SYSTEM DRIVES

ACS1000 water-cooled

User manual

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1. About this manual

1.1. Equipment covered by this manual

This manual covers a 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 (eg, layout drawings, wiring diagrams, technical data, engineering notes).

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

1.2. Structure of the user documentation

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

NOTE – These appendices are NOT included in this document.

- **Appendix A - Additional manuals** provides manuals about additional equipment delivered with the drive (such as project-specific options 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.

  “Setting of protective devices” is generated according to the customer-specific project.
- **Appendix E - Parts list** produced for each project and contains all information to identify a component.
- **Appendix F - Test reports and certificates** provides the test reports of the drive. Quality certificates, and codes and standards the drive complies with are added if necessary for the project.
- **Appendix G - Signal and parameter table** includes descriptions of actual signals, control and status words, and control parameters and their default settings.

1.3. 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/Abbreviation	Definition
ACS1000W	ACS1000 water-cooled drive
AMC circuit board	Application and motor controller The digital signal processor is the heart of the control system of the drive.
Cluster	A cluster is a synonym for a group of hardware modules of the drive control system.
CDP	Control and display panel Basic user interface for operating and monitoring the drive when local operating mode is selected.
CTI	Comparative tracking index
DDCS	Distributed drive control system DDCS is an acronym for a serial communication protocol designed for data transfer via optical fibers.
Drive	Short form for ACS1000W drive
Drive system	The drive system includes all equipment used to convert electrical into mechanical power to give motion to the machine.
DriveBus	Communication link dedicated for ABB drives
DriveDebug	DriveDebug is part of ABB's DriveWare® software tools for drives using the DDCS communications protocol. DriveDebug runs on computers with Windows® operating systems. DriveDebug is a specialist's tool used to diagnose, tune and troubleshoot ABB drives.
DriveWindow	DriveWindow is a DriveWare® product. DriveWindow is a 32 bit Windows® application for commissioning and maintaining ABB drives equipped with optical communication links.
Equipment	Frequency converter and related equipment
EMC	Electromagnetic compatibility All measures to suppress electromagnetic disturbances caused by different electrical equipment in the same electromagnetic environment, and to strengthen the immunity of the equipment to such disturbances.
Ground	Earth
To ground	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.
INU	Inverter unit of the drive. The INU converts the DC voltage to the required AC motor voltage and frequency.
IOEC module	The IOEC module is an active input and output device for digital and analog signals.
IP rating	Ingress protection rating, which grade the resistance of an enclosure against the intrusion of dust or liquids.
Line voltage	RMS voltage of the main power supply of the drive

Term/Abbreviation	Definition
MCB	Main circuit breaker The MCB is a major protection device of the drive and is the main connection and disconnection point between the main power supply and the drive.
MCD	Minimum creepage distances
Molykote	Brand name for lubricants
NETA-21	Monitoring and diagnostics tool that allows access to the drive from any location in the world via a secure Internet connection.
PCB	Printed circuit board
PCC	Point of common coupling The PCC is the point in the electrical power supply system where the responsibility of the utility changes to the industrial customer. The utility is responsible to provide clean voltage and current with respect to harmonic distortion up to the PCC. The industrial customer is responsible not to distort voltage and current by its electrical systems.
PID controller	Proportional-integral-derivative controller Control loop feedback system for controlling process variables (eg, pressure, flow)
PE	Protective earth
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.
RTD	Resistance temperature detector or device The RTD is a temperature sensor where the change in electrical resistance is used to measure the temperature.
Safeline	ABB synonym for uninterruptable power supply
Supervisory signal	Indicates the operating condition of a circuit or device.
SW	Software
TC	Short form for terminal compartment of the drive
UPS	Uninterruptible power supply
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).

1.4. Related documents

1.4.1. Maintenance

Title	Document number
ACS1000 preventive maintenance schedule	3BHS855276 E01

1.4.2. Technical data

Title	Document number
Technical data from DriveSmart[1] (configuration software for medium voltage drives)	

[1] Configuration software for medium voltage drives

1.4.3. Schematics

Title	Document number
Layout drawing	Project-specific
Fixing & Lifting details ACS1000W	3BHS853483 E01
Fixing & Lifting details ACS1000W Marine	3BHS853483 E02
Fixing & Lifting details ACS1000W Seismic	3BHS853483 E03

1.4.4. Specifications and guidelines

Title	Document number
Retrofit guideline	3BHS301179 E01
Input circuit breaker engineering guideline	3BHS104785 E01
Main transformer specification	3BHS356582 E01
Induction motor specification	3BHS260163 E01
Power cable specification	3BHS189994 E01
Power cables engineering guideline	3BHS542290 E01
Auxiliary power and control cables guideline	3BHS813742 E01
Mechanical interlock	3BHS261596 E01
ACS1000 Mechanical door interlock system UL application note	3BHS261596 E03

1.4.5. Serial communication interfaces

Title	Document number
Ethernet - NETA-21 remote monitoring tool user manual	3AUA0000096939
Modbus - NMBA-01 installation and start-up guide	3AFY58919772
Profibus - NPBA-12 installation and start-up guide	3BFE64341588
DeviceNet - NDNA-02 installation and start-up guide	3AFY58919829

1.4.6. Encoder

Title	Document number
Installation and start-up guide for the pulse encoder module NTAC-0x	3AFY58919730

1.5. Target groups and required qualification

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

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

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

1.5.1. Handling

The personnel must be skilled and experienced in unpacking and transporting heavy equipment.

1.5.2. Mechanical installation

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

1.5.3. Electrical installation

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

1.5.4. Operation

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

1.5.5. Maintenance

The personnel include all persons who

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

1.6. User's responsibilities

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

1.7. Intended use of equipment

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

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

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

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

1.8. Quality certificates and applicable standards

The following certificates and conformity declarations are available with ABB:

- ISO 9001 and ISO 14001 certificates stating that ABB Switzerland Ltd has implemented and maintains a management system which fulfills the requirements of the normative standards
- EC declaration of conformity
- List of standards the drive complies with

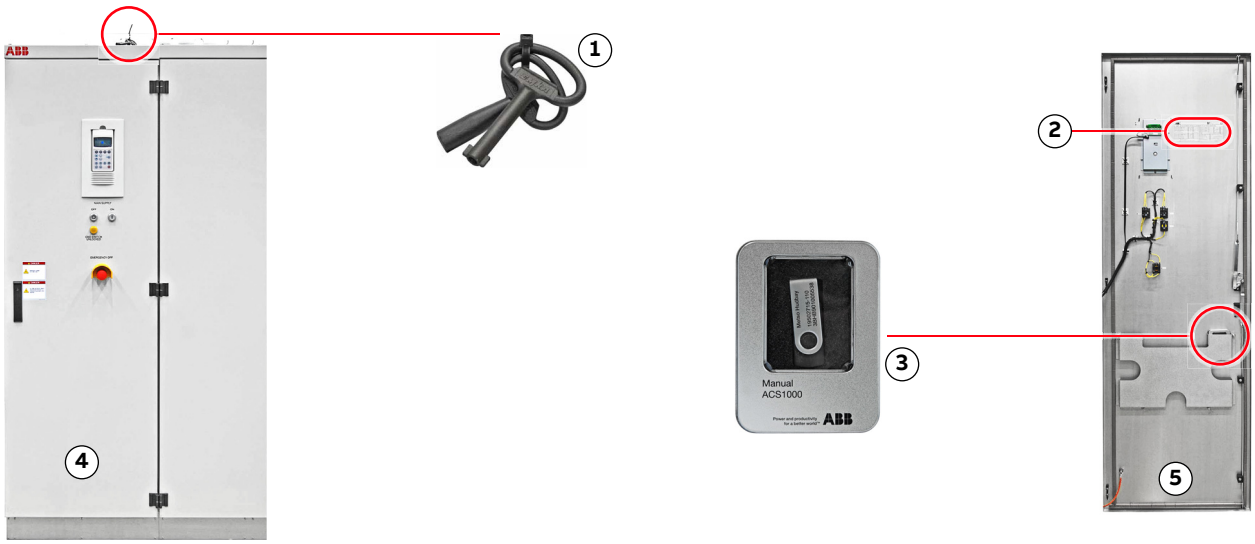
TABLE 1 Standards

Standard	Title
ANSI Z535.6	American national standard for product safety information in product manuals, instructions, and other collateral materials
ISO 3864-2	2004 (E) - Graphical symbols – Safety colors and safety signs – Part 2: Design principles for product safety labels
ISO 7010	2011 (E) - Graphical symbols - Safety colours and safety signs - Registered safety sign
EN 50110	European standard code for electrical work safety
ISO 13849-1	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design, section 6.2.6 Category 3
IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
IEC 60721-3-1	Classification of environmental conditions: Classification of groups of environmental parameters and their severities; Storage
IEC 60721-3-2	Classification of environmental conditions - Part 3-2: Classification of groups of environmental parameters and their severities - Transportation and Handling
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 location
IEC 62477-2	Safety requirements for power electronic converter systems and equipment – Part 2: Power electronic converters from 1 000 V AC or 1 500 V DC up to 36 kV AC or 54 kV DC
IEC 81346-1	Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations - Part 1: Basic rules

1.9 Items covered by delivery

Delivery typically comprises the following items:

- Drive that is shipped in sea freight or airfreight packaging.
- Optional components and cabinets
- Set of door keys attached to lifting rail (1, Fig. 1)
- Set of door keys inside the drive
- Rating label (2, Fig. 1)
- Box with USB stick (3, Fig. 1), which contains the user manual and related documents.
- Strain relief rails
- Air exhaust hood
- Redundant fan unit (option)
- Set of bolts, nuts and washers



Key:

(1) Door keys
(2) Rating label
(3) Box with USB stick
(4) Control compartment door
(5) Inside control compartment door

Fig. 1. Delivered items

For a complete list of the items in the delivery, see the shipping note.

1.10. Identifying the delivery

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

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. 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 20.

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 2 3	Callout keys on an illustration
	These pictograms refer to the subject matter of the text.
	See Section 2.1.2, “Safety signs”, page 20.

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
	Electrostatic discharge susceptible		Heavy load warning
	Hazardous voltage warning		Tipping hazard
	Arc flash warning		

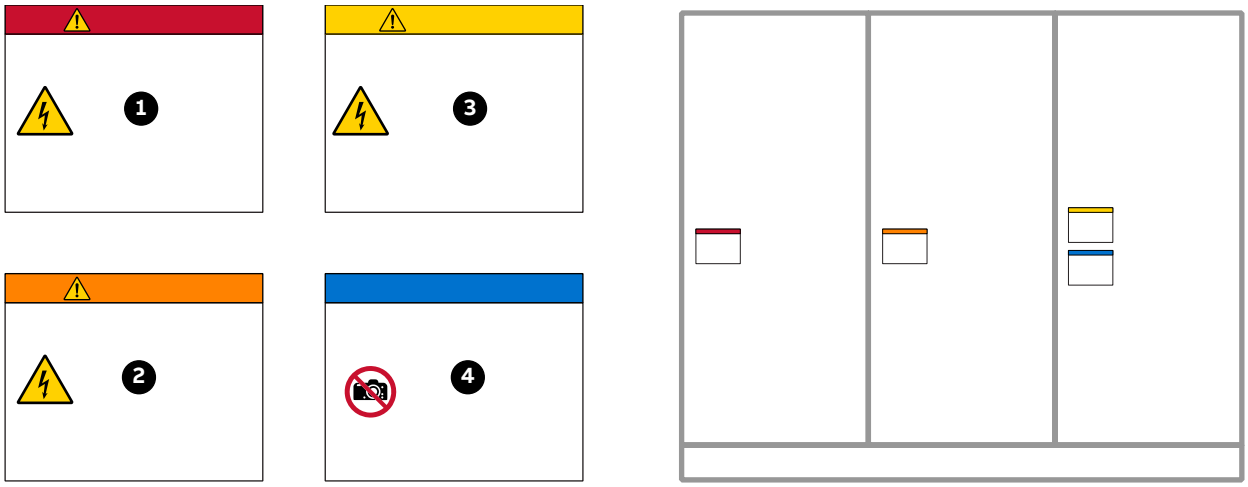
2.2. Product safety labels

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

2.3. Electrical safety

The following electrical safety instructions are based on EN 50110.

2.3.1. General safety instructions

– **Minimize hazards**

– **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

– **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.

– **While working on the drive:**
  - DO NOT step on the roof
  - DO NOT install foreign objects on the roof

– **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.

– **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

– **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 seven steps that save lives

ABB's seven 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

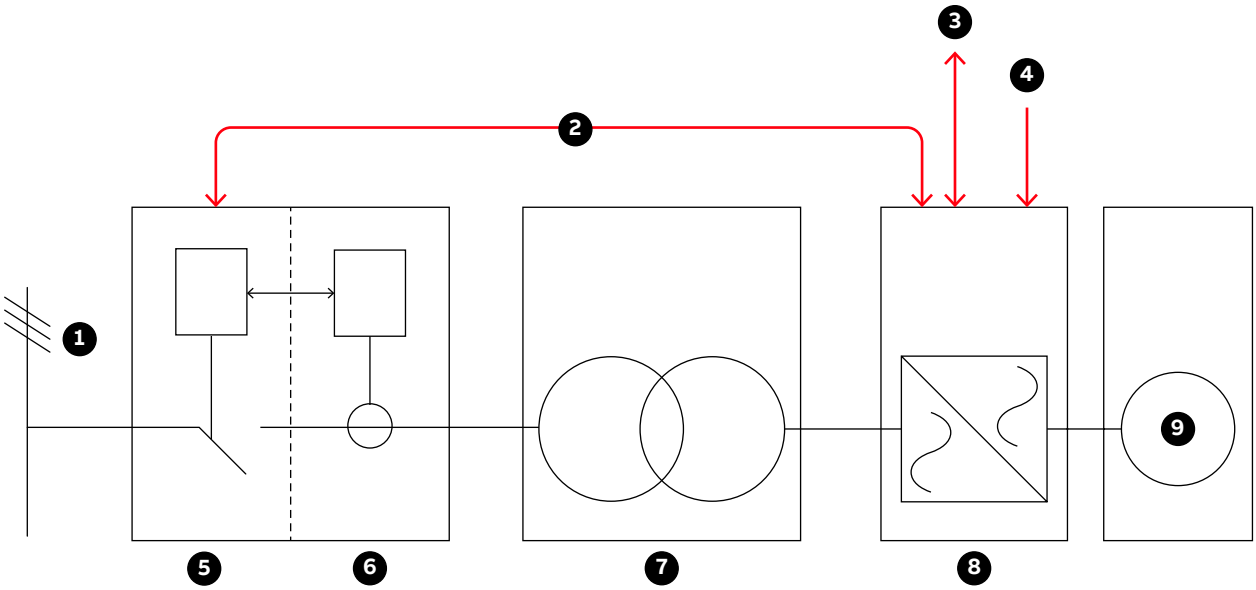
Residual risks must be considered by the drive system integrator and/or plant owner when assessing the hazards of the equipment to personnel. The following risks can pose a hazard to drive system personnel:

– **Electric power equipment generates electro-magnetic fields which can cause a hazard to people with metal implants and / or a pacemaker.**

- **Drive system components can move unintentionally when being commissioned, operated, or serviced due to:**
  - Operation of the equipment outside the scope of the specifications
  - Incorrectly assembled or installed equipment
  - Wrongly connected cables
  - External influence on, or damage of the equipment
  - Wrong parameter settings
  - Software errors
  - Faulty hardware
- **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
- **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
- **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. 3. 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

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

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

- ISO 13849-1
- IEC 60204-1

2.4.2. Minimum requirements for MCB and MCB control

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

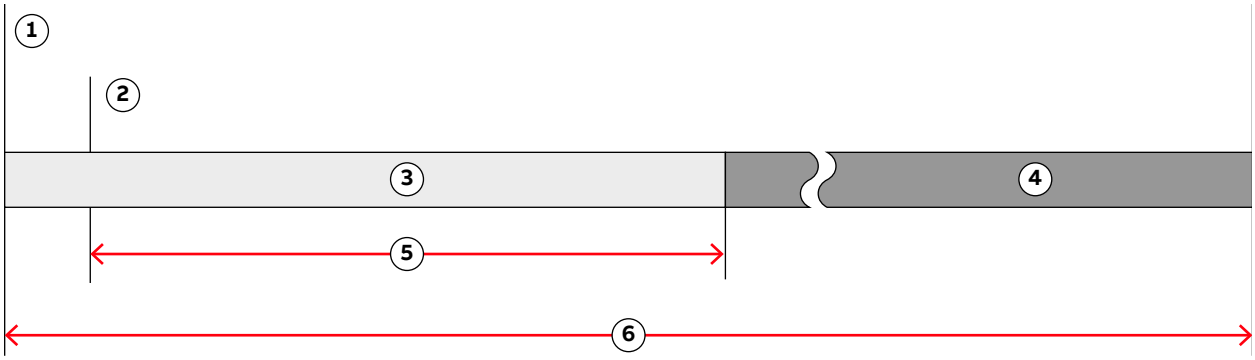
- The MCB open and / or trip command has to be wired directly from the drive to the MCB.
  - It is not permitted to wire the trip command through any PLC or DCS system if it is not certified to meet SIL three-level requirements and to fulfill the timing requirements outlined below.
  - Opening of the MCB by the drive must be possible at any time. It is not permitted to interrupt the open and / or trip command, eg, by a local-remote switch in the MCB.
- When the MCB is in service position, the drive must have exclusive control of closing the MCB. Local closing of the MCB is not permitted.
- The maximum opening time of the MCB must never exceed the product- or project-specific maximum time defined in the MCB specifications.

Typical maximum values for the drive are defined as follows:

- **Maximum protection trip time:** 120 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:** 250 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. 4. 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. Overview

The ACS1000W is a general-purpose frequency converter with an integrated converter transformer for the control of standard induction motors.

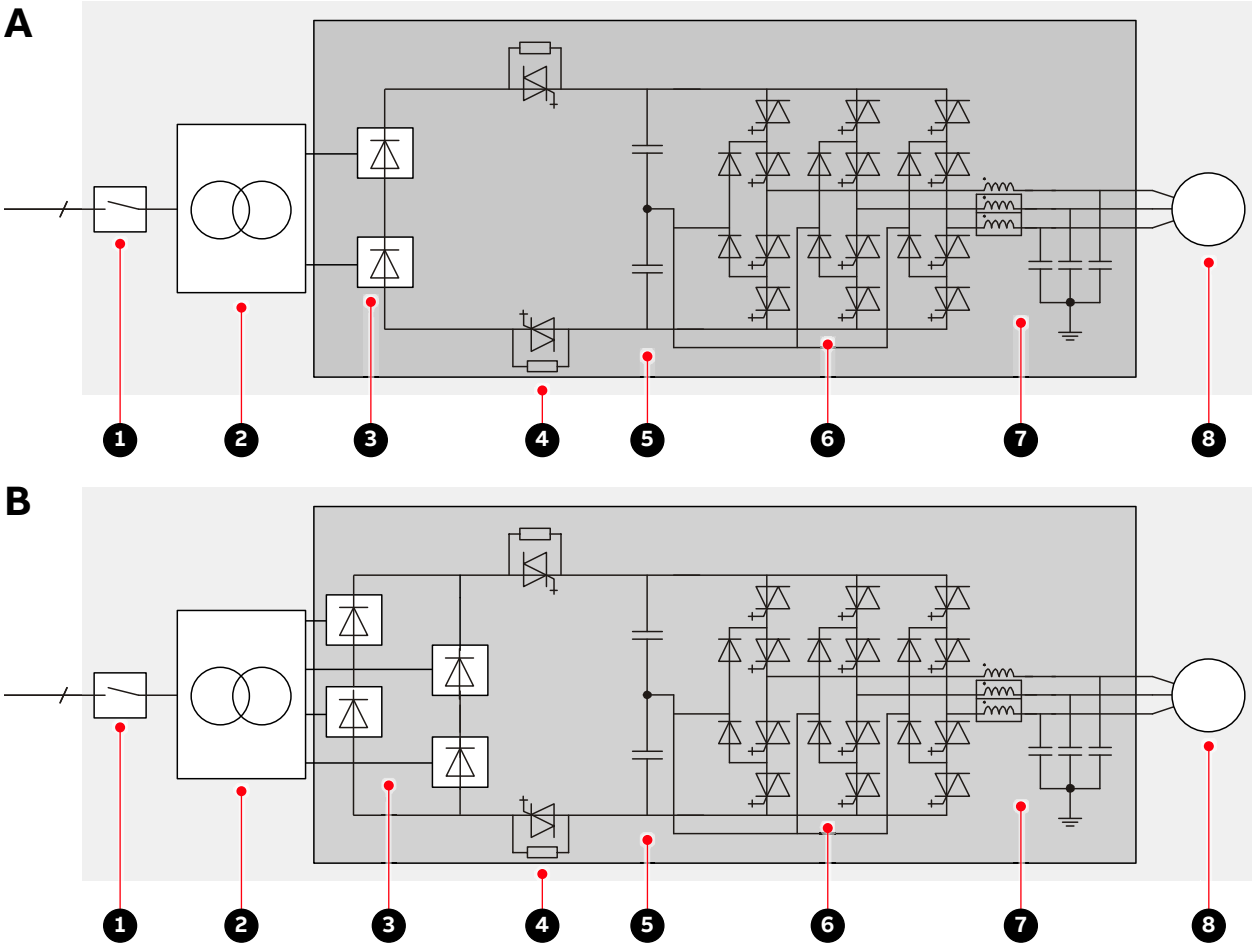
For information on the power and voltage range of the drive, see the technical specifications and the rating plate of the drive.

The following sections provide an overview of:

- Drive topology and main features
- Available main and auxiliary power configurations
- Power electronic components of the drive
- Cooling system
- Cabinet features such as the grounding switch and the electro-mechanical door interlock

Fig. 5. ACS1000 water-cooled

3.2. Main components of the drive system



Key:

(1) Medium voltage switchgear including main circuit breaker and transformer protection
(2) Transformer
(3) Rectifier
(4) Protection IGCTs
(5) DC link
(6) Inverter
(7) Filter
(8) Motor

Fig. 6. Block diagrams of an ACS1000W with a (A) 12-pulse rectifier and a drive with a (B) 24-pulse rectifier

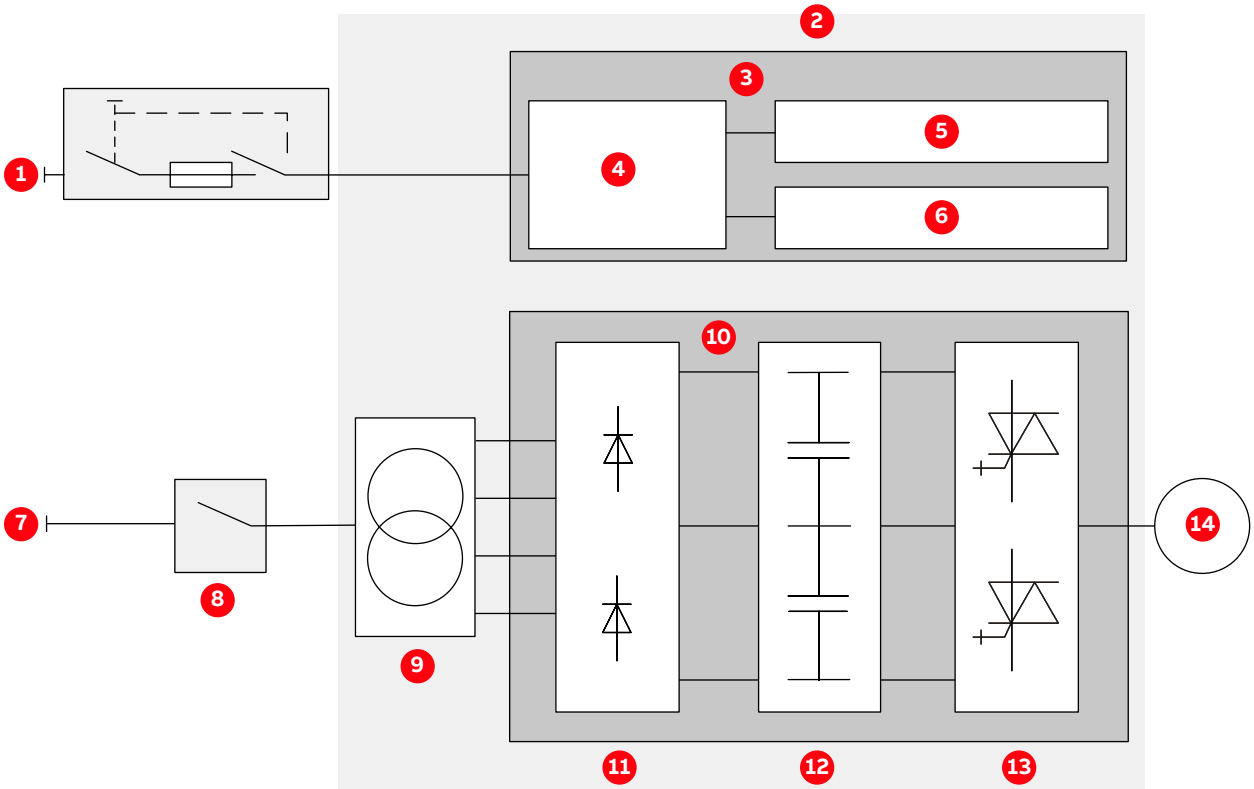
The drive system consists of the following main components:

- **Main circuit breaker (MCB)**: For more information, see Section 2.4, “Main circuit breaker protection device”, page 25.
- **Transformer:** For more information, see the “Main transformer specification”, 3BHS356582 E01.
- **Drive**
- **Asynchronous motor**: For more information, see the motor specification.

3.3. Power supply configurations

The drive requires 2 independent power supplies:

- Main power supply for the power electronic components
- Auxiliary power supply for the control and cooling system



Key:

(1) Auxiliary power supply
(2) ACS1000W
(3) Control and cooling system
(4) Auxiliary power distribution
(5) Cooling system
(6) Control system
(7) Main power supply
(8) MCB
(9) Transformer
(10) Power electronic components
(11) Rectifier
(12) DC link
(13) Inverter
(14) Motor

Fig. 7. Drive overview with power supplies

3.3.1. Main power supply configurations

The drive is connected to the main power supply via a three-winding oil or dry-type transformer.

3.3.2. Auxiliary power supply configurations

The total auxiliary power demand of the drive includes:

- Auxiliary power for the cooling system
- Auxiliary power for the control hardware and the gate units which are used to trigger the power semiconductors

The total auxiliary power can be fed to the drive in the following ways:

- Through a common power supply
  - The total auxiliary power is supplied to the drive by a three-phase AC power supply.
  - If the power supply is interrupted, drive internal batteries provide a backup for the control system, thus enabling the drive to ride-through and/or to perform a controlled shutdown.
- Through separate power supplies
  - The auxiliary power is supplied to the drive by a three-phase AC power supply and by an UPS to a separate one-phase AC or DC input.
  - Feeding the control power separately by an UPS has the advantage that the main control hardware will remain energized, the full ride-through capabilities of the drive can be used, and the communication to a higher-level control system will not be lost in the event of an auxiliary power outage.

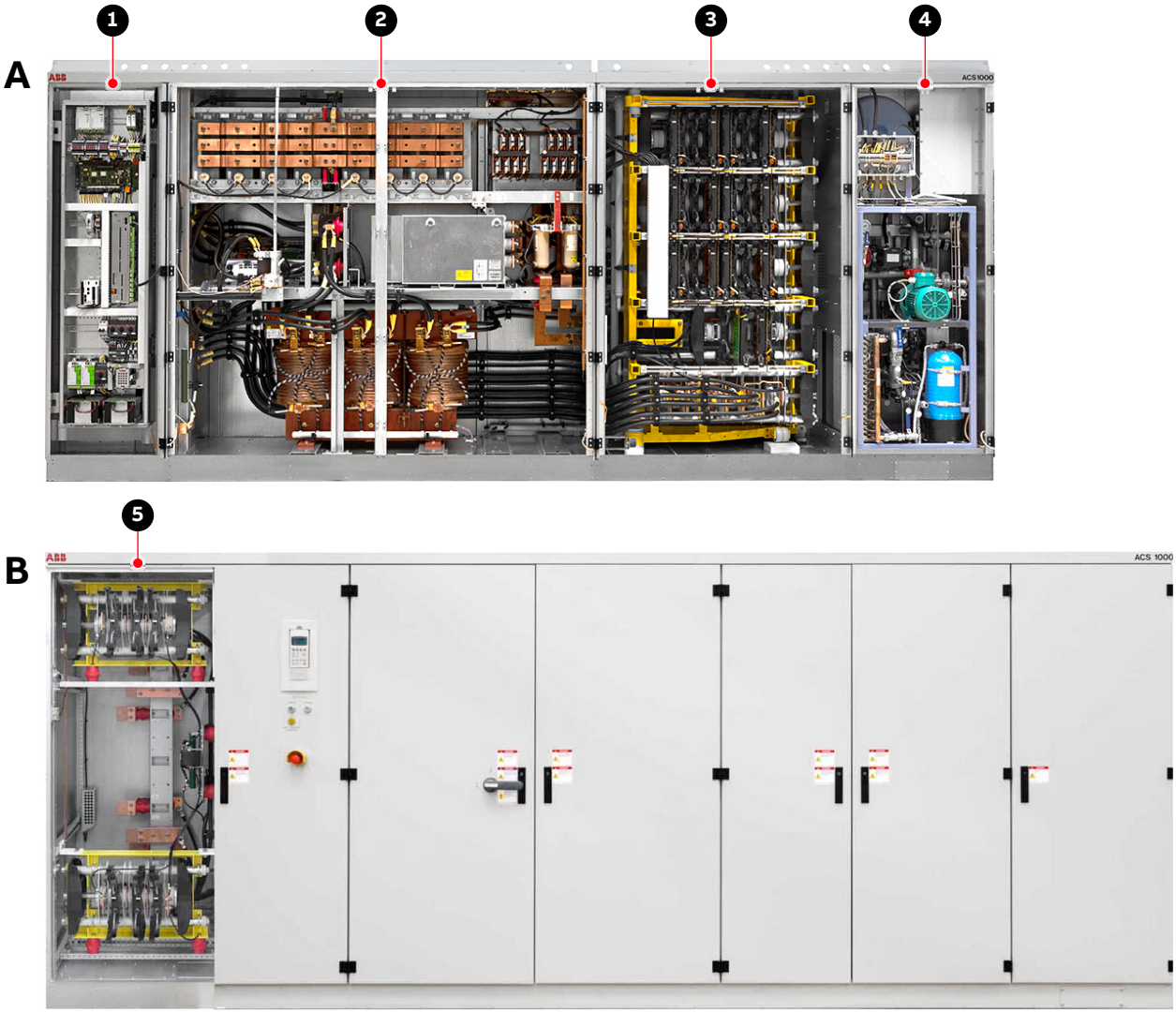
IMPORTANT! The power feed for the auxiliary supply must be protected with a suitable circuit protection rated for the inrush current.

- For more information on the auxiliary power interface of the drive, see “Appendix D - Wiring diagrams”.
- For information on the rated voltage(s) and current(s), see the rating plate of the drive.

3.4. Drive topology

This section describes the main design features and introduces the major power electronics components of a typical drive.

3.4.1. Overview



Key:

(1) Control and terminal compartment

(2) DC-link and filter compartment

(3) Rectifier and inverter compartment

(4) Water-cooling compartment

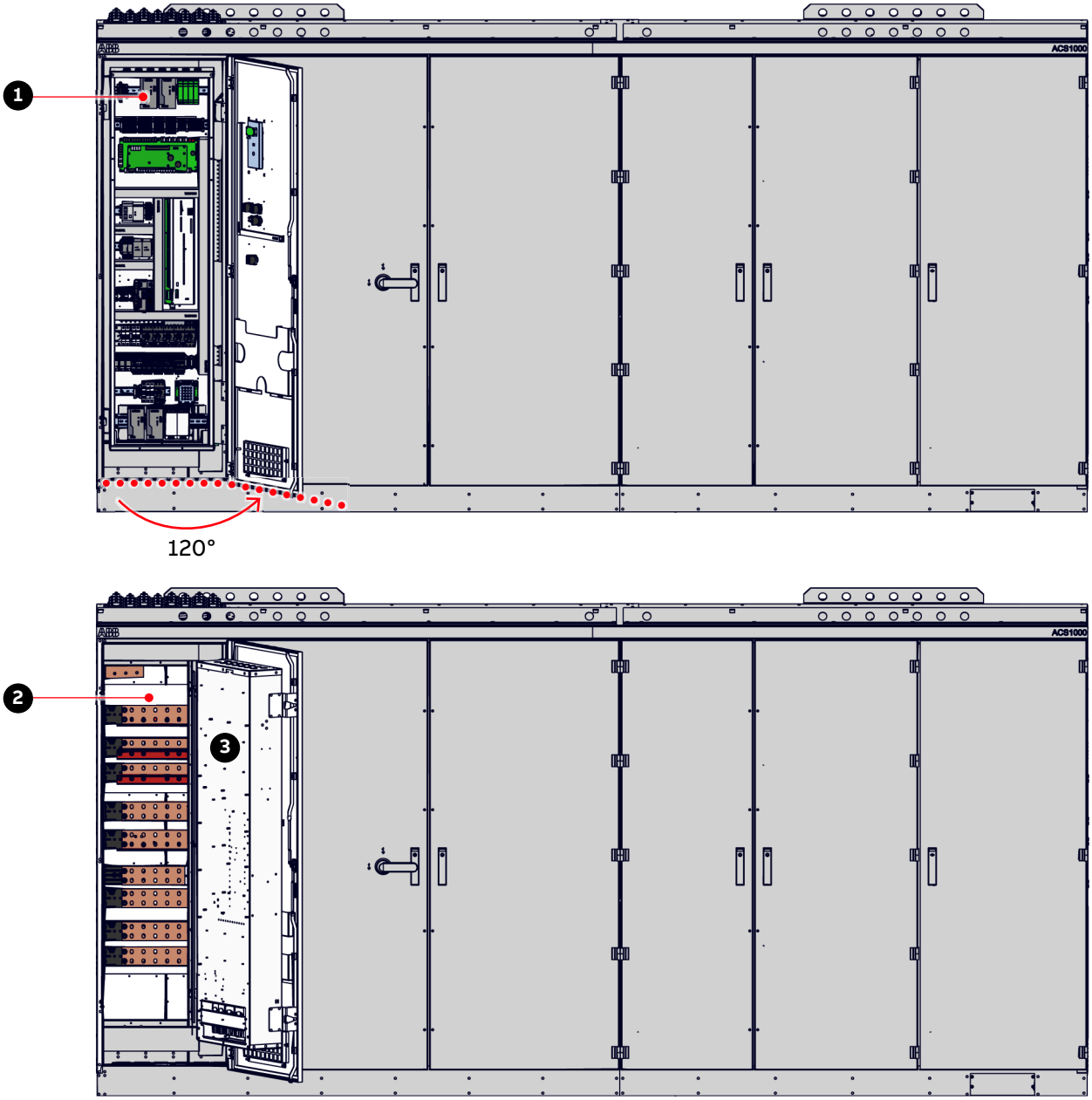
(5) Cabinet with second 12-pulse rectifier

Fig. 8. ACS1000W drive with 12-pulse rectifier and 24-pulse rectifier

3.4.2. Control and terminal compartment

The leftmost compartment of the drive divides into:

- **Control compartment (1, Fig. 9)**: contains the hardware of the control system of the drive. For more information on the control hardware, see Chapter 4, “Control system”, page 46.
- **Terminal compartment (2, Fig. 9)**: contains the busbars for the feeder and motor cables, the ground cable and the cable screens. A hinged bolted partition separates the terminal compartment from the control compartment. For more information on cable entry and cable connection, see Chapter 7, “Electrical installation”, page 76.



Key:

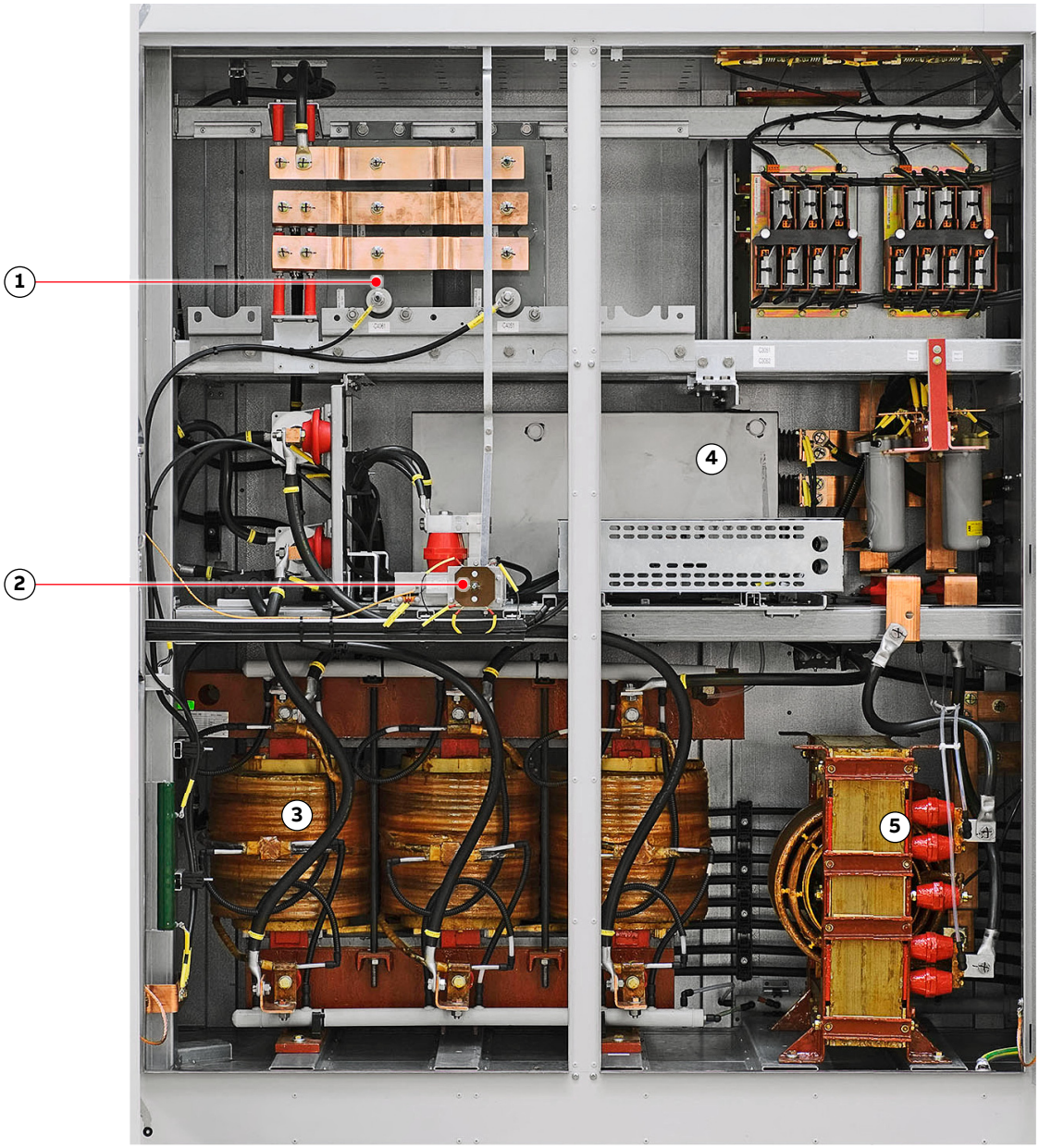
(1) Control compartment

(2) Terminal compartment

(3) Swing frame

Fig. 9. Control and terminal compartment

3.4.3. DC-link and filter compartment



Key:

(1) Filter capacitors

(2) Grounding switch

(3) Filter choke

(4) DC-link capacitors

(5) Common mode choke (option)

Fig. 10. DC link and filter compartment

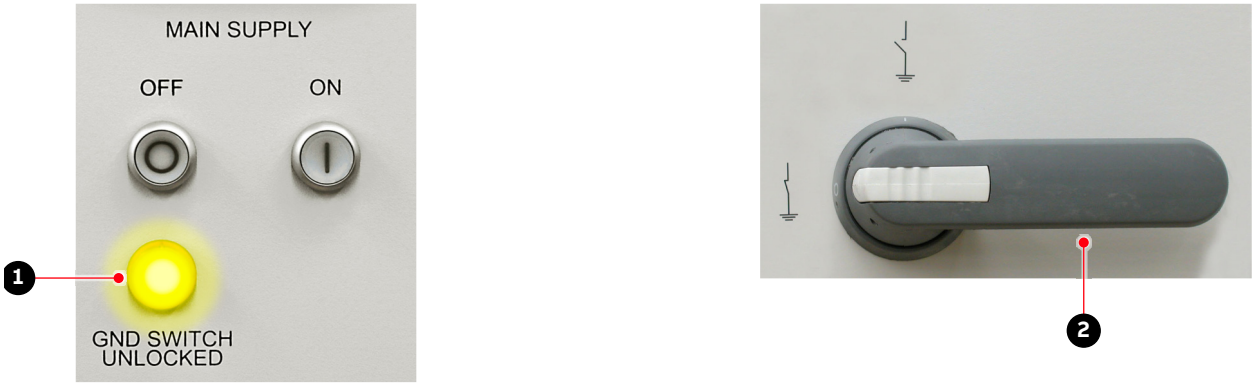
3.4.4. Grounding switch

The grounding switch is a safety device that enables safe access to the medium voltage compartments of the drive.

When the switch is in position grounded, the DC link of the drive is connected to the PE ground busbar.

The grounding switch is electro-mechanically interlocked with a discharge monitoring circuit that prevents closing of the switch while 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. When the voltage is below 50 V (DC), the lamp grounding switch unlocked (1 in Fig. 11) on the door of the control compartment lights up, and the grounding switch can be turned to position grounded (2, Fig. 11).



Key:

(1) Grounding switch unlocked lamp is on

(2) Grounding switch in grounded position

Fig. 11. Grounding switch

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

3.4.5. Preparation for mechanical interlock at ground switch (option)

In a mechanical door interlock system (1, Fig. 12) the equipment can only be accessed in a predefined and safe sequence. A drive with this option is prepared for the installation, but the key interlocks are not supplied.

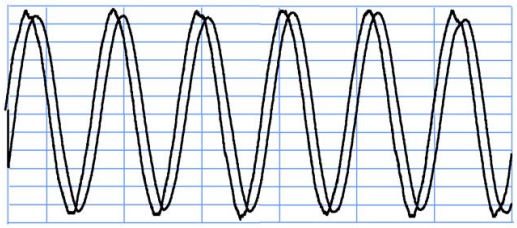
IMPORTANT! For UL certified drives, mechanical door interlocks are mandatory and the key locks are factory-installed. Additional parts for the upstream MCB are included with the delivery and must be installed according to “ACS1000 Mechanical door interlock system UL application note”, 3BHS261596 E03.

Fig. 12. Example of a customer-specific trapped (1) key interlock system

For information on the installation and type of key interlocks that are supported, see “Mechanical interlock”, 3BHS261596 E01.

3.4.6. Filter

The filter at the drive output reduces the harmonic content of the motor voltage and generates a nearly sinusoidal motor-friendly voltage waveform. The filter also eliminates all high dv/dt effects. Therefore, standard motors can be used, and voltage reflections in the motor cables are eliminated.

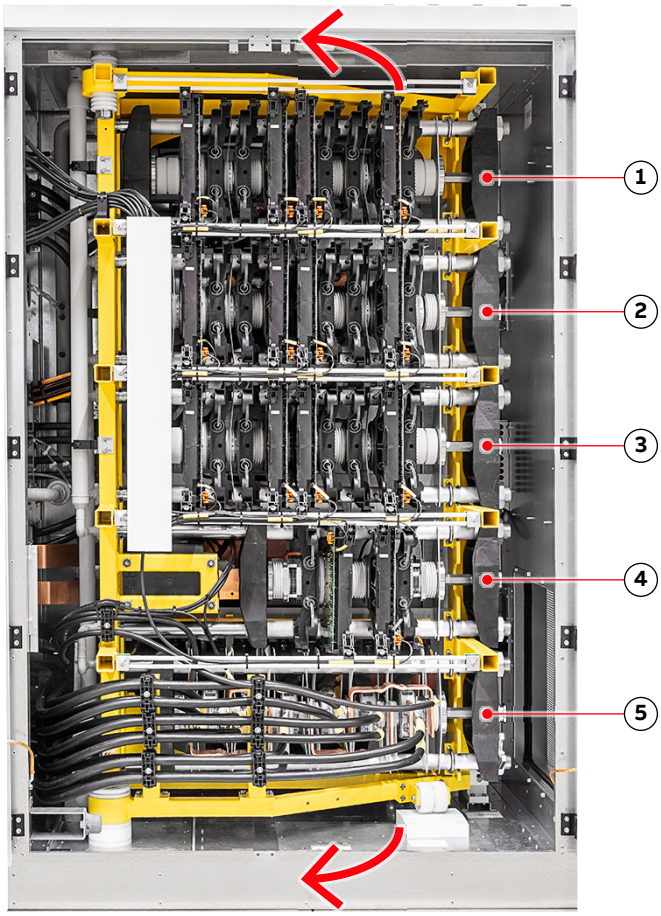


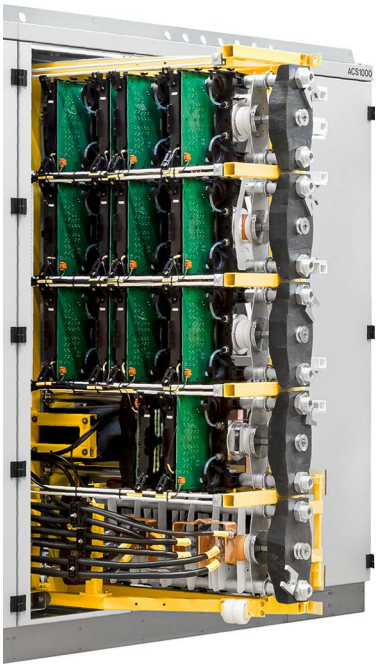
Output voltage: 4.16 kV
Output frequency: 60 Hz

Fig. 13. Voltage and current waveforms at drive output

3.4.7. Rectifier and inverter compartment

The compartment contains the rectifier, the inverter and the protection IGCTs.





Key:

(1) Inverter phase U

(2) Inverter phase V

(3) Inverter phase W

(4) Protection IGCTs

(5) Rectifiers

Fig. 14. Rectifier and inverter compartment

3.4.7.1. Rectifier

The diode rectifier converts the AC voltage of the main power supply and connects its output to the minus, neutral point, and plus side of the DC link.

Depending on the harmonics requirements for the main power supply, the drive is equipped with a 12-pulse or a 24-pulse rectifier.

3.4.7.2. Protection IGCTs

The drive features a fuseless protection design. The IGCTs are placed between the rectifier and the DC link. If necessary, the IGCTs directly isolate the inverter from the main power supply.

3.4.7.3. Inverter

The inverter converts the DC voltage to the required AC motor voltage and frequency.

Each phase of the three-phase inverter consists of a combination of four IGCTs and two NP diodes for three-level switching operation. The output is switched between positive DC voltage, neutral point (NP) and negative DC voltage. Hence, the drive can control the output voltage and the frequency continuously from zero to maximum using direct torque control. For more information, see Section 4.2.2.4, “Direct torque control”, page 50.

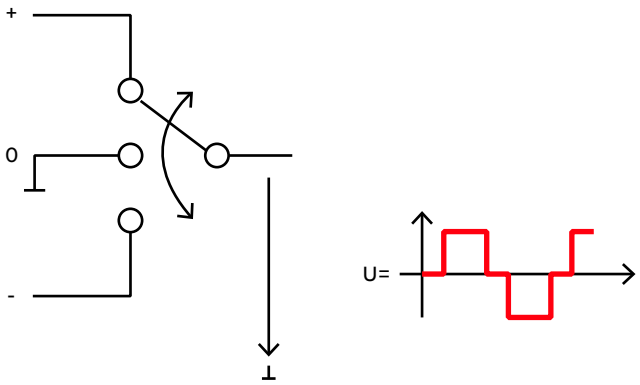


Fig. 15. Three-level voltage source inverter principle

3.4.8. Optional Braking Chopper

The optional braking chopper uses resistor braking to provide motor braking and shorter deceleration times, eg, for:

- Reduction of coasting down time, eg, for conveyor belts, fans, and pumps
- Emergency stops

The braking chopper cabinet connects to the right side of the drive as well as to the braking resistors, which are external to the ACS1000W and not part of the product scope.

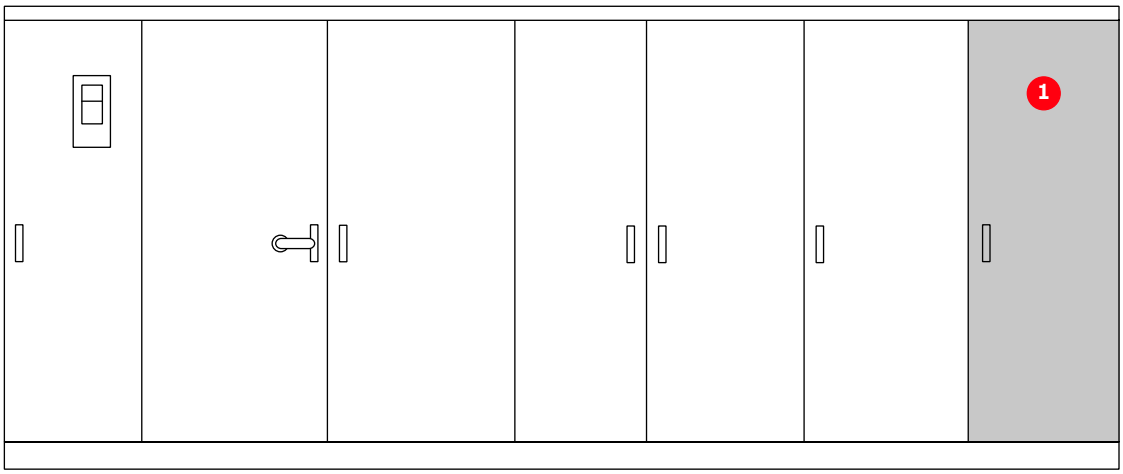
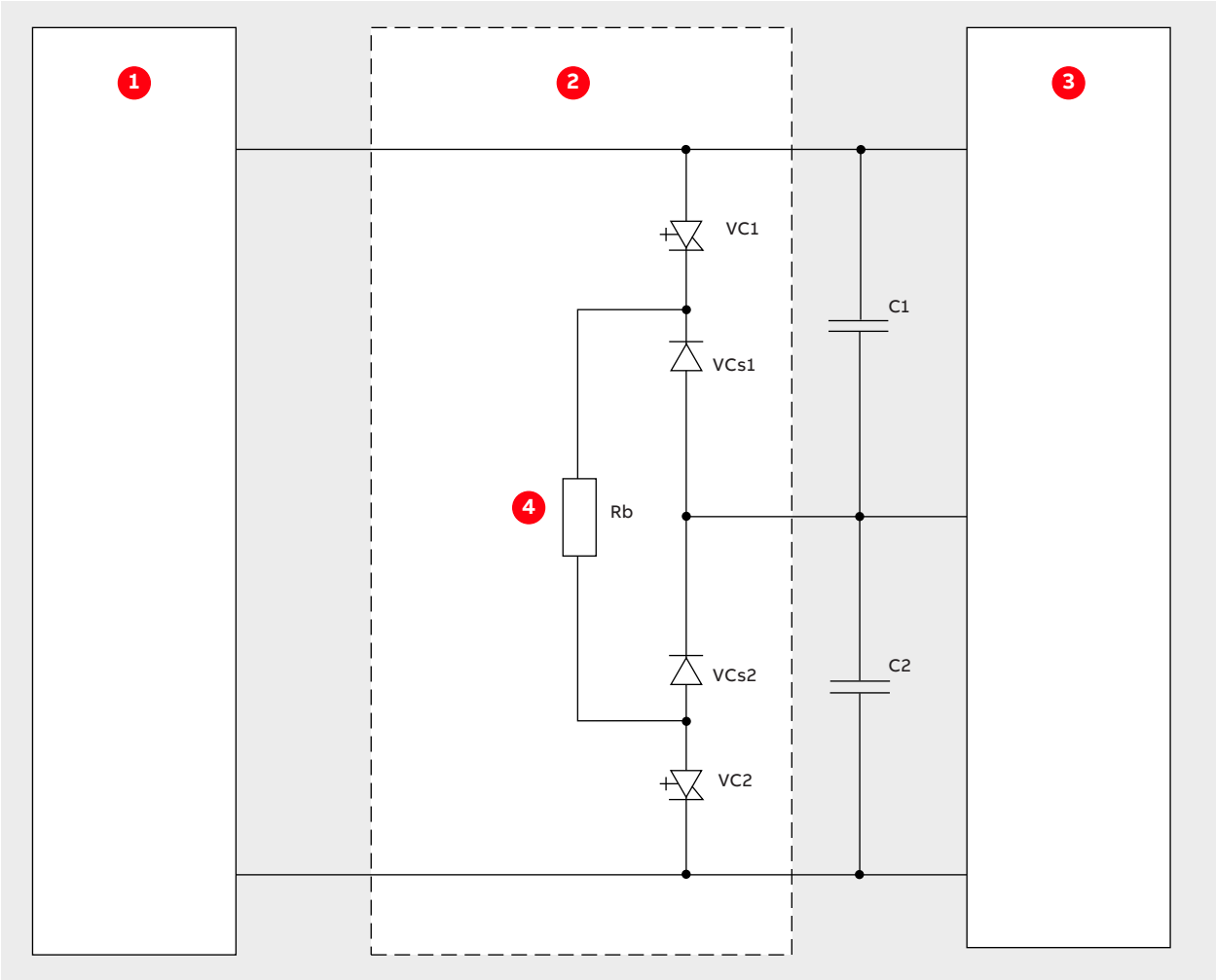


Fig. 16. ACS1000W water-cooled with (1) braking chopper

The braking chopper is controlled and monitored by the ACS1000W.



Key:

(1) Rectifier

(2) Inverter

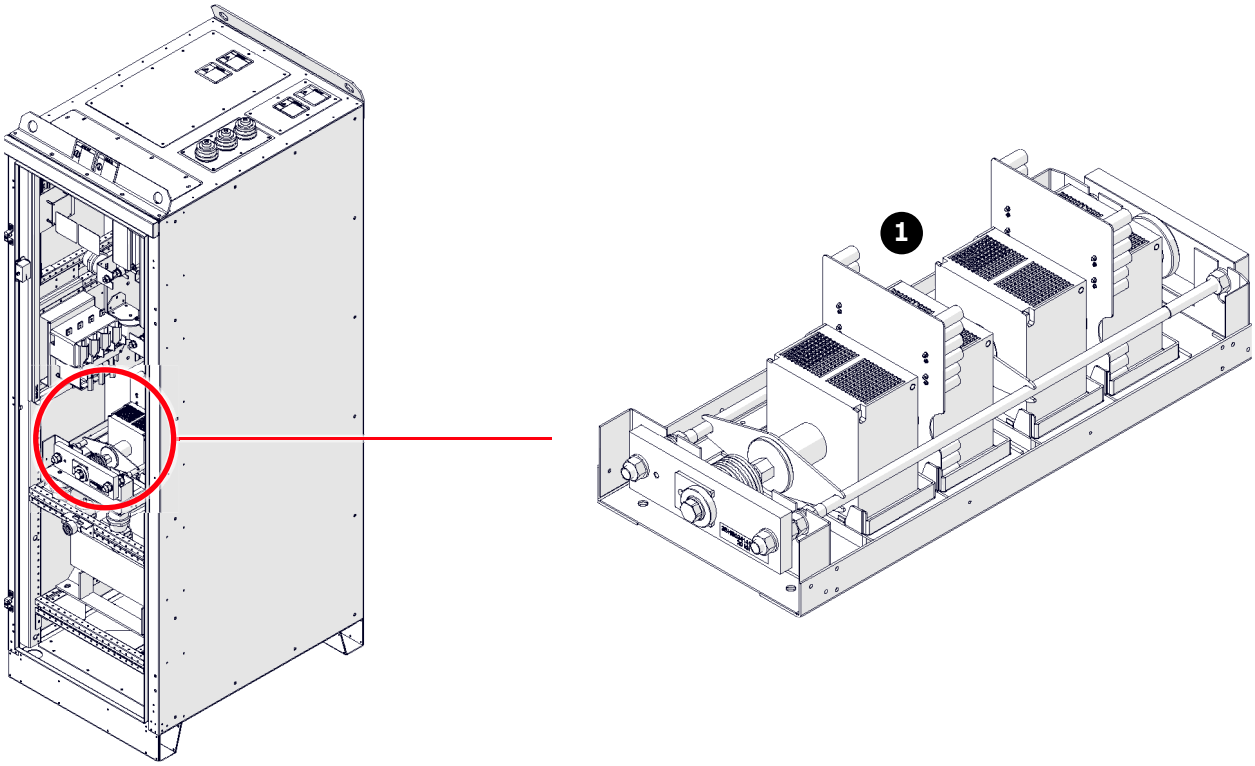
(3) Braking resistor

(4) Braking chopper

Fig. 17. Principle diagram

3.4.8.1. Control principle

If the DC-link voltage rises above a preset limit, the control system of the ACS1000W automatically activates the braking chopper. A rise of the DC-link voltage can be caused by a machine, feeding into the DC link or by an increase of the voltage in the rectifier of the ACS1000W.



Key:

(1) Semiconductor stack

Fig. 18. Braking chopper design

3.4.8.2. Monitoring and protective functions

Current monitoring

Input currents of the braking chopper are monitored for overcurrent and imbalance in order to detect any defective component in the circuit. The current can become imbalanced if one of the IGCTs conducts a current permanently or if an IGCT fails to be switched on.

If a short-circuit or an imbalance is detected in the braking chopper, the drive is shut down.

Thermal protection

The braking chopper and the braking resistors are monitored for over-temperature by the ACS1000W.

In addition, an external thermal protection device can be connected to a digital input. As soon as the temperature of the braking resistors exceeds the response threshold of the external thermal protection device, the operation of the braking chopper is disabled and an alarm message is displayed on the control panel of the ACS1000W. Braking is then only possible when the temperature falls below the threshold.

3.4.8.3. External cooling for braking resistors

A digital output and a digital input can be used to control and monitor an external cooling fan or pump for the braking resistors.

3.4.8.4. Braking chopper ratings

The maximum braking power is limited to 60% of the nominal power of the ACS1000W and must not be greater than 2.5 MW (Table 2).

The relation between maximum braking energy ($E_{brake\ max}$) and maximum chopper braking power ($P_{chopper\ max}$) is as follows:

$$E_{brake\ max}(MWs) = P_{chopper(max)}(MW) \times 30\ sec \quad [1]$$

After a braking period of 30 s with maximum braking power (2.5 MW), a cooling time of one hour is required. If two braking sequences of 30 s are necessary within an hour, the maximum braking power has to be reduced to 50% of the maximum possible braking power.

TABLE 2 Braking ratings

ACS1000W			Braking chopper	
Type	**Max. DC-link voltage (V)**	**Maximum braking power (MW)**	**Maximum braking power (MW)**	**Maximum braking energy (MWs)**
ACS1012-A1 ACS 1013-A1 ACS 1014-A1	4200 6000 7270	0.426 0.426 0.426	2.5	75
ACS1012-A2 ACS 1013-A2 ACS 1014-A2	4200 6000 7270	0.672 0.672 0.840	2.5	75
ACS1012-A3 ACS 1013-A3 ACS 1014-A3	4200 6000 7270	0.960 1.080 0.960	2.5	75
ACS1012-W1 ACS 1013-W1 ACS 1014-W1	4200 6000 7270	1.350 1.500 1.350	2.5	75
ACS1012-W2 ACS 1013-W2 ACS 1014-W2	4200 6000 7270	1.680 2.130 2.130	2.5	75
ACS 1013-W3 ACS 1014-W3	6000 7270	2.500 2.500	2.5	75

TABLE 3 Cabinet dimensions and weight

Length	644 mm
Depth	902 mm
Height	2002 (2070 including lifting eyes)
Weight	460 kg

TABLE 4 Braking resistor cables

Cable type	Shielded
Minimum cross sectional area	70 mm^2
Voltage rating	1/2 of maximum converter DC-link voltage If a multi-core cable is used, the full DC-link voltage must be taken into consideration.
Maximum length	50 m

The configuration and dimensions of the braking resistors depend on the specific application.

For information, see the “Dimensioning of braking resistors” application note.

3.4.9. Cooling systems

See the user manual for the water cooling unit of the drive in “Appendix A - Additional manuals”.

3.5. Cabinet design

The riveted and folded cabinet construction of the drive ensures a strong, flexible and self-supporting framework. The construction avoids the need for additional skeletal support and provides effective protection against electromagnetic emissions.

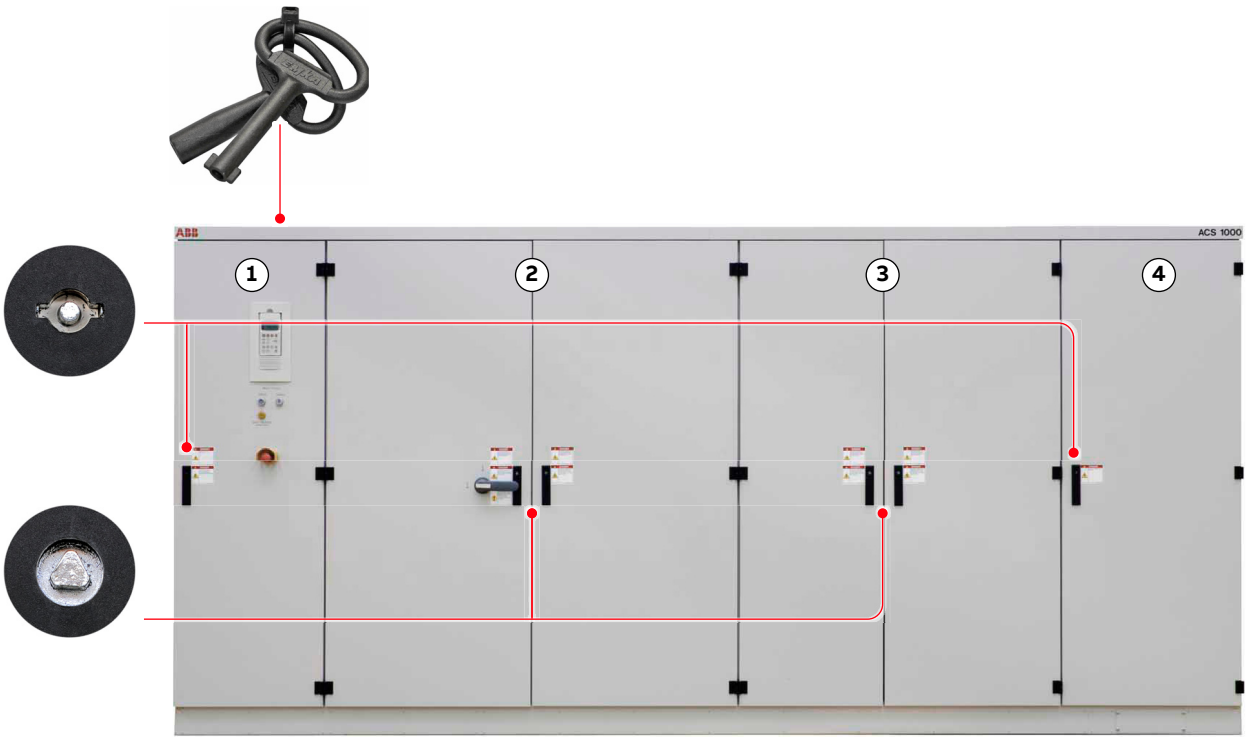
EMC has been achieved by applying a cabinet design consisting of folded, galvanized sheet metal plates (approximately 2 mm thick) and minimizing the space between the rivets. The inside walls of the cabinet are not painted, because paint tends to reduce the effectiveness of metallic bonding which is important for successful EMC.

Accordingly, only the front of the cabinet is painted while all other walls are galvanized. However, the cabinet can be ordered optionally with the whole of the outside painted. EMC performance is further enhanced by the use of metal cable ducts.

3.6. Door locking system

To ensure safety and to prevent the doors being opened unintentionally, all doors are lockable. The doors of compartments where medium voltages are present during operation (2, 3, Fig. 19) are electro-mechanically secured.

Additionally, the doors of the medium voltage compartments have locks with different inserts than the control compartment door. The different lock inserts ensure that these doors can only be opened by personnel authorized to do so.



Key:		Explanation
(1)	Door of control compartment	Lockable and partition of terminal compartment behind control compartment is bolted
(2)	Door of DC-link and filter compartment	Electro-mechanically locked, ie, door cannot be opened when the drive is energized.
(3)	Door of rectifier and inverter compartment	Electro-mechanically locked, ie, door cannot be opened when the drive is energized.
(4)	Door of water cooling compartment	Lockable

Fig. 19. Door locks

For more information, see Section 11.6.2, “De-energizing the drive locally”, page 146.

3.6.1. Optional cabinets

If medium voltages are present in an optional cabinet during operation (eg, braking chopper and output disconnector), the door is secured by an electro-mechanical lock as well as a door monitoring switch. If the cabinet is UL certified, the door is further secured with extra screws. The lock and the switch release the door after the DC link of the drive has discharged and the drive has been grounded.

3.7. Arc resistant design (optional)

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

The ABB arc resistant classes in Table 5 indicate the type of arc proofing that a drive has. Depending on the drive configuration, classes I, II and III are available for an ACS1000W.

For information on the arc resistant design class of your drive, see the project-specific “Converter Data Sheet” (“Appendix B - Technical data” of the ACS1000W user manual).

TABLE 5 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 on the control compartment door of the drive.

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	6 kA	0.5 s	Yes	No
Distance [m]	0.3	0.3	0.3	-	-				

3BHB049908R1206

Fig. 20. IAC label example

3.7.2. Power compartment doors

As part of the arc resistant design of the drive, the doors of the power compartments must be secured with bolts and washers, which are in a bag (Fig. 21) in the loose parts box. The drive frame has captive nuts for the bolts.

Fig. 21. Door bolts

3.7.3. Associated protection requirement

The arc resistant design requires associated protections that are not included in the scope of the delivery, ie, a main circuit breaker.

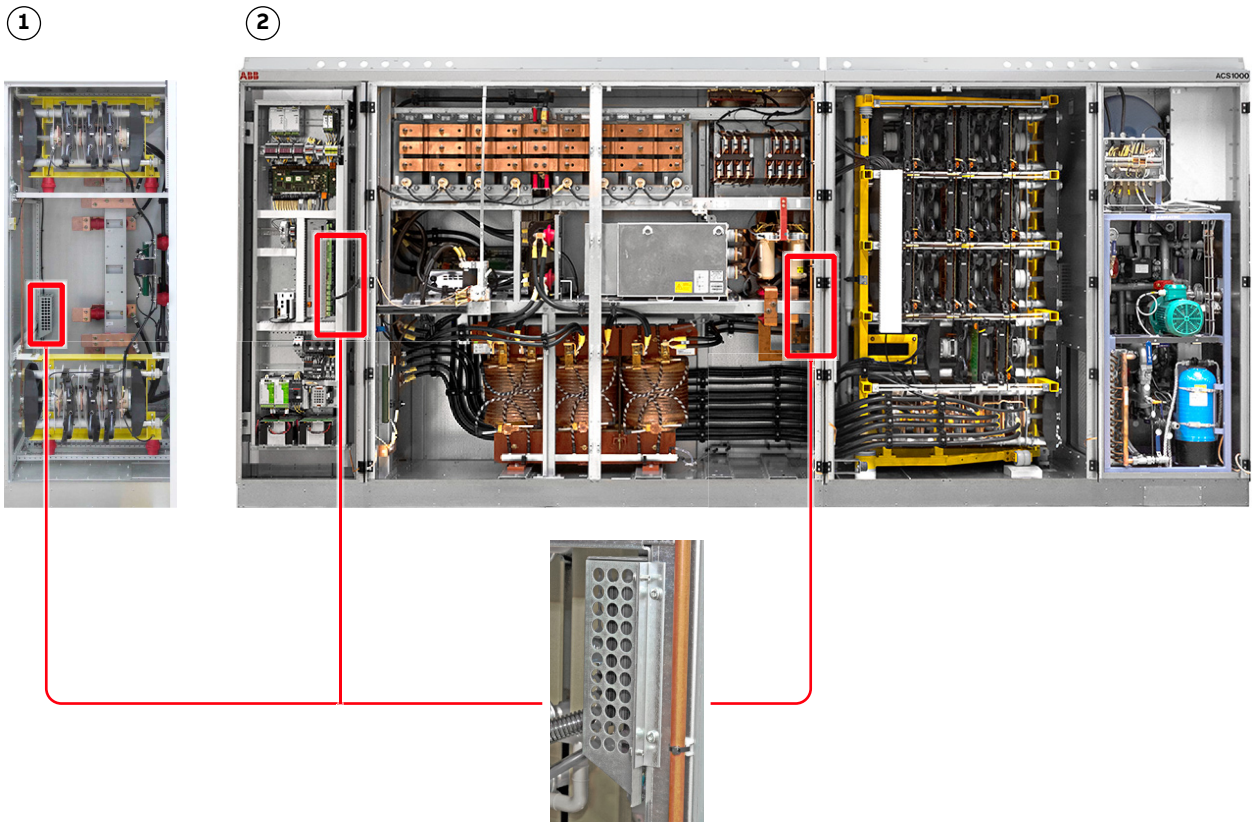
For more information on the MCB:

- MCB overview: Section 2.4, “Main circuit breaker protection device”, page 25
- MCB requirements: “Input circuit breaker engineering guideline”, 3BHS104785 E01

3.8. Space heaters

The optional space heaters protect the cabinet from condensation.

The drive switches on the space heaters when the cooling system is switched off.



Key:

(1) Drive with 24-pulse rectifier

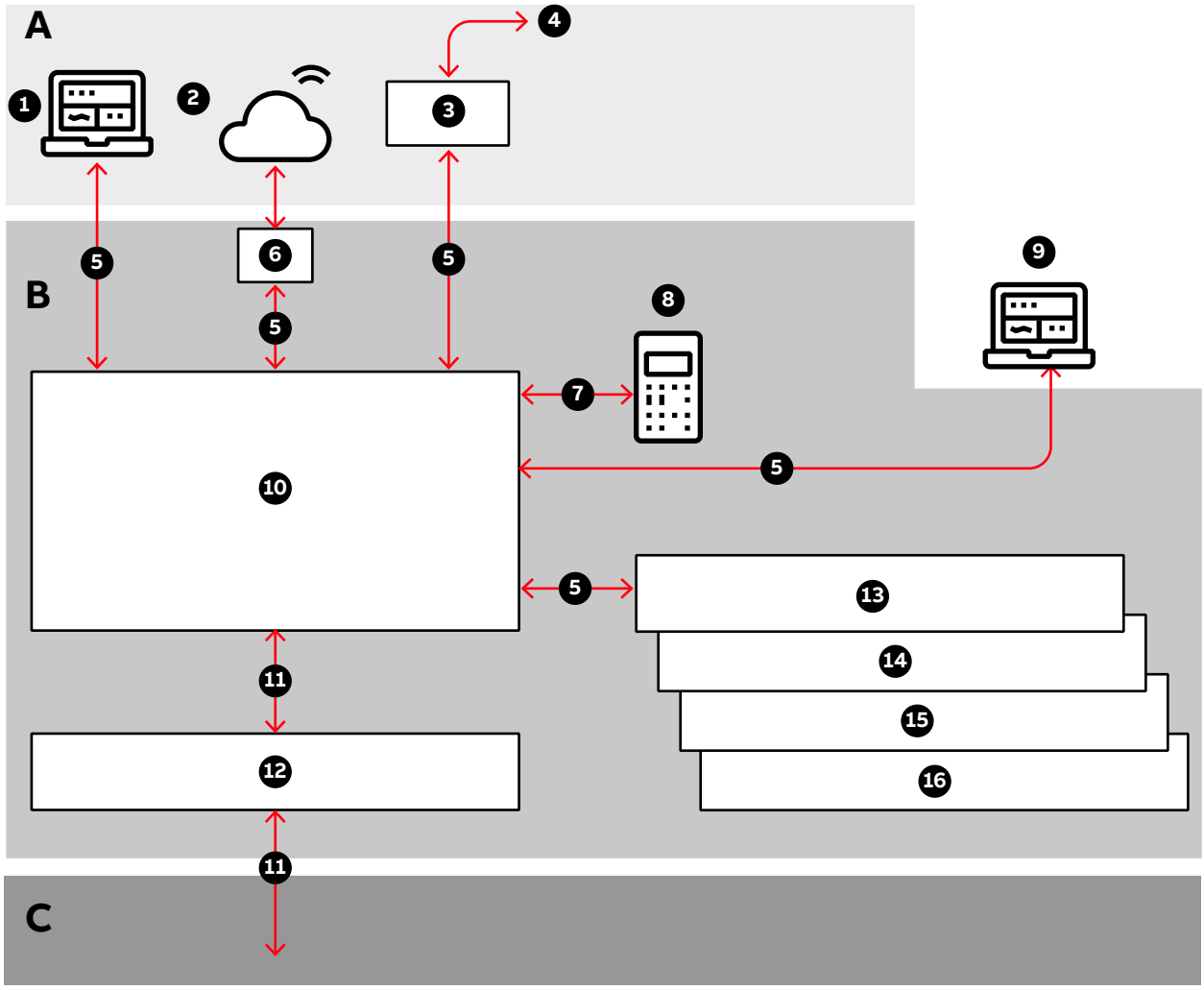
(2) Drive with 12-pulse or 24-pulse rectifier

Fig. 22. Optional space heaters

4. Control system

4.1. Overview

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



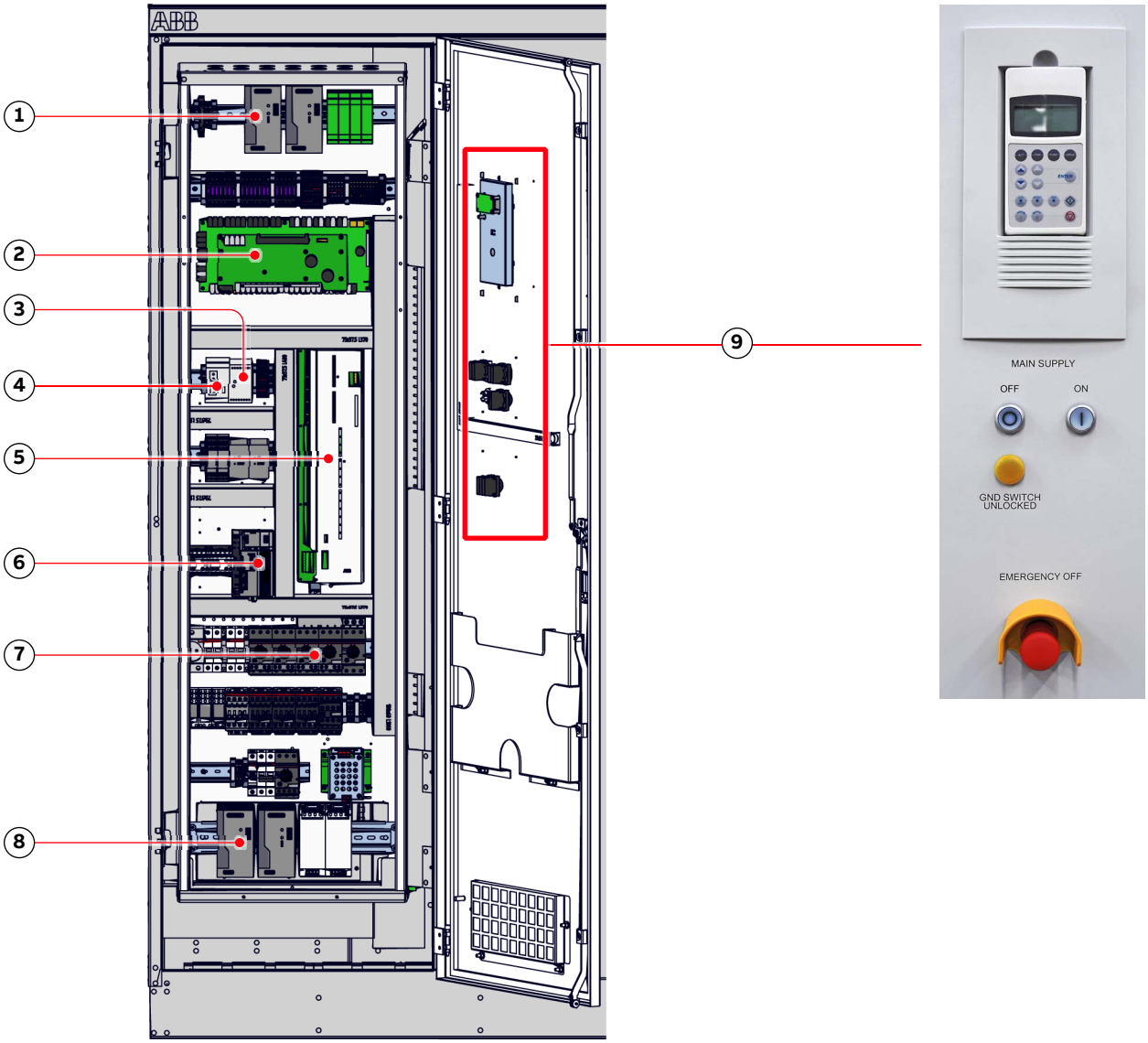
Key:

(1) ABB Ability
(2) Cloud connectivity
(3) Fieldbus
(4) Higher-level control system
(5) DDCS
(6) NETA-21
(7) RS485
(8) CDP control panel
(9) PC tools
(10) AMC circuit board
(11) Fiber-optics
(12) INT circuit board
(13) IOEC1
(14) IOEC2
(15) IOEC3 (optional)
(16) IOEC4 (optional)

Fig. 23. Block diagram of control system with (A) customer interface, (B) control system and (C) power electronics

4.2. Main components

This section provides an overview of the main hardware components of the control system and their interconnection.

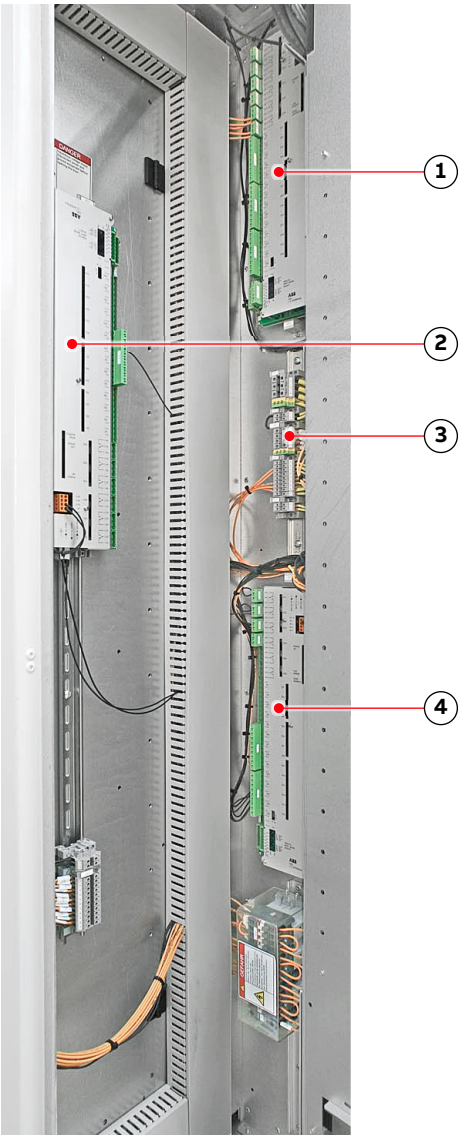


Key:

(1) Control power supply
(2) AMC circuit board and INT circuit board
(3) Pulse encoder (option)
(4) Fieldbus interface (option)
(5) IOEC1 module
(6) NETA-21
(7) Motor starters and circuit breakers
(8) Control power supply
(9) Local control panel

Fig. 24. Control compartment

- For information on the devices present in the control compartment, see “Appendix D - Wiring diagrams”.
- For information on the transformer protection, see “Appendix A - Additional manuals”.
-



Key:

(1) IOEC2 module (standard)
(2) IOEC4 module (option)
(3) Auxiliary voltage terminals
(4) IOEC3 module (option)

Fig. 25. Control compartment – I/O devices

For more information on the devices present in the control compartment, see “Appendix D - Wiring diagrams”.

4.2.1. Local control panel

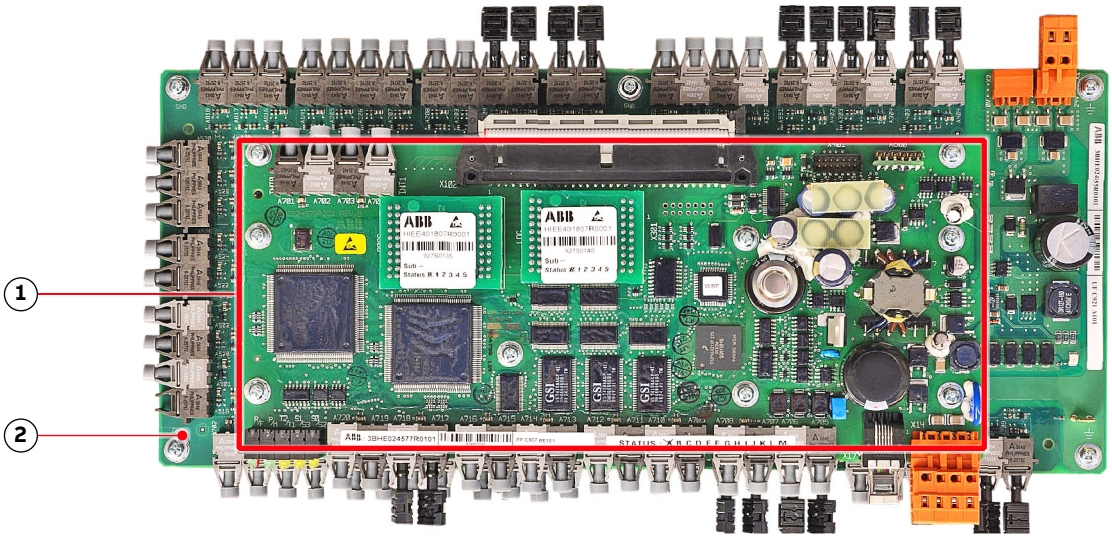
The local control panel on the door of the control compartment serves as the basic user interface for monitoring, control, operation of the drive, and setting of parameters.

For more information, see Chapter 9, “Operation”, page 104 and Chapter 10, “CDP control panel”, page 114.

4.2.2. AMC circuit board

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

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



Key:

(1) AMC circuit board

(2) Interface circuit board (INT)

Fig. 26. AMC circuit board

4.2.2.1. Control tasks

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

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

Optionally, the AMC circuit board can monitor signals from external equipment. These can be activated and adjusted with parameters.

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

- Section 2.4, “Main circuit breaker protection device”, page 25
- Section 3.4.4, “Grounding switch”, page 35
- Section 3.4.9, “Cooling systems”, page 42

4.2.2.2. Parameters

The control system is configured, customized, and tuned with a set of application parameters. The application parameters are organized in functional groups and have factory-set default values. The default parameter values are adjusted during commissioning to the specific application of the drive in order to activate the specific control, monitoring and protection functions for the driven process, and to define the signals and data transferred between drive and external equipment.

For more information on the parameters for signal allocation, signal type selection, signal inversion, scaling, and filtering, see “Appendix G - Signal and parameter table”.

4.2.2.3. Main circuit breaker

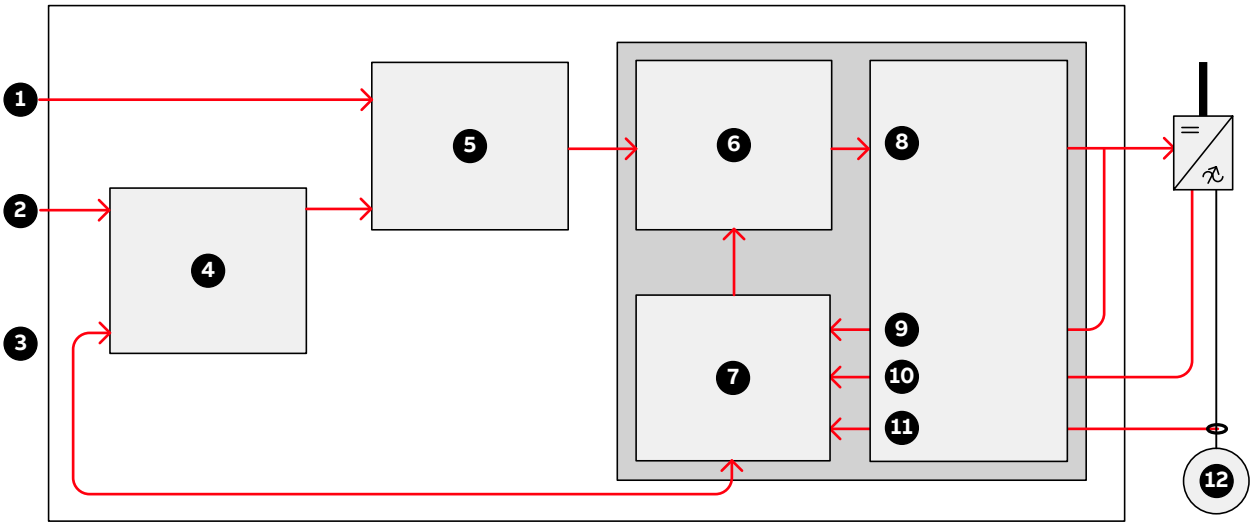
The main circuit breaker (MCB) is an important switching and protection device of the drive system. Therefore it must only be controlled and monitored by the drive.

For more information, see:

- “Input circuit breaker engineering guideline”, 3BHS104785 E01
- Section 2.4, “Main circuit breaker protection device”, page 25

4.2.2.4. Direct torque control

The speed and torque of the motor is controlled by DTC (Direct Torque Control). DTC provides accurate speed and torque control, and high dynamic speed response.



Key:

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

Fig. 27. Direct torque control

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

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

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

4.2.2.5. Peripheral I/O devices

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

- Local CDP control panel
- IOEC I/O modules for parallel signal transfer to external devices (see Section 4.3.1, “IOEC I/O modules”, page 53)
- Serial communication interface (fieldbus) for serial data transfer to a higher-level control system (see Section 4.3.2, “Serial communication interface (fieldbus)”, page 58)
- Pulse encoder interface NTAC (option) (see Section 4.3.3, “Pulse encoder interface NTAC (option)”, page 58)
- PC-based service tools comprising:
  - DriveWare® software tools, commissioning and maintenance tools, ie, DriveWindow and DriveDebug, and DriveOPC for data transfer between ABB drives and Windows®-based applications.
  - NETA-21 for monitoring and diagnostics tool that allows access to the drive from any location in the world via a secure Internet connection.

4.2.2.6. Control modes

The drive provides the following control modes:

- **Speed control mode:** Default control mode of the drive. The control mode can be used for applications where constant speed is required, such as pumps, fans and conveyors.
- **Torque control mode:** used for processes that require torque control (eg, mixers and slave drives). The torque reference comes from a process control system or a control panel.
- **PID control mode:** controls the process variable (eg, pressure, level or flow) by adjusting the speed of the motor accordingly.

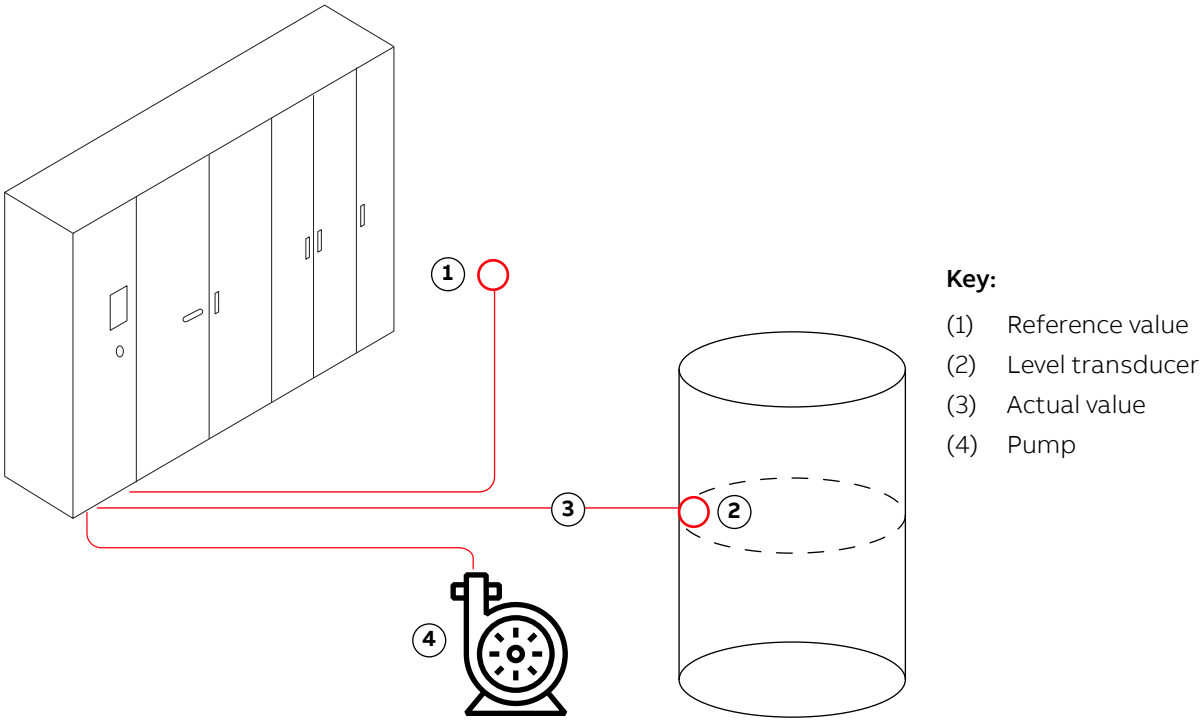


Fig. 28. PID control mode

Application examples:

- Booster pumps of municipal water supply systems
- Automatic level control of water reservoirs
- Booster pumps of district heating systems
- Speed control of different types of material handling systems where the material flow has to be regulated.
- **Sequential control mode:** used in processes that require different constant speed settings and/or different acceleration and/or deceleration settings in addition to an adjustable speed reference value.

  Up to seven constant speed settings and two acceleration and/or deceleration settings are possible. The selection of the different settings can be automated by a process control system or can be made manually by selector switches that are connected to the corresponding digital inputs of the drive.

The preset values of a control mode can be left unchanged or they can be set individually by the commissioning engineer as required for the application.

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

4.2.2.7. Operating modes

The drive provides the following operating modes:

- **Master-follower operating mode:** used for applications with several drives where the motor shafts are coupled to each other (eg, gearing, chain, belt). Owing to the master-follower operating mode the load can be evenly distributed between the drives or at some adjustable other ratio which depends on the process.
- **Hand-auto operating mode:** suitable for applications where the speed has to be controlled automatically by a process automation system and manually by an external control panel. The active control station is selected via a digital input.

  The operating mode is also recommended when two external control stations exist from where the reference value can be set and the drive can be started and stopped. The external control station is selected via a digital input.

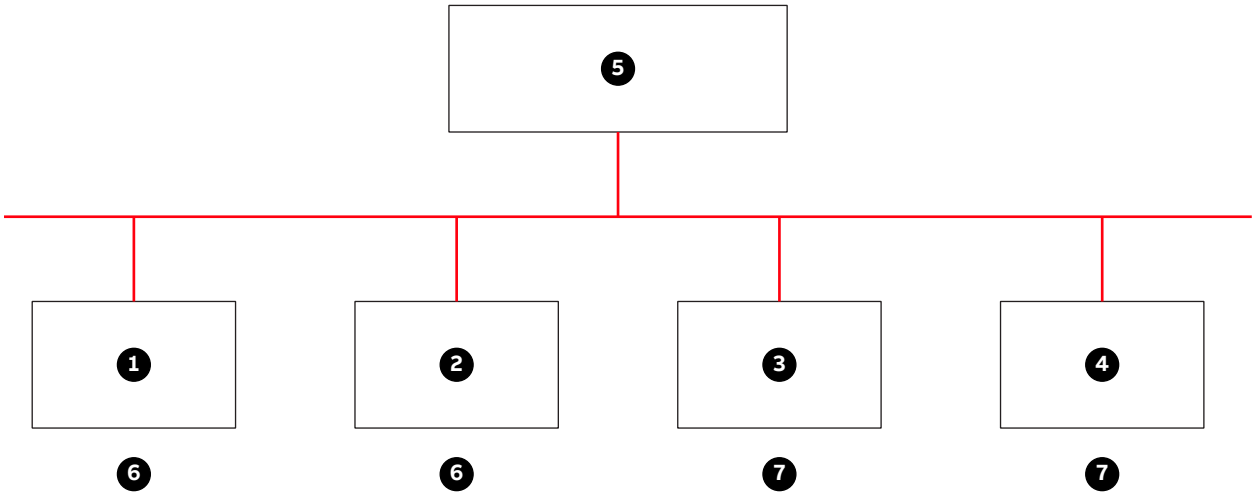
4.3. I/O interfaces

4.3.1. IOEC I/O modules

Internal and external, analog and binary I/O signals are connected to the control system by IOEC modules.

The standard I/O includes one external module (IOEC 2, IOEC 3) and one module that is internal to the drive operation (IOEC 1). The standard I/O provides standard control and supervision functionalities sufficient for most applications.

The drive can include an optional expansion I/O that includes an external module (IOEC 4). These expansion modules provide extra inputs and outputs for control and supervision as may be required by the drive or the customer to support various control options.



Key:

(1) IOEC 1
(2) IOEC 2
(3) IOEC 3
(4) IOEC 4
(5) AMC circuit board
(6) Standard
(7) Option

Fig. 29. IOEC interfaces overview

4.3.1.1. IOEC module configuration

Each IOEC module is configured with both analog and digital inputs and outputs as shown in Table 6, Table 7, Table 8 and Table 9.

TABLE 6 IOEC module configuration - analog inputs

No. of I/O	4
Resolution	10 bit
Signal interface	Floating, galvanically isolated
Signal level	0 - 20 mA, 4 - 20 mA, 0 - 10 V, 2 - 10 V Individually scalable by parameter
Input resistance	R_{in} = 105 Ω for current input R_{in} = 250 k Ω for voltage input
Common mode voltage	Maximum: 48 V
Isolation level	350 V (AC)

TABLE 7 IOEC module configuration - analog outputs

No. of I/O	2
Signal range	0 - 20 mA (load impedance: max. 250 Ω)
Resolution	12 bit
Isolation level	350 V (AC)

TABLE 8 IOEC module configuration - digital inputs

No. of I/O	14
Signal level	22 - 120 V (DC) [1] 22 - 250 V (AC)
Logical threshold	< 13 V (AC or DC) ≙ "0", > 16 V (AC or DC) ≙ "1"
Input current	13 mA steady state (14 mA max. inrush) at 24 V (DC) 11.5 mA steady state (80 mA max. inrush) at 120 V (DC) 10.5 mA steady state (92 mA max. inrush) at 230 V (AC)
Isolation level	1350 V (AC)

[1] For the 80 to120V range, an IOEC adapter board is required.

TABLE 9 IOEC module configuration - digital inputs

No. of I/O	6		
Signal level	Maximum: 120 V (DC) or 250 V (AC)		
Isolation level	4000 V (AC)		
Switching capacity	**Voltage**	**Switching current**	**Steady state current**
	24 V (DC)	8 A	6 A
	24 V (AC)	8 A	6 A
	48 V (DC)	1 A	6 A
	48 V (AC)	8 A	6 A
	120 V (DC)	0.4 A	6 A
	120 V (AC)	8 A	6 A
	230 V (AC)	8 A	6 A

4.3.1.2. Internal voltage supply (24 V)

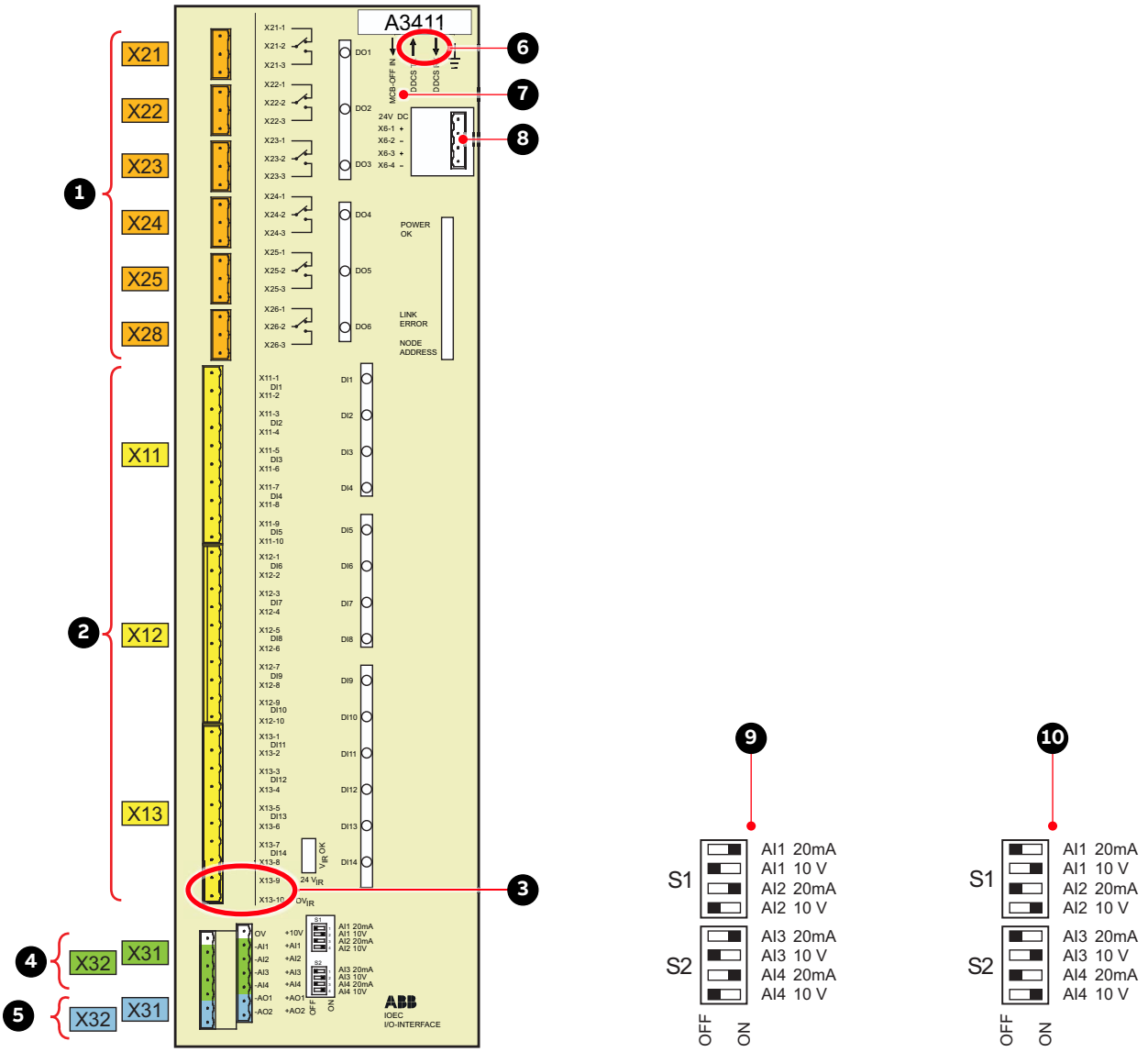
One isolated DC/DC converter supplies an overload protected voltage of 24 V (DC) to operate digital inputs from passive contacts. The output is protected by a PTC-resistor against short-circuit and external applied overvoltages.

TABLE 10 24 V internal voltage supply

Output voltage	Available output voltage
Unregulated 24 V	180 mA

4.3.1.3. Module terminals

The IOEC module has terminal blocks for internal wiring and indicator LEDs for diagnostic and I/O status.



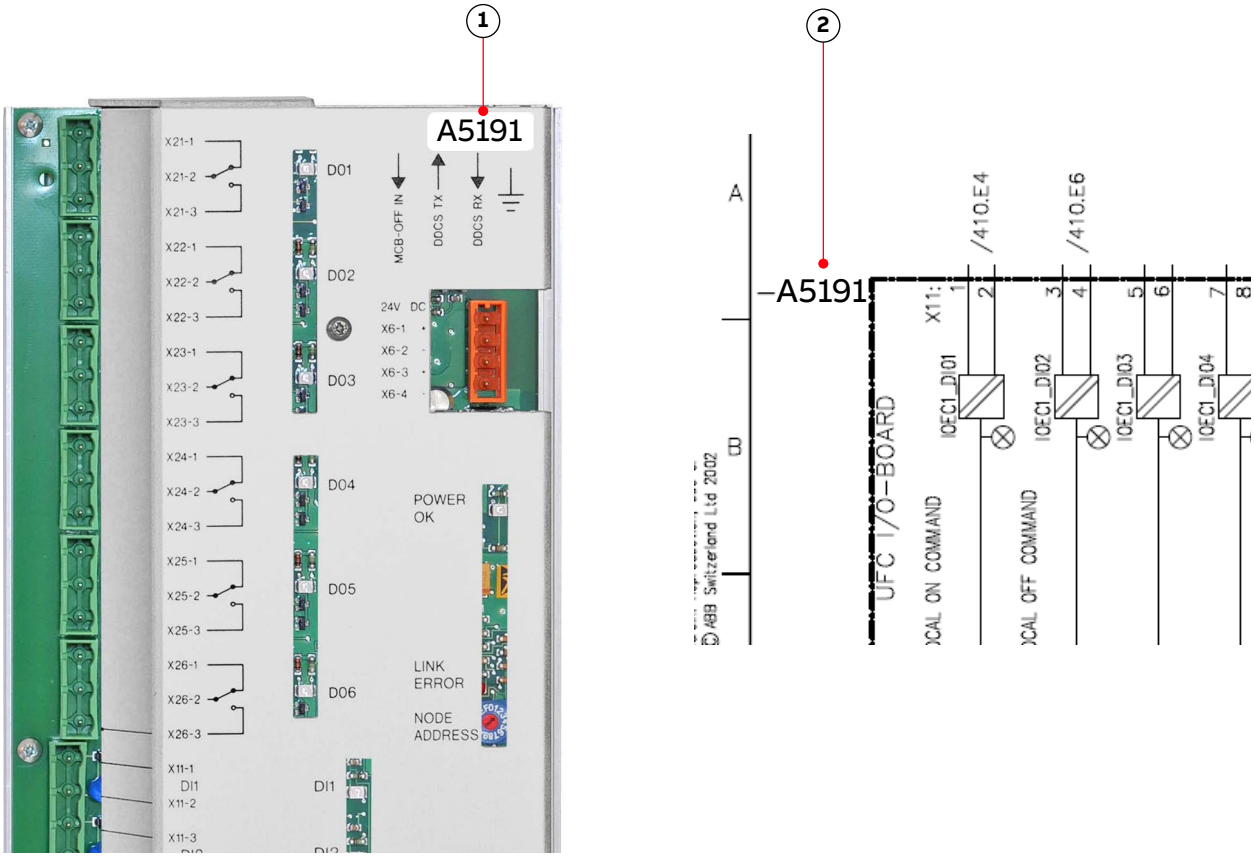
Key:

(1) Digital outputs
(2) Digital inputs
(3) 24 V internal voltage
(4) Analog inputs
(5) Analog outputs
(6) DDCS fiber optics
(7) I/O Emergency OFF function
(8) Power supply (factory-installed wiring)
(9) Voltage mode
(10) Current mode

Fig. 30. IOEC module

4.3.1.4. I/O device identification

The I/O modules are identified on the part with an identification label (1, Fig. 31), in the wiring diagram, and in the software by the wiring diagram identification number (2, Fig. 31).



Key:

(1) Identification label

(2) Identification number

Fig. 31. IOEC module identification

The way the identification number is built directly corresponds to the wiring diagram as can be seen in Fig. 31. The letter A represents the kind of part we have, an assembly, the next three digits are the page number the part is located on, page 191, and the last digit, 1, means that our part is the first assembly on the page. This identification label number is the key to track electrical devices throughout the drive and in the ABB documentation.

The designation for each IOEC module is shown in Table 11.

TABLE 11 IOEC module identification

I/O module type	Wiring diagram designation for module identification
IOEC1	A5191
IOEC2	A5201
IOEC3	A5211
IOEC4	A5221

4.3.2. Serial communication interface (fieldbus)

To identify the serial communication interface in the drive, see “Appendix D - Wiring diagrams”.

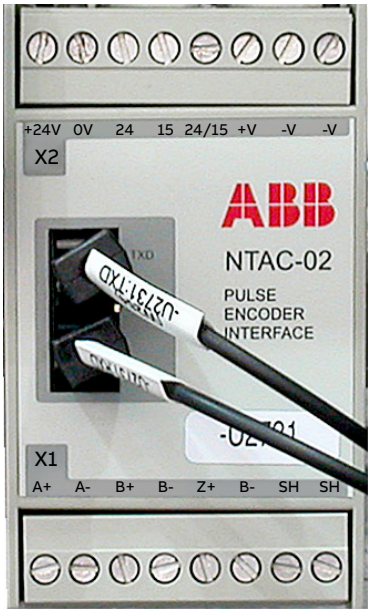
For more information on the device, consult the relevant manual:

- Modbus TCP - “Ethernet - NETA-21 remote monitoring tool user manual”, 3AUA0000096939
- Modbus RTU - “Modbus - NMBA-01 installation and start-up guide”, 3AFY58919772
- Profibus - “Profibus - NPBA-12 installation and start-up guide”, 3BFE64341588
- DeviceNet - “DeviceNet - NDNA-02 installation and start-up guide”, 3AFY58919829

4.3.3. Pulse encoder interface NTAC (option)

The NTAC interface is part of the control system of the drive if pulse encoder feedback is used to control the motor.

For more information on the device, see “Installation and start-up guide for the pulse encoder module NTAC-0x”, 3AFY58919730.



Terminals X1			Terminals X2		
1	A+	Channel A	1	-V	0 V
2	A-		2	-V	24 V
3	B+	Channel B	3	+V	
4	B-		4	24/25	
5	Z+	Channel Z	5	15	
6	Z-		6	24	
7	SH	Shield	7	0 V	
8	SH		8	+24 V	

Fig. 32. NTAC-02 pulse encoder interface

5. Transportation, storage and disposal

5.1. Safety

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

5.2. Transport conditions

The transport conditions for the drive are based on IEC 60721-3-2.

– **Transport conditions:** 2K12 / 2B1 / 2C2 / 2S5 / 2M4

– **Maximum transport time:** 2 months

5.3. 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.

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

5.4. Lifting and transportation

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!
- → Use a crane; DO NOT use a forklift
- → If the drive is delivered in several transport units, DO NOT lift and move the drive by crane after the transport units have been joined
- → Use suitable lifting gear for the load weight, eg, web slings, chain slings, round slings, and shackles
- → Only use the original lifting attachments with the original mounting bolts and washers 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 relevant dimensions and weights.

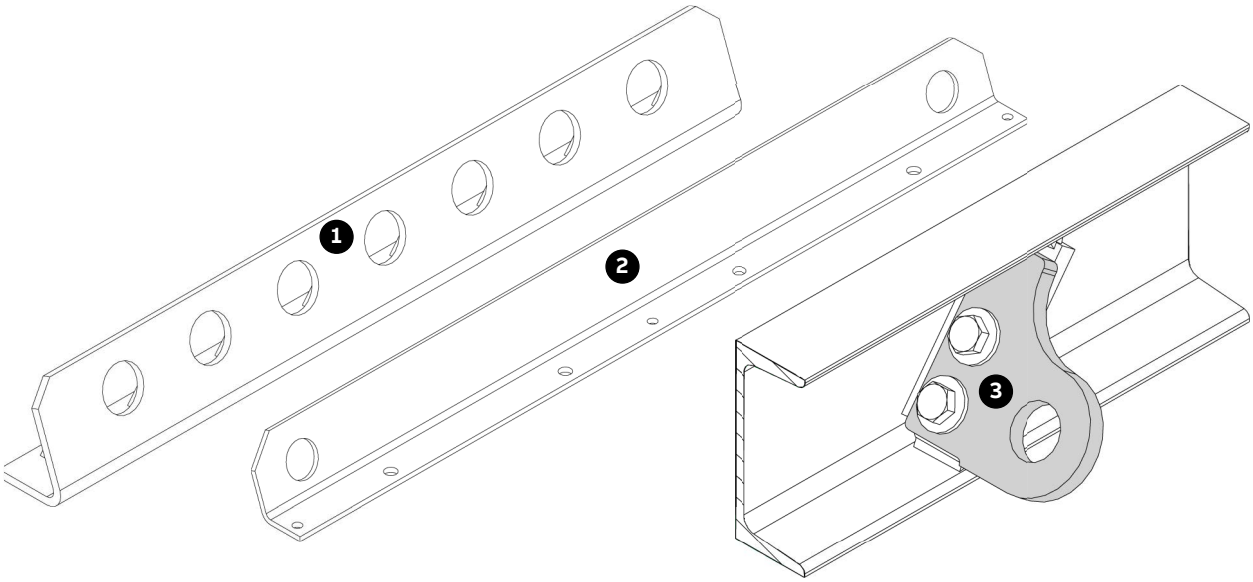
NOTICE

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

- → Keep the cabinet doors closed during lift operations

5.4.1. Lifting attachment types

IMPORTANT! The lifting attachments, which are included with the delivery, are intended exclusively for use with ACS1000W equipment. Any use beyond this is strictly prohibited. Only use the original lifting attachments to transport the equipment.



Key:		Explanation
(1)	Top lifting rail	For lifting a standard drive
(2)	Top lifting rail	For lifting an additional cabinet
(3)	Lifting plate (optional)	On base frame for lifting the drive

Fig. 33. Lifting attachment types

5.4.2. Lifting with the top lifting rails

The top lifting rails are on the roof of standard drives and additional cabinets.

1. Attach slings to the hole with the recommended lifting point labels (1) on each of the 4 top lifting rails, eg, with shackles (see Fig. 36).

   NOTICE If the labels are not visible, attach the slings to the middle holes of the rails.

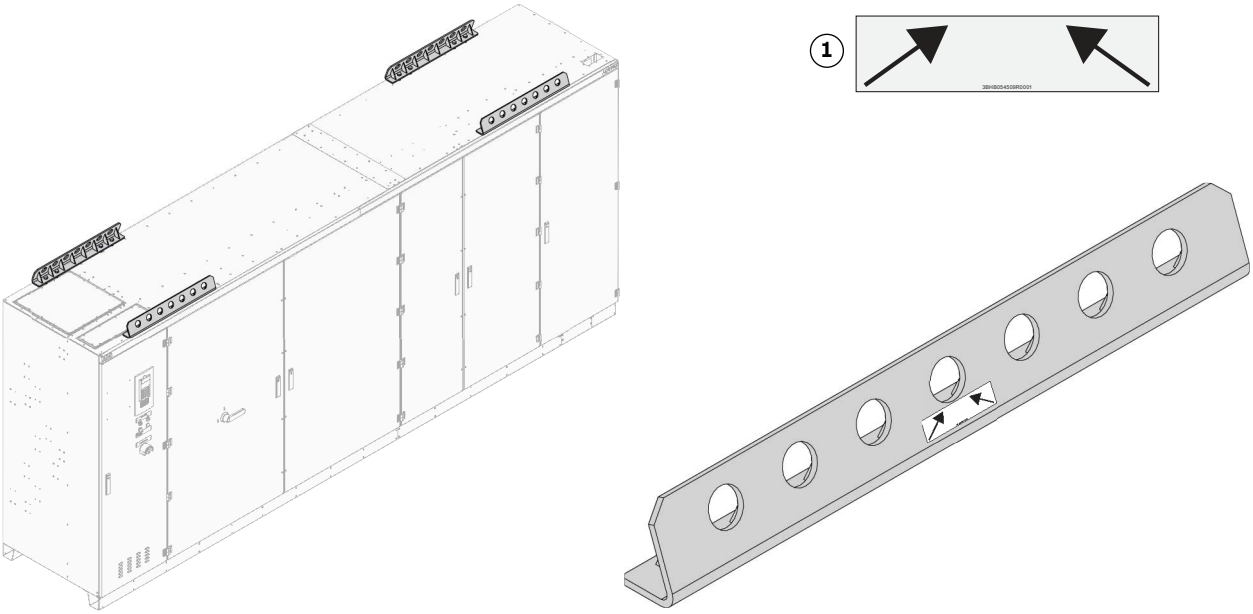


Fig. 34. Top lifting rails with recommended lifting points

2. Ensure that the maximum vertical slope angle of the slings is 60° (2, Fig. 36).
3. Lift the drive slowly and steadily to the required clearance height.

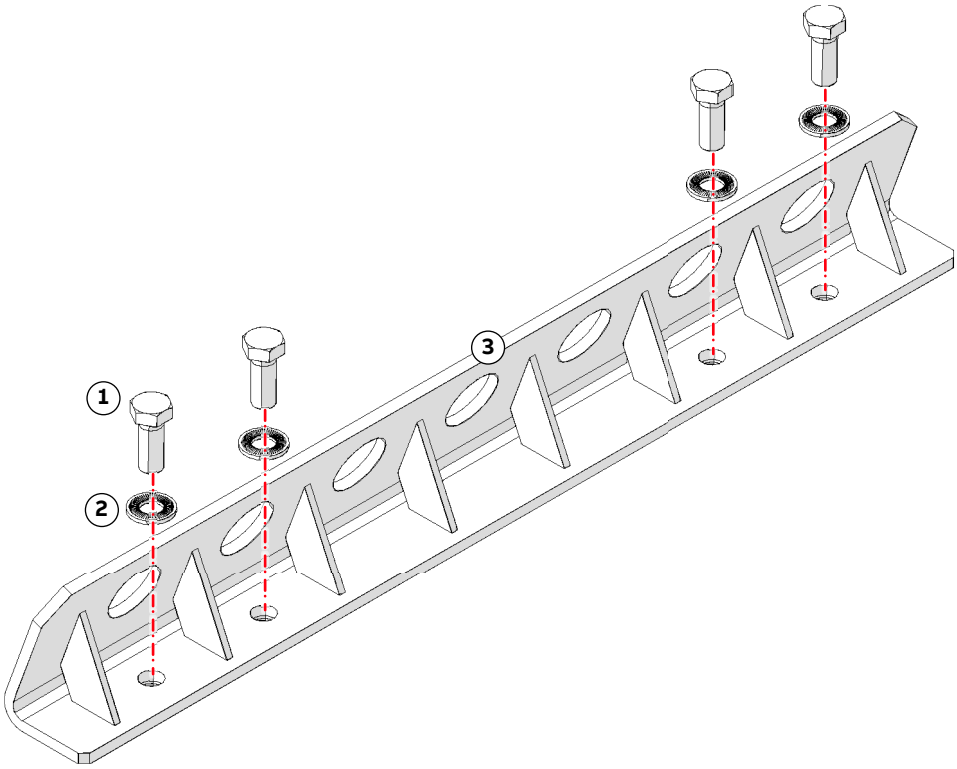
   CAUTION! If the horizontal position of the load does not remain stable, lower the drive to the floor, attach the slings to different holes on the top rails, and then lift the load again while checking the horizontal position.

If you need to remove the top lifting rails (special case only – ABB recommends that the rails remain on the roof):

4. Unbolt and remove the top rails (3, Fig. 35).

   NOTE – Keep the mounting bolts and washers for the next step.
5. Grease and re-insert the bolts with the washers from Step **4** into the mounting holes for the top rails on the roof.
6. Tighten the bolts to the torque that is specified in Table 12.

   The IP rating of the drive is restored.
7. Store the top rails in a dry, non-corrosive environment for when you need to move the drive again, eg, when the drive is at end of life (see Section 5.4.4, “Reinstalling lifting attachments”, page 65).



Key:

(1) Mounting bolt (min. A2-70)

(2) Ripp-Lock washer

(3) Top rail

Fig. 35. Mounting bolts and washers for top rail

5.4.3. Lifting with lifting plates (optional)

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

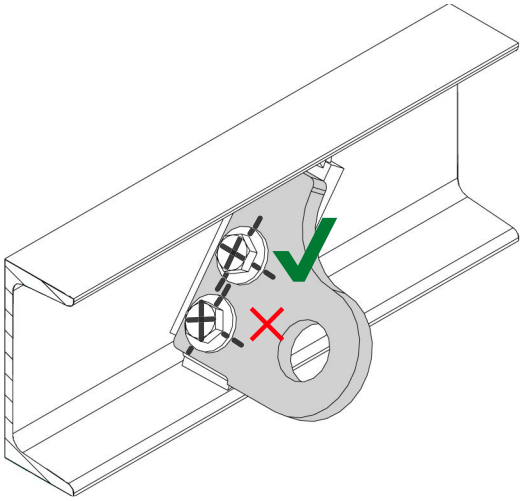
⚠ CAUTION

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

→ Ensure that the slope angle of the slings DOES NOT exceed 15° (1, Fig. 37).

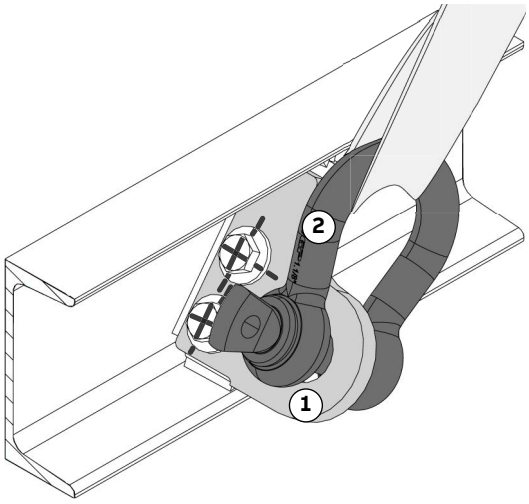
1. Verify that the factory torque marks on the mounting bolts and washers of the lifting plates are aligned.

   If the marks are not aligned or are not visible, tighten the mounting bolt to the torque that is specified in Table 12.



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

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



Referring to Fig. 37, page 66:

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

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

5.4.4. Reinstalling lifting attachments

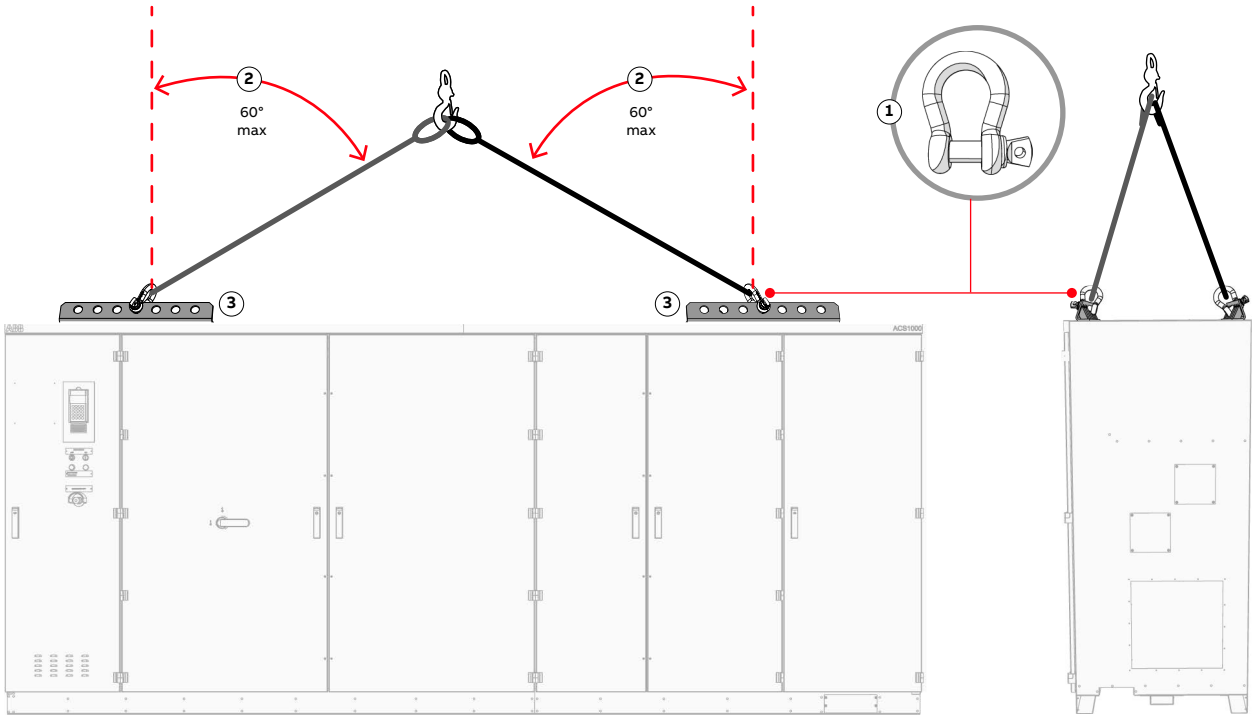
If you need to reinstall factory-mounted lifting attachments, eg, when the drive is at end of life, tighten the mounting bolts to the torque that is specified in Table 12.

TABLE 12 Lifting attachment specifications

Type	Mounting bolt and washer	Torque (Nm)	ABB ID
Top lifting rail for standard drive	4 × M16×40 (A2-70) Washer Ripp lock	204	NB 312350P0464 9ABA450078P0008
Top lifting rail for additional cabinet	3 × M8×25 combi screw 8.8	24	9ABA450093R0311
Lifting plate (optional)	2 × M16 × 40 (A2-70)	204	3BHB039841R0001

5.4.5. Sling configurations for lifting

5.4.5.1. Top lifting rails (standard)



Key:

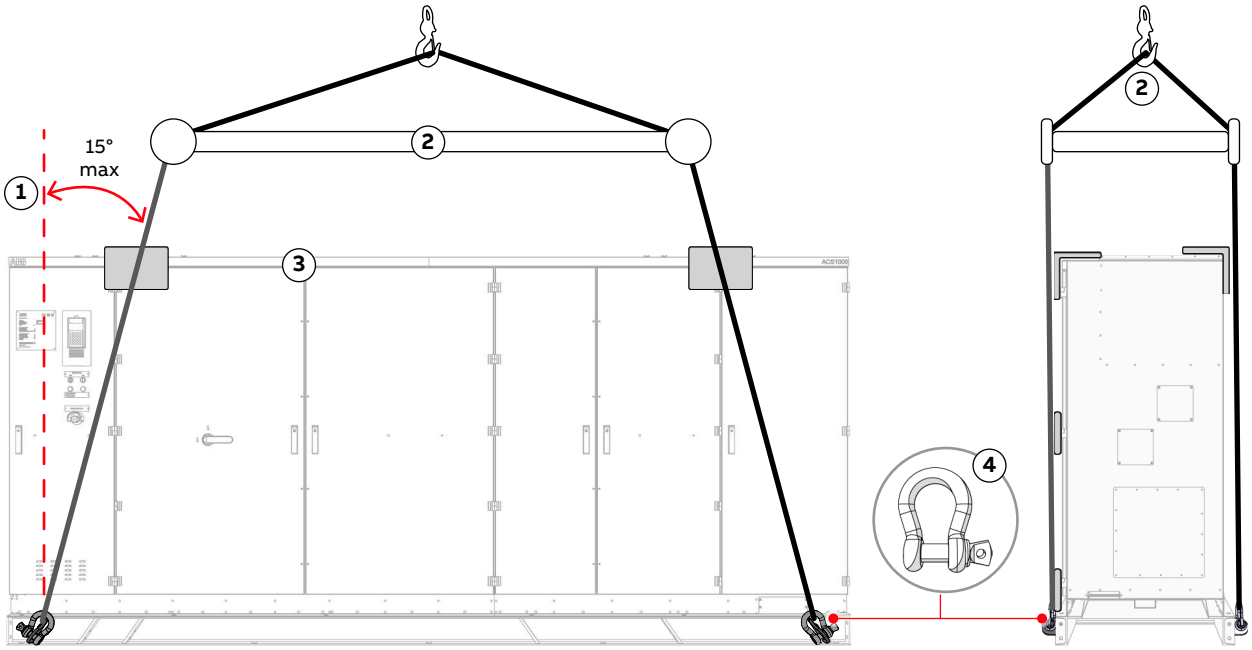
(1) Shackle

(2) Sling slope angle (maximum 60°)

(3) Top lifting rail

Fig. 36. Sling configuration - standard case with top lifting rails

5.4.5.2. Base frame lifting plates (optional)



Key:

(1) Sling slope angle (maximum 15°)

(2) Lift spreader

(3) Protect the edges

(4) Shackle

Fig. 37. Sling configuration (lift spreader shown) - optional case with base frame lifting plates

5.5. Storage

5.5.1. Storage conditions

The minimum requirements for storage are based on IEC 60721-3-1.

– **Conditions:** 1K22 / 1B1 / 1C2 / 1S11 / 1M11

5.5.1.1. Storage time

The drive can be stored for up to one year in the original packaging as long as it is not damaged or opened.

For information on longer storage periods, contact the ABB service organization.

5.5.2. Storing the drive

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

1. Drain the cooling circuit and leave the drain valves open for at least two hours to ensure a completely drained system (for information, contact the ABB service organization) 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 on frost-proofing, see the user manual for the water cooling unit.

2. Remove the batteries (if applicable).
3. Cover all cable inlets and ventilation slots with an impermeable plastic or aluminum foil and a wooden panel.
4. Add a desiccant of the appropriate quality:
   - 1 unit desiccant (30 g) absorbs 6 g water vapor.

   NOTE – The following quantity is needed when using a polyethylene foil:

   - 10 units/m^2 foil
5. Close and lock the doors of the cabinet.
6. Use polyethylene or equivalent for packaging:
   - 0,3 g/m^2/24h water vapor diffusion
7. Attach humidity indicators to the packaging.

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

5.5.3. Storage and handling of spare parts

NOTICE

Risk of component damage! Electronic devices (eg, circuit boards, semiconductors) are sensitive to electrostatic discharge (ESD), which can damage these devices. Observe the following to maintain spare parts in good condition and to keep the warranty valid during the warranty period:

→ Apply ESD handling precautions before handling these devices.

5.5.3.1. 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.

- 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 with NO condensation
  - Relative air humidity: 5 to 85%

    If in doubt whether the maximum allowed humidity is exceeded, protect the spare parts with an external heater.
- DO NOT touch a component without wearing a wrist grounding strap.
- Put the component on a grounded working surface protected against electrostatic discharges
- Hold the component only at the edge

5.6. Disposal of packaging materials and components

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

6. Mechanical installation

6.1. Safety

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

6.2. Overview of installation work

The installation includes the following work:

- “Preparing the floor”, page 70
- “Fixing the cabinet to the floor”, page 70
- “Installing the cabinet with the second rectifier”, page 73
- “Installing the redundant fan”, page 74
- “Preparing the water supply connections”, page 75
- “Checking the door center posts”, page 75

6.3. General notes on installation

NOTICE

Risk of component damage. Foreign matter, particularly metallic dust, can cause failure and damage when the drive is energized.

→ Remove all foreign matter from the cabinet.

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

6.3.1. Dimensions and clearances

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

- Cabinet dimensions
- Clearances to be observed
- Mounting hole sizes

6.3.2. Cabinet roof

The cabinet roof is not designed as a mounting base for, eg, foreign devices, cable ducts. Therefore, it is not permitted to install any foreign device on the roof.

6.3.3. Fire protection

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

6.3.4. Cable duct material

- Use non-flammable material with non-abrasive surface.
- To prevent dust, humidity and animals entering the cabinet, protect the cable entries.

6.4. Preparing the floor

Condition of the floor:

- Must support the weight of the cabinet
- Overall incline across 5 m must not exceed 5 mm
- Even
- Non-flammable, smooth and non- abrasive
- Protected against humidity diffusion

6.5. Fixing the cabinet to the floor

IMPORTANT! If the doors of medium voltage compartments cannot be opened, contact the ABB service organization.

Required layout drawings

Refer to the relevant layout drawing for detailed instructions on how to fix the cabinet to the floor:

- Standard cabinet base fixation: “Fixing & Lifting details ACS1000W”, 3BHS853483 E01
- Marine cabinet base fixation: “Fixing & Lifting details ACS1000W Marine”, 3BHS853483 E02
- Marine/seismic cabinet base and roof fixation: “Fixing & Lifting details ACS1000W Seismic”, 3BHS853483 E03

Procedure

1. Drill fixing holes into the floor as indicated on the relevant layout drawing.
2. When the cabinet is in place, check if the doors are misaligned.

   NOTE – If the doors do not open and close properly, place leveling plates at the appropriate points (arrows in Fig. 38).

– **Recommended size:** 80 x 300 x 0.5 mm

Fig. 38. Leveling the drive

3. Fix the cabinet to the floor according the relevant layout drawing (see “Required layout drawings”, page 70).

   NOTE – Floor fixings are not supplied.

Fig. 39. Location of screw holes in a standard cabinet base and anchor bolt example

4. Remove the two shipping braces.

   NOTE – Keep the shipping braces for later use.

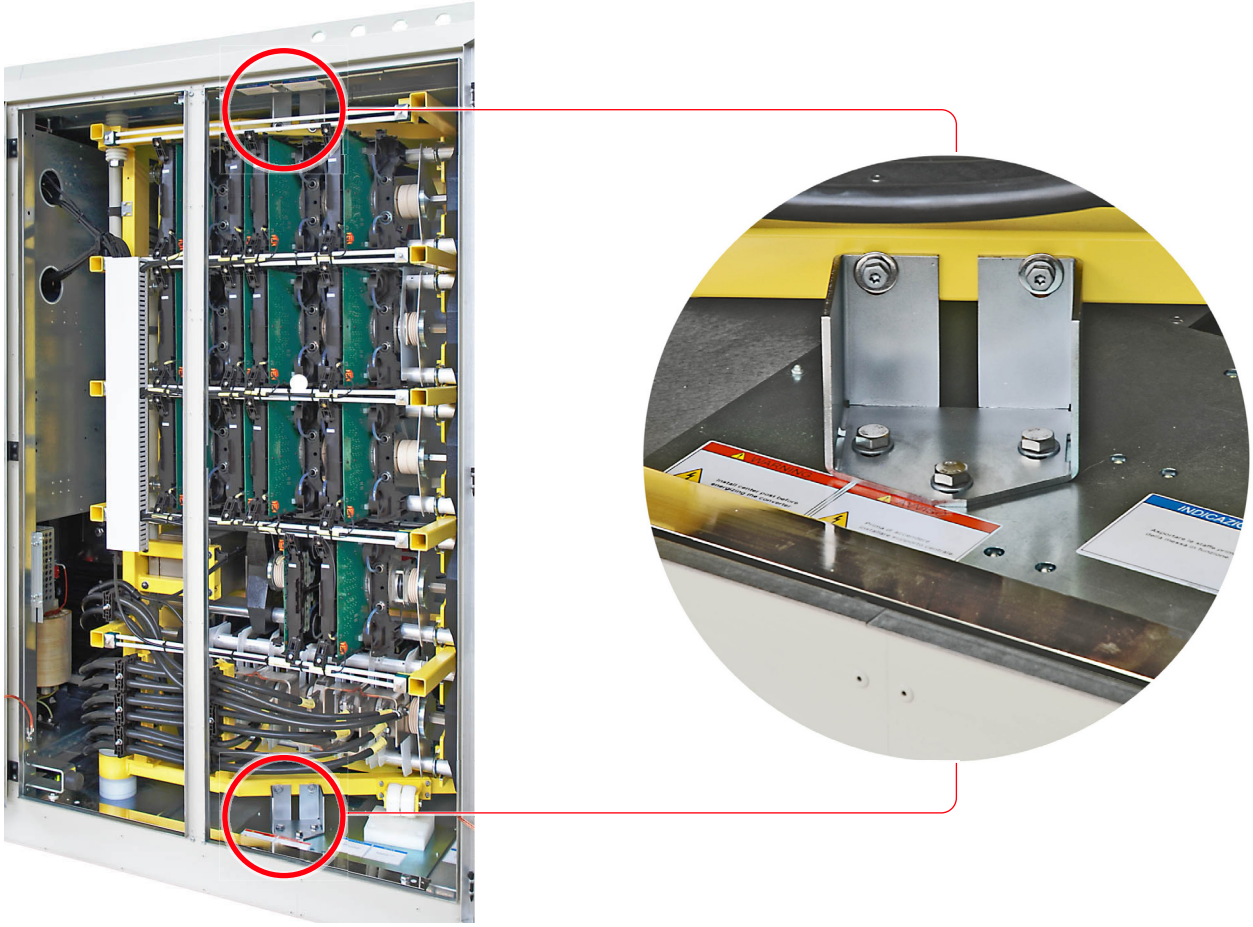


Fig. 40. Shipping braces

6.6. Installing the cabinet with the second rectifier

This section applies to 24-pulse drives if the cabinet with the 2nd rectifier is delivered separately.

1. Attach the cabinet to the drive with the supplied screws.
2. Connect the water tubes (1, 2, Fig. 41).
3. Connect the cables according to the wiring diagram.

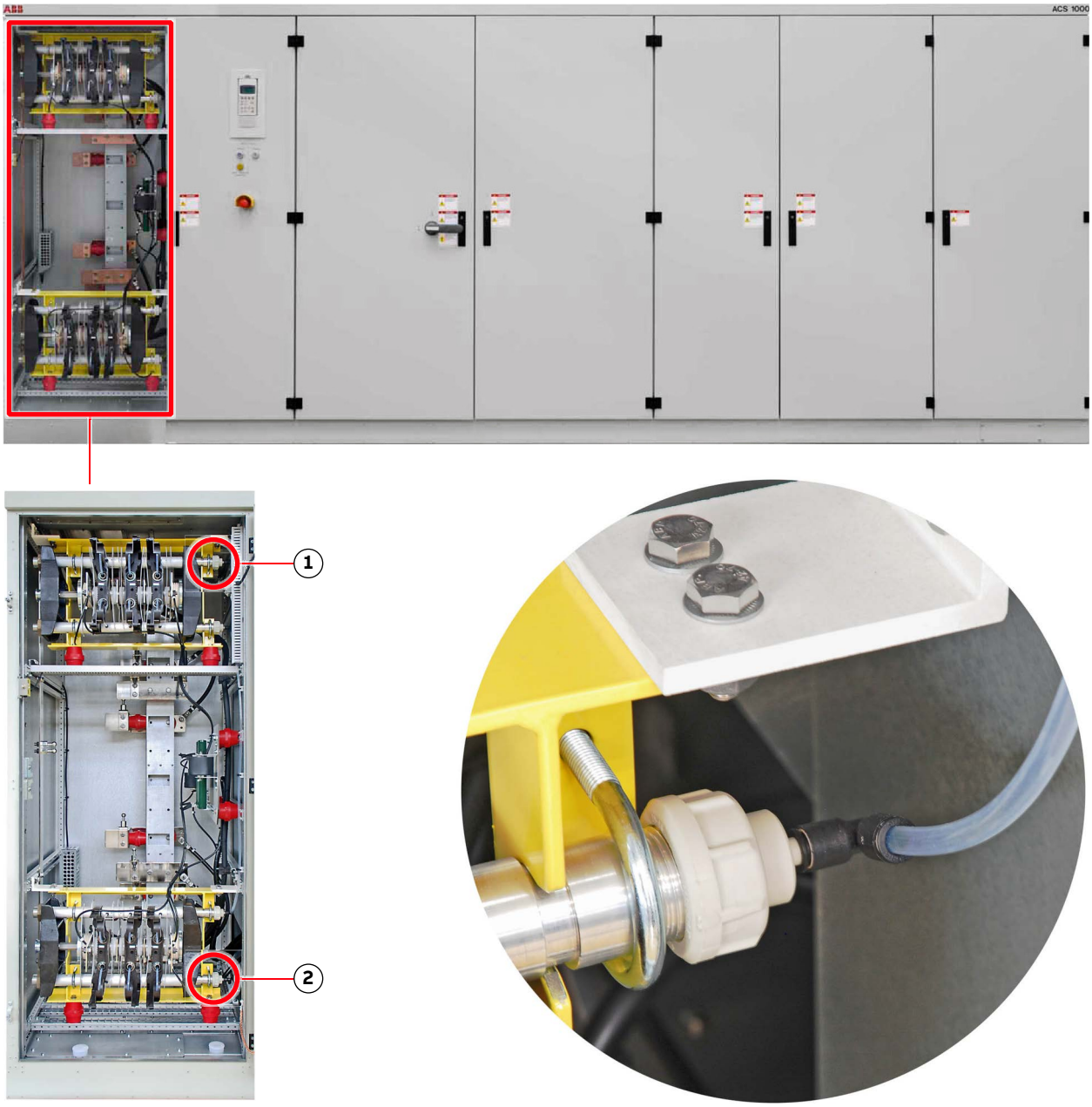
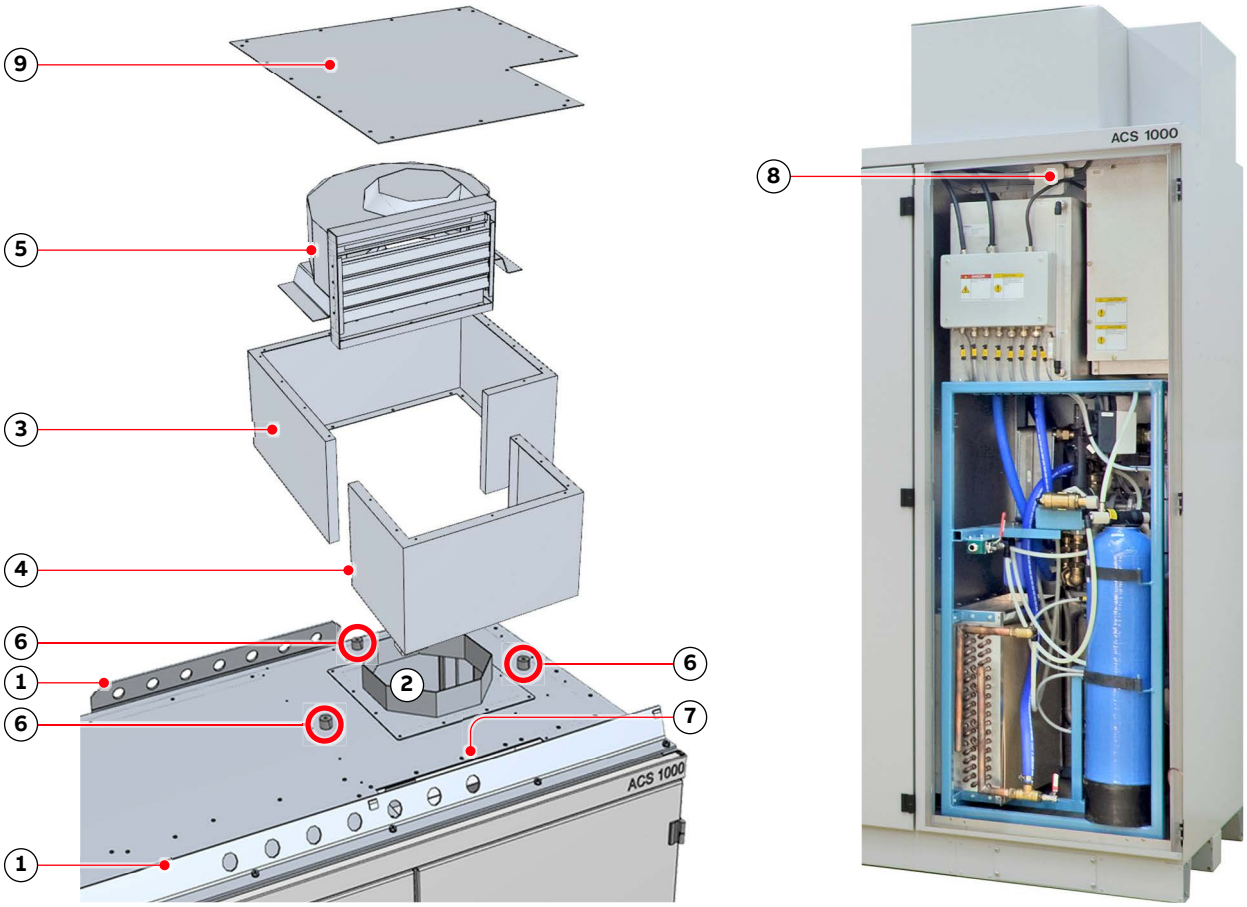


Fig. 41. Installing the cabinet with the second rectifier cabinet

6.7. Installing the redundant fan

This section applies to drives that are equipped with the optional redundant fan.

1. Remove the lifting rails (1, Fig. 42) and the cover (2, Fig. 42).
2. Fasten the two parts of the fan casing (3, 4, Fig. 42) to the roof and with each other.
3. Put the fan (5, Fig. 42) into the casing and fasten it to the vibration dampeners (6, Fig. 42).
4. Route the power supply cable through the rectangular opening (7, Fig. 42) into the cabinet and connect it inside the terminal box (8, Fig. 42).
5. Install the cover of the fan housing (9, Fig. 42).



Key:

(1) Lifting rails
(2) Cover
(3) Fan casing
(4) Fan casing
(5) Fan
(6) Vibration dampeners
(7) Opening
(8) Terminal box
(9) Fan housing

Fig. 42. Installing the redundant fan

6.8. Preparing the water supply connections

For information, see user manual of the water cooling unit in “Appendix A - Additional manuals”.

6.9. Checking the door center posts

The DC-link and filter compartment, and the rectifier and inverter compartment are equipped with center posts. If a center post has been removed for installation purposes, it must be installed again before the drive is energized. The center posts are important for securely locking the doors.

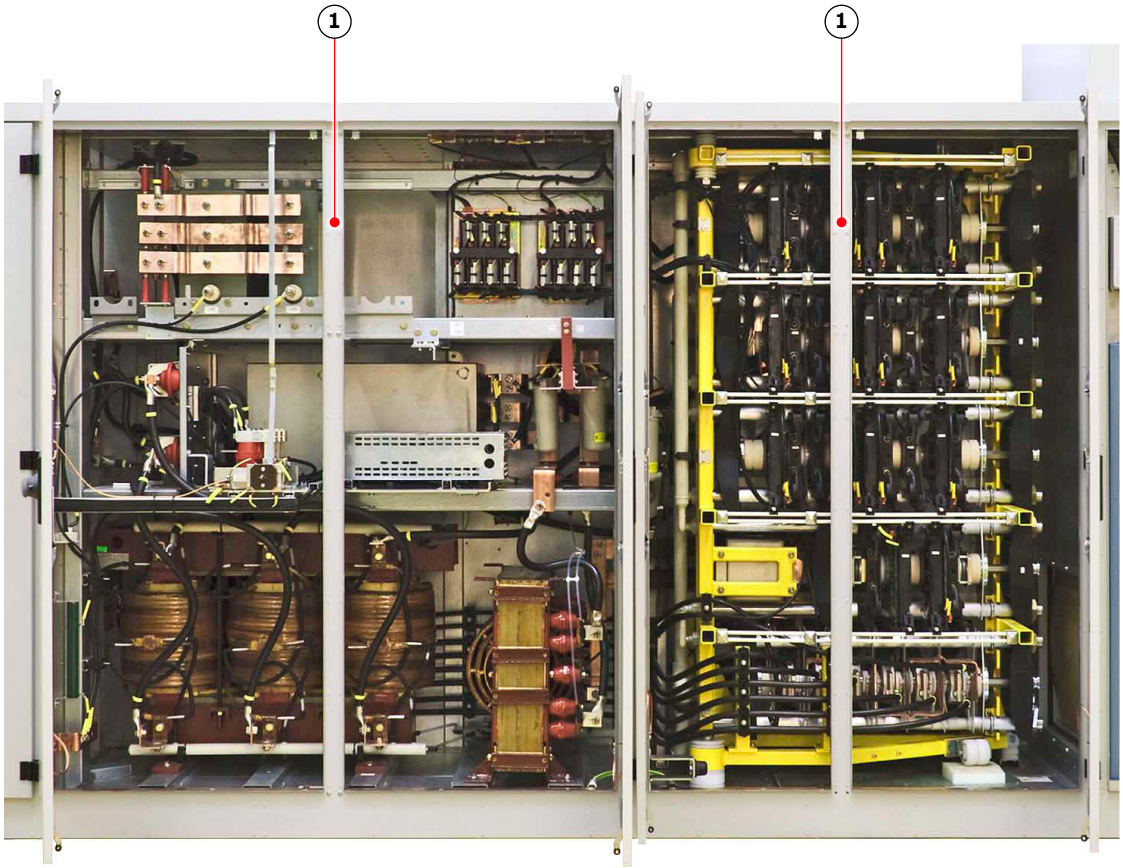


Fig. 43. Door (1) center posts

7. Electrical installation

7.1. Safety

DANGER

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

→ The electrical installation must be carried out by qualified personnel according to the site and equipment requirements, and the relevant electrical codes.

→ When the electrical installation is completed, the main and auxiliary power supply to the drive must not be switched on without the consent of the ABB commissioning personnel.

→ Take appropriate measures to prevent main and auxiliary power supply being switched on during installation.

7.2. Overview of installation work

The electrical installation includes the following wire and cable connections:

– “Power cables, ground cables and equipotential bonding conductor”, page 81

– “Auxiliary power, control and serial communication cables”, page 95

– “Power supply cable for redundant fan unit”, page 100

7.3. Cable requirements

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

– “Power cable specification”, 3BHS189994 E01

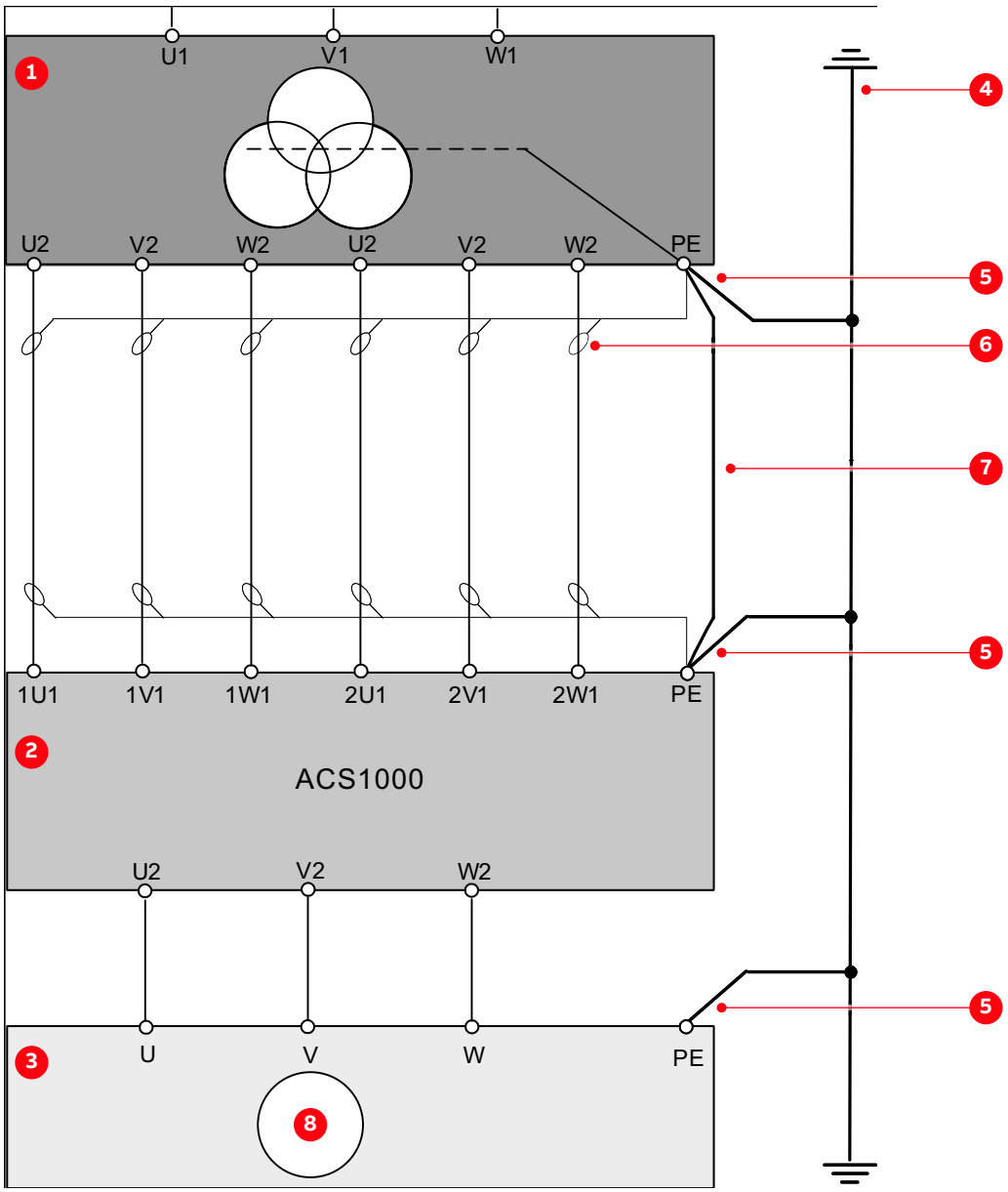
– “Power cables engineering guideline”, 3BHS542290 E01

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

7.4. Ground cable connection and cable shield connections

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

To identify the ground bus, see “Appendix D - Wiring diagrams”.



Key:

(1) Input transformer
(2) Drive
(3) Motor
(4) Earth electrode
(5) Ground cable
(6) Cable screen
(7) Equipotential bonding conductor
(8) Motor

Fig. 44. Grounding the drive system

7.5. Cable entries

The cables can be entered through the roof or the floor of the cabinet.

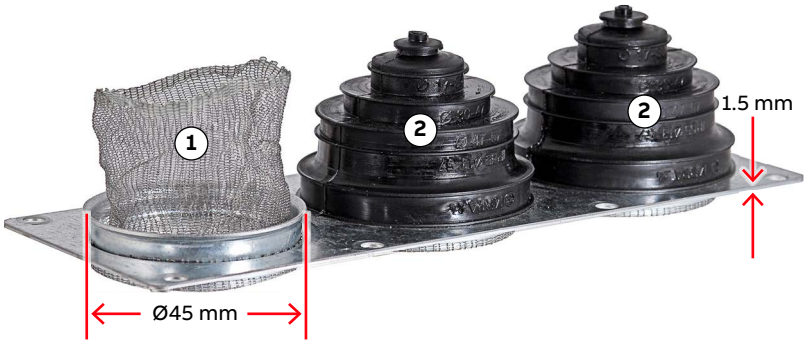
The cabinet is equipped with one of the following cable entries:

- Cable entry with EMC plates
- Cable entry with sealing modules, type 1
- Cable entry with sealing modules, type 2
- Cable entry with cable glands

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

7.5.1. Cable entry with EMC plates

- **Usage:**
  - Power cables, ground cables and bonding conductors
  - Auxiliary power cables and control cables
- **Included in delivery:** galvanized plate with net-like EMC sleeves (1, Fig. 45) and sealing grommets (2)



Key:

(1) EMC sleeves

(2) Sealing grommets

Fig. 45. EMC plate example

- EMC cushions (1, Fig. 46) on the underside of the EMC plate if the cable entry is used for control cables.

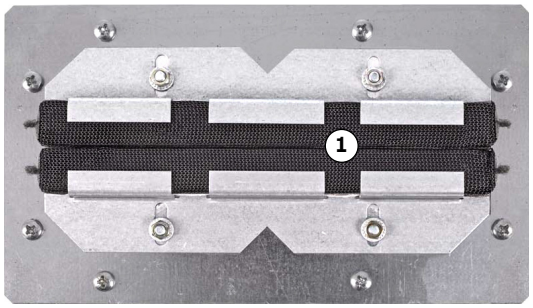
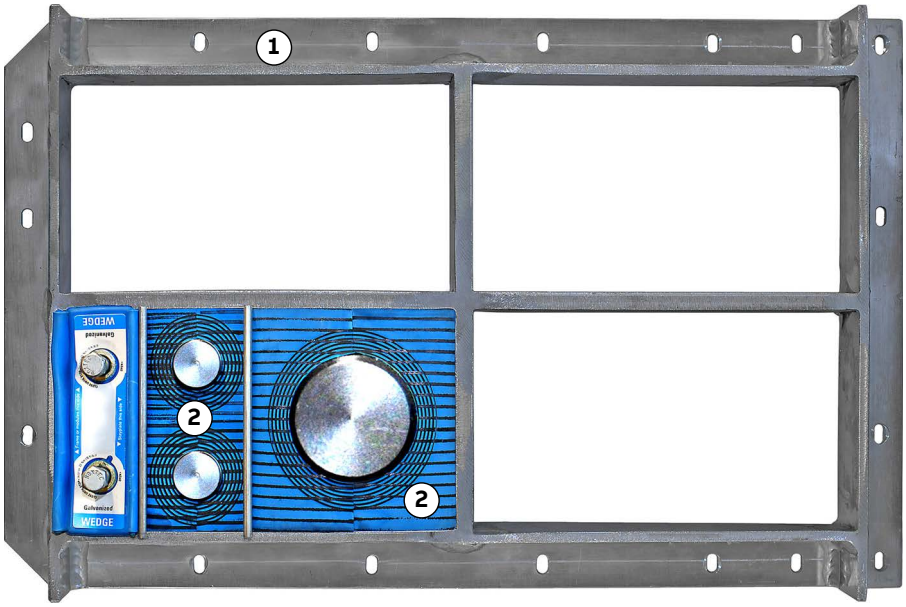


Fig. 46. EMC cushion

7.5.2. Cable entry with type 1 sealing modules

- **Usage:** power cables, ground cables and bonding conductors
- **Included in delivery:** cable entry frame (1, Fig. 47)
- **Not included in delivery:** sealing modules (2, Fig. 47), accessories and tools



Key:

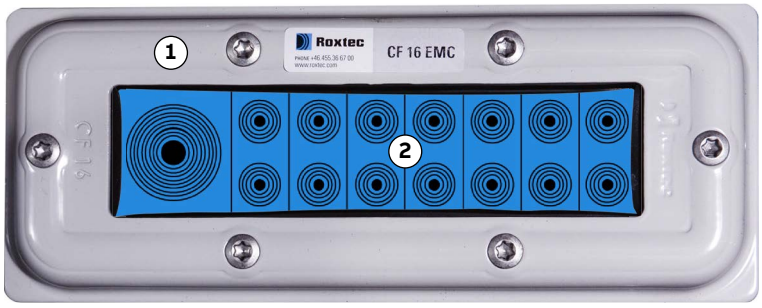
(1) EMC sleeves

(2) Sealing grommets

Fig. 47. Type 1 sealing modules example

7.5.3. Cable entry with type 2 sealing modules

- **Usage:** auxiliary power cables and control cables
- **Included in delivery:** frame (1, Fig. 48)
- **Not included in delivery:** tools, accessories and EMC sealing modules (2, Fig. 48)
- **Supplier:** Roxtec AB (www.roxtec.com)



Key:

(1) Frame

(2) EMC sealing modules

Fig. 48. Type 2 sealing modules example

7.5.4. Cable entry with cable glands

- **Usage:**
  - Power cables, ground cables and bonding conductors
  - Auxiliary power cables and control cables
- **Included in delivery:** undrilled plate for cable glands
- **Not included in delivery:** cable glands, tools and accessories

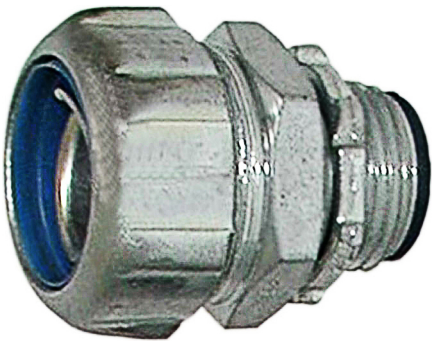


Fig. 49. Cable entry with cable glands

7.6. Power cables, ground cables and equipotential bonding conductor

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

- Project-specific cable entry
- Distance between point of cable entry and terminals
- Busbar and fastening hole dimensions
- Busbar designations

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

- Conventions for cross-reference and device identification

7.6.1. Preparing the cable entry, the cable spacers and the cables

NOTICE

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

→ If possible, DO NOT cut cables inside the terminal compartment

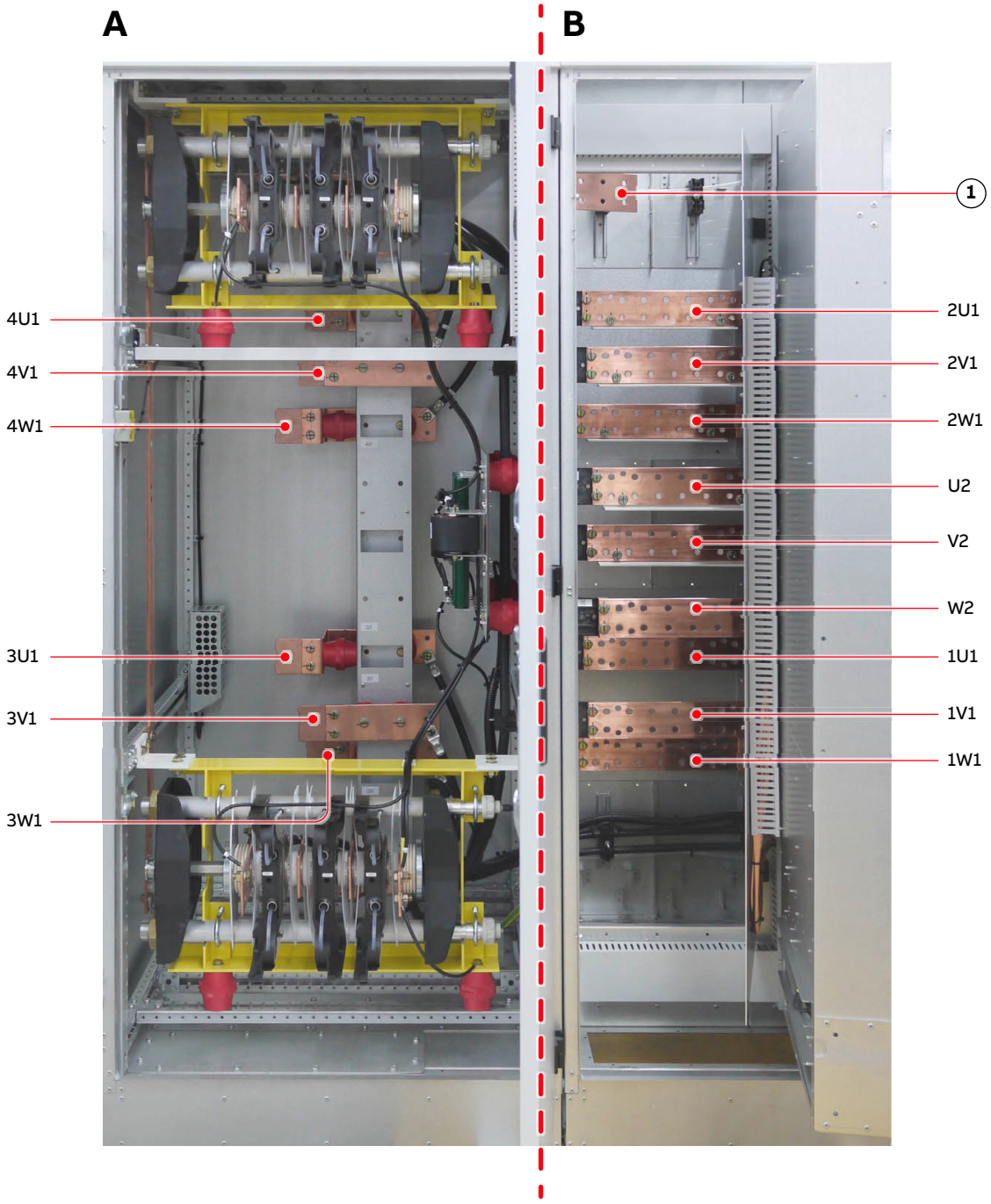
→ Remove any waste that was accidentally dropped in the cabinet

7.6.1.1. Maximum number of cables per phase

The maximum number of cables that can be used per phase depends on the type of the drive and its nominal voltage.

TABLE 13 Maximum number of cables per phase

ACS1000W type	3.3 kV nominal voltage	4.0 kV nominal voltage
W1	2 cables per phase	2 cables per phase
W2	2 cables per phase	2 cables per phase
W3	3 cables per phase	2 cables per phase



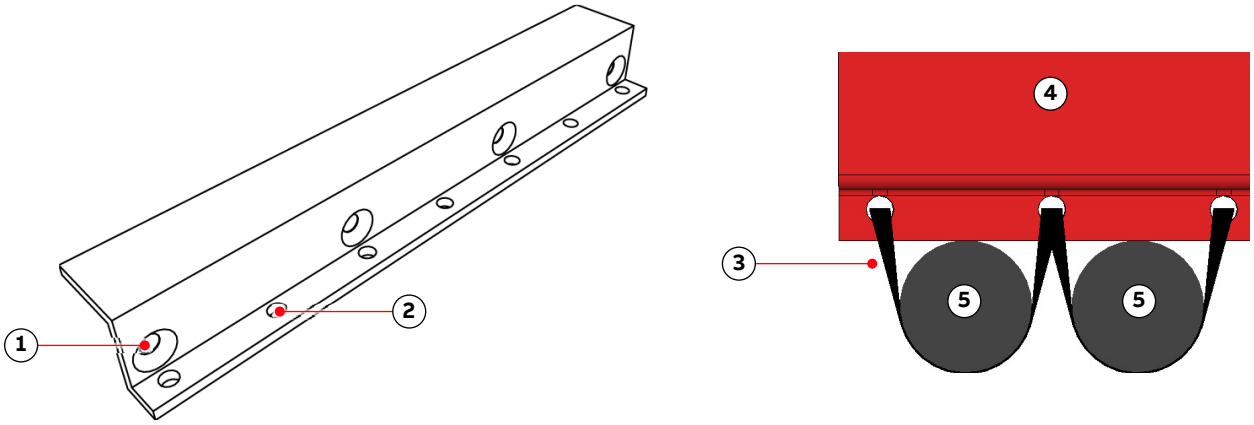
Key:

(1) PE ground busbar

Fig. 50. Busbars for (B) 12- pulse drive and (A and B) 24-pulse drive

7.6.1.2. Preparing the cable spacers

Cable spacers must be mounted on the busbars in order to guarantee the minimum required clearance between different potentials, such as busbars, cable lugs or screws.



Key:

(1) For mounting bolts

(2) For cable ties

(3) Cable tie

(4) Cable spacer

(5) Cables

Fig. 51. (A) Cable spacer and (B) cable spacer with cables attached with cable ties

If the data sheet for the drive specifies the cable entry direction (ie, 'bottom'; 'top'), the drive is delivered with the cable spacers installed in the correct locations; otherwise, the factory-installed cable spacers must be moved to their correct locations on-site. These locations, which depend on the way the motor-side and line-side cables are routed, are shown in the mechanical drawing of the drive, ie, 3BHL000886 E02.

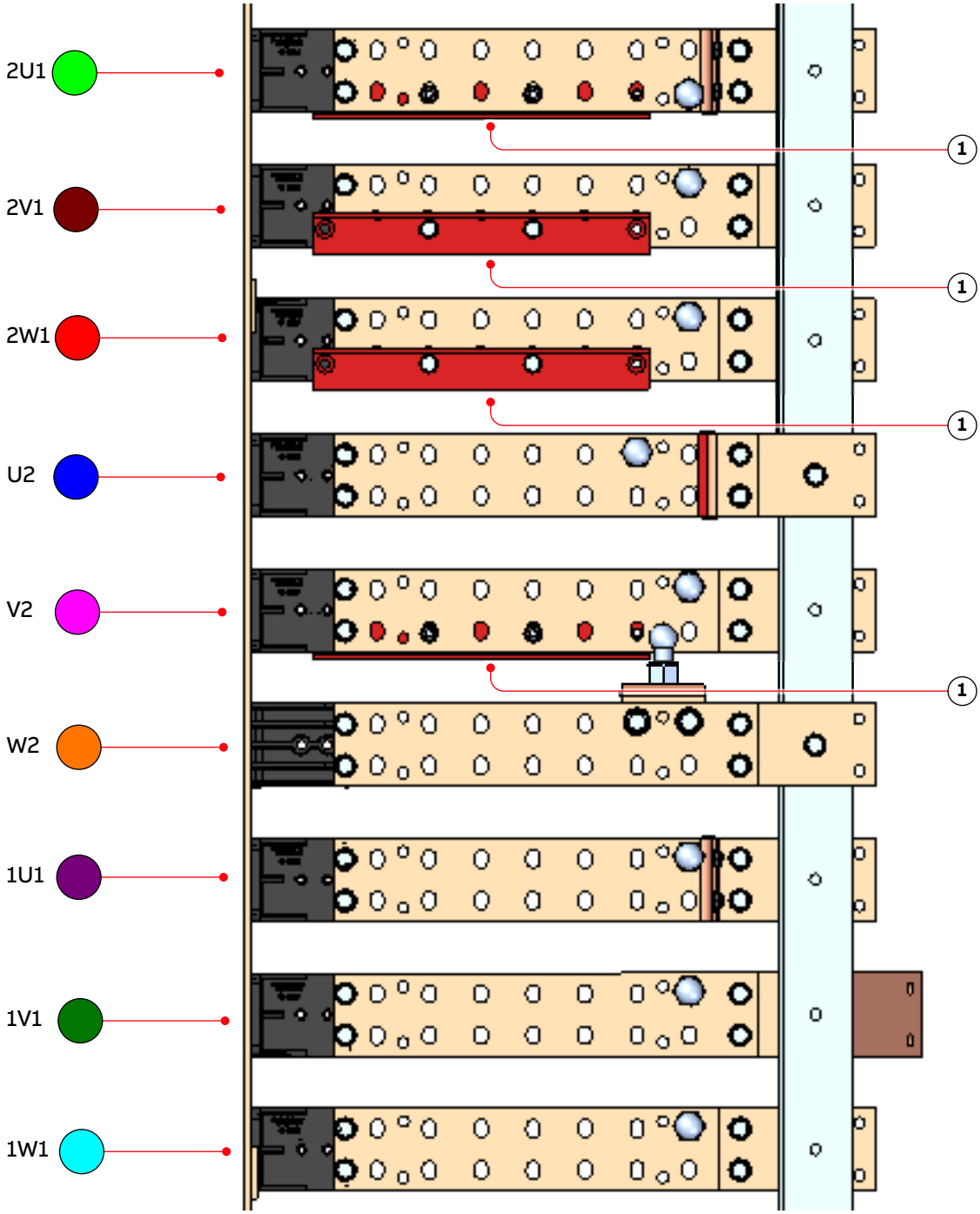
NOTE – For cables with twin hole cable lugs, install the cables first, then install the cable spacers over the attached cables.

7.6.1.3. 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.

7.6.1.4. Best practices and cable routing

- Do not block access to the optional grounding studs when routing the cables.
- Use plastic cable ties, which you can insert through designated holes on the cable spacers (Fig. 51), to hold the cables in place.
- Install the cables starting at the back of the drive and move toward the front.



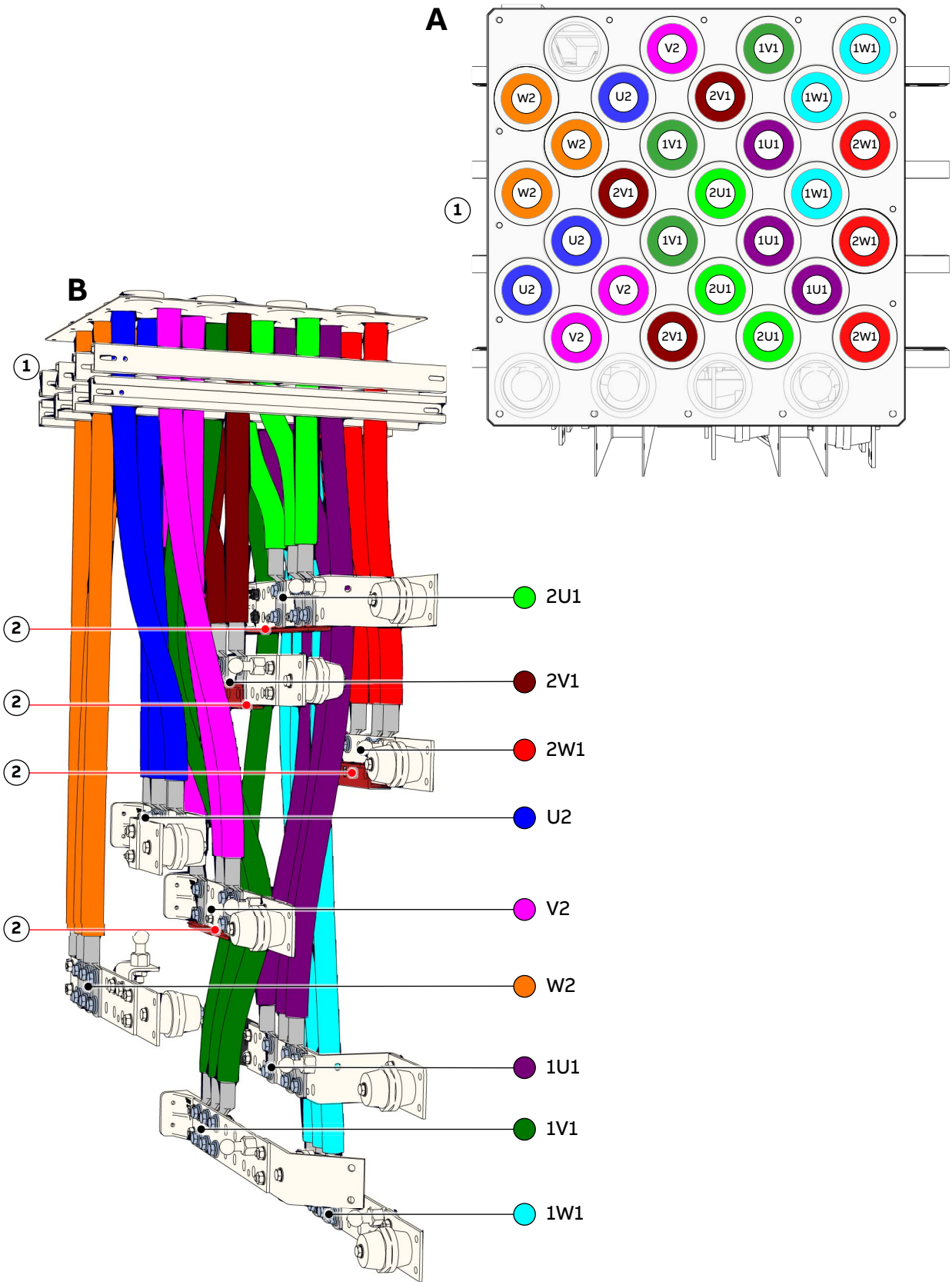
Key:

(1) Cable spacer

Fig. 52. Example of busbars with cable spacers - cable entry top

The following variants show the recommended routing for the maximum amount of cabling, ie, when the space in the terminal unit is limited. Limits on the available space in the terminal unit are less critical if fewer cables are used.

The following images show the recommended cable routing for an ACS1000W/W3 (3 kV) drive that has three cables per phase.

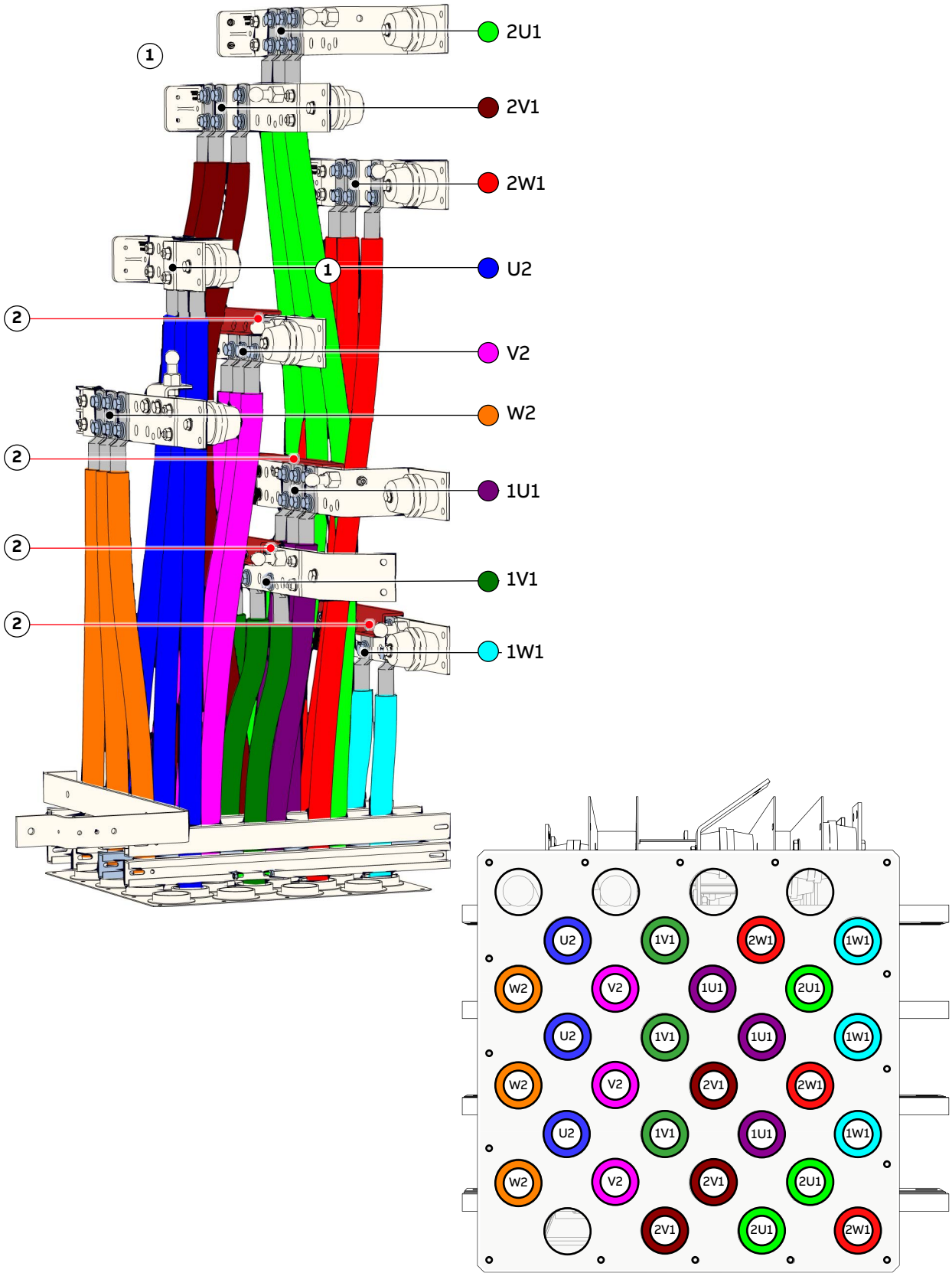


Key:

(1) Cabinet front

(2) Cable spacer

Fig. 53. Cable entry top for motor-side and line-side - (A) cable entry and (B) cable routing

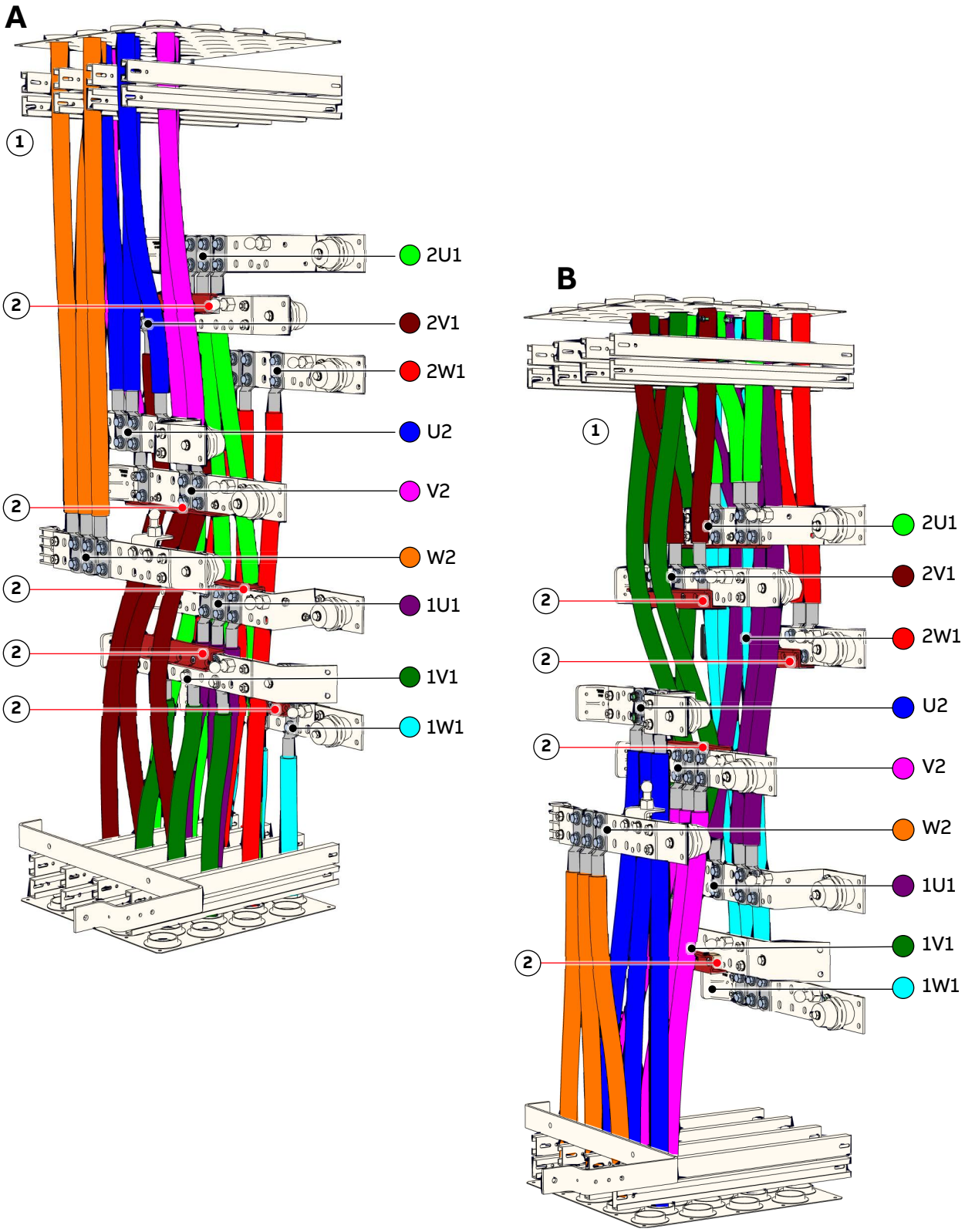


Key:

(1) Cable front

(2) Cable spacer

Fig. 54. Cable entry bottom for motor-side and line-side - (A) cable entry and (B) cable routing



Key:

(1) Cabinet front

(2) Cable spacer

Fig. 55. Additional cable routing options - cable entry top for motor-side and (A) cable entry bottom for line-side and cable entry top line-side and (B) cable entry bottom motor-side

7.6.1.5. Minimum Creepage Distance

When using spacers for cable connection to a busbar, the minimum required creepage distance must be observed. Depending on the comparative tracking index (CTI) of the insulation material of the cable the following minimum creepage distances (MCD) apply:

TABLE 14 Creepage distance

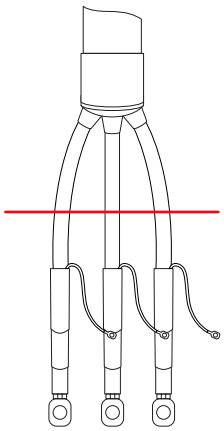
MCD in mm	CTI
63	600
71	400 to 600
80	175 to 400

If the CTI value of the insulation material is unknown, the values in row three of the table apply. The spacers shown in are installed to guarantee for the minimum creeping distance. Since cable sheaths are not normally rated for high voltage insulation, the minimum distance must be guaranteed.

7.6.1.6. Splitting multi-core cables

This section applies to drives without an additional cabinet.

- Check the distance between point of cable entry and closest busbar.
- Check the cable diameter.
- If distance and cable diameter do not allow bending the cable inside the terminal compartment, separate the conductors outside of the terminal compartment.



Continue with:

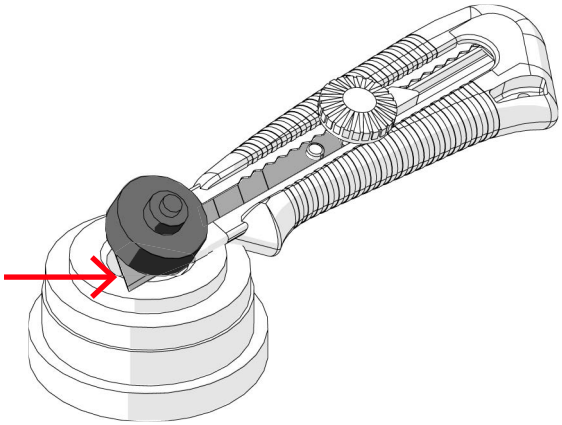
- Section 7.6.1.7, “Preparing cables for EMC plates”, page 89
- Section 7.6.1.8, “Preparing cables for cable entries with sealing modules”, page 91
- Section 7.6.1.9, “Preparing cables for cable entries with cable glands”, page 92

7.6.1.7. Preparing cables for EMC plates

As a standard, the cabinet is delivered for cable entry through the roof of the terminal compartment. If cables are entered through the floor, swap entry plate and cover plate.

The orientation of the EMC plates is the same for cable entry through the roof and through the floor, ie, the sealing grommets face upwards.

1. Remove the grommets.

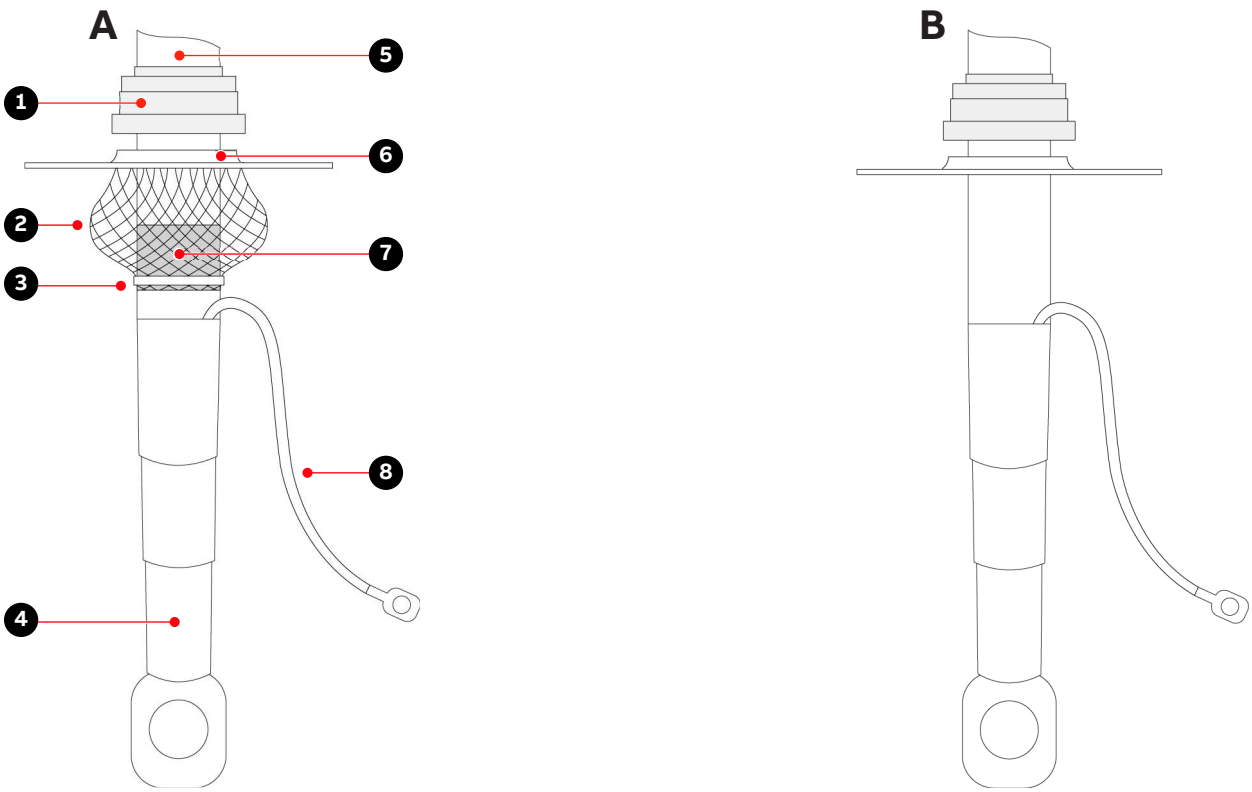


2. To ensure proper sealing, cut along the marking that corresponds to the cable diameter. Slide the grommet onto the cable.

   NOTE – The grommet must fit tightly to prevent water entering the cabinet. The grommets can be discarded if cables are entered through the floor.

3. If necessary, remove the entry plate and push the cable through the entry holes.

4. Prepare the cables as illustrated.
   - **A** in Fig. 56 illustrates how cables with an outer cable screen or shield are prepared for EMC bonding with the metal enclosure of the cabinet.
   - **B** in Fig. 56 illustrates how cables without an outer screen or shield are prepared.

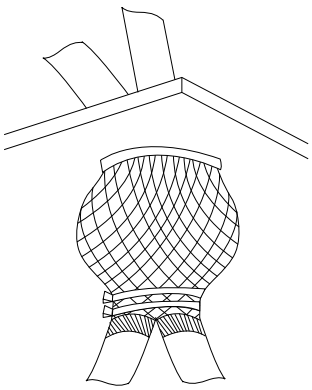


Key:

(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

Fig. 56. Preparing cables for EMC plates: (A) cables with an outer screen or shield, (B) cables without an outer screen or shield

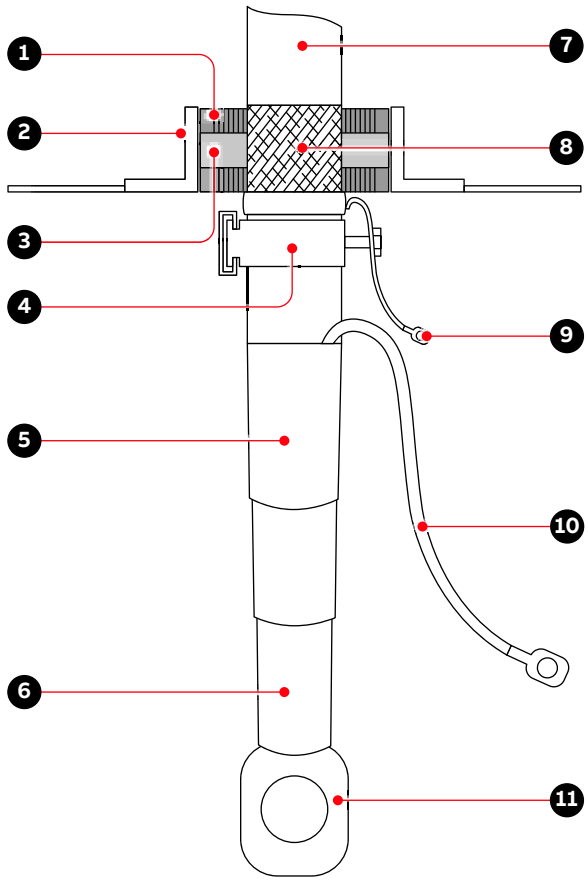
5. Enter the equipotential bonding conductor through an unused hole of the entry plate.



7.6.1.8. Preparing cables for cable entries with sealing modules

If the data sheet for the drive specifies the cable entry direction (ie, 'bottom'; 'top'), the drive is delivered with the cable entry plates installed in the correct locations; otherwise, the factory-installed cable entry plates must be moved to their correct locations on-site.

– Prepare cables with an outer cable screen or shield for EMC bonding with the metal enclosure of the cabinet as illustrated in Fig. 57.



Key:

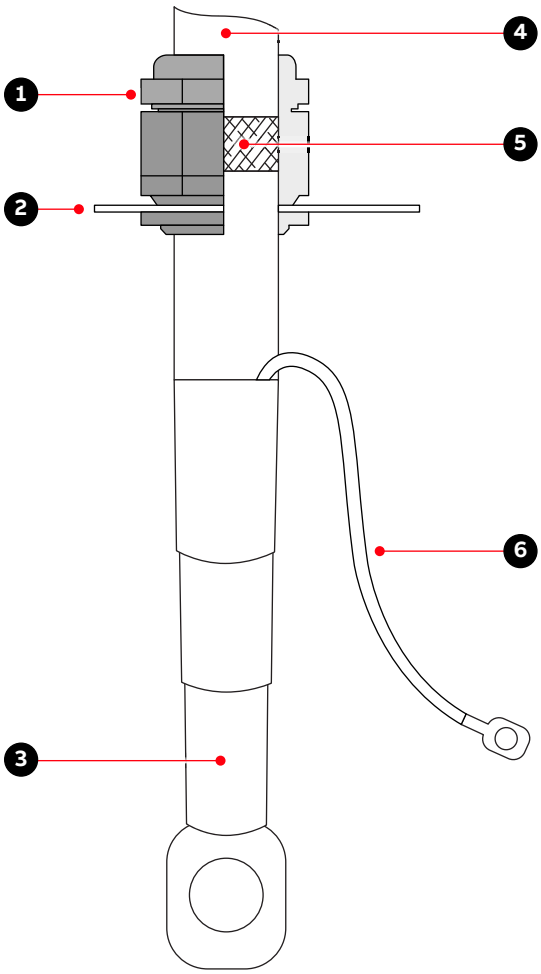
(1) Sealing module
(2) Frame
(3) Conductive foil of sealing module
(4) Cable clamp
(5) Shrinkable sheath seal
(6) Heat-shrinkable termination
(7) Outer cable sheath
(8) Cable sheath removed to expose cable shield
(9) Shield extension to be connected to PG busbar
(10) Screen extension to be connected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

Fig. 57. Preparing power cables for sealing modules

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

7.6.1.9. Preparing cables for cable entries with cable glands

Prepare cables with an outer cable screen or shield for EMC bonding with the metal enclosure of the cabinet as illustrated in Fig. 58.



Key:

(1) Outer cable sheath
(2) Cable gland
(3) Conductor insulation removed to expose cable shield
(4) Plate
(5) Screen extension to be connected to PE ground busbar
(6) Heat-shrinkable termination

Fig. 58. Preparing power cables for cable glands

7.6.2. Connecting the cables

7.6.2.1. Checking the cable insulation

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

7.6.2.2. Connections

⚠ CAUTION

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

→ 20 mm between conductors

→ 40 mm between a conductor and earth

Power and grounding cables

– Connect the feeder cable conductors to busbars
  - 1U1, 1V1, 1W1, 2U1, 2V1, 2W1 (12-pulse and 24-pulse drive, Fig. 50)
  - 3U1, 3V1, 3W1, 4U1, 4V1, 4W1 (24-pulse drive, Fig. 50)

– Connect the screens of all conductors and the shields of all cables to the PE ground busbar (1, Fig. 50).

– Connect the equipotential bonding conductor to the PE ground busbar.

– Tie the cables to the strain relief rails or to the designated holes on the cable spacers (Fig. 51).

7.6.3. Bolted connections

7.6.3.1. Material requirements

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

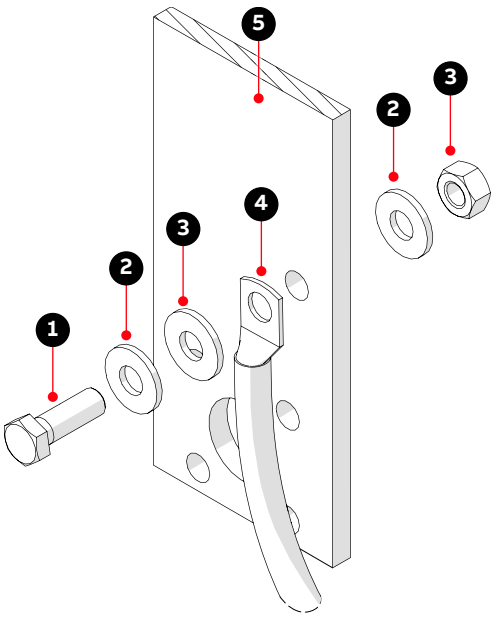
NOTE – Nuts with bonded coating can be used as an alternative to uncoated stainless steel nuts.

7.6.3.2. Connection type

The following connection type is recommended when a cable lug (5, Fig. 59) is connected to a busbar:

– Spring washer (2, Fig. 59) and flat washer (3, Fig. 59) on each side of the busbar (4, Fig. 59).

NOTE – Other washers can be used, provided they maintain the required contact pressure.



Key:

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

Fig. 59. Bolted busbar connections

– Use cable lugs suitable for M12 bolts.

7.6.3.3. 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.

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

7.6.3.4. Tightening torque

– Tighten bolted connections with bolts of sizes M10 and greater with the recommended nominal torque for the bolt size used.

7.7. Auxiliary power, control and serial communication cables

See Layout drawing in 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:

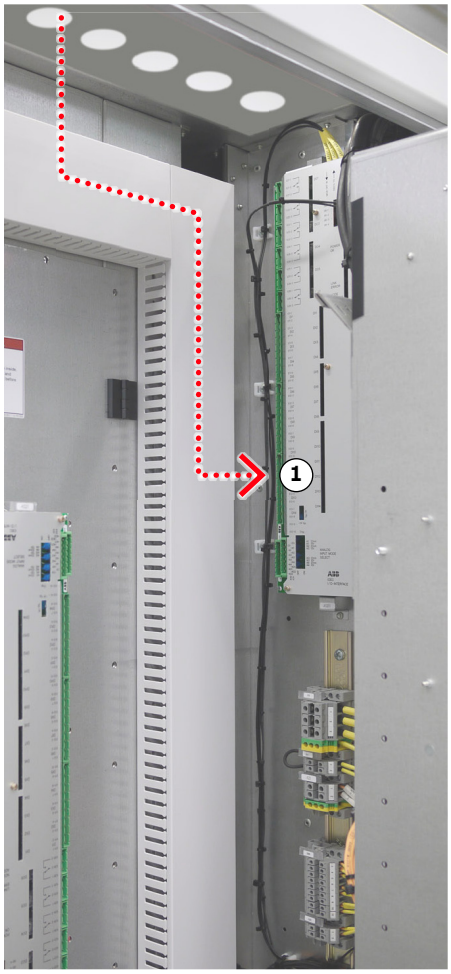
- Conventions for cross-references and device identification
- Terminal designations

7.7.1. Preparing the cable entry and the cables

7.7.1.1. Determining the cable length

1. Determine the required length of a cable between the point of entry and the connection point (1, Fig. 60) inside the cabinet.
2. Cut the cable to the required length before connection.

A



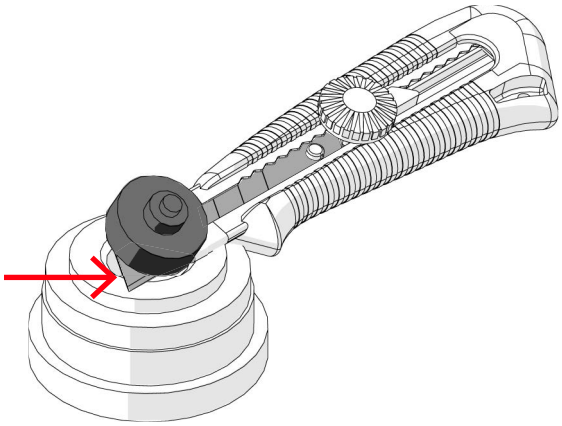
B

Fig. 60. Cable entry from (A) top, from (B) bottom

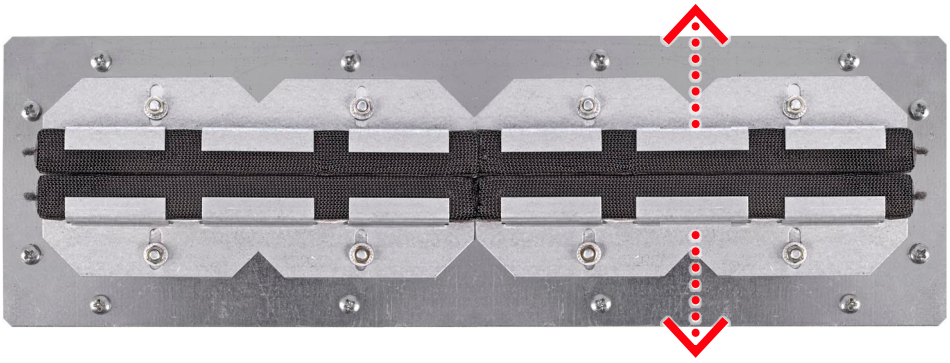
7.7.1.2. Preparing cables for EMC plates

1. Remove the grommets.
2. To ensure proper sealing, cut along the marking that corresponds to the cable diameter and slide the grommet onto the cable.

   NOTE – The grommet must fit tightly to prevent water entering the cabinet. The grommets can be discarded if cables are entered through the floor.



3. If necessary, remove the entry plate and pull the cable through the entry holes.
4. Loosen the screws of the EMC cushion brackets and push the cushions apart (arrows).



5. If the outer cable screen is non-conductive, cut open the cable screen in the middle of the stripped area (1), pull the screen ends over the cable insulation (2) and then connect the screen ends with a continuous conducting foil (3).

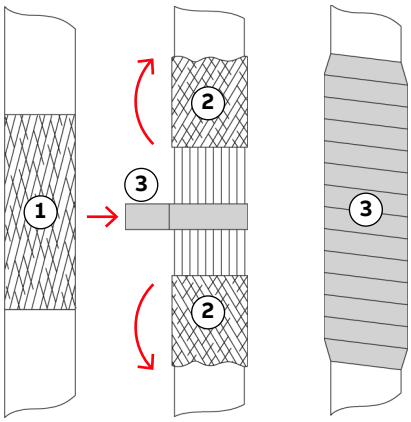
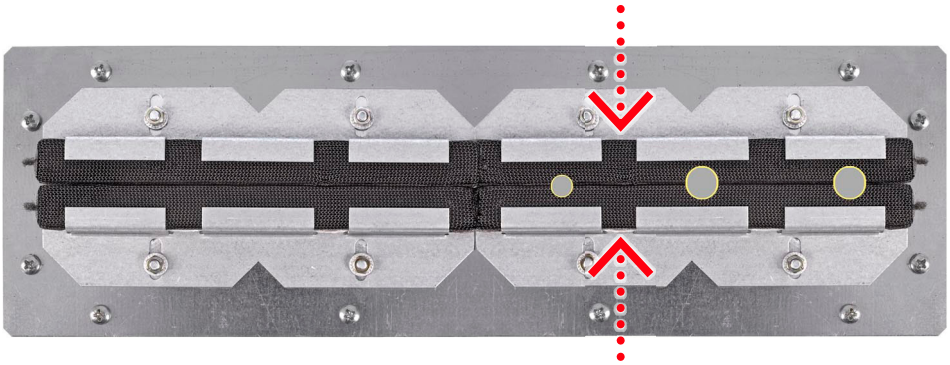


Fig. 61. Preparing control cables for EMC plates

6. Pull the cables through the EMC cushions.
7. Push the cushions together so they fit tightly around the bare screen and tighten the screws.



7.7.1.3. Preparing cables for cable entries with sealing modules

1. Unscrew the frame and remove the sealing modules.

   For information on removing and installing the sealing modules and using the compression wedge (1), see “Appendix A - Additional manuals”.

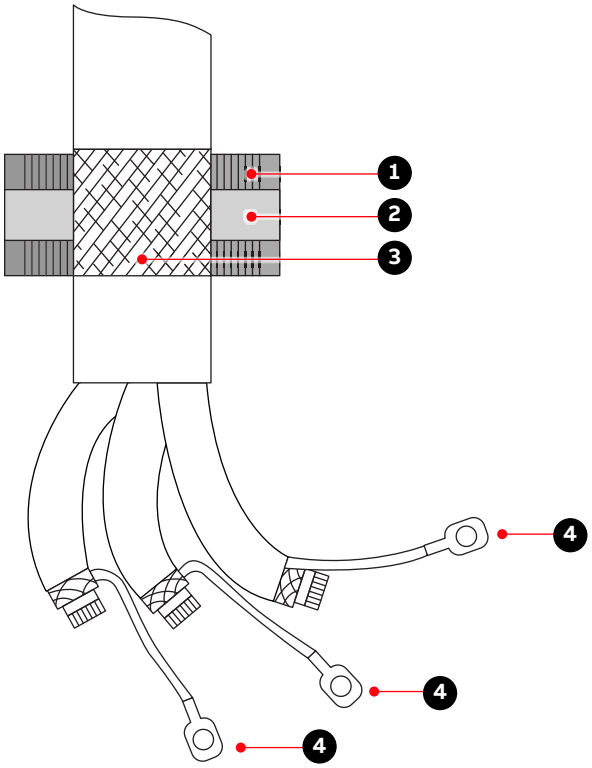
Key:

(1) Sealing modules

(2) Compression wedge

Fig. 62. Frame with sealing modules

2. Prepare the cables with an outer cable screen for EMC bonding with the metal enclosure of the cabinet as illustrated in Fig. 63.



Key:

(1) Sealing module

(2) Conductive foil

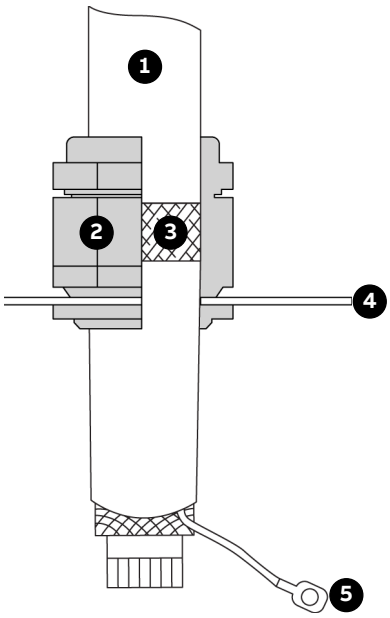
(3) Cable sheath removed to expose cable shield

(4) Conductor screen extension to be connected to PE terminal

Fig. 63. Preparing control cables for sealing modules

7.7.1.4. Preparing cables for cable entries with cable glands

– Prepare the cables with an outer cable screen for EMC bonding with the metal enclosure of the cabinet as illustrated in Fig. 64.



Key:

(1) Outer cable sheath

(2) Cable gland

(3) Conductor insulation removed to expose cable shield

(4) Plate

(5) Conductor screen extension to be connected to PE terminal

Fig. 64. Preparing control cables for cable glands

7.7.2. Connecting the cables

7.7.2.1. IOEC modules

– Connect the cables for digital and analog input and output signals to the distribution terminals.

7.7.2.2. 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 (not longer than 50 mm).

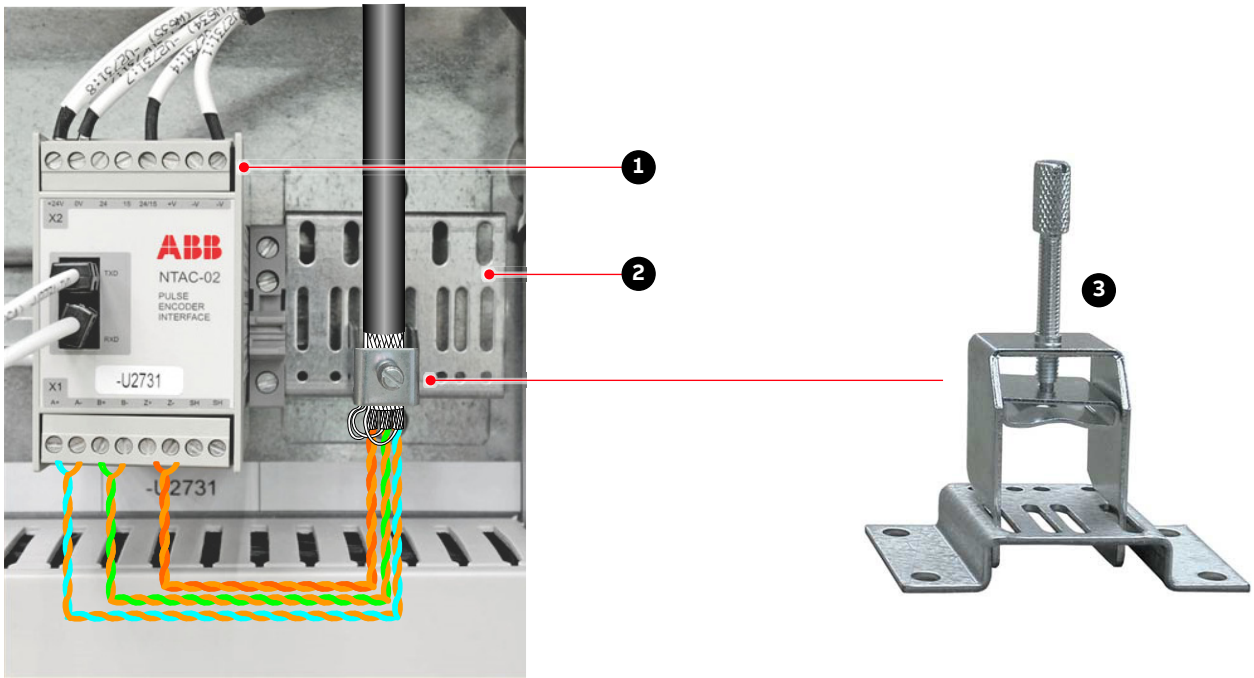
7.7.2.3. Cable shields

– Connect the shield of serial communications cables to the fieldbus adapter.

– Connect the overall shield and the individual shields of the encoder cable to the separate shield grounding bracket (2, Fig. 65)

IMPORTANT! DO NOT connect the shields directly to the encoder adapter (1, Fig. 65).

NOTE – To accommodate encoder cables of different diameters, ground clamps (3, Fig. 65) of different sizes are supplied.



Key:

(1) Encoder adapter

(2) Shield ground bracket

(3) Grounding clamp

Fig. 65. Shield grounding point for encoder cable

7.8. Power supply cable for redundant fan unit

This section applies to drives that are equipped with the optional redundant fan.

For information on the cable connection, see “Appendix D - Wiring diagrams”.

– Connect each wire from the fan to the corresponding terminal inside the terminal box (arrow).

  Wire and corresponding terminal have the same marking.

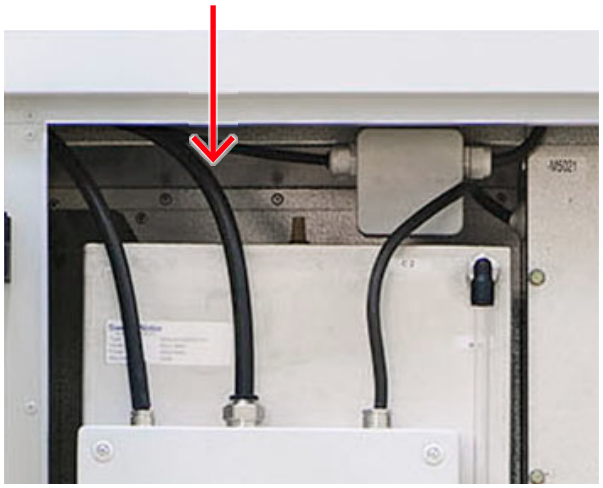


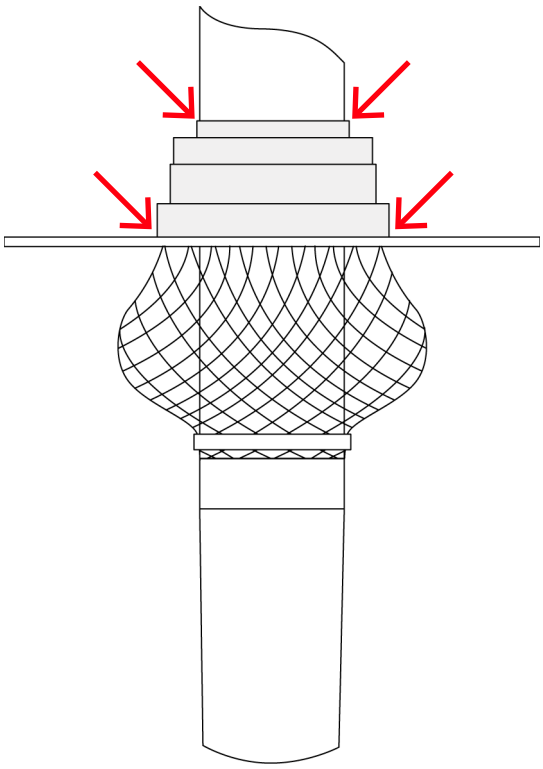
Fig. 66. Redundant fan - terminal box

7.9. 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.



8. Commissioning

8.1. Overview

The following sections provide an overview of the commissioning process for your drive.

8.1.1. Required qualification

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

8.1.2. Commissioning procedure

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

8.1.3. 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.

8.1.4. 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

8.1.5. 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.

8.2. Commissioning checklists

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

8.2.1. Mechanical installation checklist	☑
8) Drive installed according to the instructions in this user manual (3BHS213400 E01 M).	☐
9) Drive securely fastened to the floor (if applicable).	☐
10) Redundant fan unit installed (if applicable).	☐
11) Customer-side raw water piping completed and pipes connected to the drive (if applicable)	☐
12) Raw water supply ready (if applicable)	☐
13) Visual inspection: • No badly affixed or damaged components • No foreign objects left in the cabinet • No dirt, dust or moisture in the cabinet	☐

8.2.2. 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 instructions in this user manual (3BHS213400 E01 M).	☐
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 the user manual (3BHS213400 E01 M).	☐
5) Control cable screens and conductors are connected as instructed in this user manual (3BHS213400 E01 M), labeled appropriately, and the customer side connections are completed.	☐
6) Equipotential bonding conductor of drive securely connected at both ends.	☐
7) Converter transformer and motor cables not connected at both ends (cables and drive must be insulation resistance tested (Megger test) before connection)	☐

8.2.3. Main circuit breaker (MCB) checklist	☑
1) Type of MCB selected as per the MCB specification from ABB	☐
2) High-voltage power connections completed	☐
3) MCB ready to be tested with drive	☐
4) MCB protection relay settings tested	☐
5) Safety devices (eg, door locks) are tested and in operation.	☐

8.2.4. Converter transformer checklist ☑

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

8.2.5. 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.	☐

8.2.6. Insulation tests checklist ☑

1)	All power cables to converter transformer, between converter transformer and drive, and from drive to motor insulation resistance tested (Megger test), and measured values within the required limits.	☐
2)	Test report of the Megger insulation resistance test available.	☐

IMPORTANT! If the test is carried out by the commissioning engineer of the drive, an additional day per drive motor combination needs to be reserved. After the test, the feeder cables can be connected, except at the drive end. The test must comply with the specification.

8.2.7. Power supply checklist ☑

1)	Medium voltage available for start-up of drive.	☐
2)	Low voltage is available for start-up of drive.	☐

8.2.8. Miscellaneous checklist ☑

1)	Sufficient number and correct type of spare parts available	☐
2)	Air conditioning of drive room ready for load run of drive	☐
3)	Optional equipment ready	☐

9. Operation

9.1. 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

9.2. Overview

The chapter outlines the local operation of the drive.

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

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

9.3. Operating conditions

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

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

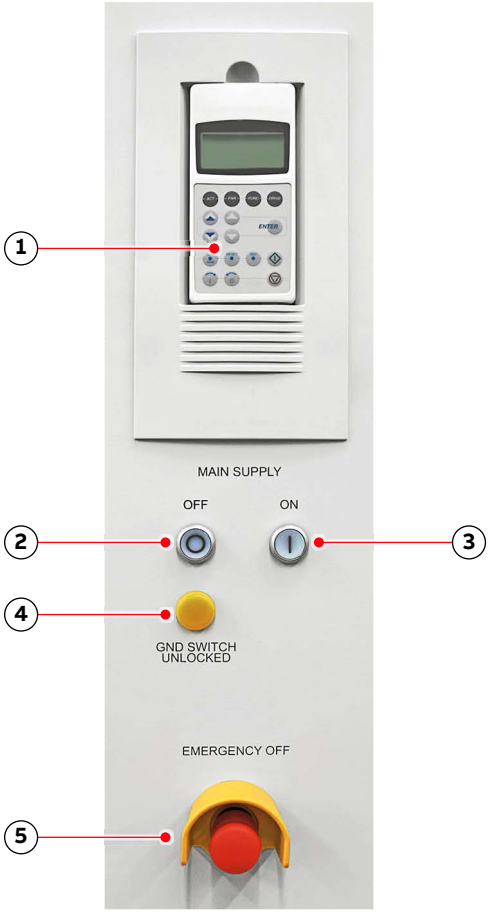
If the operating conditions are not within the specifications, contact ABB.

9.4. Sound pressure level

– **Single fan:** < 70 dB (A)

– **Redundant fan:** < 75 dB (A) for drives with IP42

9.5. Local operator panel



Under normal operating conditions, the local operator panel allows you to operate the drive without restrictions. For example, you can use the panel to perform the following actions:

- Connect and disconnect the main power supply
- Set the reference value
- Start and stop the drive
- Display actual values, status messages, alarms and fault messages
- View and setting parameters
- Reset alarm and fault messages
- Activate the emergency off circuit

For more information, see Chapter 10, “CDP control panel”, page 114.

Key:		Explanation
(1)	Control and data panel (CDP)	– Starts and stops the motor – Displays status messages – Displays alarm and fault messages of the drive and monitored foreign equipment – Resets alarm and fault messages
(2)	Main Supply OFF illuminated push button	– Opens the main circuit breaker
(3)	Main Supply ON illuminated push button	– Charges the DC link and closes the main circuit breaker
(4)	Gnd Switch Unlocked push button	– Lights up to indicate that the grounding switch of the drive can be turned to the grounded or ungrounded position
(5)	Emergency Off push button	– Prevents starting when pressed at standstill of the drive – Main circuit breaker opens immediately and DC link discharges when pressed during operation of the drive

Fig. 67. Local operator panel

9.6. Status messages

This section lists the messages of the main operating states the drive passes through, when it is put into operation, when it is stopped, or when a fault condition has occurred. The messages are sent to the higher-level control system and are displayed on the CDP control panel of the drive.

For information on other status messages, such as fault status messages in particular, see the status words in the “Appendix G - Signal and parameter table” of the drive.

RdyForMCBOn
The status message signals that the drive is healthy and ready for the ON command. The ON command initiates the closing of the MCB and then the charging of the DC-link capacitors. 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 Main circuit online push button on the control compartment door.

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

Rdy to Strt
The status message **Rdy to Strt** tells 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.

Magnetizing
The status message **Rdy to Strt** changes to **Magnetizing** when the firing pulses of the inverter are released.

Running
When the drive is in **Running** state, it is running and operating according to the set speed or torque reference value. When in remote control mode, the reference value is set by the higher-level control system. When in local control mode, the value is entered into the CDP control panel.

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 **Rdy to Strt** 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 **Running** again.

Discharging
The status message Rdy to Strt changes to Discharging when the MCB has opened and the DC-link capacitors are discharging.

Tripped
The status message 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.

9.6.1. Start sequence of the drive

1) **NotReadyOn**

   ReadyOn conditions:

   - Doors closed and locked
   - Drive not grounded
   - No emergency off
   - No fault

2) **ReadyForMCBOn**

3) **On command**

4) **Charging**

   - MCB closes
   - DC link charges
   - Fan switches on

5) **Rdy To Strt**

6) **Start command**

   - Inverter starts to modulate

7) **Magnetizing**

8) **Running**

9) **Operation**

9.6.2. Stop sequence of the drive

1) **Operation**

2) **Running**

3) **Stop command**

4) **Stopping**
   - Speed ramps down
   - Inverter stops modulating

5) **Ready To Strt**

6) **Off command**

7) **RdyForMCBOn**
   - Drive is grounded
   - Doors are released for opening
   - Auxiliary supply is switched off

8) **NotReadyOn**

9.6.3. Emergency off sequence of the drive

1) **Operation**

2) **Running**

3) **Emergency off command**
   - MCB opens
   - Inverter stops modulating
   - Speed coasts down

4) **Not ready on**

9.7. Starting the drive

DANGER

Hazardous voltages! All covers must be screwed in place to prevent unintentional contact with energized components.

9.7.1. Checks before starting the drive

It is recommended to have the following documents at hand when starting the drive locally for the first time after commissioning:

- “Appendix D - Wiring diagrams” to identify the circuit breakers to be switched on
- Chapter 10, “CDP control panel”, page 114 for information on functions and features of the CDP control panel

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

- Tools and foreign objects are 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 mounted and the doors are closed, locked or bolted.
- Grounding switch is in the ungrounded position.
- MCB is in operating position.
- No run interlocks are active.

9.7.2. Starting the drive remotely

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

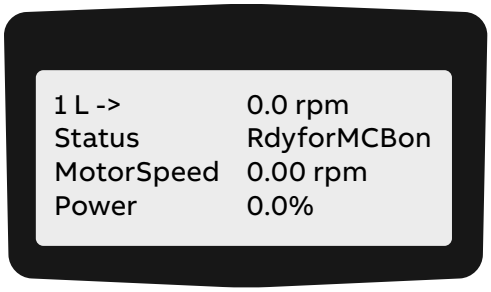
9.7.3. Starting the drive locally

1. Enable the local control mode of the drive.

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

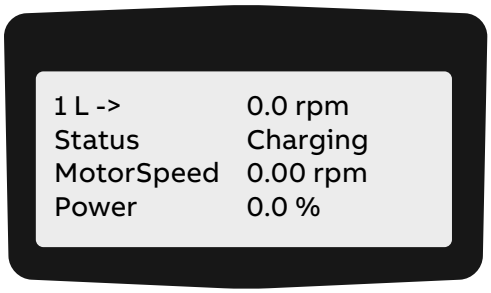
   - If a fault cannot be reset, it must be rectified by the responsible personnel.

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

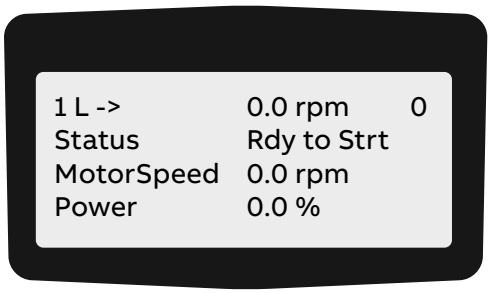


3. Press the **MAIN SUPPLY ON** push button on the control compartment door to close the MCB and charge the DC link.

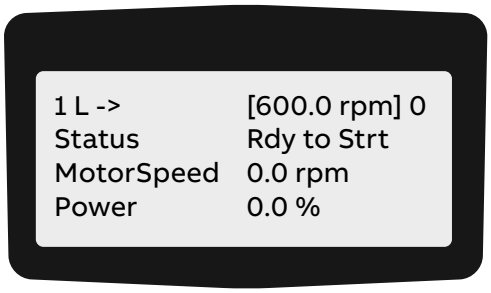
   The push button lights up and the status line of the CDP control panel changes to **Charging**.



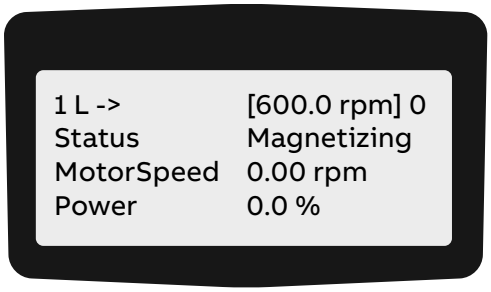
After charging has been finished, the protection IGCTs are closed, the status line of the CDP control panel changes to **Rdy to Strt** and the motor can be started.



4. Enter the reference value.



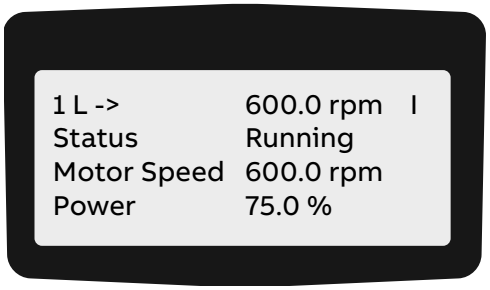
5. Start the motor.



After the motor has been magnetized, the motor speed ramps up to the reference value.

While the motor is accelerating, the run status indication on the display blinks. When the motor speed has reached the reference value, the run status indication lights up permanently.

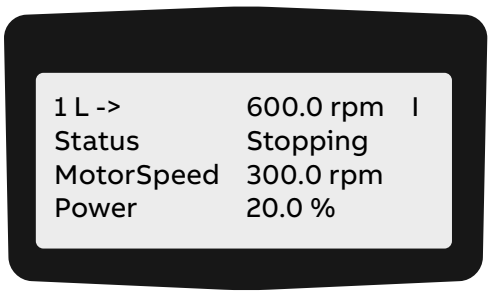
The display shows **Running** to indicate that the drive is operating.



9.8. Stopping the drive

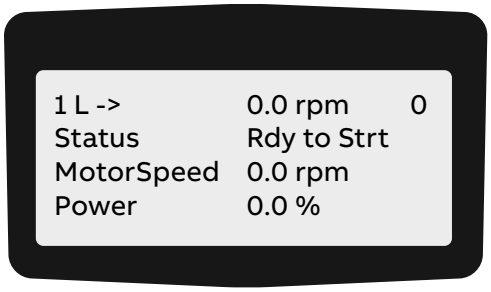
1. Press the STOP key on the CDP control panel.

The motor stops according to the preset stop function and the drive stops modulating. While the motor stops, the status line of the display shows **Stopping**. The run status message blinks during the stop sequence.



NOTE – As long as the stop sequence is in progress, the drive can always be restarted by pressing the **START** key on the CDP control panel.

When the drive has stopped modulating, the CDP control panel displays **Rdy to Strt**.



NOTE – As long as the MCB has not been opened, the motor can be started again.

9.9. Emergency-off

The drive is equipped with a hard-wired emergency off circuit. When an emergency situation occurs during operation, this safety feature ensures that the drive can be disconnected without delay from the main power supply. If the **Emergency-Off** push button has been pressed while the drive is at standstill, the main power supply cannot be connected to the drive, hence the drive cannot be started up.

The **Emergency-Off** push button of the drive is part of the operator control panel (Fig. 67) and features a latching switch action.

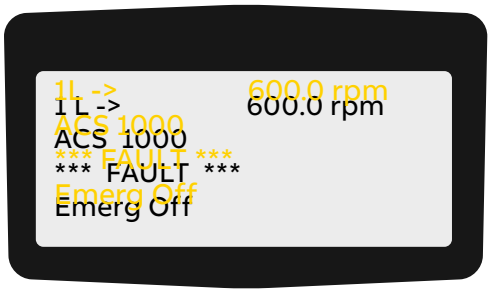
IMPORTANT! Pressing the **Emergency-off** push button does not disconnect the auxiliary power supply from the drive.

9.9.1. Initiating an emergency-off

To initiate an emergency off, press the **Emergency-off** push button on the control compartment door, or an external **Emergency-off** push button (if present) linked to the emergency-off circuit.

When an emergency-off is initiated during drive operation, the following takes place:

- MCB opens
- Drive coasts down
- Status line of the CDP control panel displays the message **Emerg Off**



- The DC link of the drive discharges.

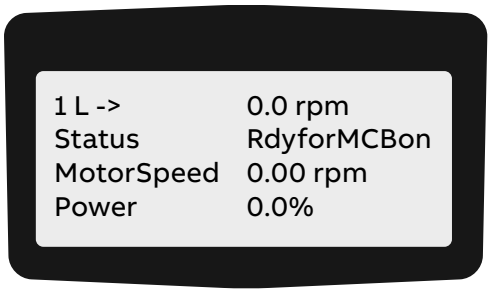
9.9.2. Starting the drive after an emergency off

1. To start the drive after an emergency-off, unlatch the **Emergency-off** push button.

   The **Emergency-off** push button returns to its initial position when turned into the direction indicated by the arrows on the push button.

2. To reset the emergency-off safety relay of the drive, press the **Reset** button on the control keypad.

After resetting, the status message of the drive changes to **RdyForMCBOn**.

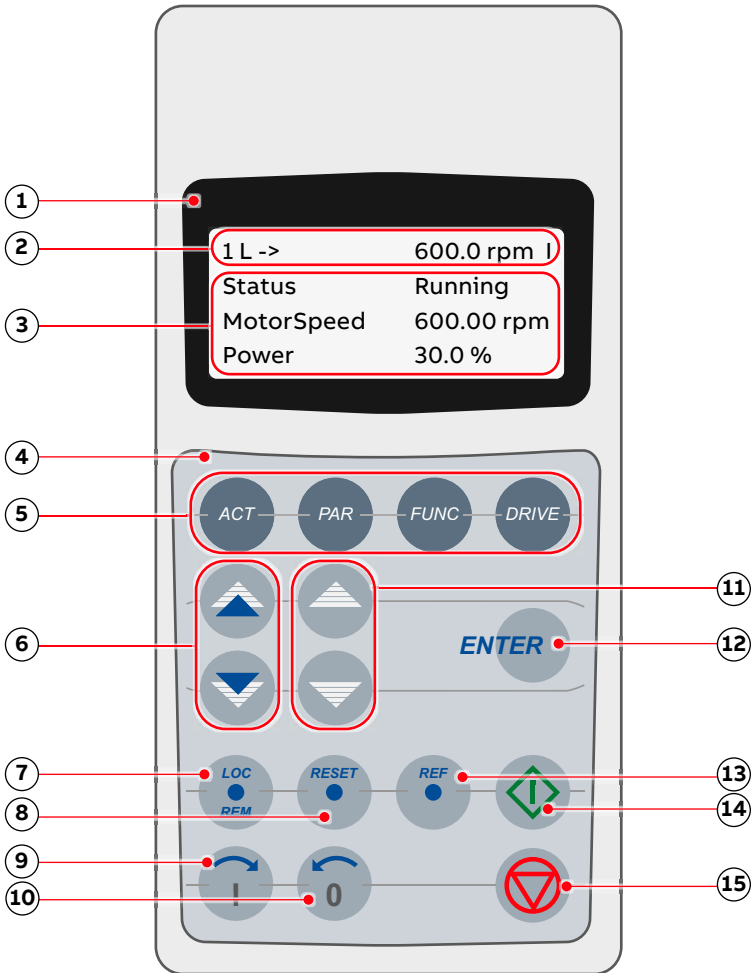


The main power supply can be connected to the drive and the drive can be started again.

10. CDP control panel

10.1. Overview

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



Key:

(1) Display
(2) Status line
(3) Actual signal names and values
(4) Keypad
(5) Mode selection keys
(6) Fast navigation key for selecting the actual signals display or the fault memory display
(7) Local / remote selection key
(8) Reset key
(9) Forward key
(10) Backward key
(11) Slow navigation key for selecting signals or fault messages
(12) Enter key, terminates a procedure
(13) Reference key
(14) Start key
(15) Stop key

Fig. 68. CDP control panel

10.2. CDP control panel functions

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

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

You can perform the following tasks with the CDP control panel:

- Enter start-up data
- Control the drive with a reference value, and start, stop and direction commands
- Display actual values (three values can be read simultaneously)
- Display and adjust parameters
- Display information on the most recent forty fault events
- Upload and download complete parameter sets from one drive to another

10.3. CDP control panel modes

The CDP control panel provides the following modes:

- Identification mode, see Section 10.3.1, “Identification mode”, page 115
- Actual signals mode, see Section 10.3.2, “Actual signals mode”, page 116
- Parameters mode, see Section 10.3.3, “Parameters mode”, page 123
- Functions mode, see Section 10.3.4, “Functions mode”, page 129

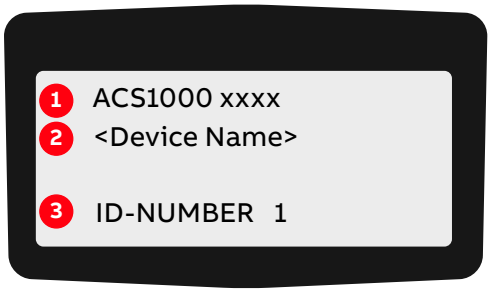
10.3.1. Identification mode

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

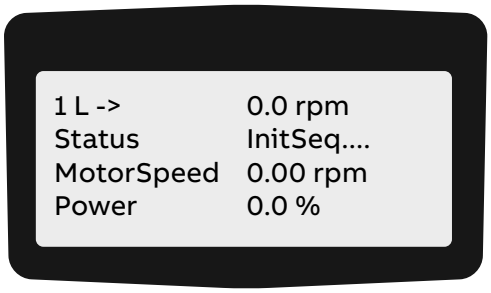
- Power supply is switched on
- CDP control panel is connected to the drive and the auxiliary voltage has already been switched on.

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

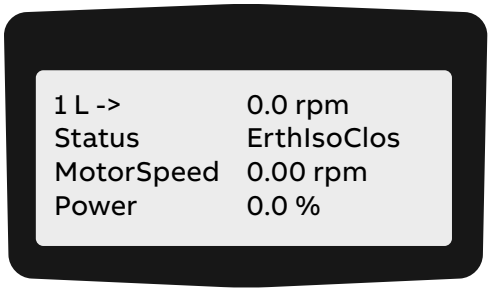
After 2-3 seconds, information on the drive (1, 2) and the drive identification (3) is displayed.



After another few seconds:



After another few seconds, the display changes to the actual signals mode.



10.3.2. Actual signals mode

10.3.2.1. Overview

Two displays can be selected in the actual signals mode:

- Actual signals display
- Fault memory display

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

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

The CDP control panel automatically returns to the actual signals display from other modes if no key is actuated within one minute (an exception from this is the fault memory display).

10.3.2.2. Actual values

The actual values are organized in groups.

Group	Description
Group 01	Measured or calculated motor values
Group 02	Measured or calculated drive values
Group 03	Speed and torque reference values
Group 04	I/O values
Group 05	Data values
Group 06	Information: software version, drive and motor nominal values
Group 07	Control words
Group 08	Status words
Group 09	Fault and alarm words

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

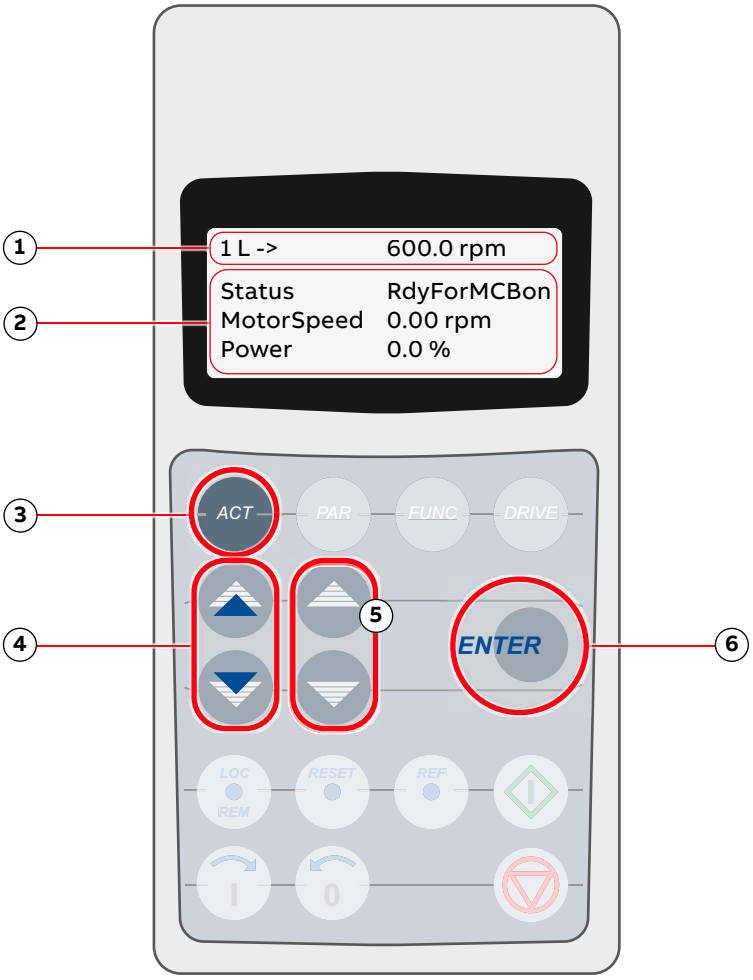
10.3.2.3. Fault memory

The fault memory display provides information on the 64 most recent fault events that occurred in the drive. It displays the name of the fault and the time it occurred. For instructions on how to display and reset the fault memory, see Section 10.3.2.5, “Displaying and resetting the fault history”, page 121.

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

Changing from the fault memory mode to other modes is possible without resetting the fault first. When no key is actuated, the fault or warning text is displayed as long as the fault is active.

Control panel overview



Key:

(1) Status line

(2) Actual signal names and values

(3) Selection key for actual signals mode

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

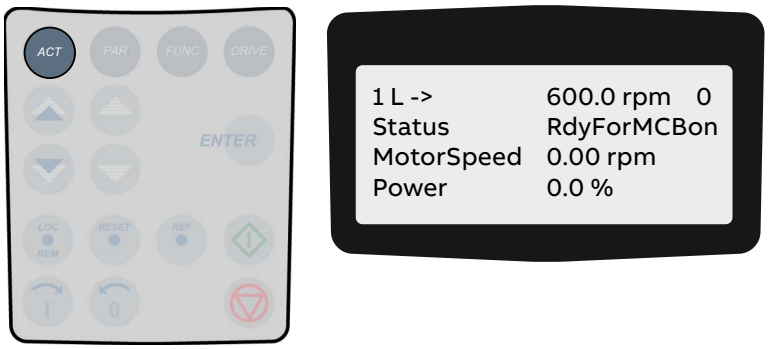
(5) Slow navigation key for selecting signals or fault messages

(6) Enter key for confirming the selection

Fig. 69. Control panel - Actual signals mode

10.3.2.4. Opening the actual signals display

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

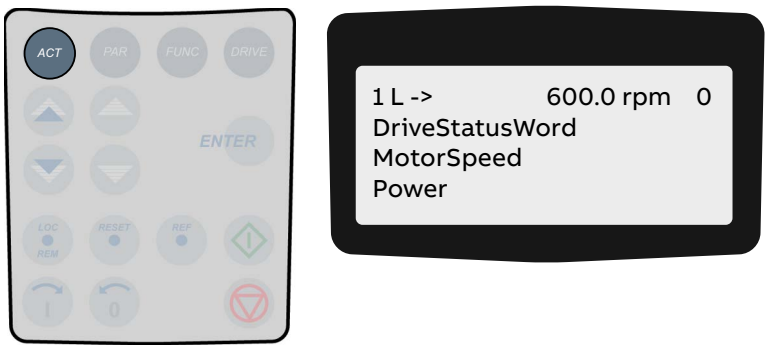


Toggle between actual signals display and fault history

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

Displaying three actual signals

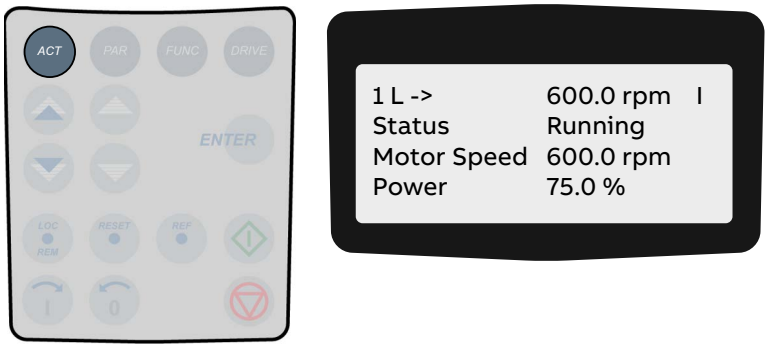
1. To display the full name of three actual signals, press and hold the **ACT** key.



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

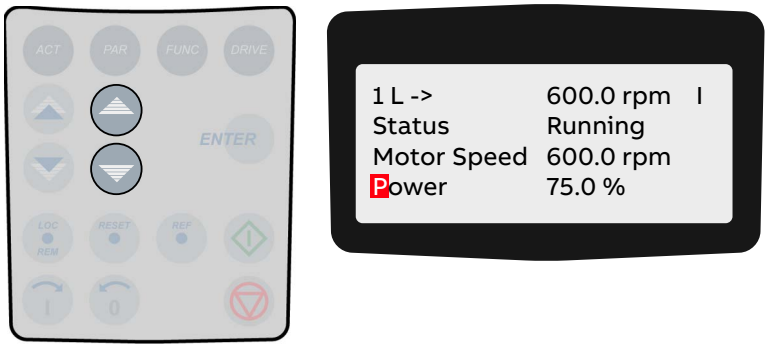
Selecting actual signals

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

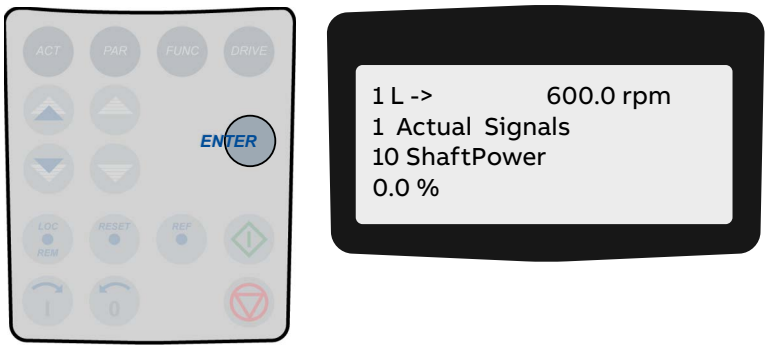


To select a line where the actual signal is to be displayed, press the corresponding slow navigation key.

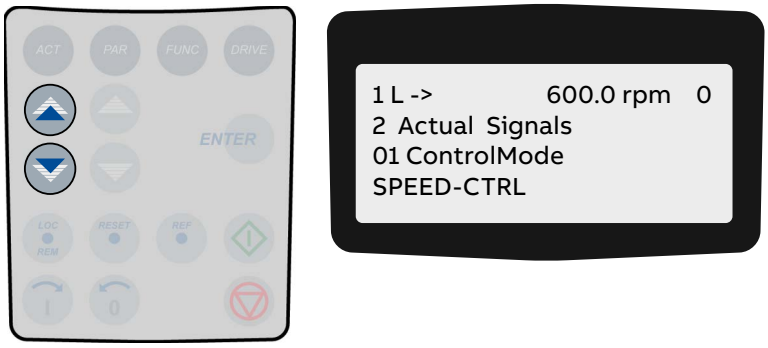
A **blinking** cursor indicates the selected line.



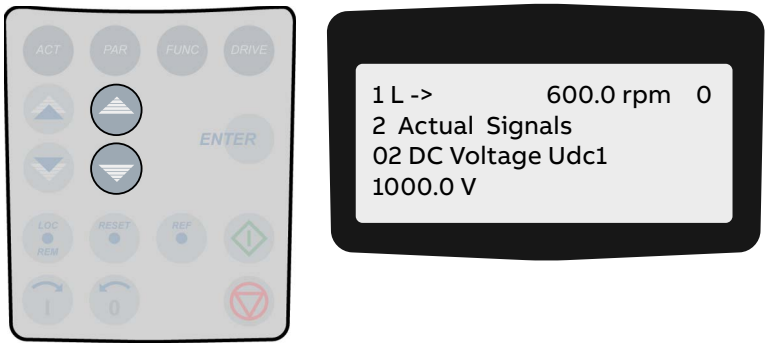
2. To enter the actual signal selection function, press the **ENTER** key.



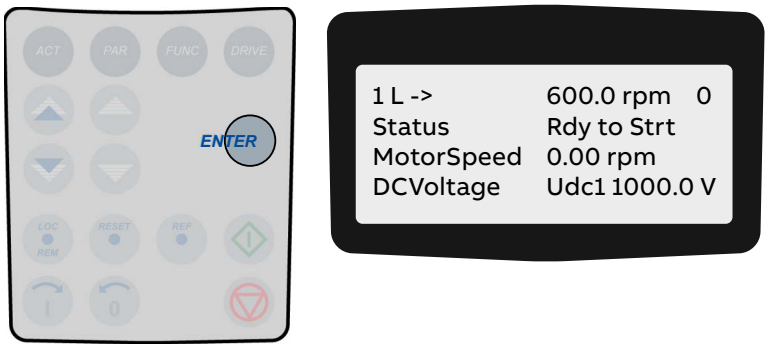
3. To select a parameter group, press a fast navigation key.



4. To select an actual signal, press a slow navigation key.

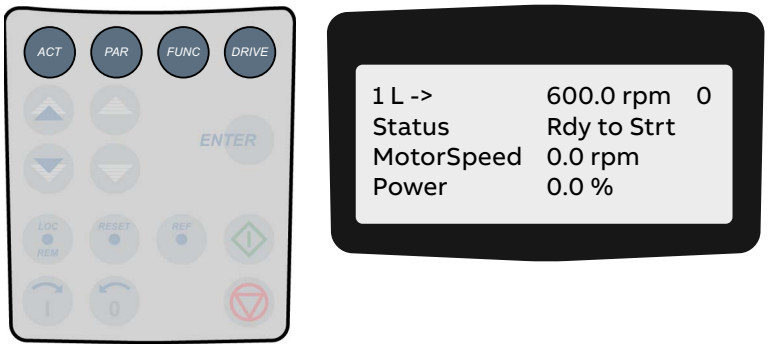


5. To confirm the selection and to return to the actual signals mode, press the **Enter** key.



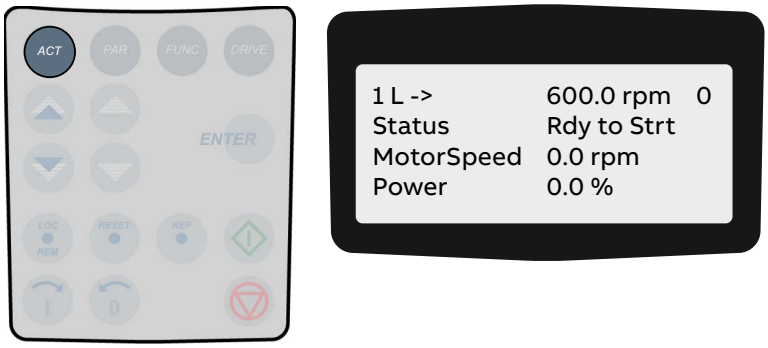
6. To cancel the selection and keep the original selection, press any of the mode selection keys.

   The selected CDP control panel mode is entered.



10.3.2.5. Displaying and resetting the fault history

1. To enter the actual signals mode, press the **ACT** key.

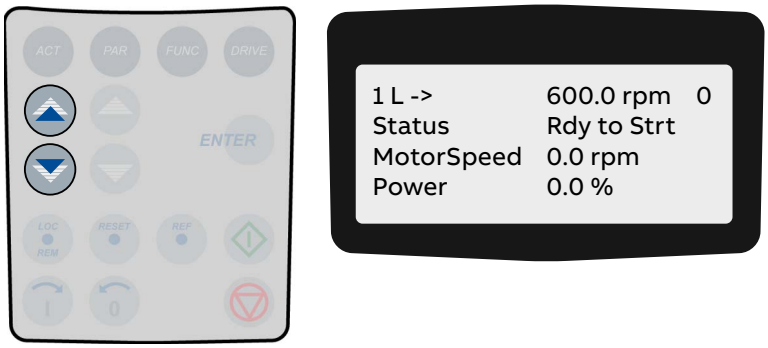


2. To change to the fault memory display, press a fast navigation key.

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

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

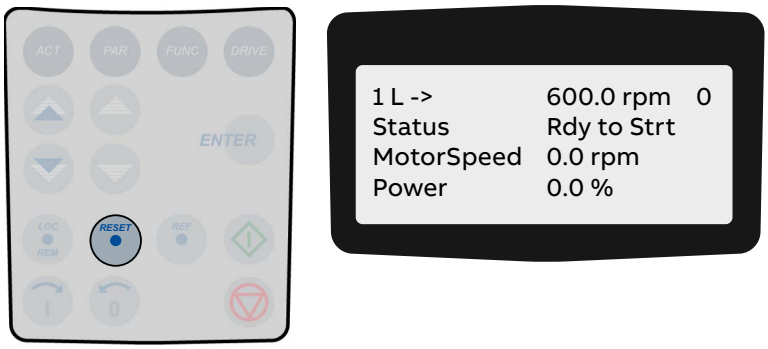
5. To return to the actual signals display, press a fast navigation key.



Displaying and resetting an active fault

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

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



10.3.3. Parameters mode

NOTICE

Risk of component damage. Running the drive system with incorrect data can result in improper operation, reduction of control accuracy and damage to equipment.

→ Parameters must only be set by qualified personnel.

→ DO NOT change any parameter, if the meaning of the parameter and the effects of the change are not fully understood.

10.3.3.1. Overview

If the parameter lock is disabled or unlocked (see Section 10.3.3.3, “Enabling / unlocking a parameter lock”, page 128), the parameters mode allows entering the parameter settings for the required drive configuration depending on the application.

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

TABLE 15 Parameter groups

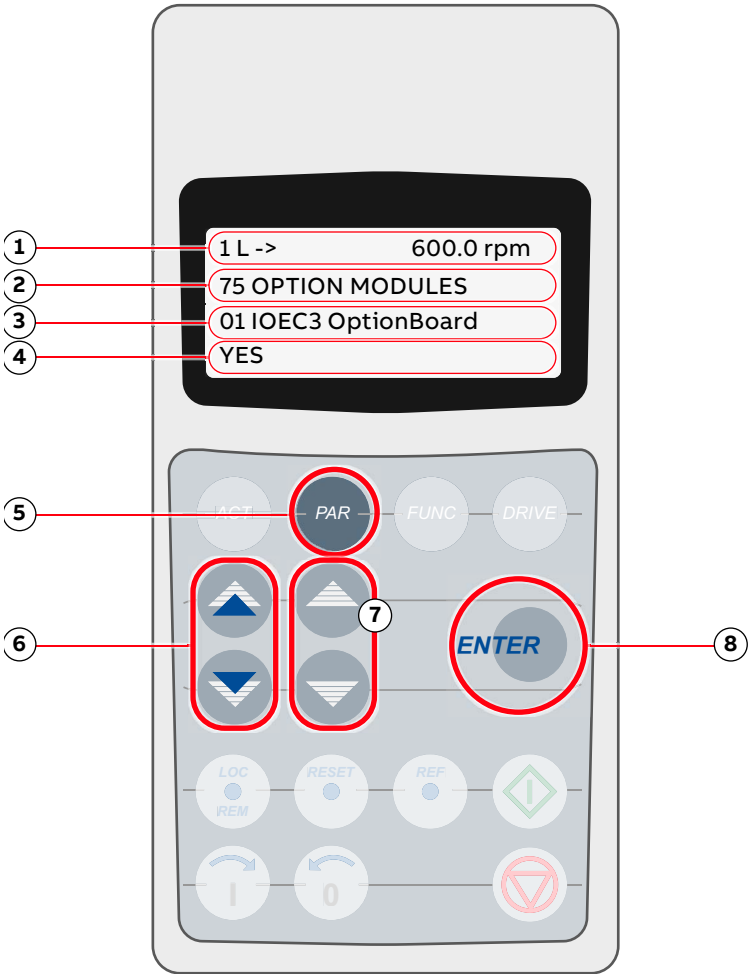
Group	Description
Group 07	Control words
Group 08	Status words
Group 09	Fault and alarm words
Group 11	Start, stop, direction, MCB and control
Group 12	Reference selection
Group 13	Basic analog inputs
Group 14	Basic digital outputs
Group 15	Basic analog outputs
Group 16	System control inputs
Group 17	Utilities
Group 18	Process speed
Group 19	Data storage
Group 20	Limits
Group 21	Start, stop and process stop
Group 22	Ramp functions
Group 23	Speed reference

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

When entering the parameter mode for the first time after the auxiliary voltage of the drive has been switched on, the CDP control panel displays the first parameter of parameter *group 99*. The next time the parameters mode is entered, the previously selected parameter displays.

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

Control panel overview



Key:

(1) Status line

(2) Group number and name

(3) Parameter number and name

(4) Parameter value

(5) Selection key for parameters mode

(6) Fast navigation key for selecting a parameter group (and a parameter value)

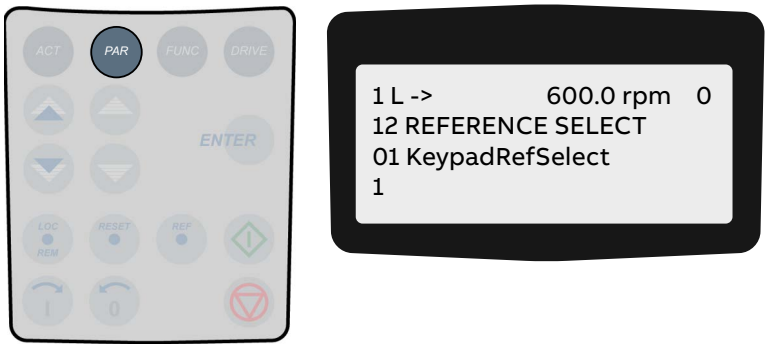
(7) Slow navigation key for selecting a parameter (and a parameter value)

(8) Enter key for confirming the selection

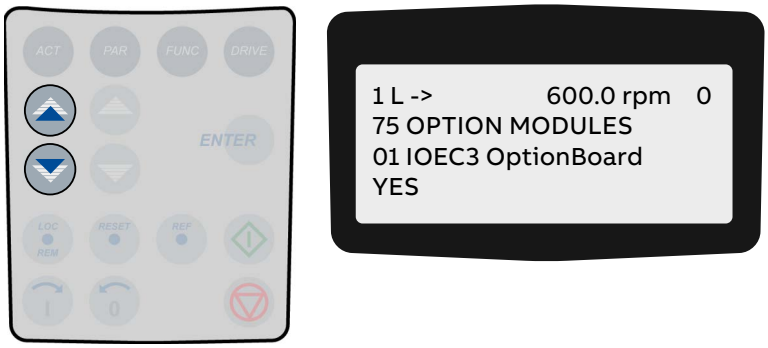
Fig. 70. Control panel - Parameters mode

10.3.3.2. Selecting and changing parameters

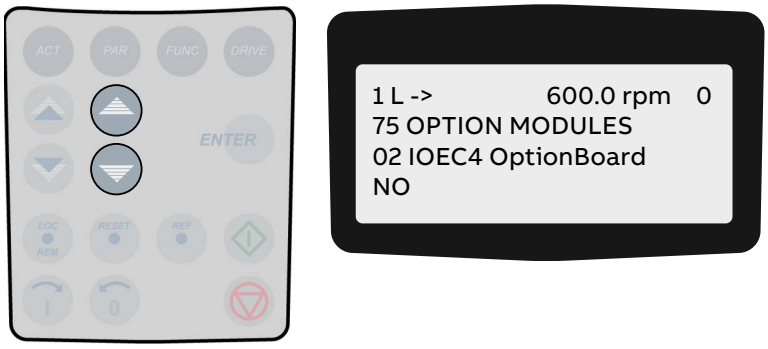
1. To enter the parameters mode, press the **PAR** key.



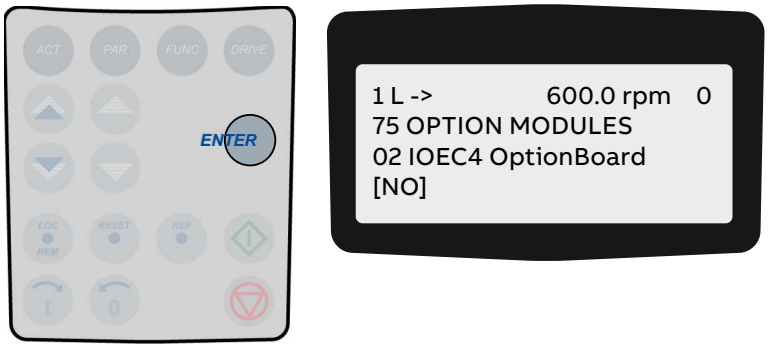
2. To select a different group, press the corresponding fast navigation key.



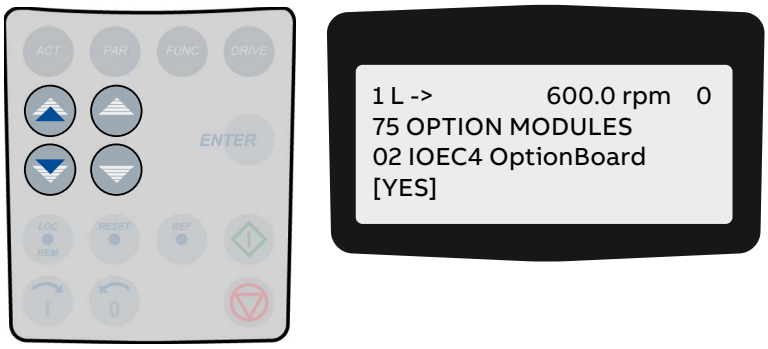
3. To select a parameter, press the corresponding slow navigation key.



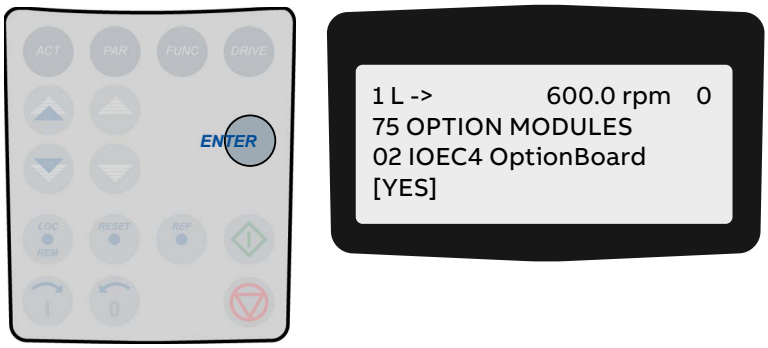
4. To enter the parameter setting function, press the **ENTER** key.



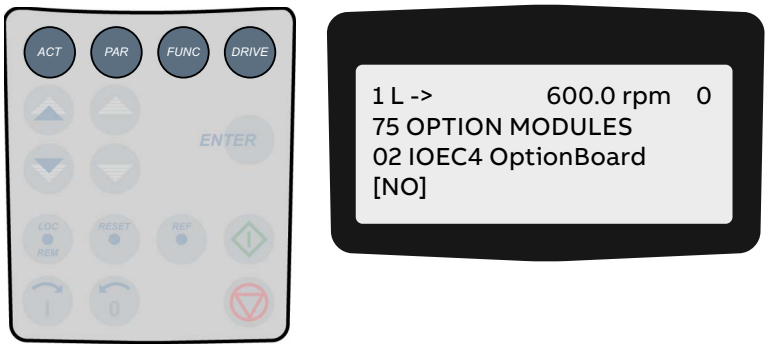
5. To change the parameter value, press the:
   - Slow navigation key for numbers and text
   - Corresponding fast navigation key for numbers only



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



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



10.3.3.3. Enabling / unlocking a parameter lock

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

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

Enabling the parameter lock

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

Unlocking the parameter lock

1. Select parameter *16.03*.
2. Set the correct pass code.
3. Confirm the setting and exit the parameters mode.
   For more information, see “Appendix G - Signal and parameter table”.

10.3.3.4. User lock

For better cyber security, ABB recommends that you set a master pass code for the control panel to prevent the parameter values from being changed.

NOTICE

Risk of component damage. ABB is not be liable for damages or losses caused by the failure to activate the user lock with a new pass code.

→ For more information, see Section 1.8, “Quality certificates and applicable standards”, page 17.

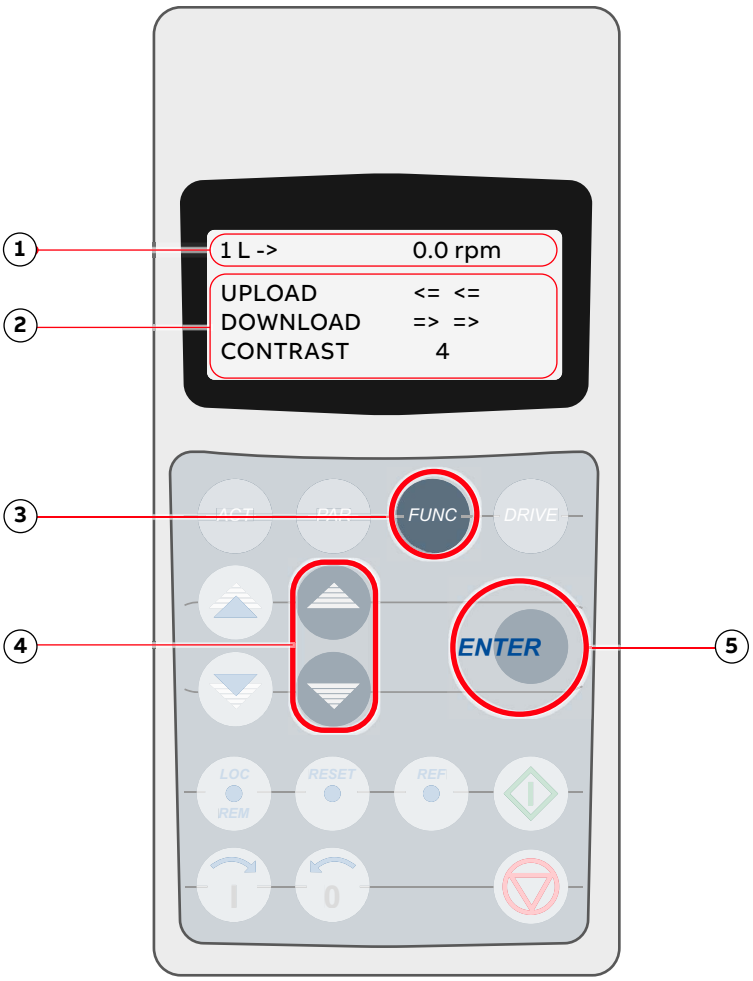
Pass code

– To activate the user lock for the first time, enter the default pass code, **358**, into *16.03 Passcode*. This will make parameters *16.06…16.07* changeable. Then enter the old pass code to *16.06 OldUserPasscode* and change user pass code in *16.07 NewUserPasscode*. In *16.02 Parameter Lock*, the user lock functionality can now be enabled.

– To reopen the lock, enter your pass code into *16.03 Passcode*. This will again make parameters *16.06* and *16.07* visible.

10.3.4. Functions mode

The functions mode is used to set the display contrast.



Key:

(1) Status line

(2) Selectable functions

(3) Selection key for functions mode

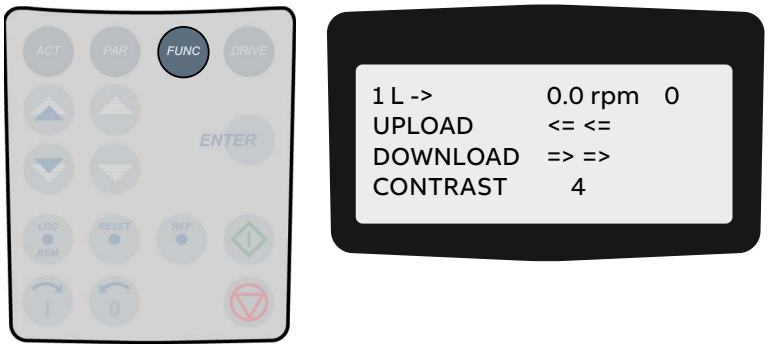
(4) Slow navigation key for selecting a line (and adjusting the contrast)

(5) Enter key for confirming the selection

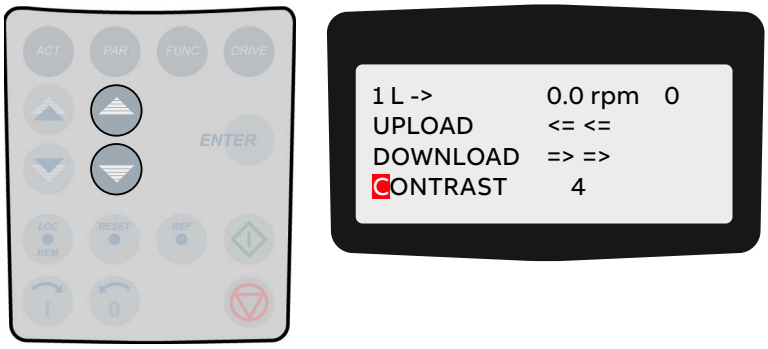
Fig. 71. Control panel - Functions mode

10.3.4.1. Adjusting the display contrast

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



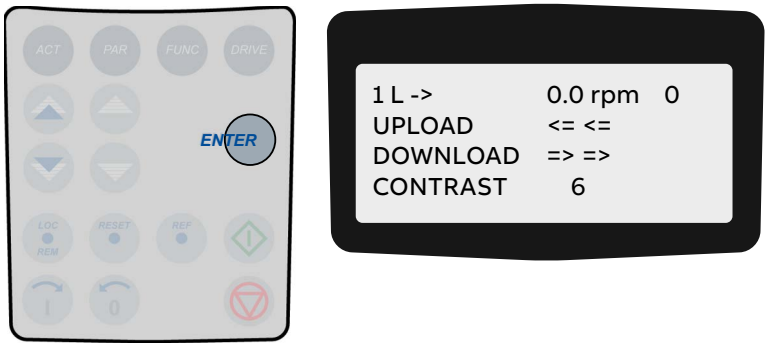
2. To select the contrast adjustment function, press the slow navigation keys until the blinking cursor reaches the **CONTRAST** line.



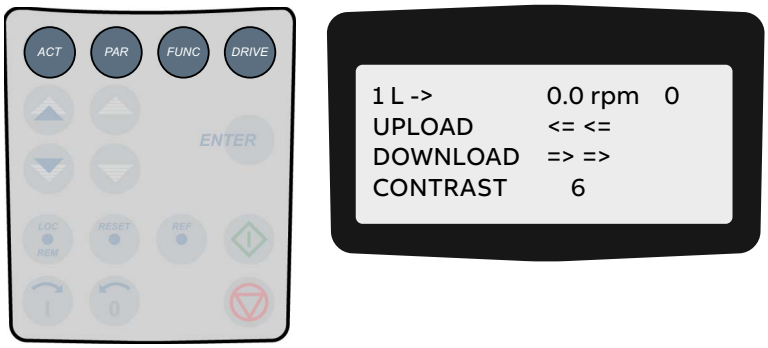
3. Press the **ENTER** key.

4. To change the contrast value, press a slow navigation key.

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



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



10.4. Local and remote control

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

– Local control

– Remote control

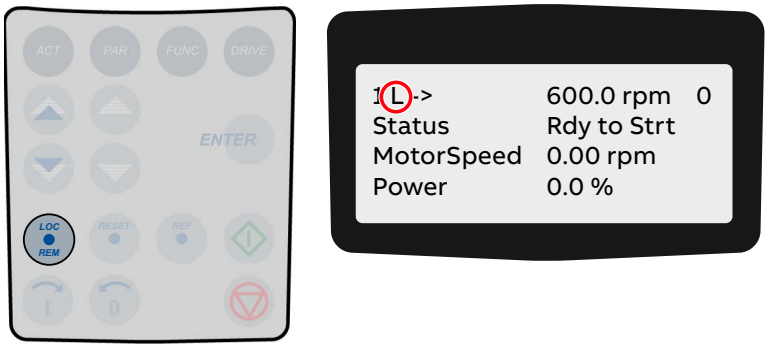
In this context, remote control is not necessarily equivalent to higher-level control. For more information, see Section 10.4.2, “Remote control”, page 133.

10.4.1. Local control

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

Entering local control mode

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


ACT
PAR
FUNC
DRIVE
ENTER
LOC
REM
RESET
REF
1 L ->
600.0 rpm
0
Status
Rdy to Strt
MotorSpeed
0.00 rpm
Power
0.0 %

10.4.2. Remote control

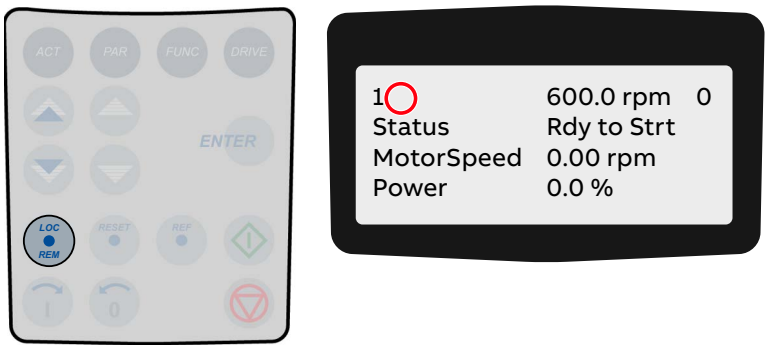
In remote control mode, operational commands or reference values come from a higher-level control system via fieldbus or remote I/O.

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

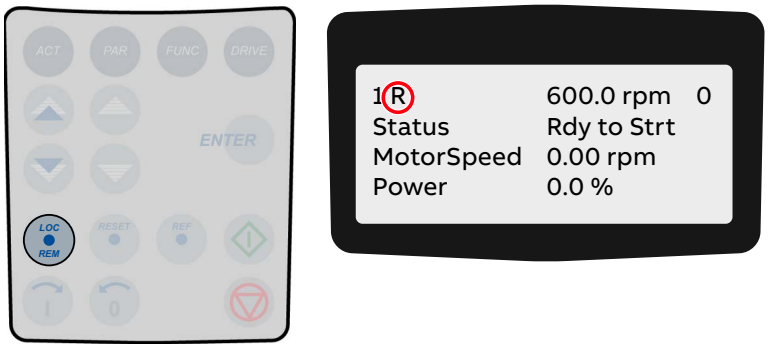
- *11.01 EXT1 START/STOP/DIR = 10 (KEYPAD)* or
  12.03 EXT REF1 SELECT = 1 (KEYPAD) and
  12.02 EXT1/EXT2 SELECT = 1 (EXT1)
- *11.02 EXT2 START/STOP/DIR 10 (KEYPAD)* or
  12.06 EXT REF2 SELECT = 1 (KEYPAD) and
  12.02 EXT1/EXT2 SELECT = 2 (EXT2)

Entering remote control mode

- To enter remote control, press the **LOC-REM** key.
  Full remote control from a higher-level control system is indicated by a blank space.



Partial remote control (some commands enabled locally) is indicated by the letter **R**.



10.5. Operational commands

For instructions on how to start and stop the drive system from the CDP control panel, see Section 9.7, “Starting the drive”, page 109 and Section 9.8, “Stopping the drive”, page 111.

10.5.1. Setting the direction of rotation

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

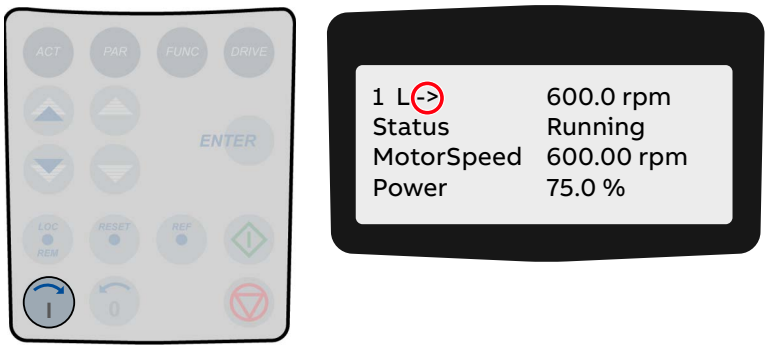
- Local control mode **L**
- Remote control mode **R**

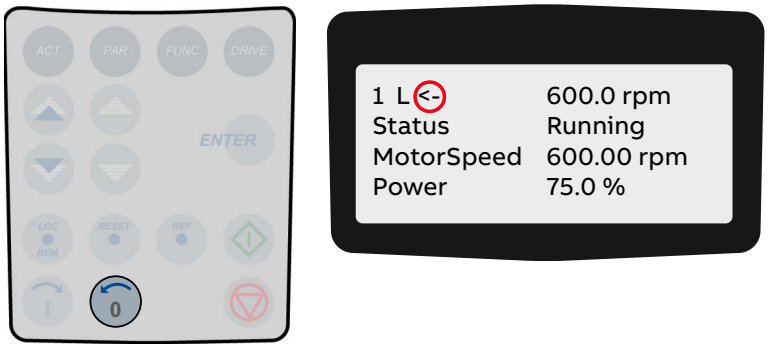
The arrow on the display indicates the direction of rotation:

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

Procedure

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





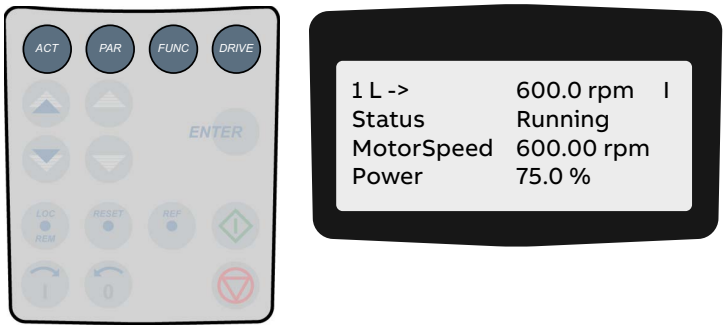
NOTE – If you change the direction while the motor is running, the motor automatically ramps down to zero speed and re-accelerates in the opposite direction to the preset speed. The arrow changes at zero speed.

10.5.2. Entering a reference value

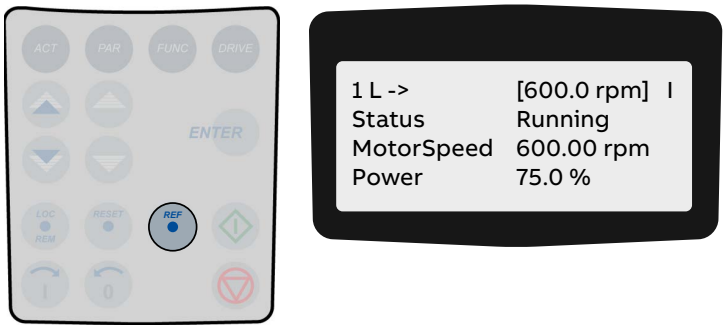
Entering a reference value from the CDP control panel is possible in:

- Local control mode **L**
- Remote control mode **R**

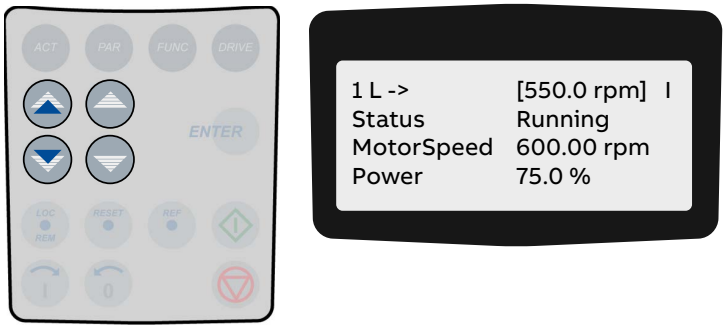
1. Press a mode selection key.



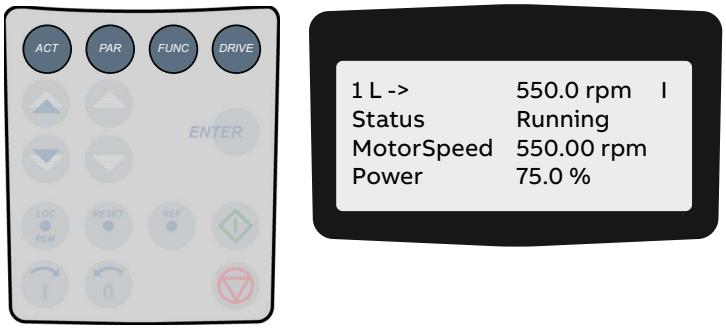
2. To enter the reference value input mode, press the REF key.



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



4. To exit the reference value input mode, press any of the mode selection keys.



11. Preventive and corrective maintenance

11.1. General information

During the warranty period of the drive, all maintenance must be performed exclusively by ABB service personnel. After the warranty period, maintenance must only be performed by certified personnel.

11.1.1. Required qualification

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

11.1.2. Maintenance schedule

Perform all maintenance tasks according to the maintenance schedule and the applicable service instructions, on time and at the intervals stated in the “ACS1000 preventive maintenance schedule”, 3BHS855276 E01.

11.1.3. Logbook

ABB recommends that you keep track of all troubleshooting and maintenance work in a logbook including:

– Date and time

– Detailed description

11.1.4. Spare parts

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

For information on types and identification codes, see “Appendix E - Parts list”.

11.2. Identifying electrical equipment

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

11.2.1. Device identification

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

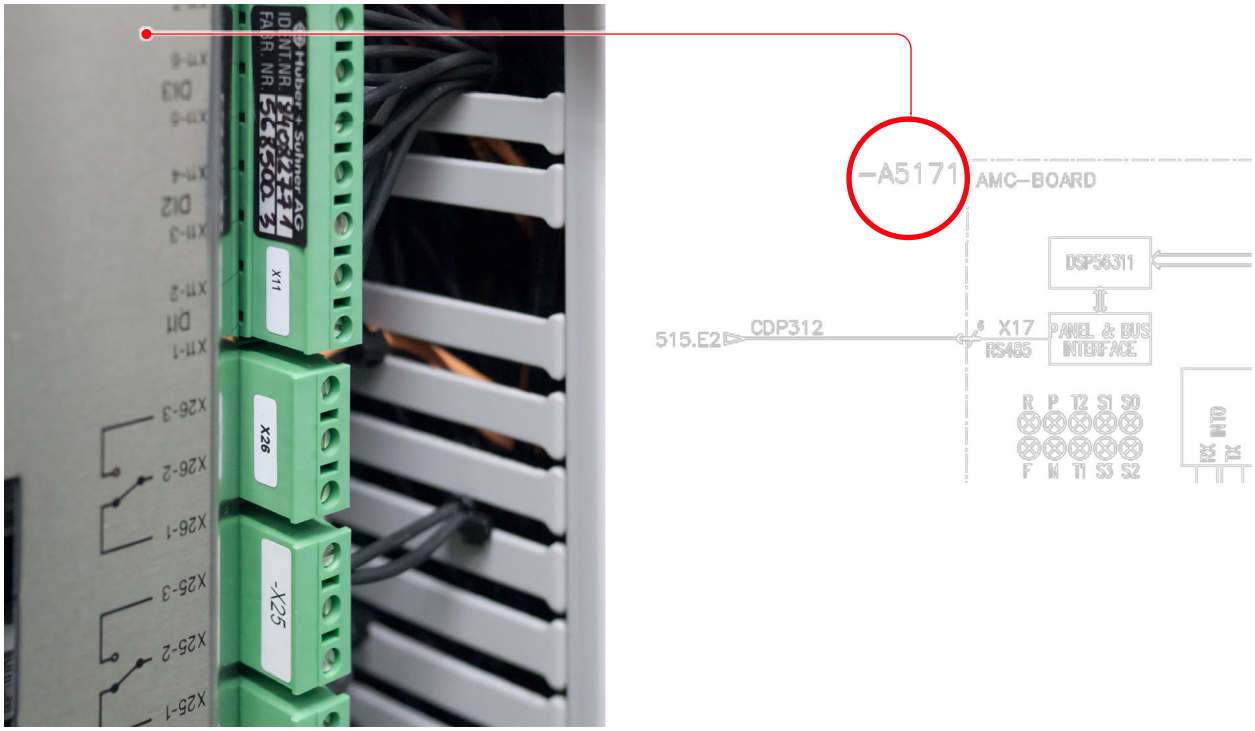


Fig. 72. Device identification

11.2.2. Cables and wires

Cables and wires in the drive are equipped with marker sleeves which carry the same identification number as in the wiring diagrams.

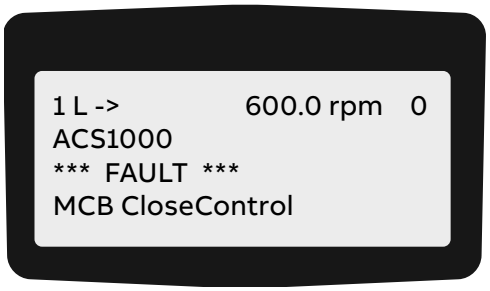
11.2.3. Understanding wiring diagrams

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

11.3. Alarm / fault indications

11.3.1. Messages

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



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

11.3.2. Error message levels

Two error message levels are used in the drive:

– **Alarm**: Does not shut down the drive. If the condition causing the alarm is not corrected, a persisting alarm can 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.

  An exception is when an alarm of the cooling system (eg, *FanDiffPres*, *AirFiltSupv*) is not reset automatically. To reset the alarm, set parameter *41.04 FanAlarmReset* to **RESET**.

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

11.3.2.1. Alarm / fault messages

If 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.

11.3.3. Fault handling

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

– The last fault entered always has number 1 assigned to it.

– The first fault always has the highest number in the fault buffer.

Date and time stamps facilitate fault tracing, especially when a fault leads to several subsequent faults.

Example:

1)	**-Fault RESET FAULT**	2011-04-26 14:57:56.5370
2)	**+Fault Undervoltage**	2011-04-26 14:47:41.1110
3)	**+Warn Undervoltage**	2011-04-26 14:47:41.1000
4)	**+Fault MCB Disturb**	2011-04-26 14:47:38.0230

In the above example:

4) **+Fault MCB Disturb** is the reason for the failure of the drive, as it occurred first.

3) **+Warn Undervoltage** occurred approximately 3 seconds after the first fault.

2) **+Fault Undervoltage** immediately followed the warning.

1) **-Fault RESET FAULT** informs that the fault has been reset.

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

11.3.4. Standard troubleshooting procedure

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

1) **DO NOT switch off the auxiliary supply voltage or try to reset a fault message before all information at the time of the occurrence of the fault condition has been saved.**

2) **Select the fault history display on the CDP control panel, but DO NOT clear the buffer!**

   For more information, see Chapter 10, “CDP control panel”, page 114.

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

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

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

5) **Contact ABB service if a fault cannot be rectified.**

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

   - Operating, ambient and load conditions
   - Unusual events

6) **After the fault has been rectified, start the drive as described in Chapter 11, “Preventive and corrective maintenance”, page 136.**

11.4. Removing the CDP control panel

IMPORTANT! If the CDP control panel is removed during operation, the drive can only be stopped by pressing the **EMERGENCY OFF** button.

1. If the panel is removed while the drive is in operation, check the setting of parameter *31.06 PANEL LOSS SUPERVISION* first.

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

   For information on setting parameters, see “Appendix G - Signal and parameter table”.

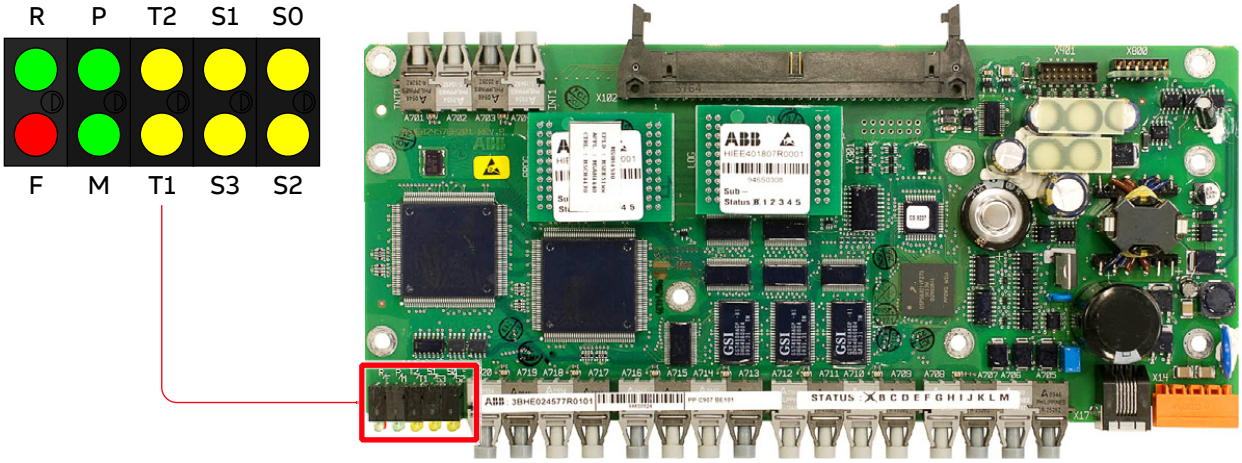
2. Proceed as illustrated.

   The green LED (4) signals that the control voltage has been switched on.

11.5. LEDs and switches on circuit boards

The following section provides an overview on the meaning of LEDs and switches of the main circuit boards and I/O devices. The LEDs presented in the following section can be checked easily with the auxiliary voltage switched on and without having to remove covers first. The LEDs provide information on the status of the devices and can be used for diagnostic purposes.

11.5.1. AMC circuit board

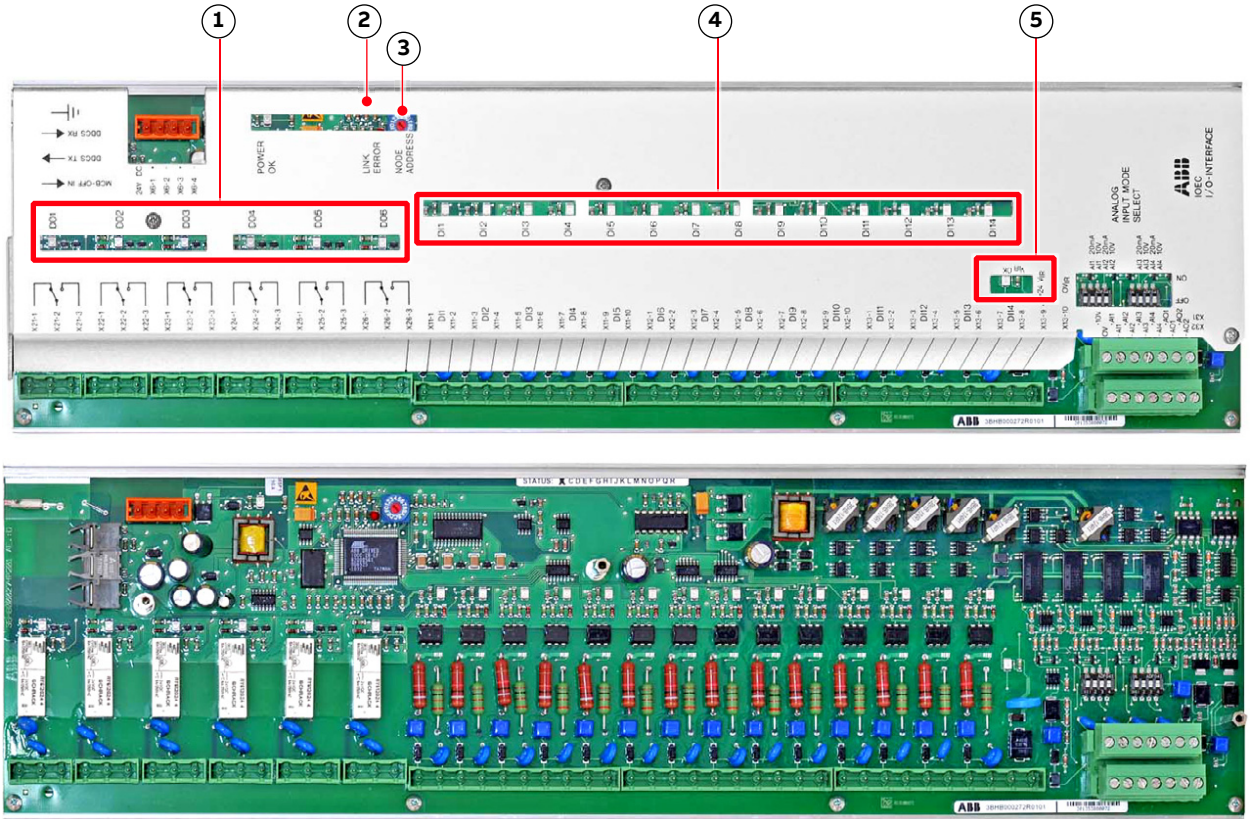


			Status when software has loaded		Status when software has not loaded	
LED	**Color**	**Description**	**Booting**	**ON**	**Booting**	**ON**
F	Red	Fault	ON	OFF	ON	ON
R	Green	Run	OFF	OFF	OFF	OFF
M	Green		ON	OFF	ON	ON
P	Green	Supply OK	ON	ON	ON	ON
T1	Yellow	Receiving data on DDCS channel 0	Flashing	ON / OFF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

Fig. 73. AMC circuit board

11.5.2. IOEC I/O modules

11.5.2.1. LEDs



Key:		Explanation
(1)	Status LED of digital outputs	On when output is energized
(2)	Link error light	Only on when there is a problem with the optical fibers.
(3)	Rotary switch	Sets the address
(4)	Status LEDs of digital inputs	On when input is energized
(5)	Status LED of the 24 V internal voltage supply	On when energized

Fig. 74. IOEC module

11.5.2.2. Cluster address

Each IOEC module has a unique cluster address that identifies the module in the software and links it to a parameter.

The address is set with the rotary switch on the module (3, Fig. 74). The factory-set value must not be changed.

For information on IOEC switch settings, see “Appendix C- Mechanical drawings”.

11.6. Corrective maintenance

Overview on maintenance tasks:

- “Visual checks on the drive”, page 151
- “Cleaning the drive”, page 152
- “Checking wire and cable connections”, page 152
- “Cleaning and replacing filter mats”, page 153
- “Inspecting and replacing batteries”, page 154
- “Replacing the fan inside the water-cooling unit”, page 156
- “Replacing the redundant fan unit”, page 158
- Inspection of cooling system
  - Replacing pumps
  - Replacing deionizer resin and micro filter
  - Replacing fan
  - Cleaning strainer
  - Replenish water

For more information, see user manual of the water cooling unit in “Appendix A - Additional manuals”.

11.6.1. Safety

DANGER

Hazardous voltages! Before starting to work on the drive, make sure that:

→ Main and auxiliary power supply to the drive is switched off, locked out, and tagged out

→ Drive is de-energized

→ Safety ground connections are in place

→ Personal protective equipment is provided and used when required

→ Everyone involved is informed

Before energizing the drive again, make sure that:

→ All foreign objects are removed from the drive

→ All internal and external covers are securely fastened and all doors are closed, locked and / or bolted

NOTICE

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

Ensure that foreign matter cannot enter the cabinet:

→ Close the doors and cover openings completely when work is discontinued.

→ Retrieve any foreign matter which accidentally dropped into the cabinet.

10 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 10 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

11.6.2. De-energizing the drive locally

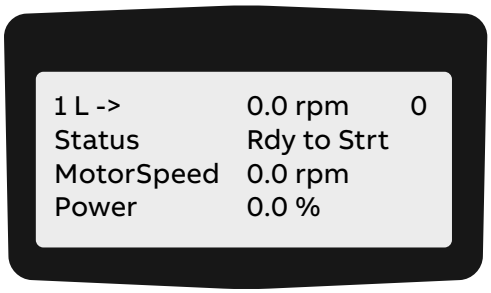
The following section describes how to de-energize the drive using the local operator panel of the drive. If the drive is controlled from remote, follow the established shutdown procedures.

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

   For more information, see Chapter 10, “CDP control panel”, page 114

2. Press the stop key.

   When the motor has reached zero speed, the display shows **Rdy to Strt**.

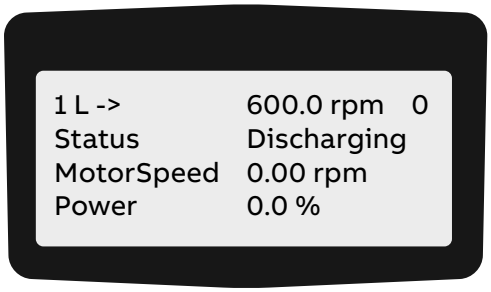


3. Press the MAIN SUPPLY OFF push button to disconnect the drive from the main power supply

   The following takes place:

   - MCB opens
   - DC link discharges for approximately five minutes

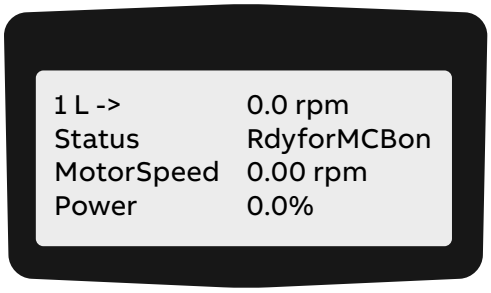
   While the DC link discharges, the display shows the following.



Alternating display message:

- Discharging
- CoolOFFDelay
- RdyForMCBon

   When the DC link has discharged completely, the status line displays **RdyforMCBOn** and the **MAIN SUPPLY OFF** push button lights up.



4. Rack-out, lock-out, ground and tag-out the main power feeder.

5. If the grounding switch is equipped with the optional lock (1) that secures the switch in the ungrounded position, unlock the grounding switch.

6. Wait until the yellow lamp **GROUNDING SWITCH UNLOCKED** lights up.

   The lamp lights up when cooling stops after a delay time.

7. If the yellow lamp is on, continue with Section 11.6.3, “Grounding”, page 148.

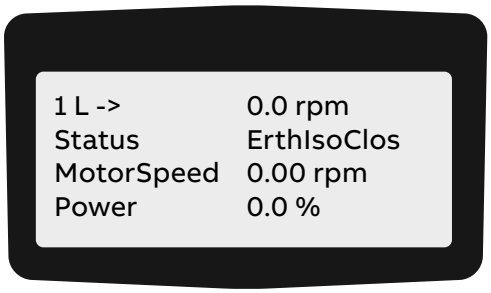
8. If the yellow lamp is not on, continue with Section 11.6.4, “Grounding switch is not released”, page 148.

11.6.3. Grounding

1. If the yellow lamp of the **GND SWITCH UNLOCKED** push button is on, turn the grounding switch to the grounded position.

   When the grounding switch is in the grounded position, the status line of the CDP control panel displays **ErthIsoClos**.

   NOTE – Earth isolator closed = grounding switch is in grounded position.



2. To de-energize the drive completely, switch off and lockout all auxiliary voltages from external sources.

   NOTE – To open the doors of medium voltage compartments and additional cabinets of the drive that are equipped with an electromechanical lock, you need to have the auxiliary voltage switched on.

3. If necessary, connect a grounding set.

11.6.4. Grounding switch is not released

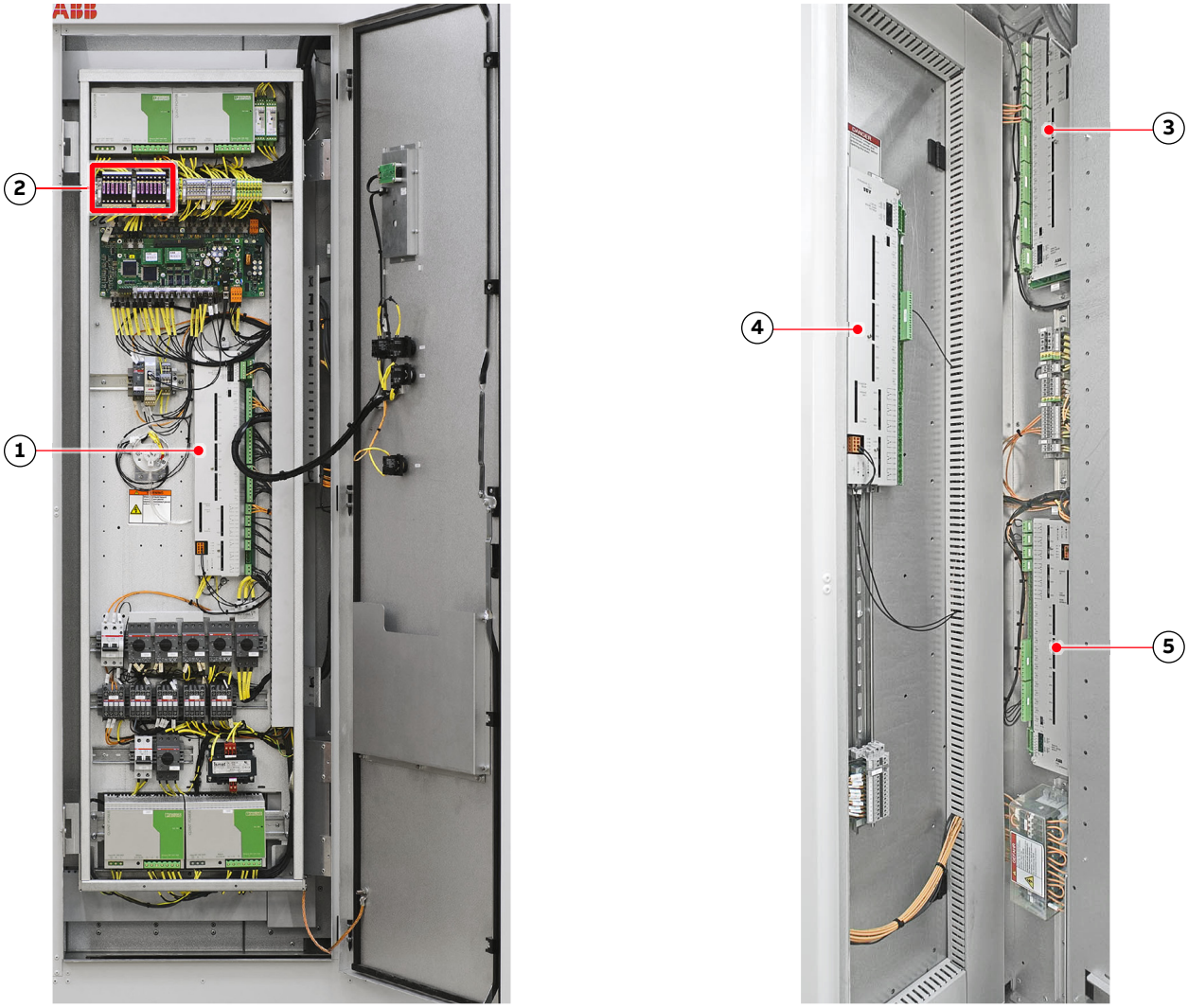
⚠ CAUTION

Hazardous voltage! Forcibly turning the grounding switch before the yellow lamp of the **GND SWITCH UNLOCKED** push button lights up can short-circuit the energized DC-link capacitors and create a loud bang or damage the grounding switch.

→ DO NOT force the grounding switch when the **GROUNDING SWITCH UNLOCKED** lamp is off.

→ If you cannot operate the grounding switch, see Section 11.6.5, “Checking the release conditions for the grounding switch”, page 150. To identify the components referred to in the check list, see the wiring diagrams and Fig. 75.

Component location



Key:

(1) Fuses

(2) IOEC1 / -A5191 (standard)

(3) IOEC4 / -A5211 (option)

(4) IOEC2 / -A5201 (standard)

(5) IOEC3 / -A5221 (option)

Fig. 75. Location of I/O modules and fuses

11.6.5. Checking the release conditions for the grounding switch

1) Check that the auxiliary voltage is switched on. ☐

2) Main power supply is disconnected from the drive.

– **Check that the MCB is open.** ☐

When the MCB is open, secure it against closing.

– **Check that the feedback signal "MCB is open" arrives at the drive, ie, if the following indicators are lit:**

- LED of digital input DI08 of I/O module -A5201 (-A2) ☐
  - **(LED is not lit)** Check the control-signal wiring between switchgear and drive as per applicable wiring diagram. ☐
- MAIN SUPPLY ON push button -S5152 (-S2) ☐

  When the LED and the push button are lit, the feedback signal “MCB is open” has arrived at the drive.
  - **(Push button is not lit)** Check if the 24 V blade-type fuse (X27_P2:14) is blown. The fuse protects the control circuit of the pushbutton. ☐

3) Discharge level of the DC link.

– **Check if the value of parameter 2.06 DC VOLTAGE is below 50 V.** ☐

When the value is below 50 V, the DC link is regarded as discharged. For information on reading actual values on the CDP control panel, see Section 10.3.2, “Actual signals mode”, page 116.

4) GROUNDING SWITCH UNLOCKED lamp and the wiring of the lamp.

– **Check if the CDP control panel displays a fault.** ☐

A fault prevents the lamp GROUNDING SWITCH UNLOCKED from lighting.

- If a fault is present, follow the instructions in Section 11.3.4, “Standard troubleshooting procedure”, page 140, before you reset a fault.
- If a fault cannot be rectified and reset, contact the ABB service organization.

– **If the CDP control panel does not display a fault, check that digital output DO04 of I/O module -A5191 (-A1) is energized.** ☐

- DO04 releases the grounding switch and lights the lamp GROUNDING SWITCH UNLOCKED (–H5152).
- When the LED of DO04 is lit and the control voltage is present at terminals X24:2 and X24:3 of DO04, DO04 is energized.

– **If digital output DO04 of the I/O module is not energized, check the I/O module -A5191 (-A1).** ☐

To do this, check if the auxiliary voltage is present at the supply terminals of the I/O module.

- X6:1.....24 V (DC)
- X6:2.....0 V

– **Check that LED V726 and LED V740 of the I/O module -A5191 are lit.** ☐

The LEDs monitor the control voltages of the I/O module (Fig. 74).

When the LEDs are lit, the I/O module functions properly.

- LED V726.....24 V (DC)
- LED V740.....5 V (DC)

– **If digital output DO04 I/O module -A5191 is energized, check that the control voltage is present at the terminals of the lamp GROUNDING SWITCH UNLOCKED.** ☐

- If the control voltage is present but the lamp is not lit, the lamp is burnt out and must be replaced.
- If the control voltage is not present, check the wiring of the lamp. Correct the wiring if necessary.

5) Check that hazardous voltages from the motor cannot be fed into the drive. ☐

IMPORTANT! When the checklist is completed, carefully try to turn the grounding switch to the grounded position. If you cannot turn the grounding switch but doors of medium voltage compartments have to be opened, call the ABB service organization.

11.6.6. Visual checks on the drive

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

– Humidity inside the drive

– Permitted range of ambient air temperature and humidity of the drive

– Dust built-up inside the drive

– Appropriate fastening of cables and wires and connections of cable screens

– Integrity of cable insulation

– Signs for overheated components, wires, cables or busbars

– Corrosion on circuit boards, connectors or busbars

– Correct type of signal and power cables

For more information, see the applicable cable specifications.

11.6.7. Cleaning the drive

NOTICE

Risk of component damage! The drive contains components which are sensitive to electrostatic discharge.

→ Apply ESD handling precautions before handling these devices.

Dust on electrical components and wiring can cause failure and damage the components. Dust and moisture can build up in loose connections and cause loss of low-level signals.

→ Check the cabinet regularly for signs of dust and humidity and clean if necessary - alcohol and solvents can damage the components.

→ Use appropriate and recommended cleansing agents.

When cleaning the drive, mind the following:

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

11.6.8. Checking wire and cable connections

NOTICE

Risk of component damage. Capacitor bushings are damaged when excessive force is applied.

→ DO NOT exceed the maximum tightening torque; the tightening torque value is printed on a label which is attached to the capacitor.If not specified, the maximum torque must not exceed 20 Nm.

Vibration can loosen electrical connections and cause occasional malfunction or equipment failure.

→ Inspect all power and control cable connections and tighten them if necessary.

→ Inspect that all plugs and connectors are tight.

11.6.9. Cleaning and replacing filter mats

This section applies to a drive without enclosure cooler in the water cooling compartment.

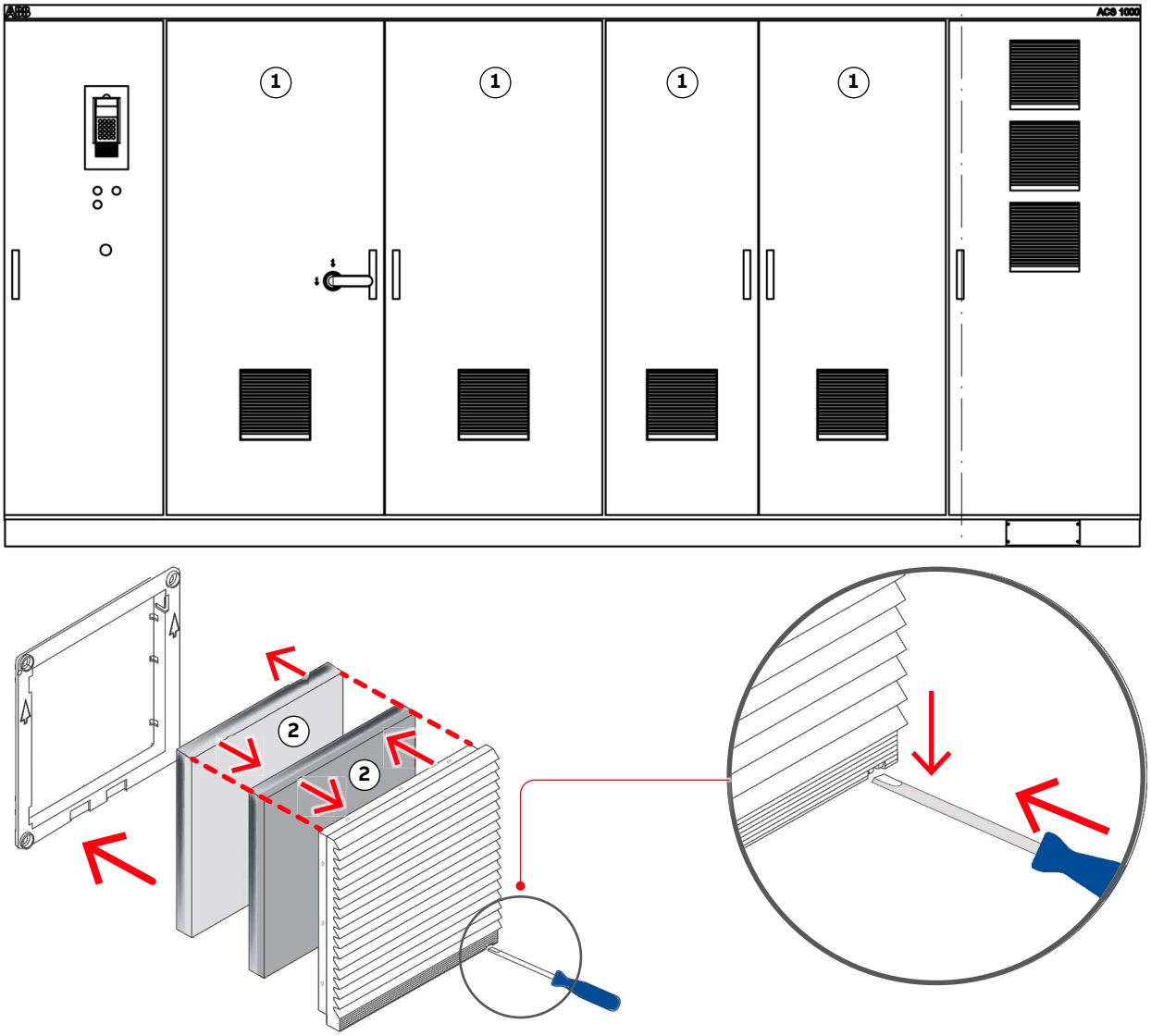
⚠ WARNING

Hazardous voltage! Removing the filter mat while the drive is running can cause serious injury or DEATH. Foreign objects can be sucked into the exposed air intake and cause FATAL short-circuits.

→ Keep long, thin objects, such as wires and screwdrivers, away from the exposed air intake.

→ DO NOT stop work for long periods while the air intake is exposed.

For information on inspection and replacement intervals, see “ACS1000 preventive maintenance schedule”, 3BHS855276 E01.



Key:

(1) Medium voltage compartment

(2) Filter mat

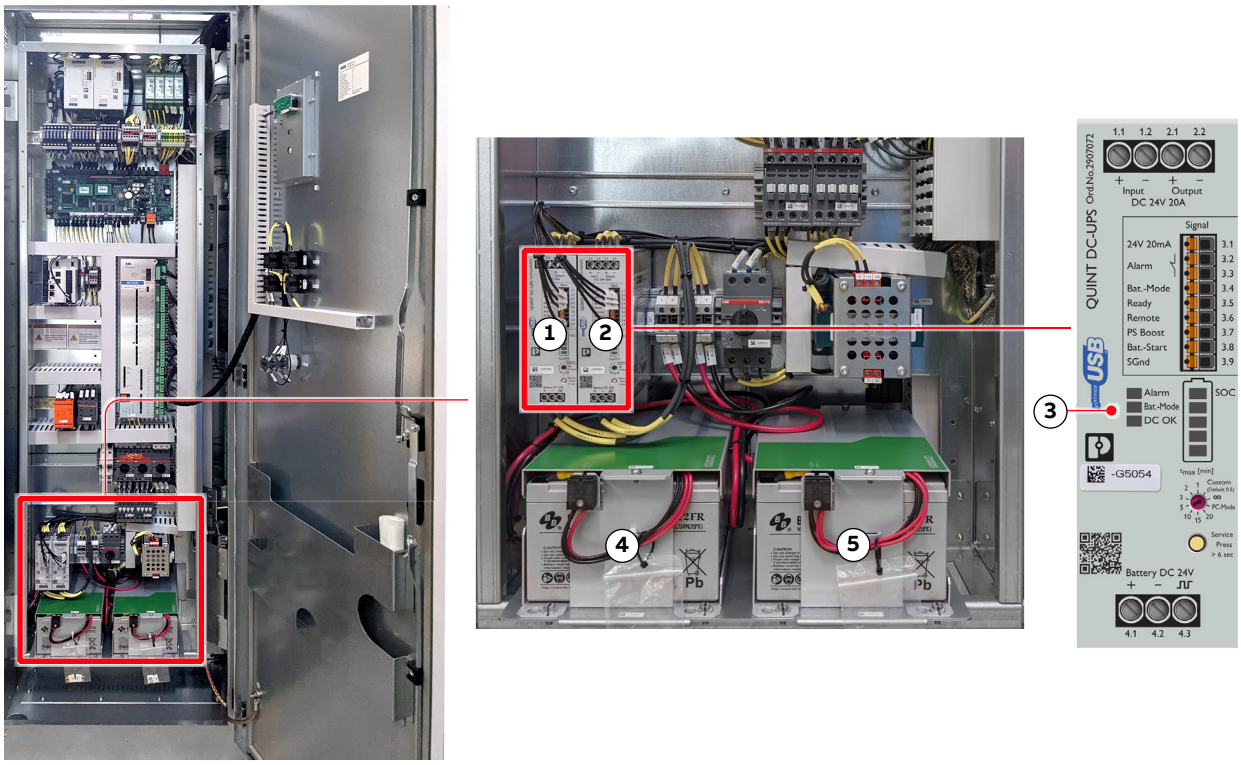
Fig. 76. Cleaning and replacing filter mats

TABLE 16 Filter information

Filter type	Thickness (mm)	Dimensions (mm)
Rittal 3172.100	~10	22.1 x 22.1

- To remove a filter mat, roll the filter mat from the top down.
- Clean the filter mat with compressed air or a vacuum cleaner away from the drive so that dust cannot enter the drive.

11.6.10. Inspecting and replacing batteries



Key:

(1) Power supply unit for battery pack 1

(2) Power supply unit for battery pack 2

(3) Alarm LED

(4) Battery pack 2 (option)

(5) Battery pack 1

Fig. 77. Control compartment – battery location

11.6.10.1. Checking and replacement indications

The end of the battery life is indicated as follows:

- CDP control panel displays an alarm message.
- Alarm LED on the power supply unit for the battery lights up (3, Fig. 77).

When the end of the battery life is indicated, the drive continues to operate until the time set with parameter *145.26 Batt-Alm.Tim-out* has elapsed.

ABB recommends replacing all of the batteries when one battery is at end-of-life.

11.6.10.2. Replacing a battery

CAUTION

Heavy object. A battery weighs approximately **10 kg**!

1. When the drive is in operation, disable the battery monitoring function first. To do this, set parameter *31.05 DISABLE BATTERY TEST* to **ON**.

   Parameter *31.05* is automatically set to **OFF** after 1 hour.

2. Disconnect the wires (1, Fig. 78).

3. Unscrew the battery at the front (2, Fig. 78) and at the back (not shown).

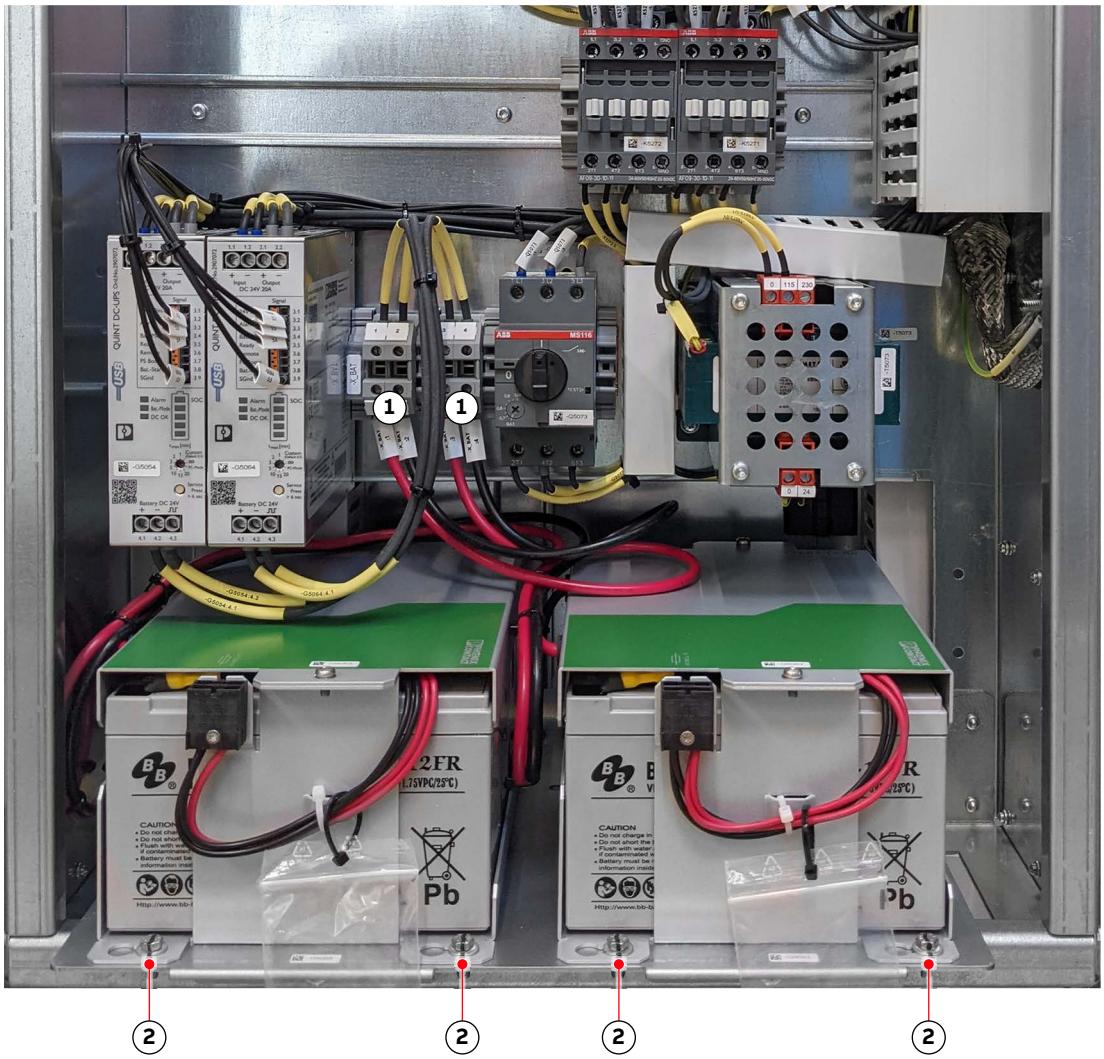


Fig. 78. Control compartment - replacing the batteries

4. Install the new battery in reverse order of removal.

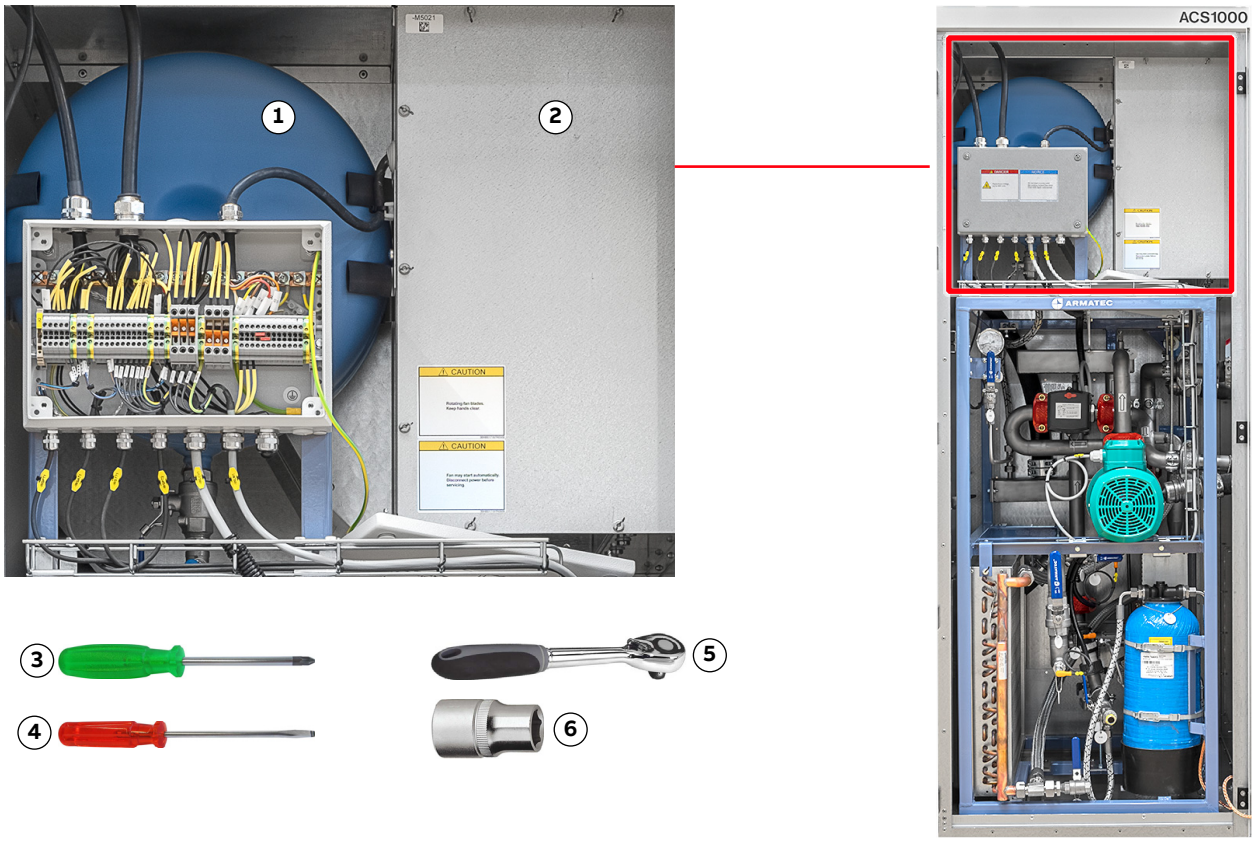
5. Record the date of battery replacement in the logbook.

11.6.11. Replacing the fan inside the water-cooling unit

⚠ CAUTION

Heavy object. A battery weighs approximately **26 kg**!

- **Replacement intervals**: see “ACS1000 preventive maintenance schedule”, 3BHS855276 E01.
- **Estimated working time**: ~1 hour



Key:

(1) Power supply cable
(2) Fan housing cover
(3) Phillips screwdriver
(4) Flat head screwdriver
(5) 1/4”
(6) 10 mm

Fig. 79. Water cooling unit – Replacing the internal fan

Procedure

1. Disconnect all power supplies to the drive and ground the drive.
   For more information, see Section 11.6.2, “De-energizing the drive locally”, page 146.
2. Disconnect and remove the power supply cable from the terminal box (1, Fig. 79) inside the water cooling cabinet.

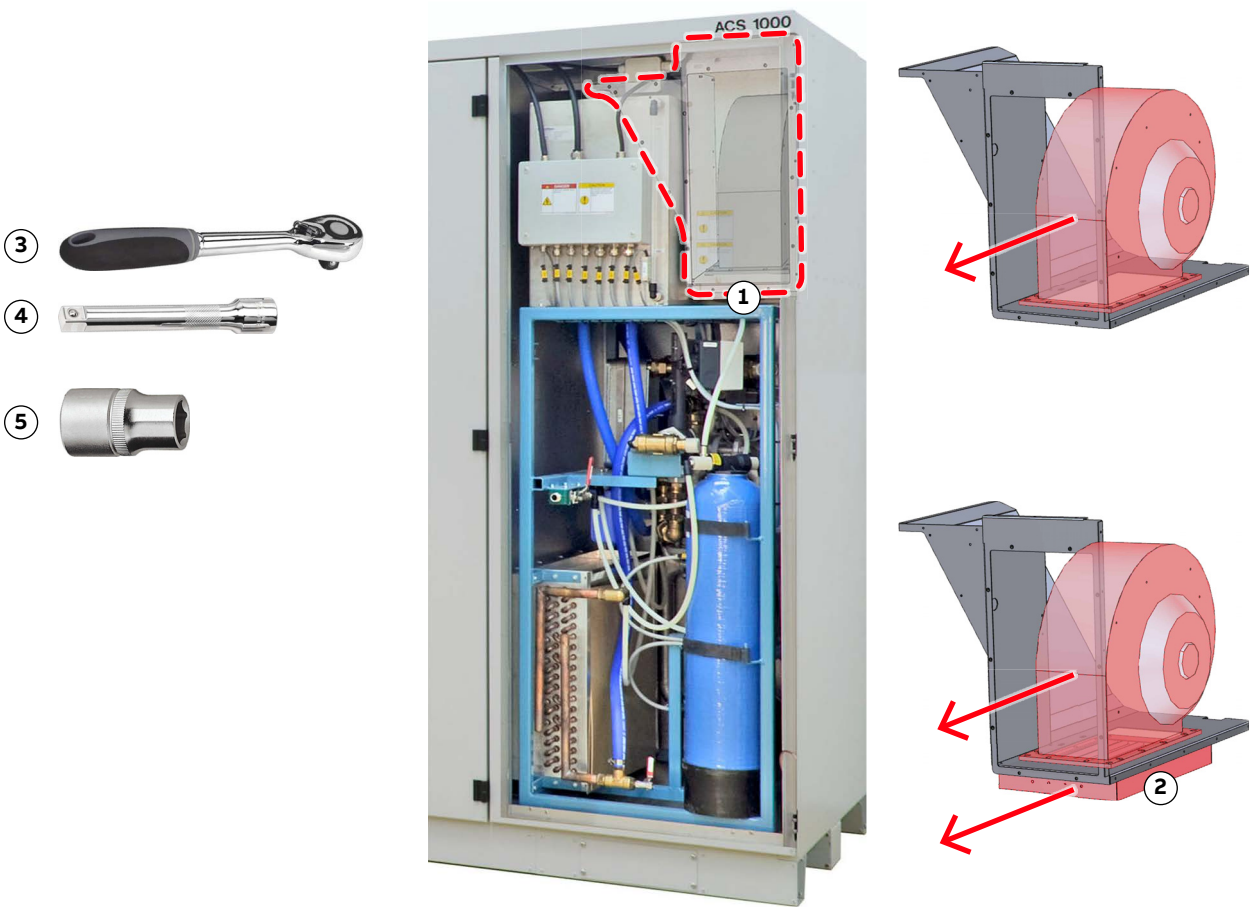


Fig. 80. Water cooling unit – replacing the internal fan

(1)	Fixing bolt location	(4)	70 mm
(2)	Baffle blade louver	(5)	13 mm
(3)	1/4”		

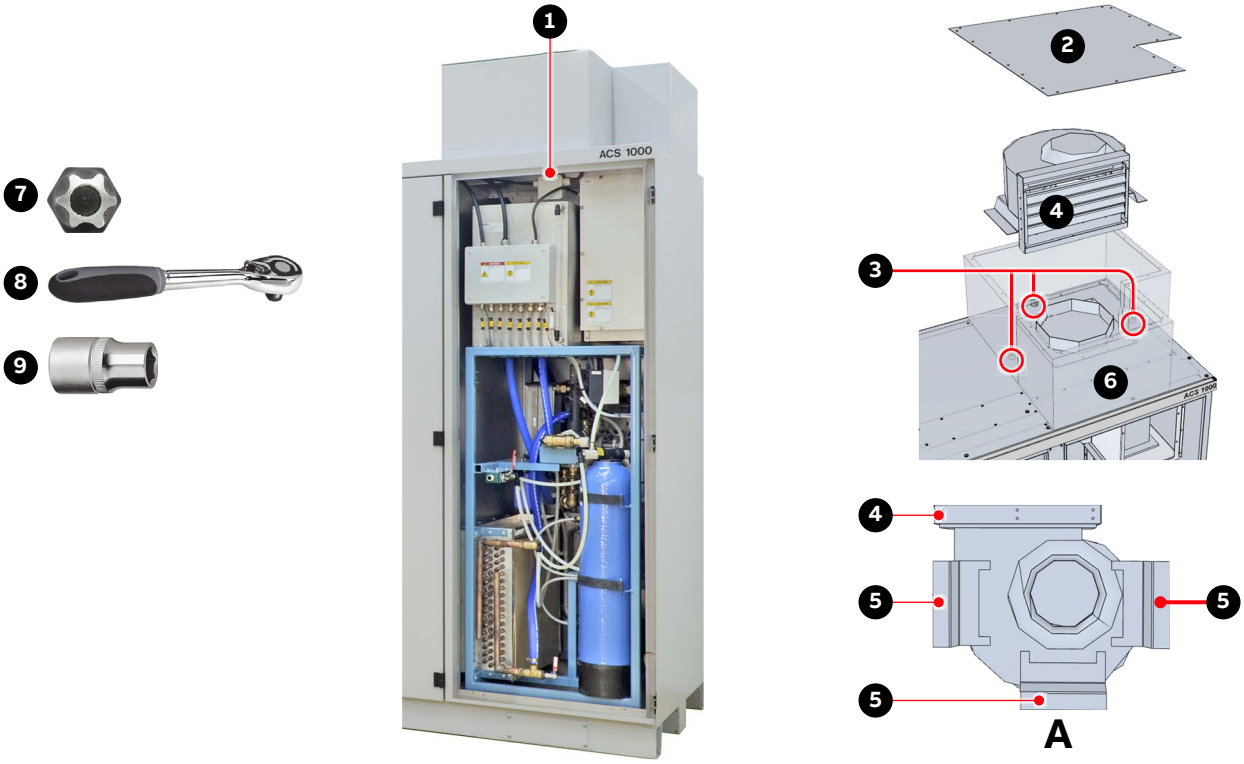
3. Unscrew the cover of the fan housing (2, Fig. 79).
4. Unscrew the fixing bolts on the underside of the fan (1, Fig. 80).
   IMPORTANT! If the fan is equipped with a baffle blade louver (2, Fig. 80), secure the baffle blade louver against dropping before you remove the bolts.
5. Install the new fan in reverse order of removal.

11.6.12. Replacing the redundant fan unit

CAUTION

Heavy object. A battery weighs approximately **26 kg**!

– **Maintenance intervals**: see “ACS1000 preventive maintenance schedule”, 3BHS855276 E01.



Key:

(1) Terminal box
(2) Top cover
(3) Vibration dampener
(4) Baffle blade louver
(5) Mounting support
(6) Front plate
(7) Torx bit for removing top cover
(8) 1/4”
(9) 13 mm socket for removing vibration dampeners and mounting brackets

Fig. 81. Water cooling unit – replacing the redundant fan – (A) bottom view

1. Disconnect the power supply cable of the fan in the terminal box (1, Fig. 81) of the water cooling compartment.
2. Remove the cover (2, Fig. 81).
3. If there is not enough room to lift the fan up, remove the plate in front of the fan (6, Fig. 81).
4. Unscrew the fan from the vibration dampeners (3, Fig. 81).
5. Unscrew the baffle blade louver (4, Fig. 81) and the mounting supports (5, Fig. 81) and attach them to the new fan.Install the new fan in reverse order of removal.

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new.abb.com/drives/medium-voltage-ac-drives

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