ABB DRIVES FOR WATER

ACQ580-34 drive modules
Hardware manual
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21 Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet

Further information
Safety instructions

Contents of this chapter
This chapter contains the safety instructions which you must obey when you install, start up, operate and do maintenance work on the drive. If you ignore the safety instructions, injury, death or damage can occur.

Use of warnings and notes
Warnings tell you about conditions which can cause injury or death, or damage to the equipment. They also tell you how to prevent the danger. Notes draw attention to a particular condition or fact, or give information on a subject.

The manual uses these warning symbols:

WARNING!
Electricity warning tells about hazards from electricity which can cause injury or death, or damage to the equipment.

WARNING!
General warning tells about conditions, other than those caused by electricity, which can cause injury or death, or damage to the equipment.

WARNING!
Electrostatic sensitive devices warning tells you about the risk of electrostatic discharge which can cause damage to the equipment.
General safety in installation, start-up and maintenance

These instructions are for all personnel who do work on the drive.

**WARNING!**
Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

- Keep the drive in its package until you install it. After unpacking, protect the drive from dust, debris and moisture.
- Use the required personal protective equipment: safety shoes with metal toe cap, safety glasses, protective gloves, etc.
- Lift a heavy drive with a lifting device. Use the designated lifting points. See the dimension drawings.
- Secure the drive cabinet to the floor to prevent it from toppling over. The cabinet has a high center of gravity. When you pull out heavy components or power modules, there is a risk of overturning. Secure the cabinet also to the wall when necessary.

- Do not use the module installation ramp with plinth heights which exceeds the maximum allowed height. See the technical data.
- Secure the module extraction/installation ramp carefully.
- To prevent the drive module from falling, attach its top lifting lugs with chains to the cabinet lifting lug (1) before you push the module into the cabinet and pull it from the cabinet. Push the module into the cabinet and pull it from the cabinet carefully preferably with help from another person. Keep a constant pressure with one foot on the base of the module (2) to prevent the module from falling on its back. Make sure that the module does not topple over when you move it on the floor. To extend the support legs, press each leg a little down (3) and turn it aside (4). Whenever possible secure the module also with chains. The module overturns from a sideways tilt of 5 degrees.
• Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, and brake resistors, remain hot for a while after disconnection of the electrical supply.
• Vacuum clean the area around the drive before the start-up to prevent the drive cooling fan from drawing the dust inside the drive.
• Make sure that debris from drilling, cutting and grinding does not enter the drive during the installation. Electrically conductive debris inside the drive may cause damage or malfunction.
• Make sure that there is sufficient cooling. See the technical data.
• Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists. If you cannot avoid working on a powered drive, obey the local laws and regulations on live working (including – but not limited to – electric shock and arc protection).
• Before you adjust the drive operation limits, make sure that the motor and all driven equipment can operate throughout the set operation limits.
• Before you activate the automatic fault reset or automatic restart functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault or supply break. If these functions are activated, the installation must be clearly marked as defined in IEC/EN 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".
• The maximum drive power cycles is five times in ten minutes. Power cycling the drive too often can damage the charging circuit of the DC capacitors.
• Validate any safety circuits (for example, Safe torque off or emergency stop) in start-up. See separate instructions for the safety circuits.
• Beware of hot air exiting from the air outlets.
• Do not cover the air inlet or outlet when the drive is running.

Note:
• If you select an external source for the start command and it is on, the drive will start immediately after fault reset unless you configure the drive for pulse start. See the firmware manual.
• Depending on the wiring and parametrization of the drive, the stop key on the control panel may not stop the drive.
• Only authorized persons are allowed to repair a malfunctioning drive.
Electrical safety in installation, start-up and maintenance

Electrical safety precautions

These electrical safety precautions are for all personnel who do work on the drive, motor cable or motor.

**WARNING!**
Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

If you are not a qualified electrician, do not do installation or maintenance work.

Go through these steps before you begin any installation or maintenance work.

1. Clearly identify the work location and equipment.
2. Disconnect all possible voltage sources. Make sure that re-connection is not possible. Lock out and tag out.
   - Open the main disconnecting device of the drive.
   - Open the charging switch if present.
   - Open the disconnector of the supply transformer. (The main disconnecting device in the drive cabinet does not disconnect the voltage from the AC input power busbars of the drive cabinet.)
   - Open the auxiliary voltage switch-disconnector (if present), and all other possible disconnecting devices that isolate the drive from dangerous voltage sources.
   - If you have a permanent magnet motor connected to the drive, disconnect the motor from the drive with a safety switch or by other means.
   - Disconnect any dangerous external voltages from the control circuits.
   - After you disconnect power from the drive, always wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.
3. Protect any other energized parts in the work location against contact.
4. Take special precautions when close to bare conductors.
5. Measure that the installation is de-energized. If the measurement requires removal or disassembly of shrouding or other cabinet structures, obey the local laws and regulations applicable to live working (including – but not limited to – electric shock and arc protection).
   - Use a multimeter with an impedance greater than 1 Mohm.
   - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is close to 0 V.
   - Make sure that the voltage between the drive DC busbars (+ and -) and the grounding (PE) busbar is close to 0 V.
   - Make sure that the voltage between the drive output terminals (T1/U, T2/V, T3/W) and the grounding (PE) busbar is close to 0 V.
6. Install temporary grounding as required by the local regulations.
7. Ask the person in control of the electrical installation work for a permit to work.
**Additional instructions and notes**

**WARNING!**
Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

If you are not a qualified electrician, do not do installation or maintenance work.

- Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists.
- Make sure that the electrical power network, motor/generator, and environmental conditions agree with the drive data.
- Do not do insulation or voltage withstand tests on the drive.
- Remove the code labels attached to mechanical parts such as busbars, shrouds and sheet metal parts before installation. They may cause bad electrical connections, or, after peeling off and collecting dust in time, cause arcing or block the cooling air flow.

**Note:**
- The motor cable terminals of the drive are at a dangerous voltage when the input power is on, regardless of whether the motor is running or not.
- When the input power is on, the drive DC bus is at a dangerous voltage.
- External wiring can supply dangerous voltages to the relay outputs of the control units of the drive.
- The Safe torque off function does not remove the voltage from the main and auxiliary circuits. The function is not effective against deliberate sabotage or misuse.

**Optical components**

**WARNING!**
Obey these instructions. If you ignore them, damage to the equipment can occur.

- Handle the fiber optic cables with care.
- When you unplug the fiber optic cables, always hold the connector, not the cable itself.
- Do not touch the ends of the fibers with bare hands as the ends are extremely sensitive to dirt.
- Do not bend the fiber optic cables too tightly. The minimum allowed bend radius is 35 mm (1.4”).

**Printed circuit boards**

**WARNING!**
Use a grounding wrist band when you handle printed circuit boards. Do not touch the boards unnecessarily. The boards contain components sensitive to electrostatic discharge.

**Grounding**
These instructions are for all personnel who are responsible for the grounding of the drive.

**WARNING!**
Obey these instructions. If you ignore them, injury or death, or equipment malfunction can occur, and electromagnetic interference can increase.
If you are not a qualified electrician, do not do grounding work.

- Always ground the drive, the motor and adjoining equipment. This is necessary for the personnel safety. Proper grounding also reduces electromagnetic emission and interference.
- Make sure that the conductivity of the protective earth (PE) conductors is sufficient. See the electrical planning instructions of the drive. Obey the local regulations.
- Connect the power cable shields to protective earth (PE) terminals of the drive to make sure of personnel safety.
- Make a 360° grounding of the power and control cable shields at the cable entries to suppress electromagnetic disturbances.
- In a multiple-drive installation, connect each drive separately to the protective earth (PE) busbar of the power supply.

**Note:**
- You can use power cable shields as grounding conductors only when their conductivity is sufficient.
- As the normal touch current of the drive is higher than 3.5 mA AC or 10 mA DC, you must use a fixed protective earth (PE) connection. The minimum size of the protective earth conductor must comply with the local safety regulations for high protective earth conductor current equipment. See standard IEC/EN 61800-5-1 (UL 61800-5-1) and the electrical planning instructions of the drive.

In addition:
- use a protective earth conductor with a cross-section of at least 10 mm² Cu or 16 mm² Al,
  or
- use a second protective earth conductor of the same cross-sectional area as the original protective earthing conductor,
  or
- use a device which automatically disconnects the supply if the protective earth conductor breaks.

If the protective earth conductor is separate (ie, it does not form part of the input power cable or the input power cable enclosure), the cross section must be at least:
- 2.5 mm² (14 AWG) when the conductor is mechanically protected, or
- 4 mm² (12 AWG) when the conductor is not mechanically protected.
General safety in operation

These instructions are for all personnel that operate the drive.

WARNING!
Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

- Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists.
- Give a stop command to the drive before you reset a fault. If you have an external source for the start command and the start is on, the drive will start immediately after the fault reset, unless you configure the drive for pulse start. See the firmware manual.
- Before you activate the automatic fault reset or automatic restart functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault or supply break. If these functions are activated, the installation must be clearly marked as defined in IEC/EN 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".

Note:
- The maximum drive power cycles is five times in ten minutes. Power cycling the drive too often can damage the charging circuit of the DC capacitors. If you need to start or stop the drive, use the control panel start and stop keys or commands through the I/O terminals of the drive.
- Depending on the wiring and parametrization of the drive, the stop key on the control panel may not stop the drive.
Additional instructions for permanent magnet motor drives

**Safety in installation, start-up, maintenance**

These are additional warnings concerning permanent magnet motor drives. The other safety instructions in this chapter are also valid.

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**WARNING!**

Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

If you are not a qualified electrician, do not do installation or maintenance work.

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- Do not do work on the drive when a rotating permanent magnet motor is connected to it. A rotating permanent magnet motor energizes the drive including its input and output power terminals.

Before installation, start-up and maintenance work on the drive:

- Stop the drive.
- Disconnect the motor from the drive with a safety switch or by other means.
- If you cannot disconnect the motor, make sure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, can rotate the motor directly or through any mechanical connection like felt, nip, rope, etc.
- Do the steps in section *Electrical safety precautions (page 16)*
- Measure that the installation is de-energized.
  - Use a multimeter with an impedance greater than 1 Mohm.
  - Make sure that the voltage between the drive output terminals (T1/U, T2/V, T3/W) and the grounding (PE) busbar is close to 0 V.
  - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is close to 0 V.
  - Make sure that the voltage between the drive DC busbars (+ and -) and the grounding (PE) busbar is close to 0 V.
- Install temporary grounding to the drive output terminals (U2, V2, W2). Connect the output terminals together as well as to the PE.

During the start up:

- Make sure that the motor cannot be run into overspeed, eg, driven by the load. Motor overspeed causes overvoltage that can damage or destroy the capacitors in the intermediate circuit of the drive.

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**Safety in operation**

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**WARNING!**

Make sure that the motor cannot be run into overspeed, e.g. driven by the load. Motor overspeed causes overvoltage that can damage or destroy the capacitors in the intermediate circuit of the drive.

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Introduction to the manual

Contents of this chapter
This chapter describes the intended audience and contents of the manual. It contains a flowchart of steps in examining the delivery, installing and commissioning the drive. The flowchart refers to chapters/sections in this manual and other manuals.

Applicability
This manual applies to ACQ580-34 drive modules intended for user-defined cabinet installations.

Target audience
This manual is intended for people who plan the installation, install, start up and service the drive, or create instructions for the end user of the drive concerning the installation and maintenance of the drive.

Read the manual before working on the drive. You are expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

The manual is written for readers worldwide. Both SI and imperial units are shown.

Purpose of the manual
This manual provides information needed for planning the installation, installing, and servicing the drive.
Related documents

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<tr>
<td>Drive hardware manuals and guides</td>
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<tr>
<td>Drive/converter/inverter safety instructions</td>
<td>Multilingual code: 3AXD50000037978</td>
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<tr>
<td>Drive modules cabinet design and construction instructions</td>
<td>3AUA0000107668</td>
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<td>Single drive cabinets and modules electrical planning instructions</td>
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<td>ACQ580-34 drive modules (250 to 500 kW) hardware manual</td>
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<td>ACx-AP-x Assistant control panels user’s manual</td>
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<td>FOCH du/dt filters hardware manual</td>
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<td>Manuals and quick guides for I/O extension modules, fieldbus adapters, etc.</td>
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<tr>
<td>Tool and maintenance manuals and guides</td>
<td></td>
</tr>
<tr>
<td>Drive composer start-up and maintenance PC tool user’s manual</td>
<td>3AUA0000094606</td>
</tr>
<tr>
<td>Converter module capacitor reforming instructions</td>
<td>3BFE64059629</td>
</tr>
</tbody>
</table>

Categorization by frame size and option code

The instructions, technical data and dimension drawings which concern only certain drive frame sizes are marked with the symbol of the frame size (R11). The frame size is marked on the type designation label.

The instructions and technical data which concern only certain optional selections are marked with option codes, eg, +E208. The options included in the drive can be identified from the option codes visible on the type designation label. The option selections are listed in section Type designation key (page 34).

Quick installation, commissioning and operating flowchart

<table>
<thead>
<tr>
<th>Task</th>
<th>See chapter/section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan the mechanical and electrical installation and acquire the accessories needed (cables, fuses, etc.).</td>
<td>Guidelines for planning the mechanical installation</td>
</tr>
<tr>
<td>Examine the ambient conditions, ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data.</td>
<td>Guidelines for planning the electrical installation</td>
</tr>
<tr>
<td>Technical data</td>
<td>Option manual (if optional equipment is included)</td>
</tr>
</tbody>
</table>
Unpack and examine the units.
Make sure that all necessary optional modules and equipment are present and correct.
Only intact units can be started up.

Examine the delivery
Makes sure that all necessary optional modules and equipment are present and correct.
If the drive module has been non-operational for a year or more, the converter DC link capacitors need to be reformed. (Reforming the capacitors)

Examining the installation site
Examinetheinstallationsite.
Fasten the base of the cabinet to the floor.

Ambient conditions
Routing the cables

Measuring the insulation of the assembly

Installing the drive module and LCL filter module into a cabinet
Standard drive modules
• Install the additional components into the cabinet: for example, main disconnector, main contactor, main AC fuses, etc.
• Install the drive module into the cabinet.
• Connect the motor cables to the drive module terminals.
• Connect the brake resistor and DC connection cables (if any) to the drive module terminals.
• If the main disconnector is installed into the cabinet, connect it to the drive module terminals and the input power cabling to the disconnector.

Drive modules with IP20 shrouds (option +B051)

Connecting the power cables and installing the shrouds (option +B051)
Connecting the control cables and installing option modules
Manuals for any optional equipment

Connecting the control cables

Installation checklist

Start-up

Operate the drive: start, stop, speed control etc.

Appropriate firmware manual

Terms and abbreviations

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCU-24</td>
<td>Type of control unit</td>
</tr>
<tr>
<td>CHDI-01</td>
<td>115/230 V digital input extension module</td>
</tr>
<tr>
<td>CMOD-01</td>
<td>Multifunction extension module (external 24 V AC/DC and digital I/O extension)</td>
</tr>
<tr>
<td>CMOD-02</td>
<td>Multifunction extension module (external 24 V AC/DC and isolated PTC interface)</td>
</tr>
<tr>
<td>Drive</td>
<td>Frequency converter for controlling AC motors</td>
</tr>
<tr>
<td>EMC</td>
<td>Electromagnetic compatibility</td>
</tr>
<tr>
<td>EMI</td>
<td>Electromagnetic interference</td>
</tr>
<tr>
<td>FBIP-21</td>
<td>BACnet/IP adapter module</td>
</tr>
</tbody>
</table>
## Introduction to the manual

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCAN</td>
<td>Optional CANopen® adapter module</td>
</tr>
<tr>
<td>FCNA-01</td>
<td>Optional ControlNet™ adapter module</td>
</tr>
<tr>
<td>FDNA-01</td>
<td>Optional DeviceNet™ adapter module</td>
</tr>
<tr>
<td>FECA</td>
<td>Optional EtherCAT adapter module</td>
</tr>
<tr>
<td>FENA-01</td>
<td>Optional Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols</td>
</tr>
<tr>
<td>FEPL-02</td>
<td>Optional EtherNet POWERLINK adapter module</td>
</tr>
<tr>
<td>FMBT-21</td>
<td>Optional Ethernet adapter module for Modbus TCP protocol</td>
</tr>
<tr>
<td>FPBA-01</td>
<td>Optional PROFIBUS DP® adapter module</td>
</tr>
<tr>
<td>FPNO-21</td>
<td>Optional Profinet IO adapter module</td>
</tr>
<tr>
<td>Frame, frame size</td>
<td>Physical size of the drive or power module</td>
</tr>
<tr>
<td>FSCA-01</td>
<td>Optional RS-485 (Modbus/RTU) adapter</td>
</tr>
<tr>
<td>IGBT</td>
<td>Insulated gate bipolar transistor</td>
</tr>
<tr>
<td>Inverter unit</td>
<td>Inverter module(s) under control of one control board, and related components. One inverter unit typically controls one motor.</td>
</tr>
<tr>
<td>NETA-21</td>
<td>Remote monitoring tool</td>
</tr>
<tr>
<td>PLC</td>
<td>Programmable logic controller</td>
</tr>
<tr>
<td>Power module</td>
<td>Common term for drive module, inverter module, supply module, brake chopper module etc.</td>
</tr>
<tr>
<td>RFI</td>
<td>Radio-frequency interference</td>
</tr>
<tr>
<td>STO</td>
<td>Safe torque off (IEC/EN 61800-5-2)</td>
</tr>
<tr>
<td>Supply unit</td>
<td>Supply module(s) under control of one control board, and related components.</td>
</tr>
</tbody>
</table>
Operation principle and hardware description

Contents of this chapter
This chapter describes the operating principle and construction of the drive module.

Operation principle
The ACQ580-34 is a low-harmonic drive module for controlling asynchronous AC induction motors, permanent magnet motors in open loop control and synchronous reluctance motors. The drive includes a line-side converter and a motor-side converter. The parameters and signals for both converters are combined into one primary user program.
# Operation principle and hardware description

## Block diagram of the main circuit of the drive module

![Block diagram of the main circuit of the drive module](image)

**A** ACQ580-34 drive module  
1 Charging circuit contactor  
2 Charging circuit  
3 Line contactor  
4 LCL filter  
5 Line-side converter  
6 DC link. DC circuit between the line-side converter and motor-side converter  
7 Motor-side converter  
8 Common mode filter (+E208)

## Line-side converter

The line-side converter rectifies three-phase AC current to direct current for the intermediate DC link of the drive.

The following figure shows the simplified main circuit diagram of the line-side converter. The line-side converter is controlled by a type ZCU control unit.
**AC voltage and current waveforms**

The AC current is sinusoidal at a unity power factor. The LCL filter suppresses the AC voltage distortion and current harmonics. The high AC inductance smooths the line voltage waveform distorted by the high-frequency switching of the converter. The capacitive component of the filter effectively filters the high-frequency (over 1 kHz) harmonics.

**Charging**

Charging is needed to power up the DC link capacitors smoothly. Discharged capacitors cannot be connected to the full supply voltage. The voltage must be increased gradually until the capacitors are charged and ready for normal use. The drive contains a resistive charging circuit consisting of fuses, contactor and charging resistors. The charging circuit is in use after start-up until the DC voltage has risen to a predefined level.

**Motor-side converter**

The motor-side converter converts the DC back to AC that rotates the motor. It is also able to feed the braking energy from a rotating motor back into the DC link. The motor-side converter is controlled by a type CCU-24 control unit. This is called the drive control unit or control unit in this manual.
## Layout

- **Standard drive module configuration**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Drive module. Contains line-side converter and motor side converter.</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>LCL filter module</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>LCL filter module connected to the drive module</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>Circuit board compartment</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>Upper front cover</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Control panel</td>
<td>9</td>
</tr>
</tbody>
</table>

See section *Drive module (page 30)* for descriptions and photos of the drive module. For LCL filter module, see section *LCL filter module (page 31).*
- **Drive with clear plastic shrouds (option +B051)**

For part descriptions, see section *Standard drive module configuration (page 28)*. For clear plastic shrouds, see section *Drive module (page 30)*
### Drive module

<table>
<thead>
<tr>
<th>Number</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clear plastic shroud to be attached onto the drive module input power cabling (1a). Entry shroud for side cabling (1b). Option +B051.</td>
</tr>
<tr>
<td>2</td>
<td>Clear plastic shrouds to be attached onto the drive module output power cabling (option +B051)</td>
</tr>
<tr>
<td>3</td>
<td>Clear plastic shroud to be attached on top of the drive module (entry for top cabling). Option +B051.</td>
</tr>
<tr>
<td>4</td>
<td>Upper back clear plastic shroud (option +B051)</td>
</tr>
<tr>
<td>5</td>
<td>Lower back clear plastic shroud (option +B051)</td>
</tr>
<tr>
<td>6</td>
<td>Front clear plastic shroud (option +B051)</td>
</tr>
<tr>
<td>7</td>
<td>Input power cable connection terminals (option +H370)</td>
</tr>
<tr>
<td>8</td>
<td>Telescopic extraction and insertion ramp</td>
</tr>
<tr>
<td>9</td>
<td>Control unit</td>
</tr>
<tr>
<td>10</td>
<td>Control cable clamp plate</td>
</tr>
<tr>
<td>11</td>
<td>Busbars for connecting the drive module to the LCL filter electrically</td>
</tr>
<tr>
<td>12</td>
<td>Cover for the busbar connection</td>
</tr>
<tr>
<td>13</td>
<td>Auxiliary cooling fan</td>
</tr>
</tbody>
</table>

#### Operation principle and hardware description

- **Clear plastic shroud** to be attached onto the drive module input power cabling (1a). Entry shroud for side cabling (1b). Option +B051.
- **Control unit**
- **Control cable clamp plate**
- **Busbars for connecting the drive module to the LCL filter electrically**
- **Cover for the busbar connection**
- **Auxiliary cooling fan**
- **Input power cable connection terminals** (option +H370)
- **Telescopic extraction and insertion ramp**
- **Handle**
LCL filter module

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Output power cable connection terminals (assembled at the factory)</td>
</tr>
<tr>
<td>9</td>
<td>Grounding terminal for output power cable shields</td>
</tr>
<tr>
<td>10</td>
<td>Metallic shroud. With option +H370, the shroud includes a ground bar.</td>
</tr>
<tr>
<td>11</td>
<td>Main cooling fans</td>
</tr>
<tr>
<td>12</td>
<td>Pedestal guide plate for the drive module</td>
</tr>
<tr>
<td>20</td>
<td>Cover. When removed, you can attach the drive module to the LCL filter module.</td>
</tr>
<tr>
<td>21</td>
<td>Lifting lugs</td>
</tr>
<tr>
<td>22</td>
<td>Connector for charging circuit switch or contactor</td>
</tr>
<tr>
<td>23</td>
<td>Input power cable connection busbars (L1/U1, L2/V1, L3/W1 and DC+ and DC- busbars (UDC+ and UDC-))</td>
</tr>
<tr>
<td>24</td>
<td>Common mode filter</td>
</tr>
</tbody>
</table>

- 1 Busbars for connecting the LCL filter module to the drive module electrically
- 2 Handle
- 3 Main cooling fans
- 4 Pedestal guide plate for the LCL filter module
- 5 Lifting lugs
Control panel

In the standard drive module configuration, the control panel is located on the front cover of the module.

DPMP-03 door mounting platform allows you to mount the control panel on the cabinet door.

For the use of the control panel, see the firmware manual or ACx-AP-x assistant control panels user’s manual (3AUA0000085685 [English]).

1  ACH-AP-H hand-off-auto control panel (standard)
2  CDUM-01 blank control panel cover (no control panel) (option +J424)
3  ACH-AP-W hand-off-auto control panel with bluetooth interface (option +J429)
4  DPMP-03 control panel mounting platform (standard)
Overview of power and control connections

The diagram shows the power connections and control interfaces of the drive module.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Line-side converter control unit</td>
</tr>
<tr>
<td>1</td>
<td>Option slot 1 for optional fieldbus adapter modules</td>
</tr>
<tr>
<td>2</td>
<td>Option slot 2 for optional I/O extension modules</td>
</tr>
<tr>
<td>3</td>
<td>Panel port</td>
</tr>
<tr>
<td>4</td>
<td>Line-side converter</td>
</tr>
<tr>
<td>5</td>
<td>DC link</td>
</tr>
<tr>
<td>6</td>
<td>Motor-side converter</td>
</tr>
<tr>
<td>7</td>
<td>Socket for external control panel (not required for normal operation of the drive)</td>
</tr>
</tbody>
</table>

Type designation label

The type designation label includes a rating, markings, a type designation and a serial number, which allow individual recognition of each drive module. The type designation label is located on the front cover. An example label is shown below.
34 Operation principle and hardware description

Type designation key

The type designation contains information on the specifications and configuration of the drive. The first digits from left express the basic drive type. The optional selections are given thereafter, separated by plus signs, for example +E202. Codes preceded by zero (for example +0J400) indicate the absence of the specified feature. The main selections are described below. Not all selections are available for all types. For more information, refer to the ordering instructions available separately on request.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACQ580</td>
<td>Product series</td>
</tr>
</tbody>
</table>

**Type**

-34 When no options are selected: low-harmonic single drive module to be installed in an enclosure, IP20 (UL open type), bookshelf mounting with pedestal, internal control unit with ACH-AP-H Assistant control panel with panel holder, build-in LCL filter, full-size output cable connection terminals, internal EMC filter (+E210), common mode filter (+E208), DC connection busbars, ACQ580 standard pump control program, RS-485 Modbus RTU adapter module, Safe torque off function, coated boards, printed multilingual quick installation and start-up guides.

**Size**

-xxxxA Refer to the rating tables

**Voltage range**

-4 380...480 V AC. This is indicated in the type designation label as typical input voltage level (3~ 400/480 V AC)

**Option codes (plus codes)**
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Degree of protection</strong></td>
<td></td>
</tr>
<tr>
<td>B051</td>
<td>IP20 shrouds for cabling area</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Filters</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Cabling</strong></td>
<td></td>
</tr>
<tr>
<td>H370</td>
<td>Full-size input terminals</td>
</tr>
<tr>
<td><strong>Control panel</strong></td>
<td></td>
</tr>
<tr>
<td>0J400</td>
<td>No control panel</td>
</tr>
<tr>
<td>J400</td>
<td>ACH-AP-H control panel (Included as standard)</td>
</tr>
<tr>
<td>J424</td>
<td>Blank control panel cover (no control panel)</td>
</tr>
<tr>
<td>J425</td>
<td>ACS-AP-I control panel</td>
</tr>
<tr>
<td>J429</td>
<td>ACH-AP-W control panel with Bluetooth interface</td>
</tr>
<tr>
<td><strong>Fieldbus adapters, diverse communication options</strong></td>
<td></td>
</tr>
<tr>
<td>K451</td>
<td>FDNA-01 DeviceNet™ adapter module</td>
</tr>
<tr>
<td>K454</td>
<td>FPBA-01 PROFIBUS DP adapter module</td>
</tr>
<tr>
<td>K457</td>
<td>FCAN-01 CANopen adapter module</td>
</tr>
<tr>
<td>K458</td>
<td>FSCA-01 RS-485 (Modbus/RTU) adapter module</td>
</tr>
<tr>
<td>K475</td>
<td>FENA-21 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET I/O protocols, 2-port</td>
</tr>
<tr>
<td>K490</td>
<td>FEIP-21 EtherNet/IP adapter module</td>
</tr>
<tr>
<td>K491</td>
<td>FMBT-21 Modbus/TCP adapter module</td>
</tr>
<tr>
<td>K492</td>
<td>FPNO-21 PROFINET IO adapter module</td>
</tr>
<tr>
<td><strong>I/O extensions and feedback interfaces</strong></td>
<td></td>
</tr>
<tr>
<td>L501</td>
<td>CMOD-01 External 24 V AC/DC and digital I/O extension (2×RO and 1×DO)</td>
</tr>
<tr>
<td>L512</td>
<td>CHDI-01 115/230 V digital input module (six digital inputs and two relay outputs)</td>
</tr>
<tr>
<td>L523</td>
<td>CMOD-02 External 24 V and isolated PTC interface</td>
</tr>
<tr>
<td>L537</td>
<td>CPTC-02 ATEX-certified thermistor protection module</td>
</tr>
<tr>
<td><strong>Control program</strong></td>
<td></td>
</tr>
<tr>
<td>N2000</td>
<td>Standard language package (default, includes EN, DE, ES, PT, FR, ZH, IT, FI, PL, RU, TR)</td>
</tr>
<tr>
<td>N2901</td>
<td>Europe language package (default for SE, CZ, HU, DA, DU, includes EN, DE, ES, PT, FR, SV, CZ, HU, DA, DU)</td>
</tr>
<tr>
<td>N2902</td>
<td>Asia language package (default for KR, TH, includes EN, DE, ES, PT, FR, ZH, KR, TH)</td>
</tr>
<tr>
<td><strong>Specialties</strong></td>
<td></td>
</tr>
<tr>
<td>P932</td>
<td>Extended warranty 60 months from delivery</td>
</tr>
<tr>
<td><strong>Safety functions</strong></td>
<td></td>
</tr>
<tr>
<td>Q971</td>
<td>ATEX-certified safe disconnection function</td>
</tr>
<tr>
<td><strong>Full set of printed manuals in the selected language</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> The delivery may include manuals in English if the requested language is not available.</td>
<td></td>
</tr>
<tr>
<td>R700</td>
<td>English</td>
</tr>
<tr>
<td>R701</td>
<td>German</td>
</tr>
<tr>
<td>R702</td>
<td>Italian</td>
</tr>
<tr>
<td>R705</td>
<td>Swedish</td>
</tr>
<tr>
<td>R707</td>
<td>French</td>
</tr>
</tbody>
</table>
### 36 Operation principle and hardware description

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>R708</td>
<td>Spanish</td>
</tr>
<tr>
<td>R709</td>
<td>Portuguese</td>
</tr>
<tr>
<td>R711</td>
<td>Russian</td>
</tr>
<tr>
<td>R714</td>
<td>Turkish</td>
</tr>
</tbody>
</table>
Guidelines for planning the mechanical installation

Contents of this chapter

This chapter guides in planning drive cabinets and installing the drive module into a user-defined cabinet. The chapter gives cabinet layout examples and free space requirements around the module for cooling. These guidelines are essential for the safe and trouble-free use of the drive system.

Limitation of liability

The installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations. Furthermore, if the recommendations given by ABB are not followed, the drive may experience problems that the warranty does not cover.

Generic cabinet planning instructions

See Drive modules cabinet design and construction instructions (3AUA0000107668 [English]).

Installation positions of the drive module

The drive module must be installed in an upright bookshelf in a cabinet.
Layout example, door closed

This diagram shows a cabinet layout example with the input power cable entry from top and the motor cable entry from bottom.

1. Air inlet for the drive module
2. An extra fan is not necessary if an extra air baffle is used on the cabinet roof (see the following layout examples)
3. Air outlet for the drive module and LCL filter module and other equipment on the cabinet roof. An exhaust fan if needed.
4. Drive control panel with DPMP-01 mounting platform (option +J410). The control panel is connected to the drive module control unit inside the cabinet.
5. Contactor control switch and emergency stop switch (connected to the contactor control circuit inside the cabinet)
6. Operating handle of the disconnector
7. Rubber grommets for degree of protection
8. Roof air flow viewed from top
9. Fan required for IP20, IP42 or IP54 air outlet kit, has to be ordered separately. See Cooling fans (page 108).

Note: The sizes of the air inlet and outlet gratings are critical for proper cooling of the drive module. For losses and cooling data requirements, see the technical data.
Layout example, door open (standard drive module configuration)

1. Supporting frame of the cabinet
2. Vertical (2a, 2b) and horizontal (2c, 2d) air baffles that separate the cool and hot areas (leak-proof lead-throughs). See section Preventing the recirculation of hot air.
2e. Optional air baffle that is needed when there is no fan on the lower part of the cabinet door. See section Preventing the recirculation of hot air.
3. Cabinet grounding busbar (PE)
4. Input power cable including the protective ground conductor (PE) of the drive
5. Disconnector and fuses
6. Contactor
7. Drive module
8. LCL filter module
9. Motor cable including the protective ground conductor of the drive module
10. Drive module control unit. **Note:** The upper door air inlet is critical for proper cooling of the control unit.
11. External control cables
12. Grounding screws
13. Alternative to grounding screws (12)
14. Airflow to the roof
15. Airflow through the drive module
16. Airflow through the LCL filter

**Note:** The power cable shields can also be grounded to the drive module grounding terminals.

**Note:** See also section Required free space.
Layout example, door open (option +B051)

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Supporting frame of the cabinet</td>
</tr>
<tr>
<td>2a</td>
<td>Vertical (2a) and horizontal (2b) air baffles that separate the cool and hot areas (leakproof entries). See section Preventing the recirculation of hot air.</td>
</tr>
<tr>
<td>2b</td>
<td>Optional air baffle that is needed when there is no fan on the lower part of the cabinet door. See section Preventing the recirculation of hot air.</td>
</tr>
<tr>
<td>3</td>
<td>Cabinet grounding busbar (PE)</td>
</tr>
<tr>
<td>4</td>
<td>Input power cable including the protective ground conductor (PE) of the drive</td>
</tr>
<tr>
<td>5</td>
<td>Disconnector and fuses</td>
</tr>
<tr>
<td>6</td>
<td>Contactor</td>
</tr>
<tr>
<td>7</td>
<td>Drive module</td>
</tr>
<tr>
<td>8</td>
<td>LCL filter module</td>
</tr>
<tr>
<td>9</td>
<td>Motor cable including the protective ground conductor of the drive</td>
</tr>
<tr>
<td>10</td>
<td>Drive module control unit.</td>
</tr>
<tr>
<td>11</td>
<td>External control cables</td>
</tr>
<tr>
<td>12</td>
<td>Grounding screws</td>
</tr>
<tr>
<td>13</td>
<td>Alternative to grounding screws (12)</td>
</tr>
<tr>
<td>14</td>
<td>Air flow to the roof</td>
</tr>
<tr>
<td>15</td>
<td>Air flow through the drive module</td>
</tr>
<tr>
<td>16</td>
<td>Air flow through the LCL filter</td>
</tr>
</tbody>
</table>
Cooling solutions

The drawing below shows typical cabinet cooling solutions. The air inlet is at the bottom of the cabinet, while the outlet is on the roof or on the upper part of the door. Use extra exhaust fans if the air outlet is on the cabinet door, see the technical data for the required cooling airflow.

---

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air inlet</td>
</tr>
<tr>
<td>2</td>
<td>Air outlet</td>
</tr>
</tbody>
</table>

Preventing the recirculation of hot air
42 Guidelines for planning the mechanical installation

- Bookshelf mounting (standard drive module configuration)

This diagram shows air baffle positions inside an example cabinet. For the descriptions, see the next page.
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air flow to the drive modules, max. 40 °C (104 °F)</td>
<td>4</td>
</tr>
<tr>
<td>2a</td>
<td>Vertical air baffle that separates the cool and hot areas in the cabinet</td>
<td>5</td>
</tr>
<tr>
<td>2b</td>
<td>Vertical air baffle</td>
<td>6</td>
</tr>
<tr>
<td>2c</td>
<td>Upper horizontal air baffle</td>
<td>7</td>
</tr>
<tr>
<td>2d</td>
<td>Lower horizontal air baffle</td>
<td>8</td>
</tr>
<tr>
<td>2e</td>
<td>Optional air baffle that is needed when there is no fan on the lower part of the cabinet door</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>Drive module</td>
<td></td>
</tr>
</tbody>
</table>
**Required free space**

Free space around the drive module is needed for ensuring that sufficient cooling air flows through the module and the module cools correctly.

- **Free space at the top of the drive module**

The required free space at the top of the drive module is shown below.

![Diagram showing free space at the top of the drive module]

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air inlet</td>
</tr>
<tr>
<td>2</td>
<td>Air outlet</td>
</tr>
</tbody>
</table>

- **Free space around the drive module**

20 mm (0.79 in) free space around the drive module is required from the cabinet back panel and front door. No free space for cooling is required on the left- and right-hand sides of the module.

The module can be installed in a cabinet with the following dimensions:

- width 800 mm (31.50 in)
- depth 600 mm (23.62 in)
- height 2000 mm (78.74 in).

**Planning the placement of the control panel**

Note the following alternatives when you plan the placement of the control panel:

The control panel can be mounted onto the cabinet door using a control panel mounting platform. For the installation instructions, refer to *DPMP-02/03 control panel mounting platform kit installation guide* (3AUA0000136205 [English]).

**ABB air inlet and outlet kits**

See chapter *Ordering information.*
Mechanical installation

Contents of this chapter
This chapter describes alternatives of the mechanical installation of the drive module. It refers to the installation example chapters which contain instructions that depend on the selected drive configuration.

Examining the installation site
The material below the drive must be non-flammable and strong enough to carry the weight of the drive.
See the technical data for the allowed ambient conditions and the required cooling air.

Moving and unpacking

WARNING!
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

Move the transport package by pallet truck to the installation site.
To unpack the package:
• Cut the straps.
• Lift the lid.
• Lift the sleeve.
• Unpack the top boxes (drive module package).
• Insert lifting hooks to the drive and LCL filter module lifting eyes and lift the modules to the installation place.
## Package drawings

### Drive module package

**Transport package contents**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Finger guard</td>
</tr>
<tr>
<td>2</td>
<td>Pedestal guide plate for the LCL filter module</td>
</tr>
<tr>
<td>3</td>
<td>Pedestal guide plate for the drive module</td>
</tr>
<tr>
<td>4</td>
<td>Accessories box</td>
</tr>
<tr>
<td></td>
<td>See below for the box contents.</td>
</tr>
<tr>
<td>5</td>
<td>Center of gravity symbol</td>
</tr>
<tr>
<td>6</td>
<td>Package for LCL filter fan</td>
</tr>
<tr>
<td>7</td>
<td>Package for LCL filter pedestal</td>
</tr>
<tr>
<td>8</td>
<td>Telescopic extraction and insertion ramp</td>
</tr>
<tr>
<td>9</td>
<td>Package for option +H370: Full-size input power cable connection terminals and PE busbar.</td>
</tr>
<tr>
<td>10</td>
<td>Plywood support</td>
</tr>
<tr>
<td>11</td>
<td>With standard drive module configuration: Clear plastic shrouds box and output cable connection terminals box.</td>
</tr>
<tr>
<td></td>
<td>With option +H370: Also Input cable connection terminals box.</td>
</tr>
<tr>
<td></td>
<td>See below for the box contents.</td>
</tr>
<tr>
<td>12</td>
<td>Lid for sleeve</td>
</tr>
<tr>
<td>13</td>
<td>Cardboard sleeve</td>
</tr>
</tbody>
</table>
14–16  Cardboard support  
17  Pallet  
18  Strap  
19  VCI film or bag  
20  Drive module with factory installed options and multilingual residual voltage warning sticker, fastening screws in a plastic bag, internal control unit, control panel and cable or control panel with door mounting kit (option +J410), delivery documents, printed multilingual installation and start-up quick guides. Other printed manuals with option +R700.

### Boxes

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Paper fill</td>
</tr>
<tr>
<td>2</td>
<td>Clear plastic shroud for output cabling</td>
</tr>
<tr>
<td>3</td>
<td>Cardboard box cover</td>
</tr>
<tr>
<td>4</td>
<td>Cardboard box bottom</td>
</tr>
<tr>
<td>5</td>
<td>Support</td>
</tr>
<tr>
<td>6</td>
<td>Bands</td>
</tr>
<tr>
<td>7</td>
<td>Back clear plastic shroud (lower)</td>
</tr>
<tr>
<td>8</td>
<td>Back clear plastic shroud (upper)</td>
</tr>
<tr>
<td>9</td>
<td>Front clear plastic shroud</td>
</tr>
<tr>
<td>10</td>
<td>Clear plastic shroud for input cabling</td>
</tr>
<tr>
<td>11</td>
<td>Top clear plastic shroud</td>
</tr>
<tr>
<td>12</td>
<td>Clear plastic shroud for input cable entry from side</td>
</tr>
<tr>
<td>13</td>
<td>Screws in a plastic bag</td>
</tr>
<tr>
<td>14</td>
<td>Metallic shroud without ground bar</td>
</tr>
</tbody>
</table>
Output connection terminals box with standard drive module configuration

1. Paper fill
2. Output cable connection terminal T3/W2
3. Output cable connection terminal T2/V2
4. Output cable connection terminal T1/U2
5. Grounding terminal
6. Cardboard box
7. Screws and insulators in a plastic bag

Option +H370: input cable connection terminals box

1. Metallic shroud with ground bar
2. Paper fill
3. Input cable connection terminal L3/W1
4. Input cable connection terminal L2/V1
5. Input cable connection terminal L1/U1
6. Cardboard box
7. Screws and insulators in a plastic bag
### Ramp box

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cardboard box</td>
</tr>
<tr>
<td>2</td>
<td>Combi screws (4 pcs)</td>
</tr>
<tr>
<td>3</td>
<td>Ramp extension (50 to 150 mm)</td>
</tr>
<tr>
<td>4</td>
<td>Ramp up to 50 mm</td>
</tr>
</tbody>
</table>

![Ramp box diagram](3AXD50000476145)

### Accessories box

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Screw package</td>
</tr>
<tr>
<td>2</td>
<td>Busbar for main contactor - LCL connection (3 pcs)</td>
</tr>
<tr>
<td>3</td>
<td>Busbar for IGBD - LCL connection (3 pcs)</td>
</tr>
<tr>
<td>4</td>
<td>Cardboard box</td>
</tr>
<tr>
<td>5</td>
<td>Installation bracket (2 pcs)</td>
</tr>
<tr>
<td>6</td>
<td>Feed through (2 pcs)</td>
</tr>
</tbody>
</table>

![Accessories box diagram](3AXD50000477104)
Examining the delivery

Make sure that all items listed in *Moving and unpacking (page 45)* are present.

Make sure that there are no signs of damage. Before attempting installation and operation, examine the information on the type designation label of the drive to verify that the unit is of the correct type.

**Lifting**

Lift the drive module only by the lifting lugs.
Attaching the drive module and LCL filter module to a mounting plate or wall

Attach the LCL filter module and the drive module to wall or a mounting plate at the fastening points shown below.

You can attach the modules to Rittal VX25 cabinet with the mounting brackets delivered with the drive, see chapter Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet (page 175).

Attaching the drive module to the LCL filter module

See chapter Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet (page 175).
Attaching the drive module and the LCL filter module to the cabinet base

See chapter Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet (page 175).

Grounding the drive module and the LCL filter module

Ground the drive module and the LCL filter module from the fastening points:

Installing the drive in Rittal VX25 cabinet

For an installation example on how to install the drive module into a Rittal VX25 cabinet, see Installation example in Rittal VX25 cabinet (page 83) and chapter Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet (page 175).

Optional input power cable connection terminals and ground busbar assembly (+H370)

Install the metallic shroud with ground bar as shown below.
Connect the input power cable connection terminals as shown in chapter *Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet* (page 175).
Guidelines for planning the electrical installation

Contents of this chapter
This chapter contains the instructions that you must obey when you select the motor, cables, protections, cable routing and way of operation for the drive system.

Generic electrical planning instructions
See Single drive cabinets and modules electrical planning instructions (3AXD5000051833 [English]).

Implementing thermal overload and short-circuit protection

- Protecting the drive and input power cable in short-circuits
Protect the drive (1) with fuses (a) and the input cable with fuses (b) or a circuit breaker with current restriction.

![Diagram](image_url)

Equip the fuses with blown fuse indicators (microswitches) for stopping the drive.

Size the fuses or the circuit breaker according to local regulations for the input cable protection. Select the fuses for the drive according to the instructions given in the technical
data. The fuses for the drive protection will restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive.

**Note:** If the fuses for the drive protection are placed at the distribution board and the input cable is dimensioned according to the nominal input current of the drive given in the technical data, the fuses protect also the input cable in short-circuit situations, restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive. No separate fuses for the input cable protection are needed.

- **Protecting the motor and motor cable in short-circuits**

  The drive protects the motor cable and motor in a short-circuit situation when the motor cable is sized according to the nominal current of the drive. No additional protection devices are needed.

- **Protecting the drive and the input power and motor cables against thermal overload**

  The drive protects itself and the motor cables against thermal overload when the cables are dimensioned according to the nominal current of the drive. No additional thermal protection devices are needed.

  **WARNING!**

  If the drive is connected to multiple motors, use a separate circuit breaker or fuses for protecting each motor cable and motor against overload. The drive overload protection is tuned for the total motor load. It may not trip due to an overload in one motor circuit only.

- **Protecting the motor against thermal overload**

  According to regulations, the motor must be protected against thermal overload and the current must be switched off when overload is detected. The drive includes a motor thermal protection function that protects the motor and switches off the current when necessary. Depending on a drive parameter value, the function either monitors a calculated temperature value (based on a motor thermal model) or an actual temperature indication given by motor temperature sensors.

  The motor thermal protection model supports thermal memory retention and speed sensitivity. The user can tune the thermal model further by feeding in additional motor and load data.

  The most common temperature sensors are:
  - motor sizes IEC180...225: thermal switch, for example Klixon
  - motor sizes IEC200...250 and larger: PTC or Pt100.

  See the firmware manual for more information on the motor thermal protection function.

- **Connecting drive modules to a common DC system**

  Do not connect the drive module to a common DC system

  **WARNING!**

  The UDC+ and UDC- terminals of the drive module must not be used for any other than optional external brake chopper connection. Drives connected to a common DC system will get damaged.
Example circuit diagram

See chapter Example circuit diagrams (page 133).
Electrical installation

Contents of this chapter
This chapter gives instructions on the wiring of the drive.

Safety

WARNING!
If you are not a qualified electrician, do not do installation or maintenance work. Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

Grounding the motor cable shield at the motor end
For minimum radio-frequency interference, ground the cable shield 360 degrees at the cable entry of the motor terminal box.
Measuring the insulation

Measuring the insulation of the drive system

**WARNING!**
Do not do any voltage withstand or insulation resistance tests on any part of the drive as testing can damage the drive. Every drive has been tested for insulation between the main circuit and the chassis at the factory. Also, there are voltage-limiting circuits inside the drive which cut down the testing voltage automatically.

Measuring the insulation of the input cable

Before you connect the input power cable to the drive, measure its insulation according to local regulations.

Measuring the insulation of the motor and motor cable

**WARNING!**
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

If you are not a qualified electrician, do not do installation or maintenance work.

1. Stop the drive and do the steps in section *Electrical safety precautions (page 16)* before you start the work.
2. Make sure that the motor cable is disconnected from the drive output terminals.
3. Measure the insulation resistance between the between each phase conductor and the protective earth conductor. Use a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must exceed 100 Mohm (reference value at 25 °C [77 °F]). For the insulation resistance of other motors, consult the manufacturer’s instructions.

**Note:** Moisture inside the motor casing reduces the insulation resistance. If moisture is suspected, dry the motor and repeat the measurement.

Compatibility with IT (ungrounded), corner-grounded delta, midpoint-grounded delta, and TT systems

EMC filter and ground-to-phase varistor

A drive with EMC filter and ground-to-phase varistor connected can be installed to a symmetrically grounded TN-S system. If you install the drive to another system, you may need to disconnect the varistor. See sections

- *When to disconnect EMC filter and ground-to-phase varistor: TN-S, IT, corner-grounded delta, and midpoint-grounded delta systems (page 61)*
### Guidelines for installing the drive to a TT system (page 62)

### Disconnecting EMC filter and ground-to-phase varistor (page 63)

**WARNING!**
Do not install the drive with the ground-to-phase varistor connected to a system that the varistor is not suitable for. If you do, the varistor circuit can be damaged.

- **Corner-grounded and midpoint-grounded delta systems**

  **WARNING!**
  Do not install the drive on a corner-grounded or midpoint-grounded delta system. Disconnecting the EMC filter and ground-to-phase varistor does not prevent damage to the drive.

- **When to disconnect EMC filter and ground-to-phase varistor: TN-S, IT, corner-grounded delta, and midpoint-grounded delta systems**

  Requirements for disconnecting EMC filter and varistor and additional requirements for different electrical power systems are given below.

<table>
<thead>
<tr>
<th>Symmetrically grounded TN systems (TN-S systems)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="Diagram of TN-S system" /></td>
</tr>
<tr>
<td>Do not disconnect EMC AC and VAR wires.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Corner-grounded delta systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="Diagram of corner-grounded delta system" /></td>
</tr>
<tr>
<td>Do not install the drive on a corner-grounded system.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Midpoint-grounded delta systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="Diagram of midpoint-grounded delta system" /></td>
</tr>
</tbody>
</table>
Guidelines for installing the drive to a TT system

The drive can be connected on a TT system under these conditions:
1. Residual current device has been installed in the supply system.
2. This wire has been disconnected. Otherwise ground-to-phase varistor capacitor leakage current will cause the residual current device to trip.

<table>
<thead>
<tr>
<th>TT system</th>
<th>Ground-to-phase varistor wire</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="drive.png" alt="Diagram" /></td>
<td><img src="VAR.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Note:
- ABB does not guarantee the functioning of the ground leakage detector built inside the drive.
- Because the varistor wire has been disconnected, ABB does not guarantee the EMC category.
- In large systems the residual current device can trip without a real reason.
## Disconnecting EMC filter and ground-to-phase varistor

EMC AC and varistor (VAR) grounding wires are located at the top of the circuit board compartment. Disconnect them (1) and attach them with the nearby plastic clamp (2).

## Identifying the earthing system of the electrical power network

**WARNING!**
Only a qualified electrical professional may do the work instructed in this section. Depending on the installation site, the work may even be categorized as live working. Proceed only if you are an electrical professional certified for the work. Obey the local regulations. If you ignore them, injury or death can occur.

To identify the earthing system, find out the supply transformer connection. If that is not possible, measure these voltages at the distribution board, and use the table below to define the earthing system type.

1. input voltage line to line ($U_{L-L}$)
2. input voltage line 1 to ground ($U_{L1-G}$)
3. input voltage line 2 to ground ($U_{L2-G}$)
4. input voltage line 3 to ground ($U_{L3-G}$).

The table below shows the line-to-ground voltages in relation to the line-to-line voltage for each earthing system.

<table>
<thead>
<tr>
<th>$U_{L-L}$</th>
<th>$U_{L1-G}$</th>
<th>$U_{L2-G}$</th>
<th>$U_{L3-G}$</th>
<th>Electrical power system type</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X$</td>
<td>0.58 (X)</td>
<td>0.58 (X)</td>
<td>0.58 (X)</td>
<td>Symmetrically grounded TN system (TN-S system)</td>
</tr>
<tr>
<td>$X$</td>
<td>1.0 (X)</td>
<td>1.0 (X)</td>
<td>0</td>
<td>Corner-grounded delta system (nonsymmetrical)</td>
</tr>
<tr>
<td>$X$</td>
<td>0.866 (X)</td>
<td>0.5 (X)</td>
<td>0.5 (X)</td>
<td>Midpoint-grounded delta system (nonsymmetrical)</td>
</tr>
<tr>
<td>$X$</td>
<td>Varying level versus time</td>
<td>Varying level versus time</td>
<td>Varying level versus time</td>
<td>IT systems (ungrounded or high-resistance-grounded [&gt;30 ohms]) nonsymmetrical</td>
</tr>
<tr>
<td>$X$</td>
<td>Varying level versus time</td>
<td>Varying level versus time</td>
<td>Varying level versus time</td>
<td>TT system (the protective earth connection for the consumer is provided by a local earth electrode, and there is another independently installed at the generator)</td>
</tr>
</tbody>
</table>
Connecting the power cables

**WARNING!**
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

### Power cable connection diagram

![Power Cable Connection Diagram](image_url)
1. For alternatives, see *Single drive cabinets and modules electrical planning instructions* (3AXD50000518333 [English]). In the installing example of this chapter, the disconnecting device is not in the same cubic with the drive module.

2. If a shielded cable is used (not required but recommended) and the conductivity of the shield is < 50% of the conductivity of the phase conductor, use a separate PE cable (2a) or a cable with a grounding conductor (2b).

3. ABB recommends 360-degree grounding at the cabinet entry if a shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.

4. ABB recommends 360-degree grounding at the cabinet entry.

5. Use a separate grounding cable if the conductivity of the cable shield is < 50% of the conductivity of the phase conductor and there is no symmetrically constructed grounding conductor in the cable (see *Single drive cabinets and modules electrical planning instructions* (3AXD50000518333 [English]).

6. Common mode filter

7. $du/dt$ filter (option)

8. EMC filter

9. The drive module frame must be connected to the cabinet frame. See *Drive modules cabinet design and construction instructions* (3AUA0000107668 [English]) and section *Grounding the drive module and the LCL filter module* (page 52).

**Note:** If there is a symmetrically constructed grounding conductor in the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends. Do not use an asymmetrically constructed motor cable. Connecting its fourth conductor at the motor end increases bearing currents and causes extra wear.

### Preparing the cable ends for connection and making 360-degree grounding at the cable entry plate

1. Peel off 3...5 cm (1 1/4 ... 2 in) of the outer insulation of the cables at the cable entries with the conductive sleeves for the 360° high-frequency grounding.

![Preparation of cable ends](image)

2. Prepare the ends of the cables.
WARNING!
Apply grease to stripped aluminum conductors before attaching them to non-coated aluminum cable lugs. Obey the grease manufacturer’s instructions. Aluminum-aluminum contact can cause oxidation in the contact surfaces.

3. If fire insulation is used, make an opening in the mineral wool sheet according to the diameter of the cable.
4. Put the cables through the entry plate.
5. Remove rubber grommets from the entry plate for the cables to be connected. Cut adequate holes into the rubber grommets. Slide the grommets onto the cables. Slide the cables through the entry plate and attach the grommets to the holes.
6. Attach the conductive sleeves to the cable shields with cable ties. Tie up the unused conductive sleeves with cable ties. An example of bottom entry is shown below. For top entry, place the grommet upwards.
**Power cable connection procedure**

**WARNING!**
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

**WARNING!**
Apply grease to stripped aluminum conductors before attaching them to non-coated aluminum cable lugs. Obey the grease manufacturer’s instructions. Aluminum-aluminum contact can cause oxidation in the contact surfaces.

1. Run the motor cables from the motor to the cabinet. Ground the cable shields 360° at the entry plate.
2. Twist the cable shields of the motor cables into bundles and connect them and any separate ground conductors or cables to the ground terminal of the drive module or to the cabinet ground bar.
3. Connect the phase conductors of the motor cables to terminals T1/U2, T2/V2 and T3/W2 of the drive module. For the tightening torques, see the technical data.
4. Make sure that all power is disconnected and reconnection is not possible. Use proper safe disconnect procedures according to local codes.
5. Run the input cables from the supply source to the cabinet. Ground the cable shields 360° at the entry plate.
6. Twist the cable shields of the input cables into bundles and connect them and any separate ground conductors or cables to the drive module ground terminal or to the cabinet PE busbar.
7. Connect the phase conductors of the input cables to terminals L1/U1, L2/V1 and L3/W1 of the drive module. For the tightening torques, see the technical data.
Connecting the control cables to the internal control unit

See chapter Control unit (page 73) for the default I/O connections of the drive control program. The default I/O connections can be different with some hardware options, see the circuit diagrams delivered with the drive for the actual wiring.

1. Remove the middle front cover of the drive module.
2. Fasten the option modules if not fastened already.
3. Ground the outer control cable shields 360 degrees at the cabinet entry plate (recommendation).
4. Route the control cables along the control cable duct from bottom or top to the control unit.
5. Ground the shields of the control cables at the clamp plate. The shields should be continuous as close to the terminals of the control unit as possible. Only remove the outer jacket of the cable at the cable clamp so that the clamp presses on the bare shield. The shield (especially in case of multiple shields) can also be terminated with a lug and fastened with a screw at the clamp plate. Leave the other end of the shield unconnected or ground it indirectly via a few nanofarads high-frequency capacitor, eg, 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points. Tighten the screws to secure the connection.
6. Connect the conductors to the appropriate detachable terminals of the control unit. Use shrink tubing or insulating tape to contain any stray strands. Tighten the screws to secure the connection.

   **Note:** Keep any signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.

7. Install the middle front cover back.

Connecting external power supply wires to the control units

The external power supply is used to keep the drive control unit (CCU) and line-side converter control unit (ZCU) powered when the main power is off.

When external power supply is used, both control units should be connected to the external supply.
1. **To connect CCU to external power:** Connect external power supply cables to terminals 40 and 41 on the CCU control unit.
2. **To connect ZCU to external power:** Connect the provided wire harness from the “ISU ZCU XPOW” plug connector to CCU terminals 40 and 41, or directly to an external power supply.

RED wire = (+) and BLACK wire = (-)
Installing option modules

**WARNING!**
Obey the instructions in chapter. If you ignore them, injury or death, or damage to the equipment can occur.

1. Stop the drive and do the steps in section *Electrical safety precautions (page 16)* before you start the work.
Option slot 2 (I/O extension modules)

1. Put the module carefully into its position on the control unit.
2. Tighten the mounting screw.
3. Tighten the grounding screw (CHASSIS) to 0.8 N·m. The screw grounds the module. It is necessary for fulfilling the EMC requirements and for correct operation of the module.
- **Option slot 1 (fieldbus adapter modules)**
  1. Put the module carefully into its position on the control unit.
  2. Tighten the mounting screw (CHASSIS) to 0.8 N·m. The screw tightens the connections and grounds the module. It is necessary for fulfilling the EMC requirements and for correct operation of the module.

- **Wiring the optional modules**
  See the appropriate option module manual or for I/O options chapter *Optional I/O extension modules* for specific installation and wiring instructions.

- **Connecting an external control panel**
  With door mounting kit (option +J410), connect the control panel to the control unit as follows:
  1. Connect an Ethernet cable to the RJ-45 connector of the control panel.
  2. Connect the other end of the cable to the X13 connector of the control unit.
Connecting a remote panel, or chaining one panel to several drives

You can connect a remote ACH-AP-H control panel to the drive, or to chain the control panel or a PC to several drives on a panel bus with a CDPI-01 communication adapter module. See CDPI-01 communication adapter module user's manual (3AXD50000009929 [English]).

Connecting a PC

A PC (with eg, the Drive composer PC tool) can be connected as follows:

1. Connect an ACx-AP-x control panel to the unit either
   • by inserting the control panel into the panel holder or platform, or
   • by using an Ethernet (eg, Cat 5e) networking cable.
2. Remove the USB connector cover on the front of the control panel.
3. Connect an USB cable (Type A to Type Mini-B) between the USB connector on the control panel (3a) and a free USB port on the PC (3b).
4. The panel will display an indication whenever the connection is active.
5. See the documentation of the PC tool for setup instructions.
Control unit

Contents of this chapter
This chapter contains the default I/O connection diagram, descriptions of the terminals and technical data for the drive control unit (CCU-24).

Layout
The layout of the external control connection terminals on the drive module control unit is shown below.
## SLOT 1

**Option slot 1 (fieldbus adapter modules)**

### ANALOG IN/OUT

| 1...3  | Analog input 1 |
| 4...6  | Analog input 2 |
| 7...9  | Analog outputs |
| 10...12| Auxiliary voltage output, digital input common |

### DIGITAL IN

| 13...18 | Digital inputs |

### STO

| 34...38 | Safe torque off connection. |
| AIR IN TEMP | Internal air temperature NTC sensor connection |
| FAN2 | Internal fan 2 connection |
| FAN1 | Internal fan 1 connection |
| X12 | Panel port (control panel connection, wired at the factory to the control panel) |
| X15 | Reserved to internal use. |

### EFB

- EIA/RS-485 fieldbus connector
- Bias resistor switch BIAS S101
- End termination switch TERM S100
- Connection terminals 29...31

## SLOT 2

**Option slot 2 (I/O extension modules)**

| 40, 41 | 24 V AC/DC external power input |
| RO1 ... RO3 |
| 19...21 | Relay output 1 (RO1) |
| 22...24 | Relay output 2 (RO2) |
| 25...27 | Relay output 3 (RO3) |
Default I/O connection diagram

The default control connections for the Water default are shown below.

**X1**
- **1** SCR: Signal cable shield (screen)
- **2** AI1: Output frequency/speed reference: 0…10 V
- **3** AGND: Analog input circuit common
- **4** +10V: Reference voltage 10 V DC
- **5** AI2: Actual feedback: 0…10 V
- **6** AGND: Analog input circuit common
- **7** AO1: Output frequency: 0…10 V
- **8** AO2: Output current: 0…20 mA
- **9** AGND: Analog output circuit common

**X2 & X3**
- **10** +24V: Aux. voltage output +24 V DC, max. 250 mA
- **11** DGND: Aux. voltage output common
- **12** DCOM: Digital input common for all
- **13** DI1: Stop (0) / Start (1)
- **14** DI2: Not configured
- **15** DI3: Constant frequency/speed selection
- **16** DI4: Not configured
- **17** DI5: Not configured
- **18** DI6: Not configured

**X6, X7, X8**
- **19** RO1C: Ready run
- **20** RO1A: 250 V AC / 30 V DC
- **21** RO1B: 2 A
- **22** RO2C: Running
- **23** RO2A: 250 V AC / 30 V DC
- **24** RO2B: 2 A
- **25** RO3C: Fault (-1)
- **26** RO3A: 250 V AC / 30 V DC
- **27** RO3B: 2 A

**X4**
- **29** B+: Embedded fieldbus, EFB (EIA-485)
- **30** A-: Embedded fieldbus
- **31** DGND: Digital input common
- **34** OUT1: Safe torque off. Factory connection. Both circuits must be closed for the drive to start. See chapter Safe torque off function
- **35** OUT2: 24 V AC/DC+ in
- **36** SGND: 24 V AC/DC- in
- **37** IN1: Ext. 24 V AC/DC input to power up the control unit when the main supply is disconnected.
- **38** IN2: 24 V AC/DC

Total load capacity of the Auxiliary voltage output +24V (X2:10) is 6.0 W (250 mA / 24 V DC).
Terminal sizes: 0.14…2.5 mm² (all terminals)
Tightening torques: 0.5…0.6 N·m (0.4 lbf·ft)

**Notes:**
1. Current [0(4)…20 mA, \( R_{in} = 100 \) ohm] or voltage [0(2)…10 V, \( R_{in} > 200 \) kohm]. Change of setting requires changing the corresponding parameter.
2. Total load capacity of the Auxiliary voltage output +24V (X2:10) is 6.0 W (250 mA / 24 V) minus the power taken by the option modules installed on the board.
3. In scalar control: See Menu - Primary settings - Drive - Constant frequencies or parameter group 28 Frequency reference chain.
   In vector control: See Menu - Primary setting - Drive - Constant speeds or parameter group 22 Speed reference selection.
4. Connected with jumpers at the factory.
5. Use shielded twisted-pair cables for digital signals.
6. Ground the outer shield of the cables 360 degrees at the cabinet entry.
7. **WARNING!** Connect external AC power supply (24 V AC) to control unit connectors 40 and 41. If you connect it to connector AGND, DGND or SGND, the power supply or the control unit can get damaged.

### Switches

<table>
<thead>
<tr>
<th>Switch</th>
<th>Description</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>TERM S4</td>
<td>EFB link termination. Must be set to the terminated (ON) position when the drive (or another device) is the first or last unit on the link.</td>
<td>Bus not terminated <em>(default)</em></td>
</tr>
<tr>
<td>BIAS S5</td>
<td>Switches on the biasing voltages to the bus. One (and only one) device, preferably at the end of the bus, must have the bias on.</td>
<td>Bias off <em>(default)</em></td>
</tr>
</tbody>
</table>

### Additional information on I/O connections

#### PNP configuration for digital inputs (X2 & X3)

Internal and external +24 V power supply connections for PNP configuration are shown in the figure below.
WARNING!
Do not connect the +24 V AC cable to the control board ground when the control board is powered using an external 24 V AC supply.

### NPN configuration for digital inputs (X2 & X3)

Internal and external +24 V power supply connections for NPN configuration are shown in the figure below.

![NPN connection diagram](image)

Note: DI6 is not supported in the NPN configuration.

WARNING!
Do not connect the +24 V AC cable to the control board ground when the control board is powered using an external 24 V AC supply.

### Connection for obtaining 0…10 V from analog output 2 (AO2)

To obtain 0…10 V from analog output AO2, connect a 500 ohm resistor (or two 1 kohm resistors in parallel) between analog output AO2 and analog common ground AGND. Examples are shown in the figure below.

![Connection diagram](image)
Connection examples of two-wire and three-wire sensors to analog input (AI2)

Note: The maximum capability of the auxiliary voltage output (24 V DC [250 mA]) must not be exceeded.

An example of a two-wire sensor/transmitter supplied by the drive auxiliary voltage output is shown below. Set the input signal to 4…20 mA, not 0…20 mA.

![Diagram of two-wire sensor/transmitter](image)

An example of a three-wire sensor/transmitter supplied by the drive auxiliary voltage output is shown below. The sensor is supplied through its current output and the drive feeds the supply voltage (+24 V DC). Thus the output signal must be 4…20 mA, not 0…20 mA.

![Diagram of three-wire sensor/transmitter](image)

DI5 as frequency input

For setting the parameters for the digital frequency input, see the firmware manual.

DI6 as PTC input

If DI6 is used as a PTC input, see firmware manual for how to set parameters accordingly.

Note: If DI6 is used as a PTC input, the wiring and the PTC sensor need to be double isolated. Otherwise the CMOD-02 I/O extension module must be used.

AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)

One, two or three Pt100 sensors; one, two or three Pt1000 sensors; or one Ni1000, KTY83 or KTY84 sensor for motor temperature measurement can be connected between an analog
input and output as shown below. Leave the other end of the shield unconnected or ground it indirectly via a few nanofarads high-frequency capacitor, for example, 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points.

1. Set the input type to voltage for analog input AI1 or analog input AI2 with parameters. Set the appropriate analog input unit to V (volt) in parameter group 12 Standard AI.
2. Select the excitation mode in parameter group 13 Standard AO.

**WARNING!**
As the inputs pictured above are not insulated according to IEC 60664, the connection of the motor temperature sensor requires double or reinforced insulation between motor live parts and the sensor.
If the assembly does not fulfill this requirement, the I/O board terminals must be protected against contact and must not be connected to other equipment or the temperature sensor must be isolated from the I/O terminals.

**Safe torque off (X4)**
For the drive to start, both connections (+24 V DC to IN1 and +24 V DC to IN2) must be closed. By default, the terminal block has jumpers to close the circuit.
Remove the jumpers before connecting an external Safe torque off circuitry to the drive.
See also chapter The Safe torque off function (page 135).

**Note:** Only 24 V DC can be used for STO. Only PNP input configuration can be used.
## Technical data

<table>
<thead>
<tr>
<th><strong>External power supply</strong>&lt;br&gt;Term. 40, 41</th>
<th>Maximum power: 36 W, 1.50 A at 24 V AC/DC ±10% as standard&lt;br&gt;Terminal size: 0.14…2.5 mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>+24 V DC output</strong>&lt;br&gt;(Term. 10)</td>
<td>Total load capacity of this output is 6.0 W (250 mA / 24 V) minus the power taken by the option modules installed on board.&lt;br&gt;Terminal size: 0.14…2.5 mm²</td>
</tr>
<tr>
<td><strong>Digital inputs DI1…DI6</strong>&lt;br&gt;(Term. 13…18)</td>
<td>Input type: NPN/PNP&lt;br&gt;Terminal size: 0.14…2.5 mm²&lt;br&gt;D1…D4 (Term. 13…16)&lt;br&gt;12/24 V DC logic levels: &quot;0&quot; &lt; 4 V, &quot;1&quot; &gt; 8 V&lt;br&gt;$R_{in}$: 3 kohm&lt;br&gt;Hardware filtering: 0.04 ms, digital filtering: 2 ms sampling&lt;br&gt;D5 (Term. 17)&lt;br&gt;Can be used as a digital or frequency input.&lt;br&gt;12/24 V DC logic levels: &quot;0&quot; &lt; 4 V, &quot;1&quot; &gt; 8 V&lt;br&gt;$R_{in}$: 3 kohm&lt;br&gt;Max. frequency 16 kHz&lt;br&gt;Symmetrical signal (duty cycle D = 0.50)&lt;br&gt;D6 (Term. 18)&lt;br&gt;Can be used as a digital or PTC input.&lt;br&gt;12/24 V DC logic levels: &quot;0&quot; &lt; 3 V, &quot;1&quot; &gt; 8 V&lt;br&gt;$R_{in}$: 3 kohm&lt;br&gt;Max. frequency 16 kHz&lt;br&gt;Symmetrical signal (duty cycle D = 0.50)&lt;br&gt;Hardware filtering: 0.04 ms, digital filtering: 2 ms sampling&lt;br&gt;Note: DI6 is not supported in the NPN configuration. PTC mode – PTC thermistor can be connected between DI6 and +24 V DC: &lt; 1.5 kohm = '1' (low temperature), &gt; 4 kohm = '0' (high temperature), open circuit = '0' (high temperature). DI6 is not a reinforced/double insulated input. Connecting the motor PTC sensor to this input requires usage of a reinforced/double insulated PTC sensor inside the motor</td>
</tr>
<tr>
<td><strong>Relay outputs RO1…RO3</strong>&lt;br&gt;(Term. 19…27)</td>
<td>250 V AC / 30 V DC, 2 A&lt;br&gt;Terminal size: 0.14…2.5 mm²&lt;br&gt;See section Isolation areas (page 81).</td>
</tr>
<tr>
<td><strong>Analog inputs AI1 and AI2</strong>&lt;br&gt;(Term. 2 and 5)</td>
<td>Current/voltage input mode selected with a parameter, see Al1 and Al2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1) (page 78).&lt;br&gt;Current input: 0(4)…20 mA, $R_{in}$: 100 ohm&lt;br&gt;Voltage input: 0(2)…10 V, $R_{in}$: &gt; 200 kohm&lt;br&gt;Terminal size: 0.14…2.5 mm²&lt;br&gt;Inaccuracy: typical ±1%, max. ±1.5% of full scale&lt;br&gt;Inaccuracy for Pt100 sensors: 10 °C (50 °F)</td>
</tr>
<tr>
<td><strong>Analog outputs AO1 and AO2</strong>&lt;br&gt;(Term. 7 and 8)</td>
<td>Current/voltage output mode for AO1 selected with a parameter, see Connection for obtaining 0…10 V from analog output 2 (AO2) (page 77).&lt;br&gt;Current output: 0…20 mA, $R_{load}$: &lt; 500 ohm&lt;br&gt;Voltage input: 0…10 V, $R_{load}$: &gt; 100 kohm (AO1 only)&lt;br&gt;Terminal size: 0.14…2.5 mm²&lt;br&gt;Inaccuracy: ±1% of full scale (in voltage and current modes)</td>
</tr>
<tr>
<td><strong>Reference voltage output for analog inputs +10 V DC</strong>&lt;br&gt;(Term. 4)</td>
<td>Max. 20 mA output Inaccuracy: ±1%</td>
</tr>
</tbody>
</table>
### Safe torque off (STO) inputs IN1 and IN2 (Term. 37 and 38)

- 24 V DC logic levels: "0" < 5 V, "1" > 13 V
- \( R_c = 2.47 \) kohm
- Terminal size: 0.14…2.5 mm²

### Embedded fieldbus (X5)

- Connector pitch 5 mm, wire size 2.5 mm²
- Physical layer: EIA-485
- Cable type: Shielded twisted pair cable with twisted pair for data and a wire or pair for signal ground, nominal impedance 100…165 ohms, for example Belden 9842
- Transmission rate: 9.6…115.2 kbit/s
- Termination by switch

### Control panel - drive connection

- EIA-485, male RJ-45 connector, max. cable length 100 m (328 ft)

### Control panel - PC connection

- USB Type Mini-B, max. cable length 2 m (7 ft)

### Isolation areas

<table>
<thead>
<tr>
<th>1…3</th>
<th>4…6</th>
<th>7…8</th>
<th>10…12</th>
<th>13…15</th>
<th>16…18</th>
<th>34…38</th>
<th>40, 41</th>
<th>19…21</th>
<th>22…24</th>
<th>25…27</th>
</tr>
</thead>
<tbody>
<tr>
<td>A11</td>
<td>A12</td>
<td>AO</td>
<td>24 V</td>
<td>GND</td>
<td>DI</td>
<td>DI</td>
<td>STO</td>
<td>RO1</td>
<td>RO2</td>
<td>RO3</td>
</tr>
</tbody>
</table>

- **SLOT 1**
  - Fieldbus module

- **SLOT 2**
  - I/O extension module

- **Panel port**

- **Power unit connection**

- **EFB**
  - EIA/R5-485 connection

#### Reinforced insulation (IEC/EN 61800-5-1:2007)

#### Functional insulation (IEC/EN 61800-5-1:2007)

The terminals on the control board fulfill the Protective Extra Low Voltage (PELV) requirements (EN 50178): There is reinforced insulation between the user terminals which only accept ELV voltages and terminals that accept higher voltages (relay outputs).

**Note:** There is functional insulation also between the individual relay outputs.

**Note:** There is reinforced insulation on the power unit.
Ground isolation diagram

*) Jumper installed at factory
Installation example in Rittal VX25 cabinet

Contents of this chapter

In this chapter, the drive module is installed in a 800 mm wide Rittal VX25 cabinet in a bookshelf way of mounting. The module is placed in an upright position on the cabinet bottom with its front facing the cabinet door. Available alternative ABB parts are also given.

Limitation of liability

The installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations. Furthermore, if the recommendations given by ABB are not followed, the drive may experience problems that the warranty does not cover.

Safety

WARNING!
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.
Required parts

<table>
<thead>
<tr>
<th>Drive module standard parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Drive module</td>
</tr>
<tr>
<td>• Fastening brackets (2 pcs)</td>
</tr>
<tr>
<td>• Pedestal guide plates (2 pcs)</td>
</tr>
<tr>
<td>• Telescopic extraction and insertion ramp</td>
</tr>
<tr>
<td>• Fastening screws and insulators in a plastic bag</td>
</tr>
<tr>
<td>• External control unit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rittal parts / Alternative ABB parts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rittal part code</strong></td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>8806.000</td>
</tr>
<tr>
<td>7967.000</td>
</tr>
<tr>
<td>8100.743</td>
</tr>
<tr>
<td>Contact ABB for the suitable filter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternative ABB parts for Rittal parts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ABB air inlet kit 800 mm</strong></td>
</tr>
<tr>
<td>3AAU000117005 (IP20)</td>
</tr>
<tr>
<td>3AAU000117009 (IP42)</td>
</tr>
<tr>
<td><strong>ABB air outlet kit 800 mm</strong></td>
</tr>
<tr>
<td>3AAU000125203 (IP20)</td>
</tr>
<tr>
<td>3AAU000114968 (IP42)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Customer-made parts (not ABB or Rittal products)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air baffles</strong></td>
</tr>
<tr>
<td><strong>Bottom plate</strong></td>
</tr>
</tbody>
</table>

Required tools

- Set of screw drivers (Torx and Pozidriv)
- Set of metric magnetic-end hexagon sockets
- Torque wrench
- Step drill bit for drilling the holes in the clear plastic shroud for input power cables (option +B051)

Overall flowchart of the installation process

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
<th>For instructions, see</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Install the Rittal parts, drive bottom guide plate and loose drive options in the drive module cubicle.</td>
<td>Installing the drive module and LCL filter module into a cabinet.</td>
</tr>
<tr>
<td>2</td>
<td>Install the auxiliary components (such as mounting plates, air baffles, switches, busbars etc.).</td>
<td>The component manufacturer’s instructions Preventing the recirculation of hot air</td>
</tr>
</tbody>
</table>
For instructions, see TaskStep

Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet

Connecting the power cables and installing the shrouds

Connecting the power cables

### Installing the drive module and LCL filter module into a cabinet

See chapter *Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet (page 175)* and *ACQ580-34 quick installation guide (3AXD50000420025 [English]).*

- Attach the plinth to the floor.
- Attach the cabinet frame to the plinth.
- Make the bottom plate with 360-degree grounding entries for power cables.
- Attach the bottom plate to the cabinet.
- Attach the punched section to the back of the cabinet frame.
- Attach the mounting brackets to the punched section.
- Install the pedestal to the LCL filter module.
- Install the cooling fan to the LCL filter module.
- Attach the LCL filter module pedestal guide plate to the cabinet bottom plate.
- Attach the telescopic insertion ramp to the pedestal guide plate.
- To prevent the LCL filter module from falling, attach its lifting lugs with chains to the cabinet frame.
- Push the LCL filter module carefully into the cabinet along the telescopic insertion ramp. Work preferably with help from another person as shown below. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
<th>For instructions, see</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Attach the drive module and LCL filter module to the cabinet</td>
<td>Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connecting the power cables and installing the shrouds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connecting the power cables</td>
</tr>
<tr>
<td>4</td>
<td>Connect the power cables and clear plastic shrouds to the drive module. Connect the power supply cable to the LCL filter cooling fan.</td>
<td>Attaching the external control unit</td>
</tr>
<tr>
<td>5</td>
<td>Install the external control unit.</td>
<td>Connecting the control cables to the terminals of the control unit</td>
</tr>
<tr>
<td>6</td>
<td>Connect the control cables.</td>
<td>The component manufacturer’s instructions</td>
</tr>
<tr>
<td>7</td>
<td>Install the remaining parts, for example, cabinet doors, side plates, etc.</td>
<td></td>
</tr>
</tbody>
</table>
• Unfasten the insertion ramp and attach the LCL filter module to bottom plate.
• Attach the drive module pedestal guide plate to the cabinet bottom plate.
• Attach the telescopic insertion ramp to the pedestal guide plate.
• Remove the sheeting from the clear plastic shrouds (option +B051) of the drive module from both sides.
• Install the top metallic shroud to the drive module.
• Install the back shrouds to the drive module.
• To prevent the drive module from falling, attach its lifting lugs with chains to the cabinet frame.
• Push the drive module carefully into the cabinet along the telescopic insertion ramp. Work preferably with help from another person as shown above. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.
• Unfasten the insertion ramp and attach the drive module to the bottom plate.
• Attach the LCL filter module and drive module to the punched section.
• Attach LCL filter module to the side of drive module from top and bottom. Reinstall the cover.
• Connect the LCL filter busbars to the drive module busbars with the connecting busbars.
• Connect the LCL filter fan power supply cable to connector FAN3:LCL.
• Connect the power cables and install the shrouds (option +B051) as described in section Connecting the power cables and installing the shrouds (option +B051) (page 86).
• Connect the control cables as described in section Connecting the control cables to the internal control unit (page 68).
• Install the air baffles.

### Connecting the power cables and installing the shrouds (option +B051)

<table>
<thead>
<tr>
<th>Step</th>
<th>Tasks (motor cables)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Install the grounding terminal to the drive module base.</td>
</tr>
<tr>
<td>2</td>
<td>Run the motor cables to the cabinet. Ground the cable shields 360 degrees at the cabinet entry.</td>
</tr>
</tbody>
</table>
3 Connect the twisted shields of the motor cables to the grounding terminal.

4 Screw in and tighten the insulators to the drive module by hand. Install the T3/W2 connection terminal to the insulators.

   **WARNING!**
   Do not use longer screws or bigger tightening torque than given in the installation drawing. They can damage the insulator and cause dangerous voltage to be present at the module frame.

5 Connect the phase T3/W2 conductors to the T3/W2 terminal.

6 Install the T2/V2 connection terminal to the insulators. See the warning in step 4.

7 Connect the phase T2/V2 conductors to the T2/V2 connection terminal.

8 Install the T1/U2 connection terminal to the insulators. See the warning in step 4.

9 Connect the phase T1/U2 conductors to the T1/U2 terminal.

10 Remove the plastic sheeting from the output clear plastic shrouds (option +B051) from both sides.

11 Install the shrouds (option +B051) to the drive module.

12 Install the lower front cover to the drive module.

---

<table>
<thead>
<tr>
<th>Step</th>
<th>Tasks (input cables)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground the input cable shields (if present) 360 degrees at the cabinet entry.</td>
</tr>
<tr>
<td>2</td>
<td>Connect the twisted shields of the input cables and separate ground cable (if present) to the cabinet grounding busbar.</td>
</tr>
<tr>
<td>3</td>
<td>Step drill carefully sufficiently big holes to the entry clear plastic shroud for the cables to be connected. Align the holes in the vertical direction according to the alignment holes in the shroud. Smooth the hole edges. Remove the plastic sheeting from both sides of the shroud. Attach the cables firmly to the cabinet frame to prevent chafing against the hole edges.</td>
</tr>
<tr>
<td>4</td>
<td>Put the conductors of the input cables through the drilled holes in the clear plastic shroud.</td>
</tr>
<tr>
<td>5</td>
<td>For drive modules without option +H370: Connect the input cable conductors to the drive module L1/U1, L2/V1 and L3/W1 connection busbars, Go to step 12. Tasks with option +H370: Do steps 6 to 11.</td>
</tr>
<tr>
<td>6</td>
<td>Screw in and tighten the insulators to the drive module by hand. Install the L1/U1 connection terminal to the insulators.</td>
</tr>
</tbody>
</table>

   **WARNING!**
   Do not use longer screws or bigger tightening torque than given in the installation drawing. They can damage the insulator and cause dangerous voltage to be present at the module frame.

| 7    | Connect the L1/U1 conductors to the L1/U1 connection terminal. |
| 8    | Install the L2/V1 connection terminal to the insulators. See the warning in step 5. |
| 9    | Connect the L2/V1 conductors to the L2/V1 connection terminal. |
| 10   | Install the L3/W1 connection terminal to the insulators. See the warning in step 5. |
| 11   | Connect the L3/W1 conductors to the L3/W1 connection terminal. |
| 12   | Install the entry clear plastic shroud (option +B051). Install the front clear plastic shroud (option +B051) and upper front cover. |
| 13   | Install the side and top clear plastic shrouds (option +B051) to the drive module. |
Installing the roof and door (Rittal parts)

This drawing shows a layout tested by ABB.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Door</td>
</tr>
<tr>
<td>2</td>
<td>Install these gratings as close to each other as possible. Remove the filter mats.</td>
</tr>
</tbody>
</table>
Installation checklist of the drive

Contents of this chapter
This chapter contains a checklist of the mechanical and electrical installation of the drive.

Checklist
Examine the mechanical and electrical installation of the drive before start-up. Go through the checklist together with another person.

WARNING!
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.
If you are not a qualified electrician, do not do installation or maintenance work.

WARNING!
Stop the drive and do the steps in section Electrical safety precautions (page 16) before you start the work.

<table>
<thead>
<tr>
<th>Make sure that …</th>
<th>□</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ambient operating conditions meet the drive ambient conditions specification, and enclosure rating (IP code or UL enclosure type).</td>
<td>□</td>
</tr>
<tr>
<td>The supply voltage matches the nominal input voltage of the drive. See the type designation label.</td>
<td>□</td>
</tr>
<tr>
<td>The drive cabinet is attached to the floor, and if necessary due to vibration etc, also by its top to the wall or roof.</td>
<td>□</td>
</tr>
<tr>
<td>The cooling air flows freely in and out of the drive. Air recirculation inside the cabinet is not be possible (air baffle plates are on place, or there is another air guiding solution).</td>
<td>□</td>
</tr>
<tr>
<td>If the drive is connected to a network other than a symmetrically grounded TN-S system; You have done all the required modifications (for example, you may need to disconnect the EMC filter or ground-to-phase varistor). See the electrical installation instructions.</td>
<td>□</td>
</tr>
</tbody>
</table>
### Installation checklist of the drive

#### Make sure that …

<table>
<thead>
<tr>
<th>Item</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>The enclosures of the equipment in the cabinet have proper galvanic connection to the cabinet protective earth (ground) busbar; The connection surfaces at the fastening points are bare (unpainted) and the connections are tight, or separate grounding conductors have been installed.</td>
<td>☐</td>
</tr>
<tr>
<td>The main circuit connections inside the drive cabinet correspond to the circuit diagrams.</td>
<td>☐</td>
</tr>
<tr>
<td>The control unit has been connected. See the circuit diagrams.</td>
<td>☐</td>
</tr>
<tr>
<td>Appropriate AC fuses and main disconnecter are installed.</td>
<td>☐</td>
</tr>
<tr>
<td>There is an adequately sized protective earth (ground) conductor(s) between the drive and the switchboard, the conductor is connected to correct terminal, and the terminal is tightened to the correct torque.</td>
<td>☐</td>
</tr>
<tr>
<td>Proper grounding has also been measured according to the regulations.</td>
<td>☐</td>
</tr>
<tr>
<td>The input power cable is connected to the correct terminals, the phase order is correct, and the terminals are tightened to the correct torque.</td>
<td>☐</td>
</tr>
<tr>
<td>There is an adequately sized protective earth (ground) conductor between the motor and the drive, and the conductor is connected to the correct terminal, and the terminal is tightened to the correct torque.</td>
<td>☐</td>
</tr>
<tr>
<td>Proper grounding has also been measured according to the regulations.</td>
<td>☐</td>
</tr>
<tr>
<td>The motor cable is connected to the correct terminals, the phase order is correct, and the terminals are tightened to the correct torque.</td>
<td>☐</td>
</tr>
<tr>
<td>The motor cable is routed away from other cables.</td>
<td>☐</td>
</tr>
<tr>
<td>No power factor compensation capacitors are connected to the motor cable.</td>
<td>☐</td>
</tr>
<tr>
<td>Proper grounding has also been measured according to the regulations.</td>
<td>☐</td>
</tr>
<tr>
<td>The control cables are connected to the correct terminals, and the terminals are tightened to the correct torque.</td>
<td>☐</td>
</tr>
<tr>
<td><strong>If a drive bypass connection will be used:</strong> The direct-on-line contactor of the motor and the drive output contactor are either mechanically and/or electrically interlocked, ie, cannot be closed simultaneously. A thermal overload device must be used for protection when bypassing the drive. Refer to local codes and regulations.</td>
<td>☐</td>
</tr>
<tr>
<td>There are no tools, foreign objects or dust from drilling inside the drive.</td>
<td>☐</td>
</tr>
<tr>
<td>The area in front of the drive is clean: the drive cooling fan cannot draw any dust or dirt inside.</td>
<td>☐</td>
</tr>
<tr>
<td>Cover(s) of the motor connection box are in place. Cabinet shrouds are in place and doors are closed.</td>
<td>☐</td>
</tr>
<tr>
<td><strong>If the drive is stored for longer than one year:</strong> The electrolytic DC capacitors in the DC link of the drive are reformed. Refer to <em>Converter module capacitor reforming instructions</em> (3BFE64059629 [English]).</td>
<td>☐</td>
</tr>
<tr>
<td>The motor and the driven equipment are ready for power-up.</td>
<td>☐</td>
</tr>
</tbody>
</table>
Start-up

Contents of this chapter

This chapter describes the start-up procedure of the drive.

Start-up procedure

1. Only qualified electricians are allowed to start-up the drive.
2. Make sure that the installation of the drive module has been checked according to the checklist in chapter Installation checklist, and that the motor and driven equipment are ready for start.
3. Perform the start-up tasks instructed by the cabinet-installer of the drive module.
4. Switch the power on, setup the drive control program, and perform the first start of the drive and motor. See ACQ580 pump control program quick startup guide (3AXD50000048773 [English]) or ACQ580 pump control program firmware manual (3AXD50000035867 [English])
5. For drive modules in which the Safe torque off function is in use: Test and validate the operation of the Safe torque off function. See Acceptance test procedure (page 144).
Fault tracing

Contents of this chapter
This chapter describes the fault tracing possibilities of the drive.

LEDs

Drive LEDs
There is a green POWER and a red FAULT LED visible when the control panel is removed. If a control panel is attached to the drive, switch to remote control (otherwise a fault will be generated), and then remove the panel to be able to see the LEDs.
The table below describes the drive LED indications.

<table>
<thead>
<tr>
<th>LEDs off</th>
<th>LED lit and steady</th>
<th>LED blinking</th>
</tr>
</thead>
<tbody>
<tr>
<td>No power</td>
<td>Green (POWER)</td>
<td>Blinking:</td>
</tr>
<tr>
<td></td>
<td>Power supply of the unit is on</td>
<td>Drive in an alarm state</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blinking for one second:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drive selected on the control panel when multiple drives are connected to the same panel bus.</td>
</tr>
<tr>
<td>Red (FAULT)</td>
<td>Active fault in the drive. To reset the fault, press RESET from the control panel or switch off the drive power.</td>
<td>Red (FAULT)</td>
</tr>
</tbody>
</table>

Control panel LEDs

The assistant control panel has one LED. For the meaning of the LED indications, see ACx-AP-x assistant control panels user's manual (3AUA0000085685 [English]).

Warning and fault messages

See the firmware manual for the descriptions, causes and remedies of the control program warning and fault messages.
Maintenance

Contents of this chapter
This chapter contains maintenance instructions of the drive modules.

Maintenance intervals
The table below shows the maintenance tasks which can be done by the end user. The complete maintenance schedule is available on the Internet (www.abb.com/drivesservices). For more information, consult your local ABB Service representative (www.abb.com/searchchannels).
## Maintenance

<table>
<thead>
<tr>
<th>Component</th>
<th>Years from start-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Cooling</td>
<td></td>
</tr>
<tr>
<td>Main cooling fan</td>
<td></td>
</tr>
<tr>
<td>LCL filter module cooling fan</td>
<td></td>
</tr>
<tr>
<td>Circuit board compartment cooling fan</td>
<td></td>
</tr>
<tr>
<td>Batteries</td>
<td></td>
</tr>
<tr>
<td>Control panel battery</td>
<td></td>
</tr>
<tr>
<td>LSU Control unit battery</td>
<td></td>
</tr>
<tr>
<td>Connections and environment</td>
<td></td>
</tr>
<tr>
<td>Quality of supply voltage</td>
<td>P</td>
</tr>
<tr>
<td>Spare parts</td>
<td>I</td>
</tr>
<tr>
<td>Reforming DC circuit capacitors (spare modules and spare capacitors)</td>
<td>P</td>
</tr>
<tr>
<td>Inspections by user</td>
<td>I</td>
</tr>
<tr>
<td>Tightness of terminals</td>
<td>I</td>
</tr>
<tr>
<td>Ambient conditions (dustiness, moisture, corrosion, temperature)</td>
<td>I</td>
</tr>
<tr>
<td>Cleaning of heatsink</td>
<td>I</td>
</tr>
</tbody>
</table>

### Symbols

- **I** Inspection (visual inspection and maintenance action if needed)
- **P** Performance of on/off-site work (commissioning, tests, measurements or other work)
- **R** Replacement

Maintenance and component replacement intervals are based on the assumption that the equipment is operated within the specified ratings and ambient conditions. ABB recommends annual drive inspections to ensure the highest reliability and optimum performance.

**Note:** Long term operation near the specified maximum ratings or ambient conditions may require shorter maintenance intervals for certain components. Consult your local ABB Service representative for additional maintenance recommendations.
Cleaning the interior of the cabinet

**WARNING!**
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

If you are not a qualified electrician, do not do installation or maintenance work.

**WARNING!**
Use a vacuum cleaner with antistatic hose and nozzle, and wear a grounding wristband. Using a normal vacuum cleaner creates static discharges which can damage circuit boards.

1. Stop the drive and do the steps in section Electrical safety precautions (page 16) before you start the work.
2. Open the cabinet door.
3. Clean the interior of the cabinet. Use a vacuum cleaner and a soft brush.
4. Clean the air inlets of the fans and air outlets of the modules (top).
5. Clean the air inlet gratings (if any) on the door.
6. Close the door.

Cleaning the interior of the heatsink

The module heatsink fins pick up dust from the cooling air. The drive runs into overtemperature warnings and faults if the heatsink is not clean.

**WARNING!**
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

**WARNING!**
Use a vacuum cleaner with antistatic hose and nozzle, and wear a grounding wristband. Using a normal vacuum cleaner creates static discharges which can damage circuit boards.

1. Stop the drive and do the steps in section Electrical safety precautions (page 16) before you start the work.
2. Make sure that the drive is disconnected from the power line and all other precautions described under Grounding (page 17) have been taken into consideration.
3. Undo the attaching screws of the handle plate of the drive module.
4. Remove the handle plate.
5. Vacuum the interior of the heatsink from the opening.
6. Blow clean compressed air (not humid or oily) upwards from the opening and, at the same time, vacuum from the top of the drive module.
   **Note:** If there is a risk of dust entering adjoining equipment, perform the cleaning in another room.
7. Reinstall the cover plate.
Cleaning the interior of the LCL filter

Clean the interior of the LCL filter in the same way as the heatsink in section *Cleaning the interior of the heatsink*.

Fans

The lifespan of the cooling fans of the drive depends on the running time, ambient temperature and dust concentration. See the firmware manual for the actual signal which indicates the running time of the cooling fan. Reset the running time signal after fan replacement.

Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

**Replacing the auxiliary cooling fans of the drive module**

**WARNING!**
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

**Fan in the front panel:**
1. Stop the drive and do the steps in section *Electrical safety precautions (page 16)* before you start the work.
2. Undo the mounting screw of the fan cassette.
3. Unplug the power supply cable of the fan.
4. Undo the mounting screws of the fan.
5. Install the new fan in reverse order. Make sure that the arrow in the fan points to the drive module.
6. Reset the counter (if used) in group 5 in the primary control program.
Fan at the bottom of the circuit board compartment:
1. Stop the drive and do the steps in section *Electrical safety precautions (page 16)* before you start the work.
2. Undo the mounting screw of the fan cassette.
3. Pull the fan cassette out:
4. Unplug the power supply cable of the fan.
5. Undo the mounting screws of the fan.
6. Install the new fan in reverse order. Make sure that the arrow in the fan points up.
7. Reset the counter (if used) in group 5 in the primary control program.

---

**Replacing the drive module main cooling fans**

**WARNING!**
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

1. Stop the drive and do the steps in section *Electrical safety precautions (page 16)* before you start the work.
2. Disconnect the power supply wires of the fans from the connector. FAN1:PWR1 and FAN2:PWR2.
3. Undo the mounting screws of the fan cassette.
4. Pull the fan cassette out.
5. Undo the mounting screws of the fan(s).
6. Install the new fans in reverse order.
7. Reset the counter (if used) in group 5 in the primary control program.

---

### Replacing the LCL filter module cooling fan

**WARNING!**
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

1. Stop the drive and do the steps in section *Electrical safety precautions (page 16)* before you start the work.
2. Disconnect the power supply wire of the fan from connector FAN3:LCL.
3. Undo the attaching screw of the fan cassette.
4. Pull the fan cassette out.
5. Undo the mounting screws of the fan. The finger guard of the fan is attached by the same screws and is removed at the same time. Keep the finger guard for reuse.
6. Install the new fan in reverse order. Make sure that the arrow in the fan points up.
Replacing the standard drive module

**WARNING!**
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

Handle the drive module carefully:
- Use safety shoes with a metal toe cap to prevent foot injury.
- Lift the drive module only by the lifting lugs.
- Make sure that the module does not topple over when you move it on the floor: Open the support legs by pressing each leg a little down (1, 2) and turning it aside. Whenever possible secure the module also with chains.
- Do not tilt the drive module (A). It is heavy and its center of gravity is high. The module overturns from a sideways tilt of 5 degrees. Do not leave the module unattended on a sloping floor.
1. Stop the drive and do the steps in section *Electrical safety precautions (page 16)* before you start the work.

2. Remove the clear plastic shrouds on the power cables and parts in front of the drive module (if present).

3. Disconnect the power cables.

4. Disconnect the external control cables connected to the control unit.

5. Disconnect the cooling fan power supply cable from the LCL filter module. Pull the cable inside the drive module.

6. Remove the screws that attach the drive module to the cabinet at the top and behind the front support legs.

7. Remove the screws that connect the drive module to the LCL filter module from top and at the side.

8. To prevent the drive module from falling, attach its top lifting lugs with chains to the cabinet frame.

9. To open the support legs 90 degrees, press each leg a little down and turn it aside.

10. Adjust the extraction ramp to the correct height and attach it to the cabinet base with the two mounting screws.
11. Pull the drive module carefully out of the cabinet preferably with help from another person.

12. Install the new module in reverse order.
Replacing the LCL filter module

Replace the LCL filter module in the same way as the drive module.

Capacitors

The DC circuit of the power modules of the drive contain several electrolytic capacitors. Their lifespan depends on the operating time of the drive, loading and ambient temperature. Capacitor life can be prolonged by lowering the ambient temperature.

Capacitor failure is usually followed by damage to the unit and an input cable fuse failure, or a fault trip. If you think that any capacitors in the drive have failed, contact ABB.

- Reforming the capacitors

The capacitors must be reformed if the drive has not been powered (either in storage or unused) for a year or more. The manufacturing date is on the type designation label. For information on reforming the capacitors, see Converter module capacitor reforming instructions (3BFE64059629 [English]) in the ABB Library (https://library.abb.com/en).

Control panel

For detailed information on the control panel, see ACx-AP-x assistant control panels user’s manual (3AUA0000085685 [English]).

- Cleaning the control panel

Use a soft damp cloth to clean the control panel. Avoid harsh cleaners which could scratch the display window.

- Replacing the control panel battery

For instructions on how to replace the control panel battery, see the separate ACx-AP-x assistant control panels user’s manual document (3AUA0000085685 [English]).
Ordering information

Contents of this chapter

This chapter gives ordering information on additional components available from ABB for the drive module installation.

Note: This chapter only lists the installation accessories available from ABB. All other parts must be sourced from a third party by the system integrator.

Output (du/dt) filters

See section du/dt filters.
# Cabinet ventilation

## Air inlet kits

Mounting screws are included.

<table>
<thead>
<tr>
<th>Enclosure width / Degree of protection</th>
<th>Kit code</th>
<th>Ordering code</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 mm / IP20</td>
<td>A-8-X-023</td>
<td>3AUA0000117005</td>
<td><img src="image1" alt="Illustration" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Instruction code: 3AUA0000116887</td>
<td></td>
</tr>
<tr>
<td>800 mm / IP42</td>
<td>A-8-X-026</td>
<td>3AUA0000117009</td>
<td><img src="image2" alt="Illustration" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Instruction code: 3AUA0000116875</td>
<td></td>
</tr>
<tr>
<td>800 mm / IP54</td>
<td>A-8-X-029</td>
<td>3AXD50000009186</td>
<td><img src="image3" alt="Illustration" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Instruction code: 3AXD5000010001</td>
<td></td>
</tr>
</tbody>
</table>
## Air outlet kits

<table>
<thead>
<tr>
<th>Enclosure width / Degree of protection</th>
<th>Qty</th>
<th>Kit code</th>
<th>Ordering code</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 mm / IP20</td>
<td>2</td>
<td>A-4-X-062</td>
<td>3AUA0000125201</td>
<td><img src="image1.png" alt="Illustration" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Instruction code: 3AXD50000001982</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Note:</strong> Fan to be ordered separately</td>
</tr>
<tr>
<td>800 mm / IP42</td>
<td>2</td>
<td>A-4-X-060</td>
<td>3AUA0000114967</td>
<td><img src="image2.png" alt="Illustration" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Instruction code: 3AUA0000115290</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Note:</strong> Fan to be ordered separately</td>
</tr>
<tr>
<td>800 mm / IP54 (IEC)</td>
<td>2</td>
<td>A-4-X-064</td>
<td>3AXD50000009187</td>
<td><img src="image3.png" alt="Illustration" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Instruction code: 3AXD50000010284</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Note:</strong> Fan to be ordered separately</td>
</tr>
</tbody>
</table>
Cooling fans

Two cooling fans must be installed inside the air outlet compartment to ensure sufficient cooling of the cabinet.

<table>
<thead>
<tr>
<th>Enclosure width / Degree of protection</th>
<th>Component</th>
<th>Name</th>
<th>Data</th>
<th>Qty</th>
<th>Ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 mm / IP20, IP42</td>
<td>Fan</td>
<td>R2E225-RA92-17 (230 V)</td>
<td>2</td>
<td>3AXD50000000514</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Capacitor</td>
<td>MSB MKP 3,5/603/E1679</td>
<td>2</td>
<td>3AXD50000000882</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connector</td>
<td>SPB2,5/7 (2.5 mm², 12AWG)</td>
<td>2</td>
<td>3AXD50000000723</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connector</td>
<td>SC 2,5-RZ/7 (2.5 mm², 12AWG)</td>
<td>2</td>
<td>3AXD50000000724</td>
<td></td>
</tr>
<tr>
<td>800 mm / IP54</td>
<td>Fan</td>
<td>RB4C-355/170</td>
<td>2</td>
<td>3AXD500000006934</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Capacitor</td>
<td>MSB MKP 6/603/E1679</td>
<td>2</td>
<td>3AXD50000006959</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connector</td>
<td>SPB2,5/7 (2.5 mm², 12AWG)</td>
<td>2</td>
<td>3AXD50000000723</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connector</td>
<td>SC 2,5-RZ/7 (2.5 mm², 12AWG)</td>
<td>2</td>
<td>3AXD50000000724</td>
<td></td>
</tr>
</tbody>
</table>

Retrofit accessory kits

<table>
<thead>
<tr>
<th>Kit</th>
<th>Option code</th>
<th>Ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common mode filter kit</td>
<td>+E208</td>
<td>3AXD50000026145</td>
</tr>
<tr>
<td>Full size cable connection terminals for input power cables</td>
<td>+H370</td>
<td>3AXD50000019542</td>
</tr>
</tbody>
</table>
Technical data

Contents of this chapter

This chapter contains the technical specifications of the drive, for example, the ratings, sizes and technical requirements, provisions for fulfilling the requirements for CE and other markings.

Ratings

The nominal rating for the drive modules with 50 Hz and 60 Hz supply are given below.

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Frame size</th>
<th>Input current</th>
<th>Output ratings</th>
<th>Light-duty use</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACQ580-34-</td>
<td></td>
<td></td>
<td>IEC RATINGS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R11</td>
<td>A</td>
<td>Nominal use</td>
<td>Light-duty use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I₁</td>
<td>I₂</td>
<td>Pₙ</td>
</tr>
<tr>
<td>Uₙ = 400 V</td>
<td></td>
<td>A</td>
<td>A</td>
<td>kW</td>
</tr>
<tr>
<td>246A-4</td>
<td>R11</td>
<td>212</td>
<td>350</td>
<td>246</td>
</tr>
<tr>
<td>293A-4</td>
<td>R11</td>
<td>257</td>
<td>418</td>
<td>293</td>
</tr>
<tr>
<td>365A-4</td>
<td>R11</td>
<td>321</td>
<td>498</td>
<td>365</td>
</tr>
<tr>
<td>442A-4</td>
<td>R11</td>
<td>401</td>
<td>621</td>
<td>442</td>
</tr>
<tr>
<td>505A-4</td>
<td>R11</td>
<td>401</td>
<td>631</td>
<td>505</td>
</tr>
<tr>
<td>585A-4</td>
<td>R11</td>
<td>505</td>
<td>751</td>
<td>585</td>
</tr>
<tr>
<td>650A-4</td>
<td>R11</td>
<td>569</td>
<td>859</td>
<td>650</td>
</tr>
</tbody>
</table>
### IEC RATINGS

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Frame size</th>
<th>Input current</th>
<th>Output ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACQ580-34- Light-duty use Max.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Max. current</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I₁</td>
<td>I_max</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>U_N = 480 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>246A-4</td>
<td>R11</td>
<td>209</td>
<td>350</td>
</tr>
<tr>
<td>293A-4</td>
<td>R11</td>
<td>233</td>
<td>418</td>
</tr>
<tr>
<td>365A-4</td>
<td>R11</td>
<td>307</td>
<td>498</td>
</tr>
<tr>
<td>442A-4</td>
<td>R11</td>
<td>363</td>
<td>621</td>
</tr>
<tr>
<td>505A-4</td>
<td>R11</td>
<td>363</td>
<td>631</td>
</tr>
<tr>
<td>585A-4</td>
<td>R11</td>
<td>389</td>
<td>751</td>
</tr>
<tr>
<td>650A-4</td>
<td>R11</td>
<td>441</td>
<td>859</td>
</tr>
</tbody>
</table>

### UL (NEC) RATINGS

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Frame size</th>
<th>Input current</th>
<th>Output ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACQ580-34- Light-duty use Max.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Max. current</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I₁</td>
<td>I_max</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>U_N = 480 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>240A-4</td>
<td>R11</td>
<td>209</td>
<td>306</td>
</tr>
<tr>
<td>302A-4</td>
<td>R11</td>
<td>258</td>
<td>408</td>
</tr>
<tr>
<td>361A-4</td>
<td>R11</td>
<td>307</td>
<td>513</td>
</tr>
<tr>
<td>414A-4</td>
<td>R11</td>
<td>363</td>
<td>614</td>
</tr>
<tr>
<td>477A-4</td>
<td>R11</td>
<td>414</td>
<td>704</td>
</tr>
</tbody>
</table>

- **U_N**: Nominal voltage of the drive
- **I₁**: Nominal input current (rms) at 40 °C (104 °F)
- **I_max**: Maximum output current. Available for 10 seconds at start, otherwise as long as allowed by drive temperature. 140% … 200% of I_Ld, depending on power rating.
- **I_Ld**: Continuous rms output current. No overload capability at 40 °C (104 °F). This is indicated in the type designation label as output current I₂.
- **P_N**: Typical motor power in no-overload use
- **P_Ld**: Continuous rms output current allowing 10% overload for 1 minute every 5 minutes when parameter 97.02 Minimum switching frequency is set to 2 kHz or less.
- **P_Ld**: Typical motor power for light-duty use
Note: To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current. The power ratings apply to most IEC 34 motors at the nominal voltage of the drive.

ABB recommends to select the drive, motor and gear combination for the required motion profile with the DriveSize dimensioning tool available from ABB.

- **When is derating needed**

  Derate the continuous output current of the drive if
  
  - drive is installed higher than 1000 m (3280 ft) above sea level
  - the minimum requirements of motor cable length are not met (see chapter du/dt filters and sine filters).

  Note: The final derating factor is a multiplication of all applicable derating factors.

- **Ambient temperature derating**

  In the temperature range +35...40 °C (+95...104 °F), the rated output current is not derated. For derating in temperatures above 40 °C (104 °F), contact ABB.

- **Altitude derating**

  At altitudes from 1000 to 4000 m (3300 to 13123 ft) above sea level, the derating is 1% for every 100 m (328 ft). If ambient temperature is below +40 °C (+104 °F), the derating can be reduced by 1.5% for every 1 °C reduction in temperature. For a more accurate derating, use the DriveSize PC tool. A few altitude derating curves are shown below.

<table>
<thead>
<tr>
<th>Altitude (m)</th>
<th>Derating Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>Derating factor 1.00</td>
</tr>
<tr>
<td>2000</td>
<td>Derating factor 0.95</td>
</tr>
<tr>
<td>2500</td>
<td>Derating factor 0.90</td>
</tr>
<tr>
<td>3000</td>
<td>Derating factor 0.85</td>
</tr>
<tr>
<td>4000</td>
<td>Derating factor 0.80</td>
</tr>
</tbody>
</table>
## Fuses (IEC)

aR fuses by Cooper Bussmann for protection against short-circuit in the input power cable of drive are listed below.

<table>
<thead>
<tr>
<th>Drive type ACQS80-34-</th>
<th>Input current (A)</th>
<th>Ultrarapid (aR) fuses</th>
<th>Fuse</th>
<th>Type DIN 43653</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>U</strong>&lt;sub&gt;N&lt;/sub&gt; = 400 V, IEC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>246A-4</td>
<td>212</td>
<td>400</td>
<td>74000</td>
<td>690</td>
<td>170M5408 2</td>
</tr>
<tr>
<td>293A-4</td>
<td>257</td>
<td>500</td>
<td>145000</td>
<td>690</td>
<td>170M5410 2</td>
</tr>
<tr>
<td>365A-4</td>
<td>321</td>
<td>630</td>
<td>210000</td>
<td>690</td>
<td>170M6410 3</td>
</tr>
<tr>
<td>442A-4</td>
<td>401</td>
<td>700</td>
<td>300000</td>
<td>690</td>
<td>170M6411 3</td>
</tr>
<tr>
<td>505A-4</td>
<td>401</td>
<td>800</td>
<td>465000</td>
<td>690</td>
<td>170M6412 3</td>
</tr>
<tr>
<td>585A-4</td>
<td>505</td>
<td>1000</td>
<td>945000</td>
<td>690</td>
<td>170M6414 3</td>
</tr>
<tr>
<td>650A-4</td>
<td>569</td>
<td>1000</td>
<td>945000</td>
<td>690</td>
<td>170M6414 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>U</strong>&lt;sub&gt;N&lt;/sub&gt; = 480 V, IEC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>246A-4</td>
<td>209</td>
<td>315</td>
<td>42000</td>
<td>690</td>
<td>170M4410 1</td>
</tr>
<tr>
<td>293A-4</td>
<td>233</td>
<td>400</td>
<td>74000</td>
<td>690</td>
<td>170M5408 2</td>
</tr>
<tr>
<td>365A-4</td>
<td>307</td>
<td>500</td>
<td>145000</td>
<td>690</td>
<td>170M5410 2</td>
</tr>
<tr>
<td>442A-4</td>
<td>363</td>
<td>630</td>
<td>210000</td>
<td>690</td>
<td>170M6410 3</td>
</tr>
<tr>
<td>505A-4</td>
<td>363</td>
<td>700</td>
<td>300000</td>
<td>690</td>
<td>170M6411 3</td>
</tr>
<tr>
<td>585A-4</td>
<td>389</td>
<td>700</td>
<td>300000</td>
<td>690</td>
<td>170M6411 3</td>
</tr>
<tr>
<td>650A-4</td>
<td>441</td>
<td>800</td>
<td>465000</td>
<td>690</td>
<td>170M6412 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>U</strong>&lt;sub&gt;N&lt;/sub&gt; = 480 V, UL (NEC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>240A-4</td>
<td>209</td>
<td>315</td>
<td>42000</td>
<td>690</td>
<td>170M4410 1</td>
</tr>
<tr>
<td>302A-4</td>
<td>258</td>
<td>400</td>
<td>74000</td>
<td>690</td>
<td>170M5408 2</td>
</tr>
<tr>
<td>361A-4</td>
<td>307</td>
<td>500</td>
<td>145000</td>
<td>690</td>
<td>170M5410 2</td>
</tr>
<tr>
<td>414A-4</td>
<td>363</td>
<td>630</td>
<td>210000</td>
<td>690</td>
<td>170M6410 3</td>
</tr>
<tr>
<td>477A-4</td>
<td>418</td>
<td>700</td>
<td>300000</td>
<td>690</td>
<td>170M6411 3</td>
</tr>
</tbody>
</table>

### Note:
- See also section Implementing thermal overload and short-circuit protection (page 55).
- In multicable installations, install only one fuse per phase (not one fuse per conductor).
- Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.
- Fuses from other manufacturers can be used if they agree with the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.
Fuses (UL recognized)

UL Recognized fuses for branch circuit protection per NEC are listed below. **Check that the operating time of the fuse is below 0.1 seconds.** The operating time depends on the fuse type, supply network impedance and the cross-sectional area, material and length of the supply cable. The fuses must be of the “non-time delay” type. Obey local regulations.

<table>
<thead>
<tr>
<th>Drive type ACQ580-34-</th>
<th>Input current (A)</th>
<th>Fuse</th>
<th>Type DIN 43653</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>V</td>
</tr>
<tr>
<td>$U_N = 400 V, IEC$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>246A-4</td>
<td>212</td>
<td>400</td>
<td>690</td>
</tr>
<tr>
<td>293A-4</td>
<td>257</td>
<td>500</td>
<td>690</td>
</tr>
<tr>
<td>363A-4</td>
<td>321</td>
<td>630</td>
<td>690</td>
</tr>
<tr>
<td>442A-4</td>
<td>401</td>
<td>700</td>
<td>690</td>
</tr>
<tr>
<td>505A-4</td>
<td>401</td>
<td>800</td>
<td>690</td>
</tr>
<tr>
<td>585A-4</td>
<td>505</td>
<td>1000</td>
<td>690</td>
</tr>
<tr>
<td>650A-4</td>
<td>569</td>
<td>1000</td>
<td>690</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drive type ACQ580-34-</th>
<th>Input current (A)</th>
<th>Fuse</th>
<th>Type DIN 43653</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$U_N = 480 V, IEC$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>246A-4</td>
<td>209</td>
<td>400</td>
<td>690</td>
</tr>
<tr>
<td>293A-4</td>
<td>233</td>
<td>500</td>
<td>690</td>
</tr>
<tr>
<td>365A-4</td>
<td>307</td>
<td>630</td>
<td>690</td>
</tr>
<tr>
<td>442A-4</td>
<td>363</td>
<td>700</td>
<td>690</td>
</tr>
<tr>
<td>505A-4</td>
<td>363</td>
<td>800</td>
<td>690</td>
</tr>
<tr>
<td>585A-4</td>
<td>389</td>
<td>1000</td>
<td>690</td>
</tr>
<tr>
<td>650A-4</td>
<td>441</td>
<td>1000</td>
<td>690</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drive type ACQ580-34-</th>
<th>Input current (A)</th>
<th>Fuse</th>
<th>Type DIN 43653</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$U_N = 480 V, UL (NEC)$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>240A-4</td>
<td>209</td>
<td>400</td>
<td>690</td>
</tr>
<tr>
<td>302A-4</td>
<td>258</td>
<td>500</td>
<td>690</td>
</tr>
<tr>
<td>361A-4</td>
<td>307</td>
<td>630</td>
<td>690</td>
</tr>
<tr>
<td>414A-4</td>
<td>363</td>
<td>700</td>
<td>690</td>
</tr>
<tr>
<td>477A-4</td>
<td>418</td>
<td>800</td>
<td>690</td>
</tr>
</tbody>
</table>

Note:
- See also *Implementing thermal overload and short-circuit protection (page 55).*
- In multicable installations, install only one fuse per phase (not one fuse per conductor).
- Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.
- Fuses from other manufacturers can be used if they agree with the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.
### Dimensions, weights and free space requirements

#### Standard drive module configuration (drive module + LCL filter module)

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Height</th>
<th>Width</th>
<th>Depth</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>kg</td>
</tr>
<tr>
<td>R11</td>
<td>1722</td>
<td>67.8</td>
<td>637</td>
<td>505</td>
</tr>
</tbody>
</table>

Weight of the drive module: 185 kg (409 lb)

Weight of the LCL filter module: 180 kg (396 lb)

#### Drive module + LCL filter module with options +B051 and +H370

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Height</th>
<th>Width</th>
<th>Depth</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>kg</td>
</tr>
<tr>
<td>R11</td>
<td>1741</td>
<td>68.5</td>
<td>685</td>
<td>505</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th>367</th>
<th>808</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>370</td>
<td>814</td>
</tr>
</tbody>
</table>

1) +B051

1) +B051 and +H370

For requirements of free space around the drive module, see Required free space (page 44).
Losses, cooling data and noise

The air flow direction is from bottom to top.

This table shows typical heat loss values, required air flow and noise at the nominal ratings of the drive. The heat loss values can vary depending on voltage, cable conditions, motor efficiency and power factor. To obtain more accurate values for given conditions, use ABB DriveSize tool (http://new.abb.com/drives/software-tools/drivesize).

<table>
<thead>
<tr>
<th>Drive type ACQ580-34-</th>
<th>Frame size</th>
<th>Air flow</th>
<th>Heat dissipation</th>
<th>Noise</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>m³/h</td>
<td>ft³/min</td>
<td>W</td>
</tr>
<tr>
<td>( U_N = 400 \text{ V, IEC} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>246A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>5280</td>
</tr>
<tr>
<td>293A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>6400</td>
</tr>
<tr>
<td>365A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>8000</td>
</tr>
<tr>
<td>442A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>10000</td>
</tr>
<tr>
<td>505A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>10000</td>
</tr>
<tr>
<td>585A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>12600</td>
</tr>
<tr>
<td>650A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>14200</td>
</tr>
<tr>
<td>( U_N = 480 \text{ V, IEC} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>246A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>5220</td>
</tr>
<tr>
<td>293A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>5220</td>
</tr>
<tr>
<td>365A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>7830</td>
</tr>
<tr>
<td>442A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>9135</td>
</tr>
<tr>
<td>505A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>9135</td>
</tr>
<tr>
<td>585A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>9135</td>
</tr>
<tr>
<td>650A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>10440</td>
</tr>
<tr>
<td>( U_N = 480 \text{ V, UL (NEC)} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>240A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>5280</td>
</tr>
<tr>
<td>302A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>6525</td>
</tr>
<tr>
<td>361A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>7830</td>
</tr>
<tr>
<td>414A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>9135</td>
</tr>
<tr>
<td>477A-4</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>10440</td>
</tr>
</tbody>
</table>

The cooling air temperature rises 30 degrees Celsius when it goes through the drive module if the temperature of the input cooling air is 40 degrees Celsius and the drive is operating with nominal load.
## Typical power cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for the drives with nominal current. The value separated by the plus sign means the diameter of the PE conductor. See also section Terminal and lead-through data for the power cables.

<table>
<thead>
<tr>
<th>Drive type</th>
<th>IEC 1)</th>
<th>US 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cu cable type</td>
<td>Al cable type</td>
</tr>
<tr>
<td></td>
<td>mm²</td>
<td>mm²</td>
</tr>
<tr>
<td>$U_N = 400 \text{ V, } 480 \text{ V (IEC)}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>246A-4</td>
<td>$2 \times (3 \times 70 + 35)$</td>
<td>$2 \times (3 \times 95)$</td>
</tr>
<tr>
<td>293A-4</td>
<td>$2 \times (3 \times 95 + 50)$</td>
<td>$2 \times (3 \times 150)$</td>
</tr>
<tr>
<td>365A-4</td>
<td>$2 \times (3 \times 120 + 70)$</td>
<td>$2 \times (3 \times 185)$</td>
</tr>
<tr>
<td>442A-4</td>
<td>$2 \times (3 \times 150 + 70)$</td>
<td>$2 \times (3 \times 240)$</td>
</tr>
<tr>
<td>505A-4</td>
<td>$3 \times (3 \times 95 + 50)$</td>
<td>$3 \times (3 \times 150)$</td>
</tr>
<tr>
<td>585A-4</td>
<td>$3 \times (3 \times 120 + 70)$</td>
<td>$3 \times (3 \times 185)$</td>
</tr>
<tr>
<td>650A-4</td>
<td>$3 \times (3 \times 150 + 70)$</td>
<td>$3 \times (3 \times 240)$</td>
</tr>
<tr>
<td>$U_N = 480 \text{ V, UL (NEC)}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>240A-4</td>
<td>$2 \times (3 \times 70 + 35)$</td>
<td>$2 \times (3 \times 95)$</td>
</tr>
<tr>
<td>302A-4</td>
<td>$2 \times (3 \times 95 + 50)$</td>
<td>$2 \times (3 \times 150)$</td>
</tr>
<tr>
<td>361A-4</td>
<td>$2 \times (3 \times 120 + 70)$</td>
<td>$2 \times (3 \times 185)$</td>
</tr>
<tr>
<td>414A-4</td>
<td>$2 \times (3 \times 150 + 70)$</td>
<td>$2 \times (3 \times 240)$</td>
</tr>
<tr>
<td>477A-4</td>
<td>$3 \times (3 \times 95 + 50)$</td>
<td>$3 \times (3 \times 150)$</td>
</tr>
</tbody>
</table>

1) The cable sizing is based on max. 9 cables laid on a cable ladder side by side, three ladder type trays one on top of the other, ambient temperature 30 °C (86 °F) PVC insulation, surface temperature 70 °C (158 °F) (EN 60204-1 and IEC 60364-5-52). For other conditions, dimension the cables according to local safety regulations, appropriate input voltage and the load current of the drive.

2) The cable sizing is based on NEC Table 310-16 for copper wires, 75 °C (167 °F) wire insulation at 40 °C (104 °F) ambient temperature. Not more than three current-carrying conductors in raceway or cable or earth (directly buried). For other conditions, dimension the cables according to local safety regulations, appropriate input voltage and the load current of the drive.

## Terminal and entry data for the power cables

The maximum accepted cable size is $4 \times (3 \times 240) \text{ mm}^2$ or $4 \times (3 \times 500 \text{ AWG})$. Screw size for connecting busbars to the drive module input and output busbars: M12, tightening torque 50...75 N·m.

## Terminal data for the control cables

See section Technical data (page 80).
## Electrical power network specification

<table>
<thead>
<tr>
<th>Voltage ($U_1$)</th>
<th>ACQ580-34-xxxx-4 drive modules; 380...480 V AC 3-phase +10%/-15%. This is indicated in the type designation label as typical input voltage levels 3~400/480 V AC.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network type</td>
<td>TN (grounded) and IT (ungrounded) systems</td>
</tr>
<tr>
<td>Short-circuit withstand strength (IEC 61439-1)</td>
<td>Maximum allowable prospective short-circuit current is 65 kA when protected by the fuses given in the fuse table. For the maximum allowable prospective short-circuit current with circuit breakers, see section Protecting the drive and input power cable in short-circuits (page 55).</td>
</tr>
<tr>
<td>Short-circuit current protection (UL 61800-5-1)</td>
<td>The drive is suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes at 600 V maximum when protected by the fuses given in the fuse table.</td>
</tr>
<tr>
<td>Short-circuit current protection (CSA C22.2 No. 14-05)</td>
<td>The drive is suitable for use on a circuit capable of delivering not more than 100 kA rms symmetrical amperes at 600 V maximum when protected by the fuses given in the fuse table.</td>
</tr>
<tr>
<td>Frequency ($f_1$)</td>
<td>50/60 Hz. Variation ±5% of nominal frequency.</td>
</tr>
<tr>
<td>Imbalance</td>
<td>Max. ±3% of nominal phase to phase input voltage</td>
</tr>
<tr>
<td>Fundamental power factor (cos $\phi_1$)</td>
<td>1.0 (at nominal load)</td>
</tr>
</tbody>
</table>
Harmonics are below the limits defined in IEEE 519-2014, and G5/4. The drive complies with IEC 61000-3-2, IEC 61000-3-4 and IEC 61000-3-12. The table below shows typical values of the drive for short-circuit ratio ($I_{sc}/I_1$) of 20 to 100. The values will be met if the supply network voltage is not distorted by other loads and when the drive operates at nominal load.

<table>
<thead>
<tr>
<th>Nominal bus voltage V at PCC</th>
<th>THDi (%)</th>
<th>THDv (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V \leq 690$ V</td>
<td>$3^*$</td>
<td>$&lt; 3^{**}$</td>
</tr>
</tbody>
</table>

THDv  Indicates the total magnitude of the voltage distortion. This value is defined as the ratio (in %) of the harmonic voltage to the fundamental (non-harmonic) voltage:

$$THDv = \frac{\sqrt{\sum_{n=2}^{40} U_n^2}}{U_1} \cdot 100\%$$

PCC  Point on a public power supply system, electrically nearest to a particular load, at which other loads are, or could be, connected. The PCC is a point located upstream of the considered installation.

$$THDi = \frac{\sqrt{\sum_{n=2}^{40} I_n^2}}{I_1} \cdot 100\%$$

$I_{sc}/I_1$  Short-circuit ratio

$I_{sc}$  Maximum short-circuit current at PCC

$I_1$  Continuous rms input current of the drive

$I_n$  Amplitude of the current harmonic n

$U_1$  Supply voltage

$U_n$  Amplitude of the voltage harmonic n

* The short-circuit ratio can influence the THDi value

** Other loads can influence the THDv value

Motor connection data

<table>
<thead>
<tr>
<th>Motor types</th>
<th>Asynchronous AC induction motors, permanent magnet motors and ABB synchronous reluctance motors (SynRM motors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage ($U_2$)</td>
<td>0 to $U_1$ nominal, can be boosted higher but requires derating. Contact ABB for more information.</td>
</tr>
<tr>
<td>Frequency ($f_2$)</td>
<td>0…500 Hz</td>
</tr>
<tr>
<td>Note: Operation above 150 Hz can require type-specific derating. For more information, contact your local ABB representative.</td>
<td></td>
</tr>
<tr>
<td>For drives with $du/dt$ filter: 0…120 Hz</td>
<td>For drives with sine filter: 0…120 Hz</td>
</tr>
<tr>
<td>Frequency resolution</td>
<td>0.01 Hz</td>
</tr>
<tr>
<td>Current</td>
<td>See section Ratings</td>
</tr>
</tbody>
</table>
Switching frequency | 2 kHz, 4 kHz, 8 kHz (depends on the parameter settings)
---|---
Maximum recommended motor cable length | Scalar control: 300 m (984 ft)
Note: For restrictions due to EMC compatibility, see section EMC compliance (IEC/EN 61800-3:2004) (page 122). Longer motor cables cause a motor voltage decrease which limits the available motor power. The decrease depends on the motor cable length and characteristics. Contact ABB for more information. Note that a sine filter (optional) at the drive output also causes a voltage decrease.
Control panel type | ACH-AP-H assistant control panel
Efficiency | Approximately 96.5% at nominal power level.
Protection classes
| Degree of protection (IEC/EN 60529) | IP00
| With option +B051; IP20
| Enclosure type (UL 508C) | UL Open Type
| Overvoltage category (IEC 60664-1) | III
Ambient conditions
Environmental limits for the drive are given below. The drive is to be used in a heated, indoor, controlled environment.

<table>
<thead>
<tr>
<th>Operation installed for stationary use</th>
<th>Storage in the protective package</th>
<th>Transportation in the protective package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation site altitude</td>
<td>For TN and TT neutral-grounded network systems and IT ungrounded network systems; 0 to 4000 m (13123 ft) above sea level Above 1000 m (3281 ft); see section When is derating needed</td>
<td>-</td>
</tr>
<tr>
<td>Air temperature</td>
<td>-15…+55 °C (5…131 °F). No frost allowed. See section When is derating needed</td>
<td>-40…+70 °C (-40…+158 °F)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>5…95%</td>
<td>Max. 95%</td>
</tr>
<tr>
<td>Max. 95%</td>
<td>No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.</td>
<td></td>
</tr>
</tbody>
</table>
### Contamination

<table>
<thead>
<tr>
<th>Contamination</th>
<th>IEC/EN 60721-3-3:2002: Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations</th>
<th>IEC 60721-3-1:1997</th>
<th>IEC 60721-3-2:1997</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical gases</td>
<td>Class 3C2</td>
<td>Class 1C2</td>
<td>Class 2C2</td>
</tr>
<tr>
<td>Solid particles</td>
<td>Class 3S2. No conductive dust allowed.</td>
<td>Class 1S3. (packing must support this, otherwise 1S2)</td>
<td>Class 2S2</td>
</tr>
</tbody>
</table>

### Pollution degree

<table>
<thead>
<tr>
<th>Pollution degree</th>
<th>2</th>
</tr>
</thead>
</table>

### Atmospheric pressure

<table>
<thead>
<tr>
<th>Atmospheric pressure</th>
<th>0.7 ... 1.05 atmospheres</th>
<th>0.7 ... 1.05 atmospheres</th>
<th>0.6 ... 1.05 atmospheres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 2S</td>
<td>70...106 kPa</td>
<td>70...106 kPa</td>
<td>60...106 kPa</td>
</tr>
<tr>
<td>Class 1S</td>
<td>0.7 ... 1.05 atmospheres</td>
<td>0.7 ... 1.05 atmospheres</td>
<td>0.6 ... 1.05 atmospheres</td>
</tr>
</tbody>
</table>

### Vibration

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 3S</td>
<td>Max. 1 mm (0.04 in) (5 ... 10 Hz), max. 7 m/s² (23 ft/s²) (13.2 ... 100 Hz) sinusoidal</td>
<td>Max. 1 mm (0.04 in) (5 ... 10 Hz), max. 7 m/s² (23 ft/s²) (13.2 ... 100 Hz) sinusoidal</td>
<td>Max. 1 mm (0.04 in) (5 ... 10 Hz), max. 7 m/s² (23 ft/s²) (13.2 ... 100 Hz) sinusoidal</td>
</tr>
<tr>
<td>Class 2S</td>
<td>Max. 0.1 mm (0.004 in) (10...57 Hz), max. 10 m/s² (33 ft/s²) (57...150 Hz) sinusoidal</td>
<td>Max. 0.1 mm (0.004 in) (10...57 Hz), max. 10 m/s² (33 ft/s²) (57...150 Hz) sinusoidal</td>
<td>Max. 0.1 mm (0.004 in) (10...57 Hz), max. 10 m/s² (33 ft/s²) (57...150 Hz) sinusoidal</td>
</tr>
</tbody>
</table>

### Shock

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 3S</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
</tr>
<tr>
<td>Class 2S</td>
<td>With packing max. 100 m/s² (330 ft/s²), 11 ms</td>
<td>With packing max. 100 m/s² (330 ft/s²), 11 ms</td>
<td>With packing max. 100 m/s² (330 ft/s²), 11 ms</td>
</tr>
</tbody>
</table>

### Free fall

<table>
<thead>
<tr>
<th>Free fall</th>
<th>Not allowed</th>
<th>100 mm (4 in) for weight over 100 kg (220 lb)</th>
<th>100 mm (4 in) for weight over 100 kg (220 lb)</th>
</tr>
</thead>
</table>

### Materials

#### Drive enclosure
- PC/ABS 2.5 mm (0.098 in), color NCS 1502-Y (RAL 9002 / PMS 420 C)
- hot-dip zinc coated steel sheet 1.5 ... 2.5 mm (0.059 ... 0.098 in), thickness of coating 100 micrometers, color NCS 1502-Y

#### Air baffles for Rittal cabinet
See section *Material of the air baffles.*

#### Package
Plywood and cardboard, bands PP.

#### Disposal
The main parts of the drive can be recycled to preserve natural resources and energy. Product parts and materials should be dismantled and separated.

Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery. Printed circuit boards and large electrolytic capacitors need selective treatment according to IEC 62635 guidelines. To aid recycling, plastic parts are marked with an appropriate identification code.

Contact your local ABB distributor for further information on environmental aspects and recycling instructions for professional recyclers. End of life treatment must follow international and local regulations.
Applicable standards

The drive complies with the following standards.

<table>
<thead>
<tr>
<th>European electrical safety requirements product standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 61800-5-1:2007</td>
</tr>
</tbody>
</table>
Provisions for compliance: The final assembler of the machine is responsible for installing:  
• emergency-stop device  
• supply disconnecting device  
• IP00 drive module into a cabinet. |
| EN 60529:1991 + A2:2013 | **Degrees of protection provided by enclosures (IP code)** |
| CSA C22.2 No. 0-10 | **General Requirements - Canadian Electrical Code, Part II** |
| CSA C22.2 No. 14-13 | **Industrial control equipment** |
| CSA C22.2 No. 274-13 | **Adjustable Speed Drives** |

Markings

These markings are attached to the drive:

- **CE mark**
  Product complies with the applicable European Union legislation. For fulfilling the EMC requirements, see the additional information concerning the drive EMC compliance (IEC/EN 61800-3).

- **UL listed mark for USA and Canada**
  Product has been tested and evaluated against the relevant North American standards by the Underwriters Laboratories.

- **EAC (Eurasian Conformity) mark**
  Product complies with the technical regulations of the Eurasian Customs Union. EAC mark is required in Russia, Belarus and Kazakhstan.

- **Electronic Information Products (EIP) green mark**
  The product complies with the People’s Republic of China Electronic Industry Standard (SJ/T 11364-2014). The product does not contain toxic and hazardous substances or elements above the maximum concentration values, and it is an environmentally-friendly product which can be recycled.

- **RCM mark**
  Product complies with Australian and New Zealand requirements specific to EMC, telecommunications and electrical safety. For fulfilling the EMC requirements, see the additional information concerning the drive EMC compliance (IEC/EN 61800-3).
EMC compliance (IEC/EN 61800-3:2004)

**Definitions**

EMC stands for Electromagnetic Compatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

*First environment* includes establishments connected to a low-voltage network which supplies buildings used for domestic purposes.

*Second environment* includes establishments connected to a network not supplying domestic premises.

*Drive of category C1*: drive of rated voltage less than 1000 V and intended for use in the first environment.

*Drive of category C2*: drive of rated voltage less than 1000 V and intended to be installed and started up only by a professional when used in the first environment. **Note**: A professional is a person or organization having necessary skills in installing and/or starting up power drive systems, including their EMC aspects.

*Drive of category C3*: drive of rated voltage less than 1000 V and intended for use in the second environment and not intended for use in the first environment.

*Drive of category C4*: drive of rated voltage equal to or above 1000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment.

**Category C3**

The drive complies with the standard with the following provisions:

1. The drive is equipped with internal EMC filter (+E210).
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. Maximum motor cable length is 100 meters.

---

**WARNING!**

A drive of category C3 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

---

**Category C4**

If the provisions under Category C3 cannot be met, the requirements of the standard can be met as follows:

1. It is ensured that no excessive emission is propagated to neighboring low-voltage networks. In some cases, the inherent suppression in transformers and cables is sufficient. If in doubt, the supply transformer with static screening between the primary and secondary windings can be used.
2. An EMC plan for preventing disturbances is drawn up for the installation. A template is available in Technical guide No. 3 EMC compliant installation and configuration for a power drive system (3AFE61348280 (English)).

3. The motor and control cables are selected as specified in the hardware manual.

4. The drive is installed according to the instructions given in the hardware manual.

**WARNING!**

A drive of category C4 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

---

**UL and CSA checklist**

**WARNING!**

Operation of this drive requires detailed installation and operation instructions provided in the hardware and software manuals. The manuals are provided in electric format in the drive package or on the Internet. Retain the manuals with the drive at all times. Hard copies of the manuals can be ordered through the manufacturer.

- Make sure that the drive type designation label includes the cULus Listed marking.
- **DANGER - Risk of electric shock.** After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.
- The drive is to be used in a heated, indoor controlled environment. The drive must be installed in clean air according to the enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust.
- The maximum ambient air temperature is 40 °C (104 °F) at rated current. The current is derated for 40 to 50 °C (104 to 122 °F).
The drive is suitable for use in a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600 V maximum when protected by the UL fuses given elsewhere in this chapter. The ampere rating is based on tests done according to the appropriate UL standard.

- The cables located within the motor circuit must be rated for at least 75 °C (167 °F) in UL-compliant installations.
- The input cable must be protected with fuses. The fuses must provide branch circuit protection in accordance with the national regulations (National Electrical Code (NEC) or Canadian Electrical Code). Obey also any other applicable local or provincial codes.

**Note:** Circuit breakers must not be used without fuses in the USA. For suitable circuit breakers, contact your local ABB representative.

---

**WARNING!**
The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electric shock, current-carrying parts and other components of the device should be examined and replaced if damaged.

---

- The drive provides motor overload protection. For adjustments, see the firmware manual.
- The drive overvoltage category according to IEC 60664-1 is III.

**EU Declaration of Conformity (Machinery Directive)**

See *The Safe torque off function (page 135)*

**Disclaimer**

- **Generic disclaimer**
  
The manufacturer shall have no obligation with respect to any product which (i) has been improperly repaired or altered; (ii) has been subjected to misuse, negligence or accident; (iii) has been used in a manner contrary to the manufacturer's instructions; or (iv) has failed as a result of ordinary wear and tear.

- **Cybersecurity disclaimer**
  
This product is designed to be connected to and to communicate information and data via a network interface. It is Customer's sole responsibility to provide and continuously ensure a secure connection between the product and Customer network or any other network (as the case may be). Customer shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.
Dimension drawings

Contents of this chapter
This chapter contains dimension drawings of the drive modules with optional parts for Rittal VX25 cabinet assembly.
126 Dimension drawings

Standard configuration (+E208 and +E210 included)
Drive module with option +B051
Drive module with options +B051, +H370
LCL filter module
Bottom plate

This drawing shows the dimensions of the bottom plate for Rittal VX25 800 mm cabinet. It is not an ABB product.
Air baffles

This drawing shows the dimensions of the air baffles around the drive module with option +B051 for Rittal VX25 800 mm cabinet.

These are not ABB products.

- **Material of the air baffles**

  0.75 mm polycarbonate (PC) film LEXAN® FR60 (GE) with UL94 V–0 listing, UV stability. (LEXAN® FR700 or Valox FR1 only with special permission). Unmarked bend radii 0.6 mm.
Example circuit diagrams

Contents of this chapter
This chapter shows an example circuit diagram for a cabinet-installed drive module.

Example circuit diagram
This diagram is an example for the main wiring of a drive cabinet. Note that the diagram includes components which are not included in a basic delivery (* plus code options, ** other options, *** to be acquired by the customer).
1 Cabinet
2 *ACx-AP-x control panel
3 CCU control unit
4 ***Main contactor
5 **Motor temperature supervision
6 ***Switch fuse disconnector
7 Common mode filter
8 **du/dt filter or sine filter
9 Drive module
10 Input and output signals
11 Alarm
12 Supply
13 360 degree grounding recommended
The Safe torque off function

Contents of this chapter

This chapter describes the Safe torque off (STO) function of the drive and gives instructions for its use.

Description

The Safe torque off function can be used, for example, to as the final actuator device of safety circuits that stop the drive in case of danger (such as an emergency stop circuit). Another typical application is a prevention of unexpected start-up function that enables short-time maintenance operations like cleaning or work on non-electrical parts of the machinery without switching off the power supply to the drive.

When activated, the Safe torque off function disables the control voltage of the power semiconductors of the drive output stage (A, see the diagrams below), thus preventing the drive from generating the torque required to rotate the motor. If the motor is running when Safe torque off is activated, it coasts to a stop.

The Safe torque off function has a redundant architecture, that is, both channels must be used in the safety function implementation. The safety data given in this manual is calculated for redundant use, and does not apply if both channels are not used.

The Safe torque off function complies with these standards:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60204-1:2016</td>
<td>Safety of machinery – Electrical equipment of machines – Part 1: General requirements</td>
</tr>
<tr>
<td>IEC 61000-6-7:2014</td>
<td>Electromagnetic compatibility (EMC) – Part 6-7: Generic standards – Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Standard</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61326-3-1:2017</td>
<td>Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications</td>
</tr>
<tr>
<td>IEC 61511-1:2016</td>
<td>Functional safety – Safety instrumented systems for the process industry sector</td>
</tr>
<tr>
<td>EN ISO 13849-1:2015</td>
<td>Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design</td>
</tr>
</tbody>
</table>

The function also corresponds to Prevention of unexpected start-up as specified by EN ISO 14118:2018 (ISO 14118:2017), and Uncontrolled stop (stop category 0) as specified in EN/IEC 60204-1.

- **Compliance with the European Machinery Directive**

  See the technical data.

  The Declaration of conformity is shown at the end of this chapter.
Wiring

For the electrical specifications of the STO connection, see the technical data of the control unit.

- **Connection principle**

Single ACQ580-34 drive, internal power supply

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Drive</td>
</tr>
<tr>
<td>2</td>
<td>Control unit</td>
</tr>
<tr>
<td>3</td>
<td>Control logic</td>
</tr>
<tr>
<td>4</td>
<td>To motor</td>
</tr>
<tr>
<td>K</td>
<td>Activation switch</td>
</tr>
</tbody>
</table>
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Single ACQ580-34 drive, external power supply

Wiring examples

Single ACQ580-34 drive, internal power supply
Single ACQ580-34 drive, external power supply

1. Drive
2. Safety PLC
K. Safety relay

The Safe torque off function
Multiple ACQ580-34 drives, internal power supply

1 Drive
2 Control unit
K Activation switch

140 The Safe torque off function
Multiple ACQ580-34 drives, external power supply

**Activation switch**

In the wiring diagrams, the activation switch has the designation [K]. This represents a component such as a manually operated switch, an emergency stop push button switch, or the contacts of a safety relay or safety PLC.

- In case a manually operated activation switch is used, the switch must be of a type that can be locked out to the open position.
- The contacts of the switch or relay must open/close within 200 ms of each other.
A CPTC-02 thermistor protection module can also be used. For more information, see the module documentation.

### Cable types and lengths
- Double-shielded twisted-pair cable is recommended.
- Maximum cable lengths:
  - 300 m (1000 ft) between activation switch [K] and drive control unit
  - 60 m (200 ft) between multiple drives or inverter units
  - 60 m (200 ft) between external power supply and first control unit

**Note:** A short-circuit in the wiring between the switch and an STO terminal causes a dangerous fault. Therefore, it is recommended to use a safety relay (including wiring diagnostics) or a wiring method (shield grounding, channel separation) which reduces or eliminates the risk caused by the short-circuit.

**Note:** The voltage at the STO input terminals of the drive must be at least 13 V DC to be interpreted as “1”.
The pulse tolerance of the input channels is 1 ms.

### Grounding of protective shields
- Ground the shield in the cabling between the activation switch and the control unit at the control unit only.
- Ground the shield in the cabling between two control units at one control unit only.
Operation principle

1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
2. The STO inputs of the drive control unit de-energize.
3. The control unit cuts off the control voltage from the output IGBTs.
4. The control program generates an indication as defined by parameter 31.22 (see the firmware manual of the drive).
   The parameter selects which indications are given when one or both STO signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs.

   **Note:** This parameter does not affect the operation of the STO function itself. The STO function will operate regardless of the setting of this parameter: a running drive will stop upon removal of one or both STO signals, and will not start until both STO signals are restored and all faults reset.

   **Note:** The loss of only one STO signal always generates a fault as it is interpreted as a malfunction of STO hardware or wiring.

5. The motor coasts to a stop (if running). The drive cannot restart while the activation switch or safety relay contacts are open. After the contacts close, a reset may be needed (depending on the setting of parameter 31.22). A new start command is required to start the drive.
Start-up including acceptance test

To ensure the safe operation of a safety function, validation is required. The final assembler of the machine must validate the function by performing an acceptance test. The acceptance test must be performed
• at initial start-up of the safety function
• after any changes related to the safety function (circuit boards, wiring, components, settings, etc.)
• after any maintenance work related to the safety function.

Competence

The acceptance test of the safety function must be carried out by a competent person with adequate expertise and knowledge of the safety function as well as functional safety, as required by IEC 61508-1 clause 6. The test procedures and report must be documented and signed by this person.

Acceptance test reports

Signed acceptance test reports must be stored in the logbook of the machine. The report shall include documentation of start-up activities and test results, references to failure reports and resolution of failures. Any new acceptance tests performed due to changes or maintenance shall be logged into the logbook.

Acceptance test procedure

After wiring the Safe torque off function, validate its operation as follows.

Note: If a CPTC-02 module is installed, refer to its documentation.

<table>
<thead>
<tr>
<th>Action</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WARNING!</strong> Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.</td>
<td>☑</td>
</tr>
<tr>
<td>Make sure that the drive can be run and stopped freely during start-up.</td>
<td>☐</td>
</tr>
<tr>
<td>Stop the drive (if running), switch the input power off and isolate the drive from the power line using a disconnector.</td>
<td>☐</td>
</tr>
<tr>
<td>Check the STO circuit connections against the wiring diagram.</td>
<td>☐</td>
</tr>
<tr>
<td>Close the disconnector and switch the power on.</td>
<td>☐</td>
</tr>
<tr>
<td>Test the operation of the STO function when the motor is stopped.</td>
<td>☐</td>
</tr>
<tr>
<td>• Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Make sure that the drive operates as follows:</td>
<td>☑</td>
</tr>
<tr>
<td>• Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter 31.22 (see the firmware manual).</td>
<td>☑</td>
</tr>
<tr>
<td>• Give a start command to verify that the STO function blocks the drive's operation. The drive generates a warning. The motor should not start.</td>
<td>☑</td>
</tr>
<tr>
<td>• Close the STO circuit.</td>
<td>☑</td>
</tr>
<tr>
<td>• Reset any active faults. Restart the drive and check that the motor runs normally.</td>
<td>☑</td>
</tr>
</tbody>
</table>
Action

Test the operation of the STO function when the motor is running.

- Start the drive and make sure the motor is running.
- Open the STO circuit. The motor should stop. The drive generates an indication if one is defined for the ‘running’ state in parameter 31.22 (see the firmware manual).
- Reset any active faults and try to start the drive.
- Make sure that the motor stays at a standstill and the drive operates as described above in testing the operation when the motor is stopped.
- Close the STO circuit.
- Reset any active faults. Restart the drive and check that the motor runs normally.

Test the operation of the failure detection of the drive. The motor can be stopped or running.

- Open the 1st channel of the STO circuit (wire coming to IN1). If the motor was running, it should coast to a stop. The drive generates a FA81 Safe Torque Off 1 loss fault indication (see the firmware manual).
- Give a start command to verify that the STO function blocks the drive’s operation. The motor should not start.
- Close the STO circuit.
- Reset any active faults. Restart the drive and check that the motor runs normally.

- Open the 2nd channel of the STO circuit (wire coming to IN2). If the motor was running, it should coast to a stop. The drive generates a FA82 Safe Torque Off 2 loss fault indication (see the firmware manual).
- Give a start command to verify that the STO function blocks the drive’s operation. The motor should not start.
- Close the STO circuit.
- Reset any active faults. Restart the drive and check that the motor runs normally.

Document and sign the acceptance test report which verifies that the safety function is safe and accepted for operation.
Use

1. Open the activation switch, or activate the safety functionality that is wired to the STO connection.
2. The STO inputs on the drive control unit de-energize, and the control unit cuts off the control voltage from the output IGBTs.
3. The control program generates an indication as defined by parameter 31.22 (see the firmware manual of the drive).
4. The motor coasts to a stop (if running). The drive will not restart while the activation switch or safety relay contacts are open.
5. Deactivate the STO by closing the activation switch, or resetting the safety functionality that is wired to the STO connection.
6. Reset any faults before restarting.

WARNING!

The Safe torque off function does not disconnect the voltage of the main and auxiliary circuits from the drive. Therefore maintenance work on electrical parts of the drive or the motor can only be carried out after isolating the drive from the supply and all other voltage sources.

WARNING!

(With permanent magnet or synchronous reluctance [SynRM] motors only)

In case of a multiple IGBT power semiconductor failure, the drive can produce an alignment torque which maximally rotates the motor shaft by 180/p degrees (with permanent magnet motors) or 180/2p degrees (with synchronous reluctance [SynRM] motors) regardless of the activation of the Safe torque off function. p denotes the number of pole pairs.

Notes:

• If a running drive is stopped by using the Safe torque off function, the drive will cut off the motor supply voltage and the motor will coast to a stop. If this causes danger or is not otherwise acceptable, stop the drive and machinery using the appropriate stop mode before activating the Safe torque off function.
• The Safe torque off function overrides all other functions of the drive.
• The Safe torque off function is ineffective against deliberate sabotage or misuse.
• The Safe torque off function has been designed to reduce the recognized hazardous conditions. In spite of this, it is not always possible to eliminate all potential hazards. The assembler of the machine must inform the final user about the residual risks.
• The Safe torque off diagnostics are not available during power outages, or when the drive is only powered by a CMOD-xx multifunction extension module.
Maintenance

After the operation of the circuit is validated at start-up, the STO function shall be maintained by periodic proof testing. In high demand mode of operation, the maximum proof test interval is 20 years. In low demand mode of operation, the maximum proof test interval is 5 or 2 years; see section Safety data (page 149). It is assumed that all dangerous failures of the STO circuit are detected by the proof test. To perform the proof test, do the Acceptance test procedure (page 144).

Note: See also the Recommendation of Use CNB/M/11.050 (published by the European co-ordination of Notified Bodies) concerning dual-channel safety-related systems with electromechanical outputs:

• When the safety integrity requirement for the safety function is SIL 3 or PL e (cat. 3 or 4), the proof test for the function must be performed at least every month.
• When the safety integrity requirement for the safety function is SIL 2 (HFT = 1) or PL d (cat. 3), the proof test for the function must be performed at least every 12 months.

The STO function of the drive does not contain any electromechanical components.

In addition to proof testing, it is a good practice to check the operation of the function when other maintenance procedures are carried out on the machinery.

Include the Safe torque off operation test described above in the routine maintenance program of the machinery that the drive runs.

If any wiring or component change is needed after start up, or the parameters are restored, do the test given in section Acceptance test procedure (page 144).

Use only spare parts approved by ABB.

Record all maintenance and proof test activities in the machine logbook.

 Competence

The maintenance and proof test activities of the safety function must be carried out by a competent person with adequate expertise and knowledge of the safety function as well as functional safety, as required by IEC 61508-1 clause 6.
Fault tracing

The indications given during the normal operation of the Safe torque off function are selected by drive control program parameter 31.22.

The diagnostics of the Safe torque off function cross-compare the status of the two STO channels. In case the channels are not in the same state, a fault reaction function is performed and the drive trips on an “STO hardware failure” fault. An attempt to use the STO in a non-redundant manner, for example activating only one channel, will trigger the same reaction.

See the firmware manual of the drive control program for the indications generated by the drive, and for details on directing fault and warning indications to an output on the control unit for external diagnostics.

Any failures of the Safe torque off function must be reported to ABB.
The safety data for the Safe torque off function is given below.

**Note:** The safety data is calculated for redundant use, and does not apply if both STO channels are not used.

<table>
<thead>
<tr>
<th>Frame size</th>
<th>SIL/ SILCL</th>
<th>PL</th>
<th>SFF (%)</th>
<th>PFF (T1 = 20 a) (1/h)</th>
<th>PFD&lt;sub&gt;avg&lt;/sub&gt; (T1 = 5 a)</th>
<th>MTTF&lt;sub&gt;0&lt;/sub&gt; (a)</th>
<th>DC (%)</th>
<th>Cat.</th>
<th>SC</th>
<th>HFT</th>
<th>CCF</th>
<th>TM (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R11</td>
<td>3</td>
<td>e</td>
<td>99.61</td>
<td>4.14E-09</td>
<td>3.63E-05</td>
<td>18044</td>
<td>≥90</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>80</td>
<td>20</td>
</tr>
</tbody>
</table>

- The following temperature profile is used in safety value calculations:
  - 670 on/off cycles per year with ΔT = 71.66 °C
  - 1340 on/off cycles per year with ΔT = 61.66 °C
  - 30 on/off cycles per year with ΔT = 10.0 °C
  - 32 °C board temperature at 2.0% of time
  - 60 °C board temperature at 1.5% of time
  - 85 °C board temperature at 2.3% of time.
- The STO is a type A safety component as defined in IEC 61508-2.
- Relevant failure modes:
  - The STO trips spuriously (safe failure)
  - The STO does not activate when requested
  - A fault exclusion on the failure mode “short circuit on printed circuit board” has been made (EN 13849-2, table D.5). The analysis is based on an assumption that one failure occurs at one time. No accumulated failures have been analyzed.
- STO response times:
  - STO reaction time (shortest detectable break): 1 ms
  - STO response time: 2 ms (typical), 30 ms (maximum)
  - Fault detection time: Channels in different states for longer than 200 ms
  - Fault reaction time: Fault detection time + 10 ms
- Indication delays:
  - STO fault indication (parameter 31.22) delay: < 500 ms
  - STO warning indication (parameter 31.22) delay: < 1000 ms

### Abbreviations

<table>
<thead>
<tr>
<th>Abbr.</th>
<th>Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat.</td>
<td>EN ISO 13849-1</td>
<td>Classification of the safety-related parts of a control system in respect of their resistance to faults and their subsequent behavior in the fault condition, and which is achieved by the structural arrangement of the parts, fault detection and/or by their reliability. The categories are: B, 1, 2, 3 and 4.</td>
</tr>
<tr>
<td>CCF</td>
<td>EN ISO 13849-1</td>
<td>Common cause failure (%)</td>
</tr>
<tr>
<td>DC</td>
<td>EN ISO 13849-1</td>
<td>Diagnostic coverage</td>
</tr>
<tr>
<td>HFT</td>
<td>IEC 61508</td>
<td>Hardware fault tolerance</td>
</tr>
</tbody>
</table>
### Description

**MTTDF\_D**
- **Reference**: EN ISO 13849-1
- **Description**: Mean time to dangerous failure: (Total number of life units) / (Number of dangerous, undetected failures) during a particular measurement interval under stated conditions

**PFD\_avg**
- **Reference**: IEC 61508
- **Description**: Average probability of dangerous failure on demand, that is, mean unavailability of a safety-related system to perform the specified safety function when a demand occurs

**PFH**
- **Reference**: IEC 61508
- **Description**: Average frequency of dangerous failures per hour, that is, average frequency of a dangerous failure of a safety-related system to perform the specified safety function over a given period of time

**PL**
- **Reference**: EN ISO 13849-1
- **Description**: Performance level. Levels a…e correspond to SIL

**SC**
- **Reference**: IEC 61508
- **Description**: Systematic capability

**SFF**
- **Reference**: IEC 61508
- **Description**: Safe failure fraction (%)

**SIL**
- **Reference**: IEC 61508
- **Description**: Safety integrity level (1…3)

**SILCL**
- **Reference**: IEC/EN 62061
- **Description**: Maximum SIL (level 1…3) that can be claimed for a safety function or subsystem

**STO**
- **Reference**: IEC/EN 61800-5-2
- **Description**: Safe torque off

**T\_1**
- **Reference**: IEC 61508-6
- **Description**: Proof test interval. \( T_1 \) is a parameter used to define the probabilistic failure rate (PFH or PFD) for the safety function or subsystem. Performing a proof test at a maximum interval of \( T_1 \) is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid.

**T\_M**
- **Reference**: EN ISO 13849-1
- **Description**: Mission time: the period of time covering the intended use of the safety function/device. After the mission time elapses, the safety device must be replaced. Note that any \( T_M \) values given cannot be regarded as a guarantee or warranty.

---

**TÜV certificate**

EU Declaration of Conformity
Machinery Directive 2006/42/EC

We, ABB Oy
Hietaniitty 13, 00380 Helsinki, Finland.
+358 10 22 11

declare under our sole responsibility that the following product:

Frequency converter(s)
ACQ580-04/34

with regard to the safety function(s)
Safe Torque Off

is/are in conformity with all the relevant safety component requirements of EU Machinery Directive 2006/42/EC, when the listed safety function is used for safety component functionality.

The following harmonized standards have been applied:
EN 61800-5-2:2001
EN ISO 13849-1:2015
EN ISO 13849-2:2022

The following other standards have been applied:
IEC 61800-5-2:2016

Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional
Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
Safety of machinery - Safety-related parts of control systems. Part 1: General requirements
Safety of machinery - Safety-related parts of the control systems. Part 2: Validation
Safety of machinery - Electrical equipment of machines – Part 1: General requirements
Functional safety of electrical/electronic/programmable electronic safety-related systems
Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional

The product(s) referred in this Declaration of conformity fulfill(s) the relevant provisions of other European Union Directives which are notified in Single EU Declaration of conformity 3AX010000497692.

Person authorized to compile the technical file
Name and address: Risto Myrkkylä, Hietaniitty 13, 00380 Helsinki, Finland.

Helsinki 12.08.2019
Manufacturer representative:

Touko Tanula
Vice President, ABB Oy

Document number 3AX010000611400
Filters

Contents of this chapter
This chapter describes how to select du/dt filters for the drive.

du/dt filters

■ When is a du/dt filter needed?
See section *Examining the compatibility of the motor and drive*.

■ Selection table
du/dt filter types for the drive modules are given below.

<table>
<thead>
<tr>
<th>Drive module type</th>
<th>du/dt filter type</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACQ580-34-</td>
<td>FOCH0875-70</td>
</tr>
<tr>
<td>246A-4...725A-4</td>
<td></td>
</tr>
</tbody>
</table>

■ Ordering codes

<table>
<thead>
<tr>
<th>Drive module type</th>
<th>Ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACQ580-34-</td>
<td>3AUA0000125245</td>
</tr>
<tr>
<td>246A-4...725A-4</td>
<td></td>
</tr>
</tbody>
</table>

■ Description, installation and technical data of the FOCH filters
See *FOCH du/dt filters hardware manual* (3AFE68577519 [English]).
Optional I/O extension modules

Contents of this chapter
This chapter describes how to install and start up the following optional modules:

- CHDI-01 115/230 V digital input extension module
- CMOD-01 multifunction extension module
- CMOD-02 multifunction extension module

This chapter also contains diagnostics and technical data of these modules.

CHDI-01 115/230 V digital input extension module

- Hardware description

Product overview
The CHDI-01 115/230 V digital input extension module expands the inputs of the drive control unit. It has six high voltage inputs and two relay outputs.
156 Optional I/O extension modules

Layout

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grounding screw</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Hole for mounting screw</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>3-pin terminal blocks for relay outputs</td>
<td>Terminal designations (page 157)</td>
</tr>
<tr>
<td>4</td>
<td>3-pin terminal block for 115/230 V inputs</td>
<td>Terminal designations (page 157)</td>
</tr>
<tr>
<td>5</td>
<td>Diagnostic LED</td>
<td>LEDs (page 159)</td>
</tr>
</tbody>
</table>

### Mechanical installation

**Necessary tools and instructions**

- Screwdriver and a set of suitable bits.

**Unpacking and checking the delivery**

1. Open the option package.
2. Make sure that the package contains:
   - CHDI-01 high voltage digital extension module
   - a mounting screw
3. Make sure that there are no signs of damage.

**Installing the module**

See section *Installing option modules (page 69)*.
Electrical installation

**WARNING!**
Obey the instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrician, do not do electrical work.

Make sure that the drive is disconnected from the input power during installation. If the drive is already connected to the input power, wait for 5 minutes after disconnecting the input power.

Necessary tools and instructions
- Screwdriver and a set of suitable bits
- Cabling tools

Terminal designations
For more detailed information on the connectors, see section *Technical data (page 159).*

**Relay outputs**

<table>
<thead>
<tr>
<th>Marking</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>RO4C Common, C</td>
</tr>
<tr>
<td>51</td>
<td>RO4A Normally closed, NC</td>
</tr>
<tr>
<td>52</td>
<td>RO4B Normally open, NO</td>
</tr>
<tr>
<td>53</td>
<td>RO5C Common, C</td>
</tr>
<tr>
<td>54</td>
<td>RO5A Normally closed, NC</td>
</tr>
<tr>
<td>55</td>
<td>RO5B Normally open, NO</td>
</tr>
</tbody>
</table>

**115/230 V inputs**

<table>
<thead>
<tr>
<th>Marking</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>HDI7 115/230 V input 1</td>
</tr>
<tr>
<td>71</td>
<td>HDI8 115/230 V input 2</td>
</tr>
<tr>
<td>72</td>
<td>NEUTRAL 1) Neutral point</td>
</tr>
<tr>
<td>73</td>
<td>HDI9 115/230 V input 3</td>
</tr>
<tr>
<td>74</td>
<td>HDI10 115/230 V input 4</td>
</tr>
<tr>
<td>75</td>
<td>NEUTRAL 1) Neutral point</td>
</tr>
<tr>
<td>76</td>
<td>HDI11 115/230 V input 5</td>
</tr>
<tr>
<td>77</td>
<td>HDI12 115/230 V input 6</td>
</tr>
<tr>
<td>78</td>
<td>NEUTRAL 1) Neutral point</td>
</tr>
</tbody>
</table>

1) Neutral points 72, 75 and 78 are connected.

**General cabling instructions**
Obey the instructions given in chapter *Guidelines for planning the electrical installation.*
Wiring

Connect the external control cables to the applicable module terminals. Ground the outer shield of the cables 360 degrees under a grounding clamp on the grounding shelf of the control cables.

Relay output connection example

![Relay output connection diagram]

Digital input connection example

![Digital input connection diagram]

Start-up

Setting the parameters

1. Power up the drive.
2. If no warning is shown,
   • make sure that the value of both parameters 15.02 and 15.01 is CHDI-01.
   
   If warning A7AB *Extension I/O configuration failure* is shown,
   • make sure that the value of parameter 15.02 is CHDI-01.
   • set parameter 15.01 value to CHDI-01.
   
   You can now see the parameters of the extension module in parameter group 15 I/O extension module.
3. Set the parameters of the extension module to applicable values.

Parameter setting example for relay output

This example shows how make relay output RO4 of the extension module indicate the reverse direction of rotation of the motor with a one-second delay.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.07 RO4 source</td>
<td>Reverse</td>
</tr>
<tr>
<td>15.08 RO4 ON delay</td>
<td>1 s</td>
</tr>
<tr>
<td>15.09 RO4 OFF delay</td>
<td>1 s</td>
</tr>
</tbody>
</table>
Diagnostics

Faults and warning messages
Warning A7AB Extension I/O configuration failure.

LEDs

The extension module has one diagnostic LED.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>The extension module is powered up.</td>
</tr>
</tbody>
</table>

Technical data

Dimension drawing:
The dimensions are in millimeters and [inches].

Installation: Into an option slot on the drive control unit
Degree of protection: IP20
Ambient conditions: See the drive technical data.
Package: Cardboard

Isolation areas:

Relay outputs (50…52, 53…55):
- Wire size max. 1.5 mm²
- Minimum contact rating: 12 V / 10 mA
- Maximum contact rating: 250 V AC / 30 V DC / 2 A
- Maximum breaking capacity: 1500 VA

115/230 V inputs (70…78):
- Wire size max. 1.5 mm²
- Input voltage: 115 to 230 V AC ±10%
- Maximum current leakage in digital off state: 2 mA
CMOD-01 multifunction extension module (external 24 V AC/DC and digital I/O)

- **Hardware description**

**Product overview**

The CMOD-01 multifunction extension module (external 24 V AC/DC and digital I/O) expands the outputs of the drive control unit. It has two relay outputs and one transistor output, which can function as a digital or frequency output.

In addition, the extension module has an external power supply interface, which can be used to power up the drive control unit in case the drive power supply is not on. If you do not need the back-up power supply, you do not have to connect it because the module is powered from the drive control unit by default.

---

**WARNING!**

Do not connect the +24 V AC cable to the control unit ground when the control unit is powered using an external 24 V AC supply.

**Layout**

![Diagram of CMOD-01 multifunction extension module]

1. Grounding screw
2. Hole for mounting screw
3. 3-pin terminal blocks for relay outputs
4. 3-pin terminal block for transistor output
5. 2-pin terminal block for external power supply
6. Diagnostic LED

---

1. Mechanical installation (page 162)
2. Mechanical installation (page 162)
3. Terminal designations (page 162)
4. Terminal designations (page 162)
5. Terminal designations (page 162)
6. LEDs (page 165)
162 Optional I/O extension modules

- **Mechanical installation**

**Necessary tools and instructions**
- Screwdriver and a set of suitable bits.

**Unpacking and checking the delivery**
1. Open the option package.
2. Make sure that the package contains:
   - CMOD-01 multifunction extension module
   - A mounting screw
3. Make sure that there are no signs of damage.

**Installing the module**
See section *Installing option modules (page 69).*

- **Electrical installation**

**WARNING!**
Obey the instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrician, do not do electrical work.

Make sure that the drive is disconnected from the input power during installation. If the drive is already connected to the input power, wait for 5 minutes after disconnecting the input power.

**Necessary tools and instructions**
- Screwdriver and a set of suitable bits
- Cabling tools

**Terminal designations**
For more detailed information on the connectors, see section *Technical data (page 166).*

**Relay outputs**

<table>
<thead>
<tr>
<th>Marking</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>RO4C Common, C</td>
</tr>
<tr>
<td>51</td>
<td>RO4A Normally closed, NC</td>
</tr>
<tr>
<td>52</td>
<td>RO4B Normally open, NO</td>
</tr>
<tr>
<td>53</td>
<td>RO5C Common, C</td>
</tr>
<tr>
<td>54</td>
<td>RO5A Normally closed, NC</td>
</tr>
<tr>
<td>55</td>
<td>RO5B Normally open, NO</td>
</tr>
</tbody>
</table>

**Transistor output**

<table>
<thead>
<tr>
<th>Marking</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>DO1 SRC Source input</td>
</tr>
<tr>
<td>43</td>
<td>DO1 OUT Digital or frequency output</td>
</tr>
<tr>
<td>44</td>
<td>DO1 SGND Ground (earth) potential</td>
</tr>
</tbody>
</table>
External power supply

The external power supply is needed only if you want to connect an external back-up power supply for the drive control unit.

**Note:** CMOD +24V external power supply terminals are not in use with CCU-24 control unit. External power supply to CCU-24 is connected to terminals 40 and 41 on the control unit.

<table>
<thead>
<tr>
<th>Marking</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>24 V AC/DC + in</td>
</tr>
<tr>
<td>41</td>
<td>24 V AC/DC - in</td>
</tr>
</tbody>
</table>

**General cabling instructions**

Obey the instructions given in chapter *Guidelines for planning the electrical installation*.

**Wiring**

Connect the external control cables to the applicable module terminals. Ground the outer shield of the cables 360 degrees under a grounding clamp on the grounding shelf of the control cables.

**Relay output connection example**

![Relay output connection diagram](image1)

**Digital output connection example**

![Digital output connection diagram](image2)

**Frequency output connection example**

![Frequency output connection diagram](image3)

1) An externally supplied frequency indicator which provides, for example:
- a 40 mA / 12 V DC power supply for the sensor circuit (CMOD frequency output)
- suitable voltage pulse input (10 Hz ... 16 kHz).

**External power supply connection example**
164 Optional I/O extension modules

WARNING!
Do not connect the +24 V AC cable to the control unit ground when the control unit is powered using an external 24 V AC supply.

Start-up

Setting the parameters

1. Power up the drive.
2. If no warning is shown,
   • make sure that the value of both parameters 15.02 and 15.01 is CMOD-01.
   If warning A7AB Extension I/O configuration failure is shown,
   • make sure that the value of parameter 15.02 is CMOD-01.
   • set the parameter 15.01 value to CMOD-01.
   You can now see the parameters of the extension module in parameter group 15 I/O extension module.
3. Set the parameters of the extension module to applicable values.
   Examples are given below.

Parameter setting example for relay output

This example shows how make relay output RO4 of the extension module indicate the reverse direction of rotation of the motor with a one-second delay.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.07 RO4 source</td>
<td>Reverse</td>
</tr>
<tr>
<td>15.08 RO4 ON delay</td>
<td>1 s</td>
</tr>
<tr>
<td>15.09 RO4 OFF delay</td>
<td>1 s</td>
</tr>
</tbody>
</table>

Parameter setting example for digital output

This example shows how to make digital output DO1 of the extension module indicate the reverse direction of rotation of the motor with a one-second delay.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.22 DO1 configuration</td>
<td>Digital output</td>
</tr>
<tr>
<td>15.23 DO1 source</td>
<td>Reverse</td>
</tr>
<tr>
<td>15.24 DO1 ON delay</td>
<td>1 s</td>
</tr>
<tr>
<td>15.25 DO1 OFF delay</td>
<td>1 s</td>
</tr>
</tbody>
</table>
Parameter setting example for frequency output

This example shows how to make digital output DO1 of the extension module indicate the motor speed 0... 1500 rpm with a frequency range of 0...10000 Hz.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.22 DO1 configuration</td>
<td>Frequency output</td>
</tr>
<tr>
<td>15.33 Freq out 1 source</td>
<td>01.01 Motor speed used</td>
</tr>
<tr>
<td>15.34 Freq out 1 src min</td>
<td>0</td>
</tr>
<tr>
<td>15.35 Freq out 1 src max</td>
<td>1500.00</td>
</tr>
<tr>
<td>15.36 Freq out 1 at src min</td>
<td>1000 Hz</td>
</tr>
<tr>
<td>15.37 Freq out 1 at src max</td>
<td>10000 Hz</td>
</tr>
</tbody>
</table>

- **Diagnostics**

  - **Faults and warning messages**

    Warning A7AB Extension I/O configuration failure.

  - **LEDs**

    The extension module has one diagnostic LED.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>The extension module is powered up.</td>
</tr>
</tbody>
</table>
166 Optional I/O extension modules

- Technical data
  
  **Dimension drawing:**
  The dimensions are in millimeters and [inches].

  ![Dimension Drawing]

  **Installation:** Into an option slot on the drive control unit
  
  **Degree of protection:** IP20
  
  **Ambient conditions:** See the drive technical data.
  
  **Package:** Cardboard
Isolation areas:

Relay outputs (50...52, 53...55):
- Wire size max. 1.5 mm²
- Minimum contact rating: 12 V / 10 mA
- Maximum contact rating: 250 V AC / 30 V DC / 2 A
- Maximum breaking capacity: 1500 VA

Transistor output (42...44):
- Wire size max. 1.5 mm²
- Type: Transistor output PNP
- Maximum load: 4 kohm
- Maximum switching voltage: 30 V DC
- Maximum switching current: 100 mA / 30 V DC, short-circuit protected
- Frequency: 10 Hz ... 16 kHz
- Resolution: 1 Hz
- Inaccuracy: 0.2%

External power supply (40...41):
- Wire size max. 1.5 mm²
- 24 V AC / V DC ±10% (GND, user potential)
- Maximum power consumption: 25 W, 1.04 A at 24 V DC
CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface)

- **Hardware description**

**Product overview**

The CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface) has a motor thermistor connection for supervising the motor temperature and one relay output, which indicates the thermistor status. In case the thermistor overheats, the drive trips on motor overtemperature. If Safe torque off tripping is required, the user must wire the overtemperature indication relay to the certified Safe torque off input of the drive.

In addition, the extension module has an external power supply interface, which can be used to power up the drive control unit in case the drive power supply is not on. If you do not need the back-up power supply, you do not have to connect it because the module is powered from the drive control unit by default.

There is reinforced insulation between the motor thermistor connection, the relay output and the drive control unit interface. Thus, you can connect a motor thermistor to the drive through the extension module.

**WARNING!**

Do not connect the +24 V AC cable to the control unit ground when the control unit is powered using an external 24 V AC supply.

**Layout**

![Diagram of CMOD-02 multifunction extension module]

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Page Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grounding screw</td>
<td>[Mechanical installation](page 169)</td>
</tr>
<tr>
<td>2</td>
<td>Hole for mounting screw</td>
<td>[Mechanical installation](page 169)</td>
</tr>
</tbody>
</table>

[168 Optional I/O extension modules]
### Mechanical installation

**Necessary tools and instructions**
- Screwdriver and a set of suitable bits

**Unpacking and checking the delivery**
1. Open the option package.
2. Make sure that the package contains:
   - CMOD-02 multifunction extension module
   - A mounting screw
3. Make sure that there are no signs of damage.

**Installing the module**
See section *Installing option modules (page 69).*

### Electrical installation

**WARNING!**
Obey the instructions in chapter *Safety instructions.* If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrician, do not do electrical work.

**Make sure that the drive is disconnected from the input power during installation.** If the drive is already connected to the input power, wait for 5 minutes after disconnecting the input power.

**Necessary tools and instructions**
- Screwdriver and a set of suitable bits
- Cabling tools

**Terminal designations**
For more detailed information on the connectors, see section *Technical data (page 171).*

#### Motor thermistor connection

<table>
<thead>
<tr>
<th>Marking</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>PTC IN</td>
</tr>
<tr>
<td>61</td>
<td>PTC IN</td>
</tr>
</tbody>
</table>

#### Relay output

<table>
<thead>
<tr>
<th>Marking</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>62</td>
<td>RO PTC C</td>
</tr>
<tr>
<td>63</td>
<td>RO PTC B</td>
</tr>
</tbody>
</table>
External power supply

The external power supply is needed only if you want to connect an external back-up power supply for the drive control unit.

**Note:** CMOD +24V external power supply terminals are not in use with CCU-24 control unit. External power supply to CCU-24 is connected to terminals 40 and 41 on the control unit.

<table>
<thead>
<tr>
<th>Marking</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>40</td>
<td>24 V AC/DC + in</td>
</tr>
<tr>
<td>41</td>
<td>24 V AC/DC - in</td>
</tr>
</tbody>
</table>

**General cabling instructions**

Obey the instructions given in chapter *Guidelines for planning the electrical installation*.

**Wiring**

Connect the external control cables to the applicable module terminals. Ground the outer shield of the cables 360 degrees under a grounding clamp on the grounding shelf of the control cables.

**Motor thermistor connection example**

1) One or 3…6 PTC thermistors connected in series.

The PTC input is reinforced/double insulated. If the motor part of the PTC sensor and wiring are reinforced/double insulated, voltages on the PTC wiring are within SELV limits.

If the motor PTC circuit is not reinforced/double insulated (ie, it is basic insulated), it is mandatory to use reinforced/double insulated wiring between the motor PTC and CMOD-02 PTC terminal.

**Relay output connection example**
Power supply connection example

![Diagram of power supply connection example]

| 1) | External power supply, 24 V AC/DC |

**WARNING!**
Do not connect the +24 V AC cable to the control unit ground when the control unit is powered using an external 24 V AC supply.

- **Start-up**

  **Setting the parameters**
  1. Power up the drive.
  2. If no warning is shown,
     - make sure that the values of both parameters 15.02 and 15.01 are CMOD-02.
     - If warning A7AB Extension I/O configuration failure is shown,
       - make sure that the value of parameter 15.02 is CMOD-02.
       - set the parameter 15.01 value to CMOD-02.
     You can now see the parameters of the extension module in parameter group 15 I/O extension module.

- **Diagnostics**

  **Faults and warning messages**
  Warning A7AB Extension I/O configuration failure.

  **LEDs**
  The extension module has one diagnostic LED.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>The extension module is powered up.</td>
</tr>
</tbody>
</table>

- **Technical data**

  **Dimension drawing:**
  The dimensions are in millimeters and [inches].
Installation: Into an option slot on the drive control unit

Degree of protection: IP20

Ambient conditions: See the drive technical data.

Package: Cardboard
Isolation areas:

```
CMOD-02

• 24 V_{in}
• RO PTC
• PTC_{in}

1 Plugged to drive SLOT2.
```

Reinforced insulation (IEC 61800-5-1:2007)

Functional insulation (IEC 61800-5-1:2007)

Motor thermistor connection (60…61):
- Wire size max. 1.5 mm²
- Supported standards: DIN 44081 and DIN 44082
- Number of PTC thermistor relays: 1 or 3…6 in series
- Triggering threshold: 3.6 kohm ±10%
- Recovery threshold: 1.6 kohm ±10%
- PTC terminal voltage: < 5.0 V
- PTC terminal current: < 1 mA
- Short-circuit detection: < 50 ohm ±10%

Relay output (62…63):
- Wire size max. 1.5 mm²
- Maximum contact rating: 250 V AC / 30 V DC / 5 A
- Maximum breaking capacity: 1000 VA

External power supply (40…41):
- Wire size max. 1.5 mm²
- 24 V AC / V DC ±10% (GND, user potential)
- Maximum power consumption: 25 W, 1.04 A at 24 V DC
21. Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet
WARNING! The UDC+ and UDC- terminals of the drive module must not be used for any other than optional external brake chopper connection.
non-ABB part (see dimension drawings)

Rittal 8806.000
Rittal 8617.140
1705.5 (67.15) Tapping screw M6×12
Torx T30 8 N·m
360 °
80.5 (3.17)
280.5 (11.04)
non-ABB part (see dimension drawings)

Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet 177
Combi screw M8×30 Hex
20 N·m

Tapping screw M6×12 Torx T30
(Hex) 8 N·m

178 Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet
Combi screw M4×8 Torx T20 2 N·m

Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet 179
Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet.
Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet 181
182 Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet
Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet 183
184 Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet
186 Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet
Tapping screw M6×12
Torx T30 (Hex) 8 N·m

Rear air baffle, non-ABB part
(see dimension drawings)

Right air baffle, non-ABB part
(see dimension drawings)

Left air baffle, non-ABB part
(see dimension drawings)

Front air baffle, non-ABB part
(see dimension drawings)

Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet 187
Step-by-step drawings for an installation example in Rittal VX25 800 mm wide cabinet
Further information

Product and service inquiries
Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/searchchannels.

Product training
For information on ABB product training, navigate to new.abb.com/service/training.

Providing feedback on ABB manuals
Your comments on our manuals are welcome. Navigate to new.abb.com/drives/manuals-feedback-form.

Document library on the Internet
You can find manuals and other product documents in PDF format on the Internet at www.abb.com/drives/documents.