ABB INDUSTRIAL DRIVES

ACS880-14 drive modules
(132 to 400 kW, 200 to 450 hp)
Hardware manual
List of related manuals

<table>
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<tr>
<th>Drive hardware manuals and guides</th>
<th>Code (English)</th>
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<tr>
<td>Drive/converter/inverter safety instructions</td>
<td>Multilingual code: 3AXD50000037978</td>
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<tr>
<td>ACS880-14 drive modules (132 to 400 kW, 200 to 450 hp) hardware manual</td>
<td>3AXD50000035160</td>
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<tr>
<td>ACS880-14 drive modules (132 to 400 kW, 200 to 450 hp) quick installation guide</td>
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<td>ACX-AP-x Assistant control panels user’s manual</td>
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<th>Drive firmware manuals and guides</th>
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<td>3AUA00000085087</td>
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<td>Quick start-up guide for ACS880 drives with primary control program</td>
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<td>ACS880 IGBT supply control program firmware manual</td>
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<th>Option manuals and guides</th>
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<td>FSO-12 safety functions module user’s manual</td>
<td>3AXD50000015612</td>
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<tr>
<td>ACS880 ATEX-certified Safe disconnection function application guide</td>
<td>3AUA0000132231</td>
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<tr>
<td>FOCH du/dt filters hardware manual</td>
<td>3AFE68577519</td>
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<tr>
<td>Sine filters hardware manual</td>
<td>3AXD50000016814</td>
</tr>
<tr>
<td>Manuals and quick guides for I/O extension modules, fieldbus adaptors, etc.</td>
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You can find manuals and other product documents in PDF format on the Internet. See section Document library on the Internet on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.

The code below opens an online listing of the manuals applicable to this product.

ACS880-14 manuals
Hardware manual

ACS880-14 drive modules
(132 to 400 kW, 200 to 450 hp)

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Safety instructions

Contents of this chapter
This chapter contains the safety instructions which you must obey when you install and operate the drive and do maintenance 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:

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

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

- **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 that install the drive module and do maintenance work on it.

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

- Use protective gloves when working on the drive module.
- Handle the drive module carefully:
  - Use safety shoes with a metal toe cap to prevent foot injury.
  - Lift the drive module and LCL filter module separately and 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.

- Do not use the module installation ramp with plinth heights which exceed the maximum height marked on the ramp. (The maximum plinth height is 50 mm [1.97 in] when the telescopic ramp is fully retracted and 150 mm [5.91 in] when the ramp is fully extended.)
- Attach the module installation ramp carefully.
- To prevent the drive module from falling, attach its top lifting lugs with chains to the cabinet frame before you push the module into the cabinet and pull it from the cabinet. Work carefully preferably with help from another person as shown below.
Safety instructions

Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.

- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, remain hot for a while after disconnection of the electrical supply.
- Make sure that debris from borings and grindings 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.
- Before you connect voltage to the drive, make sure that the cabinet doors are closed. Keep the doors closed during the operation. Obey the panel builder’s instructions.
- 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 number of drive power-ups is five in ten minutes. Too frequent power-ups can damage the charging circuit of the DC capacitors.
- Make sure that any safety circuits (for example, emergency stop and Safe torque off) are validated in start-up. See chapter Start-up (page 153) for reference of the validation instructions.

Note:
- If you select an external source for 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.
- When the control location is not set to Local, the stop key on the control panel will not stop the drive.
- Only authorized persons are allowed to repair a malfunctioning drive.
18 Safety instructions

Electrical safety in installation, start-up and maintenance

- Precautions before electrical work

These warnings are for all personnel that 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 electrical professional, 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.
2. Disconnect all possible voltage sources.
   - Open the main disconnector of the drive.
   - Open the disconnector of the supply transformer as the main disconnector of the drive does not remove the voltage from the input busbars of the drive.
   - Make sure that reconnection is not possible. Lock the disconnectors to open position and attach a warning notice to them.
   - Disconnect any external power sources from the control circuits before you do work on the control cables.
   - After you disconnect the drive, always wait for 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.
   - Use a multimeter with an impedance of at least 1 Mohm.
   - Make sure that the voltage between the drive module input power terminals (L1/U1, L2/V1, L3/W1) and the grounding (PE) busbar is close to 0 V.
   - Make sure that the voltage between the drive module UDC+ and UDC- terminals and the grounding (PE) busbar is close to 0 V.
6. Install temporary grounding as required by the local regulations.
7. Ask for a permit to work from the person in control of the electrical installation 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 electrical professional, do not do installation or maintenance work.
- Do not install a drive with EMC filter option +E200 or +E202 on an ungrounded power system or a high resistance-grounded (over 30 ohms) power system.
- Do not connect the drive to a voltage higher than what is on the type designation label.
- We do not recommend that you secure the cabinet by arc welding.
- Do not do insulation or voltage withstand tests on the drive or drive modules.

**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.
- The DC bus terminals (UDC+, UDC-) are at a dangerous voltage.
- External wiring can supply dangerous voltages to the terminals of relay outputs (XRO1, XRO2 and XRO3) of the drive control units.
- 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.

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

**WARNING!** Obey these instructions. If you ignore them, equipment malfunction and damage to the fiber optic cables can occur.

- Handle the fiber optic cables with care.
- When you unplug the 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 in).
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 electrical professional, 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 grounding conductors is sufficient. See section *Selecting the power cables* on page 63. Obey the local regulations.
- Connect the power cable shields to protective earth (PE) 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 switch board or the transformer.

**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 connection. See standard EN 61800-5-1, 4.3.5.5.2.
Additional instructions for permanent magnet motor drives

Safety in installation, start-up and maintenance

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

WARNING! Obey these instructions. If you ignore them, injury or death and equipment malfunction can occur.

• Do not do work on the drive when the permanent magnet motor is rotating. A rotating permanent magnet motor energizes the drive including its input power terminals.

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

• Stop the motor.
• 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.
• Measure that the installation is de-energized.
  • Use a multimeter with an impedance of at least 1 Mohm.
  • Make sure that the voltage between the drive output terminals (T1/U2, T2/V2, T3/W2) and the grounding (PE) busbar is close to 0 V.
  • Make sure that the voltage between the drive input power terminals (L1/U1, L2/V1, L3/W1) and the grounding (PE) busbar is close to 0 V.
  • Make sure that the voltage between the drive module UDC+ and UDC- terminals and the grounding (PE) busbar is close to 0 V.
• Install temporary grounding to the drive output terminals (T1/U2, T2/V2, T3/W2). Connect the output terminals together as well as to the PE.
• Make sure that the operator cannot run the motor over the rated speed. Motor overspeed causes overvoltage can damage or explode the capacitors in the intermediate circuit of the drive.

Additional instruction for DC connection

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.
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 checking the delivery, installing and commissioning the drive. The flowchart refers to chapters/sections in this manual and other manuals.

Target audience

This manual is intended for persons who

- plan the cabinet assembly of the drive module and install the module into a user-defined cabinet
- plan the electrical installation of the drive cabinet
- make instructions for the end user of the drive concerning the mechanical installation of the drive cabinet, connection of power and control cables to the cabinet-installed drive 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.

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 (R10 or 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, +J410. 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* on page 39.

**Quick installation, commissioning and operating flowchart**

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<th>See</th>
</tr>
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<tr>
<td>Plan the mechanical and electrical installation and acquire the accessories needed (cables, fuses, etc.). Check 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 cabinet installation (page 43) Guidelines for planning the electrical installation (page 57) Technical data (page 183) Option manual (if optional equipment is included)</td>
</tr>
<tr>
<td>Unpack and check the units. Check that all necessary optional modules and equipment are present and correct. Only intact units can be started up.</td>
<td>Moving and unpacking the unit (page 78) Checking the delivery (page 85) If the drive module has been non-operational for more than three years, the converter DC link capacitors need to be reformed. (<em>Reforming the capacitors</em>, page 171)</td>
</tr>
<tr>
<td>Check the installation site. Fasten the base of the cabinet to the floor.</td>
<td>Checking the installation site (page 77) Ambient conditions (page 196) Guidelines for planning the cabinet installation (page 43)</td>
</tr>
<tr>
<td>Route the cables.</td>
<td>Routing the cables (page 67)</td>
</tr>
<tr>
<td>Check the insulation of the supply cable, the motor and the motor cable and the resistor cable (if present).</td>
<td>Checking the insulation of the assembly (page 85)</td>
</tr>
</tbody>
</table>
| **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 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.  
  • Connect the cables from the drive module to the external control unit and install the control unit into the cabinet. | Installing the drive module and LCL filter module into a cabinet (page 133) Connecting the power cables and installing the shrouds (page 134) Connecting the external control unit to the drive module (page 103) Mounting the external control unit (page 105) Manuals for any optional equipment |
**Introduction to the manual**  

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**Drive modules with optional cabling panels (+H381)**

- Install the cabling panels into the cabinet.
- Install the additional components into the cabinet: for example, main disconnector, main contactor, main AC fuses, etc.
- If the main disconnector is installed into the cabinet, connect the input power cabling to it.
- Connect the input power cables and motor cables to the cabling panel terminals.
- Connect the DC connection cables (if any) to the cabling panel terminals.
- Install the drive module into the cabinet.
- Fasten the cabling panel busbars to the drive module busbars.
- Connect the cables from the drive module to the control unit and install the control unit into the cabinet.

**See**

- Installing the mechanical accessories into the cabinet (page 139)
- Modular design of Rittal TS8 cabinets (page 140)
- Connecting the power cables (page 93)
- Installing the drive module into the cabinet (page 144)
- Connecting the external control unit to the drive module (page 103)
- Mounting the external control unit (page 105)
- Manuals for any optional equipment

**Drive modules without full-size output cable connection terminals (+0H371) and IP20 shrouds (option +0B051):**

- Install the additional components into the cabinet: for example, main PE busbar, main disconnector, main contactor, main AC fuses, etc.
- Install the drive module into the cabinet.
- Connect the power cabling between the drive module and the rest of the main circuit components in the cabinet (if any).
- Connect the input power cables and motor cables to the drive cabinet.
- Connect the DC connection cables (if any) to the drive cabinet.
- Connect the cables from the drive module to the control unit and install the control unit into the cabinet.

**See**

- Installing the mechanical accessories into the cabinet (page 139)
- Connecting the power cables (page 93)
- Installing the drive module into the cabinet (page 144)
- Connecting the external control unit to the drive module (page 103)
- Mounting the external control unit (page 105)
- Manuals for any optional equipment

**Connect the external control cables to the drive control unit.**

- Connect the external control cables to the drive control unit.

**See**

- Connecting the control cables to the terminals of the control unit (page 107)
- Connecting the control cables to the internal control unit (option +P905) (page 121)
- Connecting the control cables to the internal control unit (options +P905 and +0B051) (page 122)

**Check the installation.**

**See**

- Installation checklist (page 149)

**Commission the drive.**

**See**

- Start-up (page 153)
**Introduction to the manual**

Terms and abbreviations

<table>
<thead>
<tr>
<th>Term/Abbreviation</th>
<th>Explanation</th>
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</thead>
<tbody>
<tr>
<td>ZPOW</td>
<td>Power supply board</td>
</tr>
<tr>
<td>BFPS</td>
<td>Fan power supply board</td>
</tr>
<tr>
<td>BGDR</td>
<td>Gate driver board</td>
</tr>
<tr>
<td>CMF</td>
<td>Common mode filtering</td>
</tr>
<tr>
<td>DDCS</td>
<td>Distributed drives communication system; a protocol used in optical fiber communication</td>
</tr>
<tr>
<td>Drive</td>
<td>Frequency converter for controlling AC motors. The drive consists of the Line-side converter and Motor-side converter connected together by the DC link. In this manual, the term refers to the ACS880-14 as a whole.</td>
</tr>
<tr>
<td>Drive control unit</td>
<td>The drive contains two control units. The drive control unit controls the drive through the motor-side converter. It is the user control interface to the drive. The line-side converter control unit controls the line-side converter.</td>
</tr>
<tr>
<td>DTC</td>
<td>Direct torque control</td>
</tr>
<tr>
<td>EMC</td>
<td>Electromagnetic compatibility</td>
</tr>
<tr>
<td>EMI</td>
<td>Electromagnetic interference</td>
</tr>
<tr>
<td>FAIO-01</td>
<td>Optional analog I/O extension module</td>
</tr>
<tr>
<td>FCAN-01</td>
<td>Optional CANopen adapter module</td>
</tr>
<tr>
<td>FCNA-01</td>
<td>Optional ControlNet fieldbus adapter module</td>
</tr>
<tr>
<td>FDCO-0x</td>
<td>Optional optical DDCS communication module</td>
</tr>
<tr>
<td>FDIO-01</td>
<td>Optional digital I/O extension module</td>
</tr>
<tr>
<td>FDNA-01</td>
<td>Optional DeviceNet™ fieldbus adapter module</td>
</tr>
<tr>
<td>FEA-03</td>
<td>Optional I/O extension and encoder module adapter</td>
</tr>
<tr>
<td>FECA-01</td>
<td>Optional EtherCAT adapter module</td>
</tr>
<tr>
<td>FEN-01</td>
<td>Optional TTL encoder interface module</td>
</tr>
<tr>
<td>FEN-11</td>
<td>Optional absolute encoder interface module</td>
</tr>
<tr>
<td>FEN-21</td>
<td>Optional resolver interface module</td>
</tr>
<tr>
<td>FEN-31</td>
<td>Optional HTL encoder interface module</td>
</tr>
<tr>
<td>FENA-11</td>
<td>Optional high performance Ethernet/IP™, Modbus/TCP and PROFINET IO adapter module</td>
</tr>
<tr>
<td>FENA-21</td>
<td>Optional high performance Ethernet/IP™, Modbus/TCP and PROFINET IO adapter module, 2-port</td>
</tr>
<tr>
<td>FEPL-01</td>
<td>Optional Ethernet POWERLINK fieldbus adapter module</td>
</tr>
<tr>
<td>FIO-01</td>
<td>Optional digital I/O extension module</td>
</tr>
<tr>
<td>FIO-11</td>
<td>Optional analog I/O extension module</td>
</tr>
<tr>
<td>Term/Abbreviation</td>
<td>Explanation</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>FLON-01</td>
<td>Optional LonWorks® adapter module</td>
</tr>
<tr>
<td>FPBA-01</td>
<td>Optional PROFIBUS DP adapter module</td>
</tr>
<tr>
<td>Frame (size)</td>
<td>Size of the drive module. The drive modules described in this manual are of frame size R11.</td>
</tr>
<tr>
<td>FSCA-01</td>
<td>Optional Modbus RTU adapter module</td>
</tr>
<tr>
<td>FSO</td>
<td>Optional safety functions module</td>
</tr>
<tr>
<td>HTL</td>
<td>High-threshold logic</td>
</tr>
<tr>
<td>IGBT</td>
<td>Insulated gate bipolar transistor; a voltage-controlled semiconductor type widely used in converters due to their easy controllability and high switching frequency.</td>
</tr>
<tr>
<td>I/O</td>
<td>Input/Output</td>
</tr>
<tr>
<td>IT system</td>
<td>Type of supply network that has no (low-impedance) connection to ground/earth.</td>
</tr>
<tr>
<td>Line-side converter</td>
<td>The part of the Drive that converts AC to DC for the motor. Includes an LCL filter. The line-side converter is also capable of feeding regenerative energy back into the electrical power network.</td>
</tr>
<tr>
<td>Motor-side converter</td>
<td>The part of the Drive that converts DC to AC for the motor. The motor-side converter is also capable of feeding energy from a decelerating motor into the DC link.</td>
</tr>
<tr>
<td>PLC</td>
<td>Programmable logic controller</td>
</tr>
<tr>
<td>QOIA</td>
<td>Optical interface adapter board</td>
</tr>
<tr>
<td>RFI</td>
<td>Radio-frequency interference</td>
</tr>
<tr>
<td>SAFUR</td>
<td>Series of optional brake resistors</td>
</tr>
<tr>
<td>STO</td>
<td>Safe torque off</td>
</tr>
<tr>
<td>QOIA</td>
<td>Optical interface adapter board</td>
</tr>
<tr>
<td>TN system</td>
<td>Type of supply network that provides a direct connection to ground (earth).</td>
</tr>
<tr>
<td>TTL</td>
<td>Transistor-transistor logic</td>
</tr>
<tr>
<td>ZBIB</td>
<td>Adapter board connected to the control board in the control unit (ZCU)</td>
</tr>
<tr>
<td>ZCON</td>
<td>Control board. The external I/O control signals are connected to the control board, or optional I/O extensions installed on it.</td>
</tr>
<tr>
<td>ZCU</td>
<td>Control unit which contains the ZCON control board. The drive contains two ZCU control units. One controls the line-side converter, the other the motor-side converter. As standard, the external I/O control signals are connected to the control unit, or optional I/O extensions mounted on it.</td>
</tr>
<tr>
<td>ZINT</td>
<td>Main circuit board</td>
</tr>
<tr>
<td>ZMU</td>
<td>The memory unit attached to the control unit of the drive</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 ACS880-14 is a four-quadrant drive module for controlling asynchronous AC induction motors, permanent magnet motors, AC induction servomotors and ABB synchronous reluctance motors (SynRM motors).
Block diagram of the main circuit of the 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 (option +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 line-side converter can transfer energy from the electrical power system to the drive DC link and vice versa. Thus, the drive can operate the motor in all four quadrants (speed, torque). The figure below visualizes the operation of the four-quadrant drive. In quadrants I and III, the drive operates in the motoring mode and takes energy from the power system. In quadrants II and IV, the drive operates in generating mode, and regenerates energy back to the power system.
The following figure shows the simplified main circuit diagram of the line-side converter part. The line-side converter is controlled by a type ZCU control unit located inside the drive module.

**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 ZCU control unit (external control unit).
Layout

- Standard drive module configuration

A Converter module. Contains line-side converter and motor side converter. This can also be called drive module.
B LCL filter module
C LCL filter module connected to the converter module
1 Clear plastic shrouds attached
2 Circuit board compartment
3 Upper front cover
4 Lower front cover
5 Cooling fan cassette
6 Support legs
7 Pedestal
8 Busbars for connecting the LCL filter module to the converter module
9 Cover on busbar connections

See the next page for descriptions and photos of the external control unit and converter module. For LCL filter module, see page 34.
Converter module

1. Clear plastic shroud to be attached onto the drive module input power cabling (a), entry shroud for side cabling (b).
2. Clear plastic shrouds to be attached onto the drive module output power cabling.
3. Clear plastic shroud to be attached on top of the drive module (entry for top cabling).
4. Upper back clear plastic shroud.
5. Lower back clear plastic shroud.
6. Front clear plastic shroud.
7. Input power cable connection terminals (option +H370).
8. Output power cable connection terminals.
9. 1a
10. 1b
11. 11
12. 12
13. 13
15. Telescopic extraction and insertion ramp.
16. External control unit. The control unit can also be inside the drive module (option +P905).
17. Control panel.
18. Control cable clamp plate.
19. Cables for connecting the control unit to the drive module (ZBIB - INU STO and 24VDC power).
20. Busbars for connecting the drive module to the LCL filter electrically.
21. Cover for the busbar connection.
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<table>
<thead>
<tr>
<th></th>
<th>Description</th>
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</thead>
<tbody>
<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>Fiber optic cables for connecting the control unit to the drive module (INU ZBIB - QOA)</td>
</tr>
<tr>
<td>12</td>
<td>PE (ground) terminal</td>
</tr>
<tr>
<td>13</td>
<td>Main cooling fans</td>
</tr>
<tr>
<td>22</td>
<td>Auxiliary cooling fan</td>
</tr>
<tr>
<td>23</td>
<td>Handle</td>
</tr>
<tr>
<td>24</td>
<td>Cover. When removed, you can attach the drive module to the LCL filter module.</td>
</tr>
<tr>
<td>25</td>
<td>Lifting lugs</td>
</tr>
<tr>
<td>26</td>
<td>Connector for charging circuit switch or contactor</td>
</tr>
</tbody>
</table>

**LCL filter module**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Busbars for connecting the LCL filter module to the drive module electrically</td>
</tr>
<tr>
<td>2</td>
<td>Handle</td>
</tr>
<tr>
<td>3</td>
<td>Main cooling fans</td>
</tr>
<tr>
<td>4</td>
<td>Pedestal guide plate for the LCL filter module.</td>
</tr>
<tr>
<td>5</td>
<td>Lifting lugs</td>
</tr>
</tbody>
</table>

---
## Power module with full power cabling panels (option +H381)

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Assembled power module</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Input power cabling panel</td>
<td>8 Input power cabling panel to be attached to the drive cabinet</td>
</tr>
<tr>
<td>2 Side guides</td>
<td>9 Output power cabling panel to be attached to the drive cabinet</td>
</tr>
<tr>
<td>3 Output power cabling panel</td>
<td>10 Front cover</td>
</tr>
<tr>
<td>4 Top guide plate</td>
<td>11 Internal control unit (option +P905) and control panel holder mounted on the drive module (option +J414)</td>
</tr>
<tr>
<td>5 Pedestal guide plate</td>
<td>12 Handle</td>
</tr>
<tr>
<td>6 Telescopic extraction and insertion ramp</td>
<td>13 Lifting lugs</td>
</tr>
<tr>
<td>7 Rubber grommet</td>
<td>14 Auxiliary cooling fan, another auxiliary cooling fan is located below the circuit board compartment, see page 162.</td>
</tr>
</tbody>
</table>
Converter module without full-size output cable connection terminals (option +0H371) and IP20 shrouds (option +0B051) and with common mode filter (option +E208)

- Lifting lugs
- Input cable connection busbars (L1/U1, L2/V1, L3/W1) and DC+ and DC- busbars (UDC+, UCD-)
- Circuit board compartment
- Output cable connection busbars (T1/U2, T2/V2, T3/W2)
- Common mode filter (option +E208)
- Pedestal
- Retractable support legs
- Handle for pulling the drive module
- Auxiliary cooling fans
- PE busbar
- Main cooling fans
- Base attaching screws
- Pedestal guide plate
- Telescopic extraction and insertion ramp
- Connector for charging circuit switch or contactor
- Cover. When removed, you can attach the drive module to the LCL filter module.

Note: The front covers are removed in this photo, see number 3 on page 32.
Control panel

The ACS-AP-W control panel is the user interface of the drive. It provides the essential controls such as Start/Stop/Direction/Reset/Reference, and the parameter settings for the motor and line-side converter control programs.

One control panel can also be used to control several drives through a panel link; see section Controlling several drives from one control panel through panel bus (page 97).

For the use of the control panel, see the firmware manual or ACX-AP-x Assistant control panels user’s manual (3UA00000085685 [English]).

In the standard drive module configuration, the control panel is located in the control panel holder of the external control unit.

The control panel can be mounted on the cabinet door using a DPMP-01 mounting platform (option +J410) or a DPMP-02 mounting platform (option +J413).

When the control unit is inside the drive module (option +P905), the control panel can be mounted on the drive module (option +J414).
Overview of power and control connections

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

---

A External control unit (motor-side converter control unit)
B Line-side converter control unit
1 Analog and digital I/O extension modules, feedback interface modules and fieldbus communication modules can be inserted into slots 1, 2 and 3. See section Type designation key on page 39.
2
3
4 Connector for the FSO-xx safety functions module (X12). The module can be installed on or above the control unit (see page 112 or 125).
5 Memory unit (see page 172)
6 I/O terminal blocks. See the layout on page 100 or 120 and default I/O connection diagram on page 108 or 123.
7 Control panel (see page 96)
8 Fiber optic link to the motor-side converter. Similarly, the line-side converter is connected to the line-side converter control unit with fiber optic cables.
9 Line-side converter
10 DC link
11 Motor-side converter
12 Socket for external ISU control (not required for normal operation of the drive)
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.

Type designation key

The type designation contains information on the specifications and configuration of the drive module. The first digits from left express the basic configuration. The optional selections are given thereafter, separated by plus signs, eg, +J410. The main selections are described below. Not all selections are available for all types.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic code, eg, ACS880-04-880A-3</td>
<td></td>
</tr>
<tr>
<td>Product series</td>
<td></td>
</tr>
<tr>
<td>ACS880</td>
<td>ACS880 product series</td>
</tr>
<tr>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>-14</td>
<td>When no options are selected: regenerative single drive module to be installed in an enclosure, IP20 (UL open type), bookshelf mounting with pedestal, external control unit with ACS-AP-W Assistant control panel with Bluetooth interface and panel holder, build-in LCL filter, full-size output cable connection terminals, EMC filter (category C3 for second environment TN [grounded] and IT [ungrounded] systems), DC connection busbars, clear plastic shrouds for covering the input power and motor cable connections, ACS880 primary control program, Safe torque off function, coated boards, printed multilingual quick installation and start-up guides, CD containing all manuals with all available languages.</td>
</tr>
<tr>
<td>Size</td>
<td></td>
</tr>
<tr>
<td>xxxA</td>
<td>Refer to the rating tables, page 183.</td>
</tr>
<tr>
<td>Voltage range</td>
<td></td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>380...415 V. This is indicated in the type designation label as typical input voltage level 3 ~ 400 V AC.</td>
</tr>
<tr>
<td>-5</td>
<td>380...500 V. This is indicated in the type designation label as typical input voltage levels 3 ~ 400/480/500 V AC.</td>
</tr>
<tr>
<td>-7</td>
<td>525...690 V. This is indicated in the type designation label as typical input voltage levels 3 ~ 525/600/690 (600 UL, CSA) V AC.</td>
</tr>
</tbody>
</table>

Option codes (plus codes)

Construction, pedal and cabling

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0B051</td>
<td>No IP20 shrouds for cabling area (not to be used with option +H381)</td>
</tr>
<tr>
<td>H370</td>
<td>Full-size input power cable connection terminals and PE busbar. Not to be used with option +H381.</td>
</tr>
<tr>
<td>0H371</td>
<td>No full-size output power cable connection terminals (not to be used with option +H381).</td>
</tr>
<tr>
<td>H381</td>
<td>Full power cabling panels to be attached to a cabinet. The drive module can be pulled from the cabinet for maintenance without disconnecting the power cables. Degree of protection IP20. (Not to be used with options +0B051 and 0H371.)</td>
</tr>
<tr>
<td>0P919</td>
<td>No installation ramp</td>
</tr>
</tbody>
</table>

Control panel and control unit

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P905</td>
<td>Internal drive control unit (attached to the power module).</td>
</tr>
<tr>
<td>0J400</td>
<td>No control panel and no control panel holder. Note: You need at least one loose control panel to be able to commission the drive.</td>
</tr>
<tr>
<td>J410</td>
<td>DPMP-01 door mounting kit (flush mounting) for the control panel. Includes a control panel mounting platform, an IP54 cover and a 3-meter panel connection cable.</td>
</tr>
<tr>
<td>J413</td>
<td>DPMP-02 door mounting kit (surface mounting) for the control panel. Includes a control panel mounting platform, an IP65 cover and a 3-meter panel connection cable.</td>
</tr>
<tr>
<td>J414</td>
<td>Control panel holder mounted on the drive module (requires option +P905).</td>
</tr>
<tr>
<td>J425</td>
<td>ACS-AP-I Assistant control panel</td>
</tr>
</tbody>
</table>

Filters

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E202</td>
<td>External EMC filter (ARFI-10) for first environment TN (grounded) system, category C2. Requires option +E208. Available for ACS880-04-xxxx-3 and -5 types only.</td>
</tr>
<tr>
<td>E208</td>
<td>Common mode filter</td>
</tr>
<tr>
<td>E210</td>
<td>EMC filter, for second environment TN (grounded) and IT (ungrounded) systems, category C3.</td>
</tr>
</tbody>
</table>

Fieldbus adapter modules

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>K451</td>
<td>FDNA-01 DeviceNet™ fieldbus adapter module</td>
</tr>
<tr>
<td>K454</td>
<td>TPBA-01 PROFIBUS DP fieldbus adapter module</td>
</tr>
<tr>
<td>K457</td>
<td>FCAN-01 CANopen fieldbus adapter module</td>
</tr>
<tr>
<td>K458</td>
<td>FSCA-01 Modbus adapter module</td>
</tr>
<tr>
<td>K462</td>
<td>FSCA-01 ControllerNet fieldbus adapter module</td>
</tr>
<tr>
<td>K469</td>
<td>FCAC-01 EtherCAT® fieldbus adapter module</td>
</tr>
<tr>
<td>K470</td>
<td>FEPL-02 Ethernet POWERLINK fieldbus adapter module</td>
</tr>
<tr>
<td>K473</td>
<td>FENA-11 EtherNet/IP™, Modbus/TCP and PROFINET IO fieldbus adapter module</td>
</tr>
<tr>
<td>K475</td>
<td>FENA-21 EtherNet/IP™, Modbus/TCP and PROFINET IO fieldbus adapter module, 2-port</td>
</tr>
</tbody>
</table>

I/O extension and feedback interface modules

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L500</td>
<td>FIO-11 analog I/O extension module</td>
</tr>
<tr>
<td>L501</td>
<td>FIO-01 digital I/O extension module</td>
</tr>
<tr>
<td>L502</td>
<td>FEN-31 TTL encoder interface module</td>
</tr>
<tr>
<td>L503</td>
<td>FDCC-01 optical DDCS communication module</td>
</tr>
<tr>
<td>L508</td>
<td>FDCC-02 optical DDCS communication module</td>
</tr>
<tr>
<td>L515</td>
<td>FEI-03 F-series extension adapter</td>
</tr>
<tr>
<td>L516</td>
<td>FEN-21 resolver interface module</td>
</tr>
<tr>
<td>L517</td>
<td>FEN-01 TTL encoder interface module</td>
</tr>
<tr>
<td>L518</td>
<td>FEN-11 absolute encoder interface module</td>
</tr>
<tr>
<td>L521</td>
<td>FSE-31 pulse encoder interface. Requires option +Q972.</td>
</tr>
</tbody>
</table>
L525 FAIO-01 analog I/O extension module
L526 FDIO-01 digital I/O extension module
L536 FPTC-01 thermistor protection module
L537 FPTC-02 ATEX-certified thermistor protection module. Requires option +Q971.

Control program
N7502 Enables setting of synchronous reluctance motor parameters in the drive control program.

Programmability
N8010 Drive application programming (CODESYS)

Safety
Q971 ATEX-certified Safe motor disconnection function using the drive Safe torque off function
Q972 FSO-21 safety functions module
Q973 FSO-12 safety functions module
Q982 PROFIsafe with FSO-xx safety functions module and FENA-21 Ethernet adapter module Requires option +Q972 or +Q973 and option +K475.

Warranty
P904 Extended warranty 24/30

Paper manuals. Note: The delivered manual set can include manuals in English if the translation is not available.
R700 English
R701 German
R702 Italian
R703 Dutch
R704 Danish
R705 Swedish
R706 Finnish
R707 French
R708 Spanish
R709 Portuguese (spoken in Portugal)
R711 Russian
R713 Polish
R714 Turkish

Code | Description
--- | ---
L525 | FAIO-01 analog I/O extension module
L526 | FDIO-01 digital I/O extension module
L536 | FPTC-01 thermistor protection module
L537 | FPTC-02 ATEX-certified thermistor protection module. Requires option +Q971.
Guidelines for planning the cabinet 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
You must always plan and make the installation 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.

Installation positions of the drive module
The drive module must be installed in an upright bookshelf or flat position in a cabinet.

Basic requirements for the cabinet
Use a cabinet which
• has a frame sturdy enough to carry the weight of the drive components, control circuitry and other equipment installed in it
• protects the user and drive module against contact and agrees with the requirements for dust and humidity
• has sufficient air inlet and outlet gratings that allow free flow of cooling air through the cabinet. This is critical for proper cooling of the drive module.
Planning the layout of the cabinet

Plan a spacious layout to ensure easy installation and maintenance. Sufficient cooling air flow, obligatory clearances, cables and cable support structures all require space.

Place the control board(s) away from:
- main circuit components such as contactors, switches and power cables
- hot parts (heat sink, air outlet of the drive module).
**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.

---

**Diagram Description**

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 page 47).
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

**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 page 192.
Guidelines for planning the cabinet installation

- Layout example, door open (standard drive module configuration)

1. Supporting frame of the cabinet
2a. Vertical (2a) and horizontal (2b) air baffles that separate the cool and hot areas (leak-proof entries). See also page 52.
2c. Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see 1b on page 44)
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: With an internal control unit (option +PR05), the upper door air inlet is critical for proper cooling of the control board.
11. External control cables
12. Grounding screws
13. Alternative to grounding screws (11)
14. Air flow to the roof
15. Air flow through the drive module
16. Air flow through the LCL filter
**Layout example, door open (option +0B051)**

This diagram shows a layout example for drive modules with no IP20 shrouds (option +0B051) or no cabling panels (option +H381 not included).

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 also page 52.
2e. Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see 1b on page 44).
3. Cabinet grounding busbar (PE)
4. Input power cable including the protective ground conductor (PE) of the drive
5. Disconnectors 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:** With an internal control unit (option +P905), the upper door air inlet is critical for proper cooling of the control board.
11. External control cables
12. Grounding screws
13. Alternative to grounding screws (11)
14. Air flow to the roof
15. Air flow through the drive module
16. Air flow to the LCL filter module
Note 1: The power cable shields can also be grounded to the drive module grounding terminals.

Note 2: See also section Required free space, page 55.

Arranging the grounding inside the cabinet

Arrange the grounding of the drive module by leaving the contact surfaces of the fastening points unpainted (bare metal-to-metal contact). The module frame will be grounded to the PE busbar of the cabinet via the fastening surfaces, screws and the cabinet frame. Alternatively, use a separate grounding conductor between the PE terminal of the drive module and the PE busbar of the cabinet.

Ground also the other components in the cabinet according to the principle above.

Selecting the busbar material and preparation of the joints

Note the following when you use busbars:
- Tin-plated copper is recommended but aluminum can also be used.
- The oxide layer from aluminum busbar joints must be removed and suitable anti-oxidant joint compound applied.

Tightening torques

Apply the following torques to grade 8.8 screws (with or without joint compound) that tighten electric contacts.

<table>
<thead>
<tr>
<th>Screw size</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>3.5 N·m (2.6 lbf·ft)</td>
</tr>
<tr>
<td>M6</td>
<td>9 N·m (6.6 lbf·ft)</td>
</tr>
<tr>
<td>M8</td>
<td>20 N·m (14.8 lbf·ft)</td>
</tr>
<tr>
<td>M10</td>
<td>40 N·m (29.5 lbf·ft)</td>
</tr>
<tr>
<td>M12</td>
<td>70 N·m (52 lbf·ft)</td>
</tr>
<tr>
<td>M16</td>
<td>180 N·m (133 lbf·ft)</td>
</tr>
</tbody>
</table>

Planning the fastening of the cabinet

Note the following when you plan the fastening of the cabinet:
- Fasten the cabinet to the floor from the front and to the floor or wall from the back.
- Always fasten the drive module from its fastening points to the cabinet. For details, see the module installation instructions.

WARNING! Do not fasten the cabinet by electric welding. ABB does not assume any liability for damages caused by electric welding as the welding circuit can damage electronic circuits in the cabinet.
Planning the cabinet placement on a cable channel

Note the following when you plan to place the cabinet on a cable channel:

• The cabinet structure must be sturdy enough. If the whole cabinet base is not supported from below, the cabinet weight will lie on the sections that the floor carries.

• Equip the cabinet with a sealed bottom plate and cable entries to ensure the degree of protection and to prevent the cooling air flow from the cable channel into the cabinet.

   **Note**: When the bottom grille and clear plastic shrouds around the motor cables are installed, the degree of protection of the drive module from bottom side is IP20.

Planning the electromagnetic compatibility (EMC) of the cabinet

Note the following when you plan the electromagnetic compatibility of the cabinet:

• Generally, the fewer and smaller the holes in the cabinet, the better the interference attenuation. The maximum recommended diameter of a hole in galvanic metal contact in the covering cabinet structure is 100 mm (3.94 in). Pay special attention to the cooling air inlet and outlet gratings.

• The best galvanic connection between the steel panels is achieved by welding them together as no holes are necessary. If welding is not possible, we recommend to leave the seams between the panels *unpainted* and equipped with special conductive EMC strips to provide adequate galvanic connection. Usually, reliable strips are made of flexible silicon mass covered with a metal mesh. The non-tightened touch-contact of the metal surfaces is not sufficient, so a conductive gasket between the surfaces is required. The maximum recommended distance between assembly screws is 100 mm (3.94 in).

• Construct sufficient high-frequency grounding network in the cabinet to avoid voltage differences and forming of high-impedance radiator structures. A good high-frequency grounding is made with short flat copper braids for low inductance. One-point high-frequency grounding cannot be used due to the long distances inside the cabinet.

• 360° high frequency grounding of the cable shields at the cable entries improves the EMC shielding of the cabinet.
• We recommend 360° high frequency grounding of the motor cable shields at their entries. The grounding can be implemented by a knitted wire mesh screening as shown below.

![Diagram of motor cable shielding](image1)

1. Cable
2. Cable tie
3. Strain relief
4. Bare cable shield
5. Knitted wire mesh
6. Cable entry plate

• We recommend 360° high frequency grounding of the control cable shields at their entries. The shields can be grounded by means of conductive shielding cushions pressed against the cable shield from both directions as shown below:

![Diagram of control cable shielding](image2)

1. Tightening screw
2. EMI conductive cushion
3. Strain relief
4. Grommet
5. Cable entry plate

Planning the cooling

Note the following guidelines when you plan the cooling of the cabinet:
• Ventilate the installation site sufficiently so that the cooling air flow and ambient temperature requirements of the drive module are met, see pages 192 and 196. The internal cooling fan of the drive module rotates at a constant speed thus blowing constant air flow through the module. Whether the same amount of air must be replaced all the time in the facility depends on how much heat must be removed.
• Leave enough free space around the components to ensure sufficient cooling. Observe the minimum clearances given for each component. For the required free space around the drive module, see page 55.
• Also ventilate the heat dissipated by cables and other additional equipment.
• **Make sure that the air inlets and outlets are large enough to allow sufficient air flow in and out of the cabinet.** This is critical for proper cooling of the drive module.

• Equip the air inlets and outlets with gratings that
  - guide the air flow
  - protect against contact
  - prevent water splashes from entering the cabinet.

• The drawings below shows two typical cabinet cooling solutions. The air inlet is at the bottom of the cabinet, while the outlet is on the roof on the upper part of the door. Use extra exhaust fans if the air outlet is on the cabinet door, see page 192 for the required cooling air flow.

• The internal cooling fans of the power and LCL filter modules are usually sufficient to keep the component temperatures low enough in IP22 cabinets.

• In IP54 cabinets, thick filter mats are used to prevent water splashes from entering the cabinet. This requires the installation of additional cooling equipment, such as a hot air exhaust fan.
Preventing the recirculation of hot air

Prevent hot air circulation outside the cabinet by leading the outcoming hot air away from the area where the inlet air to the cabinet is taken. Possible solutions are listed below:

• gratings that guide air flow at the air inlet and outlet
• air inlet and outlet at different sides of the cabinet
• cool air inlet in the lower part of the front door, and an extra exhaust fan on the roof of the cabinet.

Prevent hot air circulation inside the cabinet with, for example, leak-proof air baffles. No gaskets are usually required.
### Bookshelf mounting (standard drive module configuration)

This diagram shows the air baffle position inside an example cabinet. For dimensions of the baffle, see page 212.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air flow to the drive modules, max. 40 °C (104 °F)</td>
<td>5</td>
</tr>
<tr>
<td>2a</td>
<td>Vertical air baffle that separates the cool and hot areas in the cabinet</td>
<td>6</td>
</tr>
<tr>
<td>2b</td>
<td>Horizontal air baffle</td>
<td>7</td>
</tr>
<tr>
<td>2c</td>
<td>Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see 2 on page 44)</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Drive module</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>LCL filter module</td>
<td></td>
</tr>
</tbody>
</table>
Guidelines for planning the cabinet installation

- Bookshelf mounting (option +0B051)

This diagram shows air baffle positions inside an example cabinet. For the descriptions, see the next page.
Guidelines for planning the cabinet installation

- **Bookshelf mounting (option +H381)**

  See chapter *Installation example with full cabling panels (option +H381)* on page 137.

**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 of free space at the top of the drive module]

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air flow to the drive module, max. 40 °C (104 °F)</td>
<td>4 LCL filter module</td>
<td>5 Disconnector and fuses</td>
<td>6 Contactor</td>
<td>7 Drive control unit</td>
<td>8 Air flow out</td>
<td>9 Cabinet grounding busbar (PE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a Vertical air baffle that separates the cool and hot areas in the cabinet</td>
<td>2b Vertical air baffle</td>
<td>2c Upper horizontal air baffle</td>
<td>2d Lower horizontal air baffle</td>
<td>2e Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see 1b on page 44).</td>
<td>3 Drive module</td>
<td></td>
<td></td>
<td></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:

- When the control unit is inside the drive module (option +P905), the control panel can be integrated in the drive module (option +J414).
- The control panel can be mounted onto the cabinet door using a control panel mounting platform (options +J410 and +J413). For the installation instructions, refer to DPMP-01 mounting platform for ACS-AP control panel (3AU0000100140 [English]) or DPMP-02 mounting platform for ACS-AP-X control panel (3AU0000136205 [English]).

**Planning the use of cubicle heaters**

Use a cubicle heater if there is a risk of condensation in the cabinet. Although the primary function of the heater is to keep the air dry, it may also be required for heating at low temperatures.

**ABB air inlet and outlet kits**

See section *Cabinet ventilation* on page 176.
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.

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 obeyed, the drive can experience problems that the warranty does not cover.
Selecting the supply disconnecting device

Install a hand-operated input disconnecting device between the AC power source and the drive. The disconnecting device must be of a type that can be locked to the open position for installation and maintenance work.

- **European Union**
  
  To agree with the European Union Directives, according to standard EN 60204-1, *Safety of Machinery*, the disconnecting device must be one of the following types:
  - switch-disconnector of utilization category AC-23B (EN 60947-3)
  - disconnector that has an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector (EN 60947-3)
  - circuit breaker suitable for isolation in accordance with EN 60947-2.

- **Other regions**
  
  The disconnecting device must conform to the applicable safety regulations.

Selecting the main contactor

If a main contactor is used, its utilization category (number of operations under load) must be AC-1 according to IEC 60947-4, *Low-voltage switchgear and controlgear*. Select the contactor according to the nominal voltage and current of the drive.

Examining the compatibility of the motor and drive

Use an asynchronous AC induction motor, permanent magnet motor, AC induction servomotor or ABB synchronous reluctance motor (SynRM motor) with the drive. Several induction motors can be connected at a time.

Select the motor size and drive type from the rating tables in chapter *Technical data* on basis of the AC line voltage and motor load. Use the DriveSize PC tool if you need to tune the selection more in detail.

Make sure that the motor withstands the maximum peak voltage in the motor terminals, see the *Requirements table* on page 59. For basics of protecting the motor insulation and bearings in drive systems, refer to section *Protecting the motor insulation and bearings* below.

**Note:**
- Consult the motor manufacturer before you use a motor which nominal voltage differs from the AC line voltage connected to the drive input.
- The voltage peaks at the motor terminals are relative to the supply voltage of the drive, not the drive output voltage.
- If the motor and drive are not of the same size, consider the following operation limits of the drive control program:
  - motor nominal voltage range $1/6 \ldots 2 \cdot U_N$
  - motor nominal current range $1/6 \ldots 2 \cdot I_N$ of the drive in DTC control and $0 \ldots 2 \cdot I_N$ in scalar control. The control mode is selected by a drive parameter.
Guidelines for planning the electrical installation  59

- Protecting the motor insulation and bearings

The drive uses modern IGBT inverter technology. Regardless of frequency, the drive output has pulses of approximately the drive DC bus voltage with a very short rise time. Up to twice bus voltage can be at the motor terminals, depending on the attenuation and reflection properties of the motor cable and the terminals. The increased voltage can cause additional stress on the motor and motor cable insulation.

Modern variable speed drives with their fast rising voltage pulses and high switching frequencies can generate current pulses that flow through the motor bearings. This can gradually erode the bearing races and rolling elements.

Optional du/dt filters protect motor insulation system and reduce bearing currents. Optional common mode filters mainly reduce bearing currents. Insulated N-end (non-drive end) bearings protect the motor bearings.

- Requirements table

The following table shows how to select the motor insulation system and when optional ABB du/dt filters, insulated N-end (non-drive end) motor bearings and ABB common mode filters are required. Failure of the motor to fulfill the following requirements or improper installation may shorten motor life or damage the motor bearings and voids the motor warranty.

<table>
<thead>
<tr>
<th>Motor type</th>
<th>Nominal AC supply voltage</th>
<th>Requirement for ABB du/dt and common mode filters, insulated N-end motor bearings</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB motors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Random-wound M2_, M3_ and M4_</td>
<td>U_N ≤ 500 V</td>
<td>Standard: + N, + N + CMF</td>
</tr>
<tr>
<td></td>
<td>500 V &lt; U_N ≤ 600 V</td>
<td>Standard: + N + du/dt, + N + du/dt + CMF</td>
</tr>
<tr>
<td></td>
<td>or</td>
<td>Reinforced: + N, + N + CMF</td>
</tr>
<tr>
<td></td>
<td>600 V &lt; U_N ≤ 690 V (cable length ≤ 150 m)</td>
<td>Reinforced: + N + du/dt, + N + du/dt + CMF</td>
</tr>
<tr>
<td></td>
<td>600 V &lt; U_N ≤ 690 V (cable length &gt; 150 m)</td>
<td>Reinforced: + N, + N + CMF</td>
</tr>
<tr>
<td>Form-wound HX_ and AM_</td>
<td>380 V &lt; U_N ≤ 690 V</td>
<td>Standard: + N + CMF, + N + du/dt with voltages over 500 V + CMF</td>
</tr>
<tr>
<td>Old* form-wound HX_ and modular</td>
<td>380 V &lt; U_N ≤ 690 V</td>
<td>Check with the motor manufacturer.</td>
</tr>
</tbody>
</table>

* Old* form-wound HX_ and modular
### Guidelines for planning the electrical installation

The abbreviations used in the table are defined below.

#### Abbreviation | Definition
---|---
$U_N$ | Nominal AC line voltage
$U_{LL}$ | Peak line-to-line voltage at motor terminals which the motor insulation must withstand
$P_N$ | Motor nominal power
$du/dt$ | $du/dt$ filter at the output of the drive
CMF | Common mode filter (option +E208)
$N$ | N-end bearing (insulated motor non-drive end bearing)

#### Random-wound, HX, and AM motors

<table>
<thead>
<tr>
<th>Motor type</th>
<th>Nominal AC supply voltage</th>
<th>Requirement for ABB $du/dt$ and common mode filters, insulated N-end motor bearings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Motor insulation system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$100 , kW \leq P_N &lt; 350 , kW$ or $P_N \geq 350 , kW$ or frame size $&lt; IEC 400$ or frame size $&gt; NEMA 580$</td>
</tr>
<tr>
<td>0 V $&lt; U_N \leq 500$ V</td>
<td>+ N + CMF</td>
<td></td>
</tr>
<tr>
<td>500 V $&lt; U_N \leq 690$ V</td>
<td>$+ d_u/d_t + N + d_u/d_t + CMF$</td>
<td></td>
</tr>
</tbody>
</table>

#### Non-ABB motors

<table>
<thead>
<tr>
<th>Motor type</th>
<th>Nominal AC supply voltage</th>
<th>Requirement for ABB $du/dt$ and common mode filters, insulated N-end motor bearings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random-wound and form-wound</td>
<td>$U_N \leq 420$ V</td>
<td>Standard: $\bar{U}_{LL} = 1300$ V</td>
</tr>
<tr>
<td></td>
<td>$420$ V $&lt; U_N \leq 500$ V</td>
<td>Standard: $\bar{U}_{LL} = 1300$ V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$du/dt$ filter at the output of the drive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reinforced: $\bar{U}_{LL} = 1600$, 0.2 microsecond rise time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$+ N + CMF$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$+ d_u/d_t + (N + CMF)$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$+ N + d_u/d_t + CMF$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$+ N + CMF$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reinforced: $\bar{U}_{LL} = 1600$ V</td>
</tr>
<tr>
<td></td>
<td>$500$ V $&lt; U_N \leq 600$ V</td>
<td>Reinforced: $\bar{U}_{LL} = 1800$ V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ N or CMF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$+ d_u/d_t + (N + CMF)$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$+ N + d_u/d_t + CMF$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$+ N + CMF$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reinforced: $\bar{U}_{LL} = 1800$ V</td>
</tr>
<tr>
<td></td>
<td>$600$ V $&lt; U_N \leq 690$ V</td>
<td>Reinforced: $\bar{U}_{LL} = 2000$, 0.3 microsecond rise time$^{***}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N + CMF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$+ N + CMF$</td>
</tr>
</tbody>
</table>

$^{**}$ Manufactured before 1.1.1998

$^{***}$ If the intermediate DC circuit voltage of the drive is increased from the nominal level by resistor braking, consult the motor manufacturer if additional output filters are needed in the applied drive operation range.

The abbreviations used in the table are defined below.

---

1. Random
2. -wound
3. HX, and
4. AM
5. **
6. 0 V $< U_N < 500$ V
7. $+ N + CMF$
8. Enamelled wire with fiber glass taping
9. + N $+ d_u/d_t + CMF$
10. Consult the motor manufacturer.

$^{***}$ If the intermediate DC circuit voltage of the drive is increased from the nominal level by resistor braking, check with the motor manufacturer if additional output filters are needed in the applied drive operation range.
Additional requirements for explosion-safe (EX) motors

If you use an explosion-safe (EX) motor, obey the rules in the requirements table above. In addition, consult the motor manufacturer for any further requirements.

Additional requirements for ABB motors of types other than M2_, M3_, M4_, HX_ and AM_

Use the selection criteria given for non-ABB motors.

Additional requirements for the braking applications

When the motor brakes the machinery, the intermediate circuit DC voltage of the drive increases, the effect being similar to increasing the motor supply voltage by up to 20 percent. Consider this voltage increase when you specify the motor insulation requirements if the motor is braking a large part of its operation time.

Example: Motor insulation requirement for a 400 V AC line voltage application must be selected as if the drive were supplied with 480 V.

Additional requirements for ABB high-output and IP23 motors

The rated output power of high output motors is higher than what is stated for the particular frame size in EN 50347:2001. This table shows the requirements for ABB random-wound motor series (for example, M3AA, M3AP and M3BP).

<table>
<thead>
<tr>
<th>Nominal AC supply voltage</th>
<th>Requirement for Motor insulation system</th>
<th>ABB ( \frac{du}{dt} ) and common mode filters, insulated N-end motor bearings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 kW ≤ ( P_N ) &lt; 200 kW</td>
<td>( P_N ) ≥ 200 kW</td>
</tr>
<tr>
<td>100 kW ≤ ( P_N ) &lt; 268 hp</td>
<td>+ N</td>
<td>+ N + CMF</td>
</tr>
<tr>
<td>100 kW ≤ ( P_N ) ≥ 268 hp</td>
<td>+ ( \frac{du}{dt} ) + N</td>
<td>+ ( \frac{du}{dt} ) + N + CMF</td>
</tr>
<tr>
<td>500 V ≤ ( U_N ) ≤ 600 V</td>
<td>+ N</td>
<td>+ N + CMF</td>
</tr>
<tr>
<td>500 V ≤ ( U_N ) ≤ 690 V</td>
<td>+ ( \frac{du}{dt} ) + N</td>
<td>+ ( \frac{du}{dt} ) + N + CMF</td>
</tr>
</tbody>
</table>

Additional requirements for non-ABB high-output and IP23 motors

The rated output power of high output motors is higher than what is stated for the particular frame size in EN 50347:2001. The table below shows the requirements for random-wound and form-wound non-ABB motors with nominal power smaller than 350 kW. For bigger motors, consult the motor manufacturer.

<table>
<thead>
<tr>
<th>Nominal AC supply voltage</th>
<th>Requirement for Motor insulation system</th>
<th>ABB ( \frac{du}{dt} ) filter, insulated N-end bearing and ABB common mode filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 kW ≤ ( P_N ) &lt; 268 hp</td>
<td>+ N + CMF</td>
<td>+ N + CMF</td>
</tr>
<tr>
<td>200 kW ≤ ( P_N ) &lt; 268 hp</td>
<td>+ ( \frac{du}{dt} ) + N</td>
<td>+ ( \frac{du}{dt} ) + N + CMF</td>
</tr>
<tr>
<td>200 kW ≤ ( P_N ) ≥ 268 hp</td>
<td>+ N + CMF</td>
<td>+ N + CMF</td>
</tr>
<tr>
<td>500 V ≤ ( U_N ) ≤ 600 V</td>
<td>+ ( \frac{du}{dt} ) + N</td>
<td>+ ( \frac{du}{dt} ) + N + CMF</td>
</tr>
<tr>
<td>500 V ≤ ( U_N ) ≤ 690 V</td>
<td>+ N + CMF</td>
<td>+ N + CMF</td>
</tr>
</tbody>
</table>
### Nominal AC supply voltage

<table>
<thead>
<tr>
<th>Requirement for Motor insulation system</th>
<th>ABB du/dt filter, insulated N-end bearing and ABB common mode filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>600 V ≤ Uₙ ≤ 690 V</td>
<td>+ N + du/dt + CMF</td>
</tr>
<tr>
<td>Reinforced: Uₚₛ = 1800 V</td>
<td>N + CMF</td>
</tr>
<tr>
<td>Reinforced: Uₚₛ = 2000 V</td>
<td></td>
</tr>
<tr>
<td>0.3 microsecond rise time ***</td>
<td></td>
</tr>
</tbody>
</table>

***If the intermediate DC circuit voltage of the drive is increased from the nominal level by resistor braking, check with the motor manufacturer if additional output filters are needed in the applied drive operation range.

### Additional data for calculating the rise time and the peak line-to-line voltage

The diagrams below show the relative peak line-to-line voltage and rate of change of voltage as a function of the motor cable length with and without a du/dt filter in use.

To calculate the actual peak voltage for a certain cable length read the relative \( \frac{U_{LL}}{U_N} \) value from the appropriate diagram and multiply it by the nominal supply voltage (\( U_N \)).

To calculate the actual voltage rise time for a certain cable length read the relative values \( \frac{U_{LL}}{U_N} \) and \( \frac{du}{dt}/U_N \) from the appropriate diagram. Multiply the values by the nominal supply voltage (\( U_N \)) and substitute into equation \( t = 0.8 \cdot \frac{U_{LL}}{(du/dt)} \).

### Additional note for sine filters

Sine filters protect the motor insulation system. Therefore, the du/dt filter can be replaced with a sine filter. The peak phase-to-phase voltage with the sine filter is approximately 1.5 \( \cdot U_N \).

### Additional note for common mode filters

Common mode filters are available as plus code option +E208.

---

**Note:** \( U_{LL} \) and du/dt values are approximately 20% higher with resistor braking.
Selecting the power cables

General rules

Select the input power and motor cables according to local regulations:

- Select a cable capable of carrying the drive nominal current. See section Ratings (page 183) for the rated currents.
- Select a cable rated for at least 70 °C (158 °F) maximum permissible temperature of conductor in continuous use. For US, see Additional US requirements, page 66.
- The inductance and impedance of the PE conductor/cable (grounding wire) must be rated according to permissible touch voltage appearing under fault conditions (so that the fault point voltage will not rise excessively when a ground fault occurs).
- 600 V AC cable is accepted for up to 500 V AC. 750 V AC cable is accepted for up to 600 V AC. For 690 V AC rated equipment, the rated voltage between the conductors of the cable should be at least 1 kV.

Use symmetrical shielded motor cables (see page 66). Ground motor cable shields 360° at both ends. Keep the motor cable and its PE pigtail (twisted shield) as short as possible to reduce high-frequency electromagnetic emissions.

Note: When continuous metal conduit is employed, shielded cable is not required. The conduit must have bonding at both ends.

A four-conductor system is allowed for input cabling, but shielded symmetrical cable is recommended.

Compared to a four-conductor system, the use of symmetrical shielded cable reduces electromagnetic emission of the whole drive system as well as the stress on motor insulation, bearing currents and wear.

The protective conductor must always have an adequate conductivity.

Unless local wiring regulations state otherwise, the cross-sectional area of the protective conductor must agree with the conditions that require automatic disconnection of the supply required in 411.3.2. of IEC 60364-4-41:2005 and be capable of withstanding the prospective fault current during the disconnection time of the protective device.

The cross-sectional area of the protective conductor can either be selected from the table below or calculated according to 543.1 of IEC 60364-5-54.

This table shows the minimum cross-sectional area related to the phase conductor size according to IEC 61800-5-1 when the phase conductor and the protective conductor are made of the same metal. If this is not so, the cross-sectional area of the protective earthing conductor shall be determined in a manner which produces a conductance equivalent to that which results from the application of this table.

<table>
<thead>
<tr>
<th>Cross-sectional area of the phase conductors S (mm²)</th>
<th>Minimum cross-sectional area of the corresponding protective conductor S_p (mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S ≤ 16</td>
<td>S</td>
</tr>
<tr>
<td>16 &lt; S ≤ 35</td>
<td>16</td>
</tr>
<tr>
<td>35 &lt; S</td>
<td>S/2</td>
</tr>
</tbody>
</table>

---

Guidelines for planning the electrical installation 63
Guidelines for planning the electrical installation

**Typical power cable sizes**

The table below gives copper and aluminum cable types with concentric copper shield for the drives with nominal current. See also Terminal and entry data for the power cables on page 193.

<table>
<thead>
<tr>
<th>Drive type IEC AC55880-1434-</th>
<th>Cu cable type</th>
<th>mm²</th>
<th>AWG/kcmil</th>
<th>Cu cable type</th>
<th>mm²</th>
<th>AWG/kcmil</th>
<th>Al cable type</th>
<th>mm²</th>
<th>AWG/kcmil</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>U N = 400 V</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>246A-3</td>
<td>3 × (3×95)</td>
<td>3 × (3×150)</td>
<td>2×400 MCM or 3×4/0</td>
<td>2×600 MCM or 3×300 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>293A-3</td>
<td>3 × (3×95)</td>
<td>3 × (3×150)</td>
<td>2×500 MCM or 3×250 MCM</td>
<td>2×700 MCM or 3×350 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>363A-3</td>
<td>3 × (3×95)</td>
<td>3 × (3×150)</td>
<td>2×500 MCM or 3×250 MCM</td>
<td>2×700 MCM or 3×350 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>505A-3</td>
<td>3 × (3×95)</td>
<td>3 × (3×150)</td>
<td>2×500 MCM or 3×250 MCM</td>
<td>2×700 MCM or 3×350 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>585A-3</td>
<td>3 × (3×120)</td>
<td>3 × (3×185)</td>
<td>2×600 MCM or 3×300 MCM</td>
<td>3×400 MCM or 4×250 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>650A-3</td>
<td>3 × (3×120)</td>
<td>3 × (3×185)</td>
<td>2×700 MCM or 3×350 MCM</td>
<td>3×400 MCM or 4×250 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>725A-3</td>
<td>3 × (3×150)</td>
<td>3 × (3×240)</td>
<td>2×700 MCM or 3×350 MCM</td>
<td>3×400 MCM or 4×250 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>U N = 500 V</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>240A-5</td>
<td>3 × (3×95)</td>
<td>3 × (3×150)</td>
<td>2×400 MCM or 3×4/0</td>
<td>2×600 MCM or 3×300 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>260A-5</td>
<td>3 × (3×95)</td>
<td>3 × (3×150)</td>
<td>2×400 MCM or 3×4/0</td>
<td>2×600 MCM or 3×300 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>302A-5</td>
<td>3 × (3×95)</td>
<td>3 × (3×150)</td>
<td>2×400 MCM or 3×4/0</td>
<td>2×600 MCM or 3×300 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>361A-5</td>
<td>3 × (3×95)</td>
<td>3 × (3×150)</td>
<td>2×400 MCM or 3×4/0</td>
<td>2×600 MCM or 3×300 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>414A-5</td>
<td>3 × (3×95)</td>
<td>3 × (3×150)</td>
<td>2×400 MCM or 3×4/0</td>
<td>2×600 MCM or 3×300 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>466A-5</td>
<td>3 × (3×95)</td>
<td>3 × (3×150)</td>
<td>2×400 MCM or 3×4/0</td>
<td>2×600 MCM or 3×300 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>503A-5</td>
<td>3 × (3×120)</td>
<td>3 × (3×185)</td>
<td>2×600 MCM or 3×300 MCM</td>
<td>3×500 MCM or 4×300 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>583A-5</td>
<td>3 × (3×120)</td>
<td>3 × (3×185)</td>
<td>2×600 MCM or 3×300 MCM</td>
<td>3×500 MCM or 4×300 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>U N = 690 V</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>142A-7</td>
<td>2 × (3×120)</td>
<td>3 × (3×120)</td>
<td>2×250 MCM or 3×2/0</td>
<td>2×350 MCM or 3×4/0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>174A-7</td>
<td>2 × (3×120)</td>
<td>3 × (3×120)</td>
<td>2×250 MCM or 3×2/0</td>
<td>2×350 MCM or 3×4/0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>210A-7</td>
<td>2 × (3×120)</td>
<td>3 × (3×120)</td>
<td>2×250 MCM or 3×2/0</td>
<td>2×350 MCM or 3×4/0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>271A-7</td>
<td>2 × (3×120)</td>
<td>3 × (3×120)</td>
<td>2×250 MCM or 3×2/0</td>
<td>2×350 MCM or 3×4/0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>330A-7</td>
<td>2 × (3×120)</td>
<td>3 × (3×120)</td>
<td>2×250 MCM or 3×2/0</td>
<td>2×350 MCM or 3×4/0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>370A-7</td>
<td>2 × (3×120)</td>
<td>3 × (3×120)</td>
<td>2×300 MCM or 3×3/0</td>
<td>2×400 MCM or 3×4/0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>430A-7</td>
<td>3 × (3×95)</td>
<td>3 × (3×120)</td>
<td>2×350 MCM or 3×4/0</td>
<td>2×500 MCM or 3×250 MCM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></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.
Alternative power cable types

The recommended and not allowed power cable types to be used with the drive are presented below.

**Recommended power cable types**

<table>
<thead>
<tr>
<th>Description</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. The shield must agree with the requirements of EC 61800-5-1, see page 63. Check with local / state / country electrical codes for allowance.</td>
<td><img src="image1.png" alt="Diagram" /></td>
</tr>
<tr>
<td>Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. A separate PE conductor is required if the shield does not agree with the requirements of EC 61800-5-1, see page 63.</td>
<td><img src="image2.png" alt="Diagram" /></td>
</tr>
<tr>
<td>Symmetrical shielded cable with three phase conductors and symmetrically constructed PE conductor, and a shield. The PE conductor must agree with the requirements of EC 61800-5-1, see page 63.</td>
<td><img src="image3.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

**Power cable types for restricted use**

<table>
<thead>
<tr>
<th>Description</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>A four-conductor system (three phase conductors and a protective conductor on a cable tray) is <strong>not allowed for motor cabling</strong> (allowed for input cabling).</td>
<td><img src="image4.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

**Not allowed power cable types**

<table>
<thead>
<tr>
<th>Description</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symmetrical shielded cable with individual shields for each phase conductor is not allowed on any cable size for input and motor cabling.</td>
<td><img src="image5.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>
Motor cable shield

If the motor cable shield is used as the sole protective earth conductor of the motor, make sure that the conductivity of the shield is sufficient. See subsection General rules above, or EC 61800-5-1. To effectively suppress radiated and conducted radio-frequency emissions, the cable shield conductivity must be at least 1/10 of the phase conductor conductivity. The requirements are easily met with a copper or aluminum shield. The minimum requirement of the motor cable shield of the drive is shown below. It consists of a concentric layer of copper wires with an open helix of copper tape or copper wire. The better and tighter the shield, the lower the emission level and bearing currents.

Additional US requirements

Use type MC continuous corrugated aluminum armor cable with symmetrical grounds or shielded power cable for the motor cables if metallic conduit is not used. For the North American market, 600 V AC cable is accepted for up to 500 V AC. 1000 V AC cable is required above 500 V AC (below 600 V AC). For drives rated over 100 amperes, the power cables must be rated for 75 °C (167 °F).

Conduit

Couple separate parts of a conduit together: bridge the joints with a ground conductor bonded to the conduit on each side of the joint. Also bond the conduits to the drive enclosure and motor frame. Use separate conduits for input power, motor, brake resistor, and control wiring. When conduit is employed, type MC continuous corrugated aluminum armor cable or shielded cable is not required. A dedicated ground cable is always required.

Note: Do not install motor wiring from more than one drive in the same conduit.

Armored cable / shielded power cable

Six conductor (3 phases and 3 ground) type MC continuous corrugated aluminum armor cable with symmetrical grounds is available from the following suppliers (trade names in parentheses):

- Anixter Wire & Cable (Philsheath)
- BICC General Corp (Philsheath)
- Rockbestos Co. (Gardex)
- Oaknite (CLX).

Shielded power cables are available from Belden, LAPPKABEL (ÖLFLEX) and Pirelli.
Selecting the control cables

- **Shielding**
  
  All control cables must be shielded.
  
  Use a double-shielded twisted pair cable for analog signals. We recommend this type of cable for the pulse encoder signals also. Employ one individually shielded pair for each signal. Do not use common return for different analog signals.
  
  A double-shielded cable (figure a below) is the best alternative for low-voltage digital signals but single-shielded (b) twisted pair cable is also acceptable.

- **Signals in separate cables**
  
  Run analog and digital signals in separate, shielded cables. Never mix 24 V DC and 115/230 V AC signals in the same cable.

- **Signals allowed to be run in the same cable**
  
  Relay-controlled signals, providing their voltage does not exceed 48 V, can be run in the same cables as digital input signals. The relay-controlled signals should be run as twisted pairs.

- **Relay cable type**
  
  The cable type with braided metallic screen (for example ÖLFLEX by LAPPKABEL, Germany) has been tested and approved by ABB.

- **Control panel cable length and type**
  
  In remote use, the cable connecting the control panel to the drive must not exceed three meters (10 ft). Cable type: shielded CAT 5e or better Ethernet patch cable with RJ-45 ends.

- **Routing the cables**
  
  Route the motor cable away from other cable routes. Motor cables of several drives can be run in parallel when installed next to each other. The motor cable, input power cable and control cables should be installed on separate trays. Avoid long parallel runs of motor cables with other cables in order to decrease electromagnetic interference caused by the rapid changes in the drive output voltage.
  
  Where control cables must cross power cables, make sure they are arranged at an angle as near to 90 degrees as possible. Do not install extra cables through the drive.
  
  The cable trays must have good electrical bonding to each other and to the grounding electrodes. Aluminum tray systems can be used to improve local equalizing of potential
Guidelines for planning the electrical installation

A diagram of the cable routing is shown below.

**Separate control cable ducts**

Lead 24 V and 230 V (120 V) control cables in separate ducts unless the 24 V cable is insulated for 230 V (120 V) or insulated with an insulation sleeving for 230 V (120 V).

**Continuous motor cable shield or enclosure for equipment in the motor cable**

To minimize the emission level when safety switches, contactors, connection boxes or similar equipment are installed on the motor cable between the drive and the motor:

- **European Union:** Install the equipment in a metal enclosure with 360 degree grounding for the shields of both the incoming and outgoing cable, or connect the shields of the cables otherwise together.
- **US:** Install the equipment in a metal enclosure in a way that the conduit or motor cable shielding runs consistently without breaks from the drive to the motor.
Implementing thermal overload and short-circuit protection

- **Protecting the drive and input power cable in short-circuits**

Protect the drive with fuses (a) and the input cable with fuses (b) or a circuit breaker as shown below:

![Diagram of drive and input cable protection](image)

Size the fuses or the circuit breaker at the distribution board according to local regulations for the input cable protection. Select the fuses for the drive according to the instructions given in chapter *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 rating table on page 183, the fuses will 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.

**Circuit breakers**

AttR fuses must be used with circuit breakers.

- **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 dimensioned 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 input and 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 user can tune the thermal model further by feeding in additional motor and load data.

The most common temperature sensors are:
- motor sizes IEC 180…225: thermal switch, eg, Klixon
- motor sizes IEC 200…250 and larger: PTC or Pt100.

See the firmware manual for more information on the motor thermal protection, and the connection and use of the temperature sensors.

Protecting the drive against ground faults

The drive is equipped with an internal ground fault protective function to protect the drive against ground faults in the motor and motor cable in TN (grounded) networks. This is not a personal safety or a fire protection feature. The ground fault protective function can be disabled with a parameter, refer to the firmware manual.

Measures for protection in case of direct or indirect contact, such as separation from the environment by double or reinforced insulation or isolation from the supply system by a transformer, can be applied.

■ Residual current device compatibility

The drive is suitable to be used with residual current devices of Type B.

Note: The EMC filter of the drive includes capacitors connected between the main circuit and the frame. These capacitors and long motor cables increase the ground leakage current and can cause fault current circuit breakers to 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.

Implementing the Emergency stop function

For safety reasons, install the emergency stop devices at each operator control station and at other operating stations where emergency stop may be needed. You can implement the emergency stop function using the Safe torque off function of the drive module (see chapter Safe torque off function on page 217). Design the emergency stop according to relevant standards.

Note: Pressing the stop key 🟢 on the control panel of the drive does not generate an emergency stop of the motor or separate the drive from dangerous potential.

Implementing the Safe torque off function

See chapter Safe torque off function on page 217.
Implementing the ATEX-certified Safe motor disconnection function (option +Q971)

With option +Q971, the drive provides ATEX-certified safe motor disconnection without contactor using the drive Safe torque off function. For more information, see ACS880 ATEX-certified Safe disconnection function application guide (3AU0000132231 [English]) or FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) for ACS880 drives user’s manual (3AXD50000027782 [English]).

Implementing safety functions provided by the FSO safety functions module (options +Q972 and +Q973)

The drive can be equipped with an FSO-xx safety functions module (option +Q972 or +Q973) which enables the implementation of functions such as Safe brake control (SBC), Safe stop 1 (SS1), Safe stop emergency (SSE), Safely limited speed (SLS) and Safe maximum speed (SMS).

The settings of the FSO module are at default when delivered from the factory. The wiring of the safety circuit and configuration of the FSO module are the responsibility of the machine builder.

The FSO module reserves the standard Safe torque off (STO) connection of the drive control unit. STO can still be utilized by other safety circuits through the FSO.

For wiring instructions, safety data and more information on the functions provided by the options, see FSO-12 safety functions module user’s manual (3AXD50000015612 [English]) or FSO-21 safety functions module user’s manual (3AXD50000015614 [English]).

- Declaration of Conformity


Implementing the Power loss ride-through function

Implement the power loss ride-through function as follows:

1. Check that the power-loss ride-through function of the drive is enabled with parameter 30.31 Undervoltage control in the ACS880 primary control program.

2. If the installation is equipped with a main contactor, prevent its tripping at the input power break. For example, use a time delay relay (hold) in the contactor control circuit.

**WARNING!** Make sure that the flying restart of the motor will not cause any danger. If you are in doubt, do not implement the power-loss ride-through function.
Using power factor compensation capacitors with the drive

Power factor compensation is not needed with AC drives. However, if a drive is to be connected in a system with compensation capacitors installed, note the following restrictions.

**WARNING!** Do not connect power factor compensation capacitors or harmonic filters to the motor cables (between the drive and the motor). They are not meant to be used with AC drives and can cause permanent damage to the drive or themselves.

If there are power factor compensation capacitors in parallel with the three phase input of the drive:

1. Do not connect a high-power capacitor to the power line while the drive is connected. The connection will cause voltage transients that may trip or even damage the drive.
2. If capacitor load is increased/decreased step by step when the AC drive is connected to the power line, ensure that the connection steps are low enough not to cause voltage transients that would trip the drive.
3. Check that the power factor compensation unit is suitable for use in systems with AC drives, ie, harmonic generating loads. In such systems, the compensation unit should typically be equipped with a blocking reactor or harmonic filter.

Implementing a safety switch between the drive and the motor

We recommended that you install a safety switch between the permanent magnet motor and the drive output. The switch is needed to isolate the motor during any maintenance work on the drive.
Using a contactor between the drive and the motor

Implementing the control of the output contactor depends on how you select the drive to operate.

When you have selected to use DTC motor control mode and motor ramp stop, open the contactor as follows:

1. Give a stop command to the drive.
2. Wait until the drive decelerates the motor to zero speed.
3. Open the contactor.

When you have selected to use DTC motor control mode and motor coast stop, or scalar control mode, open the contactor as follows:

1. Give a stop command to the drive.
2. Open the contactor.

**WARNING!** When the DTC motor control mode is in use, never open the output contactor while the drive controls the motor. The DTC motor control operates extremely fast, much faster than it takes for the contactor to open its contacts. When the contactor starts opening while the drive controls the motor, the DTC control will try to maintain the load current by immediately increasing the drive output voltage to the maximum. This will damage, or even burn the contactor completely.

Protecting the contacts of relay outputs

Inductive loads (relays, contactors, motors) cause voltage transients when switched off. The relay contacts on the drive control unit are protected with varistors (250 V) against overvoltage peaks. In spite of this, it is highly recommended that inductive loads are equipped with noise attenuating circuits (varistors, RC filters [AC] or diodes [DC]) in order to minimize the EMC emission at switch-off. If not suppressed, the disturbances may connect capacitively or inductively to other conductors in the control cable and form a risk of malfunction in other parts of the system.
Install the protective component as close to the inductive load as possible. Do not install protective components at the relay outputs.

1) Relay outputs; 2) Varistor; 3) RC filter; 4) diode
Connecting a motor temperature sensor to the drive I/O

**WARNING!** IEC 60664 and IEC 61800-5-1 require double or reinforced insulation between live parts and the surface of accessible parts of electrical equipment which are either non-conductive or conductive but not connected to the protective earth.

To connect a motor temperature sensor and other similar components to the drive, you have four alternatives:

1. If there is double or reinforced insulation between the sensor and the live parts of the motor, you can connect the sensor directly to the analog/digital inputs of the drive.

2. If there is basic insulation between the sensor and the live parts of the motor, you can connect the sensor to the analog/digital inputs of the drive if all circuits connected to the drive’s digital and analog inputs (typically extra-low voltage circuits) are protected against contact and insulated with basic insulation from other low-voltage circuits. The insulation must be rated for the same voltage level as the drive main circuit. Note that extra-low voltage circuits (such as 24 V DC) typically do not meet these requirements.

3. You can connect the sensor to the drive via an option module. The sensor and the module must form a double or reinforced insulation between the motor live parts and the drive control unit. See section [Connection of motor temperature sensor to the drive via an option module](#).

4. You can connect the sensor to a digital input of the drive via a relay (internal option or customer’s external relay). The sensor and the relay must form a double or reinforced insulation between the motor live parts and the drive control unit. See section [Connection of motor temperature sensor to the drive via a relay](#).

### Connection of motor temperature sensor to the drive via an option module

This table shows:

- option module types that you can use for the motor temperature sensor connection
- insulation or isolation level that each option module forms between its temperature sensor connector and other connectors
- temperature sensor types that you can connect to each option module
- temperature sensor insulation requirement in order to form, together with the insulation of the option module, a double or reinforced insulation between the motor live parts and the drive control unit.

<table>
<thead>
<tr>
<th>Option module</th>
<th>Temperature sensor type</th>
<th>Temperature sensor insulation requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Insulation/isolation</td>
<td>PTC</td>
</tr>
<tr>
<td>FIO-11</td>
<td>Galvanic isolation between sensor connector and other connectors (including drive control unit connector)</td>
<td>-</td>
</tr>
<tr>
<td>FEN-xx</td>
<td>Galvanic isolation between sensor connector and other connectors (including drive control unit connector)</td>
<td>X</td>
</tr>
</tbody>
</table>
Guidelines for planning the electrical installation

1) Suitable for use in safety functions (SIL2 / PL c rated)

**Connection of motor temperature sensor to the drive via a relay**

**PTC alternative A.** This table shows the insulation requirement for a customer’s external relay, and the insulation requirement for the sensor to fulfill decisive voltage class A (double insulation) of IEC 60800-5-1.

<table>
<thead>
<tr>
<th>Option module</th>
<th>Temperature sensor type</th>
<th>Temperature sensor insulation requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAIO-01</td>
<td></td>
<td>Basic insulation between sensor connector and drive control unit connector. No insulation between sensor connector and other I/O connectors.</td>
</tr>
<tr>
<td>FPTC-xx 1)</td>
<td></td>
<td>Reinforced insulation between sensor connector and other connectors (including drive control unit connector).</td>
</tr>
</tbody>
</table>

1) Suitable for use in safety functions (SIL2 / PL c rated)

**External relay**

- Basic insulation 6 kV
- Basic insulation

**PTC relay**

- External relay

**PT100 relay**

- Insulation: Basic insulation 6 kV
- Insulation requirement between sensor and live parts of motor: Basic insulation

**Pt100 alternative A.** This table shows the insulation requirement for a customer’s external relay, and the insulation requirement for the sensor to fulfill decisive voltage class A (double insulation) of IEC 60800-5-1.

**Pt100 alternative B.** Decisive voltage class B of IEC 60800-5-1 (basic insulation) can be achieved when there is basic insulation between the sensor and live parts of the motor. Circuits connected to all motor protection relay inputs and outputs must be protected against direct contact.

**Example circuit diagram**

See page 215.
Installation instructions

Contents of this chapter
This chapter contains the general installation instructions for the drive module. The chapter refers to the installation example chapters which contain instructions that depend on the selected drive configuration.

Safety

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

Checking the installation site
The material below the drive must be non-flammable and strong enough to carry the weight of the drive.

See section Ambient conditions on page 196 for the allowed ambient conditions and section Losses, cooling data and noise on page 192 for the required cooling air.
Moving and unpacking the unit

WARNING! Obey the safety instructions in chapter Safety instructions. 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.

Unpack the package as follows (see the package drawing on page 78):
• Cut the straps.
• Lift the lid.
• Lift the sleeve.
• Unpack the top boxes (drive module package).
• Insert lifting hooks to the drive/LCL filter module lifting eyes and lift the module to the installation place.

Package drawings

Drive module package without option +E202

Transport package contents

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></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, see page 84</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td>---</td>
<td>----</td>
</tr>
<tr>
<td></td>
<td>6</td>
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<tr>
<td></td>
<td>7</td>
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<td></td>
<td>8</td>
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<td>9</td>
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<td></td>
<td>10</td>
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<td></td>
<td>11</td>
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<tr>
<td></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>14</td>
</tr>
<tr>
<td>15–17</td>
<td>Cardboard support</td>
</tr>
<tr>
<td></td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>21</td>
</tr>
</tbody>
</table>
## Installation instructions

### Package with option +E202

<table>
<thead>
<tr>
<th>Number</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, see page 84</td>
</tr>
<tr>
<td>5</td>
<td>Center of gravity symbol</td>
</tr>
<tr>
<td>6</td>
<td>External control unit</td>
</tr>
<tr>
<td>7</td>
<td>Package EMC filter ARFI-10 (option +E202)</td>
</tr>
<tr>
<td>8</td>
<td>Package for LCL filter fan</td>
</tr>
<tr>
<td>9</td>
<td>Package for LCL filter pedestal</td>
</tr>
<tr>
<td>10</td>
<td>Telescopic extraction and insertion ramp</td>
</tr>
<tr>
<td>11</td>
<td>Package for option H370: Full-size input power cable connection terminals and PE busbar.</td>
</tr>
<tr>
<td>12</td>
<td>Plywood support</td>
</tr>
<tr>
<td>13</td>
<td>With standard drive module configuration: Clear plastic shrouds box and output cable connection terminals box. With option +H370 also input cable connection terminals box. See below for the box contents.</td>
</tr>
<tr>
<td>14</td>
<td>Lid for sleeve</td>
</tr>
<tr>
<td>15</td>
<td>Cardboard sleeve</td>
</tr>
<tr>
<td>16</td>
<td>Cardboard support</td>
</tr>
<tr>
<td>17</td>
<td>Pallet</td>
</tr>
<tr>
<td>18</td>
<td>Strap</td>
</tr>
<tr>
<td>19</td>
<td>VCI film or bag</td>
</tr>
</tbody>
</table>
Drive module with factory installed options and multilingual residual voltage warning sticker, fastening screws in a plastic bag, internal control unit with control cable clamp plate and factory installed optional modules (option P905), control panel and cable or control panel with door mounting kit (option +J410), delivery documents, printed multilingual installation and start-up quick guides and manuals CD. Other printed manuals with option +R700.

Boxes

<table>
<thead>
<tr>
<th>Shroud box with standard drive module configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Paper fill</td>
</tr>
<tr>
<td>2 Clear plastic shroud for output cabling</td>
</tr>
<tr>
<td>3 Cardboard box cover</td>
</tr>
<tr>
<td>4 Cardboard box bottom</td>
</tr>
<tr>
<td>5 Support</td>
</tr>
<tr>
<td>6 Bands</td>
</tr>
<tr>
<td>7 Back clear plastic shroud (lower)</td>
</tr>
<tr>
<td>8 Back clear plastic shroud (upper)</td>
</tr>
<tr>
<td>9 Front clear plastic shroud</td>
</tr>
<tr>
<td>10 Clear plastic shroud for input cabling</td>
</tr>
<tr>
<td>11 Top clear plastic shroud</td>
</tr>
<tr>
<td>12 Clear plastic shroud for input cable entry from side</td>
</tr>
<tr>
<td>13 Screws in a plastic bag</td>
</tr>
<tr>
<td>14 Metallic shroud without ground bar</td>
</tr>
<tr>
<td>15 Bottom grille and mounting bracket. Not used.</td>
</tr>
</tbody>
</table>
**Option +H381 box: Input power cabling panel parts**

| 1 | Screw package |
| 2 | Paper fill    |
| 3 | Code label    |
| 4 | Output power cabling panel |
| 5 | Input power cabling panel |
| 6 | Grounding busbar to be connected to the input power cabling panel and the drive module |
| 7 | Cardboard box bottom |
| 8 | Cardboard box cover |
| 9 | Rubber grommet |
| 10 | Strap |
| 11 | Support bracket |
| 12 | Top guide |

**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 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

1. Screw package
2. Telescopic extraction and insertion ramp
3. Cardboard box
### LCL filter module package

1. VCI bag
2. Plywood support
3. Lid for cardboard sleeve
4. Cardboard sleeve
5. Cardboard support
6. Pallet
7. Strap
8. LCL filter

### Accessories box

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Screw package, includes also spacers for FSO module installation</td>
</tr>
<tr>
<td>2</td>
<td>Rubber grommets for control unit cable entry holes in the middle front cover of the drive module</td>
</tr>
<tr>
<td>3</td>
<td>Bracket for attaching the drive module from top.</td>
</tr>
<tr>
<td>4</td>
<td>Cardboard box</td>
</tr>
</tbody>
</table>
Checking the delivery

Check that all items listed in section *Moving and unpacking the unit* are present.
Check that there are no signs of damage. Before attempting installation and operation, check the information on the type designation label of the drive to verify that the unit is of the correct type.

Installing the motor cable at the motor end

Ground the motor cable shield 360 degrees at the entry of the motor terminal box.

Checking the insulation of the assembly

- **Drive**

  Do not make any voltage tolerance 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.

- **Input cable**

  Check the insulation of the input cable according to local regulations before connecting it to the drive.
Motor and motor cable

Check the insulation of the motor and motor cable as follows:

1. Stop the drive and do the steps in section Precautions before electrical work on page 18 before you start the work.

2. Check that the motor cable is disconnected from the drive output terminals T1/U2, T2/V2 and T3/W2.

3. Measure the insulation resistance between each phase conductor and then between each phase conductor and the Protective Earth conductor using a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must exceed 100 Mohm (reference value at 25 °C or 77 °F). For the insulation resistance of other motors, consult the manufacturer’s instructions. Note: Moisture inside the motor casing will reduce the insulation resistance. If you suspect moisture, dry the motor and repeat the measurement.
Checking the compatibility with IT (ungrounded), corner-grounded delta, midpoint-grounded delta, and TT systems

- **EMC filter (option +E202)**
  A drive with EMC filter +E202 (ARFI-10) 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 EMC filter. See sections:
  - *When to disconnect EMC filter (option +E202) or ground-to-phase varistor: TN-S, IT, corner-grounded delta, and midpoint-grounded delta system on page 88*
  - *Guidelines for installing the drive to a TT system on page 88*
  - *Disconnecting EMC filter and ground-to-phase varistor on page 90.*

**WARNING!** Do not install the drive with EMC filter +E202 connected to a system that the filter is not suitable for. This can cause danger, or damage the drive.

**Note:** When the EMC filter is disconnected, the drive EMC compatibility is considerably reduced.

- **Ground-to-phase varistor**
  A drive with the 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 (option +E202) or ground-to-phase varistor: TN-S, IT, corner-grounded delta, and midpoint-grounded delta system on page 88*
  - *Guidelines for installing the drive to a TT system on page 88*
  - *Disconnecting EMC filter and ground-to-phase varistor on page 90.*

**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.
When to disconnect EMC filter (option +E202) or ground-to-phase varistor: TN-S, IT, corner-grounded delta, and midpoint-grounded delta system

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Symmetrically grounded TN systems (TN-S systems)</th>
<th>Corner-grounded and midpoint-grounded delta systems</th>
<th>IT systems (ungrounded or high-resistance-grounded (&gt;30 ohms))</th>
</tr>
</thead>
<tbody>
<tr>
<td>R11</td>
<td>Do not disconnect EMC AC or VAR screws. Do not disconnect ARFI-10.</td>
<td>Do not install the drive on a corner-grounded or mid-point grounded system.</td>
<td>Disconnect EMC AC and VAR screws. Disconnect ARFI-10</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. These screws and ARFI-10 have been disconnected. Otherwise EMC filter and ground-to-phase varistor capacitor leakage current will cause the residual current device to trip.

<table>
<thead>
<tr>
<th>Frame size</th>
<th>EMC filter (+E202)</th>
<th>Ground-to-phase varistor screws</th>
</tr>
</thead>
<tbody>
<tr>
<td>R11</td>
<td>EMC AC, ARFI-10</td>
<td>VAR</td>
</tr>
</tbody>
</table>
Note:

- Because the EMC filter has been disconnected, ABB does not guarantee the EMC category C2.
- ABB does not guarantee the functioning of the ground leakage detector built inside the drive.
- In large systems the residual current device can trip without a real reason.

Identifying different types of electrical power systems

To identify the electrical power system type, find out the supply transformer connection. If that is not possible, measure these voltages at the distribution board before you connect power to the drive:

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

The line-to-ground voltages in relation to the line-to-line voltage of the electrical power system types are shown below.

<table>
<thead>
<tr>
<th>(U_{\text{L-L}})</th>
<th>(U_{\text{L1-G}})</th>
<th>(U_{\text{L2-G}})</th>
<th>(U_{\text{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>0.5 X</td>
<td>0.5 X</td>
<td>0.57 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>
</tbody>
</table>
**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). Remove the ARFI-10 filter from the cabinet.
Installation alternatives

You can install the drive module into a cabinet using different procedures depending on the drive configuration.

- **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.

  ![Diagram of drive module and LCL filter module attachment](image)

  You can attach the modules to Rittal TS 8 cabinet with the mounting brackets delivered with the drive, see Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet on page 233.

- **Attaching the drive module to the LCL filter module**
  
  See chapter Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet on page 233.

- **Attaching the drive module and the LCL filter module to the cabinet base**
  
  See chapter Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet on page 233.

- **Alternatives for grounding the drive module**
  
  You can ground the drive module from its top back to the cabinet frame with these alternatives:
1. from the grounding hole

2. to a Rittal punched section with the mounting bracket.

- **Installing standard configuration in Rittal TS cabinet**

For an installation example on how to install the drive module with clear plastic shrouds into a Rittal TS 8 cabinet, see chapter *Installation example of the standard drive module configuration* on page 131 and *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on page 233.
Optional input power cable connection terminals and ground busbar assembly (+H370)

Install the metallic shroud with ground bar as shown below.

Drive module without full-size output cable connection terminals (option +0H371) and IP20 shrouds (option +0B051)

The power cables can be connected directly to the drive module input and output terminals with cable lugs or by busbars. The drive module can also be installed self standing on the floor in an electrical equipment room when the power cable terminals and electrical parts are protected against contact and the drive module is grounded properly.

Installing the EMC filter (option +E202)

See ARFI-10 EMC filter installation guide (3AFE 68317941 [English]).

Connecting the power cables

WARNING! Obey the safety instructions in chapter Safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.
### Power cable connection diagram

1. For alternatives, see section Selecting the supply disconnecting device on page 58. In the installing example of this chapter, the disconnecting device is not in the same cubicle 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. We recommend 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. We recommend 360-degree grounding at the cabinet entry, see page 49.
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 page 69).
Power cable connection procedure

**WARNING!** Obey the safety instructions in chapter Safety instructions. 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 page 193.
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 page 193.

Connecting the control cables and installing option modules

See chapter External control unit on page 99 or Internal control unit (option +P905) on page 119.

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<table>
<thead>
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<th></th>
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<tbody>
<tr>
<td>6</td>
<td>Common mode filter (optional, see page 59)</td>
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<tr>
<td>7</td>
<td>du/dt filter (optional, see page 229)</td>
</tr>
<tr>
<td>8</td>
<td>EMC filter (option +E202, see page 93)</td>
</tr>
<tr>
<td>9</td>
<td>The drive module frame must be connected to the cabinet frame. See section Arranging the grounding inside the cabinet on page 48 and Alternatives for grounding the drive module on page 91.</td>
</tr>
</tbody>
</table>

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.
Connecting a control panel

With external control unit and control panel holder mounted on the drive module (option +J414), put the control panel on the control panel holder.

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.
Controlling several drives from one control panel through panel bus

One control panel (or PC) can be used to control several drives by constructing a panel bus. An FDPI-02 module is required. For further information, see FDPI-02 diagnostics and panel interface user’s manual (3AUA0000113618 [English]).

1. Connect the panel to one drive using an Ethernet (eg. CAT5E) cable.
   • Use Menu – Settings – Edit texts – Drive to give a descriptive name to the drive.
   • Use parameter 49.01 to assign the drive with a unique node ID number.
   • Set other parameters in group 49 if necessary.
   • Use parameter 49.06 to validate any changes.
   Repeat the above for each drive.

2. With the panel connected to one drive, link the drives together using Ethernet cables. (Each panel platform has two connectors.)

3. In the last drive, switch bus termination on by moving the terminating switch into the outer position. Termination should be off on all other drives.

4. On the control panel, switch on the panel bus functionality (Options – Select drive – Panel bus). The drive to be controlled can now be selected from the list under Options – Select drive.

If a PC is connected to the control panel, the drives on the panel bus are automatically displayed in the Drive composer tool.

The maximum allowed length of the cable chain is 100 m (328 ft).
Connecting a PC

You need a control panel to connect a PC to the drive module. Connect the control panel to the drive control unit as described in section Connecting a control panel on page 96.

**WARNING!** Do not connect the PC directly to the control panel connector of the control unit as this can cause damage.

To connect a PC to the control panel with a USB data cable (USB Type A <-> USB Type Mini-B):

1. Lift the USB connector cover on the control panel from bottom upwards.
2. Insert the USB cable Mini-B plug in the control panel USB connector.
3. Insert the USB cable A-plug in the USB connector of the PC (a). -> The panel displays: USB connected (b).

**Note 1:** When a PC is connected to the control panel, the control panel keypad is disabled. In this case, the control panel acts as a USB-RS485 adapter.
External control unit

Contents of this chapter

This chapter contains:

- instructions on how to install the external control unit
- instructions on how connect the external control unit to the drive module
- instructions on how connect the control cables to the terminals of the control unit
- default I/O connection diagram with descriptions of the terminals
- Instruction on how to install option modules
- technical data for the external control unit.
Layout

The layout of external control connection terminals of the control unit is shown below.

<table>
<thead>
<tr>
<th>Description</th>
<th>XPOW</th>
<th>XAI</th>
<th>XAO</th>
<th>XD2D</th>
<th>XRO1</th>
<th>XRO2</th>
<th>XRO3</th>
<th>XD24</th>
<th>XDIO</th>
<th>XDI</th>
<th>XSTO</th>
<th>X12</th>
<th>X13</th>
<th>Slot 1</th>
<th>Slot 2</th>
<th>Slot 3</th>
<th>X205</th>
<th>J1, J2</th>
<th>J3</th>
<th>J6</th>
</tr>
</thead>
<tbody>
<tr>
<td>External power input</td>
<td>Analog inputs</td>
<td>Analog outputs</td>
<td>Drive to drive link</td>
<td>Relay output RO1</td>
<td>Relay output RO2</td>
<td>Relay output RO3</td>
<td>Start interlock connection (DIIL) and +24 V output</td>
<td>Digital input/outputs)</td>
<td>Digital inputs</td>
<td>Safe torque off connection</td>
<td>Connector for optional safety functions modules</td>
<td>Control panel connection</td>
<td>Option module</td>
<td>Option module</td>
<td>Option module</td>
<td>Memory unit</td>
<td>Voltage/Current selection jumpers (J1, J2) for analog inputs</td>
<td>Drive-to-drive link termination jumper</td>
<td>Common digital input ground selection jumper</td>
<td></td>
</tr>
</tbody>
</table>
Removing the control panel holder from the external control unit

1. Disconnect the control panel cable from connector X13 on the control unit.
2. Loosen the mounting screws of the control panel holder and take the holder off.
Attaching the control cable clamp plate

Attach the control cable clamp plate either to the top or base of the control unit with four screws as shown below.

**Note**: If you install the FSO-xx safety functions module above the control unit, fasten the control cable clamp plate on the base of the control unit. See section *Installing the FSO safety functions module (option +Q973)* on page 112.
Connecting the external control unit to the drive module

- **External control unit connection cables**

  The cables that are delivered with the drive module for connecting the drive module and control panel to the external control unit are shown below.

  **WARNING!** Handle the fiber optic cables with care. When unplugging optic cables, always grab the connector, not the cable itself. Do not touch the ends of the fibers with bare hands as the fiber is extremely sensitive to dirt.

- **Routing the control unit cables into the drive module**

  Route the control unit connection cables to the drive module through the slot in the middle front cover at the front or left side. First, remove the plate which covers the slot. Then, install the rubber grommet from the accessories box (item 2 in the drawing on page 84).
Connecting cables between the drive module and the control unit

In the drive module:
1. Connect power supply cable to terminal X2.
2. Connect the STO cable to the INU STO connector.
3. Connect the fiber optic cables to the QOIA V8, V13, V2 and V7 connectors.

In the control unit:
1. Pull the fiber optic, power supply and STO cables through the hollow back frame of the control unit.
2. Connect the cables to the ZBIB terminals.

<table>
<thead>
<tr>
<th>QOIA</th>
<th>ZBIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>X7 (STO1)</td>
<td>X7 (STO1)</td>
</tr>
<tr>
<td>X8 (STO2)</td>
<td>X8 (STO2)</td>
</tr>
<tr>
<td>X2</td>
<td>X3</td>
</tr>
<tr>
<td>V2</td>
<td>V2</td>
</tr>
<tr>
<td>V7</td>
<td>V1</td>
</tr>
<tr>
<td>V8</td>
<td>V21</td>
</tr>
<tr>
<td>V13</td>
<td>V22</td>
</tr>
</tbody>
</table>
Mounting the external control unit

The drive control unit can be fastened on a mounting plate through the fastening holes in its back or by using a DIN rail.

- Mounting the external control unit to wall
  1. Fasten the fastening screws in the wall.
  2. Lift the unit onto the screws and tighten the screws.

---

![Diagram of mounting process](image)
Mounting the external control unit vertically on a DIN rail
1. Fasten the latch (A) to the back of the control unit with three screws.
2. Click the control unit to the rail as shown below (B).

Mounting the control unit horizontally on a DIN rail
1. Fasten the latches (A) to the back of the control unit with three screws.
2. Click the control unit to the rail as shown below (B).
Connecting the control cables to the terminals of the control unit

1. Route the cables to the control unit as shown below.

2. 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, e.g., 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.

3. Connect the conductors to the appropriate detachable terminals of the control unit, see page 108. Use shrink tubing or insulating tape to contain any stray strands.

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.
### Default I/O connection diagram

#### Relay outputs

**Ready**
- NO: 13
- COM: 12
- NC: 11

**Running**
- NO: 23
- COM: 22
- NC: 21

**Faulted**
- NO: 33
- COM: 32
- NC: 31

#### External power input

- 24 V DC, 2 A
  - GND: 2
  - +24V: 1

#### Reference voltage and analog inputs

- J1, J2, XAI
  - A11/A12: Current/voltage selection
    - A1I: U
    - A12: I
  - A1U: U
  - A12: I

- By default not in use.
  - 0(4...20 mA, R<sub>n</sub> = 100 ohm)

- Speed reference
  - 0(1...10 V, R<sub>n</sub> > 200 kohm)
  - 10 V DC, R<sub>n</sub> = 10 kohm
  - +VREF: 2
  - -VREF: 3

#### Analog outputs

- Motor current 0...20 mA, R<sub>n</sub> < 500 ohm
  - A1: 4
  - A0: 3
  - A0: 1

- Motor speed rpm 0...20 mA, R<sub>n</sub> < 500 ohm
  - A1: 4
  - A0: 3
  - A0: 1

#### Drive-to-drive link

- Drive-to-drive link termination
  - ON: 2
  - OFF: 1

- Shield: 4

- Drive-to-drive link
  - BOND: 3
  - A: 2
  - B: 1

#### Safe torque off

- Safe torque off. Both circuits must be closed for the drive to start.
  - IN2: 4
  - IN1: 3
  - SO: 2
  - OUT: 1

#### Digital inputs

- By default not in use.
  - DI6: 5
  - DI5: 4
  - DI4: 3
  - DI3: 2
  - DI2: 1
  - DI1: 0

- Constant speed 1 select (1 = on)
  - DI6: 5

- Acceleration & deceleration select
  - DI4: 4

- Reset
  - DI3: 3

- Forward (0) / Reverse (1)
  - DI2: 2

- Stop (0) / Start (1)
  - DI1: 1

#### Ground selection

- X210

#### Digital input/outputs

- Output: Running
  - DIO2: 2

- Output: Ready
  - DIO1: 1

#### Control panel connection

- X13

#### Memory unit connection

- X205

---

Wire sizes and tightening torques: 0.5 - 2.5 mm² (24 - 14 AWG) and 0.5 N·m (4 lbf·in) for both stranded and solid wiring.

See page 109 for notes.
External control unit

Notes:

1) Current [0(4)…20 mA, $R_{in} = 100$ ohm] or voltage [0(2)…10 V, $R_{in} > 200$ kohm] input selected by jumper J1.
Change of setting requires reboot of control unit.

2) Current [0(4)…20 mA, $R_{in} = 100$ ohm] or voltage [0(2)…10 V, $R_{in} > 200$ kohm] input selected by jumper J2.
Change of setting requires reboot of control unit.

3) Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.

4) $0 = $Acceleration/deceleration ramps defined by parameters 23.12/23.13 in use.
$1 = $Acceleration/deceleration ramps defined by parameters 23.14/23.15 in use.

5) Constant speed 1 is defined by parameter 22.26.

6) Must be set to ON when the drive is the last unit on the drive-to-drive (XD2D) link.

7) Determines whether DICOM is separated from DIOGND (i.e. common reference for digital inputs floats).
See also Ground isolation diagram on page 117.

$\bullet$ DICOM connected to DIOGND. $\bullet$ DICOM and DIOGND separate.

8) See section DIL input (XD24:1) on page 111.

External power supply for the control unit

External +24 V (2 A) power supply for the control unit can be connected to terminal block XPOW. Using an external supply is recommended if

- the control board needs to be kept operational during input power breaks, for example, due to uninterrupted fieldbus communication
- immediate restart is needed after power breaks (that is, no control board power up delay is allowed).

See also the firmware manual, parameter 95.04.
AI1 and AI2 as Pt100, Pt1000, PTC and KTY84 sensor inputs (XAI, XAO)

Three Pt100, Pt1000 or PTC sensors or one KTY84 sensor for motor temperature measurement can be connected between an analog input and output as shown below. Do not connect both ends of the cable shields directly to ground. If a capacitor cannot be used at one end, leave that end of the shield unconnected.

1. Set the input type to voltage with switch J1 for analog input AI1 or with J2 for analog input AI2. 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 the 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.
DI6 (XI:6) as PTC sensor input

One PTC sensor can be connected to this input for motor temperature measurement as follows. The sum of the sensor resistances must not exceed the threshold resistance of the digital input at the motor normal operating temperature. Do not connect both ends of the cable shield directly to ground. If a capacitor cannot be used at one end, leave that end of the shield unconnected. See the firmware manual for the parameter settings.

![Diagram of DI6 as PTC sensor input]

**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 the 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.

DIL input (XD24:1)

The DIL input can be used for the connection of safety circuits. By default, the input is parametrized to stop the drive when the input signal is lost.

Drive-to-drive link (XD2D)

The drive-to-drive link is a daisy-chained RS-485 transmission line that can be used for:
- basic master/follower communication with one master drive and multiple followers
- fieldbus control through the embedded fieldbus interface (EFB), and
- drive-to-drive (D2D) communication implemented by application programming.

See the firmware manual of the drive for the related parameter settings.

Set termination activation jumper J3 next to this terminal block to the ON position on the drives at the ends of the drive-to-drive link. On intermediate drives, set the jumper to the OFF position.

Use shielded twisted-pair cable with a twisted pair for data and a wire or another pair for signal ground (nominal impedance 100 to 165 ohm, for example Belden 9842) for the wiring. For best immunity, ABB recommends high quality cable. Keep the cable as short as possible. Avoid unnecessary loops and running the cable near power cables (such as motor cables).
The following diagram shows the wiring of the drive-to-drive link.

Safe torque off (XSTO)
For the drive to start, both connections (OUT1 to IN1 and 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 Safe torque off function on page 217.

Safety functions module connection (X12)
See section Installing the FSO safety functions module (option +Q973) on page 112 and FSO-12 safety functions module user’s manual (3AXD50000015612 [English]).

Installing the control panel holder back onto the external control unit
Install the control panel holder back onto the external control unit in reverse order to removing it, see section Removing the control panel holder from the external control unit on page 101.

Installing optional modules

Installing the FSO safety functions module (option +Q973)
Install the FSO safety functions module in Slot 2 of the control unit as described below.

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

1. Stop the drive and do the steps in section Precautions before electrical work on page 18 before you start work.
2. If the bottom plate of the FSO-xx module looks different from that in the drawing below, remove the bottom plate and attach the alternative bottom plate from the FSO package to module.
3. Connect the FSO-xx data cable to connector X12 on the control unit.
4. Attach the FSO-xx module to Slot 2 with four screws.
5. Tighten the FSO module electronics grounding screw to 0.8 N·m. **Note:** The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.

6. Connect the FSO-xx data cable to FSO-xx connector X110.

7. Connect the Safe torque off four-wire cable to connector X111 on the module and to connector XSTO on the drive module control unit.

8. Connect the external +24 V power supply cable to connector X112.

9. Connect the other wires as shown in FSO-12 safety functions module user’s manual (3AXD50000015612 [English]) or FSO-21 safety functions module user’s manual (3AXD50000015614 [English]).
Installing I/O extension, fieldbus adapter and pulse encoder interface modules – external control unit

See page 38 for the available slots for each module.

---

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

1. Stop the drive and do the steps in section Precautions before electrical work on page 18 before you start work.
2. Insert the module carefully into its position on the control unit.
3. Tighten the grounding screw to torque of 0.8 N·m. **Note:** The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.

---

Wiring the optional modules

See the appropriate optional module manual for specific installation and wiring instructions.
Technical data (ZCU-14)

Power supply (XPOW)
Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
24 V (±10%) DC, 2 A
Supplied from the power unit of the drive, or from an external power supply through connector XPOW. Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG).

Relay outputs RO1…RO3 (XRO1 … XRO3)
Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
250 V AC / 30 V DC, 2 A
Protected by varistors
+24 V output (XD24-2 and XD24-4)
Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.

Digital inputs DI1…DI6 (XDI:1 … XDI:6)
Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
24 V logic levels: "0" < 5 V, "1" > 15 V
Input type: NPN/PNP (DI1…DI5), NPN (DI6)
Hardware filtering: 0.04 ms, digital filtering up to 8 ms
DI6 (XDI:6) can alternatively be used as an input for PTC sensors.
"0" > 4 kohm, "1" < 1.5 kohm

Start interlock input DIIL (XD24:1)
Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
24 V logic levels: "0" < 5 V, "1" > 15 V
Input type: NPN/PNP
Hardware filtering: 0.04 ms, digital filtering up to 8 ms

Digital inputs/outputs DIO1 and DIO2 (XDIO:1 and XDIO:2)
Input/output mode selection by parameters.
DIO1 can be configured as a frequency input (0…16 kHz with hardware filtering of 4 microseconds) for 24 V level square wave signal (sinusoidal or other wave form cannot be used). DIO2 can be configured as a 24 V level square wave frequency output. See the firmware manual, parameter group 11.

As inputs:
24 V logic levels: "0" < 5 V, "1" > 15 V
Input type: NPN/NPNP
Filtering: 0.25 ms

As outputs:
Total output current from +24VD is limited to 200 mA.

Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2)
Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
10 V ±1% and ~10 V ±1%, R_L = 1…10 kohm

Analog inputs AI1 and AI2 (XAI:4 … XAI:7)
Current/voltage input mode selection by jumpers. See page 100.
Current input: –20…20 mA
Voltage input: –10…10 V
Differential inputs, common mode range ±30 V
Sampling interval per channel: 0.25 ms
Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms
Resolution: 11 bit + sign bit
Inaccuracy: 1% of full scale range
Inaccuracy for Pt100 sensors: ±0.1 °C (±0.2 °F)
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**Analog outputs AO1 and AO2** (XAO)

- Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
- 0…20 mA, \( R_{\text{load}} < 500 \text{ ohm} \)
- Frequency range: 0…300 Hz
- Resolution: 11 bit + sign bit
- Inaccuracy: 2% of full scale range

**Drive-to-drive link (XD2D)**

- Connector pitch 5 mm, wire size 2.5 mm²
- Physical layer: RS-485
- Maximum cable length of the link: 50 m
- Cable type: Shielded twisted pair cable with twisted pair for data and a wire or pair for signal ground, nominal impedance 100…165 ohm, for example Belden 9842
- Transmission rate: 8 Mbit/s
- Termination by jumper

**Embedded Modbus RTU XD2D**

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

**Safe torque off connection (XSTO)**

- Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
- Input voltage range: -3…30 V DC
- Logic levels: "0" < 5 V, "1" > 19 V
- For the drive to start, both connections must be closed (OUT1 to IN1 and IN2)
- Current consumption: 50 mA (±24 V DC, continuous) per STO channel
- Maximum output current from OUT1 (24 V DC continuous): 100 mA
- EMC (immunity) according to IEC 61326-3-1

**Control panel / PC connection**

- Connector: RJ-45
- Cable length < 3 m (10 ft)

The terminals of the control unit fulfill the Protective Extra Low Voltage (PELV) requirements. The PELV requirements of a relay output are not fulfilled if a voltage higher than 48 V is connected to the relay output.
Ground isolation diagram

**Terms:***
- XPOW
- XAI
- XAO
- XRO1, XRO2, XRO3
- XDI
- XSTO
- XRD

**Notes:**
- Ground selector (J6) settings
  - Ground selector (J6) settings (ZCU-14)
    - All digital inputs share a common ground (DICOM connected to DIOGND). This is the default setting.

**Isolation voltage:** 50 V
External control unit
Internal control unit (option +P905)

Contents of this chapter

This chapter contains:
• layout of the control unit
• instructions on how to install the external control unit
• instructions on how connect the external control unit to the drive module
• instructions on how connect the control cables to the terminals of the control unit
• default I/O connection diagram with descriptions of the terminals
• Instruction on how to install option modules
• technical data for the external control unit.
Layout

The layout of external control connection terminals of the control unit is shown below.

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>XPOW External power input</td>
<td></td>
</tr>
<tr>
<td>XAI Analog inputs</td>
<td></td>
</tr>
<tr>
<td>XAO Analog outputs</td>
<td></td>
</tr>
<tr>
<td>XD2D Drive-to-drive link</td>
<td></td>
</tr>
<tr>
<td>XRO1 Relay output 1</td>
<td></td>
</tr>
<tr>
<td>XRO2 Relay output 2</td>
<td></td>
</tr>
<tr>
<td>XRO3 Relay output 3</td>
<td></td>
</tr>
<tr>
<td>XD24 Start interlock connection (DIIL) and +24 V output</td>
<td></td>
</tr>
<tr>
<td>XDIO Digital input/outputs</td>
<td></td>
</tr>
<tr>
<td>XDI Digital inputs</td>
<td></td>
</tr>
<tr>
<td>XSTO Safe torque off connection</td>
<td></td>
</tr>
<tr>
<td>X12 Connector for optional safety functions modules</td>
<td></td>
</tr>
<tr>
<td>X13 Control panel connection</td>
<td></td>
</tr>
<tr>
<td>X202 Option slot 1</td>
<td></td>
</tr>
<tr>
<td>X203 Option slot 2</td>
<td></td>
</tr>
<tr>
<td>X204 Option slot 3</td>
<td></td>
</tr>
<tr>
<td>X205 Memory unit connection</td>
<td></td>
</tr>
<tr>
<td>X208 Auxiliary cooling fan connection</td>
<td></td>
</tr>
<tr>
<td>J1, J2 Voltage/Current selection jumpers (J1, J2) for analog inputs</td>
<td></td>
</tr>
<tr>
<td>J3, J6 Drive-to-drive link termination jumper (J3), common digital input ground selection jumper (J6)</td>
<td></td>
</tr>
</tbody>
</table>
- **Connecting the control cables to the internal control unit (option +P905)**

1. Ground the outer control cable shields 360 degrees at the cabinet entry plate (recommendation).
2. Remove the middle front cover of the drive module (view of standard drive module configuration below).
3. Fasten the clamp plate to the bottom of the control unit with two screws from front, see *Attaching the control cable clamp plate* on page 102.
4. Fasten the optional modules if not fastened already.
5. Remove the cover plate from the control cable entry and put the rubber grommet in its place. Put the control cables through the grommet. **Note:** If you route the control cables from top or bottom instead of front or side, you need to make holes for the entries to the clear plastic shrouds.
6. Ground the control cables at the clamp plate as described in Step 2 in section *Connecting the control cables to the terminals of the control unit* on page 107.
7. Connect the conductors to the appropriate detachable terminals of the control unit (see page 123). Use shrink tubing or insulating tape to contain any stray strands. **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.
8. Install the middle front cover back.
Connecting the control cables to the internal control unit (options +P905 and +0B051)

1. Remove the middle front cover of the drive module.
2. Fasten the clamp plate to the control unit with two screws from front, see Attaching the control cable clamp plate on page 102.
3. Fasten the optional modules if not fastened already.
4. Lead the control cables inside the drive cabinet.
5. Route the control cables along the control cable duct from bottom or top to the control unit. A view of a drive module with full cabling panels option +H381 is shown below.
6. Ground the outer control cable shields 360 degrees at the cabinet entry plate (recommendation).
7. Ground the control cables at the clamp plate as described in Step 2 in section Connecting the control cables to the terminals of the control unit on page 107.
8. Connect the conductors to the appropriate detachable terminals of the control unit (see page 123). 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.
Internal control unit (option +P905)

**Default I/O connection diagram**

**XPow**
- External power input
- 1: +24 V, 24 V DC, 2 A
- 2: GND, 24 V DC, 2 A

**XAI**
- Reference voltage and analog inputs
- 1: +VREF, 10 V DC, R<sub>in</sub> = 10 kohm
- 2: -VREF, 10 V DC, R<sub>in</sub> = 10 kohm
- 3: AGND, ground
- 4: AI<sup>+</sup>
- 5: AI<sup>−</sup>
- Speed reference: 0(2)...10 V, R<sub>in</sub> > 200 kohm

**XAI<sup>2</sup>**
- By default not in use.
- 0(4)...20 mA, R<sub>in</sub> = 100 ohm

**J1**
- J1: AI current/voltage selection jumper

**J2**
- J2: AI current/voltage selection jumper

**XAO**
- Analog outputs
- 1: AO1, 0(2)...10 V, R<sub>L</sub> < 500 ohm
- 2: AGND
- 3: AO2, 0(4)...20 mA, R<sub>L</sub> < 500 ohm
- 4: AGND

**XDO**
- Drive-to-drive link
- 1: B
- 2: A
- 3: BGND

**J3**
- J3: Drive-to-drive link termination switch

**XRO1, XRO2, XRO3**
- Relay outputs
- 1: NC, 250 V AC / 30 V DC, 2 A
- 2: COM
- 3: NO, 250 V AC / 30 V DC, 2 A
- 11: NC
- 12: COM
- 13: NO
- 21: NC
- 22: COM
- 23: NO
- 31: NC
- 32: COM
- 33: NO

**XD24**
- Digital interlock
- 1: DIIL, Run enable
- 2: D24V, +24 V DC 200 mA
- 3: IOC, Digital input ground
- 4: +24VDC, +24 V DC 200 mA
- 5: IOCOM: Digital input/output ground
- 6: J6, Ground selection switch

**XDI0**
- Digital inputs/outputs
- 1: DIO1, Output: Ready
- 2: DIO2, Output: Running
- 3: IN1
- 4: IN2

**X12**
- Safety functions module connection

**X13**
- Control panel connection

**X205**
- Memory unit connection

---

Accepted control unit terminal wire sizes: 0.5 ... 2.5 mm<sup>2</sup> (24 ... 12 AWG). Tightening torques: 0.5 N·m (5 lbf·in) for both stranded and solid wiring. For terminal X504 (option +L504), see page 53. See the page 124 for the notes.
Internal control unit (option +P905)

Notes:
1) Current [0(4)…20 mA, $R_{in} = 100$ ohm] or voltage [0(2)…10 V, $R_{in} > 200$ kohm] input selected with jumper J1. Change of setting requires reboot of control unit.
2) Current [0(4)…20 mA, $R_{in} = 100$ ohm] or voltage [0(2)…10 V, $R_{in} > 200$ kohm] input selected with jumper J2. Change of setting requires reboot of control unit.
3) Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.
4) 0 = open, 1 = closed
5) Constant speed 1 is defined by parameter 22.26.

Further information on the usage of the connectors and jumpers is given in the sections below. For the technical data of the connectors, see section Technical data (ZCU-12) on page 128.

### Jumper and switches

<table>
<thead>
<tr>
<th>Jumper/ Switch</th>
<th>Description</th>
<th>Positions</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1 (AI1)</td>
<td>Determines whether analog input AI1 is used as a current or voltage input.</td>
<td><img src="image" alt="Switches" /></td>
</tr>
<tr>
<td>J2 (AI2)</td>
<td>Determines whether analog input AI2 is used as a current or voltage input.</td>
<td><img src="image" alt="Switches" /></td>
</tr>
<tr>
<td>J3</td>
<td>Drive-to-drive link termination. Must be set to terminated position when the drive is the last unit on the link.</td>
<td><img src="image" alt="Switches" /></td>
</tr>
<tr>
<td>J6</td>
<td>Common digital input ground selection switch. Determines whether DICOM is separated from DIOGND (ie, common reference for digital inputs floats). See the Ground isolation diagram on page 130.</td>
<td><img src="image" alt="Switches" /></td>
</tr>
</tbody>
</table>

See
- page 109 for description of external power supply
- page 110 for description of AI1 and AI2 as Pt100 and KTY84 sensor inputs (XAI, XAO)
- page 111 for DI6 (XD1:6) as PTC sensor input
- page 111 for DII input (XDI2:1)
- page 112 for Safe torque off (XSTO)
- page 112 for Safety functions module connection (X12)
- Technical data of the connectors.

### Drive-to-drive link (XD2D)

The drive-to-drive link is a daisy-chained RS-485 transmission line that can be used for
- basic master/follower communication with one master drive and multiple followers
- fieldbus control through the embedded fieldbus interface (EFB), and
- drive-to-drive (D2D) communication implemented by application programming.
See the firmware manual of the drive for the related parameter settings.

Set termination activation jumper J3 (see section *Jumpers and switches* above) next to this terminal block to the ON position on the drives at the ends of the drive-to-drive link. On intermediate drives, set the jumper to the OFF position.

Use shielded twisted-pair cable with a twisted pair for data and a wire or another pair for signal ground (nominal impedance 100 to 165 ohm, for example Belden 9842) for the wiring. For best immunity, ABB recommends high quality cable. Keep the cable as short as possible. Avoid unnecessary loops and running the cable near power cables (such as motor cables).

This diagram shows the wiring of the drive-to-drive link.

---

**Installing optional modules**

- **Installing the FSO safety functions module (option +Q973)**

  Install the FSO safety functions module in Slot 2 of the control unit as described below.

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

  1. Stop the drive and do the steps in section *Precautions before electrical work* on page 18 before you start work.
  2. If the bottom plate of the FSO-xx module looks different from that in the drawing below, remove the bottom plate and attach the alternative bottom plate from the FSO package to module.
  3. Connect the FSO-xx data cable to connector X12 on the control unit.
  4. Attach the FSO-xx module to Slot 2 with four screws.
  5. Tighten the FSO module electronics grounding screw to 0.8 N·m. **Note:** The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.
  6. Connect the FSO-xx data cable to FSO-xx connector X110.
  7. Connect the Safe torque off four-wire cable to connector X111 on the module and to connector XSTO on the drive module control unit.
8. Connect the external +24 V power supply cable to connector X112.

9. Connect the other wires as shown in FSO-12 safety functions module user’s manual (3AXD50000015612 [English]) or FSO-21 safety functions module user’s manual (3AXD50000015614 [English]).
■ Installing I/O extension, fieldbus adapter and pulse encoder interface modules

See page 38 for the available slots for each module.

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

1. Stop the drive and do the steps in section *Precautions before electrical work* on page 18 before you start work.
2. Insert the module carefully into its position on the control unit.
3. Tighten the grounding screw to torque of 0.8 N·m. **Note:** The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.

Wiring the optional modules

See the appropriate optional module manual for specific installation and wiring instructions.
### Technical data (ZCU-12)

#### Power supply (XPOW)
- Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
- 24 V (+10%) DC, 2 A
  - Supplied from the power unit of the drive, or from an external power supply through connector XPOW. Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG).

#### Relay outputs RO1…RO3 (XRO1 … XRO3)
- Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
- 24 V (±10%) DC, 2 A
  - Supplied from the power unit of the drive, or from an external power supply through connector XPOW. Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG).

#### +24 V output (XD24:2 and XD24:4)
- Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
- Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.

#### Digital inputs DI1…DI6 (XDI:1 … XDI:6)
- Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
- 24 V logic levels: “0” < 5 V, “1” > 15 V
  - Protection by varistors
  - DIO6 (XDI:6) can alternatively be used as an input for PTC sensors.
  - “0” > 4 kohm, “1” < 1.5 kohm
  - I\(_{\text{max}}\): 15 mA (for DIO6 5 mA)

#### Start interlock input DIIL (XD24:1)
- Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
- 24 V logic levels: “0” < 5 V, “1” > 15 V
  - Hardware filtering: 0.04 ms, digital filtering up to 8 ms

#### Digital inputs/outputs DIO1 and DIO2 (XDIO:1 and XDIO:2)
- Input/output mode selection by parameters.
- DIO1 can be configured as a frequency input (0…16 kHz with hardware filtering of 4 microseconds) for 24 V level square wave signal (sinusoidal or other wave form cannot be used). DIO2 can be configured as a 24 V level square wave frequency output. See the firmware manual, parameter group 11.

#### Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2)
- Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
- 10 V ±1% and –10 V ±1%, \( R_{\text{load}} \) 1…10 kohm

#### Analog inputs AI1 and AI2 (XAI:4 … XAI:7)
- Current/voltage input mode selection by jumpers. See page 124.

---

![Digital Inputs/Outputs Diagram](attachment:diagram.png)

---

---
Analog outputs AO1 and AO2 (XAO)

- Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
- 0…20 mA, \( R_{\text{load}} < 500 \, \text{ohm} \)
- Frequency range: 0…300 Hz
- Resolution: 11 bit + sign bit
- Inaccuracy: 2% of full scale range

Drive-to-drive link (XD2D)

- Connector pitch 5 mm, wire size 2.5 mm²
- Physical layer: RS-485
- Maximum cable length of the link: 50 m
- Cable type: Shielded twisted pair cable with twisted pair for data and a wire or pair for signal ground, nominal impedance 100…165 ohm, for example Belden 9842
- Transmission rate: 8 Mbit/s
- Termination by jumper

Embedded Modbus RTU XD2D

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

Safe torque off connection (XSTO)

- Connector pitch 5 mm (0.2 in), wire size 2.5 mm² (14 AWG)
- Input voltage range: -3…+30 V DC
- Logic levels: “0” < 5 V, “1” > 17 V
- For the drive to start, both connections must be closed (OUT1 to IN1 and IN2)
- Maximum output current from OUT1 (24 V DC continuous): 100 mA
- EMC (immunity) according to IEC 61326-3-1

Control panel / PC connection

- Connector: RJ-45
- Cable length < 3 m (10 ft)

The terminals of the control unit fulfill the Protective Extra Low Voltage (PELV) requirements. The PELV requirements of a relay output are not fulfilled if a voltage higher than 48 V is connected to the relay output.
Ground isolation diagram

**Internal control unit (option +P905)**

Common mode voltage between channels ≥ 50 V

*Ground selector (J6) settings*

(ZCU-12)

- All digital inputs share a common ground (DICOM connected to DIOGND). This is the default setting.

(ZCU-13)

- Ground of digital inputs DI1…DI6 and DIL (DICOM) is isolated from DIO signal ground (DIOGND). Isolation voltage 50 V.
Installation example of the standard drive module configuration

Contents of this chapter

In this chapter, the drive module is installed in a 800 mm wide Rittal TS 8 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

Always obey the general rules given in this chapter and local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches local laws and/or other regulations.

Safety

WARNING! If you are not a qualified electrical professional do not do the installation work described in this chapter. Obey the instructions in chapter Safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.
Installation example of the standard drive module configuration

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>Rittal part code</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>TS 131 800</td>
</tr>
<tr>
<td>TS 7967.000</td>
</tr>
<tr>
<td>TS 8612.580</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>ABB air inlet kit 800 mm</td>
</tr>
<tr>
<td>3AUA0000117005 (IP20)</td>
</tr>
<tr>
<td>3AUA0000117009 (IP42)</td>
</tr>
<tr>
<td>ABB air outlet kit 800 mm</td>
</tr>
<tr>
<td>3AUA0000125203 (IP20)</td>
</tr>
<tr>
<td>3AUA0000114968 (IP42)</td>
</tr>
</tbody>
</table>

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

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 on page 133.</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 on page 82.</td>
</tr>
</tbody>
</table>
Installing the drive module and LCL filter module into a cabinet

See appendix. *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on page 233 and *ACS880-14 quick installation guide (3AXD500000212446[English]).*

3. Attach the drive module and LCL filter module to the cabinet

4. Connect the power cables and clear plastic shrouds to the drive module.
   - Connect the power supply cable to the LCL filter cooling fan.

5. Mount the external control unit.

6. Connect the control cables.
   - Connecting the control cables to the terminals of the control unit, page 107

7. Install the remaining parts, for example, cabinet doors, side plates, etc.
   - The component manufacturer’s instructions.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Attach the drive module and LCL filter module to the cabinet</td>
<td><em>Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet</em> on page 233.</td>
</tr>
<tr>
<td>4</td>
<td>Connect the power cables and clear plastic shrouds to the drive module.</td>
<td><em>Connecting the power cables and installing the shrouds on page 134</em></td>
</tr>
<tr>
<td></td>
<td>Attach the power supply cable to the LCL filter cooling fan.</td>
<td><em>Connecting the power cables on page 93.</em></td>
</tr>
<tr>
<td>5</td>
<td>Mount the external control unit.</td>
<td><em>Mounting the external control unit, page 105</em></td>
</tr>
<tr>
<td>6</td>
<td>Connect the control cables.</td>
<td><em>Connecting the control cables to the terminals of the control unit, page 107</em></td>
</tr>
<tr>
<td>7</td>
<td>Install the remaining parts, for example, cabinet doors, side plates, etc.</td>
<td>The component manufacturer’s instructions.</td>
</tr>
</tbody>
</table>
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 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 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 driver 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 as described in section Connecting the power cables and installing the shrouds on page 134.
- Install the external control unit and connect the control cables as described in chapter Installation instructions on page 77.
- Install the air baffles.

### Connecting the power cables and installing the shrouds

<table>
<thead>
<tr>
<th>Step</th>
<th>Task (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>
### Installation example of the standard drive module configuration

#### Task (motor cables)

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Connect the twisted shields of the motor cables to the grounding terminal.</td>
</tr>
<tr>
<td>4</td>
<td>Screw in and tighten the insulators to the drive module by hand. Install the T3/W2 connection terminal to the insulators. <strong>WARNING!</strong> 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.</td>
</tr>
<tr>
<td>5</td>
<td>Connect the phase T3/W2 conductors to the T3/W2 terminal.</td>
</tr>
<tr>
<td>6</td>
<td>Install the T2/V2 connection terminal to the insulators. See the warning in step 4.</td>
</tr>
<tr>
<td>7</td>
<td>Connect the phase T2/V2 conductors to the T2/V2 connection terminal.</td>
</tr>
<tr>
<td>8</td>
<td>Install the T1/U2 connection terminal to the insulators. See the warning in step 4.</td>
</tr>
<tr>
<td>9</td>
<td>Connect the phase T1/U2 conductors to the T1/U2 terminal.</td>
</tr>
<tr>
<td>10</td>
<td>Remove the plastic sheeting from the output clear plastic shrouds from both sides.</td>
</tr>
<tr>
<td>11</td>
<td>Install the shrouds to the drive module.</td>
</tr>
<tr>
<td>12</td>
<td>Install the lower front cover to the drive module.</td>
</tr>
</tbody>
</table>

#### Task (input cables)

<table>
<thead>
<tr>
<th>Step</th>
<th>Task (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 the 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>
</tbody>
</table>
| 5    | 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.  
   **For option +H370:** Do steps 6 to 11. |
| 6    | Screw in and tighten the insulators to the drive module by hand. Install the L1/U1 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. |
| 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. Install the front clear plastic shroud and upper front cover. Remove the cardboard protective covering from the drive module air outlet. |
| 13   | Install the side and top clear plastic shrouds to the drive module. |
Installing the roof and door (Rittal parts)

This drawing shows a layout tested by ABB.

1. Door
2. Install these gratings as close to each other as possible. Remove the filter mats.
Installation example with full cabling panels (option +H381)

Contents of this chapter

In this chapter, the drive module and LCL filter module are installed in a 800 mm wide Rittal TS 8 cabinet in a bookshelf way. The modules are placed in an upright position on the cabinet bottom with the front facing the cabinet door. Cabinet space for the additional components can be made by connecting two or more TS8 cabinets together. Available alternative ABB parts are also given.

Limitation of liability

Always obey the general rules given in this chapter and local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches local laws and/or other regulations.

Safety

WARNING! If you are not a qualified electrical professional do not do the installation work described in this chapter. Obey the instructions in chapter Safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.
Required parts

The parts are used in this installation example:

### Drive module standard parts
- Drive module and LCL filter module
- Top guide plate
- Fastening brackets (2 pcs)
- Grounding busbar
- Pedestal guide plates (2 pcs)
- Telescopic extraction and insertion ramp
- Fastening screws in a plastic bag
- External control unit

### Drive module options

<table>
<thead>
<tr>
<th>Option code</th>
<th>Qty (pcs)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+H381</td>
<td>1</td>
<td>Full power cabling panels</td>
</tr>
</tbody>
</table>

### Rittal parts and alternative ABB parts

<table>
<thead>
<tr>
<th>Rittal part code</th>
<th>Qty (pcs)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TS 8438.510</td>
<td>1</td>
<td>Enclosure without mounting plate, bottom plates and side panels.</td>
</tr>
<tr>
<td>TS 8109.235</td>
<td>1</td>
<td>Side panels for the cabinet</td>
</tr>
<tr>
<td>SZ/DK 7967.000 (one set = four pieces) + additional spacers</td>
<td>1</td>
<td>Spacers for roof plate. Alternative ABB roof (3AUA0000125203 [IP20], AUA0000114968 [IP42]), see section Air outlet kits on page 178.</td>
</tr>
<tr>
<td>TS 8612.560 (one set = four pieces)</td>
<td>1</td>
<td>Punched section with mounting flange, outer mounting level for 600 mm horizontal</td>
</tr>
<tr>
<td>TS 8612.580 (one set = four pieces)</td>
<td>1</td>
<td>Punched section with mounting flange, outer mounting level for 800 mm horizontal</td>
</tr>
<tr>
<td>SK 9233.2007 / ABB 3AUA0000117002 (IP20)</td>
<td>4</td>
<td>Air filter 323 mm × 323 mm. Remove the filter mat according to the manufacturer’s instructions. Alternative ABB air filters (3AUA0000117002 [IP20], 3AUA0000117007 [IP42]), see section Air inlet kits page 176.</td>
</tr>
<tr>
<td>ABB 3AUA0000117007 (IP42)</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

### Customer-made parts (not ABB or Rittal products)

<table>
<thead>
<tr>
<th>Description</th>
<th>Qty (pcs)</th>
<th>Additional description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air baffles</td>
<td>4</td>
<td>See section Air baffles for the standard drive module on page 212 for the dimension drawings of the air baffles required in the cabinet.</td>
</tr>
<tr>
<td>Cabinet bottom plate</td>
<td>1</td>
<td>See section Bottom plate on page 213 for the dimension drawing of a customer-made bottom plate.</td>
</tr>
</tbody>
</table>

### Required tools

- Set of screw drivers (Torx and Pozidriv)
- Set of metric magnetic-end hexagon sockets
- Torque wrench with a 500 mm (20 in.) or 2 × 250 mm (2 × 10 in.) long extension bar
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 and drive module mechanical accessories into the cabinet.</td>
<td>Installing the mechanical accessories into the cabinet on page 139.</td>
</tr>
<tr>
<td>3</td>
<td>Connect the power cables to the cabling panels.</td>
<td>Connecting the power cables, page 141</td>
</tr>
<tr>
<td>4</td>
<td>Install the drive module into the cabinet.</td>
<td>Installing the drive module into the cabinet, page 144</td>
</tr>
<tr>
<td>5</td>
<td>Install the external control unit.</td>
<td>Mounting the external control unit, page 105</td>
</tr>
<tr>
<td>6</td>
<td>Connect the control cables.</td>
<td>Connecting the external control unit to the drive module, page 107</td>
</tr>
<tr>
<td>7</td>
<td>Install the remaining parts, for example, cabinet doors, side plates, etc.</td>
<td>The component manufacturer’s instructions</td>
</tr>
</tbody>
</table>

Installing the mechanical accessories into the cabinet

See appendix Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet on page 233 for these steps:

- 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.

To install the full cabling panels to the cabinet frame (see the drawings on the next page):

1. Install the Rittal punched sections TS 8612.560 to which the output cabling panel and the input cabling panel will be attached.
2. Install the air baffles.
3. Attach the output cabling panel to the punched sections.
4. Install the side guides to the output cabling panel (2 screws for each guide).
5. Attach the grounding busbar to the input cabling panel.
6. Install the side guides to the input cabling panel (2 screws for each side guide).
7. Attach the input cabling panel to the punched sections.
8. Install the telescopic extraction and insertion ramp as shown in the appendix.
Installation example with full cabling panels (option +H381)
Connecting the power cables

- Connection diagram

1. For alternatives, see section Selecting the supply disconnecting device on page 58. In the installing example of this chapter, the disconnecting device is not in the same cubicle 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. We recommend 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. Input and output power cabling panels (option +H381)

5. We recommend 360-degree grounding at the cabinet entry, see page 49.

6. 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 page 65).
### Power cable connection procedure

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

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 busbar of the output power cabling panel.
3. Connect the phase conductors of the motor cables to terminals T1/U2, T2/V2 and T3/W2 of the output cabling panel. For the tightening torques, see page 193.
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 grounding busbar of the input cabling panel.
7. Connect the phase conductors of the input cables to terminals L1/U1, L2/V1 and L3/W1 of the input cabling panel. For the tightening torques, see page 193.
An example installation is shown below.

View without cabinet side plate in place.
A) 360-degree grounding at the entry plate for the input power cables
B) Grounding busbar of the input power cabling panel
C) 360-degree grounding at the entry plate for the output power cables
D) Grounding busbar of the output power cabling panel
E) Allowed space for power cables. Note: The input and output power cables must fit inside the area marked with diagonal lines to prevent chafing of the cables when the drive module is inserted into the cabinet.
Installing the drive module into the cabinet

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

Handle the drive module carefully. Make sure that the module does not fall down when moving it on the floor and during installation and maintenance work: Open the support legs by pressing each leg a little down and turning it aside (1, 2). When ever possible secure the module also with chains from top.

Do not tilt the drive module (A). It is **heavy** and its **center of gravity is high**. The module will overturn from a sideways tilt of 5 degrees. Do not leave the module unattended on a sloping floor.
Installation procedure

1. Install the drive module and the LCL filter module into the Rittal cabinet as shown in appendix Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet on page 233.

2. Attach the grounding busbar that has been previously attached to the input cabling panel to the drive module.

3. Remove the upper and lower left-hand side front covers of the drive module (M4×8 combi screws, 2 N·m).

4. Connect the busbars of the drive module to the busbars of the cabling panels (M12 combi screw, 70 N·m [52 lbf·ft]).

5. Attach the cabinet roof on the spacers.

6. Attach the side panels.

7. Remove the filter mats from the air filters according to Rittal’s instructions. Install the filters to the cabinet door.

8. Put back the removed front covers of the drive module.

9. Connect the control cables (see section Connecting the control cables to the terminals of the control unit on page 107).
Installation example with full cabling panels (option +H381)

Assembly drawing of connecting the drive module to the cabling panels
**Miscellaneous**

- **Installing the rubber grommet**

  To get IP20 degree of protection for the drive module, install the input power cables through the rubber grommet. Install the grommet as follows:
  1. Cut adequate holes into the grommet for the input power cables.
  2. Put the cables through the grommet.
  3. Attach the grommet to the input cabling panel with five M4x8 Torx T20 screws as shown below.
Modular design of Rittal TS8 cabinets

The design of the drive module with optional cabling panels (+H381) is optimized to the Rittal TS 8406.500 cabinet. To make space for the additional components, connect two or more TS8 cabinets together. An example is shown below.

<table>
<thead>
<tr>
<th>Rittal code</th>
<th>Qty (pcs)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TS 8406.500</td>
<td>1</td>
<td>Enclosure without mounting plate. Includes frame, door, side and back panels.</td>
</tr>
<tr>
<td>TS 8606.xxx</td>
<td>1</td>
<td>Enclosure without mounting plate. Includes frame, door, side and back panels.</td>
</tr>
<tr>
<td>8800.410 – One set</td>
<td>6</td>
<td>Baying clamp for connecting the cabinet frames</td>
</tr>
<tr>
<td>8800.430 – One set</td>
<td>4</td>
<td>Angular baying bracket for connecting the cabinet frames</td>
</tr>
<tr>
<td>8800.860 – One set</td>
<td>1</td>
<td>Baying cover top if two cabinet roofs are connected</td>
</tr>
</tbody>
</table>
Installation checklist

Contents of this chapter
This chapter contains a list for checking the mechanical and electrical installation of the drive module.

Installation checklist
Go through the checklist below together with another person.

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

<table>
<thead>
<tr>
<th>Check that ...</th>
<th>☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabinet construction</td>
<td>☐</td>
</tr>
<tr>
<td>The drive module is fastened properly to the cabinet. (See chapters Guidelines for planning the cabinet installation, Installation example of the standard drive module configuration)</td>
<td>☐</td>
</tr>
<tr>
<td>Mechanical joints are tightened and not broken.</td>
<td>☐</td>
</tr>
<tr>
<td>Parts are clean and painted surfaces not scratched.</td>
<td>☐</td>
</tr>
<tr>
<td>The cabinet frame and parts which are in metal to metal contact with the frame (for example seams, component fixing points on assembly plates, back of control unit mounting plate) are not finished with non-conducting paint or material.</td>
<td>☐</td>
</tr>
<tr>
<td>Degree of protection (IPxx)</td>
<td>☐</td>
</tr>
</tbody>
</table>
# Installation checklist

## Drive option modules and other components
- Type and number of option modules and other equipment is correct. Option modules and other equipment are not damaged.
- Optional modules and terminals are labelled correctly.
- The placement of optional modules and other equipment inside the cabinet and on the cabinet door is correct.
- The mounting of optional modules and other equipment is correct.

## Internal cabling of the cabinet assembly
- **Main circuit:**
  - AC supply input cabling is ok.
  - AC output cabling is ok.
- Cable types, cross-sections, colours and optional markings are correct.
- Cabling is not susceptible to interference. Check the twisting of cables and cable routes.
- Connection of cables to devices, terminal blocks and drive module circuit boards:
  - Cables are connected to terminals tight enough by pulling the cable.
  - Cable termination on terminals chaining is done correctly.
  - Bare conductors are not too far outside the terminal causing an insufficient clearance or loss of shielding against contact.
  - The control unit is wired properly to the drive module.
  - The control panel cable is connected properly.
- Cables are not lying against sharp edges or bare live parts. Bending radius of fiber optic cables is at least 3.5 cm (1.38 in.).
- The type, markings, insulation plates and cross connections of terminal blocks are correct.

## Grounding and protection
- The grounding colors, cross-section and grounding points of modules and other equipment match the circuit diagrams. No long routes for pigtails.
- Connections of PE cables and busbars are tight enough. Pull the cable to test that it does not loosen. No long routes for pigtails.
- Doors equipped with electrical equipment are grounded. No long grounding routes. From EMC standpoint best result is achieved with a flat copper braid.
- Fans that can be touched are shrouded.
- Live parts inside the doors are protected against direct contact to at least IP2x.

## Labels
- The type designation labels and warning and instruction stickers are made according to the local regulations and placed correctly.

## Switches and doors
- Mechanical switches, main disconnecting switch and cabinet doors function properly.
Installation checklist

### Installation of the cabinet

- The drive cabinet has been attached to floor and also from top to the wall or roof.
- The ambient operating conditions agree with the specifications given in chapter Technical data.
- The cooling air will flow freely in and out of the drive cabinet, and air recirculation inside the cabinet will not be possible (air baffle plates are on place).
- If the drive module has been stored over three years: The electrolytic DC capacitors in the DC link of the drive have been reformed. See page 177.
- There is an adequately sized protective ground conductor between the drive and the switchboard.
- There is an adequately sized protective ground conductor between the motor and the drive.
- All protective ground conductors have been connected to the appropriate terminals and the terminals have been tightened. (Pull the conductors to check.)
- 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.
- The supply voltage matches the nominal input voltage of the drive. Check the type designation label.
- Appropriate AC fuses and a main disconnector have been installed.
- The motor cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull the conductors to check.)
- The motor cable has been routed away from other cables.
- No power factor compensation capacitors have been connected to the motor cable.
- The control cables (if any) have been connected to the appropriate terminals, and the terminals have been tightened. (Pull the conductors to check.)
- If a drive bypass connection is used: The direct-on-line contactor of the motor and the drive output contactor are either mechanically or electrically interlocked, ie, cannot be closed simultaneously.
- There are no tools, foreign objects or dust from drilling inside the drive module.
- All shrouds and cover of the motor connection box are in place. Cabinet doors have been closed.
- The motor and the driven equipment are ready for start.

Check that ...

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The drive cabinet has been attached to floor and also from top to the wall</td>
<td></td>
</tr>
<tr>
<td>or roof.</td>
<td></td>
</tr>
<tr>
<td>The ambient operating conditions agree with the specifications given in</td>
<td></td>
</tr>
<tr>
<td>chapter Technical data.</td>
<td></td>
</tr>
<tr>
<td>The cooling air will flow freely in and out of the drive cabinet, and air</td>
<td></td>
</tr>
<tr>
<td>recirculation inside the cabinet will not be possible (air baffle plates</td>
<td></td>
</tr>
<tr>
<td>are on place).</td>
<td></td>
</tr>
<tr>
<td>If the drive module has been stored over three years: The electrolytic DC</td>
<td></td>
</tr>
<tr>
<td>capacitors in the DC link of the drive have been reformed. See page 177.</td>
<td></td>
</tr>
<tr>
<td>There is an adequately sized protective ground conductor between the drive</td>
<td></td>
</tr>
<tr>
<td>and the switchboard.</td>
<td></td>
</tr>
<tr>
<td>There is an adequately sized protective ground conductor between the motor</td>
<td></td>
</tr>
<tr>
<td>and the drive.</td>
<td></td>
</tr>
<tr>
<td>All protective ground conductors have been connected to the appropriate</td>
<td></td>
</tr>
<tr>
<td>terminals and the terminals have been tightened. (Pull the conductors to</td>
<td></td>
</tr>
<tr>
<td>check.)</td>
<td></td>
</tr>
<tr>
<td>The enclosures of the equipment in the cabinet have proper galvanic</td>
<td></td>
</tr>
<tr>
<td>connection to the cabinet protective earth (ground) busbar; The connection</td>
<td></td>
</tr>
<tr>
<td>surfaces at the fastening points are bare (unpainted) and the connections</td>
<td></td>
</tr>
<tr>
<td>are tight, or separate grounding conductors have been installed.</td>
<td></td>
</tr>
<tr>
<td>The supply voltage matches the nominal input voltage of the drive. Check</td>
<td></td>
</tr>
<tr>
<td>the type designation label.</td>
<td></td>
</tr>
<tr>
<td>Appropriate AC fuses and a main disconnector have been installed.</td>
<td></td>
</tr>
<tr>
<td>The motor cable has been connected to the appropriate terminals, the phase</td>
<td></td>
</tr>
<tr>
<td>order is right, and the terminals have been tightened. (Pull the conductors</td>
<td></td>
</tr>
<tr>
<td>to check.)</td>
<td></td>
</tr>
<tr>
<td>The motor cable has been routed away from other cables.</td>
<td></td>
</tr>
<tr>
<td>No power factor compensation capacitors have been connected to the motor</td>
<td></td>
</tr>
<tr>
<td>cable.</td>
<td></td>
</tr>
<tr>
<td>The control cables (if any) have been connected to the appropriate terminals,</td>
<td></td>
</tr>
<tr>
<td>and the terminals have been tightened. (Pull the conductors to check.)</td>
<td></td>
</tr>
<tr>
<td>If a drive bypass connection is used: The direct-on-line contactor of the</td>
<td></td>
</tr>
<tr>
<td>motor and the drive output contactor are either mechanically or electrically</td>
<td></td>
</tr>
<tr>
<td>interlocked, ie, cannot be closed simultaneously.</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>module.</td>
<td></td>
</tr>
<tr>
<td>All shrouds and cover of the motor connection box are in place. Cabinet</td>
<td></td>
</tr>
<tr>
<td>doors have been closed.</td>
<td></td>
</tr>
<tr>
<td>The motor and the driven equipment are ready for start.</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
The table below lists the actions in the start-up procedure of the drive module. The tasks which are needed in certain cases only are marked with underlining, and option codes are given in brackets. These instructions cannot and do not cover all possible start-up tasks of a customized drive. Perform the start-up tasks instructed by the cabinet-installer of the drive module.

<table>
<thead>
<tr>
<th>Action</th>
<th>Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>WARNING!</strong> Obey the safety instructions during the start-up procedure. See chapter Safety instructions on page 15. Only qualified electrical professionals are allowed to start-up the drive.</td>
</tr>
</tbody>
</table>

Checks/Settings with no voltage connected

- Ensure that the disconnector of the supply transformer is locked to the off (0) position, i.e. no voltage is, and cannot be connected to the drive inadvertently.
- Check the mechanical and electrical installation of the drive. See Installation checklist on page 149.
- Check that both channels of the Safe torque off circuit connected to the STO inputs of drive control unit are closed. Refer to the wiring diagrams delivered with the drive.
### Start-up

If the Safe torque off functionality is used, check that the STO OUT output on the drive control unit is chained to the STO inputs of all drives.

If the Safe torque off functionality is not used, check that the STO input on all drives is correctly wired to +24 V and ground.

#### Powering up the auxiliary circuit of the drive

- Make sure that it is safe to connect voltage. Ensure that
  - nobody is working on the drive or circuits that have been wired from outside into the drive cabinet
  - the cover of the motor terminal box is in place.

- Close the circuit breakers and/or fuse disconnectors supplying the auxiliary voltage circuits.

- Close the cabinet doors.

- Close the main breaker of the supply transformer.

### Setting up the line-side converter parameters

- The line-side converter control program parameters are set at the factory. Normally, there is no need to change them at the start-up.

- For more information on the line-side converter control parameters, see ACS880 primary control program firmware manual (3AU00000085697 [English]) or ACS880 IGBT supply control program firmware manual (3AU0000131562 [English]).

### Setting up the motor-side converter parameters, and performing the first start

- Set up the motor control program. See the appropriate start-up guide and/or firmware manual. There is a separate start-up guide only for some control programs.

- For drives with ABB du/dt filter, check that bit 13 of parameter 95.20 HW options word 1 is switched on.

- For drives with ABB sine filter, check that parameter 95.15 Special HW settings is set to ABB sine filter. For other sine filters, see Sine filter hardware manual (3AXD50000016814 [English]).

- For drives with a fieldbus adapter module (optional): Set the fieldbus parameters. Activate the appropriate assistant (if present) in the control program, or see the user’s manual of the fieldbus adapter module, and the drive firmware manual.

- For drives with an encoder interface module (optional): Set the encoder parameters. Activate the appropriate assistant (if present) in the control program, or see the user’s manual of the encoder interface module, and the drive firmware manual.

### On-load checks

- Start the motor to perform the ID run.

- Check that the cooling fans rotate freely in the right direction, and the air flows upwards. A paper sheet set on the intake (door) gratings stays. The fans run noiselessly.

- Check that the motor starts, stops and follows the speed reference in the correct direction when controlled with the control panel.

- Check that the motor starts, stops and follows the speed reference in the correct direction when controlled through the customer-specific I/O or fieldbus.

- Drives in which the Safe torque off control circuit is in use: Test and validate the operation of the Safe torque off function. See Start-up including acceptance test on page 223.
<table>
<thead>
<tr>
<th>Action</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>For drives with ATEX-certified Safe motor disconnection function using the drive Safe torque off function (option +Q971), see ACS880 ATEX-certified Safe disconnection function application guide (3AUA0000132231 [English]).</td>
<td></td>
</tr>
<tr>
<td>For drives with ABB motors in explosive atmospheres, see also ACS880 drives with ABB motors in explosive atmospheres (3AXD50000019585 [English]).</td>
<td></td>
</tr>
<tr>
<td>For drive modules with an FSO-12 safety functions module (option): Test and validate the operation of the safety functions. See the delivery-specific circuit diagrams and FSO-12 safety functions module user’s manual (3AXD50000015612 [English]).</td>
<td></td>
</tr>
</tbody>
</table>
Fault tracing

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

LEDs with options +J410

<table>
<thead>
<tr>
<th>Where</th>
<th>LED</th>
<th>Color</th>
<th>When the LED is lit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control panel</td>
<td>POWER</td>
<td>Green</td>
<td>Control unit is powered and +15 V is supplied to the control panel.</td>
</tr>
<tr>
<td>mounting platform</td>
<td>FAULT</td>
<td>Red</td>
<td>Drive in fault state.</td>
</tr>
</tbody>
</table>

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
If installed in an appropriate environment, the drive requires very little maintenance. 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.

The tables 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).
### Descriptions of symbols

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Visual inspection and maintenance action if needed</td>
</tr>
<tr>
<td>P</td>
<td>Performance of on/off-site work (commissioning, tests, measurements or other work)</td>
</tr>
<tr>
<td>R</td>
<td>Replacement of component</td>
</tr>
</tbody>
</table>

### Recommended annual maintenance actions by the user

<table>
<thead>
<tr>
<th>Action</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Quality of supply voltage</td>
</tr>
<tr>
<td>I</td>
<td>Spare parts</td>
</tr>
<tr>
<td>P</td>
<td>DC circuit capacitors reforming, spare modules and spare capacitors</td>
</tr>
<tr>
<td>I</td>
<td>Tightness of terminals</td>
</tr>
<tr>
<td>I</td>
<td>Dustiness, corrosion and temperature</td>
</tr>
<tr>
<td>I</td>
<td>Heat sink cleaning</td>
</tr>
</tbody>
</table>

### Recommended maintenance intervals after start-up

<table>
<thead>
<tr>
<th>Component</th>
<th>Years from start-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 8 9 12 15 18 20 21</td>
</tr>
<tr>
<td><strong>Cooling</strong></td>
<td></td>
</tr>
<tr>
<td>Main cooling fan</td>
<td></td>
</tr>
<tr>
<td>Main cooling fan (speed controlled)</td>
<td>R  R</td>
</tr>
<tr>
<td>LCL filter module cooling fan</td>
<td></td>
</tr>
<tr>
<td><strong>Auxiliary cooling fan</strong></td>
<td></td>
</tr>
<tr>
<td>Fan for circuit board compartment (speed-monitored)</td>
<td>R  R</td>
</tr>
<tr>
<td><strong>Aging</strong></td>
<td></td>
</tr>
<tr>
<td>ZCU control unit battery (real-time clock)</td>
<td>R  R  R</td>
</tr>
<tr>
<td>Control panel battery (real-time clock)</td>
<td>R  R  R</td>
</tr>
</tbody>
</table>

### Cabinet

#### Cleaning the interior of the cabinet

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

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

1. Stop the drive and do the steps in section Precautions before electrical work on page 18 before you start the work.
2. Make sure that the drive is disconnected from the power line and all other precautions described under Grounding on page 20 have been taken into consideration.
3. When necessary, clean the interior of the cabinet with a soft brush and a vacuum cleaner.
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.

Cleaning the interior of the heatsink

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

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

1. Stop the drive and do the steps in section Precautions before electrical work on page 18 before you start the work.
2. Make sure that the drive is disconnected from the power line and all other precautions described under Grounding on page 20 have been taken into consideration.
3. Undo the fastening 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.

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 on page 161.
Fans

The actual lifespan depends on the running time of the fan, ambient temperature and dust concentration. See the firmware manual for the actual signal which indicates the running time of the cooling fan. For resetting the running time signal after a fan replacement, please contact ABB.

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 in chapter Safety instructions. 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 Precautions before electrical work on page 18 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 *Precautions before electrical work* on page 18 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 in chapter Safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.

1. Stop the drive and do the steps in section Precautions before electrical work on page 18 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).
   Note: 690 V drive modules have only one fan in the cassette.
6. Install the new fans in reverse order. For 690 V drive modules, connect the fan power supply to connector FAN1:PWR1. For other drive modules, connect the power supply wires to both FAN1:PWR1 and FAN2:PWR2.
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 in chapter Safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.

1. Stop the drive and do the steps in section Precautions before electrical work on page 18 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 in chapter *Safety instructions*. 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 *Precautions before electrical work* on page 18 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. **Drives with external control unit**: Disconnect the cables between the drive module and the control unit. See section *Connecting the external control unit to the drive module* on 103.
5. **Drives with internal control unit (option +P905)**: Disconnect the external control cables connected to the control unit. See section *Internal control unit (option +P905)* on page 119.
6. Disconnect the cooling fan power supply cable from the LCL filter module. Pull the cable inside the drive module.

7. Remove the screws that attach the drive module to the cabinet at the top and behind the front support legs.
8. Remove the screws that connect the drive module to the LCL filter module from top and at the side.
9. To prevent the drive module from falling, attach its top lifting lugs with chains to the cabinet frame.
10. To open the support legs 90 degrees, press each leg a little down and turn it aside.
11. Adjust the extraction ramp to the correct height and attach it to the cabinet base with the two mounting screws.
12. Pull the drive module carefully out of the cabinet preferably with help from another person.

13. 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.
Replacing the drive module with option +H381

**WARNING!** Obey the safety instructions in chapter *Safety instructions*. 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 *Precautions before electrical work* on page 18 before you start the work.

2. To remove the left-hand side upper and lower front covers of the drive module, undo the fastening screws. M4×10 combi screws, 2 N·m. For drive modules with an internal control unit (option +P905) and control panel (option +J414): Remove the control panel and the control panel cable from the internal control unit.

3. Disconnect the drive module busbars from the input cabling panel. Combi screw M12, 70 N·m (52 lbf·ft).

4. Disconnect the drive module busbars from the output cabling panel. Combi screw M12, 70 N·m (52 lbf·ft).

5. Remove the front air baffle.

6. See *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on 233:
  - Disconnect the drive module from the LCL filter module.
  - Undo the screws that attach the drive module to the cabinet frame,
  - Attach the extraction ramp to the cabinet base with two screws.
7. Disconnect the power supply cable and the fiber optic cables from the external control unit and coil them on the top of the drive module. For drive modules with an internal control unit (option +P905): Detach the control unit from the drive module by undoing the fastening screws below the optional modules and turn the control unit and the cables aside. (Alternatively remove the clamp plate, and disconnect the cables from the control unit.)

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

9. Pull the drive module carefully out of the cabinet preferably with help from another person.

10. Install the new module in reverse order.
Replacing the LCL filter module with option +H381

1. See *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet on 233*:
   - Disconnect the LCL filter module from the drive module.
   - Undo the screws that attach the LCL filter module to the cabinet frame.
   - Attach the extraction ramp to the cabinet base with two screws.
2. To prevent the LCL filter module from falling, attach its top lifting lugs with chains to the cabinet frame.
3. Pull the LCL filter module carefully out of the cabinet preferably with help from another person.
4. Install the new module in reverse order.

Capacitors

The drive intermediate circuit employs several electrolytic capacitors. Their lifespan depends on the operating time of the drive, loading and ambient temperature. The lifespan of the capacitor can be prolonged by lowering the ambient temperature.

It is not possible to predict a capacitor failure. The capacitor failure is usually followed by damage to the unit and an input cable fuse failure, or a fault trip. Contact ABB if a capacitor failure is suspected. Replacements are available from ABB. Do not use other than ABB specified spare parts.

- **Reforming the capacitors**
  If the drive module has been stored for one year or more, reform the capacitors. See page 39 for information on finding out the manufacturing date. For the reforming instructions, see *Converter modules with electrolytic DC capacitors in the DC link, capacitor reforming instructions (3BFE64059629 [English]).*

Control panel

- **Replacing the control panel battery**
  1. Turn the lid on the back of the panel counter-clockwise until the lid opens.
  2. Replace the battery with a new CR2032 battery.
  3. Put the lid back and tighten it by turning it clockwise.
  4. Dispose of the old battery according to local disposal rules or applicable laws.
Cleaning
See ACX-AP-x assistant control panels user’s manual (3AUA0000085685 [English]).

Replacing the control unit battery – external control unit

Stop the drive and do the steps in section Precautions before electrical work on page 18 before you start the work.

To replace the control unit battery:
1. Remove the M4x8 (T20) screws at the ends of the control unit.
2. To see the battery, remove the XD2D terminal block.
3. Carefully lift the edge of the control unit cover on the side with the I/O terminal blocks.
4. Carefully pull the battery out of the battery holder.
5. Carefully put a new CR2032 battery into the battery holder.
6. Close the control unit cover.
7. Tighten the M4x8 (T20) screws.
8. Install the XD2D terminal block.

Memory unit

When a drive module is replaced, the parameter settings can be retained by transferring the memory unit from the defective drive module to the new module. One memory unit is located in the external control unit, see page 38, another on the line-side converter control unit.

WARNING! Do not remove or insert the memory unit when the drive module is powered.

After power-up, the drive scans the memory unit. If a different control program or different parameter settings are detected, they are copied to the drive. This can take several minutes.

Replacing the drive control unit memory unit

1. Stop the drive and do the steps in section Precautions before electrical work on page 18 before you start the work.
1. Remove the fastening screw.
2. Pull the memory unit out.
3. Install the new memory unit in reverse order.

**Note:** There is a spare screw next to the memory unit slot.

To remove the memory unit from the line-side converter control unit:

- **Replacing the line-side converter control unit memory unit**
  1. Stop the drive and do the steps in section *Precautions before electrical work* on page 19 before you start the work.
  2. Remove the cover on the memory unit.
  3. Pull the memory unit out.
  4. Install the new memory unit in reverse order.
Ordering information

Contents of this chapter

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

Notes:

• This chapter only lists the installation accessories available from ABB. All other parts must be sourced from a third party by the system integrator. For a listing, refer to the kit-specific installation instructions available at https://www151.abb.com/spaces/lvadriverengineering/support/content. For access, contact your local ABB representative.

Output (du/dt) filters

See section du/dt filters on page 229.

Sine filters

See section Sine filters on page 230.

EMC filter ARFI-10

Order code: 68241561
### 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>400 mm / IP20</td>
<td>A-4-X-021</td>
<td>3AU000117002</td>
<td><img src="image1.png" alt="Illustration" /></td>
</tr>
<tr>
<td>400 mm / IP42</td>
<td>A-4-X-024</td>
<td>3AU000117007</td>
<td><img src="image2.png" alt="Illustration" /></td>
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<tr>
<td>400 mm / IP54</td>
<td>A-4-X-027</td>
<td>3AX00009184</td>
<td><img src="image3.png" alt="Illustration" /></td>
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<tr>
<td>Enclosure width / Degree of protection</td>
<td>Kit code</td>
<td>Ordering code</td>
<td>Illustration</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>----------</td>
<td>---------------</td>
<td>--------------</td>
</tr>
<tr>
<td>600 mm / IP20</td>
<td>A-6-X-022</td>
<td>3AUA0000117003</td>
<td>![Image]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Instruction code: 3AUA0000116680</td>
</tr>
<tr>
<td>600 mm / IP42</td>
<td>A-6-X-025</td>
<td>3AUA0000117008</td>
<td>![Image]</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Instruction code: 3AUA0000116674</td>
</tr>
<tr>
<td>600 mm / IP54</td>
<td>A-6-X-028</td>
<td>3AXD50000009185</td>
<td>![Image]</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Instruction code: 3AXD50000009990</td>
</tr>
<tr>
<td>800 mm / IP20</td>
<td>A-8-X-023</td>
<td>3AUA0000117005</td>
<td>![Image]</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Instruction code: 3AUA0000116687</td>
</tr>
</tbody>
</table>
### Air outlet kits

**Note:** The fan is to be ordered separately.

<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>
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<td>1</td>
<td>A-4-X-062</td>
<td>3AUA0000125203</td>
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<td><img src="image2.png" alt="Illustration" /></td>
</tr>
<tr>
<td>600 mm / IP20</td>
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<td>A-6-X-063</td>
<td>3AUA0000125204</td>
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</tr>
<tr>
<td>Enclosure width / Degree of protection</td>
<td>Qty</td>
<td>Kit code</td>
<td>Ordering code</td>
<td>Illustration</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-----</td>
<td>----------</td>
<td>---------------</td>
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</tr>
<tr>
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<td>A-4-X-060</td>
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<td>800 mm / IP42</td>
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<td></td>
<td></td>
<td><img src="image2.png" alt="Illustration" /></td>
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<tr>
<td>600 mm / IP42</td>
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<td>A-6-X-061</td>
<td>3AU00001149789</td>
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<tr>
<td>400 mm / IP54 (IEC)</td>
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<td>3AXD50000009187</td>
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<tr>
<td>800 mm / IP54 (IEC)</td>
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<td>400 mm / IP54 (UL)</td>
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<td>A-4-X-067</td>
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<td>800 mm / IP54 (UL)</td>
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<td></td>
<td></td>
<td><img src="image7.png" alt="Illustration" /></td>
</tr>
</tbody>
</table>

Note: Fan to be ordered separately.
Cooling fans

One or two cooling fans are to 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>Qty</th>
<th>Ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 mm / IP54</td>
<td>Fan</td>
<td>1</td>
<td>3AXD50000006904</td>
</tr>
<tr>
<td></td>
<td>Capacitor MSB MKP 6/603/E1679</td>
<td>1</td>
<td>3AXD50000006909</td>
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<tr>
<td></td>
<td>Connector SPB2,5/7 (2.5 mm², 12AWG)</td>
<td>1</td>
<td>3AXD5000000723</td>
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<tr>
<td></td>
<td>Connector SC 2,5-RZ/7 (2.5 mm², 12AWG)</td>
<td>1</td>
<td>3AXD5000000724</td>
</tr>
<tr>
<td>600 mm / IP54</td>
<td>Fan</td>
<td>1</td>
<td>3AXD50000006111</td>
</tr>
<tr>
<td></td>
<td>Capacitor MSB MKP 12803/E1679</td>
<td>1</td>
<td>3AXD50000008885</td>
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<td>Connector SPB2,5/7 (2.5 mm², 12AWG)</td>
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<td>3AXD5000000723</td>
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<td>Connector SC 2,5-RZ/7 (2.5 mm², 12AWG)</td>
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<tr>
<td>Component</td>
<td>Qty</td>
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<tr>
<td>Fan</td>
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<tr>
<td>Connector</td>
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</tr>
<tr>
<td>Connector</td>
<td>1</td>
<td>3AXD50000000724</td>
<td></td>
</tr>
<tr>
<td>Fan</td>
<td>1</td>
<td>3AXD500000006934</td>
<td></td>
</tr>
<tr>
<td>Capacitor</td>
<td>1</td>
<td>3AXD500000006959</td>
<td></td>
</tr>
<tr>
<td>Connector</td>
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<td>3AXD50000000723</td>
<td></td>
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<tr>
<td>Connector</td>
<td>1</td>
<td>3AXD50000000724</td>
<td></td>
</tr>
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<td>Fan</td>
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<td>3AXD500000006111</td>
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</tr>
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<td>3AXD500000006885</td>
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<td>3AXD50000000723</td>
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<tr>
<td>Connector</td>
<td>1</td>
<td>3AXD50000000724</td>
<td></td>
</tr>
<tr>
<td>Fan</td>
<td>2</td>
<td>3AXD500000006934</td>
<td></td>
</tr>
<tr>
<td>Capacitor</td>
<td>2</td>
<td>3AXD500000006959</td>
<td></td>
</tr>
<tr>
<td>Connector</td>
<td>2</td>
<td>3AXD50000000723</td>
<td></td>
</tr>
<tr>
<td>Connector</td>
<td>2</td>
<td>3AXD50000000724</td>
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</tr>
</tbody>
</table>

**FSO accessories kit**

<table>
<thead>
<tr>
<th>Kit code</th>
<th>Ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-X-X-279</td>
<td>3AXD50000025495</td>
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</tbody>
</table>
## Retrofit accessory kits

<table>
<thead>
<tr>
<th>Kit</th>
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<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>
<tr>
<td>Full size cable connection terminals for output power cables</td>
<td>*</td>
<td>3AXD50000019544</td>
</tr>
<tr>
<td>For frame R11: IP20 shrouds for covering the input and motor cabling area</td>
<td>**</td>
<td>3AXD50000019538</td>
</tr>
</tbody>
</table>

* The drive module is delivered with full size cable connection terminals for output power cables as standard. They can be excluded with option +0H371.

** The drive module is delivered with IP20 shrouds for covering the input and motor cabling area as standard. The shrouds can be excluded with option +0B051.
## 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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nominal use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_1$</td>
<td>$I_{max}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>U_N = 400 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>246A-3</td>
<td>R11</td>
<td>212</td>
<td>412</td>
</tr>
<tr>
<td>290A-3</td>
<td>R11</td>
<td>257</td>
<td>492</td>
</tr>
<tr>
<td>323A-3</td>
<td>R11</td>
<td>321</td>
<td>586</td>
</tr>
<tr>
<td>442A-3</td>
<td>R11</td>
<td>401</td>
<td>728</td>
</tr>
<tr>
<td>505A-3</td>
<td>R11</td>
<td>401</td>
<td>728</td>
</tr>
<tr>
<td>585A-3</td>
<td>R11</td>
<td>505</td>
<td>884</td>
</tr>
<tr>
<td>650A-3</td>
<td>R11</td>
<td>569</td>
<td>1010</td>
</tr>
<tr>
<td>U_N = 500 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>230A-5</td>
<td>R11</td>
<td>199</td>
<td>360</td>
</tr>
<tr>
<td>260A-5</td>
<td>R11</td>
<td>205</td>
<td>480</td>
</tr>
<tr>
<td>305A-5</td>
<td>R11</td>
<td>257</td>
<td>520</td>
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<td>414A-5</td>
<td>R11</td>
<td>321</td>
<td>722</td>
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<td>460A-5</td>
<td>R11</td>
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<td>828</td>
</tr>
<tr>
<td>505A-5</td>
<td>R11</td>
<td>455</td>
<td>920</td>
</tr>
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</table>
### Technical data

#### IEC RATINGS

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Frame size</th>
<th>Input current</th>
<th>Output ratings</th>
<th>Light-duty use</th>
<th>Heavy-duty use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nominal use</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$I_1$</td>
<td>$I_{\text{max}}$</td>
<td>$P_N$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>$U_N = 690$ V</td>
<td></td>
<td></td>
<td>174A-7</td>
<td>R11</td>
<td>123</td>
</tr>
<tr>
<td>$U_N = 575$ V</td>
<td></td>
<td></td>
<td>142A-7</td>
<td>R11</td>
<td>125</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>
<th>Light-duty use</th>
<th>Heavy-duty use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nominal use</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$I_1$</td>
<td>$I_{\text{max}}$</td>
<td>$P_N$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>$U_N = 690$ V</td>
<td></td>
<td></td>
<td>174A-7</td>
<td>R11</td>
<td>123</td>
</tr>
<tr>
<td>$U_N = 575$ V</td>
<td></td>
<td></td>
<td>142A-7</td>
<td>R11</td>
<td>125</td>
</tr>
</tbody>
</table>

### Notes:

- 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.

We recommend 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
• ambient temperature exceeds +40 °C (+104 °F) or
• drive is installed higher than 1000 m (3280 ft) above sea level
• switching frequency is other than default.

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

Ambient temperature derating

In the temperature range +40…55 °C (+104…131 °F), the rated output current is derated by 1% for every added 1 °C (1.8 °F) as follows. Calculate the output current by multiplying the current given in the rating table by the derating factor.
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.

Deratings for special settings in the drive control program

Enabling special settings in the drive control program can require output current derating.

Ex motor, sine filter, low noise

Table below gives the deratings in these cases:

- drive is used with an ABB motor for explosive atmospheres (Ex) and EX motor in Parameter 95.15 Special HW settings is enabled
- sine filter given in the selection table on page 230 is used and ABB sine filter in Parameter 95.15 Special HW settings is enabled
- Low noise optimization is selected in Parameter 97.09 Switching freq mode.
With other than listed sine filters (see section *Sine filters* on page 230) and non-ABB Ex motors, contact ABB.

<table>
<thead>
<tr>
<th>Drive module type</th>
<th>Output ratings for special settings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ACS880-14</strong></td>
<td>Ex motor (ABB Ex motor)</td>
</tr>
<tr>
<td></td>
<td>Nominal use</td>
</tr>
<tr>
<td></td>
<td>$I_N$</td>
</tr>
<tr>
<td></td>
<td>kW</td>
</tr>
<tr>
<td><strong>$U_N = 400 V$</strong></td>
<td></td>
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<tr>
<td>246A-3</td>
<td>234</td>
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<tr>
<td>290A-3</td>
<td>276</td>
</tr>
<tr>
<td>363A-3</td>
<td>345</td>
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<tr>
<td>442A-3</td>
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<tr>
<td>509A-3</td>
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</tr>
<tr>
<td>586A-3</td>
<td>566</td>
</tr>
<tr>
<td>650A-3</td>
<td>618</td>
</tr>
<tr>
<td><strong>$U_N = 460 V$</strong></td>
<td></td>
</tr>
<tr>
<td>302A-5</td>
<td>287</td>
</tr>
<tr>
<td><strong>$U_N = 500 V$</strong></td>
<td></td>
</tr>
<tr>
<td>240A-5</td>
<td>228</td>
</tr>
<tr>
<td>260A-5</td>
<td>247</td>
</tr>
<tr>
<td>361A-5</td>
<td>343</td>
</tr>
<tr>
<td>414A-5</td>
<td>393</td>
</tr>
<tr>
<td>480A-5</td>
<td>437</td>
</tr>
<tr>
<td>503A-5</td>
<td>478</td>
</tr>
<tr>
<td><strong>$U_N = 690 V$</strong></td>
<td></td>
</tr>
<tr>
<td>142A-7</td>
<td>119</td>
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<tr>
<td>174A-7</td>
<td>145</td>
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<tr>
<td>210A-7</td>
<td>176</td>
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<tr>
<td>271A-7</td>
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<td>370A-7</td>
<td>317</td>
</tr>
<tr>
<td>430A-7</td>
<td>370</td>
</tr>
</tbody>
</table>

$U_N$ Nominal voltage of the drive

$I_N$ Continuous rms output current. No overload capability at 40 °C (104 °F)

$P_N$ Typical motor power in no-overload use.

$I_{ld}$ Continuous rms output current allowing 10% overload for 1 minute every 5 minutes

$P_{ld}$ Typical motor power for light-overload use.

$I_{nd}$ Continuous rms output current allowing 50% overload for 1 minute every 5 minutes
High speed mode

Selection **High speed mode** of parameter **95.15 Special HW settings** improves control performance at high output frequencies. ABB recommends it to be selected with output frequency of 120 Hz and above.

This table gives the drive module ratings for 120 Hz output frequency and the maximum output frequency for each drive ratings when **High speed mode** in parameter **95.15 Special HW settings** is enabled: With output frequencies smaller than this recommended maximum output frequency, the current derating is less than the values given in the table. Contact ABB for operation above the recommended maximum output frequency or for the output current derating with output frequencies above 120 Hz and below the maximum output frequency.

<table>
<thead>
<tr>
<th>Drive module type</th>
<th>Deratings with selection High speed mode of parameter 95.15 Special HW settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS880-14-1</td>
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<tr>
<td><strong>120 Hz output frequency</strong></td>
<td><strong>Maximum output frequency</strong></td>
</tr>
<tr>
<td>$f$</td>
<td>$I_N$</td>
</tr>
<tr>
<td>Hz</td>
<td>A</td>
</tr>
<tr>
<td>$U_N = 400$ V</td>
<td></td>
</tr>
<tr>
<td>246A-3</td>
<td>120</td>
</tr>
<tr>
<td>293A-3</td>
<td>120</td>
</tr>
<tr>
<td>363A-3</td>
<td>120</td>
</tr>
<tr>
<td>442A-3</td>
<td>120</td>
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<tr>
<td>505A-3</td>
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<tr>
<td>585A-3</td>
<td>120</td>
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<tr>
<td>650A-3</td>
<td>120</td>
</tr>
<tr>
<td>$U_N = 460$ V</td>
<td></td>
</tr>
<tr>
<td>302A-5</td>
<td>120</td>
</tr>
<tr>
<td>$U_N = 500$ V</td>
<td></td>
</tr>
<tr>
<td>400A-5</td>
<td>120</td>
</tr>
<tr>
<td>$U_N = 690$ V</td>
<td></td>
</tr>
<tr>
<td>142A-7</td>
<td>120</td>
</tr>
<tr>
<td>174A-7</td>
<td>120</td>
</tr>
<tr>
<td>210A-7</td>
<td>120</td>
</tr>
<tr>
<td>271A-7</td>
<td>120</td>
</tr>
<tr>
<td>330A-7</td>
<td>120</td>
</tr>
<tr>
<td>370A-7</td>
<td>120</td>
</tr>
<tr>
<td>430A-7</td>
<td>120</td>
</tr>
</tbody>
</table>

- $f$: Output frequency
- $f_{max}$: Maximum output frequency with High speed mode
- $U_N$: Nominal voltage of the drive
- $I_N$: Continuous rms output current, No overload capability at 40 °C (104 °F)
Derating for output voltage boosting

The drive can output a higher motor voltage than the supply voltage. This can require derating of the drive output power depending on the difference between the supply voltage and the output voltage to the motor for continuous operation.

This drawing shows the required derating for -3 and -5 (400 V and 500 V) drive types.

This drawing shows the required derating for -7 (690 V and 570 V) drive types.

<table>
<thead>
<tr>
<th>$P_n$</th>
<th>Typical motor power in no-overload use.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{dL}$</td>
<td>Continuous rms output current allowing 10% overload for 1 minute every 5 minutes</td>
</tr>
<tr>
<td>$P_{dL}$</td>
<td>Typical motor power for light-overload use</td>
</tr>
<tr>
<td>$I_{Hd}$</td>
<td>Continuous rms output current allowing 50% overload for 1 minute every 5 minutes</td>
</tr>
<tr>
<td>*</td>
<td>Continuous rms output current allowing 40% overload for 1 minute every 5 minutes</td>
</tr>
</tbody>
</table>

$U_n$  Nominal supply voltage of the drive. For -3 types $U_n = 400$ V, for -5 types $U_n = 500$ V. For -7 types $U_n = 690$ V but 575 V when $P_n$ refers to nominal power ratings in the UL 575 V rating tables.

$P$  Derated output power of the drive

$P_n$  Nominal power rating of the drive
Fuses (IEC)

aR fuses for protection against short-circuit in the input power cable or drive are listed below.

Note 1: See also Implementing thermal overload and short-circuit protection on page 69.

Note 2: In multicable installations, install only one fuse per phase (not one fuse per conductor).

Note 3: Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.

Note 4: 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.

<table>
<thead>
<tr>
<th>Drive type ACS880-14-</th>
<th>Input current (A)</th>
<th>Fuse</th>
<th>Manufacturer</th>
<th>Type DIN 43653</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ul = 400 V</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>246A-3</td>
<td>212</td>
<td>400</td>
<td>74 000</td>
<td>690</td>
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</tr>
<tr>
<td>293A-3</td>
<td>257</td>
<td>500</td>
<td>145 000</td>
<td>690</td>
<td>Bussmann 170M5410</td>
</tr>
<tr>
<td>353A-3</td>
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<td>Bussmann 170M6410</td>
</tr>
<tr>
<td>442A-3</td>
<td>404</td>
<td>700</td>
<td>300 000</td>
<td>690</td>
<td>Bussmann 170M6411</td>
</tr>
<tr>
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<td>800</td>
<td>455 000</td>
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<td>945 000</td>
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<td>1000</td>
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<tr>
<td>Ul = 500 V</td>
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<td>74 000</td>
<td>690</td>
<td>Bussmann 170M5408</td>
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<td>302A-5</td>
<td>257</td>
<td>500</td>
<td>145 000</td>
<td>690</td>
<td>Bussmann 170M5410</td>
</tr>
<tr>
<td>361A-5</td>
<td>321</td>
<td>630</td>
<td>210 000</td>
<td>690</td>
<td>Bussmann 170M6410</td>
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<tr>
<td>414A-5</td>
<td>404</td>
<td>700</td>
<td>300 000</td>
<td>690</td>
<td>Bussmann 170M6411</td>
</tr>
<tr>
<td>460A-5</td>
<td>455</td>
<td>700</td>
<td>300 000</td>
<td>690</td>
<td>Bussmann 170M6411</td>
</tr>
<tr>
<td>503A-5</td>
<td>513</td>
<td>800</td>
<td>455 000</td>
<td>690</td>
<td>Bussmann 170M6412</td>
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<td>Ul = 690 V</td>
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</tr>
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<td>21 000</td>
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<td>42 000</td>
<td>690</td>
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<tr>
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<td>74 000</td>
<td>690</td>
<td>Bussmann 170M5408</td>
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<tr>
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<td>500</td>
<td>145 000</td>
<td>690</td>
<td>Bussmann 170M5410</td>
</tr>
<tr>
<td>330A-7</td>
<td>293</td>
<td>630</td>
<td>210 000</td>
<td>690</td>
<td>Bussmann 170M6410</td>
</tr>
<tr>
<td>370A-7</td>
<td>330</td>
<td>700</td>
<td>300 000</td>
<td>690</td>
<td>Bussmann 170M6411</td>
</tr>
<tr>
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<td>300 000</td>
<td>690</td>
<td>Bussmann 170M6411</td>
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</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</th>
<th>Input current (A)</th>
<th>Fuse</th>
<th>V</th>
<th>Manufacturer</th>
<th>Size</th>
<th>Type DIN 43653</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS880-14-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>U_N = 400 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>240A-3</td>
<td>212</td>
<td>400</td>
<td>690</td>
<td>Bussmann</td>
<td>2</td>
<td>170M5408</td>
</tr>
<tr>
<td>293A-3</td>
<td>267</td>
<td>500</td>
<td>690</td>
<td>Bussmann</td>
<td>2</td>
<td>170M5410</td>
</tr>
<tr>
<td>351A-3</td>
<td>321</td>
<td>630</td>
<td>690</td>
<td>Bussmann</td>
<td>3</td>
<td>170M6410</td>
</tr>
<tr>
<td>401A-3</td>
<td>401</td>
<td>700</td>
<td>690</td>
<td>Bussmann</td>
<td>3</td>
<td>170M6411</td>
</tr>
<tr>
<td>505A-3</td>
<td>401</td>
<td>800</td>
<td>690</td>
<td>Bussmann</td>
<td>3</td>
<td>170M6412</td>
</tr>
<tr>
<td>690A-3</td>
<td>505</td>
<td>1000</td>
<td>690</td>
<td>Bussmann</td>
<td>3</td>
<td>170M6414</td>
</tr>
<tr>
<td>690A-3</td>
<td>569</td>
<td>1000</td>
<td>690</td>
<td>Bussmann</td>
<td>3</td>
<td>170M6414</td>
</tr>
<tr>
<td>U_N = 500 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>240A-5</td>
<td>169</td>
<td>315</td>
<td>690</td>
<td>Bussmann</td>
<td>1</td>
<td>170M4410</td>
</tr>
<tr>
<td>280A-5</td>
<td>205</td>
<td>400</td>
<td>690</td>
<td>Bussmann</td>
<td>2</td>
<td>170M5408</td>
</tr>
<tr>
<td>302A-5</td>
<td>239</td>
<td>500</td>
<td>690</td>
<td>Bussmann</td>
<td>2</td>
<td>170M5410</td>
</tr>
<tr>
<td>361A-5</td>
<td>257</td>
<td>630</td>
<td>690</td>
<td>Bussmann</td>
<td>3</td>
<td>170M6410</td>
</tr>
<tr>
<td>404A-5</td>
<td>404</td>
<td>700</td>
<td>690</td>
<td>Bussmann</td>
<td>3</td>
<td>170M6411</td>
</tr>
<tr>
<td>503A-5</td>
<td>455</td>
<td>800</td>
<td>690</td>
<td>Bussmann</td>
<td>3</td>
<td>170M6412</td>
</tr>
<tr>
<td>U_N = 600 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>142A-7</td>
<td>125</td>
<td>250</td>
<td>690</td>
<td>Bussmann</td>
<td>1</td>
<td>170M4409</td>
</tr>
<tr>
<td>174A-7</td>
<td>146</td>
<td>315</td>
<td>690</td>
<td>Bussmann</td>
<td>1</td>
<td>170M5410</td>
</tr>
<tr>
<td>210A-7</td>
<td>166</td>
<td>400</td>
<td>690</td>
<td>Bussmann</td>
<td>2</td>
<td>170M5408</td>
</tr>
<tr>
<td>271A-7</td>
<td>208</td>
<td>500</td>
<td>690</td>
<td>Bussmann</td>
<td>2</td>
<td>170M5410</td>
</tr>
<tr>
<td>330A-7</td>
<td>250</td>
<td>630</td>
<td>690</td>
<td>Bussmann</td>
<td>3</td>
<td>170M6410</td>
</tr>
<tr>
<td>370A-7</td>
<td>291</td>
<td>700</td>
<td>690</td>
<td>Bussmann</td>
<td>3</td>
<td>170M6411</td>
</tr>
<tr>
<td>430A-7</td>
<td>370</td>
<td>700</td>
<td>690</td>
<td>Bussmann</td>
<td>3</td>
<td>170M6411</td>
</tr>
</tbody>
</table>

Note 1: See also “Implementing thermal overload and short-circuit protection” on page 69.

Note 2: In multicable installations, install only one fuse per phase (not one fuse per conductor).

Note 3: Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.

Note 4: Fuses from other manufacturers must not be used.
**Technical data**

**Dimensions, weights and free space requirements**

*approximate (depends on the selected options)*

- **Weight of the LCL filter module:** 180 kg (396 lb)
- **The weight of the cabling panels of option +H381 is 30 kg (66 lb)**

For requirements of free space around the drive module, see page 55.

<table>
<thead>
<tr>
<th>Weight of optional selections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame size</td>
</tr>
<tr>
<td>R11</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Frame size</th>
<th>Air flow m³/h</th>
<th>Heat dissipation W</th>
<th>Noise dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uₔ = 400 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACS880-14-24A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>5,280</td>
</tr>
<tr>
<td>ACS880-14-29A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>6,400</td>
</tr>
<tr>
<td>ACS880-14-36A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>8,000</td>
</tr>
<tr>
<td>ACS880-14-44A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>10,000</td>
</tr>
<tr>
<td>ACS880-14-50A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>10,000</td>
</tr>
<tr>
<td>ACS880-14-58A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>12,600</td>
</tr>
<tr>
<td>ACS880-14-65A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>14,200</td>
</tr>
<tr>
<td>Uₔ = 500 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACS880-14-24A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>5,280</td>
</tr>
<tr>
<td>ACS880-14-26A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>6,400</td>
</tr>
<tr>
<td>ACS880-14-30A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>8,000</td>
</tr>
<tr>
<td>ACS880-14-36A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>8,000</td>
</tr>
<tr>
<td>ACS880-14-41A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>10,000</td>
</tr>
<tr>
<td>ACS880-14-46A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>12,600</td>
</tr>
<tr>
<td>ACS880-14-50A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>14,200</td>
</tr>
</tbody>
</table>

**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/drivestize).

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Frame size</th>
<th>Air flow m³/h</th>
<th>Heat dissipation W</th>
<th>Noise dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uₔ = 400 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACS880-14-24A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>5,280</td>
</tr>
<tr>
<td>ACS880-14-29A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>6,400</td>
</tr>
<tr>
<td>ACS880-14-36A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>8,000</td>
</tr>
<tr>
<td>ACS880-14-44A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>10,000</td>
</tr>
<tr>
<td>ACS880-14-50A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>10,000</td>
</tr>
<tr>
<td>ACS880-14-58A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>12,600</td>
</tr>
<tr>
<td>ACS880-14-65A-3</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>14,200</td>
</tr>
<tr>
<td>Uₔ = 500 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACS880-14-24A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>5,280</td>
</tr>
<tr>
<td>ACS880-14-26A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>6,400</td>
</tr>
<tr>
<td>ACS880-14-30A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>8,000</td>
</tr>
<tr>
<td>ACS880-14-36A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>8,000</td>
</tr>
<tr>
<td>ACS880-14-41A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>10,000</td>
</tr>
<tr>
<td>ACS880-14-46A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>12,600</td>
</tr>
<tr>
<td>ACS880-14-50A-5</td>
<td>R11</td>
<td>2100</td>
<td>1279</td>
<td>14,200</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.

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.

- **Units with optional cabling panels (+H381)**

  The maximum accepted cable size is $4 \times (3 \times 240) \text{ mm}^2$ or $4 \times (3 \times 500 \text{ AWG})$. The cabling panels are connected to the drive module busbars with M12 serpress nuts, tightening torque 30 N·m (20 lbf·ft).

  Input, motor and brake resistor cable terminal sizes and tightening torques are given below.

  Two-hole 1/2 inch diameter cable lugs can be used.

- **Units without full-size output cable connection terminals (+0H371) and with a common mode filter (+E208)**

  It is possible to use the maximum cable size ($4 \times (3 \times 240) \text{ mm}^2$ or $4 \times (3 \times 500 \text{ AWG})$) only with special cable lugs and additional insulation. For more information, contact your local ABB representative.

Terminal data for the control cables

See page 115 or 128.

Electrical power network specification

Voltage ($U_1$)

- ACS880-14-xxxx-3 drive modules: 380...415 V AC phase $+10\%$-$15\%$. This is indicated in the type designation label as typical input voltage level $3 \sim 400 \text{ V AC}$.
- ACS880-14-xxxx-5 drive modules: 380...500 V AC 3-phase $+10\%$-$15\%$. This is indicated in the type designation label as typical input voltage levels $3 \sim 400/480/500 \text{ V AC}$.
- ACS880-14-xxxx-7 drive modules: 525...690 V AC 3-phase $+10\%$-$15\%$. This is indicated in the type designation label as typical input voltage levels $3 \sim 525/600/690 (600 \text{ UL, CSA}) \text{ V AC}$.
Technical data

Network type
TN (grounded) and IT (ungrounded) systems

Short-circuit withstand strength (IEC 61439-1)
Maximum allowable prospective short-circuit current is 65 kA when 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 on page 69.

Short-circuit current protection
(UL 61800-5-1)
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 fuses given in the fuse table.

Short-circuit current protection
(CSA C22.2 No. 14-05)
The drive is suitable for use on a circuit capable of delivering not more than 150 kA rms symmetrical amperes at 600 V maximum when by the fuses given in the fuse table.

Frequency ($f_1$)
50/60 Hz, Variation ± 5% of nominal frequency.

Imbalance
Max. ± 3% of nominal phase to phase input voltage

Harmonic distortion
Harmonics are below the limits defined in IEEE519, IEC61000-3-12 and G5/4 standards.

The table below shows typical results on indicated networks. Values are measured at the input terminals of the drive.

<table>
<thead>
<tr>
<th>$R_{sc}$</th>
<th>THD voltage (%)</th>
<th>THD current (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.19</td>
<td>2.5*</td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$$THD = \sqrt{\sum_{n=2}^{\infty} \left( \frac{i_n}{i_{1\text{contmax}}} \right)^2}$$

THD Total harmonic distortion. The voltage THD depends on the short-circuit ratio ($R_{sc}$). The spectrum of the distortion also contains interharmonics.

- $i_n$ nth harmonic component
- $R_{sc}$ Short-circuit ratio. $R_{sc} = \frac{i_{sc}}{i_{N}}$
- $i_{nc}$ Short-circuit current at point of common coupling (PCC)
- $i_{1\text{contmax}}$ Continuous maximum input current of the line-side converter
- $I_L$ Maximum demand load current

Motor connection data

Motor types
Asynchronous AC induction motors, permanent magnet motors, AC induction servomotors and ABB synchronous reluctance motors (SynRM motors)

Voltage ($U_L$)
0 to $U_1$, 3-phase symmetrical. This is indicated in the type designation label as typical output voltage level as 3~ $U_1$, $U_{max}$ at the field weakening point.

Frequency ($f_2$)
0...500 Hz

Note: Operation above 150 Hz can require type-specific derating. For more information, contact your local ABB representative.

For drives with du/dt filter: 120 Hz
For drives with sine filter: 120 Hz

Frequency resolution
0.01 Hz

Current
See section Ratings.

Frequency ($f_3$)
0...500 Hz

For drives with du/dt filter: Contact ABB
For drives with sine filter: Contact ABB

Switching frequency
3 kHz (typically)

Maximum recommended motor cable length

<table>
<thead>
<tr>
<th>DTC control</th>
<th>Scalar control</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 m (1640 ft)</td>
<td>500 m (1640 ft)</td>
</tr>
</tbody>
</table>

Note: Maximum length for motor cable depends on specific application and motor type.
Note 1: Motor cable longer than 100 m (492 ft) is allowed but then the EMC Directive requirements may not be fulfilled, see section EMC compliance (IEC/EN 61800-3:2004) on page 198.

Note 2: 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.

### DC connection data

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Capacitance (mF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_N = 400$ V</td>
<td></td>
</tr>
<tr>
<td>ACS880-14-246A-3</td>
<td>10.5</td>
</tr>
<tr>
<td>ACS880-14-293A-3</td>
<td>10.5</td>
</tr>
<tr>
<td>ACS880-14-363A-3</td>
<td>10.5</td>
</tr>
<tr>
<td>ACS880-14-442A-3</td>
<td>10.5</td>
</tr>
<tr>
<td>ACS880-14-505A-3</td>
<td>10.5</td>
</tr>
<tr>
<td>ACS880-14-585A-3</td>
<td>14.0</td>
</tr>
<tr>
<td>ACS880-14-650A-3</td>
<td>14.0</td>
</tr>
<tr>
<td>$U_N = 500$ V</td>
<td></td>
</tr>
<tr>
<td>ACS880-14-240A-5</td>
<td>10.5</td>
</tr>
<tr>
<td>ACS880-14-260A-5</td>
<td>10.5</td>
</tr>
<tr>
<td>ACS880-14-302A-5</td>
<td>10.5</td>
</tr>
<tr>
<td>ACS880-14-361A-5</td>
<td>10.5</td>
</tr>
<tr>
<td>ACS880-14-414A-5</td>
<td>10.5</td>
</tr>
<tr>
<td>ACS880-14-460A-5</td>
<td>14.0</td>
</tr>
<tr>
<td>ACS880-14-503A-5</td>
<td>14.0</td>
</tr>
<tr>
<td>$U_N = 690$ V</td>
<td></td>
</tr>
<tr>
<td>ACS880-14-142A-7</td>
<td>5.3</td>
</tr>
<tr>
<td>ACS880-14-174A-7</td>
<td>5.3</td>
</tr>
<tr>
<td>ACS880-14-210A-7</td>
<td>5.3</td>
</tr>
<tr>
<td>ACS880-14-211A-7</td>
<td>5.3</td>
</tr>
<tr>
<td>ACS880-14-330A-7</td>
<td>5.3</td>
</tr>
<tr>
<td>ACS880-14-370A-7</td>
<td>5.3</td>
</tr>
<tr>
<td>ACS880-14-430A-7</td>
<td>5.3</td>
</tr>
</tbody>
</table>

### Control panel type

ACS-AP-W assistant control panel

### Efficiency

Approximately 96.5% at nominal power level

### Protection classes

- Degree of protection (IEC/EN 60529): IP20. With option +0B051: IP00
- Enclosure type (UL 50): UL Open Type
- Overvoltage category (IEC 60664-1): III

### Degree of protection

IP20 (UL Open Type), With option +0B051: IP00 (UL Open Type).
## 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></th>
<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><strong>Installation site altitude</strong></td>
<td>for neutral-grounded - TN and TT systems and IT (unrounded) systems: 0 to 4000 m (13123 ft) above sea level Above 1000 m (3281 ft), see page 185.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Air temperature</strong></td>
<td>-15 to +55 °C (5 to 131 °F). No frost allowed. See page 185.</td>
<td>-40 to +70 °C (-40 to +158 °F)</td>
<td>-40 to +70 °C (-40 to +158 °F)</td>
</tr>
<tr>
<td><strong>Relative humidity</strong></td>
<td>5 to 95%</td>
<td>Max. 95%</td>
<td>Max. 95%</td>
</tr>
<tr>
<td><strong>Contamination levels</strong></td>
<td>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</td>
<td>IEC 60721-3-1:1997</td>
<td>IEC 60721-3-2:1997</td>
</tr>
<tr>
<td><strong>Chemical gases</strong></td>
<td>Class 3C2</td>
<td>Class 1C2</td>
<td>Class 2C2</td>
</tr>
<tr>
<td><strong>Solid particles</strong></td>
<td>Class 3S2. No conductive dust allowed.</td>
<td>Class 1S3. (packing must support this, otherwise 1S2)</td>
<td>Class 2S3</td>
</tr>
<tr>
<td><strong>Pollution degree</strong></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Atmospheric pressure</strong></td>
<td>70 to 106 kPa (0.7 to 1.05 atmospheres)</td>
<td>70 to 106 kPa (0.7 to 1.05 atmospheres)</td>
<td>60 to 106 kPa (0.6 to 1.05 atmospheres)</td>
</tr>
<tr>
<td><strong>Vibration</strong></td>
<td>IEC 60068-2-6:2007, EN 60068-2-6:2008 Environmental testing Part 2-6: Tests – Test Fc: Vibration (sinusoidal)</td>
<td>Max. 0.1 mm (0.004 in.) (5 to 57 Hz), max. 10 m/s² (33 ft/s²) (57 to 150 Hz) sinusoidal</td>
<td>Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s² (23 ft/s²) (13.2 to 100 Hz) sinusoidal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Max. 3.5 mm (0.14 in.) (2 to 9 Hz), max. 15 m/s² (49 ft/s²) (9 to 200 Hz) sinusoidal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>With packing max. 100 m/s² (330 ft/s²), 11 ms</td>
</tr>
<tr>
<td><strong>Free fall</strong></td>
<td>Not allowed</td>
<td>100 mm (4 in.)</td>
<td>100 mm (4 in.)</td>
</tr>
</tbody>
</table>

## Materials

Drive enclosure - **PC/ABS 2.5 mm, color NCS 1502-Y (RAL 9002 / PMS 420 C)**

- hot-dip zinc coated steel sheet 1.5 to 2.5 mm, thickness of coating 100 micrometers, color NCS 1502-Y

Air baffles for Rittal cabinet - See section Material of the air baffles on page 213.
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 DC capacitors (C1-1 to C1-x) 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. The compliance with the European Low Voltage Directive is verified according to standard EN 61800-5-1.

Safety of machinery. Electrical equipment of machines. Part 1: General requirements. Provisions for compliance: The final assembler of the machine is responsible for installing
- emergency-stop device
- supply disconnecting device.

Degrees of protection provided by enclosures (IP code)

EN 61000-3-12:2011
Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current
The standard is met with a Rsce (transformer short circuit ratio) of 350 or higher.

Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods

IEC/EN 61800-5-1:2007
Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy

IEC/EN 60664-1:2007
Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.

UL 61800-5-1: First edition 2012
Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements - Electrical, Thermal and Energy

NEMA 250:2014
Enclosures for Electrical Equipment (1000 Volts Maximum)

CSA C22.2 No. 274-17
Industrial control equipment
Markings

These markings are attached to the drive:

<table>
<thead>
<tr>
<th>Mark</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE</td>
<td>Product complies with the applicable European Union legislation. For fulfilling the EMC requirements, see section EMC compliance (IEC/EN 61800-3:2004) on page 198.</td>
</tr>
<tr>
<td>UL</td>
<td>Product has been tested and evaluated against the relevant North American standards by Underwriters Laboratories.</td>
</tr>
<tr>
<td>EAC</td>
<td>Product complies with technical regulations of the Eurasian Customs Union. EAC marking is required in Russia, Belarus and Kazakhstan.</td>
</tr>
<tr>
<td>EIP</td>
<td>Product does not contain toxic and hazardous substances or elements above the maximum concentration values, and that it is an environmentally-friendly product which can be recycled and reused. The People’s Republic of China Electronic Industry Standard (SJ/T 11364-2014) specifies the marking requirements for hazardous substances in electronic and electrical products.</td>
</tr>
<tr>
<td>Wheelie bin symbol</td>
<td>At the end of life the product should enter the recycling system at an appropriate collection point and not placed in the normal waste stream. See Disposal on page 197.</td>
</tr>
</tbody>
</table>

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 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 C2

The drive complies with the standard with the following provisions:
1. The drive is equipped with EMC filter +E202 / ARFI-10 and common mode filter (+E208).
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 150 meters.

**WARNING!** The drive may cause radio interference if used in residential or domestic environment. The user is required to take measures to prevent interference, in association to the requirements for the CE compliance listed above, if necessary.

**Note:** Do not install a drive equipped with EMC filter +E202 grounding wire connected on IT (ungrounded) systems. The supply network becomes connected to ground potential through the EMC filter capacitors which may cause danger or damage to the unit.

- **Category C3**

The drive complies with the standard with the following provisions:
1. The drive is equipped with 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 from the local ABB representative.

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 checklist**

**WARNING!** Operation of this drive requires detailed installation and operation instructions provided in the hardware and firmware manuals. The manuals can be found on the Internet. Depending on the product series, the drive package may contain the manuals in electric format or as hard copies (as standard or ordered with option codes with the drive). Hard copies of the manuals can also be ordered through the manufacturer separately. Retain the hard copies of the manuals with the drive.

- Make sure that the drive type designation label includes the cULus Listed marking.
- **CAUTION - 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 enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust. See page \[196\].
- The maximum ambient air temperature is 40 °C (104 °F) at rated current. The current is derated for 40 to 55 °C (104 to 131 °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 with fuses listed on page \[191\]. The ampere rating is based on tests done according to UL 61800-5-1.
- 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. Suitable UL Recognized fuses are listed on page 191. These fuses provide branch circuit protection in accordance with the National Electrical Code (NEC). For installation in the United States, obey any other applicable local codes. For installation in Canada, obey any applicable 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 controller should be examined and replaced if damaged.

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• The drive provides overload protection in accordance with the National Electrical Code (NEC).

• For drive overvoltage category, see on page 195. For pollution degree, see page 196.
EU Declaration of Conformity (Machinery Directive)

The following harmonized standards have been applied:

- EN 61800-5-2:2007 Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional
- EN ISO 13849-1:2015 Safety of machinery – Safety-related parts of control systems. Part 1: General requirements

The following other standards have been applied:

- IEC 61800-5-2:2016 Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional

The products referred in this Declaration of conformity fulfil the relevant provisions of other European Union Directives which are notified in Single EU Declaration of conformity 3AXD10000497931.

Person authorized to compile the technical file:
Name and address: Ari Korpela, Hiomotie 13, 00380 Helsinki, Finland.

Helsinki, 29 Jan 2018

Manufacturer representative: Vesa Kaaden
Vice President, ABB Oy

3AXD1000009646
Disclaimers

- 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 TS 8 cabinet assembly.
Location of power cable connection terminals with options +H370, +H356
Drive module with options +0B051+H356+0H371
Configuration with option +H381
LCL filter module
Bottom plate

This drawing shows the dimensions of the bottom plate for Rittal TS 131 800 cabinet. It is not an ABB product.

Insert nut PEM-S-M8-2 or equal 4 pcs
Air baffles for the standard drive module

These drawings show the dimensions of the air baffles around the standard drive module for Rittal TS 131 800 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.

Air baffles for option +H381 in Rittal TS 8 800 mm wide cabinet

Additional air baffles for the cabling panels are shown below. Two pieces. These are not ABB products.
External control unit
Example circuit diagram

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).
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 construct safety or supervision circuits that stop the drive in case of danger (such as an emergency stop circuit). Another possible application is a prevention of unexpected start-up switch 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 diagram 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 of the drive complies with these standards:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 60204-1:2016</td>
<td>Safety of machinery – Electrical equipment of machines – Part 1: General requirements</td>
</tr>
<tr>
<td>IEC 61328-3-1:2008</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 1037:1995 + A1:2008 and Uncontrolled stop (stop category 0) as specified in EN/IEC 60204-1.

- **Compliance with the European Machinery Directive**


**Wiring**

The following diagrams show examples of Safe torque off wiring for
- a single drive (page 220)
- multiple drives (page 221)
- multiple drives when an external 24V DC power supply is used (page 222).

For drives with option +L537+Q971, see ATEX-certified Safe disconnection function, Ex II (2) GD for ACS880 drives (option +Q971) application guide (3AXA00000074343 [English]) and FPTC-02 ATEX-certified thermistor relay module, Ex II (2) GD (+L537+Q971) for ACS880 drives user's manual (3AXD50000027782 [English])

For information on the specifications of the STO input, see section Default I/O connection diagram on page 108 (external control unit) or 123 (internal control unit, option +P905).
Activation switch

In the wiring diagrams below, 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.
- An FSO-xx safety functions module or an FPTC-0x thermistor protection module can also be used. For more information, see the FSO-xx module documentation.

Cable types and lengths

We recommend double-shielded twisted-pair cable (see page 67). Maximum cable lengths:

- 300 m (1000 ft) between activation switch [K] and drive control unit
- 60 m (200 ft) between multiple drives
- 60 m (200 ft) between external power supply and first drive.

Note that the voltage at the INx terminals of each control unit must be at least 17 V DC to be interpreted as “1”.

Grounding of protective shields

- Ground the shield in the cabling between the activation switch and the control unit at the control unit.
- Ground the shield in the cabling between two control units at one control unit only.
### Single drive (internal power supply)

#### Dual-channel connection

- **ACS880-14**
- Control unit
- +24 V → OUT1
- SGND
- IN1
- IN2
- Control logic
- UDC+
- UDC–
- T1/U2, T2/V2, T3/W2

#### Single-channel connection

- ACS880-14
- Control unit
- +24 V → OUT1
- SGND
- IN1
- IN2
- Control logic
- UDC+
- UDC–
- T1/U2, T2/V2, T3/W2
Multiple drives (internal power supply)
Multiple drives (external power supply)
Operation principle

1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
2. STO inputs on 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 (refer to the firmware manual of the drive).
5. Motor coasts to 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 the drive is equipped with safety option +Q972, +Q973 or +Q982, do the procedure shown in the FSO module documentation. If an FSO-xx safety functions module or an FPTC-0x module is installed, refer to its documentation.

<table>
<thead>
<tr>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WARNING!</strong> Obey the safety instructions in chapter Safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.</td>
</tr>
<tr>
<td>Ensure that the drive can be run and stopped freely during start-up.</td>
</tr>
<tr>
<td>Stop the drive (if running), switch the input power off and isolate the drive from the power line by a disconnector.</td>
</tr>
</tbody>
</table>
Check the Safe torque off circuit connections against the wiring diagram.

Close the disconnector and switch the power on.

Test the operation of the STO function when the motor is stopped.
- Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill.
- Ensure that the drive operates as follows:
  - Open the STO circuit. The drive generates an indication if one is defined for ‘stopped’ state in parameter 31.22 (see the firmware manual).
  - Give a start command to verify that the STO function blocks the operation of the drive. The motor should not start.
  - Close the STO circuit.
  - Reset any active faults. Restart the drive and check that the motor runs normally.

Test the operation of the STO function when the motor is running.
- Start the drive and ensure the motor is running.
- Open the STO circuit. The motor should stop. The drive generates an indication if one is defined for ‘running’ state in parameter 31.22 (see the firmware manual).
- Reset any active faults and try to start the drive.
- Ensure 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 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 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. STO inputs on the drive control unit de-energize, and the drive control unit cuts off the control voltage from the output IGBTs.
3. The control program generates an indication as defined by parameter 31.22 (refer to the firmware manual of the drive).
4. Motor coasts to 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 main supply.

**WARNING!** (With permanent magnet motors or synchronous reluctance [SynRM] motors only) In case of a multiple IGBT power semiconductor failure, the drive system 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 the Safe torque off function is activated when the drive is running, the control voltage of the power semiconductors is cut off and the motor coasts 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.

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 (SIL, PL) (page 226). 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 223).
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, follow the test given in section Acceptance test procedure on page 223.

Use only ABB approved spare parts.

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 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, triggers the same reaction.

See the drive firmware manual 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.

Safety data (SIL, PL)

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.
The following temperature profile is used in safety value calculations:
- 670 on/off cycles per year with $\Delta T = 71.66 \, ^\circ C$
- 1340 on/off cycles per year with $\Delta T = 61.66 \, ^\circ C$
- 30 on/off cycles per year with $\Delta T = 10.0 \, ^\circ C$
- 32 \, ^\circ C$ board temperature at 2.0% of time
- 60 \, ^\circ C$ board temperature at 1.5% of time
- 85 \, ^\circ 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.

**Abbreviations**

<table>
<thead>
<tr>
<th>Abbrev.</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>FIT</td>
<td>IEC 61508</td>
<td>Failure in time: 1E-9 hours</td>
</tr>
<tr>
<td>HFT</td>
<td>IEC 61508</td>
<td>Hardware fault tolerance</td>
</tr>
<tr>
<td>$\text{MTTFD}$</td>
<td>EN ISO 13849-1</td>
<td>Mean time to dangerous failure: (The total number of life units)/(the number of dangerous, undetected failures) during a particular measurement interval under stated conditions</td>
</tr>
<tr>
<td>$\text{PFD}_{\text{avg}}$</td>
<td>IEC 61508</td>
<td>Average probability of failure on demand, that is, mean unavailability of a safety-related system to perform the specified safety function when a demand occurs</td>
</tr>
<tr>
<td>PFH</td>
<td>IEC 61508</td>
<td>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</td>
</tr>
<tr>
<td>PL</td>
<td>EN ISO 13849-1</td>
<td>Performance level. Levels a...e correspond to SIL</td>
</tr>
<tr>
<td>SFF</td>
<td>IEC 61508</td>
<td>Safe failure fraction (%)</td>
</tr>
<tr>
<td>SIL</td>
<td>IEC 61508</td>
<td>Safety integrity level (1...3)</td>
</tr>
<tr>
<td>SILCL</td>
<td>IEC/EN 62061</td>
<td>Maximum SIL (level 1...3) that can be claimed for a safety function or subsystem</td>
</tr>
<tr>
<td>SS1</td>
<td>IEC/EN 61800-5-2</td>
<td>Safe stop 1</td>
</tr>
<tr>
<td>STO</td>
<td>IEC/EN 61800-5-2</td>
<td>Safe torque off</td>
</tr>
</tbody>
</table>
### Safe torque off function

- **T₁**: Proof test interval. T₁ 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 T₁ is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid. See also section Maintenance (page 225).

### TM
- **TM**: Mission time, i.e., period of time that covers the intended use of safety function/device. After the mission time the safety device(s) must be replaced. Note that any TM values given cannot be regarded as a guarantee or warranty.

<table>
<thead>
<tr>
<th>Abbr.</th>
<th>Reference</th>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>IEC 61508</td>
<td>Proof test interval. T₁ 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 T₁ is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid. See also section Maintenance (page 225).</td>
<td></td>
</tr>
<tr>
<td>TM</td>
<td>EN ISO 13849-1</td>
<td>Mission time, i.e., period of time that covers the intended use of safety function/device. After the mission time the safety device(s) must be replaced. Note that any TM values given cannot be regarded as a guarantee or warranty.</td>
<td></td>
</tr>
</tbody>
</table>
**du/dt and sine filters**

**Contents of this chapter**

This chapter describes how to select du/dt and sine filters for the drive.

**du/dt filters**

- **When is a du/dt filter needed?**
  
  See section *Examining the compatibility of the motor and drive*, page 58.

- **Selection table**

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

<table>
<thead>
<tr>
<th>Drive module type ACS880-14-</th>
<th>du/dt filter type</th>
<th>Drive module type ACS880-14-</th>
<th>du/dt filter type</th>
<th>Drive module type ACS880-14-</th>
<th>du/dt filter type</th>
</tr>
</thead>
<tbody>
<tr>
<td>U_N = 400 V</td>
<td></td>
<td>U_N = 500 V</td>
<td></td>
<td>U_N = 690 V</td>
<td></td>
</tr>
<tr>
<td>246A-3 FOCH0260-7x</td>
<td>240A-5 FOCH0260-7x</td>
<td>142A-7 FOCH0260-7x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>293A-3 FOCH0260-7x</td>
<td>260A-5 FOCH0260-7x</td>
<td>174A-7 FOCH0260-7x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>363A-3 FOCH0320-5x</td>
<td>302A-5 FOCH0320-5x</td>
<td>210A-7 FOCH0260-7x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>442A-3 FOCH0320-5x</td>
<td>361A-5 FOCH0320-5x</td>
<td>271A-7 FOCH0260-7x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>505A-3 FOCH-0610-70</td>
<td>414A-5 FOCH0320-5x</td>
<td>330A-7 FOCH-0610-70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>585A-3 FOCH-0610-70</td>
<td>460A-5 FOCH0320-5x</td>
<td>379A-7 FOCH-0610-70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>650A-3 FOCH-0610-70</td>
<td>503A-5 FOCH-0610-70</td>
<td>430A-7 FOCH-0610-70</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Ordering codes

<table>
<thead>
<tr>
<th>Filter type</th>
<th>Degree of protection</th>
<th>ABB ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOCH0320-50</td>
<td>IP00</td>
<td>68612209</td>
</tr>
<tr>
<td>FOCH0320-52</td>
<td>IP22</td>
<td>3AXD900000030047</td>
</tr>
<tr>
<td>FOCH0260-70</td>
<td>IP00</td>
<td>68490308</td>
</tr>
<tr>
<td>FOCH0260-72</td>
<td>IP22</td>
<td>3AXD90000030048</td>
</tr>
<tr>
<td>FOCH-0610-70</td>
<td>IP00</td>
<td>68550505</td>
</tr>
</tbody>
</table>

Description, installation and technical data of the FOCH filters

See FOCH du/dt filters hardware manual (3AFE68577519 [English]).

Sine filters

When is a sine filter needed?

See section Examining the compatibility of the motor and drive, page 58.

Selection table

Sine filter types for the drive modules are given below.

<table>
<thead>
<tr>
<th>Drive module type ACS880-14-</th>
<th>Drive module type ACS100-240</th>
<th>Drive module type ACS100-440</th>
<th>Drive module type ACS100-690</th>
<th>Sine filter type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sine filter type</td>
<td>Sine filter type</td>
<td>Sine filter type</td>
<td>Sine filter type</td>
<td>Drive module type ACS880-14-</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>UN = 400 V</td>
<td>UN = 500 V</td>
<td>UN = 690 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>246A-3</td>
<td>BB4143V0230S229</td>
<td>240A-5</td>
<td>BB4143V0230S229</td>
<td>142A-7</td>
</tr>
<tr>
<td>293A-3</td>
<td>BB4143V0390S229</td>
<td>260A-5</td>
<td>BB4143V0390S229</td>
<td>174A-7</td>
</tr>
<tr>
<td>363A-3</td>
<td>BB4143V0390S229</td>
<td>302A-5</td>
<td>BB4143V0390S229</td>
<td>210A-7</td>
</tr>
<tr>
<td>442A-3</td>
<td>BB4143V0390S229</td>
<td>361A-5</td>
<td>BB4143V0390S229</td>
<td>271A-7</td>
</tr>
<tr>
<td>505A-3</td>
<td>NSIN900-6</td>
<td>414A-5</td>
<td>NSIN900-6</td>
<td>330A-7</td>
</tr>
<tr>
<td>585A-3</td>
<td>NSIN900-6</td>
<td>460A-5</td>
<td>NSIN900-6</td>
<td>370A-7</td>
</tr>
<tr>
<td>650A-3</td>
<td>NSIN900-6</td>
<td>503A-5</td>
<td>NSIN900-6</td>
<td>430A-7</td>
</tr>
</tbody>
</table>

* Combined value for drive and filter

ABB ordering codes

<table>
<thead>
<tr>
<th>Filter type</th>
<th>ABB ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSIN485-6</td>
<td>64254936</td>
</tr>
<tr>
<td>NSIN900-6</td>
<td>64254961</td>
</tr>
</tbody>
</table>

Derating

See section Deratings for special settings in the drive control program on page 186.
- **Description, installation and technical data of the sine filters**

du/dt and sine filters
Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet.
Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet.
Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet
Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet
Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet

Combi screw
M6×12 Torx
T25 8 N·m

Combi screw
M12×25 Hex
(Δ) 70 N·m
Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet
Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet
Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet

Combi screw
M4×10 Torx T20
2 N·m

Combi screw
M4×10 Torx T20
2 N·m

Combi screw
M6×20 Torx T25
2 N·m
Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet

Tapping screw M6×12
Torx T30 (Hex) 8 N·m
Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 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 www.abb.com/drives and select ABB University.

Providing feedback on ABB Drives manuals
Your comments on our manuals are welcome. Go to www.abb.com/drives and select Document Library – Manuals feedback form (LV AC drives).

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www.abb.com/drivespartners