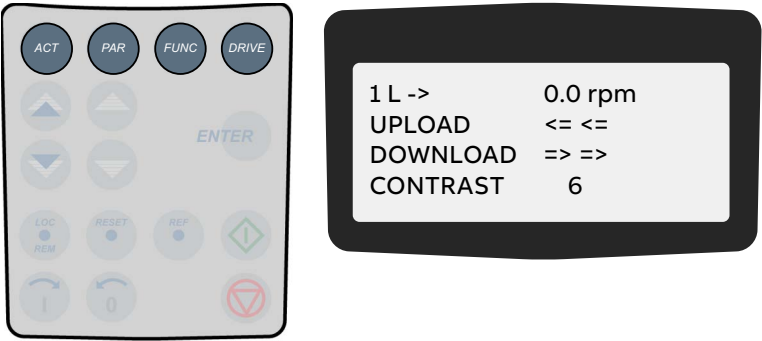
4. To change the contrast, press the slow navigation keys.



5. To confirm the setting and to return to the actual signals display, press the **ENTER** key.



6. To cancel the setting and keep the original setting, press any of the mode selection keys.
The selected keypad mode is entered.



9.2.5. Local and remote control mode

The local-remote feature of the CDP control panel allows selecting the control location of the drive. Possible are:

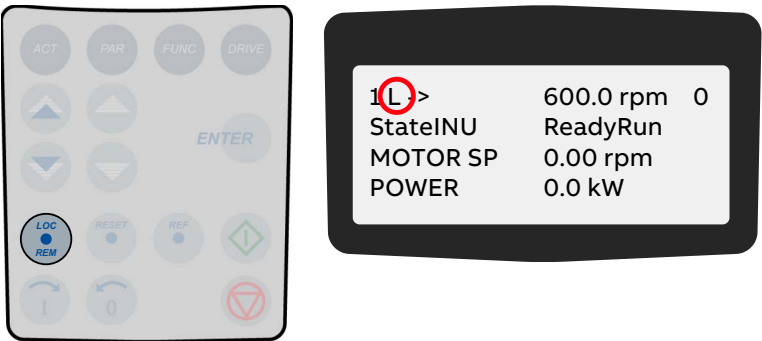
- Local control (L)
- Remote control (R)

NOTE – In this context, remote control is not necessarily equivalent to higher-level control.
For more information, see Section 9.2.5.4, “Remote control”, page 156.

9.2.5.1. Local control

In local control mode, full operational control of the drive is enabled from the local operator panel. Commands from remote have no effect.

- To enter the local control mode, press the **LOC-REM** key.
Local control is indicated by the letter **L**.



9.2.5.2. Disabling / enabling local lock function

Accidental switching from remote control to local control can be prevented with the local lock function.

The corresponding parameter is *16.04 LOCAL LOCK* and belongs to the parameter group *16 SYSTEM CTRL INPUTS*.

9.2.5.3. Enabling the local lock

- To enable the local lock, set parameter 16.04 to 2 (LOCKED).
With this parameter setting, local control (including the LOC-REM key) is disabled.
If the CDP control panel or a DriveWindow PC is in local control mode at the time that the local lock is enabled, they remain in local control mode until they are switched to remote control mode. This means that the CDP control panel displays the letter L until you press the LOC-REM key.

9.2.5.3.1. Disabling the local lock

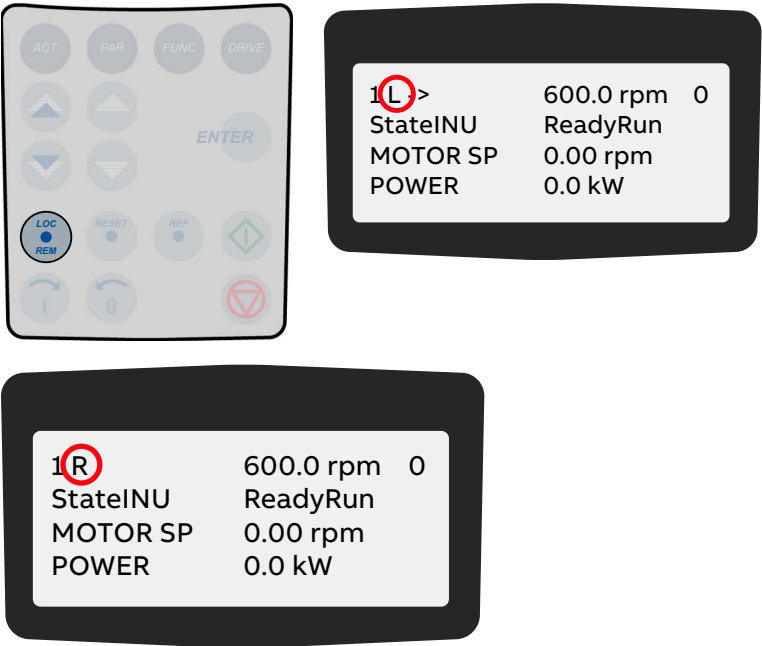
- To disable the local lock, set parameter 16.04 to 1 (OPEN).
With this parameter setting, switching between remote and local control is enabled.

9.2.5.4. Remote control

In remote control mode, operational commands or reference values usually come from a higher-level control system via fieldbus or remote I/O.

However, with the following parameter settings it is possible to start and stop the drive, to set the direction of rotation, and to enter reference values from the CDP control panel.

- 11.01 EXT1 START/STOP/DIR = 10 (KEYPAD) or
12.03 EXT REF1 SELECT = 1 (KEYPAD) and
12.02 EXT1/EXT2 SELECT = 1 (EXT1)
- 11.02 EXT2 START/STOP/DIR 10 (KEYPAD) or
12.06 EXT REF2 SELECT = 1 (KEYPAD) and
12.02 EXT1/EXT2 SELECT = 2 (EXT2)
- To enter the remote control mode, press the **LOC-REM** key.
 - A blank space indicates full remote control from a higher-level control system.
 - The letter **R** indicates partial remote control (some commands are enabled locally).



NOTE – To prevent accidental switching from remote control to local control, see Section 9.2.5.2, “Disabling / enabling local lock function”, page 155.

9.3. Operational commands

For instructions on how to start and stop the drive system from the CDP control panel, see Section 8.8, “Starting the drive”, page 129 and Section 8.9, “Stopping the drive”, page 132.

9.3.1. Setting the direction of rotation

Setting the direction of rotation from the CDP control panel is possible in:

- Local control mode (L)
- Remote control mode (R)

The arrow on the display indicates the direction of rotation:

- When the motor is running, the arrow indicates the actual direction.
- When the motor is not running, the arrow indicates the preselected direction.

To set the direction of rotation, press the forward or backward key.



If you change the direction while the motor is running, the motor automatically ramps down to zero speed and re-accelerates in the opposite direction to the preset speed. The arrow changes at zero speed.

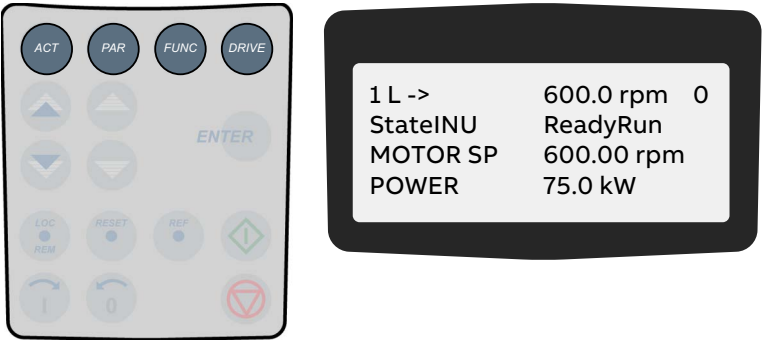
9.3.2. Entering a reference value

Entering a reference value from the CDP control panel is possible in:

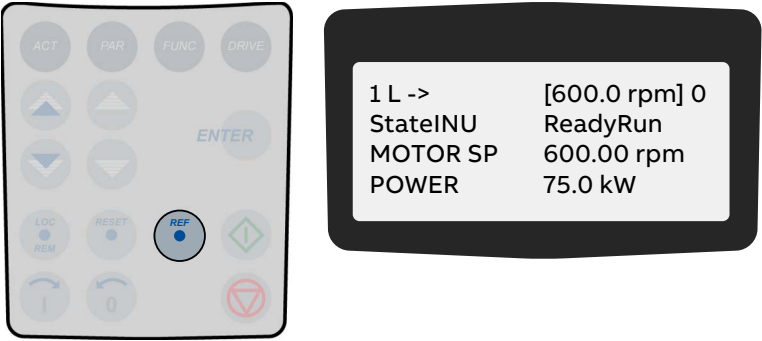
- Local control mode (L)
- Remote control mode (R)

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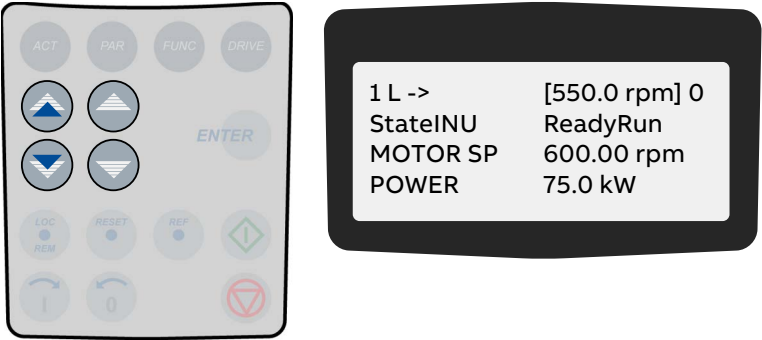
1. Press a mode selection key.



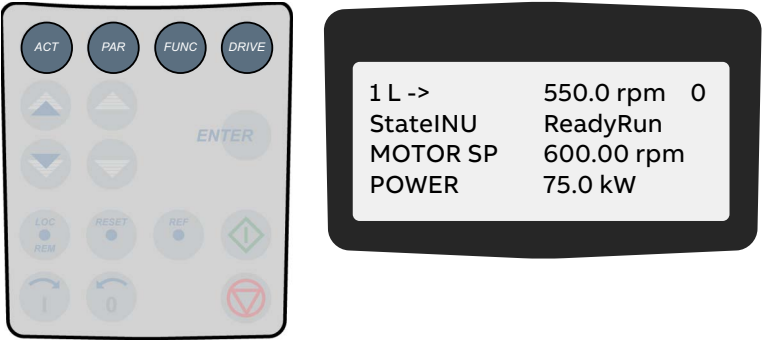
2. To enter the reference value input mode, press the REF key.



3. To enter / change the reference value, press the corresponding fast or slow navigation key.



4. To exit the mode, press a mode selection key.



10. Preventive and corrective maintenance

10.1. 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.

10.1.1. Required qualification

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

10.1.2. 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.

10.1.3. Logbook

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

- Date and time
- Detailed description

10.1.4. 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”.

10.2. Identifying electrical equipment

10.2.1. Device designation

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

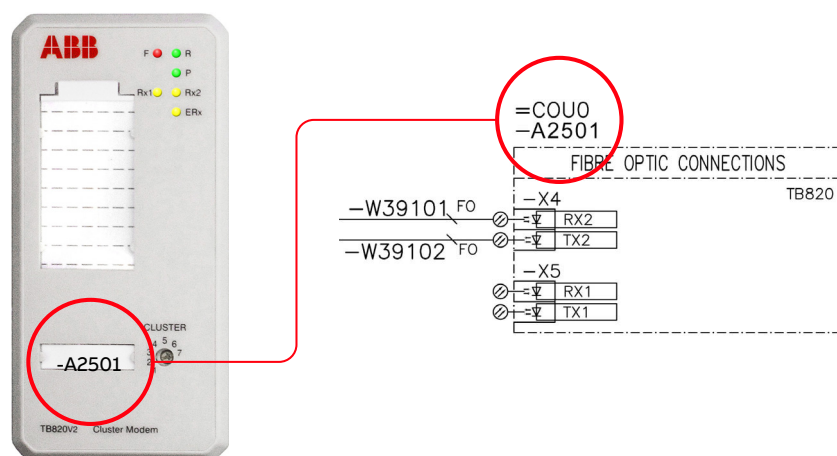
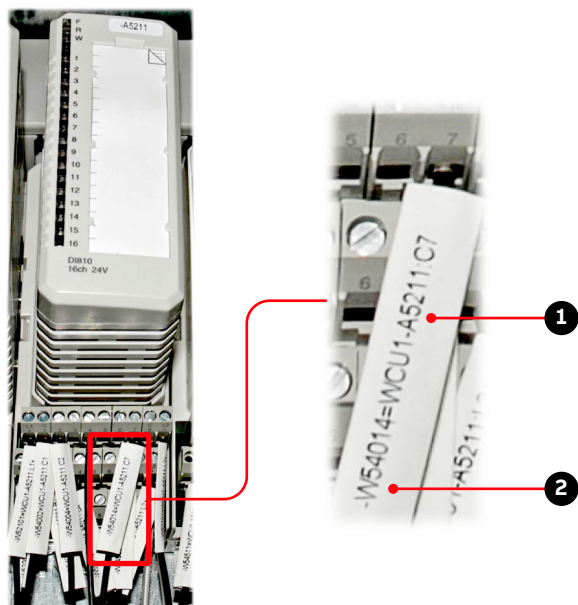


Fig. 95. Device identification

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10.2.2. Cables and wires

Cables and wires in the drive are equipped with marker sleeves that carry the same identifying number as on the wiring diagrams.



Key:

(1) Terminal number

(2) Wire number

Fig. 96. Cable and wire designation

10.2.3. Understanding wiring diagrams

For information on item designation and cross-reference conventions, see “Appendix D – Wiring diagrams”.

10.3. Alarm / fault indications

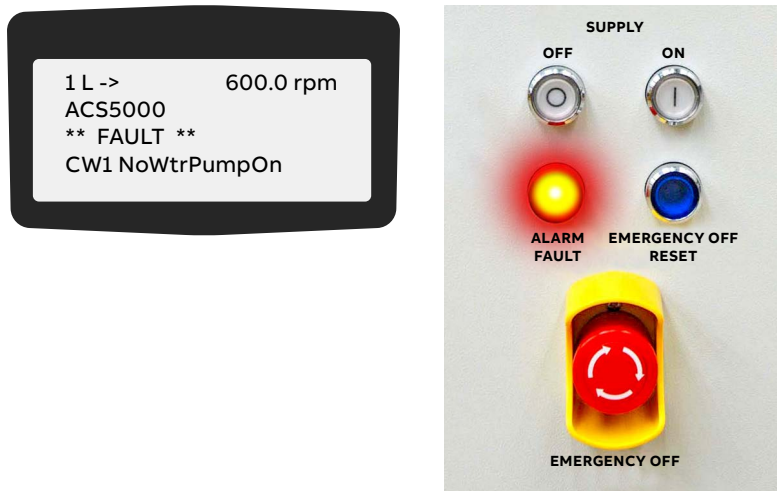
When a failure occurs in the drive or in the equipment monitored by the drive (eg, main circuit breaker, transformer, cooling system), the CDP control panel displays a corresponding alarm or fault message.

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10.3.1. Messages

The type of light emitted by the alarm / fault lamp on the control compartment door depends on the type of message:

- Flashing light: alarm
- Light remains on: fault



The message can be saved and viewed in the fault history of the drive when a PC with DriveWindow, DriveDebug or DriveMonitor is connected to the drive. The fault history can also be called up on the CDP control panel.

10.3.2. Error message levels

Two error message levels are used in the drive:

- **Alarm:** does not shut down the drive
- **Fault:** shuts down the drive

10.3.2.1. Alarm

An 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.

10.3.2.2. Fault

A 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) open the MCB.
- Class 2 faults (FC 2) do not open the MCB.

Since the MCB is controlled and monitored entirely by the drive, no external 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.

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10.3.2.3. Alarm / fault messages

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

10.3.3. 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.

Example:

1) +Fault AMC: Fault Class 2	2008-01-08 16:58:24.3770
2) +Fault PPCS Communication	2008-01-08 16:58:24.3760
3) +Fault AMC: Fault Class 1	2008-01-08 16:56:02.1170
4) +Fault DC Undervoltage	2008-01-08 16:56:02.1170

In the above example:

1) +Fault AMC: Fault Class 2	Classifies the fault
2) +Fault PPCS Communication	Represents a subsequent fault that occurred 2 min. 22 s than the first fault
3) +Fault AMC: Fault Class 1	Classifies the fault
4) +Fault DC Undervoltage	Reason for the failure of the drive system as it occurred first

For more information on alarms and faults, see “Appendix G – Signal and parameter table”.

10.3.4. 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 CDP control panel, but do not clear the buffer!**

For more information, see Chapter 9, “CDP control panel”, page 138.



- 3) **Identify the fault and make a logbook entry.**



- 4) **Save the content of the data logger when a PC is available that has the DriveWindow or DriveDebug tool installed.**

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



- 5) **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



- 6) **After the fault has been rectified, start the drive as described in Chapter 8, “Operation”, page 122.**

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10.4. Removing the CDP control panel

When the CDP control panel must be removed from its mounting cradle, follow the instructions below.

1. When the panel is removed while the drive is in operation, check the setting of parameter *31.01 PANEL LOSS SUPERVISION* first.

If the parameter is set to *NOT USED*, the panel can be removed without interrupting drive operation.

For more information on parameter settings, see “Appendix G – Signal and parameter table”.

2. To remove the panel, proceed as illustrated.

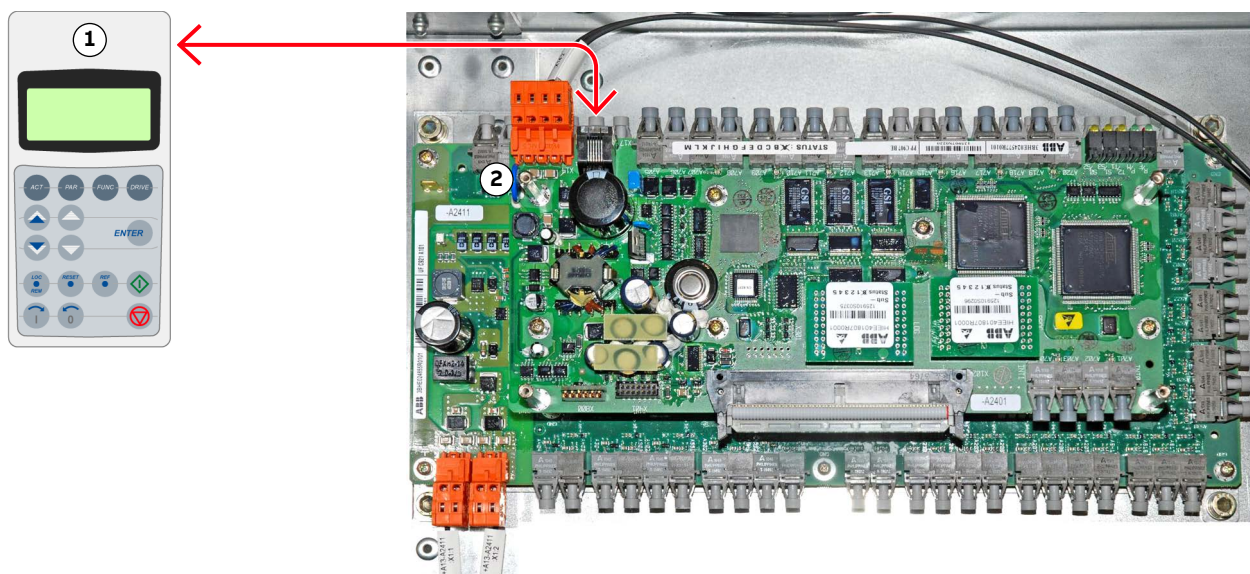
IMPORTANT! If you remove the CDP control panel during operation, you can only stop the drive by pressing the emergency-off push button.

The green LED (1) signals that the control voltage has been switched on.



10.4.1. Communication with AMC circuit board

The CDP control panel (1) is connected to the AMC circuit board (2) via an RS485 interface.

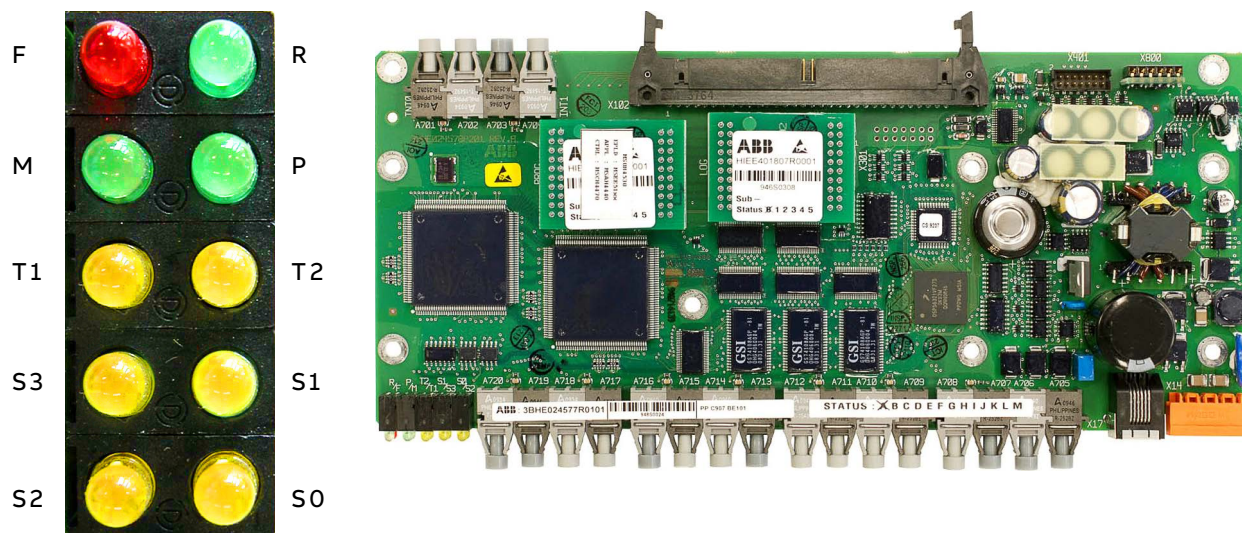


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10.5. LEDs and switches on circuit boards and I/O devices

The following section provides an overview of the meaning of LEDs and switches of the main circuit boards and I/O modules. The LEDs presented in the following section 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.

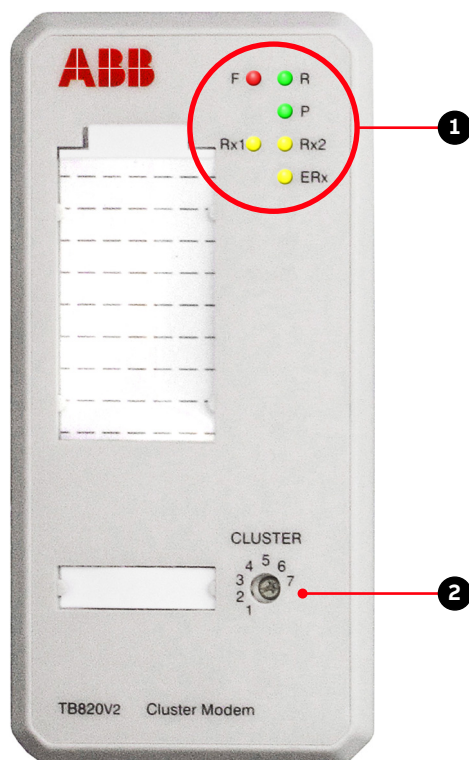
10.5.1. AMC circuit board



LED	Color	Description	Status when software has loaded		Status when software has not loaded	
			Booting	ON	Booting	ON
F	Red	Fault	ON	OFF	ON	ON
R	Green	Run	OFF	OFF	OFF	OFF
M	Green		ON	OFF	ON	ON
P	Green	Supply OK	ON	ON	ON	ON
T1	Yellow	Receiving data on DDCS channel 0	Flashing	ON / OFF	Flashing	ON / OFF
T2	Yellow	Receiving data on DDCS channel 3	Flashing	ON / OFF	Flashing	ON / OFF
S3	Yellow		OFF	OFF	OFF	OFF
S1	Yellow		Flashing	OFF	Flashing	OFF
S2	Yellow		Flashing	OFF	Flashing	OFF
S0	Yellow		Flashing	OFF	Flashing	OFF

Fig. 97. LEDs of AMC circuit board

10.5.2. S800 I/O bus modem TB820



LED	Color	Indication
F	Red	Fault in module
R	Green	Device in operation
P	Green	Power supply is healthy
Rx1	Yellow	Traffic on optical module bus
Rx2	Yellow	Traffic on optical module bus
ERx	Yellow	Traffic on electrical module bus

Fig. 98. TB820 bus modem

10.5.2.1. Bus modem address

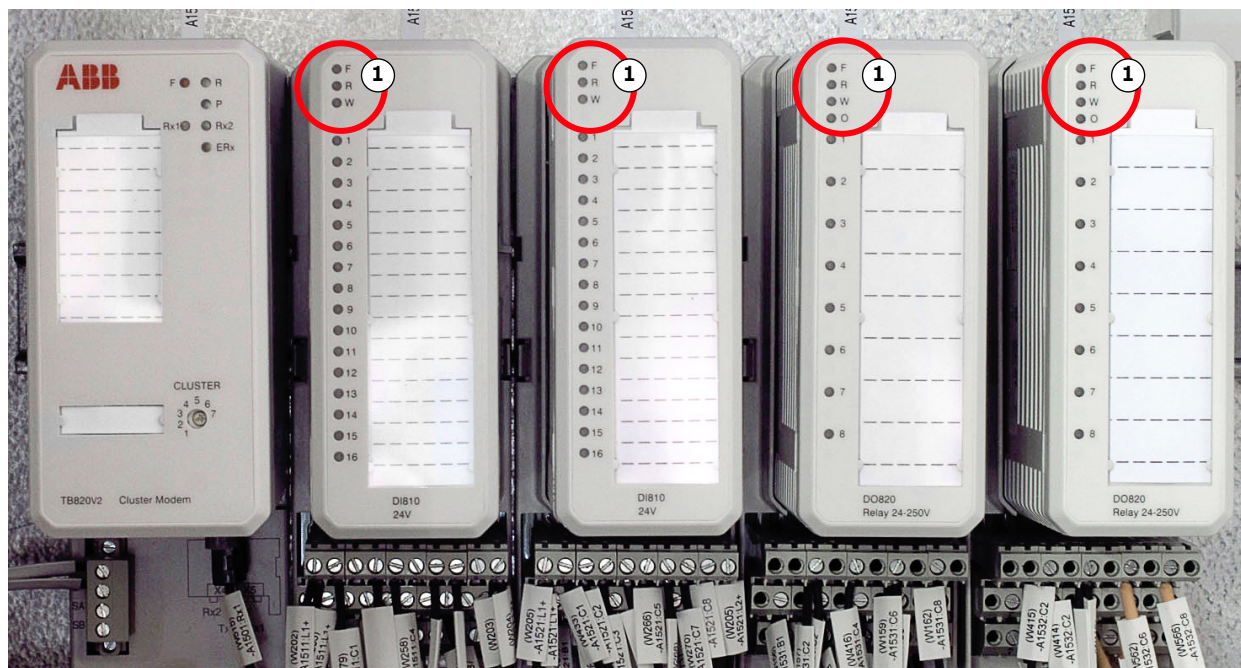
The TB820 bus modem has a unique cluster address that identifies the module in the software and links it to a parameter.

The address is set with the rotary switch on the module (1, Fig. 98). The factory-set value must not be changed.

10.5.3. S800 I/O modules

LEDs on I/O modules having the same meaning on all types of I/O modules are always at the same position. The LEDs are always at the topmost position on each module (1, Fig. 99) and are identified as follows:

- F: fault
- R: run
- W: warning
- O or OSP (only output modules)



LED	Color	Indication
F	Red	Indicates failure
R	Green	Device is operating normally
W	Yellow	External fault or minor fault in the module
O	Yellow	Indicates an active signal
OSP	Yellow	Indicates an active signal (output set as predetermined)

Fig. 99. Example of S800 I/O station

For more information, see the following manuals:

- “S800 I/O Getting started”, 3BSE020923
- “S800 I/O Modules and Termination Units”, 3BSE020924

10.6. Corrective maintenance

Overview on maintenance tasks:

- Visual checks on the drive
- Cleaning
- Checking wire and cable connections
- Checking and replacing filter mats
- Replacing a fan in an IP42 roof-mounted cooling unit (optional)
- Replacing a fan in an IP54 roof-mounted cooling unit (optional)

10.6.1. Safety



DANGER

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

- Before you work on the drive, carry out the steps in Section 2.3.2, “The 7 steps that save lives”, page 25.

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! If the control unit has buffer capacitors (depends on the auxiliary supply type), the capacitor voltage is 300 V (DC) during operation.



5 min

- After you stop the drive, wait 5 minutes for the capacitors to discharge
- BEFORE you touch a capacitor, verify that the capacitors have been discharged



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.

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10.6.2. De-energizing the drive

The following section describes how to de-energize the drive using the local operator panel of the drive. If the drive is controlled from remote, follow the established shutdown procedures.

For instructions on how to use the CDP control panel, see Chapter 9, “CDP control panel”, page 138.

10.6.2.1. Stopping the motor

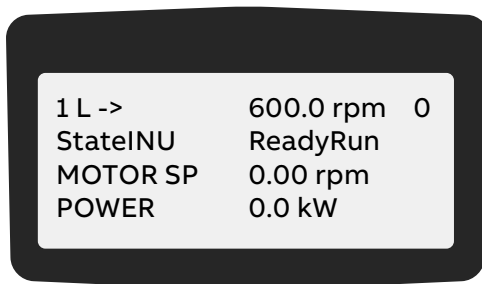
1. Enable the local control mode of the CDP control panel.



2. To stop the motor, press the STOP key.



When the motor has reached zero speed, the display shows ReadyRun.



10.6.2.2. De-energizing the drive

1. To disconnect the drive from the main power supply, press the SUPPLY OFF push button.

The following takes place:

- Main circuit breaker (MCB) opens

- DC link discharges

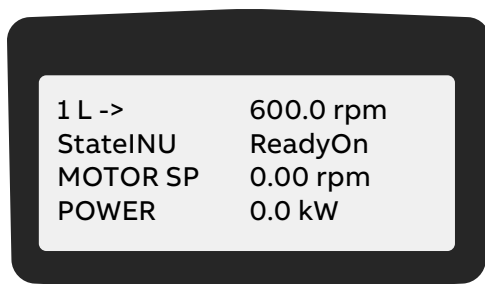
While the DC link discharges, the CDP control panel shows the following:



Alternating display message:

- OffSeqOn
- Discharging
- AuxiliaryOn

When the DC link has discharged completely, the status line displays ReadyOn and the SUPPLY OFF push button changes to a permanent light.



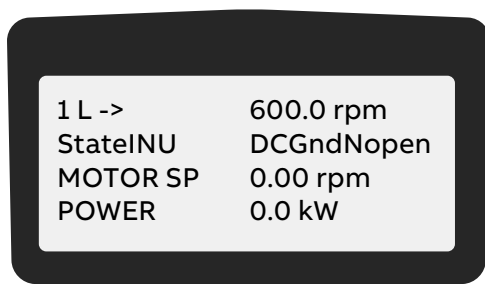
2. Rack-out, lock-out, ground and tag-out the main circuit breaker.
3. Wait for the **GROUNDING SWITCH UNLOCKED** buttons on the PCUs to turn yellow, and then continue with step 4.

Because cooling of the drive continues for a preset time after switching off the main power supply, the yellow lamp lights up with a delay.

If the lamp does not light up and there is a reason to believe that the grounding circuit is malfunctioning.

For more information, Section 10.4, "Removing the CDP control panel", page 164.

4. Once the yellow lamp **GROUNDING SWITCH UNLOCKED** is lit, turn the grounding switch to the grounded position.
5. When the grounding switch is in the grounded position, the status line alternates between **DCGnd NOpen**, **NotReadyOn**, **StateINU NotRdy**.



Alternating display message:

- DCGnd Nopen
- NotReadyOn

6. If necessary, open the doors of medium voltage compartments according to Section 10.6.3, "Opening and closing the doors", page 171.

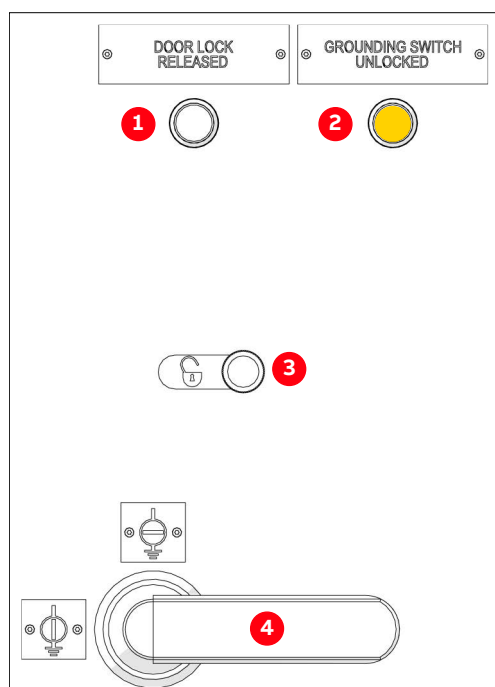
- Switch off and lock-out all auxiliary supply voltages from external sources.

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 Section 3.9, “Grounding studs”, page 52).

10.6.3. Opening and closing the doors

10.6.3.1. Releasing the doors



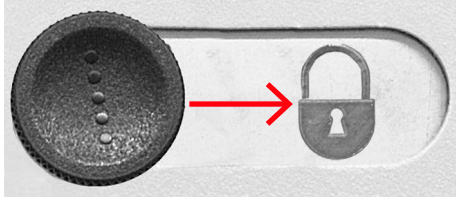
Key:

- (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.

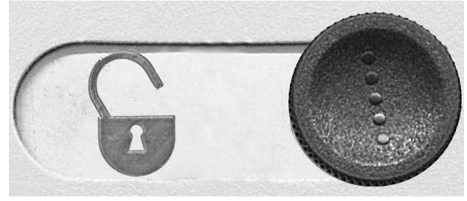
- To test the yellow lamp, press its push button.
If the lamp does not light up, see Section 10.4, “Removing the CDP control panel”, page 164.
- If the drive is in operation, stop the drive according to Section 8.9, “Stopping the drive”, page 132.
- To discharge the DC link of the drive, press the SUPPLY OFF push button on the local control panel.
The yellow lamp lights up when the DC link is discharged.
If the yellow lamp does not light up, see Section 10.4, “Removing the CDP control panel”, page 164.
- 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.

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1



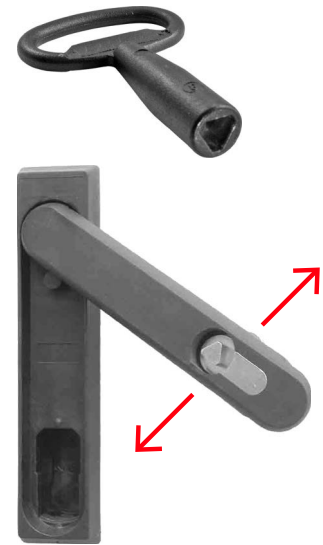
2



10.6.3.2. 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.

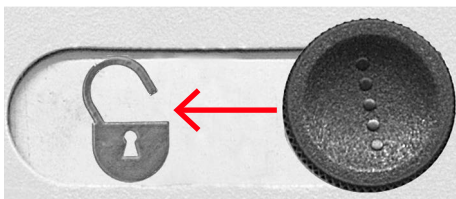


10.6.3.3. Closing and locking the doors

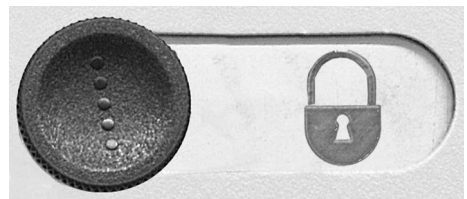
1. Align the door handle with its base and press the handle down until it snaps into place.
2. Verify that the drive is supplied with auxiliary voltage.
3. Slide the locking bar from the unlocked (1) to the locked (2) position.

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

1



2



10.6.4. 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 Section 8.9.1, “Stopping the drive in an emergency”, page 133
 - 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 Section 10.6.5, “Emergency release of a door safety switch”, page 174.

For information on the wiring of the control circuit, see the project-specific wiring diagrams in “Appendix D – Wiring diagrams”.

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10.6.5. 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 Section 10.6.2, “De-energizing the drive”, page 169.
- DO NOT unlock the safety switches permanently.

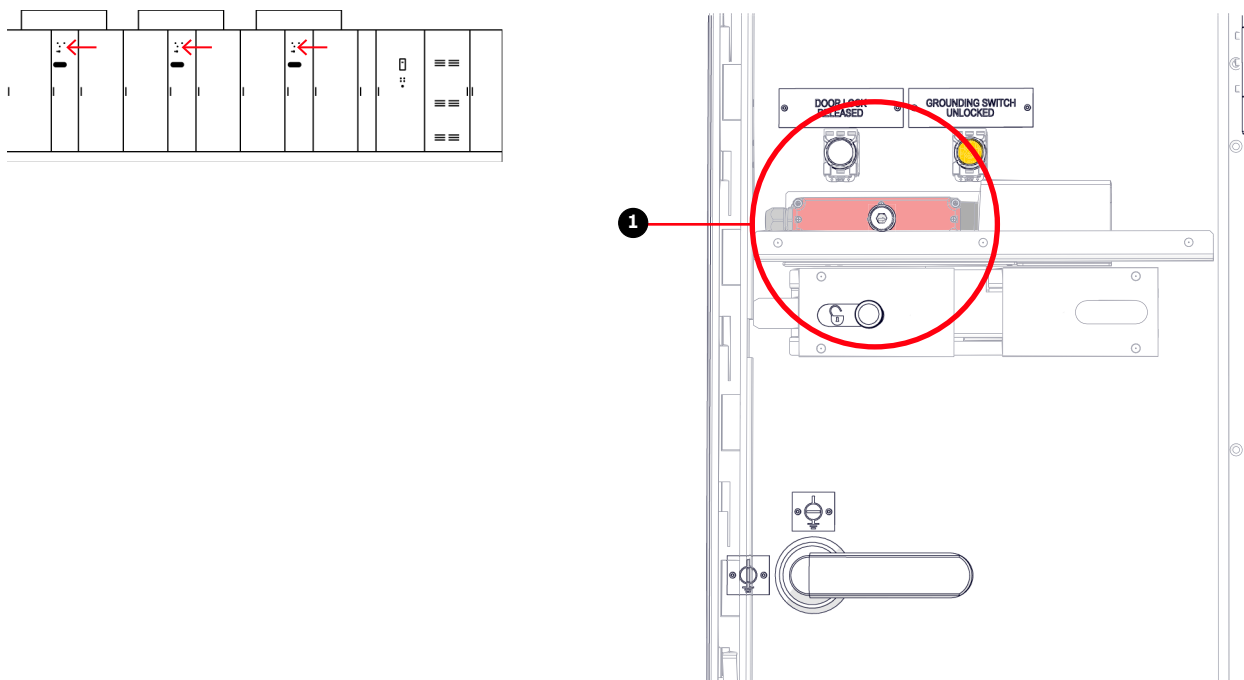
10.6.5.1. Location of safety switches

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 doors from being opened 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:

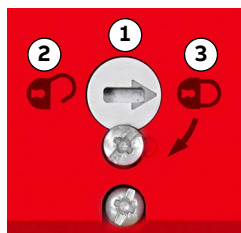
- (1) Safety switch behind door

Fig. 100. 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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10.6.5.2. Safety-switch settings



Key:

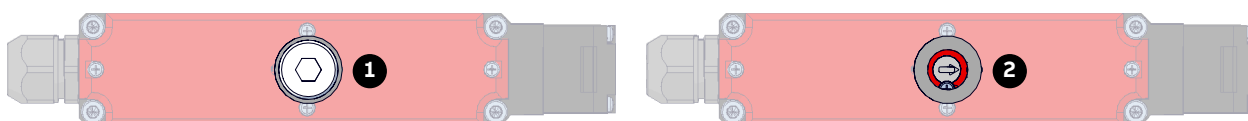
- (1) Release dial
- (2) Unlocked position: enables opening the door of a medium voltage unit whether the auxiliary voltage is switched on or off.
- (3) Locked position: Normal operating setting

Fig. 101. Safety switch

10.6.5.2.1. 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.



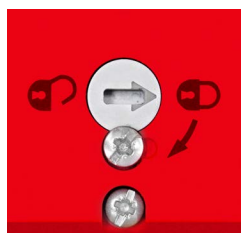
2. Turn out the locking screw (1) until the release dial can be turned.



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.

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10.6.6. 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.

10.6.7. 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.

10.6.7.1. 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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10.6.8. 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.

10.6.9. Checking and replacing 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 12 Filter mat specifications

Location	IP class	Filter class	Width (mm)	Height (mm)	Depth (mm)	ABB ID
WCU (back wall)	IP 54	G3 T15/150	250	125	10	3BHB028115R0002
EXU	IP 54	G3 T15/150	745	375	10	3BHB028115R0004
PCU	IP 42	G3 T15/150	600	652	10	3BHB030369R0800
PCU (FS2/FS4 only)	IP 42	G3 T15/150	600	352	10	3BHB030369R0500

10.6.9.1. Replacing filter mats

You can replace PCU and WCU filter mats.



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”.

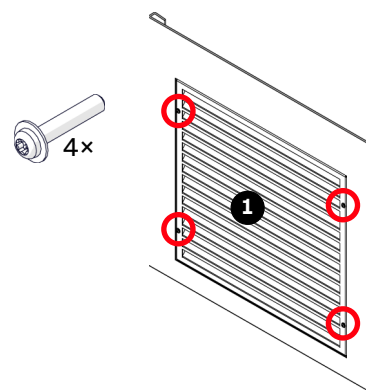
NOTICE

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

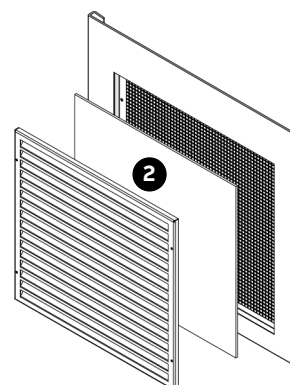
→ Always use a replacement filter mat with the same dimensions and filter class as the original filter mat (see Table 12).

10.6.9.1.1. Replacing a PCU filter mat

1. Remove the four screws from the air outlet panel (1) and then remove the panel.



2. Starting from the top, roll down the filter mat (2).



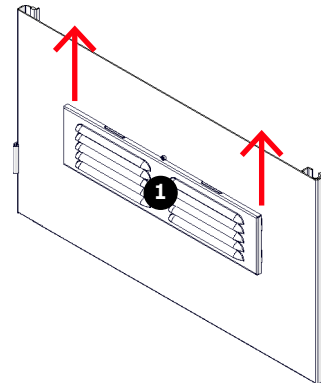
3. Insert the new filter mat.
NOTE – See Table 12 for the filter mat specifications.
4. Reattach the air outlet panel with the 4 screws.

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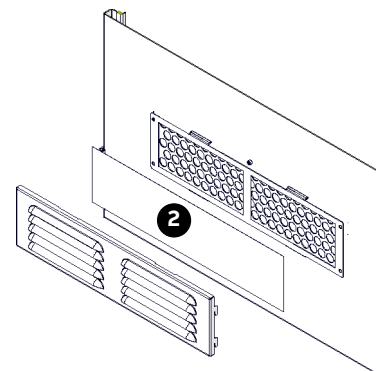
10.6.9.1.2. Replacing a WCU filter mat

Although checking and replacing the filter mats of the WCU compartment is possible during operation of the drive, it is easier to do it when the drive is shut down.

1. Slide the air outlet panel (1) up and then remove the panel.



2. Replace the filter mat (2).
NOTE – See Table 12 for the filter mat specifications.



3. Slide the air outlet panel back into place.

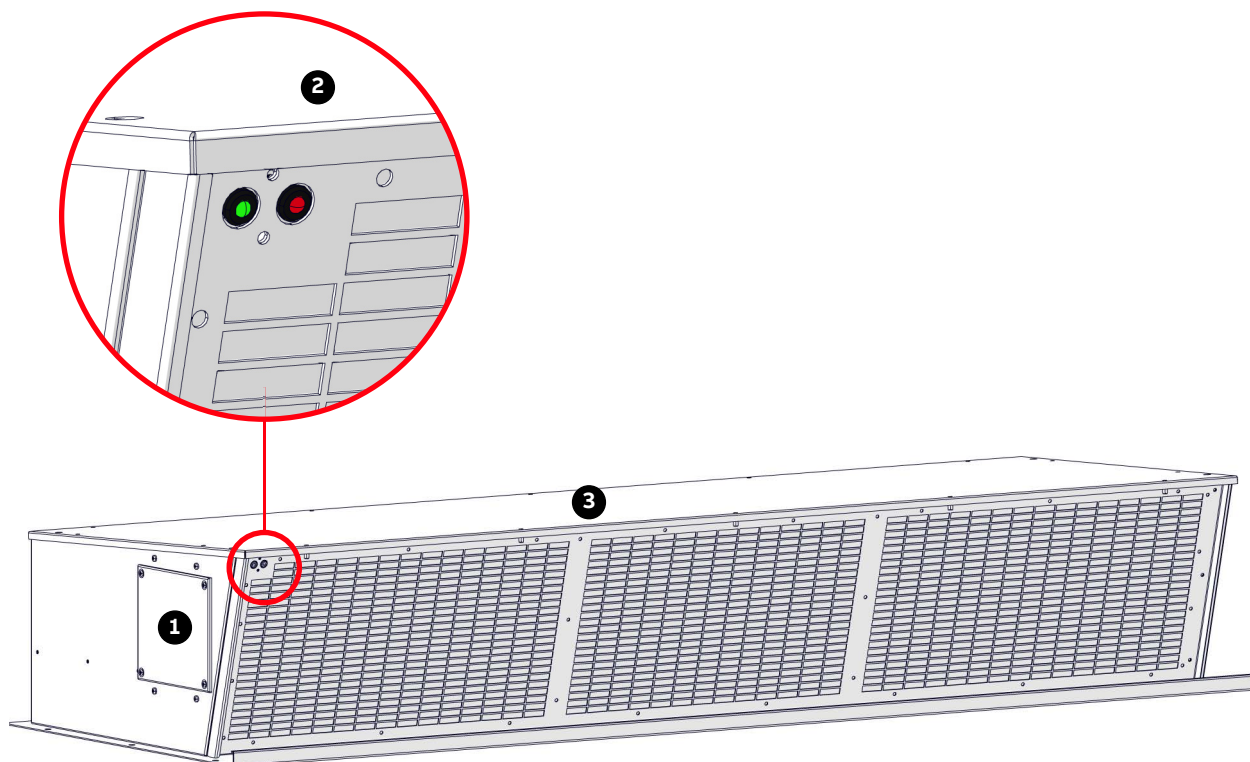
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10.6.10. Replacing a fan in an IP42 roof-mounted cooling unit

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)

Fig. 102. Roof-mounted cooling unit (IP42)

Dimensions (L × W × H)	1550 mm × 550 mm × 230 mm
Weight	40 kg

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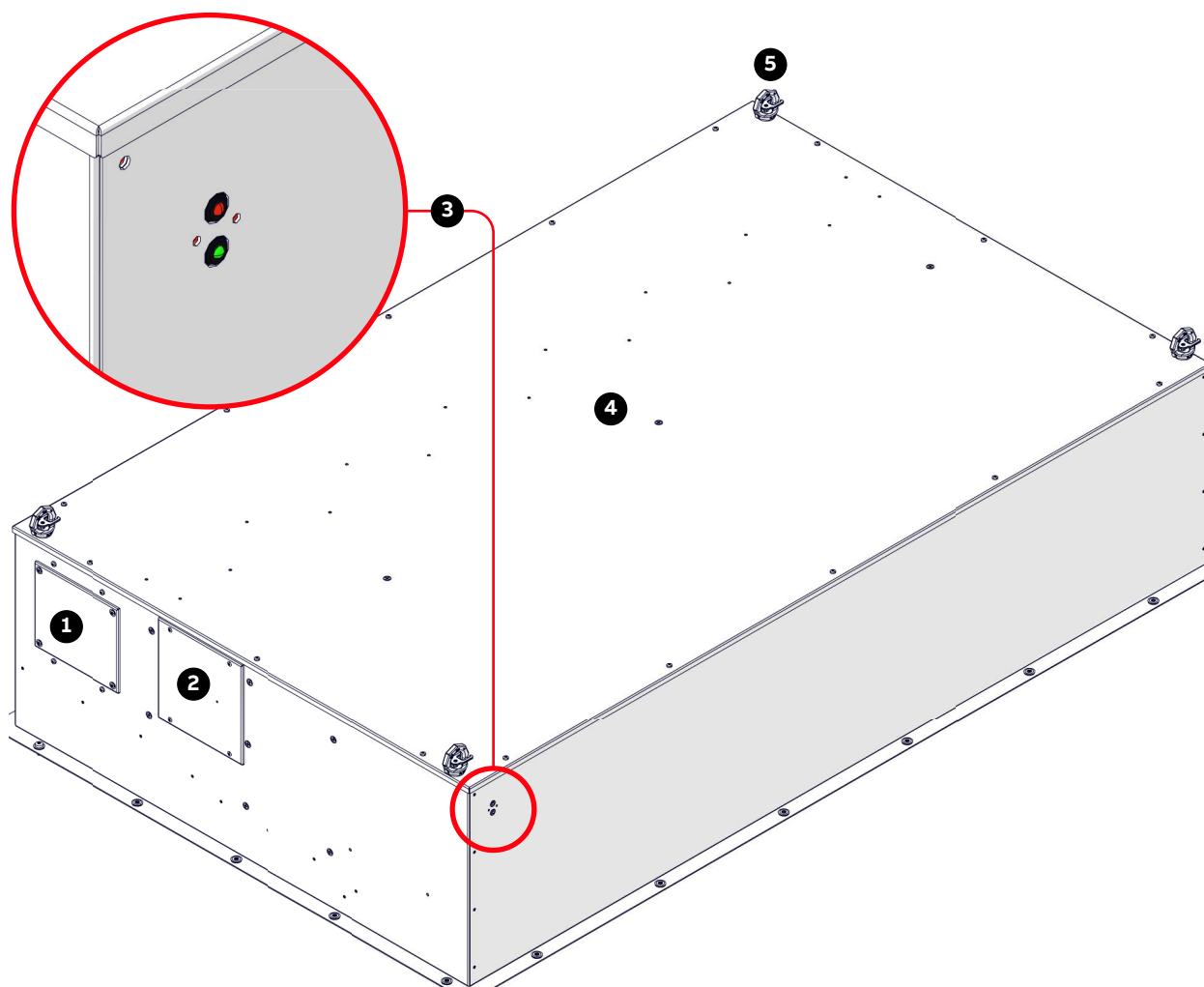
10.6.11. Replacing a fan in an IP54 roof-mounted cooling unit

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

Fig. 103. Roof-mounted cooling unit (IP54)

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

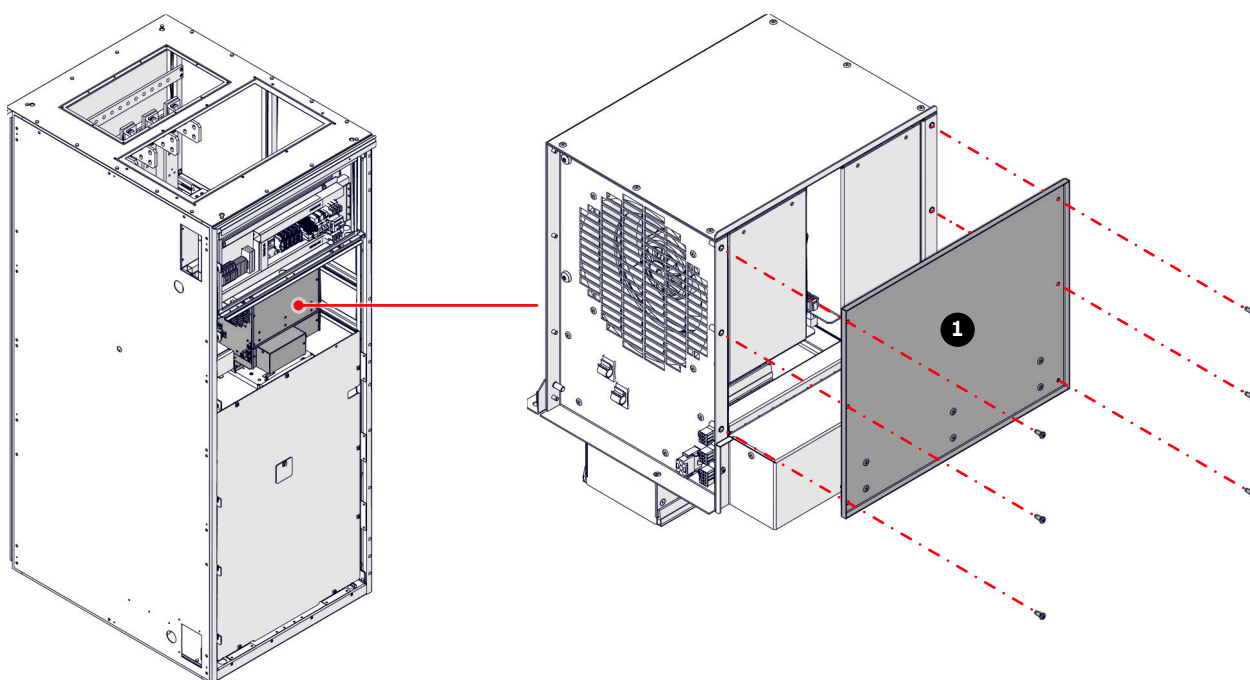
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10.6.12. Replacing a fan in an EXU with a DCS880 H4/DCT880 T4 controller



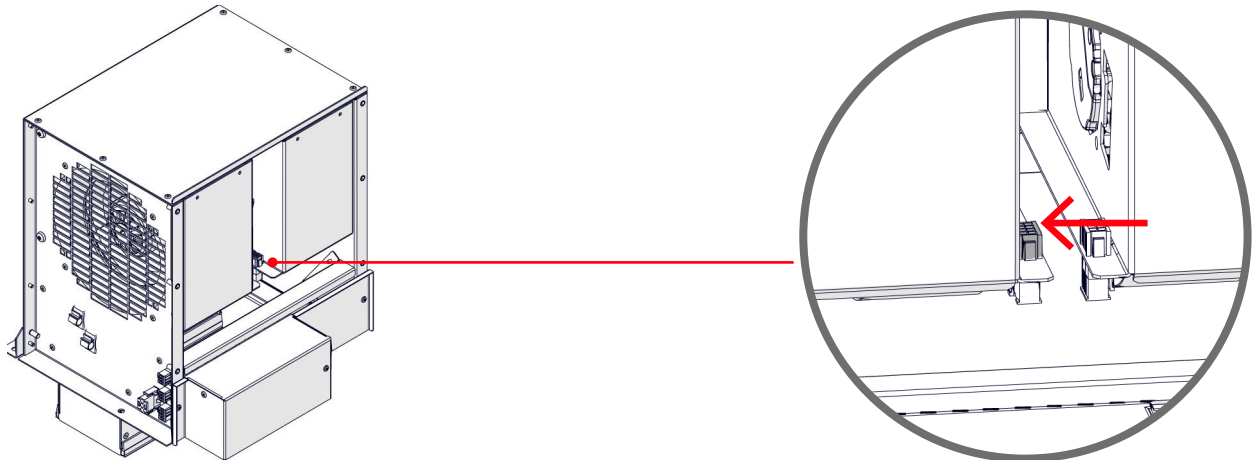
Fig. 104. DCS880 controller - size H4

1. Switch off the miniature circuit breaker of the fan unit.
NOTE – To identify the miniature circuit breaker, see “Appendix D – Wiring diagrams”.
2. Remove the 6 screws from the fan cover (1) and then remove the fan cover.

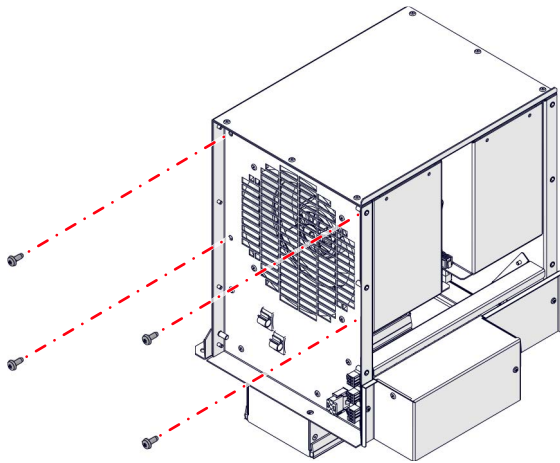


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3. Unplug the fan cables.

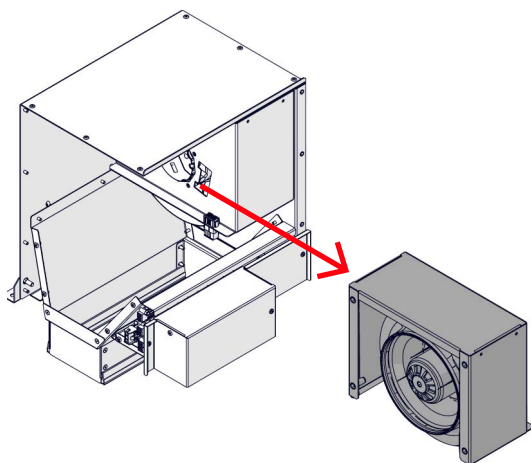


4. Remove the 4 fastening screws from the outside panel of the fan unit.



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.

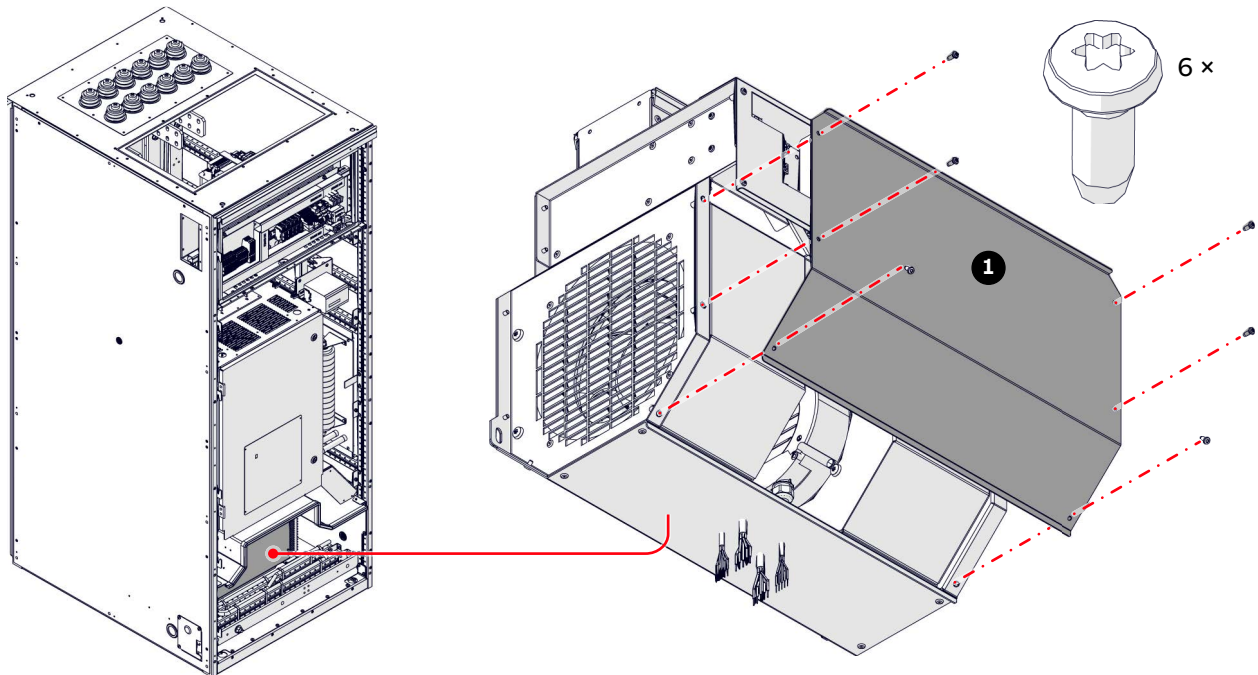
PRODUCT	DOCUMENT KIND	DOCUMENT ID.	REV.	LANG.	PAGE
ACS5000W gen. 2	User manual	3BHS799208 E01	J	en	183/186

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



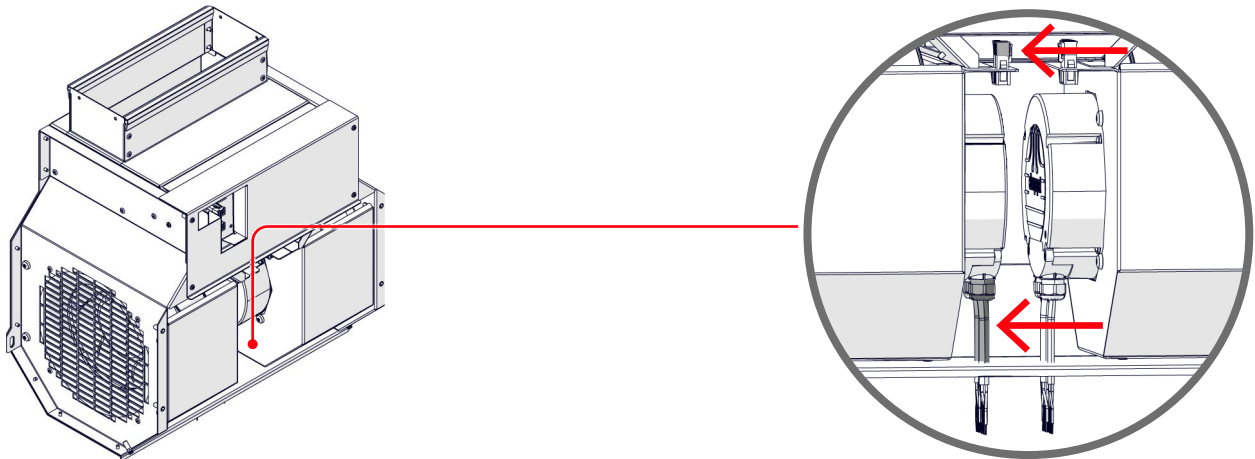
Fig. 105. DCS880 controller - size H6

1. Switch off the miniature circuit breaker of the fan unit.
To identify the miniature circuit breaker, see “Appendix D – Wiring diagrams”.
2. Remove the 6 screws from the fan cover (1) and then remove the fan cover.

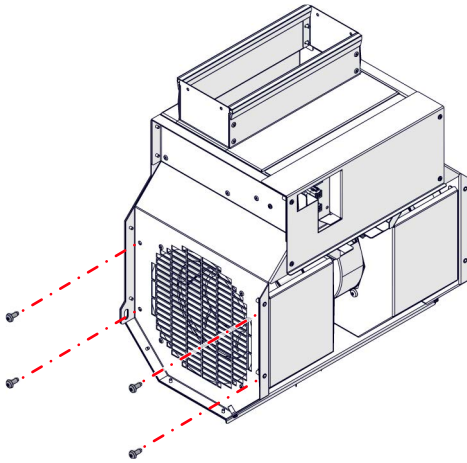


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3. Unplug the fan cables.

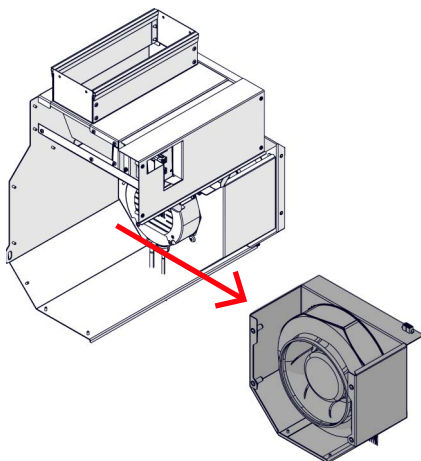


4. Remove the 4 fastening screws from the outside panel of the fan unit.



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

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



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

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