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1. About this manual

1.1. Equipment covered by this manual

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

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

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

1.2. Structure of the user documentation

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

NOTE – These appendices are NOT included in this document.

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

The following ABB documents are available for supplementary information:

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Table 1–2 Technical data

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<td>Generic motor specification</td>
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<td>Main circuit breaker engineering guideline</td>
<td>3BHS125149 E50</td>
</tr>
<tr>
<td>ACS5000 power cable specification</td>
<td>3BHS215798 E01</td>
</tr>
<tr>
<td>Power cables engineering guideline</td>
<td>3BHS542290 E01</td>
</tr>
<tr>
<td>Auxiliary power and control cables guideline</td>
<td>3BHS813742 E01</td>
</tr>
<tr>
<td>Customer interface</td>
<td>3BHS347034 E03</td>
</tr>
</tbody>
</table>

Table 1–5 Manuals

<table>
<thead>
<tr>
<th>Title</th>
<th>ABB ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS5000 Service manual</td>
<td>3BHS264270 E20</td>
</tr>
<tr>
<td>ACS5000, ACS6000 and ACS6080 water cooling unit WCU800 user manual</td>
<td>3BHS821937 E01</td>
</tr>
<tr>
<td>ACS5000, ACS6000 and ACS6080 water cooling unit WCU1400 user manual</td>
<td>3BHS835714 E01</td>
</tr>
</tbody>
</table>
1.4. Terms and abbreviations

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

**Table 1–8 Terms and abbreviations**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMC</td>
<td>The application and motor controller (AMC) is a digital signal processor and the heart of the drive control system.</td>
</tr>
<tr>
<td>Converter</td>
<td>Short form for ACS5000 frequency converter</td>
</tr>
<tr>
<td>COU</td>
<td>The control unit (COU) consists of a control section, a customer interface section and a terminal section.</td>
</tr>
<tr>
<td></td>
<td>The control section incorporates the hardware for control, monitoring and protection functions of the drive and the communication interface to the door-mounted CDP control panel.</td>
</tr>
<tr>
<td></td>
<td>The COU compartment also incorporates the grounding frame for cable screens and the ground cable, the grounding accessories and the motor terminal section.</td>
</tr>
<tr>
<td>CVMI</td>
<td>Current voltage measurement interface</td>
</tr>
<tr>
<td>DDCS</td>
<td>Distributed drive control system. DDCS is an acronym for a serial communications protocol designed for data transfer via optical fibers.</td>
</tr>
<tr>
<td>Drive</td>
<td>Synonym for ACS5000 frequency converter</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>DriveDebug</td>
<td>DriveDebug is part of ABB’s DriveWare® software tools for devices using the DDCS communications protocol. DriveDebug runs on computers with Microsoft Windows® operating systems. DriveDebug is a specialist tool used to diagnose, tune and troubleshoot frequency converters.</td>
</tr>
<tr>
<td>DriveWindow</td>
<td>DriveWindow is a DriveWare® product. DriveWindow is a 32-bit Microsoft Windows® application for commissioning and maintaining ABB drives equipped with optical communication links.</td>
</tr>
<tr>
<td>DriveMonitor</td>
<td>DriveMonitor is a monitoring and diagnostics system that allows secure access to the frequency converter via the Internet from a remote location. DriveMonitor provides long-term monitoring functions that allow to infer equipment status and improve equipment performance.</td>
</tr>
<tr>
<td>EAF</td>
<td>Earth fault monitoring</td>
</tr>
<tr>
<td>EMC</td>
<td>Electromagnetic compatibility</td>
</tr>
<tr>
<td>EOI</td>
<td>Electrical-optical interface</td>
</tr>
<tr>
<td>Equipment</td>
<td>Frequency converter and related equipment</td>
</tr>
<tr>
<td>EXU</td>
<td>The excitation unit (EXU) is part of the drive when a synchronous motor has to be supplied with excitation power.</td>
</tr>
<tr>
<td>Ground</td>
<td>Earth</td>
</tr>
<tr>
<td>To ground</td>
<td>To connect the electrical equipment to the earth, eg, by a grounding set or a grounding switch.</td>
</tr>
<tr>
<td>I/O device</td>
<td>Term of ABB’s S800 I/O process system. An I/O device consists of a module termination unit (MTU) and one I/O module.</td>
</tr>
<tr>
<td>I/O module</td>
<td>Term of ABB’s S800 I/O process system. The I/O module is an active input or output device for digital or analog signals.</td>
</tr>
<tr>
<td>I/O station</td>
<td>Term of ABB’s S800 I/O process system. The I/O station typically consists of a bus modem and several input and output devices.</td>
</tr>
<tr>
<td>IGCT</td>
<td>Integrated gate-commutated thyristor</td>
</tr>
<tr>
<td>IPS</td>
<td>Insulated power supply</td>
</tr>
<tr>
<td>LED</td>
<td>Light emitting diode</td>
</tr>
<tr>
<td>LSU</td>
<td>Line supply unit (rectifier phase module)</td>
</tr>
<tr>
<td>MCB</td>
<td>The main circuit breaker (MCB) is a major protection device of the drive system and connects and / or disconnects the main power supply to the drive.</td>
</tr>
<tr>
<td>Motor terminal section</td>
<td>This is the customer terminal for connecting motor cables. It is located behind the swing frame of the COU compartment.</td>
</tr>
<tr>
<td>NETA-21</td>
<td>Monitoring and diagnostics tool that allows access to the drive from any location in the world via a secure Internet connection.</td>
</tr>
<tr>
<td>NP</td>
<td>Neutral point</td>
</tr>
<tr>
<td>OEI</td>
<td>Optical-electrical interrupter</td>
</tr>
</tbody>
</table>
1.5. Target groups and required qualification

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

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

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

1.5.1. Handling

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

1.5.2. Mechanical installation

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

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

1.5.4. Operation

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

1.5.5. Maintenance

The personnel include all persons who

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

1.6. User’s responsibilities

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

1.7. Intended use of equipment

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

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

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

Unauthorized modifications and constructional changes of the drive are not permitted.
1.8. Quality certificates and applicable standards

The following certificates and conformity declarations are available with ABB:

- ISO 9001 and ISO 14001 certificates stating that ABB Switzerland Ltd has implemented and maintains a management system which fulfills the requirements of the normative standards
- EC declaration of conformity
- List of standards the drive complies with (see “Appendix F – Test reports and certificates”)

### Table 1–9 Standards that are referred to in this document

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI Z535.6</td>
<td>American national standard for product safety information in product manuals, instructions, and other collateral materials</td>
</tr>
<tr>
<td>ISO 3864-2</td>
<td>2004 (E) - ‘Graphical symbols – Safety colors and safety signs – Part 2: Design principles for product safety labels’</td>
</tr>
<tr>
<td>ISO 7010</td>
<td>2011 (E) - Graphical symbols - Safety colours and safety signs - Registered safety sign</td>
</tr>
<tr>
<td>EN 50110</td>
<td>European standard code for electrical work safety</td>
</tr>
<tr>
<td>ISO 13849-1</td>
<td>Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design, section 6.2.6 Category 3</td>
</tr>
<tr>
<td>IEC 60204-1</td>
<td>Safety of machinery - Electrical equipment of machines - Part 1: General requirements</td>
</tr>
<tr>
<td>IEC 60721-3-2</td>
<td>Classification of environmental conditions: Classification of groups of environmental parameters and their severities; Transportation</td>
</tr>
<tr>
<td>IEC 60721-3-1</td>
<td>Classification of environmental conditions: Classification of groups of environmental parameters and their severities; Storage</td>
</tr>
<tr>
<td>IEC 60721-3-3</td>
<td>Stationary use at weather-protected locations</td>
</tr>
<tr>
<td>IEC 62477-2</td>
<td>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</td>
</tr>
</tbody>
</table>
1.9. Items covered by delivery

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

1.9.1. Identifying the delivery

The drive and accessories are identified by the type code printed on the rating label. The rating label is located on the back of the control compartment door. The label provides information on the type of drive, the rated voltage, the frequency and the current of the main and the auxiliary power supply.

1.10. Tools

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

The following industry standards are observed:

– ANSI Z535.6
– ISO 3864-2
– ISO 7010
– EN 50110

2.2. Safety messages

The following safety messages are provided to help prevent personal injury and damage to the equipment. The indicated hazard level is based on the ANSI Z535.6 standard.

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

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

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

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

**NOTICE** Is used to address practices not related to physical injury, but which can result in equipment damage.
2.3. Product safety labels

Safety labels are affixed to the drive components to alert personnel of potential hazards when working on the equipment. For more information, see the label placement document for the drive. The instructions on the safety labels must always be followed and the labels must be kept in a perfectly legible condition.

![Figure 2–1 Product warning label examples (label placement depends on the drive)](image)

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

Additional safety labels, including the following, might also be provided:

**Electricity warning**
This sign can also have additional text below it, e.g., “High voltage”.

**No access for people with active implanted cardiac device**
The magnetic field of the drive can influence the functioning of pacemakers. The pacemaker sign should be installed at the entrance to the drive room or at a minimum distance of 6 m from the drive to stop personnel with pacemakers approaching the drive.
2.4. General safety instructions

1) Minimize hazards

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

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

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

5) In case of fire in the drive room:
   - Observe the established rules and regulations for fire safety
   - Only allow firefighters with the appropriate PPE to enter the drive room
2.5. The 7 steps that save lives

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

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

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

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

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

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

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

5) **Carry out earthing and short-circuiting.**

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

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

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

- Determine minimum approach distances, apply screening or shrouding, and when applicable, padlock both cable and busbar shutters.

- If working within the restricted approach boundary or vicinity zone where inadvertent movement could cause contact with live parts, special precautions must be employed, such as the use of the properly rated insulated gloves and tools.

7) **Complete the permit to work and “Walk the Permit”.**

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

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

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

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

3) **Hazardous touch voltages can be present on drive system components, which can be caused by:**
   - Operation of the equipment outside the scope of the specifications
   - External influence on, or damage of the equipment
   - Induced voltages by external equipment
   - Condensation on equipment components, or pollution
   - Faulty hardware

4) **High temperatures, noise, particles, or gases can be emitted from drive system components caused by:**
   - Operation of the equipment outside the scope of the specifications
   - External influence on or damage of the equipment
   - Incorrect parameter settings
   - Software errors
   - Faulty hardware

5) **Hazardous substances can be emitted from drive system components due to incorrect disposal of components**
2.7. 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.

![Diagram of Drive System Overview]

Figure 2–2 Drive system overview

- Main power supply
- MCB control interface
- Higher-level control system
- Local MCB control
- MCB
- Protection relay
- Converter transformer
- Drive
- Motor

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

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

A dedicated protection relay is used for:

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

In general, these protective measures are not included in the drive as provided by ABB.
2.7.1. Safety and protection requirements

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

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

- ISO 13849-1
- IEC 60204-1

2.7.2 Minimum requirements for MCB and MCB control

- The MCB open and / or trip command has to be wired directly from the drive to the MCB.

  It is not permitted to wire the trip command through any PLC or DCS system if it is not certified to meet SIL three-level requirements and to fulfill the timing requirements outlined below.

  Opening of the MCB by the drive must be possible at any time. It is not permitted to interrupt the open and / or trip command, eg, by a local-remote switch in the MCB.

  When the MCB is in service position, the drive must have exclusive control of closing the MCB. Local closing of the MCB is not permitted.

- The maximum opening time of the MCB must never exceed the product- or project-specific maximum time defined in the MCB specifications. Typical maximum values for the drive are defined as follows:

  - **Maximum protection trip time**: 75 ms

    The maximum protection trip time is the maximum allowed breaking time (open and arcing) of the breaking device after the open command has been initiated to prevent further damage to the drive, such as diode failures.

  - **Maximum safety trip time**: 500 ms

    The maximum safety trip time is the maximum allowed time to ensure safe disconnection of the main power supply to prevent any hazard to personnel.

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

2.7.3. Maintenance recommendation

The MCB trip circuits should be checked annually once per year.
3. Power electronics and cabinet features

3.1. Main features of the drive

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

The drive features several proven ABB technologies including:

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

![Typical block diagram of the drive](image-url)

Figure 3–1 Typical block diagram of the drive

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

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

![Switching levels diagram](image)

**Figure 3–2 Switching levels**

![Principle of 9-level topology diagram](image)

**Figure 3–3 Principle of 9-level topology**

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

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

Figure 3–4 IGCT

Fuseless protection concept

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

The drive comes in four frame sizes. Depending on the frame size, the drive has the following line-up specifications.

Table 3–1 Line-up specifications by frame size

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Rating</th>
<th>COU</th>
<th>Primary PCU</th>
<th>Secondary PCUs</th>
<th>PCU width (mm)</th>
<th>WCU width (mm)</th>
<th>Total length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12 MVA</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>1700</td>
<td>800</td>
<td>7130</td>
</tr>
<tr>
<td>2</td>
<td>18 MVA</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>2100</td>
<td>1400</td>
<td>8930</td>
</tr>
<tr>
<td>3</td>
<td>24 MVA</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1700</td>
<td>1400</td>
<td>12830</td>
</tr>
<tr>
<td>4</td>
<td>36 MVA</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2100</td>
<td>1400</td>
<td>15230</td>
</tr>
</tbody>
</table>

Figure 3–5 Frame sizes 1 – 4
3.3. Phase converter unit (PCU)

All frame sizes use three primary phase converter units, each supplying one motor phase.

In frame size 1 and 2, one primary phase converter unit represents a complete functional assembly.

In frame size 3 and 4, one primary and one secondary phase converter unit (connected via DC link) represent a complete functional assembly.

Transformer cable connection

The back left part of the primary phase converter unit contains the terminals for the transformer cables (Fig. 3–6:1 and Fig. 3–8:1).

Depending on the cable entry ordered, the unit comes with a top or bottom cable entry.

For information on the dimensions and the busbar arrangement, see “Appendix C – Mechanical drawings”.
3.3.1. Primary phase converter unit (1700 mm and 2100 mm)

**Primary PCU (1700)**

Primary phase converter units of 1700 mm are used in frame size 1 and 3.

![Figure 3–6 Primary PCU, 1700 mm](image)

1) Roof-mounted cooling unit
2) HVD circuit board
3) Crowbar circuit board or PINT circuit board
4) CVMI circuit board for voltage and current measurement
5) 2 di/dt chokes and 2 VLSCD circuit boards
6) DC-link capacitors
7) PE ground busbar
8) Main INT circuit board
9) IPS (Integrated Power Supply)
10) Grounding switch
11) Clamp resistor
12) Back oscillation damping circuit
13) DC link limiter (18-pulse only)
Figure 3–7 Primary PCU, 1700 mm: side view left (A) and side view right (B)

1) Roof-mounted cooling unit
2) Terminal compartment for transformer cables
3) LSU snubber plate (18-pulse only)
4) Rectifier stacks consisting of diodes and thyristors
5) DC-link connection
6) Water pipe
7) AC busbars for adjacent PCU and motor phase
8) Inverter stacks consisting of diodes and IGCTs
9) Gate unit
Primary PCU (2100)

Primary phase converter units of 2100 mm are used in frame size 2 and 4.

Figure 3–8 Primary PCU, 2100 mm

1) Roof-mounted cooling unit
2) HVD circuit board
3) Crowbar circuit board or PINT circuit board
4) CVMI circuit board for voltage and current measurement
5) 2 di/dt chokes and 2 VLSCD circuit boards
6) DC-link capacitors
7) PE ground busbar
8) Main INT circuit board
9) IPS (Integrated Power Supply)
10) Grounding switch
11) Clamp resistor
12) Back oscillation damping circuit
13) DC link limiter (18-pulse only)
Figure 3–9 Primary PCU, 2100 mm: side view left (A) and side view right (B)

1) Roof-mounted cooling unit
2) Terminal compartment for transformer cables
3) LSU snubber plate (18-pulse only)
4) Rectifier stacks consisting of diodes and thyristors
5) DC-link connection
6) Water pipe
7) AC busbars for adjacent PCU and motor phase
8) Inverter stacks consisting of diodes and IGCTs
9) Gate unit
3.3.2. Secondary phase converter unit (1700 mm and 2100 mm)

The secondary phase converter unit has the same design as the primary unit, except that the rectifier stack and the transformer terminal section are missing.

Secondary PCU

(1700 and 2100)

Secondary phase converter units of 1700 mm are used in frame size 3.
Secondary phase converter units of 2100 mm are used in frame size 4.

Figure 3–10 Secondary PCU, 1700 mm (A) and 2100 mm (B)
3.4. Control unit (COU)

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

Figure 3–11 Block diagram of control system

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

Figure 3–12 COU control section

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

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

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

3.4.2.1. Control tasks

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

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

 Optionally, the drive can monitor signals from external equipment. These can be activated and adjusted with parameters (see section 3.4.2.3, Parameters, page 45).

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

- Main circuit breaker (MCB)
- Grounding switches
- Door interlocking
- Cooling system
3.4.2.2. Direct torque control

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

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

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

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

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

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

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

3.4.2.4. Main circuit breaker

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

For more information, see:
- “Main circuit breaker engineering guideline”, 3BHS125149 E50
- section 2.7, Main circuit breaker protection device, page 29

Peripheral I/O devices

The peripheral input and output devices connected to the AMC circuit board include:
- Local control panel (see section 3.4.2.5, Local control panel, page 46)
- Customer interface (see section 3.4.2.6, Customer interface, page 47)
- S800 I/O system for parallel signal transfer to external devices (see section 3.4.2.7, S800 I/O system, page 48)
- Fieldbus adapters for serial data transfer to a higher-level control system
- PC-based service tools comprising:
  - DriveWare® software tools: include the commissioning and maintenance tools DriveWindow and DriveDebug, and DriveOPC for data transfer between ABB drives and Windows®-based applications.
  - DriveMonitor (option): a monitoring and diagnostics tool that allows access to the drive from any location in the world via a secure Internet connection.
  - NETA-21: monitoring and diagnostics tool that allows access to the drive from any location in the world via a secure Internet connection.
3.4.2.5. Local control panel

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

For more information on local operation and the CDP control panel, see chapter 8, Operation, page 125 and chapter 9, CDP control panel, page 143.
3.4.2.6. Customer interface

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

- Serial communications interface to a higher-level control system
- The modules of the S800 I/O system for monitoring of external equipment, such as transformer and motor
- DriveMonitor

![Diagram of customer interface section](image)

Figure 3-15 COU customer interface section

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

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

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

3.5.1. Transformer cable terminals
For information on the location of the terminals, see Fig. 3–7.

3.5.2. Motor cable terminals
The motor terminals are in the back of the COU compartment. To access them, open the swing frame of the control unit.

Besides of the busbars for motor cable terminations, this unit also includes the charging transformer for the DC link, the EMC filter and the EAF filter.

The layout of the motor terminal section depends on the following:
- Frame size (single or double busbars)
- Cable entry (from top or from bottom of the cabinet)

For information on the dimensions and the busbar arrangement, see “Appendix C – Mechanical drawings”.

Figure 3–16 Motor terminal section of frame size 1 and 2: top entry (A) and bottom entry (B)
Figure 3–17 Motor terminal section of frame size 3 and 4: top entry (A) and bottom entry (B)
3.6. Water cooling unit (WCU)

Depending on the frame size, the water cooling unit comes as one of the following two models:

- 800 mm (frame size 1 and 2)
- 1400 mm (frame size 3 and 4)

Fig. 3–18 shows the water cooling unit of frame size 3 (type WCU1400). It allows you to identify the components of other models as well.

Figure 3–18 WCU (1400 mm), frame size 3

1) Deaeration valve
2) Expansion vessel
3) Water pump 1
4) Water pump 2
5) Filter
6) Ion exchange vessel
7) Water-to-water heat exchanger
For more information on the water cooling unit, see “Appendix A – Additional manuals”.

### 3.7. EXU – Excitation unit (optional)

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

- **Brush excitation (DC excitation):** Uses a DCS880 AC-to-DC converter which is supplied by the mains. The converter controls the direct current for generating the magnetic field. Brushes and slip-rings feed the DC current to the rotor.

- **Brushless excitation (AC excitation):** Uses a three-phase DCT880 AC-power controller. The power controller feeds an exciter which is mounted on the shaft of the main motor. The rotating armature of the exciter supplies a rectifier which generates the DC current for producing the magnetic field in the synchronous motor.

![Figure 3–19 EXU H4/T4 frame cabinet (A) and EXU H6 frame cabinet (B)](image)

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

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

For more information, see section 8.5, **EXU control panel**, page 127.

3.7.2. Output disconnector

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

3.8. Door interlocking system

The doors of each PCU compartment are secured with an electromechanical interlocking mechanism to prevent them from being opened during operation.

The main protection features of the interlocking system are:

– Grounding switches (Fig. 3–21)
– Locking bars (Fig. 3–22)

The interlocking system ensures that you cannot connect the main power supply to the drive until all doors of PCU compartments are closed and locked and the grounding switches are in ungrounded position.

The interlocking system also ensures that you cannot open the doors of PCU compartments until the main power supply is disconnected, the DC-link capacitors are discharged and the grounding switches are in grounded position.

The doors of the COU compartment (control unit and motor terminal section) and the WCU compartment are not integrated into the interlocking system and can be opened at all time. However, do not open the swing frame of the control unit while the drive is in operation.

![Location of protection features and lights](image)

For instructions on how to open and close doors, see section 10.6.3, **Opening and closing the doors**, page 177.
3.9. Grounding switches

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

You can only turn the grounding switch (1) to the grounded position (horizontal) when the yellow lamp (2) is lit, i.e., after the drive has been disconnected from the main power supply and the DC link has been discharged.

![Grounding switch diagram]

Figure 3–21 Grounding switch

1) Grounding switch:
   - Horizontal position - drive is grounded
   - Vertical position - drive is ungrounded.

2) Yellow lamp (grounding switch released):
   - Lights up to indicate that you can turn the grounding switch to the grounded or ungrounded position.

For a detailed grounding diagram, see “Appendix D – Wiring diagrams”.

3.9.1. Locking bars

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

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

Figure 3-22 Locking bar positions

| 1 | Locking bar location | 3 | White lamp: lit when the drive is grounded |
| 2 | Locking bar in unlocked position | 4 | Locking bar in locked position |
3.10. Grounding studs

The COU and each PCU has grounding studs that are designed for use with the 4-way grounding set (Fig. 3–24).

"DANGER Hazardous voltages!

- Complete the steps in section 2.5, The 7 steps that save lives, page 26 before you access the grounding studs in the PCU and COU.

Figure 3–23 Grounding stud

3.10.1. Grounding set

![4-way grounding set diagram]

Figure 3–24 4-way grounding set

1) Enclosure ground clamp
2) Telescopic insulating pole
3) Busbar ground clamp
3.10.2. Output grounding studs in COU

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

Figure 3–25 Location of PE busbar and grounding studs (1L1, 1L2, and 1L3) in COU, frame sizes 1 and 2

Figure 3–26 Location of PE busbar and grounding studs (1L1, 1L2, 1L3, 2L1, 2L2, and 2L3) in COU, frame sizes 3 and 4
3.10.3. Input grounding studs in a PCU

**DANGER** Hazardous voltages!

- Complete the steps in section 2.5, *The 7 steps that save lives*, page 26 before you remove the side and back walls from the drive to access the grounding studs in a PCU.

The converter input grounding studs, ie1L1, 1L2, and 1L3 and 2L1, 2L2, and 2L3 and the protective earth busbar are at the back of each PCU.

![Figure 3–27 Location of PE busbar and grounding studs (1L1, 1L2, and 1L3) in an 18-pulse PCU](image)

![Figure 3–28 Location of PE busbar and grounding studs (1L1, 1L2, 1L3, 2L1, 2L2, and 2L3) in a 36-pulse PCU](image)
4. Transportation, storage and disposal

4.1. Safety

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

4.2. Transport conditions

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

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

4.3. Unpacking and inspection

1. Carefully remove all packaging material.

2. Inspect the drive and accompanying equipment and make note of any damage.
   - Take a photograph of the damage and inform ABB and the shipping company immediately.

3. Compare the complete delivery with the purchase order and the packing list.
   - If parts are missing, contact the shipping company and ABB immediately.

4.4. Identifying drive units

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

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

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

<table>
<thead>
<tr>
<th>ABB Item</th>
<th>Qty.</th>
<th>Unit.</th>
<th>Commodity description</th>
</tr>
</thead>
<tbody>
<tr>
<td>001201</td>
<td>1</td>
<td>PC</td>
<td>Converter 1(1), Transport Unit 1</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>ABB Item</th>
<th>Qty.</th>
<th>Unit.</th>
<th>Commodity description</th>
<th>Identnumber</th>
</tr>
</thead>
<tbody>
<tr>
<td>001221</td>
<td>1</td>
<td>PC</td>
<td>cross wiring</td>
<td></td>
</tr>
<tr>
<td>001222</td>
<td>1</td>
<td>PC</td>
<td>WCU accessory</td>
<td></td>
</tr>
<tr>
<td>001223</td>
<td>1</td>
<td>PC</td>
<td>crank for isolator</td>
<td></td>
</tr>
<tr>
<td>001500</td>
<td>1</td>
<td>PC</td>
<td>3BHBO1202R0001</td>
<td>ACS6080 Max-5L LOOSE PARTS config.</td>
</tr>
</tbody>
</table>

(1) The third digit from the right identifies the drive that the accessories belong to, i.e., drive 1.

### 4.4.2. Packing label

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

<table>
<thead>
<tr>
<th>Material no</th>
<th>3BHBO09964R1500</th>
<th>1 ST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Cabinet ARU/INU LSU config.</td>
<td></td>
</tr>
<tr>
<td>Order no/positions</td>
<td>11027727 001241(1) Project CBA</td>
<td></td>
</tr>
</tbody>
</table>

(1) The fourth digit from the right identifies the drive that the transport unit belongs to, i.e., drive 1.
4.5. Lifting and transportation

**NOTICE** Risk of component damage.

Incorrect transport can damage the drive or transport unit. Dirt particles and metallic dust can damage drive components and cause failure when the drive is energized.

- Refer to “Appendix C – Mechanical drawings” before transporting the drive. This appendix provides details on the dimensions, weight, and center of gravity of the drive.
- DO NOT use a forklift.
- DO NOT use a crane if the transport units are not secured to the base frame.
  - Use heavy load hydraulics rollers or air cushions instead. If you are in doubt, contact ABB for instructions.
- Only transport the drive or transport unit in an upright position.
- Keep the doors of the drive or a transport unit closed.
4.5.1. Using a crane

You need a crane to move the following:

- Drive
- Transport unit
- Roof-mounted cooling unit

**CAUTION** Tipping hazard and risk of falling object!

An improperly secured load can tip, shift, or fall.

- Always lift a drive or transport unit by the base frame
- Use an extra sling (Fig. 4–2) around the drive or transport unit for stabilization
- DO NOT lift more than one transport unit at a time.
- Always observe the center of gravity
- Always lift a roof-mounted cooling unit with top-mounted lifting points (ABB ID: 3BHE015753P0008) that can rotate 360°

4.5.1.1. Lifting recommendations

Referring to Fig. 4–1 and Fig. 4–2:

- Use a lift frame or a lift spreader with the crane.

**IMPORTANT!** If a lift frame or lift spreader is not available, make sure that the slope angle is a maximum of 15° (see Fig. 4–2).

- Use lifting equipment (eg, web slings, chain slings, round slings, safety hooks, shackles) that corresponds to the weight that is to be lifted.

- Attach the slings to the lifting brackets at the base frame.
  - Use appropriate safety hooks or shackles to attach a sling.
  - DO NOT pass a sling through the hole of the bracket.
  - Protect the edges and the door handles if the slings are too close to the cabinet.

- Lift the drive or a transport unit slowly and steadily to the required clearance height, maintaining it in upright position.

- Check the horizontal position and reposition the slings if necessary.
Figure 4–1 Lifting bracket on base frame of a drive and safety hook secured to lifting bracket

1) Lifting bracket (hole Ø42 mm)  
2) Safety hook
4.6. Storage

4.6.1. Storage conditions

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

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

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

4.6.2. Storage

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

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

   For information about draining and frost proofing, see the manual of the water cooling unit in “Appendix A – Additional manuals”.

2. Cover all cable inlets and ventilation slots with an impermeable plastic or aluminum foil and a wooden panel.

3. Add a desiccant of the appropriate quality:
   - One unit desiccant (30 g) absorbs 6 g water vapor
   - When using a polyethylene foil: 10 units/m² foil

4. Close and lock the doors of the drive.

5. Use polyethylene or equivalent for packaging:
   - 0.3 g/m²/24 h water vapor diffusion

6. Attach humidity indicators to the packaging.

   **NOTICE** Check storage and packaging conditions regularly. Repair damage immediately.
4.7. Storage and handling of spare parts

**NOTICE** Risk of component damage.
Static electricity can damage printed circuit boards.
- Apply static-sensitive precautions when you handle spare parts.

4.7.1. Warranty information

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

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

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

4.8. Disposal of packaging materials and components

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

5.1. Safety

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

5.2. Overview of installation work

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

- Preparing the installation site, page 69
- Aligning transport units, page 70
- Joining transport units, page 72
- Applying silicone, page 73
- Installing roof joints, page 73
- Installing roof-mounted cooling units, page 74 (option)
- Installing roof attachments on marine drives, page 78 (option)
- Joining water pipes, page 80
- Joining busbars, page 81
- Connecting the heating cable, page 84 (option)
- Connecting raw water pipes, page 85
- Fixing the drive to the floor, page 85
5.3. General notes on installation

**NOTICE** Risk of component damage.

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

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

5.4. Dimensions and clearances

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

5.4.1. Rear and top access to the cabinet

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

5.4.2. Cabinet roof

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

5.4.3. Fire protection

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

5.4.4. Cable duct material

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

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

5.4.5. Installation material

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

5.4.6. Tools

5.5. Preparing the installation site

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

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

![Figure 5–1 Floor inclination](image)

The floor must be even.

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

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

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

3. Line up the transport units as shown in “Appendix C – Mechanical drawings”.

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

4. Align the transport units.
5. Verify the following alignment parameters:

- Maximum values for the axial misalignment and the angular deflection of two adjoining water pipes are not exceeded
  - Axial misalignment: ± 3 mm
  - Axial deflection: 5°

- Bolt holes are exactly aligned.

- Cabinet doors are not misaligned and that there are no gaps between cabinet walls and cabinet frame

- Adjoining surfaces of transport units meet perfectly all around
5.7. Joining transport units

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

Figure 5–2 Connection points on side of transport units (PCU example)

Figure 5–3 Base frame connection points
5.8. Applying silicone

Silicone prevents water from entering the gap between two joining roof plates. Apply silicone where two transport units have been joined (Fig. 5–4). Gaps within a transport unit are factory-sealed.

![Figure 5–4 Applying silicone](image)

5.9. Installing roof joints

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

- Marine drives: at the front of the roof (the back is reserved for roof attachments, see section 5.11, *Installing roof attachments on marine drives*, page 78.)
- Standard drives: at the front and the back of the roof

For the exact number and fitting location of roof joints, see “Appendix C – Mechanical drawings”.

<table>
<thead>
<tr>
<th>Items</th>
<th>Details</th>
<th>ID Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecting piece</td>
<td>8 x 80 x 220 mm</td>
<td>3BHB011552R0001</td>
</tr>
<tr>
<td>Hex-head bolt</td>
<td>M16 x 40</td>
<td>NB 312350P0464</td>
</tr>
<tr>
<td>Washer</td>
<td>17 x 30 x 3</td>
<td>9ABA450078P0008</td>
</tr>
</tbody>
</table>

![Figure 5–5 Roof joint](image)
5.10. Installing roof-mounted cooling units

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

5.10.1. Installing IP42 roof-mounted cooling units

⚠️ CAUTION Heavy object!

An IP42 cooling unit weighs 40 kg.

- Use appropriate slings and shackles
- Before you begin, read section 4.5.1, Using a crane, page 62

Table 5–2 Installation material per IP42 unit

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Details</th>
<th>ID number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-tapping Torx screws</td>
<td>18</td>
<td>M6 × 16</td>
<td>HAQN401050P0259</td>
</tr>
<tr>
<td>Washers with sealing</td>
<td>18</td>
<td>6.8 × 1 (4.8 × 2.8)</td>
<td>3BHB034338R0001</td>
</tr>
<tr>
<td>Cable binders</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Referring to Fig. 5–6:

1. Install 4 RUD bolt-on lifting points (ABB ID: 3BHE015753P0008) in the 4 top corners of the IP42 cooling unit.

**NOTE** – The lifting points are in the loose parts that were delivered with the drive.
2. Attach the appropriate slings and shackles to the lifting points.

3. Lift the cooling unit above the PCU cabinet with a crane.

4. Align the cooling unit with the opening (1) in the cabinet roof and slowly lower the cooling unit onto the cabinet roof.

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

5. Secure the cooling unit to the cabinet roof with the supplied screws.

6. Feed the cables from the cooling unit into the cabinet.

   NOTE – You might need to remove the back wall of the cabinet to gain access to the cables.

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

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

![Figure 5–7 Cable duct openings (example with 1700 mm PCU)](image)

   8. In the cable duct at the front of the cabinet, connect the cables according to “Appendix D – Wiring diagrams”.
5.10.2. Installing IP54 roof-mounted cooling units

⚠️ CAUTION Heavy object!

An IP54 cooling unit weighs **98 kg**.
- Use appropriate slings and shackles
- Before you begin, read section 4.5.1, *Using a crane*, page 62

### Table 5–3 Installation material per IP54 unit

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Details</th>
<th>ID number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-tapping Torx screws</td>
<td>22</td>
<td>M6 × 16</td>
<td>HAQN401050P0259</td>
</tr>
<tr>
<td>Washers with sealing</td>
<td>22</td>
<td>6.8 × 1 (4.8 × 2.8)</td>
<td>3BHB034338R0001</td>
</tr>
<tr>
<td>Tube spacers</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Referring to Fig. 5–8:

1. Install 4 RUD bolt-on lifting points (1) in the 4 top corners of the IP54 cooling unit.

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

![Figure 5–8 Lifting an IP54 cooling unit](image)

2. Attach the appropriate slings and shackles to the lifting points.

3. Lift the cooling unit above the PCU cabinet with a crane.
4. Align the water inlet / outlet (2), drain outlet (3), and cables (4) of the cooling unit with the designated openings in the cabinet roof and then slowly lower the cooling unit onto the cabinet roof.

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

5. Secure the cooling unit to the cabinet roof with the supplied screws.

Referring to Fig. 5–9:

6. Connect the tube from the return pipe (5) to the water outlet (1).

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

   The tubes are transparent and the colors in Fig. 5–9 are for illustration only. From the back of the cabinet, the water outlet is on the left and from the front of the cabinet, the water outlet is on the right.

7. Connect the tube from the feed pipe at the bottom of cabinet to the water inlet (2).

   From the back of the cabinet, the water inlet is on the right and from the front of the cabinet, the water inlet is on the left.

8. Connect the drain tube to the drain outlet (3).

   The drain tube guides water condensation to the cabinet floor.

   ![Water tube connections (back view)](image)

9. Install the two white spacers (4) between the inlet and outlet tube.

10. In the cable duct at the front of the cabinet, connect the cables according to “Appendix D – Wiring diagrams”.
5.11. Installing roof attachments on marine drives

Roof attachments are only available on marine drives.

To prevent tilting and dampen vibrations, attach the drive to the ceiling or the back wall of the drive room according to the instructions. For information on the fitting location, see “Appendix D – Wiring diagrams”.

![Diagram of roof attachment](image)

**Figure 5–10 Roof attachment**

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
<th>ID number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>2 × nuts M12</td>
<td>HZN 452198P1022</td>
</tr>
<tr>
<td>2)</td>
<td>2 × washers 13 / 29 ST / ZN</td>
<td>9ABA450078P0007</td>
</tr>
<tr>
<td>3)</td>
<td>2 × washers 17×30×3</td>
<td>9ABA450078P0008</td>
</tr>
<tr>
<td>4)</td>
<td>2 × hex-head bolts M16×40</td>
<td>NB 312350P0464</td>
</tr>
<tr>
<td>5)</td>
<td>1 × bracket</td>
<td>3BHB035997R0002</td>
</tr>
<tr>
<td>6)</td>
<td>2 × spacers</td>
<td>3BHB032466R0001</td>
</tr>
<tr>
<td>7)</td>
<td>1 × damping pad</td>
<td>3BHB035998R0001</td>
</tr>
<tr>
<td>8)</td>
<td>1 × bracket</td>
<td>3BHB035997R0001</td>
</tr>
<tr>
<td>9)</td>
<td>2 × damping connectors</td>
<td>3BHB033405R0001</td>
</tr>
<tr>
<td>10)</td>
<td>2 × plates</td>
<td>3BHB035999R0001</td>
</tr>
<tr>
<td>11)</td>
<td>2 × washers 13 / 29 ST / ZN</td>
<td>9ABA450078P0007</td>
</tr>
<tr>
<td>12)</td>
<td>2 × hex-head bolts M12×80</td>
<td>NB 312450P8127</td>
</tr>
</tbody>
</table>
1. Assemble the roof attachment.
2. Tighten the bolts firmly.
3. To fix the drive to the ceiling or the back wall, use two suitable struts per roof attachment (the struts are not part of the scope of delivery).

   **WARNING!** DO NOT install the struts at a 90° angle to the cabinet roof (Fig. 5–11).

4. If you fix the drive to the ceiling, use two struts per roof attachment (1 in Fig. 5–11).
5. If you fix the drive to the back wall, install one strut at a 90° angle to the drive (2 in Fig. 5–11).

![Figure 5–11 Recommended ceiling and wall fixings](image)

- 1) Two struts at 45° to ceiling
- 2) One strut at 90° to wall
- 3) DO NOT install the struts at a 90° angle to the cabinet roof
5.12. Joining water pipes

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

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

3. Center the pipe joint.

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

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

5.12.1. Removing a pipe joint

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

1. Loosen the bolts alternately but do not remove them completely.

2. Slide the pipe joint to the side.

3. The sealing lip may touch the pipe end.

4. Turn and move the pipe joint smoothly.

5. Clean the pipe joint and treat the bolts with an appropriate lubricant before refitting.
5.13. Joining busbars

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

- AC busbars (Fig. 5–12: 1)
- PE ground busbar (Fig. 5–12: 2)
- DC busbars (Fig. 5–12: 3)

Figure 5–12 Busbar connections

1. Before installing the joining pieces, grease the bolts to maintain the required contact pressure.

2. Join the busbars.

3. Tighten the bolts to the torque of 40 Nm.
AC busbars

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

Figure 5–13 AC busbar connection

PE ground busbar

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

Figure 5–14 PE ground busbar connection
DC busbars

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

Figure 5–15 DC busbar connection
5.14. Connecting the heating cable

This section applies to drives that are delivered in several transport units and are equipped with a heating cable.

- Connect the heating cables of two adjoining transport units.
- Fasten the connectors with cable ties.

Figure 5–16 Heating cable connection
5.15. Connecting raw water pipes

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

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

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

5.16. Fixing the drive to the floor

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

6.1. Safety

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

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

6.2. Overview

The installation includes the following items:

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

6.3.1. Power cables

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

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

6.3.2. Auxiliary and control cables

**NOTICE** Risk of false signals!

Power supply cables can disrupt signals in control cables.

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

- Cross control and power supply cables at an angle of 90°

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

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

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

6.4.1. Grounding the transformer and an 18-pulse drive

Fig. 6–1 shows the grounding connections of an 18-pulse drive and an input transformer in the PCU compartments.

![Diagram of Grounding Connections](image)

Figure 6–1 Grounding the transformer and an 18-pulse drive (in PCU)

1) Input transformer  
2) Drive  
3) Grounding network of installation site  
4) Ground cable  
5) Cable screen  
6) Cable shield  
7) Equipotential bonding conductor
6.4.2. Grounding the transformer and a 36-pulse drive

Fig. 6–2 shows the grounding connections of a drive and an input transformer in the PCU compartments.

Figure 6–2 Grounding the transformer and a 36-pulse drive (in PCU)

1) Input transformer
2) Drive
3) Grounding network of installation site
4) Ground cable
5) Cable screen
6) Cable shield
7) Equipotential bonding conductor
6.4.3. Grounding the drive and the motor (multi-point bonding)

Fig. 6–3 shows the multi-point connections to ground a drive and a motor in the COU compartment.

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

![Diagram: Grounding the drive and the motor (multi-point bonding)]

**Figure 6–3 Grounding the drive and the motor (multi-point bonding)**

1) Drive  
2) Motor  
3) Grounding network of installation site  
4) Ground cable  
5) Cable screen  
6) Cable shield  
7) Equipotential bonding conductor
6.4.4. Grounding the drive and the motor (single-point bonding)

Fig. 6–4 shows the single-point bonding connections to ground a drive and a motor in the COU compartment.

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

Figure 6–4 Grounding the drive and the motor (single-point bonding)

1) Drive
2) Motor
3) Grounding network of installation site
4) Ground cable
5) Cable screen
6) Cable shield
6.4.5. Ground cable connection

The ground cable enters the COU compartment from the top or from the bottom. It connects to the PE ground busbar of the adjoining PCU compartment. The ground busbar spans across the entire length of the drive (Fig. 6–5 and Fig. 6–6). The connection must be in compliance with local regulations. For project-specific illustrations, see “Appendix D – Wiring diagrams”.

Figure 6–5 PE ground busbar in a COU

![Figure 6–5 PE ground busbar in a COU](image)

1) Top entry
2) PE ground busbar
3) Bottom entry

Figure 6–6 PE ground busbar in a PCU frame size 1 (A) and frame size 2 (B)

![Figure 6–6 PE ground busbar in a PCU frame size 1 (A) and frame size 2 (B)](image)

1) Top entry
2) PE ground busbar
3) Bottom entry
6.4.6. **EXU cabinet ground connections**

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

– Connect the ground to the ground system of the installation site and to the ground busbar inside the EXU.

– Cross-section of the ground cable and the ground connection must be in compliance with local regulations.

– Ground the outer cable screen at both ends of a cable.

– At the EXU, ground the cable screen via the conductive sleeve of the entry plate.

![Diagram of EXU cabinet ground connections](image)

**Figure 6–7 Grounding the EXU**

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

6.5. **Internal wiring**

For information on individual connections, see the converter hardware diagram in “Appendix D – Wiring diagrams”. Internal wiring refers to all cabling and wiring across shipping splits, including:

– Signal cable connection

– Auxiliary power supply cable connection

– Optical fiber connections

– Arc Guard sensor cabling

Each cable has a terminal designation and is ready for connection in the upper cable ducts of the cabinet (2), except for the charging cable, which is at the base of the cabinet behind the water pipe (4).
Figure 6–8 Wiring across shipping splits, frame size 1 (A) and 2 (B)

1) Shipping split PCUx1 – PCUx1
2) Cable ducts on each side of the shipping split for:
   - Auxiliary power supply cables
   - Optical fibers
   - Signal cables
3) Connection point for charging cable
4) Charging cable behind water pipe (not illustrated), laid on the brackets and connected to the busbar
Figure 6–9 Wiring across shipping splits, frame size 3 and 4

1) Shipping split
2) Cable ducts on each side of the shipping split for:
   - Auxiliary power supply cables
   - Optical fibers
   - Signal cables
3) Connection point for charging cable
4) Charging cable behind water pipe (not illustrated), laid on the brackets and connected to the busbar
6.5.1. Optical fibers

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

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

**Optical fibers for internal arc protection**

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

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

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

The Arc Guard unit and the HMI panel are in the COU (Fig. 3–15) and the detectors are pre-installed in the relevant cabinets. The optical fibers, which are coiled up beside the detectors, must be routed from the detectors to the Arc Guard unit in the COU.

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

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

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

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

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

6.6.1. Cable entry with sealing modules, type 1

- **Usage:** power cables, ground cables, bonding conductors
- **Included in delivery:** cable entry frame (Fig. 6–10: 1)
- **Not included in delivery:** sealing modules (Fig. 6–10: 2), accessories, tools

![Figure 6–10 Cable entry with sealing modules – type 1](image)

1) Compression wedge
2) Sealing module (RM120)
Figure 6–11 Cable entry frame sizes (top) for type 1 sealing modules (bottom)

Table 6–1 Type 1 sealing modules and cables per frame opening

<table>
<thead>
<tr>
<th>Frame</th>
<th>1</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6A</th>
<th>6B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>COU</td>
<td>PCU</td>
<td>PCU</td>
<td>PCU</td>
<td>PCU</td>
<td>EXU</td>
<td>SBU</td>
<td>SBU</td>
</tr>
<tr>
<td>Cable entry top</td>
<td>FS 2/4/6</td>
<td>FS 2/4/6</td>
<td>FS 1/3/5</td>
<td>-</td>
<td>-</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Cable entry bottom</td>
<td>FS 2/4/6</td>
<td>FS 2/4</td>
<td>FS 1/3</td>
<td>FS 6</td>
<td>FS 5</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

Table 6–2 Maximum number of type 1 sealing modules per frame opening

<table>
<thead>
<tr>
<th>Frame</th>
<th>1</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6A</th>
<th>6B</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM120</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>RM90</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>RM60</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 6–3 Maximum number of cables per frame opening - 3 core

<table>
<thead>
<tr>
<th>Frame</th>
<th>1</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6A</th>
<th>6B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø 68-99 mm</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Ø 48-71 mm</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 6–4 Maximum number of cables per frame opening - single core

<table>
<thead>
<tr>
<th>Frame</th>
<th>1</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6A</th>
<th>6B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø 28-50 mm</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>
6.6.2. Cable entry with sealing modules, type 2

- **Usage:** auxiliary power cables and control cables
- **Included in delivery:** frame (Fig. 6–12: 1)

Figure 6–12 Cable entry with sealing modules – type 1

- **Supplier:** Roxtec AB (roxtec.com)
- **Not included in delivery:** EMC sealing inserts (Fig. 6–10: 2), installation tools, accessories

6.6.3. Cable entry with cable glands

- **Usage:** power cables, ground cables, bonding conductors, auxiliary power cables, control cables
- **Included in delivery:** undrilled plate for cable glands

Figure 6–13 Cable entry with cable gland
- **Cable strain reliefs:** (C-rails).

- **Not included in delivery:** cable glands, tools, cable clamps, accessories

### 6.6.4. Cable entry with EMC plates

- **Usage:** power cables, ground cables, bonding conductors, auxiliary power cables, control cables
- **Included in delivery:** galvanized plate with EMC mesh (Fig. 6–14: 1) and sealing grommets (Fig. 6–14: 1)

![Cable entry with EMC plates](image)

Figure 6–14 Cable entry with EMC plates
6.7. Power cables, ground cables, equipotential bonding conductor

See “Appendix A – Additional manuals” for information on:
- Project-specific cable entry
- Distance between point of cable entry and terminals
- Busbar and fastening hole dimensions
- Installation instructions for sealing modules

See “Appendix D – Wiring diagrams” for information on:
- Designation, cross-reference and device identification conventions
- Transformer cables and motor cables and their corresponding connections

6.7.1. Preparing the cable entry and the cables

![NOTICE]

Risk of damage or malfunction!

Waste inside the cabinet can cause damage or malfunction.
- Avoid cutting cables inside the terminal compartment.
- Immediately remove waste that has been accidentally dropped in the cabinet.

6.7.1.1. Determining the cable length

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

2. Cut the cable to the required length before connection.
6.7.1.2. Preparing cables for cable entries with cable glands

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

![Diagram showing cable preparation process]

Figure 6–15 Preparing power cables for cable glands

1) Cable gland
2) Plate
3) Heat-shrinkable termination
4) Outer cable sheath
5) Conductor insulation removed to expose cable shield
6) Cable screen extension to be connected to PE ground busbar
7) Sheath seal
6.7.1.3. Preparing cables for cable entries with sealing modules

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

Figure 6–16 Preparing power cables for sealing modules

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) Cable screen extension to be connected to the PG busbar
11) Cable lug as specified by the cable supplier and suitable for M12 bolt
12) Sheath seal

Install the sealing modules according to the instructions of the sealing module supplier.
6.7.2. Connecting the cables

⚠️ **CAUTION** Risk of flashover!

High voltages in the terminal unit can cause flashover between the electric potential of different conductors and the electric potential of a conductor and earth.

When you route and connect the cables, maintain the following minimum clearances:

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

6.7.2.1. Checking the cable insulation

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

6.7.2.2. Connecting the cables

Connect the cables to their corresponding busbars:

- Transformer cables to the busbars inside the primary PCU (Fig. 6–17)
- Motor cables to the busbars inside the COU (Fig. 6–19)
- Ground cable to the PE ground busbar
Transformer cables ACS5000W 36-pulse

Figure 6–17 PCU 36-pulse top and bottom entry (back view)

1) Top cable entry
2) Busbars for transformer cables
3) Bottom cable entry

Transformer cables ACS5000W 18-pulse

Figure 6–18 PCU 18-pulse top and bottom entry (back view)

1) Top cable entry
2) Busbars for transformer cables
3) Bottom cable entry
Motor cables

Figure 6–19 COU cable terminals, top and bottom entry (back view) - frame sizes 1 and 2 (A) and 3 and 4 (B)

1) Top cable entry
2) Busbars for motor cables (frame sizes 1 and 2)
3) Bottom cable entry
6.7.2.3. Bolted connections

Material requirements

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

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

Connection type

The following connection type (see Fig. 6–20) is recommended when a cable lug (4) is connected to a busbar:

- Spring washer (1) and flat washer (2) on each side of the busbar (4).
  
  Other washers can be used, provided they maintain the required contact pressure.

- Use cable lugs suitable for M12 bolts.

Figure 6–20 Bolted busbar connection

<table>
<thead>
<tr>
<th>1) Spring washer</th>
<th>3) Cable lug</th>
</tr>
</thead>
<tbody>
<tr>
<td>2) Flat washer</td>
<td>4) Busbar</td>
</tr>
</tbody>
</table>

Lubrication

- If stainless steel bolts and nuts are used, lubricate the thread and head contact surface of the bolt using recommended pastes, eg, Molykote D paste.

- If a coated nut (eg, with bonded molybdenum-disulfide [MoS₂] coating) is used, the connection does not have to be lubricated.

Tightening torque

- Tighten bolted connections with bolts of sizes M10 and greater with the recommended nominal torque for the bolt size used.
6.8. Auxiliary power cables and control cables

See “Appendix C – Mechanical drawings” for information on:
- Project-specific cable entry
- Dimensions between point of cable entry and terminals

See “Appendix D – Wiring diagrams” for information on:
- Conventions for cross-references and device identification
- Terminal designations

6.8.1. Preparing the cable entry and the cables

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.

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

6.8.1.1. Preparing cables for EMC plates - only top cable entry
1. Remove the grommets.
2. To ensure proper sealing, cut along the marking that corresponds to the cable diameter.
3. Slide the grommet onto the cable.
   The grommet must fit tightly to prevent water entering the cabinet.

   If cables are entered through the cabinet floor, the grommets can be discarded.
4. If necessary, remove the entry plate and pull the cable through the entry holes.
5. Remove the cable insulation at the point of entry (Fig. 6–21: 1).

NOTE – If the outer cable screen is non-conductive, cut open the cable screen in the middle of the stripped area (Fig. 6–21: 1). To turn the conductive side inside out, pull the cable screen ends over the cable insulation (Fig. 6–21: 2). Connect the screens ends with a continuous conducting foil (Fig. 6–21: 3).

Figure 6–21 Preparing control cables for EMC plates

6. Pull the cable through the entry plate.

7. To prevent water from entering the cabinet, fit the grommet tightly and seal any gaps with silicone.

8. If you had removed the entry plate, remount it and fasten it properly.
6.8.1.2. Preparing cables for cable entries with sealing modules

1. Unscrew the frame and remove the sealing modules.

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

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

![Diagram of cable preparation](image)

Figure 6–22 Preparing control cables for sealing modules

| 1) Sealing module          | 4) Conductor screen extension to be connected to PE terminal |
| 2) Conductive foil         |                                                             |
| 3) Cable sheath removed to expose cable shield |                                                             |
6.8.1.3. 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.

![Diagram](image)

Figure 6–23 Preparing control cables for cable glands

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
6.8.2. Connecting the cables

- For information on project-specific connections, see “Appendix D – Wiring diagrams”.
- For information on terminal sizes, see document “Customer interface”, 3BHS347034 E03.

6.8.2.1. Connecting auxiliary power cables and space heater cables in WCU

Top cable entry

1. Route the cables through the cable transit into the terminal compartment (Fig. 6–24: 1) of the WCU.

2. Connect the cables to the relevant terminals.

Bottom entry

1. Route the cables through the floor or the top of the WCU, up the cable duct (Fig. 6–24: 4) on the right side wall and then into the terminal compartment (Fig. 6–24: 3) of the WCU.

2. Connect the cable to the bottom of the relevant terminals, according to the converter wiring diagram.

Figure 6–24 Cable routing in WCU800 (A) and WCU1400 (B) cabinets

1) Terminal compartment  
2) WCU800 cable entry bottom  
3) WCU1400 cable entry bottom  
4) Cable entry top (WCU800 and WCU1400)
6.8.2.2. Connecting cables in COU

Shielded cables

- If you use twisted pair cables, leave the unshielded cable ends twisted until they reach the terminals.
- Leave unshielded conductor ends as short as possible.
- Use a shield grounding clamp (Fig. 6–25) to fasten the overall shield and the individual shields to the ground busbar (Fig. 6–25: 8).

![Figure 6–25 Shield grounding clamp](image)

![Figure 6–26 COU customer interface section](image)

1) Arc Guard™
2) Remote condition monitoring NETA-21 and fieldbus interface
3) Customer terminals
4) S800 I/O process system (customer-specific configuration)
5) Grey encoder (optional)
6) NTAC-02 pulse encoder (optional)
7) Customer terminals
Control power supply
– Connect the cable for the control power to terminal X2 (Fig. 6–26: 11).

Control signals
– Connect the cables to the following terminals:
  • X10, X11 (Fig. 6–26: 10) Main circuit breaker signals and emergency off signals
  • X20 to X27 (Fig. 6–26: 7) Control signals of monitored equipment

Fieldbus interface
– Connect the cable directly to the fieldbus adapter.

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

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

6.8.3. Routing cables in an EXU cabinet
This section applies to a stand-alone EXU.

6.8.3.1. Auxiliary power and control cables
1. Enter the cables through a free hole of the EMC plate.
2. On the length of cable that passes through the cable transit, prepare the cable according to the following instructions:
  • Cable entries with EMC plates: see section 6.8.1.1, Preparing cables for EMC plates - only top cable entry, page 109
  • Cable entries with cable glands: see section 6.8.1.3, Preparing cables for cable entries with cable glands, page 112.

  NOTE – Materials for cable fitting, EMC requirements and sealing are not supplied for undrilled plates.
3. Route the cables through the designated cable ducts as illustrated.
4. Connect the cables to the terminals inside the terminal compartment of the cabinet.

Figure 6–27 Cable routing examples in an EXU cabinet with an ED5V, EB5R, EB5S, EB7P or EB7Q type DCS880/DCT880 converter (A) and in an EXU cabinet with an ED7Y type DCS880 converter (B)

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

**NOTICE** Risk of equipment failure!

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

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

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

1. Remove the acrylic protection cover in the cabinet.
2. Unplug the DCS880/DCT880 control panel.
3. Insert a flat-blade screwdriver into one of the indentations at the bottom of the DCS880/DCT880 front cover.
4. Gently press down the latch tab with the tip of the screwdriver and pull the corner of the cover forward and repeat for the other side.

---

**Figure 6–28 DCS880/DCT880 H4 converter (ED5V, EB5R, EB5S, EB7P and EB7Q types)**

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

---
5. Slide the removable cover up and then remove the cover.

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

7. Route the cables through the designated cable ducts as illustrated in Fig. 6–30.

---

**Figure 6–29 1 Control unit SDCS-CON-H01**

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

---

**Figure 6–30 Cable routing example in an EXU cabinet with an ED5V, EB5R, EB5S, EB7P and EB7Q type DCS880/DCT880 converter**

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

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

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

![Figure 6–31 DCS880/DCT880 converter (ED7Y)](image1)

1) Control panel
2) Removable cover

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

![Figure 6–32 1 Control unit SDCS-CON-H01](image2)

1) Slot 1 (FDCO-01 module)
2) Control panel
3. Route the cables through the designated cable ducts as illustrated in Fig. 6–33.

Figure 6–33 Cable routing example in an EXU cabinet with an ED7Y type DCS880/DCT880 converter

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

4. Reattach the DCS880/DCT880 cover.
7. Commissioning

7.1. Required qualification

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

7.2. Commissioning procedure

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

7.3. Commissioning checklist

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

7.4. Customer assistance

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

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

7.5. Customer acceptance

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

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

#### 7.6.1. Mechanical installation checklist

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<table>
<thead>
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<tbody>
<tr>
<td>1)</td>
<td>Drive is aligned according to drive layout drawing (if delivered in several transport units) and installed according to the instructions in this user manual (3BHS799208 E01).</td>
</tr>
<tr>
<td>2)</td>
<td>Silicon sealant is applied across roof plate gaps.</td>
</tr>
<tr>
<td>3)</td>
<td>Roof joints are installed.</td>
</tr>
<tr>
<td>4)</td>
<td>Pipe joints are orientated and torqued correctly.</td>
</tr>
<tr>
<td>5)</td>
<td>Roof attachments are installed (if applicable).</td>
</tr>
<tr>
<td>6)</td>
<td>Busbars are installed and torqued correctly.</td>
</tr>
<tr>
<td>7)</td>
<td>Raw water piping is completed and pipes are flanged to the drive (if applicable).</td>
</tr>
<tr>
<td>8)</td>
<td>Raw water supply is ready.</td>
</tr>
<tr>
<td>9)</td>
<td>Visual inspection:</td>
</tr>
<tr>
<td></td>
<td>• No badly affixed or damaged components</td>
</tr>
<tr>
<td></td>
<td>• No foreign objects left in the cabinet</td>
</tr>
<tr>
<td></td>
<td>• No dirt, dust or moisture in the cabinet</td>
</tr>
</tbody>
</table>

#### 7.6.2. Electrical installation checklist

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Types and cross sections of control cables suitable for the signal type and signal level.</td>
</tr>
<tr>
<td>2)</td>
<td>Types and cross sections of power cables selected according to the ABB power cable specification.</td>
</tr>
<tr>
<td>3)</td>
<td>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).</td>
</tr>
<tr>
<td>4)</td>
<td>Cable entries prepared according to the instructions in the user manual (3BHS799208 E01).</td>
</tr>
<tr>
<td>5)</td>
<td>Control cable screens and conductors are connected as instructed in the user manual, labeled appropriately, and the customer side connections are completed.</td>
</tr>
</tbody>
</table>
### 7.6.2. Electrical installation checklist (continued)

6) Heating cables (if supplied) connected

7) Wiring across shipping splits is completed according to the instructions in the user manual (3BHS799208 E01).

8) Ground cable of the drive is securely connected at both ends.

9) Cable armor and screens of power supply cables are connected to PE ground busbar.

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

### 7.6.3. Door interlocking checklist

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

### 7.6.4. Main circuit breaker (MCB) checklist

1) MCB selected as per “Main circuit breaker specification”
   - Pay attention to MCB opening time and installation of undervoltage coil or second opening coil

2) High-voltage power connections completed

3) MCB is ready to be tested with drive

4) MCB protection relay settings are tested

5) Protection devices (eg, door locks) are tested and in operation.

6) Local operation of MCB is disabled.

7) Emergency-off loop is tested.

### 7.6.5. Input transformer checklist

1) Grounding is completed

2) Transformer auxiliaries (eg, dehydrating breathers, cooling, protection devices) are ready.

3) Protection devices are tested and in operation.
### 7.6.6. Motor checklist

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

### 7.6.7. Insulation tests checklist

1. Insulation of the cables to input transformer, from input transformer to drive and from drive to motor is tested, and measured values within required limits.
2. Test report is available.

   If the commissioning personnel carry out the test, an additional day per drive-motor combination must be reserved. After the test, the mains cables can be connected, except at the drive end. Test must comply with the specification.

### 7.6.8. Power checklist

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

### 7.6.9. Miscellaneous checklist

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

8.1. Operating conditions

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

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

8.2. Safety

The drive system must only be operated by qualified and authorized personnel, i.e., personnel who are familiar with the operation of the drive system and the hazards involved.

8.3. Overview

This chapter outlines the local operation of the drive.

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

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

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

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

For more information, see chapter 9, CDP control panel, page 143.

1) CDP control panel
   - Starts / stops drive and motor
   - Displays status messages
   - Displays alarm and fault messages of the drive and monitored foreign equipment
   - Resets alarm and fault messages

2) Main power supply off
   - Illuminated push button opens the main circuit breaker

3) Main power supply on
   - Illuminated push button charges the DC link and closes the main circuit breaker

4) Alarm fault lamp
   - Flashing light: alarm
   - Permanent light: fault

5) Emergency-off reset push button
   - Resets the emergency-off relay in the drive control system
   - Flashes when the auxiliary voltage is switched on, or when an emergency-off switch is pressed

6) Emergency-off latching push button
   - Prevents starting when pressed at standstill of the drive
   - Main circuit breaker opens and DC link discharges when pressed during operation of the drive

Figure 8–1 Local operator panel
8.5. EXU control panel

The EXU assistant control panel (ACP) allows you to control the operation of the DCS880 or DCT880 unit in the EXU cabinet as well as set the parameters and view the status data of the EXU.

For instructions on how to use the ACP, see the “ACX-AP-x Assistant control panels user manual”, 3AUA0000085685.

Figure 8–2 DCS880 control panel front and back

8.5.1. Operational settings

At the end of commissioning, parameter 16.04 LocLock is set on the control panel to disable local control of the EXU. Only remote control is possible.

NOTE – When the control panel is controlled remotely, REM is in the top left corner of the display.

 NOTICE Risk of component damage!

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

▷ DO NOT enable or switch to local control during drive operation
▷ Only use the control panel to rectify an alarm or a fault condition
Display values
The actual values shown on the display can be freely selected. The following default values are shown on the display when the panel is in local control mode:

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

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

8.5.2. Resetting alarm and fault messages

- **Alarm messages:** cannot be reset by pressing the reset soft key. The alarm resets automatically as soon as the reason causing the alarm has been resolved.

- **Fault messages:** must be reset manually after the reason causing the fault has been resolved. The message on the display can be reset either by pressing the reset soft key on the EXU control panel, or by pressing the reset button on the control panel of the drive.

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

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

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

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

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

- Drive is put into operation (see section 8.7.1, **Start sequence of the drive**, page 130)
- Drive is stopped (see section 8.7.2, **Stop sequence of the drive**, page 131)
- Fault condition has occurred

The status messages are sent to the higher-level control system and are displayed on the CDP control panel of the drive.
For information on other status messages (eg, fault status messages), see the status words in “Appendix G – Signal and parameter table”.

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

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

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

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

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

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

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

1) NotReadyOn

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

3) On command

4) Charging
   - DC link charges
   - MCB closes
   - Cooling system switches on

5) ReadyRun

6) Start Command
   - Inverter starts to modulate

7) ReadyRef

8) Operation
8.7.2. Stop sequence of the drive

1) Operation

2) ReadyRef

3) Stop command

4) Stopping
   - Speed ramps down
   - Inverter stops modulating

5) ReadyRun

6) Off command
   - MCB opens
   - DC link discharges
   - Cooling system switches off after a delay

7) ReadyOn
   - Ground drive
   - PCU doors are released for opening
   - Switch off auxiliary power supply

8) NotReadyOn

8.7.3. Emergency-off sequence

1) Operation

2) ReadyRef

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

4) NotReadyOn
8.8. Starting the drive

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

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

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

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

- “Appendix D – Wiring diagrams” to identify the circuit breakers to be switched on
- “Appendix A – Additional manuals”, manual of the water cooling unit to check that the water cooling unit is ready for operation
- chapter 9, **CDP control panel**, page 143 for information on functions and features of the CDP control panel
8.8.1. Checks before starting the drive

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

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

8.8.2. Starting the drive from remote

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

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

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

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

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

   For more information, see section 8.10, Emergency-off, page 138.

3. Check that no alarm or fault messages are displayed on the CDP control panel.

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

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

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

   | StateINU | 0.0 rpm |
   | MOTOR SP  | ReadyOn |
   | POWER     | 0.0 kW  |
4. Press the SUPPLY ON push button on the control compartment door to charge the DC link. The push button flashes during charging.

The status line of the CDP control panel alternates between Charging and AuxiliaryOn.

Alternating display message:
- Charging
- AuxiliaryOn

After charging has been finished, the following takes place:

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

5. Enter the reference value.

For more information, see section 9.3.2, **Entering a reference value**, page 163.

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

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

While the motor is accelerating, the run status message in the display blinks. When the motor speed has reached the reference value, the run status message lights up permanently.
The display shows ReadyRef to indicate that the drive system is operating.

<p>| | |</p>
<table>
<thead>
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<tbody>
<tr>
<td>1 L -&gt;</td>
<td>600.0 rpm</td>
</tr>
<tr>
<td>StateNU</td>
<td>ReadyRef</td>
</tr>
<tr>
<td>MOTOR SP</td>
<td>0.00 rpm</td>
</tr>
<tr>
<td>POWER</td>
<td>1000.0 kW</td>
</tr>
</tbody>
</table>
8.9. Stopping the drive

- To stop the motor, press the STOP key.

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

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

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

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

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

The red emergency-off push button (Fig. 8–3) on the local control panel (Fig. 8–1) is a hardwired safety device that immediately disconnects the drive from the main power supply when pressed.

**CAUTION!** The emergency-off push button DOES NOT disconnect the auxiliary power supply from the drive.

![Figure 8–3 Detail of local control panel](image)

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

8.10.1. Initiating an emergency off

To initiate an emergency stop, press the emergency-off push button on the door of the control compartment or, if present, an external emergency-off push button that is linked to the emergency-off circuit.

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

- Main circuit breaker opens
- Drive coasts down
- DC link of the drive discharges
- Status line indication of the CDP control panel alternates between EmergencyOff and NotReadyOn.

**Alternating display message:**
- EmergeOff
- NotReadyOn

- Emergency-off reset push button flashes.
- Main power supply off push button flashes.
8.10.2. Starting the drive system after an emergency-off

1. To start the drive system 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 emergency-off reset push button.

   After resetting, the drive status message changes to ReadyOn.

   

   ![](image)

   You can now connect the main power supply to the drive and start the drive.

   

   ```
   1 L -&gt; 0.0 rpm
   StateINU ReadyOn
   MOTOR SP 0.00 rpm
   POWER 0.0 kW
   ```
8.11. Arc resistant design

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

The ABB arc resistant classes in Table 8–1 indicate the type of arc proofing that a drive uses. Depending on the drive configuration, classes I and IV are available for an ACS5000W.

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

Table 8–1 ABB arc resistant classes

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

8.11.1. Internal arc classification (IAC)

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

<table>
<thead>
<tr>
<th>IAC</th>
<th>F</th>
<th>L</th>
<th>R</th>
<th>T</th>
<th>B</th>
<th>I_A</th>
<th>t_A</th>
<th>APR</th>
<th>SC</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 62477-2</td>
<td>2b</td>
<td>2b</td>
<td>2b</td>
<td>1</td>
<td>1</td>
<td>19 kA</td>
<td>0.5 s</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Distance [m]</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 8–4 IAC label example

**IMPORTANT!** The Main Circuit Breaker (MCB) for the drive fulfills the APR (Associated Protection Requirement) without the need for additional devices. The MCB requirements are described in section 2.7, **Main circuit breaker protection device**, page 29.

Based on the ACS5000W IAC rating, the minimum approach distance is 0.3 m. Local rules may require additional distance. The user is responsible to determine the correct approach distance considering local rules.
8.11.2. Arc detection with the Arc Guard System™

The Arc Guard System™ detects fast arc faults in the terminal sections of the drive. When the Arc Guard System detects an arc fault the drive performs protection firing and immediately opens the main circuit breaker. The Arc Guard monitor and HMI panel are located in the COU (Fig. 3–12).

Figure 8–5 Arc Guard™ system with HMI panel

The Arc Guard System™ consists of the following:

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

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

1. De-energize and ground the drive according to section 10.6.2, De-energizing the drive, page 175.
2. Search for the location where the arc has been detected.
3. Check the Arc Guard HMI panel messages and use the circuit diagrams.

Figure 8–6 HMI panel

4. Open the power units and localize the defect.
5. Repair the defect or contact support line if needed.
6. Reset the fault on Arc Guard HMI panel.
7. Acknowledge the firing through with parameter 16.26 on the CDP control panel (only when fault was understood and corrected).
8. Restart the drive.
8.12. De-energizing and grounding the drive
See section 10.6.2, De-energizing the drive, page 175.

8.13. Opening the doors
See section 10.6.3, Opening and closing the doors, page 177.
9. CDP control panel

9.1. Overview

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

9.1.1. Display and keypad

Figure 9–1 CDP control panel

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
9.1.2. Functions

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

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

Using the CDP control panel, it is possible to:

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

9.2. Modes

The CDP control panel provides the following modes:

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

9.2.1. Identification mode

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

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

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

```
CDP312 PANEL V5.30
............
```
After 2-3 seconds the display shows the drive name (1, 2), the application software in use (3), and the drive identification (4) is displayed.

After another few seconds.

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

Alternating display message:

- DCGndNopen
- NotReadyOn
9.2.2. Actual signals mode

Two displays can be selected in the actual signals mode:
- Actual signals display
- Fault memory display

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

The actual signals display is used to monitor the drive without interfering with its operation. It continuously displays three selectable actual values.
If a key is not actuated within one minute (an exception from this is the fault memory display), the CDP control panel automatically returns to the actual signals display from other modes.

**Actual values**

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

The actual values are organized in groups.

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

**Fault memory**

The fault memory display provides information on the 64 most recent fault events that occurred in the drive. It displays the name of the fault and the time it occurred. For instructions on how to display and reset the fault memory, see section 9.2.2.7, *Displaying and resetting an active fault*, page 152.

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

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

**9.2.2.2. Selecting the actual signals display**

To select the actual signals display, press the ACT key.
9.2.2.3. Toggling between actual signals display and fault memory

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

9.2.2.4. Displaying three actual signals

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

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

9.2.2.5. Selecting actual signals

1. To select the actual signals display, press the ACT key.
2. To select a line where the actual signal is to be displayed, press the slow navigation keys.

A blinking cursor indicates the selected line.

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

4. To select a parameter group, press a fast navigation keys.
5. To select an actual signal, press a slow navigation keys.

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

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

9.2.2.6. Displaying a fault and resetting the fault memory

1. To open the actual signals display, press the ACT key.
2. To change to the fault memory display, press a fast navigation key.

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

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

5. To return to the actual signals display, press a fast navigation key.
9.2.2.7. Displaying and resetting an active fault

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

   ![Display screen showing fault details]

   1 L ->  600.0 rpm
   ACS5000
   *** FAULT ***
   MCB CloseControl

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

   ![Reset screen showing status details]

   1 L ->  600.0 rpm
   StateINU ReadyOn
   MOTOR SP 0.00 rpm
   POWER 0.0 kW
9.2.3. Parameters mode

**NOTICE**  Risk of component damage.

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

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

![Control panel functions for Parameters mode](image)

**Figure 9–3 Control panel functions for Parameters mode**

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
9.2.3.1. Overview

If the parameter lock is disabled or unlocked (see section 9.2.3.3, **Enabling / unlocking a parameter lock**, page 157) 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>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 07</td>
<td>Control words</td>
<td>21.01</td>
<td>Start function</td>
</tr>
<tr>
<td>Group 08</td>
<td>Status words</td>
<td>21.02</td>
<td>Start function</td>
</tr>
<tr>
<td>Group 09</td>
<td>Fault and alarm words</td>
<td>21.03</td>
<td>Off1 stop mode</td>
</tr>
<tr>
<td>Group 11</td>
<td>Start, stop, direction or MCB control</td>
<td>21.04</td>
<td>Process stop selection</td>
</tr>
<tr>
<td>Group 12</td>
<td>Reference selection</td>
<td>21.05</td>
<td>Process stop signal</td>
</tr>
<tr>
<td>Group 16</td>
<td>System control inputs</td>
<td>21.06</td>
<td>Process stop MCB control</td>
</tr>
<tr>
<td>Group 17</td>
<td>DC link control</td>
<td>21.07</td>
<td>Process stop mode</td>
</tr>
<tr>
<td>Group 18</td>
<td>Utility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 19</td>
<td>Data storage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 20</td>
<td>Limits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 21</td>
<td>Start / stop / process stop</td>
<td>21.17</td>
<td>MCB closing time limit</td>
</tr>
<tr>
<td>Group 22</td>
<td>Ramp functions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 23</td>
<td>Speed reference</td>
<td>21.19</td>
<td>MCB available signal</td>
</tr>
</tbody>
</table>

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

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

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

** WARNING **
WRITE ACCESS DENIED
PARAMETER SETTING NOT POSSIBLE
9.2.3.2. Changing a parameter setting

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

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

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

4. To enter the parameter setting function, press the ENTER key.
5. To change the parameter value, press:
   - Slow navigation keys for numbers and text
   - Fast navigation keys for numbers only

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

7. To cancel the setting and keep the original setting, press any of the mode selection keys.
   The selected keypad mode is entered.
9.2.3.3. Enabling / unlocking a parameter lock

Unwanted parameter settings can be prevented by activating the parameter lock function. The corresponding parameters are 16.02 PARAMETER LOCK and 16.03 PASSCODE and belong to parameter group 16 SYSTEM CTRL INPUTS.

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”.

9.2.3.4. User lock

NOTE - Risk of component damage.

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

Setting the pass code to lock the control panel

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

1. To activate the user lock for the first time, enter the default pass code, i.e., 358, in 16.02 Passcode.
   
   You can now edit parameters 16.24...16.25.

2. Enter the old pass code in 16.24 OldUserPasscode.
3. Enter the new pass code in 16.25 NewUserPasscode.
4. In 16.02 Parameter Lock, enable the user lock functionality.

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

The functions mode is used for adjusting the display contrast.

![Figure 9–4 Control panel functions for Functions mode](image)

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

![Diagram of control panel functions for Functions mode](image)

### 9.2.4.1. Adjusting the display contrast

1. To enter the functions mode, press the FUNC key.
2. To select the contrast adjustment function, press the slow navigation keys until the blinking cursor reaches the CONTRAST line.

3. Press the ENTER key.

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

5. To confirm the setting and to return to the actual signals display, press the ENTER key.
6. To cancel the setting and keep the original setting, press any of the mode selection keys. The selected keypad mode is entered.

9.2.5. Local and remote control mode

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

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

   NOTE – In this context, remote control is not necessarily equivalent to higher-level control. For more information, see section 9.2.5.4, Remote control, page 161.

9.2.5.1. Local control

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

- To enter the local control mode, press the LOC-REM key.

Local control is indicated by the letter L.

9.2.5.2. Disabling / enabling local lock function

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

The corresponding parameter is 16.04 LOCAL LOCK and belongs to the parameter group 16 SYSTEM CTRL INPUTS.
9.2.5.3. Enabling the local lock

- To enable the local lock, set parameter 16.04 to 2 (LOCKED).
  
  With this parameter setting, local control (including the LOC-REM key) is disabled.

  If the CDP control panel or a DriveWindow PC is in local control mode at the time that the local lock is enabled, they remain in local control mode until they are switched to remote control mode. This means that the CDP control panel displays the letter L until you press the LOC-REM key.

Disabling the local lock

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

9.2.5.4. Remote control

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

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

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

- 11.02 EXT2 START/STOP/DIR 10 (KEYPAD) or
  12.06 EXT REF2 SELECT = 1 (KEYPAD) and
  12.02 EXT1/EXT2 SELECT = 2 (EXT2)
To enter the remote control mode, press the LOC-REM key.

- A blank space indicates full remote control from a higher-level control system.
- The letter R indicates partial remote control (some commands are enabled locally).

NOTE – To prevent accidental switching from remote control to local control, see section 9.2.5.2, Disabling / enabling local lock function, page 160.

### 9.3. Operational commands

For instructions on how to start and stop the drive system from the CDP control panel, see section 8.8, Starting the drive, page 132 and section 8.9, Stopping the drive, page 137.

#### 9.3.1. Setting the direction of rotation

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

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

The arrow on the display indicates the direction of rotation:

- When the motor is running, the arrow indicates the actual direction.
- When the motor is not running, the arrow indicates the preselected direction.
To set the direction of rotation, press the forward or backward key.

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

**9.3.2. Entering a reference value**

Entering a reference value from the CDP control panel is possible in:
- Local control mode (L)
- Remote control mode (R)

1. Press a mode selection key.
2. To enter the reference value input mode, press the REF key.

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

4. To exit the mode, press a mode selection key.
10. Preventive and corrective maintenance

10.1. General information

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

10.1.1. Required qualification

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

10.1.2. Maintenance schedule

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

10.1.3. Logbook

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

– Date and time
– Detailed description

10.1.4. Spare parts

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

For information on types and identification codes, see “Appendix E – Parts list”.
10.2. Identifying electrical equipment

10.2.1. Device designation

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

Figure 10–1 Device identification

10.2.2. Cables and wires

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

Figure 10–2 Cable and wire designation

1) Terminal number
2) Wire number

10.2.3. Understanding wiring diagrams

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

PREVENTIVE AND CORRECTIVE MAINTENANCE
10.3. Alarm / fault indications

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

10.3.1. Messages

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

- Flashing light: alarm
- Light remains on: fault

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

10.3.2. Error message levels

Two error message levels are used in the drive:

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

10.3.2.1. Alarm

An alarm does not shut down the drive. If the condition causing the alarm is not corrected, a persisting alarm can often lead to a fault. An alarm cannot be reset manually. The alarm message is deleted from the display as soon as the alarm condition has been corrected.
10.3.2.2. Fault

A fault shuts down the drive. The type of shutdown depends on the origin of the fault.

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

- Class 1 faults (FC 1) open the MCB.
- Class 2 faults (FC 2) do not open the MCB.

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

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

10.3.2.3. Alarm / fault messages

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

10.3.3. Fault handling

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

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

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

Example:

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Date and Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+Fault AMC: Fault Class 2</td>
<td>2008-01-08 16:58:24.3770</td>
</tr>
<tr>
<td>2</td>
<td>+Fault PPCS Communication</td>
<td>2008-01-08 16:58:24.3760</td>
</tr>
<tr>
<td>3</td>
<td>+Fault AMC: Fault Class 1</td>
<td>2008-01-08 16:56:02.1170</td>
</tr>
<tr>
<td>4</td>
<td>+Fault DC Undervoltage</td>
<td>2008-01-08 16:56:02.1170</td>
</tr>
</tbody>
</table>

In the above example:

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+Fault AMC: Fault Class 2</td>
<td>Classifies the fault</td>
</tr>
<tr>
<td>2</td>
<td>+Fault PPCS Communication</td>
<td>Represents a subsequent fault that occurred 2 min. 22 s than the first fault</td>
</tr>
<tr>
<td>3</td>
<td>+Fault AMC: Fault Class 1</td>
<td>Classifies the fault</td>
</tr>
<tr>
<td>4</td>
<td>+Fault DC Undervoltage</td>
<td>Reason for the failure of the drive system as it occurred first</td>
</tr>
</tbody>
</table>

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

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

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

2) Select the fault history display on the CDP control panel, but do not clear the buffer!

For more information, see chapter 9, CDP control panel, page 143.

3) Identify the fault and make a logbook entry.

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

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

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

   When calling ABB service, it is recommended to have the following data available at the time when the fault occurred:
   - Operating, ambient and load conditions
   - Unusual events

6) **After the fault has been rectified, start the drive as described in chapter 8, Operation, page 125.**
10.4. Removing the CDP control panel

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

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

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

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

2. To remove the panel, proceed as illustrated.

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

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

---

**Communication with AMC circuit board**

The CDP control panel (1) is connected to the AMC circuit board (2) via an RS485 interface.
10.5. LEDs and switches on circuit boards and I/O devices

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

10.5.1. AMC circuit board

![AMC circuit board diagram]

Figure 10–3 LEDs of AMC circuit board

<table>
<thead>
<tr>
<th>LED</th>
<th>Color</th>
<th>Description</th>
<th>Status when software has loaded</th>
<th>Status when software has not loaded</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Red</td>
<td>Fault</td>
<td>Booting: ON, OFF</td>
<td>Booting: ON, OFF</td>
</tr>
<tr>
<td>R</td>
<td>Green</td>
<td>Run</td>
<td>Booting: OFF, OFF</td>
<td>Booting: OFF, OFF</td>
</tr>
<tr>
<td>M</td>
<td>Green</td>
<td>Supply OK</td>
<td>Booting: ON, OFF</td>
<td>Booting: ON, OFF</td>
</tr>
<tr>
<td>P</td>
<td>Green</td>
<td></td>
<td>Booting: ON, OFF</td>
<td>Booting: ON, OFF</td>
</tr>
<tr>
<td>T1</td>
<td>Yellow</td>
<td>Receiving data on DDCS channel 0</td>
<td>Flashing: ON / OFF</td>
<td>Flashing: ON / OFF</td>
</tr>
<tr>
<td>T2</td>
<td>Yellow</td>
<td>Receiving data on DDCS channel 3</td>
<td>Flashing: ON / OFF</td>
<td>Flashing: ON / OFF</td>
</tr>
<tr>
<td>S3</td>
<td>Yellow</td>
<td></td>
<td>Booting: OFF, OFF</td>
<td>Booting: OFF, OFF</td>
</tr>
<tr>
<td>S1</td>
<td>Yellow</td>
<td></td>
<td>Booting: OFF, OFF</td>
<td>Booting: OFF, OFF</td>
</tr>
<tr>
<td>S2</td>
<td>Yellow</td>
<td></td>
<td>Booting: OFF, OFF</td>
<td>Booting: OFF, OFF</td>
</tr>
<tr>
<td>S0</td>
<td>Yellow</td>
<td></td>
<td>Booting: OFF, OFF</td>
<td>Booting: OFF, OFF</td>
</tr>
</tbody>
</table>
10.5.2. S800 I/O bus modem TB820

Figure 10–4 TB820 bus modem

<table>
<thead>
<tr>
<th>LED</th>
<th>Color</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Red</td>
<td>Fault in module</td>
</tr>
<tr>
<td>R</td>
<td>Green</td>
<td>Device in operation</td>
</tr>
<tr>
<td>P</td>
<td>Green</td>
<td>Power supply is healthy</td>
</tr>
<tr>
<td>Rx1</td>
<td>Yellow</td>
<td>Traffic on optical module bus</td>
</tr>
<tr>
<td>Rx2</td>
<td>Yellow</td>
<td>Traffic on optical module bus</td>
</tr>
<tr>
<td>ERx</td>
<td>Yellow</td>
<td>Traffic on electrical module bus</td>
</tr>
</tbody>
</table>

10.5.2.1. Bus modem address

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

The address is set with the rotary switch on the module (Fig. 10–4: 1). The factory-set value must not be changed.
10.5.3. S800 I/O modules

LEDs on I/O modules having the same meaning on all types of I/O modules are always at the same position. The LEDs are always at the topmost position on each module (Fig. 10–5: 1) and are identified as follows:

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

Figure 10–5 Example of S800 I/O station

<table>
<thead>
<tr>
<th>LED</th>
<th>Color</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Red</td>
<td>Indicates failure</td>
</tr>
<tr>
<td>R</td>
<td>Green</td>
<td>Device is operating normally</td>
</tr>
<tr>
<td>W</td>
<td>Yellow</td>
<td>External fault or minor fault in the module</td>
</tr>
<tr>
<td>O</td>
<td>Yellow</td>
<td>Indicates an active signal</td>
</tr>
<tr>
<td>OSP</td>
<td>Yellow</td>
<td>Indicates an active signal (output set as predetermined)</td>
</tr>
</tbody>
</table>

For more information, see the following manuals:

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

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

10.6.1. Safety

⚠️ **DANGER** Hazardous voltages!
Risk of life-threatening injury or DEATH.
- Before you work on the drive, carry out the steps in section 2.5, The 7 steps that save lives, page 26.
- After the work is complete and before you energize the drive:
  - Remove all foreign objects.
  - Secure and fasten all covers.
  - Close all doors.
  - Lock the doors of the medium voltage compartments.
  - Verify that the release dials of the safety switches are in the locked position.

⚠️ **WARNING** Hazardous DC voltage!
If the control unit has buffer capacitors (depends on the auxiliary supply type), the capacitor voltage is 300 V (DC) during operation.
- After you stop the drive, wait 5 minutes for the capacitors to discharge
- BEFORE you touch a capacitor, verify that the capacitors have been discharged

⚠️ **NOTICE** Risk of component damage.
Foreign objects, metallic dust, and dirt can cause an energized drive to fail.
- Remove all foreign objects.
- Secure and fasten all covers.
- Close all doors.
10.6.2. De-energizing the drive

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

For instructions on how to use the CDP control panel, see chapter 9, CDP control panel, page 143.

10.6.2.1. Stopping the motor

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

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

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

10.6.2.2. De-energizing the drive

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

The following takes place:

- Main circuit breaker (MCB) opens
- DC link discharges

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

**Alternating display message:**

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

2. Rack-out, lock-out, ground and tag-out the main circuit breaker.

3. Wait until the yellow lamp GROUNDING SWITCH UNLOCKED lights up.

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

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

   For more information, section 10.4, Removing the CDP control panel, page 170.

4. Once the yellow lamp GROUNDING SWITCH UNLOCKED is lit, turn the grounding switch to the grounded position.

5. When the grounding switch is in the grounded position, the status line alternates between DCGnd NOpen, NotReadyOn, StateINU NotRdy.

6. If necessary, open the doors of medium voltage compartments according to section 10.6.3, Opening and closing the doors, page 177.

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

   The drive is now de-energized, and safe access is possible.
10.6.3. Opening and closing the doors

Releasing the doors

1. To test the yellow lamp, press its push button.
   If the lamp does not light up, see section 10.4, **Removing the CDP control panel**, page 170.

2. If the drive is in operation, stop the drive according to section 8.9, **Stopping the drive**, page 137.

3. To discharge the DC link of the drive, press the SUPPLY OFF push button on the local control panel.
   The yellow lamp lights up when the DC link is discharged.
   If the yellow lamp does not light up, see section 10.4, **Removing the CDP control panel**, page 170.

4. Once the yellow lamp lights up, turn the grounding switch to the grounded position.
   The white lamp lights up to indicate that the drive is grounded.

5. Once the white lamp lights up, slide the locking bar from the locked (1) to the unlocked (2) position.

1) White lamp: Lights up to indicate that the drive is grounded and you can slide the locking bar to the unlocked / locked position.

2) Yellow lamp: Lights up when the grounding switch has been released. You can then turn the grounding switch to the grounded or ungrounded position.

3) Locking bar: Releases or blocks the door handles of a PCU compartment.

4) Grounding switch: in horizontal position, the drive is grounded. In vertical position, the drive is not grounded.
Opening the doors

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

2. To open the door, turn the door handle:
   - To the right if the door is hinged on the right
   - To the left if the door is hinged on the left.

Closing and locking the doors

Once maintenance of medium voltage compartments is complete, proceed as follows:

1. To close a door, bring the door handle in line with the door plate and press the handle down until it clicks in.

2. Before actuating the locking bars, make sure that the drive is supplied with auxiliary voltage.

3. To lock a door, slide the locking bar from the unlocked (1) to the locked (2) position.

A limit switch monitors the locked position of the locking bars. If any door of a medium voltage compartment is not locked properly, you cannot start the drive.
10.6.4. Grounding switch is not released

When the DC link of the drive has been discharged, the lamp GROUNDING SWITCH UNLOCKED lights up to indicate that the grounding switch is released and can be turned to the grounded position.

**IMPORTANT!** DO NOT use force for turning the grounding switch in any direction. The handle and / or the switch could get damaged.

If the lamp does not light up, proceed as follows:

1) Verify that the main circuit breaker (MCB) is in the open position.

2) Check the drive status on the CDP control panel.

   The drive status should be ReadyOn, indicating that the DC link has discharged and the MCB has opened.

3) Check the actual value of the DC-link voltage on the CDP control panel.

   The actual value (parameter 2.30 DC Volt 1 to 3 MaxVal) must be < 50 V (discharged).

4) Check if there are any alarm and fault messages on the display.

   If there are alarms / faults, contact the ABB service organization
10.6.5. Emergency release of a door safety switch

**DANGER Hazardous voltages!**
Risk of life-threatening injury or DEATH!
- Before you unlock a safety switch, de-energize and ground the drive according to section 10.6.2, *De-energizing the drive*, page 175.
- DO NOT unlock the safety switches permanently.

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

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

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

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

![Figure 10–6 Location of safety switches](image)

1) Safety switch behind door

For the safety switches to work and to be able to open the doors, auxiliary power supply is required.

If the auxiliary power supply is unavailable and the doors are closed, you can only open them by unlocking the safety switch manually.
10.6.5.2. Safety-switch settings

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

To open the door of a medium voltage unit, the DC link must be discharged and the auxiliary voltage must be switched on.

Figure 10–7 Safety switch

Unlocking

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

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

3. Turn the release dial from the locked to the unlocked position.

You can now actuate the locking bar and open the doors.

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

5. Screw in the locking screw again.

6. Refit the screw cap.
10.6.6. Visual checks on the drive

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

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

For information, see the applicable cable specifications.

10.6.7. Cleaning

**NOTICE** Risk of component damage.

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

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

10.6.7.1. Cleaning the drive cabinet

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

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

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

- Tighten to the torque value on the label attached to the capacitor.
  
  **IMPORTANT!** DO NOT exceed 20 Nm if the tightening torque value is not specified.

- Check all power and control cable connections and tighten them if necessary.
- Check that all plugs and connectors are tight.

10.6.9. Checking and replacing filter mats
For the filter mat replacement interval, see the “ACS5000 preventive maintenance schedule”, 3BHS855274 E01.

10.6.9.1. Location

Drives with an IP54 cabinet have filter mats in the following compartment doors:

- Water cooling unit (WCU)

Drives with IP42 cabinet, have filter mats in the following compartment doors:

- Phase converter unit (PCU)
- Water cooling unit (WCU)
10.6.9.2. Replacing filter mats

**CAUTION** Cooling fans start automatically.

Cooling fans start automatically in response to temperature levels.

- Switch off the protection switch for the cooling fan according to “Appendix D – Wiring diagrams”.

**IMPORTANT!** A replacement filter mat must have the same dimensions and filter class as the original filter mat.

### Table 10–1 Filter mat specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter class</td>
<td>G3 (EN779)</td>
</tr>
<tr>
<td>Thickness</td>
<td>~ 10 mm</td>
</tr>
<tr>
<td>Dimensions</td>
<td>WCU: 125 x 250 mm</td>
</tr>
<tr>
<td></td>
<td>PCU: 600 x 652 mm</td>
</tr>
</tbody>
</table>

#### Replacing a PCU filter mat

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

![Diagram of PCU filter mat replacement](image)

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

3. Insert the new filter mat.

   See Table 10–1 for the filter mat specifications.

4. Reattach the air outlet panel with the 4 screws.
Replacing a WCU filter mat

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

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

2. Replace the filter mat (2).

   See Table 10–1 for the filter mat specifications.

3. Slide the air outlet panel back into place.

10.6.10. Replacing a door-mounted fan

The WCU compartment has door-mounted fans.

For replacement instructions, see “Assembly instructions for fan and filter units” in “Appendix A – Additional manuals”.

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

![WARNING Hazardous voltage!]

- De-energize the cooling unit before you begin.

The roof-mounted cooling unit as used with IP42 cabinets consists of three fans. One fan is redundant and takes over when one of the other fans fails.

If one fan fails, the red indicator lights up and replacement is required.

For replacement instructions, see the Instruction manual in “Appendix A – Additional manuals”.

Figure 10–8 Roof-mounted cooling unit (IP42)

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

- Dimensions: (L × W × H): 1550 × 550 × 230 mm
- Weight: 40 kg
10.6.12. Replacing a fan in an IP54 roof-mounted cooling unit

**WARNING** Hazardous voltage!
- De-energize the cooling unit before you begin.

The roof-mounted cooling unit as used with IP54 cabinets consists of an air-to-water heat exchanger and four fans. One fan is redundant and takes over when one of the other fans fails.

If one fan fails, the red indicator lights up and replacement is required.

For replacement instructions, see the instruction manual in “Appendix A – Additional manuals”.

Figure 10–9 Roof-mounted cooling unit (IP54)

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

- Dimensions: (L × W × H): 1550 × 975 × 386 mm
- Weight: 98 kg
10.6.13. Replacing a fan in an EXU with a DCS880 H4/DCT880 T4 controller

**Figure 10–10 DCS880 controller - size H4**

**Procedure**

1. Switch off the miniature circuit breaker of the fan unit.
   
   NOTE – To identify the miniature circuit breaker, see “Appendix D – Wiring diagrams”.

2. Remove the 6 screws from the fan cover (1) and then remove the fan cover.
3. Unplug the fan cables.

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

5. Pull the fan out of the fan unit in the cabinet.
   
   **CAUTION!** To prevent the fan from falling onto you, place a support (ie, a box) underneath.

6. Install the new fan in reverse order of removal.
10.6.14. Replacing a fan in an EXU with a DCS880 H6 unit

Figure 10–11 DCS880 controller - size H6

Procedure

1. Switch off the miniature circuit breaker of the fan unit.
   
   To identify the miniature circuit breaker, see “Appendix D – Wiring diagrams”.

2. Remove the 6 screws from the fan cover (1) and then remove the fan cover.
3. Unplug the fan cables.

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

5. Pull the fan out of the fan unit in the cabinet.
   
   **CAUTION!** To prevent the fan from falling onto you, put a support (ie, a box) underneath.

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