SYSTEM DRIVES

ACS6080

User manual

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1. About this manual

1.1. Product overview

The ACS6080 is a medium voltage drive that can control any type of AC motor, including high-power induction, synchronous, and permanent magnet motors.

The ACS6080 covers a power range of 3 – 36 MVA and delivers output frequencies of 0 – 75 Hz in the voltage range up to 3.3 kV.

Modular drive configuration

The ACS6080 has a modular design based on standardized units, each of which are dedicated to a specific function. The units are combined according to the required output power, motor configuration and process needs.

1.1.1. Standard applications

Typical fields of applications for the ACS6080 include:

- Marine
  - Main propulsion systems
  - Thruster drives

- Oil and gas
  - Compressors
  - Pumps
  - Extruders

- Metals and mining
  - Rolling mills
  - Mine hoists
  - Conveyors
  - Crushers and mills

- General industry
  - Variable speed fans and pumps
  - Pump storage plant drives
  - Test stand

1.2. 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.

1.3. 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 such as 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.

  NOTE – "Setting of protective devices" is generated according to the customer-specific project.

– **Appendix E - Parts list** is 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.

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
AC	Alternating current
ACS6080	ACS6080 medium voltage AC drive
AI	Analog input
ANSI	American National Standards Institute
AO	Analog Output
APU	Auxiliary Pump Unit
ARU	Active Rectifier Unit — rectifies the voltage of the supply network to the DC voltage and maintains the DC-link voltage at a constant level irrespective of changes in the supply network. The unit is designed as a self-commutated, 3-level voltage source inverter consisting of three identical phase modules. The unit allows regenerative braking.
ASE	Anti Saturation Equipment
Azipod®	ABB's electric propulsion system for ships

Term	Definition
BCU	Braking Chopper Unit
CBU	Capacitor Bank Unit
CCB	Converter Control Board
Control panel	Serves as the basic user interface for operating and monitoring the drive when the local operating mode has been selected, also known as assistant control panel.
CHU	Charging Unit
CIT	Conductivity Transmitter
CIU	Customer Interface Unit
Converter	Short form for ACS6080 frequency converter
COU	Control Unit — consists of a control compartment and a customer interface compartment. The control compartment incorporates the hardware for control, monitoring and protection functions of the drive and the communication interface to the door-mounted control panel.
CW1	Control water system 1
CW2	Control water system 2
CVMI	Current and Voltage Measuring Interface
DBC	Drive Backup Control
DC	Direct Current
DC_NP	DC Neutral Point. Neutral point of the DC-link of the drive
DCS	Acronym for the AC-to-DC converter or the three-phase AC power controller of an excitation unit
DDCS	Distributed drive control system. DDCS is an acronym for a serial communications protocol designed for data transfer via optical fibers.
DI	Digital Input
DIN	Deutsches Institut für Normung (German Institute for Standardization)
DO	Digital Output
Drive	Synonym for ACS6080 frequency converter
Drive Composer	Windows application for commissioning and maintaining ABB drives.
Drive system	Includes all equipment for converting electrical into mechanical power to give motion to the machine.
DTL	Direct-to-line
EAF	Earth Fault monitoring device
ECB	EXU Circuit Breaker
EIB	EXU Input Breaker
EIC	EXU Input Contactor
EIS	EXU Input Switch — general term for EIC (EXU input contactor) and EIB (EXU input breaker)
EMC	Electromagnetic Compatibility
EOB	EXU Output Breaker

Term	Definition
EOC	EXU Output Contactor
EOD	EXU Output Disconnector
EOS	EXU Output Switch — general term for EOC (EXU output contactor) and EOB (EXU output breaker)
Equipment	Frequency converter and related equipment
EXU	Excitation Unit — supplies excitation power to a synchronous motor.
FBA	Fieldbus Adapter
FCB	Function Chart Builder
FCI	Fieldbus Communication Interface
FFU	Fin Fan Unit
FIR filter	Fast Impulse Response filter
FIS	Flow meter
FRD	Full Redundant Drive — drive configuration with two identical ACS6080 drives that operate a double winding synchronous motor. Each drive has a separate transformer and MCB. The motor can be operated by both drives (full mode operation) or one drive (half mode operation).
FSCD	Fast Short-Circuit Detection
FT	Firing Through — synonym for protective firing. Meaning: simultaneous gating of the power semiconductors of the inverter unit to effectively protect the semiconductors against overvoltage and overcurrent.
Ground (noun)	Earth
ground (verb)	The conducting path (eg, conductor) between the electric equipment (eg, frequency converter) and the earth. The electric equipment is connected to the earth, eg, by a grounding set or a grounding switch.
GCT	Gate-Commutated Thyristor
GTO	Gate Turn-Off thyristor
HVD	High Voltage Divider
I/O	Input / Output
IEC	International Electrotechnical Commission
IFU	Input Filter Unit
IGBT	Insulated-Gate Bipolar Transistor
IGCT	Integrated Gate-Commutated Thyristor
ISU	Isolation Unit
IM	Induction Motor
INT	Interface circuit board
INU	Inverter Unit — converts the three DC voltages to the required AC motor voltage. The unit is designed as a self-commutated, 3-level voltage source inverter consisting of three identical power modules.
I/O device	Term ABB's S500 I/O system. An I/O device consists of a module termination unit (MTU) and one I/O module.

Term	Definition
I/O module	Term of ABB's S500 I/O system. The I/O module is an active input or output device for digital or analog signals.
I/O station	Term of ABB's S500 I/O system. The I/O station typically consists of a bus modem and several input and output devices.
IOI	Inverter Output Isolator — a switching device that disconnects the inverter from the motor.
IP	Ingress Protection — the IP code specifies the degree of protection provided by an enclosure.
IPS	Isolated Power Supply
Line voltage	RMS voltage of the main power supply of the drive
LSU	Line Supply Unit — rectifies the AC line voltage and supplies the electrical energy to the DC-link capacitors.
MCB	Main Circuit Breaker — major protection device of the drive and the main connection and disconnection point between the main power supply and the drive.
MP^3C	Model predictive pulse pattern control
MSM	Main State Machine
MVD	Medium Voltage Drive
NBIO	Fast I/O module
NDBU-95	DDCS branching unit
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 — refers to the neutral point of the DC-link
NTAC	Pulse encoder interface module
OCB	Output Circuit Breaker
PAI	Pulse Amplifier Interface board
PCB	Printed Circuit Board
PE	Protective Earth — ground bus for the connection of the ground cable
PFF	Power Feed Forward
PF	Power Failure
PG	Power Ground — ground bus for the connection of cable shields
Phase module	The phase module is a compact assembly of wired components including the power semiconductors that serves as a standardized building block for the ARU, LSU and INU of the drive.
POM	Power Operation Mode
PPCC	Power Plate Communication Circuit
PPCS	Power plate communication system — PPCS is an acronym for a serial communication protocol designed for data transfer via optical fibers between AMC circuit board and INTerface circuit boards
PUB	PPCS unit for branching software running on an INT circuit board that is used for data branching

Term	Definition
PUPA	Pulse pattern
PWM	Pulse width modulation
RAL	German color standard
RBU	Resistor Braking Unit
RDC	Redundant Drive Control Unit
RDI	Redundant Drive Interface
RDR	Receive Data Register
RMD	Rolling Mill Drive
RPM	Revolutions Per Minute
S500 I/O	The S500 I/O is a distributed process input output system that can be connected to various process controllers from ABB and other companies.
SC	Short-Circuit
SM	Synchronous Motor
SRD	Semi-Redundant Drive
SSI	Synchronous Serial Interface — a point-to-point, serial communication interface for digital data transmission between a master (eg, drive) and a follower (eg, sensor).
TEU	Terminal Unit — provides the terminals for the transformer and motor cables, the ground frame for the cable screens and the ground cable, and the grounding accessories.
THD	Total Harmonic Distortion
TT	Temperature Transmitter
UCU-26	Control unit that controls converters via fiber optic links and electrical interfaces.
UNICOS	Operating system
UPS	Uninterruptible Power Supply
USB	Universal Serial Bus
VLSCD	Voltage Limiting Short Circuit Detection
VLU	Voltage Limiter Unit
VSD	Variable Speed Drive
VSI	Voltage Source Inverter
WCU	Water Cooling Unit — dissipates the heat from the power electronics components of the drive.
Zero speed threshold	Used in the manual to indicate that the drive has reached the value “zero speed” that is set in a parameter. The value can be set in the range of 0 and maximum speed (the unit for the speed is rpm).

1.5. Related documents

The following documents are available for supplementary information:

1.5.1. Maintenance

Title	ABB ID
ACS6080 preventive maintenance schedule	3BHS838899 E01

1.5.2. Technical data

Title	ABB ID
Technical data from drive smart (configuration software for medium voltage drives)	
Air-cooled excitation units, brush brushless excitation technical data	3BHS262785 E01

1.5.3. Schematics

Title	ABB ID
Layout drawing	Project-specific

1.5.4. Specifications and guidelines

Title	ABB ID
Main circuit breaker specification	3BHS125149 E60
ABB MVD ACS Transformer Specification	3BHS356582 E01
ABB MVD ACS Motor Specification	3BHS824803 E01
Technical project Specification Motor	3BHS824804 E01
ABB MVD ACS High Performance Motor Specification	3BHS824805 E01
Power cable specification	3BHS125090 E01
Power cables engineering guideline	3BHS542290 E01
Auxiliary power and control cables guideline	3BHS813742 E01
Voltage transformer requirement specification	3BHS125393 E01
Emergency-off and stop modes and prevention of operation	3BHS196243 E01
Recycling instructions	3BHS122085 E01
Environmental information, material declaration	3BHS360175 E01
Roxtec CF16EMC installation instructions	3BHS820829 E01
ACS6000/ACS6080 label placement	3BHS544773 E01
Painting specification for ACS1000, ACS2000, ACS5000 and ACS6000/ACS6080	3BHS104301 E01
Wiring and Busbar Specification	3BHS205465 E01
Application note - Air gap torque pulsation limits	3BHS210587 E01

1.5.5. Service

Title	ABB ID
Service equipment	3BHS264536 E01

1.5.6. Communication interfaces

Title	ABB ID
Absolute Encoder interface FEN-11 user manual	3AFE68784841
ACX-AP-x Assistant control panels user manual	3AUA0000085685
Emergency off/stop modes and prevention of operation & safe torque off	3BHS196243
HTL Encoder Interface FEN-31 user manual	3AUA0000031044
Modbus TCP - NETA-21 remote monitoring tool user manual	3AUA0000096939
PLC Automation: PLCs, control panels, Engineering Suite AC500, CP600, Automation Builder	3ADR020077C0204
I/O configuration S500/BCON for ACS6080	3BHS830984 E01
System assembly and device specifications for AC500 V2 Products	3ADR010121

1.5.7. Manuals related to drive units

Title	ABB ID
ACS6080 INU primary control program firmware manual	3BHS858986 E01
ACS6080 ARU primary control program firmware manual	3BHS858986 E02
ACS6080 SFC primary control program firmware manual	3BHS858986 E03
ACS6080 INU primary control program troubleshooting manual	3BHS858986 E11
ACS6080 ARU primary control program troubleshooting manual	3BHS858986 E12
ACS6080 SFC primary control program troubleshooting manual	3BHS858986 E13
ACS6080 technical catalog	3BHS852904 E01
ACS6080 spare part packages	3BHS844005 E01
UCU-26 control unit hardware manual	3BHS897436 E01
ACS5000, ACS6000 and ACS6080 water cooling unit WCU800 user manual	3BHS821937 E01
ACS5000, ACS6000 and ACS6080 water cooling unit WCU1400 user manual	3BHS835714 E01

1.6. 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.

1.6.1. Handling

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

1.6.2. 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.

1.6.3. Electrical installation

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

1.6.4. 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.

1.6.5. 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

1.7. 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.

1.8. Intended use of equipment

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

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

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

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

1.9. 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”)

1.9.1. 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 60721-3-1	Classification of environmental conditions: Classification of groups of environmental parameters and their severities; Storage
IEC 60721-3-2	Classification of environmental conditions: Classification of groups of environmental parameters and their severities; Transportation
IEC 60721-3-3	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weather-protected locations
ISO 3506-1	Mechanical properties of corrosion-resistant stainless steel fasteners - Part 1: Bolts, screws and stud
IEC 81346-1	Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations - Part 1: Basic rules
IEC 62477-2	Safety requirements for power electronic converter systems and equipment Part 2: Power electronic converters from 1000 V AC or 1500 V DC up to 36 kV AC or 54 kV DC

1.10. 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.

1.11. 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 Service Equipment manual.

1.12. 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 27.

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…”
Italic text	Identifies software parameters, eg, *16.02 PARAMETER LOCK*.
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
Underlined text	Identifies a hyperlink
`Courier font`	Identifies software file names and file paths
Cursor	Represents blinking text on a screen

Symbols

Symbol	Description
① ❷ ❸	Figure callout on an image
	These pictograms refer to the subject matter of the text.
	See Section 2.1.2, “Safety signs”, page 27.

2. Important safety information

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

2.1. Safety messages and safety signs in this document

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

2.1.1. Safety messages

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

2.1.2. Safety signs

Sign	Description	Sign	Description	Sign	Description
	Refer to the instruction manual		Arc flash warning		Electrotechnical expertise
	Hazardous voltage warning		Falling objects warning		Elapsed time
	Overhead load warning		Automatic start-up warning		
	Tipping hazard		Electrostatic discharge susceptibility		

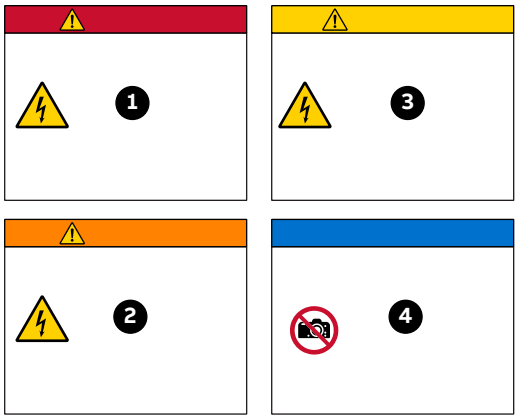
2.2. Product safety labels

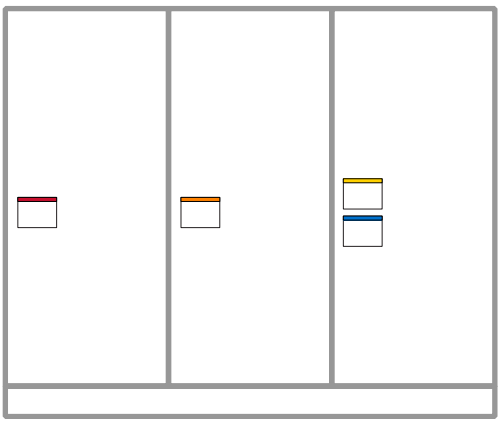
Product safety labels on the equipment alert you to the hazards that can occur when you work on or operate the equipment.

– Always follow the instructions on the labels to avoid the hazard

– Keep the labels in a perfectly legible condition

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





Key:

(1) Danger label
(2) Warning label
(3) Caution label
(4) Notice label

Fig. 1. 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 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) **While working on the drive:**
   - Do not step on the roof
   - Do not install foreign objects on the roof

5) **Before working on a water cooling unit (WCU):**

   In addition to the safety instructions for working on a drive, always read the WCU safety data sheet for relevant safety information, eg, the type of ion exchange resin and glycol.

6) **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

7) **In case of fire in the drive room:**
   - Observe the established rules and regulations for fire safety
   - Only allow firefighters with the appropriate PPE to enter the drive room

2.3.2. The 7 steps that save lives

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

1) **Prepare for the work: do an on-site risk assessment or job hazard analysis that considers the limits of approach for shock and arc-flash.**
   - Be in possession of a clear work order to execute the work.
   - When required, the access or work permit is to be obtained by a person who is authorized for the specific electrical system.
   - Engage the person responsible for electrical equipment or system to review single-line diagrams, schematics, switching plans, etc.
   - Ensure the competence of workers.
   - Check for proper tools for the job.
   - Determine and select the proper arc-rated Personal Protective Equipment (PPE).
   - Decide of the appropriate work methods and initiate the Permit To Work (PTW) process.

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

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

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

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

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

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

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

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

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

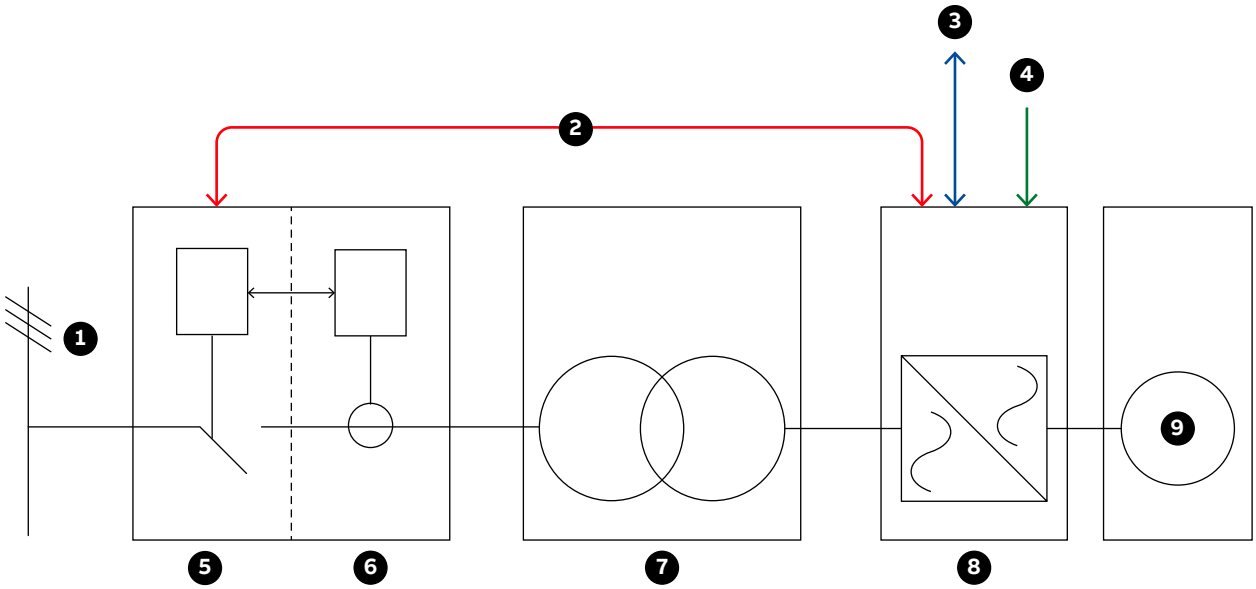
2.3.3. Possible residual risks

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
   - Incorrectly connected cables
   - External influence on, or damage of the equipment
   - Incorrect 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, eg, due to incorrect disposal of components**

2.4. Main circuit breaker protection device

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



Key:

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

Fig. 2. Drive system overview

NOTE – MCBs and protection relays are not included in the drive supply.

Typical MCBs devices

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

Dedicated protection relay

– Transformer or drive primary cable protection (DTL)
– Transformer protection (if applicable)
– Transformer secondary cable protection (if applicable)
– Backing up the drive protection

2.4.1. Safety and protection requirements

The system integrator must ensure that the following minimum safety and protection requirements for the drive are met:

- ISO 13849-1
- IEC 60204-1

2.4.2. Safety and protection requirements for the MCB

The following safety requirements are also in the MCB specifications for the drive:

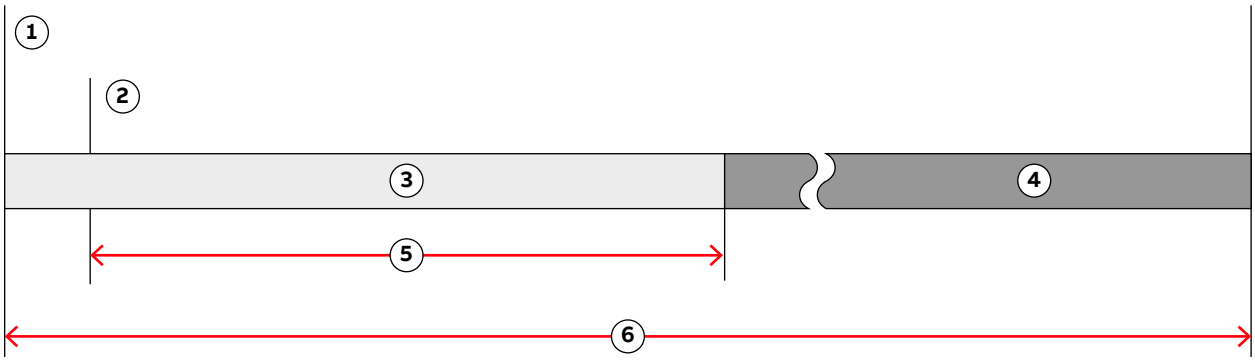
- **MCB open and/or trip command:** must be wired directly from the drive to the MCB. If you want to wire the command through a PLC or DCS system, the system must be certified to meet SIL three-level requirements and to fulfill the maximum MCB opening timing requirements. The drive must also be able to open the MCB at any time. It is not permitted to interrupt the open and/or trip command, eg, with a local-remote switch in the MCB.
- **Closing control of the MCB:** when the MCB is in service position, the drive must have exclusive control over closing the MCB, ie, local closing of the MCB is not permitted.
- **MCB maximum opening time:** cannot exceed the maximum time that is defined in the product or project-specific 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.



Key:

(1) Short-circuit occurs
(2) Open and or trip command is set at the drive control output
(3) No further damage to the drive
(4) No hazard to personnel
(5) Maximum protection trip time
(6) Maximum safety trip time

Fig. 3. MCB opening timing diagram

In order to meet the stipulated safety requirements, ABB recommends one of the following:

– MCB is equipped with 2 independent opening coils

– MCB is equipped with an opening coil and an undervoltage coil for monitoring of the control voltage

– Upstream protection coordination scheme is provided which uses the “breaker failure” (ANSI 50BF) signal to automatically trip the upstream breaker, in case the MCB does not open.

  IMPORTANT! The upstream breaker must open within the maximum safety trip time after a failure has occurred.

2.5. Maintenance recommendation

The MCB trip circuits should be checked annually.

3. Power electronics and cabinet features

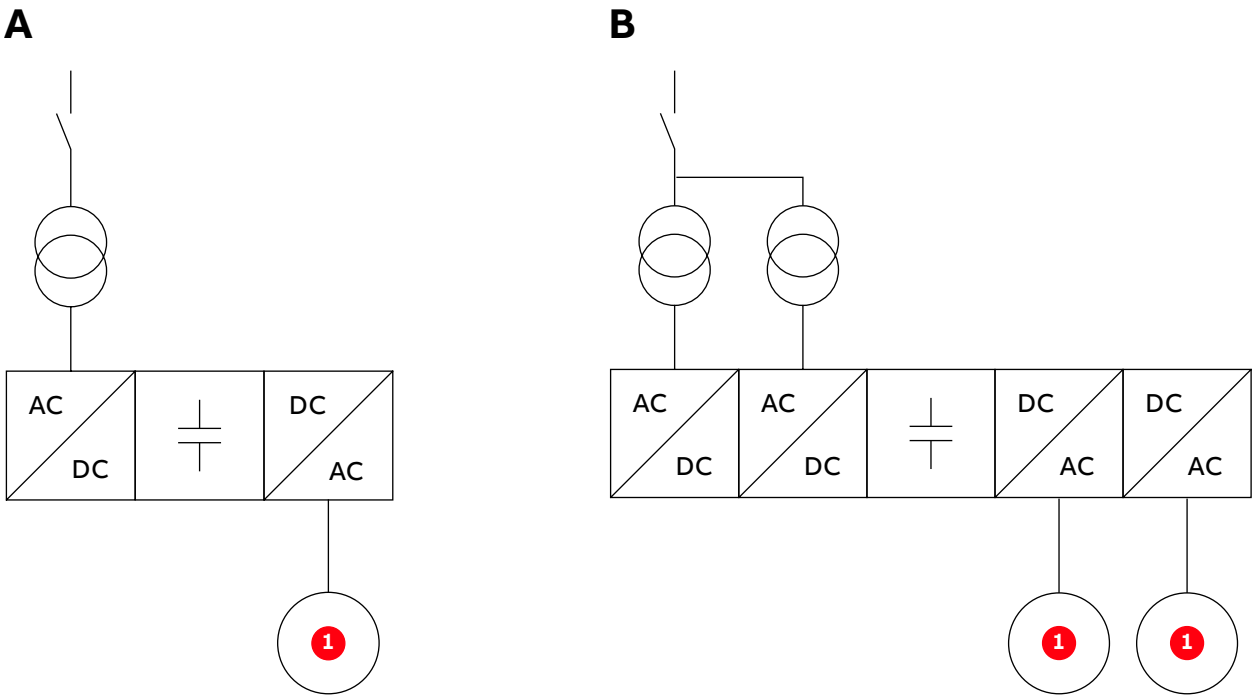
3.1. Drive system topology

The ACS6080 drive system consists of the following components:

- **Main circuit breaker:** See Section 2.5, “Maintenance recommendation”, page 34.
- **Input transformer:** Required if the line voltage must be adapted to the motor voltage. For more information, see the “Main transformer specification”.
- **Drive**
- **Motor**

3.1.1. Drive

The ACS6080 is a voltage source frequency converter for high-power induction and synchronous motors. The drive features a common DC bus permitting the configuration of single-motor or multi-motor solutions.

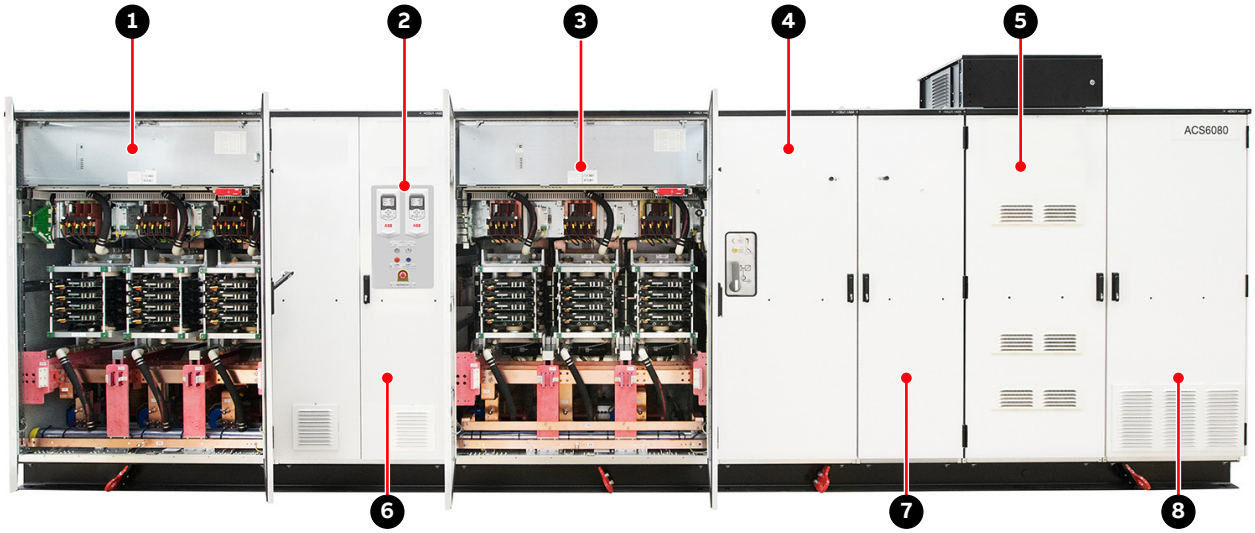


Key:

(1) Motor

Fig. 4. Common DC-bus principle for (A) single motor drive and (B) multi-motor drive

The drive has a flexible modular design with standard and optional cabinet units. Each cabinet unit is dedicated to a specific function.



Key:		Explanation
(1)	Active rectifier unit (ARU)	Self-commutated, 6-pulse, 3-level voltage source inverter with IGCT technology
(2)	Drive control panel for local operation	Keypad with multi-language display, main supply on/off push buttons, and emergency-off push button
(3)	Inverter unit (INU)	Self-commutated, 6-pulse, 3-level voltage source inverter with IGCT technology
(4)	Capacitor bank unit (CBU)	DC capacitors for smoothing the intermediate DC voltage
(5)	Water cooling unit (WCU)	Supplies deionized water for cooling the main power components
(6)	Terminal unit (TEU) and control unit (COU)	Contains the power terminals and the control swing frame
(7)	Braking chopper unit (BCU), resistor braking unit (RBU) or voltage limiter unit (VLU)	Optional cabinet units
(8)	Excitation unit (EXU)	Optional cabinet unit that supplies a synchronous motor with excitation

Fig. 5. ACS6080 drive example

The drive is assembled from standard and optional cabinet units. Each unit is dedicated to a specific function.

For more information on the cabinet units in your drive, see the layout drawing in “Appendix C - Mechanical drawings”.

3.1.1.1. ACS6080 cabinet units

Standard cabinet units	Optional cabinet units
– Active rectifier unit (ARU) – Inverter unit (INU) – Line supply unit (LSU) – Capacitor bank unit (CBU) – Terminal unit (TEU) – Control unit (COU) – Water cooling unit (WCU)	– Input reactor unit (IRU) – Input filter unit (IFU) – Voltage limiter unit (VLU) – Braking units: • Resistor braking unit (RBU) • Braking chopper unit (BCU) – Excitation unit (EXU) – Customer interface unit (CIU)

3.1.1.2. Final drive configuration

The final drive configuration depends on the following factors:

– Required output power

– Configuration of the main power supply (input transformer or direct-to-line connection)

– Ability to recover energy (active or diode front end)

– Motor type (synchronous or asynchronous)

– Single or multi-motor application.

3.1.2. Motor

See the “Motor specification”.

3.2. Standard cabinet units

The following sections describe the ARU, INU, LSU, CBU, TEU, COU and WCU cabinets.

3.2.1. Active rectifier unit (ARU)/inverter unit (INU)

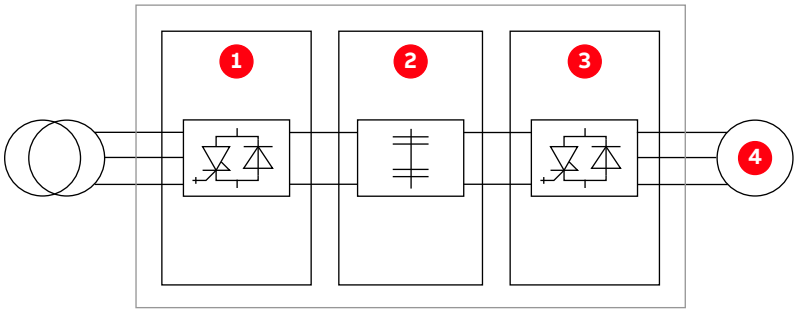
An ARU and INU have the same mechanical and electrical designs.

– **ARU:** 6-pulse self-commutated voltage source inverter that rectifies the line voltage of the supply network and maintains the DC-link voltage at a constant level irrespective of changes in the supply network.

  The active 6-pulse rectifier allows for regenerative braking.

– **INU:** controls the 3-phase motor voltage and converts the DC-link voltage to the required AC motor voltage and frequency.

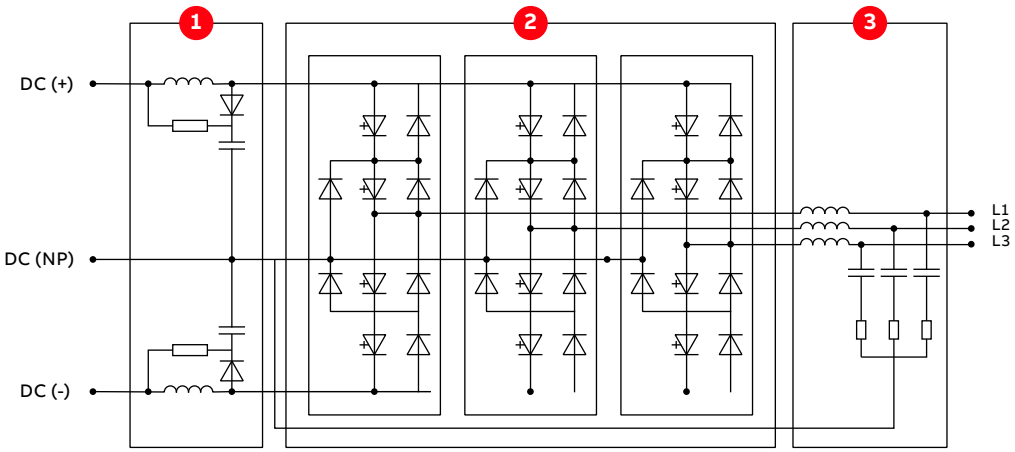
  The INU is a self-commutated voltage source inverter in 6-pulse, 3-level topology. To increase the drive power, 4 units can be operated in parallel on 1 motor.



Key:

(1) ARU
(2) DC-link
(3) INU
(4) Motor

Fig. 6. ARU/INU block diagram



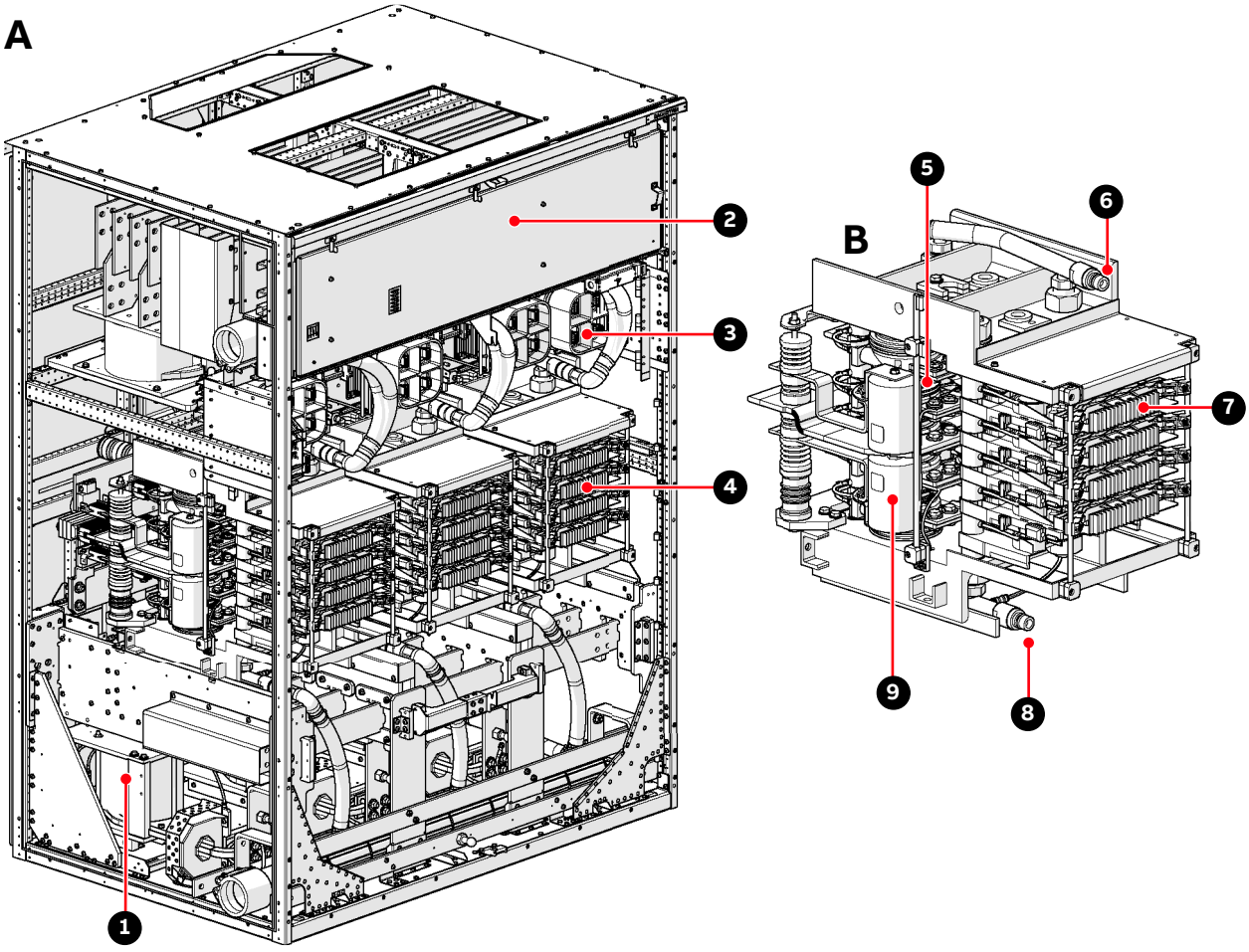
Key:

(1) Clamping circuit
(2) Phase modules
(3) EMC filter

Fig. 7. ARU/INU circuit diagram

TABLE 1 Main components in an ARU/INU cabinet

Component	Description
Phase module	Consists of integrated gate-commutated thyristors (IGCTs), diodes and clamp capacitors. The phase modules are identical in construction for all power ratings. However, the types of semiconductors vary depending on the power rating. For this reason, it is not possible to mix phase modules for different power ratings in one unit.
Clamping circuit	Protects the circuit from excessive rises in current with di/dt reactors and freewheeling diodes.
Electromagnetic compatibility (EMC) filter	Protects the transformer from excessive voltage slopes



Key:

(1) EMC filter
(2) Control interface
(3) IPS
(4) Phase module
(5) Diode
(6) Coolant outlet
(7) IGCT
(8) Coolant inlet
(9) Clamp capacitor

Fig. 8. (A) ARU/INU and (B) phase module with IGCTs

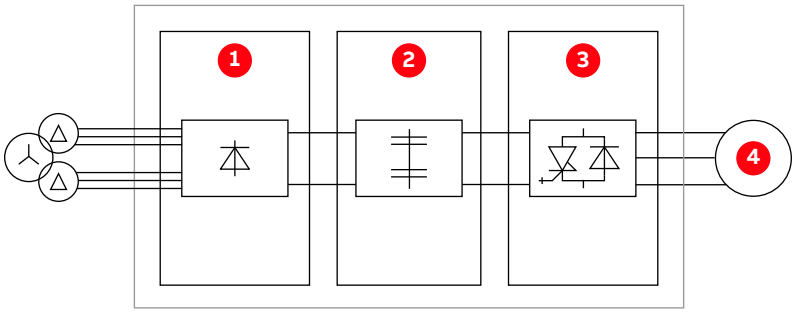
3.2.2. Line supply unit (LSU)

The LSU is a 12-pulse rectifier that rectifies the AC line voltage and supplies the DC-link with electrical energy. An LSU is used with input transformers and is available in various power ratings.

The LSU allows two-quadrant operation and maintains the power factor at 0.95 in the whole operating range.

To achieve 24-pulse rectification or to increase the drive power, units with the same power rating can be operated in parallel.

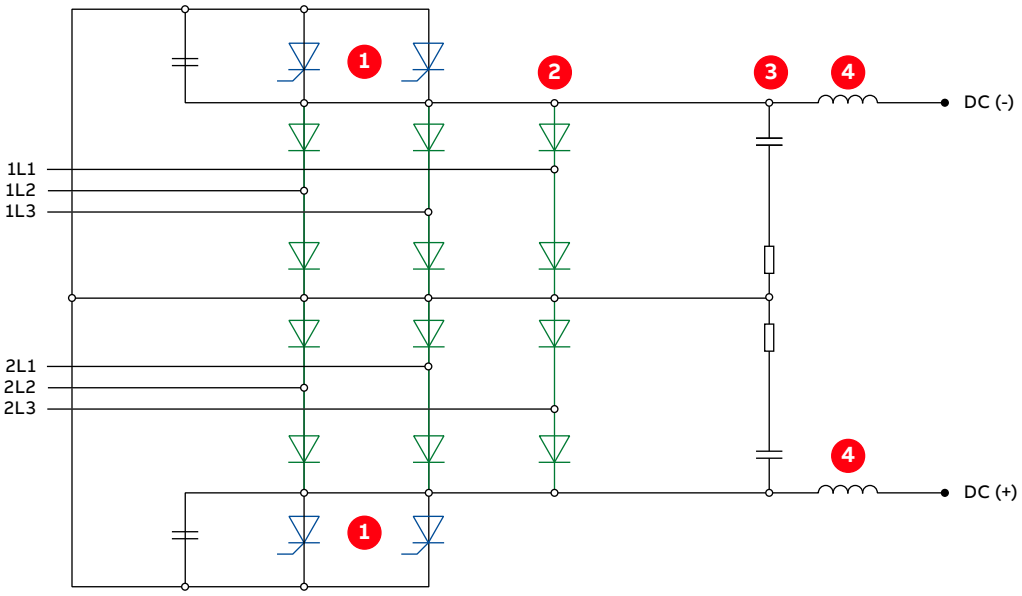
Two different types of LSUs exist.



Key:

(1) LSU
(2) DC-link
(3) INU
(4) Motor

Fig. 9. LSU block diagram



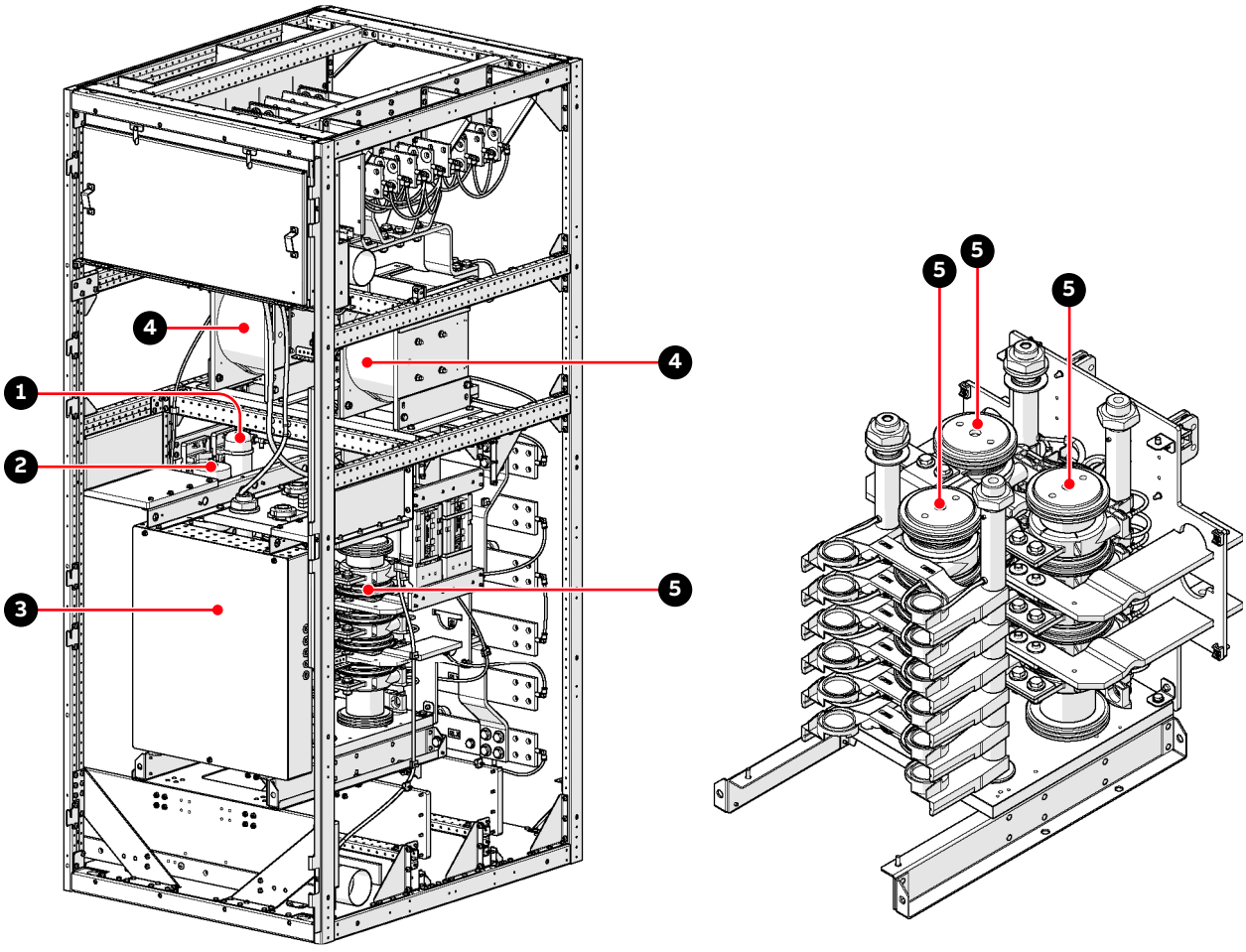
Key:

(1) Thyristor crowbar
(2) Diode rectifier
(3) Snubber circuit
(4) di/dt choke

Fig. 10. LSU (12-pulse) circuit diagram

TABLE 2 Main components in a 12-pulse LSU cabinet

Component	Description
12-pulse diode rectifier	
Snubber circuit	Limits the rate of the voltage rise (dv/dt) across the diodes and the crowbar thyristors.
di/dt limiting reactors	Define the current rise in the thyristor crowbar.
Thyristor crowbar	Protection circuit that activates when a short-circuit occurs. By applying protection firing, the thyristor crowbar short-circuits the rectifier to prevent further damage of the drive.



Key:

(1) Snubber resistor
(2) Snubber capacitor
(3) Rectifier monitoring unit
(4) di/dt limiting reactors
(5) Diode stacks

Fig. 11. LSU (12-pulse)

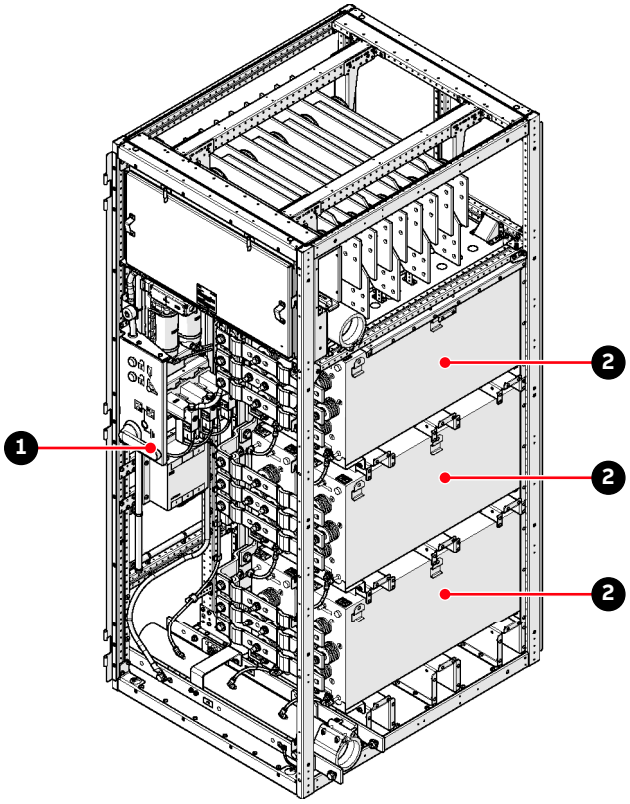
3.2.3. Capacitor bank unit (CBU)

The capacitor bank unit (CBU) smooths the DC-link voltage and decouples the rectifier from the inverter. A CBU consists of DC-link capacitors, a charging unit and a grounding switch. The CBU is based on a modular design and the amount of DC-link capacitors in the CBU depends on the converter power rating.

The width of the unit (800 mm or 1000 mm) depends of the number of capacitors that are required.

TABLE 3 Main components in a CBU cabinet

Component	Description
Liquid-cooled DC-link capacitors	
Charging unit	To avoid excessive inrush currents after the main circuit breaker has been closed, the capacitors are charged before the drive is connected to the main power source.
Discharging unit	This optional unit discharges the DC-link capacitors if the drive is not equipped with a voltage limiter unit, resistor braking unit or braking chopper unit.
Grounding switch	The grounding switch is a safety switch to ground the DC bus of the drive. These can only be closed if the DC-link capacitors have been discharged. For more information, see Section 8.4.4, “EXU control panel”, page 151.



Key:

(1) Grounding switch

(2) DC-link capacitor

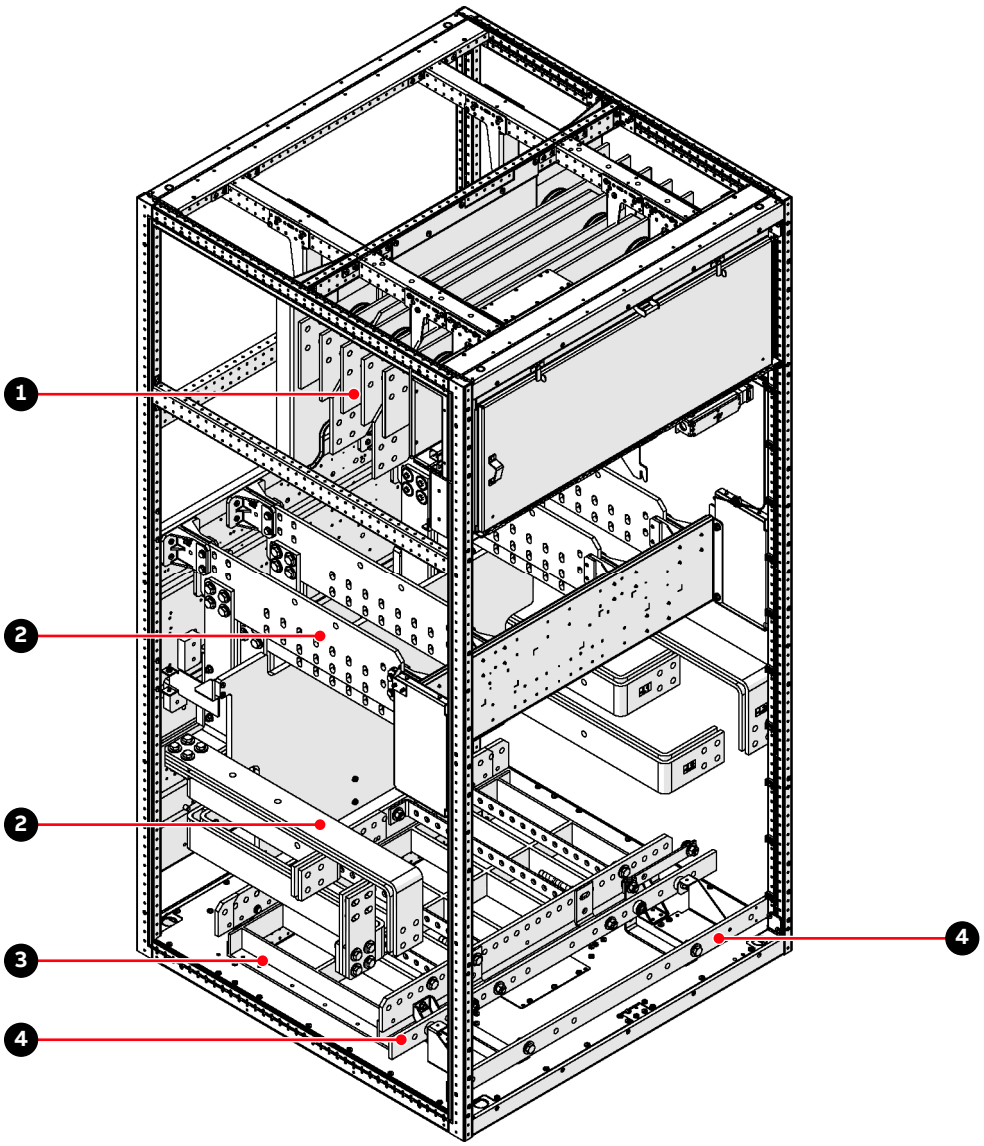
Fig. 12. CBU

3.2.4. Terminal unit (TEU)

Mains and motor cables of the drive are connected to terminal busbars of TEUs. These units are designed for top or bottom cable entry.

The terminal units are available either as individual units or are integrated into a master COU or ARU.

The width of the unit (600 mm or 1000 mm) depends of the number of line supply units or active rectifier units and/or the motors supplied via one terminal unit.



Key:

(1) DC busbars
(2) AC busbars
(3) Cable entry frame
(4) PE ground busbars

Fig. 13. TEU (1000 mm)

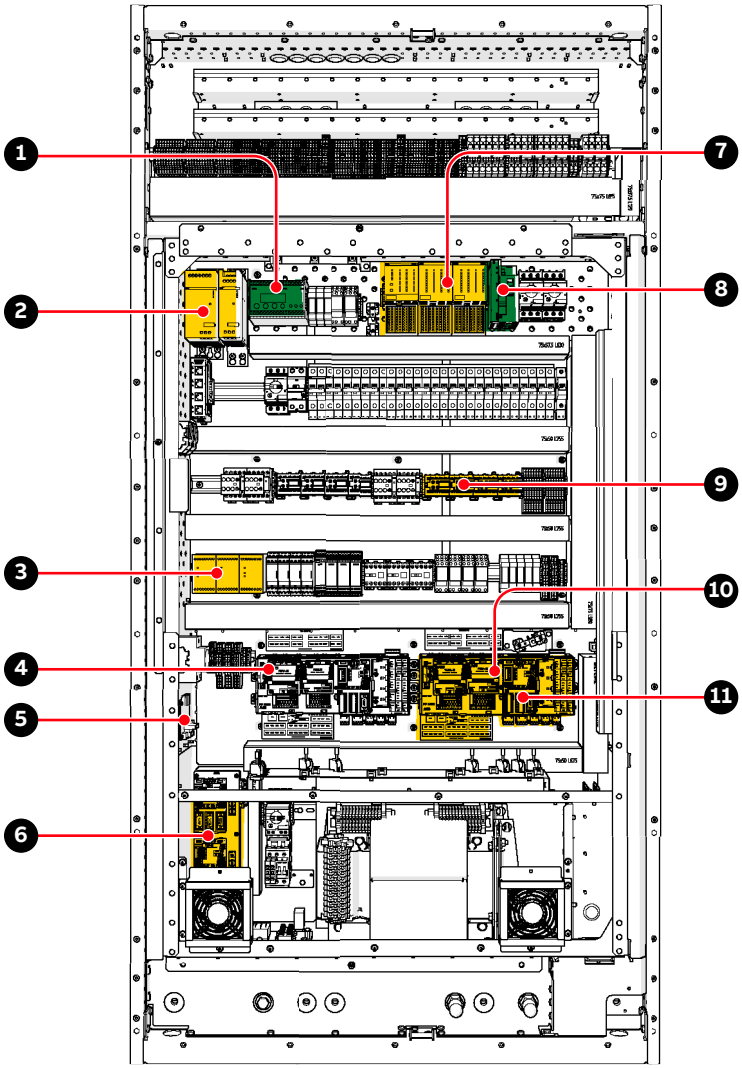
3.2.5. Control unit (COU)

The COU 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 hardware.

– A separate control unit is assigned to each INU that supplies a single motor.

– If several INUs supply one motor, they share one control unit.

For information on the number of control units and their location in the drive, see “Appendix C - Mechanical drawings”.



Key:

(1) Insulation monitoring device (optional)
(2) 24 VDC power supply unit
(3) Safety relays for emergency-off circuit
(4) Main controller for ARU
(5) Main circuit breaker control
(6) (Optional) slot extension for encoders
(7) I/O modules
(8) NETA-21 gateway to enable ABB Ability™ digital services
(9) Main circuit breaker relays
(10) (Optional) Fieldbus modules
(11) Main controller for motor

Fig. 14. Master COU (1000 mm) and control equipment

3.2.5.1. 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 specification”, 3BHS125149 E60

– “Main circuit breaker protection device”, page 32.

3.2.5.2. Speed and torque control

The speed and torque of the motor is controlled by Model Predictive Pulse Pattern Control (MP^3C). The MP^3C motor control platform is unique to ABB and has been proven in all variable speed drives of the ACS product range. MP^3C provides accurate speed and torque control, and high dynamic speed response.

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

The measured motor currents and DC-link voltage are inputs to an adaptive motor model. The model produces exact values of torque and flux every 25 microseconds. Motor torque and flux comparators compare the actual values to reference values 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 microseconds and initiates switching whenever required.

3.2.5.3. Peripheral I/O devices

– **NETA-21:** monitoring and diagnostics tool that allows access to the drive from any location in the world via a secure Internet connection.

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

– Local control panels

– S500 I/O system for parallel signal transfer to external devices
  • Connect the internal and external I/O signals to the control system
  • Connect external I/O signals to the terminals inside the water cooling unit (WCU) and are wired internally to their I/O modules

– Optional fieldbus adapters for serial data transfer to a higher-level control system

– PC-based service tools comprising:
  • DriveWare software tools
  • DriveOPC for data transfer between ABB drives and Windows-based applications.

3.2.5.4. Local control panels

Each control unit (COU) is equipped with a local control panel (1, Fig. 15). The control panel serves as the basic user interface for monitoring, control and operation of the drive and setting of parameters.

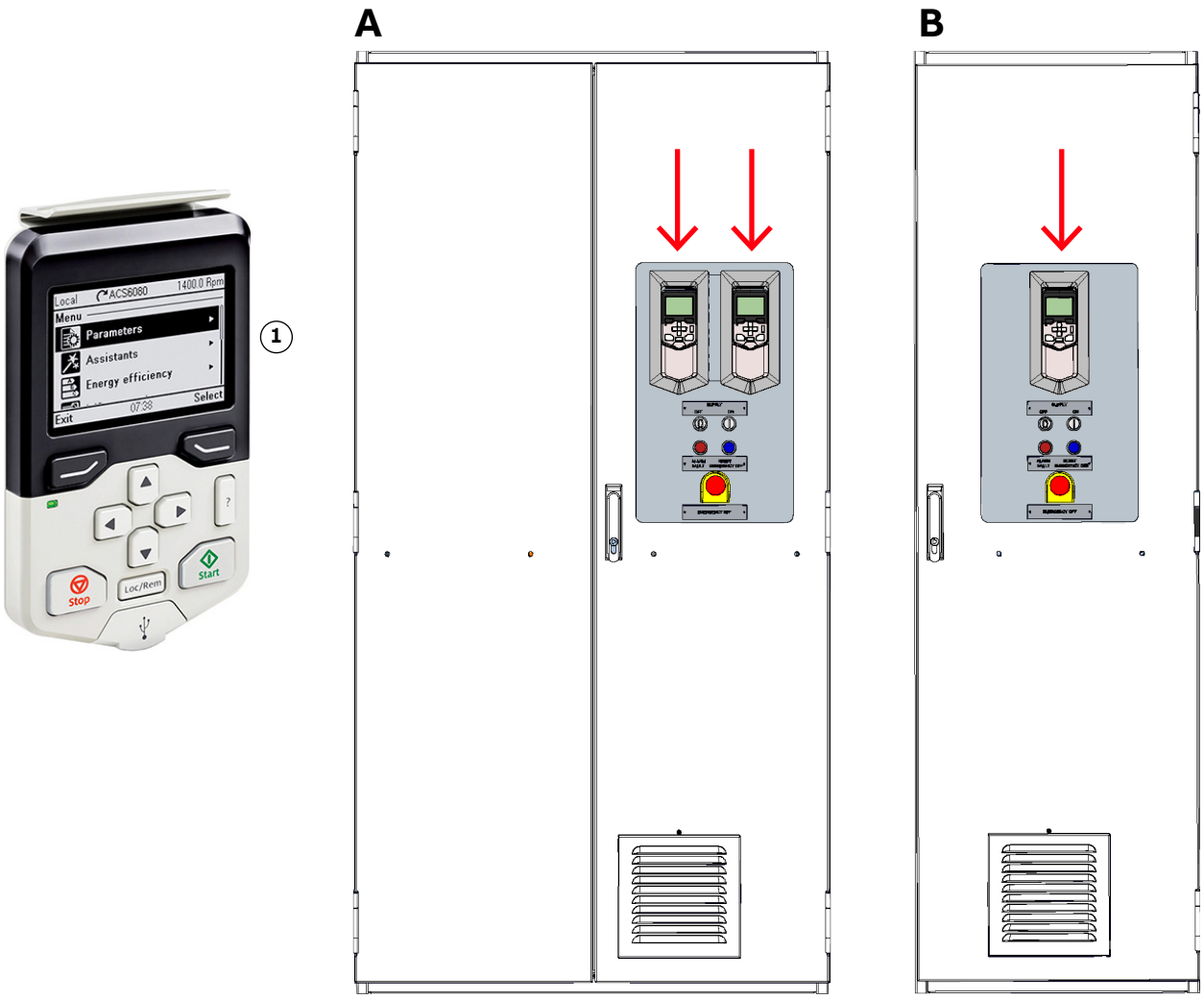


Fig. 15. Location of (1) control panels on master (A) COU and (B) follower COU

3.2.6. Water cooling unit (WCU)

The closed-loop water-cooling system transfers the heat losses of the main power electronics components of the drive (eg, rectifier bridges, inverter phase modules, DC-link capacitors) to the exterior.

Redundant pumps circulate the coolant through the feeding pipes to the power electronics components and transfer the heat losses through the return pipes and the water-to-water heat exchanger.

The water cooling units are accessible for maintenance even when the drive is in operation.

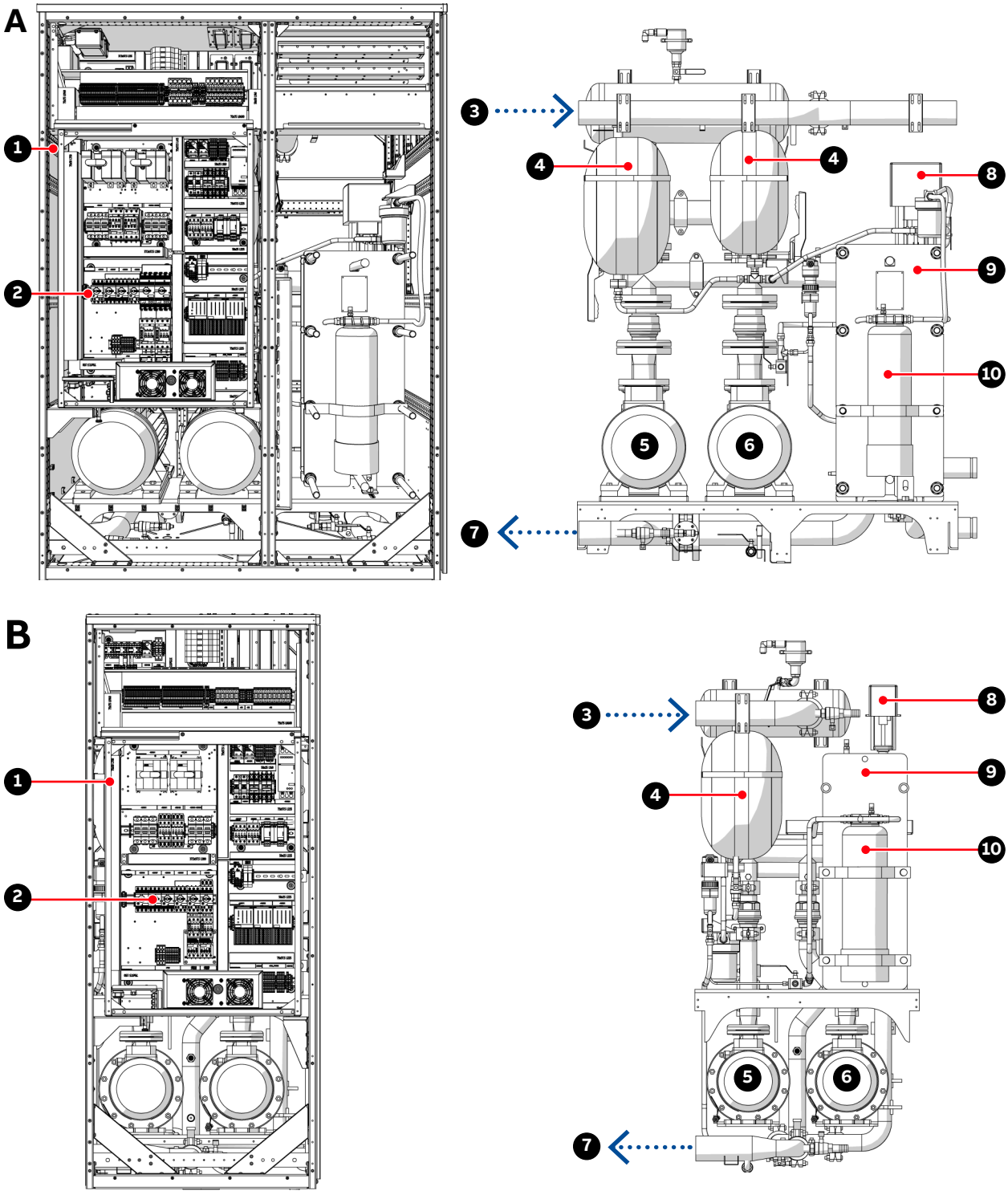
For more information, see:

– “ACS5000, ACS6000 and ACS6080 water cooling unit WCU800 user manual”, 3BHS821937 E01

– “ACS5000, ACS6000 and ACS6080 water cooling unit WCU1400 user manual”, 3BHS835714 E01.

TABLE 4 Main components in a WCU cabinet

Component	Description
Swing frame	Contains the auxiliary power supply switch, the pump motor starters and digital and analog I/O modules for controlling and monitoring the water-cooling circuit.
Control and monitoring devices	Measure the temperature, pressure and conductivity of the coolant. A solution based on a double-sensor configuration is available as an option, to guarantee full operation in case of single sensor failure.
Water pump	Circulates the coolant through the internal cooling circuit. The standard solution is based on redundant pumps (one of the two pumps is always on standby and starts automatically if the running pump fails). An alternative solution based on one pump is also available.
Water-to-water heat exchanger	Transfers the heat from the internal cooling circuit to the external cooling circuit.
Expansion vessel	Used for pressure compensations
Ion exchange vessel	The ion exchange vessel in the water treatment circuit deionizes the coolant of the internal cooling circuit and maintains the conductivity.
3-way valve	The three-way valve controls the flow of the external cooling liquid through the water-to-water heat exchanger.

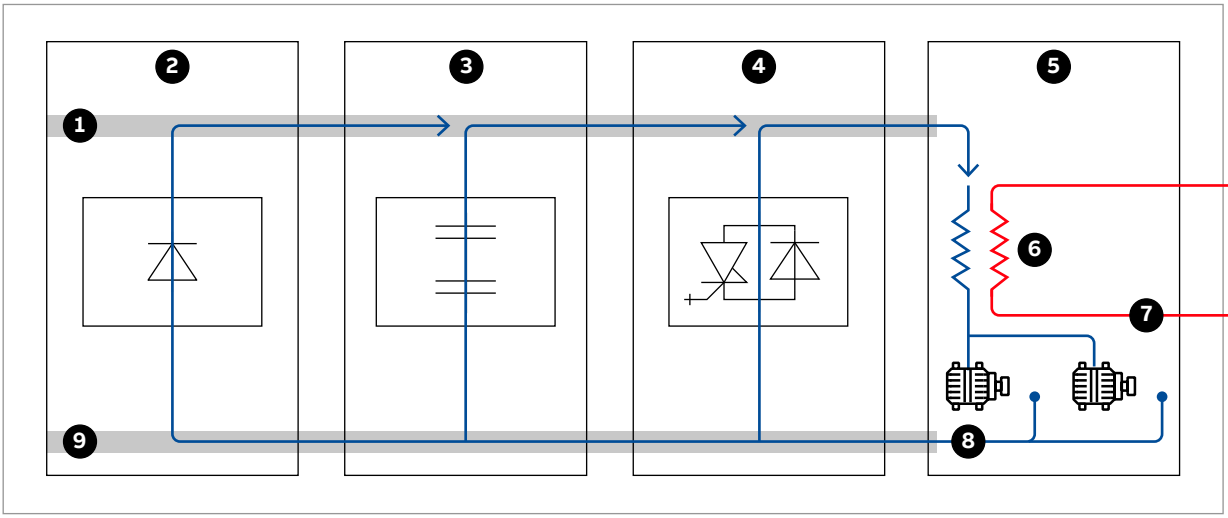


Key:

(1) Control equipment mounted on a swing frame
(2) Pump circuit breakers
(3) Warm water
(4) Expansion vessel
(5) Pump 1
(6) Pump 2
(7) Cool water
(8) Motor for 3-way valve
(9) Water-to-water heat exchanger
(10) Deionizer

Fig. 16. (A) WCU1400 and (B) WCU800 cabinet and system components

3.2.6.1. Cooling circuit



Key:

(1) Return pipes
(2) LSU
(3) CBU
(4) INU
(5) WCU
(6) Heat exchanger
(7) External cooling circuit
(8) Internal cooling circuit
(9) Feeding pipes

Fig. 17. Cooling circuit in an ACS6080 drive

The water cooling system distinguishes two circuits for dissipating heat losses:

– **Internal cooling circuit:** circulates coolant (distilled/deionized cooling liquid) and transfers the heat losses of the main power components to the exterior. The internal cooling circuit also includes - among the other components - the water treatment circuit, which continuously deionizes the cooling liquid to keep conductivity at a low level.

– **External cooling circuit:** transfers the heat losses from the water-to-water heat exchanger to the exterior.

The water cooling units are pressurized and not open to atmospheric pressure.

3.2.6.2. External cooling connection

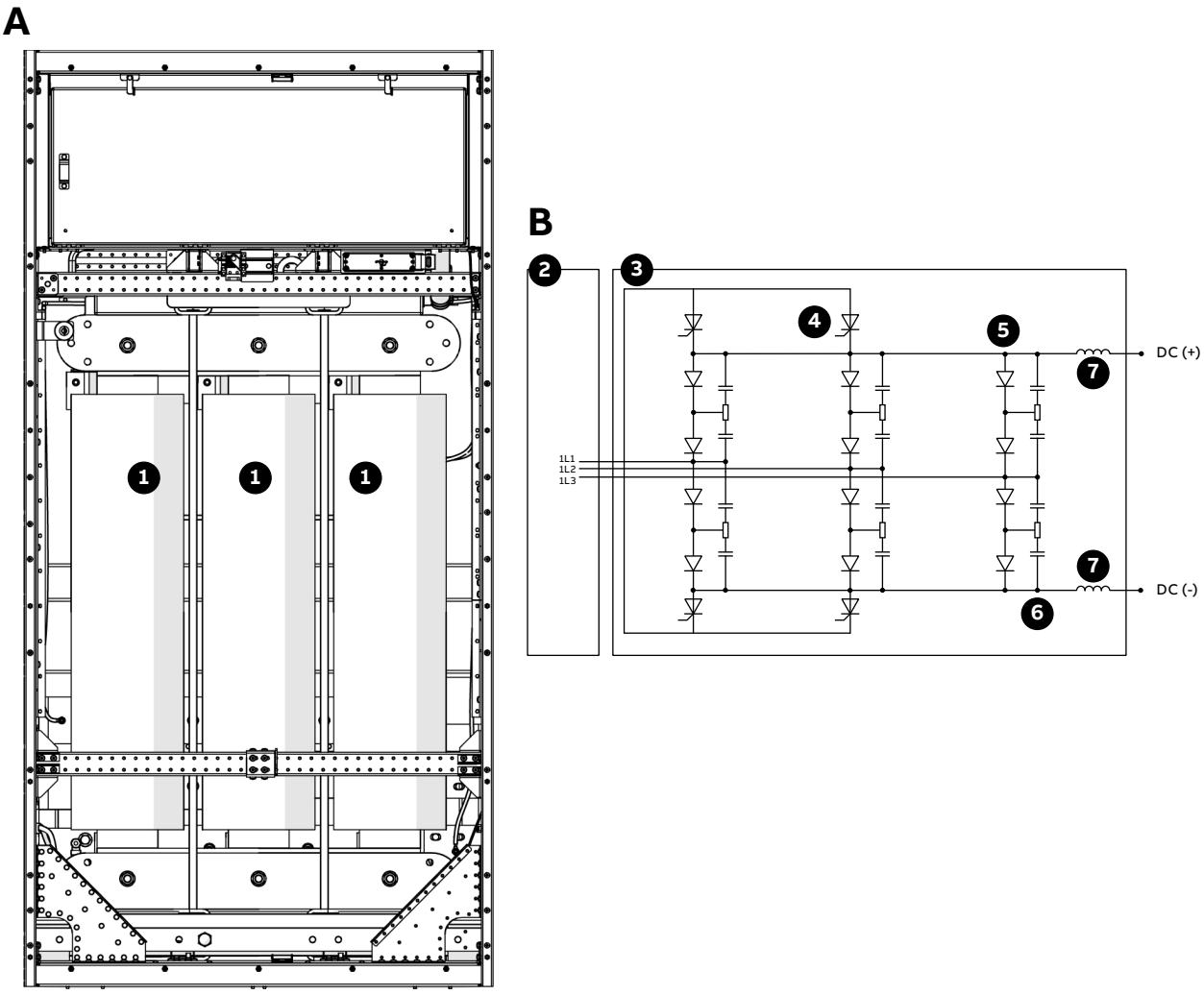
Two flanges connect the WCU to the external cooling circuit water supply and return pipes. The location of the flanges, ie, top, bottom, side, or back of the WCU, depend on your drive configuration.

3.3. Optional cabinet units

The following sections describe the IRU, IFU, VLU, BCU, RBU and EXU optional cabinet units.

3.3.1. Input reactor unit (IRU)

The IRU is used with the 6-pulse LSU for applications without an input transformer. The IRU limits the input current and improves the total harmonic distortion (THD) of the supply voltage.



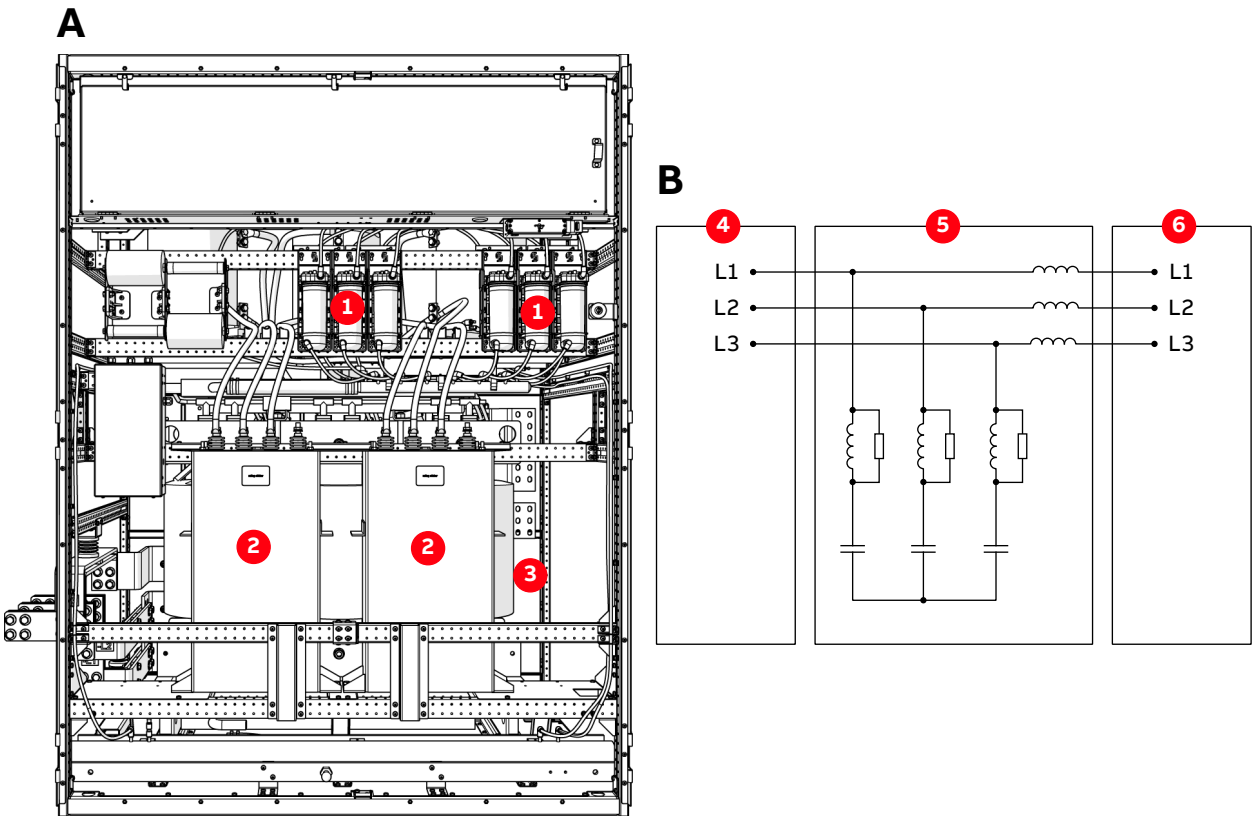
Key:

(1) Three-phase reactor
(2) IRU
(3) LSU
(4) Thyristor crowbar
(5) Diode rectifier
(6) Snubber circuit
(7) di/dt choke

Fig. 18. (A) IRU cabinet and (B) circuit diagram

3.3.2. Input filter unit (IFU)

The IFU is used in combination with 6-pulse active rectifier units connected to a weak supply network. The tuned filter is located between the input transformer and the ARU and reduces harmonic voltages injected to the supply network.



Key:

(1) Resistor
(2) Capacitor
(3) Reactor
(4) TEU
(5) IFU
(6) ARU

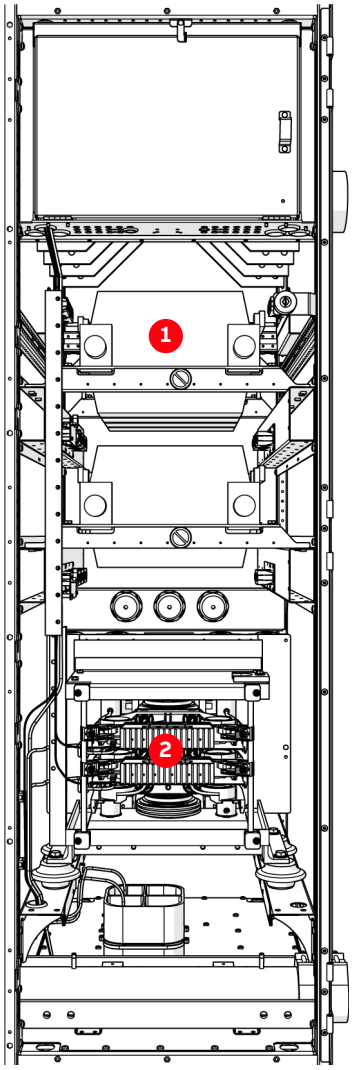
Fig. 19. (A) IFU cabinet and (B) circuit diagram

3.3.3. Voltage limiter unit (VLU)

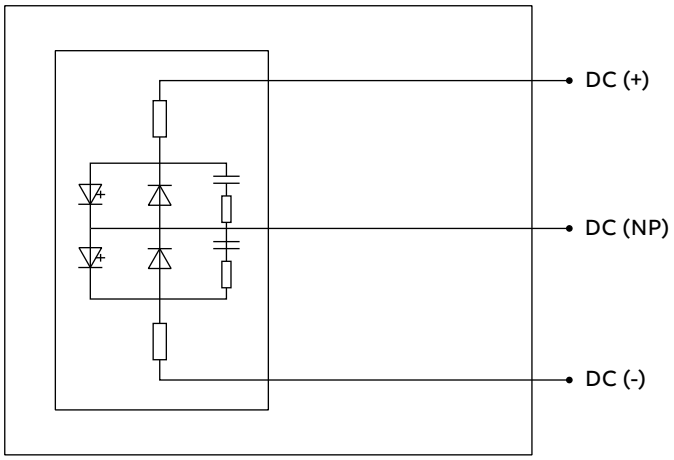
The VLU is used for applications that require dynamic changes between driving and braking mode.

During braking, the energy is dissipated in liquid-cooled resistors. The resistors are controlled by IGCT semiconductors and protected against overload.

A



B



Key:

(1) Air-cooled resistors

(2) ICGT

Fig. 20. (A) VLU cabinet and (B) circuit diagram

3.3.4. Braking units

A braking chopper unit (BCU) and a resistor braking unit (RBU) are available for the ACS6080.

TABLE 5 BCU braking power

Braking resistor (ohm)	Single braking power (kW)	Double braking power (kW)
RBU	800	1600
10	1100	2200
8	1400	2800
7	1600	2800
6	1900	3200
5	2200	3700
4	2800	4500
3.6	3100	5600

TABLE 6 RBU braking power

Single braking power (kW)	Double braking power (kW)
800	1600

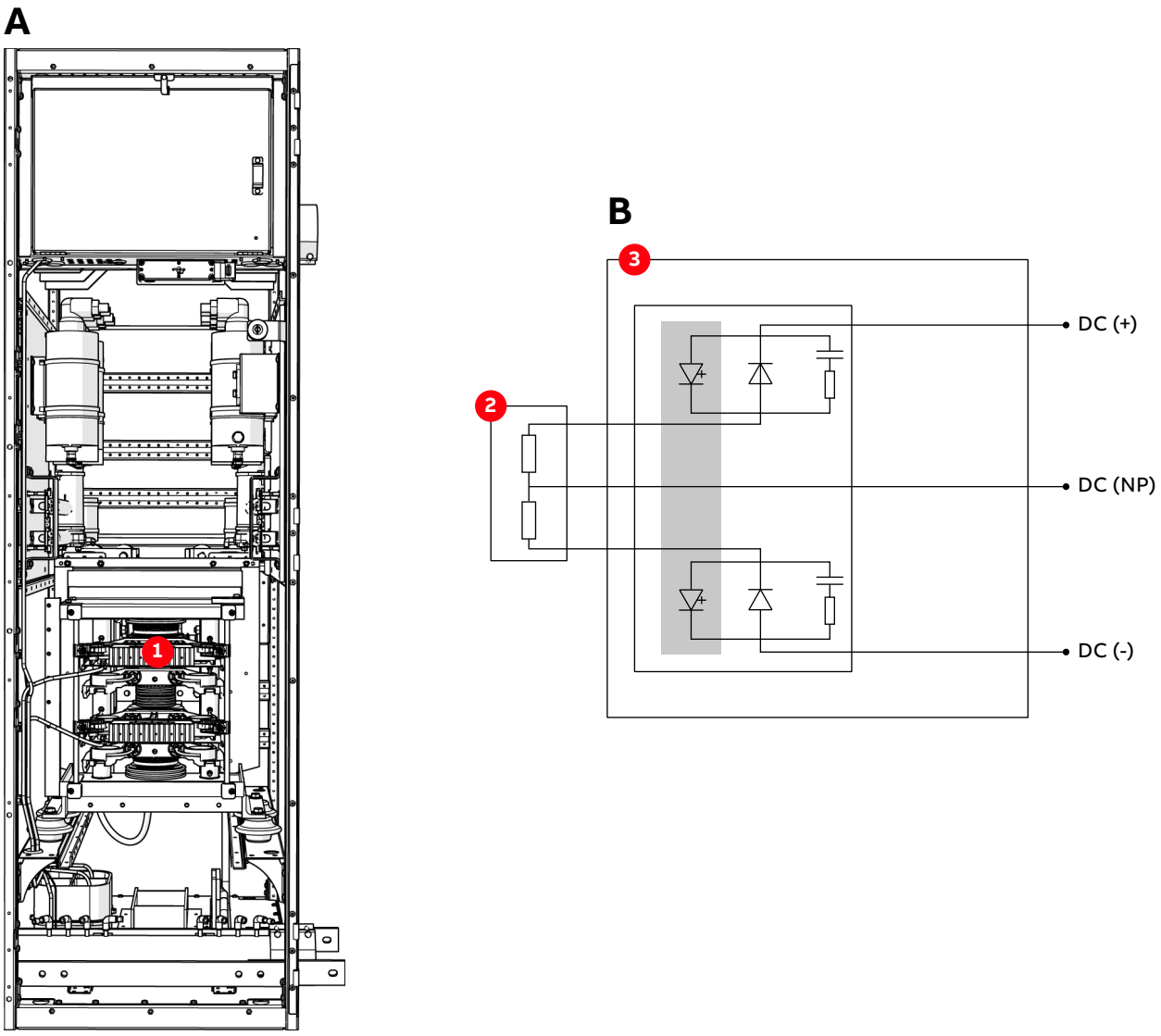
These braking units are used for applications that require fast braking where regenerative braking is not allowed, eg, marine applications; therefore these units are typically part of a drive that contains an LSU. The BCU and RBU enable such drives to perform effective motor braking.

However, BCUs and RBUs can also be used in combination with ARUs, eg, mine hoists and other special applications that require emergency braking in the event of a power outage.

During braking, the BCU limits the DC-link voltage and converts the braking energy into heat that is dissipated in resistors. IGCT semiconductors switch the braking energy to the resistors.

3.3.4.1. Braking chopper unit

A BCU is used when the braking scenario requires consistent energy dissipation. The energy generated during braking is dissipated in external water-cooled resistors, which are not part of the drive.



Key:

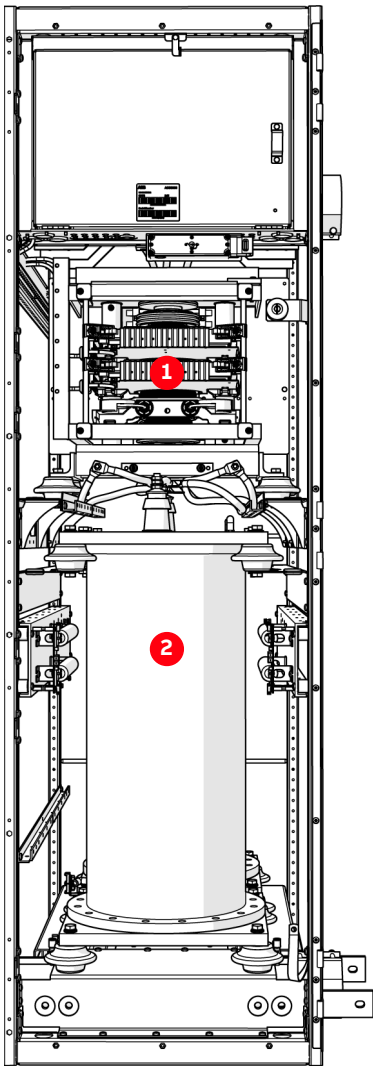
(1) IGCT
(2) Resistor (external)
(3) BCU

Fig. 21. (A) BCU cabinet and (B) circuit diagram

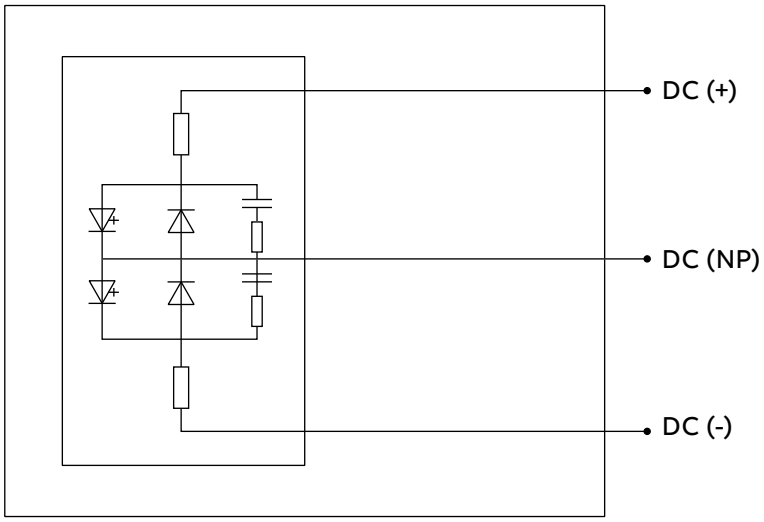
3.3.4.2. Resistor braking unit

An RBU, with integrated resistors, is used for smaller braking capabilities.

A



B



Key:

(1) IGCT

(2) Water-cooled resistor

Fig. 22. (A) RBU cabinet and (B) circuit diagram

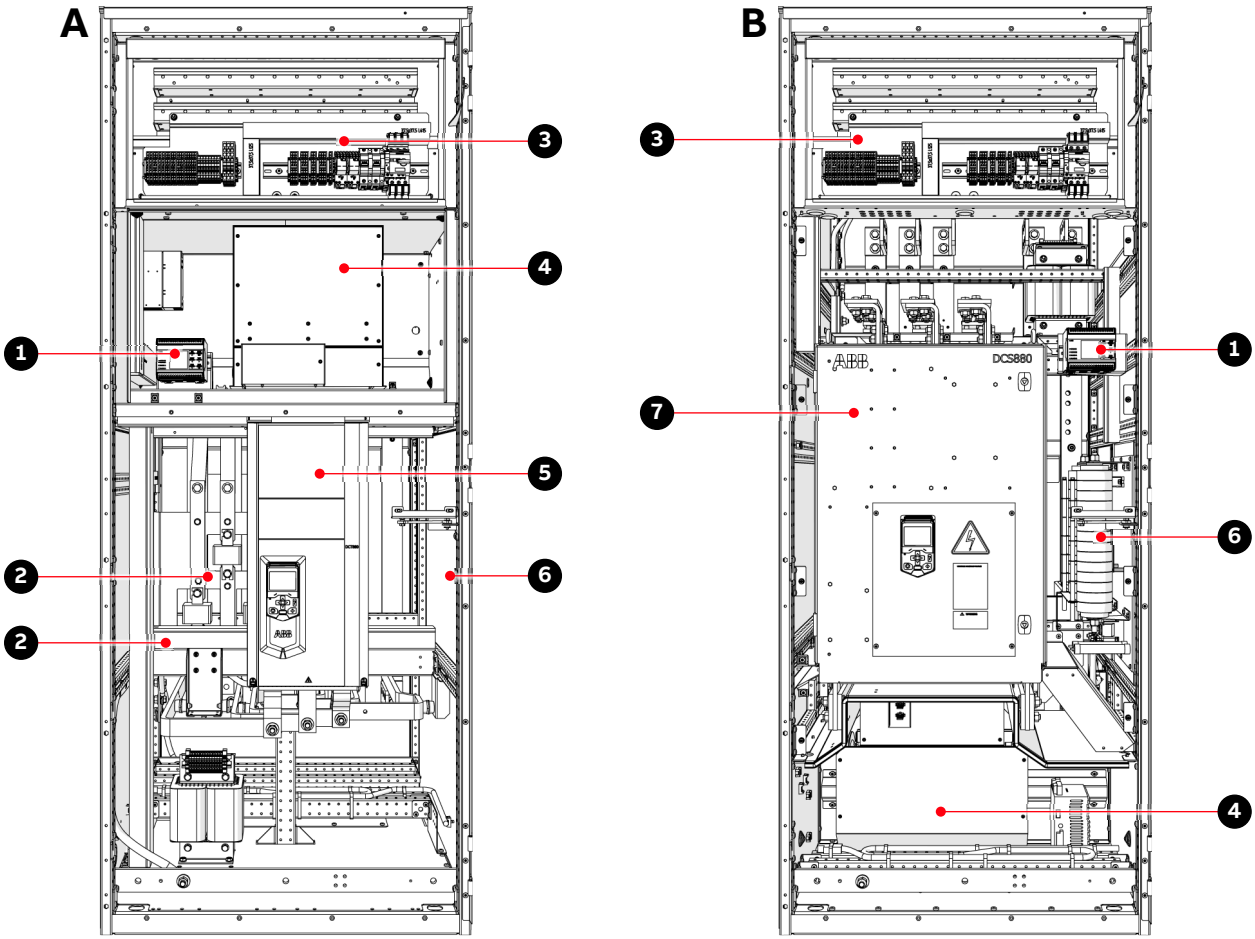
3.3.5. Excitation unit (EXU)

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.

For more information, see the “Air-cooled excitation units, brush brushless excitation technical data”, project-specific.



Key:

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

Fig. 23. (A) EXU H4/T4 frame cabinet and (B) EXU H6 frame cabinet

3.3.5.1. 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 8.4.4, “EXU control panel”, page 151.

3.3.5.2. Output disconnector

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

3.3.6. Customer interface unit (CIU)

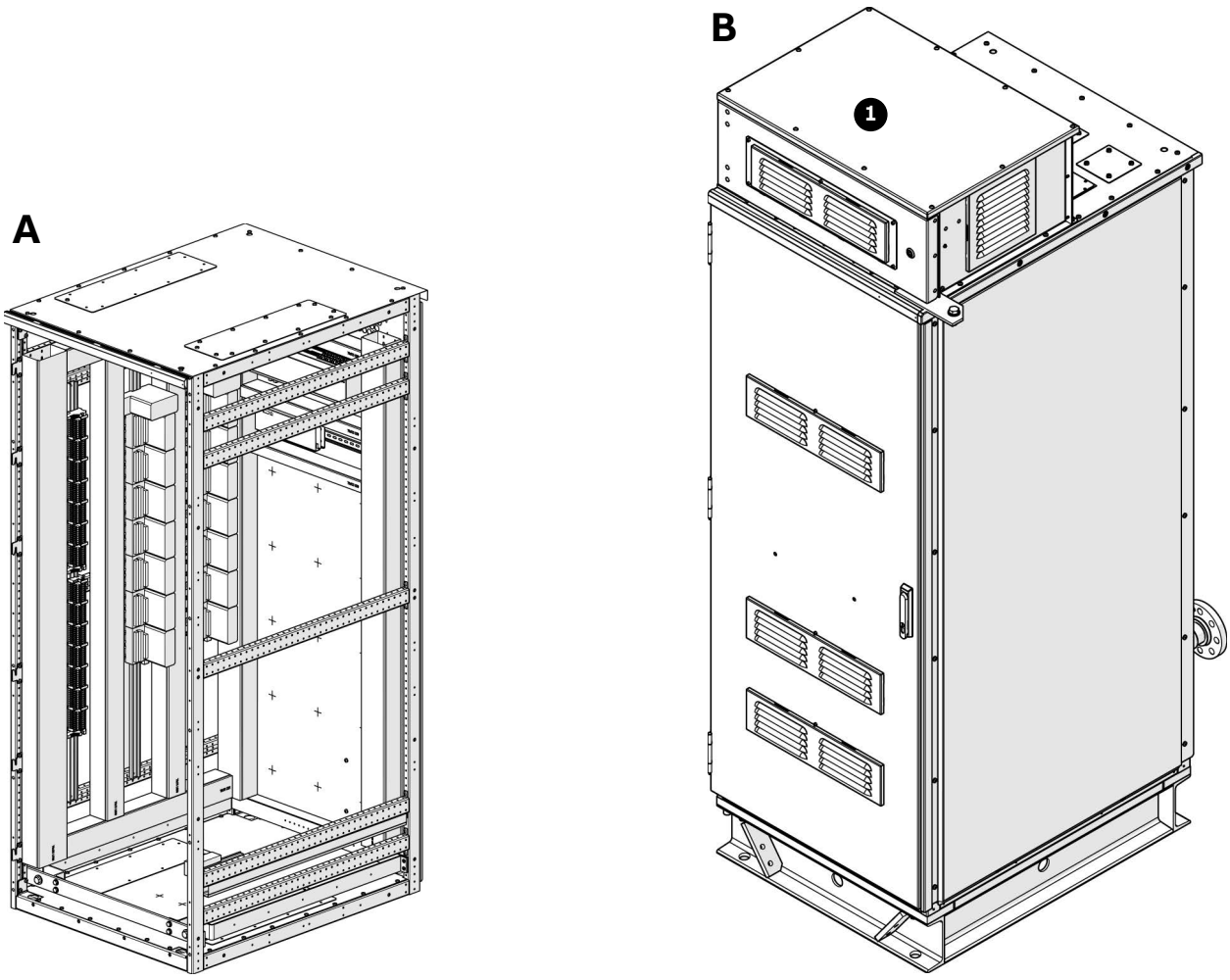
The optional customer interface unit (CIU) provides I/O modules to monitor the transformer and motors. The following units are available:

– **CIU** provides predefined I/O modules for controlling and monitoring the auxiliaries of motors and the transformers.

  The I/O module modules are connected to the drive controller.

– **CIUe** provides engineered project-specific interfaces and an application controller with customer-specific software.

As an option for single-motor drives, it is possible to integrate the predefined I/O modules (maximum 4 modules in the rooftop extension box (REB) of the water cooling unit). For more I/O modules, a CIU is required.



Key:

(1) Roof extension box (REB)

Fig. 24. (A) CIU cabinet and (B) WCU800 cabinet

3.3.6.1. Arc detection with Arc Guard (optional)

If the drive is equipped with an Arc Guard System for fast arc fault detection in the terminal sections, the arc monitor and the related HMI panel are mounted in the roof extension box (REB).

For more information, see Section 8.12, “Arc detection with the Arc Guard System™ (optional)”, page 176.

3.4. Air cooling

Air-to-air heat exchangers and auxiliary fan units can also be used for non-water-cooled components in the drive.

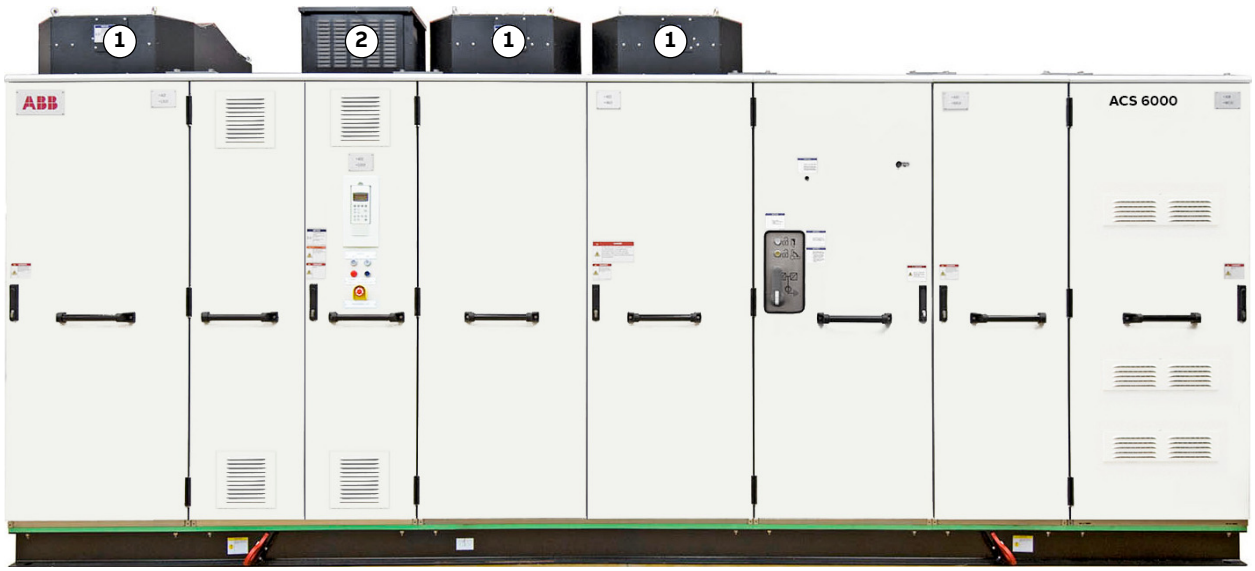
3.4.1. Air-to-air heat exchangers

Drives for high-power applications are equipped with air-to-air heat exchangers. They ensure a constant air flow through the medium voltage units and transfer the heat losses of non-water-cooled components to the exterior. The fans of the air-to-air heat exchangers are controlled by the drive.

The auxiliary power for the heat exchangers is supplied by an additional transformer.

For information on number and location of heat exchangers and transformer, see “Appendix C - Mechanical drawings”.

The number of installed air-to-air heat exchangers and transformers depends on the configuration of the drive.



Key:

(1) Air-to-air heat exchanger

(2) Additional transformer

Fig. 25. ACS6080 example drive with air-to-air heat exchanger

3.4.2. Auxiliary fan units

Thermostat-controlled fan units circulate the air in the control unit cabinet(s) and in the WCU cabinet. If installed, additional fan units are available in the optional WCU roof box.

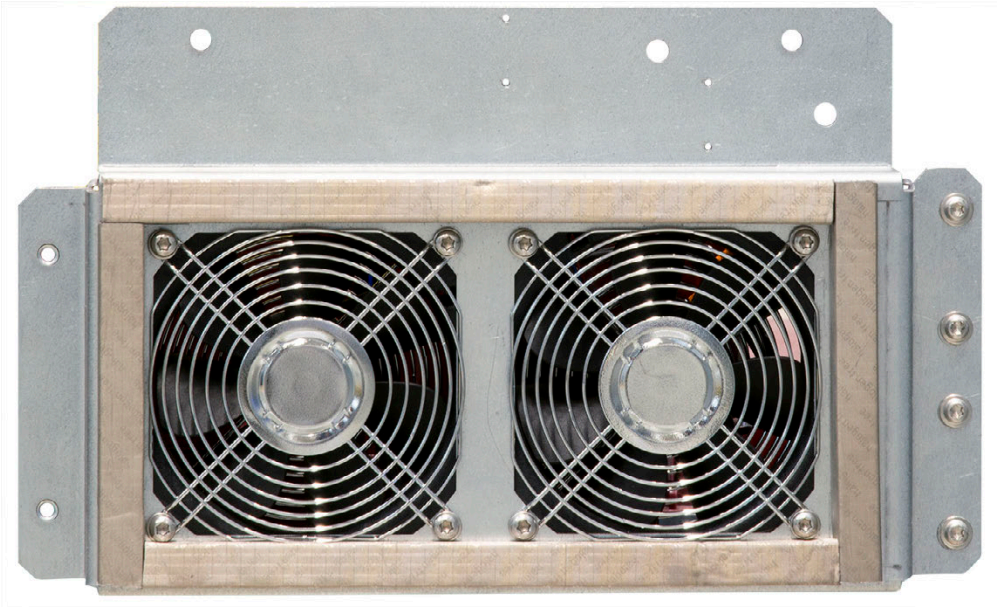


Fig. 26. Auxiliary fan unit

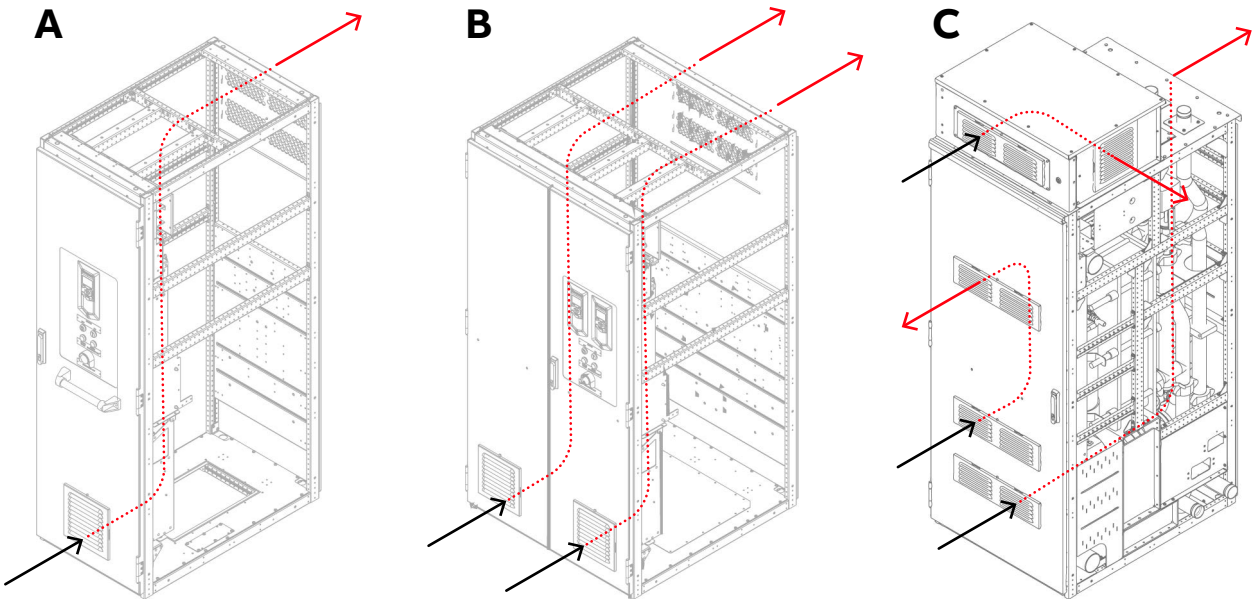


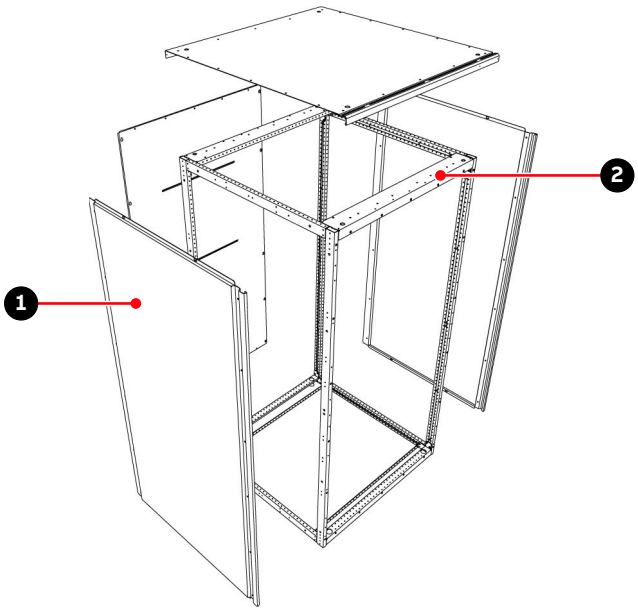
Fig. 27. Air circulation through ventilation grids in (A) 600 mm COU, (B) 1000 mm COU, and (C) WCU800

NOTE – The number of fans varies depending on the cabinet.

3.5. Cabinet design

The cabinet has been designed using the modular cabinet system of ABB and fulls the requirements of international standards.

The design consists of a skeletal frame made of galvanized steel where the outer panels made of 1.5 mm thick painted galvanized steel are bolted to. Corrosion resistant materials are used to ensure durability of the cabinets.



Key:

(1) Outer panel made with 1.5 mm powder painted (standard color - RAL 7035) galvanized steel

(2) Galvanized steel frame

Fig. 28. Basic cabinet design

Electromagnetic compatibility (EMC)

Electromagnetic compatibility (EMC) has been achieved by applying an EMC sealing around the doors and on the rear and side panels. The inside panels of the compartments are not painted, because paint tends to reduce the effectiveness of metallic bonding, which is paramount to successful EMC.

The joining surfaces of two transport units are equipped with EMC sealing strips. The cabinet doors and the internal cable ducts are also equipped with EMC sealing.

Degree of protection

The standard cabinets are rated for IP 32. Ratings for IP 42 and IP 54 are available as an option. The sound pressure level is < 75 dB (A).

Painting

The standard color for the cabinets is RAL 7035 (light gray), which is applied as a powder coat paint. Other colors are available on request.

For more information, see the “Painting specification for ACS1000, ACS2000, ACS5000 and ACS6000/ACS6080”, 3BHS104301 E01.

Transportation

Small drives are shipped as one unit. Larger drives are shipped in separate transport units. All transport units are fitted with lifting lugs for a crane that must be used to position the units.

Safety labels

Safety labels are attached to the drive doors to alert personnel of potential hazards when working on the drive.

The standard language of the labels is English; however, other languages can be ordered. The label design is based on the relevant ANSI and ISO standards.

For more information, see Section 2.2, “Product safety labels”, page 28.

3.6. Door locking system

For more information on the door locking system, including grounding switches, locking bars, and safety switches, see Section 8.4.4, “EXU control panel”, page 151.

3.7. Arc resistant design

The optional “Arc Resistant Design” provides the drive with arc fault protection (see Table 7) in accordance with IEC 62477-2.

TABLE 7 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[1]
Class III	Protection based on external arc fault limitation and elimination. HV fuses are applied externally to limit the arc fault current[1]
Class IV	Fast arc detection and elimination[1]

[1] IAC certified by 3rd body according to IEC 62477-2

3.7.1. Internal arc classification

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 II

IAC	F	L	R	T	B	I_A	t_A	APR	SC
IEC 62477-2	2b	2b	2b	1	1	20 kA	0.5 s	Yes	No
Distance [m]	0.3	0.3	0.3	-	-				

3BHB049908R6220

Fig. 29. 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 32.

Based on the ACS6080 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.

3.8. Busbars and grounding

The drive contains busbars for various types of connections.

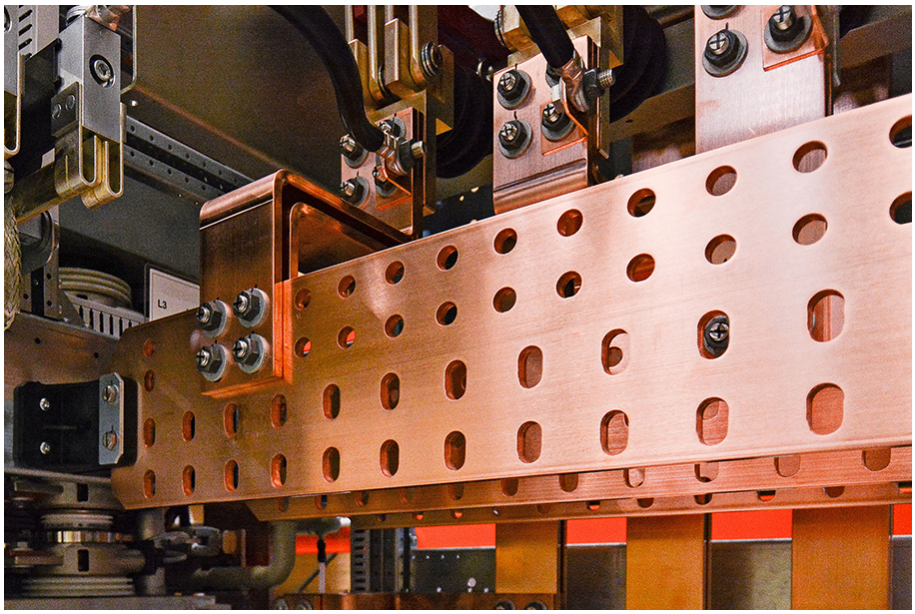


Fig. 30. Busbars

3.8.1. AC busbars

The incoming feeder and motor cables are connected to their corresponding busbars inside a TEU. In multi-motor drives, several TEUs are part of the drive lineup.

Depending on drive configuration, the incoming busbars are interconnected with the ARU or the LSU. The outgoing busbars are interconnected with the inverter unit(s). Phase designations help identifying the busbars.

3.8.2. DC busbars

The DC busbars connect the ARU or the LSU with INU(s) and CBU. A multi-motor configuration, can have up to four DC busbar arrangements. The busbars are mounted in the upper part of the drive and are marked with DC (+), DC (-) and DC (neutral point).

3.8.3. PE busbar

To maintain safety and to ensure smooth functioning of the equipment, it is important to ground the drive properly. For this reason, the ground cable of the drive is connected to the grounding system of the installation site.

The drive is equipped with a continuous PE ground busbar that stretches across the bottom part of the entire cabinet.

3.8.4. PG busbar

To ensure proper operation, cable shields are connected to the PG ground busbar. The PE and PG busbar connect inside the capacitor bank unit, which has the grounding switch on the front door. The connection is made in the factory.

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[1]

[1]Special conditions apply to marine drives

4.3. Unpacking and inspection

1. Remove all packaging material carefully.
2. Check the drive and accompanying equipment for damages.
3. Compare the complete delivery with the purchase order and the packing list.
4. If parts are missing or damaged, immediately inform the shipping company and the ABB service organization.

   It is recommended to photograph the damages and send the photographs to ABB.

4.4. Identifying transport 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 that is 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.

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
001221[1]	1	PC		cross wiring
001222	1	PC		WCU accessory
001223	1	PC		crank for isolator
001500	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 001241[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.

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 operation

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 ACS6080 equipment. Any use beyond this is strictly prohibited.

Key:

(1) M24 rotating eyebolt for 220 mm base frame
(2) Lifting plate with M16 × 40 (A2-70) bolts for 160 mm base frame
(3) M16 rotating eyebolt for top-lifting (EXU cabinet)
(4) M8 rotating eyebolt for top-lifting (air-to-air heat exchangers)

Fig. 31. Lifting attachment types

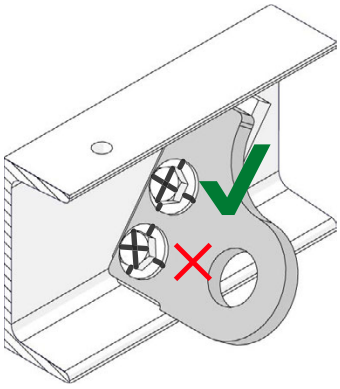
4.5.2. Lifting with lifting plates

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

⚠ CAUTION

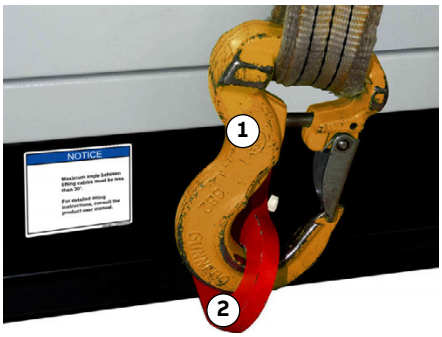
Risk of tipping! The following procedure requires a crane with a lift frame or a spreader frame. If you do not have this equipment:

→ Ensure that the slope angle of the slings DOES NOT exceed 15° (7, Fig. 33)



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

   If the marks are not aligned or are not visible, tighten the mounting bolt to the torque that is specified in Table 8.



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

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

Referring to Fig. 33, page 71:

3. Wrap a sling horizontally around the upper ⅓ 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.

4.5.3. Lifting with rotating eyebolts

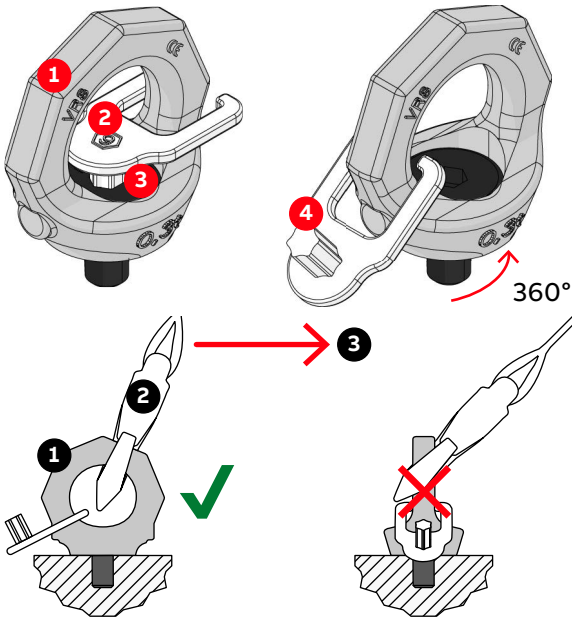
Rotating eyebolts are either installed in the factory, or are in the loose parts box for the drive. The following procedure requires a crane with a lift frame or a spreader frame.

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

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

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

   CAUTION! DO NOT run slings through the eyebolts!



Referring to Fig. 33, page 71:

3. For a large load, eg, transport unit, wrap a sling horizontally around the upper ⅓ 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.

6. 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 70) with a suitable torque wrench socket (not included in the scope of delivery).

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 8.

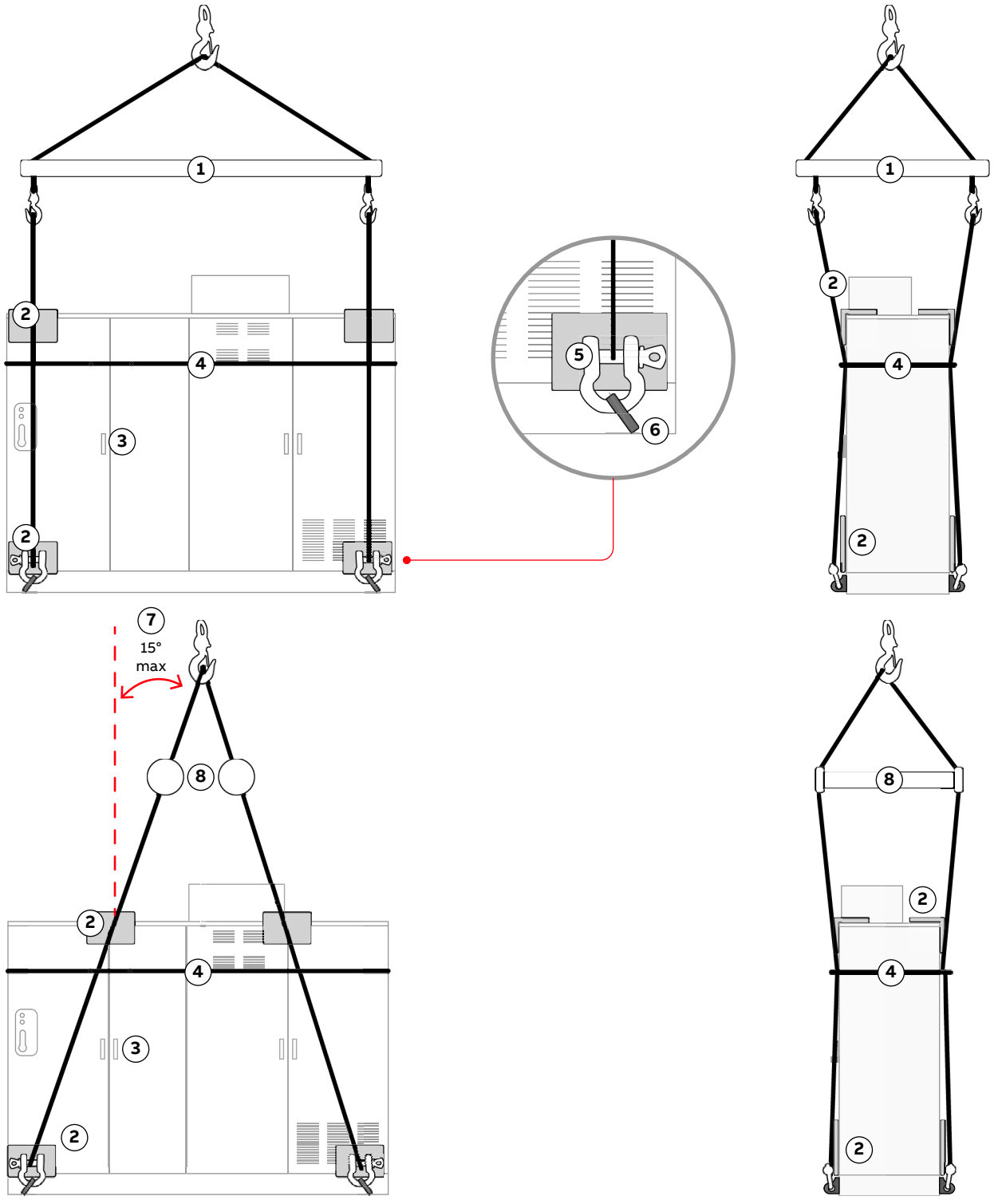
NOTE – The torque wrench sockets for the rotating eyebolts are not included in the scope of delivery.

TABLE 8 Lifting attachment specifications

Type	Mounting bolt	Torque (Nm)	ABB ID
Lifting plate	2 × M16 × 40 (A2-70)	204	3BHB039841R0001
M24 rotating eyebolt	M24	190	3BHE015753P0024
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
(2) Protect the edges
(3) Protect the door handles and levers
(4) Extra sling
(5) Safety hook or shackle
(6) Lifting plate
(7) Slope angle (maximum 15°)
(8) Spreader frame

Fig. 33. (A) Lift frame and (B) lift spreader

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[1]

[1]Special conditions apply to marine drives

4.6.2. Storing the 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: 1 unit desiccant (30 g) absorbs 6 g water vapor.

   IMPORTANT! If you use polyethylene foil to cover the cabinets, use 10 units of desiccant/m^2 foil.
4. Close and lock the doors of the drive.
5. Use polyethylene or equivalent for packaging: 0.3 g/m^2 /24 h water vapor diffusion.
6. Attach humidity indicators to the packaging.

   NOTICE The storage conditions and the packaging should be checked regularly. Any damages which occur during the storage period must be repaired immediately.

4.6.3. Storage and handling of spare parts

NOTICE

Risk of component damage! Electronic devices (eg, circuit boards, semiconductors) are sensitive to electrostatic discharge (ESD).

→ Apply ESD handling precautions before handling these devices.

4.6.3.1. Warranty information

IMPORTANT! Check the spare parts immediately after receipt for damages and report any damage to the shipping company and the ABB service organization.

Observe the following to maintain spare parts in good condition and to keep the warranty valid during the warranty period:

- Keep spare parts in their original packaging.
- Store printed circuit boards in antistatic bags or boxes.
- Storage temperature range: -5 °C to +55 °C
- Storage place requirements:
  - 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
  - Dry, no condensation
  - Relative humidity: 5 to 85%
- DO NOT touch a circuit board without wearing a wrist grounding strap.
- Put the component on a grounded working surface protected against electrostatic discharges.
- Hold the component only by the edge.

4.7. Disposing package materials and components

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

For more information on the disposal of packaging materials and drive components, see the recycling instructions.

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

The installation includes the following work:

– All drives
  - Section 5.3.8, “Floor preparation”, page 75
  - Section 5.3.9, “Floor fixation”, page 75
  - Section 5.3.10, “Raw water circuit”, page 76

– Only drives with separately delivered units
  - Section 5.4, “Aligning transport units”, page 76
  - Section 5.5, “Joining transport units”, page 78
  - Section 5.6, “Attaching the sealing tape”, page 79
  - Section 5.7, “Joining water pipes”, page 80
  - Section 5.8, “Joining busbars”, page 82
  - Section 5.11, “Installing the roof joints and the roof attachments”, page 103

– Only for optional components
  - Section 5.9, “Installing and removing air-to-air heat exchangers”, page 91
  - Section 5.10, “Installing the pressure relief vents”, page 101

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.

→ Use heavy load hydraulics rollers or air cushions for transport units that are secured to a base frame. DO NOT use a crane; If you are unsure, contact ABB for instructions.

→ DO NOT damage or dislocate the EMC sealing strips when you join 2 transport units; The strips are glued to the outer surfaces of the cabinet frames.

→ Close the doors and secure and fasten all covers of the drive when the work is complete

5.3.1. Dimensions and clearances

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

5.3.2. Access to the cabinets

Joining transport units and fitting the DC- busbar joints require rear and top access.

5.3.3. Cabinet roof

NOTICE

Risk of cabinet damage. Mounting unapproved components on the cabinet roof can damage the cabinet.

→ DO NOT install foreign objects such as cable ducts on the roof

→ DO NOT step on the roof

5.3.4. Fire protection

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

5.3.5. Cable duct material

NOTICE

Risk of component damage!

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

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

5.3.6. Installation material

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

5.3.7. Tools

See Section 1.11, “Tools”, page 26.

5.3.8. Floor preparation

See “Appendix C - Mechanical drawings”.

5.3.9. Floor fixation

The cabinet can be bolted or welded to the floor.

For more information, see “Appendix C - Mechanical drawings”.

⚠CAUTION

Hazardous voltage! Risk of electrical shock if you weld a cabinet to the floor.

→ Connect the earth clamp of the welder to the PE ground busbar of the drive.

5.3.10. Raw water circuit

The incoming and outgoing raw water pipes are connected to the flanges of the WCU. Installation material such as counter-flanges, bolts, nuts and seals are supplied.

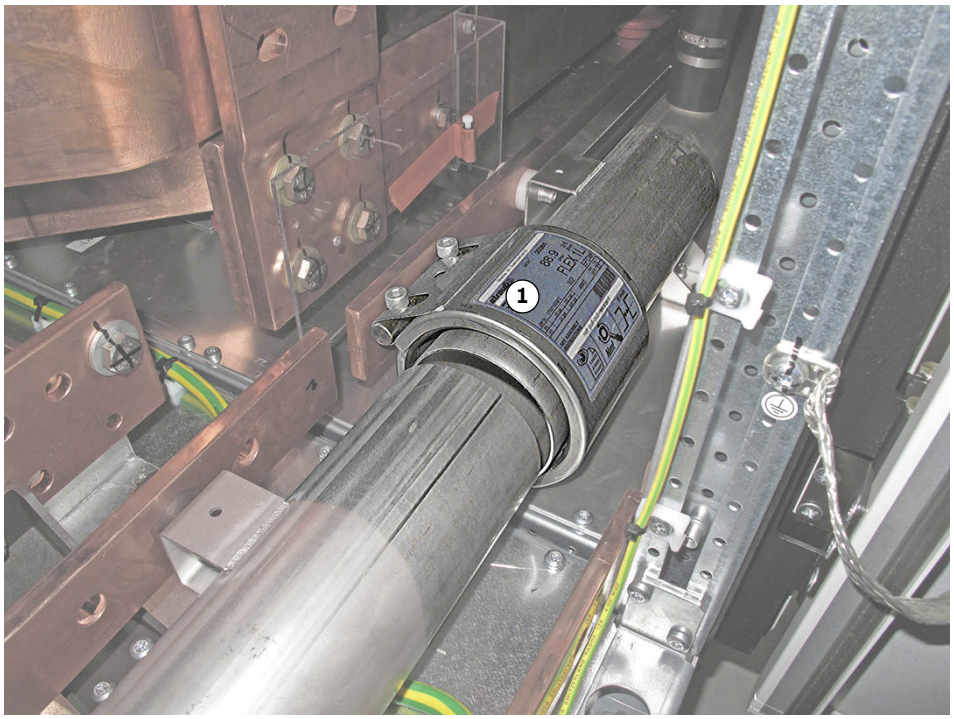
For information on dimensions of the raw water entry and the flanges, see “Appendix C - Mechanical drawings”.

5.4. Aligning transport units

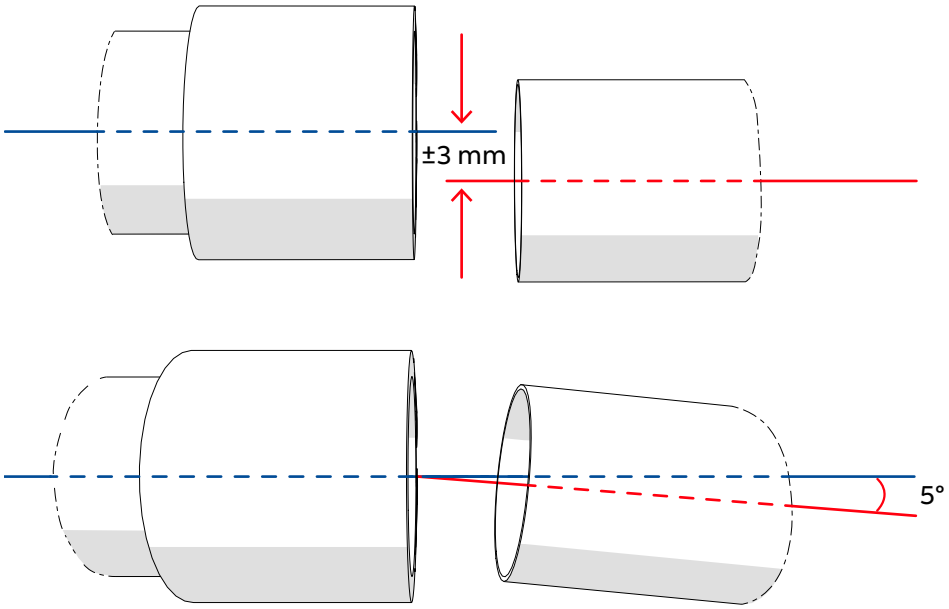
This section applies to drives that are delivered in several transport units.

1. If a transport unit has water pipes, remove the protective covers from the water pipe ends on both sides.

2. Check that a pipe joint (1) 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”.
   NOTE – The units can be lined-up either beginning from the left or the right.
4. Align the transport units and verify the following:
   - Maximum values for the axial misalignment (± 3 mm) and the angular deflection (5°) of two adjoining water pipes are not exceeded



   - Bolt holes are aligned where transport units are joined (see the connection points on Fig. 34)
   - Cabinet doors are not misaligned and that there are no gaps between cabinet walls and cabinet frame
   - Adjoining surfaces of transport units meet perfectly all around

5.5. Joining transport units

A transport unit is a drive component that is delivered separately and must be joined to the rest of the drive before use.

NOTICE

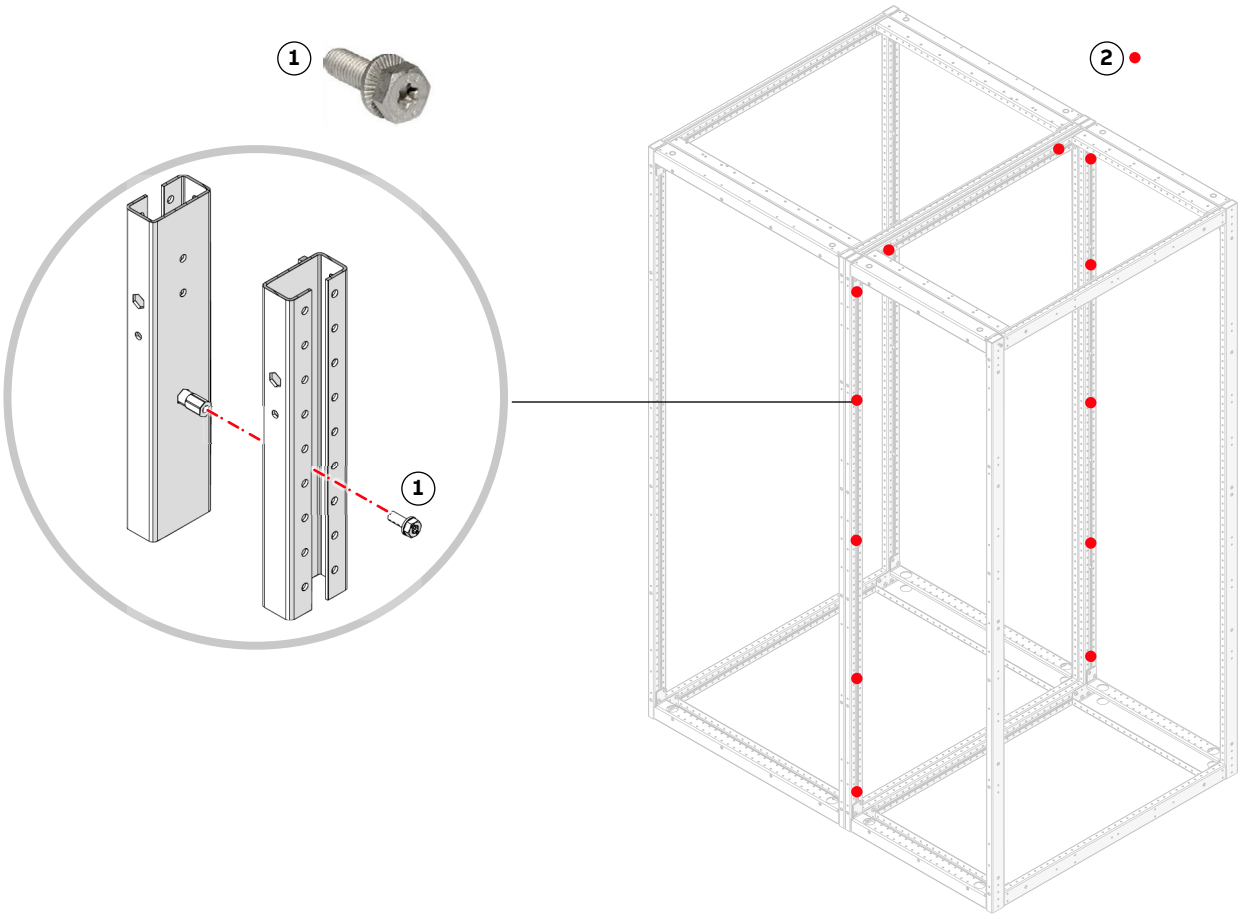
Risk of component damage!

→ DO NOT move joined transport units with a crane!

→ Use transport means such as heavy load hydraulics rollers or air cushions instead

1. Ensure that the bolt holes at the connection point locations (2, Fig. 34) on the frames of the transport units are aligned with one another.
2. Insert and tighten the provided bolts (1, Fig. 34) in the bolt holes (2, Fig. 34).

   NOTE – You need to join a minimum of 8 of the 12 connection points. Some of the connection points might not be accessible in certain configurations.



Key:

(1) M6 × 16 (9ABA450093R0259 SCR-CBS-M6X16-8_8-FLZNNC)

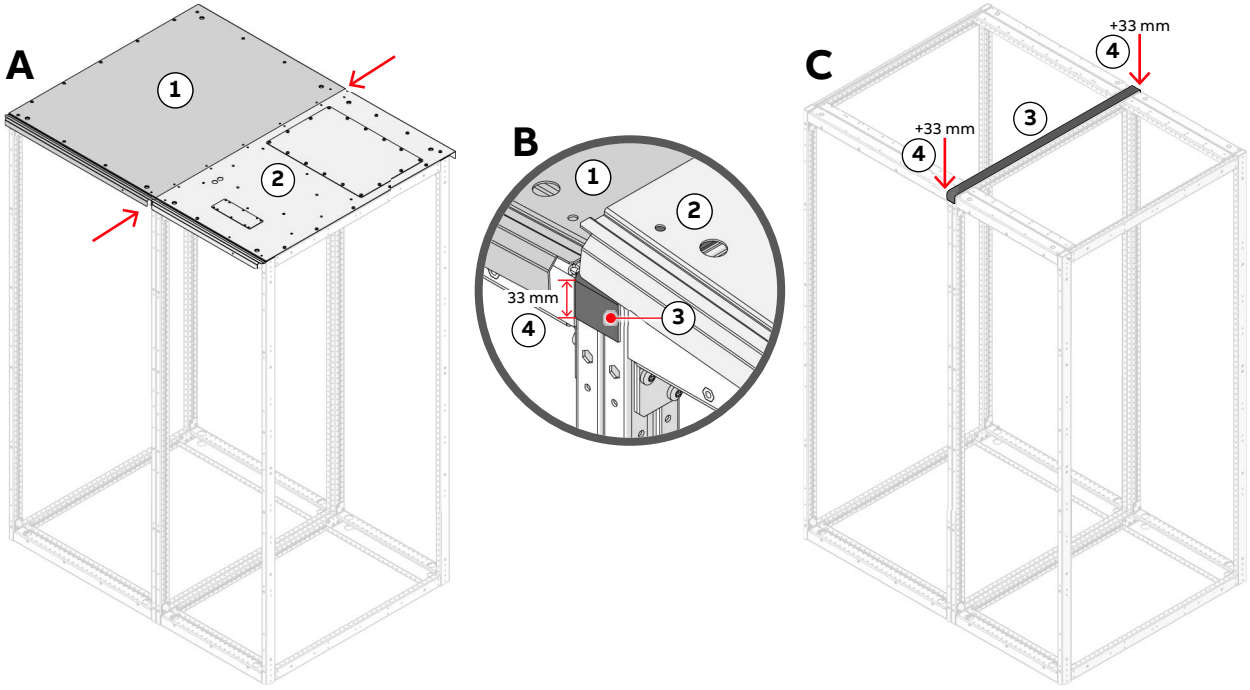
(2) Connection point location (bolt hole)

Fig. 34. Connection point locations on transport unit frames

5.6. Attaching the sealing tape

The self-adhesive sealing tape (3BHB012376R0001) supplied with the drive (1 m per transport unit) prevents water entering the gap between two adjoining roof plates. The tape is installed where two transport units have been joined. Gaps within a transport unit have been sealed with a tape in the factory.

1. Remove the screws from the adjoining edges of the transport unit roof plates (A, Fig. 34) and keep the screws for Step **4**.



Key:

(1) Roof of left transport unit
(2) Roof of right transport
(3) Sealing tape (3BHB012376R0001)
(4) Vertical overlap of sealing tape

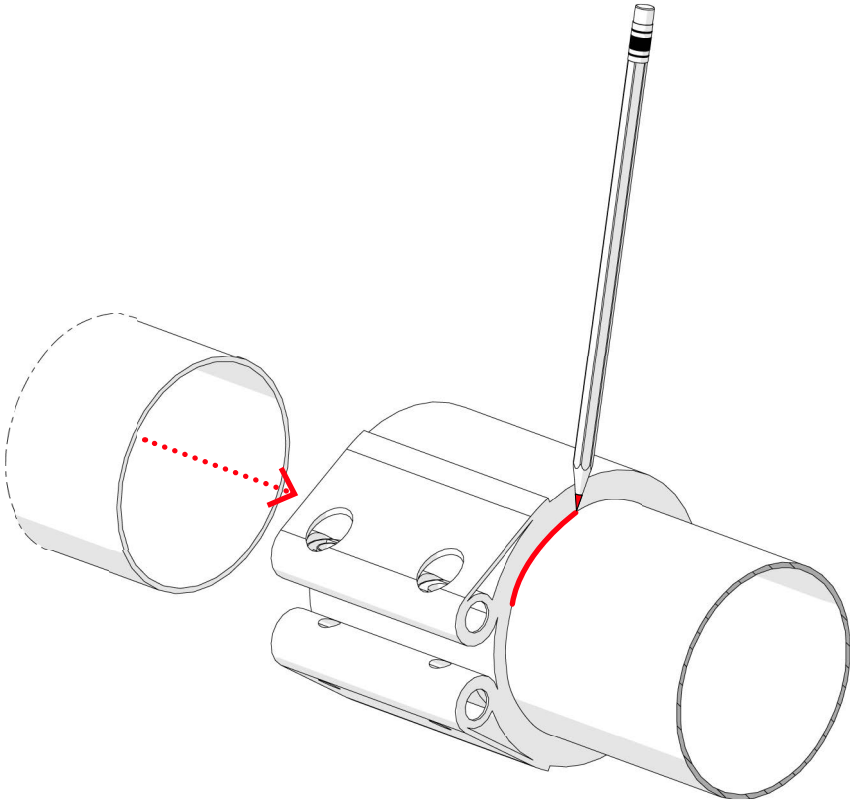
Fig. 35. Attach sealing tape to the joining crossbar

2. Cut the sealing tape to the required length (3, Fig. 35), including the 33 mm vertical overlaps (4, Fig. 35) at the front and the back of the transport units.
3. Lift the adjoining edges of the roofs (B, Fig. 35) and attach the tape along the entire length of the joining crossbars (C, Fig. 35).
4. Reinstall the roof plate screws.

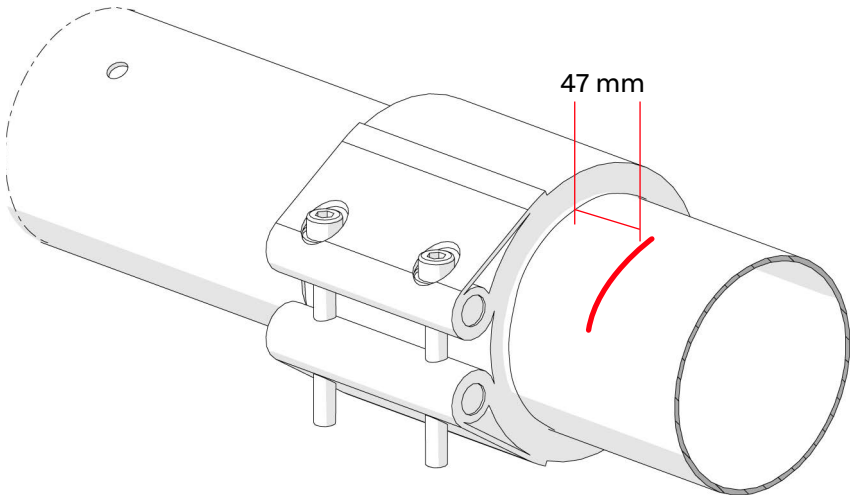
5.7. Joining water pipes

The pipe joints of two adjoining transport units have been slid onto the water pipes in the factory. The locking bolts show into the direction where they can be reached best with a wrench.

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

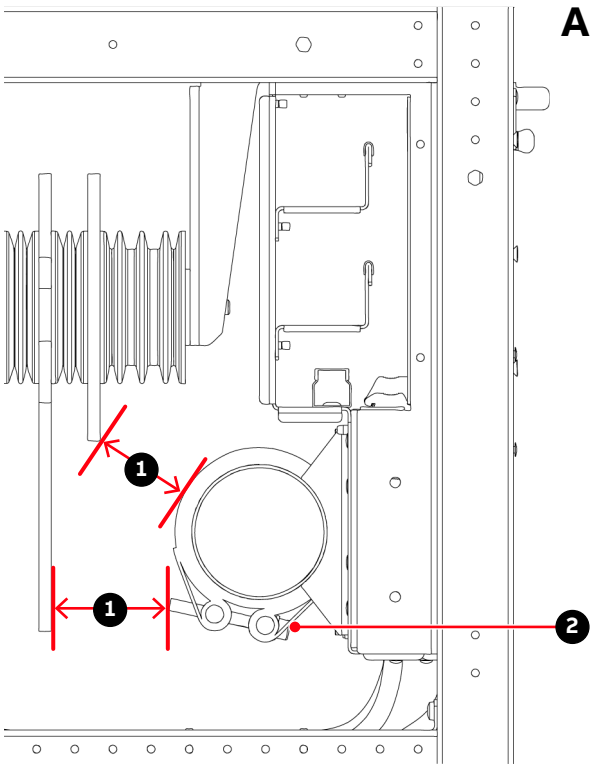


2. Slide the pipe joint over the two adjoining pipe ends.
3. Center the pipe joint.



4. Orientate the locking bolts of the pipe joint for the return water pipes (Fig. 36).

   WARNING! Flashover hazard! The locking bolts maintain the required minimum distances between pipe joint and busbars to prevent flashover when the drive is energized.



Key:

(1) 40 mm minimum

(2) Locking bolt orientation

Fig. 36. Minimum distances and locking bolt orientation (A = front)

5. After adjusting a pipe joint, alternately tighten the bolts lightly.

6. Tighten the bolts to the torque indicated on the pipe joint.

5.7.1. Removing a pipe joint

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

5.8. Joining busbars

⚠ CAUTION

Flashover hazard! Incorrect orientation of the busbar bolts can cause flashover when the drive is energized.

→ Orientate the bolts and the nuts of each connection as shown in this section to maintain the required minimal distances between busbars of different polarity.

NOTICE

Risk of component damage! Tightening torque for M12 bolts:

→ 40 Nm if two busbars are joined

→ 60 Nm if three and more busbars are joined

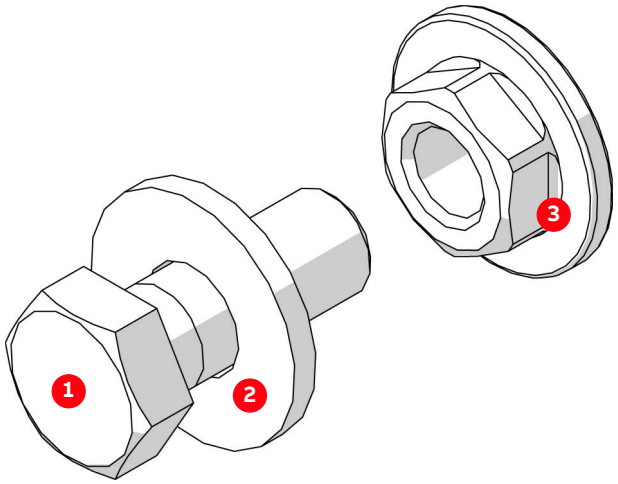
Joining the busbars of two adjoining transport units

– Busbar joints within a transport unit have been installed in the factory.

– Use only the supplied installation material.

– Orientate the parts of a joint (plates, bolts, and nuts) as shown.

– Use a conical spring washer on the bolt side of the connection.



Key:

(1) Hex-head bolt

(2) Conical spring washer

(3) Flange nut

Fig. 37. Bolted busbar connection

5.8.1. DC busbars

The DC busbars can be accessed from the back and the top of the cabinet. If necessary, you can remove the top plates and the rear walls.

NOTE – If you need to remove the air-to-air heat exchangers to access the top plates, see Section 5.9.2, “Removing air-to-air heat exchangers”, page 97.

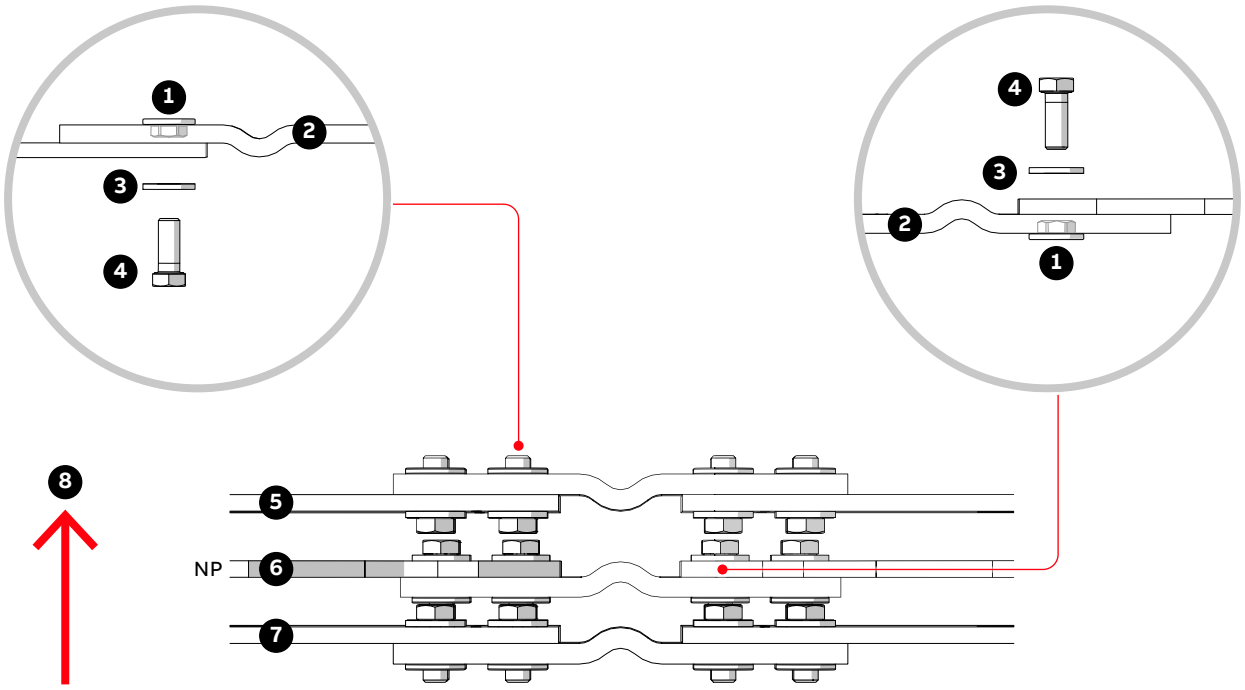
The following DC busbar configurations depend on the configuration of the drive:

– DC busbar configuration 1 (Fig. 38)

– DC busbar configuration 2 (A, Fig. 39)

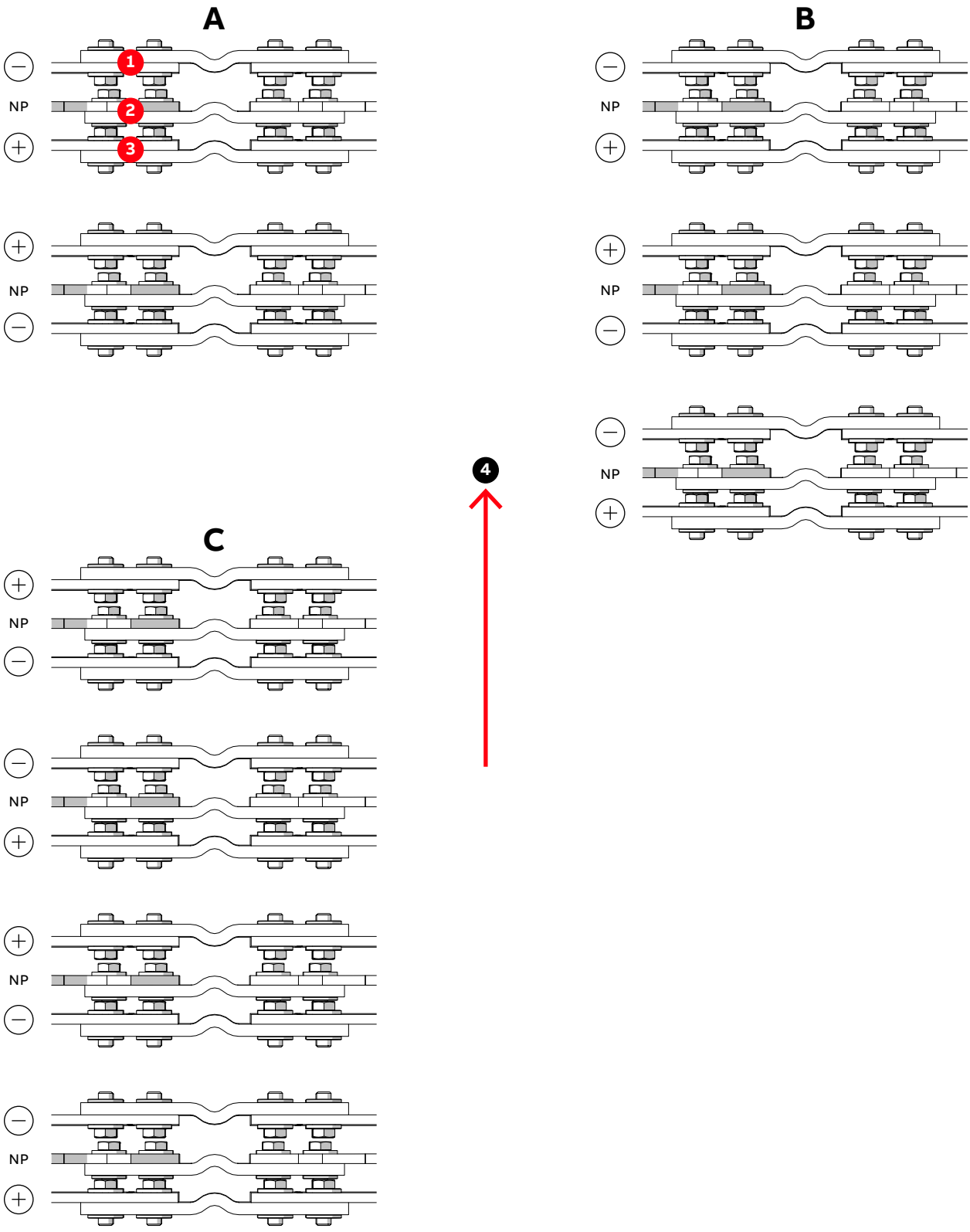
– DC busbar configuration 3 (B, Fig. 39)

– DC busbar configuration 4 (C, Fig. 39)



Key:		Quantity	Technical parameters	Identification
(1)	Captive flange nut	N/A	M12-A2-70, coated	3BHB038117R0001
(2)	Connecting plate	3	Flex	3BHB050592R0001/R0051
(3)	Conical spring washer	24	13 × 29 × 3	HAQN400344P0111
(4)	Hex-head bolt	24	M12 × 30-A2	NB 312350P8117
(5)	Busbar with positive potential	–	–	–
(6)	Busbar with neutral potential	–	–	–
(7)	Busbar with negative potential	–	–	–
(8)	Front of cabinet	–	–	–

Fig. 38. Top view of DC busbar configuration 1

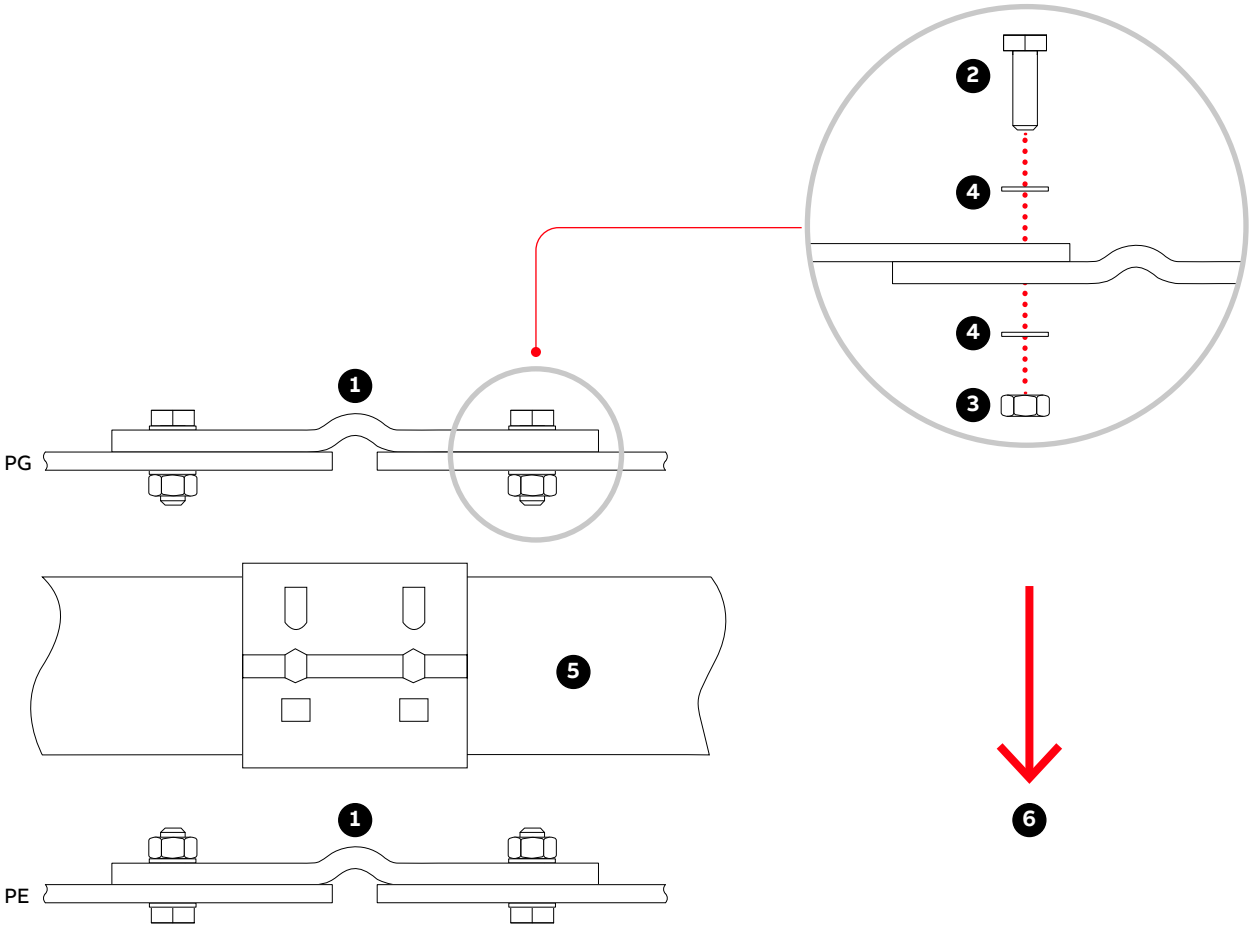


Key:

(1) Busbar with negative potential
(2) Busbar with neutral potential
(3) Busbar with positive potential
(4) Front of cabinet

Fig. 39. Top view (A) DC busbar configuration 2, (B) configuration 3, and (C) configuration 4

5.8.2. Ground busbars

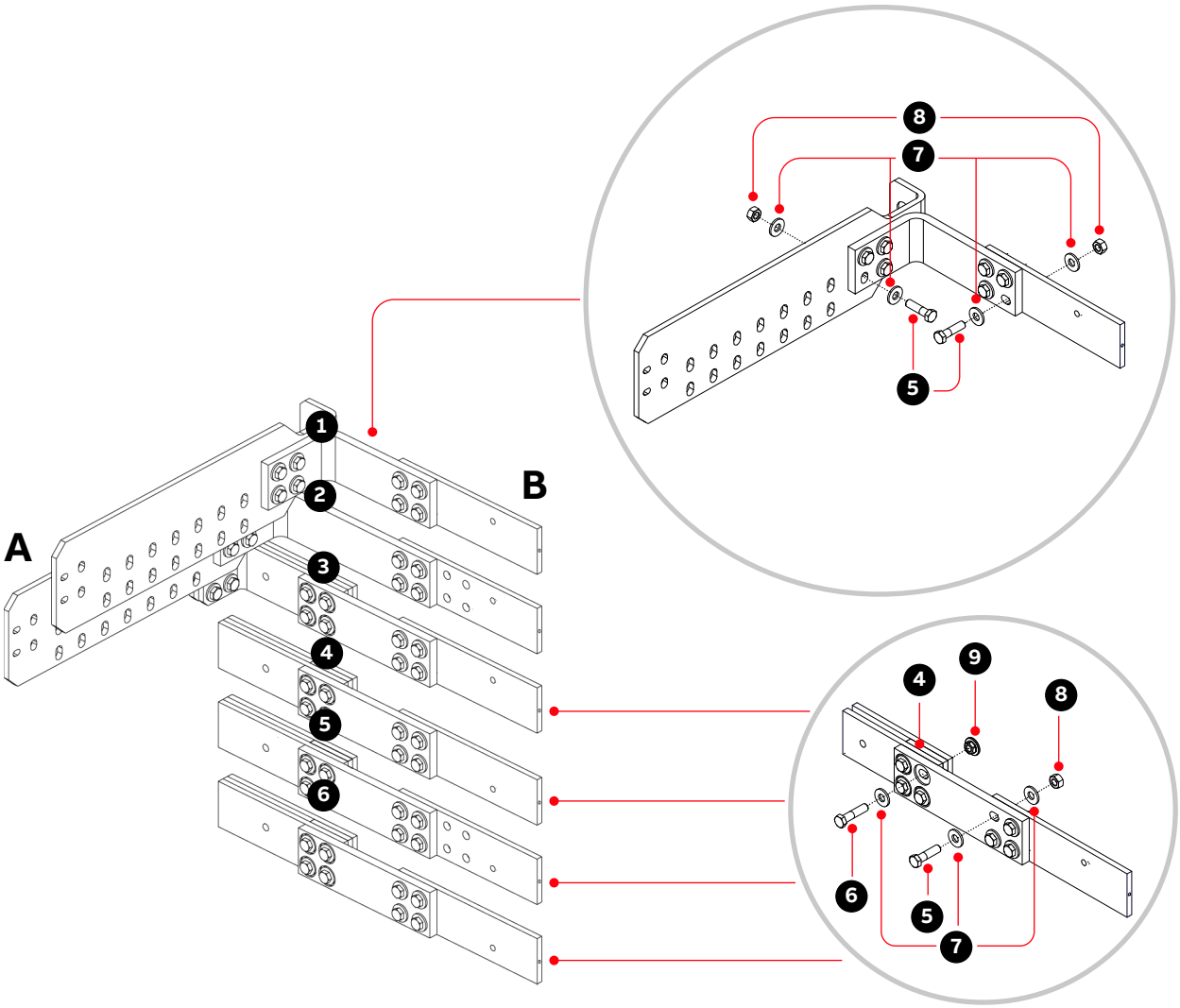


Key:		Quantity	Technical parameters	Identification
(1)	Connecting plate	2	Flex	3BHB010246R0001/R0051
(2)	Hex-head bolt	4	M12 × 40-A2	NB 312350P8119
(3)	Hex-head nut	4	M12-A2-70, coated	HZN 452198P1022
(4)	Conical spring washer	8	13 × 29 × 3	HAQN400344P0111
(5)	Water pipe	–	–	–
(6)	Cabinet front	–	–	–

Fig. 40. Ground busbar joints

5.8.3. AC busbars between COU/TEU and LSU (5/7/9 MVA)

The busbar configuration shown in Fig. 41 is for a TEU (A) connected to the left side of an LSU (B). For a TEU connected to the right side of an LSU, the busbar configuration is the mirror image of this figure.

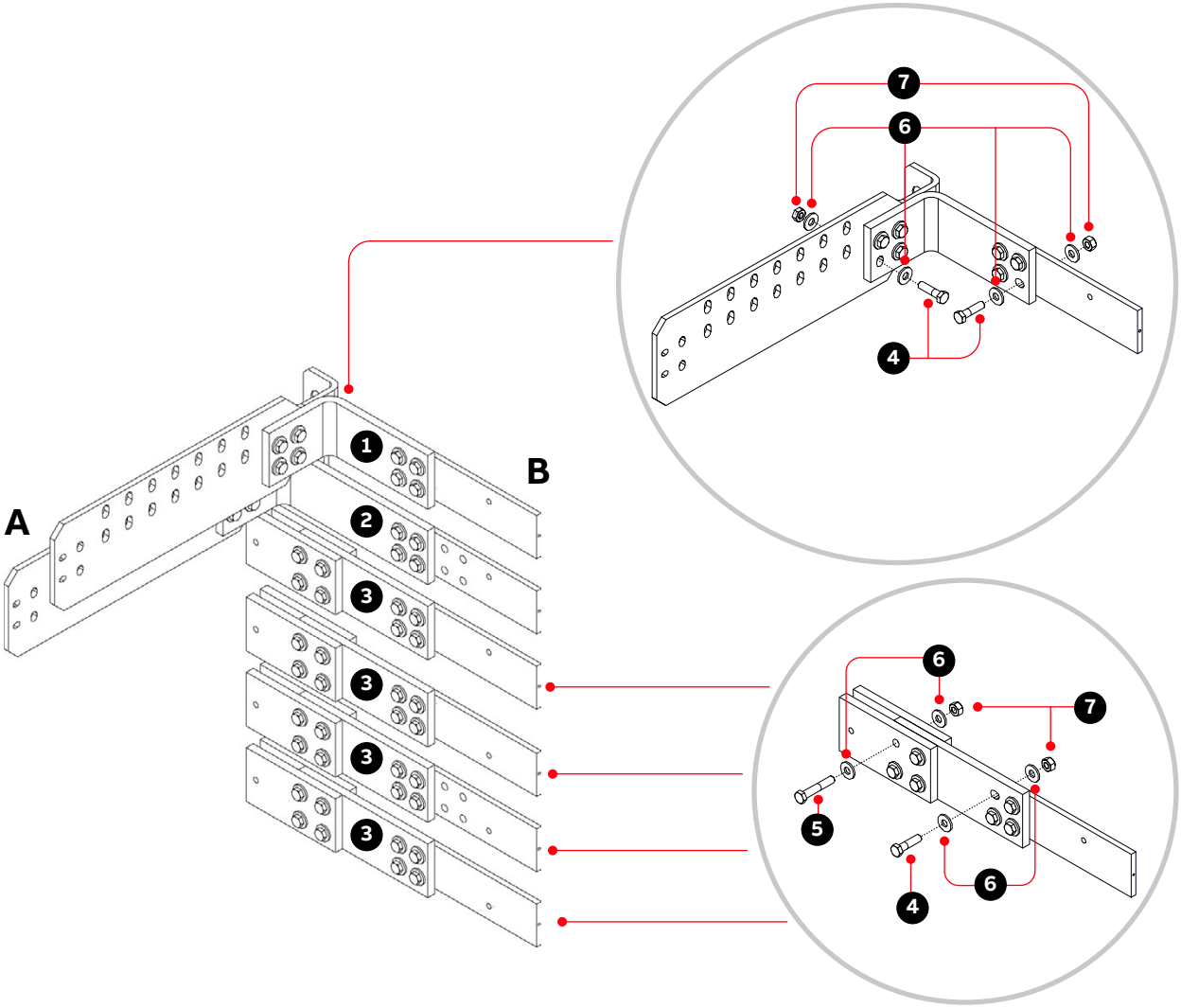


Key:		Quantity	Technical parameters	Identification
(1)	Connection bus bar	1	LSU-TEU 1b	3BHB045554R0001
(2)	Connection bus bar	1	LSU-TEU 2b	3BHB045556R0001
(3)	Connection bus bar	4	LSU-TEU 3b	3BHB045558R0001
(4)	Bus bar spacer	4	80 mm spacer 10 mm	3BHB031095R0001
(5)	Hex-head bolt	32	M12 × 45-A2-70	NB 312450P8120
(6)	Hex-head bolt	16	M12 × 50-A2-70	NB 312450P8121
(7)	Conical spring washer	80	DIN6796-13 × 29 × 3	HAQN400344P0111
(8)	Hex-head nut	32	M12-A2-70	HZN 452198P1022
(9)	Flange nut	16	M12-A2	3BHB038117R0001

Fig. 41. AC busbar joints between the COU/TEU and LSU (5/7/9 MVA)

5.8.4. AC busbars between COU/TEU and LSU (14 MVA)

The busbar configuration shown in Fig. 42 is for a TEU (A) connected to the left side of an LSU (B). For a TEU connected to the right side of an LSU, the busbar configuration is the mirror image of this figure.



Key:		Quantity	Technical parameters	Identification
(1)	Connection bus bar	1	LSU-TEU 1a	3BHB045554R0001
(2)	Connection bus bar	1	LSU-TEU 2a	3BHB045556R0001
(3)	Connection bus bar	4	LSU-TEU 3a	3BHB045558R0001
(4)	Hex-head bolt	32	M12 × 45-A2-70	NB 312450P8120
(5)	Hex-head bolt	16	M12 × 65-A2-70	NB 312450P8124
(6)	Conical spring washer	9	DIN6796-13×29×3	HAQN400344P0111
(7)	Hex-head nut	4	DIN934-M12-A2-70	HZN 452198P1022

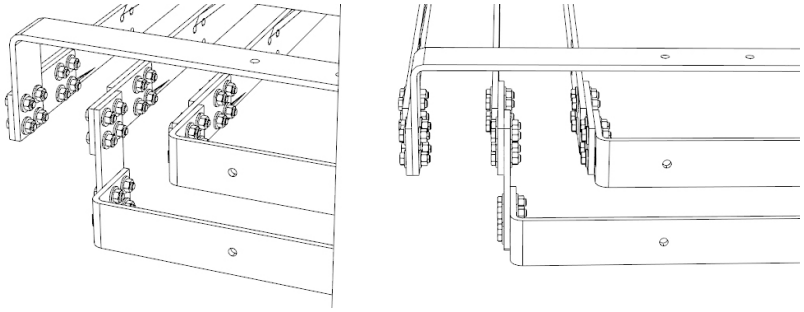
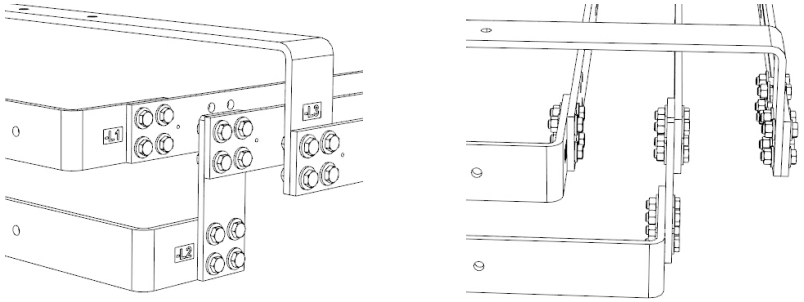
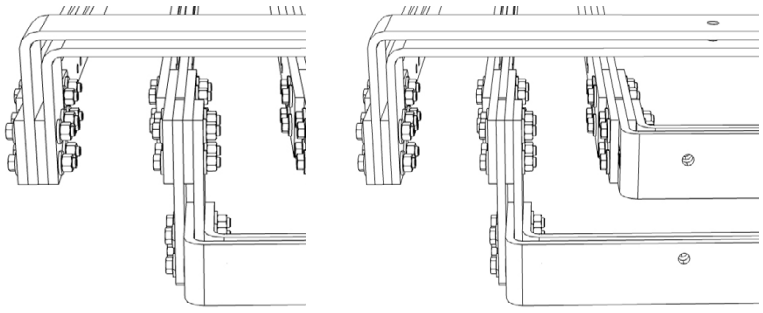
Fig. 42. AC busbar joints between the COU/TEU and LSU (14 MVA).

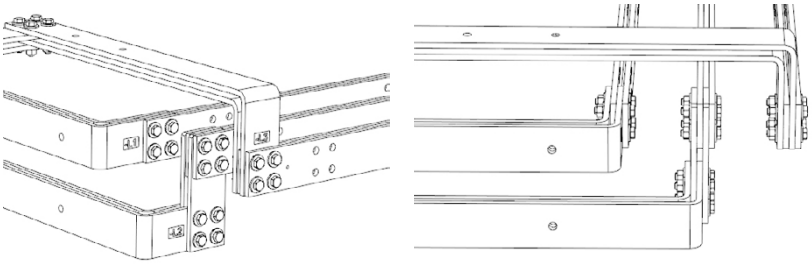
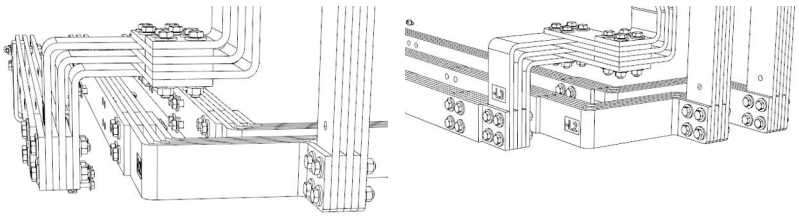
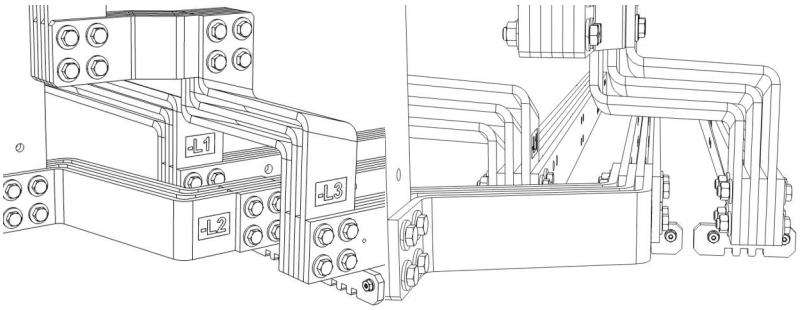
5.8.5. AC busbars between COU/TEU and ARU/INU

TABLE 9 Installation material for AC busbars (COU/TEU – ARU/INU)

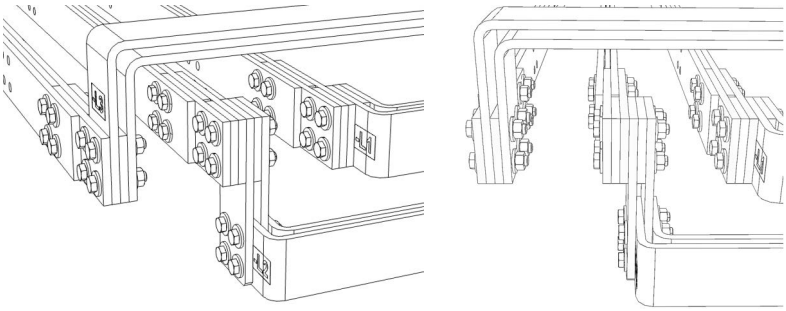
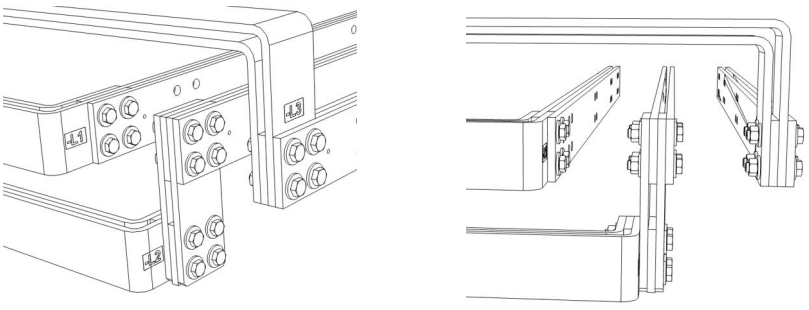
Item	Technical parameter	Identification	Usage
Hex-head bolt	M12 × 40-A2-70	NB 312350P8119	Single busbar
Hex-head bolt	M12 × 60-A2-70	NB 312450P8123	Double busbars
Hex-head bolt	M12 × 80-A2-70	NB 312450P8127	Triple busbars
Conical spring washer	13 × 29 × 3	HAQN400344P0111	–
Hex-head nut	M12-A2-70, coated	HZN 452198P1022	–

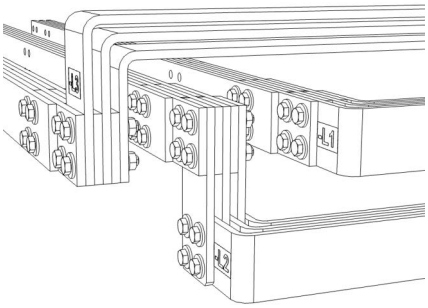
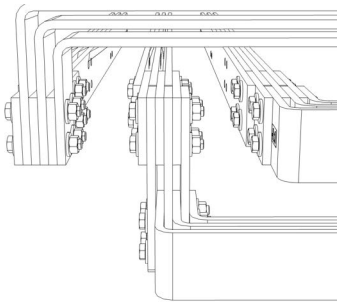
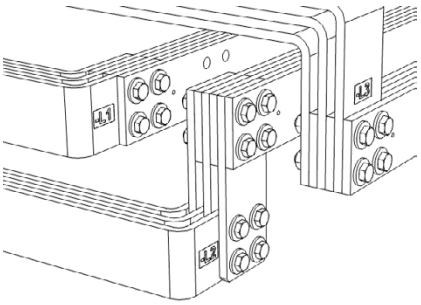
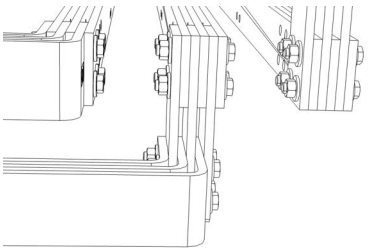
5.8.6. AC busbar joints - without disconnector

Modules	Busbar joints
• ARU/INU - COU/TEU • ARU/INU: 5 MVA (without MOI) • COU/TEU: - 600 mm - 1000 mm	
• COU/TEU - ARU/INU • ARU/INU: 5 MVA (without MOI) • COU/TEU: - 600 mm - 1000 mm	
• ARU/INU - COU/TEU • ARU/INU: - 7, 9, 13 peak MVA - 5 MVA (with MOI) • COU/TEU: - 600 mm - 1000 mm	

Modules	Busbar joints
• COU/TEU - ARU/INU • ARU/INU: - 7, 9, 13 peak MVA - 5 MVA (with MOI) • COU/TEU: - 600 mm - 1000 mm	
• ARU/INU - COU/TEU • ARU/INU: - 12 MVA • COU/TEU: - 1000 mm	
• COU/TEU - ARU/INU • ARU/INU: - 12 MVA • COU/TEU: - 1000 mm	

5.8.7. AC busbar joints - with motorized disconnector

Module	Busbar joints
• ARU/INU - COU/TEU • ARU/INU: - 5, 7, 9, 13 peak MVA • COU/TEU: - 1000 mm	
• COU/TEU - ARU/INU • ARU/INU: - 5, 7, 9, 13 peak MVA • COU/TEU: - 1000 mm	

Module	Busbar joints	
• ARU/INU - COU/TEU • ARU/INU: - 12 MVA • COU/TEU: - 1000 mm		
• COU/TEU - ARU/INU • ARU/INU: - 12 MVA • COU/TEU: - 1000 mm		

5.9. Installing and removing air-to-air heat exchangers

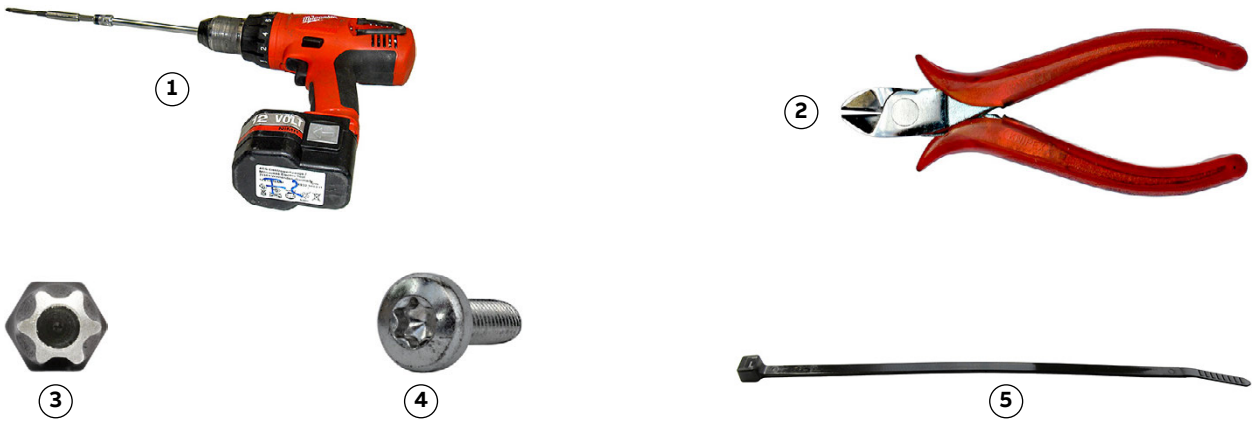
This section describes how to install and remove the optional air-to-air heat exchangers.

5.9.1. Installing air-to-air heat exchangers

For information on the number of air-to-air heat exchangers to be installed and their fitting position, see “Appendix C - Mechanical drawings”.

Weight	Length	Width	Height
~65 kg	1025 mm	750 mm	316 mm

Fig. 43. Air-to-air heat exchanger (type LT-5-5165-UL)



Key:

(1) Cordless drill
(2) Wire cutter
(3) Torx drill bit
(4) M6 × 12 Torx screw
(5) Cable tie

Fig. 44. Tools for installing an air-to-air heat exchanger

5.9.1.1. Installation

⚠CAUTION

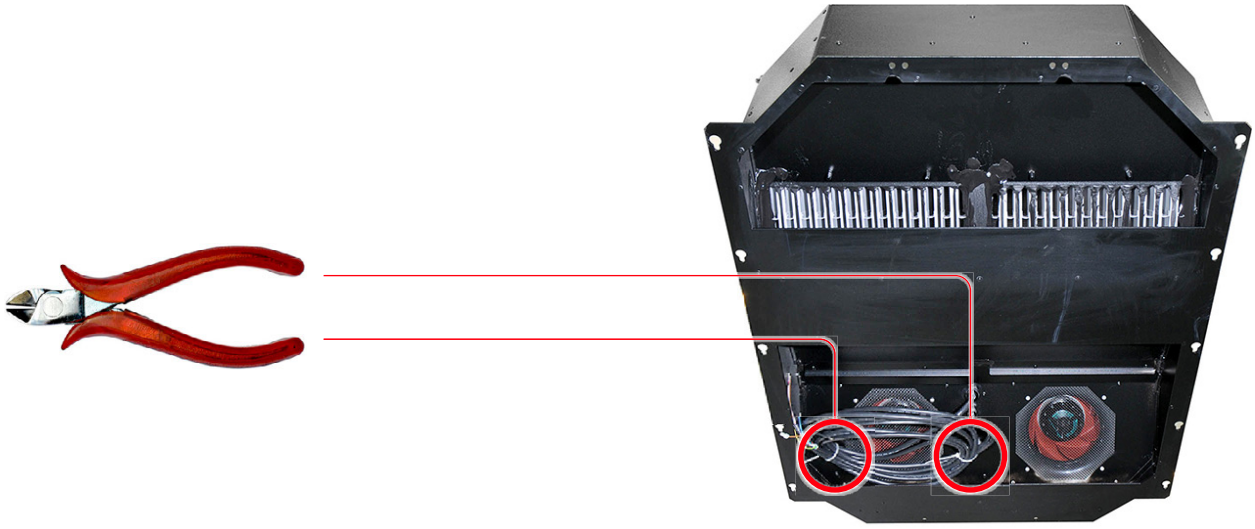
Risk of falling object An improperly secured load can shift and fall.

→ Always lift an air-to-air heat exchanger with a the rotating eyebolts (Fig. 31) that were delivered with the drive

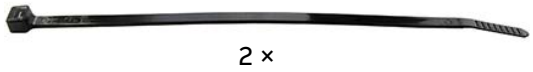
NOTICE

Risk of damage! Incorrectly installed heat exchanger cables can cause ground faults, unexpected shutdown of the drive, and damage to the heat exchanger.

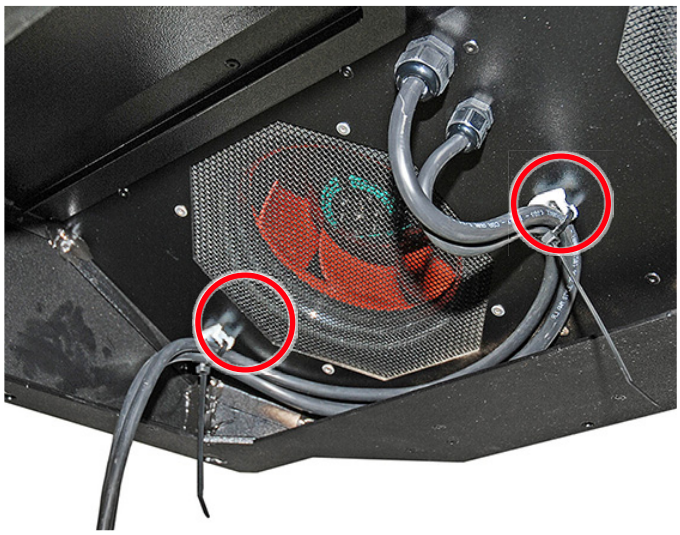
1. Before lifting the heat exchanger onto the roof, cut off the cable ties.



2. Loop the cables as illustrated and fasten them to the cable tie mounts (circles).

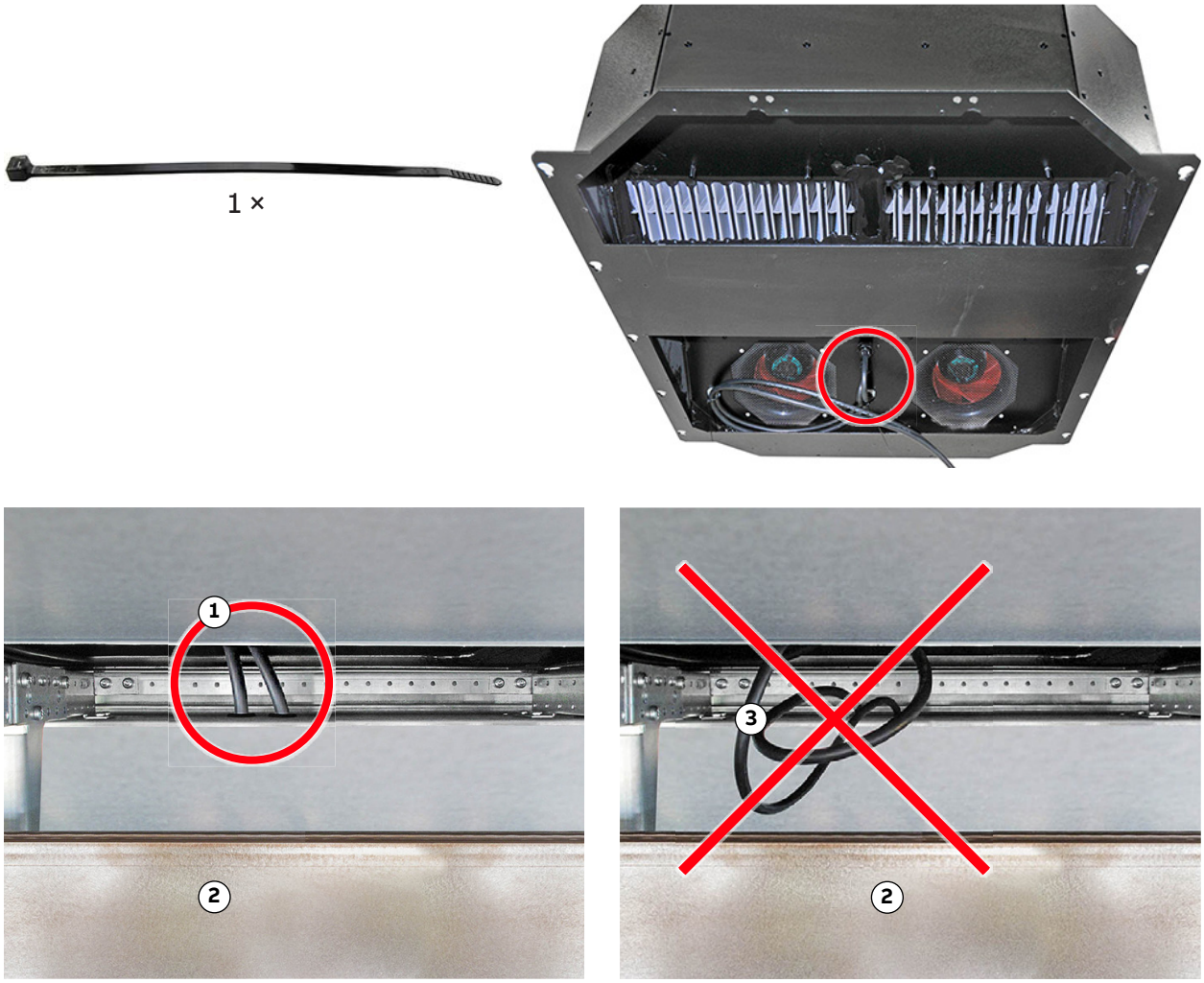


2 ×



3. Loop a length of the cables and fasten them to the cable tie mount (circle).

   CAUTION! Hazardous voltage! Make sure that the heat exchanger cables DO NOT touch the high-voltage carrying DC busbars (2, Fig. 45).



Key:

(1) Correct cable installation
(2) DC busbar
(3) Incorrect cable installation

Fig. 45. Correct and incorrect cable installation

4. Remove the cover on the roof where the heat exchanger is installed.

5. Install rotating eyebolts (1, Fig. 46) in the top corners of the heat exchanger.

   CAUTION! For a single lifting operation, tighten the eyebolts (1, Fig. 46) firmly with the star key (2, Fig. 46). 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 67.

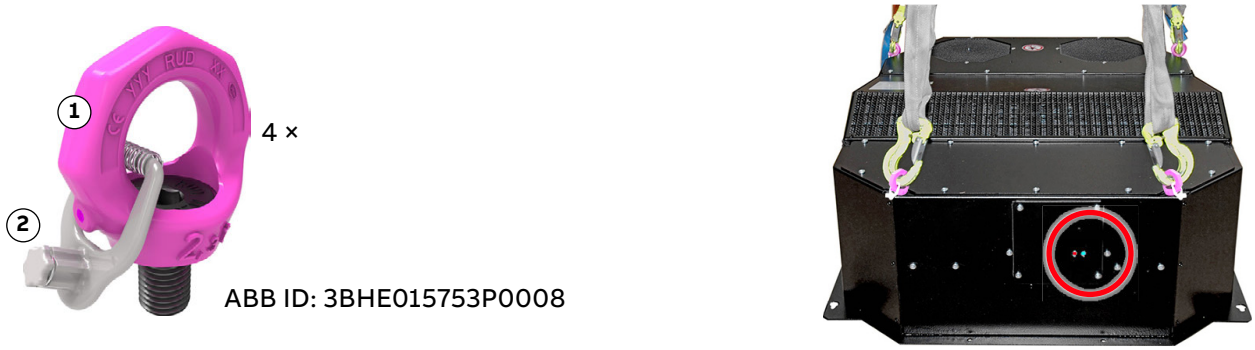


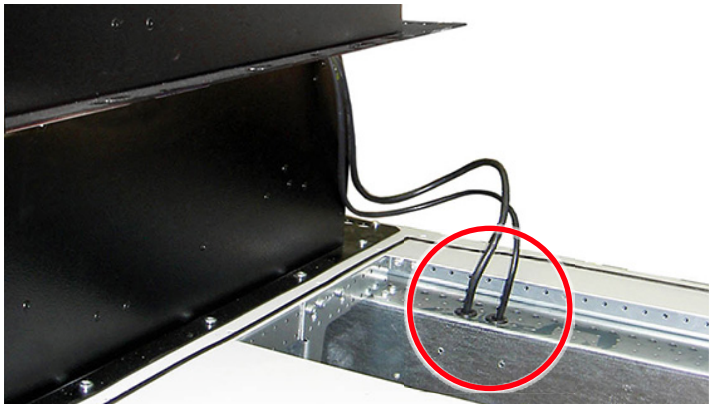
Fig. 46. M8 rotating eyebolt and heat exchanger with mounted rotating eyebolts

6. Orient the rotating eyebolts in the direction of force.

   CAUTION! Rotation during transportation must be avoided.

7. Lift the heat exchanger above the opening in the roof and orientate the heat exchanger with the LEDs (circle, Fig. 46) pointing to the front of the cabinet.

8. Route the cables through the designated openings (circle) at the front of the cabinet.



9. While lowering the heat exchanger onto the roof, pull the cables through the openings.
10. From the openings (1), route the cables to the terminals (2) as illustrated in Fig. 47 and Fig. 48.

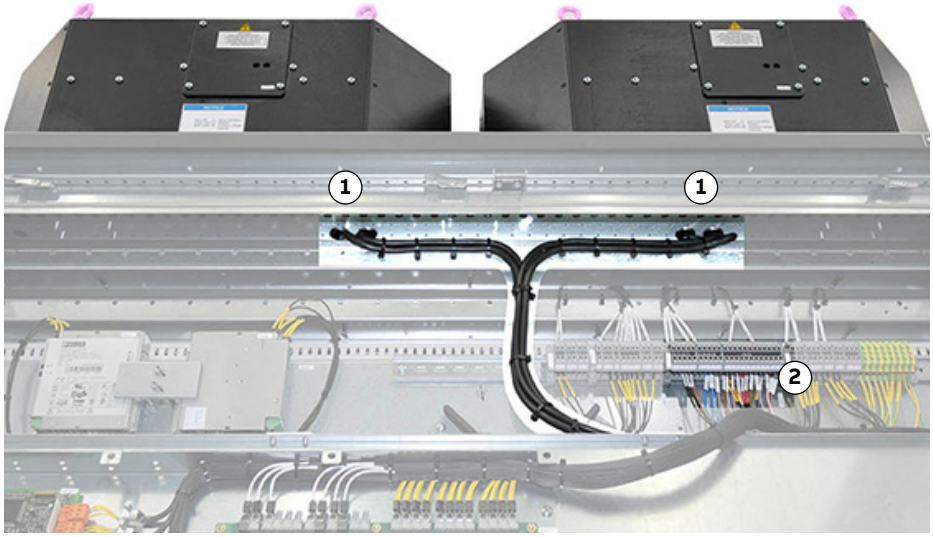


Fig. 47. ARU/INU/IFU cable routing

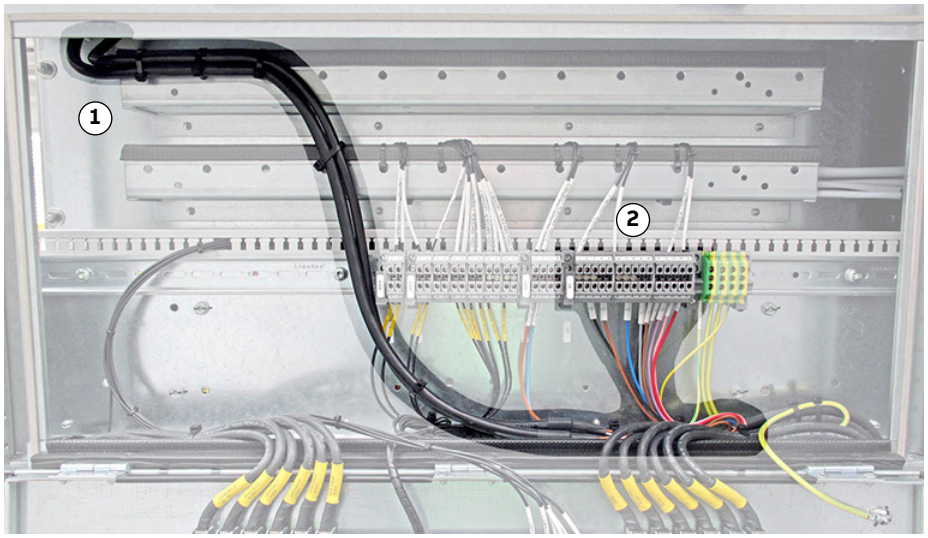
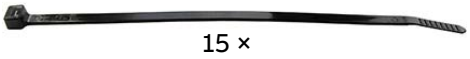


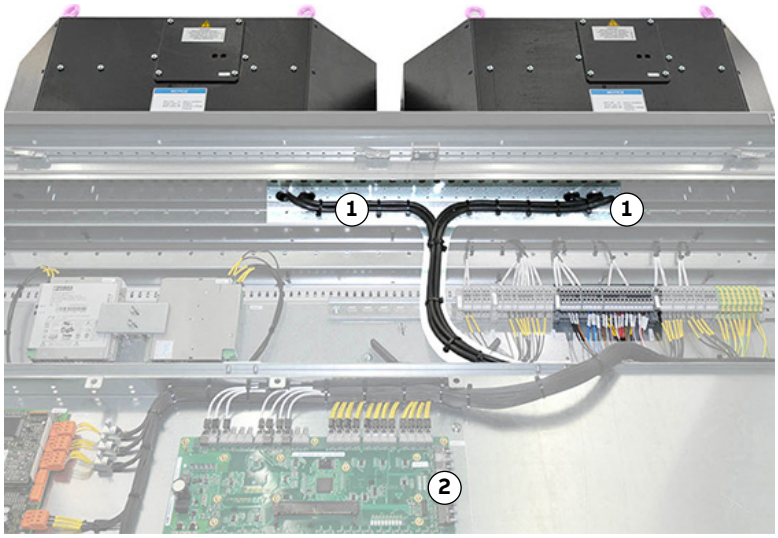
Fig. 48. LSU cable routing

11. Connect each wire to terminal block -X1 according to the terminal numbers printed on the marker sleeves (white).

12. In the upper part of the cable duct (1), fasten the cables to the cabinet frame.



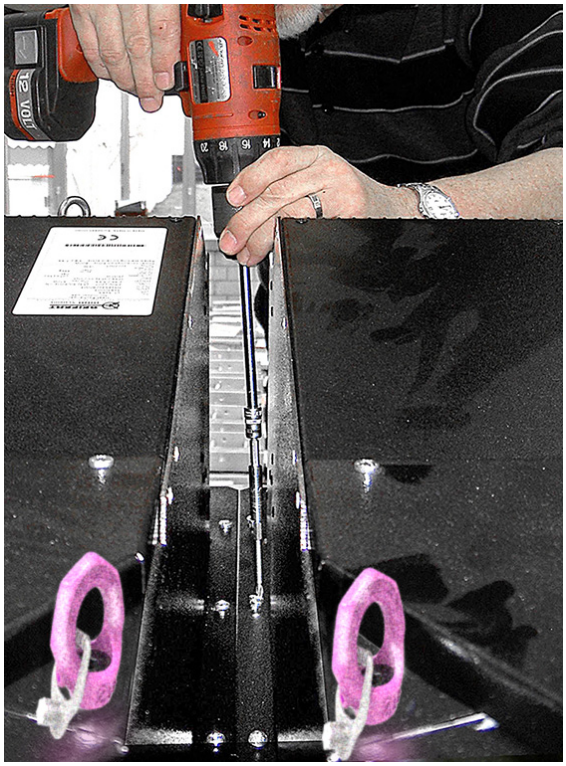
15 ×



13. In the lower part (2), tie the cables together at regular distances.

14. Check that the cables do not touch the DC busbars.

15. Fasten the heat exchanger to the roof with 14 self-tapping M6×12 screws (HAQN401205P0257).



16. Remove the rotating eyebolts that you installed in step **5**.

5.9.2. Removing air-to-air heat exchangers

This section applies to drives that are delivered in several transport units.

⚠ CAUTION

Heavy object! An air-air heat exchanger weighs approximately **65 kg**.

→ Observe the installation height of the heat exchanger as well as the dimensions and weight of the heat exchanger.

→ Take appropriate measures for removing and installing the heat exchanger safely.

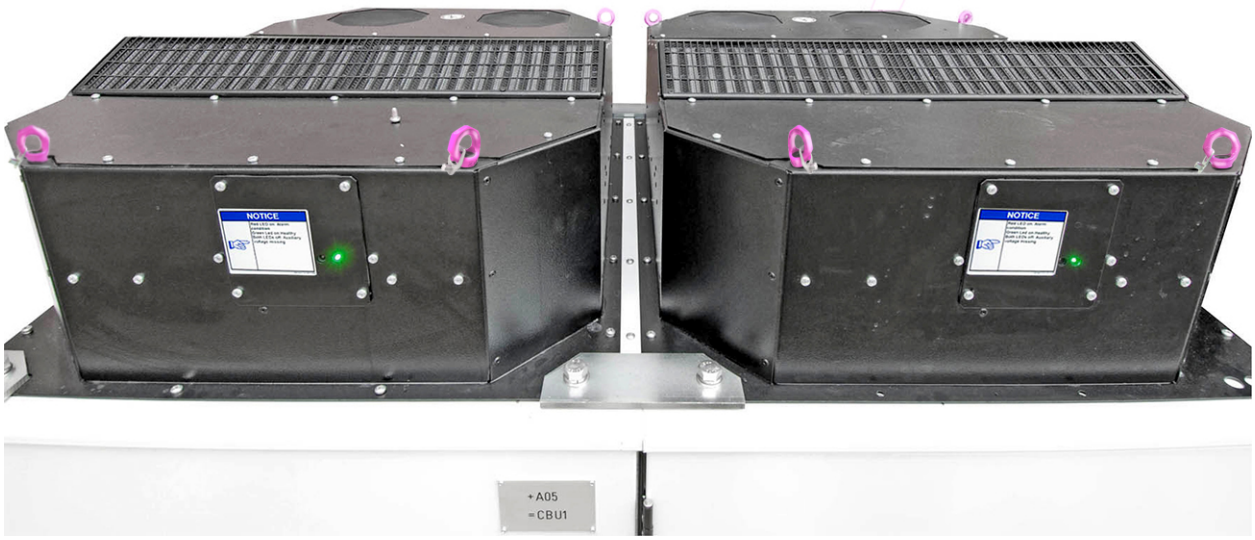


Fig. 49. Air-to-air heat exchangers (type LT-5-5165-UL)

Air-to-air heat exchangers must be removed and refitted where two transport units are joined.

Depending on the drive configuration, at least one heat exchanger must be removed for joining the DC busbars of two adjacent transport units.

Key:

(1) Cordless drill
(2) Wire cutter
(3) Torx drill bit
(4) Cable tie

Fig. 50. Tools for removing an air-to-air heat exchanger

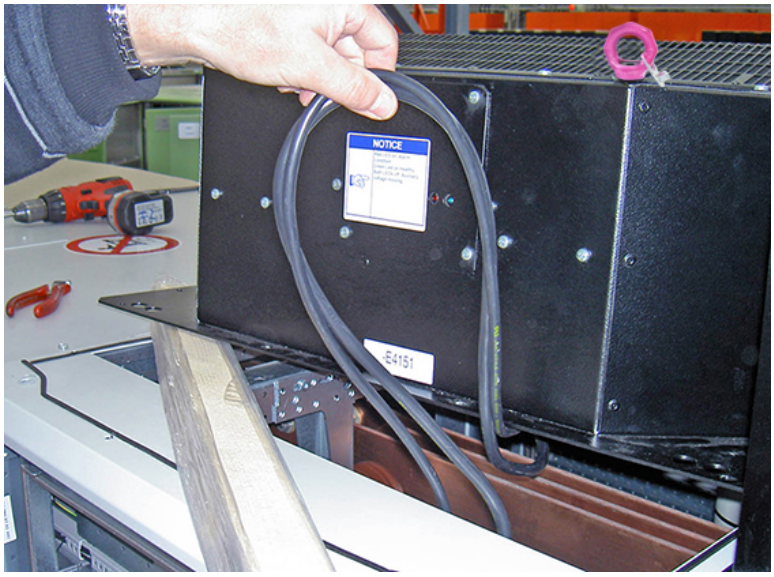
5.9.2.1. Removing an air-to-air heat exchanger

1. Loosen the 4 self-tapping M6×12 screws (HAQN401205P0257) that fasten the heat exchanger to the roof.

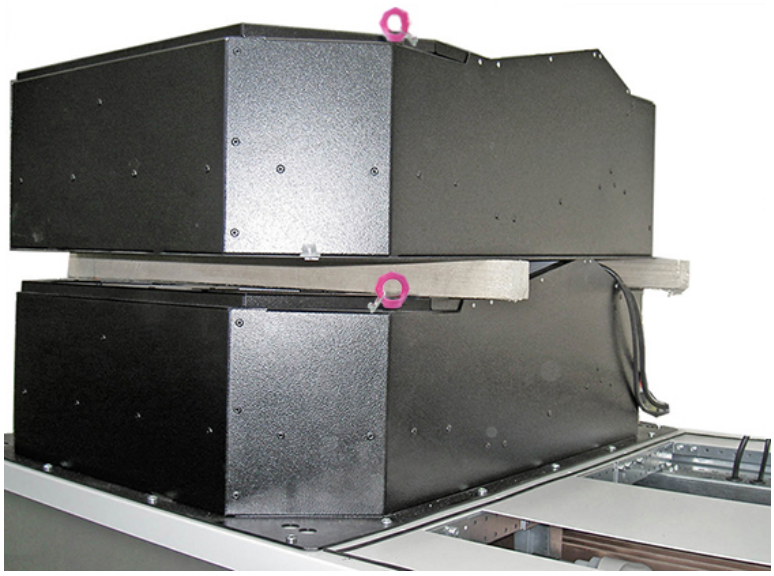
2. Remove the cable ties.

3. Lift the heat exchanger by crane and move it approximately 20 cm to the back and place it on pieces of square timber.

4. Pull out the cables, but leave them connected.



5. Put two pieces of square timber on the adjacent heat exchanger and place the removed heat exchanger on the timber.



6. Join the DC busbars with the supplied installation material.

5.9.2.2. Reinstalling an air-to-air heat exchanger

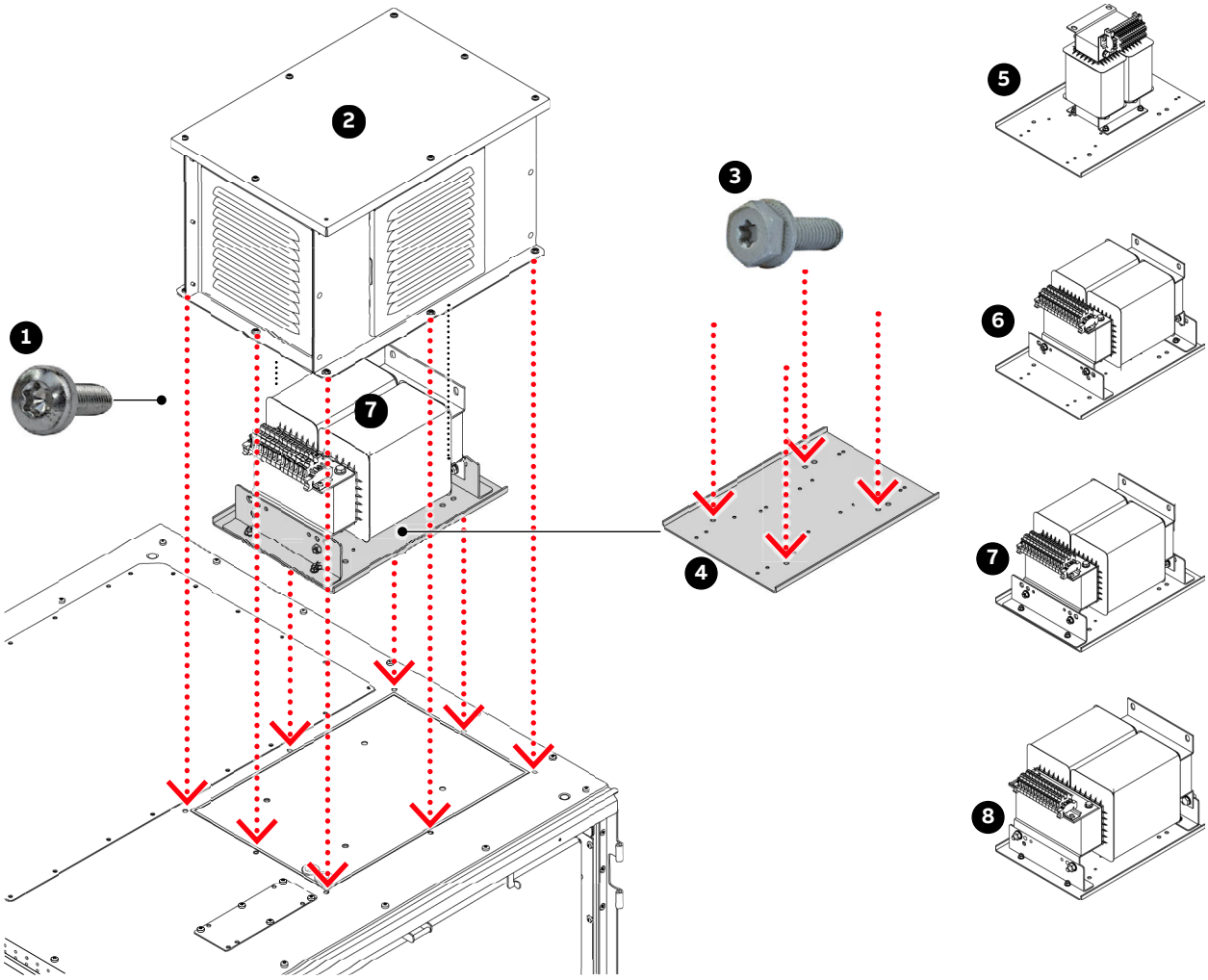
1. Move the heat exchanger to its original position.
2. Pull the cables down towards the terminal box.
3. Move the heat exchanger to its exact position.
4. Fix the cables with cable ties at regular distances of approximately 20 cm.
5. Tighten all screws of the heat exchanger.
6. Fix the cables inside the terminal box with cable ties.

5.9.3. Installing the transformers of air-to-air heat exchangers

This procedure is air-to-air heat exchangers that were delivered separately from the drive.

For information on the number of transformers to be installed and their fitting position, see “Appendix C - Mechanical drawings”.

1. Install the transformer and hood as illustrated.



Key:		Weight	Quantity	ABB ID
(1)	M6x12 screws	–	8 ×	HAQN401205P0257
(2)	Transformer hood	–	1 ×	–
(3)	M8x20 bolts	–	4 ×	9ABA450093R0310
(4)	Transformer connection plate	–	1 ×	–
(5)	1.5 kVA transformer	~17 kg	1 ×	–
(6)	2.8 kVA transformer	~49 kg	1 ×	–
(7)	3.5 kVA transformer	~49 kg	1 ×	–
(8)	6 kVA transformer	~66 kg	1 ×	–

Fig. 51. Installation example of transformers in an air-to-air heat exchanger

2. Connect each wire to the terminal block according to the terminal numbers printed on the marker sleeves.

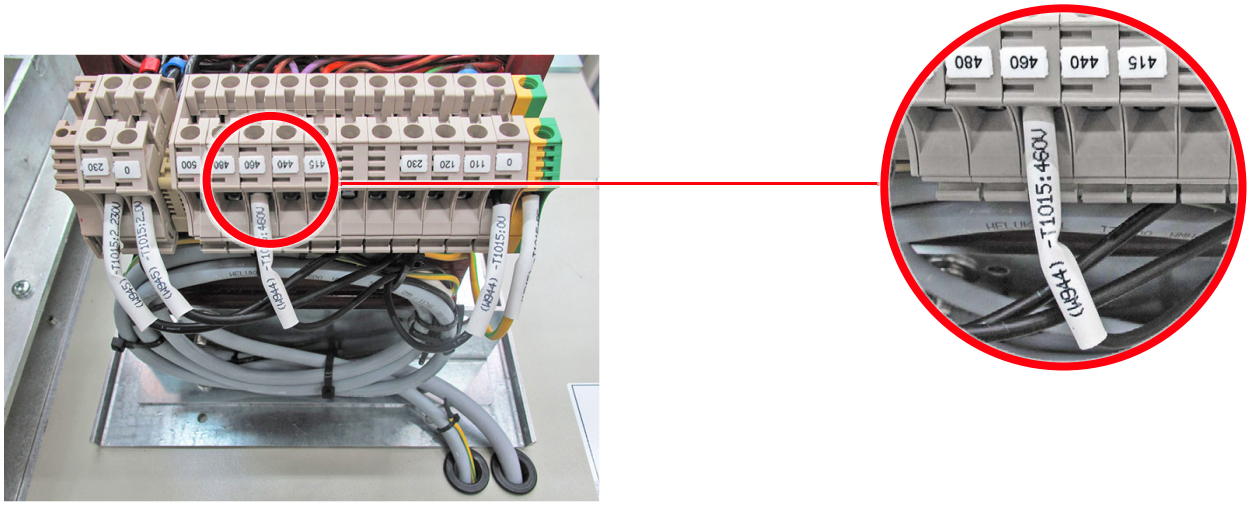


Fig. 52. Connect wires to terminal block

5.10. Installing the pressure relief vents

For some drives, the pressure relief vents are delivered separately and must be installed on the roofs of TEU and COU cabinets.

Weight	Length	Width	Height
~26 kg	840 mm	520 mm	210 mm

Fig. 53. Pressure relief vents

Key:

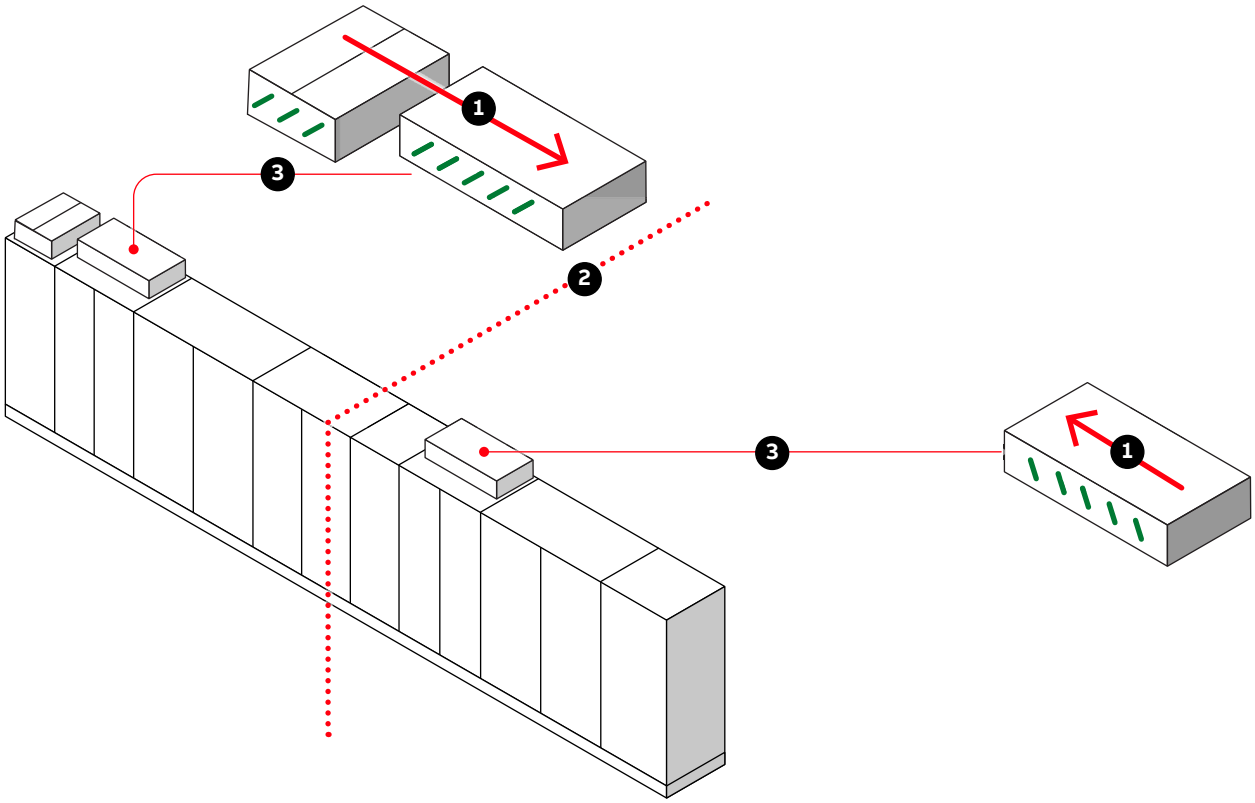
(1) Cordless drill
(2) Torx bit
(3) 24 × M6x20 Self-tapping (HAQN40105P0260)

Fig. 54. Tools required to fasten the pressure relief vent to the roof

1. Orientate the pressure relief vents with the baffle blades (arrows) pointing to the center of the drive.

   NOTE – The orientation of the baffle blades can be seen through the grill on the underside.

2. Fasten the pressure relief vent to the roof with the supplied screws (3, Fig. 54).



Key:

(1) Orientation of baffle blades
(2) Center of drive
(3) Pressure relief vents

Fig. 55. Installation example of pressure relief vents

5.11. Installing the roof joints and the roof attachments

This section applies to drives that are delivered in several transport units.

5.11.1. Installing roof joints

For information on the fitting position, see “Appendix C - Mechanical drawings”.

TABLE 10 Installation material for roof joints

Item	Technical parameter	ABB ID
Connecting plate	8 × 80 × 220 mm	3BHB011552R0001
Hex-head bolt	M16 × 40-A2	NB 312350P0464
Washer	17 × 30 × 3	9ABA450078P0008

– Install the joints at the front and the back of the roof of two adjoining transport units using the supplied installation material.

  NOTE – The joints (1) within a transport unit are factory-installed.

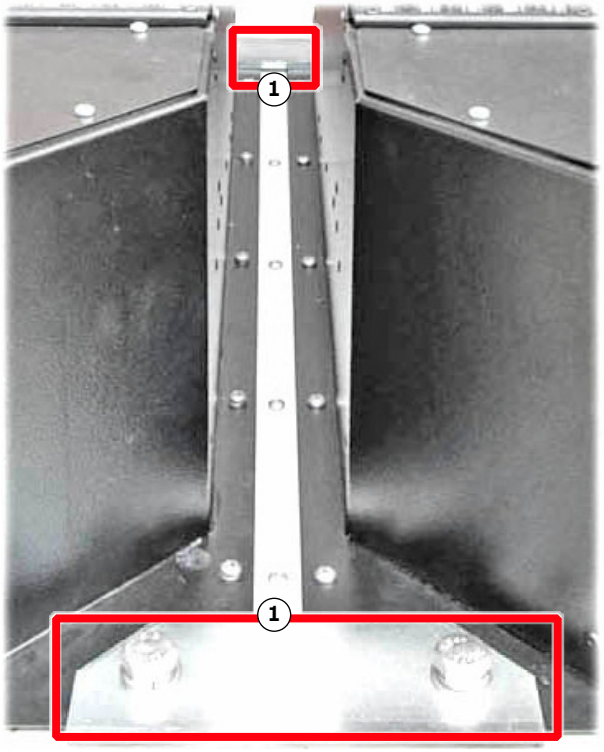


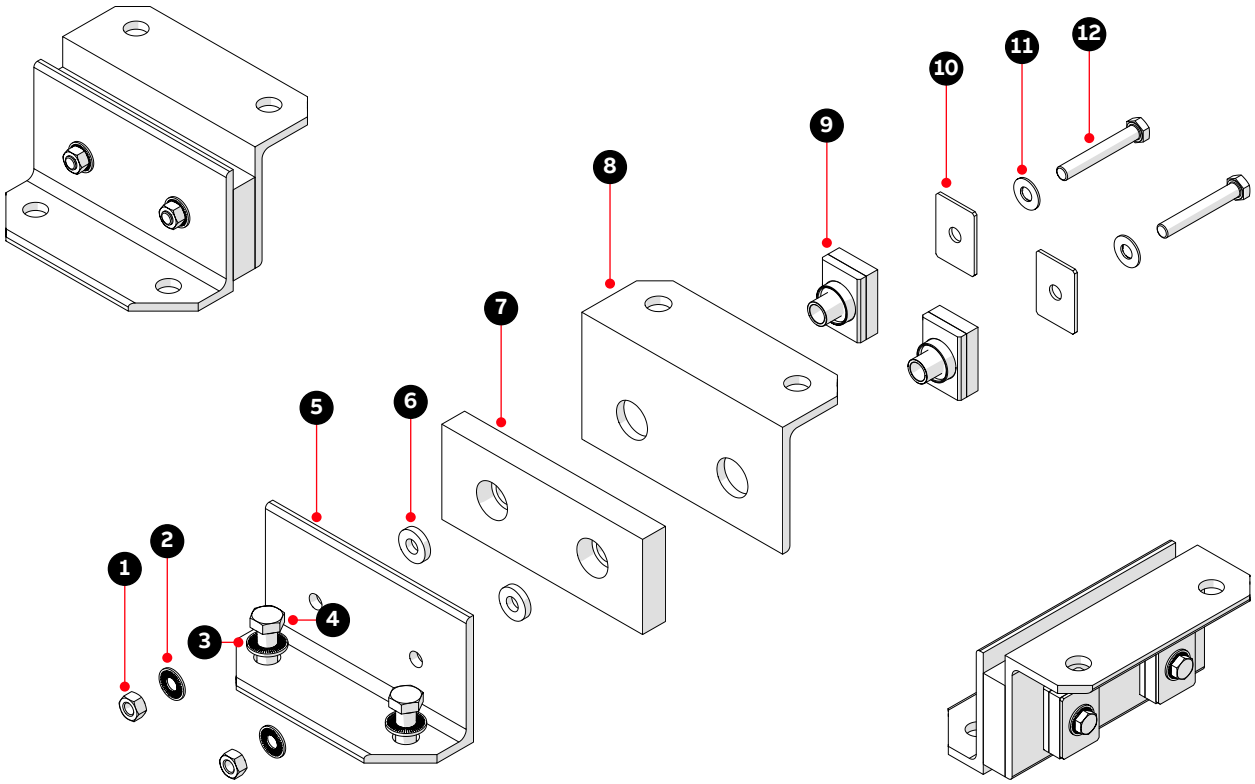
Fig. 56. Roof joints (1)

5.11.2. Installing roof attachments

This section applies to marine drives.

The roof attachments prevent tilting of the cabinets and dampen vibrations. Struts for attaching the cabinets to the wall of the drive room are not supplied.

For information on the fitting location, see “Appendix C - Mechanical drawings”.

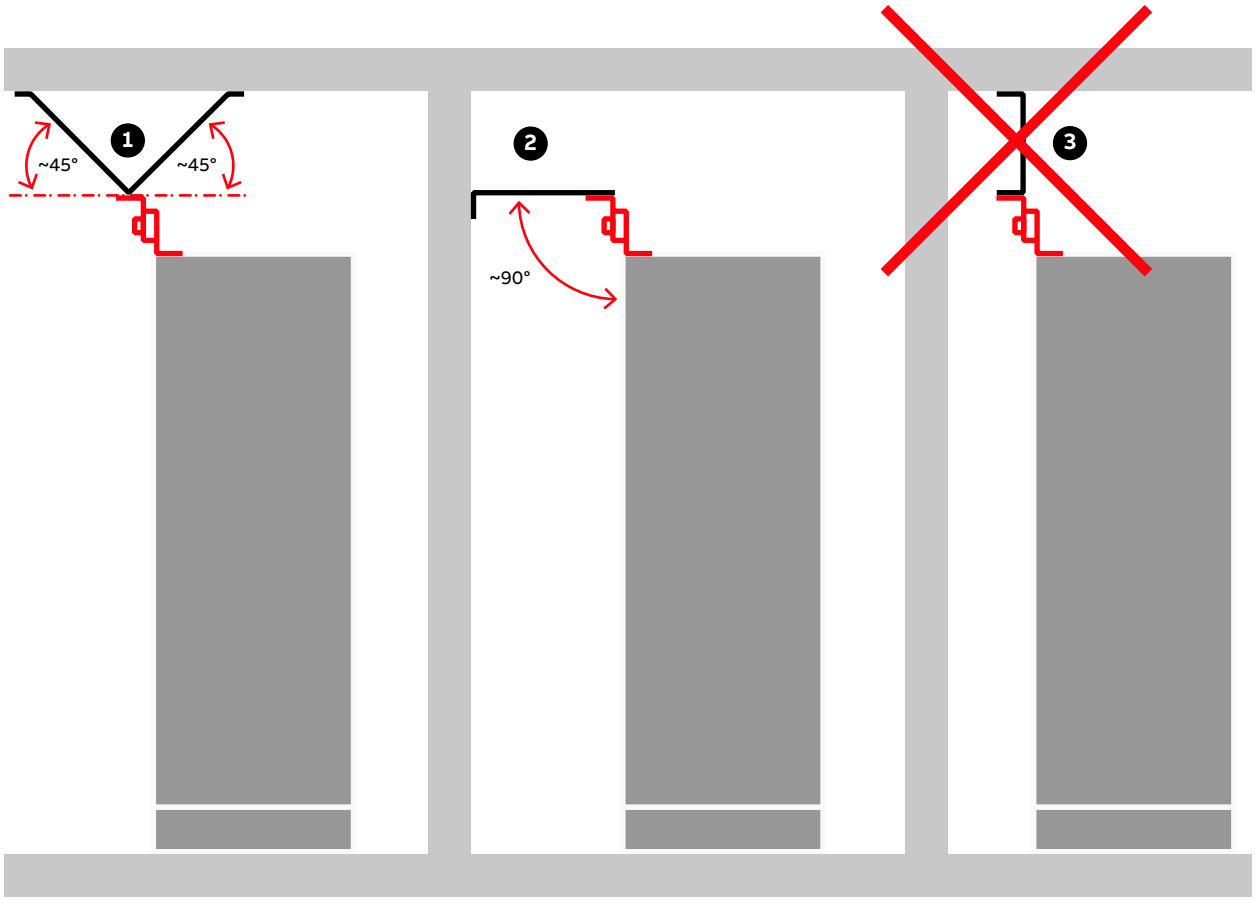


Key:		Quantity	Details	ABB ID
(1)	Nuts	2 ×	M12	HZN 452198P1022
(2)	Washers	2 ×	13 / 29 ST / ZN	9ABA450078P0007
(3)	Washers	2 ×	17 × 30 × 3	9ABA450078P0008
(4)	Hex-head bolts	2 ×	M16 × 40	NB 312350P0464
(5)	Bracket	1 ×	–	3BHB035997R0002
(6)	Spacers	2 ×	–	3BHB032466R0001
(7)	Damping pad	1 ×	–	3BHB035998R0001
(8)	Bracket	1 ×	–	3BHB035997R0001
(9)	Damping connectors	2 ×	–	3BHB033405R0001
(10)	Plates	2 ×	–	3BHB035999R0001
(11)	Washers	2 ×	13 / 29 ST / ZN	9ABA450078P0007
(12)	Hex-head bolts	2 ×	M12 × 80	NB 312450P8127

Fig. 57. Roof attachment parts

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

3. To fix the drive to the ceiling or the back wall, use two suitable struts per roof attachment.
   WARNING! DO NOT install the struts at a 90° angle to the cabinet roof (3, Fig. 58).
   NOTE – The struts are not supplied.
4. If you fix the drive to the ceiling, use two struts per roof attachment (1, Fig. 58).
5. If you fix the drive to the back wall, install one strut in a 90° angle to the drive (2, Fig. 58).



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. 58. Recommended ceiling and wall fixings

6. Electrical installation

6.1. Safety

DANGER

Hazardous voltage! Improper work can result in life-threatening injury or DEATH!

→ Only qualified personnel who are familiar with the site requirements, equipment requirements and the relevant electrical codes can perform the installation.

→ DO NOT switch on the main and auxiliary power supplies during the installation.

→ After the installation, obtain permission from the ABB commissioning personnel BEFORE you switch on the main and auxiliary power supplies.

Overview

The installation includes the following items:

– Section 6.3, “Grounding the drive system”, page 108

– Section 6.4, “Internal wiring”, page 111

– Section 6.5, “Cable entry systems”, page 114

– Section 6.8, “Auxiliary power, control and serial communication cables”, page 129

– Section 6.9, “Connecting the heating cable”, page 140

Fig. 59. Phase module on lift table

6.2. Cable requirements

Power, auxiliary and control cables have different requirements.

6.2.1. Power cables

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

– “Power cable specification”, 3BHS125090 E01

– “Power cables engineering guideline” , 3BHS542290 E01

6.2.2. Auxiliary and control cables

NOTICE

Risk of false signals!

→ DO NOT lay control cables parallel to the power supply cables; If this cannot be avoided, maintain a minimum distance of **30 cm** between the 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.

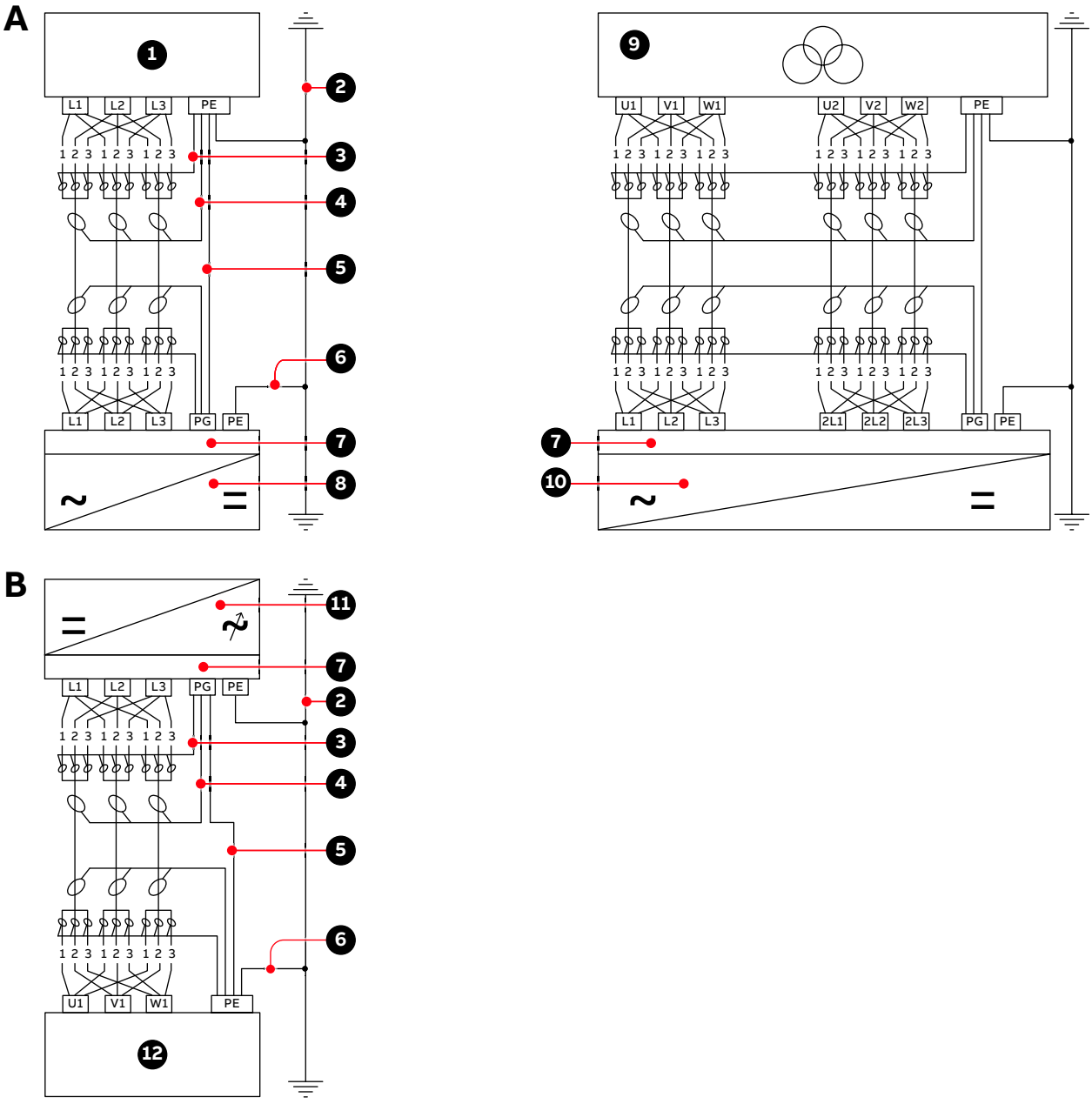
6.2.3. Synchronization cables

Synchronization cables are used in drives with an ARU. A shielded, 3-phase cable without neutral wire is required for the supply voltage of the synchronization transformer.

6.3. Grounding the drive system

To identify the ground buses, see “Appendix C - Mechanical drawings”.

6.3.1. Grounding diagrams



Key:

(1) Transformer or busbar
(2) System ground
(3) Cable shield
(4) Cable armor
(5) Equipotential bonding conductor
(6) Ground cable
(7) TEU
(8) ARU
(9) Transformer
(10) LSU
(11) INU
(12) Motor

Fig. 60. Grounding the (A) input side and (B) output side of the drive system

6.3.2. Ground cable connection

The ground cable is connected to the PE ground busbar of the drive at only one point, ie, at the ground busbar inside the TEU part of the master COU.

In cabinets with top cable entry, the PE ground busbar is fitted below the roof.

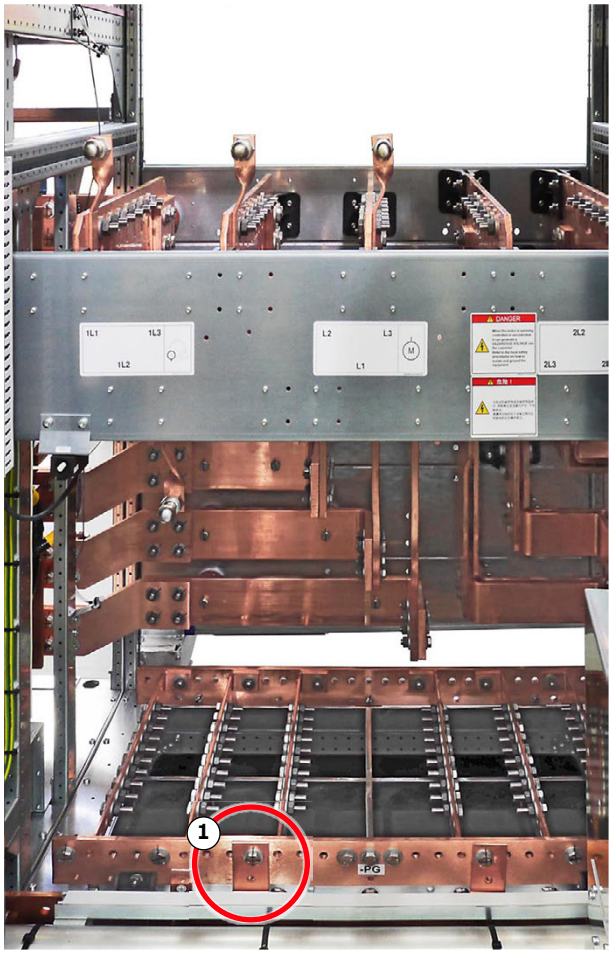


Fig. 61. System (1) ground connection in a 600 mm TEU

For project-specific information, see “Appendix D - Wiring diagrams”. For information on busbar thickness and fastening hole diameter, see “Appendix C - Mechanical drawings”.

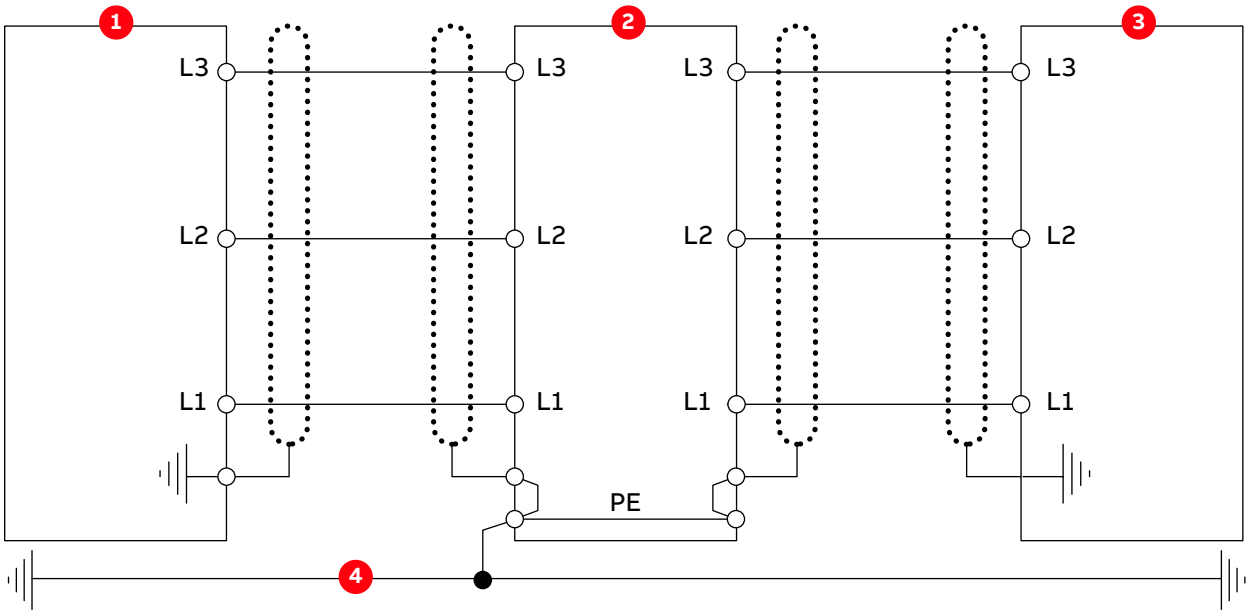
6.3.3. Cable shield ground connection

Cable shields are connected to the separate PG ground busbar. The connection between the PE and PG ground busbars inside the CBU is made in the factory. The CBU has a grounding switch on the door.

6.3.4. 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. 62. Grounding the EXU

6.4. Internal wiring

This following instructions are for a drive that must be assembled from transport units. In this scenario, the pre-assembled cables for internal wiring are delivered separately with terminal identifiers at each end.

For information on cable identifiers, cable type, cross-sectional areas, and terminal location, see the “Converter hardware diagram” and the Wiring list in “Appendix D - Wiring diagrams”:

6.4.1. Optical fiber cables

NOTICE

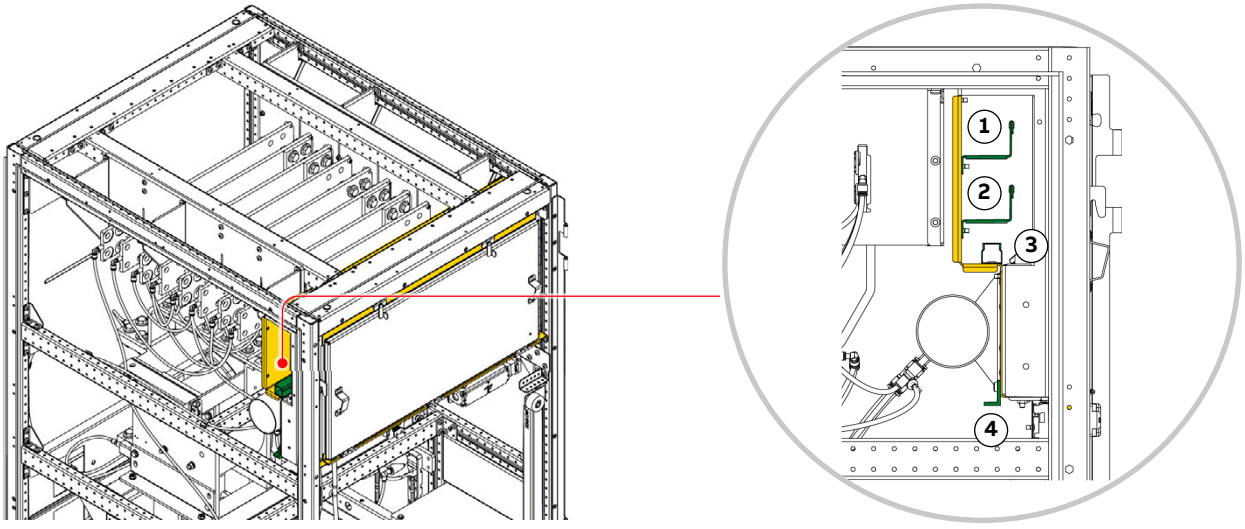
Risk of equipment failure! Handle optical fibers with care. A damaged or incorrectly installed optical fiber cable can degrade data transmission and cause equipment failure.

- → 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.
- → 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.
- → 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.

6.4.1.1. Installing the standard optical fibers

1. Pull all cables through the cable duct (3, Fig. 63) at the top of the cabinets.

   NOTE – Cut-outs in the ducts provide entry into the cabinets.



Key:

(1) Cable tray for auxiliary power supply cable
(2) Cable tray for control cables
(3) Cable duct for optical fibers
(4) Rail for IGCT power supply cables of RBU, BCU and VLU

Fig. 63. Cable tray and cable ducts in an LSU (A = front)

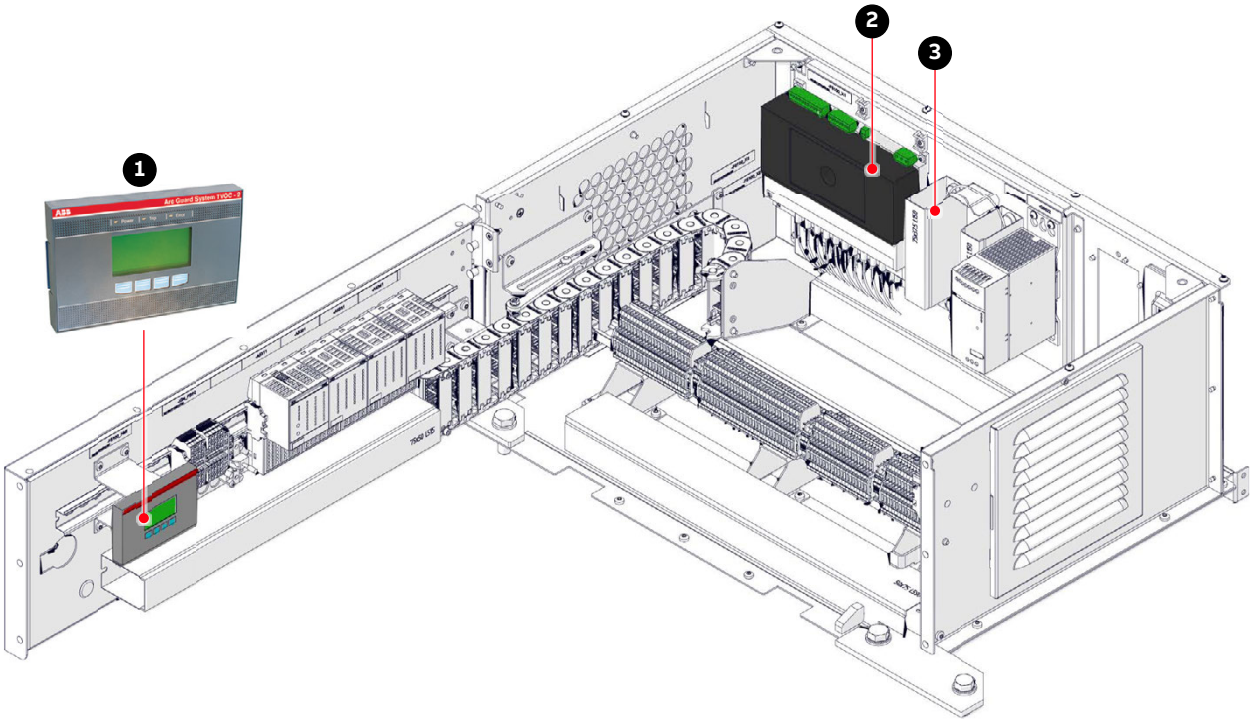
2. Lay the cables into their designated trays, (1, Fig. 63) and (2, Fig. 63), and cable ducts (3, Fig. 63).

   NOTE – When fastening IGCT power supply cables on the rail for IGCT power supply cables of RBU, BCU and VLU, make sure that the cables are at a minimum distance of 5 mm from the closest metal part.

3. Connect all cables and wires according to the “Converter hardware” diagram.

6.4.2. Optical fiber cables for the optional Arc Guard System™

The following instructions are for drives that are delivered with the optional Arc Guard System™. The arc monitor and the HMI panel are located in the WCU roof extension box (REB).



Key:

(1) Arc Guard HMI panel
(2) Arc Guard unit TVOC-2 arc monitoring device
(3) Reeling device for optical fiber detector cables

Fig. 64. Arc Guard System™ in an optional roof extension box (REB)

The Arc Guard System™ uses optical detectors to monitor the drive for arc faults. The detectors are factory-installed in the following cabinets, which have power cable entries and terminals:

– 2 detectors in COU/TEU
– 2 detectors in ARU with bottom cable entry (option)
– 1 detector in BCU

The excess optical fibers are coiled up beside the detectors (Fig. 65).

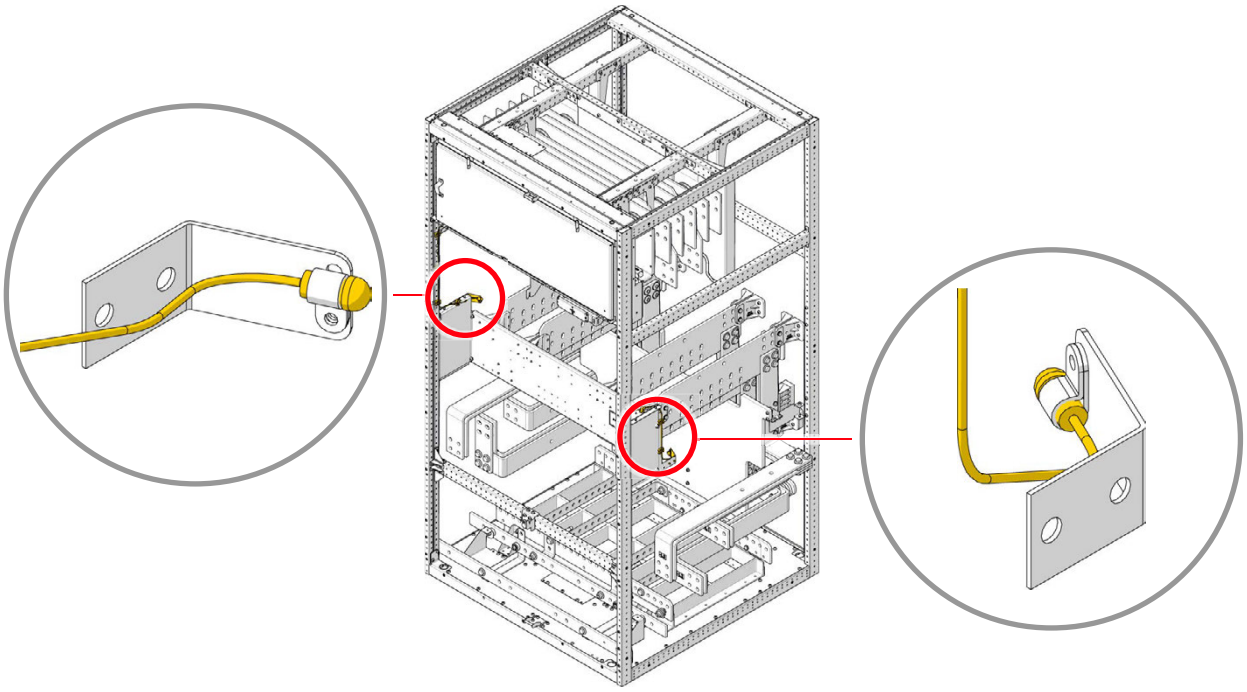


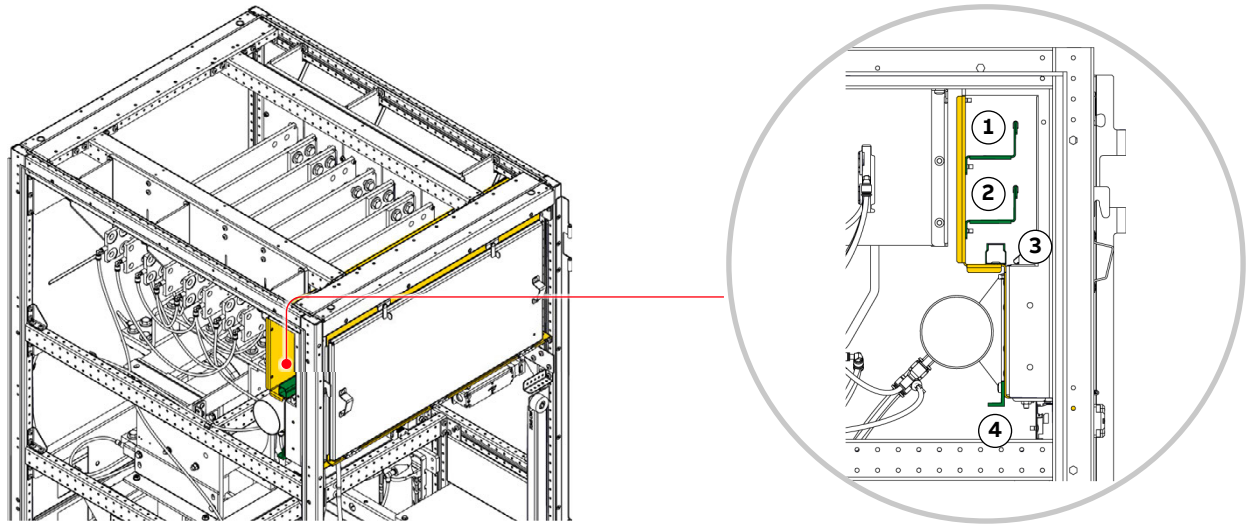
Fig. 65. Location of Arc Guard sensors in a TEU

6.4.2.1. Connecting the detector cables to the arc monitor device

To complete the optical fiber installation, the optical fibers must be routed to the arc monitor device in the REB.

1. Pull all cables through the cable duct (3, Fig. 66) at the top of the cabinets.

   NOTE – Cut-outs in the ducts provide entry into the cabinets.



Key:

(1) Cable tray for auxiliary power supply cable
(2) Cable tray for control cables
(3) Cable duct for optical fibers
(4) Rail for IGCT power supply cables of RBU, BCU, and VLU

Fig. 66. Cable tray and cable ducts in an LSU (A = front)

2. Lay the cables into their designated trays, (1, Fig. 66) and (2, Fig. 66), and cable ducts (3, Fig. 66).
3. Connect the cables to the arc monitor in the REB (2, Fig. 64), according to the wiring drawings.
4. Wind up the excess cable lengths to the reeling device in the REB (3, Fig. 64).

   NOTICE These cables are only available in standard lengths. DO NOT cut or extend the cables. Wind the excess cable into coils with a minimum diameter 100 mm.

6.5. Cable entry systems

NOTICE

Risk of component damage! Handling excessively large single core power cables inside ACS6080 modules can damage components.

→ DO NOT use a single core power cable with a cross-sectional area larger than 500 mm^2

→ Use a cable lug that is small enough for M12 bolts to connect the power cable to the busbar connection

Depending on your drive configuration, one or a combination of the following cable entry systems might be used on a cabinet for top and/or bottom cable entry:

– Section 6.5.1, “Frames with type 1 sealing modules”, page 115
– Section 6.5.2, “Frame with type 2 sealing modules”, page 117
– Section 6.5.3, “Plates with cable glands”, page 117
– Section 6.5.4, “EMC plates with sealing grommets”, page 118

For information on the location and the dimensions of the cable entry, see “Appendix C - Mechanical drawings”.

6.5.1. Frames with type 1 sealing modules

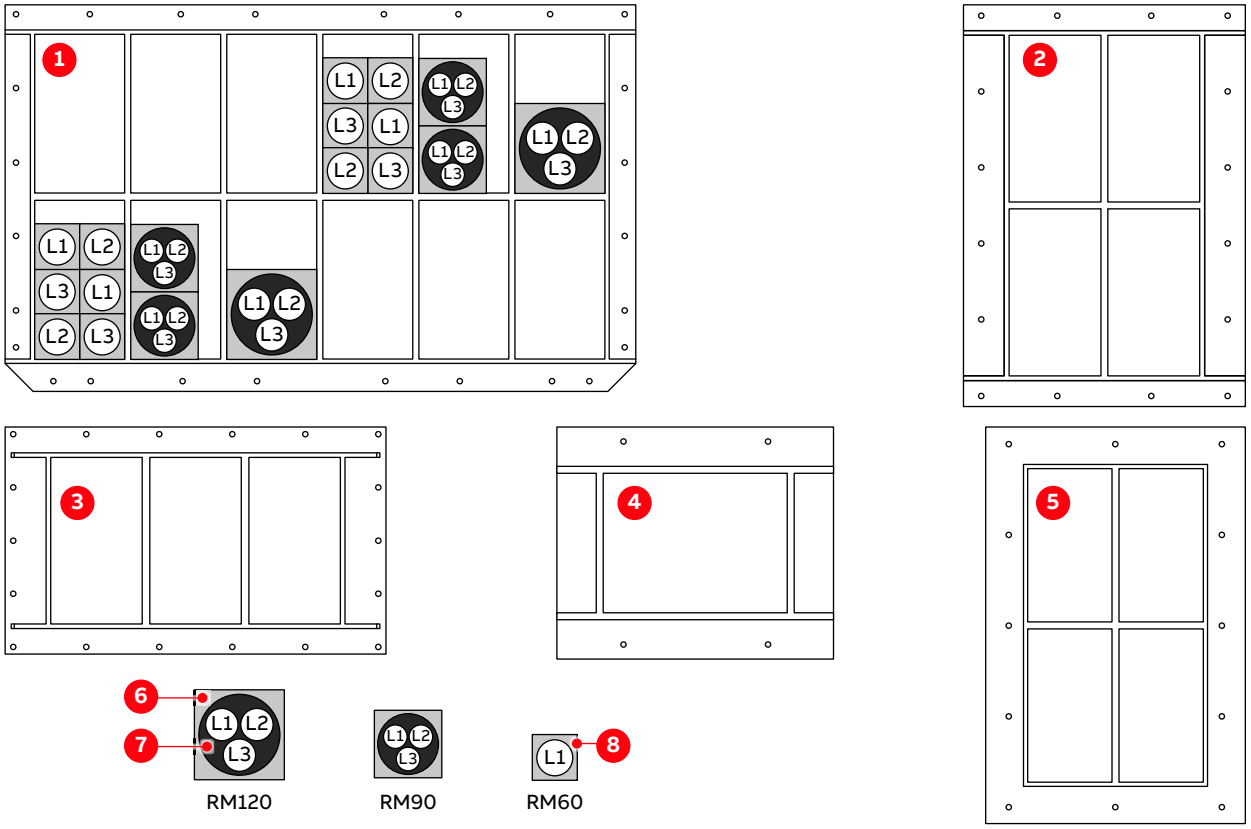
Key:

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

Fig. 67. Cable entry with type 1 sealing modules

Usage	Included in delivery	Not included in delivery
– Power cables – Ground cables – Equipotential bonding conductors	– Cable entry frame	– Sealing modules – Accessories – Tools

Usage



Key:

(1) Cable entry frame 1
(2) Cable entry frame 2
(3) Cable entry frame 3
(4) Cable entry frame 4
(5) Cable entry frame 5
(6) Sealing module
(7) Three-core cable
(8) Single-core cable

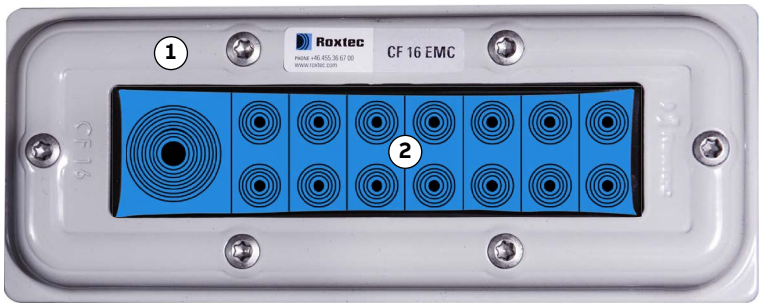
Fig. 68. Cable entry frame with type 1 sealing modules

TABLE 11 Cable entry frames for type 1 sealing modules

Cabinet entry frame	Cabinet	Maximum number of sealing modules/openings			Maximum number of cables/openings	
		RM120	RM90	RM60	Single-core Ø28 - 50 mm	Three-core Ø68 - 99 mm
1	TEU 1000 mm	1	2	6	6	1
2	TEU 600 mm	1	2	6	6	1
3	ARU	1	2	6	6	1
4	BCU	1	1	4	3	1
5	EXU	1	2	6	6	1

6.5.2. Frame with type 2 sealing modules

Usage	Included in delivery	Not included in delivery	Supplier
– Auxiliary power cables – Control cables	– Cable entry frame	– Type 2 sealing modules (2, Fig. 69) – Installation tools – Accessories	Roxtec AB (www.roxtec.com)



Key:

(1) EMC cable entry frame

(2) Type 2 sealing modules

Fig. 69. Cable entry with sealing modules – type 2

6.5.3. Plates with cable glands

Fig. 70. Cable gland

Usage	Included in delivery	Not included in delivery
– Power cables, ground cables, bonding conductors – Auxiliary power cables, control cables	– Undrilled gland plate	– Cable glands – Tools – Accessories

6.5.4. EMC plates with sealing grommets

(1) EMC sleeves
(2) Sealing grommets
(3) Ø45 mm
(4) 1.5 mm

Fig. 71. Cable entry with EMC plates

Usage	Included in delivery
– Power cables – Ground cables – Bonding conductors – Auxiliary power cables – Control cables	– Galvanized plate with net-like EMC sleeves – Sealing grommets

6.6. Preparing cable entry systems for TEU, ARU and EXU cabinets

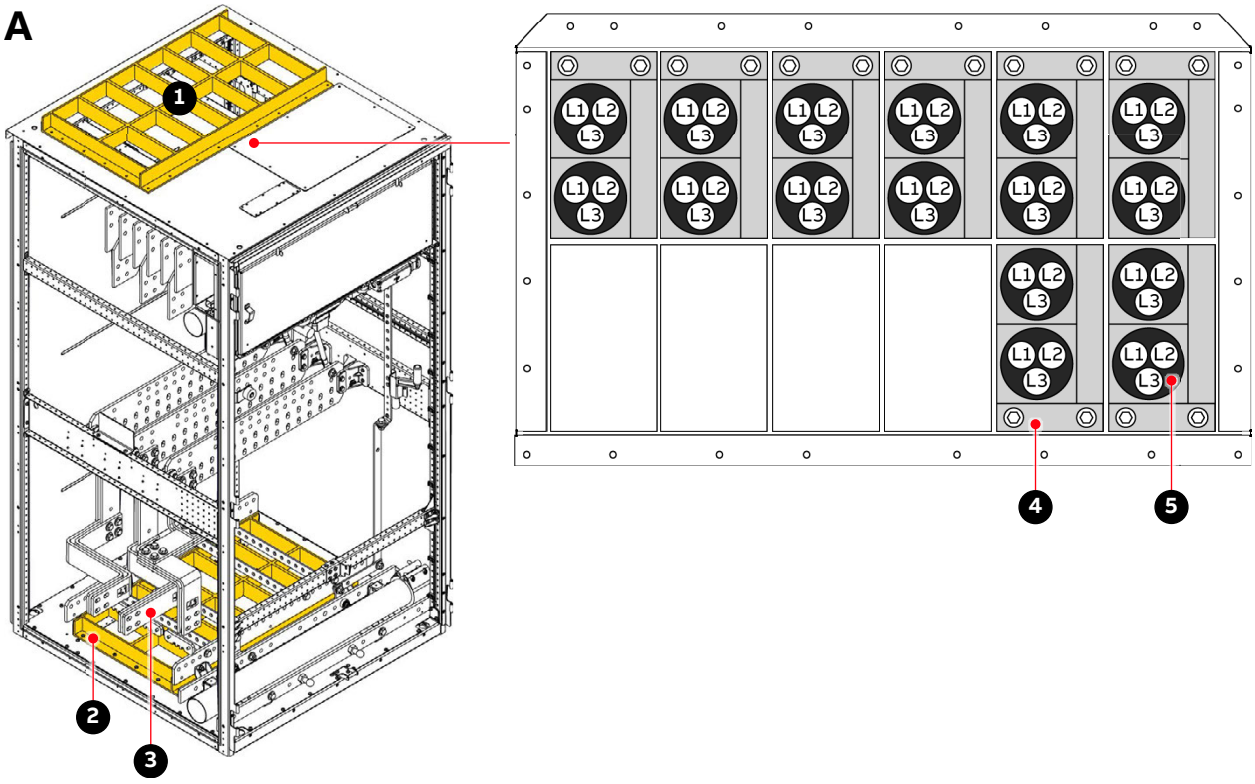
This section describes how to prepare cable entry systems for the following cabinets:

- TEU
- ARU
- EXU

6.6.1. TEU cable entry frames with type 1 sealing modules

- Use one sealing module (5) for each conductor of a three-core cable, or one sealing module for the complete cable.
- In the openings facing the back wall of the TEU, place the compression wedge (4) between the frame (1) and the sealing module (5).

  This ensures that the minimum distance to the high-voltage busbars is maintained.



Key:

(1) Top cable entry frame
(2) Bottom cable entry
(3) High-voltage busbars
(4) Compression wedge
(5) RM90 sealing module with 3-core cable

Fig. 72. TEU 1000 mm cabinet (A = back) with (1) top cable entry and (2) bottom cable entry

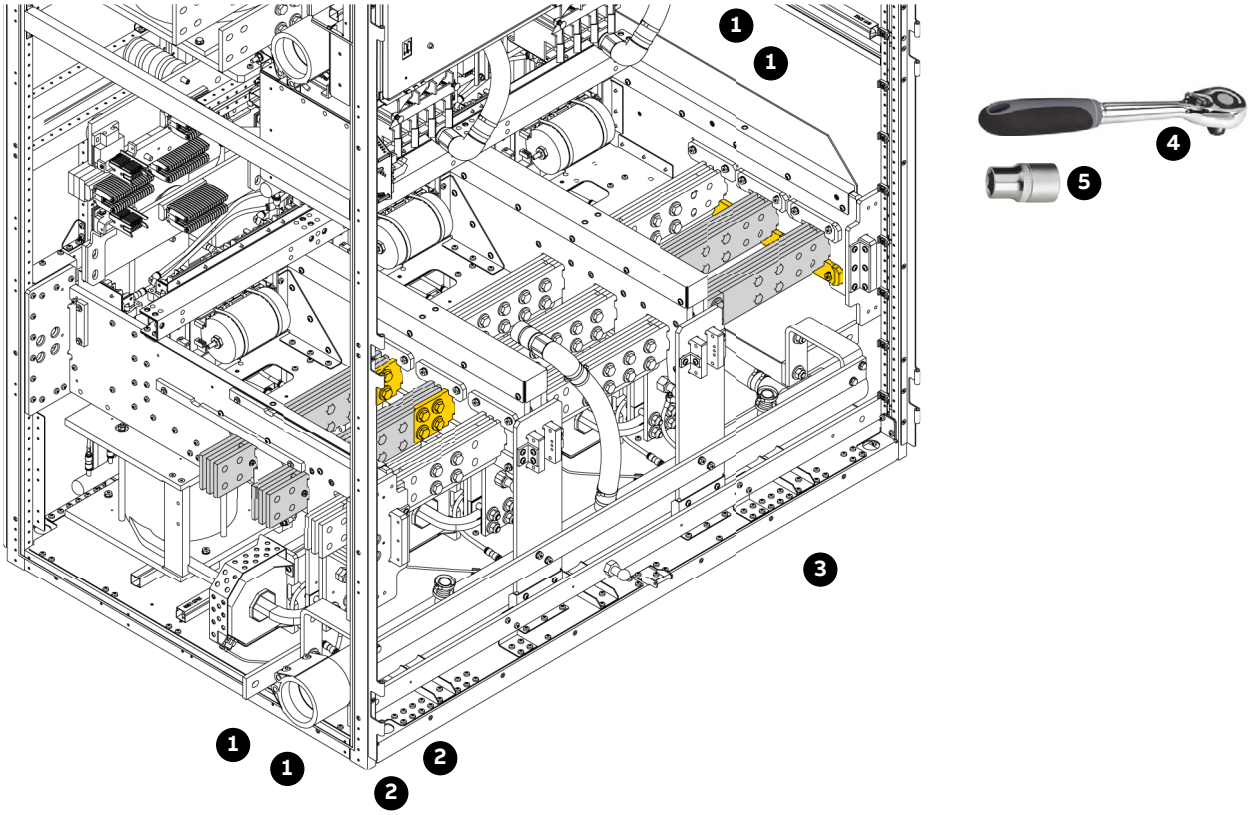
6.6.2. ARU cable entry frames with type 1 sealing modules

Depending on the configuration of the drive, ARUs can be equipped with 3 cable entry frames (size 3) on the cabinet floor.

In order to connect the cables, you need to remove the phase modules (see Section 9.4.10, “Removing and installing a phase module”, page 202) and, if necessary, the short busbars as well (Section 6.6.2.1, “Removing the short busbars”, page 120).

6.6.2.1. Removing the short busbars

1. Remove the phase module according to Section 9.4.10, “Removing and installing a phase module”, page 202.
2. If necessary, remove the short busbars (boxes) to facilitate entering the cables.
3. To remove a busbar, unscrew the bottom bracket and the bolts and then move the busbar downward and away from the cabinet.



Key:

(1) Short busbar
(2) Remove these bolts
(3) Bottom bracket
(4) 1/2” wrench
(5) 17 mm and 19 mm

Fig. 73. Short busbar removal in ARU

4. After you have routed the cables, install the busbars in the reverse order of removal.

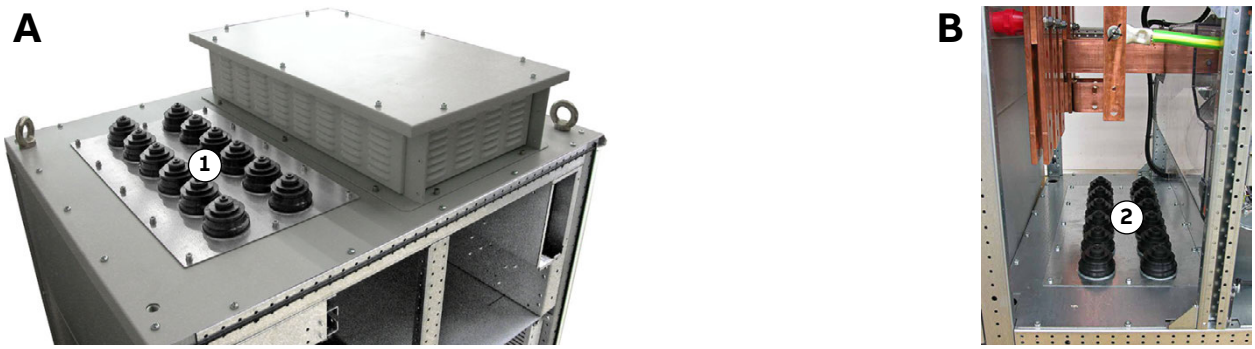
6.6.3. EXU cable entry with EMC plate and sealing grommets

This procedure applies to drives that are delivered with an EXU.

1. Insert the power cables through the EMC plates into the cabinet.

   NOTE – Depending on the cable entry configuration, the entry plate is either on the top or on the bottom of the cabinet.

2. Cover the unused cable entry with a blanking plate.



Key:

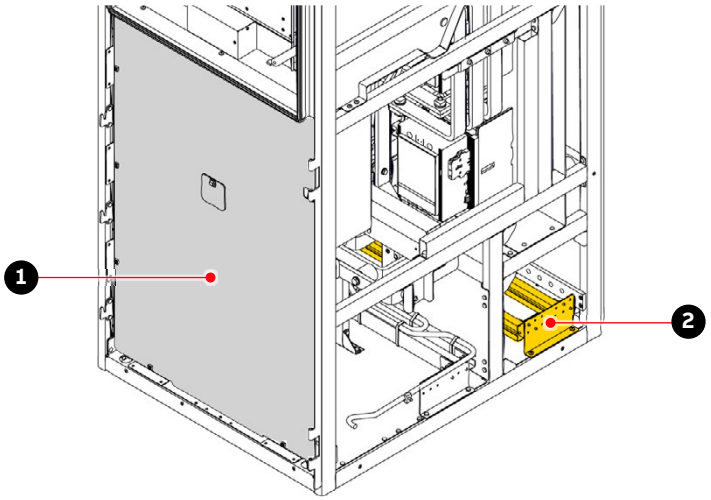
(1) Top cable entry

(2) Bottom cable entry

Fig. 74. (A) EXU with top cable entry and (B) EXU with bottom cable entry

If the cabinet is only accessible from the front and the cables are entered through the bottom, proceed as follows:

1. Remove the front cover and, if present, unplug the heating cable and remove the cross brace with the heating cable.
2. Remove the cover above the fan unit.
3. Remove the fan unit as explained in Section 9.4.17, “Replacing the fan unit in an EXU with a DCS880 H4/DCT880 T4 unit”, page 220.
4. Unplug the fan power supply cables and the tube from the air pressure switch.



Key:

(1) Front cover

(2) Pull relief

Fig. 75. EXU cabinet

6.7. Power, ground and equipotential bonding conductor cables

NOTICE

Risk of damage or malfunction! Waste left inside drive cabinets can cause the drive to malfunction.

→ Avoid cutting cables inside drive cabinets whenever possible

→ Always remove waste from the drive

The following sections describe how to prepare and route cables. For a description on how to prepare the cable entries, see Section 6.6, “Preparing cable entry systems for TEU, ARU and EXU cabinets”, page 119.

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

– Project-specific cable entry

– Distance between point of cable entry and terminals or busbars

– Busbar and fastening hole dimensions

– Busbar designations

See “Appendix D - Wiring diagrams” for information on:

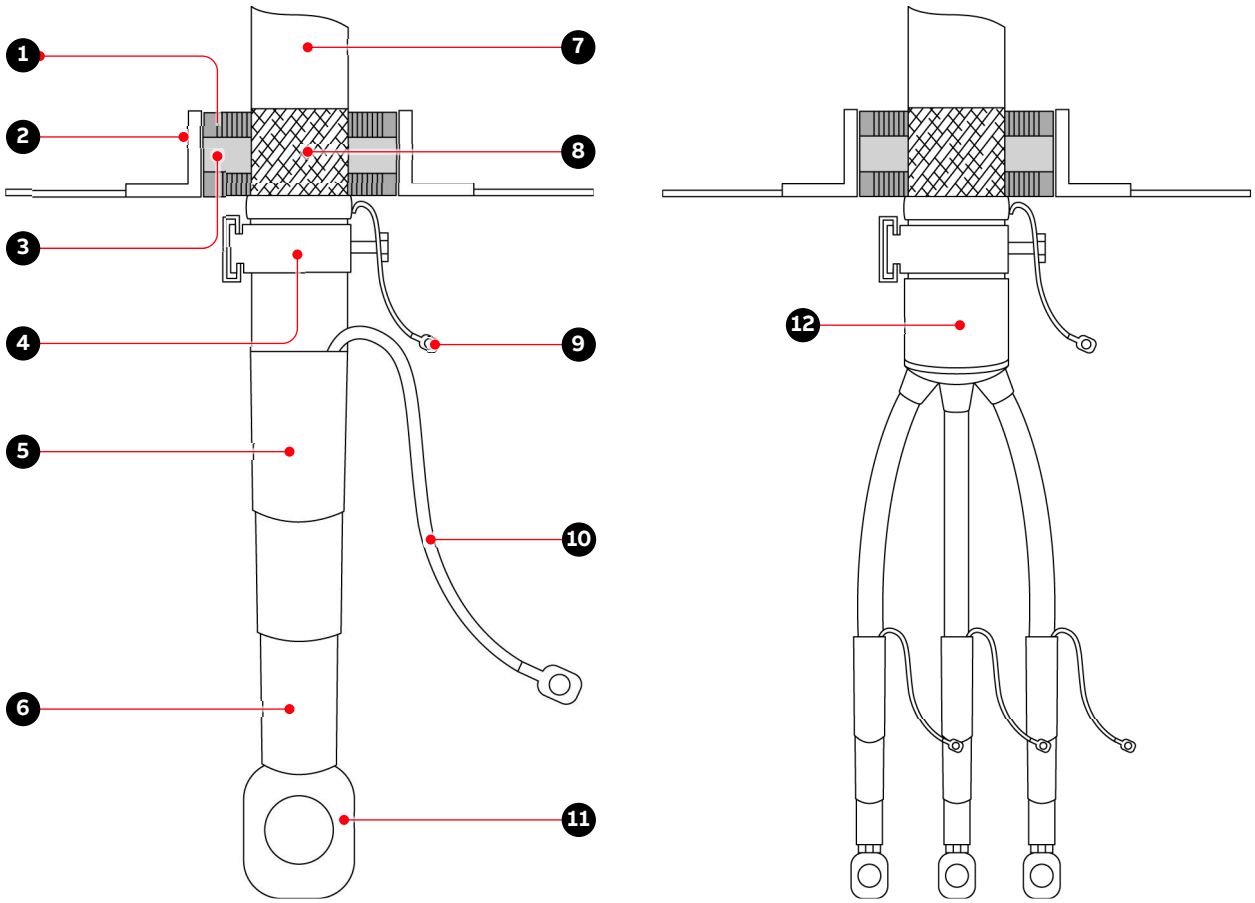
– Conventions for cross-reference and device identification

6.7.1. 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.

6.7.2. Preparing cables for sealing modules

1. Prepare cables with an outer cable screen or shield for EMC bonding with the metal enclosure of the cabinet as illustrated in Fig. 76.



Key:

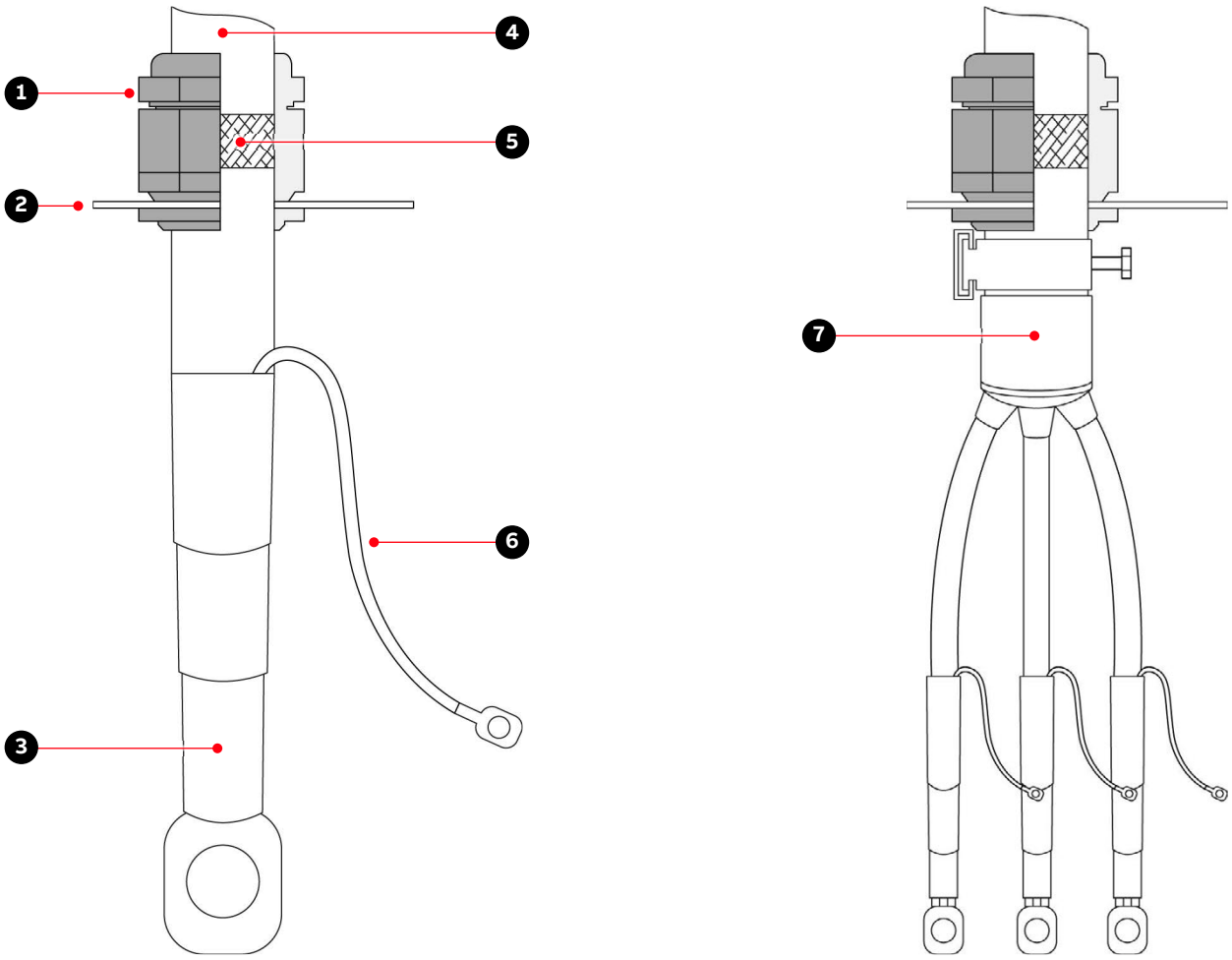
(1) Sealing module
(2) Frame
(3) Conductive foil of sealing module
(4) Cable clamp
(5) Shrinkable sheath seal
(6) Heat shrinkable termination
(7) Outer cable sheath
(8) Cable sheath removed to expose cable shield
(9) Shield extension to connect to PG busbar
(10) Cable screen extension to connect to the PG busbar
(11) Cable lug as specified by the cable supplier and suitable for M12 bolt
(12) Sheath seal

Fig. 76. Preparing power cables for sealing modules

2. Install the sealing modules according to the instructions of the sealing module supplier.

6.7.3. Preparing cables for cable glands

Prepare cables with an outer cable screen or shield for EMC bonding with the metal enclosure of the cabinet as illustrated in Fig. 77.



Key:

(1) Cable gland
(2) Plate
(3) Heat shrinkable termination
(4) Outer cable sheath
(5) Conductor insulation removed to expose cable shield
(6) Cable screen extension to be connected to PG busbar
(7) Sheath seal

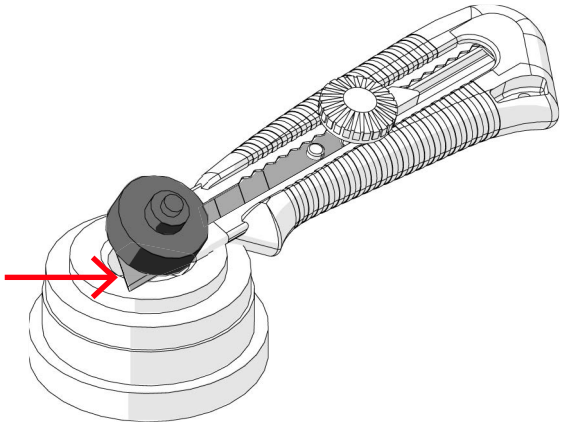
Fig. 77. Prepare power cables for cable glands

6.7.4. Preparing cables for EMC plates

This section describes how to prepare standard cables for EMC plates as well as cables for an EXU.

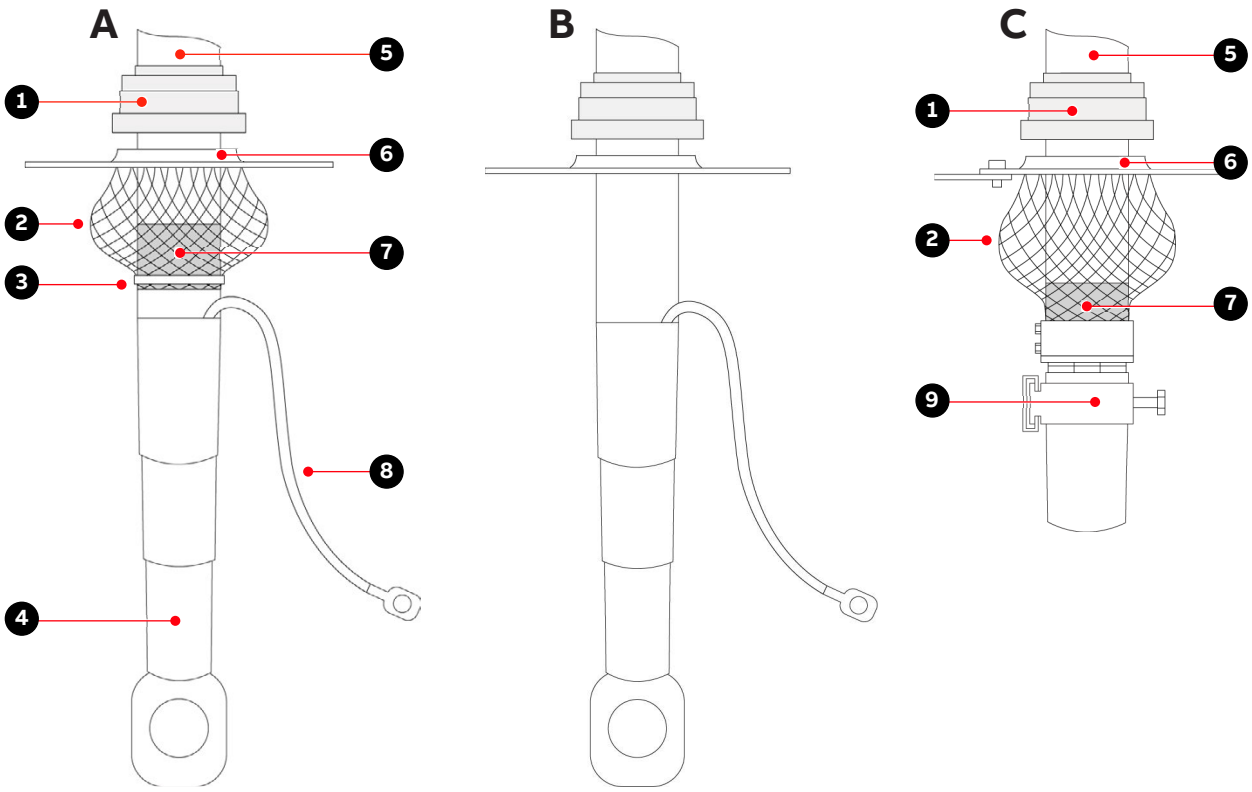
1. Remove the grommets from the entry plate.
2. To ensure proper sealing, cut along the marking that corresponds to the cable diameter.
3. Slide the grommet onto the cable and ensure that the grommet fits tightly to prevent water from entering the cabinet.

   NOTE – If cables are entered through the cabinet floor, the grommets can be discarded.
4. If necessary, remove the entry plate and push the cable through the entry holes.



5. Prepare standard cables according to Fig. 78.
6. Prepare EXU cables according to Fig. 78.

   The orientation of the EMC plates in both scenarios is the same for top and bottom cable entries, ie, the sealing grommets face upwards.



Key:

(1) Grommet
(2) EMC sleeve
(3) Cable tie
(4) Heat-shrinkable termination
(5) Outer cable sheath
(6) Entry plate
(7) Conductor insulation removed to expose cable shield
(8) Cable screen extension to connect to the PE busbar
(9) Cable clamp

Fig. 78. Preparing cables for EMC plates: (A) cables with an outer screen or shield, (B) cables without an outer screen or shield or (C) cables in an EXU cabinet

6.7.5. Connecting the cables

⚠ WARNING

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.

→ Maintain the following minimum clearance between two different potentials (phase-to-phase and ground-to-phase) in the TEU:

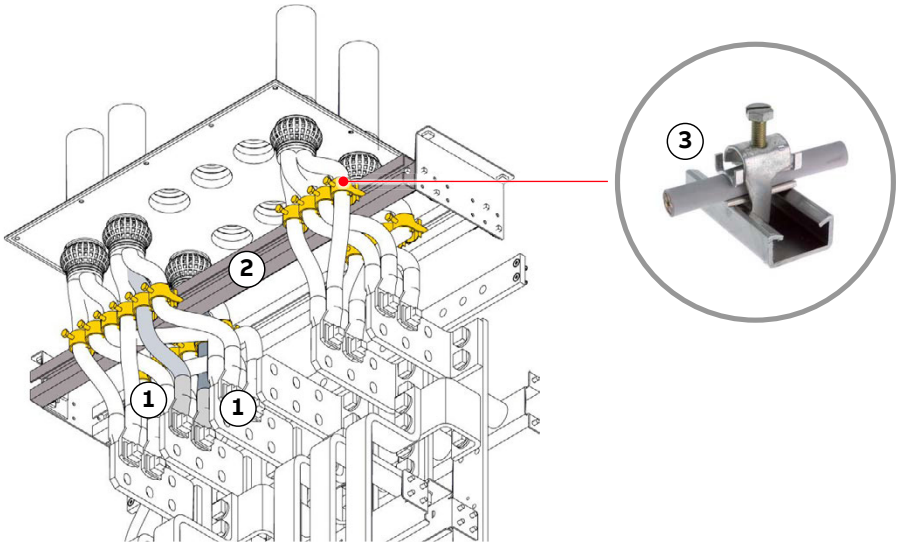
- Marine applications: 55 mm
- Other applications: 25 mm

6.7.5.1. 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.

6.7.5.2. EXU cabinet connections

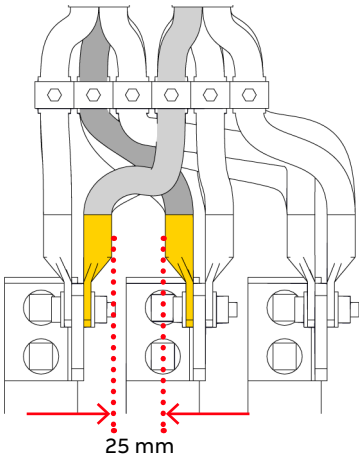


Key:

(1) Cable lug
(2) Strain relief rail
(3) Cable clamp

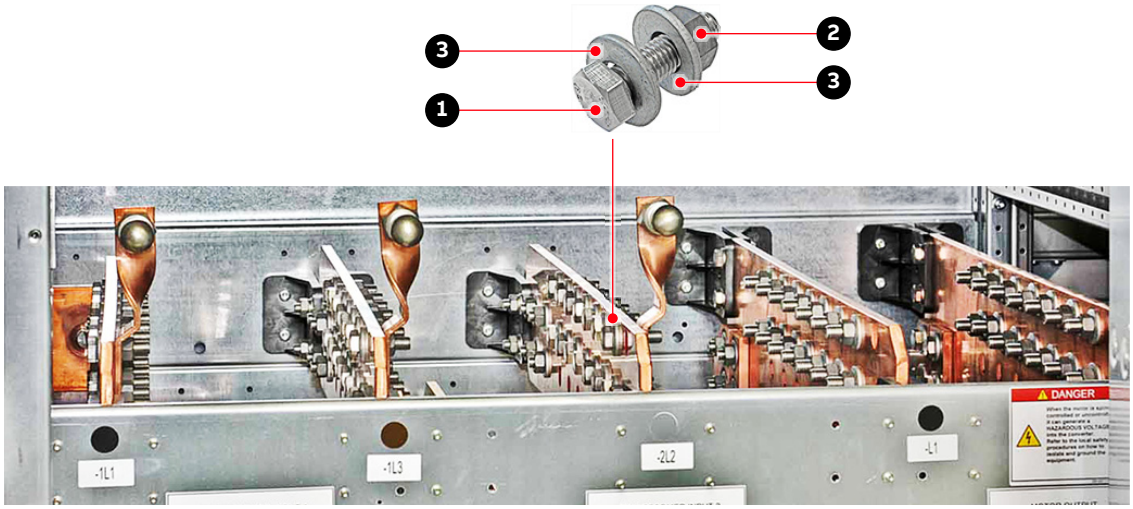
Fig. 79. EXU cable connections

1. If multi-core cables are used and several conductors of the same phase are connected to a busbar, attach the cable lugs (1, Fig. 79) of the cables on each side of the busbar.
2. Fasten the cables to the strain relief rails (2, Fig. 79) with suitable cable clamps (3, Fig. 79).
3. Choose the length and the orientation of the bolts so that the distance between bolted joints of different phases is not less than 25 mm.



6.7.5.3. Bolted busbar connections in marine drives

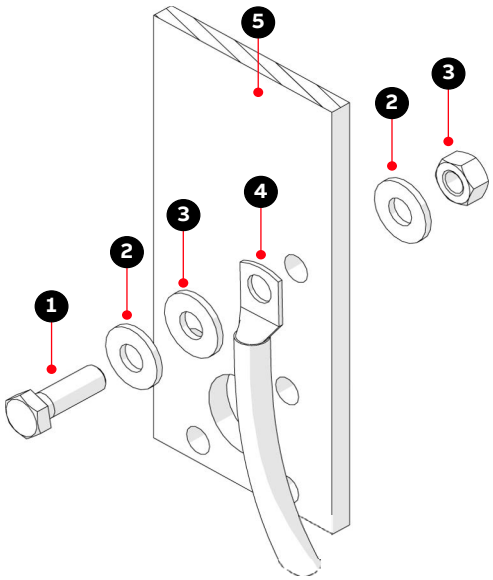
The following bolts, washers and nuts are supplied and fixed to the busbars in marine drives.



Key:		Quantity	Identification
(1)	Hex-head bolt	M12x40-A2	NB 312350P8119
(2)	Coated hex-head nut	M12-A2-70	HZN 452198P1022
(3)	Conical spring washer	13 x 29 x 3	HAQN400344P0111

Fig. 80. Bolted busbar connection - marine drives

6.7.5.4. Bolted busbar connections in non-marine drives



Key:

(1) M12 Bolt
(2) Spring washer
(3) Flat washer
(4) Cable lug
(5) Busbar

Fig. 81. Bolted busbar connection - non-marine drive

6.7.5.4.1. 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 3506-1).

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

6.7.5.4.2. Connection type

The following connection type is recommended when connecting a cable lug to a busbar.

– Spring washer and flat washer on each side of the busbar.
  The spring washer and flat washer can be replaced by a spring washer (2, Fig. 81). Other washers can be used, provided they maintain the required contact pressure.

– Use cable lugs suitable for M12 bolts.

6.7.5.4.3. Lubrication

If stainless steel bolts and nuts are used, lubricate the thread and head contact surface of the bolt using recommended pasts, eg, MOLYKOTE™ D paste.

If a coated nut (eg, with bonded molybdenum-disulfide [MoS_2] coating) is used, the connection does not need to be lubricated.

6.7.5.4.4. Tightening torque

ABB recommends a tightening torque of 40 Nm for M12 bolts. For other sizes, follow the manufacturer's recommendations.

6.8. Auxiliary power, control and serial communication cables

The following sections describe how to prepare and route cables.

For a description on how to prepare the cable entries, see Section 6.6, "Preparing cable entry systems for TEU, ARU and EXU cabinets", page 119.

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. 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.

6.8.2. Preparing cables for sealing modules

For information on installing the sealing modules and using the compression wedge, see the Roxtec CF16EMC installation instructions in “Appendix A - Additional manuals”.

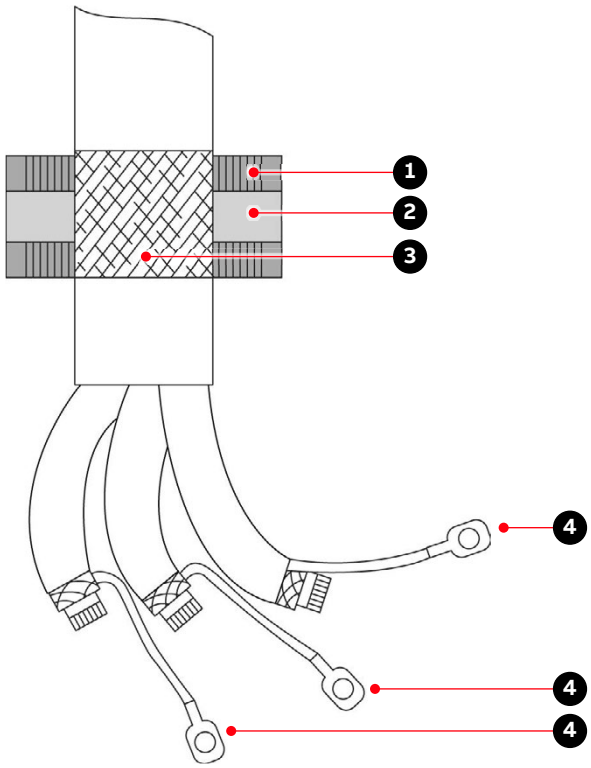
Key:

(1) Sealing modules

(2) Compression wedge

Fig. 82. Cable entry with sealing modules

1. Unscrew the frame.
2. Prepare the cables with an outer cable screen for EMC bonding with the metal enclosure of the cabinet as illustrated in Fig. 83.



Key:

(1) Sealing module

(2) Conductive foil

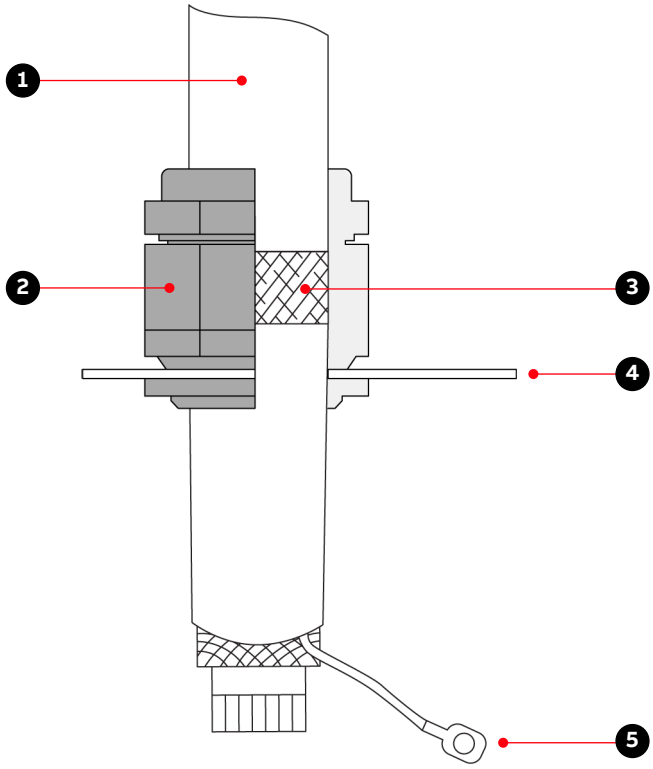
(3) Cable sheath removed to expose cable shield

(4) Conductor screen extension to connect to PE terminal

Fig. 83. Preparing control cables for sealing modules

6.8.3. Preparing cables for cable glands

Prepare the cables with an outer cable screen for EMC bonding with the metal enclosure of the cabinet as illustrated in Fig. 83.



Key:

(1) Outer cable sheath
(2) Cable gland
(3) Plate
(4) Conductor insulation removed to expose shield
(5) Conductor screen extension to connect to PE terminal

Fig. 84. Preparing auxiliary control cables for cable glands

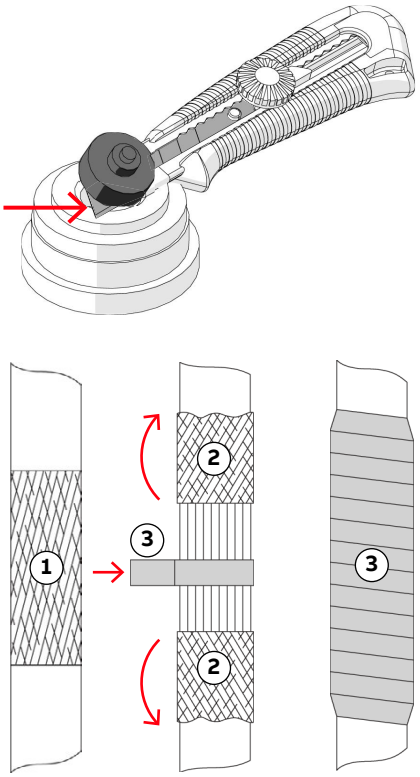
6.8.4. Preparing cables for EMC plates

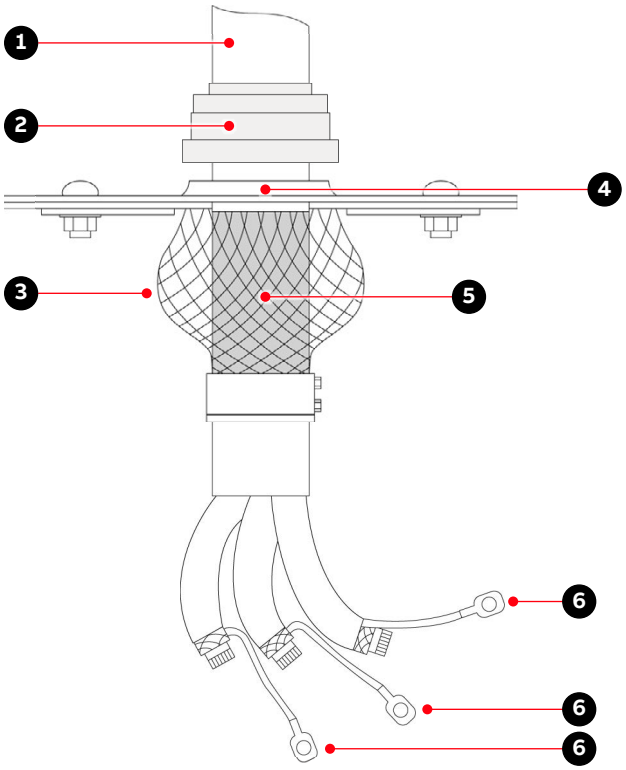
1. Remove the grommets from the entry plate.
2. To ensure proper sealing, cut along the marking that corresponds to the cable diameter (arrow).
3. Slide the grommet onto the cable and ensure that the grommet fits tightly to prevent water from entering the cabinet.

   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).

f 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).





Key:

(1) Outer cable sheath
(2) Grommet
(3) EMC sleeve
(4) Plate
(5) Cable sheath removed to expose cable shield
(6) Conductor screen extension to connect to PE terminal

Fig. 85. Preparing control cables for EMC plates

6.8.5. Routing cables in a WCU

For the available cable routing options in WCU800 and WCU1400, such as top entry and bottom entry, see “Appendix C - Mechanical drawings”.

6.8.6. Routing cables in a COU cabinet

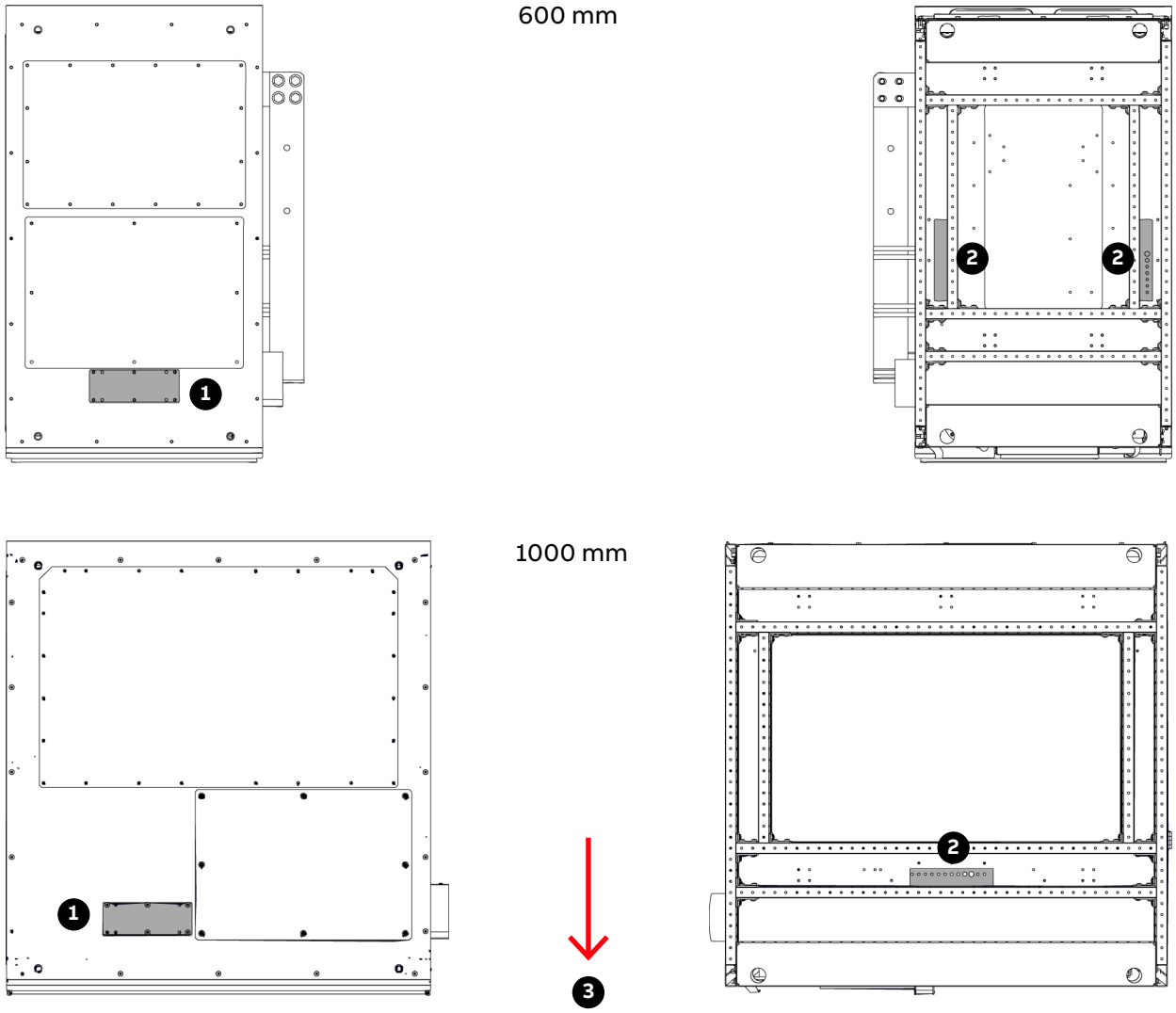
The serial communications and encoder cables are connected inside a COU.

Top and bottom cable entries are covered with blanking plates.

Materials for cable fitting, EMC requirements and sealing are not supplied.

Procedure:

1. Remove the blanking plate (s).



Key:

(1) Top blanking plate
(2) Bottom blanking plate
(3) Cabinet front

Fig. 86. Blanking plates on 600 mm COU and 1000 mm COU

2. Prepare the length of cable that passes through the cable entry according to Section 6.8.3, “Preparing cables for cable glands”, page 131.

3. Route the cables to their destination.

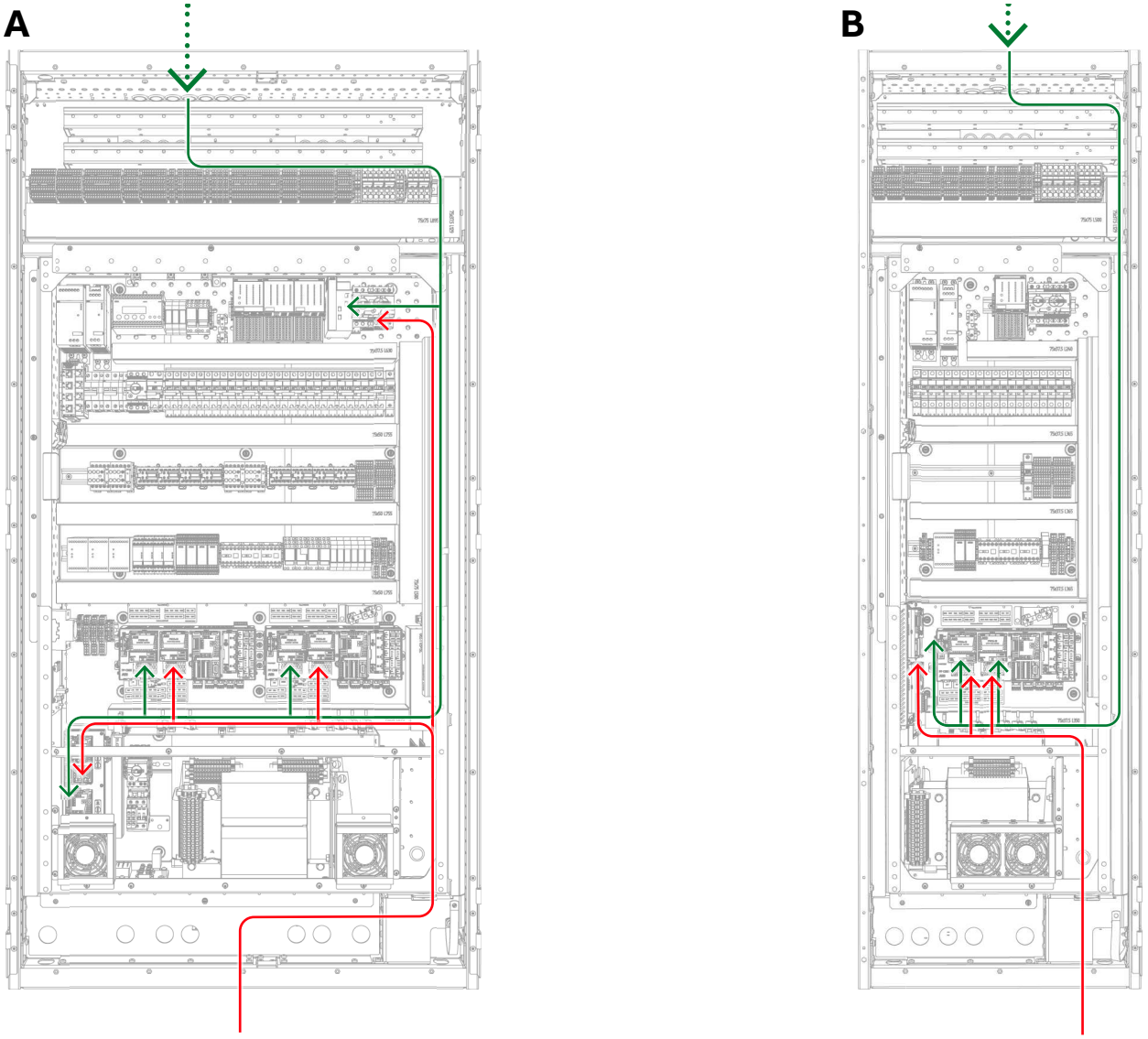


Fig. 87. Cable routing in (A) 1000 mm COU and (B) 600 mm COU

6.8.6.1. Connecting the cables

For information on the encoders, see the relevant user manual:

- **Absolute encoder (SSI) and incremental encoder (TTL):** “Absolute Encoder interface FEN-11 user manual”, 3AFE68784841
- **Incremental encoder (HTL):** “HTL Encoder Interface FEN-31 user manual”, 3AUA0000031044

Conductors

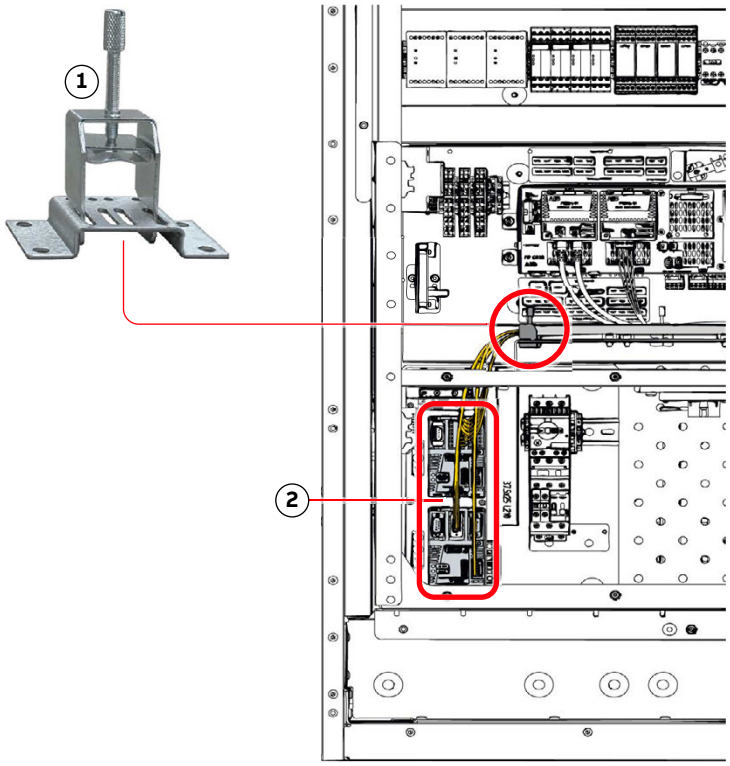
- If a twisted pair cable is used, leave the unshielded cable ends twisted until they reach the terminals.
- Leave unshielded conductor ends as short as possible (< 50 mm).

Cable shields

Refer to “Absolute Encoder interface FEN-11 user manual”, 3AFE68784841 and “HTL Encoder Interface FEN-31 user manual”, 3AUA0000031044 for the following steps.

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

     NOTICE Verify that the fixing screw of the encoder is properly tightened (see the relevant user manual).
   - Ground clamp (1, Fig. 88).



Key:

(1) Ground clamp
(2) Encoder

Fig. 88. Shield grounding for encoder cable

6.8.7. Routing cables in an EXU cabinet

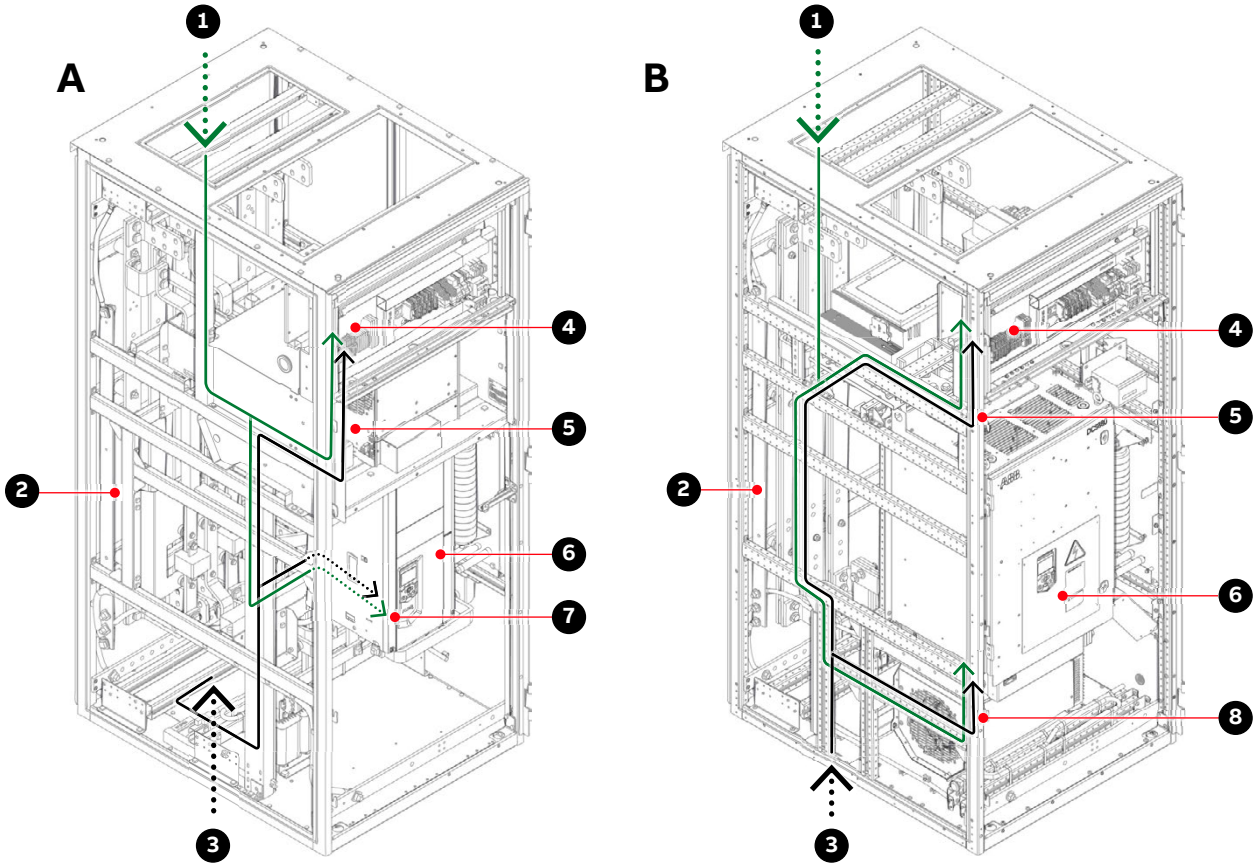
This section applies to a stand-alone EXU.

6.8.7.1. 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: Section 6.8.4, “Preparing cables for EMC plates”, page 132
   - Cable entries with cable glands: Section 6.8.3, “Preparing cables for cable glands”, page 131.

   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
(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 H4 converter
(8) Optical fibers to DCS880 H6 converter

Fig. 89. Cable routing examples in an EXU cabinet with an (A) 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.

6.8.7.2. 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.
- → 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.
- → 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.

6.8.7.3. 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.

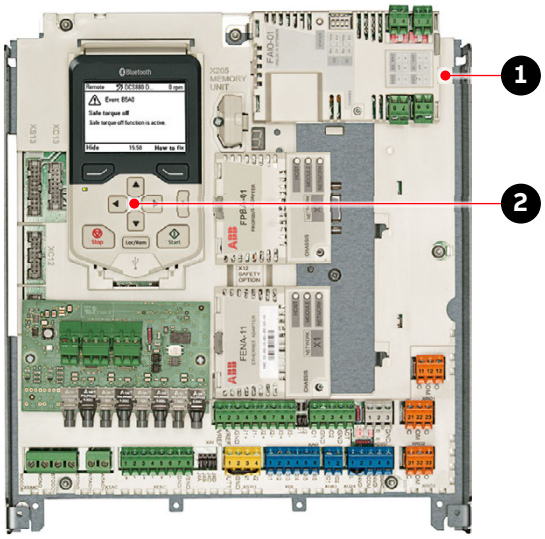
Key:

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

Fig. 90. 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.

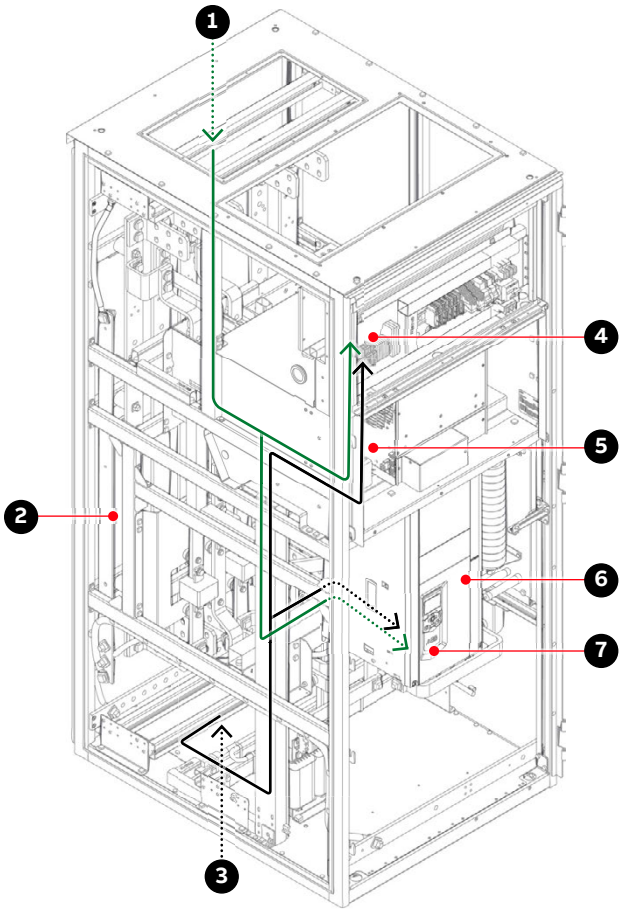


Key:

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

Fig. 91. 1 Control unit SDCS-CON-H01

7. Route the cables through the designated cable ducts as illustrated.



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. 92. 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.

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

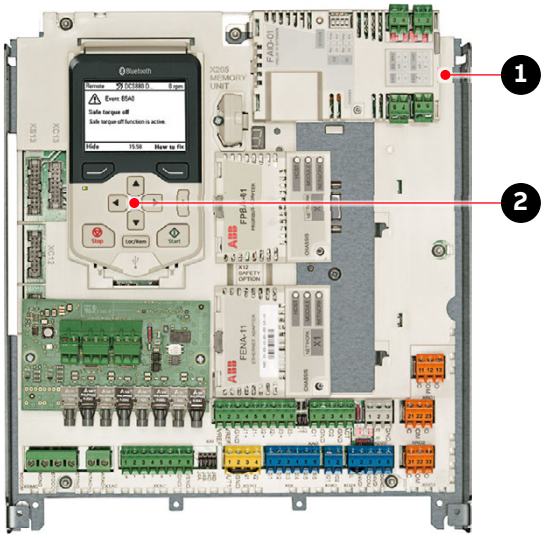
1. Unscrew the rectangular cover from the DCS880/DCT880 unit.

Key:

(1) Control panel
(2) Removable cover

Fig. 93. 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.

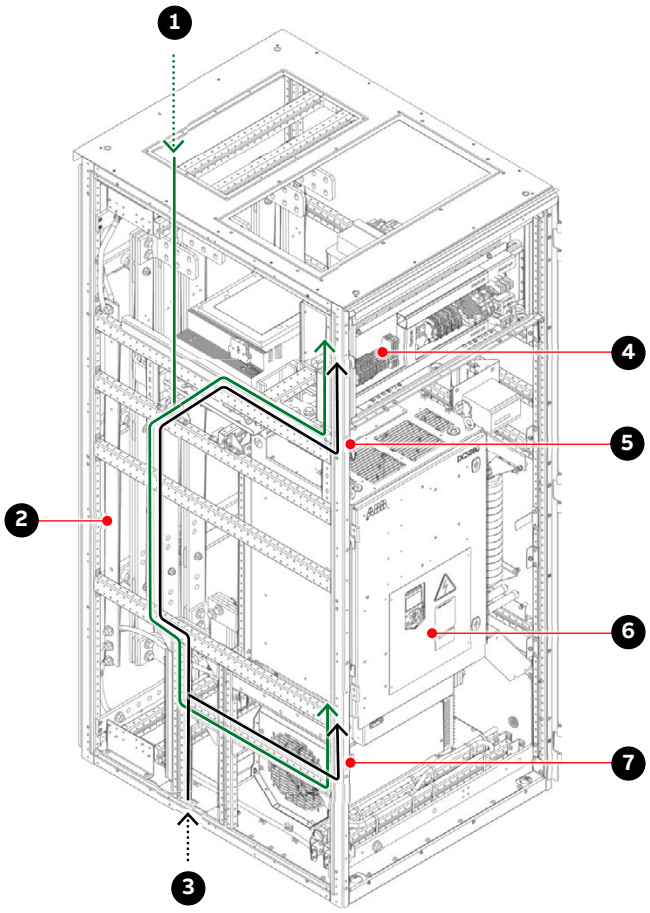


Key:

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

Fig. 94. 1 Control unit SDCS-CON-H01

3. Route the cables through the designated cable ducts as illustrated.



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 D4 converter

Fig. 95. Cable routing example in an EXU cabinet with an ED7Y type DCS880/DCT880 converter

4. Reattach the DCS880/DCT880 cover.

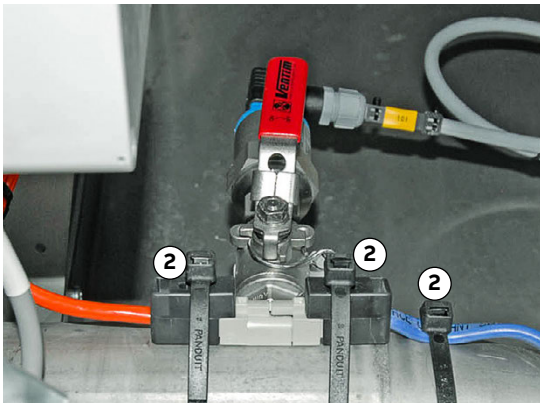
6.9. Connecting the heating cable

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

1. Connect the power supply of the heating cable.

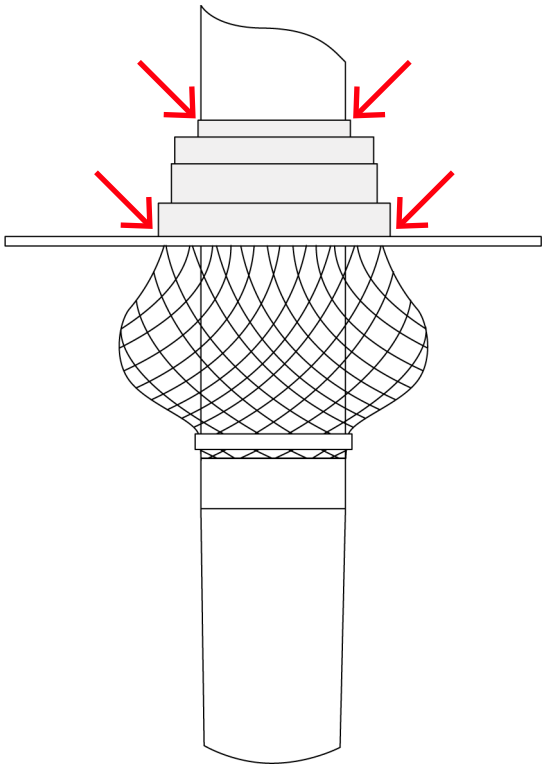
   For more information on power supply connections, see the converter hardware diagram in “Appendix D - Wiring diagrams”.

2. Connect the heating cables (1) of two adjoining transport units
3. Fasten the connectors with cable ties (2).



6.10. Final checks

- Check that the entry plates are properly secured.
- If you used EMC entry plates check that the grommets fit tightly (arrows) to prevent water entering the cabinet.
- If required, seal gaps with silicone.



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.

7.6. Commissioning checklists

The following checklists are designed to help you prepare the drive and associated equipment for commissioning.

7.6.1. Mechanical installation checklist ☑

1)	Drive is aligned according to drive layout drawing (if delivered in several transport units) and installed according to the instructions in this user manual (3BHS842007 E01 J).	☐
2)	Drive is securely fixed to the floor.	☐
3)	Roof attachments are installed (if applicable).	☐
4)	Pipe joints are orientated and torqued correctly.	☐
5)	Joints for DC-link and ground busbar are installed and correctly torqued.	☐
6)	Roof-mounted fan units are installed (if applicable).	☐
7)	Raw water piping is completed and pipes are flanged to the drive (if applicable).	☐
8)	Raw water supply is ready.	☐
9)	Visual inspection: • No badly affixed or damaged components • No foreign objects left in the cabinet • No dirt, dust or moisture in the cabinet	☐

7.6.2. Electrical installation checklist ☑

1)	Types and cross sections of control cables suitable for the signal type and signal level.	☐
2)	Types and cross sections of power cables selected according to the ABB power cable specification.	☐
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).	☐
4)	Cable entries prepared according to the instructions in this user manual (3BHS842007 E01 J).	☐
5)	Control cable screens and conductors are connected as instructed in this user manual (3BHS842007 E01 J), labeled appropriately, and the customer side connections are completed.	☐
6)	Heating cables (if supplied) is installed according to the instructions in this user manual (3BHS842007 E01 J).	☐
7)	Wiring across shipping splits is completed according to the instructions in this user manual (3BHS842007 E01 J).	☐
8)	Ground cable of the drive is securely connected at both ends.	☐
9)	Cable armor and screens of power supply cables are connected to PE ground busbar.	☐

7.6.2. Electrical installation checklist (continued) ☑

10) The transformer and motor cables are installed but the conductors not connected at both ends (cables and drive must be insulation resistance tested, ie, Megger test, before connection).	☐

7.6.3. Main circuit breaker (MCB) checklist ☑

1) MCB selected as per “Main circuit breaker specification” [1]	☐
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.	☐

[1] Pay attention to MCB opening time and installation of undervoltage coil or second opening coil

7.6.4. 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.	☐

7.6.5. 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.	☐

7.6.6. 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.	☐

7.6.7. Power checklist ☑

1)	Medium voltage available for startup of drive.	☐
2)	Low voltage is available for startup of drive.	☐

7.6.8. Water Cooling unit checklist ☑

1)	Auxiliary power is available. See WCU800 user manual , 3BHS821937 E01 or WCU1400 user manual, 3BHS835714 E01.	☐
1)	Water quality matches specification in the WCU800 user manual , 3BHS821937 E01 or WCU1400 user manual, 3BHS835714 E01.	☐
2)	Fill the internal cooling circuit according to the instructions in the WCU800 user manual, 3BHS821937 E01 or WCU1400 user manual , 3BHS835714 E01.	☐
3)	If you cannot operate the pump(s) continuously, enable the Auto Cooling Control Function according to the software firmware manual in the loading package for the drive software.	☐

7.6.9. Miscellaneous checklist ☑

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

8. Operation

8.1. Overview

The following sections describe how to operate an ACS6080 drive from an assistant control panel on a control unit of the drive, ie, local operation as well as full redundant drive operation, ie, remote operation (see Section 8.11, “Full redundant drive operation (optional)”, page 163).

NOTE – For other drive configurations that are controlled from a remote location (via a PLC or a higher level control system), refer to the applicable manuals.

Fig. 96. Assistant control panel

The panel messages and parameter settings used in this document are typical examples. They illustrate the related instructions and display functions and can differ from the actual messages and parameter settings of your drive.

8.2. Operating conditions

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

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

8.3. Safety

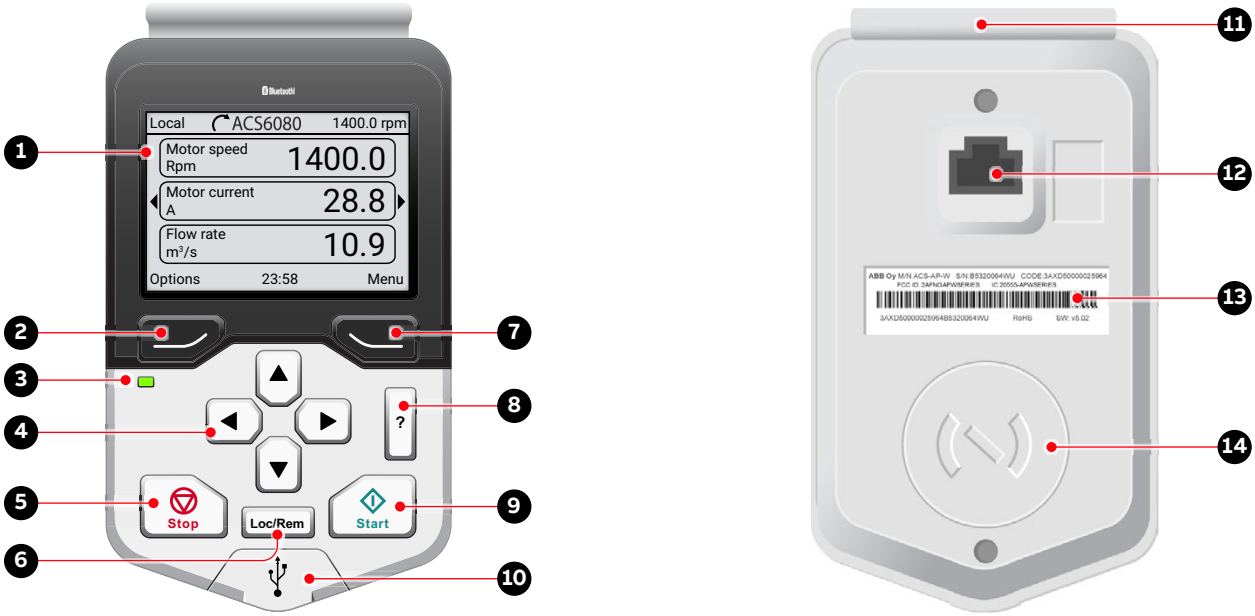
⚠ WARNING

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

8.4. Control panels

Each control unit (COU) on the drive has at least one assistant control panel (ACP) to ensure easy and intuitive operation throughout your entire installation. For instructions on how to use a control panel, see Section 8.4.1, “Navigating the home view”, page 148 and the “ACX-AP-x Assistant control panels user manual”, 3AUA0000085685.



Key:

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

Fig. 97. Assistant control panel front and back

A control panel is required for each motor in the system as well as for the line side in a drive that has an ARU. The master COU can have up to 2 control panels, whereas a slave COU has one.

User's can organize parameters in different ways and store essential parameters for different configurations for any specialized application needed. The menus and messages can be customized for specific terminology so that each application can be set up and configured to its optimum performance.

With the panel's text editor, users can also add information, customize text and label the drive. Powerful backup and restore functions are supported. The help key provides context sensitive guidance. Faults or warnings can be resolved quickly since the help key provides troubleshooting instructions.

One control panel can be connected to several drives simultaneously using the panel network feature. The user can also select the drive to operate in the panel network. The PC tool can be easily connected to the drive through the USB connector on the control panel.

8.4.1. Navigating the home view

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

– Use ◄ and ► to move between the different pages of **Home** view.

– Use ▲ or ▼ to adjust the reference (visible in the top right corner)

– Press (**Menu**) to open the main **Menu**

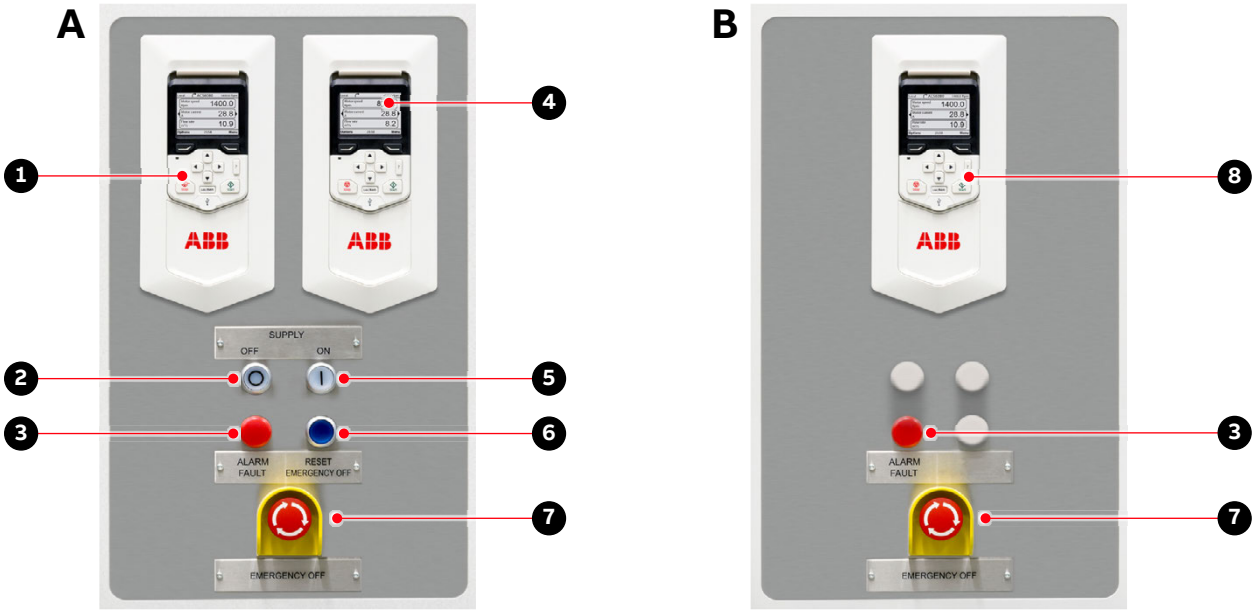
– Press (**Options**) to open the **Options** menu

– Press ? (**Help**) for a context-sensitive help page

8.4.2. Control panels for drives with an ARU

Fig. 98 shows the control panel configurations are present in drives with an ARU. The master control unit (COU1) has 2 control panels, one for the ARU and one to parameterize the INU to control motor 1. Additional motors are controlled by single control panels on slave COUs 2 to 5.

The control panels for the ARU and motor 1 are on the door of control unit COU1. The location of additional control panels depends on the configuration of the drive.



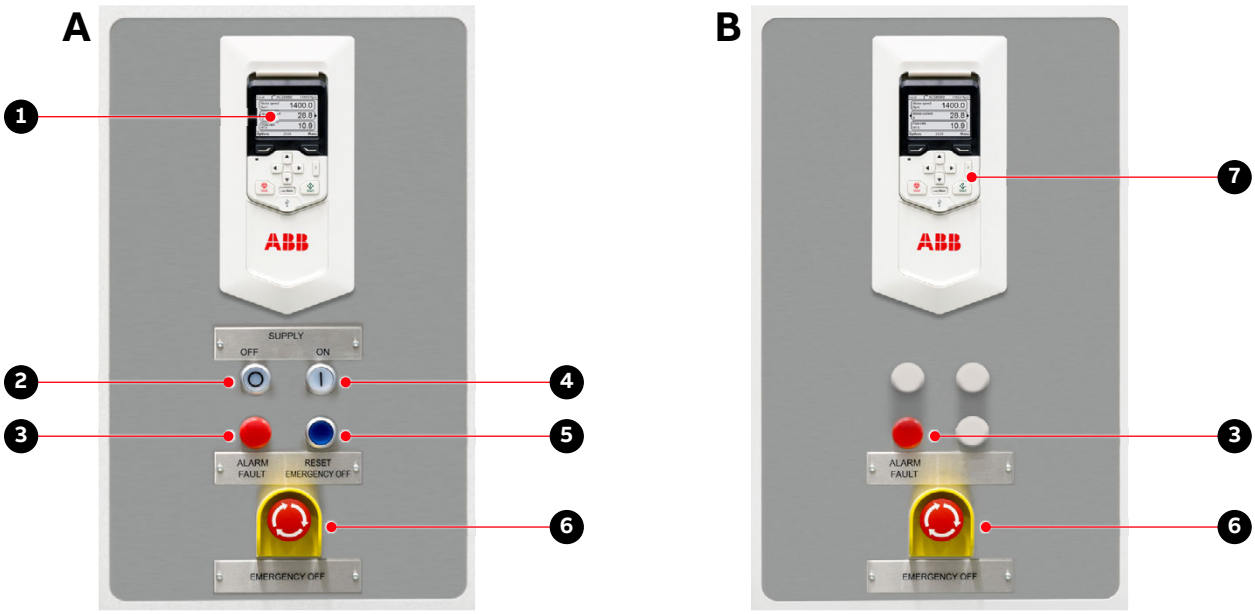
Key:		Explanation
(1)	Master control panel - ARU	– Starts and stops the ARU – Displays the status messages of the ARU
(2)	Main power supply off	– Opens the main circuit breaker
(3)	Alarm/fault lamp	– Alarm: flashing light – Fault: permanent light
(4)	Master control panel - INU	– Starts and stops the INU/motor 1 – Displays the status messages of the INU
(5)	Main power supply on	– Charges the DC-link – Closes the main circuit breaker
(6)	Reset emergency off push button	– Resets the emergency-off relay in the drive control system – Flashes when the auxiliary voltage is switched on, or when an emergency-off push button is pressed
(7)	Emergency off latching push button	– 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)	Slave control panel - INU	– Starts and stops the INU/additional motor, eg, motor 2 – Displays the status messages of the INU

Fig. 98. Master control panel on (A) COU1 and (B) slave control panel for a drive with an ARU

8.4.3. Control panels for drives with an LSU

Fig. 99 shows the control panel configurations are present in drives with an LSU. The master control unit (COU1) has 1 control panel to parameterize the INU to control motor 1. Additional motors are controlled by single control panels on slave COUs 2 to 5.

The control panels for the INU and motor 1 are on the door of control unit COU1. The location of additional control panels depends on the configuration of the drive.



Key:		Explanation
(1)	Master control panel - INU	– Starts and stops the INU/motor 1 – Displays the status messages of the INU
(2)	Main power supply off	– Opens the main circuit breaker
(3)	Alarm/fault lamp	– Alarm: flashing light – Fault: permanent light
(4)	Main power supply on	– Charges the DC-link – Closes the main circuit breaker
(5)	Reset emergency off push button	– Resets the emergency-off relay in the drive control system – Flashes when the auxiliary voltage is switched on, or when an emergency-off push button is pressed
(6)	Emergency off latching push button	– Prevents starting when pressed at standstill of the drive – Main circuit breaker opens and DC-link discharges when pressed during operation of the drive
(7)	Slave control panel - INU	– Starts and stops the INU/additional motor, eg, motor 2 – Displays the status messages of the INU

Fig. 99. (A) Master control panel on COU1 and (B) slave control panel for a drive with an LSU

8.4.4. EXU control panel

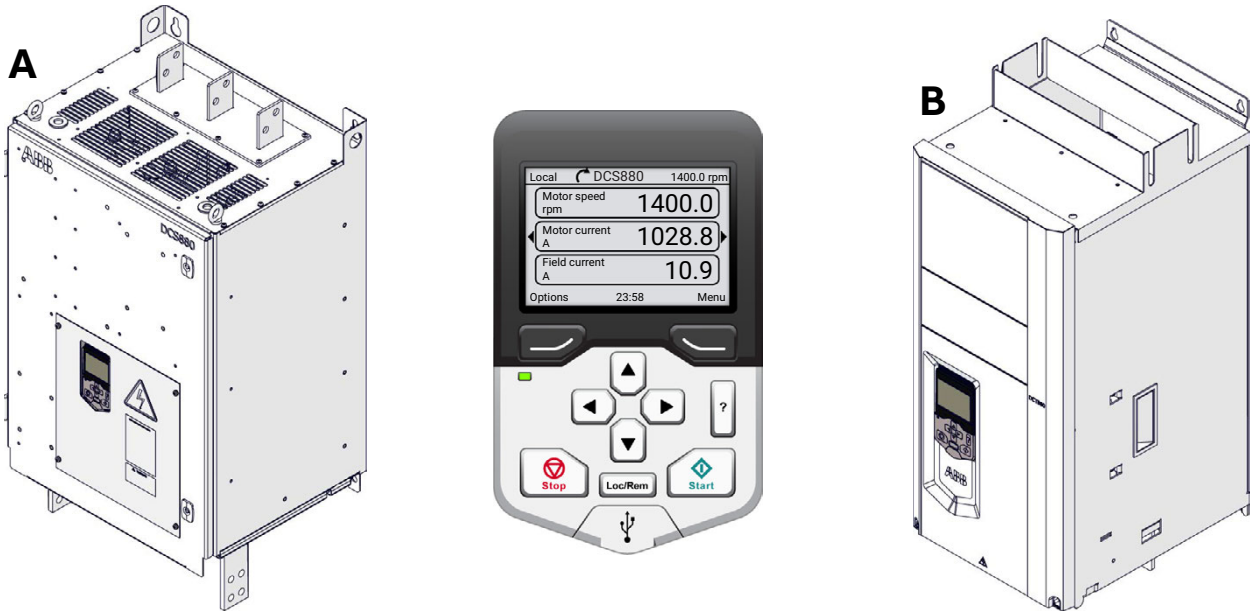


Fig. 100. DCS880 control panel

An EXU uses the same type of assistant control panel as the drive for controlling, reading the status data of and setting the parameters of a DCS880 or DCT880 unit in the EXU cabinet.

NOTE – For an overview of the control panel buttons and usage, see Section 8.4, “Control panels”, page 147.

8.4.4.1. Operational settings

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

– **DCS880 unit:** set parameter *96.08 Local control* to **1**

– **DCT880 unit:** set parameter *19.17 Local control* to **1**

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

NOTICE

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

→ DO NOT switch the control panel to local control during drive operation

→ Only use the control panel to rectify alarms or fault conditions

Display values

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

– **Motor current** in A

– **Armature voltage** in V

– **Converter current** in A (rectified AC current value)

8.4.4.2. Resetting alarm and fault messages

– **Alarm messages** reset automatically after the problem has been resolved. You cannot reset the messages manually with the (**Reset**) key on the control panel.

– **Fault messages** must be reset manually with the (**Reset**) key on the control panel after the fault has been resolved.

8.4.4.3. Parameter settings

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

NOTICE

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

→ DO NOT change a parameter if you do not understand the parameter and the effects of the change

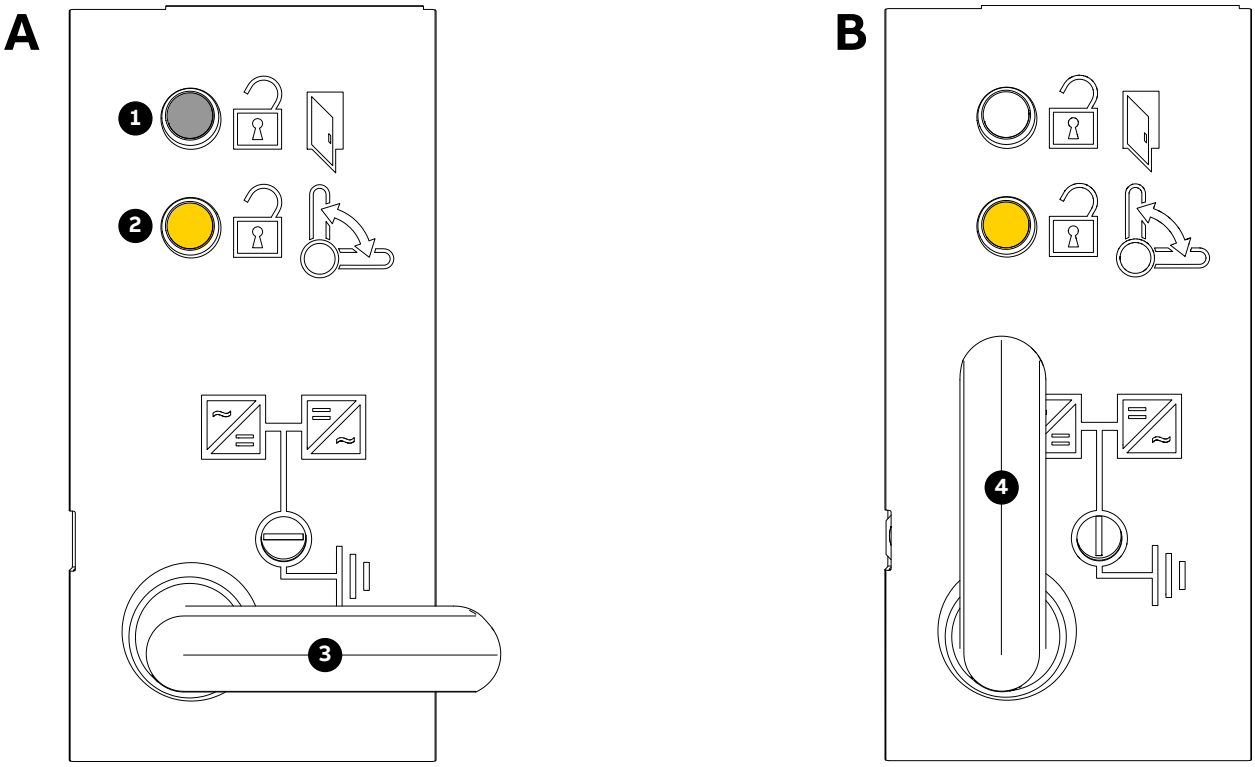
→ Contact ABB if you want to modify a parameter

8.5. Lamp test

The illuminated push buttons on the doors can be tested with the lamp test function as described in the firmware manual, see “Appendix G - Signal and parameter table”.

8.6. Grounding switch and door locking system

The grounding switch of the CBU is a protection device that enables safe access to the medium voltage units of the drive.



Key:		Explanation
(1)	White illuminated push button	Lights up to indicate that the drive is grounded and that the locking bar (1, Fig. 102), on each medium voltage unit can be moved.
(2)	Yellow illuminated push button	– Lights up to indicate that the grounding switch is unlocked and ready to turn. – You need to press this button to turn the grounding switch.
(3)	Grounding switch in ungrounded position	
(4)	Grounding switch in grounded position	DC-link of the drive is connected to the ground busbar of the drive.

Fig. 101. CBU grounding switch in (A) ungrounded and (B) grounded positions

The switch is electro-mechanically interlocked with a discharge monitoring circuit that prevents the switch from closing when the DC-link capacitors are still charged.

Grounding the drive is only possible after the main power supply has been disconnected and the DC-link has discharged. The yellow lamp lights up when the DC-link voltage is below 50 V DC.

When the grounding switch is in position grounded, the door safety switches of the medium voltage units are released and the doors can be opened.

8.6.1. Lamp test

The indicator lamp for the grounding switch and the white lamp (1, Fig. 101), have an integrated momentary push button. The lamps light up when the lamp cap is pressed.

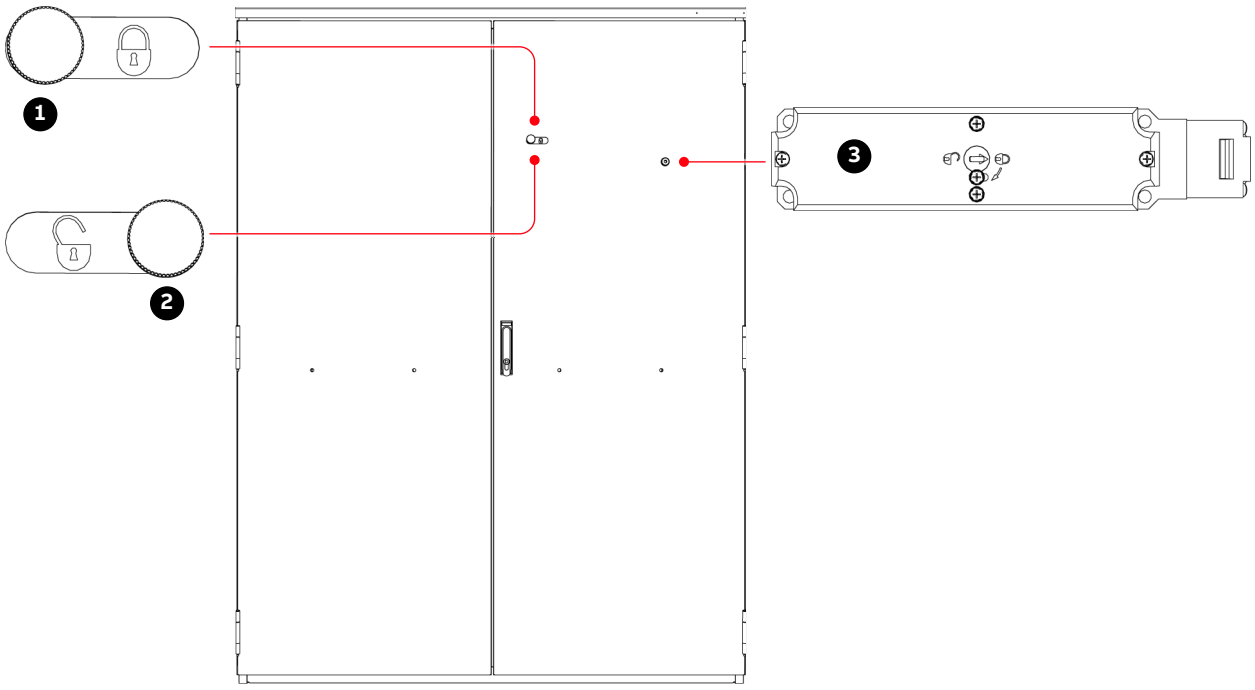
8.6.2. Door locking system

All doors of the drive are lockable. Additionally, the doors of the medium voltage units of the drive are equipped with safety switches and locking bars. The doors labeled CIU, COU, EXU and WCU are not part of the interlocking circuit and can be opened when the drive is energized.

For more information, see Section 9.4.4, “Unlocking and opening the doors”, page 188.

TABLE 12 Medium voltage units with safety switches and locking bars

Standard cabinet units	– ARU – CBU – INU – LSU – TEU
Optional cabinet units	– BCU – IFU – IRU – ISU – RBU – VLU



Key:

(1) Locking bar in locked position

(2) Locking bar in unlocked position

(3) Safety switch

Fig. 102. Safety switches

The safety switches are part of an interlocking circuit that prevents the doors being opened as long as the DC-link is charged. The interlocking circuit ensures that the:

– Main power can only be connected to the drive if the doors are securely closed, the grounding switch is in position not grounded, and the safety switches are in position locked.
– Doors can only be opened when the main power has been disconnected, the DC-link capacitors have been discharged, and the grounding switch is in position grounded.

The locking bar locks and unlocks the locking mechanism of the door of a medium voltage unit.

For more information, see Section 9.4.4, “Unlocking and opening the doors”, page 188.

8.7. Optional switchgear and controlgear

The operating personnel must be informed about the types of switches present in the drive and the parameter settings for opening and closing.

8.7.1. DC-link disconnector

Drives can be equipped with a manual controlled DC-link disconnector. The location of the control switch for opening and closing depends on the configuration of the drive. The control switch can be actuated when released by the drive.

8.7.2. Output switches

Drives can be equipped with motorized output disconnectors as well as motorized or manually-operated output grounding switches.

NOTICE

Risk of component damage!

→ DO NOT actuate an output switch in the drive if the motor is rotating

The switches for actuating the manual output switches are installed inside the drive cabinets. The location depends on the configuration of the drive. The switches are accessible after the DC-link has been discharged and the doors have been opened. The open and closed position of the switches is monitored by the drive.

Depending on the operating state of the drive and the settings of the parameters for this function, the drive opens or closes the motorized switches.

8.7.3. Manual output isolation

The manual output isolation (MOI) disconnects the output of the drive from the motor and creates a visible isolating distance in the supply line to the motor.

For more information, see Section 9.4.9, “Drives with the manual output isolation (optional)”, page 196.

8.8. 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

– Drive is stopped

– Fault condition has occurred

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

For information on other status messages (eg, fault status messages), see the status words in “Appendix G - Signal and parameter table”.

Not ready to switch on

The DC-link cannot be charged and the drive cannot be connected to the main power supply (that is, the main circuit breaker cannot be closed). The status message is displayed, when the doors of medium voltage units 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.

Ready to switch on

The drive is healthy and ready for the ON command. The ON command initiates charging of the DC-link and the closing of the main circuit breaker of the drive. Depending on the control place, 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 of the drive.

Ready run

Informs the operator that 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.

Ready ref

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 remote control system. When in local control mode, the value is entered into the control panel.

Stopping

Stopping indicates that 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 **Ready run** 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 **Ready ref** again.

Tripped

Indicates that 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.

8.8.1. Start sequence of the drive

1) Not ready to switch on

2) ARU Ready on

- Only drives with an ARU (see the next step, **Ready to switch on**, for the conditions)

3) Ready to switch on

- Auxiliary power supply on
- Doors of medium voltage units closed and locked
- Drive is not grounded
- No emergency-off
- No fault
- WCU ready

4) On command

5) Charging

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

6) ARU Ready ref

- Only in drives with an ARU

7) Ready run

- INU starts magnetizing (only in drives with an ARU)
- INU starts to modulate

8) Start command

9) Ready ref

10) Operation

8.8.2. Stop sequence of the drive

1) Operation

2) Ready ref

3) Stop command

4) Stopping

- Speed ramps down
- INU stops modulating

5) Off command

- Stop command to ARU (only in drives with an ARU)
- MCB opens
- DC-link discharges
- Cooling system switches off after a delay

6) Ready run

7) ARU Ready on

- Only in drives with an ARU

8) Ready to switch on

- Drive is grounded
- Doors in medium voltage units are released for opening
- Auxiliary power supply switched off

9) Not ready to switch on

8.8.3. Emergency-off sequence

1) Operation

2) Ready ref

3) Emergency-off command

- **Stop** command to ARU (only in drives with an ARU)
- MCB opens
- INU stops modulating
- Speed coasts down

4) Emergency-off

8.8.4. Prevention of unexpected startup sequence

1) Operation

2) Ready ref

3) Prevention of unexpected startup command

- Drives stops according to **Ramp**, **Torque**, and **Ramp stop** modes
- Open disconnector
- Prevention of unexpected startup complete
- Drive remains charged, MCB closed

4) INU operation prevention feedback

8.9. Starting the drive

The charge cycle of the drive is 3 times per 60 minutes.

You need the following documents when you start the drive system locally for the first time after commissioning:

– “Appendix D - Wiring diagrams” to identify the circuit breakers to be switched on

– “Appendix A - Additional manuals”, “Water cooling unit” to check that the water cooling unit is ready for operation

– “ACX-AP-x Assistant control panels user manual” , 3AUA0000085685 for information on the functions and features of the control panel

DANGER

Hazardous voltages!

→ To prevent unintentional contact with energized components, all covers must be screwed in place.

→ The release dial of the door safety switches must be in the locked position to prevent the doors of the medium voltage compartments from being opened unintentionally during operation.

CAUTION

Cooling system starts automatically! The cooling system can start automatically when the auxiliary voltage is switched on.

8.9.1. 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 have not been left inside the cabinet.
- ✓ All auxiliary power supplies from external sources are switched on.
- ✓ All internal circuit breakers of the drive are closed.
- ✓ All covers are fitted.
- ✓ All locking screws have been removed from the locking bars on the inside of the doors of medium voltage compartments.
- ✓ Doors are closed and locked or bolted.

8.9.2. 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.

8.9.3. Starting the drive locally

1. Press Loc/Rem (**Loc/Rem** key) on the control panel (Fig. 96) to switch local control mode if the text in the top left of the display is **Remote** instead of **Local**.
2. If the **Reset Emergency-Off** push button on the COU is flashing, press the button to cancel the flashing.
   - If the button continues to flash, check if an emergency-off command is active (see Section 8.10.2, “Stopping the drive in an emergency”, page 161).

   NOTE – The button flashes when the auxiliary voltage is switched off and on, or when another **Emergency-Off** button in the drive system has been pressed.
3. Verify that the control panel display does not show an alarm or fault message.
   - If the display shows a fault message, reset the fault; if you cannot reset the fault, contact the responsible personnel to solve the problem.
   - (Drives with an ARU) When faults are present and the drive is ready, the INU status is **Ready to switch on**.
4. Press the **Supply On** push button on the COU door.

   The button flashes while the DC-link charges. At the end of the charging process:
   1 Main circuit breaker closes automatically.
   2 **Supply On** push button lights up permanently.
   3 Drives with an ARU: ARU status changes to **Ready to switch on**.
   4 INU 1 and other INUs (if present) are now in status **ARU Not run**
5. (Drives with an ARU) Press the start key (Start) on the ARU control panel:

   The ARU starts modulating, the control panel displays **Modulating** and the status of the ARU changes to **Modulating**. When the ARU has reached the status **Ready ref**, the status of the first INU and the other INUs change to **Ready run**.

6. Enter the reference value.
7. Start the motor with the INU control panels.

   The motor magnetizes (status message on display **blinks**) and then the motor speed ramps up to the reference value. The run status message lights up permanently and the drive status changes to **Ready ref**.

8.10. Stopping the drive

8.10.1. Stopping the drive locally

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

   The motor follows the preset stop function. When the rpm is 0, the drive status changes to **Ready run**.

   NOTE – If you want to restart the drive during the stop process, press the start key (Start).

   IMPORTANT! You cannot restart the drive if the MCB is open.

8.10.2. Stopping the drive in an emergency

The drive is equipped with a hardwired emergency-off safety circuit that you activate with a self-latching **Emergency-Off** push button. Activating the push button immediately disconnects the main power supply for the drive, or the power supplies for both drives in a full redundant drive (FRD) system (see Section 8.11, “Full redundant drive operation (optional)”, page 163).

– To stop the drive in an emergency, press the **Emergency-Off** push button until it latches in place:

  - On the COU door local control panel (Fig. 98 and 99).
  - At an external location that is linked to the emergency-off circuit for the drive(s)

  CAUTION! The auxiliary power supply REMAINS connected to the drive.

  The following sequence of events occurs:

  1 MCB opens (regular drives)

  2 MCBs and IOIs open (full redundant drives)

    NOTE – If an FRD drive loses auxiliary power, you can manually open the IOI (see Section 8.11, “Full redundant drive operation (optional)”, page 163)

  3 Drive system coasts down

  4 DC-link of the drive discharges

  5 **Reset Emergency-Off** button flashes

  6 **Supply Off** push button flashes

For more information, see “Emergency off/stop modes and prevention of operation & safe torque off”, 3BHS196243.

8.10.2.1. Starting the drive system after an emergency-off

1. Turn the **Emergency-Off** push button in the direction that is indicated by the arrows.

   The button unlatches and returns to its initial position.

2. On the local control panel, press the **Reset Emergency-Off** button to reset the emergency-off safety relay of the drive.

   The drive remains in emergency-off state until the DC-link voltage has dropped to < 50 V (discharged). After resetting, the status message of the drive changes to **Ready to switch on**.

3. Re-connect the main power supply to the drive.

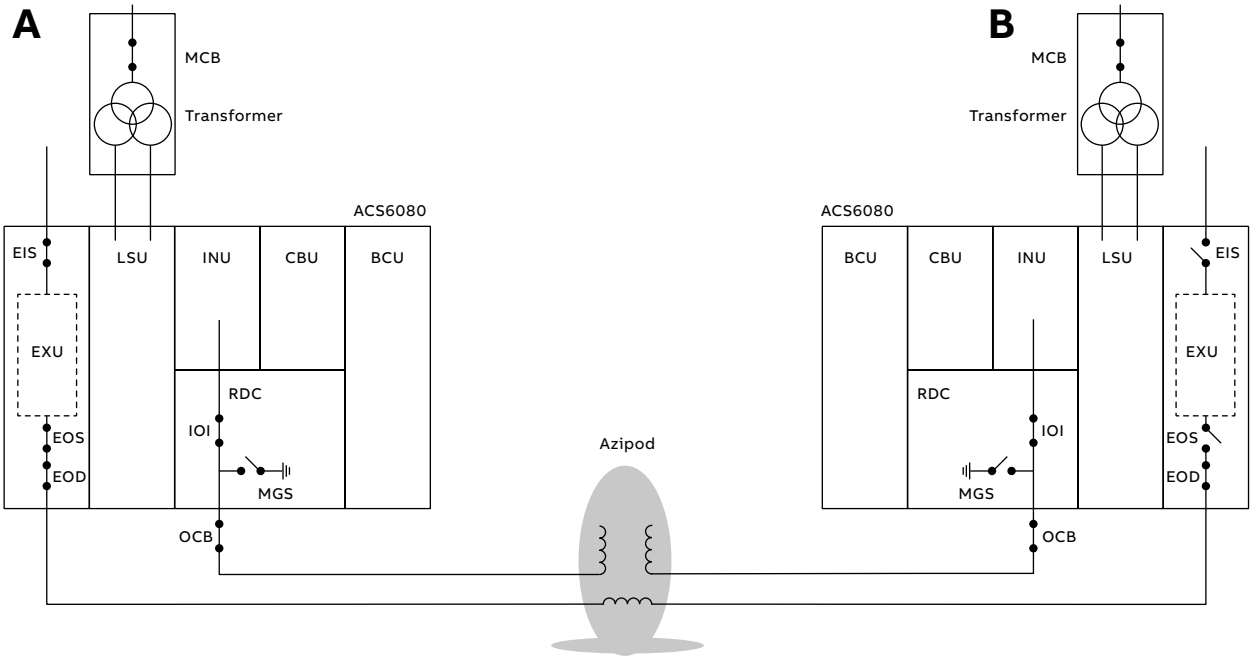
4. Start the drive according to Section 8.9, “Starting the drive”, page 159.

8.11. Full redundant drive operation (optional)

Only the procedures that are specific to full redundant drive systems (FRD) are described in this section. Standard procedures that are also used by the FRD are described elsewhere in this document.

8.11.1. Overview

The FRD system has two identical ACS6080 drives that operate a double winding synchronous motor or permanent magnet motor. Each drive has a separate transformer and MCB. The motor can be operated by both drives (full mode operation) or one drive (half mode operation).



Key:	Explanation
EIS	EXU input switch: general term for EIC (EXU input contactor) and EIB (EXU input breaker)
EOD	EXU output disconnector
EOS	EXU output switch: general term for EOC (EXU output contactor) and EOB (EXU output breaker)
IOI	INU output isolator
MGS	Motor grounding switch
OCB	Output circuit breaker
RDC	Redundant drive control unit

Fig. 103. Fully redundant drive overview with drive (A) and drive (B)

NOTE – Switch is the general term for contactor and breaker.

An FRD has the following features:

– Two separate power supplies (input transformer and MCB) that allow you to disconnect each drive from the supply network without affecting the operation of the other drive.

– Each INU supplies one of the separated double winding systems of the motor. You can disconnect an INU from the motor with a switch (IOI and/or OCB). The motorized IOI is in the COU while the OCB is external to the drive and only used for permanent magnet motors. In an emergency, the IOI can also be actuated manually with a crank.
– Each EXU has an EXU input switch (EIS) and at least one EXU output switch (EOS), depending on the type of excitation, as well as a manually (handle) operated EXU output disconnector (EOD). The controls on the RDC door can prevent the EOS from closing.

  NOTE – EXUs are not present for permanent magnet machines.

For more information about the RDC and the corresponding switches, see Section 8.11.3, “Redundant drive control panel”, page 166.

8.11.2. Operating modes

The FRD can be operated in two modes:

– Full drive mode
– Half drive mode

8.11.2.1. Full drive mode

In full drive mode, both drives power the motor, and the full drive power is available. The drives run in a master follower configuration. This is a common control method to share the load between electric drives which are mechanically coupled via the machine. With a motor whose shaft is controlled by a double winding system, the coupling is achieved via separated windings.

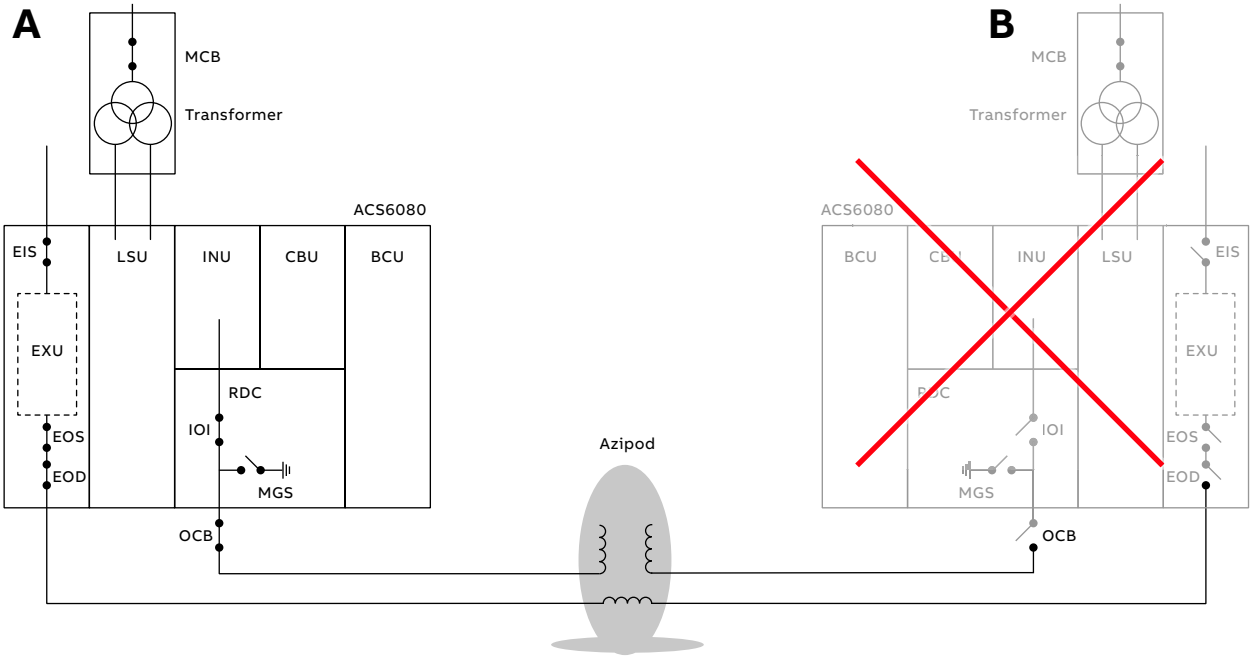
Fig. 103 shows one of two possible master follower configurations. The EIS, EOS, and the EOD of the EXU of the master are closed, ie, the master supplies the excitation power to the motor.

The master receives the main reference value from the control system. The other drive follows the run commands and the torque reference value from the master. The master also supplies the motor with excitation power. Each of the drives can be operated as master or as follower. A change of the drive configuration during operation requires stopping, reconfiguration and starting of the drive system (For more information, see Section 8.11.5.2, “Changing the master follower configuration during operation”, page 171). The follower however can be taken out of operation at any time independently of the master (For more information, see Section 8.11.5.3, “Stopping the drive system in full drive mode”, page 171).

The reaction of the drive system on a fault and the duration of a possible interruption depends on the location of the fault and the fault class. For more information, see “ACX-AP-x Assistant control panels user manual”, 3AUA0000085685.

8.11.2.2. Half drive mode

When this mode is selected, drive (A) or drive (B) controls the motor. Therefore, only half of the drive power is available. The running drive functions like a master in full drive mode but without the follower.



Key:	Explanation
EIS	EXU input switch: general term for EIC (EXU input contactor) and EIB (EXU input breaker)
EOD	EXU output disconnector
EOS	EXU output switch: general term for EOC (EXU output contactor) and EOB (EXU output breaker)
IOI	INU output isolators
MGS	Motor grounding switch
OCB	Output circuit breaker
RDC	Redundant drive control unit

Fig. 104. Half drive mode example where drive (A) controls the motor and drive (B) is out of service

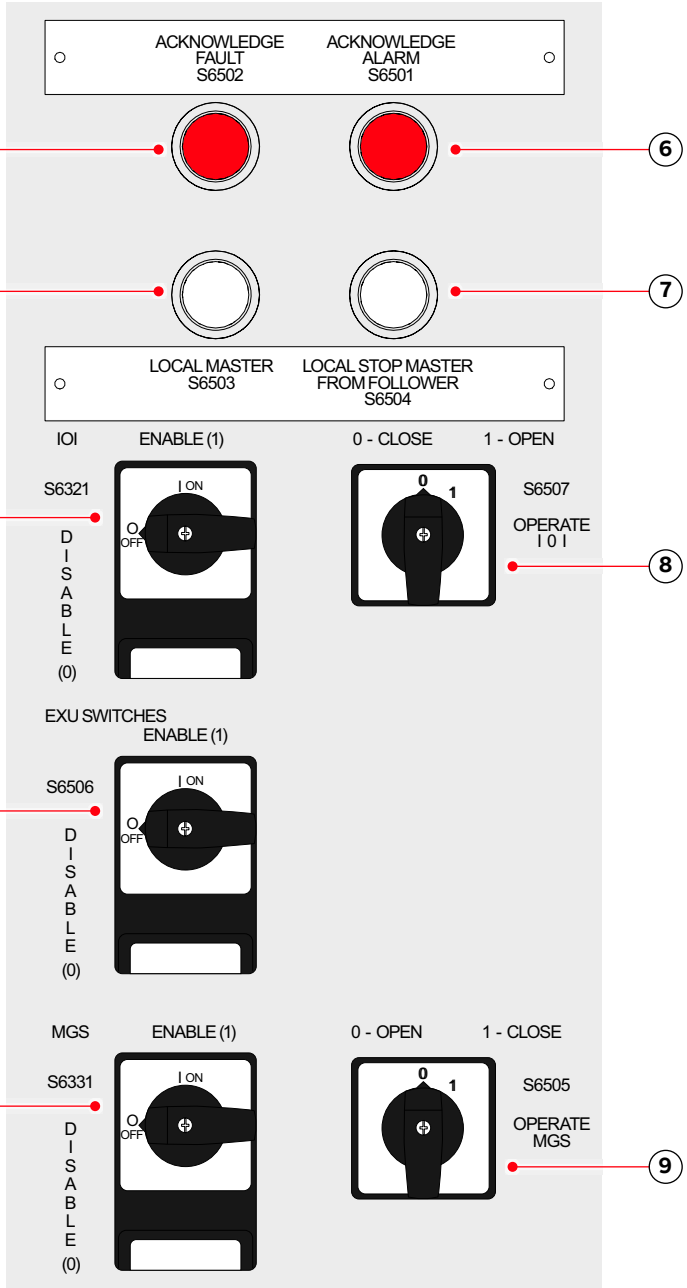
Fig. 104 shows one of two possible configurations of the half drive mode. Drive (B) is out of service and disconnected from the main power supply and the motor. The excitation unit is isolated from the main power supply and the motor.

The other drive can be shut down or it can be on standby. The standby drive can be connected to the running drive system at any time, provided the drive is in the appropriate state (For further information, see Section 8.11.6.3, “Changing from half drive to full drive mode”, page 174).

If a fault requiring a shutdown occurs in the running drive, the second drive can be taken into operation after the start sequence is completed.

8.11.3. Redundant drive control panel

Fig. 105 shows all of the available controls for an RDC. The motor grounding switch (MGS) and the EXU switches are optional.



Key:

(1) Acknowledge fault
(2) Local master
(3) Enable INU output isolator (IOI)
(4) EXU output switch (optional)
(5) Motor grounding switch (optional)
(6) Acknowledge alarm
(7) Local master stop command
(8) INU output isolator (IOI) command
(9) Motor grounding switch (optional)

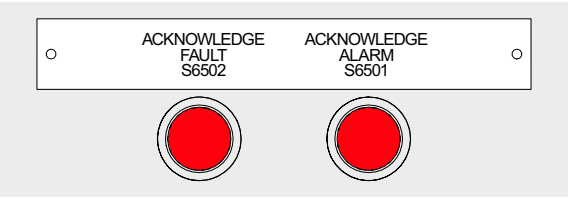
Fig. 105. Redundant drive control panel example

Table 13 describes the controls that are available for an RDC.

TABLE 13 RDC controls

Alarm/ Fault Acknowledge

– Acknowledges an alarm or a fault
– Blinks when a new alarm or fault comes up
– Steady light when alarm or fault has been acknowledged

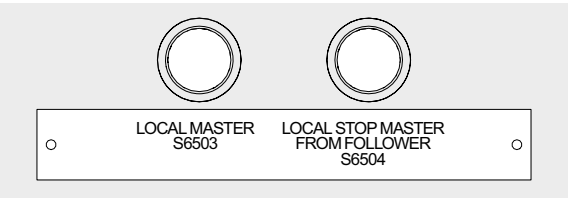


Local Master

- Changes the master follower configuration
- Push button is active when master is in **Local** control mode
- When pressed, the associated drive is master of a master follower configuration
- Must also be pressed on the drive selected for single drive operation
- Lights up to confirm that the associated drive has been selected master, either by **Local** or **Remote** control

Local Stop Master

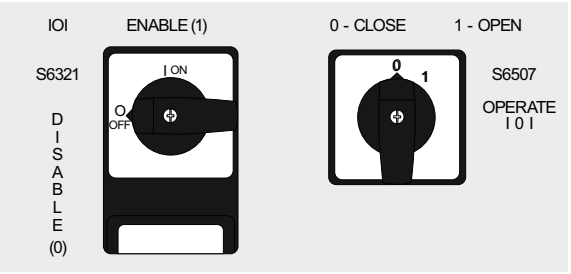
- Push button is active on follower when master drive is in **Local** control mode
- When pressed during operation, the master drive of a master follower configuration is stopped



INU output isolator (IOI)

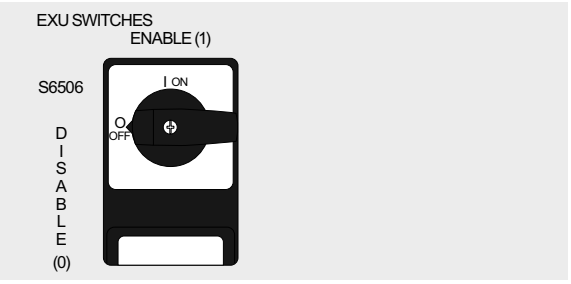
- Left switch (S6321) enables the operation; if **Off** the power to the electrically operated output isolator is cut
- Right switch (S6507) can only open the IOI; in addition to 1 = Open, drive must be discharged and parameter *88.41 INU Output Switch* open control must be set to Manual

NOTE – The alarm **FRD INU Output Switch Oper Disabled** will be raised if S6321 is set to **0 = OFF.**



EXU switches (S6506)

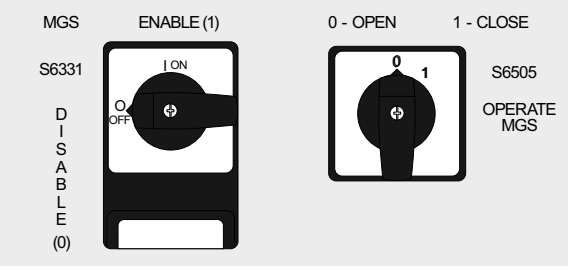
- EXU output switch (EOS) can be an EXU output breaker (EOB) or an EXU output contactor (EOC)
- EOS close command is inhibited if
  - EIS is not closed
  - EOS of other drive is closed
  - EOS closing is disabled with switch S6506
  - EOD is not closed
  - Drive is Follower



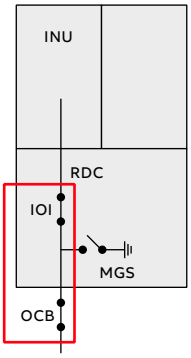
Motor Grounding Switch (MGS)

- Left switch (S6331) enables the operation; if OFF the power to the electrically operated grounding switch is cut
- Right switch (S6505) can open and close the MGS

NOTE – The alarm **FRD Motor Grounding Switch Oper Disabled** will be raised if S6331 is set to **0 = OFF**



8.11.4. Switch operation

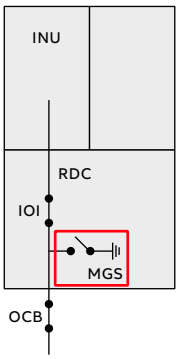


- Output Circuit Breaker (OCB) is only used in case of permanent magnet (PM) machines
- OCB can be installed instead of an INU output isolator (IOI) or in series to the IOI
- IOI/OCB can be operate by the software or by S6507.
  - IOI/OCB is closed by the software when MCB closed feedback is received.
  - IOI/OCB opens
    - Automatically when MCB opens and parameter *88.41 INU Output Switch open control* is set to **Automatic**
    - Manually if S6507 INU Output Switch Manual Operation is **1** and parameter *88.41 INU Output Switch open control* is set to **Manual** and drive is discharged
    - Always in case of: Emergency OFF, Emergency STOP or FC1.
    - If drive is a follower, MCB is open, and the motor is operated by the master drive in half mode

Operation of IOI/OCB is inhibited when:

- Output switches control is inhibited (eg, doors are not closed, current is not zero, etc.),
- MGS of current drive is closed
- MGS of the other drive is closed

NOTE – CBU ground switch operation is interlocked when the IOI of the first drive is closed or the IOI of the second drive is closed. This means in order to ground the drive, both IOIs must be open.



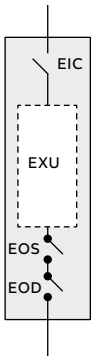
- MGS may not always be installed.
- MGS is operated by switch S6505
  - MGS can be opened when MGS is closed and switch **Operate MGS** is in **0** position
  - MGS can be closed when operation is enabled (not inhibited; see below) and switch **Operate MGS** is in **1** position

The operation of MGS is inhibited when:

- CBU is not grounded
- IOI of current drive is closed
- IOI of the second drive is closed
- Feedback of current IOI are homogeneous
- Feedback of other drives IOI are homogeneous

NOTE – CBU grounding switch operation is interlocked when the MGS of the first drive is closed or the MGS of the second drive is closed. This means the drive cannot be ungrounded if one of the MGS is closed (ie, connected to ground).

- EXU Input Switch (EIC/EIB)
  - Controlled by the software
  - Always installed for air cooled EXUs (EXU_A)
  - Not installed in case of water-cooled EXU (EXU_W). Instead, the EXU controls directly the EXU supply breaker
- EXU Output Disconnector (EOD)
  - Manual operated switch
  - Installed to ensure mechanical disconnection of EXU
- EXU Output Switch (EIS/EOB)
  - Controlled by the Software
  - In case of air cooled EXU, the EOS is a contactor. For bi-directional brushless EXUs the two phase reversal switches are used. For brushed EXUs a single contactor is installed
  - In case of water cooled EXU the EOS is a breaker due to the high current



NOTE – Default for FRD application is an air-cooled bidirectional brushless excitation unit with phase reversal switches.

- EOS will be closed after the EIS is closed.
- EOS will be open when the EIS is open.

EOS close command is inhibited when:
- EIS is not closed
- EOS of other drive is closed
- EOS closing is disabled with switch S6506 at the RDC door
- EOD is not closed
- Drive is follower.

EOS open command is inhibited when:
- EXU current is too high

NOTE – In case of master/follower changeover the EOS of the old master will open and EOS of new master will close.

8.11.5. Operation via the remote control system

8.11.5.1. Operation in full or half drive mode

Observe the following when the drive system is controlled from the remote-control system:

Preparatory steps:

1. Prepare the drive system for operation according to Section 8.9.1, “Checks before starting the drive”, page 160.
2. Check that all parameters have been set for remote control.
3. Check that the drives do not show a fault message.

   Depending on the selected operating mode, a fault message prevents starting of the complete drive system or the single drive. An alarm message has no effect on starting.

   When a fault message is displayed on the local control panel, reset the fault.

   If a fault cannot be reset, the responsible personnel must rectify it.
4. To select remote on the local control panel of each drive, press the Loc/Rem (**Loc/Rem** key).
5. To lock the local control panel, set parameter *19.17 Local control disable* of each drive to **SELECTED**.

8.11.5.1.1. Remote operation

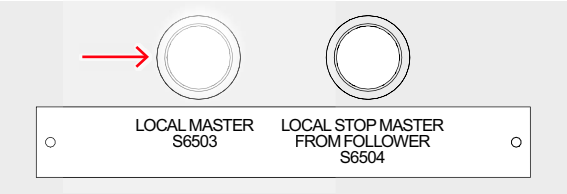
When all preparations and settings have been made, the drive system signals **Ready on** (ready to be switched on).

When the **Ready on** signal is present at the remote control system, the remote control system selects the operating mode and sends the ON command to the drive system. The ON command initiates

- Charging of the DC-link of the configured drive
- Closing of the MCB of the configured drive
- Closing of the IOI/OCB switches of the configured drive
- Closing of the EIS switches of the configured drive
- Closing of the EOS switches of the configured drive

In full drive mode only the EIS and the EOS of the master will close. The EXU switches of the follower will remain open. They will be closed once follower becomes the new master in case of master/follower changeover.

The remote control system selects which of the two drives is the master. The selection is made for half and full drive mode. On selection, the **Local Master** push button lights up on the RDC of the master.



When all switching operations have been carried out successfully (all feedback signals have arrived at the configured drives within the preset time), the status of the drives changes to **Ready run**. Then, the remote control system gives the start command and the drive system operates according to the selected operating mode and the speed or torque reference value.

For an overview of full mode drive remote operation, see “ACS6080 INU primary control program firmware manual”, 3BHS858986 E01.

When one of the two drives is running, put the drive at standstill to state **Ready run**.

1. Prepare the non-running drive system for operation according to Section 8.9.1, “Checks before starting the drive”, page 160.
2. Check that the non-running drive does not signal a fault message. A fault message prevents starting of the drive whereas an alarm message has no effect on starting.

   When a fault message is displayed on the local control panel, reset the fault.
3. Make sure that each drive is in remote control mode.

When all the preparations and settings have been made, the non-running drive signals **Ready on** (ready to be switched on).

When the **Ready on** signal is present, the remote control system gives the ON command to the drive. The ON command initiates

- Charging of the DC-link
- Closing of the MCB
- Closing of the IOI/OCB
- Closing of the EIS

When the feedback signals from the switches have arrived at the drive within the preset time, the state of the drive changes to **Ready run**. The drive follows the commands from the master when the remote control system has sent the FULL DRIVE MODE signal to the master:

– The master sends the RUN command to the follower,
– The follower starts to modulate and ramps up to the torque reference,
– After the state of the follower has changed to **Ready ref**, the drive will follow the reference value from the master.

For an overview of half mode drive remote operation, see “ACS6080 INU primary control program firmware manual”, 3BHS858986 E01.

8.11.5.2. Changing the master follower configuration during operation

The master follower configuration can be changed after the drive system has been stopped. To speed up the change-over, the DC-links of the drives stay charged. Two commands from the remote control system are required to change the drive configuration:

– Stop command
– Change-over command

The change-over command can only be given if the status of the master drive is not **Ready ref**.

The two commands can be given in any order. The control system of the drives executes the change-over in the correct sequence within the preset time.

As soon as the drive system receives the STOP command, the status message changes from **Ready ref** to **Stopping**.

When the drive system reaches the zero-speed threshold, the change-over is performed. When the CHANGE-OVER command is present at the drives, the EIS and EOS of the old master (now the new follower) open and the EIS and EOS of the new master close.

When all switching operations have been carried out successfully, the remote-control system gives the START command. During change-over, the state of the drives does not change. As soon as the START command is given, the drive system operates according to the reference value, and the state of the drives changes to **Ready Ref**.

8.11.5.3. Stopping the drive system in full drive mode

On giving the STOP command, the drive system performs a coast or ramp stop depending on the set-ting of the corresponding parameter.When the zero speed threshold is reached, the state of the two drives

changes from **Ready ref** to **Ready run**. Then, the remote control system gives the OFF command to each drive. If the OFF command is not sent, the drive system can be started again. The OFF command causes that:

– MCB of each drive opens
– IOI switch of each drive opens
– DC-link of each drive discharges

The **Supply Off** button on the control door flashes when the DC-link discharges and changes to steady light when the DC-link has discharged completely.

– EOS of the master opens
– EIS of the master opens

When all switching operations have finished and all feedback signals have arrived at the control system of the drives within the preset time, the state of the drives changes to **Ready on**. When the IOIs of the drives have been turned to position **Disable**, the grounding switches of the drives are released.

The status indication of the drives changes to **Not ready to switch on**. After the drives have been grounded, the doors can be opened.

For an overview of the full motor stop remote operation, see “ACS6080 INU primary control program firmware manual”, 3BHS858986 E01.

8.11.5.4. Stopping the follower with the drive system in full drive mode

To stop the follower, the remote control system resets the FULL DRIVE MODE signal to the master. Resetting the FULL DRIVE MODE signal, initiates the master to reset the RUN command to the follower. The follower immediately stops modulating whereas the master continues to run. The status indication of the follower changes to **Ready run**. When the FULL DRIVE MODE signal to the master is given again, the follower resumes operation.

8.11.6. Operation via the local control panel

8.11.6.1. Overview of the local control panel

The following section shows the drive panel of master and follower. If only one of the drives is selected for operation, disregard the display illustration of the follower.

The display settings can be customized., depending on the project needs. Hence the following pictures are only examples. The status words on the control panel can be customized pending on the projects needs.

Key:

(1) Inverter unit status – inverter status

(2) FRD machine status – FRD status

(3) Motor shaft power – master or follower shaft power

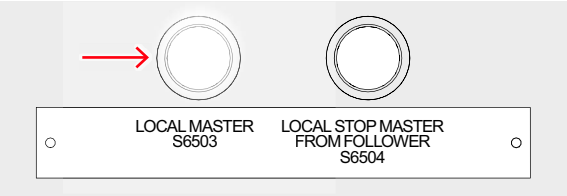
Fig. 106. INU control panel on FRD

8.11.6.2. Operation in full drive or half drive mode

Observe the following steps when the drive system is controlled locally via the local control panels:

1. Prepare the drive system for operation according to Section 8.9.1, “Checks before starting the drive”, page 160.
2. Check that there is no fault message displayed on the local control panel of the drive selected for operation.
3. When a fault message appears on the local control panel, press the (**Reset**) key.

   IMPORTANT! If the fault cannot be reset, rectify the fault first.
4. Verify that local operation is released from the remote control system.
5. Select REMOTE on the local control panel of the drive selected for operation. To do this, press the Loc/Rem (**Loc/Rem** key).
6. Check that the **Local Master** push button is on.
   - In Full drive mode the push button on the master must be on.
   - In Half drive mode the push button on the drive selected for operation must be on.

   The push button on the drive selected for operation must be on.

   If the push button is not lit, press the **Local Master** push button on the drive selected for operation.

   An automatic LOCAL MASTER selection is always performed when main and auxiliary power supply of the drives are switched off, and the auxiliary power supply is switched on again. Drive (A) then becomes the master. The initial selection can be changed when the non-illuminated **Local Master** push button is pressed.

   When the drive is ready to charge the DC-link, the local control panel displays **Ready on** and charging of the DC-link of the drive(s) is initiated.
7. Set the drive mode.
   - Full drive mode: press the **Supply On** push button on the master and the follower.
   - Half drive mode: press the **Supply On** push button on the master. If the second drive is on hot standby, press the **Supply On** push button of this drive as well.

   The **Supply On** button flashes during charging and the status line of the local control panel changes to **Charging**.

   After charging has finished, the main circuit breaker of the associated drive closes automatically and the **Supply On** button of the drive, whose DC-link has been charged, lights up permanently. The display of the master and the follower local control panel changes to **Ready run** (only if the drive system is in full drive mode). The drive system is now ready for the RUN command.

8. Enter the reference value into the master local control panel.
9. Start the motor.
   - Full drive mode: press the Start (**Start**) key first on the master and then on the follower local control panel.
   - Half drive mode: press the Start (**Start**) key on the master local control panel.

   After the motor has magnetized, the motor speed ramps up to the reference value. Operation of the drive system is displayed as follows:
   - Full drive mode: the status line of the master and follower local control panel alternates between **Ready ref** and **Full motor run**.
   - Half drive mode: the status line of the drive in operation alternates between **Ready ref** and **Half motor run**.

8.11.6.3. Changing from half drive to full drive mode

When one of the two drives is running, put the drive at standstill into state **Ready run**.

1. Prepare the drive for operation according to Section 8.9.1, “Checks before starting the drive”, page 160.
2. Check that the drive does not signal a fault message. When a fault message is present, reset the fault. If the fault cannot be reset, rectify the fault.
3. To select **Remote** on the local control panel of the drive, press the Loc/Rem (**Loc/Rem** key).

   If no fault message is present, the local control panel of the already running master shows **Ready ref** and the drive selected for operation shows **Ready on**.
4. Press the **Supply On** push button on the drive selected for operation.

   On pressing the **Supply On** push button
   - DC-link charges
   - MCB closes
   - IOI closes
   - EIS remains open

   The **Supply On** push button flashes during charging and changes to a steady light when charging has finished. While charging, the status line of the follower local control panel changes to **Charging**.

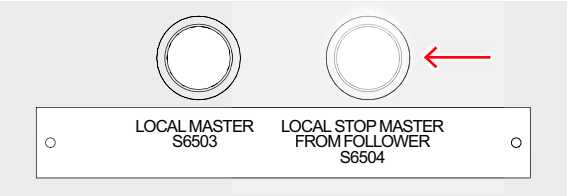
   After the DC-link has charged, the display of the follower local control panel changes to **Ready run**. The follower drive is now ready for the START command.
5. To start the motor, press the press the Start (**Start**) key on the follower.

8.11.6.4. Changing the master follower configuration during operation

The master follower configuration can be changed after the drive system has been stopped. To speed up the change-over, the DC-links of the drives stay charged.

1. Press the **Local Stop Master From Follower** push button on the follower to stop the drive system.

   The power is removed from the motor and the status messages of the two drives change from **Ready ref** to **Stopping**. When the drive system reaches the zero speed threshold, the status changes to **Ready run** and the actual change-over can be performed.



2. To initiate the change-over, press the **Local Master** push button on the new master (previous follower). As a result, the EIS and EOS switches of the old master (now the new follower) opens and the EIS and EOS switches of the new master closes.

   When all switching operations have been carried out successfully (all feedback signals have arrived at the control system of the drives within the preset time), the state of the drives changes to **Ready run**.

3. Enter the reference value for the new master on the local control panel.

4. Start the motor.

   - Full drive mode: first press the Start **(Start)** key on local control panel of the master and then on the follower.
   - Half drive mode: Press the Start **(Start)** key on local control panel of the master.

   On giving the START command, the drive system operates according to the reference value and the state of the drives changes to **Ready Ref**.

8.11.6.5. Stopping the FRD in full drive mode

– To stop the drive system, press the Stop **(Stop)** key of the master local control panel.

If you only press the Stop **(Stop)** key of the follower local control panel, the drive system continues to run in half drive mode.

When you press the Stop **(Stop)** key of the master local control panel, the drive system performs a coast or ramp stop depending on the parameter settings. When a ramp stop has been selected, the status line of the display shows **Ready ref** during the stop sequence.

When modulating has stopped, the CDP control panel displays **Ready run**.

As long as the main circuit breaker (MCB) is not opened, the motor can be started again.

If you only press the Stop **(Stop)** key of the follower local control panel, the drive system continues to run in half drive mode.

8.11.6.6. Stopping the FRD in an emergency

For more information, see:

– Section 8.10.2, “Stopping the drive in an emergency”, page 161.

– Section 8.10.2.1, “Starting the drive system after an emergency-off”, page 162

8.12. Arc detection with the Arc Guard System™ (optional)

The optional Arc Guard System™ detects fast arc faults in the terminal sections of an ACS6080 drive. When the Arc Guard System detects an arc fault the drive performs protection firing and immediately opens the main circuit breaker.

Key:

(1) Arc Guard HMI panel

(2) Arc monitor device

(3) Reeling device for optical fiber detector cables

Fig. 107. Arc Guard System™ in a WCU REB

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

1. De-energize and ground the drive according to Section 9.4.2, “De-energizing and grounding the drive”, page 185.
2. Search for the location where the arc has been detected.
3. Check the Arc Guard HMI panel messages and use the circuit diagrams.
4. Open the power units and locate the defect.
5. Repair the defect or contact support line if needed.
6. Reset the fault on Arc Guard HMI panel.
7. Acknowledge the firing through with parameter *8.50* on the control panel.

   WARNING! Only set this parameter after the fault has been identified and corrected.

Fig. 108. HMI panel

8. Restart the drive according to Section 8.9, “Starting the drive”, page 159.

9. Preventive and corrective maintenance

9.1. General information

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

9.1.1. Required qualification

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

9.1.2. Maintenance schedule

Carry out all maintenance tasks according to the maintenance schedule, on time and at the stated intervals in the “ACS6080 preventive maintenance schedule”, 3BHS838899 E01.

9.1.3. Logbook

ABB recommends recording all troubleshooting and maintenance work in a logbook including:

– Date and time

– Detailed description

9.1.4. Spare parts

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

For information on types and identification codes, see “Appendix A - Additional manuals”.

For information on storing spare parts, see Section 4.6.3, “Storage and handling of spare parts”, page 73.

9.2. Identifying electrical equipment

This section describes how to identify electrical devices, cables, and wires.

9.2.1. Device designation

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

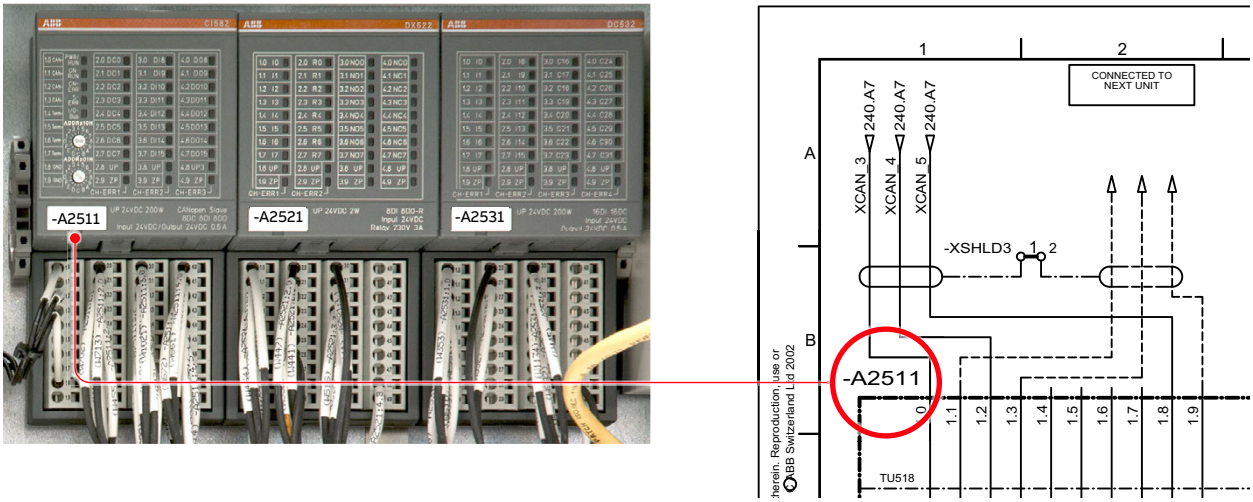
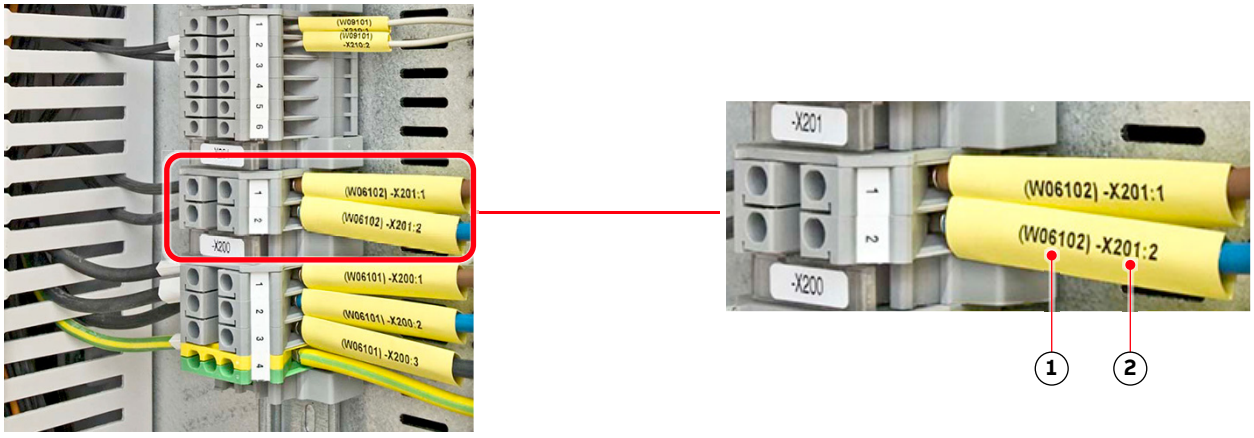


Fig. 109. Labels on S500 I/O modules and associated wiring diagram

9.2.2. 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) Wire number

(2) Terminal number

Fig. 110. Cable and wire designation

9.2.2.1. Understanding wiring diagrams

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

9.3. Status indicators

9.3.1. 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 control panel displays a corresponding alarm or fault message and the alarm / fault lamp on the control compartment door lights up:

– **Alarm:** flashing light

– **Fault:** permanent light

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

9.3.2. Error message levels

Two error message levels are used in the drive:

– **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.

– **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) with FT (firing through) and opening of the MCB

– Class 1 faults (FC 1) without FT (firing through) and opening of the MCB

– Class 2 faults (FC 2) without opening of the MCB

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

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

9.3.2.1. Alarm and fault messages

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

9.3.2.2. Fault handling

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

– The last fault entered has number 1.

– The first fault entered has the highest number.

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

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

9.3.2.3. Standard troubleshooting procedure

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

1. DO NOT switch off the auxiliary supply voltage or try to reset a fault message before all information at the time of the occurrence of the fault condition has been saved.
2. Select the fault history display on the control panel, but do not clear the buffer now!
   See Chapter 8, “Operation”, page 146.
3. Identify the fault and make a logbook entry.
4. Save the content of the data logger when a PC is available which has the Drive Composer/Startup tool installed.
   The data logger provides information (eg, waveforms of voltage, current, torque) for efficient troubleshooting.
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 Section 8.9, “Starting the drive”, page 159.

9.3.3. LEDs and switches on PCBs and I/O modules

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

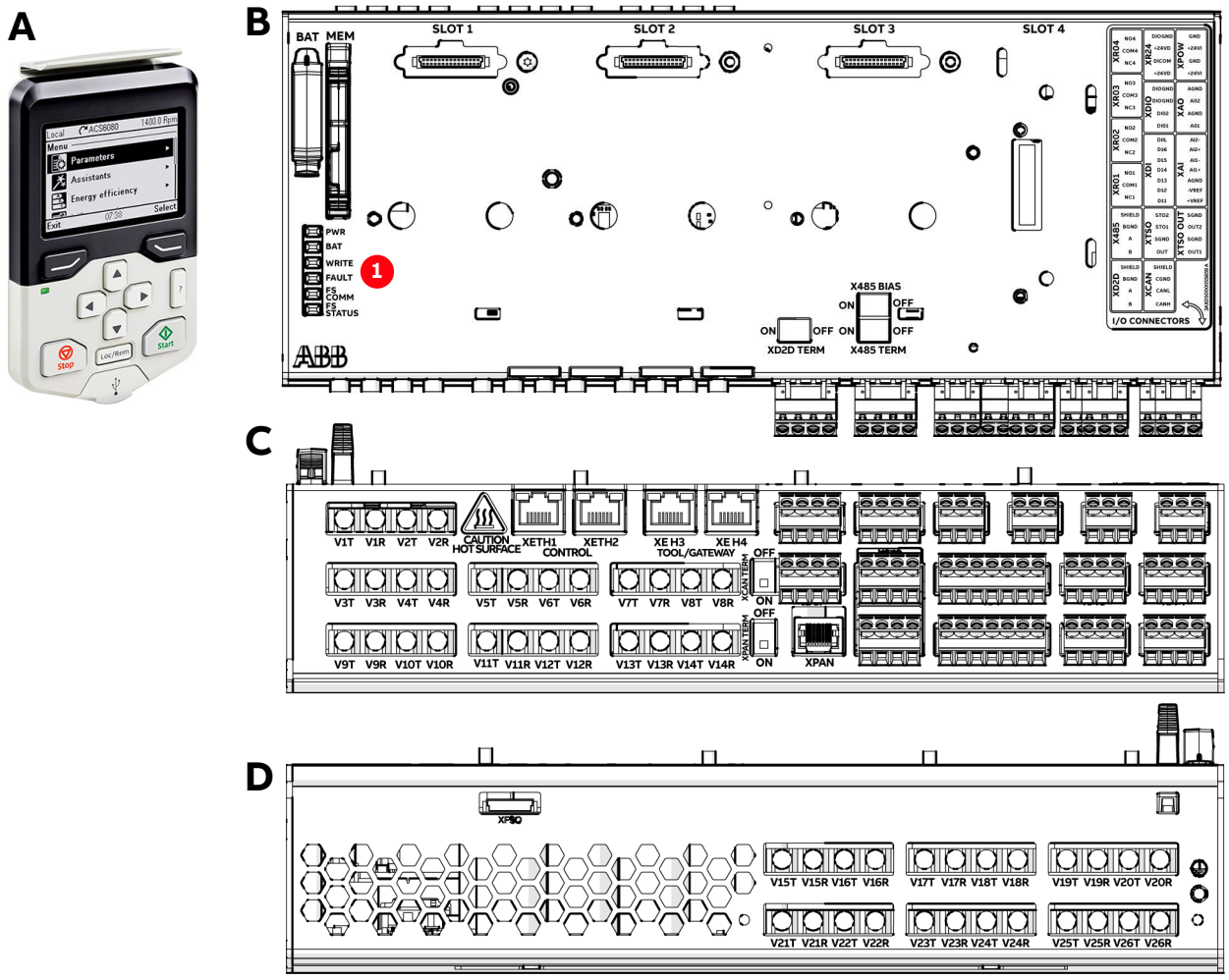
The LEDs can be checked easily while the auxiliary voltage is switched on without having to remove covers first. The LEDs provide information on the status of the devices and can be used for diagnostic purposes.

9.3.3.1. UCU-26 control unit

The UCU-26 control unit is connected to the assistant control panel via fiber optic links.

Each control panel is connected to a separate UCU-26, which contains integrated branching unit functionality for collecting and storing real-time data from the converter modules to help fault tracing and analysis. The data is stored in a secure data card.

For more information, see the “UCU-26 control unit hardware manual”, 3BHS897436 E01.



Key:

(1) Location of LEDs

Fig. 111. (A) Assistant control panel and UCU-26: (B) top (C) front and (D) rear

9.3.3.2. S500 I/O modules

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

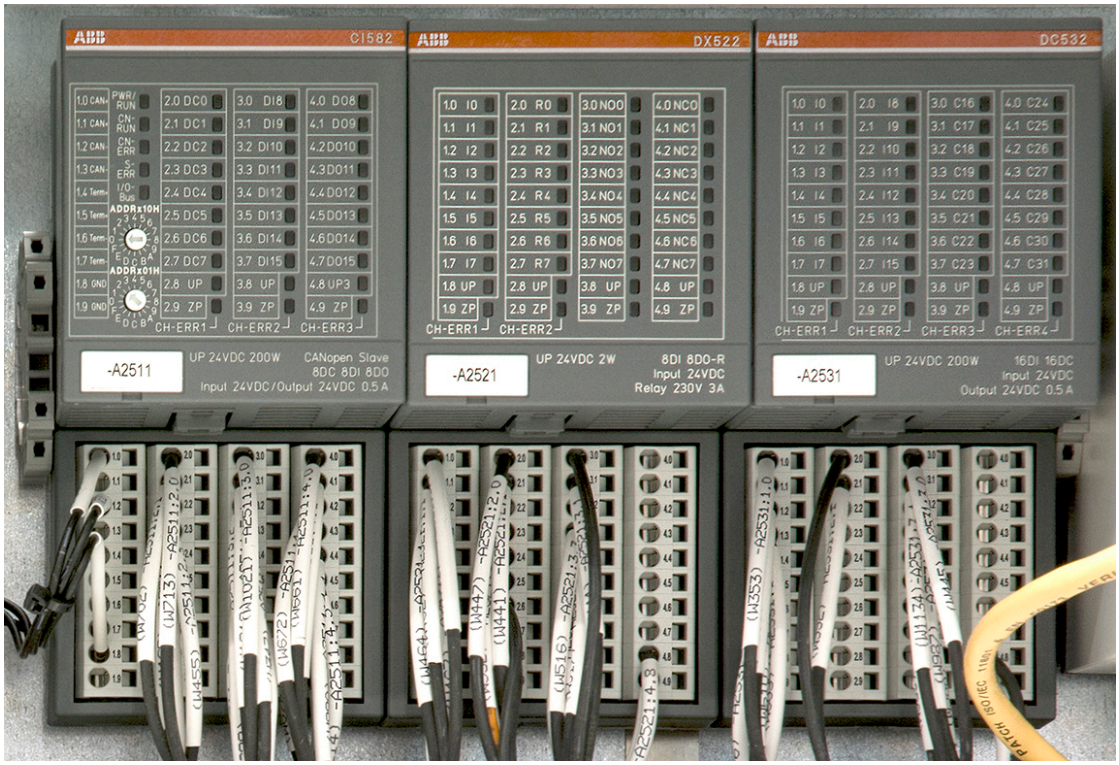


Fig. 112. S500 I/O modules in a COU

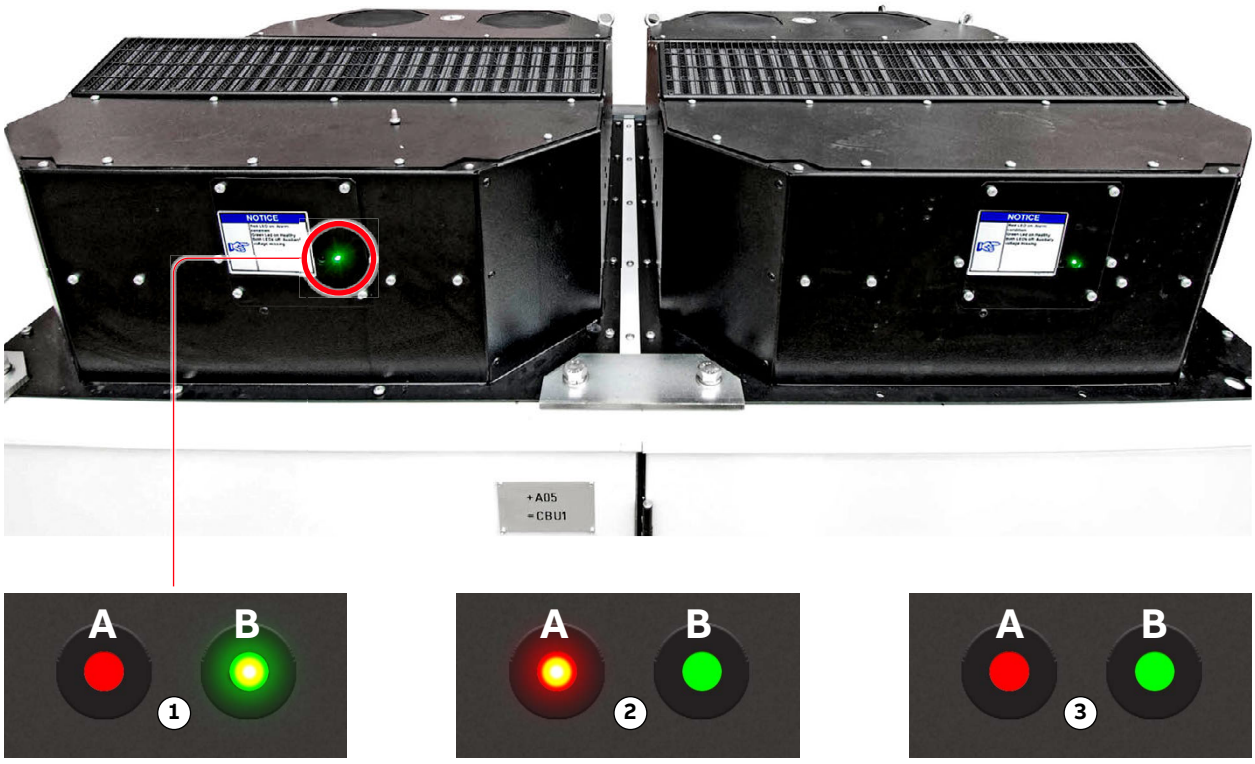
9.3.3.3. Serial communication interfaces

To identify the serial communication interface in the drive, see “Appendix D - Wiring diagrams”. For more information, see “NETA-21 remote monitoring tool user manual”, 3AUA0000096939.

9.3.3.4. LEDs on optional heat exchangers

Two LEDs on the front of the heat exchanger indicate the status of the unit.

Alarm signals are also shown on the control panel.



LED status		Explanation
(1)	(A) Red LED off and (B) green LED on	Heat exchanger is healthy
(2)	(A) Red LED on and (B) green LED off	Alarm condition
(3)	(A) Red LED off and (B) green LED off	Auxiliary voltage is missing

Fig. 113. Status LEDs on optional air-to-air heat exchangers

9.4. Maintenance tasks

The following sections describe the maintenance tasks and associated actions that you can perform on the drive.

9.4.1. Safety

DANGER

Hazardous voltages! Failure to read all of the safety and maintenance instructions before you work on the drive can result in DEATH or serious injury!

→ Complete the steps in Section 2.3.2, “The 7 steps that save lives”, page 29

When the motor is spinning, a HAZARDOUS VOLTAGE appears at the output of the IOI switch in the RDC unit, even if the switch is open and the drive is grounded.

→ Follow local safety procedures when you isolate and ground the motor

→ Remove all foreign objects, including metallic dust, from the drive

→ Securely fasten all internal covers and external covers

→ Verify that the safety switches on the doors are in the locked position

5 min

WARNING

Risk of electric shock! Contact with a charged capacitor can cause serious injury or DEATH!

→ After the drive has been de-energized, wait a MINIMUM of 5 minutes for the capacitors to fully discharge

→ Verify that a capacitor is discharged before you touch it

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

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

9.4.2. De-energizing and grounding the drive

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

⚠CAUTION

Hazardous voltages! Forcibly turning a “stuck” grounding switch can result in serious injury and damage the equipment, eg, short-circuits in the DC-link capacitors (loud bang).

→ DO NOT forcibly turn a grounding switch in any direction

→ Identify and resolve the condition that prevents the switch from turning, eg, switch was not released properly

1. Press the **Loc/Rem** key (Loc/Rem) on the control panel (Fig. 96) to switch local control mode if the text in the top left of the display is **Remote** instead of **Local**.

2. Press the stop key (Stop) on the control panel to stop the motor.

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

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

   The following takes place:

   1 MCB opens

   2 DC-link discharges

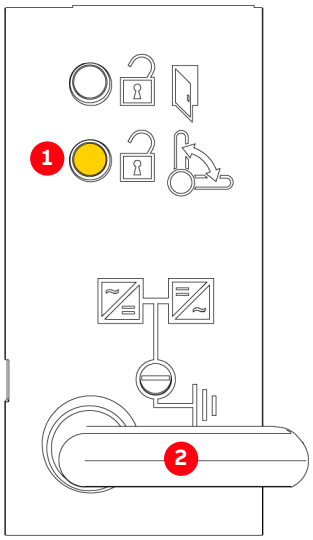
   3 **SUPPLY OFF** push button flashes and remains on after the DC-link has discharged.

   4 Drive status changes to **Ready on**

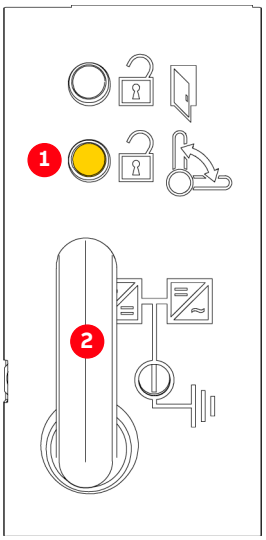
4. Rack-out, lock-out, ground and tag-out the main power supply.

5. Wait for the yellow lamp **Grounding Switch Unlocked** (1) on the CBU to light up.

   CAUTION! If the lamp does not light up, DO NOT force the grounding switch (2) in any direction. Instead, continue with Section 9.4.3, “Grounding the drive when the grounding switch is not released”, page 186.



6. If the yellow lamp **Grounding Switch Unlocked** (1) is on, keep the yellow lamp cap pressed while you turn the grounding switch to the grounded position (2).



7. Open the doors of medium voltage units according to Section 9.4.4, “Unlocking and opening the doors”, page 188.

   NOTE – To open the doors of medium voltage units, auxiliary voltage is required.

8. Switch off and lock out all auxiliary voltages from external sources.
9. Continue with Section 9.4.8, “Connecting a grounding set”, page 193.

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

Under normal conditions, the **Grounding Switch Unlocked** lamp lights up after the DC-link discharges. The lamp indicates that the switch can be turned. Take the following steps to ground the drive if the lamp remains off.

For information on the wiring of the control circuit, see:

– Converter hardware diagram
– Wiring diagram of COU1

For information on the wiring of the discharging circuit and/or the grounding circuit, see:

– Wiring diagram of COU1
– Wiring diagram of CBU.

NOTICE

Risk of component damage! Forcibly turning a “stuck” grounding switch can damage the equipment,

→ DO NOT forcibly turn a grounding switch in any direction

1. Verify that the auxiliary voltage is switched on.

2. Press the **Grounding Switch Unlocked** lamp cap to test the lamp.

Lamp status	Cause
Off	– Lamp is burnt out – Lamp-test circuit is faulty.
On	Malfunction in the discharging circuit or the grounding circuit

NOTE – The lamp-test circuit is independent from the discharging circuit and the grounding circuit, ie, if the lamp remains off, you cannot conclude that one of the other circuits is defective.

3. Verify that the MCB (main circuit breaker) is open and then secure the MCB from closing.
   The LED of the digital input IO (input module A1511 in COU1) is on when the **MCB is open** feedback signal 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 A1511 in COU1) is lit.
   The LED is on when the grounding switch has been released.
6. Check the discharging level of the DC-link.
   - If the value of the parameter *1.11 Measured DC link voltage* is below 50 V, the DC-link is discharged.
   - If the DC-link is discharged, the drive is in **Ready to switch on** status.
   - Check that **Ready to Switch ON** is enabled in parameter *6.11 Main status word*.
7. Carefully turn the grounding switch to the grounded position if the following conditions have been met:
   ✓ 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 **Ready to switch on**

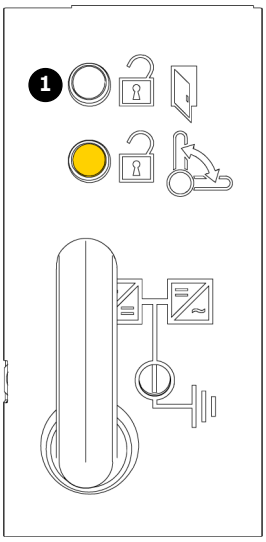
IMPORTANT! If you cannot turn the grounding switch, continue with Section 9.4.7, “Emergency release of a door safety switch”, page 190.

9.4.4. Unlocking and opening the doors

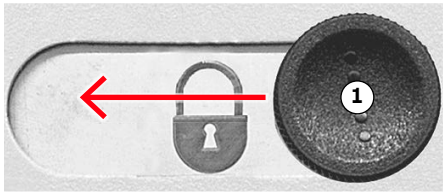
1. Check that the auxiliary voltage is on and wait for the white lamp (1) on the CBU to turn on.

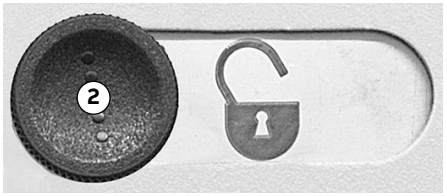
   The white lamp indicates that the drive is grounded and that the locking bars are released.

   NOTE – If the white lamp does not turn on, continue with Section 9.4.6, “Testing the white lamp”, page 190.

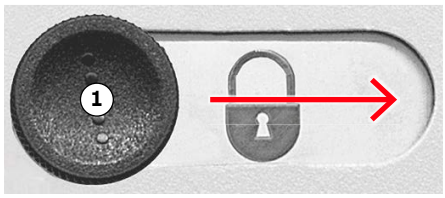


2. (Door hinged on the left) Slide the locking bar left from the locked position (1) to the unlocked (2) position.





3. (Door hinged on the right) Slide the locking bar right from the locked position (1) to the unlocked (2) position.

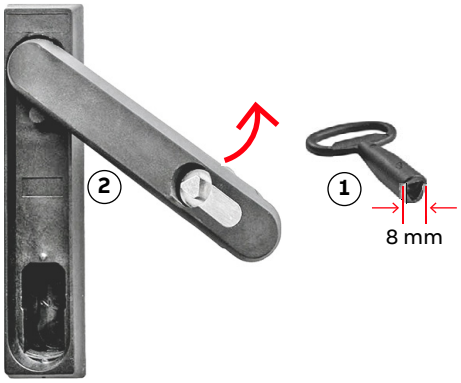


4. To release the door handle, insert and turn the key (1) to the right.

   The door handle (2) pops out.

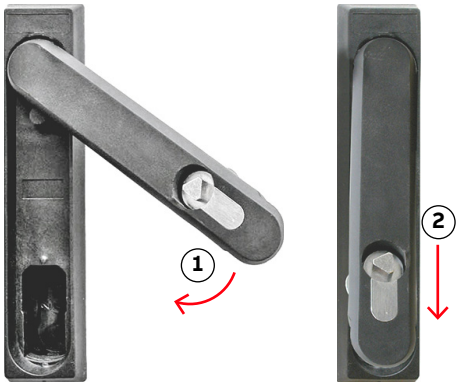
5. To open the door, turn the door handle (2) to the right if the door is hinged on the right or to the left if the door is hinged on the left.

   NOTE – If you cannot open the door, continue with Section 9.4.7, “Emergency release of a door safety switch”, page 190.

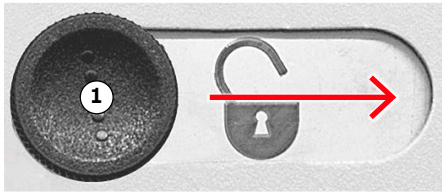


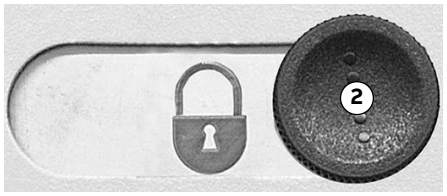
9.4.5. Closing and locking the doors

1. Close the doors.
2. Bring the door handle in line with the door plate (1) and press the handle down (2) until it clicks in.



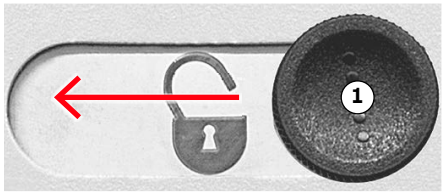
3. (Doors hinged on the left) Slide the locking bar right from the unlocked position (1) to the locked position (2).

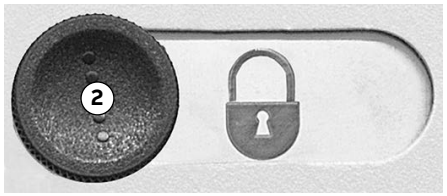




4. (Doors hinged on the right) Slide the locking bar left from the unlocked position (1) to the locked position (2).

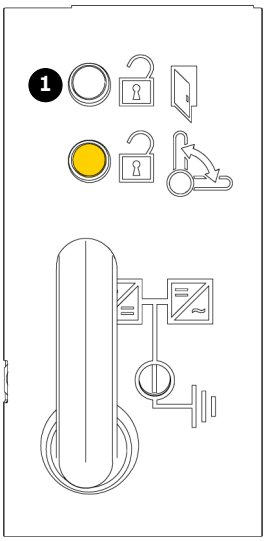
   IMPORTANT! A limit switch monitors the locked position. If a door is not locked properly, you cannot start the drive.





9.4.6. Testing the white lamp

If the white lamp does not turn on, proceed as follows:



1. To test the white lamp, press the lamp cap (1).
   - **Off**: Lamp is burnt out or lamp test is faulty
   - **On**: Malfunction in the door release circuit

   NOTE – The lamp-test circuit is independent from the door release circuit, ie, if the lamp remains off, you cannot conclude that the door release circuit is defective.
2. Check if the LED of digital input 16 (input module A1511 in COU1) is lit.
   - If the LED is lit, the drive control system receives the feedback signal “grounding switch is closed”, but the control system has not released the doors.
   - If the LED is not lit, the feedback signal is missing.
3. To open the door, continue with Section 9.4.7, “Emergency release of a door safety switch”, page 190.

For information on the wiring of the control circuit, see:

- Converter hardware diagram
- Wiring diagram of COU1

For information on the wiring of the discharging circuit and / or the grounding circuit, see:

- Wiring diagram of COU1
- Wiring diagram of CBU

9.4.7. Emergency release of a door safety switch

DANGER

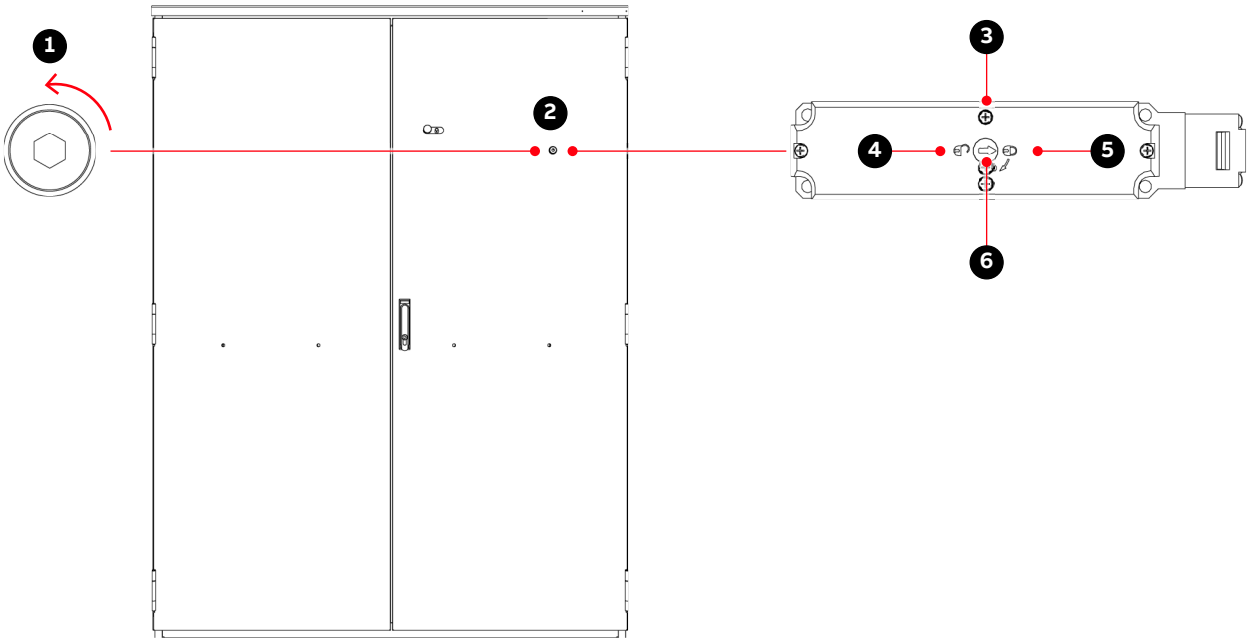
Hazardous voltages! Touching energized components can be FATAL.

→ Before you unlock a safety switch, verify that the drive is de-energized.

→ DO NOT unlock the safety switches permanently.

9.4.7.1. Location of safety switches

The doors of medium voltage units (LSU, ARU, IFU, IRU, CBU, INU, BCU, RBU, VLU, TEU and ISU) are equipped with safety switches.

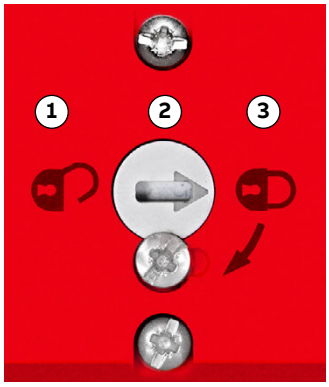


Key:

(1) Screw cap on door
(2) Safety switch location (behind door)
(3) Safety switch
(4) Unlocked position
(5) Locked position
(6) Release dial

Fig. 114. Safety switch on an ARU/INU cabinet door

9.4.7.2. Safety-switch settings

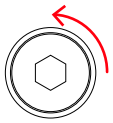


Key:		Description
(1)	Unlocked	Enables opening the door of a medium voltage unit whether the auxiliary voltage is switched on or off.
(2)	Release dial	Direction of arrow indicates safety switch status, ie, locked or unlocked
(3)	Locked	Normal operating setting. To open the door of a medium voltage unit, the DC-link must be discharged and the auxiliary voltage must be switched on.

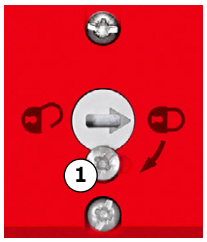
Fig. 115. Safety switch settings

9.4.7.3. Unlocking a safety switch

1. To access the release dial, remove the screw cap.

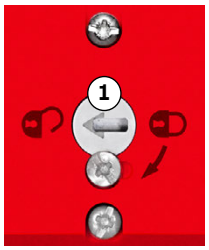


2. Loosen the locking screw (1) until the release dial can be turned.



3. Turn the release dial from the locked to the unlocked position.

   You can now actuate the locking bar and open the doors.



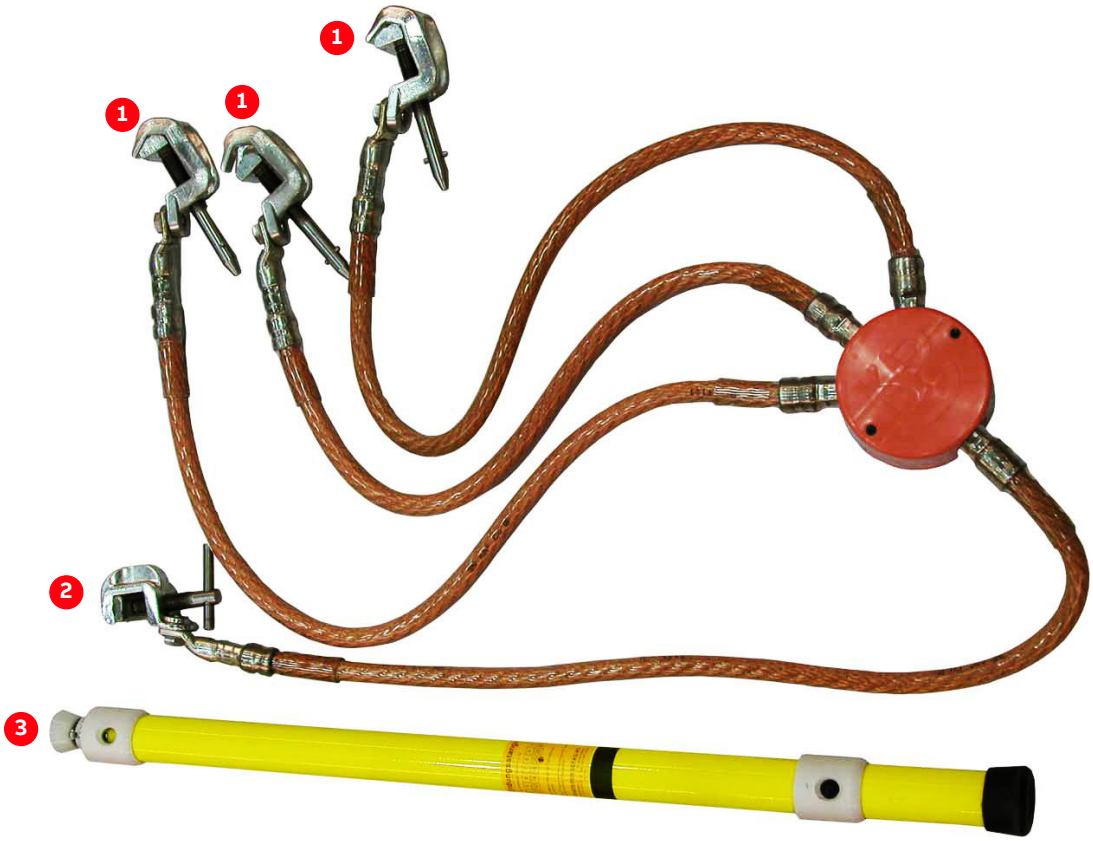
4. When the door is open, turn the release dial to the locked position.
5. Tighten the locking screw.
6. Seal the locking screw.
7. Refit the screw cap.
8. To ground the drive, continue with Section 9.4.8, “Connecting a grounding set”, page 193.

9.4.8. Connecting a grounding set

DANGER

Hazardous voltages! FATAL voltages can still be fed into an ungrounded drive from the main power supply or motor during maintenance work.

→ Connect grounding equipment at the designated locations before you work on the drive.



Key:

(1) Busbar ground clamps
(2) Enclosure ground clamp
(3) Telescopic insulating pole

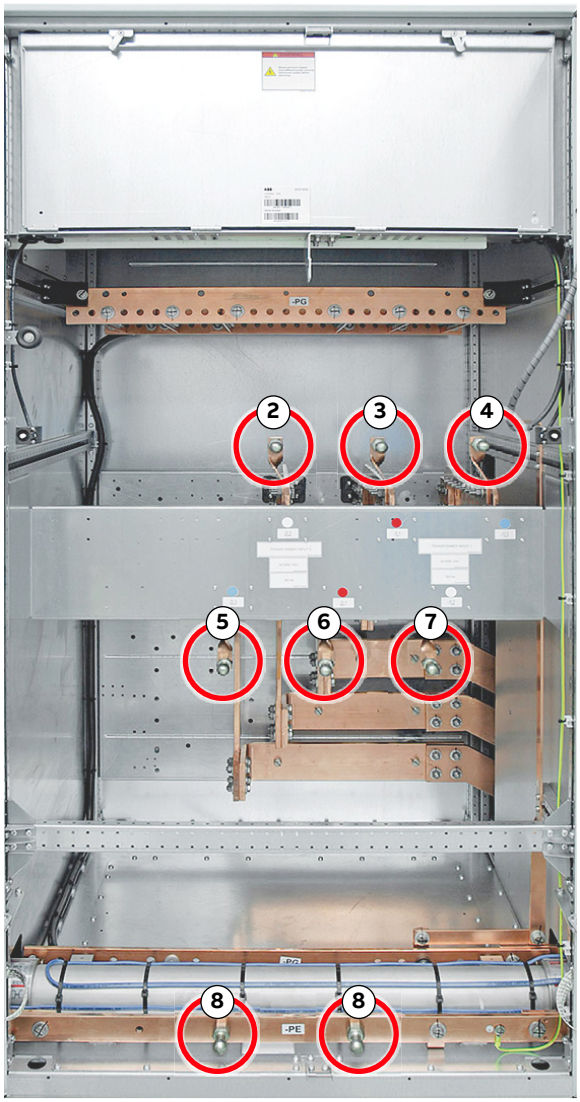
Fig. 116. Four-way grounding set

Depending on the type of line-side rectifier, continue with:

– Section 9.4.8.1, “Drives with an LSU”, page 194
– Section 9.4.8.2, “Drives with an ARU”, page 195

9.4.8.1. Drives with an LSU

1. Connect the enclosure ground clamp to the ground ball stud of the PE ground busbar inside TEU (Fig. 117).
2. Use the telescopic insulating pole to connect and tighten the busbar ground clamps to the ground ball studs (1) of the following busbars:
   - Inside TEU: 1L1, 1L2, 1L3, 2L1, 2L2 and 2L3 in Fig. 117
   - Inside INU: L1, L2 and L3 in Fig. 118

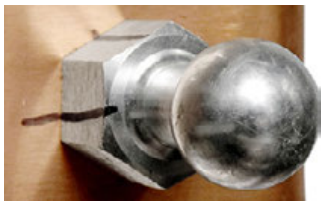


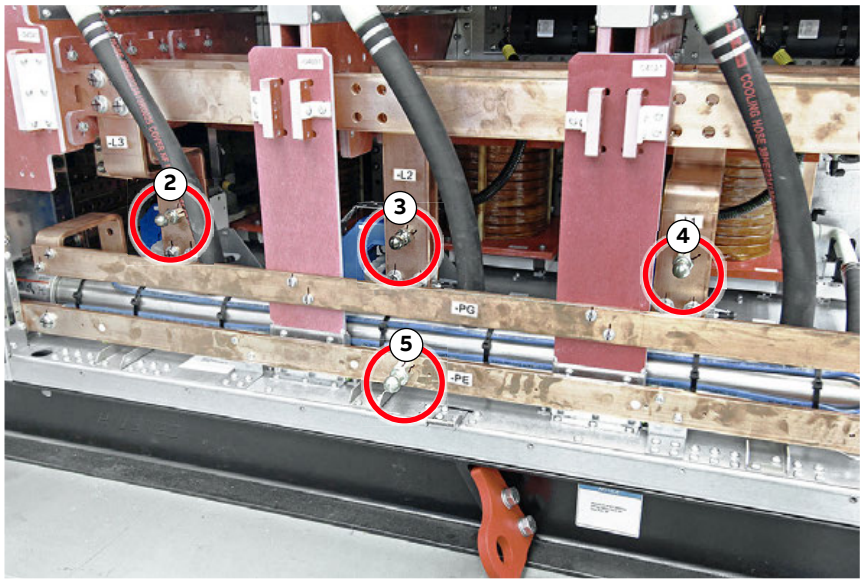
Key:

(1) Ground ball stud example
(2) 2L2
(3) 1L1
(4) 1L3
(5) 2L3
(6) 2L1
(7) 1L2
(8) PE

Fig. 117. TEU ground ball stud locations

9.4.8.2. Drives with an ARU





Key:

(1) Ground ball stud
(2) L3
(3) L2
(4) L1
(5) PE

Fig. 118. ARU/INU ground ball stud locations

Referring to Fig. 118:

1. Connect the enclosure ground clamp to the ground ball stud of the PE ground busbar inside ARU and INU (1).
2. Use the telescopic insulating pole to connect and tighten busbar ground clamps to the ground ball studs of the following busbars inside an ARU and INU:
   - L1, L2 and L3

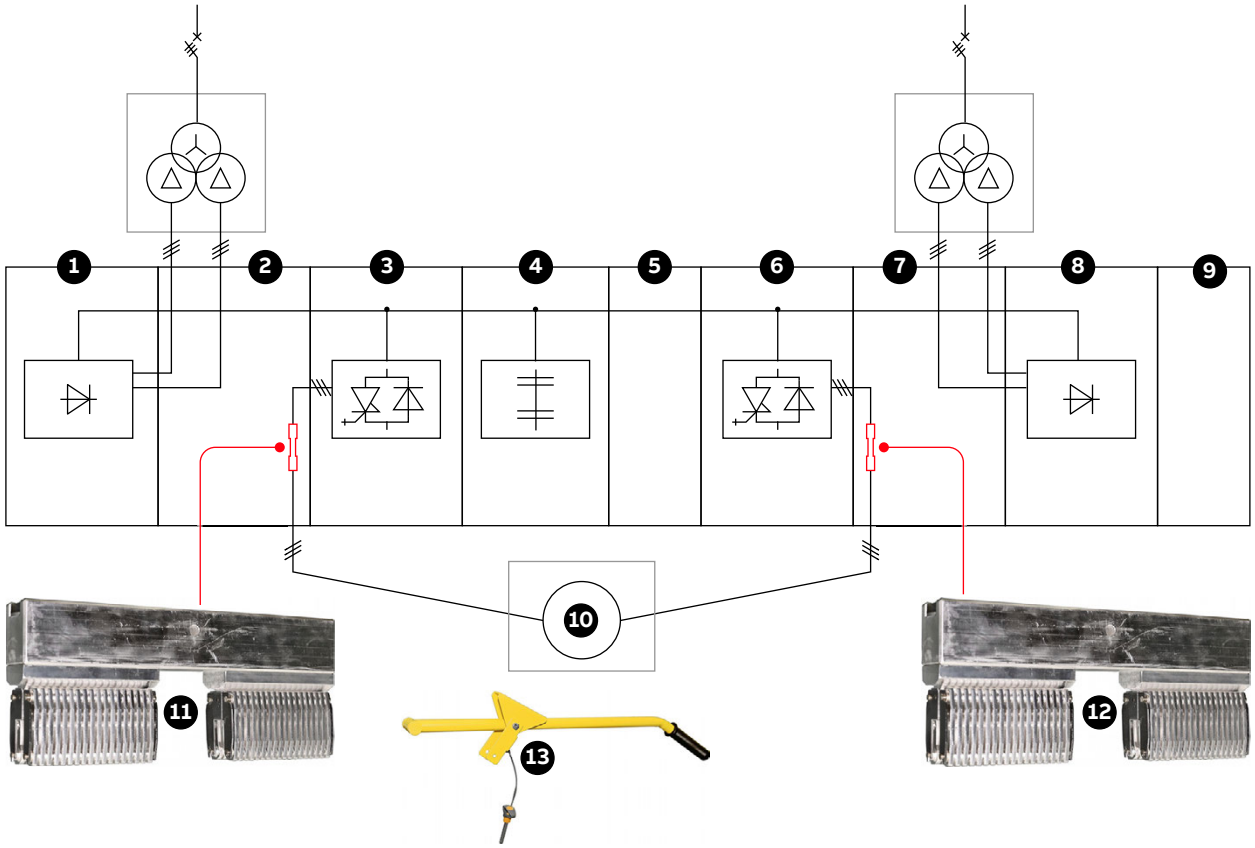
9.4.9. Drives with the manual output isolation (optional)

The manual output isolation disconnects the output of the drive (INU1 or INU2) from the motor and creates a visible isolating distance in the supply line to the motor.

The option includes the following items:

– Busbar connectors in TEU1 and COU1
  - Busbar connectors for INU1 are located in TEU1.
  - Busbar connectors for INU2 are located in the terminal compartment inside COU1.

– Lever for removing and fitting the busbar connectors



Key:

(1) LSU1
(2) TEU1
(3) INU1
(4) CBU1
(5) BCU1
(6) INU2
(7) COU1
(8) LSU2
(9) WCU1
(10) Motor
(11) Busbar connectors (3 ×) in TEU
(12) Busbar connectors (3 ×) in COU1
(13) Lever for removing and fitting the busbar connections

Fig. 119. Manual output isolation overview

9.4.9.1. Removing the busbar connectors

⚠ WARNING

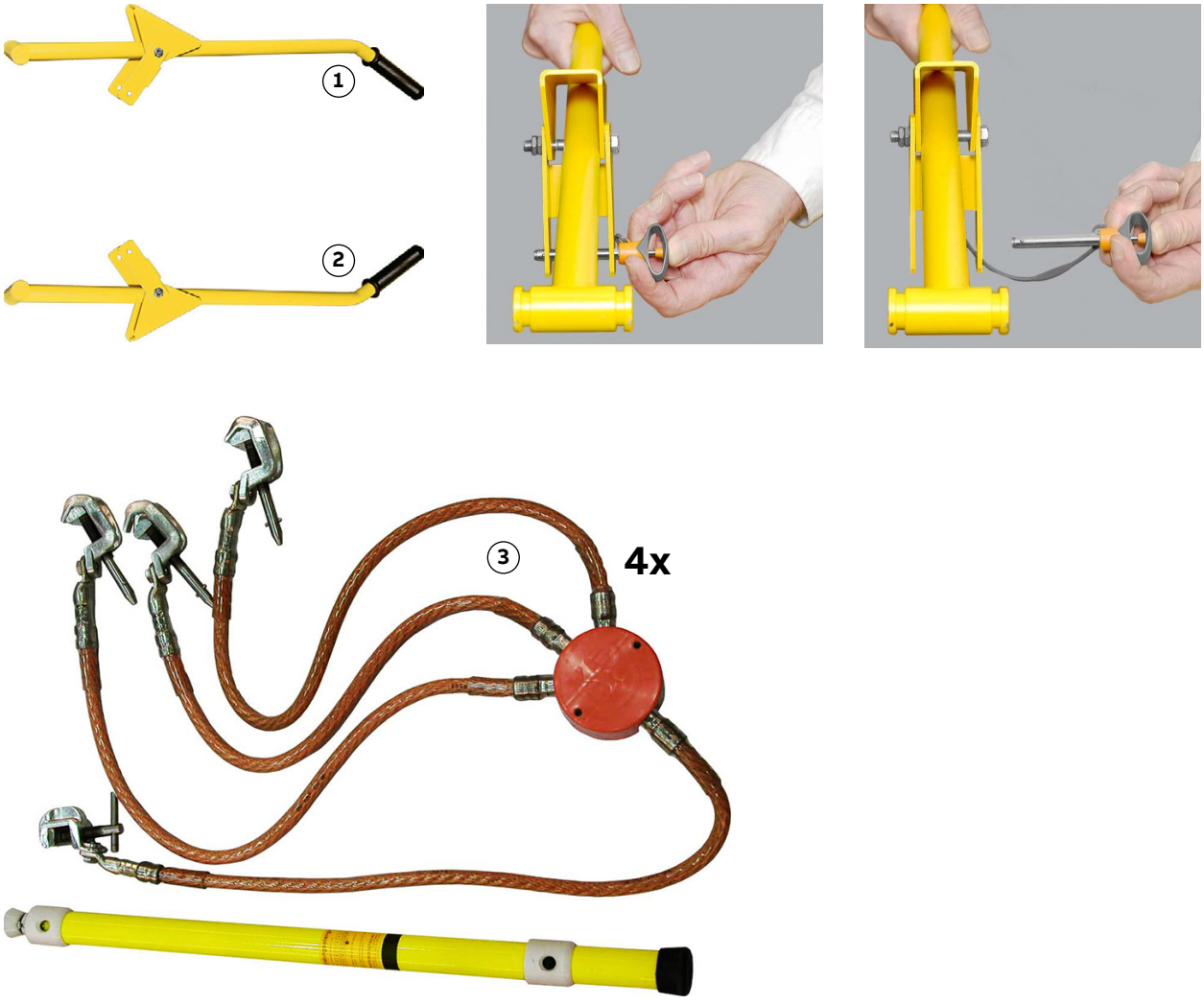
Hazardous voltages!

→ Verify that the drive system is de-energized

→ Connect grounding sets at the locations indicated in Fig. 122.

→ Be aware of arcing between ground clamp and busbar ground studs when connecting a grounding set to the busbars for the motor cables. Arcing can be caused by voltages being fed into the drive when the motor is driven by the propeller of the ship.

→ Follow local safety procedures



Key:

(1) Orientation of lever for removing busbar connectors

(2) Orientation of lever for fitting the busbar connectors

(3) Four-way grounding set

Fig. 120. Tools for removing the busbar connectors

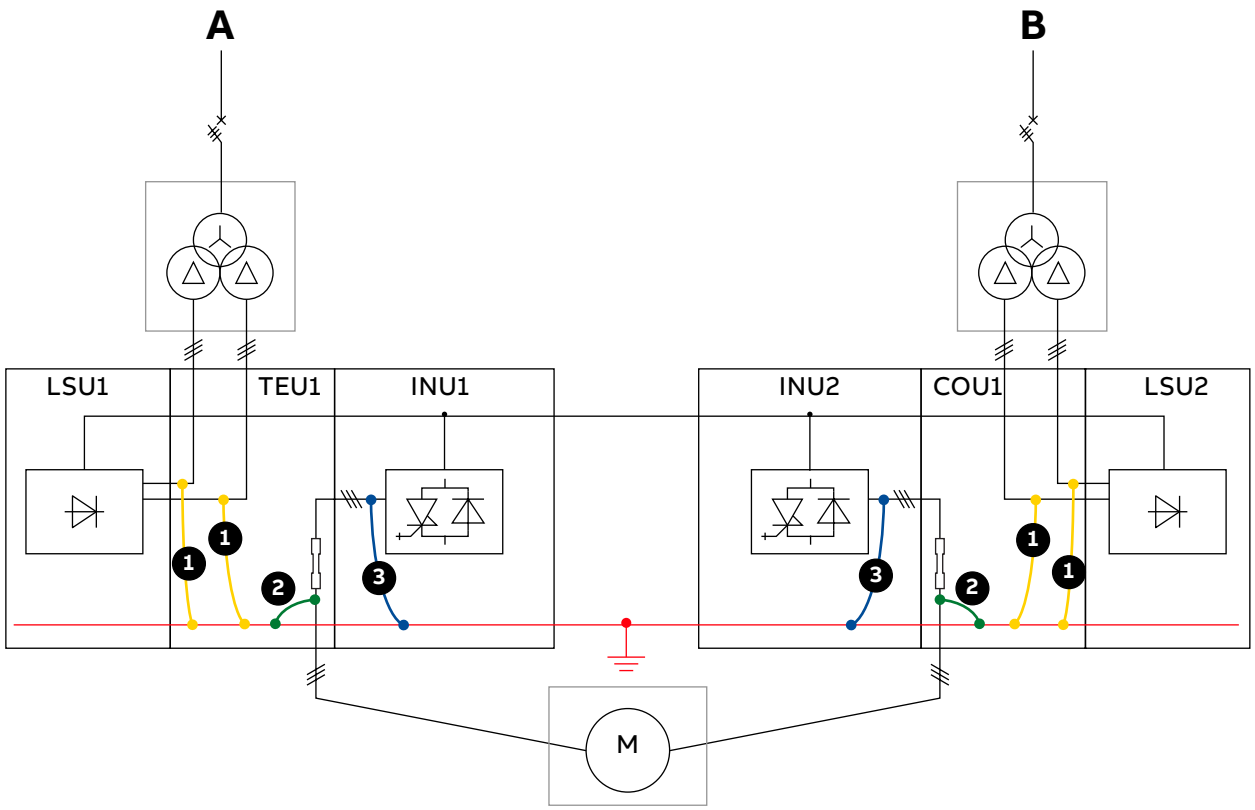


Fig. 121. Overview of grounding the drive – (A) INU1 is shut down, and (B) INU2 is shut down. Numbers indicate the connection sequence.

1. Shut down the drive according to the established procedures.

   IMPORTANT! DO NOT switch off the auxiliary voltage.

   For general information on de-energizing the drive, see “De-energizing the drive locally” on page 143.

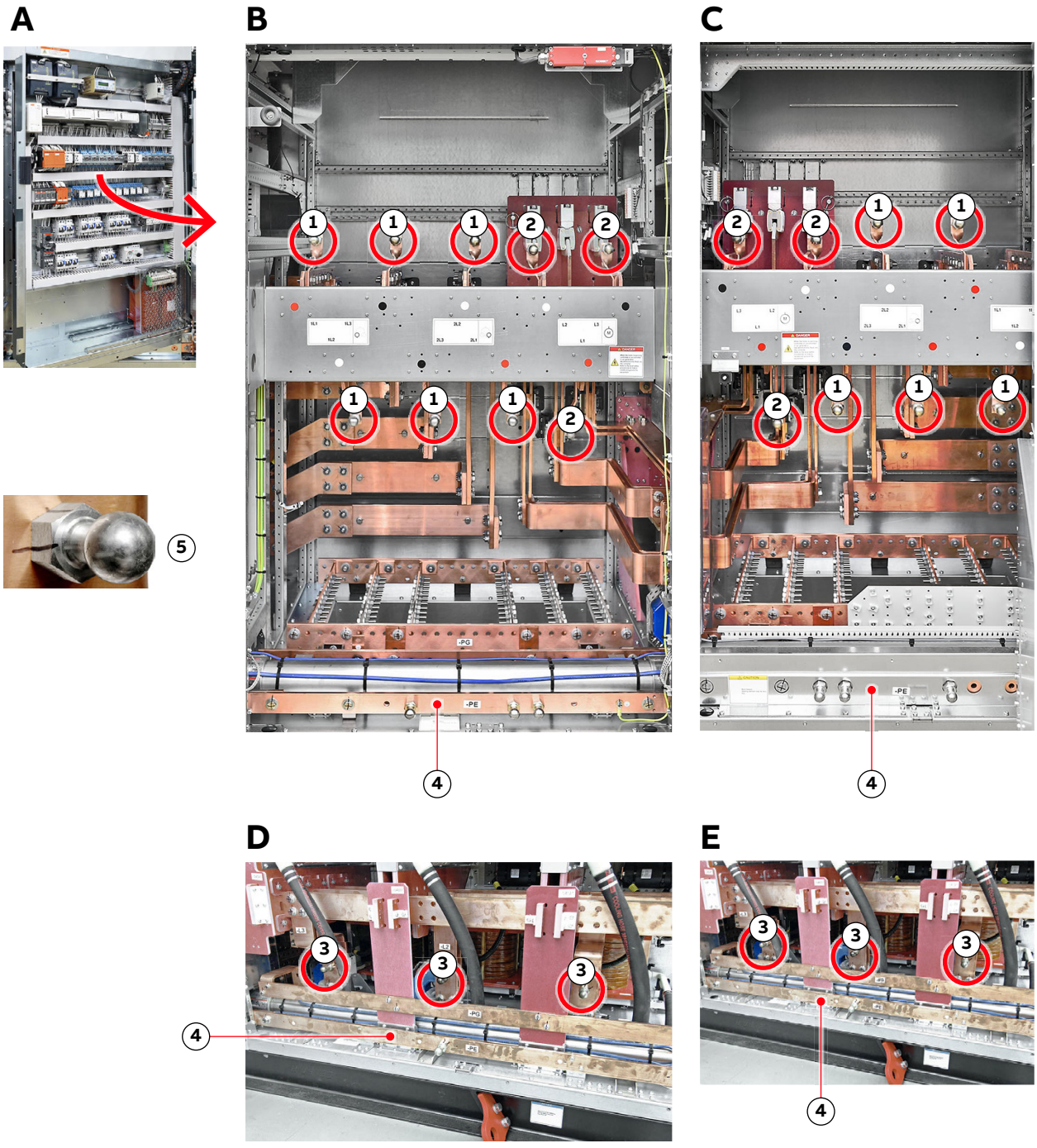
2. Use the telescopic insulating pole (Fig. 120) to connect and tighten the enclosure ground clamp to the ground ball stud of the PE ground busbar.

3. Connect the busbar ground clamps to the ground ball studs of the phase busbars in the following sequence:

   1 Busbars for the cables to the secondary transformer windings (1, Fig. 122)

   2 Busbars for the motor cables (2, Fig. 122)

   3 Busbars in the INU (3, Fig. 122)



Key:

(1) Busbars for secondary transformer windings
(2) Busbars for motor cables
(3) INU busbars
(4) PE
(5) Ground ball stud

Fig. 122. Connect the grounding sets in (A and C) COU1, (B) TEU1, (D) INU1, and (E) INU2

4. Inside TEU1 or COU1 remove the busbar connectors in the sequence shown in Fig. 123.
   CAUTION! A busbar connector weighs approximately **10 kg**.

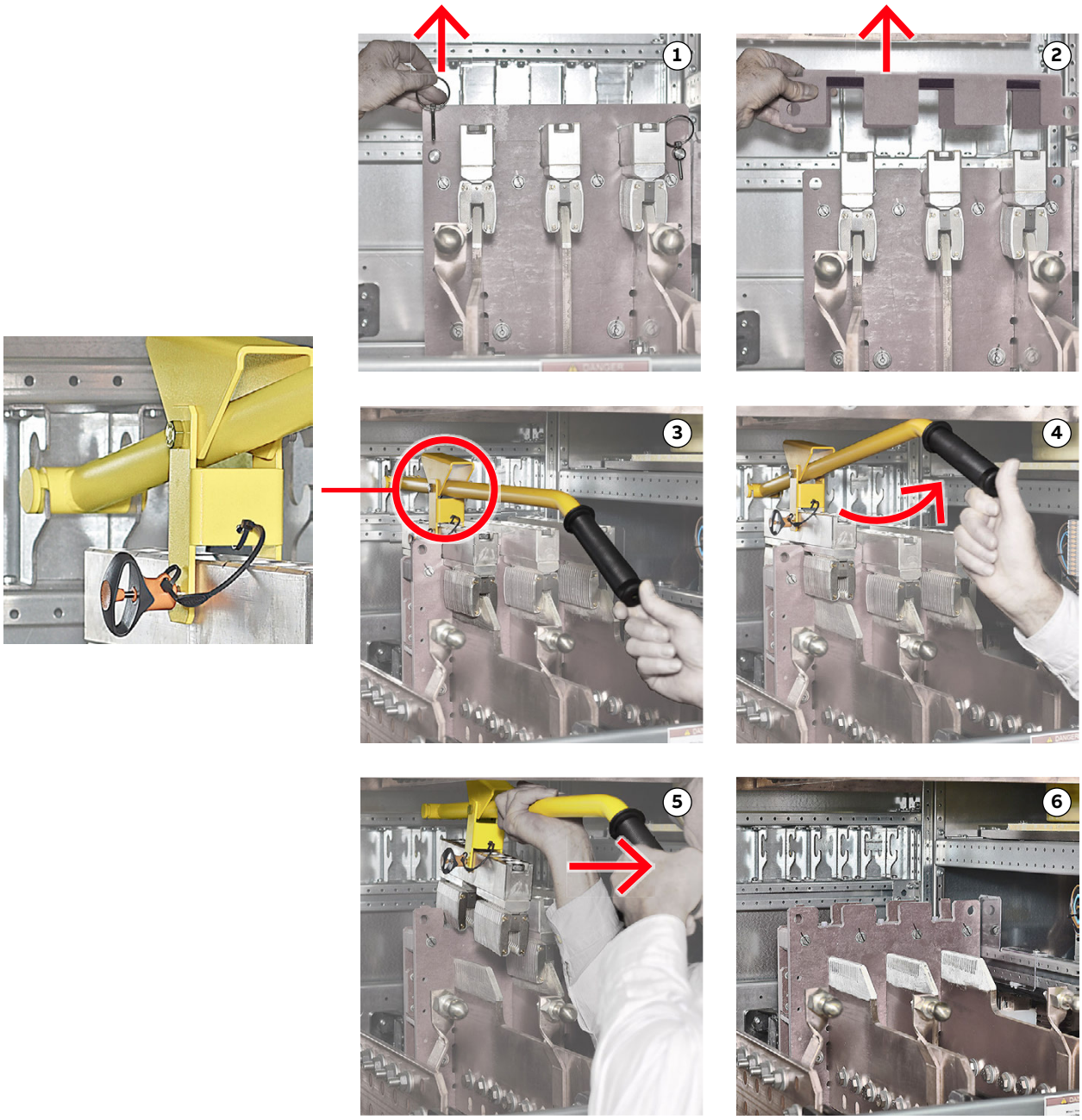


Fig. 123. Busbar connector removal sequence in TEU1 or COU1

5. Remove the grounding sets.
6. Check that the LEDs are lit.
7. Check that tools and foreign objects are not left inside the cabinets.
8. Close and lock the doors.
9. Check that the power operating mode (POM) of the drive corresponds to the busbar connectors fitted.
10. Start the drive according to the established procedures.

9.4.9.2. Fitting the busbar connectors

1. Shut down the drive according to the established procedures.
2. Fit the busbar connectors in the sequence shown in Fig. 124.

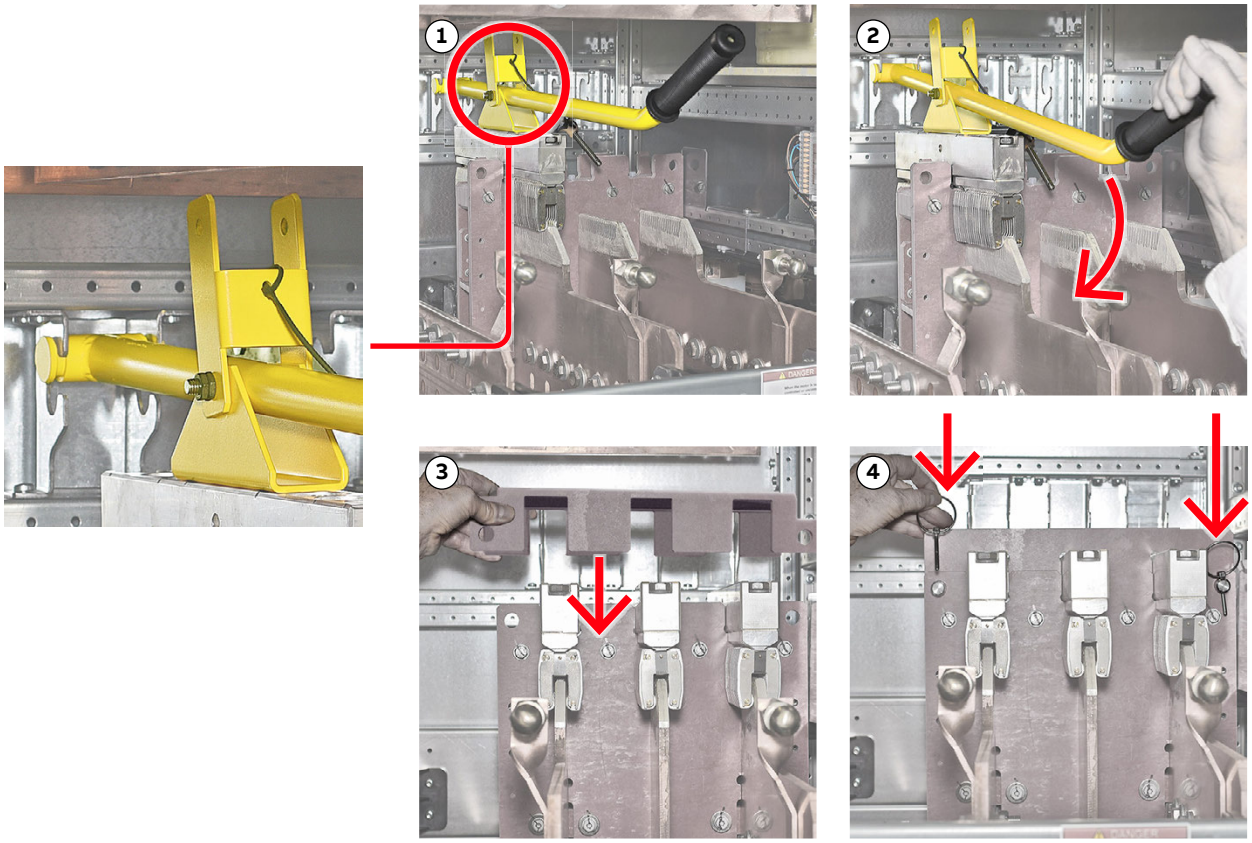


Fig. 124. Fitting sequence for busbar connectors

3. Remove the grounding sets.
4. Check that the LEDs are lit.
5. Check that tools and foreign objects are not left inside the cabinets.
6. Close and lock the doors.
7. Check that the power operation mode (POM) of the drive corresponds to the busbar connectors fitted.
8. Start the drive according to the established procedures.

9.4.10. Removing and installing a phase module

Several maintenance actions require the removal of phase module from an ARU/INU, eg, to access the back of the cabinet or to work on the phase module.

9.4.10.1. Removing a phase module

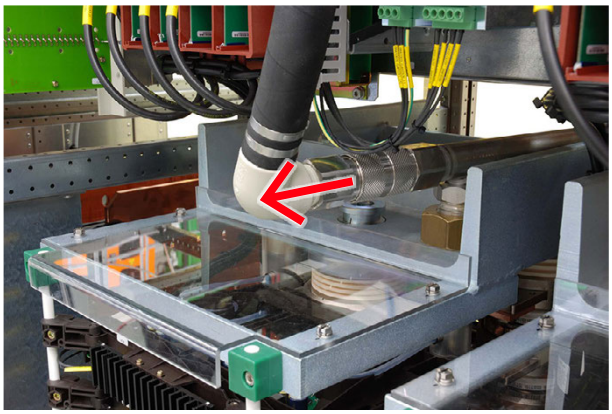
⚠CAUTION

Heavy object! A phase module weighs approximately **190 kg**.

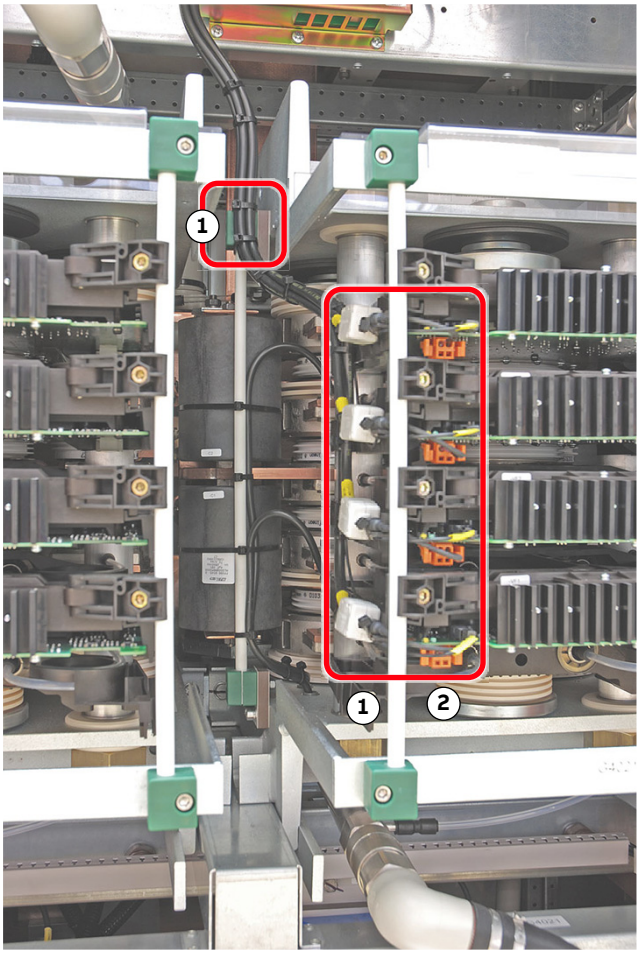
→ Always use the lifting table for the phase module

1. Disconnect the water hoses.

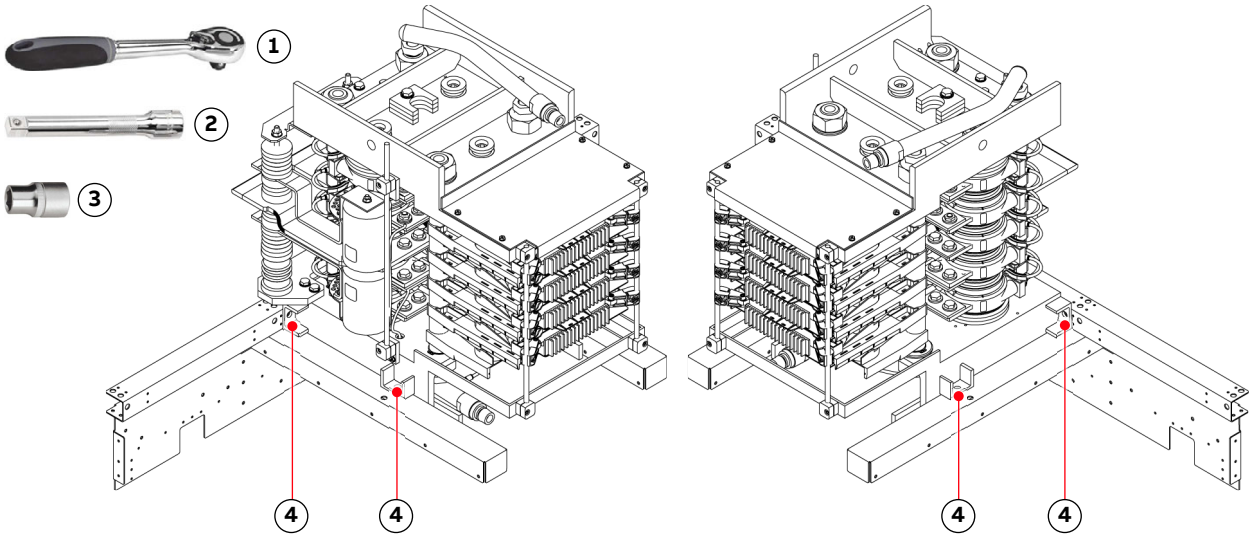
   NOTE – To disconnect the water hose, pull the locking sleeve of the coupling towards the front of the cabinet (arrow).



2. Cut off the cable ties (1) and disconnect the optical fibers and the power supply leads (2).



3. Remove the bolts (4, Fig. 125) on each side of the phase module.



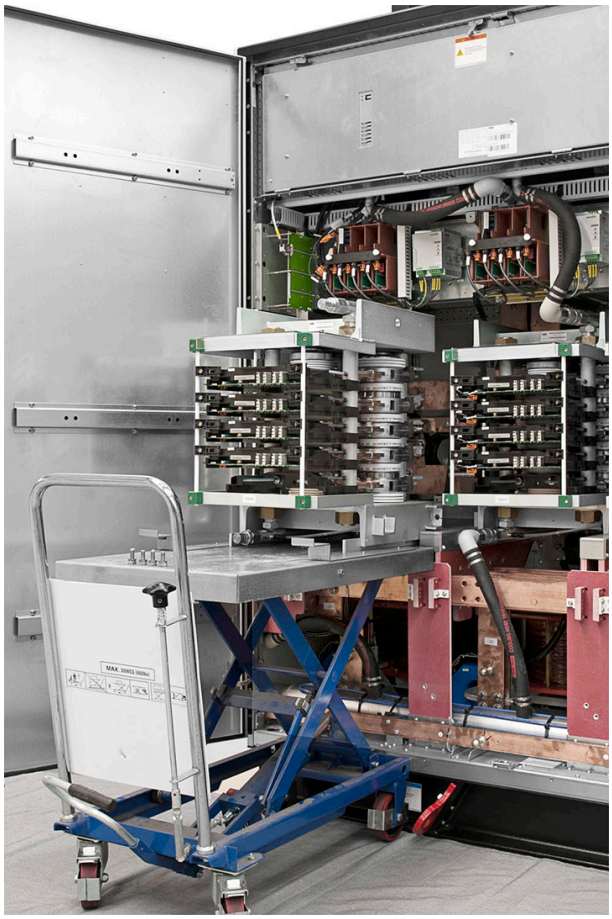
Key:

(1) 1/2”
(2) 80 mm
(3) 17 mm
(4) Location of bolts to remove

Fig. 125. Phase module removal

4. Place the lifting table in front of the phase module.
5. Adjust the height of the table so that it is level with the rails on the underside of the phase module.
6. Verify that the phase module is free of obstructions, eg, water hoses, optical fibers, and power supply leads.
7. Pull the phase module onto the table.

   CAUTION! A phase module weighs approximately **190 kg**!



9.4.10.2. Installing a phase module

NOTICE

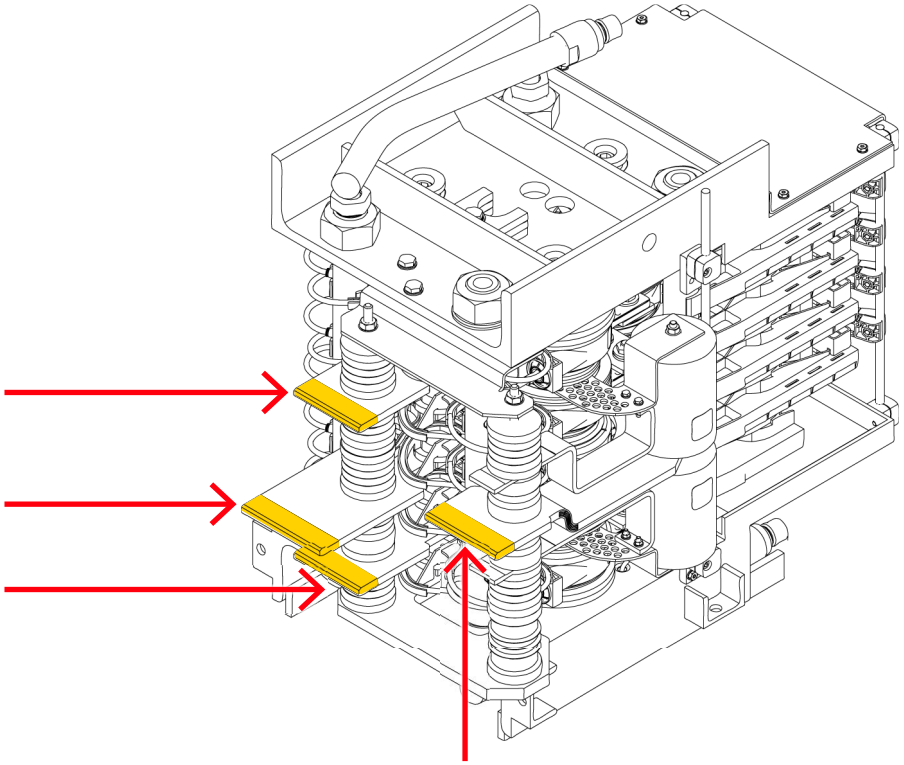
Risk of component damage. Incorrect wiring can damage the phase module when the drive is energized.

→ Verify the correct connection with the corresponding wiring diagram

→ DO NOT mix up the cables

1. Check that the busbars (arrows) of the phase module are lubricated.

   NOTE – If necessary, apply a thin layer (arrows) of the supplied electrical contact grease.



2. Make sure that the disconnected water hoses, fiber optics and power supply leads are not in the way.
3. Place the lifting table in front of the cabinet and adjust it to the required height.
4. Push the phase module slowly towards the back of the cabinet until the busbars engage with the connectors at the back of the cabinet.
5. Screw in and tighten the bolts.
6. Pull the locking sleeve of the female half of the water hose coupling back as far as possible.
7. While holding it in this position, push it over the fixed male half of the coupling until it stops.
8. Let go of the locking sleeve and firmly push the female part against the male part until the coupling locks home with a click.

9. Reconnect the optical fibers and power supply leads according to the relevant wiring diagram.

   IMPORTANT! The identification on the label must correspond to its counterpart on the phase module.

10. Fasten the cables with cable ties.

9.4.11. Visual checks on the drive

Check the drive and its immediate vicinity visually at the intervals stated in “ACS6080 preventive maintenance schedule” , 3BHS838899 E01 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
- The outer cable sheath must not be damaged.
- 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 more information, see the applicable cable specifications.

9.4.12. Cleaning

NOTICE

Risk of component damage! Dust and moisture on electrical components and wiring can cause failure and damage the components as well as the loss of low-level signals on 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.

9.4.12.1. Cleaning the drive cabinet

When cleaning the drive cabinet:

- To keep dirt out, cover the equipment or assemblies.
- Take electrostatic-sensitive precautions and use suitable tools to prevent electrostatic discharge.
- To prevent damage, use antistatic brushes and a vacuum cleaner with a soft nozzle to carefully clean circuit boards with special care.
- Remove dust from 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.
- 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.

9.4.13. Checking wire and cable connections

NOTICE

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

→ Tighten to the torque value on the label attached to the capacitor; DO NOT exceed 20 Nm if the tightening torque value is not specified.

→ Check all power and control cable connections and tighten them if necessary.

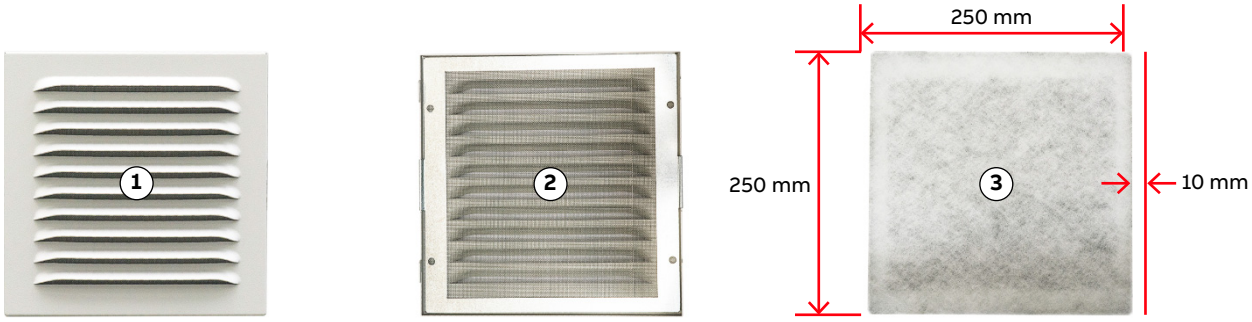
→ Check that all plugs and connectors are tight.

9.4.14. Checking and replacing filter mats

Inspection intervals	See the “ACS6080 preventive maintenance schedule” , 3BHS838899 E01.
Service during operation	Possible
Filter mat class	G3 (EN779)
Location	Installed behind the ventilation grids of control and water cooling units if the drive is prepared for protection class IP 54. The filter mats are located between the ventilation grid and the wire mesh. The wire mesh is always installed.

TABLE 14 Filter mat specifications

Location	Filter class	Width (mm)	Height (mm)	Depth (mm)	ABB material number
WCU - back wall	G3 T15/150	250	125	10	3BHB028115R0002
COU and roof boxes	G3 T15/150	250	250	10	3BHB028115R0003
EXU	G3 T15/150	745	375	10	3BHB028115R0004



Key:

(1) Ventilation grid

(2) Wire mesh

(3) Filter mat (only for protection class IP 54)

Fig. 126. COU filter

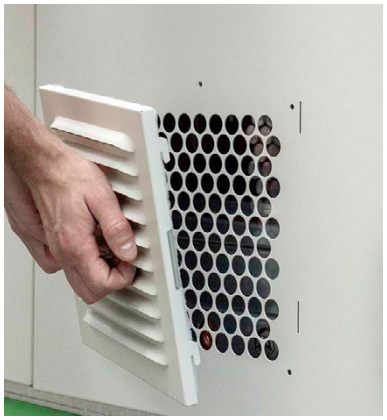
9.4.14.1. Replacing a filter mat

1. Switch off the protection switch of the cooling fans.

   CAUTION! The cooling fans behind the ventilation grids start automatically when the temperature rises above a preset level.

2. Remove the bolt at the top of the fan cover.

3. Slide the cover up and pull it out of the slots.



4. Turn the cover over and remove the filter mat.
5. Insert the new filter mat and reinstall the ventilation grid.

9.4.15. Testing and replacing auxiliary fan units

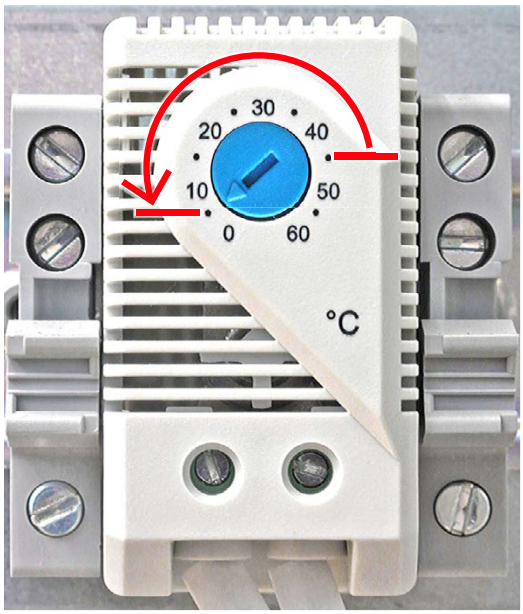
Inspection intervals	See the “ACS6080 preventive maintenance schedule” , 3BHS838899 E01.
Service during operation	Possible
Location	Installed behind the doors of the following cabinets: – COU cabinet (2 fan units) – WCU cabinet (2 fan units in WCU and 2 fan units in the optional REB) – Water-cooled EXU cabinet

9.4.15.1. Testing auxiliary fan units

To switch the fan units on and off for the test, use the thermostats of the fan units.

Thermostat location	Identification	Factory-set value
COU	B2981	45° C
WCU	B5741	45° C

1. Switch on the auxiliary voltage for the fan unit to be tested.
2. Take note the setting of the thermostat.
   The factory-set value is also stated on the **Settings** label. The label is attached to the inside of the cabinet door.
3. To switch on a fan unit, turn the dial of the thermostat from the factory-set value to a low value.



4. Check that the fans run smoothly and if a fan is faulty, replace the complete fan unit.
5. Set the thermostat to the factory-set value.

9.4.15.2. Replacing auxiliary fan units

1. Switch off the miniature circuit breaker of the fan unit that you want to replace.
   To identify the miniature circuit breaker, see “Appendix D - Wiring diagrams”.
2. (Only for fan units of the optional REB) Unscrew the ventilation grid (circles) and flip the grid downward (arrow).
   IMPORTANT! The ventilation grid is hinged; you DO NOT need to remove it.

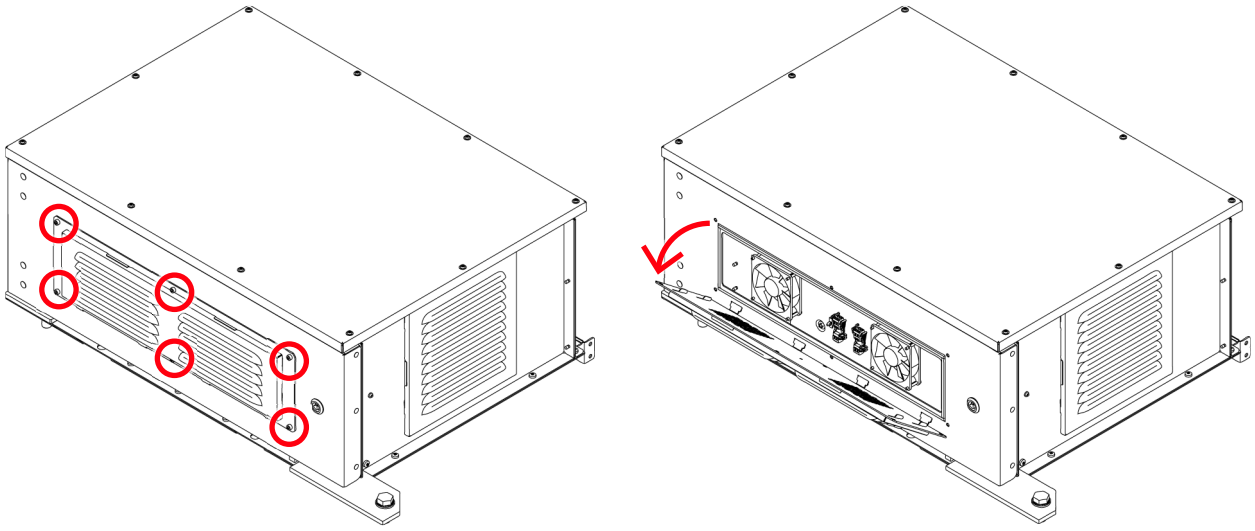
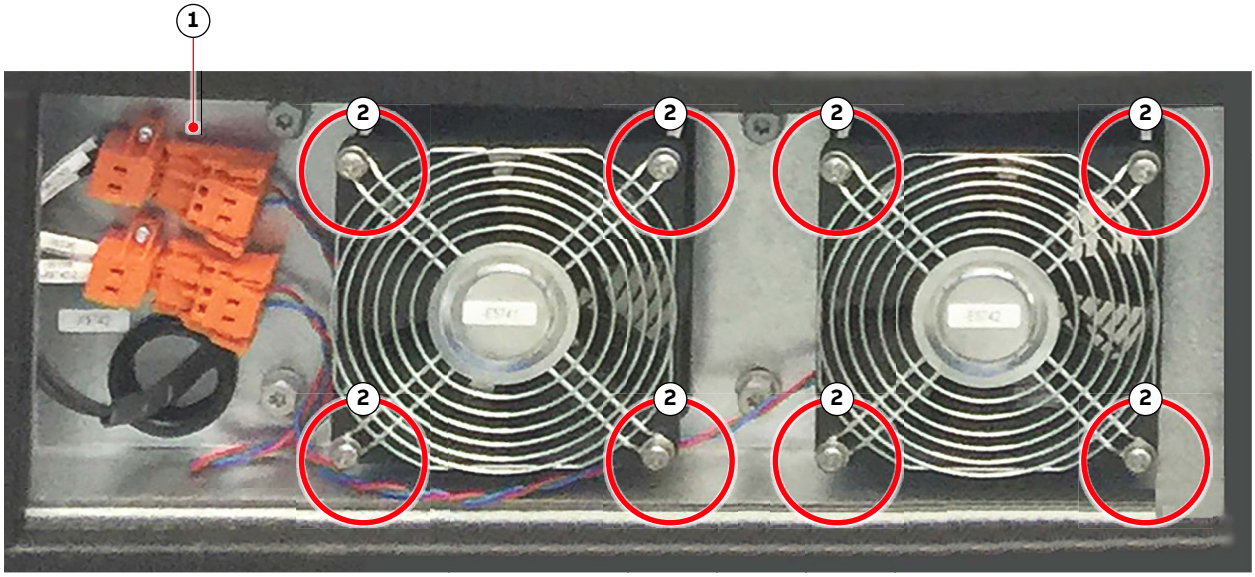


Fig. 127. Accessing the fan units in the WCU roof box

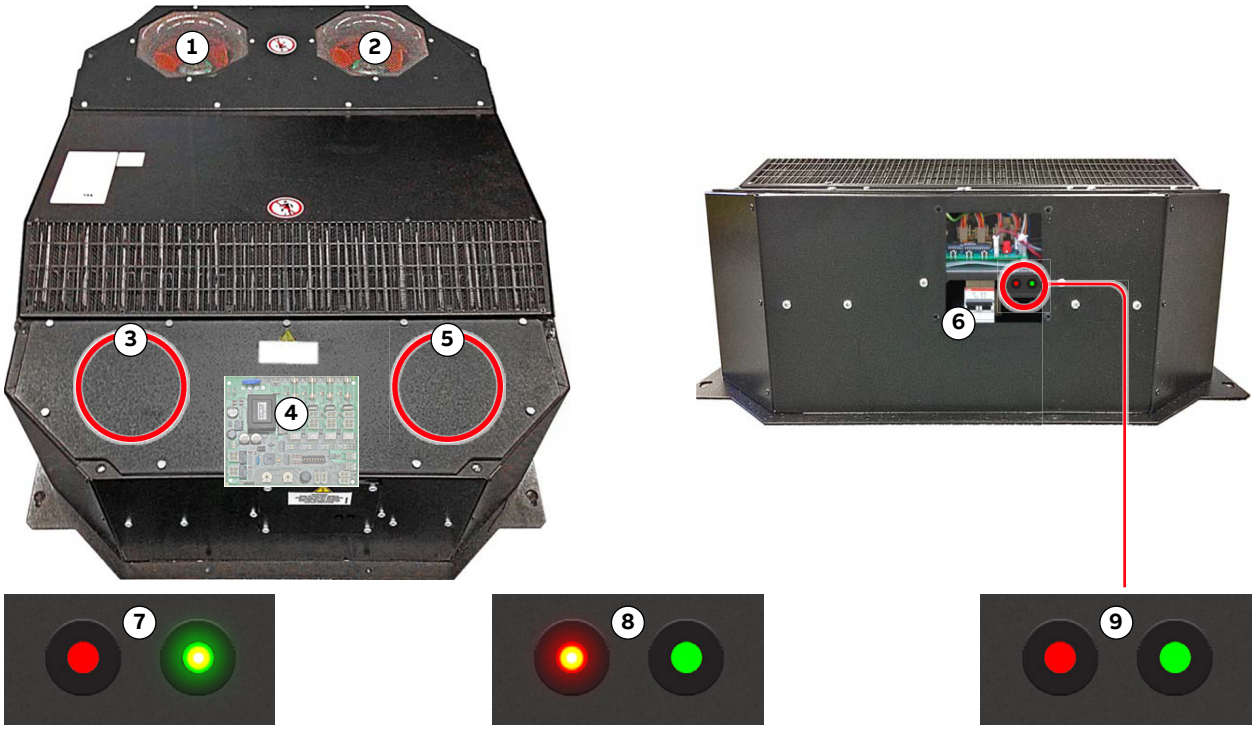
3. Disconnect the wires (1) and unscrew (2) the fan units.



4. Remove the fan unit.
5. Reinstall the new one in reverse order of removal.

9.4.16. Testing and replacing air-to-air heat exchangers

Inspection intervals	See the “ACS6080 preventive maintenance schedule” , 3BHS838899 E01.
Service during operation	Not possible



Key:		Explanation
(1)	Ambient fan 2	
(2)	Ambient fan 1	
(3)	Internal fan 1	
(4)	Circuit board location	
(5)	Internal fan 2	
(6)	Miniature circuit breaker	
(7)	Red LED off and green LED on	Heat exchanger is healthy
(8)	Red LED on and green LED off	Alarm condition
(9)	Red LED off and green LED off	Auxiliary voltage missing

Fig. 128. Air-to-air heat exchanger overview (type LT-5-5165-UL)

TABLE 15 Air-to-air heat exchanger specifications

Weight	~65 kg
Length	1025 mm
Width	750 mm
Height	316 mm

A thermostat inside the cabinet where air-to-air heat exchanger is installed controls the internal fans (3 and 5, Fig. 128). The fans are switched on when the cabinet temperature exceeds the value set on the thermostat.

The ambient fans (1 and 2, Fig. 128), are switched on by the air-to-air heat exchanger depending on the permanently measured cabinet temperature.

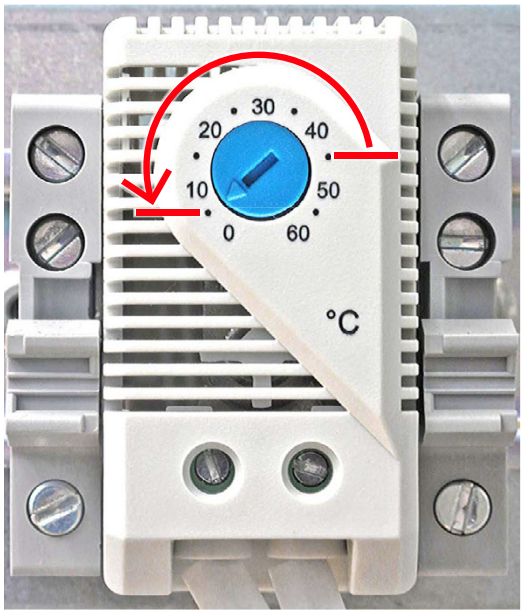
9.4.16.1. Testing the fan units

The thermostats are used to switch the fan units on and off for the test.

Thermostat location	Identification	Factory-set value
ARU	B7501	45 °C
INU	B7501	45 °C

1. Switch on the auxiliary voltage for the air-to-air heat exchanger.
2. Take note of the setting of the thermostat.

   NOTE – The factory-set value is also stated on the **Settings** label. The label is attached to the inside of the cabinet door.
3. To start a fan or a group of fans, adjust the setting of the thermostat to a low value (arrow).



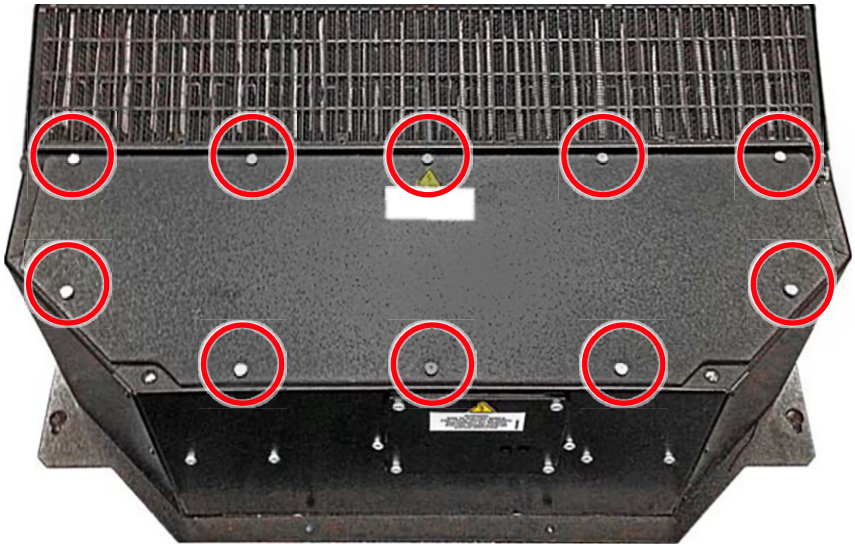
4. Check that the fans run smoothly and if a fan is defective, replace the complete fan unit.
5. Adjust the setting of the thermostat to its original value.

9.4.16.2. Replacing the complete heat exchanger

For information on replacing the complete heat exchanger, see Section 5.9, “Installing and removing air-to-air heat exchangers”, page 91.

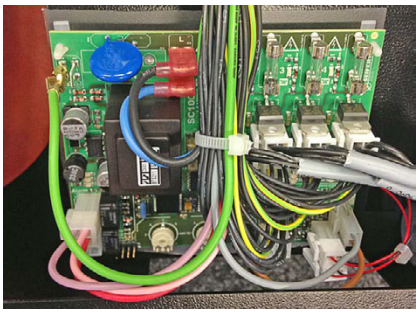
9.4.16.3. Replacing the circuit board

1. Unscrew the front and top cover.

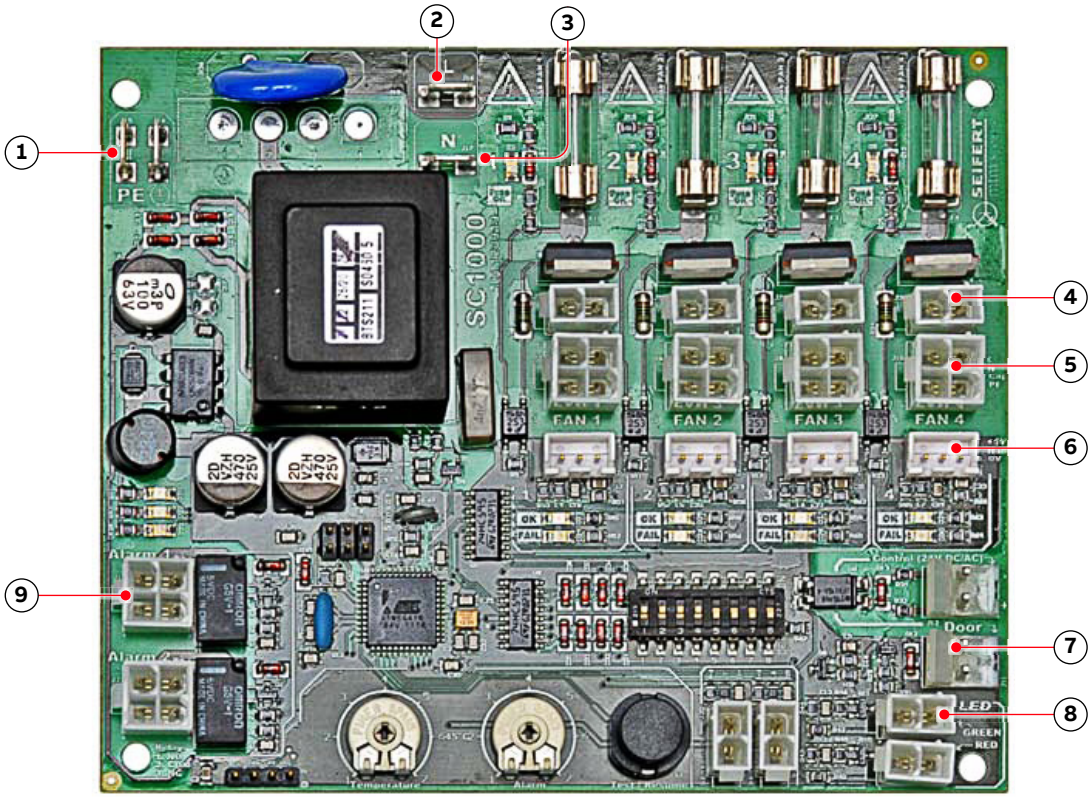


2. Disconnect the ground wire from the front cover (arrow).

3. Take note of the orientation of the circuit board and of where the plug-in connectors and wires are connected.
4. Unplug the plug-in connectors and wires from the circuit board.
5. Remove the circuit board.
6. Place the circuit board on the spacers and gently push the circuit board onto the spacers until they snap in properly.



7. Reconnect the wires to the circuit board according to Fig. 129.



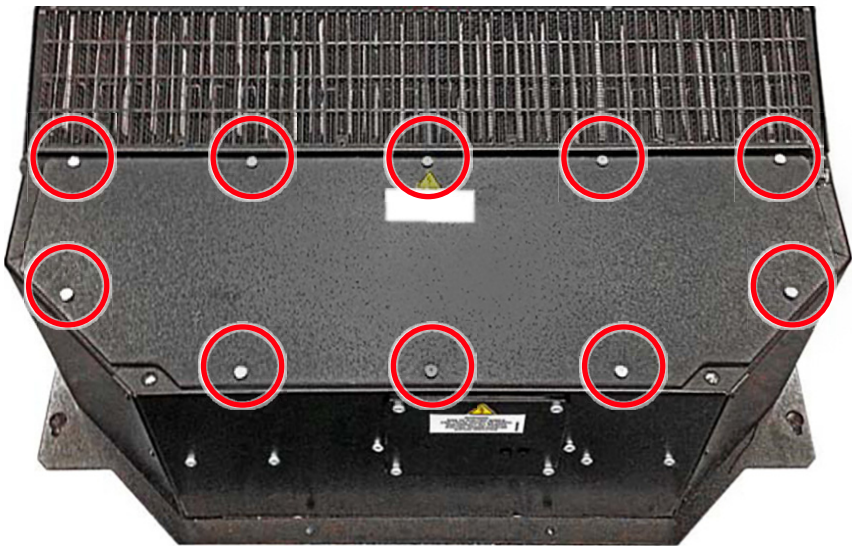
Key:		Pin	Pin	Pin	Pin
(1)	Ground wire	J15			
(2)	Supply phase	L			
(3)	Supply neutral	N			
(4)	4x external capacitors	1 × J3	2 × J5	3 × J7	4 × J9
(5)	4x fan power supply	1× J4	2 × J6	3 × J8	4 × J10
(6)	4x fan alarm signals	1 × J22	2 × J23	3 × J24	4 × J25
(7)	ON	J11			
(8)	LEDs	Red J18	Green J19		
(9)	Alarm 1	J1			

Fig. 129. Wire connection points on the circuit board

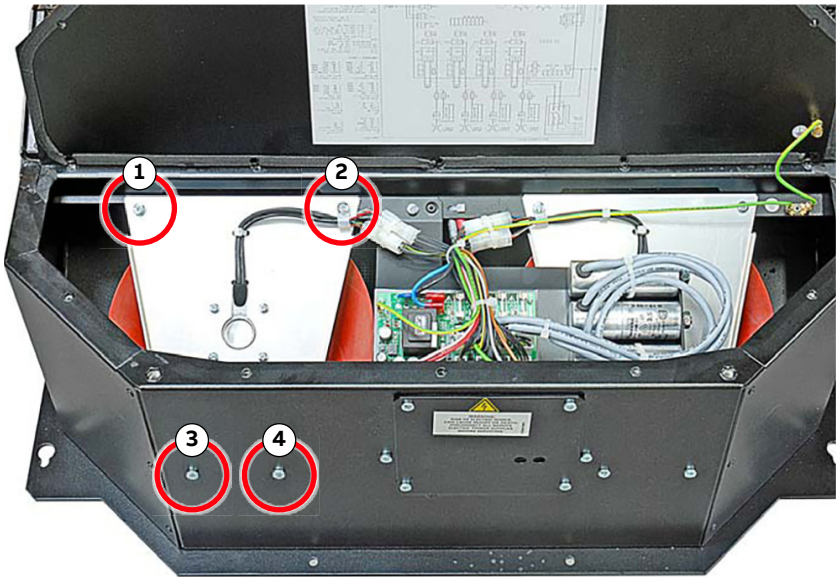
8. Reconnect the ground wire to the front cover.
9. Fasten the covers.

9.4.16.4. Replacing internal fan 1 - left side

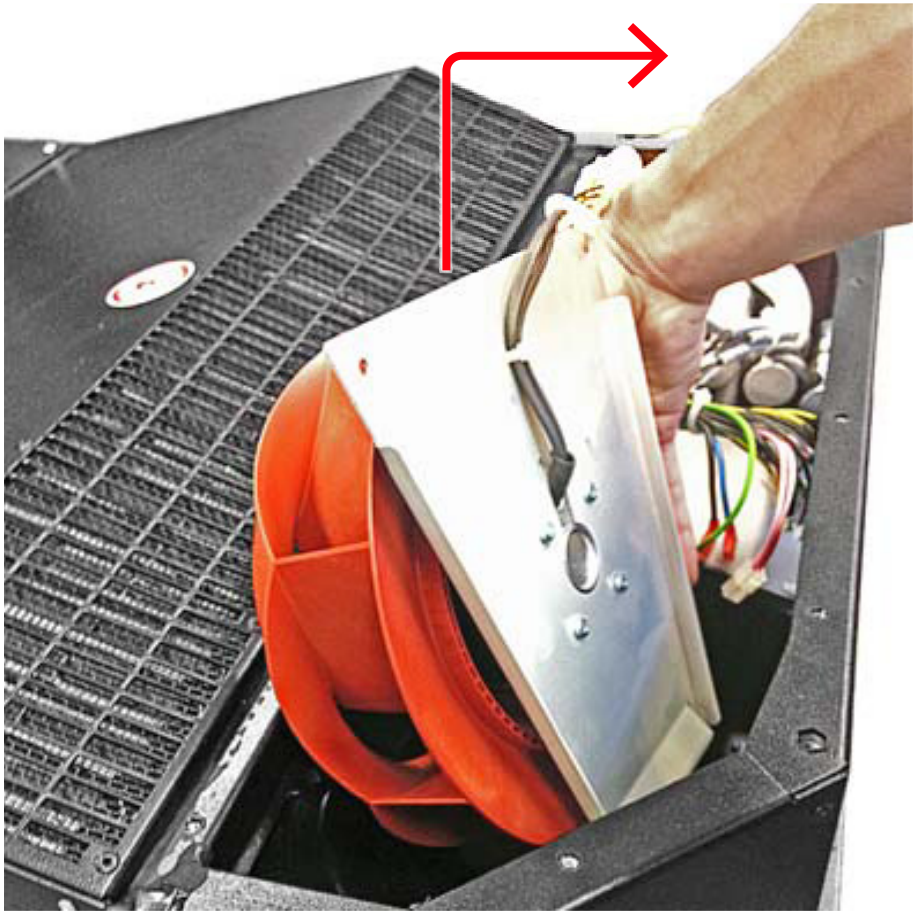
1. Unscrew the front top cover.



2. Unplug the plug-in connectors (arrows) and unscrew the screws (1, 2, 3, and 4) that fix the fan mounting bracket to the housing.



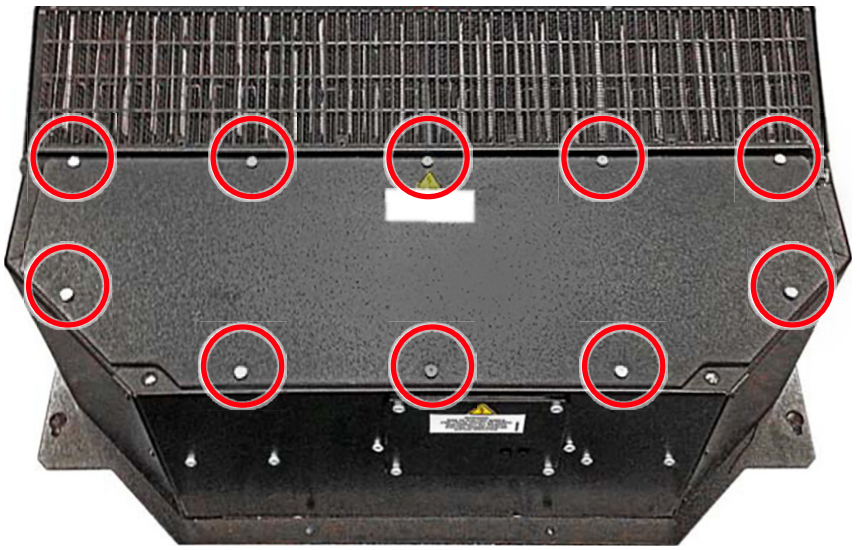
3. Remove the fan from the housing and unscrew the fan from the mounting bracket.



4. Replace the fan and reassemble the unit in reverse order of removal.

9.4.16.5. Replacing internal fan 2 - right side

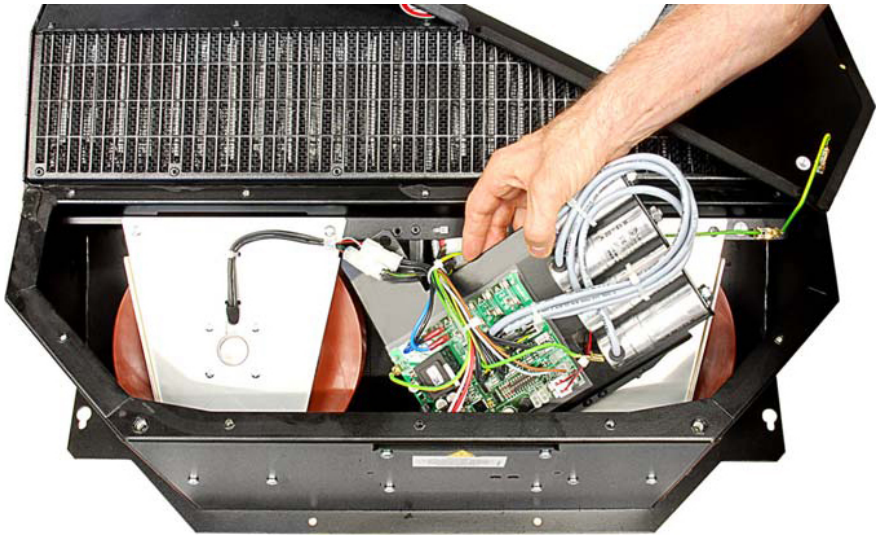
1. Unscrew the front top cover.



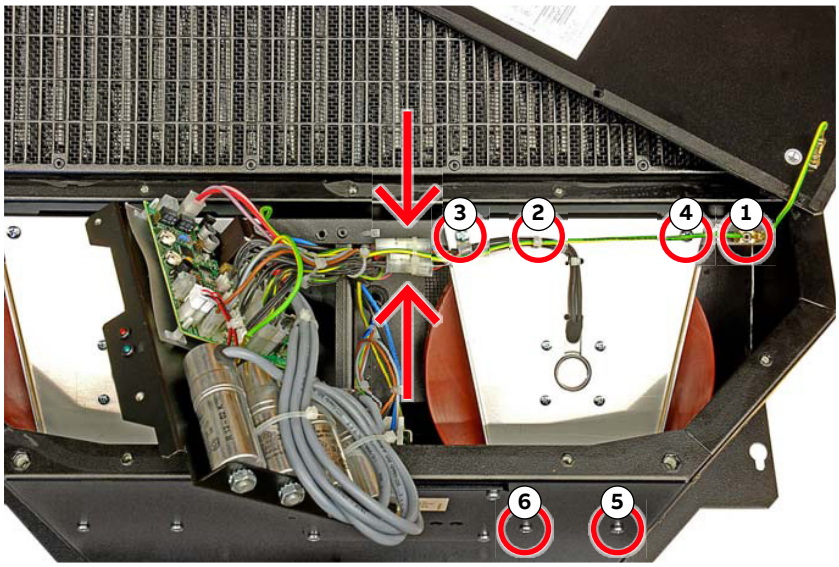
2. Remove the front cover and disconnect the ground wire (arrow).

3. Unscrew the circuit board mounting bracket (1, 2, and 3).

4. Take out the circuit board mounting bracket and place it on the heat exchanger housing.



5. Disconnect the ground wire (1), cut off the cable tie (2), unplug the plug-in connectors (arrows), and unscrew the screws (3, 4, 5, and 6) fixing the fan mounting bracket to the housing.



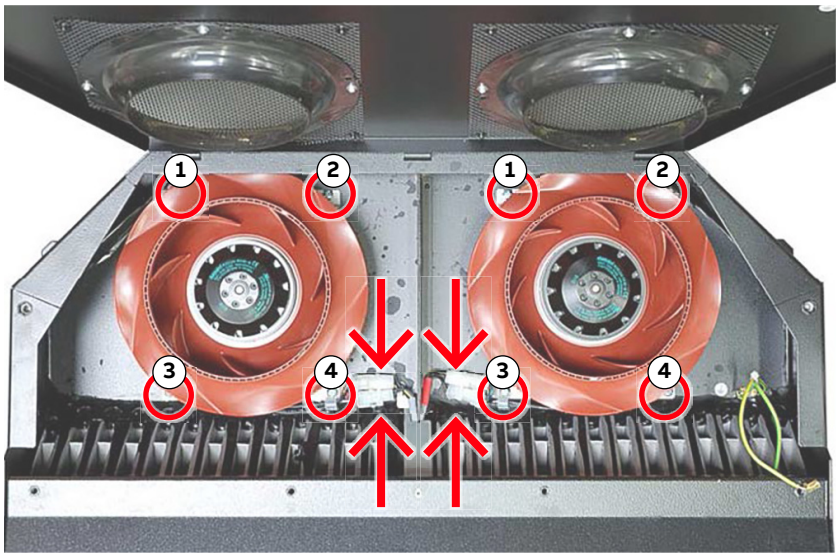
6. Remove the fan from the housing, and unscrew the fan from the mounting bracket.
7. Replace the fan and reassemble the unit in reverse order of removal.

9.4.16.6. Replacing the ambient fans

1. Unscrew the rear cover.

2. Lift the hinged cover up a little and disconnect the ground wire (arrow).

3. Disconnect the plug-in connectors (arrows) and remove the fastening screws (1, 2, 3, and 4).

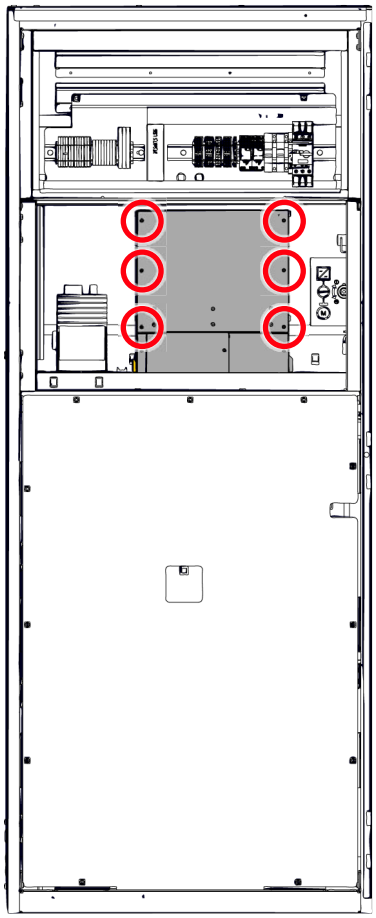


4. Replace the fan, and reassemble the unit in reverse order of removal.

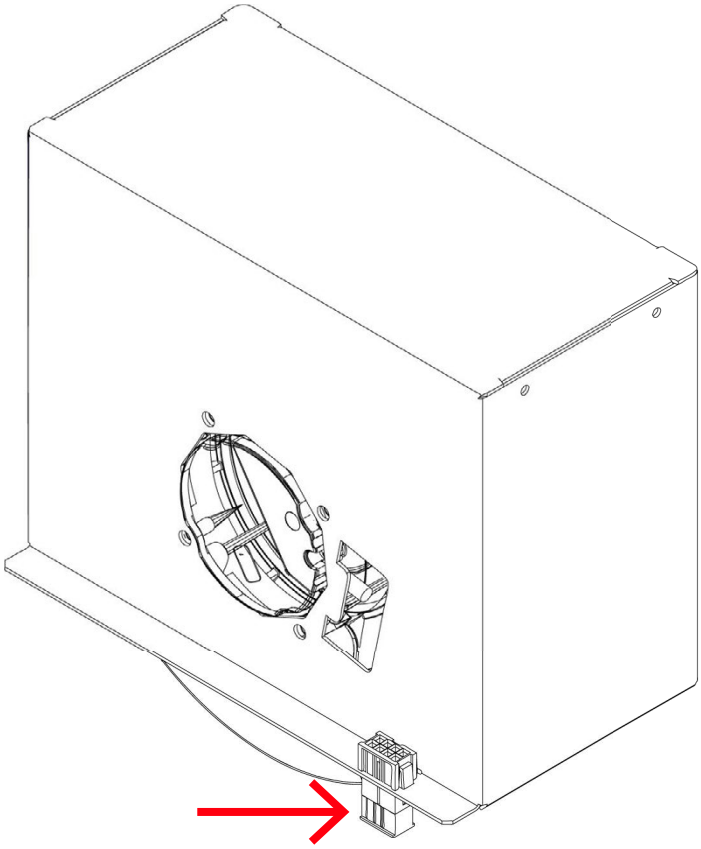
9.4.17. Replacing the fan unit in an EXU with a DCS880 H4/DCT880 T4 unit

Fig. 130. DCS880 controller - size H4

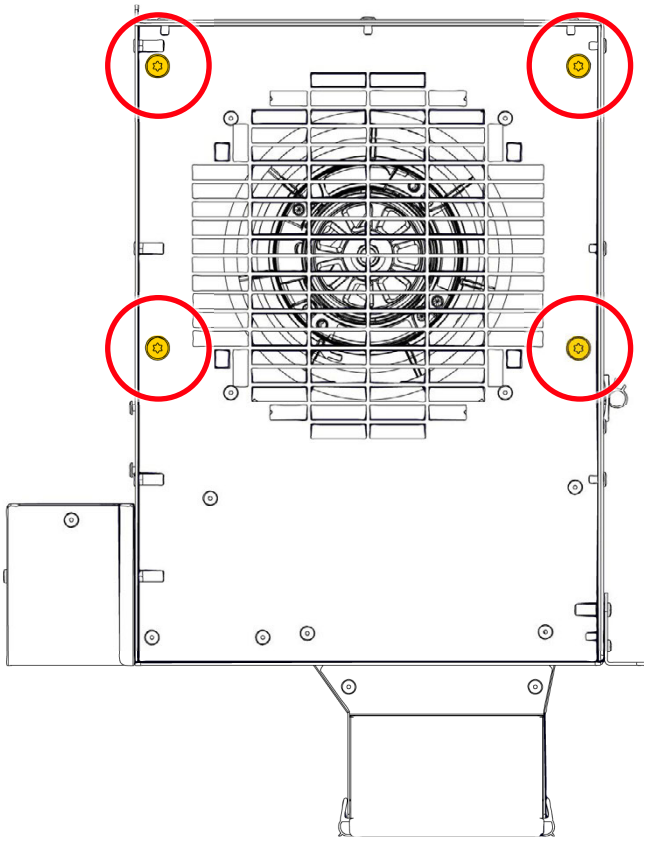
1. Switch off the miniature circuit breaker of the fan unit.
   NOTE – To identify the miniature circuit breaker, see “Appendix D - Wiring diagrams”.
2. Remove the 6 screws (circles) from the fan cover and then remove the fan cover.



3. Unplug the fan cables.

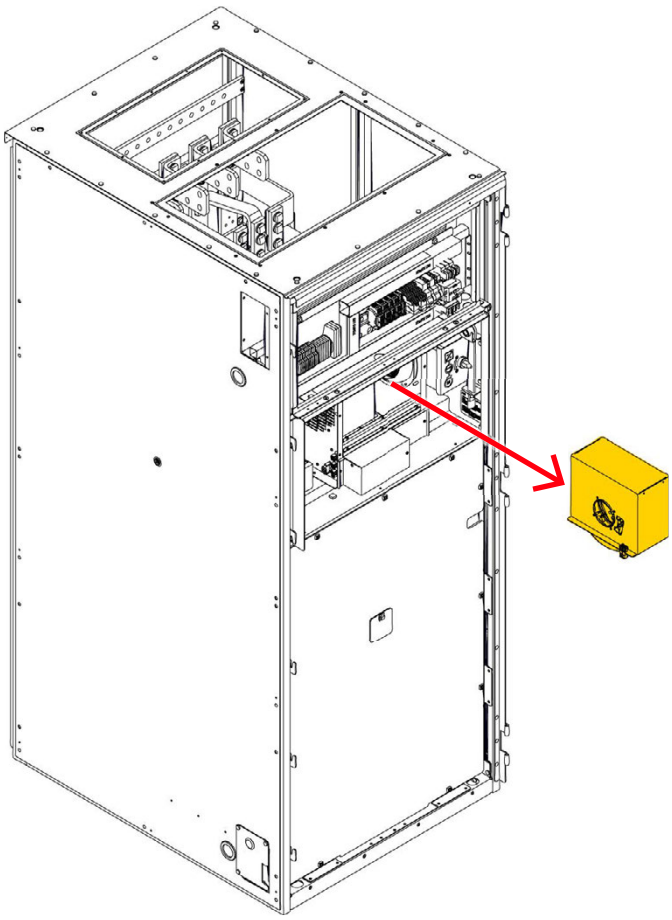


4. Remove the 4 fastening screws from the outside panel of the fan unit.



5. Pull the fan unit out of the cabinet.

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

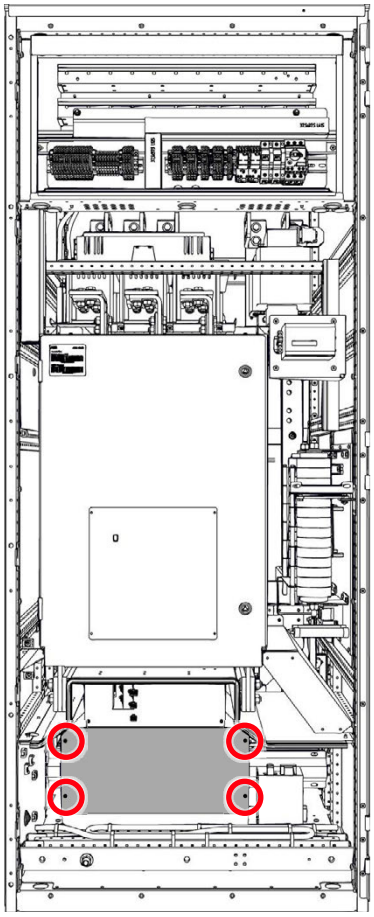


6. Install the new fan in reverse order of removal.

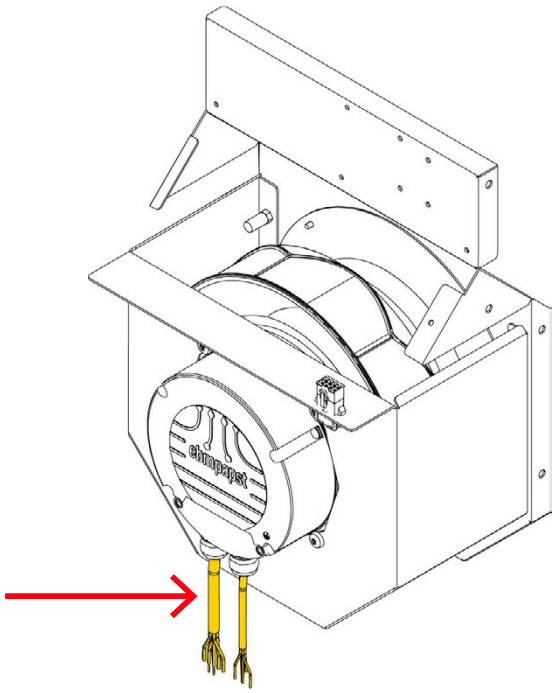
9.4.18. Replacing the fan unit in an EXU with a DCS880 H6 unit

Fig. 131. DCS880 controller - size H6

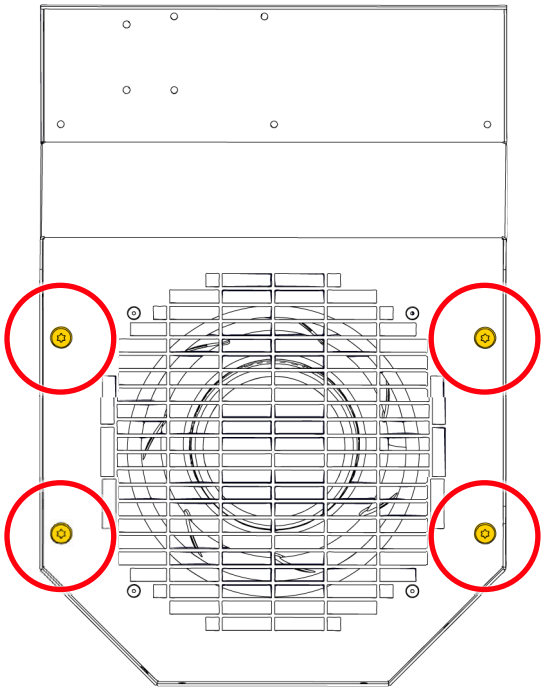
1. Switch off the miniature circuit breaker of the fan unit.
   To identify the miniature circuit breaker, see “Appendix D - Wiring diagrams”.
2. Remove the 6 screws (circles) from the fan cover and then remove the fan cover.



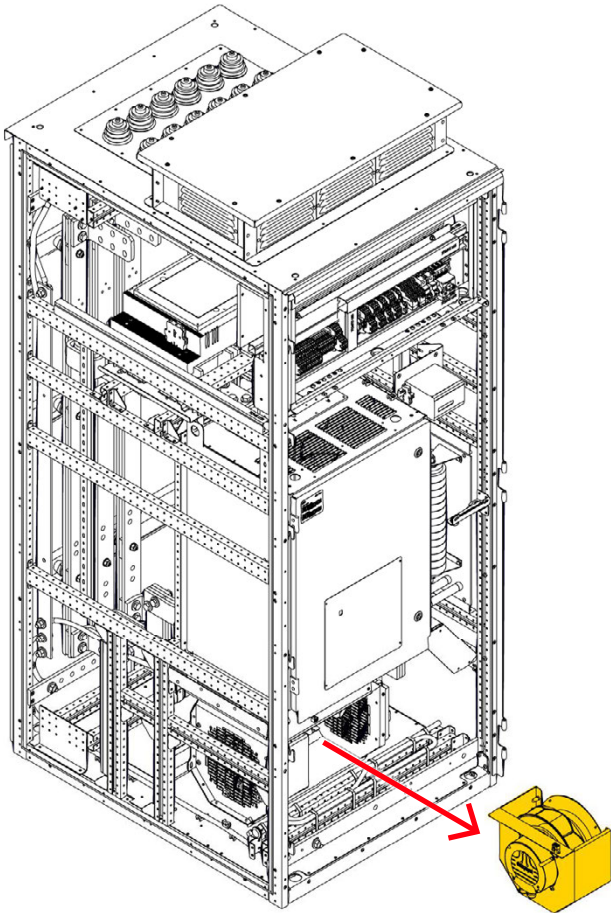
3. Unplug the fan cables.



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



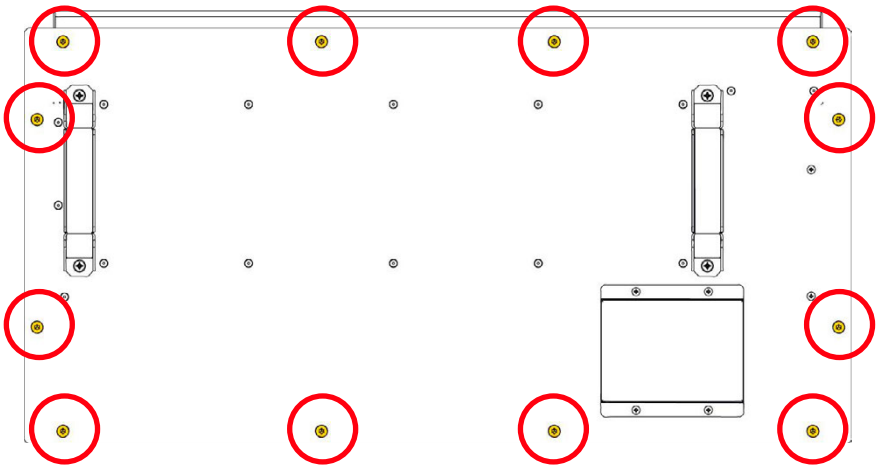
5. Pull the fan unit out of the cabinet.
   CAUTION! To prevent the fan from falling onto you, put a support (ie, a box) underneath.



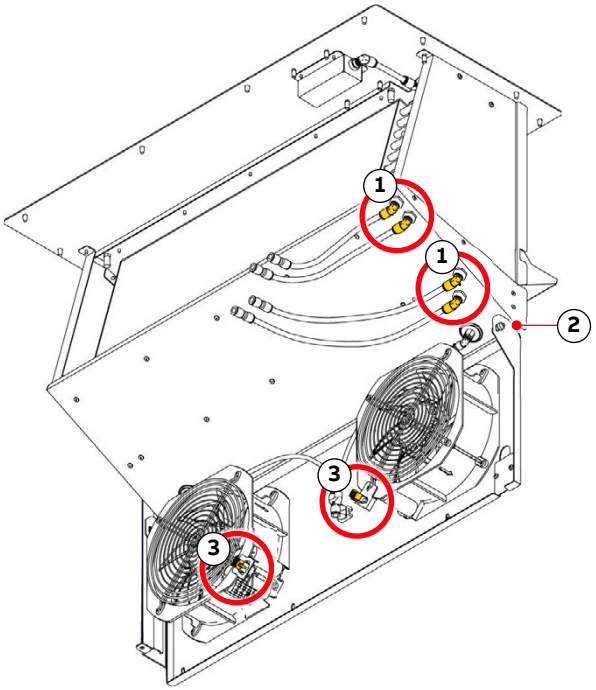
6. Install the new fan in reverse order of removal.

9.4.19. Replacing the air-to-water heat exchanger of the EXU

1. Switch off the miniature circuit breaker of the heat exchanger.
   NOTE – To identify the miniature circuit breaker, see “Appendix D - Wiring diagrams”.
2. Close valves V30 and V31 in the water-cooling unit.
3. Disconnect the hose from valve V30 to drain the WCU.
   NOTICE Expect approximately 5 liters of water.
4. Unscrew the top plate.



5. Disconnect the water tubes (1) from the air-to-water heat exchanger, unplug the cables (2) and remove the fastening screws.



Key:

(1) Water tube connection
(2) Fastening screw
(3) Cable connections

Fig. 132. Air-to-water heat connections

6. Lift the heat exchanger out of the cabinet.

   CAUTION! The heat exchanger weighs approximately **16 kg** and requires a minimum overhead clearance of 85 cm.

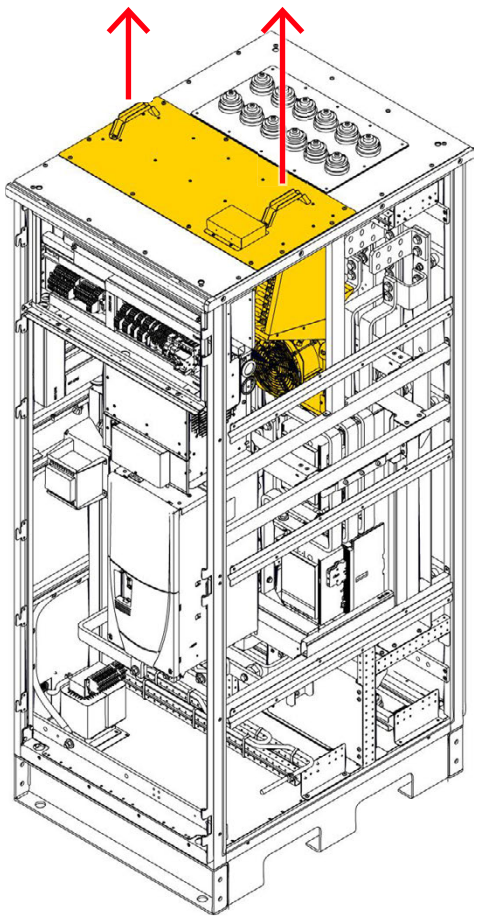


Fig. 133. Lift heat exchanger out of EXU cabinet

7. To install the new heat exchanger, proceed in reverse order of removal.

For information on adding water to the cooling system, see: “ACS5000, ACS6000 and ACS6080 water cooling unit WCU800 user manual”, 3BHS821937 E01 or “ACS5000, ACS6000 and ACS6080 water cooling unit WCU1400 user manual”, 3BHS835714 E01.

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